ELECTRIC COPY BNC-12 10-T control

TYPE
FMD-3AC-21A
3.7kW 19A

208/230V

FRENIC® 5000M2
FRENIC® 5000W

instruction manual for pulse encoder system orientation EP-2810

Fuji Electric Co.,Ltd.

INR-HF 5829b-E

CONTENTS

This is specification and instruction manual for Puls Encoder Orientation System of FUJI AC Spindle Drive System, FRENIC 5000M2 and FRENIC 5000W series.

This option is applied for unit type,

FMD—_____ A ____—22(Main P.C.B. # is EP-2809)

- Shows series (C,U or W)
- Shows inverter output.

I SPECIFICATION

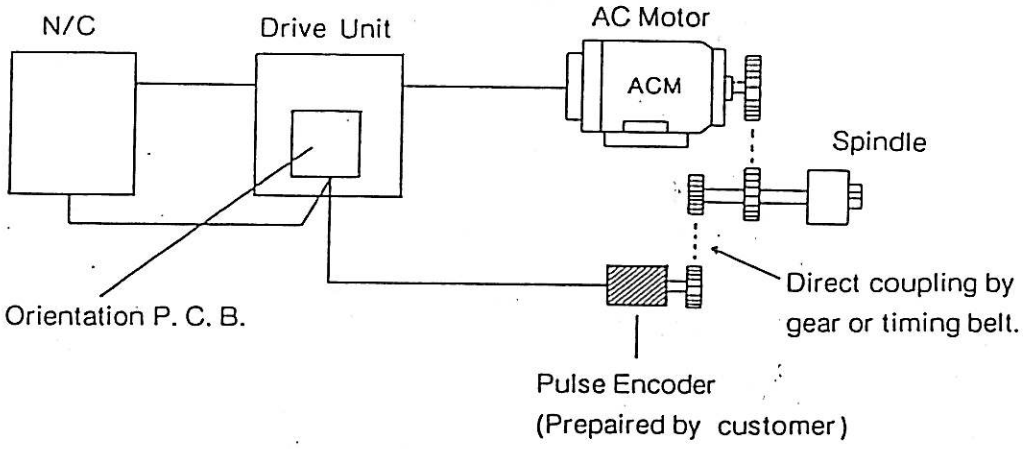
1. FEATURES

1-1 Orientation control circuit consists of positioning loop, therefore, it is easy to do highly accurate positioning.

1-2 It is possible to carry many point positioning as you want, by external position setting signal.

2. CONSTRUCTION

2-1



3. SPECIFICATIONS

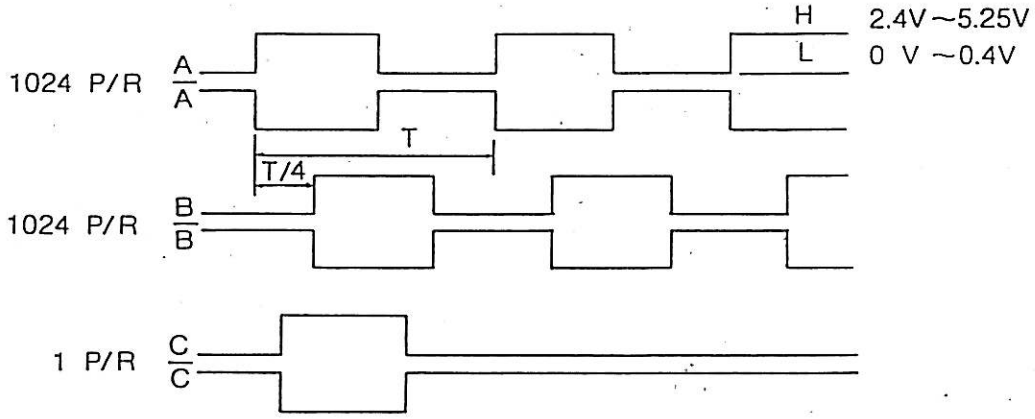
3-1 Main data

Unit type	FRENIC 5000M2, FRENIC 5000W
Stop position	* Internal setting : Multidial 3figures Hexadecimal notation. * External setting : 12bits
Accuracy	* Within ± 0.5 °
Uuit of detection	* 0.088 °/ Pulse
Adjustment range of stop position	* Adjustable with internal setting multidial switch in the case of external setting.
Creeping speed	* Less than 60rpm in spindle speed. (The optimum speed depends on load condition.)
Positioning time	* Less than 2.0 sec. after reach creeping speed. (Will varies with load GD ².)
Mechanical condition	* Spindle speed : Lessthan 6000rpm. * Gear range : Maximum 3(H.M.L.).
Orientation P.C.B.	* EP-2810 C-1 (Only for orientation) * EP-2810 C-2 (With D/A converter B,C,D or Binary 12bits)
Position detector	* 1024 P/R balanced transmission type LED type pulse encoder **. A, $\overline{A}$ signal : 1024 B, $\overline{B}$ signal : 1024 P/R (RFH-1024-22-1-68 made by Nikon Kogaku or equivalent ***) C, $\overline{C}$ signal : 1 P/R

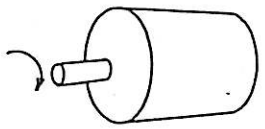
** Pulse encoder is to be supplied by customer. Since Fuji drive unit does not to be continued supply power(5V) to the pulse encoder, utilize another power source such as used for NC system etc. The current consumption of the circuit board is 3mA max.

***RFH-1024-22-1-68 Pulse out put spec.

(totem pole out put. Load impedance max 3.3kΩ)



Above shows pulse encoder when rotating clockwise.



