## **Frequency Inverter**

CFW-09

## **Convertidor de Frecuencia**

CFW-09

## Inversor de Freqüência

CFW-09

## Frequenzumrichter

CFW-09

## Variateur de Vitesse

CFW-09

## Frequentie-Omzetter

CFW-09

## **Frekvensomriktare**

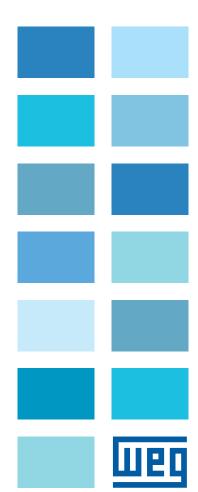
CFW-09

## Преобразователь частоты

CFW-09

User's Guide
Manual del Usuario
Manual do Usuário
Bedienungsanleitung
Guide d'instalation et d'exploitation
Installatie en gebruikshandleiding
Bruksanvisning
Руководство по эксплуатации





# FREQUENCY INVERTER MANUAL

Series: CFW-09

Software: version 4.0X

Language: English

**Document:** 0899.5306 / 12

09/2008



It is very important to check if the inverter software version is the same as indicated above.

The table below describes all revisions made to this manual.

Revision	Description	Section
1	First Edition.	-
2	Inclusion of the functions Fieldbus and Serial Communication.	Refer to item 8.12 and 8.13
2	Inclusion of the Spare Part List.	Refer to item 7.5
2	Dimension Changing.	Refer to item 3.1.2 and 9.4
3	Inclusion of the PID Regulator.	Refer to item 6
4	Inclusion of the German Language - Ride-through and Flying Start functions.	Refer to item 6
4	Inclusion of DBW-01; KIT KME; DC Link Inductor.	Refer to item 8
5	Inclusion of Item 3.3 - CE Installation.	Refer to item 3
5	Inclusion of new functions such as Ride-Through for Vector Control, Motor Phase Loss.	Refer to item 6
5	New I/O Expansion Boards EBB.04 and EBB.05.	Refer to item 8
6	General Revision.	-
7	Inclusion of the models from 2.9 to 32 A / 500-600 V.	Refer to items 2.4; 3.1; 3.2.1; 3.3; 4.2; 6.2; 6.3; 7.1; 7.2; 7.4; 7.5; 8.7.1; 8.10.1; 9.1 and 9.1.3
8	Inclusion of new functions:	Refer to item 6
	Control Type of the Speed Regulator, Speed Regulator Differential Gain, Stop Mode Selection,	
	Access to the parameters with different content than default, Hysteresis for Nx/Ny, kWh	
	Counter, Load User 1 and 2 the factory Hours Hx, via Dlx, Parameter Setting Disable via Dlx,	
	Help Message for E24, "P406 = 2 in Vector Control", Automatic SensorLess Set of P525, Last	
	10 errors indication, Motor Torque indication via AOx.	
8	New optional boards: EBC and PLC1.	Refer to item 8
8	New model CFW-09 SHARK NEMA 4X/IP56.	Refer to item 8
8	New models for voltages, currents and powers: Models 500-600 V.	Refer to items 1 to 9
8	Inclusion of the items 8.14 Modbus-RTU, 8.17 CFW-09 Supplied by the DC Link - Line HD,	Refer to item 8
	8.18 CFW-09 RB Regenerative Converter.	
8	Updating of the Spare Part List.	7
9	Inclusion of new functions:	-
	Overcurrent Protection, Default factory reset 50 Hz, Timer Relay, Ramp Holding.	
9	New lines of the current and power supply.	-
9	PID Regulator to "Academic" Changing.	-
10	General revision and update of the software version (2.6X to 3.1X):	-
	Change on the maximum value of P156 and P401 for some models; Change on the maximum	
	value of P331; Change on the factory default value of P404.	
11	New functions; Incorporation of the Mechanical Brake Logic for cranes, Load Detection Logic and addition of	Refer to items I, 6, 7 and 8
	option "Indication of Torque Current Polarity" at the DOx and RLx outputs; VVW Control; DC Braking for VVW and Sensorless; Flying Start function for the Sensorless Control; support for EtherNet/IP communication board; read/write function for the PLC board parameters through	
	Modbus; Indication of the Analog Outputs values in read only parameters P027 to P030;	
	Simultaneous indication of the speed and current in parameter P070; P313 = 4 (Changes to	
	LOCAL mode keeping the commands); Regulation of the maximum torque current through	
	options Al1+Al2 and Al2+Al3; function F > Fx; function ready 2.	
12	Updating of the software version to V4.0X.	-
12		_
	Updating of the parameters P309 and P313.	
	Addition of new parameters: P335, P336, P337, P338, P340, P341, P342, P343, P344 and P346.	
	New options for fault Reset.	
	General revision.	

	Status Messages
I. Parameters	09
II. Fault Messages	33
III. Other Messages	
	CHAPTER 1
	Safety Notices
	Carcty Notices
1.1 Safety Notices in the Manual	35
1.3 Preliminary Recommendations	35
	CHAPTER 2
Gen	eral Information
Gen	erai illioilliation
2.1 About this Manual	37
2.2 Software Version	37
2.3 About the CFW-09	37
2.4 CFW-09 Identification Label and Code Number	39
2.5 Receiving and Storage	41
	CHAPTER 3
Installation	and Connection
3.1 Mechanical Installation	
3.1.1 Environment Conditions	42
3.1.1 Environment Conditions	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses 3.2.5 Power Connections	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses 3.2.5 Power Connections 3.2.5.1 AC Input Connection	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses 3.2.5 Power Connections 3.2.5.1 AC Input Connection 3.2.5.2 Output Connections	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses 3.2.5 Power Connections 3.2.5.1 AC Input Connection 3.2.5.2 Output Connections 3.2.5.3 Grounding Connections	42 43 44 45 50urface 46 48 49 60ections 51 53 54 57 57 58
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses 3.2.5 Power Connections 3.2.5.1 AC Input Connection 3.2.5.2 Output Connections 3.2.5.3 Grounding Connections 3.2.5.4 IT Networks	42 43 44 45 50urface 46 48 49 49 60urections 51 53 57 57 58 58
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses 3.2.5 Power Connections 3.2.5.1 AC Input Connection 3.2.5.2 Output Connections 3.2.5.3 Grounding Connections 3.2.5.4 IT Networks 3.2.6 Control Wiring 3.2.7 Typical Terminal Connections	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses 3.2.5 Power Connections 3.2.5.1 AC Input Connection 3.2.5.2 Output Connections 3.2.5.3 Grounding Connections 3.2.5.4 IT Networks 3.2.6 Control Wiring	
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses 3.2.5 Power Connections 3.2.5.1 AC Input Connection 3.2.5.2 Output Connections 3.2.5.3 Grounding Connections 3.2.5.4 IT Networks 3.2.6 Control Wiring 3.2.7 Typical Terminal Connections 3.3 European EMC Directive - Requirements for Confo	42
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses 3.2.5 Power Connections 3.2.5.1 AC Input Connection 3.2.5.2 Output Connections 3.2.5.3 Grounding Connections 3.2.5.4 IT Networks 3.2.6 Control Wiring 3.2.7 Typical Terminal Connections 3.3 European EMC Directive - Requirements for Conformations 3.3.1 Installation 3.3.2 Epcos Filters	42
3.1.1 Environment Conditions 3.1.2 Dimensional of CFW-09 3.1.3 Mounting Specifications 3.1.3.1 Mounting Inside a Panel 3.1.3.2 Mounting on Surface 3.1.3.3 Mounting with the Heatsink Through a S 3.1.4 Keypad (HMI) and Cover Removal 3.2 Electrical Installation 3.2.1 Power/Grounding Terminals 3.2.2 Location of the Power/Grounding/Control Conr 3.2.3 Rated Voltage Selection 3.2.4 Power/Grounding Wiring and Fuses 3.2.5 Power Connections 3.2.5.1 AC Input Connection 3.2.5.2 Output Connections 3.2.5.3 Grounding Connections 3.2.5.4 IT Networks 3.2.6 Control Wiring 3.2.7 Typical Terminal Connections 3.3 European EMC Directive - Requirements for Confo	42 43 44 45 45 46 47 48 49 49 49 49 49 49 49 49 60 61 61 64 67 67 68

CHAPTER 4
Keypad (HMI) Operation
4.1 Description of the Keypad       86         4.2 Use of the Keypad (HMI)       88         4.2.1 Keypad Operation       88         4.2.2 "Read-Only" Variables and Status       89         4.2.3 Parameter Viewing and Programming       90
CHAPTER 5
Start-up
5.1 Pre-Power Checks       93         5.2 Initial Power-up       93         5.3 Start-up       98         5.3.1 Type of Control: V/F 60 Hz - Operation via Keypad (HMI)       99         5.3.2 Type of Control: Sensorless or Vector with Encoder (Operation Via Keypad (HMI))       102         5.3.3 Type of Control: VVW - Keypad Operation       109
CHAPTER 6
Detailed Parameter Description
6.1 Access and Read Only Parameters - P000 to P099       118         6.2 Regulation Parameters - P100 to P199       124         6.3 Configuration Parameters - P200 to P399       147         6.3.1 Parameters for Crane Applications and for Torque Master/Slave Function - P351 to P368       208         6.4 Motor Parameters - P400 to P499       214         6.5 Special Functions Parameters - P500 to P699       220         6.5.1 PID Regulator       220         6.5.2 Description       220
CHAPTER 7
Diagnostics and Troubleshooting
7.1 Faults and Possible Causes       228         7.2 Troubleshooting       233         7.3 Contacting WEG       235         7.4 Preventive Maintenance       235         7.4.1 Cleaning Instructions       236         7.5 Spare Part List       237
CFW-09 Options and Accessories
8.1 I/O Expansion Boards

8.1.2 EBB (I/O Expansion Board B)	
8.2 Incremental Encoder	
8.2.1 EBA/EBB Boards	
8.2.2 EBC1 Board	
8.3 Keypad with LEDs Only	
8.4 Remote Keypad and Cables	
8.5 Blank Covers	
8.6 RS-232 PC Communication Kit	
8.7 Line Reactor/DC Bus Choke	
8.7.1 Application Criteria	
8.7.2 DC Link Inductor Built in	
8.8 Load Reactor	
8.9 RFI Filter	
8.10 Dynamic Braking	. 268
8.10.1 DB Resistor Sizing	. 268
8.10.2 Installation	. 270
8.10.3 Dynamic Braking Module-DBW-01 and DBW-02	. 271
8.10.3.1 DBW-01 and DBW-02 Identification Label	. 272
8.10.3.2 Mechanical Installation	. 272
8.10.3.3 Installation/Connection	. 275
8.11 Through Surface Mounting Kit	
8.12 Fieldbus	
8.12.1 Installation of the Fieldbus Kit	
8.12.2 Profibus DP	
8.12.3 Profibus DP-V1	
8.12.4 DeviceNet	
8.12.5 DeviceNet Drive Profile	
8.12.6 EtherNet/IP	
	. 201
X 17 / LISE to the Fieldhils/Related Parameters of the LEVV-IIV	204
8.12.7 Use to the Fieldbus/Related Parameters of the CFW-09	
8.12.7.1 Variables Read from the Inverter	. 294
8.12.7.1 Variables Read from the Inverter	. 294 . 296
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications	. 294 . 296
8.12.7.1 Variables Read from the Inverter	. 294 . 296 . 298
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices	. 294 . 296 . 298
8.12.7.1 Variables Read from the Inverter	. 294 . 296 . 298 . 299 . 300
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction	. 294 . 296 . 298 . 299 . 300 . 300
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description	. 294 . 296 . 298 . 299 . 300 . 300 . 301
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485	. 294 . 296 . 298 . 299 . 300 . 300 . 301 . 301
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232	. 294 . 296 . 298 . 300 . 300 . 301 . 301 . 302
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions	. 294 . 296 . 298 . 300 . 300 . 301 . 301 . 302 . 302
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms	. 294 . 296 . 298 . 300 . 300 . 301 . 301 . 302 . 302 . 302
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices  8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232  8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution	. 294 . 296 . 298 . 300 . 300 . 301 . 301 . 302 . 302 . 302 . 303
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices  8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution 8.13.3.3 Characters Format	. 294 . 296 . 298 . 300 . 300 . 301 . 301 . 302 . 302 . 303 . 303
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices  8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution 8.13.3.3 Characters Format 8.13.3.4 Protocol	. 294 . 296 . 298 . 300 . 301 . 301 . 302 . 302 . 303 . 303 . 303
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution 8.13.3.3 Characters Format 8.13.3.4 Protocol 8.13.3.5 Execution and Telegram Test	. 294 . 296 . 298 . 300 . 301 . 301 . 302 . 302 . 303 . 303 . 303 . 305
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution 8.13.3.3 Characters Format 8.13.3.4 Protocol 8.13.3.5 Execution and Telegram Test 8.13.3.6 Telegram Sequence	. 294 . 296 . 298 . 300 . 300 . 301 . 301 . 302 . 302 . 303 . 303 . 303 . 305 . 306
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution 8.13.3.3 Characters Format 8.13.3.4 Protocol 8.13.3.5 Execution and Telegram Test 8.13.3.6 Telegram Sequence 8.13.3.7 Variable Code	. 294 . 296 . 298 . 300 . 300 . 301 . 301 . 302 . 302 . 303 . 303 . 303 . 305 . 306 . 306
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution 8.13.3.3 Characters Format 8.13.3.4 Protocol 8.13.3.5 Execution and Telegram Test 8.13.3.6 Telegram Sequence 8.13.3.7 Variable Code 8.13.4 Telegram Examples	. 294 . 296 . 298 . 300 . 300 . 301 . 301 . 302 . 302 . 303 . 303 . 303 . 305 . 306 . 306
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution 8.13.3.3 Characters Format 8.13.3.4 Protocol 8.13.3.5 Execution and Telegram Test 8.13.3.6 Telegram Sequence 8.13.3.7 Variable Code 8.13.4 Telegram Examples 8.13.5 Variables and Errors of the Serial Communication	. 294 . 296 . 298 . 300 . 301 . 301 . 302 . 302 . 303 . 303 . 303 . 305 . 306 . 306 . 307
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution 8.13.3.3 Characters Format 8.13.3.4 Protocol 8.13.3.5 Execution and Telegram Test 8.13.3.6 Telegram Sequence 8.13.7 Variable Code 8.13.4 Telegram Examples 8.13.5 Variables and Errors of the Serial Communication 8.13.5.1 Basic Variables	. 294 . 296 . 298 . 300 . 301 . 301 . 302 . 302 . 303 . 303 . 303 . 305 . 306 . 306 . 306 . 307 . 307
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution 8.13.3.3 Characters Format 8.13.3.4 Protocol 8.13.3.5 Execution and Telegram Test 8.13.3.6 Telegram Sequence 8.13.3.7 Variable Code 8.13.4 Telegram Examples 8.13.5 Variables and Errors of the Serial Communication	. 294 . 296 . 298 . 300 . 301 . 301 . 302 . 302 . 303 . 303 . 303 . 305 . 306 . 306 . 306 . 307 . 307
8.12.7.1 Variables Read from the Inverter 8.12.7.2 Variables Written in the Inverter 8.12.7.3 Fault Indications 8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices 8.13 Serial Communication 8.13.1 Introduction 8.13.2 Interfaces Description 8.13.2.1 RS-485 8.13.2.2 RS-232 8.13.3 Protocol Definitions 8.13.3.1 Used Terms 8.13.3.2 Parameters/Variables Resolution 8.13.3.3 Characters Format 8.13.3.4 Protocol 8.13.3.5 Execution and Telegram Test 8.13.3.6 Telegram Sequence 8.13.7 Variable Code 8.13.4 Telegram Examples 8.13.5 Variables and Errors of the Serial Communication 8.13.5.1 Basic Variables	. 294 . 296 . 298 . 300 . 300 . 301 . 301 . 302 . 302 . 303 . 303 . 303 . 305 . 306 . 306 . 306 . 307 . 307 . 310

8.13.7 Physical Connection of the RS-232 and RS-485 Interface	313
8.14 Modbus-RTU	
8.14.1 Introduction in the Modbus-RTU Protocol	
8.14.1.1 Transmission Modes	314
8.14.1.2 Message Structure in RTU Mode	
8.14.2 Operation of the CFW-09 in the Modbus-RTU Network	
8.14.2.1 Interface RS-232 and RS-485 Description	
8.14.2.2 Inverter Configuration in the Modbus-RTU Network	
8.14.2.3 Access to the Inverter Data	
8.14.3 Detailed Function Description	
8.14.3.1 Function 01 - Read Coils	
8.14.3.2 Function 03 - Read Holding Register	
8.14.3.3 Function 05 - Write Single Coil	322
8.14.3.4 Function 06 - Write Single Register	
8.14.3.5 Function 15 - Write Multiple Coils	
8.14.3.6 Function 16 - Write Multiple Registers	
8.14.3.7 Function 43 - Read Device Identification	
8.14.4 Communication Errors	
8.14.4.1 Error Messages	
8.15 KIT KME (for Extractable Mounting)	
8.16 CFW-09 SHARK NEMA 4X	
8.16.1 Enclosure Specifications	
8.16.2 Mechanical Installation	
8.16.3 Electrical Installation	
8.16.4 Closing the Inverter	
8.16.5 How to Specify	
8.17 CFW-09 Supplied by the DC Link - Line HD	
8.18 CFW-09 RB Regenerative Converter	
8.19 PLC Board	
CHAPTI	ER 9
Technical Specifical	tion
reominal opeomoc	((1011
9.1 Power Data	226
9.1.1 Power Supply Specifications	
9.1.2 220-230 V Power Supply 9.1.3 380-480 V Power Supply	აა:
9.1.4 500-600 V Power Supply	
9.1.5 660-690 V Power Supply	
9.2 Electronics/General Data	
9.2.1 Applicable Standards	
9.3 Optional Devices	
9.3.1 I/O Expansion Board EBA	
9.3.2 I/O Expansion Board EBB	
3.4 IVICUI di liudi Dala	540

8.13.6 Times for Read/Write of Telegrams .......312

## QUICK PARAMETER REFERENCE, FAULT AND STATUS MESSAGES

Software: V4.0X
Application:
CFW-09 Model:
Serial Number:
Responsible:
Date: / / .

#### I. Parameters

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
P000	Parameter Access	0 to 999	0	-	Setting	118
	READ ONLY PARAMETERS	P001 to P099				
P001	Speed Reference	0.0 to P134		rpm		118
P002	Motor Speed	0.0 to P134		rpm		118
P003	Motor Current	0.0 to 2600		A (rms)		118
P004	DC Link Voltage	0.0 to 1235		V		119
P005	Motor Frequency	0.0 to 1020		Hz		119
P006	Inverter Status	rdy run Sub Exy		-		119
P007	Motor Voltage	0 to 800		V		119
P009	Motor Torque	0.0 to 150.0		%		119
P010	Output Power	0.0 to 3276		kW		119
P012	Digital Inputs DI1 DI8 Status	0 = Inactive (Open) 1 = Active (Closed)		-		119
P013	Digital and Relay Outputs DO1, DO2, RL1, RL2, and RL3 Status	0 = Inactive (Dropped-out) 1 = Active (Picked-up)		-		120
P014	Last Fault	0 to 71		-		121
P015	Second Previous Fault	0 to 71		-		121
P016	Third Previous Fault	0 to 71		-		121
P017	Fourth Previous Fault	0 to 71		-		121
P018	Analog Input AI1' Value	-100 to +100		%		121
P019	Analog Input Al2' Value	-100 to +100		%		121
P020	Analog Input Al3' Value	-100 to +100		%		121
P021	Analog Input AI4' Value	-100 to +100		%		121
P022	WEG Use	-		-		121
P023	Software Version	V4.0X		-		121
P024	A/D Conversion Value of Al4	-32768 to +32767		-		121
P025	A/D Conversion Value of Iv	0 to 1023		-		121
P026	A/D Conversion Value of Iw	0 to 1023		-		121
P027	AO1 Value	0.0 to 100		%		122
P028	AO2 Value	0.0 to 100		%		122
P029	AO3 Value	-100 to +100		%		122
P030	AO4 Value	-100 to +100		%		122
P040	PID Process Variable	0 to 100		%		122
P042	Powered Time	0 to 65535		h		122
P043	Enabled Time	0 to 6553.5		h		122
P044	kWh Counter	0 to 65535		kWh		123

			Factory		User's	
Parameters	Function	Adjustable Range	Setting	Unit	Setting	Page
P060	Fifth Error	0 to 71		-		123
P061	Sixth Error	0 to 71		-		123
P062	Seventh Error	0 to 71		-		123
P063	Eighth Error	0 to 71		-		123
P064	Ninth Error	0 to 71		-		123
P065	Tenth Error	0 to 71		-		123
P070	Motor Current and Motor Speed	0 to 2600		A (rms)		123
		0 to P134		rpm		
P071	Command Word	0 a 65535		-		123
P072	Fieldbus Speed Reference	0 a 65535		-		123
	REGULATION PARAMETERS	P100 to P199			•	
	Ramps					
P100	Acceleration Time	0.0 to 999	20.0	S		124
P101	Deceleration Time	0.0 to 999	20.0	s		124
P102	Acceleration Time 2	0.0 to 999	20.0	s		124
P103	Deceleration Time 2	0.0 to 999	20.0	s		124
P104	S Ramp	0 = Inactive (Linear)	0 = Inactive	-		124
		1 = 50 %				
		2 = 100 %				
	Speed References					
P120	Speed Reference Backup	0 = Inactive	1 = Active	-		124
		1 = Active				
P121	Keypad Speed Reference	P133 to P134	90	rpm		125
P122 (2)(11)	JOG or JOG+ Speed Reference	00 to P134	150 (125)	rpm		125
P123 (2)(11)	JOG- Speed Reference	00 to P134	150 (125)	rpm		125
P124 (2)(11)	Multispeed Reference 1	P133 to P134	90 (75)	rpm		126
P125 (2)(11)	Multispeed Reference 2	P133 to P134	300 (250)	rpm		126
P126 (2)(11)	Multispeed Reference 3	P133 to P134	600 (500)	rpm		126
P127 (2)(11)	Multispeed Reference 4	P133 to P134	900 (750)	rpm		126
P128 (2)(11)	Multispeed Reference 5	P133 to P134	1200 (1000)	rpm		126
P129 (2)(11)	Multispeed Reference 6	P133 to P134	1500 (1250)	rpm		126
P130 (2)(11)	Multispeed Reference 7	P133 to P134	1800 (1500)	rpm		126
P131 (2)(11)	Multispeed Reference 8	P133 to P134	1650 (1375)	rpm		126
	Speed Limits					
P132 (1)	Maximum Overspeed Level	(0 to 99) x P134	10	%		127
	•	100 = Disabled				
P133 (2)(11)	Minimum Speed Reference	0 to (P134-1)	90 (75)	rpm		127
P134 (2)(11)	Maximum Speed Reference	(P133+1) to (3.4 x P402)	1800 (1500)	rpm		127
	I/F Control					
P135 (2)	Speed transition to I/F Control	0 to 90	18	rpm		128
P136 (*)	Current Reference (I*)	0 = I <sub>mr</sub>	1 = 1.11 x I <sub>mr</sub>	-		128
	for I/F Control	1 = 1.11 x I <sub>mr</sub>				
		2 = 1.22 x I <sub>mr</sub>				
		3 = 1.33 x I <sub>mr</sub>				
		$4 = 1.44 \times I_{mr}$				
		5 = 1.55 x I <sub>mr</sub>				
		6 = 1.66 x I <sub>mr</sub>				
		$7 = 1.77 \times I_{mr}$				
		8 = 1.88 x I <sub>mr</sub>				
		$9 = 2.00 \times I_{mr}$				

<sup>(\*)</sup> P136 has different functions for V/F and Vector Control.

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Page
	V/F Control				
P136 (*)	Manual Boost Torque	0 to 9	1	-	129
P137	Autommatic Torque Boost	0.00 to 1.00	0.00	-	130
P138	Slip Compensation	-10.0 to +10.0	0.0	%	130
P139	Output Current Filter	0.00 to 16.00	1.00	S	131
P140	Dwell Time at Start	0.0 to 10.0	0.0	s	131
P141	Dwell Speed at Start	0 to 300	90	rpm	131
	Adjustable V/F				
P142 (1)	Maximum Output Voltage	0.0 to 100.0	100.0	%	132
P143 (1)	Intermediate Output Voltage	0.0 to 100.0	50.0	%	132
P144 (1)	Output Voltage at 3 Hz	0.0 to 100.0	8.0	%	132
P145 (1)	Field Weakening Speed	P133 (> 90) to P134	1800	rpm	132
P146 <sup>(1)</sup>	Intermediate Speed	90 to P145	900	rpm	132
	DC Link Voltage Regulation				
P150 (1)	DC Link Voltage Regulation Mode	0 = With Losses	1 = Without Losses	-	133
		1 = Without Losses			
		2 = Enable/Disable			
		via DI3DI8			
P151 (6) (*)	DC Link Voltage Regulation Level	339 to 400 (P296 = 0)	400	V	133 and
	(V/F Control / Vector Control	585 to 800 (P296 = 1)	800		136
	with optimal braking)	616 to 800 (P296 = 2)	800		
	, 3,	678 to 800 (P296 = 3)	800		
		739 to 800 (P296 = 4)	800		
		809 to 1000 (P296 = 5)	1000		
		885 to 1000 (P296 = 6)	1000		
		924 to 1000 (P296 = 7)	1000		
		1063 to 1200 (P296 = 8)	1200		
P152	Proportional Gain	0.00 to 9.99	0.00		137
P153 <sup>(6)</sup>	Dynamic Braking Level	339 to 400 (P296 = 0)	375	V	137
. 100	Dynamic Braking Level	585 to 800 (P296 = 1)	618	•	
		616 to 800 (P296 = 2)	675		
		678 to 800 (P296 = 3)	748		
		739 to 800 (P296 = 4)	780		
		809 to 1000 (P296 = 5)	893		
		885 to 1000 (P296 = 6)	972		
		924 to 1000 (P296 = 7)	972		
		1063 to 1200 (P296 = 8)	1174		
P154	Dynamic Braking Resistor	0.0 to 500	0.0	Ω	138
P155	DB Resistor Power Rating	0.00 to 650	2.60	kW	138
1 133	Overload Currents	0.00 10 030	2.00	NV V	130
P156 (2)(7)(12)	Overload Current 100 % Speed	P157 to 1.3 x P295	1.1 x P401	A	139
P157 (2)(7)	Overload Current 100 % Speed  Overload Current 50 % Speed	P156 to P158	0.9 x P401	A	139
P158 (2) (7)	Overload Current 5 % Speed	(0.2 x P295) to P157	0.55 x P401	A	139
F I JO V / /	<u> </u>	(0.2 x F293) (0 F137	0.55 X F 401		139
P160 (1)	Speed Regulator Optimization of the	0 = Normal	0 = Normal	-	140
F 100 "	·		บ = เพิ่มเกาสเ	-	140
D4C4 (3)	Speed Regulator	1 = Saturated	7.4		110
P161 (3)	Proportional Gain	0.0 to 63.9	7.4	=	142
D400 (2)	L Intogral (-ain	0.000 to 9.999	0.023	-	142
P162 (3) P163	Integral Gain  Local Speed Reference Offset	-999 to +999	0		143

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
P165	Speed Filter	0.012 to 1.000	0.012	S		143
P166	Speed Regulator Differential Gain	0.00 to 7.99	0.00 (without	-		143
			differential action)			
	Current Regulator					
P167 (4)	Proportional Gain	0.00 to 1.99	0.50	-		143
P168 (4)	Integral Gain	0.000 to 1.999	0.010	-		143
P169 (*)(7)	Maximum Output Current (V/F Control)	(0.2 x P295) to (1.8 x P295)	1.5 x P295	Α		144
P169 (*)(7)	Maximum Forward Torque Current (Vector Control)	0 to 180	125	%		144
P170	Maximum Reverse Torque Current (Vector Control)	0 to 180	125	%		144
P171	Maximum Forward Torque Current at Maximum Speed (P134)	0 to 180	125	%		145
P172	Maximum Reverse Torque Current at Maximum Speed (P134)	0 to 180	125	%		145
P173	Curve Type of the Max. Torque	0 = Ramp 1 = Step	0 = Ramp	-		145
	Flux Regulator					
P175 (5)	Proportional Gain	0.0 to 31.9	2.0	-		146
P176 (5)	Integral Gain	0.000 to 9.999	0.020	-		146
P177	Minimum Flux	0 to 120	0	%		146
P178	Nominal Flux	0 to 120	100	%		146
P179	Maximum Flux	0 to 120	120	%		146
P180	Field Weakenig Start Point	0 to 120	95	%		146
P181 <sup>(1)</sup>	Magnetization Mode	0 = General Enable 1 = Start/Stop	0 = General Enable	-		146
	CONFIGURATION PARAMETERS	P200 to P399				
	Generic Parameters					
P200	Password	0 = Off 1 = On	1 = On	-		147
P201 (11)	Language Selection	0 = Português 1 = English 2 = Español 3 = Deutsch	0, 1, 2, 3 (11)	-		147
P202 (1)(2)(11)	Type of Control	0 = V/F 60 Hz 1 = V/F 50 Hz 2 = V/F Adjustable 3 = Sensorless Vector 4 = Vector with Encoder 5 = VVW (Voltage Vector WEG)	0 (1)	-		147
P203 <sup>(1)</sup>	Special Function Selection	0 = None 1 = PID Regulator	0 = None	-		147
P204 (1)(10)	Load/Save Parameters	0 = Not Used 1 = Not Used 2 = Not Used 3 = Reset P043 4 = Reset P044 5 = Loads Factory Default-60 Hz 6 = Loads Factory Default-50 Hz	0 = Not Used	-		148

<sup>(\*)</sup> P169 has different function for V/F or Vector Control.

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
		7 = Loads User Default 1				
		8 = Loads User Default 2				
		9 = Not Used				
		10 = Save User Default 1				
		11 = Save User Default 2				
P205	Display Default Selection	0 = P005 (Motor Frequency)	2 = P002	-		149
		1 = P003 (Motor Current)				
		2 = P002 (Motor Speed)				
		3 = P007 (Motor Voltage)				
		4 = P006 (Inverter Status)				
		5 = P009 (Motor Torque)				
		6 = P070 (Motor Speed and				
		Motor Current)				
		7 = P040 (PID Process				
		Variable)				
P206	Auto-Reset Time	0 to 255	0	S		150
P207	Reference Engineering Unit 1	32 to 127 (ASCII)	114 = r	-		150
. 20.	Troiding Engineering Critic F	A, B,, Y, Z				100
		0, 1,, 9				
		#, \$, %, (, ), *, +,				
P208 (2)(11)	Reference Scale Factor	1 to 18000	1800 (1500)	-		150
P209 <sup>(1)</sup>	Motor Phase Loss Detection	0 = Off	0 = Off	_		151
F203 \ /	Woldi Filase Loss Detection	1 = On	0 = OII	_		131
P210	Decimal Point of the Speed Indication	_	0	_		151
P210 P211(1)	· · · · · · · · · · · · · · · · · · ·	0 to 3 0 = Off	0 = Off	-		
P211 <sup>(1)</sup>	Zero Speed Disable	1 = On	U = OII	-		151
P212	Condition to Leave Zero	0 = N* or N>P291	0 = N* or N>P291	_		152
FZIZ		1 = N*>P291	0=N 01N>P291	_		152
D040	Speed Disable	-		_		450
P213	Time Delay for Zero Speed Disable	0 to 999	0	S		152
P214 (1) (9)	Line Phase Loss Detection	0 = Off	1 = On	-		152
<b></b>	14 10 5 11	1 = On	2 2"			
P215 (1)	Keypad Copy Function	0 = Off	0 = Off	-		152
		1 = Inverter → Keypad				
		2 = Keypad → Inverter				
P216	Reference Engineering Unit 2	32 to 127 (ASCII)	112 = p	-		154
		A, B, , Y, Z				
		0, 1,, 9				
		#, \$, %, (, ), *, +,				
P217	Reference Engineering Unit 3	32 to 127 (ACSII)	109 = m	-		154
		A, B,, Y, Z				
		0, 1,, 9				
		#, \$, %, (, ), *, +,				
P218	LCD Display Contrast	0 to 150	127	-		154
	Adjustment					
	Local/Remote Definition					
P220 (1)	Local/Remote Selection Source	0 = Always Local	2 = Keypad	-		154
		1 = Always Remote	(Default Local)			
		2 = Keypad (Default Local)	,			
		3 = Keypad (Default Remote)				

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
		4 = DI2 to DI8				
		5 = Serial (L)				
		6 = Serial (R)				
		7 = Fieldbus (L)				
		8 = Fieldbus (R)				
		9 = PLC (L)				
		10 = PLC (R)				
P221 <sup>(1)</sup>	Local Speed Reference Selection	0 = keypad	0 = Keypad	-		155
		1 = AI1				
		2 = AI2				
		3 = AI3				
		4 = AI4				
		5 = Add AI > 0				
		6 = Add Al				
		7 = E.P.				
		8 = Multispeed				
		9 = Serial				
		10 = Fieldbus				
		11 = PLC				
P222 <sup>(1)</sup>	Remote Speed Reference	0 = keypad	1 = AI1	-		155
	Selection	1 = AI1				
		2 = AI2				
		3 = AI3				
		4 = AI4				
		5 = Add AI > 0				
		6 = Add Al				
		7 = E.P.				
		8 = Multispeed				
		9 = Serial				
		10 = Fieldbus				
		11 = PLC				
P223 (1) (8)	Local FWD/REV Selection	0 = Always Forward	2 = Keypad	-		156
		1 = Always Reverse	(Default FWD)			
		2 = Keypad (Default FWD)				
		3 = Keypad (Default REV)				
		4 = DI2				
		5 = Serial (Default FWD)				
		6 = Serial (Default REV)				
		7 = Fieldbus (Default FWD)				
		8 = Fieldbus (Default REV)				
		9 = Polarity Al4				
		10 = PLC (FWD)				
		11 = PLC (REV)				
P224 (1)	Local Start/Stop Selection	0 = [I] and [O] Keys	0 = [I] and [O] Keys	-		156
		1 = DIx				
		2 = Serial				
		3 = Fieldbus				
P225 (1) (8)	Local JOG Selection	4 = PLC 0 = Disable	1 = Keypad	-		156

Parameters	Function	Adjustable Range	Factory	Unit	User's	Page
		2 = DI3 to DI8	Setting		Setting	
		3 = Serial				
		4 = Fieldbus				
		5 = PLC				
P226 (1) (8)	Remote FWD/REV Selection	0 = Always Forward	4 = DI2	-		157
		1 = Always Reverse				
		2 = Keypad (Default FWD)				
		3 = Keypad (Default REV)				
		4 = DI2				
		5 = Serial (Default FWD)				
		6 = Serial (Default REV)				
		7 = Fieldbus (Default FWD)				
		8 = Fieldbus (Default REV)				
		9 = Polarity AI4				
		10 = PLC (FWD)				
		11 = PLC (REV)				
P227 <sup>(1)</sup>	Remote Start/Stop Selection	0 = [I] and [O] Keys	1 = DIx	-		157
		1 = DIx				
		2 = Serial				
		3 = Fieldbus				
		4 = PLC				
P228 <sup>(1) (8)</sup>	Remote JOG Selection	0 = Disable	2 = DI3 to DI8	-		157
		1 = Keypad				
		2 = DI3 to DI8				
		3 = Serial				
		4 = Fieldbus				
	Otan Madal Dafferidan	5 = PLC				
P232 (1)	Stop Model Definition	0 = Ramp to Stop	0 = Ramp to Stop	T	1	163
F232 \**	Stop Mode Selection	1 = Coast to Stop	0 = Kamp to Stop	_		103
		2 = Fast Stop				
	Analog Inputs	2 = Fast 5t0p				
P233	Analog Inputs Dead Zone	0 = Off	0 = Off	Ι.		163
. 200	7 maiog impato Bead Zone	1 = On	0 - 011			100
P234	Analog Input Al1 Gain	0.000 to 9.999	1.000	_		164
P235 <sup>(1)</sup>	Analog Input Al1 Signal	0 = (0 to 10) V / (0 to 20) mA		<u>-</u>		165
	a menog mpaman organa	1 = (4 to 20) mA	(0 to 20) mA			
		2 = (10 to 0) V / (20 to 0) mA	1 '			
		3 = (20 to 4) mA				
P236	Analog Input Al1 Offset	-100.0 to +100.0	0.0	%		165
P237 (1) (8)	Analog Input Al2 Function	0 = P221/P222	0 = P221/P222	-		165
		1 = N* without ramp				
		2 = Maximum Torque Current				
		3 = PID Process Variable				
		4 = Maximum Torque Current				
		(Al2 + Al1)				
P238	Analog Input AI2 Gain	0.000 to 9.999	1.000	-		166

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
P239 <sup>(1)</sup>	Analog Input AI2 Signal	0 = (0 to 10) V / (0 to 20) mA	0 = (0 to 10) V /	-		166
		1 = (4 to 20) mA	(0 to 20) mA			
		2 = (10  to  0)  V / (20  to  0)  mA				
		3 = (20 to 4) mA				
P240	Analog Input Al2 Offset	-100.0 to +100.0	0.0	%		167
P241 (1) (8)	Analog Input AI3 Function	0 = P221/P222	0 = P221/P222	-		167
	(Requires Optional I/O Expansion	1 = Without ramp				
	Board EBB)	2 = Maximum Torque Current				
		3 = PID Process Variable				
		4 = Maximum Torque Current				
D040	Analan Innut Al2 Cain	(AI3 + AI2)	4.000			400
P242	Analog Input AI3 Gain	0.000 to 9.999	1.000	-		168
P243 <sup>(1)</sup>	Analog Input Al3 Signal	0 = (0  to  10)  V / (0  to  20)  mA		-		168
		1 = $(4 \text{ to } 20) \text{ mA}$ 2 = $(10 \text{ to } 0) \text{ V} / (20 \text{ to } 0) \text{ mA}$	(0 to 20) mA			
		, , , , ,				
P244	Analog Input Al3 Offset	3 = (20 to 4) mA -100.0 to +100.0	0.0	%		168
P245	Analog Input Al3 Oliset  Analog Input Al4 Gain	0.000 to 9.999	1.000	-		168
P246 <sup>(1)</sup>	Analog Input Al4 Signal	0 = (0 to 10) V / (0 to 20) mA		_		168
1 240	(Requires Optional I/O Expansion	1 = (4 to 20) mA	(0 to 20) mA			100
	Board EBA)	2 = (10  to  0)  V / (20  to  0)  mA	(0 10 20) 1117			
	Board EB/ ()	3 = (20  to  4)  mA				
		4 = (-10 to +10) V				
P247	Analog Input AI4 Offset	-100.0 to +100.0	0.0	%		169
P248	Input Filter AI2	0.0 to 16.0	0.0	s		169
	Analog Outputs					
P251	Analog Output AO1 Function	0 = Speed Reference	2 = Real Speed	-		169
	(CC9 or EBB board)	1 = Total Reference	·			
		2 = Real Speed				
		3 = Torque Current				
		Reference (Vector)				
		4 = Torque Current (Vector)				
		5 = Output Current				
		6 = PID Process Variable				
		7 = Active Current (V/F)				
		8 = Power (kW)				
		9 = PID Setpoint				
		10 = Positive Torque Current				
		11 = Motor Torque				
		12 = PLC				
		13 = Dead Zone for				
		Speed Indication				
		14 = Motor Voltage				
P252	Analog Output AO1 Gain	0.000 to 9.999	1.000	-		169
P253	Analog Output AO2 Function	0 = Speed Reference	5 = Output Current	-		169
	(CC9 or EBB board)	1 = Total Reference				
		2 = Real Speed				
		3 = Torque Current				
		Reference (Vector)				

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's	Page
Parameters P254	Function  Analog Output AO2 Gain	4 = Torque Current (Vector) 5 = Output Current 6 = PID Process Variable 7 = Active Current (V/F) 8 = Power (kW) 9 = PID Setpoint 10 = Positive Torque Current 11 = Motor Torque 12 = PLC 13 = Dead Zone for Speed Indication 14 = Motor Voltage 0.000 to 9.999	Setting 1.000	Unit	Setting	169
P255	Analog Output AO3 Function (Requires Optional I/O Expansion Board EBA)	0 = Speed Reference 1 = Total Reference 2 = Real Speed 3 = Torque Current Reference (Vector) 4 = Torque Current (Vector) 5 = Output Current 6 = PID Process Variable 7 = Active Current (V/F) 8 = Power (kW) 9 = PID Setpoint 10 = Positive Torque Current 11 = Motor Torque 12 = PLC 13 = Not Used 14 = Motor Voltage 15 to 63 = Exclusive WEG use	2 = Real Speed	-		169
P256	Analog Output AO3 Gain	0.000 to 9.999	1.000	_		170
P257	Analog Output AO3 Gain  Analog Output AO4 Function (Requires optional I/O Expansion Board EBA)	0 = Speed Reference 1 = Total Reference 2 = Real Speed 3 = Torque Current Reference (Vector) 4 = Torque Current (Vector) 5 = Output Current 6 = PID Process Variable 7 = Active Current (V/F) 8 = Power (kW) 9 = PID Setpoint 10 = Positive Torque Current 11 = Motor Torque 12 = PLC 13 = Not Used 14 = Motor Voltage 15 to 63 = Exclusive WEG use	5 = Output Current	-		170
P258	Analog Output AO4 Gain	0.000 to 9.999	1.000	-		170
P259	Dead Zone for Speed Indication	0 to P134	1000	rpm		171

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
	Digital Inputs		9		J	
P263 (1)	Digital Input DI1 Function	0 = Not Used	1 = Start/Stop	-		172
		1 = Start/Stop				
		2 = General Enable				
		3 = Fast Stop				
P264 <sup>(1)</sup>	Digital Input DI2 Function	0 = FWD/REV	0 = FWD/REV	-		172
		1 = Local/Remote				
		2 = Not Used				
		3 = Not Used				
		4 = Not Used				
		5 = Not Used				
		6 = Not Used 7 = Not Used				
P265 <sup>(1) (8)</sup>	Digital Input DI2 Function	8 = Reverse Run 0 = Not Used	0 = Not Used			172
P203(17(6)	Digital Input DI3 Function	1 = Local/ Remote	0 = Not Osed	=		172
		2 = General Enable				
		3 = JOG				
		4 = No External Fault				
		5 = Increase E.P.				
		6 = Ramp 2				
		7 = Not Used				
		8 = Forward Run				
		9 = Speed/Torque				
		10 = JOG+				
		11 = JOG-				
		12 = Reset				
		13 = Fieldbus				
		14 = Start (3 wire)				
		15 = Man/Auto				
		16 = Not used				
		17 = Disables Flying Start				
		18 = DC Voltage Regulator				
		19 = Parameter Setting				
		Disable				
		20 = Load user				
		21 = Timer (RL2)				
		22 = Timer (RL3)				
P266 (1)	Digital Input DI4 Function	0 = Not used	0 = Not Used	-		172
		1 = Local/ Remote				
		2 = General Enable				
		3 = JOG				
		4 = No external Fault				
		5 = Decrease E.P.				
		6 = Ramp 2				
		7 = Multispeed (MS0)				
		8 = Reverse Run				
		9 = Speed/Torque				
		10 = JOG+				

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
		11 = JOG-				
		12 = Reset				
		13 = Fieldbus				
		14 = Stop (3 wire)				
		15 = Man/Auto				
		16 = Not used				
		17 = Disables Flying Start				
		18 = DC voltage regulator				
		19 = Parameter Setting				
		Disable				
		20 = Load User				
		21 = Timer (RL2)				
		22 = Timer (RL3)				
P267 (1)	Digital Input DI5 Function	0 = Not Used	3 = JOG	-		172
		1 = Local/ Remote				
		2 = General Enable				
		3 = JOG				
		4 = No External Fault				
		5 = Increase E.P.				
		6 = Ramp 2				
		7 = Multispeed (MS1)				
		8 = Fast Stop				
		9 = Speed/Torque				
		10 = JOG+				
		11 = JOG-				
		12 = Reset				
		13 = Fieldbus				
		14 = Start (3 wire)				
		15 = Man/Auto				
		16 = Not Used				
		17 = Disables Flying Start				
		18 = DC Voltage Regulator				
		19 = Parameter Setting				
		Disable				
		20 = Load User				
		21 = Timer (RL2)				
		22 = Timer (RL3)				
P268 (1)	Digital Input DI6 Function	0 = Not Used	6 = Ramp 2	-		173
		1 = Local/ Remote				
		7 = Multispeed (MS2)				
		9 = Speed/Torque				
		10 = JOG+				
I		11 = JOG-				l
		2 = General Enable 3 = JOG 4 = No External Fault 5 = Decrease E.P. 6 = Ramp 2 7 = Multispeed (MS2) 8 = Fast Stop 9 = Speed/Torque				

Parameters	Function	Adjustable Range	Factory	Unit	User's	Page
raiameters	T different		Setting	Offic	Setting	raye
		12 = Reset				
		13 = Fieldbus				
		14 = Stop (3 wire)				
		15 = Man/Auto				
		16 = Not Used				
		17 = Disables Flying Start 18 = DC voltage regulator				
		19 = Parameter setting				
		disable				
		20 = Load user				
		21 = Timer (RL2)				
		22 = Timer (RL3)				
P269 (1)	Digital Input DI7 Function	0 = Not Used	0 = Not used	-		173
1 200	(Requires optional I/O	1 = Local/ Remote	0 = 1401 0300			170
	expansion board EBA or EBB)	2 = General Enable				
	expansion board EB/( or EBB)	3 = JOG				
		4 = No External Fault				
		5 = Not Used				
		6 = Ramp 2				
		7 = Not Used				
		8 = Fast Stop				
		9 = Speed/Torque				
		10 = JOG+				
		11 = JOG-				
		12 = Reset				
		13 = Fieldbus				
		14 = Start (3 wire)				
		15 = Man/Auto				
		16 = Not Used				
		17 = Disables Flying Start				
		18 = DC Voltage Regulator				
		19 = Parameter Setting				
		Disable				
		20 = Load User				
		21 = Timer (RL2)				
		22 = Timer (RL3)				
P270 (1)	Digital Input DI8 Function	0 = Not used	0 = Not used	-		173
	(Requires optional I/O	1 = Local/Remote				
	expansion board EBA or EBB)	2 = General Enable				
		3 = JOG				
		4 = No External Fault				
		5 = Not Used				
		6 = Ramp 2				
		7 = Not Used				
		8 = Fast Stop				
		9 = Speed/Torque				
		10 = JOG+				
		11 = JOG-				
		12 = Reset				

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
		13 = Fieldbus 14 = Stop (3 wire) 15 = Man/Auto 16 = Motor Thermistor 17 = Disables Flying Start 18 = DC Voltage Regulator 19 = Parameter Setting Disable 20 = Not Used 21 = Timer (RL2)				
	Digital Outputs	22 = Timer (RL3)				
P275 <sup>(1)</sup> [	Digital Ouput DO1 Function (requires optional I/O expansion board EBA or EBB)	0 = Not used 1 = N* > Nx 2 = N > Nx 3 = N < Ny 4 = N = N* 5 = Zero Speed 6 = Is > Ix 7 = Is < Ix 8 = Torque > Tx 9 = Torque < Tx 10 = Remote 11 = Run 12 = Ready 13 = No Fault 14 = No E00 15 = No E01+E02+E03 16 = No E04 17 = No E05 18 = (4 to 20) mA OK 19 = Fieldbus 20 = FWD 21 = Proc.Var. > VPx 22 = Proc. Var. < VPy 23 = Ride-Through 24 = Pre-charge OK 25 = Fault 26 = Enabled Hours > Hx 27 = Not Used 28 = Not Used 29 = N > Nx and Nt > Nx 30 = Brake (Actual Speed) 31 = Brake (Total Reference) 32 = Overweight 33 = Slack Cable 34 = Torque Polarity +/-	0 = Not Used			180

Parameters	Function	Adjustable Range	Factory	Unit	User's	Page
Farameters	FullCuon		Setting	Offic	Setting	raye
		35 = Torque Polarity -/+				
		36 = F > Fx _ 1				
		37 = F > Fx _ 2				
		38 = Set Point = Process				
		Variable				
		39 = No E32				
		40 = Ready 2				
P276 (1)	Digital Output DO2 Function	0 = Not Used	0 = Not used	-		180
	(Requires optional I/O	$1 = N^* > Nx$				
	expansion board EBA or EBB)	2 = N > Nx				
		3 = N < Ny				
		$4 = N = N^*$				
		5 = Zero Speed				
		6 = Is > Ix				
		7 = Is < Ix				
		8 = Torque > Tx				
		9 = Torque < Tx				
		10 = Remote				
		11 = Run				
		12 = Ready				
		13 = No Fault				
		14 = No E00				
		15 = No E01+E02+E03				
		16 = No E04				
		17 = No E05				
		18 = (4 to 20) mA OK				
		19 = Fieldbus				
		20 = FWD				
		21 = Proc.Var. > VPx				
		22 = Proc. Var. < VPy				
		23 = Ride-Through				
		24 = Pre-charge OK				
		25 = Fault				
		26 = Enabled Hours > Hx				
		27 = Not Used				
		28 = Not Used				
		29 = N > Nx and Nt > Nx				
		30 = Brake (Actual Speed)				
		31 = Brake (Total Reference)				
		32 = Overweight				
		33 = Slack Cable				
		34 = Torque Polarity +/-				
		35 = Torque Polarity -/+				
		36 = F > Fx _ 1				
		$37 = F > Fx _ 2$				
		38 = Set Point = Process				
		Variable				
		39 = No E32				
		40 = Ready 2				
		TO = NEauy Z				

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
P277 <sup>(1)</sup>	Relay Output RL1 Function	0 = Not Used	13 = No Fault	-		180
		1 = N* > Nx				
		2 = N > Nx				
		3 = N < Ny				
		$4 = N = N^*$				
		5 = Zero Speed				
		6 = ls > lx				
		7 = ls < lx				
		8 = Torque > Tx				
		9 = Torque < Tx				
		10 = Remote				
		11 = Run				
		12 = Ready				
		13 = No Fault				
		14 = No E00				
		15 = No E01+E02+E03				
		16 = No E04				
		17 = No E05				
		18 = (4 to 20) mA OK				
		19 = Fieldbus				
		20 = FWD				
		21 = Proc.Var. > VPx				
		22 = Proc. Var. < VPy				
		23 = Ride-Through				
		24 = Pre-charge OK				
		25 = Fault				
		26 = Enabled Hours > Hx				
		27 = PLC				
		28 = Not Used				
		29 = N > Nx and Nt > Nx				
		30 = Brake (Actual Speed)				
		31 = Brake (Total Reference)				
		32 = Overweight				
		33 = Slack Cable				
		34 = Torque Polarity +/-				
		35 = Torque Polarity -/+				
		36 = F > Fx _ 1				
		37 = F > Fx _ 2				
		38 = Set Point = Process				
		Variable				
		39 = No E32				
		40 = Ready 2				
P279 (1)	Relay Output RL2 Function	0 = Not used	2 = N > Nx	-		180
		1 = N* > Nx				
		2 = N > Nx				
		3 = N < Ny				
		4 = N = N*				
		5 = Zero Speed				

Parameters	Function	Adjustable Range	Factory	Unit	User's	Page
T dramotoro	i unouon	6 = Is > Ix	Setting	J	Setting	
		0 = 1S > 1X 7 = IS < IX				
		8 = Torque > Tx				
		9 = Torque < Tx				
		10 = Remote				
		11 = Run				
		12 = Ready				
		13 = No Fault				
		14 = No E00				
		15 = No E01+E02+E03				
		16 = No E04				
		17 = No E05				
		18 = (4 to 20) mA OK				
		19 = Fieldbus				
		20 = FWD				
		21 = Proc.Var. > VPx				
		22 = Proc. Var. < VPy				
		23 = Ride-Through				
		24 = Pre-charge OK				
		25 = Fault				
		26 = Enabled Hours > Hx				
		27 = PLC				
		28 = Timer				
		29 = N > Nx and Nt > Nx				
		30 = Brake (Actual Speed)				
		31 = Brake (Total Reference)				
		32 = Overweight				
		33 = Slack Cable				
		34 = Torque Polarity +/-				
		35 = Torque Polarity -/+				
		36 = F > Fx _ 1				
		37 = F > Fx _ 2				
		38 = Set Point = Process				
		Variable				
		39 = No E32				
		40 = Ready 2				
P280 (1)	Relay Output RL3 Function	0 = Not used	$1 = N^* > Nx$	-		180
		$1 = N^* > Nx$				
		2 = N > Nx				
		3 = N < Ny				
		4 = N = N*				
		5 = Zero Speed				
		6 = Is > Ix				
		7 = Is < Ix				
		8 = Torque > Tx				
		9 = Torque < Tx				
		10 = Remote				
		11 = Run				
		12 = Ready				
	1	13 = No Fault				<u> </u>

Donomotono	Function	Adiust	oblo Dowers	Factory	l lesia	User's	Daws
Parameters	Function		able Range	Setting	Unit	Setting	Page
		14 = No E0					
			1+E02+E03				
		16 = No E0					
		17 = No E0					
		18 = (4 to 2					
		19 = Fieldb 20 = FWD	us				
			(a.s. ) (Day				
		21 = Proc.\					
		22 = Proc. 23 = Ride-1	-				
		24 = Pre-ch	-				
		25 = Fault	large Orc				
			ed Hours > Hx				
		27 = PLC	od Flodio z Flix				
		28 = Timer					
		29 = N > N	x and Nt > Nx				
		30 = Brake	(Actual Speed)				
			(Total Reference)				
		32 = Over	weight				
		33 = Slack	Cable				
		34 = Torque	e Polarity +/-				
		35 = Torque	e Polarity -/+				
		36 = F > Fx	<u>.</u> 1				
		37 = F > Fx	2_2				
		38 = Set Po	oint = Process				
		Variable					
		39 = No E3	2				
		40 = Ready	/ 2				
P283	Time for RL2 ON	0.0 to 300	)	0.0	s		186
P284	Time for RL2 OFF	0.0 to 300		0.0	s		186
P285	Time for RL3 ON	0.0 to 300	)	0.0	s		186
P286	Time for RL3 OFF	0.0 to 300	)	0.0	s		186
	Nx, Ny, Ix, Zero Speed Zone, N =	N* and Tx					
P287	Hysteresis for Nx/Ny	0.0 to 5.0		1.0	%		193
P288 (2)(11)	Nx Speed	0 to P134		120 (100)	rpm		193
P289 (2)(11)	Ny Speed	0 to P134		1800 (1500)	rpm		193
P290 <sup>(7)</sup>	Ix Current	(0 to 2.0) x	P295	1.0 x P295	Α		193
P291	Zero Speed Zone	1 to 100		1	%		193
P292	N = N* Band	1 to 100		1	%		193
P293	Tx Torque	0 to 200		100	%		193
P294	Hours Hx	0 to 6553		4320	h		193
	Inverter Data	1		I		1 1	
P295 <sup>(1)</sup>	Inverter Rated Current	220-230 V	/ Models	According to	-		194
		3 = 6 A	10 = 28 A	Inverter Model			
		4 = 7 A	13 = 45 A				
		6 = 10 A	14 = 54 A				
		7 = 13 A	16 = 70 A				
		8 = 16 A	17 = 86 A				
		9 = 24 A	18 = 105 A				
			19 = 130 A				
				<u> </u>	l .	<u> </u>	

Parameters	Function	Adjusta	ıble Range	Factory	Unit	User's	Page
				Setting		Setting	
		380-480 V	Models 20 = 142 A				
		0 = 3.6  A	20 = 142 A 21 = 180 A				
		1 = 4 A	55 = 211 A				
		2 = 5.5 A	22 = 240 A				
		5 = 9 A	67 = 312 A				
		7 = 13 A	23 = 361 A				
		8 = 16 A 9 = 24 A	24 = 450 A				
			69 = 515 A				
		11 = 30 A 12 = 38 A	25 = 600 A				
		12 = 36  A 13 = 45  A	33 = 686 A				
		15 = 45 A 15 = 60 A	34 = 855 A				
		16 = 70 A	35 = 1140 A				
		17 = 86 A	36 = 1283 A				
		18 = 105 A	37 = 1710 A				
		10 - 10071	82 = 1468 A				
		500-600 V	Models				
		39 = 2.9 A					
		40 = 4.2 A	48 = 63 A				
		4 = 7 A	49 = 79 A				
		6 = 10 A	25 = 600 A				
		41 = 12 A	72 = 652 A				
		42 = 14 A	73 = 794 A				
		43 = 22 A					
		44 = 27 A	78 = 978 A				
		45 = 32 A	79 = 1191A				
		46 = 44 A	81 = 1345 A				
		500-690 V	Models				
			60 = 315 A				
			62 = 343 A				
		55 = 211 A					
		57 = 247 A					
		'					
		660-690 V	Models				
		50 = 107 A	68 = 492 A				
		52 = 127 A	70 = 580 A				
		54 = 179 A	71 = 646 A				
		56 = 225 A	74 = 813 A				
		58 = 259 A	75 = 869 A				
		59 = 305 A	77 = 969 A				
		61 = 340 A	80 = 1220 A				
		64 = 428 A					
		Special Mo	dels				
		38 = 2 A	29 = 400 A				
		66 = 33 A	30 = 570 A				
		26 = 200 A	31 = 700 A				
		27 = 230 A	32 = 900 A				
		28 = 320 A					
	·						

			Factory		User's	
Parameters	Function	Adjustable Range	Setting	Unit	Setting	Page
P296 <sup>(1)(11)</sup>	Inverter Rated Voltage	0 = 220-230 V	0 = for models	-	Attention	195
	(Rated Input Voltage)	1 = 380 V	220-230 V		Attention! Refer to	
		2 = 400-415 V	3 = for models		item	
		3 = 440-460 V	380-480 V		3.2.3 to	
		4 = 480 V	6 = for models		do the	
		5 = 500-525 V	500-600 V and			
		6 = 550-575 V	500-690 V		voltage selection	
		7 = 600 V	8 = for models		Selection	
		8 = 660-690 V	660-690 V			
P297 <sup>(1) (2)</sup>	Switching Frequency	0 = 1.25	2 = 5.0	kHz		195
		1 = 2.5				
		2 = 5.0				
		3 = 10.0				
	DC Braking					
P300	DC Braking Time	0.0 to 15.0	0.0	S		196
P301	DC Braking Start Speed	0 to 450	30	rpm		197
P302	DC Braking Voltage	0.0 to 10.0	2.0	%		197
	Skip Speed		T	T		
P303	Skip Speed 1	P133 to P134	600	rpm		197
P304	Skip Speed 2	P133 to P134	900	rpm		197
P305	Skip Speed 3	P133 to P134	1200	rpm		197
P306	Skip Band	0 to 750	0	rpm		197
	Serial Communication					
P308 <sup>(1)</sup>	Inverter Address	1 to 30	1 -			198
P309 (1)	Fieldbus	0 = Disable	0 = Disable	-		198
		1 = Profibus DP/DP-V1 2 I/O				
		2 = Profibus DP/DP-V1 4 I/O				
		3 = Profibus DP/DP-V1 6 I/O				
		4 = DeviceNet 2 I/O				
		5 = DeviceNet 4 I/O				
		6 = DeviceNet 6 I/O				
		7 = EtherNet/IP 2 I/O				
		8 = EtherNet/IP 4 I/O				
		9 = EtherNet/IP 6 I/O				
	0700 0 4 4 5 5 54	10 = DeviceNet Drive Profile	0.00			
P310 <sup>(1)</sup>	STOP Detection in a Profibus	0 = Off	0 = Off			198
P312 (1)	Network	1 = On	0 - MEC Protocol			400
P312**	Type of Serial Protocol	0 = WBUS Protocol	0 = WEG Protocol	-		199
		1 = Modbus-RTU, 9600 bps,				
		no parity				
		2 = Modbus-RTU, 9600 bps,				
		odd parity				
		3 = Modbus-RTU, 9600 bps,				
		even parity				
		4 = Modbus-RTU, 19200 bps,				
		no parity				
		5 = Modbus-RTU, 19200 bps,				
-		odd parity				

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
		6 = Modbus-RTU, 19200 bps,	Setting		Setting	
		even parity				
		7 = Modbus-RTU, 38400 bps,				
		no parity				
		8 = Modbus-RTU, 38400 bps,				
		odd parity				
		9 = Modbus-RTU, 38400 bps,				
		even parity				
P313 <sup>(1)</sup>	Type of disabling by E28/E29/E30	0 = Disable via Start/Stop	0 = Disable via Start/Stop	-		199
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	1 = Disable via General				
		Enable				
		2 = Not Used				
		3 = Changes to LOCAL 1				
		4 = Changes to LOCAL 2				
		5 = Causes Fatal Error				
P314 (1)	Time for Serial Watchdog	0.0 = Disable	0.0 = Disabled	S		200
	Action	0.1 to 999.0 = Enable		-		
P318	Watchdog detection for the	0 = Off	0 = Off			200
	PLC board	1 = On				
	Flying Start/Ride-Through					
P320 (1)	Flying Start/Ride-Through	0 = Inactive	0 = Inactive	-		200
		1 = Flying Start				
		2 = Flying Start/Ride-Through				
		3 = Ride-Through				
P321 <sup>(6)</sup>	Ud Line Loss Level	178 to 282 (P296 = 0)	252	V		200
		307 to 487 (P296 = 1)	436			
		324 to 513 (P296 = 2)	459			
		356 to 564 (P296 = 3)	505			
		388 to 615 (P296 = 4)	550			
		425 to 674 (P296 = 5)	602			
		466 to 737 (P296 = 6)	660			
		486 to 770 (P296 = 7)	689			
		559 to 885 (P296 = 8)	792			
P322 (6)	Ud Ride-Through	178 to 282 (P296 = 0)	245	V		201
		307 to 487 (P296 = 1)	423			
		324 to 513 (P296 = 2)	446			
		356 to 564 (P296 = 3)	490			
		388 to 615 (P296 = 4)	535			
		425 to 674 (P296 = 5)	588			
		466 to 737 (P296 = 6)	644			
		486 to 770 (P296 = 7)	672			
		559 to 885 (P296 = 8)	773			
P323 (6)	Ud Line Recover Level	178 to 282 (P296 = 0)	267	V		202
		307 to 487 (P296 = 1)	461			
		324 to 513 (P296 = 2)	486			
		356 to 564 (P296 = 3)	534			
		388 to 615 (P296 = 4)	583			
		425 to 674 (P296 = 5)	638			
		466 to 737 (P296 = 6)	699			
	1	486 to 770 (P296 = 7)	729		1	

			Factory		User's	
Parameters	Function	Adjustable Range	Setting	Unit	Setting	Page
		559 to 885 (P296 = 8)	838			
P325	Ride-Through Proportional Gain	0.0 to 63.9	22.8	-		203
P326	Ride-Through Integral Gain	0.000 to 9.999	0.128	-		203
P331	Voltage Ramp	0.2 to 60.0	2.0	S		204
P332	Dead Time	0.1 to 10.0	1.0	S		204
	DeviceNet Drive Profile					
P335	DeviceNet I/O Instances	0 = Instances 20/70	0 = Instances 20/70	-		206
		1 = Instances 21/71				
		2 = Instances 100/101				
		3 = Instances 102/103				
P336	Input Word #3	0 to 749	0	-		206
P337	Input Word #4	0 to 749	0	-		206
P338	Input Word #5	0 to 749	0	=		206
P339	Input Word #6	0 to 749	0	-		206
P340	Input Word #7	0 to 749	0	-		206
P341	Output Word #3	0 to 749	0	-		207
P342	Output Word #4	0 to 749	0	-		207
P343	Output Word #5	0 to 749	0	-		207
P344	Output Word #6	0 to 749	0	-		207
P345	Output Word #7	0 to 749	0	-		207
P346	I/O Words Quantity	2 to 7	2	-		207
	PARAMETERS FOR CRANE APPL		ER/SLAVE FUNCTION - F	351 to P399		
P351 (1)	Logic for the Mechanical Brakin Delay for E33	0.0 to 99.9	99.9	•		208
P351 (1)	,	0.0 to 99.9	99.9	S		208
P353 <sup>(1)</sup>	Delay for E34  Delay for N < Nx - Brake Activation	0.0 to 20.0	0.0	S		208
P354 <sup>(1)</sup>	Delay for Resetting the Integrator	0.0 to 10.0	2.0	S S		208
F334 **	of the Speed Regulator	0.0 to 10.0	2.0	5		200
P355 (1)	Delay for Accepting New	0.0 to 10.0	1.0	S		208
1 333 17	"Start/Stop" Commands	0.0 to 10.0	1.0	3		200
P356 (1)	Delay for Ramp Enable	0.0 to 10.0	0.0	S		209
1 000	Indication of the Torque Curren		0.0	3		200
P357 (1)	Torque Current (Iq) Filter	0.00 to 9.99	0.00	S		209
P358 <sup>(1)</sup>	Torque Current (Iq) Hysteresis	0.00 to 9.99	2.00	%		209
	Parameters for Load Detection			,,,		
P361 (1)	Load Detection	0 = Off	0 = Off	-		209
		1 = On				200
P362 (1)	Stabilization Speed	0 to P134	90	rpm		209
P363 (1)	Stabilization Time	0.1 to 10.0	0.1	S		210
P364 (1)	Slack Cable Time	0.0 to 60.0	0.0	S		210
P365 (1)	Slack Cable Level	0.0 to 1.3 x P295	0.1 x P295	A		210
P366 (1)	Lightweight Level	0.0 to 1.3 x P295	0.3 x P295	A		210
P367 (1)	Overweight Level	0.0 to 1.8 x P295	1.1 x P295	A		210
P368 (1)	Speed Reference Gain	1.000 to 2.000	1.000	-		210
	Fx					
P369 (2) (11)	Frequency Fx	0.0 to 300.0	4.0	Hz		210
P370	Hysteresis for Fx	0.0 to 15.0	2.0	Hz		213
	DC Braking					
P371	DC Braking Time at Start	0.0 to 15.0	0.0	S		213
P372	DC Braking Current Level	0.0 to 90.0	40.0	%		213

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
	VVW Control		Johnnig		Johnnig	
P398 (1)	Slip Compensation During	0 = Off	1 = On	-		213
	Regeneration	1 = On				
P399 (1) (2)	Motor Rated Efficiency	50.0 to 99.9	According to	%		213
			the motor rated			
			power factor			
			(P404)			
	MOTOR PARAMETERS	P400 to P499				
	Motor Nameplate Data					
P400 (1) (6)	Motor Rated Voltage	0 to 690	P296	V		214
P401 (1)(12)	Motor Rated Current	(0.0 to 1.30) x P295 (12)	1.0 x P295	Α		214
P402 (1)(2)(11)	Motor Rated RPM	0 to 18000	1750 (1458)	rpm		214
		(P202 = 0, 1, 2 and 5)				
		0 to 7200 (P202 = 3 and 4)				
P403 (1)(11)	Motor Rated Frequency	0 to 300 (P202 = 0,1,2 and 5)	60 (50)	Hz		214
		30 to 120 (P202 = 3 and 4)				
P404 (1)	Motor Rated hp	0 = 0.33  hp/0.25  kW	4 = 1.5 hp/1.1 kW	-		214
		1 = 0.50 hp/0.37 kW				
		2 = 0.75  hp/0.55  kW				
		3 = 1.0  hp/0.75  kW				
		4 = 1.5 hp/1.1 kW				
		5 = 2.0  hp/1.5  kW				
		6 = 3.0  hp/2.2 kW				
		7 = 4.0  hp/3.0 kW				
		8 = 5.0  hp/3.7 kW				
		9 = 5.5  hp/4.0 kW				
		10 = 6.0  hp/4.5 kW				
		11 = 7.5  hp/5.5 kW				
		12 = 10.0 hp/7.5 kW 13 = 12.5 hp/9.0 kW				
		14 = 15.0 hp/11.0 kW				
		15 = 20.0 hp/15.0 kW				
		16 = 25.0 hp/18.5 kW				
		17 = 30.0 hp/22.0 kW				
		18 = 40.0 hp/30.0 kW				
		19 = 50.0 hp/37.0 kW				
		20 = 60.0  hp/45.0 kW				
		21 = 75.0 hp/55.0 kW				
		22 = 100.0 hp/75.0 kW				
		23 = 125.0 hp/90.0 kW				
		24 = 150.0 hp/110.0 kW				
		25 = 175.0 hp/130.0 kW				
		26 = 180.0 hp/132.0 kW				
		27 = 200.0 hp/150.0 kW				
		28 = 220.0 hp/160.0 kW				
		29 = 250.0 hp/185.0 kW				
		30 = 270.0 hp/200.0 kW				
		31 = 300.0 hp/220.0 kW				
		32 = 350.0 hp/260.0 kW				

			Factory		User's	
Parameters	Function	Adjustable Range	Setting	Unit	Setting	Page
		33 = 380.0 hp/280.0 kW				
		34 = 400.0 hp/300.0 kW				
		35 = 430.0 hp/315.0 kW				
		36 = 440.0 hp/330.0 kW				
		37 = 450.0 hp/335.0 kW				
		38 = 475.0 hp/355.0 kW				
		39 = 500.0 hp/375.0 kW				
		40 = 540.0 hp/400.0 kW				
		41 = 600.0 hp/450.0 kW				
		42 = 620.0 hp/460.0 kW				
		43 = 670.0 hp/500.0 kW				
		44 = 700.0 hp/525.0 kW				
		45 = 760.0 hp/570.0 kW				
		46 = 800.0 hp/600.0 kW				
		47 = 850.0 hp/630.0 kW				
		48 = 900.0 hp/670.0 kW				
		49 = 1100.0 hp/820.0 kW				
		50 = 1600.0 hp/1190.0 kW				
P405 (1)	Encoder PPR	250 to 9999	1024	ppr		215
P406 <sup>(1)</sup>	Motor Ventilation Type	0 = Self Ventilated	0 = Self Ventilated	-		215
		1 = Separate Ventilation				
		2 = Optimal Flux				
		3 = Increased Protection				
P407 (1) (2)	Motor Rated Power Factor	0.50 to 0.99	According to the	-		216
			motor rated power			
			(P404)			
D 4 5 5 (4)	Measured Parameters		I a su		_	
P408 (1)	Self-Tuning	0 = No	0 = No	=		216
		1 = No Rotation				
		2 = Run for I <sub>mr</sub>				
		3 = Run for Tm				
7.100 (1)		4 = Estimate Tm				
P409 (1)	Motor Stator Resistance (Rs)	0.000 to 77.95	0.000	Ω		217
P410	Motor Magnetizing Current (I <sub>mr</sub> )	(0.0 to 1.25) x P295	0.0	Α		218
P411 (1)	Motor Flux Leakage Inductance ( LS)	0.00 to 99.99	0.00	mH		218
P412	LR/RR Constant (Rotor Time	0.000 to 9.999	0.000	S		218
D446 (1)	Constant (Tr))	0.00 (00.00	0.00			010
P413 <sup>(1)</sup>	Tm Constant (Mechanical Time	0.00 to 99.99	0.00	S		219
	Constant)	0 P500 (- P500				
	SPECIAL FUNCTION PARAMETER PID Regulator	S P520 to P538				
P520	PID Proportional Gain	0.000 to 7.999	1.000	-		223
P521	PID Integral Gain	0.000 to 7.999	0.043	-		223
P522	PID Differential Gain	0.000 to 7.333	0.000	<u>-</u>	+	223
P523	PID Ramp Time	0.0 to 999	3.0	S		223
P524 <sup>(1)</sup>	Selection of PID Feedback	0 = AI2 (P237 to P240)	0 = Al2 (P237 to P240)	-		223
•		1 = AI3 (P241 to P244)	3 / (1 20/ 10/ 240)			
						i
P525	PID Setpoint		0.0	%		224
P525 P526	PID Setpoint Process Variable Filter	0.0 to 100.0 0.0 to 16.0	0.0	% s		224 224

Parameters	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Page
P527	PIDAction	0 = Direct	0 = Direct	-		224
		1 = Reverse				
P528	Process Variable Scale Factor	0 to 9999	1000	-		225
P529	Decimal Point of Proc. Var.	0 to 3	1			225
P530	Engineering Unit of Proc. Var. 1	32 to 127 (ASCII) A, B,, Y, Z 0, 1,, 9 #, \$, %, (, ), *, +,	37 = %	-		226
P531	Engineering Unit of Proc. Var. 2	32 to 127 (ASCII) A, B,, Y, Z 0, 1,, 9 #, \$, %, (, ), *, +,	32 = blank	-		226
P532	Engineering Unit of Proc. Var. 3	32 to 127 (ASCII) A, B,, Y, Z 0, 1,, 9 #, \$, %, (, ), *, +,	32 = blank	-		226
P533	Value of Proc. Var. X	0.0 to 100	90.0	%		226
P534	Value of Proc. Var. Y	0.0 to 100	10.0	%		226
P535	Wake Up Band	0 to 100	0	%		227
P536 (1)	Automatic Setting of P525	0 = Active 1 = Inactive	0 = Active	-		227
P537	Hysteresis for Set point = Process Variable	1 to 100	1	%		227
P538	Hysteresis for VPx/VPy	0.0 to 50.0	1.0	%		227

Notes presented on Quick Parameter Description:

- (1) Parameter can be changed only with the inverter disabled (motor stopped).
- (2) Values may change as a function of the "Motor Parameters".
- (3) Values may change as a function of P413 (Tm Constant obtained during Self-tuning).
- (4) Values may change as a function of P409 and P411 (obtained during Selftuning).
- (5) Values may change as a function of P412 (Tr Constant obtained during Self-tuning).
- (6) Values may change as a function of P296.
- (7) Values may change as a function of P295.
- (8) Values may change as a function of P203.
- (9) Values may change as a function of P320.
- (10) User's Standard (for new inverters) = without parameter.
- (11) The inverter will be delivered with settings according to the market, considering the HMI language, V/F 50 Hz or 60 Hz and the required voltage. The reset of the standard factory setting may change the parameters related to the frequency (50 Hz/60 Hz). Values within parenthesis mean the factory setting for 50 Hz.
- (12) The maximum value of P156 and P401 is 1.8 x P295 for model 4.2 A/500-600 V and 1.6 x P295 for models 7 A and 54 A/220-230 V; 2.9 A and 7 A/500-600 V; 107 A, 147 A and 247 A/500-690 V; 100 A, 127 A and 340 A/660-690 V.

Parameters that		Condition who	ere it occurs
affect others	Parameters that are affected	During the	During
when set	and modified automatically	oriented	normal
WHOTI SOL		start-up	operation
P203	P223, P225, P226, P228, P237,	NO	YES
	P265		
P295	P156, P157, P158, P169 (V/F),	NO	YES
	P290, P365, P366, P367		
P296	P151, P153, P321, P322, P323	YES	YES
F290	P400	YES	NO
P320	P214	NO	YES
P401	P156, P157, P158	YES	NO
1 401	P297	YES	NO
P402	P122, P123, P124, P125, P126,	YES	YES
	P127, P128, P129, P130, P131,		
	P133, P134, P135, P208, P288,		
	P289		
P403	P369, P402	YES	NO
P404	P399, P407	YES	YES
P406	P156, P157, P158	YES	NO

**Table 1** - Interdependence among parameters: parameters that change the settings of others when modified versus parameters that are automatically modified as a function of a parameter setting (during start-up and/or normal operation)

#### II. Fault Messages

Display	Description	Page
E00	Output Overcurrent/Short-Circuit	228
E01	DC Link Overvoltage	228
E02	DC Link Undervoltage	228
E03	Power Supply Undervoltage/Phase Loss	229
E04 <sup>(*)</sup>	Inverter Overtemperature/Pre-charge Circuit	229
	Failure	
E05	Output Overload (I x t Function)	229
E06	External Fault	229
E07	Encoder Fault	229
LOI	Valid for P202 = 4 (Vector with Encoder)	229
E08	CPU Error (watchdog)	229
E09	Program Memory Error	229
E10	Error in the Copy Function	229
E11	Output Ground Fault	229
E12	Dynamic Braking Resistor Overload	230
E13	Motor or Encoder with Inverted Wires	230
LIJ	(Self-Tuning) (Valid for P202 = 4)	250
E15	Motor Phase Loss	230
E17	Overspeed Fault	230
E24	Programming Error	230
E28 to E30	Serial communication error	230
E31	Keypad Connection Fault	230
E32	Motor Overtemperature	230
E33	Speed without control	230
E34	Long period at torque limitation	230
E41	Self-Diagnosis Fault	230
E70	Internal DC Supply Undervoltage	231
E71	PLC Watchdog Error	231

<sup>(\*)</sup> E04 can be "Pre-charge Circuit Failure" only in the following models:  $\geq 86 \text{ A}/380\text{-}480 \text{ V}, \geq 70 \text{ A}/220\text{-}230 \text{ V}, \geq 44 \text{ A}/500\text{-}600 \text{ V}$  and for all 500-690 V and 660-690 V models. E04 can also occur when signal with inverted polarity is applied at analog inputs Al1/Al2. The E04 fault message can also occur in the models up to 130 A/ 200-230 V, 142 A/380-480 V and 63 A/500-600 V when the temperature at the heatsink is lower than -10 °C.

## III. Other Messages

Display	Description		
rdy	Inverter is Ready to be Enabled		
run	Inverter is Enabled		
Sub	Power Supply Voltage is Too Low for the Inverter Operation		
Sub	(Undervoltage)		
dCbr	Inverter in DC Braking Mode. (Refer to P300)		

#### SAFETY NOTICES

This Manual contains all necessary information for the correct installation and operation of the CFW-09 Variable Frequency Inverter.

The CFW-09 Instruction Manual has been written for qualified personnel with suitable training or technical qualifications to operate this type of equipment.

# 1.1 SAFETY NOTICES IN THE MANUAL

The following Safety Notices will be used in this Manual:



#### DANGER!

If the recommended Safety Instructions are not strictly observed, it can lead to serious or fatal injuries of personnel and/or equipment damage.



#### ATTENTION!

Failure to observe the recommended Safety Procedures can lead to material damage.



#### NOTE!

The content of this Manual supplies important information for the correct understanding of operation and proper performance of the equipment.

# 1.2 SAFETY NOTICES ON THE PRODUCT

The following symbols may be attached to the product, serving as Safety Notice:



High Voltages.



Components are sensitive to electrostatic discharge. Do not touch them without following proper grounding procedures.



Mandatory connection to ground protection (PE).



Shield connection to ground.

# 1.3 PRELIMINARY RECOMMENDATIONS



#### **DANGER!**

Only qualified personnel should plan or implement the installation, startup, operation and maintenance of this equipment. Personnel must review this entire Manual before attempting to install, operate or troubleshoot the CFW-09.

These personnel must follow all safety instructions included in this Manual and/or defined by local regulations.

Failure to comply with these instructions may result in personnel injury and/ or equipment damage.



#### NOTE!

In this Manual, qualified personnel are defined as people that are trained to:

- 1. Install, ground, power up and operate the CFW-09 according to this Manual and the local required safety procedures;
- 2. Use of safety equipment according to the local regulations;
- 3. Administer Cardio Pulmonary Resuscitation (CPR) and First Aid.



#### DANGER!

Always disconnect the supply voltage before touching any electrical component inside the inverter.

Many components are charged with high voltages, even after the incoming AC power supply has been disconnected or switched OFF. Wait at least 10 minutes for the total discharge of the power capacitors.

Always connect the frame of the equipment to the ground (PE) at the suitable connection point.



#### ATTENTION!

All electronic boards have components that are sensitive to electrostatic discharges. Never touch any of the electrical components or connectors without following proper grounding procedures. If necessary to do so, touch the properly grounded metallic frame or use a suitable ground strap.

Do not apply High Voltage (High Pot) Test on the Inverter! If this test is necessary, contact WEG.



#### NOTE!

Inverters can interfere with other electronic equipment. In order to reduce this interference, adopt the measures recommended in chapter 3 "Installation and Connection".



#### NOTE!

Read this entire Manual carefully and completely before installing or operating the CFW-09.

#### GENERAL INFORMATION

This chapter defines the contents and purpose of this manual and describes the main characteristics of the CFW-09 frequency inverter. Identification of the CFW-09, receiving and storage requirements are also provided.

#### 2.1 ABOUT THIS MANUAL

This Manual is divided into 9 Chapters, providing information to the user on how to receive, install, start-up and operate the CFW-09:

- Chapter 1: Safety Notices;
- Chapter 2: General Information and Receiving the CFW-09;
- Chapter 3: Information about the CFW-09 physical installation, electrical connection (power and control circuit) and installation of optional devices:
- Chapter 4: Keypad (HMI) Operation (Human-Machine Interface keyboard-display);
- Chapter 5: Start-up (Step-by-step);
- Chapter 6: Detailed Programming Parameters Description;
- Chapter 7: Diagnostics, troubleshooting, cleaning instructions and preventive maintenance;
- Chapter 8: Technical description of CFW-09 optional devices and accessories;
- Chapter 9: Technical specifications (electrical and mechanical).

This Manual provides information for the correct use of the CFW-09. The CFW-09 is very flexible and allows for the operation in many different modes as described in this manual.

As the CFW-09 can be applied in several ways, it is impossible to describe here all of the application possibilities. WEG does not accept any responsibility when the CFW-09 is not used according to this Manual.

No part of this Manual may be reproduced in any form, without the written permission of WEG.

#### 2.2 SOFTWARE VERSION

It is important to note the Software Version installed in the Version CFW-09, since it defines the functions and the programming parameters of the inverter. This Manual refers to the Software version indicated on the inside cover. For example, the Version 1.0X applies to versions 1.00 to 1.09, where "X" is a variable that will change due to minor software revisions. The operation of the CFW-09 with these software revisions are still covered by this version of the Manual.

The Software Version can be read in the Parameter P023.

#### 2.3 ABOUT THE CFW-09

The CFW-09 is a high performance Variable Frequency Inverter that permits the control of speed and torque of a three-phase AC induction motor. The technological advantage of the CFW-09 is due to the "Vectrue" technology that provides the following benefits:

- ☑ Programmable scalar (volts/Hz) or Vector Control with the same product;
- ✓ Vector Control can be programmed for "Sensorless" (that means that standard motors can be controlled without encoder feedback), or "Closed Loop" (with an encoder attached to the motor shaft);

- ☑ The Sensorless Vector Control permits high torques and quick response, even at very low speeds and during the starting of the motor;
- ☑ The "Optimal Braking" function allows controlled motor braking without using a Dynamic Braking (DB) resistor;
- "Self-tuning" auto-tune function with Vector Control, permitting automatic setting of the control regulators and control parameters by means of the automatic identification of the motor and the load parameters.

Technical specifications for each model of CFW-09 are described in chapter 9. The block diagram below gives a general view of the CFW-09:

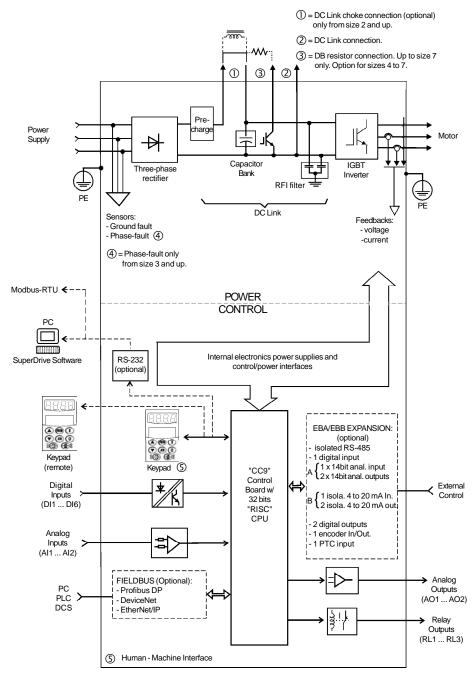
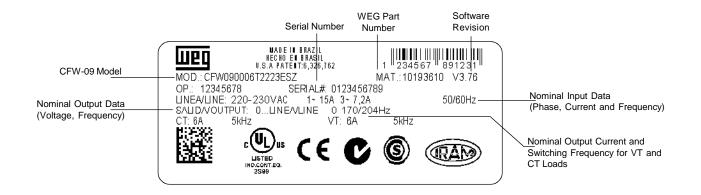


Figure 2.1 - CFW-09 block diagram

### 2.4 CFW-09 IDENTIFICATION LABEL AND CODE NUMBER



### Location of the CFW-09 Nameplate:

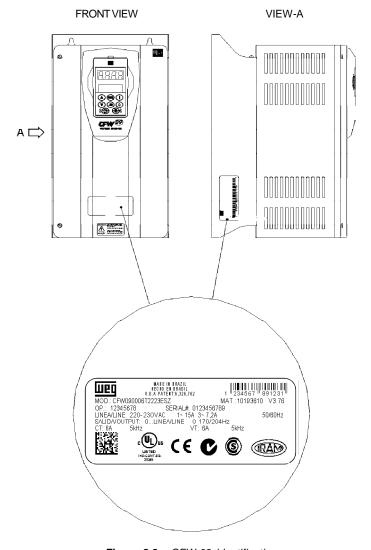


Figure 2.2 - CFW-09 identification

# HOW TO SPECIFY THE CFW-09 MODEL:

Z	(refer to note)
	Special Software: Blank = Standard St to Sn = Special Software Version SF = Metasys N2 Protocol SQ = Special version for DeviceNet Drive Porfile Kit (indicate option DD for the Fieldbus Communication Board)
-	Special Special Hardware: Software:: Software:: Blank = Standard HN = Without Standard inductor (noily valid for Version 500-690 V and SF = Models)  HD = DC Link Special School School SP = Models)  HD = DC Link version for version for supply (refer DeviceNet to chapter 8)  Chollon DD (Refer to Communication option DD (Refer to chapter 8)  Communication Communication option DD (Refer to chapter 8)  Communication option DD (Refer to chapter 8)  Communication option DD (Refer to behapter 8)  Communication option DD (Refer to chapter 8)  Communication option DD (Refer to behapter 8)
	Fieldbus  Communication  Boards:  Blank = Blank = Blank = Blank = Standard  DN = DeviceNet HN = Without Standard  DN = DeviceNet Graph valid for Version Profile  DD = DeviceNet Graph valid for Version Models)  Profile  Profile  Profile  Profile  Profile  Chapter 8)  HO = DC Link version  Stockstown of Standary  DD = DeviceNet Grapher 8)  HO = DC Link version  Stockstown of Standary  Nut = Profile  Chapter 8)  HO = DC Link version  Stockstown option I.  (Refer to chapter 8)  HO + HV = DC Kit (india)  Chapter 8)  Commun  (Refer to price)  Chapter 9  Chapter
	Expansion Boards: Blank = Standard A1 = EBA Board Complete B1 = EBB Board Complete C1 = EBC1 Board Complete E1 = EBE Board Complete P2 = PLC2.00 Board Refer to chapter 8 for other Configurations
	Braking: Blank = Standard RB = Regenerative Converter (Active Front end unit). DB = Dynamic Braking (Refer to chapter 8)
	Meypad (HMI): Brakingg Blank = Standard Standard Standard IL = Keypad Standard Only Convert SI = without (Active keypad on DN = mote) note) Dynami Braking Refer to chapter chapter
	Enclosure degree of protection: Blank = Standard N4 = NEMA 4 IP56 (Refer to chapter 8)
0	Options: S = standard O = with options (refer to note)
E	Manual language: P = Portuguese E = English S = Spanish
3848	Power supply voltage: 380-480 V 2223 = 360-600 V 5060 = 500-690 V 6669 = 660-690 V
T	Three-phase power supply.
0016	ed current -  500-600 V:  500-600 V:  0002 = 2.9 A  0002 = 2.9 A  0002 = 1.2 A  0002 = 1.2 A  0002 = 1.2 A  0012 = 1.2 A  0012 = 1.2 A  0021 = 2.1 A  0022 = 2.7 A  0022 = 2.7 A  0022 = 2.7 A  0023 = 32 A  0024 = 44 A  0027 = 2.7 A  0027 = 2.7 A  0027 = 2.7 A  0027 = 2.7 A  0048 = 448  0170 = 1107 A  0170 = 170 A  0170
0	Cutput rated current constant torque CT:           220-230 V:         500-60           0006 = 6 A         0002 =           0007 = 10 A         0007 =           0010 = 10 A         0004 =           0013 = 13 A         0010 =           0015 = 16 A         0012 =           0024 = 28 A         0027 =           0025 = 28 A         0027 =           0045 = 45 A         0027 =           0054 = 54 A         0027 =           0056 = 86 A         0027 =           0058 = 86 A         0070 =           0003 = 3.6 A         0107 =           0003 = 3.6 A         0107 =           0009 = 9 A         0247 =           0006 = 5.5 A         0247 =           0009 = 9 A         0247 =           0006 = 6.0 A         0428 =           0006 = 6.0 A         0428 =           005 = 6.0 A         0428 =           006 = 6.0 A         0428 =           0105 = 105 A         025 =
CFW-09	WEG Series 09 Frequency Inverter

- For rated output current specification of variable torque (VT), refer to chapter 9.
   The rated output current indicated for the models 500-690 V is only valid for 500 V to 600 V supply.
   For rated output current specification (CT and VT) of the models with supply voltage higher than 600 V, refer to chapter 9.



# Note:

The option field (S or O) defines if the CFW-09 is a standard version or if it is equipped with any optional devices. If the standard version is required, the code ends here. The model code number always has the letter Z at the end. For example:

CFW090045T2223ESZ = Standard 45 A CFW-09 inverter - three phase input at 220-230 V, with the Manual in English. If the CFW-09 is equipped with any optional devices, you must fill out the fields in accordance to the optional devices desired in the correct sequence up to the last optional device

Thus, for instance, if a product of the example above is required with an EBA expansion board, indicate: CFW090045T2223EOA1Z = 45 A CFW-09 inverter – three-phase input at 220-230 V, with the manual in English and with the optional EBA.01 board. desired, then the model code number is completed with the letter Z.

The standard product is defined as described here:

### **☑** Degree of protection:

NEMA 1/ IP20: 3.6 A to 240 A/380-480 V models and all 220-230 V and 500-600 V models.

Protected chassis / IP20: 361 A to 600 A/380-480 V models and all 500-690 V and 660-690 V models.

### 

HMI-CFW09-LCD (with LED and LCD displays)

### ☑ Braking:

DB Transistor for DB Resistor braking incorporated in the following models:

6 A to 45 A/220-230 V 3.6 A to 30 A/380-480 V 2.9 A to 14 A/500-600 V

### ☑ DC Link:

The DC Link choke is included in the standard product for 44 A, 53 A, 63 A and 79 A/500-600 V, all models 500-690 V and 660-690 V models.

DB Transistor can be incorporated as an option in the following models:

54 A to 130 A/220-230 V 38 A to 142 A/380-480 V 22 A to 79 A/500-600 V

Models 180 A to 600 A/380-480 V, 107 A to 472 A/500-690 V and 100 A to 428 A/660-690 V, do not have the capability to use an internal DB Transistor. In this case, use the external DB Transistor option (refer to item 8.10.3 - Dynamic Braking Module - DBW-01 and DBW-02).



### NOTE!

It is necessary to connect an external braking resistor regardless if the DB Transistor is built in, optional built in or an external module (DBW).

# 2.5 RECEIVING AND STORAGE

The CFW-09 is supplied in cardboard boxes up to size 3 (refer to item 9) and for models above, the packing will be with wood pallet and wood box.

The outside of the packing container has a nameplate that is identical to that on the CFW-09. Please check if the nameplate data matches the ordered ones.

The boxes up to size 7 must be placed and opened on a table (sizes above 3 with the help of two persons).

Open the box, remove the cardboard or expanded polystyrene protection.

The boxes of sizes above 7 must be opened on the floor. Open the wood box, remove the expanded polystyrene protection. The CFW-09 must be handled with hoist.

Check if:

- ☑ CFW-09 nameplate data matches the purchase order;
- ☑ The equipment has not been damaged during transport.

If any problem is detected, contact the carrier immediately.

If the CFW-09 is not to be installed immediately, store it in a clean and dry room (Storage temperatures between -25°C and 60°C). Cover it to prevent dust, dirt or other contamination of the inverter.



### ATTENTION!

If the inverter is stored for long periods, we recommend to power it up once a year during 1 hour. For 220-230 V and 380-480 V models apply supply voltage of approximately 220 Vac, three-phase or single-phase input, 50 or 60 Hz, without connecting motor at output. After this energization, wait 24 hours before installing it. For 500-600 V, 500-690 V and 660-690 V models use the same procedure applying a voltage between 300 and 330 Vac to the inverter input.

### INSTALLATION AND CONNECTION

This chapter describes the procedures for the electrical and mechanical installation of the CFW-09.

These guidelines must be followed for proper CFW-09 operation.

# 3.1 MECHANICAL INSTALLATION

### 3.1.1 Environment Conditions

The location of the CFW-09 installation is an important factor to assure good performance and high product reliability.

For proper installation of the inverter, we make the following recommendations:

- ☑ Avoid direct exposure to sunlight, rain, high moisture and sea air.
- ☑ Avoid exposure to gases or explosive or corrosive liquids.
- Avoid exposure to excessive vibration, dust, oil or any (conductive particles or materials).

### Allowed environmental conditions:

- ☑ Temperature: 0 °C to 40 °C (32 °F to 104 °F) nominal conditions.

  From 40 °C to 55 °C (104 °F to 131 °F) with 2 % current derating for each 1 °C (33.8 °F) degree above 40 °C (104 °F).
- ☑ Relative Air Humidity: 5 % to 90 %, non-condensing.
- ☑ Maximum Altitude: 1000 m (3.300 ft) nominal conditions.

  From 1000 m to 4000 m (3.300 ft to 13.200 ft) with 1 % current reduction for each 100 m (330 ft) above 1000 m (3.300 ft).
- ☑ Pollution Degree: 2 (according to EN50178 and UL508C) (It is not allowed the presence of water, condensation or conductive dust/particles in the air).

