

NSK

MEGATORQUE® MOTOR MAINTENANCE MANUAL (EM/EP Driver Unit)

NSK Ltd.

Document Number: C20026-03

Limited Warranty

NSK Ltd. warrants its products to be free from defects in material and/or workmanship which NSK Ltd. is notified of in writing within one (1) year of shipment. NSK Ltd., at its option, and with transportation charges prepaid by the claimant, will repair or replace any product which has been proved to the satisfaction of NSK Ltd. to have a defect in material and/or workmanship.

This warranty is the sole and exclusive remedy available, and under no circumstances shall NSK Ltd. be liable for any consequential damages, loss of profits and/or personal injury as a result of claim arising under this limited warranty. NSK Ltd. makes no other warranty express or implied, and disclaims any warranties for fitness for a particular purpose or merchantability.

Copyright 1995-2001 by NSK Ltd., Tokyo, Japan

All rights reserved.

No part of this publication may be reproduced in any form or by any means without permission in writing from NSK Ltd.

NSK Ltd. reserves the right to make changes to any products herein to improve reliability, function or design without prior notice and without any obligation.

NSK Ltd. does not assume any liability arising out of the application or use of any product described herein; neither does it convey any licence under its present patent nor the rights of others.

Patents issued and patents pending.

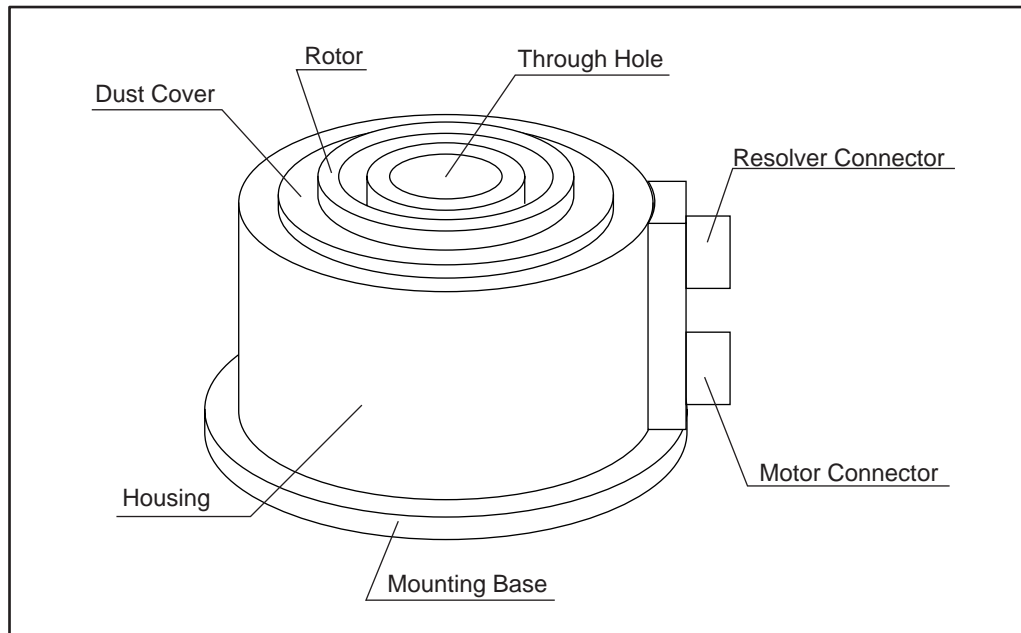
Contents

1. CAUTIONS	1
2. BASIC STRUCTURE	2
2.1. Motor	2
2.2. Driver Unit	2
3. MAINTENANCE AND INSPECTION	3
3.1. Periodic Inspection	3
3.1.1. Motor	3
3.1.2. Driver Unit (cable included)	3
3.2. Periodic Replacement	4
3.2.1. Motor	4
3.2.2. Driver Unit	4
3.3. Storage	4
4. TROUBLESHOOTING	5
4.1. Confirming alarms	5
4.2. Confirming various situations	5
4.3. Troubleshooting	6
APPENDIX 1: CHECKING THE I/O SIGNALS	1
APPENDIX 2: VIEWING THE ALARM STATE	4
Appendix 3: DESCRIPTION ALARMS	6
1. Excess Position Error (Slight)	7
2. Rotation Limit (Software Control)	8
3. Battery Life	9
4. Excess Position Error (Serious)	11
5. Internal Switch Setting Error	12
6. Control Circuit Error	12
7. Memory Error	13
8. Resolver Circuit Error	14
9. Over-Current	15
10. Heat Sink Over-Temperature	16
11. Regeneration Resistor Over-Temperature	17
12. Over-Voltage	18
13. Control AC Line Under-Voltage	19
14. Main AC Line Under-Voltage	20
15. Internal Fuse Blown	21
16. TB Connection Error	21
17. Overload	22
APPENDIX 4: ASSESSMENT OF MOTOR USEABILITY	23
APPENDIX 5: INITIALIZATION OF DRIVE UNIT	26
APPENDIX 6: HOW TO EXCHANGE EM DRIVER UNIT	29

