ALTEC®

Constant Pressure Controller

CPC316

INSTRUCTION MANUAL

Table of Contents

1 Overview

The CPC316 constant pressure controller is intended to constant pressure water system and boiler water systems. It can works with variant inverters.

The water tower or other traditional water system can be replaced by CPC316 constant pressure control system.

2 Features

(1) Programmable pumps action modes.

(2) Indicates the frequency of the inverter.

(3) Real time clock (with power backup) and programmable Time-Pressure program.

(4) Automatic pumps exchange, enhance the life time of the pumps.

(5) Second setting value (fire fighting pressure) and control.

(6) Alarms with 6 options.

(7) Small auxiliary pump controls, works in power freq. or var. freq. mode.

(8) Direct/Reverse control, reverse control for water system; direct control for water level control in water pumping systems.

3 Order code

CPC316 - [Main output] - [Pumps] - [RTC] - [Comms]

(1) (2) (3) (4)

(1) Main output

A420	4~20 mA
V10	0~10 V

(2) Pumps

S	Single variable freq. pump
M	Multiple variable freq. pumps

(3) RTC

0	No real time clock
T	With Real Time Clock (RTC)

(4) Comms

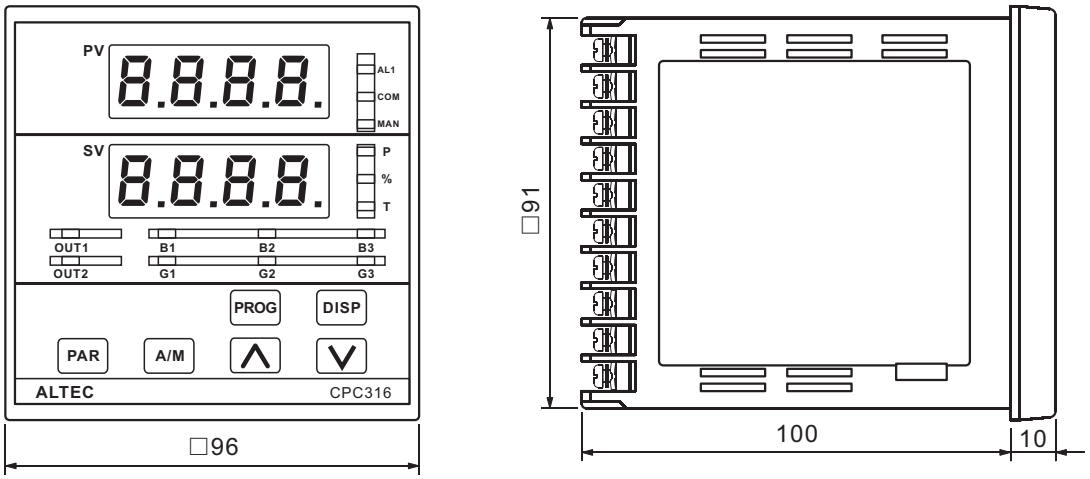
0	None
RS232	RS232
RS485	RS485

Example:
CPC316-A420-M-T: Constant pressure controller with output of 4~20mA, multiple variable freq. pumps control function and real time clock.

4 Mounting

4.1 Outline dimensions

(All dimensions are in mm)

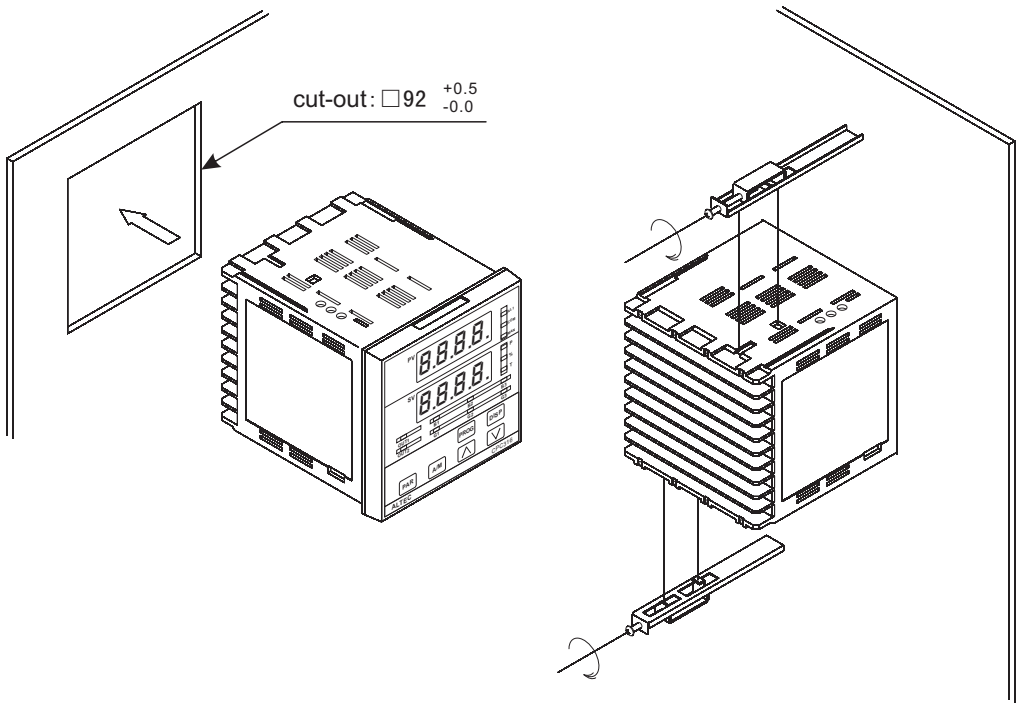


4.2 Mounting instruction

(1). Prepare a square cut-out on the mounting panel to the size shown below.

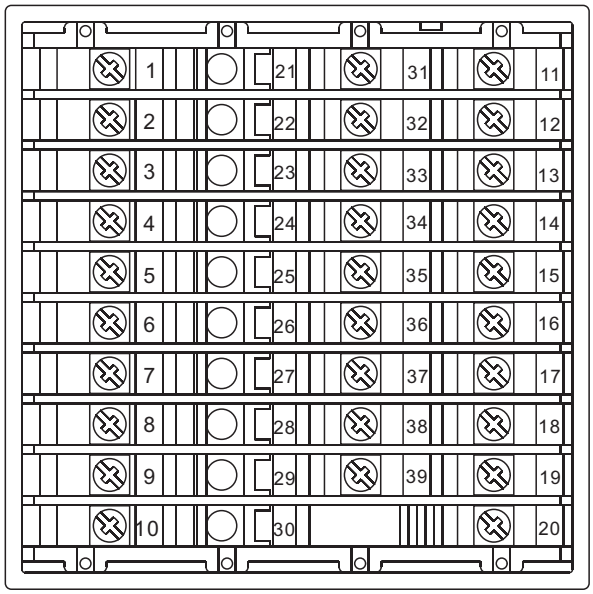
(2). Insert the controller through the cut-out.