### 3.1.2 Dimensional of CFW-09

External dimensions and mounting holes are according to figure 3.1 and table 3.1.

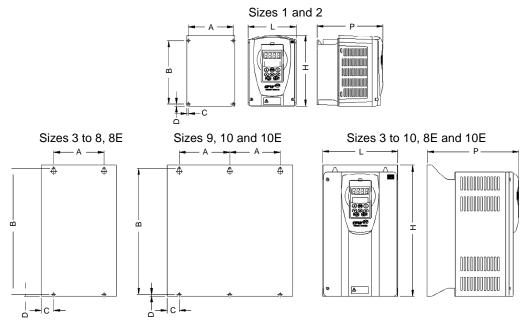


Figure 3.1 - Mounting dimensional drawings of CFW-09

Model	Height H mm (in)	Width L mm (in)	Depth P mm (in)	A mm (in)	B mm (in)	C mm (in)	D mm (in)	Mounting Screw mm (in)	Weight Kg (lb)	Degree of Protection
Size 1	210	143	196	121	180	11	9.5	M5	3.5	
	(8.27)	(5.63)	(7.72)	(4.76)	(7.09)	(0.43)	(0.37)	(3/16)	(7.7)	
Size 2	290	182	196	161	260	10.5	9.5	M5	6.0	7
	(11.42)	(7.16)	(7.72)	(6.34)	(10.24)	(0.41)	(0.37)	(3/16)	(13.2)	
Size 3	390	223	274	150	375	36.5	5	M6	19.0	
	(15.35)	(8.78)	(10.79)	(5.90)	(14.76)	(1.44)	(0.20)	(1/4)	(41.9)	
Size 4	475	250	274	150	450	50	10	M6	22.5	
	(18.70)	(9.84)	(10.79)	(5.90)	(17.72)	(1.97)	(0.39)	(1/4)	(49.6)	
Size 5	550	335	274	200	525	67.5	10	M8	41	
	(21.65)	(13.19)	(10.79)	(7.87)	(20.67)	(2.66)	(0.39)	(5/16)	(90.4)	
Size 6	675	335	300	200	650	67.5	10	M8	55	NEMA1/
	(26.57)	(13.19)	(11.77)	(7.87)	(25.59)	(2.66)	(0.39)	(5/16)	(121.3)	IP20
Size 7	835	335	300	200	810	67.5	10	M8	70	1
	(32.87)	(13.19)	(12.20)	(7.87)	(31.89)	(2.66)	(0.39)	(5/16)	(154.3)	
Size 8	975	410	370	175	950	67.5	10	M8	100	
	(38.38)	(16.14)	(14.57)	(10.83)	(37.40)	(2.66)	(0.39)	(5/16)	(220.5)	
Size 8E	1145	410	370	275	1120	67.5	10	M8	115	
	(45.08)	(16.14)	(14.57)	(10.83)	(44.09)	(2.66)	(0.39)	(5/16)	(253)	
Size 9	1020	688	492	275	985	69	15	M10	216	
	(39.37)	(27.56)	(19.33)	(10.83)	(37.99)	(2.95)	(0.59)	(3/8)	(476.2)	
Size 10	1185	700	492	275	1150	69	15	M10	259	IP20
	(46.65)	(27.56)	(19.33)	(10.83)	(45.27)	(2.95)	(0.59)	(3/8)	(571)	11 20
Size 10E	1185	700	582	275	1150	69	15	M10	310	
	(46.65)	(27.56)	(22.91)	(10.83)	(45.27)	(2.95)	(0.59)	(3/8)	(682)	

Table 3.1 - Installation data - Refer to item 9.1

### 3.1.3 Mounting Specifications

For installing the CFW-09, leave at least the minimum free spaces around the inverter according to figure 3.2. The dimensions of these free spaces are described on table 3.2.

Install the inverter in the vertical position according to the following recommendations:

- 1) Install the inverter on a flat surface.
- 2) Do not install heat sensitive components immediately above the inverter.
- 3) For the inverters 45 A to 130 A/220-230 V, 30 A to 600 A/380-480 V, 22 A to 32 A/ 500-600 V, 44 A to 79 A/500-600 V, 107 A to 472 A/500-690 V and 100 A to 428 A/660-690 V:
  - First partially tighten the bolts on the surface, then install the inverter and screw-down the bolts.
- 4) For inverters 6 A to 28 A/220-230 V, 3.6 A to 24 A/380-480 V and 2.9 A to 14 A/500-600 V:
  - -Install the 2 bottom mounting bolts first, rest the inverter on the base and then mount the 2 top bolts.



### **ATTENTION!**

When inverters are installed side by side, maintain the minimum recommended distance B. When inverters are installed top and bottom, maintain the minimum recommended distance A + C and deflect the hot air coming from inverter below.



### **ATTENTION!**

Provide independent conduits for signal, control and power conductors (Refer to item 3.2: Electrical Installation).

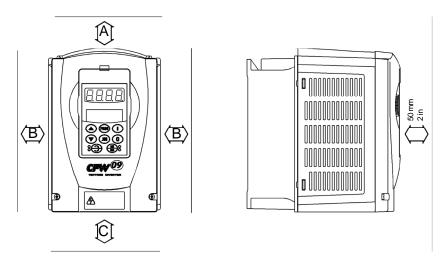


Figure 3.2 - Free space for cooling

Model	А	В	С
CFW-09	mm (in)	mm (in)	mm (in)
6 A to 28 A/220-230 V	40	0.0	
3.6 A to 24 A/380-480 V	40	30	50
2.9 A to 14 A/500-600 V	(1.57)	(1.18)	(2)
45 A to 130 A/220-230 V			
30 A to 142 A/380-480 V	100	40	130
22 A to 79 A/500-600 V	(4)	(1.57)	(5.12)
180 A to 361 A/380-480 V		55 (2.17)	
450 A to 600 A/380-480 V	150	0.0	250
107 A to 472 A/500-690 V	(6)	80 (3.15)	(10)
100 A to 428 A/660-690 V		(21.0)	

Table 3.2 - Recommended free spaces

### 3.1.3.1 Mounting Inside a Panel

When inverters are installed in panels or closed metallic boxes, adequate cooling is required to ensure that the temperature around the inverter will not exceed the maximum allowed temperature. Refer to Dissipated Power in item 9.1.

For reference, table 3.3 shows the cooling airflow for each inverter model.

Inverter Cooling Method: Internal fan, flow direction from the bottom to the top.

CFW-09 Inverter Model	Size	CFM	l/s	m³/min
6 A to 13 A/220-230 V 3.6 A to 9 A/380-480 V	1	19	9	0.5
2.9 A to 14 A/500-600 V 16 A to 28 A/220-230 V 13 A to 24 A/380-480 V	2	32	15	0.9
45 A/220-230 V 30 A/380-480 V	3	70	33	2.0
54 A/220-230 V 38 A and 45 A/380-480 V 22 A to 32 A/500-600 V	4	89	42	2.5
70 A and 86 A/220-230 V 60 A and 70 A/380-480 V	5	117	55	3.3
105 A and 130 A/220-230 V 86 A and 105 A/380-480 V 44 A to 79 A/500-600 V	6	138	65	3.9
142 A/380-480 V	7	286	135	8.1
180 A to 240 A/380-480 V 107 A to 211 A/500-690 V 100 A to 179 A/660-690 V	8 8E 8E	265	125	7.5
312 A and 361 A/380-480 V	9	852	402	24.1
450 A to 600 A/380-480 V 247 A to 472 A/500-690 V 225 A to 428A/660-690 V	10 10E 10E	795	375	22.5

Table 3.3 - Cooling air flow requirements

### 3.1.3.2 Mounting on Surface

Figure 3.3 shows the installation of the CFW-09 on a mounting plate.

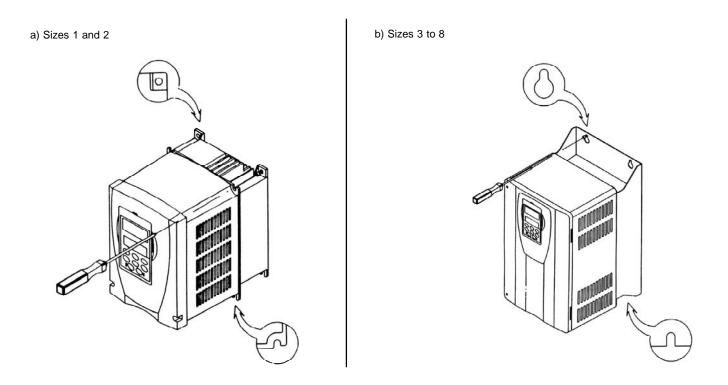


Figure 3.3 a) and b) - Mounting procedure for the CFW-09 on a surface

c) Sizes 9 and 10

d) Positioning (for all Sizes)

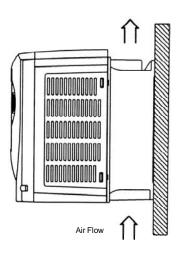


Figure 3.3 c) and d) - Mounting procedure for the CFW-09 on a surface

# 3.1.3.3 Mounting with the Heatsink Through a Surface

The CFW-09 can also be installed with the heatsink through the mounting plate, as shown in figure 3.4.

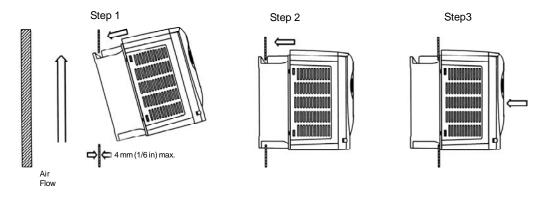
In this case, refer to installation drawings shown in figure 3.4 c) and maintain the distances indicated in table 3.4.



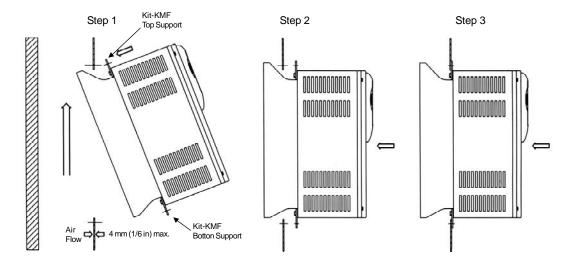
### NOTE!

When installing the heatsink through the mounting surface, according to figure 3.4, the degree of protection behind this surface is NEMA 1 / IP20. NEMA1 rating does not protect against dust and water.

### a) Sizes 1 and 2



### b) Sizes 3 to 8E



### c) Cutout Dimensions (Refer to table 3.4)

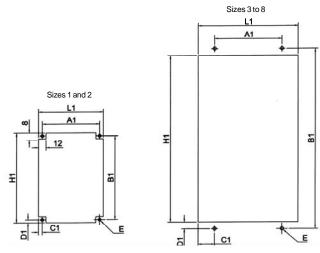


Figure 3.4 a) to c) - Mounting procedure for the CFW-09 with the heatsink through the mounting surface

CFW-09 Size	L1 mm (in)	H1 mm (in)	A1 mm (in)	B1 mm (in)	C1 mm (in)	D1 mm (in)	E mim. mm (in)	Kit KMF <sup>(*)</sup> Through Surface Mounting item n <sup>o</sup>	
Size 1	139	196	127	191	6	2.5	6		
	(5.47)	(7.72)	(5.00)	(7.52)	(0.24)	(0.10)	(0.24)		
Size 2	178	276	167	271	6	2.5	6		
SIZE Z	(7.00)	(10.87)	(6.57)	(10.67)	(0.24)	(0.10)	(0.24)		
Size 3	225	372	150	400	37.5	14	8	417102514	
Size 3	(7.00)	(14.64)	(6.57)	(15.75)	(1.44)	(0.59)	(0.31)	417102314	
Size 4	252	452	150	480	51	14	8	417102515	
3126 4	(9.92)	(17.79)	(5.91)	(18.90)	(1.97)	(0.59)	(0.31)	417102015	
Size 5	337	527	200	555	68.5	14	10	417102516	
Size 3	(13.27)	(20.75)	(7.87)	(21.85)	(2.70)	(0.59)	(0.35)	417102310	
Size 6	13.27	652	200	680	68.5	14	10	417102517	
Size 6	(13.27)	(25.67)	(7.87)	(26.77)	(2.70)	(0.59)	(0.39)	417102517	
Size 7	337	812	200	840	68.5	14	10	417102518	
Size I	(13.27)	(31.97)	(7.87)	(33.07)	(2.70)	(0.59)	(0.39)	417102316	
Size 8	412	952	275	980	68.5	14	10		
SIZE Ø	(16.22)	(37.48)	(10.38)	(38.58)	(2.70)	(0.59)	(0.39)	417102519	
Size 8E	412	1122	275	1150	68.5	14	10	417 102010	
SIZE OE	(16.22)	(44.17)	(10.83)	(45.27)	(2.70)	(0.59)	(0.39)		

<sup>(\*)</sup> The Through Surface Mounting kit (kit-KMF) is a set of supports for the CFW-09 as shown on figure 3.4 b).

Table 3.4 - Cutout dimensions and kits for CFW-09 through surface mounting

### 3.1.4 Keypad (HMI) and Cover Removal

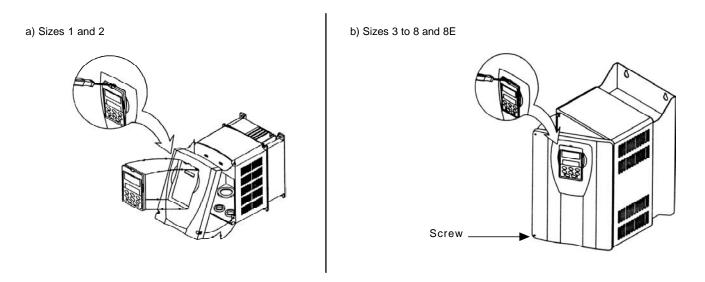


Figure 3.5 a) and b) - Keypad (HMI) and cover removal procedure

c) Sizes 9 and 10, 10E

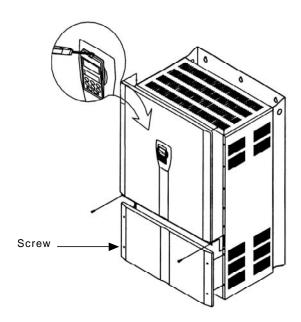


Figure 3.5 c) - Keypad (HMI) and cover removal procedure

# 3.2 ELECTRICAL INSTALLATION



### DANGER!

The information below will be a guide to achieve a proper installation. Follow also all applicable local standards for electrical installations.



### DANGER!

Be sure that the AC input power is disconnected before making any terminal connection.



### DANGER!

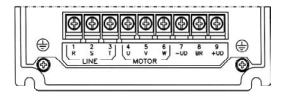
The CFW-09 frequency inverter cannot be used as an emergency stop device. Provide another devices for this function.

# 3.2.1 Power/Grounding Terminals

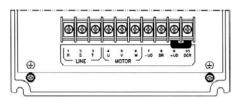
The power connection terminals can be of different sizes and configurations, depending on the inverter model as shown in figure 3.6. Terminals:

- ☑ R, S, T: AC supply line. Models up to 10 A at 220-230 V can be operated with two phases (single-phase operation) without current derating. In this case the AC supply can be connected to any 2 of the 3 input terminals.
- ☑ U, V, W: Motor connection.
- ☑ -UD: Negative pole of the DC Link circuit.
- ☑ BR: Dynamic Braking resistor connection.
- ☑ DCR: Connection to the external DC Link choke (optional).
- ☑ PE: Ground Safety.

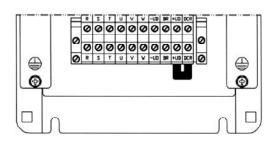
### a) Size 1 models



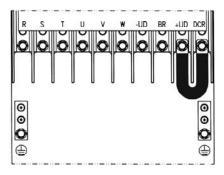
### b) Size 2 models



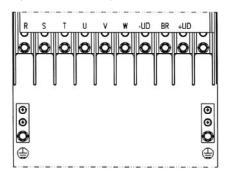
### c) Size 3, 4 and 5 models



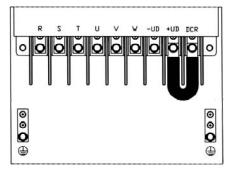
### d) Size 6 and 7 (220-230 V and 380-480 V models)



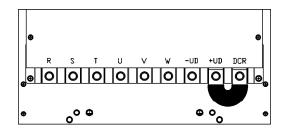
### e) Size 7 (500-600 V models)



### f) Size 8 (380-480 V models)



### g) Size 9 and 10 (380-480 V models)



### h) Size 8E (500-690 V and 660-690 V models)

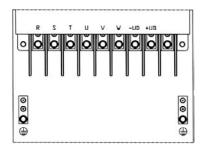


Figure 3.6 a) to h) - Power terminals

### i) Size10E (500-690 V and 660-690 V models)

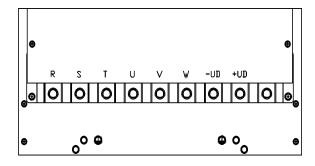
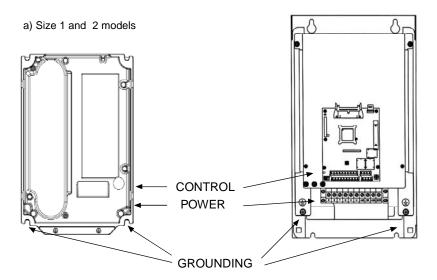


Figure 3.6 i) - Power terminals

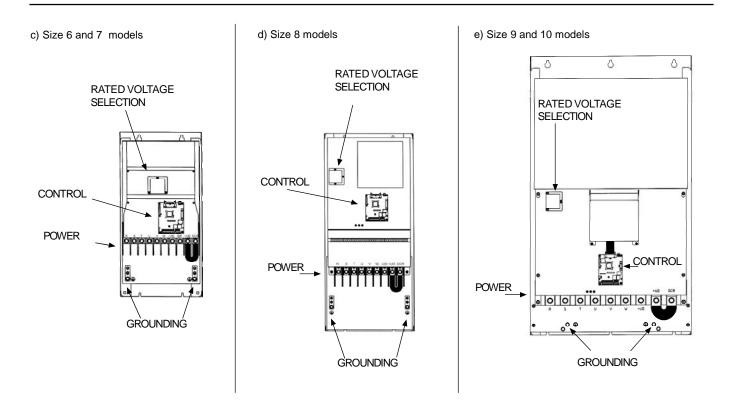
### 3.2.2 Location of the Power/ Grounding/Control Connections

b) Size 3, 4 and 5 models



Note: No voltage selection needed for these models

Figure 3.7 a) and b) - Location of the power/grounding/control connections and rated voltage



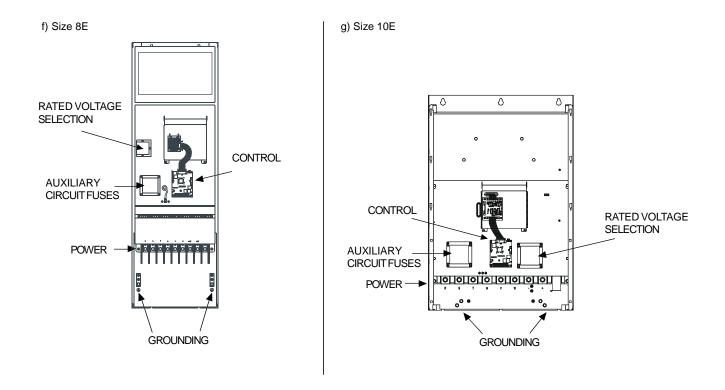


Figure 3.7 c) to g) - Location of the power/grounding/control connections and rated voltage

3.2.3 Rated Voltage Selection The following models of CFW-09 inverter series have a jumper for rated voltage selection:

- $\ge 86 \text{ A}/380-480 \text{ V}.$
- $\ge 44 \text{ A}/500-600 \text{ V}.$
- 500-690 V models.



### ATTENTION!

It is necessary to adjust the jumper in models 380-480 V when the power supply voltage is different from 440 V and 460 V. Also in models 500-600 V and 500-690 V when the power supply voltage is different from 550 V, 575 V and 600 V.

### PROCEDURE:

☑ 380-480 V models:

Remove jumper on the LVS1 board (or from the CIP2 for models ≥ 180 A) from position XC60 (440-460 V) and insert it on the proper position according to the application line voltage.

**☑** 500-600 V models:

Remove jumper on the LVS2 board from position XC62 (550 V, 575 V,600 V) and insert it on the proper position according to the line voltage.

**☑** 500-690 V models:

Remove jumper on the CIP3 board from position XC62 (550 V, 575 V,600 V) and insert it on the proper position according to the line voltage.

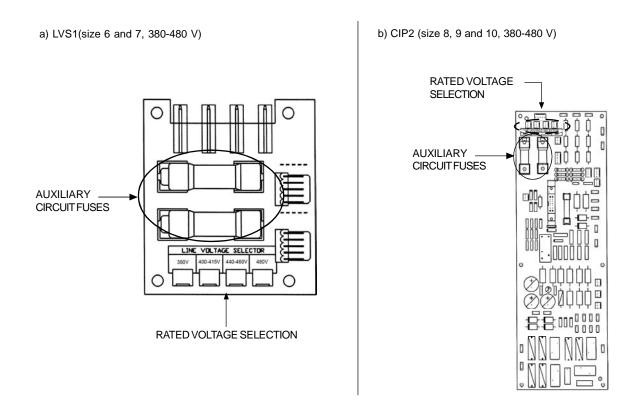


Figure 3.8 a) and b) - Rated voltage selection on boards LVS1, CIP2, LVS2 and CIP3

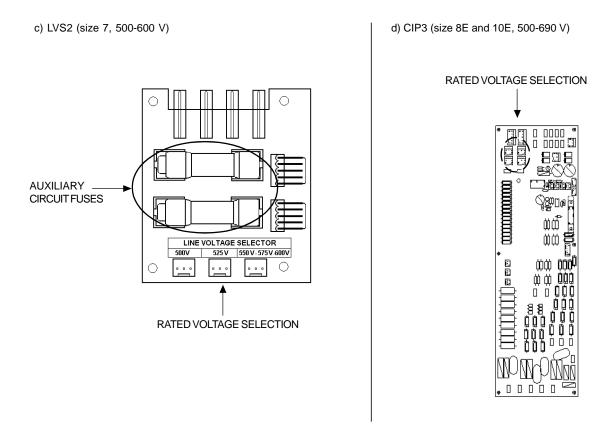


Figure 3.8 c) and d) - Rated voltage selection on boards LVS1, CIP2, LVS2 and CIP3

# 3.2.4 Power/Grounding Wiring and Fuses



### ATTENTION!

Sensitive equipment (PLCs, temperature controllers, thermocouples, etc.) and its wiring must stay at a minimum distance of 10 in (0.25 m) from the frequency inverters, the reactors and from the input and motor power cables.



### **ATTENTION!**

When flexible wires are used for power and grounding connections it is necessary to provide appropriate crimp terminals.

Use wire sizing and fuses as recommended in table 3.5.

CT		9 Rating		Cables	Groundin	~	Max. Power	High Speed	Fuse
2.95(0.0-00)   4.25(0.0-00)   1.5 (14)   1.5 (14)   2.5 (12)   2.5 (12)   4.0 (10)   15   450   4.0 (30) - 4.0 (10)   15   450   4.0 (30) - 4.0 (10)   15   450   4.0 (30) - 4.0 (10)   15   450   4.0 (30) - 4.0 (10)   15   450   4.0 (30) - 4.0 (10)   15   450   4.0 (30) - 4.0 (10)   15   450   4.0 (30) - 4.0 (10)   15   450   4.0 (30) - 4.0 (10)   15   450   4.0 (30) - 4.0 (10)   15   450   4.0 (30) - 4.0 (10)   15   450   4.0 (30)   4			1				Terminal Cable Size	Semiconductor	I <sup>2</sup> t @25°C
3.6369-480									
4.0/300-480		4.2/500-600		1.5 (14)		2.5 (12)			
1.5   1.5		-	<del></del>	-		-			
\$5,369.480		7.0/500.600		2 5 (12)		2 5 (12)			
6.0/220-230   .   2.5 (12)   .   2.5 (12)   .   4.0 (10)   25   450   7.0/220-230   .   2.5 (12)   .   2.5 (12)   .   2.5 (12)   .   2.5 (12)   .   4.0 (10)   25   450   .			, ,	2.5 (12)	` ,	2.5 (12)			
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				_		_			
10,000,000,000		-		-		-			
9,0360-480		10/500-600		2 5 (12)		2.5 (12)			
10/220-230		-				`			
10/20/20/30   -					2.0 (12)		,		
10500-600	10/220-230	-		-	2.5 (12)	-	4.0 (10)	35*2	450
12500-600	10/500-600	12/500-600		2.5 (12)	2.5 (12)	2.5 (12)	4.0 (10)		450
13/380-480									
13/380-480			` ′	` ,		()	· · ·		
14500-600		-	2.5 (12)	-	2.5 (12)	-	4.0 (10)	35	500
16/20/230		-	2.5 (12)	-	4.0 (10)	-	4.0 (10)	35	500
16380-480			` ′		` '				
22500-600 27500-600 4.0 (10) 6.0 (8) 4.0 (10) 6.0 (8) 25 (4) 50 7200 24/320-230		-	2.5 (12)	-	4.0 (10)	-		35	500
24/220-230		27/500-600	4.0 (10)	6.0 (8)	4.0 (10)	6.0 (8)	25 (4)	50	7200
24/380-480 - 40 (10) - 40 (10) - 40 (10) - 40 (10) 35 1250 28/220-230 - 6.0 (8) 16 (6) 6.0 (8) 16 (6) 25 (4) 50 7200 32/500-600 - 16 (6) - 6.0 (8) - 6.0 (8) - 6.0 (8) 50 1250 33/380-480 36/380-480 16 (6) 17 (6) 17 (6) 17 (6) 18 (6) 18 (6) 18 (6) 18 (6) 50 12 (10) 32/500-600 - 16 (6) 16 (6) 16 (6) 16 (6) 16 (6) 25 (4) 50 7200 34/500-600 53/500-600 16 (6) 16 (6) 16 (6) 16 (6) 12 (4) 50 7200 44/500-600 53/500-600 16 (6) 16 (6) 16 (6) 16 (6) 12 (4) 50 7200 44/500-600 53/500-600 16 (6) 16 (6) 16 (6) 16 (6) 12 (250) (63 14400 45/220-230 16 (6) 16 (6) 16 (6) 16 (6) 16 (6) 25 (4) 63 7200 53/500-600 53/500-600 25 (4) 25 (4) 16 (6) 16 (6) 16 (6) 25 (4) 63 7200 53/500-600 63/500-600 25 (4) 25 (4) 16 (6) 16 (6) 15 (6) 25 (4) 63 7200 53/500-600 63/500-600 25 (4) 25 (4) 16 (6) 16 (6) 15 (6) 120 (250) 63/380-480 70/380-480 25 (4) 25 (4) 16 (6) 16 (6) 16 (6) 50 (1) 80 7200 63/380-480 70/380-480 25 (4) 25 (4) 25 (3) 16 (6) 16 (6) 16 (6) 50 (1) 80 7400 70/220-230 88/220-230 25 (4) 25 (3) 16 (6) 16 (6) 16 (6) 50 (1) 80 7400 70/380-480 86/380-480 35 (2) 25 (4) 35 (2) 16 (6) 16 (6) 50 (1) 100 14400 70/380-480 10/5/380-480 50 25 (3) 50 (1) 16 (6) 25 (4) 10 (250) 80 14400 88/220-230 10/5/220-230 35 (2) 50 (1) 16 (6) 25 (4) 10 (250) 80 14400 10/5/380-480 10/5/380-480 35 (2) 50 (1) 16 (6) 25 (4) 10 (250) 25 (2) 26	24/220-230	-	4.0 (10)	- ` ´		` '		35	500
27/500-600		-	4.0 (10)	-		-	4.0 (10)		1250
28220-230	27/500-600	32/500-600	6.0 (8)	16 (6)		16 (6)	25 (4)	50	
32/500-600	28/220-230	-	6.0 (8)	-		- `		50	1250
38/380-480   45/380-480   16 (6)   16 (6)   16 (6)   16 (6)   25 (4)   50   7200   44/500-000   53/500-600   16 (6)   16 (6)   16 (6)   16 (6)   25 (4)   63   2450   45/280-230   16 (6)   16 (6)   16 (6)   16 (6)   25 (4)   63   2450   45/380-480   54/380-480   16 (6)   16 (6)   16 (6)   16 (6)   16 (6)   25 (4)   63   7200   53/500-600   63/500-600   25 (4)   25 (4)   16 (6)   16 (6)   16 (6)   12 (250)   80   14440   54/220-230   68/220-230   16 (6)   25 (4)   16 (6)   16 (6)   16 (6)   50 (1)   80   7200   60/380-480   70/380-480   25 (4)   25 (4)   16 (6)   16 (6)   16 (6)   50 (1)   80   7200   63/500-600   79/500-600   25 (4)   25 (3)   16 (6)   16 (6)   16 (6)   50 (1)   80   14440   63/500-600   79/500-600   25 (4)   25 (3)   16 (6)   16 (6)   120 (250)   80   14440   63/500-600   79/500-600   25 (4)   25 (3)   16 (6)   16 (6)   50 (1)   100   14440   63/500-600   99/500-600   25 (4)   35 (2)   16 (6)   16 (6)   50 (1)   100   14440   79/500-600   99/500-600   25 (3)   50 (1)   16 (6)   25 (4)   120 (250)   80   14440   79/500-600   99/500-600   25 (3)   50 (1)   16 (6)   25 (4)   120 (250)   125   21600   86/220-230   105/220-230   35 (2)   50 (1)   16 (6)   25 (4)   50 (1)   120 (250)   125   21600   86/220-230   105/220-230   35 (2)   50 (1)   16 (6)   25 (4)   50 (1)   125   21600   105/620-230   105/620-690   50 (1)   70 (1/0)   25 (4)   35 (2)   120 (250)   250   21600   105/620-230   105/620-230   50 (1)   70 (1/0)   25 (4)   35 (2)   120 (250)   250   21600   105/620-230   105/620-230   50 (1)   70 (1/0)   25 (4)   35 (2)   150 (300)   250   320000   105/620-690   147/600-690   50 (1)   70 (1/0)   25 (4)   35 (2)   50 (1)   150 (300)   250   320000   105/620-690   147/600-690   50 (1)   70 (1/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   105/660-690   179/660-690   70 (20)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   110/660-690   179/660-690   70 (20)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   121/600-690   179/660-690   70 (20)   95 (3/0)   35 (2)   5	30/380-480	36/380-480		16 (6)	6.0 (8)	16 (6)		50	2100
45/200-300	32/500-600	-	16 (6)		16 (6)	-		50	7200
45/280-230		45/380-480				16 (6)		50	7200
45/380-480	44/500-600	53/500-600			16 (6)	16 (6)	120 (250)	63	14400
53/500-600         63/500-600         25 (4)         25 (4)         16 (6)         16 (6)         120 (250)         80         14400           54/220-230         68/220-230         16 (6)         25 (4)         18 (6)         16 (6)         50 (1)         80         7200           60/380-480         70/380-480         25 (4)         25 (4)         16 (6)         16 (6)         50 (1)         80         14400           63/500-600         79/500-600         25 (4)         25 (3)         16 (6)         16 (6)         10 (1)         100         14400           70/380-480         86/220-230         25 (4)         35 (2)         16 (6)         16 (6)         50 (1)         100         14400           79/500-600         95/500-600         25 (3)         50 (1)         16 (6)         50 (1)         100         14400           86/220-230         105/220-230         35 (2)         50 (1)         16 (6)         25 (4)         120 (250)         125         21600           100/660-690         127/660-690         50 (1)         70 (10)         25 (4)         35 (2)         150 (300)         250         320000           105/380-480         130/380-480         130/220-230         50 (1)         70 (1/0)	45/220-230	-		` '		16 (6)		63	2450
54/220-230         68/220-230         16 (6)         25 (4)         15 (6)         16 (6)         50 (1)         80         7200           60/380-480         70/380-480         25 (4)         25 (4)         16 (6)         16 (6)         50 (1)         80         14400           63/500-600         79/500-600         25 (4)         25 (3)         16 (6)         16 (6)         120 (250)         80         14400           70/220-230         86/220-230         25 (4)         35 (2)         16 (6)         16 (6)         50 (1)         100         14400           79/500-600         99/500-600         25 (3)         50 (1)         16 (6)         25 (4)         120 (250)         125         21600           86/220-230         105/220-230         35 (2)         50 (1)         16 (6)         25 (4)         120 (250)         125         21600           100/660-690         105/380-480         35 (2)         50 (1)         70 (1/0)         25 (4)         35 (2)         150 (300)         250         320000           105/220-230         130/220-230         50 (1)         70 (1/0)         25 (4)         35 (2)         150 (300)         250         22600           127/606-690         70 (1/0)         95 (30) <td>45/380-480</td> <td>54/380-480</td> <td></td> <td></td> <td>16 (6)</td> <td>16 (6)</td> <td></td> <td>63</td> <td>7200</td>	45/380-480	54/380-480			16 (6)	16 (6)		63	7200
60/380-480 70/380-480 25 (4) 25 (4) 16 (6) 16 (6) 50 (1) 80 14400 70/280-230 86/220-230 25 (4) 25 (3) 16 (6) 16 (6) 120 (250) 80 14400 70/280-230 86/220-230 25 (4) 35 (2) 16 (6) 16 (6) 50 (1) 100 14400 79/500-600 99/500-600 25 (3) 50 (1) 16 (6) 25 (4) 120 (250) 125 21600 86/220-230 105/220-230 35 (2) 50 (1) 16 (6) 25 (4) 120 (250) 125 14400 86/220-230 105/220-230 35 (2) 50 (1) 16 (6) 25 (4) 50 (1) 120 (250) 125 14400 100/680-690 127/660-690 50 (1) 70 (1/0) 25 (4) 35 (2) 150 (300) 250 320000 105/220-230 30 (2) 50 (1) 70 (1/0) 25 (4) 35 (2) 150 (300) 250 320000 105/220-230 30 (2) 50 (1) 70 (1/0) 25 (4) 35 (2) 150 (300) 250 320000 105/220-230 130/220-230 50 (1) 70 (1/0) 25 (4) 35 (2) 150 (300) 250 320000 105/230-480 130/380-480 50 (1) 70 (1/0) 25 (4) 35 (2) 150 (300) 250 320000 105/380-480 130/380-480 50 (1) 70 (1/0) 25 (4) 35 (2) 150 (300) 250 320000 130/220-230 150/220-230 70 (1/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 130/220-230 150/220-230 70 (1/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 130/220-230 150/220-230 70 (1/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 130/220-230 150/220-230 70 (1/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 130/220-230 150/280-690 159/690-690 95 (3/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 179/680-690 179/680-690 95 (3/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 179/680-690 179/680-690 150 (300) 185 (300) 7. 50 (1/0) 7. 150 (300) 315 320000 211/380-480 - 150 (300) 185 (300) 7. 70 (1/0) 7. 150 (300) 315 320000 240/380-480 - 150 (300) 185 (300) 7. 70 (1/0) 7. 150 (300) 315 320000 240/380-480 - 150 (300) 2×70 (2×2/0) 2×10 (2×2/0) 2×10 (2×2/0) 2×240 (2×500) 500 414000 315/500-690 150 (300) 2×70 (2×2/0) 2×10 (2×2/0) 2×20 (2×20) 500 (400) 315/500-690 150 (300) 2×70 (2×2/0) 2×10 (2×2/0) 120 (4/0) 2×240 (2×500) 500 414000 34/500-690 34/500-690 150 (300) 2×70 (2×2/0) 2×10 (2×2/0) 2×20 (2×20) 500 (44000 34/500-690 41/600-690 2×10 (2×40) 2×150 (2×250) 110 (1/0) 1×150 (1×250) 500 414000 315/500-690 305/600-690 2×10 (2×40) 2×150 (2×250) 1×150 (2×250) 1×150 (1×250) 1×150 (1	53/500-600								
63/500-600         79/500-600         25 (4)         25 (3)         16 (6)         16 (6)         120 (250)         80         14400           70/220-230         86/220-230         86/220-230         25 (4)         35 (2)         16 (6)         16 (6)         50 (1)         100         14400           79/500-600         99/500-600         25 (3)         50 (1)         16 (6)         25 (4)         50 (1)         125         21600           86/220-230         105/220-230         35 (2)         50 (1)         16 (6)         25 (4)         50 (1)         125         14400           86/380-480         105/380-480         35 (2)         50 (1)         16 (6)         25 (4)         120 (250)         125         21600           105/220-230         130/220-230         50 (1)         70 (1/0)         25 (4)         35 (2)         150 (300)         250         320000           105/380-480         130/380-480         50 (1)         70 (1/0)         25 (4)         35 (2)         150 (300)         250         21600           127/660-690         179/660-690         70 (1/0)         95 (3/0)         35 (2)         50 (1)         150 (300)         250         320000           130/220-230         150/20-20-30	54/220-230								7200
Total   Tota				25 (4)					
70/380-480         86/380-480         25 (4)         35 (2)         16 (6)         16 (6)         50 (1)         100         14400           79/500-600         99/500-600         25 (3)         50 (1)         16 (6)         25 (4)         120 (250)         125         21600           86/320-230         105/220-230         35 (2)         50 (1)         16 (6)         25 (4)         50 (1)         125         21600           100/660-690         127/660-690         50 (1)         70 (1/0)         25 (4)         35 (2)         150 (300)         250         320000           105/220-230         130/220-230         50 (1)         70 (1/0)         25 (4)         35 (2)         150 (300)         250         320000           107/500-690         147/500-690         150 (1)         70 (1/0)         25 (4)         35 (2)         150 (300)         250         21600           127/660-690         147/360-690         70 (1/0)         95 (3/0)         35 (2)         50 (1)         150 (300)         250         320000           130/220-230         150/220-230         70 (1/0)         95 (3/0)         35 (2)         50 (1)         120 (250)         250         21600           14/380-480         174/380-480         70 (2/0			25 (4)	25 (3)	16 (6)	16 (6)	120 (250)	80	14400
70/380-480 86/380-480 25 (3) 50 (1) 16 (6) 25 (4) 120 (250) 125 21600 86/220-230 105/220-230 35 (2) 50 (1) 16 (6) 25 (4) 50 (1) 125 14400 86/380-480 105/380-480 35 (2) 50 (1) 16 (6) 25 (4) 50 (1) 125 126 21600 100/660-690 127/660-690 50 (1) 70 (1/0) 25 (4) 35 (2) 150 (300) 250 320000 105/220-230 130/220-230 50 (1) 70 (1/0) 25 (4) 35 (2) 120 (250) 250 21600 105/380-480 130/380-480 50 (1) 70 (1/0) 25 (4) 35 (2) 120 (250) 250 21600 105/380-480 130/380-480 70 (1/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 127/660-690 179/660-690 70 (1/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 127/660-690 179/660-690 70 (1/0) 95 (3/0) 35 (2) 50 (1) 120 (250) 250 21600 147/500-690 179/660-690 70 (2/0) 95 (3/0) 35 (2) 50 (1) 120 (250) 250 21600 147/380-480 174/380-480 70 (1/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 180/380-480 - 95 (3/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 180/380-480 - 95 (3/0) 95 (3/0) - 70 (1/0) - 150 (300) 250 320000 117/3660-690 179/660-690 95 (3/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 117/360-690 179/660-690 150 (300) - 70 (1/0) - 150 (300) 250 320000 117/360-690 179/660-690 95 (3/0) 95 (3/0) 35 (2) 50 (1) 150 (300) 250 320000 121/380-480 - 150 (300) 185 (300) 70 (1/0) 70 (1/0) 150 (300) 315 320000 211/380-480 - 150 (300) 185 (300) 70 (1/0) 70 (1/0) 150 (300) 315 320000 225/660-690 259/660-690 150 (300) 185 (300) 70 (1/0) 70 (1/0) 70 (1/0) 2x240 (2x500) 315 320000 247/500-690 315/500-690 150 (300) 2x70 (2x2/0) 70 (1/0) 70 (2/0) 2x240 (2x500) 500 31000 315/500-690 315/500-690 150 (300) 2x70 (2x2/0) 70 (1/0) 70 (1/0) 2x240 (2x500) 500 414000 315/500-690 340/660-690 2x70 (2x2/0) 2x150 (2x250) 70 (2/0) 120 (4/0) 2x240 (2x500) 500 414000 315/500-690 340/660-690 2x120 (2x4/0) 2x150 (2x250) 120 (4/0) 1x150 (1x250) 2x240 (2x500) 500 414000 315/500-690 340/660-690 2x120 (2x4/0) 2x150 (2x250) 120 (4/0) 1x150 (1x250) 2x240 (2x500) 700 1051000 4145000 416/500-690 428/660-690 2x120 (2x4/0) 2x150 (2x250) 1x150 (1x250) 1x150 (1x250) 2x240 (2x500) 700 1051000 448/660-690 428/660-690 2x120 (2x4/0) 2x1		1	25 (4)	35 (2)	16 (6)	16 (6)	50 (1)	100	14400
86/220-230         105/220-230         35 (2)         50 (1)         16 (6)         25 (4)         50 (1)         125         14400           86/380-480         105/380-480         35 (2)         50 (1)         70 (1/0)         25 (4)         35 (2)         150 (300)         250         320000           105/220-230         130/220-230         50 (1)         70 (1/0)         25 (4)         35 (2)         120 (250)         250         21600           107/500-690         130/380-480         50 (1)         70 (1/0)         25 (4)         35 (2)         150 (300)         250         320000           127/660-690         147/560-690         50 (1)         70 (1/0)         25 (4)         35 (2)         150 (300)         250         320000           130/220-230         150/220-230         70 (1/0)         95 (3/0)         35 (2)         50 (1)         150 (300)         250         320000           142/380-480         174/380-480         70 (1/0)         95 (3/0)         35 (2)         50 (1)         120 (250)         250         320000           147/500-690         196/500-690         70 (2/0)         95 (3/0)         35 (2)         50 (1)         150 (300)         250         320000           147/500-690         <			1 1		* *				
B6/380-480   105/380-480   35 (2)   50 (1)   16 (6)   25 (4)   120 (250)   125   21600   105/220-230   130/220-230   130/220-230   130/220-230   130/380-480   50 (1)   70 (1/0)   25 (4)   35 (2)   120 (250)   250   21600   107/500-690   147/500-690   50 (1)   70 (1/0)   25 (4)   35 (2)   120 (250)   250   21600   107/500-690   147/500-690   50 (1)   70 (1/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   130/3220-230   150/220-230   70 (1/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   130/220-230   150/220-230   70 (1/0)   95 (3/0)   35 (2)   50 (1)   120 (250)   250   21600   142/380-480   77 (1/0)   95 (3/0)   35 (2)   50 (1)   120 (250)   250   21600   147/500-690   196/500-690   70 (2/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   179/660-690   196/500-690   70 (2/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   179/660-690   95 (3/0)   95 (3/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   179/660-690   50 (3/0)   95									
100/660-690   127/660-690   50 (1)   70 (1/0)   25 (4)   35 (2)   150 (300)   250   320000   105/320-230   130/220-230   50 (1)   70 (1/0)   25 (4)   35 (2)   120 (250)   250   21600   105/380-480   130/320-230   50 (1)   70 (1/0)   25 (4)   35 (2)   150 (300)   250   320000   127/660-690   147/500-690   50 (1)   70 (1/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   127/660-690   70 (1/0)   95 (3/0)   35 (2)   50 (1)   120 (250)   250   21600   142/380-480   174/380-480   70 (1/0)   95 (3/0)   35 (2)   50 (1)   120 (250)   250   21600   142/380-480   174/380-480   70 (1/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   137/660-690   196/500-690   70 (2/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000   139/660-690   179/660-690   179/660-690   179/660-690   179/660-690   179/660-690   179/660-690   150 (300)   50 (1)   50 (1)   150 (300)   250   320000   130/380-480   -   150 (300)   185 (300)   70 (1/0)   -   150 (300)   315   320000   225/660-690   259/660-690   150 (300)   185 (300)   70 (1/0)   70 (1/0)   150 (300)   250   320000   226/660-690   259/660-690   150 (300)   185 (300)   70 (1/0)   70 (1/0)   70 (1/0)   2x240 (2x500)   315   320000   247/500-690   315 (300)   2x70 (2x2/0)   70 (1/0)   70 (2/0)   2x240 (2x500)   500   320000   259/660-690   315/500-690   150 (300)   2x70 (2x2/0)   70 (1/0)   70 (2/0)   2x240 (2x500)   500   414000   315/500-690   340/660-690   2x70 (2x2/0)   2x120 (2x4/0)   70 (2/0)   2x240 (2x500)   500   414000   315/500-690   343/500-690   2x70 (2x2/0)   2x120 (2x4/0)   70 (2/0)   120 (4/0)   2x240 (2x500)   500   414000   315/500-690   343/500-690   2x70 (2x2/0)   2x150 (2x250)   120 (4/0)   1x150 (1x250)   2x240 (2x500)   700   414000   340/660-690   2x150 (2x250)   2x150 (2x250)   120 (4/0)   1x150 (1x250)   2x240 (2x500)   700   1445000   448/500-690   428/660-690   2x150 (2x250)   3x120 (3x4/0)   1x150 (1x250)   2x240 (2x500)   700   1445000   448/500-690   3x150 (3x250)   3x150 (3x250)   -   2x70 (2x2/0)   -   2x240 (2x500)   700   144									
105/220-230				· · · ·					
107/500-690			50 (1)	70 (1/0)	25 (4)	35 (2)	, ,	250	320000
107/500-690			50 (1)	70 (1/0)	25 (4)	35 (2)	120 (250)	250	21600
127/660-690   179/660-690   70 (1/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000     130/220-230   150/220-230   70 (1/0)   95 (3/0)   35 (2)   50 (1)   120 (250)   250   21600     147/500-690   196/500-690   70 (2/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000     179/660-690   179/660-690   95 (3/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000     180/380-480   - 95 (3/0)   - 50 (1)   50 (1)   150 (300)   250   320000     11/380-480   - 150 (300)   - 70 (1/0)   - 150 (300)   250   320000     211/500-690   - 150 (300)   185 (300)   70 (1/0)   70 (1/0)   150 (300)   250   320000     225/660-690   259/660-690   150 (300)   185 (300)   70 (1/0)   70 (1/0)   2x240 (2x500)   315   320000     240/380-480   - 150 (300)   - 70 (1/0)   - 150 (300)   315   320000     240/380-480   - 150 (300)   270 (2x2/0)   70 (1/0)   - 150 (300)   315   320000     247/500-690   315/500-690   150 (300)   2x70 (2x2/0)   70 (1/0)   - 150 (300)   315   320000     259/660-690   305/660-690   150 (300)   2x70 (2x2/0)   70 (2/0)   2x240 (2x500)   500   320000     259/660-690   305/660-690   150 (300)   2x70 (2x2/0)   70 (2/0)   2x240 (2x500)   500   414000     312/380-480   - 2x70 (2x2/0)   2x120 (2x4/0)   70 (2/0)   2x240 (2x500)   500   414000     312/380-480   - 2x70 (2x2/0)   2x150 (2x250)   70 (2/0)   - 240 (500)   500   414000     343/500-690   343/500-690   2x120 (2x4/0)   2x150 (2x250)   70 (2/0)   - 2x240 (2x500)   500   414000     343/500-690   418/500-690   2x120 (2x4/0)   2x150 (2x250)   120 (4/0)   1x150 (1x250)   2x240 (2x500)   700   414000     343/500-690   428/660-690   2x120 (2x4/0)   2x150 (2x250)   120 (4/0)   1x150 (1x250)   2x240 (2x500)   700   4145000     428/660-690   428/660-690   2x150 (2x250)   2x150 (2x250)   1x150 (1x250)   2x240 (2x500)   700   1445000     428/660-690   428/660-690   2x150 (2x250)   2x150 (2x250)   1x150 (1x250)   2x240 (2x500)   900   1445000     450/380-480   - 3x150 (3x250)   - 2x95 (2x3/0)   - 2x240 (2x500)   900   1445000     450/380-480   - 3x150 (3x25		<del> </del>	1 1		` '	` '	150 (200)		
130/220-230									
142/380-480         174/380-480         70 (1/0)         95 (3/0)         35 (2)         50 (1)         120 (250)         250         21600           147/500-690         196/500-690         70 (2/0)         95 (3/0)         35 (2)         50 (1)         150 (300)         250         320000           180/380-480         -         95 (3/0)         -         50 (1)         50 (1)         150 (300)         250         320000           211/380-480         -         150 (300)         -         70 (1/0)         -         150 (300)         315         320000           211/500-690         -         150 (300)         185 (300)         70 (1/0)         70 (1/0)         150 (300)         250         320000           225/660-690         259/660-690         150 (300)         185 (300)         70 (1/0)         70 (1/0)         2x240 (2x500)         315         320000           240/380-480         -         150 (300)         2x70 (2x2/0)         70 (1/0)         -         150 (300)         315         320000           259/660-690         315/500-690         150 (300)         2x70 (2x2/0)         70 (1/0)         70 (2/0)         2x240 (2x500)         500         320000           259/660-690         340/660-690 <td< td=""><td></td><td></td><td>70 (1/0)</td><td>95 (5/0)</td><td>35 (2)</td><td>50 (1)</td><td>150 (300)</td><td>250</td><td>320000</td></td<>			70 (1/0)	95 (5/0)	35 (2)	50 (1)	150 (300)	250	320000
147/500-690   196/500-690   70 (2/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000     179/660-690   179/660-690   95 (3/0)   95 (3/0)   95 (3/0)   35 (2)   50 (1)   150 (300)   250   320000     180/380-480   - 95 (3/0)   - 50 (1)   50 (1)   150 (300)   250   320000     211/380-480   - 150 (300)   - 70 (1/0)   - 150 (300)   315   320000     211/500-690   - 150 (300)   185 (300)   70 (1/0)   70 (1/0)   150 (300)   250   320000     225/660-690   259/660-690   150 (300)   185 (300)   70 (1/0)   70 (1/0)   2x240 (2x500)   315   320000     240/380-480   - 150 (300)   2x70 (2x2/0)   70 (1/0)   - 150 (300)   315   320000     247/500-690   315/500-690   150 (300)   2x70 (2x2/0)   70 (1/0)   - 150 (300)   315   320000     249/660-690   305/660-690   150 (300)   2x70 (2x2/0)   2x70 (2x2/0)   70 (2/0)   2x240 (2x500)   500   320000     249/380-480   - 150 (300)   2x70 (2x2/0)   2x70 (2x2/0)   2x70 (2x2/0)   2x240 (2x500)   500   320000     249/380-480   - 2x70 (2x2/0)   2x70 (2x2/0)   2x70 (2x2/0)   2x70 (2x2/0)   2x240 (2x500)   500   414000     305/660-690   340/660-690   2x70 (2x2/0)   2x120 (2x4/0)   70 (2/0)   120 (4/0)   2x240 (2x500)   500   414000     312/380-480   - 2x70 (2x2/0)   2x150 (2x250)   70 (2/0)   120 (4/0)   2x240 (2x500)   500   414000     343/500-690   343/500-690   2x120 (2x4/0)   2x150 (2x250)   120 (4/0)   1x150 (1x250)   2x240 (2x500)   700   1051000     343/500-690   418/500-690   2x120 (2x4/0)   2x150 (2x250)   120 (4/0)   1x150 (1x250)   2x240 (2x500)   700   1445000     418/500-690   428/660-690   2x150 (2x250)   2x150 (2x250)   120 (4/0)   1x150 (1x250)   2x240 (2x500)   700   1445000     428/660-690   428/660-690   2x150 (2x250)   2x150 (2x250)   1x150 (1x250)   2x240 (2x500)   700   1445000     428/660-690   428/660-690   2x150 (2x250)   2x150 (2x250)   1x150 (1x250)   2x240 (2x500)   700   1445000     450/380-480   - 2x150 (2x250)   3x120 (3x4/0)   1x150 (1x250)   2x240 (2x500)   900   1445000     515/380-480   - 3x150 (3x250)   - 2x95 (2x3/0)   - 2x240 (2x500)   900   1445000		1	70 (1/0)	95 (3/0)	35 (2)	50 (1)	120 (250)	250	21600
179/660-690			70 (2/0)	95 (3/0)	` ,	` ,		250	220000
180/380-480					35 (2)	50 (1)	150 (300)		
211/380-480         -         150 (300)         -         70 (1/0)         -         150 (300)         315         320000           211/500-690         -         150 (300)         185 (300)         70 (1/0)         70 (1/0)         150 (300)         250         320000           225/660-690         259/660-690         150 (300)         185 (300)         70 (1/0)         70 (1/0)         2x240 (2x500)         315         320000           240/380-480         -         150 (300)         2x70 (2x2/0)         70 (1/0)         70 (2/0)         2x240 (2x500)         315         320000           247/500-690         315/500-690         150 (300)         2x70 (2x2/0)         70 (1/0)         70 (2/0)         2x240 (2x500)         500         320000           259/660-690         305/660-690         150 (300)         2x70 (2x2/0)         2x70 (2x2/0)         70 (1/0)         70 (2/0)         2x240 (2x500)         500         414000           312/380-480         -         2x70 (2x2/0)         2x150 (2x2/0)         -         70 (2/0)         -         240 (500)         500         414000           315/500-690         343/500-690         2x10 (2x4/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         500		- 11 3/000-090		_ ' '			150 (300)		
211/500-690         -         150 (300)         185 (300)         70 (1/0)         70 (1/0)         150 (300)         250         320000           225/660-690         259/660-690         150 (300)         185 (300)         70 (1/0)         70 (1/0)         2x240 (2x500)         315         320000           240/380-480         -         150 (300)         -         70 (1/0)         -         150 (300)         315         320000           247/500-690         315/500-690         150 (300)         2x70 (2x2/0)         70 (1/0)         70 (2/0)         2x240 (2x500)         500         320000           259/660-690         305/660-690         150 (300)         2x70 (2x2/0)         2x120 (2x4/0)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           315/500-690         343/500-690         2x70 (2x2/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           343/500-690         428/660-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)		-							
225/660-690         259/660-690         150 (300)         185 (300)         70 (1/0)         70 (1/0)         2x240 (2x500)         315         320000           240/380-480         -         150 (300)         -         70 (1/0)         -         150 (300)         315         320000           247/500-690         315/500-690         150 (300)         2x70 (2x2/0)         70 (1/0)         70 (2/0)         2x240 (2x500)         500         320000           259/660-690         305/660-690         150 (300)         2x70 (2x2/0)         2x70 (2x2/0)         70 (2/0)         2x240 (2x500)         500         414000           305/660-690         340/660-690         2x70 (2x2/0)         2x120 (2x4/0)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           315/500-690         343/500-690         2x70 (2x2/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           340/660-690         428/660-690         2x120 (2x4/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         700         1051000           341/500-690         418/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)		-					` '		
240/380-480         -         150 (300)         -         70 (1/0)         -         150 (300)         315         320000           247/500-690         315/500-690         150 (300)         2x70 (2x2/0)         70 (1/0)         70 (2/0)         2x240 (2x500)         500         320000           259/660-690         305/660-690         150 (300)         2x70 (2x2/0)         2x70 (2x2/0)         70 (2/0)         2x240 (2x500)         500         414000           305/660-690         340/660-690         2x70 (2x2/0)         2x120 (2x4/0)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           312/380-480         -         2x70 (2x2/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           340/660-690         343/500-690         2x70 (2x2/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           340/660-690         428/660-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           361/380-480         -         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         7		259/660-690							
247/500-690         315/500-690         150 (300)         2x70 (2x2/0)         70 (1/0)         70 (2/0)         2x240 (2x500)         500         320000           259/660-690         305/660-690         150 (300)         2x70 (2x2/0)         2x70 (2x2/0)         70 (2/0)         2x240 (2x500)         500         414000           305/660-690         340/660-690         2x70 (2x2/0)         2x120 (2x4/0)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           312/380-480         -         2x70 (2x2/0)         -         70 (2/0)         -         240 (500)         500         414000           315/500-690         343/500-690         2x70 (2x2/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           340/660-690         428/660-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           343/500-690         418/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         414000           361/380-480         -         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)		-		-		, ,			
259/660-690         305/660-690         150 (300)         2x70 (2x2/0)         2x70 (2x2/0)         70 (2/0)         2x240 (2x500)         500         414000           305/660-690         340/660-690         2x70 (2x2/0)         2x120 (2x4/0)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           312/380-480         -         2x70 (2x2/0)         -         70 (2/0)         -         240 (500)         500         414000           340/660-690         343/500-690         2x70 (2x2/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           340/660-690         428/660-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           343/500-690         418/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         414000           361/380-480         -         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           428/660-690         428/660-690         2x150 (2x250)         2x150 (2x250)         1x150 (1x250)         1x150 (1x250)         <		315/500-690		2x70 (2x2/0)					
305/660-690         340/660-690         2x70 (2x2/0)         2x120 (2x4/0)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           312/380-480         -         2x70 (2x2/0)         -         70 (2/0)         -         240 (500)         500         414000           315/500-690         343/500-690         2x70 (2x2/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           340/660-690         428/660-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           343/500-690         418/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         414000           361/380-480         -         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         414000           428/660-690         472/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           472/500-690         428/660-690         2x150 (2x250)         2x150 (2x250)         1x150 (1x250)         1x150 (1x250)									
312/380-480         -         2x70 (2x2/0)         -         70 (2/0)         -         240 (500)         500         414000           315/500-690         343/500-690         2x70 (2x2/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           340/660-690         428/660-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           343/500-690         418/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         414000           361/380-480         -         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         4000           418/500-690         472/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           428/660-690         428/660-690         2x150 (2x250)         2x150 (2x250)         1x150 (1x250)         1x150 (1x250)         2x240 (2x500)         700         1445000           450/380-480         -         2x150 (2x250)         -         150 (250)         -         2x240 (2x500)									
315/500-690         343/500-690         2x70 (2x2/0)         2x150 (2x250)         70 (2/0)         120 (4/0)         2x240 (2x500)         500         414000           340/660-690         428/660-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           343/500-690         418/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         414000           361/380-480         -         2x120 (2x4/0)         -         120 (4/0)         -         240 (500)         500         414000           418/500-690         472/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           428/660-690         428/660-690         2x150 (2x250)         2x150 (2x250)         1x150 (1x250)         1x150 (1x250)         2x240 (2x500)         700         1445000           472/500-690         555/500-690         2x150 (2x250)         3x120 (3x4/0)         1x150 (1x250)         2x95 (2x3/0)         2x240 (2x500)         900         1445000           450/380-480         -         2x150 (2x250)         -         150 (250)         -         2		-		-					
340/660-690         428/660-690         2x120 (2x4/0) 2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           343/500-690         418/500-690         2x120 (2x4/0) 2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         414000           361/380-480         -         2x120 (2x4/0)         -         120 (4/0)         -         240 (500)         500         414000           418/500-690         472/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           428/660-690         428/660-690         2x150 (2x250)         2x150 (2x250)         1x150 (1x250)         1x150 (1x250)         2x240 (2x500)         700         1445000           472/500-690         555/500-690         2x150 (2x250)         3x120 (3x4/0)         1x150 (1x250)         2x95 (2x3/0)         2x240 (2x500)         900         1445000           450/380-480         -         2x150 (2x250)         -         150 (250)         -         2x240 (2x500)         900         1445000           515/380-480         -         3x120 (3x4/0)         -         2x95 (2x3/0)         -         2x240 (2x500)         900         1445000		343/500-690	2x70 (2x2/0)		70 (2/0)	120 (4/0)			
343/500-690         418/500-690         2x120 (2x4/0) (2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         414000           361/380-480         -         2x120 (2x4/0)         -         120 (4/0)         -         240 (500)         500         414000           418/500-690         472/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           428/660-690         428/660-690         2x150 (2x250)         2x150 (2x250)         1x150 (1x250)         1x150 (1x250)         2x240 (2x500)         700         1445000           472/500-690         555/500-690         2x150 (2x250)         3x120 (3x4/0)         1x150 (1x250)         2x95 (2x3/0)         2x240 (2x500)         900         1445000           450/380-480         -         2x150 (2x250)         -         150 (250)         -         2x240 (2x500)         700         1051000           515/380-480         -         3x120 (3x4/0)         -         2x70 (2x2/0)         -         2x240 (2x500)         900         1445000           600/380-480         -         3x150 (3x250)         -         2x95 (2x3/0)         -         2x240 (2x500)         900         1445000 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2x240 (2x500)</td> <td></td> <td></td>							2x240 (2x500)		
361/380-480         -         2x120 (2x4/0)         -         120 (4/0)         -         240 (500)         500         414000           418/500-690         472/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           428/660-690         428/660-690         2x150 (2x250)         2x150 (2x250)         1x150 (1x250)         1x150 (1x250)         2x240 (2x500)         700         1445000           472/500-690         555/500-690         2x150 (2x250)         3x120 (3x4/0)         1x150 (1x250)         2x95 (2x3/0)         2x240 (2x500)         900         1445000           450/380-480         -         2x150 (2x250)         -         150 (250)         -         2x240 (2x500)         700         1051000           515/380-480         -         3x120 (3x4/0)         -         2x70 (2x2/0)         -         2x240 (2x500)         900         1445000           600/380-480         -         3x150 (3x250)         -         2x95 (2x3/0)         -         2x240 (2x500)         900         1445000									
418/500-690         472/500-690         2x120 (2x4/0)         2x150 (2x250)         120 (4/0)         1x150 (1x250)         2x240 (2x500)         700         1051000           428/660-690         428/660-690         2x150 (2x250)         2x150 (2x250)         1x150 (1x250)         1x150 (1x250)         2x240 (2x500)         700         1445000           472/500-690         555/500-690         2x150 (2x250)         3x120 (3x4/0)         1x150 (1x250)         2x95 (2x3/0)         2x240 (2x500)         900         1445000           450/380-480         -         2x150 (2x250)         -         150 (250)         -         2x240 (2x500)         700         1051000           515/380-480         -         3x120 (3x4/0)         -         2x70 (2x2/0)         -         2x240 (2x500)         900         1445000           600/380-480         -         3x150 (3x250)         -         2x95 (2x3/0)         -         2x240 (2x500)         900         1445000		-	2x120 (2x4/0)	-		, ,		500	414000
428/660-690       428/660-690       2x150 (2x250) 2x150 (2x250) 1x150 (1x250)       1x150 (1x250)       2x240 (2x500)       700       1445000         472/500-690       555/500-690       2x150 (2x250) 3x120 (3x4/0)       1x150 (1x250)       2x95 (2x3/0)       2x240 (2x500)       900       1445000         450/380-480       -       2x150 (2x250)       -       150 (250)       -       2x240 (2x500)       700       1051000         515/380-480       -       3x120 (3x4/0)       -       2x70 (2x2/0)       -       2x240 (2x500)       900       1445000         600/380-480       -       3x150 (3x250)       -       2x95 (2x3/0)       -       2x240 (2x500)       900       1445000		472/500-690	2x120 (2x4/0)	2x150 (2x250)	120 (4/0)	1x150 (1x250)	. ,	700	
472/500-690     555/500-690     2x150 (2x250)     3x120 (3x4/0)     1x150 (1x250)     2x95 (2x3/0)     2x240 (2x500)     900     1445000       450/380-480     -     2x150 (2x250)     -     150 (250)     -     2x240 (2x500)     700     1051000       515/380-480     -     3x120 (3x4/0)     -     2x70 (2x2/0)     -     2x240 (2x500)     900     1445000       600/380-480     -     3x150 (3x250)     -     2x95 (2x3/0)     -     2x240 (2x500)     900     1445000	428/660-690		2x150 (2x250)	2x150 (2x250)	1x150 (1x250)			700	1445000
450/380-480       -       2x150 (2x250)       -       150 (250)       -       2x240 (2x500)       700       1051000         515/380-480       -       3x120 (3x4/0)       -       2x70 (2x2/0)       -       2x240 (2x500)       900       1445000         600/380-480       -       3x150 (3x250)       -       2x95 (2x3/0)       -       2x240 (2x500)       900       1445000		555/500-690	2x150 (2x250)	3x120 (3x4/0)	1x150 (1x250)	2x95 (2x3/0)		900	
600/380-480 - 3x150 (3x250) - 2x95 (2x3/0) - 2x240 (2x500) 900 1445000		-			150 (250)			700	
		-	3x120 (3x4/0)	-		-			
CT Constant Torque / VT Variable Torque	600/380-480	-					2x240 (2x500)	900	1445000

CT - Constant Torque / VT - Variable Torque
\*1 - Three phase connection / \*2 - Single phase connection



### NOTE!

The wire sizing indicated in table 3.5 are reference values only. The exact wire sizing depends on the installation conditions and the maximum acceptable line voltage drop.

The tightening torque is as indicated in table 3.6. Use 75°C copper wire only.

CFW-09 Rating A/Volts	Grounding Wiring N.m (lbf.in)	Power Cables N.m (lbf.in)
6 A to 13 A/220-230 V 3.6 A to 13 A/380-480 V	1.00 (8.85)	1.76 (15.58)
16 A to 28 A/220-230 V 16 A to 24 A/380-480 V 2.9 A to 14 A/500-600 V	2.00 (17.70)	2.00 (17.70)
30 A/380-480 V	4.50 (39.83)	1.40 (12.30)
45 A/220-230 V 38 A to 45 A/380-480 V 22 A to 32 A/500-600 V	4.50 (39.83)	1.40 (12.30)
54 A to 86 A/220-230 V 60 A to 86 A/380-480 V	4.50 (39.83)	3.00 (26.10)
105 A to 130 A/220-230 V 105 A to 142 A/380-480 V 44 A to 79 A/500-600 V	15.50 (132.75)	15.50 (132.75)
180 A to 240 A/380-480 V	15.50 (132.75)	30.00 (265.50)
312 A to 600 A/380-480 V 107 A to 472 A/500-690 V 100 A to 428 A/660-690 V	30.00 (265.50)	60.00 (531.00)

**Table 3.6** - Recommended tightening torque for power and grounding connections

### **Line Fuses**

- ☑ For protecting the input rectifier diodes and the wiring, use UR Type (Ultra-Rapid) fuses with i²t equal or lower than indicated in table 3.5.
- ☑ Standard fuses may be used optionally at the input with currents as indicated in table 3.5, or circuit breakers dimensioned for 1.2 x rated inverter input current for the CT or the VT operation (refer to items 9.1.2 to 9.1.5).

However in this case, only the installation will be protected against short-circuit, but not the diodes of the rectifier bridge at the inverter input. This option may damage the inverter in case of short-circuit of some internal component.

### 3.2.5 Power Connections

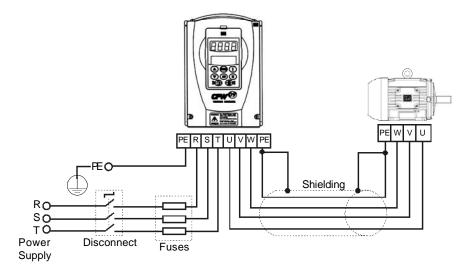


Figure 3.9 - Power/grounding connections

# 3.2.5.1 AC Input Connection



### DANGER!

Provide an AC input disconnecting switch to switch OFF input power to the inverter.

This device shall disconnect the inverter from the AC input supply when required (e.g. during maintenance services). However it cannot be used as an emergency stop device.



### ATTENTION!

The neutral conductor of the AC input for the inverter must be physically grounded, but do not use it for grounding purpose of the inverter(s).



### **ATTENTION!**

A contactor or another device that frequently disconnects and reapplies the AC supply to the inverter in order to start and stop the motor may cause damage to the inverter power section. The drive is designed to use control signals for starting and stopping the motor. If used, the input device must not exceed one operation every 6 minutes otherwise the inverter may be damaged.



### ATTENTION!

Set jumper to select the rated line voltage 380-480 V, for inverters 86 A or higher. Refer to item 3.2.3.



### NOTE!

The AC input voltage must be compatible with the inverter rated voltage.

### Supply line capacity:

- ☑ The CFW-09 is suitable for use in circuits capable of supplying not more than 30.000 A (rms) symmetrical (230 V/480 V/600 V/690 V).
- ☑ The CFW-09 can be installed on power supplies with a higher fault level provided that adequate protection is provided by the fuses or circuit breaker.

### DC Link Inductor/Line Reactor

Refer to item 8.7 relating to the requirement for using the Line Reactor / DC Link Inductor.



### NOTE!

Capacitors for power factor correction are not required at the input (R, S,T) and they MUST not be connected at the output (U, V, W).

### 3.2.5.2 Output Connections

The inverter is provided with electronic protection against motor overload. This protection must be set according the specific motor. When the same inverter drives several motors, use individual overload relays for each motor. Maintain the electrical continuity of the motor cable shield.



### ATTENTION!

If a disconnect switch or a contactor is inserted in the motor supply line, DO NOT operate the disconnect switch with the motor running or when inverter is enabled. Maintain the electrical continuity of the motor cable shield.

### Dynamic Braking (DB)

With the Dynamic Braking (DB) option, the DB resistor shall be mounted externally. Figure 8.22 shows how to connect the DB resistor. Size it according to the application, not exceeding the maximum current of the braking circuit.

Use twisted cable for the connection between inverter and DB resistor. Provide physical separation between this cable and the signal and control cables. When the DB resistor is mounted inside the panel, consider the watt loss generated when the enclosure size and ventilation required are calculated.

### 3.2.5.3 Grounding Connections



### DANGER!

Inverters must be grounded for safety purposes (PE). The earth or ground connection must comply with the local regulations. For grounding use cables with cross section as indicated in table 3.5. Make the ground connection to a grounding bar or to the general grounding point (resistance  $\leq$  10 ohms).



### DANGER!

Do not share the ground wiring with other equipment that operates with high current (for instance, high voltage motors, welding machines, etc.). If several inverters are used together, refer to figure 3.10.

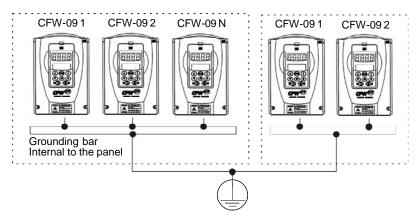


Figure 3.10 - Grounding connections for more than one inverter



### ATTENTION!

Do not use the neutral from the main power supply to ground the inverter.

### EMI

When electromagnetic interference (EMI), generated by the inverter, causes problems with other equipment, use shielded wires or install the motor wires in metallic conduits. Connect one end of the shielding to the inverter grounding point and the other end to the motor frame.

### **Motor frame**

Always ground the motor frame. Ground the motor in the panel where the inverter is installed or ground it to the inverter. The inverter output wiring must be laid separately from the input wiring, as well as from the control and signal cables.

### 3.2.5.4 IT Networks



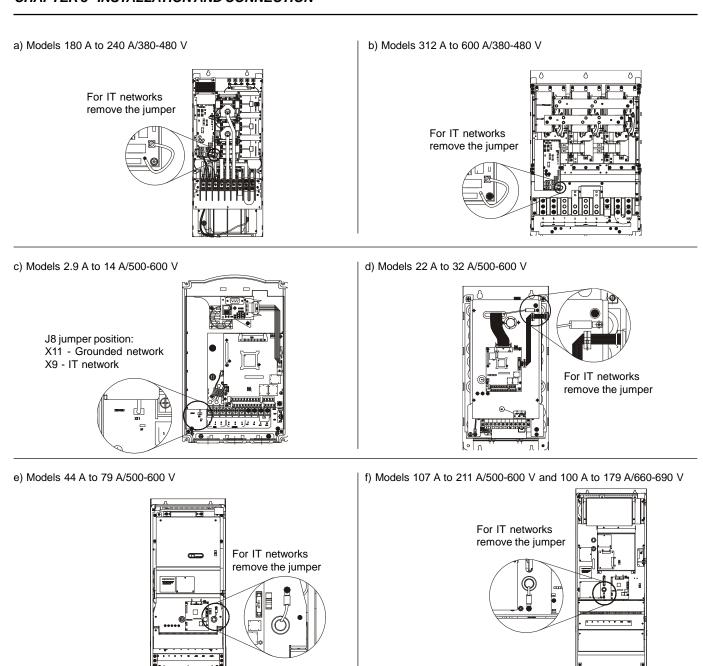
### **ATTENTION!**

For IT networks (also known as ungrounded or high earthing impedance networks) it is necessary to consider the following:

- ☑ Models 180 A to 600 A/380-480 V, 2.9 A to 79 A/500-600 V, 107 A to 472 A/500-690 V and 100 A to 428 A/660-690 V have a varistor and capacitor connected between input phase and ground that must be disconnected if an IT network is used for that, remove the jumper as shown in figure 3.11.
- ☑ In 500-600 V/500-690 V/660-690 V models, the jumper is accessible taking out (models 2.9 A to 14 A/500-600 V) or opening (models 22 A to 79 A/500-600 V, 107 A to 211 A/500-690 V and 100 A to 179 A/660-690 V) the front cover or taking out the connections cover (247 A to 472 A/500-600 V and 225 A to 428 A/660-690 V).
- ☑ In models 180 A to 600 A/380-480 V, besides opening or taking out the front cover(s), it is required to remove the control board mounting plate (shield).
- ☑ The external RFI filters that are necessary in order to fulfill the requirements
  of European EMC Directive as stated in item 3.3, cannot be used with IT
  networks.
- ☑ The user must check and assume the responsibility of personnel electrical shock risk when using inverters in IT networks.

About the use of a differential relay at the inverter input:

- The indication of phase-to-ground short-circuit must be processed by the user, in order to indicate only a fault message or to turn off the inverter.
- Check with the relay manufacturer its proper operation with frequency inverters, because of the existing high-frequency leakage currents flowing through the inverter, cable and motor parasitic capacitances to the earth.



g) Models 247 A to 472 A/500-600 V and 225 A to 428 A/660-690 V

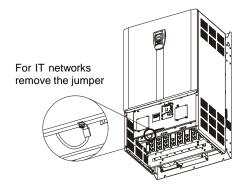


Figure 3.11 a) to g) - Location of jumper to disconnect the varistor and capacitor between input phase and ground - necessary only in models when IT network is used

### 3.2.6 Control Wiring

The control wiring (analog inputs/outputs, digital inputs/outputs and relay outputs) is made on the following terminal blocks of the Electronic Control Board CC9 (refer to location in figures 3.7, item 3.2.2).

### XC1: Digital and Analog Signals

### XC1A: Relay Outputs

The following diagram shows the control wiring with the digital inputs as active high as set on factory (jumper between XC1:8 and XC1:10).

	Terr	minal XC1	Factory Default Function	Specifications				
	1	DI1	Start / Stop	6 Isolated Digital Inputs				
	2	DI2	FWD / REV Section (Remote Mode)	Minimum High Level: 18 Vdc				
	3	DI3	No function	Maximum Low Level: 3 Vdc				
	4	DI4	No function	Maximum Voltage: 30 Vdc				
	5	DI5	JOG (Remote Mode)	Input Current:				
	6	DI6	Ramp 2 Selection	11 mA @ 24 Vdc				
	7	COM	Digital Inputs Common					
=	8	COM	Digital Inputs Common					
(*)	9	24 Vdc	Digital inputs 24 Vdc source	Isolated 24 Vdc ± 8 %, Capac: 90 mA				
	10	GND	0 V Reference of the 24 Vdc Source	Grounded by a 249 $\Omega$ resistor				
CW	11	+REF	Positive Reference for Potentiometer	+ 5.4 Vdc ± 5 %, Capacity: 2 mA				
≥5 k Ω	12	Al1+	Analog Input 1: Speed Reference (Remote Mode)	Valid for Al1 and Al2 differential, resolution: 10 bits, (0 to 10) Vdc or				
H	13	Al1-		(0 to 20) mA / (4 to 20) mA				
ccw	14	-REF	Negative Reference for Potentiometer	-4.7 Vdc ± 5 %, Capacity: 2 mA				
	15	Al2+	Analog Input 2: No Function	Valid for Al1 and Al2 Impedance: 400 kΩ [(0 to 10) Vdc]				
	16	AI2-		500 Ω [(0 to 20) mA / (4 to 20) mA]				
rpm	. 17	AO1	Analog Output 1: Speed	(0 to 10) Vdc, R <sub>L</sub> $\geq$ 10 kΩ (Max load.) resolution: 11bits				
	18	GND (AO1)	0 V Reference for Analog Outputs	Grounded by a 5.1 Ω resistor				
(A)	19	AO2	Analog Output: Motor Current	(0 to 10) Vdc, R <sub>L</sub> $\geq$ 10 k $\Omega$ (Max load.) resolution: 11 bits				
	20	GND (AO2)	0 V Reference for Analog Outputs	Grounded by a 5.1 Ω resistor				
	Tern	ninal XC1A	Factory Default Function	Specification				
<u></u>	21	RL1 NC	Relay Output - No Fault					
	22	RL1 NO						
	23	RL2 NO	Relay Output - Speed > P288 (N > Nx)	Contact capacity:				
	24	RL1 C	Relay Output - No Fault	1 A				
	25	RL2 C	Relay Output - Speed > P288 (N > Nx)	240 Vac				
	26	RL2 NC						
	27	RL3 NO	Relay Output - Speed Reference >					
	28	RL3 C	P288 (N* > Nx)					
	Note: NC = normally closed contact: NO = normally open contact: C = common							

Note: NC = normally closed contact, NO = normally open contact, C = common (\*) Factory default jumper

Figure 3.12 a) - XC1/XC1A control terminals description (CC9 board) - Active high digital inputs

Terminal XC1 Factory Default Function Specifications 1 DI1 Start / Stop 6 Isolated Digital Inputs 2 DI2 FWD / REV Section (Remote Mode) Minimum High Level: 18 Vdc 3 DI3 No function Maximum Low Level: 3 Vdc 4 DI4 No function Maximum Voltage: 30 Vdc 5 DI5 JOG (Remote Mode) Input Current: 6 DI6 11 mA @ 24 Vdc Ramp 2 Selection 7 COM Digital Inputs Common 8 COM Digital Inputs Common 9 24 Vdc Digital inputs 24 Vdc source Isolated 24 Vdc ± 8 %, Capac: 90 mA Grounded by a 249  $\Omega$  resistor 10 **GND** 0 V Reference of the 24 Vdc Source CW 11 + 5.4 Vdc ± 5 %, Capacity: 2 mA +REF Positive Reference for Potentiometer Valid for Al1 and Al2 12 AI1+ Analog Input 1: differential, resolution: (0 to 10) Vdc or Speed Reference (Remote Mode) 13 AI1-(0 to 20) mA / (4 to 20) mA 14 -REF Negative Reference for Potentiometer -4.7 Vdc ± 5 %, Capacity: 2 mA Valid for Al1 and Al2 Al2+ 15 Analog Input 2: Impedance:  $400 \text{ k}\Omega[(0 \text{ to } 10) \text{ Vdc}]$ No Function 16 AI2- $500\,\Omega$  [(0 to 20) mA / (4 to 20) mA] (0 to 10) Vdc,  $R_L \ge 10 \text{ k}\Omega$  (Max load.) Analog Output 1: Speed 17 AO1 resolution: 11 bits Grounded by a  $5.1 \Omega$  resistor 0 V Reference for Analog Outputs 18 GND (AO1) (0 to 10) Vdc,  $R_1 \ge 10 \text{ k}\Omega$  (Max. Load) AO2 19 Analog Output: Motor Current Resolution: 11 bits GND (AO2) 20 0 V Reference for Analog Outputs Grounded by a  $5.1 \Omega$  resistor Terminal XC1A Specification Factory Default Function **RL1 NC** 21 Relay Output - No Fault RL1 NO 22 RL2 NO Relay Output - Speed > P288 (N > Nx) 23 Contact capacity: 24 RL1 C Relay Output - No Fault 1 A RL2 C 25 240 Vac Relay Output - Speed > P288 (N > Nx) RL2 NC 26

The following diagram shows the control wiring with the digital inputs as active low (without a jumper between XC1:8 and XC1:10).

Note: NC = normally closed contact, NO = normally open contact, C = common

Relay Output - Speed Reference > P288

Figure 3.12 b) - XC1/XC1A control terminals description (CC9 board) - active low digital inputs



27

28

RL3 NO

RL3 C

### NOTE!

 $(N^* > Nx)$ 

For using the digital inputs as active low it is necessary to remove the jumper between XC1:8 and XC1:10 and place it between XC1:7 and XC1:9.

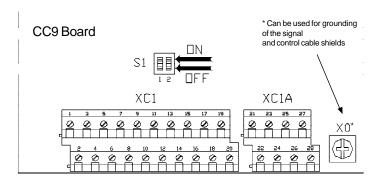


Figure 3.13 - Dip switch position for (0 to 10) V or (0 to 20) mA/(4 to 20) mA selection

As a default the analogue inputs are selected as (0 to 10) V. This can be changed using the dip switch S1 on the control board.

Analog Input	Factory Default Function	Dip Switch	Selection
Al1	Speed Reference	\$1.2	<b>OFF</b> (0 to 10) V (Factory Default) <b>ON</b> (4 to 20) mA / (0 to 20) mA
Al2	No Function	S1.1	<b>OFF</b> (0 to 10) V (Factory Default) <b>ON</b> (4 to 20) mA / (0 to 20) mA

Table 3.7 - Dip switch configuration

Related Parameters: P221, P222, P234 to P240.

# During the signal and control wire installation you must follow these guidelines:

- 1) Cable Cross Section: 0.5 mm<sup>2</sup> (20 AWG) to 1.5 mm<sup>2</sup> (14 AWG);
- 2) Max. Torque: 0.50 N.m (4.50 lbf.in);
- 3) XC1 wiring must be connected with shielded cables and installed separately from other wiring (power, control at 110 V/220 Vac, etc.), according to table 3.8.

Inverter Model	Wiring Length	Min. Separation Distance
Output current	≤ 100 m (330 ft)	≥ 10 cm (4 in)
≤ 24 A	> 100 m (330 ft)	≥ 25 cm (10 in)
Output current	≤ 30 m (100 ft)	≥ 10 cm (4 in)
≥ 28 A	> 30 m (100 ft)	≥ 25 cm (10 in)

Table 3.8 - Wiring separation distances

If the crossing of these cables is unavoidable, install them perpendicular, maintaining a minimum separation distance of 5 cm (2 in) at the crossing point.

# Insulate with Tape Inverter Side Do Not Ground

### Connect the shield as shown in figure 3.14.

Connect to Ground:

Screw located on the CC9 Board and on support plate of the CC9 Board

Figure 3.14 - Shield connection

- 4) For wiring distances longer than 50 m (150 ft), it is necessary to use galvanic isolators for the XC1:11 to XC1:20 analog signals.
- 5) Relays, contactors, solenoids or electromagnetic braking coils installed near inverters can generate interference in the control circuit. In order to eliminate this interference, connect RC suppressors in parallel with the coils of AC relays. Connect a free - wheeling diode in case of DC relays/ coils.
- 6) When an external keypad (HMI) is used (Refer to chapter 8), separate the cable that connects the keypad to the inverter from other cables, maintaining a minimum distance of 10 cm (4 in) between them.

# 3.2.7 Typical Terminal Connections

### Connection 1 – Keypad Start/Stop (Local Mode)

With the **factory default setting**, you can operate the inverter in the local mode. This operation mode is recommended for users who are operating the inverter for the first time; without additional control connections. For start-up according to this operation mode, follow chapter 5.

### <u>Connection 2</u> - 2-Wire Control Start/Stop (Remote Mode)

Valid for **factory default setting** and inverter operating in **remote mode**. For the factory default programming, the selection of the operation mode (Local/Remote) is made via the key (default is Local). Pass default of the key to remote P220 = 3.

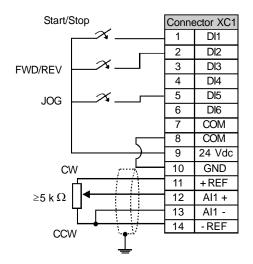


Figure 3.15 - XC1 (CC9) wiring for connection 2

### Connection 3 - 3-Wire Control Start/Stop

Selection of function Start/Stop with 3 wire control.

Parameters to be programmed:

Set DI3 to START

P265 = 14

Set DI4 to STOP

P266 = 14

Program P224 = 1 (DIx) if you want the 3 wire control in local mode.

Program P227 = 1 (DIx) if you want the 3 wire control in remote mode.

To program the rotation selection via DI2

Set P223 = 4 if in Local Mode or

Set P226 = 4 if in Remote Mode.

S1 and S2 are momentary push buttons, NO contact for Start and NC contact for Stop.

The speed reference can be via Analog Input AI (as in Connection 2), via keypad (HMI) (as in Connection 1), or via any other source. The function Start/Stop is described in chapter 6 in this manual.

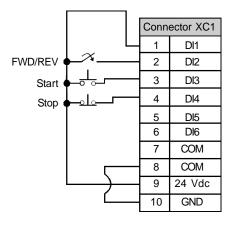


Figure 3.16 - XC1 (CC9) wiring for connection 3

### Connection 4 - FWD Run / REV Run

Selection function FWD/REV.

Parameters to be programmed:

Set DI3 to FORWARD Run

P265 = 8

Set DI4 to REVERSE Run

P266 = 8

When the FWD Run / REV Run Function is programmed, the function is always active, in both local and remote operation modes.

At the same time, the keys  $\bigcirc$  and  $\bigcirc$  remain inactive (even when **P224** = 0 or **P227** = 0)

The direction of rotation is defined automatically by the FWD Run / REV Run commands.

Clockwise rotation for Forward and Counter Clockwise rotation for Reverse. The speed reference can be from any source (as in Connection 3).

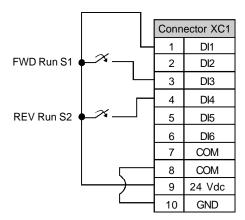


Figure 3.17 - XC1 (CC9) wiring for connection 4

# 3.3 European EMC Directive Requirements for Conforming Installations

The CFW-09 inverter series was designed taking in consideration safety and EMC aspects. The CFW-09 units do not have an intrinsic function until connected with other components (e.g. a motor). Therefore, the basic product is not CE marked for compliance with the EMC Directive. The end user takes personal responsibility for the EMC compliance of the whole installation. However, when installed according to the recommendations described in the product manual and including the recommended filters/EMC measures the CFW-09 fulfill all requirements of the EMC Directive (89/336/EEC) as defined by the Product Standard EN61800-3 "Adjustable speed electrical power drives systems", specific for variable speed drives systems.

Compliance of the whole series of the CFW-09 is based on testing some representative models. A Technical Construction File was checked and approved by a Competent Body.

The CFW-09 inverter series are intended for professional applications only. Therefore, the harmonic current emissions defined by the standards EN 61000-3-2 and EN 61000-3-2/A 14 do not apply.



### NOTE!

- ☑ The 500-600 V models are intended to be connected to an industrial low voltage power supply network, or public network which does not supply buildings used for domestic purpose second environment according to the EN61800-3 standard.
- ☑ The filters specified in items 3.3.2 and 3.3.3 do not apply to the 500-600 V models.

For installing the frequency inverters in accordance to the Product Standard EN61800-3 the following items are required:

- 1. Output cables (motor wiring) must be flexible armored or to be installed inside a metallic conduit or in a tray with equivalent attenuation.
- 2. The control (inputs and outputs) and signal wiring must be shielded or installed inside a metallic conduit or a tray with equivalent attenuation.
- 3. It is essential to follow the grounding recommendations presented in this manual.
- 4. For first environment (low-voltage public network): install an RFI filter (radio-frequency interference filter) at inverter input.
- 5. For second environment (industrial areas) and unrestricted distribution (EN61800-3): install an RFI filter at inverter input.



### NOTE!

The use of a filter requires:

- ☑ The cable's shielding must be solidly connected to the common backplane, using brackets.
- ☑ The inverter and the filter must be mounted in close proximity, electrically connected, to one another, on the same metallic backplane. The wiring between them should be kept as short as possible.

Two filters are suggested: Epcos and Schaffner, detailed on the following items 3.3.2 and 3.3.3. Figures 3.18 and 3.19 present a connection diagram for EMC filters, Epcos and Schaffner respectively.

### 3.3.1 Installation

## Description of conducted emission classes according to the standard EN61800-3:

- ☑ Class B: first environment, unrestricted distribution
- ☑ Class A1: first environment, restricted distribution
- ☑ Class A2: second environment, unrestricted distribution



### **ATTENTION!**

For installation with inverters that complies class A1 (first environment restricted distribution), note that this is a product of the restricted sales distribution class according to IEC/EN61800-3 (1996) + A11 (2000). In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.



### ATTENTION!

For installation with inverters that complies class A2 (second environment unrestricted distribution), note that this product is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if used on such a network.

### 3.3.2 Epcos Filters

The following tables 3.9, 3.10 and 3.11 show the Epcos filters for CFW-09 frequency inverters with 380-480 V, 500-600 V and 660-690 V power supply respectively, the maximum motor cable length for conducted emission classes A1, A2 and B (according to EN61800-3) and the electromagnetic radiation disturbance level.

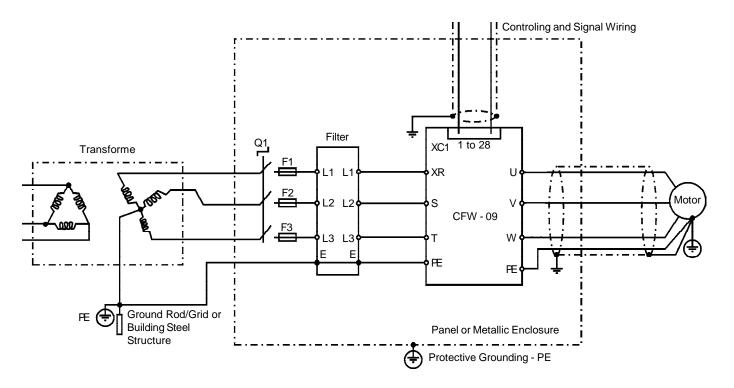


Figure 3.18 - Epcos EMC filters connection in CFW-09 frequency inverters

### 380-480 V power supply:

Inverter Model	Load Type	according t		m motor cab to conducte ss (EN61800	d emission	Inside metallic panel	Electromagnetic radiation disturbance level (Product Standard EN61800-3		
			Class A2	Class A1	Class B		(1996)+A11 (2000))		
3.6 A <sup>(2)</sup>	CT/VT						First environment, restricted distribution		
4 A <sup>(2)</sup>	CT/VT	B84143A8R105					Second environment,		
5.5 A <sup>(2)</sup>	CT/VT		100 m	50 m	20 m		unrestricted distribution Second environment,		
-	CI/VI						unrestricted distribution		
9 A <sup>(2)</sup>	CT/VT	B84143A16R105							Second environment, unrestricted distribution
13 A	CT/VT	D04143A10K103					First environment, restricted distribution		
16 A	CT/VT	B84143A25R105	N/A	100 m	35 m	NO	First environment, restricted distribution		
24 A	CT/VT	D04442A2CD405					First environment, restricted distribution		
30 A	СТ	B84143A36R105	85 m				First environment, restricted		
	VT	B84143A50R105					distribution		
38 A <sup>(3)</sup>	CT VT	201110/10011100		50 m				First environment, restricted distribution	
45 4 (3)	CT	B84143A66R105	100 m			First environment, restricted			
45 A <sup>(3)</sup>	VT						distribution		
60 A	СТ						Second environment, unrestricted distribution		
	VT	B84143A90R105							
70 A	CT VT						Second environment, unrestricted distribution		
	CT	B84143A120R105					First environment, restricted		
86 A	VT		100 m	100 m 25 m			distribution		
105 A	СТ	B84143G150R110					First environment, restricted		
	VT				N/A		distribution		
142 A <sup>(3)</sup>	СТ						First environment, restricted distribution		
	VT	B84143G220R110					First environment, restricted		
180 A	CT/VT					YES	distribution		
211 A	CT/VT		N/A	100 m			First environment, restricted distribution		
240 A	CT/VT	D04442D200C00					First environment, restricted distribution		
312 A <sup>(3)</sup>	CT/VT	B84143B320S20					First environment, restricted distribution		
361 A <sup>(3)</sup>	CT/VT	B84143B400S20					First environment, restricted distribution		
450 A	CT/VT	Da (Da Da D	100 m	25 m			First environment, restricted distribution		
515 A	CT/VT	B84143B600S20					First environment, restricted distribution		
600 A	CT/VT	B84143B1000S20 (1)					First environment, restricted distribution		

N/A = Not Applicable - The inverters were not tested with these limits.

### Notes:

Table 3.9 - Epcos filters list for CFW-09 inverter series with 380-480 V power supply

<sup>(1)</sup> The RFI filter suggested above for model 600 A/380-480 V considers a power supply with 2 % voltage drop. For a power supply with 4 % voltage drop it's possible to use B84143B600S20 RFI filter. In this case, consider the same motor cable lengths and radiated emission data as shown in table above.

<sup>(2)</sup> Minimum output frequency = 2.9 Hz.

<sup>(3)</sup> Minimum output frequency = 2.4 Hz.

### 500-600 V power supply:

Inverter Model	Load Type	Epcos Input Filter	accord	n motor cal ding to con class (EN Class A1	ducted	Inside metallic panel	Electromagnetic radiation disturbance level (Product Standard EN61800-3 (1996)+A11 (2000))
107 A/500-690 V	CT VT	B84143B150S21					First environment, restricted distribution
147 A/500-690 V	CT VT						First environment, restricted distribution
211 A/500-690 V	CT/VT	B84143B250S21		25 m		YES	First environment, restricted distribution
247 A/500-690 V	CT VT						Second environment, unrestricted distribution
315 A/500-690 V	CT VT	B84143B400S125	100 m		N/A		Second environment, unrestricted distribution
343 A/500-690 V	CT VT						Second environment, unrestricted distribution
418 A/500-690 V	CT VT						Second environment, unrestricted distribution
472 A/500-690 V	CT VT	B84143B600S125					Second environment, unrestricted distribution

N/A = Not Applicable - The inverters were not tested with these limits.