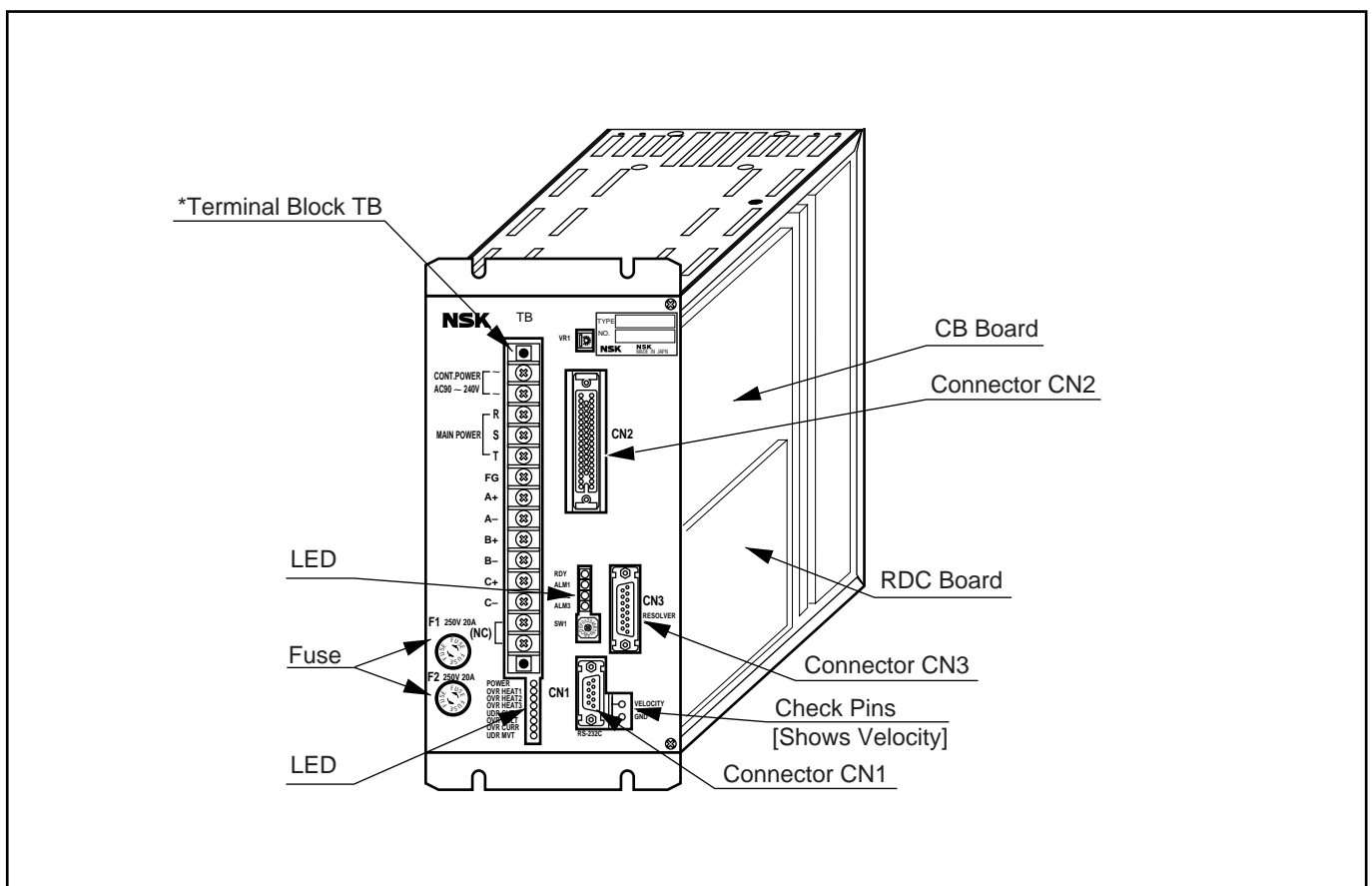
Blank Page

2. BASIC STRUCTURE

2.1. Motor



2.2. Driver Unit



- The above figure shows the EM type. For the EP type, those parts marked with “*” are duplicated.

3. MAINTENANCE AND INSPECTION

3.1. Periodic Inspection

3.1.1. Motor

- Since the Megatorque Motor does not have wear parts in both the Motor and resolver, simple daily inspection is enough. The following table shows the inspection items. Inspection frequencies are just yardsticks.
- Set appropriate ones depending on the working environment and conditions. In maintenance and inspection, never disassemble the Motor and resolver. When it is necessary to disassemble the motor, contact us.

Item	Frequency	Method	Remarks
Vibration and noise check	Daily	Touch and hearing	There should be no change when compared with normal condition.
Appearance check	According to degree of stain/damage	Clean with cloth, air, etc.	
Insulation resistance measurement	Annually	Disconnect from the Driver Unit and measure between the coil and earth at 500 V mega.	O.K. if 10MΩ or more
Overall check	According to necessity	Disassembly and check	

3.1.2. Driver Unit (cable included)

- The Driver Unit uses high-reliability semiconductors and is made contactless. Daily maintenance is not necessary. However, check the following items at least once a year.

Item	Frequency	Method	Remarks
Further tightening	At least annually	Terminal board's terminal block, connector setscrews, etc.	
Cleaning	At least annually	Eliminate dust, foreign substances, etc. from the inside.	
Electric parts check	At least annually	Check discoloration, breakage, etc. visually.	
Cable check	At least annually	Check scratch, crack, etc. visually.	When moving, make an appropriate check particularly.

3.2. Periodic Replacement

3.2.1. Motor

- The Motor has not periodic replacement parts. Check in accordance with “3.1. Periodic Inspection”.

3.2.2. Driver Unit

(1) Electronic parts

- Due to secular deterioration, the following parts may lower the performance of the system or cause a trouble.

Part	Usage	Standard Replacement Frequency	Replacement Method
Battery	Holds the servo parameters, etc.	10 years	Replace the battery or unit.
Electrolytic capacitor	Smooths the power.		

- The service lives of the above parts are greatly affected by the working conditions.
- When operated continuously under the normal indoor environment, their standard service lives are 10 years.

(2) Fan motor

- The blast fan motor inside the Driver Unit should be replaced after about 10,000-hour operation. However, since the fan motor runs only when the internal temperature of the Driver Unit is 400C, it is unnecessary to replace it periodically under a normal environment.

