PUMP GENIUS
Simplex, Multipump and Multiplex
CFW500

Application Manual

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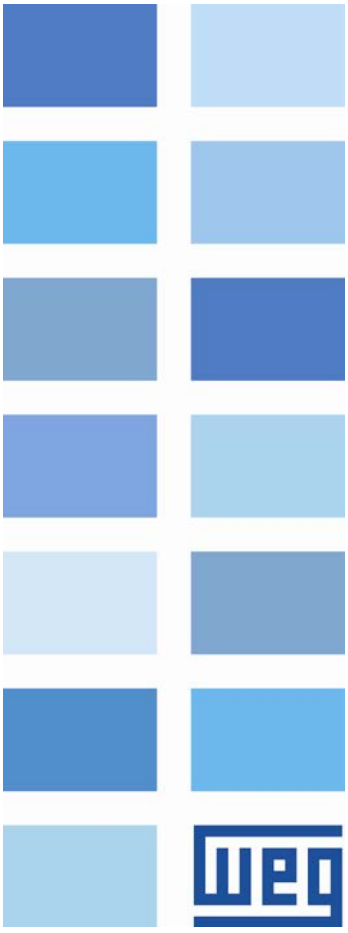

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ABOUT THE MANUAL

This manual provides the necessary information for the configuration of Pump Genius Simplex, Multipump and Multiplex application developed with the CFW500 inverter SoftPLC function. This application manual must be used together with the CFW500 user's manual, the SoftPLC function manual and the WLP software manual.

ABBREVIATIONS AND DEFINITIONS

PLC	Programmable Logic Controller
CRC	Cycling Redundancy Check
RAM	Random Access Memory
USB	Universal Serial Bus
WLP	Ladder Language Programming Software

NUMERICAL REPRESENTATION

Decimal numbers are represented by means of digits without suffix. Hexadecimal numbers are represented with the letter 'h' after the number.

QUICK PARAMETER REFERENCE

PUMP GENIUS SIMPLEX

Parameter	Description	Adjustable Range	Factory Setting	User Setting	Properties	Groups	Page
P1010	Pump Genius Simplex Application Version	0.00 to 10.00			ro	SPLC	153
P1011	Control Setpoint	-32768 to 32767 [Eng. Un. 1]	200		rw	SPLC	107
P1012	Control Setpoint 1	-32768 to 32767 [Eng. Un. 1]	200			SPLC	107
P1013	Control Setpoint 2	-32768 to 32767 [Eng. Un. 1]	230			SPLC	107
P1014	Control Setpoint 3	-32768 to 32767 [Eng. Un. 1]	180			SPLC	107
P1015	Control Setpoint 4	-32768 to 32767 [Eng. Un. 1]	160			SPLC	107
P1016	Control Process Variable	-32768 to 32767 [Eng. Un. 1]			ro	SPLC	153
P1017	Control Auxiliary Variable	0 to 32767 [Eng. Un. 2]			ro	SPLC	153
P1018	Setpoint of the PID Controller in Manual Mode	0.0 to 500.0 Hz	0.0 Hz			SPLC	112
P1019	Pump Genius Simplex Logical Status	Bit 0 = Sleep Mode Active (A750) Bit 1 = Pipe Charging (A752) Bit 2 = Sleep Boost Active (A756) Bit 3 = Low Level PV (A770) Bit 4 = Low Level PV (F771) Bit 5 = High Level PV (A772) Bit 6 = High Level PV (F773) Bit 7 = Low Level Auxiliary Variable (A774) Bit 8 = Dry Pump (A780) Bit 9 = Dry Pump (F781) Bit 10 = External Sensor Protection (A782) Bit 11 = External Sensor Protection (F783) Bit 12 = Reserved Bit 13 = Deragging in Execution (A794) Bit 14 = Pump Clogging detected (A790) Bit 15 = Excess of Clogging (F791)			ro	SPLC	157
P1020	Control Setpoint Selection Source	1 = Setpoint via Analog Input AI1 2 = Setpoint via Analog Input AI2 3 = Setpoint via Analog Input AI3 4 = Setpoint via HMI or Communication Networks (P1011) 5 = Two Setpoints via Digital Input DI4 (P1012 and P1013) 6 = Three Setpoints via Digital Inputs DI4 and DI5 (P1012, P1013 and P1014) 7 = Four Setpoints via Digital Inputs DI4 and DI5 (P1012, P1013, P1014 and P1015)	4			SPLC	108
P1021	Control Process Variable Selection Source	0 = Without Control Process Variable (Disable the PID Controller) 1 = Control Process Variable via Analog Input AI1 2 = Control Process Variable via Analog Input AI2 3= Control Process Variable via difference between Analog Input AI1 and AI2 (AI1 – AI2) 4 = Control Process Variable via Analog Input AI3	1			SPLC	100

Parameter	Description	Adjustable Range	Factory Setting	User Setting	Properties	Groups	Page
P1022	Control Process Variable Sensor Minimum Level	-32768 to 32767 [Eng. Un. 1]	0			SPLC	101
P1023	Control Process Variable Sensor Maximum Level	-32768 to 32767 [Eng. Un. 1]	400			SPLC	101
P1024	Value for Low Level Alarm for the Control Process Variable	-32768 to 32767 [Eng. Un. 1]	100			SPLC	134
P1025	Time Delay for Low Level Fault for the Control Process Variable (F771)	0 to 32767 s	0 s			SPLC	135
P1026	Value for High Level Alarm for the Control Process Variable	-32768 to 32767 [Eng. Un. 1]	350			SPLC	136
P1027	Time Delay for High Level Fault for the Control Process Variable (F773)	0 to 32767 s	0 s			SPLC	136
P1028	Selection of Control Action of the PID Controller	0 = Disable the PID Controller 1 = Direct Mode 2 = Reverse Mode	1			SPLC	112
P1029	Operation Mode of the PID Controller	0 = Manual 1 = Automatic 2 = Manual or Automatic Selection via DI3	1			SPLC	113
P1030	Automatic Adjustment of the PID Controller Setpoint	0 = P1011 Off and P1018 Off 1 = P1011 On and P1018 Off 2 = P1011 Off and P1018 On 3 = P1011 On and P1018 On	0			SPLC	113
P1031	PID Proportional Gain	0. 00 to 320. 00	1.00			SPLC	111
P1032	PID Integral Gain	0. 00 to 320. 00	25.00			SPLC	111
P1033	PID Derivative Gain	0. 00 to 320. 00	0.00			SPLC	111
P1034	Control Process Variable Deviation to Wake up the Pump Genius	-32768 to 32767 [Eng. Un. 1]	30			SPLC	116
P1035	Control Process Variable Level for Starting the Pump Genius	-32768 to 32767 [Eng. Un. 1]	180			SPLC	116
P1036	Time Delay to Wake up or Starting by Level the Pump Genius	0 to 32767 s	5 s			SPLC	116
P1037	Pump Motor Speed below which Pump Genius goes to Sleep Mode	0.0 to 500.0 Hz	42.0 Hz			SPLC	117
P1038	Time Delay for Pump Genius goes to Sleep Mode	0 to 32767 s	10 s			SPLC	117
P1039	Sleep Boost Offset	-32768 to 32767 [Eng. Un. 1]	0			SPLC	120
P1040	Sleep Boost Maximum Time	0 to 32767 s	15 s			SPLC	120
P1041	Pipe Charging Time	0 to 65535 s	30 s			SPLC	122
P1042	Maximum Output Current during the Pipe Charging	0.0 to 3200.0 A	0.0 A			SPLC	124
P1043	Motor Speed for Dry Pump	0.0 to 50.00 Hz	54.0 Hz			SPLC	137
P1044	Motor Torque for Dry Pump	0.0 to 100.0 %	20.0 %			SPLC	137
P1045	Time Delay for Dry Pump Fault (F781)	0 to 32767 s	0 s			SPLC	137
P1046	Time Delay for Pump Protection via External Sensor Fault (F783)	0 to 32767 s	2 s			SPLC	139
P1047	Control Auxiliary Variable Selection Source for Pump Protection	0 = Without Protection via Control Auxiliary Variable 1 = Control Auxiliary Variable via Analog Input AI1 2 = Control Auxiliary Variable via Analog Input AI2 3 = Control Auxiliary Variable via Analog Input AI3	0			50	141
P1048	Control Auxiliary Variable Sensor Maximum Level (Range)	0 to 32767 [Eng. Un. 2]	1000			50	142
P1049	Value to detect Low Level of Control Auxiliary Variable	0 to 32767 [Eng. Un. 2]	250			50	143
P1050	Control Setpoint in Low Level	-32768 to 32767 [Eng. Un. 1]	160			50	143
P1051	Hysteresis to reactivate the Control Setpoint	0 to 32767 [Eng. Un. 2]	100			50	143

Parameter	Description	Adjustable Range	Factory Setting	User Setting	Properties	Groups	Page
P1052	Execution Mode of the Deragging Function	0 = Not Execute Deragging Function 1 = Executes with Command to Run the Pump 2 = Executes with Command via Digital Input DI2 3 = Executes when the Clogging of Pump is Detected	0			50	145
P1053	Number of Cycles for Deragging	0 to 100	5			50	145
P1054	Speed Reference for Deragging	0.0 to 500.0 Hz	20.0 Hz			50	146
P1055	Deragging Run Time	0 to 32767 s	10 s			50	146
P1056	Deragging Stop Time	0 to 32767 s	3 s			50	146
P1057	Motor Current to detect Clogging of Pump	0.0 to 3200.0 A	20.0 A			50	146
P1058	Time Delay to detect Clogging of Pump	0 to 32767 s	60 s			50	146
P1059	Number of consecutives Clogging to generate the Fault (F791)	0 to 100	5			50	147

PUMP GENIUS MULTIPUMP

Parameter	Description	Adjustable Range	Factory Setting	User Setting	Properties	Groups	Page
P1010	Pump Genius Multipump Application Version	0.00 to 10.00			ro	SPLC	155
P1011	Control Setpoint	-32768 to 32767 [Eng. Un.1]	200		rw	SPLC	108
P1012	Control Setpoint 1	-32768 to 32767 [Eng. Un.1]	200			SPLC	109
P1013	Control Setpoint 2	-32768 to 32767 [Eng. Un.1]	230			SPLC	109
P1014	Control Setpoint 3	-32768 to 32767 [Eng. Un.1]	180			SPLC	109
P1015	Control Setpoint 4	-32768 to 32767 [Eng. Un.1]	160			SPLC	109
P1016	Control Process Variable	-32768 to 32767 [Eng. Un.1]			ro	SPLC	153
P1017	Operation Time for Forcing Rotation of Pumps	0 to 32767 h			rw	SPLC	155
P1018	Time Interval for Forcing Rotation of Pumps	0 to 32767 h	72 h			SPLC	133
P1019	Pump Motor Speed for Forcing Rotation of Pumps	0.0 to 500.0 Hz	0.0 Hz			SPLC	133
P1020	Control Setpoint Source Selection	4 = Control Setpoint via HMI or Communication Networks (P1011) 5 = Two Setpoints via 1st Digital Input (P1011 and P1012) 6 = Three Setpoints via 1st and 2nd Digital Inputs (P1011, P1012 and P1013) 7 = Four Setpoints via 1st and 2nd Digital Inputs (P1011, P1012, P1013 and P1014)	4			SPLC	108
P1021	Control Setpoint Source Selection	0 = Control Setpoint via Analog Input AI1	0			SPLC	102
P1023	Control Process Variable Sensor Maximum Level	-32768 to 32767 [Eng. Un.1]	400			SPLC	103
P1024	Value for Low Level Alarm for the Control Process Variable	-32768 to 32767 [Eng. Un.1]	400			SPLC	134
P1025	Time Delay for Low Level Fault for the Control Process Variable (F771)	0 to 32767 s	100			SPLC	135
P1026	Value for High Level Alarm for the Control Process Variable	Value for High Level Alarm for the Control Process Variable	0 s			SPLC	136
P1027	Time Delay for High Level Fault for the Control Process Variable (F773)	Time Delay for High Level Fault for the Control Process Variable (F773)	350			SPLC	136
P1028	Pump Control and Activation Mode Configuration	0 = Fixed Control with Pumps activated in a Sequence 1 = Fixed Control with Pumps Rotation 2 = Floating Control with Pumps activated in a Sequence 3 = Floating Control with Pumps Rotation	0			SPLC	77
P1030	Selection of Control Action of the PID Controller	1 = Direct Mode 2 = Reverse Mode	1			SPLC	114
P1031	PID Proportional Gain	0.00 to 320.00	1.00			SPLC	111
P1032	PID Integral Gain	0.00 to 320.00	25.00			SPLC	111
P1033	PID Derivative Gain	0.00 to 320.00	0.00			SPLC	111
P1034	Control Process Variable Deviation for Pump Genius to Wake Up	-32768 to 32767 [Eng. Un.1]	30			SPLC	116
P1035	Control Process Variable Level to Starting the Pump Genius	-32768 to 32767 [Eng. Un.1]	180			SPLC	116
P1036	Time Delay for Pump Genius to Wake up or Starting by Level	0 to 32767 s	5 s			SPLC	116
P1037	Pump Motor Speed below which Pump Genius goes to Sleep Mode	0.0 to 500.0 Hz	42.0 Hz			SPLC	117
P1038	Time Delay for Pump Genius goes to Sleep Mode	0 to 32767 s	10 s			SPLC	117
P1041	Pipe Charging Time	0 to 65000 s	30 s			SPLC	122
P1043	Motor Speed for Dry Pump	0.0 to 500.0 Hz	54.0 Hz			SPLC	137

Parameter	Description	Adjustable Range	Factory Setting	User Setting	Properties	Groups	Page
P1044	Motor Torque for Dry Pump	0.0 to 100.0 %	20.0 %			SPLC	137
P1045	Time Delay for Dry Pump Fault (F781)	0 to 32767 s	0			SPLC	137
P1047	Operation Time of the Pump Driven by the CFW500	0 to 32767 h			rw	SPLC	155
P1048	Operation Time of Pump 1	0 to 32767 h			rw	SPLC	156
P1049	Operation Time of Pump 2	0 to 32767 h			rw	SPLC	156
P1050	Operation Time of Pump 3	0 to 32767 h			rw	SPLC	156
P1052	Pump Motor Speed for Starting an additional Pump in Parallel	0.0 to 500.0 Hz	57.0 Hz			SPLC	125
P1053	Control Process Variable Deviation for Starting an additional Pump in Parallel	-32768 to 32767 [Eng. Un.1]	10			SPLC	125
P1054	Time Delay for Starting an additional Pump in Parallel	0 to 32767 s	2 s			SPLC	125
P1055	Delay in the Deceleration of the CFW500 Pump when Starting a Pump in Parallel	0.01 to 100.00 s	0.01 s			SPLC	125
P1056	Pump Motor Speed for Stopping one Pump in Parallel	0.0 to 500.0 Hz	43.0 Hz			SPLC	129
P1057	Control Process Variable Deviation for Stopping one Pump in Parallel	-32768 to 32767 [Eng. Un.1]	0			SPLC	129
P1058	Time Delay for Stopping one Pump in Parallel	0 to 32767 s	2 s			SPLC	129
P1059	Delay in the Acceleration of the CFW500 Pump when Stopping a Pump in Parallel	0.01 to 100.00 s	0.01 s			SPLC	129

PUMP GENIUS MULTIPLEX

Parameter	Description	Adjustable Range	Factory Setting	User Setting	Properties	Groups	Page
P1010	Pump Genius Multiplex Application Version	0.00 to 10.00			ro	SPLC	155
P1011	Control Setpoint	-32768 to 32767 [Eng. Un.1]	200		rw	SPLC	110
P1016	Control Process Variable	-32768 to 32767 [Eng. Un.1]			ro	SPLC	153
P1017	Operation Time for Forcing Rotation of Pumps	0 to 32767 h			rw	SPLC	156
P1018	Pump Operation Time	0 to 32767 h			rw	SPLC	157
P1019	Status of Pump Operation Mode	0 = Master Pump 1 = Slave Pump			ro	SPLC	157
P1020	Configuration of Pump Operation Mode	0 = Master/Slave Pump 1 = Slave Pump	0			SPLC	78
P1021	Automatic Master Pump Change Over Time in the event of Master Fails	0 to 32767 s	2 s			SPLC	82
P1022	Control Setpoint Source Selection	0 = Without Source for Control Setpoint (Slave Pump) 4 = Control Setpoint via HMI or Communication Networks (P1011)	4			SPLC	110
P1023	Control Process Variable Selection Source	0 = Without Source for Process Variable (Slave Pump) 1 = Control Process Variable via Analog Input AI1	1			SPLC	104
P1024	Control Process Variable Sensor Minimum Level	-32768 to 32767 [Eng. Un.1]	0			SPLC	105
P1025	Control Process Variable Sensor Maximum Level	-32768 to 32767 [Eng. Un.1]	400			SPLC	105
P1026	Value for Low Level Alarm for the Control Process Variable	-32768 to 32767 [Eng. Un.1]	400			SPLC	135
P1027	Time Delay for Low Level Fault for the Control Process Variable (F771)	0 to 32767 s	100			SPLC	135
P1028	Value for High Level Alarm for the Control Process Variable	Value for High Level Alarm for the Control Process Variable	0 s			SPLC	136
P1029	Time Delay for High Level Fault for the Control Process Variable (F773)	Time Delay for High Level Fault for the Control Process Variable (F773)	350			SPLC	137
P1030	Selection of Control Action of the PID Controller	1 = Direct Mode 2 = Reverse Mode	1			SPLC	137
P1031	PID Proportional Gain	0.00 to 320.00	1.00			SPLC	111
P1032	PID Integral Gain	0.00 to 320.00	25.00			SPLC	111
P1033	PID Derivative Gain	0.00 to 320.00	0.00			SPLC	111
P1034	Control Process Variable Deviation for Pump Genius to Wake Up	-32768 to 32767 [Eng. Un.1]	30			SPLC	116
P1036	Time Delay for Pump Genius to Wake up	0 to 32767 s	5 s			SPLC	116
P1037	Pump Motor Speed below which Pump Genius goes to Sleep Mode	0.0 to 500.0 Hz	42.0 Hz			SPLC	117
P1038	Time Delay for Pump Genius goes to Sleep Mode	0 to 32767 s	10 s			SPLC	117
P1039	Sleep Boost Offset	-32768 to 32767 [Eng. Un.1]	0			SPLC	120
P1040	Sleep Boost Maximum Time	0 to 32767 s	15 s			SPLC	120
P1041	Pipe Charging Time	0 to 65000 s	30 s			SPLC	122
P1043	Motor Speed for Dry Pump	0.0 to 500.0 Hz	54.0 Hz			SPLC	137
P1044	Motor Torque for Dry Pump	0.0 to 100.0 %	20.0 %			SPLC	137
P1045	Time Delay for Dry Pump Fault (F781)	0 to 32767 s	0 s			SPLC	137
P1046	Time Delay for Pump Protection via External Sensor (A784)	0 to 32767 s	2 s			SPLC	140
P1052	Pump Motor Speed for Starting an additional Pump in Parallel	0.0 to 500.0 Hz	57.0 Hz			SPLC	127
P1053	Control Process Variable Deviation for Starting an additional Pump in Parallel	-32768 to 32767 [Eng. Un.1]	10			SPLC	127
P1054	Time Delay for Starting an additional Pump in Parallel	0 to 32767 s	2 s			SPLC	127

Parameter	Description	Adjustable Range	Factory Setting	User Setting	Properties	Groups	Page
P1055	Pump Motor Speed for Stopping one Pump in Parallel	0.0 to 500.0 Hz	43.0 Hz			SPLC	131
P1056	Control Process Variable Deviation for Stopping one Pump in Parallel	-32768 to 32767 [Eng. Un.1]	0			SPLC	131
P1057	Time Delay for Stopping one Pump in Parallel	0 to 32767 s	2 s			SPLC	131
P1058	Time Interval for Forcing Rotation of Pumps	0 to 32767 h	72 h			SPLC	134
P1059	Pump Motor Speed Forcing Rotation of Pumps	0.0 to 500.0 Hz	0.0 Hz			SPLC	134

FAULTS AND ALARMS

Fault / Alarm	Description	Possible Causes
A750: Sleep Mode Active	It indicates that the Pump Genius is in the sleep mode	Value of the pump motor speed is below the threshold programmed in P1037 during the time programmed in P1038
A752: Pipe Charging	It indicates that the process of pipe charging is being executed	The Run/Stop command was is executed in the CFW500 inverter (Simplex) or command for enable Pump Genius via digital input DI1 (Multipump and Multiplex) with the pipe charging enabled
A754: Forcing Rotation of Pumps (PG Multipump and Multiplex)	I It indicates to the user that the Pump Genius is forcing the rotation of pumps	The Pump Genius is operating with only one pump running for a longer time than the value set in P1018 and the speed value of this pump is lower than the value set in P1019
A755: Pump Disabled via DI2	It indicates that the pump was disabled from operation in the Pump Genius	Digital input DI2 was set to logic level “0”, issuing the command to disable the pump
A756: Sleep Boost Active (PG Simplex and Multiplex)	It indicates that the sleep boost is in execution	Motor speed was below the value set in P1037 during the time set in P1038, but before going into sleep mode applies a boost in the control setpoint to increase the process variable
A758: DI3 not programmed for PID in Manual / Automatic (PG Simplex)	It indicates that the parameter of digital input DI3 (P0265) was not programmed to select the PID controller in Manual (0) / Automatic (1)	PID Controller was enabled to have selection Manual / Automatic (P1029 =2) and the digital input DI3 wasn’t programmed correctly (P0265≠40)
A758: Change Master Pump? I (yes) O (no) (PG Multiplex)	It indicates the loss of communication with the pump that was master of the Pump Genius. Waiting for user command to execute (I=yes) or not execute (O=no) the manual change-over of the master pump of the Pump Genius	Loss of communication with the pump that had assumed the master function of the Pump Genius
F759: Two or more Master Active (PG Multiplex)	It indicates that the two or more master/slave pumps assumed the master function of the Pump Genius. Setting of P1021=0 enables the fault	The user programmed two or more pumps for master/slave (P1020 = 0) and after a fault or rebooting of CFW-11 inverter, two or more CFW500 inverters assumed the master function of the Pump Genius at the same time
A760: Pump 1 Disabled (PG Multipump)	It indicates that pump 1 was disabled while it was on	Digital input DI2 went to logic level “0” while pump 1 was on
A760: Master Pump Configuration Error (PG Multiplex)	It indicates that the master/slave pump was not properly configured, i.e., is unable to control the pumping with the PID controller	The source of control setpoint was not defined (P1022 = 0) or the source of control process variable was not defined (P1023 = 0)
F761: Master Pump Configuration Error (PG Multiplex)	It indicates that the master/slave pump was not properly configured, i.e., is unable to control the pumping with the PID controller	The command for enable the Pump Genius via DI1, or to enable use of the pump via DI2 was executed with the alarm A760 active
A762: Pump 2 Disabled (Only Multipump)	It indicates that pump 2 was disabled while it was on	Digital Input programmed to Enable Pump 2 went to logic level “0” while pump 2 was on
A764: Pump 3 Disabled (PG Multipump)	It indicates that pump 3 was disabled while it was on	Digital Input programmed to Enable Pump 3 went to logic level “0” while pump 3 was on
A764: Acknowledging SymbiNet Network (PG Multiplex)	It indicates that the CFW500 inverter is in the process of acknowledging the SymbiNet network	CFW500 inverter was energized and waiting its turn for up to 3 seconds to acknowledge the SymbiNet network
A766: SymbiNet is not Active (PG Multiplex)	It indicates that the SymbiNet protocol is not configured or there is an error in RS485 interface	The user not programmed P0312 = 1, 14 or 15 (SymbiNet). If the user has programmed correctly the interface, it may be in error as the diagnostic showed by P0316.

A770: Low Level of the Control Process Variable	It indicates that the control process variable (P1016) is in low level	The control process variable (P1016) is lower than the value programmed in P1024
F771: Low Level of the Control Process Variable	It indicates that the Pump Genius was stopped due to low level of the control process variable	The control process variable (P1016) remained for a time (P1025) at a value lower than the threshold programmed in P1024
A772: High Level of the Control Process Variable	It indicates that the control process variable (P1016) is in high level	The control process variable (P1016) is higher than the value programmed in P1026
F773: High Level of the Control Process Variable	It indicates that the Pump Genius was stopped due to high level of the control process variable	The control process variable (P1016) remained for a time (P1027) at a value higher than the threshold programmed in P1026
A774: Low Level of Control Auxiliary Variable (PG Simplex)	It indicates that the control auxiliary variable (P1017) is in low level and the control setpoint was changed to the value of P1050	The control auxiliary variable (P1017) is lower than the value programmed in P1050
A780: Dry Pump	It indicates that the dry pump condition was detected	Value of the pump motor speed is above of the threshold programmed in P1043 and motor torque is below the threshold programmed in P1044
F781: Dry Pump	It indicates that the pump was stopped due to dry pump protection	During a time (P1045) the value of the pump motor speed remains above of the threshold programmed in P1043 and motor torque remains below the threshold programmed in P1044
A782: External Sensor Protection (PG Simplex and Multiplex)	It indicates that protection via external sensor (DI1) is actuated	Pump in operation and digital input DI1 is at logic level “0”
F783: External Sensor Protection (PG Simplex)	It indicates that the pump was stopped due to protection via external sensor (DI6)	Pump in operation and digital input DI6 remained at logic level “0” for a time (P1046)
A784: External Sensor Protection (PG Multiplex)	It indicates that the pump was stopped due to protection via external sensor (DI4)	Pump in operation and digital input DI4 remained at logic level “0” for a time (P1046)
A790: Clogging Detected (PG Simplex)	It indicates that the clogging of pump was detected due the high current in the pump motor	Deragging was configured to execute when clogging is detected (P1052=3) and the motor current was greater than the motor current to detect the pump clogging (P1057) during a time to detect the pump clogging (P1058).
F791: Excess of Clogging (PG Simplex)	It indicates that the pump was stopped due a excess number of clogging detected	Deragging was configured to execute when clogging is detected (P1052=3) and the number of clogging detected was equal to the value defined as limit to generate a fault by consecutives clogging (P1059)
A792: Deragging Configuration Error (PG Simplex)	Indica que o desentupimento da bomba não pode ser executado devido ao sentido de giro do motor em modo REMOTO (P0226) não estar configurado para ser via SoftPLC	Referência de velocidade em modo REMOTO foi programada para SoftPLC (P0222=12), o inversor de frequência CFW500 está em modo REMOTO, mas o sentido de giro do motor em modo REMOTO não foi programado para SoftPLC (P0226 = 12)
A794: Deragging is in Execution (PG Simplex)	It indicates that the deragging function is in execution	The deragging function is enabled (P1052≠0) and in execution
A796: Deragging not Executed (PG Simplex)	It indicates that the deragging couldn’t be executed due to the CFW500 inverter be in LOCAL mode	The deragging function is enabled (P1052≠0), but couldn’t be executed due to the CFW500 inverter be operating in LOCAL mode
F799: Incompatible Software Version	It Indicates that the software version of the CFW500 inverter is not compatible with the software version required to use the Pump Genius application	The value of the P0023 parameter that indicates the software version of the CFW500 inverter is less than 1.50 to PG Simplex and Multipump or less than 3.50 to PG Multiplex

1 INTRODUCTION TO THE PUMP GENIUS APPLICATION

The Pump Genius Simplex, Multipump and Multiplex application developed for the CFW500 inverter SoftPLC function provides the user with flexibility in the operation and configuration. Tools, already developed for the WLP programming software, are being used together with configuration wizards and monitoring dialogs boxes.

1.1 PUMPS

Pumps are hydraulic operating machines that transfer energy to the fluid for the purpose of transporting it from one point to another. They receive energy from a motor source and transfer part of it to the fluid in the form of pressure energy, kinetic energy, or both, i.e., increase the fluid's pressure or speed, or both quantities.

Commonly used ways to drive pumps are:

- Electric motors;
- Internal combustion motors;
- Turbines.

Pumps can be classified into two wide categories:

- Centrifugal pumps or turbo pumps;
- Volumetric pumps or positive displacement pumps.

1.1.1 Centrifugal Pumps

The operating based on the principle of transferring kinetic energy to the fluid to be pumped; this kinetic energy is transformed into potential energy (pressure). The rotational movement of a rotor inserted into a casing is the functional part responsible for this transformation.

Depending on the types and shapes of rotors, centrifugal pumps can be classified as follows:

- Radial or pure, when the direction of the pumped fluid is perpendicular to the rotating axle;
- Mixed flow or semi-axial, when the direction of the pumped fluid is inclined in relation to the rotating axle;
- Axial flow, when the direction of the pumped fluid is parallel in relation to the rotating axle.

1.1.2 Positive Displacement Pumps

The operating principle of this type of pump is based on the direct transfer of mechanical work (of a motor shaft rotation against a load torque) into potential energy (pressure energy). This transfer is obtained by the movement of a mechanical apparatus of the pump (piston, diaphragm, gears, screws, etc.), which forces the fluid to execute the same movement.

The liquid cyclical fills and then is ejected from a given volume of space inside the pump, a process which is responsible for the name "Volumetric Pump".

Variations of these mechanical apparatuses permit the classification of volumetric or positive displacement pumps:

- Piston or alternative pumps, when the apparatus which produces the movement of the fluid is a piston which moves in alternating directions and expels the pumped fluid;
- Rotary pumps, when the apparatus which produces the movement of the fluid is driven by rotational movement, like a screw, gear, flakes, lobes, etc.

1.2 CRITERIA FOR ASSOCIATION OF PUMPS IN PARALLEL

It is useful to analyze some data in order to designing a pumping system to determine whether it shall be composed of a single pump or through association of pumps in parallel:

■ Determine whether a single pump can alone meet the flow required by the pumping system;
■ Determine if over the long term there is potential for a change in the needed flow rate, for example, due to a population increase;
■ Note the range of consumption which needs to be supported by the pumping system during the day.

1.2.1 Advantages in the Association of Pumps in Parallel

A pumping system with association of pumps in parallel has the following advantages compared to a single pump system:

■ Greater flexibility of the pumping system, both in operation and in implementation;
■ Energy saving;
■ Increased life span of the pumping system;
■ It facilitates uninterrupted operation;
■ It provides the necessary flow according to the pumping system demand;
■ It simplifies a pumping system fault diagnosis;
■ Pump operation time equalization, thus assuring uniform wear.

1.2.2 Disadvantages in the Association of Pumps in Parallel

A pumping system with association of pumps in parallel has the following disadvantages compared to a single pump system:

■ More units (pumps, sensors, piping, etc.) to be maintained;
■ Larger space of plant, increasing construction costs;
■ The greater the number of pumps associated in parallel, the lower the flow of each individual pump. For example, if we have only one pump at maximum flow rate of 150 l/s, by associate a second pump in parallel, we will have a maximum flow of 260 l/s, i.e., each pump will have maximum flow of 130l/s.

1.3 GENERAL CHARACTERISTICS OF THE PUMP GENIUS

1.3.1 PG Simplex

The main characteristic of the Pump Genius Simplex application developed for the CFW500 inverter SoftPLC function is the control of one pump using for this a frequency inverter that will control your speed as required by the user demand.

Each is notable for the following characteristics:

- Control of only one pump driven by CFW500 inverter;
- Acceleration and deceleration ramps for the pump driven by inverter;
- Maximum and minimum speed limits for the pump driven by inverter;
- Selection of the control setpoint via analog input, CFW500 HMI, logical combination of the two digital inputs DI4 and DI5 (maximum of 4 setpoints);
- Selection of the control process variable via analog input or the difference between analog input AI1 and AI2 (AI1 – AI2); allows also not have the control process variable so disabling the PID controller;
- Selection of the engineering unit and range of the control process variable sensor via CFW500 parameters;
- Gain, offset and filter adjustments for the control signals via analog inputs;
- PID controller gains setting of the pumping control via HMI parameters;
- Control action of the PID controller configured for direct mode or reverse mode, or can be disabled;
- Selection of operation mode of the PID controller in Manual or Automatic, and may be selecting via digital input DI3 or via parameter;
- Enable or not of the sleep mode with the PID controller enabled;
- Enable or not of the sleep boost before to going into sleep mode;
- Wake up mode or start level mode for starting the pump with the PID controller enabled;
- Initiate the pumping with pipe charging through the pump driven by inverter;
- Adjustment of the motor current limitation during the pipe charging process;
- Low level protection for the control process variable (pipe breaking);
- High level protection for the control process variable (pipe obstruction);
- Indication of the low or high level alarm protection for the control process variable via digital outputs DO1, DO2, DO3, DO4 or DO5;
- Dry pump protection through evaluation of motor torque and pump speed;
- Pump protection via external sensor in the digital input DI1;
- Selection of an analog input as a control auxiliary variable for pump protection;
- Pump cavitation protection via low level limitation for the control auxiliary variable;
- Detection clogging of a pump driven by the inverter via high current in the motor;
- Execution of the deragging of the pump via a command in the digital input DI2, or a command to start the pump or when the clogging of pump is detected;
- Possibility to enable the pump driven by the frequency inverter via HMI (local mode)
- Possibility of implementation or modification of the application by the user through the WLP software.

1.3.2 PG Multipump

The main characteristic of the Pump Genius Multipump application developed for the CFW500 inverter SoftPLC function is the control of two or more pumps in parallel using only one frequency inverter; and it will control the speed of only one pump.

Each is notable for the following characteristics:

■ Fixed Control: control of up to 4 (four) pumps associated in parallel;
■ Floating Control: control of up to 3 (three) pumps associated in parallel;
■ Fixed and Floating Control: control of the activation mode of the pumps (sequence or rotation);
■ Fixed and Floating Control: logic for rotation of the pumps according to the operation time;
■ Floating Control: rotate (change) of the pump driven by the frequency inverter;
■ Floating Control: possibility of forcing the rotation pumps, i.e. if the Pump Genius operate for a long time with only one pump (Pump Genius does not enter in sleep mode), the Pump Genius is disabled, then another pump is turned on (as operating time) for controlling the pumping;
■ Acceleration and deceleration ramps for the pump driven by inverter;
■ Maximum and minimum speed limits for the pump driven by inverter;
■ Selection of the pumping control setpoint via CFW500 HMI or logical combination of two digital inputs (maximum of 4 setpoints)
■ Selection of the pumping control process variable via analog input AI1
■ Selection of the engineering unit and range of the control process variable sensor via CFW500 parameters;
■ Gain, offset and filter adjustments for the control signals via analog inputs;
■ PID controller gain setting of the pumping control via HMI parameters;
■ Control action of the PID controller configured for direct or reverse mode;
■ Enabling of the Pump Genius through digital input DI1;
■ Enable or not of the Sleep mode;
■ Wake up mode or start level mode for starting the 1st pump in the Pump Genius;
■ Initiate the pumping with pipe charging through the pump driven by inverter;
■ Low level protection for the control process variable (pipe breaking);
■ High level protection for the control process variable (pipe obstruction);
■ Dry pump protection through evaluation of motor torque and pump speed;
■ Possibility of running the pump driven by inverter via HMI (local mode);
■ Possibility of implementation or modification of the application by the user through the WLP software.

1.3.3 PG Multiplex

The main characteristic of the Pump Genius Multiplex application developed for the CFW500 inverter SoftPLC function is the control of two or more pumps in parallel with each pump being driven by its respective CFW500 inverter.

Each is notable for the following characteristics:

■ Control of up to 3 (three) associated pumps in parallel with each pump driven by their respective CFW500 inverter;
■ Communication (data exchange) between the associated pumps through the SymbiNet network protocol via RS485 interface;
■ Configuration of each pump to function as either master/slave pump or slave pump; this configuration determines how the respective pump will take appropriate actions to control the pumping;
■ Logic to equalize pump operation time, by rotating active pumps in and out of the pumping control;
■ In case of communication loss with the actual master pump, another master/slave pump can assume the pumping (becoming master). This change can be done automatically or manually via a command in the CFW500 HMI;
■ Executes the change of master pump if the broken cable of the control process variable sensor is detected when the analog input is 4-20mA;
■ Acceleration and deceleration ramps for each inverter driven pump;
■ Maximum and minimum speed limits for each inverter driven pump;
■ Control setpoint via CFW500 HMI or Communication Networks;
■ Pumping control process variable via analog input AI1;
■ Selection of the engineering unit and range of the control process variable sensor via CFW500 parameters;
■ Gain, offset and filter adjustments for the control signals via analog input;
■ PID controller gain setting of the pumping control via HMI parameters;
■ Control action of the PID controller configured for direct or reverse mode;
■ Enabling of the Pump Genius through digital input DI1;
■ Enable or not of the sleep mode;
■ Enable or not of the sleep boost before to going into sleep mode;
■ Wake up mode for starting the 1st pump in the Pump Genius;
■ Initiate the pumping with pipe charging through inverter driven pump;
■ Low level protection for the control process variable (pipe breaking);
■ High level protection for the control process variable (pipe obstruction);
■ Indication of the sleep mode active via digital output DO1;
■ Indication of the low or high level alarm protection for the control process variable via digital output DO2;
■ Indication of the master pump active via digital output DO3;
■ Dry pump protection through evaluation of motor torque and pump speed;
■ Pump protection via external sensor through digital input DI4;
■ Possibility to forcing the rotation of pumps, i.e., if the Pump Genius be operating for a long time with only one pump (Pump Genius does not go into sleep mode), the Pump Genius will be disabled and then, the other pump is started (as the operation time) for controlling the pumping;
■ Possibility of enabling an individual pump to work within the Pump Genius through digital input DI2;
■ Possibility of running the inverter driven pump via HMI (local mode);
■ Possibility of implementation or modification of the application by the user through the WLP software.

2 PUMP GENIUS CONFIGURATIONS

2.1 PG SIMPLEX

In the Pump Genius Simplex application developed for the CFW500 SoftPLC function several possibilities of use or configuration were implemented: have only one pump, protect the pump using an analog variable or a digital sensor, enable the PID controller in automatic or manual, enable the functionality for deragging the pump, etc.

NOTE!
The Pump Genius Simplex application only works on CFW500 inverter with firmware version over V1.50. So upgrading the CFW500 inverter firmware to the working of this application is required.

2.1.1 Control Setpoint via HMI

The user can configure the Pump Genius Simplex application to having one pump and the control setpoint adjusted via HMI of the CFW500 inverter, which is the simplest way configuration. It basically comprises:

- 01 CFW500 Inverter (D1);
- 01 Electric motor and pump (P1);
- 01 Sensor with analog output signal for measurement of the control process variable (A1);
- Command for Run/Stop (S1);
- Status light for inverter fault (H1);
- Status light for motor running (H2).

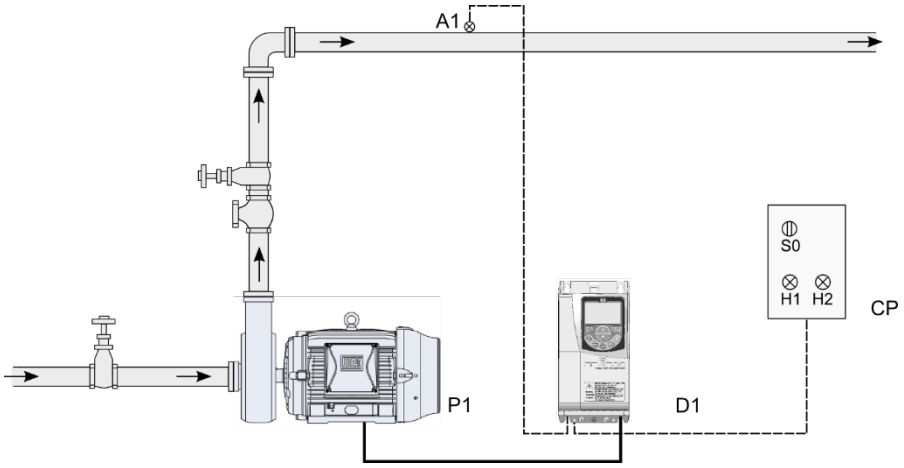
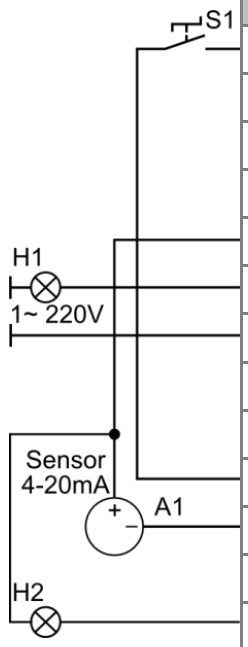


Figure 2.1 – Pump Genius Simplex application and control setpoint via HMI

NOTE!
Using the Pump Genius Simplex configuration wizard to configure the pump driven by CFW500 inverter with control setpoint via HMI.

NOTE!
The indicating lights H1 and H2 are not necessary for the operation of the Pump Genius with control setpoint via HMI. They only indicate the condition of the pump operation at the command panel (CP).

The figure 2.2 presents the control connections (analog inputs/outputs, digital inputs/outputs) that must be made to connector of the CFW500-IOS plug-in module of the CFW500 frequency inverter to have the control setpoint adjusted via HMI.



Connector			Default function for Control Setpoint via HMI
1	DI1	Upper Terminal	Digital input 1: Run/Stop
3	DI2		Digital input 2: No function
5	DI3		Digital input 3: No function
7	DI4		Digital input 4: No function
9	+24V		Power supply +24 Vdc
11	DO1-NO		Relay digital output 1 (DO1): No fault
13	DO1-C		
15	DO1-NC		
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (4-20 mA): Control process variable
8	+ 10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): Motor running (F>Fx)
12	RS485 - A		RS485 (Terminal A)
14	RS485 - B		RS485 (Terminal B)
16	GND		Reference 0 V

Figure 2.2 – Signals on connector of the CFW500-IOS plug-in module for setpoint via HMI

NOTE!
Refer to the CFW500 frequency inverter manual and the CFW500-IOS installation guide for further details about connections.

2.1.2 Control Setpoint via Analog Input

The user can configure the Pump Genius Simplex application to having one pump and the control setpoint adjusted via one analog input of the CFW500 inverter, which basically comprises:

- 01 CFW500 inverter (D1);
- 01 Electric motor and pump (P1);
- 01 Sensor with analog output signal for measurement of the control process variable (A1);
- 01 Potentiometer for adjusting the control setpoint via input analog (R1);
- Command for Run/Stop (S1);
- Status light for inverter fault (H1);
- Status light for motor running (H2).

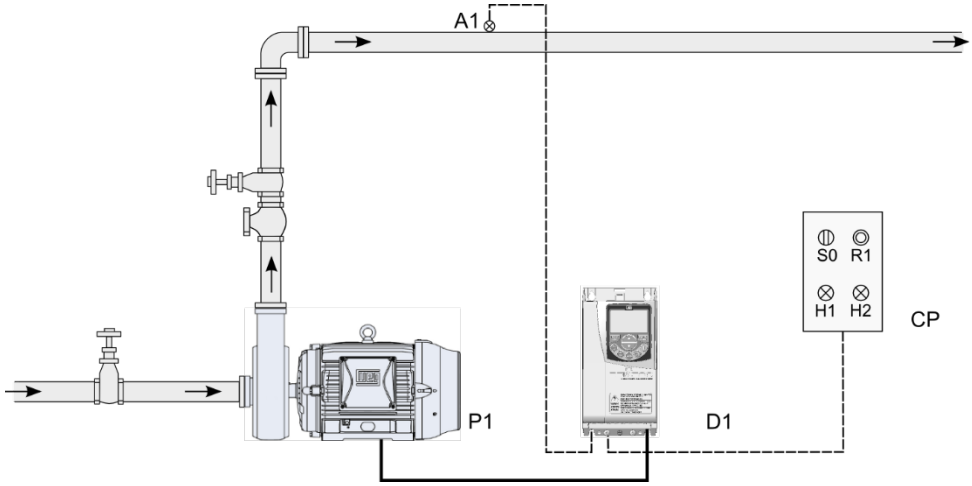
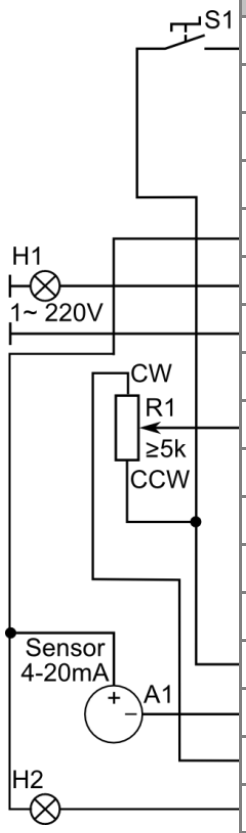


Figure 2.3 – Pump Genius Simplex application and control setpoint via analog input

NOTE!
Using the Pump Genius Simplex configuration wizard to configure the pump driven by CFW500 inverter with control setpoint via analog input.

NOTE!
The indicating lights H1 and H2 are not necessary for the operation of the Pump Genius with control setpoint via analog input. They only indicate the condition of the pump operation at the command panel (CP).

The figure 2.4 presents the control connections (analog inputs/outputs, digital inputs/outputs) that must be made to connector of the CFW500-IOAD plug-in module of the CFW500 frequency inverter to have the control setpoint adjusted via analog input.



Connector			Default function for Control Setpoint via Analog Input
1	DI1	Upper Terminal	Digital input 1: Run/Stop
3	DI2		Digital input 2: No function
5	DI3		Digital input 3: No function
7	DI4		Digital input 4: No function
9	+24V		Power supply +24 Vdc
11	DO1–RL-NO		Relay digital output 1 (DO1): No fault
13	DO1–RL-C		
15	DO1-RL-NC		
17	AI2		Analog output 2 (0–10 V): Control setpoint
19	AI3		Analog output 3 (0–10 V): No function
21	DI5		Digital input 5: No function
23	DI6		Digital input 6: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog Input1 (4-20 mA): Control process variable
8	+10 V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): Motor running (F>Fx)
12	RS485 - A		RS485 (Terminal A)
14	RS485 - B		RS485 (Terminal B)
16	GND		Reference 0 V
18	GND		Reference 0 V
20	AO2		Analog Output 2: No function
22	DO3		Digital Output 3 (DO3): No function
24	DO4		Digital Output 4 (DO4): No function

Figure 2.4 – Signals on connector of the CFW500-IOAD plug-in module for setpoint via analog input

NOTE!
Refer to the CFW500 frequency inverter manual and the CFW500-IOAD installation guide for further details about connections.

2.1.3 Control Setpoint via Logic combination of the Digital Inputs DI4 and DI5

The user can configure the Pump Genius Simplex application to having one pump and two, three or four setpoint values for control via logic combination of DI4 and DI5, which basically comprises:

- 01 CFW500 inverter (D1);
- 01 Electric motor and pump (P1);
- 01 Sensor with analog output signal for measurement of the control process variable (A1);
- Command for Run/Stop (S1);
- Switch of "n" positions for selection of the control setpoint (S4);
- Status light for inverter fault (H1);
- Status light for motor running (H2).

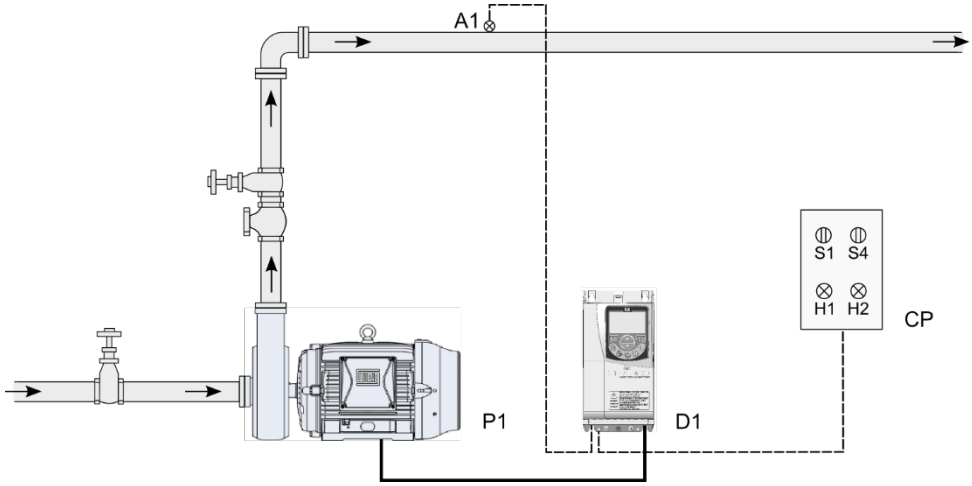
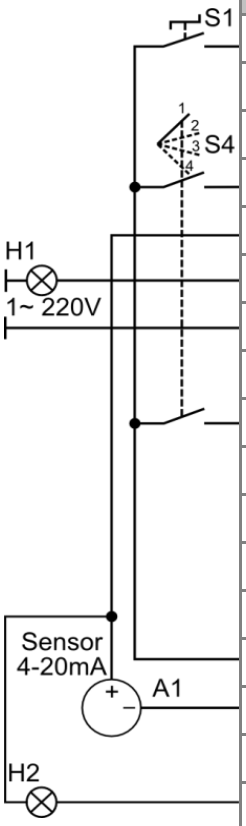


Figure 2.5 – Pump Genius Simplex application and control setpoint via combination of the digital inputs DI4 and DI5

NOTE!
Using the Pump Genius Simplex configuration wizard to configure the pump driven by CFW500 inverter with control setpoint via logical combination of the digital inputs DI4 and DI5.

NOTE!
The indicating lights H1 and H2 are not necessary for the operation of the Pump Genius with control setpoint via logical combination of DI's. They only indicate the condition of the pump operation at the command panel (CP).

The figure 2.6 presents the minimum control connections (analog inputs/outputs, digital inputs/outputs) that must be done to connector of the CFW500-IOD plug-in module of the CFW500 frequency inverter to use the control setpoint via logic combination of the digital inputs DI4 and DI5.



Conector			Default function for Control Setpoint via Logic Combination of DI's
1	DI1	Upper Terminal	Digital input 1: Run/Stop
3	DI2		Digital input 2: No function
5	DI3		Digital input 3: No function
7	DI4		Digital input 4: 1st DI for selection of the control setpoint
9	+24V		Power supply +24 Vdc
11	DO1-NO		Relay digital output 1 (DO1): No fault
13	DO1-C		
15	DO1-NC		
17	DI5		Digital input 5: 2nd DI for selection of the control setpoint
19	DI6		Digital input 6: No function
21	DI7		Digital input 7: No function
23	DI8		Digital input 8: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (4-20 mA): Control process variable
8	+ 10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): Motor running (F>Fx)
12	RS485 - A		RS485 (Terminal A)
14	RS485 - B		RS485 (Terminal B)
16	GND		Reference 0 V
18	GND		Reference 0 V
20	DO3-TR		Transistor digital output 3 (DO3): No function
22	DO4-TR		Transistor digital output 4 (DO4): No function
24	DO5-TR		Transistor digital output 5 (DO5): No function

Figure 2.6 – Signals on connector of the CFW500-IOD plug-in module for setpoint via logic combination of Digital Inputs

NOTE!
Refer to the CFW500 frequency inverter manual and the CFW500-IOD installation guide for further details about connections.

2.1.4 Selection of PID Controller in Manual or Automatic via Digital Input DI3

The user can configure the Pump Genius Simplex application to having one pump and the selection of PID controller operation mode in manual or automatic via digital input DI3 which basically comprises:

- 01 CFW500 inverter (D1);
- 01 Electric motor and pump (P1);
- 01 Sensor with analog output signal for measurement of the control process variable (A1);
- Command for Run/Stop (S1);
- Manual (0) / Automatic (1) commutation switch to select the operation mode of the PID controller (S3);
- Status light for inverter fault (H1);
- Status light for motor running (H2).

