Frequency Inverter

CFW300 V1.3X

Programming Manual

Programming Manual

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Summary of Reviews

The information below describes the revisions made to this manual.

Version	Review	Description
V1.1X	R00	First edition
V1.2X	R01	General review Version update Addition of new parameter: P841 Change of parameters: P402 and P840
V1.3X	R02	General review Version update Addition of new parameters: P080, P081, P082, P580, P582

QUICK REFERENCE OF PARAMETERS, ALARMS AND FAULTS

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Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
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Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
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P143	Intermediate Output Voltage	0.0 to 100.0 %	50.0 %	cfg, V/f	9-5
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Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
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P221	LOC Reference Sel.	0 = HMI Keys 1 = AI1 2 = AI2 3 = Not Used 4 = FI 5 = AI1 + AI2 > 0 6 = AI1 + AI2 7 = E.P. 8 = Multispeed 9 = Serial/USB 10 = Not Used 11 = CO/DN/DP 12 = SoftPLC 13 = Not Used 14 = AI1 > 0 15 = AI2 > 0 16 = Not Used 17 = FI > 0	0	cfg	7-4
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Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
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0

Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
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Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
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Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
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P311	Serial Bytes Config.	0 = 8 bits, No, 1 1 = 8 bits, Even, 1 2 = 8 bits, Odd, 1 3 = 8 bits, No, 2 4 = 8 bits, Even, 2 5 = 8 bits, Odd, 2	1	cfg	16-1
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P313	Action for Comminic. Error	0 = Inactive 1 = Ramp Stop 2 = General Disable 3 = Go to LOC 4 = LOC Keep Enab 5 = Cause Fault	1		16-1
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P403	Motor Rated Frequency	0 to 400 Hz	60 (50) Hz	cfg	10-4
P404	Motor Rated Power	0 = 0.16 HP (0.12 kW) 1 = 0.25 HP (0.18 kW) 2 = 0.33 HP (0.25 kW) 3 = 0.50 HP (0.37 kW) 4 = 0.75 HP (0.55 kW) 5 = 1.00 HP (0.75 kW) 6 = 1.50 HP (1.10 kW) 7 = 2.00 HP (1.50 kW) 8 = 3.00 HP (2.20 kW) 9 = 4.00 HP (3.00 kW) 10 = 5.00 HP (3.70 kW)	According to inverter model	cfg, VVW	10-5
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Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
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P589	Level of Minimum Applied Voltage	40 to 80 %	40 %	cfg, V/f	9-8
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Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
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P685 (**)	CO/DN/DP Speed Ref.	0 to FFFF (hexa)		ro	16-2
P695	Value for DOx	0 to F (hexa) Bit 0 = DO1 Bit 1 = DO2 Bit 2 = DO3 Bit 3 = DO4		ro	16-4
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P700 (**)	CAN Protocol	1 = CANopen 2 = DeviceNet	2		16-2
P701 (**)	CAN Address	0 to 127	63		16-2
P702 (**)	CAN Baud Rate	0 = 1 Mbps/Auto 1 = Reserved/Auto 2 = 500 Kbps 3 = 250 Kbps 4 = 125 Kbps 5 = 100 Kbps/Auto 6 = 50 Kbps/Auto 7 = 20 Kbps/Auto 8 = 10 Kbps/Auto	0		16-2
P703 (**)	Bus Off Reset	0 = Manual 1 = Automatic	1		16-2
P705 (**)	CAN Controller Status	0 = Inactive 1 = Auto-baud 2 = CAN Active 3 = Warning 4 = Error Passive 5 = Bus Off 6 = No Bus Power		ro	16-2
P706 (**)	CAN RX Telegrams	0 to 9999		ro	16-2
P707 (**)	CAN TX Telegrams	0 to 9999		ro	16-2
P708 (**)	Bus Off Counter	0 to 9999		ro	16-2
P709 (**)	CAN Lost Messages	0 to 9999		ro	16-2
P710 (**)	DeviceNet I/O Instances	0 = ODVA Basic 2 W 1 = ODVA Extend 2 W 2 = Manuf. Spec. 2 W 3 = Manuf. Spec. 3 W 4 = Manuf. Spec. 4 W 5 = Manuf. Spec. 5 W 6 = Manuf. Spec. 6 W	0		16-2
P711 (**)	DeviceNet Reading #3	0 to 1199	0		16-2
P712 (**)	DeviceNet Reading #4	0 to 1199	0		16-2
P713 (**)	DeviceNet Reading #5	0 to 1199	0		16-2
P714 (**)	DeviceNet Reading #6	0 to 1199	0		16-2
P715 (**)	DeviceNet Writing #3	0 to 1199	0		16-3
P716 (**)	DeviceNet Writing #4	0 to 1199	0		16-3
P717 (**)	DeviceNet Writing #5	0 to 1199	0		16-3
P718 (**)	DeviceNet Writing #6	0 to 1199	0		16-3
P719 (**)	DeviceNet Network Status	0 = Offline 1 = OnLine, Not Conn. 2 = OnLine Connect. 3 = Connection Timed Out 4 = Link Failure 5 = Auto-Baud	5	ro	16-3
P720 (**)	DNet Master Status	0 = Run 1 = Idle		ro	16-3

Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
P721 (**)	CANopen Com. Status	0 = Inactive 1 = Reserved 2 = Communic. Enabled 3 = Error Ctrl. Enable 4 = Guarding Error 5 = Heartbeat Error		ro	16-3
P722 (**)	CANopen Node Status	0 = Inactive 1 = Initialization 2 = Stopped 3 = Operational 4 = Preoperational		ro	16-3
P740 (**)	Profibus Communication Status	0 = Inactive 1 = Access Error 2 = Offline 3 = Configuration Error 4 = Parameterization Error 5 = Clear Mode 6 = Online		ro	16-3
P742 (**)	Profibus Reading # 3	0 to 1199	0		16-3
P743 (**)	Profibus Reading # 4	0 to 1199	0		16-3
P744 (**)	Profibus Reading # 5	0 to 1199	0		16-3
P745 (**)	Profibus Reading # 6	0 to 1199	0		16-3
P746 (**)	Profibus Writing # 3	0 to 1199	0		16-3
P747 (**)	Profibus Writing # 4	0 to 1199	0		16-3
P748 (**)	Profibus Writing # 5	0 to 1199	0		16-3
P749 (**)	Profibus Writing # 6	0 to 1199	0		16-3
P750 (**)	Profibus Address	1 to 126	1		16-3
P751 (**)	Profibus Telegram Selection	1 = Standard Telegram 1 2 = Telegram 100 3 = Telegram 101 4 = Telegram 102 5 = Telegram 103	1		16-3
P754 (**)	Profibus Baud Rate	0 = 9.6 kbit/s 1 = 19.2 kbit/s 2 = 93.75kbit/s 3 = 187.5 kbit/s 4 = 500 kbit/s 5 = Not Detected 6 = 1500 kbit/s 7 = 3000 kbit/s 8 = 6000 kbit/s 9 = 12000 kbit/s 10 = Reserved 11 = 45.45 kbit/s	0	ro	16-4
P770 (**)	Bluetooth Name	0 to 9999	0		16-1
P771 (**)	Bluetooth Password	0 to 9999	1234		16-2
P840 (*)	IR Control Command	0 to FFFF (hexa)		ro	12-20
P841 (*)	IR Control Selection	0 = Without Display 1 = With Display	0	cfg	
P842 (*)	Quick View 1 IR	0 to 959	2		5-3
P843 (*)	Quick View 2 IR	0 to 959	375		5-3
P900	SoftPLC Status	0 = No Application 1 = Installing Application 2 = Incompat. Application 3 = Application Stopped 4 = Application Running	0	ro	17-1
P901	SoftPLC Command	0 = Stop Program 1 = Run Program	0	cfg	17-1
P902	Scan Cycle Time	0 to 9.999 s	0	ro	17-1
P903	SoftPLC Application	0 = User 1 = PID Controller	1	cfg	17-1
P904	Action for SoftPLC Application not Running	0 = Inactive 1 = Generate Alarm (A708) 2 = Generate Fault (F709)	0	cfg	17-2

Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
SoftPLC Parameter Configuration for the User's Application (P903 = 0)					
P910	SoftPLC Parameter 1	-9999 to 9999	0		17-2
P911	SoftPLC Parameter 2	-9999 to 9999	0		17-2
P912	SoftPLC Parameter 3	-9999 to 9999	0		17-2
P913	SoftPLC Parameter 4	-9999 to 9999	0		17-2
P914	SoftPLC Parameter 5	-9999 to 9999	0		17-2
P915	SoftPLC Parameter 6	-9999 to 9999	0		17-2
P916	SoftPLC Parameter 7	-9999 to 9999	0		17-2
P917	SoftPLC Parameter 8	-9999 to 9999	0		17-2
P918	SoftPLC Parameter 9	-9999 to 9999	0		17-2
P919	SoftPLC Parameter 10	-9999 to 9999	0		17-2
P920	SoftPLC Parameter 11	-9999 to 9999	0		17-2
P921	SoftPLC Parameter 12	-9999 to 9999	0		17-2
P922	SoftPLC Parameter 13	-9999 to 9999	0		17-2
P923	SoftPLC Parameter 14	-9999 to 9999	0		17-2
P924	SoftPLC Parameter 15	-9999 to 9999	0		17-2
P925	SoftPLC Parameter 16	-9999 to 9999	0		17-2
P926	SoftPLC Parameter 17	-9999 to 9999	0		17-2
P927	SoftPLC Parameter 18	-9999 to 9999	0		17-2
P928	SoftPLC Parameter 19	-9999 to 9999	0		17-2
P929	SoftPLC Parameter 20	-9999 to 9999	0		17-2
P930	SoftPLC Parameter 21	-9999 to 9999	0		17-2
P931	SoftPLC Parameter 22	-9999 to 9999	0		17-2
P932	SoftPLC Parameter 23	-9999 to 9999	0		17-2
P933	SoftPLC Parameter 24	-9999 to 9999	0		17-2
P934	SoftPLC Parameter 25	-9999 to 9999	0		17-2
P935	SoftPLC Parameter 26	-9999 to 9999	0		17-2
P936	SoftPLC Parameter 27	-9999 to 9999	0		17-2
P937	SoftPLC Parameter 28	-9999 to 9999	0		17-2
P938	SoftPLC Parameter 29	-9999 to 9999	0		17-2
P939	SoftPLC Parameter 30	-9999 to 9999	0		17-2
P940	SoftPLC Parameter 31	-9999 to 9999	0		17-2
P941	SoftPLC Parameter 32	-9999 to 9999	0		17-2
P942	SoftPLC Parameter 33	-9999 to 9999	0		17-2
P943	SoftPLC Parameter 34	-9999 to 9999	0		17-2
P944	SoftPLC Parameter 35	-9999 to 9999	0		17-2
P945	SoftPLC Parameter 36	-9999 to 9999	0		17-2
P946	SoftPLC Parameter 37	-9999 to 9999	0		17-2
P947	SoftPLC Parameter 38	-9999 to 9999	0		17-2
P948	SoftPLC Parameter 39	-9999 to 9999	0		17-2
P949	SoftPLC Parameter 40	-9999 to 9999	0		17-2
P950	SoftPLC Parameter 41	-9999 to 9999	0		17-2
P951	SoftPLC Parameter 42	-9999 to 9999	0		17-2
P952	SoftPLC Parameter 43	-9999 to 9999	0		17-2
P953	SoftPLC Parameter 44	-9999 to 9999	0		17-2
P954	SoftPLC Parameter 45	-9999 to 9999	0		17-2
P955	SoftPLC Parameter 46	-9999 to 9999	0		17-2
P956	SoftPLC Parameter 47	-9999 to 9999	0		17-2
P957	SoftPLC Parameter 48	-9999 to 9999	0		17-2
P958	SoftPLC Parameter 49	-9999 to 9999	0		17-2
P959	SoftPLC Parameter 50	-9999 to 9999	0		17-2

Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
SoftPLC Parameter Configuration for PID Controller Application (P903 = 1)					
P910	PID Controller Application Version	0.00 to 90.00		ro	18-8
P911	Control Setpoint	-9999 to 9999 [SPLC Eng. Un.]	200	rw	18-8
P912	Control Setpoint 1	-9999 to 9999 [SPLC Eng. Un.]	200		18-8
P913	Control Setpoint 2	-9999 to 9999 [SPLC Eng. Un.]	230		18-8
P914	Control Setpoint 3	-9999 to 9999 [SPLC Eng. Un.]	180		18-8
P915	Control Setpoint 4	-9999 to 9999 [SPLC Eng. Un.]	160		18-8
P916	Control Process Variable	-9999 to 9999 [SPLC Eng. Un.]		ro	18-9
P917	PID Controller Output	0.0 to 100.0 %		ro	18-9
P918	PID Controller Setpoint in Manual Mode	0.0 to 400.0 Hz	0.0 Hz		18-9
P919	PID Controller Logical Status	Bit 0 = Sleep Mode Active (A750) Bit 1 = PID in Manual (0) / Automatic (1) Bit 2 = PV Low Level (A760) Bit 3 = PV Low Level (F761) Bit 4 = PV High Level (A762) Bit 5 = PV High Level (F763) Bit 6 to 15 = Reserved		ro	18-9
P920	Selection of the Control Setpoint Source	0 = Control Setpoint via HMI or Communication Networks (P911) 1 = Control Setpoint via Analog Input AI1 2 = Control Setpoint via Analog Input AI2 3 = Control Setpoint via Electronic Potentiometer (EP) 4 = Two Setpoints via Digital Input DI3 (P912 and P913) 5 = Three Setpoints via Digital Inputs DI3 and DI4 (P912, P913 and P914) 6 = Four Setpoints via Digital Inputs DI3 and DI4 (P912, P913, P914 and P915)	0	cfg	18-10
P921	Selection of the Control Process Variable Source	1 = Control Process Variable via Analog Input AI1 2 = Control Process Variable via Analog Input AI2 3 = Control Process Variable via Difference between Analog Input AI1 and AI2	1	cfg	18-12
P922	Minimum Sensor Level of the Control Process Variable	-9999 to 9999 [SPLC Eng. Un.]	0		18-12
P923	Maximum Sensor Level of the Control Process Variable	-9999 to 9999 [SPLC Eng. Un.]	400		18-12
P924	Value for Low Level Alarm for the Control Process Variable;	-9999 to 9999 [SPLC Eng. Un.]	100		18-13
P925	Time for Low Level Fault for the Control Process Variable	0 to 9999 s	0 s		18-13
P926	Value for High Level Alarm for the Control Process Variable	-9999 to 9999 [SPLC Eng. Un.]	350		18-13
P927	Time for High Level Fault for the Control Process Variable	0 to 9999 s	0 s		18-14
P928	Selection of the PID Controller Control Action	0 = Disable PID Controller 1 = Enable PID Controller in Direct Mode 2 = Enable PID Controller in Reverse Mode	0	cfg	18-14
P929	PID Controller Operation Mode	0 = Manual 1 = Automatic 2 = Select Control to Manual (0) or Automatic (1) via digital input DI2	2		18-15

Param.	Description	Adjustable Range	Factory Setting	Prop.	Page
P930	Automatic Adjustment of the PID Controller Setpoint	0 = P911 inactive and P918 inactive 1 = P911 active and P918 inactive 2 = P911 inactive and P918 active 3 = P911 active and P918 active	0		18-15
P931	Proportional Gain	0.00 to 99.99	1.00		18-16
P932	Integral Gain	0.00 to 99.99	5.00		18-16
P933	Derivative Gain	0.00 to 99.99	0.00		18-16
P934	PID Controller Sampling Period	0.050 to 9.999 s	0.100 s	cfg	18-16
P935	Filter for the PID Controller Control Setpoint	0.000 to 9.999 s	0.150 s		18-17
P936	Deviation of the Control Process Variable to Wake Up	-9999 to 9999 [SPLC Eng. Un.]	30		18-17
P937	Time to Wake Up	0 to 9999 s	5 s		18-18
P938	Motor Speed to activate the Sleep Mode	0.0 to 400.0 Hz	0.0 Hz		18-18
P939	Time to activate de Sleep Mode	0 to 9999 s	10 s		18-18

(*) Only available when some IO expansion accessory (CFW300-IOAR, CFW300-IODR, CFW300-IOADR or CFW300-IOAENC) is present (connected). For further information, refer to the respective accessory guide.

(**) Only available when some communication accessory (CFW300-CBLT, CFW300-CCAN or CFW300-CPDP) is present (connected). For further information, refer to the respective accessory guide.

ro = read only parameter.
V/f = parameter available in V/f mode.
cfg = configuration parameter, value can only be changed with the motor stopped.
VVW = parameter available in VVW mode.

Fault / Alarm	Description	Possible Causes
A046 Motor Overload	Motor overload alarm.	■ Settings of P156 is too low for the used motor. ■ Overload on the motor shaft.
A050 Power Module Overtemperature	Overtemperature alarm from the power module temperature sensor (NTC).	■ High temperature at IGBTs. P030> Level A050, according to Table 14.1 on page 14-3. ■ High ambient temperature around the inverter (> 50 °C (> 122 °F)) and high output current. For further information, refer to of the user's manual available for download on the website: **www.weg.net.** ■ Blocked or defective fan. ■ Heatsink is too dirty, preventing the air flow.
A090 External Alarm	External alarm via DIx (option "no external alarm" in P263 to P270).	■ Wiring on DI1 to DI8 inputs are open or have poor contact.
A128 Telegram Reception Timeout	Alarm that indicates serial communication fault. It indicates the equipment stopped receiving valid serial telegrams for a period longer than the setting in P314.	■ Check network installation, broken cable or fault/poor contact on the connections with the network, grounding. ■ Ensure the master always sends telegrams to the equipment in a time shorter than the setting in P314. ■ Disable this function in P314.
A133 No Power Supply on the CAN Interface	It indicates that the CAN interface has no power supply between pins 25 and 29 of the connector.	■ Measure if there is voltage within the allowed range between pins 25 and 29 of the CAN interface connector. ■ Check if the power supply cables are not misconnected or inverted. ■ Check for contact problems on the cable or connector of the CAN interface.
A134 Bus Off	Buss off error detected on the CAN interface.	■ Check for short circuit on the CAN circuit transmission cable. ■ Check if the cables are not misconnected or inverted. ■ Check if all the network devices use the same baud rate. ■ Check if the termination resistors with the right specification were installed only at the end of the main bus. ■ Check if the CAN network was properly installed.
A135 Node Guarding/ Heartbeat	CANopen communication error control detected communication error using the guarding mechanism.	■ Check the times set on the master and on the slave for message exchange. In order to prevent problems due to transmission delays and time counting, it is recommended that the values set for error detection by the slave be multiples of the times set for message exchange on the master. ■ Check if the master is sending the guarding telegrams in the time set. ■ Check problems in the communication that may cause missing telegrams or transmission delays.
A136 Idle Master	Alarm indicates that the DeviceNet network master is in Idle mode.	■ Set the switch that controls the master operation of the master for Run or the corresponding bit on the configuration word of the master software. If further information is needed, refer to the documentation of the master used.
A137 DeviceNet Connection Timeout	Alarm that indicates that one or more DeviceNet connections timed out.	■ Check the network master status. ■ Check network installation, broken cable or fault/poor contact on the connections with the network.
A138 Profibus DP Interface in Clear Mode	It indicates that the inverter received the command from the Profibus DP network master to go into clear mode.	■ Check the network master status, ensuring it is in the run mode.
A139 Offline Profibus DP Interface	It indicates interruption in the communication between the Profibus DP network master and the inverter. The Profibus DP communication interface went into offline status.	■ Check if the network master is correctly configured and operating properly. ■ Check for short-circuit or poor contact on the communication cables. ■ Check if the cables are not misconnected or inverted. ■ Check if the termination resistors with the right value were installed only at the end of the main bus. ■ Check the network installation in general - cabling, grounding.
A140 Profibus DP Module Access Error	It indicates error in the access to the Profibus DP communication module data.	■ Check if the Profibus DP module is correctly fitted. ■ Hardware errors due to improper handling or installation of the accessory, for instance, may cause this error. If possible, carry out tests by replacing the communication accessory.
A163 Signal Fault AI1 4...20 mA	Analog input signal AI1 at 4 to 20 mA or 20 to 4 mA is below 4 to 20 mA.	■ Current signal on the analog input AI1 interrupted or null. ■ Parameterization error on analog input AI1.
A164 Signal Fault AI2 4...20 mA	Analog input signal AI2 at 4 to 20 mA or 20 to 4 mA is below 4 to 20 mA.	■ Current signal on the analog input AI2 interrupted or null. ■ Parameterization error on analog input AI2.
A177 Replace Fan	Alarm to replace the fan (P045 > 50000 hours).	■ Maximum number of operation hours of the heatsink fan exceeded.
A211 Drive in Fire Mode	Indicates that the drive is in Fire Mode.	■ The digital input programmed for activating the Fire Mode is active.

Fault / Alarm	Description	Possible Causes
A700 Remote HMI Communication	No communication with remote HMI, but here is frequency command or reference for this source.	■ Check if the communication interface with the HMI is properly configured in parameter P312. ■ HMI cable disconnected.
A702 Inverter Disabled	This failure occurs when there is a SoftPLC movement block active and the "General Enable" command is disabled.	■ Check if the drive General Enable command is active.
A704 Two Movem. Enabled	It occurs when 2 or more SoftPLC movement blocks are enabled at the same time.	■ Check the user's program logic.
A706 Refer. Not Progr. SPLC	This failure occurs when a SoftPLC movement block is enabled and the speed reference is not programmed for the SoftPLC.	■ Check the programming of the references in the Local and/or Remote mode (P221 and P222).
A708 SoftPLC Application Stopped	SoftPLC Application not running	■ SoftPLC Application is stopped (P901 = 0 and P900 = 3). ■ SoftPLC state presents application incompatible with the firmware version of the CFW300.
A712 SPLC Protected Against Copy	It occurs when there is an attempt to copy the SoftPLC application protected against copies.	■ Attempt to copy WLP application protected against copies ("never permit copies"). ■ Attempt to copy WLP from a copy protected against copies ("no permission to copy from a copy").
A750 to **A799** User's Alarms for SoftPLC	Alarm range intended for the user's application developed in the SoftPLC function.	■ Defined by the user's application developed in the SoftPLC function.
F021 Undervoltage on the DC Link	Undervoltage fault on the intermediate circuit.	■ Wrong voltage supply; check if the data on the inverter label comply with the power supply and parameter P296. ■ Supply voltage too low, producing voltage on the DC Link below the minimum value (Level F021) according to Table 14.4 on page 14-4: Ud < 200 Vdc. ■ Phase fault in the input. ■ Fault in the pre-charge circuit.
F022 Overvoltage on the DC Link	Overvoltage fault on the intermediate circuit.	■ Wrong voltage supply; check if the data on the inverter label comply with the power supply and parameter P296. ■ Supply voltage is too high, producing voltage on the DC Link above the maximum value (Level F022) according to Table 14.4 on page 14-4. ■ Load inertia is too high or deceleration ramp is too fast. ■ P151 setting is too high.
F031 Fault in Communication with IOs Expansion Accessory	Main control cannot establish the communication link with the IOs expansion accessory.	■ Accessory damaged. ■ Poor connection of the accessory. ■ Problem in the identification of the accessory; refer to P027.
F032 Fault in Communication with IO Communication Accessory	Main control cannot establish the communication link with the communication acccessory.	■ Accessory damaged. ■ Poor connection of the accessory. ■ Problem in the identification of the accessory; refer to P028.
F033 VVW Self-tuning Fault	Stator resistance setting fault P409.	■ Stator resistance value in P409 does not comply with the inverter power. ■ Motor connection error; turn off the power supply and check the motor terminal box and the connections with the motor terminals. ■ Motor power too low or too high in relation to the inverter.
F051 IGBTs Overtemperatures	Overtemperature fault measured on the temperature sensor of the power pack.	■ High temperature at IGBTs. P030> Level A051, according to Table 14.1 on page 14-3. ■ High ambient temperature around the inverter (> 50 °C (> 122 °F)) and high output current. For further information, refer to of the user's manual available for download on the website: **www.weg.net**. ■ Blocked or defective fan. ■ Heatsink is too dirty, preventing the air flow.
F067 Incorrect Encoder/ Motor Wiring	Fault related to the phase relation of the encoder signals.	■ Output motor cables U, V, W are inverted. ■ Encoder channels A and B are inverted. ■ Encoder was not properly mounted.
F070 Overcurrent/Shortcircuit	Overcurrent or short-circuit on the output, DC link or braking resistor.	■ Short-circuit between two motor phases. ■ IGBTs module in short-circuit or damaged. ■ Start with too short acceleration ramp. ■ Start with motor spinning without the Flying Start function.
F072 Motor Overload	Motor overload fault, according to actuation defined by the curve of Figure 14.1 on page 14-2.	■ P156, P157 or P158 setting is too low in relation to the motor operating current. ■ Overload on the motor shaft.

Fault / Alarm	Description	Possible Causes
F078 Motor Overtemperature	Overtemperature fault measured on the motor temperature sensor (Triple PTC) via analog input AIx	■ Overload on the motor shaft. ■ Load cycle is too high (high number of starts and stops per minute). ■ High ambient temperature around the motor. ■ Poor contact or short-circuit (3k9 < R_{PTC} < 0k1). ■ Motor thermistor not installed. ■ Motor shaft is stuck.
F079 Encoder Signal Fault	Fault of encoder signals absent.	■ Wiring between encoder and interface accessory to encoder broken. ■ Encoder defective.
F080 CPU Fault (Watchdog)	Fault related to the supervision algorithm of the inverter main CPU.	■ Electric noise. ■ Inverter firmware fault.
F081 End of User's Memory	Fault of end of memory to save user's parameter table.	■ Attempt to save (P204 = 9) more than 32 parameters (with values different from the factory default) on the User parameter table.
F082 Fault in Data Transfer (MMF)	Fault in data transfer using MMF accessory.	■ Attempt to download data from the flash memory module to the inverter with the inverter energized. ■ Attempt to download a SoftPLC application incompatible with the destination inverter. ■ Problems saving data downloaded to the inverter.
F084 Auto-diagnosis Fault	Fault related to the automatic identification algorithm of the inverter hardware.	■ Poor contact in the connection between the main control and the power pack. ■ Hardware not compatible with the firmware version. ■ Defect on the internal circuits of the inverter.
F091 External Fault	External fault via DIx ("no external fault" in P263 to P270).	■ Wiring on DI1 to DI8 inputs are open or have poor contact.
F228 Timeout in Receipt of Telegrams	Indicates fault in the serial communication. It indicates the equipment stopped receiving valid serial telegrams for a period longer than the setting in P314.	■ Check network installation, broken cable or fault/poor contact on the connections with the network, grounding. ■ Ensure the master always sends telegrams to the equipment in a time shorter than the setting in P314. ■ Disable this function in P314.
F233 No Power Supply on the CAN Interface	It indicates that the CAN interface has no power supply between pins 25 and 29 of the connector.	■ Measure if there is voltage within the allowed range between pins 25 and 29 of the CAN interface connector. ■ Check if the power supply cables are not misconnected or inverted. ■ Check for contact problems on the cable or connector of the CAN interface.
F234 Bus Off	Buss off error detected on the CAN interface.	■ Check for short circuit on the CAN circuit transmission cable. ■ Check if the cables are not misconnected or inverted. ■ Check if all the network devices use the same baud rate. ■ Check if the termination resistors with the right specification were installed only at the end of the main bus. ■ Check if the CAN network was properly installed.
F235 Node Guarding/ Heartbeat	CANopen communication error control detected communication error using the guarding mechanism.	■ Check the times set on the master and on the slave for message exchange. In order to prevent problems due to transmission delays and time counting, it is recommended that the values set for error detection by the slave be multiples of the times set for message exchange on the master. ■ Check if the master is sending the guarding telegrams in the time set. ■ Check problems in the communication that may cause missing telegrams or transmission delays.
F236 Idle Master	Fault indicates that the DeviceNet network master is in Idle mode.	■ Set the switch that controls the master operation for Run or the corresponding bit on the configuration word of the master software. If further information is needed, refer to the documentation of the master used.
F237 DeviceNet Connection Timeout	Fault that indicates that one or more DeviceNet connections timed out.	■ Check the network master status. ■ Check network installation, broken cable or fault/poor contact on the connections with the network.
F238 Profibus DP Interface in Clear Moder	It indicates that the inverter received a command from the Profibus DP network master to enter the clear mode.	■ Verify the network master status, making sure it is in the execution mode (Run).
F239 Offline Profibus DP Interface	It indicates an interruption in the communication between the Profibus DP network master and the inverter. The Profibus DP communication interface went into offline status.	■ Check if the network master is correctly configured and operating properly. ■ Check for short-circuit or poor contact on the communication cables. ■ Check if the cables are not misconnected or inverted. ■ Check if the termination resistors with the right value were installed only at the end of the main bus. ■ Check the network installation in general - cabling, grounding.

Fault / Alarm	Description	Possible Causes
F240 Profibus DP Module Access Fault	It indicates fault in the access to the Profibus DP communication module data.	■ Check if the Profibus DP module is correctly fitted. ■ Hardware errors due to improper handling or installation of the accessory, for instance, may cause this fault. If possible, carry out tests by replacing the communication accessory.
F701 Remote HMI Communication Fault	No communication with the remote HMI; however, there is command or frequency reference for this source.	■ Check that the HMI communication interface is properly configured in parameter P312. ■ HMI cable disconnected.
F709 SPLC Application Stopped	SoftPLC application not running.	■ SoftPLC application stopped (P901 = 0 and P900 = 3). ■ SoftPLC state presents incompatible application with the CFW300 firmware version.
F710 Size of the SoftPLC Application	The size of the SoftPLC user's program exceeded the maximum memory capacity.	■ The logic implemented on the WLP is too large. Check project size.
F711 Fault on SoftPLC Application	Fault found in SoftPLC user's program.	■ SoftPLC user's program stored on flash memory is corrupted. ■ Timeout during execution of SoftPLC scan cycle.
F750 to **F799** User's Faults for SoftPLC	Fault range intended for the user's application developed in the SoftPLC function.	■ Defined by the user's application developed in the SoftPLC function.
Faults and Alarms for PID Controller Application (P903 = 1)		
A750 Sleep Mode Active	It indicates that the PID Controller is in the sleep mode.	■ The motor speed remained below the value programmed in P938 for the time programmed in P939.
A760 Low Level of the Control Process Variable	It indicates that the level of the control process variable (P916) is low.	■ The control process variable (P916) remained below the value programmed in P924 for 150 ms.
F761 Low Level of the Control Process Variable	It indicates the motor was switched off due to the low level of the control process variable.	■ The control process variable (P916) remained below the value programmed in P924 for a certain time (P925).
A762 High Level of the Control Process Variable	It indicates that the level of the control process variable (P916) is high.	■ The control process variable (P916) remained above the value programmed in P926 for 150 ms.
F763 High Level of the Control Process Variable	It indicates the motor was switched off due to the high level of the control process variable.	■ The control process variable (P916) remained above the value programmed in P926 for a certain time (P927).
A790 Speed reference source not programmed for the SoftPLC	It indicates that parameters of the speed reference sources in local mode (P221) and in remote mode (P222) were not programmed for the SoftPLC.	■ The PID Controller was enabled, the Run/Stop command is active, and neither of the two parameters of the speed reference source was programmed in 12 (SoftPLC).

1 SAFETY INSTRUCTIONS

This manual contains the information necessary for the correct setting of the CFW300 frequency inverter.

It was developed to be used by people with proper technical training or qualification to operate this kind of equipment. These people must follow the safety instructions defined by local standards. The noncompliance with the safety instructions may result in death risk and/or equipment damage.

1.1 SAFETY WARNINGS IN THIS MANUAL

DANGER!
The procedures recommended in this warning have the purpose of protecting the user against death, serious injuries and considerable material damage.

ATTENTION!
The procedures recommended in this warning have the purpose of avoiding material damage.

NOTE!
The information mentioned in this warning is important for the proper understanding and good operation of the product.

1.2 SAFETY WARNINGS IN THE PRODUCT

The following symbols are fixed to the product, as a safety warning:


High voltages present.


Components sensitive to electrostatic discharge.
Do not touch them.


Mandatory connection to the protective earth (PE).


Connection of the shield to the ground.


Hot surface.

1.3 PRELIMINARY RECOMMENDATIONS

DANGER!
Only qualified personnel, familiar with the CFW300 inverter and related equipment must plan or perform the installation, start-up, operation and maintenance of this equipment.
The personnel must follow the safety instructions described in this manual and/or defined by local standards.
The noncompliance with the safety instructions may result in death risk and/or equipment damage.

NOTE!
For the purposes of this manual, qualified personnel are those trained in order to be able to:
1. Install, ground, power up and operate the CFW300 in accordance with this manual and the safety legal procedures in force.
2. Use the protective equipment in accordance with the relevant standards.
3. Give first aid.

DANGER!
Always disconnect the general power supply before touching any electric component associated to the inverter.
Many components may remain loaded with high voltages and/or moving (fans), even after the AC power supply input is disconnected or turned off. Wait for at least ten minutes in order to guarantee the full discharge of the capacitors. Always connect the frame size of the equipment to the protective earth (PE) at the proper point for that.

ATTENTION!
Electronic boards have components sensitive to electrostatic discharge. Do not touch directly the component parts or connectors. If necessary, first touch the grounded metallic frame size or use proper grounding strap.

Do not execute any applied potential test on the inverter!
If necessary, contact WEG.

NOTE!
- Frequency inverters may interfere in other electronic equipments. Observe the recommendations of chapter 3 Installation and Connection of the user's manual in order to minimize these effects.
- Read the user's manual completely before installing or operating this inverter.

2 GENERAL INFORMATION

2.1 ABOUT THE MANUAL

This manual presents information necessary for the configuration of all the functions and parameters of the CFW300 frequency inverter. This manual must be used together with the user's manual of the CFW300.

The text provides additional information so as simplify the use and programming of the CFW300 in certain applications.

2.2 TERMINOLOGY AND DEFINITIONS

2.2.1 Terms and Definitions Used

I_{nom}: inverter rated current by P295.

Rectifier: input circuit of the inverters that transforms the input AC voltage into DC. It is formed by high-power diodes.

IGBT: insulated gate bipolar transistor - basic component part of the output inverter bridge. It works as an electronic switch in the saturated (closed switch) and cut-off (open switch) modes.

DC Link: intermediary circuit of the inverter; voltage in direct current obtained by rectifying the power supply alternate voltage or external supply; it supplies the output inverter bridge with IGBTs.

Pre-Charge Circuit: charges the capacitors of the DC link with limited current, avoiding current peaks in the inverter power-up.

NTC: resistor whose resistance value in ohms decreases proportionally to the increase of the temperature; it is used as a temperature sensor in power packs.

HMI: human-machine interface; device which allows controlling the motor, viewing and changing the inverter parameters. It features keys to control the motor, navigation keys and graphic LCD display.

PE: protective earth.

PWM: pulse width modulation - modulation by pulse width; pulsed voltage that supplies the motor.

Switching Frequency: switching frequency of the IGBTs of the inverter bridge, normally expressed in kHz.

General Enable: when activated, it accelerates the motor by acceleration ramp and Run/Stop = Run. When disabled, the PWM pulses will be immediately blocked. It may be controlled by digital input set for this function, via serial or via SoftPLC.

Run/Stop: inverter function which, when activated (run), accelerates the motor by acceleration ramp up to the reference frequency and, when deactivated (stop), decelerates the motor by deceleration ramp. It may be controlled by digital input set for this function, via serial or via SoftPLC.

Heatsink: metal part designed to dissipate the heat produced by power semiconductors.

Amp, A: ampere; unit of measurement of electric current.

°F: Fahrenheit degree.

°C: Celsius degrees; unit of measurement of temperature.

AC: alternate current.

DC: direct current.

hp (HP): horse power = 746 Watts (unit of measurement of power, normally used to indicate mechanical power of electric motors).

Hz: hertz; unit of measurement of frequency.

kHz: kilohertz = 1000 Hertz.

mA: miliampere = 0.001 ampere.

Nm: Newton meter; unit of torque.

rms: root mean square; effective value.

rpm: revolutions per minute; unit of measurement of rotation.

s: second; unit of measurement of time.

V: volts; unit of measurement of electric voltage.

Ω: ohms; unit of measurement of electric resistance.

2.2.2 Numerical Representation

The decimal numbers are represented by means of digits without suffix. Parameters P012, P013, P045, P397, P680, P682, P684, P685, P695, P697, P757, P758 and P840 are represented in hexadecimal numbers.