(3). Catch the mounting bracket to the holes top and bottom of the case, and screw to fix.

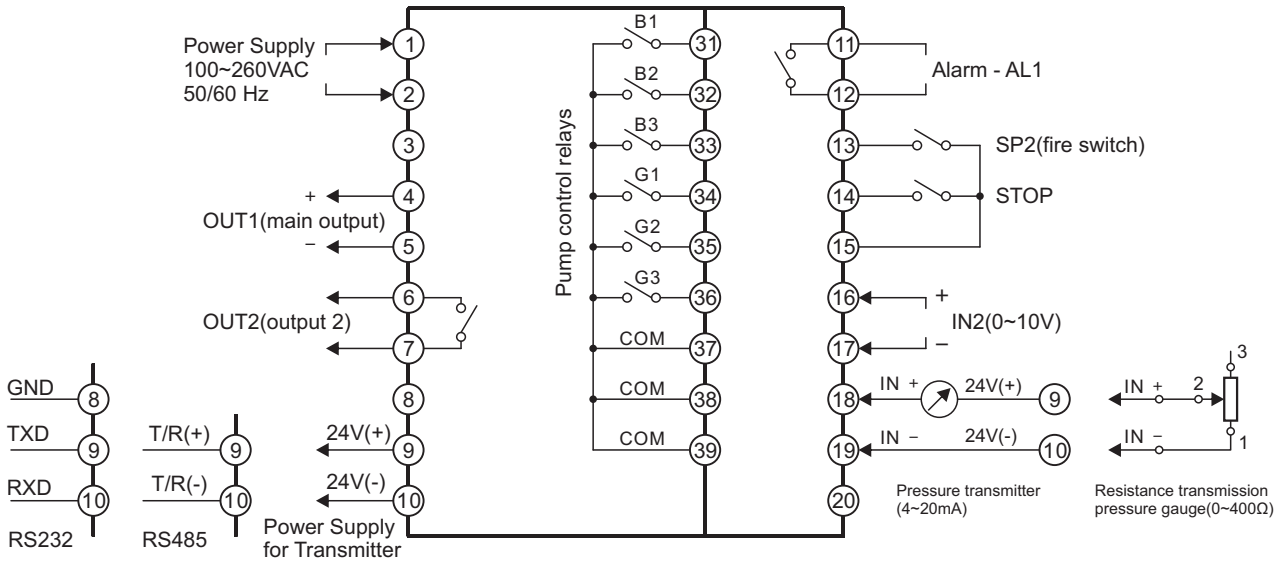


5 Electrical connections

5.1 Terminals layout



5.2 Basic wiring



Note:

The wire connected to terminal 18, 19 must be shield cable and away from the power line, otherwise the electrical noise may effect the input signal.

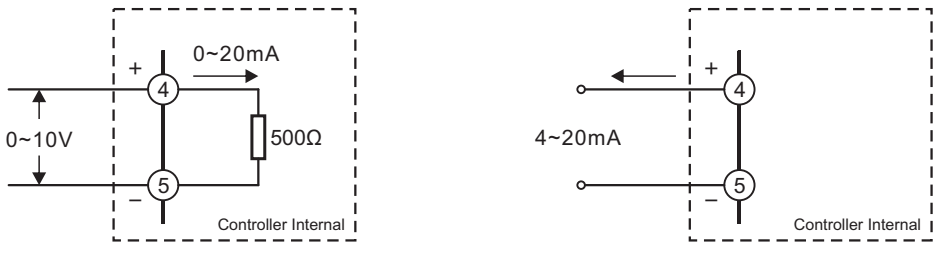
Terminal #	Name	Description
1, 2	Power supply	100~260VAC, 50/60Hz
4, 5	OUT1	The main output, to inverter (4~20mA or 0~10V)
6, 7	OUT2	Output 2
8	GND	24V DC power supply for pressure transmitter or RS232/RS485 interface
9	TXD	
10	RXD	
11, 12	AL1	Alarm output
13	SP2	Setpoint 2 switch, fire switch
14	STOP	Stop switch
15		External switch input COM terminal
18	IN+	Pressure signal input +
19	IN-	Pressure signal input -
31	B1	Var. Freq. Pump #1 contact
32	B2	Var. Freq. Pump #2 contact
33	B3	Var. Freq. Pump #3 contact
34	G1	Power Freq. Pump #1 contact
35	G2	Power Freq. Pump #2 contact
36	G3	Power Freq. Pump #3 contact
37,38,39	COM	Relay common terminal

5.3 Comments on wiring

OUT1

This is the main output, it can be configured as 0~20mA or 4~20mA output(See parameters: OP1).

Note:
If the model code is CPC316-V10, OUT1 will output a 0~10V DC signal, and there is a 500Ω resistor connected in parallel with OUT1 inside the controller. If you want to use current output signal, you must remove this resistor, and vice versa. See the following figure.



CPC316-V10 (0~10 V output) **CPC316-A420 (4~20mA Output)**

Input signal

The range of the input signal is -10~50mV. Voltage signal which **exceed** this range must be attenuated with an appropriately sized input adapter. Current signals are converted to the -10 to 50mV range with a shunt input adapter.

e.g., suppose the output signal of the two-wire pressure transducer is 4~20mA, now connect a 2.5 Ohm resistor in parallel with the input terminals.(18, 19). Due to the Ohm's law, this converts the input signal to 10~50mV.

SP2 Switch / Fire Switch

When the switch SP2 is on, the alteration of the value of SP2 is enabled, just press the UP and DOWN key to alter the setting value. The value will be stored automatically.

When the switch SP2 is off, the alteration of the value of SP is enabled.

Stop Switch

When the STOP switch is on, the all outputs will be turned off.

First turn OUT1 off, then the Var. Freq. Pump relay, last the Power Freq. Pump relays(First Start First Stop), the interval between two power freq. pumps is 2 seconds.

B1, B2, B3 / G1, G2, G3

B1, B2 and B3 are relays for switching ON/OFF the contacts for the Var. Freq. Pumps while G1, G2 and G3 are relays for switching ON/OFF the contacts for the Power Freq. Pumps. The common wiring terminal is COM.