3.3. Storage

- Both Motor and Driver Unit should be kept in a clean and dry room.
- Particularly, cover the Driver Unit to protect from dust (because it has a vents.)

Storage Condition		Remarks
Storage temperature	-20°C ~ +70°C	Under -100C, the backup data may be corrupted. (→ reset) High temperature damages the battery.
Storage humidity	20% ~ 80%	No dew condensation allowed

4. TROUBLESHOOTING

4.1. Confirming alarms

- The alarms (warnings) of the Megatorque Motor system are represented by the combination shown in the following table. If a certain trouble occurs, confirm the alarm signals and outputs listed below first.

#	Output Form	Output Location ^{*1}	Signal/Output Name
1.	Output signal	CN2 ^{*2}	DRDY, OVER, BRK
2.	LED	Front panel	RDY, ALM1, ALM2, ALM3
3.	LED	Front panel	POWER, OVR HEAT1, OVR HEAT2, OVR HEAT3, UDRCVT, OVR VOLT, OVR CURR, UDR MVT

*1: For the location, refer to “2. BASIC STRUCTURE, 2.1. Driver Unit”.

*2: The output of CN2 can be read out to the Handy Terminal using the IO command.

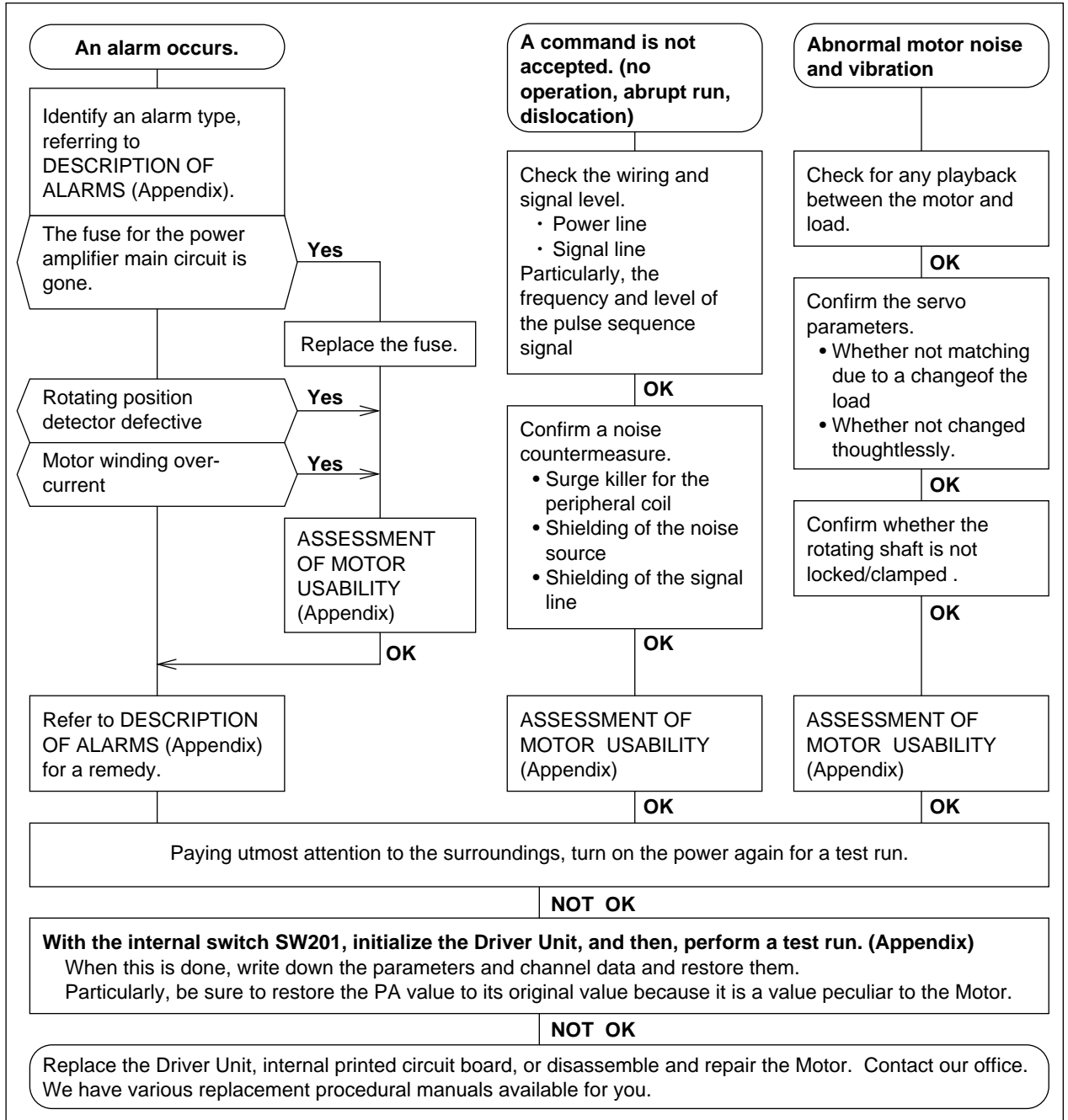
4.2. Confirming various situations

- Next, check for the following situations.
- Also, when contacting our office, let us know the condition of the items listed below.

#	Item	Remarks
1.	Serial No.	The motor and Driver Unit must be matching.
2.	Supply voltage	Whether a fluctuation is within the specifications.
3.	Repeatability of trouble	
4.	Under specific operation (external)	Whether it is when specific control is given or when a specific device is operating.
5.	Under specific operation (internal)	Rotating position, rotating direction, under acceleration/deceleration
6.	Alarm code	Reconfirm the alarm state with a TA command (refer to Appendix).