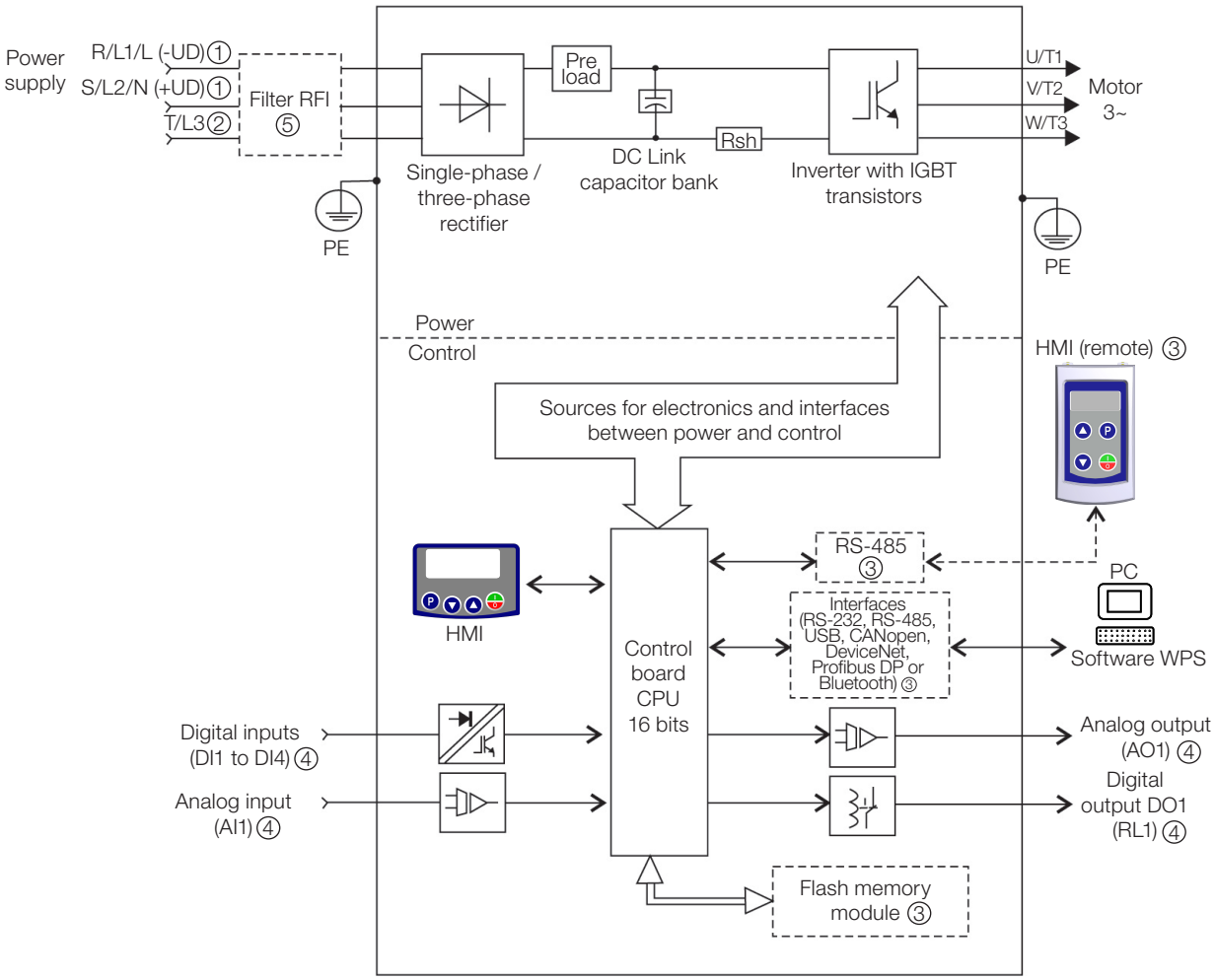
3 ABOUT THE CFW300

The CFW300 frequency inverter is a high performance product which enables speed and torque control of three-phase induction motors. This product provides the user with the options of vector (VVW) or scalar (V/f) control, both programmable according to the application.

In the vector mode (VVW), the operation is optimized for the used motor, providing a better performance in terms of speed regulation.

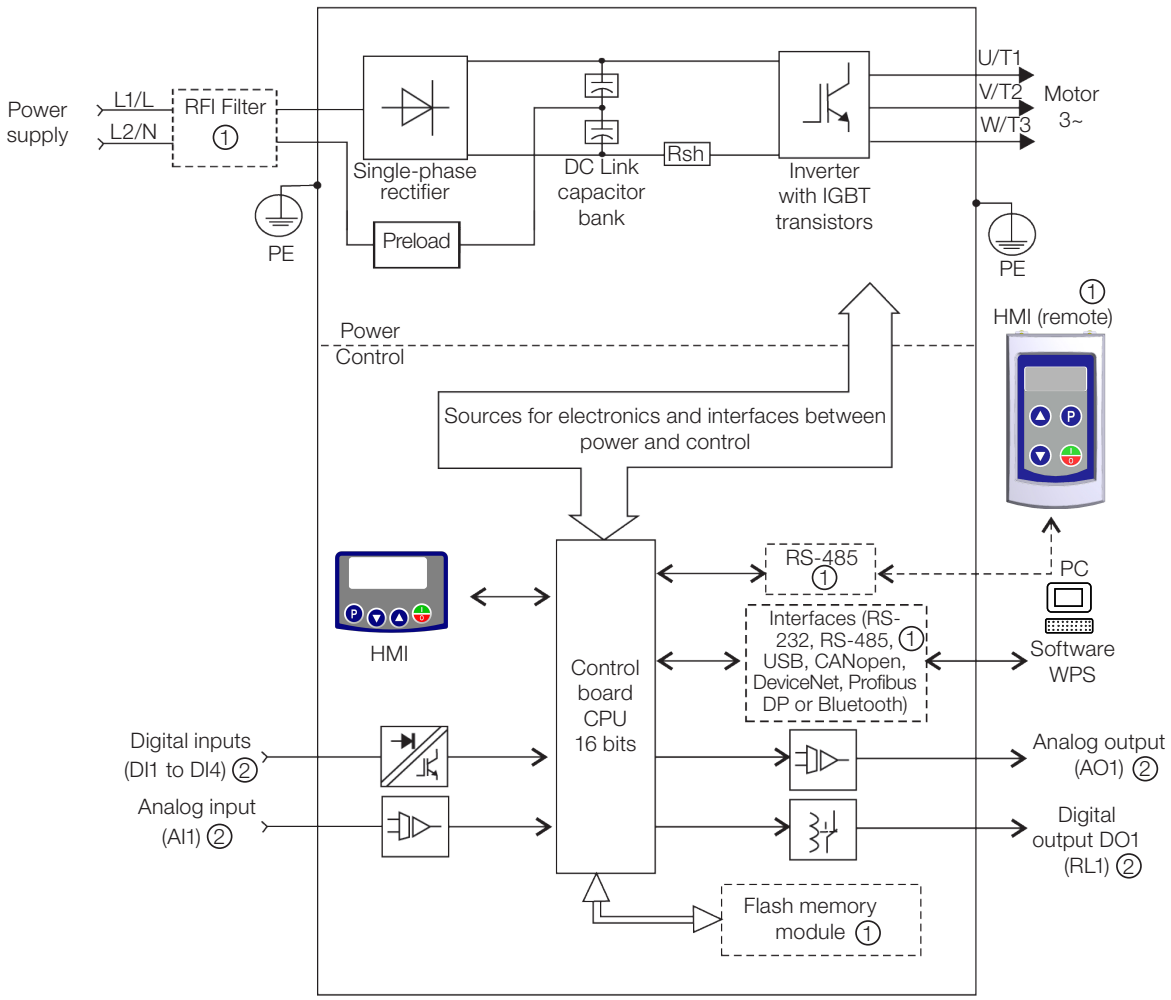
The scalar mode (V/f) is recommended for simpler applications, such as the activation of most pumps and fans. In those cases, it is possible to reduce the motor and inverter losses using the option "Quadratic V/f", which results in energy saving. The V/f mode is used when more than a motor is activated by an inverter simultaneously (multi-motor applications).

The main components of the CFW300 can be viewed in the block diagram of Figure 3.1 on page 3-1, Figure 3.2 on page 3-2 and Figure 3.3 on page 3-3. The mechanical project was designed to simplify the connection and maintenance, as well as to ensure the safety of the product.



① DC power supply connection available for specific models only.
② Three-phase power supply connection available for specific models only.
③ Available as accessory.
④ Number of Inputs/Outputs depends on the I/O expansion accessory used.
⑤ Available as accessory only for models Single-phase.

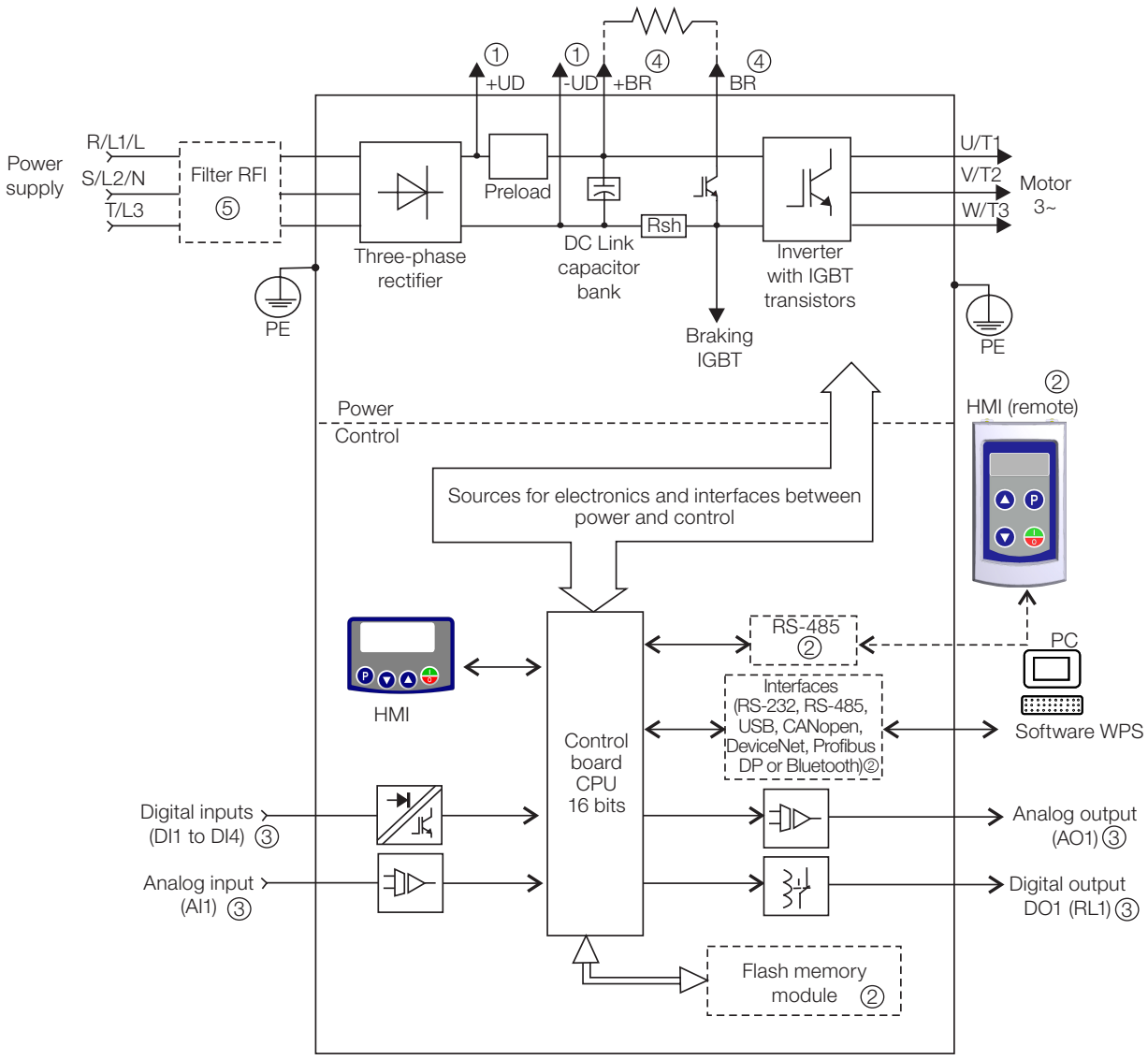
Figure 3.1: *Block diagram of CFW300 for frame size A 220 V*



① Available as accessory.

② Number of Inputs/Outputs depends on the I/O expansion accessory used.

Figure 3.2: *Block diagram of CFW300 for frame size A 110 V*

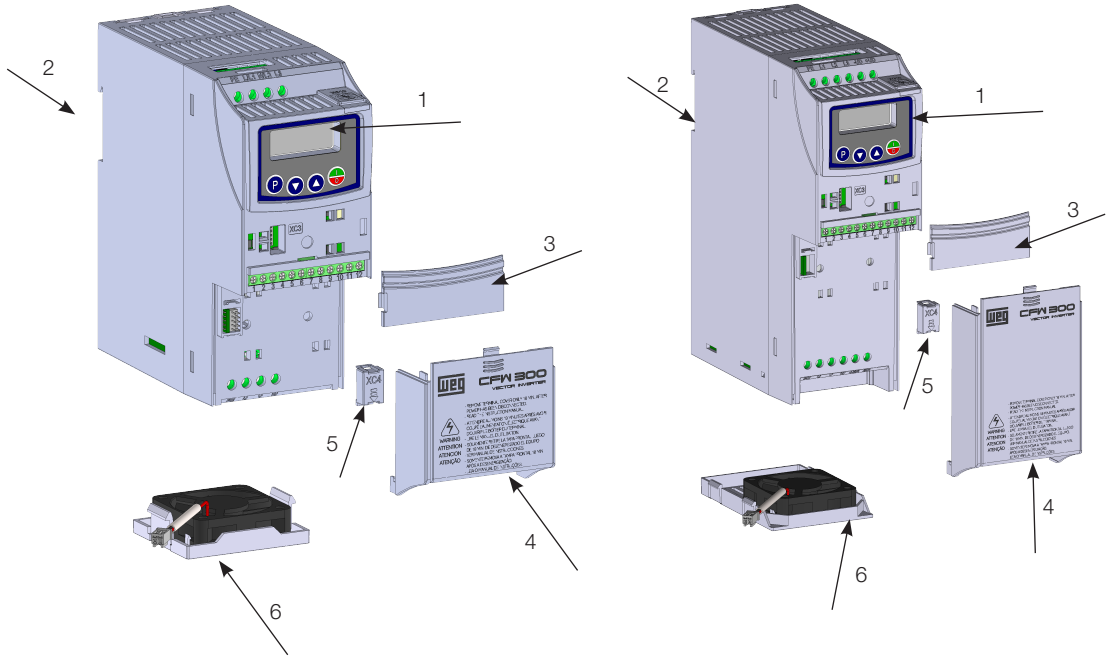


① DC power supply connection.
② Available as accessory.
③ Number of Inputs/Outputs depends on the I/O expansion accessory used.
④ Braking resistor connection.
⑤ Available as accessory only for models Single-phase.

Figure 3.3: *Block diagram of CFW300 for frame size B 220 V*

Frame size A

Frame size B



1 - HMI
2 - mounting supports (for DIN rail mounting)
3 - communication accessory cover
4 - cover of the IO expansion accessory
5 - protection cover of the connection of the IO expansion accessory
6 - fan with mounting support

Figure 3.4: *Main components of the CFW300*

4 HMI AND BASIC PROGRAMMING

4.1 USE OF THE HMI TO OPERATE THE INVERTER

Using the HMI, it is possible to command the inverter, view and adjust all of its parameters. The HMI presents the following functions:

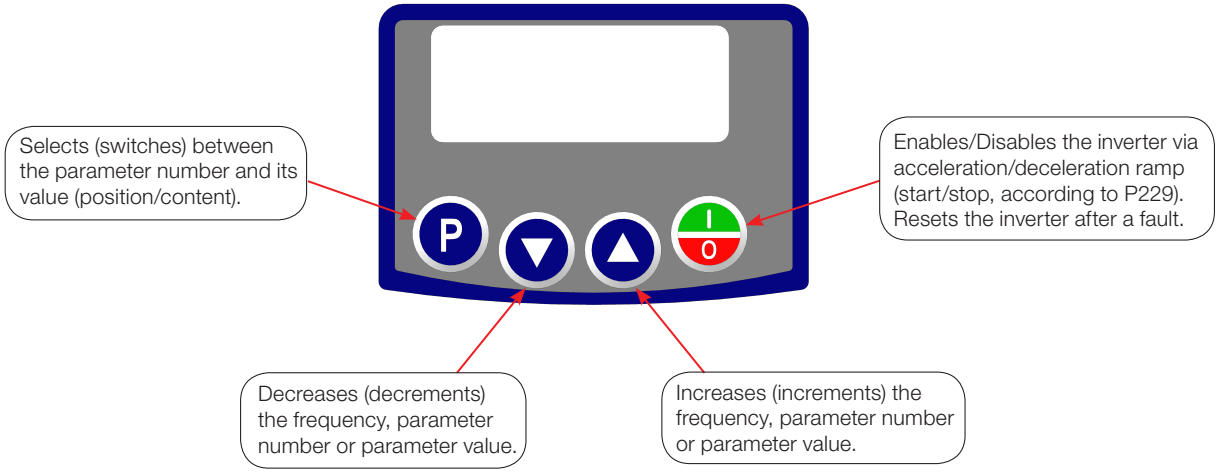


Figure 4.1: *HMI keys*

4.2 INDICATIONS ON THE HMI DISPLAY

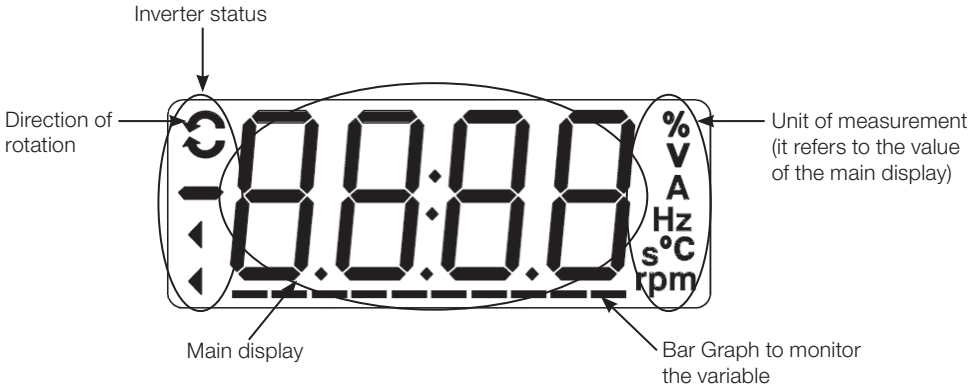


Figure 4.2: *Display areas*

4.3 OPERATING MODES OF THE HMI

When inverter is powered-up, the initial state of the HMI remains in the start-up mode as long as no faults, alarms, undervoltages occur or no keys are pressed.

The setting mode is composed of two levels: Level 1 allows browsing the parameters. Level 2 allows the modification of the parameter selected in level 1. At the end of this level, the modified value is saved when the key P is pressed.

The Figure 4.3 on page 4-2 illustrates the basic browsing of the operating modes of the HMI.

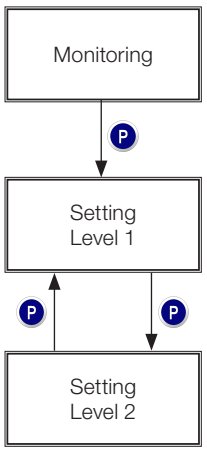
Start-up Mode		
■ It is the initial status of the HMI after the successful power-up (without fault, alarms or undervoltages). ■ Press the P key to go to level 1 of the setting mode - parameter selection. Pressing any other key will also change to the setting mode.		
Setting Mode		
Level 1: ■ This is the first level of the setting mode. The number of the parameter is shown on the main display. ■ Use the ▲ and ▼ keys to find the desired parameter. ■ Press the P key to go to level 2 of the setting mode - modification of the parameter content.		
Level 2: ■ The content of the parameter is shown on the main display. ■ Use the ▲ and ▼ keys to configure the new value for the selected parameter. ■ Press the P key to confirm the modification (save the new value). After the change is confirmed, the HMI returns to level 1 of the setting mode.		

Figure 4.3: HMI operating modes

NOTE!
When the inverter is in the fault state, the main display indicates the number of the fault in the format **Fxxx**. The browsing is allowed after pressing the P key.

NOTE!
When the inverter is in the alarm state, the main display indicates the number of the alarm in the format **Axxx**. The browsing is allowed after pressing the P key, and then the indication **"A"** is displayed on the unit of measurement display, flashing until the situation causing the alarm is solved.

5 PROGRAMMING BASIC INSTRUCTIONS

NOTE!
The inverter comes from the factory with the frequency (V/f 50/60 Hz mode) and voltage adjusted according to the market.
The reset to factory default may change the content of the parameters related to frequency. In the detailed description, some parameters have values between brackets, which represents the default value for operation in 50 Hz; thus the value without brackets is the default for operation in 60 Hz.

5.1 ACCESS AND INDICATIONS OF HMI

Whenever the inverter is powered up, the HMI display goes to the start-up mode if no faults, alarms or undervoltages are present. In order to simplify the reading of the inverter parameters, the display was designed to show two parameters simultaneously, at the user's discretion. One of those parameters (main display) is shown in the numeric form and the other parameter as a bar graph. The parameter monitored by the bar graph is selected via P207, as indicated in Figure 5.1 on page 5-1.

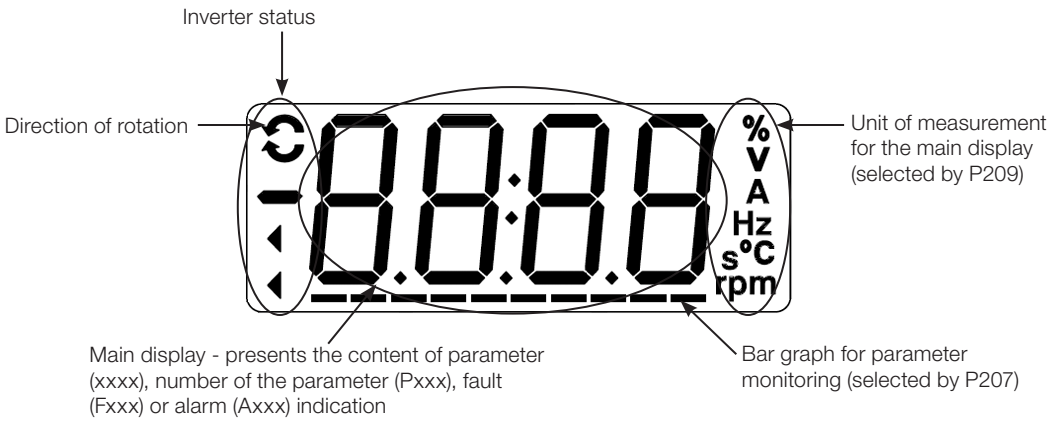


Figure 5.1: *Screen on initialization and display fields*

P000 - Access to Parameters

Adjustable Range:	0 to 9999	**Factory Setting:**	1
Properties:			

Description:

Password input to release the access to the parameters. Once a password is saved in P200, the access to the parameters is only allowed if this password is set in P000. After setting P000 with a password value, P000 will show "1" or "0", keeping the set password value hidden. Where "1" releases the access to parameters and "0" locks the access to the parameters.

NOTE!
The view of parameter P000 on the HMI will only be available when the password is active (P200 = 1).
The access to the parameters and P000 is cleared together with the powering down of the inverter.

P200 - Password

Adjustable Range:	0 = Inactive 1 = Active 2 to 9999 = New Password	**Factory Setting:**	0
Properties:	cfg		

Description:

It allows activating the password (by inserting a new value) or disabling it. For further details regarding the use of this parameter, refer to Table 5.1 on page 5-2.

Table 5.1: *Required procedure for each kind of action*

Action	Procedure
Activate password	1. Set P200 with the desired value for the password (P200 = password) 2. The setting is completed, the new password is active and P200 is automatically adjusted for 1 (password active) (1)
Change password	1. Set the current value of the password (P000 = password) 2. Set the desired value for the new password in P200 (P200 = new password) 3. The setting is completed, the new password is active and P200 is automatically adjusted for 1 (password active) (1)
Disable password	1. Set the current value of the password (P000 = password) 2. Set inactive password (P200 = 0) 3. The setting is completed, the password is disabled (2)
Disable password	1. Activate a factory default by means of P204 2. The setting is completed, the password is disabled (2)

(1) It only allows changing the content of the parameters when P000 is equal to the value of the password.
(2) It is allowed to change the content of the parameters and P000 is inaccessible.

P205 - Main Display Parameter Selection

Adjustable Range:	0 to 999	**Factory Setting:**	2
Properties:			

Description:

This parameter defines which parameter will be viewed on the HMI when the motor is enabled after initialization.

P207 - Bar Graph Parameter Selection

Adjustable Range:	0 to 999	**Factory Setting:**	3
Properties:			

Description:

This parameter defines which parameter will be shown on the HMI bar graph.

P208 - Reference Scale Factor

Adjustable Range:	1 to 9999	**Factory Setting:**	600 (500)
Properties:			

Description:

This parameter allows adjusting the scale of the parameter speed reference P001 and output (motor) speed P002 so as to convert the indication of frequency values applied to the motor (Hz) into angular speed in "rpm" or a proportional value in "%", for instance.

Together with the unit in P209 and the decimal places in P210, the rated reference (P208) defines the speed indication on the inverter HMI. According to the factory default of those parameters, the preset scale on the inverter is in "Hz" and with a decimal place (60.0 Hz or 50.0 Hz). On the other hand, by setting P208 = 1800 or 1500, P209 = 7 and P210 = 0, a scale in "rpm" with no decimal places is defined (1800 rpm or 1500 rpm).

P209 - Reference Engineering Unit

Adjustable Range:	0 and 1 = Without Unit 2 = V 3 = Hz 4 = Without Unit 5 = % 6 = Without Unit 7 = rpm	**Factory Setting:**	3
Properties:			

Description:

This parameter selects the engineering unit that will be presented on parameters P001 and P002.

P210 - Reference Decimal Point

Adjustable Range:	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz	**Factory Setting:**	1
Properties:			

Description:

This parameter allows setting the form of indication of parameters P001 and P002.

P213 - Bar Graph Scale Factor

Adjustable Range:	1 to 9999	**Factory Setting:**	1 x I_{nom}
Properties:			

Description:

This parameter configures the full scale (100 %) of the bar graph to indicate the parameter selected by P207.

P842 - Quick View 1 IR

P843 - Quick View 2 IR

Adjustable Range:	0 to 959	**Factory Setting:**	P842 = 2 P843 = 375
Properties:			

Description:

These parameters define which parameters (their respective values) will be viewed by using the  of the infrared remote control (available with the accessory CFW300-IOADR).

For further details, refer to the installation, configuration and operation guide of the CFW300-IOADR I/O expansion module.

5.2 BACKUP PARAMETERS

The CFW300 BACKUP functions allow saving the inverter current parameter contents in a specific memory (virtual EEPROM - flash memory area of the microprocessor), or overwrite the current parameters with the content of the specified memory.

P204 - Load / Save Parameters

Adjustable Range:	0 to 4 = Not Used 5 = Load WEG 60 Hz 6 = Load WEG 50 Hz 7 = Load User 8 = Not Used 9 = Save User 10 = Not Used 11 = Load Default SoftPLC 12 and 13 = Reserved	**Factory Setting:**	0
Properties:	cfg		

Description:

Table 5.2 on page 5-4 describes the actions performed by each option.

Table 5.2: *Option of parameter P204*

P204	Action
0 to 4	**Not Used:** no action
5	**Load WEG 60 Hz:** it loads the default parameters on the inverter with the factory default for 60 Hz
6	**Load WEG 50 Hz:** it loads the default parameters on the inverter with the factory default for 50 Hz
7	**Load User:** it transfers the content of the memory from user parameter to the inverter current parameters
8	**Not Used:** no action
9	**Save User:** it transfers the current content of the parameters to the memory of user parameters
10	**Not Used:** no action
11	**Load Default SoftPLC:** it loads the factory default in SoftPLC parameters (P910 to P959)
12 and 13	Reserved

In order to load the parameters of user to the CFW300 operating area (P204 = 7) it is necessary that this area be previously saved.

The operation of uploading this memory (P204 = 7), can also be done via digital inputs (DIx). For further details referring to this programming, refer to Section 12.5 DIGITAL INPUTS on page 12-11.

NOTE!
When P204 = 5 or 6, parameters P295 (Inv. Rated Current), P296 (Line Rated Voltage) and P308 (Serial Address) are not changed.

NOTE!
In order to upload the user parameters (P204 = 7), the factory default must be uploaded first (P204 = 5 or 6).

5.3 SITUATIONS FOR CONFIG STATUS

The Config status is indicated by the HMI "ConF" status, as well as in parameters P006 and P680. Such status indicates that the CFW300 cannot enable the output PWM pulses because the inverter configuration is incorrect or incomplete. For further details about indications of Config state on the HMI, refer to Chapter 15 READING PARAMETERS on page 15-1.

P047 - Estado CONF

Adjustable Range:	0 a 999	**Factory Setting:**	
Properties:	ro		

Description:

The table below shows the situations of Config status, where the user can identify the origin condition through parameter P047.

Table 5.3: *Situations for Config status*

P047	Condition
0	Out of CONFIG status. The HMI and parameters P006 and P680 must not indicate ConF
1	Two or more DIx (P263...P270) programmed for (4 = Forward Run)
2	Two or more DIx (P263...P270) programmed for (5 = Reverse Run)
3	Two or more DIx (P263...P270) programmed for (6 = Start)
4	Two or more DIx (P263...P270) programmed for (7 = Stop)
5	Two or more DIx (P263...P270) programmed for (8 = Direction of Rotation)
6	Two or more DIx (P263...P270) programmed for (9 = LOC/REM)
7	Two or more DIx (P263...P270) programmed for (11 = Accelerate E.P.)
8	Two or more DIx (P263...P270) programmed for (12 = Decelerate E.P.)
9	Two or more DIx (P263...P270) programmed for (14 = 2nd Ramp)
10	Reserved
11	Two or more DIx (P263...P270) programmed for (24 = Disable Flying Start)
12	Two or more DIx (P263...P270) programmed for (26 = Programming Off)
13	Reserved
14	Reserved
15	DIx (P263...P270) programmed for (4 = Forward Run) without DIx (P263...P270) programmed for (5 = Reverse Run) or the opposite
16	DIx (P263...P270) programmed for (6 = Start) without DIx (P263...P270) programmed for (7 = Stop) or the opposite
17	P221 or P222 programmed for (8 = Multispeed) without DIx (P263...P270) programmed for (13 = Multispeed) or the opposite
18	P221 or P222 programmed for (7 = E.P.) without DIx (P263...P270) programmed for (11 = Accelerate E.P) or the opposite
19	P224 programmed for (1 = DIx) **OR** P227 programmed for (1 = DIx) without DIx (P263...P270) programmed for (1 = Run/Stop) **AND** without DIx (P263...P270) programmed for (2 = General Enable) **AND** without DIx (P263...P270) programmed for (3 = Quick Stop) **AND** without DIx (P263...P270) programmed for (4 = Forward Run) **AND** without DIx (P263...P270) programmed for (6 = Start)
20	Reserved
21	P221 or P222 programmed for (8 = Multispeed) with DI1 (P263) **AND** DI2 (P264) **OR** DI1 (P263) **AND** DI5 (P267) **OR** DI1 (P263) **AND** DI6 (P268) **OR** DI2 (P264) **AND** DI5 (P267) **OR** DI2 (P264) **AND** DI6 (P268) **OR** DI5 (P267) **AND** DI6 (P268) programmed for (13 = Multispeed)
22	Minimum Frequency Reference (P133) greater than Maximum Frequency Reference (P134)
29	Two or more DIx (P263...270) programmed for (49 = Enable Fire Mode) **OR** two or more DOx (P275...P278) Programmed for (45 = Fire Mode **OR** P580 programmed for 1, 2 or 4 (Fire Mode Enabled) without DIx programmed for (49 = Enable Fire Mode) **OR** Dix programmed for (49 = Enable Fire Mode) **OR** Dox programmed for (47 = Fire Mode) and P580 programmed for (0 = Fire Mode Disabled) or (3 = Reserved)

5.4 ENGINEERING UNITS FOR SOFTPLC

This parameter group allows the user to configure the engineering units for indication on the HMI of the user's parameters of the SoftPLC module.

P510 - SoftPLC Engineering Unit

Adjustable Range:	0 = Without Unit 1 = A 2 = V 3 = Hz 4 = s 5 = % 6 = ºC (ºF) 7 = rpm	**Factory Setting:** 0
Properties:		

Description:

This parameter selects the engineering unit that will be viewed on the HMI, that is, any user's parameter of the SoftPLC which is related to the SoftPLC engineering unit will be viewed in this format.

P511 - SoftPLC Indication Form

Adjustable Range:	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz	**Factory Setting:** 1
Properties:		

Description:

This parameter selects the decimal point that will be viewed on the HMI, that is, any user's parameter of the SoftPLC which is related to the SoftPLC indication form will be viewed in this format.

NOTE!
The engineering unit may be selected in the "Configuration of the User's Parameters" window in the WPS program.

6 IDENTIFICATION OF THE INVERTER MODEL AND ACCESSORIES

In order to check the inverter model, see the code on the product nameplate on the side of the inverter.

Once the inverter model identification code is checked, it is necessary to interpret it in order to understand its meaning. Refer to chapter 2 General Information of the CFW300 user's manual.

Below are the parameters related to the inverter model which change according to the inverter model and version. Those parameters must comply with the data read on the product identification label.

6.1 INVERTER DATA

P023 - Main Software Version

P024 - IO's Expansion Accessory Software Version

P025 - Communication Accessory Software Version

Adjustable Range:	0.00 to 99.99	**Factory Setting:**	
Properties:	ro		

Description:

They indicate the software versions of the microprocessors: main, on the control card C300X and accessories, on the accessories connected according to parameters P027 and P028.

P613 – Software Revision

Adjustable Range:	-9999 a 9999	**Factory Setting:**	According to software revision
Properties:	ro		
Access Groups via HMI:	READ		

Description:

This parameter is a counter that indicates the software revision. It is automatically generated by the machine that generated the firmware.

P027 - Configuration of the IO's Expansion Accessories

P028 - Configuration of the Communication Accessories

Adjustable Range:	0 to 10	**Factory Setting:**	
Properties:	ro		

Description:

These parameters identifies the accessories connected to the product. The following tables present the accessories that depend on parameters P027 and P028.

Table 6.1: IO's expansion accessories identified on the CFW300

Name	Description	P027
-	No accessories	0
CFW300-IOAR	Accessory for IO's expansion: 1 analog input + 1 analog output + 3 relay digital outputs	1
CFW300-IODR	Accessory for IO's expansion: 4 digital inputs (NPN/PNP) + 3 relay digital outputs	2
CFW300-IOADR	Accessory for IO's expansion: 1 input for infrared receiver + 1 NTC sensor input + 3 relay digital outputs	3
CFW300-IOAENC	Accessory for IO's expansion: 1 analog input + 2 analog outputs + 1 differential encoder input	4
-	Reserved	5
CFW300-IODF	Accessory for IO expansion: 3 inputs and 3 outputs in frequency	6
-	Reserved	7 to 10

Table 6.2: Communication expansion accessories identified on the CFW300

Name	Description	P028
-	No accessories	0
CFW300-HMIR	Remote HMI accessory (via CFW300-CRS485 accessory)	1
CFW300-CBLT	Bluetooth communication accessory	2
CFW300-CCAN	Accessory with communication CANopen and DeviceNet	3
CFW300-CPDP	Accessory with communication Profibus DP	4
-	Reserved	5 to 10

6

P029 - Power Hardware Configuration

Adjustable Range:	0 to 11	**Factory Setting:**	According to inverter model
Properties:	ro		

Description:

This parameter identifies the inverter model, distinguishing the supply voltage and the rated current according to Table 6.3 on page 6-2.

From P029, the CFW300 determines the current and voltage parameters depending on the model identification. On the other hand, this action is only effected at the moment of the factory standard load (P204 = 5 or 6).

Table 6.3: Identification of the CFW300 models

Frame Size	Voltage	Power Supply	Current	P029
A	110 / 127 Vac	Single-Phase	1.6 A	1
			2.6 A	2
			4.2 A	3
			6.0 A	4
	200 / 240 Vac	Single-Phase or Three-Phase	1.6 A	5
			2.6 A	6
			4.2 A	7
			6.0 A	8
			7.3 A	9
	310 Vdc	DC Link	1.6 A	5
			2.6 A	6
			4.2 A	7
			6.0 A	8
			7.3 A	9
B	200 / 240 Vac	Single-Phase or Three-Phase	10.0 A	10
		Three-Phase	15.2 A	11
	310 Vdc	DC Link	10.0 A	10
			15.2 A	11

(*) The value 0 corresponds to an unidentified model (F084).

P295 - Inverter Rated Current

Adjustable Range:	1.6 to 15.2 A	**Factory Setting:**	According inverter model
Properties:	ro		

Description:

This parameter presents the inverter rated current as per Table 6.3 on page 6-2.

P296 - Line Rated Voltage

Adjustable Range:	0 = Reserved 1 = 110 / 127 Vac 2 = 200 / 240 Vac or 310 Vdc	**Factory Setting:**	According inverter model
Properties:	ro		

Description:

This parameter presents the inverter power supply according to identification performed after power-up.

P297 - Switching Frequency

Adjustable Range:	2.5 to 15.0 kHz	**Factory Setting:**	5.0 kHz
Properties:	cfg		

Description:

You can use this parameter to define the inverter IGBT switching frequency.

The inverter switching frequency may be adjusted according to the application needs. Higher switching frequencies imply less acoustic noise in the motor. However, the switching frequency choice results in a compromise among the acoustic noise in the motor, the inverter IGBT losses and the maximum permitted currents.

The reduction of the switching frequency reduces the effects related to the motor instability, which occurs in certain application conditions. Besides, it reduces the earth leakage current, preventing the actuation of the faults F070 (output overcurrent or short-circuit).

P219 - Start Point of the Switching Frequency Reduction

Adjustable Range:	0.0 to 15.0 Hz	**Factory Setting:**	15.0 Hz
Properties:	cfg		

Description:

It defines the point at which automatic gradual reduction of the switching frequency occurs. That significantly improves the measurement of the output current at low frequencies and consequently the performance of the inverter.

NOTE!
Both the function related to P219 and the function controlled by P397 (bit 3) act by reducing the switching frequency. As the function related to P219 is intended to improve the reading of the inverter current, that function has priority of action over the function controlled by P397 (bit 3).

7 LOGICAL COMMAND AND FREQUENCY REFERENCE

The drive of the electric motor connected to the inverter depends on the logical command and on the reference defined by one of the several possible sources, such as: HMI keys, digital inputs (DIx), analog inputs (AIx), Serial/USB interface, CANopen/DeviceNet interface, SoftPLC, etc.

