

INSTRUCTION MANUAL for
AC Spindle Drive System

FRENIC[®] 5000V3

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Thank you for your purchase of Fuji's product, AC Spindle Drive System FRENIC 5000V3 for machine tools. The user is requested to thoroughly read this manual before the actual use.

1. Notes

- (1) There remains still some charging voltage impressed in the capacitor after the power source has been turned off. Therefore, be sure not to touch the terminals by hands or to inspect the inside until the CHARGE lamp (LED 6, red) goes off.
- (2) Perform no dielectric strength test.
- (3) All volumes and switches except SW1 have been already set at the time of delivery from factory, so that no adjustment of these is required. (As to SW1, refer to No.7 2-1.)
- (4) Do not connect to a 400V power supply, since that connection causes damage to the system.
- (5) Do not mistake in the connection between the power source input terminals (R, S, T) of Drive unit and the output terminals (U, V, W) for induction motor. The incorrect connection will cause damages to the system.

2. Test run

2-1 Confirmation

Check and confirm the following points before turning on their power source.

No.	Confirmation		
1	Make sure that voltage level, voltage fluctuation, and power source capacity of the input power is as prescribed.		
2	Make sure that the phase rotation of the power source connecting to the power input terminals (R, S, T) follows the R - S - T phase sequence. (Above FRN 022V3)		
3	Make sure not mistake in the connection between the power source input terminals (R, S, T) of Drive unit and the output terminals (U, V, W) for induction motor.		
4	Make sure that the connections with the external circuits (by connectors and terminal blocks) are proper. (Clamp CN1 and CN3 surely with lock screws).		
5	Make sure that wirings of power circuit and control circuit are not earthed nor short circuit.		
6	Make sure that no metal chip or other foreign matter is mixed into the Drive unit.		
7	Make sure that the setting terminals (short-circuit pins) on the printed circuit board are pre-set as specified. (Standard delivery: 1 - 2 short-circuited)		
	Set terminal	Details	Setting
	SW1	Performance at the occurrence of instantaneous power failure	1 ● ● ○ 3
		The free run stops at the occurrence of instantaneous power failure. After the recovery, automatic restarting is not performed.	
		The free run stops at the occurrence of instantaneous power failure. After the recovery, automatic restarting is performed.	1 ○ ● ● 3
8	Make sure that the connectors and screws on the printed circuit board are not loose.		

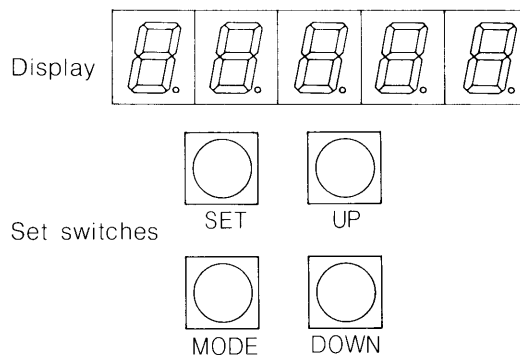
2-2 TEST run instruction

No.	Particulars	Procedures items to be confirmed
1	Power supply	5 figures seven-segment, LED not showing AL- ** Main circuit charging display LED 6 (red) lights CPU running display LED 5 (green) flickers
2	Confirmation of parameters	Confirm and set the parameters in accordance with the descriptions on Display/Setting parts in Section 3.
3	Operating preparation signal ON	Electromagnetic contactor is turned on. (Note) When parameter P-002 is 001 or 003.
4	Operating command ON (Forward/ Reverse operation commands)	Check the rotating directions by instructing minimum speed command: By forward operation command: the counterclockwise rotation By reverse operation command: the clockwise rotation Notes: The rotating direction should be considered as a direction viewed from the motor power shaft.
5	Adjustment of speed setting level and motor speed	Adjust parameters P-013, 014, and 015 as described in Display/Setting parts of Section 3.
6	Optimum adjustment of Speed controller	Adjust parameters P-016 - P-29 as described in Display/Setting parts of Section 3.
7	Final confirmation	Check and make sure that motor, Drive unit, and the main shaft rotation operate normally under various speed commands instructed including the forward and reverse commands.

3. Description on Display and Setting parts

1. Parameter setting method

Set switches and Display are arranged on the printed circuit board as shown on the right. The data confirmation and modification on each mode can be achieved by operating these switches as described as below:



- (1) In the case of confirming the current mode: (In the following descriptions, "ON" implies pressing a switch, and "OFF" implies releasing it.)
 - (a) Normally, the display shows a motor speed actual value (with 5 figures). (Note) Refer to Selection of the normal display data of No.13 in 3-2.
When the **[MODE]** ON, displays the current mode number as "P-XXX".
- (2) In the case of confirming the set data:
 - (a) Selected a mode for the data to be confirmed in accordance with the following procedures.
 - (b) The **[MODE]** ON displays the current mode number.
 - (c) The **[UP]** and the **[MODE]** ON add one mode.
 - (d) Keeping the **[UP]** and **[MODE]** ON continuously adds modes.
 - (e) The **[DOWN]** and **[MODE]** ON reduces one mode.
 - (f) Keeping the **[DOWN]** and **[MODE]** ON continuously reduces modes.
 - (g) All keys OFF, displays the data after about 0.5 sec.
 - (h) The display will return to the normal display of motor speed actual value about 5 sec. after changing to the data display.
 - (i) The mode to display only digital input/output conditions, etc. (Note) continues to display for approx. 5 min. after that the mode will return to the normal display of motor speed actual value.
(Note) Modes classified as R in 3-2.
 - (j) The selection mode for the normal data display (P-00D) will return to the display of the selected data 1-sec. after the selection.
- (3) In the case of modifying data
 - (a) In accordance with the procedures from (a) to (f) described in (2), select the mode number of "P-001".
 - (b) Make sure that the data display shows "0001".
If it shows "0000", modify it to "0001" by the **[UP]** ON.
 - (c) In accordance with the procedures from (a) to (f) described in (2), select a mode to be modified.
After confirming that the display shows the data display, modify the data in accordance with the following procedures.
 - (d) The **[UP]** ON adds one-data.
 - (e) Keeping the **[UP]** ON continuously adds data.
 - (f) The **[DOWN]** ON reduces one data.
 - (g) Keeping the **[DOWN]** ON continuously reduces data.
 - (k) The motor is controlled with using the data being displayed.
 - (i) If it is desired to hold the modified data after the power source has been cut off, execute the **[SET]** ON.
The display will disappear for about 5 sec., and then will return to the normal display of motor speed actual value, which indicates the completion of data modification.
 - (j) In the case of executing the data modification again, follow the procedures from (c) in (3).
 - (k) About 5 sec. after all switches OFF the display will automatically return to the normal display of motor speed actual value.

(Note) There are some modes where the data modification is feasible while the motor is running, and some not. Details should be referred to 3-2. In the occurrence failure, no data modification can be made.

3-2 FRENIC500V3: Parameter lists

(1) Definition, etc.

No.	Mode No.	Classification	Contents	Data range	Unit	Standard setting	Remarks	Meaning of Data	Detailed description
1	P-001		Permit of data modification	0000,0001		0000		For data modification prohibit---0000, For data modification permit---0001	
2	P-002	*	Use of Operation preparation signal and Definition of forward and reverse operation signals	0000 0001 0002 0003		0001		For not using operation preparation signal (RDY) and executing the forward rotation by forward operation signal (FOR) ON---0000 For using operation preparation signal (RDY) and executing the forward rotation by forward operation signal (FOR) ON---0001 For not using operation preparation signal (RDY) and executing the reverse rotation by forward operation signal (FOR) ON---0002 For using operation preparation signal (RDY) and executing the reverse rotation by forward operation signal (FOR) ON---0003	Yes
3	P-003	*	Use of speed override	0000,0001		0000		For not using speed override---0000, For using speed override---0001	
4	P-004	*	Speed override range	0000,0001		0001		50~100%---0000, 50~150%---0001	Yes
5	P-005	*	Use of soft start stop (normally)	0000,0001		0001		For not using soft start stop---0000, For using soft start stop---0001	
6	P-006	*	Use of rigid tap mode	0000,0001		0000		For using torque limit L signal (TLML) as torque limit---0000 For using torque limit L signal (TLML) as rigid tap mode---0001	
7	P-007	*	Use of speed deviation over alarm	0000,0001		0001		For not using speed deviation over alarm---0000 For using speed deviation over alarm---0001	
8	P-008	*	Max. speed	1500~8000	rpm			Setting motor max. speed at 10V (MAX) of speed command voltage (The upper limit of Max. speed differs depending on the motor capacity.)	
9	P-009	*	Setting of Power limit pattern	0000~0006		0000		Setting when limiting the power	Yes
10	P-00A	*	Setting of power limit value for limiting the power	0000~0100	%	0100		Limit value when limiting the power	Yes
11	P-00B								
12	P-00C								
13	P-00D		Selection of the normal display data	0000 0001 0002 0003 0004		0000		For displaying motor speed actual value (rpm) ---0000 For displaying motor speed command value (rpm)---0001 For displaying motor torque command value (%) (max. rating torque = 100%)---0002 For displaying motor estimate temp. ---0003 For displaying motor power (kw)(command value)---0004	

Classification: * --- Item whose setting is not feasible while the motor is running.
R --- Item for only display is presented

Detailed description: Yes --- Detailed descriptions are provided in 3-3

(2) Adjust of max. rotation speed, etc.