4.3. Troubleshooting

- Troubleshoot the Megatorque Motor system, following the flow shown below.
 - Although it is assumed that positioning control is being applied, the troubleshooting procedures also conform to the following when speed control or torque control is applied.

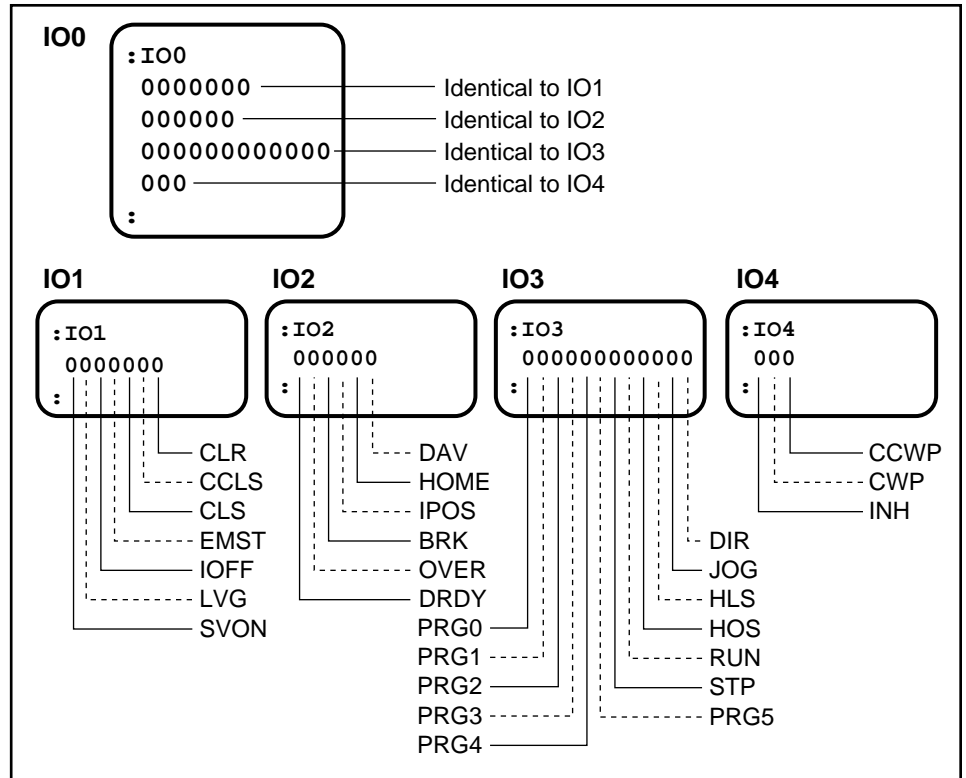


APPENDIX 1: CHECKING THE I/O SIGNALS

IO: Signal I/O State Read-out

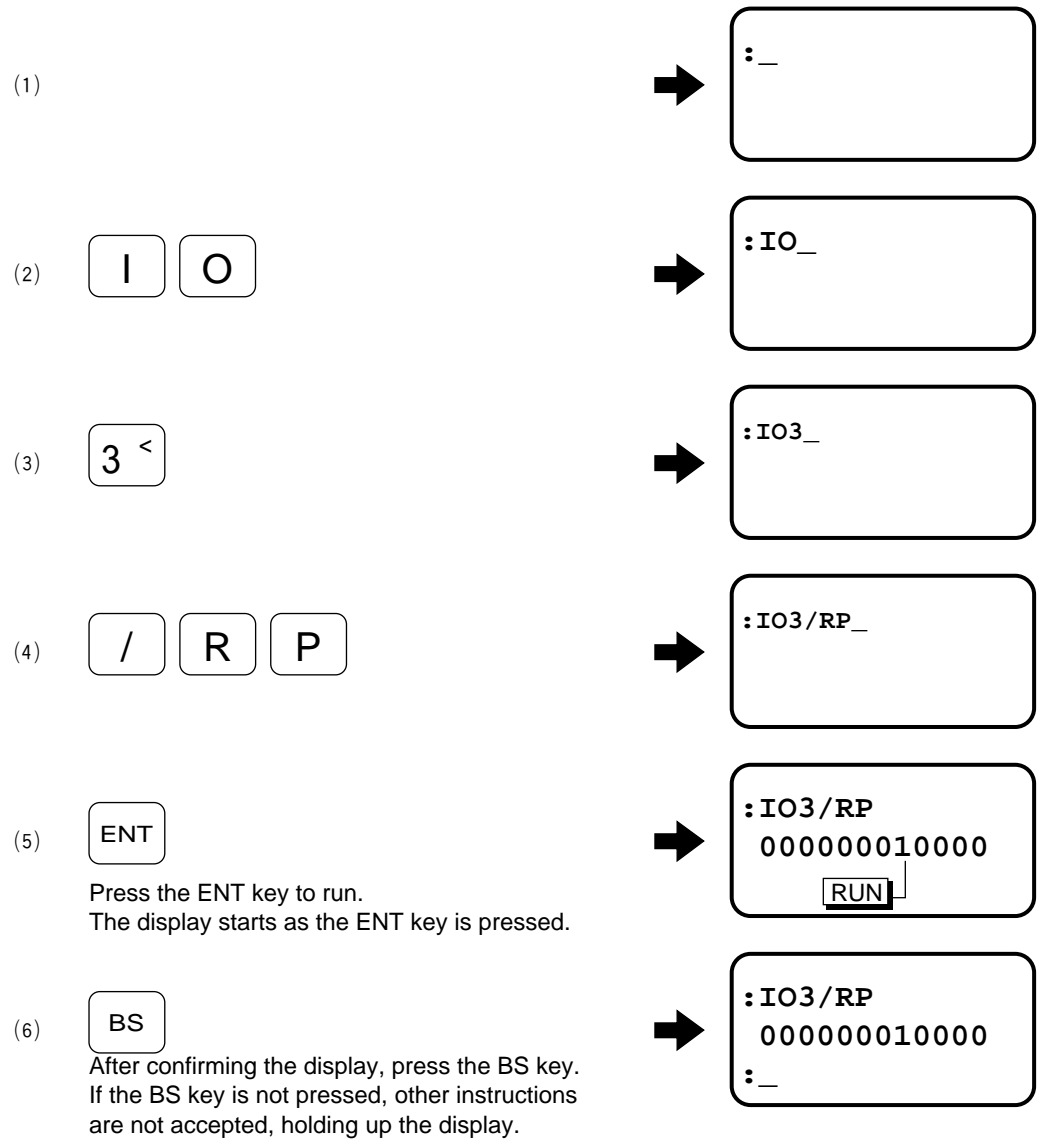
Format : IO sub./opt. ENT
Subscript : 0 to 4
Option code : /RP