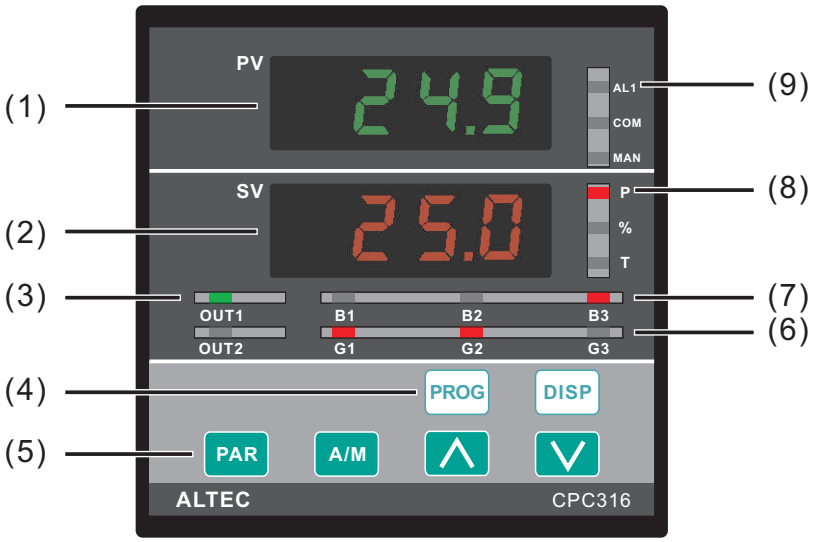
The variable frequency pumps control relays are interlocked, at any time, only one var. freq. pump contactor will be switch on.

For the same motor, the var. freq. contactor and the power freq. contactor are also interlocked, i.e. either the var. freq. contactor is on or the power freq. contactor is on for the same motor.

Alarm - AL1

The alarm relay's contact rating is 3A/250VAC, Normally Open.

6 User interface



No.	Meaning
1	**PV Display**(green) Indicates the Process Value(i.e. measured pressure here), also for parameter code display while programming the controller
2	**SV Display**(red) The display contents can be switched with the **DISP** key: **P** is lit : Setting Pressure **%** is lit : Output Power **T** is lit : Time or Frequency(see note 2) When programming the controller, parameter value appears here
3	**OUT1**[1] Output 1 indicator, lit when OUT1 is 'ON'
	OUT2 Output 2 indicator, lit when OUT2 is 'ON'
4	**PROG key** Used to set the "Time-Pressure" program
	DISP key Lower display selector, the type of contents displayed on the lower display is changed every time the DISP key is pressed, the type of contents displayed is indicated by the LED provided on the right side of the lower display.
5	**PAR key** Parameters scroll key
	A/M key Switch between automatic & manual mode
	Up key Increase value
	Down key Decrease value

No.	Meaning
6	**G1** #1 power freq. pump working indicator
	G2 #2 power freq. pump working indicator
	G3 #3 power freq. pump working indicator
7	**B1** #1 variable freq. pump working indicator
	B2 #2 variable freq. pump working indicator
	B3 #3 variable freq. pump working indicator
8	**P** Lit when **setting pressure** is showing in the lower display
	% Lit when **output power** is showing in the lower display
	T[2] Lit when the **Time/Frequency** is showing in the lower display
9	**AL1** Alarm 1 indicator, lit when alarm is 'ON'.
	COM Communication indicator, flashes when communicates with a host computer.
	MAN Manual mode indicator, lit in manual mode

Notes:
[1]. The brightness was proportioned to the output power level.
[2]. If controller with real time clock, LED **T** indicates time;
If controller without real time clock, LED **T** indicates frequency of the inverter.

7 Operation

7.1 Setpoint adjusting

During the basic functioning, press keys ∧ or ∨ to increase or decrease setpoint. Keeping it pressed results in a progressively faster variation. Setpoint adjustable range is SP L to SP H.

7.2 Automatic and Manual Mode

When the “Automatic/Manual selection” function is enabled (A H = HAnd), press the **A/M** key, the automatic operation mode and manual operation mode can be changed conveniently.

When the controller performs manual operation, the indicator ‘**MAN**’ will be lit, if output power is displaying on the lower display(LED ‘**%**’ is lit) the control output can be altered by pressing ∧ and ∨ key.

7.3 Parameters accessing

The parameters of the controller is structured on two access levels: **Operator Level** and **Configuration Level**.

Operator Level:
This level is intended for normal, everyday operation of the controller at the plant.

Configuration Level:
With the configuration parameter list, the controller can be programed for running in the specific application.

7.3.1 Operator parameters

With the controller works in the PV/SV indication status, press **PAR** key and hold for 3 seconds, this will reveals the first operation parameter. The parameter value can either be modified with the ∧ or ∨ key, or left unmodified. Press **PAR** again, the next parameter and its current value appears, set the value with the same method.

If the last parameter has been reached or there is no key operation within 16 seconds, the menu times out automatically.

Operator Parameter List

SN	Mnemonic	Parameter	Adjustable Range	Comments
1	SP	Pressure Setpoint 1	SP L to SP H	Setting values
2	SP2	Pressure Setpoint 2	SP L to SP H	
3	AL1	Alarm 1 setpoint	Measurement range	Pressure alarm
4	HYS 1	Alarm 1 hysteresis	0.1~99.9 unit	
5	ProP	Proportional band	0.1~999.9 unit	The smaller value, the faster response The greater value, the slower response
6	Int.t	Integral time	0.1~10.0 seconds	The smaller value, the faster response The greater value, the slower response
7	tH	max output duration	1~600 seconds	condition of adding pump
8	tL	min output duration	1~600 seconds	condition of stopping pump
9	db	Dead band for pump switching	0.00~99.99 unit	Allowable pressure oscillation during the adding or stopping of pumps
10	tc	Delay time for contactor switching	0.1~24.0 seconds	The delay time for motor switches from variable freq. mode to fixed freq. mode
11	td	Delay time for inverter output switching	5.0~25.0 seconds	The delay time for Inverter switches to the next variable freq.motor
12	SLEP	enter sleep threshold	0.0~100.0%	If the following condition has been met, the system will enter sleep mode: 1. There is only one variable freq. pump is working; 2. The output power is less than SLEP and lasts for tb seconds.
13	tb	enter sleep duration	1~600 seconds	
14	LoP	exit sleep threshold	-9.9~99.9 unit	In sleep mode, if the measured pressure is less than LoP and the time lasts for tR seconds, the system will exit sleep mode, one variable freq. pump will be started.
15	tR	exit sleep duration	1~600 seconds	
16	Loc	Lock Code(password)	0~9999	Set to 808 to enter the configuration menu

7.3.2 Configuration parameters

The CPC316 pressure controller must be configured properly in order to perform the correct control function.

How to enter the configuration menu:

1) Press PAR key and hold for 3 seconds to enter the first level menu(i.e. operator parameter list);

2) Press PAR key to scroll the parameter to Loc and set its value to 808(the initial password);

3) Press PAR key, the first parameter appears on the upper display, at the same time the lower display will display the value of this parameter. The values can be modified by pressing ∧ or ∨ key. After modification, press the PAR key, the next parameter appears, at the same time, the modified data has been saved.

If the last parameter has been reached or there is no key operation within 16 seconds, the menu times out automatically.

After configuration, set the configuration password(code Loc) to data other than 808 to protect the parameter values from being inadvertent modification.

