

TOSVERT VF-AS3

Pump control function Manual

TOSHIBA INDUSTRIAL PRODUCTS AND SYSTEMS CORPORATION

NOTICE

1. Read this manual before installing or operating the inverter. Keep it in a safe place for reference.
2. All information contained in this manual will be changed without notice.

■ Function

VF-AS3 can save the power of water pump system by controlling each pump appropriately.

To control number of pump, the following methods are available.

DO NOT use this function after execute F519=1, which means the unit of Acc/Dec are 0.01s, in case you use software version V106 or before.

- Operate pump 0 by inverter, and increase/decrease the number of pumps connected to commercial power (A200=1)
- For up to four pumps by one inverter, increase/decrease the number of pumps by switching inverter operation and commercial power operation (A200=2)
- Operate up to 10 pumps by inverter (for each pump), and increase/decrease the number of pumps via RS485 communication (A200=7)

■ Parameter setting

No.	Parameter name	Adjustment range	Default setting	Parameter Available (X) Not available (-)		
				A200=1	A200=2	A200=7
A200	Pump control	0: Disabled 1: Multiple operation1 (Inverter fix, PID) 2: Multiple operation1 (regular operation, PID) 3-6: - 7: INV to INV communication drive 1 (PID)	0	X	X	X
A201	Terminal R4 (B) function	210: Always OFF	210	X	X	-
A202	Terminal R5 (B) function	211: Always ON 212: Pump control	210	X	X	-
A203	Terminal R6 (B) function	213: Pump control (Inverse)	210	X	X	-
A209	Pump follower number	0-9	0	-	-	X
A210	Pump number select	Set the pump number you want to disconnect from the system 0: Disabled +1: Pump 1 +2: Pump 2 +4: Pump 3 +8: Pump 4 +16: Pump 5 +32: Pump 6 +64: Pump 7 +128: Pump 8 +256: Pump 9	0	X	X	X
A211	Pump cumulative data clear	0-9: - 10-19: Pump 0 to 9 Cumulative run time clear 20-29: Pump 1 to 9 Number of starting clear (The number of starting of the pump 1 to 9 cannot be monitored.)	0	X	X	X
A212	Pump Switching sequence	0: Fix 1: Round 2: Operation time homogenization	0	X	X	X

No.	Parameter name	Adjustment range	Default setting	Parameter Available (X) Not available (-)		
				A200=1	A200=2	A200=7
A213	Commercial power running pump operation during run command OFF	0: Stop 1: Stop when trip only 2: Continue running	0	X	X	-
A220	Pump increase detection frequency	0.0 – UL (Hz)	50.0/60.0 ^{*1} (after V106) UL (before V104)	X	X	X
A221	Pump increase detection time	0.0 – 600.0 (s)	3.0 (after V106) 0.0 (before V104)	X	X	X
A222	Pump decrease detection frequency	0.0 – UL (Hz)	0.0	X	X	X
A223	Pump decrease detection time	0.0 – 600.0 (s)	3.0 (after V106) 0.0 (before V104)	X	X	X
A224	Pump switching wait time	0.0 – 10.0 (s)	0.5	-	X	-
A225	Pump increase switching Dec	0.0: Depend on Dec time 0.1 – 6000 (s)	10.0	X	-	-
A226	Pump increase switching frequency	0.0 – A220 (Hz)	0.0	X	-	-
A227	PID start frequency at pump increase switching	0.0 – UL (Hz)	0.0 (after V106) A222 (before V104)	X	-	-
A228	Pump decrease switching ACC	0.0: Depend on ACC time 0.1 – 6000 (s)	10.0	X	-	-
A229	Pump decrease switching frequency	A222 – UL (Hz)	50.0/60.0 ^{*1} (after V106) UL (before V104)	X	-	-
A230	PID start frequency at pump decrease switching	0.0 – UL (Hz)	50.0/60.0 ^{*1} (after V106) A220 (before V104)	X	-	-
A231	Pump increase/decrease detection deadband	0.0: Disabled 0.1 – 50.0 (%)	0.0	X	X	X

*1: depend on the setup menu

RS485 communication function parameters (for A200=7)

Title	Parameter name	Adjustment range	Default setting
F802	Inverter number	0 to 247	0
F820	RS485 (2) baud rate	0: 9600bps 1: 19200bps 2: 38400bps	1
F821	RS485 (2) parity	0: Disabled 1: Even parity 2: Odd parity	1
F823	RS485 (2) time-out time	0.0: Disabled 0.1 to 100.0(s)	0.0
F824	RS485 (2) time-out operation	1: Continue running 4: Trip 6: Trip after Deceleration stop	1
F827	RS485 (2) protocol	0: TOSHIBA 1: MODBUS	0
F828	RS485 (2) time-out detection	0: Always 1: Run command and frequency command by communication are enabled. 2: During run by communication	1
F829	RS485 (2) wiring type	0: 2-wire 1: 4-wire	0

Title	Terminal function, Monitor	Function	No.	A200=1	A200=2	A200=7
F1xx	Input terminal function	Output terminal function OFF during pump control (disabled pump control output set by [A210])	176/177	X	X	-
		Pump switching during pump control (enabled when [A212]=1,2)	138/139	X	X	-
F7xx	Monitor	Pump 0 run time	95	X	-	X
		Pump 1 run time	96	X	X	X
		Pump 2 run time	97	X	X	X
		Pump 3 run time	98	X	X	X
		Pump 4 run time	99	X	X	X
		Pump 5 run time	105	X	-	X
		Pump 6 run time	106	X	-	X
		Pump 7 run time	107	X	-	X
		Pump 8 run time	108	X	-	X
Pump 9 run time	109	X	-	X		

■ Pump number and relay

Each pump is connected to commercial power via magnetic contactor which is controlled by relay output signal of the inverter.

