Frequency Inverter

CFW701 V2.1X

Programming Manual
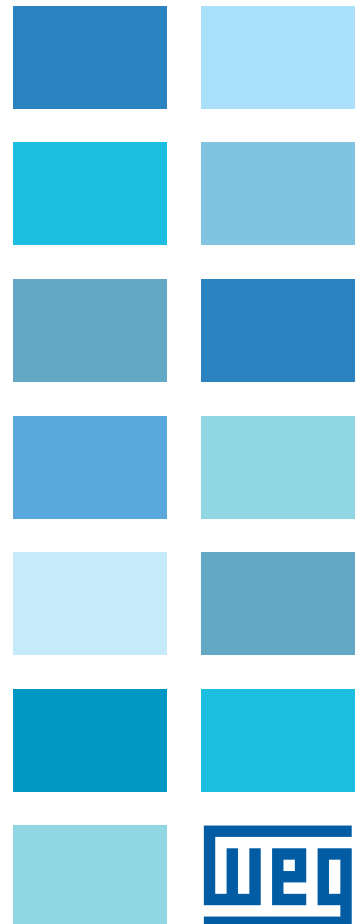
Programming Manual

The table below describes all revisions made to this manual.

Version	Review	Description
V1.2X	R00	First edition
V2.0X	R01	General review
V2.1X	R02	General review New parameters: P0342, P0613, P0614 e P0692 New fault F0076 Change of standard value P0136 according to the frames

QUICK PARAMETER REFERENCE, FAULTS AND ALARMS

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0000	Access to Parameters	0 to 9999	0				5-1
P0001	Speed Reference	0 to 18000 rpm			ro	READ	16-1
P0002	Motor Speed	0 to 18000 rpm			ro	READ	16-1
P0003	Motor Current	0.0 to 4500.0 A			ro	READ	16-1
P0004	DC Link Voltage (Ud)	0 to 2000 V			ro	READ	16-2
P0005	Motor Frequency	0.0 to 1020.0 Hz			ro	READ	16-2
P0006	VFD Status	0 = Ready 1 = Run 2 = Undervoltage 3 = Fault 4 = Self-Tuning 5 = Configuration 6 = DC-Braking 7 = STO 8 = Fire Mode 9 = Bypass			ro	READ	16-2
P0007	Motor Voltage	0 to 2000 V			ro	READ	16-3
P0009	Motor Torque	-1000.0 to 1000.0 %			ro	READ	16-3
P0010	Output Power	0.0 to 6553.5 kW			ro	READ	16-4
P0011	Output Cos ϕ	0.00 to 1.00			ro	READ, I/O	16-4
P0012	DI8 to DI1 Status	Bit 0 = DI1 Bit 1 = DI2 Bit 2 = DI3 Bit 3 = DI4 Bit 4 = DI5 Bit 5 = DI6 Bit 6 = DI7 Bit 7 = DI8			ro	READ, I/O	13-9
P0013	DO5 to DO1 Status	Bit 0 = DO1 Bit 1 = DO2 Bit 2 = DO3 Bit 3 = DO4 Bit 4 = DO5			ro	READ, I/O	13-14
P0014	AO1 Value	0.00 to 100.00 %			ro	READ, I/O	13-6
P0015	AO2 Value	0.00 to 100.00 %			ro	READ, I/O	13-6
P0018	AI1 Value	-100.00 to 100.00 %			ro	READ, I/O	13-1
P0019	AI2 Value	-100.00 to 100.00 %			ro	READ, I/O	13-1
P0020	AI3 Value	-100.00 to 100.00 %			ro	READ, I/O	13-1
P0022	Frequency Input	3.0 to 6500.0 Hz			ro	READ, I/O	13-23
P0023	Software Version	0.00 to 655.35			ro	READ	6-1
P0028	Accessories Config.	0000h to FFFFh			ro	READ	6-2
P0029	Power Hardware Config	Bit 0 to 5 = Rated Current Bit 6 and 7 = Rated Voltage Bit 8 = RFI Filter Bit 9 = Safety Relay Bit 10 = (0)24 V/(1)DC Link Bit 11 = Always 0 Bit 12 = Dyn. Brak. IGBT Bit 13 = Special Bit 14 and 15 = Reserved			ro	READ	6-2
P0030	IGBTs Temperature	-20.0 to 150.0 °C			ro	READ	15-4
P0034	Internal Air Temp.	-20.0 to 150.0 °C			ro	READ	15-4
P0036	Fan Heatsink Speed	0 to 15000 rpm			ro	READ	16-5
P0037	Motor Overload Status	0 to 100 %			ro	READ	16-5
P0042	Powered Time	0 to 65535 h			ro	READ	16-6
P0043	Enabled Time	0.0 to 6553.5 h			ro	READ	16-6
P0044	kWh Output Energy	0 to 65535 kWh			ro	READ	16-6
P0045	Enabled Fan Time	0 to 65535 h			ro	READ	16-7
P0048	Present Alarm	0 to 999			ro	READ	16-7
P0049	Present Fault	0 to 999			ro	READ	16-7
P0050	Last Fault	0 to 999			ro	READ	16-8
P0054	Second Fault	0 to 999			ro	READ	16-8

Quick Parameter Reference, Faults and Alarms

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0058	Third Fault	0 to 999			ro	READ	16-8
P0062	Fourth Fault	0 to 999			ro	READ	16-8
P0066	Fifth Fault	0 to 999			ro	READ	16-8
P0090	Current At Last Fault	0.0 to 4500.0 A			ro	READ	16-9
P0091	DC Link At Last Fault	0 to 2000 V			ro	READ	16-9
P0092	Speed At Last Fault	0 to 18000 rpm			ro	READ	16-9
P0093	Reference Last Fault	0 to 18000 rpm			ro	READ	16-10
P0094	Frequency Last Fault	0.0 to 1020.0 Hz			ro	READ	16-10
P0095	Motor Volt. Last Fault	0 to 2000 V			ro	READ	16-10
P0096	DIx Status Last Fault	Bit 0 = DI1 Bit 1 = DI2 Bit 2 = DI3 Bit 3 = DI4 Bit 4 = DI5 Bit 5 = DI6 Bit 6 = DI7 Bit 7 = DI8			ro	READ	16-11
P0097	DOx Status Last Fault	Bit 0 = DO1 Bit 1 = DO2 Bit 2 = DO3 Bit 3 = DO4 Bit 4 = DO5			ro	READ	16-11
P0100	Acceleration Time	0.0 to 999.0 s	20.0 s			BASIC	12-1
P0101	Deceleration Time	0.0 to 999.0 s	20.0 s			BASIC	12-1
P0102	Acceleration Time 2	0.0 to 999.0 s	20.0 s				12-1
P0103	Deceleration Time 2	0.0 to 999.0 s	20.0 s				12-1
P0104	Ramp Type	0 = Linear 1 = S Ramp	0				12-2
P0105	1st/2nd Ramp Select.	0 = 1st Ramp 1 = 2nd Ramp 2 = DIx 3 = Serial 4 = SoftPLC	2		cfg		12-3
P0120	Speed Ref. Backup	0 = Inactive 1 = Active	1				12-3
P0121	Keypad Reference	0 to 18000 rpm	90 rpm				12-4
P0122	JOG/JOG + Reference	0 to 18000 rpm	150 (125) rpm				12-4
P0123	JOG - Reference	0 to 18000 rpm	150 (125) rpm		Vector		12-5
P0132	Max. Overspeed Level	0 to 100 %	10 %		cfg		12-5
P0133	Minimum Speed	0 to 18000 rpm	90 (75) rpm			BASIC	12-6
P0134	Maximum Speed	0 to 18000 rpm	1800 (1500) rpm			BASIC	12-6
P0135	Max. Output Current	0.2 to $2xI_{nom-HD}$	$1.5xI_{nom-HD}$		V/f, VVW	BASIC	9-6
P0136	Manual Torque Boost	0 to 9	According to inverter model		V/f	BASIC	9-2
P0137	Autom. Torque Boost	0.00 to 1.00	0.00		V/f		9-2
P0138	Slip Compensation	-10.0 to 10.0 %	0.0 %		V/f		9-3
P0139	Output Current Filter	0.0 to 16.0 s	0.2 s		V/f, VVW		9-4
P0142	Max. Output Voltage	0.0 to 100.0 %	100.0 %		cfg, Adj		9-5
P0143	Interm. Output Voltage	0.0 to 100.0 %	50.0 %		cfg, Adj		9-5
P0144	3 Hz Output Voltage	0.0 to 100.0 %	8.0 %		cfg, Adj		9-5
P0145	Field Weakening Speed	0 to 18000 rpm	1800 rpm		cfg, Adj		9-5
P0146	Intermediate Speed	0 to 18000 rpm	900 rpm		cfg, Adj		9-5
P0150	V/f DC Regulation Type	0 = Ramp Hold 1 = Ramp Accel.	0		cfg, V/f, VVW		9-10
P0151	V/f DC Regulation Level	339 to 1000 V	800 V		V/f, VVW		9-10
P0152	DC Link Regul. P Gain	0.00 to 9.99	1.50		V/f, VVW		9-11
P0153	Dyn. Braking Level	339 to 1000 V	748 V				14-1
P0156	100 % Speed Overload Current	0.1 to $1.5xI_{nom-ND}$	$1.05xI_{nom-ND}$				15-4
P0157	50 % Speed Overload Current	0.1 to $1.5xI_{nom-ND}$	$0.9xI_{nom-ND}$				15-4
P0158	5 % Speed Overload Current	0.1 to $1.5xI_{nom-ND}$	$0.65xI_{nom-ND}$				15-4

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0159	Motor Thermal Class	0 = Class 5 1 = Class 10 2 = Class 15 3 = Class 20 4 = Class 25 5 = Class 30 6 = Class 35 7 = Class 40 8 = Class 45	1		cfg		15-5
P0160	Speed Regul. Config.	0 = Normal 1 = Saturated	0		cfg, Vector		11-12
P0161	Speed Prop. Gain	0.0 to 63.9	7.4		Vector		11-12
P0162	Speed Integral Gain	0.000 to 9.999	0.023		Vector		11-12
P0163	LOC Reference Offset	-999 to 999	0		Vector		11-13
P0164	REM Reference Offset	-999 to 999	0		Vector		11-13
P0165	Speed Filter	0.012 to 1.000 s	0.012 s		Vector		11-13
P0166	Speed Diff. Gain	0.00 to 7.99	0.00		Vector		11-14
P0167	Current Prop. Gain	0.00 to 1.99	0.50		Vector		11-14
P0168	Current Integral Gain	0.000 to 1.999	0.010		Vector		11-14
P0169	Max. + Torque Curr.	0.0 to 350.0 %	125.0 %		Vector		11-20
P0170	Max. - Torque Curr.	0.0 to 350.0 %	125.0 %		Vector		11-20
P0175	Flux Proport. Gain	0.0 to 31.9	2.0		Vector		11-14
P0176	Flux Integral Gain	0.000 to 9.999	0.020		Vector		11-15
P0178	Rated Flux	0 to 120 %	100 %		Vector		11-15
P0180	Iq* After I/f	0 to 350 %	10 %		Sless		11-16
P0182	Speed for I/f Activ.	0 to 90 rpm	18 rpm		Sless		11-16
P0183	Current in I/f Mode	0 to 9	1		Sless		11-16
P0184	DC Link Regul. Mode	0 = With losses 1 = Without losses 2 = Enab/Disab Dlx	1		cfg, Vector		11-22
P0185	DC Link Regul. Level	339 to 1000 V	800 V		Vector		11-23
P0186	DC Link Prop. Gain	0.0 to 63.9	26.0		Vector		11-23
P0187	DC Link Integral Gain	0.000 to 9.999	0.010		Vector		11-23
P0190	Max. Output Voltage	0 to 600 V	440 V		Vector		11-15
P0200	Password	0 = Inactive 1 = Active 2 = Change Pass.	1			HMI	5-2
P0202	Control Type	0 = V/f 60 Hz 1 = V/f 50 Hz 2 = V/f Adjustable 3 = VVW 4 = Sensorless	0		cfg		9-5
P0204	Load/Save Parameters	0 = Not Used 1 = Not Used 2 = Reset P0045 3 = Reset P0043 4 = Reset P0044 5 = Load 60 Hz 6 = Load 50 Hz 7 = Load User 1 8 = Load User 2 9 = Save User 1 10 = Save User 2	0		cfg		7-1
P0205	Main Display Parameter Sel.	0 to 1199	2			HMI	5-3
P0206	Secondary Display Parameter Sel.	0 to 1199	3			HMI	5-3
P0208	Main Display Scale Factor	0.1 to 1000.0 %	100.0 %			HMI	5-3

0

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0209	Main Display Eng. Unit	0 = None 1 = V 2 = A 3 = rpm 4 = s 5 = ms 6 = None 7 = m 8 = None 9 = None 10 = % 11 = °C 12 = None 13 = Hz 14 = None 15 = h 16 = W 17 = kW 18 = None 19 = None 20 = min 21 = °F 22 = bar 23 = mbar 24 = psi 25 = Pa 26 = kPa 27 = MPa 28 = mwc 29 = mca 30 = gal 31 = l 32 = in 33 = ft 34 = m³ 35 = ft³ 36 = gal/s 37 = gal/min 38 = gal/h 39 = l/s 40 = l/min 41 = l/h 42 = m/s 43 = m/min 44 = m/h 45 = ft/s 46 = ft/min 47 = ft/h 48 = m³/s 49 = m³/min 50 = m³/h 51 = ft³/s 52 = ft³/min 53 = ft³/h 54 = As per P0510 55 = As per P0512 56 = As per P0514 57 = As per P0516	3			HMI	5-5
P0210	Main Display Decimal Point	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz 4 = As per P0511 5 = As per P0513 6 = As per P0515 7 = As per P0517	0			HMI	5-4
P0211	Secondary Display Scale Factor	0.1 to 1000.0 %	100.0 %			HMI	5-3
P0212	Secondary Display Decimal Point	See options in P0210	1			HMI	5-4
P0216	HMI Backlighting	0 to 15	15			HMI	5-6

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0217	Zero Speed Disable	0 = Inactive 1 = Active (N* and N) 2 = Active (N*)	0		cfg		12-7
P0218	Zero Speed Dis. Out	0 = Ref. or Speed 1 = Reference	0				12-7
P0219	Zero Speed Time	0 to 999 s	0 s				12-8
P0220	LOC/REM Selection Src	0 = Always LOC 1 = Always REM 2 = LR Key LOC 3 = LR Key REM 4 = DIx 5 = Serial LOC 6 = Serial REM 7 = SoftPLC LOC 8 = SoftPLC REM	2		cfg	I/O	13-24
P0221	LOC Reference Sel.	0 = HMI 1 = AI1 2 = AI2 3 = AI3 4 = Sum AIs > 0 5 = Sum AIs 6 = Serial 7 = SoftPLC	0		cfg	I/O	13-24
P0222	REM Reference Sel.	See options in P0221	1		cfg	I/O	13-24
P0223	LOC FWD/REV Selection	0 = Forward 1 = Reverse 2 = FR Key FWD 3 = FR Key REV 4 = DIx 5 = Serial FWD 6 = Serial REV 7 = SoftPLC FWD 8 = SoftPLC REV 9 = AI2 Polarity	2		cfg	I/O	13-25
P0224	LOC Run/Stop Sel.	0 = I,O Keys 1 = DIx 2 = Serial 3 = SoftPLC	0		cfg	I/O	13-25
P0225	LOC JOG Selection	0 = Disable 1 = JOG Key 2 = DIx 3 = Serial 4 = SoftPLC	1		cfg	I/O	13-26
P0226	REM FWD/REV Sel.	See options in P0223	4		cfg	I/O	13-25
P0227	REM Run/Stop Sel.	See options in P0224	1		cfg	I/O	13-25
P0228	REM JOG Selection	See options in P0225	2		cfg	I/O	13-26
P0229	Stop Mode Selection	0 = Ramp to Stop 1 = Coast to Stop 2 = Fast Stop	0		cfg		13-26
P0230	Dead Zone (AIs)	0 = Inactive 1 = Active	0			I/O	13-1
P0231	AI1 Signal Function	0 = Speed Ref. 1 = No Ramp Ref. 2 = Max. Torque Cur 3 = SoftPLC 4 = PTC 5 = Main PID Feedback 1 6 = Main PID Feedback 2 7 = Main PID Feedback 3 8 = External PID 1 Feedback 9 = External PID 2 Feedback	5		cfg	I/O	13-2
P0232	AI1 Gain	0.000 to 9.999	1.000			I/O	13-3
P0233	AI1 Signal Type	0 = 0 to 10 V / 20 mA 1 = 4 to 20 mA 2 = 10 V / 20 mA to 0 3 = 20 to 4 mA 4 = -10 to +10 V	0		cfg	I/O	13-5
P0234	AI1 Offset	-100.00 to 100.00 %	0.00 %			I/O	13-3
P0235	AI1 Filter	0.00 to 16.00 s	0.15 s			I/O	13-4
P0236	AI2 Signal Function	See options in P0231	8		cfg	I/O	13-2

0

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0237	AI2 Gain	0.000 to 9.999	1.000			I/O	13-3
P0238	AI2 Signal Type	See options in P0233	0		cfg	I/O	13-5
P0239	AI2 Offset	-100.00 to 100.00 %	0.00 %			I/O	13-3
P0240	AI2 Filter	0.00 to 16.00 s	0.15 s			I/O	13-4
P0241	AI3 Signal Function	See options in P0231	9		cfg	I/O	13-2
P0242	AI3 Gain	0.000 to 9.999	1.000			I/O	13-3
P0243	AI3 Signal Type	0 = 0 to 20mA 1 = 4 to 20 mA 2 = 20 to 0 mA 3 = 20 to 4 mA	0		cfg	I/O	13-5
P0244	AI3 Offset	-100.00 to 100.00 %	0.00 %			I/O	13-3
P0245	AI3 Filter	0.00 to 16.00 s	0.15 s			I/O	13-4
P0246	Frequency Input Configuration	0 = Off 1 = DI3 2 = DI4	0		cfg		13-23
P0251	AO1 Function	0 = Speed Ref. 1 = Total Ref. 2 = Real Speed 3 = Torque Cur. Ref 4 = Torque Current 5 = Output Current 6 = Active Current 7 = Output Power 8 = Torque Cur. > 0 9 = Motor Torque 10 = SoftPLC 11 = PTC 12 = Motor Ixt 13 = P0696 Value 14 = P0697 Value 15 = Id* Current 16 = External PID 1 Output 17 = External PID 2 Output	16			I/O	13-6
P0252	AO1 Gain	0.000 to 9.999	1.000			I/O	13-7
P0253	AO1 Signal Type	0 = 0 to 10 V / 20 mA 1 = 4 to 20 mA 2 = 10 V / 20 mA to 0 3 = 20 to 4 mA	0		cfg	I/O	13-8
P0254	AO2 Function	See options in P0251	17			I/O	13-6
P0255	AO2 Gain	0.000 to 9.999	1.000			I/O	13-7
P0256	AO2 Signal Type	See options in P0253	0		cfg	I/O	13-8
P0263	DI1 Function	0 = Not Used 1 = Run/Stop 2 = General Enable 3 = Fast Stop 4 = FWD/REV 5 = LOC/REM 6 = JOG 7 = SoftPLC 8 = Ramp 2 9 = Speed/Torque 10 = JOG+ 11 = JOG- 12 = No Ext. Alarm 13 = No Ext. Fault 14 = Reset 15 = Disab.FlyStart 16 = DC Link Regul. 17 = Progr. Off 18 = Load User 1 19 = Load User 2 20 = Main PID Aut/Man 21 = External PID 1 Aut/Man 22 = External PID 2 Aut/Man 23 = Bypass Mode 24 = Fire Mode	1		cfg	I/O	13-10
P0264	DI2 Function	See options in P0263	4		cfg	I/O	13-10
P0265	DI3 Function	See options in P0263	0		cfg	I/O	13-10
P0266	DI4 Function	See options in P0263	20		cfg	I/O	13-10
P0267	DI5 Function	See options in P0263	21		cfg	I/O	13-10

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0268	DI6 Function	See options in P0263	22		cfg	I/O	13-10
P0269	DI7 Function	See options in P0263	0		cfg	I/O	13-10
P0270	DI8 Function	See options in P0263	0		cfg	I/O	13-10
P0275	DO1 Function (RL1)	0 = Not Used 1 = N* > Nx 2 = N > Nx 3 = N < Ny 4 = N = N* 5 = Zero Speed 6 = Is > Ix 7 = Is < Ix 8 = Torque > Tx 9 = Torque < Tx 10 = Remote 11 = Run 12 = Ready 13 = No Fault 14 = No F0070 15 = No F0071 16 = No F0006/21/22 17 = No F0051 18 = No F0072 19 = 4-20 mA OK 20 = P0695 Value 21 = Forward 22 = Ride-Through 23 = Pre-Charge OK 24 = Fault 25 = Enabled Time > Hx 26 = SoftPLC 27 = N>Nx/Nt>Nx 28 = F > Fx (1) 29 = F > Fx (2) 30 = STO 31 = No F0160 32 = No Alarm 33 = No Fault/Alarm 34 = Dry Pump Alarm/Fault 35 = Broken Belt Alarm/Fault 36 = Filter Mainten. Alarm/Fault 37 = Sleep Mode 38 = Not Used 39 = Drive Bypass Contactor 40 = Mains Bypass Contactor 41 = Fire Mode 42 = Self-Tuning	11		cfg	I/O	13-16
P0276	DO2 Function (RL2)	See options in P0275	24		cfg	I/O	13-16
P0277	DO3 Function	See options in P0275	0		cfg	I/O	13-16
P0278	DO4 Function	See options in P0275	0		cfg	I/O	13-16
P0279	DO5 Function	See options in P0275	0		cfg	I/O	13-16
P0281	Fx Frequency	0.0 to 300.0 Hz	4.0 Hz				13-21
P0282	Fx Hysteresis	0.0 to 15.0 Hz	2.0 Hz				13-21
P0287	Nx/Ny Hysteresis	0 to 900 rpm	18 (15) rpm				13-21
P0288	Nx Speed	0 to 18000 rpm	120 (100) rpm				13-21
P0289	Ny Speed	0 to 18000 rpm	1800 (1500) rpm				13-21
P0290	Ix Current	0 to 2xI$_{nom-ND}$	1.0xI$_{nom-ND}$				13-22
P0291	Zero Speed	0 to 18000 rpm	18 (15) rpm				13-22
P0292	N = N* Band	0 to 18000 rpm	18 (15) rpm				13-22
P0293	Tx Torque	0 to 200 %	100 %				13-22
P0294	Hx Time	0 to 6553 h	4320 h				13-23

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0295	ND/HD VFD Rated Curr.	0 = 2 A / 2 A 1 = 3.6 A / 3.6 A 2 = 5 A / 5 A 3 = 6 A / 5 A 4 = 7 A / 5.5 A 5 = 7 A / 7 A 6 = 10 A / 8 A 7 = 10 A / 10 A 8 = 13 A / 11 A 9 = 13.5 A / 11 A 10 = 16 A / 13 A 11 = 17 A / 13.5 A 12 = 24 A / 19 A 13 = 24 A / 20 A 14 = 28 A / 24 A 15 = 31 A / 25 A 16 = 33.5 A / 28 A 17 = 38 A / 33 A 18 = 45 A / 36 A 19 = 45 A / 38 A 20 = 54 A / 45 A 21 = 58.5 A / 47 A 22 = 70 A / 56 A 23 = 70.5 A / 61 A 24 = 86 A / 70 A 25 = 88 A / 73 A 26 = 105 A / 86 A 27 = 105 A / 88 A 28 = 142 A / 115 A 29 = 180 A / 142 A 30 = 211 A / 180 A 31 = 2.9 A / 2.7 A 32 = 4.2 A / 3.8 A 33 = 7 A / 6.5 A 34 = 10 A / 9 A 35 = 12 A / 10 A 36 = 17 A / 17 A 37 = 22 A / 19 A 38 = 27 A / 22 A 39 = 32 A / 27 A 40 = 44 A / 36 A 41 = 53 A / 44 A 42 = 63 A / 53 A 43 = 80 A / 66 A 44 = 107 A / 90 A 45 = 125 A / 107 A 46 = 150 A / 122 A			ro	READ	6-6
P0296	Line Rated Voltage	0 = 200 / 240 V 1 = 380 V 2 = 400 / 415 V 3 = 440 / 460 V 4 = 480 V 5 = 500 / 525 V 6 = 550 / 575 V 7 = 600 V	According to inverter model		cfg		6-7
P0297	Switching Frequency	0 = 1.25 kHz 1 = 2.5 kHz 2 = 5.0 kHz 3 = 10.0 kHz 4 = 2.0 kHz	According to inverter model		cfg		6-7
P0298	Application	0 = Normal Duty 1 = Heavy Duty	0		cfg		6-8
P0299	DC-Braking Start Time	0.0 to 15.0 s	0.0 s		V/f, VVW, Sless		12-16
P0300	DC-Braking Stop Time	0.0 to 15.0 s	0.0 s		V/f, VVW, Sless		12-16
P0301	DC-Braking Speed	0 to 450 rpm	30 rpm		V/f, VVW, Sless		12-18
P0302	DC-Braking Voltage	0.0 to 10.0 %	2.0 %		V/f, VVW		12-18
P0303	Skip Speed 1	0 to 18000 rpm	600 rpm				12-19

0

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0304	Skip Speed 2	0 to 18000 rpm	900 rpm				12-19
P0305	Skip Speed 3	0 to 18000 rpm	1200 rpm				12-19
P0306	Skip Band	0 to 750 rpm	0 rpm				12-19
P0308	Serial Address	1 to 247	1			NET	17-1
P0310	Serial Baud Rate	0 = 9600 bits/s 1 = 19200 bits/s 2 = 38400 bits/s 3 = 57600 bits/s 4 = Reserved	1			NET	17-1
P0311	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			NET	17-1
P0312	Serial Protocol	2 = Modbus RTU 3 = BACnet 4 = N2	2			NET	17-1
P0313	Comm. Error Action	0 = Off 1 = Ramp Stop 2 = General Disab. 3 = Go to LOC 4 = LOC Keep Enab. 5 = Cause Fault	1			NET	17-2
P0314	Serial Watchdog	0.0 to 999.0 s	0.0 s			NET	17-1
P0316	Serial Interf. Status	0 = Off 1 = On 2 = Watchdog Error			ro	NET	17-1
P0317	Oriented Start-up	0 = No 1 = Yes	0		cfg	STARTUP	7-2
P0318	Copy Function MMF	0 = Off 1 = VFD → MMF 2 = MMF → VFD 3 = Sync VFD → MMF 4 = Format MMF 5 = Copy SoftPLC Program. 6 = SoftPLC Program Save	0		cfg		7-2
P0320	FlyStart/Ride-Through	0 = Off 1 = Flying Start 2 = FS/RT 3 = Ride-Through	0		cfg		12-8
P0321	DC Link Power Loss	178 to 770 V	505 V		Vector		12-14
P0322	DC Link Ride-Through	178 to 770 V	490 V		Vector		12-14
P0323	DC Link Power Back	178 to 770 V	535 V		Vector		12-14
P0325	Ride-Through P Gain	0.0 to 63.9	22.8		Vector		12-15
P0326	Ride-Through I Gain	0.000 to 9.999	0.128		Vector		12-15
P0327	F.S. I/f Current Ramp	0.000 to 1.000 s	0.070 s		Sless		12-10
P0328	Flying Start Filter	0.000 to 1.000 s	0.085 s		Sless		12-10
P0329	Frequency Ramp F. S.	2.0 to 50.0	20.0		Sless		12-10
P0331	Voltage Ramp	0.2 to 60.0 s	2.0 s		V/f, VVW		12-12
P0332	Dead Time	0.1 to 10.0 s	1.0 s		V/f, VVW		12-12
P0340	Auto-reset Time	0 to 255 s	0 s				15-8
P0341	AIPTC Configuration	0 = Off 1 = Fault/Alarm 2 = Fault 3 = Alarm	0		cfg	I/O	15-8
P0342	Motor Unbal. Curr. Conf	0 = Off 1 = On	0		cfg		15-9
P0343	Ground Fault Config.	0 = Off 1 = On	1		cfg		15-9
P0344	Current Lim. Conf.	0 = Hold 1 = Decel.	1		cfg, V/f, VVW		9-6
P0348	Motor Overload Conf.	0 = Off 1 = Fault/Alarm 2 = Fault 3 = Alarm	1		cfg		15-10
P0349	Ixt Alarm Level	70 to 100 %	85 %		cfg		15-10

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0350	IGBTs Overload Conf.	0 = F, w/ SF rd. 1 = F/A, w/ SF rd. 2 = F, no SF rd. 3 = F/A, no SF rd.	1		cfg		15-11
P0351	Motor Overtemp. Conf.	0 = Off 1 = Fault/Alarm 2 = Fault 3 = Alarm	1		cfg		15-11
P0352	Fan Control Config.	0 = HS-OFF, Int-OFF 1 = HS-ON, Int-ON 2 = HS-CT, Int-CT 3 = HS-CT, Int-OFF 4 = HS-CT, Int-ON 5 = HS-ON, Int-OFF 6 = HS-ON, Int-CT 7 = HS-OFF, Int-ON 8 = HS-OFF, Int-CT 9 = HS-CT, Int -CT * 10 = HS-CT, Int -OFF * 11 = HS-CT, Int -ON * 12 = HS-ON, Int -CT * 13 = HS-OFF, Int -CT *	2		cfg		15-12
P0353	IGBTs/Air Overtemp. Cfg	0 = HS-F/A, Air-F/A 1 = HS-F/A, Air-F 2 = HS-F, Air-F/A 3 = HS-F, Air-F 4 = HS-F/A, Air-F/A * 5 = HS-F/A, Air-F * 6 = HS-F, Air-F/A * 7 = HS-F, Air-F *	0		cfg		15-13
P0354	Fan Speed Config.	0 = Inactive 1 = Fault	1		cfg		15-14
P0355	F0185 Fault Config.	0 = Off 1 = On	1		cfg		15-14
P0356	Dead Time Compens.	0 = Off 1 = On	1		cfg		15-15
P0357	Line Phase Loss Time	0 to 60 s	3 s				15-15
P0360	Speed Hysteresis	0.0 to 100.0 %	10.0 %		Vector		11-21
P0361	Time with Speed Different from Reference	0.0 to 999.0 s	0.0 s		Vector		11-22
P0372	DC-Braking Curr. Sless	0.0 to 90.0 %	40.0 %		Sless		12-18
P0397	Slip Compens. Regen.	0 = Off 1 = On	1		cfg, VVW		10-3
P0398	Motor Service Factor	1.00 to 1.50	1.00		cfg	MOTOR	11-7
P0399	Motor Rated Eff.	50.0 to 99.9 %	67.0 %		cfg, VVW	MOTOR	10-3
P0400	Motor Rated Voltage	0 to 600 V	440 V		cfg	MOTOR	11-8
P0401	Motor Rated Current	0 to $1.3xI_{nom-ND}$	$1.0xI_{nom-ND}$		cfg	MOTOR	11-8
P0402	Motor Rated Speed	0 to 18000 rpm	1750 (1458) rpm		cfg	MOTOR	11-8
P0403	Motor Rated Frequency	0 to 300 Hz	60 (50) Hz		cfg	MOTOR	11-9

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0404	Motor Rated Power	0 = 0.33 hp / 0.25 kW 1 = 0.5 hp / 0.37 kW 2 = 0.75 hp / 0.55 kW 3 = 1 hp / 0.75 kW 4 = 1.5 hp / 1.1 kW 5 = 2 hp / 1.5 kW 6 = 3 hp / 2.2 kW 7 = 4 hp / 3 kW 8 = 5 hp / 3.7 kW 9 = 5.5 hp / 4 kW 10 = 6 hp / 4.5 kW 11 = 7.5 hp / 5.5 kW 12 = 10 hp / 7.5 kW 13 = 12.5 hp / 9 kW 14 = 15 hp / 11 kW 15 = 20 hp / 15 kW 16 = 25 hp / 18.5 kW 17 = 30 hp / 22 kW 18 = 40 hp / 30 kW 19 = 50 hp / 37 kW 20 = 60 hp / 45 kW 21 = 75 hp / 55 kW 22 = 100 hp / 75 kW 23 = 125 hp / 90 kW 24 = 150 hp / 110 kW 25 = 175 hp / 130 kW	Motor$_{max-ND}$		cfg	MOTOR	11-9
P0406	Motor Ventilation	0 = Self-Vent. 1 = Separate Vent. 2 = Optimal Flux 3 = Extended Protection	0		cfg	MOTOR	11-10
P0407	Motor Rated Power Fac	0.50 to 0.99	0.68		cfg, V/f, VVW	MOTOR	10-4 19-7
P0408	Run Self-Tuning	0 = No 1 = No Rotation 2 = Run for I$_m$	0		cfg, VVW, Vector	MOTOR	11-17
P0409	Stator Resistance	0.000 to 9.999 Ω	0.000 Ω		cfg, VVW, Vector	MOTOR	11-18
P0410	Magnetization Current	0 to 1.25xI$_{nom-ND}$	I$_{nom-ND}$			MOTOR	11-18
P0411	Leakage Inductance	0.00 to 99.99 mH	0.00 mH		cfg, Vector	MOTOR	11-19
P0412	T$_r$ Time Constant	0.000 to 9.999 s	0.000 s		Vector	MOTOR	11-19
P0413	T$_m$ Time Constant	0.00 to 99.99 s	0.00 s		Vector	MOTOR	11-20

0

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0510	Ind. Eng. Unit 1	0 = None 1 = V 2 = A 3 = rpm 4 = s 5 = ms 6 = None 7 = m 8 = None 9 = None 10 = % 11 = °C 12 = None 13 = Hz 14 = None 15 = h 16 = W 17 = kW 18 = None 19 = None 20 = min 21 = °F 22 = bar 23 = mbar 24 = psi 25 = Pa 26 = kPa 27 = MPa 28 = mwc 29 = mca 30 = gal 31 = l 32 = in 33 = ft 34 = m³ 35 = ft³ 36 = gal/s 37 = gal/min 38 = gal/h 39 = l/s 40 = l/min 41 = l/h 42 = m/s 43 = m/min 44 = m/h 45 = ft/s 46 = ft/min 47 = ft/h 48 = m³/s 49 = m³/min 50 = m³/h 51 = ft³/s 52 = ft³/min 53 = ft³/h	22			HMI	5-7
P0511	Ind. Decimal Point 1	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz	1			HMI	5-8
P0512	Ind. Eng. Unit 2	See options in P0510	11			HMI	5-9
P0513	Ind. Decimal Point 2	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz	1			HMI	5-10
P0514	Ind. Eng. Unit 3	See options in P0510	10			HMI	5-11
P0515	Ind. Decimal Point 3	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz	1			HMI	5-12
P0516	Ind. Eng. Unit 4	See options in P0510	13			HMI	5-13

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0517	Ind. Decimal Point 4	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz	1			HMI	5-14
P0579	Reference to Fire Mode	0 to 18000 rpm	1800 (1500) rpm			HVAC	19-2
P0580	Fire Mode Configuration	0 = Disabled 1 = Enabled 2 = Enabled/P0579 3 = Enabled/P0581 4 = Enabled/Gen. Disable	0		cfg	HVAC	19-3
P0581	Fire Mode PID Setpoint	-32768 to 32767	0			HVAC	19-3
P0582	Auto-reset Configuration	0 = Limited 1 = Unlimited	0		cfg	HVAC	19-3
P0583	Bypass Mode Configuration	0 = Off 1 = On/DIx 2 = On/DIx+Fault	0		cfg	HVAC	19-6
P0584	Bypass Contactor Time	0.00 to 300.00 s	0.30 s			HVAC	19-7
P0585	Short Cycle Protection Config.	0 = Off 1 = On	0		cfg	HVAC	19-9
P0586	Minimum RUN Time	0.00 to 650.00 s	5.00 s			HVAC	19-9
P0587	Minimum STOP Time	0.00 to 650.00 s	5.00 s			HVAC	19-9
P0588	Maximum Torque Level	0 to 85 %	0 %		cfg, V/f	HVAC	19-8
P0589	Energy Saving Min. Mag.	40 to 80 %	40 %		cfg, V/f	HVAC	19-8
P0590	Energy Saving Min. Speed	0 to 18000 rpm	600 (525) rpm		cfg, V/f	HVAC	19-8
P0591	Energy Saving Histeresis	0 to 30 %	10 %		cfg, V/f	HVAC	19-8
P0613	Firmware Revision	-32768 to 32767	0		ro		16-7
P0614	PLD Revision	-32768 to 32767	0		ro		16-8
P0680	Logical Status	Bit 0 = Not Used Bit 1 = Run Command Bit 2 = Fire Mode Bit 3 = Bypass Bit 4 = Quick Stop ON Bit 5 = 2nd Ramp Bit 6 = Config. Mode Bit 7 = Alarm Bit 8 = Running Bit 9 = Enabled Bit 10 = Forward Bit 11 = JOG Bit 12 = Remote Bit 13 = Subvoltage Bit 14 = Not Used Bit 15 = Fault			ro	READ, NET	17-2
P0681	Speed in 13 bits	-32768 to 32767			ro	READ, NET	17-2
P0682	Serial Control Word	Bit 0 = Ramp Enable Bit 1 = General Enable Bit 2 = Run Forward Bit 3 = JOG Enable Bit 4 = Remote Bit 5 = 2nd Ramp Bit 6 = Quick Stop Bit 7 = Fault Reset Bit 8 to 12 = Reserved Bit 13 = Internal PID Bit 14 = External PID 1 Bit 15 = External PID 2			ro	READ, NET	17-1 17-2
P0683	Serial Speed Ref.	-32768 to 32767			ro	READ, NET	17-1 17-2
P0692	Operating Mode States	0 to 65535	0		ro		16-8
P0695	DOx Value	Bit 0 = DO1 Bit 1 = DO2 Bit 2 = DO3 Bit 3 = DO4 Bit 4 = DO5	Bit 4			NET	17-2
P0696	AOx Value 1	-32768 to 32767	0			NET	17-2
P0697	AOx Value 2	-32768 to 32767	0			NET	17-2
P0760	BACnet Dev Inst High	0 to 419	0			NET	17-1

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P0761	BACnet Dev Inst Low	0 to 9999	0			NET	17-1
P0762	Max. Number of Master	0 to 127	127			NET	17-1
P0763	MS/TP Max. Info Frame	1 to 65535	1			NET	17-1
P0764	I-AM Msg Transmition	0 = Power Up 1 = Continuos	0			NET	17-1
P0765	Token RX Qtde	0 to 65535			ro	READ, NET	17-1
P1000	SoftPLC Status	0 = No Application 1 = Install. App. 2 = Incompat. App. 3 = App. Stopped 4 = App. Running			ro	READ, HVAC	18-1
P1001	SoftPLC Command	0 = Stop Application 1 = Run Application 2 = Delete Application	1			HVAC	18-1
P1002	Scan Cycle Time	0.0 to 999.9 ms			ro	READ, HVAC	18-1
P1003	SoftPLC Appl. Sel.	0 = User 1 = HVAC	1		cfg	HVAC	18-2
P1010	Version of the HVAC Application	0.00 to 10.00			ro	HVAC	19-39
P1011	Main PID Aut. Setpoint	-32768 to 32767	0			HVAC	19-14
P1012	SoftPLC Parameter 3	-32768 to 32767	0			HVAC	18-2
P1013	SoftPLC Parameter 4	-32768 to 32767	0			HVAC	18-2
P1014	Main PID Man. Setpoint	0.0 to 100.0 %	0.0 %			HVAC	19-14
P1015	Main PID Process Variable	-32768 to 32767			ro	READ, HVAC	19-14
P1016	Main PID Output	0.0 to 100.0 %			ro	READ, HVAC	19-15
P1017	Main PID Act. Control	0 = Disable PID 1 = Direct Mode 2 = Reverse Mode	0		cfg	HVAC	19-15
P1018	Main PID Operation Mode	0 = Always Automatic 1 = Always Manual 2 = A/M DI w/o bumpless 3 = A/M Net w/o bumpless 4 = A/M DI w/ bumpless 5 = A/M Net w/ bumpless	0			HVAC	19-16
P1019	Main PID Sampling Time	0.10 to 60.00 s	0.10 s			HVAC	19-16
P1020	Main PID P. Gain	0.000 to 32.767	1.000			HVAC	19-17
P1021	Main PID I. Gain	0.000 to 32.767	0.430			HVAC	19-17
P1022	Main PID D. Gain	0.000 to 32.767	0.000			HVAC	19-17
P1023	Main PID Output Min. Value	0.0 to 100.0 %	0.0 %			HVAC	19-17
P1024	Main PID Output Max. Value	0.0 to 100.0 %	100.0 %			HVAC	19-18
P1025	SoftPLC Parameter 16	-32768 to 32767	0			HVAC	18-2
P1026	Main PID Feedback Conf.	0 = Sum Feed. 1, 2 and 3 1 = Difference Feed. 1 and 2 2 = Average Feed. 1, 2 and 3 3 = Minimum Feed. 1, 2 and 3 4 = Maximum Feed. 1, 2 and 3	0		cfg	HVAC	19-18
P1027	Main PID Min. Feedback	-32768 to 32767	0			HVAC	19-18
P1028	Main PID Max. Feedback	-32768 to 32767	1000			HVAC	19-19
P1029	SoftPLC Parameter 20	-32768 to 32767	0			HVAC	18-2
P1030	Main PID Fdbck Alarms Conf.	0 = Disable 1 = Enable Alarm 2 = Enable Fault	0			HVAC	19-19
P1031	M. PID Fdbck Alarm Low V.	-32768 to 32767	50			HVAC	19-20
P1032	M. PID Fdbck Alarm Low T.	0.00 to 650.00 s	5.00 s			HVAC	19-20
P1033	M. PID Fdbck Alarm High V.	-32768 to 32767	900			HVAC	19-20
P1034	M. PID Fdbck Alarm Hig T.	0.00 to 650.00 s	5.00 s			HVAC	19-21
P1035	SoftPLC Parameter 26	-32768 to 32767	0			HVAC	18-2
P1036	Sleep Mode Speed	0 to 18000	350			HVAC	19-21
P1037	Sleep Mode Time	0.00 to 650.00 s	5.00 s			HVAC	19-22
P1038	Wake Up Main Deviation	0.0 to 100.0 %	5.0 %			HVAC	19-22
P1039	Wake Up Main Time	0.00 to 650.00 s	10.00 s			HVAC	19-22

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P1040	HVAC Fun. Log. Status	0000h to FFFFh			ro	READ, HVAC	19-38
P1041	SoftPLC Parameter 32	-32768 to 32767	0			HVAC	18-2
P1042	Dry Pump Config.	0 = Disable 1 = Enable Alarm 2 = Enable Fault	0		cfg	HVAC	19-10
P1043	Dry Pump Speed	0 to 18000	400			HVAC	19-10
P1044	Dry Pump Torque	0.0 to 350.0 %	20.0 %			HVAC	19-10
P1045	Dry Pump Time	0.00 to 650.00 s	20.00 s			HVAC	19-11
P1046	Broken Belt Config.	0 = Disable 1 = Enable Alarm 2 = Enable Fault	0		cfg	HVAC	19-11
P1047	Broken Belt Speed	0 to 18000	400			HVAC	19-11
P1048	Broken Belt Torque	0.0 to 350.0 %	20.0 %			HVAC	19-12
P1049	Broken Belt Time	0.00 to 650.00 s	20.00 s			HVAC	19-12
P1050	Filter Mainten. Alarm Conf.	0 = Disable 1 = Enable Alarm 2 = Enable Fault	0		cfg	HVAC	19-12
P1051	Filter Mainten. Alarm Time	0 to 32000 h	5000 h			HVAC	19-13
P1052	Filter Mainten. Alarm Counter	0 to 32000 h			ro	READ, HVAC	19-13
P1053	SoftPLC Parameter 44	-32768 to 32767	0			HVAC	18-2
P1054	SoftPLC Parameter 45	-32768 to 32767	0			HVAC	18-2
P1055	SoftPLC Parameter 46	-32768 to 32767	0			HVAC	18-2
P1056	SoftPLC Parameter 47	-32768 to 32767	0			HVAC	18-2
P1057	SoftPLC Parameter 48	-32768 to 32767	0			HVAC	18-2
P1058	SoftPLC Parameter 49	-32768 to 32767	0			HVAC	18-2
P1059	SoftPLC Parameter 50	-32768 to 32767	0			HVAC	18-2
P1060	Ext. PID 1 Aut. Setpoint	-32768 to 32767	0			HVAC	19-24
P1061	Ext. PID 1 Man. Setpoint	0.0 to 100.0 %	0.0 %			HVAC	19-24
P1062	Ext. PID 1 Feedback	-32768 to 32767			ro	READ, HVAC	19-25
P1063	Ext. PID 1 Output	0.0 to 100.0 %			ro	READ, HVAC	19-25
P1064	Ext. PID 1 Act. Control	0 = Disable PID 1 = Direct Mode 2 = Reverse Mode	0		cfg	HVAC	19-25
P1065	Ext. PID 1 Operation Mode	0 = Always Automatic 1 = Always Manual 2 = A/M DI w/o bumpless 3 = A/M Net w/o bumpless 4 = A/M DI w/ bumpless 5 = A/M Net w/ bumpless	0			HVAC	19-26
P1066	Ext. PID 1 Sampling Time	0.10 to 60.00 s	0.10 s			HVAC	19-27
P1067	Ext. PID 1 P. Gain	0.000 to 32.767	1.000			HVAC	19-27
P1068	Ext. PID 1 I. Gain	0.000 to 32.767	0.430			HVAC	19-27
P1069	Ext. PID 1 D. Gain	0.000 to 32.767	0.000			HVAC	19-27
P1070	Ext. PID 1 Output Min. Value	0.0 to 100.0 %	0.0 %			HVAC	19-28
P1071	Ext. PID 1 Output Max. Value	0.0 to 100.0 %	100.0 %			HVAC	19-28
P1072	SoftPLC Parameter 63	-32768 to 32767	0			HVAC	18-2
P1073	Ext. PID 1 Min. Feedback	-32768 to 32767	0			HVAC	19-28
P1074	Ext. PID 1 Max. Feedback	-32768 to 32767	1000			HVAC	19-28
P1075	Ext. PID 1 Fdbck Alarms Conf.	0 = Disable 1 = Enable Alarm 2 = Enable Fault	0			HVAC	19-29
P1076	Ext. PID 1 Fdbck Alarm Low V.	-32768 to 32767	2			HVAC	19-29
P1077	Ext. PID 1 Fdbck Alarm Low T.	0.00 to 650.00 s	5.00 s			HVAC	19-30
P1078	Ext. PID 1 Fdbck Alarm High V.	-32768 to 32767	900			HVAC	19-30
P1079	Ext. PID 1 Fdbck Alarm Hig T.	0.00 to 650.00 s	5.00 s			HVAC	19-30
P1080	Ext. PID 2 Aut. Setpoint	-32768 to 32767	0			HVAC	19-31
P1081	Ext. PID 2 Man. Setpoint	0.0 to 100.0 %	0.0 %			HVAC	19-32
P1082	Ext. PID 2 Feedback	-32768 to 32767			ro	READ, HVAC	19-32

0

Param.	Function	Adjustable Range	Factory Setting	User Setting	Propr.	Groups	Pág.
P1083	Ext. PID 2 Output	0.0 to 100.0 %			ro	READ, HVAC	19-32
P1084	Ext. PID 2 Act. Control	0 = Disable PID 1 = Direct Mode 2 = Reverse Mode	0		cfg	HVAC	19-32
P1085	Ext. PID 2 Operation Mode	0 = Always Automatic 1 = Always Manual 2 = A/M DI w/o bumpless 3 = A/M Net w/o bumpless 4 = A/M DI w/ bumpless 5 = A/M Net w/ bumpless	0			HVAC	19-33
P1086	Ext. PID 2 Sampling Time	0.10 to 60.00 s	0.10 s			HVAC	19-34
P1087	Ext. PID 2 P. Gain	0.000 to 32.767	1.000			HVAC	19-34
P1088	Ext. PID 2 I. Gain	0.000 to 32.767	0.430			HVAC	19-34
P1089	Ext. PID 2 D. Gain	0.000 to 32.767	0.000			HVAC	19-35
P1090	Ext. PID 2 Output Min. Value	0.0 to 100.0 %	0.0 %			HVAC	19-35
P1091	Ext. PID 2 Output Max. Value	0.0 to 100.0 %	100.0 %			HVAC	19-35
P1092	SoftPLC Parameter 83	-32768 to 32767	0			HVAC	18-2
P1093	Ext. PID 2 Min. Feedback	-32768 to 32767	0			HVAC	19-35
P1094	Ext. PID 2 Max. Feedback	-32768 to 32767	1000			HVAC	19-36
P1095	Ext. PID 2 Fdbck Alarms Conf.	0 = Disable 1 = Enable Alarm 2 = Enable Fault	0			HVAC	19-36
P1096	Ext. PID 2 Fdbck Alarm Low V.	-32768 to 32767	2			HVAC	19-37
P1097	Ext. PID 2 Fdbck Alarm Low T.	0.00 to 650.00 s	5.00 s			HVAC	19-37
P1098	Ext. PID 2 Fdbck Alarm High V.	-32768 to 32767	900			HVAC	19-37
P1099	Ext. PID 2 Fdbck Alarm Hig T.	0.00 to 650.00 s	5.00 s			HVAC	19-38

Notes:

ro = Read-only parameter

rw = Reading/writing parameter

cfg = Configuration parameter, it can be changed only with stopped motor

V/f = Parameter available in V/f mode

Adj = Parameter available only in adjustable V/f mode

VVW = Parameter available in VVW mode

Vector = Parameter available in vector mode

Sless = Parameter available only in sensorless mode

Fault/Alarm	Description	Possible Causes
F0006: Input Voltage Imbalance or Phase Loss	The mains voltage imbalance is too high or phase loss at the supply line has occurred. **Note:** - This fault may not occur if the load at the motor shaft is too low or nonexistent. P0357 sets the time for the trip, and P0357 = 0 disables this fault.	■ A Phase Loss at the inverter input. ■ The input voltage imbalance is > 5 %.
F0021: DC Link Undervoltage	A DC link undervoltage condition has occurred.	■ The input voltage is too low and the DC link voltage dropped below the minimum permitted value (monitor the P0004 parameter value): Ud < 223 V - 200 / 240 V three-phase input voltage; Ud < 170 V - 200 / 240 V single-phase input voltage (CFW701XXXXS2 or CFW701XXXXB2 models) (P0296 = 0); Ud < 385 V - 380 V input voltage (P0296 = 1); Ud < 405 V - 400 / 415 V input voltage (P0296 = 2); Ud < 446 V - 440 / 460 V input voltage (P0296 = 3); Ud < 487 V - 480 V input voltage (P0296 = 4); Ud < 530 V - input voltage 500 / 525 V (P0296 = 5); Ud < 580 V - input voltage 550 / 575 V (P0296 = 6); Ud < 605 V - input voltage 600 V (P0296 = 7). ■ Phase loss at the inverter input. ■ Pre-charge circuit failure. ■ Parameter P0296 was set to a value higher than the power supply rated voltage.
F0022: DC Link Overvoltage	A DC link overvoltage condition has occurred.	■ Too high input voltage, resulting in a DC link voltage higher than the maximum permitted value: Ud > 400 V - 220 / 230 V models (P0296 = 0); Ud > 800 V - 380 / 480 V models (P0296 = 1, 2, 3, or 4); Ud > 1000 V - 500 / 600 V models (P0296 = 5, 6 or 7). ■ The inertia of the driven-load is too high or the deceleration time is too short. ■ The parameter P0151, P0153 or P0185 setting is too high.
A0046: High Load at the Motor	It is the motor overload alarm. **Note:** It can be disabled by setting P0348 = 0 or 2.	■ The settings of P0156, P0157 and P0158 are too low for the used motor. ■ There is excessive load at the motor shaft.
A0047: IGBT Overload Alarm	It is the IGBT overload alarm. **Note:** It can be disabled by setting P0350 = 0 or 2.	■ The inverter output current is too high.
F0048: IGBT Overload Fault	It is the IGBT overload fault.	■ The inverter output current is too high.
A0050: IGBT High Temperature	The NTC temperature sensors located in the IGBTs detected a high temperature alarm. **Note:** It can be disabled by setting P0353 = 2 or 3.	■ High surrounding air temperature (>50 °C (122 °F)) and high output current. ■ Blocked or defective fan. ■ Very dirty heatsink.
F0051: IGBT Overtemperature	The NTC temperature sensors located in the IGBTs detected a high temperature fault.	
F0070: Overcurrent/ Short-circuit	An overcurrent or a short-circuit at the output, at the DC link or at the braking resistor, has occurred.	■ Short-circuit between two motor phases. ■ Short-circuit between the dynamic braking resistor connection cables. ■ Shorted IGBT modules.
F0071: Output Overcurrent	An output overcurrent has occurred.	■ Excessive load inertia or too short acceleration ramp. ■ P0135, or P0169 and P0170 settings are too high.
F0072: Motor Overload	The motor overload protection has tripped. **Note:** It can be disabled by setting P0348 = 0 or 3.	■ The settings of P0156, P0157 and P0158 are too low for the used motor. ■ There is excessive load at the motor shaft.
F0074: Ground Fault	A ground fault occurred either in the cable between the inverter and the motor or in the motor itself. **Note:** It can be disabled by setting P0343 = 0.	■ Short-circuit to the ground in one or more output phases. ■ Motor cable capacitance is too large, resulting in current peaks at the output.
F0076: Motor Current Unbalance	Fault of motor current unbalance. **Note:** It may be disabled by setting P0342 = 0.	■ Loose connection or broken wiring between the motor and inverter connection. ■ Vector control with wrong orientation. ■ Vector control with encoder, encoder wiring or encoder motor connection inverted.

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Fault/Alarm	Description	Possible Causes
F0078: Motor Overtemperature	Fault related to the PTC temperature sensor installed in the motor. **Note:** - It can be disabled by setting P0351 = 0 or 3. - An analog input and an analog output must be set for the PTC function.	■ Excessive load at the motor shaft. ■ Severe duty cycle (too many starts / stops per minute). ■ Too high surrounding air temperature. ■ Loose connection or short-circuit (resistance < 100 Ω) in the wiring connected to the motor thermistors. ■ Not installed motor thermistors. ■ Blocked motor shaft.
F0080: CPU Watchdog	Microcontroller watchdog fault.	■ Electrical noise.
F0084: Auto-Diagnosis Fault	Auto-Diagnosis Fault.	■ Defect in the inverter internal circuitry. ■ Firmware incompatible with an accessory.
A0090: External Alarm	External alarm monitored through a digital input. **Note:** It is necessary to program a digital input for "No external alarm".	■ A digital input (DI1 to DI8) programmed for "No external alarm" is open.
F0091: External Fault	External fault monitored through a digital input. **Note:** It is necessary to program a digital input for "No external fault".	■ A digital input (DI1 to DI8) programmed for "No external fault" is open.
A0098: Activate General Enable	General Enable signal is missing during the self-tuning.	■ The digital input programmed for "General Enable" is open.
F0099: Invalid Current Offset	The current measurement circuit is presenting an abnormal value for null current.	■ Defect in the inverter internal circuitry.
A0110: High Motor Temperature	Fault detected through PTC type temperature sensors installed in the motor. **Note:** - It can be disabled by setting P0351 = 0 or 2. - An analog input and an analog output must be set for the PTC function.	■ Excessive load at the motor shaft. ■ Severe duty cycle (too many starts / stops per minute). ■ Too high surrounding air temperature. ■ Not installed motor thermistors. ■ Blocked motor shaft.
A0128: Serial Communication Timeout	It indicates that the inverter stopped receiving valid telegrams during a certain period. **Note:** It can be disabled by setting P0314 = 0.0 s	■ Check the wiring and the ground installation. ■ Make sure that the inverter has sent a new message within the time interval set at P0314.
F0150: Motor Overspeed	Overspeed fault. It trips when the actual speed exceeds the value of $P0134 \times \frac{(100\ \% + P0132)}{100\%}$ for more than 20 ms.	■ Wrong settings of P0161 and/or P0162. ■ Problem with a hoist-type load.
F0151: FLASH Memory Module Fault	FLASH Memory Module (MMF-01) fault.	■ Defective FLASH memory module. ■ Check the connection of the FLASH memory module.
A0152: High Internal Air Temperature	This alarm indicates that the internal air temperature is too high. **Note:** It can be disabled by setting P0353 = 1 or 3.	■ High surrounding air temperature (>50 °C (122 °F)) and high output current. ■ Defective internal fan (if existent). ■ High temperature (> 45 ºC) inside the cabinet.
F0153: Internal Air Overtemperature	It indicates internal air overtemperature fault.	■ High surrounding air temperature (>50 °C (122 °F)) and high output current. ■ Defective internal fan (if existent).
F0156: Undertemperature	The temperature sensors located in the IGBTs or in the rectifier detected a low temperature, below -30 °C (-22 °F), fault.	■ Surrounding air temperature ≤ -30 °C (-22 °F).
F0157: Parameter Table Data Loss	There was a problem during the initialization, during the parameter table loading routine. Some recent parameter modifications may have been lost.	■ The control was switched off very fast while a parameter was being modified.
F0158: Parameter Table Fault	There was a problem during the initialization, during the parameter table loading routine. All the parameters were lost and the factory settings were loaded.	■ Firmware updating fault. ■ Defective control board.
A0159: Incompatible HMI	Incompatible HMI	■ HMI of another product being used.
F0160: Safety Stop Relays	Safety stop relay fault.	■ One of the relays is defective or it does not have +24 V applied to its coil.
A0163: AI1 Broken Cable	It indicates that the AI1 current (4-20 mA or 20-4 mA) reference is out of the 4 to 20 mA range.	■ Broken AI1 cable. ■ Bad contact at the connection of the signal to the terminal strip.

