MMC function user manual

1.1 Introduction of constant pressure water supply system

The multi-pump control function is suitable for multiple motor systems where one drive controls the pump. The main pump connected to the output of the drive is controlled by PID, the auxiliary pump is connected to the power supply of the grid, and the breaking and closing are controlled by the internal relay of the drive.

2.1 Function code introduction

Function code introduction：
×— Indicates that this parameter cannot be changed during running
○— Indicates that the parameter can be changed during the running
●— Indicates the actual detection parameter and cannot be changed
*— Indicates that the parameter is reserved for the manufacturer and cannot be modified

2.1.1 Parameter macro

Parameter group	Parameter code	Parameter name	Parameter description	Factory value	Change
FF	**01**	**Parameter macro**	**0：Invalid** **1：MMC auto mode parameter macro** **2~9：Reserved**	**0**	×

Note: When the FF.01 is set to 1, the relevant parameters in the user manual of multi-pump control function will be set to the corresponding factory value, and the FF.01 will automatically restore to 0.

Parameter group	Parameter code	Parameter name	Parameter description	Factory value	Change
F0	04	Industry code	1：Special drive for water supply	1	×
F1	01	Channel of running commands	1：Terminal run command channel	1	○
	02	Setting channel of main frequency x command	8：PID	8	○
	06	Max output frequency	Upper limit frequency～599.00Hz	60.00Hz	×
	09	Upper limit of running frequency	Lower limit frequency ~ maximum output frequency	60.00Hz	○
	11	ACC time 1	0.01~600.00s	20.00s	○
	12	DEC time 1		30.00s	
F2	06	Start protection selection (only valid for two-wire control)	2: If the run command is valid, the drive starts at the start frequency (F2.01).	2	×
	07	Start protection wait time	0.0~1000.0s	5.0s	○

Parameter group	Parameter code	Parameter name	Parameter description	Factory value	Change
	08	Stop mode	0：Deceleration stop	0	×
	20	Running frequency of jog	0.10~F1.09	10.00Hz	○
	22	ACC time for jogging	0.01~600.00s	20.00s	○
	23	DEC time for jogging		30.00s	○
F4	00	MMC sel	4: Floating mode	4	×
	01	The number of the pump	2~8	4	×
	02	The tolerance of adding pump	0 ~ Maximum sensor range	0.2bar	○
	03	The ACC time of reducing pump	0.01~600.00s	6.00s	○
	04	Aux start DT	0.0~3600.0s	30.0s	○
	05	Auto change frequency	0.00~50.00Hz	20.00Hz	○
	06	The tolerance of reducing pump	0 ~ Maximum sensor range	0.2bar	○
	07	The DEC time of adding pump	0.01~600.00s	6.00s	○
	08	Aux stop DT	0.0~3600.0s	30.0s	○
	10	Auto change mode selection	0: None 1: Main Exchange	1	×
	11	Auto change time	1~65535min	72min	○
	12	Interlock DT	0.0~60.0s	3.0s	×
	13	The operating priority of MMC	0：FIFO 1：FILO	1	×
F6	00	Function selection of DI1	1: Forward running FWD (edge+ level)	1	×
	01	Function selection of DI2-DI5	44: Interlock 1	44	×
	02		45: Interlock 2	45	×
	03		46: Interlock 3	46	×
	04		47: Interlock 4	47	×
	06	Function selection of DI7 (expansion card)	48: Interlock 5	48	×
	08	Function selection of DI9 (expansion card)	49: Interlock 6	49	×
Fb	34	Function selection of DI11 (expansion card)	50: Interlock 7	50	×

Parameter group	Parameter code	Parameter name	Parameter description	Factory value	Change
	35	Function selection of DI13 (expansion card)	51: Interlock 8	51	×
F6	13	Relay output (TA/TB/TC)	17: Drive fault	17	×
	38	TC1~TC8 Relay output	0: No function 30: MMC output	30	×
	39				×
	40				×
	41				×
	42			0	×
	43				×
F9	58				×
	59				×
F8	02	PID feedback source	1：AI2	1	×
	05	PID digital setting	0~ Maximum sensor range	5.0bar	○
	27	Water supply wake pressure tolerance	**Notes：Wake up pressure = PID digital setting (F8.05) – Water supply wake pressure tolerance (F8.27)**	1.0bar	○
	15	PID control deviation limit	**Sleep pressure = PID digital setting (F8.05) – PID control deviation limit (F8.15)**	0.2bar	○
	28	Water supply wake detection time	0.0~3600.0s	20.0s	○
	35	Water supply sleep detection time	0.0~3600.0s	20.0s	○
	36	Sleep frequency	Lower limit frequency ~ upper limit frequency	55.00Hz	○
F9	50	Motor 1 start frequency	F9.54~F1.09	45.00Hz	○
	51	Motor 2 start frequency	F9.55~F1.09	45.00Hz	○
	52	Motor 3 start frequency	F9.56~F1.09	45.00Hz	○
	53	Motor 4 start frequency	F9.57~F1.09	45.00Hz	○
	54	Motor 1 stop frequency	F1.10~F9.50	20.00Hz	○
	55	Motor 2 stop frequency	F1.10~F9.51	20.00Hz	○
	56	Motor 3 stop frequency	F1.10~F9.52	20.00Hz	○
	57	Motor 4 stop frequency	F1.10~F9.53	20.00Hz	○
FC	25	Motor 5 start frequency	FC.29~F1.09	45.00Hz	○
	26	Motor 6 start	FC.30~F1.09	45.00Hz	○