**Note:** Minimum output frequency = 2.4 Hz.

Table 3.10 - Epcos filters list for CFW-09 inverter series with 500-600 V power supply

### 660-690 V power supply:

Inverter Model	Load Epcos Input Filter		Maximum motor cable length according to conducted emission class (EN61800-3)			Inside metallic panel	Electromagnetic radiation disturbance level (Product Standard EN61800-3 (1996)+A11	
			Class A2	Class A1	Class B		(2000))	
100 A/660-690 V and	СТ		100 m	25 m	N/A		First environment, restricted distribution	
107 A/500-690 V	VT	B84143B150S21						
127 A/660-690 V and 147 A/500-690 V	СТ						First environment, restricted distribution	
	VT	B84143B180S21						
179 A/660-690 V and 211 A/500-690 V	CT/VT						First environment, restricted distribution	
225 A/660-690 V and	СТ	B84143B400S125					Second environment, unrestricted distribution	
247 A/500-690 V	VT					YES	unrestricted distribution	
259 A/660-690 V and	СТ						Second environment,	
315 A/500-690 V	VT						unrestricted distribution	
305 A/660-690 V and 343 A/500-690 V 340 A/660-690 V and 418 A/500-690 V	СТ						Second environment,	
	VT						unrestricted distribution	
	СТ						Second environment, unrestricted distribution	
	VT	B						
428 A/660-690 V and 472 A/500-690 V	CT/VT	B84143B600S125					Second environment, unrestricted distribution	

N/A = Not Applicable - The inverters were not tested with these limits.

**Note:** Minimum output frequency = 2.4 Hz.

Table 3.11 - Epcos filters list for CFW-09 inverter series with 660-690 V power supply

### 3.3.3 Schaffner Filters

The following tables 3.12 and 3.13 show the Schaffner filters list for CFW-09 inverter series with 380-480 V and 220-230 V power supply, respectively.

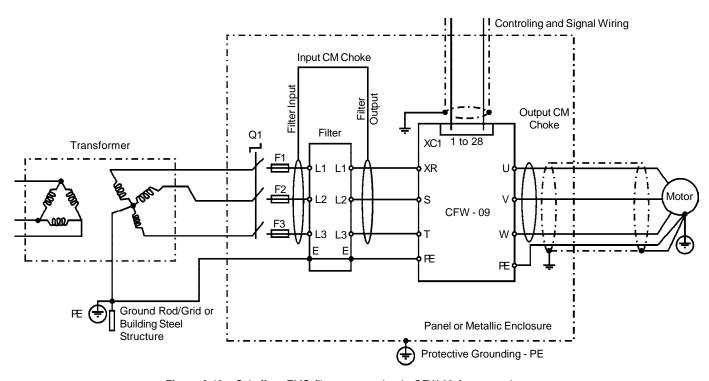


Figure 3.19 - Schaffner EMC filters connection in CFW-09 frequency inverters

### 380-480 V power supply:

Model	Optional Device	Input filter	Input CM Choke	Output CM Choke	Inside Metallic Panel	Electromagnetic radiation disturbance level (Product Standard EN61800-3 (1996) + A11 (2000) (1)	Conducted Emission Class (2)
3.6 A	RS-232	FN-3258-7-45	No	No	No	First environment, restricted distribution	В
4 A, 5 A	EBA RS-485 Serial Interface	FN-3258-7-45	No	No	No	Second environment, unrestricted distribution	В
9 A	EBA RS-485 Serial Interface	FN-3258-16-45	No	No	No	Second environment, unrestricted distribution	В
13 A	No	FN-3258-16-45	No	No	No	First environment, restricted distribution	В
16 A 24 A	No	FN-3258-30-47	No	No	No	First environment, restricted distribution	В
30 A	EBB RS-485 Serial Interface	FN-3258-55-52	Schaffner 203 (1151- 042) - 2 turns (filter input side)	No	Yes	First environment, restricted distribution	A1
30 A 38 A	No	FN-3258-55-52	No	No	No	First environment, restricted distribution	A1
45 A	No	FN-3258-100-35	2 x Schaffner 203 (1151-042) - (filter input/output sides)	No	No	First environment, restricted distribution	A 1

Table 3.12 - Schaffner filters list for CFW-09 inverter series with 380-480 V power supply

### 380-480 V power supply:

Model	Optional Device	Input filter	Input CM Choke	Output CM Choke	Inside Metallic Panel	Electromagnetic radiation disturbance level (Product Standard EN61800-3 (1996) + A11 (2000) (1)	Conducted Emission Class (2)
45 A	EBA RS-485 Serial Interface	FN-3258-100-35	2 x Schaffner 203 (1151-042) - (filter input/ output sides)	No	No	First environment, restricted distribution	A1
45 A	EBB RS-485 Serial Interface	FN-3258-100-35	2 x Schaffner 203 (1151-042) - (filter input/output sides) Schaffner 203 (1151- 042) 2 turns in the control cable	No	No	First environment, restricted distribution	A1
45 A	Profibus DP 12 MBaud	FN-3258-100-35	2 x Schaffner 203 (1151-042) - (filter input/output sides)	No	No	First environment, restricted distribution	A1
60 A 70 A	No	FN-3258-100-35	No	No	Yes	Second environment, unrestricted distribution	A1
86 A 105 A	No	FN-3359-150-28	2 X Schaffner 203 (1151-042) Output filter side	2 X Schaffner 203 (1151-042) (UVW)	Yes	First environment, restricted distribution	A1
142 A	No	FN-3359-250-28	2 X Schaffner 167 (1151-043) output filter side	2 X Schaffner 167 (1151-043) (UVW)	Yes	First environment, restricted distribution	A1
180 A	No	FN-3359-250-28	Schaffner 159 (1151-044) output filter side	Schaffner 159 (1151-044) (UVW)	Yes	First environment, restricted distribution	A1
211 A 240 A 312 A 361 A	No	FN-3359-400-99	Schaffner 159 (1151-044) Output filter side	Schaffner 159 (1151-044) (UVW)	Yes	First environment, restricted distribution	A1
450 A	No	FN-3359-600-99	Schaffner 159 (1151-044) Output filter side	Schaffner 159 (1151-044) (UVW)	Yes	First environment, restricted distribution	A1
515 A 600 A	No	FN-3359-1000-99	Schaffner 159 (1151-044) Output filter side	Schaffner 159 (1151-044) (UVW)	Yes	First environment, restricted distribution	A1

### Notes:

(1) - First environment/restricted distribution (Basic Standard CISPR 11):

30 to 230 MHz: 30 dB (uV/m) in 30 m 230 to 1000 MHz: 37 dB (uV/m) in 30 m  $\,$ 

Second environment/unrestricted distribution (Basic Standard CISPR 11: Group 2, class A):

30 to 230 MHz: 40 dB (uV/m) in 30 m 230 to 1000 MHz: 50 dB (uV/m) in 30 m  $\,$ 

(2) - Motor shielded cable length: 20 m.

### 220-230 V power supply:

	Optional	Optional   Input   Commonmoder emite		disturbance level	Conducted		
Model	Device	filter	(Input)	mode Ferrite		(Product Standard EN61800-	Emission
				(Output)	Panel	3 (1996) + A11 (2000)) <sup>(1)</sup>	Class (2)
6 A	No	FN-3258-7-45	No	No	No	First environment, restricted	В
						distribution	
7 A	No	FN-3258-16-45	No	No	No	First environment, restricted	В
10 A						distribution	
13 A							
16 A	No	FN-3258-30-47	No	No	No	First environment, restricted	В
24 A						distribution	
28 A	No	FN-3258-55-52	No	No	Yes	First environment, restricted distribution	A1
45 A	No	FN-3258-100-35	2 x Schaffner 203	No	No	First environment, restricted	A1
			(1151-042) - (filter			distribution	
45 A	EBA	FN-3258-100-35	input/output sides)				
	RS-485		2 x Schaffner 203	No	No	First environment, restricted	A1
	Serial Interface		(1151-042) - (filter			distribution	
			input/output sides)				
45 A	EBB	FN-3258-100-35	2 x Schaffner 203	No	No	First environment, restricted	A1
	RS-485		(1151-042) - (filter input/output sides)			distribution	
	Serial Interface		Schaffner 203 (1151-				
			042)choke- 2 turns				
			in the control cable				
45 A	Profibus DP	FN-3258-100-35	2 x Schaffner 203	No	No	First environment, restricted	A1
	12 MBaud		(1151-042) -			distribution	
			(filter input/output sides)				
54 A	No	FN-3258-100-35	No No	No	Yes	Second environment,	A1
70 A	140	111 0200 100 00	110		100	unrestricted distribution	,,,
86 A	No	FN-3258-130-35	2 X Schaffner 203	2 X	Yes	First environment, restricted	A1
0071			(1151-042)	Schaffner		distribution	
			Filter output side	203			
				(1151-042)			
				(UVW)			
105 A	No	FN-3359-150-28	2 X Schaffner 203	2 X	Yes	First environment, restricted	A1
			(1151-042)	Schaffner		distribution	
			Filter output side	203			
				(1151-042)			
		EN 0050 250 55	0 / 0 / " / (5=	(UVW)	.,		
130 A	No	FN-3359-250-28	2 X Schaffner 167	2 X	Yes	First environment, restricted	A1
			(1151-043)	Schaffner		distribution	
			Filter output side	167			
				(1151-043)			
				(UVW)			

### Notes:

(1) - First environment/restricted distribution (Basic Standard CISPR 11):

30 to 230 MHz: 30 dB (uV/m) in 30 m 230 to 1000 MHz: 37 dB (uV/m) in 30 m  $\,$ 

Second environment/unrestricted distribution (Basic Standard CISPR 11: Group 2, class A):

30 to 230 MHz: 40 dB (uV/m) in 30 m 230 to 1000 MHz: 50 dB (uV/m) in 30 m  $\,$ 

(2) - Motor shielded cable length: 20 m.

Table 3.13 - Schaffner filters list for CFW-09 inverter series with 220-230 V power supply

#### 3.3.4 EMC Filter Characteristics

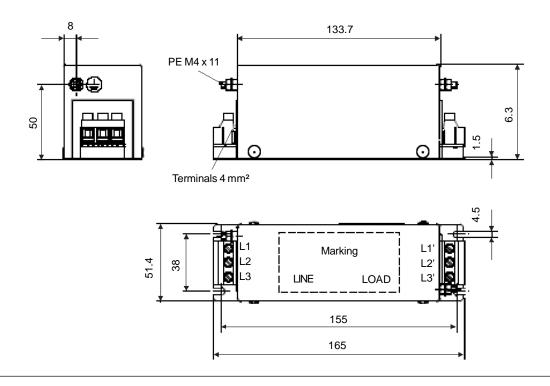
Table 3.14 shows the main technical characteristics of Epcos and Shaffner filters used in CFW-09 inverter series. Figure 3.20 presents drawings of these filters.

WEG P/N	Filter	Manufacturer	Nominal current [A]	Power losses [W]	Weight [kg]	Drawing (figure 3.20)	Connector type
0208.2126	B84143A8R105		8	6	0.58	а	
0208.2127	B84143A16R105		16	9	0.90	b	
0208.2128	B84143A25R105		25	12	1.10	С	
0208.2129	B84143A36R105		36	18	1.75	d	
0208.2130	B84143A50R105		50	15	1.75	u	
0208.2131	B84143A66R105		66	20	2.7	е	
0208.2132	B84143A90R105		90	27	4.2	f	
0208.2133	B84143A120R105		120	39	4.9	g	
0208.2134	B84143G150R110		150	48	8.0	h	
0208.2135	B84143G220R110	Epcos	220	60	11.5	i	-
0208.2136	B84143B320S20		320 (*)	21	21	:	
0208.2137	B84143B400S20	1	400	33	21	J	
0208.2138	B84143B600S20		600	57	22	k	
0208.2139	B84143B1000S20		1000	99	28		
0208.2140	B84143B150S21		150	12	13		
0208.2141	B84143B180S21		180	14	13	m	
0208.2142	B84143B250S21		250	14	15	n	
0208.2143	B84143B400S125		400	33	21	0	
0208.2144	B84143B600S125		600	57	22	р	
0208.2075	FN3258-7-45		7	3.8	0.5		/45
0208.2076	FN3258-16-45		16	6	0.8		/45
0208.2077	FN3258-30-47		30	12	1.2	s	/47
0208.2078	FN3258-55-52		55	26	1.8	5	/52
0208.2079	FN3258-100-35		100	35	4.3		/35
0208.2080	FN3258-130-35		130	43	4.5		/35
0208.2081	FN3359-150-28	Schaffner	150	28	6.5		/28
0208.2082	FN3359-250-28	Jochanner	250	57	7.0		/28
0208.2083	FN3359-400-99		400	50	10.5	t	
0208.2084	FN3359-600-99		600	65	11		Bus /99
0208.2085	FN3359-1000-99		1000	91	18		
0208.2086	1151-042						
0208.2087	1151-043		-	-	-	-	-
0208.2088	1151-044						

<sup>(\*)</sup> According to the manufacturer, this filter can be used up to 331 A.

Table 3.14 - Technical specifications of EMC filters for the CFW-09 inverter series

#### a) EPCOS B84143A8R105 Filter



#### b) EPCOS B84143A16R105 Filter

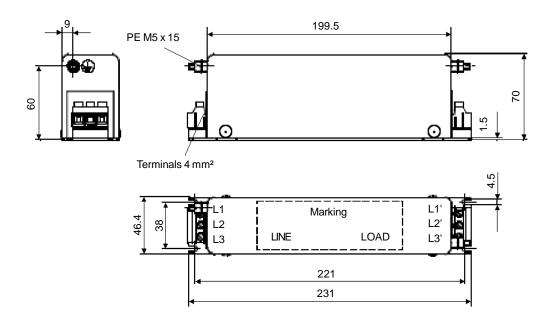
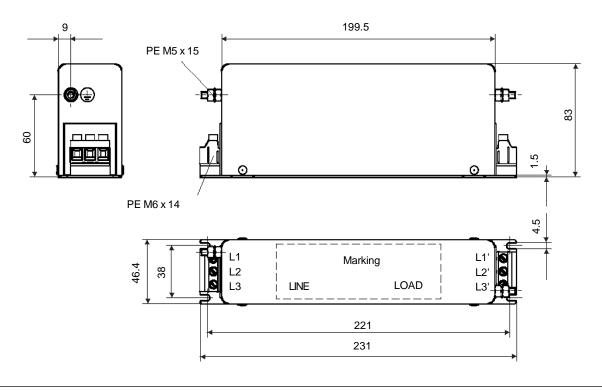


Figure 3.20 a) and b) - EMC filters for CFW-09 inverter series [dimensions in mm]

#### c) EPCOS B84143A25R105 Filter



#### d) EPCOS B84143A36R105 and B84143A50R105 Filter

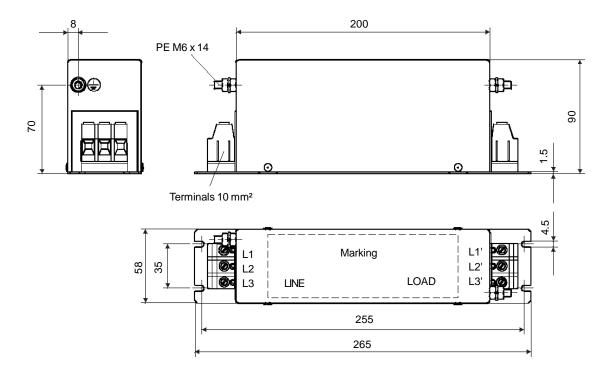
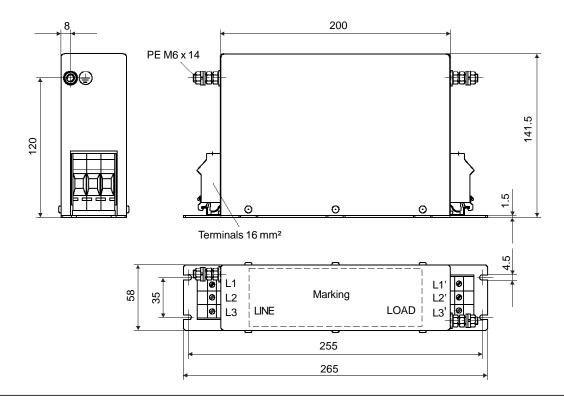


Figure 3.20 c) and d) - EMC filters for CFW-09 inverter series [dimensions in mm]

#### e) EPCOS B84143A66R105 Filter



#### f) EPCOS B84143A90R105 Filter

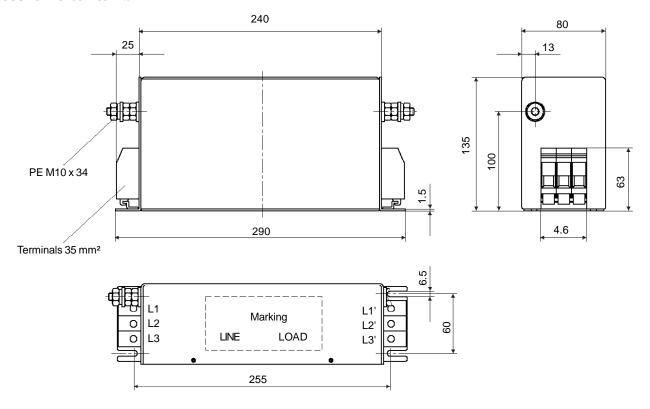
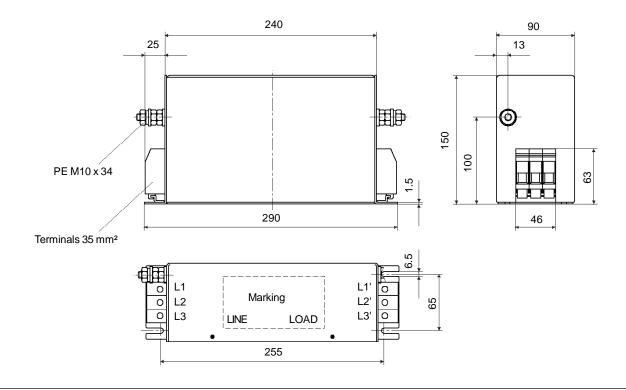


Figure 3.20 e) and f) - EMC filters for CFW-09 inverter series [dimensions in mm]

#### g) EPCOS B84143A120R105 Filter



#### h) EPCOS B84143G150R110 Filter

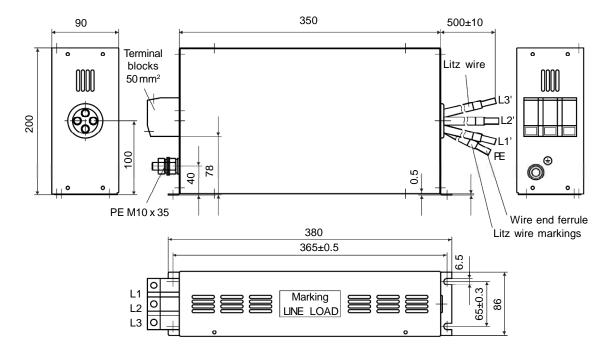
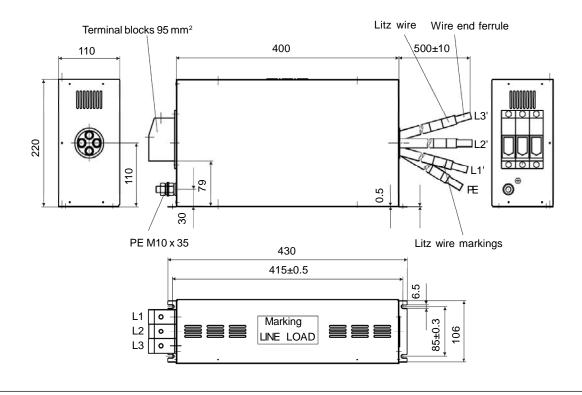


Figure 3.20 g) and h) - EMC filters for CFW-09 inverter series [dimensions in mm]

#### i) EPCOS B84143G220R110 Filter



#### j) EPCOS B84143B320S20 and B84143B400S20 Filters

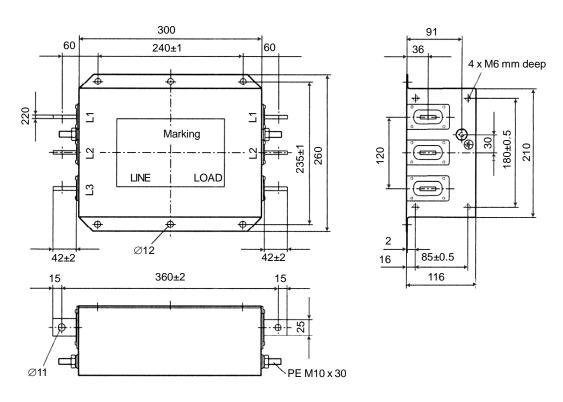
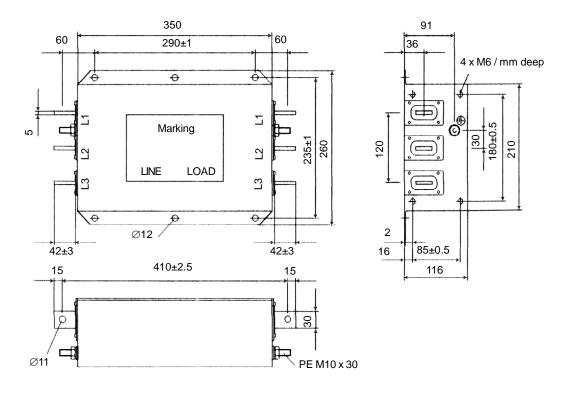


Figure 3.20 i) and j) - EMC filters for CFW-09 inverter series [dimensions in mm]

#### k) EPCOS B84143B600S20 Filter



#### I) EPCOS B84143B1000S20 Filter

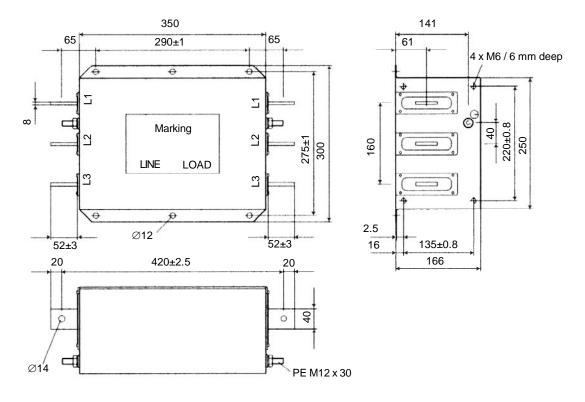
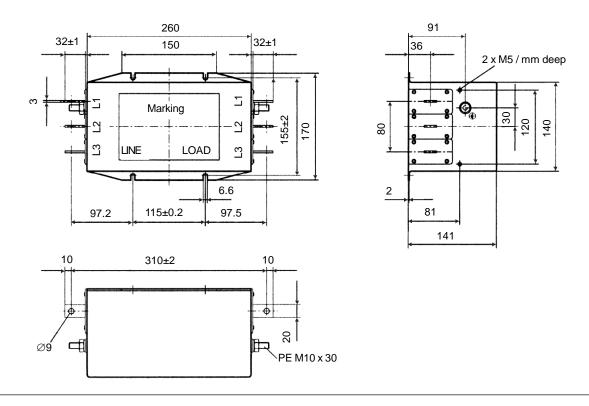


Figure 3.20 k) and I) - EMC filters for CFW-09 inverter series [dimensions in mm]

#### m) EPCOS B84143B150S21 and B84143B180S21 Filters



#### n) EPCOS B84143B250S21 Filter

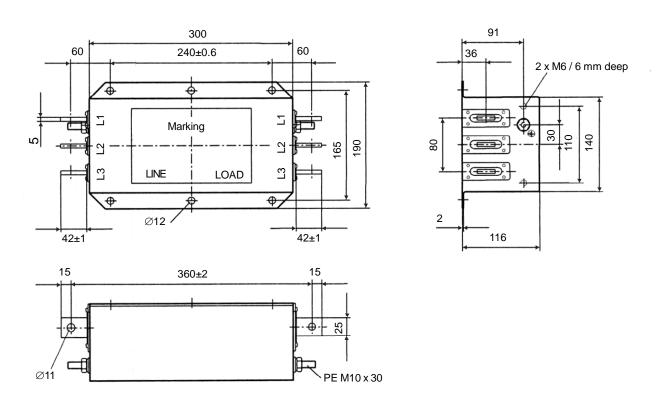
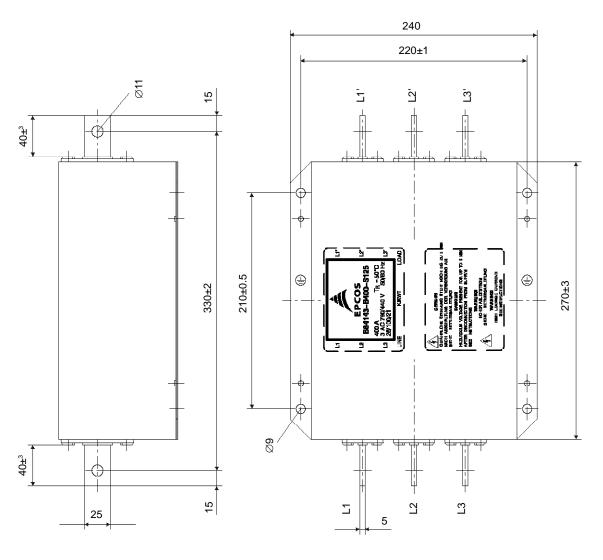


Figure 3.20 m) and n) - EMC filters for CFW-09 inverter series [dimensions in mm]

#### o) EPCOS B84143B400S125 Filter



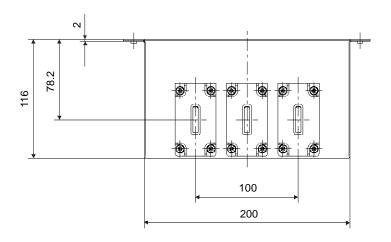


Figure 3.20 o) - EMC filters for CFW-09 inverter series [dimensions in mm]

#### p) EPCOS B84143B600S125 Filter

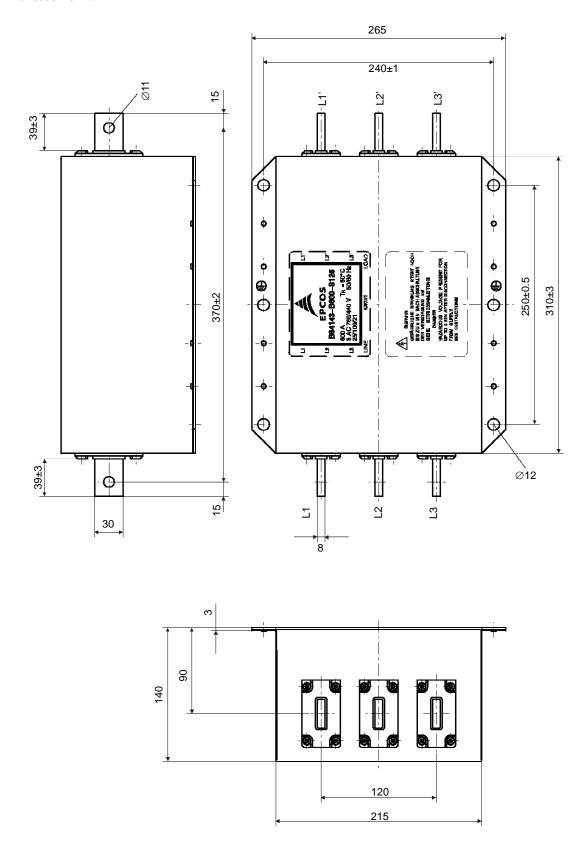


Figure 3.20 p) - EMC filters for CFW-09 inverter series [dimensions in mm]

MECHANICAL DATA SIDE VIEW

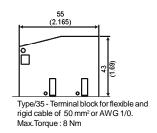
Top

q) Schaffner FN3258-7-45, FN3258-16-45, FN3258-30-47, FN3258-55-52, FN3258-100-35 and FN3258-130-35 filters

0

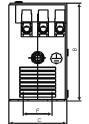
LOAD

	Rated Current					
	7.A	16A	30 A	55 A	100 A	130A
A	190	250	270	250	270	270
B	70:	£0.6	85	90	150	)±1
C	40	45	50	85	90:	±0.8
D	160	220	240	220	2	40
E	180	235	255	235	2	:55
E	20	25	30	60	6	5
G	4.5	5.4	5.4	5.4	6	5.5
H	,				1,5:	±0,2
	M5			M6	M	10
Connector	/45		/47	/52	/35	/35

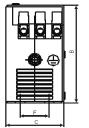


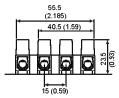


Type/45 - Terminal block for 6 mm<sup>2</sup> solid cable, 4 mm² flexible cable AWG 12.

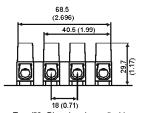


FRONT VIEW





Type/47 - Terminal block for 16 mm² solid wires,10 mm² flexible wires AWG8.



Type/52 - Dimesions in mm (inch) Terminal block for 25 mm<sup>2</sup> solid wires,16 mm² flexible wires AWG 6.

Figure 3.20 q) - EMC filters for CFW-09 inverter series [dimensions in mm (in)]

r) Schaffner FN3359-150-28, FN3359-250-28, FN3359-400-99, FN3359-600-99 and FN3359-1000-99 filters

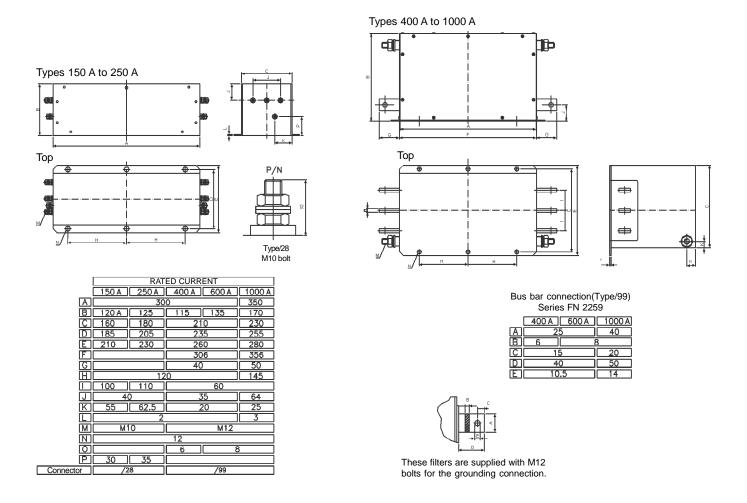


Figure 3.20 r) - EMC filters for CFW-09 inverter series [dimensions in mm]



#### NOTE!

The declaration of conformity CE is available on the website www.weg.net or on the CD, which comes with the products.

### KEYPAD (HMI) OPERATION

This chapter describes the CFW-09 operation via the standard Keypad or Human-Machine Interface (HMI), providing the following information:

- ☑ General Keypad Description;
- ☑ Use of the Keypad;
- ☑ Parameter Programming;
- Description of the Status Indicators.

## 4.1 DESCRIPTION OF THE KEYPAD

The standard CFW-09 Keypad has two readout displays: a LED readout with a 4 digit, seven-segment display and a LCD display with two lines of 16 alphanumeric characters. There are also 4 indicator LEDs and 8 keys. Figure 4.1 shows the front view of the Keypad and indicates the position of the readouts, keys and status LEDs.

#### **Functions of the LED Display:**

The LED Display shows the fault codes, inverter status, the parameter number and its value. For units of current, voltage or frequency, the LED display shows the unit in the right side digit (L.S.D.) as shown here.

- $\triangle$  A  $\rightarrow$  current (A)

- $\square$  Blank  $\rightarrow$  speed and other parameters



#### NOTE!

When the indication is higher than 9999 (for instance in rpm) the number corresponding to the ten of thousand will not be displayed (ex.: 12345 rpm will be read as 2345 rpm). The correct indication will be displayed only on the LCD display.

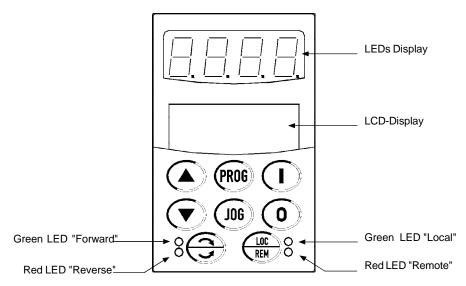


Figure 4.1 - CFW-09 standard keypad

#### Functions of the LCD Display:

The LCD Display shows the parameter number and its value simultaneously, without requiring the toggling of the **PROG** key. It also provides a brief description of each parameter function, fault code and inverter status.

#### **LOCAL and REMOTE LEDs:**

Inverter in Local Mode: Green LED ON and Red LED OFF.

Inverter in Remote Mode:

Green LED OFF and Red LED ON.

#### **Direction of Rotation (FWD/REV) LEDs:**

Refer to figure 4.2 below.

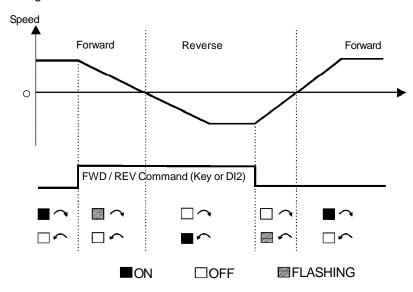
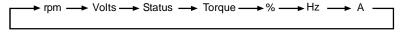


Figure 4.2 - Direction of rotation (FWD / REV) LEDs

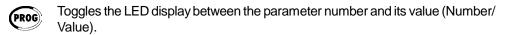
#### **Basic Functions of the Keys:**

The functions described below are valid for factory default programming and Local Mode operation. The actual function of the keys may vary if parameters P220 through P228 are re-programmed.

Starts the inverter via acceleration ramp. After starting, the display sequences through these units at each touch of the Start key in the order shown here (refer to item 4.2.2 a):



Stops (disables) the inverter via deceleration ramp. Also resets the inverter after a fault has occurred.



Increases the speed, the parameter number or the parameter value.

Decreases the speed, the parameter number or the parameter value.

Reverses the direction of motor rotation between Forward/Reverse.

Toggles between the LOCAL and REMOTE modes of operation.

Performs the JOG function when pressed.

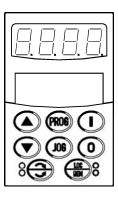
Any DIx programmed for General Enable must be closed (and the CFW-09 must be stopped) to enable JOG function.

#### 4.2 USE OF THE KEYPAD (HMI)

The keypad is used for programming and operating the CFW-09 allowing the following functions:

- ✓ Indication of the inverter status and operation variables;
- ☑ Fault Indication and Diagnostics;
- ☑ Viewing and programming parameters;
- Operation.

#### 4.2.1 Keypad Operation



All functions relating to the CFW-09 operation (Start, Stop, Motor Direction of Rotation, JOG, Increment/Decrement of the Speed Reference and Selection of Local Mode/Remote Mode) can be performed through the Keypad. This is valid with the factory default programming of the inverter. All keypad keys are enabled when the Local Mode has been selected. These same functions can be performed in Remote Mode by means of digital and analog inputs.

Flexibility is provided through the ability to program the parameters that define the input and output functions.

#### Keypad keys operation description:

Both and keys are enabled when P224 = 0 (I, O Key) for Local Mode and/or P227 = 0 (I, O Key) for Remote Mode.

- Starts inverter via Acceleration Ramp.
- Stops the inverter via Deceleration Ramp.



It resets the inverter after a Fault Trip (always active).

When the Jog key is pressed, it accelerates the motor according to the JOG Acceleration Ramp up to the JOG speed programmed in P122 (default is 150) rpm). When released, the motor decelerates according to the Deceleration Ramp and stops.

Enabled when P225 = 1 (Keypad) for Local Mode and/or P228 = 1 (Keypad) for Remote Mode.

If a Digital Input is set to General Enable (P263 to P270 = 2) it has to be closed to allow the JOG function.



Selects the control input and speed reference source, toggling between LO-CAL Mode and REMOTE Mode.

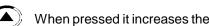
Enabled when P220 = 2 (Keypad LOC) or 3 (Keypad REM).



Reverses the motor direction of rotation.

Enabled when P223 = 2 (Keypad FWD) or 3 (Keypad REV) for Local Mode and/or P226 = 2 (Keypad FWD) or 3 (Keypad REV) for Remote Mode.

The keys described below are enabled when P221 = 0 (Keypad) for Local Mode and/or P222 = 0 (Keypad) for Remote Mode. The parameter P121 contains the speed reference set by the keypad.



When pressed it increases the speed reference.



When pressed it decreases the speed reference.



#### NOTE!

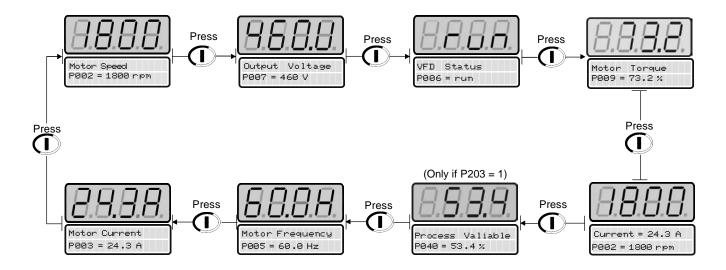
#### Reference Backup

The last frequency Reference set by the keys and is stored when the inverter is stopped or the AC power is removed, provided P120 = 1 (Reference Backup active is the factory default). To change the frequency reference before starting the inverter, the value of parameter P121 must be changed.

## 4.2.2 "Read-Only" Variables and Status

Parameters P002 to P099 are reserved for the display of "read-only" values. The factory default display when power is applied to the inverter is P002. Motor speed in rpm. The user can scroll through the various read-only parameters or use the factory configured display of the key values. This is done by pressing the start key (1).

a) Some selected "read-only" variables can be viewed following the procedure below:

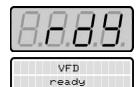


The "read-only" variable to be shown after AC power is applied to the inverter is defined in Parameter P205:

P205	Initial Monitoring Parameter
0	P005 (Motor Frequency)
1	P003 (Motor Current)
2	P002 (Motor Speed)
3	P007 (Output Voltage)
4	P006 (Inverter Status)
5	P009 (Motor Torque)
6	P070 (motor speed and motor current)
7	P040 (PID process variable)

Table 4.1 - Choosing the initial monitoring parameter

#### b) Inverter Status:



Inverter is READY to be started (No Fault condition)



Inverter has been started (Run condition)





Line voltage in too low for inverter operation (Undervoltage condition)



c) LED display flashing:

The display flashes in the following conditions:

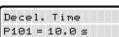
- ☑ During the DC Injection braking;
- ☑ Trying to change a parameter value when it is not allowed;
- ✓ Inverter in a current overload condition (Refer to chapter 7 Diagnostics and Troubleshooting);
- ✓ Inverter in Fault condition (Refer to chapter 7 Diagnostics and Troubleshooting).

## 4.2.3 Parameter Viewing and Programming

All CFW-09 settings are made through the parameters. The parameters are shown on the display with the letter **P** followed by a number. Example (P101):



101 = Parameter Number



Each parameter is associated to a numerical value (parameter content), that corresponds to an option selected among those options that are available for this parameters.

The values of the parameters define the inverter programming or the value of a variable (e.g. current, frequency, voltage). For inverter programming you should change the parameter content(s).

To allow the reprogramming of any parameter value it is required to change parameter P000 to the password value. The factory default password value is 5. Otherwise you can only read the parameter values and not reprogram them. For more detail refer to P000 description in chapter 6.

ACTION	LED DISPLAY LCD DISPLAY	Comments
Press the PROG key	Motor Speed P002 = 0 npm	
Use the and keys to reach P100	Accel. Time P100 = 5.0 s	Select the desired parameter
Press the <b>PROG</b> key	Accel. Time P100 = 5.0 s	Numeric value associated to the parameter <sup>(4)</sup>
Use the and keys to set the new value	Accel. Time P100 = 6.1 s	Sets the new desired value.
Press the <b>Proc</b> key	Accel. Time P100 = 6.1 s	(1) (2) (3)



#### **NOTES:**

(1) For parameters that can be changed with the motor running, the inverter will use the new value immediately after it has been set. For the parameters that can be changed only with motor stopped, the inverter will use this new

set value only after the PROG key is pressed.

- (2) By pressing the key after the reprogramming, the new programmed value will be stored automatically and will remain stored until a new value is programmed.
- (3) If the last value programmed in the parameter is not functionally compatible with other parameter values already programmed, an E24 Programming Error will be displayed.

Example of programming error:

Programming two digital inputs (DIx) with the same function. Refer to table 4.2 for the list of programming errors that will generate an E24 Programming Error.

(4) To allow the reprogramming of any parameter value it is required to change parameter P000 to the password value. The factory default password value is 5. Otherwise you can only read the parameter values and not reprogram them. For more detail refer to P000 description in chapter 6.

#### E24 - Incompatibility between parameters

- 1) Two or more parameters between P264 or P265 or P266 or P267 or P268 or P269 and P270 equal to 1 (LOC/REM).
- 2) Two or more parameters between P265 or P266 or P267 or P268 or P269 and P270 equal to 6 (Ramp 2).
- 3) Two or more parameters between P265 or P266 or P267 or P268 or P269 and P270 equal to 9 (Speed/Torque).
- 4) P265 equal to 8 and P266 different than 8 or vice versa (FWD Run / REV Run).
- 5) P221 or P222 equal to 8 (Multispeed) and P266  $\neq$  7 and P267  $\neq$  7 and P268  $\neq$  7.
- 6) [P221 = 7 or P222 = 7] and [(P265 ≠ 5 and P267 ≠ 5) or (P266 ≠ 5 and P268 ≠ 5)]. (with reference = E.P. and without DIx = increase E.P. or without DIx = decrease E.P.).
- 7) P264 and P266 equal to 8 (Reverse Run).
- 8) [P221 ≠ 7 and P222 ≠ 7] and [(P265 = 5 or P267 = 5 or P266 = 5 or P268 = 5)]. (without reference = E.P. and with DIx = increase E.P. or with DIx = decrease E.P.).
- 9) P265 or P267 or P269 equal to 14 and P266 and P268 and P270 different than 14 (with DIx = Start and DIx ≠ Stop).
- 10) P266 or P268 or P270 equal to 14 and P265 and P267 and P269 different than 14 (with DIx ≠ Start and DIx = Stop).
- 11) P220 > 1 and P224 = P227 = 1 without any DIx set for Start/Stop or DIx = Fast Stop or General Enable.
- 12) P220 = 0 and P224 = 1 and without DIx = Start/Stop or Fast Stop and without DIx = General Enable.
- 13) P220 = 1 and P227 = 1 and without DIx = Start/Stop or Fast Stop and without DIx = General Enable.
- 14) DIx = START and DIx = STOP, but P224  $\neq$  1 and P227  $\neq$  1.
- 15) Two or more parameters between P265 or P266 or P267 or P268 or P269 and P270 equal to 15 (MAN/AUT).
- Two or more parameters between P265 or P266 or P267 or P268 or P269 and P270 equal to 17 (Disables Flying Start).
- 17) Two or more parameters between P265 or P266 or P267 or P268 or P269 and P270 equal to 18 (DC Voltage Regulator).
- 18) Two or more parameters between P265 or P266 or P267 or P268 or P269 and P270 equal to 19 (Parameter Setting Disable).
- 19) Two or more parameters between P265, P266, P267, P268 and P269 equal to 20 (Load user via Dlx).
- 20) P296 = 8 and P295 = 4, 6, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, or 49 (P295 incompatible with inverter model To avoid damages of the internal inverter components).
- 21) P296 = 5, 6, 7 or 8 and P297 = 3 (P297 incompatible with inverter model).
- 22) Two or more parameters between P265 or P266 or P267 or P268 or P269 and P270 equal to 21 (Timer RL2).
- 23) Two or more parameters between P265 or P266 or P267 or P268 or P269 and P270 equal to 22 (Timer RL3).
- 24) P265 or P266 or P267 or P268 or P269 or P270 = 21 and P279 ≠ 28.
- 25) P265 or P266 or P267 or P268 or P269 or P270 = 22 and P280  $\neq$  28.
- 26) P279 = 28 and P265 or P266 or P267 or P268 or P269 or  $P270 \neq 21$ .
- 27) P280 = 28 and P265 or P266 or P267 or P268 or P269 or  $P270 \neq 22$ .
- 28) P202 ≤ 2 and P237 = 1 or P241 = 1 or P265 to P270 = JOG+ or P265 to P270 = JOG-.
- 29) P203 = 1 and P211 = 1 and [P224 = 0 or P227 = 0]
- 30) P220 = 0 and P224 = 1 and P227 = 0 or P227 = 1 and P263 = 0
- 31) P220 = 1 and P224 = 0 or P224 = 1 and P227 = 1 and P263 = 0
- 32) P220 = 2 and P224 = 0 or P224 = 1 and P227 = 0 or P227 = 1 and P263 = 0

Table 4.2 - Incompatibility between parameters - E24

#### START-UP

This chapter provides the following information:

- ☑ How to check and prepare the inverter before power-up;
- ☑ How to power-up and check for proper operation;
- ☑ How to operate the inverter.

## 5.1 PRE-POWER CHECKS

5.2 INITIAL

POWER-UP



#### **DANGER!**

Disconnect the AC input power before making any connections. Even when the inverter project is different from the suggested connections, the following recommendations are applicable.

The inverter shall be installed according to chapter 3: Installation and Connection.

#### 1) Check all connections

Check if the power, grounding and control connections are correct and well tightened.

#### 2) Clean the inside of the inverter

Remove all shipping material from the inside of the inverter or cabinet.

- 3) Check if the selected inverter AC power is correct (refer to item 3.2.3)
- 4) Check the motor

Check all motor connections and verify if its voltage, current and frequency match the inverter specifications.



#### NOTES!

#### Operation in VT mode

When the motor data is set properly during the first power-up routine, the inverter automatically sets the additional parameters used for the correct operation under this control mode.

#### 5) Uncouple the load from the motor

If the motor cannot be uncoupled, make sure that the direction of rotation (FWD/REV) cannot cause damage to the machine.

#### 6) Close the inverter cover or cabinet doors

After the inverter has been checked, AC power can be applied:

#### 1) Check the supply voltage

Measure the line voltage and check if it is within the specified range (refer to item 9.1).

#### 2) Power-up the AC input

Close the input circuit breaker or disconnect switch.

#### 3) Check if the power-up has been successful

When the inverter is powered up for the first time or when the factory default parameter values are loaded (P204 = 5), a start-up sub-routine is run. This sub-routine requests the user to program some basic parameters to ensure proper operation and motor protection.

A start-up programming example is shown below:

#### Inverter

Line: CFW-09 Rated Current: 9 A

Rated Voltage: 380 V to 480 V Model: CFW090009T3848ESZ Cooling: Self-ventilated

#### Motor

WEG IP55
Power: 5 hp
rpm: 1730, 4 POLE
Rated Current: 7.9 A
Rated Voltage: 460 V
Frequency: 60 Hz
Cooling: Self-ventilated

11eu 93

## ORIENTED START-UP

## Initial Power-up - Programming via Keypad (HMI) (Based on the example above):

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
After power-up, the display shows the following message	language P201=English	Language Selection:  0 = Português  1 = English  2 = Español  3 = Deutsch
Press the <b>Prog</b> key to enter the programming mode	language P201=English	Enter the programming mode
Use the and keys to select the language	language P201=English	Selected Language: 1 = English
Press the PROG key to save the selected option and exit the programming mode	language P201=English	Exit the programming mode
Press the key to go to the next parameter	VFD Rated Volt. P296=440/460 V	Inverter Rated Voltage Selection: 0 = 220 V/230 V 1 = 380 V 2 = 400 V/415 V 3 = 440 V/460 V 4 = 480 V 5 = 500 V/525 V 6 = 550 V/575 V 7 = 600 V 8 = 660 V/690 V
Press the <b>Prog</b> key to enter the programming mode	VFD Rated Volt. P296=440/460 V	Enter the programming mode

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Use the and keys to select the inverter power supply voltage	VFD Rated Volt. P296 = 380 V	Selected Inverter Rated Voltage: 1 = 380 V
Press the selected option and exit the programming mode	VFD Rated Volt. P296 = 380 V	Exit the programming mode
Press the key to go to the next parameter	Motor Rated Volt P400 = 440 V	Motor Rated Voltage: 0 to 690 V
Press the Programming mode key to enter the	Motor Rated Volt P400 = 440 V	Enter the programming mode
Use the and keys to set the correct motor rated voltage value	Motor Rated Volt P400 = 380 V	Programmed Motor Rated Voltage: 380 V
Press the key to save the programmed value and exit the programming mode	Motor Rated Volt P400 = 380 V	Exit the programming mode
Press the key to go to the next parameter	Motor Rated Cur. P401 = 9.0 A	Motor Rated Current Range: (0.0 to 1.30) x P295 (1)
Press the PROG key to enter the programming mode	Motor Rated Cur. P401 = 9.0 A	Enter the programming mode

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Use the and keys to set the correct motor rated current value	Motor Rated Cur. P401 = 7.9 A	Programmed Motor Rated Current: 7.9 A
Press the key to save the programmed value and exit the programming mode	Motor Rated Cur. P401 = 7.9 A	Exit the programming mode
Press the key to go to the next parameter	Motor Rated Freq P403 = 60 Hz	Motor Rated Frequency Range: 0 to 300 Hz
Press the Roger key to enter the programming mode	Motor Rated Freq P403 = 60 Hz	Enter the programming mode
Use the and keys to set the correct motor rated frequency value	Motor Rated Freq P403 = 60 Hz	Programmed Motor Rated Frequency: 60 Hz
Press the key to save the programmed value and exit the programming mode	Motor Rated Freq P403 = 60 Hz	Exit the programming mode
Press the key to go to the next parameter	Motor Rated rpm P402 = 1750 rpm	Motor Rated rpm Range: 0 to 18000 rpm
Press the key to enter the programming mode	Motor Rated rpm P402 = 1750 rpm	Enter the programming mode

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Use the and keys to set the correct motor rated rpm value	Motor Rated rpm P402 = 1730 rpm	Programmed Motor Rated rpm: 1730 rpm
Press the key to save the programmed value and exit the programming mode	Motor Rated rpm P402 = 1730 rpm	Exit the programming mode
Press the key to go to the next parameter	Motor Rated HP P404 = 0.33 HP	Motor Rated hp Range: 1 to 1600.0 hp 1 to 1190.0 kW
Press the <b>PROG</b> key to enter the programming mode	Motor Rated HP P404 = 0.33 HP	Enter the programming mode
Use the and keys to select the motor rated power	Motor Rated HP P404 = 5.0 HP	Selected Motor Rated Power: 5.0 hp/3.7 kW
Press the selected option and exit the programming mode	Motor Rated HP P404 = 5.0 HP	Exit the programming mode
Press the key to go to the next parameter	Ventilation Type P406 = Self Vent.	Motor Ventilation Type Selection: 0 = Self Ventilated 1 = Separate Ventilation 3 = Increased Protection
Press the ROG key to enter the programming mode	Ventilation Type P406 = Self Vent.	Enter the programming mode

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Use the and keys to select the motor ventilation type	Ventilation Type P406 = Self Vent.	Selected Motor Ventilation Type: 0 = Self Ventilated
Press the PROG key to save the selected option and exit the programming mode	Ventilation Type P406 = Self Vent.	Exit the programming mode
Refer to item 5.3	VFD ready	The first power-up routine is finished. Inverter is ready to operate



#### NOTE!

(1) P401 maximum value is 1.8 x P295 for model 4.2 A/500-600 V and 1.6 x P295 for models 7 A and 54 A/220-230 V; 2.9 A and 7 A/500-600 V; 107 A, 147 A and 247 A/500-690 V; 100 A, 127 A and 340 A/660-690 V.



#### ATTENTION!

Open the input circuit breaker or disconnect switch to shut down the CFW-09.



#### NOTES!

- ☑ To repeat the initial power-up procedure: Set the parameter P204 = 5 or 6 (this loads the factory default parameters) and follow the initial power-up sub-routine again;
- ☑ The initial power-up sub-routine described above automatically sets some parameters according to the entered data. For more details, refer to chapter 6.
- ☑ Modification of motor characteristics after the first power up:
  - a) Insert the motor data at parameters P400 to P407;
  - b) For operation in the vector mode run the self-tuning routine (P408 > 0);
  - c) Set P156, P157, P158, P169, P170, P171, and P172;
  - d) Power the inverter down and up for the new settings to take place and for the proper motor operation.
- Modification of motor characteristics after the first power up, for operation in VT mode:

Follow the previous procedures and also set parameter P297 to 2.5 kHz.

#### 5.3 START-UP

This item describes the start-up procedure when operating via the Keypad (HMI). Four types of control will be considered: V/F 60 Hz, Sensorless Vector, Vector with Encoder Feedback and VVW (Voltage Vector WEG).



#### DANGER!

Even after the AC input is disconnected, high voltages may still be present. Wait at least 10 minutes after powering down to allow a full discharge of the capacitors.

### 5.3.1 Type of Control: V/F 60 Hz - Operation Via Keypad (HMI)

The V/F or Scalar Control is recommended in the following cases:

- ☑ Several motors driven by the same inverter;
- ☑ Motor rated current lower than 1/3 of the inverter rated current;
- ☑ For test purposes, without a motor connected to the inverter.

The V/F Control can also be used in applications that do not require fast dynamic responses, accurate speed regulation or high starting torque (speed error will be a function of the motor slip).

When parameter **P138** (Rated Slip) is programmed, speed accuracy of 1 % can be obtained.

The sequence below is valid for the Connection 1 (refer to item 3.2.7). The inverter must be already installed and powered up according to chapter 3 and item 5.2.

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Power-up the inverter	VFD ready	Inverter is ready to be operated
Press the <b>PROG</b> key. Press the keys or until P000 is reached	Parameter Access	Enables the access to change parameters content.  With the factory default programming [P200 = 1 (Password Active)], P000 must be set to 5 to allow parameters changes
Press the PROG key to enter the programming mode	Parameter Access	Enter the programming mode
Use the and keys to set the password value	Parameter Access P000 = 5	Password value (factory default = 5)
Press the PROG key to save the programmed value and exit the programming mode	Parameter Access	Exit the programming mode
Press the keys or until P202 is reached	Type of control P202 = V/F60 Hz	Type of Control Selection:  0 = V/F 60 Hz  1 = V/F 50 Hz  2 = V/F Adjustable  3 = Sensorless Vector  4 = Vector with Encoder  5 = VVW

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the Rey to enter the programming mode	Type of control P202 = V/F 60 Hz	Enter the programming mode
Use the and keys to select the type of control	Type of control P202 = V/F 60 Hz	If the option V/F 60 Hz (value = 0) is already programmed, ignore this action
Press the selected option and exit the programming mode	Type of control P202 = V/F 60 Hz	Exit the programming mode
Press the keys or until P002 is reached	Motor Speed P002 = 0 rpm	Motor Speed (rpm)
Press the PROG key	Motor Speed P002 = 0 rpm	This is a read-only parameter
Press the Start key	Motor Speed P002 = 90 rpm	Motor accelerates from 0 to 90 rpm* (Minimum Speed), in the Forward (CW) direction of rotation <sup>(1)</sup> * for 4 pole motors
Press the key and hold until 1800 rpm is reached	Motor Speed P002 = 1800 rpm	Motor accelerates up to 1800 rpm* (2) * for 4 pole motors
Press the FWD / REV key.  Obs.: The LEDs on the keypad show whether the motor is running FWD or REV.	Motor Speed P002 = 1800 rpm	Motor decelerates <sup>(3)</sup> down to 0 rpm and then reverses the direction of rotation accelerating back up to 1800 rpm

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the <b>(0)</b> Stop key	VFD ready	Motor decelerates down to 0 rpm
Press the (J06) key and hold it	Motor Speed P002 = 150 npm	Motor accelerates from 0 rpm up to the JOG speed set at P122  Ex.: P122 = 150 rpm  CCW direction of rotation
Release the key	VFD ready	Motor decelerates down to 0 rpm



#### NOTE!

The last frequency reference value set via the and keys is saved. If you wish to change this value before enabling the inverter, change parameter P121 (Keypad Reference).

#### **OBSERVATIONS:**

- (1) If the rotation direction of the motor is not correct, switch off the inverter. Wait 10 minutes to allow a complete discharge of the capacitors and then swap any two wires at the motor output.
- (2) If the acceleration current becomes too high, specially at low frequencies (< 15 Hz), adjust the Torque Boost at P136. Increase/decrease the content of P136 gradually until you obtain an operation with constant current over the entire frequency range. Refer to P136 in chapter 6.
- (3) If E01 fault occurs during deceleration, increase the deceleration time at P101 / P103.

# 5.3.2 Type of Control: Sensorless or Vector with Encoder (Operation Via Keypad (HMI))

For the majority of the applications, the **Sensorless Vector** Control is recommended. This mode permits an operation over a 100:1 speed range, a speed control accuracy of 0.5 % (Refer to P412 - chapter 6), high torque and fast dynamic response.

Another advantage of this type of control is a higher immunity to sudden AC input voltage variation and load changes, thus avoiding nuisance tripping due to overcurrent.

The adjustments necessary for a good sensorless control operation are made automatically.

The **Vector Control with Encoder** Feedback offers the same advantages as the Sensorless Control described above, with the following additional benefits:

- ☑ Torque and speed control down to zero speed (rpm);
- ☑ Accuracy of 0.01 % in the speed control.

The closed loop vector control with encoder requires the use of the optional board EBA or EBB for encoder connection - Refer to chapter 8.

#### **OPTIMAL BRAKING:**

This setting allows controlled motor braking within shortest possible times without using other means, such as DC Link chopper with braking resistor (for more details about this function refer to P151 – chapter 6). The inverter is supplied with this function set at maximum. This means that the braking is disabled. To enable the braking, set P151 according to table 6.8.

The sequence below is based on the example in item 5.2.

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Power-up the inverter	VFD ready	Inverter is ready to be enabled
Press the PROG key. Press the keys or until P000 is reached	Parameter Access	Enables the access to change parameters content. With the factory default programming [P200 = 1 (Password Active)], P000 must be set to 5 to allow parameters changes
Press the Rey to enter the programming mode	Parameter Access	Enter the programming mode

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Use the and keys to set the password value	Parameter Access P000 = 5	Password value (factory default = 5)
Press the PROG key to save the programmed value and exit the programming mode	Parameter Access P000 = 5	Exit the programming mode
Press the keys or until P202 is reached	Type of control P202 = V/F 60 Hz	Type of Control Selection:  0 = V/F 60 Hz  1 = V/F 50 Hz  2 = V/F Adjustable  3 = Sensorless Vector  4 = Vector with Encoder  5 = VVW
Press the <b>PROG</b> key to enter the programming mode	Type of control P202 = V/F 60 Hz	Enter the programming mode
Use the and keys to select the type of control (Sensorless)	Type of control P202 = Sensorless	Selected Type of Control: 3 = Sensorless Vector
OR		
Use the and keys to select the type of control (with Encoder)	Type of control P202 = Encoder	Selected Type of Control: 4 = Vector with Encoder

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the PROG key to save the selected option and start the tuning routine after changing to Vector Control Mode	Motor Rated Volt P400 = 380 V	Motor Rated Voltage Range: 0 to 690 V
Press the PROG key and use the and keys to set the correct motor rated voltage value	Motor Rated Volt P400 = 460 V	Programmed Motor Rated Voltage: 460 V
Press the key to save the programmed value and exit the programming mode	Motor Rated Volt P400 = 460 V	Exit the programming mode
Press the key to go to the next parameter	Motor Rated Cur. P401 = 7.9 A	Motor Rated Current Range: (0.0 to 1.30) x P295 <sup>(1)</sup>
Press the <b>PROG</b> key to enter the programming mode	Motor Rated Cur. P401 = 7.9 A	Enter the programming mode
Use the and keys to set the correct motor rated current value	Motor Rated Cur. P401 = 7.9 A	Programmed Motor Rated Current: 7.9 A
Press the PROG key to save the programmed value and exit the programming mode	Motor Rated Cur. P401 = 7.9 A	Exit the programming mode
Press the key to go to the next parameter	Motor Rated Freq P403 = 60 Hz	Motor Rated Frequency Range: 0 to 300 Hz

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the Rog key to enter the programming mode	Motor Rated Freq P403 = 60 Hz	Enter the programming mode
Use the and keys to set the correct motor rated frequency value	Motor Rated Freq P403 = 60 Hz	Programmed Motor Rated Frequency: 60 Hz
Press the key to save the programmed value and exit the programming mode	Motor Rated Freq P403 = 60 Hz	Exit the programming mode
Press the key to go to the next parameter	Motor Rated rpm P402 = 1730 rpm	Motor Rated rpm Range: 0 to 18000 rpm
Press the key to enter the programming mode	Motor Rated rpm P402 = 1730 rpm	Enter the programming mode
Use the and keys to set the correct motor rated rpm value	Motor Rated rpm P402 = 1730 rpm	Programmed Motor Rated rpm: 1730 rpm
Press the key to save the programmed value and exit the programming mode	Motor Rated rpm P402 = 1730 rpm	Exit the programming mode
Press the key to go to the next parameter	Motor Rated HP P404 = 5.0 HP	Motor Rated hp Range: 1 to 1600.0 hp 1 to 1190.0 kW

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the ROG key to enter the programming mode	Motor Rated HP P404 = 5.0 HP	Enter the programming mode
Use the and keys to select the motor rated power	Motor Rated HP P404 = 5.0 HP	Selected Motor Rated Power: 7 = 5.0 hp/3.7 kW
Press the key to save the selected option and exit the programming mode	Motor Rated HP P404 = 5.0 HP	Exit the programming mode
Press the key to go to the next parameter	Encoder PPR P405 = 1024 PPR	Encoder Pulses per Rotation (PPR) Range: 0 to 9999
Press the <b>Prog</b> key to enter the programming mode. (Vector with Encoder only)	Encoder PPR P405 = 1024 PPR	Enter the programming mode
Use the and keys to set the correct encoder PPR value. (Vector with Encoder only)	Encoder PPR P405 = XXXX PPR	Programmed Encoder PPR:
Press the <b>PROG</b> key to save the programmed value and exit the programming mode. (Vector with Encoder only)	Encoder PPR P405 = XXXX PPR	Exit the programming mode
Press the key to go to the next parameter	Ventilation Type P406 = Self Vent.	Motor Ventilation Type Selection:  0 = Self Ventilated  1 = Separate Ventilation  2 = Optional Flux  (only for P202 = 3)  3 = Increased Protection

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the Programming mode key to enter the programming mode	Ventilation Type P406 = Self Vent.	Enter the programming mode
Use the and keys to select the motor ventilation type	Ventilation Type P406 = Self Vent.	Selected Motor Ventilation Type: 0 = Self Ventilated
Press the key to save the selected option and exit the programming mode	Ventilation Type P406 = Self Vent.	Exit the programming mode
Press the key to go to the next parameter  Note: Display shows during 3 s: P409 to P413 = 0 Run Self-tuning	Run Self Tuning P408 = No	Self-tuning Mode Selection:  0 = No  1 = No Rotation  2 = Run for Im  3 = Run for Tm (only with Encoder)  4 = Estimate Tm (only with Encoder)
Press the <b>PROG</b> key to enter the programming mode	Run Self Tuning P408 = No	Enter the programming mode
Use the and keys to select the desired Self-tuning mode	Run Self Tuning P408 = No	Sensorless: Only select option 2 (Run for Im) if no load is coupled to the motor shaft. Otherwise, select option 1 (No Rotation) (2). With Encoder: In addition to the options above, it is also possible to estimate the Tm (Mechanical Time Constant) value. With the load coupled to the motor shaft, select 3 (Run for Tm). The motor will only run when Tm is estimated. All other parameters are estimated with the motor at standstill. If only Tm estimation is desired, select option 4 (Estimate Tm) (Refer to P408 in chapter 6)

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the <b>Prog</b> key to start the self-tuning routine	Messages and values of the estimated parameters are shown	Self-tuning routine in progress
End of the Self-tuning routine. Inverter is back to normal operation	Motor Speed P002 = XXXX rpm	Motor Speed (rpm)
Press the Start key	Motor Speed P002 = 90 npm	Motor accelerates from 0 to 90 rpm* (Minimum Speed), in the Forward (CW) direction of rotation (3) * for 4 pole motors
Press the key and hold until 1800 rpm is reached	Motor Speed P002 = 1800 rpm	Motor accelerates up to 1800 rpm* * for 4 pole motors
Press the FWD / REV key  Obs.: The LEDs on the keypad show whether the motor is running FWD or REV	Motor Speed P002 = 1800 npm	Motor decelerates (4) down to 0 rpm and then reverses the direction of rotation accelerating back up to 1800 rpm
Press the Stop key	VFD ready	Motor decelerates down to 0 rpm
Press the key and hold it	Motor Speed P802 = 150 rpm	Motor accelerates from 0 rpm up to the speed set at P122  Ex.: P122 = 150 rpm  CCW direction of rotation
Release the (106) key	VFD ready	Motor decelerates down to 0 rpm



#### NOTES!

- (1) P401 maximum value is 1.8 x P295 for model 4.2 A/500-600 V and 1.6 x P295 for models 7 A and 54 A/220-230 V; 2.9 A and 7 A/500-600 V; 107 A, 147 A and 247 A/500-690 V; 100 A, 127 A and 340 A/660-690 V.
- (2) The self-tuning routine can be cancelled by pressing the (0) key.



- (3) The last speed reference value set via the and keys is saved. If you wish to change this value before enabling the inverter, change parameter P121 (Keypad Reference).
- (4) If E01 fault occurs during deceleration, you must increase deceleration time at P101 / P103.

#### **OBSERVATION:**

If the rotation direction of the motor is not correct, switch off the inverter. Wait 10 minutes to allow a complete discharge of the capacitors and swap any two wires at the motor output. If motor is equipped with an encoder, change the phase of the encoder connections (exchange channel A and  $\overline{A}$ ).



#### ATTENTION!

In Vector Mode (P202 = 3 or 4), when the command STOP (START/STOP) is enabled - refer to figure 6.37, the motor will decelerate up to zero speed, but it maintains the magnetization current (no-load current). This maintains the motor with rated flux and when the next START command is given, it will achieve a quick response.

For self-ventilated motors with no-load current higher than 1/3 of the rated current (generally small motors lower than 10 hp), it is recommended that the motor does not stay in this condition (magnetization current) for a long time, since it may overheat. In these cases, we recommend to deactivate the command "General Enable" (when the motor has stopped), thus decreasing the motor current to zero when stopped.

Another way to disable magnetization current with the motor stopped is to program P211 to 1 (zero speed disable is ON) for both vector modes and, for vector with encoder, still another option is to program P181 to 1 (Magnetization mode). If magnetization current is disabled with the motor stopped, there will be a delay at start while the flux builds up.

5.3.3 Type of Control: VVW - Keypad Operation

The VVW (Voltage Vector WEG) Control Mode follows the same philosophy of the V/F Control. The VVW Control allows a reasonable improvement of the steadystate inverter performance: it results in a better speed regulation and in a higher torque capability at low speeds (frequencies lower than 5 Hz).

As a result, the frequency (speed) range of the system is increased with respect to the V/F Control. Other advantages of this control are the simplicity and ease of setting.

The VVW Control uses the stator current measurement, the stator resistance (that can be obtained from the self-tuning routine) and the motor nameplate data to automatically estimate the torque value, the output compensation voltage value and, consequently, the slip compensation value, which substitute the function of parameters P137 and P138.

In order to get a good steady-state speed regulation, the slip frequency is calculated from the estimated load torque value (which uses the motor nameplate data).

The following sequence is valid for Connection #1 (refer to item 3.2.7). The inverter should have been already installed and powered up according to instructions in chapter 3 and item 5.2.

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Power-up the inverter	VFD ready	Inverter is ready to be operated
Press the keys or until P000 is reached	Parameter Access	Enables the access to change parameters content. With the factory default programming [P200 = 1 (Password Active)], P000 must be set to 5 to allow parameters changes
Press the PROG key to enter the programming mode	Parameter Access P000 = 0	Enter the programming mode
Use the keys and to set the password value	Parameter Access P000 = 5	Password value (factory default = 5)
Press the key rogrammed value and exit the programming mode	Parameter Access P000 = 5	Exit the programming mode
Press the keys or until P202 is reached	Type of control P202 = V/F60 Hz	Type of Control Selection:  0 = V/F 60 Hz  1 = V/F 50 Hz  2 = V/F Adjustable  3 = Sensorless Vector  4 = Vector with Encoder  5 = VVW
Press the PROG key to enter the programming mode	Type of control P202 = V/F60 Hz	Enter the programming mode

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Use the and keys to select the type of control (VVW)	Type of control P202 = VVW	Selected Type of Control: 5 = VVW
Press the key PROG to save the selected option and start the tuning routine after changing to VVW Control Mode	Motor Rated Volt P400 = 460 V	Motor Rated Voltage Range: 0 to 690 V
Press the key and use the and keys to set the correct motor rated voltage value	Motor Rated Volt P400 = 460 V	Programmed Motor Rated Voltage: 460 V
Press the <b>PROG</b> key to save the programmed value and exit the programming mode	Motor Rated Volt P400 = 380 V	Exit the programming mode
Press the key to go to the next parameter	Motor Rated Cur. P401 = 7.9 A	Motor Rated Current Range: (0.0 to 1.30) x P295 (1)
Press the <b>PROG</b> key to enter the programming mode	Motor Rated Cur. P401 = 7.9 A	Enter the programming mode
Use the and keys to set the correct motor rated current value	Motor Rated Cur. P401 = 7.9 A	Programmed Motor Rated Current: 7.9 A
Press the <b>PROG</b> key to save the programmed value and exit the programming mode	Motor Rated Cur. P401 = 7.9 A	Exit the programming mode

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the key to go to the next parameter	<b>8888</b> Motor Rated Freq P403 = 60 Hz	Motor Rated Frequency Range: 0 to 300 Hz
Press the Region key to enter the programming mode	Motor Rated Freq P403 = 60 Hz	Enter the programming mode
Use the and keys to set the correct motor rated frequency value	Motor Rated Freq P403 = 60 Hz	Programmed Motor Rated Frequency: 60 Hz
Press the key to save the programmed value and exit the programming mode	Motor Rated Freq P403 = 60 Hz	Exit the programming mode
Press the key to go to the next parameter	Motor Rated rpm P402 = 1730 rpm	Motor Rated rpm Range: 0 to 18000 rpm
Press the <b>PROG</b> key to enter the programming mode	Motor Rated rpm P402 = 1730 rpm	Enter the programming mode
Use the and keys to set the correct motor rated rpm value	Motor Rated rpm P402 = 1730 rpm	Programmed Motor Rated rpm: 1730 rpm
Press the <b>PROG</b> key to save the programmed value and exit the programming mode	Motor Rated rpm P402 = 1730 rpm	Exit the programming mode

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the key to go to the next parameter	Motor Rated HP P404 = 5.0 CV	Motor Rated hp Range: 1 to 1600.0 CV 1 to 1190.0 kW
Press the PROG key to enter the programming mode	Motor Rated HP P404 = 5.0 CV	Enter the programming mode
Use the and keys to select the motor rated power	Motor Rated HP P404 = 5.0 CV	Selected Motor Rated Power: 5.0 CV/3.7 kW
Press the <b>PROG</b> key to save the programmed value and exit the programming mode	Motor Rated HP P404 = 5.0 CV	Exit the programming mode
Press the key to go to the next parameter	FP Nom. Motor P407 = 0.68	Motor Rated Power Factor 0.50 to 0.99
Press the PROG key to enter the programming mode	FP Nom. Motor P487 = 8.68	Enter the programming mode
Use the and keys to select the Motor Rated Power Factor	FP Nom. Motor P407 = 0.68	Motor Power Factor: 0.68
Press the PROG key to save the programmed value and exit the programming mode	FP Nom. Motor P407 = 0.68	Exit the programming mode

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the key to go to the next parameter	Rendim.Nom.Motor P399 = 67.0 %	Motor Rated Efficiency 50.0 to 99 %
Press the <b>Prog</b> key to enter the programming mode	Rendim.Nom.Motor P399 = 67.8 %	Enter the programming mode
Use the and keys to select the Motor Rated Efficiency	Rendim.Nom.Motor P399 = 67.0%	Motor Rated Efficiency 67.0 %
Press the <b>PROG</b> key to save the programmed value and exit the programming mode	Rendim.Nom.Motor P399 = 67.0 %	Exit the programming mode
Press the key to go to the next parameter	Ventilation Type P406 = Self Vent.	Motor Ventilation Type Selection:  0 = Self Ventilated  1 = Separate Ventilation  2 = Optimal Flux  3 = Increased Protection
Press the PROG key to enter the programming mode	Ventilation Type P406 = Self Vent.	Enter the programming mode
Use the and keys to select the motor ventilation type	Ventilation Type P406 = Self Vent.	Selected Motor Ventilation Type: 0 = Self Ventilated
Press the PROG key to save the programmed value and exit the programming mode	Ventilation Type P406 = Self Vent.	Exit the programming mode

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the key to go to the next parameter	Run Self Tuning P408 = No	Self-tuning Mode Selection: 0 = No 1 = No Rotation
Press the <b>PROG</b> key to enter the programming mode	Run Self Tuning P408 = No	Enter the programming mode
Use the and keys to select the desired Self-tuning mode	Run Self Tuning P408 = No Rotation	Only select option 1 (No Rotation)
Press the PROG key to start the self-tuning routine Note: Display shows P409 to P413 during the Self-Tuning routine	Messages and values of the estimated parameters are shown	Self-tuning routine in progress (2)
End of the Self-tuning routine. Inverter is back to normal operation	Motor Speed P002 = XXXX rpm	Motor Speed (rpm)
Press the	Motor Speed P002 = 90 rpm	Motor accelerates from 0 to 90 rpm* (Minimum Speed), in the Forward (CW) direction of rotation (3) * for 4 pole motors
Press the key and hold until 1800 rpm is reached	Motor Speed P002 = 1800 rpm	Motor accelerates up to 1800 rpm* * for 4 pole motors

ACTION	LED DISPLAY LCD DISPLAY	DESCRIPTION
Press the FWD / REV key  Obs.: The LEDs on the keypad show whether the motor is running  FWD or REV	Motor Speed P002 = 1800 rpm	Motor decelerates (4) down to 0 rpm and then reverses the direction of rotation accelerating back ⇒ up to 1800 rpm
Press the	VFD ready	Motor decelerates down to 0 rpm
Press the (J06) key and hold it	Motor Speed P802 = 150 rpm	Motor accelerates from 0 rpm up to the speed set at P122 <b>Ex.:</b> P122 = 150 rpm  CCW direction of rotation
Release the 106 key	VFD ready	Motor decelerates down to 0 rpm



### NOTE!

The inverter always stores the last speed reference value set through the keypad. Therefore, if you want to change this value before enabling the inverter use the parameter **P121** - Keypad Speed Reference.

#### NOTES!

- (1) P401 maximum value is 1.8 x P295 for model 4.2 A/500-600 V and 1.6 x P295 for models 7 A and 54 A/220-230 V; 2.9 A and 7 A/500-600 V; 107 A, 147 A and 247 A/500-690 V; 100 A, 127 A and 340 A/660-690 V.
- (2) The last speed reference value set via the and keys is saved. If you wish to change this value before enabling the inverter, change parameter P121 (Keypad Reference).
- (3) If the direction of rotation of the motor is inverted, power the inverter down, waits 10 minutes for the complete discharge of capacitors and interchange any two motor output cables.
- (4) In case of having E01 during deceleration, increase the deceleration time through P101 / P103.

#### DETAILED PARAMETER DESCRIPTION

This chapter describes in detail all CFW-09 parameters. In order to simplify the explanation, the parameters have been grouped by characteristics and functions:

Read Only Parameters	Variables that can only be viewed on the display but not changed. Examples would be motor speed or motor current.
Regulation Parameters	Programmable values used by the CFW-09 functions. Examples would be Acceleration and Deceleration times.
Configuration Parameters	Set-up parameters that are programmed during inverter start-up and define its basic operation. Examples would be Control Type, Scale Factors and the Input/Output functions.
Motor Parameters	Motor data that is indicated on the motor nameplate. Other motor parameters are automatically measured or calculated during the Self-tuning routine.
Special Function Parameters	It includes parameters related to special functions.

Symbols and definitions used in this chapter:

- (1) Indicates that the parameter can be changed only with the inverter disabled (motor stopped).
- (2) Indicates that the values can change as a function of the motor parameters.
- (3) Indicates that the values can change as a function of P413 (Tm Constant obtained during Self-tuning).
- (4) Indicates that the values can change as a function of P409, P411 (obtained during Self-tuning).
- (5) Indicates that the values can change as a function of P412 (Tr Constant obtained during Self-tuning).
- (6) Indicates that the values can change as a function of P296.
- (7) Indicates that the values can change as a function of P295.
- (8) Indicates that the values can change as a function of P203.
- (9) Indicates that the values can change as a function of P320.
- (10) (For new inverters) User Default = no parameters.
- (11) The inverter will be delivered with settings according to the market, considering the HMI language, V/F 50 Hz or 60 Hz and the required voltage. The reset of the standard factory setting may change the parameters related to the frequency (50 Hz/60 Hz). Values within parenthesis mean the factory setting for 50 Hz.
- (12) The maximum value of P156 and P401 is 1.8 x P295 for model 4.2 A/500-600 V and 1.6 x P295 for models 7 A and 54 A/220-230 V; 2.9 A and 7 A/500-600 V; 107 A, 147 A and 247 A/500-690 V; 100 A, 127 A and 340 A/660-690 V.

**Torque Current** = it is the component of the motor total current responsible for torque generation (used in Vector Control).

**Active Current** = it is the component of the motor total current proportional to active electric power absorbed by the motor (used in V/F control).

## 6.1 ACCESS AND READ ONLY PARAMETERS - P000 to P099

Parameter	Range [Factory Setting] Unit	Description / Notes
P000 Parameter Access/ Password Value	0 to 999 [ 0 ] -	☑ This parameter opens the access to change other parameter values. When P200 = 1 (Password Active)] it is necessary to set P000 = 5 to change parameter values.
Setting		☑ By programming P000 with the password that releases access to changing of parameter content plus 1 (Password + 1), you will obtain access only to the parameters with different content that the factory default setting.
		☑ To change the password to any other value (password 1), proceed as follows:
		1) Set P000 = 5 (current password) and P200 = 0 (password inactive).
		2) Press the Key (PROG).
		3) Change P200 to 1 (password active).
		4) Press (PROG) again: display shows: P000.
		5) Press (PROG) again: display shows 5 (last password).
		6) Use the and keys to change to the desired password value (password 1).
		7) Press (ROG): display shows P000. From this moment on, the new password becomes active. Thus, to change parameters content P000 has to be set to the new password (password 1).
P001	0.0 to P134	☑ Speed Reference value in rpm (Factory Default). With filter of 0.5 s.
Speed Reference	[ - ] 1 rpm	☑ The displayed units can be changed from rpm to other units at parameters P207, P216 and P217. The scale factor can be changed at P208 and P210.
		☑ It does not depend on the speed reference source.
		☑ Through this parameter is possible to change the speed reference (P121) when P221 or P222 = 0.
P002 Motor Speed	0.0 to P134 [ - ]	✓ Indicates the actual motor speed in rpm, (factory default). With filter of 0.5 s.
1 r	1 rpm	☑ The displayed units can be changed from rpm to other units at parameters P207, P216 and P217. The scale factor can be changed at P208 and P210.
		☑ Through this parameter is possible to change the speed reference (P121) when P221 or P222 = 0.
P003 Motor Current	0.0 to 2600 [ - ] 0.1 A(< 100) -1 A(> 99.9)	☑ Indicates inverter output current in ampère (A).

Parameter	Range [Factory Setting] Unit	Description / Notes
P004 DC Link Voltage	0.0 to 1235 [ - ] 1 V	☑ Indicates the inverter DC Link voltage in volt (V).
P005 Motor Frequency	0.0 to 1020 [ - ] 0.1 Hz	☑ Indicates the inverter output frequency in hertz (Hz).
P006 Inverter Status	rdy, run, Sub, Exy [ - ] -	<ul> <li>✓ Indicates the inverter status:</li> <li>rdy- inverter is ready to be started or enabled;</li> <li>run- inverter is enabled;</li> <li>Sub- inverter is disabled and line voltage is too low for operation (undervoltage);</li> <li>Exy- inverter is in a fault condition, 'xy' is the number of the Fault code, example: E06.</li> </ul>
P007 Output Voltage	0 to 800 [-] 1 Vac	☑ Indicates the inverter output voltage in volt (V).
P009 Motor Torque	0.0 to 150.0 [ - ] 0.1 %	Indicates the torque developed by the motor. It is determined as follows: $P009 = \frac{Tm.100}{I_{Tm}} \times Y$ Where: $Tm = \text{Measured motor torque current}$ $I_{Tm} = \text{Nominal motor torque current given by:}$ $N = \text{Speed}$ $I_{Tm} = \sqrt{P401^2 - X^2}$ $X = P410 \times \frac{P178}{100}$ $Y = \frac{Nrated}{N} \text{ for } N > Nrated$
P010 Output Power	0.0 to 3276 [ - ] 0.1 kW	☑ Indicates the instantaneous output power in kilowatt (kW).
P012 Digital Inputs DI1 to DI8 Status	LCD = 1 or 0 LED = 0 to 255 [-]	<ul> <li>Indicates on the Keypad LCD display the status of the 6 digital inputs of the control board (DI1 to DI6), and the 2 digital inputs of the I/O Expansion Board (DI7 and DI8). Number 1 stands for Active (DIx closed) and number 0 stands for Inactive (DIx open), in the following order:</li> <li>DI1, DI2,, DI7, DI8.</li> <li>The LED display shows a decimal value related to the 8 Digital Inputs, where the status of each input is considered one bit of a binary number where:</li> </ul>

Parameter	Range [Factory Setting] Unit	Description / Notes
		Inactive = 0, Active = 1, and the DI1 status is the most significant bit (MSB).
		Example:
		DI1 = Active (+24 V); DI2 = Inactive (0 V);
		DI3 = Inactive (0 V); DI4 = Active (+24 V);
		DI5 = Inactive (0 V); DI6 = Inactive (0 V);
		DI7 = Inactive (0 V); DI8 = Inactive (0 V);
		This is equivalent to the binary sequence:
		10010000
		Which corresponds to the decimal number 144.
		The Keypad displays will be as follows:
		DI1 to DI8 Status P012 = 10010000
P013 Digital and Relay Outputs DO1, DO2 RL1, RL2 and RL3	LCD = 0 or 1 LED = 0 to 255 [ - ]	☑ Indicates on the Keypad LCD Display the status of the 2 Digital Outputs of the I/O Expansion Board (DO1, DO2) and the 3 Relay Outputs of the control board. Number 1 stands for Active and number 0 stands for Inactive, in the following order: DO1, DO2, RL1, RL2, RL3.
Status		☑ The LED display shows a decimal value related to the status of the 5 Digital and Relay Outputs, where the status of each output is considered one bit of a binary number where:
		Inactive = 0, Active = 1, and the status of DO1 is the most significant bit (MSB). The 3 least significant bits are always '0'.
		Example:
		DO1 = Inactive; DO2 = Inactive
		RL1 = Active: RL2 = Inactive; RL3 = Active
		This is equivalent to the binary sequence:
		00101000
		Which corresponds to the decimal number 40.
		The Keypad displays will be:
		D01 to RL3 Status P013 = 00101

Parameter	Range [Factory Setting] Unit	Description / Notes
P014	0 to 71	✓ Indicates the numbers of the last, second, third and fourth previous Faults.
Last Fault	[-]	✓ Fault Sequence:
P015 Second Previous Fault	0 to 71 [ - ]	Exy $\rightarrow$ P014 $\rightarrow$ P015 $\rightarrow$ P016 $\rightarrow$ P017 $\rightarrow$ P060 $\rightarrow$ P061 $\rightarrow$ P062 $\rightarrow$ P063 $\rightarrow$ P064 $\rightarrow$ P065.
<b>P016</b> Third Previous Fault	0 to 71 [ - ]	☑ Ex: When the display shows 0 (zero), this means E00, 1 (one) means E01 and so on.
<b>P017</b> Fourth Previous Fault	0 to 71 [ - ] -	
P018 Analog Input AI1' Value	-100 to +100 [ - ] 0.1 %	☑ Indicate the percentage value of the analog inputs Al1 to Al4. The indicated values are obtained after offset action and multiplication by the gain. Refer to parameters P234 to P247.
P019 Analog Input AI2' Value	-100 to +100 [ - ] 0.1 %	
P020 Analog Input AI3' Value	-100 to +100 [ - ] 0.1 %	
P021 Analog Input AI4' Value	-100 to +100 [ - ] 0.1 %	
P022 WEG Use	- [-] -	
P023 Software Version	V4.0X [ - ] -	☑ Indicates the CFW-09 Software Version.
P024 A/D Conversion	LCD: -32768 to +32767	✓ Indicates the A/D conversion result of the analog input A14 located on the I/O Expansion Board.
Value of Analog Input Al4	LED: 0 to FFFFH [-] -	☑ The LCD display indicates the conversion value as a decimal number and the LED display as a hexadecimal number with negative values in supplement of 2.
P025 A/D Conversion Value of Iv Current	0 to 1023 [ - ] -	☑ P025 and P026 indicate the A/D conversion result, in module, of the V and W phase currents, respectively.
P026 A/D Conversion Value of Iw Current	0 to 1023 [ - ] -	

	_	
	Range [Factory Setting]	
Parameter	Unit	Description / Notes
P027 Analog Output AO1	0.0 to 100 [ - ] 0.1 %	☑ Indicate the percentage value of the analog outputs AO1 to AO4 with respect to the full-scale value. The indicated values are obtained after the multiplication by the gain. Refer to the description of parameters P251 to P258.
P028 Analog Output AO2	0.0 to 100 [ - ] 0.1 %	1 201 10 1 200.
P029 Analog Output AO3	-100 to +100 [ - ] 0.1 %	
P030 Analog Output AO4	-100 to +100 [ - ] 0.1 %	
P040 PID Process Variable	0 to 100 [ - ]	☑ It indicates the process variable in % (factory setting), used as the PID Feedback.
	%	☑ The indication unit can be changed through P530, P531 and P532. The scale can be changed through P528 and P529.
		☑ Refer to detailed description in item 6.5 - Special Function Parameters.
		☑ This parameter also allows to modify the PID set point (see P525), when P221 = 0 or P222 = 0.
P042	LCD: 0 to 65535	☑ Indicates the total number of hours that the inverter was powered.
Powered Time	LED: 0 to 6553h (x10) [ - ]	☑ The LED Display shows the total number of hours that the inverter was energized divided by 10.
	1 h	☑ This value remains stored even when the inverter is turned OFF.
		Example: Indication of 22 hours powered.
		Hours Energized P042 = 22 h
P043	0 to 6553.5	☑ Indicates the total number of hours that the inverter has <b>run</b> .
Enabled Time	[-]	☑ Indicates up to 6553.5 hours, rolls over to 0000.
	0.1 h (< 999.9) 1 h (> 1000)	☑ If P204 is set to 3, the P043 is reset to zero.
		☑ This value remains stored even when inverter is turned OFF.

Parameter	Range [Factory Setting] Unit	Description / Notes
P044 kWh Counter	0 to 65535	☑ Indicates the energy consumed by the motor.
KWITCounter	[ - ] 1 kWh	☑ Indicates up to 65535 kWh, then it returns to zero.
		☑ If P204 is set to 4, the P044 is reset to zero.
		☐ This value remains stored even when inverter is turned OFF.
P060 Fifth Error	0 to 71 [ - ]	☑ Indicates the numbers of the fifth, sixth, seventh, eighth ninth and tenth occurred error, respectively.
Occurred	-	☑ Record Systematic:
P061 Sixth Error	0 to 71 [ - ]	$Exy \to P014 \to P015 \to P016 \to P017 \to P060 \to P061 \to P062 \to P063 \to P064 \to P065$
P062 Seventh Error Occurred	- 0 to 71 [ - ] -	☑ Ex: When the display show 0 (zero), this means E00, 1 (one) means E01 and so on.
P063 Eighth Error Occurred	0 to 71 [ - ] -	
P064 Ninth Error Occurred	0 to 71 [ - ] -	
P065 Tenth Error Occurred	0 to 71 [ - ] -	
P070	0 to 2600	☑ Indicates simultaneously the motor current value (A) and the motor speed
Current and Motor Speed	[ - ] 0.1 A(< 100)	value (rpm).
Motor Opeca	1 A(> 99.9)	It is possible to use this parameter to change the speed reference (P121) when P221 or P222 = 0.
	0 to P134 [ - ]	NOTE!
	1 rpm	The LED display shows the speed.
P071	LCD: 0 to 65535	☑ Shows the command word value set through the network.
Command Word	LED: 0 to FFFFh	☑ The LCD display of the keypad shows the value in a decimal representation, while the LED display shows the value in a hexadecimal representation.
P072	LCD: 0 to 65535	☑ Shows the speed reference value set through the Fieldbus network.
Fieldbus Speed Reference	LED: 0 to FFFFh	☑ The LCD display of the keypad shows the value in a decimal representation, while the LED display shows the value in a hexadecimal representation.