Fault/Alarm	Description	Possible Causes
A0164: AI2 Broken Cable	It indicates that the AI2 current (4-20 mA or 20-4 mA) reference is out of the 4 to 20 mA range.	■ Broken AI2 cable. ■ Bad contact at the connection of the signal to the terminal strip.
A0165: AI3 Broken Cable	It indicates that the AI3 current (4-20 mA or 20-4 mA) reference is out of the 4 to 20 mA range.	■ Broken AI3 cable. ■ Bad contact at the connection of the signal to the terminal strip.
A0168: Speed Error too High	Difference between speed reference and effective speed greater than the setting in P0360.	Inverter in torque current limitation.
F0169: Speed Error too High	Difference between speed reference and effective speed greater than the setting in P0360 for longer than P0361.	Inverter in torque current limitation for too long.
A0170: Safety Stop	The Safety Stop function is active.	■ The CFW701 went to the STO state.
A0177: Fan Replacement	Fan replacement alarm (P0045 > 50000 hours). **Note:** This function can be disabled by setting P0354 = 0.	■ The heatsink fan maximum number of operating hours has been reached.
F0179: Heatsink Fan Speed Fault	This fault indicates a problem with the heatsink fan. **Note:** This function can be disabled by setting P0354 = 0.	■ Dirt on the blades and in the bearings of the fan. ■ Defective fan. ■ Defective fan power supply connection.
F0182: Pulse Feedback Fault	It indicates a fault in the output pulses feedback.	■ Defect in the inverter internal circuitry.
F0183: IGBT Overload + Temperature	Overtemperature related to the IGBT overload protection.	■ Too high inverter surrounding temperature. ■ Operation with frequencies < 10 Hz with overload.
F0185: Pre-Charge Contactor Fault	It indicates a fault at the pre-charge contactor.	■ Defective pre-charge contactor. ■ Open command fuse. ■ Phase loss at the L1/R or L2/S input. ■ P0355 = 1 (incorrect setting for mechanical models "E" powered by the DC Link. For these models should be set P0355 = 0).
A0210: Drive in Bypass mode	Indicates that the drive is in Bypass mode.	The digital input programmed for activating the Bypass mode is active.
A0211: Drive in Fire Mode	Indicates that the drive is in Fire Mode.	The digital input programmed for activating the Fire Mode is active.
F0228: Serial Communication Timeout	■ Refer to the RS-232 / RS-485 Serial Communication Manual.	
A0702: Disabled Inverter	■ Refer to the SoftPLC Manual.	
A0704: Two Enabled Movements		
A0706: Reference not Programmed for SoftPLC		
F0711: Fault in the Execution of the SoftPLC	Fault in the execution of the SoftPLC.	■ Incompatible applicative. ■ Fault during upload of the applicative.
A0750: Programming AIx for Main PID Controller Feedback	It indicates to the user there is not analog input programmed for Main PID controller feedback.	Parameter P0231 or P0236 or P0241 is not programmed in 5, 6 or 7.
A0752: Programming DIx for Main PID Controller Automatic/Manual Selection	It indicates to the user there is not digital input programmed for Main PID controller Automatic/Manual selection.	Parameter P0263 or P0264 or P0265 or P0266 or P0267 or P0268 or P0269 or P0270 is not programmed in 20.
A0754: Programming Local Reference (P0221) for SoftPLC	It indicates to the user that the origin of the speed reference in the Local situation is not programmed for SoftPLC .	Main PID controller is enabled (P1017 in 1 or 2) and CFW701 frequency inverter run the motor in Local situation and parameter P0221 is not programmed in 7.

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Fault/Alarm	Description	Possible Causes
A0756: Programming Remote Reference (P0222) for SoftPLC	It indicates to the user that the origin of the speed reference in the Remote situation is not programmed for SoftPLC.	Main PID controller is enabled (P1017 in 1 or 2) and CFW701 frequency inverter run the motor in Remote situation and parameter P0222 is not programmed in 7.
A0758: Programming Indirect Engineering Unit 4 (P0516) for Hz or rpm	It indicates to the user that the engineering unit parameters for motor speed is not programmed for Hz or rpm.	Parameter P0516 is not programmed in 13 (Hz) or 3 (rpm).
A0760: Low Level for Main PID Controller Feedback	It indicates to the user that the Main PID controller feedback is low.	Parameter P1030 is programmed in 1 and the Main PID controller feedback value is remaining below the value programmed in P1031 for the time programmed in P1032.
F0761: Low Level for Main PID Controller Feedback	It indicates to the user that the Main PID controller feedback is low.	Parameter P1030 is programmed in 2 and the Main PID controller feedback value is remaining below the value programmed in P1031 for the time programmed in P1032.
A0762: High Level for Main PID Controller Feedback	It indicates to the user that the Main PID controller feedback is high.	Parameter P1030 is programmed in 1 and the Main PID controller feedback value is remaining above the value programmed in P1033 for the time programmed in P1034.
F0763: High Level for Main PID Controller Feedback	It indicates to the user that the Main PID controller feedback is high.	Parameter P1030 is programmed in 2 and the Main PID controller feedback value is remaining above the value programmed in P1033 for the time programmed in P1034.
A0764: CFW701 in Sleep Mode	It indicates to the user that the CFW701 frequency inverter is in Sleep mode.	Main PID controller is enabled and in Automatic mode and the motor speed is remaining below the speed value programmed in P1036 for the time programmed in P1037.
A0766: Dry Pump Detected	It indicates to the user that the dry pump condition was detected for the pump driven by CFW701 frequency inverter.	Parameter P1042 is programmed in 1 and the pump driven by CFW701 frequency inverter is running faster than speed programmed in P1043 and the motor torque is remaining below the torque value programmed in P1044 for the time programmed in P1045.
F0767: Dry Pump Detected	It indicates to the user that the dry pump condition was detected for the pump driven by CFW701 frequency inverter.	Parameter P1042 is programmed in 2 and the pump driven by CFW701 frequency inverter is running faster than speed programmed in P1043 and the motor torque is remaining below the torque value programmed in P1044 for the time programmed in P1045.
A0768: Broken Belt Detected	It indicates to the user that the broken belt condition was detected for the motor driven by CFW701 frequency inverter.	Parameter P1046 is programmed in 1 and the motor driven by CFW701 frequency inverter is running faster than speed programmed in P1047 and the motor torque is remaining below the torque value programmed in P1048 for the time programmed in P1049.
F0769: Broken Belt Detected	It indicates to the user that the broken belt condition was detected for the motor driven by CFW701 frequency inverter.	Parameter P1046 is programmed in 2 and the motor driven by CFW701 frequency inverter is running faster than speed programmed in P1047 and the motor torque is remaining below the torque value programmed in P1048 for the time programmed in P1049.
A0770: Filter Maintenance	It indicates to the user that the need to change the filter system.	Parameter P1050 is programmed in 1 and the operation time of motor driven by CFW701 frequency inverter displayed in P1052 is greater than the time programmed in P1051.
F0771: Filter Maintenance	It indicates to the user that the need to change the filter system.	Parameter P1050 is programmed in 2 and the operation time of motor driven by CFW701 frequency inverter displayed in P1052 is greater than the time programmed in P1051.
A0780: Programming AIx for External PID Controller 1 Feedback	It indicates to the user there is not analog input programmed for External PID controller 1 feedback.	Parameter P0231 or P0236 or P0241 is not programmed in 8.
A0782: Programming DIx for External PID Controller 1 Automatic/Manual Selection	It indicates to the user there is not digital input programmed for External PID controller 1 Automatic/Manual selection.	Parameter P0263 or P0264 or P0265 or P0266 or P0267 or P0268 or P0269 or P0270 is not programmed in 21.
A0784: Programming AOx for External PID Controller 1 Output	It indicates to the user there is not analog output programmed for External PID controller 1 output.	Parameter P0251 or P0254 is not programmed in 16.
A0786: Low Level for External PID Controller 1 Feedback	It indicates to the user that the External PID controller 1 feedback is low.	Parameter P1075 is programmed in 1 and the External PID controller 1 feedback value is remaining below the value programmed in P1076 for the time programmed in P1077.

Fault/Alarm	Description	Possible Causes
F0787: Low Level for External PID Controller 1 Feedback	It indicates to the user that the External PID controller 1 feedback is low.	Parameter P1075 is programmed in 2 and the External PID controller 1 Feedback value is remaining below the value programmed in P1076 for the time programmed in P1077.
A0788: High Level for External PID Controller 1 Feedback	It indicates to the user that the External PID controller 1 feedback is high.	Parameter P1075 is programmed in 1 and the External PID controller 1 feedback value is remaining above the value programmed in P1078 for the time programmed in P1079.
F0789: High Level for External PID Controller 1 Feedback	It indicates to the user that the External PID controller 1 feedback is high.	Parameter P1075 is programmed in 2 and the External PID controller 1 feedback value is remaining above the value programmed in P1078 for the time programmed in P1079.
A0790: Programming AIx for External PID Controller 2 Feedback	It indicates to the user there is not analog input programmed for External PID controller 2 feedback.	Parameter P0231 or P0236 or P0241 is not programmed in 9.
A0792: Programming DIx for External PID Controller 2 Automatic/Manual Selection	It indicates to the user there is not digital input programmed for External PID controller 2 Automatic/Manual selection.	Parameter P0263 or P0264 or P0265 or P0266 or P0267 or P0268 or P0269 or P0270 is not programmed in 22.
A0794: Programming AOx for External PID Controller 2 Output	It indicates to the user there is not analog output programmed for External PID controller 2 output.	Parameter P0251 or P0254 is not programmed in 17.
A0796: Low Level for External PID Controller 2 Feedback	It indicates to the user that the External PID controller 2 feedback is low.	Parameter P1095 is programmed in 1 and the External PID controller 2 feedback value is remaining below the value programmed in P1096 for the time programmed in P1097.
F0797: Low Level for External PID Controller 2 Feedback	It indicates to the user that the External PID controller 2 feedback is low.	Parameter P1095 is programmed in 2 and the External PID controller 2 feedback value is remaining below the value programmed in P1096 for the time programmed in P1097.
A0798: High Level for External PID Controller 2 Feedback	It indicates to the user that the External PID controller 2 feedback is high.	Parameter P1095 is programmed in 1 and the External PID controller 2 feedback value is remaining above the value programmed in P1098 for the time programmed in P1099.
F0799: High Level for External PID Controller 2 Feedback	It indicates to the user that the External PID controller 2 feedback is high.	Parameter P1095 is programmed in 2 and the External PID controller 2 feedback value is remaining above the value programmed in P1098 for the time programmed in P1099.

Notes:

(1) Very long motor cables, with more than 100 m (328.08 ft), presents a high parasitic capacitance to the ground. The circulation of a leakage current through this capacitance may cause the activation of the ground fault circuit, and consequently an F0074 trip immediately after the inverter enabling.

POSSIBLE SOLUTION:
■ To reduce the switching frequency (P0297).

⚠ **ATTENTION!**
A bad contact in the HMI cable, or electric noise in the installation, can cause a failure in the communication between the HMI and the control board. In such case, the operation through the HMI becomes impossible and the HMI indicates the following message on the display:

```
Conn
LoSt
```

0
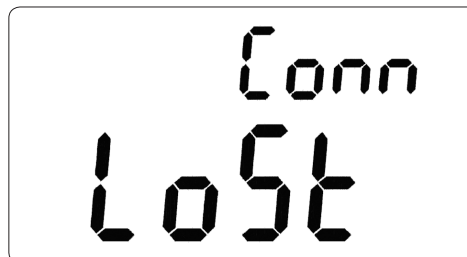
1 SAFETY NOTICES

This Manual contains the information necessary for the correct use of the CFW701 Frequency Inverter.

It has been developed to be used by qualified personnel with suitable training or technical qualification for operating this type of equipment.

1.1 SAFETY NOTICES IN THIS MANUAL

The following safety notices are used in this manual:

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

DANGER!
Les procédures concernées par cet avertissement sont destinées à protéger l'utilisateur contre des dangers mortels, des blessures et des détériorations matérielles importantes.

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 NOTICES ON THE PRODUCT

The following symbols are attached to the product, serving as safety notices:

High voltages are present.

Components sensitive to electrostatic discharge.
Do not touch them.

Mandatory connection to the protective ground (PE).

Connection of the shield to the ground.

Hot surface.

1.3 PRELIMINARY RECOMMENDATIONS

DANGER!
Only qualified personnel familiar with the CFW701 Frequency Inverter and associated equipment should plan or implement the installation, start-up and subsequent maintenance of this equipment. These personnel must follow all the safety instructions included in this manual and/or defined by local regulations.
Failure to comply with these instructions may result in life threatening and/or equipment damage.

DANGER!
Seulement personnes avec la qualification adéquate et familiarisation avec le CFW701 et équipements associés doivent planifiquer ou implementer l'installation, mise en marche, operation et entretien de cet équipement.
Cettes personnes doivent suivre toutes les instructions de sécurités indiquées dans ce manuel, et/ou définies par normes locales.
L'inobservance des instructions de sécurité peut résulter en risque de vie et/ou dommages de cet équipement.

NOTE!
For the purposes of this manual, qualified personnel are those trained to be able to:
1. Install, ground, energize and operate the CFW701 according to this manual and the effective legal safety procedures.
2. Use protection equipment according to the established standards.
3. Give first aid services.

DANGER!
Always disconnect the input power before touching any electrical component associated to the inverter. Many components can remain charged with high voltages or remain in movement (fans) even after that AC power is disconnected or switched off.
Wait at least 10 minutes to assure a total discharge of the capacitors.
Always connect the equipment frame to the protection earth (PE) at the suitable connection point.

DANGER!
Débranchez toujours l'alimentation principale avant d'entrer en contact avec un appareil électrique associé au variateur. Plusieurs composants peuvent rester chargés à un potentiel électrique élevé et/ou être en mouvement (ventilateurs), même après la déconnexion ou la coupure de l'alimentation en courant alternatif.
Attendez au moins 10 minutes que les condensateurs se déchargent complètement.
Raccordez toujours la masse de l'appareil à une terre protectrice (PE).

ATTENTION!
Electronic boards have components sensitive to electrostatic discharges. Do not touch directly on components or connectors. If necessary, touch the grounded metallic frame before or use an adequate grounded wrist strap.

Do not perform any high pot tests with the inverter!
If it is necessary consult WEG.

NOTE!
Frequency inverter may interfere with other electronic equipment. In order to reduce these effects, take the precautions recommended in the chapter 3 Installation and Connection, of the user's manual.

NOTE!
Read the user's manual completely before installing or operating the inverter.

1

2 GENERAL INFORMATION

2.1 ABOUT THIS MANUAL

This manual presents the necessary information for the configuration of all of the functions and parameters of the CFW701 Frequency Inverter. This manual must be used together with the CFW701 user's manual.

The text intents to supply additional information to facilitate the use and programming of the CFW701 in specific applications.

2.2 TERMINOLOGY AND DEFINITIONS

2.2.1 Terms and Definitions Used in the Manual

Normal Duty Cycle (ND): it is the inverter operation regimen that defines the maximum current value for continuous operation I_{nom-ND} and overload of 110 % during 1 minute. It is selected by programming P0298 (Application) = 0 (Normal Duty – ND). It must be used for driving motors that are not subject in that application to high torques in relation to their rated torque, when operating in permanent regimen, during start, acceleration or deceleration.

I_{nom-ND}: inverter rated current for use with normal overload regimen (ND = Normal Duty).
Overload: 1.1 x I_{nom-ND} / 1 minute.

Heavy Duty Cycle (HD): it is the inverter operation regimen that defines the maximum current value for continuous operation I_{nom-HD} and overload of 150 % during 1 minute. It is selected by programming P0298 (Application) = 1 (Heavy Duty (HD)). It must be used for driving motors that are subject in that application to high overload torques in relation to their rated torque, when operating in constant speed, during start, acceleration or deceleration.

I_{nom-HD}: inverter rated current for use with heavy overload regimen (HD = Heavy Duty).
Overload: 1.5 x I_{nom-HD} / 1 minute.

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

Pre-charge Circuit: it charges the DC Link capacitors with a limited current, thus avoiding current peaks when powering the inverter.

DC Link: this is the inverter intermediate circuit, with DC voltage and current, obtained from the rectification of the AC supply voltage, or from an external source; it supplies the output IGBTs inverter bridge.

U, V and W Arm: it is a set of two IGBTs of the phases U, V and W at the inverter output.

IGBT: "Insulated Gate Bipolar Transistor"; It is the basic component of the output inverter bridge. It operates like an electronic switch in the saturated (closed switch) and cut (open switch) modes.

Braking IGBT: operates as a switch for the connection of the braking resistor. It is commanded by the DC Link level.

PTC: it's a resistor whose resistance value in ohms increases proportionally to the increase of the temperature; it is used as a temperature sensor in motors.

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

Keypad (HMI): Human-Machine Interface; It is the device that allows the control of the motor, the visualization and the modification of the inverter parameters. It presents keys for commanding the motor, navigation keys and a graphic LCD display.

MMF (Flash Memory Module): it is the nonvolatile memory that can be electrically written and erased.

RAM Memory: Random Access Memory (volatile).

PE: "Protective Earth".

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RFI Filter: "Radio Frequency Interference Filter". It is a filter that avoids interference in the radiofrequency range.

PWM: "Pulse Width Modulation". It is a pulsing voltage that supplies the motor.

Switching Frequency: it is the inverter bridge IGBTs commutation frequency, specified normally in kHz.

General Enable: when activated, it accelerates the motor with the acceleration ramp provided Run/Stop = Run. When deactivated, the PWM pulses are immediately blocked. It can be commanded through digital input programmed for that function or via serial.

Run/Stop: inverter function that when activated (Run) accelerates the motor with the acceleration ramp until reaching the speed reference, and when deactivated (Stop) decelerates the motor with the deceleration ramp down to stop. It can be commanded through digital input programmed for that function or via serial. The HMI keys **I** and **O** work in a similar manner:
I = Run, **O** = Stop.

Heatsink: it is a metal part designed for dissipating the heat generated by the power semiconductors.

Amp, A: ampères.

°C: degrees celsius.

°F: fahrenheit degree.

AC: alternating current.

DC: direct current.

CFM: "Cubic feet per minute"; it is a flow measurement unit.

hp: "Horse Power" = 746 Watts (power measurement unit, normally used to indicate the mechanical power of electric motors).

Hz: hertz.

l/s: liters per second.

kg: kilogram = 1000 gram.

kHz: kilohertz = 1000 Hz.

mA: milliamp = 0.001 Amp.

min: minute.

ms: millisecond = 0.001 second.

Nm: Newton meter; torque measurement unit.

rms: "Root mean square"; effective value.

rpm: revolutions per minute: speed measurement unit.

s: second.

V: volts.

Ω: ohms.

2.2.2 Numerical Representation

The decimal numbers are represented by means of digits without suffix. Hexadecimal numbers are represented with the letter "h" after the number.

2.2.3 Symbols for the Parameter Properties Description

ro   Reading only parameter.
cfg   Parameter that can be changed only with a stopped motor.
V/f   Parameter visible on the keypad (HMI) only in the V/f mode: P0202 = 0, 1 or 2.
Adj   Parameter visible on the keypad (HMI) only in the V/f adjustable mode: P0202 = 2.
Vector   Parameter visible on the keypad (HMI) only in the vector sensorless mode: P0202 = 4.
VVW   Parameter visible on the keypad (HMI) only in the VVW mode: P0202 = 3.
Sless   Parameter visible on the keypad (HMI) only in the vector sensorless mode: P0202 = 4.

2

3 ABOUT THE CFW701

The CFW701 is a high performance frequency inverter that makes it possible the control of speed and torque of three-phase AC induction motors. The principal characteristic of this product is the "Vectrue" technology, which presents the following advantages:

- Scalar control (V/f), VVW or vector control programmable in the same product.

- The "sensorless" vector control allows high torque and fast response, even at very slow speeds or during starting.

- The "Optimal Braking" function for the vector control allows a controlled motor braking, eliminating in some applications the braking resistor.

- The vector control "Self-Tuning" function allows the automatic setting of the regulators and control parameters, from the identification (also automatic) of the motor and load parameters.

3

① = DC link connection
② = Braking resistor connection
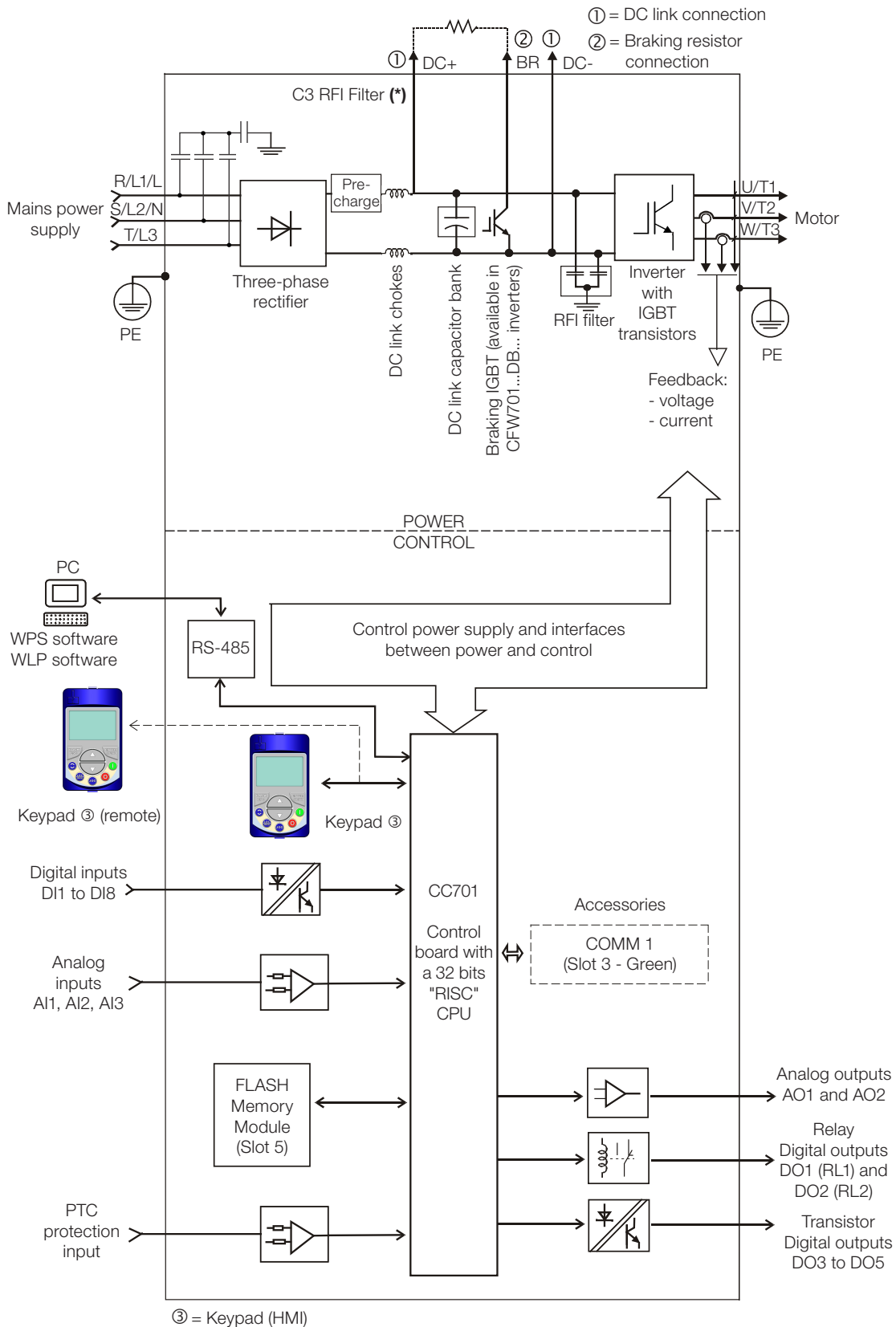
Figure 3.1: *CFW701 block diagram*

(*) The capacitor to the ground of the C3 RFI filter (it is possible to meet the requirements of category C2 with this filter on mechanics A models) must be disconnected for IT networks and grounded delta power supplies. Please refer to item 3.2.3.1 Input Connections, of the CFW701 user's manual.
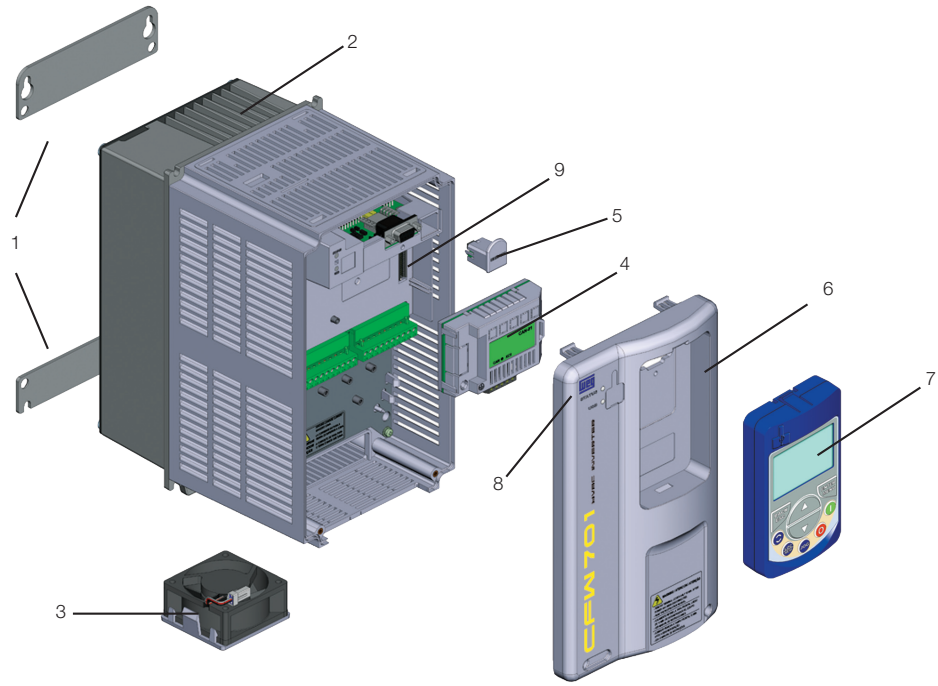
1 - Mounting supports
    (for surface mounting)
2 - Back side of the inverter (outside for flange
    mounting)
3 - Fan with fixing support
4 - Control accessory module (refer to section 7.2 -
    Accessories, of the CFW701 user's manual)
5 - FLASH memory module (not included)
6 - Front cover frame sizes (sizes A, B and C)
7 - Keypad (HMI)
8 - Status LED (STATUS)
9 - CC700 control board

Figure 3.2: CFW701 main components

1   Status LED
     Green: Normal operation without fault or alarm
     Yellow: In the alarm condition
     Blinking red: In the fault condition

Figure 3.3: LEDs

3

4 KEYPAD (HMI)

The integral keypad can be used to operate and program (view / edit all parameters) of the CFW701 inverter. There are two operation modes in the keypad: monitoring and programming. The key functions and display indications of the keypad may change according to the operation mode. The programming mode consists of three levels.

- When in monitoring mode: press this key to increase the speed.
- When in programming mode, level 1: press this key to go back to the previous group.
- When in programming mode, level 2: press this key to go to the next parameter.
- When in programming mode, level 3: press this key to increase the parameter value.

USB communication port

- When in monitoring mode: press this key to decrease the speed.
- When in programming mode, level 1: press this key to go to the next group.
- When in programming mode, level 2: press this key to go back to the previous parameter.
- When in programming mode, level 3: press this key to decrease the parameter value.

- When in programming mode, level 1: press this key to go back to the monitoring mode.
- When in programming mode, level 2: press this key to go back to the level 1.
- When in programming mode, level 3: press this key to cancel the new value (the value will not be saved) and it will return to level 2 of the programming mode.

- When in monitoring mode: press this key to enter in the programming mode.
- When in programming mode, level 1: press this key to select the desired parameter group – it shows the parameters of the selected group.
- When in programming mode, level 2: press this key to show the parameter – it shows the parameter value for its modification.
- When in programming mode, level 3: press this key to save the new parameter value – it returns to level 2 of the programming mode.

- Press this key to define the motor rotation.
  This option is active when:
  P0223 = 2 or 3 in LOC and/or
  P0226 = 2 or 3 in REM.

- Press this key to accelerate the motor according to the acceleration ramp time.
  This option is active when:
  P0224 = 0 in LOC and/or
  P0227 = 0 in REM.

- Press this key to change between Local and Remote mode.
  This option is active when:
  P0220 = 2 or 3.

- Press this key to decelerate the motor according to the deceleration ramp time.
  This option is active when:
  P0224 = 0 in LOC and/or
  P0227 = 0 in REM.

- Press this key to accelerate the motor up to the speed set in P0122. The motor speed is maintained while the key is pressed. When the key is released the motor decelerates up to its complete stop.
  This function is active when all the following conditions are met:
  1. Start/Stop = Stop.
  2. General Enable = Active.
  3. P0225 = 1 in LOC and/or P0228 = 1 in REM.

Figure 4.1: HMI keys

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5 PROGRAMMING BASIC INSTRUCTIONS

5.1 PARAMETERS STRUCTURE

In order to make the programming of the inverter easier, the parameters of the CFW701 were divided into 10 groups that can be individually selected in the Menu area of the keypad. When the ENTER/MENU key is pressed on monitoring mode, the programming mode is set. In this mode, it is possible to select the desired group of parameters through the keys ▲ and ▼. Refer to the CFW701 user's manual for more details on the keypad keys programming. The parameter group structure is presented in the next item.

> **NOTE!**
> The inverter leaves the factory with frequency (V/f 50/60 Hz mode) and voltage adjusted according to the market.
> The reset to the factory default may change the content of the parameters related to the frequency (50 Hz / 60 Hz). In the detailed description, some parameters present values in parentheses, which must be adjusted in the inverter for using the 50 Hz frequency.

5.2 GROUPS ACCESSED IN THE OPTION MENU IN THE MONITORING MODE

In the monitoring mode access the groups of the option "Menu" by pressing the ENTER/MENU "soft key".

Table 5.1: Parameter groups accessed in the option menu of the monitoring mode

Group	Contained Parameters or Groups
PARAM	All the parameters
READ	Parameters used only for reading
MODIF	Only parameters whose contents are different from the factory settings
BASIC	Parameters for simple applications: ramps, minimum and maximum speed, maximum current and torque boost. Presented in details in the CFW701 user's manual at item 5.2.2 Basic Application Menu.
MOTOR	Parameters related to the motor data control
I/O	Groups related to digital and analog, inputs and outputs
NET	Parameters related to the communication network
HMI	Parameters for the keypad (HMI) configuration
HVAC	Parameters related to the HVAC functions
STARTUP	Parameter for entering the "Oriented Start-up" mode

5.3 PASSWORD SETTING IN P0000

P0000 – Access to Parameters

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

Properties:

Access Groups via HMI:

In order to be able to change the content of the parameters, it is necessary to set correctly the password in P0000, as indicated below. Otherwise the content of the parameters can only be visualized.

It is possible to customize the password by means of P0200. Refer to the description of this parameter in the , of this manual.

Seq.	Action/Result	Display Indication
1	- Monitoring mode. Press the ENTER/MENU key to enter into the 1° level of the programming mode.	LOC 90 0 rpm
2	- The PARAM group is already available, press the ENTER/MENU key to access parameter P0000.	PARAM LOC
3	- Press ENTER/MENU key again to access the parameter value.	PARAM LOC 0 P0000
4	- Press the ▲ or ▼ keys to set the desired value.	PARAM LOC P0000 0
5	- Press ENTER/MENU key when the desired value is reached in order to confirm the modification.	PARAM LOC P0000 5
6	- Press the BACK/ESC key to go back to the 2° level of programming mode.	PARAM LOC 5 P0000
7	- Press the BACK/ESC key in order to go back to the monitoring mode.	PARAM LOC
8	- Monitoring mode.	LOC 90 0 rpm

Figure 5.1: Sequence for allowing parameter changes via P0000

5.4 HMI

In the group "HMI" are the parameters related to the presentation of information on the keypad (HMI) display. See next the detailed description of the possible settings for those parameters.

P0200 – Password

Adjustable Range:	0 = Inactive 1 = Active 2 = Change Password	Factory Setting:	1
Properties:			
Access Groups via HMI:	HMI		

Description:

It allows changing the password and/or setting its status, configuring it as active or inactive. For more details on each option, refer to the Table 5.2 on page 5-3 described next.

Table 5.2: Options for the parameter P0200

P0200	Kind of Action
0 (Inactive)	It allows parameter changes regardless of P0000
1 (Active)	It does only allow parameter changes when the content of P0000 is equal to the password
2 (Change Password)	It makes the value presented in P0000 the current password

Follow the procedure below to change your password:

1. Enter the current password value (factory settings, P0000 = 5).

2. Set the password parameter to inactive (P0200 = 0).

3. Enter the new desired password value in P0000.

4. Set the password parameter to change password (P0200 = 2).

5. The setting is completed, the new password is active and P0200 is automatically set to 1 (Enables password).

P0205 – Main Display Parameter Selection

P0206 – Secondary Display Parameter Selection

Adjustable Range:	0 to 1199	**Factory Setting:**	P0205 = 2 P0206 = 3
Properties:			
Access Groups via HMI:	HMI		

Description:

These parameters define which parameters are displayed on the keypad in the monitoring mode.

More details on the programming can be seen in section 5.6 DISPLAY INDICATIONS IN THE MONITORING MODE SETTINGS on page 5-14.

P0208 – Main Display Scale Factor

P0211 – Secondary Display Scale Factor

Adjustable Range:	0.1 to 1000.0 %	**Factory Setting:**	100.0 %

P0210 – Main Display Decimal Point

P0212 – Secondary Display Decimal Point

Adjustable Range:	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz 4 = As P0511 5 = As P0513 6 = As P0515 7 = As P0512	Factory Setting:	P0210 = 0 P0212 = 1
Properties:			
Access Groups via HMI:	HMI		

Description:

These parameters allow changing the range of the Main Display and the Secondary Display in order to convert motor variables such as speed (rpm) in application units such as meters/minutes or cubic feet/minutes for example.

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P0209 – Main Display Engineering Unit

Adjustable Range:	0 = None 1 = V 2 = A 3 = rpm 4 = s 5 = ms 6 = None 7 = m 8 = None 9 = None 10 = % 11 = °C 12 = None 13 = Hz 14 = None 15 = h 16 = W 17 = kW 18 = None 19 = None 20 = min 21 = °F 22 = bar 23 = mbar 24 = psi 25 = Pa 26 = kPa 27 = MPa 28 = mwc 29 = mca 30 = gal 31 = l 32 = in 33 = ft 34 = m³ 35 = ft³ 36 = gal/s 37 = gal/min 38 = gal/h 39 = l/s 40 = l/min 41 = l/h 42 = m/s 43 = m/min 44 = m/h 45 = ft/s 46 = ft/min 47 = ft/h 48 = m³/s 49 = m³/min 50 = m³/h 51 = ft³/s 52 = ft³/min 53 = ft³/h 54 = As per P0510 55 = As per P0512 56 = As per P0514 57 = As per P0516	**Factory Setting:**	3

Properties:

Access Groups via HMI:	HMI

Description:

This parameter selects the engineering unit to be presented in the main display. The content of this parameter is automatically adjusted to match the unit of the parameter selected by P0205 when its value is changed by the HMI.

P0216 – HMI Backlighting

Adjustable Range:	0 to 15		Factory Setting:	15
Properties:				
Access Groups via HMI:	HMI			

Description:

It allows setting the keypad (HMI) display contrast level. Higher values configure a higher contrast level.

5.5 INDIRECT ENGINEERING UNITS

This parameter group allows the user to configure the indirect engineering units for SoftPLC user parameters.

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P0510 – Indirect Engineering Unit 1

Adjustable Range:	0 = None 1 = V 2 = A 3 = rpm 4 = s 5 = ms 6 = None 7 = m 8 = None 9 = None 10 = % 11 = °C 12 = None 13 = Hz 14 = None 15 = h 16 = W 17 = kW 18 = None 19 = None 20 = min 21 = °F 22 = bar 23 = mbar 24 = psi 25 = Pa 26 = kPa 27 = MPa 28 = mwc (meter of water column) 29 = mca (metro de coluna d'agua) 30 = gal 31 = l (liter) 32 = in 33 = ft 34 = m³ 35 = ft³ 36 = gal/s 37 = gal/min (= GPM) 38 = gal/h 39 = l/s 40 = l/min 41 = l/h 42 = m/s 43 = m/min 44 = m/h 45 = ft/s 46 = ft/min 47 = ft/h 48 = m³/s 49 = m³/min 50 = m³/h 51 = ft³/s 52 = ft³/min 53 = ft³/h	**Factory Setting:**	22

Properties:

Access Groups via HMI:	HMI

Description:

This parameter selects the engineering unit that will be displayed in SoftPLC user parameter that is associated whit it, i.e., any SoftPLC user parameter that has its engineering unit associated with an indirect engineering unit 1 will be displayed in this format in the CFW701 HMI.

> **NOTE!**
> The parameters P1011, P1015, P1027, P1028, P1031 and P1033 of the Main PID controller (HVAC functions) are associated with the indirect engineering unit 1.

P0511 – Indirect Decimal Point 1

Adjustable Range:	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz	Factory Setting:	1
Properties:			
Access Groups via HMI:	HMI		

Description:

This parameter selects the decimal point that will be displayed in SoftPLC user parameter that is associated whit it, i.e., any SoftPLC user parameter that has its decimal point associated with an indirect decimal point 1 will be displayed in this format in the CFW701 HMI.

> **NOTE!**
> The parameters P1011, P1015, P1027, P1028, P1031 and P1033 of the Main PID controller (HVAC functions) are associated with the indirect decimal point 1.

P0512 – Indirect Engineering Unit 2

Adjustable Range:	0 = None 1 = V 2 = A 3 = rpm 4 = s 5 = ms 6 = None 7 = m 8 = None 9 = None 10 = % 11 = °C 12 = None 13 = Hz 14 = None 15 = h 16 = W 17 = kW 18 = None 19 = None 20 = min 21 = °F 22 = bar 23 = mbar 24 = psi 25 = Pa 26 = kPa 27 = MPa 28 = mwc (meter of water column) 29 = mca (metro de coluna d'agua) 30 = gal 31 = l (liter) 32 = in 33 = ft 34 = m^3 35 = ft^3 36 = gal/s 37 = gal/min (= GPM) 38 = gal/h 39 = l/s 40 = l/min 41 = l/h 42 = m/s 43 = m/min 44 = m/h 45 = ft/s 46 = ft/min 47 = ft/h 48 = m^3/s 49 = m^3/min 50 = m^3/h 51 = ft^3/s 52 = ft^3/min 53 = ft^3/h	**Factory Setting:** 11

Properties:	
Access Groups via HMI:	HMI

Description:

This parameter selects the engineering unit that will be displayed in SoftPLC user parameter that is associated whit it, i.e., any SoftPLC user parameter that has its engineering unit associated with an indirect engineering unit 2 will be displayed in this format in the CFW701 HMI.

> ✓ **NOTE!**
> The parameters P1060, P1062, P1073, P1074, P1076 and P1078 of the External PID controller 1 (HVAC functions) are associated with the indirect engineering unit 2.

P0513 – Indirect Decimal Point 2

Adjustable Range:	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz	Factory Setting:	1
Properties:			
Access Groups via HMI:	HMI		

Description:

This parameter selects the decimal point that will be displayed in SoftPLC user parameter that is associated whit it, i.e., any SoftPLC user parameter that has its decimal point associated with an indirect decimal point 2 will be displayed in this format in the CFW701 HMI.

> ✓ **NOTE!**
> The parameters P1060, P1062, P1073, P1074, P1076 and P1078 of the External PID controller 1 (HVAC functions) are associated with the indirect decimal point 2.

P0514 – Indirect Engineering Unit 3

| **Adjustable Range:** | 0 = None
1 = V
2 = A
3 = rpm
4 = s
5 = ms
6 = None
7 = m
8 = None
9 = None
10 = %
11 = °C
12 = None
13 = Hz
14 = None
15 = h
16 = W
17 = kW
18 = None
19 = None
20 = min
21 = °F
22 = bar
23 = mbar
24 = psi
25 = Pa
26 = kPa
27 = MPa
28 = mwc (meter of water column)
29 = mca (metro de coluna d'agua)
30 = gal
31 = l (liter)
32 = in
33 = ft
34 = m³
35 = ft³
36 = gal/s
37 = gal/min (= GPM)
38 = gal/h
39 = l/s
40 = l/min
41 = l/h
42 = m/s
43 = m/min
44 = m/h
45 = ft/s
46 = ft/min
47 = ft/h
48 = m³/s
49 = m³/min
50 = m³/h
51 = ft³/s
52 = ft³/min
53 = ft³/h | **Factory Setting:** | 10 |

Properties:

| **Access Groups via HMI:** | HMI |

Description:

This parameter selects the engineering unit that will be displayed in SoftPLC user parameter that is associated whit it, i.e., any SoftPLC user parameter that has its engineering unit associated with an indirect engineering unit 3 will be displayed in this format in the CFW701 HMI.

> **NOTE!**
> The parameters P1080, P1082, P1093, P1094, P1096 and P1098 of the External PID controller 2 (HVAC functions) are associated with the indirect engineering unit 3.

P0515 – Indirect Decimal Point 3

Adjustable Range:	0 = wxyz 1 = wxy.z 2 = wx.yz 3 = w.xyz	Factory Setting:	1
Properties:			
Access Groups via HMI:	HMI		

Description:

This parameter selects the decimal point that will be displayed in SoftPLC user parameter that is associated whit it, i.e., any SoftPLC user parameter that has its decimal point associated with an indirect decimal point 3 will be displayed in this format in the CFW701 HMI.

> **NOTE!**
> The parameters P1080, P1082, P1093, P1094, P1096 and P1098 of the External PID controller 2 (HVAC functions) are associated with the indirect decimal point 3.

P0516 – Indirect Engineering Unit 4

| **Adjustable Range:** | 0 = None
1 = V
2 = A
3 = rpm
4 = s
5 = ms
6 = None
7 = m
8 = None
9 = None
10 = %
11 = °C
12 = None
13 = Hz
14 = None
15 = h
16 = W
17 = kW
18 = None
19 = None
20 = min
21 = °F
22 = bar
23 = mbar
24 = psi
25 = Pa
26 = kPa
27 = MPa
28 = mwc (meter of water column)
29 = mca (metro de coluna d'agua)
30 = gal
31 = l (liter)
32 = in
33 = ft
34 = m³
35 = ft³
36 = gal/s
37 = gal/min (= GPM)
38 = gal/h
39 = l/s
40 = l/min
41 = l/h
42 = m/s
43 = m/min
44 = m/h
45 = ft/s
46 = ft/min
47 = ft/h
48 = m³/s
49 = m³/min
50 = m³/h
51 = ft³/s
52 = ft³/min
53 = ft³/h | **Factory Setting:** | 13 |

Properties:

| **Access Groups via HMI:** | HMI |

Description:

This parameter selects the engineering unit that will be displayed in SoftPLC user parameter that is associated whit it, i.e., any SoftPLC user parameter that has its engineering unit associated with an indirect engineering unit 4 will be displayed in this format in the CFW701 HMI.

> ✓ **NOTE!**
> The parameters P1036, P1043 and P1047 are related to speed limits (Hz or rpm) on HVAC functions and are associated with the indirect engineering unit 4.

P0517 – Indirect Decimal Point 4

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

Properties:	
Access Groups via HMI:	HMI

Description:

This parameter selects the decimal point that will be displayed in SoftPLC user parameter that is associated whit it, i.e., any SoftPLC user parameter that has its decimal point associated with an indirect decimal point 4 will be displayed in this format in the CFW701 HMI.

> ✓ **NOTE!**
> The parameters P1036, P1043 and P1047 are related to speed limits (Hz or rpm) on HVAC functions and are associated with the indirect decimal point 4.

5.6 DISPLAY INDICATIONS IN THE MONITORING MODE SETTINGS

Every time the inverter is powered the display goes to the Monitoring Mode. To facilitate reading the parameters of the inverter, the display is designed to show two parameters at the same time according to the user's choice. These parameters (Main Display and Secondary Display) are shown in numerical form. The selection of these parameters is done via P0205 and P0206, as shown in .
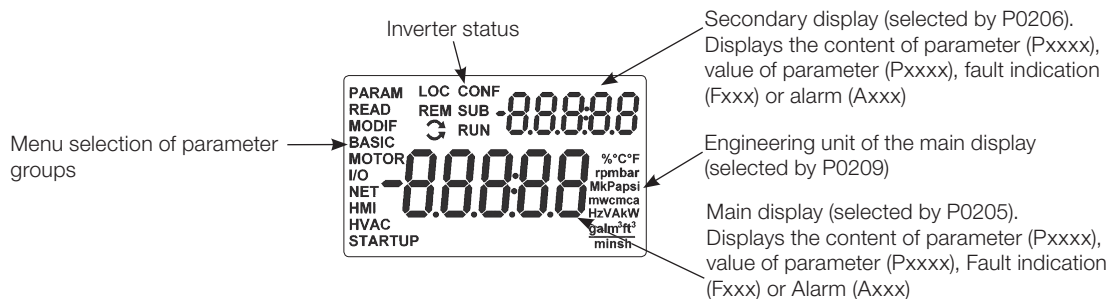
Figure 5.2: Screen at startup and display indication

5.7 INCOMPATIBILITY BETWEEN PARAMETERS

If any of the combinations listed below occur, the CFW701 goes to the "Config" state.

1. Two or more DIx (P0263...P0270) programmed for (8 = FWD/REV).

2. Two or more DIx (P0263 .... P0270) programmed for (9 = LOC/REM).

3. Two or more DIx (P0263 .... P0270) programmed for (14 = Ramp 2).

4. Two or more DIx (P0263 .... P0270) programmed for (15 = Speed/Torque).

5. Two or more DIx (P0263 .... P0270) programmed for (24 = Disable Flying Start).

6. Two or more DIx (P0263 .... P0270) programmed for (25 = DC Link Regulator).

7. Two or more DIx (P0263 .... P0270) programmed for (26 = Programming Off).

8. Two or more DIx (P0263 .... P0270) programmed for (27 = Load User 1).

9. Two or more DIx (P0263 .... P0270) programmed for (28 = Load User 2).

10. Two or more DIx (P0263...P0270) programmed for (23 = Bypass mode).

11. Two or more DIx (P0263...P0270) programmed for (24 = Five mode).

12. Two or more DOx (P0275 ...P0279) programed for (39 = Drive Bypass Contactor).

13. Two or more DOx (P0275 ...P0279) programed for (40 = Mains Bypass Contactor).

14. [P0583 ≠ 0] and [P0029.bit9 = 1] (with Safety Stop) OR no DIx (P0263...P0270) programmed for (23 = Bypass mode) OR no DOx (P0275 ...P0279) programed for (39 = Drive Bypass Contactor) OR no DOx (P0275 ...P0279) programed for (40 = Mains Bypass Contactor).

15. [P0583 = 0] and OR any DIx (P0263...P0270) programmed for (23 = Bypass mode) OR any DOx (P0275 ...P0279) programed for (39 = Drive Bypass Contactor) OR any DOx (P0275 ...P0279) programed for (40 = Mains Bypass Contactor).

16. [P0580 ≠ 0] AND [P0029.bit9 = 1] (with Safety Stop).

17. [P0202 programmed for (0 = V/f 60 Hz) OR (1 = V/f 50 Hz) OR (2 = Adjustable V/f) OR (3 = VVW)] AND [P0231 = 1 (No Ramp Ref.) OR P0231 = 2 (Max.Torque Cur) OR P0236 = 1 (No Ramp Ref.) OR P0236 = 2 (Max.Torque Cur) OR P0241 = 1 (No Ramp Ref.) OR P0241 = 2 (Max.Torque Cur).

18. [P0202 programmed for (0 = V/f 60 Hz) OR (1 = V/f 50 Hz) OR (2 = Adjustable V/f) OR (3 = V V W)] AND [DIx (P0263... P0270) programmed for (10 = JOG+) OR (11 = JOG-).

19. [P0224 programmed for (1 = DIx) OR P0227 programmed for (1 = DIx)] AND [without DIx (P0263...P0270) programmed for (1 = Run/Stop) AND without DIx (P0263...P0270) programmed for (2 = General Enable) AND without DIx (P0263...P0270) programmed for (3 = Fast Stop).

20. P0202 programed for 4 (Sensorless) and P0297 = 0 (1.25 kHz).

21. [P0296 < 5] and [P0297 = 4 (2 kHz)].

22. [(Frame Size B...D) and (P0296 ≥ 5)] and [P0297 = 3 (10 kHz) or P0297 = 4 (2 kHz)].

23. [(Frame Size E) and (P0296 ≥ 5)] and [P0297 ≠ 0 (1.25 kHz) or P0297 ≠ 4 (2 kHz)].

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6 INVERTER MODEL AND ACCESSORIES IDENTIFICATION

In order to identify the model of the inverter, verify the code existent on the product identification labels: the complete one, located at the side of the inverter, or the abbreviated one, under the keypad (HMI). The figures below show examples of those labels.
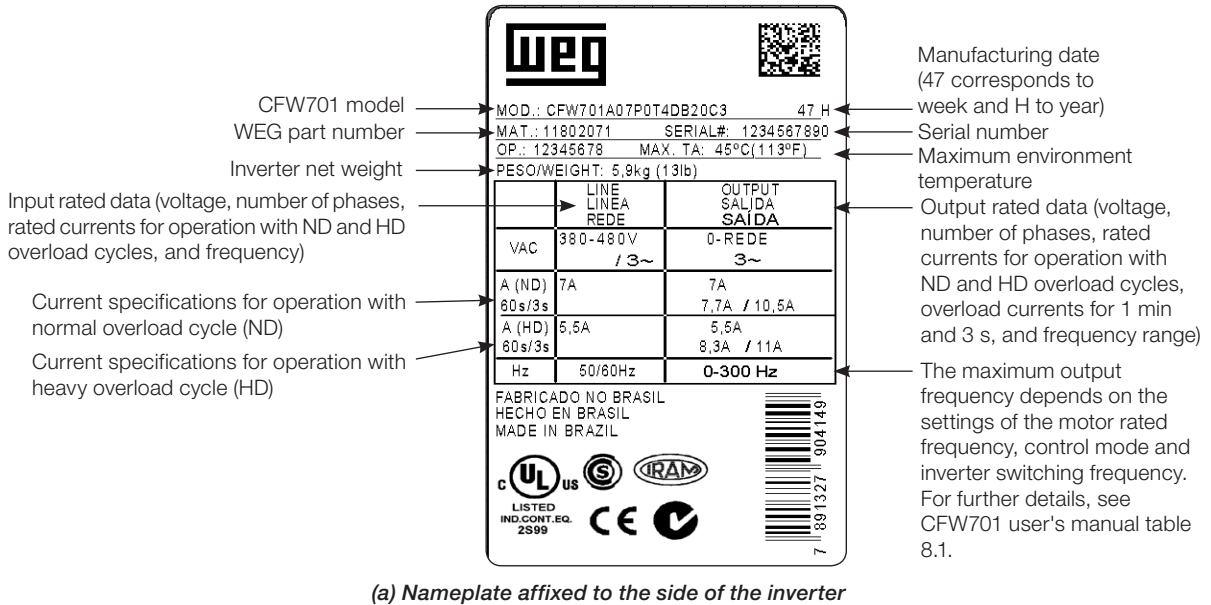
(a) Nameplate affixed to the side of the inverter
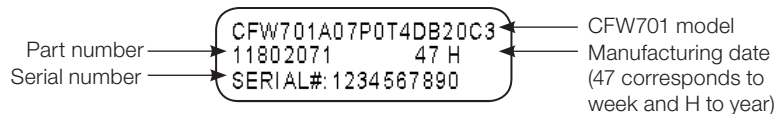
(b) Nameplate located under the keypad

Figure 6.1: *(a) and (b) Nameplates*

Once the inverter model identification code is verified, one must interpret it in order to understand its meaning. Refer to the section 2.3 Identification, of the CFW701 user's manual.

6.1 INVERTER DATA

In this group are the parameters related to the inverter information and characteristics, such as inverter model, accessories identified by the control circuit, software version, switching frequency, etc.

P0023 – Software Version

Adjustable Range:	0.00 to 655.35	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ	

Description:

It indicates the software version contained in the FLASH memory of the microcontroller located on the control board.

P0028 – Accessories Configuration

Adjustable Range:	0000h to FFFFh	Factory Setting:	
Properties:	ro		
Access Groups via HMI:	READ		

Description:

Those parameters identify by means of a hexadecimal code the accessories that were found installed on the control module.

The next table shows the codes shown in those parameters, regarding the main CFW701 accessories.

Table 6.1: CFW701 accessory identification codes

Name	Description	Identification Code P0028
RS-485-01	RS-485 serial communication module	CE--
MMF-02	FLASH memory module	----[1]

[1] Bit 6: indicates the presence of the FLASH memory module (0 = without memory module, 1 = with memory module).

For the FLASH memory module, the P0028 identification code will depend on the combination of these accessories, as presented in the next table.

Table 6.2: Formation of the two first codes for P0028 parameter

Bits							
7	6	5	4	3	2	1	0
∅	FLASH Memory Module	∅		0	0	0	0
2nd Hexadecimal Code				1st Hexadecimal Code			

P0029 – Power Hardware Configuration

Adjustable Range:	Bit 0 to 5 = Rated Current Bit 6 and 7 = Rated Voltage Bit 8 = RFI Filter Bit 9 = Safety Relay Bit 10 = (0)24 V/(1)DC Link Bit 11 = Always 0 Bit 12 = Dyn. Brak. IGBT Bit 13 = Special Bit 14 and 15 = Reserved	Factory Setting:	
Properties:	ro		
Access Groups via HMI:	READ		

Description:

In a similar way than parameters P0028, the parameter P0029 identifies the inverter model and the present accessories.

The codification is formed by the combination of binary digits, and presented in the keypad (HMI) in hexadecimal format.

The bits that compose the code are explained in the next table.

Table 6.3: Parameter P0029 code constitution

Bits															
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
1	1	0	with braking IGBT	0	with 24 V supply	with safety relay	1	Voltage 00 = 200…240 V 01 = 380…480 V 10 = 500...600 V		Current					
4th Hexadecimal Code				3rd Hexadecimal Code				2nd Hexadecimal Code				1st Hexadecimal Code			

Bits 15, 14 and 13: are fixed in 110.

Bit 12: it indicates the presence of the dynamic braking IGBT (0 = with braking IGBT, 1 = without braking IGBT).
Note:
Frame size D/500 / 600 V models are not able to identify the absence of the dynamic braking IGBT, always indicate "0 = with braking IGBT", even if the dynamic braking IGBT is absent. See intelligent code on the product label to identify the presence or absence of the dynamic braking IGBT.

Bit 11: always 0.