Parameter group	Parameter code	Parameter name	Parameter description	Factory value	Change
		frequency			
	27	Motor 7 start frequency	FC.31~F1.09	45.00Hz	○
	28	Motor 8 start frequency	FC.32~F1.09	45.00Hz	○
	29	Motor 5 stop frequency	F1.10~FC.25	20.00Hz	○
	30	Motor 6 stop frequency	F1.10~FC.26	20.00Hz	○
	31	Motor 7 stop frequency	F1.10~FC.27	20.00Hz	○
	32	Motor 8 stop frequency	F1.10~FC.28	20.00Hz	○
FA	08	Automatic reset times	0~100	10	×
	09	Automatic reset interval time	0.1~1000.0s	8.0s	×

Note: Please refer to the detailed user manual for detailed explanation of the above table parameters;

2.1.2 Parameter specification

Parameter group	Parameter code	Parameter name	Parameter description
F4	00	MMC sel	2: Fixed mode 4: Floating mode
	01	The number of the pump	2~8 Decide how many pumps you need to use.
	02	The tolerance of adding pump	0~ Maximum sensor range Pressure difference between source and feedback to turn on aux motors. When the feedback pressure < (setting pressure-F4.02), the pressure conditions for adding an auxiliary pump are met. Pressure difference between source and feedback to turn off aux motors. When the feedback pressure > (setting pressure+F4.06), the pressure conditions for reducing an auxiliary pump are met.
	06	The tolerance of reducing pump	
	03	The ACC time of reducing pump	0.01~600.00s When the auxiliary pump starts or stops, the main pump stops PID control and performs general acceleration and deceleration operations. When the auxiliary pump starts, the main pump decelerates to the auxiliary pump reducing pump frequency (F9.54~F9.57, F9.29~F9.32 pump 1~8 reducing pump frequency) according to the deceleration time set at F4.07. When the auxiliary pump stops, the main pump will speed up to the adding pump frequency (F9.50~F9.53, F9.25~F9.28 pump 1~8 adding pump frequency) Accelerate according to the acceleration time set at F4.03.
	07	The DEC time of adding pump	
	04	Aux start DT	0.0～3600.0s When the pressure conditions of adding pump or reducing pump are met (see F4.02 or F4.06 parameter explanation), and the pump can be added or reduced at this time, the pump is added after the pump delay time (F4.04) or the pump is reduced after the pump delay time (F4.08).
	08	Aux stop DT	
	05	Auto change frequency	0.00~50.00Hz
	10	Auto change mode selection	0: None 1: Main Exchange
	11	Auto change time	1~65535min
	12	Interlock DT	0.0~60.0s
	13	The operating priority of MMC	0: FIFO 1: FILO Set the pump sequency in floating mode. FIFO: Same on/off sequence as auxiliary pump. FILO: Reverse the on/off sequence of the auxiliary pump.
	14	The number of	0~8

Parameter group	Parameter code	Parameter name	Parameter description
		running pump	Displays the number of pumps in operation.
	15	Pump priority 1	0~9999 Displays the running priority of the pump. According to setting by users, it can be influenced by Interlock, Auto Change and operating time. **Each digit of F4.15 represents one pump**: Thousand digits: pump 4 Hundreds digit: pump 3 Tens digit: pump 2 Unit digit: pump 1 **Each digit of F4.16 represents one pump**: Thousand digits: pump 8 Hundreds digit: pump 7 Tens digit: pump 6 Unit digit: pump 5 Value explanation： A smaller value indicates a higher priority. Eg: 1>2>3>4>5>6>7>8。
	16	Pump priority 2	
	17	Auto change operation time	000min:00s~655min:35s
	18	Pump running status 1	0~3333 Displays the running status of the pump. According to setting by users, it can be influenced by Interlock, Auto Change and operating time. **Each digit of F4.18 represents one pump**: Thousand digits: pump 4 Hundreds digit: pump 3 Tens digit: pump 2 Unit digit: pump 1 **Each digit of F4.19 represents one pump**: Thousand digits: pump 8 Hundreds digit: pump 7 Tens digit: pump 6 Unit digit: pump 5 **Value explanation** 1：Drive control 2：Power grid control 3：Standby 9：Stop
	19	Pump running status 2	
	20	Pump start serial number	0~7 The serial number of the pump with the highest priority 0 to 7 indicates pump 1 to 8.

3.1 Function Introduction

- Basic Sequence
- Standby Motor
- Auto Change
- Interlock

3.1.1 Multiple Motor Control (MMC) Basic Sequence

Multiple motor control (MMC) is an operation based on PID control. During an MMC operation, the main and auxiliary motors organically operate together.

In PID operation, there are two basic sequences, the sequence of adding pump and reducing pump.