## 6.2 REGULATION PARAMETERS - P100 to P199

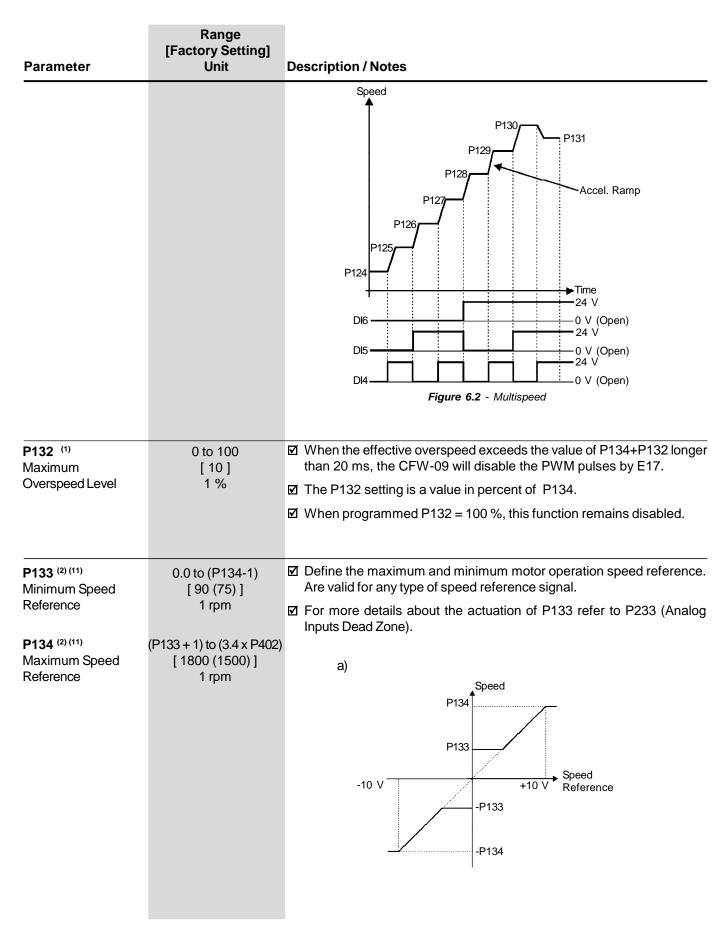
Parameter	Range [Factory Setting] Unit	Description	n / Notes				
P100	0.0 to 999	☑ Setting th	ne value to 0.0 s res	sults in no Acceleration ramp.			
Acceleration Time	[ 20 ] 0.1 s (< 99.9) -1 s (> 99.9)	maximur		rate (P100) linearly from zero up to r to decelerate (P101) linearly from pm.			
P101 Deceleration Time	0.0 to 999 [ 20 ] 0.1 s (< 99.9) -1 s (> 99.9)	☑ The sele P103) ca	☑ The selection of the acceleration / deceleration time ramp 2 (P102 or				
P102 Acceleration Time 2	0.0 to 999 [ 20 ] 0.1 s (< 99.9) - 1 s (> 99.9)						
P103 Deceleration Time 2	0.0 to 999 [ 20 ] 0.1 s (< 99.9) - 1 s (> 99.9)						
P104	0 to 2		P104	S Ramp			
S Ramp	[0]		0	Inactive			
	-		1	50 %			
			2	100 %			
		☑ The ramp	Accel. Time (P100/102)  Figure 6	near % S ramp Decel. Time (P101/103) 6.1 - S or linear ramp hanical stress during the acceleration	and		
P120 Speed Reference Backup	0 or 1 [1] -	enabled ( ☑ If P120 = when the frequence ☑ This back	1). Off, the inverter doe inverter is enabled y setting (P133).	erence Backup function is disabled (0 pes not save the current reference value again, it will restart from the minimal plicable to the keypad (HMI), E.P., Sep 2525) references.	alue, num		

Parameter	Range [Factory Setting] Unit	Descrip	tion / Notes				
			P120	В	ackup		
			0		Off		
			1		On		
			Table 6	5.2 - Speed reference	backup		
P121	P133 to P134	☑ To ac	☑ To activate the ▲ and ▼ active: P221 = 0 or P222 = 0.				
Keypad Speed Reference	[ 90 ] 1 rpm		P120 = 1 (On) the the inverter is disa		s maintained (back	up) even	
P122 (2)(11) JOG or JOG+ Speed Reference	0 to P134 [ 150 (125) ] 1 rpm	(Rem	note Mode).		P225 (Local Mode)		
opeca recording		☑ If the JOG command is selected for DI3 to DI8, one of the Digital Input must be programmed as follows:					
<b>P123</b> (2)(11) JOG - Speed	0 to P134 [ 150 (125) ]		Digital Input	F	Parameters		
Reference	1 rpm		DI3	P2	65 = 3 (JOG)		
			DI4		66 = 3 (JOG)		
			DI5		67 = 3 (JOG)		
			DI6		68 = 3 (JOG)		
			DI7 DI8		69 = 3 (JOG) 70 = 3 (JOG)		
			<b>Table 6.3</b> - JO	OG Command selected			
			ng the JOG comma 22, following the ac		elerates to the value setting.	e defined	
		☑ The don't P2		s defined by the For	ward/Reverse functi	on (P223	
		☑ JOG	is effective only wi	th the motor at sta	ndstill.		
		☑ The J	JOG+ and JOG- co	mmands are alwa	ys via Digital Inputs.		
		☑ One [	Olx must be progran	nmed for JOG+ an	d another for JOG- a	s follows:	
			District in	Parar	neters		
			Digital Inputs	JOG+	JOG-		
			DI3	P265 = 10	P265 = 11		
			DI4	P266 = 10	P266 = 11		
			DI5	P267 = 10	P267 = 11		
			DI6 DI7	P268 = 10 P269 = 10	P268 = 11 P269 = 11		
			DI8	P209 = 10 P270 = 10	P209 = 11 P270 = 11		
		-		1 2.5 = 10	12.0-11		

125

Table 6.4 - JOG+ and JOG- command selection

Parameter	Range [Factory Setting] Unit	Description / No	tes					
		respectively ad		cted from the spe	es of P122 or P123 are ed reference to generate			
P124 (2) (11) Multispeed Reference 1 P125 (2) (11)	P133 to P134 [ 90 (75) ] 1 rpm P133 to P134	or P222 = 8 (M ✓ Multispeed is	lultispeed).	selection of a nu	nly when P221 = 8 and/ umber (up to 8) of pre-			
Multispeed Reference 2	[ 300 (250) ] 1 rpm	<ul> <li>If you want to use only 2 or 4 speeds, any input combination of DI4, D and DI6 can be used. The input(s) programmed for other function(must be considered as 0 V in the table 6.5.</li> <li>It allows control of the speed by relating the values programmed parameters P124 to P131 to a logical combination of the Digital Input</li> </ul>						
P126 (2) (11) Multispeed Reference 3	P133 to P134 [ 600 (500) ] 1 rpm							
P127 (2) (11) Multispeed Reference 4 P128 (2) (11)	P133 to P134 [ 900 (750) ] 1 rpm P133 to P134	<ul> <li>The advantages of this function are stability of the fixed references an electrical noise immunity (isolated digital inputs DIx).</li> <li>Multispeed function is active when P221 (Local Mode) or P222 (Remot Mode) is set to 8 (Multispeed).</li> </ul>						
Multispeed	[ 1200 (1000) ]	Digita	I Input	Prog	ramming			
Reference 5	1 rpm		014		266 = 7			
P129 (2) (11)	P133 to P134		015	P	267 = 7			
Multispeed	[ 1500 (1250) ]		016	P	268 = 7			
Reference 6	1 rpm		8	speeds				
D400 (2) (11)	D400 to D404			4 speeds				
P130 <sup>(2) (11)</sup> Multispeed	P133 to P134 [ 1800 (1500) ]		_	2	speeds			
Reference 7	1 rpm	DI6	DI5	DI4	Speed Ref.			
	,	0 V	0 V	0 V	P124			
P131 (2) (11)	P133 to P134	0 V	0 V	24 V	P125			
Multispeed	[ 1650 (1375) ]	0 V	24 V	0 V	P126			
Reference 8	1 rpm	0 V	24 V	24 V	P127			
		24 V	0 V	0 V	P128			
		24 V	0 V	24 V	P129			
		24 V	24 V	0 V	P130			
		24 V	24 V	24 V	P131			
			Table 6.5 -	Multispeed referenc	es			

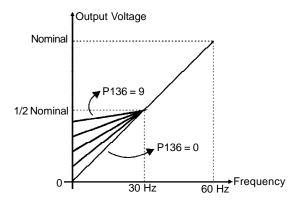


Parameter	Range [Factory Setting] Unit	Description / Notes
P135 (2) Speed Transition to I/F Control This parameter is shown on the display(s) only when P202 = 3 (Sensorless Vector Control)	0 to 90 [ 18 ] 1 rpm	b)  Speed  P134  Speed  P134  Speed  Reference  Speed  Speed  Reference  Speed  Speed  Reference  Speed  Spe
P136 Current Reference for I/F Mode For Sensorless Vector Control (P202 = 3)	0 to 9 [ 1 ] 1	Sets the current to be applied to the motor when in I/F Mode. I/F Mode occurs when the motor speed is lower than the value defined by parameter P135.  P136  Current in I/F Mode % of P410 (Imr)  0 100 % 1 111 % 2 122 % 3 133 % 4 144 % 5 155 % 6 166 % 7 177 % 8 188 % 9 200 %

Table 6.6 - Current reference for I/F mode

Parameter	Range [Factory Setting] Unit	De
P136 Manual Torque Boost	0 to 9 [ 1 ] 1	Ø
For V/F Control (P202 = 0, 1 or 2)		Ø

- Description / Notes
- I Compensates for the voltage drop on the motor stator resistance at low frequencies and increases the inverter output voltage in order to maintain a constant torque in V/F operation.
- Always set P136 to the lowest value that permits the motor to start satisfactorily. If the value is higher than required, an inverter overcurrent (E00 or E05) may occur due to high motor currents at low frequencies.



**Figure 6.4 -** P202 = 0 - V/F 60 Hz curve

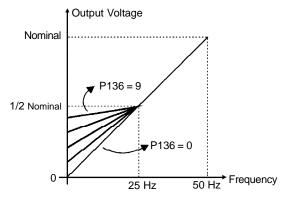
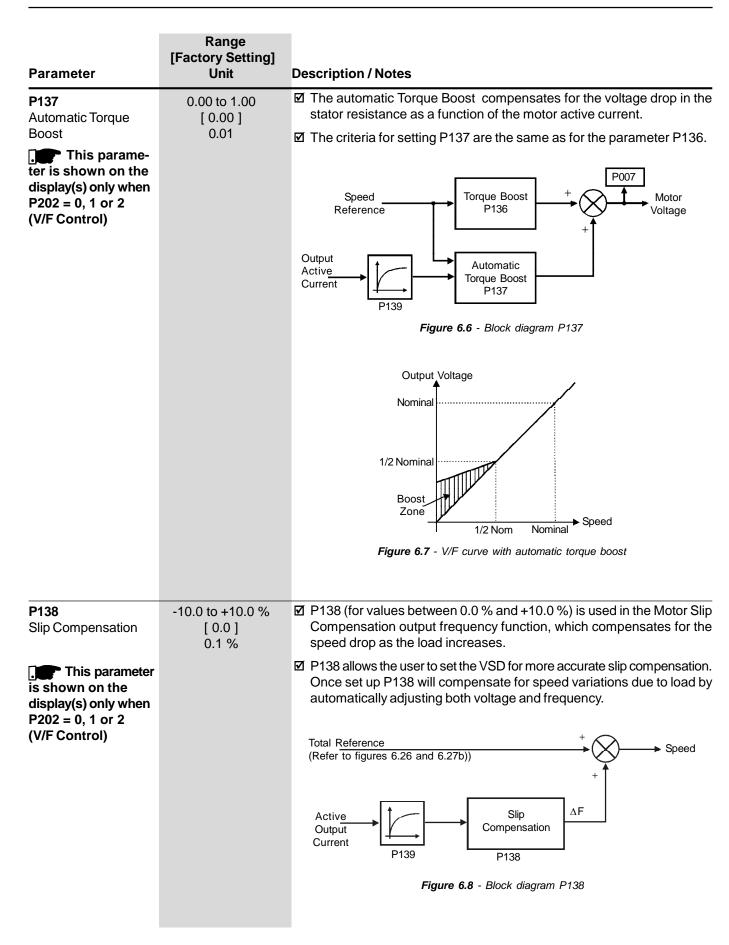
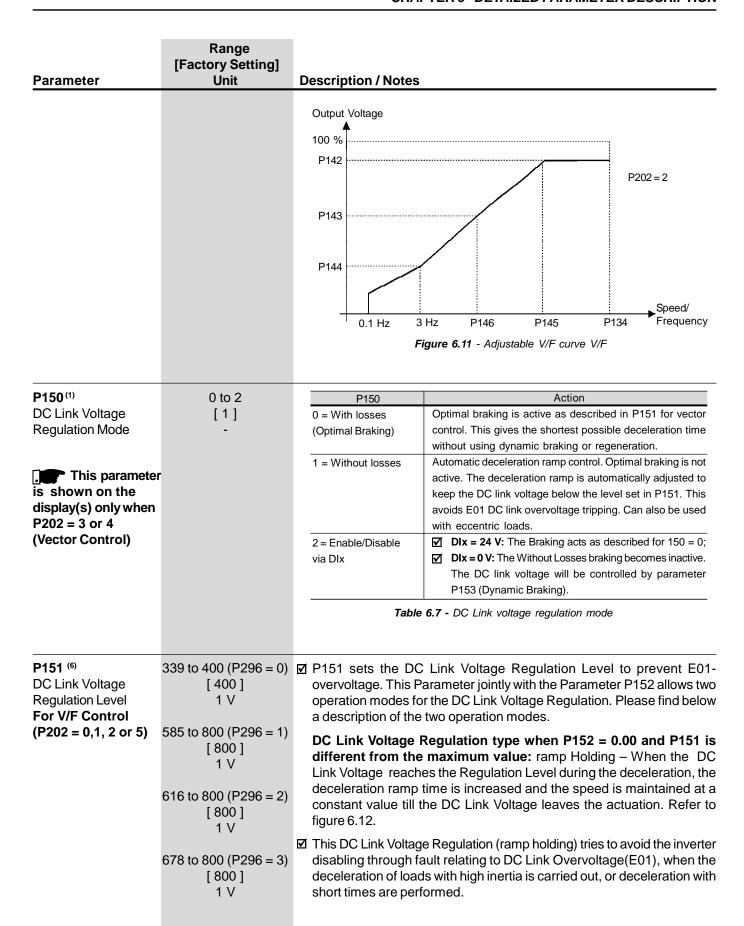


Figure 6.5 - P202 = 1 - V/F 50 Hz curve



Parameter	Range [Factory Setting] Unit	Description / Notes
P139 Output Current Filter [only for P202 = 0, 1	0.00 to 16.00 [ 1.00 ] 0.01 s	Output Voltage  Vnom  Figure 6.9 - V/F curve with slip compensation  ▼ To set Parameter 138:  ⇒ Run the motor without load up to approximately half of the application top speed;  ⇒ Measure the actual motor or equipment speed;  ⇒ Apply load;  ⇒ Increase P138 until the speed reaches its no-load value.  ▼ Values of P138 < 0.0 are used in special applications, where the reduction of the output speed is desired as function of the motor current increase. Ex.: load sharing between two motor/drive sets.  ▼ Adjusts the time constant of the active current filter.  ▼ It is used in the Automatic Torque Boost and Slip Compensation functions. Refer to figures 6.7 and 6.8
or 2 (for V/F Control)]  This parameter is shown on the display(s) only when P202 = 0, 1, 2 (V/F Control) or 5 (VVW)		<ul> <li>functions. Refer to figures 6.7 and 6.8.</li> <li>☑ Adjusts the response time of the slip compensation and automatic torque boost. Refer to figures 6.6 and 6.8.</li> </ul>
P140 Dwell Time at Start	0.0 to 10.0 [ 0.0 ] 0.1 s	Assist during high torque starts by allowing the motor to establish the flux before starting to accelerate the load.
P141 Dwell Speed at Start  This parameter is shown on the display(s) only when P202 = 0, 1, 2 (V/F Control) or 5 (VVW)	0 to 300 [ 90 ] 1 rpm	

	Range [Factory Setting]	
Parameter	Unit	Description / Notes
		P141  P140  Figure 6.10 - Curve for high torque starts
P142 <sup>(1)</sup> Maximum Output Voltage	0.0 to 100.0 [ 100.0 ] 0.1 %	☑ These parameters allow changing the standard V/F curves defined at P202. Special V/F profiles may be necessary when motors with non- standard voltages/frequencies are used.
P143 <sup>(1)</sup> Intermediate Output Voltage	0.0 to 100.0 [ 50.0 ] 0.1 %	☑ This function allows changing the predefined standard curves, which represents the relationship between the output voltage and the output frequency of the inverters and consequently, the motor magnetization flux. This feature may be useful with special applications that require rated voltage values or rated frequency values different from the standard
P144 <sup>(1)</sup> Output Voltage	0.0 to 100.0 [ 8.0 ]	ones.  ✓ ones.  Function activated by setting P202 = 2 (V/F Adjustable).
P145 <sup>(1)</sup> Field Weakening Speed	0.1 % P133(> 90) to P134 [ 1800 ] 1 rpm	The factory default value of P144 (8.0 %) is defined for standard 60 Hz motors. If the rated motor frequency (set at P403) is different from 60 Hz, the factory default value of P144 can become unsuitable and may cause troubles during motor start. A good approach for the setting of P144 is given by $P144 = \frac{3}{P403} \times P142$
P146 <sup>(1)</sup> Intermediate Speed	90 to P145 [ 900 ]	
These parameters are shown	1 rpm	If an increase of the starting torque is required, increase the value of P144 gradually.  ☑ Procedures for the parameter setting of the function "Adjustable V/F":
on the display(s) only when P202 = 2		1.Disable Inverter;
(Adjustable V/F Control)		2.Check inverter data (P295 to P297);  3.Set motor data (P400 to P406);
Control		4.Set display data in P001 and P002 (P208, P210, P207, P216 and P217);
		5. Set speed limits (P133 and P134);
		6.Set parameters of the function "Adjustable V/F" (P142 to P146);
		7.Enable function "Adjustable V/F" (P202 = 2).



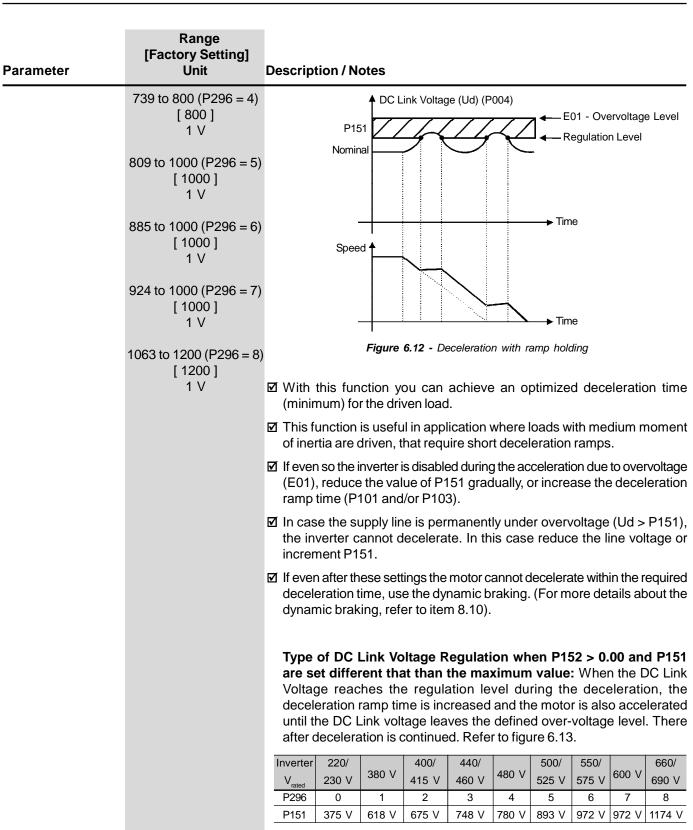


Table 6.8 - Recommended values for DC Link voltage regulation level

# Range [Factory Setting] **Parameter** Unit **Description / Notes** ↑ DC Link Voltage (Ud) (P004) E01 - Overvoltage Level P151 Regulation Level Nominal Time Speed 4 Figure 6.13 - Deceleration curve with DC Link voltage limitation (regulation) **NOTES!** ☑ The factory setting is at maximum (Link regulation is deactivated). To activate this regulation, we recommend to set P151 according table 6.8. ☑ If even after this setting the inverter is still disabled due to overvoltage (E01) during the load acceleration, increase the value of the Parameter P152 gradually, or increase the deceleration ramp time (P101 and/or P103). The inverter will not decelerate, if the supply line is permanently under overvoltage Ud > P151). In this case reduce the line voltage or increment P151. P152 DC Link Speed Voltage (Ud) Speed Ramp P151 Output Figure 6.14 - Voltage regulation block diagram of the DC Link NOTE! For large motors it's recommended the use of the ramp holding function.

Parameter	Range [Factory Setting] Unit	Description / Notes
P151 <sup>(6)</sup> DC Link Voltage Regulation Level For Vector Control (P202 = 3 or 4)	339 to 400 (P296 = 0) [ 400 ] 1 V 585 to 800 (P296 = 1) [ 800 ]	<ul> <li>P151 defines the level for the DC Link voltage regulation during braking. The time of the deceleration ramp is automatically extended, thus avoiding overvoltage error (E01).</li> <li>The DC Link voltage regulation has two modes of operation:</li> <li>With losses (Optimal braking) – set P150 to 0. In this mode the flux</li> </ul>
	1 V 616 to 800 (P296 = 2) [ 800 ] 1 V	current is modulated so as to increase the losses in the motor, there by increasing the braking torque. It works better with lower efficiency motors (smaller motors). It is not recommended for motors bigger than 75 hp/55 kW. Refer to explanation below.
	678 to 800 (P296 = 3) [ 800 ] 1 V	<ol> <li>Without losses – set P150 to 1. Only the DC Link voltage regulation is active.</li> </ol> NOTE!
	739 to 800 (P296 = 4) [ 800 ]	P151 factory setting is set at maximum this disables the DC Link voltage regulation. To enable it, adjust according to table 6.8.
	1 V 809 to 1000 (P296 = 5) [ 1000 ] 1 V	Dynamic Braking components. In the case of DC Braking, except for the friction losses, only the rotor losses are used to dissipate the stored
	885 to 1000 (P296 = 6) [ 1000 ] 1 V 924 to 1000 (P296 = 7) [ 1000 ] 1 V 1063 to 1200 (P296 = 8) [ 1200 ] 1 V	With Optimal Braking, both the total motor losses and the inverter losses are used. In this way, it is possible to achieve a braking torque of approximately 5 times higher than with the DC braking (Refer to figure
		This feature allows high dynamic performance without the use of a Dynamic Braking resistor.
		Figure 6.15 shows a Torque x Speed curve of a typical 7.5 kW/10 hp, IV pole motor. The braking torque developed at full speed, with torque (P169 and P170) limited by the CFW-09 at a value equal to the motor rated torque, is given by TB1 point (figure 6.15).
		TB1 value depends on the motor efficiency and disregarding the friction losses it is given by the following equation:
		$TB1 = \frac{1 - \eta}{\eta}$
		Where:
		$\eta$ = motor efficiency
		For the case in figure 6.15, the motor efficiency at full load condition is 84 % $\eta$ = 0.84, that results in TB1 = 0.19 or 19 % of the motor rated torque. Starting at TB1 point, the braking torque varies in the reverse proportion of the speed (1/N). At low speeds, the braking torque reaches the torque limit level set by the inverter. For the case of figure 6.15, the torque limit (100 %) is reached when the speed is 20 % of the rated speed.

Parameter	Range [Factory Setting] Unit	Description / Notes
		The braking torque indicated in figure 6.15 can be increased by increasing the inverter torque limit: P169 (maximum forward torque current) or P170 (maximum reverse torque current).
		☑ In general, smaller motors have lower efficiency (higher losses) consequently Optimal Braking can achieve higher braking torques with smaller motors.
		Examples: 0.75 kW/1 hp, IV poles: $\eta$ = 0.76 that results in TB1 = 0.32
		15 kW/20 hp, IV poles: $\eta$ = 0.86 that results in TB1 = 0.16
		Torque (PU)  (a)  Figure 6.15 - T x rpm curve for optimal braking and typical 10 hp/7.5 kW motor driven by an inverter with torque limitation set for a value equal to the rated motor torque  (a) Torque generated by the motor in normal operation, driven by an inverter in "motor mode".  (b) Braking torque generated by Optimal Braking (c) Braking torque generated with DC Injection Braking
		The enabling of the optimal braking can increase the motor noise level and the vibration level. If this is not desired, disable the optimal braking.
P152	0.00 to 9.99	☑ Refer to P151 for V/F Control (figure 6.14).
Proportional Gain of the DC Link Voltage Regulator [Only for P202 = 0,	[ 0.00 ] 0.01	☑ If P152 = 0.00 and P151 is different from the maximum value, the Ramp Holding function is active. (Refer to P151 for the Scalar Control Mode)
1, 2 (V/F Control) or 5 (VVW)]		P152 multiplies the DC Link voltage error, i.e. DC Link actual - DC Link setting (P151). P152 is typically used to prevent overvoltage in applications with eccentric loads.
P153 <sup>(6)</sup> Dynamic Braking Voltage Level	339 to 400 (P296 = 0) [ 375 ] 1 V 585 to 800 (P296 = 1) [ 618 ] 1 V 616 to 800 (P296 = 2) [ 675 ] 1 V	☑ Dynamic braking can only be used if the inverter is fitted with a dynamic braking resistor. The voltage level for actuation of the brake chopper must be set according to the supply voltage. If P153 is set too close to the overvoltage trip level (E01) an overvoltage trip may occur before the brake chopper and resistor can dissipate the braking energy. The following are the recommended settings:

Parameter	Range [Factory Setting] Unit	Descript	tion / Notes				
	678 to 800 (P296 = 3)		Inverter V <sub>nom</sub>	P296	P153	E01	
	[ 748 ]		220/230 V	0	375 V	> 400 V	
	1 V		380 V	1	618 V		
	739 to 800 ( $P296 = 4$ )		400/415 V	2	675 V	000 1/	
	[ 780 ]		440/460 V	3	748 V	> 800 V	
	1 V		480 V	4	780 V		
	809 to 1000 (P296 = 5)		500/525 V	5	893 V		
	[ 893 ]		550/575 V	6	972 V	> 1000 V	
	1 V		600 V	7	972 V		
	885 to 1000 (P296 = 6)		660/690 V	8	1174 V	> 1200 V	
	[ 972 ] 1 V 924 to 1000 (P296 = 7)		<b>ble 6.9</b> - Recon	nmended settin	gs of the dyna	mic braking actuation	
	[ 972 ] 1 V 1063 to 1200 (P296 = 8) [ 1174 ] 1 V		P153 Nominal	ink Voltage (Ud		E01 -Overvoltage Level Dynamic Braking Level	
		DE	Resistor Voltage	Ud  6 - Curve of th	Ud Ud ►Ti	me	
		☑ To act	uate the Dyna	amic Braking	<b>g</b> :		
		⇒Cor	nnect the DB	resistor. Ref	er to chapte	r 8.	
			P154 and P		•	e of the Dynamic braking	
		⇒ Set P151 to its maximum value: 400 V (P296 = 0), 800 V (P29 3 or 4), 1000 V (P296 = 5, 6 or 7) or 1200 V (P296 = 8), to avoid a of the DC Link Voltage Regulation before Dynamic Braking.					
P154	0.0 to 500	☑ Resist	tance value o	f the Dynami	ic Braking res	sistor (in ohms).	
Dynamic Braking Resistor	[ $0.0$ ] $0.1 \Omega$ ( $\leq 99.9$ )- $1 \Omega$ ( $\geq 100$ )		= 0 disables ammed to 0 w			rload protection. Must be ot used.	
P155 DB Resistor Power	0.00 to 650 [ 2.60 ]		sts the overlo	•	•	nic Braking resistor. Set it stor (in kW).	
Rating	0.01 kW (< 9.99) 0.1 kW (> 9.99) 1 kW(> 99.9)	<ul> <li>✓ If the average power in the braking resistor during 2 minutes is higher than the value set at P155, the inverter trips on an E12 fault.</li> <li>✓ Refer to item 8.10.</li> </ul>					

Parameter	Range [Factory Setting] Unit	Description / Notes
P156 (2) (7) (12) Motor Overload Current at 100 % Speed	P157 to 1.3 x P295 [ 1.1 x P401 ] 0.1 A(< 100) -1 A(> 99.9)	I (A) = Motor Current (P003) Overload Current
P157 (2) (7) Motor Overload Current at 50 % Speed	P156 to P158 [ 0.9 x P401 ] 0.1 A(< 100) -1 A(> 99.9)	2.5
P158 <sup>(2) (7)</sup> Motor Overload Current at 5 % Speed	0.2 x P295 to P157 [ 0.55 x P401 ] 0.1 A(< 100) -1 A(> 99.9)	2 1.5 1.3 1.1 0.5
		0 15 30 60 75 100 150 300  Figure 6.17 - Ixt function - Overload detection
		% P401
		P156
		100 98
		90 P157
		0 5 50 100 % Speed
		Curve for motor with separate ventilation  Curve for self-ventilated motor  Increased Protection Curve  Figure 6.18 - Overload protection levels
		☑ Used to protect motor and inverter against timed overload (Ixt - E05).
		☑ The Motor Overload Current (P156, P157 and P158) is the current level above which the CFW-09 will consider the motor operating under overload. The higher the overload, the sooner the Overload Fault E05 will occur.
		☑ Parameter P156 (motor overload current at base speed) must be set 10 % higher than the used rated motor current (P401).

☑ The overload current is given as a function of the motor speed. The parameters P156, P157 and P158 are the three points used to form the overload curve, as shown in figure 6.18 with the factory default levels.

Parameter	Range [Factory Setting] Unit	<ul> <li>Description / Notes</li> <li>☑ This overload curve adjustment improves the protection of self-ventilated motors, or it can be programmed with a constant overload level at any speed for blower cooled motors.</li> <li>☑ This curve is changed when P406 (Ventilation Type) is changed during the start-up subroutine. (Refer to item 5.2).</li> </ul>
P160 (1) Optimization of the Speed Regulator (for torque control)	0 or 1 [0]	Speed Regulator Normal or Saturated? Set P160 = 1 (P202 = 4) Set P160 = 0 (P202 = 3)  Speed reference setting. Refer to the text below.  Setting of the desired Torque. Refer to the text below.  Figure 6.19 - Torque control  Speed Regulator operating with Current Limitation (Saturated) for torque limitation purposes  The speed reference shall be set to value at least 10 % higher than the working speed. It ensures that the output of the speed regulator will be equal to the maximum allowed value set for the maximum torque current (P169, or P170, or external limitation through Al2 or Al3). In such way, the regulator will operate with current limitation, i.e., saturated.  When the speed regulator is positively saturated, i.e., in the forward direction (set in P223/P226), the value for the torque current limitation is set at parameter P160.  When the speed regulator is negatively saturated, i.e., in the reverse direction (set in P223/P226), the value for the torque current limitation is set at parameter P170.  The torque limitation with the saturated speed regulator has also a protection function (limitation). For instance: in a winder, if the winding material is disrupted, then the regulator leaves the saturated condition and starts controlling the motor speed, which will be limited by the speed reference value.

	Range [Factory Setting]	
Parameter	Unit	Description / Notes
		Torque limitation settings
		☑ The torque can be limited as follows:
		1. Through parameters P169/P170 (by using the keypad, the Serial Wegbus protocol or the Fieldbus protocols)
		2. Through AI2 (P237 = 2 - Maximum torque current)
		3. Through Al3 (P241 = 2 - Maximum torque current)
		Notes:
		☑ The motor current shall be equivalent to the CFW-09 inverter current so that the torque control can achieve its best precision.
		☑ The Sensorless Control (P202 = 3) does not work with torque limitation at frequencies lower than 3 Hz. Use the Vector with Encoder Control (P202 = 4) for applications that require torque limitation at frequencies lower than 3 Hz.
		☑ The torque limitation (P169/P170) shall be greater than 30 % in order to guarantee the motor start in the Sensorless Mode (P202 = 3). After the motor has started and it is running above 3 Hz, the torque limitation value (P169/P170) may be reduced below 30 %, if required.
		☑ The motor torque (Tmotor) can be calculated from the value at P169/ P170 by using the following equation:
		Tmotor = $\frac{P295 \times \frac{P169 *}{100} \times K}{\sqrt{(P401)^2 - \left(P410 \times \frac{P178}{100}\right)^2}} \times 100$
		where: Tmotor - Percentage value of the rated motor torque.
		$K = \begin{cases} 1 & \text{for } N \leq N \text{ rated} \\ \frac{N \text{ rated}}{N} \times \frac{P180}{100} & \text{for } N > N \text{ rated} \end{cases}$
		Nrated = Motor synchronous speed N = Motor actual speed * The above equation is valid for forward torque. To reverse torque, replace P169 by P170.

	Range	
Parameter	[Factory Setting] Unit	Description / Notes
P161 (3) Proportional Gain of	0.0 to 63.9 [ 7.4 ]	☑ The gains for the speed regulator are automatically set based on the value of parameter P413 (Tm Constant).
the Speed Regulator	0.1	☑ However, these gains can be manually adjusted in order to optimize the dynamic response of the speed. Increase this value to have a faster response. Although, reduce this value in case of speed oscillations.
Integral Gain of the [ 0.023	0.000 to 9.999 [ 0.023 ] 0.001	☑ In general, P161 smoothes abrupt changes of speed or reference, while P162 reduces the error between the set point and the real speed value, as well as improves the torque response at low speeds.
		☑ Optimization of the Speed Regulator – Procedure for manual setting:
		Select the acceleration (P100) and/or deceleration (P101) time according to the application;
		2 - Set the speed reference to 75 % of the maximum value;
		3 - Configure the analog output AO3 or AO4 to Real Speed by setting P255 or P257 to 2;
		<ul><li>4 - Block the speed ramp – Start/Stop = Stop and wait until the motor stops;</li></ul>
		<ul><li>5 - Release the speed ramp – Start/Stop = Start; observe the motor speed signal at the analog output AO3 or AO4 with an oscilloscope;</li></ul>
		6 - Check among the options in figure 6.20 which waveform best represents the signal measured with the oscilloscope.
		$\begin{array}{c} N(V) \\ \downarrow \\ $
		a) Low Gain(s) b) Optimized Speed c) High Gain(s)  Regulator
		Figure 6.20 - Types of response for the speed regulator
		Settings of P161 and P162 as a function of the type of response presented in figure 6.20:
		a) Increase the proportional gain (P161), and/or increase the integral gain (P162).
		b) Speed regulator is optimized.
		c) Decrease the proportional gain (P161), and/or decrease the integral gain (P162).

Parameter	Range [Factory Setting] Unit	Description / Notes
P163 Local Speed Reference Offset	-999 to 999 [ 0 ] 1	☑ Parameters P163 or P164 may be used to compensate a bias offset at the analog input signals, when the speed reference is given by the analog inputs (Al1 to Al4).
P164 Remote Speed Reference Offset	-999 to 999 [ 0 ] 1	☑ Refer to figure 6.26.
These parameters (P160 to P164) are shown on the display(s) only when P202 = 3 or 4 (Vector Control)		
P165 Speed Filter This para-	0.012 to 1.000 [ 0.012 ] 0.001 s	☑ Adjusts the time constant for the Speed Filter. Refer to figure 6.27 a).  NOTE!
meter is shown on the display(s) only when P202 = 3 or 4 (Vector Control)		In general, this parameter shall not be changed. Increasing the speed filter value renders the system response slower.
P166 Speed Regulator Differential Gain	0.00 to 7.99 [ 0.00 ]	☑ The differential action may reduce the effects on the motor speed caused by the load variation. Refer to figure 6.27 a).
This para-		P166 Differential Gain Action  0.0 Off
meter is shown on		0.01 to 7.99 On
the display(s) only when P202 = 3 or 4 (Vector Control)		Table 6.10 - Speed regulator differential gain action
P167 (4) Proportional Gain of the Current Regulator	0.00 to 1.99 [ 0.5 ] 0.01	☑ The parameters P167 and P168 are set by the self-tuning routine as a function of parameters P411 and P409, respectively.
P168 <sup>(4)</sup> Integral Gain of the Current Regulator	0.000 to 1.999 [0.010] 0.001	These parameters must not be changed.
Parameters (P166 and P167 and P168) are shown on the display(s) only when P202 = 3 or 4 (Vector Control)		

Parameter P169 (7) Maximum Output Current For V/F Control (P202 = 0, 1, 2 or 5)	[ 1.5 x P295 ]	Description / Notes  ☑ This parameter limits the motor output current by reducing the speed, which avoids motor stalling under overload conditions.  ☑ As the motor load increases, the motor current also increases. When this current exceeds the value set at parameter P169, the motor speed is reduced (by using the deceleration ramp) until the current value falls below the value set at P169. The motor speed is resumed when the overload condition stops.  Motor current P169  Accel. Ramp (P100/P102)  During During Cont. Duty Decel. accel.  Figure 6.21 - Curves showing the actuation of the current limitation
P169 (7) Maximum Forward Torque Current For Vector Control (P202 = 3 or 4)	0 to 180 [ 125 ] 1 %	<ul> <li>☑ This parameter limits the value of the component of the motor current that produces forward torque. The setting is expressed as a percentage value of the inverter rated current (P295 = 100 %).</li> <li>☑ The values of P169/P170 can be calculated from the maximum desired value for the motor current (Imotor) by using the following equation:</li> <li>P169/P170 (%) = √(100 x Imotor)<sup>2</sup> - (100 x P410)<sup>2</sup> P295)</li> </ul>
P170  Maximum Reverse Torque Current  This parameters (P169 and P170) are shown on the display(s) only when P202 = 3 or 4 (Vector Control)	0 to 180 [ 125 ] 1 %	☑ This parameter limits the value of the component of the motor current that produces reverse torque. While operating in torque limitation, the motor current can be calculated by: $Imotor = \sqrt{\left(\frac{P169 \text{ or } P170}{100} \times P295\right)^2 + (P410)^2}$

Parameter	Range [Factory Setting] Unit	Description / Notes
		☑ The maximum torque produced by the motor is given by:
		Tmotor (%) = $\frac{P295 \times \frac{P169}{100} \times K}{\sqrt{(P401)^2 - \left(\frac{P410 \times P178}{100}\right)^2}} \times 100$
		where: $K = \begin{cases} 1 \text{ for } N \leq N \text{ rated} \\ \frac{N \text{ rated}}{N} \times \frac{P180}{100} \text{ for } N > N \text{ rated} \end{cases}$
		☑ While the Optimal Braking is operating, P169 limits the maximum output current in order to produce the braking forward torque (refer to P151). Refer to the description for P169 above.
P171	0 to 180	☑ Torque current limitation as a function of the speed:
Maximum Forward Torque Current at the Maximum Speed (N = P134)	[ 125 ] 1 %	Torque Current
P172 Maximum Reverse Torque Current at the Maximum Speed	0 to 180 [ 125 ] 1 %	P170/P169 P173 = 0
(N = P134)		P173 = 1
These parameters (P171 and P172) are shown on		100  Figure 6.22 – Operation curve of the torque limitation at maximum speed
the display(s) only when P202 = 3 or 4 (Vector Control)		☑ This function is disabled while the value of P171/P172 is equal to or greater than the value of P169/170.
		☑ P171 and P172 operate also during the optimal braking by limiting the maximum output current.
P173 Type of Curve for the Maximum Torque	0 or 1 [ 0 ] -	☑ It defines the operation curve of the torque limitation at the field-weakening region. Refer to figure 6.22.
This para-		P173 Curve Type
meter is show on the display(s) only		0 Ramp
when $P202 = 3 \text{ or } 4$		1 Step
(Vector Control)		Table 6.11 - Curve type of the maximum torque

	_					
	Range [Factory Setting]					
Parameter	Unit	Description / Notes				
P175 <sup>(5)</sup> Proportional Gain of the Flux Regulator	0.0 to 31.9 [ 2.0 ] 0.1	☑ P175 and P176 are automatically set as a function of parameter P412. In general the automatic setting is adequate and there is no need for a reconfiguration.				
P176 <sup>(5)</sup> Integral Gain of the Flux Regulator	0.000 to 9.999 [ 0.020 ] 0.001	☑ These gains shall only be manually reconfigured when the excitation current signal (id*) is oscillating and compromising system operation.				
		NOTE! The excitation current (id*) may be unstable in case of P175 > 12.				
		<b>Note</b> : (id*) can be observed at analog outputs AO3 and /or AO4 by setting P255 = 14 and / or P257 = 14, or at P029 and / or P030.				
P177 Minimum Flux	0 to 120 [ 0 ] 1 %	☑ Parameters P177 and P179 define the output limits of the flux regulator in the Sensorless Vector Control.				
P178 Rated Flux	0 to 120 [ 100 ] 1 %	NOTE! These parameters shall not be changed.				
P179 Maximum Flux	0 to 120 [ 120 ] 1 %	☑ P178 is the flux reference to both Vector controls (Sensorless and with Encoder).				
P177 and P179 are active only when P202 = 3 (Sensorless Vector)						
P180 Starting Point of the Field Weakening Region	0 to 120 [ 95 ] 1 %	☑ This parameter is represented as a percentage of the motor rated speed (P402) and defines the speed where the field weakening region of the motor starts. ☑ If the inverter is exercting in Vector Central and the motor is not reaching.				
These parameters (P175, P176, P178 and P180) are shown on the display(s) only when P202 = 3 or 4 (Vector Control)		☑ If the inverter is operating in Vector Control and the motor is not reaching its rated speed, it is possible to gradually reduce the value of parameters P180 and/or P178 until it works appropriately.				
P181 <sup>(1)</sup>	0 or 1	P181 Function Action				
Magnetization Mode	[0]	0 General Enable It applies magnetization current after General Enable ON				
This parameter is shown on the		1 Start/Stop It applies magnetization current after Start/Stop ON				
display only when P202 = 4 (Vector		Table 6.12 - Magnetization mode				
Control with Encoder)		☑ In sensorless vector, magnetization current is permanently ON. To disable magnetization current when the motor is stopped, program P211 to 1 (ON). This can be given a time delay by programming P213 greater than zero.				

zero.

# 6.3 CONFIGURATION PARAMETERS - P200 to P399

	DC3011	ption / No	otes			
0 or 1		P200	Function	Result		
[1]		0	Off	Disables the Password and allows changing parameters content independently of P000.		
		1	On	Enables the Password and allows changing parameters content only when P000 is set to the password value.		
			Tal	ble 6.13 - Password		
		•				
0 to 3			P201	Language		
				Português		
-			1	English		
			2	Español		
			3	Deutsch		
0 to 5				.14 - Language selection		
				Type of Control		
-				V/F 60 Hz		
				V/F 50 Hz		
				V/F Adjustable (Refer to P142 to P146)  Sensorless Vector		
				Vector with Encoder		
				VVW (Voltage Vector WEG)		
		•	5	VVVV (Vollage Vector VVLG)		
0 or 1			the Type of (	Control selection Refer to item 5.3.  De of special functions:		
[0]			P203	Functions		
			0	Not Used		
				PID Regulator		
	Table 6.16 - Special function selection					
	rela ☑ Whe	ted param en P203 is	eters (P520	PID regulator, refer to detailed description of to P535). o 1, P265 is changed automatically to 15 -		
	0 to 3 [-] - 0 to 5 [0 (1)]	[1] -  ☑ The ☑ To o  O to 3 [-] -  O to 5 [0 (1)] -  ☑ For rela ☑ Who	[1]	Table 6.16    Table 6.16   Table 6.16   Table 6.16   For the special function of related parameters (P520)   When P203 is changed to		

Parameter	Range [Factory Setting] Unit	Description / Notes
P204 (1)(10) Load/Save Parameters	0 to 11 [ 0 ] -	☑ The parameters P295 (Inverter Rated Current), P296 (Inverter Rated Voltage), P297 (Switching Frequency), P308 (Serial Address) and P201 (Language) are not changed when the factory default parameters are loaded through P204 = 5 and 6.
		☑ In order to load the User Parameters #1 (P204 = 7) and/or the User Parameters #2 (P204 = 8) into the operation area of the CFW-09, it is necessary that the User Memory #1 and/or the User Memory #2 have been previously saved (P204 = 10 and/or P204 = 11).
		☑ Once entered the user parameters are automatically saved to the VSD EEPROM. In addition it is possible to save two further sets of parameters, or to use these as a "backup".
		☑ The operation of Load User 1 and/or 2 can also be done by DIx (refer to parameters P265 to P269).
		$\blacksquare$ The options P204 = 5, 6, 7, 8, 10 and 11 are disables when P309 $\neq$ 0 (Active Fieldbus).
		User Default 1
		Current Inverter Parameters  P204 = 5 or 6  Factory Default
		User Default 2
		Figure 6.23 - Parameter transference

Parameter	Range [Factory Setting] Unit	Descrip	otion / Note	s		
			P204		Action	
			0, 1, 2, 9		Used:	
			3	Rese	et P043: ets the Time Enabled hour	
			4	Rese Rese	r to zero et P044: ets the kWh counter to zero	
			5	Rese	I WEG-60 Hz:  ts all parameters to the 60 Hz  ry default values.	
			6	Rese	I WEG-50 Hz: ets all parameters to the 50 Hz ry default values.	
			7	<b>Load</b> Rese	I User 1: ets all parameters to the values stored rameter Memory 1.	
			8	<b>Load</b> Rese	I user 2: ets all parameters to the value d in Parameter Memory 2.	
			10	Save Store	es all current inverter parameter es to Parameter Memory 1.	
			11	Save Store	e User 2: es all current inverter parameter values arameter Memory 2.	
				e 6.17 -	Action of loading/saving parameters	
		T			g/saving parameters will take eand the <b>Proo</b> key is pressed.	effect only after
P205 Display Default	0 to 7 [2] -			-	ameters listed below will be show erter has been powered up:	n on the display
			P20	05	Display Default	
			0		P005 (Motor Frequency)	
			1		P003 (Motor Current)	
			2		P002 (Motor Speed)	
			3		P007 (Motor Voltage) P006 (Inverter Status)	
			4		P009 (Motor Torque)	
			6		P070 (Motor Speed and Motor Curre	ent)
			7		P040 (PID Process Variable)	
				Table (	6.18 - Options displays default	

Parameter	Range [Factory Setting] Unit	Description / Notes					
<b>P206</b> Auto-Reset	0 to 255 [ 0 ]	☑ In the event of a fault trip, except for E09, E24, E31 and E41, the CFW-09 can initiate an automatic reset after the time given by P206 is elapsed.					
Time	1 s	<b>☑</b> If P206 ≤ 2 Auto-R	eset does not occu	r.			
			ction will be disable	peated three times consects. A fault is considered cons after Auto-Reset.			
		☑ Hence, if an error indicated (and the		utive times, it will be perm bled).	anently		
P207 Reference	32 to 127 [ 114 = r ]	☑ This parameter is useful only for inverters provided with a keyp LCD display.					
Engineering Unit 1	-	·	eed). The letters rp	isplay to P001 (Speed refe m can be changed to user s	,		
		☑ The Reference Engineering Unit is formed by three characters, which will be applied to the Speed Reference (P001) and the Motor Speed (P002) LCD display indications. P207 defines the left character. P216 defines the center character and P217 the right character.					
		All characters correspondent to the ASCII code from chosen.					
		Examples: A, B,	, Y, Z, a, b, $\dots$ , y,	z, 0, 1,  , 9, #, \$, %, (,  )	ı, *, +,		
P208 (2)(11) Reference Scale	1 to 18000 [ 1800 (1500) ]	☑ Defines how the S will be displayed.	peed Reference (P	001) and the Motor Speed	(P002)		
Factor	1	☑ For indicating the	e values in rpm:				
		Set the synchrono	-	g to table 6.19.			
		Frequen	Motor Pol	e Syncronous			
		Trequen	Number	Speed - rpm			
			2	3000			
		50 Hz	4	1500			
			6	1000			
			8	750			
			2	3600			
		60 Hz	4	1800			
			6 8	1200 900			
			'				
		For indicating ot	5.19 - Synchronous sp ner values:	eed reference in rpm			

The displayed value when the motor is running at synchronous speed can be calculated through the following equations:

 $P002 = Speed \times P208 / Sync speed \times (10)^{P210}$ 

Parameter	Range [Factory Setting] Unit	Description / Notes
		P001 = Reference x P208 / Sync speed x (10) <sup>P210</sup> Where: Reference = Speed Reference in rpm; Speed = Motor speed in rpm; Sync Speed = Motor synchronous speed (120 x P403 / Poles); Poles = Motor number of poles (120 x P403 / P402). Example: Desired indication: 90.0 l/s at 1800 rpm Motor synchronous speed: 1800 rpm Programming: P208 = 900, P210 = 1, P207 = I, P216 = /, P217 = s
P209 <sup>(1)</sup> Motor Phase Loss Detection	0 or 1 [0]	P209 Motor Phase Loss (E15)  0 Off 1 On  Table 6.20 - Actuation motor phase loss detection  ✓ With the Motor Phase Loss Detector enabled (P209 = 1), E15 happens when the following conditions occur simultaneously during a minimum time of 2 seconds:  I. P209 = On; II. Inverter enabled; III. Speed reference higher than 3 %; IV.  I <sub>u</sub> -I <sub>v</sub>   > 0.125 x P401 or  I <sub>u</sub> -I <sub>w</sub>   > 0.125 x P401 or  I <sub>v</sub> -I <sub>w</sub>   > 0.125 x P401.
P210 Decimal Point of the Speed Indication	0 to 3 [ 0 ] 1	☑ Defines the number of digits after the decimal point of the Speed Reference (P001) and the Motor Speed indications (P002).
P211 <sup>(1)</sup> Zero Speed Disable	0 or 1 [0] -	P211 Zero Speed Disable  0 Off 1 On  Table 6.21 - Zero speed disable  ☑ When active, it disables (general disabling, motor runs freely) the inverter when the speed reference and the actual motor speed are lower than the value set at P291 (Zero Speed Zone).  ☑ The CFW-09 will be enabled again, when one of the conditions defined by the Parameter P212 is satisfied.

Parameter	Range [Factory Setting] Unit	Description / Notes
<b>P212</b> Condition to Leave Zero Speed Disable	0 or 1 [ 0 ] -	P212 Inverter leaves zero (P211 = 1) speed disable if  0 P001 (Speed ref. N*) > P291 or P002 (Motor speed N) > P291
		1   P001 (Speed ref. N*) > P291  Table 6.22 - Condition to leave zero speed disable
		☑ When the PID Regulator is active (P203 = 1) and in Automatic mode, the inverter leaves the Zero Speed, besides the programmed condition in P212, only when the PID input error (the difference between setpoint and process variable) is higher than the value programmed in P535.
P213	0 to 999	☑ P213 = 0: Zero speed disable without timing.
Time Delay for Zero Speed Disable	[0] 1s	☑ P213 > 0: Zero speed disable will only become active after the time delay set in P213. Timing starts when the zero speed zone conditions are met. If these conditions are no longer met during the delay time, the timer will reset.
P214 <sup>(1)(9)</sup> Line Phase Loss	0 or 1 [ 1 ]	P214 Line Undervoltage/
Detection	-	Phase Fault (E03)  O Off
		1 On
		Table 6.23 - Actuation line phase loss detection
		The phase loss detector is active when:
		P214 = On and the CFW-09 is enabled.
		The display indication and the updating of the fault memory happen 3 seconds after the fault has occurred.
		NOTE! The phase loss detection is not available in types up to 28 A for 220-230 V and 380-480 V supply voltage and in types up to 14 A for 500-600 V supply voltage, independently of the value set in P214.
P215 <sup>(1)</sup>	0 to 2	P215 Action
Copy Function	[0]	0 = Off None
		1 = INV → Keypad  Transfers the current parameter values and the content of the User 1/2 Memories to the non volatile EEPROM memory of the Keypad (HMI). The current inverter parameters are not changed.
		2 = Keypad  → INV  Transfers the content of the Keypad  (HMI) memory to the current inverter parameters and to the User 1/2  Memories.
		Table 6.24 - Action copy function

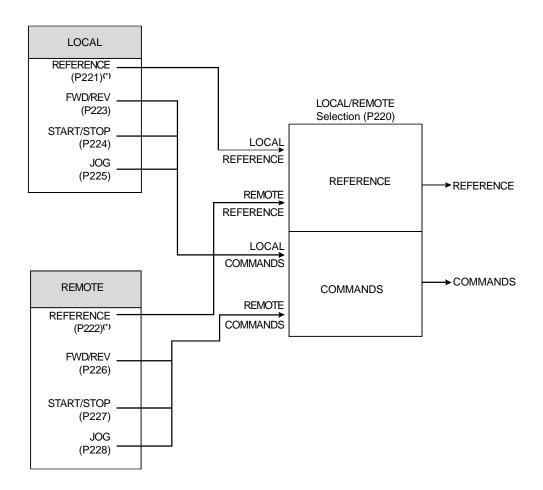
	Range [Factory Setting]	
Parameter	Unit	Description / Notes
		☑ The copy function is used to transfer the content of the parameters from one inverter to another. The inverters must be of the same type (voltage/current and the same software version must be installed.
		If the HMI has parameters saved of a "different version" than installed in the inverter to which it is trying to copy the parameters, the operation will not be executed and the inverter will display the error E10 (Error: not permitted Copy Function). "Different Version" are those that are different in "x" or "y", supposing that the numbering of Software Versions is described as Vx.yz.
		Example: version V1.60 $\rightarrow$ (x = 1, y = 6 and z = 0) stored in the HMI previously I. Inverter version: V1.75 $\rightarrow$ (x´ = 1, y´ = 7 and z´ = 5) P215 = 2 $\rightarrow$ E10 [(y = 6) $\neq$ (y´ = 7)] II. Inverter version: V1.62 $\rightarrow$ (x´ = 1, y´ = 6 and z´ = 2) P215 = 2 $\rightarrow$ normal copy [(y = 6) = (y´ = 6)]
		The procedure is as follows:
		<ol> <li>Connect the Keypad to the inverter from which the parameters will be copied (Inverter A).</li> </ol>
		<ol> <li>Set P215 = 1 (INV → HMI) to transfer the parameter values from the Inverter A to the Keypad.</li> </ol>
		3. Press the key. P204 resets automatically to 0 (Off) after the transfer is completed.
		4. Disconnect the Keypad from the inverter.
		<ol><li>Connect the same Keypad to the inverter to which the parameters will be transferred (Inverter B).</li></ol>
		6. Set P215 = 2 (HMI → INV) to transfer the content of the Keypad memory (containing the Inverter A parameters) to Inverter B.
		7. Press the key. When P204 returns to 0, the parameter transfer has been concluded. Now Inverters A and B have the same parameter values.
		Note:
		☑ In case Inverters A and B are not of the same model, check the values of P295 (Rated Current) and P296 (Rated Voltage) of Inverter B.
		☑ If the inverters are driving different motors, check the motor related parameters of Inverter B.
		8. To copy the parameters content of the Inverter A to other inverters, repeat items 5 to 7 of this procedure.

Parameter	Range [Factory Setting] Unit	Description / Notes
		INVERTER B
		Parameters    Parameters   Par
P216 Reference Engineering Unit 2 P217 Reference Engineering Unit 3	32 to 127 [ 112 = p ] - 32 to 127 [ 109 = m ] -	<ul> <li>☑ These parameters are useful only for inverters provided with a keypad with LCD display.</li> <li>☑ The engineering unit of the speed reference is composed of three characters, which will be displayed on the indication of the Speed Reference (P001) and Motor Speed (P002). P207 defines the left character, P216 the center character and P217 the right character.</li> <li>☑ For more details, refer to Parameter P207.</li> </ul>
P218 LCD Display Contrast Adjustment	0 to 150 [ 127 ] -	<ul> <li>☑ This parameter is useful only for inverters provided with a keypad with LCD display.</li> <li>☑ It allows the adjustment of the LCD Display contrast. Increase/decrease the parameter content to obtain the best contrast.</li> </ul>
P220 <sup>(1)</sup> LOCAL/REMOTE Selection Source	0 to 10 [2]	☑ Defines the source of the LOCAL / REMOTE selection command.

Parameter	Range [Factory Setting] Unit	Description	/ Notes				
		P220	LOCAL/REMOTE Selection				
		0	Always LOCAL Mode				
		1	Always REMOTE mode				
		2	Key  of the Keypad (HMI) (LOCAL Default)				
		3	Key of the Keypad (HMI) (REMOTE Default)				
		4	Digital inputs DI2 to DI8 (P264 to P270)				
		5	Serial (Local Default) - SuperDrive or incorporated Modbus				
		6	Serial (Remote Default) - SuperDrive or incorporated Modbus				
		7	Fieldbus (Local Default) - Optional Fieldbus board				
		8	Fieldbus (Remote Default) - Optional Fieldbus board				
		9	PLC (L) - Optional PLC board				
		10	PLC (R) - Optional PLC board				
			Table 6.25 - LOCAL/REMOTE selection				
			ry default setting, the key of the Keypad (HMI) will select emote Mode. When powered up, the inverter starts in Local				
P221 <sup>(1)</sup> LOCAL Speed Reference Selection	0 to 11 [ 0 ] -		otion Al1' as apposed to Al1 refers to the analogue signal after d/or gain calculations have been applied to it (Refer to figure				
		P221/P222	LOCAL/REMOTE Speed Reference Selection				
P222 (1)	0 to 11	0	and  of the keypad				
REMOTE Speed	[1]	1	Analog Input AI1' (P234/P235/P236)				
Reference Selection	-	2	Analog Input AI2' (P237/P238/P239/P240)				
		3	Analog Input AI3' (P241/P242/P243/P244)				
		4	Analog Input AI4' (P245/P246/P247)				
		5	Sum of the Analog Inputs AI1' + AI2' > 0 (Negative values are zeroed)				
		6	Sum of the Analog Inputs AI1' + AI2'				
		7	Electronic Potentiometer (E.P.)				
		8	Multispeed (P124 to P131)				
		9	Serial				
		10	Fieldbus				
		11	PLC				
		1	Fable 6.26 - LOCAL/REMOTE speed reference selection				
		☑ The referen	ce value set by the and keys is contained in parameter				
		☑ Details of the second o	ne Electronic Potentiometer (E.P.) operation in figure 6.37m).				
		☑ When option 7 (E.P.) is selected, program P265 or P267 = 5 and P266 or P268 = 5.					
		☑ When option	on 8 is selected, program P266 and/or P267 and/or P268 to 7.				
		☑ When P203	3 = 1 (PID), do not use the reference via E.P. (P221/P222 = 7).				
		☑ When P203 PID setpoir	3 = 1 (PID), the value programmed in P221/P222 becomes the nt.				

Range [Factory Setting] Unit	Description /	Notes		
0 to 11			LOCAL EWD/REV Selection	
			of the Keypad (Reverse Default)	
			Digital Input DI2 (P264 = 0)	
	5		Serial (FWD Default)	
	6		Reserved Serial (REV Default)	
	7		Fieldbus (FWD Default)	
	8		Fieldbus (REV Default)	
	9		Polarity AI4	
	10	)		
	11		PLC (REV)	
		Table	6.27 - LOCAL FWD/REV selection	
		D224	LOCAL START/STOR Soloction	
[0]				
-				
	Run, the	and (	keys will remain disabled independ	
0 to 5	_	Door	LOCAL IOC Calastian	
	_			
-	_			
	_			
	_			
	_			
	_			
	_			
	☑ The JOG sp	eed refere	ence is given by parameter P122.	
	[Factory Setting]	Factory Setting   Unit   Description /	Table   Pescription   Notes	Tactory Setting   Unit   Description / Notes

Parameter	Range [Factory Setting] Unit	Descriptio	on / Notes	
P226 (1) (8)	0 to 11			
REMOTE FWD/REV	[4]		P226	REMOTE FWD/REV Selection
Selection	-		0	Always Forward
			1	Always Reverse
			2	Key  of the Keypad (Default Forward )
			3	Key 😌 of the Keypad (Default Reverse )
			4	Digital Input DI2 (P264 = 0)
			5	Serial (FWD Default)
			6	Serial (REV Default)
			7	Fieldbus (FWD Default)
			8	Fieldbus (REV Default)
			9	Polarity AI4
			10	PLC (FWD)
			11	PLC (REV)
			Tab	ple 6.30 - REMOTE FWD/REV selection
P227 (1)	0 to 4		P227	REMOTE START/STOP Selection
REMOTE START/	[1]			and of the Keypad
STOP Selection	-		0	
			1	Digital Input (DIx)
			2	Serial
			3	Fieldbus PLC
			4	e 6.31 - REMOTE START/STOP selection
		Run, the	① and	nputs are programmed for Forward Run/Reverse defense keys will remain disabled independently of ned at P227.
P228 (1) (8)	0 to 5		D000	DEMOTE IOC Colorifor
REMOTE JOG	[2]		P228	
Selection	-		0	Disable
			1	Key 06 of the Keypad
			2	Digital inputs DI3 to DI8 (P265 to P270)
			3	Serial
			4	Fieldbus
			5	PLC
			,	Table 6.32 - REMOTE JOG selection
		☑ The JOG	S speed ref	erence is given by parameter P122.



(\*) For P221 = 11 (PLC) or P222 = 11 (PLC) the speed reference will be the total reference according to the figure 6.26.

Figure 6.25 - Block diagram of the local / remote mode

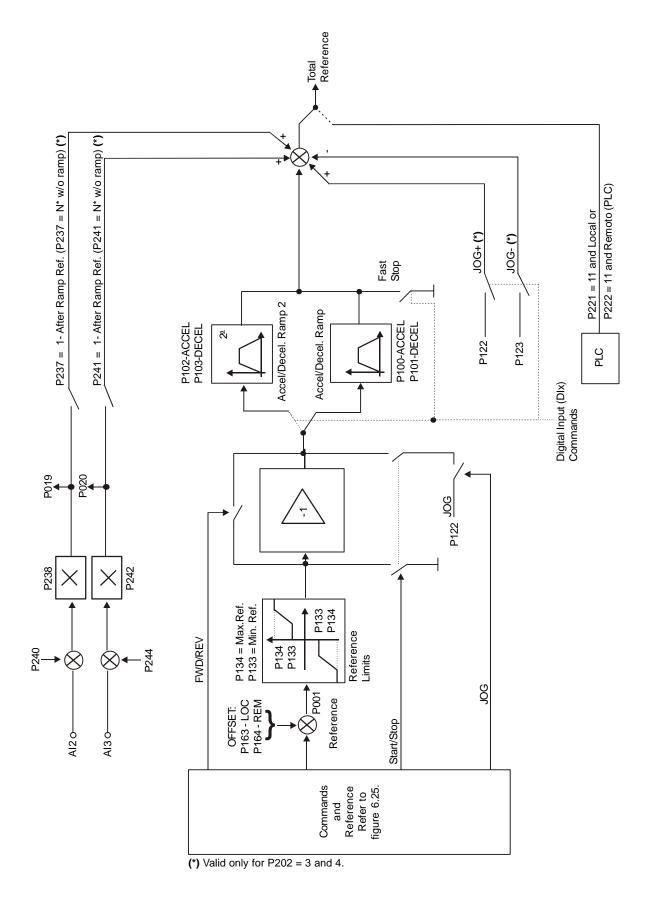


Figure 6.26 - Block diagram of the speed reference

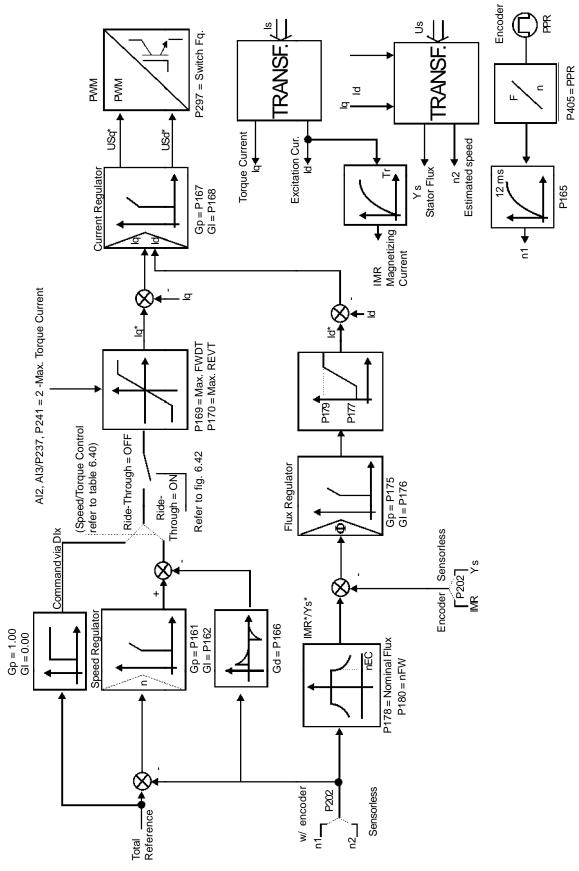


Figure 6.27 a) - Block diagram of the Vector Control

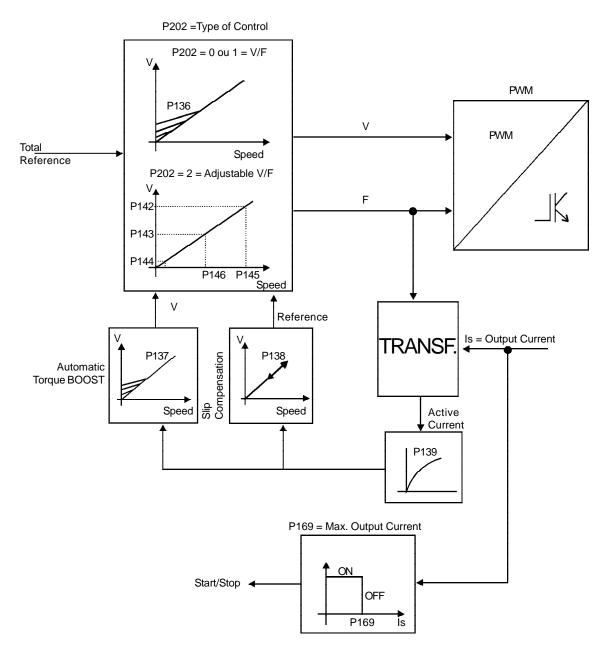


Figure 6.27 b) - Block diagram of the V/F control (Scalar)

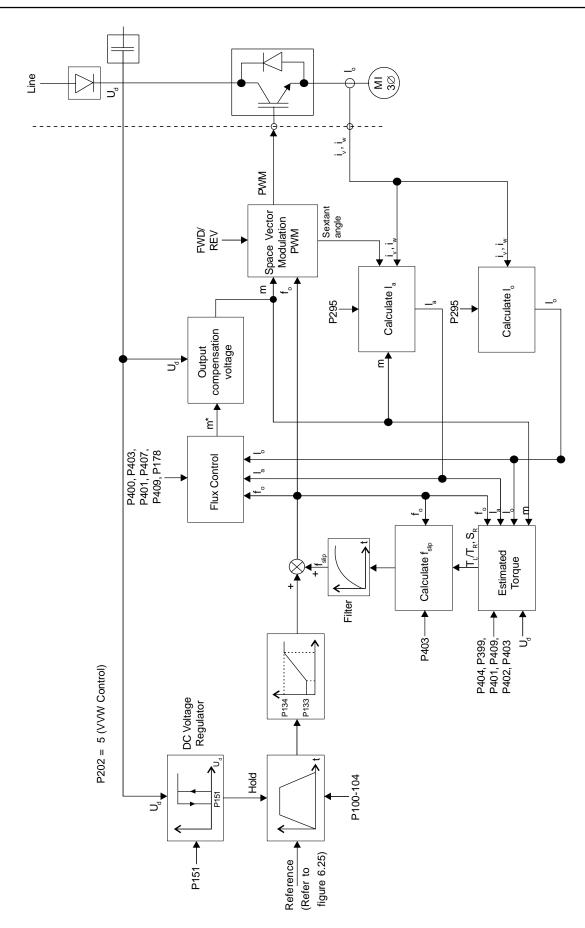
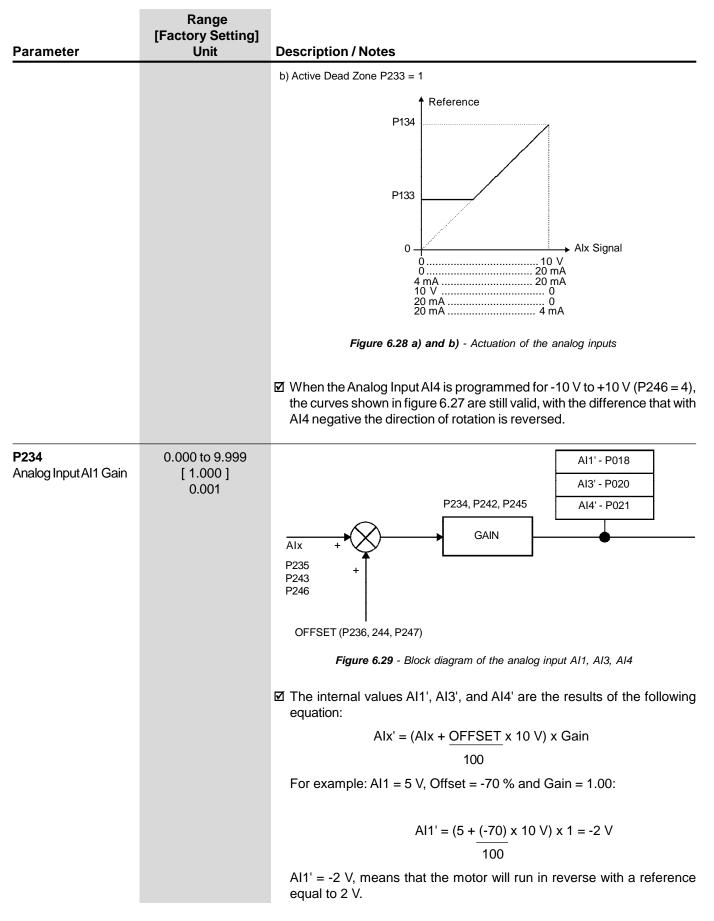


Figure 6.27 c) - Block diagram of the VVW Control

Parameter	Range [Factory Setting] Unit	Description	/ Notes				
P232 <sup>(1)</sup>	0 to 2		P232	Stop Mode			
Stop Mode Selection	[0]		0	Ramp to Stop			
Selection	_		1	Coast to Stop			
			2	Fast Stop			
		1) The key 2) Start/Sto 3) Start/Sto to P270 fo ☑ In the V/F  NOT When	r P232 is valid only for v 0 of the keypar op function with 2-with pp function with 3-with a complete description Mode the option 2 (	or the following commands: d; re control (through DI1 = 1); re control (refer to parameters from P265 otion about the function 14). Fast Stop) is not available.  option is selected, only start the motor if			
P233	Analog Inputs [ 0 ]	☑ This parameter is active only for the analog inputs (Alx) programmed as speed reference.					
Dead Zone		<ul><li>✓ When set to 1 enables the Dead Zone for the Analog Inputs.</li></ul>					
		✓ If P233 = 0 (Off) the "zero" signal at the Analog Inputs (0 V/0 mA/4 mA or 10 V/20 mA) is directly related to the minimum speed programmed at P133. Refer to figure 6.28 a).					
		✓ If P233 = 1 (On) the Analog Inputs have a "dead zone", and the speed reference remains at its minimum value (defined by P133) until the input signal reaches a level proportional to the minimum speed. Refer to figure 6.28 b).					
		a) Inactive Dea	id Zone P233 = 0				
		0 4 mA	Alx Signal				
		20 mA	0 0 4 mA				



Parameter	Range [Factory Setting] Unit	Description /	Notes					
P235 (1)	0 to 3	P235	Inpi	ut AI1 Signal	Switch S1.2			
Analog Input AI1	[0]	0		) V / (0 to 20) mA	OFF/ON			
Signal	-	1	(4	4 to 20) mA	ON			
		2	(10 to 0	) V / (20 to 0) mA	OFF/ON			
		3		20 to 4) mA	ON			
		switch on th  ☑ Options 2 a	rrent signal is ne control boa nd 3 provide a	ard to "ON".	alog Input AI1, set the S1.2			
P236 Analog Input AI1 Offset	-100.0 to +100.0 [ 0.0 ] 0.1 %	☑ Refer to P23	34.					
P237 (1)(8)	0 to 3		P237	Input AI2 F	unction			
Analog Input AI2	[0]		0	P221/P				
Function	-		1	After Ramp				
			2	Maximum Toro	que Current			
		3	PID Process	s Variable				
			4	Maximum Torque Co	urrent (AI2+AI1)			
		Table 6.35 - Al2 function						
		reference (if	set to do so	at P221/P222), whe acceleration/de	I, AI2 may supply the speed hich is subject to the speed eceleration ramps (P100 to			
		generally u	sed as an a	dditional referen	only for P202 = 3 and 4) is ce signal, for instance, in 6.25. It bypasses the accel/			
		current limit P170 will be	P169, P170 tl Read Only Pa	hrough the analog	ermits controlling the torque input AI2. In this case P169, o figure 6.26 a). For this type o one or zero.			
		Arr When Al2 is set to maximum (P019 = 100 %), the torque limit will also maximum - P169/P170 = 180 %.						
		_	PID regulato		es the input AI2 as feedback essure, temperature sensor,			
				kimum value (P019 kimum value (100 º	9 = 100 %), the PID process %).			

Parameter	Range [Factory Setting] Unit	Description / Notes
		Option 4 – Maximum Torque Current (Al2+Al1):
		<ul> <li>✓ When parameters P237 = 2 and P241 = 0, the torque current limit (P169 and P170) is given by the signal at the Analog Input Al2.</li> </ul>
		☑ When parameters P237 = 4 and P241 = 0, the torque current limit (P169 and P170) is given by the sum of the signals at Analog Inputs AI1 and AI2.
		☑ When parameters P237 = 2 and P241 = 2, the torque current limit (P169 and P170) is given by the signal at the Analog Input Al2.
		☑ When parameters P237 = 4 and P241 = 2, the torque current limit (P169 and P170) is given by the sum of the signals at Analog Inputs Al1 and Al2.
		☑ When parameters P237 = 4 and P241 = 4, the torque current limit (P169 and P170) is given by the sum of the signals at Analog Inputs AI1 and AI2.
		<b>Note:</b> The range of the sum between Al1 and Al2 may vary from 0 to 180 %. If the sum result is negative, then the value will be set to zero.
P238 Analog Input AI2 Gain	0.000 to 9.999 [ 1.000 ] 0.001	Al2' - P019  Al2 Gain  Filter (P248)  Figure 6.30 - Block diagram of the analog input Al2  The internal value of Al2' is the result of the following equation:  Al2' = (Al2 + $\frac{OFFSET}{100}$ x 10 V) x Gain  For example: Al2 = 5 V, OFFSET = -70 % and Gain = 1.00:  Al2' = (5 + $\frac{(-70)}{100}$ x 10 V) x 1 = -2 V  Al2' = -2 V, means that the motor runs in reverse direction reference equal to 2 V
P239 <sup>(1)</sup> Analog Input AI2 Signal	0 to 3 [ 0 ] -	P239         Input Al2 Signal         Switch S1.1           0         (0 to 10) V / (0 to 20) mA         OFF/ON           1         (4 to 20) mA         ON           2         (10 to 0) V / (20 to 0) mA         OFF/ON           3         (20 to 4) mA         ON   Table 6.36 - Al2 signal selection

Parameter	Range [Factory Setting] Unit	Description	/ Notes	
			urrent signal is e control board	s used at the Analog Input AI2, set the switch
		☑ Options 2	and 3 provide	an inverse reference with which is possible to the minimum reference.
P240 Analog Input AI2 Offset	-100.0 to +100.0 [ 0.0 ] 0.1 %	☑ Refer to P2	234.	
P241 (1)	0 to 3		D044	Innuit AIO Function
Analog Input AI3	[0]		P241	Input Al3 Function
Function			0	P221/P222
(Isolated analog			1	After Ramp Reference
input on the optional			2	Maximum Torque Current
board EBB.			3	PID Process Variable
Refer to chapter 8)			4	Maximum Torque Current (Al3+Al2)
,			T	able 6.37 - Al3 function
		reference limits (P13 P103). Ref  ☑ The option generally application decel ramp  ☑ The option current lim P170 will b of control,  ☑ When Al3 also maxin  ☑ The option of the PID DP524 = 1.  ☑ When Al3 variable will will be option 4 -	(if set to do so 33, P134) and fer to figure 6.2 and 1 (After Ramused as an ans with a dancto.  1 2 (Maximum it P169, P170 to be Read only pacheck if P160 is set to maximum - P169/P13 (Process Var Regulator (for it is set to its maximum to a meters P237 is given by the sameters P237 is given by the samete	p Reference, valid only for P202 = 3 and 4) is additional reference signal, for instance, in er. Refer to figure 6.25. It bypasses the accel/ Torque Current) permits controlling the torque through the analog input Al3. In this case P169, arameters. Refer to figure 6.26 a). For this type should be equal to one or zero.  mum (P020 = 100 %), the torque limit will be

Parameter	Range [Factory Setting] Unit	Description / Notes	
		☑ When parameters P237 = 2 and P241 = 2, t and P170) is given by the signal at the Ana	
		☑ When parameters P237 = 2 and P241 = 4, t and P170) is given by the sum of the signal Al3.	
		☑ When parameters P237 = 4 and P241 = 4, t and P170) is given by the sum of the signal Al2.	
		<b>Note:</b> The range of the sum between Al2 180 %. If the sum result is negative, then the	
P242 Analog Input Al3 Gain	0.000 to 9.999 [ 1.000 ] 0.001	☑ Refer to P234.	
P243 <sup>(1)</sup> Analog Input AI3 Signal	0 to 3 [ 0 ] -	P243 Input Al3 Signal 0 (0 to 10) V / (0 to 20) mA 1 (4 to 20) mA	Switch S4.1 (EBB) Off/On On
		2 (10 to 0) V / (20 to 0) mA	Off/On
		3 (20 to 4) mA	On
		<b>Table 6.38</b> - Al3 signal se	election
		<ul> <li>☑ When a current signal is used at the Anaswitch on the EBB board to "ON".</li> <li>☑ Options 2 and 3 provide an inverse referer have maximum speed with minimum refere</li> </ul>	nce with which is possible to
P244 Analog Input AI3 Offset	-100.0 to +100.0 [ 0.0 ] 0.1 %	☑ Refer to P234.	
P245 Analog Input AI4 Gain (14 bit Analog Input of the optional board EBA. Refer to chapter 8)	0.000 to 9.999 [ 1.000 ] 0.001	☑ Refer to P234.	
P246 (1)	0 to 4	P243 Input AI4 Signal	Switch S2.1 (EBA)
Analog Input AI4	[0]	0 (0 to 10) V / (0 to 20) mA	OFF/ON
Signal	-	1 (4 to 20) mA	ON
		2 (10 to 0) V / (20 to 0) mA	OFF/ON
		3 (20 to 4) mA	ON
		4 (-10 to +10) V	OFF
		<b>Table 6.39</b> - Al4 signal se	election

Parameter	Range [Factory Setting] Unit	Description / Notes
		☑ When a current signal is used at the Analog Input AI4, set the switch S2.1 on the EBA board to "ON".
		☑ Options 2 and 3 provide an inverse reference with which is possible to have maximum speed with minimum reference.
P247 Analog Input AI4 Offset	-100.0 to +100.0 [ 0.0 ] 0.1 %	☑ Refer to P234.
P248 Filter Input AI2	0.0 to 16.0 [ 0.0 ] 0.1 s	☑ It sets the time constant of the RC Filter of the Input Al2 (refer to figure 6.29).
P251	0 to 14	☑ Check possible options on table 6.40.
Analog Output AO1 Function	[2]	☑ With factory default values (P251 = 2 and P252 = 1.000) AO1 = 10 V when the motor speed is equal to the maximum speed defined at P134.
		☑ The AO1 output can be physically located on the control board CC9 (as a 0 V to 10 V output) or on the option board EBB (AO1', as a (0 to 20) mA/ (4 to 20) mA output). Refer to chapter 8.
P252 Analog Output AO1 Gain	0.000 to 9.999 [ 1.000 ] 0.001	☑ Adjusts the gain of the AO1 analog output. For P252 = 1.000 the AO1 output value is set according to the description after figure 6.31.
P253	0 to 14	☑ Check possible options on table 6.40.
Analog Output AO2 Function	[5] -	$\blacksquare$ With factory default values (P253 = 5 and P254 = 1.000) AO2 = 10 V when the output current is equal to 1.5 x P295.
		☑ The AO2 output can be physically located on the control board CC9 (as a 0 V to 10 V output) or on the option board EBB [(AO2', as a (0 to 20) mA/ (4 to 20) mA output)]. Refer to chapter 8.
P254 Analog Output AO2 Gain	0.000 to 9.999 [ 1.000 ] 0.001	☑ Adjusts the gain of the AO2 analog output. For P254 = 1.000 the AO2 output value is set according to the description after figure 6.31.
P255	0 to 63	☑ Check possible options on table 6.40.
Analog Output AO3 Function (Located on the Optional I/O	[2]	☑ With factory default values (P255 = 2 and P256 = 1.000) AO3 = 10 V when the motor speed is equal to maximum speed defined at P134.
Expansion Board EBA)		☑ For more information about the Analog Output AO3, refer to chapter 8.

Parameter	Range [Factory Setting] Unit	Desc	ription / Notes					
P256 Analog Output AO3 Gain	0.000 to 9.999 [ 1.000 ] 0.001	<ul> <li>✓ Adjusts the gain of the AO3 analog output for P256 = 1.000 the AO3 output value is set according to the description after figure 6.31.</li> </ul>						
P257 Analog Output AO4 Function (Located on the Optional I/O Expansion Board EBA)	0 to 63 [ 5 ] -	<ul> <li>☑ Check possible options on table 6.40.</li> <li>☑ For factory default values (P257 = 5 and P258 = 1.000) AO4 = 1 when the output current is equal to 1.5 x P295.</li> <li>☑ For more information about the AO4 output, refer to chapter 8.</li> </ul>					= 10 V	
			Functions	P251	P253	P255	P257	
			Speed Reference	(AO1) 0	(AO2) 0	(AO3) 0	(AO4) 0	
			Total Reference	1	1	1	1	
			Real Speed	2	2	2	2	
			Torque Reference [P202 = 3 or 4 (Vector)]	3	3	3	3	
			Torque Current [P202 = 3 or 4 (Vector)]	4	4	4	4	
			Output Current (with filter 0.3 s)	5	5	5	5	
			PID Process Variable	6	6	6	6	
			Active Current [P202 = 0, 1, 2 or 5] (with filter 0.1 s)	7	7	7	7	
			Power (kW) (with filter 0.5 s)	8	8	8	8	
			PID Setpoint	9	9	9	9	
			Torque Positive [P202 = 3 or 4 (vector)]	10	10	10	10	
			Motor Torque	11	11	11	11	
			PLC Dead Zone for Speed	12	12	12	12	
			Indication WEG Use	13	13	- 15 to 62	- 45 to 62	
			Motor Voltage	14	14	15 to 63	15 to 63 14	
			Table 6.40 - F	unctions	of the an	alog outpu	ts	
P258 Analog Output AO4 Gain	0.000 to 9.999 [ 1.000 ] 0.001		usts the gain of the AO4 put value is set according					

	Range [Factory Setting]	
Parameter	Unit	Description / Notes
		Speed Reference Total Reference Real Speed Torque Reference Total Current Output Current Output Current Power PID Process Variable Active Current Power PlD Setpoint Positive Torque Current Motor Torque Dead Zone for Speed Indication PLC Motor Voltage
		Figure 6.31 - Block diagram of the analog outputs
		Scale of the Analog Outputs indications:
		☑ Full Scale = 10 V: for outputs AO1 and AO2 located on the control board CC9 and AO3 and AO4 located on the optional board EBA.
		☑ Full Scale = 20 mA for the outputs AO1I and AO2I located on the optional board EBB.
		☑ Speed Reference (P001): full scale = P134
		☑ Total Reference: full scale = P134
		☑ Motor Speed (P002): full scale = P134
		☑ Torque Reference: full scale = 2.0 x P295
		☑ Torque Current: full scale = 2.0 x P295
		☑ Output Current: full scale = 1.5 x P295
		☑ PID Process Variable: full scale = 1.0 x P528
		☑ Active Current: full scale = 1.5 x P295
		☑ Power: full scale = $1.5 \times \sqrt{3} \times P295 \times P296$
		☑ PID Setpoint: full scale = 1.0 x P528
		☑ Motor Torque: full scale = 2.0 x P295
		☑ Dead Zone for Speed Indication: full scale = P134
		☑ Motor Voltage: full scale = 2.0 x P400
P259 Dead Zone for Speed Indication	0 a P134 [ 1000 ] 1 rpm	☑ While the speed indication in P002 is below of the value set at P259 (P002 < P259), the value of the analog output (P251 and/or P253 = 13) will remain at 0 V or 0 mA/4 mA. When the speed value is above the value set at P259, then the analog output will vary between its minimum and maximum value.

Parameter	Range [Factory Setting] Unit	Description / Notes
		A01 A02 20 mA 10 V
		4 mA 0 V P259 P134 n  Figure 6.32 - Dead zone for speed indication
		NOTES!
		☑ For current analog output (0 to 20 mA or 4 to 20 mA) it is necessary to use the EBB expansion board.
		A voltage analog output (0 to 10 V) is available at the CC9 control board.
		☑ The analog outputs AO3 and AO4 do not have this function, i.e., set P255 and/or P257 = 13 will program no function.
P263 <sup>(1)</sup> Digital Input DI1 Function	0 to 3 [ 1 (Start/Stop) ] -	<ul> <li>☑ Check possible options on table 6.41 and details about each function's operation on figure 6.37.</li> <li>☑ The status of the digital inputs can be monitored at Parameter P012.</li> </ul>
P264 <sup>(1)</sup> Digital Input DI2 Function	0 to 8 [ 0 (FWD/REV) ] -	
P265 (1) (8) Digital Input DI3 Function	0 to 22 [ 0 (Not Used) ] -	
P266 <sup>(1)</sup> Digital Input DI4 Function	0 to 22 [ 0 (Not Used) ] -	
P267 <sup>(1)</sup> Digital Input DI5 Function	0 to 22 [ 3 (JOG) ]	

Parameter	Range [Factory Setting] Unit	Description / Note	s							
P268 <sup>(1)</sup>	0 to 22	Parameter	P263	P264	P265	P266	P267	P268	P269	P270
Digital Input DI6	[ 6 (Ramp 2) ]	Function (Input)	(DI1)	(DI2)	(DI3)	(DI4)	(DI5)	(DI6)	(DI7)	(DI8)
Function	-	Not Used	0	2 to 7	0, 7	0 and	0 and	0 and	0, 5, 7	0, 5
		Start/Stop	1	-	and 16	16	16	16	and 16	and 7
P269 (1)	0 to 22	General Enable	2		2	2	2	2	2	2
Digital Input DI7	[ 0 (Not Used) ]		3	-			8	8	8	8
Function	-	Fast Stop FWD/REV		- 0	-	-	0	0	0	0
(Located on the		Local/Remote	-	1	1	1	1	1	1	1
optional board EBA		JOG	-	-	3	3	3	3	3	3
or EBB)		No external Fault	-	-	4	4	4	4	4	4
,		Increase E.P.		-	5	-	5	4	-	4
D070 (1)	0.4 00	Decrease E.P.	-	-	- -	5	5	5	-	-
P270 <sup>(1)</sup>	0 to 22	Ramp 2	-	-	6	6	6	6	6	6
Digital Input DI8	[ 0 (Not Used) ]	FWD Run	-	-	8	-	-	-	-	0
Function	-	REV Run	-	8	-	8	-	-	-	-
(Located on the		Speed/Torque	-	0	9	9	9	9	9	9
optional board EBA		JOG+	-	-	10	10	10	10	10	10
or EBB)		JOG-	-	-	11	11	11	11	11	11
		Reset		<del>-</del>	12	12	12	12	12	12
		Fieldbus		+ -	13	13	13	13	13	13
		Start (3 wire)		<u> </u>	14	-	14	13	14	13
		Stop (3 wire)	-	-	-	14	-	14	- 14	14
		Multispeed (MSx)	-	-	-	7	7	7	_	-
		Manual/Automatic	_		15	15	15	15	15	15
		Motor Thermistor	_	_	-	-	-	-	-	16
		Disables Flying	_	_						
		Start	_	_	17	17	17	17	17	17
		DC Link Voltage Regulator	-	-	18	18	18	18	18	18
		Parameter Setting								
		Disable	-	-	19	19	19	19	19	19
		Load User	-	-	20	20	20	20	20	-
		Timer RL2	-	-	21	21	21	21	21	21
		Timer RL3	-	_	22	22	22	22	22	22
		7:	abla 6.4	11 - Eun	ctions o	f the di	aital inn	uto		

Table 6.41 - Functions of the digital inputs

#### ☑ Notes about the Digital Inputs Functions:

- **Start/Stop** To ensure the right actuation, this function needs programming P224 and/or P227 = 1.
- Increase E.P. (Electronic Potentiometer) is active when DI3 or DI5 = +24 V.
   Beyond parameters P265 and P267 = 5, it is also necessary setting P221 and/or P222 to 7.
- Decrease E.P. (Electronic Potentiometer) is active when DI4 or DI6 = 0 V. Beyond parameters P266 and P268 = 5, it is also necessary setting P221 and/or P222 to 7.
- **Local/Remote** = 0 V/24 V at the digital input, respectively.
- **Speed /Torque** is valid for P202 = 3 and 4 (Vector Control Sensorless and Vector Control with encoder).

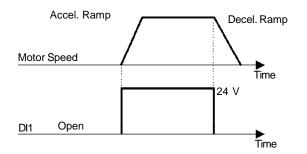
Parameter	Range [Factory Setting] Unit	Description / Notes
		- <b>Speed</b> = DIx Open (0 V), <b>Torque</b> = DIx Closed (+24 V).
		When Torque is selected the speed regulators gains P161 and P162 are not used and changed to: Gp (Proportional Gain) = 1.00 and Gi (Integral Gain) = 0.00. Thus the Total Reference becomes the input of the Torque Regulator. Refer to figure 6.26.
		<b>When Speed</b> is selected, the speed regulator gains are defined again by P161 and P162. In applications with torque control, proceed as described at P160.
		- The Option <b>DC Link Voltage Regulator</b> must be used, when P150 = 2. Refer to description of parameter P150.
		- DI8 is designed to be used as <b>Motor Thermistor</b> (PTC) input on the option boards EBA/EBB. It can also be used with just one PTC.
		XC4/XC5:  EBA/EBB  DI8 (P270 = 16)
		Temperature increase Inactive / Without error Without error Active / E32
		Temperature decrease Inactive / Without error Active / E32 Active / E32
		PTC resistance oscillation in ohms $(\Omega)$ 1k6 3k9
		Figure 6.33 - DI8 used as PTC input
		- If DI8 should be used as normal digital input - Program the parameter P270 to the required function and connect a resistor between 270 $\Omega$ and 1600 $\Omega$ in series with the input 4, as indicated below:
		XC4/XC5:  CONTACT 2  CONTACT DI8  DI8 OPEN DEACTIVATED
		BBA/EBB (P270) CLOSED ACTIVATED

Figure 6.34 - DI8 used as normal DI

	Range [Factory Setting]	
Parameter	Unit	Description / Notes
		- The functions <b>JOG+</b> and <b>JOG</b> – are valid only for P202 = 3 and 4.
		- The option <b>Fieldbus</b> sets the DI as a remote input for the Fieldbus system and in order to become effective it must be read as any other DI of the inverter.
		<b>Disable Flying Start</b> : Put +24 V at the digital input to disable Flying Start.
		- The function <b>Loads user via DIx</b> , permits the memory selection of the user 1 or 2, process similar to P204 = 7 and P204 = 8, but the user is loaded from the transition of a DIx programmed for this function.
		The memory of user 1 is loaded, when the DIx status changes from low level to high level (transition from 0 V to 24 V) and P265 to P269 = 20, provided the current parameter contents of the inverter have been transferred previously to the parameter memory 1 (P204 = 10).
		The memory of user 2 is loaded, when the DIx status changes from high level to low level (transition from 24 V to 0 V) and P265 to P269 = 20, provided the current parameter contents of the inverter have been transferred previously to the parameter memory 2 (P204 = 11).
		Inverter Parameters  P265 to P269 (Dlx) = 20  User 1  Dlx = 24 V  Dlx = 0 V  P204 = 11  User 2  P265 to P269 (Dlx) = 20  Figure 6.35 - Details about the operation of the function load user via Dlx
		<ul> <li>NOTE!</li> <li>☑ Ensure that when using this function, the parameter sets (User Memory 1 and 2) are totally compatible with the used installations (motors, ON/OFF commands, etc.).</li> <li>☑ User memory cannot be loaded when motor is enabled.</li> <li>☑ When two different motor parameter sets are saved into the User Memory 1 and 2, respectively, set for each user the correct values at the Parameters P156, P157 and P158.</li> </ul>
		☑ When the function 'Parameter Setting Disable' is programmed and the DIx input is +24 V, the parameters cannot be changed, independent of the values that have been set at P000 and P200. When the Dix input is set to 0 V, the parameter changing will be conditioned to the values set at P000 and P200.

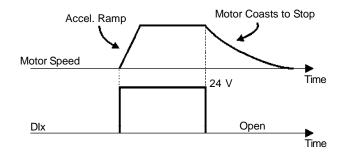
Parameter	Range [Factory Setting] Unit	Description / Notes
		☑ 'Timer RL2 and RL3' function enables and disables the Relays 2 and 3 (RL2 and RL3).  When the timing function of the relays 2 and 3 is programmed at any Dlx, and when the transition is effected from 0 V to 24 V, the relay will be enabled according to the time set at P283 (RL2) or P285 (RL3). When the transition from 24 V to 0 V occurs, the programmed relay will be disabled according to the time set at P284 (RL2) or P286 (RL3). After the Dlx transition, to enable or disable the programmed relay, it is required that the Dlx remains in on/off status during the time set at parameters P283/P285 and P284/P286. Otherwise the relay will be reset. Refer to figure 6.36.  Note: For this function, program P279 and/or P280 = 28 (Timer).
		P283/ P284/ P285 P286  Figure 6.36 - Operation of the function of the timers RL2 and RL3
		☑ Multispeed: The selection of P266 and/or P267 and/or P268 = 7 requires that P221 and/or P222 = 8. Refer to parameters P124 to P131.

## a) START/STOP



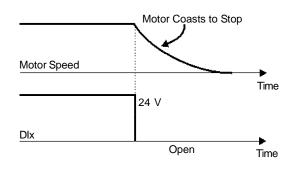
**Note:** All digital inputs set to general enable must be on in order that the inverter operates as shown above.