Pump number and relay output are below.

There are 3 relay output terminals on the inverter.

Furthermore, 2 of ETB014Z (I/O extension (2)) can be inserted to the inverter. There are 3 relay output terminals on the option, so maximum 9 relay output terminals can be used.

Option A: ETB014Z in slot A

Option B: ETB014Z in slot B

●[A200]="1"

Pump No.	[A210] ^{*1} detached pump	Relay	Output terminal setting	Note	Run time Monitor No.
Pump 0	-	Inverter	-	-	95
Pump 1	+1	R1	F133=212	Determine the pump number by the relay.	96
Pump 2	+2	R2	F134=212		97
Pump 3	+4	R4A(option in slot A)	F161=212		98
Pump 4	+8	R5A(option in slot A)	F162=212		99
Pump 5	+16	R6A(option in slot A)	F163=212		105
Pump 6	+32	R4B(option in slot B)	A201=212		106
Pump 7	+64	R5B(option in slot B)	A202=212		107
Pump 8	+128	R6B(option in slot B)	A203=212		108
Pump 9	+256	FL (R0)	F132=212		109

^{*1}: If you want to detach the pump from the system, set the appropriate number to A210.

•[A200]="2"

Pump No.	[A210] ^{*1} detached pump	Relay	Output terminal setting	Note	Run time Monitor No.
Pump 1 inverter	+1	R1	F133=212	Determine the pump number by the relay.	96
Pump 1 commercial power		R2	F134=212		
Pump 2 inverter	+2	R4A (option in slot A)	F161=212		97
Pump 2 commercial power		R5A(option in slot A)	F162=212		
Pump 3 inverter	+4	R6A(option in slot A)	F163=212		98
Pump 3 commercial power		R4B(option in slot B)	A201=212		
Pump 4 inverter	+8	R5B(option in slot B)	A202=212		99
Pump 4 commercial power		R6B(option in slot B)	A203=212		
-	-	FL (R0)	-		-

^{*1}: If you want to detach the pump from the system, set the appropriate number to A210.

■ Pump number and inverter number

In case there are multiple systems which consists a pump driven by inverter, all pumps can be operated by following way.

- Fix one "Master inverter", and "follower inverter (for others)"
- Connect RS485 between "master inverter" to "follower inverters"
- Send frequency command from "master inverter" to each "follower inverter" via RS485 communication

To realize this operation, each inverter number must be set as the table below.

•[A200]="7: INV to INV communication drive 1 (PID)"

Pump No.	[A210] ^{*1} detached pump	Inverter No.	Run time Monitor No.	Note
Pump 0	-	Inverter No.=10	95	This inverter is fixed to "master inverter"
Pump 1	+1	Inverter No.=1	96	Fix the "inverter number" for each inverter, set it to F802 of each follower inverter. The value of F802 must be equal or less than A209 (pump follower number) of master inverter
Pump 2	+2	Inverter No.=2	97	
Pump 3	+4	Inverter No.=3	98	
Pump 4	+8	Inverter No.=4	99	
Pump 5	+16	Inverter No.=5	105	
Pump 6	+32	Inverter No.=6	106	
Pump 7	+64	Inverter No.=7	107	
Pump 8	+128	Inverter No.=8	108	
Pump 9	+256	Inverter No.=9	109	

^{*1}: If you want to detach the pump from the system, set the appropriate number to A210.

■ Operation

Detailed specification

1) [A200] = "1: Multiple operation1 (Inverter fix, PID)"

Pump 0 is operated by inverter, others are connected to commercial power via magnetic contactor which is controlled by relay output signal of the inverter.

While pump 0 is operated on PID control, in case "pump increase condition" is satisfied due to output frequency increase, "pump ON" signal output from the inverter. At that time, when the signal is assigned to relay output controlled to magnetic contactor, the pump connected to commercial power is ON.

On the contrary, in case "pump decrease condition" is satisfied due to output frequency decrease, "pump ON" signal of the inverter is clear, the pump connected to commercial power is OFF.

●[A212] = "0" (Refer to operation example 1)

Small number of pump is higher priority. (ON first, OFF last)

●[A212] = "1" (Refer to operation example 2)

The pump priority is rotated. (ON first, OFF first)

●[A212] = "2" (Refer to operation example 3)

The pump of shortest runtime has higher priority.