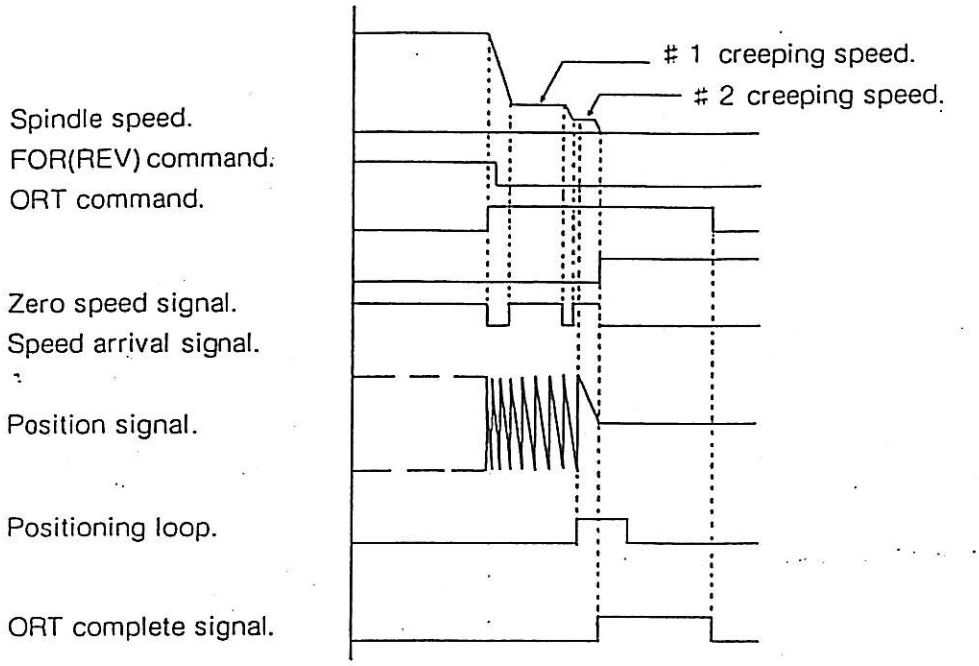
Pulse encoder.

Note ; EP-2810 is only usable with EP-2809.

3-2 Out line of operation.

(1) Positioning when spindle is running.

a. Time chart.



b. Basic operations.

1) When orientation command is given,motor speed will slow down to #1 creeping speed (adjustable), then before 30° to 170° from stop position, slow down to #2 creeping speed (fixed).
2) After reaching #2creeping speed and entering the control zone (approx. ±11°from stop position), the control system will change to positioning control (APR control). The positioning control loop active time can be adjusted by DCBR TIME potentio meter.
3) After change to positioning control, when the spindle comes near the stop position the orientation complete signal will be made.(adjustable).

(2) Positioning when spindle is not running.

When the orientation command is given after ordinary running (M03, M04 ← M05) the following action will be made.

a. When spindle stops out of positioning control zone, spindle will start at creeping speed of commanded direction and then stops at positioning

Direction of creeping speed is;

1) Forward of spindle motor (CCW as viewed from motor out put shaft) if only the orientetion command is given.
2) If you desire to get reverse direction, command "Reverse orientation command=RORT".

b. When spindle stops in the positioning control zone, please see section 3-2-(5), (Continuous multipoints orientation).

(3) When orientation command is given just after main power is turned on.
Witnout ordinary running (M03or M04),the following action will be made because of the lack of the lack of logic condition for control circuit.
The spindle will start at creeping speed in the specified direction.
After the spindle passes through the origin of encoder (C pulse), the spindle stops at the position.

(4) Orientation after inverter alarm has happened,follow next steps.

a. Cancel all command to the inverter before resetting the alarm.

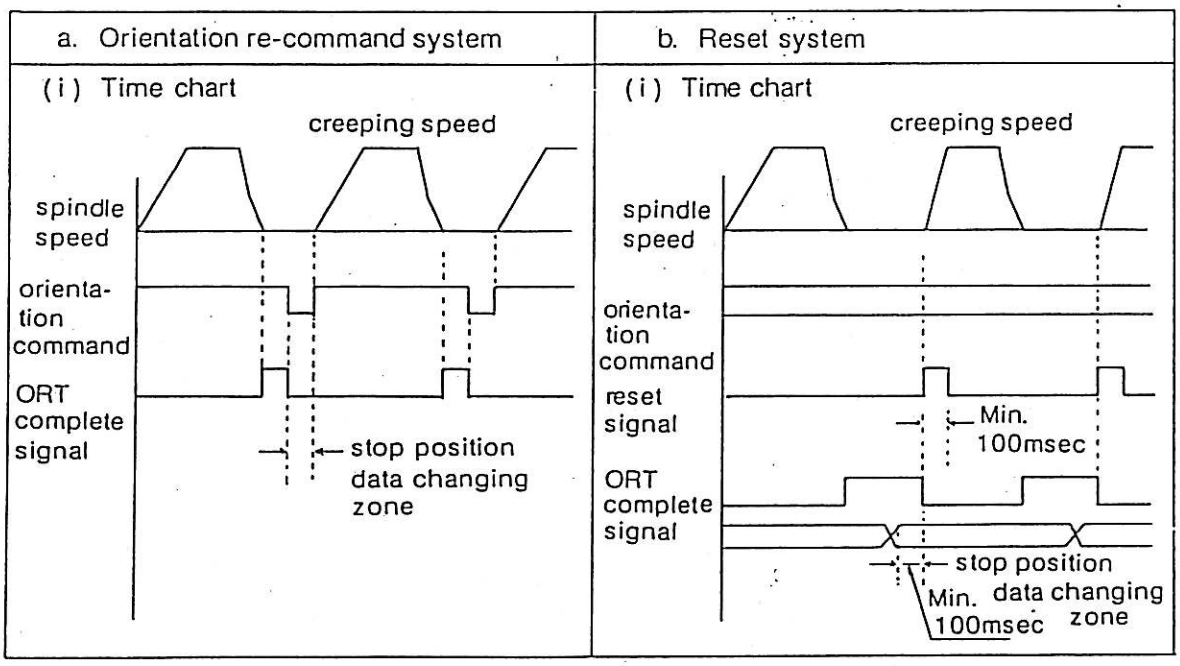
b. Reset the alarm.

c. Give orientation command.