No.	Mode No.	Classification	Contents	Data range	Unit	Standard setting	Remarks	Meaning of Data	Detailed description
14	P-00E		Soft start stop: Accelerating time	000.1~120.0	SEC	005.0		Adjusting the accelerating time required from stopping to max. speed	
15	P-00F		Soft start stop: Decelerating time	000.1~120.0	SEC	005.0		Adjusting the decelerating time required from max. speed to stopping	
16	P-010		Limiting the regeneration power	0001~0100	%	0100		Limit value of the regeneration power (Max. torque=100%)	Yes
17	P-011	*	Speed command offset adjustment					Used for the adjustment of speed command offset	Yes
18	P-012	*	Speed detecting offset adjustment					Used for the adjustment of speed detecting offset	Yes
19	P-013		Speed command level adjustment (for the + polarity)	0000~8000	rpm			Used for the adjustment of speed command at the + polarity	Yes
20	P-014		Speed command level adjustment (for the - polarity)	0000~8000	rpm			Used for the adjustment of speed command at the - polarity	Yes
21	P-015		Motor speed adjustment		rpm			Used for the adjustment of motor speed	Yes

Classification: * Item whose setting is not feasible while the motor is running.

R Item for only display is presented

Detailed description: Yes Detailed descriptions are provided in 3-3.

(3)ASR adjustment (Adjustment of Speed controller)

No.	Mode No.	Classification	Contents	Parameter range	Unit	Standard setting	Remarks	Meaning of Data	Detailed description
22	P-016		Speed controller: Proportional gain (H gear)	0000~0100		0020		Proportional gain of PI controller	
23	P-017		Speed controller: Proportional gain (M gear)	0000~0100		0020			
24	P-018		Speed controller: Proportional gain (L gear)	0000~0100		0020			
25	P-019		Speed controller: Proportional gain (Rigid)	0000~0100		0020	"Rigid" stands for rigid tap mode. All the same in the following.		
26	P-01A		Speed controller: Proportional gain (ORT H)	0000~0100		0040		Proportional gain of PI controller for orientation mode	
27	P-01B		Speed controller: Proportional gain (ORT M)	0000~0100		0040			
28	P-01C		Speed controller: Proportional gain (ORT L)	0000~0100		0040			
29	P-01D		Speed controller: Proportional gain (ORT Attach)	0000~0100		0040	"Attach"stands for attachment mode. All the same in the following.		
30	P-01E		Speed controller: Integral action time (H gear)	0000~0200	mSEC	0020		Integral action time for PI controller	
31	P-01F		Speed controller: Integral action time (M gear)	0000~0200	mSEC	0020			
32	P-020		Speed controller: Integral action time (L gear)	0000~0200	mSEC	0020	"O" setting makes PI controller be P controller		
33	P-021		Speed controller: Integral action time (Rigid)	0000~0200	mSEC	0020			
34	P-022		Speed controller: Integral action time (ORT H gear)	0000~0200	mSEC	0020		Integral action time of PI controller for orientation mode	
35	P-023		Speed controller: Integral action time (ORT M gear)	0000~0200	mSEC	0020			
36	P-024		Speed controller: Integral action time (ORT L gear)	0000~0200	mSEC	0020	"O" setting makes the PI controller be P controller		
37	P-025		Speed controller: Integral action time (ORT Attach)	0000~0200	mSEC	0020			
38	P-026		Speed detecting: Time constant for filtering (H gear)	0000~0050	mSEC	0005		Time constant for first-order lag filtering of speed detecting element	
39	P-027		Speed detecting: Time constant for filtering (M, L, Rigid)	0000~0050	mSEC	0005			
40	P-028		Speed detecting: Time constant for filtering (ORT H)	0000~0050	mSEC	0005		Time constant for first-order lag filtering of speed detecting element	
41	P-029		Speed detecting: Time constant for filtering (ORT M, L, Attach)	0000~0050	mSEC	0005			

(4) Level adjustment for digital signal output

No.	Mode No.	Classification	Contents	Parameter range	Unit	Standard setting	Remarks	Meaning of Data	Detailed description
42	P-02A		Speed zero detecting level	00.20~02.00	%	00.30		Setting zero detecting level	Yes
43	P-02B		Arbitrary speed detecting level	0000~0100	%	0003		Setting arbitrary speed detecting level	Yes
44	P-02C		Speed arriving detecting level	0002~0015	%	0005		Setting speed arriving detecting level	Yes
45	P-02D		Torque detecting level	0000~0100	%	0090		Setting torque detecting level	Yes
46	P-02E		Setting of torque limit L	0000~0050	%	0050		Torque limit value when TLML signal ON (Max. torque = 100%)	
47	P-02F		Setting of torque limit H	0000~0100	%	0100		Torque limit value when TLMH signal ON (Max. torque = 100%)	
48	P-030		Magnet flux level (for the normal operation)	0010~0100	%	0025		Setting magnetic flux level at light loading	
49	P-031		Magnet flux level (for rigid tap)	0010~0100	%	0025			
50	P-032		Magnet flux level (for ORT)	0010~0100	%	0025			
51	P-033								

Detailed description: Yes.....Detailed descriptions are provided in 3-3

(5) Setting for orientation

No.	Mode No.	Classification	Contents	Parameter range	Unit	Standard setting	Remarks	Meaning of Data	Detailed description
52	P-034	*	Use of soft start stop (for ORT)	0000,0001		0001		For not using soft start stop.....0000, For using soft start stop.....0001	
53	P-035		No.1 creeping speed command (ORT H gear)	0000~2550	rpm	1000		Setting No.1 creeping speed commands for orientation	
54	P-036		No.1 creeping speed command (ORT M gear)	0000~2550	rpm	1200			
55	P-037		No.1 creeping speed command (ORT L gear)	0000~2550	rpm	1500			
56	P-038		No.1 creeping speed command (ORT Attach)	0000~2550	rpm	0500			
57	P-039		No.2 creeping speed command (ORT H gear)	0000~1275	rpm	0100		Setting No.2 creeping speed commands for orientation (This setting is not required for the PE system)	
58	P-03A		No.2 creeping speed command (ORT M gear)	0000~1275	rpm	0120			
59	P-03B		No.2 creeping speed command (ORT L gear)	0000~1275	rpm	0150			
60	P-03C		No.2 creeping speed command (ORT Attach)	0000~1275	rpm	0050			

No.	Mode No.	Classification	Contents	Parameter range	Unit	Standard setting	Remarks	Meaning of Data	Detailed description
61	P-03D		Position controller Proportional gain (ORTH)	0000~0255		0020		Setting proportional gain of the position controller at orientation mode	
62	P-03E		Position controller Proportional gain (ORTM)	0000~0255		0040			
63	P-03F		Position controller Proportional gain (ORTL)	0000~0255		0080			
64	P-040		Position controller Proportional gain (ORT Attach)	0000~0255		0100			
65	P-041		Gear ratio (ORT H gear)	000.5~020.0		001.0		Setting gear ratios for orientation. (This setting is not required for the PE system)	
66	P-042		Gear ratio (ORT M gear)	000.5~020.0		002.0			
67	P-043		Gear ratio (ORT L gear)	000.5~020.0		004.0			
68	P-044		Gear ratio (ORT Attach)	000.5~020.0		004.0			
69	P-045		ORT completion range	0000~0127		0010		PE system ORT completion range = (Display data) pulse, One pulse = 360°/4096 MG system, Do. = (Display data) × approx. 11°/255	
70	P-046		ORT completion range (Addition after stopping)	0000~0127		0000		PE system completion range addition after stopping = (Display data) pulse (One pulse = 360°/4096) MG system Do. = (Display data) × approx. 11°/255	
71	P-047		ORT completion signal ON timer time	00.00~01.00	SEC	00.10		Setting a timer time required from the ORT completion until the ORT completion signal to be ON	
72	P-048		ORT completion signal OFF timer time	000.0~010.0	SEC	000.2		Setting a timer required from the ORT cancellation until the ORT completion signal to be off	
73	P-049	R	External stopping position set value(HEX display)					Only PE system.	Yes
74	P-04A	R	0° reference main shaft position (HEX display)					Only PE system, main shaft position = (Display data) pulse, One pulse = 360°/4096	Yes
75	P-04B	R	Position deviation (HEX display)					Only PE system, Position deviation=(position set value)-(position detected) One pulse = 360°/4096	-Yes

Classification: *Item whose setting is not feasible while motor is running.

R Item for only display is presented

Detailed description: YesDetailed descriptions are presented in 3-3.