## b) GENERAL ENABLE

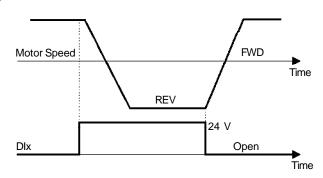


**Note:** All digital inputs set to start/stop must be on in order that the inverter operates as shown above.

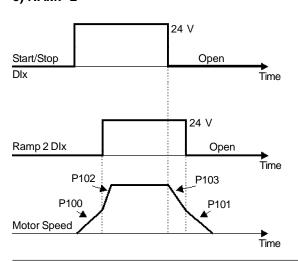
#### c) NO EXTERNAL FAULT



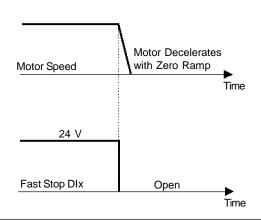
#### d) FWD/REV



#### e) RAMP 2



## f) FAST STOP



#### g) LOAD USER VIA DIX

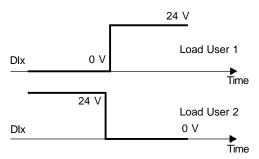
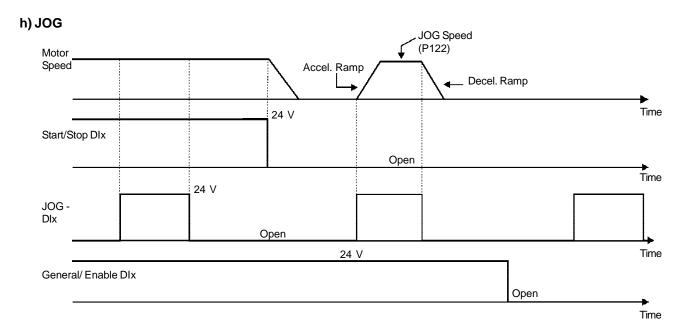
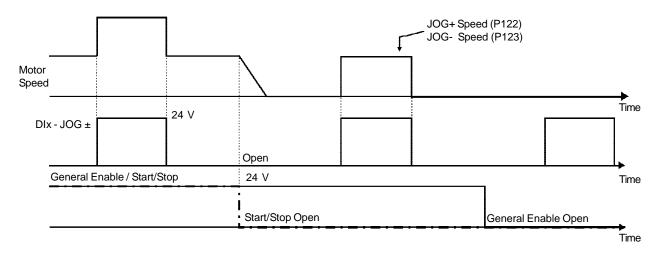


Figure 6.37 a) to g) - Details about the function of the digital inputs



## i) JOG + and JOG -



## j) RESET

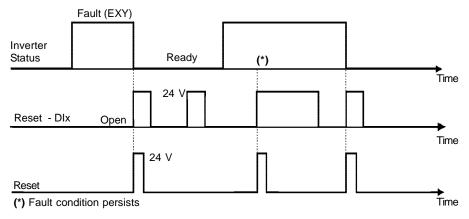
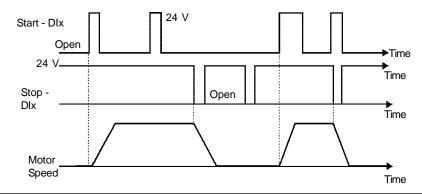
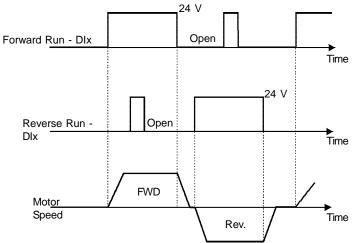


Figure 6.37 (cont.) h) to j) - Details about the function of the digital inputs

## k) 3 WIRE START / STOP



## I) FORWARD RUN / REVERSE RUN



## m) ELECTRONIC POTENTIOMETER (E.P.)

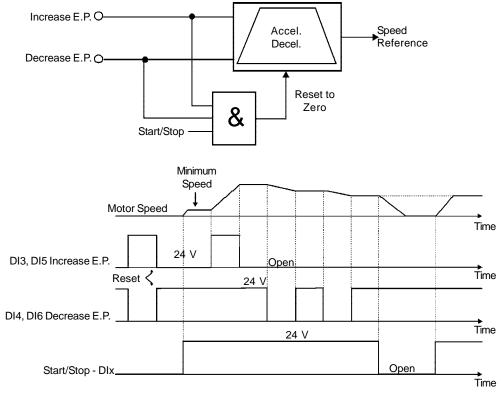


Figure 6.37 (cont.) k) to m) - Details about the function of the digital inputs

Parameter	Range [Factory Setting] Unit	Description / Notes					
			on table 6	12 and d	lotoilo obc	out ooob i	function's
P275 (1)	0 to 40	☑ Check possible options of			ietalis abc	out each	iuriction 5
Digital Output DO1 Function (located on the Optional I/O	[ 0 (Not Used) ] -	operation on the charts in the figure 6.36.					
		☑ The status of the Digital •	Outputs o	an be mo	onitored at	t Parame	ter P013.
Expansion Board		☑ The Digital Output will b	oe activat	ed when	the conc	dition sta	ted by its
EBA or EBB)		function becomes true.					-
LB/( or LBB)		applied to the load conr					
		pick up when the output	is activate	ed.	•		•
P276 (1)	0 to 40	Parameter	P275	P276	P277	P279	P280
Digital Output DO2	[ 0 (Not Used) ]	Function (Output)	(DO1)	(DO2)	(RL1)	(RL2)	(RL3)
Function (located on	-	Not Used	0, 27 and 28	0, 27 and 28	0 and 28	0	0
the Optional I/O		N* > Nx	1	1	1	1	1
Expansion Board		N > Nx	2	2	2	2	2
EBA or EBB)		N < Ny	3	3	3	3	3
		N = N*	4	4	4	4	4
<b>DOTE</b> (1)	0	Zero Speed	5	5	5	5	5
P277 <sup>(1)</sup>	0 to 40	ls > lx	6	6	6	6	6
Relay Output RL1	[ 13 (No Fault) ]	Is < Ix	7	7	7	7	7
Function	-	Torque > Tx	8	8	8	8	8
		Torque < Tx	9	9	9	9	9
P279 (1)	0 to 40	Remote	10	10	10	10	10
Relay Output RL2	[ 2 (N > Nx) ]	run	11 12	11 12	11 12	11 12	11
Function	[2(14>14x)]	ready No Fault	13	13	13	13	13
1 dilottori		No E00	14	14	14	14	14
		No E01+E02+E03	15	15	15	15	15
P280 (1)	0 to 40	No E04	16	16	16	16	16
Relay Output RL3	$[1 (N^* > Nx)]$	No E05	17	17	17	17	17
Function	- \ -	(4 to 20) mA OK	18	18	18	18	18
		Fieldbus	19	19	19	19	19
		FWD	20	20	20	20	20
		Proc. Var. > VPx	21	21	21	21	21
		Proc. Var. < VPy	22	22	22	22	22
		Ride-Through	23	23	23	23	23
		Pre-charge OK	24	24	24	24	24
		With error	25	25	25	25	25
		Enabled Hours > Hx	26	26	26	26	26
		PLC	-	-	27	27	27
		Timer N > Nx and Nt > Nx	- 20	- 20	- 20	28	28
		Brake (Vel) - Real Speed	29 30	29 30	29 30	29 30	30
		Brake (Ref) -	30	30	30	30	30
		Total Reference	31	31	31	31	31
		Overweight	32	32	32	32	32
		Slack Cable	33	33	33	33	33
		Torque Polarity +/-	34	34	34	34	34
		Torque Polarity -/+	35	35	35	35	35
		F > Fx _ 1	36	36	36	36	36
		F > Fx _ 2	37	37	37	37	37
		Set point =	38	38	38	38	38
		Process Variable No E32	30	30	30	30	30
		Ready 2	39 40	39 40	39 40	39 40	39 40
		Table 6.42 - Functi	1		ll		
100		Table 0.42 - Fulleti	ons or lite	aigilai oulp	ato and Itle	λη σαιραίδ	

	Range [Factory Setting]	
Parameter	Unit	Description / Notes
		☑ Additional Notes about the Digital Output Functions:
		- Remote: Inverter is operating in Remote mode.
		- Run: Inverter is enabled (the IGBTs are switching, the motor may be at any speed, including zero).
		- Ready: Inverter neither is in fault non in undervoltage condition.
		- No Fault: Inverter is not in any fault condition.
		- With Error means that the inverter is disabled due to some error.
		- No E00: Inverter is not in an E00 fault condition.
		- No E01+E02+E03: Inverter is not in an E01 or E02 or E03 fault condition.
		- No E04: Inverter is not in an E04 fault condition.
		- No E05: Inverter is not in an E05 fault condition.
		- 4 to 20 mA OK: If applicable, the 4 to 20 mA current reference is present.
		<ul> <li>Zero Speed: Motor speed is lower than the value set at P291 (Zero Speed Zone)</li> </ul>
		- Not Used: Digital Output remains inactive.
		- Forward: Motor is running forward.
		<ul> <li>Torque &gt; Tx and Torque &lt; Tx: Valid only for P202 = 3 or 4 (Vector Control).</li> </ul>
		Torque corresponds to motor Torque as indicated in Parameter P009.
		- Ride-Through: means that the inverter is executing the Ride-Through function.
		- <b>Pre-charge OK:</b> means that the DC-Link voltage is higher than the pre-charge voltage level.
		- <b>Fieldbus:</b> allows changing the state of the digital outputs (P275 to P280) from the Fieldbus network. Refer to item 8.12.7.
		- N > Nx and Nt > Nx: (this option works only for P202 = 4 - Vector with Encoder Control) means that both conditions must be satisfied in order that DOx = Saturated Transistor and/or RLx = relay picked up. The Digital Outputs will come back to its OFF state, that is, DOx = Cut-off Transistor and/or RLx = released relay, when only N>Nx condition is not satisfied (that is, independent of Nt>Nx condition).
		- Timer: These times enable and disable the relays 2 and 3 (refer P283 to P286).
		- Brake (Vel) - Real Speed
		It uses the Real Speed in the comparison of N > Nx to activate the brake.  Note: Nx is programmable at P288.
		- Brake (Ref) – Total Reference
		If P202 = 3 (Sensorless Control) – It uses the Total Reference in the comparison of N* > Nx to activate the brake.

	D	
	Range [Factory Setting]	
Parameter	Unit	Description / Notes
		If P202 $\neq$ 3 (V/F, VVW or Vector with Encoder control), the comparison of N > Nx to activate the brake will always use the Real Speed, regardless of the selection ("31 = Brake (Ref)" or "30 = Brake (Vel))".
		Refer to figures 6.39 q), r) and s).
		Preliminary settings:
		Nx (P288) = 7 % to 10 % of the motor speed (Sensorless Control), 2 % to 5 % of the speed (Vector with Encoder Control)
		Ix (P290) = 20 % to 130 % of P401
		P355 = 0 seconds
		P354 = 1.5 x time to activate the brake
		P356 = 0.85 x time to release the brake
		P353 = 0.2 seconds
		These preliminary settings are suggestive and may be changed according to the application.
		- Overweight - Situation where the lifted load weight is greater than the maximum allowed.
		☑ When the CFW-09 is powered up, the output set to the option "32 = Overweight" is activated. In order to deactivate the output, i.e., detect the overweight condition, the following conditions shall be satisfied:
		- P361 = 1 (Load Detection = On);
		- Parameters P362, P363 and P367 properly set;
		<ul> <li>P367 (Overweight Level) lower than the output current (P367 &lt; Is) during the stabilization time.</li> </ul>
		☑ If P361 = 0 (Load Detection = Off) – the output always remains activated.
		- Slack Cable - Situation where the lifted load weight is lower than the minimum weight detected by the crane.
		☑ When the CFW-09 is powered up, the output set to the option "33 = Slack Cable" is activated. In order to deactivate the output, i.e., detect the slack cable condition, the following conditions shall be satisfied:
		- P361 = 1 (Load Detection = On);
		- Parameters P362, P363, P364 and P365 properly set;
		- Slack cable condition detected.

Parameter	Range [Factory Setting] Unit	Desc

#### **Description / Notes**

# NOTES!

- ☑ If the slack cable condition is detected during the stabilization time, the motor remains at the stabilization speed until receiving a "Stop" command. However, if this condition is detected outside of the stabilization time, the output set to this option will be deactivated and the motor will maintain the same speed.
- ☑ The only way of disabling the Slack Cable function is stopping the motor.
- ☑ To a better understanding refer to figures 6.46 a) and b).
- ☑ If P361 = 0 (Load Detection = Off) the output always remains activated.

#### - Torque Polarity +/-

The output programmed to this function will be activated when the torque is positive.

#### - Torque Polarity -/+

The output programmed to this function will be activated when the torque is negative.



The outputs that are set to the function "Torque Polarity" have a hysteresis in its operation that can be configured at parameter P358 (Hysteresis for the Torque Current – Iq). This resource works in the transition of these outputs at the moment they are activated or deactivated.

#### DOx or RLx = 34 - Torque Polarity +/-

Torque XC4 Voltage		Status of the contacts at XC1				
Polarity	DO1 (5, 6)	(NC) RI	L1 (NO)	(NO) R	_2 (NC)	RL3 (NO)
1 Clarity	DO2 (7, 6)	21-24	22-24	23-25	25-26	27-28
Positive (+)	0 V	Open	Closed	Closed	Open	Closed
Negative (-)	+24 V	Closed	Open	Open	Closed	Open

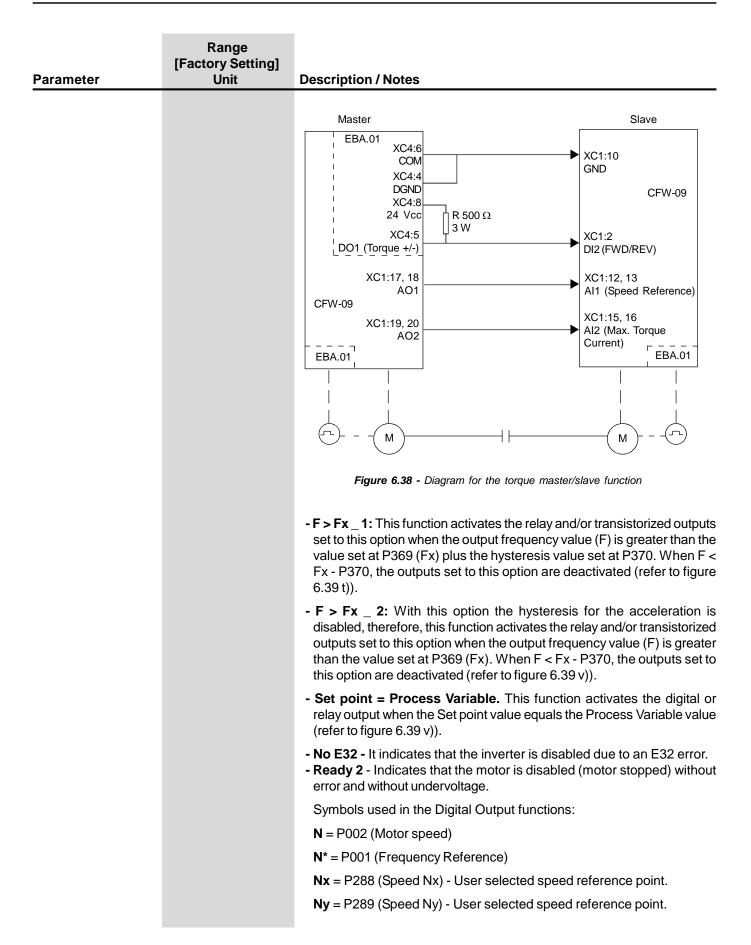
**Table 6.43 a)** - Status of the DOx and RLx contacts with the torque polarity +/- function

#### DOx or RLx = 35 - Torque Polarity -/+

Torque	XC4 Voltage	Status of the contacts at XC1				
Polarity	DO1 (5, 6)	(NC) RI	_1 (NO)	(NO) F	RL2 (NC)	RL3 (NO)
1 Clarity	DO2 (7, 6)	21-24	22-24	23-25	25-26	27-28
Positive (+)	+24 V	Closed	Open	Open	Closed	Open
Negative (-)	0 V	Open	Closed	Closed	Open	Closed

Table 6.43 b) - Status of the DOx and RLx contacts with the torque polarity -/+ function

_	Range [Factory Setting]				
Parameter	Unit	Description / Notes			
		NOTE!			
		It is used only with the Master/Slave function to indicate the torque polarity at the digital or relay outputs.			
		Description of the Torque Po Master/Slave function	larity +/- function for the Torque		
			on requires the digital or relay outputs et to the options P275 = 34 (Torque e Polarity -/+).		
		Therefore, a load resistor (Rc) shall be connected at the digital output DO1 (XC4:5) or DO2 (XC4:7), as presented in figure 8.1. This output shall be connected to the digital input DI2 of the "Slave" CFW-09, which shall be set to the option P264 = 0 (Direction of Rotation).			
		In the master CFW-09 (Vector with encoder):	In the slave CFW-09 (Vector with encoder):		
		P275 or P276 = 34 or 35 P357 = 0.1 s P358 = 2.00 % P253 = 4	P100 = P101 = 0 P160 = 1 P223 = P226 = D12 = 4 P264 = 0 P237 = 2 P234 = 1.2		
		Table 6.44 - Minimum required setting	is for the torque Master/Slave function		
		For P275 or P276 = 34 or 35			
		output DO1 or DO2 will be se	master" CFW-09 is positive, the digital to zero, which will force the speed trate positively, producing a positive		
		digital output DO1 or DO2 will	e "master" CFW-09 is negative, the be set to 24 V, which will force the to saturate negatively, producing a		



Range [Factory Setting] Unit	Description / Notes
C	Ix = P290 (Current Ix) - User selected current reference point.
	Is = P003 (Motor Current).
	Torque = P009 (Motor Torque).
	<b>Tx</b> = P293 (Torque Tx) - User selected torque reference point.
	<b>Vpx</b> = P533 (Process Variable x) - User selected reference point.
	<b>Vpy</b> = P534 (Process Variable y) - User selected reference point.
	<b>Nt</b> = Total Reference (Refer to figure 6.26) after all scalings, offsets, additions, etc.
	<b>Hx</b> = P294 (Hours Hx).
	PLC = Refer to PLC board manual.
	<b>Fx</b> = P370 (Frequency Fx) – Frequency reference defined by the user.
0.0 to 300	☑ Used in the function as Relay Output: Timer of the relay 2 or 3.
[ 0.0 ] 0.1 s	☑ When the timing function of the relays 2 and 3 is programmed at any DIx, and when the transition is effected from 0 V to 24 V, the relay will
0.0 to 300 [ 0.0 ] 0.1 s	be enabled according to the time set at P283 (RL2) or P285 (RL3). When the transition from 24 V to 0 V occurs, the programmed relay will be disabled according to the time set at P284 (RL2) or P286 (RL3).
0.0 to 300 [ 0.0 ] 0.1 s	☑ After the DIx transition, to enable or disable the programmed relay, it is required that the DIx remains in on/off status during the time set at parameters P283/P285 and P284/P286. Otherwise the relay will be reset. Refer to figure 6.34.
0.0 to 300 [ 0.0 ] 0.1 s	Note: For this function, program P279 and/or P280 = 28 (Timer).
	0.0 to 300 [ 0.0 ] 0.1 s

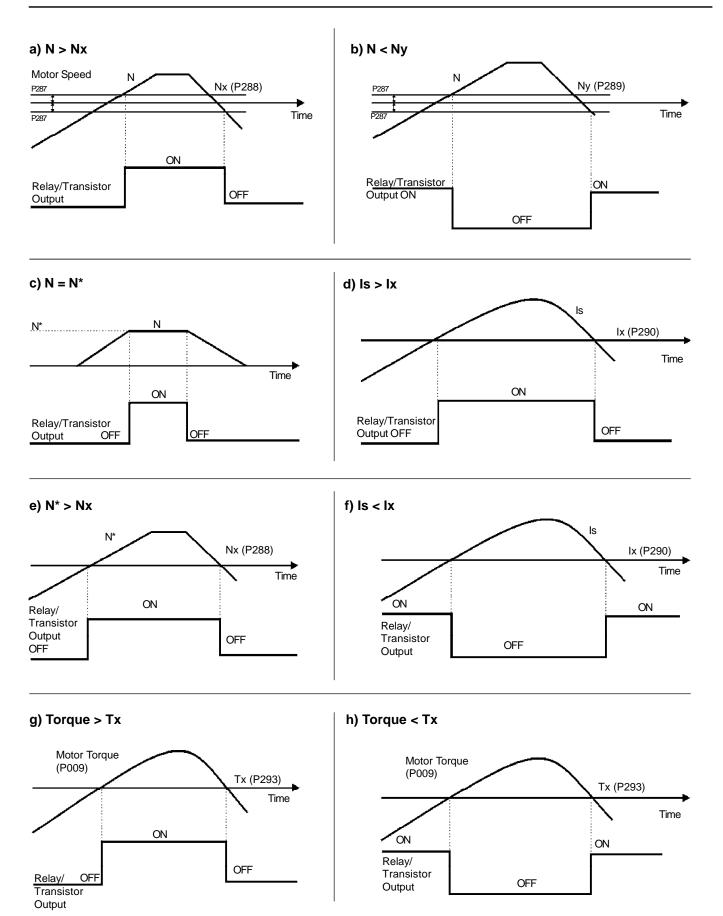


Figure 6.39 a) to h) - Details about the operation of the digital and relay output functions

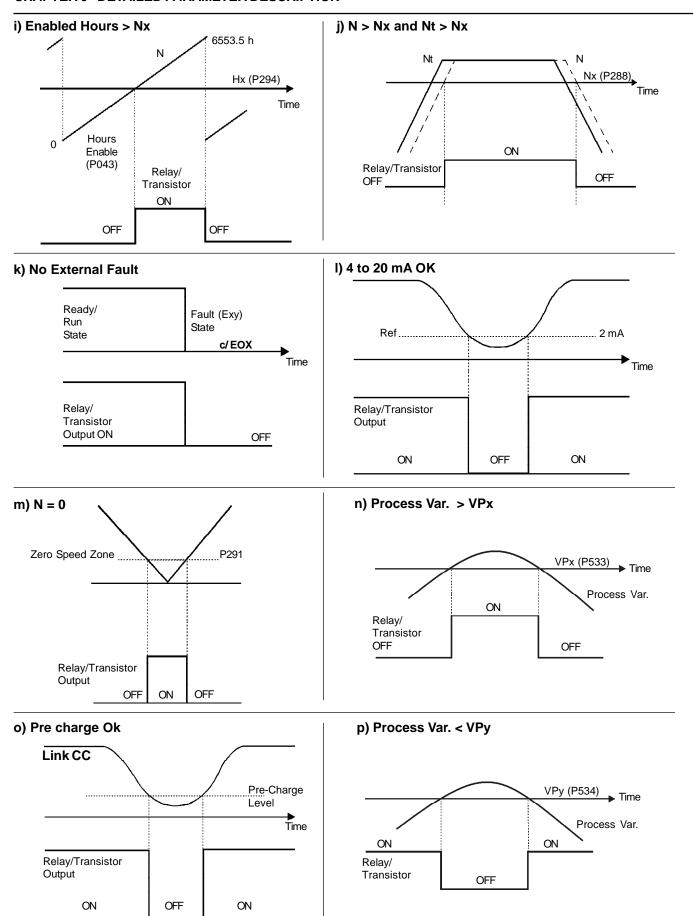
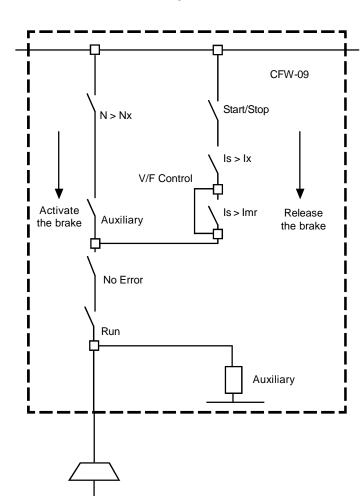


Figure 6.39 (cont.) i) to p) - Details about the operation of the digital and relay output functions



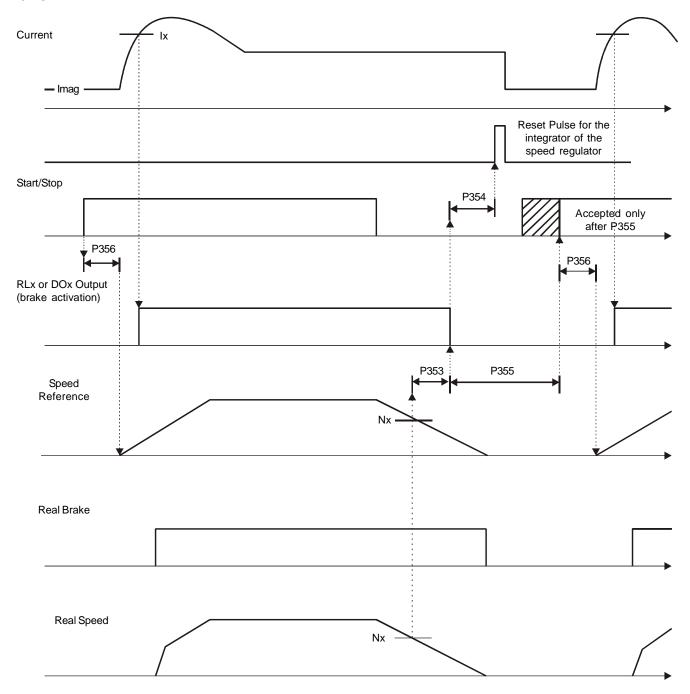
### q) Logic for the Brake Activation when DOx or Relay = 30 or 31

# NOTES!

- 1) To release the brake (transition from NC to NO) both comparisons are performed Is > Ix, Is > Imr. At the same time, the inverter shall receive a Start/Stop command in the "Run" state and with no error.
- 2) To activate the brake (transition from NO to NC) the comparison N > Nx is performed.
- 3) If P202 = 4 (Vector with Encoder), the brake is not activated when the speed crosses zero at the reversing of the direction of rotation.

Figure 6.39 (cont.) q) - Details about the operation of the digital and relay output functions

# r) Operation of Parameters P353 to P356 with Ix > Imr.



Note: The Start/Stop function in the figure above is valid only for commands from the DI1 (Digital Input #1) set to the option "1 = Start/Stop".

Figure 6.39 (cont.) r) - Details about the operation of the digital and relay output functions

# s) Operation of Parameters P353 to P356 with Ix < Imr.

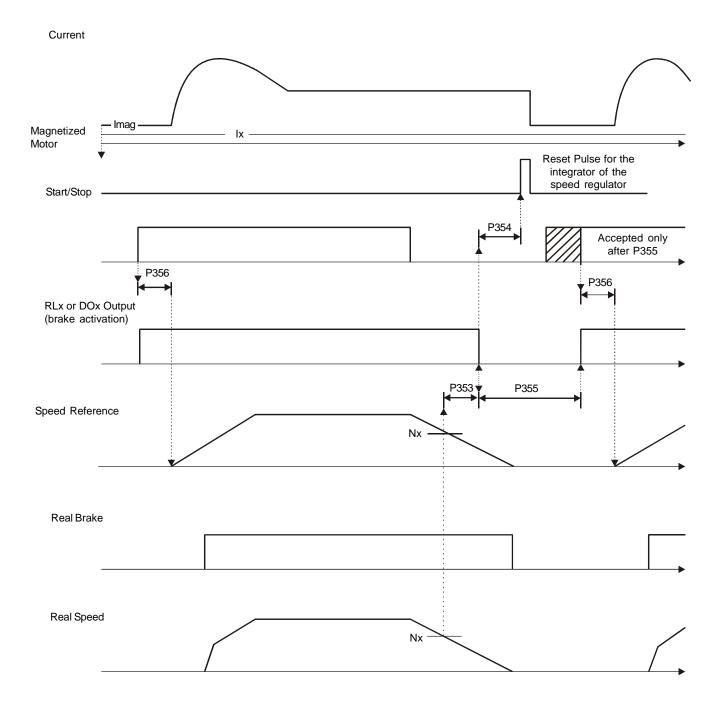
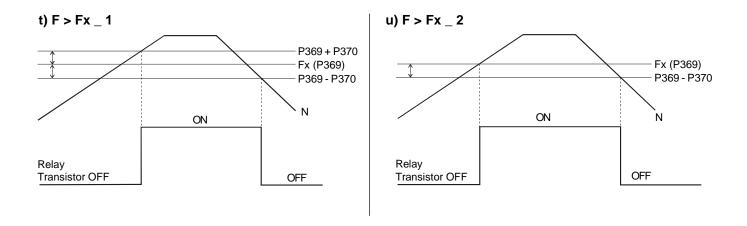


Figure 6.39 (cont.) s) - Details about the operation of the digital and relay output functions



### v) Set Point = Process Variable

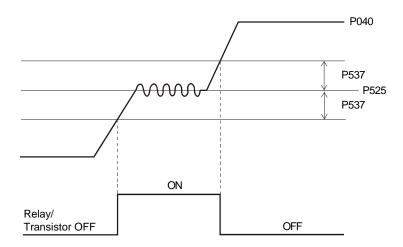


Figure 6.39 (cont.) t) to v) - Details about the operation of the digital and relay output functions

Parameter	Range [Factory Setting] Unit	Description / Notes
P287	0.0 to 5.0	☑ Used by the Digital and Relay Outputs functions:
Hysteresis for Nx/Ny	[ 1.0 ] 0.1 %	N > Nx and N < Ny.
P288 (2) (11)	0 to P134	☑ Used by the Digital and Relay Outputs functions:
Nx Speed	[ 120 (100) ] 1 rpm	$N^* > Nx$ , $N > Nx$ and $N < Ny$ .
<b>P289</b> <sup>(2) (11)</sup> Ny Speed	0 to P134 [ 1800 (1500) ] 1 rpm	
P290 <sup>(7)</sup> Ix Current	0.0 to 2.0 x P295 [ 1.0 x P295 ] 0.1 A(< 100)-1 A(> 99.9)	☑ Used by the Digital and Relay Outputs functions: Is > Ix and Is < Ix.
P291 Zero Speed Zone	1 to 100 [1] 1%	☑ Used by the Digital and Relay Outputs function Zero Speed and the Zero Speed Disable (Refer to P211 and P212).
P292 N = N* Band (At Speed Band)	1 to 100 [1] 1%	$\  \   \square$ Used by the Digital and Relay Outputs function N = N* (At Speed).
P293 Tx Torque	0 to 200 [ 100 ] 1 %	☑ Used by the Digital and Relay Outputs functions Torque > Tx and Torque < Tx. In this output mode, the motor torque indicated in parameter P009 is compared with the value programmed in P293.
		☑ The setting is expressed in % of the motor rated current (P401 = 100 %)
P294 Hours Hx	0 to 6553 [ 4320 ] 1 h	☑ Used in the functions of the digital outputs Hours Enabled higher than Hx.

# Range [Factory Setting] Unit Parameter P295 (1) 0 to 81 Inverter Rated [ According to the Current CFW-09 rated current for CT application]

# **Description / Notes**

- ☑ Even if some models withstand a higher current for VT applications, the setting of P295 shall be kept in accordance with the inverter rated current (CT).
- ☑ Do not modify the value of P295 for VT applications.

220-230 V Models				
IN	P295	Size		
6 A	3			
7 A	4	1		
10 A	6	'		
13 A	7			
16 A	8			
24 A	9	2		
28 A	10			
45 A	13	3		
54 A	14	4		
70 A	16	5		
86 A	17	3		
105 A	18	6		
130 A	19	٥		
500 600 V Models				

130 /	10				
500-600 V Models					
IN	P295	Size			
2.9 A	39				
4.2 A	40				
7 A	4	2			
10 A	6	2			
12 A	41				
14 A	42				
22 A	43				
27 A	44	4			
32 A	45				
44 A	46				
53 A	47	7			
63 A	48	,			
79 A	49				
600 A	25	above			
652 A	72	500 hp			
794 A	73				
897 A	76				
978 A	78				
1191 A	79				
1345 A	81				

660-690 V Models				
IN	P295	Size		
100 A	50			
127 A	52	8E		
179 A	54			
225 A	56			
259 A	58			
305 A	59	10E		
340 A	61			
428 A	64			
492 A	68	above		
580 A	70	500 hp		
646 A	71			
813 A	74			
869 A	75			
969 A	77			
1220 A	80			

380-480 V Models				
IN	Size			
3.6 A	0			
4 A	1	1		
5.5 A	2	'		
9 A	2 5 7			
13 A				
16 A	8	2		
24 A	9			
30 A	11	3		
38 A	12	4		
45 A	13			
60 A	15	5		
70 A	16			
86 A	17	6		
105 A	18			
142 A	20	7		
180 A	21			
211 A	55	8		
240 A	22			
312 A	67	9		
361 A	23			
450 A	24			
515 A	69	10		
600 A	25			
686 A	33	above		
855 A	34	500 hp		
1140 A	35			
1283 A	36			
1710 A	37			
1468 A	82			

500-690 V Models				
IN	P295	Size		
107 A	51			
147 A	53	8E		
211 A	55			
247 A	57			
315 A	60			
343 A	62	10E		
418 A	63			
472 A	65			

Special Models				
P295				
38				
66				
26				
27				
28				
29				
30				
31				
32				

Table 6.45 - Inverter rated current selection

Parameter	Range [Factory Setting] Unit	Description / Notes
P296 (1) (11) Inverter Rated Voltage (Rated Input Voltage)	0 to 8 [ 0 for models 220-230 V 3 for models 380-480 V 6 for models 500-600 V and 500-690 V 8 for models 600-690 V ]	P296
	-	ATTENTION!  ☑ Set P296 according to the rated AC line voltage! Do not set according to short term peak values.  ☑ For CFW-09 models ≥ 86 A/380-480 V, ≥ 44 A/500-600 V and 500-690 V models, also adjust the voltage selection jumper (Refer to item 3.2.3).
P297 (1) (2) Switching Frequency	0 to 3 [ 2 (5.0 kHz) ] 1	P297 Switching Frequency  1 2.5 kHz  1 0.0 kHz  Table 6.47 - Switching frequency selection  ✓ The rated switching frequency for each model is shown in item 9.1. When a higher switching frequency is used, it is necessary to derate the output current as specified in item 9.1 note 3.  ✓ Note that the switching frequency must be reduced from 5 kHz to 2.5 kHz when the VT rated current is used in the following models: from 54 A to 130 A/220-230 V, from 30 A to 142 A/380-480 V and 63 A/500-600 V.  ✓ Note that the following models have a rated switching frequency of 2.5 kHz: from 180 A to 600 A/380-480 V, 44 A and 79 A/500-600 V, from 107 A to 472 A/500-690 V and all 660-690 V models.  ✓ The switching frequency is a compromise between the motor acoustic noise level and the inverter IGBTs losses. Higher switching frequencies cause lower motor acoustic noise level, but increase the IGBTs losses, increasing inverter components temperature, thus reducing their useful life.  ✓ The predominant frequency on the motor is twice the switching frequency programmed at P297.  P297 = 5.0 kHz results in an audible motor noise corresponding to 10.0 kHz. This is due to the PWM technique used.  A reduction of the switching frequency also:  - Helps reducing instability and resonance problems that may occur in certain application conditions.

E11 (Output Ground Fault).

- Reduces the leakage currents to ground, which may avoid nuisance

Parameter	Range [Factory Setting] Unit	Description / Notes
		$\blacksquare$ The option 1.25 kHz is not valid for the Vector Control (P202 = 3 or 4).
		☑ The option 10 kHz is not valid for the Sensorless Vector Control (P202 = 3) and for the models with supply voltage between 500 V and 690 V (2.9 A to 79 A/500-600 V, 107 A to 472 A/500-690 V and 100 A to 428 A/660-690 V).
P300	0.0 to 15.0	☑ The DC braking feature provides a motor fast stop through the injection of
DC Braking Time	[ 0.0 ]	DC current.
This parameter is shown on the	0.1 s	☑ This parameter sets the DC Braking Time when the inverter is operating in the V/F, VVW or Sensorless Vector Control modes.
display(s) only when		Control Mode DC Braking at Start DC Braking at Stop
P202 = 0, 1, 2, 3 or 5		V/Hz         -         P300, P301 and P302           VVW         P302 and P371         P300, P301 and P302
		Vector Sensorless P371 and P372 P300, P301 and P372
		Table 6.48 - Parameters related to the DC braking  ✓ Figure 6.40 shows the operation of the DC Braking with a ramp to stop (stop command). Refer to P301:  a) V/F Control  ✓ P300  ——————————————————————————————————
		b) VVW and Sensorless Control  Motor Speed  P300  P301  Time  +24 V  Start/ Stop - Dlx  Open
		Figure 6.40 a) and b) - DC braking operation with a ramp to stop

	Range [Factory Setting]	
Parameter	Unit	Description / Notes
		☑ For the V/F Control, there is a "Dead Time" (motor runs freely) before the DC braking starts. This time is required in order to demagnetize the motor and it is a function of the motor speed.
		☑ During the DC Braking the LED displays flashes ☑[br].
		☑ The DC braking does not work with P202 = 4 (Vector with Encoder Control).
		☑ If the inverter is enabled during the DC braking operation, the braking process is interrupted and the inverter will return to its normal operation.
		ATTENTION!  The DC braking may continue working even after the motor has already stopped. Pay special attention to the motor thermal sizing for cyclic braking of short time.
P301 DC Braking Starting Speed	0 to 450 [ 30 ] 1 rpm	☑ This parameter establishes the starting point from where the DC Braking takes place. Refer to figure 6.40.
This parameter is shown on the display(s) only when P202 = 0, 1, 2, 3 or 5		
P302 DC Braking	0.0 to 10.0 [ 2.0 ]	☑ This parameter adjusts the DC voltage (DC braking torque) applied to the motor during the braking process.
Voltage  This parameter is shown on the	0.1 %	☑ The setting shall be done by gradually increasing the value of P302, which varies from 0 to 10 % of the rated supply voltage, until the desired braking torque is reached.
display(s) only when P202 = 0, 1, 2 or 5		☑ This parameter works only for the V/F and VVW Control Modes. For the Sensorless Mode, refer to parameter P372.
P303 Skip Speed 1	P133 to P134 [ 600 ] 1 rpm	Motor Speed
P304 Skip Speed 2	P133 to P134 [ 900 ] 1 rpm	P305  2 x P306  2 x P306  P306
P305 Skip Speed 3	P133 to P134 [ 1200 ] 1 rpm	P303
<b>P306</b> Skip Band Range	0 to 750 [ 0 ] 1 rpm	Speed Reference
		Figure 6.41 - Actuation of the skip speed

Parameter	Range [Factory Setting] Unit	Description / Notes
		☑ This feature prevents the motor from operating permanently at speeds where the mechanical system enters into resonance, causing high vibration or noise levels.
		☑ The passage through the skip speed band (2 x P306) is made at the programmed acceleration/deceleration rates.
		☑ This function does not operate properly when two skip speeds are overlapped.
P308 <sup>(1)</sup> Serial Address	1 to 30 [ 1 ] -	☑ Sets the address of the inverter for the serial communication. Refer to item 8.13.
P309 (1) Fieldbus	0 to 10 [0]	☑ Defines the Fieldbus standard to be used (Profibus DP/DP-V1, DeviceNet, EtherNet/IP or DeviceNet Drive Profile) and the number of variables to be exchanged with the master. Refer to item 8.12.7.     P309
P310 <sup>(1)</sup> STOP Detection in a Profibus Network	0 or 1 [ 0 ] -	☑ This parameter allows programming the bit #6 of the Fieldbus control word (refer to item 8.12.7.2 - Variable Written in the Inverter).
		P310 Function Bit #6 CFW-09 Action 0 Off No function -
		If bit6 = 0  If bi
		If bit6 = 1  Executes the commands that were programmed at the remaining bits of the control word.
		Table 6.50 - STOP detection in a Profibus network

Parameter	Range [Factory Setting] Unit	Description / I		to ON, the hit #6 of the control word shall be kent	
		☑ If this parameter is set to ON, the bit #6 of the control word shall be ke in 1 to the inverter operation. It will allow the inverter to be disabled case of STOP in the master of the Fieldbus network, where the contr word is reset (all bits are set to zero).			
P312 (1) Type of Serial Protocol	0 to 9 [0]			Type of Serial Protocol  WBUS Protocol  Modbus-RTU, 9600 bps, no parity  Modbus-RTU, 9600 bps, odd parity  Modbus-RTU, 9600 bps, even parity  Modbus-RTU, 19200 bps, no parity  Modbus-RTU, 19200 bps, odd parity  Modbus-RTU, 19200 bps, even parity  Modbus-RTU, 38400 bps, no parity  Modbus-RTU, 38400 bps, odd parity  Modbus-RTU, 38400 bps, even parity  Me 6.51 - Type of serial protocol  type used for the serial communication.	
P313 Disabling with E28/E29/E30	0 to 5 [0]	(causing err Fieldbus is i is inactive (d ✓ For P313 = 4 and change speed refere will be kept and Electron ✓ For P313 = 5 a fatal error	inverter be ror E28), when the series comming the comm	Disabling with E28/E29/E30  Disable via Start/Stop  Disable via General Enable  No Action  Changes to LOCAL 1  to LOCAL 2 - Keeping the Commands and the Reference  Causes Fatal Error  6.52 - Disabling with E28/E29/E30  Phavior when the serial communication is inactive when physical connection with the master of the discussing error E29) or when the Fieldbus board ror E30). Refer to item 8.12.7.  The inverter detects Fieldbus communication fault mote to Local mode, then the Start/Stop and the mands the inverter was receiving in Remote mode mode, if these commands were 3-wire Start/Stop iometer or Start/Stop and reference via HMI.  The inverter detects Fieldbus communication fault, the inverter detects Fieldbus communication fault, are rated in the equipment, disabling the motor and an error reset, so that the operation be possible	

Parameter	Range [Factory Setting] Unit	Description /	Notes		
P314 <sup>(1)</sup>	0.0 to 999.0		P3′	14	Time for serial
Time for Serial	[ 0.0 ]		10		watchdog action
Watchdog Action	0.1 s		0.0		Disable
			0.1 to	999.0	Enable
			Table	<b>e 6.53 -</b> Seri	al Watchdog action
		programme	ed at P314 erter will re	has elapse turn to the	ny valid serial telegram after the time ed, the Fault Message E28 on the HMI action programmed at P313 - Type of
					e this action, the inverter commands rial" option at the parameters P220 to
P318	0 or 1		P318	Function	Description
Watchdog detection for the PLC board	[0]		0	Off	Disables the activation of the Watchdog Error for the PLC board - E71.
			1	On	Enables the activation of the Watchdog Error for the PLC board - E71.
			Table 6.54 -	Watchdog o	letection for the PLC board
P320 <sup>(1)</sup> Flying Start/Ride-	0 to 3 [ 0 (Inactive) ]	☑ The Param	neter P320	selects the	use of the following functions:
Through	[ 0 (mactive) ] -	P320			Function
-		0	Inactive	01	
		1		Start is activ 202 = 0 1 2	e (V/F Control), 3 (sensorless) or 5 (VVW)]
			_		rough are active
		_	'		(V/F Control), 3 (sensorless) or 5 (VVW)]
		3	Only Ride-	Through is ac	tive
			Table	<b>6.55 -</b> Flying	g Start/Ride-Through
P321 <sup>(6)</sup> Ud Line Loss Level	178 V to 282 V (P296 = 0) [252 V] 1 V	outputs D	01, DO2, F	RL1, RL2 a	ugh function can be visualized at the and/or RL3 ( <b>P275, P276, P277</b> , <b>P279</b> or programmed to "23 = Ride-Through".
This parameter is shown on the display(s) only when P202 = 3 or 4 (Vector Control)	307 V to 487 V (P296 = 1) [436 V] 1 V	the p	n one of the		Ride-Through or Flying Start is activated, Phase Loss Detection) is automatically

Parameter	Range [Factory Setting] Unit	Description / Notes
	324 V to 513 V (P296 = 2) [459 V] 1 V	NOTE!  This parameter works together with P322, P323, P325, P326 for Ride-Through in Vector Control, and with P331, P332 for V/F Control Ride-Through and Flying Start.
	356 V to 564 V (P296 = 3) [505 V] 1 V	NOTE! Ud = Vac x 1.35.
	388 V to 615 V (P296 = 4) [550 V] 1 V  425 V to 674 V (P296 = 5) [602 V] 1 V	<ul> <li>Ride-Through for Vector Control (P202 = 3 or 4)</li> <li>☑ The purpose of the Ride-Through function, in Vector Mode (P202 = 3 or 4), is to ensure that the inverter maintains the motor running during the line loss, not allowing interruption or fault storing. The energy required for motor running is obtained from the kinetic energy of the motor (inertia) during its deceleration. As soon as the line is reestablished, the motor accelerates again to the speed defined by the reference.</li> <li>☑ After line loss (t0), the DC Link voltage (Ud) starts to decrease in a rate that depends on the motor load condition and may reach the undervoltage level (t2), if the Ride-Through function is not operating. The time required for this condition, the included saturates in a range from 5 to 15 mg.</li> </ul>
	(P296 = 6) [660 V] 1 V 486 V to 770 V (P296 = 7) [689 V] 1 V 559 V to 885 V (P296 = 8) [792 V] 1 V	for this condition, typical for rated load, situates in a range from 5 to 15 ms.   ☑ With Ride-Through function active, the line loss is detected when Ud voltage becomes lower than the "Ud line loss" value (t1). The inverter immediately starts a controlled motor deceleration, regenerating the energy into the DC Link and thus maintaining the motor running, where the Ud voltage is regulated to the "Ud Ride-Through" value.
P322 <sup>(6)</sup> Ud Ride-Through  This parameter is shown on the display(s) only when P202 = 3 or 4 (Vector Control)	178 V to 282 V (P296 = 0) [245 V] 1 V  307 V to 487 V (P296 = 1) [423 V] 1 V	☑ If the line loss is not recovered, the motor remains in this condition as long as possible (depending on the energy equilibrium), until the undervoltage condition (E02 at t5) occurs. If the line loss is recovered (t3) before the undervoltage condition, the inverter detects its reestablishment when the Ud voltage reaches the "Ud Loss Recover" level (t4). Then the motor is accelerated according to the set ramp, from the current speed value up to the value defined by the active speed reference. Refer to figure 6.42. If the input voltage drops to a value between parameters P322 and P323, the values of P321, P322 and 323 shall be readjusted.

	Range	
Parameter	[Factory Setting]	Description / Notes
Parameter	324 V to 513 V (P296 = 2) [446 V] 1 V 356 V to 564 V (P296 = 3) [490 V] 1 V 388 V to 615 V (P296 = 4) [535 V] 1 V 425 V to 674 V (P296 = 5) [588 V] 1 V 466 V to 737 V (P296 = 6) [644 V] 1 V 486 V to 770 V (P296 = 7) [672 V] 1 V 559 V to 885 V (P296 = 8) [773 V] 1 V	NOTE! Cares with Application: The use of the line reactance or DC choke is mandatory to limit the inrush current when the network is reestablished.  NOTE! The function Ride-Through in Vector Mode for models 107 A to 472 A/500-690 V and 100 A to 428 A/660-690 V works only up to a maximum time of 2 s. In these models the control power supply is not fed from the DC Link, it is a separate power supply with 2 s autonomy.  NOTE! To activate the Ride-Through, the line supply must fall to a value lower than (P321 ÷ 1.35).
P323 <sup>(6)</sup> Ud Loss Recover Level  This parameter is shown on the display(s) only when P202 = 3 or 4 (Vector Control)	178 V to 282 V (P296 = 0) [267 V] 1 V 307 V to 487 V (P296 = 1) [461 V] 1 V 324 V to 513 V (P296 = 2) [486 V] 1 V	Nominal Loss Recover (P323) Line Loss (P321) Ride-Through (P322) Undervoltage (75%)  Figure 6.42 - Actuation of the Ride-Through function in Vector Control mode

Parameter	Range [Factory Setting] Unit	Description / Notes
	356 V to 564 V (P296 = 3) [534 V] 1 V 388 V to 615 V (P296 = 4) [583 V] 1 V 425 V to 674 V (P296 = 5) [638 V] 1 V 466 V to 737 V (P296 = 6) [699 V] 1 V 486 V to 770 V (P296 = 7) [729 V] 1 V 559 V to 885 V (P296 = 8) [838 V] 1 V	<ul> <li>☑ t0 - Line Loss;</li> <li>☑ t1 - Line Loss Detection;</li> <li>☑ t2 - Trip by Undervoltage (E02 without Ride-Through);</li> <li>☑ t3 - Line Recover;</li> <li>☑ t4 - Line Recover Detection;</li> <li>☑ t5 - Trip by Undervoltage (E02 with Ride-Through).</li> </ul>
P325 Ride-Through Proportional Gain  This parameter is shown on the display(s) only when P202 = 3 or 4 (Vector Control)	0.0 to 63.9 [22.8] 0.1	Ud Ride-Through    Blockdiagram figure 6.27 a) Input
P326 Ride-Through Integral Gain  This parameter is shown on the display(s) only when P202 = 3 or 4 (Vector Control)	0.000 to 9.999 [0.128] 0.001	✓ Normally the factory setting for P325/P326 is adequate for most applications.

	Range	
Parameter	[Factory Setting] Unit	Description / Notes
P331 Voltage Ramp	0.2 to 60.0 [ 2.0 ] 0.1 s	The Flying Start function allows the inverter to start a motor that is running freely. This function takes the motor from its actual speed to the speed reference set at the inverter.
P332	0.1 to 10.0	☑ In order to enable the Flying Start function set P320 = 1 or 2.
Dead Time	[ 1.0 ] 0.1 s	☑ If the Flying Start function is not needed at some moments, a digital input may be set to disable the Flying Start (set only one of the parameters between P265 and P270 to 17).
parameters (P331 and P332) are only displayed when P202 = 0, 1, 2 or 5 (V/F / VVW Control)		Flying Start for V/F/VVW Control Mode:  ☑ To do that it has a voltage ramp (adjusted in P331) and the motor frequency is fixed and defined by the speed setpoint. The Flying Start will always work when a start or run command is given, after the time adjusted in P332 (to allow for the motor demagnetization).
		☑ Parameter P331 sets the time required for the output voltage reaching the rated voltage.
		Flying Start (FS) function for the Sensorless Vector Control (P202 = 3)
		☑ The Flying Start function takes place after the START command. At this moment, the inverter senses the motor speed, and once the motor speed is found, which may be in the forward or reverse direction, the motor is accelerated to the speed reference indicated in P001.
		☑ Parameters P135, P331 and P332 are not used by the Flying Start function when P202 = 3.
		Settings:
		☑ It is recommended to adjust P151 to the value in table 6.8 and P150 to 1.
		Ride-Through for V/F Control Mode or VVW:
		☑ The Ride-Through function for the V/F and VVW Control Modes works in a different manner than in the Vector Control Mode. As soon as the line supply falls to a value lower than the undervoltage (E02) Trip level (refer to item 7.1), the IGBT inverter is disabled (no voltage pulses at the motor). There is no tripping due to undervoltage, and the DC Link voltage will slowly fall until the line supply comes back.
		☑ If the line supply takes too long to come back (more than 2 s) the inverter may trip by E02 or E70. If it comes back before, the inverter will start the motor with a voltage ramp like in the Flying Start function. The voltage ramp time is defined also in P331. Refer to figures 6.44 a) and b).
		☑ The parameter P332, used for the Ride-Through function, sets the minimum time which the inverter will wait to restart the motor after voltage re-establishment. This time is computed from the line loss and is required for the motor demagnetization. Set this time at two times the motor rotor constant, refer to table in P412.
		☑ The Ride-Through function allows recovering the inverter without E02 trip (under voltage) during a momentary power supply interruption.

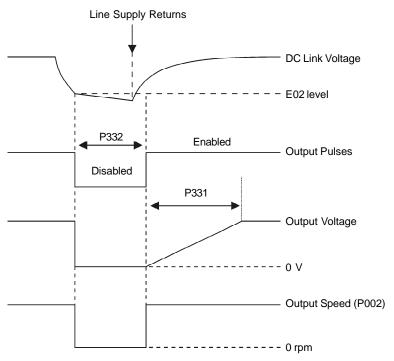


Figure 6.44 a) - Ride-Through actuation (line returns before time set at P332 elapses) in V/F mode

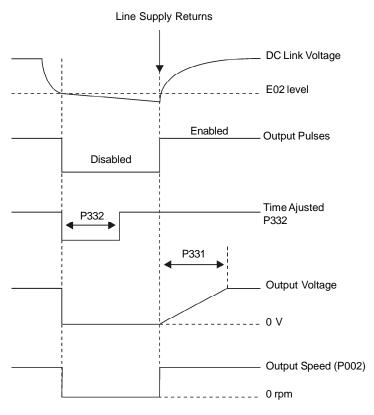


Figure 6.44 b) - Ride-Through actuation (line returns after time set in P332, but before 2 sec for  $P332 \le 1$  sec or before 2 x P332 for P332 > 1 sec) in V/F mode

Parameter	Range [Factory Setting] Unit	Description	/ Notes			
P335 DeviceNet I/O	0 to 3 [ 0 ]	☑ This parameter is applicable only if an optional DeviceNet Drive Profile communication kit were used.				
Instances	F	Profile inte	rface. These ins	I/O instances used by the DeviceNet Drive stances define the contents and the number ith the network master.		
			P335	DeviceNet I/O Instances		
			0	Instances 20/70		
			1	Instances 21/71		
			3	Instances 100/101 Instances 102/103		
				instances 102/103		
			Table 6.	56 - DeviceNet I/O instances		
			cation of this pa of the inverter.	rameter will become valid only after cycling		
		of the Devi	ceNet Drive Prof	tion on the parameterization and the operation file interface, refer to the CFW-09 frequency rofile Communication Manual.		
<b>P336</b> Input Word #3	0 to 749 [ 0 ]	☑ These parameters are applicable only if an optional DeviceNet Drive Profile communication kit were used.				
P337 Input Word #4 P338 Input Word #5	-	input word parameter	s 3 to 7 (input: th s it is possible to	340 permit programming the content of the e inverter sends to the master). Using these program the number of another parameter nade available at the network master input		
P339 Input Word #6		current in parameter	Amps, one mus, because the p	o read from the CFW-09 inverter the motor ust program the value 3 in one of these parameter P003 is the one that contains this		
P340 Input Word #7		information. It is worthwhile to remind that the value read fr parameter is represented with a 16 bit word with sign, i complement. Even if the parameter has decimal resolution, the transmitted without the indication of the decimal point. E.g parameter P003 has the value 4.7 A, the value supplied via the will be 47.				
		ed only if the number of input/output words greater than 2, and if the I/O instances 102/ 2335.				
		of the Devi	ceNet Drive Pro	tion on the parameterization and the operation file interface, refer to the CFW-09 frequency rofile Communication Manual.		

Parameter P341	Range [Factory Setting] Unit	Description / Notes  ☑ These parameters are applicable only if an optional DeviceNet Drive
Output Word #3 P342 Output Word #4 P343 Output Word #5	[0]	Profile communication kit were used.  ☑ The parameters P341 to P345 permit programming the content of the output words 3 to 7 (output: the master sends to the inverter). Using these parameters it is possible to program the number of another parameter whose content must be made available at the network master output area.
Output Word #5 P344 Output Word #6 P345 Output Word #7		☑ For instance, if one wishes to write the acceleration ramp value in the CFW-09 inverter, one must program the value 100 in one of these parameters, because the parameter P100 is the one where this data is programmed. It is worthwhile to remind that the value read from any parameter is represented with a 16 bit word with sign, in two's complement. Even if the parameter has decimal resolution, the value is transmitted without the indication of the decimal point. E.g., if one wishes to write value 5.0s in the parameter P100, the value programmed via the network must be 50.
		☑ These parameters are used only if the inverter were programmed to use the I/O instances 102/103, and if the number of input/output words programmed in P346 were greater than 2.
		☑ In order to get more information on the parameterization and the operation of the DeviceNet Drive Profile interface, refer to the CFW-09 frequency inverter DeviceNet Drive Profile Communication Manual.
P346 Number of I/O Words	2 to 7 [2]	<ul> <li>☑ This parameter is applicable only if an optional DeviceNet Drive Profile communication kit were used.</li> <li>☑ If the option 3, instances 102/103, is programmed in P335, it will be possible to program in P346 the number of words exchanged with the master from 2 up to 7 words.</li> <li>☑ The modification of this parameter will become valid only after cycling the power of the inverter.</li> <li>☑ In order to get more information on the parameterization and the operation of the DeviceNet Drive Profile interface, refer to the CFW-09 frequency inverter DeviceNet Drive Profile Communication Manual.</li> </ul>

# 6.3.1 Parameters for Crane Applications and for Torque Master/Slave Function - P351 to P368

Parameter	Range [Factory Setting] Unit	Description / Notes
P351 (1) Delay for E33 Speed without Control  This parameter is shown on the display(s) only when P202 = 3 or 4.	0.0 to 99.9 [ 99.9 ] 0.1 s	<ul> <li>✓ If the difference between N (Real Speed) and N* (Speed Reference) remains greater than the value set at parameter P292 for a period longer than that set at parameter P351 the inverter will trip with an error code E33.</li> <li>99.9 = E33 is disabled</li> </ul>
P352 (1) Delay for E34 Long Period at Torque Limitation  This parameter is shown on the display(s) only when P202 = 3 or 4.	0 to 999 [ 999 ] 1 s	<ul> <li>✓ If the CFW-09 remains at torque limitation for a period longer than the value set at P352 the inverter will trip with an error code E34.</li> <li>999 = E34 is disabled.</li> <li>NOTE!         When the CFW-09 is used in "master/slave" applications, disable this function on the slave inverter.     </li> </ul>
P353 <sup>(1)</sup> Delay for N < Nx Brake Activation	0.0 to 20.0 [0.0] 0.1 s	☑ Defines the time to activate the brake, i.e., the time that elapses between the condition N < Nx and the brake activation.
P354 (1) Delay for Resetting the Integrator of the Speed Regulator  This parameter is shown on the display(s) only when P202 = 4 (vector with encoder)	0.0 to 10.0 [2.0] 0.1 s	☑ This adjustment is needed to ensure that the motor current will be reduced after the brake activation. ATTENTION! If this value is lower than time needed to activate the mechanical braking, jerking, swinging or even falling may happen. If this value is greater than that set at P351 or P352, the inverter may trip with an error code E33 or E34, respectively.
P355 <sup>(1)</sup> Delay for Accepting new "Start/Stop" commands	0.0 to 10.0 [1.0] 0.1 s	<ul> <li>☑ This is the dead time that ensures the braking activation. Any other "Start/Stop" command is not accepted during this period.</li> <li>☑ Defines the time that the CFW-09 waits before accepting a new "Start" command after the motor is stopped. During the period set at P355 the commands are ignored.</li> </ul>

	Range [Factory Setting]					
Parameter	Unit	Description / Notes				
P356 <sup>(1)</sup> Delay for Ramp Enable	0.0 to 10.0 [ 0.0 ] 0.1 s	☑ This is the time that the CFW-09 waits before enabling the ramp after receiving the "Start" command.				
P357 <sup>(1)</sup> Filter for the Torque Current -lq	0.00 to 9.99 [0.00] 0.01 s	<ul> <li>☑ Time constant of the filter applied to the torque current. The sampling time is 5 ms.</li> <li>☑ It works along with P358 and activates a digital or relay output that was set to the option Torque Polarity +/</li> <li>☑ The filtered torque current may be available at analog outputs AO3 and AO4 when they are set to the option "Iq with P357" (P255 and/or P257 = 38).</li> </ul>				
P358 <sup>(1)</sup> Hysteresis for the Torque Current - Iq	0.00 to 9.99 [2.00] 0.01 %	Establishes the percentage of hysteresis that is applied to the commutation of a digital (DOx) or relay output when they are set to the options 34 or 35.  Torque Polarity  Positive Torque (+)  H1  Iq with P357  Negative Torque (-)  H1 = P358 x rated torque H2 = P358 x rated torque Figure 6.45 - Hysteresis for the torque current - Iq				
P361 (1)	0 or 1	Docarintian Description				
Load Detector	[0]	P361 Function Description  Off Functions that are set at parameters from P362 to P368				
		are disabled.  1 On The following functions are enabled: Slack Cable Detection, Lightweight Level and Overweight Detection.  Table 6.57 - Load detector				
		NOTE! Refer to figures 6.46 a) and b).				
P362 (1) Stabilization Speed  Available only	0 to P134 [90] 1 rpm	<ul> <li>The motor accelerates up to the stabilization speed and remains at this speed during the time set at parameter P363.</li> <li>During this period, the CFW-09 detects the load condition by using the average current.</li> </ul>				
if P361 = 1 (On)						

Parameter	Range [Factory Setting] Unit	Description / Notes
P363 <sup>(1)</sup> Stabilization Time	0.1 to 10.0 [ 0.1 ] 0.1 s	☑ Time that the CFW-09 waits before starting the load detection after the stabilization speed has been reached.
Available only if P361 = 1 (On)		
P364 <sup>(1)</sup> Slack Cable Time	0.0 to 60.0 [0.0] 0.1 s	☑ Time that the CFW-09 waits to commutate the digital (DOx) and relay outputs set to the option "Slack Cable Detection". If the Slack Cable condition is no longer valid, the CFW-09 resets the digital or relay outputs.
Available only if P361 = 1 (On)		NOTE!  When P364 = 0, the detection logic of slack cable is disabled.
P365 (1) Slack Cable Level	0.0 to 1.3 x P295 [0.1 x P295] 0.1 A	☑ Output current value used to detect the slack cable condition.
Available only if P361 = 1 (On)	0.174	
P366 (1) Light Load Level  Available only if P361 = 1 (On)	0.0 to 1.3 x P295 [0.3 x P295] 0.1 A	☑ Output current value used to detect the light load condition. At the end of this process the speed reference is increased according to P368. The new speed value is N = N* x P368. This condition is reset when the motor remains stopped for 1 second.
		NOTE!  This condition is verified only during the stabilization time.
P367 (1) Overweight Level  Available only	0.0 to 1.8 x P295 [1.1 x P295] 0.1 A	☑ Output current value used to detect the overweight condition. This function is only enabled during the stabilization time. This condition is reset when the motor remains stopped (N = 0) for 1 second.
if P361 = 1 (On)		This condition is verified only during the stabilization time.
P368 <sup>(1)</sup> Speed Reference Gain	1.000 to 2.000 [1.000]	☑ This parameter increases the speed reference under the light load condition.
Available only if P361 = 1 (On)	-	
<b>P369</b> (2) (11) Frequency Fx	0.0 to 300.0 [4.0] 0.1 Hz	☑ It is used in functions of the digital and relay outputs: F > Fx.

# a) Activation of the load detection parameters during the stabilization time and with P361 = On

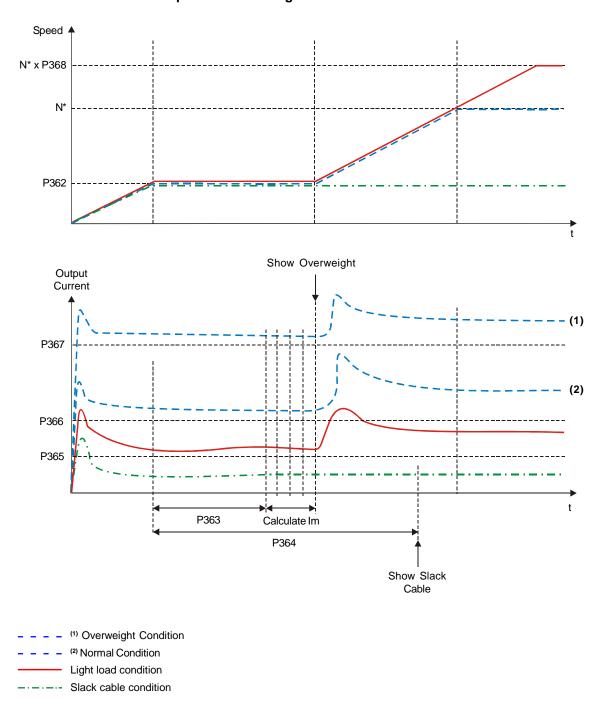


Figure 6.46 a) - Details of the operation of digital functions

Im - Average Current

# b) Diagram of the Load Detection Logic

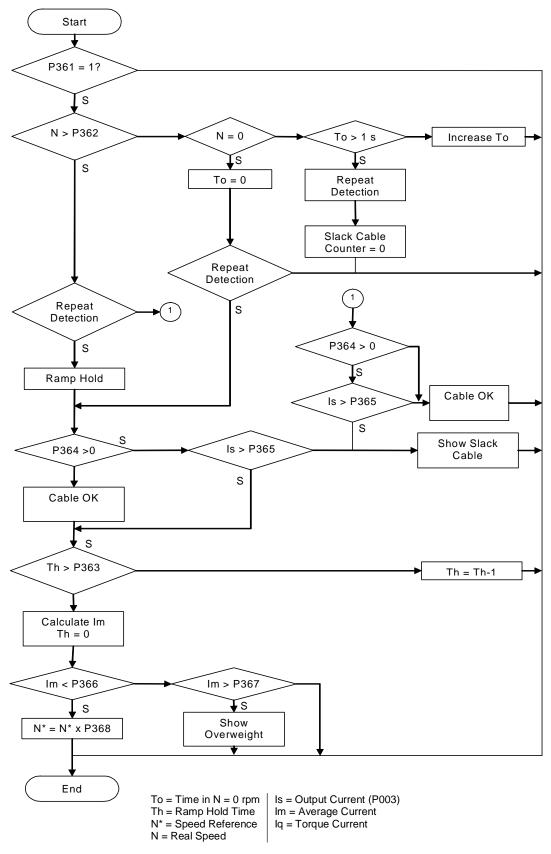


Figure 6.46 b) - Details of the operation of digital functions

Parameter	Range [Factory Setting] Unit	Description / Notes
P370 Hysteresis for Fx	0.0 to 15.0 [2.0] 0.1 Hz	☑ It is used in functions of the digital and relay outputs: F > Fx.
P371 DC Braking Time at Start  This parameter is shown on the display(s) only when P202 = 3 (Sensorless) or 5 (VVW)	0.0 to 15.0 [0.0] 0.1 s	<ul> <li>☑ The DC braking at start consists of applying a DC current to the motor between the "Start" command and the motor acceleration.</li> <li>☑ This parameter adjusts the DC braking time at start for the VVW and Sensorless Vector Control Modes.</li> <li>☑ If the inverter is disabled during the DC braking operation, the braking process will continue until the braking time set at P371 finishes. After that the inverter returns to the "RDY" state.</li> <li>☑ The DC braking at start is not available for:         <ul> <li>The V/Hz and Vector with Encoder Control Modes;</li> <li>Start commands through the serial and Fieldbus interfaces with P202 = 3;</li> <li>When P211 = 1;</li> <li>When the Flying Start function is set (P320 ≥ 1).</li> </ul> </li> <li>☑ The DC current level is set at P302 (VVW) and P372 (sensorless).</li> <li>☑ During the DC Braking the LED displays flashes</li> </ul>
P372 DC Braking Current Level  This parameter is shown on the display(s) only when P202 = 3 (Sensorless)	0.0 to 90.0 [40.0] 0.1 %	<ul> <li>This parameter adjusts the DC voltage (DC braking torque) applied to the motor during the braking process.</li> <li>The current level set at this parameter represents a percentage of the inverter rated current.</li> <li>This parameter works only for the Sensorless Vector Control.</li> </ul>
P398 (1) Slip Compensation During Regeneration  This parameter is shown on the display(s) only when P202 = 5 (VVW)	0 or 1 [1] -	P398 Function 0 Off 1 On  Table 6.58 - Slip compensation during regeneration
P399 (1)(2) Rated Motor Efficiency  This parameter is shown on the display(s) only when P202 = 5 (VVW)	50.0 to 99.9 [According to the motor rated power (P404)] 0.1 %	<ul> <li>☑ This parameter sets the motor rated efficiency;</li> <li>☑ This parameter is important to the correct operation of the VVW Control. The incorrect setting of this parameter results in the incorrect calculation of the slip compensation;</li> <li>☑ The default value of this parameter is automatically set when parameter P404 is modified. The suggested value is valid only for IV pole standard three-phase WEG motors. The user shall set this parameter manually for other motor types.</li> </ul>

# 6.4 MOTOR PARAMETERS - P400 to P499

Parameter	Range [Factory Setting] Unit	Description /	/ Notes				
P400 (1) (6) Motor Rated Voltage	0 to 690 [ P296 ]	☑ Set this parameter value according to the motor nameplate and the connection diagram in the terminal box.					
-	1 V	<ul><li>☑ This value cannot be greater than the rated voltage value set at P296.</li></ul>					
				-		ffective while not the inverter dov	•
P401 (1) (12) Motor Rated Current	0.0 to 1.30 x P295 [ 1.0 x P295 ] 0.1 A(< 100)-1 A(> 99.9)	<ul> <li>✓ Set this parameter according to the motor nameplate, considering the motor operating voltage.</li> </ul>					
P402 (1) (2) (11)	0 to 18000	☑ Set this pa	rameter	according to the	ne mot	or nameplate.	
Motor Rated Speed	[ 1750 (1458) ]	☑ 0 to 18000	rpm for	V/F and VVW	Contro	ol.	
	1 rpm	☑ 0 to 7200 r	pm for V	ector Control.			
	0 to 7200 [ 1750 (1458) ] 1 rpm						
P403 (1) (11)	0 to 300  Set this parameter according to the motor namep						
Motor Rated Frequency	[ 60 (50) ] 1 Hz	☑ 0 to 300 Hz for V/F and VVW Control.					
Trequency		☑ 30 to 120 H	Hz for Ve	ector Control.			
	30 to 120 [ 60 (50) ] 1 Hz						
P404 (1)	0 to 50	☑ Set this parameter according to the motor nameplate.					
Motor Rated Power	[4]		P404	Motor Rated Power (hp/kW)	P404	Motor Rated Power (hp/kW)	
			0	0.33/0.25	26	180.0/132.0	
				0.50/0.37 0.75/0.55	27	200.0/150.0	
			3	1.0/0.75	28 29	220.0/160.0 250.0/185.0	
			4	1.5 /1.1	30	270.0/200.0	
			<u>5</u> 6	2.0 /1.5 3.0 /2.2	31 32	300.0/220.0 350.0/260.0	
			7	4.0 /3.0	33	380.0/280.0	
			8	5.0 /3.7	34	400.0/300.0	
			9 10	5.5 /4.0 6.0/4.5	35 36	430.0/315.0 440.0/330.0	
			11	7.5/5.5	37	450.0/335.0	
			12	10.0/7.5	38	475.0/355.0	
			13 14	12.5/9.0 15.0/11.0	39 40	500.0/375.0 540.0/400.0	
			15	20.0/15.0	41	600.0/450.0	
			16	25.0/18.5	42	620.0/460.0	
			17 18	30.0/22.0	43 44	670.0/500.0 700.0/525.0	
			19	40.0/30.0 50.0/37.0	44	760.0/525.0	
			20	60.0/45.0	46	800.0/600.0	
			21	75.0/55.0	47	850.0/630.0	
			22	100.0/75.0 125.0/90.0	48 49	900.0/670.0 1100.0/ 820.0	
			24	150.0/110.0	50	1600.0/1190.0	
			25	175.0/130.0			

Table 6.59 - Motor rated power selection

Parameter	Range [Factory Setting] Unit	Description	/ Notes				
P405 (1) Encoder PPR  This parameter is shown on the display(s) only when	250 to 9999 [ 1024 ] 1 ppr	☑ Sets the number of pulses per revolution (PPR) of the increment encoder, when P202 = 4 (Vector with Encoder).					ie incremental
P202 = 4 (Vector Control with Encoder)							
P406 (1)	0 to 3		D4	06	Fun ati		
Motor Ventilation	[0]		P4		Function Self-vention		
Type	-				Forced Ver		
				2	Optimal		
			3	3	Increased Pi		
			Table	<b>6.60 -</b> Type	of motor ver	ntilation	
			cally change	P156	P157	P158	
			0	1.1 x P401	0.9 x P401	0.55 x P401	i
			1	1.1 x P401	1.0 x P401	1.0 x P401	
			2	1.1 x P401	1.0 x P401	1.0 x P401	
			3	0.98 x P401	0.9 x P401	0.55 x P401	
		Table 6.61 - Motor overload protection action					
		ATTENTION!					
		The option P406 = 2 may be used (refer to Use Conditions below when motor should be operated at low frequencies with rated torque without requiring forced ventilation, for the operation range 12: i.e., 5 at 60 Hz/4.2 at 50 Hz according the rated motor frequence.					
		CONDITIONS FOR USING OPTION P406 = 2:					
		<ol> <li>Sensorless Vector Mode (P202 = 3);</li> </ol>					
		II. WEG motors series: Nema Premium Efficiency, Nema High Efficiency, IEC Premium Efficiency and Alto Rendimento Plus.					
		☑ When P4	106 = 3, the s	switching fro	equency is	limited to 5	i kHz.

Parameter	Range [Factory Setting] Unit	Description / Notes					
P407 (1) (2)	0.50 to 0.99	☑ This parameter sets the motor power factor;					
Rated Motor Power Factor	[ According to the motor rated power (P404) ]	WE This harameter is important to the correct operation of the VVVV C.					
This parameter is shown on the display(s) only when P202 = 5 (VVW)							
P408 <sup>(1)</sup> Run Self-Tuning	0 to 2 (P202 = 3) [0] 1	☑ This parameter controls the self-tuning routine, which estimates the value of parameters related to the motor under use. When P408 is set to options 1, 2, or 3, the self-tuning routine estimates the value of parameters P409 to P413. When this parameter is set to option 4, the self-tuning					
This parameter is shown on the display(s) only when P202 = 3 or 4	0 to 4 (P202 = 4) [0]	routine only estimates the value of parameter P413. <b>Note:</b> Best results for the self-tuning routine are obtained with a ho motor.					
(Vector Control)	1	P408	Self-tuning	Type of Control	P202		
The Self-tuning	0 or 1	<u>0</u> 1	No No rotation	Sensorless Vector, Vector with Encoder or VVW	3, 4 or 5		
Routine can be cancelled by	(P202 = 5) [ 0 ]	2	Run for Imr	Sensorless Vector or Vector with Encoder	3 or 4		
pressing the	1	3	Run for Tm	Vector with Encoder	4		
(0) key, only		4	Measure Tm	Vector with Encoder	4		
when P409 to P413 are different from			Table	6.62 - Self-tuning options			
zero.		<ul> <li>No rotation - The motor remains stationary during the self-tuning routine The value of P410 is obtained from a table, which is valid for WEG motors up to 12 poles.</li> </ul>					
Self-tuning can be realized only with P309 = Inactive (0)							
		<b>Note:</b> When using a non-WEG motor, set P410 to the proper value (n load current) before running the self-tuning routine.					
				of P410 is estimated with that the of P410 is estimated without load coupled to	•		
		If the motor P410 of P4 Tm). / opera Note:	and with P40 (Imr) may be 12 (Lr/Tr Con: An overcurren tion. The word "lo	outine is executed with a loa 8 set to option 2 (Run for Imr) obtained. This will result in a stant) and P413 (Mechanical It fault (E00) may also occur of ad" represents anything courters.	, a wrong value of wrong estimation I Time Constant - luring the inverter		

shaft such as a gearbox, an inertia wheel, etc.

	Range [Factory Setting]	
Parameter	Unit	Description / Notes
		<ul> <li>- Run for Tm - The value of parameter P413 (Mechanical Time Constant</li> <li>- Tm) is measured with the motor rotating. It shall be run, preferentially, with the load coupled to the motor.</li> </ul>
		- <b>Measure Tm</b> – It estimates only the value of P413 (Mechanical Time Constant – Tm) with the motor rotating. It shall be run, preferentially, with the load coupled to the motor.
		NOTES!
		☑ When P408 = 1 or 2: The parameter P413 (Mechanical Time Constant – Tm) is set to an approximated value of the motor mechanical time constant. The value of this parameter is set based on the motor rotor inertia (table data is valid for WEG motors), on the Drive Rated Current, and on the Drive Rated Voltage.
		✓ Vector with Encoder Control (P202 = 4): When P408 is set to option 2 (Run for Imr) and the self-tuning routine is finished, it is mandatory to couple the load to the motor and set parameter P408 to 4 (Measure Tm) in order to estimate P413 (Mechanical Time Constant – Tm). In this case, parameter P413 will also consider the driven load.
		☑ VVW Control - Voltage Vector WEG (P202 = 5): In the self-tuning routine for the VVW Control, only the mot stator resistance (P409) is obtained. Therefore, the self-tuning routine is always run with the motor stationary.
P409 <sup>(1)</sup> Motor Stator Resistance (Rs)	0.000 to 77.95 [ 0.000 ] 0.001 Ω	☑ Value estimated by the Self-tuning routine.
This parameter is shown on the display(s) only when P202 = 3, 4 (Vector Control) a 5 (VVW)		

Parameter	Range [Factory Setting] Unit	Description / Notes
P410 Motor Magnetizing Current (I <sub>m</sub> )	0 to 1.25 x P295 [ 0.0 ] 0.1 A	☑ When the motor can operate decoupled from the load (P408 = 2) this value is estimated by the Self-tuning routine (P408 = 1 or 3) otherwise it is obtained from a pre-stored value array valid for WEG motors.
This parame-		☑ If a non WEG motor is being used set this parameter to the correct value before starting Self-tuning.
ter is shown on the display(s) only when P202 = 3 or 4 (Vector Control)		For P202 = 4 (vector with encoder), the value set at P410 determines the motor flux. Thus ensure correct setting. If this setting is too low, the motor will lose flux and torque, if too high, the motor running starts to oscillate at rated speed or even this speed may not be reached. In this case, decrement P410 or P178 till speed oscillation stops or the rated speed is reached.
P411 <sup>(1)</sup> Motor Flux Leakage Inductance	0.00 to 99.99 [ 0.00 ] 0.01 mH	☑ Value estimated by the Self-tuning routine.
This parameter is shown on the display(s) only when P202 = 3 or 4 (Vector Control)		
P412 Lr/Rr Constant (Rotor	0.000 to 9.999 [ 0.000 ]	☑ The setting of P412 determines the gains of the flux regulator (P175 and P176).
Time Constant - Tr)  This parameter is shown on the	0.001 s	☑ The value of P412 is estimated by the self-tuning routine for motors up to 75 hp/55 kW. For higher ratings, this parameter is set according to the values for the WEG standard motors (table 6.63 shows typical values for some motors).
display(s) only when P202 = 3 or 4 (Vector Control)		☑ The value of this parameter affects the speed accuracy for the Sensorless Vector Mode Control.
`		☑ Usually, the self-tuning routine is run when the motor is cold. Depending on the motor, the value of P412 may vary more or less according to the motor temperature. Therefore, when running a hot motor, adjust P412 so that the loaded motor speed (measured at the motor shaft with a tachometer) is the same as that indicated on the inverter keypad (P001). This setting shall be performed at the half of the rated speed.
		☑ For P202 = 4 (Vector with Encoder Control), if the setting of P412 is incorrect the motor will lose torque. In this case, set P412 so that the motor current (P003) reaches the lowest value at the half of the rated speed and with a steady load.
		☑ In the Sensorless Vector Control the value of the parameter P175 will be limited in the range: $3.0 \le P175 \le 8.0$ .

Parameter	Range [Factory Setting] Unit	Description / Notes	s			
		☑ Typical T <sub>R</sub> values	for WEG sta	ndard motors	s:	
		Motor Power			r (s): er of poles	
		CV-hp / kW	2	4	6	8
			(50 Hz/60 Hz)	(50 Hz/60 Hz)	(50 Hz/60 Hz)	(50 Hz/60 Hz)
		2 / 1.5	0.19 / 0.14	0.13 / 0.14	0.1 / 0.1	0.07 / 0.07
		5 / 3.7	0.29 / 0.29	0.18 / 0.12	- / 0.14	0.14 / 0.11
		10 / 7.5	- / 0.38	0.32 / 0.25	0.21 / 0.15	0.13 / 0.14
		15 / 11	0.52 / 0.36	0.30 / 0.25	0.20 / 0.22	0.28 / 0.22
		20 / 15	0.49 / 0.51	0.27 / 0.29	0.38 / 0.2	0.21 / 0.24
		30 / 22	0.70 / 0.55	0.37 / 0.34	0.35 / 0.37	- / 0.38
		50 / 37	- / 0.84	0.55 / 0.54	0.62 / 0.57	0.31 / 0.32
		100 / 75	1.64 / 1.08	1.32 / 0.69	0.84 / 0.64	0.70 / 0.56
		150 / 110	1.33 / 1.74	1.05 / 1.01	0.71 / 0.67	- / 0.67
		200 / 150	- / 1.92	- / 0.95	- / 0.65	- / 1.03
		300 / 220	- / 2.97	1.96 / 2.97	1.33 / 1.30	-/-
		350 / 250	-/-	1.86 / 1.85	- / 1.53	-/-
		500 / 375	-/-	- / 1.87	-/-	-/-
P413 <sup>(1)</sup> Tm Constant (Mechanical Time Constant)	0.00 to 99.99 [ 0.00 ] 0.01 s	<ul> <li>☑ The setting of P413 determines the gains of the speed regulator (P161 and P162).</li> <li>☑ When P408 = 1 or 2, observe the following:</li> <li>If P413 = 0, then the Tm constant will be obtained as a function of the</li> </ul>				
This parameter is shown on the		<ul> <li>motor inertia (memory stored value).</li> <li>If P413 &gt; 0, then the value of P413 will not be changed during the self-tuning routine.</li> </ul>				
display(s) only when						
P202 = 3 or 4 (Vector Control)		Sensorless Vect	or Control (I	<sup>2</sup> 202 = 3):	<u>):</u>	
(roote, control,		When the value of P413 (obtained from the self-tuning routine) provides unsuitable gains for the speed regulator, modify this parameter to better adjust the speed regulator gains.				
		☑ The value of P161, provided by the self-tuning routine or through the changing of P413, will be limited in the range: $6.0 \le P161 \le 9.0$ .				
		☑ The value of P162 varies according to the value of P161.				
		<ul><li>In case it is needed to increase more these gains, set them directly at P161 and P162.</li></ul>				
		<b>Note:</b> Values of P161 > 12.0 may cause oscillations in the torque currer (iq) and in the speed.				
		Vector with Enc	oder Contro	I (P202 = 4):	_	
		The value of P413 or 4. In case it is no manually. (Refer to	B is estimated of possible to	by the self-to	uning routine	

# 6.5 SPECIAL FUNCTIONS PARAMETERS P500 to P699

### 6.5.1 PID Regulator

- ☑ The CFW-09 is fitted with the PID regulator that can be used for closed loop process control. This function acts as a proportional, integral and derivative regulator, superimposed on the normal inverter speed control.
- ☑ The speed will be changed in order to maintain the process variable (the variable that should be controlled for instance: water level of a container) at the desired value, set in the setpoint.
- ☑ This regulator can control, for example, the flow in a piping system through the flow feedback to the analog input AI2 or AI3 (selected via P524), and the flow reference set at P221 or P222 AI1, when the inverter drives the motor of a pump that circulates the fluid through this piping system.
- Other application examples: level control, temperature control, dosing control, etc.

### 6.5.2 Description

- ☑ The function of the PID regulator is activated by setting P203 to 1.
- ☑ Figure 6.47 shows the block diagram of the Academic PID regulator.
- ☑ The transference function in the frequency domain of the Academic PID regulator is:

$$y(s) = Kp e(s)[1 + \frac{1}{sTi} + sTd]$$

Substituting the integrator by a sum and the derivative by the incremental quotient, we will obtain an approximate value for the discrete (recursive) transfer equation shown below:

$$y(kTa) = y(k-1)Ta + Kp[(e(kTa) - e(k-1)Ta) + Ke(k-1)Ta + Kd(e(kTa) - 2e(k-1)Ta + e(k-2)Ta)]$$

where:

Kp (Proportional Gain):  $Kp = P520 \times 4096$ ;

Ki (Integral Gain) : Ki = P521 x 4096 = [Ta/Ti x 4096]; Kd (Differential Gain) : Kd = P522 x 4096 = [Td/Ta x 4096];

Ta = 0.02 s (sampling period of the PID Regulator);

SP\*: reference, has 13 bits max. (0 to 8191);

X: process variable (or controlled), read at Al2 or Al3, has 13 bits maximum;

y(kTa): current PID output, has 13 bits maximum;

v(k-1)Ta: previous OPID output;

e(kTa): current error [SP\*(k) – X(k)];

e(k-1)Ta: previous error [SP\*(k-1) – X(k-1)];

e(k-2)Ta: error of the two previous samplings [SP\*(k-2) – X(k-2)].

☑ The feedback signal must be sent to the analog inputs Al2' and Al3' (refer to figure 6.29 and 6.30).



#### NOTE!

When using the PID function P233 must be set to 1, otherwise the minimum speed (P133) will be added to the PID feedback via AI2.

#### The setpoint can be defined:

- ☑ Keypad: parameter P525.
- Analog inputs Al1', Al2', Al3', Al4', (Al1'+ Al2')>0, (Al1'+ Al2'), Multispeed, Serial, Fieldbus and PLC.



#### NOTE!

When P203 = 1, do not use the reference via E.P. (P221/P222 = 7).

#### When the PID function (P203 = 1) is set:

- ☑ The following parameters are automatically changed: P223 = 0 (always forward), P225 = 0 (JOG disabled), P226 = 0 (always forward), P228 = 0 (JOG disabled), P237 = 3 (PID process variable) e P265 = 15 (Manual/Automatic).
- ☑ The JOG Function and the direction of rotation function remain disabled. The Enabling and Start/Stop controls are defined in P220, P224 and P227.
- ☑ The digital input DI3 is programmed automatically for the function Manual/ Automatic (P265 = 15), according to table 6.64.

Dlx	Operating Mode
0 (0 V)	Manual
1 (24 V)	Automatic

Table 6.64 - DIx operating mode

- ☑ The change between Manual/Automatic can be realized by one of the digital inputs DI3 to DI8 (**P265** to **P270**).
- ☑ Parameter P040 indicates the value of the Process Variable feedback) in the chosen scale/unit. This parameter can be selected as monitoring variable (refer to item 4.2.2), provided P205 = 6. To prevent the saturation of the analog feedback input during the regulation "overshoot", the signal must vary between 0 V to 9.0 V [(0 to 18) mA / (4 to 18) mA]. The adaptation between the setpoint and the feed back can be realized by changing the gain of the selected analog input as feedback (P238 for Al2 or P242 for Al3). The Process Variable can also be displayed at the outputs AO1 to AO4 provided they were programmed at P251, P253, P255 or P257. The same is valid for the PID setpoint.
- ☑ The outputs DO1, DO2 and RL1 to RL3 can be programmed (P275 to P277, P279 or P280) to the functions of the Process Variable > VPx (P533) and Process Variable < VPy (P534).
  </p>
- ☑ When the setpoint is defined by P525 (P221 or P222 = 0), and if it is changed from manual to automatic, following setting P525 = P040 is performed automatically, provided the parameter P536 is active. In this case, the commutation from manual to automatic is smooth (there is no abrupt speed oscillation).
- ☑ In case of function "Stop Logic" is active (P211 = 1) and P224 = 0, P224 is automatically changed to the option "Digital Input (DIx)" (P224 = 1).
- ☑ In case of function "Stop Logic" is active (P211 = 1) and P227 = 0, P227 is automatically changed to the option "Digital Input (DIx)" (P227 = 1).

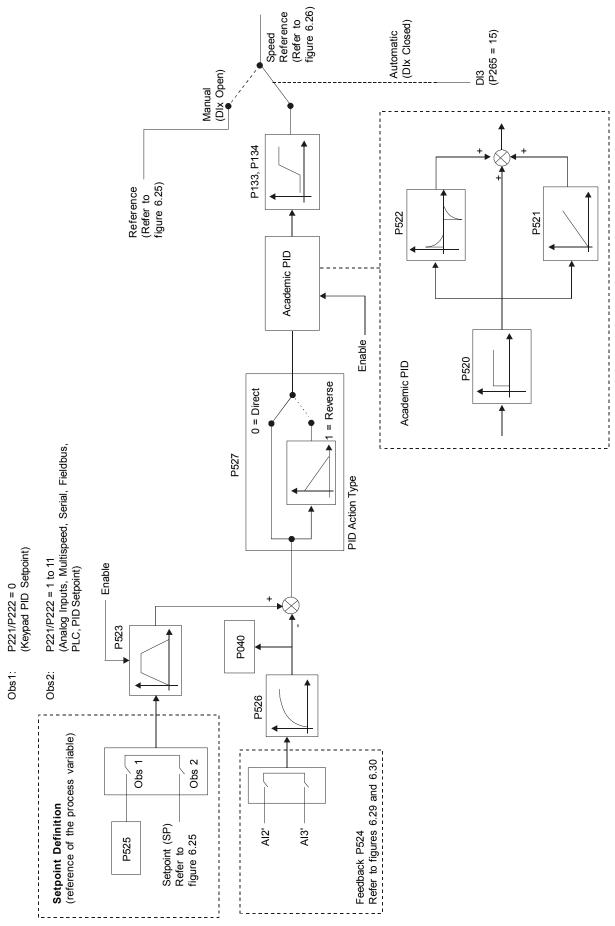


Figure 6.47 - Block diagram of the PID regulator function

	Range						
Parameter	[Factory Setting] Unit	Description / Note	s				
P520 PID Proportional Gain	0.000 to 7.999 [ 1.000 ] 0.001	☑ Some examples Ramp Times for s in table 6.65.					
				Gains		PID Ramp	)
<b>P521</b> PID Integral Gain	0.000 to 7.999 [ 0.043 ]	Magnitude	Proportiona P520	I Integral P521	Derivative P522	Time P523	Action Type P527
1 12 integral Cam	0.001	Pressure pneumatic		0.043	0.000	3.0	0 = Direct
P522	0.000 to 3.499	Flow pneumatic system	1	0.037	0.000	3.0	0 = Direct
PID Differential Gain	[ 0.000 ] 0.001	Pressure hydraulic system	1	0.043	0.000	3.0	0 = Direct
P523	0.0 to 999	Flow hydraulic system	1	0.037	0.000	3.0	0 = Direct
PID Ramp Time	[ 3.0 ]	Temperature	2	0.004	0.000	3.0	Refer to note (1)
	0.1 s (< 99.9 s)	Level	1	Refer to note (2	0.000	3.0	Refer to note (1)
		on the prinverter divill be contank and increase inverter and tank will be contank will be contank will be contank will be consider flow.  In the inconsider flow.	rocess. For rives the montrary as we thus the fitthe motor action that doe direct. If level contrare required the desired acting the motor aring the motor are aring the motor are arring the motor are arrived arrived are arrived arrived arrived are arrived arrive	or instance, notor that remove the investment incomplete incomplet	in the lever oves fluid for the driver driver driver driver dreases and for the fluid flowing following following the shout flow and the flow and th	rel contributed from a tage of the model of the individual of the individual of the mires. The maximum of the m	neasured by nimum output neasured by kimum output
		☑ The equation to calculate an initial value for P521 (PID Integral Gain) as a function of the system response time, is presented below:					
		P521 = 0.02 / t					
			t =	time (secon	ds)		
P524 <sup>(1)</sup> Selection of the	0 or 1 [ 0 ]	☑ It selects the feedback input (Process Variable) of the PID regulator:				regulator:	
PID Feedback	-		P524		Alx		
			0	Al2 (	P237 to P24	40)	
			1	AI3 (	P241 to P24	44)	
			Table 6.6	66 - Feedback	selection		

Parameter	Range [Factory Setting] Unit	Description / Notes	
		☑ After the feedback input has been of selected at P237 (to Al2) or P241	•
		Feedback Type:	
		☑ The PID action Type described above signal increases when the proceed feedback). This is the most common terms of the proceeding of	ess variable also increases (direct
		analog input for the PID (AI2 or AI3 to 0) V/(20 to 0) mA] or P239 = 3 [ through AI2 and P243 = 2 [(10 to 0	s required to program the selected as a sinverse reference: P239 = 2 [(10 (20 to 4) mA]. When the feedback is 0) V/(20 to 0) mA] or P243 = 3 [(20 to rough Al3. When this setting is not
P525 Keypad PID Setpoint	0.0 to 100.0 [ 0.0 ] 0.1 %	inverter is in the Automatic mode the speed reference is given by P	O (LOC) or P222 = 0 (REM) and the . If it has been set to Manual Mode, 121.
		☑ The value of P525 is maintained when inverter is disabled or enable.	
		☑ Once PID is in Automatic mode, the entered into the CFW-09 via any reor P222 (REMOTE mode). Particulars the setpoint via the Al1 [P22]	ne Setpoint value for PID regulator is eference set by P221 (LOCAL mode) larly, most of general PID applications I = 1 (LOC) or P222 = 1 (REM)] or via (LOC) or P222 = 0 (REM)]. Refer to
P526	0.0 to 16.0	☑ It sets the time constant of the Pr	ocess Variable Filter.
Process Variable Filter	[ 0.1 ] 0.1 s	☑ Generally 0.1 will be a suitable vasignal has a too high noise level gradually by checking the result.	lue, excepting the process variable el. In this case, increase this value
P527	0 or 1	☑ It defines the control action type:	
PID Action Type	[0]	P527	Action Type
		0	Direct
		1	Reverse
		Table 6.67 - F	PID action type

	D	
	Range [Factory Setting]	
Parameter	Unit	Description / Notes
		☑ Select according to the process
		Motor Speed Fault Select
		Increase Positive Direct  Negative Reverse
		Table 6.68 - PID action selection
		Process requirement:
		<ul> <li>✓ PID action type: the PID action should be selected as Direct, when it is required to increase the motor speed in order to increase the process variable. Otherwise, select the Reverse.</li> </ul>
		☑ Example 1 - Direct: pump driven by frequency inverter and filling a tank, where PID regulates the level. To increase the level (process variable) it is required to increase the flow and consequently, the motor speed.
		☑ Example 2 - Reverse: Fan driven by frequency inverter and cooling a cooling tower, with PID controlling its temperature. With the temperature increase the error becomes negative and the speed increases, cooling down the tower.
P528	0 to 9999	☑ P528 and P529 define the way the Process variable (P040) will be shown.
Process Variable	[ 1000 ]	☑ P529 defines how many digits are indicated after the decimal point.
Scale Factor	1	☑ P528 must be set according to the equation below:
P529 Decimal Point of Process Variable	0 to 3 [ 1 ] -	P528 = $\frac{\text{F. S. V. Indication Process x } (10)^{\text{P529}}}{\text{Gain (AI2 or AI3)}}$
		where:
		F. S. V. Indication Process is the full scale value of the Process Variable, corresponding to 10 V (20 mA) at the Analog Input (Al2 or Al3) used as feedback.
		☑ Example 1: (Pressure Transducer 0 to 25 bar - Output 4 to 20 mA)
		- Desired indication: 0 to 25 bar (F. S.)
		- Feedback Input: Al3
		- Gain Al3 = P242 = 1.000
		- Signal AI3 = P243 = 1 (4 to 20 mA)
		- P529 = 0 (no digit after decimal point)
		$P528 = \frac{25 \times (10)^{0}}{1.000} = 25$

Parameter	Range [Factory Setting] Unit	Description / Notes
		☑ Example 2 (values are factory standards):
		- Desired indication: 0.0 % to 100.0 % (F. S.)
		- Feedback Input: AI2
		- Gain Al2 = P238 = 1.000
		- P529 = 1 (one number after decimal point)
		$P528 = \frac{100.0 \times (10)^1}{1.000} = 1000$
P530 Engineering Unit of	32 to 127 [ 37 (%) ]	☑ These parameters are only useful, if the inverter is fitted with HMI with LCD display.
the Process Variable 1  P531 Engineering Unit of the Process Variable 2	32 to 127 [ 32 ( ) ]	<ul> <li>☑ The Engineering Unit of the Process Variable is formed by three characters that are used for the indication of P040. P530 defines the left character, P531 defines the central character and P532 defines the right character.</li> <li>☑ Possible characters to be chosen:</li> </ul>
		Characters corresponding to the ASCII code from 32 to 127.
P532 Engineering Unit of	32 to 127 [ 32 ( ) ]	Examples:
the Process Variable 3		A, B,, Y, Z, a, b,, y, z, 0, 1,, 9, #, \$, %, (, ), *, +,
		Examples:
		- To indicate "bar":   - To indicate "%":
		P530 = "b" (98) P530 = "%" (37)
		P531 = "a" (97) P531 = " " (32)
		P532 = "r" (114) P532 = " " (32)
P533	0.0 to 100	☑ Used in the functions of the Digital/Relay Outputs:
Value of Process Variable X	[ 90.0 ] 0.1 %	V. Pr. > VPx and V. Pr. < VPy aiming signaling/alarm.
<b>P534</b> Value of Process	0.0 to 100 [ 10.0 ]	☑ Full scale percentage values of the Process Variable:
Variable Y	0.1 %	$(P040 = \frac{(10)^{P529}}{P528} \times 100 \%)$

Parameter	Range [Factory Setting] Unit	Description / Notes
P535 Wake Up Band	0 to 100 [0] 1%	☑ The value of this parameter is used along with P212 (Condition to Leave Zero Speed Disable), providing additional condition to leave zero speed disable, that is, error of PID > P535. Refer to P211 to P213.
P536 <sup>(1)</sup> Automatic Set of P525	0 or 1 [ 0 ] -	☑ When the setpoint of the PID regulator is by HMI (P221/P222 = 0) and P536 is zero (active) by commutating from manual to automatic, the process variable value will be loaded at P525. In this way you prevent PID oscillations during the commutation from "Manual" to "Automatic".
		P536 Action Type
		0 Active
		1 Inactive
		Table 6.69 - Automatic set of P525
P537 Hysteresis for the Set Point = Process Variable	0 to 100 [ 1 ] 1 %	<ul> <li>When the Set Point value is equal to the Process Variable and it is within the range defined by the hysteresis value (set at parameter P537), the digital or relay output set to the option Set Point = Process Variable (SP = PV) is activated and remains in this condition until the process variable reaches a value outside of the hysteresis range (refer to figure 6.39 v)).</li> <li>NOTE!         This function is enabled only in the automatic mode and when P203 = 1.     </li> </ul>
P538	0.0 to 50.0	☑ It is used in functions of the digital and relay outputs:
Hysteresis VPx/VPy	[ 1.0 ] 0.1 %	Process Variable > VPx and Process Variable < VPy

# DIAGNOSTICS AND TROUBLESHOOTING

This chapter assists the user to identify and correct possible faults that can occur during the CFW-09 operation. Guidance on Preventive Maintenance is also provided.

