

Mitsubishi Electric Automation

Instruction Manual


FR-A5AC


Auxiliary Control Option



NOTES, CAUTIONS AND WARNINGS


NOTE: Notes are used to provide additional detail about a procedure. The Note will always precede the text that the Note refers to.

CAUTION:  Cautions provide additional detail where failure to observe the Caution may result in damage to the equipment or injury to the user.

WARNING:  Warnings provide additional information, where failure to observe the Warning may result in death or severe injury.


SAFETY INSTRUCTION

1. Electric Shock Prevention

WARNING:  Do not open or remove the front cover while the Variable Frequency Drive is running. You may get an electrical shock.

- When necessary to perform inspections or when wiring the unit, switch power off and wait at least 10 minutes and until the bus charge light is off. Check for residual voltage.
- Do not attempt to inspect or wire any VFD or option unit unless you are fully competent to perform the work.
- Be sure hands are dry before operating any switches.
- Be sure cables do not have scratches, excessive stress, heavy loads or pinching to prevent electrical shock

2. Injury Prevention

CAUTION:  Be sure all connections are in accordance with instructions in this manual

- Check that cables are properly connected before turning equipment on.

- After turning equipment off, wait at least 10 minutes and until the bus charge light is off before removing cover. With cover removed, charged components may be exposed.

3. Additional Cautions and Warnings

CAUTION:



- Do not install the option unit if it is damaged or has parts missing
- Check that option unit is securely fastened to the variable frequency drive.
- Do not stand or rest heavy objects on top of unit.
- Do not allow metal fragments, conductive bodies, oil or other flammable substance to enter the variable frequency drive.
- Before starting operation, confirm and adjust the parameters. Failure to do so may cause the machines to make unexpected motions.
- When parameter clear or parameter all clear is performed, each parameter returns to the factory setting. Reset the required parameters before starting operation
- For prevention of damage caused by static buildup, touch a nearby grounded metal object to remove static from your body.
- Dispose of this product as general industrial waste.

WARNING:



- Do not modify this equipment

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1. Introduction

Thank you for choosing this option unit for the Mitsubishi FR-A560(L)-NA, A500L-NA, and F500-NA series VFD's.

Please read this manual carefully before using this option unit. This instruction manual gives handling information and precautions for use of this product as well as the information required for the installation of the FR-A5AC option.

It is assumed that the reader of this manual possesses an understanding of the configuration, implementation, and operation of Mitsubishi FR-A560(L)-NA, A500L-NA, and F500-NA series VFD's

Auxiliary Control Option Unit (FR-A5AC)

This option unit lets you connect a FR-A560(L)-NA, A500L-NA, and F500-NA series VFD with up to eight 120 VAC input signals which are then isolated and connected to the VFD's 24 V signal input terminal block. This option also permits the user to run two SPDT relays for output from one of several VFD functions.

Some important features of this option unit include:

- All input / output functions are electrically isolated to 2500 Vrms from the VFD
- User selectable input / output functions.
- Can be used with communications options.
- Designed and assembled in the U.S.A.
- UL & C-UL Approved.