(5) Continuous multipoints orientation.
For the externally position setting pulse encoder system, it is possible to perform continuous multipoints orientation in one complete rotation of the spindle,using either of the following two methods.

a. Input the orientation command repeatedly.

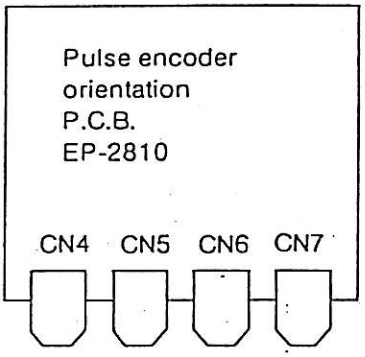
b. Input the reset signal.



3-3 Connectors

(1) Kind of connectors

symbol	Using (for connection)	Receptacle (for P.C.B.)	MaKer
		Plug (for external)	
CN4 ~CN7	Orientation	MR-20RMA	Honda Tsushin
		MR-20LF	



(2) Pin arrangement

CN4 CN5

14	SC	8	1	0H	
15	*SC	9	2	0H	
16	PA	10	3	0H	
17	*PA	11	4	5H	
18	PB	12	5	5H	
19	*PB	13	6	5H	
20	Sheilo		7		

CN6:

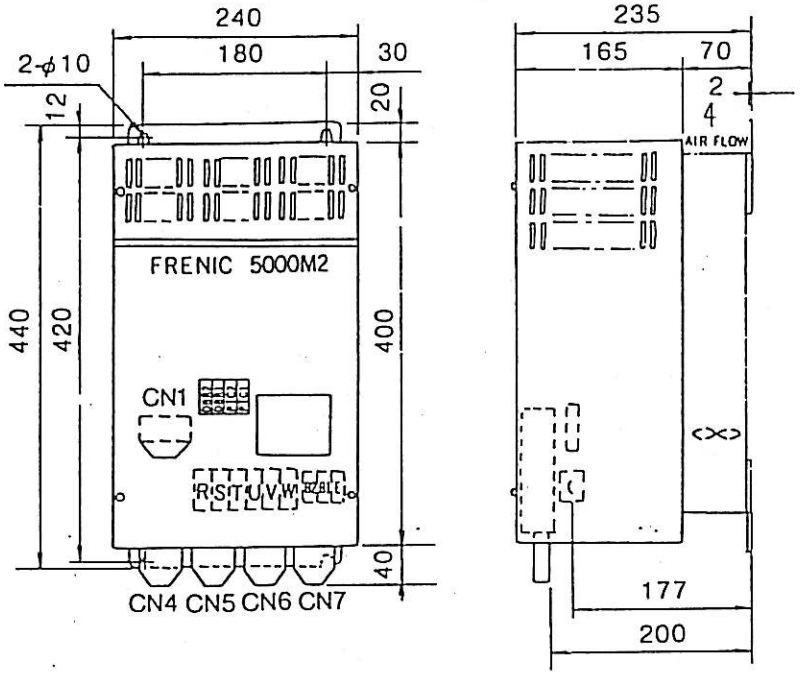
14	ES07	8	ES01	1	ESM
15	ES08	9	ES02	2	ESM
16	ES09	10	ES03	3	
17	ES10	11	ES04	4	
18	ES11	12	ES05	5	
19	ES12	13	ES06	6	
20	ESM			7	RES

CN7:

14	ORAR1	8	R08	1	R10 (LSB)
15	ORAR2	9	R09	2	RO2
16	ORT	10	R10	3	RO3
17	RORT	11	R11	4	RO4
18	RES	12	R12 (MSB)	5	RO5
19	MG	13	CM	6	RO6
20	LG			7	RO7

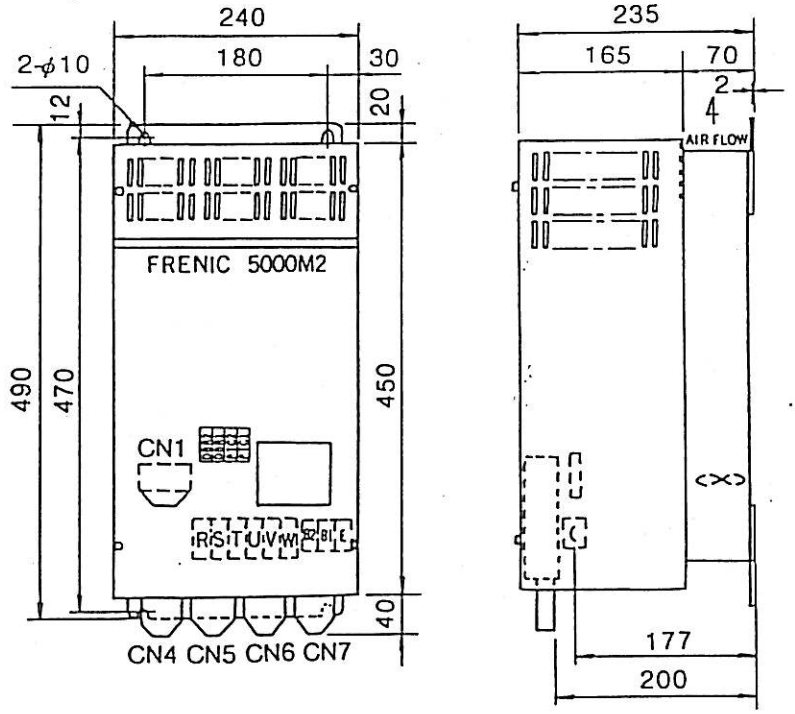
3-4 3-4 Dimension (mm)