# 7.1 FAULTS AND POSSIBLE CAUSES

When a fault is detected, the inverter is disabled and the Fault Code is displayed on the readout in the EXX form, where XX is the actual Fault Code. (ie. E01).

To restart the inverter after a fault has occurred, the inverter must be reset. The reset can be made as follows:

- ☑ Disconnecting and reapplying AC power (power-on reset).
- ☑ By pressing the key (1) (manual reset).☑ Automatic reset through P206 (auto-reset).
- $\square$  By digital input: DIx = 12 (P265 to P270).
- ☑ By Serial interface.
- ☑ By Fieldbus interface.

The table below defines each Fault Code, explains how to reset the fault and shows the possible causes for each Fault Code.

FAULT	RESET	POSSIBLE CAUSES
E00	☑ Power-on	☑ Short-circuit between two motor phases
Output	✓ Manual reset (Key  )	☑ Short-circuit between braking resistor cables
	☑ Overcurrent Auto-reset	☑ When the output current reaches 2 x P295, caused by: very high
	✓ Dlx (Digital Input)	load inertia, acceleration ramp too fast or incorrect regulation and/
	☑ Serial	or configuration parameters
	☑ Fieldbus	☑ Transistor module shorted
		☑ P169 to P172 set too high
E01		☑ Power Supply voltage too high, check Ud in P004:
Overvoltage (Ud)		220-230 V Models - Ud > 400 V
		380-480 V Models - Ud > 800 V
		500-600 V and 500-690 V Models with power supply between
		500 V and 600 V - Ud > 1000 V
		500-690 V models with power supply between 660 V and 690 V
		and 660-690 V models - Ud > 1200 V
		✓ Load inertia too high or deceleration ramp too short
		☑ P151 or P153 set too high
E02		☑ Power Supply voltage too low, DC Link check Ud in P004:
Undervoltage (Ud)		220-230 V power supply - Ud < 223 V
		380 V power supply - Ud < 385 V
		400-415 V power supply - Ud < 405 V
		440-460 V power supply - Ud < 446 V
		480 V power supply - Ud < 487 V
		500-525 V power supply - Ud < 532 V
		550-575 V power supply - Ud < 582 V
		600 V power supply - Ud < 608 V
		660-690 V power supply - Ud < 699 V
		☑ Phase loss at the input
		☑ Auxiliary circuit fuse blown (only valid for 105 A and 130 A/220-230 V,
		86 A to 600 A/380-480 V and 44 A to 79 A/500-600 V refer to item 3.2.3)
		☑ Pre-charge contactor defective     ☐
		☑ P296 set to a voltage higher than the power supply voltage

Table 7.1 - Faults and possible causes

FAULT	RESET	POSSIBLE CAUSES
E03 <sup>(1)</sup> Input Undervoltage/ Phase Loss	☑ Power-on ☑ Manual reset (Key ① ) ☑ Auto-reset ☑ Dlx (Digital Input) ☑ Serial ☑ Fieldbus	Power Supply voltage is too low, check Power Supply voltage:  220-230 V Models - Power Supply < 154 V  380-480 V Models - Power Supply < 266 V  500-600 V and 500-690 V Models - Power Supply < 361 V  660-690 V Models - Power Supply < 462 V  Phase loss at the inverter input  Activation Time: 2.0 s
E04 <sup>(2)(3)</sup> Inverter Overtemperature or Pre-charge Circuit Defective	☑ Power-on ☑ Manual reset (Key ① ) ☑ Auto-reset ☑ Dlx (Digital Input) ☑ Serial ☑ Fieldbus	<ul> <li>☑ Ambient temperature too high (&gt; 40 °C) and/or output current too high; or ambient temperature &lt; -10 °C</li> <li>☑ Blowers locked or defective</li> <li>☑ Auxiliary circuit fuse blown (only valid for 105 A and 130 A/220-230 V, 86 A to 600 A/380-480 V and 44 A to 79 A/500-600 V refer to item 3.2.3)</li> <li>☑ Problem with the supply voltage - voltage sag or interruption (phase loss) - last for more than 2 seconds and with the phase loss detection disabled (P214 = 0)</li> <li>☑ Signal with inverted Polarity at Analog inputs AI1/AI2</li> </ul>
E05 Inverter / Motor Overload I x t Function		☑ P156, P157 and P158 set too low for the motor being used ☑ Motor is under an actual overload condition
E06 External Fault		<ul> <li>☑ Any DIx (DI3 to DI7) programmed for external fault detection (P265 to P270 set to 4 – No Ext FIt) is open (not connected to + 24 V)</li> <li>☑ Terminal block XC12 on the control board CC9 is not properly connected</li> </ul>
E07 Encoder Fault (Valid only if P202 = 4 - Vector with Encoder)		<ul> <li>✓ Miswiring between encoder and terminal block XC9 (optional board EBA/EBB/EBC/EBE). Refer to item 8.2</li> <li>✓ Encoder is defective</li> </ul>
E08 CPU Error (watchdog)	_	☑ Electrical noise
E09 Program Memory Error (Checksum)	Contact WEG	☑ Memory with corrupted values
E10 Error in the Copy Function	☑ Power-on ☑ Manual Reset (Key ① ☑ Auto-reset ☑ Dlx	☑ A bid to copy the HMI parameters to the inverter with different Software version
E11 <sup>(7)</sup> Ground Fault	☑ Serial ☑ Fieldbus	☑ Short-circuit between one or more output phases and ground ☑ Motor cable capacitance to ground is too high

Table 7.1 (cont.) - Faults and possible causes

# **CHAPTER 7 - DIAGNOSTICS AND TROUBLESHOOTING**

FAULT	RESET	POSSIBLE CAUSES
E12 Braking Resistor Overload	☑ Power-on ☑ Manual Reset (Key <b>①</b> ) ☑ Auto-reset ☑ Dlx	<ul> <li>✓ Load inertia too high or deceleration ramp too short</li> <li>✓ Load on the motor shaft too high</li> <li>✓ P154 and P155 programmed incorrectly</li> </ul>
E13 Incorrect encoder sense of rotation (for P202 = 4 - Encoder), with P408 = runs to Imr	Do not reset this fault and restart without first correcting the direction of either the encoder or of the motor.	<ul> <li>☑ Cables U, V, W to motor are inverted</li> <li>☑ Encoder channels A and B are inverted</li> <li>☑ Encoder mounted in wrong position</li> <li>Note: This fault can only occur during Self-tuning</li> </ul>
E15 Motor Phase Loss	☑ Power-on ☑ Manual Reset (Key <b>(0)</b> ) ☑ Auto-reset ☑ Dlx ☑ Serial ☑ Fieldbus	<ul> <li>☑ Bad contact or broken wiring between motor and inverter</li> <li>☑ Incorrect value programmed in P401</li> <li>☑ Vector Control without orientation</li> <li>☑ Vector Control with encoder, encoder wiring or connection to motor is inverted</li> </ul>
E17 Overspeed Fault		☑ When the effective overspeed exceeds the value of P134+P132 longer than 20 ms
E24 Programming Error (5)	It is automatically reset when the incompatible parameters are correctly programmed.	☑ Incompatible parameters were programmed. Refer to table 4.2
E31 Keypad (HMI) Connection Fault	It is automatically reset when HMI communication with inverter is reestablished.	<ul> <li>✓ Keypad cable misconnected</li> <li>✓ Electrical noise in the installation (electromagnetic interference)</li> </ul>
E32 Motor Overtemperature <sup>(4)</sup>	☑ Power-on ☑ Manual Reset (Key ①) ☑ Auto-reset ☑ Dlx ☑ Serial ☑ Fieldbus	<ul> <li>✓ Motor is under an actual overload condition</li> <li>✓ Duty cycle is too high (too many starts/stops per minute)</li> <li>✓ Ambient temperature is too high</li> <li>✓ Motor thermistor miswiring or short-circuit (resistance &lt; 100 Ω) at the terminals XC4:2 and XC4:3 of the optional board EBA or at the terminals XC5:2 and XC5:3 of the optional board EBB</li> <li>✓ P270 programmed to 16 unintentionally, with EBA/EBB board not installed and/or motor thermistor not connected</li> <li>✓ Motor in locked rotor condition</li> </ul>
E33 Speed without Control (8)	_	☑ Overweight ☑ Brake Failure
E34 Long Period at Torque Limitation (9)		☑ The load was too heavy and the CFW-09 operated at torque limitation for a period longer than allowed Failure on the brake opening caused the CFW-09 to operate at torque limitation for a period longer than allowed
E41 Self Diagnosis Fault	Contact WEG	Memory error or any internal inverter circuit defective

Table 7.1 (cont.) - Faults and possible causes

FAULT	RESET	POSSIBLE CAUSES
E70 Internal DC Supply Undervoltage <sup>(6)</sup>	☑ Power-on ☑ Manual Reset (key ①) ☑ Auto-reset ☑ Dlx ☑ Serial ☑ Fieldbus	☑ Phase loss at the R or S input ☑ Auxiliary circuit fuse blown (only valid for 500-690 V and 660-690 V models - refer to figures 3.7 f) and g))
E71		☑ When the PLC board stops communicating with the CFW-09 for more
Watchdog error		than 200 ms
for the PLC board		

Table 7.1 (cont.) - Faults and possible causes

#### Notes:

- (1) E03 Fault can occur only with:
  - 220-230 V Models with rated current equal or higher than 45 A;
  - 380-480 V Models with rated current equal or higher than 30 A;
  - 500-600 V Models with rated current equal or higher than 22 A;
  - 500-690 V Models;
  - 660-690 V Models;
  - P214 set to 1.
- (2) In case of E04 Fault due to inverter overtemperature, allow the inverter to cool before trying to reset it. The E04 fault code can also indicate a failure in the pre-charge circuit. But this is valid only for:
  - 220-230 V Models with rated current equal or higher than 70 A;
  - 380-480 V Models with rated current equal or higher than 86 A.
  - 500-690 V Models with rated current equal or higher than 107 A;
  - 660-690 V Models with rated current equal or higher than 1000 A. The failure in the pre-charge circuit means that the pre-charge contactor sizes up to 130 A/220-230 V, 142 A/380-480 V and 79 A/500-600 V) or pre-charge thyristor (sizes above 130 A/220-230 V, 142 A/380-480 V, 500-690 V and 660-690 V) is not closed, thus overheating the pre-charge resistors.
- (3) For:
  - 220-230 V Models with rated current equal or higher than 16 A;
  - 380-480 V Models with rated current equal or higher than 13 A, and equal or lower than 142 A;
  - 500-600 V Models with rated current equal or higher than 12 A, and equal or smaller than 79 A;
  - E04 Fault can also be caused by internal airflow overtemperature. In this case, check the electronics blower.
- **(4)** When E32 is displayed due to motor overtemperature, please allow the motor to cool down before restarting the inverter.
- (5) When an incompatible parameter is programmed, a Fault Message E24 - will be displayed and the LCD display will show a Help Message by indicating the Cause and how to correct the fault status.
- (6) Only for models 107 Ato 472 A/500-690 V and 100 Ato 428 A/660-690 V.
- (7) Long motor cables (longer than 100 m (330 ft)) can cause excessive capacitance to ground. This can cause nuisance E11 ground fault trips immediately after the inverter has been enabled.

#### **SOLUTION:**

- ☑ Reduce the switching frequency (P297).
- Connect a load reactor in series with the motor supply line. Refer to item 8.8.
- (8) This error occurs when the comparison  $[N = N^*]$  is greater than the maximum admissible error (set at P292) for a period longer than that set at P351. When P351 = 99.9 the detection logic for the error E33 is disabled. This error is only active in Vector Modes (P202 = 3 or 4).
- (9) If the CFW-09 remains at torque limitation for a period longer than the value set at P352 the inverter will trip with an error code E34. When P352 = 999 the detection logic for the error E34 is disabled. This error is only active in Vector Modes (P202 = 3 or 4).



#### NOTE!

When a fault occurs the following steps take place:

- ☑ E00 to E08, E10, E11, E12, E13, E15, E17, E32, E33, E34 and E71:
  - "No Fault" relay drops "out";
  - PWM pulses are stopped;
  - The LED display indicates the fault code;
  - The LCD display indicates the fault code and description;
  - The "ERROR" LED flashes;
  - The following data is stored in the EEPROM:
    - Speed reference via Keypad or E.P. (Electronic Potentiometer), if the function "Reference Backup" is active (P120 set to 1 – On);
    - Fault code:
    - The status of the I x t function (motor overload);
    - The status of the powered time (P042) and Enabled Time (P043).
- ☑ E09:
  - Does not allow inverter operation.
- **☑** E24:
  - Indicates the code on the LED display plus and description on the LCD display;
  - It blocks the PWM pulses;
  - It doe nor permit motor driving;
  - It switches OFF the relay that has been programmed to "Without Error";
  - It switches ON the relay that has been programmed to "With Error".
- ☑ E31:
  - The inverter continues to operate normally;
  - It does not accept the Keypad commands;
  - The fault code is indicated on the LED display;
  - The LCD display indicates the fault code and description;
  - E31 is not stored in the fault memories (P014 to P017 and P060 to P065).
- ☑ E41:
  - Does not allow inverter operation;
  - The fault code is indicated on the LED display;
  - The LCD display indicates the fault code and description;
  - The "ERROR" LED flashes.

# Indication of the inverter status LEDs:

LED Power	LED Error	Description
*	0	Inverter is powered up and is ready
*	(Flashing)	A fault has been detected. The FAULT LED flashes, indicating the number of the Fault Code Example:
		Note: If the fault E00 occurs, the ERROR LED is ON continuously.

# 7.2 TROUBLESHOOTING

PROBLEM	POINT TO BE CHECKED	CORRECTIVE ACTION
Motor does not run	Incorrect Wiring	Check the power and control connections. For example the digital inputs DIX programmed for Start/Stop, General Enable and No External Fault must be connected to +24 V. For factory default programming, XC1:1 (DI1) must be connected to +24 V(XC1:9) and XC1:10 connected to XC1:8.
	Analog Reference (if used)	Check if the external signal is properly connected.     Check the status of the speed potentiometer (if used).
	Incorrect Programming	Check if the parameters are properly programmed for the application.
	Fault	Check if the inverter is not disabled due to a Fault condition (Refer to table 7.1).     Check if there is a short-circuit between terminals XC1:9 and XC1:10 (short-circuit at 24 Vdc power supply).
	Motor Stall	1. Reduce the motor load. 2. Increase P169/P170 or P136/P137.

Table 7.2 - Troubleshooting

PROBLEM	POINT TO BE CHECKED	CORRECTIVE ACTION
Motor speed varies (oscillates)	Loose Connections	<ol> <li>Disable the inverter, switch OFF the supply voltage and tighten all connections.</li> <li>Check if all internal connection is tightened.</li> </ol>
	Speed Potentiometer	1. Replace the speed potentiometer.
	Variation of the external analog reference	1. Identify the cause of the variation.
	Parameters not set correctly (for P202 = 3 or 4)	1. Refer to chapter 6, parameters P410, P412, P161, P162, P175 and P176.
Motor speed too high or too low	Programming error (reference limits)	Check if the contents of P133 (Min. Speed) and P134 (Max. Speed) are according to the motor and the application.
	Signal of the reference control	<ol> <li>Check the control signal level of the reference.</li> <li>Check the programming (gains and offset) in P234 to P247.</li> </ol>
	Motor Nameplate Data	Check if the used motor meets the application requirements.
Motor does not reach rated speed or it starts to oscillate at rated speed for P202 = 3 or 4 - Vector		1. Reduce P180 (set to 90 to 99 %).
Display OFF	Connection of the Keypad	1. Check the Keypad connections to the inverter.
	Power Supply voltage  Blown Fuse(s)	1. The power supply voltage must be within the following ranges:  220-230 V power supply: - Min: 187 V  - Max: 253 V  380-480 V power supply: - Min: 323 V  - Max: 528 V  500-600 V power supply: - Min: 425 V  - Max: 660 V  660-690 V power supply: - Min: 561 V  - Max: 759 V  1. Replace the fuse(s).
Motor does not enter the field weakening range (for P202 = 3 or 4)		1. Set P180, between 90 % and 99 %.
Motor speed too low and P009 = P169 or P170 (motor with torque limitation), for P202 = 4 - Vector with encoder	Encoder signals or power connections	Check the signals A - A, B - B according to figure 8.7. If this connections are correct invert two output phases, for instance U and V. Refer to figure 3.9.

Table 7.2 (cont.) - Troubleshooting

# 7.3 CONTACTING WEG



#### NOTE!

When contacting WEG for service or technical assistance, please have the following data on hand:

- ✓ Inverter Model:
- ☑ Serial number, manufacturing date and hardware revision, as indicated on the inverter nameplate (Refer to item 2.4);
- ☑ Software Version (Refer to item 2.2);
- ☑ Information about the application and inverter programming.

# 7.4 PREVENTIVE MAINTENANCE



#### DANGER!

Always disconnect the power supply voltage before touching any component of the inverter.

Even after switching OFF the inverter, high voltages may be present. Wait 10 minutes to allow complete discharge of the power capacitors.

Always connect the equipment frame to a suitable ground (PE) point.



#### **ATTENTION!**

Electronic boards have components sensitive to electrostatic discharges. Never touch the components or connectors directly. If this is unavoidable, first touch the metallic frame or use a suitable ground strap.

Never apply a high voltage test on the inverter! If this is necessary, contact WEG.

To avoid operation problems caused by harsh ambient conditions, such as high temperature, moisture, dirt, vibration or premature aging of the components, periodic inspections of the inverter and installations are recommended.

COMPONENT	PROBLEMS	CORRECTIVE ACTIONS
Terminal Blocks, Connectors	Loose screws	Tighten them
	Loose connectors	
Blowers (1)/ Cooling System	Blowers are dirty	Clean them
	Abnormal acoustic noise	Replace the blower
	Blower is not running	
	Abnormal vibration	
	Dust in the air filters	Clean or replace them
Printed Circuit Boards	Dust, oil or moisture accumulation	Clean them
	Smell	Replace them
Power Module (3)/ Power Connections	Dust, oil or moisture accumulation, etc.	Clean them
	Connection screws are loose	Tighten them
DC Bus Capacitors (2)	Discoloration / smell / electrolyte leakage	Replace them
	Safety valve is expanded or broken	
	Deformation	
Power Resistor	Discoloration	Replace it
	Smell	

Table 7.3 - Periodic inspections after start-up

#### Notes:

- (1) It is recommended to replace the blowers after each 40.000 hours of operation.
- (2) Check the capacitors every six months. It is recommended to replace them after five years of operation.
- (3) If the inverter is stored for long periods, we recommend to power it up once a year during 1 hour. For 220-230 V and 380-480 V models apply supply voltage of approximately 220 Vac, three-phase or single-phase input, 50 or 60 Hz, without connecting motor at output. After this energization, wait 24 hours before installing it. For 500-600 V, 500-690 V and 660-690 V models use the same procedure applying a voltage between 300 V and 330 Vac to the inverter input.

### 7.4.1 Cleaning Instructions

When necessary clean the CFW-09 following the instructions below:

#### Cooling system:

- ☑ Remove AC power from the inverter and wait 10 minutes;
- ☑ Remove all dust from the ventilation openings by using a plastic bush or a soft cloth;
- Remove dust accumulated on the heat sink fins and from the blower blades with compressed air.

#### **Electronic Boards:**

- ☑ Remove AC power form the inverter and wait 10 minutes;
- ☑ Remove all dust from the printed circuit boards by using an anti-static soft brush or remove it with an ionized compressed air gun;
- ☑ If necessary, remove the PCBs from the inverter;
- ✓ Always use a ground strap.

# 7.5 SPARE PART LIST

# Models 220-230 V

					Т	ypes	(Amp	ères)		
Name	Item N°	Specification	6	7	10	13	16	24	28	45
					U	nits p	er Inv	erter		
_	5000.5275	Fan 0400.3681 Length 255 mm (60 x 60)	1	1	1	1				
Fan	5000.5292	Fan 0400.3679 Length 165 mm (40 x 40)					1	1	1	
_	5000.5267	Fan 0400.3682 Length 200 mm (80 x 80)								2
	5000.5364	Fan 0400.3679 Length 230 mm (40 x 40)								1
	5000.5305	Fan 2x04003680 (60 x 60)					1	1	1	
Fuse	0305.6716	Fuse 6.3X32 3.15 A 500 V								1
HMI-CFW09-LCD	S417102024	HMI-LCD	1	1	1	1	1	1	1	1
CC9 - 00	S41509651	Control Board CC9.00	1	1	1	1	1	1	1	1
CFI1.00	S41509929	Interface Board with the HMI	1	1	1	1	1	1	1	1
DPS1.00	S41512431	Driver and Power Supply Board								1
CRP1.00	S41510960	Pulse Feedback Board	1	1	1	1	1	1	1	
KML-CFW09	S417102035	Kit KML	1	1						1
P06 - 2.00	S41512296	Power Board P06-2.00	1							
P07 - 2.00	S41512300	Power Board P07-2.00		1						
P10 - 2.00	S41512318	Power Board P10-2.00			1					
P13 - 2.00	S41512326	Power Board P13-2.00				1				
P16 - 2.00	S41512334	Power Board P16-2.00					1			
P24 - 2.00	S41512342	Power Board P24-2.00						1		
P28 - 2.00	S41512350	Power Board P28-2.00							1	
P45 - 2.00	S41510587	Power Board P45-2.00								1
HMI-CFW09-LED	S417102023	HMI-LED (Optional)	1	1	1	1	1	1	1	1
KMR-CFW09	S417102036	Kit KMR (Optional)	1	1	1	1	1	1	1	1
CFI1.01	S41510226	Interface Board with HMI (Optional)	1	1	1	1	1	1	1	1
EBA1.01	S41510110	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBA1.02	S41511761	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBA1.03	S41511770	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.01	S41510200	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.02	S41511788	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.03	S41511796	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.04	S41512671	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.05	S41512741	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.01	S41513174	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.02	S41513175	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.03	S41513176	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
SCI1.00	S41510846	RS-232 Module for PC (Optional)	1	1	1	1	1	1	1	1

# Models 220-230 V

Nome	Item N°	Specification	54	pères	res) 05   130		
Name	item iv	ореоновног	54	70 Units	86 s per	105 Invert	
Pre-charge	035502345	Cont.CWM32.10 220 V 50/60 Hz		1	1		
Contactors	035502394	Cont.CWM50.00 220 V 50/60 Hz				1	1
Pre-charge Resistor	0301.1852	Vitrified wire Resistor 20 R 75 W		1	1	1	1
	5000.5267	Fan 0400.3682 Length 200 mm	2				
	5000.5127	Fan 0400.3682 Length 285 mm	1				
Fan	5000.5208	Fan 0400.3683 Lenght 230 mm (120 x 120)		1	1		
	5000.5364	Fan 0400.3679 Length. 230 mm (40 x 40)	1	1	1	1	1
	5000.5216	Fan 0400.3683 Length 330 mm		1	1		
	0400.2547	Fan 220 V 50/60 Hz				1	1
Fuse	0305.6716	Fuse 6.3 x 32 3.15 A 500 V	1	1	1	1	1
ruse	0305.5604	Ret Fuse 0.5 A 600 V FNQ-R1		2	2	2	2
HMI-CFW09-LCD	S417102024	HMILCD	1	1	1	1	1
CC9.00	S41509651	Control Board CC9.00	1	1	1	1	1
LVS1.01	S41510927	Board LVS1.01		1	1	1	1
CFI1.00	S41509929	Interface Board with the HMI	1	1	1	1	1
DPS1.00	S41512431	Power Supplies and Firing Board	1				
KML-CFW09	S417102035	Kit KML	1	1	1	1	1
DPS1.01	S41512440	Driver and Power Supply Board		1	1	1	1
*P54 - 2.00	S41510552	Power Board P54-2.00	1				
P54 - 2.01	S41511443	Power Board P54-2.01	1				
*P70 - 2.00	S41511354	Power Board P70-2.00		1			
P70 - 2.01	S41511451	Power Board P70-2.01		1			
*P86 - 2.00	S41510501	Power Board P86-2.00			1		
P86 - 2.01	S41511460	Power Board P86-2.01			1		
*P105 - 2.00	S41511362	Power Board P105-2.00				1	
P105 - 2.01	S41511478	Power Board P105-2.01				1	
*P130 - 2.00	S41510439	Power Board P130-2.00					1
P130 - 2.01	S41511486	Power Board P130-2.01					1
HMI-CFW09-LED	S417102023	HMI LED (Optional)	1	1	1	1	1
KMR-CFW09	S417102036	Kit KMR (Optional)	1	1	1	1	1
CFI1.01	S41510226	Interface Board with HMI (Optional)	1	1	1	1	1
EBA1.01	S41510110	Function Expansion Board (Optional)	1	1	1	1	1
EBA1.02	S41511761	Function Expansion Board (Optional)	1	1	1	1	1
EBA1.03	S41511770	Function Expansion Board (Optional)	1	1	1	1	1
EBB.01	S41510200	Function Expansion Board (Optional)	1	1	1	1	1
EBB.02	S41511788	Function Expansion Board (Optional)	1	1	1	1	1
EBB.03	S41511796	Function Expansion Board (Optional)	1	1	1	1	1
EBB.04	S41512671	Function Expansion Board (Optional)	1	1	1	1	1
EBB.05	S41512741	Function Expansion Board (Optional)	1	1	1	1	1
EBC1.01	S41513174	Function Expansion Board (Optional)	1	1	1	1	1
EBC1.02	S41513175	Function Expansion Board (Optional)	1	1	1	1	1
EBC1.03	S41513176	Function Expansion Board (Optional)	1	1	1	1	1
SCI1.00	S41510846	RS-232 module for PC (Optional)	1	1	1	1	1
	0307.2495	Current transformer 200 A/100 mA		-	-	2	2

<sup>\*</sup> Only the types specified with braking (DB)

# Models 380-480 V

				Т	ype (	Ampè	res)			
Name	Item N°	Specification	3.6	4	5.5	9	13	16	24	30
					U	nits p	er Inv	erter		
	5000.5275	Fan 0400.3284 Length 190 mm (60 x 60)	1	1	1	1				
	5000.5305	Fan 2 x 0400.2423 150/110 mm (60 x 60)					1	1		
Fan	5000.5292	Fan 0400.3679 Length 165 mm (40 x 40)					1	1	1	
i ali	5000.5283	Fan 2 x 0400.3681 (135/175) mm (60 x 60)							1	
	5000.5259	Fan 0400.3682 Length 140 mm (80 x 80)								2
	5000.5364	Fan 0400.3679 Length 230 mm (40 x 40)								1
Fuse	0305.6716	Fuse 6.3 x 32 3.15 A 500 V								1
CC9.00	S41509651	Control Board CC9.00	1	1	1	1	1	1	1	1
HMI-CFW09-LCD	S417102024	HMILCD	1	1	1	1	1	1	1	1
CFI1.00	S41509929	Interface Board with HMI	1	1	1	1	1	1	1	1
DPS1.00	S41512431	Driver and Power Supply Board								1
CRP1.01	S41510820	Pulse Feedback Board	1	1	1	1	1	1	1	
KML-CFW09	S417102035	Kit KML								1
P03 - 4.00	S41512369	Power Board P03-4.00	1							
P04 - 4.00	S41512377	Power Board P04-4.00		1						
P05 - 4.00	S41512385	Power Board P05-4.00			1					
P09 - 4.00	S41512393	Power Board P09-4.00				1				
P13 - 4.00	S41512407	Power Board P13-4.00					1			
P16 - 4.00	S41512415	Power Board P16-4.00						1		
P24 - 4.00	S41512423	Power Board P24-4.00							1	
P30 - 4.00	S41509759	Power Board P30-4.00								1
HMI-CFW09-LED	S417102023	HMI LED (Optional)	1	1	1	1	1	1	1	1
KMR-CFW09	S417102036	Kit KMR (Optional)	1	1	1	1	1	1	1	1
CFI1.01	S41510226	Interface Board with HMI (Optional)	1	1	1	1	1	1	1	1
EBA1.01	S41510110	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBA1.02	S41511761	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBA1.03	S41511770	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.01	S41510200	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.02	S41511788	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.03	S41511796	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.04	S41512671	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.05	S41512741	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.01	S41513174	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.02	S41513175	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.03	S41513176	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
SCI1.00	S41510846	RS-232 Module for PC (Optional)	1	1	1	1	1	1	1	1

# Models 380-480 V

		0					pères	•		
Name	Item N°	Specification	38	45	60	70	86	105	142	
Pre-charge Contactor	005500004	Contactor CWM50.10 220 V 50/60 Hz			Units	per	invert 1	er 1	1	
Pre-charge	000002004	Transformer 100 VA					1	1	<u>'</u>	
Transformer	0307.0034	Transformer 300 VA					<u> </u>	'	1	
Pre-charge Resistor	0307.0042	Vitrified wire Resistor 20 R 75 W					1	1	1	
	0301.1852	Fan 0400.3682 Length.200 mm (80 x 80)	3	3			<u>'</u>	<u>'</u>	<u> </u>	
	5000.5267	Fan 0400.3683 Length 230 mm (120 x 120)	+	3	1	1				
Fan	5000.5208	Fan 0400.3683 Length 330 mm (40 x 40)			1	1				
i aii	5000.5216	Fan 0400.3663 Length 330 mm (40 x 40)	1	1	1	1	1	1	1	
	5000.5364	• , , ,	'	'	'	'	1	1	'	
	0400.2547	Fan 220 V 50/60 Hz						-		
_	0305.5604	Ret. Fuse 0.5 A 600 V FNQ-R1					2	2		
Fuse	0305.5663	Ret. Fuse 1.6 A 600 V	1	_	4	4	4	4	2	
LIMI OF MODILOR	0305.6716	Fuse 6.3 x 32 3.15 A 500 V	1	1	1	1	1	1	1	
HMI-CFW09-LCD	S417102024	HMILCD	1	1	1	1	1	1	1	
CC9.00	S41509651	Control Board CC9.00	1	1	1	1	1	1	1	
CFI1.00	S41509929	HMI Interface Board	1	1	1	1	1	1	1	
DPS1.00	S41512431	Driver and Power Supply Board	1	1						
DPS1.01	S41512440	Driver and Power Supply Board			1	1	1	1	1	
LVS1.00	S41510269	Voltage Selection Board					1	1	1	
CB1.00	S41509996	Board CB1.00			2	2				
CB3.00	S41510285	Board CB3.00					2	2	2	
KML-CFW09	S417102035	Kit KML	1	1	1	1	1	1	1	
*P38-4.00	S41511753	Power Board P38-4.00	1							
P38-4.01	S41511370	Power Board P38-4.01	1							
*P45-4.00	S41509805	Power Board P45-4.00		1						
P45-4.01	S41511389	Power Board P45-4.01		1						
*P60-4A.00	S41513141	Power Board P60-4A.00			1					
P60-4A.01	S41513142	Power Board P60-4A.01			1					
*P70-4A.00	S41513118	Power Board P70-4A.00				1				
P70-4A.01	S41513140	Power Board P70-4A.01				1				
*P86-4A.00	S41513108	Power Board P86-4A.00					1			
P86-4A.01	S41513109	Power Board P86-4A.01					1			
*P105-4A.00	S41513110	Power Board P105-4A.00						1		
P105-4A.01	S41513111	Power Board P105-4A.01						1		
*P142-4A.00	S41513112	Power Board P142-4A.00							1	
P142-4A.01	S41513113	Power Board P142-4A.01							1	
HMI-CFW09-LED	S417102023	HMI LED (Optional)	1	1	1	1	1	1	1	
KMR-CFW09	S417102036	Kit KMR (Optional)	1	1	1	1	1	1	1	
CFI1.01	S41510226	Interface Board with HMI (Optional)	1	1	1	1	1	1	1	
EBA1.01	S41510110	Function Expansion Board (Optional)	1	1	1	1	1	1	1	
EBA1.02	S41511761	Function Expansion Board (Optional)	1	1	1	1	1	1	1	
EBA1.03	S41511770	Function Expansion Board (Optional)	1	1	1	1	1	1	1	
EBB.01	S41510200	Function Expansion Board (Optional)	1	1	1	1	1	1	1	
EBB.02	S41511788	Function Expansion Board (Optional)	1	1	1	1	1	1	1	
EBB.03	S41511796	Function Expansion Board (Optional)	1	1	1	1	1	1	1	
EBB.04	S41511790 S41512671	Function Expansion Board (Optional)	1	1	1	1	1	1	1	
EBB.05	S41512071	Function Expansion Board (Optional)	1	1	1	1	1	1	1	
	341312/41	Tanoson Expansion Board (Optional)	1 '	l '	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	

	Item N°		Type (Ampères)									
Name		Specification	38	45	60	70	86	105	142			
					Units	per	invert	er				
EBC1.01	S41513174	Function Expansion Board (Optional)	1	1	1	1	1	1	1			
EBC1.02	S41513175	Function Expansion Board (Optional)	1	1	1	1	1	1	1			
EBC1.03	S41513176	Function Expansion Board (Optional)	1	1	1	1	1	1	1			
CB7D.00	S41513136	Board CB7D.00			1	1						
CB7E.00	S41513134	Board CB7E.00			1	1						
CB4D.00	S41513058	Board CB4D.00					1	1	1			
CB4E.00	S41513107	Board CB4E.00					1	1	1			
SCI1.00	S41510846	RS-232 Module for PC (Optional)	1	1	1	1	1	1	1			
Current Trasformer	0307.2495	Current transformer 200 A/100 mA					2	2	2			

<sup>\*</sup>Only for the types specified with braking (DB)

### Models 380-480 V

						Туре	(Amp	ères)		
Name	Item Nº	Specification	180	211	240	312	361	450	515	600
					l	Jnits <sub>I</sub>	per in	verter		
IGBT Module	0303.7118	IGBT Module 200 A 1200 V	6							
.02 :0000	0298.0001	IGBT Module 300 A 1200 V - (EUPEC)			6					
	0303.9315	IGBT Module 300 A 1200 V				6	6	9	12	12
	417102497	Inverter Arm 361 A - EP				3	3			
Inverter Arm	417102498	Inverter Arm 450 A - EP						3		
	417102499	Inverter Arm 600 A - EP							3	3
	417102496	InverterArm 600 A				6	6	9	12	12
	0298.0016	Thyristor-Diode Module TD330N16				3	3			
Thyristor-Diode Module	0303.9986	Thyristor-Diode Module TD425N16						3		
	0303.9994	Thyristor-Diode Module TD500N16							3	3
	0298.0003	Thyristor-Diode Module SKKH 250/16	3	3	3					
Pre-charge	0307.0204	Transformer of Fan and SCR Firing Pulse 250 VA	1	1	1					
Transformer	0307.0212	Transformer of Fan and SCR Firing Pulse 650 VA				1	1	1	1	1
Pre-charge Resistor	0301.9250	Vitrified Wire Resistor 35 R 75 W	6	6	6	8	8	10	10	10
Rectifier Bridge	0303.9544	Three-Phase Rectifier Bridge 35 A 1400 V	1	1	1	1	1	1	1	1
Electrolytic Capacitor	0302.4873	Electrolytic Capacitor 4700 uF/400 V	8	12	12	18	18	24	30	30
Fan	6431.3207	Centrifugal Fan 230 V 50/60 Hz	1	1	1	3	3	3	3	3
Fuse	0305.5663	Ret. Fuse 1.6 A 600 V	2	2	2					
i use	0305.6112	Ret. Fuse 2.5 A 600 V				2	2	2	2	2
HMI-CFW09-LCD	S417102024	HMI LCD	1	1	1	1	1	1	1	1
KML-CFW09	S417102035	Kit KML	1	1	1	1	1	1	1	1
CC9.00	S41509651	Control Board CC9.00	1	1	1	1	1	1	1	1
DPS2.00	S41510897	Driver and Power Supply Board DPS2.00	1	1	1	1	1			
DPS2.01	S41511575	Driver and Power Supply Board DPS2.01						1	1	1
CRG2.00	S41512615	Gate Resistor Board CRG2X.00	3	3	3	3	3			
CRG3X.01	S41512618	Gate Resistor Board CRG3X.01						3		
CRG3X.00	S41512617	Gate Resistor Board CRG3X.00							3	3
CIP2.00	S41513217	CIP2A.00 Board	1							
CIP2.01	S41513218	CIP2A.01 Board			1					

						Туре	(Amp	ères)		
Name	Item Nº	Specification	180	211	240	312	361	450	515	600
					Į	Jnits	per in	verter		
CIP2.02	S41513219	CIP2A.02 Board					1			
CIP2.03	S41513220	CIP2A.03 Board						1		
CIP2.04	S41513221	CIP2A.04 Board								1
CIP2.52	S41513228	CIP2A.52 Board		1						
CIP2.53	S41513229	CIP2A.53 Board				1				
CIP2.54	S41513230	CIP2A.54 Board							1	
SKHI23MEC8	S41511532	Board SKHI23/12 for MEC8	3	3	3					
SKHI23MEC10	S41511540	Board SKHI23/12 for MEC10				3	3	3		
HMI-CFW09-LED	S417102023	HMI LED (Optional)	1	1	1	1	1	1	1	1
KMR-CFW09	S417102036	Kit KMR (Optional)	1	1	1	1	1	1	1	1
CFI1.01	S41510226	Interface Board with HMI (Optional)	1	1	1	1	1	1	1	1
EBA1.01	S41510110	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBA1.02	S41511761	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBA1.03	S41511770	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.01	S41510200	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.02	S41511788	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.03	S41511796	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.04	S41512671	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.05	S41512741	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.01	S41513174	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.02	S41513175	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.03	S41513176	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
SCI1.00	S41510846	RS-232 Module for PC (Optional)	1	1	1	1	1	1	1	1
	0307.2509	Current Transformer 500 A/250 mA	2	2	2					
Current Transducers	0307.2550	Current Transformer 5000 A/1 A LT SI							2	2
	0307.2070	Current Transformer 1000 A/200 mA LT 100SI				2	2	2		

# Models 500-600 V

				7	ypes	(Amp	ères)	
Name	Item N°	Specification	2.9	4.2	7	10	12	14
				U	nits p	er Inv	erter	
Fan	5000.5291	Fan 0400.3217 Comp. 145 mm (40 x 40)	1	1	1	1	1	1
ran	5000.5435	Fan 2 x 400.3284 290/200 mm (60 x 60)			1	1	1	1
CC9.00	S41509651	Control Board CC9.00	1	1	1	1	1	1
HMI-CFW09-LCD	S417102024	HMILCD	1	1	1	1	1	1
CIF1.00	S41509929	Interface Board with HMI	1	1	1	1	1	1
CRP2.00	S41512862	Pulse Feedback Board	1	1	1	1	1	1
P02-6.00	S41512855	Power Board P02-6.00	1					
P04-6.00	S41512856	Power Board P04-6.00		1				
P07-6.00	S41512857	Power Board P04-6.00			1			
P10-6.00	S41512858	Power Board P10-6.00				1		
P12-6.00	S41512859	Power Board P12-6.00					1	
P14-6.00	S41512860	Power Board P14-6.00						1

				٦	Гуреѕ	(Amp	ères)	
Name	Item N°	Specification		4.2	7	10	12	14
				U	nits p	per Inverter		
HMI-CFW09-LED	S417102023	HMI LED (Optional)	1	1	1	1	1	1
KMR-CFW09	S417102036	Kit KMR (Optional)	1	1	1	1	1	1
CIF1.01	S41510226	Interface Board with HMI (Optional)	1	1	1	1	1	1
EBA1.01	S41510110	Function Expansion Board (Optional)	1	1	1	1	1	1
EBA1.02	S41511761	Function Expansion Board (Optional)	1	1	1	1	1	1
EBA1.03	S41511770	Function Expansion Board (Optional)	1	1	1	1	1	1
EBB.01	S41510200	Function Expansion Board (Optional)	1	1	1	1	1	1
EBB.02	S41511788	Function Expansion Board (Optional)	1	1	1	1	1	1
EBB.03	S41511796	Function Expansion Board (Optional)	1	1	1	1	1	1
EBB.04	S41512671	Function Expansion Board (Optional)	1	1	1	1	1	1
EBB.05	S41512741	Function Expansion Board (Optional)	1	1	1	1	1	1
EBC1.01	S41513174	Function Expansion Board (Optional)	1	1	1	1	1	1
EBC1.02	S41513175	Function Expansion Board (Optional)	1	1	1	1	1	1
EBC1.03	S41513176	Function Expansion Board (Optional)	1	1	1	1	1	1
SCI1.00	S41510846	RS-232 Module for PC (Optional)	1	1	1	1	1	1

### Models 500-600 V

			Туре	es (Am	npères)	
Name	Item N°	Specification	22	27	32	
			Unit	s per li	nverter	
Fan	5000.5267	Fan 0400.2482 Comp. 150mm (80 x 80)	3	3	3	
Fuse	0305.6716	Fuse 6.3 x 32 3.15 A 500 V	1	1	1	
CC9.00	S41509651	Control Board CC9.00		1	11	
HMI-CFW09-LCD	S417102024	HMILCD	1	1	1	
CIF1.00	S41509929	Interface Board with HMI	1	1	1	
KML-CFW09	S417102035	Kit KML	1	1	1	
DPS4.00	S41512864	Driver and Power Supply Board	1	1	1	
P22-6.01	S41512867	Power Board P22-6.01				
P22-6.00	S41512866	Power Board P22-6.00				
P27-6.01	S41512869	Power Board P27-6.01		1		
*P27-6.00	S41512868	Power Board P27-6.00		1		
P32-6.01	S41512872	Power Board P32-6.01			1	
*P32-6.00	S41512871	Power Board P32-6.00			1	
HMI-CFW09-LED	S417102023	HMI LED (Optional)	1	1	1	
KMR-CFW09	S417102036	Kit KMR (Optional)	1	1	11	
CIF1.01	S41510226	Interface Board with HMI (Optional)	1	1	1	
EBA1.01	S41510110	Function Expansion Board (Optional)	1	1	1	
EBA1.02	S41511761	Function Expansion Board (Optional)	1	1	1	
EBA1.03	S41511770	Function Expansion Board (Optional)		1	1	
EBB.01	S41510200	Function Expansion Board (Optional)	1	1	1	
EBB.02	S41511788	Function Expansion Board (Optional)		1	1	
EBB.03	S41511796	Function Expansion Board (Optional)		1	1	

# Models 500-600 V

			Types (Ampères)				
Name	lame Item N° Specification		22	27	32		
				s per l	nverter		
EBB.04	S41512671	Function Expansion Board (Optional)	1	1	1		
EBB.05	S41512741	Function Expansion Board (Optional)		1	1		
EBC1.01	S41513174	Function Expansion Board (Optional)	1	1	1		
EBC1.02	S41513175	Function Expansion Board (Optional)	1	1	1		
EBC1.03	S41513176	Function Expansion Board (Optional)		1	1		
SCI1.00	S41510846	RS-232 Module for PC (Optional)	1	1	1		

<sup>\*</sup> Only for types specified with braking (DB).

### Models 500-600 V

				pes (	Ampè	res)
Name	Item N°	Specification	44	53	63	79
			Ur		er Inve	rter
Pre-charge Contactor	035506138	Contactor CWM50.00 220 V 50/60 Hz	1	1	1	1
Pre-charge Transformer	0299.0160	Preload Transformer	1	1	1	1
Pre-charge Resistor	0301.1852	Vetrified Wire Resistor 20 R 75 W	1	1	1	1
Fan	0400.2547	Fan 220 V 50/60 Hz	1	1	1	1
Fuse	0305.6166	Fuse 14 x 51 mm 2 A 690 V	2	2	2	2
HMI-CFW09-LCD	S417102024	HMILCD	1	1	1	1
CC9	S41509651	Control Board CC9	1	1	1	1
CFI1.00	S41509929	HMI Interface Board	1	1	1	1
DPS5.00	S41512966	Driver and Power Supply Board DPS5.00	1	1	1	1
LVS2.00	S41512990	Voltage Selection Board LVS2.00	1	1	1	1
CB5D.00	S41512986	Board CB5D.00				1
CB5E.00	S41413063	CB5E.00 Board		1	1	
CB5E.01	S41413081	CB5E.01 Board				1
KML-CFW09	S417102035	Kit KML	1	1	1	1
*P44-6.00	S41512968	Power Board P44-6.00	1			
P44-6.01	S41512969	Power Board P44-6.01	1			
*P53-6.00	S41512973	Power Board P53-6.00		1		
P53-6.01	S41512974	Power Board P53-6.01		1		
*P63-6.00	S41512975	Power Board P63-6.00			1	
P63-6.01	S41512976	Power Board P63-6.01			1	
*P79-6.00	S41512977	Power Board P79-6.00				1
P79-6.01	S41512978	Power Board P79-6.01				1
HMI-CFW09-LED	S417102023	HMI LED (Optional)	1	1	1	1
KMR-CFW09	S417102036	Kit KMR (Optional)	1	1	1	1
CFI1.01	S41510226	HMI Interface Board (Optional)	1	1	1	1
EBA1.01	S41510110	Function Expansion Board (Optional)	1	1	1	1
EBA1.02	S41511761	Function Expansion Board (Optional)	1	1	1	1
EBA1.03	S41511770	Function Expansion Board (Optional)	1	1	1	1

			Ту	pes (	Ampè	res)
Name	Item Nº	Item N° Specification 2		53	63	79
			Ur	nits pe	er Inve	rter
EBB.04	S41512671	Function Expansion Board (Optional)	1	1	1	1
EBB.05	S41512741	Function Expansion Board (Optional)	1	1	1	1
EBC1.01	S41513174	unction Expansion Board (Optional) 1		1	1	1
EBC1.02	S41513175	Function Expansion Board (Optional)		1	1	1
EBC1.03	S41513176	Function Expansion Board (Optional)	1	1	1	1
SCI1.00	S41510846	RS-232 Module for PC (Optional)	1	1	1	1
DC Link Inductor	0299.0156	DC Link Inductor 749 μH	1			
DC Link Inductor	0299.0157	DC Link Inductor 562 μH		1		
DC Link Inductor	0299.0158	DC Link Inductor 481 μH			1	
DC Link Inductor	0299.0159	DC Link Inductor 321 μH				1

<sup>\*</sup> Only for types specified with braking (DB).

# Models 500-690 V

Name		Constitue			Т	• •	(Amp	ères)		
Name	ltem N°	Specification	107	147	211		315		418	472
					Un	its pe	er inve	rter		
IGBT Module	0298.0008	IGBT Module 200 A 1700 V		6						
	0298.0009	IGBT Module 300 A 1700 V	3		6	6	9	9	12	12
	S417104460	Inverter Arm 247 A – EP				3				
	S417104461	Inverter Arm 315 A – EP					3			
Inverter Arm	S417104462	Inverter Arm 343 A – EP						3		
	S417104463	Inverter Arm 418 A – EP							3	
	S417104464	Inverter Arm 472 A – EP								3
Thyristor-Diode	0303.9978	Thyristor-Diode Module TD250N16	3	3	3	3	3	3		
Module	0303.9986	Thyristor-Diode Module TD425N16							3	
Module	0303.9994	Thyristor-Diode Module TD500N16								3
Rectifier Bridge	0298.0026	Rectifier Bridge 36MT160	1	1	1	1	1	1	1	1
Pre-charge Resistor	0301.9250	Vitrified Wire Resistor 35 R 75 W	6	6	6	8	8	8	8	10
Fan	64313207	Centrifugal Fan 230 V 50/60 Hz	1	1	1	3	3	3	3	3
Electrolytic Capacitor	0302.4873	Electrolytic Capacitor 4700 uF/400 V	9	12	12	18	18	18		
Licetrolytic Capacitor	0302.4801	Electrolytic Capacitor 4700 uF/400 V							18	27
<b>F</b>	0305.6166	Fuse 2 A 690 V	2	2	2					
Fuse	0305.6171	Fuse 4 A 690 V				2	2	2	2	2
HMI-CFW09-LCD	S417102024	HMILCD	1	1	1	1	1	1	1	1
KML-CFW09	S417102035	Kit KML	1	1	1	1	1	1	1	1
CC9	S41509651	Control Board CC9	1	1	1	1	1	1	1	1
DPS3	S41512834	Driver and Power Supply Board DPS3.00	1	1	1	1	1	1	1	1
CRG7	S41512951	Gate Resistor Board CRG7.00	3	3	3	3				
CRG6	S41512798	Gate Resistor Board CRG6.00			3	3	3	3		
FCB1.00	S41512821	Board FCB1.00				3	3	3	3	3
FCB1.01	S41512999	Board FCB1.01				3	3	3	3	3
FCB2	S41513011	Board FCB2.00	1	1	1					
CIP3	S41512803	Board CIP3.00	1	1	1	1	1	1	1	1

		<u>.</u>			T	ypes	(Amp	ères)		
Name	Item N°	Specification	107	147	211		315		418	472
					Ur	nits pe	er inv	erter		
RCS3	S41512846	Rectifier Snubber Board RCS3.00							3	3
	S41512836	Signal Interface Board CIS1.00	1							
	S41512883	Signal Interface Board CIS1.01		1						
	S41512884	Signal Interface Board CIS1.02			1					
CIS1	S41512885	Signal Interface Board CIS1.03				1				
	S41512886	Signal Interface Board CIS1.04					1			
	S41512887	Signal Interface Board CIS1.05						1		
	S41512888	Signal Interface Board CIS1.06							1	
	S41512889	Signal Interface Board CIS1.07								1
GDB1.00	S41512963	Gate Driver Board GDB1.00	3	3	3	3	3	3	3	3
HMI-CFW09-LED	S417102023	HMI LED (Optional)	1	1	1	1	1	1	1	1
KMR-CFW09	S417102036	Kit KMR (Optional)	1	1	1	1	1	1	1	1
CFI1.01	S41510226	Interface board with HMI (Optional)	1	1	1	1	1	1	1	1
EBA1.01	S41510110	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBA1.02	S41511761	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBA1.03	S41511770	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.01	S41510200	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.02	S41511788	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.03	S41511796	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.04	S41512671	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBB.05	S41512741	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.01	S41513174	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.02	S41513175	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
EBC1.03	S41513176	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1
SCI1.00	S41510846	RS-232 Module for PC (Optional)	1	1	1	1	1	1	1	1

# Models 660-690 V

2013 000 030 V					т.	vnoo i	Amn	àrool		
Name	Itama No	Specification	100	127	179	ypes	259		340	128
	Item Nº	·	100	121		its pe			340	420
IGBT Module	0298.0008	IGBT Module 200 A 1700 V		6						
IGBT Module	0298.0009	IGBT Module 300 A 1700 V	3		6	6	9	9	12	12
	S417104460	Inverter Arm 225 A – EP				3				
	S417104461	Inverter Arm 259 A – EP					3			
Inverter Arm	S417104462	Inverter Arm 305 A – EP						3		
	S417104463	Inverter Arm 340 A – EP							3	
	S417104464	Inverter Arm 428 A – EP								3
	0303.9978	Thyristor-Diode Module TD250N16	3	3	3	3	3	3		
Thyristor-Diode	0303.9986	Thyristor-Diode Module TD425N16							3	
Module	0303.9994	Thyristor-Diode Module TD500N16								3
Rectifier Bridge	0298.0026	Rectifier Bridge 36MT160	1	1	1	1	1	1	1	1
Pre-charge Resistor	0301.9250	Vitrified Wire Resistor 35 R 75 W	6	6	6	8	8	8	8	10

					Т	ypes	(Amp	ères)			
Name	Item N°	Specification	100	127	179	225			340	428	
					Ur	its pe	r Inve	erter			
Fan	6431.3207	Centrifugal Fan 230 V 50/60 Hz	1	1	1	3	3	3	3	3	
Electrolytic Capacitor	0302.4873	Electrolytic Capacitor 4700 uF/400 V	9	12	12	18	18	18			
	0302.4801	Electrolytic Capacitor 4700 uF/400 V							18	27	
Fuse	0305.6166	Fuse 2 A 690 V	2	2	2						
	0302.6171	Fuse 4 A 690 V				2	2	2	2	2	
HMI-CFW09-LCD	S417102024	HMILCD	1	1	1	1	1	1	1	1	
KML-CFW09	S417102035	Kit KML	1	1	1	1	1	1	1	1	
CC9	S41509651	Control Board CC9	1	1	1	1	1	1	1	1	
DPS3	S41512834	Driver and Power Supply Board DPS3.00	1	1	1	1	1	1	1	1	
CRG7	S41512951	Gate Resistor Board CRG7.00	3	3	3	3					
CRG6	S41512798	Gate Resistor Board CRG6.00					3	3	3	3	
ECD4	S41512821	Board FCB1.00				3	3	3	3	3	
FCB1	S41512999	Board FCB1.01				3	3	3	3	3	
FCB2	S41513011	Board FCB2.00	1	1	1						
CIP3	S41512803	Board CIP3.00	1	1	1	1	1	1	1	1	
RCS3	S41512846	Rectifier Snubber Board RCS3.00							3	3	
	S41512890	Signal Interface Board CIS1.08	1								
	S41512891	Signal Interface Board CIS1.09		1							
	S41512892	Signal Interface Board CIS1.10			1						
CIS1	S41512893	Signal Interface Board CIS1.11				1					
	S41512894	Signal Interface Board CIS1.12					1				
	S41512895	Signal Interface Board CIS1.13						1			
	S41512896	Signal Interface Board CIS1.14							1		
	S41512897	Signal Interface Board CIS1.15								1	
GDB1.00	S41512963	Gate Driver Board GDB1.00	3	3	3	3	3	3	3	3	
HMI-CFW09-LED	S417102023	HMI LED (Optional)	1	1	1	1	1	1	1	1	
KMR-CFW09	S417102036	Kit KMR (Optional)	1	1	1	1	1	1	1	1	
CFI1.01	S41510226	Interface board with HMI (Optional)	1	1	1	1	1	1	1	1	
EBA1.01	S41510110	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1	
EBA1.02	S41511761	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1	
EBA1.03	S41511770	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1	
EBB.01	S41510200	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1	
EBB.02	S41511788	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1	
EBB.03	S41511796	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1	
EBB.04	S41512671	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1	
EBB.05	S41512741	Function Expansion Board (Optional)	1	1	1	1	1	1	1		
EBC1.01	S41513174	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1	
EBC1.02	S41513175	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1	
EBC1.03	S41513176	Function Expansion Board (Optional)	1	1	1	1	1	1	1	1	
SCI1.00	S41510846	, , ,									
SCI1.00	S41510846	RS-232 Module for PC (Optional)	1	1 1 1 1 1 1		1	1	1			

# CFW-09 OPTIONS AND ACCESSORIES

This chapter describes the optional devices that are available for the CFW-09 and the accessories that may be necessary in specific applications. Options include the Expanded I/O Boards (EBA/EBB), LED-only Keypad, Remote Keypad and Cables, Blank Cover, RS-232 PC Communication kit, The accessories comprise: Encoder, Line Reactor, DC Bus Choke, Load Reactor and RFI filter, boards for Fieldbus communication, kit for extractable assembling, NEMA 4X/IP56 line, HD and RB and PLC board line.

# 8.1 I/O EXPANSION BOARDS

The I/O expansion boards expand the function of the CC9 control board. There are four different I/O expansion boards available and their selection depends on the application and extended functions that are required. The four boards cannot be used simultaneously. The difference between EBA and EBB option boards is in the analog inputs/outputs. The EBC1 board is used for the encoder connection. The EBE board is for RS-485 and motor PTC. A detailed description of each board is provided below.

# 8.1.1 EBA (I/O Expansion Board A)

The EBA board can be supplied in different configurations, combining some specific features. The available configurations are show on table 8.1.

	EBA	Board models	- Code
Included Features	EBA.01	EBA.02	EBA.03
	A1	A2	A3
Differential input for incremental encoder with isolated internal 12 V power supply;	Available	Not available	Not available
Buffered encoder output signals: isolated input signal repeater, differential output, available to external 5 V to 15 V power supply;	Available	Not available	Not available
Analog differential input (Al4): 14 bits (0.006 % of the full scale range), bipolar: -10 V to +10 V, (0 to 20) mA/(4 to 20) mA programmable;	Available	Not available	Available
2 Analog outputs (AO3/AO4): 14 bits (0.006 % of the range [±10 V]), bipolar: -10 V to + 10 V, programmable;	Available	Not available	Available
Isolated RS-485 serial port;	Available	Available	Not available
Digital Input (DI7): isolated, programmable, 24 V;	Available	Available	Available
Digital Input (DI8) for special motor thermistor (PTC) function: actuation 3.9 k $\Omega$ , release 1.6 k $\Omega$ ;	Available	Available	Available
2 isolated Open Collector transistor outputs (DO1/DO2): 24 V, 50 mA, programmable.	Available	Available	Available

Table 8.1 - EBA board versions and included features



#### NOTE!

The use of the RS-485 serial interface does not allow the use of the standard RS-232 input - they can not be used simultaneously.

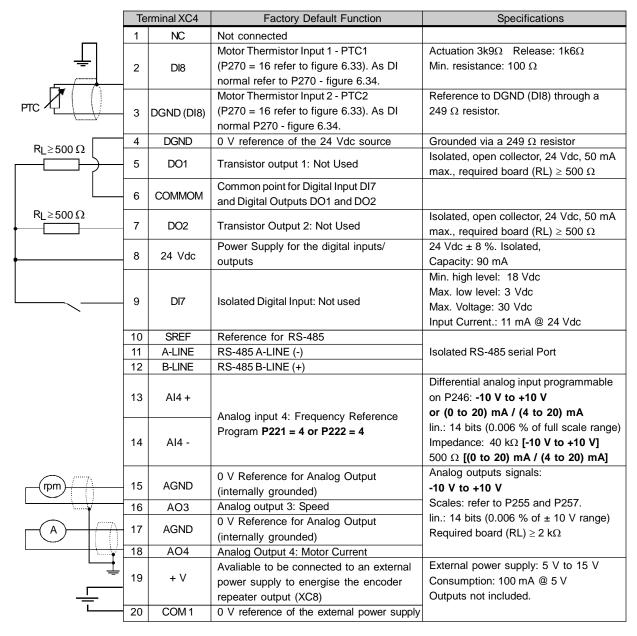


Figure 8.1 – XC4 terminal block description (EBA board complete)

#### **ENCODER CONNECTION: Refer to item 8.2.**

#### **INSTALLATION**

The EBA board is installed on the CC9 control board, secured with spacers and connected via terminal blocks XC11 (24 V) and XC3.



#### NOTE!

For the CFW-09 Size 1 Models ( $6\,A$ ,  $7\,A$ ,  $10\,A$  and  $13\,A/220-230\,V$  and  $3.6\,A$ ,  $4\,A$ ,  $5.5\,A$  and  $9\,A/380-480\,V$ ) the plastic cover must be removed to install the EBA board.

#### **Mounting Instructions:**

- 1. Set the board configuration via S2 and S3 dip switches (Refer to table 8.2);
- 2. Carefully insert terminal block XC3 (EBA) into the female connector XC3 of the CC9 control board. Check that all pins fit in the XC3 connector;

- 3. Press on the EBA board (near XC3) and on the left top edge until complete insertion of the connector and plastic spacer;
- 4. Secure the board to the metallic spacers with the screws provided;
- 5. Plug XC11 connector of the EBA board to the XC11 connector of the (CC9) control board.

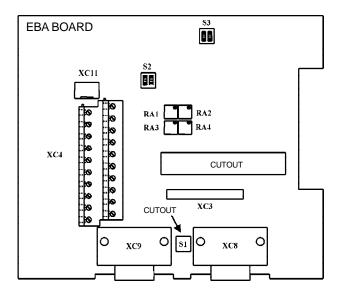


Figure 8.2 - EBA board layout

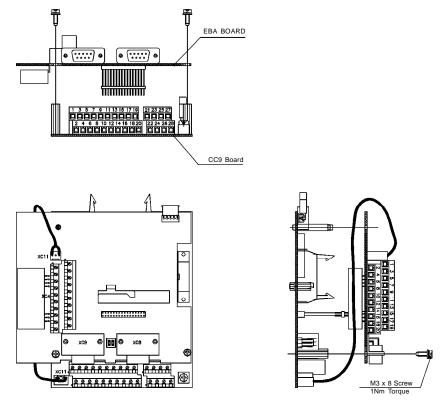


Figure 8.3 - EBA board installation procedure

Switch	Function	OFF (Standard)	ON
S2.1	Al4 – Speed reference	(0 to 10) V	(0 to 20) mA or (4 to 20) mA
S3.1	RS-485 B-LINE (+)	Without termination	With termination (120 Ω)
S3.2	RS-485 A-LINE (-)	Williout terrification	vviin termination (120 52)

**Obs.:** Both S3.1 and S3.2 switches must be set for the same option (ON or OFF). **Note:** For Size 1 models the CFI1 board (interface between the CC9 control board and the HMI) must be removed to clear access to these switches.

Table 8.2 a) - EBA board selector switches configurations

Trimpot	Function	Factory default function
RA1	AO3 – Offset	Motor Speed
RA2	AO3 – Gain	Wotor Speed
RA3	AO4 – Offset	Motor Current
RA4	AO4 – Gain	Motor Current

Table 8.2 b) - Trimpots configurations EBA board



#### NOTE!

The external signal and control wiring must be connected to XC4 (EBA), following the same recommendations as for the wiring of the control board CC9 (refer to item 3.2.6).

# 8.1.2 EBB (Expansion I/O Board B)

The EBB board can be supplied in different configurations, combining the features included. The available configurations are shown in table 8.3.

	EBA Board models - code				
Included Features	EBB.01 B1	EBB.02 B2	EBB.03 B3	EBB.04 B4*	EBB.05 B5
Differential input for incremental encoder with isolated internal 12 V power supply;	Available	Available	Not available	Available	Not available
Buffered encoder output signals: isolated input signal repeater, differential output, must use to external 5 V to 15 V power supply;	Available	Not available	Not available	Available	Not available
Analog input (Al3): 10 bits, isolated, unipolar, (0 to 10) V, (0 to 20) mA/(4 to 20) mA, programmable;	Available	Not available	Available	Available	Not available
2 Analog outputs (AO1'/AO2'): 11 bits (0.05 % of full scale), unipolar, isolated (0 to 20) mA/(4 to 20) mA, programmable;	Available	Not available	Available	Available	Available
Isolated RS-485 serial port;	Available	Not available	Not available	Available	Not available
Digital Input (DI7): isolated, programmable, 24 V;	Available	Available	Available	Available	Not available
Digital Input (DI8) for special motor thermistor function (PTC): actuation 3.9 k $\Omega$ , release 1.6 k $\Omega$ ;	Available	Available	Available	Available	Not available
2 isolated Open Collector transistor outputs (DO1/DO2): 24 V, 50 mA, programmable.	Available	Available	Available	Available	Not available

<sup>\*</sup> Board with 5 V power supply for the encoder.

Table 8.3 - EBB board versions and included features



#### NOTE!

The use of the RS-485 serial interface does not allow the use of the standard RS-232 input - they can not be used simultaneously.

The functions analogic outputs AO1' and AO2' are identical to the AO1/AO2 outputs of the control board CC9.

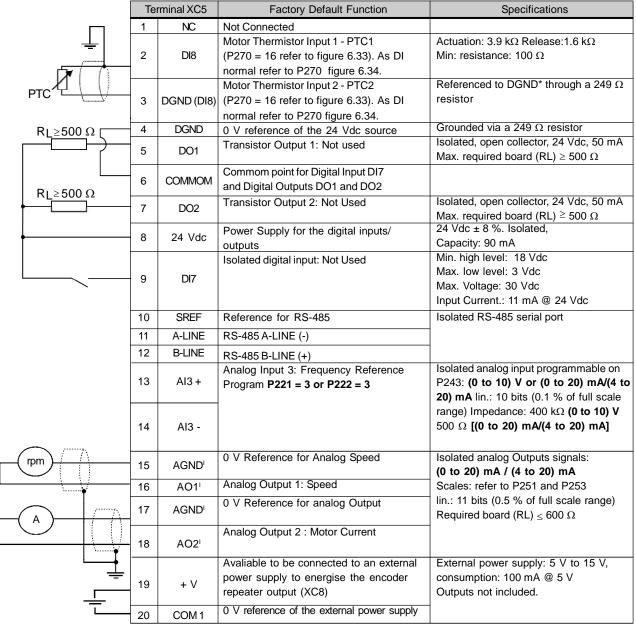


Figure 8.4 - XC5 terminal block description (complete EBB board)



#### ATTENTION!

The isolation of the analog input Al3 and the analog outputs  $AO1^1$  and  $AO2^1$  is designed only to interrupt the ground loops. Do not connect these inputs to high potentials.

# **ENCODER CONNECTION:** Refer to item 8.2. **INSTALLATION**

The EBB board is installed on the CC9 control board, secured with spacers and connected via Terminal blocks XC11 (24 V) and XC3.



### NOTE!

For the CFW-09 Size 1 Models ( $6\,A$ ,  $7\,A$ ,  $10\,A$  and  $13\,A/220-230\,V$  and  $3.6\,A$ ,  $4\,A$ ,  $5.5\,A$  and  $9\,A/380-480\,V$ ) the plastic cover must be removed to install the EBB board.

#### **Mounting Instructions:**

- 1. Set the board configuration via S4, S5, S6 and S7 dip switches (refer to table 8.4 a) );
- 2. Carefully insert terminal block XC3 (EBB) into the female connector XC3 of the CC9 control board. Check that all pins fit in the XC3 connector;
- 3. Press on the EBB board (near XC3) and on the left top edge until complete insertion of the connector and plastic spacer;
- 4. Secure the board to the metallic spacers with the screws provided;
- 5. Plug XC11 connector of the EBB board to the XC11 connector of the (CC9) control board.

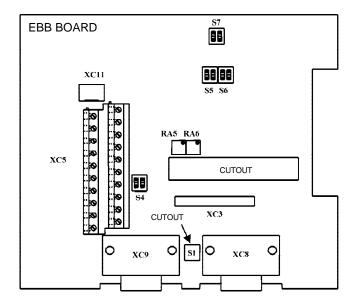


Figure 8.5 - EBB board layout

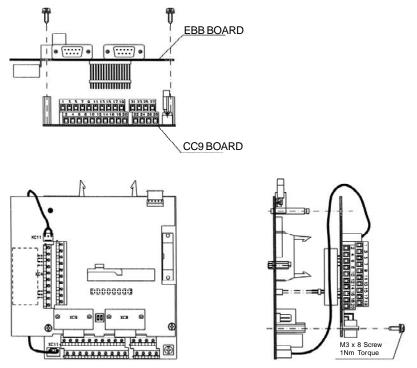


Figure 8.6 - EBB board installation procedure

Switch	Function	OFF	ON	
S4.1	Al3 – Speed reference	(0 to 10) V*	(0 to 20) mA or (4 to 20) mA	
S5.1 and S5.2	AO1 - Speed	(0 to 20) mA**	(4 to 20) mA*	
S6.1 and S6.2	AO2 – Motor Current	(0 to 20) IIIA	(4 to 20) IIIA	
S7.1 and S7.2	RS-485 B-Line (+)	Without termination*	With tormination (120.0)	
37.1 and 37.2	RS-485 A-Line (-)	Williout tellilliation	With termination (120 Ω)	

<sup>\*</sup>Factory default

**Obs.:** Each group of switches must be set for the same option (ON or OFF for both).

Ex.: S6.1 and 6.2 = ON.

When the outputs are set to (0 to 20) mA, it may be necessary to readjust the full scale.

**Note:** For Size 1 models the CFI1 board (interface between the CC9 control board and the HMI) must be removed to clear access to these switches.

Table 8.4 a) - EBB board selector switches configurations

Trimpot	Function	Factory default function
RA5	AO1 – Full scale adjustment	Motor Speed
RA6	AO2 – Full scale adjustment	Motor Current

Table 8.4 b) - Trimpots configurations EBB board



## NOTE!

The external signal and control wiring must be connected to XC (EBB), following the same recommendations as for the wiring of the control board CC9 (refer to item 3.2.6).

# 8.1.3 EBE

Please download from www.weg.net the EBE Board Quick Guide.

# 8.2 INCREMENTAL ENCODER

For applications that require high-speed accuracy, the actual motor speed must be fed back via motor-mounted incremental encoder. The encoder is connected electrically to the inverter through the XC9 (DB9) connector of the Function Expansion Board - EBA or EBB and XC9 or XC10 to EBC.

## 8.2.1 EBA/EBB Boards

When the board EBA or EBB is used, the selected encoder should have the following characteristics:

- ☑ Power supply voltage: 12 Vdc, less than 200 mA current draw;
- ☑ 2 quadrature channels (90°) + zero pulse with complementary outputs (differential): signals A,  $\overline{A}$ , B,  $\overline{B}$ , Z and  $\overline{Z}$ ;
- ☑ "Linedriver" or "Push-Pull" output circuit type (level 12 V);
- ☑ Electronic circuit isolated from encoder frame;
- ☑ Recommended number of pulses per revolution: 1024 ppr.

For mounting the encoder on the motor, follow the recommendations bellow:

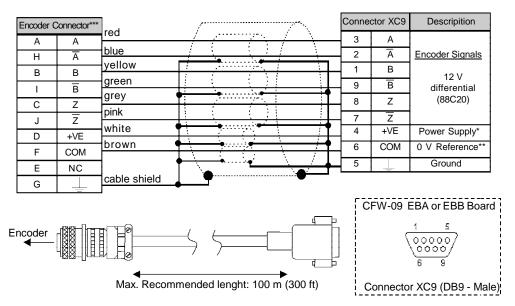
- ✓ Couple the encoder directly to the motor shaft (use a flexible coupling without torsional flexibility);
- ☑ Both the shaft and the metallic frame of the encoder must be electrically isolated from the motor (min. Spacing: 3 mm (0.119 in));
- ☑ Use high quality flexible couplings to prevent mechanical oscillation or backlash.

The electrical connections must be made with shielded cable, maintaining a minimum distance of about 25 cm (10 in) from other wires (power, control cables, etc.). If possible, install the encoder cable in a metallic conduit.

<sup>\*\*</sup>Factory default

At start-up, program Parameter **P202** – Type of Control = 4 (Vector with Encoder) to operate the motor with incremental encoder speed feedback. For more details about Vector Control operation refer to chapter 5.

The Expanded I/O Boards EBA and EBB are provided with externally powered, isolated encoder output signals.



- \* Power supply voltage 12 Vdc / 220 mA for encoder.
- \*\* Referenced to ground via 1  $\mu F$  in parallel with 1  $k\Omega$ .
- \*\*\* Valid pin position with encoder HS35B models from Dynapar. For other encoder modules, check the correct connection to meet the required sequence.

Figure 8.7 - Encoder cable



## NOTE!

The max. permitted encoder frequency is 100 kHz.

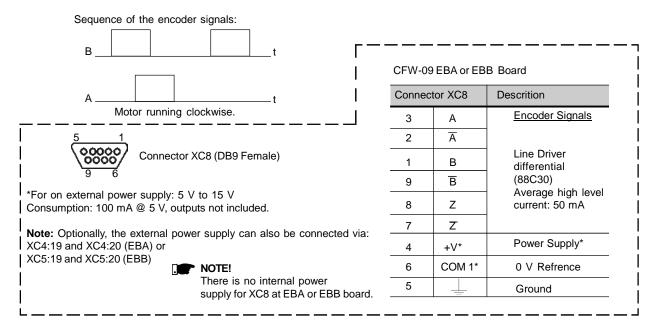


Figure 8.8 - Encoder signals repeater output

# 8.2.2 EBC1 Board

When the board EBC1 is used, the selected encoder should have the following characteristics:

- ☑ Power Supply Voltage: 5 V to 15 V;
- ✓ 2 quadrature channels (90°) with complementary outputs (differential):
  - Signals A,  $\overline{A}$ , B and  $\overline{B}$ ;
  - "Linedriver" or "Push-Pull" output circuit type (with identical level as the power supply voltage).
- ☑ Electronic circuit isolated from the encoder frame:
- ☑ Recommended number of pulse per revolution: 1024 ppr.

# INSTALLATION OF THE EBC BOARD

The EBC board is installed directly on the control board CC9, fixed by means of spacers and connected through the XC3 connector.



#### NOTE!

For installation in the models of size 1, remove the lateral plastic cover of the product.

# Mounting instructions:

- 1. Insert carefully the pins of the connector XC3 (EBC1) into the female connector XC3 of the control board CC9. Check if all pins of the connector XC3 fit exactly;
- 2. Press on the board center (near to XC3) until the connector is inserted completely;
- 3. Fix the board to the 2 metallic spacers by means of the 2 bolts.

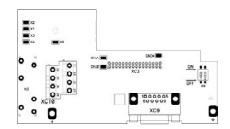


Figure 8.9 - EBC board layout

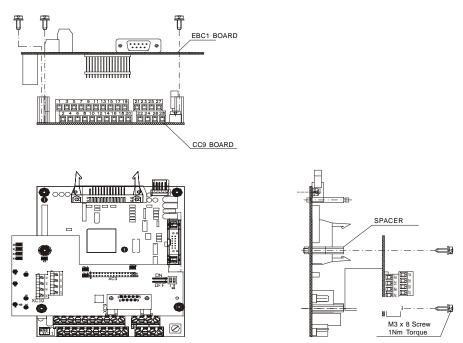


Figure 8.10 - EBC1 board installation procedures

### **CONFIGURATIONS**

Expansion	Power	Encoder	Customer
Board	Supply	Voltage	Action
EBC1.01	External 5 V	5 V	Commutate switch S8 to ON, refer
			to figure 8.9
	External 8 to 15 V	8 to 15 V	None
EBC1.02	Internal 5 V	5 V	None
EBC1.03	Internal 12 V	12 V	None

Table 8.5 - EBC1 board configuration



# NOTE!

The terminals XC10:22 and XC10:23 (refer to figure 8.9), should be used only for encoder supply, when encoder power supply is not coming from DB9 connection.

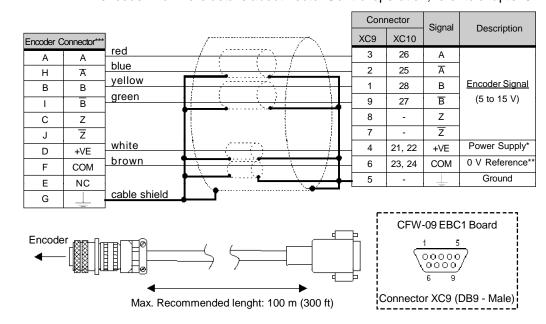
### MOUNTING OF THE ENCODER

For mounting the encoder on the motor, follow the recommendations below:

- ✓ Couple the encoder directly to the motor shaft (use a flexible coupling without torsional flexibility);
- Both the shaft and the metallic frame of the encoder must be electrically isolated from the motor. (min. spacing: 3 mm (0.119 in));
- ☑ Use high quality flexible couplings to prevent mechanical oscillation or backlash.

The electrical connection must be made with shielded cable, maintaining a minimum distance of about 254 mm (10 in) from other wiring (power, control cables, etc.). If possible, install the encoder cable in a metallic conduit.

At start-up, program Parameter **P202** - type of control - = 4 (vector with encoder) to operate the motor with speed feedback through incremental encoder. For more details about Vector Control operation, refer to chapter 5.



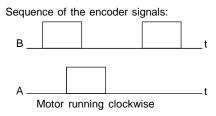
- \* External Power Supply Voltage for encoder: 5 to 15 Vdc, consumption = 40 mA plus consumption of the encoder.
- \*\* 0 V reference of the Power Supply Voltage.
- \*\*\* Valid pin position with encoder HS35B models from Dynapar. For other encoder models, check the correct connection to meet the required sequence.

Figure 8.11 - EBC1 encoder input



# NOTE!

The maximum permitted encoder frequency is 100 kHz.



# 8.3 KEYPAD WITH LEDs ONLY

The CFW-09 standard Keypad (HMI) is provided with LEDs and LCD display. It can also be supplied with an LED Display only.

In this case the keypad model number is: HMI-CFW-09-LED. It operates in the same way as the standard keypad, but it does not show the text messages of the LCD and does not provide the copy function.

The dimensions and the electrical connections are the same as for the standard keypad. Refer to item 8.4.

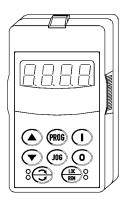


Figure 8.12 - Keypad with LED display only

# 8.4 REMOTE KEYPAD AND CABLES

The CFW-09 keypad (both the standard or the LED display only) can be installed directly on the inverter cover or remotely. If the keypad is installed remotely, the HMI-09 Frame can be used. The use of this frame improves the visual aspect of the remote keypad, as well as provides a local power supply to eliminate voltage drop problems with long cables. It is necessary to use the **frame** when the keypad cable is longer than 5 m (15 ft).

The table below shows the standard cable lengths and their part numbers:

Cable Length	WEG Part N°
1 m (3 ft)	0307.6890
2 m (6 ft )	0307.6881
3 m (10 ft)	0307.6873
5 m (15 ft)	0307.6865
7.5 m *(22 ft)	0307.6857
10 m * (30 ft )	0307.6849

<sup>\*</sup> These cables require the use of the remote HMI-09 frame

Table 8.6 - CFW-09 keypad cables

The keypad cable must be installed separately from the power cables, following the same recommendations as for the CC9 control board (refer to item 3.2.6). For assembling refer to details in figure 8.13 and 8.14.







Figure 8.13 - Standard HMI, remote HMI frame kit and HMI CFW09 – LCD N4 for panel installation

To meet NEMA 250 and IEC 60529 the HMI can be supplied with two specific degrees of protection:

a) Dimensions of the HMI – CFW09 – LED/LCD with NEMA 5-IP51 degree of protection.

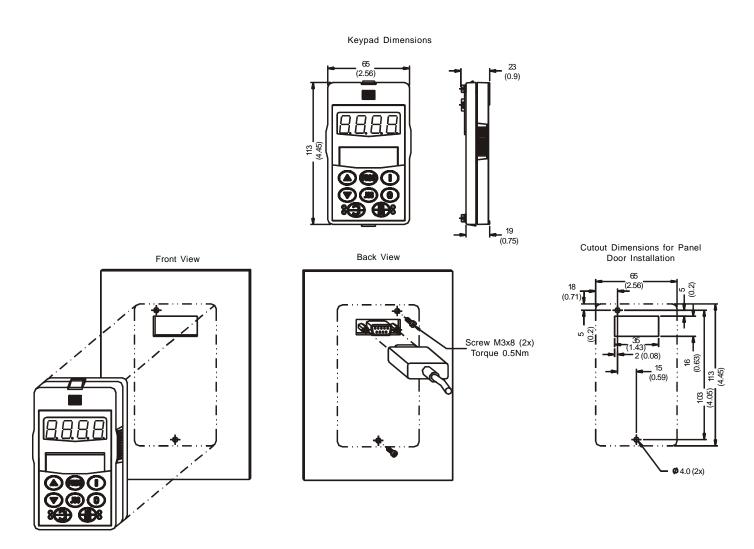
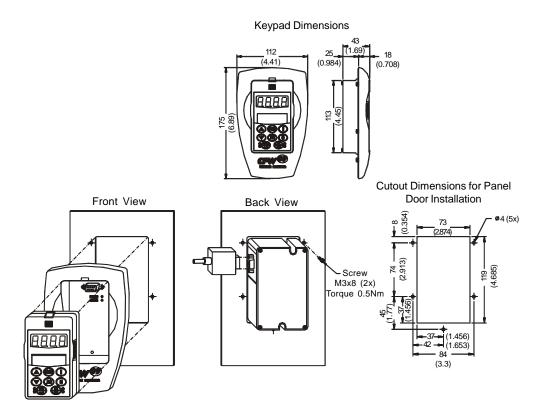


Figure 8.14 a) - Keypad dimensions in mm (inch) and mounting procedures

b) Dimensions of the HMI – CFW09 – LED/LCD + remote HMI frame kit with NEMA5-IP51 degree of protection.



c) Dimensions of the HMI – CFW09 – LED/LCD-N4 with NEMA 4-IP56 degree of protection.

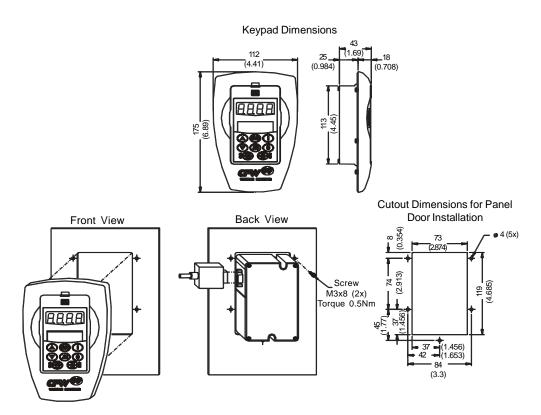


Figure 8.14 b) and c) - Keypad dimensions in mm (inch) and mounting procedures

# Remote HMI connection for distances lower than 10 m (30 ft):

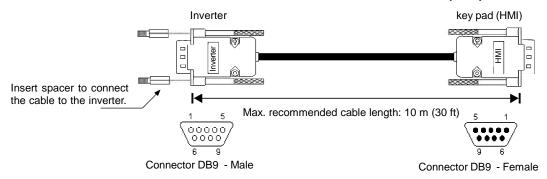


Figure 8.15 - Cable for remote keypad connection ≤ 10 m

CABLE CONNECTION 5 m ≤ (15 ft)						
Connector Pin/ Inverter Side	Connector Pin/ HMI Side	Signal				
1	1	+5 V				
2	2	Rx				
3	3	Tx				
4	4	GND				
8	8	+15 V				
9	9	SHIELD				

Note: The frame can be used or not.

**Table 8.7** - Connections for remote keypad cable up to 5 m (15 ft)

CABLE CONNECTION > 5 m (> 15 ft)						
Connector Pin/	Connector Pin/	Signal				
Inverter Side	HMI Side	- 3				
2	2	Rx				
3	3	Tx				
4	4	GND				
8	8	+15 V				
9	9	SHIELD				

Note: The frame must be used.

**Table 8.8** - Connections for remote keypad cable from 7.5 m (22 ft) to 10 m (30 ft)

# Remote HMI connection for distances higher than 10 m (30 ft):

The HMI can be connected to the inverter using a cable length up to 200 m (600 ft). It is necessary to use an external power supply of 15 Vdc, according to figure 8.16.

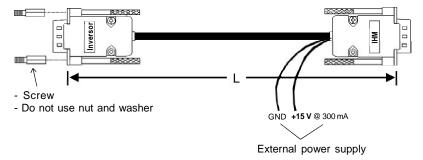


Figure 8.16 - Cable for remote keypad connection > 10 m

CABLE CONNECTION					
Connector Pin/	Connector Pin/	Signal			
Inverter Side	HMI Side	Olgridi			
2	2	Rx			
3	3	Tx			
-	4	GND			
-	8 (Ext. power supply)	+15 V			
9	9 (Ext. power supply)	Shield			

**Table 8.9 -** Pin connection (DB9) for cable > 10 m (32.80 ft ) and  $\leq$  200 m (656 ft)

## 8.5 BLANK COVERS

As shown in figure 8.17, two types of blank covers are available to be used, in the inverter or in the frame, when the keypad is not in place.

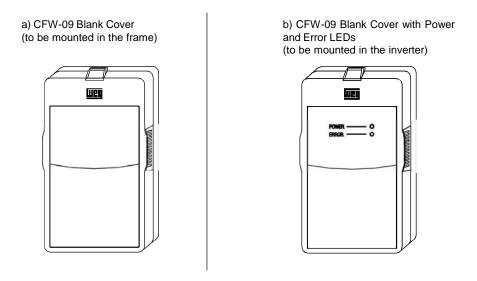


Figure 8.17 a) and b) - CFW-09 blank covers

# 8.6 RS-232 PC COMMUNICATION KIT

The CFW-09 can be controlled, programmed and monitored via an RS-232 Serial Interface. The communication protocol is based on question/response telegrams according to ISO 1745 and ISO 646 standards, with ASCII characters exchanged between the inverter and a master (network controller, which can be a PLC, PC, etc.). The maximum transfer rate is 9600 bps. The RS-232 serial interface is not galvanically isolated from the 0 V reference of the inverter electronics, therefore the maximum recommended serial cable length is 10 m (30 ft).

To implement the serial communication, an RS-232 SERIAL INTERFACE module has to be added to the CFW-09. This module is installed in place of the Keypad, making the RS-232 connection (RJ11 connector) available. If the use of the HMI is also required, the RS-232 module also provides its connection.

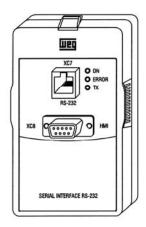


Figure 8.18 - RS-232 module

The RS-232 PC Communication Kit which allows the connection of the CFW-09 to a PC via the RS-232 interface is composed of:

- ☑ RS-232 Serial Interface Module;
- ☑ 3 m (10 ft) Cable for RJ-11 to DB9 connection;
- ☑ SuperDrive Software for Windows for CFW-09 programming, operation and monitoring. Refer to hardware and system needs for SuperDrive.

To install the RS-232 PC communication kit, proceed as follows:

- ☑ Remove the keypad (HMI) from the inverter;
- ✓ Install RS-232 Serial Interface Module in place of the keypad;
- ✓ Install the SuperDrive software in the PC. Consult the on-line help or installation guide;
- ☑ Use the cable to connect the inverter to the PC;
- ☑ Follow the SuperDrive software instructions. Consult the on-line help or installation guide.

# 8.7 LINE REACTOR / DC BUS CHOKE

Due to the input circuit characteristic, common to all passive front end inverters available in the market, which consists of a six diode rectifier and capacitor bank, the input current (drained from the power supply line) of inverters is non sinusoidal and contains harmonics of the fundamental frequency.

These harmonic currents circulate through the power supply line, causing harmonic voltage drops which distort the power supply voltage of the inverter and other loads connected to this line. These harmonic current and voltage distortions may increase the electrical losses in the installation, overheating components (cables, transformers, capacitor banks, motors, etc.), as well as a lowering power factor.

The harmonic input currents depend on the impedance values that are present in the rectifier input/output circuit. The addition of a line reactor and/or DC bus choke reduces the current harmonic content, providing the following advantages:

- ✓ Increased input power factor;
- ☑ Reduced RMS input current;
- ☑ Reduced power supply voltage distortion;
- ☑ Increased life of the DC Link capacitors.

The Line Reactor and the DC Bus Choke, when properly sized, have practically the same efficiency in reducing the harmonic currents. The DC Bus Choke has the advantage of not introducing a motor voltage drop, while the Line Reactor is more efficient to attenuate power supply voltage transients.

DC Link Inductor equivalent to the line reactor is:

$$L_{\text{DC-EQUIVALENT}} = L_{\text{AC}} \times \sqrt{3}$$



# NOTE!

The 44 A to 79 A/500-600 V, 107 A to 472 A/500-690 V and 100 A to 428 A/660-690 V models have a DC Link inductor built in the standard version. It is not necessary to have minimum supply impedance or add external line inductors for protecting these models.

# 8.7.1 Application Criteria

The line reactor or the DC Link Inductor shall be applied when required impedance is insufficient for limiting the input current peaks, thus preventing damages to the CFW-09. The minimum required impedances, expressed as impedance drop in percent are following:

- a) For the model with rated current  $\leq$  130 A/220-230 V,  $\leq$  142 A/380-480 V or  $\leq$  32 A/500-600 V: drop of 1 % for the line voltage;
- b) For the model with rated current ≥ 180 A/380-480 V : drop of 2 % for the line voltage;
- c) For models with rated current ≥ 44 A/500-600 V or ≥ 107 A/500-690 V or ≥ 100 A/660-690 V: there is no requirement for the minimum required line impedance for the CFW-09 protection. These impedances are ensured by the internal existing DC choke. The same is applicable when DC Link inductor is incorporated into the product (Special Hardware Code HC or HV), in the models with currents ≥ 16 A/220-230 V or ≥ 13 A/380-480 V and ≤ 240 A/380-480 V.

As an **alternative criteria**, a line reactor should be added when the inverter supply transformer has a rated power higher than indicated below:

volts Power [kVA]  6 A to 28 A/220-230 V  3.6 A to 24 A/380-480 V  2.9 A to 14 A/500-600 V  45 A to 130 A/220-230 V  30 A to 142 A/380-480 V  22 A to 32 A/500-600 V	CFW-09 Rated Current/	Transformer
3.6 A to 24 A/380-480 V 2.9 A to 14 A/500-600 V 45 A to 130 A/220-230 V 30 A to 142 A/380-480 V 5 X Inverter Rated Power 22 A to 32 A/500-600 V	volts	Power [kVA]
2.9 A to 14 A/500-600 V 45 A to 130 A/220-230 V 30 A to 142 A/380-480 V 22 A to 32 A/500-600 V	6 A to 28 A/220-230 V	
45 A to 130 A/220-230 V 30 A to 142 A/380-480 V 22 A to 32 A/500-600 V 5 X Inverter Rated Power	3.6 A to 24 A/380-480 V	125
30 A to 142 A/380-480 V 5 X Inverter Rated Power 22 A to 32 A/500-600 V	2.9 A to 14 A/500-600 V	
22 A to 32 A/500-600 V	45 A to 130 A/220-230 V	
	30 A to 142 A/380-480 V	5 X Inverter Rated Power
400 A 1 - 000 A /000 400 V	22 A to 32 A/500-600 V	
180 A to 600 A/380-480 V	180 A to 600 A/380-480 V	2 X Inverter Rated Power

Table 8.10 - Line reactor usage criteria

☑ To determine the line reactor needed to obtain the desired voltage drop, use equation below:

$$L = \frac{\text{Voltage Drop [\%] x Line Voltage [V]}}{\sqrt{3} \text{ x } 2\pi \text{ Line Freq [}Hz\text{] x Rated Cur.[A]}}$$
 [H]

The electrical installation of an input line reactor is shown on figure 8.19 a). For CFW-09 sizes above 16 A/220-230 V or 13 A/380-480 V, the connection of a DC Bus Choke is possible. The DC bus choke connection is also possible in all 2.9 A to 32 A/500-600 V models. Figure 8.19 b) shows this connection.

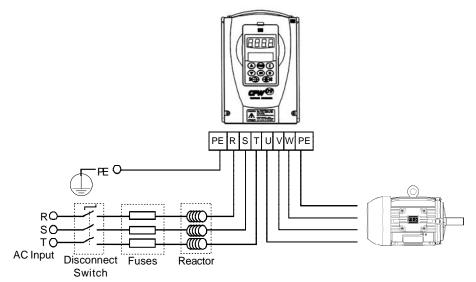


Figure 8.19 a) - Line reactor connection

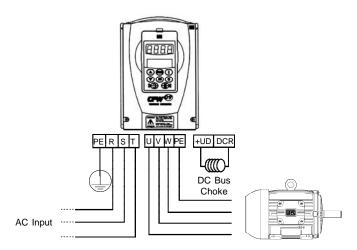


Figure 8.19 b) - DC bus choke connection

# 8.7.2 DC Link Inductor Built in

The following CFW-09 inverter models, can be fitted with an inductor at the DC Link already incorporated into the product:

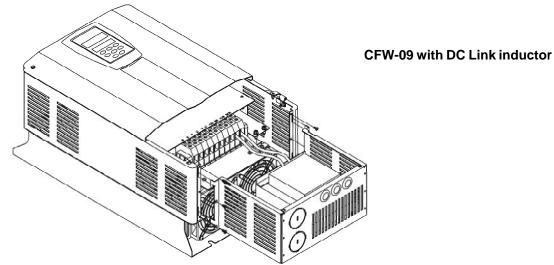
Models  $\geq$  16 A/220-230 V, Models  $\geq$  13 A/380-480 V and Models  $\leq$  240 A/380-480 V.

To request the inverter with an inductor already assembled, please add the code "HC" (for inverter operating at constant torque) or "HV" (for inverter operating with variable torque) in the model CFW-09, in the option field "Special Hardware" (refer to item 2.4).

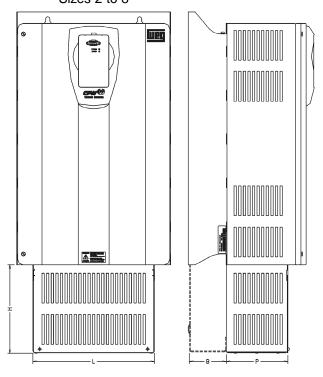


# NOTE!

Remember that the operation at higher currents than the rated current in variable Torque mode is not possible with all inverter types (refer to items 9.1.2 and 9.1.3). Thus the HV option is only possible with the types that can be operated in that situation.