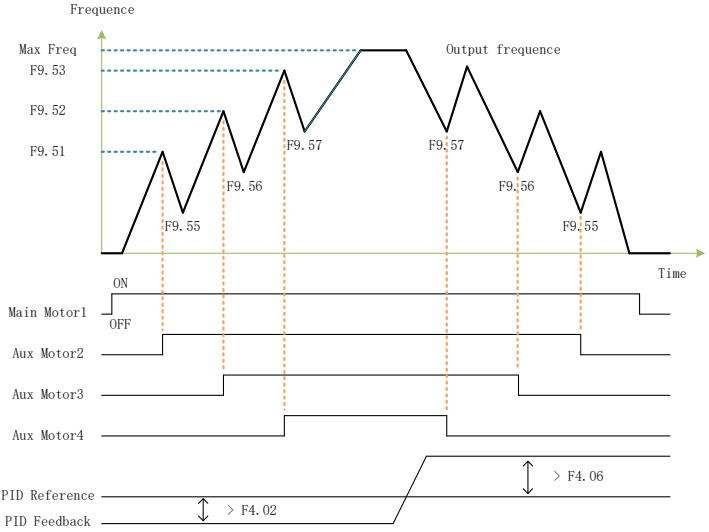
When the drive frequency reaches the start frequency set at F9.50-F9.53, F9.25-F9.28 (Pump 1-8 start frequency)，and after the Aux start delay time (F4.04), if the pressure conditions are met: feedback pressure < (setting pressure - the tolerance of adding pump (F4.02)), will add one aux pump. At the same time, in order to reduce the excessive fluctuation of water pressure, the drive stop PID control, and go to deceleration operation. After the DEC time of adding pump (F4.07), decelerating to the reducing pump frequency of the auxiliary pump. (F9.54~F9.57, F9.29~F9.32 pump 1~8 stop frequency).

When the drive frequency drop to the stop frequency set at (F9.54~F9.57, F9.29~F9.32 pump 1~8 stop frequency), and after the Aux stop delay time (F4.08), if the pressure conditions are met: feedback pressure > (setting pressure + the tolerance of reducing pump (F4.06)), will reduce one aux pump. At the same time, in order to reduce the excessive fluctuation of water pressure, the drive stop PID control, and go to acceleration operation. After the ACC time of reducing pump (F4.03)，accelerating to the adding pump frequency of the auxiliary pump. (F9.50~F9.53, F9.25~F9.28 pump 1~8 start frequency).

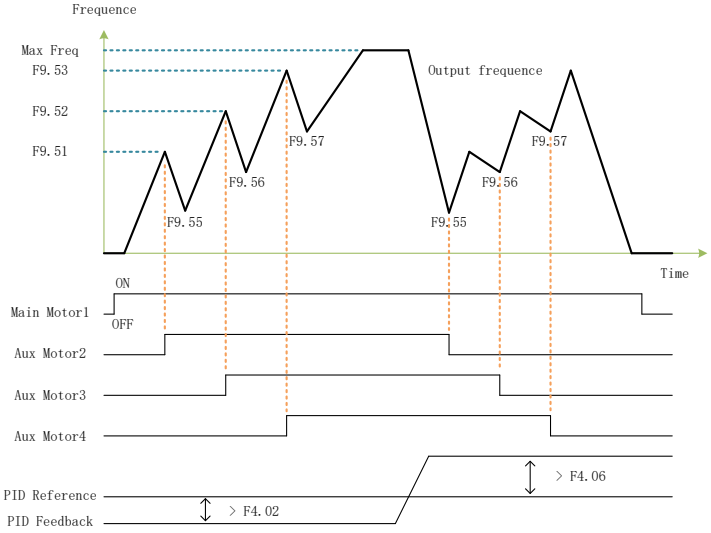
Parameter group	Parameter code	Parameter name	Parameter description
F9	50	Motor 1 start frequency	F9.54~F1.09
	51	Motor 2 start frequency	F9.55~F1.09
	52	Motor 3 start frequency	F9.56~F1.09
	53	Motor 4 start frequency	F9.57~F1.09
	54	Motor 1 stop frequency	F1.10~F9.50
	55	Motor 2 stop frequency	F1.10~F9.51
	56	Motor 3 stop frequency	F1.10~F9.52
	57	Motor 4 stop frequency	F1.10~F9.53
FC	25	Motor 5 start frequency	FC.29~F1.09
	26	Motor 6 start frequency	FC.30~F1.09
	27	Motor 7 start frequency	FC.31~F1.09
	28	Motor 8 start frequency	FC.32~F1.09
	29	Motor 5 stop frequency	F1.10~FC.25
	30	Motor 6 stop frequency	F1.10~FC.26
	31	Motor 7 stop frequency	F1.10~FC.27
	32	Motor 8 stop frequency	F1.10~FC.28

The following diagram depicts the basic sequence setup for multi-pump control based on FILO

and FIFO:

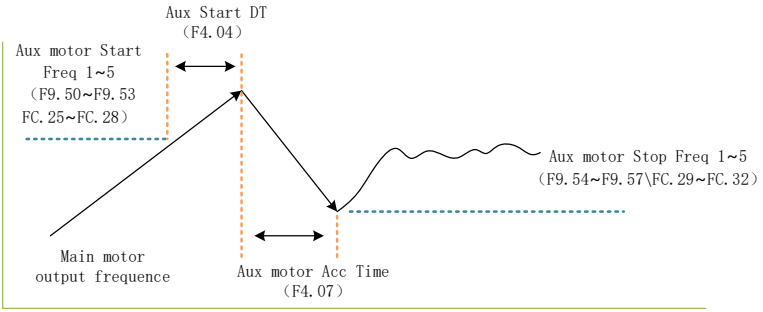


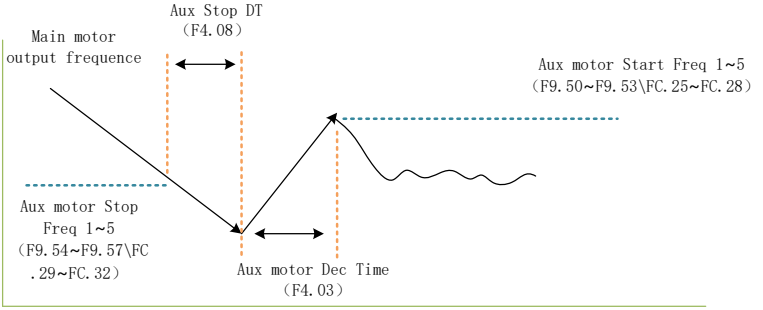
Basic operation - FILO



Basic operation - FIFO

The following diagram shows the running curves of the delay time for starting and stopping the auxiliary pump based on F4.04 (Start DT) and F4.08 (Stop DT) Settings。





When the output frequency of the drive reaches the start frequency or stop frequency of the auxiliary pump, the auxiliary pump waits for the time set by F4.04 (pumping delay) or F4.08 (depumping delay) before the auxiliary pump performs pumping or depumping operation.

3.1.2 Standby Motor

The drive will calculate the number of functions selected as 30 (multi-pump control output) according to the settings of parameters F6.38~F6.43 and F9.58~F9.59 (relay TC1~TC8 output function selection), and the calculation result is equivalent to the number of pumps connected.

The drive recognizes the maximum number of pumps operating at the same time according to the setting of parameter F4.01 (Number of pumps).

The drive determines whether the corresponding pump is allowed to participate in the multi-pump control according to the settings of parameters F6.01~F6.04, F6.06, F6.08, Fb.34, Fb.35 (function selection of multi-function input terminals DI2~DI5, DI7, DI9, DI11, DI139). Functions 44 to 51 correspond to multiple pump control input functions 1 to 8.

Eg: In this case, the parameters F6.38 = 30, F6.39 = 30, F6.40 = 30, F6.43 = 30, F9.58 = 30, then it is determined that five pumps are connected on the wiring, and these five pumps are pumps 1 to 5. If pumps 1 to 5 all detect multiple pump control input signals, and F4.01 = 3 (Number of pumps), the maximum number of pumps working at the same time is 3, and it is any 3 of pumps 1 to 5.