Bit 10: indicates if the inverter has the DC/DC converter for receiving external 24 V electronics power supply (0 = with DC/DC converter, 1 = without DC/DC 24 V converter).

Bit 9: indicates the presence of the safety relay (0 = without safety relay, 1 = with safety relay).

Bit 8: indicates if the inverter is equipped with RFI suppressor filter (0 = without RFI filter, 1 = with RFI filter).
Note:
Frame size B/500 / 600 V models are not able to identify the presence of the Suppressor RFI Filter, always indicate "0 = without RFI Filter ", even if the Suppressor RFI Filter is present. See intelligent code on the product label to identify the presence or absence of the Suppressor RFI Filter.

Bits 7 and 6: indicate the inverter power supply voltage (00 = 200...240 V, 01 = 380…480 V, 10 = 500...600 V).

Bits 5, 4, 3, 2, 1 and 0: together with the voltage indication bits (7 and 6), they indicate the inverter rated current (ND). The next table presents the combinations available for those bits.

Table 6.4: Current codification for the parameter P0029

Frame Size	Voltage	Current	2nd Hexadecimal Code	1st Hexadecimal Code
A	200...240 V	2 A *	0	0
		6 A *	0	1
		7 A *	0	2
		10 A *	0	3
		7 A	0	4
		10 A	0	5
		13 A	0	6
		16 A	0	7
B		24 A	0	8
		28 A	0	9
		33.5 A	0	A
C		45 A	0	C
		54 A	0	D
		70 A	0	E
D		86 A	1	0
		105 A	1	1
E		180 A	1	2
		211 A	1	3
		142 A	1	4
A	380...480 V	3.6 A	4	0
		5 A	4	1
		7 A	4	2
		10 A	4	4
		13.5 A	4	5
B		17 A	4	8
		24 A	4	6
		31 A	4	7
C		38 A	4	3
		45 A	4	A
		58.5 A	4	B
D		70.5 A	4	C
		88 A	4	D
E		105 A	5	0
		142 A	5	1
		180 A	5	2
		211 A	5	3
B	500...600 V	2.9 A	8	A
		4.2 A	8	B
		7 A	8	C
		10 A	8	D
		12 A	8	E
		17 A	8	F
C		22 A	8	6
		27 A	8	7
		32 A	8	8
		44 A	8	9
D		22 A	8	6
		27 A	8	7
		32 A	8	8
		44 A	8	9
E		53 A	9	0
		63 A	9	1
		80 A	9	2
		107 A	9	3
		125 A	9	4
		150 A	9	5
		53 A **	B	1
		63 A **	B	2
		80 A **	B	3

* Models with single-phase/three-phase power supply.

** Models with 24 V fan power supply.

Example: For a 10 A, 380...480 V CFW701, with RFI suppressor filter, without safety relay and without external 24 V supply, the hexadecimal code presented in the keypad (HMI) for the parameter P0029 is C544 (refer to the Table 6.5 on page 6-5).

Table 6.5: Example of the code at P0029 for a specific inverter model

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	0	0	1	0	1	0	1	0	0	0	1	0	0
C				5				4				4			

P0295 – ND/HD VFD Rated Current

Adjustable Range:	0 = 2 A / 2 A	**Factory Setting:**	
	1 = 3.6 A / 3.6 A		
	2 = 5 A / 5 A		
	3 = 6 A / 5 A		
	4 = 7 A / 5.5 A		
	5 = 7 A / 7 A		
	6 = 10 A / 8 A		
	7 = 10 A / 10 A		
	8 = 13 A / 11 A		
	9 = 13.5 A / 11 A		
	10 = 16 A / 13 A		
	11 = 17 A / 13.5 A		
	12 = 24 A / 19 A		
	13 = 24 A / 20 A		
	14 = 28 A / 24 A		
	15 = 31 A / 25 A		
	16 = 33.5 A / 28 A		
	17 = 38 A / 33 A		
	18 = 45 A / 36 A		
	19 = 45 A / 38 A		
	20 = 54 A / 45 A		
	21 = 58.5 A / 47 A		
	22 = 70 A / 56 A		
	23 = 70.5 A / 61 A		
	24 = 86 A / 70 A		
	25 = 88 A / 73 A		
	26 = 105 A / 86 A		
	27 = 105 A / 88 A		
	28 = 142 A / 115 A		
	29 = 180 A / 142 A		
	30 = 211 A / 180 A		
	31 = 2.9 A / 2.7 A		
	32 = 4.2 A / 3.8 A		
	33 = 7 A / 6.5 A		
	34 = 10 A / 9 A		
	35 = 12 A / 10 A		
	36 = 17 A / 17 A		
	37 = 22 A / 19 A		
	38 = 27 A / 22 A		
	39 = 32 A / 27 A		
	40 = 44 A / 36 A		
	41 = 53 A / 44 A		
	42 = 63 A / 53 A		
	43 = 80 A / 66 A		
	44 = 107 A / 90 A		
	45 = 125 A / 107 A		
	46 = 150 A / 122 A		
Properties:	ro		
Access Groups via HMI:	READ		

Description:

This parameter presents the inverter rated current for the normal overload regimen (ND) and for the heavy overload regimen (HD). The inverter operation mode, if it is ND or HD, is defined by the content of P0298.

P0296 – Line Rated Voltage

Adjustable Range:	0 = 200 / 240 V 1 = 380 V 2 = 400 / 415 V 3 = 440 / 460 V 4 = 480 V 5 = 500 / 525 V 6 = 550 / 575 V 7 = 600 V	Factory Setting:	According to the inverter model
Properties:	cfg		
Access Groups via HMI:			

Description:

Setting according to the inverter power supply voltage.

The adjustable range depends on the inverter model, according to the Table 6.6 on page 6-7, which also presents the factory default value.

> ✓ **NOTE!**
> When adjusted via the keypad (HMI), this parameter may change automatically the following parameters: P0151, P0153, P0185, P0321, P0322 and P0323.

Table 6.6: P0296 setting according to the CFW701 inverter model

Inverter Model	Adjustable Range	Factory Setting
200-240 V	0 = 200 ... 240 V	0
380-480 V	1 = 380 V 2 = 400 / 415 V 3 = 440 / 460 V 4 = 480 V	3
500-600V	5 = 500 / 525 V 6 = 550 / 575 V 7 = 600 V	6

P0297 – Switching Frequency

Adjustable Range:	0 = 1.25 kHz 1 = 2.5 kHz 2 = 5.0 kHz 3 = 10.0 kHz 4 = 2.0 kHz	Factory Setting:	According to the inverter model
Properties:	cfg		
Access Groups via HMI:			

Description:

Refer to the allowed current for switching frequencies different from the default, in the tables available in chapter 8 Technical Specifications, of the CFW701 user's manual.

The inverter switching frequency can be adjusted according to the needs of the application. Higher switching frequencies imply in lower motor acoustic noise, however, the selection of the switching frequency results in a compromise between the motor acoustic noises, the losses in the inverter IGBTs and the maximum allowed currents.

The reduction of the switching frequency reduces effects related to motor instability, which occur in specific application conditions. It also reduces the earth leakage current, being able to avoid the actuation of the faults F0074 (Ground Fault) or F0070 (Output Overcurrent/Short-circuit).

Note: The option 0 (1.25 kHz) is only allowed for the V/f or VVW control (P0202 = 0, 1, 2 or 3).

P0298 – Application

Adjustable Range:	0 = Normal Duty (ND) 1 = Heavy Duty (HD)	**Factory Setting:**	0
Properties:	cfg		
Access Groups via HMI:			

Description:

Set the content of this parameter according to the application.

The **Normal Duty Regimen (ND)** defines the maximum current for continuous operation (I_{nom-ND}) and an **overload of 110 % during 1 minute**. It must be used for driving motors that are not subject in that application to high torques in relation to their rated torque, when operating in permanent regimen, during start, acceleration or deceleration.

The **Heavy Duty Regimen (HD)** defines the maximum current for continuous operation (I_{nom-HD}) and an **overload of 150 % during 1 minute.** It must be used for driving motors that are subject in that application to high overload torques in relation to their rated torque, when operating in constant speed, during start, acceleration or deceleration.

The I_{nom-ND} and I_{nom-HD} are presented in P0295. Refer to the CFW701 user's manual chapter 8 Technical Specifications, for more details regarding these operation regimens.

6

7 STARTING-UP AND SETTINGS

In order to start-up in the several types of controls, beginning from the factory settings, consult the following sections:

-

-

-

In order to use previously loaded parameters, refer to the described next.

7.1 BACKUP PARAMETERS

The CFW701 BACKUP functions allow saving the content of the current inverter parameters in a specific memory, or vice-versa (overwrite the contents of the current parameters with the memory contents). Besides, there is a function exclusive for software update, by means of the FLASH Memory Module.

P0204 – Load/Save Parameters

Adjustable Range:	0 = Not Used 1 = Not Used 2 = Reset P0045 3 = Reset P0043 4 = Reset P0044 5 = Load WEG 60 Hz 6 = Load WEG 50 Hz 7 = Load User 1 8 = Load User 2 9 = Save User 1 10 = Save User 2	**Factory Setting:**	0
Properties:	cfg		
Access Groups via HMI:			

Description:

It makes it possible to save the actual inverter parameters in an area of the control module memory or the other way around, to load the contents of that area into the parameters. It also allows resetting the Time Enabled (P0043), kWh (P0044) and Fan Enabled Time (P0045) counters. The Table 7.1 on page 7-1 describes the actions performed by each option.

Table 7.1: Parameter P0204 options

P0204	Action
0, 1	**Not Used:** no action
2	**Reset P0045:** resets the enabled fan hour counter
3	**Reset P0043:** resets the enabled hours counter
4	**Reset P0044:** resets the kWh counter
5	**Load WEG 60 Hz:** loads the 60 Hz factory settings into the inverter parameters
6	**Load WEG 50 Hz:** loads the 50 Hz factory settings into the inverter parameters
7	**Load User 1:** loads the User 1 parameters into the current inverter parameters
8	**Load User 2:** loads the User 2 parameters into the current inverter parameters
9	**Save User 1:** saves the current inverter parameters into the User 1 parameter memory
10	**Save User 2:** saves the current inverter parameters into the User 2 parameter memory
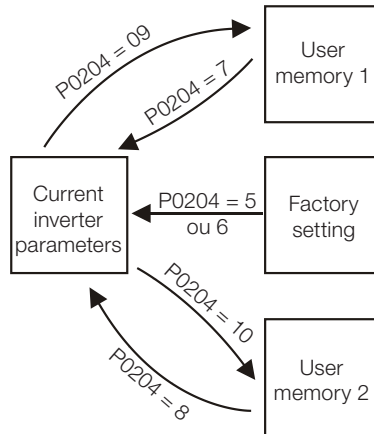
Figure 7.1: *Parameter transfer*

In order to load parameters from user 1 and/or User 2 to the CFW701 operation area (P0204 = 7 or 8), it is necessary that these areas had been saved previously.

The operation of loading one of those memories can also be performed via digital inputs (DIx). Refer to item 13.1.3 Digital Inputs on page 13-9, for more details regarding this programming (P0204 = 9 or 10).

> **⊘ NOTE!**
> When P0204 = 5 or 6, the parameters P0296 (Rated voltage), P0297 (Switching frequency), P0308 (Serial address) are not changed by the factory settings.

P0317 – Oriented Start-up

Adjustable Range:	0 = No 1 = Yes	Factory Setting:	0
Properties:	cfg		
Access Groups via HMI:	STARTUP		

Description:

When this parameter is changed to "1", the Oriented Start-up routine starts. The CFW701 goes into the "CONF" state, which is indicated on the HMI. Within the Oriented Start-up, the user has access to the important configuration parameters of the CFW701 and of the motor for the control type to be used in the application. For further information on the use of this parameter, refer to the following sections:

- section 10.3 VVW CONTROL MODE START-UP on page 10-4.
- section 11.9 START-UP IN THE VECTOR MODES SENSORLESS on page 11-24.

P0318 – Copy Function MMF

Adjustable Range:	0 = Off 1 = VFD → MMF 2 = MMF → VFD 3 = VFD Synchronization → MMF 4 = MMF Format 5 = SoftPLC Program Copy 6 = SoftPLC Program Save	Factory Setting:	0
Properties:	cfg		
Access Groups via HMI:			

Description:

This function allows saving the contents of the inverter writing parameters in the FLASH Memory Module (MMF), or vice-versa, and can be used to transfer the contents of the parameters from one inverter to another.

Table 7.2: Parameter P0318 options

P0318	Action
0	Inactive: no action
1	Inverter → MMF: transfers the inverter current parameters contents to the MMF
2	MMF → Inverter: transfers the contents of the parameters stored in the MMF to the inverter control board
3	Updates the MMF automatically whenever any parameter of the CFW701 is changed
4	Format the MMF
5	Copy the SoftPLC program from the MMF to the CFW701
6	Save the SoftPLC program of the CFW701 to the MMF

After storing the parameters of one inverter in a FLASH memory module, it is possible to pass them to another inverter with this function.

NOTE!
During the inverter operation, the modified parameters are saved in the FLASH memory module regardless of user's command, when P0318 = 3. This assures that the MMF will always have an updated copy of the inverter parameters.

NOTE!
When the inverter is powered on and the memory module is present, the current values of its parameters is overridden if P0318 = 3. If you want to copy from another inverter, set P0318 to 0 before inserting the card.

NOTE!
When the inverter is powered on and the memory module is not detected, P0318 is not visible or changeable by the user and it is automatically set to 0.

7

8 AVAILABLE CONTROL TYPES

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

Choose the control type in function of the static and dynamic, torque and speed requirements of the driven load.

Control modes and their main characteristics:

- **V/f:** scalar control; it is the simplest control mode, by imposed voltage/frequency; with an open loop speed regulation or with slip compensation (programmable); it allows multimotor operation.

- **VVW:** Voltage Vector WEG; it allows a static speed control more accurate than the V/f mode; it adjusts itself automatically to the line variations, and also to the load variations, however it does not present fast dynamic response.

- **Sensorless Vector:** it is a field oriented control; without motor speed sensor; able to drive any standard motor; speed control range of 1:100; speed control static precision of 0.5 % of the rated speed; high control dynamics.

All these control modes are described in details in the chapter 9 SCALAR CONTROL (V/f) on page 9-1, chapter 10 VVW CONTROL on page 10-1 and chapter 11 VECTOR CONTROL on page 11-1, the related parameters and orientations regarding the use of each of these modes.

8

9 SCALAR CONTROL (V/f)

It consists of a simple control based on a curve that links output voltage and frequency. The inverter operates as a voltage source, generating frequency and voltage values according to that curve. It is possible to adjust this curve to standard 50 Hz or 60 Hz motors or to special ones through the adjustable V/f curve. Refer to the block diagram at the Figure 9.1 on page 9-1.

The advantage of the V/f control is that due to its simplicity just a few settings are necessary. The start-up is fast and simple, and the factory settings require generally few or no modifications.
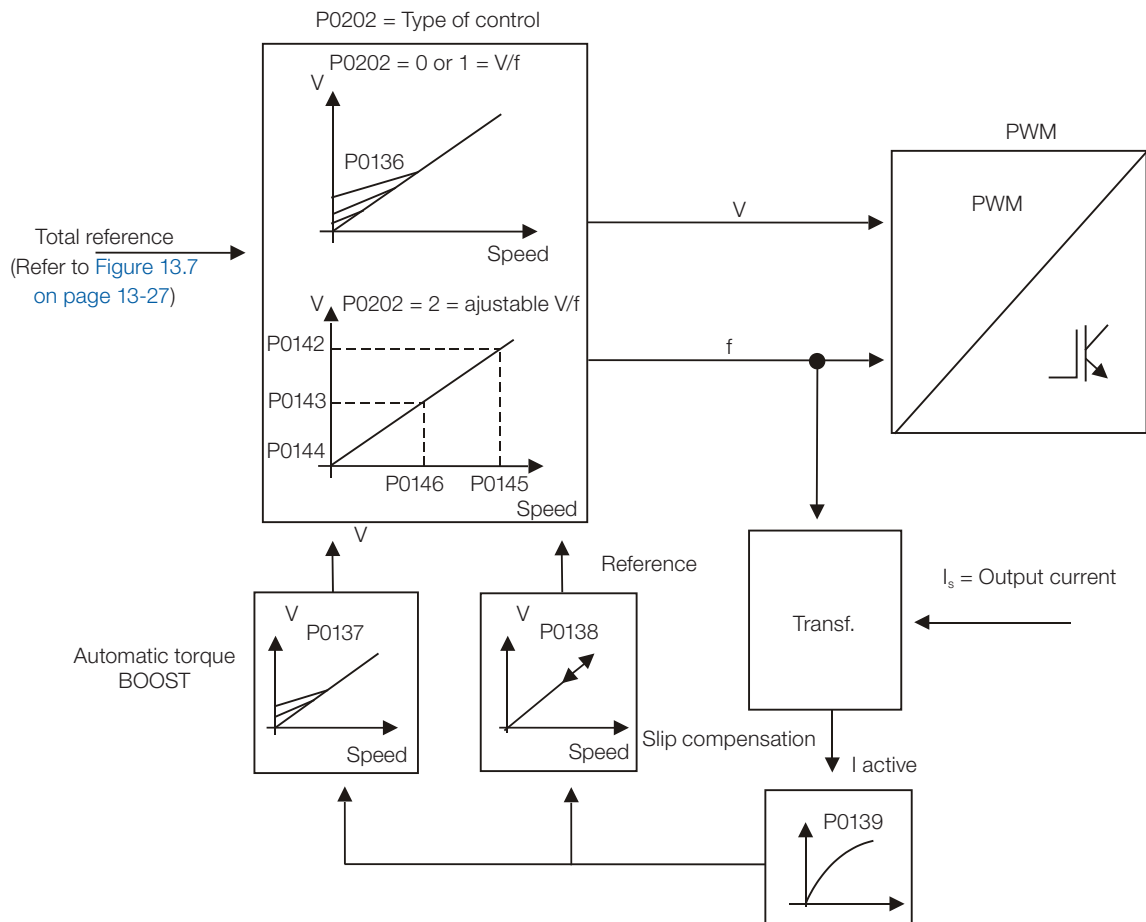
Figure 9.1: V/f control block diagram

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

- Operation of several motors with the same inverter (multimotor operation).
- The motor rated current is less than 1/3 of the inverter rated current.
- The inverter is, for test purposes, enabled without motor or with a small motor and no load.

The scalar control can also be used in applications that do neither require fast dynamic response, nor accuracy in the speed regulation, and also do not require high starting torque (the speed error is a function of the motor slip, and by programming the parameter P0138 – Slip Compensation – it is possible to get a accuracy of approximately 1 % at the rated speed with the load variation).

9.1 V/f CONTROL

P0136 - Manual Torque Boost

Adjustable Range:	0 to 9	Factory Setting:	According to the inverter model
Properties:	V/f		
Access Groups via HMI:	BASIC		

Description:

It acts at low speeds, increasing the inverter output voltage in order to compensate the voltage drop across the motor stator resistance, with the purpose of keeping the torque constant.

The optimum setting is the lowest value of P0136 that allows a satisfactory starting of the motor. Values higher than the necessary will increase the motor current at low speeds, being able to lead the inverter to a fault (F0048, F0051, F0071, F0072, F0078 or F0183) or alarm (A0046, A0047, A0050 or A0110) condition.
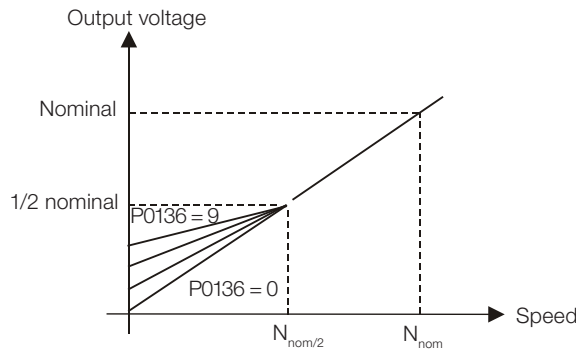
Figure 9.2: *Effect of P0136 on the V/f curve (P0202 = 0 or 1)*

> **NOTE!**
> For large frames than frame C, the standard value is 0. For others, the standard value is 1.

P0137 – Automatic Torque Boost

Adjustable Range:	0.00 to 1.00	Factory Setting:	0.00
Properties:	V/f		
Access Groups via HMI:			

Description:

The Automatic Torque Boost compensates the voltage drop on the stator resistance in function of the motor active current.

The criteria for adjusting P0137 are the same as for the parameter P0136.
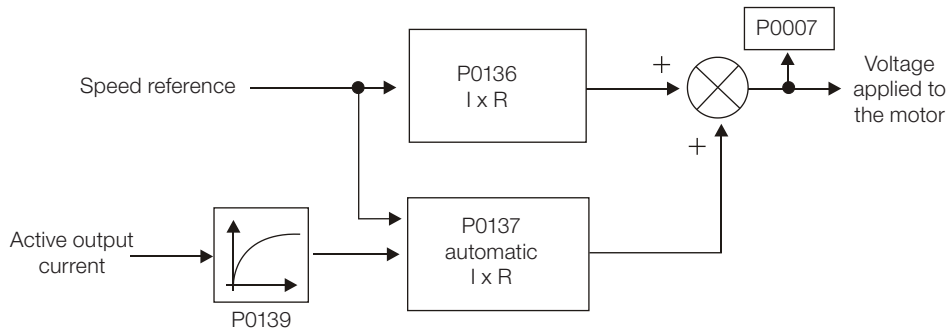
Figure 9.3: Torque Boost block diagram
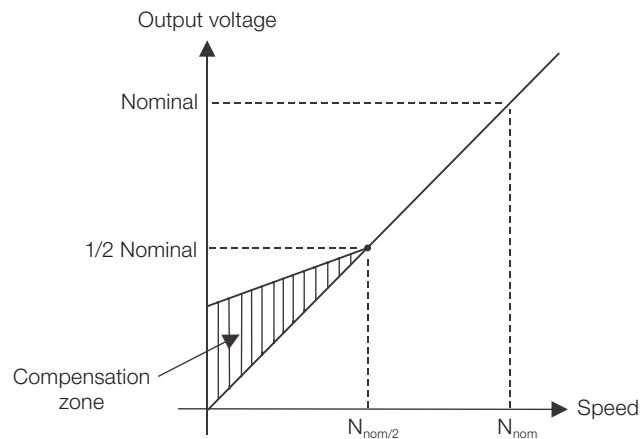
Figure 9.4: Effect of P0137 on the V/f curve (P0202 = 0...2)

P0138 – Slip Compensation

Adjustable Range:	-10.0 to 10.0 %		Factory Setting:	0.0 %
Properties:	V/f			
Access Groups via HMI:				

Description:

The parameter P0138 is used in the motor slip compensation function, when adjusted to positive values. In this case it compensates the drop in the speed due to the application of load to the motor shaft. It increases the output frequency in function of the increase in the motor active current.

The setting of P0138 allows regulating the slip compensation precisely. Once P0138 is adjusted the inverter will keep the speed constant even with load variations by adjusting the voltage and frequency automatically.

Negative values are used in special applications where one wants to reduce the output speed in function of the increase in the motor current.

E.g.: Load distribution in motors operated in parallel.
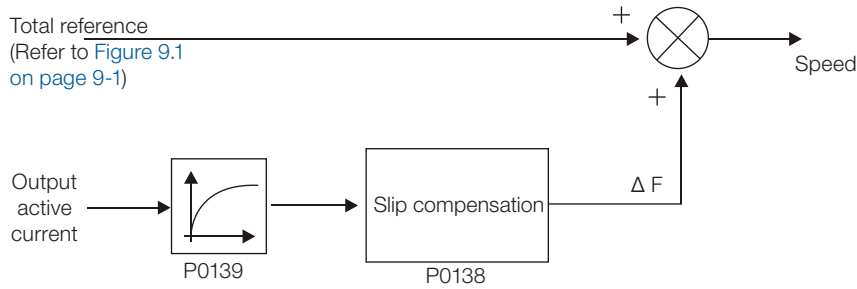
Figure 9.5: *Slip compensation block diagram*
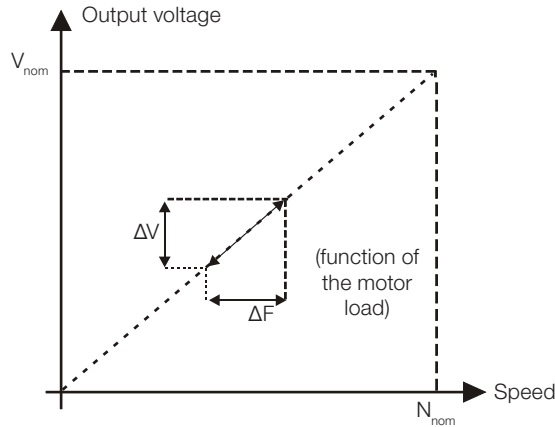
Figure 9.6: *V/f curve with slip compensation*

For the adjustment of the parameter P0138 to compensate the motor slip:

1. Run the motor with no load at approximately half the working speed.

2. Measure the motor or equipment speed with a tachometer.

3. Apply rated load to the equipment.

4. Increase the content of P0138 until the speed reaches the value measured before with no load.

P0139 – Output (Active) Current Filter

Adjustable Range:	0.0 to 16.0 s		Factory Setting:	0.2 s
Properties:	V/f, VVW			
Access Groups via HMI:				

Description:

It sets the active current filter time constant.

It is used in the Automatic Torque Boost and Slip Compensation functions. Refer to the Figure 9.3 on page 9-3 and Figure 9.5 on page 9-4.

It sets the response time of the Slip Compensation and of the Automatic Torque Boost. Refer to the Figure 9.3 on page 9-3 and Figure 9.5 on page 9-4.

P0202 – Control Type

Adjustable Range:	0 = V/f 60 Hz 1 = V/f 50 Hz 2 = V/f Adjustable 3 = VVW (Voltage Vector WEG) 4 = Sensorless	Factory Setting:	0
Properties:	cfg		
Access Groups via HMI:			

Description:

In order to get an overview of the control types, as well as orientation to choose the most suitable type for the application, refer to the chapter 8 AVAILABLE CONTROL TYPES on page 8-1.

For the V/f mode, select P0202 = 0, 1 or 2:

Parameter P0202 setting for the V/f mode:

- P0202 = 0 for motors with rated frequency = 60 Hz.
- P0202 = 1 for motors with rated frequency = 50 Hz.

Notes:

- The correct setting of P0400 assures the application of the correct V/f ratio at the output, in case of 50 Hz or 60 Hz motors with voltage different from the inverter input voltage.

- P0202 = 2: for special motors with rated frequency different from 50 Hz or 60 Hz, or for the adjustment of special V/f curve profiles. Example: the approximation of a quadratic V/f curve for energy saving in variable torque loads like centrifuge pumps and fans.

9.2 ADJUSTABLE V/f CURVE

P0142 – Maximum Output Voltage

P0143 – Intermediate Output Voltage

P0144 – 3 Hz Output Voltage

Adjustable Range:	0.0 to 100.0 %	Factory Setting:	P0142 = 100.0 % P0143 = 50.0 % P0144 = 8.0 %

P0145 – Field Weakening Speed

P0146 – Intermediate Speed

Adjustable Range:	0 to 18000 rpm	Factory Setting:	P0145 = 1800 rpm P0146 = 900 rpm
Properties:	cfg, Adj		
Access Groups via HMI:			

Description:

This function allows the adjustment of the curve that links output voltage and frequency by means of parameters, as presented by the Figure 9.7 on page 9-6, in V/f mode.

It is necessary when the used motor has a rated frequency different from 50 Hz or 60 Hz, or when a quadratic V/f curve, for energy saving in the operation of centrifuge pumps and fans, is desired, or even in special applications, such as, for instance, when a transformer is used at the inverter output, between it and the motor.

The function is activated with P0202 = 2 (Adjustable V/f).

The factory setting of P0144 (8.0 %) is adequate for standard motors with rated frequency of 60 Hz. When using a motor with rated frequency (adjusted in P0403) different from 60 Hz, the default value for P0144 may become inadequate, being able to cause difficulties in the motor starting. A good approximation for the setting of P0144 is given by the formula:

$$P0144 = \frac{3}{P0403} \times P0142$$

If it is necessary to increase the starting torque, increase gradually the value of P0144.
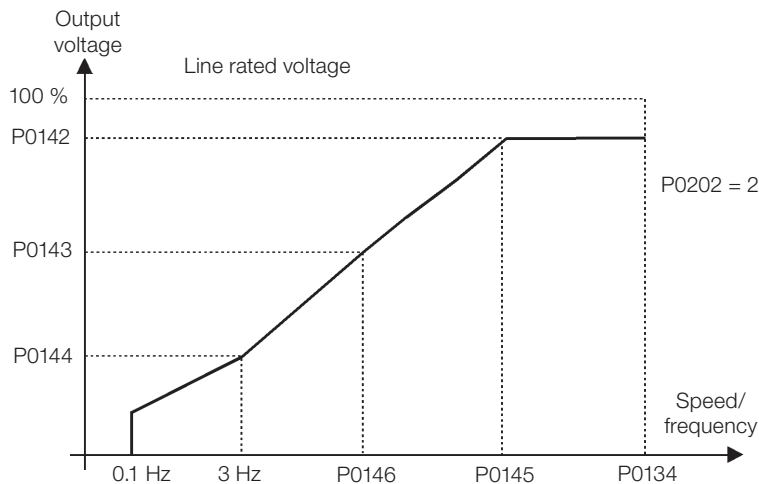
Figure 9.7: *V/f curve in function of P0142 to P0146*

9.3 V/f CURRENT LIMITATION

P0135 – Maximum Output Current

Adjustable Range:	0.2 to 2xI$_{nom-HD}$	Factory Setting:	1.5xI$_{nom-HD}$
Properties:	V/f, VVW		
Access Groups via HMI:	BASIC		

P0344 – Current Limitation Configuration

Adjustable Range:	0 = Hold 1 = Decel.	Factory Setting:	1
Properties:	cfg, V/f, VVW		
Access Groups via HMI:			

Description:

It is the current limitation for the V/f control with actuation mode defined by P0344 (refer to the Table 9.1 on page 9-7) and the current limit defined by P0135.

Table 9.1: Current limitation configuration

P0344	Function	Description
0 = Hold	Current limitation of the "Ramp Hold" type	Current limitation according to the Figure 9.8 on page 9-8
1 = Decel.	Current limitation of the "Ramp Deceleration" type	Current limitation according to the Figure 9.8 on page 9-8

Current limitation of the "Ramp Hold" type:

- It avoids the stalling of the motor during a torque overload at the acceleration or at the deceleration.

- Working: if the motor current exceeds the value adjusted in P0135 during the acceleration or the deceleration, the speed will no longer be increased (acceleration) or decreased (deceleration). When the motor current reaches a value below P0135 the motor will again accelerate or decelerate. Refer to the Figure 9.8 on page 9-8.

- It acts faster than the "Ramp Deceleration" mode.

- It acts in the motorization and braking modes.

Current limitation of the "Ramp Deceleration" type:

- It avoids the stalling of the motor during a torque overload at the acceleration or at constant speed.

- Working: if the motor current exceeds the value adjusted in P0135, the input of the speed ramp is set to zero forcing a deceleration. When the motor current reaches a value below P0135 the motor will accelerate again. Refer to the Figure 9.8 on page 9-8.

(a) "Ramp Hold"

(b) "Ramp Deceleration"
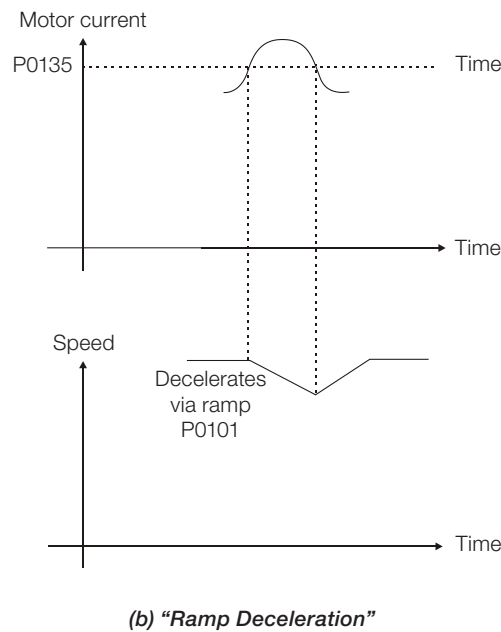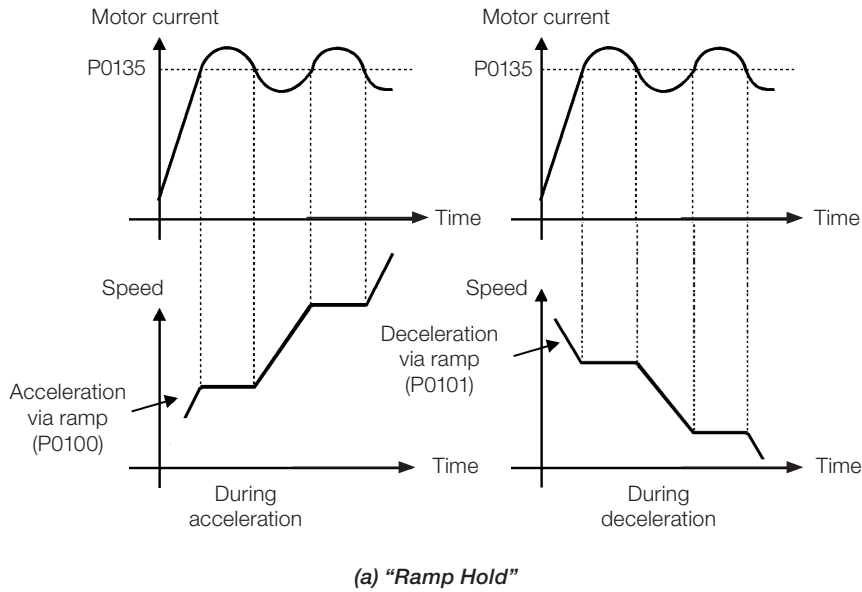
Figure 9.8: *(a) and (b) Current limitation via P0135 working modes*

9.4 V/f DC VOLTAGE LIMITATION

There are two functions in the inverter for limiting the DC link voltage during the motor braking. They act limiting the braking torque and power, avoiding therefore the tripping of the inverter by overvoltage (F0022).

The overvoltage on the DC link is more common when a load with high inertia is driven or when a short deceleration time is programmed.

> ✓ **NOTE!**
> When using the dynamic braking the function "Ramp Hold" or "Ramp Acceleration" must be disabled.
> Refer to the P0151 description.

In the V/f mode, there are two types of function to limit the DC link voltage:

1 - "Ramp Hold":

It is effective only during the deceleration.

Working: When the DC link voltage reaches the level adjusted in P0151, a command is sent to the "ramp" block, which inhibits the motor speed variation ("ramp hold"). Refer to the Figure 9.9 on page 9-9 and Figure 9.10 on page 9-9.

With this function an optimized deceleration time (minimum possible) for the driven load is obtained.

The use is recommended for loads running with high inertia moment referenced to the motor shaft, or loads with medium inertia, which require short deceleration ramps.
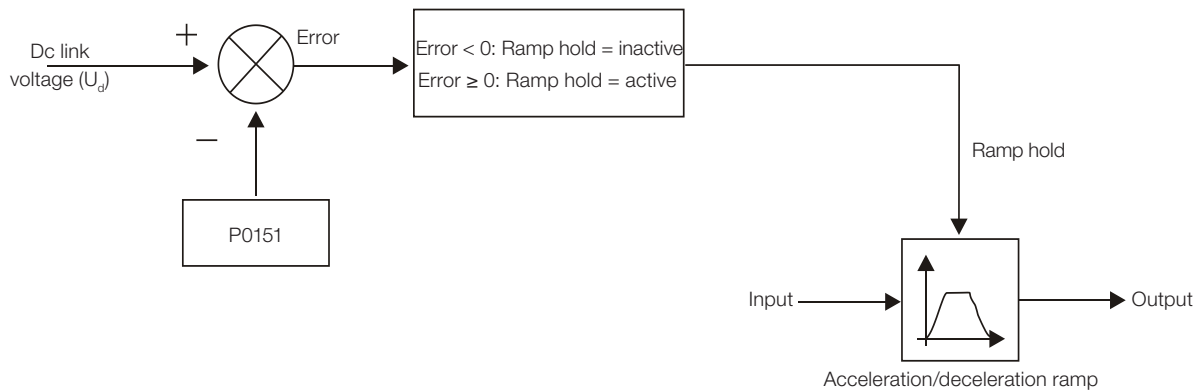
Figure 9.9: Limitation of the DC link voltage using ramp acceleration function block diagram
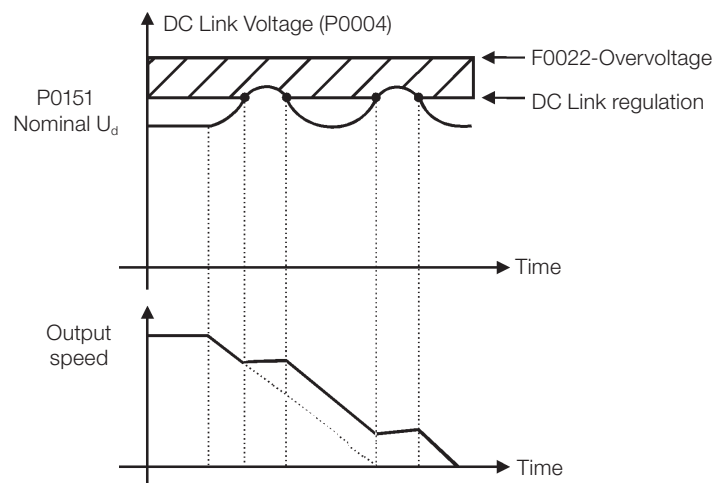
Figure 9.10: Example of the DC link voltage limitation working with the Ramp Hold function

2 - Ramp Acceleration:

It is effective in any situation, regardless of the motor speed condition, accelerating, decelerating or at constant speed.

Working: the DC link voltage is compared with the value adjusted in P0151, the difference between these signals is multiplied by the proportional gain (P0152) and the result is added to the ramp output. Refer to the Figure 9.11 on page 9-10 and Figure 9.12 on page 9-10.

In a similar manner as the Ramp Hold, with this function an optimized deceleration time (minimum possible) for the driven load is also obtained.

The use is recommended for loads that require braking torques in constant speed situation. Example: driving of loads with eccentric shafts such as the existent in pumpjacks.
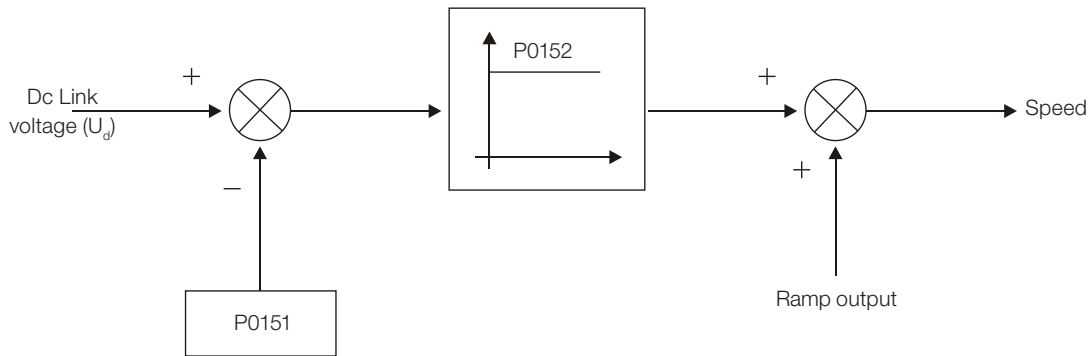
Figure 9.11: Limitation of the DC link voltage using ramp acceleration function block diagram
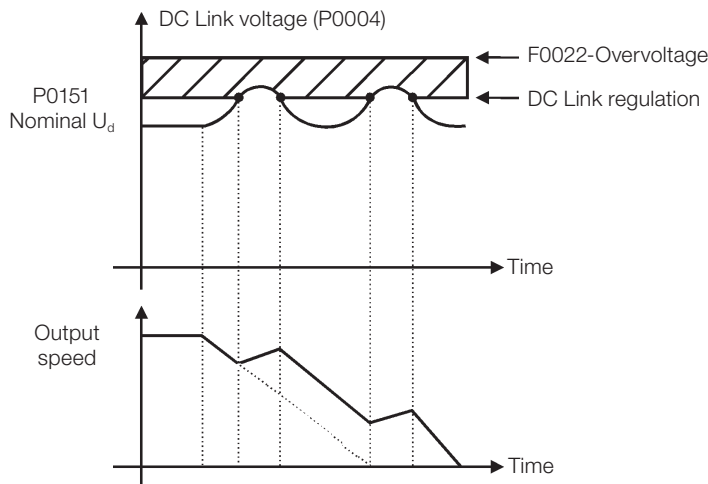
Figure 9.12: Example of the DC link voltage limitation working with the ramp acceleration function

P0150 – V/f DC Regulation Type

Adjustable Range:	0 = Ramp Hold 1 = Ramp Acceleration	Factory Setting:	0
Properties:	V/f, VVW, cfg		
Access Groups via HMI:			

Description:

It selects the DC link voltage limitation function type in the V/f mode.

P0151 – V/f DC Regulation Level

Adjustable Range:	339 to 400 V 585 to 800 V 585 to 800 V 585 to 800 V 585 to 800 V 809 to 1000 V 809 to 1000 V 809 to 1000 V	Factory Setting:	400 V (P0296 = 0) 800 V (P0296 = 1) 800 V (P0296 = 2) 800 V (P0296 = 3) 800 V (P0296 = 4) 1000 V (P0296 = 5) 1000 V (P0296 = 6) 1000 V (P0296 = 7)
Properties:	V/f, VVW		
Access Groups via HMI:			

Description:

It is the actuation level of the DC link voltage limitation function for the V/f mode.

Setting of P0151 value:

1. The P0151 factory setting leaves inactive the DC link voltage limitation function for the V/f mode. In order to activate it, one must reduce the value of P0151 as suggested in the Table 9.2 on page 9-11.

Table 9.2: Recommended actuation levels for the DC link regulation

Inverter V_{nom}	220 / 230 V	380 V	400 / 415 V	440 / 460 V	480 V	500 / 525 V	550 / 575 V	600 V
P0296	0	1	2	3	4	5	6	7
P0151	375 V	618 V	675 V	748 V	780 V	893 V	972 V	972 V

2. In case DC link overvoltage (F0022) keeps happening during the deceleration, reduce the value of P0151 gradually or increase the deceleration ramp time (P0101 and/or P0103).

3. If the supply line is permanently at a voltage level that results in a DC link voltage higher than the P0151 setting, it will not be possible to decelerate the motor. In this case, reduce the line voltage or increase the value of the P0151 setting.

4. If, even with the procedures above, it is not possible to decelerate the motor in the necessary time, use the dynamic braking (Refer to the chapter 14 DYNAMIC BRAKING on page 14-1).

P0152 – V/f DC Regulation Proportional Gain

Adjustable Range:	0.00 to 9.99	**Factory Setting:**	1.50
Properties:	V/f, VVW		
Access Groups via HMI:			

Description:

It defines the DC Link Voltage Regulator proportional gain (refer to the Figure 9.11 on page 9-10).

P0152 multiplies the DC link voltage error, i.e., Error = actual DC link voltage – (P0151), and it is normally used to prevent overvoltage in applications with eccentric loads.

9.5 START-UP IN THE V/f CONTROL MODE

> ✓ **NOTE!**
> Read the whole CFW701 user's manual before installing, powering or operating the inverter.

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

1. **Install the inverter:** according to the chapter 3 Installation and Connection, of the CFW701 user's manual, wiring all the power and control connections.

2. **Prepare the inverter and apply power:** according to the section 5.1 Prepare for Start-Up, of the CFW701 user's manual.

3. **Adjust the password P0000 = 5:** according to the section 5.3 PASSWORD SETTING IN P0000 on page 5-1, of this manual.

4. Adjust the inverter to operate with the application line and motor: execute the Oriented Start-up routine according to item 5.2.1 Oriented Start-up Menu, of the CFW701 user's manual. Refer to the section 11.7 MOTOR DATA on page 11-7, of this manual.

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 needs.

For applications:

■ That are simple, which can use the factory settings programming for the digital and analog inputs and outputs, use the Menu "BASIC". Refer to item 5.2.2 Basic Application Menu, of the CFW701 user's manual.

■ That require only the digital and analog inputs and outputs with programming different from the factory settings, use the Menu "I/O".

■ That need functions as Flying Start, Ride-Through, DC Braking, Dynamic Braking, etc., access and modify those functions parameters by means of the Menu "PARAM".

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10 VVW CONTROL

The VVW (Voltage Vector WEG) control mode uses a control method with intermediate performance between V/f and Sensorless Vector. Refer to the Figure 10.1 on page 10-2 block diagram.

The main advantage compared to the V/f control is the better speed regulation with higher torque capability at low speeds (frequencies below 5 Hz), allowing a sensible improvement of the inverter performance in permanent regimen. Comparing to the Sensorless Vector, the settings are simpler and easier.

The VVW control uses the stator current measurement, the stator resistance value (that can be obtained with the self-tuning routine) and the induction motor nameplate data to perform automatically the torque estimation, the output voltage compensation and consequently the slip compensation, replacing the function of the parameters P0137 and P0138.

In order to obtain a good speed regulation in permanent regimen, the slip frequency is calculated based on the load estimated torque, which considers the existent motor data.

10
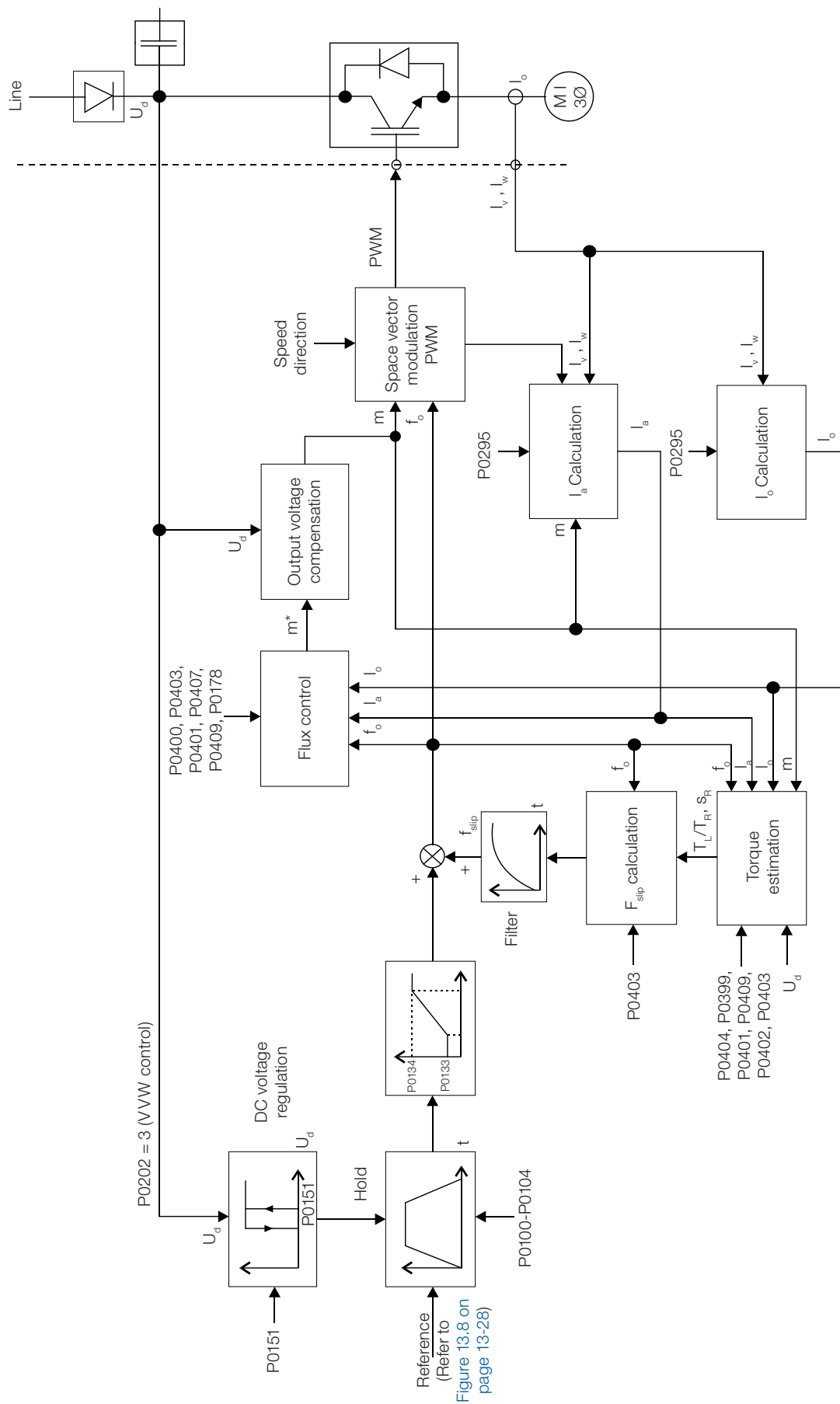
Figure 10.1: VVW control block diagram

10.1 VVW CONTROL

Only three parameters are related to this function: P0139, P0202 and P0397.

However, since the parameters P0139 and P0202 were already presented in the section 9.1 V/f CONTROL on page 9-2, only the parameter P0397 will be described next.

P0397 – Slip Compensation During Regeneration

Adjustable Range:	0 = Off 1 = On		Factory Setting:	1
Properties:	cfg, VVW			
Access Groups via HMI:				

Description:

It enables or disables the slip compensation during the regeneration in the VVW control mode. Refer to the parameter P0138 in the section 9.1 V/f CONTROL on page 9-2, for more details on the slip compensation.

10.2 MOTOR DATA

The parameters for the used motor data setting are listed in this group. They must be adjusted according to the motor nameplate data (P0398 to P0407) and by means of the Self-Tuning or from data of the motor data sheet (other parameters).

In this section only the parameters P0399 and P0407 will be presented, the others are presented in the section 11.7 MOTOR DATA on page 11-7.

P0398 – Motor Service Factor

Refer to the section 11.7 MOTOR DATA on page 11-7, for more information.

P0399 – Motor Rated Efficiency

Adjustable Range:	50.0 to 99.9 %		Factory Setting:	67.0 %
Properties:	cfg, VVW			
Access Groups via HMI:	MOTOR			

Description:

It sets the motor rated efficiency.

This parameter is important for the VVW control precise operation. The inaccurate setting implies in incorrect calculation of the slip compensation and consequently an imprecise speed control.

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P0400 – Motor Rated Voltage

P0401 – Motor Rated Current

P0402 – Motor Rated Speed

P0403 – Motor Rated Frequency

P0404 – Motor Rated Power

P0406 – Motor Ventilation

Refer to the section 11.7 MOTOR DATA on page 11-7, for more information.

P0407 – Motor Rated Power Factor

Adjustable Range:	0.50 to 0.99	Factory Setting:	0.68
Properties:	cfg and VVW		
Access Groups via HMI:	MOTOR		

Description:

It is the motor power factor setting, according to the motor nameplate data (cos Ø).

This parameter is important for the VVW control operation. The inaccurate setting will imply in incorrect calculation of the slip compensation.

The default value of this parameter is adjusted automatically when the parameter P0404 is changed. The suggested value is valid for three-phase, IV pole WEG motors. For other motor types the setting must be done manually.

P0408 – Run Self-Tuning

P0409 – Motor Stator Resistance (Rs)

P0410 – Motor Magnetizing Current (I_m)

Refer to section 11.8.5 Self-Tuning on page 11-17, for more information.

10.3 VVW CONTROL MODE START-UP

> ✓ **NOTE!**
> Read the whole CFW701 user's manual before installing, powering or operating the inverter.

10

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

1. **Install the inverter:** according to the chapter 3 Installation and Connection, of the CFW701 user's manual, wiring all the power and control connections.

2. **Prepare the inverter and apply power:** according to the section 5.1 Prepare for Start-up, of the CFW701 user's manual.

3. **Adjust the password P0000 = 5:** according to the , of this manual.

4. **Adjust the inverter to operate with the application line and motor:** by means of the "STARTUP" Menu access P0317 and change its content to 1, which makes the inverter initiate the "Oriented Start-up" routine.

The "Oriented Start-up" routine presents on the keypad (HMI) the main parameters in a logical sequence. The setting of these parameters prepares the inverter for operation with the application line and motor. Verify the step by step sequence in the .

The setting of the parameters presented in this operation mode results in the automatic modification of the content of other inverter parameters and/or internal variables, as indicated in the . In this way one gets a stable operation of the control circuit with adequate values to obtain the best motor performance.

During the "Oriented Start-up" routine the "Config" (Configuration) status will be indicated on the keypad (HMI).

Parameters related to the motor:

■ Program the contents of parameters from P0398 to P0407 directly with the motor nameplate data. Refer to the .

■ Options for the setting of parameter P0409:

    I – Automatic by the inverter, performing the self-tuning routine selected in P0408.
    II – From the motor test data sheet, supplied by the manufacturer. Refer to , in this manual.
    II – Manually, copying the parameters content of another CFW701 that runs an identical motor.

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 needs.

For applications:

■ That are simple, which can use the factory settings programming for the digital and analog inputs and outputs, use the Menu "BASIC". Refer to item 5.2.2 Basic Application Menu, of the CFW701 user's manual.

■ That require only the digital and analog inputs and outputs with programming different from the factory settings, use the Menu "I/O".

■ That need functions as Flying Start, Ride-Through, DC Braking, Dynamic Braking, etc., access and modify those function parameters by means of the Menu "PARAM".

Step	Action/Result	Display Indication	Step	Action/Result	Display Indication
1	- Monitoring Mode. - Press the **ENTER/MENU** key to get into the first level of the programming mode.	LOC 90 0 rpm	2	- The **PARAM** group is selected, press the ▲ or ▼ keys to select the **STARTUP** group.	PARAM LOC
3	- Press **ENTER/MENU** when the group is selected.	LOC STARTUP	4	- The parameter **"P0317 – Oriented Start-up"** is then selected, press the **ENTER/MENU** to get into the parameter content.	LOC 0 P0317 STARTUP
5	- Change the parameter P0317 to **"1 - Yes"**, by using the ▲ key.	LOC P0317 0 STARTUP	6	- Press **ENTER/MENU** to save.	LOC P0317 1 STARTUP

10

Step	Action/Result	Display Indication	Step	Action/Result	Display Indication
7	- In this moment the Oriented Start-up routine is initiated and the **"CONF"** status is indicated at the keypad (HMI). - The parameter **"P0000 - Access to Parameters"** is selected. Change the password to set the remaining parameters if necessary. - Press the ⬆ key to the next parameter.	LOC CONF 5 **P0000** STARTUP	8	- If necessary, change **"P0296 - Line Rated Voltage"**. This change will affect P0151, P0153, P0185, P0321, P0322, P0323 and P0400. - Press the ⬆ key to the next parameter.	LOC CONF 3 **P0296** STARTUP
9	- If necessary, change **"P0298 - Application"** parameter. This change will affect P0156, P0157, P0158, P0401, P0404 and P0410 (this last one only if P0202 = 0, 1 or 2 - V/f modes). The time and level of the IGBT overload protection will also be affected. - Press the ⬆ key to the next parameter.	LOC CONF 0 **P0298** STARTUP	10	- Set parameter **"P0202 - Type of Control"** pressing **"ENTER/MENU"**. Press the ⬆ key to select the desired option: **"[3] = VVW"**. Then, press **"ENTER/MENU"**. There are three options to exit the oriented start-up: 1. Running the Self-tunning; 2. Manual settings of parameters from P0409 to P0413; 3. Changing P0202 from vector to V/Hz control. - Press the ⬆ key to the next parameter.	LOC CONF 0 **P0202** STARTUP
11	- If necessary, change **"P0398 - Motor Service Factor"** parameter. This change will affect the current and the time of the motor overload protection operation. - Press the ⬆ key to the next parameter.	LOC CONF 1.00 **P0398** STARTUP	12	- If necessary, change **"P0399 - Motor Rated Efficiency"** parameter. - Press the ⬆ key to the next parameter.	LOC CONF 67.0 **P0399** STARTUP
13	- If necessary, change **"P0400 - Motor Rated Voltage"** parameter. - This change corrects the output voltage by the factor "x = P0400/P0296". - Press the ⬆ key to the next parameter.	LOC CONF 440 **P0400** STARTUP	14	- If necessary, change **"P0401 - Motor Rated Current"** parameter. This change will affect P0156, P0157, P0158 and P0410. - Press the ⬆ key to the next parameter.	LOC CONF 10.0 **P0401** STARTUP
15	- If necessary, change **"P0404 - Motor Rated Power"** parameter. This change will affect P0410. - Press the ⬆ key to the next parameter.	LOC CONF 10 **P0404** STARTUP	16	- If necessary, change **"P0403 - Motor Rated Frequency"** parameter. This change will affect P0402. - Press the ⬆ key to the next parameter.	LOC CONF 60 **P0403** STARTUP
17	- If necessary, change **"P0402 - Motor Rated Speed"**. This change will affect P0122 to P0131, P0133, P0134, P0135, P0182, P0208, P0288 and P0289. - Press the ⬆ key to the next parameter.	LOC CONF 1750 **P0402** STARTUP	18	- If necessary, change **"P0406 - Motor Ventilation"** parameter. - Press the ⬆ key to the next parameter.	LOC CONF 0 **P0406** STARTUP
19	- If necessary, change **"P0407 - Motor Rated Power Factor"**. - Press the ⬆ key to the next parameter.	LOC CONF 0.68 **P0407** STARTUP	20	- In this moment the keypad presents the option to perform **"Self-tunning"**. The Self-tunning should be performed whenever it is possible. Press **"ENTER/MENU"** key to access parameter P0408 and press ⬆ to select the option **"1 = No rotation"**. Refer to , for more details. Then, press **"ENTER/MENU"** to start the Self-tunning. - The keypad will show **"CONF"** and **"RUN"** status simultaneously during the self-tunning. The **"RUN"** status is automatically off and parameter P0408 is automatically set back to zero.	LOC CONF 0 **P0408** STARTUP
21	- Press **BACK/ESC** key to finish the start-up routine. - Press **BACK/ESC** key again to get back to the monitoring mode.	LOC 90 0 rpm			

Figure 10.2: VVW mode Oriented Start-up

11 VECTOR CONTROL

It consists in the control type based on the separation of the motor current into two components:

- Flux producing current I_d (oriented with the motor electromagnetic flux).