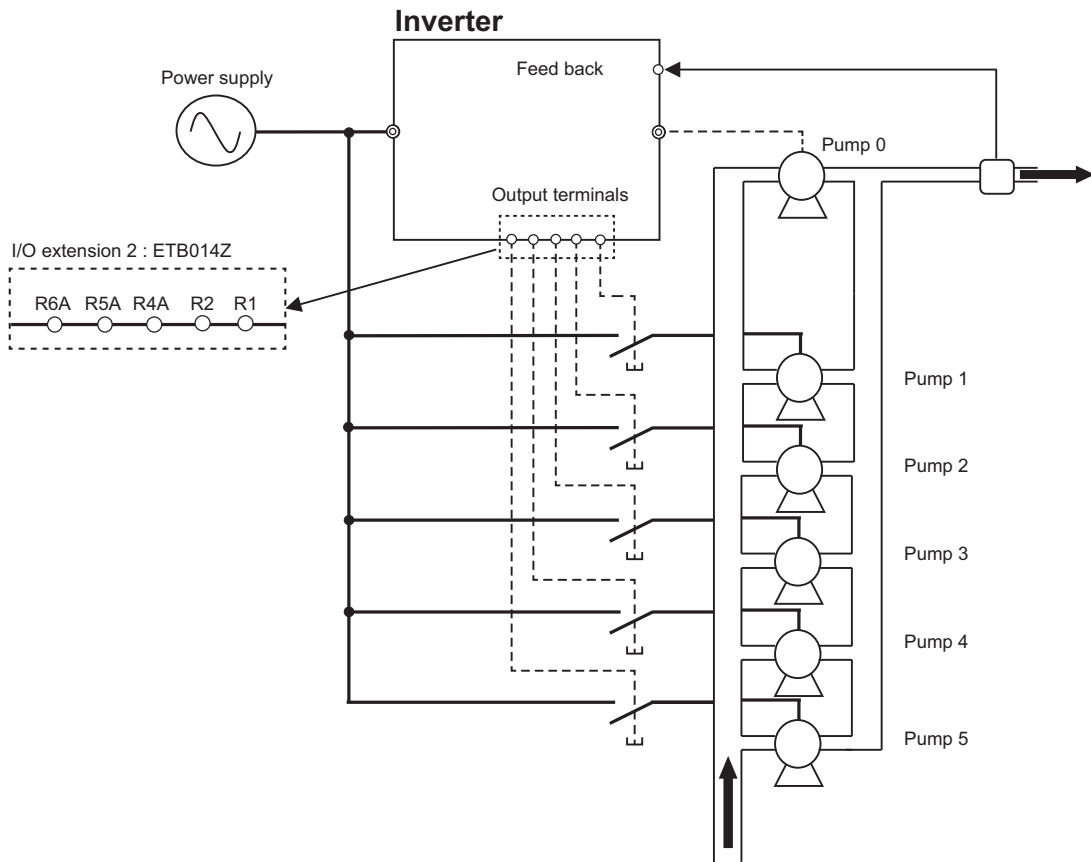
2 of ETB014Z (I/O extension (2)) can be inserted to the inverter. There are 3 relay output terminals on the option, so maximum 9 relay output terminals can be used.

- Number of pump operated by inverter: 1(fix)
- Number of pump operated by inverter: 9(fix): 1(fix)
- Number of magnetic contactor: 1x Number of pump operated by inverter: 1(fix)

This method can control large number of the pump by small number of magnetic contactor.

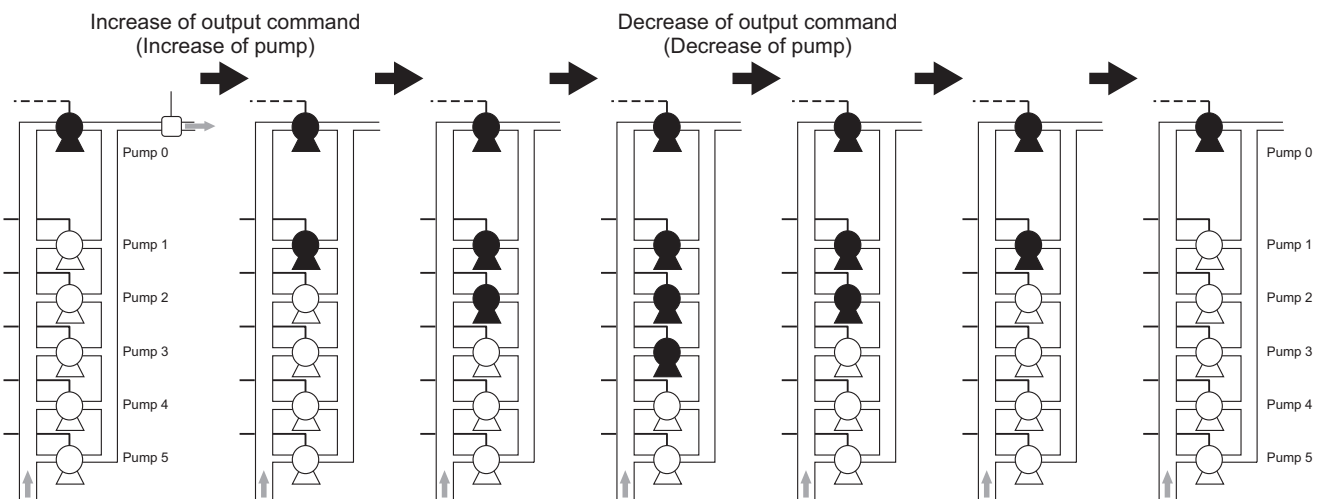
The pressure fluctuation is large when the pumps which are connected to commercial power start and stop.