Controller Configuration Paramter List

SN	Mnemonic	Parameter	Adjustable Range	Comments
1	SP H	Pressure setpoint high limit	Measurement Range	Limits the adjustable range of the pressure setpoint
2	SP L	Pressure setpoint low limit	Measurement Range	
3	H PL	Max output power	0.0~100.0%	Limits the range of output (corresponds to inverter frequency)
4	L PL	Min output power	0.0~99.0%	
5	OFSt	Input/calibration offset	-9.99~99.99 units	
6	dot	precision of display	00 0.0 0.00 0.000	No fraction 1/10 precision 1/100 precision 1/1000 precision
7	Sn	Input signal selection	Lin PrE	Linear signal Resistance Transmission Pressure Gauge(0~400Ω)
8	Addr	Instrument address	00~99	For communication purpose
9	bAud	Baud rate	2400, 4800, 9600, 19.2	
10	CtrL	Control algorithm	Pid prog	Constant pressure control Time-Pressure program control
11	Func[1]	Pumps action mode	PF0 PF3 PF4 PF6	Single pump control 3 pumps loop 4 pumps loop 1 var. freq.+6 power freq. pump(direct start/stop)
12	no.1	Pump 1 on/off(Relay 1)	OFF on	Idle Enable
13	no.2	Pump 2 on/off(Relay 2)	OFF on	Idle Enable
14	no.3	Pump 3 on/off(Relay 3)	OFF on	Idle Enable
15	no.4	Pump 4 on/off(Relay 4)	OFF on	Idle Enable
16	no.5	Pump 5 on/off(Relay 5)	OFF on	Idle Enable
17	no.6	Pump 6 on/off(Relay 6)	OFF on	Idle Enable

18	OP1	Output 1 (To inverter)		0-20 4-20	0 to 20 mA 4 to 20 mA
19	OP2	Output 2		OFF PFG PFb	Off aux. pump output(power frequency) aux. pump output(var. frequency)
20	ALo1	Alarm 1 output mode		OFF Hi AL LoAL HdA LdA	Alarm 1 OFF Full-scale high alarm Full-scale low alarm High deviation alarm Low deviation alarm
21	A H	Automatic/Manual selection		Auto HAnd	Auto/manual mode switch disabled Switching enabled
22	tchA	Pump continuous running time		OFF, 1~9999 min.	no pump change with value OFF
23	tdE	remaining time of pump change		1~9999 minute	Read only
24	StoP	Rule of pumps stopping		F--F L--F	**F**irst start **F**irst stop **L**ast start **F**ist stop	For the situation of Func=PFb
25	tt	Time		00.00~24.00	Adjustable real time clock
26	Act	Control action		dir rEu	Direct control Reverse control
27	Hi L	Max pressure	measurement range of pressure sensor	-99.9~999.9	Display value for 50 mV input
28	Lo L	Min pressure		-99.9~999.9	Display value for 0 mV input
29	FiL	Input filter coefficient		0.01~99.99	

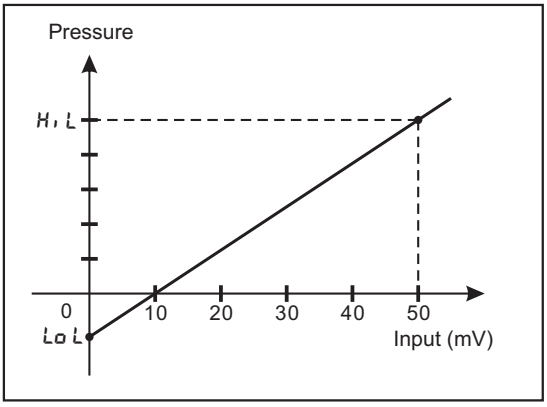
Note[1]: The application samples illustrate the action modes.

8 Parameters description

8.1 Pressure measurements

The measurement of pressure is affected by parameters Sn, dot, OFSt, HiL, LoL and FiL. These parameter must be set properly according to the specify condition, otherwise the indication of the measured pressure will be incorrect.

The input must be between -10~50mV, voltage signal which **exceed** this range must be attenuated with an appropriately sized input adapter. Current signals are converted to the -10 to 50mV range with a shunt input adapter.



(1). When using the “Resistance Transmission Pressure Gauge” as the pressure sensor, the input signal parameter Sn must be set to PrE, set HiL to the full scale value of the sensor, set LoL to 0.

(2). When using the other pressure sensors, the input signal parameter Sn must be set to Lin(linear signal).
Set HiL, make it corresponds to the pressure value represented by 50mV (the full scale).
Set LoL, make it corresponds to the pressure value represented by 0mV.

(3). Set proper value for “Input filter coefficient” (code FiL), the greater value, the more stable display but slower response.

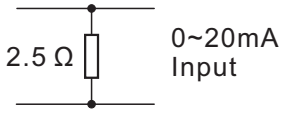
Example 1: Resistance Transmission Pressure Gauge Input
Suppose use the “Resistance Transmission Pressure Gauge” as the pressure sensor, the measurement range is 16.0kg.

The settings: Sn = PrE, HiL = 16.0, LoL = 0

Example 2: 0~20mA Input
Suppose use the two-wire pressure transducer as the pressure sensor, the output signal of the transducer is 4 to 20mA and the measurement range is 10.0kg.

A 2.5 Ohm resistor must be connected with the input terminals in parallel, due to the Ohm’s Law, this convert 4~20mA to the range of 10~50mV.

The settings: Sn = Lin, HiL = 10.0 (display value for 50mV), LoL = -2.5 (display value for 0mV)

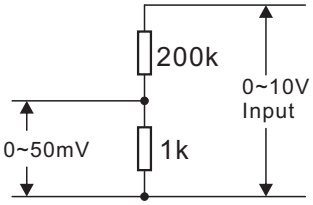


Current Input Adapter

Example 3: 0-10V Input
Suppose use the pressure transmitter with 0~10V signal, the measurement range is 10.0kg.

A 200K/1K voltage divider can adapt the input signal to the range of 0~50mV. (see the right figure)

The settings: Sn = Lin, HiL = 10.0 (display value for 50mV), LoL = 0 (display value for 0mV)



Voltage Input Adapter

8.2 Pumps action mode

8.2.1 Single pump control (Func = FP0)

This mode is suitable for water systems with only one pump, the pump is soft-start/stop controlled.

8.2.2 Three looped pumps control (Func = FP3)

This mode is suitable for water systems which using 3 standard pumps and a small auxiliary pump.

The three standard pump are soft-start controlled and the auxiliary pump works in power frequency mode.

B1, B2 and B3 are defined as var. freq. contator control relays.
G1, G2 and G3 are defined as power freq. contactor control relays.
OUT2 is for auxiliary pump.

See Application Note 1 and 2 for wiring and details.