1.1 FR-A5AC Structure

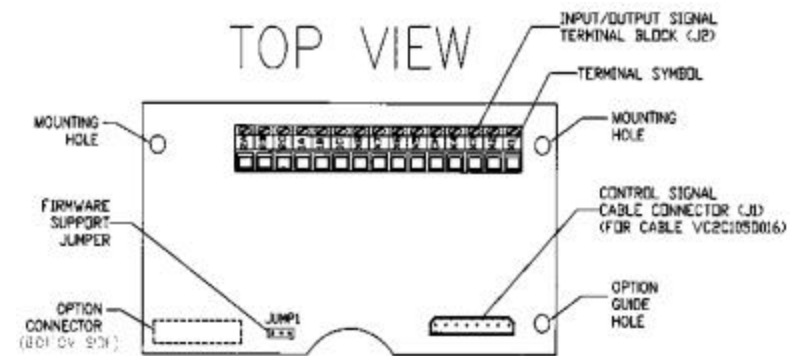


Figure 1: Top view

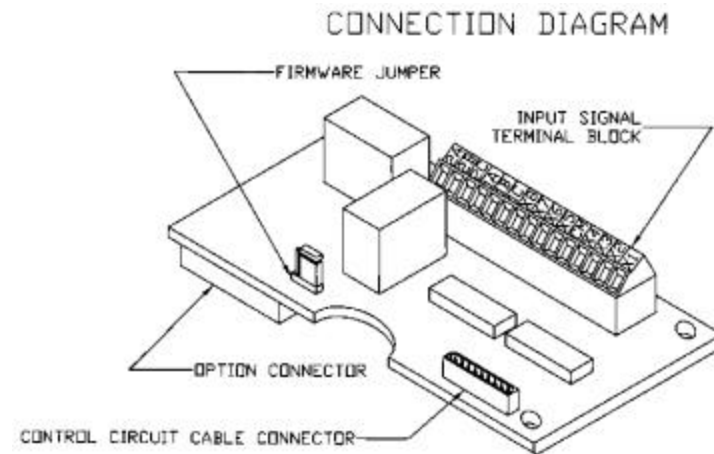


Figure 2: Connection Diagram

1.2 FR-A5AC Signal Description

Name	Description
FR-A5AC Input / Output Signal Terminal Block (J2)	Eight 120 VAC inputs, X1 – X8, and a common, CM. Two relay contacts with one each of a normally open contact, a normally closed contact, and a common.
FR-A5AC Control Signal Terminal Block (J1)	FR-A5AC output signal for the A560(L)-NA, A500L-NA, AND F500-NA VFD's control signal terminal block, Y1 – Y8
FR-A5AC Firmware Support Jumper (Jump1)	This jumper activates the relay output function for A560(L)-NA, A500L-NA, AND F500-NA VFD's with firmware support.

Table 1: FR-A5AC Signal Description

(Note) Recommended cable size for terminal J2 :
AWG18 to AWG22 (0.75mm² to 0.3mm²)

2. Installation

2.1 Unpacking the FR-A5AC Option

1. Check that all required components were received from the factory. The FR-A5AC option should have the following items included.
 - ◆ 1 Instruction Manual
VC2BNA00019
 - ◆ 1 Option Terminal Block Cable for Control Signal Terminal Block (J1)
VC2C105A016

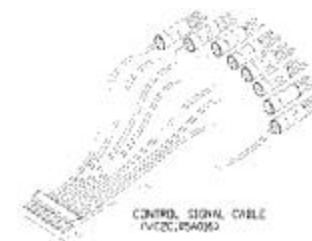


Figure 4: Option Cable

- ◆ 1 FR-A5AC Option in an anti-static bag.
 - ◆ 2 3 x 8 mm Machine Screws
2. The FR-A5AC option should be left in the anti-static bag until installation to prevent damage caused by ESD.



CAUTION

The option module is sensitive to Electro static discharge. Proper ESD measures required.

2.2 Pre-Installation Checks

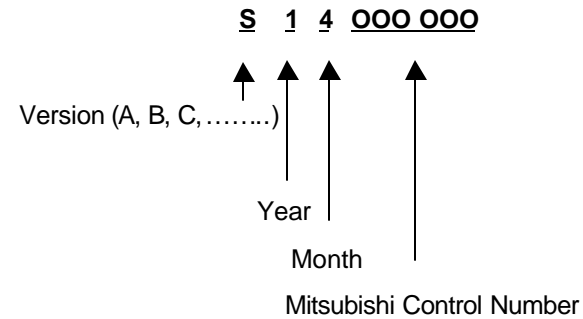
The FR-A5AC option will only be recognized and be fully functional with the following A560(L)-NA, A500L-NA, AND F500-NA series VFD's manufactured after the following serial number listed below. For all A560(L)-NA, A500L-NA, AND F500-NA VFD's manufactured prior to this serial number the FR-A5AC will have only the 120 VAC isolated input function with use of a jumper, JUMP1. At that time, JUMP1 should be set to "AC Input Only" position.

NOTE: The FR-A5AC is factory set to the "Active Relay Output" position.

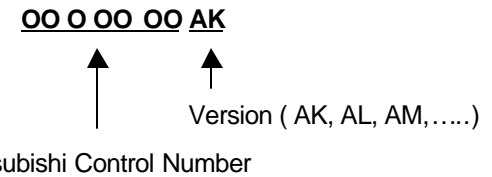
The serial number is made up of 9 characters, a version letter and 8 numerals. The first two numerals represent the year and month it was manufactured followed by a 6 digit Mitsubishi control number.