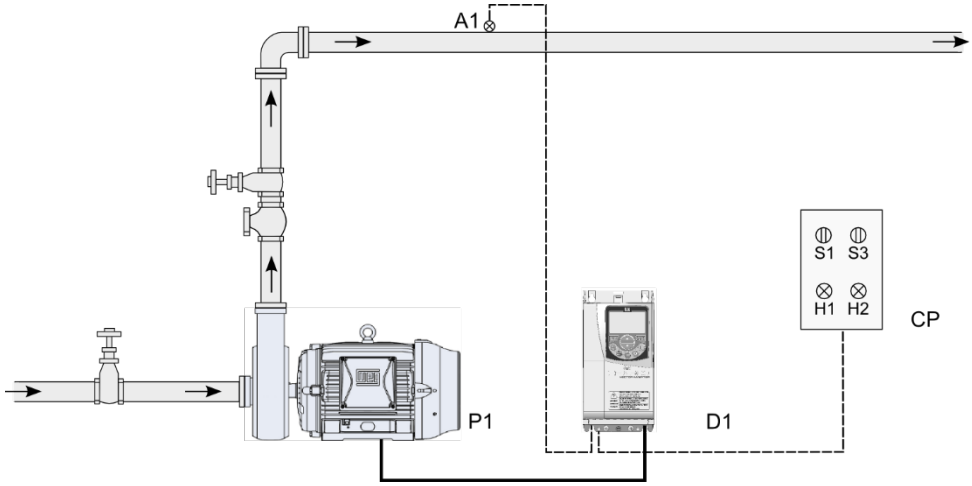
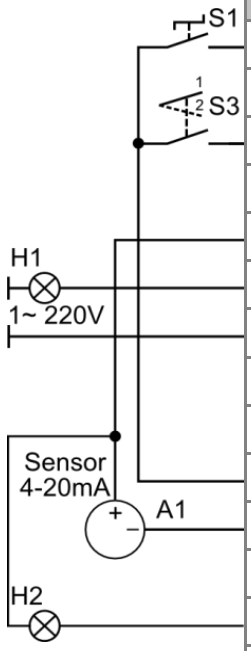


Figure 2.7 – Pump Genius Simplex application and selection of PID controller in manual or automatic via digital input DI3

NOTE!
Using the Pump Genius Simplex configuration wizard to configure the pump driven by CFW500 inverter with selection of PID controller in manual or automatic via digital input DI3.

NOTE!
The indicating lights H1 and H2 are not necessary for the operation of the Pump Genius with selection of PID controller in manual or automatic via digital input DI3. They only indicate the condition of the pump operation at the command panel (CP).

The figure 2.8 presents the control connections (analog inputs/outputs, digital inputs/outputs) that must be done to connector of the CFW500-IOS plug-in module of the CFW500 frequency inverter with selection of PID controller in manual or automatic via digital input DI3.



Conector			Default function for Selection of the PID Controller in Man/Auto via DI3
1	DI1	Upper Terminal	Digital input 1: Run/Stop
3	DI2		Digital input 2: No function
5	DI3		Digital input 3: Selection of the PID controller in manual (0) or automatic (1)
7	DI4		Digital input 4: No function
9	+24V		Power supply +24 Vdc
11	DO1-NO		Relay digital output 1 (DO1): No fault
13	DO1-C		
15	DO1-NC		
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (4-20 mA): Control process variable
8	+ 10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): Motor running (F>Fx)
12	RS485 - A		RS485 (Terminal A)
14	RS485 - B		RS485 (Terminal B)
16	GND		Reference 0 V

Figure 2.8 – Signals on connector of the CFW500-IOS plug-in module for setpoint for Selection of the PID controller in Manual / Automatic via DI3

NOTE!
Refer to the CFW500 frequency inverter manual and the CFW500-IOS installation guide for further details about connections.

2.1.5 Pump Protection via External Sensor in the Digital Input DI1

The user can configure the Pump Genius Simplex application to having one pump and protect it via an external sensor installed in the digital input DI1 which basically comprises:

- 01 CFW500 inverter (D1);
- 01 Electric motor and pump (P1);
- 01 Sensor with analog output signal for measurement of the control process variable (A1);
- 01 Sensor with "NO" contact for pump protection (S5);
- Command for Run/Stop (S1);
- Status light for inverter fault (H1);
- Status light for motor running (H2).

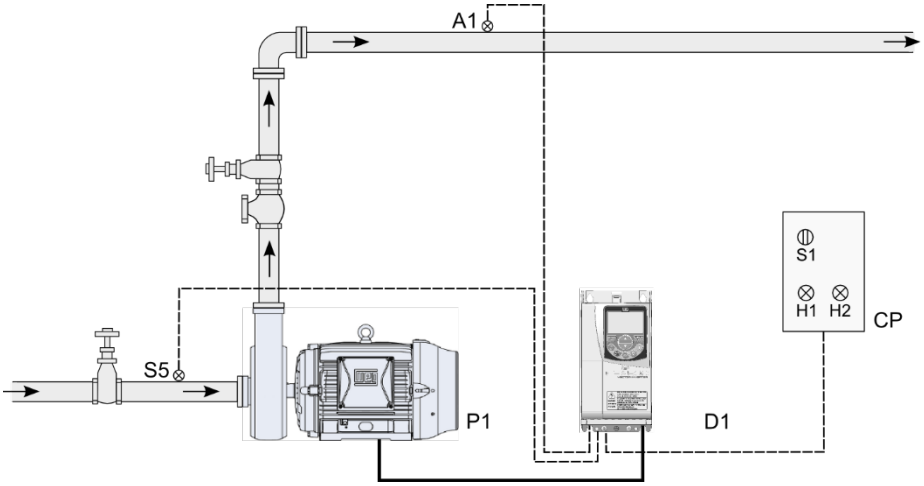
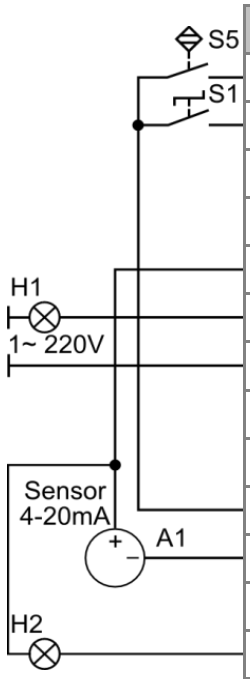


Figure 2.9 – Pump Genius Simplex application and pump protection via external sensor in the digital input DI1

NOTE!
Using the Pump Genius Simplex configuration wizard to configure the pump driven by CFW500 inverter and pump protection with an external sensor via digital input DI1.

NOTE!
The indicating lights H1 and H2 are not necessary for the operation of the Pump Genius and pump protection with an external sensor via digital input DI1. They only indicate the condition of the pump operation at the command panel (CP).

The figure 2.10 presents the control connections (analog inputs/outputs, digital inputs/outputs) that must be done to connector of the CFW500-IOS plug-in module of the CFW500 frequency inverter to have the pump protection via external sensor in the digital input DI1.



Conector			Default function for Pump protection via External Sensor in the DI1
1	DI1	Upper Terminal	Digital input 1: External sensor
3	DI2		Digital input 2: Run/Stop
5	DI3		Digital input 3: No function
7	DI4		Digital input 4: No function
9	+24V		Power supply +24 Vdc
11	DO1-NO		Relay digital output (DO1): No fault
13	DO1-C		
15	DO1-NC		
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (4-20 mA): Control process variable
8	+ 10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): Motor running (F>Fx)
12	RS485 - A		RS485 (Terminal A)
14	RS485 - B		RS485 (Terminal B)
16	GND		Reference 0 V

Figure 2.10 – Signals on connector of the CFW500-IOS plug-in module for pump protection via external sensor in the digital input DI1

NOTE!
Refer to the CFW500 frequency inverter manual and the CFW500-IOS installation guide for further details about connections.

2.1.6 Pump Protection via Control Auxiliary Variable

The user can configure the Pump Genius Simplex application to having one pump and protect it via a sensor with analog output signal for measure the control auxiliary variable via an analog input which basically comprises:

- 01 CFW500 inverter (D1);
- 01 Electric motor and pump (P1);
- 01 Sensor with analog output signal for measurement of the control process variable (A1);
- 01 Sensor with analog output signal for measurement of the control auxiliary variable (A2);
- Command for Run/Stop (S1);
- Status light for inverter fault (H1);
- Status light for motor running (H2).

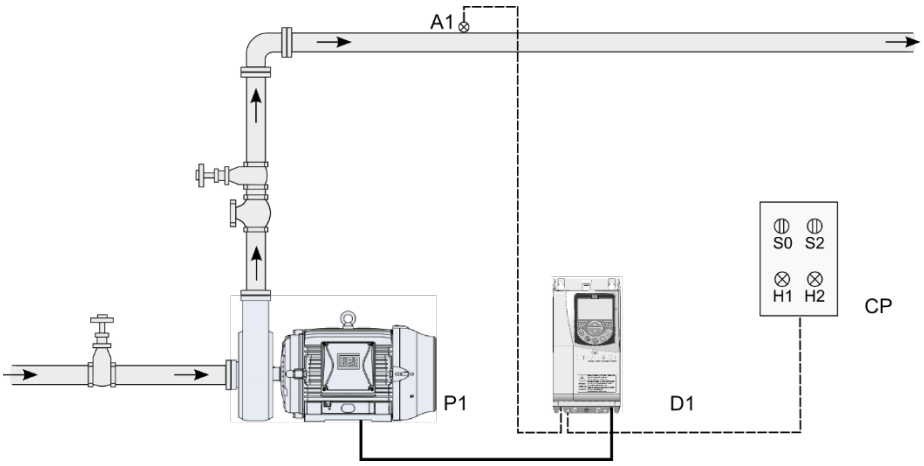
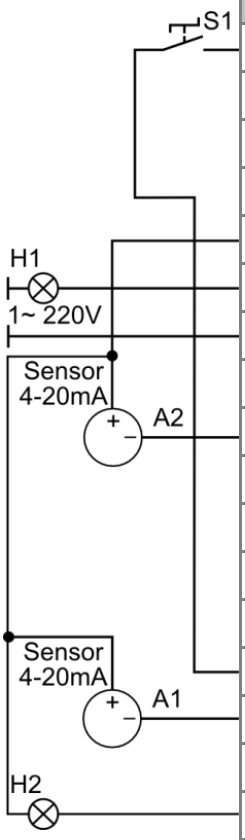


Figure 2.11 – Pump Genius Simplex application and pump protection via control auxiliary variable read by analog input

NOTE!
Using the Pump Genius Simplex configuration wizard to configure the pump driven by CFW500 inverter and pump protection via control auxiliary variable.

NOTE!
The indicating lights H1 and H2 are not necessary for the operation of the Pump Genius and pump protection with an external sensor via digital input DI1. They only indicate the condition of the pump operation at the command panel (CP).

The figure 2.12 presents the control connections (analog inputs/outputs, digital inputs/outputs) that must be done to connector of the CFW500-IOAD plug-in module of the CFW500 frequency inverter to have the pump protection via control auxiliary variable.



Conector			Default function for Pump protection via Control Auxiliary Variable
1	DI1	Upper Terminal	Digital input 1: Run/Stop
3	DI2		Digital input 2: No function
5	DI3		Digital input 3: No function
7	DI4		Digital input 4: No function
9	+24V		Power supply +24 Vdc
11	DO1–RL-NO		Relay digital output (DO1): No fault
13	DO1–RL-C		
15	DO1-RL-NC		
17	AI2		Analog input 2 (0-10 V): Control auxiliary variable
19	AI3		Analog input 3 (4-20 mA): No function
21	DI5		Digital input 5: No function
23	DI6		Digital input 6: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (4-20 mA): Control process variable
8	+10 V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): Motor running (F>Fx)
12	RS485 - A		RS485 (Terminal A)
14	RS485 - B		RS485 (Terminal B)
16	GND		Reference 0 V
18	GND		Reference 0 V
20	AO2		Analog output 2: No Function
22	DO3-TR		Transistor digital output 3 (DO3): No function
24	DO4-TR		Transistor digital output 4 (DO4): No function

Figure 2.12 – Signals on connector of the CFW500-IOAD plug-in module for pump protection via control auxiliary variable

NOTE!
Refer to the CFW500 frequency inverter manual and the CFW500-IOAD installation guide for further details about connections.

2.1.7 Deragging Function with Command via Digital Input DI2

The user can configure the Pump Genius Simplex application to having one pump and execute the deragging function through a command via digital input DI2 which basically comprises:

- 01 CFW500 inverter (D1);
- 01 Electric motor and pump (P1);
- 01 Sensor with analog output signal for measurement of the control process variable (A1);
- Command for Run/Stop (S1);
- Command to execute the deragging function (S2);
- Status light for inverter fault (H1);
- Status light for motor running (H2).

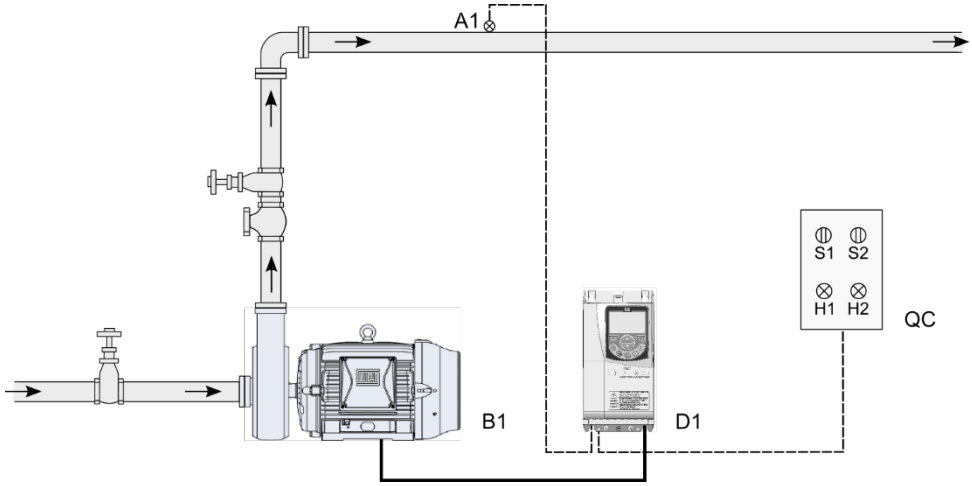
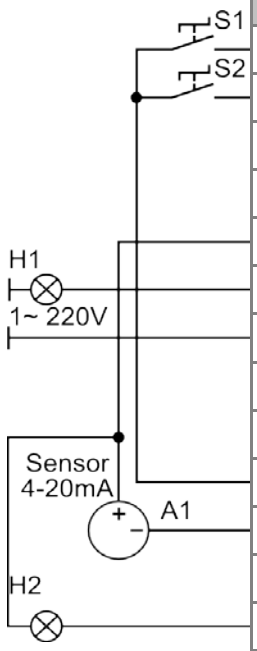


Figure 2.13 – Pump Genius Simplex application and deragging function with command via digital input DI2

NOTE!
Using the Pump Genius Simplex configuration wizard to configure the pump driven by CFW500 inverter and the deragging function with command via digital input DI2.

NOTE!
The indicating lights H1 and H2 are not necessary for the operation of the Pump Genius and the deragging function with command via digital input DI2.They only indicate the condition of the pump operation at the command panel (CP).

The figure 2.14 presents the control connections (analog inputs/outputs, digital inputs/outputs) that must be done to connector of the CFW500-IOS plug-in module of the CFW500 frequency inverter to have the deragging function with command via digital input DI2.



Conector			Default function for Deragging Function with command via DI2
1	DI1	Upper Terminal	Digital input 1: Run/Stop
3	DI2		Digital input 2: Command to execute the deragging function
5	DI3		Digital input 3: No function
7	DI4		Digital input 4: No function
9	+24V		Power supply +24 Vdc
11	DO1-NO		Relay digital output (DO1): No fault
13	DO1-C		
15	DO1-NC		
2	AO1	Lower Terminal	Terminal Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (4-20 mA): Control process variable
8	+ 10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): Motor running (F>Fx)
12	RS485 - A		RS485 (Terminal A)
14	RS485 - B		RS485 (Terminal B)
16	GND		Reference 0 V

Figure 2.14 – Signals on connector of the CFW500-IOS plug-in module for deragging function with command via digital input DI2

NOTE!
Refer to the CFW500 frequency inverter manual and the CFW500-IOS installation guide for further details about connections.

2.2 PG MULTIPUMP

In the Pump Genius Multipump application developed for the CFW500 SoftPLC were implemented two distinct ways of control (fixed control and floating control) and several possibilities of use or configuration: associating pumps in parallel with fixed control, associating pumps in parallel with floating control, defining the setpoint via HMI / communication networks or via logic combination of digital inputs, etc. Below are details about the two control modes and examples of some other type of configuration.

However, it is important to check which plug-in module that will be used in the CFW500 frequency inverter, because it determines the maximum number of pumps that can configure in the Pump Genius Multipump application according to table 2.1.

Table 2.1 – Maximum number of parallel pumps as CFW500 plug-in module

Plug-in module	Parallel Pumps for Fixed Control	Parallel Pumps for Floating Control
CFW500–IOR	4	3
CFW500–IOS	3	2
CFW500–IOD	4	3
CFW500–IOAD	4	3
CFW500–CUSB	3	2
CFW500–CCAN	2	-
CFW500–CRS232	2	-
CFW500–CRS485	4	3
CFW500–CPDP	2	-

NOTE!
The digital outputs of the plug-in module can be relay or transistor. If the transistor will be necessary to add an external relay or auxiliary contactor at 24Vdc for command of the pump. Refer to the installation guide of the plug-in module used for more information.

NOTE!
The Pump Genius Multipump application only works on CFW500 inverter with firmware version over V1.50. So upgrading the CFW500 inverter firmware to the working of this application is required.

2.2.1 Fixed Control

The system is composed of the association of two or more pumps in parallel, and the frequency inverter always controls the speed of the same pump. The other pumps of the system are commanded by the digital outputs of the CFW500 frequency inverter and operate at the rated speed. Thus, the users can use the start mode that best suits their needs: direct on line, star delta, softstater, etc.

The user can configure the Pump Genius Multipump application with fixed control for up to four pumps associated in parallel, one always driven by the frequency inverter and the others commanded to the digital outputs of the frequency inverter so that it controls the moment to start or stop of the system. It also allows the following settings: setpoint via HMI and setpoint via logic combination of digital inputs.

The figure 2.15 presents a typical system with four pumps in parallel and control setpoint via HMI basically composed of:

- 01 CFW500 frequency inverter (D);
- 04 Motor + pump (P1, P2, P3 e DP);
- 01 Sensor with analog output signal to measure the control process variable (A0);
- Command to enable Pump Genius (S0);
- Command to enable the use of the pump 1, 2 and 3 (S1, S2 and S3);
- Signaling of the pumps 1, 2 and 3 are running (H1, H2 and H3).

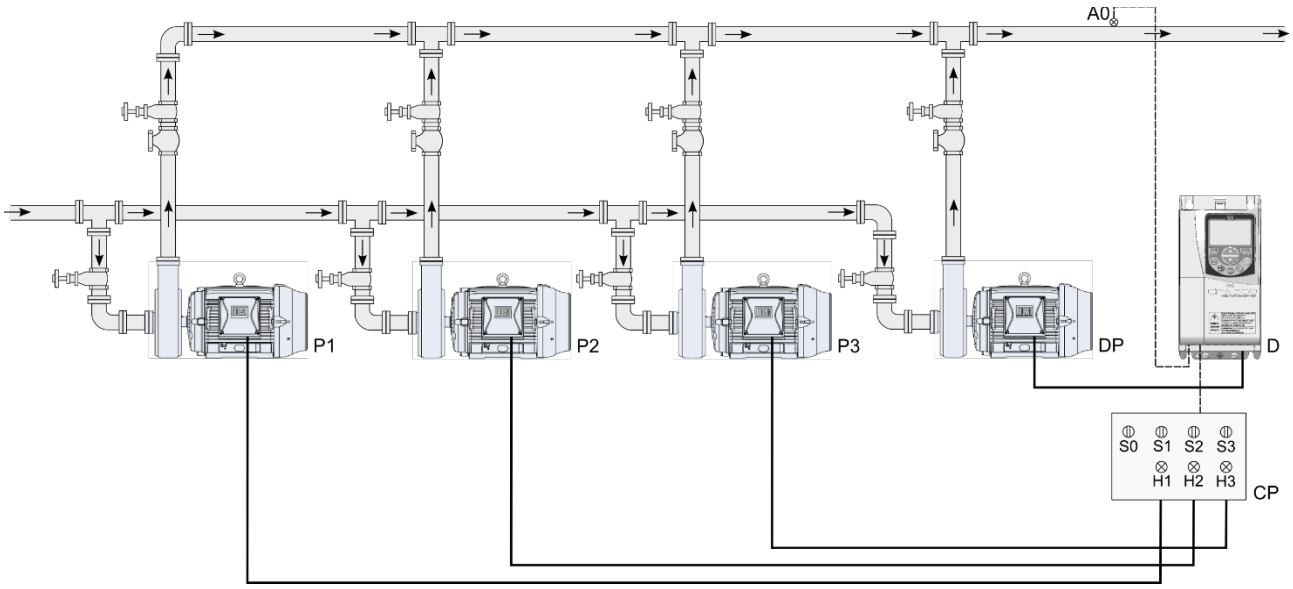


Figure 2.15 – Pump Genius Multipump application with fixed control, four pumps in parallel and control setpoint via HMI

NOTE!
Use the Fixed Control configuration wizard to configure the Pump Genius Multipump application with fixed control, four pumps in parallel and control setpoint via HMI.

NOTE!
The pumps 1 to 3 can be driven by contactors (direct on line or star delta start), softstater, intelligent relays, etc. The signals H1, H2 and H3 are not necessary for the operation of the Pump Genius Multipump with fixed control, 3 pumps in parallel and control setpoint via HMI, because they only serve to indicate the operating condition of the pumps on the command panel (CP). In the figure 2.15, the signals H1, H2 and H3 come from auxiliary contacts of contactors K1, K2 and K3 which start the pumps 1, 2 and 3.

2.2.1.1 Power Connections

The figure 2.16 presents the power connection diagram for a system with four pumps in parallel with fixed control.

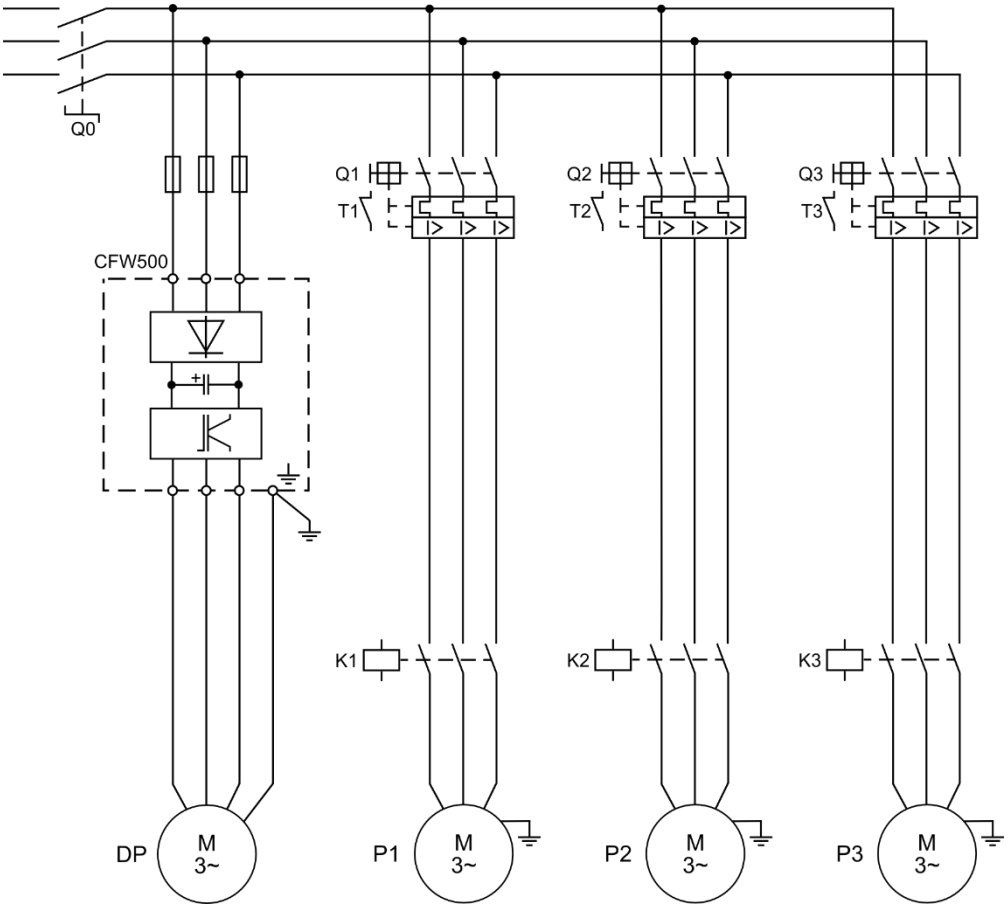


Figure 2.16 – Power connections of the Pump Genius Multipump application with fixed control and four pumps in parallel

Where:

- Q0: Protection circuit breaker for the system power supply;
- Q1, Q2 and Q3: Motor circuit breaker for the protection of the pumps;
- K1, K2 and K3: Contactors for starting the pumps;
- P1, P2, P3 and PD: System pump motors;
- The protection of CFW500 inverter is done with fuses.

NOTE!
It is recommended the protection of the inverter so as to avoid damages.

2.2.1.2 Command Connections

The figure 2.17 presents the command connection diagram for fixed control and four pumps in parallel.

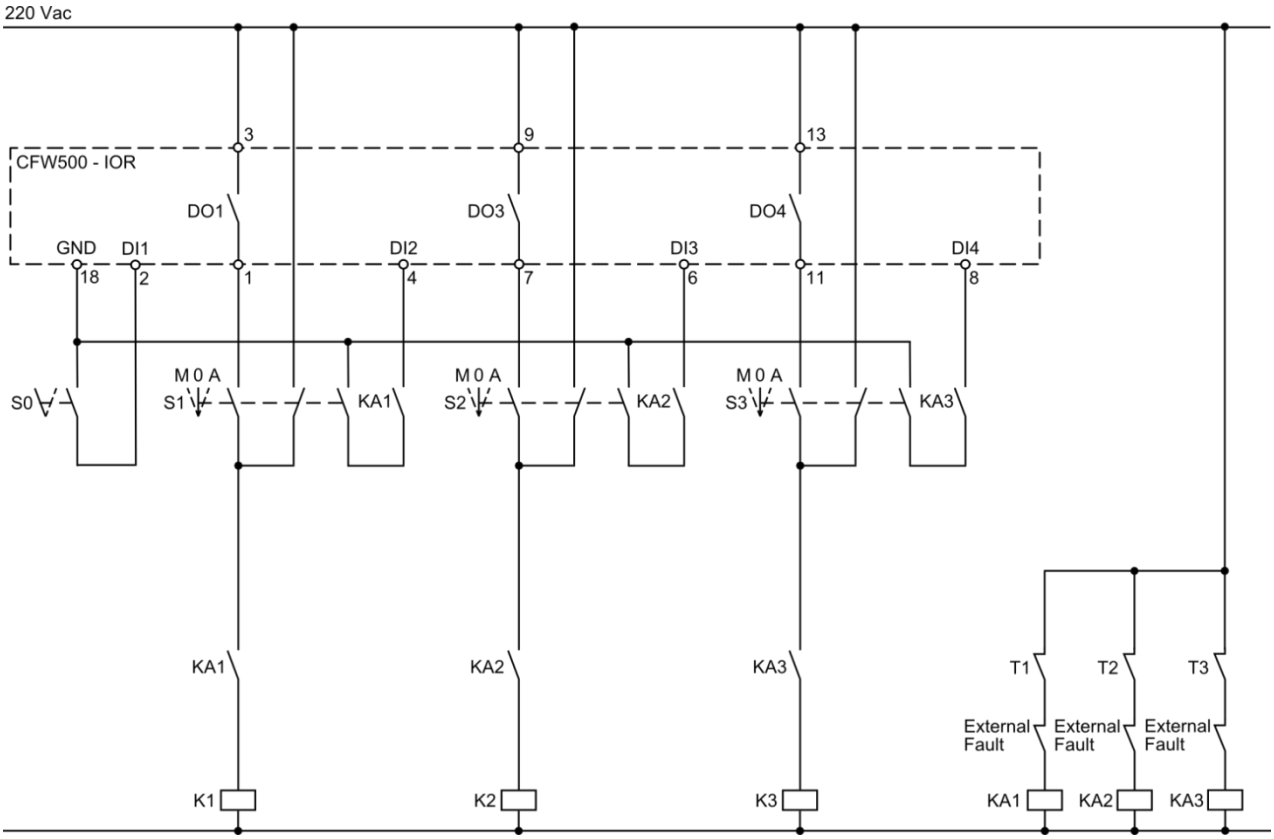


Figure 2.17 – Command connections of the Pump Genius Multipump application with fixed control and four pumps in parallel

Where:

■ S0: Start/Stop switch. The “Start” position issues the command for enabling the Pump Genius operation. The “Stop” position disables the Pump Genius operation, that is, it stops all the pumps of the system;

■ S1, S2 and S3: Manual / 0 / Automatic commutation switches (optional). The “Manual” position issues the command for starting the pump independent of the Pump Genius. The “0” position switches off the pump and disables it from the Pump Genius. The “Automatic” position enables the pump to be used in the Pump Genius;

■ K1, K2 and K3: Contactors for starting the pumps;

■ KA1, KA2 and KA3: Auxiliary contactors for the pump protection logics;

■ T1, T2 and T3: Contact of the pump motors protection thermal;

■ External Fault: A sensor, such as a pressure switch, can be used for the protection of the pumps;

■ DO1, DO3 and DO4: Relay digital outputs of the CFW500-IOR plug-in module of the CFW500 frequency inverter to command pumps 1, 2 and 3;

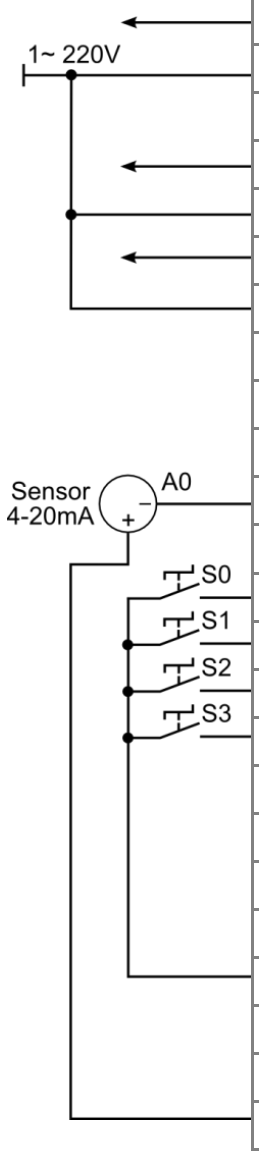
■ DI1: Digital input of the CFW500-IOR plug-in module of the CFW500 frequency inverter to enable the pumping control operation;

■ DI2, DI3 and DI4: Digital inputs of the CFW500-IOR plug-in module of the CFW500 frequency inverter indicating that the pumps are enabled for the pumping control.

NOTE!
The connections of the command shown in figure 2.17 are relative to the CFW500-IOR plug-in module. If you use another plug-in module, please refer to the appropriate installation guide.

2.2.1.3 Control Connections

The figure 2.18 presents the control connections (analog inputs/outputs, digital inputs/outputs) that must be made to connector of the CFW500-IOR plug-in module of the CFW500 frequency inverter for the Pump Genius Multipump configured for fixed control, four pumps in parallel and setpoint via HMI.



Conector			Default function for Fixed Control, four pumps in parallel and Setpoint via HMI
1	DO1-NO	Upper Terminal	Relay digital output 1 (DO1): Start pump 1
3	DO1-C		
5	DO1-NC		
7	DO3-NO		Relay digital output 3 (DO3): Start pump 2
9	DO3-C		
11	DO4-NO		Relay digital output 4 (DO4): Start pump 3
13	DO4-C		
15	DO5-NO		Relay digital output 5 (DO5): No function
17	DO5-C		
19	NC		Not connected
21	AI1		Analog input 1 (4-20 mA): Control process variable
23	+ 10V		Reference +10 Vdc for potentiometer
2	DI1	Lower Terminal	Digital input 1: Enable pump genius
4	DI2		Digital input 2: Enable pump 1 via DO1
6	DI3		Digital input 3: Enable pump 2 via DO3
8	DI4		Digital input 4: Enable pump 3 via DO4
10	DI5		Digital input 5: No function
12	RS485 - A		RS485 (Terminal A)
14	RS485 - B		RS485 (Terminal B)
16	GND		Reference 0 V
18	GND		Reference 0 V
20	AO1		Analog output 1: Real speed
22	DO2-TR		Transistor digital output 2 (DO2): No function
24	+24V		Power supply +24 Vdc

Figure 2.18 – Signals on connector of the CFW500-IOR plug-in module for Pump Genius Multipump configured for fixed control, four pumps in parallel and setpoint via HMI

NOTE!
Refer to the CFW500 frequency inverter manual and the CFW500-IOR installation guide for further details about connections.

2.2.1.4 Operation Description

The figure 2.19 presents the operation scheme of the Pump Genius Multipump configured for fixed control, four pumps in parallel and setpoint via HMI. The pumps will be starting in the "In a Sequence" activation mode in order to simplify the understanding of their drive. For the “Pump Rotation” activation mode, the operation time for the start or stop of the pumps is taken into account.

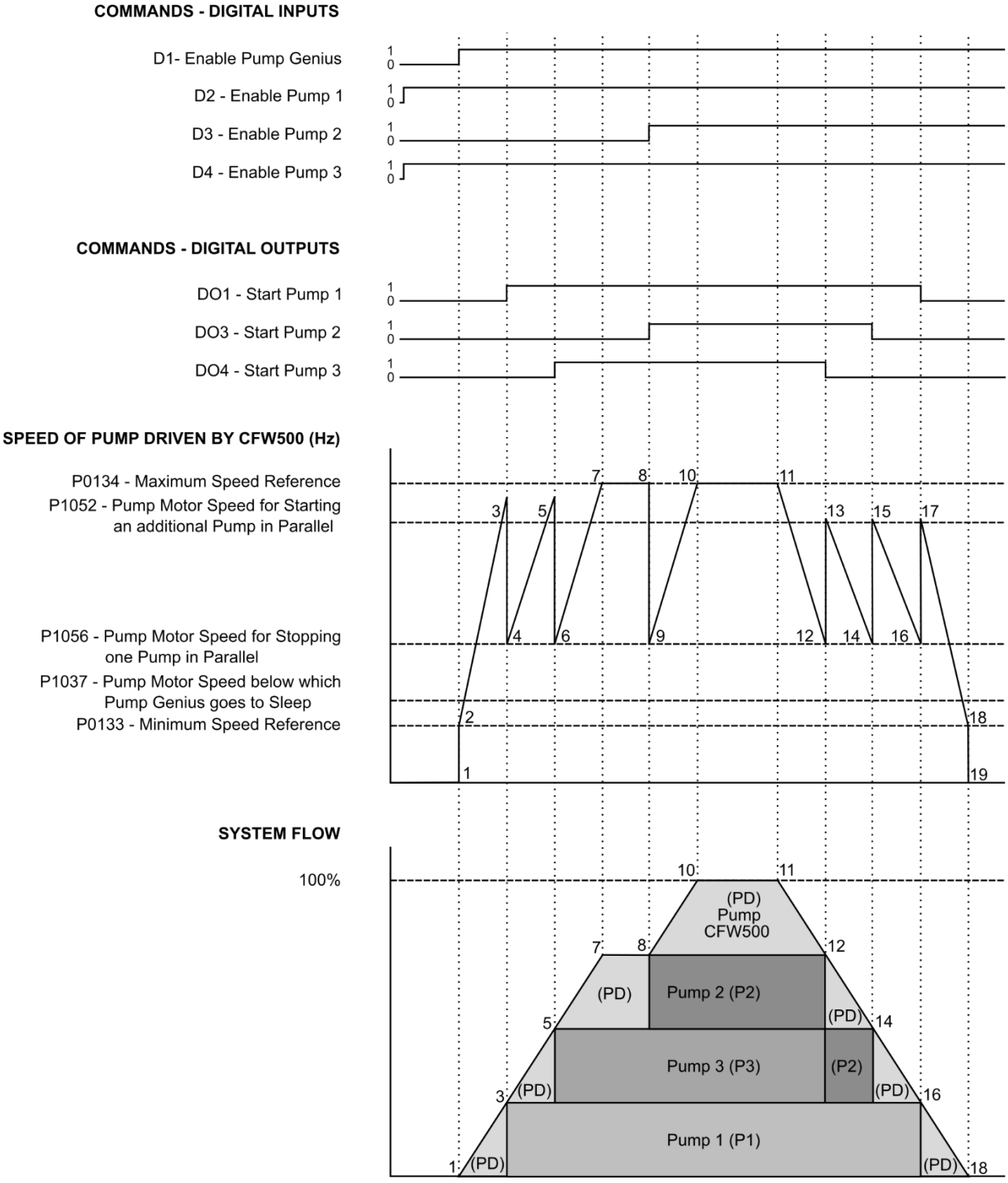


Figure 2.19 – Operation description of the Pump Genius for fixed control

The graph of the figure 2.19 shows the digital inputs for the command and enabling of the pumps, the digital outputs for the start of the pumps, the motor speed behavior of the pump driven by the CFW500 frequency inverter as the pumps are started and stopped in order to maintain the control process variable according to the setpoint of the required control. The analysis below of the behavior according to the identified moments:

1 – The digital input DI1 is activated in order to enable the Pump Genius. It is verified if the control will remain in the sleep mode or in the wake up mode. The wake up mode is activated (the first time the system is enabled, the time (P1036) is discarded) and the pump driven by the CFW500 frequency inverter is switched on;

2 – The pump driven by the CFW500 inverter (PD) accelerated to the minimum speed (P0133) and then the PID controller is enabled. If the pipe charging process is enabled, a period of time (P1041) is awaited to enable the PID controller;

3 – According to the control setpoint and the control process variable, the PID controller responds and accelerates the pump driven by the CFW500 inverter (PD). At this moment, the pump motor speed exceeds the threshold value programmed for starting an additional pump (P1052) and the deviation from the control setpoint exceeds the threshold programmed for starting an additional pump (P1053), initiating the time count P1054 and it is awaited and the command to start one more pump in parallel is issued. It is verified which pump will enter the system. In this case, since the activation mode is "In a Sequence", and pump 1 (P1) is enabled for operation, the command is issued to start pump 1 (P1) via digital output DO1, which, according to the wiring diagram, commands contactor K1;

4 – After pump 1 (P1) is started, the speed of the pump driven by the CFW500 inverter (PD) is reduced to the value of the motor speed programmed to stop a pump in parallel (P1057). This is done to minimize oscillations in the system. After that, the Pump Genius takes back the speed control of the pump driven by the CFW500 inverter (PD) and it accelerates again;

5 – Following the analysis at instant "3", the command is issued to start one more pump in parallel and it is checked which pump must enter the system. In this case, as the pump 1 (P1) is already running, in the sequence pump 2 (P2) should be started, but it is disabled via digital input DI3; therefore, since pump 3 (P3) is enabled to operate, the command to start pump 3 (P3) is issued via digital output DO4, which, according to the wiring diagram, commands contactor K3;

6 – After pump 3 (P3) is started, the analysis at instant “4” follows;

7 – Following the analysis at instant "3", the command is issued to start one more pump in parallel and it is checked which pump must enter the system. In this case, as the pump 1 (P1) and pump 3 (P3) are already running, in the sequence pump 2 (P2) should be started, but it is disabled via digital input DI3; therefore, the system remains as it is and the pump driven by the CFW500 inverter (PD) reaches the maximum programmed speed;

8 – Because the system needs another pump in parallel, when pump 2 (P2) is enabled via digital input DI3 the command to start the pump 2 (P2) is immediately issued via digital output DO3, which, according to the wiring diagram, commands contactor K2;

9 – After pump 2 (P2) is started, the analysis at instant “4” follows;

10 – With all pumps of the system are running, the pump driven by the CFW500 inverter (PD) reaches the maximum programmed speed and continues to control the system;

11 – The system begins to feel an increase in the process variable and starts to decrease the speed of the pump driven by CFW500 inverter (PD);

12 – When the value of motor speed programmed to stop one pump in parallel (P1056) is reached and there is a certain difference (deviation) between the control setpoint and the process variable (P1057), a period of time is awaited (P1058) and the command to stop one pump in parallel is issued. It is checked which pump will be removed from system. In this case, since the activation mode is "In a Sequence", the pump 3 (P3) must be stopped. The command to stop pump 3 (P3) is issued via digital output DO4, which, according to the wiring diagram, commands contactor K3;

13 – After stopping pump 3 (P3), the speed of the pump driven by the CFW500 inverter (PD) is increased to the value of motor speed to start one more pump in parallel (P1052). This is done so as to minimize oscillations in the system. After that, the Pump Genius takes back the speed control of the pump driven by CFW500 inverter (PD) and it decelerates again;

14 – Following the analysis done at moment “12”, the command for stopping another pump in parallel is issued, and it is checked which pump must be removed from the system. In this case, since pump 3 (P3) is already stopped, the next pump to be stopped is pump 2 (P2). The command to stop pump 2 (P2) is issued via digital output DO3, which, according to the wiring diagram, commands contactor K3;

15 – After stopping pump 2 (P2), the analysis done at moment “13” follows;

16 – Following the analysis done at moment “12”, the command for stopping another pump in parallel is issued, and it is checked which pump must be removed from the system. In this case, since pump 3 (P3) and pump 2 (P2), are already stopped, the next pump to be stopped is pump 1 (P1). The command to stop pump 1 (P1) is issued via digital output DO1, which, according to the wiring diagram, commands contactor K1;

17 – After stopping pump 1 (P1), the analysis done at moment “13” follows;

18 – When the motor speed programmed to sleep (P1037) is reached, a period of time is awaited (P1038) and, since the pump driven by the CFW500 inverter (PD) remains with speed below the value programmed to sleep, the sleep mode is activated;

19 – With the sleep mode active, the pump driven by the CFW500 inverter (PD) is stopped, but the Pump Genius remains enabled, and the control process variable is monitored. If the value falls below the deviation of the process variable to wake up (P1034) for a period of time (P1036), the wake up mode is activated and the control begins to start and stop the pumps again according to the requirements of the control setpoint.

NOTE!
Refer the chapter 3 for further details on the parameters.

2.2.2 Floating Control

The system is composed of the association of two or more pumps in parallel, and the frequency inverter can be connected (via inverter output contactor commanded by a digital output) and control the speed of any of the pumps. The other pumps of the system are commanded by the digital outputs of the CFW500 frequency inverter that drive the contactors directly connected to the mains power and operate at the rated speed. That is, with the control turned off, the first pump to be started is connected to the inverter via the digital output command and the other pumps will be connected directly to the mains power via the command of other outputs subsequently activated. At another moment, according to the setting, another pump can be driven by CFW500 inverter; by doing that, all pumps in the system are used in a uniform way. The interlock that prevents two or more pumps are connected to the inverter is done as electric as figure 2.22.

The user can configure the Pump Genius Multipump application with floating control to have up to three pumps associated in parallel, being the first pump to be started connected to the CFW500 inverter and the others commanded via digital outputs of the CFW500 inverter so that it controls the moment to start them or stop them in the system. It also allows the following settings: setpoint via analog inputs, via HMI and setpoint via logic combination of digital inputs.

The figure 2.20 presents a typical system with three pumps and control setpoint via HMI basically composed of:

- 01 CFW500 frequency inverter (D);
- 03 Motor + pump (P1, P2 and P3);
- 01 Sensor with analog output signal to measure the control process variable (A0);
- Command to enable the Pump Genius (S0);
- Command to enable the use of the pump 1, 2 and 3 (S1, S2 and S3);
- Status light for the pumps 1, 2 and 3 are running (H1, H2 and H3).

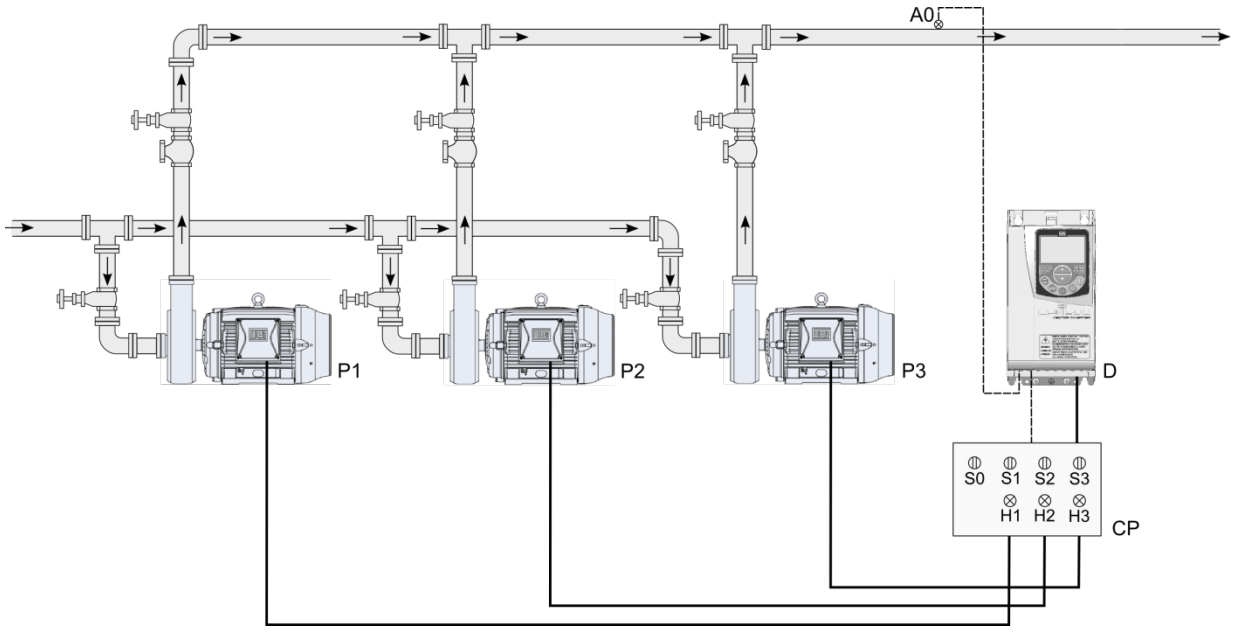


Figure 2.20 – Pump Genius Multipump application with floating control, three pumps in parallel and control setpoint via HMI

NOTE!
Use the Floating Control configuration wizard to configure the Pump Genius Multipump application with floating control, three pumps in parallel and control setpoint via HMI.

NOTE!
The signals H1, H2 and H3 are not necessary for the operation of the Pump Genius Multipump with floating control, three pumps in parallel and control setpoint via HMI, because they only serve to indicate the operating condition of the pumps on the command panel (CP). In the figure 2.20, the signals H1, H2 and H3 come from auxiliary contacts of contactors K1, K1.1, K2, K2.1, K3 and K3.1 which start the pumps 1, 2 and 3.

2.2.2.1 Power Connections

The figure 2.21 presents the power connection diagram for a system with three pumps in parallel with floating control.

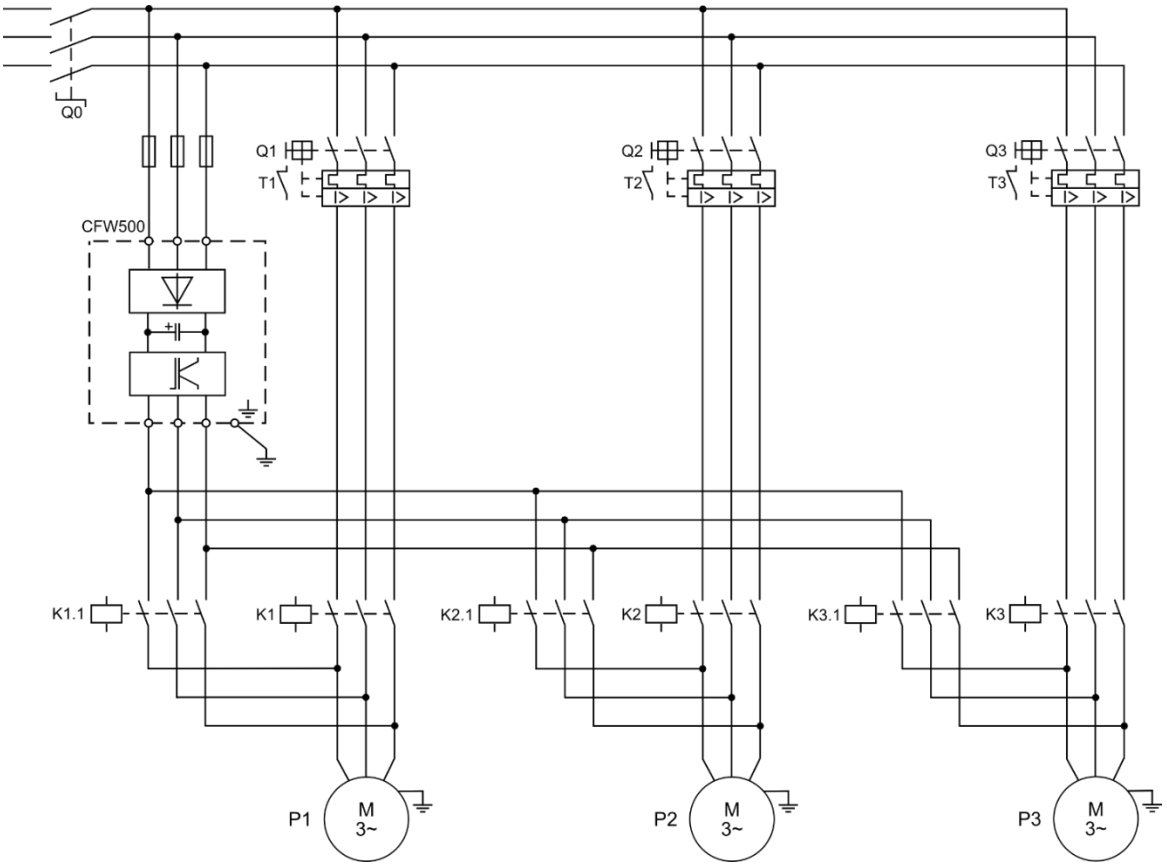


Figure 2.21– Power connections of the Pump Genius Multipump application with floating control and three pumps in parallel

Where:

- Q0: Protection circuit breaker for the system power supply;
- Q1, Q2 and Q3: Motor circuit breaker for the protection of the pumps;
- K1, K2 and K3: Contactors for starting the pumps directly on line, i.e., when they do not have their speed controlled by the CFW500 inverter;
- K1.1, K2.1and K3.1: Contactors to start the pump with the CFW500 inverter;
- P1, P2 and P3: System pump motors;
- The protection of CFW500 inverter is done with fuses.

NOTE!
It is recommended the protection of the inverter so as to avoid damages.

2.2.2.2 Command Connections

The figure 2.22 presents the command connection diagram for three pumps in parallel and floating control.

