

AC SPINDLE DRIVE UNITS
FREQROL-SE
INSTRUCTIONS FOR OPERATION
AND ADJUSTMENTS

NO. 2

MITSUBISHI ELECTRIC CORPORATION
NAGYA WORKS

[1] PREPARING TO OPERATE

Check the following points when switching on the power to the controller for the first time:

- (1) Has all the equipment been properly wired and connected as shown in the drawings?
- (2) Have the motor and control panel been grounded properly?
- (3) Have the shield wire terminations been connected properly?
 - o Make the proper connections to the shield terminals.
 - o Make the connections so that the shield areas do not form a loop.
- (4) Check that the equipment is secured properly to avoid looseness and damage.
- (5) Check that metal chips, pieces of wire and other foreign matter have not entered inside the equipment.
- (6) Check that there is nothing abnormal with the exteriors of the printed circuit boards.
- (7) Check that the ROM numbers and DIP switch settings are as per the order list.

[2] RECEIVING POWER

If all items under section [1] are satisfactory, power up the equipment as follows:

- (1) Switch on the incoming power.
- (2) Check that light-emitting diodes LED13, 14, 15 and 16, which are designed to indicate trouble and which are located on the front of the controller, have not lighted.
- (3) Check that light-emitting diodes LED2 (READY) and LED10 (ZERO SPEED), which are designed to indicate the status and

which are located on the front of the controller, have lighted.

These procedures enable operation.

No problems are posed with the controller and re-connection is not necessary even if the phase sequence of the incoming power reversed. It is possible to check whether the phase sequence is positive or reversed by observing LED1 (PHASE SEQUENCE). A positive phase sequence is indicated when LED1 lights.

[3] ADJUSTMENT LOCATIONS

- (1) Speed meter adjustment (effective only with connections to ammeter terminals SM1 and LM1)

| Item | Method | | Adjustment VR |
|-------------|------------------------|---|----------------------|
| Speed meter | SW6-6 on SE-CPU1(2) | Set to maximum speed meter indication. | VR14, SE-101 card |
| Load meter | card to OFF. | Set to 120% load meter in- dication. | VR15, SE-101 card |

- (2) Setting DIP switches, setting pins

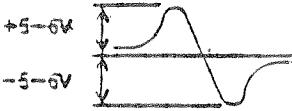
Check again that the settings in the order list corresponding to the machine have been made. Change the settings if they have not been made. To change the settings, set the set switch (ST1) to ON.

Refer to pages 10 to 14 for details on the settings.

(3) Orient operation adjustment (only when optional functions are provided)

Magnetic sensor orient (SE-CPU1 card)

(A) Magnetic sensor sensitivity adjustment

| Check location | Between CON4(14)-(15) | Check location | Between CH53-54 |
|----------------|---|----------------|---|
| |  | |  |

Gap adjustment is required if the status is not as that in the figure above. Refer to the INSTRUCTIONS FOR OPERATION AND ADJUSTMENT.

VR2 for adjustment

(B) Use VR1 to adjust the orient stop position.

(C) Use switches SW4-8 to identify the mounting direction of the magnetic sensors.

* Set SW4-8 in reverse of their present settings to identify the mounting direction of the sensors with a high degree hunting at orient stop.

Encoder orient (SE-CPU2 card)

(A) Orient stop position adjustment

| Change angle Per notch | Change switch |
|---------------------------|---------------|
| 0.088 deg. (1 pulse) | SW15 |
| 1.4 deg. (16 pulses) | SW14 |
| 22.5 deg. (256 pulses) | SW13 |

$$\text{Position shift} = 360 \text{ deg.} \times \frac{\text{set value}}{4096}$$

(B) Use SW4-8 to identify the encoder mounting direction.