- Torque producing current I_q (perpendicular to the motor flux vector).

The I_d current is related to the motor electromagnetic flux, while the I_q current is directly related to the torque produced at the motor shaft. With this strategy one gets the so called decoupling, i.e., one can control the motor flux and torque independently by controlling the I_d and I_q currents respectively.

Since these currents are represented by vectors that rotate at the synchronous speed, when observed from a stationary referential, a referential transformation is done so that they are changed to the synchronous referential. In the synchronous referential these values become DC values proportional the respective vector amplitudes. This simplifies considerably the control circuit.

When the I_d vector is aligned with the motor flux, it can be said that the vector control is orientated. Therefore it is necessary that the motor parameters be correctly adjusted. Some of those parameters must be programmed with the motor nameplate data and others obtained automatically through self-tuning or from the motor data sheet supplied by the manufacturer.

The Figure 11.1 on page 11-2 presents the block diagram for the sensorless vector control. The information of the speed, as well as of the currents measured by the inverter, will be used to obtain the correct vector orientation. In the vector with encoder control case, the speed is obtained directly from the encoder signal, while in the sensorless vector control there is an algorithm which estimates the speed, based in the output currents and voltages.

The vector control measures the current, separates the flux and torque portions and transforms these variables to the synchronous referential. The motor control is accomplished by imposing the desired currents and comparing them with the actual values.

11.1 SENSORLESS CONTROL

The Sensorless Vector Control is recommended for the majority of the applications, because it allows the operation in a speed variation range of 1:100, speed control with 0.5 % accuracy of rated speed, high starting torque and fast dynamic response.

Another advantage of this control type is the greater robustness against sudden line voltage and load changes, avoiding unnecessary overcurrent trips.

The necessary settings for the good operation of the sensorless vector control are done automatically. Therefore the used motor must be connected to the CFW701 inverter.

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Figure 11.1: *Sensorless vector control block diagram*

11.2 I/f MODE (SENSORLESS)

> ✓ **NOTE!**
> It is activated automatically at low speeds if P0182>3 and when the Control Mode is Sensorless Vector (P0202 = 4).

The operation at the low speed region may present instability. In this region the motor operation voltage is also very low, being difficult to be measured accurately.

In order to keep a stable operation of the inverter in that region, the automatic commutation occurs, from sensorless mode to the so called I/f mode, which is a scalar control with imposed current. Scalar control with imposed current means a current control with a constant reference value, adjusted in a parameter and controlling only the frequency in an open loop.

The parameter P0182 defines the speed below which the transition to I/f mode occurs and the parameter P0183 defines the value of the current to be applied to the motor.

The minimum speed recommended for the operation of the Sensorless Vector Mode is 18 rpm for 60 Hz IV pole motors, and 15 rpm for 50 Hz IV pole motors. If P0182 ≤ 3 rpm the inverter will always operate in Sensorless Vector mode, i.e., the I/f function will be disabled.

11.3 SELF-TUNING

Some motor parameters that are not available on the motor nameplate, necessary for the operation of the sensorless vector control, are estimated:

- Stator resistance.

- Motor flux leakage inductance.

- Rotor time constant T_r.

- Rated magnetizing current of the motor.

- Mechanic time constant of the motor and the driven load.

These parameters are estimated with the application of voltages and currents to the motor.

The parameters related to the regulators used by the vector control, as well as other control parameters, are adjusted automatically in function of the motor parameters estimated through the self-tuning routine. The best self-tuning results are obtained with a preheated motor.

The parameter P0408 controls the self-tuning routine. Depending on the chosen option some parameters can be obtained from tables that are valid for WEG motors.

In the option P0408 = 1 (No Rotation) the motor remains stopped throughout the self-tuning. The magnetizing current value (P0410) is obtained from a table, valid for WEG motors up to 12 poles.

In the option P0408 = 2 (Run for I_m) the value of P0410 is estimated with the motor rotating and the load decoupled from the motor shaft.

> ✓ **NOTE!**
>   Every time that P0408 = 1 or 2 the parameter P0413 (Mechanic time constant – T_m) will be adjusted
>   for a value close to the motor rotor mechanic time constant. Therefore, the motor rotor inertia (table
>   data valid for WEG motors), the inverter rated voltage and current, are taken into consideration.
>   If the option P0408 = 2 (Run for I_m) is executed with the load coupled to the motor, an incorrect value
>   of P0410 (I_m) may be estimated. This will implicate in estimation error for P0412 (rotor time constant
>   - T_r) and for P0413 (mechanic time constant – T_m). Overcurrent fault (F0071) may also occur during
>   the inverter operation.
>   **Note**: The term "load" includes everything that might be coupled to the motor shaft, for instance,
>   gearbox, inertia disk, etc.
>   During its execution, the self-tuning routine can be canceled by pressing the ⓞ key, provided that
>   the values of P0409 through P0413 be all different from zero.

For more details on the self-tuning parameters, refer to item 11.8.5 Self-Tuning on page 11-17, in this manual.

Alternatives for the acquisition of the motor parameters:

Instead of running the self-tuning, it is possible to obtain the values for P0409 to P0412 in the following manner:

■ From the motor test data sheet that can be supplied by its manufacturer. Refer to item 11.7.1 Adjustment of the Parameters P0409 to P0412 Based on the Motor Data Sheet on page 11-11, of this manual.

■ Manually, by copying the contents of the parameters from another CFW701 inverter that uses an identical motor.

11.4 OPTIMAL FLUX FOR SENSORLESS VECTOR CONTROL

> ✓ **NOTE!**
>   Active function only on the Sensorless Vector mode (P0202 = 4), if P0406 = 2.

The Optimal Flux function can be used for driving some types of WEG motors **(*)** making it possible the operation at low speed with rated torque without the need of forced ventilation on the motor. The frequency range for operation is 12:1, i.e., from 5 Hz to 60 Hz for 60 Hz rated frequency motors and from 4.2 Hz to 50 Hz for 50 Hz rated frequency motors.

> ✓ **NOTE!**
>   **(*)** WEG motors that can be used with the Optimal Flux function:
>   ■ Nema Premium Efficiency.
>   ■ Nema High Efficiency.
>   ■ IEC Premium Efficiency.
>   ■ IEC Top Premium Efficiency.
>   ■ Alto Rendimento Plus.

When this function is activating, the motor flux is controlled in a way to reduce their electric losses on slow speeds. That flux is dependent of the torque current filtered (P0009). The Optimal Flux function is unnecessary in motors with independent ventilation.

11.5 TORQUE CONTROL

In sensorless vector control mode it is possible to use the inverter in torque control mode instead of using it in speed control mode. In this case the speed regulator must be kept saturated and the imposed torque value is defined by the torque limits in P0169/P0170.

Performance of the torque control:
Vector control with encoder:

Torque control range: 10 % to 180 %.
Accuracy: ± 5 % of the rated torque.

Sensorless vector control:
Torque control range: 20 % to 180 %.
Accuracy: ± 10 % of the rated torque.
Minimum operating frequency: 3 Hz.

When the speed regulator is positively saturated, i.e., forward speed direction defined in P0223/P0226, the value for the torque current limitation is adjusted in P0169. When the speed regulator is negatively saturated, i.e., reverse speed direction, the value for the torque current limitation is adjusted in P0170.

The torque at the motor shaft (T_{motor}) in % is given by the formula:
(*) The equation below must be used for "+" torque. Replace P0169 by P0170 for "-" torque.

$$T_{motor} = \left(\frac{P0401 \times \dfrac{P0169^{(*)}}{100} \times K}{\sqrt{(P0401)^2 - \left(P0410 \times \dfrac{P0178}{100}\right)^2}} \right) \times 100$$

Where:
N_{nom} = motor synchronous speed,
N = motor current speed

$$K = \begin{cases} 1 \text{ for } N \leq \dfrac{P0190 \times N_{nom}}{P0400} \\[3mm] \dfrac{N_{nom}}{N} \times \dfrac{P0190}{P0400} \text{ for } N > \dfrac{P0190 \times N_{nom}}{P0400} \end{cases}$$

✓ **NOTE!**
For torque control in the sensorless vector mode (P0202=4), observe:
■ The torque limits (P0169/P0170) must be higher than 30 % to assure the motor starting. After the start and with the motor rotating above 3 Hz, they can be reduced, if necessary, to values below 30 %.

✓ **NOTE!**
The motor rated current must be equivalent to the CFW701 rated current, in order that the torque control has the best possible accuracy.

Settings for the torque control:

Torque limitation:

1. Via parameters P0169, P0170 (through the keypad (HMI or Serial). Refer to .

2. Through the analog inputs AI1, AI2 or AI3. Refer to , option 2 (maximum torque current).

Speed reference:

3. Set the speed reference 10 %, or more, higher than the working speed. This assures that the speed regulator output remains saturated at the maximum value allowed by the torque limit adjustment.

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> **NOTE!**
> The torque limitation with the saturated speed regulator has also a protection (limitation) function. E.g.: for a winder, when the material being wound brakes, the regulator leaves the saturated condition and starts controlling the motor speed, which will be kept at the speed reference value.

11.6 OPTIMAL BRAKING

> **NOTE!**
> Only activated on the Vector control mode (P0202 = 4), when P0184 = 0, P0185 is smaller than the standard value and P0404 < 21 (75 CV).

> **NOTE!**
> The occurrence of optimal braking may cause at the motor:
> - Increase of the vibration level.
> - Increase of the acoustic noise.
> - Increase of the temperature.
> Verify the impact of those effects in the application before using the optimal braking.

It is a function that helps the motor controlled braking, eliminating in many cases the need of additional braking IGBT and braking resistor.

The Optimal Braking makes it possible braking the motor with a higher torque than the one obtained with traditional methods, as for instance, the braking by the injection of direct current (DC braking). In the DC braking case, only the losses in the motor rotor are used to dissipate the energy stored as the mechanic load inertia, rejecting the total friction losses. With the Optimal Braking, in the other hand, the total losses in the motor, as well as the total inverter losses, are used. It is possible to get a braking torque roughly 5 times greater than with DC braking.

In the Figure 11.2 on page 11-7 the Torque x Speed curve of a typical 10 hp/7.5 kW IV pole motor is presented. The braking torque obtained at the rated speed, for an inverter with a torque limit (P0169 and P0170) adjusted in a value equal to the motor rated torque, is supplied by the TB1 point on the Figure 11.2 on page 11-7. The value of TB1 is on the function of the motor efficiency, and it is defined by the following expression, being despised the attrition losses:

$$\text{TB1} = \frac{1-\eta}{\eta}$$

Where:
η = motor efficiency.

In the Figure 11.2 on page 11-7 case, the efficiency of the motor for the rated load is $\eta=0.84$ (or 84 %), which results in TB1=0.19 or 19 % of the motor rated torque.

The braking torque, starting from the TB1 point, varies in the inverse ratio of the speed (1/N). At low speeds, the braking torque reaches the torque limit of the inverter. In the Figure 11.2 on page 11-7 case, the torque reaches the torque limitation (100 %) when the speed is less than approximately 20 % of the rated speed.

It is possible to increase the braking torque by increasing the inverter current limitation during the optimal braking (P0169 – torque in the forward speed direction or P0170 – reverse).

Generally smaller motors have lower efficiency because they present more losses. Therefore, comparatively higher braking torque is obtained if they are compared to bigger motors.

Examples: 1 hp/0.75 kW, IV poles: $\eta = 0.76$ resulting in TB1 = 0.32;
            20 hp/15.0 kW, IV poles: $\eta = 0.86$ resulting in TB1 = 0.16.
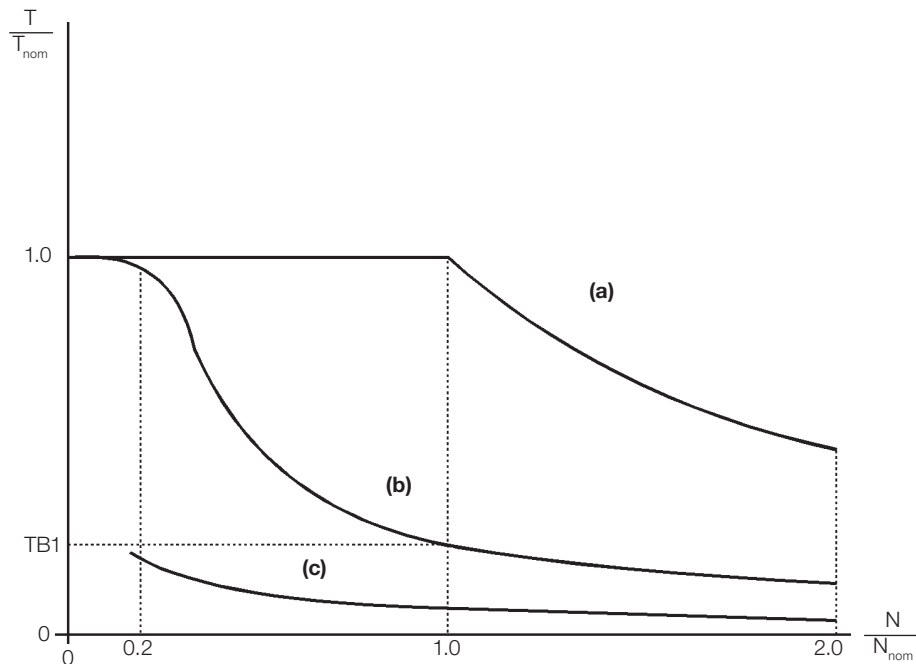
(a) Torque generated by the motor in normal operation, driven by the inverter in the "motor mode" (load resistant torque).
(b) Braking torque generated by the Optimal Braking use.
(c) Braking torque generated by the DC braking use.

Figure 11.2: T x N curve for Optimal Braking with a typical 10 hp/7.5 kW motor, driven by an inverter with the torque adjusted at a value equal to the motor rated torque

In order to use the Optimal Braking:

1. Activate the optimal braking by setting P0184 = 0 (DC Link Regulation Mode = with losses) and set the DC link regulation level in P0185, as presented in , with P0202 = 4 and P0404 smaller than 21 (75hp).

2. In order to enable and disable the Optimal Braking via a digital input, set one of the inputs (DIx) for "DC Link Regulation". (P0263...P0270 = 16 and P0184 = 2).
   Results:
   DIx = 24 V (closed): Optimal Braking is active, equivalent to P0184 = 0.
   DIx = 0 V (open): Optimal Braking is inactive.

11.7 MOTOR DATA

In this group are listed the parameters for the setting of the used motor data. Adjust them according to the motor nameplate data (P0398 to P0407), and by means of the self-tuning routine or with the data existent in the motor data sheet (the other parameters). In the Vector Control mode the parameters P0399 and P0407 are not used.

P0398 – Motor Service Factor

Adjustable Range:	1.00 to 1.50		Factory Setting:	1.00
Properties:	cfg			
Access Groups via HMI:	MOTOR			

Description:

It is the continuous overload capability, i.e., a reserve of power that gives the motor the capability to withstand working in adverse conditions.

Set it according to the value informed on the motor nameplate.

It affects the motor overload protection.

P0399 – Motor Rated Efficiency

Refer to the section 10.2 MOTOR DATA on page 10-3, for more details.

P0400 – Motor Rated Voltage

Adjustable Range:	0 to 600 V	Factory Setting:	220 V (P0296 = 0) 440 V (P0296 = 1, 2, 3 or 4) 575 V (P0296 = 5, 6 or 7)
Properties:	cfg		
Access Groups via HMI:	MOTOR		

Description:

Set it according to the motor nameplate data and to the motor cable wiring in the connection box.

This value cannot be higher than the rated voltage adjusted in P0296 (Line Rated Voltage).

> ✓ **NOTE!**
> In order to validate a new P0400 setting out of the Oriented Start-up Routine it is necessary to cycle the power of the inverter.

P0401 – Motor Rated Current

Adjustable Range:	0 to 1.3xI_{nom-ND}	Factory Setting:	1.0xI_{nom-ND}
Properties:	cfg		
Access Groups via HMI:	MOTOR		

Description:

Set it according to the used motor nameplate data, taking into consideration the motor voltage.

In the Guided Start-up routine the value adjusted in P0401 automatically modifies the parameters related to the motor overload protection, according to the Table 11.2 on page 11-10.

P0402 – Motor Rated Speed

Adjustable Range:	0 to 18000 rpm	Factory Setting:	1750 (1458) rpm
Properties:	cfg		
Access Groups via HMI:	MOTOR		

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Description:

Set it according to the used motor nameplate data.

For V/f and VVW controls the setting is from 0 to 18000 rpm.

For vector control the setting is from 0 to 7200 rpm.

P0403 – Motor Rated Frequency

Adjustable Range:	0 to 300 Hz		Factory Setting:	60 (50) Hz
Properties:	cfg			
Access Groups via HMI:	MOTOR			

Description:

Set it according to the used motor nameplate data.

For V/f and VVW controls the setting range goes up to 300 Hz.

For vector control the setting range is from 30 Hz to 120 Hz.

P0404 – Motor Rated Power

Adjustable Range:	0 to 25 (refer to the next table)		Factory Setting:	Motor$_{max-ND}$
Properties:	cfg			
Access Groups via HMI:	MOTOR			

Description:

Set it according to the used motor nameplate data.

Table 11.1: P0404 (Motor Rated Power) setting

P0404	Motor Rated Power (hp)
0	0.33
1	0.50
2	0.75
3	1.0
4	1.5
5	2.0
6	3.0
7	4.0
8	5.0
9	5.5
10	6.0
11	7.5
12	10.0
13	12.5
14	15.0
15	20.0
16	25.0
17	30.0
18	40.0
19	50.0
20	60.0
21	75.0
22	100.0
23	125.0
24	150.0
25	175.0

NOTE!
When adjusted via keypad (HMI), this parameter may change the parameter P0329 automatically. Refer to item 12.5.2 Vector Flying Start on page 12-9.

P0406 – Motor Ventilation

Adjustable Range:	0 = Self-Ventilated 1 = Separated Ventilation 2 = Optimal Flux 3 = Extended Protection	**Factory Setting:**	0
Properties:	cfg		
Access Groups via HMI:	MOTOR		

Description:

During the Oriented Start-up Routine, the value adjusted in P0406 changes the parameters related to the motor overload automatically, in the following manner:

Table 11.2: Motor overload protection modification in function of P0406

P0406	P0156 (Overl. Curr. 100 %)	P0157 (Overl. Curr. 50 %)	P0158 (Overl. Curr. 5 %)
0	1.05xP0401	0.9xP0401	0.65xP0401
1	1.05xP0401	1.05xP0401	1.05xP0401
2	1.05xP0401	1.0xP0401	1.0xP0401
3	0.98xP0401	0.9xP0401	0.55xP0401

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> **ATTENTION!**
> Refer to the section 11.4 OPTIMAL FLUX FOR SENSORLESS VECTOR CONTROL on page 11-4, for more details on the use of option P0406 = 2 (Optimal Flux).

P0407 – Motor Rated Power Factor

Refer to the section 10.2 MOTOR DATA on page 10-3, for more details.

P0408 – Run Self-Tuning

P0409 – Motor Stator Resistance (Rs)

P0410 – Motor Magnetization Current (I_m)

P0411 – Motor Flux Leakage Inductance (σls)

P0412 – Lr/Rr Constant (Rotor Time Constant – T_r)

P0413 – T_m Constant (Mechanical Time Constant)

Self-Tuning function parameters. Refer to item 11.8.5 Self-Tuning on page 11-17.

11.7.1 Adjustment of the Parameters P0409 to P0412 Based on the Motor Data Sheet

Being in the possession of the motor equivalent circuit data, it is possible to calculate the value to be programmed in the parameters from P0409 to P0412, instead of using the self-tuning to obtain them.

Input data:

Motor data sheet:

V_n = testing voltage to get the motor parameters in Volts.
f_n = testing frequency to get the motor parameters in Hz.
R_1 = resistance of the motor stator per phase, in Ohms.
R_2 = resistance of the motor rotor per phase, in Ohms.
X_1 = stator inductive reactance, in Ohms.
X_2 = rotor inductive reactance, in Ohms.
X_m = magnetizing inductive reactance, in Ohms.
I_o = motor no load current.
ω = angular speed.

$$\omega = 2 \times \pi \times f_n$$

$$P0409 = \frac{P0400 \times R_1}{V_n}$$

$$P0410 = \frac{V_n \times I_o \times 0.95}{P0400}$$

$$P0411 = \frac{P0400 \times [X_1 + (X_2 \times X_m)/(X_2 + X_m)]}{V_n \times \omega}$$

$$P0412 = \frac{P0400 \times (X_m + X_2)}{V_n \times \omega \times R_2}$$

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11.8 VECTOR CONTROL

11.8.1 Speed Regulator

The parameters related to the CFW701 speed regulator are presented in this group.

P0160 – Speed Regulation Configuration		

Adjustable Range:	0 = Normal 1 = Saturated	**Factory Setting:** 0
Properties:	cfg, Vector	
Access Groups via HMI:		

Description:

Set P0160 = 1 in the applications you want a stable torque control, as in a processwinding materials in these cases the reference speed is always kept greater than the value of feedback speed, i.e., to keep its output equal to the value set in P0169 or P0170 during the process. If used for speed control F0022 can happen even when the regulation of DC link voltage is active (P0185 < default value).

P0161 – Speed Regulator Proportional Gain		

Adjustable Range:	0.0 to 63.9	**Factory Setting:** 7.4

P0162 – Speed Regulator Integral Gain		

Adjustable Range:	0.000 to 9.999	**Factory Setting:** 0.023
Properties:	Vector	
Access Groups via HMI:		

Description:

The speed regulator gains are calculated automatically in function of the parameter P0413 (T_m constant).

However, these gains can be adjusted manually in order to optimize the speed dynamic response, which becomes faster with their increase. Yet, if the speed begins to oscillate, they must be reduced.

In a general manner, one can say that the Proportional gain (P0161) stabilizes abrupt speed or reference changes, while the Integral gain (P0162) corrects the error between the reference and the speed, and improves the torque response at low speeds as well.

Procedure for Manual Optimization of the Speed Regulator:

1. Select the acceleration (P0100) and/or deceleration (P0101) time according to the application.

2. Adjust the speed reference for 75 % of the maximum value.

3. Configure an analog output (AOx) for Real Speed, by programming P0251 or P0254 in 2.

4. Disable the speed ramp (Run/Stop = Stop) and wait until the motor stops.

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5. Enable the speed ramp (Run/Stop = Run). Observe with an oscilloscope the motor speed signal at the chosen analog output.

6. Verify among the options of the Figure 11.3 on page 11-13, which waveform best represents the observed signal.

(a) Low integral gain (P0162) and/ or high proportional gain (P0161)   **(b) Optimized speed regulator**   **(c) High integral gain (P0162) and/or low proportional gain (P0161)**
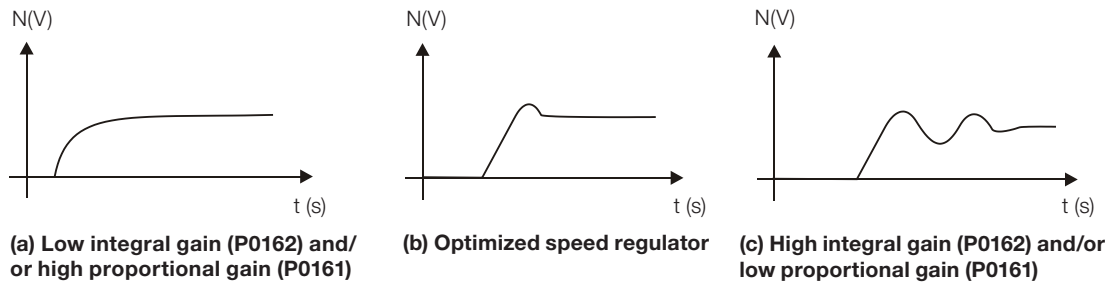
Figure 11.3: (a) to (c) Speed regulators response types

7. Adjust P0161 and P0162 according to the response type presented in the Figure 11.3 on page 11-13.

(a) Reduce the proportional gain (P0161) and/or increase the integral gain (P0162).
(b) Speed regulator is optimized.
(c) Increase the proportional gain and/or reduce the integral gain.

P0163 – Local Reference Offset

P0164 – Remote Reference Offset

Adjustable Range:	-999 to 999		Factory Setting:	0
Properties:	Vector			
Access Groups via HMI:				

Description:

It adjusts the analog inputs (AIx) speed reference offset. Refer to the Figure 13.7 on page 13-27.

P0165 – Speed Filter

Adjustable Range:	0.012 to 1.000 s		Factory Setting:	0.012 s
Properties:	Vector			
Access Groups via HMI:				

Description:

It adjusts the speed filter time constant. Refer to the Figure 11.1 on page 11-2.

> ✔ **NOTE!**
> Generally, this parameter must not be changed. The increment in its value turns the system response slower.

P0166 – Speed Regulator Differential Gain

Adjustable Range:	0.00 to 7.99	**Factory Setting:**	0.00
Properties:	Vector		
Access Groups via HMI:			

Description:

The differential action may minimize the effects of the application or removal of load, in the motor speed. Refer to the Figure 11.1 on page 11-2.

Table 11.3: Differential gain action in the speed regulator

P0166	Diferential Gain Actuation
0.00	Inactive
0.01 to 7.99	Active

11.8.2 Current Regulator

The parameters related to the CFW701 current regulator are presented in this group.

P0167 – Current Regulator Proportional Gain

Adjustable Range:	0.00 to 1.99	**Factory Setting:**	0.50

P0168 – Current Regulator Integral Gain

Adjustable Range:	0.000 to 1.999	**Factory Setting:**	0.010
Properties:	Vector		
Access Groups via HMI:			

Description:

Parameters P0167 and P0168 are adjusted automatically as a function of the parameters P0411 and P0409.

> ✓ **NOTE!**
> Do not change these parameters values.

11.8.3 Flux Regulator

The parameters related to the CFW701 flux regulator are presented next.

P0175 – Flux Regulator Proportional Gain

Adjustable Range:	0.0 to 31.9	**Factory Setting:**	2.0

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P0176 – Flux Regulator Integral Gain

Adjustable Range:	0.000 to 9.999	**Factory Setting:**	0.020
Properties:	Vector		
Access Groups via HMI:			

Description:

These parameters are adjusted automatically in function of the parameter P0412. In general, the automatic setting is sufficient and the readjustment is not necessary.

These gains must only be readjusted manually when the flux current signal (Id*) is unstable (oscillating) and compromising the system operation.

> ✓ **NOTE!**
> For gains in P0175 > 12.0 the flux current (Id*) may become unstable.

Note:
(Id*) is observed at the analog outputs AO1 and/or AO2, by setting P0251 = 15 and/or P0254 = 15.

P0178 – Rated Flux

Adjustable Range:	0 to 120 %	**Factory Setting:**	100 %
Properties:	Vector		
Access Groups via HMI:			

Description:

The parameter P0178 is the flux reference, while the maximum value for the flux (magnetization) current is 120 %.

> ✓ **NOTE!**
> This parameter must not be modified.

P0190 – Maximum Output Voltage

Adjustable Range:	0 to 600 V	**Factory Setting:**	P0296. Automatic setting during the Oriented Start-up Routine: P0400.
Properties:	Vector		
Access Groups via HMI:			

Description:

This parameter defines the value of the maximum output voltage. Its standard value is defined in the condition of the nominal supply voltage.

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The voltage reference used in the regulator "Maximum output voltage" (see the Figure 11.1 on page 11-2) is directly proportional to the voltage supply.

If this voltage increases, the output voltage will then be able to increase to the adjusted value in the parameter P0400 - Motor Rated Voltage.

If the voltage supply decreases, the maximum output voltage will decrease in the same proportion.

11.8.4 I/f Control

P0180 – Iq* After the I/f

Adjustable Range:	0 to 350 %		Factory Setting:	10 %
Properties:	Sless			
Access Groups via HMI:				

Description:

It allows setting an offset in the torque current reference variable (Iq*) of the speed regulator in the first execution of this regulator after the transition from I/f mode to sensorless vector.

P0182 – Speed for I/f Control Activation

Adjustable Range:	0 to 90 rpm		Factory Setting:	18 rpm
Properties:	Sless			
Access Groups via HMI:				

Description:

It defines the speed of the transition from I/f mode to the sensorless vector control and vice-versa.

The minimum recommended speed for the sensorless vector control operation is 18 rpm for 60 Hz rated frequency IV pole motors and 15 rpm for 50 Hz rated frequency IV pole motors.

> **NOTE!**
> For P0182 ≤ 3 rpm the I/f function will be disabled and the inverter will remain always in the sensorless vector mode.

P0183 – Current in the I/f Mode

Adjustable Range:	0 to 9		Factory Setting:	1
Properties:	Sless			
Access Groups via HMI:				

Description:

It defines the current to be applied to the motor when the inverter is operating in the I/f mode, i.e., with the motor speed below the value defined by P0182.

Table 11.4: Current applied in the I/f mode

P0183	Current in the I/f Mode as a Percentage of P0410 (I_m)
0	100 %
1	120 %
2	140 %
3	160 %
4	180 %
5	200 %
6	220 %
7	240 %
8	260 %
9	280 %

11.8.5 Self-Tuning

In that group are the parameters that are related to the motor and can be estimated by the inverter during the self-tuning routine.

P0408 – Run Self-Tuning

Adjustable Range:	0 = No 1 = No Rotation 2 = Run for I_m	Factory Setting:	0
Properties:	cfg, VVW, Vector		
Access Groups via HMI:	MOTOR		

Description:

By changing from the factory setting to one of the 2 available options, it is possible to estimate the value of the parameters related to the motor being used. Refer to the next description for more details on each option.

Table 11.5: Self-tuning options

P0408	Self-tuning	Control Type	Estimate Parameter
0	No	–	–
1	No Rotation	Sensorless vector, VVW	P0409, P0410, P0411,
2	Run for I_m	Sensorless vector	P0412 and P0413

P0408 = 1 – No rotation: The motor stands still during the self-tuning. The P0410 value is obtained from a table, valid for WEG motors up to 12 poles.

✓ **NOTE!**
Therefore P0410 must be equal to zero before initiating the self-tuning. If P0410 ≠ 0, the self-tuning routine will keep the existent value.

Note: When using another brand of motor P0410 must be adjusted with the adequate value (no load motor current) before initiating the self-tuning.

P0408 = 2 – Run for Im: The P0410 value is estimated with the motor rotating. It must be executed without load coupled to the motor. P0409, P0411 to P0413 are estimated with the motor standing still.

> **ATTENTION!**
> If the option P0408 = 2 (Run for I_m) is performed with the load coupled to the motor, an incorrect value of P0410 (Im) may be estimated. This will implicate in estimation error for P0412 (Rotor time constant - T_r) and for P0413 (Mechanic time constant – T_m). Overcurrent fault (F0071) may also occur during the inverter operation.

Note: The term "load" includes everything that might be coupled to the motor shaft, for instance, gearbox, inertia disk, etc.

> **NOTES!**
> - Every time that P0408 = 1 or 2:
>   The parameter P0413 (Mechanic time constant – T_m) will be adjusted to a value close to the motor mechanic time constant. Therefore, the motor rotor inertia (table data valid for WEG motors), the inverter rated voltage and current are taken into consideration.
> - VVW mode – Voltage Vector WEG (P0202 = 3):
>   In the VVW control self-tuning routine only the value of the stator resistance (P0409) will be obtained. Therefore, the self-tuning will always be performed without rotating the motor.
> - Better self-tuning results are obtained with the motor warm.

P0409 – Motor Stator Resistance (Rs)

Adjustable Range:	0.000 to 9.999 Ω	Factory Setting:	0.000 Ω
Properties:	cfg, VVW, Vector		
Access Groups via HMI:	MOTOR		

Description:

It is the value estimated by the self-tuning.

> **NOTE!**
> The P0409 setting determines the value of the current regulator integral gain P0168. The parameter P0168 is recalculated every time the content of P0409 is modified via keypad (HMI).

P0410 – Motor Magnetization Current (I_m)

Adjustable Range:	0 to 1.25 x I_{nom-ND}	Factory Setting:	I_{nom-ND}
Properties:			
Access Groups via HMI:	MOTOR		

Description:

It is the motor magnetization current value.

It can be estimated by the self-tuning routine when P0408 = 2 (Run for I_m) or obtained from an internal table based in standard WEG motors, when P0408 = 1 (No rotation).

When a standard WEG motor is not used and it is not possible to run the self-tuning with P0408 = 2 (Run for I_m), then adjust P0410 with a value equal to the motor no load current, before initiating the self-tuning.

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P0411 – Motor Flux Leakage Inductance (σls)

Adjustable Range:	0.00 to 99.99 mH	**Factory Setting:**	0.00 mH
Properties:	cfg, Vector		
Access Groups via HMI:	MOTOR		

Description:

It is the value estimated by the self-tuning.

The P0411 setting determines the current regulator proportional gain.

> ✓ **NOTE!**
> When adjusted via the keypad (HMI), this parameter may change the parameter P0167 automatically.

P0412 – Lr/Rr Constant (Rotor Time Constant – T$_r$)

Adjustable Range:	0.000 to 9.999 s	**Factory Setting:**	0.000 s
Properties:	Vector		
Access Groups via HMI:	MOTOR		

Description:

The P0412 setting determines the flux regulator gains (P0175 and P0176).

The value of this parameter interferes in the speed accuracy in the sensorless vector control.

Normally the self-tuning is performed with the motor cold. Depending on the motor, the P0412 value may vary with the temperature. Thus, for the sensorless vector control and normal operation with the motor warm, P0412 must be adjusted until the speed of the motor with load (measured at the motor shaft with a tachometer) stays equal to that one indicated on the keypad (HMI) (P0001).

This adjustment must be performed with half the rated speed.

In the sensorless vector control mode the P0175 gain, provided by the self-tuning, will be limited in the range: $3.0 \leq P0175 \leq 8.0$.

Table 11.6: Typical rotor constant (T$_r$) values for WEG motors

Motor Power (hp) / (kW)	T$_r$ (s)			
	Number of Poles			
	2 (50 Hz/60 Hz)	4 (50 Hz/60 Hz)	6 (50 Hz/60 Hz)	8 (50 Hz/60 Hz)
2 / 1.5	0.19 / 0.14	0.13 / 0.14	0.1 / 0.1	0.07 / 0.07
5 / 3.7	0.29 / 0.29	0.18 / 0.12	0.14 / 0.14	0.14 / 0.11
10 / 7.5	0.36 / 0.38	0.32 / 0.25	0.21 / 0.15	0.13 / 0.14
15 / 11	0.52 / 0.36	0.30 / 0.25	0.20 / 0.22	0.28 / 0.22
20 / 15	0.49 / 0.51	0.27 / 0.29	0.38 / 0.2	0.21 / 0.24
30 / 22	0.70 / 0.55	0.37 / 0.34	0.35 / 0.37	0.37 / 0.38
50 / 37	0.9 / 0.84	0.55 / 0.54	0.62 / 0.57	0.31 / 0.32
100 / 75	1.64 / 1.08	1.32 / 0.69	0.84 / 0.64	0.70 / 0.56
150 / 110	1.33 / 1.74	1.05 / 1.01	0.71 / 0.67	0.72 / 0.67
200 / 150	1.5 / 1.92	1.0 / 0.95	1.3 / 0.65	0.8 / 1.03

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> **NOTE!**
> When adjusted via the keypad (HMI), this parameter may change automatically the following parameters: P0175, P0176, P0327 and P0328.

P0413 – T_m Constant (Mechanical Time Constant)

Adjustable Range:	0.00 to 99.99 s		Factory Setting:	0.00 s
Properties:	Vector			
Access Groups via HMI:	MOTOR			

Description:

The P0413 setting determines the speed regulator gains (P0161 and P0162).

When P0408 = 1 or 2, it must be observed:

- If P0413 = 0, the time constant T_m will be obtained in function of the inertia of the programmed motor (table value).

- If P0413 > 0, the value of P0413 will not be changed by the self-tuning.

Sensorless vector control (P0202 = 4):

- When the P0413 value obtained through the self-tuning provides inadequate speed regulator gains (P0161 and P0162), it is possible to change them by setting P0413 via keypad (HMI).

- The P0161 gain provided by the self-tuning or through P0413 change, will be limited to the range: $6.0 \leq P0161 \leq 9.0$.

- The P0162 value varies in function of the P0161 value.

- In case it be necessary to increase even more these gains, they must be adjusted directly at P0161 and P0162.

Note: Values of P0161 > 12.0 may turn the torque current (I_q) and the motor speed unstable (oscillating).

11.8.6 Torque Current Limitation

The parameters placed in this group define the torque limitation values.

P0169 – Maximum "+" Torque Current

P0170 – Maximum "-" Torque Current

Adjustable Range:	0.0 to 350.0 %		Factory Setting:	125.0 %
Properties:	Vector			
Access Groups via HMI:				

Description:

These parameters limit the value of the motor current component that produces "+" torque (P0169) or "-" torque (P0170). The setting is expressed as a percentage of rated motor current (P0401).

In case that any Analog Input (AIx) be programmed for the option 2 (Maximum Torque Current), P0169 and P0170 become inactive and the current limitation will be specified by the AIx. In this case the limitation value can be monitored at the parameter correspondent to the programmed AIx (P0018, P0019 or P0020).

In the torque limitation condition the motor current can be calculated by:

$$I_{motor}= \sqrt{\left(\frac{P0169 \text{ or } P0170^{(*)} \times P0401}{100}\right)^2 + (P0410)^2}$$

The maximum torque developed by the motor is given by:

$$T_{motor}(\%)= \left\{ \frac{P0401 \times \frac{P0169^{(*)} \text{ or } P0170 \times K}{100}}{\sqrt{(P0401)^2 - \left(P0410 \times \frac{P0178}{100}\right)^2}} \right\} \times 100$$

Where:
N_{nom} = motor synchronous speed,
N = motor current speed

$$K = \begin{cases} 1 \text{ for } N \leq \dfrac{P0190 \times N_{nom}}{P0400} \\ \dfrac{N_{nom}}{N} \times \dfrac{P0190}{P0400} \text{ for } N > \dfrac{P0190 \times N_{nom}}{P0400} \end{cases}$$

(*) In case that the torque current limitation be provided by an analog input, replace P0169 or P0170 by P0018, P0019 or P0020 according to the programmed AIx. For more details refer to item 13.1.1 Analog Inputs on page 13-1.

11.8.7 Supervision of Motor Real Speed

In some applications, the frequency inverter cannot operate in torque limitation, that is, the motor real speed cannot be much different from the speed reference. In case of operation in this condition, the frequency inverter will detect it and generate an alarm (A0168) or fault (F0169).

For this type of application, a maximum acceptable value of speed hysteresis for normal operating condition is defined (P0360). In case the value of the difference between the real speed and reference speed is greater than this hysteresis, the alarm condition Real Motor Speed Different from Speed Reference (A0168) will be detected. In case this alarm remains for a period (P0361), the fault condition Real Motor Speed Different from Speed Reference (F0169) will be generated.

P0360 – Speed Hysteresis

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	10.0 %
Properties:	Vector			
Access Groups via HMI:				

Description:

This parameter defines the percentage of the motor synchronous speed that will be the speed hysteresis to detect that the Motor Real Speed is different from the Speed Reference and generate the alarm A0168. Value in 0.0 % disables the alarm A0168 and fault F0169.

P0361 – Time with Speed Different from Reference

Adjustable Range:	0.0 to 999.0 s	Factory Setting:	0.0 s
Properties:	Vector		
Access Groups via HMI:			

Description:

This parameter defines the time that the condition Motor Real Speed different from Speed Reference (A0168) must remain active in order to generate the fault Motor Real Speed different from Speed Reference (F0169). Value in 0.0 s disables fault F0169.

11.8.8 DC Link Regulator

For the deceleration of high inertia loads or with short deceleration times, the CFW701 has available the DC Link Regulation function, which avoids the tripping of the inverter by overvoltage in the DC link (F0022).

P0184 – DC Link Regulation Mode

Adjustable Range:	0 = With losses 1 = Without losses 2 = Enable/Disable DIx	Factory Setting:	1
Properties:	cfg, Vector		
Access Groups via HMI:			

Description:

It enables or disables the Optimal Braking function (section 11.6 OPTIMAL BRAKING on page 11-6) in the DC voltage regulation, according to the next table.

Table 11.7: DC link regulation modes

P0184	Action
0 = With losses (Optimal Braking)	The Optimal Braking is active as described at P0185. This assures the minimum possible deceleration time without using dynamic or regenerative braking.
1 = Without losses	Automatic control of the deceleration ramp. The Optimal Braking is inactive. The deceleration ramp is automatically adjusted in order to keep the DC link below the level adjusted in P0185. This procedure avoids the overvoltage fault at the DC link (F0022). It can also be used with eccentric loads.
2 = Enable/Disable via DIx	■ DIx = 24 V: Braking actuates as described for P0184 = 1. ■ DIx = 0 V: The Without Losses Braking stays inactive. The DC link voltage will be controlled by the parameter P0153 (Dynamic Braking).

P0185 – DC Link Voltage Regulation Level

Adjustable Range:	339 to 400 V 585 to 800 V 585 to 800 V 585 to 800 V 585 to 800 V 809 to 1000 V 809 to 1000 V 809 to 1000 V	**Factory Setting:**	400 V (P0296 = 0) 800 V (P0296 = 1) 800 V (P0296 = 2) 800 V (P0296 = 3) 800 V (P0296 = 4) 1000 V (P0296 = 5) 1000 V (P0296 = 6) 1000 V (P0296 = 7)
Properties:	Vector		
Access Groups via HMI:			

Description:

This parameter defines the DC link voltage regulation level during the braking. During the braking, the time of the deceleration ramp is automatically extended, thus avoiding an overvoltage fault (F0022). The setting of the DC link regulation can be done in two manners:

1. With losses (Optimal Braking) – set P0184 = 0.

   1.1. P0404 < 20 (60 hp): In this way the current flux is modulated in a way to increase the losses of the motor, increasing the break torque. A better operation can be obtained with motors of smaller efficiency (small motors).

   1.2. P0404 > 20 (60 hp): the current flux will be increased up to the maximum value defined on P0169 or P0170, as the speed is reduced. The break torque in the weakness field area is small.

2. Without losses – set P0184 = 1. Activates only the DC link voltage regulation.

> ✓ **NOTE!**
> The factory setting for P0185 is adjusted at the maximum, which disables the DC link voltage regulation. In order to activate it, set P0185 according to the .

Table 11.8: DC link voltage regulation recommended levels

Inverter V_{nom}	200 ... 240 V	380 V	400 / 415 V	440 / 460 V	480 V	500 / 525 V	550 / 575 V	600 V
P0296	0	1	2	3	4	5	6	7
P0185	375 V	618 V	675 V	748 V	780 V	893 V	972 V	972 V

P0186 – DC Link Voltage Regulation Proportional Gain

Adjustable Range:	0.0 to 63.9	**Factory Setting:**	26.0

P0187 – DC Link Voltage Regulation Integral Gain

Adjustable Range:	0.000 to 9.999	**Factory Setting:**	0.010
Properties:	Vector		
Access Groups via HMI:			

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Description:

These parameters adjust the DC link voltage regulator gain.

Normally the factory settings are adequate for the majority of the applications, not being necessary to adjust them.

11.9 START-UP IN THE VECTOR MODES SENSORLESS

> **✓ NOTE!**
> Read the whole CFW701 user's manual before installing, powering or operating the inverter.

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

1. **Install the inverter:** according to the chapter 3 Installation and Connection, of the CFW701 user's manual, wiring all the power and control connections.

2. **Prepare the inverter and apply power:** according to the section 5.1 Prepare for Start-up, of the CFW701 user's manual.

3. **Adjust the password P0000 = 5:** according to the section 5.3 PASSWORD SETTING IN P0000 on page 5-1, of this manual.

4. **Adjust the inverter to operate with the application line and motor:** by means of the "STARTUP" Menu access **P0317** and change its content to 1, which makes the inverter initiate the "Oriented Start-up" routine.

The "Oriented Start-up" routine presents on the keypad (HMI) the main parameters in a logical sequence. The setting of these parameters prepares the inverter for operation with the application line and motor. Verify the step by step sequence in the Figure 11.4 on page 11-26.

The setting of the parameters presented in this operation mode results in the automatic modification of the content of other inverter parameters and/or internal variables, as indicated in the Figure 11.4 on page 11-26. In this way one gets a stable operation of the control circuit with adequate values to obtain the best motor performance.

During the "Oriented Start-up" routine the "Config" (Configuration) status will be indicated on the keypad (HMI).

Parameters related to the motor:

■ Program the contents of parameters from P0398, P0400 to P0406 directly with the motor nameplate data.

■ Options for the setting of parameters P0409 to P0412:
   - Automatic, with the inverter executing the self-tuning routine as selected in one of the P0408 options.
   - From the motor data sheet supplied by its manufacturer. Refer to the procedure in item 11.7.1 Adjustment of the Parameters P0409 to P0412 Based on the Motor Data Sheet on page 11-11, of this manual.
   - Manually, copying the contents of the parameters from another CFW701 inverter, which uses an identical motor.

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

For applications:

■ That are simple, which can use the factory settings programming for the digital and analog inputs and outputs, use the Menu "BASIC". Refer to item 5.2.2 Basic Application Menu, of the CFW701 user's manual.

■ That require only the digital and analog inputs and outputs with programming different from the factory settings, use the Menu "I/O".

■ That need functions as Flying Start, Ride-Through, DC Braking, Dynamic Braking, etc., access and modify those function parameters by means of the Menu "PARAM".

Seq.	Action/Result	Display Indication	Seq.	Action/Result	Display Indication
1	- Monitoring Mode. - Press **ENTER/MENU** key to go to the 1st level of the programming mode.	LOC **90** **0** rpm	2	- The **PARAM** group is selected, press the ▲ or ▼ keys to select the **STARTUP** group.	PARAM LOC
3	- Press **ENTER/MENU** when the group is selected.	LOC STARTUP	4	- The parameter **"P0317 - Oriented Start-up"** is then selected, press the **ENTER/MENU** to get into the parameter content.	LOC **0** **P0317** STARTUP
5	- Change the parameter P0317 to **"1 - Yes"**, by using the ▲ key.	LOC **P0317** **0** STARTUP	6	- Press **ENTER/MENU** to save.	LOC **P0317** **1** STARTUP
7	- In this moment the Oriented Start-up routine is initiated and the **"CONF"** status is indicated at the keypad (HMI). - The parameter **"P0000 - Access to Parameters"** is selected. Change the password to set the remaining parameters if necessary. - Press the ▲ key to the next parameter.	LOC CONF **5** **P0000** STARTUP	8	- If necessary, change **"P0296 - Line Rated Voltage"**. This change will affect P0151, P0153, P0185, P0321, P0322, P0323 and P0400. - Press the ▲ key to the next parameter.	LOC CONF **3** **P0296** STARTUP
9	- If necessary, change **"P0298 - Application"** parameter. This change will affect P0156, P0157, P0158, P0169, P0170, P0401, P0404 and P0410 (P0410 only will affect if P0202 = 0, 1, 2 or 3). The time and level of the IGBT overload protection will also be affected. - Press the ▲ key to the next parameter.	LOC CONF **0** **P0298** STARTUP	10	- Set parameter **"P0202 - Type of Control"** pressing **"ENTER/MENU"**. Press the ▲ key to select the desired option: **"[4] = Sensorless"** or **"[5] = Encoder"**. This change resets P0410. Then, press **"ENTER/MENU"**. - There are three options to exit the oriented start-up: 1. Running the Self-tunning; 2. Manual settings of parameters from P0409 to P0413; 3. Changing P0202 from vector to scalar control. - Press the ▲ key to the next parameter.	LOC CONF **0** **P0202** STARTUP
11	- If necessary, change **"P0398 - Motor Service Factor"** parameter. This change will affect the current and the time of the motor overload protection operation. - Press the ▲ key to the next parameter.	LOC CONF **1.00** **P0398** STARTUP	12	- If necessary, change **"P0400 - Motor Rated Voltage"** parameter. - This change corrects the output voltage by the factor "x = P0400/P0296". - Press the ▲ key to the next parameter.	LOC CONF **440** **P0400** STARTUP
13	- If necessary, change **"P0401 - Motor Rated Current"** parameter. This change will affect P0156, P0157, P0158 and P0410. - Press the ▲ key to the next parameter.	LOC CONF **10.0** **P0401** STARTUP	14	- If necessary, change **"P0404 - Motor Rated Power"** parameter. This change will affect P0410. - Press the ▲ key to the next parameter.	LOC CONF **10** **P0404** STARTUP
15	- If necessary, change **"P0403 - Motor Rated Frequency"** parameter. This change will affect P0402. - Press the ▲ key to the next parameter.	LOC CONF **60** **P0403** STARTUP	16	- If necessary, change **"P0402 - Motor Rated Speed"**. This change will affect P0122 to P0131, P0133, P0134, P0135, P0182, P0208, P0288 and P0289. - Press the ▲ key to the next parameter.	LOC CONF **1750** **P0402** STARTUP

Seq.	Action/Result	Display Indication	Seq.	Action/Result	Display Indication
17	- If necessary, change **"P0406 - Motor Ventilation"** parameter. - Press the ⬆ key to the next parameter.	LOC CONF 0 ~ P0406 STARTUP	18	- In this moment the keypad presents the option to perform **"Self-tuning".** The Self-tuning should be performed whenever it is possible. Press **"ENTER/MENU"** key to access parameter P0408 and press ⬆ to select the desired option. Refer to item 11.8.5 Self-Tuning on page 11-17, for more details. Then, press **"ENTER/MENU"** to start the Self-tuning. The keypad will show **"CONF"** and **"RUN"** status simultaneously during the self-tuning. At the end of the Self-Tuning the **"RUN"** status is automatically set to off and the parameter P0408 is automatically reset.	LOC CONF 0 ~ P0408 STARTUP
19	- Press **BACK/ESC** key to finish the start-up routine. - Press **BACK/ESC** key again to get back to the monitoring mode.	LOC 90 ~ 0 rpm			

Figure 11.4: Vector mode Oriented Start-up

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12 FUNCTIONS COMMON TO ALL THE CONTROL MODES

This section describes the functions that are common to all the CFW701 inverter control modes (V/f, VVW and Sensorless).

12.1 RAMPS

The inverter RAMPS functions allow the motor to accelerate and decelerate in a faster or a slower manner.

P0100 – Acceleration Time

P0101 – Deceleration Time

Adjustable Range:	0.0 to 999.0 s		Factory Setting:	20.0 s
Properties:				
Access Groups via HMI:	BASIC			

Description:

These parameters define the time to accelerate (P0100) lineally from 0 to the maximum speed (defined in P0134) and decelerate (P0101) lineally from the maximum speed down to 0.

Note: The setting 0.0 s means that the ramp is disabled.

P0102 – Acceleration Time 2

P0103 – Deceleration Time 2

Adjustable Range:	0.0 to 999.0 s		Factory Setting:	20.0 s
Properties:				
Access Groups via HMI:				

Description:

Those parameters allow a second ramp to be configured for the motor acceleration (P0102) or deceleration (P0103), which is activated via an external digital command (defined by P0105). Once this command is activated, the inverter ignores the times of the first ramp (P0100 or P0101) and starts obeying the value adjusted at the second ramp. Refer the example for external command via DIx showed next in the .
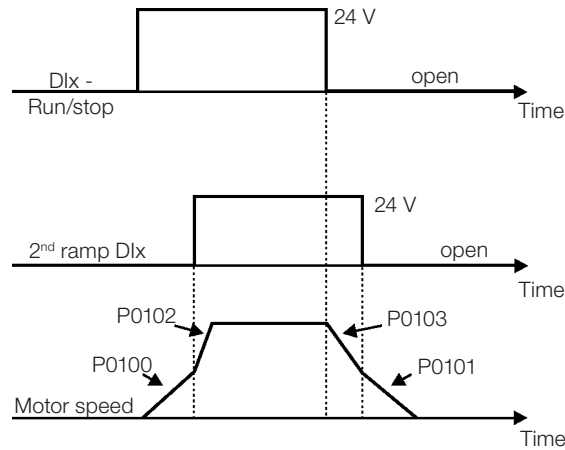
Figure 12.1: Second ramp actuation

In this example, the commutation to the 2nd ramp (P0102 or P0103) is done by means of one of the digital inputs from DI1 to DI8, provided that it had been programmed for 2nd ramp function (refer to item 13.1.3 Digital Inputs on page 13-9, for more details).

Note: The setting 0.0 s means that the ramp is disabled.

P0104 – Ramp Type

Adjustable Range:	0 = Linear 1 = S Ramp	Factory Setting:	0
Properties:			
Access Groups via HMI:			

Description:

This parameter allows that the acceleration and deceleration ramps have a nonlinear profile, similar to an "S", as showed in the Figure 12.2 on page 12-2 next.
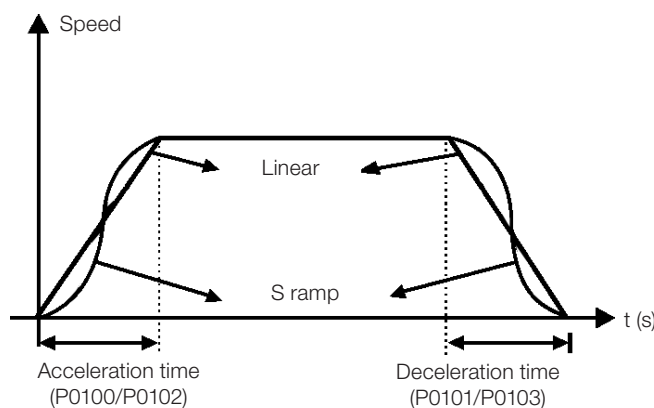
Figure 12.2: S or linear ramp

The S ramp reduces mechanic shock during accelerations/decelerations.

P0105 – 1st/2nd Ramp Selection

Adjustable Range:	0 = 1st Ramp 1 = 2nd Ramp 2 = DIx 3 = Serial 4 = SoftPLC	Factory Setting:	2
Properties:	cfg		
Access Groups via HMI:			

Description:

It defines the source of the command that will select between the Ramp 1 and the Ramp 2.

Notes:

■ "Ramp 1" means that the acceleration and deceleration ramps are following the values programmed in P0100 and P0101.