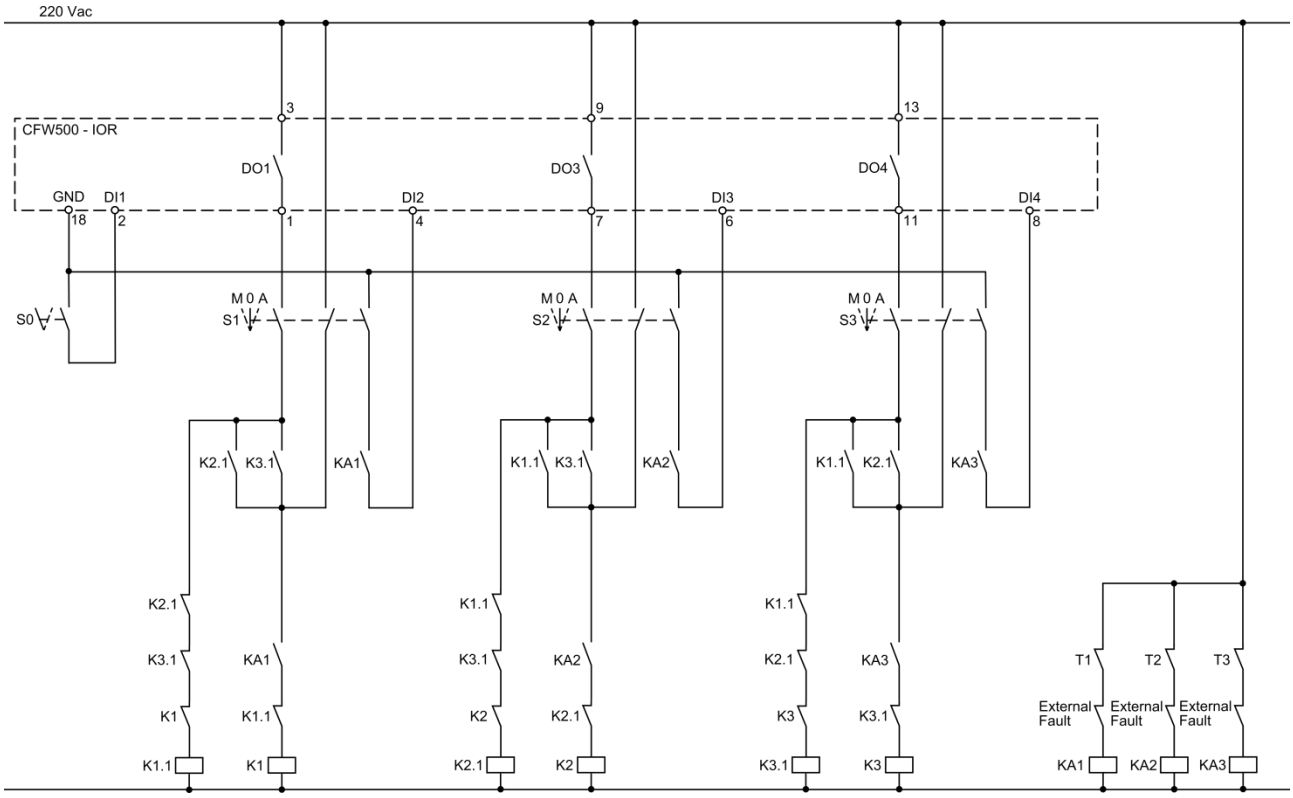


Figure 2.22 – Command connections of the Pump Genius Multipump application with floating control and three pumps in parallel

Where:

■ S0: Start/Stop switch. The “Start” position issues the command for enabling Pump Genius operation. The “Stop” position disables the Pump Genius operation, that is, it stops all the pumps of the system;

■ S1, S2 and S3: Manual / 0 / Automatic commutation switches (optional). The “Manual” position issues the command for starting the pump independent of the pumping control. The “0” position switches off the pump and disables it from the pumping control. The “Automatic” position enables the pump to be used in the Pump Genius;

■ K1.1, K2.1 and K3.1: Contactors to start the pump with the frequency inverter;

■ KA1, KA2 and KA3: Auxiliary contactors for the pump protection logics;

■ T1, T2 and T3: Contact of the pump motors protection thermal;

■ External Fault: A sensor, such as a pressure switch, can be used for the protection of the pumps;

■ DO1, DO3 and DO4: Relay digital outputs of the CFW500-IOR plug-in module of the CFW500 frequency inverter to command pumps 1, 2 and 3;

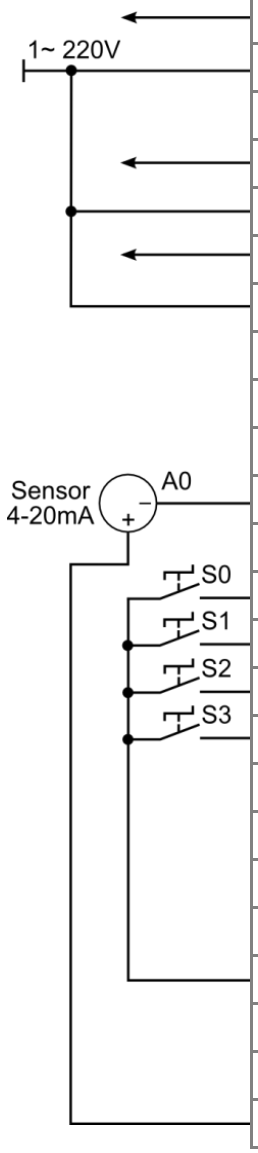
■ DI1: Digital input of the CFW500-IOR plug-in module of the CFW500 frequency inverter to enable the Pump Genius operation;

■ DI2, DI3 and DI4: Digital inputs of the CFW500-IOR plug-in module of the CFW500 frequency inverter indicating that the pumps are enabled for the Pump Genius.

NOTE!
The connections of the command shown in figure 2.22 are relative to the CFW500-IOR plug-in module. If you use another plug-in module, please refer to the appropriate installation guide.

2.2.2.3 Control Connections

The figure 2.23 presents the control connections (analog inputs/outputs, digital inputs/outputs) that must be made to connector of the CFW500-IOR plug-in module of the CFW500 frequency inverter for the Pump Genius Multipump configured for floating control, three pumps in parallel and setpoint via HMI.



Conector			Function for Floating Control, three pumps in parallel and Setpoint via HMI
1	DO1-NO	Upper Terminal	Relay digital output 1 (DO1): Start pump 1
3	DO1-C		
5	DO1-NC		
7	DO3-NO		Relay digital output 3 (DO3): Start pump 2
9	DO3-C		
11	DO4-NO		Relay digital output 4 (DO4): Start pump 3
13	DO4-C		
15	DO5-NO		Relay digital output 5 (DO5): No function
17	DO5-C		
19	NC		Not connected
21	AI1		Analog input 1 (4-20 mA): Control process variable
23	+ 10V		Reference +10 Vdc for potentiometer
2	DI1	Lower Terminal	Digital input 1: Enable pump genius
4	DI2		Digital input 2: Enable pump 1 via DO1
6	DI3		Digital input 3: Enable pump 2 via DO3
8	DI4		Digital input 4: Enable pump 3 via DO4
10	DI5		Digital input 5: No function
12	RS485 - A		RS485 (Terminal A)
14	RS485 - B		RS485 (Terminal B)
16	GND		Reference 0 V
18	GND		Reference 0 V
20	AO1		Analog output 1: Real speed
22	DO2-TR		Transistor digital output 2 (DO2): No function
24	+24V		Power supply +24 Vdc

Figure 2.23 – Signals on connector of the CFW500-IOR plug-in module for floating control, three pumps in parallel and setpoint via HMI

NOTE!
Refer to the CFW500 frequency inverter manual and the CFW500-IOR installation guide for further details about connections.

2.2.2.4 Operation Description

The figure 2.24 presents the operation scheme of the Pump Genius configured for floating control, three pumps in parallel and setpoint via HMI. The pumps will be starting in the "In a Sequence" activation mode in order to simplify the understanding of their drive. For the “Pump Rotation” activation mode, the operation time for the start or stop of the pumps is taken into account.

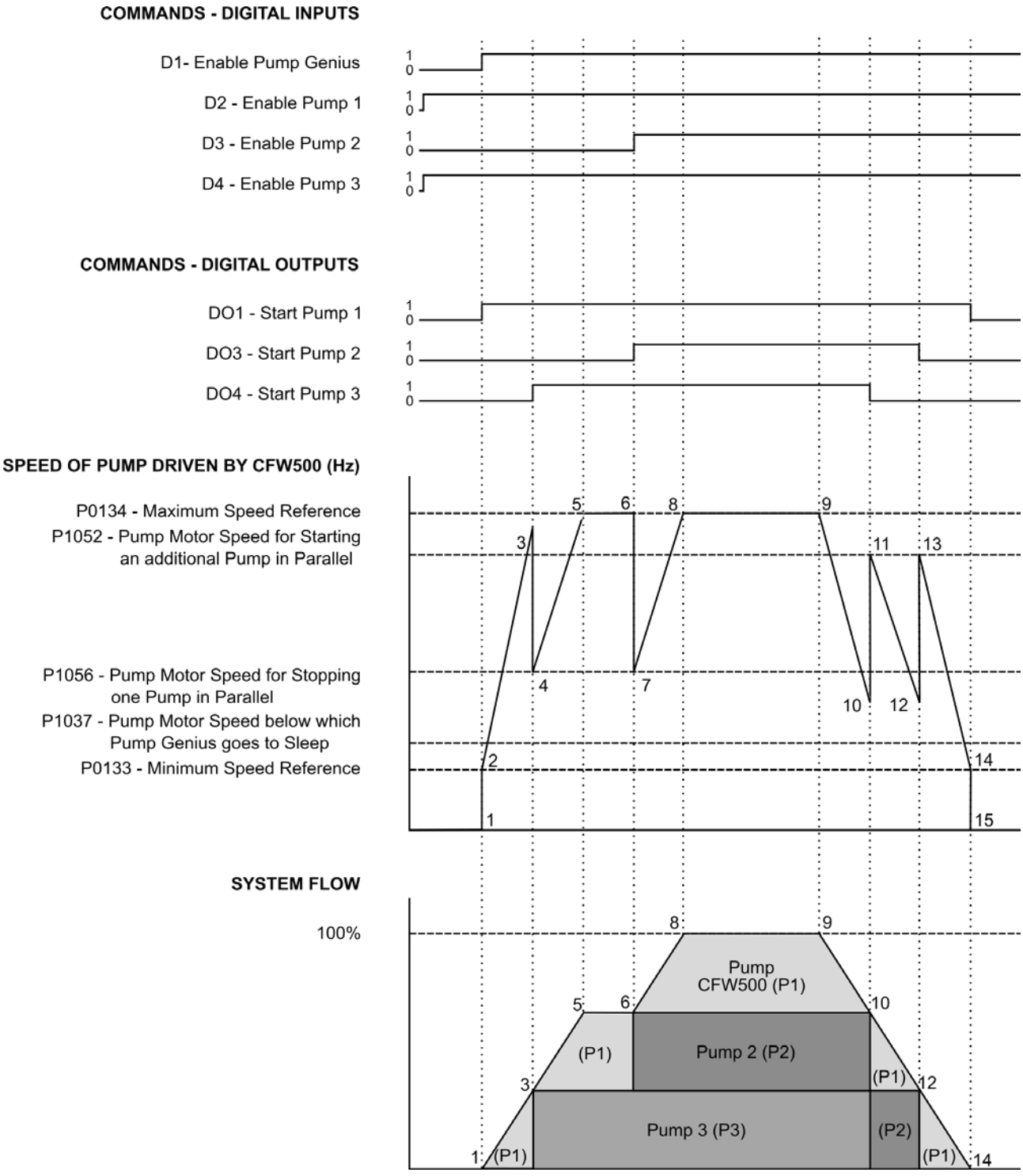


Figure 2.24 – Operation description of the Pump Genius for floating control

The graph of the figure 2.24 shows the digital inputs for the command and enabling of the pumps, the digital outputs for the start of the pumps, the motor speed behavior of the pump driven by the CFW500 frequency inverter as the pumps are started and stopped in order to maintain the control process variable according to the setpoint of the required control. The analysis below of the behavior according to the identified moments:

1 – The digital input DI1 is activated in order to enable the Pump Genius. It is verified if the control will remain in the sleep mode or in the wake up mode. The wake up mode is activated (the first time the system is enabled, the time (P1036) is discarded) and the pump driven by the CFW500 frequency inverter accelerates up to the minimum speed programmed. It is verified which pump must enter the system and be driven by the inverter. In this case, as the activation mode is “In a Sequence” and pump 1 (P1) is enabled for operation, the command for starting pump 1 (P1) is issued via digital output DO1, which, according to the wiring diagram, commands the K1.1 contactor so that the motor is driven by the inverter. Then a period of time of 500ms is awaited (a fixed time value for this application) until the acceleration of pump 1 (P1) begins up to the minimum programmed speed;

2 – The pump 1 (P1) being driven by the CFW500 inverter is accelerated to the minimum speed (P0133) and then the PID controller is enabled. If the pipe charging process is enabled, a period of time (P1041) is awaited to enable the PID controller;

3 – According to the control setpoint and the control process variable, the PID controller responds and accelerates the pump 1 (P1) being driven by the CFW500 inverter. At this moment, the pump 1 (P1) motor speed exceeds the threshold value programmed for starting an additional pump (P1052) and the deviation from the control setpoint exceeds the threshold programmed for starting an additional pump (P1053), initiating the time count P1054 and it is awaited and the command to start one more pump in parallel is issued. It is verified which pump will enter the system. In this case, since pump 1 (P1) is already started and being driven by the inverter, in the sequence pump 2 (P2) must be started, but it is disabled via digital input DI3; therefore, since pump 3 (P3) is enabled to operate, the command to start pump 3 (P3) is issued via digital output DO4, which, according to the wiring diagram, commands contactor K3;

4 – After pump 3 (P3) is started, the speed of the pump 1 (P1) driven by the inverter is reduced to the value of the motor speed programmed to stop a pump in parallel (P1057). This is done to minimize oscillations in the system. After that, the Pump Genius takes back the speed control of the pump 1 (P1) driven by the inverter and it accelerates again;

5 – Following the analysis at instant "3", the command is issued to start one more pump in parallel and it is checked which pump must enter the system. In this case, as the pump 1 (P1) and pump 3 (P3) are already running, in the sequence pump 2 (P2) should be started, but it is disabled via digital input DI3; therefore, the system remains as it is and the pump 1 (P1) reaches the maximum programmed speed;

6 – Because the system needs another pump in parallel, when pump 2 (P2) is enabled via digital input DI3, the command to start the pump 2 (P2) is immediately issued via digital output DO3, which, according to the wiring diagram, commands contactor K2;

7 – After pump 2 (P2) is started, the analysis at instant “4” follows;

8 – With all pumps of the system are running, the pump 1 (P1) driven by CFW500 inverter reaches the maximum programmed speed and continues to control the system;

9 – The system begins to feel an increase in the process variable and starts to decrease the speed of the pump 1 (P1) driven by CFW500 inverter;

10 – When the value of motor speed programmed to stop one pump in parallel (P1056) is reached and there is a certain difference (deviation) between the control setpoint and the process variable (P1057), a period of time is awaited (P1058) and the command to stop one pump in parallel is issued. It is checked which pump will be removed from system. In this case, since the activation mode is "In a Sequence", the pump 3 (P3) must be stopped. The command to stop pump 3 (P3) is issued via digital output DO4, which, according to the wiring diagram, commands contactor K3;

11 – After stopping pump 3 (P3), the speed of the pump 1 (P1) driven by CFW500 inverter is increased to the value of motor speed to start one more pump in parallel (P1052). This is done so as to minimize oscillations in the system. After that, the Pump Genius takes back the speed control of the pump 1 (P1) driven by CFW500 inverter and it decelerates again;

12 – Following the analysis done at moment “10”, the command for stopping another pump in parallel is issued, and it is checked which pump must be removed from the system. In this case, since pump 3 (P3) is already stopped, the next pump to be stopped is pump 4 (P2). The command to stop pump 4 (P2) is issued via digital output DO3, which, according to the wiring diagram, commands contactor K2;

13 – After stopping pump 2 (P2), the analysis at instant “11” follows;

14 – When the motor speed programmed to sleep (P1037) is reached, a period of time is awaited (P1038) and, since the pump 1 (P1) driven by CFW500 inverter remains with speed below the value programmed to sleep, the sleep mode is activated;

15 – With the sleep mode active, pump 1 (P1), which is being driven by CFW500 inverter, is stopped. After 500ms (fixed time for this application) the command to stop digital output DO1 is issued, which, according wiring diagram, commands contactor K1.1. But the Pump Genius remains enabled, monitoring the control process variable. If the value falls below the deviation of the process variable to wake up (P1034) for a period of time (P1035), the wake up mode is activated and the control begins to start and stop the pumps again according to the requirements of the control setpoint.

NOTE!
Refer the chapter 3 for further details on the parameters.

2.3 PG MULTIPLEX

In the Pump Genius Multiplex application developed for the CFW500 SoftPLC function several possibilities of use or configuration were implemented: associated pumps in parallel defining whether it will operate as a master/slave or slave, the possibility of having more than one process variable sensor allowing the exchange of the master/slave pump, protect the pump using a digital sensor, etc. Below are details about some association types of pumps in parallel.
.

NOTA!
The Pump Genius Multiplex application only works on CFW500 inverter with firmware version V3.50 or over. So upgrading the CFW500 inverter firmware to the working of this application is required.

2.3.1 ONE MASTER/SLAVE PUMP WITH ONE SLAVE PUMP

The user can configure the Pump Genius Multiplex application to having two pumps in parallel, each pump being driven by its respective CFW500 inverter. One pump will be a master/slave pump (one that performs the actions for pumping control) and the other pump will be a slave pump (receives commands from the master/slave pump). The communication between the pumps is accomplished via RS485 interface using the SymbiNet network protocol.

The pumping system to be presented in the sequence contains one master/slave pump, one slave pump and communication done via RS485 interface, which basically comprises:

- 02 CFW500 inverters + CFW500-RS485 plug-in module (D1 and D2);
- 02 Electric motors and pumps (P1 and P2);
- 01 Sensor with analog output signal for measurement of the control process variable (A1);
- Command for enabling the Pump Genius (S1);
- Command for enabling the use of the pump driven by CFW500 inverter (S2.1 and S2.2);
- Status light for inverter fault (H1.1 and H1.2);
- Status light for motor running (H2.1 and H2.2);
- Status light for low or high level protection for the control process variable (H3).

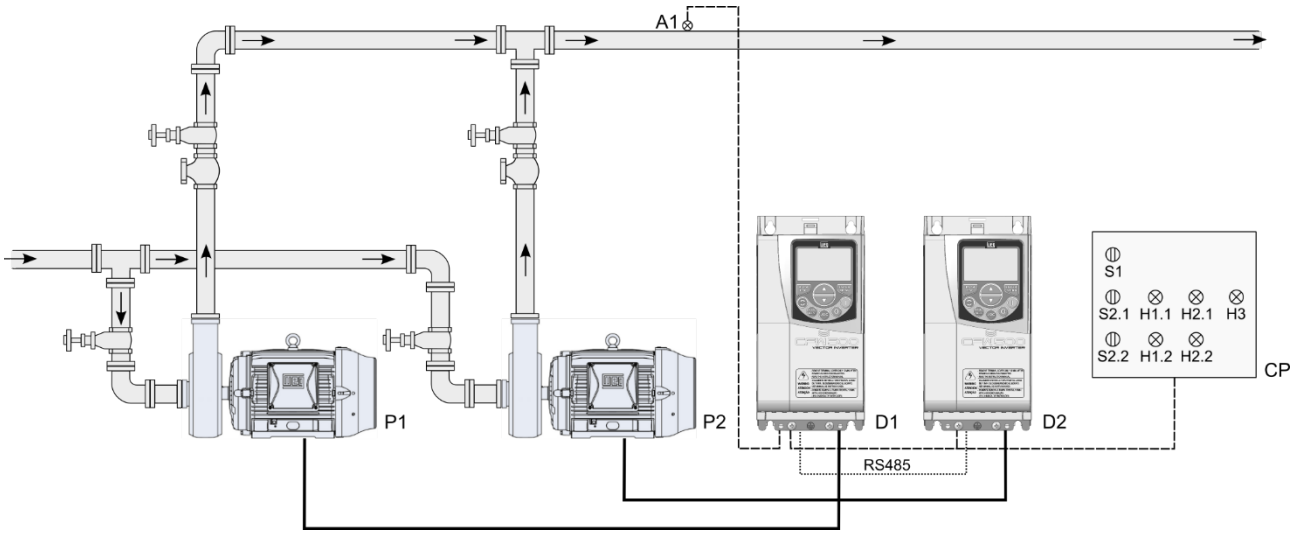


Figure 2.25 – Pump Genius Multiplex application with two pumps in parallel and RS485 communication interface

NOTE!
Using the Master/Slave Pump configuration wizard to configure the pump 1 and the Slave Pump configuration wizard to configure the pump 2 in this pumping system with two pumps in parallel and RS485 communication interface.

NOTE!
The indicating lights H1.1, H1.2, H2.1, H2.2 and H3 are not necessary for the operation of the Pump Genius with two pumps in parallel and RS485 communication interface. They only indicate the condition of the pumps' operation at the command panel (CP).

2.3.1.1 Power Connections

The figure 2.26 presents the power connection diagram for a Pump Genius Multiplex application with two pumps in parallel.

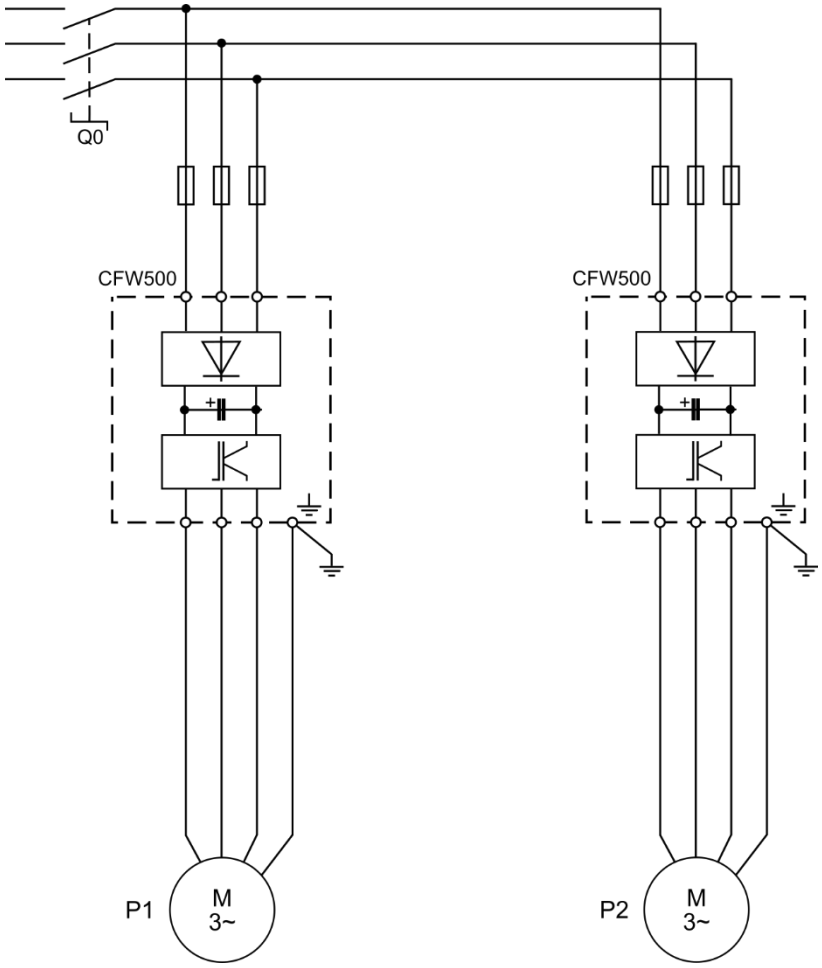


Figure 2.26 – Power connections of the Pump Genius Multiplex application with two pumps in parallel

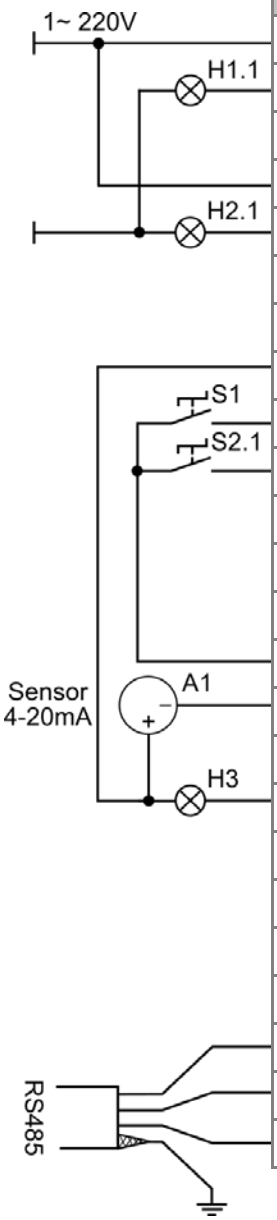
Where:

- Q0: Protection circuit breaker for the system power supply;
- P1 and P2: Pump motors;
- The protection of CFW500 inverter is done with fuses.

NOTE!
It is recommended the protection of the inverter so as to avoid damages.

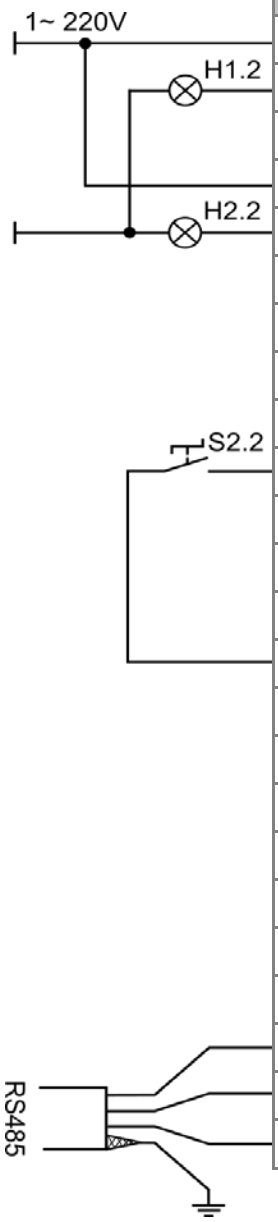
2.3.1.2 Control Connections

The figure 2.27 and 2.28 presents the control connections (analog inputs/outputs, digital inputs/outputs), that must be done to connector of the CFW500-RS485 plug-in module of the CFW500 inverters of the master/slave pump (Pump 1) and the slave pump (Pump 2).



Conector			Default Function for Master/Slave Pump (Pump 1)
1	DO1-NO	Upper Terminal	Relay digital output 1 (DO1): No fault
3	DO1-C		
5	DO1-NC		
7	DO3-NO		Relay digital output 3 (DO3): F > Fx
9	DO3-C		
11	DO3-NC		
13	NC		Not connected
15	+24V		Power supply +24 Vdc
17	DI1		Digital input 1: Enable pump genius
19	DI2		Digital input 2: Enable the use of the pump
21	DI3		Digital input 3: No function
23	DI4		Digital input 3: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (4-20 mA): Control process variable
8	+10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): A770/A772 or F771/F773 (SoftPLC)
12	RS485 – A		RS485 (Terminal A(-))
14	RS485 – B		RS485 (Terminal B(+))
16	GND		Reference 0 V
18	AI2		Analog input 2 (0-10 V): No function
20	RS485 – A2		RS485 (Terminal A2(-))
22	RS485 – B2		RS485 (Terminal B2(+))
24	GND		Reference 0 V

Figure 2.27 – Signals on connector of the CFW500-RS485 plug-in module for master/slave pump (Pump 1)



Conector			Default Function for Slave Pump (Pump 2)
1	DO1-NO	Upper Terminal	Relay digital output 1 (DO1): No fault
3	DO1-C		
5	DO1-NC		
7	DO3-NO		Relay digital output 3 (DO3): F > Fx
9	DO3-C		
11	DO3-NC		
13	NC		Not connected
15	+24V		Power supply +24 Vdc
17	DI1		Digital input 1: No function
19	DI2		Digital input 2: Enable the use of the pump
21	DI3		Digital input 3: No function
23	DI4		Digital input 3: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (0-10 V): No function
8	+10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): No function
12	RS485 – A		RS485 (Terminal A(-))
14	RS485 – B		RS485 (Terminal B(+))
16	GND		Reference 0 V
18	AI2		Analog input 2 (0-10 V): No function
20	RS485 – A2		RS485 (Terminal A2(-))
22	RS485 – B2		RS485 (Terminal B2(+))
24	GND		Reference 0 V

Figure 2.28 – Signals on connector of the CFW500-RS485 plug-in module for slave pump (Pump 2)

NOTE!
Refer to the CFW500 inverter manual and the CFW500-RS485 installation guide for more information on the connections.

2.3.1.3 Operation Description

The figure 2.29 presents a timing analysis of the Pump Genius configured with two pumps in parallel being one master/slave pump (Pump 1) and one slave pump (Pump 2

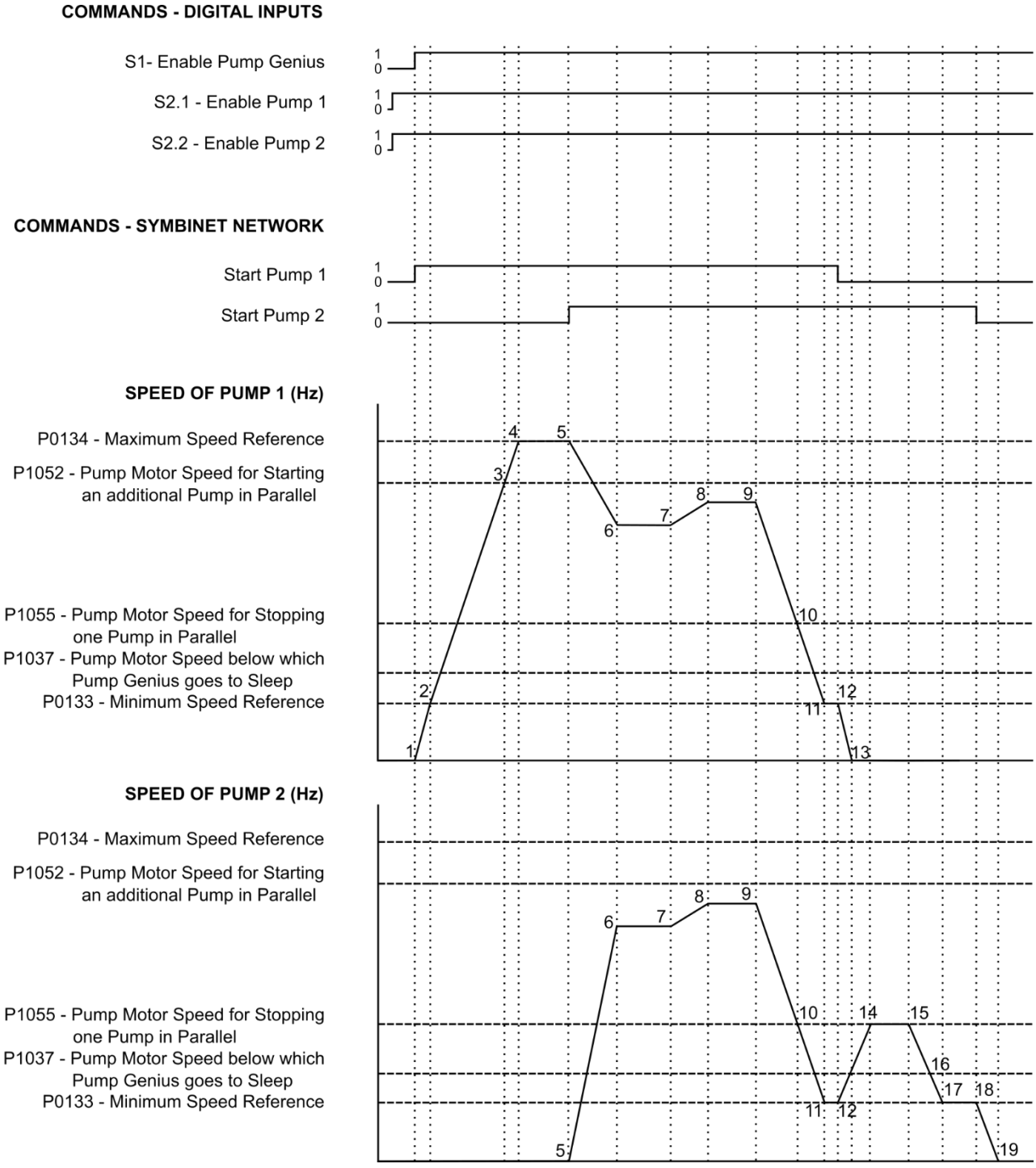


Figure 2.29 – Operation description of the Pump Genius Multiplex with two pumps in parallel

1 – The digital input DI1 is activated in order to enable the Pump Genius. It is verified if the control will remain in the sleep mode or in the wake up mode. The wake up mode is activated (the first time the Pump Genius is enabled, the time (P1036) is discarded) and the control (pump 1 – master/slave) verify which pump have the lower operation time. In this example the operation time of the pump 1 and pump 2 are equal, the pump 1 (highest priority) is started;

2 – The pump 1 is accelerated to the minimum speed (P0133) and then the PID controller is enabled. If the pipe charging process is enabled, a period of time (P1041) is awaited to enable the PID controller;

3 – According to the control setpoint and the control process variable, the PID controller responds and accelerates the pump 1. At this moment the pump motor speed exceeds the threshold value programmed for starting an additional pump (P1052) and the deviation from the control setpoint exceeds the threshold programmed for starting an additional pump (P1053), initiating the time count P1054;

4 – The pump 1 is accelerated to the maximum speed (P0134), the conditions for starting an additional pump in parallel (P1052 and P1053) remain actives and the time (P1054) is awaited;

5 – All processes continue as at time point 4, until the time count (P1054) has elapsed. At this moment among the enabled pumps, the one with the lowest accumulated operating time receives the command to start via SymbiNet network. Then, is done the command via SymbiNet network to start the pump 2;

6 – The pump 2 is accelerated to the speed reference from the PID controller as the acceleration ramp set in the P0100 parameter. Then, the control process variable begins to increase due to the addition of another pump; the PID controller begins to decrease the speed reference for the pump 1 until the moment that both pumps operate at the same speed;

7 – The PID controller can control the pumping, then the control process variable begins to decrease and is necessary to increase the speed of the pumps to keep pumping controlled;

8 – The PID controller increases the reference speed for the pump 1 and pump 2 and the two pumps are accelerated until the control process variable value becomes equal to the setpoint control required;

9 – Eventually, through the continued action of the PID controller, the pumping control achieves stabile operation at the control setpoint as required by the user.

10 – According to the control setpoint and the control process variable, the PID controller responds and decelerates the pump 1 and pump 2. At this moment the pumps motor speed drops below the threshold programmed for stopping one pump (P1055) and the deviation from the control setpoint exceeds the threshold programmed for stopping one pump (P1056), initiating the time count P1057;

11 –The pump 1 and pump 2 can be decelerated to the minimum speed (P0133), the conditions for stopping one pump in parallel (P1055 and P1056) remain actives and the time (P1057) is awaited;

12 – All processes continue as at time point 11, until the time count (P1057) is elapsed. At this moment the command for stopping one pump in parallel is issued via SymbiNet network. From among the activated pumps, the one with the largest accumulated operating time will be stopped. As the pump 1 is running more time, is done the command via SymbiNet network to stop the pump 1;

13 – The pump 1 is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and then is disabled, i.e., one of the parallel pumps was successfully stopped. At this moment the control process variable reaches the control setpoint required by the user and the PID controller responds and accelerates the pump 2;

14 – The PID controller increases the reference speed for the pump 2 until the control process variable value becomes equal to the setpoint control required;

15 – The PID controller can control the pumping, then the process variable begins to increase and is necessary to decrease the speed of the pump 2 to keep pumping controlled;

16 – According to the control setpoint and the control process variable, the PID controller responds and decelerates the pump 2. At this moment the pump motor speed exceeds the threshold value programmed to sleep (P1037), initiating the time count P1038;

17 – The pump 2 is decelerated to the minimum speed (P0133), the conditions to sleep remain active and the time (P1038) is awaited;

18 – All processes continue as at time point 17, until the time count (P1038) is elapsed. Then, the sleep mode is activated and it is done the command via SymbiNet network to stop the pump 2;

19 – The pump 2 is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and then is disabled; but the Pump Genius remains enabled, and the control process variable is monitored. If the value falls below the deviation of the control process variable to wake up (P1034) for a period of time (P1036), the wake up mode is activated and the control begins to start and stop the pumps again according to the requirements of the control setpoint.

NOTE!
Refer the chapter 3 for further details on the parameters.

2.3.2 ONE MASTER/SLAVE PUMP WITH SLAVE PUMPS

The user can configure the Pump Genius Multiplex application to having up to three pumps in parallel, each pump being driven by its respective CFW500 inverter. One pump will be a master/slave pump (one that performs the actions for pumping control) and the others pumps will be a slave pumps (receives commands from the master pump). The communication between the pumps is accomplished via RS485 interface using the SymbiNet network protocol.

The pumping system to be presented in the sequence contains one master/slave pump, two slave pumps and communication done via RS485 interface, which basically comprises:

- 03 CFW500 inverters + CFW500-RS485 plug-in module (D1, D2 and D3);
- 03 Electric motors and pumps (P1, P2 and P3);
- 01 Sensor with analog output signal for measurement of the control process variable (A1);
- Command for enabling the Pump Genius (S1);
- Command for enabling the use of the pump driven by CFW500 inverter (S2.1, S2.2 and S2.3);
- Status light for inverter fault (H1.1, H1.2 and H1.3);
- Status light for motor running (H2.1, H2.2 and H2.3);
- Status light for low or high level protection for the control process variable (H3).

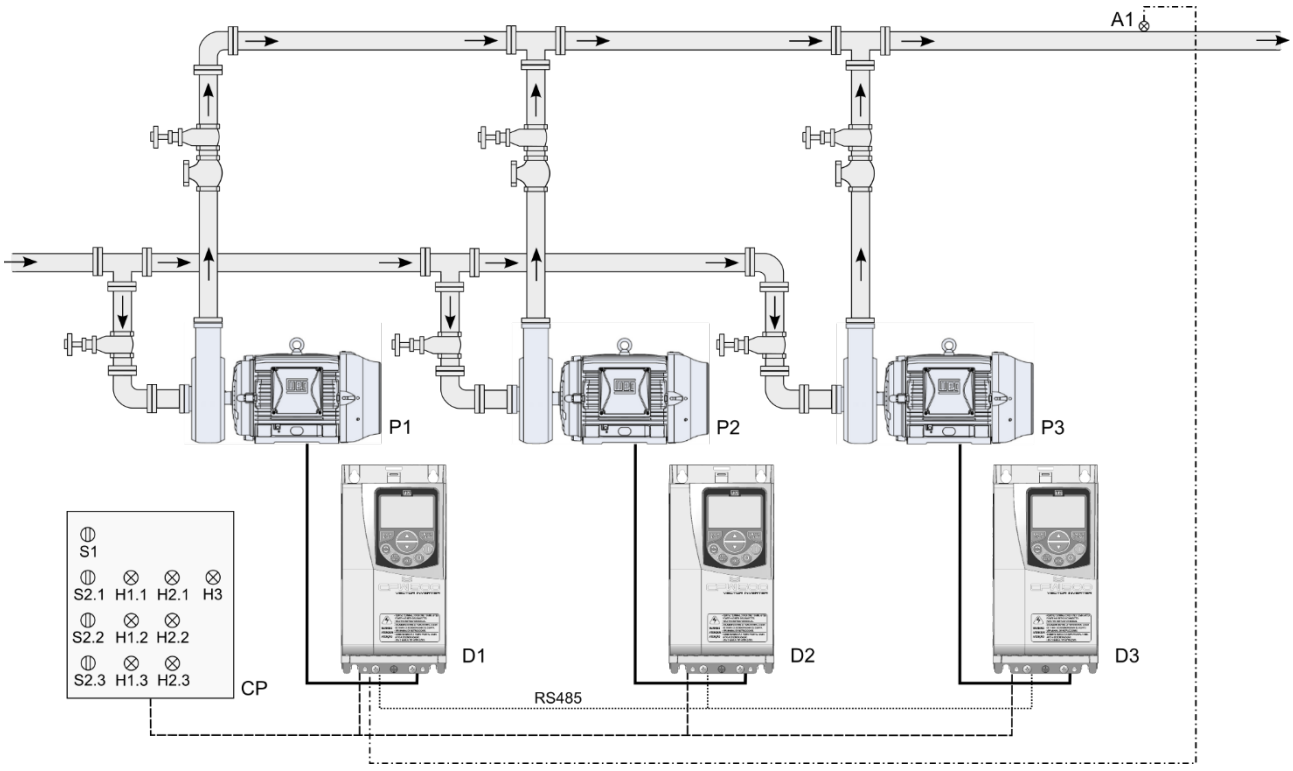


Figure 2.30 – Pump Genius Multiplex application with 1 master Pump and two slave pumps in parallel and RS485 communication interface

NOTE!
Using the Master/Slave Pump configuration wizard to configure the pump 1 and the Slave Pump configuration wizard to configure the pump 2 and pump 3 in this pumping system with three pumps in parallel and RS485 communication interface.

NOTE!
The indicating lights H1.1, H1.2, H1.3, H2.1, H2.2, H2.3 and H3 are not necessary for the operation of the Pump Genius with three pumps in parallel and RS485 communication interface. They only indicate the condition of the pumps' operation at the command panel (CP).

2.3.2.1 Power Connections

The figure 2.31 presents the power connection diagram for a Pump Genius Multiplex application with three pumps in parallel.

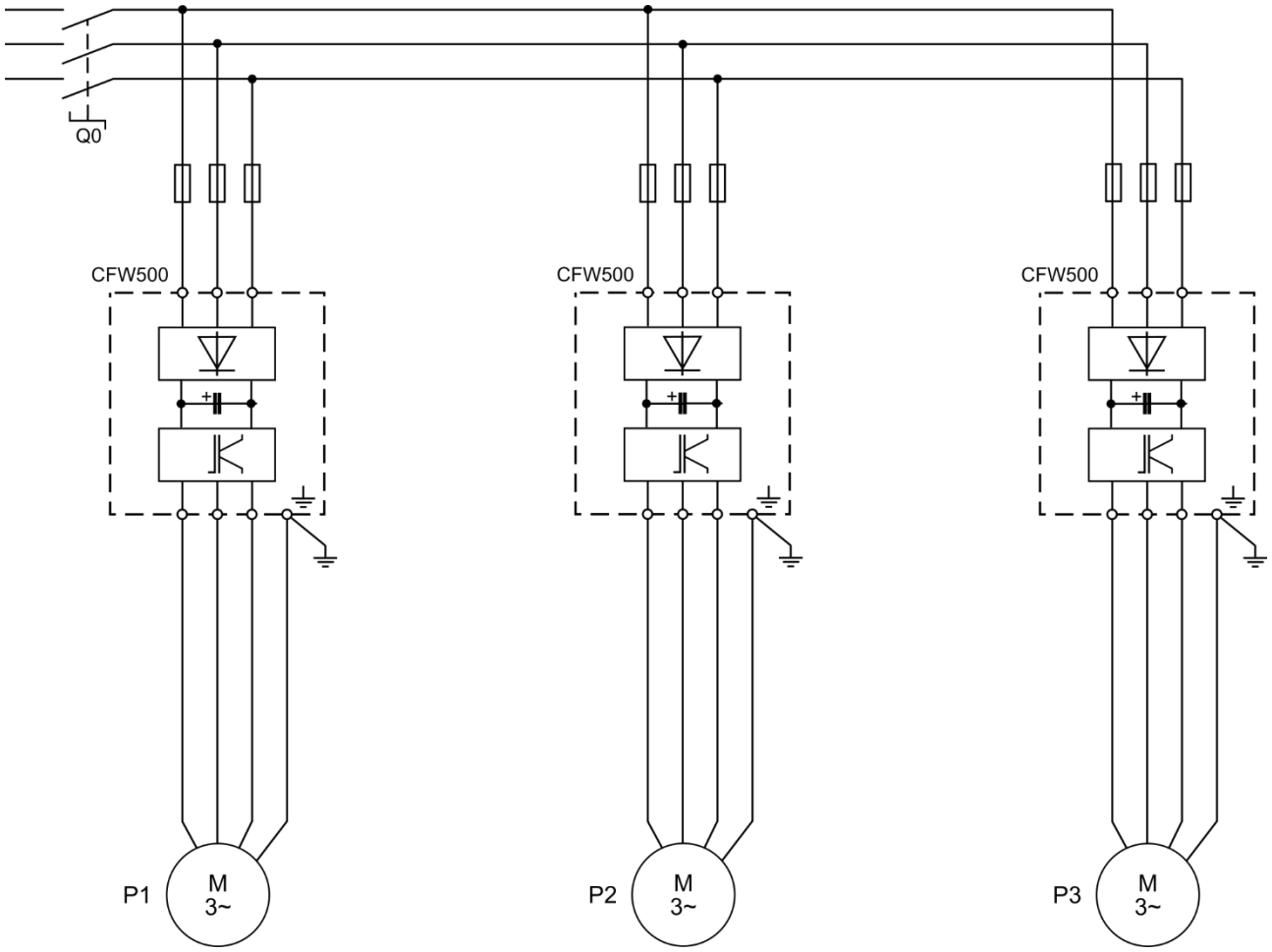


Figure 2.31– Power connections of the Pump Genius Multiplex application with three pumps in parallel

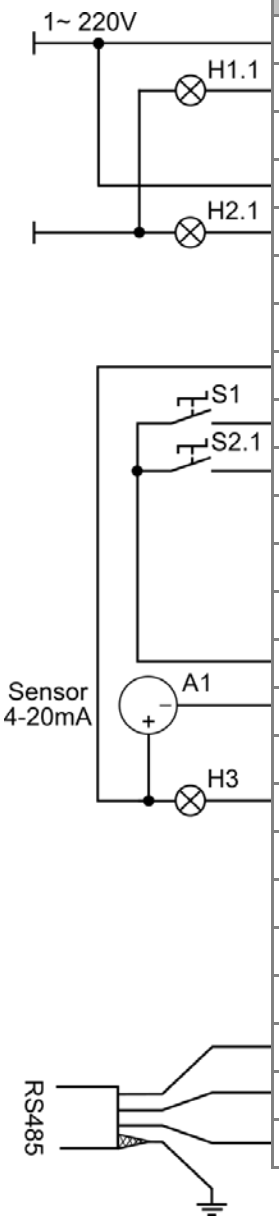
Where:

- Q0: Protection circuit breaker for the system power supply;
- P1, P2 and P3: Pump motors;
- The protection of CFW-11 inverter is done with fuses.

NOTE!
It is recommended the protection of the inverter so as to avoid damages.

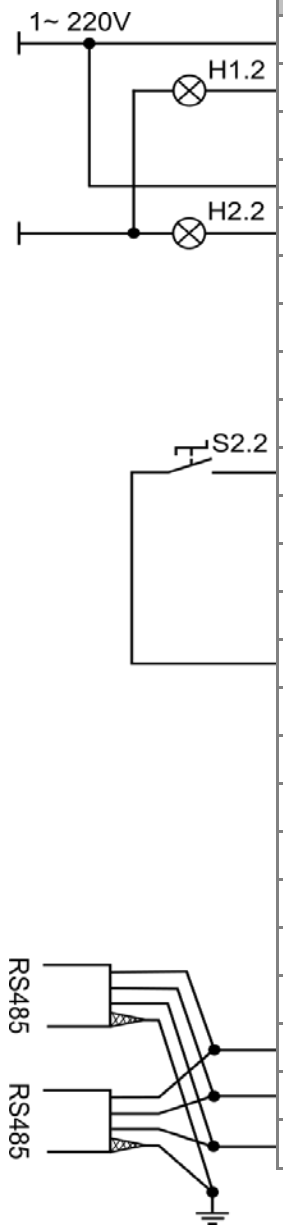
2.3.2.2 Control Connections

The figure 2.32, 2.33 and 2.34 presents the control connections (analog inputs/outputs, digital inputs/outputs), that must be done to connector of the CFW500-RS485 plug-in module of the CFW500 inverters of the master/slave pump (Pump 1) and the slave pumps (Pump 2 and Pump 3).



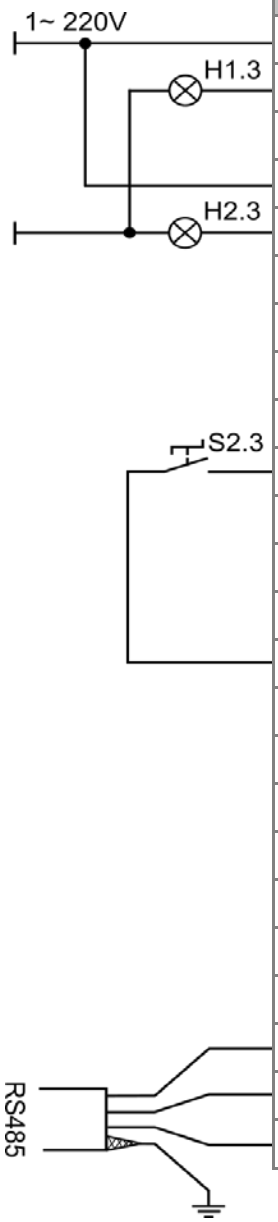
Conector			Default Function for Master/Slave Pump (Pump 1)
1	DO1-NO	Upper Terminal	Relay digital output 1 (DO1): No fault
3	DO1-C		
5	DO1-NC		
7	DO3-NO		Relay digital output 3 (DO3): F > Fx
9	DO3-C		
11	DO3-NC		
13	NC		Not connected
15	+24V		Power supply +24 Vdc
17	DI1		Digital input 1: Enable pump genius
19	DI2		Digital input 2: Enable the use of the pump
21	DI3		Digital input 3: No function
23	DI4		Digital input 3: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (4-20 mA): Control process variable
8	+10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): A770/A772 or F771/F773 (SoftPLC)
12	RS485 – A		RS485 (Terminal A(-))
14	RS485 – B		RS485 (Terminal B(+))
16	GND		Reference 0 V
18	AI2		Analog input 2 (0-10 V): No function
20	RS485 – A2		RS485 (Terminal A2(-))
22	RS485 – B2		RS485 (Terminal B2(+))
24	GND		Reference 0 V

Figure 2.32 – Signals on connector of the CFW500-RS485 plug-in module for master/slave pump (Pump 1)



Conector			Default Function for Slave Pump (Pump 2)
1	DO1-NO	Upper Terminal	Relay digital output 1 (DO1): No fault
3	DO1-C		
5	DO1-NC		
7	DO3-NO		Relay digital output 3 (DO3): F > Fx
9	DO3-C		
11	DO3-NC		
13	NC		Not connected
15	+24V		Power supply +24 Vdc
17	DI1		Digital input 1: No function
19	DI2		Digital input 2: Enable the use of the pump
21	DI3		Digital input 3: No function
23	DI4		Digital input 3: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (0-10 V): No function
8	+10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): No function
12	RS485 – A		RS485 (Terminal A(-))
14	RS485 – B		RS485 (Terminal B(+))
16	GND		Reference 0 V
18	AI2		Analog input 2 (0-10 V): No function
20	RS485 – A2		RS485 (Terminal A2(-))
22	RS485 – B2		RS485 (Terminal B2(+))
24	GND		Reference 0 V

Figure 2.33 – Signals on connector of the CFW500-RS485 plug-in module for slave pump (Pump 2)



Conector			Default Function for Slave Pump (Pump 3)
1	DO1-NO	Upper Terminal	Relay digital output 1 (DO1): No fault
3	DO1-C		
5	DO1-NC		
7	DO3-NO		Relay digital output 3 (DO3): F > Fx
9	DO3-C		
11	DO3-NC		
13	NC		Not connected
15	+24V		Power supply +24 Vdc
17	DI1		Digital input 1: No function
19	DI2		Digital input 2: Enable the use of the pump
21	DI3		Digital input 3: No function
23	DI4		Digital input 3: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (0-10 V): No function
8	+10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): No function
12	RS485 – A		RS485 (Terminal A(-))
14	RS485 – B		RS485 (Terminal B(+))
16	GND		Reference 0 V
18	AI2		Analog input 2 (0-10 V): No function
20	RS485 – A2		RS485 (Terminal A2(-))
22	RS485 – B2		RS485 (Terminal B2(+))
24	GND		Reference 0 V

Figure 2.34 – Signals on connector of the CFW500-RS485 plug-in module for slave pump (Pump 3)

NOTE!
Refer to the CFW500 inverter manual and the CFW500-RS485 installation guide for more information on the connections.