- Reads out the on/off (open/close) state on the CN2 control input and output.
- Which signal's state is to be read is determined by the subscript.
 - 0 ----- Reads out all the contents of the subscripts 1-4 hereafter.
 - 1 ----- Reads out the on/off state of the CN2 control inputs.
 - 2 ----- Reads out the close/open state of the CN2 control outputs.
 - 3 ----- Reads out the on/off state of the CN2 control inputs.
(related to positioning)
 - 4 ----- Reads out the on/off state of the CN2 control inputs.
(related to pulse train input)
- If a command IO1 through IO4 is executed with the option code /RP added, read-out is repeated automatically. That is,
 - Space code (20H) + Read-out value + Carriage return code (0DH)is output repeatedly from the Driver Unit. To exit this automatic read-out, enter a backspace code (08H).
- The option code /RP is not available to IO0.
- The output format is shown in the next table.



Note: For the input signals (IO1, IO3, IO4), "1" indicates ON and "0" indicates OFF. For the output signal (IO2), "1" indicates an open circuit and "0" indicates a closed circuit.

[Example] Checking whether the internal program start input RUN has been entered.



Description

- From the above operations, it is now known that because the internal program start input RUN is represented by “1”, this input signal has been turned on.

(Reference)

[Example] displays the state of the I/O signal while monitoring it, until the BS key is pressed. If the I/O signal is turned on/off while it is being displayed, its representation is also changed to 1/0.

If the steps (4) and (5) are omitted in the procedure for [Example], the I/O signal immediately after pressing the ENT key is displayed.

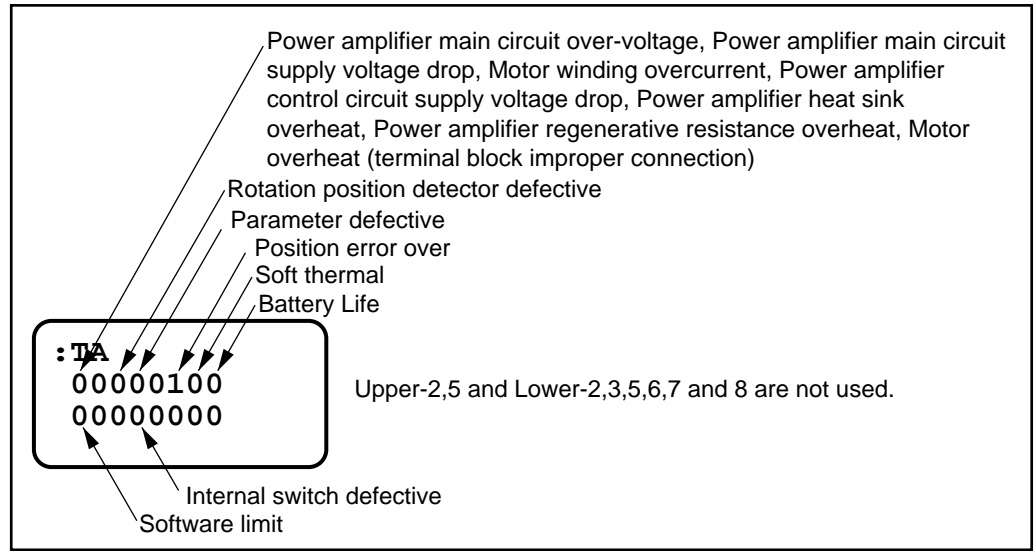
APPENDIX 2: VIEWING THE ALARM STATE

TA: Alarm State Read-out

Format : TA ENT

- Reads out the alarm state.
- Entering TA displays the alarm state as shown below.

Alarm Display



0: Normal

1: Alarm

[Example] Viewing the alarm state because the ALARM lamp is illuminated

(1)



```
:_
```

(2)

T A



```
:TA_
```

(3)

ENT

Press the ENT key to run.
The display starts as the ENT key is pressed.



```
:TA  
00000100  
00000000  
:_
```

Description

From the above operations, it is now known that the alarm is "Position Error Over."

APPENDIX 3: DESCRIPTION ALARMS

<This appendix contains excerpts from the users manual plus a supplementary description for maintenance>

- The following LED symbols are used in this section.
 - ☆ — illuminated
 - ★ — blinking
 - | — off
- If a warning or alarm cannot be canceled through measures described below, contact NSK immediately.
- If the LEDs indicate a pattern not shown below, contact NSK immediately.