8.2.3 Four looped pumps control (Func = FP4)

This mode is suitable for water systems which using 4 standard pumps, the four standard pumps are soft-start controlled.

B1, B2, B3 and OUT2 are defined as var. freq. contator control relays.
G1, G2, G3 and AL1 are defined as power freq. contactor control relays.

See Application Note 3 for wiring and details.

8.2.4 Direct start/stop (Func = FP6)

This mode is suitable for water systems which using 1 variable frequency pump and 6 power frequency pumps.

The connection of the var. freq. pump is fixed. The 6 power freq. pumps are controlled by B1, B2, B3, G1, G2 and G3 respectively.

If the measured pressure PV is less than the setting pressure SV and the adding pump condition is met, B1, B2, B3, G1, G2, and G3 will be switched on to start the corresponding pump in sequence, and the six pumps works in power frequency mode.

If the measured pressure PV is greater than the setting value SV, the power frequency pumps will be stopped with order of First Start Last Stop.

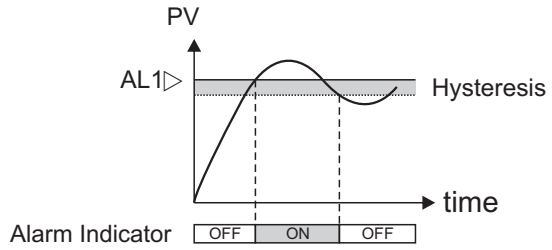
See Application Note 4 for wiring and details.

8.3 Alarm

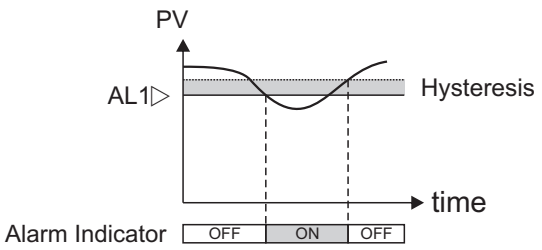
Four different types of alarm can be configured with *ALo1*: *H, AL*, *LoAL*, *HdA* and *LdA*, as the following table shows.

The alarm hysteresis is *HYS1*. Hysteresis is used to provide a definite indication of the alarm condition and to prevent alarm relay chatter.

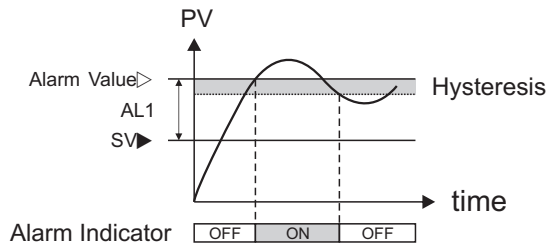
Full-scale high alarm(*H, AL*)



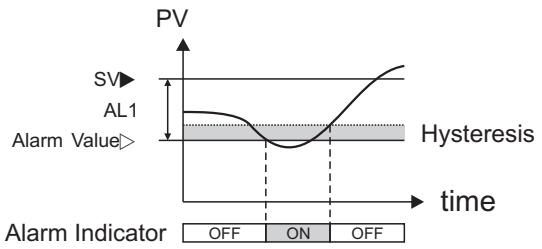
Full-scale low alarm(*LoAL*)



High deviation alarm(*HdA*)



Low deviation alarm(*LdA*)



9 Adding/Stopping pumps

9.1 Adding pump procedure

When the inverter is running, if the measured pressure PV is less than the setting pressure SV, the output of the PI algorithm will be increased and reach the highest frequency HPL.

If SV-PV > db, and the max output HPL was kept and lasts for tH, the adding pump event will be triggered.
db: Allowable pressure oscillation during the adding or stopping of pumps
tH: Max output (highest freq.) duration

In the adding pump procedure, the following table lists the output and the action sequence of the relays.

Function	**Main output** (to inverter)	**Action of Relays**
Direct start	The output will be reduced to 0, after the power freq. pump relay was switched on, the PI regulation and the output will be restarted.	Switch on the next power freq. pump (i.e. switch on the corresponding relay)
Looped soft-start	The output will be reduced to 0, after the next var. freq. pump was switched on, the PI regulation and the output will be restarted.	1. Switch off the relay connected with the inverter 2. Delay time tc 3. Switch the inverter controlled motor to power freq. mode(swich on the corresponding relay) 4. Delay 3 seconds 5. Switch on the next var. freq. pump (switch on the corresponding relay)

9.2 Stopping pump procedure

When the inverter is running, if the measured pressure PV is greater than the setting pressure SV, the output of the PI algorithm will be decreased and reach the lowest frequency LPL.

If PV-SV > db, and the min output LPL was kept and lasts for tL, the stopping pump event will be triggered.
db: Allowable pressure oscillation during the adding or stopping of pumps
tL: Min output (lowest freq.) duration

In the stopping pump procedure, the following table lists the output and the action sequence of the relays.

Function	**Main output** (to inverter)	**Action of Relays**
All modes	Perform the PI regulation and outputs	Switch off the next power freq. pump which should be (i.e. switch off the corresponding relay) Direct start: use sequence of Fist Start Last Stop Looped soft-start: use sequence of First Start First Stop

9.3 Sleep mode and the auxiliary pump

9.3.1 Enter sleep mode

Entering sleep mode and employing auxiliary pump in the water system is useful when the duty is low (such as in the night), this can prevents the main pump from starting and stopping frequently.

While there is only one var. freq. pump is running and if the measure pressure PV is greater than setting pressure SV, the output of the PI algorithm will be decreased and reach the “enter sleep threshold” SLEP. If PV > SV + db, and the output keeps SLEP and lasts for “enter sleep duration” tb, the water system will enter sleep mode, the main output will be turned off.(OUT1 outputs 0)

If OP2 = OFF, after the system enters sleep mode, the all pumps will be switched off.
If OP2 = PFG, after the system enters sleep mode, the var. freq. pump will be switched off, the auxiliary pump will be switched on and runs in power frequency mode.
If OP2 = PFb, after the system enters sleep mode, the var. freq. pump will be switched off, the auxiliary pump will be switched on and runs in var. frequency mode.

9.3.2 Exit sleep mode

When the system works in sleep mode, if the measured pressure PV is less than LoP and lasts form tA, the water system will exit sleep mode and the main var. freq. pump will be restarted.