■ "Ramp 2" means that the acceleration and deceleration ramps are following the values programmed in P0102 and P0103.

■ It is possible to monitor the set of ramps being used in a defined moment at the parameter P0680 (Logical status).

12.2 SPEED REFERENCES

This parameter group makes it possible that the reference values for the motor speed and for the functions JOG, JOG+ and JOG- be established. It is also possible to define if the reference value will be kept when the inverter is switched off or disabled. For more details refer to the Figure 13.7 on page 13-27 and Figure 13.8 on page 13-28.

P0120 – Speed Reference Backup

Adjustable Range:	0 = Inactive 1 = Active	Factory Setting:	1
Properties:			
Access Groups via HMI:			

Description:

This parameter defines if the speed reference backup function is active or inactive.

If P0120 = Inactive, then the inverter will not save the speed reference when it is disabled. Thus, when the inverter is enabled again the speed reference will assume the value of the minimum speed limit (P0133).

This backup function applies to the references via keypad (HMI), Serial.

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P0121 – Keypad Reference

Adjustable Range:	0 to 18000 rpm	Factory Setting:	90 rpm
Properties:			
Access Groups via HMI:			

Description:

When the ▲ and ▼ HMI keys are active (P0221 or P0222 = 0), this parameter sets the value of the motor speed reference.

The value of P0121 will be kept with the last adjusted value when the inverter is disabled or powered off, provided that the parameter P0120 is configured as Active (1).

P0122 – JOG Speed Reference

Adjustable Range:	0 to 18000 rpm	Factory Setting:	150 (125) rpm
Properties:			
Access Groups via HMI:			

Description:

During the JOG command the motor accelerates up to the value defined in P0122 following the adjusted acceleration ramp.

The source of the JOG command is defined in the parameters P0225 (Local Situation) or P0228 (Remote Situation).

If the JOG command source has been defined for the digital inputs (DI1 to DI8), one of these inputs must be programmed as presented in the .

Table 12.1: JOG command via digital input selection

Digital Input	Parameters
DI1	P0263 = 6 (JOG)
DI2	P0264 = 6 (JOG)
DI3	P0265 = 6 (JOG)
DI4	P0266 = 6 (JOG)
DI5	P0267 = 6 (JOG)
DI6	P0268 = 6 (JOG)
DI7	P0269 = 6 (JOG)
DI8	P0270 = 6 (JOG)

For more details refer to the .

The speed direction is defined by the parameters P0223 or P0226.

The JOG command is effective only with the motor stopped.

For the JOG+ refer to the description below.

P0122 – JOG+ Speed Reference

P0123 – JOG- Speed Reference

Adjustable Range:	0 to 18000 rpm		Factory Setting:	150 (125) rpm
Properties:	Vector			
Access Groups via HMI:				

Description:

The JOG+ or JOG- commands are always carried out via digital inputs.

One DIx input must be programmed for JOG+ and another for JOG- as presented in the next:

Table 12.2: Selection of the JOG+ and JOG- commands via digital inputs

Digital Input	Function	
	JOG+	**JOG -**
DI1	P0263 = 10	P0263 = 11
DI2	P0264 = 10	P0264 = 11
DI3	P0265 = 10	P0265 = 11
DI4	P0266 = 10	P0266 = 11
DI5	P0267 = 10	P0267 = 11
DI6	P0268 = 10	P0268 = 11
DI7	P0269 = 10	P0269 = 11
DI8	P0270 = 10	P0270 = 11

During the JOG+ or JOG- commands the values of P0122 and P0123 are, respectively, added or subtracted from the speed reference to generate the total reference (refer to the).

For the JOG option refer to the previous parameter description.

12.3 SPEED LIMITS

The parameters of this group have the purpose of acting as motor speed limits.

P0132 – Maximum Overspeed Level

Adjustable Range:	0 to 100 %		Factory Setting:	10 %
Properties:	cfg			
Access Groups via HMI:				

Description:

This parameter sets the highest speed allowed for the motor to operate, and must be adjusted as a percentage of the maximum speed limit (P0134).

When the actual speed exceeds the value of P0134 + P0132 longer than 20 ms, the CFW701 will disable the PWM pulses and indicate the fault (F0150).

In order to disable this function, set P0132 = 100 %.

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P0133 – Minimum Speed Reference Limit

Adjustable Range:	0 to 18000 rpm	**Factory Setting:**	90 (75) rpm

P0134 – Maximum Speed Reference Limit

Adjustable Range:	0 to 18000 rpm	**Factory Setting:**	1800 (1500) rpm
Properties:			
Access Groups via HMI:	BASIC		

Description:

They define the maximum/minimum values for the motor speed reference when the inverter is enabled. They are valid for any type of reference signal. For details on the actuation of P0133, refer to the parameter P0230 (Dead Zone of the Analog Inputs).
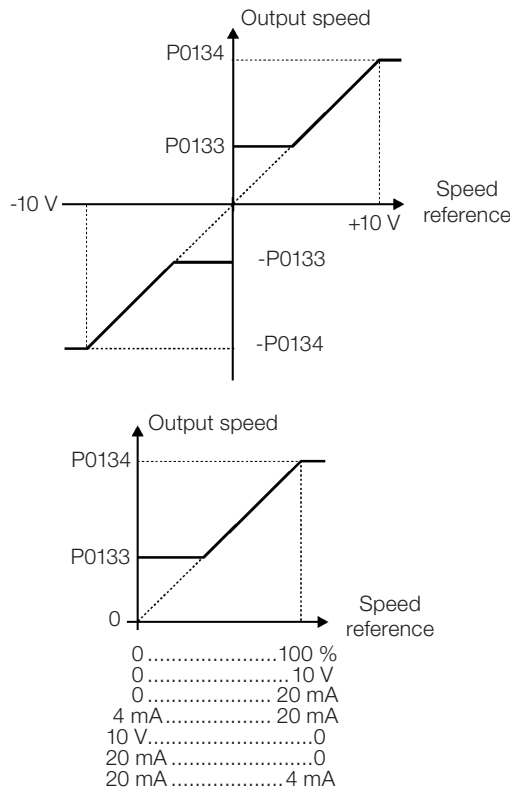
Figure 12.3: Speed limits considering the "Dead Zone" active (P0230 = 1)

12.4 ZERO SPEED LOGIC

This function allows the configuration of a speed in which the inverter will enter a stop condition (general disable).

P0217 – Zero Speed Disable

Adjustable Range:	0 = Inactive 1 = Active (N* and N) 2 = Active (N*)	**Factory Setting:**	0
Properties:	cfg		
Access Groups via HMI:			

Description:

When on (N* and N), it disables the inverter after the speed reference (N*) and the actual speed (N) become lower than the value adjusted in the parameter P0291 ± 1 % of the motor rated speed (hysteresis).

When on (N*), it disables the inverter after the speed reference (N*) becomes lower than the value adjusted in parameter P0291 ± 1 % of the motor rated speed (hysteresis).

The inverter is enabled again when one of the conditions defined by the parameter P0218 is satisfied.

> ⚠ **DANGER!**
> Be careful when approaching the motor while it is in the disable condition. It may get back to operation at any moment because of the process conditions. In case you want to handle or perform any type of maintenance, remove power from the inverter.

> ⚠ **DANGER!**
> Attention en approchant le moteur quand il est en condition de blocage. Il peut retourner à l'opération d'un moment à l'autre en fonction des conditions du procès. Si ont veut manipuler le moteur ou faire du entretien, mettez le converseur hors tension.

P0218 – Condition to Leave the Zero Speed Disable

Adjustable Range:	0 = Reference or Speed 1 = Reference	**Factory Setting:**	0
Properties:			
Access Groups via HMI:			

Description:

It specifies if the condition to leave the zero speed disable will be only the speed reference or also the actual speed.

Table 12.3: Condition to leave the N = 0 disable

P0218 (P0217 = 1)	Inverter Leaves the Condition of Disable by N = 0
0	P0001 (N*) > P0291 or P0002 (N) > P0291
1	P0001 (N*) > P0291

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P0219 – Delay for Zero Speed Disable

Adjustable Range:	0 to 999 s		Factory Setting:	0 s
Properties:				
Access Groups via HMI:				

Description:

It defines whether or not the Zero Speed Disable function will be timed.

If P0219 = 0, the function works without timing.

If P0219 > 0, the function will be configured with timing, and the counting of the time adjusted in this parameter will be initiated after the Speed Reference and the Actual Motor Speed become lower than the value adjusted in P0291. When the counting reaches the time defined in P0219, the inverter will be disabled. If during the time counting any of the conditions that cause the zero speed disable ceases being fulfilled, then the time counting will be reset and the inverter continues enabled.

P0291 – Zero Speed Zone

Refer to item 13.1.4 Digital Outputs / Relays on page 13-14, for more details.

12.5 FLYING START / RIDE-THROUGH

The Flying Start function allows starting a motor that is spinning freely, accelerating it from the speed it is found.

The other function, Ride-Through, allows the recovery of the inverter, without being disabled by undervoltage, when a failure in the voltage supply occurs.

Since these functions work in different manners depending on the used control mode (V/f, VVW or Vector), they will be described in full detail next, for each one of the modes.

P0320 – Flying Start/Ride-Through

Adjustable Range:	0 = Off 1 = Flying Start 2 = Flying Start / Ride-Through 3 = Ride-Through		Factory Setting:	0
Properties:	cfg			
Access Groups via HMI:				

Description:

The parameter P0320 selects the functions Flying Start and Ride-Through use. More details in the subsequent sections.

12.5.1 V/f or VVW Flying Start

In the V/f or VVW modes, the inverter imposes a fixed frequency at the start, defined by the speed reference, and applies a voltage ramp defined at the parameter P0331. The Flying Start function will be activated after the time adjusted in P0332 elapses (to allow the motor demagnetization), every time a "Run" command is driven.

12.5.2 Vector Flying Start

12.5.2.1 P0202 = 4

The behavior of the Flying Start function (FS) in the sensorless mode during acceleration and reacceleration can be understood from the Figure 12.4 on page 12-11.

The Figure 12.4 on page 12-11 shows the behavior of the speed reference when the FS function is started with stopped motor shaft and small P0329 value (not optimized).

Operation analysis:

1. The frequency correspondent to the P0134 adjustment is applied, with approximately the motor nominal current (I/f control).

2. The frequency is reduced down to zero using the ramp given by: P0329 x P0412.

3. If the speed is not found during this frequency scan, a new scan in the opposite speed direction is initiated, in which the frequency goes from -P0134 to zero. After this second scan the FS is finished and the control mode changes to vector sensorless.

The Figure 12.4 on page 12-11 shows the speed reference when the FS function is initiated with the motor shaft already running in the desired direction, or with stopped shaft and an already optimized P0329.

Operation analysis:

1. The frequency correspondent to the P0134 adjustment is applied, with approximately the motor nominal current.

2. The frequency is reduced using the ramp given by: P0329 x P0412 until reaching the motor speed.

3. In this moment the control mode changes to vector sensorless.

> ✓ **NOTE!**
> In order that the motor speed is found in the first scan, proceed with the P0329 setting in the following manner:
> 1. Increase P0329 using 1.0 steps.
> 2. Enable the inverter and observe the motor shaft movement during the FS process.
> 3. If the shaft rotates in both directions, stop the motor and repeat the steps 1 and 2.

> ✓ **NOTE!**
> The used parameters are P0327 to P0329 and the not used ones are P0182, P0331 and P0332.

> ✓ **NOTE!**
> When the General Enable command is activated, the motor magnetization will not occur.

> ✓ **NOTE!**
> For a better performance of the function, the activation of the braking without losses is recommended by setting the parameter P0185 according to the Table 11.8 on page 11-23.

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P0327 – FS I/f Current Ramp

Adjustable Range:	0.000 to 1.000 s	**Factory Setting:**	0.070 s
Properties:	Sless		
Access Groups via HMI:			

Description:

It defines the time for the I/f current to change from 0 to the level used in the frequency sweep (f). It is determined by: P0327 = P0412/8.

P0328 – Flying Start Filter

Adjustable Range:	0.000 to 1.000 s	**Factory Setting:**	0.085 s
Properties:	Sless		
Access Groups via HMI:			

Description:

It establishes the time of permanence in the condition that indicates that the speed of the motor was found. It is defined by: P0328 = (P0412/8 + 0.015 s).

P0329 – FS I/f Frequency Ramp

Adjustable Range:	2.0 to 50.0	**Factory Setting:**	20.0
Properties:	Sless		
Access Groups via HMI:			

Description:

It defines the rate of frequency variation used in the motor speed search.

The frequency variation rate is determined by: (P0329 x P0412).
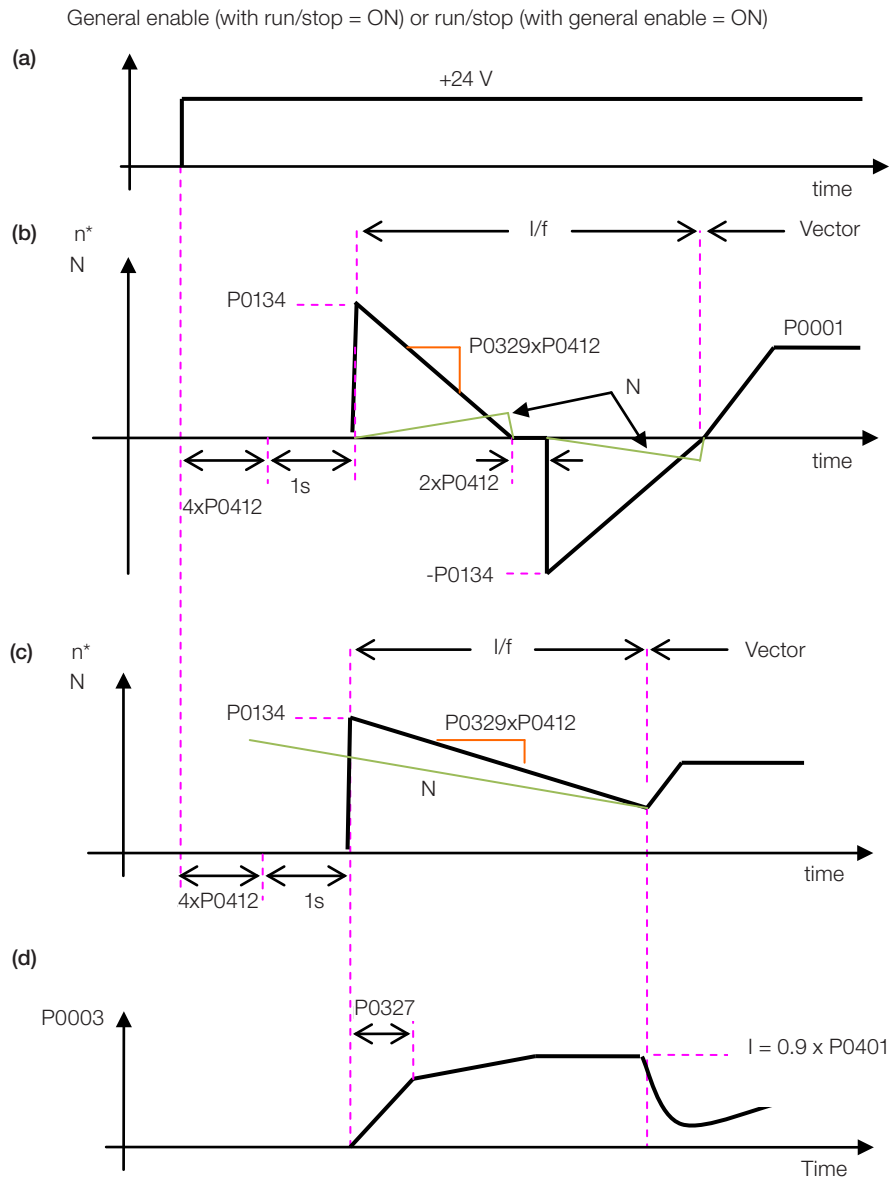
Figure 12.4: *(a) to (d) Influence of P0327 and P0329 during Flying Start (P0202 = 4)*

If it is wished to deactivate momentarily the Flying Start function, one can program one of the digital inputs P0263 to P0270 as 15 (Disab.FlyStart). Refer to item 13.1.3 Digital Inputs on page 13-9.

12.5.3 VVW or V/f Ride-Through

The Ride-Through function in the V/f mode will disable the output pulses (IGBT) of the inverter as soon as the input voltage reaches a value below the undervoltage level. The undervoltage fault (F0021) does not occur and the DC link voltage will decrease slowly until the line voltage returns.

If the line takes too long to return (more than 2 seconds), the inverter may indicate F0021 (DC link undervoltage). If the line voltage returns before a fault, the inverter will enable the pulses again, imposing the speed reference instantaneously (as in the Flying Start function) and applying a voltage ramp with the time defined by P0331. Refer to the Figure 12.5 on page 12-12.

(a) with the line returning before the time adjusted in P0332

(b) with the line returning after the time adjusted in P0332, but before 2 s (for P0332 ≤ 1 s), or before 2 x P0332 (for P0332 > 1 s)
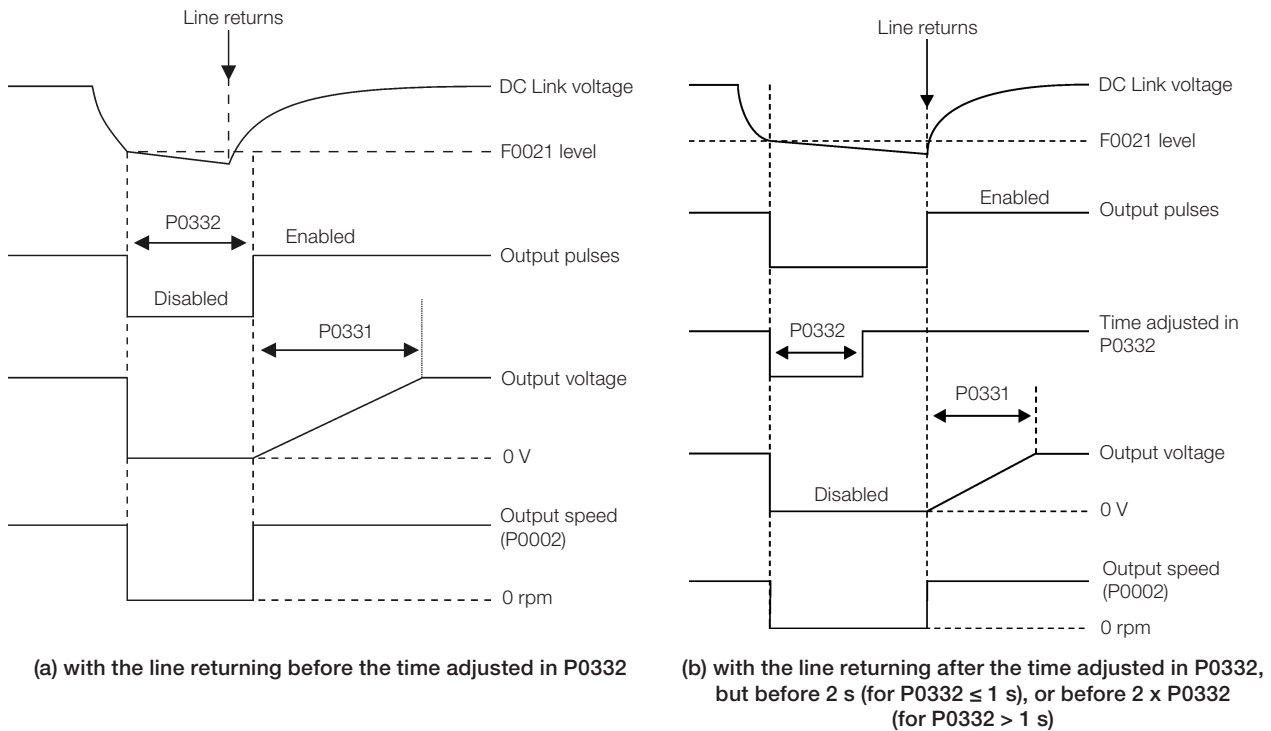
Figure 12.5: (a) and (b) Ride-Through actuation in V/f or VVW modes

The actuation of the Ride-Through function can be visualized at the outputs DO1/RL1, DO2, DO3, DO4 and/or DO5 (P0275 to P0279), provided that they have been programmed in "22 = Ride-Through".

P0331 – Voltage Ramp

Adjustable Range:	0.2 to 60.0 s	Factory Setting:	2.0 s
Properties:	V/f, VVW		
Access Groups via HMI:			

Description:

This parameter sets the necessary time for the output voltage to reach the rated voltage value.

It is used by the Flying Start function as well as by the Ride-Through function (both in V/f or VVW modes), together with the parameter P0332.

P0332 – Dead Time

Adjustable Range:	0.1 to 10.0 s	Factory Setting:	1.0 s
Properties:	V/f, VVW		
Access Groups via HMI:			

Description:

The parameter P0332 sets the minimum time that the inverter will wait to activate the motor again, which is necessary for the motor demagnetization.

12

In the Ride-Through function case, the time is counted starting from the line drop. However in the Flying Start function actuation, the counting begins after the "Run/Stop = Run" command is given.

For the correct operation, this time must be adjusted to twice the motor rotor constant (see table available at P0412 in item 11.8.5 Self-Tuning on page 11-17).

12.5.4 Vector Ride-Through

Different from the V/f and VVW modes, in the vector mode the Ride-Through function tries to regulate the DC link voltage during the line failure. The energy necessary to keep the aggregate working is obtained from the motor kinetic energy (inertia) by means of its deceleration. Thus, at the line return the motor is reaccelerated to the speed defined by the reference.

After the line failure (t0), the DC link voltage (U_d) starts diminishing according to a rate depending on the motor load condition, being able to reach the undervoltage level (t2) if the Ride-Through function is not working. The typical necessary time for this to occur, with rated load, is from a magnitude of 5 to 15 ms.

With the Ride-Through function active, the line loss is detected when the U_d voltage reaches a value below the "DC Link Power Loss" value (t1), defined at the parameter P0321. The inverter initiates a controlled deceleration of the motor immediately, regenerating energy to the DC link in order to keep the motor operating with the U_d voltage regulated at the value "DC Link Ride-Through" (P0322).

In case that the line does not return, the aggregate remains in this condition the longest possible time (depends on the energetic balance) until undervoltage (F0021 in t5) occurs. If the line returns before the undervoltage occurrence (t3), the inverter will detect its return when the U_d voltage reaches the "DC Link Power Back" (t4) level, defined at the parameter P0323. The motor is then reaccelerated, following the adjusted ramp, from the actual speed value to the value defined by the speed reference (P0001) (refer to the Figure 12.6 on page 12-13).
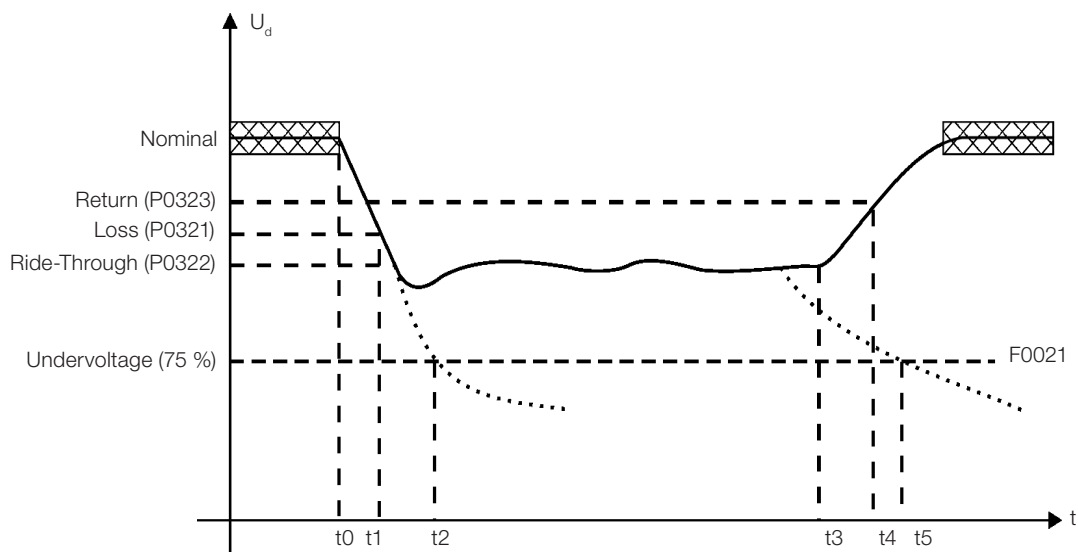
Figure 12.6: *Ride-Through function actuation in vector mode*

- t0 – Line loss.
- t1 – Line loss detection.
- t2 – Undervoltage actuation (F0021 without Ride-Through).
- t3 – Line return.
- t4 – Line return detection.
- t5 – Undervoltage actuation (F0021 with Ride-Through).

If the line voltage produces an U_d voltage between the values adjusted in P0322 and P0323, the fault F0150 may occur, the values of P0321, P0322 and P0323 must be readjusted.

> **NOTE!**
> When one of the functions, Ride-Through or Flying Start, is activated, the parameter P0357 (Line Phase Loss Time) is ignored, regardless of the adjusted time.

> **NOTE!**
> All the drive components must be dimensioned so as to withstand the transitory conditions of the application.

> **NOTE!**
> The Ride-Through function activation occurs when the power supply voltage is lower than the value (P0321/1.35).
> $U_d = Vac \times 1.35$

P0321 – DC Link Power Loss

Adjustable Range:	178 to 282 V	**Factory Setting:**	252 V (P0296 = 0)
	308 to 616 V		436 V (P0296 = 1)
	308 to 616 V		459 V (P0296 = 2)
	308 to 616 V		505 V (P0296 = 3)
	308 to 616 V		551 V (P0296 = 4)
	425 to 770 V		602 V (P0296 = 5)
	425 to 770 V		660 V (P0296 = 6)
	425 to 770 V		689 V (P0296 = 7)

P0322 – DC Link Ride-Through

Adjustable Range:	178 to 282 V	**Factory Setting:**	423 V (P0296 = 1)
	308 to 616 V		245 V (P0296 = 0)
	308 to 616 V		446 V (P0296 = 2)
	308 to 616 V		490 V (P0296 = 3)
	308 to 616 V		535 V (P0296 = 4)
	425 to 770 V		585 V (P0296 = 5)
	425 to 770 V		640 V (P0296 = 6)
	425 to 770 V		668 V (P0296 = 7)

P0323 – DC Link Power Back

Adjustable Range:	178 to 282 V	**Factory Setting:**	267 V (P0296 = 0)
	308 to 616 V		462 V (P0296 = 1)
	308 to 616 V		486 V (P0296 = 2)
	308 to 616 V		535 V (P0296 = 3)
	308 to 616 V		583 V (P0296 = 4)
	425 to 770 V		638 V (P0296 = 5)
	425 to 770 V		699 V (P0296 = 6)
	425 to 770 V		729 V (P0296 = 7)
Properties:	Vector		
Access groups via HMI:			

Description:

- P0321 - defines the U_d voltage level under which the line loss will be detected.

- P0322 - defines the U_d voltage level that the inverter will try to keep regulated, so that the motor keeps operating.

- P0323 - defines the U_d voltage level at which the inverter will identify the return of the line, and from where the motor must be reaccelerated.

> **✓ NOTE!**
> These parameters work together with the parameters P0325 and P0326 for the Ride-Through in vector control.

P0325 – Ride-Through Proportional Gain

Adjustable Range:	0.0 to 63.9		**Factory Setting:**	22.8

P0326 – Ride-Through Integral Gain

Adjustable Range:	0.000 to 9.999		**Factory Setting:**	0.128
Properties:	Vector			
Access groups via HMI:				

Description:

These parameters configure the vector mode Ride-Through PI controller, which is responsible for keeping the DC link voltage at the level set in P0322.
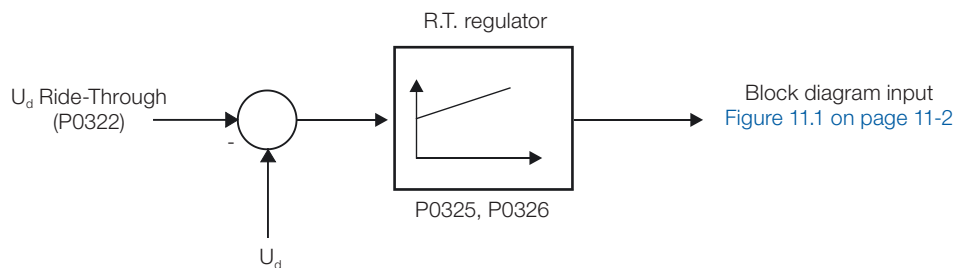
Figure 12.7: Ride-Through PI controller

Normally the factory settings for P0325 and P0326 are adequate for the majority of the applications. Do not change these parameters.

12.6 DC BRAKING

> **✓ NOTE!**
> The DC braking at start does not act when the Flying Start function is active (P0320 = 1 or 2).

The DC braking consists in the application of direct current to the motor, allowing its fast stopping.

Table 12.4: Parameters related to the DC braking

Control Mode	DC Braking at Starting	DC Braking at Stopping
V/f scalar	P0299 and P0302	P0300, P0301 and P0302
VVW	P0302 and P0299	P0300, P0301 and P0302
Sensorless Vector	P0299 and P0372	P0300, P0301 and P0372

P0299 – Starting DC-Braking Time

Adjustable Range:	0.0 to 15.0 s	**Factory Setting:**	0.0 s
Properties:	V/f, VVW, Sless		
Access Groups via HMI:			

Description:

This parameter sets the DC braking time at starting.
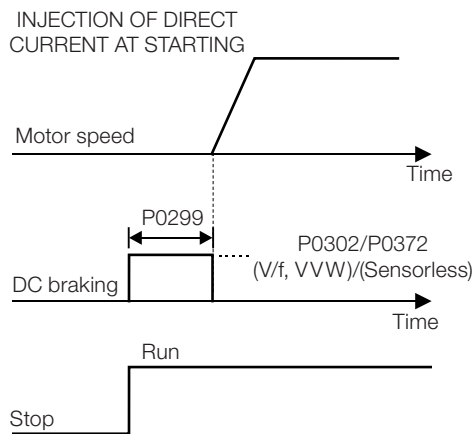
Figure 12.8: DC braking operation at starting

P0300 – Stopping DC-Braking Time

Adjustable Range:	0.0 to 15.0 s	**Factory Setting:**	0.0 s
Properties:	V/f, VVW, Sless		
Access Groups via HMI:			

Description:

This parameter sets the DC braking time at stopping.

The presents the DC braking operation via ramp disabling (refer to P0301).

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(a) V/f scalar

(b) VVW and sensorless vector
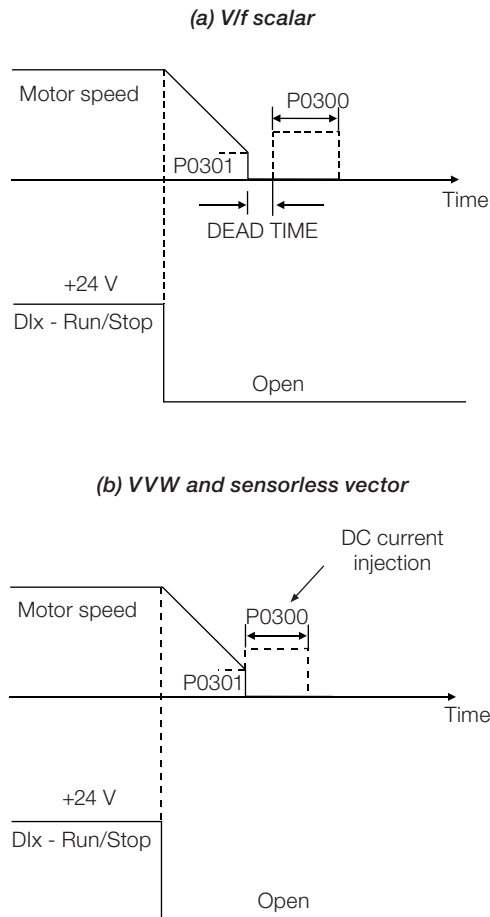
Figure 12.9: *(a) and (b) DC braking operation at the ramp disabling (via ramp disable)*

The Figure 12.10 on page 12-17 presents the DC braking operation via general disabling. This condition does only work in the V/f scalar mode.
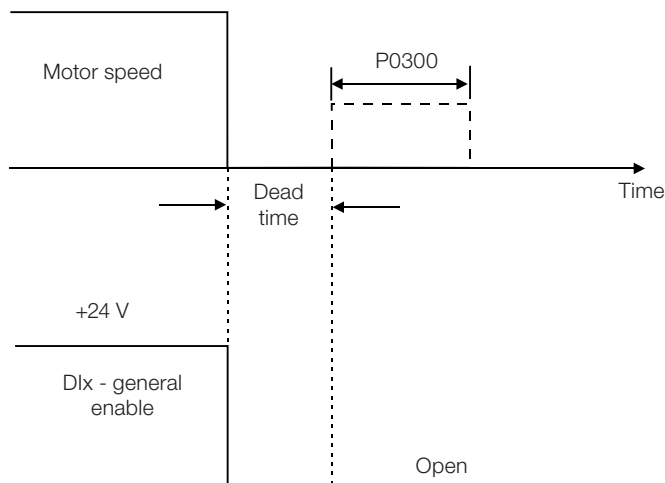
Figure 12.10: *DC braking operation via general disabling – V/f mode*

For the V/f scalar control mode there is a "dead time" (motor rotates free), before starting the DC braking. This time is necessary to the demagnetization of the motor and it is proportional to its speed.

During the DC braking the inverter indicates the "RUN" status at the keypad (HMI).

During the braking process, if the inverter is enabled, the braking is interrupted and the inverter will operate normally again.

> **ATTENTION!**
> The DC braking may continue active after the motor has already stopped. Be careful with the motor thermal sizing for short period cyclic braking.

P0301 – DC-Braking Speed

Adjustable Range:	0 to 450 rpm		Factory Setting:	30 rpm
Properties:	V/f, VVW, Sless			
Access Groups via HMI:				

Description:

This parameter establishes the beginning point for the DC braking application at stopping. Refer to the Figure 12.9 on page 12-17.

P0302 – DC-Braking Voltage

Adjustable Range:	0.0 to 10.0 %		Factory Setting:	2.0 %
Properties:	V/f, VVW			
Access Groups via HMI:				

Description:

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

The adjustment must be done by increasing gradually the P0302 value, which varies from 0 to 10 % of the rated voltage, until getting the desired braking.

This parameter works only for the V/f scalar and VVW control modes.

P0372 – DC-Braking Current for Sensorless

Adjustable Range:	0.0 to 90.0 %		Factory Setting:	40.0 %
Properties:	Sless			
Access Groups via HMI:				

Description:

This parameter adjusts the current level (DC braking torque) applied to the motor during the braking.

The programmed current level is a percentage of the inverter rated current.

This parameter works only in the Sensorless Vector control mode.

12.7 SKIP SPEED

The parameters of this group prevent the motor from operating permanently at speed values where, for instance,

the mechanic system enters in resonance (causing exaggerated vibration or noise).

P0303 – Skip Speed 1

Adjustable Range:	0 to 18000 rpm	**Factory Setting:**	600 rpm

P0304 – Skip Speed 2

Adjustable Range:	0 to 18000 rpm	**Factory Setting:**	900 rpm

P0305 – Skip Speed 3

Adjustable Range:	0 to 18000 rpm	**Factory Setting:**	1200 rpm

P0306 – Skip Band

Adjustable Range:	0 to 750 rpm	**Factory Setting:**	0 rpm
Properties:			
Access Groups via HMI:			

Description:

This actuation of these parameters occurs as presented in the next.

The passage through the avoided speed range (2 x P0306) takes place by means of the acceleration/deceleration ramps.

The function does not operate properly if two bands of "Skip Speed" overlap.
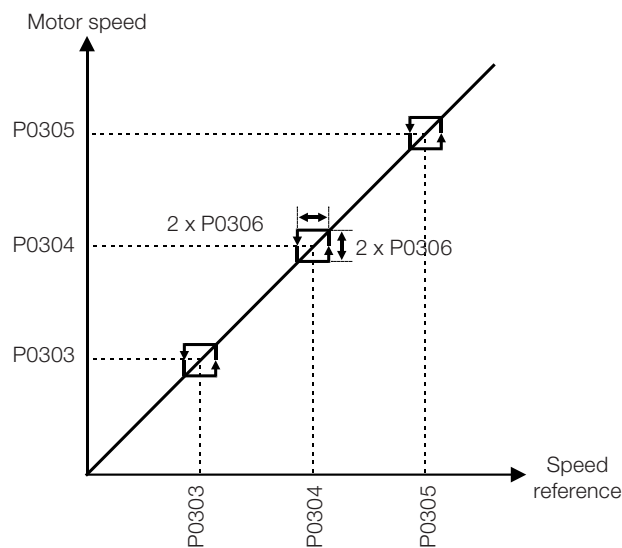
Figure 12.11: *"Skip Speed" actuation curve*

13 DIGITAL AND ANALOG INPUTS AND OUTPUTS

This section presents the parameters for the configuration of the CFW701 inputs and outputs, as well as the parameters for the command of the inverter in the Local or Remote Situations.

13.1 I/O CONFIGURATION

13.1.1 Analog Inputs

Four analog inputs (AI1, AI2, AI3 and AIPTC) are available in the CFW701 standard configuration.

The AI3 input allows only current signals and the input AIPTC allows only PTC connections.

With those inputs it is possible, for instance, the use of an external speed reference or the connection of a sensor for the temperature measurement (PTC). The details for those configurations are described in the following parameters.

P0018 – AI1 Value

P0019 – AI2 Value

P0020 – AI3 Value

Adjustable Range:	-100.00 to 100.00 %	Factory Setting:	
Properties:	ro		
Access Groups via HMI:	READ, I/O		

Description:

These read only parameters indicate the value of the analog inputs AI1, AI2 and AI3, as a percentage of the full scale. The indicated values are the ones obtained after the offset action and the multiplication by the gain. Refer to the description of the parameters P0230 to P0245.

P0230 – Analog Input Dead Zone

Adjustable Range:	0 = Inactive 1 = Active	Factory Setting:	0
Properties:			
Access Groups via HMI:	I/O		

Description:

This parameter acts only for the analog inputs (AIx) programmed as speed reference, and it defines if the Dead Zone at those inputs is Active (1) or Inactive (0).

If the parameter is configured as Inactive (P0230 = 0), the signal at the analog input will work on the Speed Reference starting from the minimum value (0 V / 0 mA / 4 mA or 10 V / 20 mA), and will be directly related to the minimum speed programmed at P0133. Refer to the .

If the parameter is configured as Active (P0230 = 1), the signal at the analog inputs will have a Dead Zone, where the Speed Reference remains in the minimum value (P0133), even with the variation of the input signal. Refer to the .

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(a) Zone inactive

(b) Zone active

Figure 13.1: *(a) and (b) analog input actuation*

In case that the analog inputs AI1 and AI2 are programmed for -10 V to +10 V (P0233 and P0238 configured in 4), there will be curves identical to those of the Figure 13.1 on page 13-2 above; only when AI1 or AI2 is negative the speed direction will be inverted.

P0231 – AI1 Signal Function

P0236 – AI2 Signal Function

P0241 - AI3 Signal Function

Adjustable Range:	0 = Speed Reference 1 = N* without Ramp 2 = Maximum Torque Current 3 = SoftPLC 4 = PTC (AI1 and AI2 only) 5 = Main PID 1 Feedback 6 = Main PID 2 Feedback 7 =Main PID 3 Feedback 8 = External PID 1 Feedback 9 = External PID 2 Feedback	Factory Setting:	P0231 = 5 P0236 = 8 P0241 = 9
Properties:	cfg		
Access Groups via HMI:	I/O		

Description:

The functions of the analog inputs are defined in those parameters.

When the option 0 (Speed Reference) is selected, the analog inputs are able to supply the reference for the motor, subject to the specified limits (P0133 and P0134) and to the ramp action (P0100 to P0103). Therefore, it is also necessary to configure the parameters P0221 and/or P0222, selecting the use of the desired analog input. For more details refer to the description of those parameters in the section 13.2 LOCAL AND REMOTE COMMAND on page 13-24, and to the Figure 13.7 on page 13-27 in this manual.

The option 1 (No Ramp Reference – valid only for the vector mode) is used generally as an additional reference signal, for instance in applications using a dancer. Refer to the Figure 13.7 on page 13-27, option without acceleration and deceleration ramp.

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The option 2 (Maximum Torque Current) makes it possible that the forward and reverse torque current limit control be done by means of the selected analog input. In this case P0169 and P0170 are not used.

The adjustment done at the analog input AI1 or AI2 can be monitored via parameters P0018 or P0019 respectively. The value presented at this parameter will be the maximum torque current expressed as a percentage of the motor rated current (P0401). The indication range will be from 0...200 %. When the analog input is equal to 10 V (maximum), the corresponding monitoring parameter will show 200 %, and the value of the maximum forward and reverse torque current will be 200 %. In order that the expressions which determine the total current and the maximum torque developed by the motor (section 11.5 TORQUE CONTROL on page 11-4) remain valid, replace P0169, P0170 by P0018 or P0019.

The option 3 (SoftPLC) sets the input to be used by the programming done in the SoftPLC reserved memory area. Refer to the SoftPLC manual for more details.

The option 4 (PTC) configures the input for motor temperature monitoring by means of a PTC type sensor, when it is present in the motor. Therefore it is also necessary to configure one analog output (AO) as a current source for feeding the PTC. More details of this function are described in the section 15.2 MOTOR OVERTEMPERATURE PROTECTION on page 15-2.

Option 5 (Feedback 1 of Main PID) configures the input to be used as the feedback 1 of the Main PID Controller. The parameter P1026 defines its function in the feedback of the Main PID Controller.

Option 6 (Feedback 2 of Main PID) configures the input to be used as the feedback 2 of the Main PID Controller. The parameter P1026 defines its function in the feedback of the Main PID Controller.

Option 7 (Feedback 3 of Main PID) configures the input to be used as the feedback 3 of the Main PID Controller. The parameter P1026 defines its function in the feedback of the Main PID Controller.

Option 8 (Feedback of External PID 1) configures the input to be used as the feedback of the External PID 1.

Option 9 (Feedback of External PID 2) configures the input to be used as the feedback of the External PID 2.

> ✓ **NOTE!**
> In options 5 to 9, in case two or more analog inputs are selected for the same function, for instance, P0231 = 5 and P0236 = 5, only the analog input with higher priority will be valid, being AI1>AI2>AI3, that is, in this case the analog input AI1 will be the input used as feedback 1 of the Main PID Controller. Refer to chapter 19 HVAC FUNCTIONS on page 19-1, for further information.

P0232 – AI1 Gain

P0237 – AI2 Gain

P0242 – AI3 Gain

Adjustable Range:	0.000 to 9.999	Factory Setting:	1.000

P0234 – AI1 Offset

P0239 – AI2 Offset

P0244 – AI3 Offset

Adjustable Range:	-100.00 to 100.00 %	Factory Setting:	0.00 %

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P0235 – AI1 Filter

P0240 – AI2 Filter

P0245 – AI3 Filter

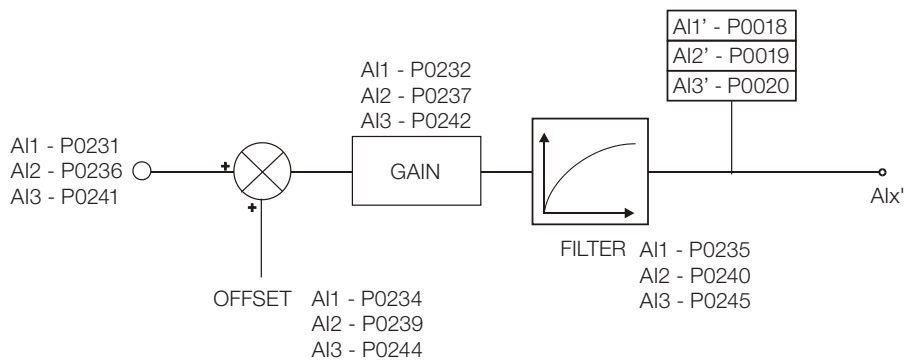| Adjustable Range:	0.00 to 16.00 s		Factory Setting:	0.15 s
Properties:				
Access Groups via HMI:	I/O			

Description:

Figure 13.2: Analog input block diagram

The AIx' internal value is the result of the following equation:

$$AIx' = AIx + \left(\frac{OFFSET}{100} \times 10 \text{ V} \right) \times \text{ Gain}$$

For instance: AIx = 5 V, OFFSET = -70 % and Gain = 1.000:

$$AIx' = 5 + \left(\frac{(-70)}{100} \times 10 \text{ V} \right) \times 1 = -2 \text{ V}$$

AIx' = -2 V means that the motor will rotate in the reverse direction with a reference in module equal to 2 V, provided that the AIx function is "Speed Reference". For the AIx function "Maximum Torque Current", negative values are clipped at 0.0 %.

For the filter parameters (P0235, P0240 and P0245), the adjusted value corresponds to the RC constant used for filtering the signal read at the input.

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P0233 – AI1 Signal Type

P0238 – AI2 Signal Type

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 4 = -10 V to +10 V (AI1 and AI2 only)	**Factory Setting:**	0
Properties:	cfg		
Access Groups via HMI:	I/O		

Description:

These parameters configure the signal type (if it is current or voltage) that will be read at each analog input, as well as its range. Refer to the Table 13.1 on page 13-5 and Table 13.2 on page 13-5 for more details on this configuration. For AI3 only current settings are valid.

Table 13.1: DIP Switches related to the analog inputs

Parameter	Input	Switch	Location
P0233	AI1	S1.2	Control Board
P0238	AI2	S1.1	

Table 13.2: Configuration of the analog input signals

P0238, P0233	Input Signal	Switch Position
0	(0 to 10) V / (0 to 20) mA	Off/On
1	(4 to 20) mA	On
2	(10 to 0) V / (20 to 0) mA	Off/On
3	(20 to 4) mA	On
4	(-10 to +10) V	Off

When current signals are used at the input, the switch corresponding to the desired input must be set in the "ON" position.

Inverse reference is obtained with the options 2 and 3, i.e., maximum speed is obtained with minimum reference.

P0243 - AI3 Signal Type

Adjustable Range:	0 = 0 to 20 mA 1 = 4 to 20 mA 2 = 20 to 0 mA 3 = 20 to 4 mA	**Factory Setting:**	0
Properties:	cfg		
Access Groups via HMI:	I/O		

Description:

These parameters configure the signal type (only in current) that will be read at each analog input, as well as its range.

Inverse reference is obtained with the options 2 and 3, i.e., maximum speed is obtained with minimum reference.

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13.1.2 Analog Outputs

In the CFW701 standard configuration are available 2 analog outputs (AO1 and AO2). The parameters related to those outputs are described next.

P0014 – AO1 Value

P0015 – AO2 Value

Adjustable Range:	0.00 to 100.00 %		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ, I/O			

Description:

Those read only parameters indicate the value of the analog outputs AO1 and AO2, as a percentage of the full scale. The indicated values are those obtained after the multiplication by the gain. Refer to the description of the parameters P0251 to P0256.

P0251 – AO1 Function

P0254 – AO2 Function

Adjustable Range:	0 = Speed Reference 1 = Total Reference 2 = Real Speed 3 = Torque Current Reference 4 = Torque Current 5 = Output Current 6 = Active Current 7 = Output Power 8 = Torque Current > 0 9 = Motor Torque 10 = SoftPLC 11 = PTC 12 = Motor Ixt 13 = P0696 Value 14 = P0697 Value 15 = Id* Current 16 = External PID 1 output 17 = External PID 2 output	Factory Setting:	P0251 = 16 P0254 = 17
Properties:			
Access Groups via HMI:	I/O		

Description:
These parameters set the functions of the analog outputs.

P0252 – AO1 Gain

P0255 – AO2 Gain

Adjustable Range:	0.000 to 9.999	Factory Setting:	1.000
Properties:			
Access Groups via HMI:	I/O		

Description:

They adjust the analog output gains. Refer to the Figure 13.3 on page 13-7.
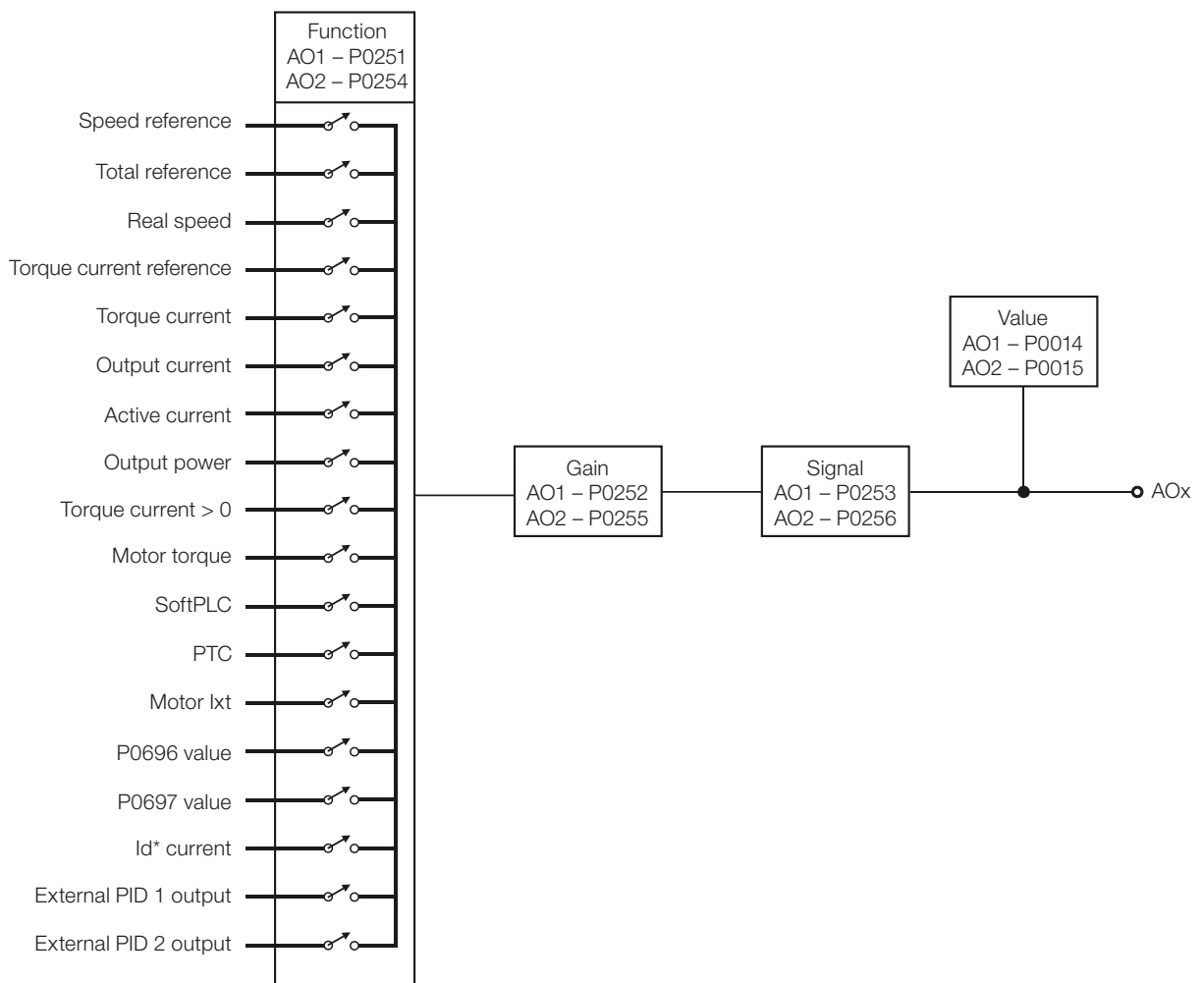
Figure 13.3: Analog output block diagram

Table 13.3: *Full scale*

Scale of the Analog Output Indications	
Variable	**Full Scale (*)**
Speed Reference	P0134
Total Reference	
Real Speed	
Torque Current Reference	$2.0 \times I_{nomHD}$
Torque Current	
Torque Current > 0	
Motor Torque	$2.0 \times I_{nom}$
Output Current	$1.5 \times I_{nomHD}$
Active Current	
Output Power	$1.5 \times \sqrt{3} \times P0295 \times P0296$
Motor Ixt	100 %
SoftPLC	32767
P0696 Value	
P0697 Value	
External PID 1 output (P1063)	0 – 100 %
External PID 2 output (P1083)	

(*) When the signal is inverse (10 to 0 V, 20 to 0 mA or 20 to 4 mA) the values in the table become the beginning of the scale.

P0253 – AO1 Signal Type

P0256 – AO2 Signal Type

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:	cfg		
Access Groups via HMI:	I/O		

Description:

These parameters configure if the analog output signal will be in current or voltage, with direct or inverse reference.

In order to adjust these parameters, it is also necessary to set the "DIP switches" of the control board according to the and .

Table 13.4: *DIP switches related to the analog outputs*

Parameter	Output	Switch	Location
P0253	AO1	S1.3	Control Board
P0256	AO2	S1.4	

Table 13.5: *Configuration of the analog outputs AO1 and AO2 signals*

P0253, P0256	Output Signal	Switch Position
0	(0 to 10) V / (0 to 20) mA	On / Off
1	(4 to 20) mA	Off
2	(10 to 0) V / (20 to 0) mA	On / Off
3	(20 to 4) mA	Off

For AO1 and AO2, when current signals are used, the switch corresponding to the desired output must be set in the "OFF" position.

13.1.3 Digital Inputs

The CFW701 has 8 digital inputs in the standard version. The parameters that configure those inputs are presented next.

P0012 – DI8 to DI1 Status

Adjustable Range:	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	
Access Groups via HMI:	READ, I/O	

Description:

By means of this parameter it is possible to visualize the status of the 8 control board digital inputs (DI1 to DI8).

The indication is done by means of an hexadecimal code which, when converted to binary, will represent, by the numbers 1 and 0, respectively, the "Active" and "Inactive" status of the digital inputs. The status of each input is considered as one binary digit in the sequence, where DI1 represents the least significant digit.

Example: If the code presented for the parameter P0012 on the keypad (HMI) is 00A5h, it will correspond to the sequence **10100101**, indicating that the inputs DI8, DI6, DI3 and DI1 are active, as shown in Table 13.6 on page 13-9.

Table 13.6: Example of correspondence between the P0012 hexadecimal and binary codes and the DIx status

0				0				A				5			
0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1
Without relation to DIx (always zero)								DI8 Active (+24 V)	DI7 Inactive (0 V)	DI6 Active (+24 V)	DI5 Inactive (0 V)	DI4 Inactive (0 V)	DI3 Active (+24 V)	DI2 Inactive (0 V)	DI1 Active (+24 V)

P0263 – DI1 Function

P0264 – DI2 Function

P0265 – DI3 Function

P0266 – DI4 Function

P0267 – DI5 Function

P0268 – DI6 Function

P0269 – DI7 Function

P0270 – DI8 Function

Adjustable Range:	0 = Not used 1 = Run/Stop 2 = General Enable 3 = Fast Stop 4 = FWD/REV 5 = LOC/REM 6 = JOG 7 = SoftPLC 8 = Ramp 2 9 = Speed/Torque 10 = JOG+ 11 = JOG- 12 = No Ext. Alarm 13 = No Ext. Fault 14 = Reset 15 = Disable FlyStart 16 = DC Link Regul. 17 = Program. Off 18 = Load User 1 19 = Load User 2 20 = Main PID Aut/Man 21 = External PID 1 Aut/Man 22 = External PID 2 Aut/Man 23 = Bypass mode 24 = Fire mode	Factory Setting:	P0263 = 1 P0264 = 4 P0265 = 0 P0266 = 20 P0267 = 21 P0268 = 22 P0269 = 0 P0270 = 0
Properties:	cfg		
Access Groups via HMI:	I/O		

Description:

Those parameters make it possible to configure the functions of the digital inputs, according to the listed range.

Some notes regarding the Digital Input functions are presented next.

- **Run/Stop:** in order to assure the correct operation of this function, it is necessary to program P0224 and/or P0227 in 1.

- **Local/Remote:** when programmed, this function activates "Local" when 0 V is applied to the input, and "Remote" when +24 V are applied. It is also necessary to program P0220 = 4 (DIx).

■ **Speed/Torque:** this function is valid for P0202 = 4 (Sensorless Vector Control), and "Speed" is selected with 0 V applied to the input, whereas "Torque" by applying 24 V.