2.3.2.3 Operation Description

2.3.2.3.1 Starting the Pumps

The figure 2.35 presents a timing analysis of the Pump Genius configured with three pumps in parallel being one master/slave (Pump 1) and two slaves (Pump 2 and Pump 3) in the process of starting the pumps.

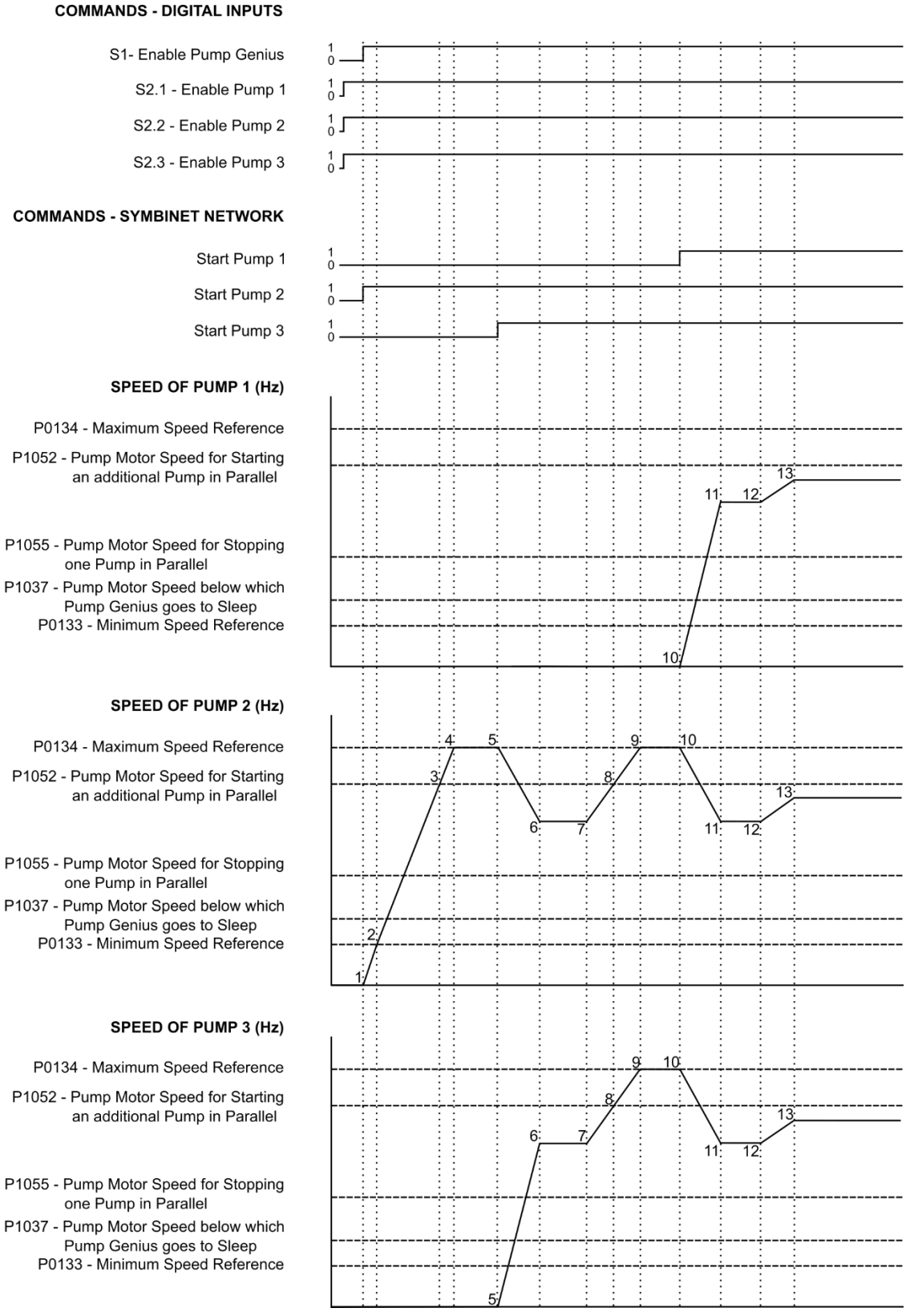


Figure 2.35 – Operation description of the Pump Genius Multiplex with three pumps in parallel

1 – The digital input DI1 is activated in order to enable the Pump Genius. It is verified if the control will remain in the sleep mode or in the wake up mode. The wake up mode is activated (the first time the Pump Genius is enabled, the time (P1036) is discarded) and the control (pump 1 – master/slave) verify which pump have the lower operation time. In this example the operation time of the pump 2 is lower than pump 1 and pump 3, then the pump 2 is started;

2 – The pump 2 is accelerated to the minimum speed (P0133) and then the PID controller is enabled. If the pipe charging process is enabled, a period of time (P1041) is awaited to enable the PID controller;

3 – According to the control setpoint and the control process variable, the PID controller responds and accelerates the pump 2. At this moment, the pump motor speed exceeds the threshold value programmed for starting an additional pump (P1052) and the deviation from the control setpoint exceeds the threshold programmed for starting an additional pump (P1053), initiating the time count P1054;

4 –The pump 2 is accelerated to the maximum speed (P0134), the conditions for starting an additional pump in parallel (P1052 and P1053) remain actives and the time (P1054) is awaited;

5 – All processes continue as at time point 4, until the time count (P1054) has elapsed. At this moment among the enabled pumps, the one with the lowest accumulated operating time receives the command to start via SymbiNet network. Then, as the operation time of the pump 3 is lower than pump 1, it is done the command via SymbiNet network to start the pump 3;

6 – The pump 3 is accelerated to the speed reference from the PID controller as the acceleration ramp set in the P0100 parameter. Then, the control process variable begins to increase due to the addition of another pump; the PID controller begins to decrease the speed reference for the pump 2 until the moment that both pumps operate at the same speed;

7 – The PID controller can control the pumping, then the control process variable begins to decrease and is necessary to increase the speed of the pumps to keep pumping controlled;

8 – At this moment the pumps motor speed exceeds the threshold value programmed for starting an additional pump (P1052) and the deviation from the control setpoint exceeds the threshold programmed for starting an additional pump (P1053), initiating the time count P1054;

9 – The pump 2 and pump 3 are accelerated to the maximum speed (P0134), the conditions for starting an additional pump in parallel (P1052 and P1053) remain actives and the time (P1054) is awaited;

10 – All processes continue as at time point 9, until the time count (P1054) has elapsed. At this moment among the enabled pumps, the one with the lowest accumulated operating time receives the command to start via SymbiNet network. Then, as the pump 2 and pump 3 are in running, it is done the command via SymbiNet network to start the pump 1;

11 – The pump 1 is accelerated to the speed reference from the PID controller as the acceleration ramp set in the P0100 parameter. Then, the control process variable begins to increase due to the addition of another pump; the PID controller begins to decrease the speed reference for the pump 2 and pump 3 until the moment that both pumps operate at the same speed;

12 – The PID controller can control the pumping, then the control process variable begins to decrease and is necessary to increase the speed of the pumps to keep pumping controlled;

13 – The PID controller increases the reference speed for the pump 1, pump 2 and pump 3 and the three pumps are accelerated until the control process variable value becomes equal to the setpoint control required.

NOTE!
Refer the chapter 3 for further details on the parameters.

2.3.2.3.2 Stopping the Pumps

The figure 2.36 presents a timing analysis of the Pump Genius configured with three pumps in parallel being one master/slave (Pump 1) and two slaves (Pump 2 and Pump 3) in the process of stopping the pumps.

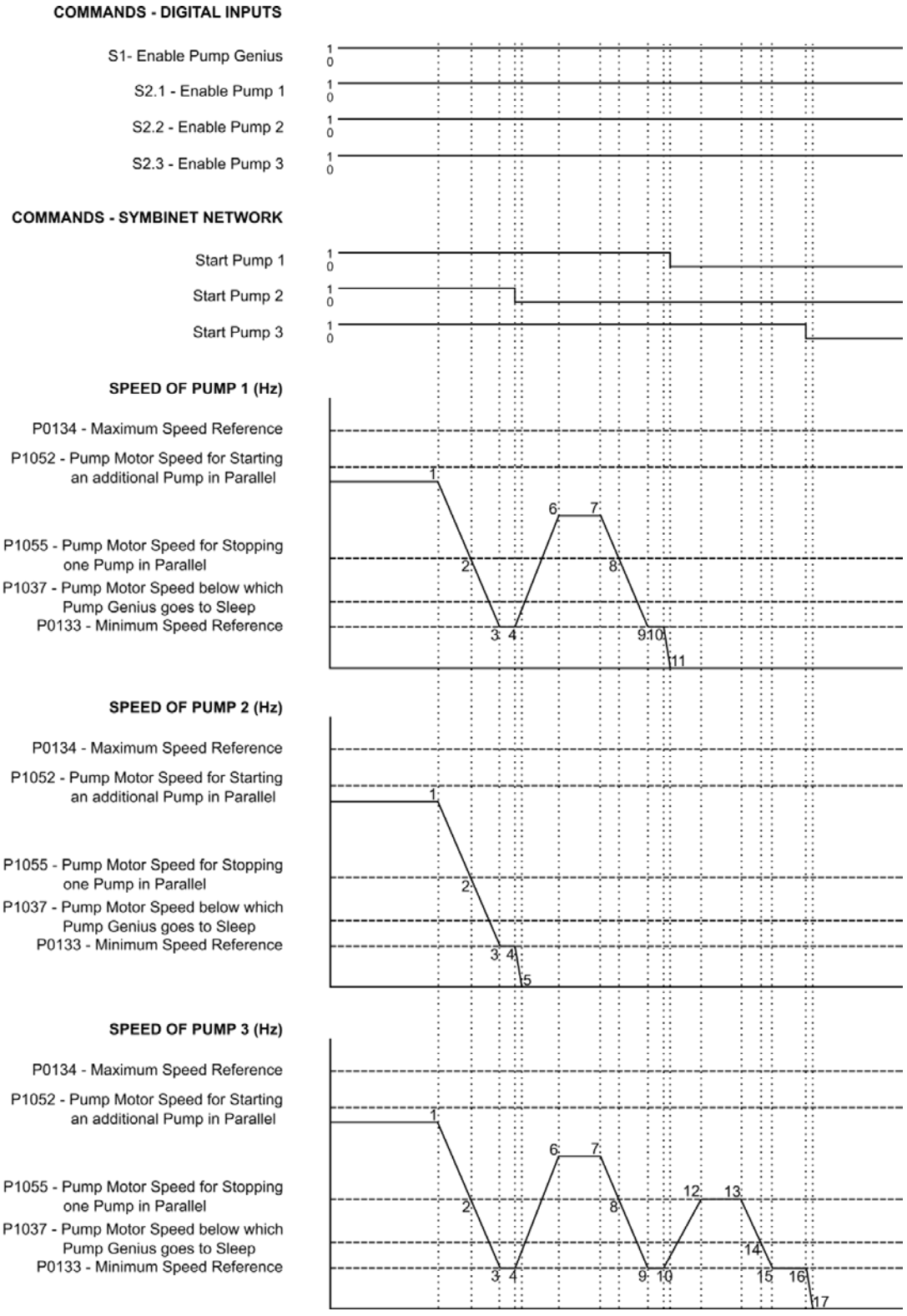


Figure 2.36 – Operation description of the Pump Genius Multiplex with three pumps in parallel

1 – The PID controller is controlling the pumping using the pump 1, pump 2 and pump 3. Then, the control process variable begins to increase and is necessary to decrease the speed of the pumps to keep pumping controlled;

2 – According to the control setpoint and the control process variable, the PID controller responds and decelerates the pump 1, pump 2 and pump 3. At this moment, the pumps motor speed drops below the threshold programmed for stopping one pump (P1055) and the deviation from the control setpoint exceeds the threshold programmed for stopping one pump (P1056), initiating the time count P1057;

3 –The pump 1, pump 2 and pump 3 can be decelerated to the minimum speed (P0133), the conditions for stopping one pump in parallel (P1055 and P1056) remain actives and the time (P1057) is awaited;

4 – All processes continue as at time point 3, until the time count (P1057) is elapsed. At this moment, the command for stopping one pump in parallel is issued via SymbiNet network. From among the activated pumps, the one with the largest accumulated operating time will be stopped. In this example the pump 2 is running more time, then a command via SymbiNet network to stop the pump 2 is done;

5 – The pump 2 is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and then is disabled, i.e., one of the parallel pumps was successfully stopped. At this moment, the control process variable reaches the control setpoint required by the user and the PID controller responds and accelerates the pump 1 and pump 3;

6 – Eventually, with the continued action of the PID controller, the pumping control achieves stabile operation at the control setpoint as required by the user.

7 – The PID controller is controlling the pumping using the pump 1 and pump 3. Then, the control process variable begins to increase and is necessary to decrease the speed of the pumps to keep pumping controlled;

8 – According to the control setpoint and the control process variable, the PID controller responds and decelerates the pump 1 and pump 3. At this moment, the pumps motor speed drops below the threshold programmed for stopping one pump (P1055) and the deviation from the control setpoint exceeds the threshold programmed for stopping one pump (P1056), initiating the time count P1057;

9 –The pump 1 and pump 3 can be decelerated to the minimum speed (P0133), the conditions for stopping one pump in parallel (P1055 and P1056) remain actives and the time (P1057) is awaited;

10 – All processes continue as at time point 9, until the time count (P1057) is elapsed. At this moment, the command for stopping one pump in parallel is issued via SymbiNet network. From among the activated pumps, the one with the largest accumulated operating time will be stopped. In this example the pump 1 is running more time, then a command via SymbiNet network to stop the pump 1 is done;

11 – The pump 1 is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and then is disabled, i.e., one of the parallel pumps was successfully stopped. At this moment, the control process variable reaches the control setpoint required by the user and the PID controller responds and accelerates the pump 3;

12 – The PID controller increases the reference speed for the pump 3 until the control process variable value becomes equal to the setpoint control required;

13 – The PID controller can control the pumping, then the control process variable begins to increase and is necessary to decrease the speed of the pump 3 to keep pumping controlled;

14 – According to the control setpoint and the control process variable, the PID controller responds and decelerates the pump 3. At this moment, the pump motor speed exceeds the threshold value programmed to sleep (P1037), initiating the time count P1038;

15 – The pump 3 is decelerated to the minimum speed (P0133), the conditions to sleep remain active and the time (P1038) is awaited;

16 – All processes continue as at time point 15, until the time count (P1038) is elapsed. Then, the sleep mode is activated and it is done the command via SymbiNet network to stop the pump 3;

17 – The pump 3 is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and then is disabled; but the pumping control remains enabled, and the control process variable is monitored. If the value falls below the deviation of the control process variable to wake up (P1034) for a period of time (P1036), the wake up mode is activated and the control begins to start and stop the pumps again according to the requirements of the control setpoint.

NOTE!
Refer the chapter 3 for further details on the parameters.

2.3.3 MASTER/SLAVE PUMPS WITH SLAVE PUMPS

The user can configure the Pump Genius Multiplex application to having up to three pumps in parallel, each pump being driven by its respective CFW500 inverter. Some pumps will be a master/slave pump (one that performs the actions for pumping control) and the others pumps will be a slave pumps (receives commands from the master pump). The communication between the pumps is accomplished via RS485 interface using the SymbiNet network protocol.

The pumping system to be presented in the sequence contains two master/slave pumps, one slave pump and communication done via RS485 interface, which basically comprises:

- 03 CFW500 inverters + CFW500-RS485 plug-in module (D1, D2 and D3);
- 03 Electric motors and pumps (P1, P2 and P3);
- 02 Sensor with analog output signal for measurement of the control process variable (A1.1 and A1.2);
- Command for enabling the Pump Genius (S1);
- Command for enabling the use of the pump driven by CFW500 inverter (S2.1, S2.2 and S2.3);
- Status light for inverter fault (H1.1, H1.2 and H1.3);
- Status light for motor running (H2.1, H2.2 and H2.3);
- Status light for low or high level protection for the control process variable (H3.1 and H3.2).

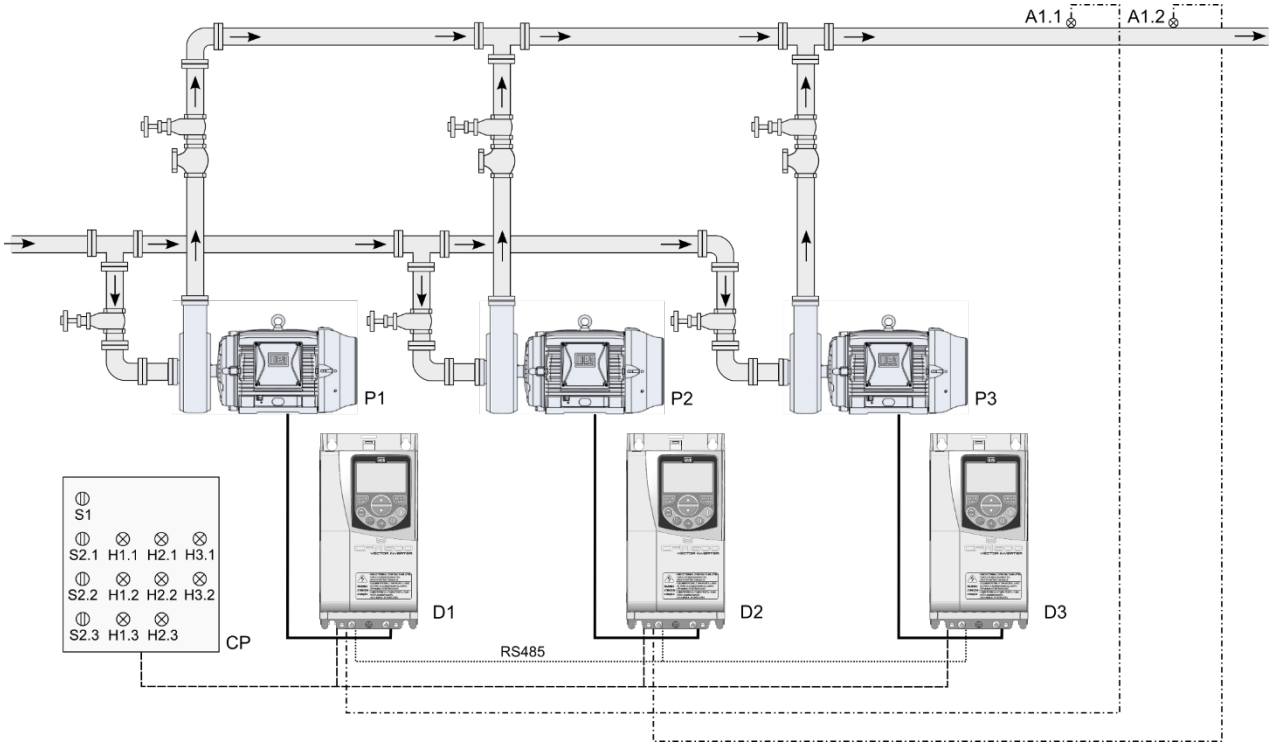


Figure 2.37 – Pump Genius Multiplex application with 2 master/slave pumps and one slave pump in parallel and RS485 communication interface

NOTE!
Using the Master/Slave Pump configuration wizard to configure the pump 1 and pump 2, and the Slave Pump configuration wizard to configure the pump 3 in this pumping system with three pumps in parallel and RS485 communication interface.

NOTE!
The indicating lights H1.1, H1.2, H1.3, H2.1, H2.2, H2.3, H3.1 and H3.2 are not necessary for the operation of the Pump Genius Multiplex with four pumps in parallel and RS485 communication interface. They only indicate the condition of the pumps' operation at the command panel (CP).

2.3.3.1 Power Connections

The figure 2.38 presents the power connection diagram for a Pump Genius Multiplex application with three pumps in parallel.

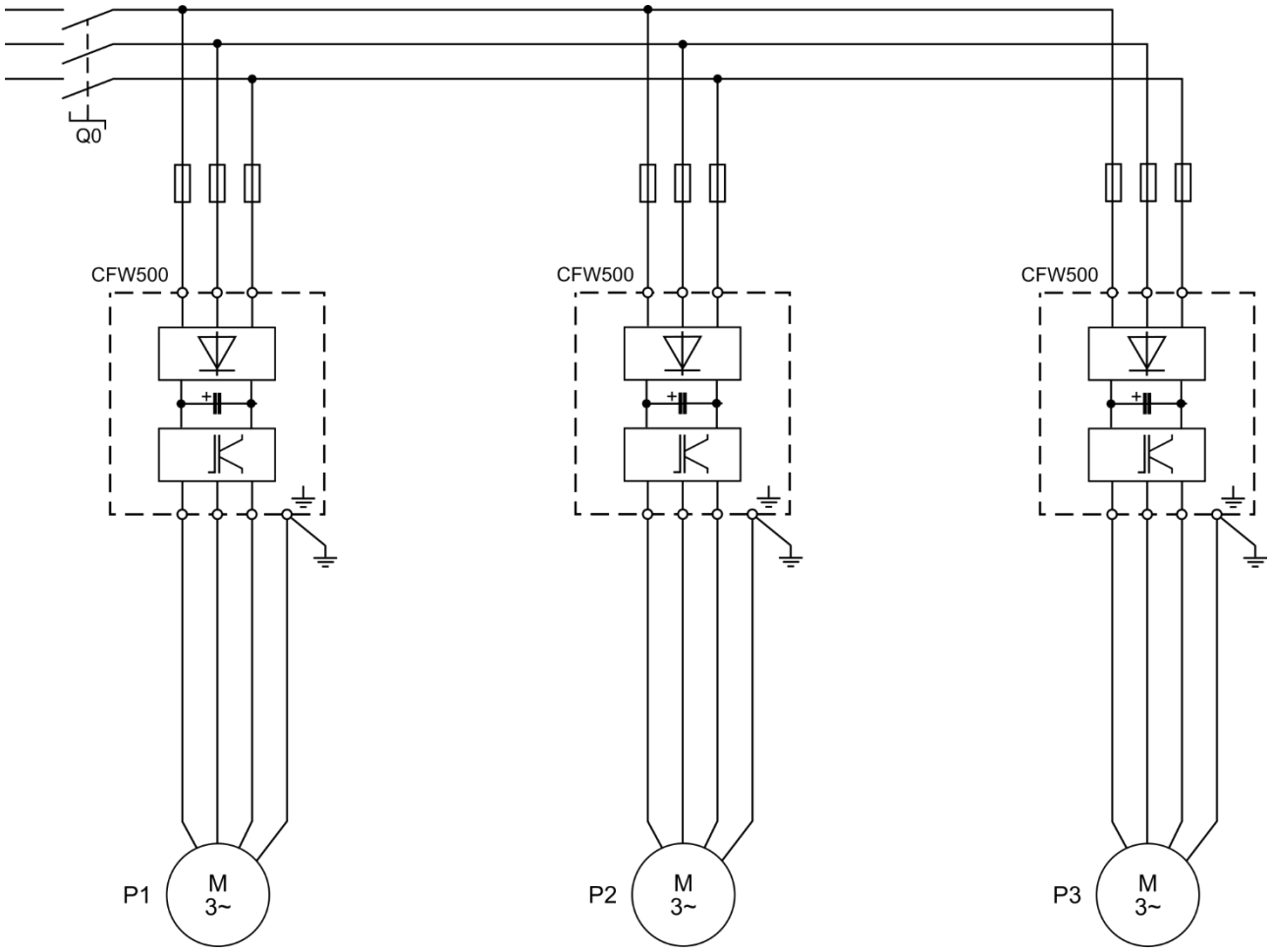


Figure 2.38– Power connections of the Pump Genius Multiplex application with three pumps in parallel

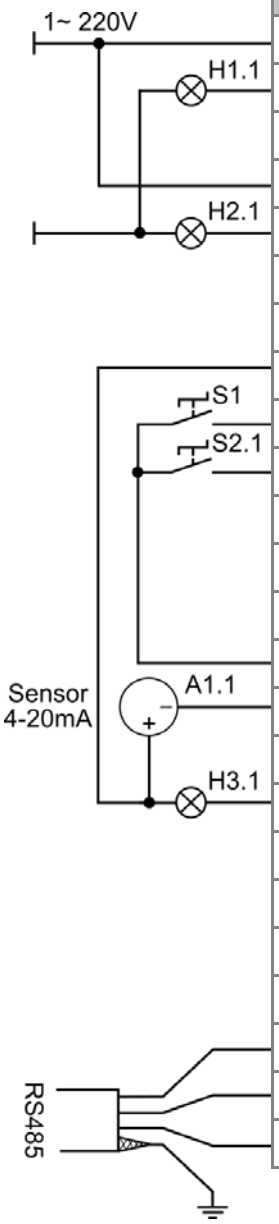
Where:

- Q0: Protection circuit breaker for the system power supply;
- P1, P2, and P3: Pump motors;
- The protection of CFW500 inverter is done with fuses.

NOTE!
It is recommended the protection of the inverter so as to avoid damages.

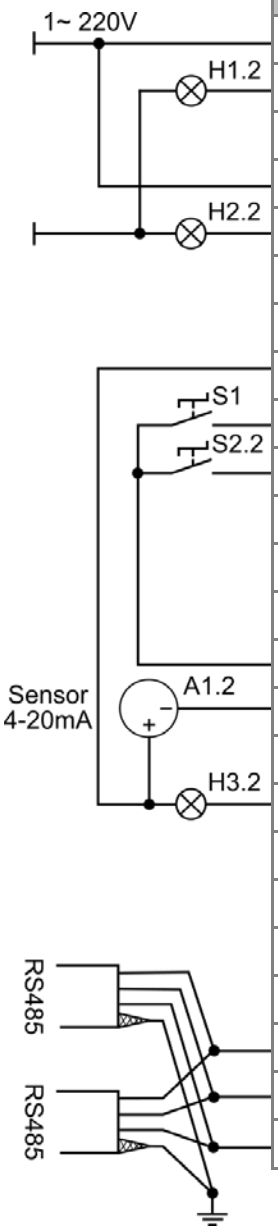
2.3.3.2 Control Connections

The figure 2.39, 2.40 and 2.41 presents the control connections (analog inputs/outputs, digital inputs/outputs), that must be done to connector of the CFW500-RS485 plug-in module of the CFW500 inverters of the master/slave pump (Pump 1 and Pump 2) and the slave pumps (Pump 3).



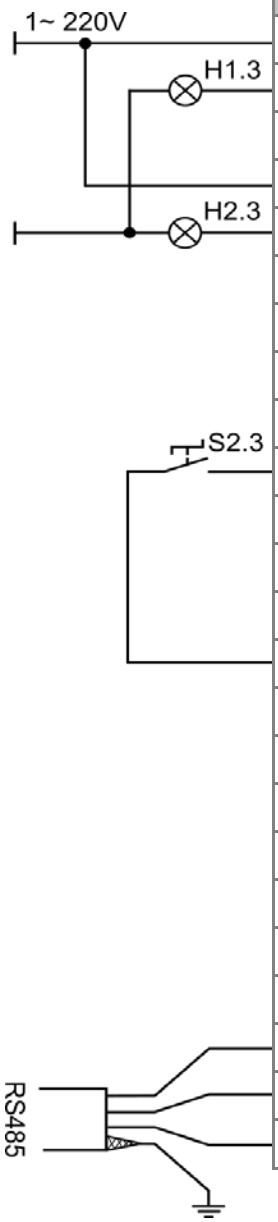
Conector			Default Function for Master/Slave Pump (Pump 1)
1	DO1-NO	Upper Terminal	Relay digital output 1 (DO1): No fault
3	DO1-C		
5	DO1-NC		
7	DO3-NO		Relay digital output 3 (DO3): F > Fx
9	DO3-C		
11	DO3-NC		
13	NC		Not connected
15	+24V		Power supply +24 Vdc
17	DI1		Digital input 1: Enable pump genius
19	DI2		Digital input 2: Enable the use of the pump
21	DI3		Digital input 3: No function
23	DI4		Digital input 3: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (4-20 mA): Control process variable
8	+10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): A770/A772 or F771/F773 (SoftPLC)
12	RS485 – A		RS485 (Terminal A(-))
14	RS485 – B		RS485 (Terminal B(+))
16	GND		Reference 0 V
18	AI2		Analog input 2 (0-10 V): No function
20	RS485 – A2		RS485 (Terminal A2(-))
22	RS485 – B2		RS485 (Terminal B2(+))
24	GND		Reference 0 V

Figure 2.39 – Signals on connector of the CFW500-RS485 plug-in module for master/slave pump (Pump 1)



Conector			Default Function for Master/Slave Pump (Pump 2)
1	DO1-NO	Upper Terminal	Relay digital output 1 (DO1): No fault
3	DO1-C		
5	DO1-NC		
7	DO3-NO		Relay digital output 3 (DO3): F > Fx
9	DO3-C		
11	DO3-NC		
13	NC		Not connected
15	+24V		Power supply +24 Vdc
17	DI1		Digital input 1: Enable pump genius
19	DI2		Digital input 2: Enable the use of the pump
21	DI3		Digital input 3: No function
23	DI4		Digital input 3: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (4-20 mA): Control process variable
8	+10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): A770/A772 or F771/F773 (SoftPLC)
12	RS485 – A		RS485 (Terminal A(-))
14	RS485 – B		RS485 (Terminal B(+))
16	GND		Reference 0 V
18	AI2		Analog input 2 (0-10 V): No function
20	RS485 – A2		RS485 (Terminal A2(-))
22	RS485 – B2		RS485 (Terminal B2(+))
24	GND		Reference 0 V

Figure 2.40 – Signals on connector of the CFW500-RS485 plug-in module for master/slave pump (Pump 2)



Conector			Default Function for Slave Pump (Pump 3)
1	DO1-NO	Upper Terminal	Relay digital output 1 (DO1): No fault
3	DO1-C		
5	DO1-NC		
7	DO3-NO		Relay digital output 3 (DO3): F > Fx
9	DO3-C		
11	DO3-NC		
13	NC		Not connected
15	+24V		Power supply +24 Vdc
17	DI1		Digital input 1: No function
19	DI2		Digital input 2: Enable the use of the pump
21	DI3		Digital input 3: No function
23	DI4		Digital input 3: No function
2	AO1	Lower Terminal	Analog output 1: Real speed
4	GND		Reference 0 V
6	AI1		Analog input 1 (0-10 V): No function
8	+10V		Reference +10 Vdc for potentiometer
10	DO2-TR		Transistor digital output 2 (DO2): No function
12	RS485 – A		RS485 (Terminal A(-))
14	RS485 – B		RS485 (Terminal B(+))
16	GND		Reference 0 V
18	AI2		Analog input 2 (0-10 V): No function
20	RS485 – A2		RS485 (Terminal A2(-))
22	RS485 – B2		RS485 (Terminal B2(+))
24	GND		Reference 0 V

Figure 2.41 – Signals on connector of the CFW500-RS485 plug-in module for slave pump (Pump 3)

NOTE!
Refer to the CFW500 inverter manual and the CFW500-RS485 installation guide for more information on the connections.

2.3.3.3 Operation Description

2.3.3.3.1 Starting the Pumps

The figure 2.42 presents a timing analysis of the Pump Genius configured with three pumps in parallel being two master/slave (Pump 1 and Pump 2) and one slave (Pump 3) in the process of starting the pumps.

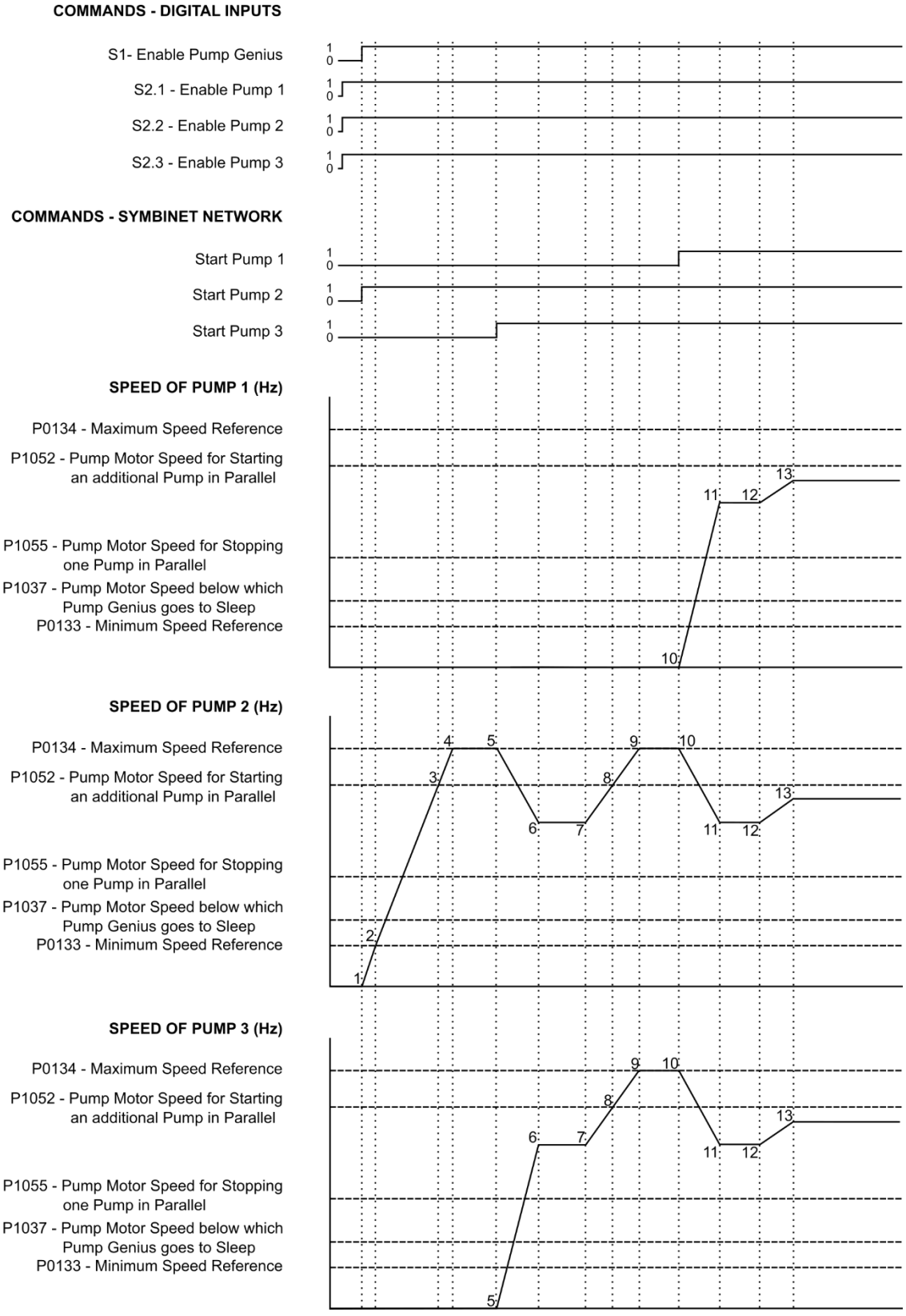


Figure 2.42 – Operation description of the Pump Genius with four pumps in parallel

1 – Because of having two master/slave pumps, first it is necessary that one of the two pumps (Pump 1 or Pump 2) assume the master function of the Pump Genius. This is done in the power-on of the CFW500 inverter, and assuming that all inverters are energized at the same time, the pump 1 will assume the master function due to having higher priority. The digital input DI1 is activated in order to enable the Pump Genius. It is verified if the control will remain in the sleep mode or in the wake up mode. The wake up mode is activated (the first time the Pump Genius is enabled, the time (P1036) is discarded) and the control (pump 1 – master/slave) verify which pump have the lower operation time. In this example the operation time of the pump 2 is lower than pump 1 and pump 3, then the pump 2 is started;

2 – The pump 2 is accelerated to the minimum speed (P0133) and then the PID controller is enabled. If the pipe charging process is enabled, a period of time (P1041) is awaited to enable the PID controller;

3 – According to the control setpoint and the control process variable, the PID controller responds and accelerates the pump 2. At this moment, the pump motor speed exceeds the threshold value programmed for starting an additional pump (P1052) and the deviation from the control setpoint exceeds the threshold programmed for starting an additional pump (P1053), initiating the time count P1054;

4 –The pump 2 is accelerated to the maximum speed (P0134), the conditions for starting an additional pump in parallel (P1052 and P1053) remain actives and the time (P1054) is awaited;

5 – All processes continue as at time point 4, until the time count (P1054) has elapsed. At this moment among the enabled pumps, the one with the lowest accumulated operating time receives the command to start via SymbiNet network. In this example the operation time of the pump 3 is lower than pump 1, then a command via SymbiNet network to start the pump 3 is done;

6 – The pump 3 is accelerated to the speed reference from the PID controller as the acceleration ramp set in the P0100 parameter. Then, the control process variable begins to increase due to the addition of another pump; the PID controller begins to decrease the speed reference for the pump 2 until the moment that both pumps operate at the same speed;

7 – The PID controller can control the pumping, then the control process variable begins to decrease and is necessary to increase the speed of the pumps to keep pumping controlled;

8 – At this moment the pumps motor speed exceeds the threshold value programmed for starting an additional pump (P1052) and the deviation from the control setpoint exceeds the threshold programmed for starting an additional pump (P1053), initiating the time count P1054;

9 – The pump 2 and pump 3 are accelerated to the maximum speed (P0134), the conditions for starting an additional pump in parallel (P1052 and P1053) remain actives and the time (P1054) is awaited;

10 – All processes continue as at time point 9, until the time count (P1054) has elapsed. At this moment among the enabled pumps, the one with the lowest accumulated operating time receives the command to start via SymbiNet network. Then, as the pump 2 and pump 3 are in running, it is done the command via SymbiNet network to start the pump 1;

11 – The pump 1 is accelerated to the speed reference from the PID controller as the acceleration ramp set in the P0100 parameter. Then, the control process variable begins to increase due to the addition of another pump; the PID controller begins to decrease the speed reference for the pump 2 and pump 3 until the moment that both pumps operate at the same speed;

12 – The PID controller can control the pumping, then the control process variable begins to decrease and is necessary to increase the speed of the pumps to keep pumping controlled;

13 – The PID controller increases the reference speed for the pump 1, pump 2 and pump 3 and the three pumps are accelerated until the control process variable value becomes equal to the setpoint control required.

NOTE!
Refer the chapter 3 for further details on the parameters.

2.3.3.3.2 Stopping the Pumps

The figure 2.43 presents a timing analysis of the Pump Genius configured with three pumps in parallel being two master/slave (Pump 1 and Pump 2) and one slave (Pump 3) in the process of stopping the pumps.

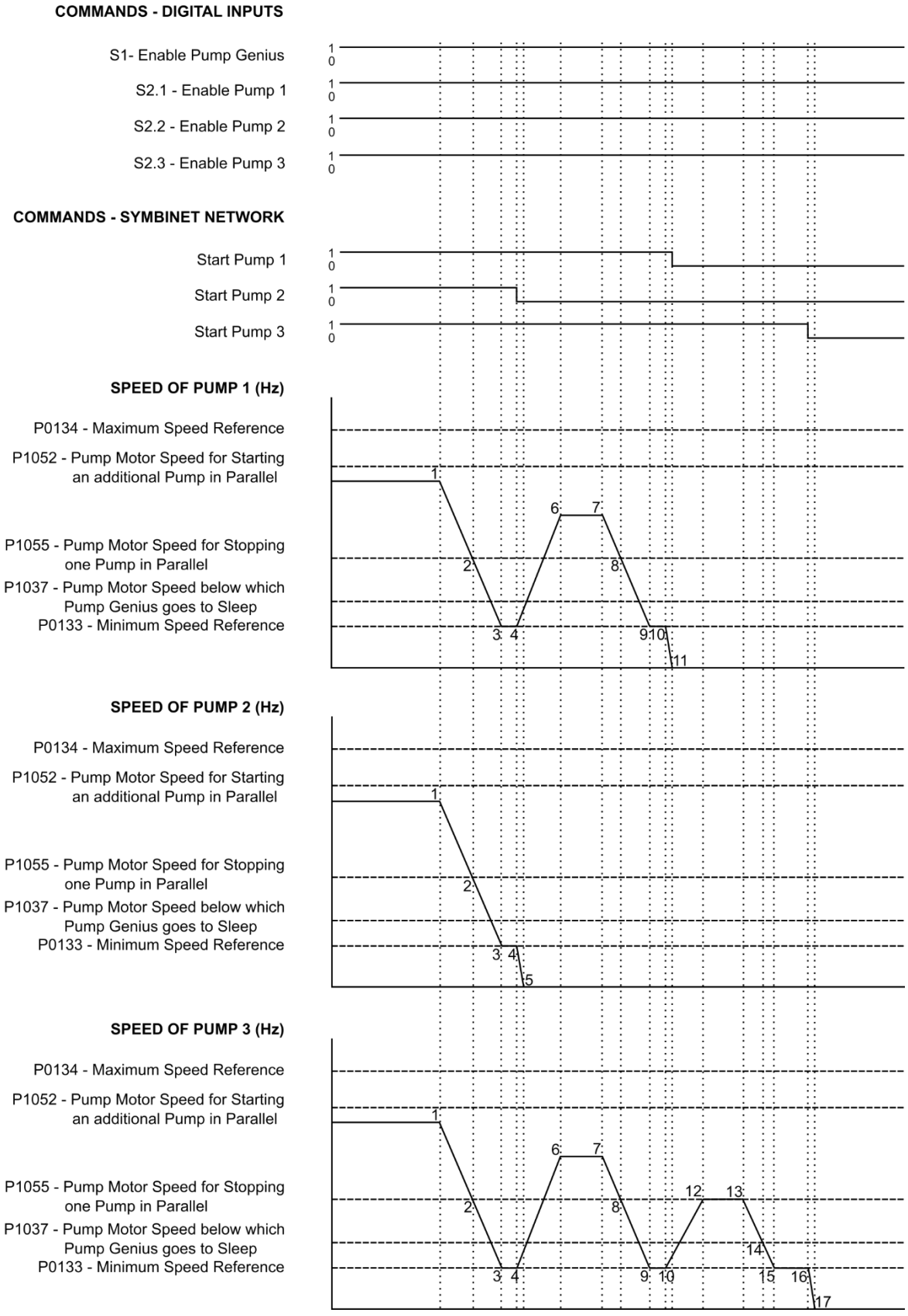


Figure 2.43 – Operation description of the Pump Genius Multiplex with three pumps in parallel

1 – The PID controller is controlling the pumping using the pump 1, pump 2 and pump 3. Then, the control process variable begins to increase and is necessary to decrease the speed of the pumps to keep pumping controlled;

2 – According to the control setpoint and the control process variable, the PID controller responds and decelerates the pump 1, pump 2 and pump 3. At this moment, the pumps motor speed drops below the threshold programmed for stopping one pump (P1055) and the deviation from the control setpoint exceeds the threshold programmed for stopping one pump (P1056), initiating the time count P1057;

3 –The pump 1, pump 2 and pump 3 can be decelerated to the minimum speed (P0133), the conditions for stopping one pump in parallel (P1055 and P1056) remain actives and the time (P1057) is awaited;

4 – All processes continue as at time point 3, until the time count (P1057) is elapsed. At this moment, the command for stopping one pump in parallel is issued via SymbiNet network. From among the activated pumps, the one with the largest accumulated operating time will be stopped. In this example pump 2 is running more time, then a command via SymbiNet network to stop the pump 2 is done;

5 – The pump 2 is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and then is disabled, i.e., one of the parallel pumps was successfully stopped. At this moment, the control process variable reaches the control setpoint required by the user and the PID controller responds and accelerates the pump 1 and pump 3;

6 – Eventually, with the continued action of the PID controller, the pumping control achieves stabile operation at the control setpoint as required by the user.

7 – The PID controller is controlling the pumping using the pump 1 and pump 3. Then, the control process variable begins to increase and is necessary to decrease the speed of the pumps to keep pumping controlled;

8 – According to the control setpoint and the control process variable, the PID controller responds and decelerates the pump 1 and pump 3. At this moment, the pumps motor speed drops below the threshold programmed for stopping one pump (P1055) and the deviation from the control setpoint exceeds the threshold programmed for stopping one pump (P1056), initiating the time count P1057;

9 –The pump 1 and pump 3 can be decelerated to the minimum speed (P0133), the conditions for stopping one pump in parallel (P1055 and P1056) remain actives and the time (P1057) is awaited;

10 – All processes continue as at time point 9, until the time count (P1057) is elapsed. At this moment, the command for stopping one pump in parallel is issued via SymbiNet network. From among the activated pumps, the one with the largest accumulated operating time will be stopped. In this example pump 1 is running more time, then a command via SymbiNet network to stop the pump 1 is done;

11 – The pump 1 is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and then is disabled, i.e., one of the parallel pumps was successfully stopped. At this moment, the control process variable reaches the control setpoint required by the user and the PID controller responds and accelerates the pump 3;

12 – The PID controller increases the reference speed for the pump 3 until the control process variable value becomes equal to the setpoint control required;

13 – The PID controller can control the pumping, then the control process variable begins to increase and is necessary to decrease the speed of the pump 3 to keep pumping controlled;

14 – According to the control setpoint and the control process variable, the PID controller responds and decelerates the pump 3. At this moment, the pump motor speed exceeds the threshold value programmed to sleep (P1037), initiating the time count P1038;

15 – The pump 3 can be decelerated to the minimum speed (P0133), the conditions to sleep remain active and the time (P1038) is awaited;

16 – All processes continue as at time point 15, until the time count (P1038) is elapsed. Then, the sleep mode is activated and it is done the command via SymbiNet network to stop the pump 3;

17 – The pump 3 is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and then is disabled; but the pumping control remains enabled, and the control process variable is monitored. If the value falls below the deviation of the control process variable to wake up (P1034) for a period of time (P1036), the wake up mode is activated and the control begins to start and stop the pumps again according to the requirements of the control setpoint.

NOTE!
Refer the chapter 3 for further details on the parameters.

3 PARAMETERS DESCRIPTION

The CFW500 inverter parameters (P0000 to P0999) and the SoftPLC function parameters (P1000 to P1059) for the Pump Genius applications will be presented next.

NOTE!
The Pump Genius Simplex and Multipump application only work on CFW500 inverter with firmware version over V1.50. So, upgrading the CFW500 inverter firmware to the working of this application is required.

NOTE!
The Pump Genius Multiplex application only work on CFW500 inverter with firmware V3.50 or over. So, upgrading the CFW500 inverter firmware to the working of this application is required.

NOTE!
The adjustable range of the CFW500 parameters has been customized for the Pump Genius Simplex, Multipump and Multiplex application. Refer to the CFW500 programming manual for more details on the parameters.

Symbols for property description:

CFG Configuration parameter, value can be programmed only with motor stopped
RO Read-only parameter
RW Read and write parameter

3.1 GENERAL CONFIGURATIONS

3.1.1 PG Multipump

3.1.1.1 Pump Control and Activation Mode

This group of parameters allows the user to configure the control mode that the CFW500 frequency inverter will use to activate the pumps.

P1028 – Pump Control and Activation Mode Configuration

Adjustable Range:	0 = Fixed Control with Pumps activated in a Sequence 1 = Fixed Control with Pumps Rotation 2 = Floating Control with Pumps activated in a Sequence 3 = Floating Control with Pumps Rotation	**Factory Setting:** 1
Properties:	CFG	
Access groups via HMI:	SPLC	

Description:
This parameter defines the control mode that the CFW500 frequency inverter will apply to control the pump(s) connected to it and how the command to start and stop the pump(s) will be done.

Table 3.1 – Description of the control and activation mode of the Pump Genius Multipump

P1028	Description
0	Defines the system will be controlled by the speed variation of a pump (always the same pump), and it may be associated to up to other five pumps in parallel operating at fixed speed. The activation mode (start and stop) of the pumps will be in a sequence: - To Start: Start CFW500 Pump → Pump 1 → Pump 2 → Pump 3; - To Stop: Stop Pump 3 → Pump 2 → Pump 1 → CFW500 Pump.

1	Defines the system will be controlled by the speed variation of a pump (always the same pump), and it may be associated to up to other five pumps in parallel operating at fixed speed. The activation mode (start and stop) of the pumps will be with rotation: - To Start: Starts the CFW500 pump and after the pump that has the shortest operating time; - To Stop: Stops the pump that has the longest operating time and at last the CFW500 pump.
2	Defines the system will be controlled by the speed variation of any of the pumps (but only one of them), and it may be associated to up to other four pumps in parallel operating at fixed speed. The activation mode (start and stop) of the pumps will be in a sequence: - To Start: Start Pump 1 → Pump 2 → Pump 3; - To Stop: Stop Pump 3 → Pump 2 → Pump 1.
3	Defines the system will be controlled by the speed variation of any of the pumps (but only one of them), and it may be associated to up to other four pumps in parallel operating at fixed speed. The activation mode (start and stop) of the pumps will be with rotation: - To Start: Starts the pump that has the shortest operating time; - To Stop: Stops the pump that has the longest operating time.

3.1.2 PG Multiplex

3.1.2.1 Configuration of Pump Operation

This group of parameters allows the user to configure the pump operation mode in the Pump Genius Multiplex application.

P1020 – Configuration of Pump Operation Mode

Adjustable	0 = Master/Slave Pump	**Factory Setting:**	0
Range:	1 = Slave Pump		
Properties:	CFG		
Access groups via HMI:	SPLC		

Description:
This parameter defines the pump operation mode in the Pump Genius Multiplex

Table 3.2 – Description of the pump operation mode in the Pump Genius Multiplex

P1020	Description
0	Indicates that this pump can be master or slave depending on its priority (Pump 1 > Pump 2 > Pump 3), i.e., this pump can control the pumping, defining speed reference through the PID controller and the need for starting or stopping other pumps. You must configure the SymbiNet communication network for data exchange between the pumps (CFW500 inverter).
1	Indicates that this pump will always be a slave, i.e., this pump will receive from the master pump the speed reference and the Start/Stop command. You must configure the SymbiNet communication network for data exchange between the pumps (CFW500 inverter).

NOTE!
For a pump to assume the master function of the Pump Genius, besides configuring its operation as master/slave (P1020 = 0), the source of the control setpoint (P1022 ≠ 0) and the source of the control process variable (P1023 ≠ 0) must also be configured.

NOTE!
When a pump is configured as master/slave (P1020 = 0) it may assume the function of master pump in the following circumstances:

1) Loss of the SymbiNet communication network; this transition can be performed automatically (P1021 ≠ 0), or manually via a command in the CFW500 HMI;
2) Detection of broken cable of the control process variable sensor, when the analog input is 4 - 20mA; in this case, the transition will take place automatically.

Any change of the master in a Pump Genius leads to a shutdown of all pumps. Another pump will have to assume the master function of the Pump Genius and restart in this new configuration.

3.1.2.2 Configuration of the SymbiNet Protocol

This group of parameters allows the user to adjust the SymbiNet protocol for communication between CFW500 inverters; it is through this network that the data exchange between the parallel pumps of the Pump Genius Multiplex application is executed.

3.1.2.2.1 General Characteristics of SymbiNet

SymbiNet is a protocol to allow several WEG devices to send and receive operational data among them. It is totally configured using parameters, without the need of a network master or a configuration tool.