(6) Failure display and digital input/output signal display

No.	Mode No.	Classification	Contents	Parameter range	Unit	Standard setting	Remarks	Meaning of Data	Detailed description
76	P-04C	R	No.1 failure contents					No.1 to No.4 failures contents are displayed.	Yes
77	P-04D	R	No.2 failure contents						
78	P-04E	R	No.3 failure contents						
79	P-04F	R	No.4 failure contents						
80	P-050	R	Speed command value at the occurrence of failure		rpm			Various kinds of data at the occurrence of failure are displayed.	
81	P-051	R	Speed detecting value at the occurrence of failure		rpm				
82	P-052	R	Torque current command value at the occurrence of failure		%				
83	P-053	R	Torque current detecting value at the occurrence of failure		%				
84	P-054	R	Magnetic flux current command value at the occurrence of failure		%				
85	P-055	R	Magnetic flux detecting value at the occurrence of failure		%				
86	P-056	R	Motor estimate temp. at the occurrence of failure		°C				
87	P-057	R	Digital input at the occurrence of failure (LED display)					Digital input at the occurrence of failure is LED-displayed.	Yes
88	P-058	R	Digital input at the occurrence of failure (HEX display)					Digital input at the occurrence of failure is HEX-displayed.	Yes
89	P-059	R	The current digital input (LED display)					The current digital input is LED-displayed	Yes
90	P-05A	R	The current digital output (LED display)					The current digital output is LED-displayed	Yes
91	P-05B	R	The current digital input(HEX display)					The current digital input is HEX-displayed.	Yes
92	P-05C	R	The current digital output (HEX display)					The current digital output is HEX-displayed.	Yes
93	P-05D								
94	P-05E								

Classification: *Item whose setting is not feasible while the motor is running

RItem for which only display is presented.

Detailed description: YesDetailed descriptions are provided in 3 - 3

3-3 Detailed description on parameters

(The data modification on mode marked * can not be made in while the motor is running.)

*No.2 Use of operation preparation signal and definition of the forward and reverse operation signals

Mode No.	Display data (4 figures)	Data range	
P - 0 0 2	0 0 0 1	0000, 0001 0002, 0003	(Standard setting: 0001)

Description: (1) For Analog +10V input

	Not using operation preparation signal (RDY)	Using operation preparation signal (RDY)
The forward rotation by forward operation signal "FOR" ON The reverse rotation by reverse operation signal "REV" ON	0000	0001
The reverse rotation by forward operation signal "FOR" ON The forward rotation by reverse operation signal "REV" ON	0002	0003

(2) For Analog $\pm 10V$ input

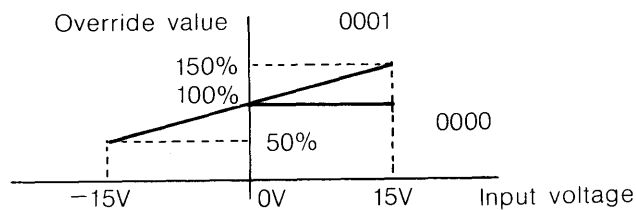
	Not using operation preparation signal (RDY)	Using operation preparation signal (RDY)
Forward operation signal "FOR" ON: The forward rotation by the + polarity The reverse rotation by the - polarity	0000	0001
Forward operation signal "FOR" ON: The reverse rotation by the + polarity The forward rotation by the - polarity	0002	0003

*No.4 Speed override range setting

Mode No.	Display data (4 figures)	Data range	
P - 0 0 4	0 0 0 1	0000, 0001	(Standard setting: 0001)

Data

Description: Speed override range = 50%~100%.....0000
Speed override range = 50%~150%.....0001



Note that the upper limit of speed command value is limited to max. speed set value (P-008). (See Control block diagram, Sec. 6.)

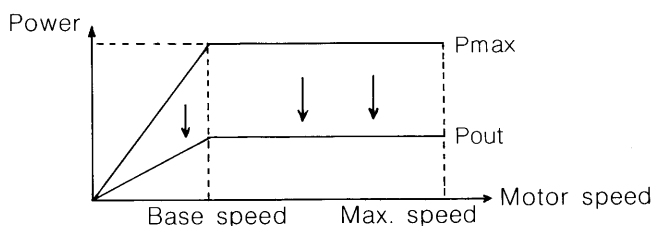
*No. 9 Setting of power limit pattern

Mode No.	Display data (4 figures)	Data range	
P - 0 0 9	0 0 0 0	0000~0006	(Standard setting:0000)

- Description: In the case of limiting the power described as follows, select each appropriate pattern.
- A. Case when limiting the power only at accelerating and decelerating to slowly accelerate and decelerate and operating with the max. power at the normal rotation: (Set data: 0001 or 0002)
 - B. Case when accelerating and decelerating with the max. power and limiting the power at the normal rotation: (Set data: 0003 or 0004)
 - C. Case when, with using the same motor and inverter, applying different power specifications: (Set data: 0005 or 0006)

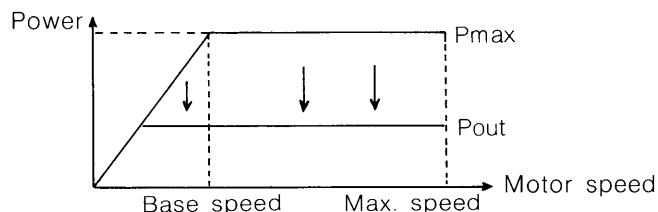
Details	Set data	
	Pattern 1	Pattern 2
Not limiting the power	0000	
A. Limiting the power only at accelerating and decelerating	0001	0002
B. Limiting the power only at the normal rotation	0003	0004
C. Limiting the power only in the whole operation	0005	0006

[Power limit pattern 1]Set data 0001, 0003, 0005



$$P_{out} = \frac{[P-00A]}{100} \times P_{max}$$

[Power limit pattern 2]Set data 0002, 0004, 0006



$$P_{out} = \frac{[P-00A]}{100} \times P_{max}$$

Pmax.....Max.power(equivalent to the over load endurance)

Pout.....Max.power after limiting

[P-00A].....Set data of Mode No. P - 00A

*No.10 Setting of a limit at limiting the power

Mode No.	Display data	Data range	
P - 0 0 A	0 1 0 0	0000~0100	(Standard Setting:0100)

Description: Set a desired limit as 100% = the max. power.
 This set value is a power limit of the power limit pattern to set Mode No. P-0009.
 Power limit = Max. power x (Set data)%

No.16 limiting the regenerative power (Adjustment of the decelerating time)

Mode No.	Display data	Data range	
P - 0 1 0	0 1 0 0	0000~0100	(Standard Setting:0100)

Description: This is used to adjust to a decelerating time to be identical with the accelerating time.
 A larger setting reduces the decelerating time.
 A smaller setting extends the decelerating time.
 Note that, when the regenerative power is too larger, the motor current waveform fluctuates because the regenerative limit circuit operates, resulting in the occurrence of a gear noise. When that occurs, reducing this set can solve the fluctuation of the current waveform.

*No.17 Speed command offset adjustment

Mode No.	Display data (4 figures)	Data range
P - 0 1 1		(Standard Setting:)

Description: Input a speed set voltage equivalent to zero speed. When the data display shows 0 by operating the **UP** or **DOWN** key, press the **SET** key. (If the display does not show 0 even by operating the **UP** or **DOWN** key, confirm the speed set voltage, and try the operation again.)
Adjustable range: $\pm 40\text{mV}$ at check pin NC
Normally, this adjustment is not required since it has been already done at the delivery time.

*No.18 Speed detecting offset adjustment

Mode No.	Display data (4 figures)	Data range
P - 0 1 2		(Standard Setting:)

Description: Stop the motor. When the data display shows 0 by operating the **UP** or **DOWN** key, press the **SET** key. (If the display does not show 0 even by operating the **UP** and **DOWN** key, confirm that the motor is stopping, and try the operation again.)
Adjustable range: $\pm 40\text{mV}$ at check pin NF.
Normally, this adjustment is not required since it has been already done at the delivery time.

No.19 Speed command level adjustment (Case of the + polarity of speed command voltage)

Mode No.	Display data (4 figures)	Data range
P - 0 1 3		0000~ (Standard Setting:)

Description: Adjust with a value as high as possible. The selection of this mode No. gives speed command value to the display data.
Input a given speed set voltage of the + polarity.
Adjust the display data to be identical with the given speed input.
When increasing the display data (speed set value), press the **UP** key.
Adjustable range: Max. speed set value/ +10V $\pm 0.5\text{V}$ at check pin NC.

No.20 Speed set level adjustment (Case of the - polarity of speed command voltage)

Mode No.	Display data (4 figures)	Data range
P - 0 1 4		0000~ (Standard Setting:)

Description: Adjust with a value as high as possible. The selection of this mode No. gives speed command value to the display data.
Input a given speed set voltage of the - polarity.
Adjust the display data to be identical with the given speed input.
When increasing the display data (speed set value), press the **UP** key.
Adjustable range: Max. speed set value/ -10V $\pm 0.5\text{V}$ at check pin NC.