Model	Serial Number of full functional VFD
FR-A560-0.75K-NA	S14 000 000 or greater
FR-A560-2.2K-NA	S14 000 000 or greater
FR-A560-3.7K-NA	S14 000 000 or greater
FR-A560-7.5K-NA	R14 000 000 or greater
FR-A560-15K-NA	D14 000 000 or greater
FR-A560-22K-NA	D14 000 000 or greater
FR-A560-37K-NA	C14 000 000 or greater
FR-A560-55K-NA	C14 000 000 or greater
FR-F520-0.75 to 55K-NA	May 2001 shipping and after
FR-F540-0.75 to 55K-NA	May 2001 shipping and after

Table 2: A560(L)-NA, A500L-NA, AND F500-NA VFD Compatibility Chart



FR-A560, F520, F540-00K-NA serial numbering system



FR-A560L, A520L, A540L-00K-NA serial numbering system

The FR-A5AC option is not compatible with any other series VFD (e.g. A200E, A200, A100, Z and F series). These other series VFD's have a different option connector to prevent installation; if you force the connector, you may damage the VFD as well as the option unit.

2.3 Mounting Procedure

Remove the VFD cover carefully, following the directions given in the VFD instruction manual. Be sure to install the option unit using the following procedure:

WARNING



HAZARDOUS VOLTAGE PRESENT

Always isolate power from the VFD and wait 10 minutes until the bus charge light is off and check for residual before inserting or removing this option unit or touching the terminals.

1. Make sure the VFD input line power is off and the charge light on the VFD shows that the VFD is not storing an electrical charge, always check for residual voltage. Refer to the VFD instruction manual if necessary. You may damage the option unit if you install it with the line power connected.

Insert the FR-A5AC option unit into VFD's option port #2 or option port #3 (option port #1 is not recommended for easy wiring when installed). Carefully insert the connector of the option unit into the connector of the VFD. Use the two mounting holes and the guide hole to align the option with the matching machine screw inserts and the plastic guide pin on the VFD. Make sure that the FR-A5AC option is firmly seated in the VFD and the connector is completely plugged in and secured.

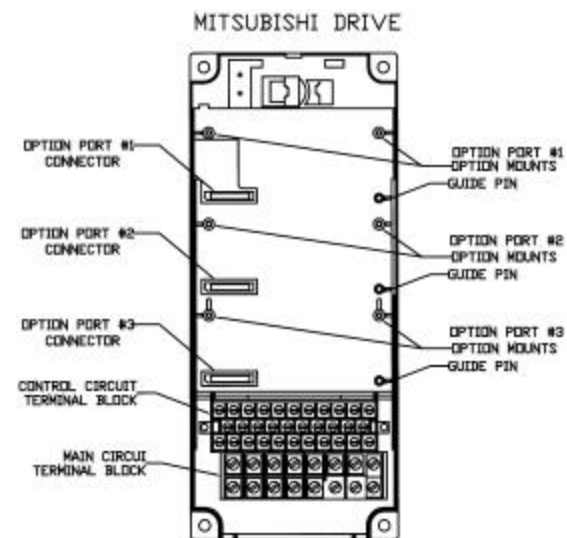


Figure 5: Drive View

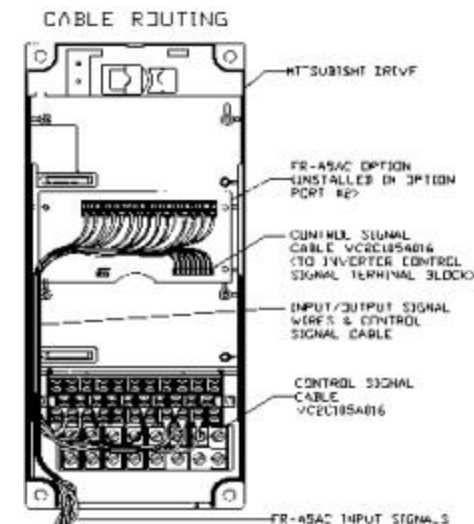


Figure 6: Cable Routing View

- Secure the option unit to the VFD with two mounting screws. If the screw holes in the option unit do not line up with the VFD mounting holes, check that the connectors have been fitted correctly.
- Route the 120 VAC signal cables and the control signal terminal block cable along the side of the VFD case as shown in figure 6.