FMD-1 AC～5AC

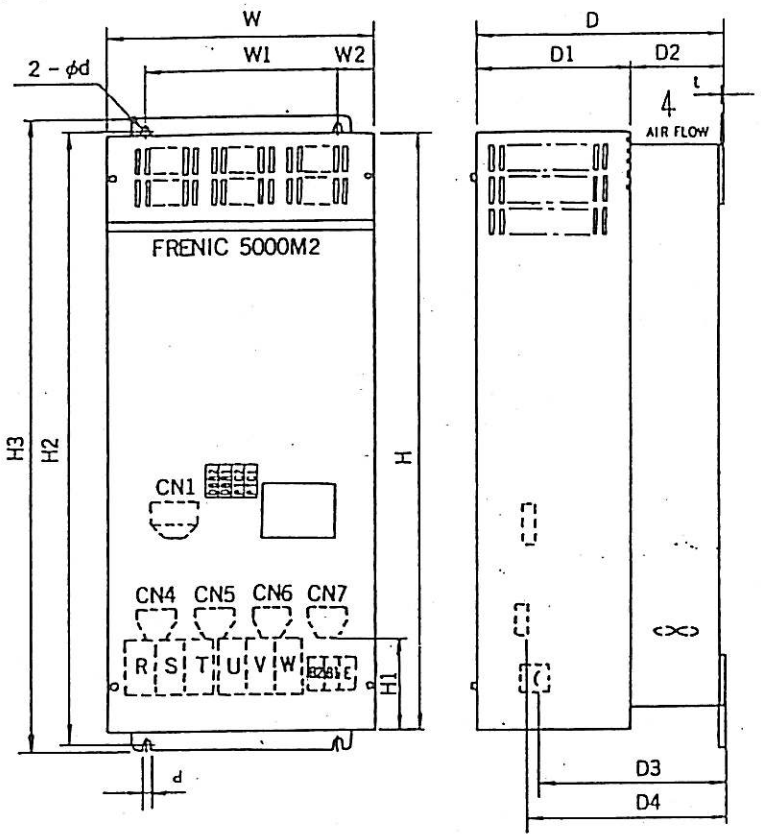


FMD-7 AC

FMD-7 AW



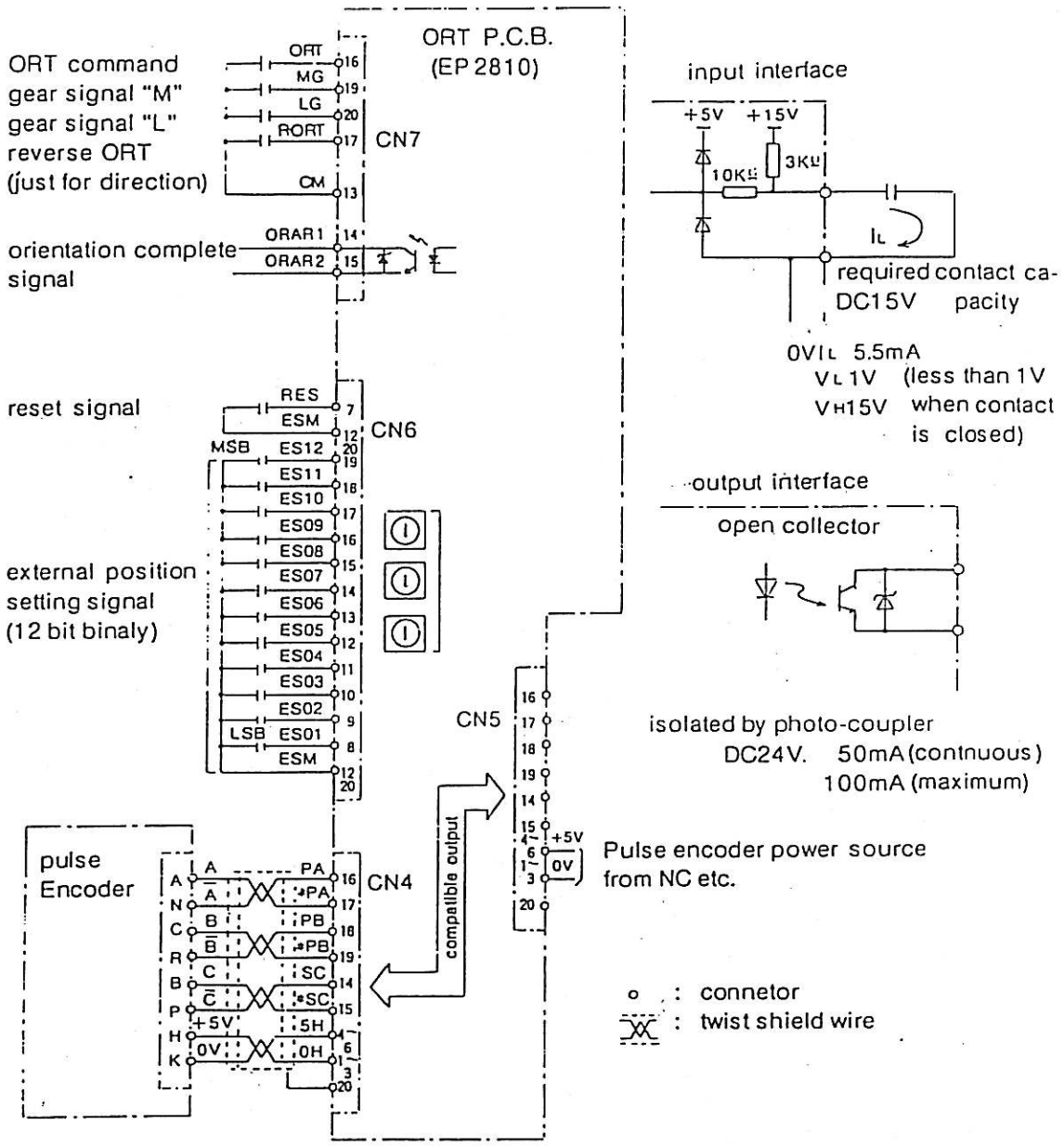
FMD-11AC～15AC
FMD-18AU～37AU
FMD-11AW～37AW