When **Torque** is selected, the speed regulator parameters P0161 and P0162 become inactive (*). Thus the Total Reference becomes the Torque Regulator input. Refer to the Figure 11.1 on page 11-2 and Figure 11.2 on page 11-7.

(*) The speed regulator of the PID type is converted into a P type, with proportional gain 1.00 and a null integral gain.

When **Speed** is selected, the gains of the speed regulator become again defined by P0161 and P0162. In the applications with torque control it is recommended to follow the method described at the parameter P0160.

■ **DC Link Regulation:** it must be used when P0184 = 2. For more details, refer to this parameter description in item 11.8.7 Supervision of Motor Real Speed on page 11-21, of this manual.

■ **JOG+ and JOG-:** those are functions valid only for P0202 = 5 or 4.

■ **Disables Flying Start:** it is valid for P0202 ≠ 5. By applying +24 V to the digital input programmed for this purpose, the Flying Start function is disabled. By applying 0 V, the Flying Start function is enabled again, provided that P0320 be equal to 1 or 2. Refer to the section 12.5 FLYING START / RIDE-THROUGH on page 12-8.

■ **Load User 1:** this function allows the selection of the user memory 1, in a similar process than P0204 = 7, with the difference that the user memory is loaded from a transition of the DIx programmed for this function.

When the state of the DIx changes from low level to high level (transition from 0 V to 24 V), the user memory 1 is loaded, provided that the contents of the inverter actual parameters had been previously transferred to the parameter memory 1 (P0204 = 9).
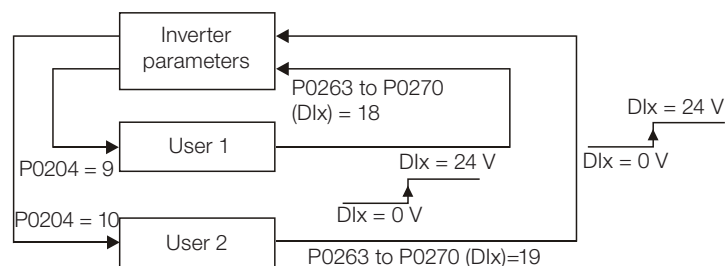
Figure 13.4: Details on the working of the Load User 1 or 2 function

■ **Load User 2:** this function allows the selection of the user memory 2, in a similar process than P0204=8, with the difference that the user memory is loaded from a transition of the DIx programmed for this function.

When the state of the DIx changes from low level to high level (transition from 0 V to 24 V), the user memory 2 is loaded, provided that the contents of the inverter actual parameters had been previously transferred to the parameter memory 2 (P0204 = 10).

> **NOTES!**
> Make sure that when using those functions the parameter sets (user memory 1, 2) be totally compatible with the application (motors, Run/Stop commands, etc.).
> It will not be possible to load the user memory with the inverter enabled.
> If two parameter sets from different motors were saved in the user memories 1 and 2, the correct current values must be adjusted at the parameters P0156, P0157 and P0158 for each user memory.

■ **Parametrization Blocking:** when this function is programmed and the digital input is with +24 V, parameter changes will not be allowed, regardless of the values set at P0000 and P0200. When the DIx input is with 0 V, the parameter changes will be conditioned to the P0000 and P0200 settings.

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- **No External Alarm:** this function will indicate "External Alarm" (A0090) on the keypad (HMI) display when the programmed digital input is open (0 V). If +24 V is applied to the input, the alarm message will disappear automatically from the keypad (HMI) display. The motor keeps working normally, regardless of the state of that input.

- **Bypass Mode:** signals the switch to bypass mode

- **Fire Mode:** signals the switch to fire mode

- **Automatic/Manual for Main PID** configures the input to select the operating mode of the Main PID Controller, being automatic with the application of 0 V, or manual with the application of 24 V. The parameter P1018 defines its functionality in the operation of the Main PID Controller.

- **Automatic/Manual for External PID 1** configures the input to select the operating mode of the External PID Controller 1, being automatic with the application of 0 V, or manual with the application of 24 V. The parameter P1065 defines its functionality in the operation of the External PID Controller 1.

- **Automatic/Manual for External PID 2** configures the input to select the operating mode of the External PID Controller 2, being automatic with the application of 0 V, or manual with the application of 24 V. The parameter P1085 defines its functionality in the operation of the External PID Controller 2.

NOTE!
In options 20, 21 and 22, in case two or more digital inputs are selected for the same function, for instance, P0266 = 20 and P0267 = 20, only the digital input with higher priority will be valid, being DI1>DI2>DI3>DI4>DI5>DI6>DI7>DI8, that is, in this case the digital input DI4 will be the input used as Automatic/Manual of the Main PID Controller. Refer to chapter 19 HVAC FUNCTIONS on page 19-1, for further information.

(a) RUN/STOP
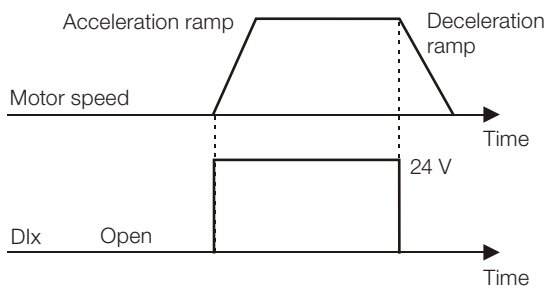
Note: All the digital inputs programmed for General Enable, Fast Stop, Forward Run or Reverse Run must be in the ON state, so that the CFW701 operates as described above.

(b) GENERAL ENABLE
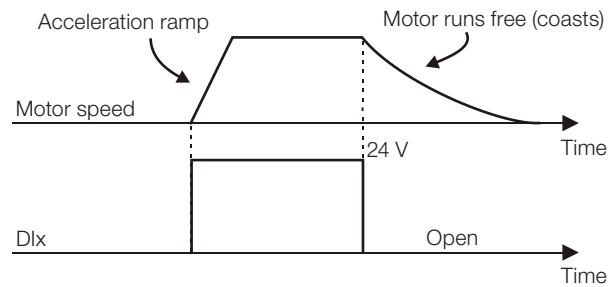
Note: All the digital inputs programmed for Run/Stop, Fast Stop, Forward Run or Reverse Run must be in the ON state, so that the CFW701 operates as described above.
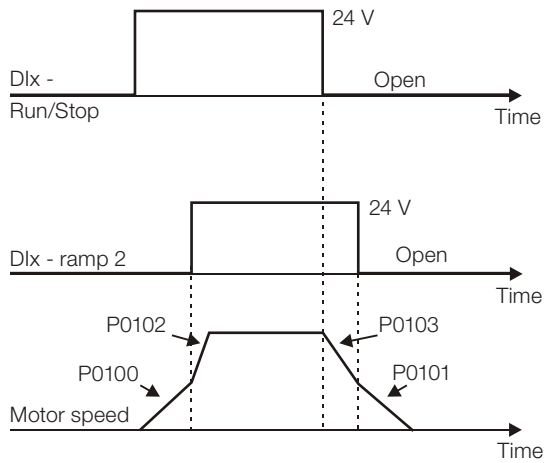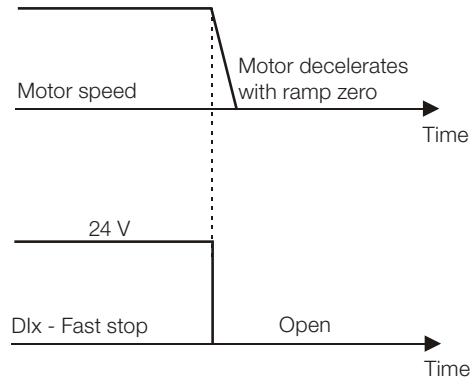
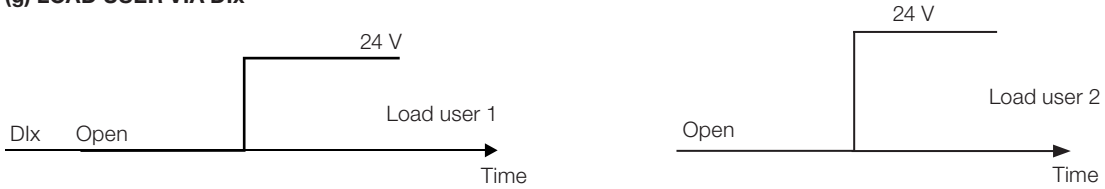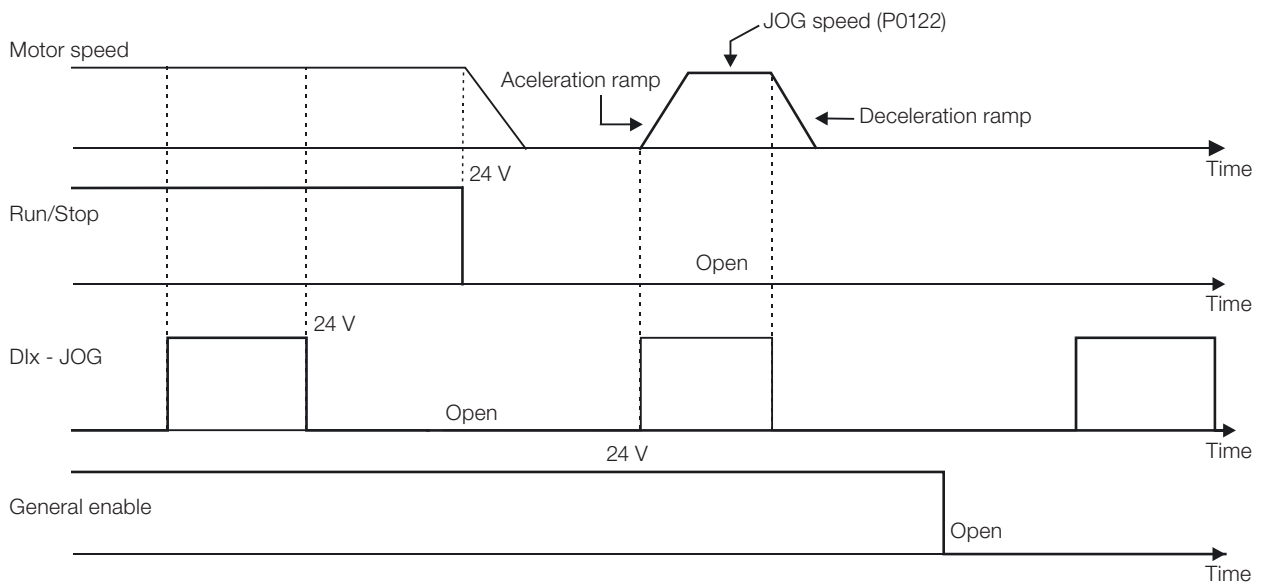**(c) NO EXTERNAL FAULT**
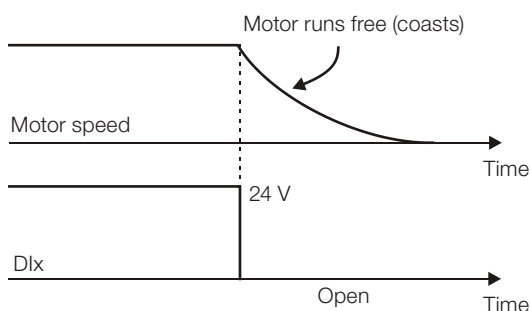
(d) FWD/REV
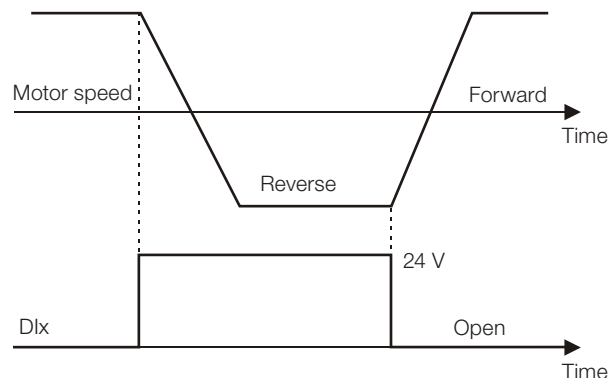
(e) RAMP 2

(f) FAST STOP

(g) LOAD USER VIA DIx

(h) JOG

(i) JOG + and JOG -

(j) RESET

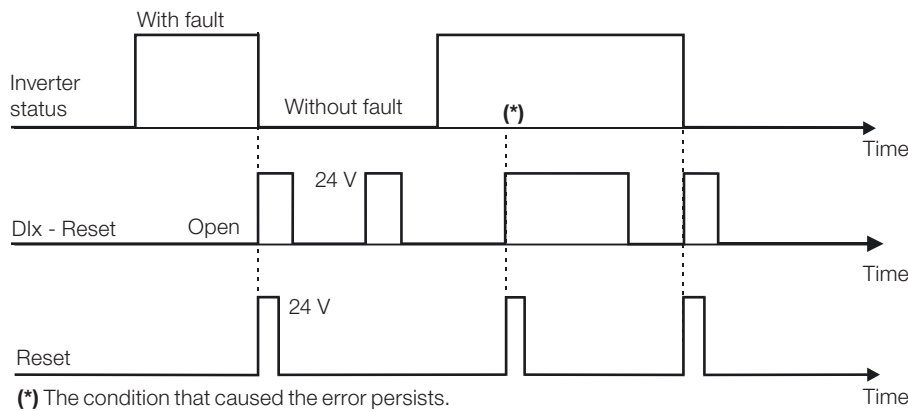(*) The condition that caused the error persists.
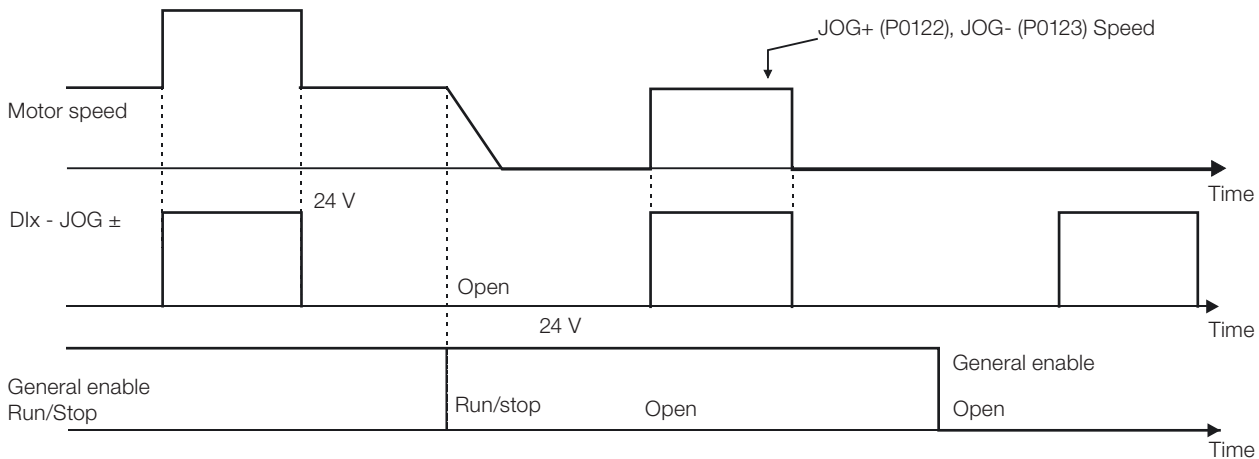
Figure 13.5: (a) to (j) Details on the operation of the digital input functions

13.1.4 Digital Outputs / Relays

The CFW701 has two digital output relays and 3 open collector outputs available in the control board as standard. The next parameters configure the functions related to those outputs.

P0013 – DO5 to DO1 Status

Adjustable Range:	Bit 0 = DO1 Bit 1 = DO2 Bit 2 = DO3 Bit 3 = DO4 Bit 4 = DO5	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ, I/O	

Description:

By means of this parameter it is possible to visualize the status of the control board 5 digital outputs (DO1 to DO5).

The indication is done by means of an hexadecimal code which, when converted to binary, will represent, by the numbers 1 and 0, respectively, the "Active" and "Inactive" status of the digital outputs. The status of each output is considered as one binary digit in the sequence, where DO1 represents the least significant digit.

Example: If the code presented for the parameter P0013 on the keypad (HMI) is 001Ch, it will correspond to the sequence 00011100, indicating that the outputs DO5, DO4 and DO3 are active, as shown in .

Table 13.7: Example of correspondence between the P0013 hexadecimal and binary codes and the DOx status

0				0				1				C				
0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0
No relation with the DOx (always zero)								No relation with the DOx (always zero)			DO5 Active (+24 V)	DO4 Active (+24 V)	DO3 Active (+24 V)	DO2 Inactive (0 V)	DO1 Inactive (0 V)

P0275 – DO1 Function (RL1)

P0276 – DO2 Function (RL2)

P0277 – DO3 Function

P0278 – DO4 Function

P0279 – DO5 Function

Adjustable Range:	0 = Not Used 1 = N* > Nx 2 = N > Nx 3 = N < Ny 4 = N = N* 5 = Zero Speed 6 = Is > Ix 7 = Is < Ix 8 = Torque > Tx 9 = Torque < Tx 10 = Remote 11 = Run 12 = Ready 13 = No Fault 14 = No F0070 15 = No F0071 16 = No F0006/21/22 17 = No F0051 18 = No F0072 19 = 4-20 mA OK 20 = P0695 Value 21 = Forward 22 = Ride-Through 23 = Pre-Charge OK 24 = Fault 25 = Enabled Time > Hx 26 = SoftPLC 27 = N>Nx/Nt>Nx 28 = F > Fx (1) 29 = F > Fx (2) 30 = STO 31 = No F0160 32 = No Alarm 33 = No Fault/No Alarm 34 = Dry Pump Alarm/Fault 35 = Broken Belt Alarm/Fault 36 = Filter Mainten. Alarm/Fault 37 = Sleep Mode 38 = Not Used 39 = Drive Bypass Contactor 40 = Mains Bypass Contactor 41 = Fire Mode 42 = Self-Tuning	**Factory Setting:**	P0275 = 11 P0276 = 24 P0277 = 0 P0278 = 0 P0279 = 0
Properties:	cfg		
Access Groups via HMI:	I/O		

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Description:

They program the functions of the digital outputs, according to the options presented previously.

When the condition declared by the function is true, the digital output will be activated.

Example: Is>Ix function – when Is>Ix then DOx = saturated transistor and/or relay with the coil energized, and when Is≤Ix then DOx = open transistor and/or relay with the coil not energized.

Some notes regarding the Digital and Relay Outputs are presented next.

- **Not Used:** it means that the digital outputs will remain always in a resting state, i.e., DOx=open transistor and/or relay with the coil not energized.

- **Zero Speed:** it means that the motor speed is below the value adjusted in P0291 (Zero Speed).

- **Torque > Tx and Torque < Tx:** they are valid only for P0202 = 5 or 4 (Vector Control). In those functions "Torque" corresponds to the motor torque as indicated at parameter P0009.

- **Remote:** it means that the inverter is operating in Remote situation.

- **Run:** it corresponds to enabled inverter. In this moment the IGBTs are commutating, and the motor may be at any speed, including zero.

- **Ready:** it corresponds to the inverter without fault and without undervoltage.

- **No Fault:** it means that the inverter is not disabled by any type of fault.

- **No F0070:** it means that the inverter is not disabled by the F0070 fault (Overcurrent or Short-circuit).

- **No F0071:** it means that the inverter is not disabled by the F0071 fault (Output Overcurrent).

- **No F0006+F0021+F0022:** it means that the inverter is not disabled by the F0006 fault (Input Voltage Imbalance or Phase Loss), neither by F0021 (DC Link Undervoltage), nor by F0022 (DC Link Overvoltage).

- **No F0051:** it means that the inverter is not disabled by the F0051 fault (IGBT Overtemperature).

- **No F0072:** it means that the inverter is not disabled by the F0072 fault (Motor Overload).

- **4 - 20 mA OK:** it means that the current reference (4 to 20 mA) at the analog inputs AIx is inside the 4 to 20 mA range.

- **P0695 Value:** it means that the state of the digital output will be controlled by P0695, which is written via the network. Refer to the CFW701 Serial communication manual for more details on this parameter.

- **Forward:** it means that when the motor is rotating in the forward direction the DOx = saturated transistor and/or relay with the coil energized, and when the motor is rotating in the reverse direction, the DOx = open transistor and/or relay with the coil not energized.

- **Ride-Through:** it means that the inverter is executing the Ride-Through function.

- **Pre-charge OK:** it means that the DC Link voltage is above the pre-charge voltage level.

- **Fault:** it means that the inverter is disabled by any type of fault.

- **N > Nx and Nt > Nx:** (valid only for P0202 = 5 – Vector with Encoder) it means that both the conditions must be satisfied so that DOx = saturated transistor and/or relay with the coil energized. In other words, it is enough that the condition N>Nx be not satisfied (regardless of the Nt>Nx condition) so that DOx = open transistor and/or relay with the coil not energized.

- **SoftPLC:** it means that the digital output state will be controlled by the programming done in the memory area

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reserved to the SoftPLC function. Refer to the SoftPLC manual for more details.

- **STO:** it signalizes the STO state (Safety Stop active).

- **No F0160:** it signalizes that the inverter is not disabled by F0160 fault (Safety Stop Relay).

- **No Alarm:** it means that the inverter is not in the alarm condition.

- **No Fault and No Alarm:** it means that the inverter is not disabled by any type of fault and it is not in alarm condition.

- **Dry Pump:** it means that the dry pump condition was detected (A0766 / F0767).

- **Broken Belt:** it means the condition that the broken belt condition was detected (A0768 / F0769).

- **Filter Change:** it means that the condition to change the filter was detected (A0770 / F0771).

- **Sleep Mode:** it means that the motor driven by the frequency inverter CFW701 is with the Sleep mode active (A0764).

- **Drive Bypass Contactor:** it means that the output is activating the drive bypass contactor, that is, the motor is being powered by the drive.

- **Mains Bypass Contactor:** it means that the output is activating the mains bypass contactor, that is, the motor is being powered directly by the mains.

- **Fire Mode:** it means that the CFW701 is operating in Fire Mode.

> **NOTE!**
> Refer to chapter 19 HVAC FUNCTIONS on page 19-1, for further information on the options 34 to 41.

Definitions of the symbols used in the function:

N = P0002 (Motor Speed).
N* = P0001 (Speed Reference).
Nx = P0288 (Nx Speed) – It is a reference point of the speed selected by the user.
Ny = P0289 (Ny Speed) – It is a reference point of the speed selected by the user.
Ix = P0290 (Ix Current) – It is a reference point of the current selected by the user.
Is = P0003 (Motor Current).
Torque = P0009 (Motor Torque).
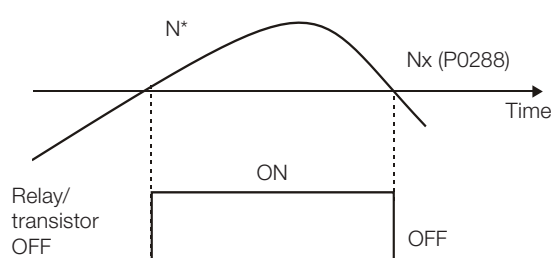**Tx** = P0293 (Tx Torque) – It is a reference point of the torque selected by the user.
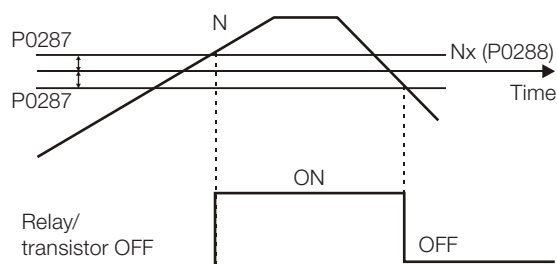**Nt** = Total Reference (refer to the Figure 13.7 on page 13-27).
Hx = P0294 (Hx Time).
F = P0005 (Motor Frequency).
Fx = P0281 (Fx Frequency) – It is a reference point of the motor frequency selected by the user.
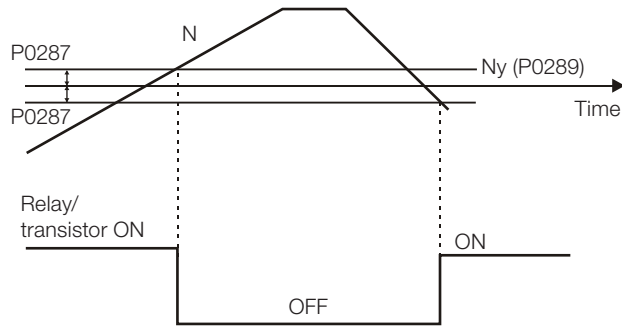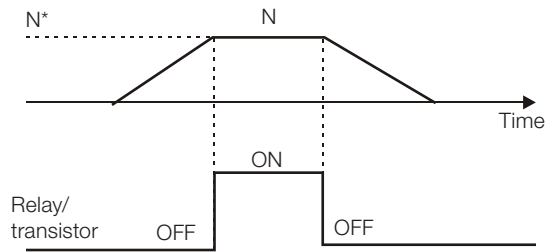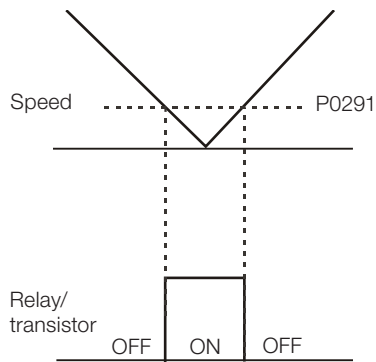
(a) N* > Nx

(b) N > Nx

(c) N < Ny

(d) N = N*

(e) N = 0 (Zero) Speed

(f) Is > Ix
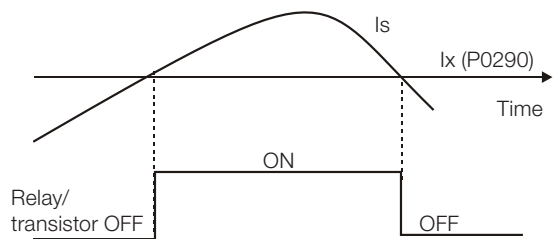
(g) Is < Ix
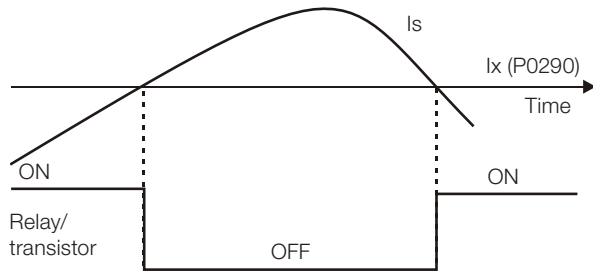
(h) Torque > Tx
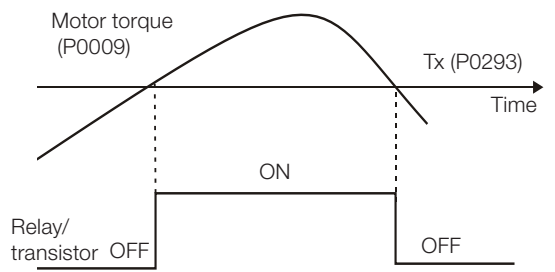
(i) Torque <Tx
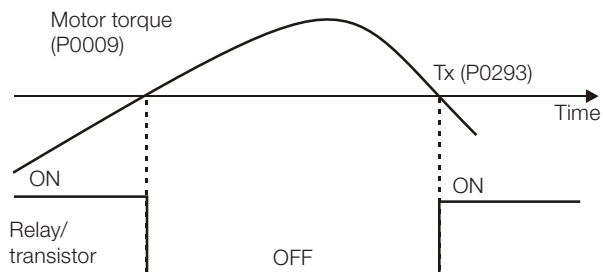
(j) No fault
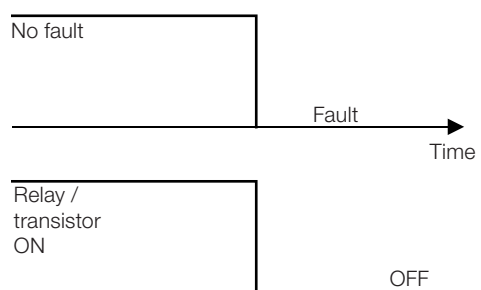
(k) Fault
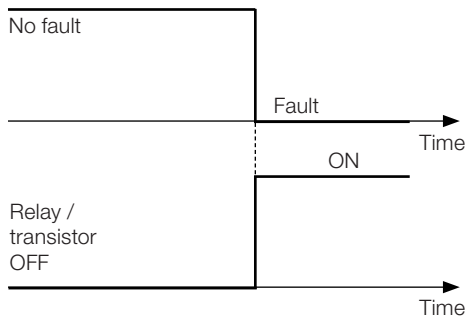
No fault

Fault

Time

ON

Relay /
transistor
OFF

Time

(l) 4-20 mA Reference OK

Reference .... 2 mA

Time

Relay /
transistor

ON   OFF   ON

(m) Pre-Charge Ok

DC Link

Pre-charge
level

Time

Relay /
transistor

ON   OFF   ON

(n) Enabled Time > Hx

6553 h

N

Hx (P0294)

Time

0   Enable
hours.
(P0043)

Relay/
transistor

ON

OFF   OFF

(o) N > Nx and Nt > Nx

Nt   N

Nx (P0288)

Time

ON

Relay/transistor
OFF   OFF

(p) F > Fx [1]

P0281 + P0282
Fx (P0281)
P0281 - P0282

ON   N

Relay   OFF

(q) F > Fx [2]

Fx (P0281)
P0281 - P0282

ON   N

Relay /
transistor OFF   OFF

(r) No Alarm

No alarm

alarm

Time

Relay /
transistor
ON

OFF
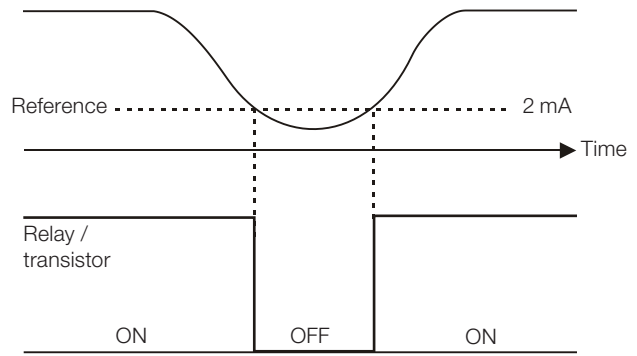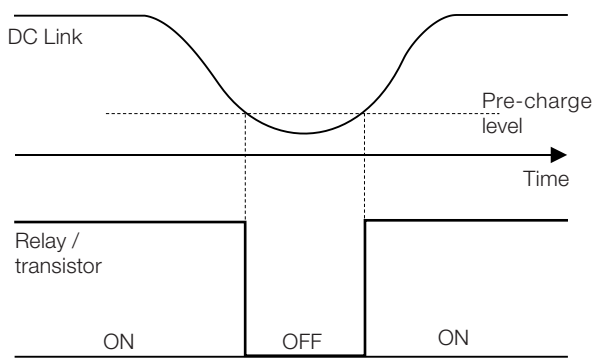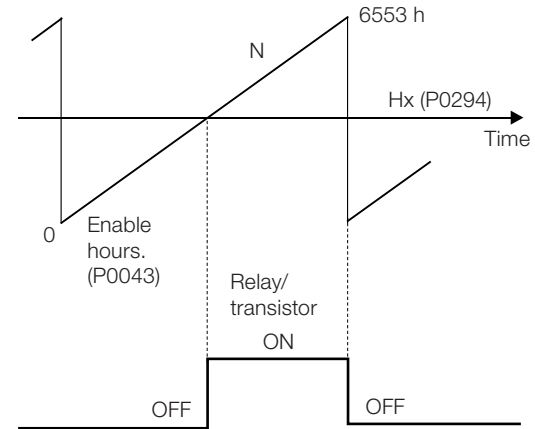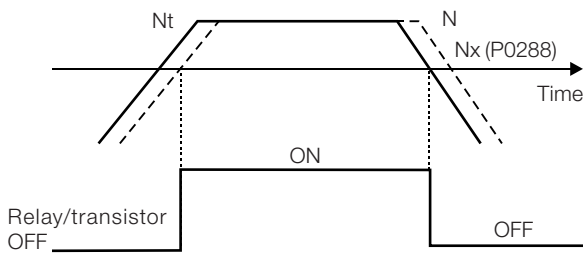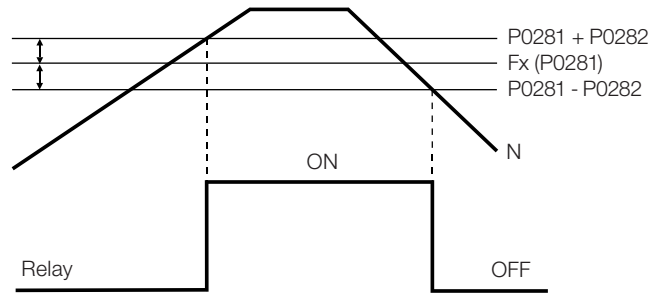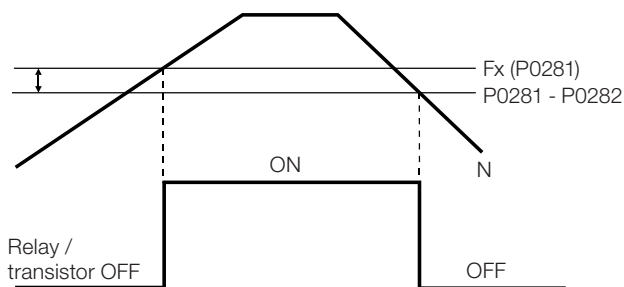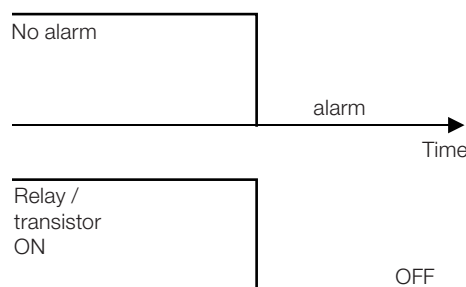
Figure 13.6: (a) to (r) Details on the operation of the digital and relay output functions

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P0281 – Fx Frequency

Adjustable Range:	0.0 to 300.0 Hz	**Factory Setting:**	4.0 Hz
Properties:			
Access Groups via HMI:			

Description:

It is used in the digital output and relay functions:

$F > Fx$[1] and $F > Fx$ [2]

P0282 – Fx Hysteresis

Adjustable Range:	0.0 to 15.0 Hz	**Factory Setting:**	2.0 Hz
Properties:			
Access Groups via HMI:			

Description:

It is used in the digital output and relay functions:

$F > Fx$[1] and $F > Fx$ [2]

P0287 – Nx/Ny Hysteresis

Adjustable Range:	0 to 900 rpm	**Factory Setting:**	18 (15) rpm
Properties:			
Access Groups via HMI:			

Description:

It is used in the **N > Nx** and **N < Ny** functions of the digital and relay outputs.

P0288 – Nx Speed

Adjustable Range:	0 to 18000 rpm	**Factory Setting:**	120 (100) rpm

P0289 – Ny Speed

Adjustable Range:	0 to 18000 rpm	**Factory Setting:**	1800 (1500) rpm
Properties:			
Access Groups via HMI:			

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Description:

They are used in the **N* > Nx, N > Nx,** and **N < Ny** functions of the digital and relay outputs.

P0290 – Ix Current

Adjustable Range:	0 to 2 x I$_{nom-ND}$		Factory Setting:	1.0 x I$_{nom-ND}$
Properties:				
Access Groups via HMI:				

Description:

It is used in the **Is > Ix** and **Is < Ix** functions of the digital and relay outputs.

P0291 – Zero Speed

Adjustable Range:	0 to 18000 rpm		Factory Setting:	18 (15) rpm
Properties:				
Access Groups via HMI:				

Description:

It specifies the value in rpm below which the actual speed will be considered null for the Zero Speed Disable function.

This parameter is also used by the functions of the digital and relay outputs.

P0292 – N = N* Band

Adjustable Range:	0 to 18000 rpm		Factory Setting:	18 (15) rpm
Properties:				
Access Groups via HMI:				

Description:

It is used in the **N = N*** function of the digital and relay outputs.

P0293 – Tx Torque

Adjustable Range:	0 to 200 %		Factory Setting:	100 %
Properties:				
Access Groups via HMI:				

Description:

It is used in the **Torque > Tx** and **Torque < Tx** functions of the digital and relay outputs.

In those functions the motor torque indicated in P0009 is compared with the value adjusted in P0293.

The setting of this parameter is expressed as a percentage of the motor rated current (P0401 = 100 %).

P0294 – Hx Time

Adjustable Range:	0 to 6553 h	**Factory Setting:**	4320 h
Properties:			
Access Groups via HMI:			

Description:
It is used in the **Enabled Hours > Hx** function of the digital and relay outputs.

13.1.5 Frequency Input

A Frequency Input is a Digital Input (DIx) able to receive a pulsed signal within a preset frequency range with 10 bit resolution. This signal can be used by a SoftPLC application. Parameter P0246 defines if the function is inactive and, if active, which digital input (DI3 or DI4) is selected to receive the signal frequency. When the function is active, the DI3/DI4 will not perform the function set in P0265/P0266. The parameter P0022 indicates the value read from the digital input in Hz. The operating range is between 3.0 Hz and 6500.0 Hz.

P0022 – Frequency Input Value

Adjustable Range:	3.0 to 6500.0 Hz	**Factory Setting:**	
Properties:	ro		
Access Groups via HMI:	READ		

Description:
Frequency input value in Hertz (Hz).

> ✓ **NOTE!**
> The correction of P0022 values outside of the range (3.0 to 6500.0 Hz) is not guaranteed.

P0246 – Frequency Input Configuration

Adjustable Range:	0 = Off 1 = DI3 2 = DI4	**Factory Setting:**	0
Properties:	cfg		
Access Groups via HMI:			

Description:
This parameter sets the operation of the Frequency Input function.

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Table 13.8: Frequency input configuration

P0246	Description
0	The Frequency Input function is inactive. The inputs DI3 and DI4 work as defined by P0265 and P0266 respectively.
1	The Frequency Input function is active to DI3. The function set in P0265 will not run
2	The Frequency Input function is active to DI4. The function set in P0266 will not run

13.2 LOCAL AND REMOTE COMMAND

In those parameter groups one can configure the origin of the main inverter commands when in the Local or in the Remote situation, as the Speed Reference, Speed Direction, Run/Stop and JOG.

P0220 – Local/Remote Selection Source

Adjustable Range:	0 = Always Local 1 = Always Remote 2 = Local/Remote Key Local 3 = Local/Remote Key Remote 4 = DIx 5 = Serial Local 6 = Serial Remote 7 = SoftPLC Local 8 = SoftPLC Remote	Factory Setting:	2
Properties:	cfg		
Access Groups via HMI:	I/O		

Description:

It defines the origin of the command that will select between the Local situation and the Remote situation, where:

- LOC: Means Local Default situation.
- REM: Means Remote Default situation.
- DIx: Refer to item 13.1.3 Digital Inputs on page 13-9.

P0221 – Speed Reference Selection – Local Situation

P0222 – Speed Reference Selection – Remote Situation

Adjustable Range:	0 = HMI 1 = AI1 2 = AI2 3 = AI3 4 = AI1+AI2 > 0 (Sum AIs>0) 5 = AI1+AI2 (Sum AIs) 6 = Serial 7 = SoftPLC	Factory Setting:	P0221 = 0 P0222 = 1
Properties:	cfg		
Access Groups via HMI:	I/O		

Description:

They define the origin of the Speed Reference in the Local situation and in the Remote situation.

Some notes about the options for those parameters:

■ The AIx' designation refers to the analog signal obtained after the addition of the AIx input to the offset and its multiplication by the applied gain (refer to item 13.1.1 Analog Inputs on page 13-1).

■ The value of the reference adjusted with the ▲ and ▼ is contained in the parameter P0121.

P0223 – Forward/Reverse Selection - Local Situation

P0226 – Forward/Reverse Selection - Remote Situation

Adjustable Range:	0 = Forward 1 = Reverse 2 = Forward/Reverse Key (FWD) 3 = Forward/Reverse Key (REV) 4 = DIx 5 = Serial (FWD) 6 = Serial (REV) 7 = SoftPLC (FWD) 8 = SoftPLC (REV) 9 = AI2 Polarity	**Factory Setting:**	P0223 = 2 P0226 = 4
Properties:	cfg		
Access Groups via HMI:	I/O		

Description:

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

■ FWD: Means Forward Default situation.
■ REV: Means Reverse Default situation.
■ DIx: Refer to item 13.1.3 Digital Inputs on page 13-9.

P0224 – Run/Stop Selection – Local Situation

P0227 – Run/Stop Selection – Remote Situation

Adjustable Range:	0 = Keys 🟢, 🔴 1 = DIx 2 = Serial 3 = SoftPLC	**Factory Setting:**	P0224 = 0 P0227 = 1
Properties:	cfg		
Access Groups via HMI:	I/O		

Description:

They define the origin of the Run/Stop command in the Local situation and in the Remote situation.

P0225 – JOG Selection – Local Situation

P0228 – JOG Selection – Remote Situation

Adjustable Range:	0 = Inactive 1 = JOG Key 2 = DIx 3 = Serial 4 = SoftPLC	Factory Setting:	P0225 = 1 P0228 = 2
Properties:	cfg		
Access Groups via HMI:	I/O		

Description:

They define the origin of the JOG command in the Local situation and in the Remote situation.

> ✓ **NOTE!**
> The JOG command will only be active if the General Enable command is active, that is, if the inverter is disabled by a General Disable or Coast to Stop command (P0229 = 1), JOG commands will be ignored. See Figure 13.5 on page 13-14.

P0229 – Stop Mode Selection

Adjustable Range:	0 = Ramp to Stop 1 = Coast to Stop 2 = Fast Stop	Factory Setting:	0
Properties:	cfg		
Access Groups via HMI:			

Description:

It defines the motor stop mode when the inverter receives the "Stop" command. The Table 13.9 on page 13-26 describes the options of this parameter.

Table 13.9: Stop mode selection

P0229	Description
0 = Ramp to Stop	The inverter will apply the ramp programmed P0101 and/or P0103
1 = Coast to Stop	The motor will run free until stopping
2 = Fast Stop	The inverter will apply a null ramp (time = 0.0 second), in order to stop the motor in the shortest possible time.

> ✓ **NOTE!**
> When the control modes V/f or VVW are selected, the use of the option 2 (Fast Stop) is not recommended.

> ✓ **NOTE!**
> When the Coast to Stop mode, is programmed and the Flying Start function is not enabled, then start the motor again only if it is standing still.

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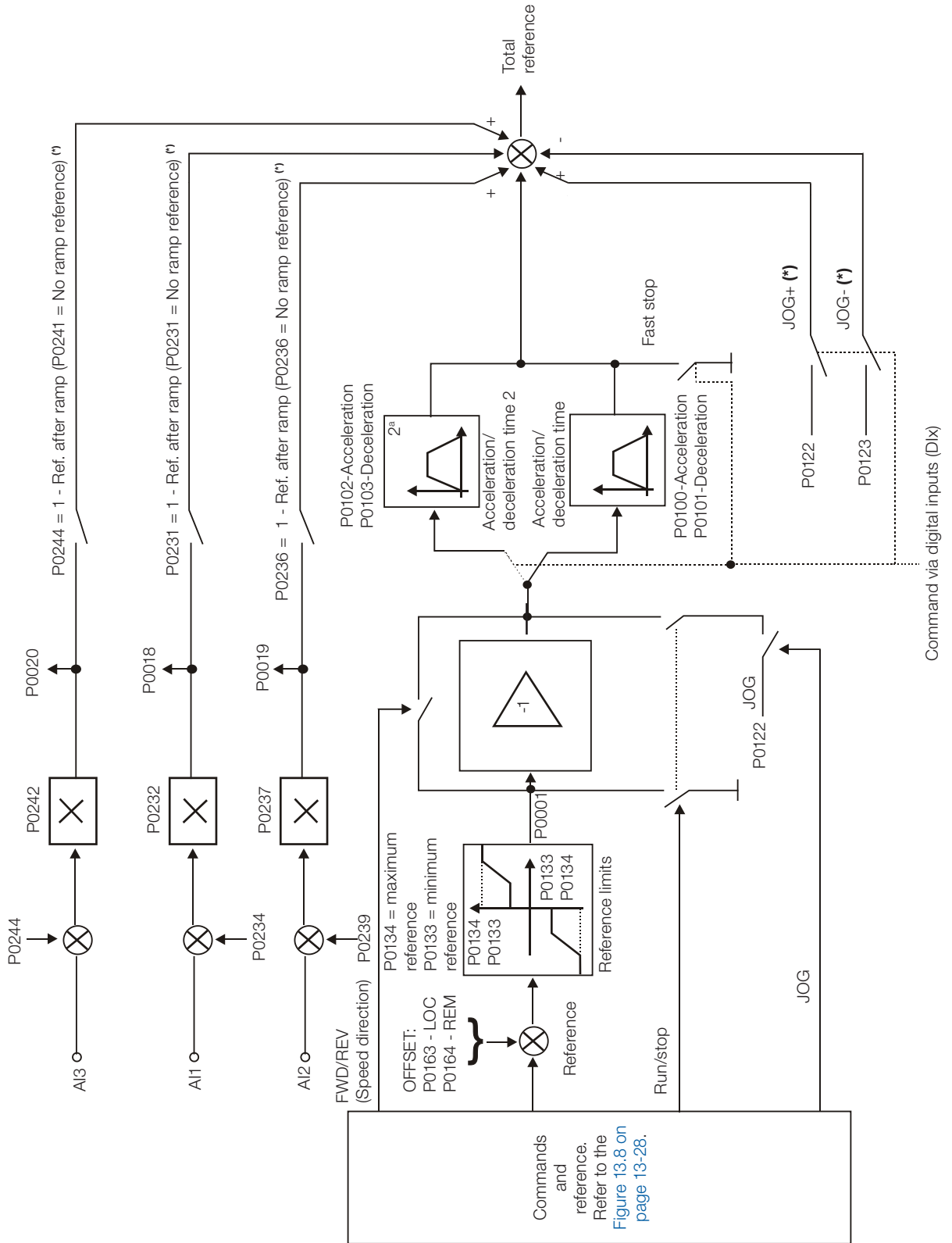
(*) Valid only for P0202 = 4.

Figure 13.7: Speed reference block diagram
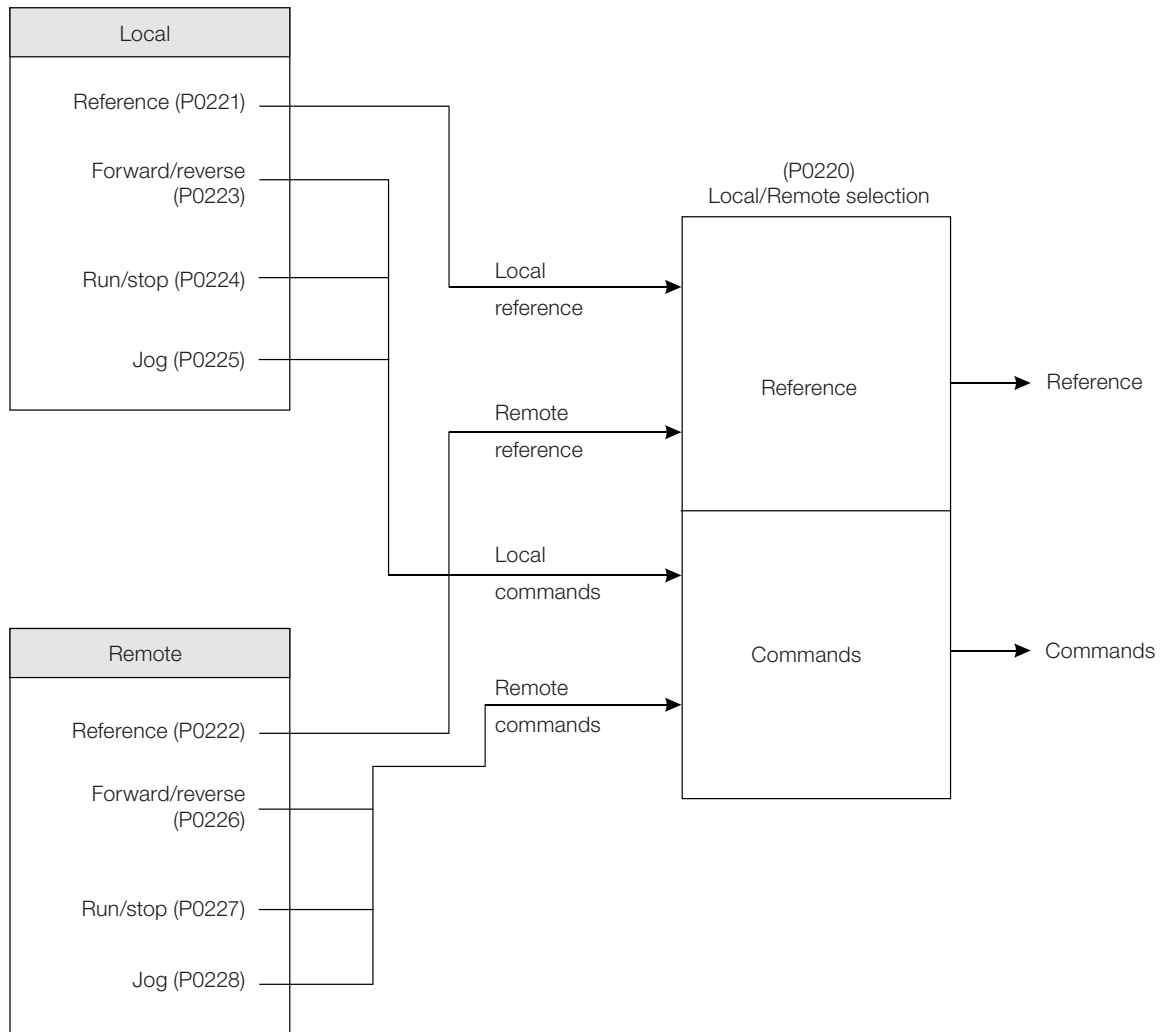
Figure 13.8: Local/Remote situation block diagram

14 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.

For the vector control mode there is the possibility of the use of the "Optimal Braking", eliminating in many cases the need of the dynamic braking.

The Dynamic Braking function can only be used if a braking resistor has been connected to the CFW701, and if the parameters related to it have been adjusted properly.

See next the description of the parameters in order to know how to program each one.

P0153 – Dynamic Braking Level

Adjustable Range:	339 to 400 V	**Factory Setting:**	375 V (P0296 = 0)
	585 to 800 V		618 V (P0296 = 1)
	585 to 800 V		675 V (P0296 = 2)
	585 to 800 V		748 V (P0296 = 3)
	585 to 800 V		780 V (P0296 = 4)
	809 to 1000 V		893 V (P0296 = 5)
	809 to 1000 V		972 V (P0296 = 6)
	809 to 1000 V		912 V (P0296 = 7)

Properties:

Access Groups via HMI:

Description:

The parameter P0153 defines the voltage level for the braking IGBT actuation, and it must be compatible with the power supply voltage.

If P0153 is adjusted at a level very close to the overvoltage (F0022) actuation level, the fault may occur before the braking resistor is able to dissipate the regenerated energy.

The next table presents the overvoltage trip level.

Table 14.1: Overvoltage (F0022) trip levels

Inverter V_{nom}	P0296	F0022
220/230 V	0	> 400 V
380 V	1	
400/415 V	2	
440/460 V	3	> 800 V
480 V	4	
500/525 V	5	
550/575 V	6	> 1000 V
600 V	7	
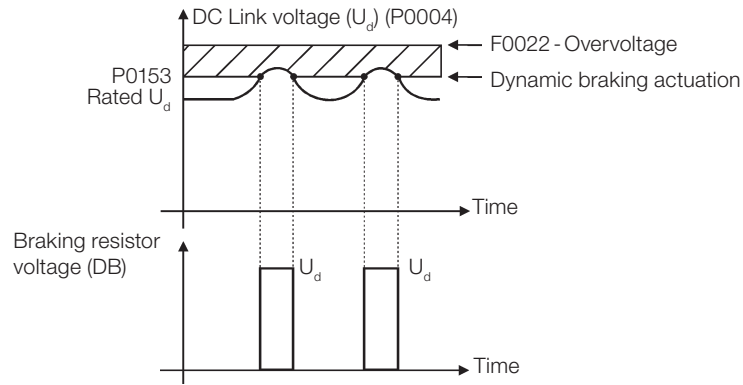
Figure 14.1: *Dynamic braking actuation curve*

Steps to enable the dynamic braking:

- Connect the braking resistor. Refer to item 3.2.3.2 Dynamic Braking (standard built-in for frame sizes A, B, C and D and optional built-in for frame size E - CFW701...DB...), of the user's manual.

- Set P0151 at the maximum value: 400 V (P0296 = 0), 800 V (P0296 = 1, 2, 3 or 4) or 1000 V (P0296 = 5, 6 or 7), according to the case, in order to prevent the activation of the DC voltage regulation before the dynamic braking.

15 FAULTS AND ALARMS

The troubleshooting structure of the inverter is based on the indication of faults and alarms.

In a fault event the IGBTs firing pulses are disabled and the motor coasts to stop.

⚠️ **ATTENTION!**
If the Fire Mode function is active, most failures will be detected, but ignored by CFW701, i.e., will not block the IGBTs. If the motor was spinning, will continue spinning. Some faults as DC Voltage (F0022), over current / short circuit (F0070), Safety Stop (F0160) will not be ignored, but may be self-reset infinitely (select this option in parameter P0582). For more information see the section 19.1 FIRE MODE on page 19-1.

The alarm works as a warning to the user that critical operation conditions are occurring and a fault may occur if the situation does not change.

Refer to the CFW701 user's manual chapter 6 Troubleshooting and Maintenance, and the chapter QUICK PARAMETER REFERENCE, FAULTS AND ALARMS on page 0-1 of this manual to obtain more information regarding the Faults and Alarms.

15.1 MOTOR OVERLOAD PROTECTION

The Motor Overload protection is based on the use of curves that simulate the heating and cooling of the motor in overload events, according to IEC 60947-4-2 and UL 508C standards. The fault and alarm codes for the motor overload protection are F0072 and A0046, respectively.

The motor overload is given in function of the reference value In x SF (motor rated current multiplied by the service factor), which is the maximum value at which the protection must not actuate because the motor is able to operate indefinitely with this current value without suffering damages.

However, for that protection to act in an appropriate manner, the thermal image of the motor, which corresponds to the heating up and cooling down times of the motor, is estimated.

The thermal image, in its turn, depends on the motor thermal constant, which is estimated based on the motor power and number of poles.

The thermal image is important to allow that a derating in the fault actuation time be given, so that shorter actuation times be obtained when the motor is hot.

This function applies a derating in the fault actuation time depending on the output frequency supplied to the motor, because for the self-ventilated ones there will be less ventilation on the frame at lower speeds, and the motor will be subject to more heating. Thus, it becomes necessary to reduce the fault actuation time in order to prevent the motor from burning.

In order to assure more protection in case of restart, this function keeps the information regarding the motor thermal image in the CFW701 nonvolatile memory. Therefore, after the inverter restart, the function will use the value saved in the thermal memory to perform a new overload evaluation.

The parameter P0348 configures the desired protection level for the motor overload function. The possible options are: Fault and Alarm, only Fault, only Alarm, and disabled motor overload protection. The actuation level for the motor overload alarm (A0046) is adjusted via P0349.

In order to get more information, refer to parameters P0156, P0159, P0348 and P0349 in the section 15.3 PROTECTIONS on page 15-4.

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> ✓ **NOTE!**
> In order to assure the conformity of the CFW701 motor overload protection with the UL508C standard, observe the following:
> - The "TRIP" current is equal to 1.25 times the motor nominal current (P0401) set in the "Oriented Start-up" menu.
> - The maximum allowed value for P0159 (Motor Tripping Class) is 3 (Class 20).
> - The maximum allowed value for P0398 (Motor Service Factor) is 1.15.

15.2 MOTOR OVERTEMPERATURE PROTECTION

> ⚠ **ATTENTION!**
> The PTC must have a reinforced insulation of the energized parts of the engine and other installations.

This protection performs the motor overtemperature protection by means of the alarm (A0110) and the fault (F0078) indication.