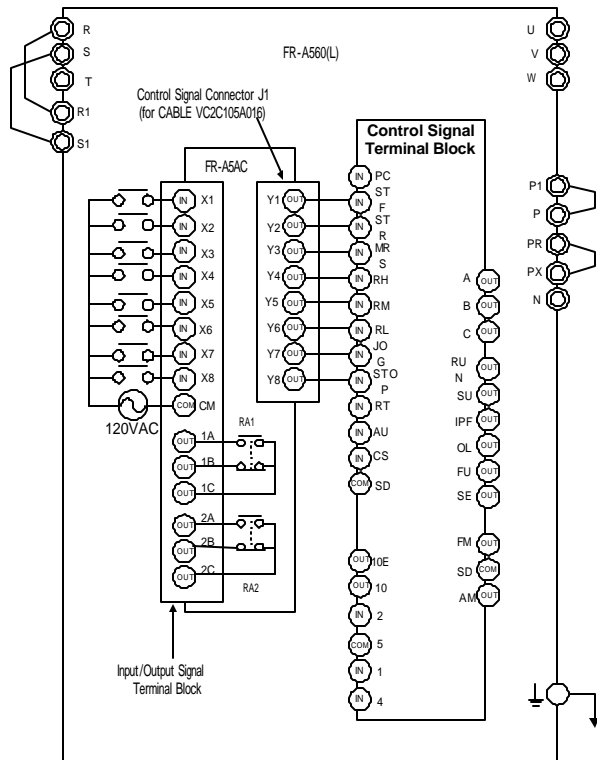



Figure 7: Wiring Diagram

- When wiring the option follow local electrical codes concerning proper wire gauge and circuit protection.

- All external signals are connected to the option through the options terminal block labeled for signal Identification. The terminal block is UL & CSA approved for 28-16 AWG wire.
- The 120VAC inputs are located at terminals X1 to X8 with common CM. The corresponding isolated outputs are the terminals labeled Y1 to Y8 and are designed to be connected directly to the VFD terminal block control input terminals via the FR-A5AC control signal cable. The FR-A5AC control signal cable can be connected to any 8 of the 11 standard input signals.
- Any unused terminals from the cable should be removed or properly insulated to prevent accidental shorting.



CAUTION

Insulate or remove any unused terminals from the terminal block cable to prevent accidental shorting.

- After connecting the terminal block cable to the VFD, plug the connector on the other end into the socket J1 on the FR-A5AC AC Input Interface option.
- Finally replace the VFD cover, while making sure that the signal wires are not caught or pinched between the cover and the chassis.

3. FR-A5AC Operation

The operation of the A560(L)-NA, A500L-NA, AND F500-NA VFD does not change when you install the FR-A5AC option unit. The option has two features, eight input 120 VAC interface function and 2 VFD driven relay outputs. The eight 120 VAC inputs are converted to be used with the VFD's terminal block to enter command signals. The two VFD driven relays are two SPDT relays driven by the set VFD function.

3.1 Operating Modes

The FR-A5AC has two operating modes, an "AC input only mode" and an "active relay output mode". These modes are selected by way of a jumper found on the FR-A5AC. The AC only input mode will allow FR-A5AC's 120 VAC input functions to work on any A560(L)-NA, A500L-NA, AND F500-NA VFD. The Active Relay Output setting will allow the FR-A5AC relay contacts to function from the user's set A560(L)-NA, A500L-NA, AND F500-NA VFD parameters. The relay contacts will only function with the proper VFD as described in section 2.2 of this manual.

3.1.1 A560(L)-NA, A500L-NA, AND F500-NA VFD's without FR-A5AC Firmware support

The 120VAC inputs on the FR-A5AC option can be used on any A560(L)-NA, A500L-NA, AND F500-NA VFD without supporting firmware(see section 2.2 of this manual). Use JUMP1 and move the jumper from "Active Relay Output" to "AC Input Only", this will allow the user to use the FR-A5AC 120VAC inputs in any A560(L)-NA, A500L-NA, AND F500-NA series VFD. The relay outputs are inactive since the VFD firmware does not support them. (Note: the VFD will not recognize the option as being installed in the VFD in this mode of operation.)