Connection



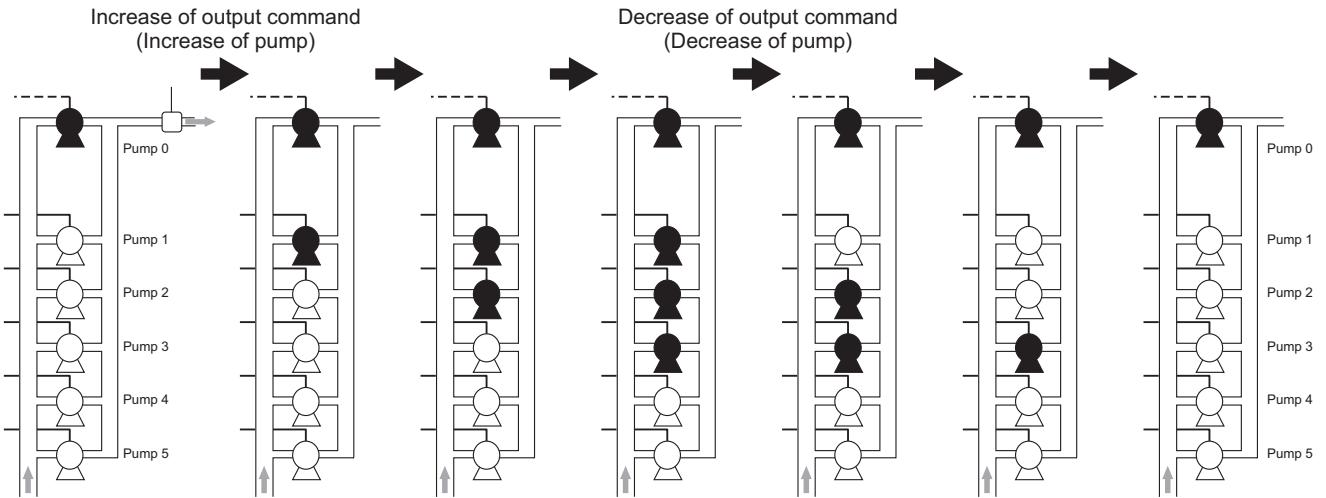
Example of operation 1: When [A212]="0"

● : Run ○ : Stop



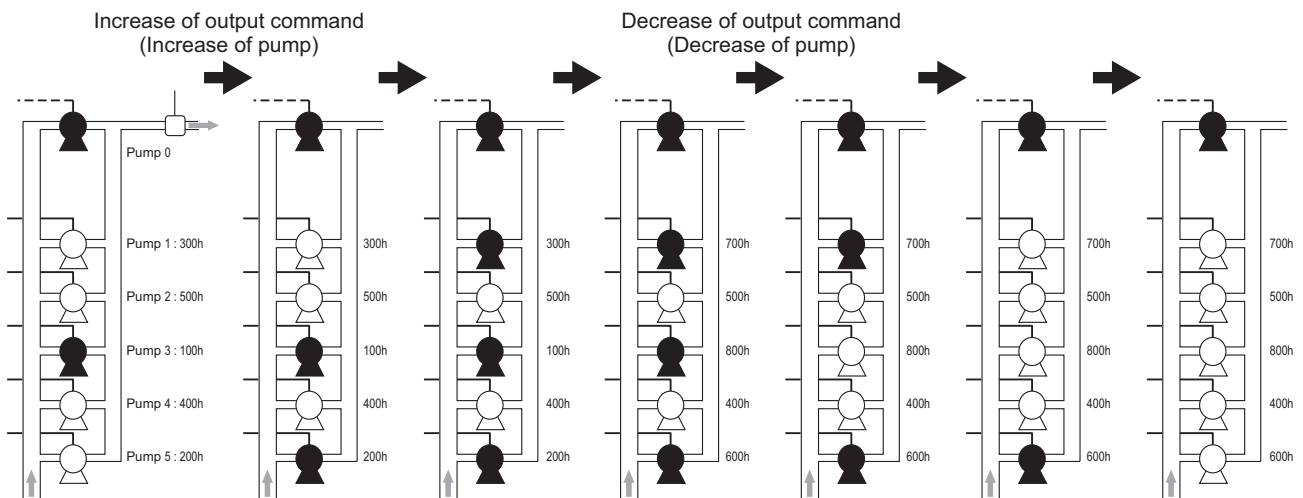
Example of operation 2: When [A212]="1"