The command via HMI is limited to a set of functions pre-defined for the keys according to Chapter 4 HMI AND BASIC PROGRAMMING on page 4-1, similarly to the digital inputs (DIx), with the functions implemented in parameter P263 to P270. On the other hand, the command via digital interfaces, such as communication network and SoftPLC, act directly on the inverter control word by means of control parameters and system markers of the SoftPLC, respectively.

The frequency reference in turn is a numeric value in 16 bits with signal with scale in Hertz (Hz), a resolution of 0.1 Hz and full scale at 400.0 Hz.

7.1 SELECTION FOR LOGICAL COMMAND AND FREQUENCY REFERENCE

The inverter command and reference source is defined by the inverter parameters for two different situations: Local and Remote, which can be switched dynamically during the inverter operation. Thus, for a certain parameterization, the inverter has two sets for command and reference, according to block diagram of Figure 7.1 on page 7-2.

Parameter P220 determines the source of commands for Local and Remote situations.

Parameters P223, P224 and P225 define the commands in the Local situation; parameters P226, P227 and P228 define the commands in the Remote situation, and parameter P105 determines the source for selection between 1st and 2nd Ramp. This structure for the selection of the command source is shown in Figure 7.1 on page 7-2.

Parameters P221 and P222 define the frequency reference in the Local and Remote situations.

This structure for the selection of the reference source is shown in Figure 7.2 on page 7-3.

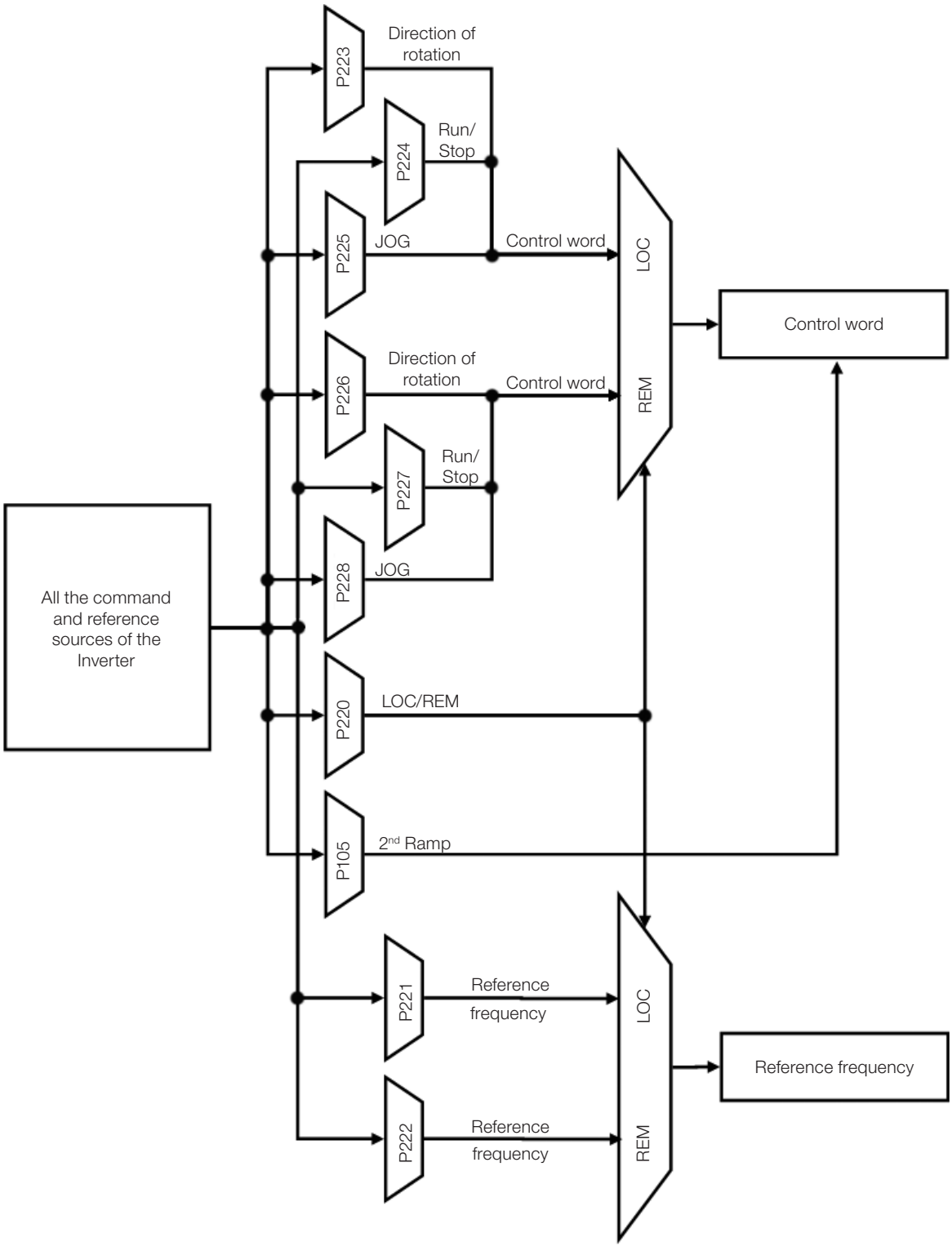


Figure 7.1: *Block diagram for commands and references*

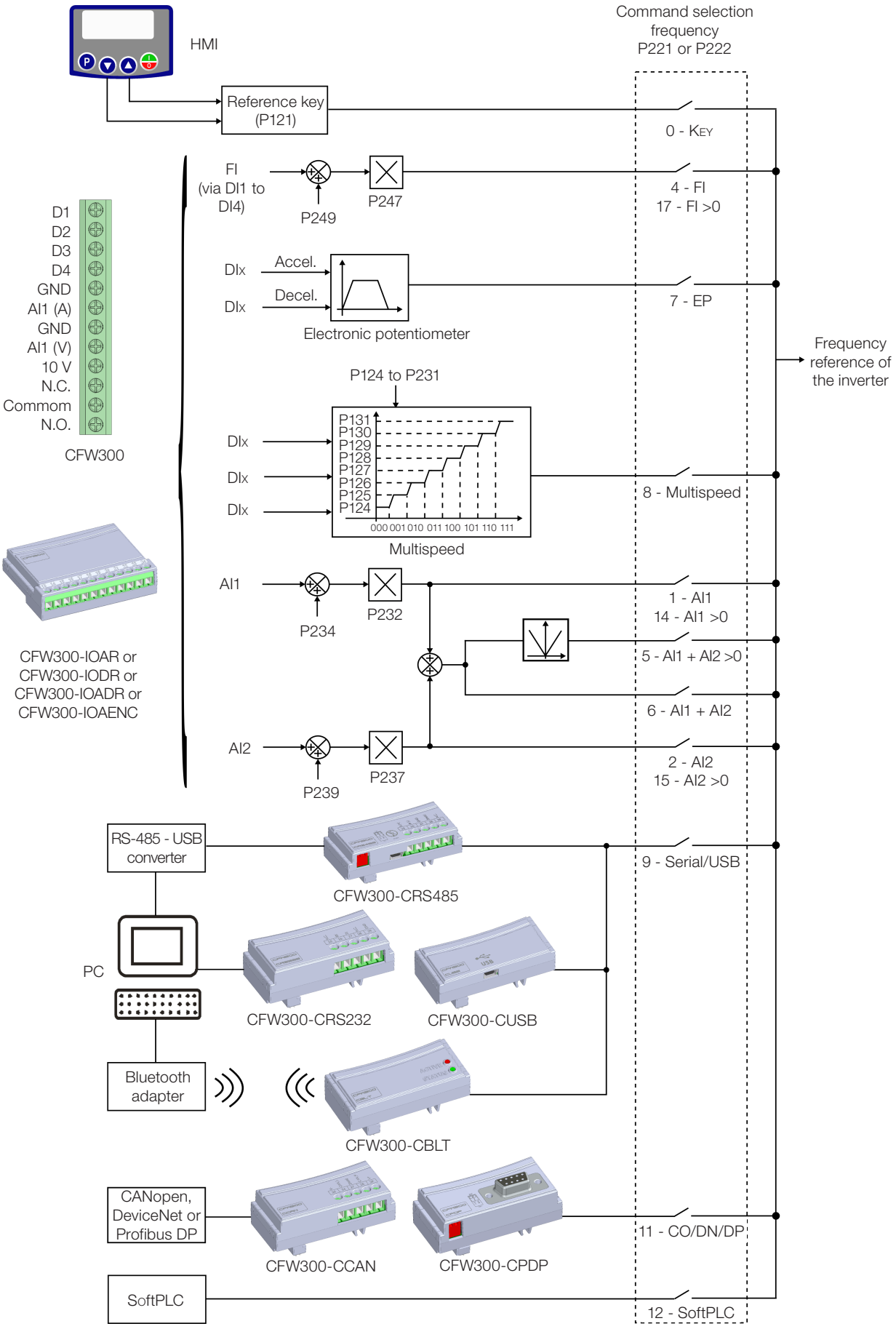


Figure 7.2: *Structure to select the frequency reference*

P220 - Local/Remote Selection

Adjustable Range:	0 = Always Local 1 = Always Remote 2 and 3 = Not Used 4 = Digital Input (DIx) 5 = Serial/USB (LOC) 6 = Serial/USB (REM) 7 and 8 = Not Used 9 = CO/DN/DP (LOC) 10 = CO/DN/DP (REM) 11 = SoftPLC	**Factory Setting:**	0
Properties:	cfg		

Description:

It defines the command origin source which will select between Local situation and Remote situation, where:

- **LOC:** means Local situation default.
- **REM:** means Remote situation default.
- **DIx:** according to function programmed for digital input in P263 to P266.
- **CO / DN / DP:** CANopen, DeviceNet or Profibus DP Interface.

P221 - Frequency Reference Selection - LOCAL Situation

P222 - Frequency Reference Selection - REMOTE Situation

Adjustable Range:	0 = HMI 1 = AI1 2 = AI2 3 = Not Used 4 = Frequency Input (FI) 5 = AI1 + AI2 > 0 6 = AI1 + AI2 7 = E.P. 8 = Multispeed 9 = Serial/USB 10 = Not Used 11 = CO/DN/DP 12 = SoftPLC 13 = Not Used 14 = AI1 > 0 15 = AI2 > 0 16 = Not Used 17 = FI > 0	**Factory Setting:**	P221 = 0 P222 = 1
Properties:	cfg		

Description:

These parameters define the origin source for the frequency reference in the Local situation and Remote situation. Some comments on the options of this parameter:

- **AIx:** it refers to the analog input signal according to Section 12.1 ANALOG INPUTS on page 12-1.
- **HMI:** the reference value set by the keys and are contained in parametere P121.

- **E.P.:** electronic potentiometer; refer to Section 12.5 DIGITAL INPUTS on page 12-11.
- **Multispeed:** refer to Section 12.5 DIGITAL INPUTS on page 12-11.
- **AIx > 0:** the negative values of the AIx reference are zeroed.
- **CO / DN / DP:** CANopen, DeviceNet or Profibus DP Interface.

P223 - FORWARD/REVERSE Selection - LOCAL Situation

P226 - FORWARD/REVERSE Selection - REMOTE Situation

Adjustable Range:	0 = FORWARD 1 = REVERSE 2 and 3 = Not Used 4 = DIx 5 = Serial/USB (FWD) 6 = Serial/USB (REV) 7 and 8 = Not Used 9 = CO/DN/DP (FWD) 10 = CO/DN/DP (REV) 11 = Not Used 12 = SoftPLC	**Factory Setting:**	P223 = 0 P226 = 4
Properties:	cfg		

Description:

They define the origin source for the "Direction of Rotation" command in the Local and Remote situation, where:

- **FWD:** Means Forward.
- **REW:** Means Reverse.
- **DIx:** refer to Section 12.5 DIGITAL INPUTS on page 12-11.
- **CO / DN / DP:** CANopen, DeviceNet or Profibus DP Interface.

P224 - Run / Stop Selection - LOCAL Situation

P227 - Run / Stop Selection - REMOTE Situation

Adjustable Range:	0 = HMI Keys 1 = DIx 2 = Serial/USB 3 = Not Used 4 = CO/DN/DP 5 = SoftPLC	**Factory Setting:**	P224 = 0 P227 = 1
Properties:	cfg		

Description:

These parameters define the origin source for the "Run/Stop" command in the Local and Remote situation. This command corresponds to the functions implemented in any of the command sources able to enable the motor movement, that is, General Enable, Ramp Enable, Forward Run, Reverse Run, Start, etc.

P225 - JOG Selection - LOCAL Situation

P228 - JOG Selection - REMOTE Situation

Adjustable Range:	0 = Disabled 1 = Not Used 2 = DIx 3 = Serial/USB 4 = Not Used 5 = CO/DN/DP 6 = SoftPLC	**Factory Setting:**	P225 = 1 P228 = 2
Properties:	cfg		

Description:

These parameters define the origin source for the JOG function in the Local and Remote situation. The JOG function means a Run/Stop command added to the reference defined by P122; see Item 7.2.3 Parameters for Frequency Reference on page 7-8.

7.2 FREQUENCY REFERENCE

The frequency reference is the value applied to the input of the acceleration ramp module (P001) to control the frequency applied to the inverter output (P002) and consequently the motor shaft speed.

Inside the CPU, the inverter uses signed 16 bit variables to treat the frequency references. Besides, the full scale of the reference, output frequency and related variables are defined in 400.0 Hz. On the other hand, depending on the source, this scale is conveniently modified considering the interface with the user by standardization or application requirements.

In general, the digital references defined by parameters such as: HMI keys (P121), Multispeed (P124 to P131) and E.P. have a scale from 0.0 to 400.0 Hz with resolution of 0.1 Hz.

In digital inputs (DIx), on the other hand, the reference is defined according to the function predefined for P263 to P266.

The frequency reference via analog inputs and frequency input is according to the signal, gain and offset parameters P230 to P250. The full scale of the reference is always by P134, that is, maximum value in AIx is equivalent to the frequency reference equal to P134.

The digital references Serial/USB, CANopen, DeviceNet, Profibus DP and SoftPLC act on a standardized scale called "13-bit speed", where the value 8192 (2^{13}) is equivalent to the motor rated frequency (P403). Those references are accessed by parameters P683 and P685.

The digital references, though, have a different scale and the frequency reference parameters with their range from 0.0 to 400.0 Hz, according to previous descriptions. The frequency value on the ramp input (P001) is always limited by P133 and P134. For example, the JOG reference is given by P122, this parameter may be set in up to 400.0 Hz, but the value applied to the ramp input as reference will be limited by P134 when the function is executed.

Table 7.1: *Summary of the scales and resolutions of the frequency references*

Reference	Full Scale	Resolution
Analog Inputs (AIx)	-P134 to P134	10 bits or (P134/1024)
Communication Networks and SoftPLC	-400.0 Hz to 400.0 Hz	Speed 13 Bits (P403/8192)
HMI Parameter	-400.0 Hz to 400.0 Hz	0.1 Hz

7.2.1 Limits for Frequency Reference

Although the parameters to adjust the reference have a wide range of values (0 to 400.0 Hz), the value applied to the ramp is limited by P133 and P134. Therefore, the values in module out of this range will have no effect on the reference.

P133 - Minimum Frequency Reference

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	3.0 Hz
Properties:			

P134 - Maximum Frequency Reference

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	66.0 (55.0) Hz
Properties:			

Description:

Limits for frequency reference of the inverter. These limits are applied to any reference source, even in case of "13-bit speed".

7.2.2 Speed Reference Backup

P120 - Speed Reference Backup

Adjustable Range:	0 = Inactive 1 = Active 2 = Backup by P121	**Factory Setting:**	1
Properties:			

Description:

This parameter defines the operation of the backup function of the speed reference from one of the options active (P120 = 1), inactive (P120 = 0) and by P121 (P120 = 2). This function, in turn, determines the form of backup of the digital references of the sources: HMI (P121), E.P., Serial/USB (P683), according to Table 7.2 on page 7-7.

Table 7.2: *Options of parameter P120*

P120	Reference Initial Values at the Enabling or Power-Up
0	Value of P133
1	Last adjusted value
2	Value of P121

If P120 = Inactive, the inverter will not save the speed reference value when it is disabled. Thus, when the inverter is enabled again, the speed reference value will become the frequency minimum limit value (P133).

If P120 = Active, the value set in the reference is not lost when the inverter is disabled or powered down.

If P120 = Backup by P121, the reference initial value is fixed by P121 at the enabling or power-up of the inverter.

7.2.3 Parameters for Frequency Reference

P121 - Frequency Reference via HMI

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	3.0 Hz
Properties:			

Description:

Parameter P121 stores the frequency reference via HMI (P221 = 0 or P222 = 0). When the keys ▲ and ▼ are active and the HMI in the monitoring mode, the value of P121 is increased and shown on the HMI main display. Besides, the P121 is used as input for the reference backup function.

NOTE!
The maximum setting value of parameter P121 via HMI is limited by P134 and P133.

P122 - Frequency Reference for JOG

Adjustable Range:	-400.0 to 400.0 Hz	**Factory Setting:**	5.0 Hz
Properties:			

Description:

During the JOG command, the motor accelerates up to the value defined in P122, following the acceleration ramp set according to P105. This command may be activated by any of the sources, as per Section 7.1 SELECTION FOR LOGICAL COMMAND AND FREQUENCY REFERENCE on page 7-1. The negative values determine a direction of rotation opposite to that defined by the inverter command word.

P124 - Multispeed Reference 1

Adjustable Range:	-400.0 to 400.0 Hz	**Factory Setting:**	3.0 Hz

P125 - Multispeed Reference 2

Adjustable Range:	-400.0 to 400.0 Hz	**Factory Setting:**	10.0 (5.0) Hz

P126 - Multispeed Reference 3

Adjustable Range:	-400.0 to 400.0 Hz	**Factory Setting:**	20.0 (10.0) Hz

P127 - Multispeed Reference 4

Adjustable Range:	-400.0 to 400.0 Hz	**Factory Setting:**	30.0 (20.0) Hz

P128 - Multispeed Reference 5

Adjustable Range:	-400.0 to 400.0 Hz	**Factory Setting:**	40.0 (30.0) Hz

P129 - Multispeed Reference 6

Adjustable Range:	-400.0 to 400.0 Hz	**Factory Setting:**	50.0 (40.0) Hz

P130 - Multispeed Reference 7

Adjustable Range:	-400.0 to 400.0 Hz	**Factory Setting:**	60.0 (50.0) Hz

P131 - Multispeed Reference 8

Adjustable Range:	-400.0 to 400.0 Hz	**Factory Setting:**	66.0 (55.0) Hz
Properties:			

Description:

By the combination of up to three digital inputs, one from eight levels that form the multispeed reference is selected. Read the description of the of the digital inputs in Section 12.5 DIGITAL INPUTS on page 12-11, as well the reference selection in Section 7.1 SELECTION FOR LOGICAL COMMAND AND FREQUENCY REFERENCE on page 7-1. The negative values determine a direction of rotation opposite to that defined by the inverter command word (bit 2 of P682).

Figure 7.3 on page 7-10 and Table 7.3 on page 7-10 show the operation of the Multispeed. Although the most significant digital input may be set at DI1 or DI2, only one of those options is allowed; otherwise, the Config state (ConF), according to Section 5.3 SITUATIONS FOR CONFIG STATUS on page 5-5, is activated to indicate parameterization incompatibility.

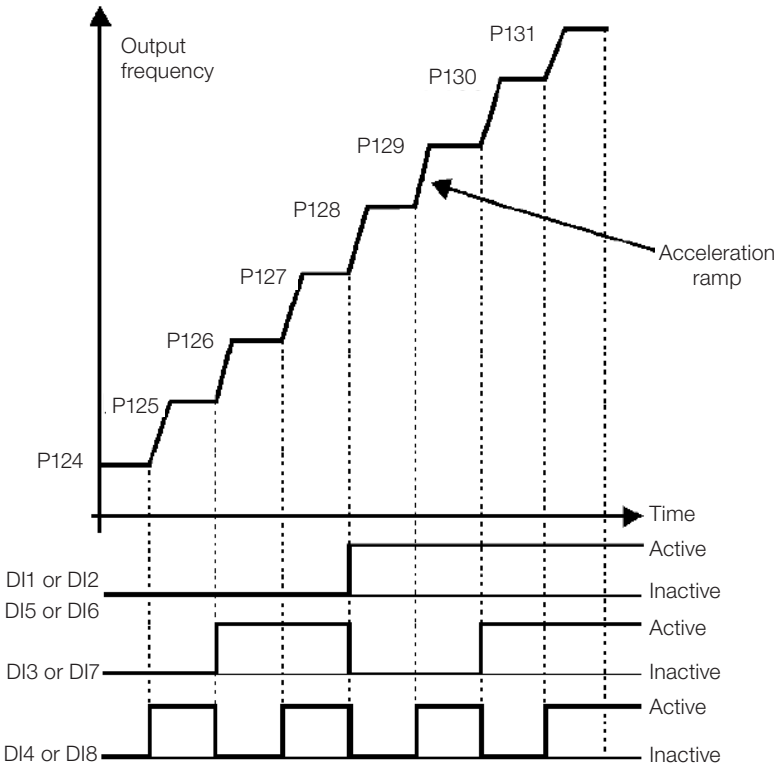


Figure 7.3: *Operating graph of the Multispeed function*

Table 7.3: *Multispeed frequency reference*

8 Referency			
	4 Referency		
		2 Referency	
DI1 or DI2 or DI5 or DI6	**DI3 or DI7**	**DI4 or DI8**	**Frequency Reference**
Inactive	Inactive	Inactive	P124
Inactive	Inactive	Active	P125
Inactive	Active	Inactive	P126
Inactive	Active	Active	P127
Active	Inactive	Inactive	P128
Active	Inactive	Active	P129
Active	Active	Inactive	P130
Active	Active	Active	P131

7.2.4 Reference via Electronic Potentiometer

The Electronic Potentiometer function (E.P.) allows the frequency reference to be set by means of two digital inputs (one to increment it and another to decrement it).

In order to enable this function, you must first configure the referency reference via E.P., program P221 = 7 and/or P222 = 7. After enabling this function, just program two digital inputs (P263 to P266) in 11 or 33 (Accelerate E.P.) and 12 or 34 (Decelerate E.P.).

Figure 7.4 on page 7-11 shows the operation of E.P. function of three digital inputs (Accelerate E.P., Decelerate E.P. and Run/Stop). In this example, the reference reset is done with the inverter disabled and activating both Accelerate and Decelerate E.P. inputs. Besides, you can monitor the action of the inputs individually, as well as the action of the reference backup (P120 = 1) when the Run/Stop command is opened and closed again.

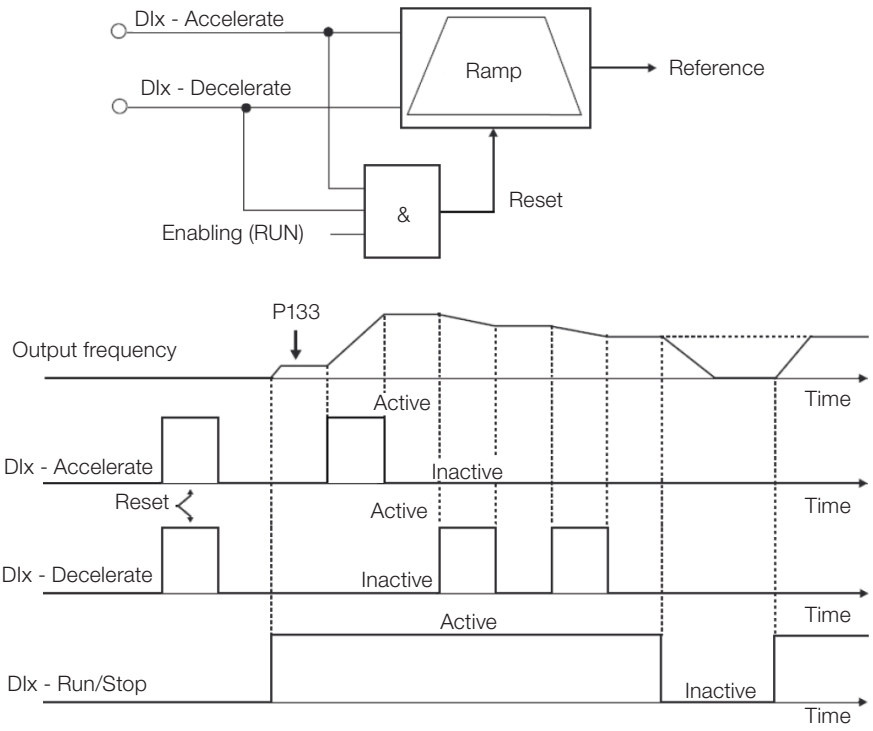


Figure 7.4: *Operating graph of the E.P. function*

7

7.2.5 Frequency Input FI

The behaviors of the analog input and frequency input are described in details in Section 12.4 FREQUENCY INPUT on page 12-9. Thus, after the proper signal treatment, it is applied to the ramp input according to the selection of the reference described in Section 7.1 SELECTION FOR LOGICAL COMMAND AND FREQUENCY REFERENCE on page 7-1.

7.2.6 "13-Bit Speed" Reference

The 13-bit Frequency Reference is a scale based on the motor rated speed (P402) or on the motor rated frequency (P403). In the CFW300, parameter P403 is taken as the base to determine the frequency reference.

Thus, the 13-bit frequency value has a range of 16 bits with signal, that is, -32768 to 32767; however, the rated frequency in P403 is equivalent to the value 8192. Therefore, the maximum value in the range 32767 is equivalent to four times P403.

The 13-bit frequency reference is used in parameters P681 and P683, which are related to the interfaces with communication (Serial/USB, CANopen, DeviceNet and Profibus DP) of the product.

7.3 CONTROL WORD AND INVERTER STATUS

The inverter control word is the grouping of a set of bits to determine the commands received by the inverter from an external source. On the other hand, the status word is another set of bits that define the inverter status. This way, the control and status words establish an interface for the exchanging of information between the inverter and an external module, such as a communication network or a controller.

P680 - Logical Status

Adjustable Range:	0 to FFFF (hexa)	**Factory Setting:**	-
Properties:	ro		

Description:

The inverter status word is unique for all the sources and can only be accessed for reading. It indicates all the relevant operating status and modes of the inverter. The function of each bit of P680 is described in Table 7.4 on page 7-12.

Table 7.4: *Status word*

BIT	Function	Description
0	Reserved	-
1	Run Command	**0:** There was no Run command **1:** There was Run command
2	Fire Mode	**0:** Fire Mode function inactive **1:** Fire Mode function active
3 and 4	Reserved	-
5	2nd Ramp	**0:** 1st acceleration and deceleration ramp by P100 and P101 **1:** 2nd acceleration and deceleration ramp by P102 and P103
6	Config. Status	**0:** inverter operating in normal conditions **1:** inverter in configuration state. It indicates a special condition in which the inverter cannot be enabled, because it has parameterization incompatibility
7	Alarm	**0:** inverter is not in alarm state **1:** inverter is in alarm state
8	Running	**0:** motor is stopped **1:** inverter is running according to reference and command
9	Enabled	**0:** inverter is completely disabled **1:** inverter is completely enabled and ready to turn the motor
10	Forward	**0:** motor is running in the reverser direction **1:** motor is running in the foward direction
11	JOG	**0:** JOG function inactive **1:** JOG function active
12	Remote	**0:** inverter in Local mode **1:** inverter in Remote mode
13	Undervoltage	**0:** no undervoltage **1:** with undervoltage
14	Reserved	-
15	Fault	**0:** inverter is not in fault state **1:** some fault registered by the inverter

P682 - Serial / USB Control

P684 - CANopen / DeviceNet / Profibus DP Control

Adjustable Range:	0000h to FFFFh (hexa)	**Factory Setting:**	-
Properties:	ro		

Description:

The inverter control word for a certain source is accessible for reading and writing, but read only access is permitted for the other sources. The inverter has a common word for each interface, which is defined by the function of its bits separately as per Table 7.5 on page 7-13. The value of P682 is indicated in hexadecimal.

Table 7.5: Control word

BIT	Function	Description
0	Ramp Enable	**0:** stops the motor by deceleration ramp **1:** spins the motor according to the acceleration ramp until reaching the speed reference value
1	General Enable	**0:** disables the inverter completely, interrupting the power supply to the motor **1:** enables the inverter completely, allowing the operation of the motor
2	Run Forward	**0:** spins the motor in the opposite direction of the reference signal (reverse) **1:** spins the motor in the direction of the reference signal (forward)
3	Enable JOG	**0:** disable JOG function **1:** enable JOG function
4	Remote	**0:** inverter goes into Local mode **1:** inverter goes into Remote mode
5	2nd Ramp	**0:** acceleration and deceleration ramp by P100 and P101 **1:** acceleration and deceleration ramp by P102 and P103
6	Reserved	-
7	Fault Reset	**0:** no function **1:** if in fault state, reset the fault
8 to 15	Reserved	-

P229 - Stop Mode

Adjustable Range:	0 = Ramp to Stop 1 = Coast to Stop	**Factory Setting:**	0
Properties:	cfg		

Description:

This parameter defines the motor stop mode when the inverter receives the "Stop" command. Table 7.6 on page 7-13 describes the options of this parameter.

Table 7.6: Selection of stop mode

P229	Description
0	The inverter will apply the stop ramp programmed in P101 or P103
1	The motor will run free until it stops

NOTE!
When the Coast Stop mode is programmed and the Flying Start function is disabled, only activate the motor if it is stopped.

NOTE!
This parameter is applied to all the inverter command sources, but it was created aiming at allowing the command via HMI to be able to disable the motor by inertia instead of deceleration ramp. In this way, when P229 = 1, Bit 0 of the control word (Ramp Enable) has a function similar to Bit 1 (General Enable). The same way, the digital input functions such as: Run/Stop, Forward/Reverse Run stop the motor by inertia in this condition of P229.

7.3.1 Control via HMI Inputs

Contrary to the network interfaces and SoftPLC, the HMI commands do not access the inverter control word directly, because of limitations of key functions and HMI behavior. The HMI behavior is described in Chapter 4 HMI AND BASIC PROGRAMMING on page 4-1.

7.3.2 Control via Digital Inputs

Contrary to the network interfaces and SoftPLC, the digital inputs do not access the inverter control word directly, because there are several functions for DIx that are defined by the applications. Such digital input functions are detailed in Section 12.5 DIGITAL INPUTS on page 12-11.

8 AVAILABLE MOTOR CONTROL TYPES

The inverter feeds the motor with variable voltage, current and frequency, providing control of the motor speed. The values applied to the motor follow a control strategy, which depends on the selected type of motor control and on the inverter parameter settings.

The selection of the proper control type for the application depends on the static and dynamic requirements of torque and speed of the driven load, that is, the control type is directly connected to the required performance. Additionally, proper configuration of the selected control mode parameters is essential to reach maximum performance.

The CFW300 is equipped with three control modes for the three-phase induction motor, that is:

- **V/f Scalar Control:** for basic applications without output speed control.
- **Quadratic V/f Scalar Control:** for applications that reduce motor and inverter losses without regulation of the output speed.
- **VVW Sensorless Vector Control:** for applications that need high performance in the control of the output speed.

In Chapter 9 V/f SCALAR CONTROL on page 9-1 and Chapter 10 VVW VECTOR CONTROL on page 10-1, each of these kinds of control, related parameters and directions regarding the use of each of these modes are described in details.

P202 - Control Type

Adjustable Range:	0 = V/f 1 = Quadratic V/f 2 to 4 = Not Used 5 = VVW	**Factory Setting:**	0
Properties:	cfg		

Description:

This parameter selects the kind of three-phase induction motor control used.

P139 - Output Current Filter

Adjustable Range:	0 to 9.999 s	**Factory Setting:**	0.05 s
Properties:			

Description:

Time constant of the filter for the total and active output current. You must consider a filter response time equal to three times the time constant set in P139.

P140 - Slip Compensation Filter

Adjustable Range:	0 to 9.999 s	**Factory Setting:**	0.5 s
Properties:	VVW		

Description:

Time constant of the filter for slip compensation in the output frequency. You must consider a filter response time equal to three times the time constant set in P140.

P397 - Control Configuration

Adjustable Range:	0000h to 000Fh	**Factory Setting:**	000Bh
Properties:	cfg		

Description:

The bits of parameter P397, as shown in Table 8.1 on page 8-2, enable a series of internal options to configure the control of the induction motor, such as:

- **Slip Compensation during the Regeneration (Bit 0)**
  The regeneration is an operating mode of the inverter which occurs when the power flux goes from the motor to the inverter. The bit 0 of P397 (set in 0) allows the slip compensation to be turned off in this situation. This option is particularly useful when the compensation during the motor deceleration is necessary.

- **Output Current Stabilization (Bit 2)**
  High-performance motors with power above 5 HP are marginally stable when driven by frequency inverters and at operation with no load. Therefore, in this situation a resonance may occur in the output current which may reach the overcurrent level F070. Bit 2 of P397 (set to 1) activates an algorithm for regulation of the output current in closed loop which neutralizes the oscillations of resonant output current.

- **Reduction of P297 at high temperature (Bit 3)**
  Bit 3 of P397 controls the overtemperature protection action according to section Section 14.2 IGBTS OVERLOAD PROTECTION (F051 AND A050) on page 14-3.

NOTE!
Both the function related to P219 and the function controlled by P397 (bit 3) act by reducing the switching frequency. As the function related to P219 is intended to improve the reading of the inverter current, that function has priority of action over the function controlled by P397 (bit 3).

ATTENTION!
The default setting of P397 meets most application needs of the inverter.
Therefore, avoid modifying its content without knowing the related consequences. If you are not sure, contact WEG Technical Assistance before changing P397.

Table 8.1: *Options available to configure the control (P397)*

P397	Bit 3 Reduction of P297 in A050	Bit 2 Output Current Stabilization	Bit 1 Reserved	Bit 0 Slip Compensation During Regeneration
0000h	Disabled	Disabled	-	Disabled
0001h	Disabled	Disabled	-	Enabled
0002h	Disabled	Disabled	-	Disabled
0003h	Disabled	Disabled	-	Enabled
0004h	Disabled	Enabled	-	Disabled
0005h	Disabled	Enabled	-	Enabled
0006h	Disabled	Enabled	-	Disabled
0007h	Disabled	Enabled	-	Enabled
0008h	Enabled	Disabled	-	Disabled
0009h	Enabled	Disabled	-	Enabled
000Ah	Enabled	Disabled	-	Disabled
000Bh	Enabled	Disabled	-	Enabled
000Ch	Enabled	Enabled	-	Disabled
000Dh	Enabled	Enabled	-	Enabled
000Eh	Enabled	Enabled	-	Disabled
000Fh	Enabled	Enabled	-	Enabled

9 V/f SCALAR CONTROL

This is the classical control method for three-phase induction motors, based on a curve that relates output frequency and voltage. The inverter works as a variable frequency and voltage source, generating a combination of voltage and frequency according to the configured curve. It is possible to adjust this curve for standard 50 Hz, 60 Hz or special motors.

According to the block diagram of Figure 9.1 on page 9-2, the frequency reference f* is limited by P133 and P134 and applied to the input of "V/f Curve" block, where the output voltage amplitude and frequency imposed to the motor are obtained. For further details on the frequency reference, refer to Chapter 7 LOGICAL COMMAND AND FREQUENCY REFERENCE on page 7-1.

By monitoring the total and active output current, and the DC link voltage, compensators and regulators are implanted so as to help in the protection and performance of the V/f control. The operation and parameterization of those blocks are detailed in Section 11.2 DC LINK VOLTAGE AND OUTPUT CURRENT LIMITATION on page 11-3.

The advantage of the V/f control is its simplicity and the need of few settings. The start-up is quick and simple and the factory default, in general, requires little or no modification. In cases whose objective is to reduce losses on the motor and inverter, the "Quadratic V/f" may be used, where the flow in the motor air-gap is proportional to the output frequency up to the field weakening point (also defined by P142 and P145). Thus, the result is a torque capacity as a quadratic function of the frequency. The great advantage of such control is the capacity to save energy when driving loads with variable resistant torque, due to the reduction of motor losses (especially losses in the air-gar, magnetic losses).

The V/f or scalar control is recommended for the following cases:

- Drive of several motors with the same inverter (multi-motor drive).
- Energy saving in the drive of loads with quadratic torque/frequency relationship.
- Motor rated current lower than 1/3 of the inverter rated current.
- For test purposes, the inverter is turned on without motor or with a small motor with no load.
- Applications where the load connected to the inverter is not a three-phase induction motor.
- Applications that aim at reducing losses on the motor and inverter (Quadratic V/f).