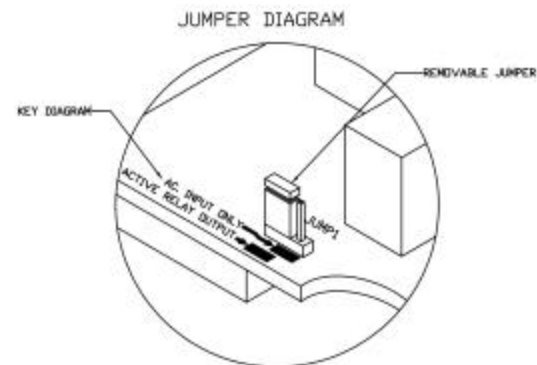


Figure 7: Jumper Diagram

3.2 AC Input Function

By using the 120VAC inputs to enter command signals, any terminal block functions can be implemented including running a motor in the forward or reverse rotation direction. The 120VAC inputs are isolated and entered into the VFD as open collector signals.

Signal	Name	Description
X1,X2,X3,X4, X5,X6,X7,X8	120 VAC control input Signal	120VAC Input signals
CM	120 VAC control input Signal Common	Common terminal to X1-X8 (Isolated from VFD Control Circuit)
Y1,Y2,Y3,Y4, Y5,Y6,Y7,Y8	Open Collector Output	Output signals corresponding to X1 – X8 as open collector signals. Connect to the control input terminals of the VFD. Common terminal handled internally.

Table 2: AC I/O Terminal Description

Note: sink logic must be used on the VFD's control signal terminal block, see the A500(L) instruction manual for more details.

3.2.1 VFD terminal block control input terminals

The FR-A5AC outputs, Y1-Y8, can be connected to eight of the following VFD control signal terminal block terminals. See the A560(L)-NA, A500L-NA, AND F500-NA instruction manual for more details of each terminal description.

Symbol	Terminal Name
STF	Forward rotation start
STR	Reverse rotation start
STOP	Start self-holding selection
RL	Low Speed Operation Command
RM	Medium Speed Operation Command
RH	High Speed Operation Command
JOG	Jog Operation Selection
RT	Second Function Selection
MRS	Output stop
RES	Reset
AU	Current input selection
CS	Automatic Restart After Instantaneous Power Failure

3.2.2 User Selectable Terminal Functions

Several of the terminals listed above are user selectable to implement different functions when the signal to that terminal is asserted. The RL, RM, RH, RT, AU, JOG, & CS terminals are of this type and are set with the A560(L)-NA, A500L-NA, AND F500-NA parameters 180-186. See the A560(L)-NA, A500L-NA, AND F500-NA instruction manual for more details.

3.2.2.1 Parameter Functions

The following parameters are used to change the VFD control signal terminal blocks functions. The terminals listed below can be changed by the user, and can implement any one of several functions. The valid value range for parameters 180-186 are 0 to 99, & 9999.

Parameter Number	Terminal Symbol	Factory Setting	Factory Setting Terminal Function
180	RL	0	Low Speed Operation Command
181	RM	1	Medium Speed Operation Command
182	RH	2	High Speed Operation Command
183	RT	3	Second Function Selection
184	AU	4	Current Input Selection
185	JOG	5	Jog Operation Selection
186	CS	6	Automatic Restart After Instantaneous Power Failure

Table 3: Control Signal Parameters

3.2.2.2 Parameter Settings

Use the following list for setting parameters, Pr. 180 - 186. See the A560(L)-NA, A500L-NA, AND F500-NA instruction manual for more details.