No.21 Motor speed adjustment

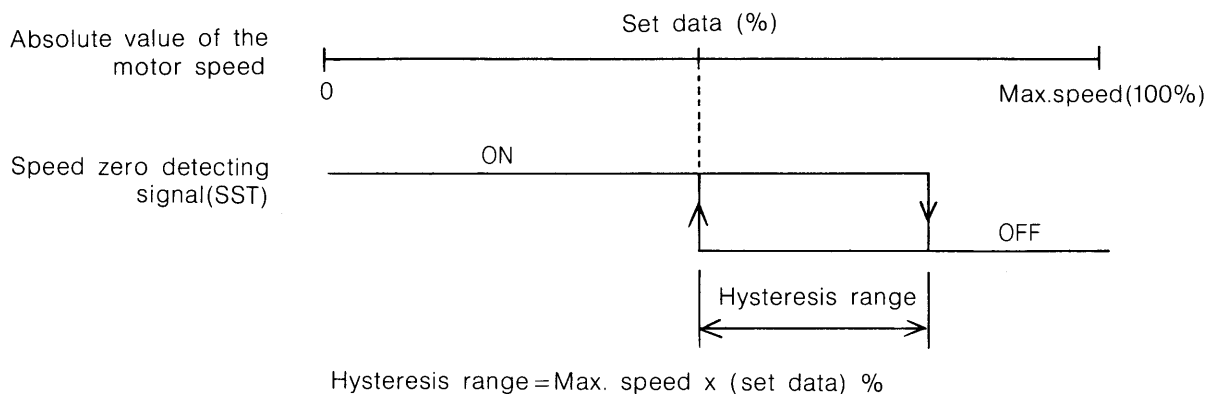
Mode No.	Display data (4 figures)	Data range
P - 0 1 5		(Standard setting:)

Description: The selection of this mode No. gives speed deviation (= Speed command value-Speed actual value) to the data display.
Input a given speed command voltage. After confirming that the speed is in the steady-state, press the set key when the display shows 0 by operating the **UP** or **DOWN** key. For example, in order to make speed deviation of the + be 0, press the **DOWN** key.

No.42 Setting of speed zero detecting level

Mode No.	Display data (4 figures)	Data range	
P - 0 2 A	0 0 . 3 0	00.20~02.00	(Standard setting: 00.30)

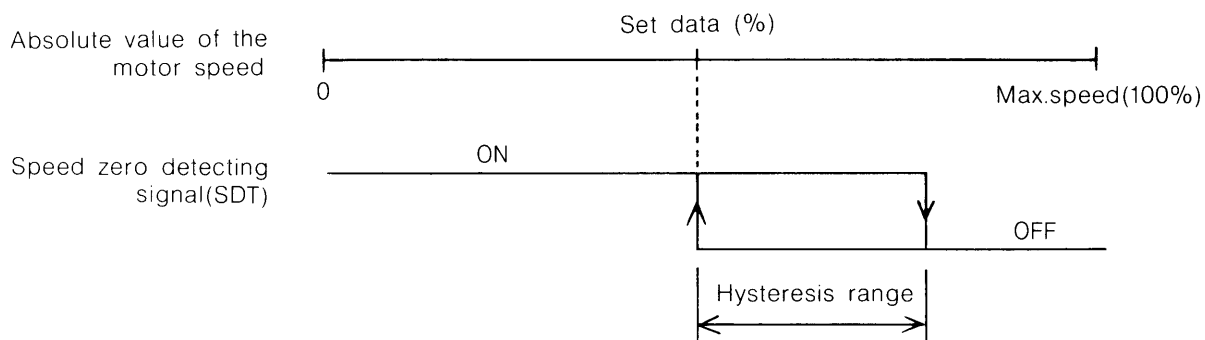
Description: Set the detecting range of speed zero signal(SST). When the motor speed becomes (the set data)% of the max.speed or below, the speed zero signal will be ON.



No.43 Setting of arbitrary speed detecting level

Mode No.	Display data (4 figures)	Data range	
P - 0 2 B	0 0 0 3	0000~0100	(Standard setting: 0003)

Description: Set the detecting range of arbitrary speed detecting signal(SDT). When a speed of the motor becomes (the set data) % of the max. speed or below, an arbitrary speed detecting signal will be ON.



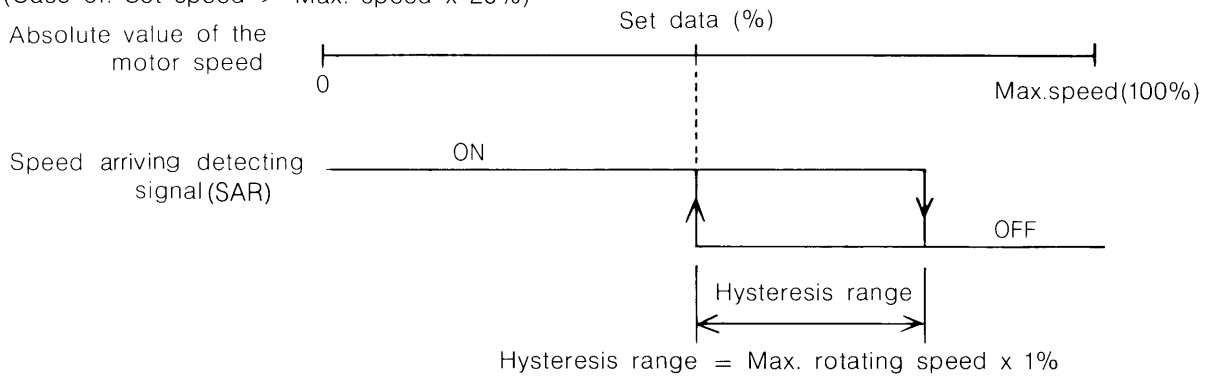
Case of set data > 20% Hysteresis range = Max. speed x (the set data)% x 5%
 Case of set data ≤ 20% Hysteresis range = Max. speed x 1%

No.44 Setting of speed arriving detecting level.

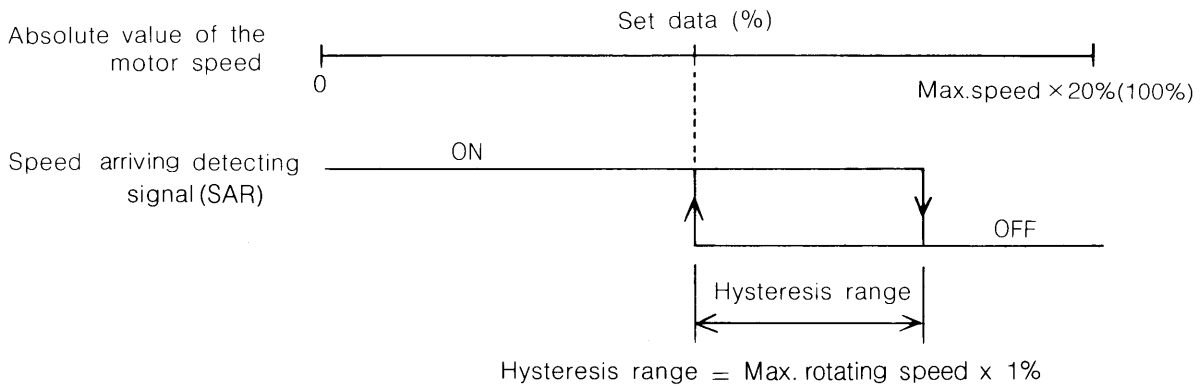
Mode No.	Display data (4 figures)	Data range	
P - 0 2 C	0 0 0 5	002~0015	(Standard setting: 0005)

Description: Set the detecting range of speed arriving detecting signal(SAR). When the speed deviation becomes within (\pm the set data)% of the set speed, a speed arriving detecting signal will be ON. If the set speed is 20% and less of the max. speed, the speed arriving detecting signal be ON when the speed deviation becomes within (\pm the set data)% of 20% of the max. speed. On the contrary, if the motor speed is the zero speed detecting level or below, the speed arriving detecting signal will be always OFF.

(Case of: Set speed > Max. speed x 20%)



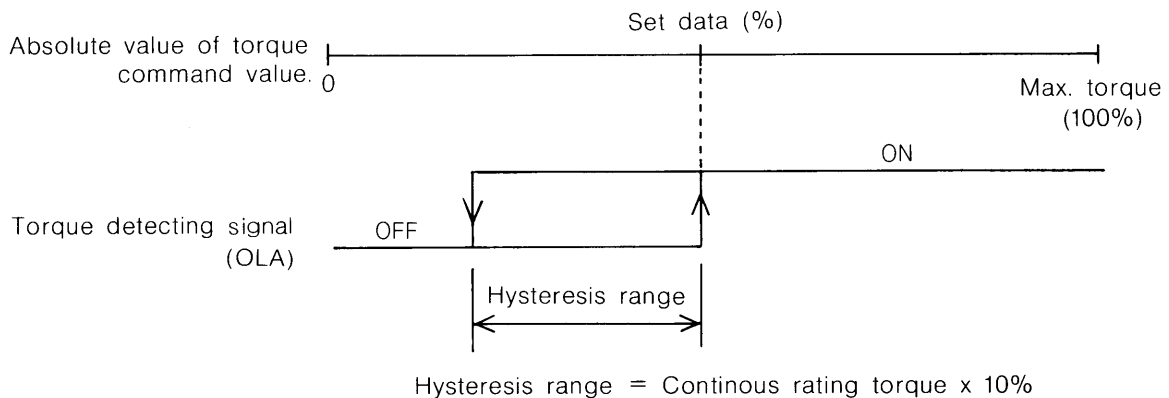
(Case of: Set speed \leq Max. rotating speed x 20%)



No.45 Setting of torque detecting level

Mode No.	Display data (4 figures)	Data range	
P - 0 2 D	0 0 9 0	0000~0100	(Standard setting: 0090)

Description: Set the detecting range of torque detecting signal(OLA). When a torque command value becomes(the set data)% of the max. torque or over, a torque detecting signal will be ON.