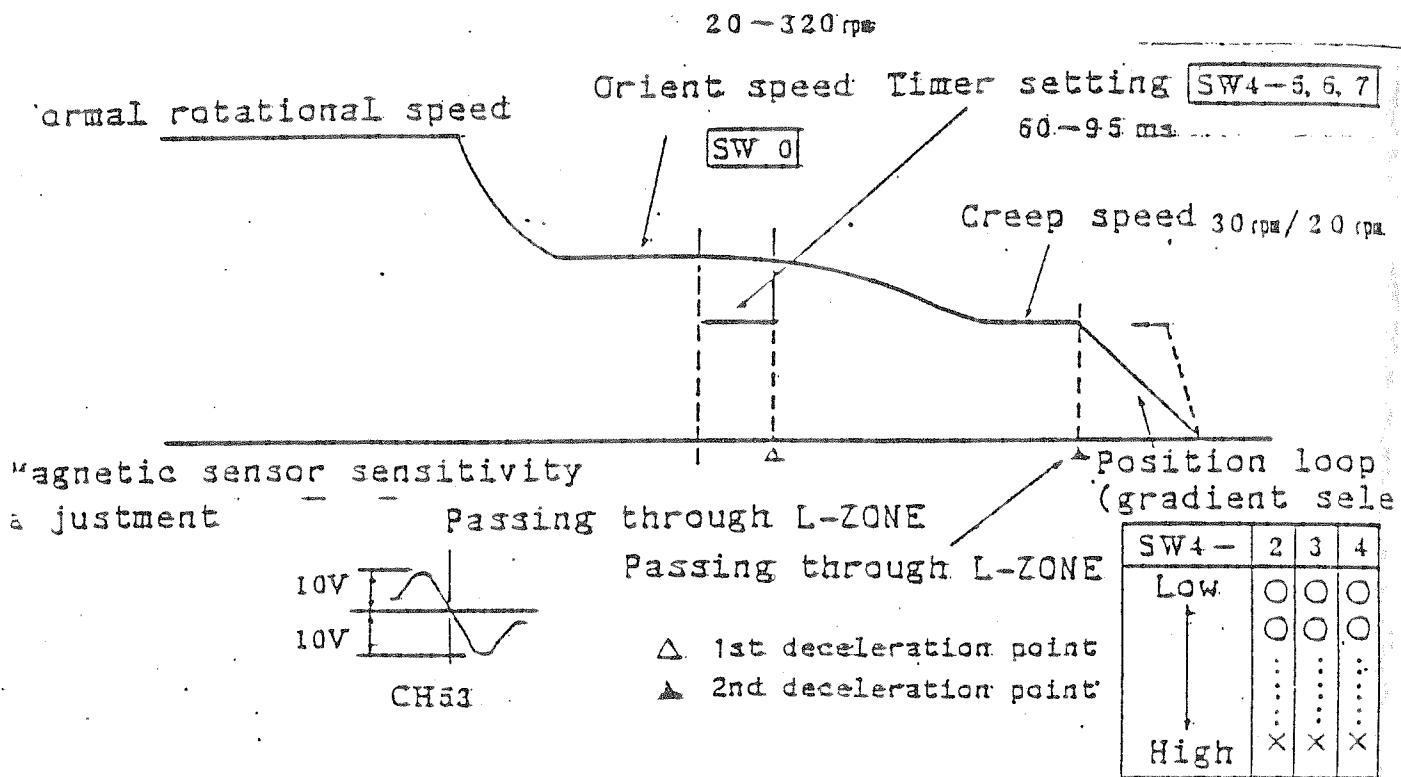
* Set SW4-8 in reverse of their present positions to identify the mounting direction of the encoder with a high degree hunting at orient stop.

These procedures complete the adjustments made when combining the machines.

Refer to pages 7 to 9 for the adjustments applying to the first machine.

[4] ORIENT ADJUSTMENTS

(1) Magnetic sensor system



Operate at the orient speed with SW6-10FF and ST2, adjust VR2 to the limit at which the magnetic sensor sensitivity LED11 lights and set CH53 to the peak voltage +/-10V.

The speed pattern for orient is now as shown in the figure above. Therefore,

proceed as follows when over shoot with stop:

- o Reduce the timer setting (SW4-5,6,7) time.
- o Reduce the position loop gain (SW4-2,3,4) gradient.
- o Reduce the orient speed. (SW10 F → E → ... → 0)
- o Reduce the creep speed. (SW4 OFF → ON)

Reduce the orient time.