● : Run ○ : Stop

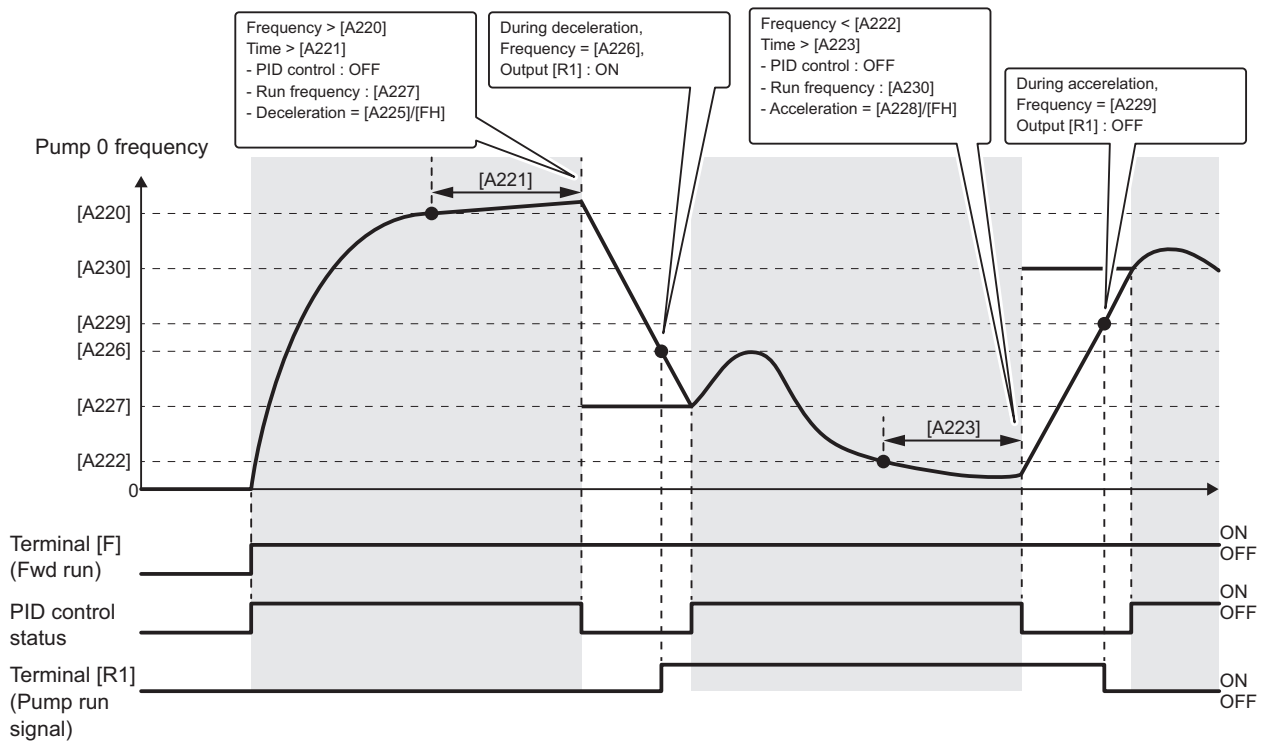


Example of operation 3: When [A212]="2"

● : Run ○ : Stop



diagram



[A220: Pump increase detection frequency]

[A221: Pump increase detection time]

Number of pump increase when PID output or output frequency is [A220] or more for the period of time specified by [A221].

[A222: Pump decrease detection frequency]

[A223: Pump decrease detection time]

Number of pump decrease when PID output or output frequency is [A222] or less for the period of time specified by [A223].

[A225: Pump increase switching Dec]

[A226: Pump increase switching frequency]

[A227: PID start frequency at pump increase switching]

In case increase of pump, the pump operated by the inverter decelerate by [A225] set time, then relay for increase of the pump outputs when the output frequency is [A226] or less. When the output frequency reaches [A227] after starting of the pump operated by commercial supply, the inverter restarts PID control.

[A228: Pump decrease switching ACC]

[A229: Pump decrease switching frequency]

[A230: PID start frequency at pump decrease switching]

In case decrease of pump, the pump operated by the inverter accelerate by [A228] set time, then relay for decrease of the pump outputs when the output frequency is [A229] or more. When the output frequency reaches [A230] after OFF of the pump operated by commercial supply, the inverter restarts PID control.

2) [A200] ="2: Multiple operation2 (regular operation, PID)"

Maximum 4 pumps can be connected to 1 inverter. Inverter and commercial power are both connected to each pump via magnetic contactor which is controlled by relay output signal of the inverter.

While pump 1 is operated on PID control, in case "pump increase condition" is satisfied due to output frequency increase, "pump ON" signal output from the inverter. At that time, the pump controlled by inverter is switched to commercial power, and another pump is started and controlled by inverter.

On the contrary, in case "pump decrease condition" is satisfied due to output frequency decrease, "pump ON" signal of inverter is clear, the pump connected to commercial power is OFF.

●At A212=0:

Small number of pump is higher priority. (ON first, OFF last)

●At A212=1:

The pump priority is rotated. (ON first, OFF first)

●At A212=2:

The pump of shortest runtime has higher priority.

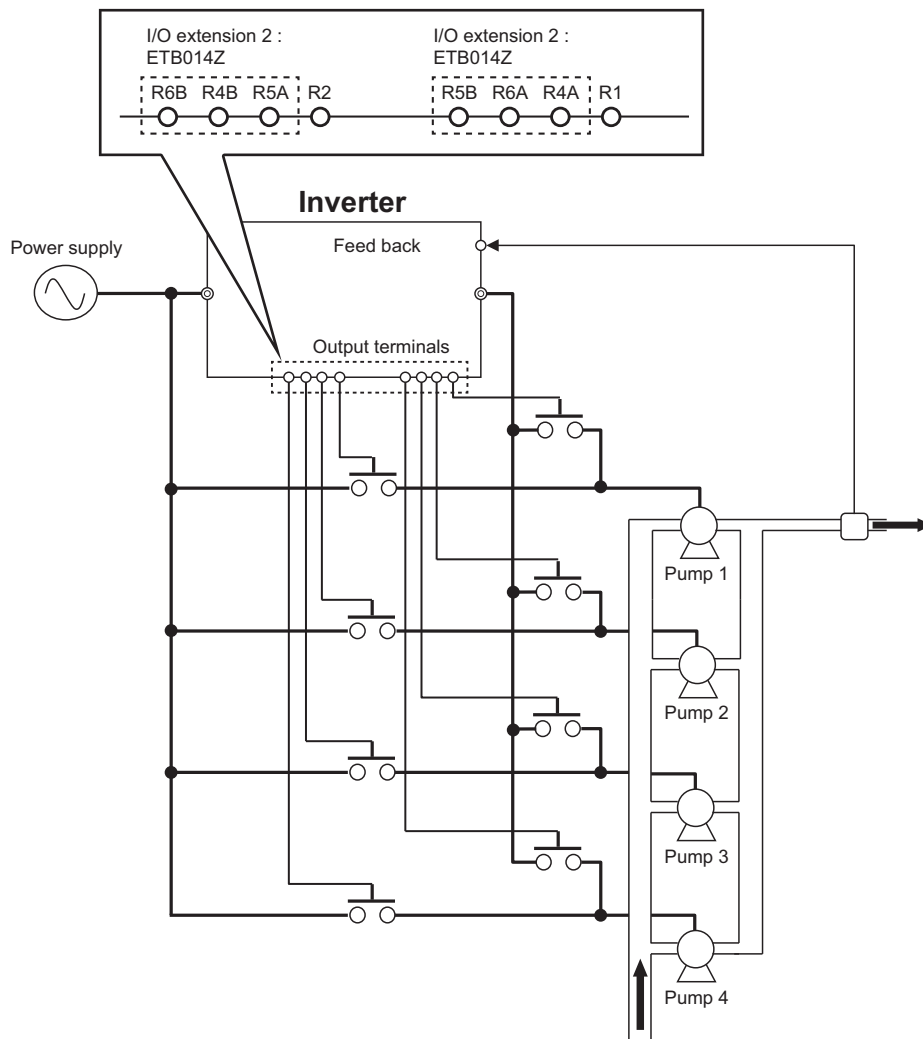
2 of ETB014Z (I/O extension (2)) can be inserted to the inverter. There are 3 relay output terminals on the option, so maximum 9 relay output terminals can be used.