Setting	Signal Name	Functions
0	RL	Low speed operation command / Remote setting (setting clear) / Programmed operation group selection / Stop-on-contact selection 0
1	RM	Medium speed operation command / Remote setting (deceleration) / Programmed operation group selection
2	RH	High speed operation command / Remote setting (acceleration) / Programmed operation group selection
3	RT	Second function selection
4	AU	Current input selection
5	JOG	Jog operation selection
6	CS	Automatic Restart After Instantaneous Power Failure
7	OH	External thermal relay input
8(*1)	REX	15 speed selection
9(*1)	X9	Third function
10	X10	FR-HC connection (Inverter operation enable)
11	X11	FR-HC connection (instantaneous power failure detection)
12	X12	PU operation external interlock

Setting	Signal Name	Functions
13	X13	External DC dynamic braking start
14	X14	PID control valid terminal
15(*1)	BRI	Brake opening completion signal
16	X16	PU-external operation switch-over
17	X17	Load pattern selection forward / reverse rotation boost
18(*1)	X18	Advanced magnetic flux vector-V/F switch-over
19(*1)	X19	Load torque high speed frequency
20(*1)	X20	S-pattern acceleration / deceleration C switch-over terminal (only when FR-A5AP option is fitted)
22(*1)	X22	Orientation command (only when FR-A5AP option is fitted)
23(*1)	LX	Pre-excitation (only when FR-A5AP option is fitted)
9999		No function

(*1) FR-F500-NA does not have these parameters.

3.3 Relay Output Function

This function allows two output signals to be selected from among the ten standard signals (RUN, SU, IPF/UVT, OL, FU1, FU2, RBP(*1), THP, PRG(*1), and PU) of the VFD. The selected signal will activate the relay contacts for output signals. The relays are electrically isolated from the VFD. When a FR-A5AC and a FR-A5AR are both installed, priority is given to the FR-A5AC option. In order for the relay outputs to function JUMP1 must be set to the Active Relay Output setting and the VFD must have supporting firmware (see section 2.2 of this manual).

(*1) FR-F500-NA does not have these outputs.

3.3.1 Terminal Description

Terminal Symbol	Terminal Description
1A	Normally open contact for RA1
1B	Normally closed contact for RA1
1C	Common terminal for RA1
2A	Normally open contact for RA2
2B	Normally closed contact for RA2
2C	Common terminal for RA2

Table 6: Relay Output Terminal Description

3.3.2 Selection of Output Signals

Set the required values in Pr.320,321 to set the required function to activate the output signals of relays RA1 and RA2. When the VFD function is implemented, the signal is asserted and the relay is activated. Both positive and negative logic can be used on RA1 or RA2.

3.3.2.1 Parameter Functions

The following parameters are used to set the function used to drive the relay contacts. The valid value ranges for parameters 320 & 321 are listed below in table 7.

Parameter Number	Factory Setting	Description	Range
320	0	RA1 Output Selection	0-99, 9999
321	1	RA2 Output Selection	0-99, 9999

Table 7: Control Signal Parameters

3.3.2.2 Parameter Settings

Use the following list for parameter settings.

Value	Signal Name	Function	Operation	Relevant parameters
0	RUN	VFD Running	Output during operation when the VFD output frequency reaches or exceeds the starting frequency.	-----
1	SU	Up to Frequency	Output during operation when the VFD output frequency reaches or exceeds the set frequency. Refer to parameter 41 "up to frequency sensitivity" (* 1).	Pr.41

Value	Signal Name	Function	Operation	Relevant parameters
2	IPF/ UVT	Instantaneous Power Failure or Under-voltage	Output when an instantaneous power failure or under-voltage occurs.	-----
3	OL	Overload Alarm	Output while stall prevention function is activated.	Pr. 22, Pr. 23, Pr. 66, Pr. 148, Pr. 149, Pr. 154
4	FU	Output Frequency Detection	Output during operation when the VFD output frequency reaches or exceeds the set frequency. Refer to parameter 42 & 43 "output frequency detection".	Pr. 42, Pr. 43
5	FU2	2 nd Output Frequency Detection	Output during operation when the VFD output frequency reaches or exceeds the set frequency. Refer to parameter 50 "2 nd output frequency detection".	Pr.50
6(*4)	FU3	3 rd Output Frequency Detection	Output during operation when the VFD output frequency reaches or exceeds the set frequency. Refer to parameter 116 "3 rd output frequency detection".	Pr.116
7(*4)	RBP	Regenerative Brake Pre-Alarm	Output when 85% of the regenerative brake duty set in Pr.70 is reached.	Pr.70
8	THP	Electronic Over-Current Protection Pre-Alarm	Output when the cumulative electronic over-current protection value reaches 85% of the present level.	Pr.9
9(*4)	PRG	Programmed Mode	Output when the VFD is operating in the programmed mode. (* 2)	Pr. 79, Pr. 200 to 231
10	PU	PU Operation Mode	Output when the PU operation mode is selected	Pr.17