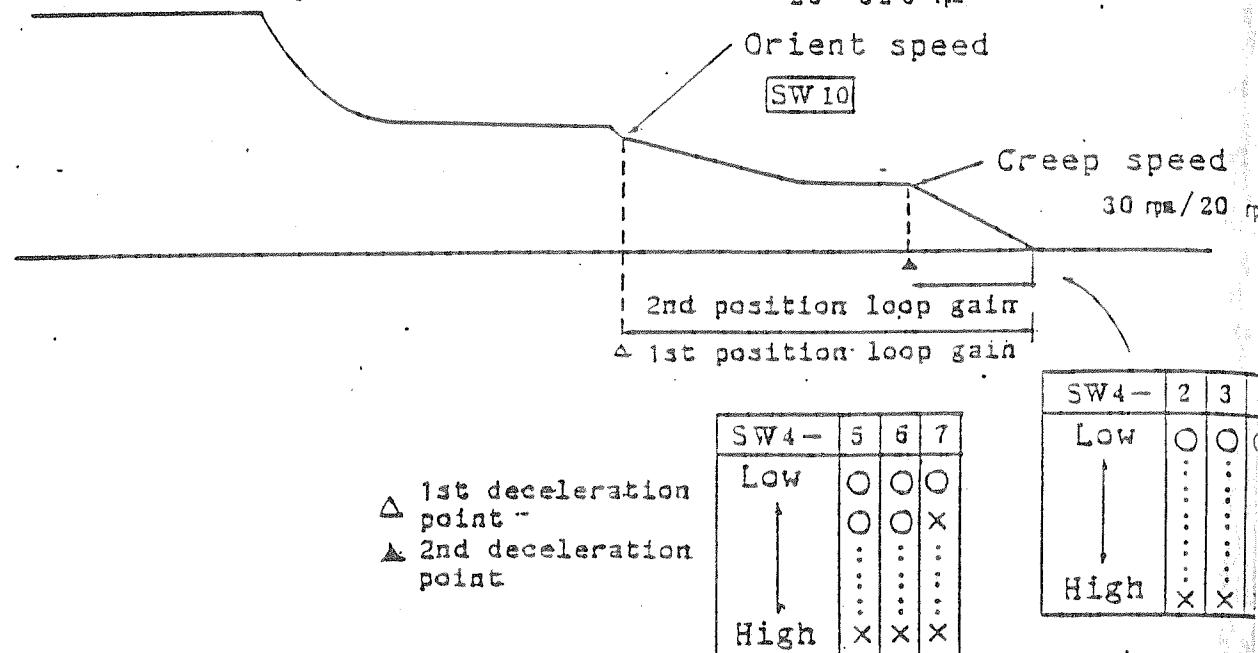
- o Increase the timer setting (SW4-5,6,7) time.
- o Increase the position loop gain (SW4-2,3,4) gradient.
- o Increase the orient speed. (SW10 0 → 1 → ... F)

Hunting when drive unit stops

- o Reduce the position loop gain (SW4-2,3,4) gradient.
- o Reduce the magnetic sensor sensitivity. (VR2)
- o Reduce the creep speed. (SW4 OFF → ON)

Furthermore, adjust the stop position with position shift VR1.

(2) Encoder system
Normal rotational speed



The speed pattern for orient is the same as that shown above.

Therefore,

Proceed as follows when over shoot with stop:

- o Reduce the 1st position loop gain.
- o Reduce the orient speed. (SW10 F → E → ... → 0)
- o Reduce the 2nd position loop gain.
- o Reduce the creep speed. (SW4 OFF → ON)

Reduce the orient time.

- o Increase the 1st position loop gain.
- o Increase the orient speed. (SW10 0 → 1 → ... F)
- o Increase the 2nd position loop gain.

Hunting when drive unit stops

- o Reduce the 2nd position loop gain.
- o Reduce the creep speed. (SW4 OFF → ON)

Furthermore, adjust the stop position with position shift switches 13, 14 and 15.

(5) SETTING DIP SWITCHES AND SETTING PINS.