1. Excess Position Error (Slight)

Output

DRDY : closed
 OVER : closed
 BRK : closed

TA Report

00000000
 00000000

LED

☆ RDY
 | ALM1
 | ALM2
 | ALM3
 ☆ POWER
 | OVER HEAT1
 | OVER HEAT2
 | OVER HEAT3
 | UDR CVT
 | OVR VOLT
 | OVR CURR
 | UDR MVT

Motor Condition:

- The Motor keeps rotating normally.

Cause:

- The position error counter reads a value over the criterion specified in CO during a positioning operation (including Home Return and jogging). If the value exceeds a value 8 times the CO value, a excess position error (serious) occurs.

Remedy:

- If the error is left as is, the Motor operates so that the error counter reaches 0. Thus, no special remedy is required normally. If the error occurs frequently, tuning may be incorrect. Carry out the following adjustment:
 - Adjust the gains (VG and PG).
 - Decrease the acceleration (MA, CA, HA, JA, etc.).
 - Increase the CO value (judgment criterion).

Note:

- This warning is not given if /AL option is specified when setting CO value.

Supplementary Description for Maintenance

- The following causes are likely.

#	Cause	Confirmation/Remedy
1	The "position error over" detection value (parameter CO) is too small.	Set the CO value appropriately. *1
2	Insufficient torque or large overshoot because the servo parameters are not set appropriately	Set the servo parameters appropriately. *2
3	Lock by the external brake, or excessive brake	See to it that the Megatorque Motor torque and external brake do not interfere with each other.
4	A feedback signal is disturbed due to trouble with the resolver winding or cable.	Check the resolver cable and connector joint.

*1: The position error value can be confirmed at the Handy Terminal with the command TE. (Refer to the instruction manual)

*2: Observe the rotating speed at the check pin of the Driver Unit front panel, compare with the command, and set the servo parameters so that phase delay and overshoot are reduced.

2. Rotation Limit (Software Control)

Output

DRDY : closed
OVER : closed
BRK : closed

TA Report

00000000
10000000

LED

★ RDY
| ALM1
| ALM2
☆ ALM3
☆ POWER
| OVER HEAT1
| OVER HEAT2
| OVER HEAT3
| UDR CVT
| OVR VOLT
| OVR CURR
| UDR MVT

Motor Condition:

- The Motor will only rotate in a direction opposite to that of the rotation limit. For the rotation limit direction, the Motor servo locks.

Cause:

- The Motor enters a inhibited area specified by LS.

Remedy:

- Get out of the inhibited area. The OVER output opens. The OVER output may also be reset by inputting CLR. However, a warning is given again if the Motor is in the inhibited area.

Supplementary Description for Maintenance

- (1) Over-travel indicated by the CLS/CCLS inputs of CN2 do not result in an alarm. Its state and remedy are similar to those of this alarm.
- (2) It is necessary that the region has been set so that this alarm will stop the Motor at the position where it is not locked or restricted mechanically.

3. Battery Life

Output

DRDY : closed
OVER : closed
BRK : closed

TA Report

00000001
00000000

LED

☆ RDY
| ALM1
☆ ALM2
☆ ALM3
☆ POWER
| OVER HEAT1
| OVER HEAT2
| OVER HEAT3
| UDR CVT
| OVR VOLT
| OVR CURR
| UDR MVT

Motor Condition:

- The Motor keeps operating.

Cause:

- The voltage of the RAM backup battery lowers below 2.2VDC.

Remedy:

- Replace the battery.

Replacing Battery

- The Driver Unit uses a lithium battery to back up the control parameters written in the RAM after power is turned off. In normal service condition, it backs up data in the RAM for approximately 10 years after delivery without replacing the battery. Thus, battery replacement is not usually required. If it needs replacing for some reason, follow the steps shown below.

- (1) Turn on power of the Driver Unit, then leave the Driver Unit for 30 minutes or more.
 - This wait period is used to charge the super capacitor, which backs up the RAM while replacing the battery.
 - During this period, the Driver Unit may drive the Motor.
 - If power has been supplied to the Driver Unit for 30 minutes or more (including motor operation time) when the battery is to be replaced, the capacitor charging period is not required.
- (2) Turn off power of the Driver Unit, then detach the front and side panels from the Driver Unit.

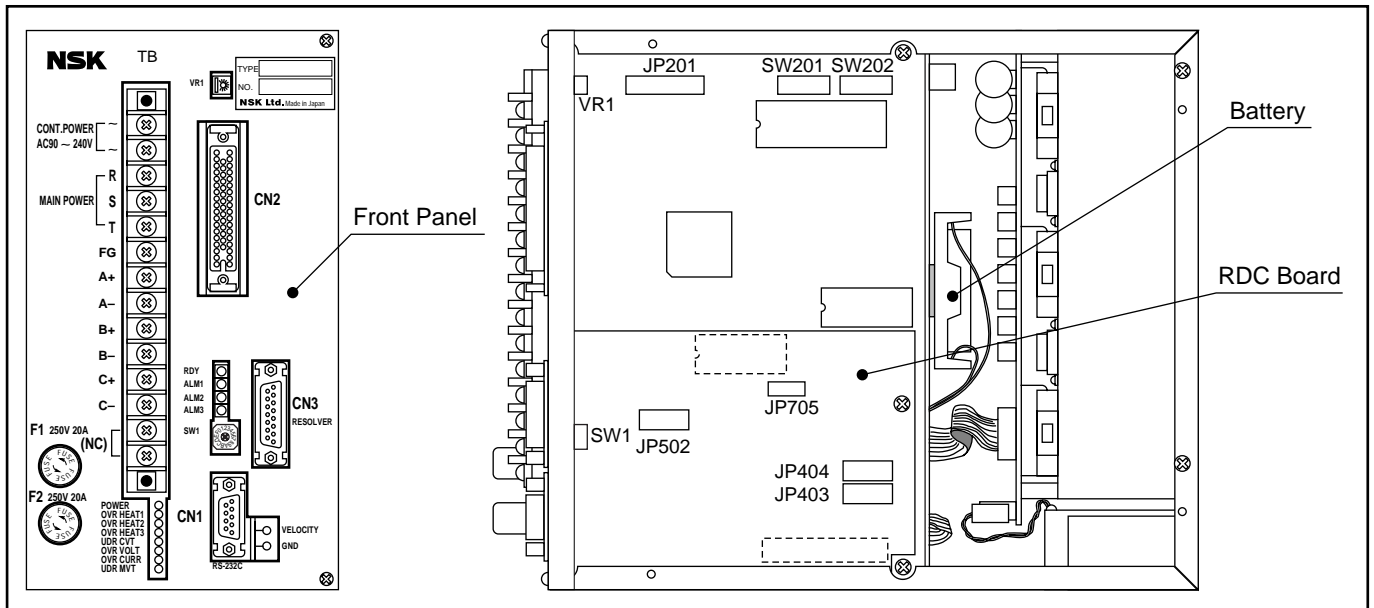
Front panel: M3 × 6 countersunk screws × 2 and blind screws × 2