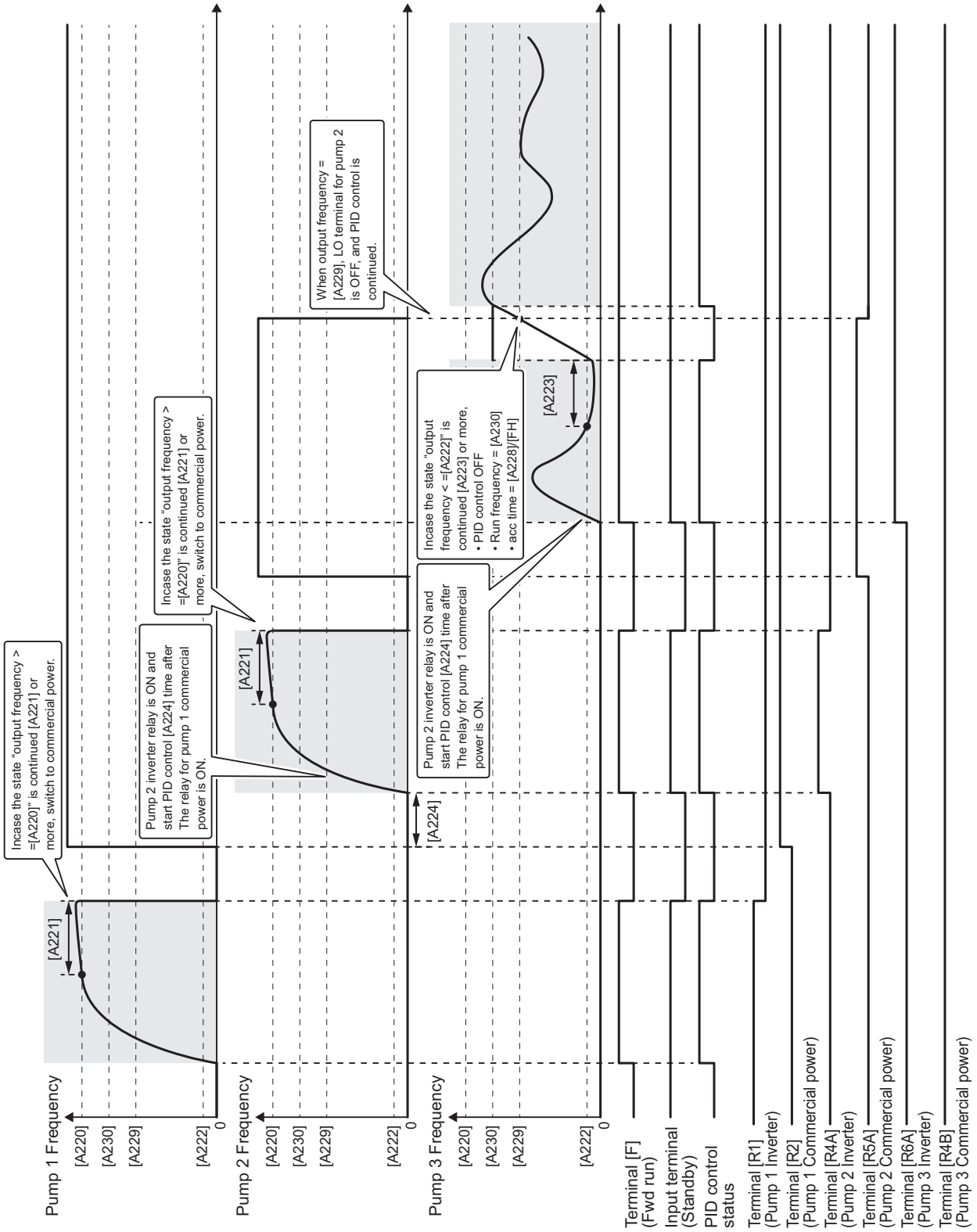
- Number of pump operated by inverter: 1(regular operation)
- Number of pump operated by inverter: Maximum 4 (regular operation)
- Number of magnetic contactor: 2x Number of pump (regular operation)

The pressure fluctuation is small when the pumps start and stop.

This method is necessary two magnetic contactors to each pump and wiring is longer.

Connection





[A220: Pump increase detection frequency]**[A221: Pump increase detection time]**

Number of pump increase when PID output or output frequency is [A220] or more for the period of time specified by [A221].

[A222: Pump decrease detection frequency]**[A223: Pump decrease detection time]**

Number of pump decrease when PID output or output frequency is [A222] or less for the period of time specified by [A223].

[A224: Pump switching wait time]

Start of operation is delay by set time of [A224] considering delay of magnet contactor ON.

[A228: Pump decrease switching ACC]**[A229: Pump decrease switching frequency]****[A230: PID start frequency at pump decrease switching]**

In case decrease of pump, the pump operated by the inverter accelerate by [A228] set time, then relay for decrease of the pump outputs when the output frequency is [A229] or more. When the output frequency reaches [A230] after OFF of the pump operated by commercial supply, the inverter restarts PID control.

A200=7 (INV to INV communication drive 1) is available, in case you use software version V106 or after.