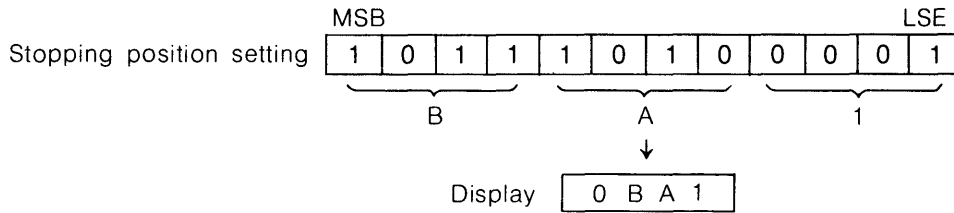


Note) Modes whose numbers come after P-049 are only applied for display and cannot be for data modification.

No.73 Display of the external stopping position set value (HEX display)

Mode No. Display data (4 figures)
P - 0 4 9

Description: In the case of using the MG orientation, this mode cannot be applied.



No.74 Display of 0° reference main shaft position(HEX code)

Mode No. Display data (4 figures)
P - 0 4 A

Description: In the case of using the MG orientation, this mode cannot be applied.
 Main shaft position = (Display data) pulse

$$\text{One pulse} = \frac{360^\circ}{4096}$$

No.75 Display of position deviation (HEX code display)

Mode No. Display data (4 figures)
P - 0 4 B

Description: In the case of using the MG orientation, this mode cannot be applied.
 Position command value - Position detected value = (Display data) pulse

$$\text{One pulse} = \frac{360^\circ}{4096}$$

No.76 Display of No.1 failure contents

Mode No. Display data (4 figures)
P - 0 4 C A L - X X

No.77 Display of No.2 failure contents

Mode No. Display data (4 figures)
P - 0 4 D A L - X X

No.78 Display of No.3 failure contents

Mode No. Display data (4 figures)
P - 0 4 E A L - X X

No.79 Display of No.4 failure contents

Mode No. Display data (4 figures)
P - 0 4 F A L - X X

Description: (P-04C~P-04F in common)

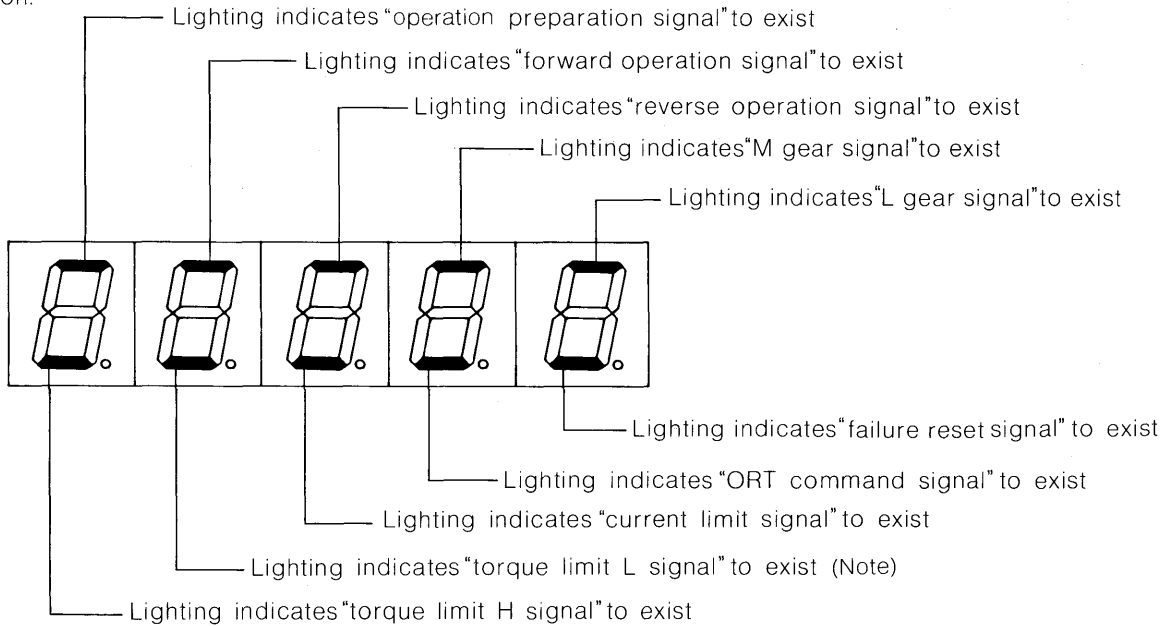
Display	Failure detail
AL-01	DC line fuse trip
AL-02	AC line fuse trip
AL-03	Over current
AL-04	Regeneration error
AL-05	DC intermediate over voltage
AL-06	Input over voltage
AL-07	Inverter overheat
AL-08	Inverter overload
AL-09	Over speed
AL-10	Over speed deviation
AL-11	Current detecting circuit error
AL-12	Under voltage
AL-13	Motor overheat
AL-14	Fault of thermistor
AL-15	The external failure
noAL	No failure

No.87 Display of the digital input at the occurrence of failure (LED display)

Mode No. Display data (4 figures)

P - 0 5 7

Description:



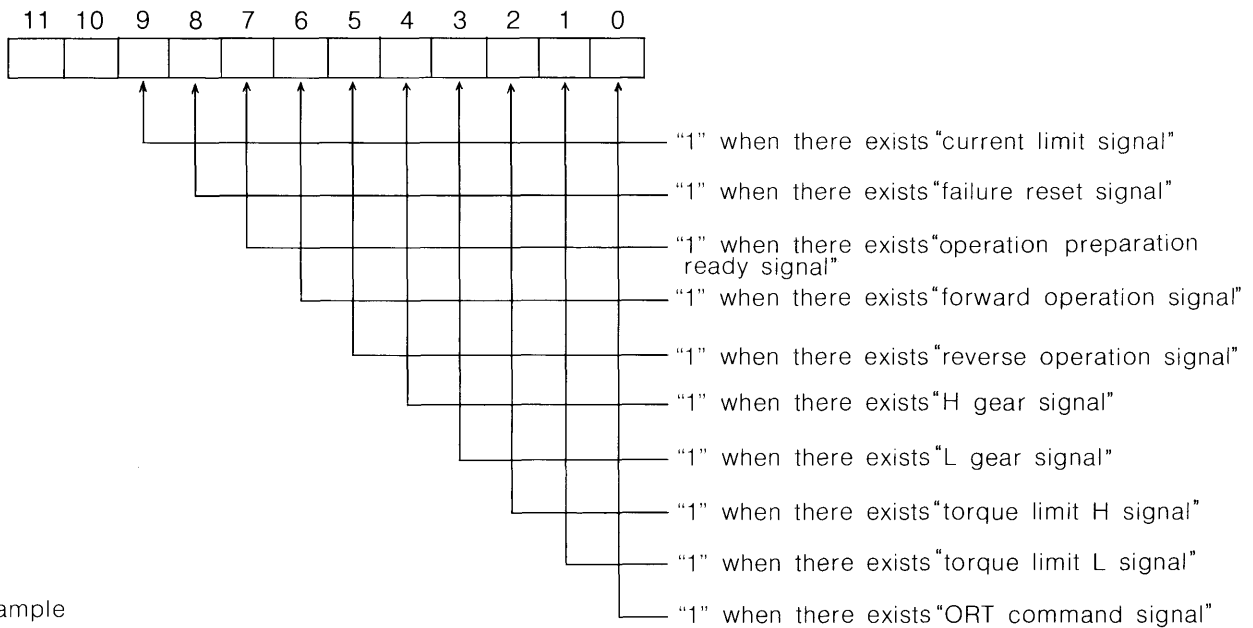
(Note) when P-006 = 0001, lighting means "rigid tap signal" to exist.

No.88 Display of the digital input at the occurrence of failure (HEX display)

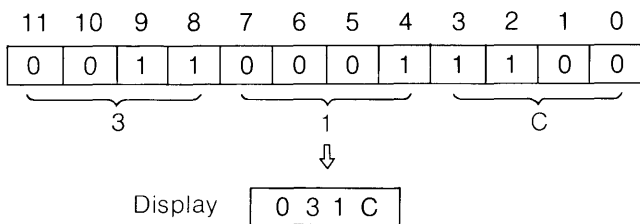
Mode No. Display data (4 figures)

P - 0 5 8

Description:



Example



(Note) After all failures have been cleared, data of P-04C~P-058 will be held until some new failure occurs, if the input power supply is cut off.