	(mm)													
	W	W1	W2	H	H1	H2	H3	D	D1	D2	D3	D4	d	t
FMD-11AC FMD-11AW FMD-15AU	280	200	40	550	95	570	590	235	165	70	186	231	10	2
FMD-15AC FMD-15AW FMD-18AU	280	200	40	650	95	670	690	265	165	100	198	231	10	2
FMD-22AU FMD-22AW	310	210	50	750	95	770	800	265	165	100	203	231	12	3.2
FMD-30AU FMD-30AW	310	210	50	860	270	880	910	265	165	100	219	231	12	3.2
FMD-37AU FMD-37AW	450	360	45	860	270	890	920	265	165	100	227	231	15	3.2

4. INTERFACE

4-1 Connection



4-2 Description of interface

<table>
<tr><th>Name of signal</th><th>Description</th></tr>
<tr><td>Orientation Command</td><td>* Stop the spindle at desired position
* When the contact is closed,orientation control will be made automatically from any spindle speed.(Use a holding signal)</td></tr>
<tr><td>Reset Signal</td><td>* This signal is for reading external stop position data under continuous multipoints orientation.
* When the contact is closed, the external stop position datas are read. (Use a holding or one-shot signal).
* This signal is effective only when the orientation command is inputted.</td></tr>
<tr><td>Reverse Orientation Command</td><td>* This signal is used when the spindle is not running.
* When the contact is closed spindle will turn in reverse to make positioning. (When open it,spindle turns in forward)
Those directions are of the motor itself.
*This signal is effective only when the orientation command is inputted.</td></tr>
<tr><td>Gear Signal
<table>
<tr><th>MG</th><th>LG</th><th>Decel Time</th><th>±2 Creep-speed</th></tr>
<tr><td>open</td><td>open</td><td>1</td><td>0.5 HZ</td></tr>
<tr><td>close</td><td>open</td><td>1/2</td><td>1.0 HZ</td></tr>
<tr><td>open</td><td>close</td><td>1/2.5</td><td>1.5 HZ</td></tr>
<tr><td>close</td><td>close</td><td>1/3</td><td>2.0 HZ</td></tr>
</table></td><td>* These signals are used to make suitable orientation control if there are speed ranges. (H,M,L, Gear)
* When the contact is closed it is effective,both open means "H" gear.
* These signals will be read when spindle is stopped.</td></tr>
<tr><td>Orientation Complete Signal</td><td>* This signal will be made after complete the positioning control. When orientation command is ON and Zero speed signal is ON.
When this signal is made the small dot will be flickering on P,C,B.</td></tr>
<tr><td>External Position Setting Signal</td><td>* This signal should be given by 12 bit binary signal.
* This signal (s) (position data) is(are) read by orientation command or reset signal. (rising portion of signal)</td></tr>
<tr><td colspan="2">Note : Test mode, This orientation system has test mode built in in itself.
So it need not orientation command from NC to make sure orientation.</td></tr>
</table>

4-3 LED Display

Orientation P.C.B. EP-2810

Display		Description	Unit	Adjustment	REMARKS
Function code	Data (example)				
0	00.0°	Position of spindle		Dot flicker after ORT. 000~FFF	1 pulse = 360°/4096
1	000	External position setting		000~FFF	
2	000	Internal position setting		DSW 0~2 000~FFF	
3	2	Orientation complete zone		ORT WD 1~F	
4	2	Position of DC brake starting		DCBR TIMING 1~F	
5	60°	Position of changing creeping speed from #1 to #2	° (deg.)	CHANGE FRE 30~170	
6	2.0	DC brake effective time	Sec.	DCBR TIME 1.0~10.0	
7	0.5	#2 creeping speed	HZ	———	
8	--	Orientation command		ORT ON ····· Or ORT OFF ····· --	
9	F0	Direction of orientation		FWD ····· F0 REV ····· rE	
A	--	Reset signal		ON ····· CP OFF ····· --	

Main P.C.B. EP—2809

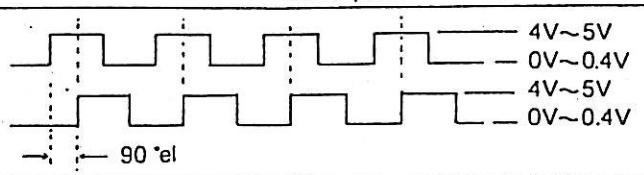
Display		Description	Unit	Adjustment	
Function code	Data (example)				
6	0	DC Brake	%	DCBR 0~100	
9	2.0	#1 Creeping speed	Hz	ORT FI	

Adjustable zone of #1 creeping speed (depends on the gear position)

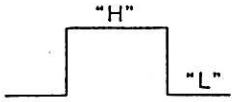
MG	LG	Accel and decel time ratio	#1 creeping speed [Hz]
Open	Open	1	0.5~10
Close	Open	1/2	1.0~20
Open	Close	1/2.5	1.5~30
Close	Close	1/3	2.0~40

Ⅱ HANDLING

1. CHECK TERMINALS

Symbol	Function	Description
CH 1 CH 2	Encoder A pluse Encoder B pulse	
CH 3	Clock pulse	Counter clock pulse(4096 P/R) 4 times of CH 1 or CH 2
CH 4	Direction of rotation	"H" level means A pulse delay "L" level means A pulse advance
CH 5	Counter clear signal	Counter is cleared at "H" level of this signal synchronized with Cpulse
CH 6	D/A converter output	In case of EP-2810-C2, Analogue output for speed command.
P	+15V	+14.25 to +15.75V for analogue circuit
P 5	+5V	+5V ±5% for digital circuit
M	Commom line	Zero (0) V
N	−15V	−14.25 to −15.75V for analogue circuit

Note : Standard values of "H" level and "L" level are as follow;



"H" : 4 to 5V
"L" : 0 to 0.4V

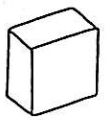
2. SWITCHOVER PINS

Symbol	Function	Short pin ≠	Description
SW1	D/A converter tip selection,BCD or 12 bit binary. Applicable for EP-2810 C2.	1-2	12 bit
		2-3	BCD
SW2		1-2	BCD
		2-3	12 bit
SW3	Select direction of rotation	F-2 or 2-R	Give FOR signal to the drive unit, and when motor is running in forward set this short pin to get "L" level on CH4
TEST	Test switch	2-3	Normal mode (select this side when command ORT from NC.)
		1-2	Make ORT command same as from NC, but do not make complete signal.