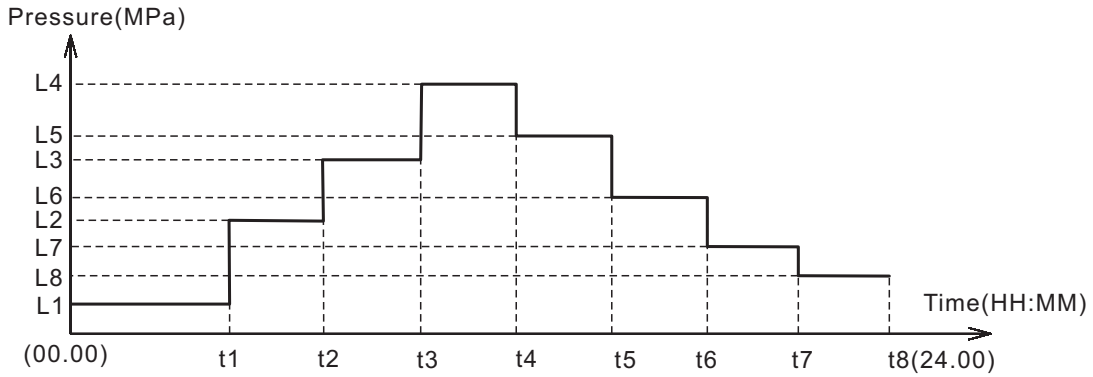
db: Allowable pressure oscillation during the adding or stopping of pumps
SLEP: Enter sleep threshold
tb: Enter sleep duration
LoP: Exit sleep threshold
tA: Exit sleep duration

10 Time-Pressure program

10.1 Overview

When the Real Time Clock (RTC) function is available, a Time-Pressure program(pattern) can be set up to implement the Time-Pressure pattern control.

In this program, a day was divided into 8 duration, with the real time clock and the pre-set pattern, the controller adjust the setting pressure and perform the closed-loop control to the pressure continuously, the time starts from 00:00 and ends at 24:00.



Time-Pressure Program

10.2 Parameters setup

With parameter CtrL=Prog and the controller works in the PV/SV indication status, press **PROG/SET**, this will reveals the first parameter in the Time-Pressure program parameter list. The parameter value can either be modified with the ∧ or ∨ key, or left unmodified. Press **PAR** key, the next parameter and its current value appears, alter the value in the same way.

If the last parameter has been reached or there is no key operation within 16 seconds, the menu times out automatically.

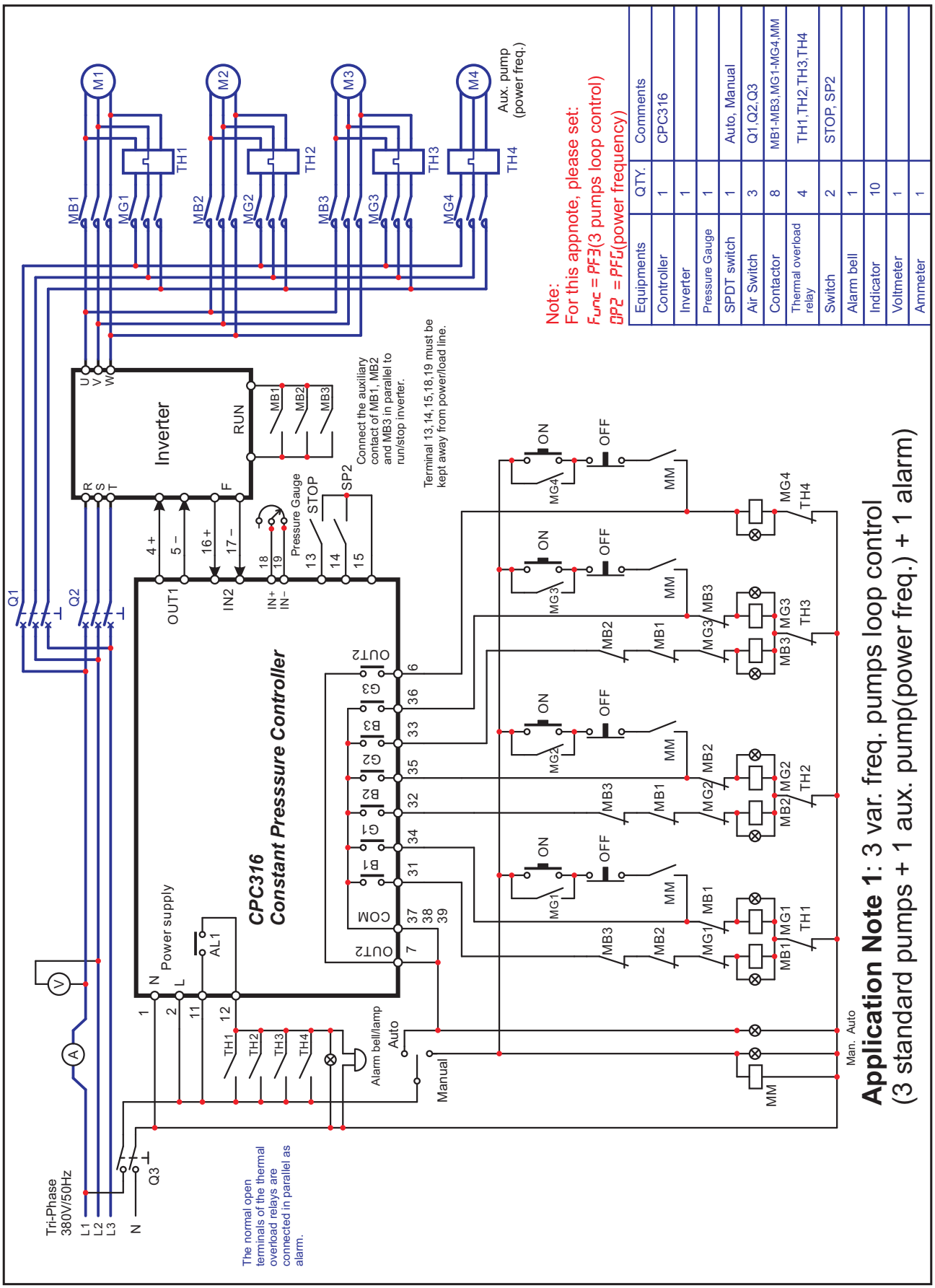
Time-Pressure Program Parameter List

No.	Mnemonic	Parameter	Adjustable Range	Comments
1	t1	Segment 1 end time	00.00 to 24.00	Only appears when CtrL = Prog
2	L1	Segment 1 target pressure	SPL to SP H	
3	t2	Segment 2 end time	00.00 to 24.00	
4	L2	Segment 2 target pressure	SPL to SP H	
…	…	…	…	