3) A200=7: INV to INV communication drive 1 (PID)

Up to 10 pumps that each pump is controlled by inverter are connected via RS485 communication.

- Connect between RS485 CN2 terminal on master inverter , and that of follower inverter by the cable. (Detailed information for wiring is referred to RS485 communication function manual(E6582143).)
- Set the parameters below for both master and follower inverters.
F820=1, F821=1, F827=0, F829=0(2-wire)
After the setting is completed, shut off the power, confirm LCD display is off, then power-up again. After this procedure, the setting is valid.
- Set the parameters for "communication timeout" as below for only follower inverters. Under this setting, when communication timeout continues over 3 seconds during running Err5 trip occurs.
F823=3.0, F824=4

For INV to INV communication, it is necessary to fix 1 inverter for "master", others for "follower".

For "master" inverter, it is necessary to set

- A200=7
- A209=number of follower (must be set 1 or more)
- F802=10

For "follower" inverters, it is necessary to set F802=inverter number.

The value of F802 must be equal or less than A209 setting in "master" inverter.

Moreover, the value of F802 for each "follower" inverter are not duplicated.

(The value of A209 for each "follower" inverter must be set to 0.)

"master" inverter operates PID control, and send frequency command to "follower" inverter. in case "pump increase condition" is satisfied due to output frequency increase, the frequency command for 2nd inverter is increased.

On the contrary, in case "pump decrease condition" is satisfied due to output frequency decrease, the frequency command for 2nd inverter is decreased. If the frequency command for 2nd inverter is 0, 2nd inverter is stopped.

The order of inverter ON/OFF depends on A212 setting as below.

- [A212] = "0" (Refer to operation example 1)

Small number of pump is higher priority. (ON first, OFF last)

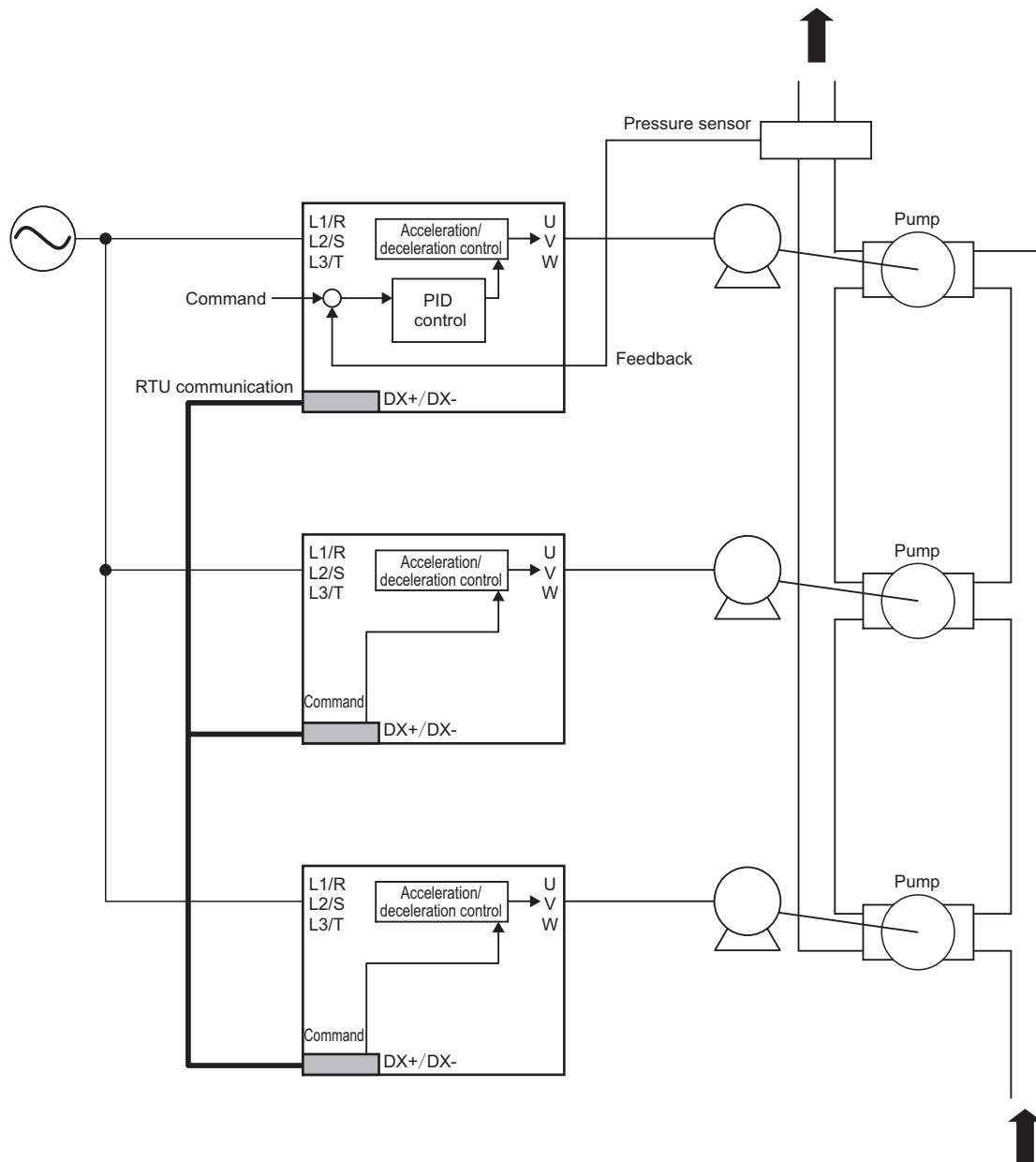
- [A212] = "1" (Refer to operation example 2)