Side panel: M3 × 6 countersunk screws × 4

- (3) Detach the RDC board.
 - The RDC board is attached to the CB board with screws (M3 × 6 Semus screws × 3) and connector. Remove the screws, then lift the RDC board with care not to damage its connector.

(4) Replace the battery.

- The battery is connected with a connector. Soldering is not required.
 - The super capacitor will last for approximately 30 minutes. Complete operation to this point within 30 minutes since power is turned off.
 - The battery socket is fixed to the middle chassis with velcro. Replace the battery with the socket.
 - Make sure that the “Battery Life” alarm is not activated after turning on the main power supply.
- NSK will provide the battery (part number: M-E5118-0003). Contact NSK to order a battery. A battery has a holder and connector. It may be replaced without any tools.



4. Excess Position Error (Serious)

Output

DRDY : open*
 OVER : closed
 BRK : closed

TA Report

00000100
 00000000

LED

☆ RDY
 ☆ ALM1
 | ALM2
 ☆ ALM3
 ☆ POWER
 | OVER HEAT1
 | OVER HEAT2
 | OVER HEAT3
 | UDR CVT
 | OVR VOLT
 | OVR CURR
 | UDR MVT

Motor Condition:

- The Motor servo locks in velocity control mode.

Cause:

- The value of the position error counter exceeds a value 8 times the detection criterion (specified with CO).
 - Breakage of the Motor wiring
 - The servo parameters (VG, VI and PG) are not set properly.
 - The velocity and/or acceleration (MV, MA, etc.) is too high.

Remedy:

- This alarm is canceled if the CLR input is activated or the CL command is input. The position error counter is cleared to zero.

Note:

* The DRDY output will be closed if /AL option is specified when setting CO.

Supplementary Description for Maintenance

- The following causes are likely.

#	Cause	Confirmation/Remedy
1	The "position error over" detection value (parameter CO) is too small.	Set the CO value appropriately. *1
2	Insufficient torque or large overshoot because the servo parameters are not set appropriately	Set the servo parameters appropriately. *2
3	Lock by the external brake, or excessive brake	See to it that the Megatorque Motor torque and external brake do not interfere with each other.
4	A feedback signal is disturbed due to trouble with the resolver winding or cable.	Check the resolver cable and connector joint.

*1: The position error value can be confirmed at the Handy Terminal with the command TE. (Refer to the instruction manual)

*2: Observe the rotating speed at the check pin of the Driver Unit front panel, compare with the command, and set the servo parameters so that phase delay and overshoot are reduced.

5. Internal Switch Setting Error

Output	LED	Motor Condition:
DRDY : open	RDY	● Servo-off
OVER : open	ALM1	Cause:
BRK : open	☆ ALM2	● Power is turned on under the condition where the internal switch SW201 #2 ~ #4 are set improperly.
TA Report	☆ ALM3	Remedy:
00000000	☆ POWER	● Turn off power, set SW201 #2 ~ #4 properly, then turn on power.
00010000	OVER HEAT1	
	OVER HEAT2	
	OVER HEAT3	
	UDR CVT	
	OVR VOLT	
	OVR CURR	
	UDR MVT	

6. Control Circuit Error

Output	LED	Motor Condition:
DRDY : open	☆ RDY	● Servo-off
OVER : open	☆ ALM1	Cause:
BRK : open	☆ ALM2	● An error occurs in the control circuit in the Driver Unit.
TA Report	☆ ALM3	Remedy:
Not available	☆ POWER	● This alarm is canceled by turning off power, then turning it on again. If this alarm occurs frequently, contact NSK.
	OVER HEAT1	
	OVER HEAT2	
	OVER HEAT3	
	UDR CVT	
	OVR VOLT	
	OVR CURR	
	UDR MVT	

Supplementary Description for Maintenance

- (1) The CPU is not working. Therefore, RS232C and other controls are all disabled.
- (2) Contact our office.