Every device on the network must have a different network address, independent of the communication interface. The data exchange is programmed based on the list of Modbus registers available for the several devices. For each device, the user must program which Modbus registers it should utilize, i.e., which Modbus registers should be transmitted by the other devices on the network to be used locally. With all devices programmed, the protocol automatically manages data transmission, sending and receiving telegrams with Modbus registers, and indicating the communication status.

The SymbiNet protocol was implemented only on the RS485 communication interface for the CFW500 inverter.

The network address configuration of the SymbiNet protocol depends on the interface used. Valid values for these addresses are 1 to 63; values out of this range disable the protocol. For communication performance optimization, it is recommended to program the device addresses sequentially, starting from address 1.

For programming which registers should be utilized locally, there are groups of 4 parameters each, through which it is possible to program who should transmit, which registers should be transmitted, where the received values should be stored and the quantity of registers (in sequence) will be transmitted.

3.1.2.2.2 RS485 Communication Interface

This group of parameters allows the user to configure the RS485 communication interface for operation of the SymbiNet protocol, required to perform the communication between the CFW500 inverters present in the Pump Genius Multiplex application.

P0308 – Serial Address

Adjustable Range:	1 to 63	**Factory Setting:**	1
Properties:	CFG		
Access groups via HMI:	NET		

Description:
This parameter defines the inverter address used for serial communication. It is necessary that each device of the SymbiNet network has a distinct address.

P0310 – Serial Communication Rate

Adjustable Range:	0 = 9600 bits/s 1 = 19200 bits/s 2 = 38400 bits/s	**Factory Setting:**	2
Properties:	CFG and Serial		
Access groups via HMI:	NET		

Description:
This parameter defines the desired baud rate for the serial interface, in bits per second. This rate must be the same for all the devices connected to the SymbiNet network

P0311 – Serial Interface Byte Configuration

Adjustable Range:	0 = 8 data bits, no parity, 1 stop bit 1 = 8 data bits, parity even, 1 stop bit 2 = 8 data bits, parity odd, 1 stop bit 3 = 8 data bits, no parity, 2 stop bits 4 = 8 data bits, parity even, 2 stop bits 5 = 8 data bits, parity odd, 2 stop bits	**Factory Setting:**	1
Properties:	CFG		
Access groups via HMI:	NET		

Description:
This parameter defines the number of data bits, parity and stop bits of the serial interface bytes. This configuration must be identical for all the devices connected to the SymbiNet network.

P0312 – Serial Protocol

Adjustable Range:	0 = HMIR (1) 1 = SymbiNet (1) 2 = Modbus RTU (1) 3 e 4 = Reserved 5 = RTU Master (1) 6 = HMIR (1) + Modbus RTU (2) 7 = Modbus RTU (2) 8 a 11 = Reserved 12 = HMIR (1) + RTU Master (2) 13 = RTU Master (2) 14 = HMIR (1) + SymbiNet (2) 15 = Modbus RTU (1) + SymbiNet (2)	**Factory Setting:**	5
Properties:	CFG		
Access groups via HMI:	NET		

Description:
This parameter defines the desired protocol for the serial interface.

NOTE!
The SymbiNet protocol is the protocol that must be used in the Pump Genius Multiplex application.

P0313 – Communication Error Action

Adjustable Range:	0 = Inactive 1 = Disable via Start/Stop 2 = Disable via General Enable 3 = Change to Local 4 = Change to Local keeping the commands and the reference 5 = Fault trip	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	NET		

Description:
This parameter defines the action to be executed by the inverter when a communication error is detected.

P0314 – Serial Watchdog

Adjustable Range:	0.0 to 999.0 s	**Factory Setting:**	0.0 s
Properties:	CFG		
Access groups via HMI:	NET		

Description:
This parameter defines a time limit for the detection of a serial interface communication error.

NOTE!
A setting of "0.0 s" disables this function.

P0316 – Serial Interface Status

Adjustable Range:	0 = Inactive 1 = Active 2 = Watchdog Error	**Factory Setting:**	-
Properties:	RO		
Access groups via HMI:	NET		

Description:
It allows identifying if the RS485 serial interface board is properly installed and if the serial communication presents errors.

NOTE!
Refer to the RS485 serial communication manual for more information on the parameters. Some parameter options have been removed from the configuration wizard.

3.1.2.2.3 SymbiNet Protocol Configuration

This group of parameters allows the user to configure the SymbiNet protocol to perform the communication between the CFW500 inverters present in the Pump Genius Multiplex application.

P0768 – Enable Pump 1 Address (Group 1 Source Address)

Adjustable Range:	0 to 63	**Factory Setting:**	1
Properties:	CFG		
Access groups via HMI:	NET		

Description:
This parameter defines the address of the pump that will send registers. In the Pump Genius, it is defined that group 1 is the pump 1.

NOTE!
The address setting "0" disables the transmission of data by the respective pump. For example, if there are only pumps 1 and 2, it is not necessary to send the data request of the pump 3. This optimizes the transmission of data over the network SymbiNet.

P0772 – Enable Pump 2 Address (Group 2 Source Address)

Adjustable Range:	0 to 63	**Factory Setting:**	2
Properties:	CFG		
Access groups via HMI:	NET		

Description:
This parameter defines the address of the pump that will send registers. In the Pump Genius application, it is defined that group 2 is the pump 2.

NOTE!
The address setting "0" disables the transmission of data by the respective pump. For example, if there are only pumps 1 and 2, it is not necessary to send the data request of the pump 3. This optimizes the transmission of data over the network SymbiNet.

P0776 – Enable Pump 3 Address (Group 3 Source Address)

Adjustable Range:	0 to 63	**Factory Setting:**	3
Properties:	CFG		
Access groups via HMI:	NET		

Description:
This parameter defines the address of the pump that will send registers. In the Pump Genius application, it is defined that group 3 is the pump 3.

NOTE!
The address setting "0" disables the transmission of data by the respective pump. For example, if there are only pumps 1 and 2, it is not necessary to send the data request of the pump 3. This optimizes the transmission of data over the network SymbiNet.

P0796 – Highest Allowed Address (RS485 Interface)

Adjustable Range:	0 to 63	**Factory Setting:**	3
Properties:	CFG		
Access groups via HMI:	NET		

Description:
This parameter defines the highest or last one address used for the communication on the SymbiNet network. It is displayed only when using the RS485 interface.

NOTE!
If there are only pumps 1 and 2, this parameter should be programmed to 2. This optimizes the transmission of data over the network SymbiNet.

P1021 – Automatic Master Pump Change Over Time in the event of Master Fails

Adjustable Range:	0 to 32767 s	**Factory Setting:**	2 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the time delay for the master/slave pump assuming the master function in the Pump Genius after the communication with the original master/slave pump was lost (A758). This loss of communication will be detected by the pumps that are configured as Master/Slave.

If the set time delay elapses without the reception of a valid telegram from the original master, a command to all pumps will be generated, to recognize a new master/salve pump as master for Pump Genius. Only pumps programmed with the function master/slave (P1020 = 0), which have an analog input programmed to read the control process variable, may assume the master function of the Pump Genius.

NOTE!
A setting of “0 s” disables the automatic change of the master pump and enables the fault “Two or more masters active (F759)”. The change can also be performed manually through the HMI of the CFW500 inverter in the presence of alarm A758. Waiting for user command to execute (I=yes) or not execute (O=no) the manual change-over of the master pump of the Pump Genius

3.2 ORIGIN OF COMMANDS

This group of parameters allows the user to configure the origin of the CFW500 inverter commands. For this application inverter control in the LOCAL situation is performed through the HMI, and in the REMOTE situation via the SoftPLC function, i.e., by the logical of Pump Genius.

3.2.1 PG Simplex

LOCAL Situation:
It allows the user to command the respective pump driven by the CFW500 inverter, while disregarding the control logic of the Pump Genius.

NOTE!
The parameter P0206 (Secondary Display Parameter Selection) is automatic changed for “P0121 - Reference via HMI” when the CFW500 inverter operates in LOCAL mode, if programmed in configuration wizards to show the parameter “P1011 – Control Setpoint”.

REMOTE Situation:
Enables the pump control logics according to the programming made by the user.

NOTE!
The parameter P0206 (Secondary Display Parameter Selection) is automatic changed for “P1011 – Control Setpoint” when the CFW500 inverter operates in REMOTE mode, if programmed in configuration wizards to show the parameter “P0121 – Speed Reference”.

P0220 – LOCAL/REMOTE Selection Source

P0221 – Speed Reference Selection – LOCAL Situation

P0222 – Speed Reference Selection – REMOTE Situation

P0223 – FORWARD/REVERSE Selection - LOCAL Situation

P0226 – FORWARD/REVERSE Selection - REMOTE Situation

P0224 – Run/Stop Selection – LOCAL Situation

P0227 – Run/Stop Selection – REMOTE Situation

P0225 – JOG Selection – LOCAL Situation

P0228 – JOG Selection – REMOTE Situation

NOTE!
Refer to the CFW500 programming manual for more information on the command origin parameters. Some parameter options have been removed from the configuration wizard.

3.2.2 PG Multipump

LOCAL Situation:
It allows the user to command the pump driven by the CFW500 frequency inverter disregarding the pump control logics. The command is made via HMI and it is only accepted in case the pumping control is disabled, that is, the digital input DI1 must be at logic level "0" and, for floating control, with only one of the digital inputs DI2, DI3, or DI4 at logic level "1".

REMOTE Situation:
Enables the pump control logics according to the programming made by the user.

P0220 – LOCAL/REMOTE Selection Source

P0221 – Speed Reference Selection – LOCAL Situation

P0222 – Speed Reference Selection – REMOTE Situation

P0223 – FORWARD/REVERSE Selection - LOCAL Situation

P0226 – FORWARD/REVERSE Selection - REMOTE Situation

P0224 – Run/Stop Selection – LOCAL Situation

P0227 – Run/Stop Selection – REMOTE Situation

P0225 – JOG Selection – LOCAL Situation

P0228 – JOG Selection – REMOTE Situation

NOTE!
Refer to the CFW500 programming manual for more information on the command origin parameters. Some parameter options have been removed from the configuration wizard.

3.2.3 PG Multiplex

LOCAL Situation:
It allows the user to command the respective pump driven by the CFW500 inverter, while disregarding the control logic of the Pump Genius. The command is issued via HMI or digital input and is accepted only if the pump is not running.

NOTE!
The parameter P0206 (Secondary Display Parameter Selection) is automatic changed for "P0121 - Reference via HMI" when the CFW500 inverter operates in LOCAL situation.

REMOTE Situation:
It enables the Pump Genius logic, according to the programming performed by the user.

NOTE!
The parameter P0206 (Secondary Display Parameter Selection) is automatic changed for "P1011 – Control Setpoint" when the CFW500 inverter operates in REMOTE mode.

P0220 – LOCAL/REMOTE Selection Source

P0221 – Speed Reference Selection – LOCAL Situation

P0222 – Speed Reference Selection – REMOTE Situation

P0223 – FORWARD/REVERSE Selection - LOCAL Situation

P0226 – FORWARD/REVERSE Selection - REMOTE Situation

P0224 – Run/Stop Selection – LOCAL Situation

P0227 – Run/Stop Selection – REMOTE Situation

P0225 – JOG Selection – LOCAL Situation

P0228 – JOG Selection – REMOTE Situation

NOTE!
Refer to the CFW500 programming manual for more information on the command origin parameters. Some parameter options have been removed from the configuration wizard.

3.3 RAMPS

This group of parameters allows the user to adjust the inverter ramps, so that the motor can be accelerated or decelerated at a faster or slower rate.

P0100 – Acceleration Time

Adjustable Range:	0.1 to 999.0 s	**Factory Setting:**	10.0 s
Properties:			
Access groups via HMI:	BASIC		

Description:
This parameter determines the time of linear acceleration between zero and maximum speed (defined in P0134).

P0101 – Deceleration Time

Adjustable Range:	0.1 to 999.0 s	**Factory Setting:**	10.0 s
Properties:			
Access groups via HMI:	BASIC		

Description:
This parameter determines the time of linear deceleration between the maximum speed (defined in P0134) and zero.

NOTE!
Refer to the CFW500 programming manual for more information on the ramp parameters.

3.4 SPEED LIMITS

This group of parameters allows the user to configure the motor speed limits.

P0133 – Minimum Speed Reference Limit

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	40.0 Hz
Properties:			
Access groups via HMI:	BASIC		

Description:
This parameter defines the minimum value for the motor speed reference when the inverter is enabled.

P0134 – Maximum Speed Reference Limit

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	60.0 Hz
Properties:			
Access groups via HMI:	BASIC		

Description:
This parameter defines the maximum value for the motor speed reference when the inverter is enabled.

NOTE!
Refer to the CFW500 programming manual for more information on the speed limit parameters. With the CFW500 inverter programmed to scalar (V/f) mode, the motor slip is disregarded.

3.5 DIGITAL INPUTS

P0271 – Digital Input Signal

Adjustable Range:	0 = All DIx are NPN 1 = DI1 is PNP 2 = DI1..DI2 are PNP 3 = DI1..DI3 are PNP 4 = DI1..DI4 are PNP 5 = DI1..DI5 are PNP 6 = DI1..DI6 are PNP 7 = DI1..DI7 are PNP 8 = All DIx are PNP	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines the default for the digital input signal, i.e., NPN the digital input is activated with 0 V, PNP the digital input is activated with +24 V.

NOTE!
Some parameter options have been removed from the configuration wizard.

3.5.1 PG Simplex

This parameter group allows the user to configure the command function of each digital input on the ladder application of the Pump Genius Simplex.

P0263 – DI1 Function

Adjustable Range:	0 to 46/ 43 = External Sensor (App. Function 5)	**Factory Setting:**	1
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the function of the digital input DI1 in the application ladder as enabling the pump protection via an external sensor.

Logic level “0” indicates that the external sensor for pump protection is actuated. When the pump is running, the alarm “A782: External Sensor for Pump Protection actuated” will be generated. After the programmed time in P1046 elapses, the fault “F783: External Sensor for Pump Protection actuated” will be generated, and the pump will be disabled.

Logic level “1” indicates that the condition for pump protection was not detected.

NOTE!
Refer to the section 3.19 for more information on the use of an external pump for jockey pump function.

P0264 – DI2 Function

Adjustable Range:	0 to 46 / 39 = Execute Deragging Function (App. Function 1)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the function of the digital input DI2 in the application ladder as the command to execute the deragging function.

When the transition from logic level "0" to "1" in the digital input DI2 occurs, it initiates the logic to execute the deragging function. At the end of the number of cycles set in P1053 parameter, the Pump Genius returns to normal operation.

NOTE!
Refer to the section 3.21 for more information on the deragging function.

P0265 – DI3 Function

Adjustable Range:	0 to 46 / 40 = Sel. Control in Manual (0) or Automatic (1) (App. F. 2)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the function of the digital input DI3 in the application ladder as the selection the operation mode of PID controller in manual or automatic.

Logic level “0”, defines that the control (i.e., the PID controller) will operate in manual mode.
Logic level “1”, defines that the control (i.e., the PID controller) will operate in automatic mode.

NOTE!
Refer to the section 3.10 for more information on operation mode of PID controller.

P0266 – DI4 Function

Adjustable Range:	0 to 46 / 41 = 1st DI for Control Setpoint Selection (App. Function 3)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the function of the digital input DI4 in the application ladder as the 1st digital input of the logical combination which defines the control setpoint of the Pump Genius.

P0267 – DI5 Function

Adjustable Range:	0 to 46 / 42 = 2nd DI for Control Setpoint Selection (App. Function 4)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the function of the digital input DI5 in the application ladder as the 2nd digital input of the logical combination which defines the control setpoint of the Pump Genius.

NOTE!
Refer to the section 3.9 for more information on the control setpoint via logical combination of the digital inputs DI4 and DI5.

P0268 – DI6 Function

P0269 – DI7 Function

P0270 – DI8 Function

Adjustable Range:	0 to 46	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
These parameters configure the function of digital input DI6, DI7 and DI8. It has no specific function in the Pump Genius Simplex application.

NOTE!
Refer to the CFW500 programming manual for more information on the digital inputs parameters. Some parameter options have been removed from the configuration wizard.

3.5.2 PG Multipump

This parameter group allows the user to configure the command function of each digital input on the ladder application of the Pump Genius Multipump.

P0263 – DI1 Function

Adjustable Range:	0 to 46 / 44 = Enable Pump Genius (App. Function 6)	**Factory Setting:**	44
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the function of the digital input DI1 in the application ladder as enable the Pump Genius for operation.

Logic level “0” the Pump Genius is disabled for operation.

Logic level “1” the Pump Genius is enabled for operation.

P0264 – DI2 Function

Adjustable Range:	0 to 46 / 39 = Enable Pump 1 via DO1 (App. Function 1)	**Factory Setting:**	39
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines that the digital input DI2 function will be to enable the use of the pump 1 (commanded by the digital output DO1) on the pumping control. According to section 2.2.1.2 and 2.2.2.2, a selector switch, sensors for the motor or pump protection, etc. can be inserted in this command.

At logic level "0", it indicates that pump 1 operation is disabled on the Pump Genius.

At logic level "1", it indicates that pump 1 operation is enabled on the Pump Genius, and can be started or stopped according to use requirements.

P0265 – DI3 Function

Adjustable Range:	0 to 46 / 40 = Enable Pump 2 via DO2 (App. Function 2) 41 = Enable Pump 2 via DO3 (App. Function 3) 45 = 1st DI for Control Setpoint Selection (App. Function 7)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines that digital input DI3 function will be to enable the use of pump 2 (commanded by the digital output DO2 or DO3) on the Pump Genius or will be the 1st digital input of the logic combination of the digital inputs which defines the Pump Genius control setpoint.

a) Enable Pump 2 via DO2 or DO3 Function

According to section 2.2.1.2 and 2.2.2.2, a selector switch, sensors for the motor or pump protection, etc. can be inserted in this command.

At logic level "0", it indicates that pump 2 operation is disabled on the Pump Genius.

At logic level "1", it indicates that pump 2 operation is enabled on the Pump Genius, and can be started or stopped according to use requirements.

b) 1st DI for Control Setpoint Selection Function

NOTE!
Refer to section 3.9 for further information about pumping control setpoint via logic combination of digital inputs.

P0266 – DI4 Function

Adjustable Range:	0 to 46 / 42 = Enable Pump 3 via DO3 (App. Function 4) 43 = Enable Pump 3 via DO4 (App. Function 5) 45 = 1st DI for Control Setpoint Selection (App. Function 7) 46 = 2nd DI for Control Setpoint Selection (App. Function 8)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines that digital input DI4 function will be to enable the use of pump 3 (commanded by the digital output DO3 or DO4) on the Pump Genius or will be the 1st or 2nd digital input of the logic combination of the digital inputs which defines the Pump Genius control setpoint.
a) Enable Pump 3 via DO3 or DO4 Function

According to section 2.2.1.2 and 2.2.2.2 a selector switch, sensors for the motor or pump protection, etc. can be inserter in this command.

At logic level “0”, it indicates that pump 3 operation is disabled on the Pump Genius.

At logic level “1”, it indicates that pump 3 operation is enabled on the Pump Genius, and can be started or stopped according to use requirements.

b) 1st or 2nd DI for Control Setpoint Selection Function

NOTE!
Refer to section 3.9 for further information about Pump Genius control setpoint via logic combination of digital inputs.

P0267 – DI5 Function

Adjustable Range:	0 to 46 / 45 = 1st DI for Control Setpoint Selection (App. Function 7) 46 = 2nd DI for Control Setpoint Selection (App. Function 8)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines that the digital input DI5 function will be the 1st or the 2nd digital input of the logic combination of the digital inputs which defines the Pump Genius control setpoint.

NOTE!
Refer to section 3.9 for further information about Pump Genius control setpoint via logic combination of digital inputs.

P0268 – DI6 Function

Adjustable Range:	0 to 46 / 46 = 2nd DI for Control Setpoint Selection (App. Function 8)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines that the digital input DI5 function will be the 2nd digital input of the logic combination of the digital inputs which defines the Pump Genius control setpoint.

NOTE!
Refer to section 3.9 for further information about Pump Genius control setpoint via logic combination of digital inputs.

P0269 – DI7 Function

P0270 – DI8 Function

Adjustable Range:	0 to 46	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
These parameters configure the function of digital input DI7 and DI8. It has no specific function in the Pump Genius Multipump application.

3.5.3 PG Multiplex

This group of parameters allows the user to configure the command function of each digital input in the Pump Genius Multiplex application.

P0263 – DI1 Function

Adjustable Range:	0 to 46 / 39 = Enable Pump Genius (App. Function 1)	**Factory Setting:**	P1020 = 0: 39 P1020 = 1: 0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the function of the digital input DI1 in the application ladder as enable the Pump Genius for operation.

Logic level “0” the Pump Genius is disabled for operation.

Logic level “1” the Pump Genius is enabled for operation.

P0264 – DI2 Function

Adjustable Range:	0 to 46 / 40 = Enable use of Pump in the P. G. (App. Function 2)	**Factory Setting:**	40
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the function of the digital input DI2 in the application ladder as enabling the use of the pump in the Pump Genius. I.e., when the Pump Genius is enabled for operation (DI1 at the logic level "1"), this pump can be started to execute its control function. Additional switching elements can be inserted into the wiring of this digital input in order to perform protection functions, such as: a protection sensor for pump or motor, etc.

Logic level “0” indicates that the pump driven by CFW500 inverter is disabled for the operation in the Pump Genius.

Logic level “1” indicates that the pump driven by CFW500 inverter is enabled for the operation in the Pump Genius.

NOTE!
If the digital input DI2 has not been programmed to “Enable use of the Pump in the Pump Genius”, the pump driven by CFW500 inverter will always be enabled for use in the Pump Genius.

NOTE!
If the digital input DI2 has been programmed to “Run/Stop”, the pump driven by CFW500 inverter will be enabled for use in the Pump Genius in REMOTE mode and will be started by digital input when in LOCAL mode.

P0265 – DI3 Function

Adjustable Range:	0 to 46	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the function of digital input DI3. It has no specific function in the Pump Genius Multiplex application.

P0266 – DI4 Function

Adjustable Range:	0 to 46 / 41 = External Sensor (PLC Use)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the function of the digital input DI4 in the application ladder as enabling the pump protection via an external sensor.

Logic level “0” indicates that the external sensor for pump protection is actuated. When the pump is running, the alarm “A782: External Sensor for Pump Protection actuated” will be generated. After the programmed time in P1046 elapses, the alarm “A784: External Sensor for Pump Protection” will be generated, and the pump will be disabled.

Logic level “1” indicates that the condition for pump protection was not detected.

NOTE!
Refer to the section 3.19 for more information on the pump protection via an external sensor.

3.6 DIGITAL OUTPUTS

3.6.1 PG Simplex

This group of parameters allows the user to configure the command function of each digital output in the Pump Genius Simplex application.

P0275 – DO1 Function

P0276 – DO2 Function

P0277 – DO3 Function

P0278 – DO4 Function

P0279 – DO5 Function

Adjustable Range:	0 to 44 / 37 = With A770/A772 or F771/F773 (App. F.1)	**Factory Setting:**	P0275 = 13 P0276 = 02 P0277 = 00 P0278 = 00 P0279 = 00
Properties:			
Access groups via HMI:	I/O		

Description:
This parameter defines the function of the digital output DO1, DO2, DO3, DO4 and DO5. If you selected the "37 = Alarm A770/A772 or Fault F771/F773 active (SoftPLC)”, the output assumes the function of indicating that the alarm “A770: Low Level Alarm for the Control Process Variable” or “A772: High Level Alarm for the Control Process Variable” or “F771: Low Level Fault for the Control Process Variable” or “F773: High Level Fault for the Control Process Variable” is active. According to the chapter 2, a NO contact of the relay digital output must be used.

3.6.2 PG Multipump

This group of parameters allows the user to configure the command function of each digital output in the Pump Genius Multipump application.

P0275 – DO1 Function

Adjustable Range:	0 to 44 / 37 = Start Pump 1 (Application Function 1)	**Factory Setting:**	37
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines the function of the digital output DO1. If function "37 = Start Pump 1 (Application Function 1)" is selected, it assumes the function of starting pump 1, according the Pump Genius. According to section 2.2.1.2 and 2.2.2.2, the NO contact of the digital output DO1 relay must be used.

P0276 – DO2 Function

Adjustable Range:	0 to 44 / 38 = Start Pump 2 (Application Function 2)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines the function of the digital output DO2. If function "38 = Start Pump 2 (Application Function 2)" is selected, it assumes the function of starting pump 2, according the Pump Genius.

NOTE!
To use the digital output DO2 is always necessary an external relay or auxiliary contactor at 24Vdc, because the digital output 2 is always transistor independent of the plug-in module used.

P0277 – DO3 Function

Adjustable Range:	0 to 44 / 38 = Start Pump 2 (Application Function 2) 39 = Start Pump 3 (Application Function 3)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines the function of the digital output DO3. If function "38 = Start Pump 2 (Application Function 2)" is selected, it assumes the function of starting pump 2, according the pumping control. If function "39 = Start Pump 3 (Application Function 3)" is selected, it assumes the function of starting pump 3, according the Pump Genius.

NOTE!
If the plug-in module used has the digital output DO3 transistor, will be necessary the use an external relay or auxiliary contactor at 24Vdc.

P0278 – DO4 Function

Adjustable Range:	0 to 44 / 39 = Start Pump 3 (Application Function 3)	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines the function of the digital output DO4. If function "39 = Start Pump 3 (Application Function 3)" is selected, it assumes the function of starting pump 3, according the Pump Genius.

NOTE!
If the plug-in module used has the digital output DO4 transistor, will be necessary the use an external relay or auxiliary contactor at 24Vdc.

P0279 – DO5 Function

Adjustable Range:	0 to 44	**Factory Setting:**	0
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines the function of the digital output DO5; it has no specific function in the application ladder of the Pump Genius Multipump application.

NOTE!
Refer to the CFW500 frequency inverter programming manual and the installation guide of the plug-in module used for further information about the digital outputs. On the configuration wizard, some value options for the parameters were taken.

3.6.3 PG Multiplex

This group of parameters allows the user to configure the command function of each digital output in the Pump Genius Multiplex application.

P0275 – DO1 Function

Adjustable Range:	0 to 44 / 37 = Sleep Mode active (App. Function 1)	**Factory Setting:**	13
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
These parameters define the function of the digital output DO1. If you selected the "37 = Sleep Mode active (Application Function 1)", the output assumes the function of indicating that the Pump Genius is in Sleep Mode.

P0276 – DO2 Function

Adjustable Range:	0 to 44 / 39 = A770/A772 or F771/F773 active (App. Function 3)	**Factory Setting:**	39
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines the function of the digital output DO2. If you selected the "39 = Alarm A770/A772 or Fault F771/F773 active (Application Function 3)", the output assumes the function of indicating that the alarm "A770: Low Level Alarm for the Control Process Variable" or "A772: High Level Alarm for the Control Process Variable" or "F771: Low Level Fault for the Control Process Variable" or "F773: High Level Fault for the Control Process Variable" is active.

NOTA!
To use the digital output DO2 is always necessary an external relay or auxiliary contactor at 24Vdc, because the digital output 2 is always transistor independent of the plug-in module used

P0277 – DO3 Function

Adjustable Range:	0 to 44 / 38 = Master Pump active (App. Function 2)	**Factory Setting:**	2
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines the function of the digital output DO3. If you selected the "38 = Master Pump active (Application Function 2)", the output assumes the function of indicating that this pump is a master pump of the Pump Genius Multiplex application.

NOTE!
Refer to the CFW500 frequency inverter programming manual and the installation guide of the plug-in module used for further information about the digital outputs. On the configuration wizard, some value options for the parameters were taken.

3.7 ANALOG INPUTS

3.7.1 PG Simplex

This group of parameters allows the user to configure the function of each analog input in the Pump Genius Simplex application.

P0231 – AI1 Signal Function

P0236 – AI2 Signal Function

P0241 – AI3 Signal Function

Adjustable Range:	0 to 15 / 8 = Control Setpoint (App. F. 1) (P1020 = 1 to 3) 0 to 15 / 9 = Control Process Variable (App. F. 2) (P1021 = 1 to 4) 0 to 15 / 10 = Control Auxiliary Variable (App. F. 3) (P1047 = 1 to 3)	**Factory Setting:**	P0231 = 8 P0236 = 0 P0241 = 0
Properties:			
Access groups via HMI:	I/O		

Description:
These parameters configure the function of the analog inputs AI1, AI2 and AI3 in the Pump Genius Simplex application as reading of the control setpoint (P1020=1 to 3), or as control process variable (P1021=1) or as control auxiliary variable (P1047=1 to 3).

P0233 – AI1 Signal Type

P0238 – AI2 Signal Type

P0243 – AI3 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:**	1
Properties:			
Access groups via HMI:	I/O		

Description:
These parameters configure the type of signal (voltage or current) that will be read at each analog input, as well as its range.

NOTE!
Refer to the installation guide of the plug-in module used to verify the setting of switch type selection signal (voltage or current).

P0232 – AI1 Gain

P0237 – AI2 Gain

P0242 – AI3 Gain

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

Description:
These parameters configure the type of signal (voltage or current) that will be read at each analog input, as well as its range.

P0234 – AI1 Offset

P0239 – AI2 Offset

P0254 – AI3 Offset

Adjustable Range:	-100.00 % to +100.00 %	**Factory Setting:**	0.00 %
Properties:			
Access groups via HMI:	I/O		

Description:
These parameters add to the measured quantity a value, in percentage, in order to adjust the read variable.

P0235 – AI1 Filter

P0240 – AI2 Filter

P0245 – AI3 Filter

Adjustable Range:	0.00 to 16.00 s	**Factory Setting:**	0.25 s
Properties:			
Access groups via HMI:	I/O		

Description:
These parameters configure the 1st order filter time constant that will be applied to the analog inputs AI1, AI2 and AI3.

NOTE!
Refer to the CFW500 programming manual for more information on the analog inputs parameters. Some parameter options have been removed from the configuration wizard.

3.7.2 PG Multipump

This group of parameters allows the user to configure the function of each analog input in the Pump Genius Multipump application.

P0231 – AI1 Signal Function

Adjustable Range:	0 to 15 / 8 = Control Process Variable (App. Function. 1)	**Factory Setting:**	8
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines that the function of analog input AI1 on the ladder application will be to supply the control process variable for Pump Genius.

P0233 – AI1 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:**	1
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the type of signal (voltage or current) which will be read by analog input AI1, as well as their variation range.

NOTE!
Refer to the installation guide of the plug-in module used to verify the setting of switch type selection signal (voltage or current).

P0232 – AI1 Gain

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

Description:
This parameter applies a gain to the value read by the analog input AI1, i.e., the value read by the analog input is multiplied by the gain, thus allowing possible adjustments to the variable read.

P0234 – AI1 Offset

Adjustable Range:	-100.0 % to +100.0 %	**Factory Setting:**	0.0 %
Properties:			
Access groups via HMI:	I/O		

Description:
This parameter adds a value, in percentage, to the value read for settings of the variable read.

P0235 – AI1 Filter

Adjustable Range:	0.00 to 16.00 s	**Factory Setting:**	0.25 s
Properties:			
Access groups via HMI:	I/O		

Description:
This parameter configures the time constant of the 1st order filter to be applied to the analog input AI1.

NOTE!
Refer to the CFW500 frequency inverter programming manual and the installation guide of the plug-in module used for further information about the analog inputs. On the configuration wizard, some value options for the parameters were taken.

3.7.3 PG Multiplex

This group of parameters allows the user to configure the function of each analog input in the Pump Genius Multiplex application.

P0231 – AI1 Signal Function

Adjustable Range:	0 to 15 / 8 = Control Process Variable (App. Function. 1)	**Factory Setting:**	8
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter defines that the function of analog input AI1 on the ladder application will be to supply the control process variable for Pump Genius.

P0233 – AI1 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:**	1
Properties:	CFG		
Access groups via HMI:	I/O		

Description:
This parameter configures the type of signal (voltage or current) which will be read by analog input AI1, as well as their variation range.

NOTE!
Refer to the installation guide of the plug-in module used to verify the setting of switch type selection signal (voltage or current).

P0232 – AI1 Gain

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

Description:
This parameter applies a gain to the value read by the analog input AI1, i.e., the value read by the analog input is multiplied by the gain, thus allowing possible adjustments to the variable read.

P0234 – AI1 Offset

Adjustable Range:	-100.0 % to +100.0 %	**Factory Setting:**	0.0 %
Properties:			
Access groups via HMI:	I/O		

Description:
This parameter adds a value, in percentage, to the value read for settings of the variable read.

P0235 – AI1 Filter

Adjustable Range:	0.00 to 16.00 s	**Factory Setting:**	0.25 s
Properties:			
Access groups via HMI:	I/O		

Description:
This parameter configures the time constant of the 1st order filter to be applied to the analog input AI1.

NOTE!
Refer to the CFW500 frequency inverter programming manual and the installation guide of the plug-in module used for further information about the analog inputs. On the configuration wizard, some value options for the parameters were taken.

3.8 CONTROL PROCESS VARIABLE

3.8.1 PG Simplex

This group of parameters allows the user to configure the control process variable of the Pump Genius Simplex application.

P1021 – Control Process Variable Selection Source

Adjustable Range:	0 = Without Control Process Variable (Disable the PID Controller) 1 = Control Process Variable via Analog Input AI1 2 = Control Process Variable via Analog Input AI2 3 = Control Process Variable via difference between Analog Input AI1 and AI2 4 = Control Process Variable via Analog Input AI3	**Factory Setting:**	1
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the source of the Pump Genius control process variable.

Table 3.3 – Description of the control process variable source

P1021	Description
0	It defines that there is no source for the control process variable of the Pump Genius, thereby disabling the PID controller.
1	It defines that the source of the control process variable of the Pump Genius is the value read by the analog input AI1. The value is converted according to engineering unit 1 and displayed in parameter P1016.
2	It defines that the source of the control process variable of the Pump Genius is the value read by the analog input AI2. The value is converted according to engineering unit 1 and displayed in parameter P1016.
3	It defines that the source of the control process variable of the Pump Genius is the value read by the analog input AI1 subtracted from the value read by the analog input AI2. The value of AI1 – AI2 is converted according to engineering unit 1 and displayed in parameter P1016.
4	It defines that the source of the control process variable of the Pump Genius is the value read by the analog input AI3. The value is converted according to engineering unit 1 and displayed in parameter P1016.

3.8.1.1 Engineering Unit Configuration

This group of parameters allows the user to configure the engineering unit of the Pump Genius control process variable.

P0510 – Engineering Unit 1

Adjustable Range:	0 = None 1 = V 2 = A 3 = rpm 4 = s 5 = ms 6 = N 7 = m 8 = Nm 9 = mA 10 = % 11 = °C 12 = CV 13 = Hz 14 = HP 15 = h 16 = W 17 = kW 18 = kWh 19 = H	**Factory Setting:**	0
Properties:			

Access groups via HMI:	HMI

Description:
This parameter selects the engineering unit that will be displayed in the SoftPLC user parameter that is associated with it. I.e., any SoftPLC user parameter that is associated with the engineering unit 1 will be displayed in this format on the CFW500 inverter HMI.

NOTE!
The parameters P1011, P1012, P1013, P1014, P1015, P1016, P1022, P1023, P1024, P1026, P1034, P1035, P1039 and P1050 are associated with the engineering unit 1.

P0511– Decimal Point of Engineering Unit 1

Adjustable Range:	0 = xywz 1 = xyw.z 2 = xy.wz 3 = x.ywz	**Factory Setting:**	2
Properties:			
Access groups via HMI:	HMI		

Description:
This parameter selects the decimal point that will be displayed in the SoftPLC user parameter that is associated with it. I.e., any SoftPLC user parameter that is associated with the decimal point of engineering unit 1 will be displayed in this format on the CFW500 inverter HMI.

NOTE!
The parameters P1011, P1012, P1013, P1014, P1015, P1016, P1022, P1023, P1024, P1026, P1034, P1035, P1039 and P1050 are associated with decimal point of engineering unit 1.

3.8.1.2 Sensor Scale Configuration

This group of parameters allows the user to configure the scaling of the control process variable.

P1022 – Control Process Variable Sensor Minimum Level

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	0
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the minimum level of the Pump Genius control process variable sensor according to its engineering unit.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1023 – Control Process Variable Sensor Maximum Level

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	400
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the maximum level of the Pump Genius control process variable sensor according to its engineering unit.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

Through the minimum and maximum level of control process variable sensor and the value of analog input AIx, we have the line equation for conversion of the Pump Genius control process variable:

$$P1016 = (P1023 - P1022) \times AIx + P1022$$

Where,

P1016 = Control process variable;
P1022 = Minimum level of control process variable sensor;
P1023 = Maximum level of control process variable sensor;
AIx = Value of analog input AI1, AI2 and AI3 or difference between AI1 and AI2 (AI1 – AI2) in %.

3.8.2 PG Multipump

This group of parameters allows the user to configure the control process variable of the Pump Genius Multipump application.

P1021 – Control Process Variable Selection Source

Adjustable Range:	0 = Control Process Variable via Analog Input AI1	**Factory Setting:**	0
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the source of the Pump Genius process variable.

Table 3.4– Description of the control process variable source

P1021	Description
0	It defines that the source of the control process variable of the Pump Genius is the value read by the analog input AI1. The value is converted according to engineering unit 1 and displayed in parameter P1016.

3.8.2.1 Engineering Unit Configuration

This group of parameters allows the user to configure the engineering unit of the Pump Genius control process variable.

P0510 – Engineering Unit 1

Adjustable Range:	0 = None 1 = V 2 = A 3 = rpm 4 = s 5 = ms 6 = N 7 = m 8 = Nm 9 = mA 10 = % 11 = °C 12 = CV 13 = Hz 14 = HP 15 = h 16 = W	**Factory Setting:**	0

	17 = kW 18 = kWh 19 = H	
Properties:		
Access groups via HMI:	HMI	

Description:
This parameter selects the engineering unit that will be displayed in the SoftPLC user parameter that is associated with it. I.e., any SoftPLC user parameter that is associated with the engineering unit 1 will be displayed in this format on the CFW500 inverter HMI.

NOTE!
The parameters P1011, P1012, P1013, P1014, P1015, P1016, P1023, P1024, P1026, P1034, P1035, P1053 and P1057 are associated with the engineering unit 1.

P0511 – Decimal Point of Engineering Unit 1

Adjustable Range:	0 = xywz 1 = xyw.z 2 = xy.wz 3 = x.ywz	**Factory Setting:** 2
Properties:		
Access groups via HMI:	HMI	

Description:
This parameter selects the decimal point that will be displayed in the SoftPLC user parameter that is associated with it. I.e., any SoftPLC user parameter that is associated with the decimal point of engineering unit 1 will be displayed in this format on the CFW500 inverter HMI.

NOTE!
The parameters P1011, P1012, P1013, P1014, P1015, P1016, P1023, P1024, P1026, P1034, P1035, P1053 and P1057 are associated with the decimal point of engineering unit 1.

3.8.2.2 Sensor Scale Configuration

This group of parameters allows the user to configure the scaling of the control process variable.

P1023 – Control Process Variable Sensor Maximum Level

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:** 400
Properties:		
Access groups via HMI:	SPLC	

Description:
This parameter defines the maximum level of the Pump Genius control process variable sensor according to its engineering unit.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

Through the maximum level of control process variable sensor and the value of analog input AIx, we have the line equation for conversion of the Pump Genius control process variable:

$$P1016 = P1023 \times AI1$$

Where,

P1016 = Control process variable;
P1023 = Maximum level of control process variable sensor;
AI1 = Value of analog input AI1 in %.

3.8.3 PG Multiplex

This group of parameters allows the user to configure the control process variable of the Pump Genius Multiplex application.

P1023 – Control Process Variable Selection Source

Adjustable Range:	0 = Without Source for Process Variable (Slave Pump) 1 = Control Process Variable via Analog Input AI1	**Factory Setting:**	P1020 = 0: 1 P1020 = 1: 0
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the source of the Pump Genius process variable.

Table 3.5 – Description of the control process variable source

P1023	Description
0	It defines that there is no source for the control process variable of the Pump Genius. This option is valid when the pump function is defined as slave (P1020 = 1), because as such, it can never provide the control process variable for controlling the pumping.
1	It defines that the source of the control process variable of the Pump Genius is the value read by the analog input AI1. The value is converted according to engineering unit 1 and displayed in parameter P1016.

3.8.2.1 Engineering Unit Configuration

This group of parameters allows the user to configure the engineering unit of the Pump Genius control process variable.

P0510 – Engineering Unit 1

Adjustable Range:	0 = None 1 = V 2 = A 3 = rpm 4 = s 5 = ms 6 = N 7 = m 8 = Nm 9 = mA 10 = % 11 = °C 12 = CV 13 = Hz 14 = HP 15 = h 16 = W 17 = kW 18 = kWh 19 = H	**Factory Setting:**	0
Properties:			

Access groups via HMI: HMI

Description:
This parameter selects the engineering unit that will be displayed in the SoftPLC user parameter that is associated with it. I.e., any SoftPLC user parameter that is associated with the engineering unit 1 will be displayed in this format on the CFW500 inverter HMI.

NOTE!
The parameters P1011, P1016, P1024, P1025, P1026, P1028, P1034, P1035, P1039, P1053 and P1056 are associated with the engineering unit 1.

P0511 – Decimal Point of Engineering Unit 1

Adjustable Range: 0 = xywz; 1 = xyw.z; 2 = xy.wz; 3 = x.ywz
Factory Setting: 2
Properties:
Access groups via HMI: HMI

Description:
This parameter selects the decimal point that will be displayed in the SoftPLC user parameter that is associated with it. I.e., any SoftPLC user parameter that is associated with the decimal point of engineering unit 1 will be displayed in this format on the CFW500 inverter HMI.

NOTE!
The parameters P1011, P1016, P1024, P1025, P1026, P1028, P1034, P1035, P1039, P1053 and P1056 are associated with the decimal point of engineering unit 1.

3.8.2.2 Sensor Scale Configuration

This group of parameters allows the user to configure the scaling of the control process variable.

P1024 – Control Process Variable Sensor Minimum Level

Adjustable Range: -32768 to 32767 [Eng. Unit 1]
Factory Setting: 0
Properties:
Access groups via HMI: SPLC

Description:
This parameter defines the minimum level of the Pump Genius control process variable sensor according to its engineering unit.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1025 – Control Process Variable Sensor Maximum Level

Adjustable Range: -32768 to 32767 [Eng. Unit 1]
Factory Setting: 400
Properties:
Access groups via HMI: SPLC

Description:
This parameter defines the maximum level of the Pump Genius control process variable sensor according to its engineering unit.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

Through the minimum and maximum level of control process variable sensor and the value of analog input AI1, we have the line equation for conversion of the Pump Genius control process variable:

$$P1016 = (P1025 - P1024) \times AI1 + P1024$$

Where,

P1016 = Control process variable;
P1024 = Minimum level of control process variable sensor;
P1025 = Maximum level of control process variable sensor;
AI1 = Value of analog input AI1 in %.

3.9 CONTROL SETPOINT

This group of parameters allows the user to configure the control setpoint of the Pump Genius applications.

3.9.1 PG Simplex

P1011 – Control Setpoint

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	200
Properties:	RW		
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of the control setpoint of the Pump Genius in engineering units when the control setpoint source was programmed to be via HMI or communication networks (P1020=4). When the control setpoint source was programmed to be another source (P1020≠4), it is indicates the actual control setpoint of the Pump Genius.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1012 – Control Setpoint 1

P1013 – Control Setpoint 2

P1014 – Control Setpoint 3

P1015 – Control Setpoint 4

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	P1012 = 200 P1013 = 230 P1014 = 180 P1015 = 160
Properties:			
Access groups via HMI:	SPLC		

Description:
These parameters define the value of the control setpoint of the Pump Genius in engineering units when the control setpoint source was programmed to be via logical combination of digital inputs DI4 and DI5 (P1020=5, 6 or 7) according the table 3.6.

NOTE!
These parameters are displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1020 – Control Setpoint Selection Source

Adjustable Range:	1 = Control Setpoint via Analog Input AI1 2 = Control Setpoint via Analog Input AI2 3 = Control Setpoint via Analog Input AI3 4 = Control Setpoint via HMI or Communication Networks (P1011) 5 = Two Setpoints via Digital Input DI4 (P1012 and P1013) 6 = Three Setpoints via Digital Inputs DI9 and DI10 (P1012, P1013 and P1014) 7 = Four Setpoints via Digital Inputs DI9 and DI10 (P1012, P1013, P1014 and P1015)	**Factory Setting:** 4
Properties:		
Access groups via HMI:	SPLC	

Description:
This parameter defines the source of the Pump Genius control setpoint.

Table 3.6 – Description of the control setpoint source

P1020	Description
1	It defines that the source of the control setpoint of the Pump Genius is the value read by the analog input AI1. The value is converted according to engineering unit 1 and displayed in parameter P1011.
2	It defines that the source of the control setpoint of the Pump Genius is the value read by the analog input AI2. The value is converted according to engineering unit 1 and displayed in parameter P1011.
3	It defines that the source of the control setpoint of the Pump Genius is the value read by the analog input AI3. The value is converted according to engineering unit 1 and displayed in parameter P1011.
4	It defines that the source of the control setpoint of the Pump Genius is the value programmed in the parameter P1011 of the CFW500 inverter HMI or the value written via communication networks.
5	It defines that there are two setpoints for the Pump Genius selected via logical combination of the digital input DI4. The setpoint value selected is displayed in parameter P1011.
6	It defines that there are three setpoints for the Pump Genius selected via logical combination of the digital inputs DI4 and DI5. The setpoint value selected is displayed in parameter P1011.
7	It defines that there are four setpoints for the Pump Genius selected via logical combination of the digital inputs DI4 and DI5. The setpoint value selected is displayed in parameter P1011.

When the control setpoint is via logical combination of the digital inputs DI4 and DI5, the following truth table should be applied for obtaining the control setpoint of the Pump Genius:

Table 3.7 – Truth table for control setpoint via logical combination of the digital inputs DI4 and DI5

	P1012 – Control Setpoint 1	P1013 – Control Setpoint 2	P1014 – Control Setpoint 3	P1015 – Control Setpoint 4
Digital Input DI4	0	1	0	1
Digital Input DI5	0	0	1	1

3.9.2 PG Multipump

P1011 – Control Setpoint

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:** 200
Properties:	RW	
Access groups via HMI:	SPLC	

Description:
This parameter defines the value of the control setpoint of the Pump Genius in engineering units when the control setpoint source was programmed to be via HMI or communication networks (P1020=4). When the control setpoint source was programmed to be another source (P1020≠4), it is indicates the actual control setpoint of the Pump Genius.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1012 – Control Setpoint 1

P1013 – Control Setpoint 2

P1014 – Control Setpoint 3

P1015 – Control Setpoint 4

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	P1012 = 200 P1013 = 230 P1014 = 180 P1015 = 160
Properties:			
Access groups via HMI:	SPLC		

Description:
These parameters define the value of the control setpoint of the Pump Genius in engineering units when the control setpoint source was programmed to be via logical combination of digital inputs DI4 and DI5 (P1020=5, 6 or 7) according the table 3.8.

NOTE!
These parameters are displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1020 – Control Setpoint Selection Source

Adjustable Range:	4 = Control Setpoint via HMI or Communication Networks (P1011) 5 = Two Setpoints via 1st Digital Input (P1012 and P1013) 6 = Three Setpoints via 1st and 2nd Digital Inputs (P1012, P1013 and P1014) 7 = Four Setpoints via 1st and 2nd Digital Inputs (P1012, P1013, P1014 and P1015)	**Factory Setting:**	4
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the source of the Pump Genius control setpoint.

Table 3.8 – Description of the control setpoint source

P1020	Description
4	It defines that the source of the control setpoint of the Pump Genius is the value programmed in the parameter P1011 of the CFW500 inverter HMI or the value written via communication networks.
5	Defines that there will be two setpoints for the pumping control selected via logic combination of one digital input programmed for 1st DI for control setpoint selection. The selected setpoint value is viewed in parameter P1011.
6	Defines that there will be three setpoints for the pumping control selected via logic combination of two digital inputs programmed for 1st and 2nd DI for control setpoint selection. The selected setpoint value is viewed in parameter P1011.
7	Defines that there will be four setpoints for the pumping control selected via logic combination of two digital inputs programmed for 1st and 2nd DI for control setpoint selection. The selected setpoint value is viewed in parameter P1011.

When the control setpoint is via logic communication of digital inputs, the following true table must be applied so as to obtain the pumping control setpoint.

Table 3.9 – True table for the control setpoint via logic combination of digital inputs

	P1012 – Control Setpoint 1	P1013 – Control Setpoint 2	P1014 – Control Setpoint 3	P1015 – Control Setpoint 4
1st DI for Setpoint Selection	0	1	0	1
2nd DI for Setpoint Selection	0	0	1	1

3.9.3 PG Multiplex

P1011 – Control Setpoint

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	200
Properties:	RW		
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of the control setpoint of the Pump Genius in engineering units when the control setpoint source was programmed to be via HMI or communication networks (P1022=4).

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1022 – Control Setpoint Selection Source

Adjustable Range:	0 = Without Source for Control Setpoint (Slave Pump) 4 = Control Setpoint via HMI (P1011) or Communication Networks	**Factory Setting:**	P1020 = 0: 4 P1020 = 1: 0
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the source of the Pump Genius control setpoint.

Table 3.10 – Description of the control setpoint source

P1022	Description
0	It defines that there is no source for the control setpoint of the Pump Genius. This option is valid when the pump operation is defined as slave (P1020 = 1), because as such, it can never provide the setpoint for controlling the pumping.
4	It defines that the source of the control setpoint of the Pump Genius is the value programmed in the parameter P1011 of the CFW500 inverter HMI or the value written via communication networks.

3.10 PID CONTROLLER

This group of parameters allows the user to adjust the operating conditions of the PID controller for controlling the pumping.

The PID controller can control the motor (pump) speed driven by CFW500 inverter through the comparison of the control process variable (feedback) with the control setpoint.

The PID controller will be set up to operate from 0.0 to 100.0 %, where 0.0 % equates to minimum speed programmed in P0133 and 100.0 % equates to maximum speed programmed in P0134.

The control process variable is read via an analog input, which requires the chosen input to be appropriately configured for the purpose.

The "Academic" structure has been adopted as algorithm for the PID controller. It 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) = PID controller output
i(k-1) = integral part in the previous sampling instant
Kp = proportional gain
Ki = integral gain
Kd = derivative gain
Ts = cyclic sampling time (fixed at 50ms)
e(k) = error in the present sampling instant (setpoint – process variable (direct), or process variable – setpoint (reverse))
e(k-1) = error in the previous sampling instant

P1031 – PID Proportional Gain

Adjustable Range:	0.00 to 320.00	**Factory Setting:**	1.00
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the proportional gain value of the PID controller for the Pump Genius.

P1032 – PID Integral Gain

Adjustable Range:	0.00 to 320.00	**Factory Setting:**	25.00
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the integral gain value of the PID controller for the Pump Genius.

P1033 – PID Derivative Gain

Adjustable Range:	0.00 to 320.00	**Factory Setting:**	0.00
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the derivative gain value of the PID controller for the Pump Genius.

NOTE!
The PID controller of the standard Pump Genius applications are of the academic type. Should a different structure be adopted for the PID controller (through WLP), then the controller gains must be re-optimized by the user. PID block input arguments can only be changed in the ladder application developed with the WLP. Refer to the WLP programming software help topics for more information on the PID block.

3.10.1 PG Simplex

P1018 – Setpoint of the PID Controller in Manual mode

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	0.0 Hz
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the PID controller setpoint value when it is operating in manual mode. When the PID controller operates in manual mode, the speed value set in parameter P1018 (setpoint in manual mode) is transferred directly to the PID controller output, thus defining the speed reference of the pump driven by the CFW500 inverter.