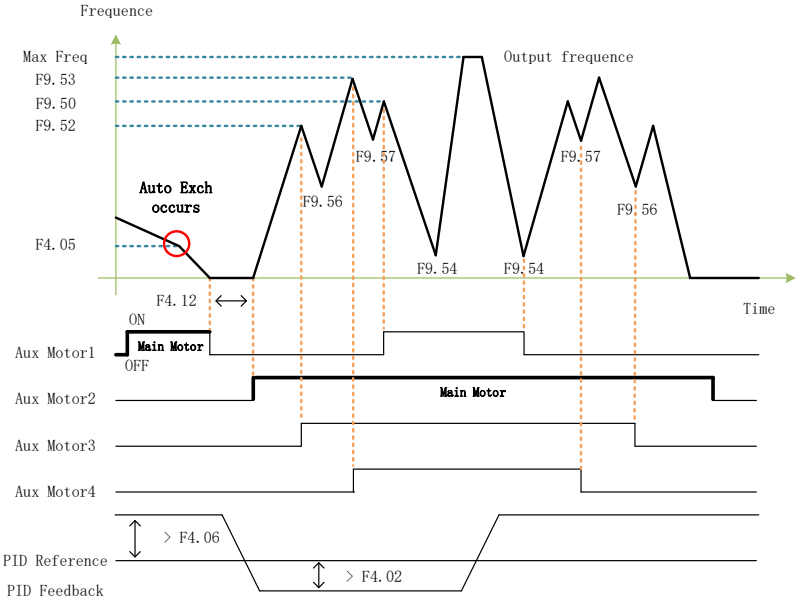
As shown in the following table：

Pump 1	Pump 2	Pump 3	Pump 4	Pump 5
Operable	Operable	Operable	Standby	Standby

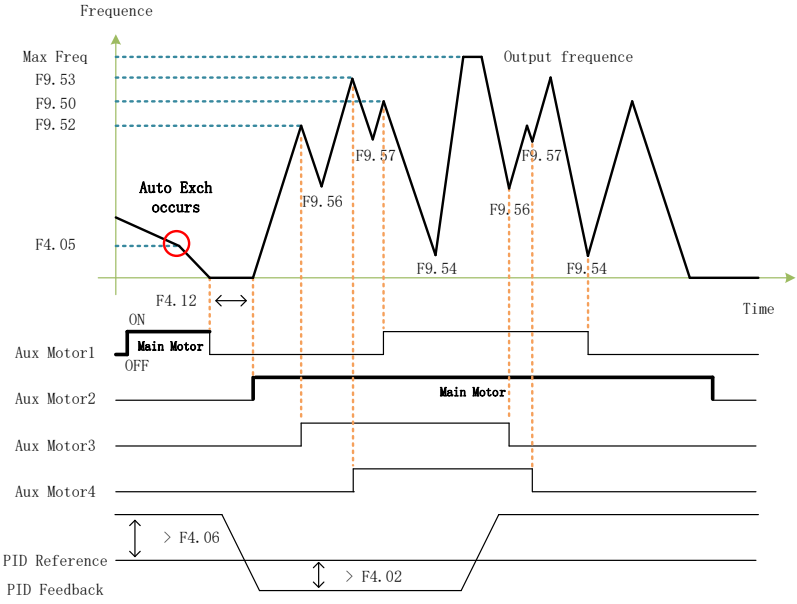
3.1.3 Auto Change

Parameter group	Parameter code	Parameter name	Parameter description
F4	10	Auto change mode selection	0: None 1: Main Exchange Choose whether to use auto change function
	05	Auto change frequency	0.00~50.00Hz
	11	Auto change time	1~65535min
	12	Interlock DT	0.0~60.0s
	17	Auto change operation time	000min:00s~655min:35s In the multi-pump control automatic mode, when only a single pump is running at a small flow, the inverter operating frequency is lower than F4.05 (auto change frequency) and F4.17 (auto change operation time display) < F4.11 (auto change setting time), F4.17 will start timing. F4.17 will clear to zero when the auto change operation is complete. The high three bits of F4.17 represent the running time in minutes, and the low two bits of F4.17 represent the running time in seconds. For example: 120:33: indicates that the running time is 120 minutes and 33 seconds.

In the multi-pump control automatic mode, when only one pump is running at a low flow, when the drive operating frequency is lower than F4.05 (auto change frequency) and F4.17 (auto change operating time display) > F4.11 (auto change setting time), the auto change operation will be carried out, and the pump driven by the current drive will be switched to the set pump.



Auto Change operation - FIL0



Auto Change operation - FIF0

3.1.4 Interlock

When there is motor trouble, the interlock feature is used to stop the affected motor and replace it with another that is not currently operating (off state). To activate the interlock feature, connect the cables for abnormal motor signal to the drive digit input terminal and configure the DI terminals as interlock 1–5 inputs (F6.01~F6.04, F6.06, F6.08, Fb.34~Fb.35 Set to functions 44~51, corresponding to pumps 1~8 interlock). The drive determines whether the corresponding pump needs to be repaired according to the DI input signal (with signal input: no repair, without signal input: repair).

After F6.01~F6.04, F6.06, F6.08, Fb.34~Fb.35 are set as No. 44~51 interlock functions, for example, when the multi-pump control input signal of pump 1 is not detected, the output relay of the pump is off, and motor 1 will not participate in the auto change of multi-pump control, and the priority will be displayed as' 9 '. When the multi-pump control input signal of pump 1 is detected, the pump will re-participate in the auto change of multi-pump control, and the priority will change to the lowest priority, starting from the lowest priority.

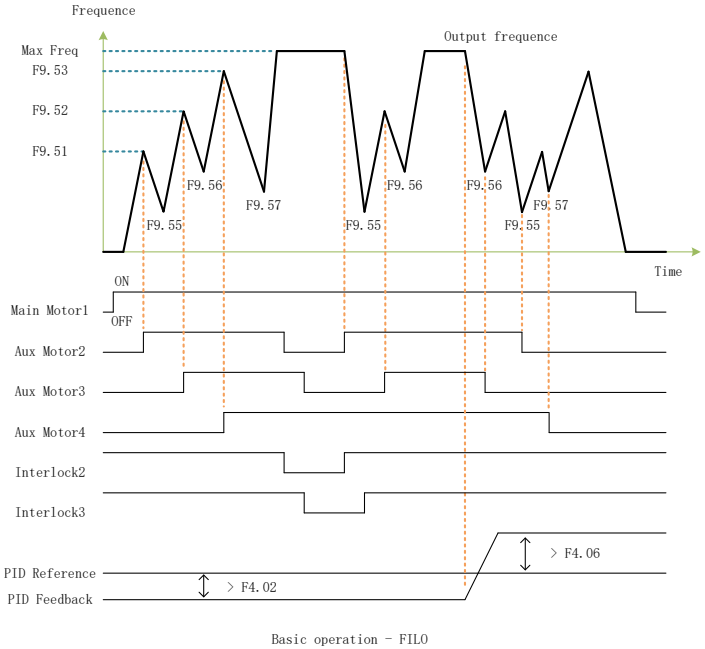
The following figure illustrates the interlock function with examples of FILO and FIFO sequence respectively.

In the figure below, motor 1 is the main pump, motor 2~4 are the auxiliary pump, where Interlock2 and Interlock3 respectively represent the multi-pump control input signals of pump 2 and pump 3, 'ON' is the signal input, 'OFF' is the no signal input.