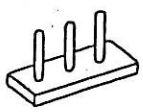
Notes :

(1) Setting of the short pins.
When setting the short pins,use the attached short-circuit tip (green).

(2) Selecting the direction of rotation of the motor.
The direction of rotation of the motor is regarded as normal if the motor rotates counterclockwise as viewed from the motor output shaft side.



Short-circuit tip(green)



Short pins (on the P.C.B.)

3. POTENTIO METERS (Variable resistors)

Symbol	Function	Description
ORT WD	Adjust completion zone of ORT	Adjust to get completion signal near the stopping position, check value by LED display
DCBR TIMING	Adjust DC brake zone	Adjust from APR mode to DC brake mode near the stopping position, check value by LED.
DCBR TIME	Adjust DC brake time	Adjust DC brake time, check value by LED.
DCBR	Adjust DC brake value	Adjust DC brake value, check value by LED. on the main P.C.B. EP-2809.
ORT FI	Adjust #1 creeping speed	Adjust #1 creeping speed, check value by LED. on the main P.C.B. EP-2809.
CHANGE FRE.	Change creeping speed from #1 to #2	Adjust the position (°) creeping speed from #1 to #2, check value by LED.
VR 1	Adjust D/A converter gain	Clockwise =inclease gain (output voltage getting high). Applicable for EP-2810 C2 only

Note : Relation of ORT WD and DCBR TIMING must be satisfied following:

DCBR TIMING < ORT WD

4. ADJUSTMENTS

4-1 Matters to be comfirmed before electricity is turned on.

No.	Item	Description	Refference
1	Pulse encoder specification	Check specification of pulse encoder.	I-3-1
2	Wiring and connections	Check interface.	I-4-1
3	Short pins	Check SW3 position.	II-2

4-2 Check the wave form at check terminals.

Check CH1, CH2 and CH5 with oscilloscope during the spindle running at 100 to 200 rrpm, see II-1 for details.