P1028 – Selection of Control Action of the PID Controller

Adjustable Range:	0 = Disable the PID Controller 1 = Direct Mode 2 = Reverse Mode	**Factory Setting:**	1
Properties:	CFG		
Access groups via HMI:	SPLC		

Description:
This parameter defines the control action of the PID controller for the Pump Genius when it is enabled. I.e. it defines how will be the error signal.

Table 3.11 – Description of the control action of the PID controller

P1028	Description
0	It defines that the PID controller will be disabled. I.e., will not have control of the process variable.
1	It defines that the control or regulation action of the PID controller will be in direct mode. I.e., the error is the control setpoint value (P1011) minus the control process variable value (P1016).
2	It defines that the control or regulation action of the PID controller will be in reverse mode. I.e., the error is the control process variable value (P1016) minus the control setpoint value (P1011).

NOTE!
The PID control action should be set to direct mode, when, in order to increase the control process variable value, it is necessary to increase the PID output. Ex: Pump driven by the inverter is filling a reservoir. Raising the reservoir level (control process variable), requires a higher flow rate, which is achieved by increasing the motor speed.
The PID control action should be selected to reverse mode, when, in order to increase the control process variable value, it is necessary to reduce the PID output. Ex: Pump driven by the inverter is removing fluid from a reservoir. In order to increase the fluid level in the reservoir (control process variable), it is necessary to reduce the pump speed by reducing the motor speed.

P1029 – Operation Mode of the PID Controller

Adjustable Range:	0 = Manual 1 = Automatic 2 = Manual or Automatic selection via digital input DI3	**Factory Setting:** 1
Properties:		
Access groups via HMI:	SPLC	

Description:
This parameter defines the operation mode of the PID controller for the Pump Genius.

Table 3.12 – Description of operation mode of the PID controller

P1029	Description
0	It defines that the PID controller will operate in manual mode. I.e., the process variable will not be controlled as the control setpoint required by the user and the PID controller output value will be the setpoint value in manual mode set in parameter P1018.
1	It defines that the PID controller will operate in automatic mode. I.e., the process variable will be controlled as the control setpoint required by the user and the output value of the PID controller will behave as the setting defined by de user.
2	It defines that the PID controller can operate in manual or automatic mode according to the state of digital input DI3. I.e., if the digital input is in logic level "0", the PID controller will operate in manual mode; if the digital input is in logic level "1" the PID controller will operate in automatic mode.

NOTE!
The change from one operation mode to another with the Pump Genius in operation can cause disturbances in the pumping control. This can be optimized as the automatic adjustment of the PID controller setpoint defined in P1030 parameter together with the bumpless transfer characteristic from manual to automatic mode of the SoftPLC PID block.
The Bumpless transfer is merely making the transfer from the manual mode to the automatic mode without causing variation in the PID controller output. I.e., when the transition occurs from the manual mode to the automatic mode, the PID controller output value in manual mode is used to start the integral part of the PID controller. That ensures that the output will start from this value.

P1030 – Automatic Adjustment of the PID Controller Setpoint

Adjustable Range:	0 = P1011 Off and P1018 Off 1 = P1011 On and P1018 Off 2 = P1011 Off and P1018 On 3 = P1011 On and P1018 On	**Padrão:** 0
Properties:		
Access groups via HMI:	SPLC	

Description:
This parameter defines if the setpoint of the PID controller in automatic mode (P1011) and / or manual mode (P1018) will be changed or adjusted automatically in change of operation mode of the PID controller.

NOTE!
The adjustment of the control setpoint in automatic mode is only valid when the control setpoint source is set to HMI or communication networks (P1020 = 4). For other control setpoint sources, the automatic adjust of the control setpoint is not executed.

Table 3.13 – Description of automatic adjustment of the PID controller setpoint

P1030	Description
0	It defines that in the transition of the PID controller operation mode from manual to automatic, the control setpoint value (P1011) is **not** loaded with the current value of the control process variable (P1016); and that in the transition of the PID controller operation mode from automatic to manual, the PID controller setpoint value in manual mode (P1018) is **not** loaded with the current value of the pump motor speed (P0002).
1	It defines that in the transition of the PID controller operation mode from manual to automatic, the control setpoint value (P1011) **will be** loaded with the current value of the control process variable (P1016); and that in the transition of the PID controller operation mode from automatic to manual, the PID controller setpoint value in manual mode (P1018) is **not** loaded with the current value of the pump motor speed (P0002).

2	It defines that in the transition of the PID controller operation mode from manual to automatic, the control setpoint value (P1011) is **not** loaded with the current value of the control process variable (P1016); and that in the transition of the PID controller operation mode from automatic to manual, the PID controller setpoint value in manual mode (P1018) **will be** loaded with the current value of the pump motor speed (P0002).
3	It defines that in the transition of the PID controller operation mode from manual to automatic, the control setpoint value (P1011) **will be** loaded with the current value of the control process variable (P1016); and that in the transition of the PID controller operation mode from automatic to manual, the PID controller setpoint value in manual mode (P1018) **will be** loaded with the current value of the pump motor speed (P0002).

3.10.2 PG Multipump

P1030 – Selection of Control Action of the PID Controller

Adjustable	1 = Direct Mode	**Factory Setting:**	1
Range:	2 = Reverse Mode		
Properties:	CFG		
Access groups via HMI:	SPLC		

Description:
This parameter defines the control action of the PID controller for the Pump Genius when it is enabled. I.e. it defines how will be the error signal.

Table 3.14 – Description of the control action of the PID controller

P1030	Description
1	It defines that the control or regulation action of the PID controller will be in direct mode. I.e., the error is the control setpoint value (P1011) minus the control process variable value (P1016).
2	It defines that the control or regulation action of the PID controller will be in reverse mode. I.e., the error is the control process variable value (P1016) minus the control setpoint value (P1011).

NOTE!
The PID control action should be set to direct mode, when, in order to increase the control process variable value, it is necessary to increase the PID output. Ex: Pump driven by the inverter is filling a reservoir. Raising the reservoir level (control process variable), requires a higher flow rate, which is achieved by increasing the motor speed.
The PID control action should be selected to reverse mode, when, in order to increase the control process variable value, it is necessary to reduce the PID output. Ex: Pump driven by the inverter is removing fluid from a reservoir. In order to increase the fluid level in the reservoir (control process variable), it is necessary to reduce the pump speed by reducing the motor speed.

3.10.3 PG Multiplex

P1030 – Control Action of the PID Controller

Adjustable	1 = Direct Mode	**Factory Setting:**	1
Range:	2 = Reverse Mode		
Properties:	CFG		
Access groups via HMI:	SPLC		

Description:
This parameter configures the control action of the Pump Genius's PID controller, by defining the effect of the error polarity.

Table 3.15 – Description of the control action of the PID controller

P1030	Description
1	It defines that the control or regulation action of the PID controller will be in direct mode. I.e., the error is the control setpoint value (P1011) minus the control process variable value (P1016).
2	It defines that the control or regulation action of the PID controller will be in reverse mode. I.e., the error is the control process variable value (P1016) minus the control setpoint value (P1011).

NOTE!
The PID control action should be set to direct mode, when, in order to increase the control process variable value, it is necessary to increase the PID output. Ex: Pump driven by the inverter is filling a reservoir. Raising the reservoir level (control process variable), requires a higher flow rate, which is achieved by increasing the motor speed.
The PID control action should be selected to reverse mode, when, in order to increase the control process variable value, it is necessary to reduce the PID output. Ex: Pump driven by the inverter is removing fluid from a reservoir. In order to increase the fluid level in the reservoir (control process variable), it is necessary to reduce the pump speed by reducing the motor speed.

3.11 STARTUP MODES

It defines the conditions to startup the Pump Genius.

3.11.1 Wake up and Start Level Mode

This group of parameters allows the user to set the conditions to startup and control the pumping, and it may be:

■ Wake up Mode: Configures the Pump Genius to start the pump and resume control of the pumping when the deviation between the control process variable and the control setpoint reaches a programmed threshold;
■ Start Level Mode: Configures the Pump Genius to start the pump and resume control of the pumping when the control process variable reaches a programmed threshold;

P1034 – Control Process Variable Deviation to Wake up the Pump Genius

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	30
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value to be reduced (direct PID) or increased (reverse PID) to the control setpoint for starting the pump and resuming control of the pumping. Becoming this value is compared with the control process variable and, if the value of the control process variable is less (direct PID) or greater (reverse PID) than this value, the condition to wake up is enabled.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1035 – Control Process Variable Level for Starting the Pump Genius (Simplex and Multipump)

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	180
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the control process variable level for starting the pump and resuming control of the pumping. With a Direct Mode PID controller, the pumping control will be enabling to start when the control process variable drops lower than P1035. With a Reverse Mode PID controller it will be enabling to start when the process variable rises above P1035.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1036 – Time Delay to Wake up or Starting by Level the Pump Genius

Adjustable Range:	0 to 32767 s	**Factory Setting:**	5 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the waiting time after the condition for wake up mode or start level mode becomes true, as follows:

■ Wake up Mode: The Wake up condition, as defined in P1034, must remain TRUE continuously for the time programmed in P1036, in order for the pump to start and pumping control to resume. The P1036 waiting time restarts from zero, if the Wake up condition momentarily becomes FALSE.
■ Start Level Mode (Simplex and Multipump): The control process variable Start Level condition, as defined in P1035, must remain TRUE continuously for the time programmed in P1036, in order for the pump to start and pumping control to resume. The P1036 waiting time restarts from zero, if the Start Level condition momentarily becomes FALSE.

NOTE!
If in enabling of the Pump Genius operation (command “Run/Stop” active or “Enable Pump Genius”), the condition for Wake up or Start by Level is active, the time set in P1036 is not awaited, and thus, the pump will start operating immediately.

3.11.2 Sleep Mode

This group of parameters allows the user to configures the Pump Genius to stop the pump when the pump motor speed drops below a programmed threshold (low control demand). Even though apparently the pumping control is off, the control process variable is still monitored for wake up or start level conditions.

P1037 – Pump Motor Speed below which Pump Genius goes to Sleep Mode

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	42.0 Hz
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of the pump motor speed below which the Pump Genius will stop the pump keeping the control active, i.e., will sleep.

NOTE!
A setting of “0 Hz” disables the sleep mode, it means that the pump will be started or stopped according to the status of the command "Run/Stop” or the command “Enable Pump Genius”.

P1038 – Time Delay for Pump Genius goes to Sleep Mode

Adjustable Range:	0 to 32767 s	**Factory Setting:**	10 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the waiting time with the value of the pump motor speed should remain below the value set in P1037 in order for sleep mode to be activated and the pump to be stopped.

NOTE!
The alarm message "A750: Sleep Mode Active" will be generated on the HMI of the CFW500 inverter to alert that the Pump Genius is in sleep mode.

The figure 3.1 presents a timing analysis of the Pump Genius operation with a direct mode PID controller when it is configured for Wake up Mode and Sleep Mode.

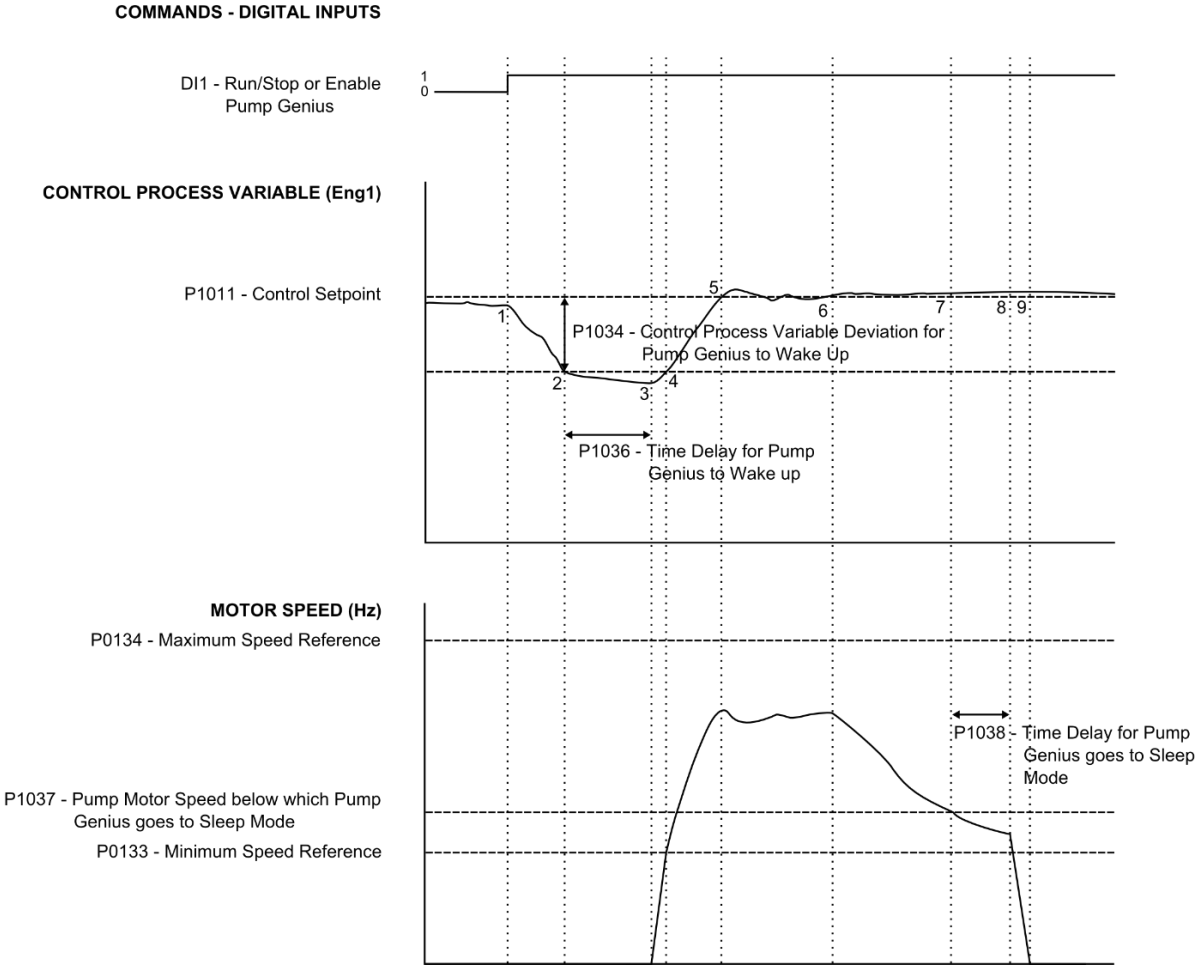


Figure 3.1 – Operation of the Pump Genius for wake up mode and sleep mode

1 – The "Run/Stop" or "Enable Pump Genius" command via digital input DI1 enable starting the motor, but also enable the operation of Pump Genius. As the condition to wake up was not detected, the pumping control remains in the sleep mode and the pump remains stopped;

2 – The control process variable begins to decrease and is lower than the control process variable deviation programmed to wake up the Pump Genius (P1034); in this moment the time count to wake up (P1036) is initiated;

3 – The control process variable remains smaller than the control process deviation to wake up the Pump Genius (P1034) and the time delay to wake up (P1036) is elapsed; at this moment the control issues the command to start the pump and resumes controlling the pumping with variable speed;

4 – The inverter accelerates the pump up to the minimum speed (P0133). After that, the PID controller is enabled and starts controlling the pump speed;

5 – The resumed Pump Genius allows the value of the control process variable to catch up with the control setpoint required by the user. The PID controller output increases during the catch-up phase, raising the pumping speed. A stabile phase with constant pumping speed may follow;

6 – The value of the control process variable continues above the setpoint due to a decrease in demand and pump speed begins to decrease;

7 – The pump motor speed output drops below the speed for Pump Genius goes to sleep mode threshold (P1037); the time count for Pump Genius goes to sleep mode (P1038) is initiated;

8 – The pump motor speed remains below the speed for Pump Genius goes to sleep mode threshold (P1037) and the time delay for Pump Genius goes to sleep mode (P1038) is elapsed; at this moment the control issues the command to stop the pump;

9 – The inverter driven pump reaches "zero" speed, and remains stopped; at this moment the Pump Genius goes into sleep mode.

The figure 3.2 presents a timing analysis of the Pump Genius operation with a Direct Mode PID controller when it is configured for Start Level Mode and Sleep Mode:

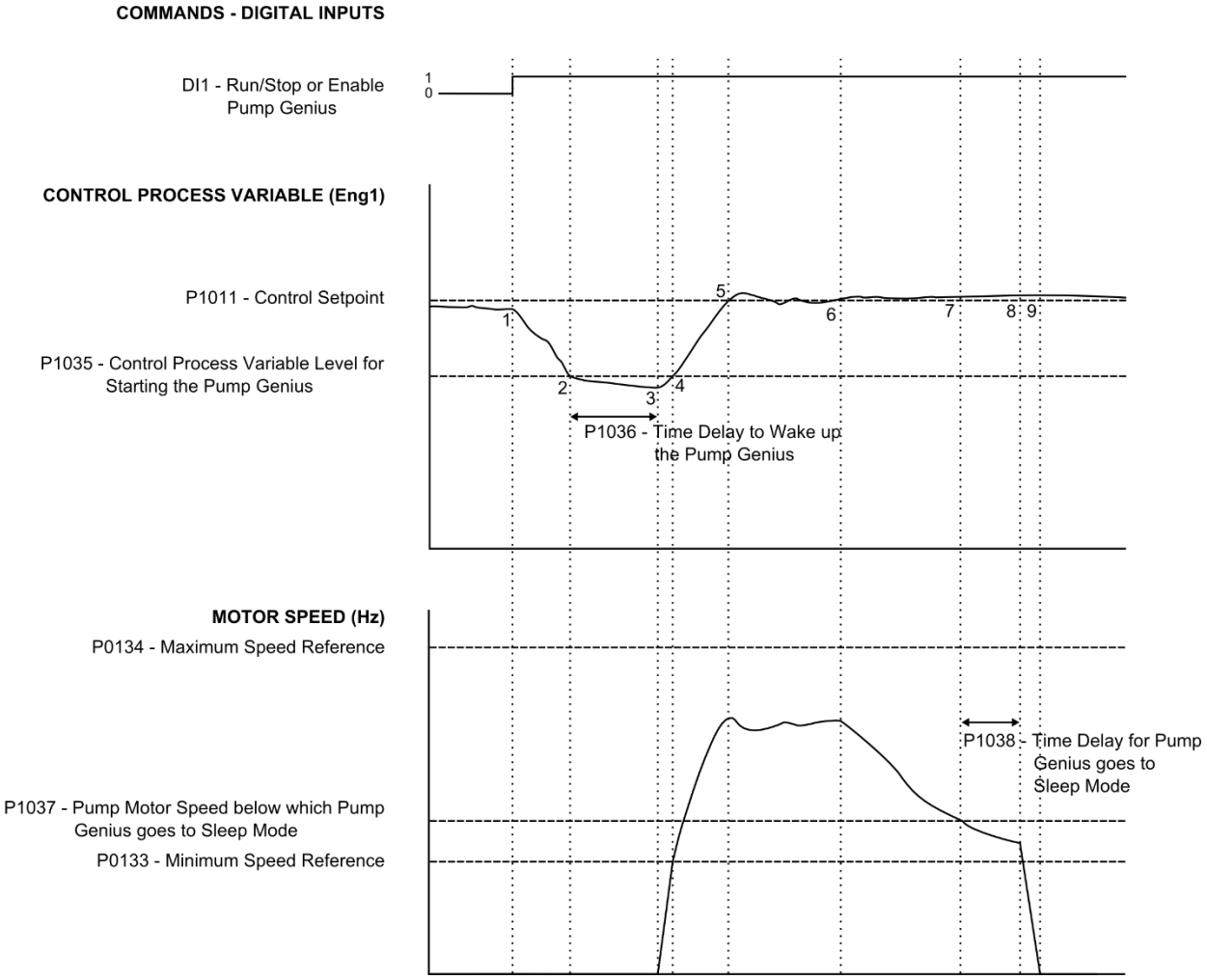


Figure 3.2 – Operation of the Pump Genius for start level mode and sleep mode

1 – The “Run/Stop” or “Enable Pump Genius” command via digital input DI1 enable starting the motor, but also enable the operation of Pump Genius. As the control process variable level condition to start the Pump Genius was not detected, the Pump Genius remains in the sleep mode and the pump remains stopped;

2 – The control process variable begins to decrease and is lower than the control process variable threshold programmed starting the Pump Genius (P1035); in this moment the time count for starting by level the Pump Genius (P1036) is initiated;
3 – The control process variable remains smaller than the threshold for starting the Pump Genius (P1035) and the time delay for starting by level the Pump Genius (P1036) is elapsed; at this moment the control issues the command to start the pump and resumes controlling the pumping with variable speed;

4 – The inverter accelerates the pump up to the minimum speed (P0133). After that, the PID controller is enabled and starts controlling the pump speed;

5 – The resumed Pump Genius allows the value of the control process variable to catch up with the control setpoint required by the user. The PID controller output increases during the catch-up phase, raising the pumping speed. A stabile phase with constant pumping speed may follow;

6 – The value of the control process variable continues above the setpoint due to a decrease in demand and pump speed begins to decrease;

7 – The pump motor speed output drops below the speed for Pump Genius goes to sleep mode threshold (P1037); the time count for Pump Genius goes to sleep mode (P1038) is initiated;

8 – The pump motor speed remains below the speed for Pump Genius goes to sleep mode threshold (P1037) and the time delay for Pump Genius goes to sleep mode (P1038) is elapsed; at this moment the control issues the command to stop the pump;

9 – The inverter driven pump reaches "zero" speed, and remains stopped; at this moment the Pump Genius goes into sleep mode.

3.11.3 Sleep Boost (PG Simplex and Multiplex)

This group of parameters allows the user to configures the Pump Genius Simplex and Multiplex so before stop the pump when the pump motor speed drops below a programmed threshold (low demand control), i.e., enable the sleep mode, to be added to the control setpoint a value to increase the control process variable with the purpose of the pump will remain in sleep mode longer.

NOTE!
The Sleep Boost for Sleep Mode is a function exclusive to Pump Genius Simplex and Multiplex, then is not possible to configure this function in Pump Genius Multipump.

P1039 – Sleep Boost Offset

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	0
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value to be added to the control setpoint in automatic mode to increase the control process variable before the Pump Genius go into sleep mode. When the control process variable reach the control setpoint value added to the sleep boost offset, the Pump Genius will go into sleep mode.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511). A setting of “0” disable the sleep boost. This function is only enabled to use for control action of the PID controller in direct mode.

NOTE!
The alarm message “A756: Sleep Boost Active” will be generated on the HMI of the CFW500 inverter to alert that the Pump Genius is executing the sleep boost.

P1040 – Sleep Boost Maximum Time

Adjustable Range:	0 to 32767 s	**Factory Setting:**	15 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the maximum time that the control process variable has to reach the control setpoint value added to the sleep boost offset, i.e., the maximum time that the sleep boost will be active. If the control process variable does not reach the control setpoint value added to the sleep boost offset during this time, the Pump Genius will go into sleep mode.

The figure 3.3 presents a timing analysis of the Pump Genius operation with a Direct Mode PID controller when it is configured for Wake up Mode and Sleep Mode with Sleep Boost enabled:

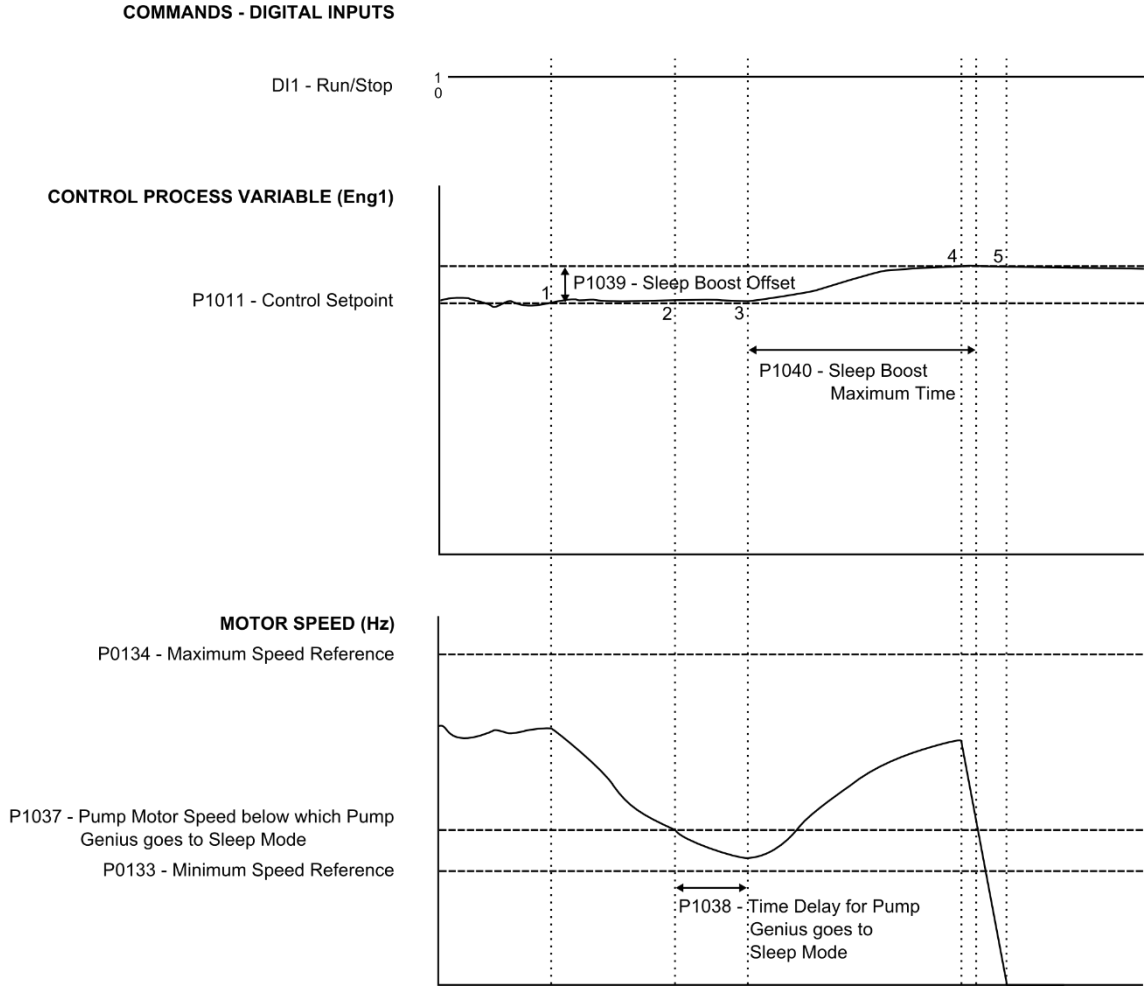


Figure 3.3 – Operation of the Pump Genius for sleep mode with sleep boost enabled

1 – The Pump Genius is keeping the system controlled as the control setpoint required by the user. At this moment the value of the control process variable begins to increase and the speed motor begins to decrease;

2 – The pump motor speed output drops below the speed for Pump Genius goes to sleep mode threshold (P1037); the time count for the Pump Genius go to sleep mode (P1038) is initiated;

3 – The pump motor speed remains below the speed for Pump Genius goes to sleep mode threshold (P1037) and the time delay for Pump Genius goes to sleep mode (P1038) is elapsed; at this moment, as the sleep boost is enabled will not be made the command to stop the pump. It will be added the sleep boost offset (P1039) to the control setpoint for increase the control process variable; at this moment the count of the sleep boost maximum time (P1040) is initiated;

4 – The inverter accelerates the pump again as the action of the PID controller and the control process variable reaches the control setpoint value added to the sleep boost active; at this moment the control issues the command to stop the pump before the count of the sleep boost maximum time be elapsed;

5 – The inverter driven pump reaches "zero" speed, and remains stopped; at this moment the Pump Genius goes into sleep mode.

3.12 PIPE CHARGING

This group of parameters allows the user to configure the Pump Genius to execute the pipe charging sequence using the pump driven by the CFW500 inverter (Simplex and Multipump) or the 1st pump to be started by Pump Genius (Multiplex).

The Pipe Charging assures that the pumping pipe is charged gradually, thus avoiding the "water hammer" pressure shock at the instant the pipe is filled with fluid. It is executed every time the Pump Genius receives a new enable, either via enable command or an exit from a disabled by fault state. If the control process variable in the newly enabled Pump Genius is already at a certain value, and it enters into sleep mode, the pipe charging sequence is not executed.

NOTE!
If in enabling the Pump Genius operation (command Run/Stop or Enable Pump Genius active) it enters into sleep mode, the pipe charging process will not executed.

P0105 – Enable Pipe Charging (1st/2nd Ramp Selection)

Adjustable Range:	0 = Disable (1st Ramp) 6 = Enable (SoftPLC)	**Factory Setting:**	6
Properties:	CFG		
Access groups via HMI:	SPLC		

Description:
This parameter allows enabling of the pipe charging sequence (assigns to the SoftPLC function the ramp selection command) using the pump driven by CFW500 inverter (Simplex and Multipump) or the 1st pump to be started by Pump Genius (Multiplex).

NOTE!
The alarm message "A752: Pipe Charging" will be generated in the HMI of the CFW500 inverter providing an alert that the Pump Genius control is in the pipe charging sequence.

P0102 – Acceleration Time 2

Adjustable Range:	0.1 to 999.0 s	**Factory Setting:**	40.0 s
Properties:			
Access groups via HMI:			

Description:
This parameter defines a second acceleration time for the pump driven by CFW500 inverter for the purpose of pipe charging.

NOTE!
Refer to the CFW500 inverter programming manual for more information on the ramp parameters.

P1041 – Pipe Charging Time

Adjustable Range:	0 to 65000 s	**Factory Setting:**	60 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the elapsed time for pipe charging.

The figure 3.4 presents a timing analysis of the Pump Genius operation when is configured for execution of the pipe charging sequence (the PID controller shown in this example is Direct Mode, which is, however, irrelevant for the pipe charging sequence):

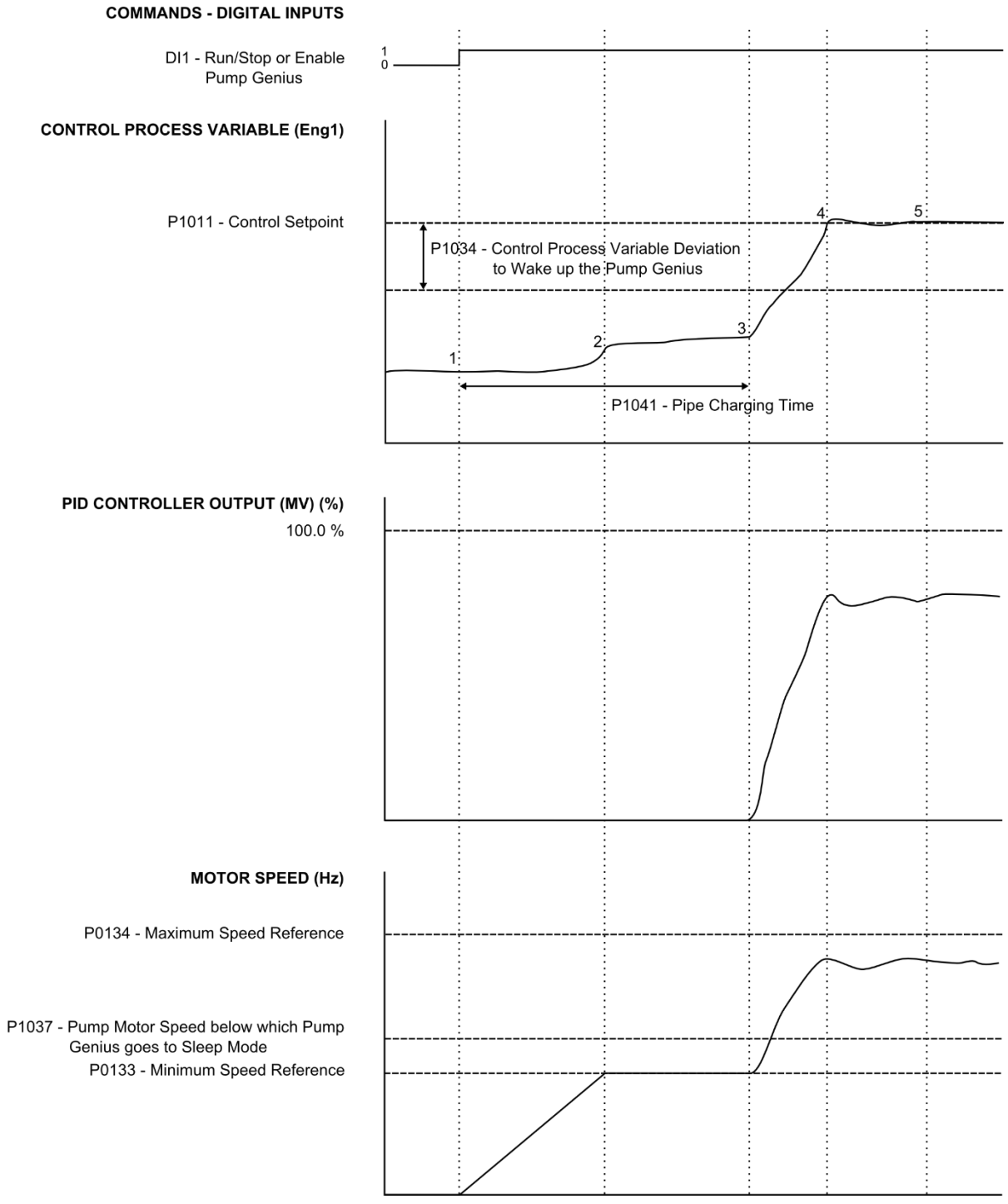


Figure 3.4 – Operation of the Pump Genius with pipe charging enabled

1 – The “Run/Stop” or “Enable Pump Genius” command via digital input DI1 enables starting the motor, but also enables the operation of Pump Genius. As the control process variable is lower than the control process deviation for Pump Genius to wake up (P1034), the time delay to wake up (P1036) is not awaited and the command run is issued. As pipe charging is enabled (P0105), the time count (P1041) is initiated, while the PID controller remains disabled. The pump is accelerated to the minimum speed (P0133) with a slower ramp in order to avoid the “water hammer;

2 – The pump speed reaches the value programmed for minimum speed (P0133) and continues at this speed during the course of time for pipe charging (P1041);

3 – The time for pipe charging (P1041) is elapsed; at this moment the PID controller is enabled and begins to increase the pump speed in order for the control process variable to catch up with the control setpoint required by the user;

4 – With increasing the pump speed, the control process variable reaches the control setpoint value;

5 – A short time later the control process variable stabilizes and pumping continues at steady speed.

3.12.1 PG Simplex

P1042 – Maximum Output Current during the Pipe Charging

Adjustable Range:	0.0 to 200.0 A	**Factory Setting:**	0.0 A
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of the maximum motor current during the pipe charging process to execute the current limit defined by P0150.

NOTE!
A setting of “0.0 A” executed the motor current limitation only by the value set in P0135 parameter

NOTE!
Refer to the CFW500 inverter programming manual for more information on the motor current limitation parameters.

3.13 STARTING AN ADDITIONAL PUMP IN PARALLEL

This group of parameters allows the user to adjust the operating conditions for starting an additional pump in parallel in the Pump Genius Multipump or Multiplex.

3.13.1 PG Multipump

P1052 – Pump Motor Speed for Starting an additional Pump in Parallel

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	57.0 Hz
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the pump motor speed above which starting an additional pump in parallel in the Pump Genius is enabled in order to maintain control according to the required setpoint.

P1053 – Control Process Variable Deviation for Starting an additional Pump in Parallel

Adjustable Range:	0 to 32767 [Eng. Un. 1]	**Factory Setting:**	10
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the maximum deviation of the control process variable from the control setpoint (a negative value for a Direct Mode PID, or a positive value for a Reverse Mode PID), which, if exceeded, enables starting an additional pump in the Pump Genius.

NOTE!
A setting of "0" disables the P1053 condition of the logic for starting an additional pump in parallel.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1054 – Time Delay for Starting an additional Pump in Parallel

Adjustable Range:	0 to 65000 s	**Factory Setting:**	2s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines a time delay during which both, the conditions of P1052 and P1053 must remain satisfied, before an additional pump is started in parallel in the Pump Genius.

P1055 – Delay in the Deceleration of the CFW500 Pump when Starting a Pump in Parallel

Adjustable Range:	0.00 to 100.00 s	**Factory Setting:**	0.01 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines a delay for the beginning of the deceleration of the pump driven by the CFW500 frequency inverter when a new pump is started in parallel.

NOTE!
Value of the parameter in 100.00 will not apply the deceleration of the pump driven by the CFW500 frequency inverter, i.e., the pump remains at the same speed it was before a new pump is started.

The figure 3.5 presents a timing analysis of the Pump Genius operation with Direct Mode PID controller, when the need to start an additional pump in parallel is detected:

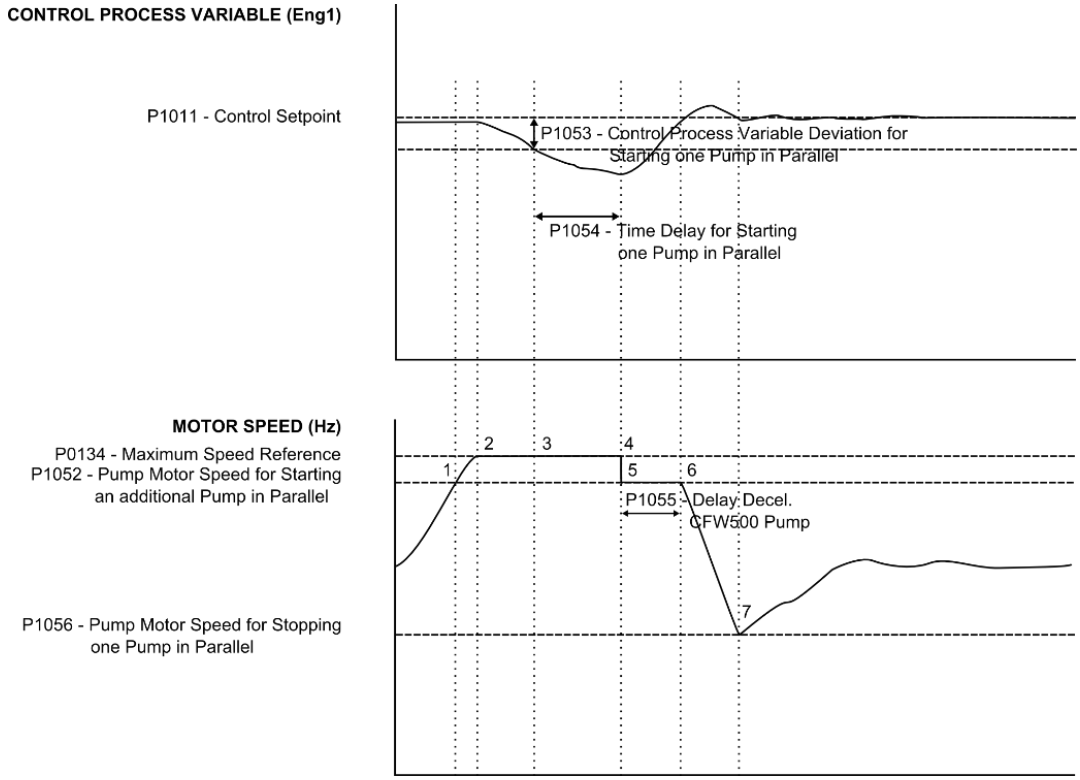


Figure 3.5 – Pump Genius operation for starting an additional pump in parallel

1 – The Pump Genius is operating with one pump running and it is increasing its speed to keep the pumping control according to the required setpoint. At this moment, it is detected that the PID controller output is above the value set to start one more pump (P1052), but the difference between the setpoint and the control process variable remains below the deviation set to start one more pump (P1053); therefore, it is not still necessary to start one more pump in parallel;

2 – The motor speed reaches the maximum speed programmed for the pump (P0134) and the value of the control process variable keeps decreasing, the value of the difference between the setpoint and the control process variable continues lower than the deviation set to start one more pump (P1053);

3 – The motor speed still at the maximum speed programmed for the pump (P0134) and the value of the control process variable keeps decreasing, the value of the difference between the setpoint and the control process variable is still above the deviation set to start one more pump (P1053) and the time to start one more pump in parallel on the pumping control (P1054) initiates;

4 – The motor speed still at the maximum speed programmed for the pump (P0134) and the value of the control process variable keeps decreasing, the value of the difference between the setpoint and the control process variable is still above the deviation set to start one more pump (P1053) and the time to start one more pump in parallel on the pumping control (P1054) elapses; at this moment, a command is issued (via digital output) to start one more pump in parallel on the pumping control. The pump to be started will be the one with the shortest operation time among those which are enabled for operation;

5 – One pump is started; at this moment, the PID controller goes into the manual control mode and the speed of the pump driven by the inverter goes to the value set in P1052. Then the time count of the delay to start the deceleration of the pump driven by the inverter (P1055) begins;

6 – The time count of the delay to start the deceleration of the pump driven by the inverter (P1055) elapses; the PID controller remains in the manual control mode and the speed reference of the pump driven by the inverter goes to the value set in P1056;

7 – The motor decelerates down to the value set to stop one pump (P1056) and the PID controller goes to the automatic control mode. Then the PID controller begins to control the system again to stabilize the pumping control according to the setpoint required by the user, but now with one more pump in parallel.

3.13.2 PG Multiplex

P1052 – Pump Motor Speed for Starting an additional Pump in Parallel

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	57.0 Hz
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the pump motor speed above which starting an additional pump in parallel in the Pump Genius is enabled in order to maintain control according to the required setpoint.

P1053 – Control Process Variable Deviation for Starting an additional Pump in Parallel

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	10
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the maximum deviation of the control process variable from the control setpoint (a negative value for a Direct Mode PID, or a positive value for a Reverse Mode PID), which, if exceeded, enables starting an additional pump in the Pump Genius.

NOTE!
A setting of "0" disables the P1053 condition of the logic for starting an additional pump in parallel.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1054 – Time Delay for Starting an additional Pump in Parallel

Adjustable Range:	0 to 32767 s	**Factory Setting:**	2s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines a time delay during which both, the conditions of P1052 and P1053 must remain satisfied, before an additional pump is started in parallel in the Pump Genius.

The figure 3.6 presents a timing analysis of the Pump Genius operation with Direct Mode PID controller, when the need to start an additional pump in parallel is detected:

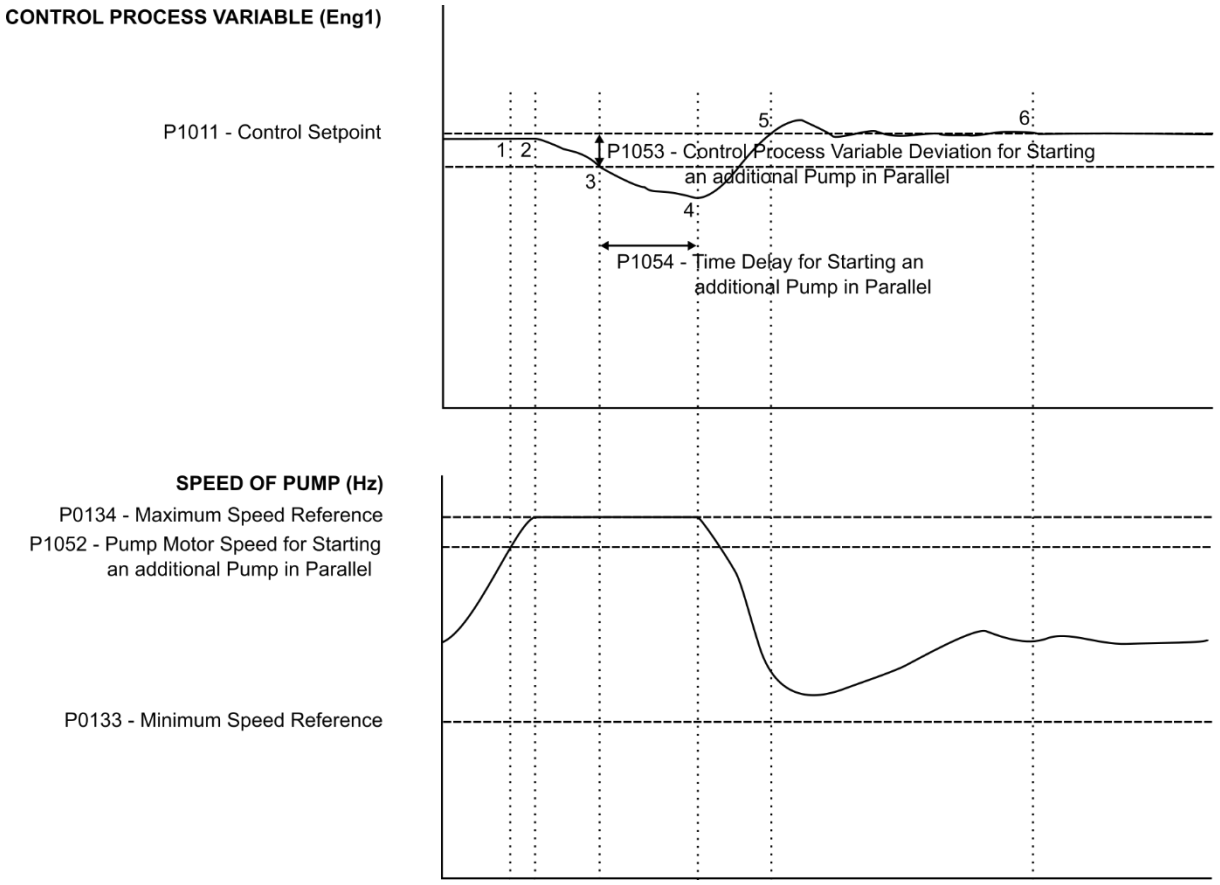


Figure 3.6 – Pump Genius operation for starting an additional pump in parallel

1 – The Pump Genius is operating with one pump running and is increasing its speed according to PID control, to keep up with demand. At this moment, the pump motor speed exceeds the threshold value programmed for starting an additional pump (P1052). However, the difference between the control setpoint and control process variable remains lower than the deviation programmed for starting an additional pump (P1053); it is thus not yet necessary to start an additional pump;

2 – The pump motor speed reaches its maximum value (P0134) and the value of the control process variable begins to decrease, but its deviation from the control setpoint remains lower than the threshold programmed for starting an additional pump (P1053); it is thus not yet necessary to start an additional pump;

3 – The pump motor speed remains saturated at maximum value (P0134), as the value of the control process variable continues to decrease. At this point, however, its deviation from the control setpoint exceeds the threshold programmed for starting an additional pump (P1053), initiating the time count P1054;

4 – All processes continue as at time point 3, until the time count (P1054) has elapsed; At this moment among the enabled pumps, the one with the lowest accumulated operating time receives the command to start via SymbiNet network;

5 – An additional pump was successfully started, all activated inverter driven pumps receiving the same speed reference from the PID controller of the master pump; With the added pumping capacity, the control process variable catches up with the control setpoint required by the user, but the Pump Genius is not yet stabilized;

6 – Eventually, through the continued action of the PID controller, the Pump Genius achieves stabile operation at the control setpoint as required by the user.

3.14 STOPPING ONE PUMP IN PARALLEL

This group of parameters allows the user to adjust the operating conditions for stopping one of the activated pumps in parallel in the Pump Genius Multipump or Multiplex.

3.14.1 PG Multipump

P1056 – Pump Motor Speed for Stopping one Pump in Parallel

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	43.0 Hz
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of the pump motor speed below which stopping one pump in parallel in the Pump Genius becomes enabled.

P1057 – Control Process Variable Deviation for Stopping one Pump in Parallel

Adjustable Range:	0 to 32767 [Eng. Un. 1]	**Factory Setting:**	0
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the maximum deviation of the control process variable from the control setpoint (a positive value for a Direct Mode PID, or a negative value for an Inverse Mode PID), which, if exceeded, enables stopping one pump in parallel in the Pump Genius.

NOTE!
A setting of "0" disables the P1057 condition of the logic for stopping one pump in parallel.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1058 – Time Delay for Stopping one Pump in Parallel

Adjustable Range:	0 to 65000 s	**Factory Setting:**	2s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines a time delay during which both conditions of P1056 and P1057 must remain satisfied before stopping one of the pumps in parallel in the Pump Genius.

P1059 – Delay in the Acceleration of the CFW500 Pump when Stopping a Pump in Parallel

Adjustable Range:	0.00 to 100.00 s	**Factory Setting:**	0.01 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines a delay for the beginning of the acceleration of the pump driven by the CFW500 frequency inverter when a pump in parallel is stopped.

NOTE!
Value of the parameter in 100.00 will not apply the acceleration of the pump driven by the CFW500 frequency inverter, i.e., the pump remains at the same speed it was before a pump is stopped.

The figure 3.7 presents a timing analysis of the Pump Genius operation with Direct Mode PID controller, when the need to stop one pump in parallel is detected:

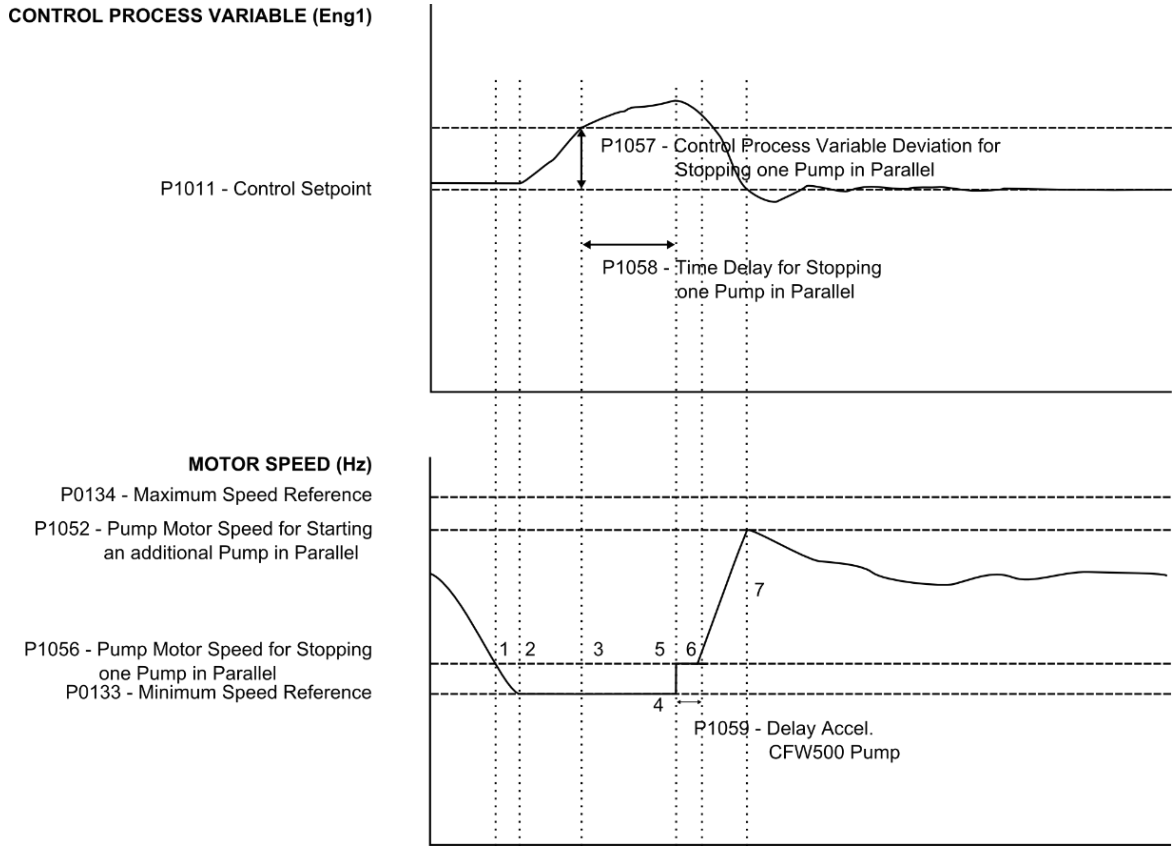


Figure 3.7 – Pump Genius operation for stop one pump in parallel

1 – The Pump Genius is operating with more than one pump activated and is decreasing its speed to control the process variable. At this moment the pumps motor speed drops below the threshold programmed for stopping one pump (P1056), but the control process variable deviation from the control setpoint remains lower than the threshold programmed for stopping one pump (P1057); it is thus not necessary to stop one pump in parallel;

2 – The pumps motor speed reaches its minimum value, i.e., the pumps are operating at their minimum speed defined by P0133 and the value of the control process variable begins to increase. However, its deviation from the control setpoint remains lower than the threshold programmed for stopping one pump in parallel (P1057); it is thus not yet necessary to stop one pump.