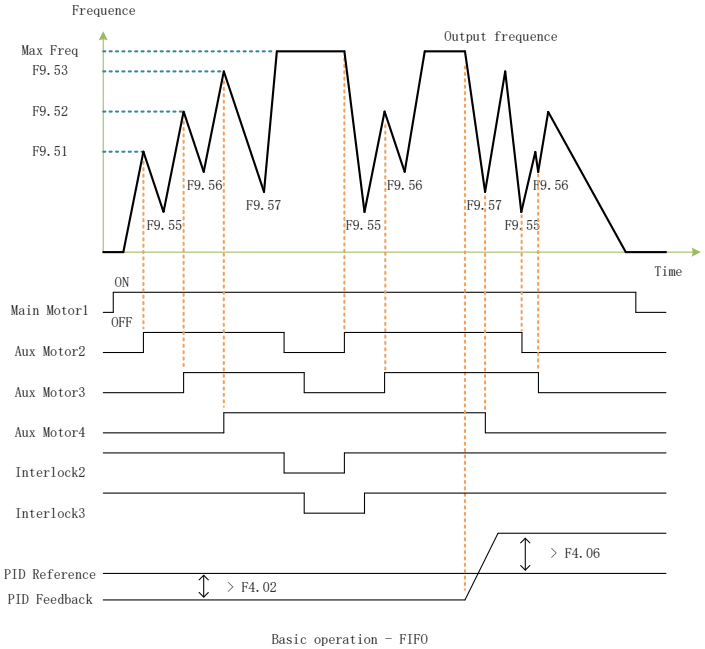
In the figure below, before Interlock2 and Interlock3 change from 'ON' to 'OFF', pumps 1 to 4 are in the running state. When Interlock2 and Interlock3 change from 'ON' to 'OFF', the relays controlling pump 2 and pump 3 are disconnected respectively. At this time, pump 2 and pump 3 are shut down freely, and only pump 1 and pump 4 are in operation.

When Interlock2 and Interlock3 change from 'OFF' to 'ON', since the feedback pressure < (set pressure - F4.02), it is still necessary to start pump 2 and pump 3 again.

When the feedback pressure > (set pressure + F4.06), the pump is shut down in accordance with FILO or FIFO sequence, as shown in the figure below.



Basic operation - FILO



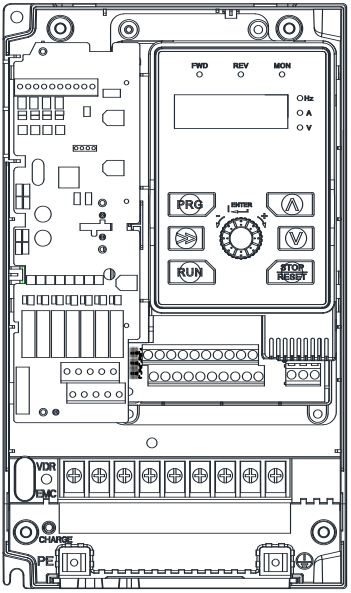
In the above figure, before Interlock2 and Interlock3 change from 'ON' to 'OFF', the priority display parameter (F4.15) of pumps 1 to 4 is' 4321 '. When Interlock2 changes from 'ON' to 'OFF', F4.15 becomes' 3291 '. When Interlock3 changes from 'ON' to 'OFF', F4.15 changes to '2991', where '9' indicates that the maintenance exits the multi-pump automatic control mode.

When Interlock2 changes from 'OFF' to 'ON', F4.15 becomes' 2931 ', and when Interlock3 changes from 'OFF' to 'ON', F4.15 becomes' 2431 '.

In the priority, 1>2>3>4>5>6>7>8, so according to the pump stop sequence of FILO, the pumps that are shut down in turn are: pump 3, pump 2, pump 4, pump 1, according to the pump stop sequence of FIFO, the pumps that are shut down in turn are: pump 4, pump 2, pump 3, pump 1.

3.2 The introduction of expansion card for multi-pump control function

3.2.1 The installation of expansion card



3.2.2 The terminal instruction of expansion card

This expansion card is usually used when using the MMC control function.
The external terminal layout is shown in the table.

Expansion card

DI7	DI9	DI11	DI13	COM	COM	PLC	PLC	24V	24V

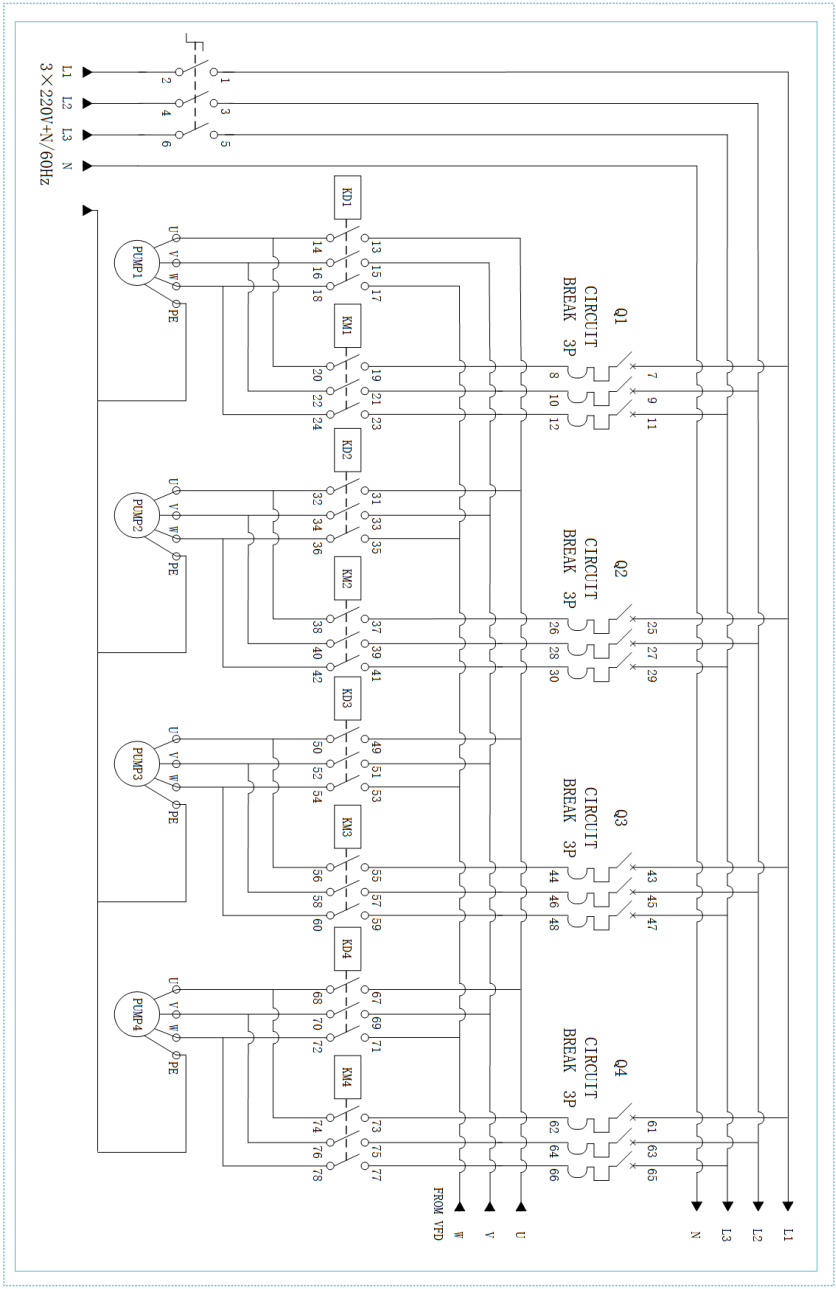
DI7/DI9/DI11/DI13 are multi-function input terminals. Their corresponding function setting parameters are F6.06/F6.08/Fb.34/Fb.35. For parameter setting, refer to the parameter F6.00 set in the manual or the application documentation.