Sizes 2 to 8



## Dimensions mm (inch)

Model	L	Н	Р	В
Size 2	160	120	105.5	-
	(6.30)	(4.72)	(4.15)	
Size 3	153	137	134	-
	(6.02)	(5.39)	(5.27)	
Size 4	180	172	134	-
	(7.08)	(6.77)	(5.27)	
Size 5	265	193.5	134	-
	(10.43)	(7.57)	(5.27)	
Size 6-7	265	212.5	159	-
	(10.43)	(8.36)	(6.25)	
Size 8	325	240	221.5	80.5
	(12.79)	(9.44)	(8.72)	(3.16)

**Table 8.11** - CFW-09 with DC Link inductor dimensions

## 8.8 LOAD REACTOR

The use of a three-phase load reactor, with an approximate 2 % voltage drop decreases the dv/dt (voltage rising rate) of the PWM pulses commonly generated at the inverter output of any AC frequency converter.

This practice reduces the voltage spikes on the motor windings and leakage currents that may be generated when long distance cables between inverter and motor are used.

There are many factors that influence the peak level (Vp) and rise time (tr) of voltage spikes: Cable type, cable length, motor size, switching frequency and other variables all affect Vp and dv/dt.

WEG, as specialists in both VSDs and motors are able to provide an integrated solution. The load reactor value is calculated in the same way as the line reactor (refer to item 8.7.1).

If the cables between inverter and motor are longer than 100 m (300 ft), the cable capacitance to ground may cause nuisance overcurrent (E00) or ground fault (E11) trips. In this case it is also recommended to use a load reactor.

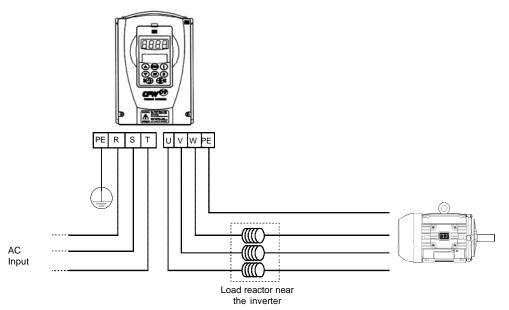


Figure 8.20 - Load reactor connection

## 8.9 RFI FILTER

The installation of frequency inverters requires certain care in order to prevent electromagnetic interference (EMI). This interference may disturb the operation of the inverter itself or other devices, such as, electronic sensors, PLCs, transducers, radio equipment, etc.

To avoid these problems, follow the installation instructions contained in this Manual. Never install electromagnetic noise generating circuits such as input power and motor cables near analog signal or control cables.

Care should also be taken with the radiated interference, by shielding the cables and circuits that tend to emit electromagnetic waves and cause interference.

The electromagnetic interference can also be transmitted through the power supply line. This type of interference is minimized in the most cases by capacitive Radio Frequency Filters (common and differential mode) which are already installed inside the CFW-09. However, when inverters are installed in residential areas, the installation of an external additional filter may be required. In this case contact WEG to select the most suitable filter type.

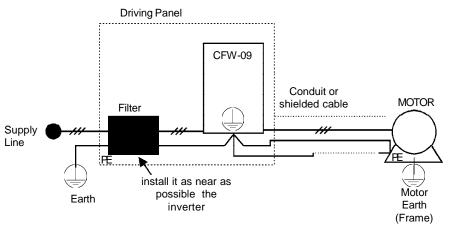


Figure 8.21 - RFI filter connection

# Instructions for the RFI filter installation:

- ☑ Install the inverter and the filter on a metallic grounded plate as near to each other as possible and ensure a good electrical contact between the grounded plate and the inverter and filter frames;
- ☑ If the cable between inverter and filter is longer than 30 cm (12 in), use a shielded cable and ground each shield end on the grounded mounting plate.



### NOTE!

Installations that must meet the European standards, refer to item 3.3.

## 8.10 DYNAMIC BRAKING

The amount of braking torque that can be generated when a motor is controlled by an inverter, without dynamic braking or any other braking schemes, varies from 10 % to 35 % of the motor rated torque.

During the deceleration process, the kinetic energy of the load is regenerated into the inverter's DC Link. This energy loads up the capacitors increasing the DC Link voltage. When this energy is not fully dissipated, it may generate a DC Link overvoltage trip (E01).

To obtain higher braking torque, the use of Dynamic Braking, where the excess regenerated energy is dissipated in an external resistor, is recommended.

The Dynamic Braking is used in cases where short braking times are required or where high inertia loads are driven.

For Vector Control Modes the "Optimal Braking" feature can be used and in many cases eliminate the need for Dynamic Braking. Refer to chapter 6, Parameter **P151**.



## NOTE!

If dynamic braking will be used, set P151 to its maximum value.

# 8.10.1 DB Resistor Sizing

For a precise sizing of the dynamic braking resistor, application data, such as: deceleration time, load inertia and braking duty cycle must be considered.

The RMS current capacity of the inverter's dynamic braking transistor must also be taken into account, as well as its maximum peak current, which defines the minimum resistance value (ohms) of the braking resistor. Refer to table 8.12.

The DC Link voltage level at which dynamic braking is activated is defined by the Parameter **P153** – Dynamic Brake Level.

The braking resistor is defined according to the deceleration time, load inertia and resistive torque. In most cases a resistor with an ohmic value indicated on table 8.12 and a power rating of 20 % of the driven motor can be used.

Use Wire type resistors with suitable insulation to withstand the instantaneous current peaks.

For critical applications with very short braking times, high inertia loads (Excentrifuges) or with very short and frequent duty cycles, contact WEG, to define the most suitable resistor.

CFW-09 M	odel	Maximum	P <sub>max</sub>	RMS Braking	P <sub>rated</sub>	Minimum	Power Wiring
Power Supply Voltage [V]	Rated Current [A]	Braking Current [A] (1)	[kW] <sup>(3)</sup>	Current [A] (2)	[kW] <sup>(3)</sup>	recommended resistor [ohms]	(BR, -UD, +UD) mm² - AWG
	6	10	3.9	5	0.97	39	2.5 - 14
	7 and 10	15	6.1	7	1.3	27	2.5 - 14
	13 and 16	20	8.8	10	2.2	22	4.0 - 12
	24	26	10.1	13	2.5	15	6.0 - 10
220 220	28	38	14.4	18	3.2	10	10 - 8
220-230	45	45	17.4	22	4.2	8.6	10 - 8
	54	95	42.4	48	10.8	4.7	35 - 3
	70 and 86	120	47.5	60	11.9	3.3	50 - 1
	105 and 130	180	71.3	90	17.8	2.2	95 - 3/0
	3.6 and 4	6	3.6	3.5	1.2	100	2.5 - 14
	5.5	8	5.5	4	1.4	86	2.5 - 14
	9 and 13	16	10.0	10	3.9	39	4.0 - 12
	16	24	15.6	14	5.3	27	6.0 - 10
380	24	34	20.8	21	7.9	18	10 - 8
and	30	48	34.6	27	10.9	15	10 - 8
400-415	38 and 45	78	52.3	39	13.1	8.6	25 - 4
	60 and 70	120	80.6	60	20.1	5.6	50 - 1
	86 and 105	180	126.4	90	31.6	3.9	95 - 3/0
	142	250	168.8	125	42.2	2.7	120 - 4/0
	3.6 and 4	6	4.3	3.5	1.5	120	2.5 - 14
	5.5	8	6.4	4	1.6	100	2.5 - 14
	9 and 13	16	12.0	10	4.7	47	4.0 - 12
	16	24	19.0	14	6.5	33	6.0 - 10
440-460	24	34	25.4	21	9.7	22	10 - 8
and	30	48	41.5	27	13.1	18	10 - 8
480	38 and 45	78	60.8	39	15.2	10	25 - 4
	60 and 70	120	97.9	60	24.5	6.8	50 - 1
	86 and 105	180	152.3	90	38.1	4.7	95 - 3/0
	142	250	206.3	125	51.6	3.3	120 - 4/0
	2.9 and 4.2	8.33	12	4.2	2.08	120	2.5 - 14
	7	10	10	5	2.5	100	2.5 - 14
	10	12.2	12.81	6.1	3.05	82	2.5 - 14
500-525	12	14.71	20.83	7.4	3.68	68	4.0 - 12
and	14	14.71	15.3	7.4	3.68	68	2.5 - 14
575-600	22, 27 and 32	66.67	337.5	33.33	16.67	15	95 - 3/0
	44 and 53	100	225	50	25	10	95 - 3/0
	63 and 79	121.95	184.5	61	30.49	8.2	95 - 3/0

Table 8.12 - Recommended braking resistor

8.10.2 Installation

- (1) The maximum current can be determined by: I<sub>max</sub> = Value set at P153 [V] / Resistor Ohms
- (2) The RMS braking current can be calculated by

$$I_{rms} = I_{max} \cdot \sqrt{\frac{t_{br}^{[min]}}{5}}$$
 Where  $t_{br}$  corresponds to the sum of the braking

times during the most severe 5 minute cycle.

- (3) P<sub>max</sub> and P<sub>rated</sub> are the maximum peak and rated powers that the braking chopper can deliver. The resistor power must be sized according to the application braking duty cycle.
- Connect the braking resistor between the +UD and BR power terminals (refer to item 3.2.1);
- Make this connection with a twisted pair. Run this cable separately from any signal or control wire;
- Size the cable cross section according to the application, considering the maximum and RMS current;
- ☑ If the braking resistor is installed inside the inverter panel, consider the heat dissipated by the resistor when defining the panel ventilation;
- ☑ Set Parameter P154 to the Ohms value of the DB resistor and Parameter P155 to the resistor power rating in kW.



## **DANGER!**

The CFW-09 provides an electronic thermal protection for the braking resistor to avoid overheating. The braking resistor and the transistor can be damaged if:

- ☑ They are not properly sized;
- ☑ Parameters P153, P154 and P155 are not properly set;
- ☑ The line voltage exceeds the maximum allowed value.

The electronic thermal protection provided by the inverter, if properly programmed, protects the DB resistor in case of overloads not expected during normal operation, but it does not ensure protection in case of a dynamic braking circuit failure.

In this case the only guaranteed method to avoid burning the resistor and eliminate risk of fire is the installation of a thermal overload relay in series with the resistor and/or the installation of a thermostat on the resistor body, wiring it in a way to disconnect the inverter power supply is case of overheating, as shown below:

CFW-09

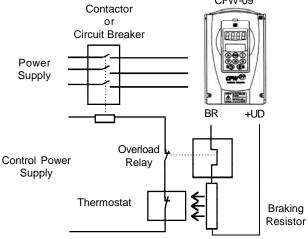


Figure 8.22 - Braking resistor connection



## NOTE!

Through the power contacts of the bimetallic overload relay circulates Direct Current during the DC-Braking process.

# 8.10.3 Dynamic Braking module - DBW-01 and DBW-02

In the CFW-09 220-230 V or 380-480 V types with currents higher or equal to 180 A, dynamic braking uses the DBW-01 external braking module. For 500-690 V and 660-690 V with currents higher or equal 100 A, dynamic braking uses the DBW-02 external braking module.

Supply Voltage [V]	Inverter Types	Braking Module	Max. Braking Current A <sup>(1)</sup>	RMS Braking Current A <sup>(2)</sup>	Minimum Resistor Ω <sup>(3)</sup>	Power Wiring (BR, -UD, +UD) mm² (AWG)
	180 A	DBW010165D21802SZ	200	165	4	70 (2/0)
	211 A	DBW010240D21802SZ	320	240	2.5	120 (250 MCM)
	240 A	DBW010240D21802SZ	320	240	2.5	120 (250 MCM)
000 400 1/	312 A	DBW010300D21802SZ	400	300	2	2 x 50 (2 x 1/0)
380-480 V	361 A	DBW010300D21802SZ	400	300	2	2 x 50 (2 x 1/0)
	450 A	DBW010300D21802SZ	400	300	2	2 x 50 (2 x 1/0)
	515 A	DBW010300D21802SZ	400	300	2	2 x 50 (2 x 1/0)
	600 A	DBW010300D21802SZ	400	300	2	2 x 50 (2 x 1/0)
	100 A/107 A	DBW020210D5069SZ	250	210	4.8	120( 250 MCM)
	127 A/147 A	DBW020210D5069SZ	250	210	4.8	120 (250 MCM)
500-690 V /	179 A/211 A	DBW020210D5069SZ	250	210	4.8	120 (250 MCM)
660-690 V	225 A/247 A	DBW020210D5069SZ	250	210	4.8	120 (250 MCM)
	259 A/315 A	DBW020300D5069SZ	400	300	3	2 x 50 (2 x 1/0)
	305 A/343 A	DBW020300D5069SZ	400	300	3	2 x 50 (2 x 1/0)
	340 A/418 A	DBW020380D5069SZ	500	380	2.5	2 x 120 (2 x 250 MCM)
	428 A/472 A	DBW020380D5069SZ	500	380	2.5	2 x 120 (2 x 250 MCM)

Table 8.13 - Inverter and corresponding DBW

(1)The maximum current can be calculated by:
I<sub>max</sub> = set value at P153 [V]/value of the resistor [ohms].

(2) The rms braking current can be calculated by:

$$I_{rms} = I_{max} \cdot \sqrt{\frac{t_{br}^{[min]}}{5}}$$
 where  $t_{br}$  corresponds to the sum of the braking

actuation times during the most severe 5-minute cycle.

- (3) The minimum resistor value of each shown model has been calculated so the braking current does not exceed the maximum current specified in table 8.13. For this, following parameters have been considered
  - DBW-01: rated line voltage = 480 V.
  - DBW-02: rated line voltage = 690 V.
  - Factory Standard Value of P153.

# **HOW TO SPECIFY THE DBW TYPE:**

DBW-01	0165	D	2180	1	S	Z
WEG Braking Module: DBW-01	Rated Output Current: 220 to 480 V: 0165 = 165 A 0240 = 240 A 0300 = 300 A	DC Supply at Input	Input Supply Voltage: 2180 = 210 to 800 Vdc	Fan Supply Voltage: 1 = 110 Vrms 2 = 220 Vrms	Standard	Code End
DBW-02	0210 = 210 A 0380 = 380 A		5069 = 500 to 1200 Vdc			

# 8.10.3.1 DBW-01 and DBW-02 Identification Label



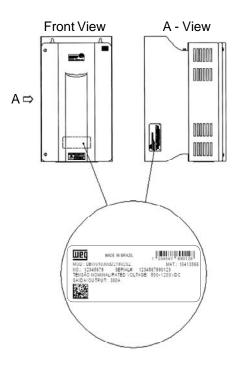


Figure 8.23 - Identification label

# 8.10.3.2 Mechanical Installation

The environmental operating conditions of the DBW are the same as of the CFW-09 inverter (refer to item 3.1.1).

For panel installation, provide an additional airflow of 120 CFM (57 L/s) for cooling of the braking module.

When installing module, provide free spaces around the module, as shown in figure 8.24, where A = 100 mm (4 in), B = 40 mm (1.57 in) and C = 130 mm (5.12 in).

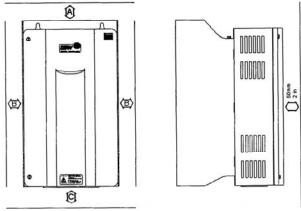


Figure 8.24 - Free spaces for cooling

Check the other recommendations for the CFW-09 inverter installation, since from the mechanical viewpoint, the module is compatible with CFW-09 frame size 3.

External dimensions and mounting holes are according to figure 8.25.

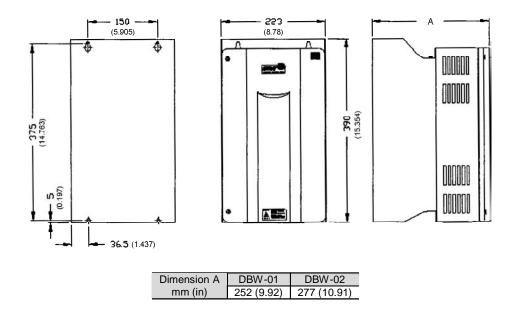


Figure 8.25 - Dimensional drawing of DBW-01 and DBW-02 - mm (inch)

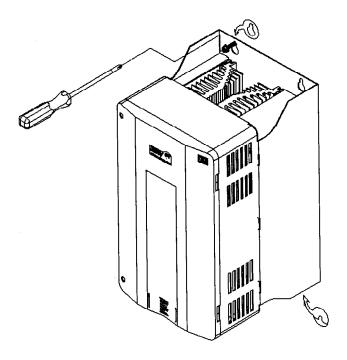


Figure 8.26 - Installation procedures for the DBW-01 and DBW-02 on surface

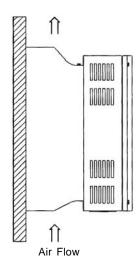


Figure 8.27 - DBW-01 and DBW-02 positioning

The DBW-01 and DBW-02 can also be installed with a through surface mounting kit as described in item 8.11. In this case, use the available installation kit, which contains the respective installation supports. Figure 8.28 shows the mounting cutouts.

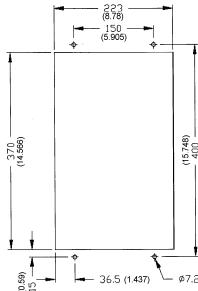


Figure 8.28 - Cutout dimensions in air duct - Dimensions mm (inch)

Table 8.14 shows the weights of the different DBW-01 types.

Туре	Fastening Screw	Weight (Kg)	Degree of Protection
DBW-01 165		14.2	
DBW-01 240		13.8	
DBW-01 300		13.4	IP20
DBW-02 210	M6	14.2	11 20
DBW-02 300		13.8	
DBW-02 380		13.4	

Table 8.14 - Mechanical data of the DBW-01 and DBW-02

# 8.10.3.3 Installation/Connection

Location of the power connections is shown in figures 8.29, 8.30 and 8.31.

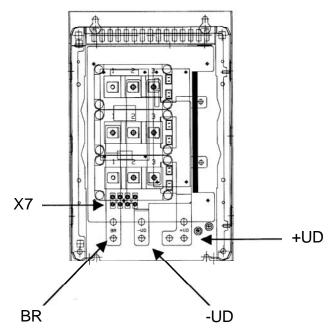


Figure 8.29 - Connection location

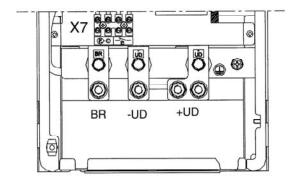


Figure 8.30 - Power terminals

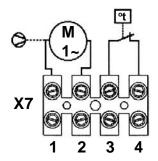


Figure 8.31 - X7 terminal block

Supply the fan of the braking module with the suitable supply voltage (110 Vrms or 220 Vrms) at X7:1 and X7:2, connector (refer to figure 8.32). The fan requires a current of about 0.14 A. The terminals 3 and 4 of the terminal bock X7 are the NC-contact of a thermostat that must be installed for the thermal protection of the braking module. This protection must be installed external to the braking module (refer to figure 8.32); in this example, the relay is connected to DI3 (XC1:3,9 of the board CC9) and the parameter P265 is programmed as Without External Error (P265 = 4).

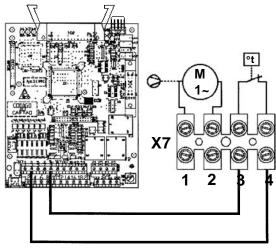


Figure 8.32 - Example of thermal protection

- ☑ Connect the +UD grounding of the braking module to the +UD terminal of the inverter;
- ☑ Connect the -UD grounding of the braking module to the -UD terminal of the inverter;
- ☑ The control connection between the CFW-09 and the braking module is made through a cable (0307.7560). One end of this cable is connected to the XC3 connector that can be found at the CRG4 board (refer to figure 8.33) in the braking module. The other end of this cable is connected to a DB9 connector that is fastened to a metallic support at the side of the control board in the CFW-09.

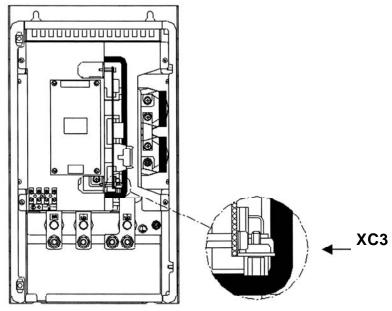


Figure 8.33 - Location of the XC3 connector

Figure 8.34 shows the connection of the braking module to the inverter, as well as the connections of the resistor to the braking module. It shows also the inclusion of a thermal relay and a thermostat in contact with the resistor body, thus ensuring its thermal protection. The connection cables between the inverter and the module and between the module and the braking resistor must be dimensioned according to the thermal braking cycle.

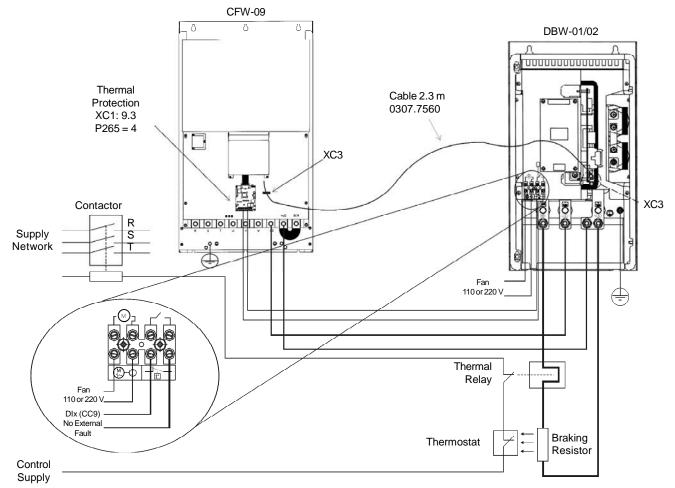


Figure 8.34 - Connections between the DBW, the CFW-09 and the braking resistor



## NOTE!

- ☑ Through the power contacts of the bimetallic overload relay circulates Direct Current during the DC-Braking process.
- ☑ The DBW-02 has a duplicated XC3 connector (A and B). The XC3B is for connecting other DBW-02 module for parallel operation. It is possible to connect up to 3 DBW-02 modules in parallel. The interconnecting cable should be limited to 2 meters maximum cable length.

# 8.11 THROUGH SURFACE MOUNTING KIT

The kit for through surface mounting is composed of metallic supports that must be mounted on the rear of the CFW-09 frames 3 to 8 to allow through surface mounting. For further information refer to item 3.1.3.3, figure 3.4 and table 3.4. Degree of protection is NEMA 1/IP20.

# 8.12 FIELDBUS

CFW-09 can be connected to Fieldbus networks allowing its control and parameter setting. For this purpose you need to include an optional electronic board according to the desired Fieldbus standard: Profibus DP, DeviceNet or EtherNet/IP.



# NOTE!

The chosen Fieldbus option can be specified in the suitable field of the CFW-09 coding.

In this case the CFW-09 will be supplied with all needed components already installed in the product. For later installation you must order and install the desired Fieldbus kit (KFB).

8.12.1 Installation of the Fieldbus kit

The communication board that forms the Fieldbus Kit is installed directly onto the CC control board, connected to the XC140 connector and fixed by spacers.



# NOTE!

- ☑ Follow the Safety Notices in chapter 1.
- ☑ If a Function Expansion Board (EBA/EBB) is already installed, it must be removed provisionally. For the frame size 1 you must remove the lateral plastic cover of the product.
  - 1. Remove the bolt from the metallic spacer near to the XC140 (CC9) connector.
  - 2. Connect carefully the pin connector of the Fieldbus board to the female connector XC140 of the CC9 control board. Check the exact coincidence of all pins of the XC140 connector (refer to figure 8.35).

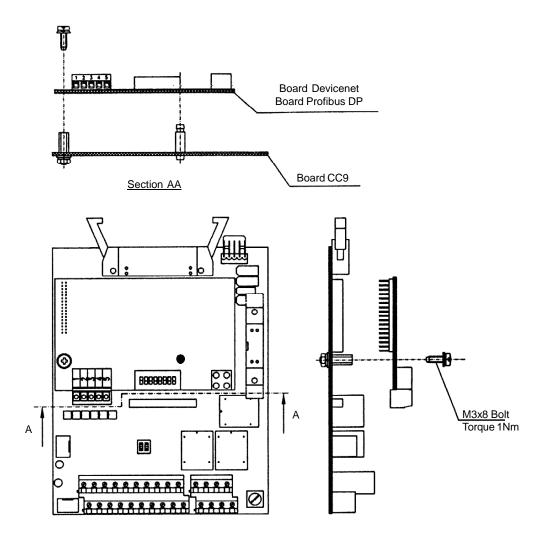


Figure 8.35 - Installation of the electronic board of the Fieldbus

- 3. Press the board near to XC140 and on the lower right edge until the connector and the plastic spacer is inserted completely.
- 4. Fix the board to the metallic spacer through the bolt (except ModBus RTU).
- 5. Fieldbus Connector:

# Sizes 1 and 2 (Models up to 28 A):

- Fix the Fieldbus connector to the inverter frame by using the 150 mm (5.9 in) cable (refer to figure 8.36).

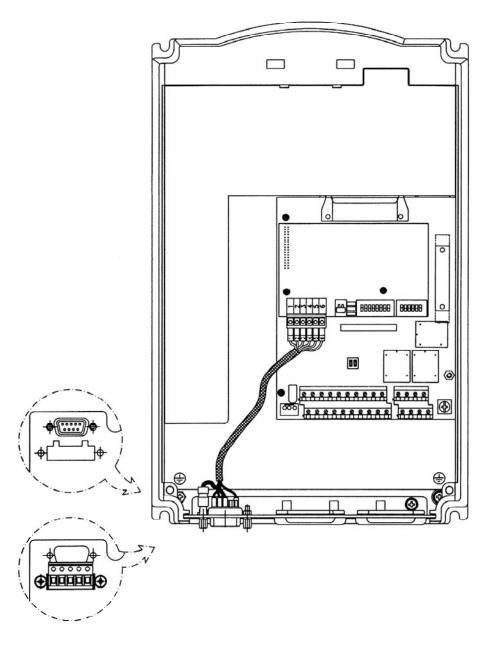


Figure 8.36 - Fastening of the Fieldbus connector

# Sizes 3 to 10 - (models up to 30 A):

- Connect the Fieldbus connector to the metallic "L" by using the 150 mm (5.9 in).
- Fasten the set to the metallic support plate of the control board (refer to figure 8.37).

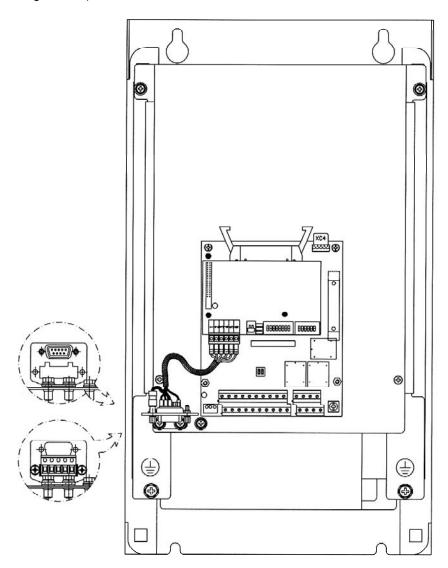


Figure 8.37 - Fastening of the Fieldbus connector

6. Connect the other cable end of the Fieldbus connector to the electronic Fieldbus board, as shown in figure 8.38.

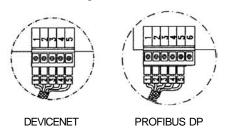


Figure 8.38 - Connection to the Fieldbus board

## 8.12.2 Profibus DP

### Introduction

The inverter that is fitted with the Profibus DP Kit operates in slave mode, allowing the reading/writing of their parameters through a master. The inverter does not start the communication with other nodes, it only answers to the master controls. A twisted pair of copper cable realizes the connection of the Fieldbus (RS-485) allowing the data transmission at rates between 9.6 kbits/s and 12 Mbits/s. Figure 8.39 show a general view of a Profibus DP network.

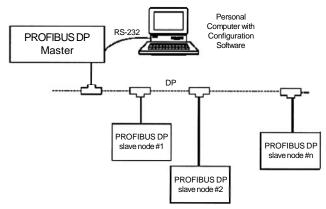


Figure 8.39 - Profibus DP network

- Fieldbus Type: PROFIBUS DP EN 50170 (DIN 19245)

# **Physical Interface**

- Transmission means: Profibus bus bar line, type A or B as specified in EN50170.
- Topology: Master-Slave communication.
- Insulation: the bus is supplied by DC/DC inverter and isolated galvanically from remaining electronics and the signals A and B are isolated by means of optocouplers.
- It allows the connection/disconnection of only one node without affecting the network.

### Fieldbus connector of the inverter user

- Connector D-sub 9 pins female.
- Pins:

Pin	Name	Function
1	Not connected	-
2	Not connected	-
3	B-Line	RxD/TxD positive, according to
	B Zino	specification RS-485
4	Not connected	-
5	GND	0 V isolated against RS-485 circuit
6	+ 5 V	5 V isolated against RS-485 circuit
7	Not connected	-
8	A-Line	RxD/TxD negative, according to
O		specification RS-485
9	Not connected	-
Frame	Shield	Connected to the ground protection (PE)

Table 8.15 - Pin connection (DB9) to the Profibus DP

#### Line Termination

The initial and the en points of the network must be terminated with the characteristic impedance in order to prevent reflections. The DB 9 cable male connector has the suitable termination. When the inverter is the first or the last of the network, the termination switch must be set to Pos. "ON". Otherwise set the switch to Pos. "OFF". The terminating switch of the PROFIBUS DP board must be set to 1 (OFF).

# Transfer Rate (baud rate)

The transfer rate of a Profibus DP network is defined during the master configuration and only one rate is permitted in the same network. The Profibus DP board has automatic baud rate detection and the user does not need to configure it on the board. The supported baud rates are: 9.6 kbits/s, 19.2 kbits/s, 45.45 kbits/s, 93.75 kbits/s, 187.5 kbits/s, 500 kbits/s, 1.5 Mbits/s, 3 Mbits/s, 6 Mbits/s and 12 Mbits/s.

## **Node Address**

The node address is established by means of two rotating switches on the electronic Profibus DP board, permitting the addressing from 1 to 99 addresses. Looking onto the front view of the board with the inverter in normal position, the switch at left sets the ten of the address, while the left switch sets the unit of the address:

Address = (set left rotary switch x = 10) + (set right rotary switch x = 1)



## NOTE!

The node address can not be changed during operation.

# **Configuration File (GSD File)**

Each element of a Profibus DP network is associated to a GSD file that has all information about the element. This file is used by program of the network configuration. Use the file with the extension .gsd stored on the floppy disk contained in the Fieldbus kit.

### Signaling

The electronic board has a bicolor LED at right underside indicating the status of the Fieldbus according to the table 8.16 and figure 8.40 below:

Color LED	Frequency	Status
Red	2 Hz	Fault during the test of the ASIC and Flash ROM
Green	2 Hz	Board has not been initialized
Green	1 Hz	Board has been initialized and is operating
Red	1 Hz	Fault during the RAM test
Red	4 Hz	Fault during the DPRAM test

Table 8.16 - Signaling LED of the Fieldbus board status



## NOTE!

The red fault indications mean hardware problems of the electronic board. The reset is realized by switching OFF / ON the inverter. If the problem persists, replace the electronic board.

The electronic board is also fitted with four other bicolor LEDs placed at the right bottom side, indicating the Fieldbus status according to the figure below:

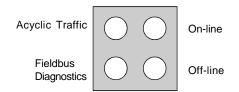


Figure 8.40 - LEDs indicating the status of the Profibus DP network

LED	Color	Function
Fieldbus Diagnostics	Red	Indicates certain faults at the Fieldbus:  Flashing at 1 Hz - Configuration error: the IN/OUT area size programmed at the board initialization is different from the size programmed during the network configuration.  Flashing at 2 Hz - User parameter data error: the size/contents of the user parameter data programmed at the board initialization are different from the size/contents programmed during the network configuration.  Flashing 4 Hz - Enabling error of the Profibus Communication ASIC.  OFF - no problems.
On-Line	Green	Indicates that the board is On-line at the Fieldbus.  ON - the board is off-line and the data exchange is not possible.  OFF - the board is not On-line.
Off-Line	Red	Indicates that the board is Off-line at the Fieldbus.  ON - the board is off-line and the data exchange is not possible.  OFF - the board is not Off-line.
Acyclic Traffic	Green	Valid only for the Profibus DP-V1 interface. It indicates that the board is processing a DP-V1 request:  ON - The board is executing a DP-V1 request.  OFF - There is no DP-V1 request being processed.

Table 8.17 - Signaling LEDs indicating the status of the Profibus DP network



## NOTE!

When power is applied to the inverter and both on-line and off-line LEDs on the Profibus DP board keep flashing, then a network address configuration or installation problem may be present.

Check the installation and the network node address.



### NOTE!

Use of the Profibus DP/related CFW-09 Parameters. Refer to item 8.12.7.

# 8.12.3 Profibus DP-V1

By using the DP-V1 communication kit, besides the exchange of cyclic data, which is performed in a similar form to that of Profibus DP-V0, it is also possible to perform services of reading/writing parameters through DP-V1 acyclic functions, by the network master as well as by a commissioning tool. The parameter mapping is done based in the slot and index addressing, according to the equationing below:

☑ Slot: (parameter number - 1) / 255 ☑ Index: (parameter number -1) MOD 255



# NOTE!

MOD represents the remainder of the integer division.

For instance, the parameter P100 will be identified through the acyclic messages as being located at slot 0, index 99.

The value for the parameters is always communicated with a 2 byte (1 word) size. The value is also transmitted as an integer, without decimal point, and its representation depends on the used resolution.

E.g.: P003 = 3.6 A; value read via the network = 36.



## NOTE!

- ☑ The parameters P000, P001, P215 and P408 are not available for access via network.
- ☑ In order to be able to use the Profibus DP-V1 interface, one must select the option 1, 2 or 3 at P309. This programming is the same for the Profibus DP-V0 or DP-V1 interfaces.
- ☑ A specific GSD file for this interface is supplied with the Profibus DP-V1 communication kit.

## 8.12.4 DeviceNet

### Introduction

The DeviceNet communication is used for industrial automation, mainly for the control of valves, sensors, input/output units and automation equipment. The DeviceNet communication Link is based on a communication protocol "broadcast oriented", the Controller Area Network (CAN). The connection to the DeviceNet network is realized by means of a shielded cable comprising a twisted pair and two wires for the external power supply. The baud rate can be set to 125 kbits/s, 250 kbits/s or 500 kbits/s. Figure 8.41 gives a general view of a DeviceNet network.

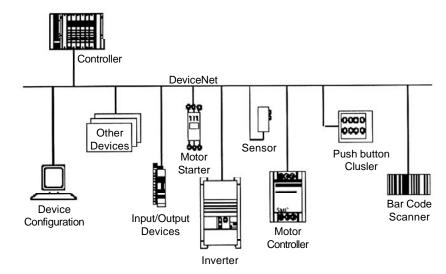


Figure 8.41 - DeviceNet network

## Fieldbus connector of user of the inverter

- Connector: 5 ways-connector of type plug-in with screwed terminal (screw terminal).
- Pin:

Pin	Description	Color
1	V-	Black
2	CAN_L	Blue
3	Shield	-
4	CAN_H	White
5	V+	Red

Table 8.18 - Connection of the pins to the DeviceNet

## Line Termination

To avoid reflection, the initial and the end points of the network must be terminated with the characteristic impedance. Thus a 120-ohms/0.5W resistor must be connected between the pins 2 and 4 of the Fieldbus connector.

## **Baud Rate/ Node Address**

There are three different baud rates for the DeviceNet: 125 kbits/s, 250 kbits/s or 500 kbits/s. Choose one of these baud rates by setting the DIP switches on the electronic board.

The node address is selected through the six DIP switches on the electronic board, permitting an addressing from 0 to 63 addresses.

Baud Rate [bits/s]	DIPs 1 and 2
125 k	00
250 k	01
500 k	10
Reserved	11

Address	DIP 3 to DIP 8
0	000000
1	000001
2	000010
:	:
61	111101
62	111110
63	111111

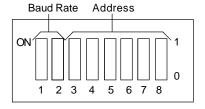


Figure 8.42 - Baud rate configuration an addressing to the DeviceNet

# **Configuration File (EDS File)**

Each element of a DeviceNet network is associated to an EDS file that has all information about the element. This file is used by program of the network configuration during its configuration. Use the file with the extension .eds stored on the floppy disk contained in the Fieldbus kit.

Setting parameter P309 to 4, 5 or 6 selects 2, 4 or 6 input/output words (refer to item 8.12.7).

With the assistance of the network configuration software define the number of words for the device according to the value set on parameter P309. The type of connection used for data exchange shall be set for "Polled I/O".



### NOTE!

The PLC (master) must be programmed for Polled I/O connection.

# Signaling

The electronic board has a bicolor LED at right topside indicating the status of the Fieldbus according to the table 8.16.



## NOTE!

The red fault indications mean hardware problems of the electronic board. The reset is realized by switching OFF / ON the inverter. If the problem persists, replace the electronic board.

The electronic board is also fitted with other four bicolor LEDs placed at the right bottom side, indicating the DeviceNet status according to figure 8.43 and table 8.19:

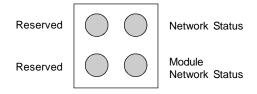


Figure 8.43 - LEDs for status indication of the DeviceNet network

LED	Color	Description
Module Network Status	ON	Without supply
Module Network Status	Red	Fault not recoverable
Module Network Status	Green	Board operating
Module Network Status	Red Flashing	Smaller fault
Network Status	Off	Without supply/off-line
Network Status	Green	Link operating, connected
Network Status	Red	Critical fault at Link
Network Status	Green Flashing	On-line not connected
Network Status	Red Flashing	Timeout of the connection

Table 8.19 - Signaling LEDs indicating the DeviceNet status



# NOTE!

Use of the DeviceNet /related CFW-09 Parameters. Refer to item 8.12.7.

# 8.12.5 DeviceNet Drive Profile

The DeviceNet Drive Profile communication board has the purpose of making available at the product a communication interface for a DeviceNet network with the following characteristics:

- ☑ It makes it possible the parameterization of the inverter via the network, with direct access to the parameters through messages sent by the master.
- It follows the Device Profile standard for AC and DC Inverters specified by the ODVA (Open DeviceNet Vendor Association), which defines a common set of objects for inverters that operate in a DeviceNet network.

With the DeviceNet Drive Profile interface the I/O data exchanged with the DeviceNet network master present format and parameterization different from the data exchanged by using the normal DeviceNet board. For more information on the parameterization and operation of this interface, refer to the CFW-09 frequency inverter DeviceNet Drive Profile Communication Manual.

# 8.12.6 EtherNet/IP

EtherNet/IP (Industrial EtherNet Protocol) is a communication system proper for the industrial environment. This system allows application data exchange, time-restricted or critical, between industrial systems. The EtherNet/IP is available for simple devices such as sensors/actuators as well as for complex devices such as robots, PLCs, keypads and inverters.

The EtherNet/IP application layer protocol is based on the Control and Information Protocol (CIP) layer that is used in both DeviceNet™ and ControlNet™. The CIP organizes the devices as collection of objects and defines the methods and procedures for data access. Furthermore, the EtherNet/IP uses the standard IEEE 802.3 for the low level layers and the TCP/IP and UDP/IP protocols for the intermediary layers to transport the CIP packets.

Therefore, the infrastructure used by the EtherNet/IP is the same used by the corporate computer networks (EtherNet). This fact extends considerably the means of controlling and monitoring the devices connected to the network:

- ☑ Availability of application protocols (HTTP, FTP, etc.).
- ✓ Integration between the assembly line and the corporate.
- ☑ It is based on a widely used and accepted standard.
- ☑ Greater data flow than the standard protocols used for the industrial automation.

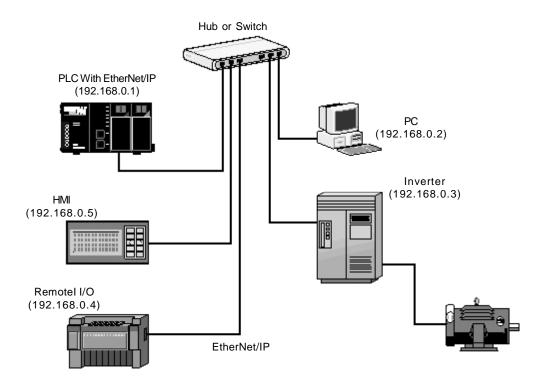


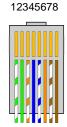
Figure 8.44 - Example of an EtherNet/IP network

### **Fieldbus Connector**

- Connector: RJ-45 connector with 8-pin.
- Pinout: two standards for straight-through cables are available: EtherNet: T-568A and T-568B. The function of each pin is shown in figure 8.45 a) and b). The cable to be used with the CFW-09 shall follow one of these two standards. Furthermore, only one standard shall be used for the cables, i.e., the connectors of both cable ends shall be crimped according to standard T-568A or T-568B.

## a) RJ-45 Plug - T-568A Standard

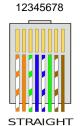
Pin	Cable Color	Signal
1	White/Green	TX+
2	Green	TX-
3	White/Orange	RX+
4	Blue	-
5	White/Blue	-
6	Orange	RX-
7	White/Brown	-
8	Brown	-





b) RJ-45 Plug - T-568B Standard

Pin	Cable Color	Signa
1	White/Orange	TX+
2	Orange	TX-
3	White/Green	RX+
4	Blue	-
5	White/Blue	-
6	Green	RX-
7	White/Brown	-
8	Brown	-



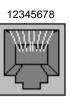


Figure 8.45 a) and b) - Straight-Through EtherNet cables

# **Line Termination**

With the EtherNet 10BASE-T (10 Mbps) or 100BASE-TX (100 Mbps) the line termination is already on the communication board and also on any other device that uses a point-to-point twisted pair cable. Therefore, no additional setting is needed for the CFW-09.

### **Communication Bit-rate**

The CFW-09 can operate in an EtherNet network at 10 Mbps or 100 Mbps and also in half-duplex or full-duplex modes. When operating at 100 Mbps in full-duplex mode, the effective rate doubles to 200 Mbps. These configurations are performed through the network configuration and programming software. No board setting is needed. It is recommended to use the auto-sensing resource.

## **Configuration File (EDS file)**

Each device on an EtherNet/IP network is associated to an EDS file that contains information about the device operation. The EDS file provided along with the product is used by the network configuration software.

## **Configuration of the Network Master Data**

For the master configuration, besides the IP address used by the EtherNet/IP board, it is necessary to indicate the number of I/O instances and the quantity of data exchanged with the master in each instance. For the CFW-09 with Anybus-S EtherNet/IP board, the following values must be programmed:

- ☑ Input Instance: 100☑ Output Instance: 150
- ☑ Data amount programmable through P309: it may be 2, 4 or 6 words with 16 bits (4, 8 or 12 bytes).

The EtherNet/IP board for the CFW-09 is described in the network as a Generic Ethernet Module. By using these configurations it is possible to program the network master so that it communicates with the inverter.

## Indication

The communication board has four two-color LEDs located on the right bottom corner to indicate the module and the network status.

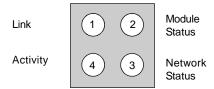


Figure 8.46 - Indication LEDs for the status of the EtherNet/IP network

LED	Color	Function	
Link	Green	On: the module is connected to another device on the network (typically a hub or switch).  Off: the module is not connected to another device.	
Module Status	Green or Red	Steady Off: No power applied o the module.	
		Steady Green: The module is operating correctly.	
		Flashing Green: the module has not been configured.	
		Flashing Red: A minor recoverable error has been detected.	
		Steady Red: A major internal error has been detected.	
		Flashing Green/Red: The module is performing a power on self-test.	
Network Status	Green or Red	Steady Off: The module has no power or no IP address has been assigned.	
		Steady On: the module has at least one established EtherNet/IP connection.	
		Flashing Green: There are no EtherNet/IP connections established to the module.	
		Flashing Red: One or more of the connections in which this module is the target has timed out.	
		Steady Red: The module has detected that its IP address is already in use.	
		Flashing Green/Red: The module is performing a power on self-test.	
Activity	Green	Flashing: indicates that a packet has been received and/or transmitted.	



### NOTE!

The communication board that comes with the product has been developed by the HMS Industrial Networks AB company. Therefore, the network configuration software will not recognize the product as the CFW-09 variable frequency inverter, but as the "Anybus-S EtherNet/IP" at the "Communication Adapter". The differentiation among several CFW-09 inverters will be based on the device address on the network.

### Related errors

The EtherNet/IP uses the same error codes as the other Fieldbus protocols, i.e., E29 and E30.

E29: Fieldbus communication is off.

E30: Communication board is off.

For detailed information refer to the item 8.12.7.3.



### NOTE!

The inverter will indicate E29 only when the connection with the master is lost. The inverter will not indicate this error while no connection has been established.

### **Control and Monitoring Through the WEB**

The EtherNet/IP communication board has an HTTP server internally. This means that the communication board can serve HTML pages. In such a way, it is possible to configure network parameters, control, and monitor the CFW-09 inverter through a WEB browser installed in a computer connected to the same network of the inverter. Use the same read/write variables of the inverter to perform these operations (refer to items 8.12.7.1 and 8.12.7.2).



### NOTE!

For the first WEB access use the factory default username and password.

Username: web Password: web

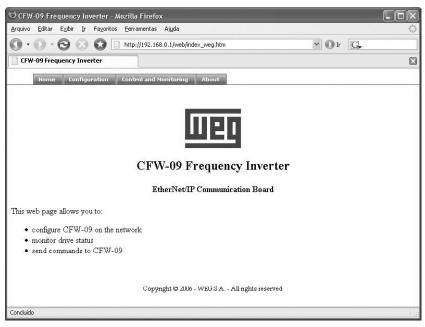


Figure 8.47 - Open window when accessing the CFW-09 through the WEB

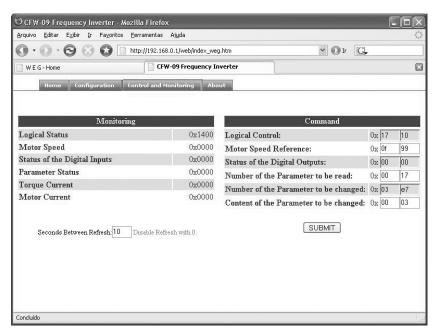


Figure 8.48 - Control and monitoring window when accessing the CFW-09 through the WEB



### NOTE!

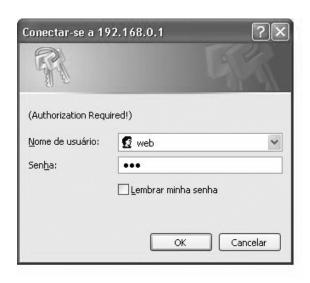
It is necessary to have a PC with an EtherNet card connected to the same network of the CFW-09 and a WEB browser (MS Internet Explorer or Mozilla/Firefox.

### **Configurations**

Follow the steps below to operate the CFW-09 in an EtherNet/IP network.

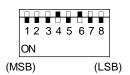
- 1) Install the KFB-EN kit into the CFW-09 variable frequency inverter.
- 2) At parameter P309 select the EtherNet/IP protocol and the number of input/output words, P309 = 7, 8 or 9.
- 3) Connect the RJ-45 plug of the EtherNet cable to the inverter and make sure that the Link LED is ON (LED 1).
- 4) Open your WEB browser and type the inverter address on the network. The factory default value is 'http://192.168.0.1'. Make sure that JavaScript and cookies are enabled in the WEB browser.

The data access is protected by username and password. The CFW-09 has the following factory default values: Username: web Password: web



- 5) At the 'Configuration' tab of the WEB page shown in figure X set, if needed, the 'Network Parameters'. Set also the value of parameter P309.
- 6.1) If the inverter address on the network belongs to the reserved range '192.168.0.X', it is possible to use the DIP-switches of the communication board for addressing purposes. In this case, the DIP-switch represents the binary value of the last byte in the IP address.

### Example:



The DIP-switch is set to 00010100 (20 in decimal format).

Thus, the inverter address on the network is 192.168.0.20.

- 6.2) If the inverter has an IP address out of the default range (192.168.0.X), deactivate the hardware addressing by setting the DIP-switches to zero (00000000).
- 6.3) If the network addressing is performed through a DHCP server, select the box 'DHCP enabled' and set the DIP-switches to zero (00000000).
- 7) Click on the button 'STORE CONFIGURATION' to save the new settings. Restart the CFW-09.

### Access to the communication board

The communication board supports FTP and Telnet services. In such a way, it is possible to upload/download files to/from the board and also access the file system in an interactive way.

In order to use these services follow the instructions below:

- Open a MS-DOS command window.
- Type the desired service (FTP or Telnet) followed by the IP address or hostname of the CFW-09 on the network.
- Enter with: Login: user Password: user

### Examples:

Telnet session for the CFW-09 with IP address 192.168.0.4.

FTP session for the CFW-09 whit IP address 192.168.0.4.

```
C:\Vitp 192.168.0.4
Conectado a 192.168.0.4.
220 Service ready
Usuário (192.168.0.4:(none)): user
331 User name ok, need password
Senha:
230 User logaed in
ftp> ___
```

### Security and access passwords

The file system of the communication board has two security levels for the user: **admin** and **normal**.

It is only permitted to connect in the **normal** mode. In this case, the users are restricted to the directory 'user\', where it is possible to create or delete files and/or folders. The accounts for normal users are defined in the file 'sys\_pswd.cfg' that is located under directory 'user\pswd\'. Each line of the file has a pair 'login:password' that corresponds to a user account.

In order to change the file containing the user accounts, create, with the assistance of a simple text editor, a file that contains in each line a pair 'login:password'. A colon shall separate the two words. Notice that no password cryptography is available, i.e., the login and the password are completely visible. After creating/modifying the user accounts, transfer via FTP the file 'sys\_pswd.cfg' to the directory 'user\pswd\'.

### Example of file transfer through FTP:

### NOTE!

The CFW-09 that comes from the factory has a **normal** user account:

Username: user Password: user

Users of the normal security level are restricted to the directory '\user'.

In addition to the access control for the file system, there is also an access control for the HTML pages of the communication board. The file containing the access passwords is located under the directory 'user\pswd', and it is named 'web\_accs.cfg'. As in the previous case, each line of the 'web\_accs.cfg' file represents an access account. In order to change the user accounts for the HTML pages, create a text file with the same name ('web\_accs.cfg') and insert in each line of this file a pair 'login:password' for the users with access permission. After that, transfer this new file through FTP to the communication board, exactly as in the previous case.



### NOTE!

It is strongly recommended to change all passwords of the EtherNet/IP communication board after the start-up of the device. The new passwords will be effective only after powering down and up the CFW-09.



### NOTE!

When the inverter returns from the off-line state the output values are reset.

### 8.12.7 Use to the Fieldbus/ Related Parameters of the CFW-09

There are two main parameters: P309 and P313:

**P309** - defines the used standard Fieldbus (Profibus DP, DeviceNet or EtherNet/IP) and the number of variables (I/O) exchanged with the master (2, 4 or 6). The parameter P309 has the following options:

**P313** - defines the inverter behavior when the physical connection with the master is interrupted and/or the Fieldbus board is inactive (E29/E30).

- The parameter P313 has the following options:
- 0 = Disables the inverter by using the Start/Stop controls via deceleration ramp.
- 1 = Disables the inverter by using the General Enabling, stop by inertia.
- 2 = The inverter status is not changed.
- 3 = The inverter goes to Local mode.
- 4 = The inverter changes to Local mode keeping the commands and the reference.

## 8.12.7.1 Variables Read from the Inverter

- 1 Logical Status of the inverter,
- 2 Motor speed,

For the option P309 = 1 or 4 (2I/O) - read 1 and 2,

- 3 Status of the Digital Inputs (P012),
- 4 Parameter Status,

For the option P309 = 2 or 5 (4I/O) - it reads 1, 2, 3 and 4,

- 5 Torque current (P009),
- 6 Motor current (P003),

For the option P309 = 3 or 6 (6I/O) - it reads 1, 2, 3, 4, 5 and 6.

### 1. Logical Status (E.L.):

The word that defines the E.L. is formed by 16 bits, being 8 bits of high order and 8 bits of low order. It has the following construction:

High-Order Bits - they indicate the status of the associated function

**EL.15** - Active error: 0 = No, 1 = Yes;

**EL.14** - PID Regulator 0 = Manual, 1 = Automatic;

**EL.13** - Undervoltage : 0 = Without, 1 = With;

**EL.12** - Local/Remote Control: 0 = Local, 1 = Remote;

**EL.11** - JOG Control: 0 = Inactive, 1 = Active;

**EL.10** - Direction of rotation: 0 = Counter-Clockwise, 1 = Clockwise;

**EL.09** - General Enabling: 0 = Disabled, 1 = Enabled;

**EL.08** - Start/Stop: 0 = Stop, 1 = Start.

**Low-Order Bits** - they indicate the error code number, (i.e. 00, 01, ..., 09, 11(0Bh), 12(0Ch), 13(0Dh), 24(18h), 32(20h) and 41(29h)). Refer to item 7.1- Faults and Possible Causes.

### 2. Motor Speed:

This variable is shown by using the 13-bit resolution plus signal. Thus the rated value will be equal to 8191(1FFFh) (clockwise rotation) or -8191(E001h) (counterclock wise rotation) when the motor is running at synchronous speed (or base speed, for instance 1800 rpm for IV-pole motor, 60 Hz).

### 3. Status of the Digital Inputs:

Indicates the content of the Parameter P012, where the level 1 indicates active input (with +24 V), and the level 0 indicates the inactive input (with 0 V). Refer to item 6.1 - Access and Read Parameter. The digital inputs are so distributed in this byte:

Bit.7 - DI1 status
Bit.6 - DI2 status
Bit.5 - DI3 status
Bit.4 - DI4 status
Bit.5 - DI3 status
Bit.6 - DI2 status
Bit.7 - DI5 status
Bit.7 - DI6 status
Bit.7 - DI8 status

### 4. Parameter Content:

This position permits to read the inverter parameter contents that are selected at Position 4. Number of parameter to be read from the "Variables Written in the Inverter". The read values will have the same order as described in the product Manual or shown on the HMI.

The values are read without decimal point, when it is the case. Examples:

- a) HMI displays 12.3, the read via Fieldbus will be 123,
- b) HMI displays 0.246, the read via Fieldbus will be 246.

There are some parameters which representation on the 5 segment display can suppress the decimal point when the values are higher than 99.9. These parameters are: P100, P101, P102, P103, P155, P156, P157, P158, P169 (for P202 = 0, 1, 2 and 5), P290 and P401.

Example: Indication on the 7 segment display: 130,

Indication on the LCD display LCD: 130.0, the read value via

Fieldbus is: 1300.

The read of the Parameter P006 via Fieldbus has the following meaning:

0 = ready;

1 = run;

2 = Undervoltage:

3 = with fault, except E24 to E27.

### 5. Torque Current:

This position indicates de P009 Parameter content, disregarding the decimal point. A lowpass filter with a time constant of 0.5s filters this variable.

### 6. Motor Current:

This position indicates de P003 Parameter content, disregarding the decimal point. A lowpass filter with a time constant of 0.3 s filters this variable.

## 8.12.7.2 Variables Written in the Inverter

The variables are written in the following order:

- 1 Logical Control;
- 2 Motor speed reference, for option P309 = 1 or 4 (2I/O) - it writes in 1 and 2;
- 3 Status of the Digital Outputs;
- 4 Number of the Parameter to be read, for option P309 = 2 or 5 (4I/O) - it writes in 1, 2, 3 and 4;
- 5 Number of the Parameter to be changed;
- 6 Content of the Parameter to be changed, selected in the previous position, for option P309 = 3 or 6 (6I/O) it writes in 1, 2, 3, 4, 5 and 6.

### 1. Logical Control (C.L.):

The word that defines the C.L. is formed by 16 bits, being 8 bits of high orders and 8 bits of low orders and having the following construction:

**High-Order Bits** - they select the function that shall be driven when the bit is set to 1.

- CL.15 Inverter fault reset;
- **CL.14** Without function;
- CL.13 To save the changes of the parameter P169/P170 in the EEPROM;
- CL.12 Local/Remote control;
- **CL.11** Jog control;
- CL.10 Direction of rotation;
- CL.09 General enabling;
- CL.08 Start/Stop.

**Low-Order Bits** - they determine the status that is wanted for the function selected in the high-order bits.

- CL.7 Inverter fault reset: always it varies from 0 → 1, an inverter reset is caused, with the presence of faults (except E24, E25, E26 e E27);
- CL.6 No function / STOP detection. It is not necessary to activate the correspondent upper bit (refer to the description of parameter P310);
- **CL.5** To save P169/P170 in the EEPROM: 0 = to save, 1 = to not save;
- **CL.4** Local/Remote control: 0 = Local, 1 = Remote;
- **CL.3** Jog control: 0 = Inactive, 1 = Active;
- **CL.2** Direction of rotation: 0 = counter-clockwise, 1 = clockwise;
- **CL.1** General enabling: 0 = Disabled, 1 = Enabled;
- **CL.0** Start/Stop: 0 = Stop, 1 = Start.



### NOTE!

The inverter will execute only the command indicated in the low-order bit, when the corresponding high-order bit has the value 1 (one). When the high-order bit has the value 0 (zero), the inverter will disregard the value of the corresponding low-order bit.



### NOTE!

### CL.13:

The function to save the changes of the parameters content in EEPROM occurs usually when the HMI is used. The EEPROM admits a limit number of writings (100 000). In the applications where the speed regulator is saturated, but the torque control is desired, you must change the current limitation value at P169/P170 (valid for P202 = 3 and 4). In this torque control condition, check if P160 (control type) = 1 (Regulator for torque control). When the network Master is writing in P169/P170 continuously, avoid to save the changes in the EEPROM, by setting:

### CL.13 = 1 and CL.5 = 1

To control the functions of the Logical Control, you must set the respective inverter parameters with the Fieldbus option.

- a) Local/Remote selection P220;
- b) Speed reference P221 and/or P222;
- c) Direction of rotation P223 and/or P226;
- d) General Enabling, Start/Stop P224 and/or P227;
- e) Jog Selection P225 and/or P228.

### 2. Motor Speed Reference

This variable is shown by using 13-bit resolution. Hence, the reference value for the motor synchronous speed will be equal to 8191 (1FFFh).

This value shall be used just as a base speed to calculate the desired speed (reference speed).

For example:

1) 4-poles motor, 60 Hz, synchronous speed = 1800 rpm and reference speed = 650 rpm

1800 rpm - 8191 650 rpm - X

X = 2958 = 0B8Eh

This value 0B8Eh shall be written in the second word which represents motor speed reference.

2) 6-poles motor, 60 Hz, synchronous speed = 1200 rpm and reference speed = 1000 rpm.

1200 rpm - 8191 1000 rpm - X

X = 4096 = 1AAAh

This value 1AAAh shall be written in the second word which represents motor speed reference.



### NOTE!

It is possible to use values higher than 8191 (1FFFh) when it is desired to have values higher than the motor synchronous speed, since the maximum speed reference set for the inverter is respected.

### 3. Status of the Digital Outputs:

It allows changing the status of the Digital Outputs that are programmed for the Fieldbus in the Parameters P275 to P280.

The word that defines the status of the digital outputs is formed by 16 bits, having the following construction:

**High-order bits:** define the output that shall be controlled when set to 1:

**bit.08** - 1 = control of the output DO1;

**bit.09** - 1 = control of the output DO2;

**bit.10** - 1 = control of the output RL1; **bit.11** - 1 = control of the output RL2; **bit.12** - 1 = control of the output RL3.

Low-order bits: define the status desired for each output:

**bit.0** - output status DO1: 0 = output inactive, 1 = output active; **bit.1** - output status DO2: 0 = output inactive, 1 = output active; **bit.2** - output status RL1: 0 = output inactive, 1 = output active; **bit.3** - output status RL2: 0 = output inactive, 1 = output active; **bit.4** - output status RL3: 0 = output inactive, 1 = output active.

### 4. Parameter Number to be Read:

Through this position you can read any inverter parameter.

You must enter the number corresponding to the desired parameter and its content will be displayed in Position 4 of the "Read Inverter Variables".

### 5. Number of the Parameter to be changed:

(Parameter Content Changing)

This position works jointly with Position 6 below.

If no Parameter change is desired, you have to enter in this position the code **999**.

During the changing process you must:

- 1) Maintain in Position 5. the code 999;
- 2) Change the code 999 by the parameter number you want to change;
- 3) If no fault code (24 to 27) is displayed in the E.L., replace the code number by the code 999, to end the change.

The change can be checked through the HMI or by reading the parameter content.



### NOTES!

- The control change from Scalar Control to Vector Control will not be accepted
  if any of the parameters P409 to P413 is set to zero. This must be effected
  through the HMI.
- 2) Do not set P204 = 5, since P309 = Inactive in the factory setting.
- The desired content must be maintained by the master during 15.0 ms.
   Only after this time you can send a new value or write another parameter.

### **6.** Content of the Parameter to be changed, selected at Position 5. (Number of the Parameter to be changed)

The format of the values set at this position must be as described in the Manual, but the value must be written without the decimal point, when the case. When Parameters P409 to P413 are changed, small content differences can occur, when the value sent via Fieldbus is compared with the value read at Position 4 ("Parameter Content"), or with the value read via HMI. This is due the truncation (rounding off) during the reading process.

### 8.12.7.3 Fault Indications

During the read/write process via Fieldbus the following variable indications in the Logical Status can occur:

### Indications in the Logical Status variable:

- **E24** Parameter changing only permitted with disabled inverter.
  - Parameter setting fault (refer to item 4.2.3).

E25 - Caused by:

- Read Parameter inexistent, or
- Write Parameter inexistent, or
- Write in P408 and P204.

**E26** - The desired content value is out of permitted range.

E27 - Caused by:

- a) The function selected in the Logical Control is not enabled for the Fieldbus, or
- b) The control of the Digital Output is not enabled for the Fieldbus, or
- c) The parameter write is read-only.

The fault indication described above will be removed from the Logical Status when the desired action is sent correctly. Except for E27 (case (b)), which reset is via write in the Logical Control.

**Example:** supposing that no digital output is programmed for Fieldbus, thus when in position 3, the word 11h is written, the inverter answer indicating E27 in E.L.. To remove this indication from E.L., you must:

- 1) Write zero in Pos. 3.(since no DO is programmed for Fieldbus);
- 2) Change the variable of the logical control, to remove from E.L. the E27 indication.

The removal of the fault indication from E.L. described above, can also be realized by writing the code 999 in Pos. 5 of the "Variables written in the Inverter". Except for the fault E27(in the cases (a) and (b)), which reset is realized only through the writing in the Logical Control, as above exemplified.



### NOTE!

The faults E24, E25, E26 and E27 do not cause any change in the inverter operation status.

### **☑** HMI displays:

E29 - Fieldbus is inactive.

- This display appears when the physical connection of the inverter to the Master is interrupted.
- You can program in Parameter P313 the action that the inverter shall execute when the fault E29 is detected.
- When the PROG key of the HMI is pressed, the E29 Fault indication is removed from the display.

E30 - Fieldbus Board is inactive.

This fault is displayed when:

- 1) P309 is programmed different than Inactive, without Fieldbus board in the XC140 connector of the CC9 control board; or
- 2) The Fieldbus board is inserted, but is defective; or
- 3) The Fieldbus board is inserted, but the standard programmed at P309 is not equal to the standard of the used board.

You can program in Parameter P313 which action the inverter will perform when E30 is detected.

When the PROG key of the HMI is pressed, the E30 Fault indication is removed from the display.

8.12.7.4 Addressing of the CFW-09 Variables in the Fieldbus Devices

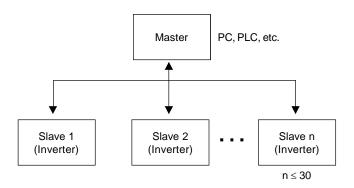
The variables are arranged in the memory of the Fieldbus device, starting at the address 00h, both for writing and reading. The address differences are corrected by the protocol and by communication board.

The way the variables are arranged at each address in the memory of the Fieldbus depends on the equipment that is used as Master. For instance: in the PLC A the variables are arranged as High and Low, and in the PLC B the variables are arranged as Low and High.

### 8.13 SERIAL COMMUNICATION

### 8.13.1 Introduction

The basic objective of the serial communication is the physical connection of inverters in a configured equipment network, as shown below:



The inverters possess a control software for the transmission/reception of data through the serial interface, to facilitate the data reception sent by the master and the sending of data requested by the same.

The transfer rate is 9600 bits/s, following an exchange protocol, question/answer type by using ASCII characters.

The master is able to realize the following operations related to each inverter:

### - IDENTIFICATION

- ☑ inverter type;

### - CONTROL

- ☑ general enabling/disabling;
- ☑ enabling/disabling by ramp;
- ☑ direction of rotation;
- ☑ speed reference;
- ✓ local/remote;
- ☑ JOG;
- ☑ error RESET.

### - STATUS RECOGNITION

- ✓ ready;
- ☑ Sub;
- ☑ run;
- ✓ local/remote;
- ☑ JOG;
- ☑ direction of rotation;
- ☑ setting mode after Reset to Factory Setting;
- ☑ setting mode after changing the Scalar Control Mode to Vector Mode;

### - PARAMETERS READING

### - CHANGE OF PARAMETERS

Typical examples of network use:

- ☑ PC (master) for parameterization of one or several inverters at the same time;
- ☑ SDCD monitoring inverter variables;
- ☑ PLC controlling the operation of an inverter in an industrial process.

### 8.13.2 Interfaces Description

The physical connection between the inverters and the network master is performed according to one of the standards below:

- a. RS-232 (point-to-point, up to 10 m);
- b. RS-485 (multipoint, galvanic isolation, up to 1000 m).

### 8.13.2.1 RS-485

This interface allows the connection of up to 30 inverters to a master (PC, PLC, etc), attributing to each inverter an address (1 to 30) that must be set. In addition to these 30 addresses, there are two other addresses to perform special tasks:

- Address 0: any network inverter is inquired, independently of its address. Only one inverter can be connected to the network (point-to-point) in order to prevent short- circuits in the line interface.
- ☑ Address 31: a control can be transmitted to all inverters in the network simultaneously, without acceptance recognition.

### List of addresses and corresponding ASCII characters

ADDRESS	ASCII			
(P308)	CHAR	DEC	HEX	
0	@	64	40	
1	Α	65	41	
2	В	66	42	
3	С	67	43	
4	D	68	44	
5	E	69	45	
6	F	70	46	
7	G	71	47	
8	Н	72	48	
9	I	73	49	
10	J	74	4A	
11	K	75	4B	
12	L	76	4C	
13	M	77	4D	
14	N	78	4E	
15	0	79	4F	
16	Р	80	50	
17	Q	81	51	
18	R	82	52	
19	S	83	53	
20	Т	84	54	
21	U	85	55	
22	V	86	56	
23	W	87	54	
24	X	88	58	
25	Y	89	59	
26	Z	90	5A	
27	]	91	5B	
28	\	92	5C	
29	[	93	5D	
30	۸	94	5E	
31	_	95	5F	

Table 8.20 - ASCII characters

### Other ASCII characters used in protocol

ASCII				
CODE	DEC	HEX		
0	48	30		
1	49	31		
2	50	32		
3	51	33		
4	52	34		
5	53	35		
6	54	36		
7	55	37		
8	56	38		
9	57	39		
=	61	3D		
STX	02	02		
ETX	03	03		
EOT	04	04		
ENQ	05	05		
ACK	06	06		
NAK	21	15		

Table 8.21 - ASCII characters used in protocol

The connection between the network participants is performed through a pair of wires. The signal levels are according to STANDARD EIA RS-485 with differential receivers and transmitters. Expansion boards of the types EBA.01, EBA.02 or EBB.01 (refer to items 8.1.1 and 8.1.2).

When the master is fitted with only a serial interface - standard RS-232, you must apply a level conversion module from RS-232 to RS-485.

8.13.2.2 RS-232

In this case we have the connection of a master to an inverter (point-to-point). Data can be changed in a bi-directional way, but not simultaneous (HALF DUPLEX).

The logical levels meet STANDARD EIARS-232C that determines the use of balanced signals.

In this case, one wire is used for transmission (TX), one for reception (RX) and one for return (0 V). This configuration is a three-wire economy model. (Refer to item 8.6)

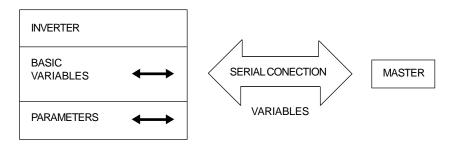
8.13.3 Protocol Definitions

This item describes the protocol used for serial communication.

8.13.3.1 Used Terms

- ☑ Parameters: are those existing in the inverters whose visualization or alteration is possible through the HMI interface.
- ☑ Variables: are values that have specific inverter functions and that can be read and, in some cases, modified by the master.
- ☑ Basic variables: are those that can be accessed only through the serial interface.

### SCHEMATIC DIAGRAM:



8.13.3.2 Parameters/Variables Resolution

During the parameter reading/changing the decimal point is disregarded in the values received with the telegram, excepting the Basic Variables V04 (Reference via Serial) and V08 Motor Speed) that are standardized in 13 bits (0 to 8191). For instance:

☑ Writing: if the purpose is to change the content of P100 to 10.0 s, you must send 100 (disregarding the decimal point);

☑ Reading: If we read 1387 in P409, the value is 1.387 (the decimal point is disregarded);

☑ Writing: to change the content of V04 to 900 rpm, we must send:

$$V04 = 900 \times \frac{8191}{P208} = 4096$$

Supposing P208 = 1800 rpm

Reading: If we read 1242 in V08, this value is given by:

$$V08 = 1242 \text{ x } \frac{P208}{8191} = 273 \text{ rpm}$$

Supposing P208 = 1800 rpm

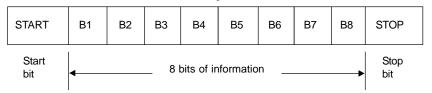
8.13.3.3 Characters Format

☑ 1 start bit;

☑ 8 information bits [they codify text characters and transmission characters, removed from the 7 bits code, according to ISO 646 and complemented for even parity (eighth bit)];

☑ 1 stop bit.

After the start bit, follows the less significant bit:



8.13.3.4 Protocol

The transmission protocol meets Standard ISO 1745 for data transmission in code. Only text characters sequences without header are used.

The errors monitoring is made through transmission related to the parity of the individual 7 bit characters, according to ISO 646. The parity monitoring is made according to DIN 66219 (even parity).

The master uses two types of messages:

- ☑ **READING TELEGRAM:** for inquiring of the inverter variable content;
- WRITING TELEGRAM: to change inverter variable content or to send controls to the inverters.



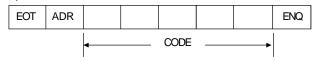
### NOTE!

No transmission between two inverters is possible. The master has the bus access control.

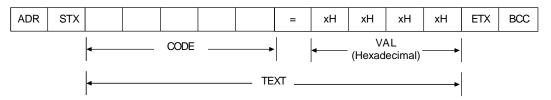
### **Reading Telegram**

This telegram allows the master receive from the inverter the content corresponding to the inquiry code. In the answer telegram the inverter transmits the data requested by the master.

### 1) Master:



### 2) Inverter:



Format of the reading telegram:

**EOT:** control character of End of Transmission;

**ADR:** inverter address (ASCII@, A, B, C, to ) (ADdRess); **CODE:** address of the 5-digit variable coded in ASCII;

**ENQ:** control character ENQuiry (enquiry).

Format of the inverter answer telegram:

ADR: 1 character - inverter address; STX: control character - Start of TeXt;

**TEXT:** consists in:

☑ CODE: address of the variable;☑ "=": separation of character;

✓ **VAL:** 4 digits value (HEXADECIMAL);

ETX: control character - End of TeXt;

BCC: CheCksum Byte- EXCLUSIVE OR of all the bytes between STX

(excluded) and ETX (included).



### NOTE!

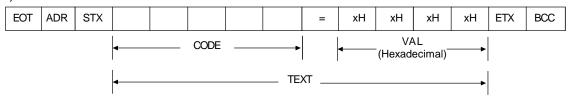
In some cases there can be an inverter answer with:

ADR NAK refer to item 8.13.3.5

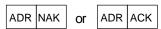
### Writing Telegram

This telegram sends data to the inverters variables. The inverter answers by indicating if the data have been accepted or not.

### 1) Master:



### 2) Inverter:



### Format of the writing telegram:

**EOT:** control character of End Of Transmission;

ADR: inverter address;

STX: control character of Start of TeXt;

**TEXT:** consists in:

☑ CODE: variable address;☑ "=": separation character;

☑ VAL: 4 HEXADECIMAL digit value;
ETX: control character of End of TeXt;

**BCC:** Byte of CheCksum - EXCLUSIVE OR of all the bytes between STX (excluded) and ETX (included).

Format of the inverter answer telegram:

### Acceptance:

☑ ADR: inverter address:

☑ ACK: ACKnowledge control character;

### No acceptance:

☑ ADR: inverter address;

NAK: Not AcKnowledge control character.
That means that the data were not accepted and the addressed variable continues with its old value.

## 8.13.3.5 Execution and Telegram Test

The inverters and the master test the telegram syntax.

The answers for the respective verified conditions are defined as follows:

### Reading telegram:

- ✓ No answer: with wrong telegram structure, control characters received incorrectly or wrong inverter address;
- ✓ NAK: CODE corresponding to the variable does not exist or there is only writing variable;
- ☑ TEXT: with valid telegrams.

### Writing telegram:

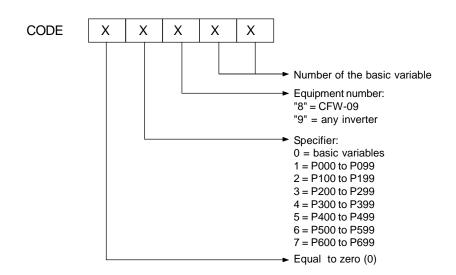
- ☑ No answer: with wrong telegram structure, control characters received incorrectly or wrong inverter address;
- NAK: code corresponding to the variable does not exist, wrong BCC (checksum byte), only reading variable, VAL out of the allowed range for the respective variable, operation parameter out of the alteration mode;
- ACK: with valid telegrams.
  The master should maintain, between two variable transmissions to the same inverter, a waiting time that is compatible with the used inverter.

### 8.13.3.6 Telegram Sequence

In the inverters, the telegrams are processed in determined time intervals. Therefore, a pause larger than the sum of the times  $T_{proc} + T_{di} + T_{txi}$  cit should be guaranteed, between two telegrams addressed to the same inverter (refer to item 8.13.6).

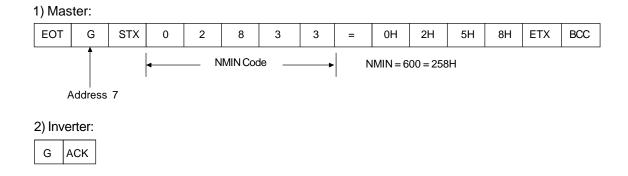
### 8.13.3.7 Variable Code

The field designated with CODE contains the parameter address and the basic variables formed by 5 digits (ASCII characters) as follows:

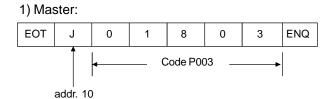


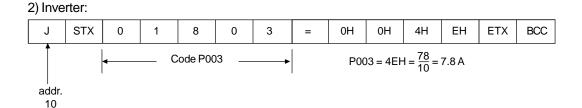
### 8.13.4 Telegram Examples

☑ Change of the minimum speed (P133) to 600 rpm in the inverter 7.



☑ Reading of output current from the inverter at address 10 (supposing that the same was at 7.8 A at the moment of the enquiry).







### NOTE!

Values sent and received via serial interface are always integer values. It is necessary to know the parameter resolution in order to read the correct value. Ex. Real Current Value = 7.8 A ⇔ Received Value = 78.

## 8.13.5 Variables and Errors of the Serial Communication

### 8.13.5.1 Basic Variables

### V00 (code 00800):

✓ Indication of the inverter type (reading variable).
The reading of this variable allows the inverter type identification. For the CFW-09 this value is 8, as defined in 8.13.3.7.

### V02 (code 00802):

- ☑ Indication of the inverter state (reading variable).
  - Logical status (byte-high)
  - Error code (byte-low)

Where:

☑ Logical status:

EL15	EL14	EL13	EL12	EL11	EL10	EL9	EL8
------	------	------	------	------	------	-----	-----

EL8: 0 = ramp enabling (run/stop) inactive 1 = ramp enabling EL9: 0 = general enabling inactive enabled 1 = general enabling active EL8 = EL9 = 1EL10: 0 = reverse1 = forward0 = JOG inactive EL11: 1 = JOG active EL12: 0 = local1 = remote0 = without undervoltage EL13: 1 = with undervoltage not used EL14: EL15: 0 = without error

Inverter

☑ Error Code: hexadecimal error number

1 = with error

Ex.:  $E00 \rightarrow 00H$  $E01 \rightarrow 01H$  $E10 \rightarrow 0AH$ 

### V03 (code 00803):

- ☑ Selection of the Logical Control Writing variable, whose bits have the following meaning:
- ☑ BYTE HIGH: desired action mask. The corresponding bit should be set to 1, so the action happens.

- CL8: 1 = enabling ramp (Start/Stop)
- CL9: 1 = general enabling
- CL10: 1 = Forward/Reverse rotation
- CL11: 1 = JOG
- CL12: 1 = Local/Remote
- CL13: not used
- CL14: not used
- CL15: 1 = inverter "RESET"
- ☑ BYTE LOW: logical level of the desired action.

CL7	CL6	CL5	CL4	CL3	CL2	CL1	CL0
MSB							LSB
- CL0:	1 = en	abling	(Start)				
	0 = dis	sabling	by rar	np (Sto	p)		
- CL1:	1 = en	abling					
	0 = ge	neral o	disablir	ng (sto	ps by ir	nertia)	
- CL2: 1 = forward							
0 = reverse							
- CL3:	L3: 1 = JOG active						
0 = JOG inactive							
- CL4:	1 = rei	mote					
	0 = loc	cal					

- ✓ CL5: not used
- CL6: not used
- ☑ CL7: the transition in this bit from 0 to 1 causes the inverter "RESET", when any error condition is present.



### NOTE!

- Disabling via Dix has priority over these disabling;
- ▼ To enable the inverter by the serial it is necessary that CL0 = CL1 = 1 and that the external disabling is inactive;
- ☑ If CL0 = CL1 = 0 simultaneously, a general disabling occurs.

### V04 (code 00804):

☑ Reference of Frequency given by Serial (reading/writing variable).

It permits sending reference to the inverter provided P221 = 9 for LOC or P222 = 9 for REM. This variable has a 13-bit resolution (refer to item 8.13.3.2).

### V06 (code 00806):

☑ Status of the Operation Mode (read variable)

| EL2 |
|-----|-----|-----|-----|-----|-----|-----|-----|
| 7   | 6   | 5   | 4   | 3   | 2   | 1   | 0   |
| MSB |     |     |     |     |     |     |     |

- EL2.0:1 = in setting mode after Reset for Factory Setting/First Start-up. The inverter enter in this status as it is energized by the first time or when the factory setting for the parameters is loaded (P204 = 5 or 6). In this mode only the parameters P023, P295, P201, P296, P400, P401, P403, P402, P404 and P406 can be accessed. If any other parameter is accessed, the inverter displays E25. For more details, refer to item 5.2 Initial Start-up.
- EL2.1:1 = in setting mode after changing the Scalar Control to Vector Control The inverter enters in this operation mode, when the Control Mode is changed from Scalar Control (P202 = 0, 1) or VVW (P202 = 5) to Vector Control (P202 = 3 or 4). In this mode only the parameters P023, P202, P295, P296, P400, P401, P403, P402, P404, P405, P406, P408, P409, P410, P411, P412 and P413 can be accessed. If any other parameter is accessed, the inverter displays E25. For more details, refer to item 5.3.2 Start-up Operation Type of Control: Vector Sensorless or with Encoder.
- EL2.2:1 = Self-Tuning execution

The inverter enters in this operation mode when P202 = 3 or 4 and  $P408 \neq 0$ . For more details about Self-tuning, refer to chapter 6 - Detailed Parameter Description, Parameter 408.

- EL2.3: 1 = in the setting mode after changing the Control Mode from V/Hz or Vector Controls to VVW.

The inverter will enter in this operation mode when the control is changed from V/Hz (P202 = 0, 1 or 2) or Vector (P202 = 3 or 4) to VVW (P202 = 5). In this mode only parameters P023, P202, P295, P296, P400, P401, P403, P402, P404, P406, P407, P399, P408, P409 are accessible. In case of accessing any other parameter, the inverter will trip with an error code E25. For additional information refer to item 5.3.3 - Start-up - Type of Control: VVW.

- EL2.4: not used

- EL2.5: not used
- EL2.6: not used
- EL2.7: not used

### V07 (code 00807):

☑ Status of the Operation Mode (read/write variable)

| CL2 |
|-----|-----|-----|-----|-----|-----|-----|-----|
| 7   | 6   | 5   | 4   | 3   | 2   | 1   | 0   |
| MSB |     |     |     |     |     |     |     |

- CL2.0: 1 It exit after reset from the setting mode to factory setting
- CL2.1: 1 After changing it exit from Scalar or VVW Control to Vector Control
- CL2.2: 1 Aborts self-tuning
- CL2.3: 1 Exits the setting mode after changing the Control Mode from V/Hz or Vector to VVW
- CL2.4: 1 Not used
- CL2.5: 1 Not used
- CL2.6: 1 Not used
- CL2.7: 1 Not used

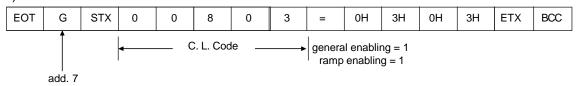
### V08 (code 00808):

☑ Motor speed in 13 bits (read variable). It permits the reading of the motor speed with a 13-bit resolution (refer to item 8.13.3.2).

## 8.13.5.2 Examples of Telegrams with Basic Variables

✓ Inverter enabling (provided P224 = 2 to LOC or P227 = 2 to REM)

### 1) Master:

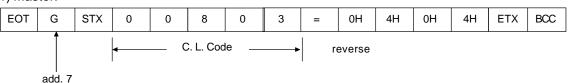


2) Inverter:

G ACK

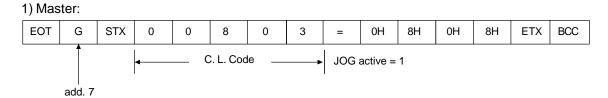
☑ Change of the direction of rotation to reverse (provided P223 = 5 or 6 to LOC or P226 = 5 or 6 to REM)

### 1) Master:



2) Inverter:

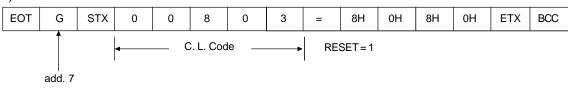
### ☑ JOG enabling (provided P225 = 3 to LOC or P228 = 3 to REM)



## 2) Inverter:

### ☑ Fault Reset

### 1) Master:



### 2) Inverter:



## 8.13.5.3 Parameters Related to the Serial Communication

Parameter number	Parameter description		
P220	Local/Remote selection		
P221	Local reference selection		
P222	Remote reference selection		
P223	Local forward/reverse selection		
P224	Local Start/Stop selection		
P225	Local JOG selection		
P226	Remote forward/reverse selection		
P227	Remote Start/Stop selection		
P228	Remote JOG selection		
P308	Inverter address on the Serial communication network		
1 300	(range values from 1 to 30)		

Table 8.22 - Parameters related to the serial communication

For further information about the parameters above, refer to chapter 6 - Detailed Parameter Description.

## 8.13.5.4 Errors Related to the Serial Communication

They act as follows:

- ☑ They do not disable the inverter;
- ☑ They do not disable defective relays;
- ☑ They are informed in the word the logical status.

### ☑ Fault Types

- -E22: longitudinal parity fault;
- -E24: parameterization fault (when some situation occurs as indicated in table 4.2. (parameter incompatibility), chapter 4 Keypad (HMI) Operation, or when there is a parameter change attempt that cannot be changed with running motor;
- -E25: variable or parameter not existing;
- -E26: expected value out of the allowed limits;
- -E27: writing attempt in a read only variable or logical control disabled;
- -E28: Serial communication is inactive. If the time programmed at P314 has elapsed without the inverter receiving a valid Modbus telegram, this is displayed by the HMI and the inverter adopts the action programmed at P313.



### NOTE!

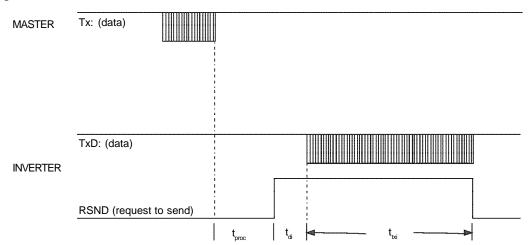
If a parity fault is detected during inverter data reception, the telegram will be ignored.

The same happens when syntax errors occur.

### Ex.:

- Code values different from the numbers 0 to 9;
- Separation character different from "=", etc.

## 8.13.6 Times for Read/Write of Telegrams



1	Time (ms)	Typical
T <sub>proc</sub>		10
T <sub>d</sub>		5
т	reading	15
txi	writing	3

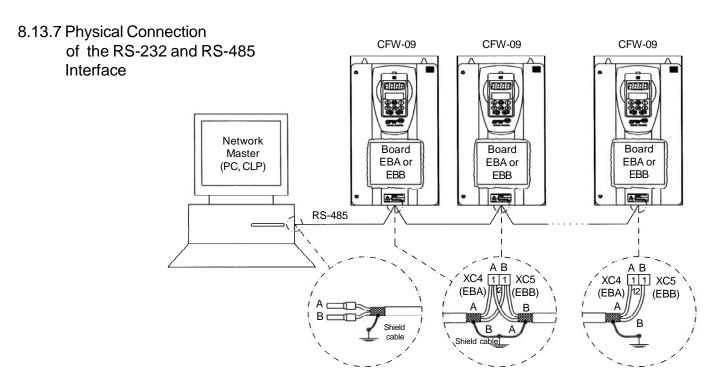


Figure 8.49 - CFW-09 network connection through RS-485 Serial Interface

### Notes:

- Arr LINE TERMINATION: include line termination (120  $\Omega$ ) at the ends. So set S3.1/S3.2 (EBA) and S7.1/S7.2 (EBB) to "ON" (refer to items 8.1.1 and 8.1.2);
- ☑ GROUNDING OF THE CABLE SHIELD: connect the shielding to the equipment frame (suitable grounding);
- ☑ RECOMMENDED CABLE: for balanced shielding. Ex: AFS series from KMP:
- ☑ The RS-485 wiring must be laid separately from the power and control cables in 110/220 V.
- ☑ The reference signal for the RS-485 interface (SREF) shall be used when
  the network master is not connected to the system/installation ground.
  For instance, if the master is powered from an isolated power supply it is
  necessary to ground the power supply reference or carry this reference
  signal to the whole system.
  - In general, it is possible to connect only signals A (-) and B (+), without connecting the signal SREF.

### **RS-232 Serial Interface Module**

The RS-232 interface is available for the CFW-09 through the module presented in item 8.6.

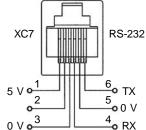


Figure 8.50 - Description of the XC7 (RJ12) connector

### Note:

The RS-232 wiring must be laid separately from the power and control cables in 110/220 V.



### NOTE!

You cannot use simultaneously the RS-232 and the RS-485 interface.

### 8.14 MODBUS-RTU

## 8.14.1 Introduction in the Modbus-RTU Protocol

The Modbus protocol has been already developed 1979 firstly. Currently it is a wide diffused open protocol, used by several manufacturers in different equipment. The Modbus-RTU communication of the do CFW-09 has been developed by considering two documents:

- 1. MODBUS Protocol Reference Guide Rev. J, MODICON, June 1996.
- 2. MODBUS Application Protocol Specification, MODBUS.ORG, may 8th 2002.

In these documents are defined the format of the messages used by these elements that are part of the Modbus network, the services (or functions) that can be made available via network, and also how these elements exchange the data on the network.

### 8.14.1.1 Transmission Modes

Two transmission modes are defined in the protocol definition: ASCII and RTU. The transmission modes define the form how the message bytes are transmitted. It is not permitted to use the two transmission modes on the same network.

In the RTU mode each transmitted word has one start bit, eight data bits, 1 parity bit (optional) and 1 stop bit (2 stop bits, if no parity bit is used). Thus the bit sequence for the transmission of 1 byte is as follows:

In the RTU mode each transmitted word has 1 start bit, eight data bits, 1 parity bit (optional) and 1 stop bit (2 stop bits, if parity bit is not used). Thus the bit sequence for the transmission is as follows:

## 8.14.1.2 Message Structure in RTU Mode

The Modbus RTU network operates in Master-Slave system and it can consist of up to 247 slaves but only one Master. The master always initiates the communication with a question to a slave and the slave answers the question. Both messages (question and answer) have the same structure: Address, Function Code and CRC. Depending on what is being requested, only the data field has variable length.

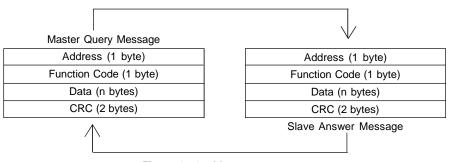


Figure 8.51 - Message structure

### Address:

The master initiates the communication by sending one byte with the address of the slave to which the message is addressed. The slave with the right slave address initiates the message with its own address. The master can also send a message destined to address 0 (zero), which means that the message is destined to all network slaves (broadcast). In this case no slave will answer to the master.

### **Function Code:**

This field contains an only byte, where the master specifies the type of service or the function requested to the slave (read, write, etc.). According to the protocol, each function is used to access a specific data type. In the CFW-09 all data are available as holding type registers (referenced from the address 40000 or' 4x'). Besides these registers, the inverter status (enabled/disabled, with error/no error and the command for the inverter (Start/Stop, Run CW/CCW, etc.) can be also accessed through the coils read/write functions or the internal bits (referenced from the address 00000 or '0x' on).

### Data Field:

This field has variable length. The format and the content of this field depend on the used function and transmitted values. This field and the respective functions are described in item 8.14.3.

### CRC:

The last part of the message is the field for checking the transmission errors. The used method is the CRC-16 (Cycling Redundancy Check). This field is formed by two bytes, where the least significant byte (CRC-) is transmitted first and only then the most significant byte is transmitted (CRC+).

CRC calculation is started by loading a 16-bit variable (mentioned from now on as CRC variable) with FFFFh value. Then following steps are executed with the following routine:

- The first message byte (only the data bits the start bit, parity bit and stop bit are not used) is submitted to the XOR logic (OR exclusive) with the 8 least significant bits of the CRC variable, returning the result to the CRC variable.
- 2. Then the CRC variable is displaced one position to the right, in the direction of the least significant bit and the position of the most significant bit is filled out with zero 0 (zero).
- 3. After this displacement, the flag bit (bit that has been displaced out the CRC variable) is analyzed, by considering the following:
  - ☑ If the bit value is 0 (zero), no change is made.
  - If the bit value is 1, the CRC variable content is submitted to XOR logic with a constant A001h value and the value is returned to the CRC variable.
- 4. Repeat steps 2 and 3 until the eight displacements have been realized.
- 5. Repeat the steps 1 to 4, by using the next byte message until the whole message have been processed. The end content of the CRC variable is the value of the CRC field that is transmitted at the end of the message. The least significant part is transmitted first (CRC), only then the most significant part (CRC+) is transmitted.

### **Times between Messages:**

In the RTU mode there is no specific character that indicates the beginning or the end of a message. Thus the only indication for the beginning or the end of a new message is the data transmission absence in the network by 3.5 times the time required for transmission of one data word (11 bits). Thus if a message is initiated after elapsing of the minimum time required without transmission, the network elements assume that the received character represents the beginning of a new message. In similar mode, after this time has elapsed, the network elements will assume that the message has been ended.

If during the transmission of a message, the time between the bytes is longer than this minimum required time, the message will be considered invalid, since the inverter will discard the already received bytes and will mount a new message with the bytes that are being transmitted.

The table below shows the time for three different communication rates.

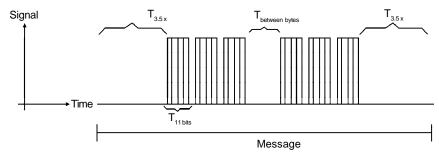


Figure 8.52 - Times required during the communication of a message

Communication Rate	T <sub>11 bits</sub>	T <sub>3.5x</sub>
9600 kbits/sec	1.146 ms	4.010 ms
19200 kbits/sec	573 μs	2.005 ms
38400 kbits/sec	285 μs	1.003 ms

 $\begin{array}{ll} T_{_{11\, bits}} &= Time\ to\ transmit\ one\ word\ of\ the\ message. \\ T_{_{entre\ bytes}} &= Time\ between\ bytes\ (can\ not\ be\ longer\ than\ T_{_{3.5x}}). \\ T_{_{3.5x}} &= Minimum\ interval\ to\ indicate\ the\ begin\ and\ the\ end$ = Minimum interval to indicate the begin and the end of the message  $(3.5 \times T_{11bits})$ .

8.14.2 Operation of the CFW-09 in the Modbus-RTU Network

The CFW-09 frequency inverters operate as slaves of the Modbus-RTU network. The communication initiates with the master of the Modbus-RTU network requesting a service for a network address. When the inverter is configured to the corresponding address, it processes the question and answers to the master as requested.

8.14.2.1 Interface RS-232 and **RS-485 Description** 

The CFW-09 frequency inverters use a serial interface for the communication with the Modbus-RTU network. There are two ways to perform the connection between the network master and the CFW-09:

### RS-232:

- ☑ The interface is used for the point-to-point connection (between a single slave and the master).
- ☑ Maximum distance: 10 meters.
- ☑ Signal levels according to EIA STANDARD RS-232C.
- ☑ Three wires: transmission (TX), reception (RX) and return (0 V).
- ☑ The serial interface RS-232 must be used.