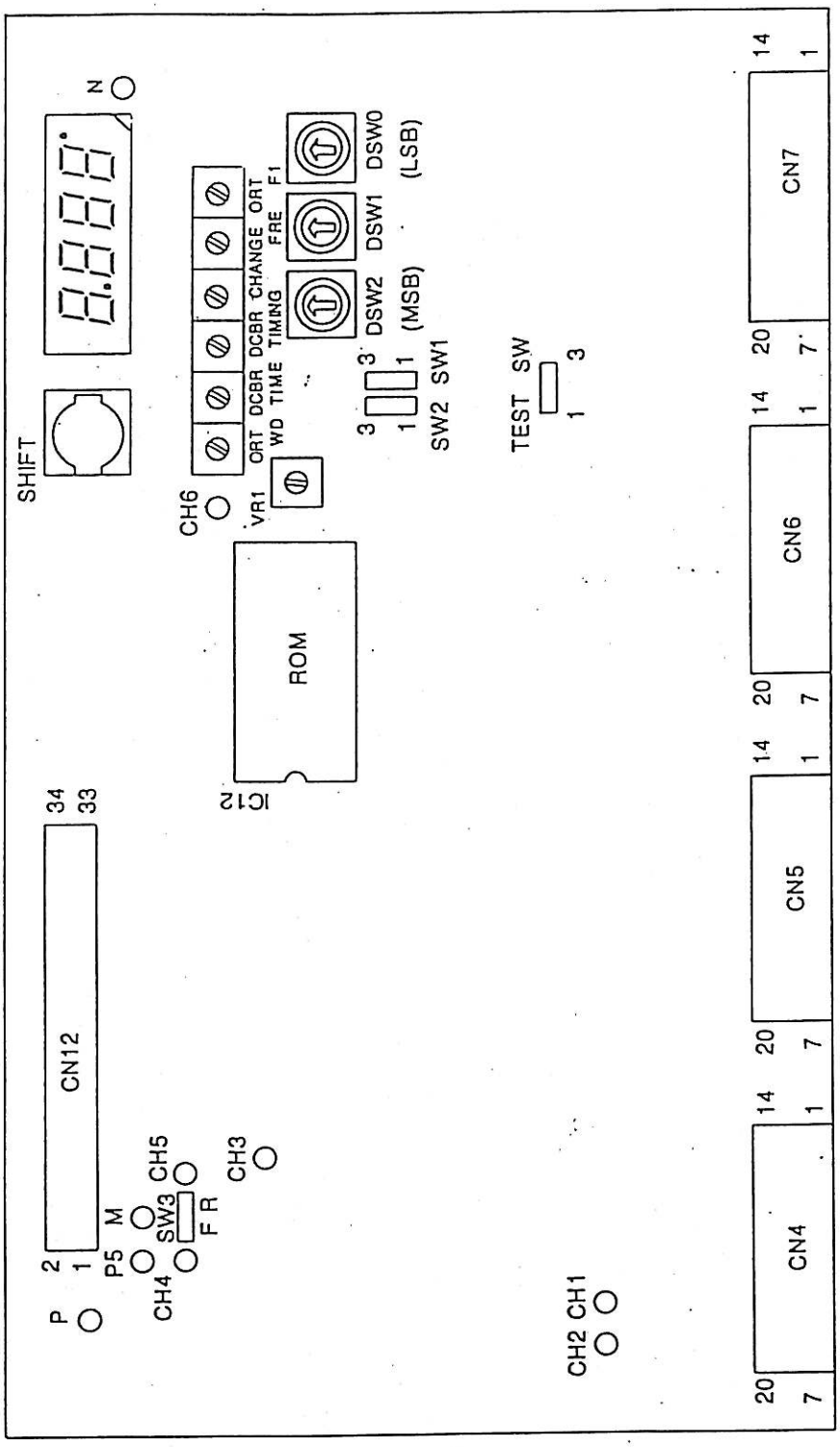
4-3 Adjustments

No.	Symbol	Description	Function code
1	DCBR	If hunting is big when positioning, increase DCBR %.	6(main P.C.B.)
2	DCBR TIMING	To get correct ORT position, reduce the value. • DCBR TIMING < ORT WD	4
3	DCBR TIME	If ORT could not be finished within the fixed time, increase the value.	6
4	ORT WD	When need to get ORT completion signal before ORT position , increase value. • ORT WD > DCBR TIMING	3
5	DSW 0 DSW 1 DSW 2	Adjust the origin point of machine and pulse encoder. 1) Set DSW 0-DSW 2 all "0" then command ORT. 2) Measure the anglar difference between the stopped position and desired position. Then set DSW 0-DSW 2. See next page for detail.	2