No.89 Display of the current digital input (LED display)

Mode No. Display data (4 figures)

P - 0 5 9

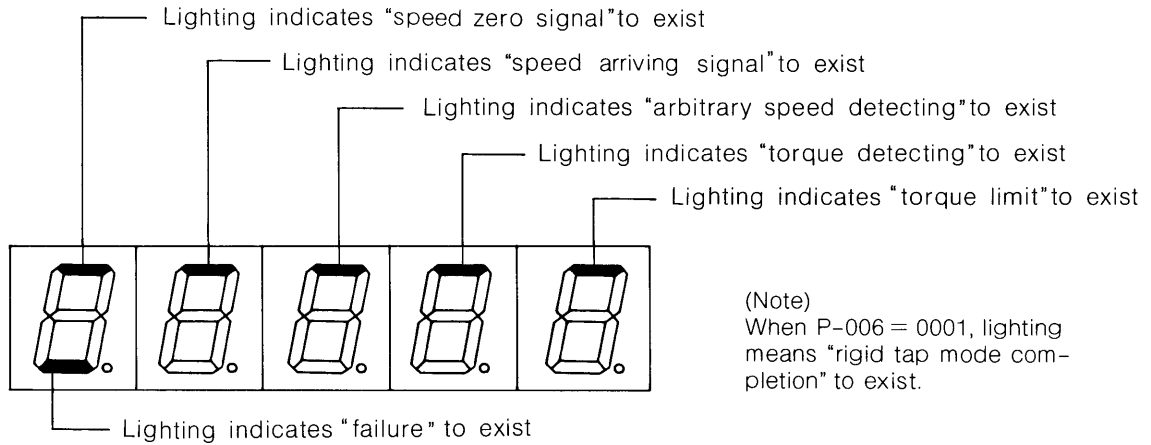
Description: Refer to Description of No.87 Display of the digital input at occurrence of failure.

No.90 Display of the current digital output (LED display)

Mode No. Display data (4 figures)

P - 0 5 A

Description:



No.91 Display of the current digital input (HEX display)

Mode No. Display data (4 figures)

P - 0 5 B

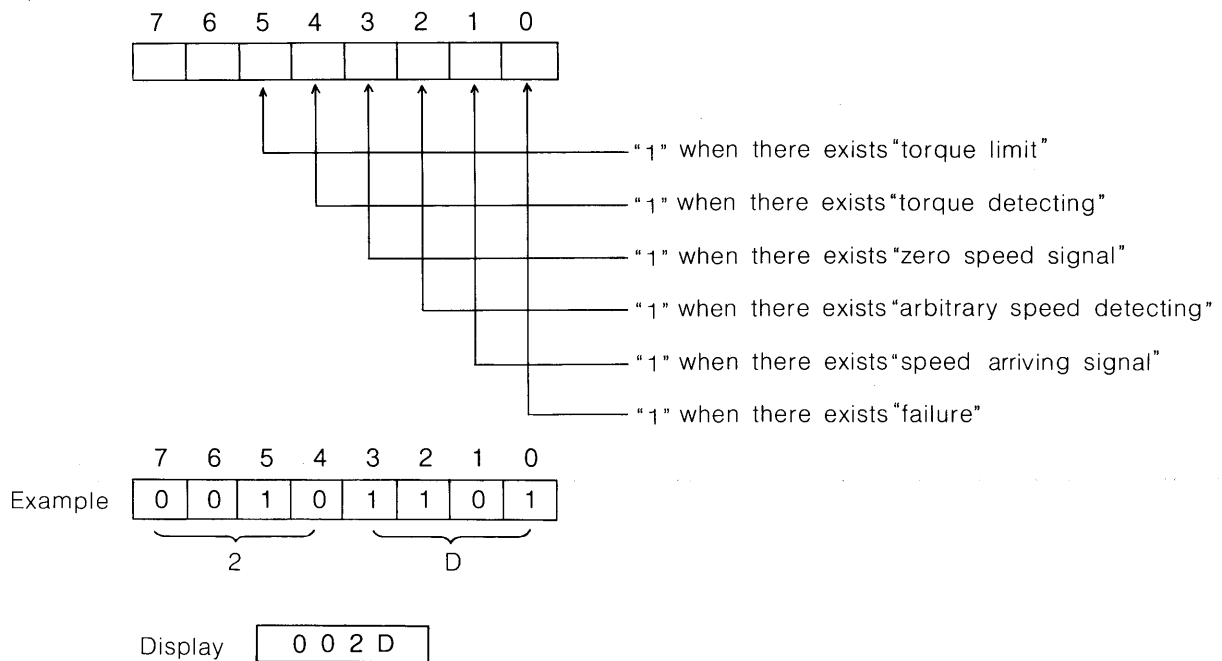
Description: Refer to Description of No.88 Display of the digital input at occurrence of failure.

No.92 Display of the current digital output (HEX display)

Mode No. Display data (4 figures)

P - 0 5 C

Description:



4. Maintenance inspection

Routine inspection

It is necessary to conduct a desirable inspection in order to achieve full performance of the unit and to continue a highly reliable operation over a long period with preventing the occurrence of failure. The inspection should be conducted every 3 - 6 months in consideration of the following notes.

- (1) Be sure to turn off the power source.
- (2) The smoothing capacitor (large capacity capacitor) does not discharge immediately after the power source has been turned off. Therefore, after the power source has been turned off, wait for several minutes until a CHARGE lamp (LED 6, red) goes out, and then carry out the inspection.
- (3) When connecting or disconnecting such as connectors, be sure to carry out the operation by holding the housing of a connector.
- (4) Do not perform any megger test or withstand voltage test.
- (5) Check items

No.	Check items	Details	Dispositions
1	Electromagnetic contactor	<ul style="list-style-type: none"> ● Whether the contacts are not worn out. ● Whether it is smoothly and reliably operating. 	Replacement
2	Transistor, Diode, Smoothing capacitor, and Printed circuit board	<ul style="list-style-type: none"> ● Whether there are no abnormal phenomena observed such as discoloring and stinking. ● Whether there are no metal fragments and wire chips contained in the units. ● Whether no parts of the printed circuit board is discoloring and deformed. ● Whether dust has not accumulated in the units. 	Replace defective parts after checking. Replace the printed circuit board.
3	Unit cooling fan	<ul style="list-style-type: none"> ● Whether it turns powerfully when the power is supplied. ● Whether no abnormal noise comes from the bearing part. ● Whether dust has not accumulated in the air suction part. 	Replace unit cooling fan.
4	Terminals and Connectors	<ul style="list-style-type: none"> ● Whether they are not loose. 	Tightening up

Remarks: If a large amount of dust has been accumulated, clean up with such as an electric cleaner without giving shock to the parts.

5. Troubleshooting

In case of any abnormal event should occur during or at the operation, try to understand the accurate cause of the event, and apply appropriate solutions based on the troubleshooting lists provided herein, in consideration of the following notes. When failing or finding some parts failure, the user is requested to consult Fuji. (At that time, inform Fuji of the display details of P-04C-P-05Cas well.)

Notes:

- (1) Repair and adjustment of the units should be conducted by no one other than the persons responsible.
- (2) Use appropriate tools, such as a tester, a digital voltmeter, and a synchroscope, to check the circuits, etc. (Use instruments which have more 1MΩ and more of input impedance, and not an electromagnetic oscillograph.)
- (3) Be sure not to disconnect and connect the wiring while the power is supplied, since that causes short-circuiting.
- (4) Do not make any unnecessary re-adjustment of sw's and parameters which have been already adjusted. If necessary, record the current position in prior to the re-adjustment as to restore to the original conditions.