The motor must have a PTC type temperature sensor. An analog output supplies constant current for the PTC (2 mA), while an inverter analog input reads the voltage across the PTC and compares it with the limit values for fault and alarm. Refer to the Table 15.1 on page 15-2. When those values are exceeded, the alarm or fault indication occurs.

The analog outputs AO1 and AO2 of the control module can be used to supply the constant current for the PTC. Therefore it is necessary to configure the DIP switches of the output for current and to set the output function parameter for 11 = PTC.

The analog inputs AI1 and AI2 of the control module can be used to read the PTC voltage. Therefore it is necessary to configure the input DIP switch for voltage and to set the input function parameter for 4 = PTC. Refer to the parameter P0351 on the section 15.3 PROTECTIONS on page 15-4.

> ✓ **NOTE!**
> In order that this function works properly, it is important to keep gains and offset of the analog input and output in the default values.

Table 15.1: A0110 and F0078 trip levels for AI1 and AI2 inputs

Action	PTC	AI Voltage
A0110 occurs during the temperature increase	R_{PTC}>3.51 kΩ	V_{AI}>7.0 V
F0078 trips during the temperature increase	R_{PTC}>3.9 kΩ	V_{AI}>7.8 V
Resets A0110 alarm	150 Ω < R_{PTC}<1.6 kΩ	0.3<V_{AI}<3.2 V
Allows the reset of the F0078 fault	150 Ω < R_{PTC}<1.6 kΩ	0.3<V_{AI}<3.2 V
F0078 trips (minimum resistance detection)	R_{PTC}<60 Ω	<0.12 V

Additionally, the analog input AIPTC was specifically designed for this purpose. This input does not require DIP-switch configuration, nor parameter adjustments. Just connect the PTC as shown in Figure 15.1 on page 15-3. Refer to parameter P0341 in section 15.3 PROTECTIONS on page 15-4.

Table 15.2: A0110 and F0078 trip levels for AIPTC input

Action	PTC	AI Voltage
A0110 occurs during the temperature increase	$R_{PTC} > 3.51$ kΩ	$V_{AI} > 2.3$ V
F0078 trips during the temperature increase	$R_{PTC} > 3.9$ kΩ	$V_{AI} > 2.5$ V
Resets A0110 alarm	$150\ \Omega < R_{PTC} < 1.6$ kΩ	$0.18 < V_{AI} < 1.4$ V
Allows reset of the F0078 fault	$150\ \Omega < R_{PTC} < 1.6$ kΩ	$0.18 < V_{AI} < 1.4$ V
F0078 trips (minimum resistance detection)	$R_{PTC} < 60\ \Omega$	< 0.07 V
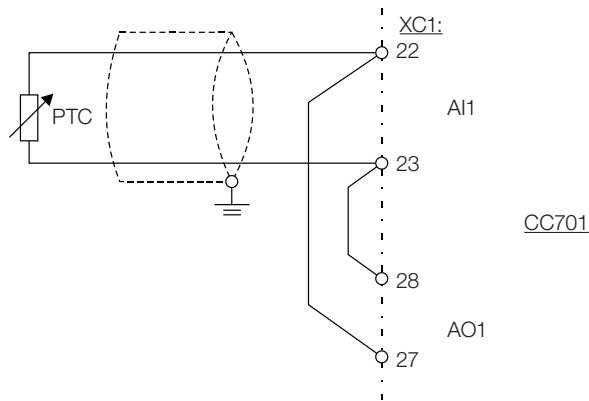
Program P0231 = 4;
Set S1.2 = OFF (0 to 10 V).

Program P0251 = 11;
Set S1.3 = OFF (4 to 20 mA, 0 to 20 mA).

(a) AO1, AI1
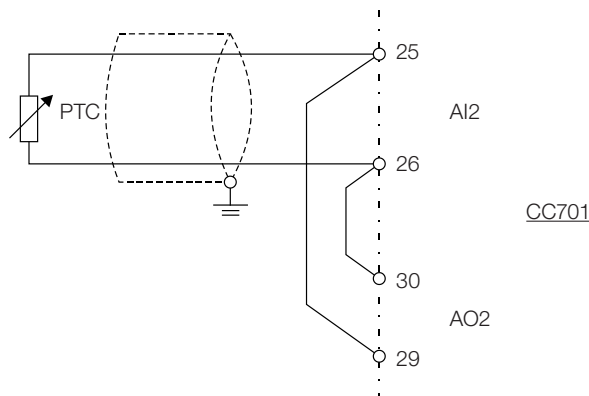
Program P0236 = 4;
Set S1.1 = OFF (0 to 10 V).

Program P0254 = 11;
Set S1.4 = OFF (4 to 20 mA, 0 to 20 mA).

(b) AO2, AI2
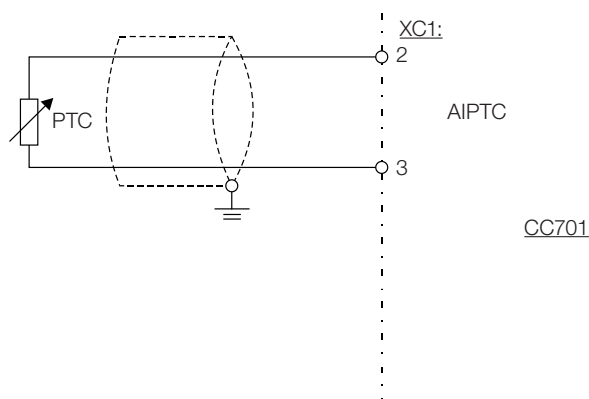
(c) AIPTC

Figure 15.1: (a) to (c) PTC connection examples

15.3 PROTECTIONS

The parameters related to motor and inverter protections are found in this group.

P0030 – IGBTs Temperature

P0034 – Internal Air Temperature

Adjustable Range:	-20.0 to 150.0 °C	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ	

Description:

These parameters present, in Celsius degrees, the heatsink temperature (P0030) and also of the internal air (P0034).

They are useful to monitor the temperature on the main inverter sections in case of an occasional inverter overheating.

P0156 – 100 % Speed Overload Current

P0157 – 50 % Speed Overload Current

P0158 – 5 % Speed Overload Current

Adjustable Range:	0.1 to 1.5 x I_{nom-ND}	Factory Setting:	$P0156 = 1.05x\ I_{nom-ND}$ $P0157 = 0.9x\ I_{nom-ND}$ $P0158 = 0.65x\ I_{nom-ND}$
Properties:			
Access Groups via HMI:			

Description:

These parameters are used for the motor overload protection (I x t – F0072).

The motor overload current (P0156, P0157 and P0158) is the value from which the inverter starts considering that the motor is operating with overload.

The bigger the difference between the motor current and the overload current, the faster F0072 trip will occur.

The parameter P0156 (Motor Overload Current at 100 % of its Rated Speed) must be adjusted 5 % higher than the motor rated current (P0401).

The overload current is given as a function of the speed being applied to the motor, according to the overload curve. The parameter P0156, P0157 and P0158 are the three points used to form the motor overload curve, as presented in the Figure 15.2 on page 15-5.
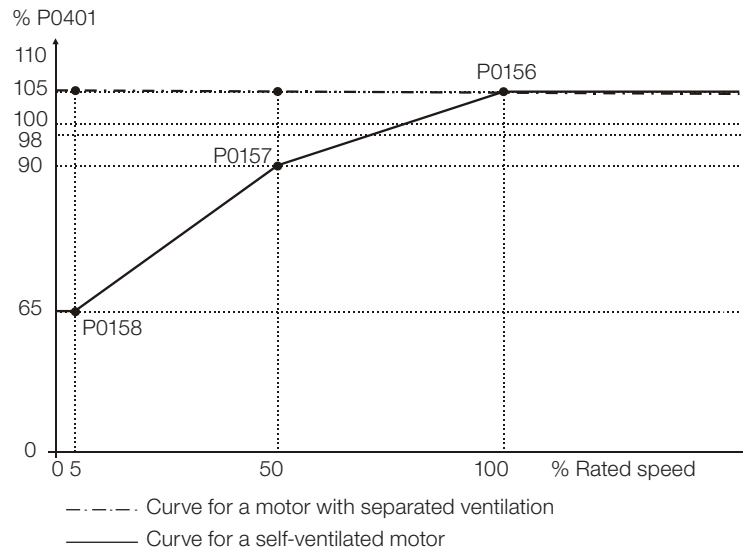
Figure 15.2: *Overload protection levels*

With the setting of the overload current curve, it is possible to set an overload value that varies according to the operation speed of the motor (factory setting), improving the protection for self-ventilated motors, or a constant overload level for any speed applied to the motor (motors with separated ventilation).

This curve is adjusted automatically when P0406 (Motor Ventilation) is set during the "Oriented Start-up" routine (refer to this parameter description in the section 11.7 MOTOR DATA on page 11-7).

P0159 – Motor Tripping Class

Adjustable Range:	0 = Class 5 1 = Class 10 2 = Class 15 3 = Class 20 4 = Class 25 5 = Class 30 6 = Class 35 7 = Class 40 8 = Class 45	Factory Setting:	1
Properties:	cfg		
Access Groups via HMI:			

Description:

This parameter sets the motor thermal class, and the time for the correct actuation of the F0072 fault depends on it. The higher the thermal class, the longer the fault actuation time will be.

⚠️ **ATTENTION!**
The incorrect selection of the thermal class may cause the burning of the motor.

⚠️ **ATTENTION!**
In order the CFW701 motor overload protection is in accordance with UL508C, the thermal class should be ≤20 (P0159 ≤ 3).

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The necessary data for choosing the thermal class are the following:

- Motor rated current (I_n).
- Blocked rotor current (I_p).
- Blocked rotor time (T_{RB})[*].
- Service factor (SF).

(*) It must be verified if the given blocked rotor time is for hot or cold motor, so that the correspondent thermal class curves be used.

With those values, the overload current and the overload time must be calculated using the following equations:

$$\text{Overload Current} = \frac{I_p}{I_n \times FS} \times 100 \ (\%)$$

$$\text{Overload Time} = T_{BR} \ (s)$$

These equations provide the limit conditions for the error actuation, i.e., the motor cannot work with a longer fault actuation time than this one, because of burning risk. Thus, a thermal class immediately inferior must be chosen so that the motor protection is assured.

Example: For a motor with the following characteristics,

I_n = 10.8 A
T_{RB} = 4 s (hot motor blocked rotor time)
I_p / I_n = 7.8 $\Rightarrow$ I_p = 7.8 x 10.8 A = 84.2 A
FS = 1.15

One gets,

$$\text{Overload Current} = \frac{I_p}{I_n \times FS} = \frac{84.2}{10.8 \times 1.15} \times 100 = 678 \ \%$$

$$\text{Overload Time} = T_{RB} = 4 \ s$$

After this, it is only necessary to plot the calculated values on the motor overload graph (), and to select the thermal class curve immediately below the calculated point.

Overload Time (t(s))

(a) Cold motor

Overload time (t(s))
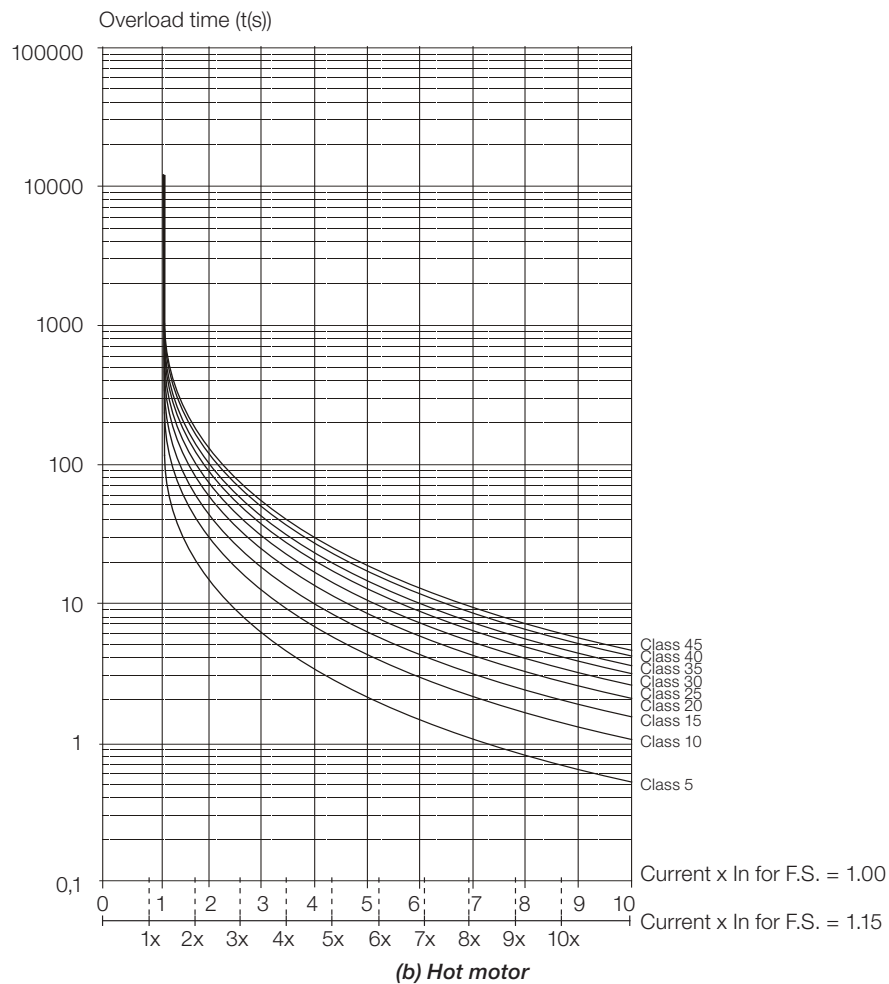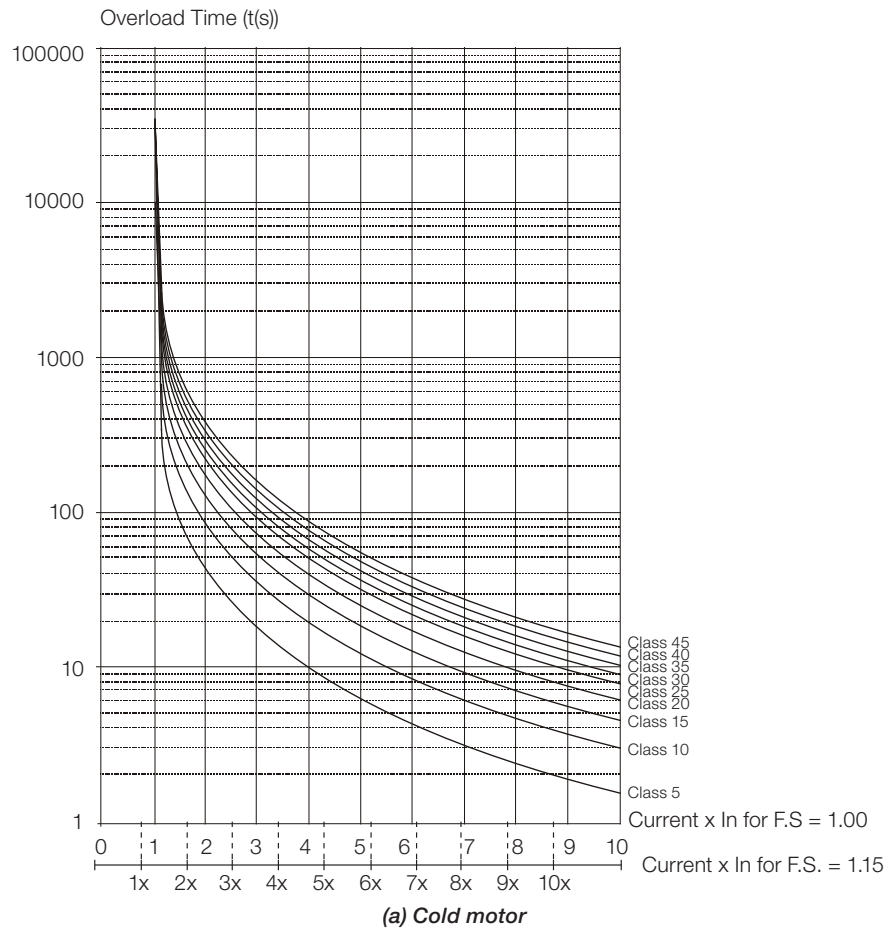
(b) Hot motor

Figure 15.3: *(a) and (b) Overload curves for loads of the HD and ND types*

For the previous example, by plotting the 678 % value (x axis) of the Overload Current with the 4 seconds (y axis) of the Overload Time in the graph of the Figure 15.3 on page 15-7 (hot motor), the thermal class to be selected will be the class 15 (t15).

P0340 – Auto-reset Time

Adjustable Range:	0 to 255 s	Factory Setting:	0 s
Properties:			
Access Groups via HMI:			

Description:

When a fault occurs (except F0099 – Invalid Current Offset), the inverter can reset itself automatically after the time set in P0340 has elapsed.

> ⚠ **ATTENTION!**
> In case the Fire Mode function is active and the DC Overvoltage (F0022), Overcurrent/Short Circuit (F0070) or Safety Stop (F0160) faults are detected, the value set in P0340 may be ignored and those faults may be self-reset infinitely (select this option in parameter P0582). For further information, refer to "operation in Fire Mode" in chapter 19 HVAC FUNCTIONS on page 19-1.

> ✓ **NOTE!**
> The faults F0051, F0078 and F0156 allow a conditional Reset, i.e., the Reset will only occur if the temperature gets back to the normal operation range.

If after Auto-reset, the same fault is repeated three times consecutively, the Auto-reset function will be disabled. A fault is considered consecutive if it happens again within 30 seconds after the Auto-reset.

Therefore, if a fault occurs four consecutive times, the inverter will remain disabled (general disable) and the fault will remain being indicated.

If P0340 ≤ 2, auto-reset will not occur.

P0341 – AIPTC Configuration

Adjustable Range:	0 = Off 1 = Fault/Alarm 2 = Fault 3 = Alarm	Factory Setting:	0
Properties:	cfg		
Access Groups via HMI:	I/O		

Description:

This parameter is useful when the motor is equipped with PTC type temperature sensors, allowing the configuration of the protection level for the motor over temperature function. The details on the actuation of the available options are in the Table 15.3 on page 15-9. Refer also to the section 15.2 MOTOR OVERTEMPERATURE PROTECTION on page 15-2.

Table 15.3: Actions for the parameters P0341 options

P0341	Action
0 = Off	The over temperature protection is disabled. Faults or alarms for the motor operation in the over temperature condition will not be generated.
1 = Fault/Alarm	The inverter will show an alarm (A0110) and will generate a fault (F0078) when the motor reaches the over temperature actuation values. Once a fault is generated, the inverter will be disabled.
2 = Fault	Only the fault (F0078) will be generated when the motor reaches the over temperature protection trip level, and the inverter will be disabled.
3 = Alarm	Only the alarm (A0110) will be generated when the motor reaches the protection actuation level, and the inverter remains operating.

P0342 – Motor Unbalanced Current Detection

Adjustable Range:	0 = Off 1 = On	**Factory Setting:**	0
Properties:	cfg		
Access Groups via HMI:			

Description:

This parameter enables the motor unbalanced current detection, which will be responsible for the F076 fault actuation.

This function will be enable to actuate when the conditions below were fulfilled simultaneously for longer than 2 seconds.

1. P0342 = On.
2. Enabled inverter.
3. Speed reference higher than 3 %.
4. | Iu - Iv | or | Iu - Iw | or | Iv - Iw | > 0.125 x P0401.

P0343 – Ground Fault Configuration

Adjustable Range:	0 = Off 1 = On	**Factory Setting:**	1
Properties:	cfg		
Access Groups via HMI:			

Description:

This parameter enables the Ground Fault Detection, which will be responsible for the F0074 (Ground Fault) actuation.

Thus if wished, it is possible to inhibit the Ground Fault (F0074) occurrence by setting P0343 = Off.

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P0348 – Motor Overload Configuration

Adjustable Range:	0 = Off 1 = Fault/Alarm 2 = Fault 3 = Alarm	**Factory Setting:**	1
Properties:	cfg		
Access Groups via HMI:			

Description:

This parameter allows the desired protection level for the motor overload function to be configured. Refer to the table below for details on the actuation of each one of the available options.

Table 15.4: Actions for the parameter P0348 options

P0348	Action
0 = Off	The overload protection is disabled. Faults or alarms will not be generated for the motor operation in overload conditions.
1 = Fault/Alarm	The inverter will display an alarm (A0046) when the motor overload reaches the level programmed in P0349, and will generate a fault (F0072) when the motor overload reaches the overload protection tripping level.
2 = Fault	Only the fault (F0072) will be generated when the motor overload reaches the overload protection trip level, and the inverter will be disabled.
3 = Alarm	Only the alarm (A0046) is generated when the motor overload reaches the value programmed in P0349 and the inverter continues operating.

The trip level of the overload protection is calculated internally by the CFW701, taking into account the motor current, its thermal class and its service factor. Refer to the parameter P0159 in this section.

P0349 – I x t Alarm Level

Adjustable Range:	70 to 100 %	**Factory Setting:**	85 %
Properties:	cfg		
Access Groups via HMI:			

Description:

This parameter defines the level for the motor overload protection alarm actuation (A0046), it is expressed as a percentage of the trip level of the overload integrator.

It will only be effective if P0348 is programmed in 1 (Fault/Alarm) or 3 (Alarm).

P0350 – IGBT Overload Configuration

Adjustable Range:	0 = Fault is active, with switching frequency reduction 1 = Fault and alarm are active, with switching frequency reduction 2 = Fault is active, without switching frequency reduction 3 = Fault and alarm are active, without switching frequency reduction	**Factory Setting:**	1
Properties:	cfg		
Access Groups via HMI:			

Description:

The inverter overload function operates separately from the motor overload protection, and it has the purpose of protecting the IGBTs and rectifiers in case of overload, avoiding that damage due to overtemperature at their junctions occurs.

Thus, the parameter P0350 allows configuring the desired protection level for this function, even with the automatic reduction of the switching frequency, in order to avoid the fault occurrence. The next table describes each of the available options.

Table 15.5: Actions for the parameter P0350 options

P0350	Action
0	It enables F0048 – IGBT Overload Fault. In order to avoid the occurrence of the fault, the switching frequency is reduced automatically to 2.5 kHz. **(*)**
1	It enables the fault F0048 and the alarm A0047 – IGBT Overload Alarm. In order to avoid the occurrence of the fault, the switching frequency is reduced automatically to 2.5 kHz. **(*)**
2	It enables F0048. Without the reduction of the switching frequency.
3	It enables the alarm A0047 and the fault F0048. Without the reduction of the switching frequency.

(*) It reduces the switching frequency when:
- The output current exceeds 1.5 x I_{nom-HD} (1.1 x I_{nom-ND}); **or**
- The temperature at the IGBT case is less than 10 °C from the maximum temperature; **and**
- P0297 = 2 (5 kHz).

P0351 – Motor Overtemperature Configuration

Adjustable Range:	0 = Off 1 = Fault/Alarm 2 = Fault 3 = Alarm	**Factory Setting:**	1
Properties:	cfg		
Access Groups via HMI:			

Description:

This parameter is useful when the motor is equipped with PTC type temperature sensors, allowing the configuration of the protection level for the motor overtemperature function. The details on the actuation of the available options are in the Table 15.6 on page 15-12. Refer also to the section 15.2 MOTOR OVERTEMPERATURE PROTECTION on page 15-2.

Table 15.6: Actions for the parameter P0351 options

P0351	Action
0 = Off	The overtemperature protection is disabled. Faults or alarms for the motor operation in the overtemperature condition will not be generated.
1 = Fault/Alarm	The inverter will show an alarm (A0110) and will generate a fault (F0078) when the motor reaches the overtemperature actuation values. Once a fault is generated, the inverter will be disabled.
2 = Fault	Only the fault (F0078) will be generated when the motor reaches the overtemperature protection trip level, and the inverter will be disabled.
3 = Alarm	Only the alarm (A0110) will be generated when the motor reaches the protection actuation level, and the inverter remains operating.

P0352 – Fan Control Configuration

Adjustable Range:	0 = Heatsink fan and internal fan are OFF 1 = Heatsink fan and internal fan are ON 2 = Heatsink fan and internal fan are controlled via software 3 = Heatsink fan is controlled via software and internal fan is OFF 4 = Heatsink fan is controlled via software and internal fan is ON 5 = Heatsink fan is ON and internal fan is OFF 6 = Heatsink fan is ON and internal fan is controlled via software 7 = Heatsink fan is OFF and internal fan is ON 8 = Heatsink fan is OFF and internal fan is controlled via software 9 = Fan of the heatsink and internal fan controlled by software (*) 10 = Fan of the heatsink controlled by software, internal fan turned off (*) 11 = Fan of the heatsink controlled by software, internal fan turned on (*) 12 = Fan of the heatsink turned on, internal fan controlled by software (*) 13 = Fan of the heatsink turned off, internal fan controlled by software (*)	**Factory Setting:**	2
Properties:	cfg		
Access Groups via HMI:			

Description:

The CFW701 is equipped with two fans: an internal fan and a heatsink fan, and the activation of both will be controlled via software by means of the inverter programming.

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

Table 15.7: Options of the parameter P0352

P0352	Action
0 = HS-OFF, Int-OFF	Heatsink fan is always OFF Internal fan is always OFF
1 = HS-ON, Int-ON	Heatsink fan is always ON Internal fan is always ON
2 = HS-CT, Int-CT	Heatsink fan is controlled via software Internal fan is controlled via software
3 = HS-CT, Int-OFF	Heatsink fan is controlled via software Internal fan is always OFF
4 = HS-CT, Int-ON	Heatsink fan is controlled via software Internal fan is always ON
5 = HS-ON, Int-OFF	Heatsink fan is always ON Internal fan is always OFF
6 = HS-ON, Int-CT	Heatsink fan is always ON Internal fan is controlled via software
7 = HS-OFF, Int-ON	Heatsink fan is always OFF Internal fan is always ON
8 = HS-OFF, Int-CT	Heatsink fan is always OFF Internal fan is controlled via software
9 = HS-CT, int-CT *	Heatsink fan is controlled via software. Internal fan is controlled via software **(*)**
10 = HS-CT, int-OFF *	Heatsink fan is controlled via software. Internal fan is always OFF **(*)**
11 = HS-CT, int-ON *	Heatsink fan is controlled via software. Internal fan is always ON **(*)**
12 = HS-ON, int-CT *	Heatsink fan is always ON Internal fan is controlled via software **(*)**
13 = HS-OFF, int-CT *	Heatsink fan is always OFF Internal fan is controlled via software **(*)**

(*) The fans will not turn on for one minute after the power-on or after a fault reset.

> ✓ **NOTE!**
> The Heatsink Fan will stay ON at least 15 seconds before change to OFF.
> The Heatsink Fan will stay OFF at least 15 seconds before change to ON.

P0353 – IGBTs/Air Overtemperature Configuration

Adjustable Range:	0 = IGBTs: fault and alarm, Internal air: fault and alarm 1 = IGBTs: fault and alarm, Internal air: fault 2 = IGBTs: fault, Internal air: fault and alarm 3 = IGBTs: fault, Internal air: fault 4 = IGBTs: fault and alarm, Internal air: fault and alarm **(*)** 5 = IGBTs: fault and alarm, Internal air: fault **(*)** 6 = IGBTs: fault, Internal air: fault and alarm **(*)** 7 = IGBTs: fault, Internal air: fault **(*)**	**Factory Setting:**	0
Properties:	cfg		
Access Groups via HMI:			

Description:

The overtemperature protection is carried out by means of the measurement of the temperature with the IGBTs and power board internal air NTCs, being able to generate alarms and faults.

In order to configure the desired protection, set P0353 according to the table below.

Table 15.8: Options of the parameter P0353

P0353	Action
0 = HS-F/A, Air-F/A	Enables fault (F0051) – IGBT Overtemperature and alarm (A0050) – IGBT High Temperature Enables fault (F0153) – Internal Air Overtemperature and alarm (A0152) – High Internal Air Temperature
1 = HS-F/A, Air-F	Enables fault (F0051) and alarm (A0050) for IGBTs overtemperature Enables only fault (F0153) for internal air overtemperature
2 = HS-F, Air-F/A	Enables only fault (F0051) for IGBT overtemperature Enables fault (F0153) and alarm (A0152) for internal air overtemperature
3 = HS-F, Air-F	Enables only fault (F0051) for IGBT overtemperature Enables only fault (F0153) for internal air overtemperature
4 = HS-F/A, Air-F/A *	Enables fault (F0051) – IGBT Overtemperature and alarm (A0050) – IGBT High Temperature Enables fault (F0153) – Internal Air Overtemperature and alarm (A0152) – High Internal Air Temperature **(*)**
5 = HS-F/A, Air-F *	Enables fault (F0051) and alarm (A0050) for IGBTs overtemperature Enables only fault (F0153) for internal air overtemperature **(*)**
6 = HS-F, Air-F/A *	Enables only fault (F0051) for IGBT overtemperature Enables fault (F0153) and alarm (A0152) for internal air overtemperature **(*)**
7 = HS-F, Air-F *	Enables only fault (F0051) for IGBT overtemperature Enables only fault (F0153) for internal air overtemperature **(*)**

(*) Disable fault (F0156).

P0354 – Fan Speed Configuration

Adjustable Range:	0 = Inactive 1 = Fault	Factory Setting:	1
Properties:	cfg		
Access Groups via HMI:			

Description:

When the heatsink fan speed reaches a value below ¼ of the rated speed the fault F0179 (Heatsink Fan Speed Fault) will be generated. This parameter makes it possible that the generation of this fault be disabled, as presented in the next table.

Table 15.9: Actions for the parameter P0354 options

P0354	Action
0 = Inactive	The heatsink fan speed fault protection is disabled
1 = Fault	It enables the fault (F0179). The inverter will be disabled if the fault occurs

P0355 – Configuration of Fault F0185

Adjustable Range:	0 = Off 1 = On	Factory Setting:	1
Properties:	cfg		
Access Groups via HMI:			

Description:

This parameter allows disabling the actuation of F0185 fault – Fault in the preload contactor.

If P0355 = 0, the Fault in the preload contactor will remain deactivated. F0185 fault will not be generated. When the inverter is a frame size E with DC power supply it's necessary to adjust P0355 = 0.

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P0356 – Dead Time Compensation

Adjustable Range:	0 = Off 1 = On	Factory Setting:	1
Properties:	cfg		
Access Groups via HMI:			

Description:

This parameter must be kept always in 1 (On). Only in special maintenance cases the value 0 (Off) can be used.

P0357 – Line Phase Loss Time

Adjustable Range:	0 to 60 s	Factory Setting:	3 s
Properties:			
Access Groups via HMI:			

Description:

It configures the time for the line phase loss indication (F0006).

If P0357 = 0, the function remains disabled.

16 READ ONLY PARAMETERS

In order to facilitate the visualization of the main reading variables of the inverter, the group "READ" can be accessed directly.

It is important to point out that all the parameters of that group can only be visualized on the keypad (HMI) display, and that they do not allow changes by the user.

P0001 – Speed Reference

Adjustable Range:	0 to 18000 rpm		Factory Setting:
Properties:	ro		
Access Groups via HMI:	READ		

Description:

This parameter presents, regardless of the origin source, the value of the speed reference in rpm (factory setting).

It is also possible to change the speed reference (P0121) through this parameter, when P0221 or P0222=0.

P0002 – Motor Speed

Adjustable Range:	0 to 18000 rpm		Factory Setting:
Properties:	ro		
Access Groups via HMI:	READ		

Description:

This parameter indicates the motor actual speed value in rpm (factory setting), with a 0.5 second filter.

It is also possible to change the speed reference (P0121) through this parameter, when P0221 or P0222 = 0.

P0003 – Motor Current

Adjustable Range:	0.0 to 4500.0 A		Factory Setting:
Properties:	ro		
Access Groups via HMI:	READ		

Description:

It indicates the inverter output current in Amps (A).

P0004 – DC Link Voltage (U$_d$)

Adjustable Range:	0 to 2000 V		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ			

Description:

It indicates the DC Link actual dc voltage in volts (V).

P0005 – Motor Frequency

Adjustable Range:	0.0 to 1020.0 Hz		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ			

Description:

It indicates the inverter output frequency in Hertz (Hz).

P0006 – VFD Status

Adjustable Range:	0 = Ready 1 = Run 2 = Undervoltage 3 = Fault 4 = Self-Tuning 5 = Configuration 6 = DC Braking 7 = STO 8 = Fire mode 9 = Bypass		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ			

Description:

It indicates one of the 10 possible inverter states. The description of each state is presented in the next table.

In order to facilitate the visualization, some inverter status are also showed on the keypad (HMI) (Figure 5.2 on page 5-14). The states 3 to 7 are presented in an abbreviated form, as follows:

Table 16.1: Description of the inverter status

State	Abbreviated Form on the Keypad (HMI)	Description
Ready		It indicates that the inverter is ready to be enabled
Run	RUN	It indicates that the inverter is enabled
Undervoltage	SUB	It indicates that the inverter is with insufficient line voltage for operation (undervoltage), and does not accept enabling commands.
Fault	Fxxx, where xxx is the number of the occurred fault	It indicates that the inverter is in the fault state
Self-Tuning	CONF RUN	It indicates that the inverter is executing the self-tuning routine
Configuration	CONF	It indicates that the inverter is in the Oriented Start-up routine or with incompatible parameter programming. Refer section 5.7 INCOMPATIBILITY BETWEEN PARAMETERS on page 5-14.
DC Braking	RUN	It indicates that the inverter is applying DC braking to stop the motor
STO		It indicates that the Safety Stop is active (the 24 Vdc voltage from the safety relays coils has been removed).
Fire Mode	A0211	It indicates that the drive is in fire mode
Bypass	A0210	It indicates that the drive is in Bypass mode

P0007 – Motor Voltage

Adjustable Range:	0 to 2000 V		Factory Setting:
Properties:	ro		
Access Groups via HMI:	READ		

Description:

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

P0009 – Motor Torque

Adjustable Range:	-1000.0 to 1000.0 %		Factory Setting:
Properties:	ro		
Access Groups via HMI:	READ		

Description:

It indicates the torque developed by the motor, calculated as follows:

$$P0009 = \frac{Tm \times 100}{I_{TM}} \times Y$$

$$I_{TM} = \left(P0401^2 - \left(\frac{P0410 \times P0178}{100}\right)^2\right)^{1/2}$$

$$Y = 1 \text{ for } N \leq \frac{P0190 \times N_{nom}}{P0400}$$

$$Y = \frac{N_{nom}}{N} \times \frac{P0190}{P0400} \text{ for } N > \frac{P0190 \times N_{nom}}{P0400}$$

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Where:
N_{nom} = Motor synchronous speed.
N = Motor actual speed.
T_m = Motor torque current.
I_{TM} = Rated motor torque current.

P0010 – Output Power

Adjustable Range:	0.0 to 6553.5 kW		Factory Setting:
Properties:	ro		
Access Groups via HMI:	READ		

Description:

It indicates the electric power in the inverter output. This power is determined by the formula:
$P0010 = \sqrt{3}$ x P0003 x P0007 x P0011.

Where:
P0003 is the measured output current.
P0007 is the reference (or estimated) output voltage.
P0011 is the value of the cosine [(vector angle of the reference output voltage) - (vector angle of the output current measured)].

> ✓ **NOTE!**
> The value indicated in this parameter is calculated indirectly, and must not be used to measure the energy consumption.

P0011 - Output Cos φ

Adjustable Range:	0.00 to 1.00		Factory Setting:
Properties:	ro		
Access Groups via HMI:	READ, I/O		

Description:

This parameter indicates the value of the cosine of the angle between the voltage and output current. The electric motors are inductive loads and, therefore, consume reactive power. This power is exchanged between the motor and the inverter and does not conduct useful power. According to the operating condition of the motor, the ratio [reactive power / active power] may increase, resulting in a reduction of the cosine φ of the output.

P0012 – DI8 to DI1 Status

Refer to .

P0013 – DO5 to DO1 Status

Refer to .

P0014 – AO1 Value

P0015 – AO2 Value

P0018 – AI1 Value

P0019 – AI2 Value

P0020 – AI3 Value

P0023 – Software Version

Refer to the section 6.1 INVERTER DATA on page 6-1, for more details.

P0028 – Accessories Configuration

P0029 – Power Hardware Configuration

Refer to the section 6.1 INVERTER DATA on page 6-1.

P0030 – IGBTs Temperature

P0034 – Internal Air Temperature

Refer to the section 15.3 PROTECTIONS on page 15-4.

P0036 – Heatsink Fan Speed

Adjustable Range:	0 to 15000 rpm	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ	

Description:

It indicates the fan actual speed, in revolutions per minute (rpm).

P0037 – Motor Overload Status

Adjustable Range:	0 to 100 %	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ	

Description:

It indicates the actual overload percentage of the motor. When this parameter reaches 100 % the fault "Motor Overload" (F0072) will occur.

P0042 – Powered Time

Adjustable Range:	0 to 65535 h	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ	

Description:

It indicates the total number of hours that the inverter remained powered.

This value is kept even when power is removed from the inverter.

P0043 – Enabled Time

Adjustable Range:	0.0 to 6553.5 h	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ	

Description:

It indicates the total number of hours that the inverter remained enabled.

It indicates up to 6553.5 hours, and then it gets back to zero.

By setting P0204 = 3, the value of the parameter P0043 is reset to zero.

This value is kept even when power is removed from the inverter.

P0044 – kWh Output Energy

Adjustable Range:	0 to 65535 kWh	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ	

Description:

It indicates the energy consumed by the motor.

It indicates up to 65535 kWh, and then it gets back to zero.

By setting P0204 = 4, the value of the parameter P0044 is reset to zero.

This value is kept even when power is removed from the inverter.

> ✓ **NOTE!**
> The value indicated in this parameter is calculated indirectly, and must not be used to measure the energy consumption.

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P0045 – Enabled Fan Time

Adjustable Range:	0 to 65535 h		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ			

Description:

It indicates the total number of hours that the heatsink fan remained enabled.

It indicates up to 65535 hours, and then it gets back to zero.

By setting P0204 = 2, the value of the parameter P0045 is reset to zero.

This value is kept even when power is removed from the inverter.

P0048 – Present Alarm

P0049 – Present Fault

Adjustable Range:	0 to 999		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ			

Description:

They indicate the alarm (P0048) or fault (P0049) number that occasionally is present at the inverter.

In order to understand the meaning of the codes used for faults and alarms, refer to the chapter 15 FAULTS AND ALARMS on page 15-1, in this manual and the chapter 6 Troubleshooting and Maintenance, of the user's manual.

P0613 - Firmware Revision

Adjustable Range:	-32768 to 32767		Factory Setting:	0
Properties:	ro			
Access Groups via HMI:				

Description:

It indicates the number of the inverter firmware version for Weg's internal control.

P0614 – PLD Revision

Adjustable Range:	-32768 to 32767	Factory Setting:	0
Properties:	ro		
Access Groups via HMI:			

Description:

It indicates the number of the inverter PLD version for Weg's internal control.

P0692 – Operating Mode States

Adjustable Range:	0 to 65535	Factory Setting:	0
Properties:	ro		
Access Groups via HMI:			

Description:

Parameter reserved for WEG.

16.1 FAULT HISTORY

In this group are described the parameters that record the last faults occurred in the inverter, together with other relevant information for the fault interpretation, as current, motor speed, etc.

> **NOTE!**
> If the fault occurs simultaneously with the CFW701 power up or reset, the parameters regarding this fault, as current, motor speed, etc., may contain invalid information.

P0050 – Last Fault

P0054 – Second Fault

P0058 – Third Fault

P0062 – Fourth Fault

P0066 – Fifth Fault

Adjustable Range:	0 to 999	Factory Setting:	
Properties:	ro		
Access Groups via HMI:	READ		

Description:

They indicate the codes from the last to the fifth fault that have occurred.

The recording system is the following:

Fxxx → P0050 → P0054 → P0058 → P0062 → P0066

P0090 – Last Fault Current

Adjustable Range:	0.0 to 4500.0 A		**Factory Setting:**
Properties:	ro		
Access Groups via HMI:	READ		

Description:

It is the record of the current supplied by the inverter at the moment of the last fault occurrence.

P0091 – Last Fault DC Link Voltage

Adjustable Range:	0 to 2000 V		**Factory Setting:**
Properties:	ro		
Access Groups via HMI:	READ		

Description:

It is the record of the inverter DC link voltage at the moment of the last fault occurrence.

P0092 – Last Fault Speed

Adjustable Range:	0 to 18000 rpm		**Factory Setting:**
Properties:	ro		
Access Groups via HMI:	READ		

Description:

It is the record of the motor speed at the moment of the last fault occurrence.

P0093 – Last Fault Reference

Adjustable Range:	0 to 18000 rpm	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ	

Description:

It is the record of the speed reference at the moment of the last fault occurrence.

P0094 – Last Fault Frequency

Adjustable Range:	0.0 to 1020.0 Hz	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ	

Description:

It is the record of the inverter output frequency at the moment of the last fault occurrence.

P0095 – Last Fault Motor Voltage

Adjustable Range:	0 to 2000 V	Factory Setting:
Properties:	ro	
Access Groups via HMI:	READ	

Description:

It is the record of the motor voltage at the moment of the last fault occurrence.

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P0096 – Last Fault DIx Status

Adjustable Range:	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		
Access Groups via HMI:	READ		

Description:

It indicates the state of the digital inputs at the moment of the last fault occurrence.

The indication is done by means of an hexadecimal code, which when converted to binary will indicate the states "active" and "inactive" of the inputs through numbers 1 and 0.

Example: If the code presented for the parameter P0096 on the keypad (HMI) is 00A5, it will correspond to the sequence **10100101**, indicating that the inputs 8, 6, 3 and 1 were active at the moment of the last fault occurrence.

Table 16.2: Example of correspondence between the P0096 hexadecimal code and the DIx states

0				0				A				5			
0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1
No relation with the DIx (always zero)								DI8 Active (+24 V)	DI7 Inactive (0 V)	DI6 Active (+24 V)	DI5 Inactive (0 V)	DI4 Inactive (0 V)	DI3 Active (+24 V)	DI2 Inactive (0 V)	DI1 Active (+24 V)

P0097 – Last Fault DOx Status

Adjustable Range:	Bit 0 = DO1 Bit 1 = DO2 Bit 2 = DO3 Bit 3 = DO4 Bit 4 = DO5		Factory Setting:
Properties:	ro		
Access Groups via HMI:	READ		

Description:

It indicates the state of the digital outputs at the moment of the last fault occurrence.

The indication is done by means of an hexadecimal code, which when converted to binary will indicate the states "active" and "inactive" of the outputs through numbers 1 and 0.

Example: If the code presented for the parameter P0097 on the keypad (HMI) is 001C, it will correspond to the sequence **00011100**, indicating that the outputs 5, 4, and 3 were active at the moment of the last fault occurrence.

Table 16.3: Example of correspondence between the P0097 hexadecimal code and the DOx states

0				0				1				C			
0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
No relation with the DOx (always zero)				No relation with the DOx (always zero)				DO5 Active (+24 V)	DO4 Active (+24 V)	DO3 Active (+24 V)		DO2 Inactive (0 V)	DO1 Inactive (0 V)		

17 COMMUNICATION

For the exchange of information through communication networks, the CFW701 has several standardized communication protocols, like MODBUS, BACnet and Metasys N2.

For more details regarding the inverter configuration for operating with those protocols, refer to the CFW701 communication manual. The parameters related to the communication are explained next.

17.1 RS-485 SERIAL INTERFACE

P0308 – Serial Address

P0310 – Serial Baud Rate

P0311 – Serial Interface Byte Configuration

P0312 - Serial Protocol

P0314 – Serial Watchdog

P0316 – Serial Interface Status

P0682 – Serial Control Word

P0683 – Serial Speed Reference

Those are parameters for the configuration and operation of the RS-485 serial interfaces. For a detailed description, refer to the Modbus RTU, BACnet and N2 user's manual, supplied in electronic format on the CD-ROM that comes with the product.

17.2 COMMUNICATION BACNET

P0760 – BACnet Equipment Instance – High Part

P0761 – BACnet Equipment Instance – Low Part

P0762 – Maximum Master Number

P0763 – Maximum Number of MS/TP Frame

P0764 – I-AM Transmission

P0765 – Number of Received Tokens

Those are parameters for the configuration and operation of the communication BACnet. For a detailed description, refer to the BACnet user's manual, supplied in electronic format on the CD-ROM that comes with the product.

17.3 COMMUNICATION METASYS N2

For a detailed description, refer to the N2 user's manual, supplied in electronic format on the CD-ROM that comes with the product.

17.4 COMMUNICATION STATES AND COMMANDS

P0313 – Communication Error Action

P0680 – Logical Status

P0681 – Motor Speed in 13 bits

P0695 – Settings for the Digital Outputs

P0696 – Value 1 for Analog Outputs

P0697 – Value 2 for Analog Outputs

P0682 – Serial Control Word

P0683 – Serial Speed Reference

Those parameters are used for monitoring and controlling the CFW701 inverter by means of communication interfaces. For a detailed description, refer to the communication manual of the user interface. These manuals are supplied in electronic format on the CD-ROM that comes with the product.

18 SOFTPLC [50]

The SoftPLC function allows the frequency inverter to assume PLC (Programmable Logical Controller) functions. For more details regarding the programming of those functions in the CFW701, refer to the CFW701 SoftPLC manual. The parameters related to the SoftPLC are described next.

P1000 – SoftPLC Status

Adjustable Range:	0 = No Application 1 = Installing App. 2 = Incompatible App. 3 = App. Stopped 4 = App. Running		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ, HVAC			

Description:

It allows the user to visualize the current SoftPLC status. If there is no installed application, the parameters from P1010 to P1099 will not be showed on the keypad.

If this parameter presents the option 2 ("Incompat. App."), it indicates that the version that has been loaded in the flash memory board is not compatible with the current CFW701 firmware.

In this case it is necessary to recompile the project in the WLP software with the new CFW701 version and download it again. If this is not possible, the upload of this application with the WLP can be done since the password of the application software is known or it is not enabled.

P1001 – SoftPLC Command

Adjustable Range:	0 = Stop Application 1 = Run Application 2 = Delete Application		Factory Setting:	1
Properties:				
Access Groups via HMI:	HVAC			

Description:

It allows stopping, running or excluding the installed application, however, the motor must be disabled.

P1002 – Scan Cycle Time

Adjustable Range:	0.0 to 999.9 ms		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ, HVAC			

Description:

It consists in the application scanning time. The bigger the application, the longer the scanning time will be.

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P1003 – SoftPLC Application Selection

Adjustable Range:	0 = User 1 = HVAC	Factory Setting:	1
Properties:	cfg		
Access Groups via HMI:	HVAC		

Description:

It allows the user to select the CFW701 built in applications.

Table 18.1: Parameter P1003 option description

P1003	Description
0	The application that will run in the SoftPLC is that loaded by the user via ladder programming
1	It defines that the application to be executed on the SoftPLC is the HVAC. Further detail on chapter 19 HVAC FUNCTIONS on page 19-1.

> **NOTE!**
> Refer to SoftPLC manual for more information about the CFW701 user applications.

From P1010 to P1099 – SoftPLC Parameters

Adjustable Range:	-32768 to 32767	Factory Setting:	0
Properties:	cfg		
Access Groups via HMI:	HVAC		

Description:

They consist of parameters defined by the selected application in parameter P1003.

19 HVAC FUNCTIONS

The CFW701 frequency inverter is an equipment optimized for applications in heating, ventilation, air conditioning and refrigeration, i.e., HVAC market. It was implemented some functionalities / protections commons for this market, how:

- Fire Mode.
- Bypass Mode.
- Automatic Energy Saving.
- Short Cycle Protection.
- Dry Pump.
- Broken Belt.
- Filter Maintenance Alarm.
- Main PID Controller for Motor Control.
- Sleep Mode for Main PID Controller.
- External PID Controller 1.
- External PID Controller 2.

19.1 FIRE MODE

> ⚠️ **DANGER!**
> - Notice that the CFW701 is just one of the components of the HVAC system, and it is configurable for different functions, including the "Fire Mode" function.
> - Thus, the full operation of the "Fire Mode" function depends on the accuracy of the project and on the joint performance of the components of the system.
> - Ventilation systems that work on life safety applications must be approved by the Fire Department and/or another competent public authority.
> - The non-interruption of the operation of the CFW701, when configured for operation in the "Fire Mode" function, is critical and must be taken into account in the preparation of safety plans in the environments in which they are installed, since damages may occur to the CFW701 itself and to other components of the HVAC system, to the environment in which it is installed and to people with risk of death.
> - The operation in the "Fire Mode" function may, under certain circumstances, result in fire, since the protection devices will be disabled.
> - Only personnel from engineering and safety must consider the configuration of the equipment for the "Fire Mode" function.
> - WEG strongly recommends to follow the cares and procedures above before using the CFW701 in the "Fire Mode" function, and it will not be liable to the final user or third parties for any losses or damages direct or indirectly incurred due to the programming and operation of the CFW701 in "Fire Mode" regime, considering the critical and special use of this function.

⚠️ **DANGER!**

- Remarque: le CFW701 n'est que l'un des composants du système de climatisation qui peut être configuré pour différentes fonctions, telles que le « mode incendie ».
- Par conséquent, le fonctionnement complet de la fonction « mode incendie » dépend de la précision du projet et de la performance des raccords des composants de ce système.
- Les systèmes de ventilation qui fonctionnent dans des applications de sécurité des personnes doivent être homologués par les sapeurs-pompiers et/ou une autre autorité publique compétente.
- Il est critique que le fonctionnement du CFW701 ne soit pas interrompu lorsqu'il est configuré pour fonctionner en « mode incendie » et ceci doit être pris en compte dans la préparation des plans de sécurité dans les environnements où il doit être installé, car le CFW701 et d'autres composants de la climatisation risquent d'être endommagés, de plus cela représenterait un risque de dégâts matériels pour l'environnement où il est installé et un risque de mort.
- Le fonctionnement en « mode incendie » peut, dans certaines circonstances, causer un incendie, car les dispositifs de protection seront désactivés.
- Seul le personnel technique et de sécurité doivent activer le « mode incendie » de l'équipement.
- WEG recommande fortement de suivre les implications et procédures ci-dessus avant d'utiliser le CFW701 en « mode incendie », et décline toute responsabilité vis-à-vis de l'utilisateur final ou de tiers quant à des pertes ou des dommages directs ou indirects résultant de la programmation et de l'utilisation du CFW701 en « mode incendie », étant donné l'usage critique et particulier de cette fonction.

✓ **NOTE!**

When the user activates the "Fire Mode" function, he/she acknowledges that the protection functions of the CFW701 are disabled, which may result in damages to the CFW701 itself, to the components connected to it, to the environment in which it is installed and to people present in such environment; therefore, the user takes full responsibility for the risks arising from such operating condition. Operation with the "Fire Mode" function programmed voids the warranty of the product. The operation in this condition is internally registered by the CFW701 and must be validated by a duly qualified professional of engineering and occupational safety, since such procedure significantly increases the operating risk.

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 in order to protect itself or protect the motor. The "Fire Mode" is selected by driving a digital input previously set to "Fire Mode" with logic level "0" (0 V) at the input terminals. When the drive enters the "Fire Mode", the alarm "A0211" will be generated on the HMI (keypad) and the status of the operation mode will be updated in parameter P0006.

If the user presses the ESC key, this message will move from the main display to the secondary display the operation mode shown in parameter P0006 will continue unchanged. It is also possible monitor this condition by a digital output set to "Fire Mode". During operation in "Fire Mode" all STOP commands are ignored (even General Enable), except only for the Safety Stop Relay. A couple of Faults (considered critical) that can damage the drive will not be disabled, but can be endlessly auto-reset (set this condition in P0582 parameter): DC Link Overvoltage (F0022), Overcurrent/Short-circuit (F0070) and Safety Stop Relays (F0160).

P0579 – Reference to Fire Mode

Adjustable Range:	0 to 18000 rpm		Factory Setting:	1800 (1500) rpm
Properties:				
Access Groups via HMI:	HVAC			

Description:

When Fire Mode is detected the drive will accelerate to the value set in this parameter if P0580 = 2.

P0580 – Fire Mode Configuration

Adjustable Range:	0 = Disabled ("Fire Mode" inactive) 1 = Enabled (keeps speed reference/PID setpoint) 2 = Enabled (set speed reference to Fire Mode [P0579]) 3 = Enabled (set PID setpoint to the value programmed in P0581) 4 = Enabled (disables the output, motor will coast to stop)	Factory Setting:	0
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines how the Fire Mode functionality will work in the CFW701 frequency inverter.

Table 19.1: Description of fire mode configuration

P0580	Description
0	Fire Mode function is inactive
1	Fire Mode function is active. When the DIx set to Fire Mode is opened (0 V), "A0211" will be shown on the HMI but the Speed Reference or PID setpoint will not change.
2	Fire Mode function is active. When the DIx set to Fire Mode is opened (0 V), "A0211" will be shown on the HMI and the Speed Reference will be set automatically to reference Fire Mode (P0579 value).
3	Fire Mode function is active. When the DIx set to Fire Mode is opened (0 V), "A0211" will be shown on the HMI and the PID setpoint will be set automatically to the P0581 value.
4	Fire Mode function is active. When the DIx set to Fire Mode is opened (0 V), "A0211" will be shown on the HMI and the output will be disabled. Motor will coast to stop.

P0581 – Fire Mode PID Setpoint

Adjustable Range:	-32768 to 32767	Factory Setting:	0
Properties:			
Access Groups via HMI:	HVAC		

Description:

It defines the setpoint to be used by Fire Mode when the Main PID is enabled and P0580 = 3.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 1 parameters (P0510 and P0511).

P0582 – Fire Mode Auto-reset Configuration

Adjustable Range:	0 = Limited 1 = Unlimited	Factory Setting:	0
Properties:	cfg		
Access Groups via HMI:	HVAC		

Description:

This parameter defines how the auto-reset functionality will work in Fire Mode when a critical fault occur (DC Link Overvoltage [F0022], Overcurrent/Short-circuit [F0070] and Safety Stop Relays [F0160]).

Table 19.2: *Description of auto-reset configuration in fire mode*

P0582	Description
0	Limited. Auto-reset works as defined in P0340 parameter.
1	Unlimited. The auto-reset happens after 1 s of a critical failure detection regardless of the value set in P0340.

19.2 BYPASS MODE

The Bypass Mode allows switching the motor controlled by the CFW701 inverter to be fed directly by the mains using an external contactor the will make the connection. In order to achieve that, two contactors will be necessary, one for connecting the motor to the drive and another for connecting the motor to the mains.

The contactors will be driven by two digital outputs (DOx) previously programmed for "Drive Bypass Contactor" and "Mains Bypass Contactor". The drive will ensure the correct interlocking.

When entering Bypass Mode, the Alarm "A0210" will be generated and shown at the HMI. This state can also be verified in the Parameter P0006 and P0680.

The drive will enter in the Bypass Mode when the digital input (DIx) previously programmed for "Bypass" is set to logic level high (24 V). At this moment the drive will perform a "General Disable" command (the motor will coast to stop) and will signal that the Bypass Mode is active in both P0006 and P0680. Following that, the digital output DOx set to "Drive Bypass Contactor" is reset after a delay for demagnetizing the motor. This delay is fixed in 3 s if the motor speed is greater or equal to the motor rated speed or set to 3s*(Speed/Rated Speed) otherwise. The next step is to set the output configured as "Mains Bypass Contactor" to connect the motor to the mains, action taken after a delay set in P0584 to ensure that the drive output contactor is effectively open. The drive is then bypassed and will stay so as long as the digital input set as "Bypass" is set (24 V).

As soon as the digital input set to "Bypass" is reset (0 V), the output programmed for "Mains Bypass Contactor" is also reset, disconnecting the motor from the mains. The drive is kept in Bypass Mode until a "Run" command is received by the drive, when the "Bypass" digital input is checked whether it's still deactivated and, if so, the state of P0006 and P0680 is updated to reflect the exit from the Bypass Mode. No longer in Bypass Mode, the drive waits for the demagnetization of the motor and sets the "Drive Bypass Contactor" output, connecting the motor back to the drive output. After another delay (set by P0584) for ensuring that the contactor is effectively closed, the inverter output is enabled again to drive the motor.

This activation logic is shown in .