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|------|-----|-----|----|-----|------|---|-----|------|---|------|---|----|----|---|---|---|---|---|---|---|---|---|---|---|---|-----|-----|---|---|---|---|---|---|---|---|---|---|---|---|--|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|----|---|---|---|---|---|---|---|---|---|---|---|---|-----|-----|---|---|---|---|---|---|---|---|---|---|---|---|--|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|----|---|---|---|---|---|---|---|---|---|---|---|---|-----|-----|---|---|---|---|---|---|---|---|---|---|---|---|--|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|----|---|---|---|---|---|---|---|---|---|---|---|---|-----|-----|---|---|---|---|---|---|---|---|---|---|---|---|---|--|--|--|
| SI-101 card settings | Digital speed command interface setting | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Speed setting | Maximum speed at speed command 10V (RPM) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum speed setting | RPM | A | B | | A1 | *1 | PIN1 | A | B | PIN2 | C | D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1000 | 1000 | 1000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1000 | 1000 | 1000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1000 | 1000 | 1000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1000 | 1000 | 1000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SI-CPU1 or SI-CPU2 card settings | SW1 | SW2 | | | SW3 | | | SW4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>ON</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>OFF</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>ON</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>OFF</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>ON</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>OFF</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>ON</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>OFF</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SW5 | SW6 | | | SW7 | | | SW8 | | | SW9 | | | SW10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>ON</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>OFF</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>ON</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>OFF</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>ON</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>OFF</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>ON</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>OFF</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ROM number | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>ON</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>OFF</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OFF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (3) ROM number | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

- SW1 Gear ratio H
- SW2 Gear ratio MH·ML
- SW3 Gear ratio L

Set value = $\frac{\text{Last axis}}{\text{(magnetic sensor/encoder axis)}} \times 128$ (hexadecimal)
Maximum motor speed

Decimal
Hexadecimal
 $\begin{array}{l} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \\ A \\ B \\ C \\ D \\ E \\ F \end{array}$
 $\begin{array}{l} 12 \\ 24 \\ 36 \\ 48 \\ 60 \\ 72 \\ 84 \\ 96 \\ 108 \\ 120 \\ 144 \\ 168 \\ 180 \\ 204 \\ 228 \\ 240 \end{array}$

| J. Machine specifications | |
|---|---|
| Direction of encoder rotation with forward motor rotation | Forward rotation (M03) Reverse rotation (M04) |
| Drive system | Gear Belt Direct |
| Final magnetic sensor/encoder axis speed with respect to maximum speed of motor shaft | 10 1100 rpm 11 1150 12 1200 13 1250 14 1300 15 1350 16 1400 17 1450 18 1500 |
| Motor shaft-converted load (kg) | 10 11 12 13 14 15 16 17 18 |

(Example)

$$H = \frac{4950}{4500} \times 128 = 1408^D = 8C^H$$

$$MH = \frac{1650}{4500} \times 128 = 4693^D = 2E^H$$

$$ML = \frac{535}{4500} \times 128 = 1522^D = F^H$$

Note: Circle when there is no gear.

| H | MH·ML | L |
|-----|-------|-----|
| SW1 | SW2 | SW3 |
| 1 | 1 | 1 |
| 2 | 1 | 1 |
| 3 | 1 | 1 |
| 4 | 1 | 1 |
| 5 | 1 | 1 |
| 6 | 1 | 1 |
| 7 | 1 | 1 |
| 8 | 1 | 1 |
| 9 | 1 | 1 |
| A | 1 | 1 |
| B | 1 | 1 |
| C | 1 | 1 |
| D | 1 | 1 |
| E | 1 | 1 |
| F | 1 | 1 |

Switch OFF position

| | | | |
|---|---|---|---|
| 1 | 1 | 1 | 1 |
| 2 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 |
| 4 | 1 | 1 | 1 |
| 5 | 1 | 1 | 1 |
| 6 | 1 | 1 | 1 |
| 7 | 1 | 1 | 1 |
| 8 | 1 | 1 | 1 |
| 9 | 1 | 1 | 1 |
| A | 1 | 1 | 1 |
| B | 1 | 1 | 1 |
| C | 1 | 1 | 1 |
| D | 1 | 1 | 1 |
| E | 1 | 1 | 1 |
| F | 1 | 1 | 1 |

Switch []
number []

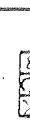
(7) Orientation setting

Direction of magnetic sensor (encoder) mounting

SW4

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----|---|---|---|---|---|---|---|---|
| ON | | | | | | | | |
| OFF | | | | | | | | |