NOTE : PLC and 24V are shorted by short splicing before delivery.

TC1	TC3	TC5	TC7	TA2
TC2	TC4	TC6	TC8	TA2

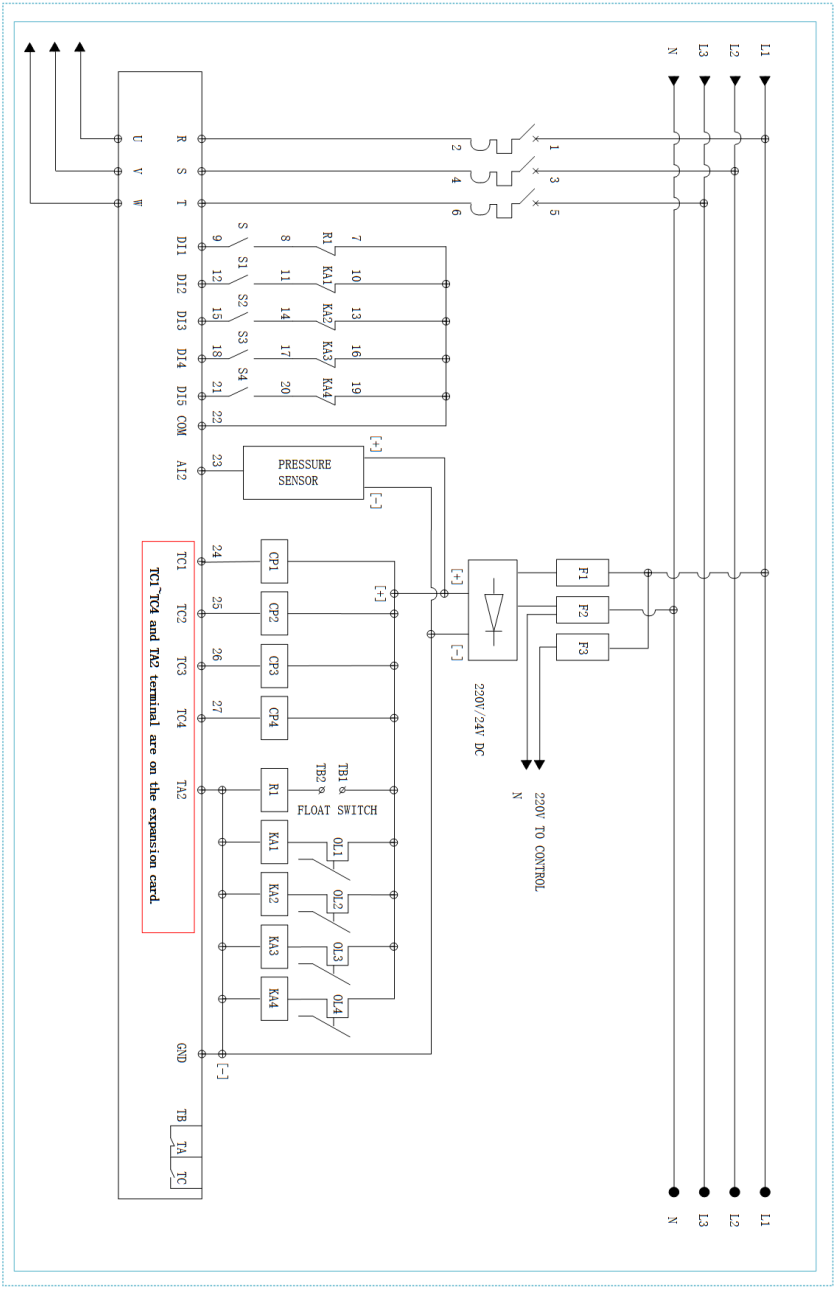
TC1~TC8 are normally open relays, among which TA2 is their common contact, TC1~TC8 relays corresponding function setting parameters are F6.38/F6.39/F6.40/F6.41/F6.42/F6.43/F9.58/F9.59, parameter setting can refer to the instruction manual And the application documentation on parameter F6.13 setting.