Value	Signal Name	Function	Operation	Relevant parameters
11	RY	VFD Operation Ready	Output when the VFD can be started by switching the start signal on or while it is running.	-----
12 (*4)	Y12	Output Current Detection	Output when current remains greater than the value set in Pr.150 for a time greater than the value set in Pr.151.	Pr.150, Pr.151
13	Y13	Zero Current Detection	Output when current remains less than the value set in Pr.152 for a time greater than the value set in Pr.153.	Pr.152, Pr.153
14	FDN	PID Lower Limit	Output when the process value is less than the value set in PR 132.	Pr.128 to Pr. 134
15	FUP	PID Upper Limit	Output when the process value is greater than the value set in Pr.131.	Pr. 128 to Pr. 134
16	RL	PID Forward / Reverse Rotation Output	Output when the parameter unit is set for forward rotation. Reverse rotation and stop negate the output.	Pr. 128 to Pr. 134
17	MC1	Commercial Power Supply – VFD Switch-Over #1	Output during normal operation, the output is negated when a VFD fault occurs.	Pr. 135 to Pr. 139
18	MC2	Commercial Power Supply – VFD Switch-Over #2	Output during commercial power supply operation, the output is negated for VFD operation or if a fault occurs.	Pr. 135 to Pr. 139
19	MC3	Commercial Power Supply – VFD Switch-Over #3	Output during normal operation, the output is negated during commercial power supply operation or when a VFD fault occurs.	Pr. 135 to Pr. 139
20 (*4)	BOF	Brake Opening Request	Output when the set values for the brake opening function are achieved.	Pr. 278 to Pr. 285

Value	Signal Name	Function	Operation	Relevant parameters
25	FAN	Fan Fault Output	Output when a fan fault occurs.	-----
26	FIN	Fin Overheat Pre-Alarm	Output when the heat sink temperature reaches about 85% of the fin overheat protection temperature.	-----
27 (*4)	ORA	In Position	Output when orientation is valid. (FR-A5AP option installed)	-----
28 (*4)	ORM	Orientation Error	Output when orientation is invalid. (FR-A5AP option installed)	-----
98	LF	Minor Fault Output	Output when a minor fault occurs.	-----
99	ABC	Alarm Output	Output when the VFD's protective function is activated to stop the output. (major Fault)	-----
9999	-----	No Function	None	-----

(* 1) When the analog signal or PU's [UP]/[DOWN] key is used to change the frequency setting, the output of the SU (up to frequency) signal may alternate between ON and OFF according to the changing speed and timing of the changing speed which depends on the acceleration/deceleration time setting (this ON-OFF alternation does not occur when the acceleration/deceleration time setting is "0 seconds").

(* 2) This signal is output when Pr.79 = "5" (operation mode selection) and the external operation mode is selected (the VFD goes into programmed mode).

(* 3) The same function may be set to more than one terminal.

(*4) FR-F500-NA does not have these parameters.

Table 8: Relay Signal Parameter Settings

4. FR-A5AC Specifications

1. AC Input Voltage: 90 – 132 VAC
2. AC input signal cable length : max 30m
3. Output Signal Type: Contact Type
4. Contact Ratings (RA1, RA2):
 - 125 VAC 0.6A
 - 115 VDC 0.6A
 - 30VDC 2A
5. The contacts should be used within the rated capacity to ensure long contact life.
6. Operating Temperature $-10^{\circ} \sim 50^{\circ} \text{C}$
7. Relative Humidity $\leq 90\%$ @ 50°C , non-condensing.
8. Dimensions 96 x 49 x 18 mm

5. References

Mitsubishi Electric Corp.

FR-A560(L)-NA, A500L-NA, AND F500-NA VFD Instruction Manual

6. Revisions

Print Date	Manual Number	Revision
June 2000	VC2BNA00019 REV A	Original Version
Jan. 2001	VC2BNA00019 REV B	2 nd edition