↓



- Forward direction
- Reverse direction

Creep speed Position loop gain (1st position loop gain) Magnetic sensor orient (position loop gain)

| 1 | 2 | 3 | 4 |
|-------------------------------------|--------|-----|-----|
| <input type="checkbox"/> | 20 rpm | 25° | 25° |
| <input checked="" type="checkbox"/> | 30 rpm | 24 | 24 |

| 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
|-------------------------------------|-------|-----|-----|---|---|---|--|
| <input type="checkbox"/> | O C O | 25° | 25° | | | | |
| <input checked="" type="checkbox"/> | C O X | 24 | 24 | | | | |
| | C X O | 23 | 23 | | | | |
| | C X X | 21 | 21 | | | | |
| | X O O | 20 | 20 | | | | |
| | X O X | 19 | 18 | | | | |
| | X X O | 18 | 17 | | | | |
| | X X X | 16 | 15 | | | | |

| 3 | 6 | 7 | 8 |
|-------------------------------------|----|------|---|
| <input type="checkbox"/> | 60 | 225° | |
| <input checked="" type="checkbox"/> | 65 | 214 | |
| | 70 | 203 | |
| | 75 | 191 | |
| | 80 | 180 | |
| | 85 | 169 | |
| | 90 | 158 | |
| | 95 | 146 | |

(8) SW5

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----|---|---|---|---|---|---|---|---|
| ON | | | | | | | | |
| OFF | | | | | | | | |

(9) SW6

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----|---|---|---|---|---|---|---|---|
| ON | C | O | | O | | O | | |
| OFF | | | | | | | | |

Acceleration/ deceleration Torque restriction time constant Speed detection range

| 1 2 | 3 4 5 | 6 7 8 |
|-------------------------------------|-------|-------|
| <input type="checkbox"/> | O C O | 0.5S |
| <input checked="" type="checkbox"/> | C O X | 1.5S |
| | O X O | 2.5S |
| | X O O | 3.5S |
| | X O X | 4.5S |
| | X X O | 5.5S |
| | X X X | 6.5S |
| | | 7.5S |
| | | 8.5S |
| | | 9.5S |
| | | 10.5S |

NOTE: In the charts for SW 5, 6, 7,

O indicates The ON side,
and X indicates The OFF side.

3 Speed command
--- BINARY 12BIT
--- BCD 2 digits

4 Speed command input
--- Source drive (open emi)
--- Sync drive (open colle)

5 Position command input
--- Source drive (open emi)
--- Sync drive (open colle)

7 Maximum speed 1500 base
--- L When 5000/1000
--- H HH 6000 - L
10000 - H

9 Zero speed 8000 rpm
--- 25 RPM specification
--- 50 RPM Make the H
setting.

SW7

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 3 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

- 1 Magnetic sensor
in-position
---- range LOW (1°)
X " HIGH (5°)
- 2 With
emergency
stop LED ON
X " LED OFF
- 3 Load meter
output, HIGH (10V)
X " LOW (3V)
- 4 ---- Base speed 1150 rpm
X " 1500 rpm

Base = 1150 rpm

| 5 | 6 | 7 | 8 | Capacity | ToOp speed |
|---|---|---|---|----------------|---------------|
| O | O | O | O | ----- Spare | Spare |
| O | O | O | X | ----- 22/3.7kW | 3450/4600 rpm |
| O | O | X | O | ----- 3.7/5.5 | " |
| O | O | X | X | ----- 5.5/7.5 | " |
| O | X | O | O | ----- 7.5/11 | " |
| O | X | O | X | ----- 11/15 | " |
| O | X | X | O | ----- 15/18.5 | " |
| O | X | X | X | ----- 18.5/22 | " |
| X | O | O | O | ----- Spare | Spare |
| X | O | O | X | ----- Spare | Spare |
| X | O | X | O | ----- 22/37 | 8000 |
| X | O | X | X | ----- 3.7/5.5 | " |
| X | X | O | O | ----- 5.5/7.5 | 6000 |
| X | X | O | X | ----- 7.5/11 | " |
| X | X | X | O | ----- 11/15 | " |
| X | X | X | X | ----- Spare | Spare |