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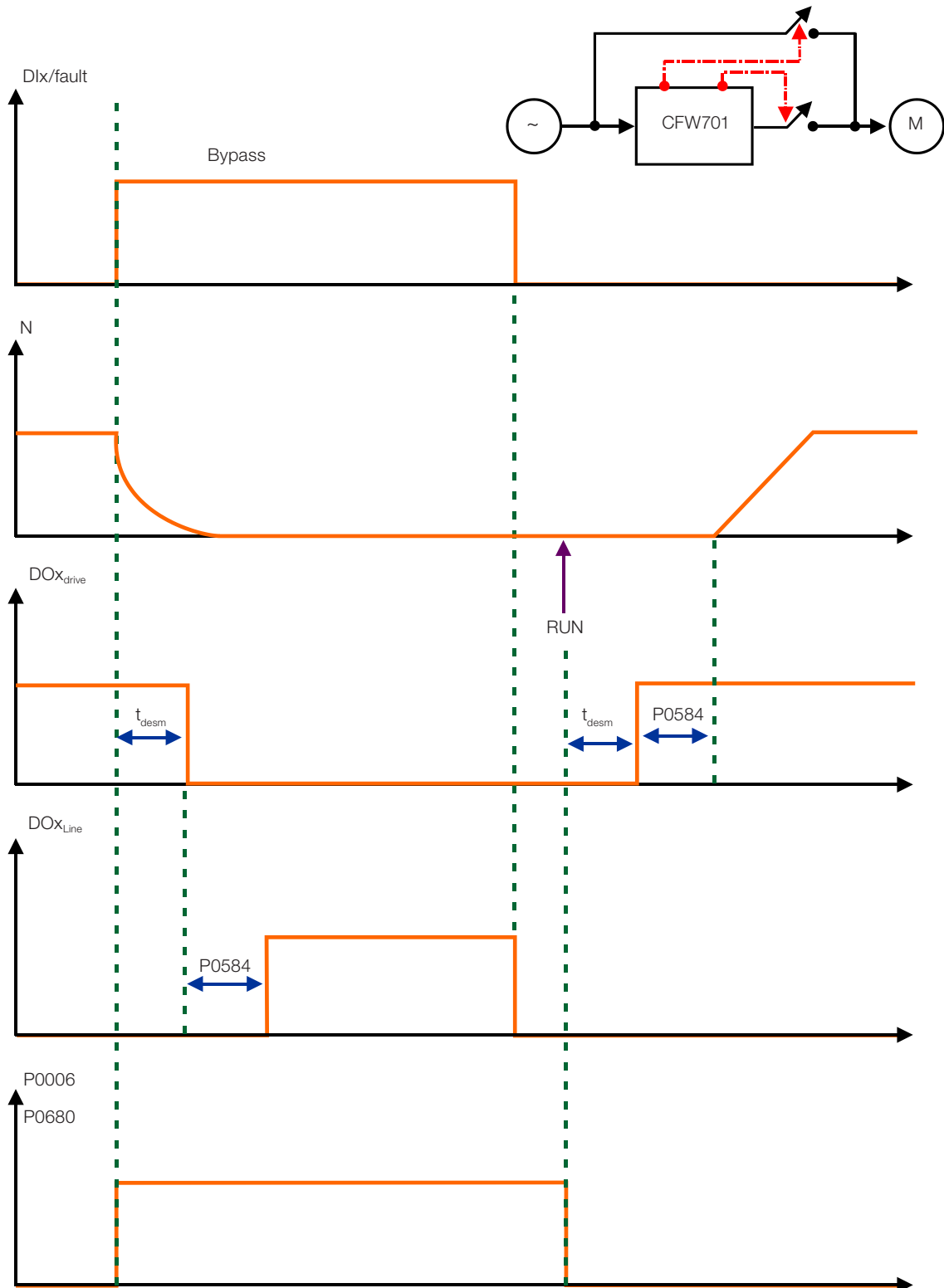
Figure 19.1: Bypass mode activation logic

An example of connecting the bypass can be seen in Figure 19.2 on page 19-6. Setting used in this example:

P0268 = 23 (DI6 = Bypass Mode)
P0275 = 39 (RL1 = Drive Bypass Contactor)
P0276 = 40 (RL2 = Mains Bypass Contactor)
P0583 = 1 (Bypass enabled by DIx)
P0584 = 0.30 s
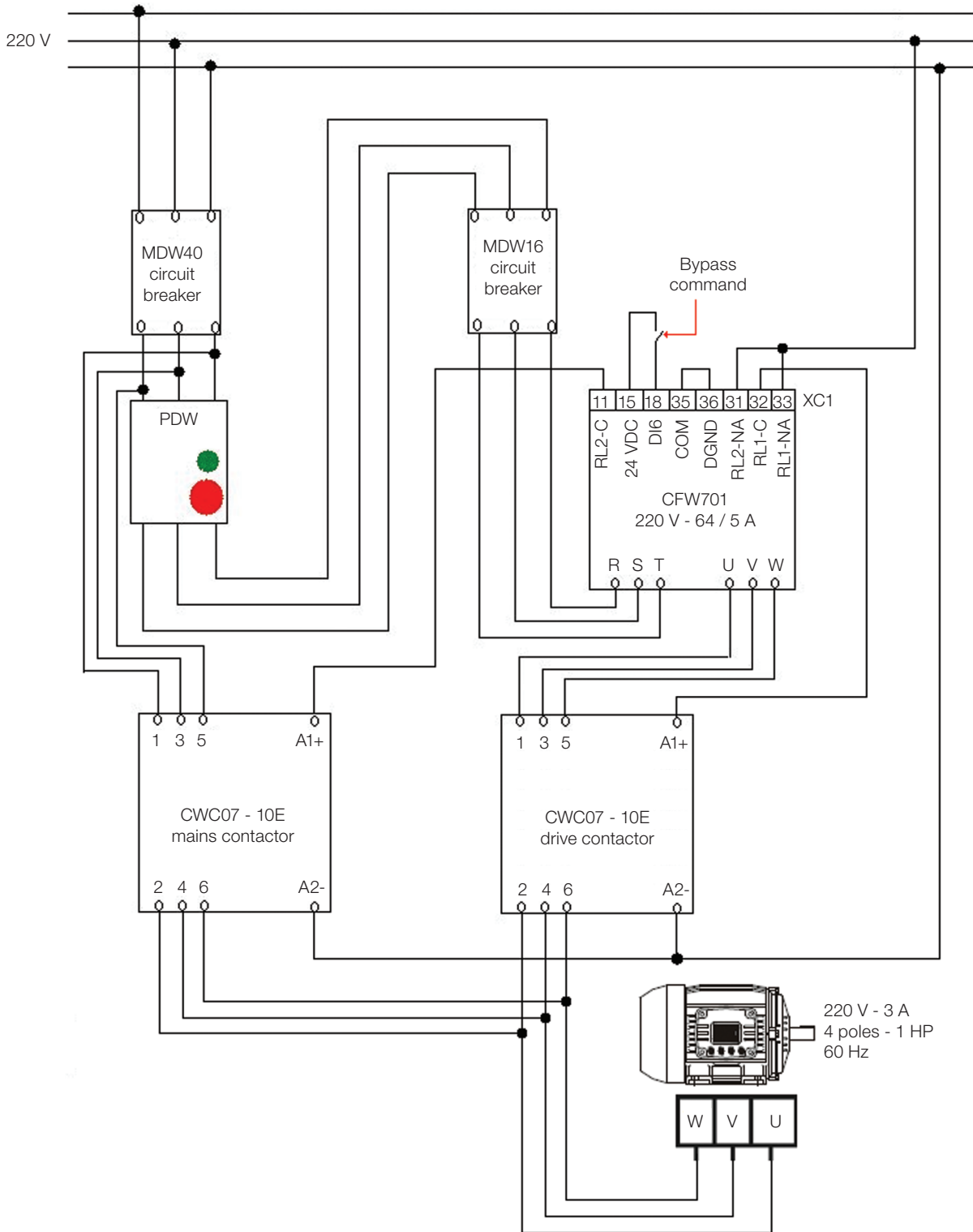
Figure 19.2: Bypass mode example

P0583 – Bypass Mode Configuration

Adjustable Range:	0 = Off 1 = On/DIx 2 = On/DIx + Fault	Factory Setting:	0
Properties:	cfg		
Access Groups via HMI:	HVAC		

Description:

This parameter configured the triggering event for the CFW701 entering the Bypass Mode.

Table 19.3: Bypass mode configuration description

P0583	Description
0	Bypass mode is always disabled
1	Bypass mode is enabled by a digital input (DIx) set to "Bypass"
2	Bypass mode is enabled either by a digital input (DIx) set to "Bypass" or when a fault happens

P0584 – Bypass Contactor Time

Adjustable Range:	0.00 to 300.00 s	**Factory Setting:**	0.30 s
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the delay between the opening of one contactor and the closing of the other contactor.

19.3 ENERGY SAVING MODE

The efficiency of a machine is defined as the ratio between the mechanical power output and the electrical power input. The output mechanical power is the product of speed and torque and the electrical input power equates to the mechanical output power plus the motor losses.

In three-phase induction motors, the optimal operating point is around ¾ of the rated load. On the region below that the Energy Saving function will perform better.

The Energy Saving function will work directly on the output voltage provided to the motor, changing the flux in the motor and minimizing the losses. This will ensure a better efficiency and lower acoustic noise.

The function will be active when the load is below the maximum value set on P0588 and the speed is greater than the minimum speed set on P0590. A minimum voltage level, set by P0589, that the controller can output is defined to avoid the motor stalling.

P0407 – Motor Rated Power Factor

Adjustable Range:	0.50 to 0.99	**Factory Setting:**	0.68
Properties:	cfg, V/f, VVW		
Access Groups via HMI:			

Description:

It sets the Motor Rated Power Factor.

Note:

On some applications this value should be set slightly lower than the value on the motor plate. These can be identified by an increase on the motor current when enabling the energy saving function. In these cases, reduce this value slowly until the minimum output current is found.

For information on the use of P0407 in the VVW motor control mode, please check the , of this manual.

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P0588 – Maximum Torque Level

Adjustable Range:	0 to 85 %		**Factory Setting:**	0 %
Properties:	cfg, V/f			
Access Groups via HMI:	HVAC			

Description:

This parameter define the torque value on which the energy saving function is activated. Setting this value to 0 % effectively disables the function.

The recommended value for this parameter with the function active is 60 %, but other values can be used depending on the application and the motor.

P0589 – Energy Saving Min. Mag.

Adjustable Range:	40 to 80 %		**Factory Setting:**	40 %
Properties:	cfg, V/f			
Access Groups via HMI:	HVAC			

Description:

This parameter defines the minimum voltage level that will be output to the motor with the energy saving function active. The setting is a proportion to the voltage imposed by the V/f curve.

P0590 – Energy Saving Min. Speed

Adjustable Range:	0 to 18000 rpm		**Factory Setting:**	600 (525) rpm
Properties:	cfg, V/f			
Access Groups via HMI:	HVAC			

Description:

This parameter defines the minimum speed on which the energy saving function will be active. Speeds lower that this will disable the function.

The histeresis for the minimum speed level is 2 Hz.

P0591 – Energy Saving Histeresis

Adjustable Range:	0 to 30 %		**Factory Setting:**	10 %
Properties:	cfg, V/f			
Access Groups via HMI:	HVAC			

Description:

This is the torque histeresis used to turning the energy saving function on and off.

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Too low values will cause the output current to oscilate. Simply increasing the value should solve this.

> ✓ **NOTE!**
> These parameters can't be set while the motor is running.

19.4 SHORT CYCLE PROTECTION

The short cycles protection has the objective of avoiding turning on and off a compressor with too short time periods. A minimum on and a minimum off time are set so that during these periods Stop and Run commands are ignored, with the exception of "general disable" and faults.

P0585 – Short Cycle Protection Configuration

Adjustable Range:	0 = Off 1 = On	Factory Setting:	0
Properties:	cfg		
Access Groups via HMI:	HVAC		

Description:
This parameter define whether the short cycles protection is active or not.

P0586 – Minimum RUN Time

Adjustable Range:	0.00 to 650.00 s	Factory Setting:	5.00 s
Properties:			
Access Groups via HMI:	HVAC		

Description:
Defines the minimum time that compressor will be kept on, ignoring stop commands.

P0587 – Minimum STOP Time

Adjustable Range:	0.00 to 650.00 s	Factory Setting:	5.00 s
Properties:			
Access Groups via HMI:	HVAC		

Description:
Defines the minimum time that the compressor will be kept off, ignoring Run commands.

19.5 DRY PUMP

This parameter group allows the user to configure the dry pump operation detection.

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The **dry pump** detection is intended to avoid the pump driven by frequency inverter to operate at vacuum, i.e., without the liquid being pumped. This is done by detecting the operation speed in conjunction with the motor torque.

P1042 – Dry Pump Detection Configuration

Adjustable Range:	0 = Disable 1 = Enable and only alarm 2 = Enable and generate fault	Factory Setting:	0
Properties:	cfg		
Access Groups via HMI:	HVAC		

Description:

This parameter defines how the dry pump detection functionality will go act in the CFW701 frequency inverter.

Table 19.4: Description of dry pump detection configuration

P1042	Description
0	It defines will not be done the dry pump detection
1	It defines the dry pump detection will be enabled and only will generate the alarm message "A0766: Dry pump detected", i.e., the CFW701 frequency inverter will continue control the motor.
2	It defines the dry pump detection will be enabled and will generate the alarm message "A0766: Dry pump detected" during motor deceleration and the fault "F0767: Dry pump detected" in the CFW701 frequency inverter after stopping the motor.

P1043 – Dry Pump Detection Speed

Adjustable Range:	0 to 18000	Factory Setting:	400
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the speed above which will be enabling to compare the actual motor torque with the motor torque for dry pump detection set in P1044.

NOTE!
This parameter can be displayed in Hz or rpm as selection in the indirect engineering unit 4 parameters (P0516 and P0517):
- Set P0516 in 13 (Hz) and P0517 in 1 (wxy.z) for displaying in Hz.
- Set P0516 in 3 (rpm) and P0517 in 0 (wxyz) for displaying in rpm.

P1044 – Dry Pump Detection Motor Torque

Adjustable Range:	0.0 to 350.0 %	Factory Setting:	20.0 %
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the motor torque value below which will be detected the dry pump condition.

P1045 – Dry Pump Detection Time

Adjustable Range:	0.00 to 650.00 s		Factory Setting:	20.00 s
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines a time interval required on the dry pump condition active to generate the alarm (A0766) or fault (F0767) by dry pump.

19.6 BROKEN BELT

This parameter group allows the user to configure the broken belt operation detection.

The broken belt detection is intended to avoid the motor driven by frequency inverter to operate empty, i.e., to a mechanical problem between the motor and load, it continues to operate. This is done by detecting the operation speed in conjunction with the motor torque.

P1046 – Broken Belt Detection Configuration

Adjustable Range:	0 = Disable 1 = Enable and only alarm 2 = Enable and generate fault		Factory Setting:	0
Properties:	cfg			
Access Groups via HMI:	HVAC			

Description:

This parameter defines how the broken belt detection functionality will go act in the CFW701 frequency inverter.

Table 19.5: Description of broken belt detection configuration

P1046	Description
0	It defines will not be done the broken belt detection
1	It defines the broken belt detection will be enabled and only will generate the alarm message "A0768: Broken belt detected", i.e., the CFW701 frequency inverter will continue control the motor.
2	It defines the broken belt detection will be enabled and will generate the alarm message "A0768: Broken belt detected" during motor deceleration and the fault "F0769: Broken belt detected" in the CFW701 frequency inverter after stopping the motor.

P1047 – Broken Belt Detection Speed

Adjustable Range:	0 to 18000		Factory Setting:	400
Properties:				
Access Groups via HMI:	HVAC			

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Description:

This parameter defines the speed above which will be enabling to compare the actual motor torque with the motor torque for broken belt detection set in P1048.

> **✓ NOTE!**
> This parameter can be displayed in Hz or rpm as selection in the indirect engineering unit 4 parameters (P0516 and P0517):
> - Set P0516 in 13 (Hz) and P0517 in 1 (wxy.z) for displaying in Hz.
> - Set P0516 in 3 (rpm) and P0517 in 0 (wxyz) for displaying in rpm.

P1048 – Broken Belt Detection Motor Torque

Adjustable Range:	0.0 to 350.0 %		Factory Setting:	20.0 %
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the motor torque value below which will be detected the broken belt condition.

P1049 – Broken Belt Detection Time

Adjustable Range:	0.00 to 650.00 s		Factory Setting:	20.00 s
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines a time interval required on the broken belt condition active to generate the alarm (A0768) or fault (F0769) by broken belt.

19.7 FILTER MAINTENANCE ALARM

This parameter group allows the user to configure the filter maintenance alarm operation.

The filter maintenance alarm is intended to alert the user of the need to change the filter system. It has the preventive maintenance function in the filtration system.

P1050 – Filter Maintenance Alarm Configuration

Adjustable Range:	0 = Disable 1 = Enable and only alarm 2 = Enable and generate fault		Factory Setting:	0
Properties:	cfg			
Access Groups via HMI:	HVAC			

Description:

This parameter defines how the filter maintenance alarm functionality will go act in the CFW701 frequency inverter.

Table 19.6: Description of filter maintenance alarm configuration

P1050	Description
0	It defines will not be done the counting of operation time for change the filter system. Also resets the operation time for filter maintenance alarm in P1052 parameter.
1	It defines the counting of operation time for filter maintenance alarm will be enabled and only will generate the alarm message "A0770: Filter maintenance", i.e., the CFW701 frequency inverter will continue control the motor.
2	It defines the counting of operation time for filter maintenance alarm will be enabled and will generate the alarm message "A0770: Filter maintenance" during the motor deceleration and the fault "F0771: Filter maintenance" in the CFW701 frequency inverter after stopping the motor.

P1051 – Filter Maintenance Alarm Time

Adjustable Range:	0 to 32000 h	**Factory Setting:**	5000 h
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the operation time of motor driven by CFW701 frequency inverter needed to be done changing the filter system. This value is compared with the operation time (P1052) to be generated the alarm (A0770) or fault (F0771) due to filter maintenance.

P1052 – Operation Time for Filter Maintenance Alarm

Adjustable Range:	0 to 32000 h	**Factory Setting:**	
Properties:	ro		
Access Groups via HMI:	READ, HVAC		

Description:

This parameter indicates the operation time of motor driven by CFW701 frequency inverter.

> ✓ **NOTE!**
> Set P1050 in "0" to reset the operation time for filter maintenance alarm.

19.8 MAIN PID CONTROLLER

This parameter group allows the user to configure the Main PID controller operation.

The Main PID controller is used to control a closed loop process through the regulator proportional, integral and derivative superimposed on the normal control speed of the CFW701 frequency inverter. The control of the motor speed driven by CFW701 frequency inverter is done by comparing the process variable (feedback) with the required automatic setpoint.

The Main PID controller will be marked out to operate from 0.0 to 100.0 %, which 0.0 % equates to minimum speed programmed in P0133 and 100.0 % equals maximum speed programmed in P0134.

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The process variable is that the Main PID controller takes as return (feedback) of its control action being compared with the setpoint required to generate the control error. The same is read via an analog input, so you will need to configure which of the analog inputs serve as feedback for the Main PID controller.

Is adopted the "Academic" structure for the Main PID controller, which obeys the following equation:

$u(k) = i(k-1) + Kp \cdot [(1 + Ki \cdot Ts + (Kd/Ts)) \cdot e(k) - (Kd/Ts) \cdot e(k-1)]$

Where:
        u(k) = Main PID controller output
        i(k-1) = integral value in the previous status of the PID Controller
        Kp = proportional gain
        Ki = integral gain
        Kd = derivative gain
        Ts = sampling time
        e(k) = error in the actual instant (process variable)
        e(k-1) = error in the last instant

P1011 – Main PID Controller Automatic Setpoint

Adjustable Range:	-32768 to 32767		Factory Setting:	0
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the value of Main PID controller setpoint in engineering unit when it is in Automatic mode.

> **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 1 parameters (P0510 and P0511).

P1014 – Main PID Controller Manual Setpoint

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	0.0 %
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the value of Main PID controller setpoint when it is in Manual mode.

P1015 – Main PID Controller Process Variable

Adjustable Range:	-32768 to 32767		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ, HVAC			

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Description:

This parameter indicates the actual value of Main PID controller process variable in engineering unit.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 1 parameters (P0510 and P0511).

P1016 – Main PID Controller Output

Adjustable Range:	0.0 to 100.0 %	**Factory Setting:**	
Properties:	ro		
Access Groups via HMI:	READ, HVAC		

Description:

This parameter indicates the actual value of Main PID controller output.

P1017 – Main PID Controller Action Control

Adjustable Range:	0 = Disable PID 1 = Direct Mode 2 = Reverse Mode	**Factory Setting:**	0
Properties:	cfg		
Access Groups via HMI:	HVAC		

Description:

This parameter defines how the action control or regulation of Main PID controller.

Table 19.7: Description of Main PID controller action control

P1017	Description
0	It defines the Main PID controller will be disabled to operation
1	It defines the Main PID controller action control or regulation will be enabled in direct mode
2	It defines the Main PID controller action control or regulation will be enabled in reverse mode

> ✓ **NOTE!**
> The PID action control should be selected to Direct Mode when to increase the value of the process variable is necessary increase the output of the PID. E.g.: Pump driven by inverter to filling a reservoir. For the reservoir level process variable increases, it is necessary that the flow rate increases, which is achieved with increasing motor speed.
> The PID action control should be selected to Reverse Mode when to increase the value of the process variable is necessary reduce the output of the PID. E.g.: Fan driven by inverter causing the cooling of a cooling tower. When you want to increase the temperature process variable, it is necessary reduce ventilation by reducing motor speed.

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P1018 – Main PID Controller Operation Mode

Adjustable Range:	0 = Always Automatic 1 = Always Manual 2 = Automatic or Manual selection via DIx and transition without bumpless 3 = Automatic or Manual selection via Network and transition without bumpless 4 = Automatic or Manual selection via DIx and transition with bumpless 5 = Automatic or Manual selection via Network and transition with bumpless	Factory Setting:	0
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines how the Main PID controller will work.

Table 19.8: Description of Main PID controller operation mode

P1018	Description
0	It defines the Main PID controller will be work always in Automatic mode
1	It defines the Main PID controller will be work always in Manual mode
2	It defines the digital input DIx programmed for Automatic/Manual will select the operation mode of Main PID controller in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done without bumpless.
3	It defines the bit 13 of serial control word (P0682) will select the operation mode of Main PID controller in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done without bumpless.
4	It defines the digital input DIx programmed for Automatic/Manual will select the operation mode of Main PID controller in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done with bumpless.
5	It defines the bit 13 of serial control word (P0682) will select the operation mode of Main PID controller in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done with bumpless.

NOTE!
Bumpless transfer is making the transition from Manual to Automatic mode or Automatic to Manual mode without causing variation in the output of the PID controller.
When the transition occurs from Manual to Automatic mode, the output value in Manual mode is used to start the Integral portion of the PID controller. This ensures that the output will start at this value.
When the transition occurs from Automatic to Manual mode, the output value in Automatic mode is used as the setpoint in Manual mode.

P1019 – Main PID Controller Sampling Time

Adjustable Range:	0.10 to 60.00 s	Factory Setting:	0.10 s
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the sampling time of the Main PID controller.

P1020 – Main PID Controller Proportional Gain

Adjustable Range:	0.000 to 32.767		**Factory Setting:**	1.000
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the proportional gain of Main PID controller.

P1021 – Main PID Controller Integral Gain

Adjustable Range:	0.000 to 32.767		**Factory Setting:**	0.430
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the integral gain of Main PID controller.

P1022 – Main PID Controller Derivative Gain

Adjustable Range:	0.000 to 32.767		**Factory Setting:**	0.000
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the derivative gain of Main PID controller.

P1023 – Main PID Controller Output Minimum Value

Adjustable Range:	0.0 to 100.0 %		**Factory Setting:**	0.0 %
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the minimum output value of the Main PID controller.

> ✓ **NOTE!**
> Value in 0.0 % indicates the speed programmed in P0133.

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P1024 – Main PID Controller Output Maximum Value

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	100.0 %
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the maximum output value of the Main PID controller.

> ✓ **NOTE!**
> Value in 100.0 % indicates the speed programmed in P0134.

P1026 – Main PID Controller Process Variable Configuration

Adjustable Range:	0 = Sum feedback 1, 2 and/or 3 1 = Difference between feedback 1 and 2 2 = Media value of feedback 1, 2 and/or 3 3 = Minimum value of feedback 1, 2 and/or 3 4 = Maximum value of feedback 1, 2 and/or 3		Factory Setting:	0
Properties:	cfg			
Access Groups via HMI:	HVAC			

Description:

This parameter defines some features for the analog inputs selected for the Main PID controller feedback 1, 2 and 3.

Table 19.9: Description of Main PID controller feedback configuration

P1026	Description
0	It defines the Main PID controller process variable will be the sum of feedbacks 1, 2 and/or 3
1	It defines the Main PID controller process variable will be the difference between feedback 1 and feedback 2
2	It defines the Main PID controller process variable will be the media value of feedbacks 1, 2 and/or 3
3	It defines the Main PID controller process variable will be the minimum value of feedbacks 1, 2 and/or 3
4	It defines the Main PID controller process variable will be the maximum value of feedbacks 1, 2 and/or 3

P1027 – Main PID Controller Process Variable Minimum Level

Adjustable Range:	-32768 to 32767		Factory Setting:	0
Properties:				
Access Groups via HMI:	HVAC			

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Description:

This parameter defines the minimum value of the analog input sensor of the Main PID controller process variable for conversion into engineering unit.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 1 parameters (P0510 and P0511).

P1028 – Main PID Controller Process Variable Maximum Level

Adjustable Range:	-32768 to 32767		Factory Setting:	1000
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the maximum value of the analog input sensor of the Main PID controller process variable for conversion into engineering unit.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 1 parameters (P0510 and P0511).

By means of the minimum and maximum levels of the process variable of the PID controller, and of the value of analog input(s) AIX, we obtain the equation of the curve to convert the process variable of the Main PID controller:

$$P1015 = [(P1028 - P1027) \times (AIx)] + P1027$$

Where:
P1015 = process variable of the Main PID controller.
P1027 = minimum level for process variable of the Main PID controller.
P1028 = maximum level for process variable of the Main PID controller.
AIX = value of the analog input(s) according to P1026.

P1030 – Main PID Controller Process Variable Alarms Configuration

Adjustable Range:	0 = Disable 1 = Enable and only alarm 2 = Enable and generate fault (stops the motor before)		Factory Setting:	0
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines how the Main PID controller process variable alarms for low or high level will go act in the CFW701 frequency inverter.

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Table 19.10: Description of the alarm configuration for the Main PID controller

P1030	Description
0	It defines the Main PID controller feedback alarms for low or high level will be disabled
1	It defines the Main PID controller feedback alarms for low or high level will be enabled and only will generate the respective alarm message (A0760 or A0762), leaving the Main PID controller active and controlling the motor driven by CFW701 frequency inverter.
2	It defines the Main PID controller feedback alarms for low or high level will be enabled and will generate the fault (A0760 or F0761) in the CFW701 frequency inverter after stopping the motor.

P1031 – Main PID Controller Process Variable Alarm Low Level Value

Adjustable Range:	-32768 to 32767		Factory Setting:	50
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the feedback value below which is considered low level for the sensor of analog input of the Main PID controller process variable in engineering unit.

> **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 1 parameters (P0510 and P0511).

P1032 – Main PID Controller Process Variable Alarm Low Level Time

Adjustable Range:	0.00 to 650.00 s		Factory Setting:	5.00 s
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the time on the Main PID controller process variable low level condition active to be generated the alarm message "A0760: Low level for Main PID controller process variable". With P1030 in 2, will be generated a fault "F0761: Low level for Main PID controller process variable" in the CFW701 frequency inverter after stopping the motor.

> **NOTE!**
> Value in 0.00 s disables the alarm detection.

P1033 – Main PID Controller Process Variable Alarm High Level Value

Adjustable Range:	-32768 to 32767		Factory Setting:	900
Properties:				
Access Groups via HMI:	HVAC			

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Description:

This parameter defines the feedback value above which is considered high level for the sensor of analog input of the Main PID controller feedback in engineering unit.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 1 parameters (P0510 and P0511).

P1034 – Main PID Controller Process Variable Alarm High Level Time

Adjustable Range:	0.00 to 650.00 s		Factory Setting:	5.00 s
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the time on the Main PID controller process variable high level condition active to be generated the alarm message "A0762: High level for Main PID controller process variable". With P1030 in 2, will be generated a fault "F0763: High level for Main PID controller process variable" in the CFW701 frequency inverter after stopping the motor.

> ✓ **NOTE!**
> Value in 0.00 s disables the alarm detection.

19.8.1 Sleep Mode

This parameter group allows the user to configure the Sleep mode operation for Main PID controller.

Sleep Mode is a state of the controlled system where the control request is null or almost null, and may at this moment, stop the motor driven by CFW701 frequency inverter; that avoids the motor remain in operation at a low speed that contributes little or nothing in controlled system. However, the process variable (feedback) continues to be monitored so that when necessary (a level below a setpoint required), the controlled system can start the motor again (wake up mode).

> ✓ **NOTE!**
> The Sleep mode works only if Main PID controller is enabled and in Automatic mode.

P1036 – Main PID Controller Sleep Mode Speed

Adjustable Range:	0 to 18000		Factory Setting:	350
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the motor speed below which will be considered that the speed control is low, thus activating the Sleep mode.

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> **NOTE!**
> This parameter can be displayed in Hz or rpm as selection in the indirect engineering unit 4 parameters (P0516 and P0517):
> - Set P0516 in 13 (Hz) and P0517 in 1 (wxy.z) for displaying in Hz.
> - Set P0516 in 3 (rpm) and P0517 in 0 (wxyz) for displaying in rpm.

> **NOTE!**
> Value set to 0 disables the Sleep mode.

P1037 – Main PID Controller Sleep Mode Time

Adjustable Range:	0.00 to 650.00 s		Factory Setting:	5.00 s
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines a time with the motor speed in low conditions for the controlled system is in Sleep mode, will be generated the alarm message "A0764: Sleep Mode Active".

P1038 – Main PID Controller Wake up Percentage Deviation

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	5.0 %
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines a percentage difference (deviation) between the process variable (feedback) and the Main PID controller automatic setpoint required for the controlled system to operate again (wake up). When the difference between process variable and Main PID controller automatic setpoint is greater than this percentage programmed, the wake up condition will be activated.

> **NOTE!**
> Value in 0.0 % keeps the wake up active all the time, i.e., disables the Sleep mode detection.

P1039 – Main PID Controller Wake up Time

Adjustable Range:	0.00 to 650.00 s		Factory Setting:	10.00 s
Properties:				
Access Groups via HMI:	HVAC			

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Description:

This parameter defines a time with the wake up condition programmed activated for the CFW701 frequency inverter start the motor again.

See below the operation diagram of the motor driven by the CFW701 frequency inverter for the sleep and wake up operation.
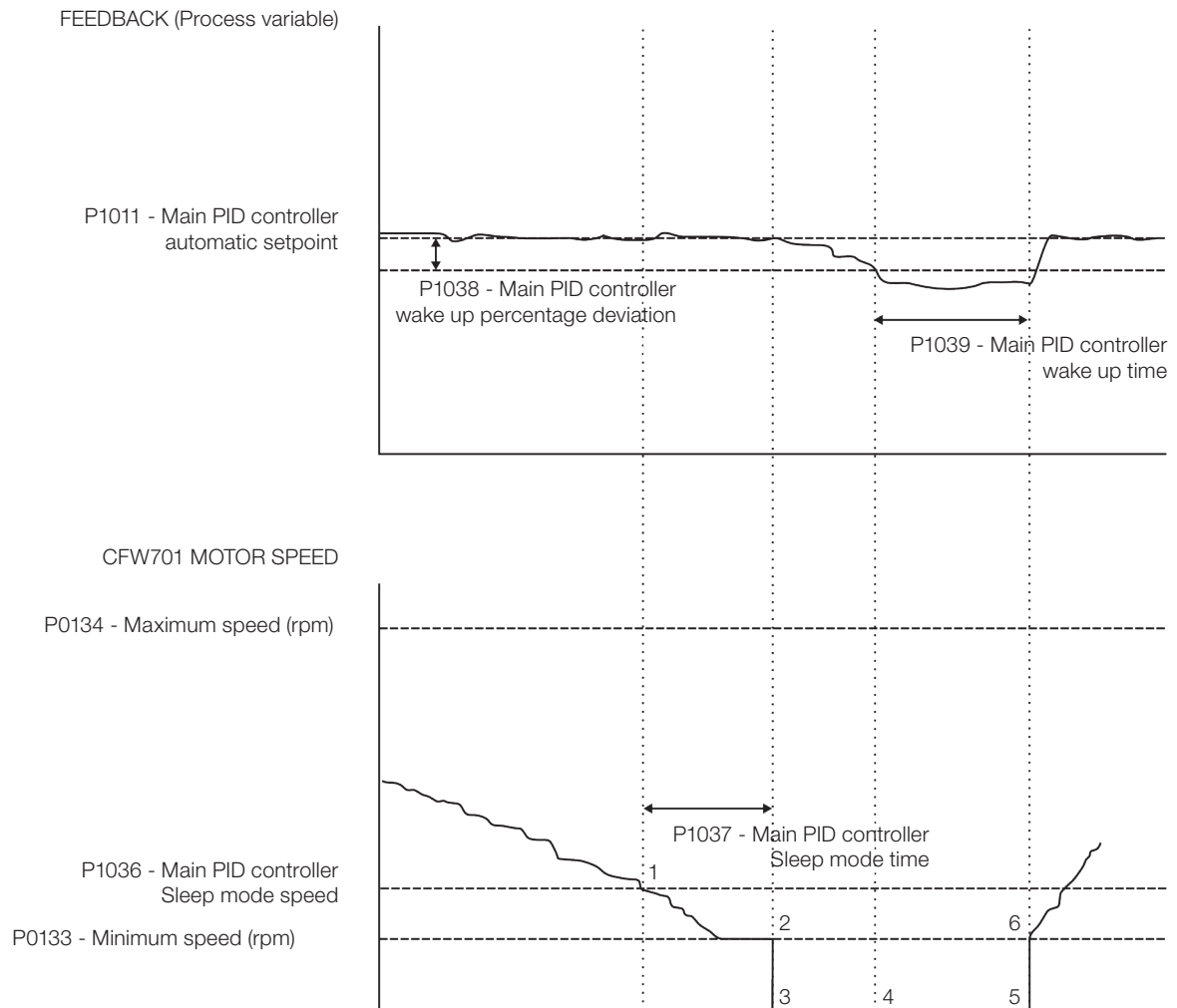

Figure 19.3: *Operation diagram of the sleep and wake up*

The analysis of the identified moments follows below:

1. The Main PID controller is controlling the motor speed and begins to reduce its. The motor speed is below the value to activate the Sleep mode (P1036) and the timing for the activation of the Sleep mode (P1037) begins.

2. The motor stays with the speed lower than the programmed (P1036) and the Sleep mode activation time (P1037) elapses. The Sleep mode is then activated.

3. The command for stopping the motor is issued. The controlled system remains enabled and keeps monitoring the process variable (feedback).

4. The difference between process variable (feedback) and automatic setpoint Main PID controller is greater than the value programmed for activating the wake up (P1038) and the timing for the activation of the wake up (P1039) begins.

5. The difference between process variable (feedback) and automatic setpoint Main PID controller remains higher than the programmed (P1038) and the wake up time (P1039) elapses. The wake up condition is then activated.

6. The command to run the motor is given, and the system controls the process variable again according to the control logic.

19.9 EXTERNAL PID CONTROLLER 1

This parameter group allows the user to configure the External PID controller 1 operation.

The External PID controller 1 allows controlling an external actuator to the CFW701 frequency inverter via analog output by comparing the process variable control (feedback) with the required setpoint.

The process variable control is that the External PID controller 1 takes as return (feedback) of its control action being compared with the setpoint required to generate the control error. The same is read via an analog input, so you will need to configure which of the analog inputs serve as feedback for the External PID controller 1.

Is adopted the "Academic" structure for the External PID controller 1, which obeys the following equation:

$$u(k) = i(k-1) + Kp \cdot [(1 + Ki \cdot Ts + (Kd/Ts)) \cdot e(k) - (Kd/Ts)) \cdot e(k-1)]$$

Where:
   $u(k)$ = external PID controller 1 output
   $i(k-1)$ = integral value in the previous status of the PID controller
   Kp = proportional gain
   Ki = integral gain
   Kd = derivative gain
   Ts = sampling time
   $e(k)$ = error in the actual instant (setpoint – process variable)
   $e(k-1)$ = error in the last instant

P1060 – External PID Controller 1 Automatic Setpoint

Adjustable Range:	-32768 to 32767	Factory Setting:	0
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the value of External PID controller 1 setpoint in engineering unit when it is in Automatic mode.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 2 parameters (P0512 and P0513).

P1061 – External PID Controller 1 Manual Setpoint

Adjustable Range:	0.0 to 100.0 %	Factory Setting:	0.0 %
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the value of External PID controller 1 setpoint when it is in Manual mode.

P1062 – External PID Controller 1 Process Variable

Adjustable Range:	-32768 to 32767		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ, HVAC			

Description:

This parameter indicates the actual value of External PID controller 1 process variable in engineering unit.

> **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 2 parameters (P0512 and P0513).

P1063 – External PID Controller 1 Output

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	
Properties:	cfg			
Access Groups via HMI:	READ, HVAC			

Description:

This parameter indicates the actual value of External PID controller 1 output.

P1064 – External PID Controller 1 Action Control

Adjustable Range:	0 = Disable PID 1 = Direct Mode 2 = Reverse Mode		Factory Setting:	0
Properties:	cfg			
Access Groups via HMI:	HVAC			

Description:

This parameter defines how the action control or regulation of External PID controller 1.

Table 19.11: Description of External PID controller 1 action control

P1064	Description
0	It defines the External PID controller 1 will be disabled to operation
1	It defines the External PID controller 1 action control or regulation will be enabled in direct mode
2	It defines the External PID controller 1 action control or regulation will be enabled in reverse mode

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✓ **NOTE!**

The External PID 1 action control should be selected to Direct Mode when to increase the value of the process variable is necessary increase the output of the External PID 1. E.g.: Valve positioned in entry of water from a reservoir. For the reservoir level (process variable) increases, it is necessary that the flow rate increases, which is achieved by opening the valve.

The External PID 1 action control should be selected to Reverse Mode when to increase the value of the process variable is necessary reduce the output of the External PID 1. E.g.: Valve positioned in water outlet of a reservoir. For the reservoir level (process variable) increases, it is necessary that the flow rate decreases, which is achieved by closing the valve.

P1065 – External PID Controller 1 Operation Mode

Adjustable Range:	0 = Always Automatic 1 = Always Manual 2 = Automatic or Manual selection via DIx and transition without bumpless 3 = Automatic or Manual selection via Network and transition without bumpless 4 = Automatic or Manual selection via DIx and transition with bumpless 5 = Automatic or Manual selection via Network and transition with bumpless	**Factory Setting:**	0
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines how the External PID controller 1 will work.

Table 19.12: Description of External PID controller 1 operation mode

P1065	Description
0	It defines the External PID controller 1 will be work always in Automatic mode
1	It defines the External PID controller 1 will be work always in Manual mode
2	It defines the digital input DIx programmed for Automatic/Manual will select the operation mode External PID controller 1 in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done without bumpless.
3	It defines the bit 14 of serial control word (P0682) will select the operation mode of External PID controller 1 in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done without bumpless.
4	It defines the digital input DIx programmed for Automatic/Manual will select the operation mode of External PID controller 1 in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done with bumpless.
5	It defines the bit 14 of serial control word (P0682) will select the operation mode of External PID controller 1 in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done with bumpless.

✓ **NOTE!**

Bumpless transfer is making the transition from Manual to Automatic mode or Automatic to Manual mode without causing variation in the output of the External PID controller 1.

When the transition occurs from Manual to Automatic mode, the output value in Manual mode is used to start the Integral portion of the External PID controller 1. This ensures that the output will start at this value.

When the transition occurs from Automatic to Manual mode, the output value in Automatic mode is used as the setpoint in Manual mode.

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P1066 – External PID Controller 1 Sampling Time

Adjustable Range:	0.10 to 60.00 s		Factory Setting:	0.10 s
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the sampling time of the External PID controller 1.

P1067 – External PID Controller 1 Proportional Gain

Adjustable Range:	0.000 to 32.767		Factory Setting:	1.000
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the proportional gain of External PID controller 1.

P1068 – External PID Controller 1 Integral Gain

Adjustable Range:	0.000 to 32.767		Factory Setting:	0.430
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the integral gain of External PID controller 1.

P1069 – External PID Controller 1 Derivative Gain

Adjustable Range:	0.000 to 32.767		Factory Setting:	0.000
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the derivative gain of External PID controller 1.

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P1070 – External PID Controller 1 Output Minimum Value

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	0.0 %
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the minimum output value of the External PID controller 1.

P1071 – External PID Controller 1 Output Maximum Value

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	100.0 %
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the maximum output value of the External PID controller 1.

P1073 – External PID Controller 1 Process Variable Minimum Level

Adjustable Range:	-32768 to 32767		Factory Setting:	0
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the minimum value of the analog input sensor of the External PID controller 1 process variable for conversion into engineering unit.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 2 parameters (P0512 and P0513).

P1074 – External PID Controller 1 Process Variable Maximum Level

Adjustable Range:	-32768 to 32767		Factory Setting:	1000
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the maximum value of the analog input sensor of the External PID controller 1 process variable for conversion into engineering unit.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 2 parameters (P0512 and P0513).

By means of the minimum and maximum levels of the process variable sensor and the value of analog input AIx, we obtain the equation of the curve to convert the process variable of the External PID controller 1:
$P1062 = [(P1074 - P1073) \times (AIx)] + P1073$

Where:

P1062 = process variable of the External PID controller 1.
P1073 = minimum level for the process variable of the External PID controller 1.
P1074 = maximum level for the process variable of the External PID controller 1.
AIx = value of the analog input AI1, AI2 or AI3.

P1075 – External PID Controller 1 Process Variable Alarms Configuration

Adjustable Range:	0 = Disable 1 = Enable and only alarm 2 = Enable and generate fault (stops the motor before)	**Factory Setting:**	0
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines how the External PID controller 1 process variable, alarms for low or high level will go act in the CFW701 frequency inverter.

Table 19.13: Description of the alarm configuration for the External 1 PID controller

P1075	Description
0	It defines the External PID controller 1 process variable, alarms for low or high level will be disabled
1	It defines the External PID controller 1 process variable, alarms for low or high level will be enabled and only will generate the respective alarm message (A0786 or A0788), leaving the External PID controller 1 active.
2	It defines the External PID controller 1 process variable, alarms for low or high level will be enabled and will generate the fault (F0787 or F0789) in the CFW701 frequency inverter after stopping the motor.

P1076 – External PID Controller 1 Process Variable Alarm Low Level Value

Adjustable Range:	-32768 to 32767	**Factory Setting:**	2
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the process variable value below which is considered low level for the sensor of analog input of the External PID controller 1 process variable in engineering unit.

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> **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 2 parameters (P0512 and P0513).

P1077 – External PID Controller 1 Process Variable Alarm Low Level Time

Adjustable Range:	0.00 to 650.00 s		Factory Setting:	5.00 s
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the time on the External PID controller 1 process variable low level condition active to be generated the alarm message "A0786: Low level for External PID controller 1 process variable". With P1075 in 2, will be generated a fault "F0787: Low level for External PID controller 1 process variable" in the CFW701 frequency inverter after stopping the motor.

> **NOTE!**
> Value in 0.00 s disables the alarm detection.

P1078 – External PID Controller 1 Process Variable Alarm High Level Value

Adjustable Range:	-32768 to 32767		Factory Setting:	900
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the process variable value above which is considered high level for the sensor of analog input of the External PID controller 1 process variable in engineering unit.

> **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 2 parameters (P0512 and P0513).

P1079 – External PID Controller 1 Process Variable Alarm High Level Time

Adjustable Range:	0.00 to 650.00 s		Factory Setting:	5.00 s
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the time on the External PID controller 1 process variable high level condition active to be generated the alarm message "A0788: High level for External PID controller 1 process variable". With P1075

in 2, will be generated a fault "F0789: High level for External PID controller 1 process variable" in the CFW701 frequency inverter after stopping the motor.

> **NOTE!**
> Value in 0.00 s disables the alarm detection.

19.10 EXTERNAL PID CONTROLLER 2

This parameter group allows the user to configure the External PID controller 2 operation.

The External PID controller 2 allows controlling an external actuator to the CFW701 frequency inverter via analog output by comparing the process variable control (feedback) with the required setpoint.

The process variable control is that the External PID controller 2 takes as return (feedback) of its control action being compared with the setpoint required to generate the control error. The same is read via an analog input, so you will need to configure which of the analog inputs serve as feedback for the External PID controller 2.

Is adopted the "Academic" structure for the External PID controller 2, which obeys the following equation:

$$u(k) = i(k-1) + Kp \cdot [(1 + Ki \cdot Ts + (Kd/Ts)) \cdot e(k) - (Kd/Ts) \cdot e(k-1)]$$

Where:

$u(k)$ = External PID controller 2 output
$i(k-1)$ = integral value in the previous status of the PID Controller
Kp = proportional gain
Ki = integral gain
Kd = derivative gain
Ts = sampling time
$e(k)$ = error in the actual instant (setpoint – process variable)
$e(k-1)$ = error in the last instant

P1080 – External PID Controller 2 Automatic Setpoint

Adjustable Range:	-32768 to 32767	Factory Setting:	0
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the value of External PID controller 2 setpoint in engineering unit when it is in Automatic mode.

> **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 3 parameters (P0514 and P0515).

P1081 – External PID Controller 2 Manual Setpoint

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	0.0 %
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the value of External PID controller 2 setpoint when it is in Manual mode.

P1082 – External PID Controller 2 Process Variable

Adjustable Range:	-32768 to 32767		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ, HVAC			

Description:

This parameter indicates the actual value of External PID controller 2 process variable in engineering unit.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 3 parameters (P0514 and P0515).

P1083 – External PID Controller 2 Output

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	
Properties:	ro			
Access Groups via HMI:	READ, HVAC			

Description:

This parameter indicates the actual value of External PID controller 2 output.

P1084 – External PID Controller 2 Action Control

Adjustable Range:	0 = Disable PID 1 = Direct Mode 2 = Reverse Mode		Factory Setting:	0
Properties:	cfg			
Access Groups via HMI:	HVAC			

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Description:

This parameter defines how the action control or regulation of External PID controller 2.

Table 19.14: Description of External PID controller 2 action control

P1084	Description
0	It defines the External PID controller 2 will be disabled to operation
1	It defines the External PID controller 2 action control or regulation will be enabled in direct mode
2	It defines the External PID controller 2 action control or regulation will be enabled in reverse mode

> **NOTE!**
> The External PID 2 action control should be selected to Direct Mode when to increase the value of the process variable is necessary increase the output of the External PID 2. E.g.: Valve positioned in entry of water from a reservoir. For the reservoir level (process variable) increases, it is necessary that the flow rate increases, which is achieved by opening the valve.
> The External PID 2 action control should be selected to Reverse Mode when to increase the value of the process variable is necessary reduce the output of the External PID 2. E.g.: Valve positioned in water outlet of a reservoir. For the reservoir level (process variable) increases, it is necessary that the flow rate decreases, which is achieved by closing the valve.

P1085 – External PID Controller 2 Operation Mode

Adjustable Range:	0 = Always Automatic 1 = Always Manual 2 = Automatic or Manual selection via DIx and transition without bumpless 3 = Automatic or Manual selection via Network and transition without bumpless 4 = Automatic or Manual selection via DIx and transition with bumpless 5 = Automatic or Manual selection via Network and transition with bumpless	Factory Setting:	0
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines how the External PID controller 2 will work.

Table 19.15: Description of External PID controller 2 operation mode

P1085	Description
0	It defines the External PID controller 2 will be work always in Automatic mode
1	It defines the External PID controller 2 will be work always in Manual mode
2	It defines the digital input DIx programmed for Automatic/Manual will select the operation mode External PID controller 2 in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done without bumpless.
3	It defines the bit 15 of serial control word (P0682) will select the operation mode of External PID controller 2 in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done without bumpless.
4	It defines the digital input DIx programmed for Automatic/Manual will select the operation mode of External PID controller 2 in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done with bumpless.
5	It defines the bit 15 of serial control word (P0682) will select the operation mode of External PID controller 2 in automatic (0) or manual (1). It also defines the transition from automatic to manual or manual to automatic will be done with bumpless.

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> **NOTE!**
> Bumpless transfer is making the transition from Manual to Automatic mode or Automatic to Manual mode without causing variation in the output of the External PID Controller 2.
> When the transition occurs from Manual to Automatic mode, the output value in Manual mode is used to start the Integral portion of the External PID Controller 2. This ensures that the output will start at this value.
> When the transition occurs from Automatic to Manual mode, the output value in Automatic mode is used as the setpoint in Manual mode.

P1086 – External PID Controller 2 Sampling Time

Adjustable Range:	0.10 to 60.00 s		Factory Setting:	0.10 s
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the sampling time of the External PID controller 2.

P1087 – External PID Controller 2 Proportional Gain

Adjustable Range:	0.000 to 32.767		Factory Setting:	1.000
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the proportional gain of External PID controller 2.

P1088 – External PID Controller 2 Integral Gain

Adjustable Range:	0.000 to 32.767		Factory Setting:	0.430
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the integral gain of External PID controller 2.

P1089 – External PID Controller 2 Derivative Gain

Adjustable Range:	0.000 to 32.767		Factory Setting:	0.000
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the derivative gain of External PID controller 2.

P1090 – External PID Controller 2 Output Minimum Value

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	0.0 %
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the minimum output value of the External PID controller 2.

P1091 – External PID Controller 2 Output Maximum Value

Adjustable Range:	0.0 to 100.0 %		Factory Setting:	100.0 %
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the maximum output value of the External PID controller 2.

P1093 – External PID Controller 2 Process Variable Minimum Level

Adjustable Range:	-32768 to 32767		Factory Setting:	0
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the minimum value of the analog input sensor of the External PID controller 2 process variable for conversion into engineering unit.

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> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 3 parameters (P0514 and P0515).

P1094 – External PID Controller 2 Process Variable Maximum Level

Adjustable Range:	-32768 to 32767		**Factory Setting:**	1000
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the maximum value of the analog input sensor of the External PID controller 2 process variable for conversion into engineering unit.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 3 parameters (P0514 and P0515).

By means of the minimum and maximum levels of the process variable sensor and the value of analog input AIx, we obtain the equation of the curve to convert the process variable of the External PID controller 1:
P1082 = [(P1094 - P1093) x (AIx)] + P1093

Where:

P1082 = process variable of the External PID controller 2.
P1093 = minimum level for the process variable of the External PID controller 2.
P1094 = maximum level for the process variable of the External PID controller 2.
AIx = value of the analog input AI1, AI2 or AI3.

P1095 – External PID Controller 2 Process Variable Alarms Configuration

Adjustable Range:	0 = Disable 1 = Enable and only alarm 2 = Enable and generate fault (stops the motor before)		**Factory Setting:**	0
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines how the External PID controller 2 process variable alarms for low or high level will go act in the CFW701 frequency inverter.

Table 19.16: Description of the alarm configuration for the External 2 PID controller

P1095	Description
0	It defines the External PID controller 2 process variable alarms for low or high level will be disabled
1	It defines the External PID controller 2 process variable alarms for low or high level will be enabled and only will generate the respective alarm message (A0796 or A0798), leaving the External PID controller 2 active and controlling the motor driven by CFW701.
2	It defines the External PID controller 2 process variable alarms for low or high level will be enabled and will generate the fault (F0797 or F0799) in the CFW701 frequency inverter after stopping the motor.

P1096 – External PID Controller 2 Process Variable Alarm Low Level Value

Adjustable Range:	-32768 to 32767	Factory Setting:	2
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the feedback value below which is considered low level for the sensor of analog input of the External PID controller 2 feedback in engineering unit.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 3 parameters (P0514 and P0515).

P1097 – External PID Controller 2 Process Variable Alarm Low Level Time

Adjustable Range:	0.00 to 650.00 s	Factory Setting:	5.00 s
Properties:			
Access Groups via HMI:	HVAC		

Description:

This parameter defines the time on the External PID controller 2 process variable low level condition active to be generated the alarm message "A0796: Low level for External PID controller 2 process variable". With P1095 in 2, will be generated a fault "F0797: Low level for External PID controller 2 process variable" in the CFW701 frequency inverter after stopping the motor.

> ✓ **NOTE!**
> Value in 0.00 s disables the alarm detection.

P1098 – External PID Controller 2 Process Variable Alarm High Level Value

Adjustable Range:	-32768 to 32767	Factory Setting:	900
Properties:			
Access Groups via HMI:	HVAC		

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Description:

This parameter defines the feedback value above which is considered high level for the sensor of analog input of the External PID controller 2 process variable in engineering unit.

> ✓ **NOTE!**
> This parameter is displayed as the selection in the indirect engineering unit 3 parameters (P0514 and P0515).

P1099 – External PID Controller 2 Process Variable Alarm High Level Time

Adjustable Range:	0.00 to 650.00 s		Factory Setting:	5.00 s
Properties:				
Access Groups via HMI:	HVAC			

Description:

This parameter defines the time on the External PID controller 2 process variable high level condition active to be generated the alarm message "A0798: High level for External PID controller 2 process variable". With P1095 in 2, will be generated a fault "F0799: High level for External PID controller 2 process variable" in the CFW701 frequency inverter after stopping the motor.

> ✓ **NOTE!**
> Value in 0.00 s disables the alarm detection.

19.11 HVAC FUNCTIONS LOGICAL STATUS

This parameter group allows the user to monitoring the status of HVAC functions.

P1040 – HVAC Functions Logical Status

Adjustable Range:	0000h to FFFFh	Factory Setting:
Properties:	ro	
Access Groups via HMI:	HVAC	

Description:

This parameter allows the user to monitoring the logical status of HVAC functions. Each bit represents a specific status.

Table 19.17: Description of HVAC function logical status

Bits	15 to 10	9	8	7	6	5	4	3	2	1	0
Function	Reserved	Automatic/Manual for External PID Controller 2	Automatic/Manual for External PID Controller 1	Sleep Mode	Automatic/Manual for Main PID Controller	Filter Maintenance	Broken Belt	Dry Pump	Short Cycle Protection	Bypass Mode	Fire Mode

Bits	Values
Bit 0 Fire Mode	**0**: The inverter is not in Fire Mode **1**: The inverter is operated in Fire Mode
Bit 1 Bypass Mode	**0**: The inverter is not in Bypass Mode **1**: The inverter is operated in Bypass Mode
Bit 2 Short Cycle Protection	**0**: Short cycle protection is not active **1**: Short cycle protection is active
Bit 3 Dry Pump	**0**: Dry pump condition was not detected **1**: Dry pump condition was detected
Bit 4 Broken Belt	**0**: Broken belt condition was not detected **1**: Broken belt condition was detected
Bit 5 Filter Maintenance	**0**: Filter maintenance alarm was not detected **1**: Filter maintenance alarm was detected
Bit 6 Automatic/Manual for Main PID Controller	**0**: Main PID controller in Automatic mode **1**: Main PID controller in Manual mode
Bit 7 Sleep Mode	**0**: The inverter is not in Sleep Mode **1**: The inverter is operated in Sleep Mode
Bit 8 Automatic/Manual for External PID Controller 1	**0**: External PID controller 1 in Automatic mode **1**: External PID controller 1 in Manual mode
Bit 9 Automatic/Manual for External PID Controller 2	**0**: External PID controller 2 in Automatic mode **1**: External PID controller 2 in Manual mode
Bits 10 to 15	Reserved

19.12 VERSION OF THE HVAC APPLICATION

P1010 – Version of the HVAC Application

Adjustable Range:	0.00 to 10.00	**Factory Setting:**	
Properties:	ro		
Access Groups via HMI:	HVAC		

Description:

Read only parameter that shows the software version of the HVAC application developed for the SoftPLC function of the CFW701 and encompasses the following functions:

- Dry pump.
- Broken belt.
- Filter maintenance alarm.
- Main PID controller for motor control.
- Sleep Mode for Main PID controller.
- External PID controller 1.
- External PID controller 2.

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