3 – The pumps motor speed continues at minimum speed (P0133), as the value of the control process variable continues to increase. At this moment its deviation from the control setpoint exceeds the threshold programmed for stopping one pump in parallel (P1057), and the time count (P1058) is initiated;

4 – The pumps motor speed continues at minimum speed (P0133), the value of the control process variable keeps increasing, the difference between the setpoint and the control process variable is still above the deviation set to stop one pump (P1057) and the time to start one pump in parallel on the pumping control (P1058) elapses; at this moment, a command is issued (via digital output) to stop one pump in parallel on the pumping control. The pump to be stopped will be the one with the longest operation time among those which are enabled for operation;

5 – One pump is stopped; at this moment, the PID controller goes into the manual control mode and the speed of the pump driven by the inverter goes to the value set in P1056. Then the time count of the delay to start the acceleration of the pump driven by the inverter (P1059) begins;

6 – The time count of the delay to start the acceleration of the pump driven by the inverter (P1059) elapses; the PID controller remains in the manual control mode and the speed reference of the pump driven by the inverter goes to the value set in P1056;

7 – The motor accelerates up to the value set to start a pump (P1052) and the PID controller goes to the automatic control mode. Then the PID controller begins to control the system again to stabilize the pumping control according to the setpoint required by the user, but now with least one pump in parallel.

3.14.2 PG Multiplex

P1055 – Pump Motor Speed for Stopping one Pump in Parallel

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	43.0 Hz
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of the pump motor speed below which stopping one pump in parallel in the Pump Genius becomes enabled.

P1056 – Control Process Variable Deviation for Stopping one Pump in Parallel

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	0
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the maximum deviation of the control process variable from the control setpoint (a positive value for a Direct Mode PID, or a negative value for an Inverse Mode PID), which, if exceeded, enables stopping one pump in parallel in the Pump Genius.

NOTE!
A setting of “0” disables the P1056 condition of the logic for stopping one pump in parallel.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1057 – Time Delay for Stopping one Pump in Parallel

Adjustable Range:	0 to 32767 s	**Factory Setting:**	2 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines a time delay during which both conditions of P1055 and P1058 must remain satisfied before stopping one of the pumps in parallel in the Pump Genius.

The figure 3.8 presents a timing analysis of the Pump Genius operation with Direct Mode PID controller, when the need to stop one pump in parallel is detected:

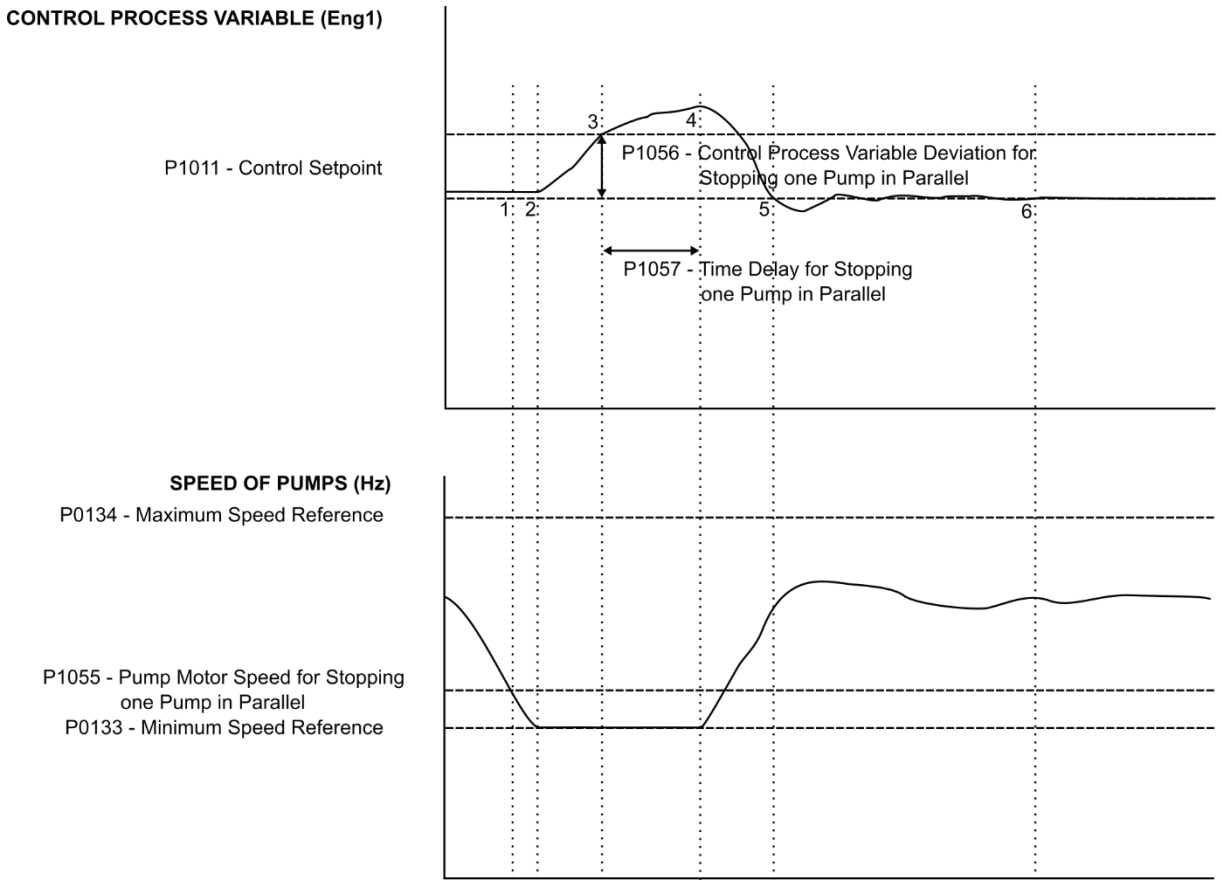


Figure 3.8 – Pump Genius operation for stop one pump in parallel

1 – The Pump Genius is operating with more than one pump activated and is decreasing its speed to control the process variable. At this moment the pumps motor speed drops below the threshold programmed for stopping one pump (P1055), but the control process variable deviation from the control setpoint remains lower than the threshold programmed for stopping one pump (P1056); it is thus not necessary to stop one pump in parallel;

2 – The pumps motor speed reaches its minimum value, i.e., the pumps are operating at their minimum speed defined by P0133 and the value of the control process variable begins to increase. However, its deviation from the control setpoint remains lower than the threshold programmed for stopping one pump in parallel (P1056); it is thus not yet necessary to stop one pump.

3 – The pumps motor speed continues at minimum speed (P0133), as the value of the control process variable continues to increase. At this moment its deviation from the control setpoint exceeds the threshold programmed for stopping one pump in parallel (P1056), and the time count (P1057) is initiated;

4 – All processes continue as at time point 3, until the time count (P1057) is elapsed. At this moment the command for stopping one pump in parallel is issued via SymbiNet network. From among the activated pumps, the one with the largest accumulated operating time will be stopped;

5 – One of the parallel pumps was successfully stopped; at this moment the control process variable reaches the control setpoint required by the user, but the Pump Genius is not yet stabilized;

6 – Eventually, with the continued action of the PID controller, the Pump Genius achieves stabile operation at the control setpoint as required by the user.

3.15 FORCING ROTATION OF PUMPS

This group of parameters allows the user to adjust the operating conditions for forcing rotation of pumps in the Pump Genius in case it operates for an uninterrupted period of time. I.e., if the Pump Genius remains with only one pump operating for a certain period of time (the control does not go into sleep mode), a command is executed to turn off the pump is running; at this moment the Pump Genius verify which pump have the lower operation time; then the pump driven by the inverter is rotated and resumes controlling the pumping with variable speed. With this, the rotation of pumps still done even without the sleep mode is active.

3.15.1 PG Multipump

NOTE!
Forcing rotation of pumps is valid only to Pump Genius Multipump with floating control and when one pump is running.

NOTE!
The operation time of Pump Genius Multipump for forcing rotation of pumps is displayed in P1017.

P1018 – Time Interval for Forcing Rotation of Pumps

Adjustable Range:	0 to 32767 h	**Factory Setting:**	72 h
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the maximum time interval the Pump Genius can run uninterruptedly with only one pump started. After this time, it is checked the condition set in P1019 for the Pump Genius to be shut down and a new pump to be started and resumes controlling the pumping with variable speed.

NOTE!
A setting of “0 h” enables the test mode, in which at every 60 seconds the logic for forcing rotation of pumps is enabled.

P1019 – Pump Motor Speed for Forcing Rotation of Pumps

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	0.0 Hz
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of pump motor speed below which forcing rotation of pumps becomes enabled.

NOTE!
A setting of “0.0 Hz” disables the rotation of the pump driven by the CFW500 frequency.

3.15.2 PG Multiplex

NOTE!
Forcing rotation of pumps is valid only when one pump is running in the Pump Genius Multiplex.

NOTE!
The operation time of Pump Genius Multiplex for forcing rotation of pumps is displayed in P1017.

P1058 – Time Interval for Forcing Rotation of Pumps

Adjustable Range:	0 to 32767 h	**Factory Setting:**	72 h
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the maximum time interval the Pump Genius can run uninterruptedly with only one pump started. After this time, it is checked the condition set in P1059 for the Pump Genius to be shut down and a new pump to be started and resumes controlling the pumping with variable speed.

NOTE!
A setting of “0 h” enables the test mode, in which at every 60 seconds the logic for forcing rotation of pumps is enabled.

P1059 – Pump Motor Speed for Forcing Rotation of Pumps

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	0.0 Hz
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of pump motor speed below which forcing rotation of pumps becomes enabled.

NOTE!
A setting of “0.0 Hz” disables the rotation of the pump driven by the CFW500 frequency.

3.16 LOW LEVEL PROTECTION FOR THE CONTROL PROCESS VARIABLE (PIPE BREAKING)

This group of parameters allows the user to configure the conditions for alarm and failure to detect low level for the control process variable of the Pump Genius. This allows detecting non-ideal conditions of the pumping operation, for example, a pipe breaking.

3.16.1 PG Simplex and Multipump

P1024 – Value for Low Level Alarm for the Control Process Variable

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	100
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value below which a low level alarm will be generated for the control process variable of the pumping control (A770).

NOTE!
A setting of “0” disables the low level alarm and fault for the control process variable.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1025 – Time Delay for Low Level Fault for the Control Process Variable (F771)

Adjustable Range:	0 to 32767 s	**Factory Setting:**	0 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the waiting time with the low level alarm (A770) for the control process variable active, before the fault “F771: Low Level Fault for the Control Process Variable” is generated.

NOTE!
A setting of “0 s” disables the low level fault for the control process variable.

3.16.2 PG Multiplex

P1026 – Value for Low Level Alarm for the Control Process Variable

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	100
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value below which a low level alarm will be generated for the control process variable of the pumping control (A770).

NOTE!
A setting of “0” disables the low level alarm and fault for the control process variable.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1027– Time Delay for Low Level Fault for the Control Process Variable (F771)

Adjustable Range:	0 to 32767 s	**Factory Setting:**	0 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the waiting time with the low level alarm (A770) for the control process variable active, before the fault “F771: Low Level Fault for the Control Process Variable” is generated.

NOTE!
A setting of “0 s” disables the low level fault for the control process variable.

3.17 HIGH LEVEL PROTECTION FOR THE CONTROL PROCESS VARIABLE (PIPE OBSTRUCTION)

This group of parameters allows the user to configure the conditions for alarm and failure to detect high level for the control process variable for the Pump Genius. This allows detecting non-ideal conditions of the pumping operation, for example, a pipe obstruction.

3.17.1 PG Simplex and Multipump

P1026 – Value for High Level Alarm for the Control Process Variable

Adjustable Range:	32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	350
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value above which a high level alarm will be generated for the control process variable of the Pump Genius (A772).

NOTE!
A setting of “0” disables the high level alarm and fault for the control process variable.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1027 – Time Delay for High Level Fault for the Control Process Variable (F773)

Adjustable Range:	0 to 32767 s	**Factory Setting:**	0 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the waiting time with the high level alarm (A772) for the control process variable active, before the fault “F773: High Level Fault for the Control Process Variable” is generated.

NOTE!
A setting of “0 s” disables the high level fault for the control process variable.

3.17.2 PG Multiplex

P1028 – Value for High Level Alarm for the Control Process Variable

Adjustable Range:	32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	350
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value above which a high level alarm will be generated for the control process variable of the Pump Genius (A772).

NOTE!
A setting of “0” disables the high level alarm and fault for the control process variable.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1029 – Time Delay for High Level Fault for the Control Process Variable (F773)

Adjustable Range:	0 to 32767 s	**Factory Setting:**	0 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the waiting time with the high level alarm (A772) for the control process variable active, before the fault "F773: High Level Fault for the Control Process Variable" is generated.

NOTE!
A setting of "0 s" disables the high level fault for the control process variable.

3.18 DRY PUMP PROTECTION

This group of parameters allows the user to configure dry pump detection, to protect the inverter driven pump.

P1043 – Motor Speed for Dry Pump

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	54.0 Hz
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the pump motor speed threshold value, above which evaluation of actual motor torque to detect the dry pump condition (P1044) is enabled.

P1044 – Motor Torque for Dry Pump

Adjustable Range:	0.0 to 100.0 %	**Factory Setting:**	20.0 %
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the pump motor torque threshold value, below which the dry pump condition is detected, resulting in the alarm message "A780: Dry Pump".

P1045 – Time Delay for Dry Pump Fault (F781)

Adjustable Range:	0 to 32767 s	**Factory Setting:**	0 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the waiting time with the dry pump condition (A780) active, before the dry pump fault "F781: Dry Pump" is generated.

NOTE!
A setting of "0 s" disables the dry pump fault.

The figure 3.9 presents a timing analysis of the Pump Genius operation when a Dry Pump Fault is detected:

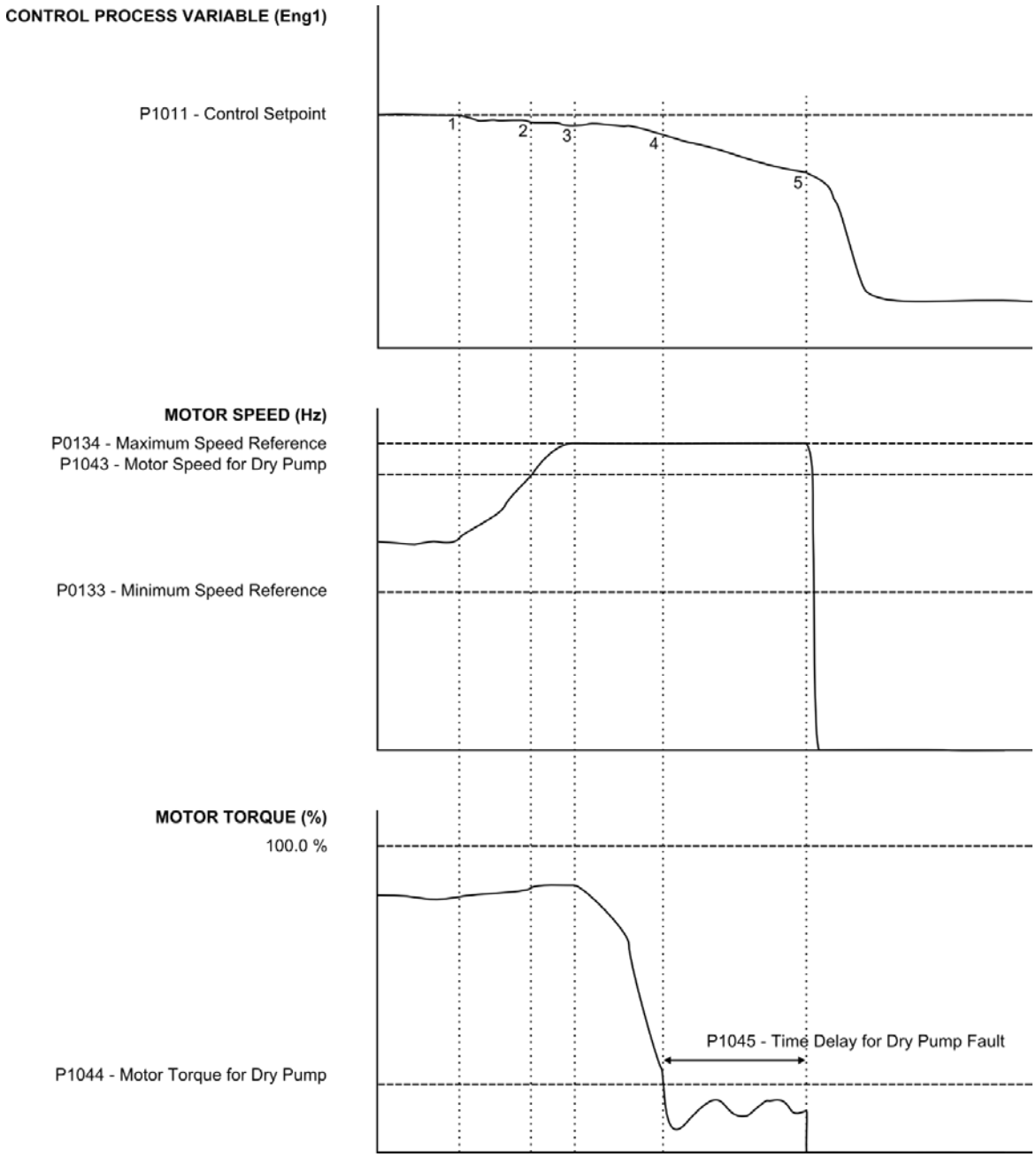


Figure 3.9 – Operation of the Pump Genius for dry pump protection

1 – The Pump Genius is running at a speed satisfying the control setpoint required by the user. At this moment the value of the control process variable begins to decrease and pump speed begins to increase;

2 – The pump speed continues to increase and becomes greater than the threshold programmed for detecting dry pump (P1043);

3 – The pump speed continues to increase and reaches the maximum speed programmed for the pump (P0134), but as the pump motor torque is still greater than the threshold programmed to detect dry pump (P1044), pumping continues while the value of the control process variable continues to decrease;

4 – As the pump continues to operate at maximum speed, and the process variable continues to decrease, the pump motor torque drops below the threshold programmed to detect dry pump (P1044). At this moment the time count to generate Dry Pump Fault (P1045) is initiated and the alarm message "A780: Dry Pump" is generated to alert the user, that the protection for dry pump is about to act and disable the inverter driven pump;

5 – The pump continues to operate at maximum speed, and the control process variable continues to decrease, while the pump motor torque remains below the threshold programmed to detect Dry Pump (P1044). At this moment the time delay to generate Dry Pump Fault (P1045) is elapsed, and the fault "F781: Dry Pump" is generated, disabling the inverter driven pump.

3.19 PUMP PROTECTION VIA EXTERNAL SENSOR (PG SIMPLEX)

This group of parameters allows the user to configure an external sensor (pressure switch, level sensor, etc.) to protect the inverter driven pump.

3.19.1 PG Simplex

The sensor can be wired to the digital input DI1.

NOTE!
Enabling the use of external sensor for Pump protection is done by programming the digital input DI1 in “43 = External Sensor” (Application Function 5) as described in section 3.5.1.

P1046 – Time Delay for Pump Protection via External Sensor (F783)

Adjustable Range:	0 to 32767 s	**Factory Setting:**	2 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the waiting time with the condition of sensor (DI1) at logic level “0” while the pump is running, before the external sensor fault “F783: External Sensor Protection” is generated.

NOTE!
A setting of “0 s” disables the pump protection faults via external sensor (DI1).

3.19.2 PG Multiplex

O sensor ou sensores podem ser instalados na entrada digital DI4.

NOTA!
Enabling the use of external sensor for Pump protection is done by programming the digital input DI4 in “41 = External Sensor” (Application Function 3) as described in section 3.5.3.

P1046 – Time Delay for Pump Protection via External Sensor (A784)

Adjustable Range:	0 to 32767 s	**Factory Setting:**	2 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the waiting time with the condition of sensor (DI4) at logic level “0” while the pump is running, before the external sensor alarm “A784: External Sensor Pump Protection” is generated, and the pump is stopped.

NOTE!
A setting of “0 s” disables the pump protection faults via external sensor (DI4).

3.20 CONTROL AUXILIARY VARIABLE FOR PUMP PROTECTION (PG SIMPLEX)

This group of parameters allows the user to configure a control auxiliary variable for the protection of pump. This protection is accomplished by reading a sensor installed on an analog input, and comparing its value with low level conditions. The low level condition is directly associated with pump cavitation protection.

Cavitation is a phenomenon that occurs in a pump when the pressure at the inlet side of the rotor drops below the vapor pressure of the pumped liquid, resulting in evaporation with the formation of small vapor bubbles (cavities) in the liquid part. When these cavities, formed in the low pressure region of the rotor, reach the high pressure region at the outlet side of the rotor, they immediately collapse, returning to the liquid phase. The rapid implosion of the cavities results in violent shock waves and momentary huge temperature gradients between the bubble surface and the surrounding liquid (10000°C have been measured). If, prior to their collapse, these bubbles adhere to rotor surfaces, their implosion produces microjets, which impact the surface with sufficient energy to remove microscopic amounts of material. Immediate negative consequences of cavitation and its cumulative effects over extended periods of time are as follows:

- Operation with high level of noise and vibration;
- Impairment of performance, changing the pump characteristics;
- Premature wear of the rotor by removal of metal particles.

Occurrence of pump cavitation can be prevented by avoiding operation with insufficient liquid at the inlet of the pump. Installing an external sensor in the suction part, for example a level sensor, which measures the inlet reservoir fluid level, can help detect conditions that lead to cavitation. When this level is below a certain threshold, the control setpoint is changed to a value that reduces pump suction, thus lowering the pressure difference between the inlet and outlet of the pump.

P1047 – Control Auxiliary Variable Selection Source for Pump Protection

Adjustable Range:	0 = Without Protection via Control Auxiliary Variable 1 = Control Auxiliary Variable via Analog Input AI1 2 = Control Auxiliary Variable via Analog Input AI2 3 = Control Auxiliary Variable via Analog Input AI3	**Factory Setting:** 0
Properties:		
Access groups via HMI:	SPLC	

Description:
This parameter defines the source of the control auxiliary variable for pump protection.

Table 3.16 – Description of control auxiliary variable source for pump protection

P1047	Description
0	It defines that there is no pump protection via control auxiliary variable.
1	It defines that the source of the control auxiliary variable for pump protection is the value read by the analog input AI1. The value is converted according to engineering unit 2 and displayed in parameter P1017.
2	It defines that the source of the control auxiliary variable for pump protection is the value read by the analog input AI2. The value is converted according to engineering unit 2 and displayed in parameter P1017.
3	It defines that the source of the control auxiliary variable for pump protection is the value read by the analog input AI3. The value is converted according to engineering unit 2 and displayed in parameter P1017.

3.20.1 Engineering Unit Configuration

This group of parameters allows the user to configure the engineering unit of the control auxiliary variable for pump protection.

P0512 – Engineering Unit 2

Adjustable Range:	0 = None 1 = V 2 = A 3 = rpm 4 = s 5 = ms 6 = N 7 = m 8 = Nm 9 = mA 10 = % 11 = °C 12 = CV 13 = Hz 14 = HP 15 = h 16 = W 17 = kW 18 = kWh 19 = H	**Factory Setting:** 10
Properties:		
Access groups via HMI:	HMI	

Description:
This parameter selects the engineering unit that will be displayed in the SoftPLC user parameter that is associated with it. I.e., any SoftPLC user parameter that is associated with the engineering unit 2 will be displayed in this format on the CFW500 inverter HMI.

NOTE!
The parameters P1017, P1048, P1049 and P1051 are associated with engineering unit 2.

P0513 – Decimal Point of Engineering Unit 2

Adjustable Range:	0 = xywz 1 = xyw.z 2 = xy.wz 3 = x.ywz	**Factory Setting:**	1
Properties:			
Access groups via HMI:	HMI		

Description:
This parameter selects the decimal point that will be displayed in the SoftPLC user parameter that is associated with it. I.e., any SoftPLC user parameter that is associated with the decimal point of engineering unit 2 will be displayed in this format on the CFW500 inverter HMI.

NOTE!
The parameters P1017, P1048, P1049 and P1051 are associated with engineering unit 2.

3.20.2 Sensor Scale Configuration

This group of parameters allows the user to configure the scale of the control auxiliary variable for pump protection.

P1048 – Control Auxiliary Variable Sensor Maximum Level (Range)

Adjustable Range:	0 to 32767 [Eng. Un. 2]	**Factory Setting:**	1000
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the maximum level (or range) of the control auxiliary variable sensor for pump protection according to its engineering unit.

NOTE!
The minimum level of the control auxiliary variable sensor is “0”.

NOTE!
This parameter is displayed according to the selection of the engineering unit 2 parameters (P0512 and P0513).

The relationship between the analog input, AIx, configured for control auxiliary variable sensor, and the display value, P1017, in engineering units, is as follows:

$$P1017 = P1048 \times AIx$$

Where,

P1017 = Control auxiliary variable;
P1048 = Maximum level (or range) of the control auxiliary variable sensor;
AIx = Value of analog input AI1, AI2 or AI3 in %.

3.20.3 Pump Protection Configuration

This group of parameters allows the user to configure the protection of pump via control auxiliary variable.

P1049 – Value to detect Low Level of Control Auxiliary Variable

Adjustable Range:	0 to 32767 [Eng. Un. 2]	**Factory Setting:**	250
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the control auxiliary variable threshold below which the control setpoint will be changed to the value programmed in P1050. I.e., when low level is detected, the control setpoint can be changed to a different value (lower), thus assuring a decrease in consumption of the pump, preventing it to operate in cavitation for example.

NOTE!
The alarm message "A774: Low Level of Control Auxiliary Variable" will be generated in the HMI of the CFW500 inverter, to alert that the control auxiliary variable is in low level.

NOTE!
This parameter is displayed according to the selection of the engineering unit 2 parameters (P0512 and P0513).

P1050 – Control Setpoint in Low Level

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:**	160
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of the control setpoint in automatic mode for the Pump Genius, when a low level of the control auxiliary variable is detected.

NOTE!
The control setpoint should be adjusted to an appropriate value that reduces the consumption of the pump to prevent the cavitation.

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

P1051 – Hysteresis to reactivate the Control Setpoint

Adjustable Range:	0 to 32767 [Eng. Un. 2]	**Factory Setting:**	100
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of control auxiliary variable hysteresis to be applied for the reset of its low or high level condition, after which the Pump Genius returns to operate with the control setpoint required by the user.

NOTE!
This parameter is displayed according to the selection of the engineering unit 2 parameters (P0512 and P0513).

The figure 3.10 presents a timing analysis of the Pump Genius operation when low level of the control auxiliary variable is detected:

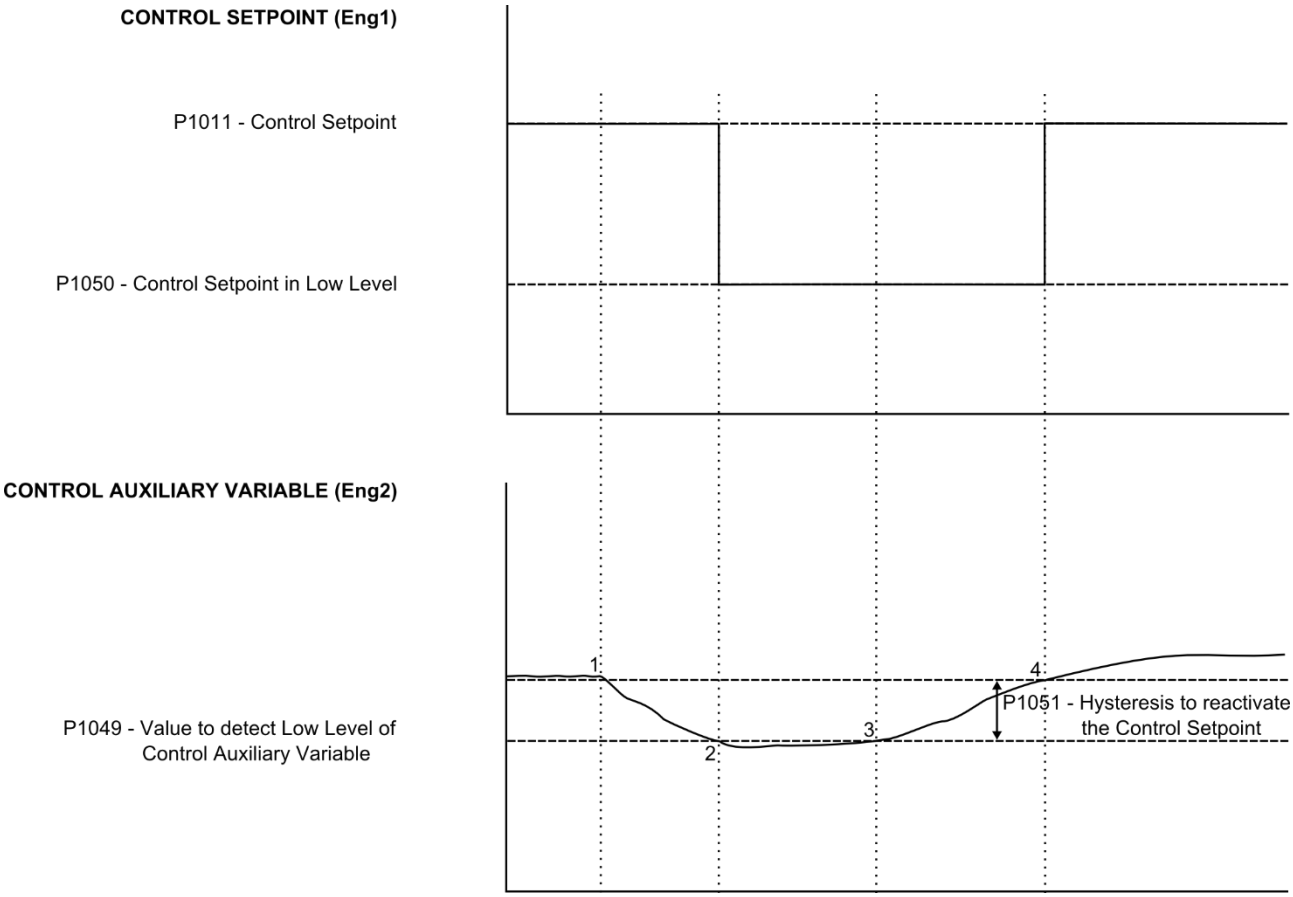


Figure 3.10 – Pump Genius operation with pump protection via control auxiliary variable

1 – The Pump Genius is running at a speed satisfying the control setpoint required by the user. At this moment, the value of the auxiliary variable begins to decrease;

2 – The control auxiliary variable drops below the threshold programmed to detect low level of the control auxiliary variable (P1049). At this moment, the value of the control setpoint is changed to the value programmed as control setpoint in low level (P1050);

3 – The change of control setpoint results in an increase of the control auxiliary variable and the same reaches the value programmed to detect low level of control auxiliary variable (P1049), but to reactivate the control setpoint is necessary to be greater than the value set in hysteresis to reactivate the control setpoint (P1051);

4 – At this moment, its value exceeds the programmed hysteresis threshold (P1051), and the control setpoint is reset back to the value required by the user, according to the value programmed in P1011.

3.21 DERAGGING FUNCTION (PG SIMPLEX)

This group of parameters allows the user to enable the logic to execute the deragging function in the inverter driven pump in order to prevent it reaches the clogging, and thus, it can't come into operation.

Its basic principle is running the pump in the reverse pumping direction to remove the accumulated debris, and thus, the pump can run again.

NOTE!
This function should only be enabled on a pump that can run with rotation in the reverse pumping direction; otherwise it may cause damage to it.

P1052 – Execution Mode of the Deragging Function

Adjustable Range:	0 = Not Execute Deragging Function 1 = Executes with Command to Run the Pump 2 = Executes with Command via Digital Input DI2 3 = Executes when the Clogging of Pump is Detected	**Factory Setting:** 0
Properties:		
Access groups via HMI:	SPLC	

Description:
This parameter defines the execution mode of the deragging function for the pump driven by the CFW500 inverter.

Table 3.17 – Description of execution mode of the deragging function

P1052	Description
0	It defines that the deragging function will not be executed, i.e., is disabled.
1	It defines that the deragging function will be enabled and executed every time there is a command to run the pump driven by CFW500 inverter. This command can be from HMI, a digital input, via communications networks, etc.
2	It defines that the deragging function will be enabled and executed every time the digital input DI2 receives a command, i.e., change the logic level "0" to logic level "1".
3	It defines that the deragging function will be enabled and executed every time that the clogging of pump is detected via high motor current.

NOTE!
Order to be able execute the deragging function, it is necessary that the SoftPLC function controls the motor speed direction to do with the pump operates in reverse pumping direction. Thus, was defined that the deragging function only will operate with the CFW500 inverter operating in REMOTE mode Beyond that, is too necessary program the P0226 parameter in 12 (SoftPLC) to defines the motor speed direction in remote mode. When in 12, defines that the speed direction for pumping will be FOWARD and for deragging will be REVERSE.

P1053 – Number of Cycles for Deragging

Adjustable Range:	0 to 100	**Factory Setting:** 5
Properties:		
Access groups via HMI:	SPLC	

Description:
This parameter defines the number of times (cycles) that the pump will operate in reverse pumping direction to execute the deragging function for the pump driven by CFW500 inverter.

P1054 – Speed Reference for Deragging

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	20.0 Hz
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the speed reference value for the pump to execute the deragging function. This speed is used in the pumping direction as the deragging direction.

P1055 – Deragging Run Time

Adjustable Range:	0 to 32767 s	**Factory Setting:**	10 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of time that the pump will run (with speed reference for deragging) in the deragging cycle execution. This time is used in the pumping direction as the deragging direction.

P1056 – Deragging Stop Time

Adjustable Range:	0 to 32767 s	**Factory Setting:**	3 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of time that the pump remains stopped in the deragging cycle execution.

P1057 – Motor Current to detect Clogging of Pump

Adjustable Range:	0.0 to 200.0 A	**Factory Setting:**	20.0 A
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the value of motor current above which will be considered that the pump is running at high current, i.e., the pump is in clogging process.

P1058 – Time Delay to detect Clogging of Pump

Adjustable Range:	0 to 32767 s	**Factory Setting:**	60 s
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter define the waiting time with the condition of high current in the pump motor to detect that it is in clogging process, being thus generated the alarm message “A790: Clogging Detected” to indicate this situation.

P1059 – Number of consecutives Clogging to generate the Fault (F791)

Adjustable Range:	0 to 100	**Factory Setting:**	5
Properties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the number of consecutives clogging detected to generate the fault “F791: Excess of Clogging Detected”.

NOTE!
A setting of “0” disables the fault by excess of clogging detected. Every time that the Pump Genius is disabled or goes to sleep mode, i.e., the pump is stopped, the count of clogging is reset.

3.21.1 Deragging with Command to Run the Pump (P1052=1)

Selecting the execution mode of the deragging function (P1052) in 1 is defined that the deragging is enabled and it is executed every time there is a command to run the pump. This command can be from HMI, a digital input, via communications networks, etc.

The figure 3.11 presents a timing analysis of the deragging function operation when occurs a command to run the pump driven by the CFW500 inverter.

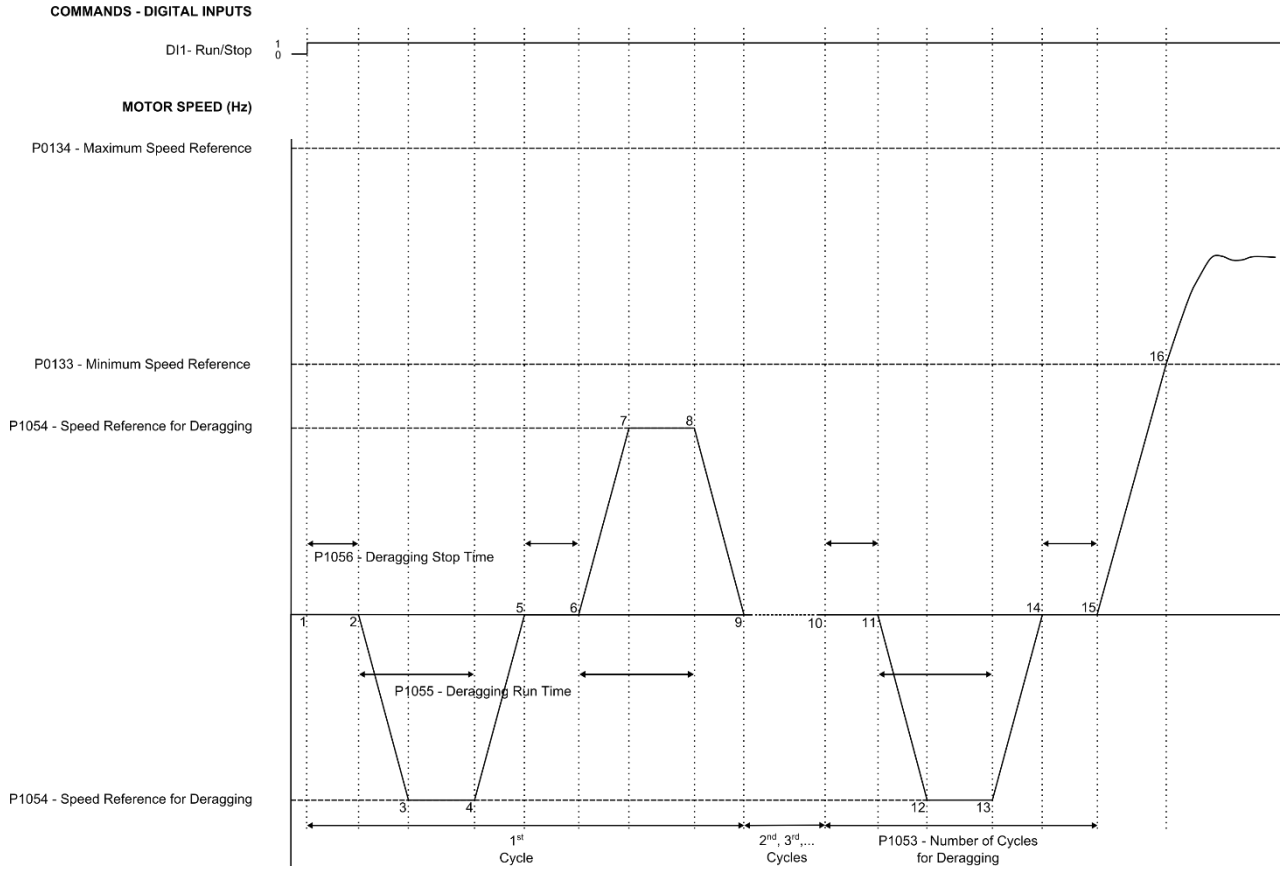


Figure 3.11 – Deragging pump operation with command to run the pump

1 – The command Run/Stop via digital input DI1 enables run the motor, as well as, enable the operation of Pump Genius. In this moment, initiate the count of the first cycle to deragging the pump and the counting time of pump stopped (P1056) is initiated;

2 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump in the reverse direction of the pumping and with the speed reference to deragging (P1054); the PID controller stays disabled. In this moment the counting time of pump running (P1055) is initiated;

3 – The pump is accelerated until the speed reference for deragging (P1054) with the acceleration ramp set in P0100 parameter and stays in this speed until that the counting time of pump running (P1055) is elapsed;

4 – The deragging run time (P1055) is elapsed; in this moment is done the command to stop the pump in reverse direction of the pumping;

5 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment the counting time of pump stopped (P1056) is initiated;

6 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump in the direction of the pumping and with the speed reference to deragging (P1054); the PID controller stays disabled. In this moment the counting time of pump running (P1055) is initiated;

7 – The pump is accelerated until the speed reference for deragging (P1054) with the acceleration ramp set in P0100 parameter and stays in this speed until that the counting time of pump running (P1055) is elapsed;

8 – The deragging run time (P1055) is elapsed; in this moment is done the command to stop the pump in direction of the pumping;

9 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment the counter of cycles is increased and the counting time of pump stopped (P1056) is initiated; the steps 2 to 9 occur again until that the number of cycles is equal to the number of cycles for deragging (P1053);

10 – The number of cycles arrives to the number of cycles for deragging (P1053) programmed and the last cycle is initiated; thus, the deragging stop time (P1056) is initiated;

11 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump in the reverse direction of the pumping and with the speed reference to deragging (P1054); the PID controller stays disabled. In this moment the counting time of pump running (P1055) is initiated

12 – The pump is accelerated until the speed reference for deragging (P1054) with the acceleration ramp set in P0100 parameter and stays in this speed until that the counting time of pump running (P1055) is elapsed;

13 – The deragging run time (P1055) is elapsed; in this moment is done the command to stop the pump in reverse direction of the pumping;

14 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment the counting time of pump stopped (P1056) is initiated

15 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump and control the pumping again, i.e., the deragging function was finished;

16 – The pump is accelerated until the minimum speed reference. After this the PID controller is enabled and starts to control the pump speed in order for the control process variable to catch up with the control setpoint required by the user.

3.21.2 Deragging with Command via Digital Input DI2 (P1052=2)

Selecting the execution mode of the deragging function (P1052) in 2 is defined that the deragging is enabled and it is executed every time there is a command via digital input DI2, i.e., the digital input DI2 change the logic level “0” to logic level “1”.

The figure 3.12 presents a timing analysis of the deragging function operation when occurs a command in the digital input DI2.

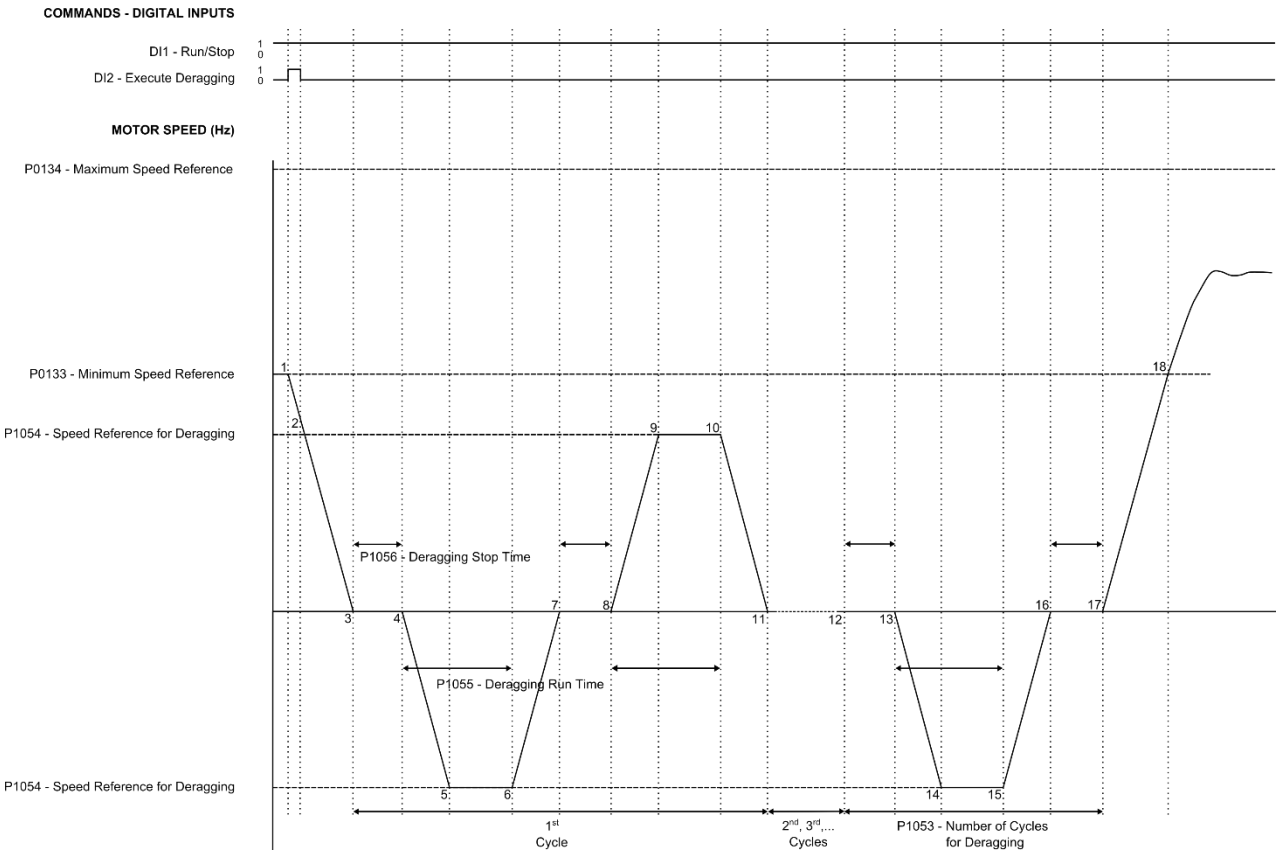


Figure 3.12 – Deragging pump operation with command via digital input DI2

1 – The Pump Genius is enabled to run through the command Run/Stop via digital input DI1 and is controlling the pump driven by the CFW500 inverter. In this moment, a command is done in the digital input DI2 to execute the deragging function, i.e., the digital input DI2 goes from logic level "0" to logic level "1". So, it is done the command to stop the pump and starts the deragging function;

2 – The digital input DI2 goes to logic level “0”, because the command to execute the deragging function is done when the pump change the logic level of “0” to “1”, i.e., when execute a pulse in the digital input DI2. The pump continues in deceleration process;

3 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment initiate the count of the first cycle to deragging the pump and the counting time of pump stopped (P1056) is initiated;

4 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump in the reverse direction of the pumping and with the speed reference to deragging (P1054); the PID controller stays disabled. In this moment the counting time of pump running (P1055) is initiated;

5 – The pump is accelerated until the speed reference for deragging (P1054) with the acceleration ramp set in P0100 parameter and stays in this speed until that the counting time of pump running (P1055) is elapsed;

6 – The deragging run time (P1055) is elapsed; in this moment is done the command to stop the pump in reverse direction of the pumping;

7 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment the counting time of pump stopped (P1056) is initiated;

8 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump in the direction of the pumping and with the speed reference to deragging (P1054); the PID controller stays disabled. In this moment the counting time of pump running (P1055) is initiated;

9 – The pump is accelerated until the speed reference for deragging (P1054) with the acceleration ramp set in P0100 parameter and stays in this speed until that the counting time of pump running (P1055) is elapsed;

10 – The deragging run time (P1055) is elapsed; in this moment is done the command to stop the pump in direction of the pumping;

11 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment the counter of cycles is increased and the counting time of pump stopped (P1056) is initiated; the steps 2 to 9 occur again until that the number of cycles is equal to the number of cycles for deragging (P1053);

12 – The number of cycles arrives to the number of cycles for deragging (P1053) programmed and the last cycle is initiated; thus, the deragging stop time (P1056) is initiated;

13 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump in the reverse direction of the pumping and with the speed reference to deragging (P1054); the PID controller stays disabled. In this moment the counting time of pump running (P1055) is initiated

14 – The pump is accelerated until the speed reference for deragging (P1054) with the acceleration ramp set in P0100 parameter and stays in this speed until that the counting time of pump running (P1055) is elapsed;

15 – The deragging run time (P1055) is elapsed; in this moment is done the command to stop the pump in reverse direction of the pumping;

16 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment the counting time of pump stopped (P1056) is initiated

17 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump and control the pumping again, i.e., the deragging function was finished;

18 – The pump is accelerated until the minimum speed reference. After this the PID controller is enabled and starts to control the pump speed in order for the control process variable to catch up with the control setpoint required by the user.

3.21.3 Deragging when Clogging of Pump is detected (P1052=3)

Selecting the execution mode of the deragging function (P1052) in 3 is defined that the deragging is enabled and it is executed when the clogging of pump is detected.

The figure 3.13 presents a timing analysis of the deragging function operation when occurs a clogging of pump.