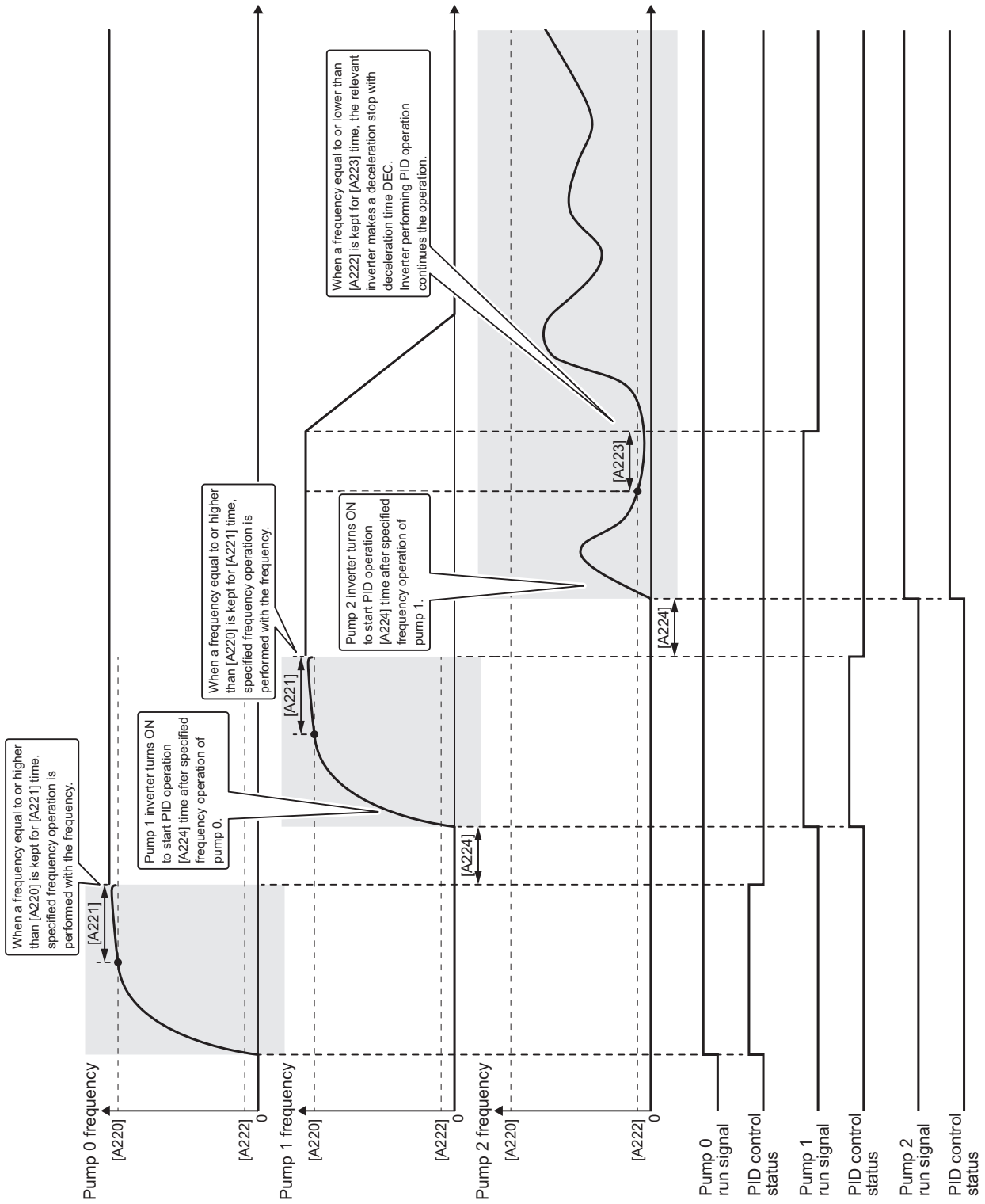
The pump priority is rotated. (ON first, OFF first)

- [A212] = "2" (Refer to operation example 3)

The pump of shortest runtime has higher priority.

Connection example





The parameters below must be set on "master" inverter. DO NOT set them on "follower" inverter.

●**[A209: Number of followers]**

Number of follower pumps.

●**[A220: Pump increase detection frequency]**

●**[A221: Pump increase detection time]**

Number of pump increase when PID output or output frequency is [A220] or more for the period of time specified by [A221].

●**[A222: Pump decrease detection frequency]**

●**[A223: Pump decrease detection time]**

Number of pump decrease when PID output or output frequency is [A222] or less for the period of time specified by [A223].

●**[A224: Pump switching wait time]**

Start of operation is delay by set time of [A224] considering delay of magnet contactor ON.

■ **Other parameters**

[A213: Commercial power running pump operation during run command OFF]

0 = stop In case run command is OFF, inverter is deceleration stop, and output terminal for pump control is OFF when inverter is stop.

In case inverter is trip, inverter is coast stop, and output terminal for pump control is OFF.

1 = Stop when trip only In case run command is OFF, inverter is deceleration stop, but output terminal for pump control is still ON.

In case inverter is trip, inverter is coast stop, and output terminal for pump control is OFF.

2 = Continue running In case run command is OFF, inverter is deceleration stop, but output terminal for pump control is still ON.

In case inverter is trip, inverter is coast stop, but output terminal for pump control is still ON.

In case A200=7, the parameter A213 does not work.

The behavior "A213=0 (Stop)" is always taken.

[A231: Pump increase/decrease detection deadband]

The differential of PID control is under [A231], pump increase/decrease control is not activated.