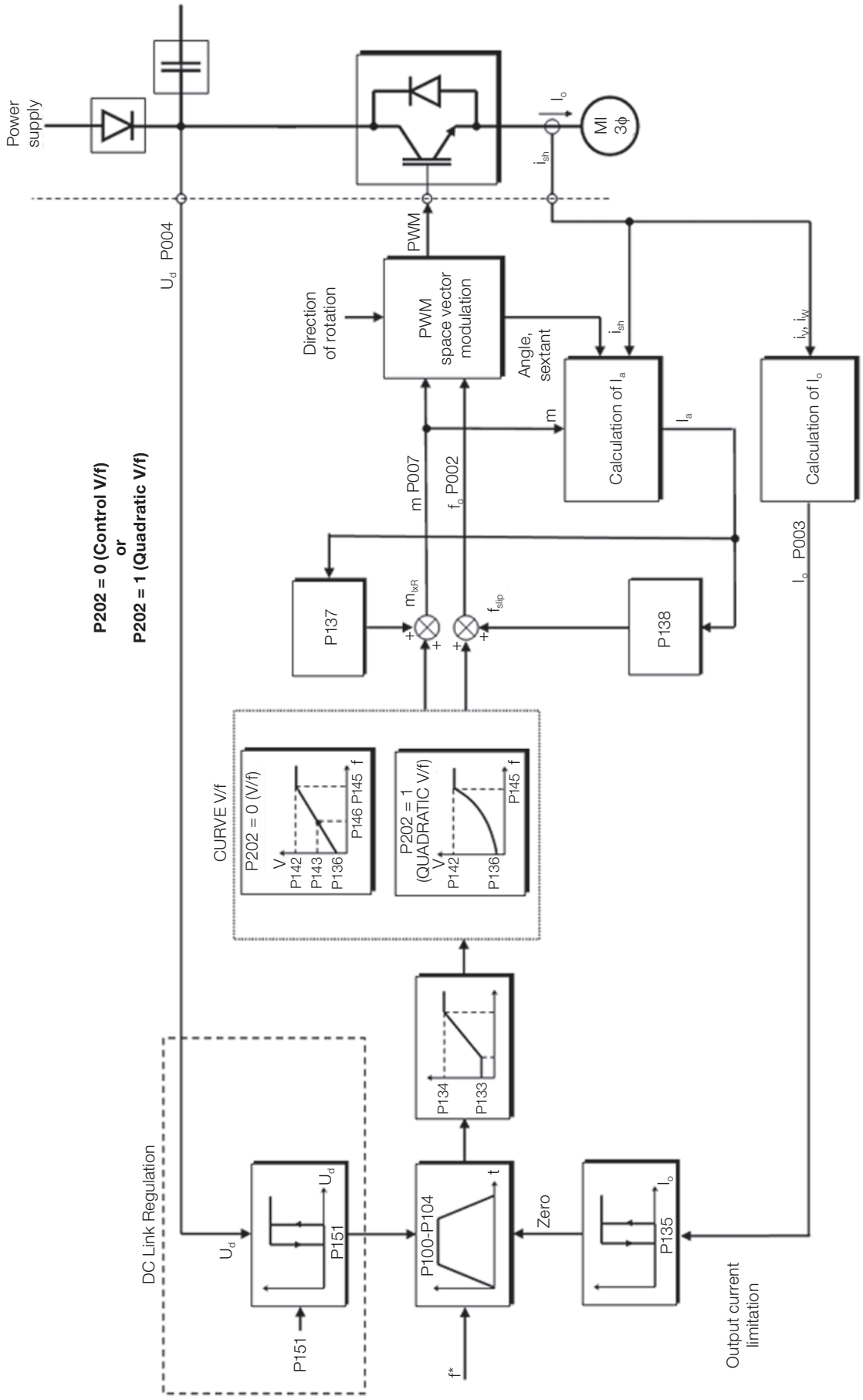


Figure 9.1: *Block diagram of V/f scale control*

9.1 PARAMETERIZATION OF THE V/f SCALAR CONTROL

The scalar control is the inverter factory default control mode for its popularity and because it meets most applications of the market. However, parameter P202 allows the selection of other options for the control mode, as per Chapter 8 AVAILABLE MOTOR CONTROL TYPES on page 8-1.

The V/f curve is completely adjustable in four different points as shown in Figure 9.2 on page 9-3, although the factory default set a curve pre-adjusted for motors 50 Hz or 60 Hz, as options for P204. This format, point P0 defines the amplitude applied at 0 Hz, while P2 defines the rated amplitude and frequency and beginning of field weakening. Intermediate points P1 allow the setting of the curve for a non-linear relationship between torque and frequency, for instance, in fans where the load torque is quadratic in relation to the frequency. The field weakening region is determined between P2 and P3, where the amplitude is maintained in 100 %.

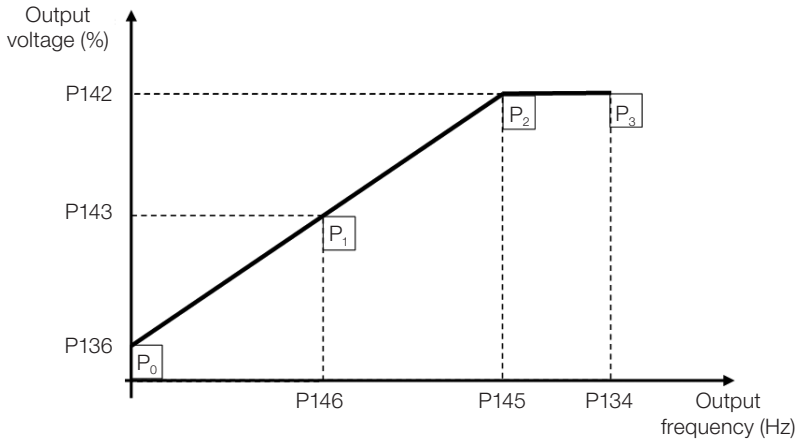


Figure 9.2: *Curve V/f*

The factory default setting of the CFW300 defines a linear relation of the torque with the frequency by means of three points (P_0, P_1 and P_2).

The points **P_0**[P136, 0 Hz], **P_1**[P143, P146], **P_2**[P142, P145] and **P_3**[100 %, P134] can be set so that the voltage and frequency relation imposed to the output approximates the ideal curve for the load. Therefore, for loads in which the torque behavior is quadratic in relation to the frequency, such as in centrifugal pumps and fans, the points of the curve can be set or the Quadratic V/f control mode can be used so as to save energy. This Quadratic V/f curve is presented in Figure 9.3 on page 9-3.

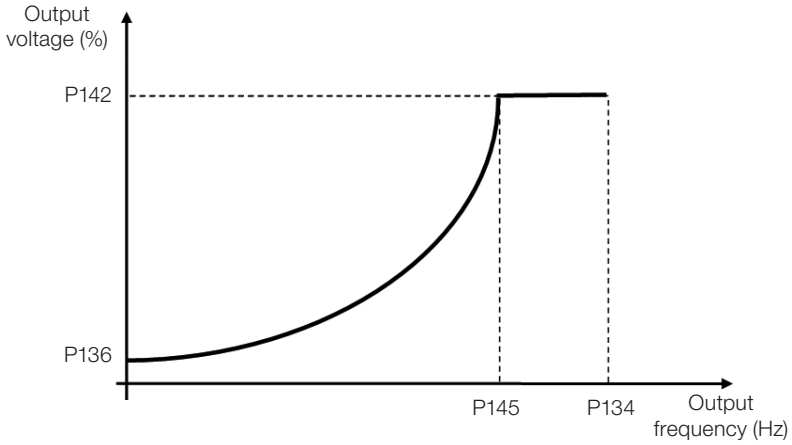


Figure 9.3: *Quadratic V/f Curve*

NOTE!
In frequencies below 0.1 Hz, the output PWM pulses are cut, except when the inverter is in DC Braking mode.

P136 - Manual Torque Boost

Adjustable Range:	0.0 to 30.0 %	**Factory Setting:**	5.0 %
Properties:	V/f		

Description:

It actuates at low speeds, that is, in the range 0 to P146 (V/f) or 0 to P145 (Quadratic V/f), increasing the inverter output voltage so as to compensate the voltage drop in the motor stator resistance in order to keep the torque constant.

The optimum setting is the smallest value of P136 which allows the motor satisfactory start. A value greater than necessary will excessively increase the motor current at low speeds, which may lead the inverter to a fault condition (F051 or F070) or alarm condition (A046 or A050), as well as motor overheating. Figure 9.4 on page 9-4 and Figure 9.5 on page 9-4 show the actuation regions of the Torque Boost for the V/f and Quadratic V/f mode, respectively.

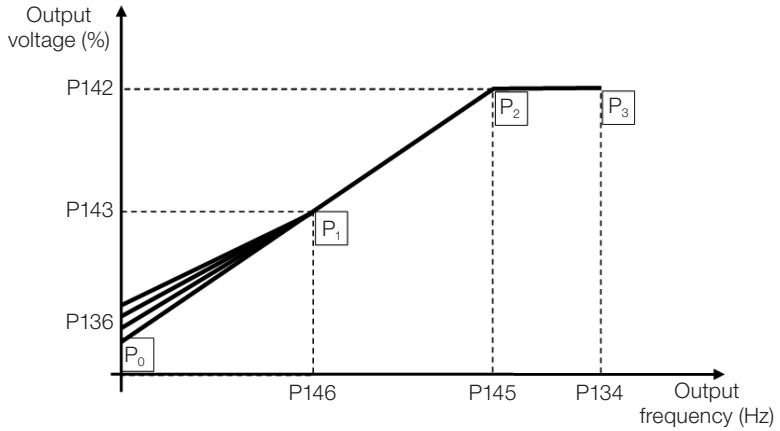


Figure 9.4: *Torque boost region for V/f control mode*

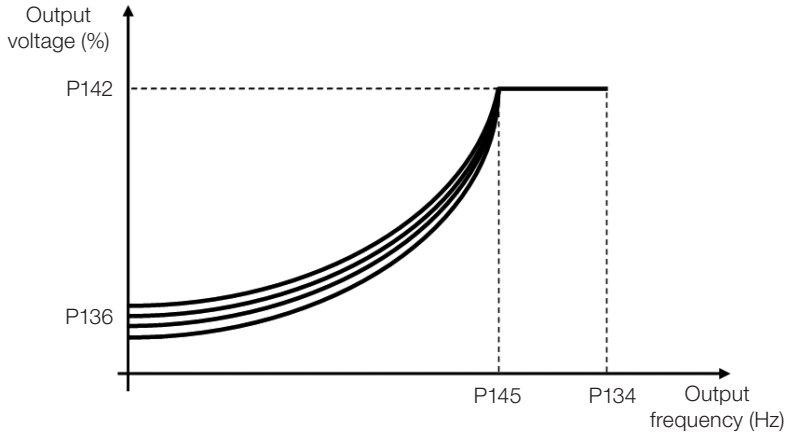


Figure 9.5: *Torque boost region for quadratic V/f control mode*

P142 - Maximum Output Voltage

P143 - Intermediate Output Voltage

Adjustable Range:	0.0 to 100.0 %	**Factory Setting:**	P142 = 100.0 % P143 = 50.0 %
Properties:	cfg, V/f		

Description:

These parameters allow adjusting the inverter V/f curve together with its orderly pairs P145 and P146.

P145 - Field Weakening Start Frequency

P146 - Intermediate Output Frequency

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	P145 = 60.0 (50.0) Hz P146 = 30.0 (25.0) Hz
Properties:	cfg, V/f		

Description:

These parameters allow adjusting the inverter V/f curve together with its orderly pairs P142 and P143.

The V/f curve can be adjusted in applications where the motor rated voltage is smaller than the power supply voltage, for example, a power supply of 220 V with motor of 200 V.

The adjustment of the V/f curve is necessary when the motor has a frequency different from 50 Hz or 60 Hz, or when a quadratic approximation is desired for energy saving in centrifugal pumps and fans, or in special applications: when a transformer is used between the inverter and the motor or the inverter is used as a power supply.

P137 - Automatic Torque Boost

Adjustable Range:	0.0 to 30.0 %	**Factory Setting:**	0.0 %
Properties:	V/f		

Description:

The automatic torque boost compensates the voltage drop in the stator resistance because of active current. Look at Figure 9.1 on page 9-2, where variable $\mathbf{m_{IxR}}$ corresponds to the automatic torque boost action on the modulation index defined by V/f curve.

P137 actuates similarly to P136, but the value set is applied proportionally to the output active current in relation to the maximum current (2 x P295).

The setting criteria of P137 are the same as those of P136, that is, set the value as low as possible for the motor start and operation at low frequencies, because values above those increase the losses, heating and overload of the motor and inverter.

The block diagram of Figure 9.6 on page 9-6 shows the automatic compensation action IxR responsible for the increment of the voltage in the ramp output according to the increase of the active current.

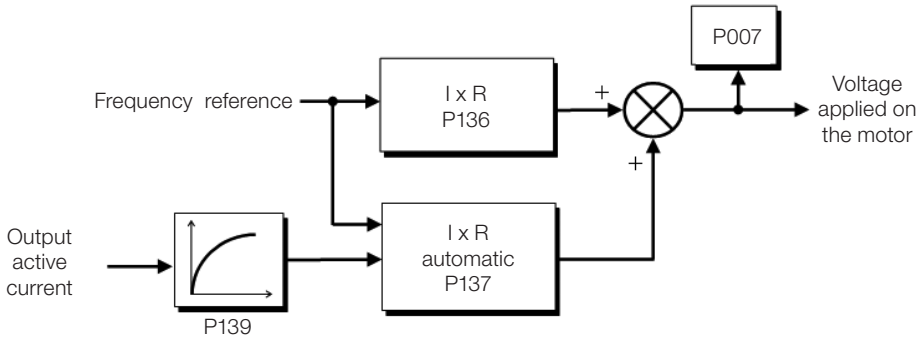


Figure 9.6: *Block diagram of the automatic torque boost*

P138 - Slip Compensation

Adjustable Range:	-10.0 to 10.0 %	**Factory Setting:**	0.0 %
Properties:	V/f		

Description:

Parameter P138 is used in the motor slip compensation function, when set for positive values. In this case, it compensates the speed drop due to the application of load on the shaft and, consequently, the slip. Thus, it increments the output frequency (Δf) considering the increase of the motor active current, as shown in Figure 9.7 on page 9-6. In Figure 9.1 on page 9-2 this compensation is represented in the variable $\mathbf{f_{Slip}}$.

The setting in P138 allows regulating with good accuracy the slip compensation by moving the operation point on the V/f curve, as shown in Figure 9.7 on page 9-6. Once P138 is set, the inverter is able to keep the frequency constant even with load variations.

Negative values are used in special applications where you wish to reduce the output frequency considering the increase of the motor current.

Eg.: load distribution in motors driven in parallel.

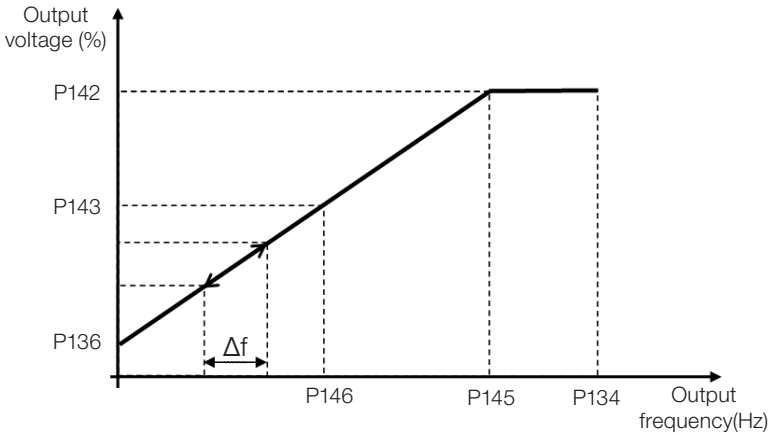


Figure 9.7: *Slip compensation in an operation point of the standar V/f curve*

9.2 START-UP IN V/f MODE

NOTE!
Read chapter 3 Installation and Connection of the CFW300 user manual before installing, energizing or operating the inverter.

Sequence for installation, verification, power up and start-up.

1. Install the inverter: according to chapter 3 Installation and Connection of the user's manual, making all the power and control connections.

2. Prepare and power up the inverter according to section 3.2 Electrical Installation of the user's manual of the CFW300.

3. Load the factory default with P204 = 5 (60 Hz) or P204 = 6 (50 Hz), according to the input rated frequency (power supply) of the inverter used.

4. In order to set a V/f curve different from the default, set the V/f curve using parameters P136 to P146.

5. Setting of specific parameters and functions for the application: program the digital and analog inputs and outputs, HMI keys, etc., according to the application requirements.

9.3 ENERGY SAVING

The efficiency of a machine is defined as being the ratio between the output mechanical power and the input electrical power. Remember that the mechanical power is the product between torque and rotor speed, and that the input electric power is the sum of the output mechanical power and the motor losses.

In the case of the three-phase induction motor, the optimized efficiency is achieved with ¾ of the rated load. In the region below this point, the Energy Saving function has its best performance.

The Energy Saving function acts directly on the voltage applied on the inverter output; thus, the flux relationship delivered to the motor is changed so as to reduce the motor losses and enhance the efficiency, consequently reducing consumption and noise.

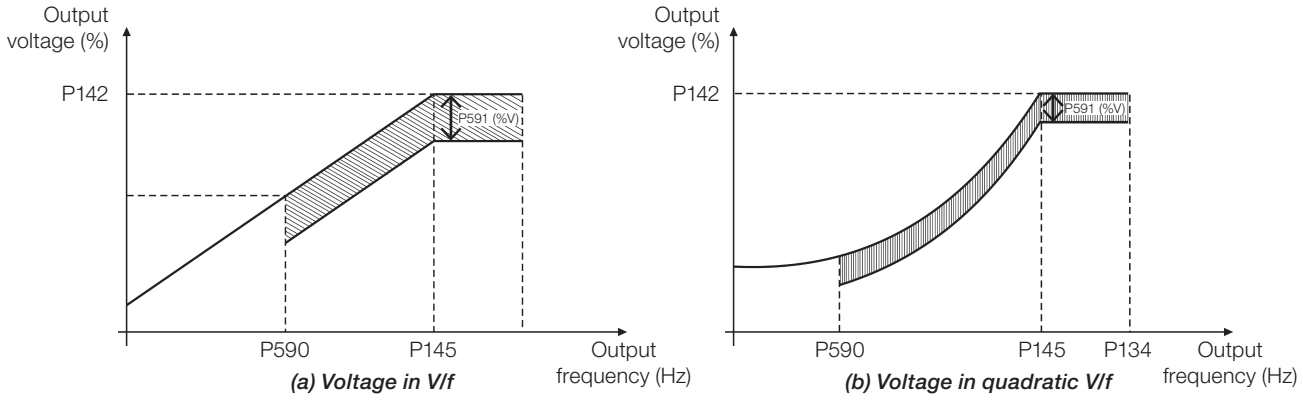


Figure 9.8: *(a) and (b) Example of voltage behavior in V/f and quadratic V/f*

The function will be active when the motor load is below the maximum value (P588) and the frequency is above the minimum value (P590). In addition, in order to prevent the stalling of the motor, the applied voltage is limited to a minimum acceptable value (P589). The parameter group presented in the sequence defines the characteristics necessary for the energy saving function.

NOTE!
The use of the energy saving function is recommended in quadratic torque applications (blowers, fans, pumps and compressors).

P401 - Motor Rated Current

Adjustable Range:	0.0 to 40.0 A	**Factory Setting:**	1.0 x I_{nom}
Properties:	cfg		

Description:

In order to obtain the proper operation of the energy saving function, the motor current value must be correctly set, according to the information on the motor nameplate.

P407 – Motor Rated Power Factor

Adjustable Range:	0.50 to 0.99	**Factory Setting:**	0.80
Properties:	cfg, V/f, VVW		

Description:

Setting of the motor rated power factor. In order to obtain the proper operation of the energy saving function, the motor power factor must be correctly set, according to the information on the motor nameplate.

NOTE!
With the motor nameplate data and for applications with constant torque, the motor optimum efficiency is normally obtained with the energy saving function active. In some cases, the output current may increase, and then it is necessary to gradually reduce the value of this parameter to the point in which the current value remains equal to or below the current value obtained with the function disabled.

9

For information regarding the actuation of P407 in the VVW control mode, refer to Chapter 10 VVW VECTOR CONTROL on page 10-1.

P588 – Energy Saving Maximum Torque Adjustable

Adjustable Range:	0 to 85 %	**Factory Setting:**	0 %
Properties:	cfg, V/f		

Description:

This parameter defines the torque value to activate the operation of the energy saving function.

Setting this parameter to 0 % disables the function.

It is recommended to set this parameter to 60 %, but it has to be set according the application requirements.

P589 – Level of Minimum Applied Voltage

Adjustable Range:	40 to 80 %	**Factory Setting:**	40 %
Properties:	cfg, V/f		

Description:

This parameter defines the minimum voltage value that will be applied to the motor when the energy saving function is active. This minimum value is relative to the voltage imposed by the V/f curve for a certain speed.

P590 – Energy Saving Minimum Frequency

Adjustable Range:	12.0 to 400.0 Hz	**Factory Setting:**	20 Hz
Properties:	cfg, V/f		

Description:

This parameter defines the minimum speed value at which the energy saving function will remain active.

The hysteresis for the minimum speed level is of 2 Hz.

P591 – Energy Saving Hysteresis Adjustable

Adjustable Range:	0 to 30 %	**Factory Setting:**	10 %
Properties:	cfg, V/f		

Description:

Hysteresis used to activate and deactivate the energy saving function.

If the function is active and the output current oscillates, it is necessary to increase the hysteresis value.

NOTE!
It is not possible to set those parameters, while the motor is spinning.

10 VVW VECTOR CONTROL

The VVW vector control mode (Voltage Vector WEG) uses a control method with a much higher performance than the V/f control because of the load torque estimation and of the control of the magnetic flux in the air gap, as per scheme of Figure 10.1 on page 10-2. In this control strategy, losses, efficiency, rated slip and power factor of the motor are considered in order to improve the control performance.

The main advantage compared to the V/f control is the best frequency regulation with greater torque capacity at low speeds (frequencies below 5 Hz), allowing a relevant improvement in the drive performance in permanent duty. Besides, the VVW control has a quick and simple setting and it is suitable for most medium-performance applications in the control of three-phase induction motor.

By just measuring the output current, the VVW control instantly obtains the motor torque and slip. Thus, the VVW actuates in the output voltage compensation and slip compensation. Therefore, the VVW controller action replaces the classical V/f functions in P137 and P138, but with a calculation model much more sophisticated and accurate, meeting several load conditions or operation points of the application.

In order to achieve a good frequency regulation in permanent duty with a good operation of the VVW control, the parameter setting in the range P399 to P407, and the stator resistance in P409 are essential for the good operation of the VVW control. These parameters can be easily obtained on the motor nameplate.

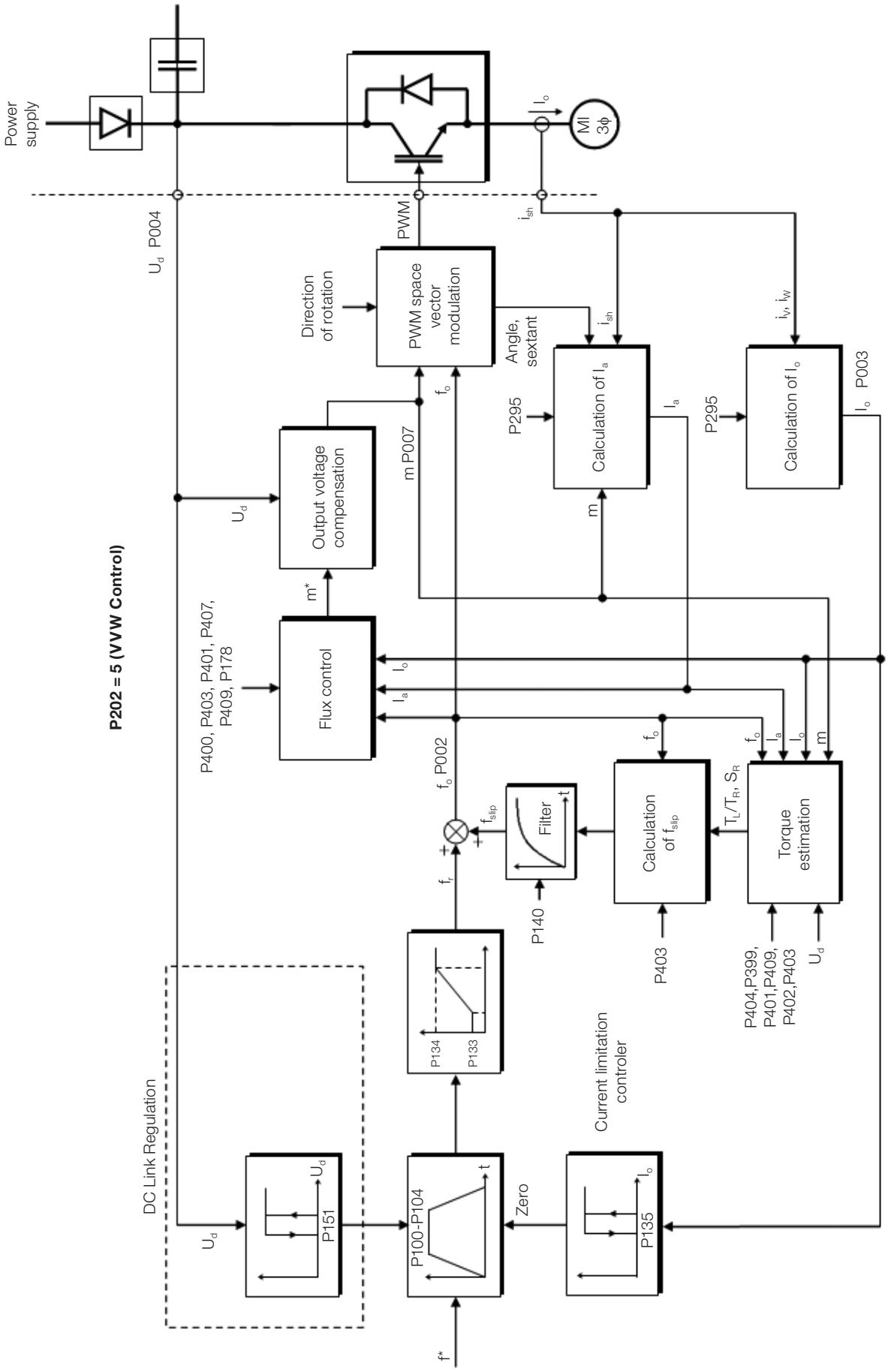


Figure 10.1: *VVW control flow*

10.1 VVW VECTOR CONTROL PARAMETERIZATION

The VVW control mode is selected by parameter P202, control mode selection, as described in Chapter 8 AVAILABLE MOTOR CONTROL TYPES on page 8-1.

Opposite to the V/f scalar control, the VVW control requires a series of data from the motor nameplate and a self-tuning for its proper operation. Besides, it is recommended that the driven motor match the inverter, that is, the motor and inverter power be as close as possible.

Below are described the parameters to configure the VVW vector control setting. This data is easily obtained on WEG standard motor nameplates, however in older motors or motors made by other manufacturers, the data may not be readily available. In those cases, it is recommended first contact the motor manufacturer, measure or calculate the desired parameter. As a last resort, the user always can make a relationship with Table 10.1 on page 10-3 and use the equivalent or approximate WEG standard motor parameter.

NOTE!
The correct setting of the parameters directly contributes to the VVW control performance.

Table 10.1: *Characteristics of IV pole WEG standard motors*

Power [P404]		Frame size	Voltage [P400] (V)	Current [P401] (A)	Frequency [P403] (Hz)	Speed [P402] (rpm)	Efficiency [P399] (%)	Power Factor	Stator Resistance [P409] (Ω)
(HP)	(kW)								
0.16	0.12	63	220	0.85	60	1720	56.0	0.66	21.77
0.25	0.18	63		1.12		1720	64.0	0.66	14.87
0.33	0.25	63		1.42		1720	67.0	0.69	10.63
0.50	0.37	71		2.07		1720	68.0	0.69	7.37
0.75	0.55	71		2.90		1720	71.0	0.70	3.97
1.00	0.75	80		3.08		1730	78.0	0.82	4.13
1.50	1.10	80		4.78		1700	72.7	0.83	2.78
2.00	1.50	90S		6.47		1720	80.0	0.76	1.55
3.00	2.20	90L		8.57		1710	79.3	0.85	0.99
4.00	3.00	100L		11.6		1730	82.7	0.82	0.65
5.00	3.70	100L		13.8		1730	84.6	0.83	0.49
0.16	0.12	63	230	0.73	50	1375	57.0	0.72	30.62
0.25	0.18	63		1.05		1360	58.0	0.74	20.31
0.33	0.25	71		1.4		1310	59.0	0.76	14.32
0.50	0.37	71		1.97		1320	62.0	0.76	7.27
0.75	0.55	80		2.48		1410	68.0	0.82	5.78
1.00	0.75	80		3.23		1395	72.0	0.81	4.28
1.50	1.10	90S		4.54		1420	77.0	0.79	2.58
2.00	1.50	90L		5.81		1410	79.0	0.82	1.69
3.00	2.20	100L		8.26		1410	81.5	0.82	0.98
4.00	3.00	100L		11.3		1400	82.6	0.81	0.58
5.00	3.70	112M		14.2		1440	85.0	0.83	0.43

P178 - Rated Flux

Adjustable Range:	50.0 to 150.0 %	**Factory Setting:**	100.0 %
Properties:	VVW		

Description:

It defines the desired flux in the motor air gap in percentage (%) of the rated flux. In general, it is not necessary to modify the value of P178 of the standard value of 100 %. However, some specific situations may use values slightly above to increase the torque, or below to reduce the energy consumption.

P399 - Motor Rated Efficiency

Adjustable Range:	50.0 to 99.9 %	**Factory Setting:**	67.0 %
Properties:	cfg, VVW		

Description:

This parameter is important for the precise operation of the VVW control. A misconfiguration will cause incorrect calculation of the slip compensation, reducing the performance of the speed control.

P400 - Motor Rated Voltage

Adjustable Range:	0 to 240 V	**Factory Setting:**	According inverter model
Properties:	cfg, VVW		

Description:

Set according to the data on the motor nameplate and the wire connection on the motor terminal box. This value cannot be above the rated voltage value set in P296 (power supply rated voltage).

Table 10.2: *Default setting of P400 according to the identified inverter model*

P296	P145 (Hz)	P400 (V)
0	Reserved	Reserved
1	50.0	230
	60.0	220
2	50.0	230
	60.0	220

For further information on model identification, refer to Table 6.3 on page 6-2 of Chapter 6 IDENTIFICATION OF THE INVERTER MODEL AND ACCESSORIES on page 6-1.

P401 - Motor Rated Current

Adjustable Range:	0.0 to 40.0 A	**Factory Setting:**	1.0 x I_{nom}
Properties:	cfg		

P402 - Motor Rated Speed

Adjustable Range:	0 to 30000 rpm	**Factory Setting:**	1720 (1310) rpm
Properties:	cfg		

P403 - Motor Rated Frequency

Adjustable Range:	0 to 400 Hz	**Factory Setting:**	60 Hz (50 Hz)
Properties:	cfg		

P404 - Motor Rated Power

Adjustable Range:	0 = 0.16 HP (0.12 kW) 1 = 0.25 HP (0.18 kW) 2 = 0.33 HP (0.25 kW) 3 = 0.50 HP (0.37 kW) 4 = 0.75 HP (0.55 kW) 5 = 1.00 HP (0.75 kW) 6 = 1.50 HP (1.10 kW) 7 = 2.00 HP (1.50 kW) 8 = 3.00 HP (2.20 kW) 9 = 4.00 HP (3.00 kW) 10 = 5.00 HP (3.70 kW4)	**Factory Setting:**	According inverter model
Properties:	cfg, VVW		

Description:

The setting of parameters P401, P402, P403 and P404 must be according to the data on the nameplate of the motor used, taking into account the motor voltage.
The setting of parameter P402 via HMI for values above 9999 rpm is performed from 10.00 to 30.00 rpm (x 1000).

P405 - Encoder Pulse Number

Adjustable Range:	32 to 9999 ppr	**Factory Setting:**	1024
Properties:	cfg		

Description:

It sets the number of pulses per revolution (ppr) of the incremental encoder. This parameter influences the indication of the speed parameters (P038) and pulse counter (P039) of the encoder.

NOTE!
Parameter P405 is only visible on the HMI if the CFW300-IOAENC expansion module is connected to the inverter.

P407 - Motor Rated Power Factor

Adjustable Range:	0.50 to 0.99	**Factory Setting:**	0.69
Properties:	cfg, VVW		

Description:

The setting of this parameter must be according to the data on the nameplate of the motor used, taking into account the motor voltage.

P408 - Self-Tuning

Adjustable Range:	0 = No 1 = Yes	**Factory Setting:**	0
Properties:	cfg, VVW		

Description:

Parameter P408 in 1 activates the self-tuning of the VVW mode, where the motor stator resistance is measured. The self-tuning can only be activated via HMI, and it can be interrupted at any time with the P key.

During the self-tuning, the bar graph shows the progress of the operation and the motor remains still, because a DC signal is sent to measure the stator resistance.

If the estimated value of the motor stator resistance is too high for the inverter used (for example: motor not connected or motor too small for the inverter) the inverter indicates fault F033.

At the end of the self-tuning process, the measured motor stator resistance is saved in P409.

P409 - Stator Resistance

Adjustable Range:	0.01 to 99.99 Ω	**Factory Setting:**	According inverter model
Properties:	cfg, VVW		

Description:

Motor phase stator resistance in ohms (Ω), assuming a star (Y) motor connection.

If the value adjusted in P409 is too high or too low for the inverter used, the inverter indicates fault F033. In order to exit this condition, just perform a reset by using the I/O key. In this case, P409 will be loaded with the factory default value.

10.2 START-UP IN VVW MODE

NOTE!
Read chapter 3 Installation and Connection of the user's manual before installing, powering up or operating the inverter.

Sequence for installation, verification, power up and start-up:

1. **Install the inverter:** according to chapter 3 Installation and Connection of the user's manual, making all the power and control connections.

2. **Prepare and power up the inverter:** according to section 3.2 Electrical Installation of the user's manual.

3. **Load the correct factory default in P204:** based on the motor rated frequency (set P204 = 5 for 60 Hz motors and P204 = 6 for 50 Hz motors).

4. **Adjustment of parameters and specific functions for the application:** program the digital and analog inputs and outputs, HMI keys, etc., according to the application requirements.

5. **Activation of the VVW control:** set P202 = 5 and parameters P399, P400, P401, P402, P403, P404 and P407 according to the motor nameplate. Also set the value of P409. If some of those data are not available, enter the approximate value by calculation or by similarity with WEG standard motor - see Table 10.1 on page 10-3.

6. **Self-Tuning of the VVW control:** the self-tuning is activated by setting P408 = 1. In this process, the inverter applies DC to the motor to measure the stator resistance, while the HMI bar graph shows the progress of the self-tuning. The self-tuning process can be interrupted at any time by pressing the P key.

7. **End of the Self-Tuning:** at end of the self-tuning, the HMI returns to the browsing menu, the bar displays the parameter programmed by P207 again and the stator resistance measured is stored in P409. On the other hand, if the self-tuning fails, the inverter will indicate a fault. The most common fault in this case is F033, which indicates error in the estimated stator resistance. Refer to Chapter 14 FAULTS AND ALARMS on page 14-1.

For better visualization of the start-up in the VVW mode, check Figure 10.2 on page 10-7, below:

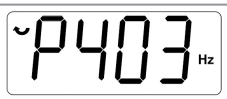
Seq	Action/Indication on the Display	Seq	Action/Indication on the Display
1	 ■ Monitoring mode ■ Press this key P to enter the first level of the setting mode	2	 ■ Press the keys ▲ or ▼ until selecting parameter P202
3	 ■ Press the key P to change the content of “P202 -Control Type” to P202 = 5 (VVW). Use the key ▲	4	 ■ Press the key P to save the change of P202 ■ Use the keys ▲ until selecting parameter P399
5	 ■ If necessary, change the content of “P399 - Motor Rated Efficiency” according to data on the nameplate ■ Press the key ▲ for the next parameter	6	 ■ If necessary, change the content of “P400 - Motor Rated Voltage” ■ Press the key ▲ for the next parameter
7	 ■ If necessary, change the content of “P401 - Motor Rated Current” ■ Press the key ▲ for the next parameter	8	 ■ If necessary, change the content of “P402 - Motor Rated Speed” ■ Press the key ▲ for the next parameter
9	 ■ If necessary, change the content of “P403 - Motor Rated Frequency” ■ Press the key ▲ for the next parameter	10	 ■ If necessary, change the content of “P404 - Motor Rated Output” ■ Press the key ▲ for the next parameter
11	 ■ If necessary, change the content of “P407 - Motor Rated Power Factor” ■ Press the key ▲ for the next parameter	12	 ■ If necessary to make the self-tuning, change the value of P408 to “I”
13	 ■ During the self-tuning, the HMI will show “Auto”, and the bar will indicate the operation progress	14	 ■ When the self-tuning is completed, it will return to the (comp) Initialization Mode
15	 ■ If necessary, change the content of “P409 - Stator Resistance”		

Figure 10.2: *Start-up of the VVW mode*

11 FUNCTIONS COMMON TO ALL THE CONTROL MODES

This chapter describes the functions common to the inverter V/f and VVW control modes, but which interferes in the drive performance.

11.1 RAMPS

The inverter ramp functions allow the motor to accelerate or decelerate faster or slower. They are adjusted by parameters that define the linear acceleration time between zero and the maximum frequency (P134) and the time for a linear deceleration from the maximum frequency zero.

In the CFW300, three ramps with different functions were implemented:

- 1st Ramp - standard for most functions.
- 2nd Ramp - it may be activated by the user, according to the drive requirement, by means of the inverter command word or by a digital input.
- Emergency Ramp - it is used for the inverter internal protection functions, such as: current limitation, DC link regulation, etc. The Emergency Ramp has priority over the other ramps.

NOTE!
The setting with too short ramp time may cause overcurrent in the output (F070), undervoltage (F021) or overvoltage (F022) of the DC link.

P100 - Acceleration Time

Adjustable Range:	0.1 to 999.9 s	**Factory Setting:**	5.0 s
Properties:			

Description:
Acceleration time from zero to maximum frequency (P134).

P101 - Deceleration Time

Adjustable Range:	0.1 to 999.9 s	**Factory Setting:**	10.0 s
Properties:			

Description:
Deceleration time from maximum frequency (P134) to zero.

P102 - Acceleration Time 2nd Ramp

Adjustable Range:	0.1 to 999.9 s	**Factory Setting:**	5.0 s
Properties:			

Description:
Acceleration time from zero to maximum frequency (P134) when the 2nd Ramp is active.

P103 - Deceleration Time 2nd Ramp

Adjustable Range:	0.1 to 999.9 s	**Factory Setting:**	10.0 s
Properties:			

Description:

Deceleration time from maximum frequency (P134) to zero when the 2nd Ramp is active.