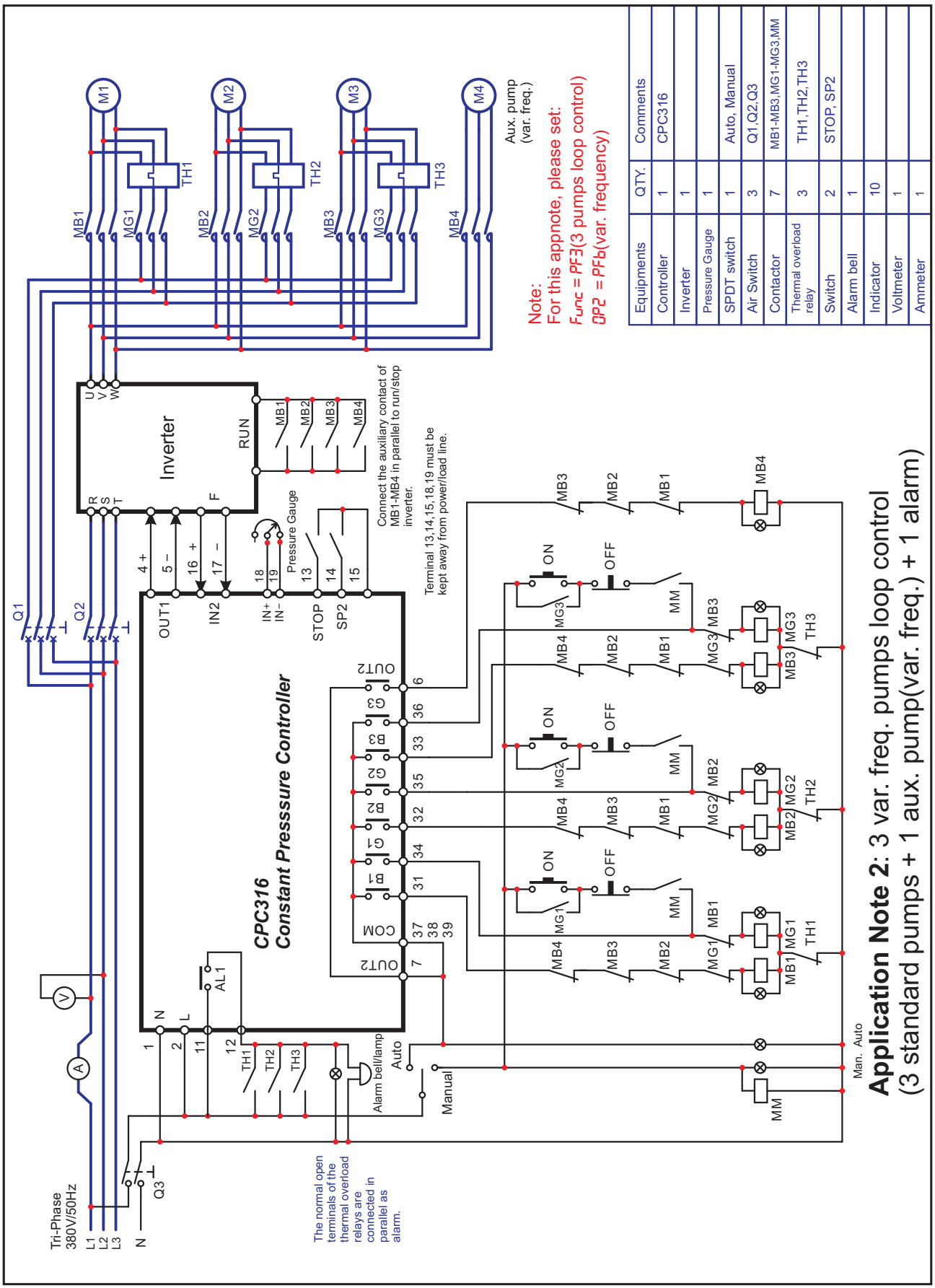
The Time-Pressure program consists of 8 segments at most, the time value in the “Time-Pressure Program” must meet the following condition: t1 < t2 < t3 < t4 < t5 < t6 < t7 < t8

According to the requirements, the user can set 1 to 8 segments(not all 8 segments), the last segment end time must be 24.00 thus the following segments will be prohibited.