5-1 Confirmation on Power supply voltage

When any trouble has occurred, first of all, check the power supply voltage described as follows:

Confirmation on AC power source voltage	Check whether the voltage satisfies "the specifications of connection power supply."																
Confirmation on Control power source voltages	Check whether the control power source voltages on the main printed circuit board satisfy the following rating values: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Voltage</th> <th>Application</th> <th>Check terminal</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>+15V</td> <td>Analog circuit</td> <td>P-M</td> <td>+15V ±5% (14.25V ~ 15.75V)</td> </tr> <tr> <td>-15V</td> <td>Analog circuit</td> <td>N-M</td> <td>-15V ±5% (-14.25V ~ -15.75V)</td> </tr> <tr> <td>+5V</td> <td>Digital circuit</td> <td>P5-M</td> <td>+5V ±1% (4.95V ~ 5.05V)</td> </tr> </tbody> </table>	Voltage	Application	Check terminal	Rating	+15V	Analog circuit	P-M	+15V ±5% (14.25V ~ 15.75V)	-15V	Analog circuit	N-M	-15V ±5% (-14.25V ~ -15.75V)	+5V	Digital circuit	P5-M	+5V ±1% (4.95V ~ 5.05V)
Voltage	Application	Check terminal	Rating														
+15V	Analog circuit	P-M	+15V ±5% (14.25V ~ 15.75V)														
-15V	Analog circuit	N-M	-15V ±5% (-14.25V ~ -15.75V)														
+5V	Digital circuit	P5-M	+5V ±1% (4.95V ~ 5.05V)														

5-2 Troubleshooting lists

(1) When a failure display is shown on the seven segment LED (AL - * *)

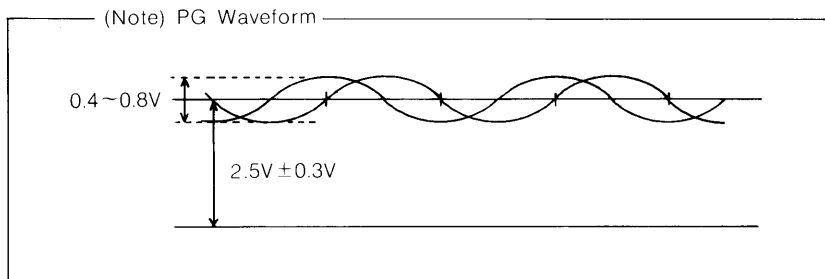
No.	Problem	Cause of failure	Check method	Dispositions
1	DC line fuse trip AL -01 As to this failure, the user is re- quested to con- tact Fuji.	Defective power transistor on the motor side	Check of the motor side power transistor	Replace the motor side power tran- sistor
		Defective base drive circuit	Check the base drive circuit	Replace the main printed circuit board Replace the power transistor
		Defective current feedback system	Check the Disconnected hall CT cable and loosed connectors	Recondition, or replace the calbe Replace the power transistor
			Defective hall CT	Replace hall CT Replace the power transistor
Short-circuiting or ground- ing of output wiring.	Check of the wiring	Recodition the wiring Replace the power transistor		
2	AC line fuse trip AL -02 (Above FRN022V3) As to this failure, the user is re- quested to con- tact Fuji.	Defective power transistor	Check of the power transistor	Replace the power transistor
		Defective surge absorber or capacitor	Check of the surge absorber and the capacitor	Replace the surge absorber and capacitor
		Defective main printed cir- cuit board		Replace the main printed curcuit board
		Breakage of charging resis- tor	Check of the charging resistor	Replace the charging resistor
			Check of the contactor making cuircuit	Replace the making circuit
		Defective regenerative printed circuit board		Replace the regenerative printed circuit board
Loosed connection of fuse	Check of tightening being sufficient	Tighten up the fuse		
3	Overcurrent AL-03	Short-circuiting or grounding output wiring	Check the wiring	Repair the defective parts
		Detective hall CT	Check whether the fluctuation of the output voltage (Check pins IU and IW) of hall CT is not large	Replace hall CT
		Maloperation due to noises	Check the waveforms of check pins IU and IW	Re-examine the grounding treatment
		Motor abnormal	Insulation resistance measurement [500V megger measurement for the motor (disconnect the wiring for inverter unit connection)]	Replace the motor
4	Regenerative error (Above FRN 022V3) AL-04	Maloperation due to noises	Check whether the noise is affecting the waveforms of hall CT output voltage.	Apply solutions for noise problem and re-examine the wiring
		Defective hall CT	Check whether the fluctuation of hall CT output voltage (check pin ID) is severe.	Replace the hall CT
		Phase sequence	Check the phase order of R, S, and T.	Change the wiring
		Input under voltage	Check the input power source vol- tage.	
5	DC intermediate over voltage AL-05	Input AC over voltage	Check the input power source vol- tage.	Re-examine the power source speci- fications
		Breakage of currenct limiting resistance (Above FRN 022V3)	Check the resistance value of the limiting-current resistor	Replace the limiting-current resistor
		Loose connectors of the regenerative circuit element (Above FRN 022V3)	Check the loose and disconnected connectors	Repair the connectors
		Defective main printed cir- cuit board	Check the level of over voltage	Re-adjust, and replace the main printed circuit board
6	Input overvoltage (Above FRN 022 V3) AL-06	Input voltage over	Check that the input power source voltage is not over 253V	Re-examine the power source, and check the surge absorber (whether it has been damaged)

No.	Problem	Cause of failure	Check method	Dispositions
7	Inverter overheat AL-07	Overload (Overheated fin)	Check by a loadmeter	Reduce the load, and examine the cutting conditions
		Defective detecting sensor	Check the detecting sensor	
		Defective unit cooling system	Check the unit cooling fan	Clean the unit, and replace the fan
		Increased temp. inside the panel	Check the temp. inside the panel	Enhance the panel cooling conditions
		Overheated limiting-current resistor The regenerative duty is too severe.(Above FRN 022V3)	Check the operation cycle	Re-examine the operation cycle.
	Defective sensor detecting overheat of the limiting-current resistor (Above FRN 022V3)	Check the detecting sensor	Replace the detecting sensor	
8	Inverter overload AL-08	The load is too much.	Check whether the accelerating time at the max. torque may require one min.	Re-examine the machine side
		The mechanical lock is effective.	Check whether the orientation (tool chngement) and the lock state may be cotinuos.	Re-examine the machine side
9	Over speed AL-09	Defective speed detecting circuit	Check whether the check pin FV may be satulated.	Replace the main printed circuit board
		Improper adjustment	Check whether the motor actual speed may be too high.	See "Display and Setting parts" in Section 3.
10	Over speed deviation AL-10	Defective speed detecting PG	Check the PG wavefrom (check pins PA and PB).	Replace the PG
		Overload, and the mechanical lock	Check whether the loadmeter may have reached the limited.	Change the cutting conditions, and replace the motor
11	Current detecting circuit error AL-11	Defective hall CT	Check whether each voltage of check pin IU and IW may be over 200mV whin the motor is stopping.	Re-place the hall CT
12	Under voltage AL-12	The input AC voltage is too low.	Check the input power source voltage	Examine the power source specifications (power source capacity, waveform distortion power regulation, etc.)
		Instantaneous power failure due to lightning etc.		Restore to the normal state with the failure reset.
13	Motor overheat AL-13	Overload	Check whether the loadmeter may have reached the limited.	Reduce the load, examine the cutting conditions, and re-examine the tools.
		Defective motor cooling system	Check the fan is working.	Replace the fan
			Check whether the fan ventilation channel is clean.	Clean up the motor
	Defective temp. sensing element (NTC thermister) built in the motor.	Check whether the motor may be actually overheated.	Replace the motor	
14	Fault of thermister AL-14	Improper wiring, and loose connectors	Check the wiring and the connectors.	Replace the wires and connectors.
		Disconnected NTC thermister (inside the motor)		Replace the motor
		The peripheral temp. is too low (under -10°C)	Check the peripheral temp.	Examine the installation enviroment.

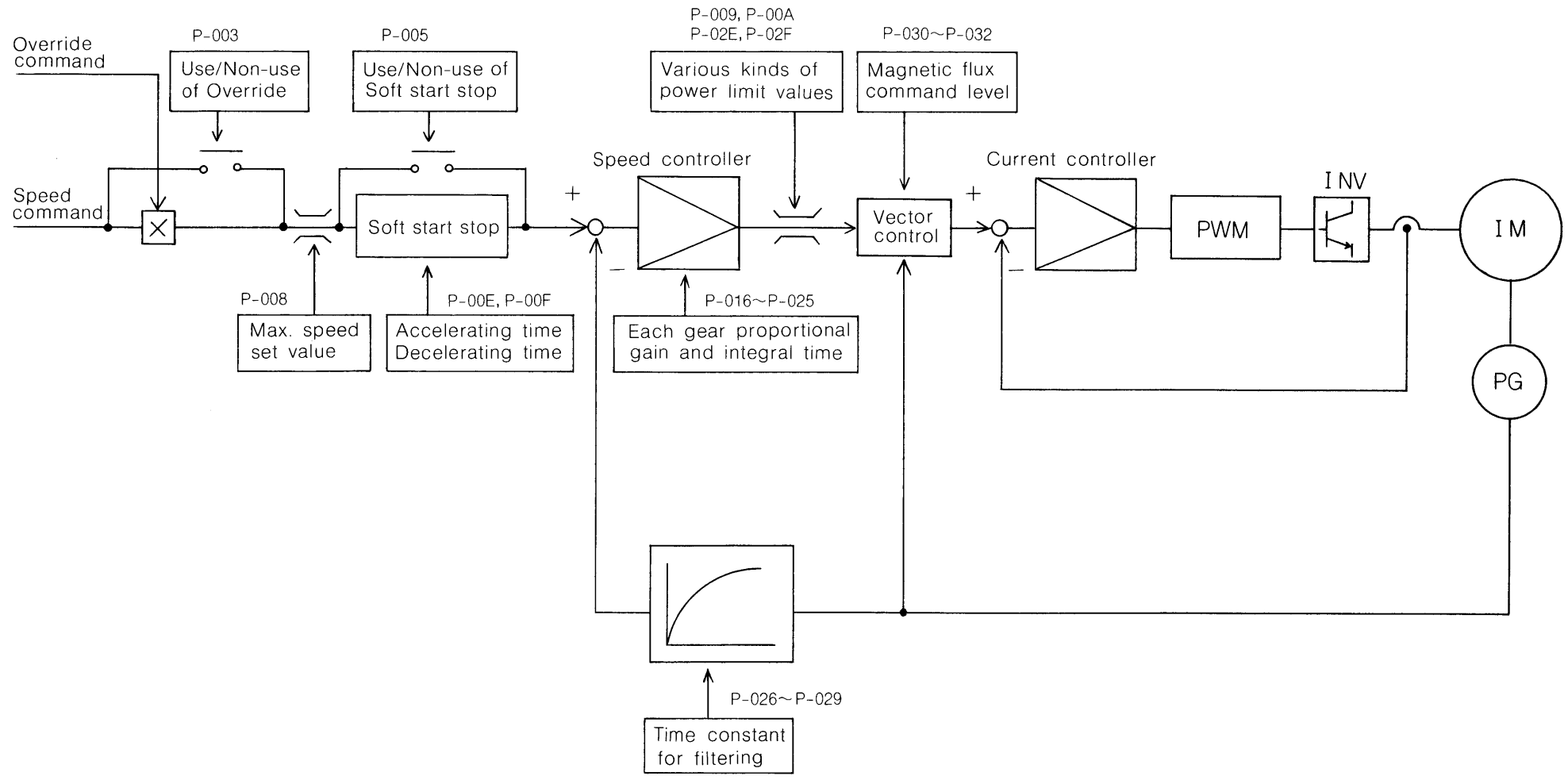
(2) When the failure display LED does not light