Base = 1500 rpm

| 5 | 6 | 7 | 8 | ----- Spare | Spare |
|---|---|---|---|------------------|---------------|
| O | O | O | O | ----- 22/37kW | 4500/6000 rpm |
| O | O | O | X | ----- 3.7/5.5 | " |
| O | O | X | O | ----- 5.5/7.5 | " |
| O | X | O | O | ----- 7.5/11 | " |
| O | X | O | X | ----- 11/15 | " |
| O | X | X | O | ----- 15/18.5 | " |
| O | X | X | X | ----- 18.5/22 | " |
| X | O | O | O | ----- Spare | Spare |
| X | O | O | X | ----- Spare | Spare |
| X | O | X | O | ----- 3.7/5.5 | 8000 |
| X | O | X | X | ----- 5.5/7.5 | 8000 |
| X | X | O | O | ----- 7.5/9 | 8000 |
| X | X | O | X | ----- 22/3.7 | 6000/1000 |
| X | X | X | O | ----- 22/3.7/5.5 | " |
| X | X | X | X | ----- 5.5/7.5 | " |

(.) [SW8] Speed control loop proportional gain

| Notch | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | A | B | C | D | E | F | |
|---------------|------|-------|-------|-------|-------|-------|-------|-------|-----|-----|-----|-----|-----|-----|-----|-----|
| Magnification | 8/32 | 11/32 | 14/32 | 17/32 | 20/32 | 23/32 | 26/32 | 29/32 | 1 | 1.2 | 1.4 | 1.6 | 1.8 | 2 | 2.2 | 2.4 |
| W_C | 25 | 34 | 44 | 55 | 63 | 72 | 81 | 91 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 |

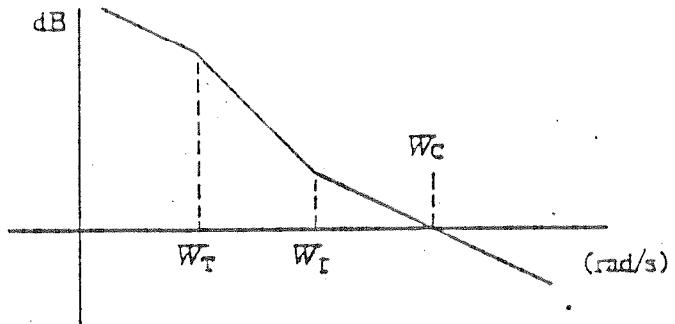
(rad/s)

[SW9] Speed control loop integral gain

| Notch | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | A | B | C | D | E | F | |
|---------------|------|-------|-------|-------|-------|-------|-------|-------|-----|-----|-----|-----|------|------|------|------|
| Magnification | 8/32 | 11/32 | 14/32 | 17/32 | 20/32 | 23/32 | 26/32 | 29/32 | 1 | 1.2 | 1.4 | 1.6 | 1.8 | 2 | 2.2 | 2.4 |
| W_I | 1.5 | 2.1 | 2.6 | 3.2 | 3.8 | 4.3 | 4.9 | 5.4 | 6.0 | 7.2 | 8.4 | 9.6 | 10.8 | 12.0 | 13.2 | 14.4 |

(rad/s)

Determine the loop transfer function of the speed control in combination with the SW11-3.4 mode selection.



Note: The condition of $W_T > W_I > W_C$ must be met.

The standard settings are notch 8 for both SW8 and for SW9

12) [SW10] Orient speed setting

| Notch | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | ⑩ | ⑪ | ⑫ | ⑬ | ⑭ | ⑮ | |
|-------|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| rpms | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 | 300 | 320 |

(13) SW11

| | | | | |
|-----|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| ON | | | | |
| OFF | | | | |

Orient rotation direction

| | |
|---|---|
| 1 | 2 |
| O | O |
| O | X |
| X | O |
| X | X |

---- Pre-mode

---- Reverse rotation mode

---- Forward rotation mode

---- *

Control with orient stop

| | |
|---|---|
| 3 | 4 |
| O | O |
| O | X |
| X | O |
| X | X |

---- PI control

---- Lag/advance WT = 1.17
control 0.78

0.39

rad/sec

(14) SW12 In-position range

| | | | | |
|-------------------|---|-------------|---|-------------|
| In-position range | 0 | ± 0 | S | ± 0.704 |
| | 1 | ± 0.088 | 9 | ± 0.792 |
| | 2 | ± 0.176 | A | ± 0.88 |
| | 3 | ± 0.264 | B | ± 0.968 |
| | 4 | ± 0.352 | C | ± 1.056 |
| | 5 | ± 0.44 | D | ± 1.144 |
| | 6 | ± 0.528 | E | ± 1.232 |
| | 7 | ± 0.616 | F | ± 1.320 |