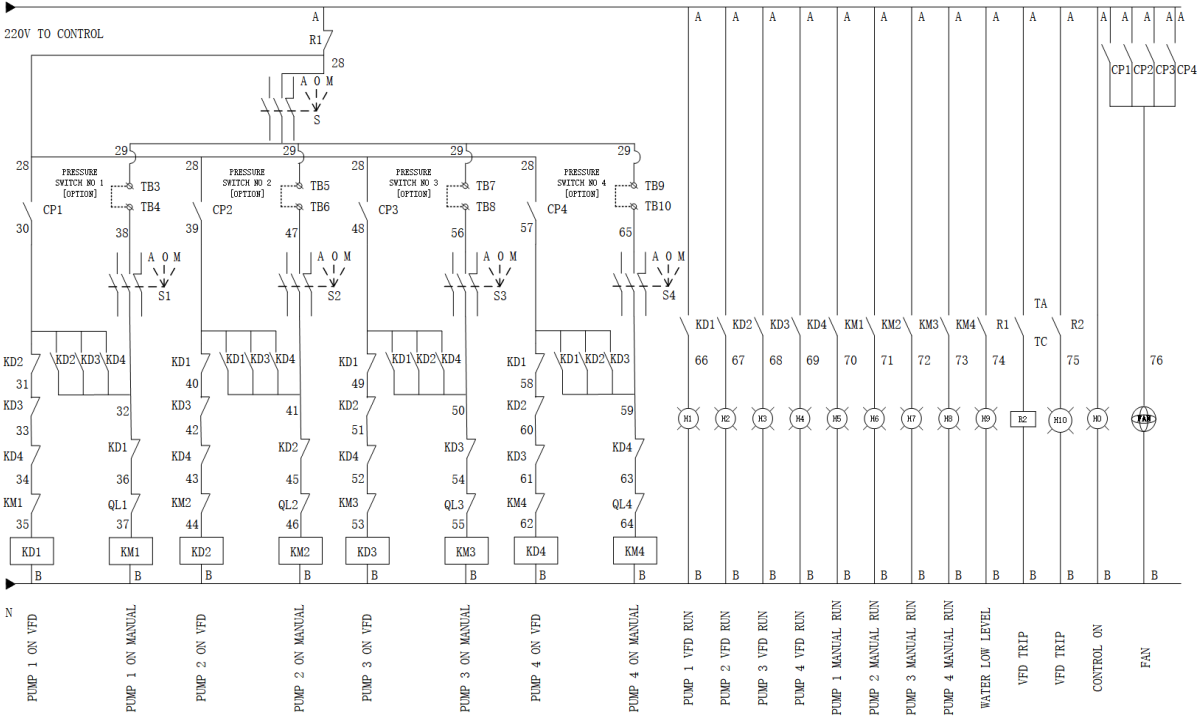
3.3 Power supply circuit



S

3.4 Control circuit




220V TO CONTROL
A
R1
28
A O M
S
29
28
PRESSURE SWITCH NO 1 [OPTION]
TB3
TB4
CP1
30
38
A O M
S1
KD2
31
KD3
33
KD4
34
KM1
35
KD1
B
KD2 KD3 KD4
32
KD1
36
QL1
37
KM1
B
N
PUMP 1 ON VFD
PUMP 1 ON MANUAL
39
47
PRESSURE SWITCH NO 2 [OPTION]
TB5
TB6
CP2
A O M
S2
KD1
40
KD3
42
KD4
43
KM2
44
KD2
B
KD1 KD3 KD4
41
KD2
45
QL2
46
KM2
B
PUMP 2 ON VFD
PUMP 2 ON MANUAL
48
56
PRESSURE SWITCH NO 3 [OPTION]
TB7
TB8
CP3
A O M
S3
KD1
49
KD2
51
KD4
52
KM3
53
KD3
B
KD1 KD2 KD4
50
KD3
54
QL3
55
KM3
B
PUMP 3 ON VFD
PUMP 3 ON MANUAL
57
65
PRESSURE SWITCH NO 4 [OPTION]
TB9
TB10
CP4
A O M
S4
KD1
58
KD2
60
KD3
61
KM4
62
KD4
B
KD1 KD2 KD3
59
KD4
63
QL4
64
KM4
B
PUMP 4 ON VFD
PUMP 4 ON MANUAL
A
KD1
66
M1
B
PUMP 1 VFD RUN
KD2
67
M2
PUMP 2 VFD RUN
KD3
68
M3
PUMP 3 VFD RUN
KD4
69
M4
PUMP 4 VFD RUN
KM1
70
M5
PUMP 1 MANUAL RUN
KM2
71
M6
PUMP 2 MANUAL RUN
KM3
72
M7
PUMP 3 MANUAL RUN
KM4
73
M8
PUMP 4 MANUAL RUN
R1
74
M9
WATER LOW LEVEL
TA
TC
R2
75
B2
M10
VFD TRIP
M0
VFD TRIP
CONTROL ON
CP1 CP2 CP3 CP4
76
FAN