P106 - Emergency Ramp Acceleration Time

Adjustable Range:	0.1 to 999.9 s	**Factory Setting:**	5.0 s
Properties:			

Description:

Acceleration time from zero to maximum frequency (P134) when the emergency ramp is active.

P107 - Emergency Ramp Deceleration Time

Adjustable Range:	0.1 to 999.9 s	**Factory Setting:**	5.0 s
Properties:			

Description:

Deceleration time from maximum frequency (P134) to zero when the emergency ramp is active.

P104 - S Ramp

Adjustable Range:	0 = Inactive 1 = Active	**Factory Setting:**	0
Properties:	cfg		

Description:

This parameter allows the inverter acceleration and deceleration ramps to have a non-linear profile, similar to an "S", aiming at reducing the mechanical shocks on the load, as shown in Figure 11.1 on page 11-2.

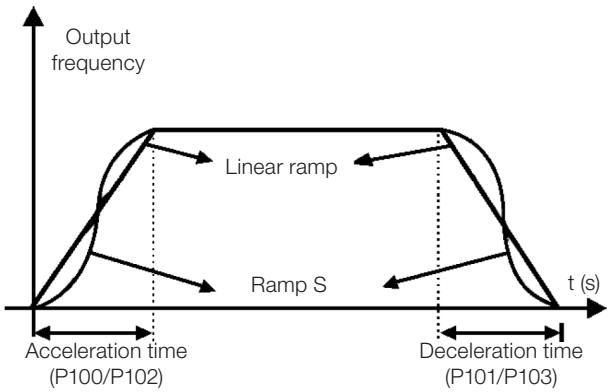


Figure 11.1: *S or Linear ramp*

P105 - 1st / 2nd Ramp Selection

Adjustable Range:	0 = 1st Ramp 1 = 2nd Ramp 2 = DIx 3 = Serial/USB 4 = Reserved 5 = CO/DN/DP 6 = SoftPLC	**Factory Setting:**	0
Properties:			

Description:

It defines the origin source of the command to select between the first and second Ramp.

Note: Parameter P680 (Logical Status) indicates if the 2nd Ramp is active or not. For further information on this parameter, refer to Section 7.3 CONTROL WORD AND INVERTER STATUS on page 7-11.

11.2 DC LINK VOLTAGE AND OUTPUT CURRENT LIMITATION

The DC link voltage and output current limitation are protection functions of the inverter which act on the ramp control, aiming at containing the rise of voltage on the DC link and of the output current. In this way, the following of the reference by the ramp is blocked and the output frequency follows the Emergency Ramp for a preset safety value.

When the DC link voltage is too high, the inverter may freeze the deceleration ramp. On the other hand, when the output current is too high, the inverter may decelerate or freeze the acceleration ramp in order to reduce this current. Those actions prevent the occurrence of faults F022 and F070, respectively.

Both protections normally occur at different moments of the inverter operation, but in case of occurrence at the same time, by definition, the DC link limitation has higher priority than the output current limitation.

The voltage limitation on the DC link during braking actuates limiting the braking power and torque, so as to prevent the shutting down of the inverter for overvoltage (F022). This situation often occurs when a load with high moment of inertia is decelerated or when short deceleration time is programmed.

11.2.1 DC Link Voltage Limitation by "Ramp Hold" P150 = 0 or 2

- It has effect during deceleration only.
- Actuation: when the DC link voltage reaches the level set in P151, a command is sent to the "ramp" block, which inhibits the motor frequency variation according to Figure 9.1 on page 9-2 and Figure 10.1 on page 10-2.
- Use recommended in the drive of loads with high moment of inertia referred to the motor shaft or loads that require short deceleration ramps.

11.2.2 DC Link Voltage Limitation by "Accelerate Ramp" P150 = 1 or 3

- It has effect in any situation, regardless the motor frequency condition: accelerating, decelerating or constant frequency.
- Actuation: when the DC link voltage reaches the level set in P151, a command is sent to the "ramp" block to accelerate the motor.
- Use recommended for the drive of loads that require braking torques at constant frequency in the inverter output. For example, the drive of loads with eccentric shaft as in sucker rod pumps; another application is the handling of loads with balance like in the translation in overhead cranes.

P149 - Compensation of the DC Link Voltage

Adjustable Range:	0 = Inactive 1 = Active	**Factory Setting:**	0
Properties:	cfg		

Description:

It enables the use of Compensation of the DC link.

P150 - Type DC V/f Link Regulator

Adjustable Range:	0 = Hold_Ud and Decel_LC 1 = Accel_Ud and Decel_LC 2 = Hold_Ud and Hold_LC 3 = Accel_Ud and Hold_LC	**Factory Setting:**	0
Properties:	cfg		

Description:

P150 configures the behavior of the ramp for the limitation functions of the DC Link Voltage and Current Limitation. In those cases, the ramp ignores the reference and takes an action of accelerating (accel), decelerating (decel) or freezing (hold) the normal path of the ramp. That occurs because of the limit pre-defined in P151 and P135 for the DC Link (Ud) Limitation and for Current (LC) Limitation, respectively.

P151 - DC Link Regulation Level

Adjustable Range:	348 to 460 V	**Factory Setting:**	According to Table 11.1 on page 11-4
Properties:			

Description:

Voltage level to activate the DC link voltage regulation.

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Table 11.1: *Actuation Level of the Voltage Regulation*

Input Voltage	P151 Actuation Band	P151 Factory Default
100 to 127 Vac	391 to 460 Vdc	395 Vdc
200 to 240 Vac	348 to 410 Vdc	365 Vdc

Figure 11.2 on page 11-4 shows the block diagram of the actuation of the limitation. Figure 11.3 on page 11-5 and Figure 11.4 on page 11-5 show the example chart.

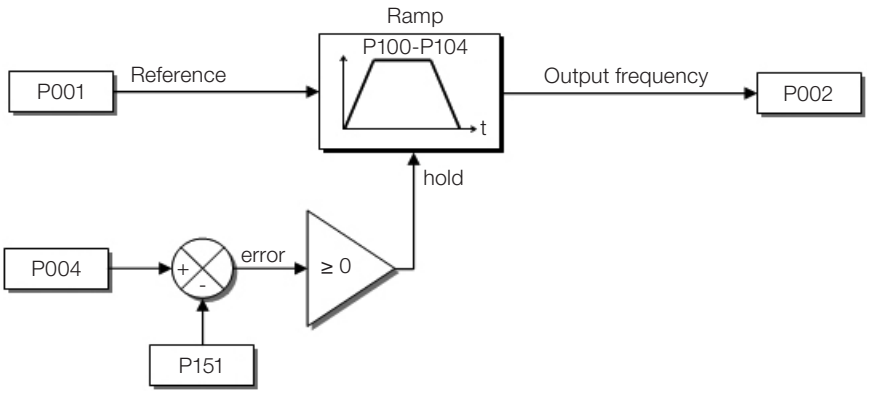

Figure 11.2: *Block diagram DC Link voltage limitation*

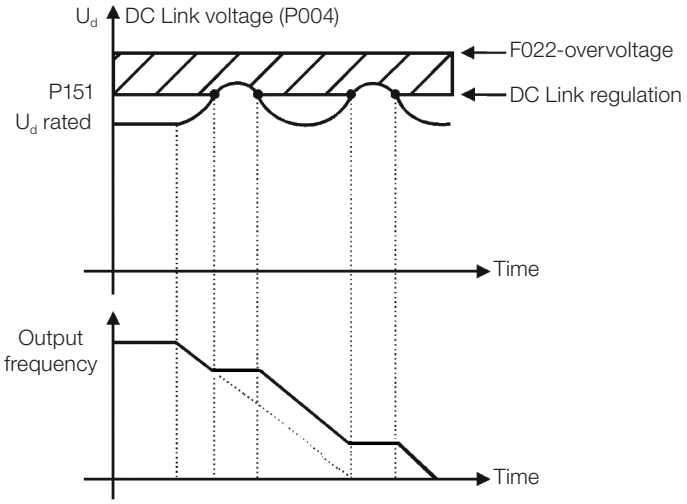

Figure 11.3: *Example graph of DC Link voltage limitation - Ramp Hold*

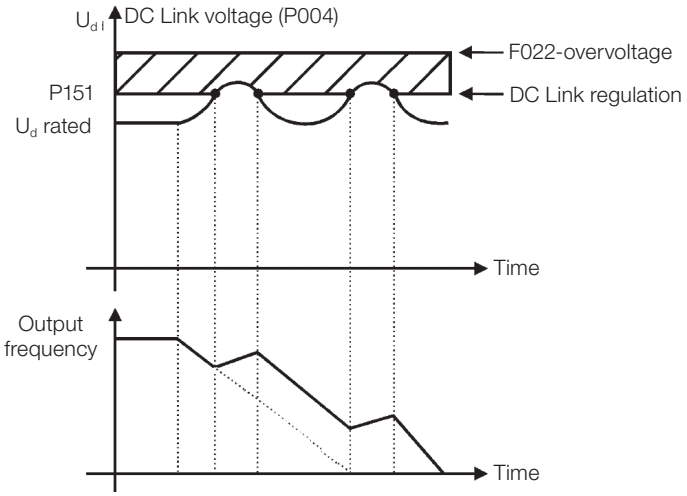

Figure 11.4: *Example graph of the DC Link voltage limitation - Accelerate Ramp*

Like in the DC Link voltage regulation, the output current regulation also has two operating modes: "Ramp Holding" (P150 = 2 or 3) and "Decelerate Ramp" (P150 = 0 or 1). Both actuate limiting the torque and power delivered to the motor, so as to prevent the shutting down of the inverter by overcurrent (F070). This situation often occurs when a load with high moment of inertia is accelerated or when short acceleration time is programmed.

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11.2.3 Output Current Limitation by "Ramp Hold" P150 = 2 or 3

- It prevents the motor from collapsing during torque overload in the acceleration or deceleration.
- Actuation: if the motor current exceeds the value set in P135 during acceleration or deceleration, the frequency will not be incremented (acceleration) or decremented (deceleration). When the motor current reaches a value below P135 the motor accelerates or decelerates again. Refer to Figure 11.5 on page 11-6.
- It has a faster action than the "Decelerate Ramp" mode.
- It acts in the motorization and regeneration modes.

11.2.4 Current Limitation Type "Decelerate Ramp" P150 = 0 or 1

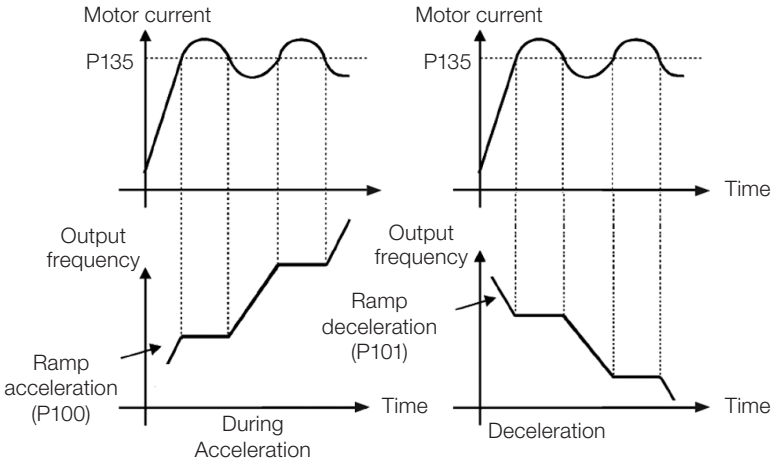
- It prevents the motor from collapsing during torque overload in the acceleration or constant frequency.
- Actuation: if the motor current exceeds the value set in P135, a null value is forced for the frequency ramp input forcing the motor deceleration. When the motor current reaches a value below P135 the motor accelerates again. Look at Figure 11.5 on page 11-6.

P135 - Maximum Output Current

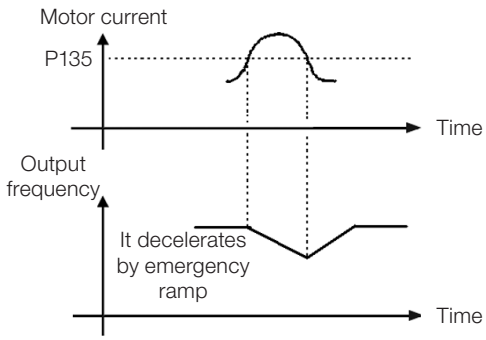
Adjustable Range:	0.0 to 40.0 A	**Factory Setting:**	1.5 x I_{nom}
Properties:			

Description:

Current level to activate the current limitation for the Ramp Hold and Decelerate Ramp modes, as per Figure 11.5 on page 11-6 (a) and (b), respectively. In order to disable the current limitation, you must set parameter P135 > 1.9 x I_{nom}.



(a) "Ramp Hold"



(b) "Ramp Deceleration"

Figure 11.5: *(a) and (b) Actuation modes of current limitation via P135*

11.3 FLYING START / RIDE-THROUGH

The Flying Start function allows driving a motor that is in free running, accelerating it from the rotation in which it is. The Ride-Through function allows recovering the inverter, with no locking by undervoltage, when there is an instant drop in the power supply.

Both functions assume the special case in which the motor is running in the same direction and at a frequency close to the frequency reference, thus, by immediately applying the frequency reference to the output and increasing the output voltage in ramp, the slip and the starting torque are minimized.

P320 - Flying Start (FS) / Ride Through (RT)

Adjustable Range:	0 = Inactive 1 = Flying Start 2 = Flying Start / Ride-Through 3 = Ride-Through	**Factory Setting:**	0
Properties:	cfg		

Description:

Parameter P320 selects the use of the Flying Start and Ride-Through functions. More details in the following sections.

P331 - Voltage Ramp for FS and RT

Adjustable Range:	0.2 to 60.0 s	**Factory Setting:**	2.0 s
Properties:			

Description:

This parameter determines the rising time of the output voltage during the execution of the Flying Start and Ride-Through functions.

P332 - Dead Time

Adjustable Range:	0.1 to 10.0 s	**Factory Setting:**	1.0 s
Properties:			

Description:

Parameter P332 sets the minimum time the VSD will wait until driving the motor again with the Ride Through function, which is necessary to demagnetize the motor.

11.3.1 Flying Start Function

In order to activate this function, just program P320 in 1 or 2; thus the inverter will impose a fixed frequency at the start, defined by the frequency reference, and apply the voltage ramp defined in parameter P331. In this way, the start current is reduced. On the other hand, if the motor is at rest, the frequency reference and the real frequency of the motor are very different or the direction of rotation is inverted; the result in such cases may be worse than the conventional start without Flying Start.

The Flying Start function is applied on loads with high inertia or systems that require start with the motor spinning. Besides, the function may be deactivated dynamically by a digital input P263 to P266 programmed for "24 = Disable Flying Start". In this way, the user may activate the function in a convenient way according to the application.

11.3.2 Ride-Through Function

The Ride-Through function will disable the inverter output pulses (IGBT) as soon as the supply voltage reaches a value below the undervoltage value. A fault due to undervoltage (F021) does not occur and the DC link voltage will slowly drop until the supply voltage returns. In case it takes the supply voltage too long to return (over 2 seconds), the inverter may indicate F021 (undervoltage on the DC link). If the supply voltage returns before, the inverter will enable the pulses again, imposing the frequency reference instantly (like in the Flying Start function) and making a voltage ramp with time defined by parameter P331. Refer to Figure 11.6 on page 11-8.

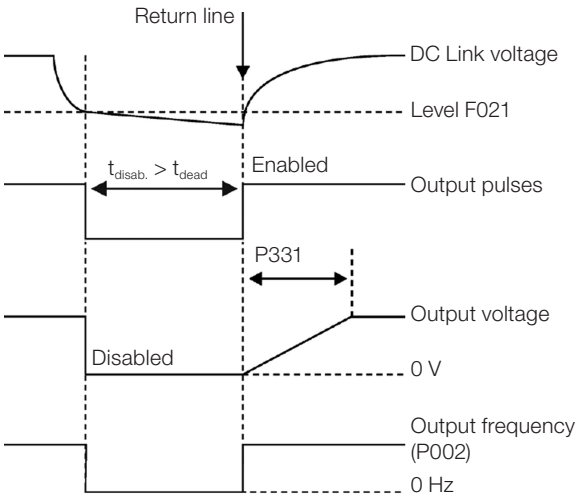


Figure 11.6: *Actuation of the Ride-Through function*

The Ride-Through function allows recovering the inverter without locking by undervoltage F021 for momentary power supply drops. The time interval accepted during a fault is at most two seconds.

11.4 DC BRAKING

The DC Braking allows stopping the motor by applying direct current to it. The current applied at the DC Braking is proportional to the braking torque and may be set in P302. It is set in percentage (%) of the inverter rated current considering the motor of power compatible with the inverter.

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P299 - DC Braking Time at Start

Adjustable Range:	0.0 to 15.0 s	**Factory Setting:**	0.0 s
Properties:			

Description:

DC braking duration at the start.

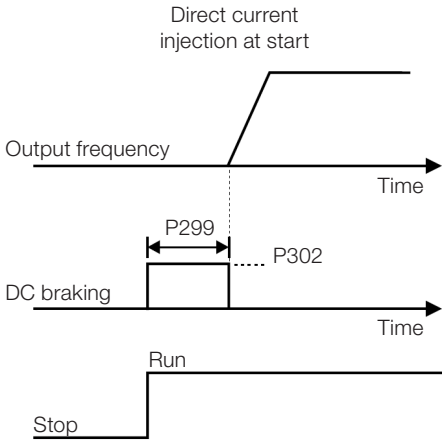


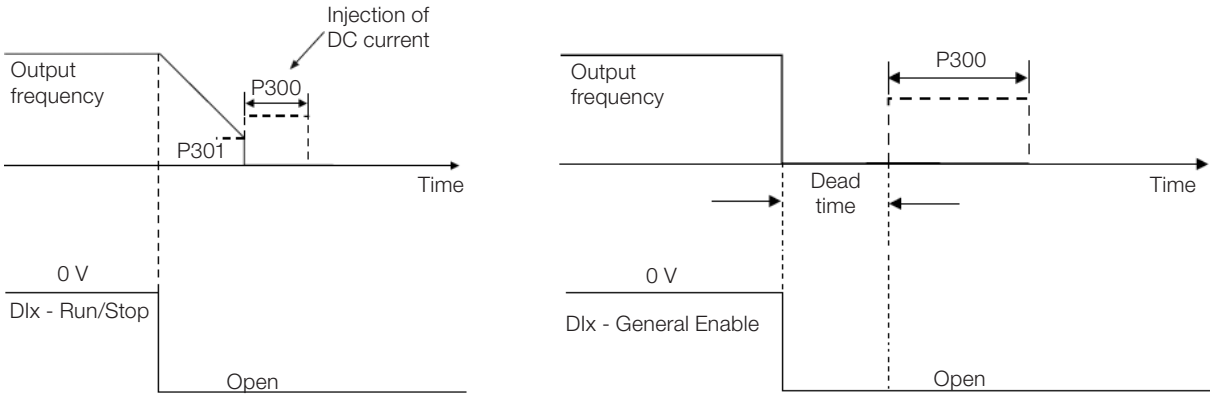
Figure 11.7: DC Braking actuation at start

P300 - DC Braking Time at Stop

Adjustable Range:	0.0 to 15.0 s	**Factory Setting:**	0.0 s
Properties:			

Description:

DC Braking duration at the stop. Figure 11.8 on page 11-9 shows the braking behavior at the stop, where the dead time for the de-magnetization of the motor can be observed. This time is proportional to the frequency at the moment of the injection of direct current.



(a) Run/Stop ***(b) General Enable***

Figure 11.8: *(a) and (b) Actuation of DC Braking*

During the braking process, if the inverter is enabled, the braking is interrupted and the inverter will start operating normally.

ATTENTION!
The DC Braking can continue acting even if the motor has already stopped. Be careful with the thermal dimensioning of the motor for short-period cyclic braking.

P301 - Frequency to Begin DC Braking at Stop

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	3.0 Hz
Properties:			

Description:

This parameter establishes the initial point to apply the DC Braking at the stop when the inverter is disabled by ramp, as per Figure 11.8 on page 11-9.

P302 - Voltage Applied to the DC Braking

Adjustable Range:	0.0 to 100.0 %	**Factory Setting:**	20.0 %
Properties:			

Description:

This parameter sets the DC voltage (DC Braking torque) applied to the motor during the braking.

The setting must be done by gradually increasing the value of P302, which varies from 0.0 to 100.0 % of the rated braking voltage, until the desired braking is obtained.

The rated braking voltage is the DC voltage value, which results in the rated current for the motor with power matched to the inverter. Therefore, if the inverter has a power too much higher than the motor, the braking torque will be too low. On the other hand, if the opposite is true, overcurrent may occur during the braking, as well as overheating of the motor.

11.5 SKIP FREQUENCY

This inverter function prevents the motor from operating permanently at frequency values in which, for example, the mechanical system goes into resonance (causing excessive vibration or noises).

P303 - Skip Frequency 1

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	0.0 Hz

P304 - Skip Frequency 2

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	0.0 Hz

P306 - Skip Band

Adjustable Range:	0.0 to 25.0 Hz	**Factory Setting:**	0.0 Hz
Properties:			

Description:

The actuation of those parameters is done as presented in Figure 11.9 on page 11-11 below.

The passage by the skip frequency band (2 x P306) is done through acceleration/deceleration ramp.

The function does not operate correctly if two bands of "Skip Frequency" overlap.

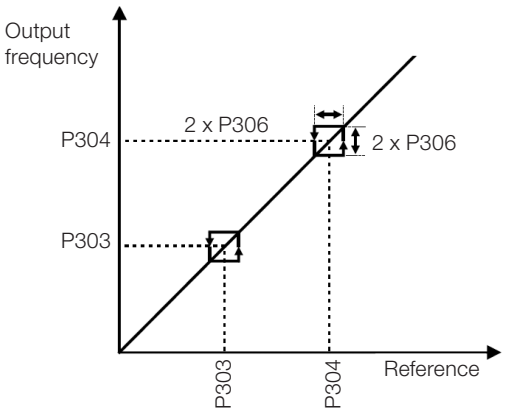


Figure 11.9: *Actuation of the skip frequency*

11.6 FIRE MODE

The “Fire Mode” function is intended to make the frequency inverter continue to drive the motor even under adverse conditions, inhibiting most faults generated by the frequency inverter. The “Fire Mode” is activated by driving a digital input previously set to “Fire Mode” with logic level “0” at the input terminals. When the drive enters the“Fire Mode”, the alarm “A211” will be generated on the HMI (keypad) and the status of the operation mode will be updated in parameter P006.

DANGER!
“FIRE MODE” FUNCTION – RISK OF DEATH!

- Notice that the CFW300 is only one of the components of the system, and it is configurable for several functions that must be pre-established in the project.
- Therefore, the full operation of the "Fire Mode" function, with the required safety, depends on the specification in the project, as it also requires the compatibility with all the other components of the system and the installation environment.
- Ventilation systems that operate in life safety applications must be approved by the Fire Department and/or another competent local public authority.
- The activation of the “Fire Mode” function disables essential protection functions for the safety of the CFW300 and of the system as a whole.
- The non-interruption of the CFW300 operation due to the improper activation of the “Fire Mode” function is critical, as it may cause injuries or even death, and damages to the CFW300, to the other components of the system and to the environment where it is installed.
- The operation in the “Fire Mode” function may, under certain circumstances, result in fire, as the protection devices will be disabled.
- Only qualified personnel from safety engineer departments must evaluate and activate the equipment “Fire Mode” function.
- It is essential to follow the aforementioned instructions before using the CFW300 in the "Fire Mode" function.

Under no circumstance shall WEG take any liability for deaths, damages, compensations and/or losses occurred due to the improper programming or operation of the CFW300 in the "Fire Mode" function.

IMPORTANT – RISK OF DEATH!

When activating the “Fire Mode” function, the user must be aware of the fact that the protection functions of the CFW300 will be disabled, which may result in damages:
- To the inverter.
- To the components connected to it.
- To the environment where it is installed.
- To the people present in the place.

Therefore, the operator who activates the “Fire Mode” function takes full liability for the resulting risks. The operation of the inverter with the “Fire Mode” function programmed voids the warranty of the product.

The operation in this condition is internally registered by the CFW300, and it may be validated by an engineer and occupational safety professional duly qualified by the manufacturer.

NOTE!
When activating the "Fire Mode" function, the user acknowledges that the protection functions of the CFW300 are disabled, which may result in damages to the CFW300, to the components connected to it, to the environment in which it is installed and to the people present in such environment.
Therefore, the user takes full liability for the resulting risks. The operation of the inverter with the “Fire Mode” function enabled voids the warranty of the product. The operation under such condition is internally registered by the CFW300 and must be validated by an engineer and occupational safety professional duly qualified.
If the user presses the P key, the message will disappear from the display (A211), but the operation mode will continue to be shown in parameter P0006. It is also possible to indicate this condition in a digital output (DOx) previously programmed for “Fire Mode”. During the operation in “Fire Mode”, all the stop commands are ignored (even General Enable).
Some Faults (considered critical) that may damage the CFW300 will not be disabled, but they can be infinitely reset automatically (define this condition in parameter P582): Overvoltage on the DC Link (F022), Overcurrent/Short Circuit (F070).

P580 – Configuration “Fire Mode”

Adjustable Range:	0 = Disabled 1 = Enabled (keeps speed reference) 2 = Enabled (set speed reference to maximum [P0134]) 3 = Reserved 4 = Enabled (general disable, motor will coast to stop)	**Factory Setting:**	0
Properties:	cfg		

Description:

This parameter defines how the Fire Mode functionality will work in the CFW501 frequency inverter.

Table 11.2: *Options for the parameter P580*

P580	Description
0	Fire Mode function is inactive
1	Fire Mode function is active. When the DIx set to Fire Mode is opened, “A211” will be shown on the HMI and no changes will be made to the Speed Reference or to the inverter control
2	Fire Mode function is active. When the DIx set to Fire Mode is opened, “A211” will be shown on the HMI and the Speed Reference will be set automatically to maximum (P134) value. The motor will accelerate to this new reference
3	Reserved
4	Fire Mode function is active. When the DIx set to Fire Mode is opened, “A211” will be shown on the HMI and the pulses in the output will be disabled. Motor will coast to stop

P582 – Fire Mode Auto-reset Adjustable

Adjustable Range:	0 = Limited 1 = Unlimited	**Factory Setting:**	0
Properties:	cfg		

Description:

This parameter defines how the auto-reset functionality will work in Fire Mode when a critical fault occur (DC Link Overvoltage (F022) and Overcurrent/Short-circuit (F070)).

Table 11.3: *Options for the parameter P582*

P582	Description
0	Limited. Auto-reset works as defined in P340 parameter
1	Unlimited. The auto-reset happens after 1s of a critical failure detection regardless of the value set in P340

12 DIGITAL AND ANALOG INPUTS AND OUTPUTS

This section presents the parameters to configure the CFW300 inputs and outputs. This configuration depends on the accessory, as per Table 12.1 on page 12-1.

Table 12.1: *I/O configurations of the CFW300*

Functions												Accessory
FI	FO	DI	AI	DOR	AO	NTC	ENC	IR	SH	Supply 5 V	Supply 10 V	
-	-	4	1	1	-	-	-	-	-	-	1	Without accessory
-	-	4	2	4	1	-	-	-	-	-	1	CFW300-IOAR
-	-	8	1	4	-	-	-	-	-	-	1	CFW300-IODR
-	-	4	1	4	-	1	-	1	-	-	1	CFW300-IOADR
-	-	4	2	1	2	-	1	-	-	1	1	CFW300-IOAENC
3	3	-	-	-	-	-	-	-	-	-	-	CFW300-IODF

DI - digital input AI - analog input DOR - relay digital output AO - analog output NTC - temperature sensor ENC - differential encoder input
IR - infrared receiver SH - hall sensor FI - Frequency Input FO - Frequency Output

NOTE!
CFW300 HMI shows just the parameters related to the resources available in the accessory connected to the product.

12.1 ANALOG INPUTS

With the analog inputs, it is possible, for instance, to use an external frequency reference or to connect a sensor in order to measure temperature (PTC). Details for those configurations are described in the parameters below.

P018 - Analog Input Value AI1

P019 - Analog Input Value AI2

Adjustable Range:	-100.0 to 100.0 %	**Factory Setting:**	
Properties:	ro		

Description:

Those read-only parameters indicate the value of the analog inputs AI1 and AI2 in percentage of the full scale. The indicated values are those obtained after the offset action and multiplication by the gain. Check the description of parameters P230 to P245.

P230 - Dead Zone of the Analog Inputs

Adjustable Range:	0 = Inactive 1 = Active	**Factory Setting:**	0
Properties:	cfg		

Description:

This parameter acts for the analog inputs (AIx) or for the frequency input (FI) programmed as frequency reference, and it defines if the dead zone in those inputs is Active (1) or Inactive (0).

If the parameter is configured as Inactive (P230 = 0), the signal in the analog inputs will actuate on the frequency reference from the minimum point (0 V / 0 mA / 4 mA or 10 V / 20 mA), and it will be directly related to the minimum frequency set in P133. Check Figure 12.1 on page 12-2.

If the parameter is set as Active (P230 = 1), the signal in the analog inputs will have a dead zone, where the frequency reference remains at the Minimum frequency value (P133), even with the variation of the input signal. Check Figure 12.1 on page 12-2.

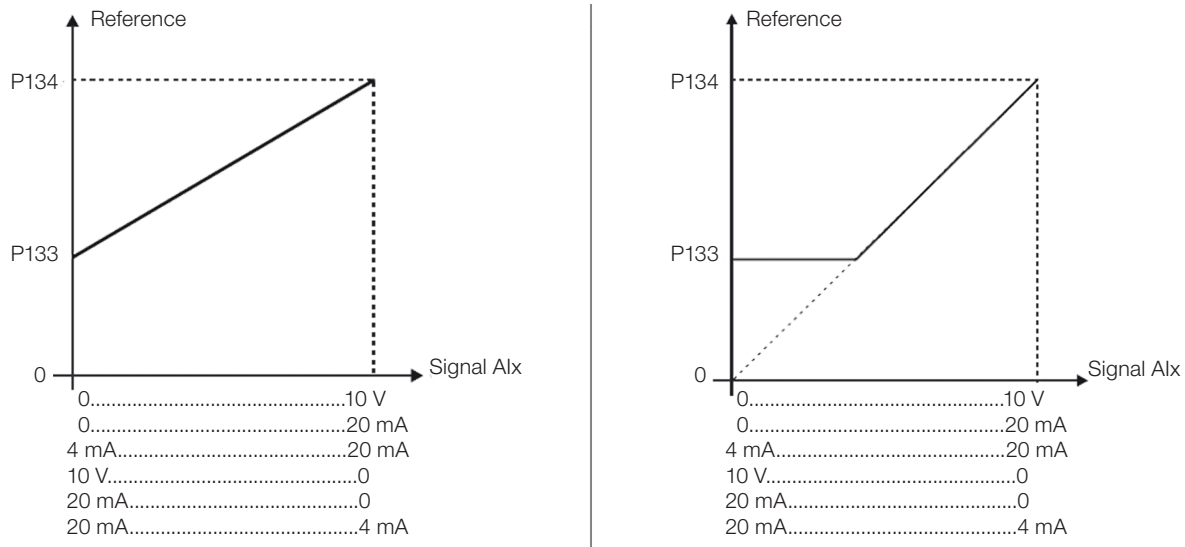


Figure 12.1: *(a) and (b) Actuation of the analog inputs with inactive dead zone and active dead zone*

P231 - AI1 Signal Function

P236 - AI2 Signal Function

Adjustable Range:	0 = Frequency Reference 1 to 3 = Not Used 4 = PTC 5 and 6 = Not Used 7 = SoftPLC 8 = Application Function 1 9 = Application Function 2 10 = Application Function 3 11 = Application Function 4 12 = Application Function 5 13 = Application Function 6 14 = Application Function 7 15 = Application Function 8 16 = Control Setpoint (PID Controller Application) 17 = Process Variable (PID Controller Application)	**Factory Setting:**	0
Properties:			

Description:

These parameters define the analog inputs functions.

When the 0 option is selected (Reference Frequency), the analog inputs can provide the reference for the motor, subject to the specified limits (P133 and P134) and to the action of the ramps (P100 to P103). However, in order to do so, it is also necessary to configure parameters P221 and/or P222, by selecting the use of the desired analog input. For further detail, refer to the description of those parameters in Chapter 7 LOGICAL COMMAND AND FREQUENCY REFERENCE on page 7-1.

Option 4 (PTC) configures the input to monitor the motor temperature. For further details on this function, refer to Section 14.4 OVERCURRENT PROTECTION (F070) on page 14-4.

Option 7 (PLC Use) configures the input to be used by the programming done in the memory area reserved for the SoftPLC function. For further details, refer to the SoftPLC user's manual.

Options 16 and 17 configure the input for the use of the PID Controller application (P903 = 1). For further details, see Chapter 18 APPLICATIONS on page 18-1.

P232 - AI1 Input Gain

P237 - AI2 Input Gain

Adjustable Range:	0.000 to 9.999	**Factory Setting:**	1.000

P234 - AI1 Input Offset

P239 - AI2 Input Offset

Adjustable Range:	-100.0 to 100.0 %	**Factory Setting:**	0.0 %

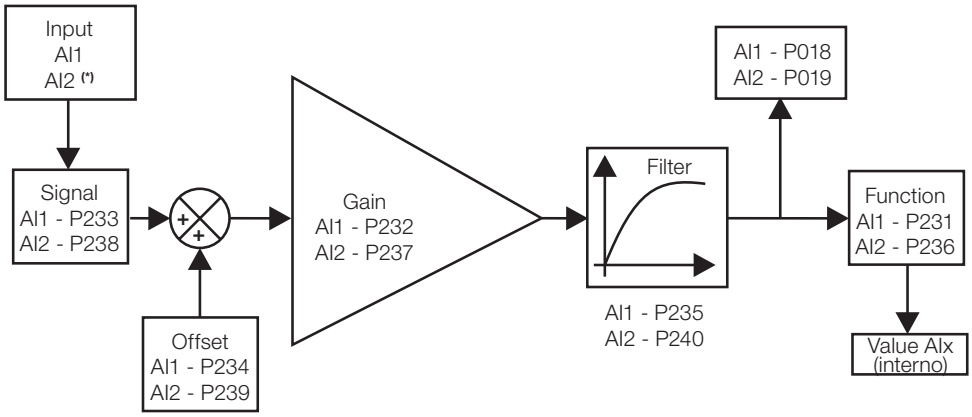
P235 - AI1 Input Filter

P240 - AI2 Input Filter

Adjustable Range:	0.00 to 16.00 s	**Factory Setting:**	0.00 s
Properties:			

Description:

Each analog input of the inverter is defined by the steps of calculation of Signal, Offset, Gain, Filter, Function and Value AIx, as shown in Figure 12.2 on page 12-4.



(*) Control terminal available on the IO's expansion accessory.

Figure 12.2: *Block diagram of the analog inputs - (AIx)*

P233 - AI1 Input Signal

P238 - AI2 Input Signal

Adjustable Range:	0 = 0 to 10 V / 20 mA 1 = 4 to 20 mA 2 = 10 V / 20 mA to 0 3 = 20 to 4 mA	**Factory Setting:**	0
Properties:			

Description:

These parameters configure the signal type (if current or voltage) that will be read in each analog input, as well as its variation range. In options 2 and 3 of the parameters, the reference is inverse, that is, the maximum frequency is obtained with the minimum reference.

In order to use the analog input AI1 with voltage signal, terminal 8 of the control board of the frequency inverter must be used. For current signal, terminal 6 of the inverter must be used. In the other cases, (AI2, for instance), refer to the installation, configuration and operation guide of the IO's expansion accessory used.

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Table 12.2: *AIx configuration and equation*

Signal	P233 or P238	DIP Switch	Equation AIx (%)
0 to 10 V	0	8	$AIx = \left(\frac{AIx(V)}{10\ V} \times (100\ \%) + offset \right) \times gain$
0 to 20 mA	0	6	$AIx = \left(\frac{AIx(mA)}{20\ mA} \times (100\ \%) + offset \right) \times gain$
4 to 20 mA	1	6	$AIx = \left(\left(\frac{(AIx(mA) - 4\ mA)}{16\ mA} \right) \times (100\ \%) + offset \right) \times gain$
10 to 0 V	2	8	$AIx = 100\ \% - \left(\frac{AIx(V)}{10\ V} \times (100\ \%) + offset \right) \times gain$
20 to 0 mA	2	6	$AIx = 100\ \% - \left(\frac{AIx(mA)}{20\ mA} \times (100\ \%) + offset \right) \times gain$
20 to 4 mA	3	6	$AIx = 100\ \% - \left(\left(\frac{(AIx(mA) - 4\ mA)}{16\ mA} \right) \times (100\ \%) + offset \right) \times gain$

For example: AIx = 5 V, offset = -70.0 %, gain = 1.000, with signal of 0 to 10 V, that is, AIx_{ini} = 0 and AIx_{FE} = 10.

$$AIx(\%) = \left(\frac{5}{10} \text{ x } (100\ \%) + (-70\ \%)\right) \text{x } 1 = -20.0\ \%$$

Another example: AIx = 12 mA, offset = -80.0 %, gain = 1.000, with signal of 4 to 20 mA, that is, AIx_{ini} = 4 and AIx_{FE} = 16.

$$AIx(\%) = \left(\frac{12 - 4}{16} \text{ x } (100\ \%) + (-80\ \%)\right) \text{x } 1 = -30.0\ \%$$

AIx' = -30.0 % means that the motor will spin forward with a reference in module equal to 30.0 % of P134, if the signal AIx function is "Frequency Reference".

In the case of filter parameters (P235), the value set corresponds to the time constant used to filter the input signal read. Therefore, the filter response time is around three times the value of this time constant.

12.2 NTC SENSOR INPUT

The CFW300-IOADR accessory has an exclusive analog input to connect an NTC sensor. The temperature reading parameter is described below.