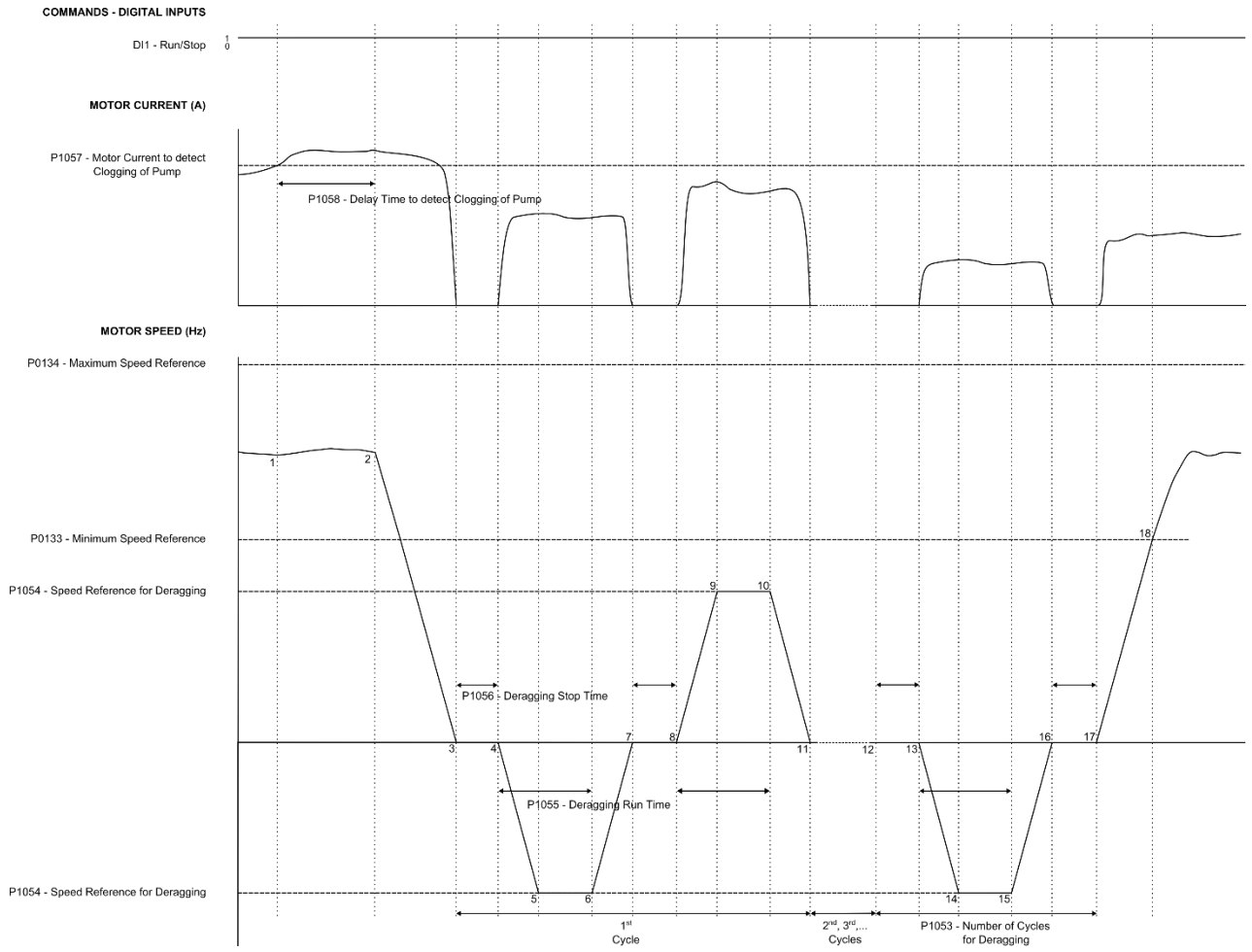


Figure 3.13 – Deragging pump operation when a clogging of pump is detected

1 – The Pump Genius is enabled to run through the command Run/Stop via digital input DI1 and is controlling the pump driven by the CFW500 inverter. In this moment the motor current is greater than the motor current to detect clogging of pump (P1057) and the counting time to detect clogging of pump (P1058) is initiated;

2 – The motor current remains greater than the motor current to detect clogging of pump (P1057) and the time to detect clogging of pump (P1058) is elapsed; in this moment is done the command to stop the pump and starts the deragging function;

3 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment, initiate the count of the first cycle to deragging the pump and the counting time of pump stopped (P1056) is initiated;

4 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump in the reverse direction of the pumping and with the speed reference to deragging (P1054); the PID controller stays disabled. In this moment the counting time of pump running (P1055) is initiated;

5 – The pump is accelerated until the speed reference for deragging (P1054) with the acceleration ramp set in P0100 parameter and stays in this speed until that the counting time of pump running (P1055) is elapsed;

6 – The deragging run time (P1055) is elapsed; in this moment is done the command to stop the pump in reverse direction of the pumping;

7 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment the counting time of pump stopped (P1056) is initiated;

8 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump in the direction of the pumping and with the speed reference to deragging (P1054); the PID controller stays disabled. In this moment the counting time of pump running (P1055) is initiated;

9 – The pump is accelerated until the speed reference for deragging (P1054) with the acceleration ramp set in P0100 parameter and stays in this speed until that the counting time of pump running (P1055) is elapsed;

10 – The deragging run time (P1055) is elapsed; in this moment is done the command to stop the pump in direction of the pumping;

11 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment the counter of cycles is increased and the counting time of pump stopped (P1056) is initiated; the steps 2 to 9 occur again until that the number of cycles is equal to the number of cycles for deragging (P1053);

12 – The number of cycles arrives to the number of cycles for deragging (P1053) programmed and the last cycle is initiated; thus, the deragging stop time (P1056) is initiated;

13 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump in the reverse direction of the pumping and with the speed reference to deragging (P1054); the PID controller stays disabled. In this moment the counting time of pump running (P1055) is initiated

14 – The pump is accelerated until the speed reference for deragging (P1054) with the acceleration ramp set in P0100 parameter and stays in this speed until that the counting time of pump running (P1055) is elapsed;

15 – The deragging run time (P1055) is elapsed; in this moment is done the command to stop the pump in reverse direction of the pumping;

16 – The pump is decelerated to the zero speed as the deceleration ramp set in the P0101 parameter and stays stopped. In this moment the counting time of pump stopped (P1056) is initiated

17 – The deragging stop time (P1056) is elapsed; in this moment is done the command to run the pump and control the pumping again, i.e., the deragging function was finished;

18 – The pump is accelerated until the minimum speed reference. After this the PID controller is enabled and starts to control the pump speed in order for the control process variable to catch up with the control setpoint required by the user.

3.22 HMI MONITORING

This parameter group allows the user to configure which parameters will be shown on the HMI display in the monitoring mode.

P0205 – Main Display Parameter Selection

P0206 – Secondary Display Parameter Selection

P0207 – Bar Graph Parameter Selection

NOTE!
Refer to the CFW500 frequency inverter programming manual for further information about the HMI parameters. On the configuration wizard, some value options for the parameters were taken.

3.23 READING PARAMETERS

This parameter group allows the user to view some control variables of the Pump Genius application of the CFW500 inverter.

P1016 – Control Process Variable

Adjustable Range:	-32768 to 32767 [Eng. Un. 1]	**Factory Setting:** -
Properties:	RO	
Access groups via HMI:	SPLC	

Description:
This parameter indicates the value of the Pump Genius process variable according to the source of the control process variable selected by P1021 (PG Simplex and Multipump) or P1023 (PG Multiplex).

NOTE!
This parameter is displayed according to the selection of the engineering unit 1 parameters (P0510 and P0511).

3.23.1 PG Simplex

P1010 – Pump Genius Simplex Application Version

Adjustable Range:	0.00 to 10.00	**Factory Setting:** -
Properties:	RO	
Access groups via HMI:	SPLC	

Description:
This parameter indicates the version of the Pump Genius Simplex application.

P1017 – Control Auxiliary Variable

Adjustable Range:	0 to 32767 [Eng. Un. 2]	**Factory Setting:** -
Properties:	RO	
Access groups via HMI:	SPLC	

Description:
This parameter indicates the value of the Pump Genius control auxiliary variable according to the source of the control auxiliary variable selected by P1047.

NOTE!
This parameter is displayed according to the selection of the engineering unit 2 parameters (P0512 and P0513).

P1019 – Pump Genius Simplex Logical Status

Adjustable Range:	0000h a FFFFh	**Factory Setting:**	-
Properties:	RO		
Access groups via HMI:	SPLC		

Description:
This parameter allows the monitoring of the Pump Genius Simplex application status. Each bit corresponds to one state.

Table 3.18– Description of Pump Genius Simplex status word

Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Function	Excess of Clogging (F791)	Pump Clogging detected (A790)	Deragging in Execution (A794)	Reserved	External Sensor Protection (F873)	External Sensor Protection (A872)	Dry Pump (F781)	Dry Pump (A780)	Low Level Auxiliary Variable (A774)	High Level Process Variable (F773)	High Level Process Variable (A772)	Low Level Process Variable (F771)	Low Level Process Variable (A770)	Sleep Boost Active (A756)	Pipe Charging (A752)	Sleep Mode Active (A750)

Bits	Valores
Bit 0 Sleep Mode Active (A750)	0: No alarm indication. 1: It indicates that the Pump Genius is in the sleep mode (A750).
Bit 1 Pipe Charging (A752)	0: No alarm indication. 1: It indicates that the process of pipe charging is being executed (A752).
Bit 2 Sleep Boost Active (A756)	0: No alarm indication. 1: It indicates that the Pump Genius is executing the Sleep Boost before to sleep (A756).
Bit 3 Low Level Process Variable (A770)	0: No alarm indication. 1: It indicates that the control process variable (P1016) is in low level (A770).
Bit 4 Low Level Process Variable (F771)	0: No fault indication. 1: It indicates that the Pump Genius was stopped due to low level of the control process variable (F771).
Bit 5 High Level Process Variable (A772)	0: No alarm indication. 1: It indicates that the control process variable (P1016) is in high level (A772).
Bit 6 High Level Process Variable (F773)	0: No fault indication. 1: It indicates that the Pump Genius was stopped due to high level of the control process variable (F773).
Bit 7 Low Level Auxiliary Variable (A774)	0: No alarm indication. 1: It indicates that the control auxiliary variable (P1017) is in low level and the control setpoint was changed to the value of P1048 (A774).
Bit 8 Dry Pump (A780)	0: No alarm indication. 1: It indicates that the dry pump condition was detected (A780).
Bit 9 Dry Pump (F781)	0: No fault indication. 1: It indicates that the pump was stopped due to dry pump protection (F781).

Bit 10 External Sensor Protection (A782)	0: No alarm indication. 1: It indicates that protection via external sensor (DI6) is actuated (A782).
Bit 11 External Sensor Protection (F783)	0: No fault indication. 1: It indicates that the pump was stopped due to protection via external sensor (DI6) (F783).
Bit 12 Reserved	Reserved
Bit 14 Deragging in Execution (A794)	0: No alarm indication. 1: It indicates that the deragging process is in execution (A794).
Bit 14 Pump Clogging detected (A790)	0: No alarm indication. 1: It indicates it has detected clogging the pump to operate with high current (A790).
Bit 15 Excess of Clogging (F791)	0: No fault indication. 1: It indicates that the pump was stopped due an excessive number of clogging detected (F791).

3.23.2 PG Multipump

P1010 – Pump Genius Multipump Application Version

Adjustable Range:	0.00 to 10.00	**Factory Setting:**	-
Properties:	RO		
Access groups via HMI:	SPLC		

Description:
This parameter indicates the version of the Pump Genius Multipump application.

P1017 – Operation Time for Forcing Rotation of Pumps

Adjustable Range:	0 to 32767 h	**Factory Setting:**	-
Properties:	RW		
Access groups via HMI:	SPLC		

Description:
This parameter indicates the operation time of the Pump Genius operating with only one pump started. It times is used in the logic of force rotation of the pumps.

NOTE!
The value of hours is reset every time the pump driven by the CFW500 frequency inverter is stopped.

NOTE!
It is possible to change the operation time of the pump since the motor is stopped.

P1047 – Operation Time of the Pump Driven by the CFW500

Adjustable Range:	0 to 32767 h	**Factory Setting:**	-
Properties:	RW		
Access groups via HMI:	SPLC		

Description:
This parameter indicates the value of the operation time of the pump driven by the CFW500 inverter.

P1048 – Operation Time of Pump 1

Adjustable Range:	0 to 32767 h	**Factory Setting:**	-
Properties:	RW		
Access groups via HMI:	SPLC		

Description:
This parameter indicates the operation time of pump 1. It is used to define which pump will be started or stopped on the Pump Genius.

P1049 – Operation Time of Pump 2

Adjustable Range:	0 a 32767 h	**Factory Setting:**	-
Properties:	RW		
Access groups via HMI:	SPLC		

Description:
This parameter indicates the operation time of pump 2. It is used to define which pump will be started or stopped on the Pump Genius.

P1050 – Operation Time of Pump 3

Adjustable Range:	0 a 32767 h	**Factory Setting:**	-
Properties:	RW		
Access groups via HMI:	SPLC		

Description:
This parameter indicates the operation time of pump 3. It is used to define which pump will be started or stopped on the Pump Genius.

3.23.3 PG Multiplex

P1010 – Pump Genius Multiplex Application Version

Adjustable Range:	0.00 to 10.00	**Factory Setting:**	-
Properties:	RO		
Access groups via HMI:	SPLC		

Description:
This parameter indicates the version of the Pump Genius Multiplex application.

P1017 – Operation Time for Forcing Rotation of Pumps

Adjustable Range:	0 to 32767 h	**Factory Setting:**	-
Properties:	RW		
Access groups via HMI:	SPLC		

Description:
This parameter displays the operation time of the Pump Genius operating with only one pump running for logic to forcing rotation of pumps driven by CFW500 inverter.

NOTE!
This operation time will only work on the master pump and can be changed by the user at any time.

P1018 – Pump Operation Time

Adjustable Range:	0 to 32767 h	**Factory Setting:** -
Properties:	RW	
Access groups via HMI:	SPLC	

Description:
This parameter displays the operation time of the pump driven by CFW500 inverter.

It determines which pump will be started or stopped in parallel in the Pump Genius, when all appropriate conditions are met.

NOTE!
It is possible to change the pump operation time since the motor is stopped.

P1019 – Status of Pump Operation Mode

Adjustable Range:	0 = Master Pump 1 = Slave Pump	**Factory Setting:** -
Properties:	RO	
Access groups via HMI:	SPLC	

Description:
This parameter displays the pump operation mode in the Pump Genius Multiplex application.

Table 3.19 – Description of the pump operation mode in the Pump Genius Multiplex application

P1019	Description
0	Indicates that this pump is the master of the Pump Genius, i.e., this pump is control the pumping, defining speed reference through the PID controller and the need for starting or stopping other pumps.
1	Indicates that this pump is the slave, i.e., this pump is receive from the master pump the speed reference and the Start/Stop command.

4 CREATION AND DOWNLOAD THE APPLICATION

In order to configure the CFW500 inverter for Pump Genius applications, it is necessary to create the ladder application on the WLP and then download it to the SoftPLC function of the CFW500 inverter, as well as the parameter values configured on the configuration wizard.

The following steps show how to create and configure the Pump Genius application in the WLP and how to transfer it to the CFW500 inverter.

NOTE!
The Pump Genius Simplex and Multipump only works on CFW500 inverter with **firmware version over V1.50**. So upgrading the CFW500 inverter firmware to the working of this application is required.

NOTE!
The Pump Genius Multiplex application only works on CFW500 inverter with **firmware version equal or over V3.50**. So, upgrading the CFW500 inverter firmware to the working of this application is required.

1st Step: Create a new project on the WLP based on the Pump Genius ladder standard application. For this, select Tools, Application, CFW500, Create, Pump Genius and finally click in an application selected;

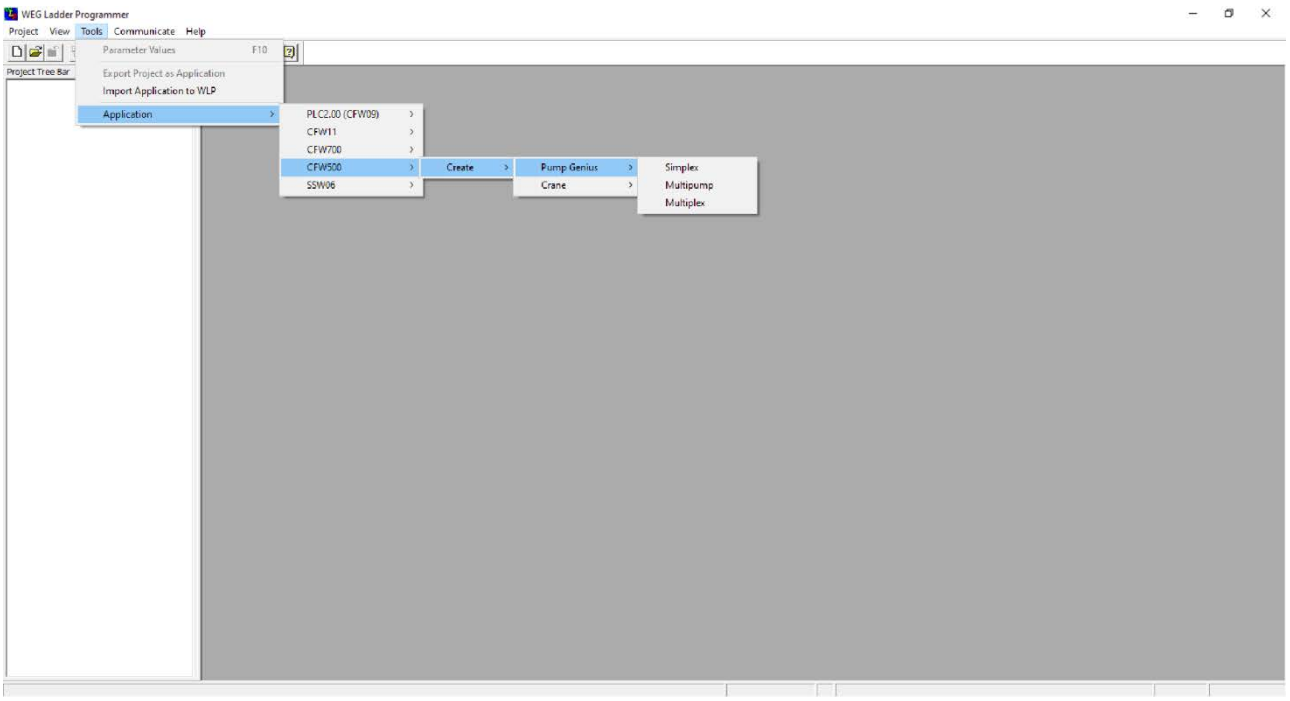


Figure 4.1 – Create the Pump Genius application in the WLP

2nd Step: Name the new project created;

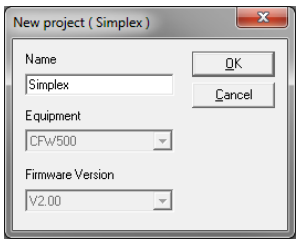


Figure 4.2 – Dialog to name the new project

3rd Step: Adjust the configuration of the WLP communication interface with the equipment, can be via serial port (COM1..COM8) or via USB. In order to do so, go to Communicate and click on Configuration (Shift + F8);

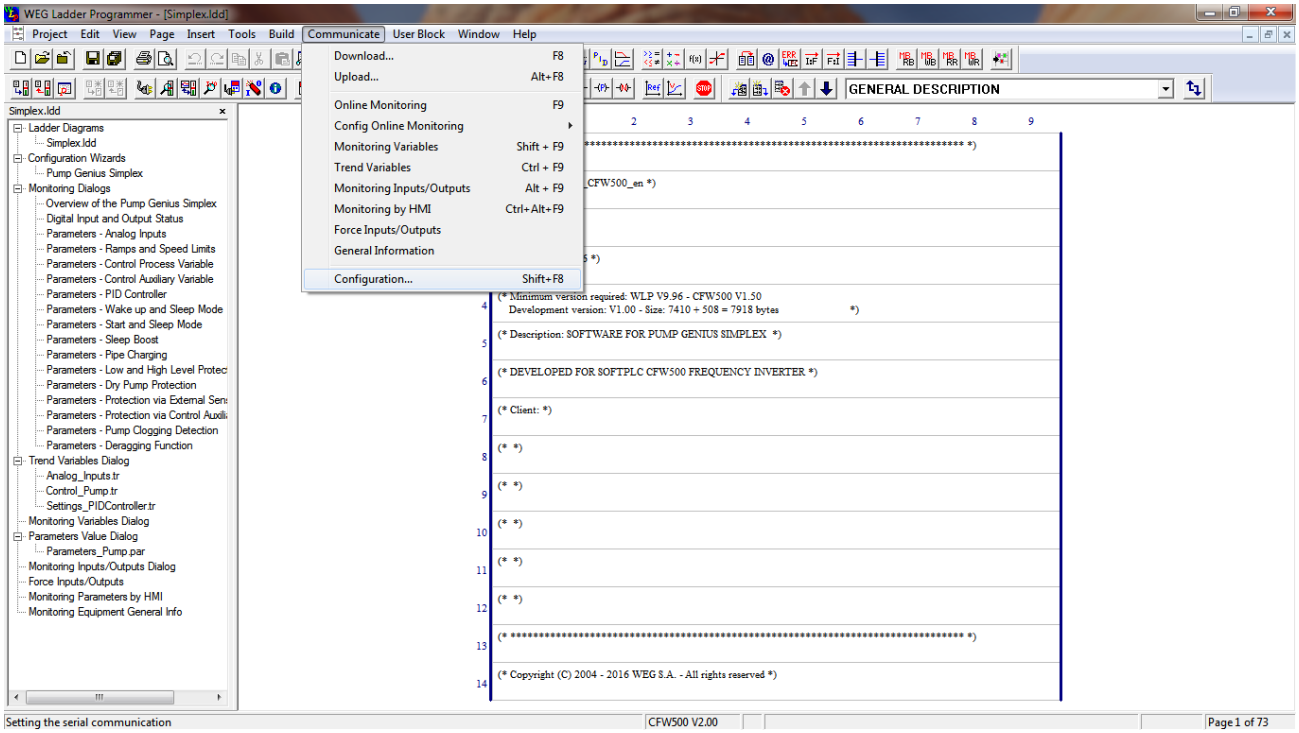


Figure 4.3 – Adjust the communication the new project

4th Step: Download the ladder application and user's parameter. For this, select Communicate and then click Download (F8);

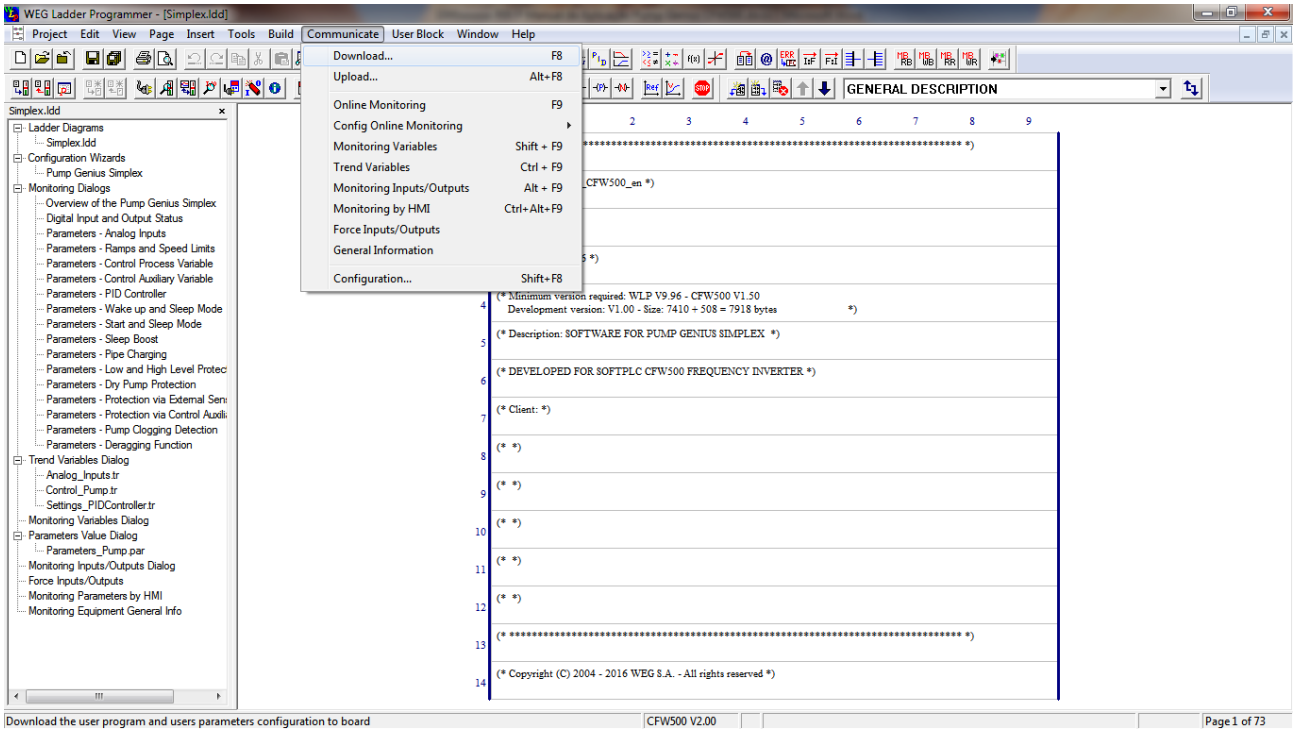


Figure 4.4– Download the new project

5th Step: Select “User Program” and “Users Parameters Configuration” in the download dialog. Then click “Ok” to start the transfer to the CFW500 inverter;

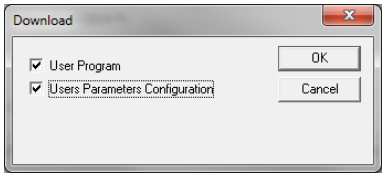


Figure 4.5 – Ladder application download dialog

6th Step: Transfer the ladder application and the user’s parameter configuration to the CFW500 frequency inverter. In order to do so, after the project is compiled and the CFW500 frequency inverter identified, click on “Start” to start transferring.

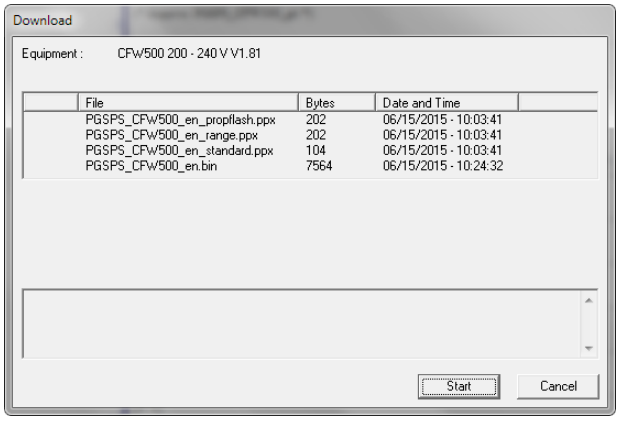


Figure 4.6 – User’s program and user’s parameter download dialog

7th Step: Transfer the ladder application and the user’s parameter configuration to the CFW500 frequency inverter. In order to do so, after the project is compiled and the CFW500 frequency inverter identified, click on “Start” to start transferring.

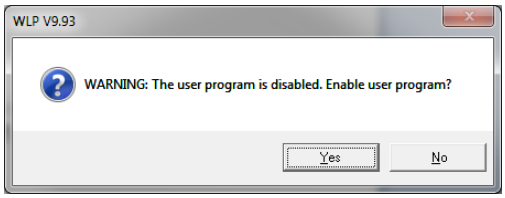


Figure 4.7 – Enabling dialog of the SoftPLC user’s program

8th Step: Start the configuration of the configuration wizard for an application.

For the Pump Genius Simplex, click on the “Pump Genius Simplex” configuration wizard on the project tree;

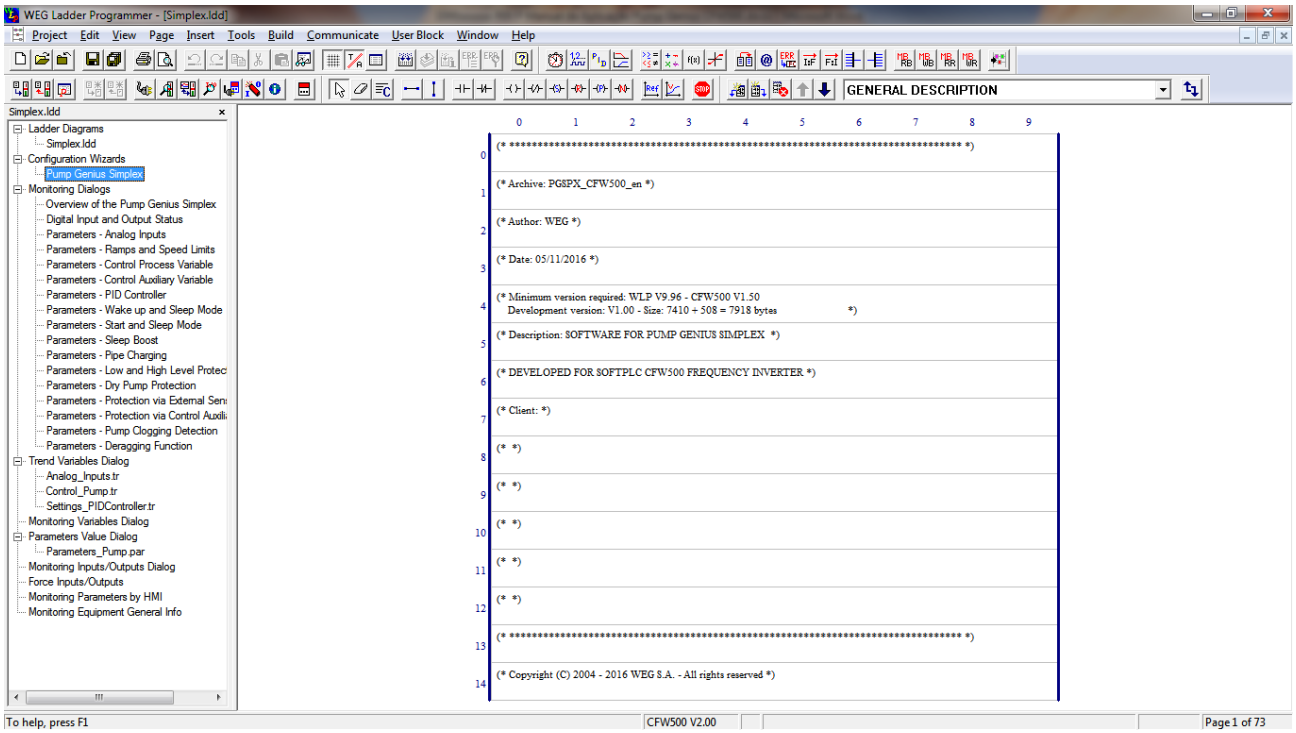


Figure 4.8 – Select the configuration wizard for Pump Genius Simplex

For the Pump Genius Multipump, click on the “Fixed Control” or “Floating Control” configuration wizard on the project tree;

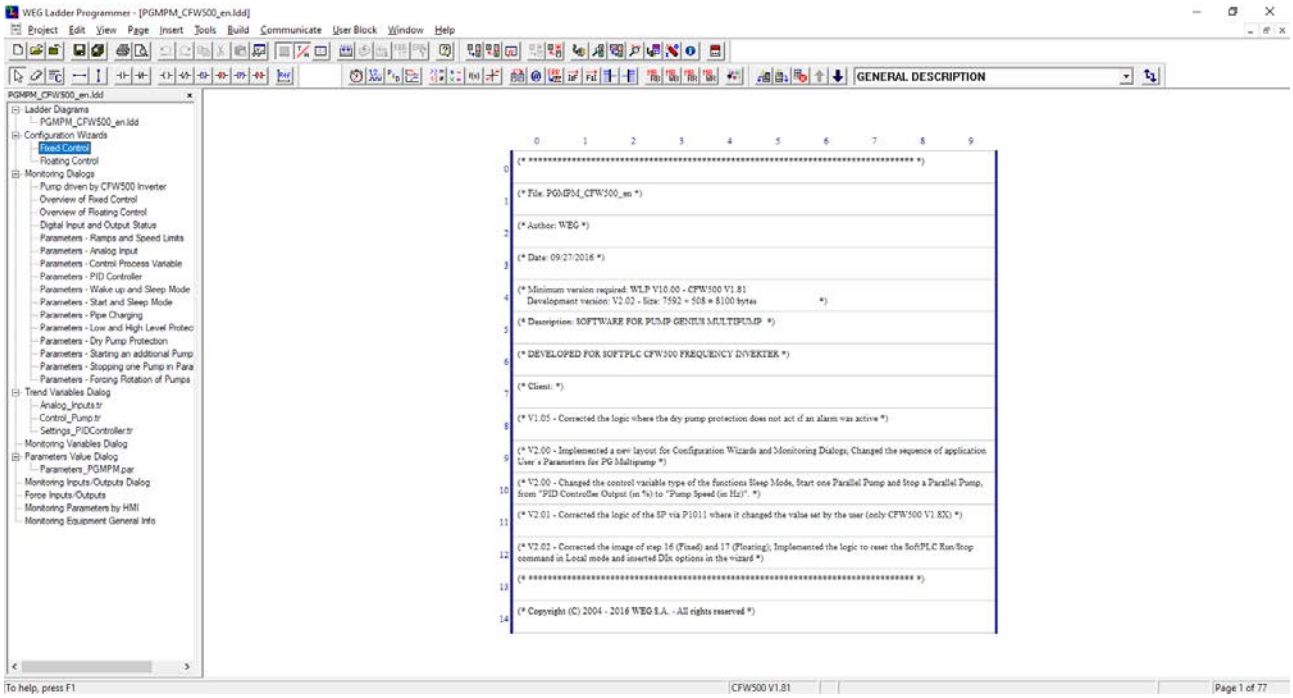


Figure 4.9 – Select the configuration wizard for Pump Genius Multipump

For the Pump Genius Multiplex, click on the “Master/Slave Pump” or “Slave Pump” configuration wizard on the project tree;

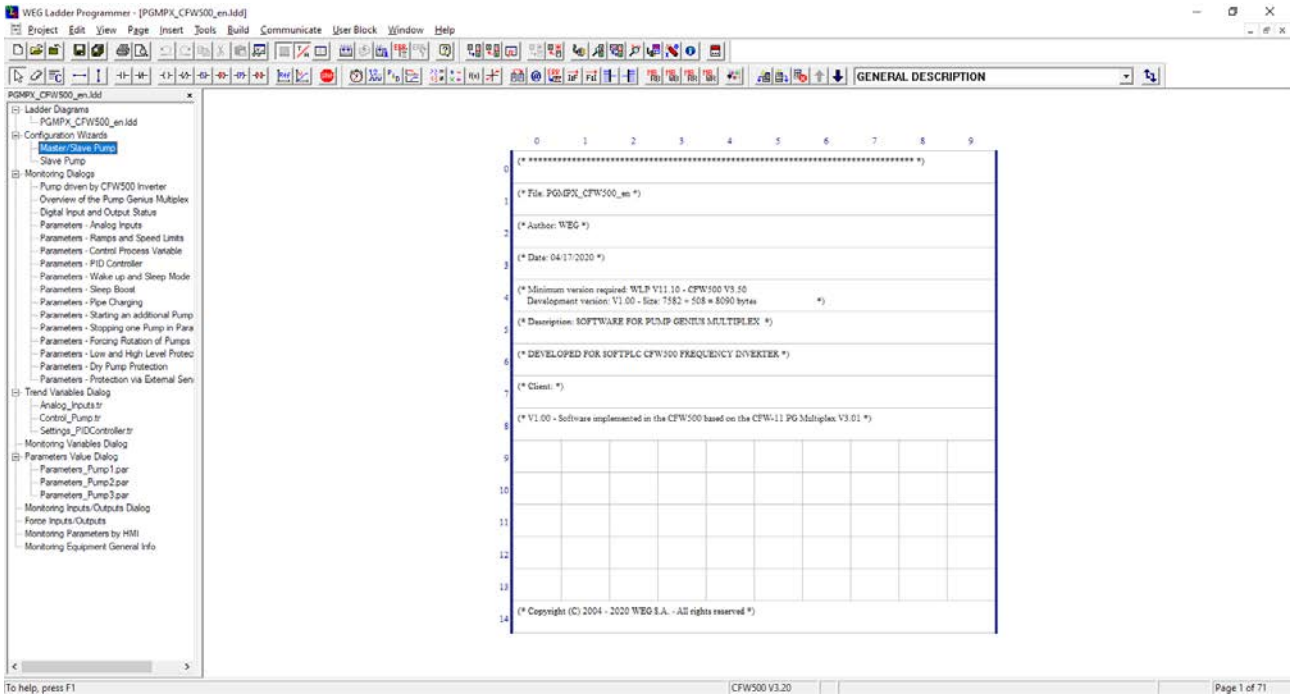


Figure 4.10 – Select the configuration wizard for Pump Genius Multiplex

9th Step: Click "Finish" in the summary of Pump Genius Simplex, Multipump or Multiplex configuration to finish the configuration wizard;

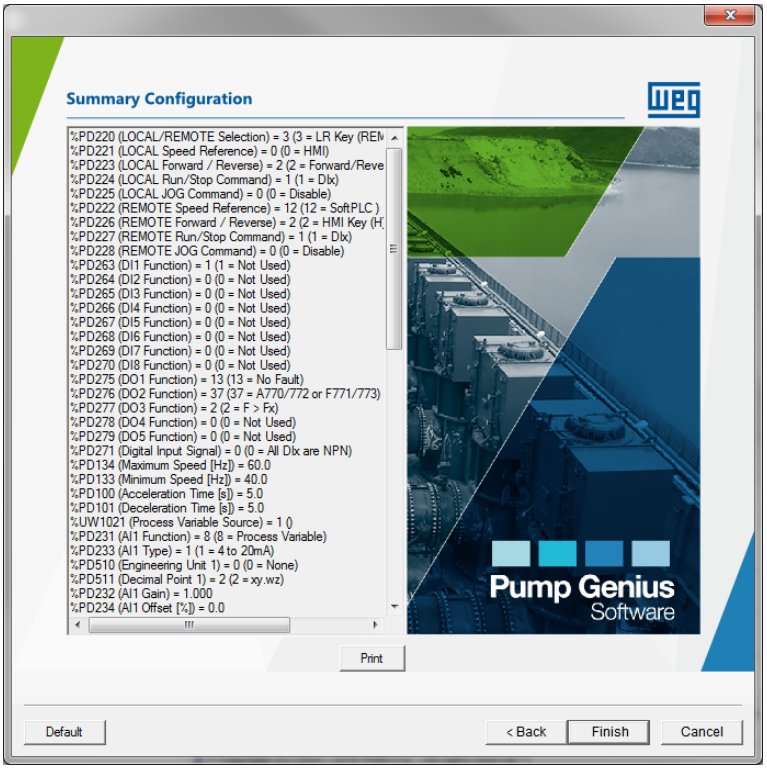


Figure 4.11 – Summary of Pump Genius configuration

10th Step: Send the values of the parameters configured in the configuration wizard of Pump Genius Simplex or Multipump for the CFW500 inverter. For this, click "Yes" to start sending the values.

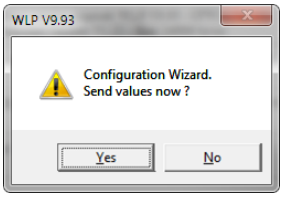


Figure 4.12 – Dialog for download the values of configuration wizard

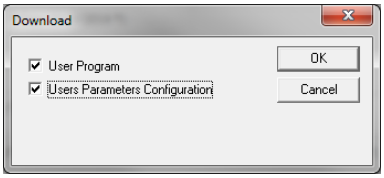
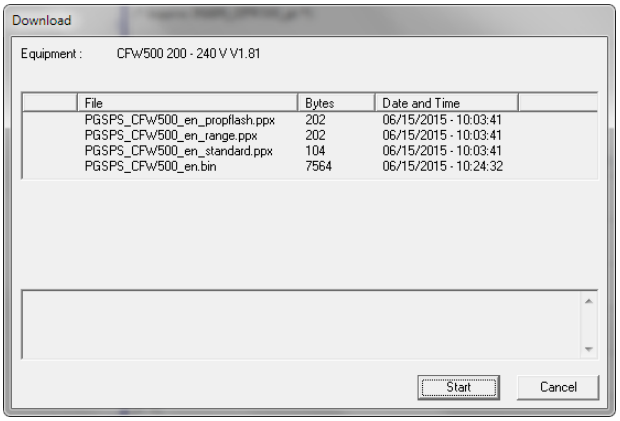
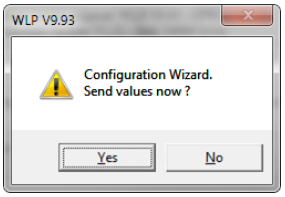
NOTE!
After performing these steps, the CFW500 inverter is configured for Pump Genius Simplex or Multipump application. For Pump Genius Multiplex application, you need to repeat these steps for the next pump in parallel defining another network address for it (the address of pump 1 is 1, the address of pump 2 is 2, and so on until the pump 3).

5 DOWNLOAD DIALOG BOXES

Through the WLP (WEG Ladder Programmer) software it is possible to download the user´s ladder program, the configuration of user´s parameters and the values configured in the configuration wizard. Below are the main download dialogs to the CFW500 frequency inverter

NOTE!
Refer to the help topics in the WLP programming software for more details on the download.

Table 5.1 – Download dialog box for the Pump Genius Simplex, Multipump and Multiplex application

Description	WLP Download Dialog Box
Download dialog box of the application developed with the WLP containing the following options: ■ User Program; ■ Configuration of the User's Parameters.	
User program download dialog box containing: ■ Characteristics of the connected equipment; ■ Name of the file to be downloaded; ■ Size of the application to be downloaded; ■ File compilation date; ■ File compilation hour; ■ Command to transfer or not the compiled application.	
Dialog box for the download of the values configured with the Pump Genius Simplex, Multipump or Multiplex configuration wizard.	

6 PROJECT TREE ON WLP

Using WLP programming software can implement or change ladder application of Pump Genius application, configure the parameters through the Configuration Wizards (2), monitor parameters and variables through the Monitoring Dialogs (3), monitor variables through Trend Variables Dialogs (4), and upload/download drive parameters CFW500 through the parameter Values Dialogues (5). The figure 6.1 presents the project tree where the functions mentioned before.

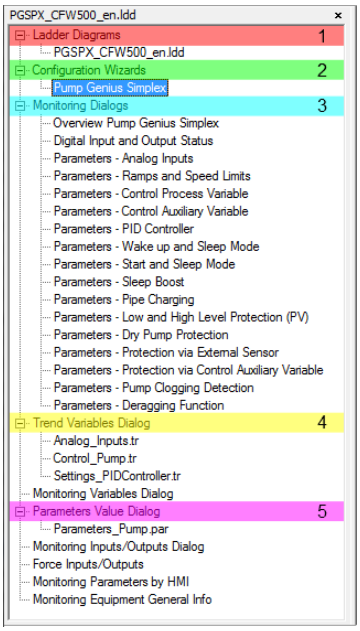


Figure 6.1 – Project Tree

6.1 LADDER DIAGRAMS

Using WLP (WEG Ladder Programmer) software is possible to open and to edit the programming done in ladder language. The figure 6.2 presents a page programmed in ladder.

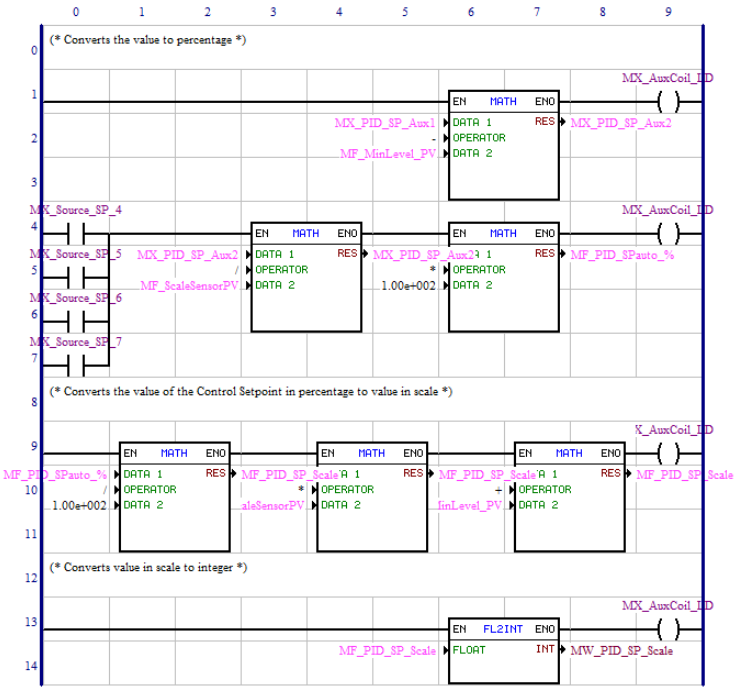


Figure 6.2 – Ladder Diagrams

6.2 APPLICATION CONFIGURATION WIZARD

The Pump Genius application can be configured with the WLP (WEG Ladder Programmer) software using the configuration wizards, which consists of an oriented step by step guide for the configuration of the parameters regarding the application.

NOTE!
When powering up the inverter for the first time follow the steps described in the chapter 5 “First time Power-up and Start-up” of the CFW500 user´s guide inverter. It is recommended to use the V/f control mode for this type of application!

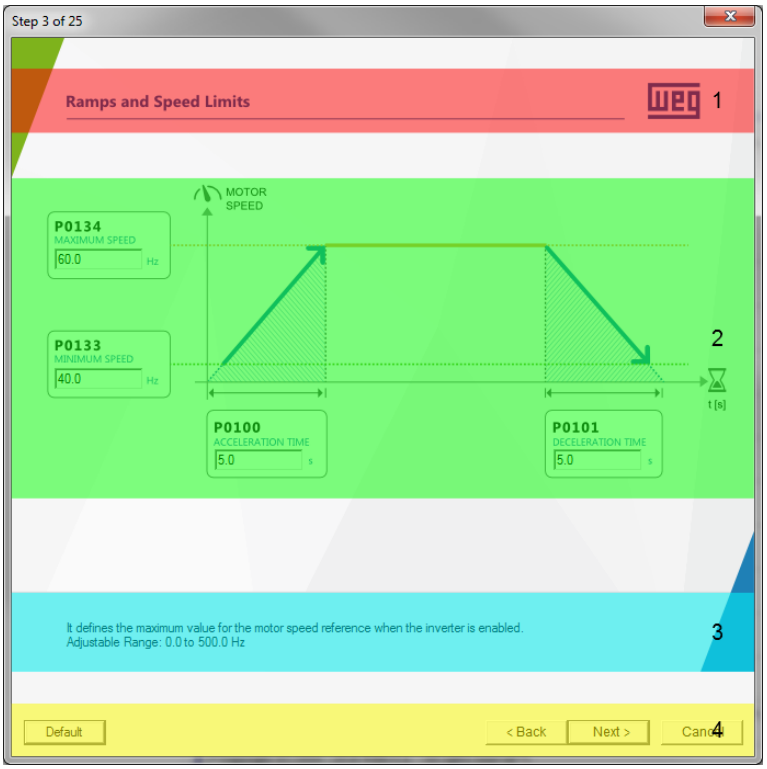


Figure 6.3 – Configuration wizard for Pump Genius Simplex application

6.2.1 Tittle

The page title indicates that the feature is covered.

6.2.2 Input Value for Parameters

The input values for the parameters are spaces where are inserted values of drive parameters. Only after finishing the configuration wizard, the same will be sent to CFW500 frequency inverter.

6.2.3 Info

The info is to explain previously which of the selected parameter functionality, adjustable range and relevant comments.

6.2.4 Browse Buttons

The configuration wizard has four kinds of browse buttons being:

- **Default:** loads the default values of each parameter on the page in use;
- **Back:** back to previous page;
- **Next:** advance to the next page;
- **Cancel:** close the configuration wizard without sending/save the values of the parameters edited.

6.3 MONITORING DIALOG BOXES

It is possible to monitor and change the parameters of the Pump Genius application through the WLP.

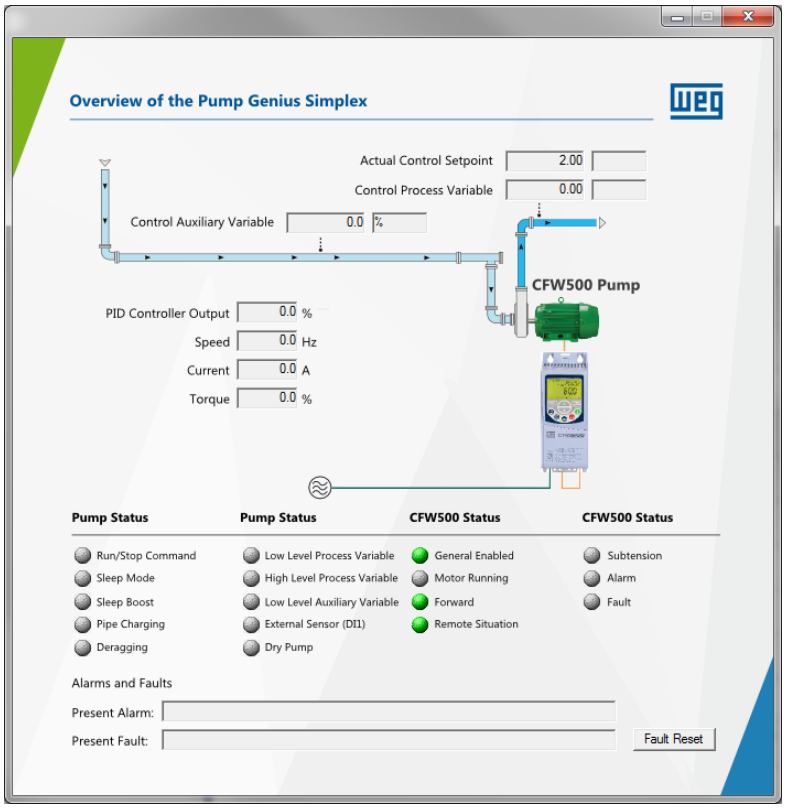


Figure 6.4 – Monitoring dialog of the Pump Genius Simplex application

6.4 TREND VARIABLES DIALOG BOXES

It is possible to monitor variables of the Pump Genius application through the WLP.

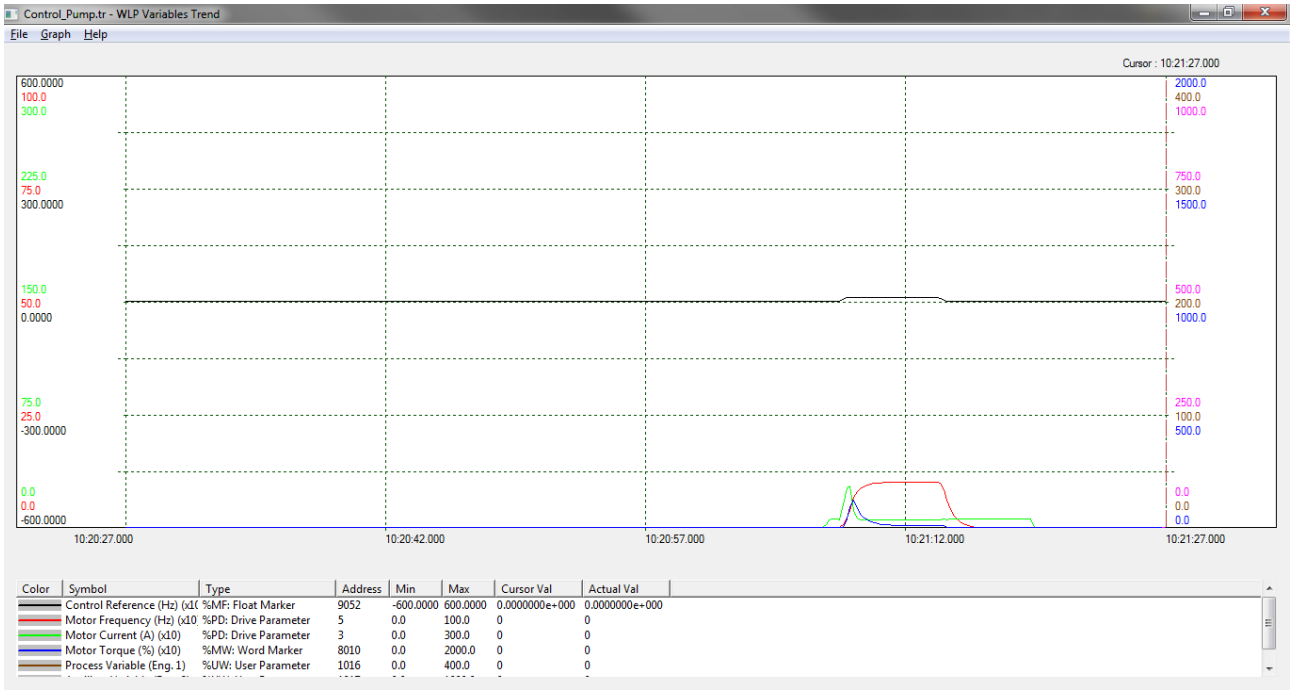


Figure 6.5 – Trend variable dialog

NOTE!
Refer to the WLP programming software help topics for more information on the use of the trend variables.

6.5 PARAMETER VALUE DIALOG

It is possible to save the parameters of the pump configured in the Pump Genius application through the WLP.

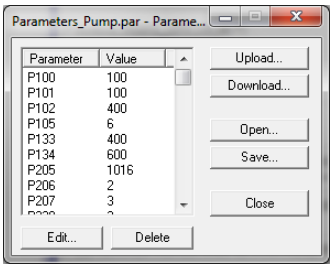


Figure 6.6 – Parameter value dialog

NOTE!
Refer to the WLP programming software help topics for more information on the use of the parameter value dialog box.

NOTE!
In the Pump Genius Multiplex application, there is a value dialog for each pump in the system, that is, a dialog for Pump 1, another for Pump 2 and another for Pump 3.