No.	Problem	Cause of failure	Check method	Dispositions
1	Trip of the input side power breaker (ELB)	Short-circuited or grounded main circuit	Check the main circuit.	Repair the defective parts.
		The breaker rating current is too small.	Check the breaker current capacity.	Repair the breaker.
		ELB is not a type applicable to inverter.	Check the breaker specifications (trip, values, etc.)	Replace with a breaker applicable to inverter.
		The rush current has flowed due to a failure of the charging resistance.	Check the charging resistance	Replace the charging resistance
2	The motor does not rotate	An operation preparation signal and an operation signal have not been input.	Check the sequence	Repair the sequence.
		Defective MAIN printed circuit board		Replace the MAIN printed circuit board
3	The motor does not reach to the prescribed speed level, or motor does not smoothly rotates	The incorrect speed setting voltage (the N/C side), or improper digital signal	Check the N/C max. speed parameters.	Modify the parameter.
			Check the digital signals (binary or BCD code)	Excuse the troubleshooting for the N/C side.
			The incorrect connection of the digital signal lines	Repair the wiring.
		The incorrect speed setting voltage (the printed circuit board)	Check that the offset of the speed setting circuit does not deviate	Re-adjust the offset.
		A noise exists in the speed setting circuit.	Check at check pin NC, and the shield method.	Repair the shielding. (In some cases, the 2 point shield is better.)
		A noise exists in the speed feedback circuit.	Check the PG waveform (check pins AP and BP). Check the PG shielding.	Repair the PG shielding.
4	The motor rotate irregularly and the motor speed does not increase.	Disconnected PG circuit, and incorrect binding.	Check the PG circuit. (The loadmeter has reached the limit.)	Re-examine the wiring (particularly the connector part).
		The incorrect phase order connection of the motor's main circuit.	Check the motor wiring.(The loadmeter has reached the limit.)	Re-examine the wiring.
		Defective PG	Check the PG waveform (Check pins PA and PB).	Replace the PG, or the motor.
		Defective soldering of the PG connectors, and the imperfect connection contact.	Check the PG connector part.	Replace the PG connector part.

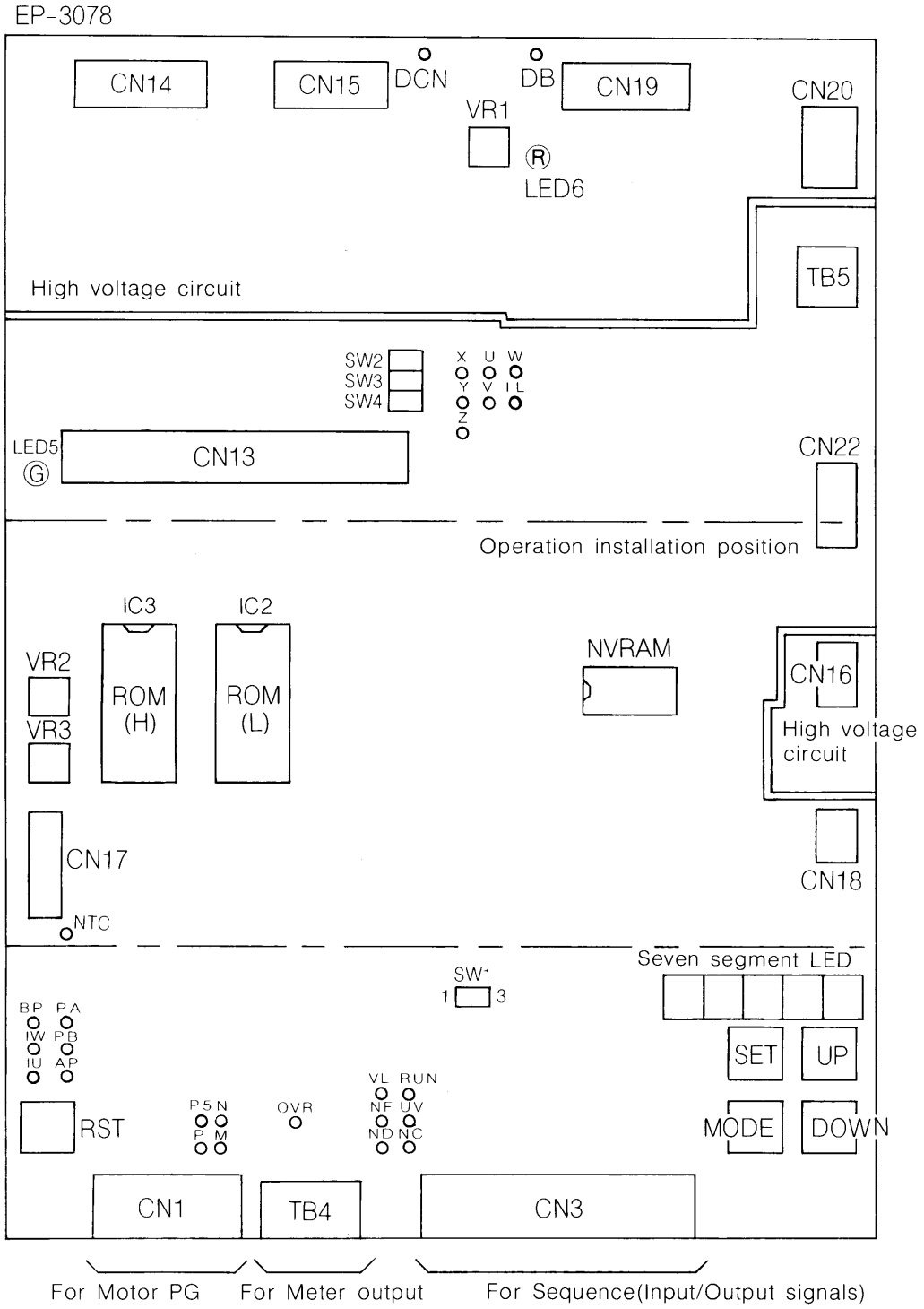
No.	Problem	Cause of failure	Check method	Dispositions
5	The motor keeps slowly rotating without stopping.	The incorrect speed setting voltage	Check whether the offset of the speed setting circuit may deviate.	Re-adjust the offset.
		A noise exists in the speed setting voltage.	Check at check pin NC. Check the shielding	Repair the shielding. (In some cases, the 2 point shielding is better.)
		A noise exists in the speed setting voltage.	Check the PG waveform (check pin PA and PB). Check the shielding of PG.	Repair the PG shielding.
		Defective main printed circuit board		Replace the main printed circuit board
6	The overshoot of motor speed is too large.	The improper adjustment of ASR	Check whether the ASR gains may be too low.	Increase the ASR gains.
		The load GD2 is large	Check the machine specifications.	Re-examine the machine specifications.
7	The cutting power is low.	The torque limit is effective, or the cutting speed fluctuation is large.	Check whether the external torque limit (H or L) may have not been input.	Re-examine the sequence.
		Improper cutting amount and feed speed.	Check the program.	Re-examine the program.
		The belt is loose	Check the tension of the belt.	
8	A gear sound and vibration occurs.	The improper adjustment of ASR	Check whether the ASR gains may be too high.	Decrease the ASR gains.
		The improper shielding of PG	Check the PG waveform (check pin PA and PB). Check the shielding of PG.	Repair the PG shielding.
		Failure of the machine side (motor).	Check whether this occurs in free run as well.	Re-examine the machine side (motor).
		Defective MAIN printed circuit board		Replace the MAIN printed circuit board.



6. Control block diagram



7. Layout diagram of the adjustment parts of Main printed circuit board



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