P375 - Value of the NTC Sensor

Adjustable Range:	0 to 100 °C (32 °F to 212 °F)	**Factory Setting:**	
Properties:	ro		

Description:

This read-only parameter indicates the temperature value obtained from the NTC sensor.

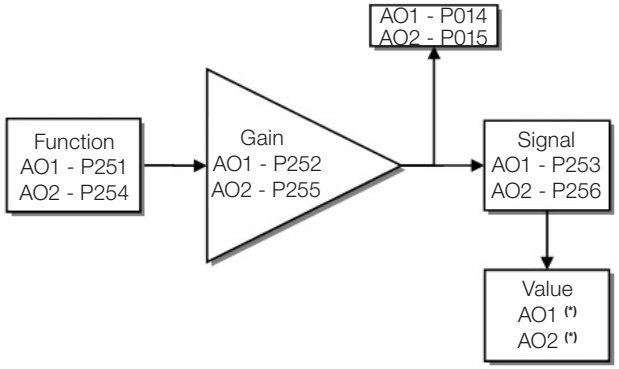
For further details, refer to the installation, configuration and operation guide of the CFW300-IOADR IO's Expansion Module.

NOTE!
When the NTC sensor is not connected to the accessory, the CFW300 frequency inverter will show 999 °C (1830 °F) in parameter P375. If pins 13 and 14 (accessory connector) are short circuited, the value indicated in P375 will be 0 °C (32 °F).

12.3 ANALOG OUTPUT

The analog output (AOx) is configured by means of three types of parameters: Function, Gain and Signal, according to the block diagram below.

The quantity of analog outputs depends on the expansion accessory IO's. For further details, refer to the installation, configuration and operation guide of the IO's expansion accessory used.



(*) Control terminals available on the accessory.

Figure 12.3: *Block diagram of the analog output (AOx)*

P014 - Value of Analog Output AO1

P015 - Value of Analog Output AO2

Adjustable Range:	0.0 to 100.0%	**Factory Setting:**	
Properties:	ro		

Description:

These read-only parameters indicates the value of analog outputs AO1 and AO2 in percentage of the full scale. The indicated values is obtained after multiplication by the gain. Check the description of the parameters P251 to P256.

P251 - AO1 Function

P254 - AO2 Function

Adjustable Range:	0 = Speed Ref. 1 = Not Used 2 = Real Speed 3 and 4 = Not Used 5 = Output Current 6 = Not Used 7 = Active Current 8 to 10 = Not Used 11 = Motor Torque 12 = SoftPLC 13 to 15 = Not Used 16 = Motor Ixt 17 = Not Used 18 = Content of P696 19 = Content of P697 20 = Not Used 21 = Application Function 1 22 = Application Function 2 23 = Application Function 3 24 = Application Function 4 25 = Application Function 5 26 = Application Function 6 27 = Application Function 7 28 = Application Function 8 29 = Control Setpoint (PID Controller Application) 30 = Process Variable (PID Controller Application)	**Factory Setting:**	P251 = 2 P254 = 5
Properties:			

Description:

These parameters sets the functions of the analog outputs, according to function and scale presented in Table 12.3 on page 12-7.

Table 12.3: *Full scale of the analog output*

Function	Description	Full Scale
0	Speed reference at the input of the ramp P001	P134
2	Effective speed at the inverter output	P134
5	Total output current RMS	2 x P295
7	Active current	2 x P295
11	Torque on the motor in relation to the rated torque	200.0 %
12	SoftPLC scale for analog output	32767
16	Ixt overload of the motor (P037)	100 %
18	Value of P696 for analog output AOx	32767
19	Value of P697 for analog output AOx	32767
29	Control Setpoint (PID Controller Application)	(*)
30	Process Variable (PID Controller Application)	(*)

(*) For further details refer the Chapter 18 APPLICATIONS on page 18-1.

P252 - AO1 Gain

P255 - AO2 Gain

Adjustable Range:	0.000 to 9.999	**Factory Setting:**	1.000
Properties:			

Description:

It determines the analog outputs gain according to the equations of Table 12.4 on page 12-8.

P253 - AO1 Signal

P256 - AO2 Signal

Adjustable Range:	0 = 0 to 10 V 1 = 0 to 20 mA 2 = 4 to 20 mA 3 = 10 to 0 V 4 = 20 to 0 mA 5 = 20 to 4 mA	**Factory Setting:**	0
Properties:			

Description:

These parameters configures if the analog outputs signal will be in current or voltage, with direct or reverse reference.

Table 12.4 on page 12-8 below summarizes the configuration and equation of the analog output, where the relationship between the analog output function and the full scale is defined by P251 (AO1) or P256 (AO2), as per Table 12.3 on page 12-7.

Table 12.4: *Configuration and equations characteristic of AOx*

Signal	P253 or P256	Equation
0 to 10 V	0	$AOx\ (\%) = \left(\frac{function}{scale} \times gain\right) \times 10\ V$
0 to 20 mA	1	$AOx\ (\%) = \left(\frac{function}{scale} \times gain\right) \times 20\ mA$
4 to 20 mA	2	$AOx\ (\%) = \left(\frac{function}{scale} \times gain\right) \times 16\ mA + 4\ mA$
10 to 0 V	3	$AOx\ (\%) = 10\ V - \left(\frac{function}{scale} \times gain\right) \times 10\ V$
20 to 0 mA	4	$AOx\ (\%) = 20\ mA - \left(\frac{function}{scale} \times gain\right) \times 20\ mA$
20 to 4 mA	5	$AOx\ (\%) = 20\ mA - \left(\frac{function}{scale} \times gain\right) \times 16\ mA$

12.4 FREQUENCY INPUT

A frequency input consists of a fast digital input able to convert the frequency of the pulses in the input into a proportional signal with 15-bit resolution. After the conversion, this signal is used as an analog signal for frequency reference, process variable, for example.

According to the block diagram of Figure 12.4 on page 12-9, the signal in frequency is converted into a digital quantity in 15 bits by means of the block "Calc. Hz / %", where parameters P248 and P250 define the input signal frequency band, while parameter P022 shows the frequency of the pulses in Hz.

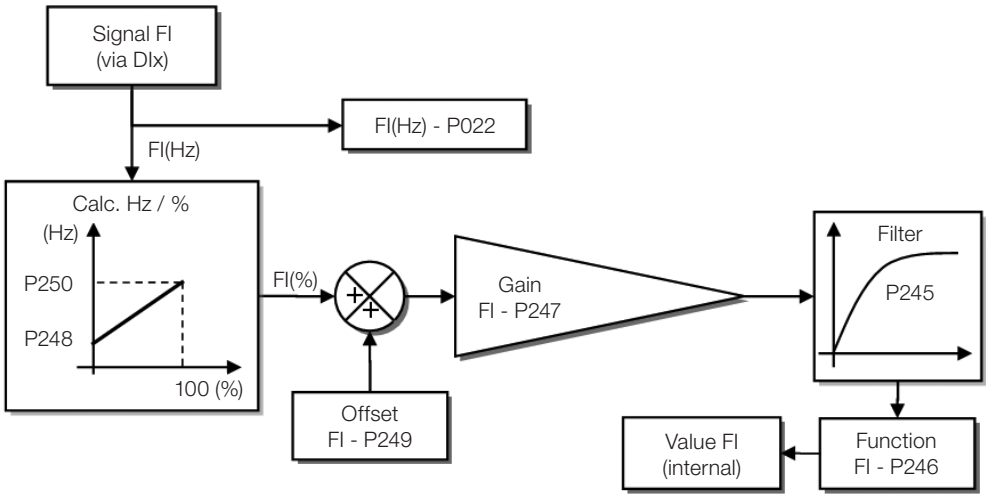


Figure 12.4: *Block diagram of frequency input - FI (DIx)*

Digital input DIx is pre-defined for frequency input via parameter P246, with operating capacity in a wide band from 1 to 3000 Hz.

P022 - Value of Frequency Input

Adjustable Range:	1 to 3000 Hz	**Factory Setting:**	
Properties:	ro		

Description:

Value in hertz of the frequency input FI.

> **NOTE!**
> The operation of parameters P022 as well as of the frequency input, depends on the configuration of the parameter P246.

P245 - Filter of the Frequency Input

Adjustable Range:	0.00 to 16.00 s	**Factory Setting:**	0.00 s
Properties:			

Description:

This parameter sets the time constant of the Frequency Input filter. It is intended to attenuate sudden changes in its value.

P246 - Frequency Input FI

Adjustable Range:	0 = Inactive 1 = Active in DI1 2 = Active in DI2 3 = Active in DI3 4 = Active in DI4	**Factory Setting:**	0
Properties:	cfg		

Description:

When set to "0" the frequency input is inactive, keeping parameter P022 at zero. In the other cases, this parameter activates the frequency input on the DIx, making any other function in this digital input DIx (P263-P266) be ignored, and the value of its respective bit in parameter P012 is kept at "0". In order to do so, it is also necessary to configure parameters P221 and/or P222, selecting the use of the frequency input.

P247 - Input Gain in Frequency FI

Adjustable Range:	0.000 to 9.999	**Factory Setting:**	1.000

P248 - Minimum Frequency Input FI

Adjustable Range:	1 to 3000 Hz	**Factory Setting:**	100 Hz

P249 - Input Offset in Frequency FI

Adjustable Range:	-100.0 to 100.0 %	**Factory Setting:**	0.0 %

P250 - Maximum Frequency Input FI

Adjustable Range:	1 to 3000 Hz	**Factory Setting:**	1000 Hz
Properties:			

Description:

Those parameters define the behavior of the frequency input according to the equation:

$$FI = \left(\left(\frac{FI\ (Hz) - P248}{P250 - P248} \right) x\ (100\ \%) + P249 \right) x\ P247$$

Parameters P248 and P250 determine the operation range of the frequency input (FI), while parameters P249 and P247 determine the offset and gain, respectively. For example, FI = 2000 Hz, P248 = 1000 Hz, P250 = 3000 Hz, P249 = -70.0 % and P247 = 1.000, thus:

$$FI = \left(\left(\frac{2000 - 1000}{3000 - 1000} \right) x\ (100\ \%) - 70\ \% \right) x\ 1.000 = -20.0\ \%$$

The value FI = -20.0 % means that the motor will run in the opposite direction with a reference in module equal 20.0 % of P134, with the function of the FI signal for "Frequency Reference" (P221 = 4).

When P246 = 3, the digital input DI3 is defined for frequency input, regardless the value of P265, with operating capacity in the band from 0 to 3000 Hz in 10 Vpp.

The time constant of the digital filter for the frequency input is defined by means of parameter P245.

12.5 DIGITAL INPUTS

Below is a detailed description of the parameters for the digital inputs.

P012 - Status of Digital Inputs

Adjustable Range:	0 to FF (hexa) Bit 0 = DI1 Bit 1 = DI2 Bit 2 = DI3 Bit 3 = DI4 Bit 4 = DI5 Bit 5 = DI6 Bit 6 = DI7 Bit 7 = DI8	**Factory Setting:**
Properties:	ro	

Description:

Using this parameter, it is possible to view the status of the digital inputs, according to the IO's expansion accessory connected. Refer to parameter P027 in Section 6.1 INVERTER DATA on page 6-1.

The P012 value is indicated in hexadecimal, where each bit of the number indicates the status of a digital input, that is, if Bit0 is "0", DI1 is inactive; or if Bit0 is "1", DI1 is active, and so on, up to DI8. Besides, the determination of DIx active or inactive takes into account the type of signal of DIx defined by P271.

The activation of DIx depends on the signal at the digital input and on P271, as per Table 12.5 on page 12-11, which lists the threshold voltage for activation "V_{TH}", the threshold voltage for deactivation "V_{TL}" and the status indication of DIx in parameter P012.

Table 12.5: *Values of P012 for x from 1 to 8*

Set in P271	Limit Voltage in DIx	P012
NPN	V_{TL} > 10 V	Bit_{x-1} = 0
	V_{TH} < 3 V	Bit_{x-1} = 1
PNP	V_{TL} < 10 V	Bit_{x-1} = 0
	V_{TH} > 20 V	Bit_{x-1} = 1

NOTE!
Parameter P012 requires the user to know the conversion between binary and hexadecimal numerical system.

P263 - Function of Digital Input DI1

P264 - Function of Digital Input DI2

P265 - Function of Digital Input DI3

P266 - Function of Digital Input DI4

P267 - Function of Digital Input DI5

P268 - Function of Digital Input DI6

P269 - Function of Digital Input DI7

P270 - Function of Digital Input DI8

Adjustable Range:	0 to 54	**Factory Setting:**	P263 = 1 P264 = 8 P265 = 0 P266 = 0 P267 = 0 P268 = 0 P269 = 0 P270 = 0
Properties:	cfg		

Description:

These parameters allow configuring the digital input function, according to the adjustable range listed in Table 12.6 on page 12-13.

Table 12.6: Digital input functions

Value	Description	Dependence
0	Not used	-
1	Run/Stop command	P224 = 1 or P227 = 1
2	General Enable command	-
3	Fast Stop	P224 = 1 or P227 = 1
4	Forward run command	(P224 = 1 and P223 = 4) or (P227 = 1 and P226 = 4)
5	Reverse run command	P224 = 1 or P227 = 1
6	Start command	P224 = 1 or P227 = 1
7	Stop command	P224 = 1 or P227 = 1
8	Forward Rotation Direction	P223 = 4 or P226 = 4
9	Local/Remote selection	P220 = 4
10	JOG command	(P224 =1 and P225 = 2) or (P227 =1 and P228 = 2)
11	Electronic Potentiometer: Accelerate E.P.	P221 = 7 or P222 = 7
12	Electronic Potentiometer: Decelerate E.P.	P221 = 7 or P222 = 7
13	Multispeed reference	P221 = 8 or P222 = 8
14	2nd Ramp selection	P105 = 2
15 to 17	Not used	-
18	No external alarm	-
19	No external fault	-
20	Fault reset	Active fault
21 to 23	Not used	-
24	Disable flying start	P320 = 1 or 2
25	Not used	-
26	Lock Prog.	-
27 to 31	Not used	-
32	Multispeed reference with 2nd Ramp	(P221 = 8 or P222 = 8) and P105 = 2
33	Electronic Potentiometer: Accelerates E.P. with 2nd Ramp	(P221 = 7 or P222 = 7) and P105 = 2
34	Electronic Potentiometer: Decelerates E.P. with 2nd Ramp	(P221 = 7 or P222 = 7) and P105 = 2
35	Forward run with 2nd Ramp	(P224 = 1 and P223 = 4) or (P227 = 1 and P226 = 4) and P105 = 2
36	Reverse run with 2nd Ramp	(P224 = 1 and P223 = 4) or (P227 = 1 and P226 = 4) and P105 = 2
37	Accelerates E.P./Start	P224 = 1 or P227 = 1 P221 = 7 or P222 = 7
38	Decelerates E.P./ Stop	P224 = 1 or P227 = 1 P221 = 7 or P222 = 7
39	Stop command	P224 = 1 or P227 = 1
40	Safety switch command	P224 = 1 or P227 = 1
41	Application Function 1	-
42	Application Function 2	-
43	Application Function 3	-
44	Application Function 4	-
45	Application Function 5	-
46	Application Function 6	-
47	Application Function 7	-
48	Application Function 8	-
49	Activate Fire Mode	(*)
50	Manual/Automatic PID (Only DI2 for P903 = 1)	(*)
51	Increase Setpoint Command (PE) (Only DI3 for P903 = 1)	(*)
52	Decrease Setpoint Command (Only DI4 for P903 = 1)	(*)
53	1st DI Control Setpoint (Only DI3 for P903 = 1)	(*)
54	2st DI Control Setpoint (Only DI4 for P903 = 1)	(*)

(*) For further details refer the Chapter 18 APPLICATIONS on page 18-1.

P271 - Digital Input Signal

Adjustable Range:	0 = All DIx NPN 1 = (DI1...DI4) - PNP 2 = (DI5...DI8) - PNP 3 = (DI1...DI8) - PNP	**Factory Setting:**	0
Properties:	cfg		

Description:

It configures the default for the digital input signal, that is, NPN and the digital input is activated with 0 V, PNP and the digital input is activated with +24 V.

a) RUN/STOP

It enables or disables the motor rotation through the acceleration and deceleration ramp.

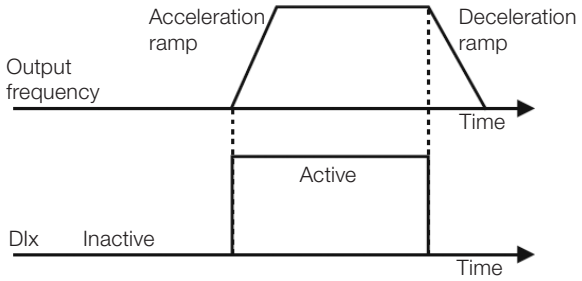


Figure 12.5: *Example of the Run/Stop function*

b) GENERAL ENABLE

It enables the motor rotation through the acceleration ramp and disables it by cutting off the pulses immediately; the motor stops by inertia.

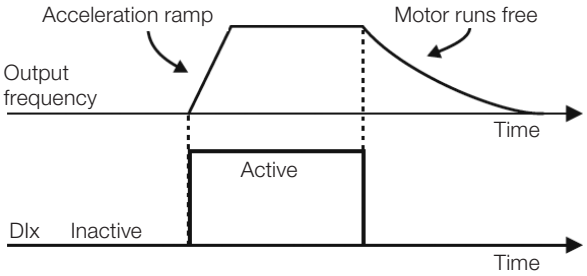


Figure 12.6: *Example of the General Enable function*

c) QUICK STOP

When inactive, it disables the inverter by the emergency deceleration (P107).

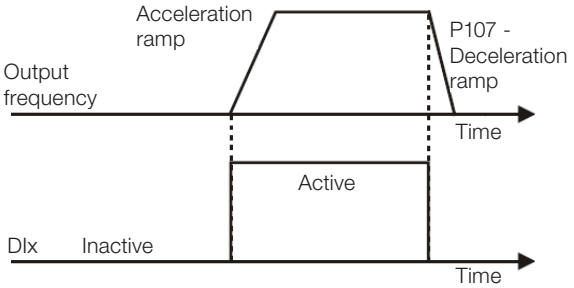


Figure 12.7: *Example of the Quick Stop function*

d) FORWARD/REVERSE COMMAND

This function is the combination of two DIS: one programmed for forward run and the other for reverse run.

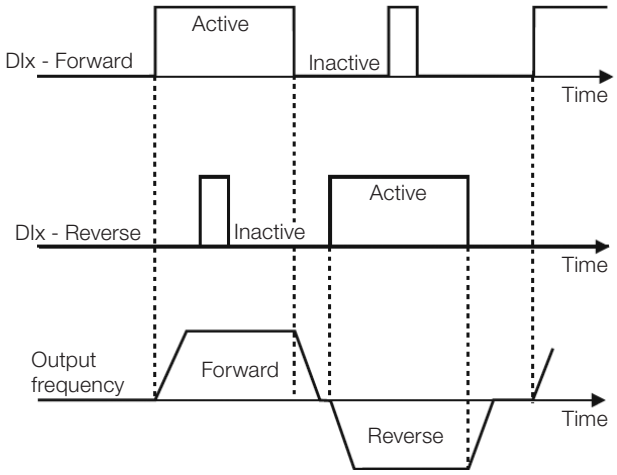


Figure 12.8: *Example of the Forward /Reverse command*

e) START / STOP

This function tries to reproduce the activation of a three-wire direct start with retention contact, where a pulse in the DIx-Start enables the motor spin while the DIx-Stop is active.

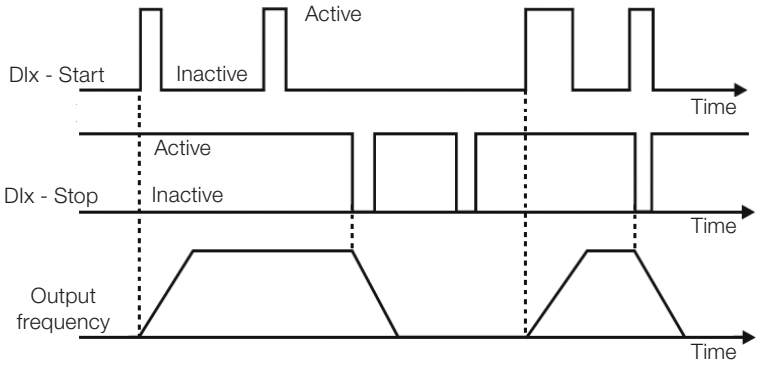


Figure 12.9: *Example of the Start/Stop*

NOTE!
All the digital inputs set for General Enable, Fast Stop, Forward Run/Reverse Run and Start/Stop must be in the "Active" state so that the inverter can enable the motor run.

f) DIRECTION OF ROTATION

If the DIx is Inactive, the Direction of Rotation is Forward, otherwise, the direction of rotation will be REVERSE.

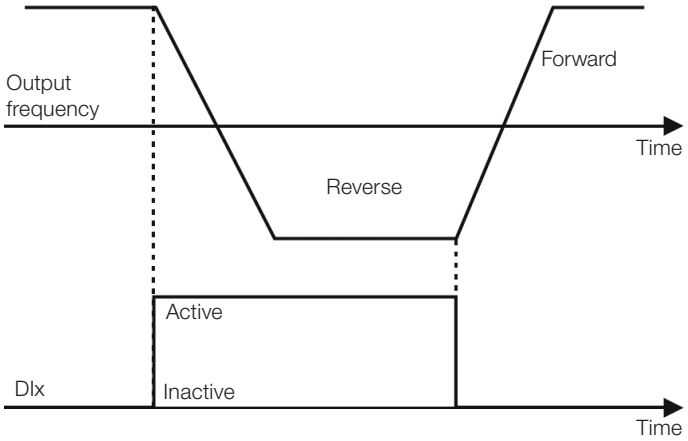


Figure 12.10: *Example of the Direction of Rotation function*

g) LOCAL / REMOTO

If DIx is inactive, the Local command is selected, reverse the Remote command is selected.

h) JOG

The JOG command is the combination of the Run/Stop command with a speed reference via parameter P122.

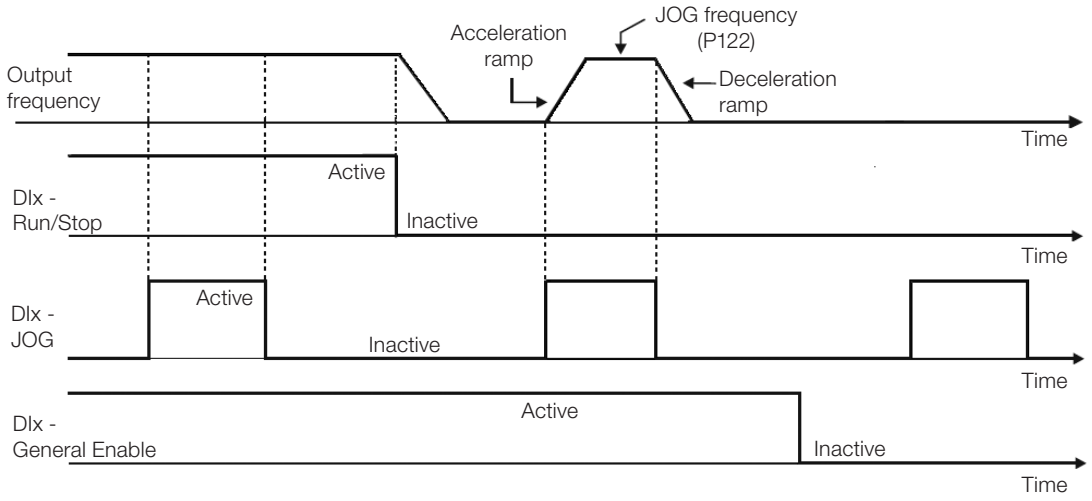


Figure 12.11: *Example of the JOG function*

i) ELECTRONIC POTENTIOMETER (E.P.)

The E.P. function enables the setting of the speed via digital inputs programmed for Accelerate E.P. and Decelerate E.P. The basic principle of this function is similar to the sound volume and intensity control of electronic appliances.

The operation of the E.P. function is also affected by the behavior of parameter P120, that is, if P120 = 0 the E.P. reference initial value will be P133; if P120 = 1 the initial value will be the last reference value before the disabling of the inverter, and if P120 = 2, the initial value will be the reference via P121 keys.

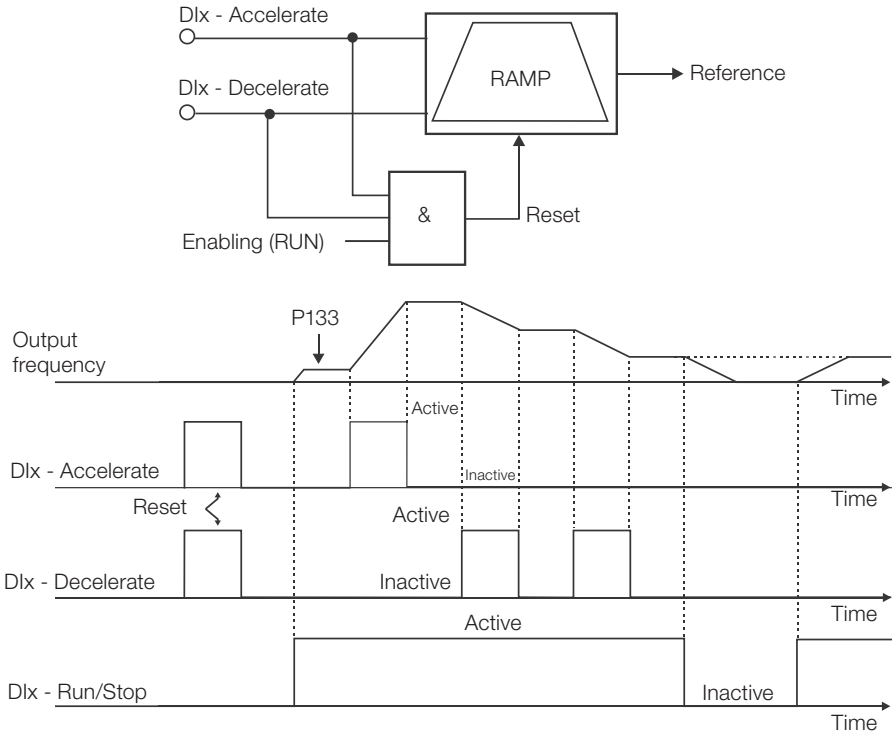


Figure 12.12: *Example of the Electronic Potentiometer (E.P.) function*

j) MULTISPEED

The Multispeed reference, as described in Item 7.2.3 Parameters for Frequency Reference on page 7-8, enables, by means of the combination of up to three digital inputs, the selection of one from eight reference levels predefined in parameters P124 to P131. For further details, refer to Chapter 7 LOGICAL COMMAND AND FREQUENCY REFERENCE on page 7-1.

k) 2nd RAMP

If DIx is inactive, the inverter uses the default ramp by P100 and P101, otherwise, it will use the 2nd Ramp by P102 and P103.

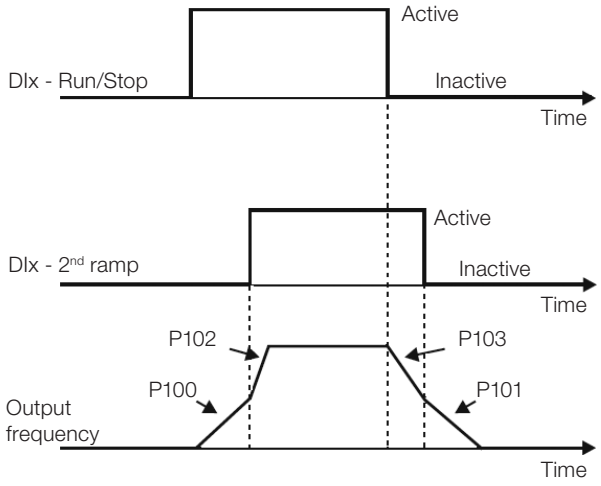


Figure 12.13: *Example of the 2nd Ramp function*

l) NO EXTERNAL ALARM

If DIx is inactive, the inverter will activate the external alarm A090.

m) NO EXTERNAL FAULT

If DIx is inactive, the inverter will activate the external fault F091. In this case, the PWM pulses are disabled immediately.

n) FAULT RESET

Once the inverter is with the fault state active, and the fault origin condition is no longer active.
The reset of the fault state will occur when the DIx set for this function is active.

o) DISABLE FLYING START

It allows the DIx, when active, to disable the action of the Flying Start function preset in parameter P320 = 1 or 2. When the DIx is inactive, the Flying Start function operates normally again. Refer to Section 11.3 FLYING START / RIDE-THROUGH on page 11-7.

p) LOCK PROG

When the DIx input is active, parameters cannot be changed, no matter the values set in P000 and P200. When the DIx input is Inactive, the modification of parameters will depend on the values set in P000 and P200.

q) ACCELERATE E.P. - TURN ON / DECELERATE E.P. - TURN OFF

It consists of the Electronic Potentiometer function with capacity to enable the inverter by means of a pulse at the start, and a pulse for the stop when the output speed is minimum (P133).

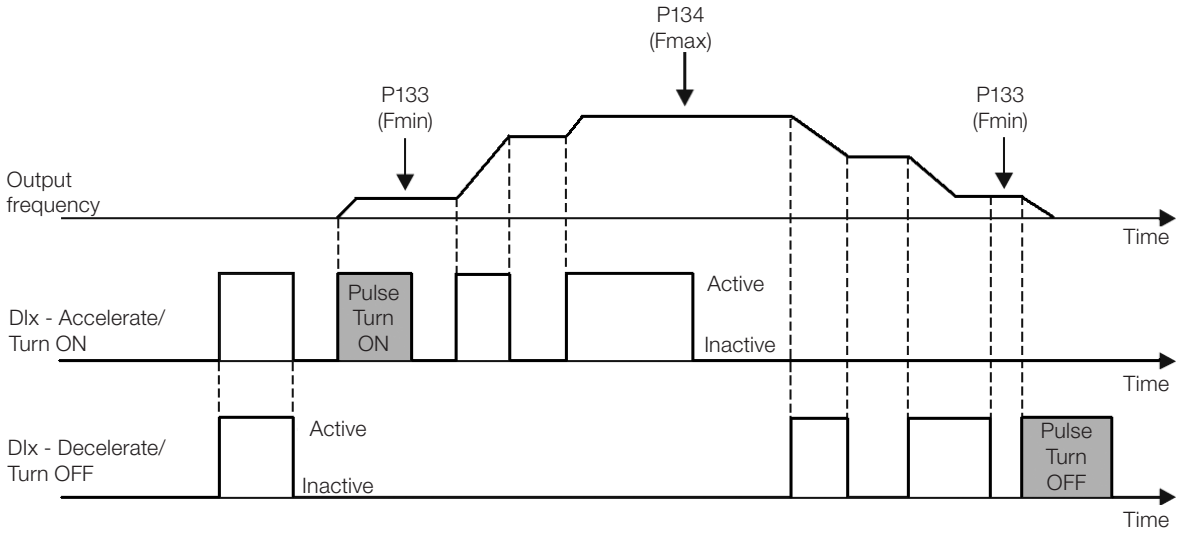


Figure 12.14: *Example of the Accelerate Turn ON / Decelerate Turn OFF*

r) STOP

Only on pulse in the DIx disables the inverter.

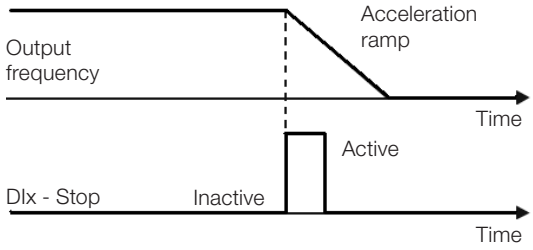


Figure 12.15: *Example the stop function*

s) SAFETY SWITCH

Only one inactive pulse in the DIx disables the inverter.

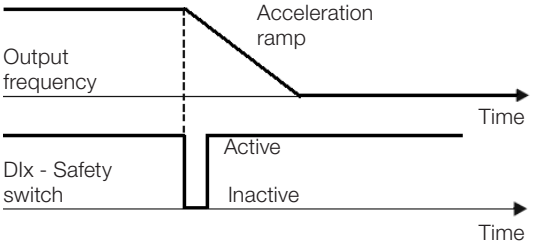


Figure 12.16: *Example of the Emergency function*

12.6 INPUT FOR INFRARED RECEIVER

The CFW300-IOADR accessory uses an infrared remote control to control the inverter. The RC-5 protocol (Philips) was used for the communication of the control with the accessory. The information on the control/selection of remote control is available in the parameters below.

P840 – IR Control Command

Adjustable Range:	0 to FFFF (hexa)	**Factory Setting:**	
Properties:	ro		

Description:

By means of this parameter it is possible to check if the frequency inverter is receiving any valid command from the infrared control. The use of the remote control depends on the logic implanted on the LADDER of the WPS software via system markers (bits).

For further details, refer to the help of the WPS software.

P841 – IR Control Selection

Adjustable Range:	0 = Without Display 1 = With Display	**Factory Setting:**	0
Properties:	cfg		

Description:

Through this parameter it is possible to select which infrared remote control will be used.
For further details, refer to the installation, configuration and operation guide of the CFW300-IOADR I/O Expansion Module.

12.7 DIGITAL OUTPUTS

The CFW300 frequency inverter can drive up to 4 relay digital outputs (DO1 to DO4), according to the IO expansion accessory connected to the product. For further information, see Table 12.1 on page 12-1. The parameter configuration of the digital outputs follows the pattern described below.

P013 - Digital Outputs Status DO4 to DO1

Adjustable Range:	0 to F (hexa) Bit 0 = DO1 Bit 1 = DO2 Bit 2 = DO3 Bit 3 = DO4	**Factory Setting:**	
Properties:	ro		

Description:

Using this parameter, it is possible to view the CFW300 digital outputs status.

The P013 value is indicated in hexadecimal, where each bit of the number indicates the status of a digital output, that is, if Bit0 is "0", DO1 is inactive; if Bit0 is "1", DO1 is active, and so on, up to DO4.

NOTE!
Parameter P013 requires the user to know the conversion between binary and hexadecimal numerical system.

P275 - DO1 Output Function

P276 - DO2 Output Function

P277 - DO3 Output Function

P278 - DO4 Output Function

Adjustable Range:	0 to 47	**Factory Setting:**	P275 = 13 P276 = 0 P276 = 0 P278 = 0
Properties:			

Description:

These parameters define the DOx digital output function, as per Table 12.7 on page 12-22.

Table 12.7: Digital Output Functions

Value	Function	Description
0	Not used	It deactivates the digital output
1	F* ≥ Fx	Active when the frequency reference F* (P001) is greater or iqual the Fx (P281)
2	F ≥ Fx	Active when the Output Frequency F (P002) is greater or iqual the Fx (P281)
3	F ≤ Fx	Active when the Output Frequency F (P002) is smaller or iqual the Fx (P281)
4	F = F*	Active if the Output Frequency F (P002) is equal to the reference F* (P001) (ramp end)
5	Not used	It deactivates the digital output
6	Is > Ix	Active if the output current Is (P003) > Ix (P290)
7	Is < Ix	Active if the output current Is (P003) < Ix (P290)
8	Torque > Tx	Active if the motor torque T (P009) > Tx (P293)
9	Torque < Tx	Active if the motor torque T (P009) < Tx (P293)
10	Remote	Active if the command is in the remote situation (REM)
11	Run	Active if the motor is running (active output PWM pulses)
12	Ready	Active if the inverter is ready for enabling
13	Without fault	Active if the inverter has no faults
14	Without F070	Active if the inverter has no overcurrent fault (F070)
15	Not used	It deactivates the digital output
16	Without F021/F022	Active if the inverter has no overvoltage or undervoltage fault (F022 or F021)
17	Not used	It deactivates the digital output
18	Without F072	Active if the inverter has no motor overload fault (F072)
19	4-20 mA OK	Active if AIx setting is 4 to 20 mA (P233 = 1 or 3) and AIx < 2 mA
20	Value of P695	Status of the bits 0 to 4 of P695 activate digital outputs DO1 to DO5, respectively
21	Forward	Active if the inverter direction of rotation is forward
22 to 23	Not used	It deactivates the digital output
24	Ride-Through	Active if the inverter is executing the Ride-Through function
25	Pre-Charge OK	Active if the pre-charge relay of the DC link capacitors was already activated
26	With fault	Active if the inverter has a fault
27	Not used	It deactivates the digital output
28	SoftPLC	It activates the output DOx according to the SoftPLC memory area. Check the SoftPLC user manual
29 to 34	Not used	It deactivates the digital output
35	Without alarm	Active when the inverter has no alarms
36	Without fault and alarm	Active when the inverter has neither alarms nor faults
37	Application Function 1	If activates the output DOx according to the application of SoftPLC
38	Application Function 2	If activates the output DOx according to the application of SoftPLC
39	Application Function 3	If activates the output DOx according to the application of SoftPLC
40	Application Function 4	If activates the output DOx according to the application of SoftPLC
41	Application Function 5	If activates the output DOx according to the application of SoftPLC
42	Application Function 6	If activates the output DOx according to the application of SoftPLC
43	Application Function 7	If activates the output DOx according to the application of SoftPLC
44	Application Function 8	If activates the output DOx according to the application of SoftPLC
45	Fire Mode	Activates DOx output when Fire Mode is enabled
46	Process Control	Process Variable Low Level (A760/F761) (For P903 = 1) (*)
47	Process Control	Process Variable High Level (A762/F763) (For P903 = 1) (*)

(*) For further details refer the Chapter 18 APPLICATIONS on page 18-1.

P281 - Frequency Fx

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	3.0 Hz

P282 - Hysteresis Fx

Adjustable Range:	0.0 to 15.0 Hz	**Factory Setting:**	0.5 Hz
Properties:			

Description:

These parameters set the hysteresis and actuation level on the Fx output frequency signal and on the F* ramp input of the relay digital output. In this way, the relay commutation levels are "P281 + P282" and "P281 - P282".