Application Note 1

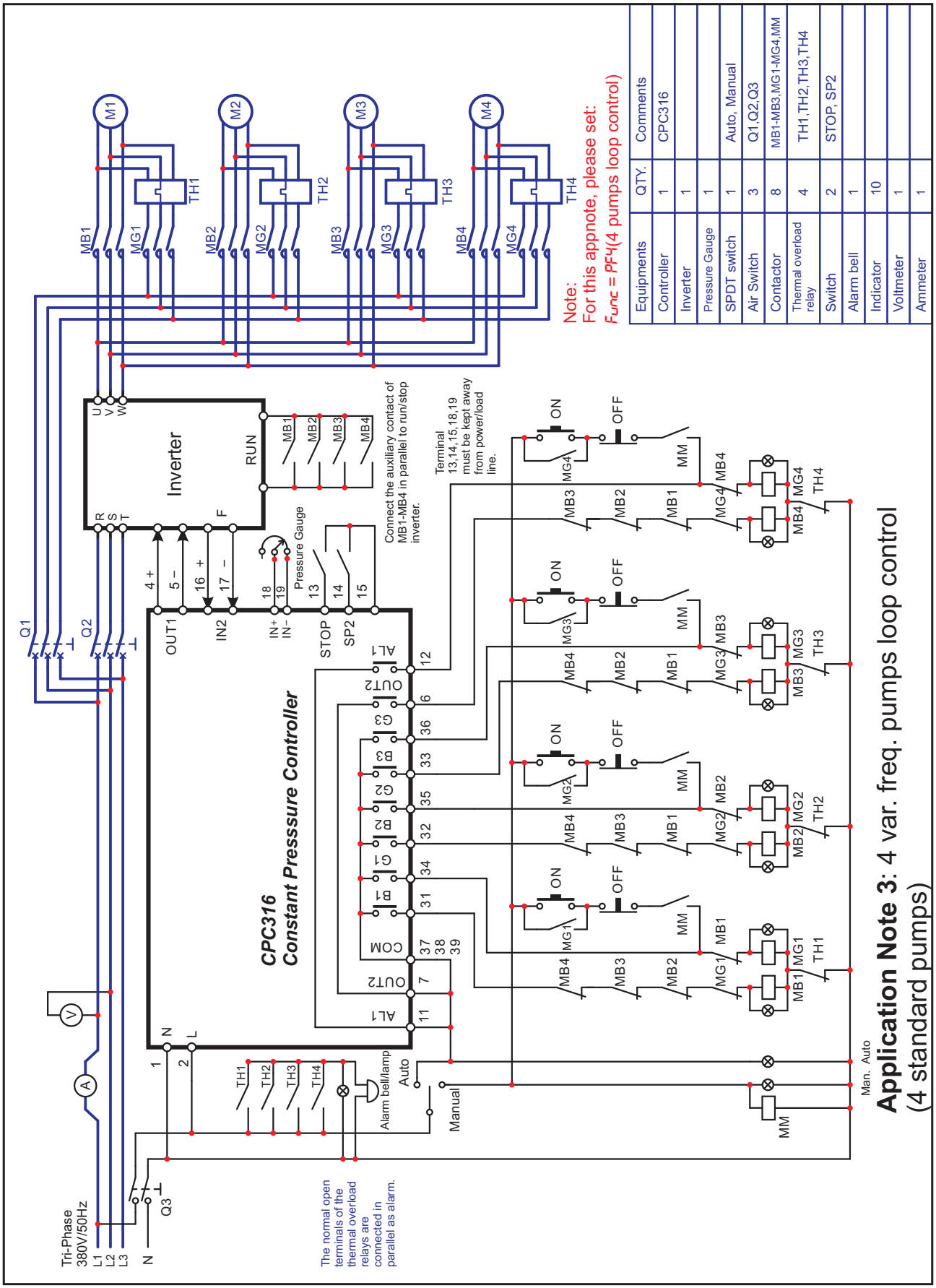


Application Note 2



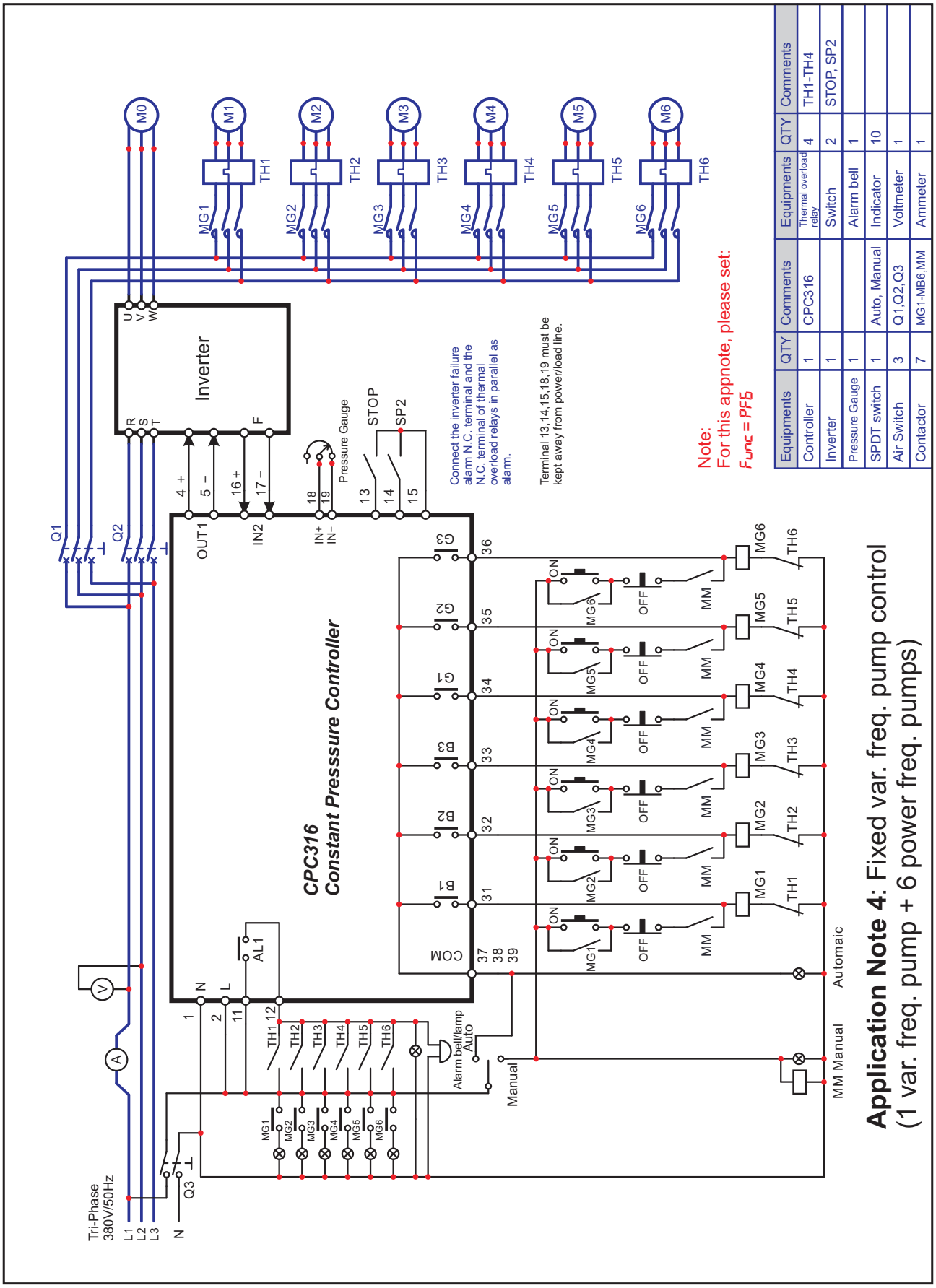
Equipments	QTY.	Comments
Controller	1	CPC316
Inverter	1	
Pressure Gauge	1	
SPDT switch	1	Auto, Manual
Air Switch	3	Q1,Q2,Q3
Contactor	7	MB1-MB3,MG1-MG3,MM
Thermal overload relay	3	TH1,TH2,TH3
Switch	2	STOP, SP2
Alarm bell	1	
Indicator	10	
Voltmeter	1	
Ammeter	1	

Application Note 3



Equipments	QTY.	Comments
Controller	1	CPC316
Inverter	1	
Pressure Gauge	1	
SPDT switch	1	Auto, Manual
Air Switch	3	Q1,Q2,Q3
Contactor	8	MB1-MB3,MG1-MG4,MM
Thermal overload relay	4	TH1,TH2,TH3,TH4
Switch	2	STOP, SP2
Alarm bell	1	
Indicator	10	
Voltmeter	1	
Ammeter	1	

Application Note 4



Equipments	QTY	Comments
Controller	1	CPC316
Inverter	1	
Pressure Gauge	1	
SPDT switch	1	Auto, Manual
Air Switch	3	Q1,Q2,Q3
Contactor	7	MG1-MB6,MM

Equipments	QTY	Comments
Thermal overload relay	4	TH1-TH4
Switch	2	STOP, SP2
Alarm bell	1	
Indicator	10	
Voltmeter	1	
Ammeter	1	

Application Note 4: Fixed var. freq. pump control
(1 var. freq. pump + 6 power freq. pumps)

Technical data

Measurement Precision	± 0.2%FS ± 1 digit
Sample Rate	100ms
Pressure Signal Inputs	0~50mV, 4~20mA, 0~10V, 0~400Ω
Outputs	Analog, 4~20mA, 0~20mA or 0~10V Relay (Normally Open, max.250VAC/3A)
Alarm	Relay (Normally Open, max.250VAC/3A)
Control Algorithm	PI (Proportional Integral)
Communications	RS232, RS485
Power Supply	100~260VAC, 50/60Hz
Environmental	Ambient temperature: 0~50 °C Relativity humidity: ≤85%
Size	96(W)x96(H)x100(D)mm

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