### RS-485:

- ☑ This interface is used for multipoint connection (several slaves and the master).
- ☑ Maximum distance: 1000 meters (use of shielded cables).
- ☑ Signal levels according to EIA STANDARD RS-485.
- ☑ You must use the EBA or EBB expansion board that has interface for the RS-485 communication.

Note: for connection, refer to item 8.13.7.

# 8.14.2.2 Inverter Configuration in the Modbus-RTU Network

To ensure a correct communication in the network, you must configure the inverter address in the network as well as the transfer rate and the existing parity type, besides the correct physical connection.

### **Inverter Address in the Network:**

- ☑ The inverter address is defined through the parameter P308.
- ☑ If the serial communication type (P312) has been configured to Modbus-RTU, you may select the addresses from 1 to 247.
- ☑ Each slave shall have a different address.
- ☑ The master does not have address.
- The slave address must be known, even when connection is made point-to-point.

### **Transmission Rate and Parity:**

- ☑ Both configurations are defined by parameter P312.
- ☑ Baud rates: 9600, 19200 or 38400 kbits/sec.
- Parity: None, odd or even.
- All slaves and even the network master must use the same baud rate and parity.

## 8.14.2.3 Access to the Inverter Data

All parameters and available basic variables for the CFW-09 can be accessed through the network:

- ✓ Parameters: are those set in the inverter and that can be displayed and changed through the HMI (Human-Machine Interface) (refer to item I -Parameters).
- ☑ Basic Variables: are the internal inverter variables that can be accessed only through serial interface. For instance, through these basic variables you can change the speed reference, read the inverter status, enable or disable the inverter, etc. (refer to item 8.13.5.1 - Basic Variables).
- ☑ Register: nomenclature used to represent both parameters and basic variables during data transfer.
- ✓ Internal Bits: bits that are accessed only through the serial interface and that are used for inverter status controlling and monitoring. item 8.13.3.2 defines the resolution of the parameters and variables transmitted via serial interface.

### Available Functions and Response Times:

In the Modbus RTU protocol specification is defined the functions used for accessing different types of registers described in the specification. In the CFW-09 both parameters and basic variables are defined as being holding type registers (referenced as 4x). In addition to these registers, it is also possible to access the internal controlling and monitoring bits directly (referenced as 0x).

Following services (or functions) are available in the CFW-09 frequency inverter for accessing these registers:

### ☑ Read Coils

Description: reading of internal register blocks or coils.

Function code: 01.

Broadcast: not supported. Response time: 5 to 10 ms.

### ☑ Read Holding Registers

Description: reading of register blocks of holding type.

Function code: 03. Broadcast: not supported. Response time: 5 to 10 ms.

### **☑** Write Single Coil

Description: writing in a single internal bit or coil.

Function code: 05. Broadcast: supported. Response time: 5 to 10 ms.

### **☑** Write Single Register

Description: writing in a single register of holding type.

Function code: 06. Broadcast: supported. Response time: 5 to 10 ms.

### ☑ Write Multiple Coils

Description: writing in internal bit blocks or coils.

Function code: 15. Broadcast: supported. Response time: 5 to 10 ms.

### ☑ Write Multiple Registers

Description: writing in register blocks of holding type.

Function code: 16. Broadcast: supported.

Response time: 10 to 20 ms for each written register.

### ☑ Read Device Identification

Description: Identification of the inverter model.

Function code: 43. Broadcast: not supported. Response time: 5 a 10 ms.

Note: The Modbus RTU network slaves are addressed from 1 to 247. Master uses address 0 to send messages that are common to all slaves (broadcast).

### **Data Addressing and Offset:**

The CFW-09 data addressing is realized with an offset equal to zero that means that the address number is equal to the register number. The parameters are available from address 0 (zero) on, whilst the basic variables are available from address 5000 on. In same way, the status bits are made available from

address 0 (zero) on and the control bits are made available from address 100 on.

Table below shows the addressing of bits, parameters and basic variables:

Parameters					
Parameter Number	Modbus	Address			
Parameter Number	Decimal	Hexadecimal			
P000	0	00h			
P001	1	01h			
:	:	:			
P100	100	64h			
:	:	:			

Basic Variables				
Number of the	Modbus Address			
Basic Variable	Decimal	Hexadecimal		
V00	5000	1388h		
V01	5001	1389h		
<u> </u>	:	:		
V08	5008	1390h		

Status Bits			
DitNiverbox	Modbus Address		
Bit Number	Decimal	Hexadecimal	
Bit 0	00	00h	
Bit 1	01 01h		
:	i i	:	
Bit 7	07	07h	

Commands Bits			
Bit Number	Modbus Address		
Dit Number	Decimal	Hexadecimal	
Bit 100	100	64h	
Bit 101	101 65h		
:	:	:	
Bit 107	107	6Bh	

**Note:** All registers (parameters and basic variables) are considered as *holding* type registers, referenced from 40000 or 4x, whilst the bits are referenced from 0000 or 0x.

The status bits have the same functions of the bits 8 to 15 of the logic status (basic variable 2). These bits are available only for read, thus any attempt to write command returns error status to the master.

Status Bits		
Bit Number Function		
Bit 0	0 = Ramp enabling inactive	
Dit 0	1 = Ramp enabling active	
Bit 1	0 = General enabling inactive	
DIC 1	1 = General enabling active	
Bit 2	0 = Counter-clockwise direction of rotation	
DIL Z	1 = Clockwise direction of rotation	
Bit 3	0 = JOG inactive	
	1 = JOG active	
Bit 4	0 = Local Mode	
Bit 4	1 = Remote Mode	
Bit 5	0 = No undervoltage	
	1 = With undervoltage	
Bit 6	Not used	
Bit 7	0 = No fault	
	1 = With fault	

The command bits are available to read and write and they have the same function of the logic command bits 0 to 7 (basic variable 3), however no requiring the use of the mask. The basic variable 3 write influences the status of these bits.

Command Bits		
Bit Number	Function	
Bit 100	0 = Ramp disable (Stop)	
Bit 100	1 = Ramp enable (Start)	
Bit 101	0 = General disable	
DIL 101	1 = General enable	
Bit 102	0 = Counter-clockwise direction of rotation	
Dit 102	1 = Clockwise direction of rotation	
Bit 103	0 = JOG disable	
DIL 103	1 = JOG enable	
Bit 104	0 = Goes to local mode	
DIL 104	1 = Goes to remote mode	
Bit 105 Not used		
Bit 106	Not used	
Bit 107	0 = It does not reset inverter	
DIL 107	1 = It resets inverter	

## 8.14.3 Detailed Function Description

This Item describes in details the functions that are available in the CFW-09 for the Modbus RTU communication. Please note the following during the message preparation:

- ☑ Values are always transmitted as hexadecimal values.
- ☑ The address of one data, the data number and the value of the registers are always represented through 16 bits. Thus these fields are transmitted by using two bytes (high and low). To access the bits, and the form to represent one bit depend on the used function.
- ☑ The messages, both for enquiry and response, cannot be longer than 128 bytes.
- ☑ The resolution of each parameter or basic variable is as described in item 8.13.3.2.

## 8.14.3.1 Function 01 - Read Coils

It reads the content of an internal group of bits that must compulsorily in a numerical sequence. This function has the following structure for the read and response messages (the values are always hexadecimal, and each filed represents one byte):

Query (Master)	Response (Slave)
Slave address	Slave address
Function	Function
Initial bit address (byte high)	Byte Count Field (number of data bytes)
Initial bit address (byte low)	Byte 1
Number of bits (byte high)	Byte 2
Number of bits (byte low)	Byte 3
CRC-	etc to
CRC+	CRC-
-	CRC+

Each response bit is placed at a position of the data bytes sent by the slave. The first byte, from the bits 0 to 7, receives the first 8 bits from the initial address indicated by the master. The other bytes (if the number of the read bits is higher than 8) remain in the same sequence. If the number of the read bits is not a multiple of 8, the remaining bits of the last byte should be filled out with 0 (zero).

☑ Example: reading of the status bits for general enable (bit 1) and direction of rotation (bit 2) of then CFW-09 at the address 1:

Query (Master)		Response (Slave)	
Field	Value	Field	Value
Slave address	01h	Slave address	01h
Function	01h	Function	01h
Initial bit address (byte high)	00h	Byte Count	01h
Initial bit address (byte low)	01h	Status of the bits 1 and 2	02h
Number of bits (byte high)	00h	CRC-	D0h
Number of bits (byte low)	02h	CRC+	49h
CRC-	ECh	-	-
CRC+	0Bh	-	-

As the number of read bits in the example is smaller than 8, the slave required only 1 byte for the response. The value of the byte was 02h, that as binary value will have the form 0000 0010. As the number of read bits is equal to 2, only the two less significant bits, that have the value 0 = general disable and 1 = direction of rotation, are of interest. The other bits, as they did not be requested, are filled out with 0 (zero).

## 8.14.3.2 Function 03 - Read Holding Register

It reads the content of a group of registers that must be compulsorily in a numerical sequence. This function has following structure for the read and response messages (the values are always hexadecimal values, and each field represents one byte):

Query (Master)	Response (Slave)
Slave address	Slave address
Function	Function
Initial register address (byte high)	Byte Count Field
Initial register address (byte low)	Data 1 (high)
Number of registers (byte high)	Data 1 (low)
Number of registers (byte low)	Data 2 (high)
CRC-	Data 2 (low)
CRC+	etc to
	CRC-
-	CRC+

☑ Example: Read of the value proportional to the frequency value (P002) and motor current (P003) of the CFW-09 at address 1:

Query (Master)		Response (Slave)	
Field	Value	Field	Value
Slave address	01h	Slave address	01h
Function	03h	Function	03h
Initial register (byte high)	00h	Byte Count	04h
Initial register (byte low)	02h	P002 (high)	03h
Number of registers (byte high)	00h	P002 (low)	84h
Number of registers (byte low)	02h	P003 (high)	00h
CRC-	65h	P003 (low)	35h
CRC+	CBh	CRC-	7Ah
	-	CRC+	49h

Each register is always formed by two bytes (high e low). For the example, we have P002 = 0384h, that in decimal number is equal to 900. As these parameters do not have a decimal place indication, the real read value is 900 rpm. In the same way we will have a current value P003 = 0035h, that is equal to a 53 decimal. As the current has a decimal resolution, the read value is 5.3 A.

## 8.14.3.3 Function 05 - Write Single Coil

This function is used to write a value to a single bit. The bit value is represented by using two bytes, where FF00h represents the bit that is equal to 1, and 0000h represents the bit that is equal to 0 (zero). It has the following structure (the values are always hexadecimal, and each field represents one byte):

Query (Master)	Response (Slave)
Slave address	Slave address
Function	Function
Bit address (byte high)	Bit address (byte high)
Bit address (byte low)	Bit address (byte low)
Bit value (byte high)	Bit value (byte high)
Bit value (byte low)	Bit value (byte low)
CRC-	CRC-
CRC+	CRC+

$\checkmark$	Example: to drive a ramp enable command (bit $100 = 1$ ) of a CFW-09
	at the address 1:

Query (Master)		Response (Slave)	
Field	Value	Field	Value
Slave address	01h	Slave address	01h
Function	05h	Function	05h
Bit number (high)	00h	Bit number (high)	00h
Bit number (low)	64h	Bit number (low)	64h
Bit value (high)	FFh	Bit value (high)	FFh
Bit value (low)	00h	Bit value (low)	00h
CRC-	CDh	CRC-	CDh
CRC+	E5h	CRC+	E5h

For this function, the slave response is an identical copy of the query sent by the master.

## 8.14.3.4 Function 06 - Write Single Register

This function is used to write a value to a single register. This function has following structure (values are always hexadecimal values, and each field represents one byte):

Query (Master)	Response (Slave)
Slave address	Slave address
Function	Function
Register address (byte high)	Register address (byte high)
Register address (byte low)	Register address (byte low)
Value for the register (byte high)	Value for the register (byte high)
Value for the register (byte low)	Value for the register (byte low)
CRC-	CRC-
CRC+	CRC+

Example: write of the speed reference (basic variable 4) equal to 900 rpm, of a CFW-09 at address 1. Please, remember that the value for the basic variable 4 depends on the used motor type and that the value 8191 is equal to the rated motor speed. In this case, we suppose that the used motor has a rated speed of 1800 rpm, thus the value to be written into the basic variable 4 for a speed of 900 rpm is the halve of 8191, i.e., 4096 (1000h).

Query (Master)		Response (Slave)	
Field	Value	Field	Value
Slave address	01h	Slave address	01h
Function	06h	Function	06h
Register (high)	13h	Register (high)	13h
Register (low)	8Ch	Register (low)	8Ch
Value (high)	10h	Value (high)	10h
Value (low)	00h	Value (low)	00h
CRC-	41h	CRC-	41h
CRC+	65h	CRC+	65h

For this function, the slave response will be again a copy identical to the request made by the master. As already informed above, the basic variables are addressed from 5000, thus the basic variable 4 will be addressed at 5004 (138Ch).

## 8.14.3.5 Function 15 - Write Multiple Coils

This function allows writing values for a bit group that must be in numerical sequence. This function can be also used to write a single bit (the values are always hexadecimal, and each field represents one byte).

Query (Master)	Response (Slave)
Slave address	Slave address
Function	Function
Initial bit address (byte high)	Initial bit address (byte high)
Initial bit address (byte low)	Initial bit address (byte low)
Number of bits (byte high)	Number of bits (byte high)
Number of bits (byte low)	Number of bits (byte low)
Byte Count Field (number of data bytes)	CRC-
Byte 1	CRC+
Byte 2	-
Byte 3	-
etc to	-
CRC-	-
CRC+	-

The value of each bit that is being sent is placed at a position of the data bytes sent by the master. The first byte, in the bits 0 to 7, receives the 8 first bits by starting from the initial address indicated by the master. The other bytes (if the number of inscribed bits is higher than 8) remain in sequence. If the number of inscribed bits is not a multiple of 8, the remaining bits of the last byte should be filled in with 0 (zero).

☑ Example: command writing for general enabling (bit 100 = 1), general enabling (bit 101 = 1) and CWW-direction of rotation (bit 102 = 0), for a CFW-09 at address 1:

Query (Master)		Response (Slave)	
Field	Value	Field	Value
Slave address	01h	Slave address	01h
Function	0Fh	Function	0Fh
Initial bit (byte high)	00h	Initial bit (byte high)	00h
Initial bit (byte low)	64h	Initial bit (byte low)	64h
Number of bits (byte high)	00h	Number of bits (byte high)	00h
Number of bits (byte low)	03h	Number of bits (byte low)	03h
Byte Count	01h	CRC-	54h
Bits Value	03h	CRC+	15h
CRC-	BEh	-	-
CRC+	9Eh	-	-

As only three bits are written, the master needed only one byte to transmit the data. The transmitted values are in the three less significant bits of the byte that contains the value for the bits. The other bits of this byte remained with the value 0 (zero).

## 8.14.3.6 Function 16 - Write Multiple Registers

This function allows writing values to a register group that must be in numerical sequence. This function can also be used to write a single register (the values are always hexadecimal values and each field represents one byte).

Query (Master)	Response (Slave)	
Slave address	Slave Address	
Function	Function	
Initial register address (byte high)	Initial register address (byte high)	
Initial register address (byte low)	Initial register address (byte low)	
Number of registers (byte high)	Number of registers (byte high)	
Number of registers (byte low)	Number of registers (byte low)	
Byte Count Field (number of data bytes)	CRC-	
Data 1 (high)	CRC+	
Data 1 (low)	-	
Data 2 (high)	-	
Data 2 (low)	-	
etc to	-	
CRC-	-	
CRC+	-	

☑ Example: writing of the acceleration time P100 = 1.0 s and deceleration time P101 = 2.0 s, of a CFW-09 at the address 20:

Query (Master)		Response (Slave)	
Field	Value	Field	Value
Slave address	14h	Slave address	14h
Function	10h	Function	10h
Initial register (byte high)	00h	Initial register (byte high)	00h
Initial register (byte low)	64h	Initial register (byte low)	64h
Number of registers (byte high)	00h	Number of registers (byte high)	00h
Number of registers (byte low)	02h	Number of registers (byte low)	02h
Byte Count	04h	CRC-	02h
P100 (high)	00h	CRC+	D2h
P100 (low)	0Ah	-	-
P101 (high)	00h	-	-
P101 (low)	14h	-	-
CRC-	91h	-	-
CRC+	75h	-	-

As the two parameters have a resolution of a decimal place for writing of 1.0 and 2.0 seconds, thus the values 10 (000Ah) and 20 (0014h) should be transmitted.

## 8.14.3.7 Function 43 - Read Device Identification

Auxiliary function that permits reading of the manufacturer, model and version of the product firmware. It has following structure.

Query (Master)	Response (Slave)
Slave address	Slave Address
Function	Function
MEI Type	MEI Type
Read Code	Conformity Level
Object Number	More Follows
CRC-	Next Object
CRC+	Number of Objects
<u>-</u>	Object Code*
<u>-</u>	Object Length*
-	Object Value*
-	CRC-
-	CRC+

<sup>\*</sup>The fields are repeated according to the number of objects.

This function permits reading of three information categories:

Basic, Regular and Extended and each category are formed by a group of objects. Each object is formed by a sequence of ASCII characters For the CFW-09 are only available basic information formed by three objects:

- ☑ Object 00 VendorName: always 'WEG'.
- ☑ Object 01 ProductCode: formed by the product code (CFW-09), plus the rated inverter current.
- ☑ Object 02 MajorMinorRevision: it indicates the inverter firmware version, in 'VX.XX' format.

The read code indicates which information categories are being read and if the objects are accessed individually of by sequence.

In the example, the inverter supports 01 (basic information in sequence), and 04 (individual access to the objects).

The other fields for the CFW-09 have fixed values.

Example: read o basic information in sequence, starting from object 00, of a CFW-09 at address 1:

Query (Master)		Response (Slav	re)		
Field	Value	Field	Value		
Slave address	01h	Slave address	01h		
Function	2Bh	Function	2Bh		
MEI Type	0Eh	MEI Type	0Eh		
Read Code	01h	Read Code	01h		
Object Number	00h	Conformity Level	51h		
CRC-	70h	More Follows	00h		
CRC+	77h	Next Object	00h		
<u>-</u>	-	Number of Objects	03h		
-	-	Object Code	00h		
-	-	Object Length	03h		
-	-	Object Value	'WEG'		
-	-	Object Code	01h		
-	-	Object Length	0Eh		
-	-	Object Value	'CFW-09 7.0A'		
-	-	Object Code	02h		
-	-	Object Length	05h		
-	-	Object Value	'V2.09'		
-	-	CRC-	B8h		
- 	-	CRC+	39h		

In the example the Object Value has not been represented as hexadecimal value, but with corresponding ASCII characters.

For instance, for the object 00, the 'WEG' value has been transmitted as being three ASCII characters, that as hexadecimal have the values 57h (W), 45h (E) and 47h (G).

### 8.14.4 Communication Errors

Errors can occur during the message transmission on network, or in the content of the received messages. Depending on the error type, inverter may answer or not to the master:

When the master sends a message to an inverter configured at determined network address, the inverter will not response if:

- ☑ Error in the parity bit.
- ☑ Error the CRC.
- ☑ Timeout between transmitted bytes (3.5 times the time required for the transmission of an 11-bit word).

In the case of a successful reception of the message, the inverter can detect problems and send an error message to the master indicating the problem that has been verified:

- ☑ Invalid function (error code = 1): the requested function has not been implemented for the inverter.
- ✓ Invalid data address (error code = 2): the data address (register or bit) does not exist.
- ☑ Data value invalid (error code = 3): this error occurs in the following conditions:
  - Value is out of permitted range.
  - Writing in data that cannot be changed (only read register, or register that does not allow changing with enabled inverter or bits of logic status).
  - Writing in function of the logic command that has not been enabled via serial interface.

## 8.14.4.1 Error Messages

When any error occurs in the message content (not during the data transfer), the slave must return a message indicating the error type that occurred. The errors that may occur in the CFW-08 during the message processing are errors relating to invalid function (code 01), invalid data address (code 02) and invalid data value (code 03).

The messages sent by the slave have following structure:

Response (Slave)
Slave address
Function Code
(with most significant bit to 1)
Error code
CRC-
CRC+

☑ Master requests from the slave at address 1 to write parameter 89 (inexistent parameter):

## CHAPTER 8 - CFW-09 OPTIONS AND ACCESSORIES

Query (Master)		Response (Slave)				
Field	Value	Field	Value			
Slave address	01h	Slave address	01h			
Function	06h	Function	86h			
Register (high)	00h	Error Code	02h			
Register (low)	59h	CRC-	C3h			
Value (high)	00h	CRC+	A1h			
Value (low)	00h	-	-			
CRC-	59h	-	-			
CRC+	D9h	-	-			

## 8.15 KIT KME (for Extractable Mounting)

Lifting support set

The kit KME enables the mounting of CFW-09 inverter in the sizes 7, 8, 8E, 9, 10 and 10E (models 361 A to 600 A/380-480 V, 107 A to 472 A/500-690 V and 100 A to 428 A/660-690 V) in the panel in an extractable form. The inverter is mounted in the panel like a sliding drawer, thus making easier the assembling and maintenance works. When requesting this kit, please specify the following:

Item	Description	Notes				
		Size 10 - 450 A to 600 A/380-480 V and				
<i>4</i> 1710 <i>4</i> 800	KIT KME - CFW-09 M10/L = 1000	Size 10E - 247 A to 472 A/500-690 V and				
417104033		255 A to 428 A/660-690 V				
		Panel width = 1000 mm (39.37 in)				
		Size 10 - 450 A to 600 A/380-480 V and				
417104467	KIT KME - CFW-09 M10/L = 800	Size 10E - 247 A to 472 A/500-690 V and				
417104407	KIT KIVIL - CIT VV-09 IVI TO/L = 000	255 A to 428 A/660-690 V				
		Panel width = 800 mm (31.50 in)				
117101909	KIT KME - CFW-09 M9/L = 800	Size 9 - 312 A to 361 A/380-480 V				
	NT NVIL - OF W-03 W3/L = 000	Panel width = 800 mm (31.50 in)				
		Size 8 - 211 A to 240 A/380-480 V and				
/1710/806	KIT KME - CFW-09 M8/L = 600	Size 8E - 107 A to 211 A/500-690 V and				
417104030	NT NIVIL - OF W-03 W0/L = 000	100 A to 179 A/660-690 V				
		Panel width = 600 mm (23.62 in)				
		Size 8 - 211 A to 240 A/380-480 V				
/1710/807	KIT KME - CFW-09 M8/L = 800	Size 8E - 107 A to 211 A/500-690 V and				
417104097	KIT KIVIL - CIT VV-09 IVIO/L = 000	100 A to 179 A/660-690 V				
		Panel width = 800 mm (31.50 in)				
		Size 7 - 142 A/380-480 V and				
417104895	KIT KME - CFW-09 M7/L = 600	44 A to 79 A/500-600 V				
		Painel width = 600 mm (23.62 in)				

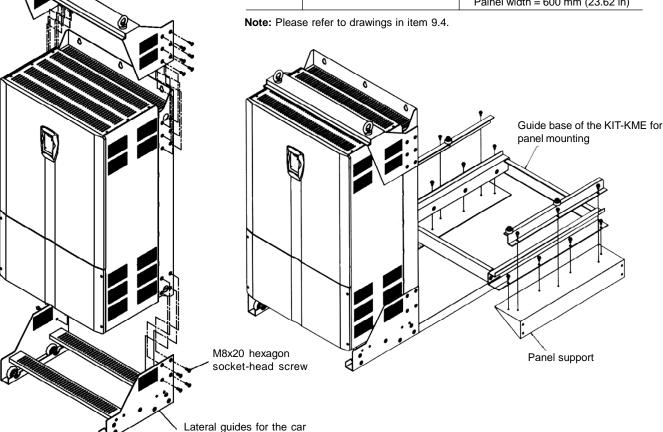


Figure 8.53 - Mounting of the KIT-KME on the inverter

## 8.16 CFW-09 SHARK NEMA 4X

In applications that need a inverter with a higher protection enclosure, the CFW-09 SHARK NEMA 4X is indicated. The NEMA 4X provides protection against dust, dirt and splashing or hose-directed water.

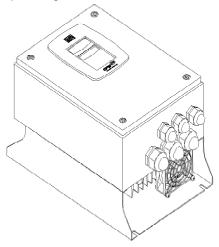


Figure 8.54 - CFW-09 Shark Nema 4X

The SHARK NEMA 4X is the CFW-09 standard with a stainless steel enclosure. The models are:

_						
	CFW	09	0006	Т	2223	
	CFW	09	0007	Т	2223	Size 1 (*)
	CFW	09	0010	Т	2223	
	CFW	09	0016	Т	2223	Size 2 <sup>(*)</sup>
	CFW	09	0003	Τ	3848	
	CFW	09	0004	Т	3848	Size 1 <sup>(*)</sup>
	CFW	09	0005	Т	3848	
	CFW	09	0009	Т	3848	
	CFW	09	0013	Т	3848	Size 2 <sup>(*)</sup>
_	CFW	09	0016	Т	3848	

(\*) The Shark inverter dimensions are distinct from the standard CFW-09 inverter, so, the Sizes 1 and 2 from the Shark inverter are different from the Sizes 1 and 2 of the standard CFW-09.

## 8.16.1 Enclosure Specifications

NEMA Type 4X indoors;

NEMA Type 12 indoors;

IP 56;

Other specifications are same to the standard CFW-09 and are explained along this manual.

## 8.16.2 Mechanical Installation

The inverter comes covered by a plastic film. Remove this sheet before starting the installation.

Install the inverter in an environment that does not exceed Type 4 / 4X / 12 limitations.

Install the inverter on a flat surface, in the vertical position.

External dimensions and mounting holes are according to figures 8.55 and 8.56.

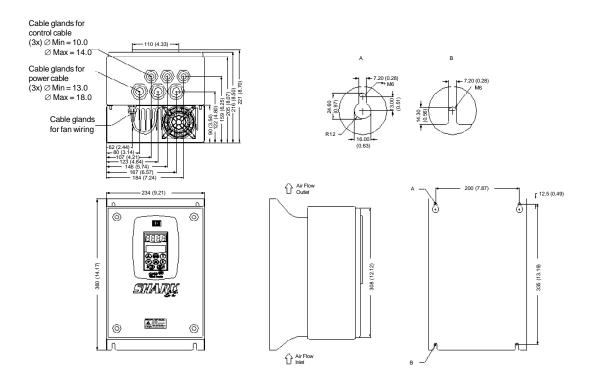


Figure 8.55 - Mechanical data - Size 1, dimensions mm (in)

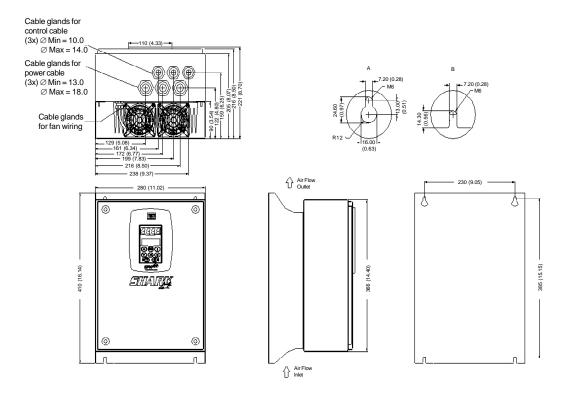


Figure 8.56 - Mechanical data - Size 2, dimensions mm (in)

## 8.16.3 Electrical Installation

The electrical installation is the same as CFW-09 standard. Refer to chapter 3, item 3.2 to make a correct electrical installation.



#### NOTE!

To assure the NEMA 4X total protection, it is necessary to use correct cables. It is recommended to use armored multi-core cables. For example, one tetrapolar armored cable for Power supply (R, S, T) plus grounding, and another tetra-polar armored cable for output (motor) connection.

The wire sizing and fuses are presented in table 3.5, chapter 3.



Figure 8.57 - Tetra-polar armored cable

The control and power wiring access to the inverter is through the cable glands. All the cable glands come with a gasket inside. To make the electrical installation it is necessary to remove the gasket from the cable gland and then pass the armored multi-core cable in the cable gland.

After doing the electrical connection and arrange the cables properly, tight the cable glands to assure that the cable is very strongly fastened. The recommended torque is 2 N.m (0.2 kgf.m).

The control wiring has to be made by armored multi-core cables too. It is necessary to use this type of cables to guarantee total closing after cable glands tightening. Check the maximum and minimum diameter of the cables supported by the Cable Glands in figures 8.55 and 8.56.

## 8.16.4 Closing the Inverter

To guarantee NEMA 4X degree of protection, it is very important to close correctly the inverter after doing the electrical installation. Please, follow these instructions:

After the electrical installation is completed and the cable glands tightened, close the frontal cover (certify that the flat cable that interconnects the HMI to the control card is correctly connected) by tightening each screw a little at a time, until total tightening.

The gaskets provide the protection of the electronic parts of the SHARK inverter. Any problem with them can cause problems with the protection degree. Opening and closing the inverter many times reduces the gaskets lifetime. It is recommended to do this no more than 20 times. If problems are detected on the gaskets, we recommend changing the failed gasket immediately. Certify that the door gasket is on its correct position at the moment you will close the inverter.

Certify that the door screw gaskets are perfect on the moment you are ready to close the inverter.

All these recommendations are very important to become a successful installation.



#### NOTE!

Do not remove the gaskets inside the cable glands, which were not used. They are necessary to guarantee NEMA 4X protection.

8.16.5 How to Specify

To specify a NEMA 4X inverter, it is necessary to include the term "N4" in the field "Enclosure Degree of Protection" according to the CFW-09 specification in chapter 2, item 2.4 (CFW-09 Identification). Remember that the NEMA 4X line is only up to 10 hp.

8.17 CFW-09 SUPPLIED BY THE DC LINK – LINE HD

- ☑ The CFW-09HD inverter line, supplied by DC Link, has the same installation, mechanical, programming and performance characteristics as the Standard CFW-09 line;
- ☑ Up to size 5, an HD inverter is required to make the supply through the DC Link. In this case is sufficient to supply a standard inverter through the DC Link with an external pre-charge circuit;
- ☑ The models of size 6 and larger are fitted with an internal pre-charge circuit and have internal changes;
- ☑ For more detail, refer please to the Addendum of the CFW-09 Frequency Inverter Manual of the CFW-09HD line supplied by DC Link. (Refer to www.weg.net).
- 8.18 CFW-09 RB
  REGENERATIVE
  CONVERTER

There are two problems associated to a conventional inverter with diode bridge at the input: harmonics injection to the network and braking of loads with high inertia, or that run at high speeds and require short braking times. The harmonic injection to the network happens with any type of load. The braking problems appear with loads such as sugar centrifuges, dynamometers, cranes and winders. The CFW-09 converter with RB option (Regenerative Braking) is WEG solution for these problems (refer to figure 8.58).

Shows the main components of a inverter with CFW-09 RB.

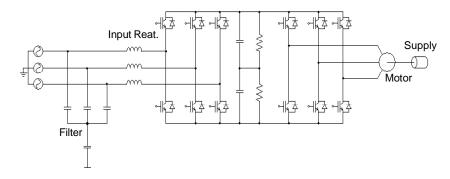


Figure 8.58 - Simplified diagram of a driving with CFW-09 RB

As shown in the figure 8.58, CFW-09RB unit is fitted with a capacitor bank and an IGBTs bridge.

Externally is mounted a network reactance and a capacitive filter.

By switching the IGBTs bridge, the energy can be transferred in a controlled way from the network to the capacitor bank. One can say that by means of the switching process, the CFW-09RB emulates a resistive load. There is also a capacitive filter to prevent the bridge switching interferes in other network loads. To complete this drive, the use of a CFW-09HD is required that drives the motor and its load. This drive is shown in figure 8.58 by the second de IGBTs bridge. Figure 8.59 a) shows wave shapes of the CFW-09 RB input voltage and current, when the motor at the drive output is operating normally.

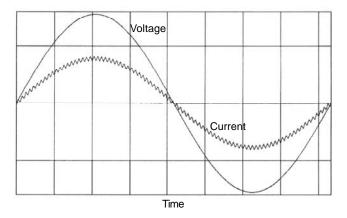


Figure 8.59 a) - Functioning during operation as motor

Figure 8.59 b) shows the wave shapes of the CFW-09 RB input voltage and current, when the motor at the drive output is submitted to a braking process.

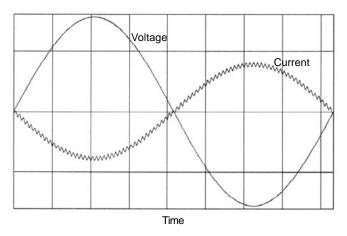


Figure 8.59 b) - Functioning during the braking process

For more details, refer to the CFW-09 RB Regenerative Converter Manual. (Refer to www.weg.net).

### 8.19 PLC BOARD

The PLC1 and PLC2 boards allow the CFW-09 inverter to have PLC function, speed reference and positioning modules. This board is optional and is incorporated internally into the CFW-09.

Both boards cannot be used simultaneously with the EBA, EBB, EBC, EBE boards.

The PLC1 cannot be used with Fieldbus boards.

The PLC2 can have Fieldbus board mounted.

#### **Technical Characteristics**

- ☑ Positioning with trapezoidal and "S" profile (absolute and relative);
- ☑ Homing (machine zero search);
- ☑ Programming in Ladder language through the WLP Software, Timers, Contactors, Coils and Contacts;
- ☑ RS-232 with Modbus RTU protocol;
- Availability of 100 parameters that may be set by the user through the Software or via HMI;
- ☑ CAN interface with CANopen and DeviceNet protocols;
- ☑ Master/Slave function (ElectronicGear Box);
- ☑ It has own 32 bits CPU with flash memory.

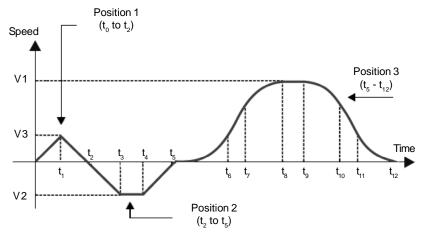


Figure 8.60 - Trajectory example by using the PLC board

	Technical Specification											
Input/Output	I	PLC 1	PLC 2									
input/Output	Quantities	Description	Quantities	Description								
Digital inputs	9	24 Vdc bipolar	9	24 Vdc bipolar								
		250 Vac/3 A ou		250 Vac/3 A or								
Relay outputs	3	250 Vdc/3 A	3	250 Vdc/3 A								
		04 \/ d= /500 A		24 )/4-/500 4								
Transistorized outputs	3	24 Vdc/500 mA	3	24 Vdc/500 mA								
Encoder power supply	1	15 V	2	5 to 24 V								
Analog output	-	-	2	12 bits (-10 V to +10 V or (0 to 20) mA)								
Analog input	-	-	1	14 bits (-10 V to +10 V or (-20 to 20) mA)								
Motor PTC isolated input	-	-	1	Motor PTC isolated input								

Note: For more details, refer to the PLC Board Manual. The manual is available in the site: www.weg.net.

## TECHNICAL SPECIFICATIONS

This chapter describes the technical specifications (electrical and mechanical) of the CFW-09 inverter series.

### 9.1 POWER DATA

## 9.1.1 Power Supply Specifications

### Operating voltage range:

- ☑ 220-230 V, 380-480 V and 660-690 V models: -15 % to +10 %.
- ☑ 500-600 V models up to 32 A: -15 % of rated input voltage up to 690 V.
- **☑** 500-600 V models higher or equal to 44 A:
  - -500 V = -15 % to +15 %;
  - -525 V = -15 % to +15 %;
  - -550 V = -15 % to +20 %;
  - -575 V = -15 % to +15 %;
  - -600 V = -15 % to +10 %.

### ☑ 500-690 V models:

- 500 V = -15 % to +15 %:
- -525 V = -15 % to +15 %;
- -550 V = -15 % to +20 %;
- -575 V = -15 %to +15 %;
- -600 V = -15 %to +10 %;
- $-660 \text{ V} = -15 \% \text{ to } +10 \% ^{(1)};$
- $-690 \text{ V} = -15 \% \text{ to } +10 \% \text{ }^{(1)}.$

(1) When a line voltage higher than 600 V (rated value) supplies the 500-690 V models, it is necessary to derate the output current as stated in item 9.1.5.



### NOTE!

- ☑ In all models, P296 parameter shall be set to the rated input voltage.
- ☑ When input voltage is lower than motor rated voltage the motor power will be reduced.

#### Other AC input specifications:

- ☑ Frequency: 50/60 Hz (± 2 Hz).
- $\square$  Phase Unbalance  $\leq 3\%$  of rated phase to phase input voltage.
- ☑ Overvoltage Category III (EN 61010/UL 508C).
- ☑ Transient voltages according to Category III.

### Minimum line impedance:

- $\ \ \, \ \,$  1 % voltage drop for models with rated current up to 130 A/220-230 V, up to 142 A/380-480 V and up to 32 A/500-600 V.
- 2 % voltage drop for 380-480 V models with rated current 180 A and above. 500-600 V models with current higher or equal to 44 A/500-600 V and all 500-690 V and 660-690 V models do not require minimum line impedance, because they have an internal DC Link inductance.
- ☑ Refer to item 8.7.1 guidelines.

## Power-up:

10 ON/OFF cycles per hour maximum (1 every 6 minutes).

## 9.1.2 220-230 V Power Supply

Model: Current / Voltage	6/	7/	10/	13/	16/	24/	28/
Wodel. Current / Voltage	220-230	220-230	220-230	220-230	220-230	220-230	220-230
Load (1)	CT/VT	CT/VT	CT/VT	CT/VT	CT/VT	CT/VT	CT/VT
Power (kVA) (2)	2.3	2.7	3.8	5	6.1	9.1	10.7
Rated Output Current (A) (3)	6	7	10	13	16	24	28
Maximum Output Current (A) (4)	9	10.5	15	19.5	24	36	42
Rated Input Current (A) (7)	7.2/15 <sup>(6)</sup>	8.4/18 <sup>(6)</sup>	12/25 <sup>(6)</sup>	15.6	19.2	28.8	33.6
Rated Switching Frequency (kHz)	5	5	5	5	5	5	5
Maximum Motor (hp)/(kW) <sup>(5)</sup>	1.5/1.1	2/1.5	3/2.2	4/3.0	5/3.7	7.5/5.5	10/7.5
Watts Loss (W) (8)	69	80	114	149	183	274	320
Frame Size	1	1	1	1	2	2	2

Model: Current / Voltage	45/ 220-230	54/ 220-230		70/ 220-230		86/ 220-230		105/ 220-230		130/ 220-230	
Load (1)	CT/VT	СТ	VT	СТ	VT	СТ	VT	СТ	VT	СТ	VT
Power (kVA) (2)	18	21	27	28	34	34	42	42	52	52	60
Rated Output Current (A) (3)	45	54	68	70	86	86	105	105	130	130	150
Maximum Output Current (A) (4)	68	81		105		129		158		195	
Rated Input Current (A) (7)	54	65	82	84	103	103	126	126	156	156	180
Rated Switching Frequency (kHz)	5	5	2.5	5	2.5	5	2.5	5	2.5	5	2.5
Mariana Marian (Inn.) ((INA)) (E)	15/11	20/	25/	25/	30/	30/	40/	40/	50/	50/	60/
Maximum Motor (hp)/(kW) (5)	13/11	15	18.5	18.5	22	22	30	30	37	37	45
Watts Loss (kW) (8)	0.5	0.6	0.8	0.8	1.0	1.0	1.2	1.2	1.5	1.5	1.7
Frame Size	3	4		5		5		6		6	

## 9.1.3 380-480 V Power Supply

Model: Current / Voltage	3.6/ 380-480	4/ 380-480	5.5/ 380-480	9/ 380-480	13/ 380-480	16/ 380-480	24/ 380-480
Load <sup>(1)</sup>	CT/VT	CT/VT	CT/VT	CT/VT	CT/VT	CT/VT	CT/VT
Power (kVA) (2)	2.7	3.0	4.2	6.9	9.9	12.2	18.3
Rated Output Current (A) (3)	3.6	4	5.5	9	13	16	24
Maximum Output Current (A) (4)	5.4	6	8.3	13.5	19.5	24	36
Rated Input Current (A) (7)	4.3	4.8	6.6	10.8	15.6	19.2	28.8
Rated Switching Frequency (kHz)	5	5	5	5	5	5	5
Maximum Motor (hp)/(kW) (5)	1.5/1.1	2/1.5	3/2.2	5/3.7	7.5/5.5	10/7.5	15/11
Watts Loss (W) (8)	60	66	92	152	218	268	403
Frame Size	1	1	1	1	2	2	2

Model: Current / Voltage		30/		38/		45/		60/		70/		86/		105/	
woder. Current / Voltage	380	-480	380-	480	380-480		380-480		380-480		380-480		380-480		
Load (1)	СТ	VT	СТ	VT	СТ	VT	СТ	VT	СТ	VT	СТ	VT	СТ	VT	
Power (kVA) (2)	24	29	30	36	36	43	48	56	56	68	68	84	84	100	
Rated Output Current (A) (3)	30	36	38	45	45	54	60	70	70	86	86	105	105	130	
Maximum Output Current (A) (4)		15		57	(	68	9	90	10	)5		129	15	58	
Rated Input Current (A) (7)	36	43.2	45.6	54	54	64.8	72	84	84	103	103	126	126	156	
Rated Switching Frequency (kHz)	5	2.5	5	2.5	5	2.5	5	2.5	5	2.5	5	2.5	5	2.5	
Maximum Motor (hp)/(kW) (5)	20/	25/	25/	30/	30/	40/	40/	50/	50/	60/	60/	75/	75/	100/	
waximum wotor (np)/(kw) (4)	15	18.5	18.5	22	22	30	30	37	37	45	45	55	55	75	
Watts Loss (kW) (8)	0.50	0.60	0.70	0.80	0.80	0.90	1.00	1.20	1.20	1.50	1.50	1.80	1.80	2.20	
Frame Size		3	4		4	4		5		5		6		6	

Model: Current / Voltage		-480	180/ 380-480	211/ 380-480	240/ 380-480	312 380-480	361/ 380-480	450/ 380-480	515 380-480	600/ 380-480
Load (1)	CT	VT	CT/VT	CT/ VT	CT/ VT	CT/VT	CT/VT	CT/VT	CT/VT	CT/VT
Power (kVA) (2)	113	138	143	161	191	238	287	358	392.5	478
Rated Output Current (A) (3)	142	174	180	211	240	312	361	450	515	600
Maximum Output Current (A) (4)	21	3	270	317	360	468	542	675	773	900
Rated Input Current (A) (7)	170	209	191	223	254	331	383	477	546	636
Rated Switching Frequency (kHz)	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Maximum Motor (hp)/(kW) (5)	100/	125/	150/	175/	200/	250/	300/	350/	450/	500/
	75	90	110	130.5	150	186.5	220	250	335.7	375
Watts Loss (kW) (8)	2.4	2.9	3	3.5	4	5.2	6	7.6	8.5	10
Frame Size	7	,	8	8	8	9	9	10	10	10

## 9.1.4 500-600 V Power Supply

Model: Current / Voltage		2.9/		.2/	7/		10/		12/		14/
iviouel. Current / Voltage	500-600		500	-600	500	500-600		-600	500-600		500-600
Load (1)	СТ	VT	СТ	VT	СТ	VT	C	VT	CT	VT	CT/VT
Power (kVA) (2)	2.9	4.2	4.2	7	7	10	10	12	12	13.9	13.9
Rated Output Current (A) (3)	2.9	4.2	4.2	7	7	10	10	12	12	14	14
Maximum Output Current (A) (4)	4.4	4.6	6.3	7.7	10.5	11	15	15	18	18	21
Rated Input Current (A) (7)	3.6	5.2	5.2	8.8	8.8	12.5	12.5	15	15	17.5	17.5
Rated Switching Frequency (kHz)	5	5	5	5	5	5	5	5	5	5	5
Maximum Motor (hp)/(kW) (5)	2/1.5	3/2.2	3/2.2	5/3.7	5/3.7	7.5/5.5	7.5/5.5	10/7.5	10/7.5	12.5/9.2	12.5/9.2
Watts Loss (W) (8)	70	100	100	160	160	230	230	280	280	330	330
Frame Size	:	2	:	2	:	2	2	2		2	2

Model: Current / Voltage	1	22/	27	7/	32/	
Wodel. Surent / Voltage	500	0-600	500-	500-600		
Load (1)	СТ	VT	СТ	VT	CT/VT	
Power (kVA) (2)	21.9	26.9	26.9	31.9	31.9	
Rated Output Current (A) (3)	22	27	27	32	32	
Maximum Output Current (A) (4)	33	33	40.5	40.5	48	
Rated Input Current (A) (7)	27.5	33.8	33.8	40	40	
Rated Switching Frequency (kHz)	5	5	5	5	5	
Maximum Motor (hp)/(kW) (5)	20/15	25/18.5	25/18.5	30/22	30/22	
Watts Loss (W) (8)	500	620	620	750	750	
Frame Size		4		4		

Model: Current / Voltage	44/ 53/		63	3/	79/			
wodel. Current / voltage	500-	500-600 500-600		500-	-600 500-		600	
Load (1)	СТ	VT	CT	VT	СТ	VT	СТ	VT
Power (kVA) (2)	43.8	52.8	52.8	62.7	62.7	78.7	78.7	98.6
Rated Output Current (A) (3)	44	53	53	63	63	79	79	99
Maximum Output Current (A) (4)	66	66	79.5	79.5	94.5	94.5	118.5	118.5
Rated Input Current (A) (7)	46	56	56	66	66	83	83	104
Rated Switching Frequency (kHz)	2.5	2.5	5	5	5	2.5	2.5	2.5
Maximum Motor (hp)/(kW) (5)	40/30	50/37	50/37	60/45	60/45	75/55	75/55	100/75
Watts Loss (kW) (8)	1	1.2	1.2	1.5	1.5	1.8	1.8	2.5
Frame Size	7			7		7		7

Model: Current / Voltage	107/		14	17/	211/	24	47/
Wodel. Garrent / Voltage	500	500-690 500-690		-690	500-690	500	-690
Load (1)	CT	VT	СТ	VT	CT/VT	СТ	VT
Power (kVA) (2)	107	147	147	195	210	210	314
Rated Output Current (A) (3)	107	147	147	196	211	247	315
Maximum Output Current (A) (4)	160	160	220.5	220.5	316.5	370.5	370.5
Rated Input Current (A) (7)	107	147	147	196	211	247	315
Rated Switching Frequency (kHz)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Maximum Motor (hp)/(kW) (5)	100/75	150/110	150/110	200/150	200/150	250/185	300/220
Watts Loss (kW) (8)	2.5	3	3	4.1	4.1	5.1	6
Frame Size	8E		8E		8E		10E

Model: Current / Voltage	315/			43/ 41			472/	
	500	500-690		-690	500-	690	500-690	
Load (1)	СТ	VT	СТ	VT	CT	VT	СТ	VT
Power (kVA) (2)	314	342	342	416	416	470	470	553
Rated Output Current (A) (3)	315	343	343	418	418	472	472	555
Maximum Output Current (A) (4)	472.5	472.5	514.5	514.5	627	627	708	708
Rated Input Current (A) (7)	315	343	343	418	418	472	472	555
Rated Switching Frequency (kHz)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Maximum Motor (hp)/(kW) (5)	300/220	350/250	350/250	400/300	400/300	500/370	500/370	600/450
Watts Loss (kW) (8)	6	6.8	6.8	8.2	8.2	11	11	12.3
Frame Size	10E		10E 10E		)E	1	0E	

## 9.1.5 660-690 V Power Supply

Model: Current / Voltage	100/		12	27/	179/	22	25/
Wodel. Garrent / Voltage	660-690		660	-690	660-690	660	-690
Load (1)	CT	VT	СТ	VT	CT/VT	СТ	VT
Power (kVA) (2)	120	152	152	214	214	269	310
Rated Output Current (A) (3)	100	127	127	179	179	225	259
Maximum Output Current (A) (4)	150	150	190.5	197	268.5	337.5	337.5
Rated Input Current (A) (7)	100	127	127	179	179	225	259
Rated Switching Frequency (kHz)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Maximum Motor (hp)/(kW) (5)	100/75	150/110	150/110	200/150	200/150	250/185	300/220
Watts Loss (kW) (8)	2.5	3	3	4.1	4.1	5.1	6
Frame Size	8E			8E 8			10E

Model: Current / Voltage	2	259/ 305/ 660-690 660-690		340/		428/	
Wodel. Current / Voltage	660			660-690		660-690	
Load (1)	СТ	VT	СТ	VT	СТ	VT	CT/VT
Power (kVA) (2)	310	365	365	406	406	512	512
Rated Output Current (A) (3)	259	305	305	340	340	428	428
Maximum Output Current (A) (4)	388.5	388.5	457.5	457.5	510	510	642
Rated Input Current (A) (7)	259	305	305	340	340	428	428
Rated Switching Frequency (kHz)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Maximum Motor (hp)/(kW) (5)	300/220	350/250	350/250	400/300	400/300	500/370	500/370
Watts Loss (kW) (8)	6	6.8	6.8	8.2	8.2	11	11
Frame Size		10E		10E		10E	

Model: Current / Voltage	1	107/ 147/		211/	247/		
Wodel. Gulletti / Voltage	500	500-690 500-690		500-690	500	-690	
Load (1)	CT	VT	СТ	VT	CT/VT	СТ	VT
Power (kVA) (2)	120	152	152	214	214	269	310
Rated Output Current (A) (3)	100	127	127	179	179	225	259
Maximum Output Current (A) (4)	150	150	190.5	197	268.5	337.5	337.5
Rated Input Current (A) (7)	100	127	127	179	179	225	259
Rated Switching Frequency (kHz)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Maximum Motor (hp)/(kW) (5)	100/75	150/110	150/110	200/150	200/150	250/185	300/220
Watts Loss (kW) (8)	2.5	3	3	4.1	4.1	5.1	6
Frame Size		8E		8E	8E		10E

Model: Current / Voltage	3	315/		343/		418/	
Wodel. Current / Voltage	500-690		500-690		500-690		500-690
Load (1)	СТ	VT	СТ	VT	СТ	VT	CT/VT
Power (kVA) (2)	310	365	365	406	406	512	512
Rated Output Current (A) (3)	259	305	305	340	340	428	428
Maximum Output Current (A) (4)	388.5	388.5	457.5	457.5	510	510	642
Rated Input Current (A) (7)	259	305	305	340	340	428	428
Rated Switching Frequency (kHz)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Maximum Motor (hp)/(kW) (5)	300/220	350/250	350/250	400/300	400/300	500/370	500/370
Watts Loss (kW) (8)	6	6.8	6.8	8.2	8.2	11	11
Frame Size		10E		10E	10	E	10E



### NOTES:

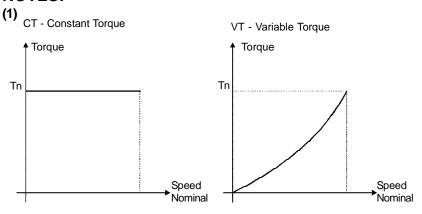


Figure 9.1 - Load characteristics

(2)

The power rating in kVA is determined by the following equation:

$$P(kVA) = \frac{\sqrt{3}. \text{ Input Voltage (V) x Current Rating (A)}}{1000}$$

The values shown on the tables 9.1.2 to 9.1.5 were calculated considering the inverter rated current rating and an input voltage of 230 V for 220-230 V models, 460 V for 380-480 V models, 575 V for 500-600 V models and 690 V for 660-690 V models.

(3)

Rated Output Current is valid for the following conditions:

- ☑ Relative Air Humidity: 5 % to 90 %, non condensing.
- ☑ Altitude: 1000 m (3.300 ft) nominal conditions.
  From 1000 m to 4000 m (3.300 ft to 13.200 ft) with 1 % current reduction for each 100 m (330 ft) above 1000 m (3.300 ft).
- ☑ Ambient Temperature: 0 °C to 40 °C (32 °F to 104 °F) nominal conditions.
  From 0 °C to 55 °C (32 °F to 131 °F) with 2 % current derating for each 1 °C (1.8 °F) degree above 40 °C (104 °F).
- ☑ The rated current values are valid for the indicated switching frequencies.
- ☑ The 10 kHz switching frequency is not possible for the 2.9 A to 79 A/500-600 V, 107 A to 472 A/500-690 V and 100 A to 428 A/660-690 V models.
- ☑ The operation at 10 kHz is possible for V/F Control Mode and Vector Control with Encoder Mode. In this case it's necessary to derate the output current according to table 9.1.

Models	Load	Switching	Output Current
	Type	Frequency	Derating - %
6 A to 45 A / 220-230 V	CT/VT	10 kHz	0.8
	CT	10 1012	0.0
54 A to 130 A/220-230 V	VT	5 kHz	Contact WEG
	V I	10 kHz	Oornact WEG
3.6 A to 24 A / 380-480 V	CT/VT	10 kHz	0.7
	CT	TORTZ	0.7
30 A to 142 A / 380-480 V	VT	5 kHz	
	V I	10 kHz	Contact WEG
180 A to 600 A / 380-480 V	CTA/T	5 kHz	Contact WEG
100 A to 000 A / 300-400 V	CT/VT	10 kHz	
63 A / 500-600 V	VT		0.8
79 A / 500-600 V	CT		
79 A7 300-000 V	VT	<b>511</b>	
107 A to 472 A / 500-690 V	СТ	5 kHz	Contact WFG
101 A to 412 A / 300-090 V	VT		Comast WEG
100 A to 428 A / 660-690 V	СТ		
100 A to 426 A / 660-690 V	VT		

Table 9.1 - Output current derating for switching frequency ≥ rated switching frequency

### (4)

- Maximum Current: 1.5 x I Nominal (for 60 seconds every 10 minutes). I Nominal = Rated Current for CT applications considering the applicable derating (depending on altitude or ambient temperature as specified in note (3)).
- ☑ The maximum output current is the same for CT and VT. This way the inverter has a lower overload capacity when VT current is used.

#### (5)

The indicated maximum motor hp/kW ratings are based on WEG 230 V/ 460 V/575 V 4 pole motors and normal duty loads. A precise inverter sizing must consider the actual motor nameplate and application data.

#### (6)

Rated input current for single-phase operation.

**Note:** The 6A, 7A and 10A/220-230 V models can be operated with 2 input phases only (single-phase operation) without output current derating.

#### (7

Rated input current for three-phase operation:

This is a conservative value. In practice the value of this current depends on the line impedance. Please refer to table 9.2:

X (%)	I input (rms) (%)
0.5	131
1.0	121
2.0	106
3.0	99
4.0	96
5.0	96

**Table 9.2** - X = Line impedance drop @ rated inverter output current;  $I_{input \, (rms)}$  = % of the rated output current

#### (8)

Loss considering rated work conditions (rated output current and rated switching frequency).

## 9.2 ELECTRONICS/GENERAL DATA

<u>0.2                                    </u>	NICO/OLINLINAL DAT	/ \
CONTROL	METHOD	<ul> <li>✓ Voltage Source V/F (Scalar), or</li> <li>✓ Vector Control with Encoder Feedback, or</li> <li>✓ Sensorless Vector Control (without Encoder)</li> <li>✓ PWM SVM (Space Vector Modulation)</li> <li>✓ Current, Flux and Speed Digital Regulators</li> <li>✓ Scan Time:         <ul> <li>Current Regulators: 0.2 ms (5 kHz)</li> <li>Flux Regulator: 0.4 ms (2.5 kHz)</li> <li>Speed Regulator / Speed Measurement: 1.2 ms</li> </ul> </li> </ul>
	OUTPUT FREQUENCY	<ul> <li>✓ 0 to 3.4 x motor rated frequency (P403). This rated frequency can be set from 0 Hz to 300 Hz in Scalar and VVW Mode from 30 Hz to 120 Hz in Vector Mode.</li> </ul>
PERFORMANCE (Vector Mode)	SPEED CONTROL	<ul> <li>VVW:</li> <li>✓ Regulation: 1 % of Base Speed</li> <li>✓ Speed Range: 1:30</li> <li>Sensorless:</li> <li>✓ Regulation: 0.5 % of Base Speed</li> <li>✓ Speed Range: 1:100</li> <li>With Encoder: (with EBA or EBB Board)</li> <li>✓ Regulation:</li> <li>+/- 0.01 % of Base Speed with 14 bit Analog Input (EBA Board);</li> <li>+/- 0.01 % of Base Speed with Digital Reference (Keypad, Serial Port, Fieldbus, Electronic Potentiometer, Multispeed);</li> <li>+/- 0.1 % of Base Speed with 10 bit Analog Input (CC9 Board).</li> </ul>
TORQUE CONTROL		<ul> <li>✓ Range: 10 to 180 %, Regulation: +/-10 % of Rated Torque (with encoder)</li> <li>✓ Range: 20 to 180 %, Regulation: +/-10 % of Rated Torque (sensorless above 3 Hz)</li> </ul>
INPUTS (CC9 Board)	ANALOG	2 Non Isolated Differential Inputs: (0 to 10) V, (0 to 20) mA or (4 to 20) mA; Impedance: 400 kΩ [(0 to 10) V], 500 Ω [(0 to 20) mA or (4 to 20) mA]; Resolution: 10 bit, Programmable Functions.
	DIGITAL	☑ 6 Isolated Inputs: 24 Vdc; Programmable Functions.
OUTPUTS	ANALOG	☑ 2 Non Isolated Outputs: (0 to 10) V; RL ≥ 10 kΩ (1 mA Maximum);  Resolution: 11 bits; Programmable Functions.
(CC9 Board)	RELAY	<ul> <li>2 Relays: NO/NC contacts available; 240 Vac, 1 A; Programmable Functions.</li> <li>1 Relay: NO contact available; 240 Vac, 1 A; Programmable Functions.</li> </ul>
SAFETY	PROTECTION	✓ Overcurrent/Output Short-circuit (Trip Point: > 2 x Rated Current for CT application) ✓ DC Link Under/Overvoltage ✓ Power Supply Undervoltage/Phase Fault (1) ✓ Inverter Overtemperature ✓ Dynamic Braking Resistor Overload ✓ Motor/Inverter Overload (I x t) ✓ External Fault ✓ CPU/EPROM Error ✓ Output Ground Fault ✓ Programming Error

KEYPAD (HMI)	STANDARD (HMI-CFW09-LCD)	<ul> <li>✓ 8 Keys: Start, Stop, Increase, Decrease, FWD/REV, JOG, Local/Remote and Program</li> <li>✓ LCD display: 2 lines x 16 characters</li> <li>✓ LED display: 4 digits with 7 segments</li> <li>✓ LEDs for FWD/REV and LOC/REM indication</li> <li>✓ Display Accuracy:         <ul> <li>Current: 5 % of Rated Current</li> <li>Speed Resolution: 1 rpm</li> </ul> </li> <li>✓ Remote mounting possibility, cables available up to 10 m (30 ft)</li> </ul>
DEGREE OF PROTECTION	NEMA1/IP20	✓ NEMA 1/ IP20: 3.6 A to 240 A/380-480 V models and all 220-230 V and 500-600 V models and 107 A to 211 A/500-690 V and 100 A to 179 A/660-690 V.
	PROTECTED CHASSIS/IP20	✓ Protected chassis/IP20: 361 A to 600 A/380-480 V models, 247 A to 472 A/500-690 V and 225 A to 428 A/660-690 V.

**<sup>(1)</sup>** Available in models  $\geq$  30 A / 220-230 V or  $\geq$  30 A / 380-480 V or  $\geq$  22 A / 500-600 V or for all 500-690 V and 660-690 V models.

## 9.2.1 Applicable Standards

	☑ UL508C - Power conversion equipment.
	☑ UL840 - Insulation coordination including clearances and creepage distances for electrical equipment.
	☑ EN50178 - Electronic equipment for use in power installations.
	☑ EN60204-1 - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
GENERAL	Provisions for compliance: the final assembler of the machine is responsible for installing:
	- an emergency-stop device.
	- a supply disconnecting device.
	☑ EN60146 (IEC 146) - Semiconductor convertors.
	☑ EN61800-2 - Adjustable speed electrical power drive systems - Part 2: General requirements - Rating
	specifications for low voltage adjustable frequency AC power drive systems.
	☑ EN 61800-3 - Adjustable speed electrical power drive systems - Part 3: EMC product standard
	including specific test methods.
	☑ EN55011 - Limits and methods of measurement of radio disturbance characteristics of industrial,
	scientific and medical (ISM) radio-frequency equipment.
	☑ CISPR11 - Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic
	disturbance characteristics - Limits and methods of measurement.
EMC	☑ EN61000-4-2 - Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques -
	Section 2: Electrostatic discharge immunity test.
	☑ EN61000-4-3 - Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques -
	Section 3: Radiated, radio-frequency, electromagnetic field immunity test.
	☑ EN61000-4-4 - Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques -
	Section 4: Electrical fast transient/burst immunity test.
	☑ EN61000-4-5 - Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques -
	Section 5: Surge immunity test.
	☑ EN61000-4-6 - Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques -
	Section 6: Immunity to conducted disturbances, induced by radio-frequency fields.
MECHANICAL	☑ EN60529 - Degrees of protection provided by enclosures (IP code).
	☑ UL50 - Enclosures for electrical equipment.

## 9.3 OPTIONAL DEVICES

## 9.3.1 I/O Expansion Board EBA

COMMUNICATION	SERIALINTERFACE	☑ Isolated RS-485 Serial Interface (the RS-485 and RS-232 serial interfaces cannot be used simultaneously).
	ANALOG	☑ 1 Bipolar Analog Input (AI4): -10 V to +10 V; (0 to 20) mA or (4 to 20) mA; Linearity: 14 bits (0.006 % of 10 V range). Programmable Functions.
INPUTS	INCREMENTAL ENCODER	☑ Incremental Encoder Feedback Input:Internal 12 Vdc, 200 mA max isolated power supply. Differential inputs A, A, B, B, Z and Z signals (100 kHz max) 14 bits resolution. Used as speed feedback for the speed regulator and digital speed measurement.
	DIGITAL	<ul> <li>1 Programmable Isolated 24 Vdc Digital Input (DI7).</li> <li>1 Programmable Digital Input (DI8). For motor PTC - thermistor:         Actuation: 3.9 kΩ         Release: 1.6 kΩ     </li> </ul>
OUTPUTS	ANALOG	☑ 2 Bipolar Analog Outputs (AO3/AO4): -10 V to +10 V. Linearity: 14 bits (0.006 % of +/- 10 V range). Programmable Functions.
3311 313	ENCODER	☑ Buffered Encoder Output:Input signal repeater; Isolated differential outputs.
	DIGITAL	☑ 2 Isolated Transistor Outputs (DO1/DO2): Open collector, 24 Vdc, 50 mA. Programmable Functions.

## 9.3.2 I/O Expansion Board EBB

es cannot
mΔ
lated
ax) 14 bits
al speed
Linearity:
nd AO2 of
utputs.
nA.
1

## 9.4 MECHANICAL DATA SIZE 1 В 132 (5.19)-Ø22.4 \$33.5 **\q** 6 (0.24) D 104 (4.09) С 28 (1.10) 20 (0.78) 50 (1.97) -134 (5.27) -1<sub>11</sub> |-(0.43) Air Flow outlet 143 (5.63) 8888 210 (8.26) Air Flow inlet Air Flow outlet 139 (5.47) 12 (0.47) . 2.5 (0.098) 6 (0.23) ø6

Figure 9.2 - Size 1 - dimensions in mm (inch)

Air Flow inlet

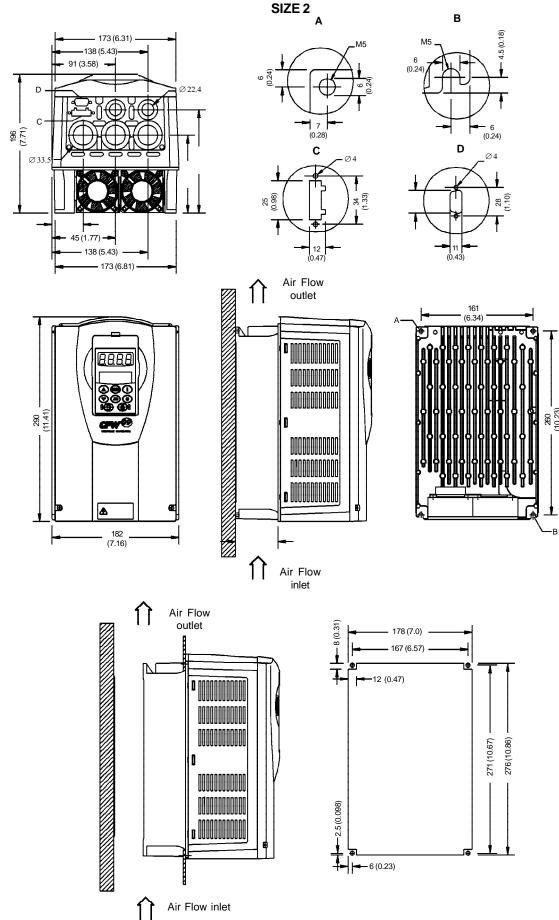


Figure 9.3 - Size 2 - dimensions in mm (inch)

## SIZE 3

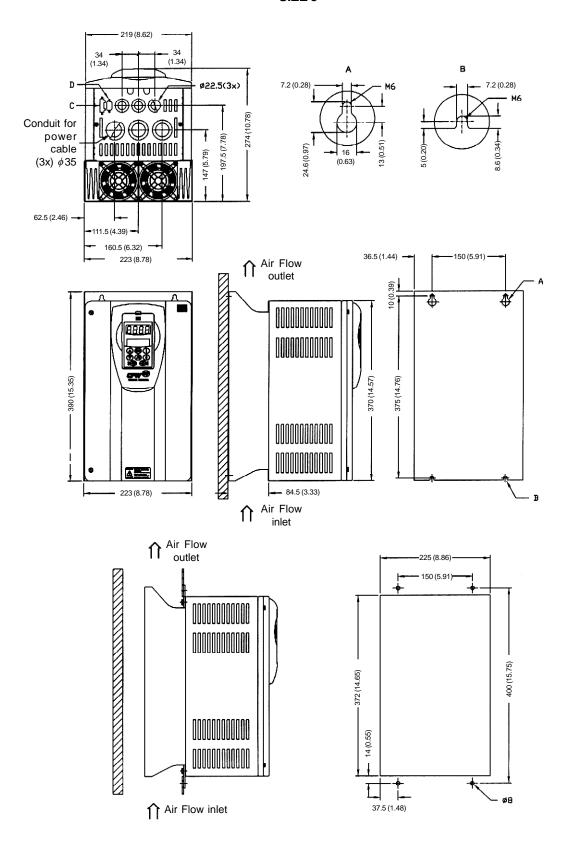


Figure 9.4 - Size 3 - dimensions in mm (inch)

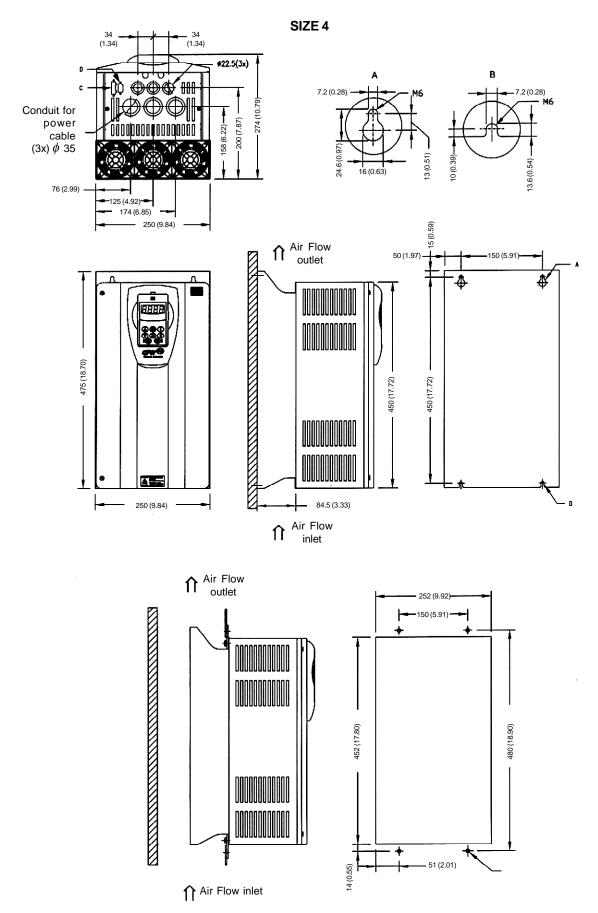


Figure 9.5 - Size 4 - dimensions in mm (inch)

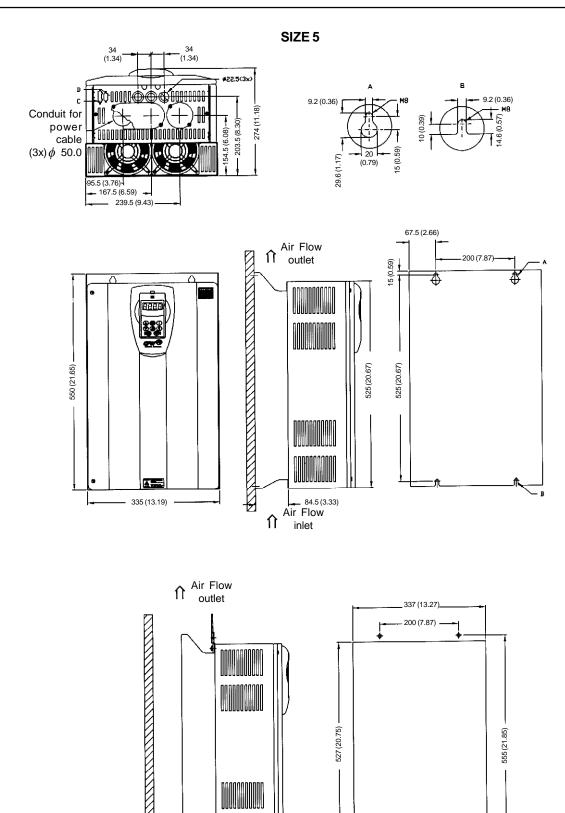


Figure 9.6 - Size 5 - dimensions in mm (inch)

↑ Air Flow inlet

14 (0.55)

68.5 (2.70)

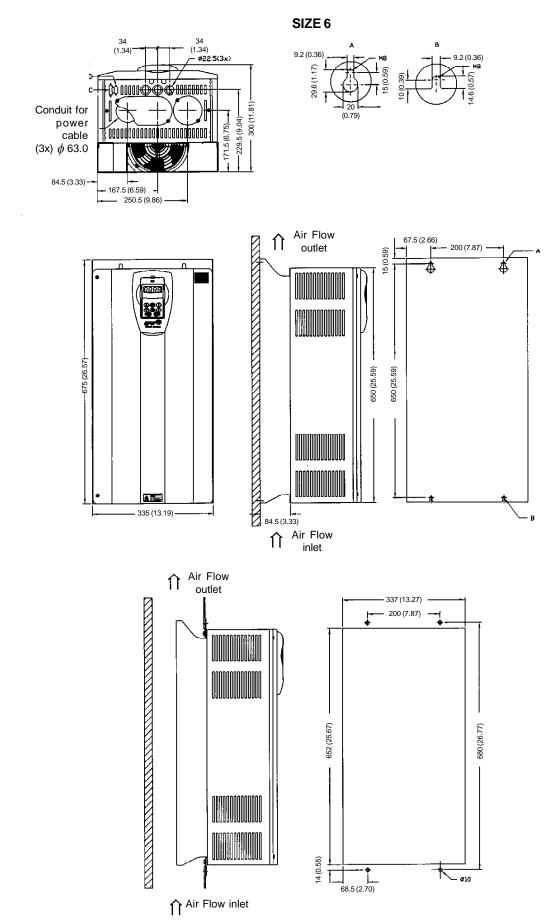


Figure 9.7 - Size 6 - dimensions in mm (inch)

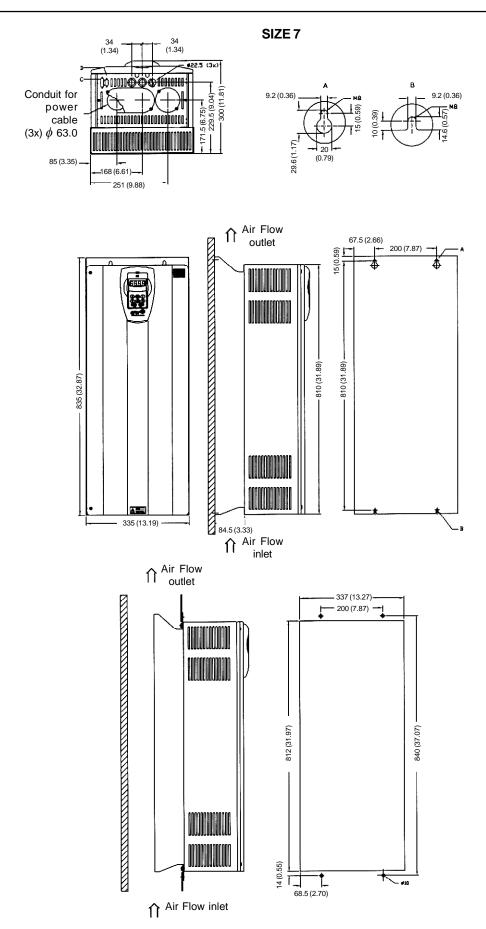


Figure 9.8 - Size 7 - dimensions in mm (inch)

## **SIZE 8 AND 8E**

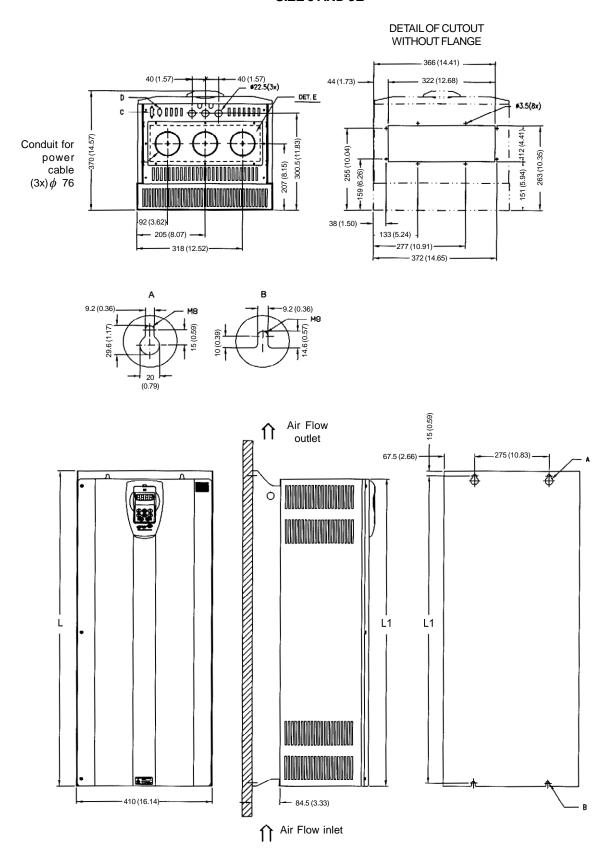
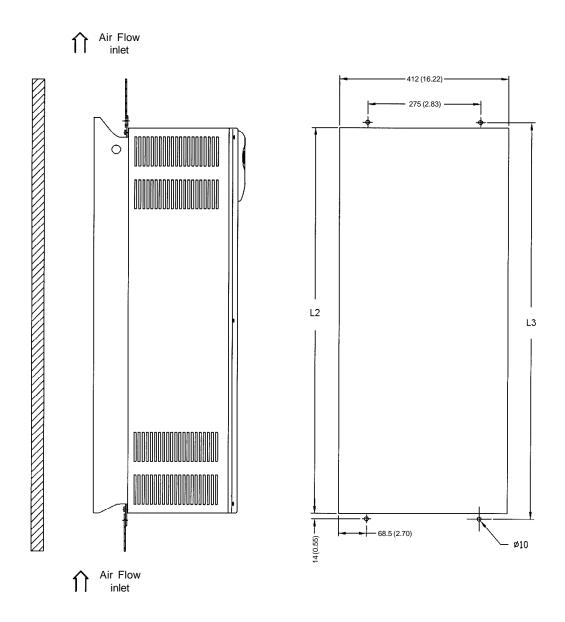


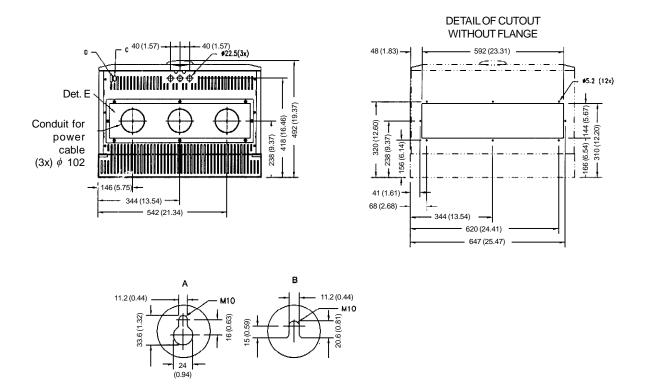
Figure 9.9 - Size 8 and 8E - dimensions in mm (inch)



Length		L	L1		L2		L3	
Dimensions	mm	in	mm	in	mm	in	mm	in
Size 8	975	38.38	950	37.4	952	37.48	980	38.58
Size 8E		1145	1122.5	44.19	1124.5	44.27	1152.5	45.37
	45.08							

Figure 9.9 (cont.) - Size 8 and 8E - dimensions in mm (inch)

## SIZE 9



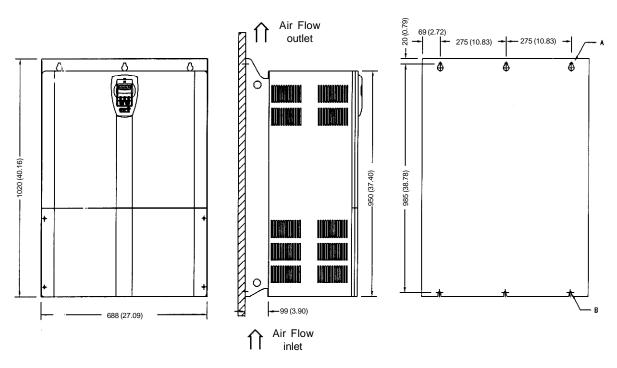


Figure 9.10 - Size 9 - dimensions in mm (inch)

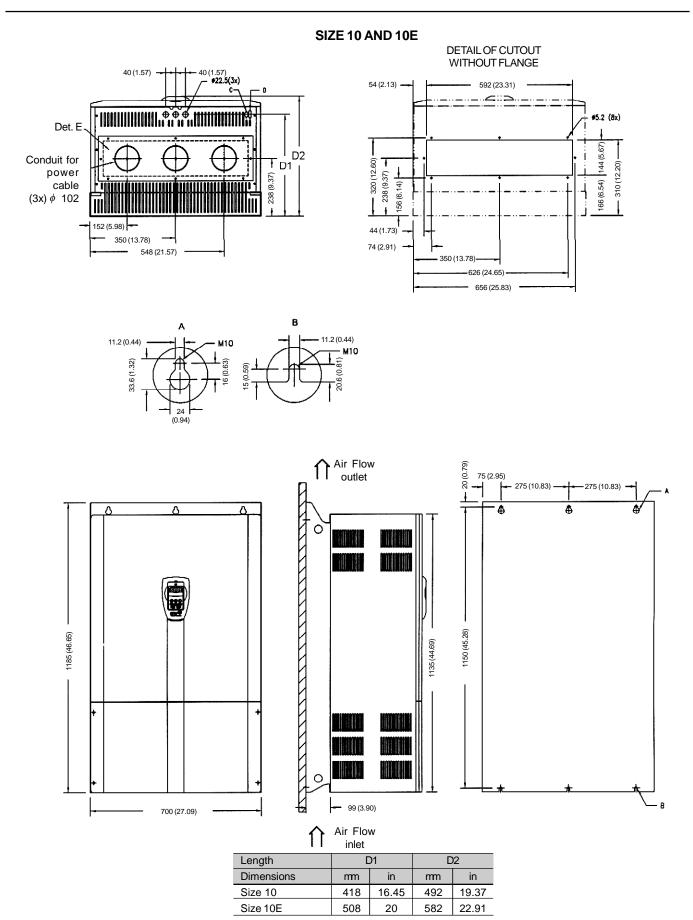


Figure 9.11 - Size 10 and 10E - dimensions in mm (inch)

## 180 A-240 A/380-480 V Models (size 8)

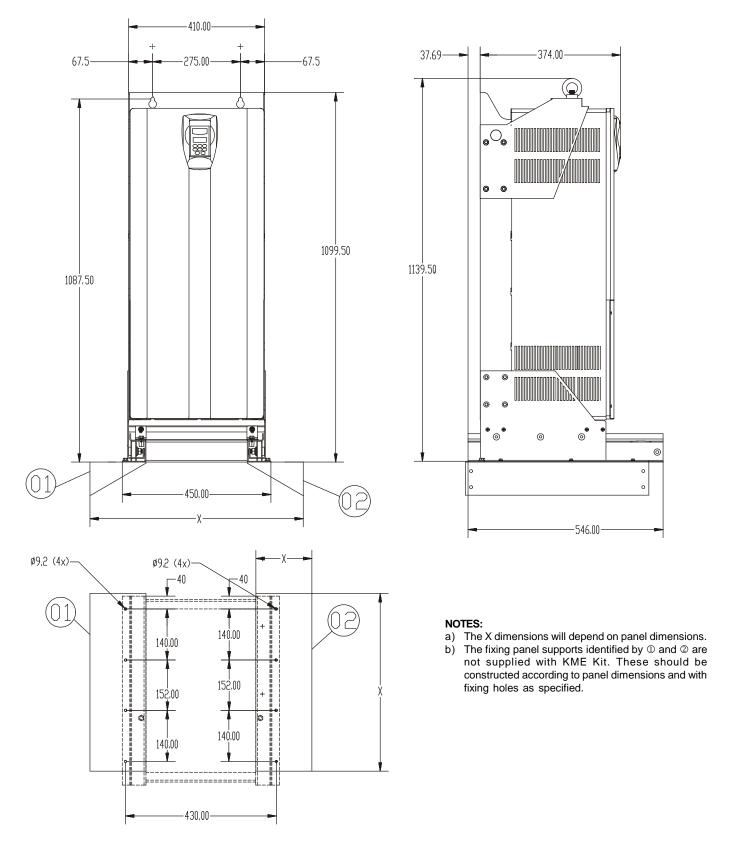


Figure 9.12 a) - KIT-KME for Size 8 - Panel Width = 600 mm (23.62 in)

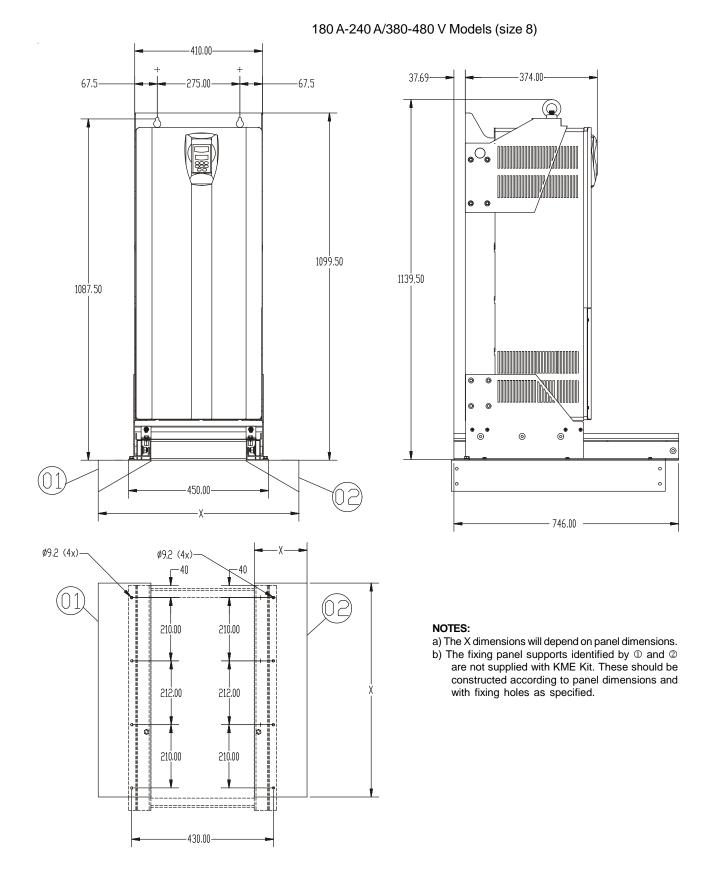


Figure 9.12 b) - KIT-KME for Size 8 - Panel Width = 800 mm (31.50 in)

## 410.00-37.69--374.00-67.5--275.00--67.5 1309,50 1269,50 1257,50 450,00 -546.00· Ø9,2 (4x)-Ø9.2 (4x)-40 NOTES: a) The X dimensions will depend on panel 140.00 140.00 dimensions. b) The fixing panel supports identified by $\ensuremath{\mathbbm 0}$ and $\ensuremath{\mathbbm 0}$ are not supplied with KME Kit. These should be 152.00 constructed according to panel dimensions and 152.00 with fixing holes as specified. 140.00 140.00 430,00-

## 107 A to 211 A/500-600 V Models (size 8E) and 100 A to 179 A/660-690 V Models (size 8E)

Figure 9.12 c) - KIT-KME for Size 8E - Panel Width = 600 mm (23.62 in)

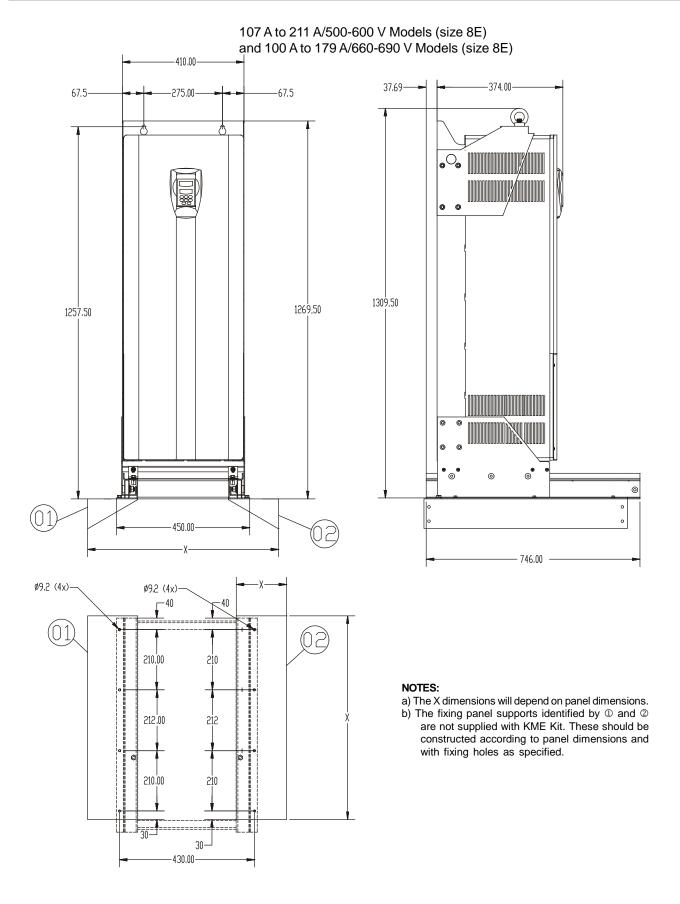
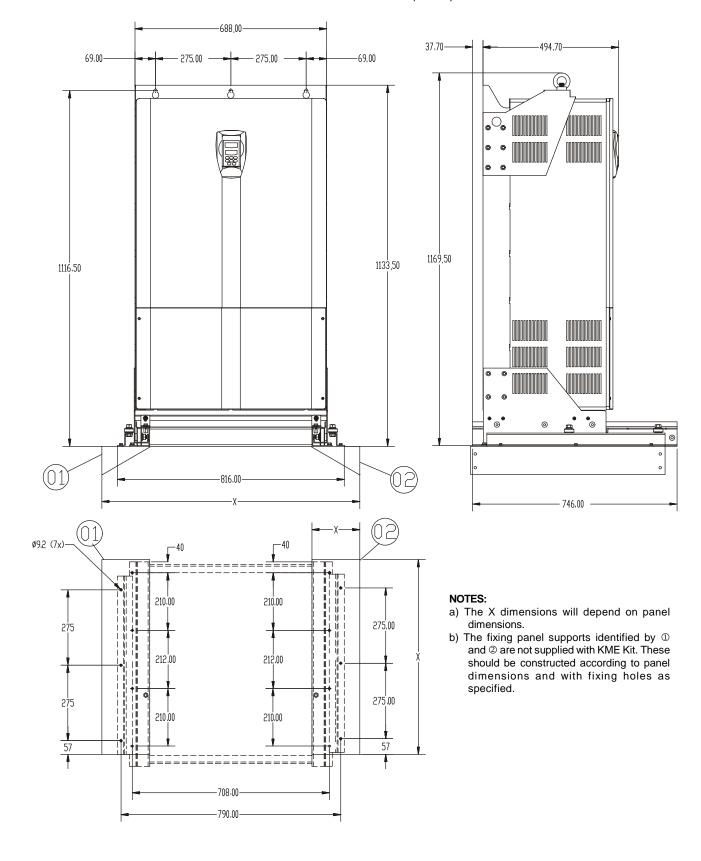


Figure 9.12 d) - KIT-KME for Size 8E - Panel Width = 800 mm (31.50 in)



### 312 A to 361 A/380-480 V (size 9) Models

Figure 9.13 - KIT-KME for Size 9 - Panel Width = 800 mm (31.50 in) and 1000 mm (39.37 in)

### 450 A to 600 A/380-480 V Models (size 10)

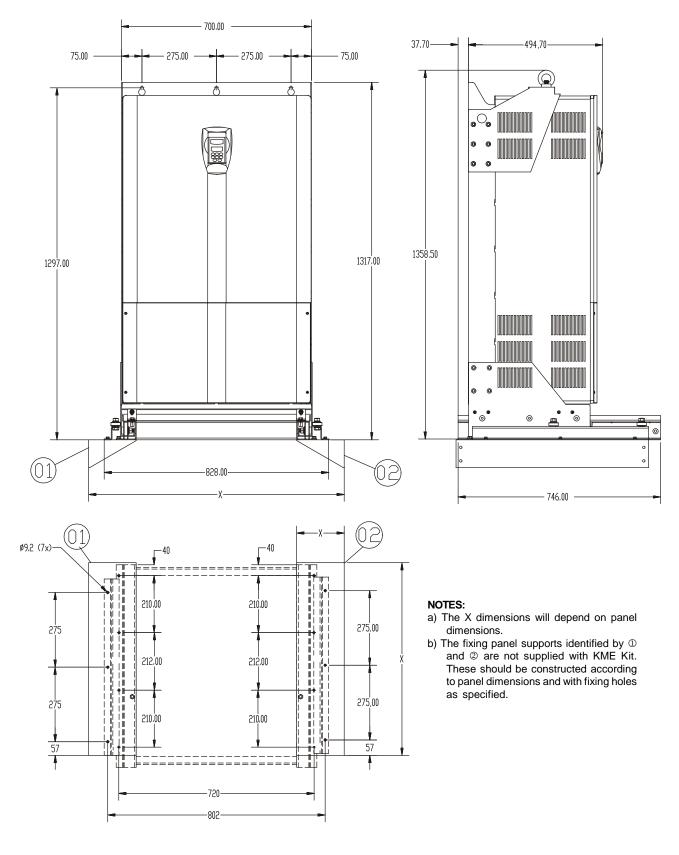


Figure 9.14 a) - KIT-KME for Size 10 - Panel Width = 800 mm (31.50 in) and 1000 mm (39.37 in)

# 247 A to 472 A/500-690 V Models (size 10E) and 225 A to 428 A/660-690 V Models (size 10E)

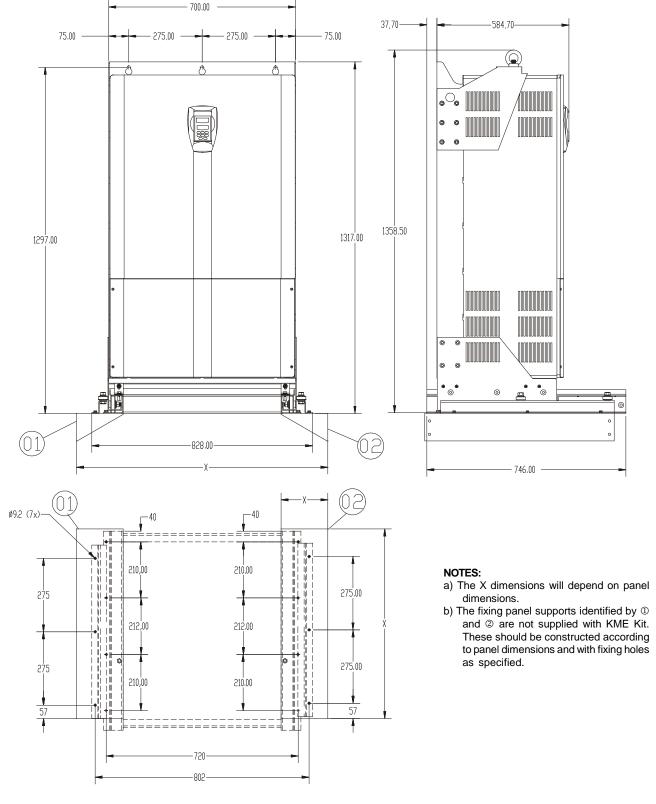


Figure 9.14 b) - KIT-KME for Size 10E - Panel Width = 800 mm (31.50 in) and 1000 mm (39.37 in)