P290 - Current Ix

Adjustable Range:	0 a 40 A	**Factory Setting:**	1.0 x I_{nom}
Properties:			

Description:

Current level to activate the relay output in the Is > Ix (6) and Is < Ix (7) functions. The actuation occurs on a hysteresis with upper in P290 and lower level in: P290 - 0.05 x P295, that is, the equivalent value in Amperes for 5 % of P295 below P290.

P293 - Torque Tx

Adjustable Range:	0 to 200 %	**Factory Setting:**	100 %
Properties:			

Description:

Torque percentage level to activate the relay output in the Torque > Tx (8) and Torque < Tx (9) functions. The actuation occurs on a hysteresis with upper level in P293 and lower level in: P293 - 5 %. This percentage value is related to the motor rated torque matched to the inverter power, and it is expressed in percentage of the motor rated current (P401 = 100 %).

13 DYNAMIC BRAKING

The braking torque that can be obtained through the application of frequency inverters without dynamic braking resistors varies from 10 % to 35 % of the motor rated torque.

In order to obtain higher braking torques, resistors for dynamic braking are used. In this case the regenerated energy is dissipated on the resistor mounted externally to the inverter.

This type of braking is used in the cases when short deceleration times are wished or when high inertia loads are driven.

The Dynamic Braking function can only be used if a braking resistor has been connected to the CFW300, and if the parameters related to it have been adjusted properly.

P153 - Dynamic Braking Level

Adjustable Range:	348 to 460 V	**Factory Setting:**	According to Table 13.1 on page 13-1
Properties:			

Description:

The parameter P153 defines the voltage level for the braking IGBT actuation, and it must be compatible with the power supply voltage.

If P153 is set at a level too close to the overvoltage actuation level (F022), it may occur before the braking resistor can dissipate the motor regenerated energy. Table 13.1 on page 13-1 contains the adjustment ranges for the actuation of the dynamic braking according to the model.

Table 13.1: *Dynamic Braking actuation value*

Input Voltage	P0153 Actuation Band	P0153 Factory Default
100 to 127 Vac	391 to 460 Vdc	395 Vdc
200 to 240 Vac	348 to 410 Vdc	365 Vdc

The Figure 13.1 on page 13-2 shows and example of typical DC braking actuation, where the hypothetical wave shapes of the voltage on the braking resistor and the DC link voltage can be observed. Thus, when the braking IGBT connects the link to the external resistor, the DC link voltage drops below the value set by P153, keeping the level below fault F022.

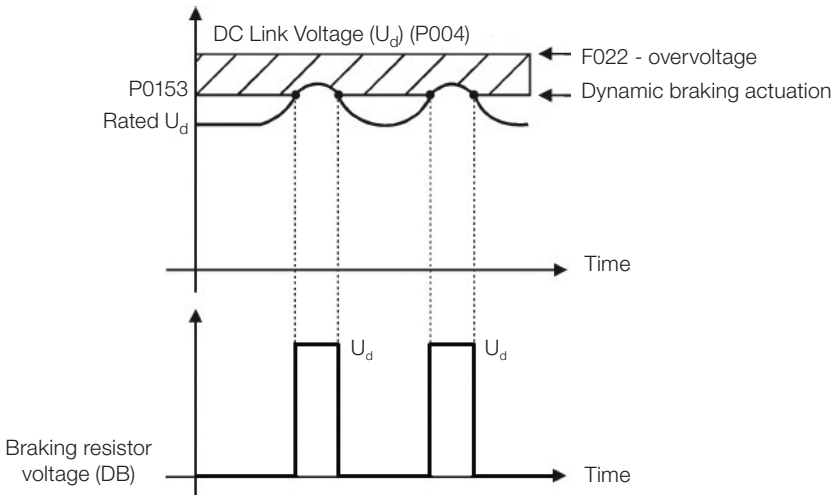


Figure 13.1: *Dynamic Braking actuation curve*

Steps to enable the Dynamic Braking.

- Connect the braking resistor. Refer to item 3.2.3.2 Dynamic Braking of the CFW300 user's manual.
- Set P151 at the maximum value: (According to inverter model) to prevent the activation of the DC voltage regulation before the Dynamic Braking.

DANGER!
Be sure the inverter is OFF and disconnected before handling the electric connections and read carefully the installation instructions of the CFW300 user's manual.

14 FAULTS AND ALARMS

The problem detection structure in the inverter is based on the fault and alarm indication.

In case of fault, the locking the IGBTs and motor stop by inertia will occur.

The alarm works as a warning for the user of critical operating conditions and that may cause a fault if the situation is not corrected.

Refer to chapter 6 of the CFW300 user's manual and the QUICK REFERENCE OF PARAMETERS, ALARMS AND FAULTS on page 0-1 of this manual to obtain more information regarding Faults and Alarms.

14.1 MOTOR OVERLOAD PROTECTION (F072 AND A046)

The motor overload protection is based on the use of curves that simulate the heating and cooling of the motor in cases of overload. The motor overload protection fault and alarm codes are F072 and A046 respectively.

The motor overload is given considering the reference value In x SF (motor rated current multiplied by the service factor), which is the maximum value at which the overload protection must not actuate, because the motor can work continuously at that current value without damages.

However, for that protection to actuate properly, the winding-temperature supervision (which corresponds to the time of heating and cooling of the motor) is estimated.

This winding-temperature supervision is approximated by a function called Ixt, which integrates the output current value from a level previously defined by P156, P157 and P158. When the accumulated value reaches the limit, an alarm and/or fault are indicated.

P156 - Overload Current at Rated Speed

P157 - Overload Current 50 % of Rated Speed

P158 - Overload Current 20 % of Rated Speed

Adjustable Range:	0.1 to 2 x I_{nom}	**Factory Setting:**	1.2 x I_{nom}
Properties:			

Description:

These parameters define the motor overload current (Ixt - F072). The motor overload current is the current value (P156, P157 or P158) based on which the inverter will understand that the motor is operating in overload.

For self-ventilated motors, the overload current depends on the speed at which the motor is spinning. Therefore, for speeds below 20% of the rated speed, the overload current is P158, while for speeds between 20% and 50%, the overload current is P157, and above 50%, it is P156.

The greater the difference between the motor current and the overload current (P156, P157 or P158) the faster the actuation of fault F072.

It is recommended that parameter P156 (motor overload current at rated speed) be set at a value 10 % above the used motor rated current.

In order to deactivate the motor overload function, just set parameter P156 to P158 to values equal to or above twice the inverter rated current P295.

P037 - Motor Overload Ixt

Adjustable Range:	0.0 to 100.0 %	**Factory Setting:**	
Properties:	ro		

Description:

It indicates the present motor overload percentage or overload intergrator level. When this parameter reaches 6.3 %, the inverter will indicate the motor overload alarm (A046). Or when this parameter reaches 100 %, the "Motor Overload" fault (F072) will occur (F072).

Figure 14.1 on page 14-2 shows the actuation time of the overload as a function of the output current (P003) normalized in relation to the overload current (P156, P157 or P158).

For example, for a constant ratio with 150 % of overload, Fault F072 occurs in 60 seconds. On the other hand, for output current values below P156, P157 or P158 according to the output frequency, fault F0072 does not occur. For ratio values above 150 %, the fault actuation time is below 60 s.

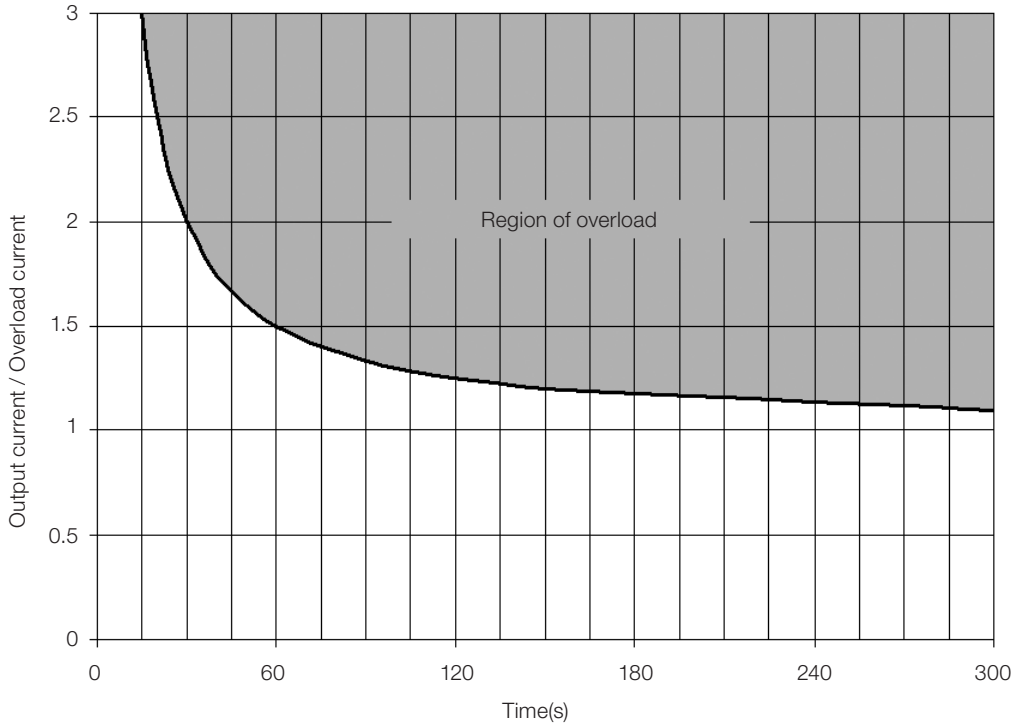


Figure 14.1: *Actuation of the motor overload*

NOTE!
In order to ensure greater protection in case of de-energization of the inverter, this function keeps the information regarding the motor thermal image in a non-volatile memory area of the inverter. Thus, after the inverter energization, the function will use the saved value of the thermal image to execute a new overload assessment.

14.2 IGBTS OVERLOAD PROTECTION (F051 AND A050)

The power module temperature is monitored and indicated in parameter P030 in degrees Celsius. This value is constantly compared to the overtemperature fault and alarm trigger value of the power module F051 and A050, according to Table 14.3 on page 14-4.

Table 14.1: Overtemperature actuation levels of the power module

Frame Size	Level A050	Level F051
A	90 °C (194 °F)	100 °C (212 °F)
B	116 °C (240 °F)	126 °C (258 °F)

In addition to the indication of alarm A050, the overtemperature protection gradually reduces the switching frequency to 2.5 kHz. This overtemperature protection characteristic can be disabled in the control configuration parameter P397.

ATTENTION!
The default setting of P397 meets most application needs of the inverter.
Therefore, avoid modifying its content without knowing the related consequences. If you are not sure, contact WEG Technical Assistance before changing P397.

P352 - Fan Control Configuration

Adjustable Range:	0 = OFF 1 = ON 2 = CT	**Factory Setting:**	2
Properties:	cfg		

Description:
The CFW300 is equipped with a heatsink fan, and the activation will be controlled via software by means of the inverter programming.

The options available for the setting of this parameter are the following.

Table 14.2: Options of the parameter P0352

P0352	Action
0 = OFF	Fan off
1 = ON	Fan on
2 = CT	Fan is controlled via software

14.3 MOTOR OVERTEMPERATURE PROTECTION (F078)

ATTENTION!
The PTC must have reinforced insulation of the live parts of the motor and other installations.

This function protects the motor against overtemperature through indication of fault F078.
The motor needs a triple PTC temperature sensor. The reading of the sensor may be done by means of the analog inputs.

For the reading of the PTC, it is necessary to configure it for current input and select the option “4 = PTC” in P231 or P236. Connect the PTC between the supply +10 Vdc and the analog input.

The analog input reads the PTC resistance and compares it to the limits for the fault. When those values are exceeded, fault F078 is indicated. As shown in Table 14.3 on page 14-4.

Table 14.3: *Actuation levels of fault F078*

PTC Resistance	AIx	Overtemperature
R_{PTC} < 50 Ω	V_{IN} > 9.1 V	F078
50 Ω < R_{PTC} < 3.9 kΩ	9.1 V > V_{IN} > 1.3 V	Standard
R_{PTC} > 3.9 kΩ	V_{IN} < 1.3 V	F078

NOTE!
For this function to work properly, it is important to keep the gain(s) and offset(s) of the analog inputs at the factory setting values.

Figure 14.2 on page 14-4 shows the connection of the PTC to the inverter terminals via analog input.

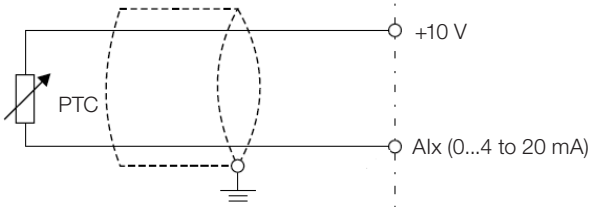


Figure 14.2: *Connection of the PTC to the CFW300*

14.4 OVERCURRENT PROTECTION (F070)

The ground fault and output overcurrent protections act very fast by means of the hardware to instantly cut the output PWM pulses when the output current is high. Fault F070 corresponds to a current surge between output phases.

The protection current level depends on the used power module so as the protection is effective, still this value is well above the inverter rated operating current (P295).

14.5 LINK VOLTAGE SUPERVISION (F021 AND F022)

The DC link voltage is constantly compared to the maximum and minimum values according to the inverter power supply, as shown in Table 14.4 on page 14-4.

Table 14.4: *Levels of performance monitoring of the DC link voltage*

Supply	Level F021	Level F022
100 to 127 Vac	200 Vdc	460 Vdc
200 to 240 Vac	200 Vdc	410 Vdc

14.6 VVW CONTROL MODE SELF-TUNING FAULT (F033)

At the end of the self-tuning process of the VVW mode (P408 = 1), if the estimate motor stator resistance (P409) is too high for the inverter in use, the inverter will indicate fault F033. Besides, the manual modification of P409 may also cause fault F033.

14.7 REMOTE HMI COMMUNICATION FAULT ALARM (A700)

After connecting the remote HMI to the CFW300 terminals, the communication with the HMI is supervised so that alarm A700 is activated whenever this communication link is broken.

14.8 REMOTE HMI COMMUNICATION ERROR FAULT (F701)

The condition for fault F701 is the same as that of alarm A700, but it is necessary that the HMI be the source for some command or reference (HMI Keys option) in parameters P220 to P228.

14.9 AUTO-DIAGNOSIS FAULT (F084)

Before starting loading the factory default (P204 = 5 or 6), the inverter identifies the power hardware in order to obtain information on the module voltage, current and trigger, the power module.

Fault F084 indicates something wrong happened during the identification of the hardware: nonexistent inverter model, some loose connection cable or damaged internal circuit.

NOTE!
When this fault occurs, contact WEG.

14.10 FAULT IN THE CPU (F080)

The execution of the inverter firmware is monitored at several levels of the firmware internal structure. When some internal fault is detected in the execution, the inverter will indicate F080.

NOTE!
When this fault occurs, contact WEG.

14.11 SAVE USER FUNCTION FAULT (F081)

This fault occurs during the attempt to save (P204 = 9) more than 32 parameters with values different from the factory default (P204 = 5 or 6) or the Save User function is protected against writing.

14.12 COPY FUNCTION FAULT (F082)

In case the flash memory module (MMF) has been previously loaded with parameters of a "different" version from that of the inverter to which it is trying to copy the parameters, the operation will not be executed and the HMI will indicate fault F082. It is considered a "different" version those which are different in "x" or "y", assuming that the number of the software versions are represented as Vx.yz.

14.13 EXTERNAL ALARM (A090)

It is necessary to set the digital input DIx for "without external alarm". If DIx is inactive, the inverter will activate the external alarm A090. When DIx is activated, the alarm message will automatically disappear from the HMI display. The motor keeps running normally, regardless the state of this input.

14.14 EXTERNAL FAULT (F091)

It is necessary to set the digital input DIx for "without external fault". If DIx is inactive, the inverter will activate the external fault F091. In this case, the PWM pulses are immediately disabled.

14.15 FAULT HISTORY

The inverter is able to store a set of data on the last three faults occurred, such as: fault number, current (P003), DC link voltage (P004), output frequency (P005), power module temperature (P030).

P048 - Present Alarm

P049 - Present Fault

Adjustable Range:	0 to 999	**Factory Setting:**
Properties:	ro	

Description:

These parameters indicate the alarm (P048) or the fault (P049) number that may be present in the inverter.

P050 - Last Fault

P060 - Second Fault

P070 - Third Fault

Adjustable Range:	0 to 999	**Factory Setting:**
Properties:	ro	

Description:

These parameters indicates the number of the occurred fault.

P080 – Last Fault in “Fire Mode”

P081 – Second Fault in “Fire Mode”

P082 – Third Fault in “Fire Mode”

Adjustable Range:	0 to 9999	**Factory Setting:**
Properties:	ro	

Description:

These parameters indicate the last three faults that occurred on the inverter while the "Fire Mode" was active.

P051 - Output Current Last Fault

Adjustable Range:	0.0 to 40.0 A	**Factory Setting:**
Properties:	ro	

Description:

It indicates the output current at the moment of the last occurred fault.

P052 - Last Fault DC Link

Adjustable Range:	0 to 524 V	**Factory Setting:**	
Properties:	ro		

Description:

It indicates the DC link voltage at the moment of the last occurred fault.

P053 - Output Frequency Last Fault

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	
Properties:	ro		

Description:

If indicates the output frequency at the moment of the last occurred fault.

P054 - Temperature in the IGBTs Last Fault

Adjustable Range:	0.0 to 200.0 ºC (32 °F to 392 °F)	**Factory Setting:**	
Properties:	ro		

Description:

It indicates the IGBTs temperature at the moment of the last occurred fault.

14.16 FAULT CONTROL

The parameters related to the control of the motor protections of operation and the inverter are in this group.

P340 - Auto-Reset Time

Adjustable Range:	0 to 255 s	**Factory Setting:**	0 s
Properties:	cfg		

Description:

It defines the interval after a fault (except F067: Incorrect Encoder/Motor Wiring) to activate the inverter auto-reset. If the value of P340 is zero the fault autoreset function is disabled.

NOTE!
The function auto-reset is locked if the same fault occurs three times in a row within 30 seconds after the reset.

P358 - Encoder Fault Configuraton

Adjustable Range:	0 = Off 1 = F067 ON 2 = F079 ON 3 = F067, F079 ON	**Factory Setting:**	3
Properties:	cfg		

Description:

This parameter allows individually disabling the fault detection by software: a) F067 - Inverted Encoder/Motor Wiring and b) F079 - Encoder Signal Fault. The verification by software of faults F067 and F079 will remain disabled when P358 = 0.

15 READING PARAMETERS

It is important to point out that all the parameters of this group can only be viewed on the HMI display, and cannot be changed by the user.

P001 - Speed Reference

Adjustable Range:	0 to 9999	**Factory Setting:**	
Properties:	ro		

Description:

This parameter presents, regardless the origin source, the speed reference value in the unit and scale defined for the reference by P208, P209 and P210. The full scale and reference unit in the factory default are 60.0 Hz for P204 = 5 and 50.0 Hz for P204 = 6.

P002 - Output Speed (Motor)

Adjustable Range:	0 to 9999	**Factory Setting:**	
Properties:	ro		

Description:

Parameter P002 indicates the speed imposed to the inverter output at the same scale defined for P001. In this parameter, the compensations made to the output frequency are not shown. In order to see them, use P005.

P003 - Motor Current

Adjustable Range:	0.0 to 40.0 A	**Factory Setting:**	
Properties:	ro		

Description:

It indicates the inverter output current in amperes RMS (Arms).

P004 - DC Link Voltage (Ud)

Adjustable Range:	0 to 524 V	**Factory Setting:**	
Properties:	ro		

Description:

It indicates the DC link direct current voltage in (V).

P005 - Output Frequency (Motor)

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	
Properties:	ro		

Description:

Real frequency instantly applied to the motor in Hertz (Hz).

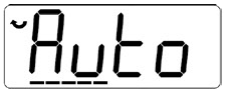
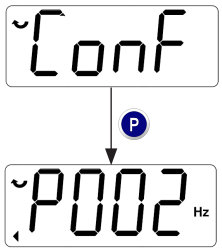
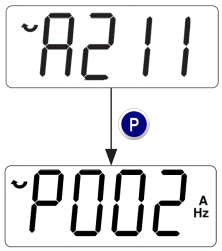
P006 - Inverter Status

Adjustable Range:	According to Table 15.1 on page 15-2	**Factory Setting:**	
Properties:	ro		

Description:

It indicates one of the possible inverter status. The following table contains the description of each state, as well as the indication on the HMI.

Table 15.1: *Inverter status- P006*

P006	Status	HMI	Description
0	Ready		Indicates the inverter is ready to be enabled
1	Run		Indicates the inverter is enabled
2	Sub		Indicates the voltage in the inverter is too low for operation (undervoltage), and will not accept the enabling command
3	Fault		Indicates the inverter is in the fault status. The fault code will flash
4	Self-tuning		Indicates the inverter is executing the Self-Tuning routine
5	Configuration		Indicates the inverter has incompatible parameter programming. After pressing the key P, it will keep showing an arrow until the incorrect setting is corrected, as shown in the figure. Refer to Section 5.3 SITUATIONS FOR CONFIG STATUS on page 5-5
7	Reserved	-	-
8	Fire Mode		Indicates that the inverter is in Fire Mode. After pressing the P key, letter "A" will continue to flash indicating the state. See Section 9.3 ENERGY SAVING on page 9-7

P007 - Output Voltage

Adjustable Range:	0 to 240 V	**Factory Setting:**	
Properties:	ro		

Description:

It indicates the line voltage in inverter output, in Volts (V).

P009 - Motor Torque

Adjustable Range:	-200.0 to 200.0 %	**Factory Setting:**	
Properties:	ro, VVW		

Description:

It indicates the torque developed by the motor in relation to the rated torque.

P011 – Output Cos φ

Adjustable Range:	-1.00 to 1.00	**Factory Setting:**	
Properties:	ro		

Description:

It indicates the power factor, that is, the relationship between the real power and the total power absorbed by the motor.

P012 - Digital Inputs Status

Refer to Section 12.5 DIGITAL INPUTS on page 12-11.

P013 - Digital Outputs Status

Refer to Section 12.7 DIGITAL OUTPUTS on page 12-20.

P014 - Analog Output Value AI1

P015 - Analog Output Value AI2

Refer to Section 12.3 ANALOG OUTPUT on page 12-6.

P018 - Analog Input Value AI1

P019 - Analog Input Value AI2

Refer to Section 12.1 ANALOG INPUTS on page 12-1.

P022 - Frequency Input Value FI in Hz

Refer to Section 12.4 FREQUENCY INPUT on page 12-9.

P023 - Version of Main Software

P024 - IO's Expansion Accessory Software Version

P025 - Communication Accessory Software Version

P027 - Configuration of the IO's Expansion Accessories

P028 - Configuration of the Communication Accessories

P029 - Power Hardware Configuration

Refer to Section 6.1 INVERTER DATA on page 6-1.

P030 - Power Module Temperature

Adjustable Range:	0.0 to 200.0 ºC (32 °F to 392 °F)	**Factory Setting:**
Properties:	ro	

Description:

Temperature in ºC measured inside the power module by the internal NTC.

P037 - Motor Overload Ixt

Refer to Section 14.1 MOTOR OVERLOAD PROTECTION (F072 AND A046) on page 14-1.

P038 - Encoder Speed

Adjustable Range:	-9999 to 9999 rpm	**Factory Setting:**
Properties:	ro	

Description:

This parameter presents the instant speed of the encoder in revolutions per minute (RPM); the measurement is not filtered and it is updated every 6 ms.

P039 - Encoder Pulse Counter

Adjustable Range:	0 to 9999	**Factory Setting:**
Properties:	ro	

Description:

Using this parameter it is possible to check the number of pulses counted from the encoder in quadrature. The count can be incremented from 0 to 9999 (clockwise) or decremented from 9999 to 0 (counterclockwise).

P045 - Enabled Fan Time

Adjustable Range:	0 to FFFF(hexa)	**Factory Setting:**
Properties:	ro	

Description:

It indicates the total number of hours that the heatsink fan remained connected. This value is kept even when the inverter is disconnected. Setting P204 = 2, the value of parameter P045 goes to zero.

P047 - CONFIG Status

Adjustable Range:	0 to 999	**Factory Setting:**	
Properties:	ro		

Description:

This parameter shows the origin situation of CONFIG mode. Refer to Section 5.3 SITUATIONS FOR CONFIG STATUS on page 5-5.

16 COMMUNICATION

In order to exchange information via communication network, the CFW300 features several standardized communication protocols, such as Modbus, CANopen, DeviceNet and Profibus DP.

For further details referring to the inverter configuration to operate in those protocols, refer to the CFW300 user's manual for communication with the desired network. Below are listed the parameters related to the communication.

16.1 SERIAL USB, BLUETOOTH, RS-232 AND RS-485 INTERFACE

P308 - Serial Address

P310 - Serial Baud Rate

P311 - Serial Interface Byte Configuration

P312 - Serial Protocol

P313 - Action for Communication Error

P314 - Serial Watchdog

P316 - Serial Interface Status

P681 - Motor Speed in 13 Bits

P682 - Serial / USB Control

P683 - Speed Reference via Serial

Description:

These parameters are used for configuration and operation of the RS-232, RS-485, USB and Bluetooth. For a detailed description, refer to the Modbus RTU, user's manual, available for download on the website: **www.weg.net**.

P770 - Bluetooth Local Name

Adjustable Range:	0 to 9999	**Factory Setting:**	0
Properties:			

Description:

This parameter identifies the bluetooth device with a friendly name on the network. This name is limited to the four digits available on the inverter display.

The default value of this parameter is the last four digits of the inverter serial number.

NOTE!
Parameter P770 is only available with the bluetooth accessory connected.

P771 - Bluetooth Parity Password

Adjustable Range:	0 to 9999	**Factory Setting:**	1234
Properties:			

Description:

This parameter defines the bluetooth parity password. This password is limited to the four digits available on the inverter display. It is recommended that the user change this password.

NOTE!
Parameter P771 is only available with the bluetooth accessory connected.

16.2 CAN - CANOPEN / DEVICENET INTERFACE

P684 - CANopen/DeviceNet/Profibus DP Speed Reference Control

P685 - CANopen/DeviceNet/Profibus DP Speed Reference

P700 - CAN Protocol

P701 - CAN Address

P702 - CAN Baud Rate

P703 - Bus Off Reset

P705 - CAN Controller Status

P706 - Counter of Received CAN Telegrams

P707 - Counter of Transmitted CAN Telegrams

P708 - Counter of Bus Off Errors

P709 - Counter of Lost CAN Messages

P710 - DeviceNet I/O Instances

P711 - DeviceNet Reading #3

P712 - DeviceNet Reading #4

P713 - DeviceNet Reading #5

P714 - DeviceNet Reading #6

P715 - DeviceNet Writing #3

P716 - DeviceNet Writing #4

P717 - DeviceNet Writing #5

P718 - DeviceNet Writing #6

P719 - DeviceNet Network Status

P720 - DeviceNet Master Status

P721 - CANopen Communication Status

P722 - CANopen Node Status

Description:

Parameters for configuration and operation of the CAN interface. For detailed description, refer to the CANopen communication manual or DeviceNet communication manual available for download on the website: **www.weg.net**.

16.3 PROFIBUS DP INTERFACE

P740 - Profibus Com. Status

P742 - Profibus Reading #3

P743 - Profibus Reading #4

P744 - Profibus Reading #5

P745 - Profibus Reading #6

P746 - Profibus Writing #3

P747 - Profibus Writing #4

P748 - Profibus Writing #5

P749 - Profibus Writing #6

P750 - Profibus Address

P751 - Profibus Teleg. Sel.

P754 - Profibus Baud Rate

Description:

Parameters for configuration and operation of the Profibus DP interface. For detailed description, refer to the Profibus communication manual available for download on the website: **www.weg.net**.

16.4 COMMANDS AND COMMUNICATION STATUS

P681 - Speed at 13 bits

P695 - Value for Digital Outputs

P696 - Value 1 for Analog Outputs

P697 - Value 2 for Analog Outputs

Description:

Parameters used for monitoring and controlling the CFW300 inverter by using the communication interfaces. For detailed description, refer to the communication manual (User) according to the interface used. These manuals are they are available for download on the website: **www.weg.net**.

17 SOFTPLC

The SoftPLC function allows the inverter to assume PLC (Programmable Logical Controller). For further details regarding the programming of those functions in the CFW300, refer to the "Help" menu of the WPS software. Below are described the parameters related to the SoftPLC.

P900 - SoftPLC Status

Adjustable Range:	0 = No Application 1 = Installing Application 2 = Incompat. Application 3 = Application Stopped 4 = Application Running	**Factory Setting:**	0
Properties:	ro		

Description:

It allows the user to view the status in which the SoftPLC is. If there is no application installed, the parameters P910 to P959 will not be shown on the HMI.

If this parameter presents option 2 = Incompat. App., it indicates the user's program loaded on the SoftPLC is not compatible with the CFW300 firmware version.

In this case, it is necessary that the user recompile the project on the WPS, considering the new CFW300 version and redo the download.

P901 - SoftPLC Command

Adjustable Range:	0 = Stop Application 1 = Run Application	**Factory Setting:**	0
Properties:	cfg		

Description:

This parameter allows stopping, running or excluding an application installed, but to do so, the motor must be disabled.

P902 - Scan Cycle Time

Adjustable Range:	0 to 9.999 s	**Factory Setting:**	0
Properties:	ro		

Description:

This parameter sets the application scanning time. The larger the application, the longer is the scanning time.

P903 – SoftPLC Application

Adjustable Range:	0 = User 1 = PID Controller	**Factory Setting:**	1
Properties:	cfg		

Description:

It allows the user to select the application to be executed.

Figure 17.1: Description of the parameter P903 options

P903	Description
0	It defines that the application that will run on the SoftPLC is the one loaded by the user through the ladder programming tool
1	It defines that the application that will run on the SoftPLC is the PID controller

ATTENTION!
It is recommended to load the factory setting (P204 = 5 or 6) after alternating between user's application and PID controller application.

P904 - Action for Application not Running

Adjustable Range:	0 = Inactive 1 = Generate Alarm	**Factory Setting:**	0
Properties:	cfg		

Description:

It defines which action will be taken by the product in case the SoftPLC not running condition is detected, and it may generate alarm A708 (1), fault F709 (2) or neither of the previous actions, remaining inactive (0).

P910 to P959 - SoftPLC Parameters

Adjustable Range:	-9999 to 9999	**Factory Setting:**	0
Properties:			

Description:

These are parameters whose use is defined by the SoftPLC function.

NOTE!
Parameters P910 to P959 can only be viewed when there are application installed.

18 APPLICATIONS

18.1 INTRODUCTION

Using the SoftPLC function of the CFW300, it is possible to develop an application (or functionality) in ladder language and include it in the CFW300 inverter software.

Parameter P903 allows selecting the application and uploading it to the SoftPLC execution area of the CFW300. The CFW300 has the following application already implanted:

- PID controller

18.2 PID CONTROLLER

The PID controller application can be used to control a process in closed loop. This application adds a proportional, integral and derivative controller superimposed to the regular speed control of the CFW300. It enables the selection of the control setpoint source and process variable source, the selection of operation in manual or automatic mode, alarms by low or high process variable level, the configuration of the control action in direct or reverse mode, and also the possibility of setting the conditions to activate the sleep and wake up mode.

Basically, the PID controller application compares the control setpoint to the process variable and controls the motor speed to try to eliminate any errors so as to keep the process variable equal to the control setpoint required by the user. The setting of the gains P, I and D determine the speed at which the inverter will respond to eliminate that error. See the PID controller block diagram below.

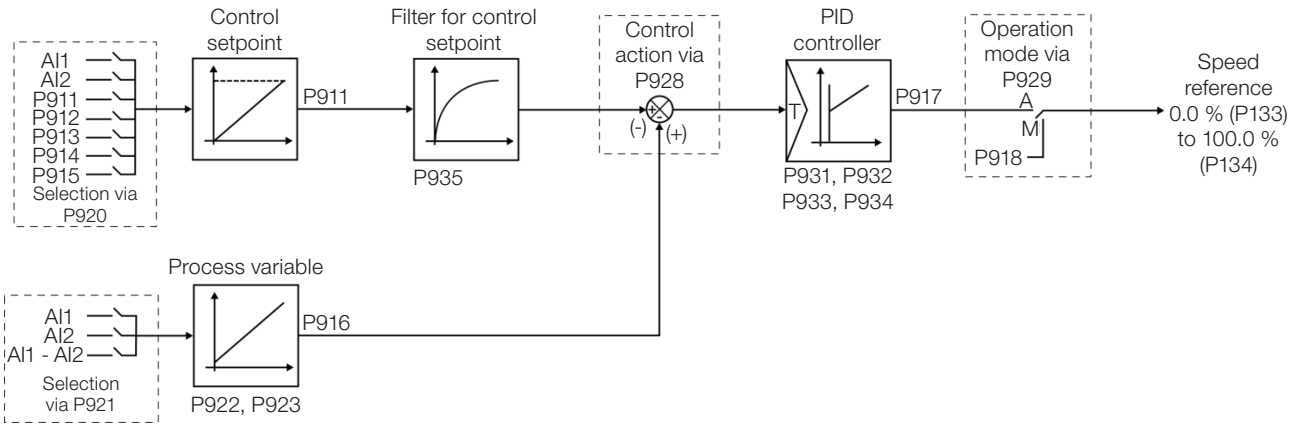


Figure 18.1: *PID controller block diagram*

Application examples of the PID controller:

- Flow or pressure control in a pipe system.
- Temperature of a furnace or oven.
- Dosing of chemicals in tanks.

The example below defines the terms used by the PID controller application.

An electric pump used in a water pumping system in which the pressure must be controlled at the pump output pipe. A pressure transducer is installed on the pipe and provides an analog feedback signal to the CFW300 proportional to the water pressure. That signal is called process variable and can be viewed in parameter P916. A control setpoint is programmed in the CFW300 via HMI (P911), or via analog input (AI1 or AI2), or via electronic potentiometer function (DI3 and DI4), or via logical combination of digital inputs DI3 and DI4 according to the control setpoint source defined in P920. The control setpoint is the water pressure which the pump must produce regardless of the demand variations in the pump output at any moment.

In order to enable the operation of the PID controller application, it is necessary to program the speed reference for the SoftPLC function, that is, parameter P221 or P222 in 12 = SoftPLC, and select the PID controller control action in P928 for direct action (=1) or reverse action (=2), thus enabling the PID operation. Otherwise, the alarm message “A790: Speed reference source (P221 or P222) not programmed for the SoftPLC (12)” will be generated.

The functionalities that can be programmed in the analog and digital inputs and outputs are shown in the Table 18.1 on page 18-2:

Table 18.1: *Functionalities and programming of the analog and digital inputs and outputs*

Analog Inputs AI1 (P231) and AI2 (P236)	
Control Setpoint	= 16
Process Variable	= 17
Analog Outputs AO1 (P251) and AO2 (P254)	
Control Setpoint	= 29
Process Variable	= 30
Digital Inputs DI2 (P264) to DI4 (P266)	
Manual / Automatic PID (DI2)	= 50
Increase Setpoint Command (EP) (DI3)	= 51
Decrease Setpoint Command (EP) (DI4)	= 52
1st DI of the Control Setpoint (DI3)	= 53
2nd DI of the Control Setpoint (DI4)	= 54
Digital Outputs DO1 (P275) to DO4 (P278)	
Process Variable Low Level (A760/F761)	= 46
Process Variable High Level (A762/F763)	= 47

The control setpoint source of the PID controller is defined in parameter P920, and it may be: via parameter P911, which can be changed via HMI (or communication networks); via analog input AI1 or AI2, being parameter P231 (AI1) or P236 (AI2) previously programmed to 16 = Control Setpoint so that it is enabled for operation; via Electronic Potentiometer (EP) through increase and decrease commands in digital inputs DI3 and DI4, being parameter P265 (DI3) previously programmed to 51 = Increase Setpoint Command (EP) and P266 (DI4) to 52 = Decrease Setpoint Command (EP); via logical combination of digital inputs, with the selection of up to four control setpoints, being parameter P265 (DI3) previously programmed to 53 = 1st DI for Control Setpoint and P266 (DI4) to 54 = 2nd DI for Control Setpoint.

The value of the present control setpoint of the PID controller (P911) can be indicated via analog output AO1 or AO2, being necessary to program P251 (AO1) or P254 (AO2) to 29 = Control Setpoint. The variable full scale is 100.0% and corresponds to 10 V or 20 mA.

The source of the PID controller process variable is defined in parameter P921, and it can be via analog input AI1 and/or AI2, being then parameter P231 (AI1) and/or P236 (AI2) previously programmed to 17 = Process Variable.

The value of the PID controller process variable (P916) can be indicated via analog output AO1 or AO2, being necessary to program P251 (AO1) or P254 (AO2) to 30 = Process Variable. The variable full scale is 100.0% and corresponds to 10 V or 20 mA.

The PID controller operation mode is defined in parameter P929, which can be manual, always automatic or via a Manual/Automatic command through digital input DI2, being then parameter P264 (DI2) previously programmed to 50 = Man/Auto PID Selection. Digital input DI2 programmed to PID in Manual/Automatic is active while it is at logical level “1”, indicating automatic command, and inactive at logical level “0”, indicating manual command.

Digital outputs DO1 to DO4 can be programmed to indicated alarm/fault conditions for low level or high level of the process variable (PV), seeing that one of the respective parameters (P275 to P278) must be programmed to 46 = Process Variable Low Level (equivalent to PV<PVy) or 47 = Process Variable High Level (equivalent to PV>PVx).

18.2.1 Start-Up

See below the required steps to put the PID controller application into operation.