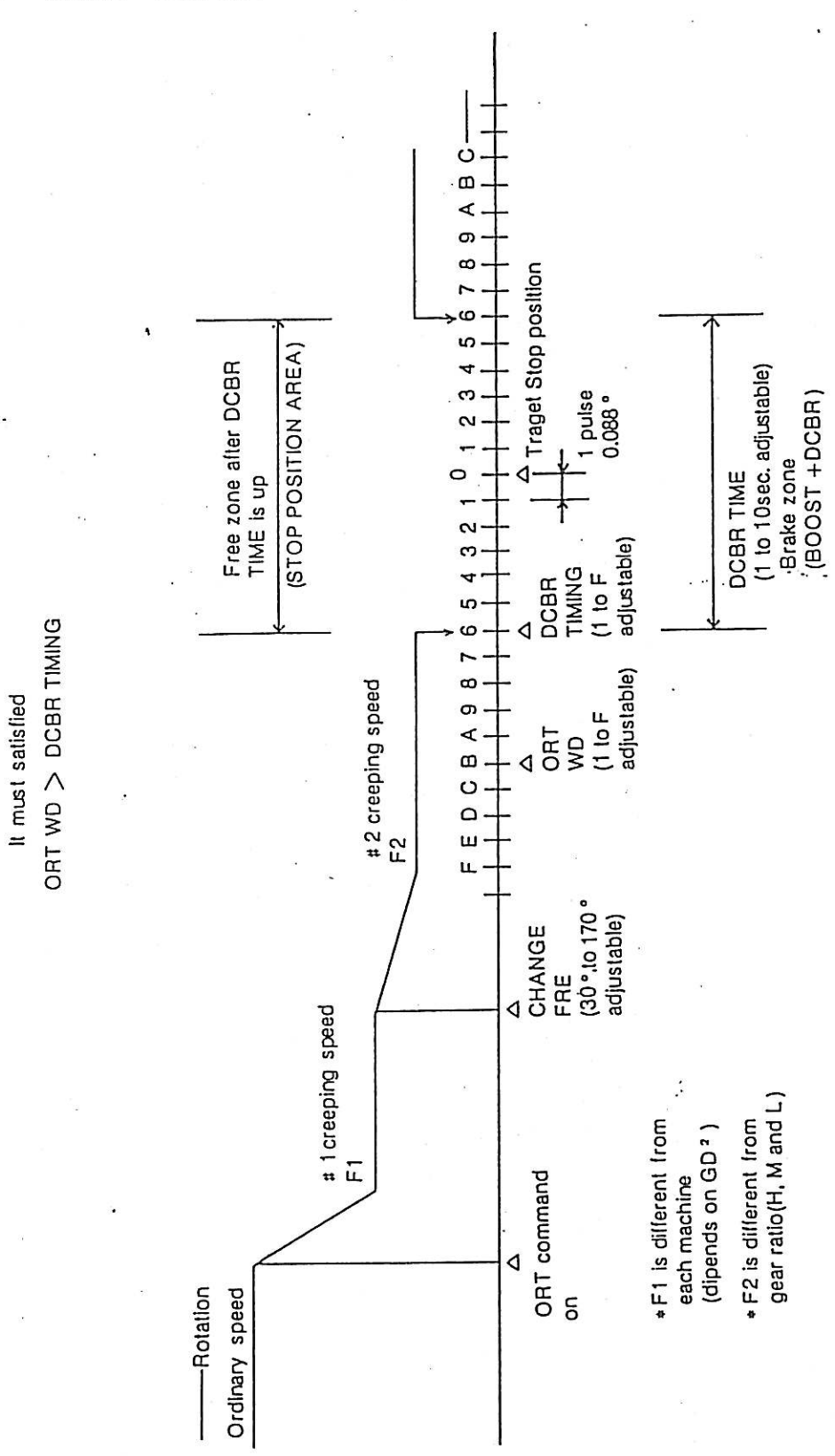
4-4 Adjustments of stop position

<table>
<tr><th>No.</th><th>Item</th><th>Switch</th><th>Description</th></tr>
<tr><td>1</td><td>Internal position setting</td><td>DSW0
DSW1
DSW2</td><td>When external position setting is not in use, set the stop position using the digital switches DSW 0 to DSW 2 on the orientation P.C.B.
1) Set all switches "0"
2) Performorent tation. Turn the spindle from stopped position to the desired position using these switches.
<table>
<tr><th>Switch</th><th>Number of pulse(s)</th><th>Angle</th></tr>
<tr><td>DSW0</td><td>1/Notch</td><td>0.088°</td></tr>
<tr><td>DSW1</td><td>16/Notch</td><td>1.4063°</td></tr>
<tr><td>DSW2</td><td>256/Notch</td><td>22.50°</td></tr>
</table></td></tr>
<tr><td>2</td><td>External position setting</td><td>ES-1
|
ES-12</td><td>External position setting can be made with ES-1 to ES-12(CN6).
1) Set ES-1 to ES-12 all "H" level (open the contacts) and perform orientation.
3) Measure the anglar difference between the stopped position and desired stop position. (θ °)
4) Convert the angle into the number of pulse "X" using following equation.
$X = \theta \times \frac{4096}{360}$
5) Convert the X into 12 bit code and input it to ES-1 to ES-12. See next page for example.
Example
$\theta = 55°$
$X = 55 \times \frac{4096}{360} = 626$ (pulses)
626 = 272HEX (Hexadecimal notation)
<table>
<tr><th></th><th>Input</th><th>Logical</th><th></th><th></th><th>Number of pulses</th></tr>
<tr><td>LSB</td><td>ES-1</td><td>0</td><td rowspan="4">2</td><td>1</td><td rowspan="4">16° = 1</td><td>1</td></tr>
<tr><td></td><td>ES-2</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td></td><td>ES-3</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td></td><td>ES-4</td><td>0</td><td>8</td><td>8</td></tr>
<tr><td></td><td>ES-5</td><td>1</td><td rowspan="4">7</td><td>1</td><td rowspan="4">16 ' = 16</td><td>16</td></tr>
<tr><td></td><td>ES-6</td><td>1</td><td>2</td><td>32</td></tr>
<tr><td></td><td>ES-7</td><td>1</td><td>4</td><td>64</td></tr>
<tr><td></td><td>ES-8</td><td>0</td><td>8</td><td>128</td></tr>
<tr><td></td><td>ES-9</td><td>0</td><td rowspan="4">2</td><td>1</td><td rowspan="4">16² = 256</td><td>256</td></tr>
<tr><td></td><td>ES-10</td><td>1</td><td>2</td><td>512</td></tr>
<tr><td></td><td>ES-11</td><td>0</td><td>4</td><td>1024</td></tr>
<tr><td>MSB</td><td>ES-12</td><td>0</td><td>8</td><td>2048</td></tr>
</table>
1) 256) 626 (2 — 512 — 114
ES-9 ES-10 ES-11 ES-12
1 ② 4 8 ⇨ 16²
2) 16) 114 (7 — 112 — 2
ES-5 ES-6 ES-7 ES-8
② ② ④ 8 ⇨ 16 '
3) 2
ES-1 ES-2 ES-3 ES-4
1 ② 4 8 ⇨ 16 °
* (256 ×2) +(16 ×7) +2 = 626
* Logical "1" is read when input of ES-1 to ES-12 are shorted to M(OV).
Note : The stop position can be shifted to desired position by the digital switches DSW 0 to DSW 2.
The final datas for stop position are the sum of internal and external code.</td></tr>
</table>

5. P.C. BOARD COMPONENTS LAYOUT.



6. TIME CHART FOR ORIENTATION



7. TROUBLE SHOOTING

In case of any abnormal symptom occurs in the orientation mode, trace symptom correctly and take corrective action to recover it based on the trouble shooting check list, while observing, the precautions are given below.
If impossible to recover the trouble or find any defective part, please contact with our company.

Precautions

a) Unless authorized, never repair or adjust any equipment.
b) Ues the tester, digital voltmeter, oscilloscope, or other proper equipment to check any circuit.
c) Never connect or disconnect the wire while the power is on or short circuit might happen and damage the equipment.
d) Do not readjust any switch or potentiometer (variable resistor) which has already been adjusted. If readjustment is required, write the preadjustment position (number of notches) down on your notebook to return to the original position.

7-1 Procedure of tracing abnormality

In case of any abnormal symptom occurs, trace it with the following procedure.

1) Check power supply (AC main power, control circuit etc).
2) Check for loosening of wiring(especially in the connectors).
3) Perform checking the trouble and taking the necessary measures in accordance with the trouble shooting check list.

7-2 Check the control circuit power supply

Check following voltage on the main P.C.B. and orientation P.C.B.

Volts(DC)	Use for (circuit)	Check terminal	Spec.
+15V	Analogue	P-M	+14.25 to +15.75V
−15V	Analogue	N-M	−14.25 to −15.75V
+5V	Digital	P5-M	+5V ±5%

7-3 Trouble shooting check list

Spindle fails to stop at the stop position

No.	Trouble	Possible cause	Check and adjustment
1	Do not make ORT action	No ORT command	Check command by LED. Function code 8 Check interface. Check for loose connectors.
2	Spindle keeps turning in creeping speed	Pulse encoder is wrong	Check wave form at CH1, CH2 and CH5. Check pulse encoder. Check for loose connectors.
		Creeping speed is too high	Spindle speed must be lower than 40 to 60rpm. Adjust ORT F1.
3	When input ORT command the spindle turns in reverse, then approach to the stop position, it is turned back by repulsion.	Mismatching of the direction of pulse encoder and the spindle rotation	Check the SW3 position.
4	When input ORT command and the spindle stops at any position	Creeping speed is too low	Check creeping speed F1 on main P.C.B. Adjust ORT F1.

Spindle comes to the stop position but has some trouble

No.	Trouble	Possible cause	Check and adjustment
1	Hunts near the stop position	Incorrect ground of drive unit	Make proper ground.
2	Large gear noise(shock) near the stop position	Change over point from #1 creeping speed to #2 creeping speed is near the stop position	Adjust CHANGE FRE point to far position.
		#1 creeping speed is too high	Reduce #1 creeping speed by ORT F1
3	Stop at position but not send complete signal	Wrong interface	Check interface and make correction
		Complete zone is too narrow	Adjust ORT WD
4	Stop at some different position	Zone of DC brake is too wide	Adjust DCBR TIMING
		DC brake is weak	Adjust DCBR (increase).