NOTE!
For the PID controller application to work properly, it essential to check if the CFW300 is configured properly to drive the motor at the desired speed. In order to do so, check the following settings:
- Acceleration and deceleration ramps (P100 to P101).
- Current limit (P135) for V/f and VVW control modes.
- Torque boost (P136 and P137) and slip compensation (P138) if in the V/f control mode.

Configuring the PID Controller Application

The PID controller application will be configured according to the example shown below, where:

- The CFW300 frequency inverter will be configured to operate in the local mode.
- Digital input DI1 will be used for the Run/Stop command in local mode.
- Digital input DI2 will be used to select the PID to Manual/Automatic.
- The PID controller process variable (PV) will be connected to analog input AI1 in the scale of 4-20 mA, where 4mA is equal to 0 bar and 20 mA is equal to 4.0 bar.
- The PID controller control setpoint (SP) will be via HMI (keys).

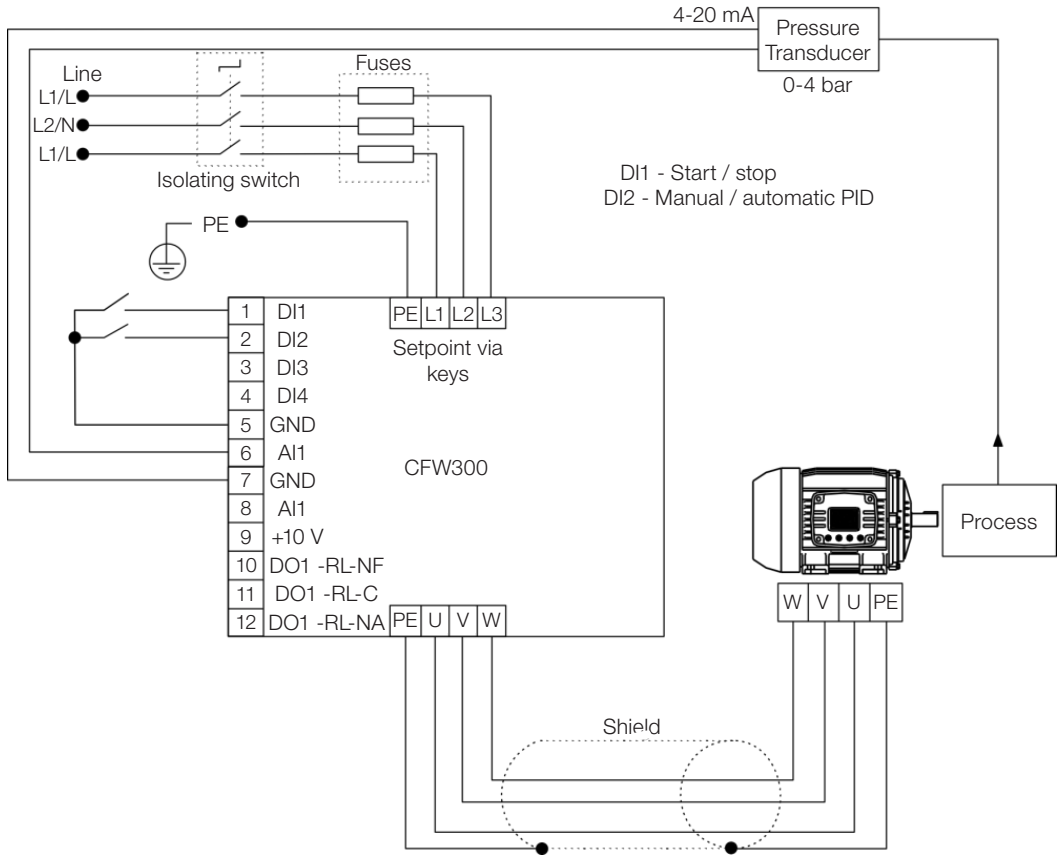


Figure 18.2: *Example of the PID controller application on the CFW300*

Table 18.2: Programming sequence of the PID controller application on the CFW300

Seq.	Action / Result	Indication on the Display
1	It selects the PID controller application in the SoftPLC function of the CFW300	P903 = 1
2	It enables the execution of the PID controller application	P901 = 1
3	It selects the PID controller control action, thus enabling its operation and uploading, at this moment, the application default setting (which is indicated below) to the CFW300 frequency inverter. 1 = Direct	P928 = 1
4	Acceleration time in seconds	P100 = 2.5 s
5	Deceleration time in seconds	P101 = 2.5 s
6	Minimum motor speed in rpm	P133 = 40.0 Hz
7	Maximum motor speed in rpm	P134 = 60.0 Hz
8	It selects the parameter of the HMI main display to show the value of the PID controller process variable. This setting is optional	P205 = 916
9	It selects the HMI bar graph parameter to show the present motor speed. This setting is optional	P207 = 002
10	Full scale of the Speed Reference	P208 = 600
11	Engineering unit of the Speed Reference	P209 = 3
12	Speed Reference indication form	P210 = 1
13	Full scale of the HMI bar graph	P213 = 600
14	LOC/REM Source Selection 0 = Always Local	P220 = 0
15	Selection of the Reference in Local mode. 12 = SoftPLC	P221 = 12
16	Selection of the Run/Stop Command in Local mode. 1 = DIx	P224 = 1
17	AI1 Signal Function. 17 = Process Variable (PV)	P231 = 17
18	AI1 Gain	P232 = 1.000
19	AI1 Signal. 1 = 4 to 20 mA	P233 = 1
20	AI1 Offset	P234 = 0.00 %
21	AI1 Filter	P235 = 0.25s
22	Digital input DI1 is used for the motor run or stop command. 1 = run/stop	P263 = 1
23	Digital input DI2 is used to set the PID to Automatic or Manual. 50 = PID Man/Auto	P264 = 50
24	SoftPLC Engineering Unit. 0 = none. The sensor of the process variable is in bar, and this variable is not available on the HMI of the CFW300	P510 = 0
25	Indication form of the SoftPLC engineering unit. 2 = wx.yz	P511 = 2
26	It selects the PID controller operation mode. 2 = manual/automatic via DI2	P929 = 2
27	It selects the automatic setting mode of the control setpoint. 0 = P911 inactive and P918 inactive	P930 = 0
28	The PID controller Setpoint will be set via HMI. 0 = via HMI	P920 = 0
29	The PID Process Variable will be read via analog input AI1. 0 = via HMI	P921 = 1
30	The range of the sensor connected to analog input AI1 is 0 to 4.0 bar. Program this parameter for the minimum sensor value, which is the maximum of the analog input 4 mA	P922 = 0.00
31	The range of the sensor connected to analog input AI1 is 0 to 4.0 bar. Program this parameter for the maximum sensor value, which is the maximum of the analog input 20mA	P923 = 4.00
32	Setting of the control Setpoint via HMI	P911 = 2.00
33	Control Setpoint Filter	P935 = 0.150 s
34	PID controller Sampling Period	P934 = 0.100 s
35	Proportional Gain of the PID controller	P931 = 1.00
36	Integral Gain of the PID controller	P932 = 5.00
37	Derivative Gain of the PID controller	P933 = 0.00

Parameters P931, P932, P933 and P934 must be set according to the response of the process to be controlled. See below suggestions for initial values of sampling time and gain setting for the PID controller according to the process to be controlled.

Table 18.3: Suggestions for the PID controller gain settings

Quantity	Sampling Time P934	Gains		
		Proportional P931	Integral P932	Derivative P933
Pressure in pneumatic system	0.10 s	1.00	5.00	0.00
Flow in pneumatic system	0.10 s	1.00	5.00	0.00
Pressure in hydraulic system	0.10 s	1.00	5.00	0.00
Flow in hydraulic system	0.10 s	1.00	5.00	0.00
Temperature	0.50 s	2.00	0.50	0.10

Putting into Operation

Check the state of the PID controller application in parameter P900. Value equal to 4 indicates the application is already in operation. Value equal to 3 indicates the application is stopped; therefore, it is necessary to change the command value for the SoftPLC in parameter P901 to 1 (execute application). Value different from 3 or 4 indicates the application cannot go into operation. For further details, refer to the CFW300 SoftPLC manual.

1. **Manual Operation (DI2 open):** keeping DI2 open (Manual), check the indication of the process variable on the HMI (P916) based on an external measurement of the sensor signal (transducer) in analog input AI1.

Then, changes the manual setpoint value of the PID controller (P918) until reaching the desired process variable value. Check if the control setpoint value (P911) is set to this value, and then put the PID controller into the automatic mode.

NOTE!
The PID controller only begins the speed regulation when the motor reaches the minimum speed programmed in P133, as it was configured to operate from 0.0 to 100.0%, where 0.0% corresponds to the minimum speed programmed in P133, and 100.0% corresponds to the maximum speed programmed in P134.

2. **Automatic Operation (DI2 closed):** close DI2 and make the dynamic adjustment of the PID controller, that is, of the proportional (P931), integral (P932) and derivative (P933) gains, checking if the regulation is being done correctly. In order to do so, just compare the control setpoint and the process variable and check if the values are close. Also check how fast the motor responds to the oscillations of the process variable.

It is important to point out that the setting of the PID controller gains is a step that requires some attempt and error procedure to reach the desired response time. If the system responds quickly and oscillates close to the control setpoint, then the proportional gain is too high. If the system responds slowly and it takes a long time to reach the control setpoint, the proportional gain is too low and must be increased. In case the process variable does not reach the required value (control setpoint), the integral gain must be set then.

18.2.2 Academic PID Controller

The PID controller implemented on the CFW300 is academic. See below the equations that characterize the Academic PID controller, which is the base of this function algorithm.

The transfer function in the frequency domain of the Academic PID controller is:

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

Replacing the integrator by a sum and the derivative by the incremental quotient, we obtain the approximation for the discrete (recursive) transfer equation presented below:

$$y(k) = i(k-1) + Kp[(1 + Ki.Ta + Kd/Ta).e(k) – (Kd/Ta).e(k-1)] \times 10$$

Where:

y(k): present output of the PID controller; it may vary from 0.0 to 100.0 %.
i(k-1): integral value in the previous state of the PID controller.
Kp: Proportional gain = P931.
Ki: Integral gain = P932 = [1 / Ti (s)].
Kd: Differential gain = P933 = [Td (s)].
Ts: sampling period of the PID controller = P934.
e(k): present error, being [SP(k) – PV(k)] for direct action, and [PV(k)].– SP(k)] for reverse action.
e(k-1): previous error, being [SP(k-1) – PV(k-1)] for direct action, and [PV(k-1)].– SP(k-1)] for reverse action.
SP: present control setpoint of the PID controller.
PV: process variable of the PID controller, read through the analog inputs (AI1 and AI2).

18.2.3 Parameters

See below the description of the parameters related to the PID controller application.

P100 – Acceleration Time

P101 – Deceleration Time

P133 – Minimum Speed

P134 – Maximum Speed

P221 – LOC Reference Selection

P222 – REM Reference Selection

P231 – AI1 Signal Function

P232 – AI1 Gain

P233 – AI1 Signal

P234 – AI1 Offset

P235 – AI1 Filter

P236 – AI2 Signal Function

P237 – AI2 Gain

P238 – AI2 Signal

P239 – AI2 Offset

P240 – AI2 Filter

P251 – AO1 Function

P252 – AO1 Gain

P253 – AO1 Signal

P254 – AO2 Function

P255 – AO2 Gain

P256 – AO2 Signal

P263 – DI1 Function

P264 – DI2 Function

P265 – DI3 Function

P266 – DI4 Function

P275 – DO1 Function (RL1)

P276 – DO2 Function

P277 – DO3 Function

P278 – DO4 Function

P510 – SoftPLC Engineering Unit

P511 – Indication Form of the SoftPLC Engineering Unit

P900 – SoftPLC Status

P901 – SoftPLC Command

P902 – SoftPLC Scan Time

P903 – SoftPLC Application Selection

NOTE!
Refer to Chapter 11 FUNCTIONS COMMON TO ALL THE CONTROL MODES on page 11-1 and Chapter 17 SOFTPLC on page 17-1 for further information.

P910 – PID Controller Application Version

Faixa de Valores:	0.00 to 90.00	**Factory Setting:**	-
Propriedades:	ro		

Description:

Read-only parameter which presents the software version of the PID controller application developed for the SoftPLC function of the CFW300.

P911 – Control Setpoint

Adjustable Range:	-99.99 a 99.99 [Eng. Un. SoftPLC]	**Factory Setting:**	2.00
Properties:	rw		

Description:

This parameter defines the setpoint value in automatic mode for the PID controller in engineering unit when the control setpoint source is programmed to be via HMI or communication networks (P920=0). When the control setpoint source is programmed for some other source (P920≠0), this parameter will show the present setpoint in automatic mode for the PID controller.

NOTE!
This parameter will be viewed according to the selection of the parameters for the SoftPLC engineering unit (P510 and P511).

P912 – Control Setpoint 1

P913 – Control Setpoint 2

P914 – Control Setpoint 3

P915 – Control Setpoint 4

Adjustable Range:	-99.99 a 99.99 [SoftPLC Eng. Un.]	**Factory Setting:**	P912 = 2.00 P913 = 2.30 P914 = 1.80 P915 = 1.60
Properties:			

Description:

These parameters define the setpoint value in automatic mode of the PID controller in engineering unit when the control setpoint source is programmed to be via logical combination of digital inputs DI3 and DI4 (P950 = 4, 5 or 6) according to Table 18.4 on page 18-8.

Table 18.4: *Truth table for the control setpoint via logical combination of digital inputs DI3 and DI4*

	P912 – Control Setpoint 1	P913 – Control Setpoint 2	P914 – Control Setpoint 3	P915 – Control Setpoint 4
Digital input DI3	0	1	0	1
Digital input DI4	0	0	1	1

NOTE!
These parameters will be viewed according to the selection of the parameters for the SoftPLC engineering unit (P510 and P511).

P916 – PID Controller Process Variable

Adjustable Range:	-99.99 a 99.99 [SoftPLC Eng. Un.]	**Factory Setting:**	-
Properties:	ro		

Description:

Read-only parameter which presents the value of the PID controller process variable according to the source defined in P921 and scale defined in P922 and P923.

NOTE!
This parameter will be viewed according to the selection of the parameters for the SoftPLC engineering unit (P510 and P511).

The conversion of the value read by the analog input in percentage into the value of the process variable shown in P916 according to the scale is done through the following formula:

P916 = [ValueAI(%) x (P923 - P922)] + [P922]

P917 – PID Controller Output

Adjustable Range:	0.0 to 100.0 %	**Factory Setting:**	-
Properties:	ro		

Description:

Read-only parameter which presents, in percentage (%), the value of the PID controller output, where 0.0 % corresponds to the motor minimum speed (P133), and 100.0 % corresponds to the motor maximum speed (P134).

P918 – PID Controller Setpoint in Manual mode

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	0.0 Hz
Properties:			

Description:

This parameter defines the value of the PID controller output when it is in the manual mode, that is, when the PID controller works in manual mode, the value defined as manual setpoint is transferred directly to the PID controller output.

P919 – PID Controller Logical Status

Adjustable Range:	0000h to FFFFh	**Factory Setting:**	-
Properties:	ro		

Description:

This parameter allows monitoring the logical status of the PID controller application. Each bit represents a state.

Table 18.5: Description of the logical status of the PID controller application

Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Function	Reserved										Process Variable High Level (F763)	Process Variable High Level (A762)	Process Variable Low Level (F761)	Process Variable Low Level (A760)	PID controller in Manual or Automatic	Sleep Mode Active (A750)

Bits	Values
Bit 0 Sleep Mode Active (A750)	**0:** Inverter is not in the alarm condition **1:** It indicates that the PID controller is in the sleep mode (A750)
Bit 1 PID Controller in Manual or Automatic	**0:** PID controller operating in Manual mode **1:** PID controller operating in Automatic mode
Bit 2 Control Process Variable Low Level (A760)	**0:** Inverter is not in the alarm condition **1:** It indicates that the control process variable (P916) is in low level (A760)
Bit 3 Fault for Control Process Variable Low Level (F761)	**0:** Inverter is not in the fault condition **1:** It indicates that the inverter switched the motor off due to the control process variable low level (F761)
Bit 4 Control Process Variable High Level (A762)	**0:** Inverter is not in the alarm condition **1:** It indicates that the control process variable (P916) is in high level (A762)
Bit 5 Fault for Control Process Variable High Level (F763)	**0:** Inverter is not in the fault condition **1:** It indicates that the inverter switched the motor off due to the control process variable high level (F763)
Bit 6 Reserved	Reserved
Bit 7 Reserved	Reserved
Bit 8 Reserved	Reserved
Bit 9 Reserved	Reserved
Bit 10 Reserved	Reserved
Bit 11 Reserved	Reserved
Bit 12 Reserved	Reserved
Bit 13 Reserved	Reserved
Bit 14 Reserved	Reserved
Bit 15 Reserved	Reserved

P920 – Selection of the Control Setpoint Source

Adjustable Range:	0 = Control Setpoint via HMI or Communication Networks (P911) 1 = Control Setpoint via Analog Input AI1 2 = Control Setpoint via Analog Input AI2 3 = Control Setpoint via Electronic Potentiometer (DI3 and DI4) 4 = Two Setpoints via Digital Input DI3 (P912 and P913) 5 = Three Setpoints via Digital Inputs DI3 and DI4 (P912, P913 and P914) 6 = Four Setpoints via Digital Inputs DI3 and DI4 (P912, P913, P914 and P915)	**Factory Setting:**	0
Properties:			

Description:

This parameter defines the control setpoint source in automatic mode of the PID controller.

Table 18.6: Description of the control setpoint source

P920	Description
0	It defines that the control setpoint source in automatic mode of the PID controller will be the value programmed in parameter P911 via HMI of the CFW300 frequency inverter or written via communication networks
1	It defines that the control setpoint source in automatic mode of the PID controller will be the value read by the analog input AI1. The value is converted according to the engineering unit 1 and viewed in parameter P911
2	It defines that the control setpoint source in automatic mode of the PID controller will be the value read by the analog input AI2. The value is converted according to the engineering unit 1 and viewed in parameter P911
3	It defines that the control setpoint source in automatic mode of the PID controller will be the value defined through the electronic potentiometer function via the Increase Setpoint (DI3) and Decrease Setpoint (DI4) commands. The value of the count is stored in parameter P911
4	It defines that there will be two control setpoints in automatic mode of the PID controller selected via logical combination of digital input DI3. The selected control setpoint value is viewed in parameter P911
5	It defines that there will be three control setpoints in automatic mode of the PID controller selected via logical combination of digital inputs DI3 and DI4. The selected control setpoint value is viewed in parameter P911
6	It defines that there will be four control setpoints in automatic mode of the PID controller selected via logical combination of digital inputs DI3 and DI4. The selected control setpoint value is viewed in parameter P911

When the control setpoint is via Electronic Potentiometer (EP) function (P920 = 3), the control setpoint of the PID controller is adjusted by means of digital inputs DI3 and DI4, being DI3 to increase it and DI4 to decrease it.

Figure 18.4 on page 18-19 shows the operation of the EP function: when digital input DI3 is activated, the control setpoint value (P911) is incremented, and when digital input DI4 is activated, the control setpoint value (P911) is decremented. In case both digital inputs are activated at the same time, the value remains the same.

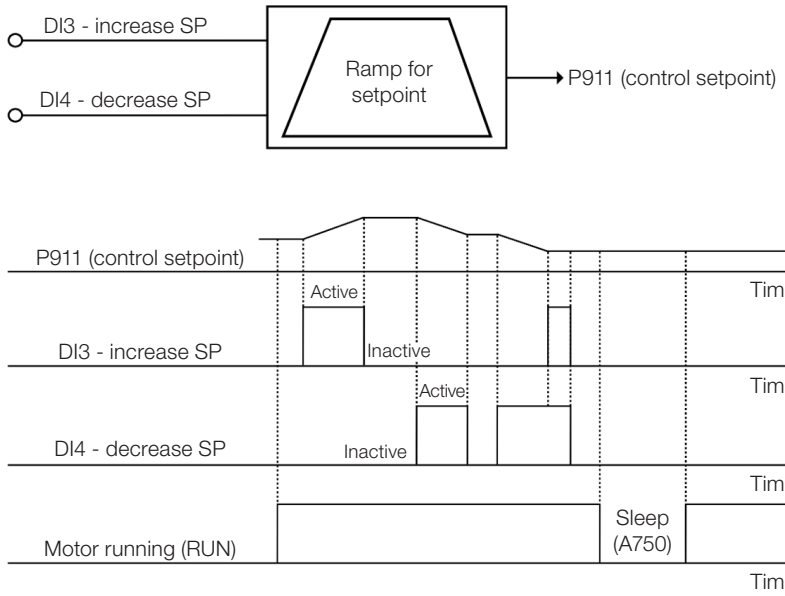


***Figure 18.3:** EP function operation chart*

When the control setpoint is via logical combination of digital inputs DI3 and DI4 (P920 = 4, 5 or 6), the following truth table must be used so as to obtain the control setpoint of the PID controller in automatic mode.

Table 18.7: Truth table for the control setpoint via logical combination of digital inputs DI3 and DI4

	P912 – Control Setpoint 1	P913 – Control Setpoint 2	P914 – Control Setpoint 3	P915 – Control Setpoint 4
Digital input DI3	0	1	0	1
Digital input DI4	0	0	1	1

P921 – Selection of the Source for the PID Controller Process Variable

Adjustable Range:	1 = Process Variable via Analog Input AI1 2 = Process Variable via Analog Input AI2 3 = Process Variable via Difference between AI1 and AI2	**Factory Setting:**	1
Properties:			

Description:

This parameter defines the source of the PID controller process variable.

Table 18.8: Description of the source of the PID controller process variable

P921	Description
1	It defines that the control variable source will be the value read by AI1 and viewed in parameter P916
2	It defines that the control variable source will be the value read by AI2 and viewed in parameter P916
3	It defines that the control variable source will be the value read by AI1 minus the value read by AI2, that is, the difference between AI1 and AI2, and viewed in parameter P916

P922 – Minimum Sensor Level of the PID Controller Process Variable

Adjustable Range:	-99.99 a 99.99 [SoftPLC Eng. Un.]	**Factory Setting:**	0
Properties:			

Description:

This parameter defines the minimum value of the sensor connected to the analog input configured for the PID controller process variable according to its engineering unit.

NOTE!
This parameter will be viewed according to the selection of the parameters for the SoftPLC engineering unit (P510 and P511).

P923 – Maximum Sensor Level of the PID Controller Process Variable

Adjustable Range:	-99.99 a 99.99 [SoftPLC Eng. Un.]	**Factory Setting:**	4.00
Properties:			

Description:

This parameter defines the maximum value of the sensor connected to the analog input configured for the PID controller process variable according to its engineering unit.

NOTE!
This parameter will be viewed according to the selection of the parameters for the SoftPLC engineering unit (P510 and P511).

P924 – Value for Low Level Alarm for the Control Process Variable

Adjustable Range:	-99.99 a 99.99 [SoftPLC Eng. Un.]	**Factory Setting:**	1.00
Properties:			

Description:

This parameter defines the value below which the low level alarm will be generated for the control process variable (A760).

NOTE!
Setting it to "0" disables the low level alarm and fault for the control process variable.

NOTE!
This parameter will be viewed according to the selection of the parameters for the SoftPLC engineering unit (P510 and P511).

P925 – Time for Low Level Fault for the Control Process Variable (F761)

Adjustable Range:	0.0 to 999.9 s	**Factory Setting:**	0.0 s
Properties:			

Description:

This parameter defines how long the low level alarm condition should remain so that the control process variable (A760) will generate fault “F761: Low Level Fault of the Control Process Variable”.

NOTE!
Setting it to "0.0 s" disables the low level fault for the control process variable.

P926 – Value for High Level Alarm for the Control Process Variable

Adjustable Range:	-99.99 a 99.99 [SoftPLC Eng. Un.]	**Factory Setting:**	3.50
Properties:			

Description:

This parameter defines the value above which the high level alarm will be generated for the control process variable (A762).

NOTE!
Setting it to "0" disables the high level alarm and fault for the control process variable.

NOTE!
This parameter will be viewed according to the selection of the parameters for the SoftPLC engineering unit (P510 and P511).

P927 – Time for Low Level Fault for the Control Process Variable (F763)

Adjustable Range:	0.0 to 999.9 s	**Factory Setting:**	0.0 s
Properties:			

Description:

This parameter defines how long the high level alarm condition should remain so that the control process variable (A762) will generate fault “F763: High Level Fault of the Control Process Variable”.

NOTE!
Setting it to "0.0 s" disables the high level fault for the control process variable.

P928 – Selection of the PID Controller Control Action

Adjustable Range:	0 = Disable PID Controller 1 = Enable PID Controller in Direct Mode 2 = Enable PID Controller in Reverse Mode	**Factory Setting:**	0
Properties:	cfg		

Description:

This parameter enables the PID controller and defines how the control action will be.

Table 18.9: *Description of the PID controller control action*

P928	Description
0	It defines that the PID controller will be disabled
1	It defines that the PID controller will be enabled, and the regulation or control action will be in direct mode. In other words, the error will be the control setpoint value (P911) minus the control process variable value (P916)
2	It defines that the PID controller will be enabled, and the regulation or control action will be in reverse mode. In other words, the error will be the control process variable value (P916) minus the control setpoint value (P911)

NOTE!
When enabling the PID controller, that is, changing the content of parameter P928 from 0 to 1 or 2, the following parameters related to the PID controller application will be loaded: P100, P101, P133, P134, P205, P207, P208, P209, P210, P213, P220, P221, P224, P231, P232, P233, P234, P235, P263, P264, P510, P511, P911, P918, P920, P921, P922, P923, P924, P925, P926, P927, P929, P930, P931, P932, P933, P934, P935, P936, P937, P938, P939.

NOTE!
The control action of the PID controller must be selected for direct mode when it is necessary to increase the PID controller output in order to increase the process variable value. E.g.: Pump driven by an inverter and filling a tank. For the level of the tank (process variable) to increase, it is necessary that the flow increase, which is accomplished by increasing the speed of the motor.
The control action of the PID controller must be selected for reverse mode when it is necessary to decrease the PID controller output in order to increase the process variable value. E.g.: Fan driven by inverter cooling a refrigeration tower. When an increase in temperature is desired (process variable), it is necessary to reduce the ventilation by reducing the motor speed.

P929 – PID Controller Operation Mode

Adjustable Range:	0 = Manual 1 = Automatic 2 = Control Selection to Manual (0) or Automatic (1) via digital input DI2	**Factory Setting:**	2
Properties:	cfg		

Description:

This parameter defines the operation mode of the CFW300 PID controller.

Table 18.10: *Description of the PID controller operation mode*

P928	Description
0	It defines that the PID controller will always operate in manual mode. In other words, the process variable will not be controlled according to the control setpoint required by the user, and the PID controller output value will be the setpoint value in manual mode programmed in parameter P918
1	It defines that the PID controller will operate in automatic mode, that is, the process variable will be controlled according to the control setpoint required by the user and the PID controller output value will behave according to the settings defined by the user
2	It defines the PID controller will be able to operate in manual or automatic mode according to the state of digital input DI2. In other words, if the digital input is in logical level "0", the PID controller will operate in manual mode; if the digital input is in logical level "1", the PID controller will operate in automatic mode

NOTE!
The change from an operation mode to another with the motor running may cause disturbances on the system control. That can be optimized according to the automatic adjustment mode of the PID controller setpoint defined in parameter P930 together with the bumpless transfer characteristic from the manual mode to the automatic mode of the PID block of the SoftPLC function.
Bumpless transfer is merely making the transfer from the manual mode to the automatic mode without causing variation in the PID controller output. In other words, when the transition from the manual mode to the automatic mode occurs, the PID controller output value in manual mode is used to start the integral part of the PID controller in automatic mode. That ensures that the output will start from this value.

P930 – Automatic Adjustment of the PID Controller Setpoint

Adjustable Range:	0 = P911 inactive and P918 inactive 1 = P911 active and P918 inactive 2 = P911 inactive and P918 active 3 = P911 active and P918 active	**Factory Setting:**	0
Properties:			

Description:

This parameter defines if the PID controller setpoint in automatic mode (P911) and/or in manual mode (P918) will be automatically changed or adjusted when the PID controller operation mode changes.

NOTE!
The adjustment of the control setpoint in automatic mode is only valid when the control setpoint source is HMI or communication networks (P920 = 0) or via the Electronic Potentiometer Function (P920 = 3). For other control setpoint sources, the automatic adjustment is not executed.

Table 18.11: Description of the PID controller setpoint automatic adjustment

P930	Description
0	It defines that, in the transition of the PID controller operation mode from manual to automatic, the control setpoint value (P911) will not be uploaded with the present value of the control process variable (P916), and, in the transition of the PID controller operation mode from automatic to manual, the setpoint value of the PID controller in manual mode (P918) will not be uploaded with the present value of the motor speed (P002)
1	It defines that, in the transition of the PID controller operation mode from manual to automatic, the control setpoint value (P911) will be uploaded with the present value of the control process variable (P916), and, in the transition of the PID controller operation mode from automatic to manual, the setpoint value of the PID controller in manual mode (P918) will not be uploaded with the present value of the motor speed (P002)
2	It defines that, in the transition of the PID controller operation mode from manual to automatic, the control setpoint value (P911) will not be uploaded with the present value of the control process variable (P916), and , in the transition of the PID controller operation mode from automatic to manual, the setpoint value of the PID controller in manual mode (P918) will be uploaded with the present value of the motor speed (P002)
3	It defines that, in the transition of the PID controller operation mode from manual to automatic, the control setpoint value (P911) will be uploaded with the present value of the control process variable (P916), and , in the transition of the PID controller operation mode from automatic to manual, the setpoint value of the PID controller in manual mode (P918) will be uploaded with the present value of the motor speed (P002)

P931 – PID Controller Proportional Gain

P932 – PID Controller Integral Gain

P933 – PID Controller Derivative Gain

Adjustable Range:	0.00 to 99.99	**Factory Setting:**	P931 = 1.00 P932 = 5.00 P933 = 0.00
Properties:			

Description:

These parameters define the gains of the PID controller and must be set according to the magnitude or process that is being controlled.

NOTE!
Table 18.3 on page 18-5 suggests setting values for the gains according to the process to be controlled by the PID controller.

P934 – PID Controller Sampling Period

Adjustable Range:	0.050 to 9.999 s	**Factory Setting:**	0.100 s
Properties:			

Description:

This parameter defines the sampling time of the PID controller.

NOTE!
Table 18.3 on page 18-5 suggests setting values for the sampling time according to the process to be controlled by the PID controller.

P935 – Filter for the PID Controller Control Setpoint

Adjustable Range:	0.000 to 9.999 s	**Factory Setting:**	0.150
Properties:			

Description:

This parameter configures the time constant of the 1st order filter to be applied to the PID controller control setpoint, and it is intended to reduce sudden changes in the control setpoint value of the PID controller.

18.2.3.1 Sleep Mode

This parameter group allows the user to set the operation conditions of the sleep mode.

Sleep Mode is a controlled system state in which the control demand is zero or almost zero, and, at this moment, the motor driven by the CFW300 frequency inverter may be switched off. That prevents the motor from running at a low speed, doing little or nothing for the controlled system. Even if the motor is apparently OFF, the process variable continues to be monitored so that, when necessary, the controlled system can start the motor again according to the conditions of the wake up mode.

The **Wake Up Mode** switches on the motor when the difference between the control process variable and the control setpoint is greater than a certain programmed value.

NOTE!
The sleep mode only actuates if the PID controller is enabled and in the automatic mode.

DANGER!
When the CFW300 inverter is in the sleep mode, the motor may spin at any moment because of the process conditions. If you wish to handle the motor or execute any kind of maintenance, power down the inverter.

P936 – Process Variable Deviation to Wake up

Adjustable Range:	-99.99 a 99.99 [SoftPLC Eng. Un.]	**Factory Setting:**	0.30
Properties:			

Description:

This parameter defines the value to be subtracted from (direct PID) or added to (reverse PID) the control setpoint to start the motor and return to the system control. This value is compared to the control process variable, and, if the control process variable value is smaller (direct PID) or greater (reverse PID) than this value, the wake up condition is enabled.

NOTE!
This parameter will be viewed according to the selection of the parameters for the SoftPLC engineering unit (P510 and P511).

P937 – Time to Wake Up

Adjustable Range:	0.0 to 999.9 s	**Factory Setting:**	5.0 s
Properties:			

Description:

This parameter defines the time the wake up mode active condition should remain to start the motor and control the system. The control process variable must remain smaller (direct PID) or greater (reverse PID) than the deviation defined in P936 for the time set in P937 for the motor to be started and its speed controlled. In case the wake up condition (P937) remains inactive for some time, the timer is reset and the time count is restarted.

NOTE!
If, in the energization of the inverter, the "Run/Stop" command is active and the condition to Wake Up is active, the time programmed in P937 will not be waited for, and thus the motor will be started instantly.

P938 – Motor Speed to Activate the Sleep Mode

Adjustable Range:	0.0 to 400.0 Hz	**Factory Setting:**	0.0 Hz
Properties:			

Description:

This parameter defines the motor speed value below which the motor will be switched off and go into the sleep mode.

NOTE!
Setting it to “0.0 Hz” disables the sleep mode; that means the motor will be switched on or off according to the state of the “Run/Stop” command.

P939 – Time to Activate the Sleep Mode

Adjustable Range:	0.0 to 999.9 s	**Factory Setting:**	10.0 s
Properties:			

Description:

This parameter defines the time the motor speed should remain below the value set in P938 for the motor to be switched off and go into the sleep mode.

NOTE!
The alarm message “A750: Sleep Mode Active” will be shown on the HMI of the CFW300 frequency inverter warning that the motor is in the sleep mode.

Figure 18.4 on page 18-19 shows an analysis of the PID controller operation programmed with control action in direct mode and configured for the Sleep Mode.

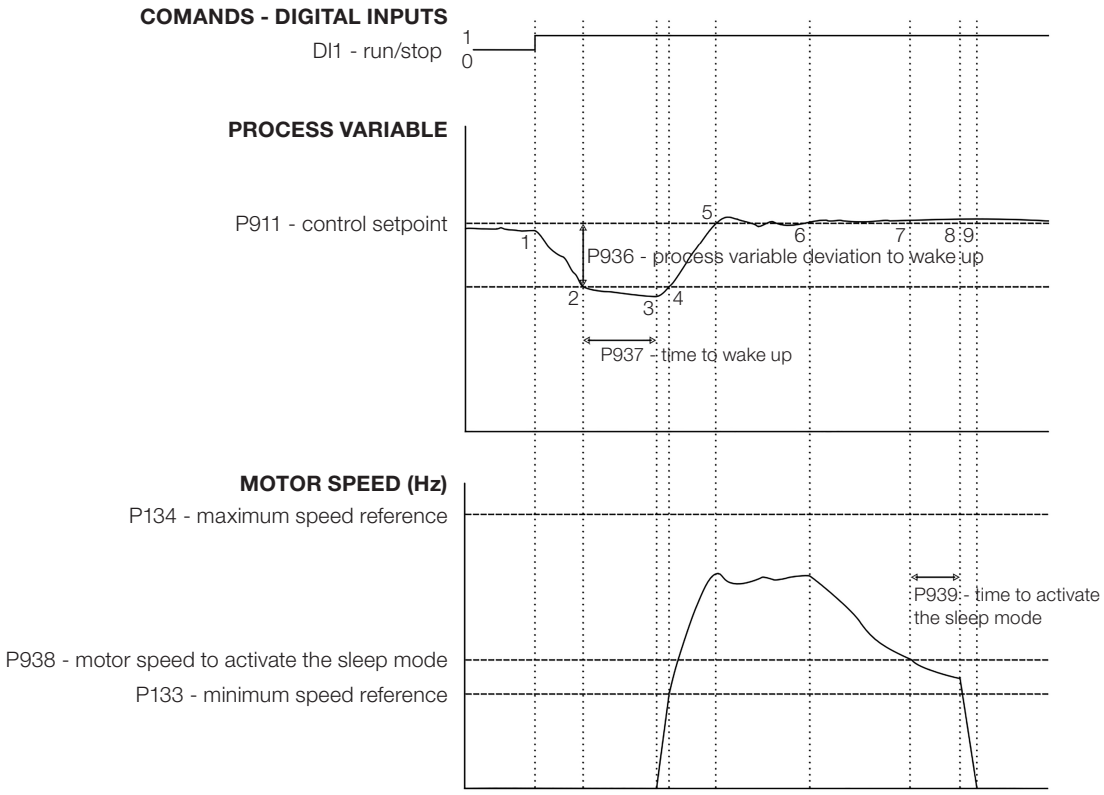


Figure 18.4: *Operation of the PID controller with the sleep mode enabled*

1. The Run/Stop command via digital input DI1 enables the starting of the motor. As the wake up condition was not detected, it remains in sleep mode, and the motor remains stopped.

2. The process variable starts to decrease and becomes smaller than the deviation of the process variable programmed to wake up (P936); at this moment, the time count to wake up (P937) begins.

3. The process variable remains smaller than the process variable deviation to wake up (P936), and the time to wake up (P937) elapses; at this moment, the command to start the motor and control the system with its speed variation is executed.

4. The inverter accelerates the motor up to the minimum speed (P133). After that, the PID controller is enabled and starts controlling the motor speed.

5. Then it is possible to control the process variable so that it reaches the control setpoint required by the user. To that end, the PID controller output is incremented, making the motor speed increase until reaching the control stabilization.

6. The value of the process variable remains above the required control setpoint due to a decrease in demand, and the motor speed starts slowing down.

7. The value of the motor speed falls below the value to sleep (P938); the time count to activate the sleep mode (P939) begins.

8. The motor speed remains below the value to sleep (P938), and the time to activate the sleep mode (P939) elapses; at this moment, the command to switch off the motor is executed.

9. The motor is decelerated down to 0 Hz and remains stopped; at this moment the PID controller goes into the sleep mode.