7. Memory Error

Output

DRDY : open
 OVER : open
 BRK : open

TA Report

00010000
 00000000

LED

☆ RDY
 ☆ ALM1
 | ALM2
 | ALM3
 ☆ POWER
 | OVER HEAT1
 | OVER HEAT2
 | OVER HEAT3
 | UDR CVT
 | OVR VOLT
 | OVR CURR
 | UDR MVT

Motor Condition:

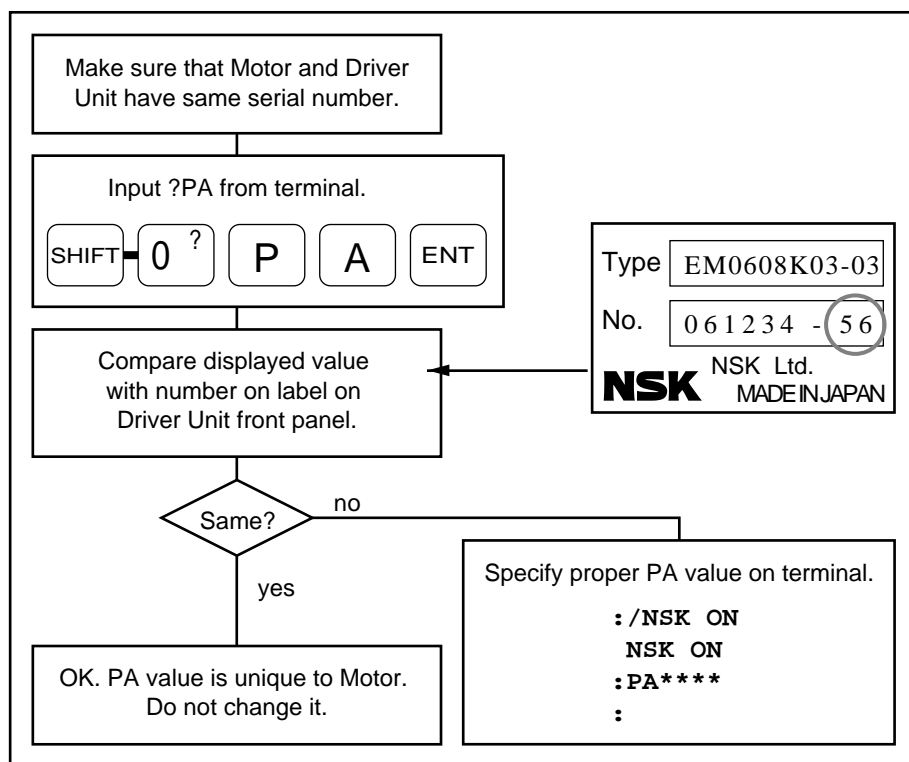
- Servo-off

Cause:

- The parameters stored in the RAM in the Driver Unit contain some error.

Remedy:

- Turn off power, then turn it on again under the condition where the parameters are initialized (with SW201 #1 off). Note that all the parameters and channel data are reset to the shipping-set values. Thus, it is necessary to record them and input them afterwards. (Among the parameters, PA should be set the different way than other parameters.)



Supplementary Description for Maintenance

The following causes are likely.

#	Cause	Situation	Remedy
1	The parameter backup battery has deteriorated.	The alarm is repeated when the power is turned on again, even if the Driver Unit is reset.	Replace the battery.
2	The RAM data was corrupted due to the storage conditions.	Possible at -200C or less	For storage, -100C or more is recommended.

8. Resolver Circuit Error

Output

DRDY : open

OVER : open

BRK : open

TA Report

00100000

00000000

LED

☆ RDY
| ALM1
☆ ALM2
| ALM3
☆ POWER
| OVER HEAT1
| OVER HEAT2
| OVER HEAT3
| UDR CVT
| OVR VOLT
| OVR CURR
| UDR MVT

Motor Condition:

- Servo-off

Cause:

- Position detection is disabled due to breakage of the resolver cable, etc.

Remedy:

- Turn off power, check the resolver wiring, then turn on the power again. The alarm will be canceled.
- If this alarm occurs frequently, contact NSK.

Supplementary Description for Maintenance

- (1) Visually check the cable for disconnection and shorting.
- (2) Check the connector joint for its contact as well.
- (3) When the cable moves, its rotation radius and rotation frequency affect its service life greatly. A continuity test and insulation test of the cable are required.

9. Over-Current

Output

DRDY : open

OVER : open

BRK : open

TA Report

10000000

00000000

LED

| RDY
☆ ALM1
☆ ALM2
☆ ALM3
☆ POWER
| OVER HEAT1
| OVER HEAT2
| OVER HEAT3
| UDR CVT
| OVR VOLT
☆ OVR CURR
| UDR MVT

Motor Condition:

- Servo-off

Cause:

- Short-circuit of the Motor windings or the Motor cable.

Remedy:

- (1) Turn off the Driver Unit and try to find the exact cause of the short. Use a continuity tester or other instrument for evaluating insulation quality at high voltage. Factory insulation test of the Motor is 1 500VAC. You should find a minimum breakdown voltage of 500VAC including the Motor Cable. Test the cable separately to check for shorts between the wires of one phase, since the Motor winding would short the tester. Never test the Driver Unit. Only after finding and eliminating shorts or poor insulation should the AC power be re-applied. Don't use the Driver Unit as a circuit tester. Although the Driver Unit is short-circuit protected, operation with a shorted output is stressful and carries the possibility of the Driver Unit damage.
- (2) Re-applying AC power to the Driver Unit resets the alarm if the condition has been eliminated.

Supplementary Description for Maintenance

- (1) A main circuit fuse blow-out alarm may occur depending on the degree of overcurrent.
- (2) The final stage FET of the Driver Unit may be deteriorated.

10. Heat Sink Over-Temperature

Output

DRDY : open

OVER : open

BRK : open

TA Report

10000000

00000000

LED

| RDY
☆ ALM1
☆ ALM2
☆ ALM3
☆ POWER
☆ OVER HEAT1
| OVER HEAT2
| OVER HEAT3
| UDR CVT
| OVR VOLT
| OVR CURR
| UDR MVT

Motor Condition:

- Servo-off

Cause:

- The temperature of the heat sink in the power amplifier exceeds 90°C due to continued heavy torque demand. There is a thermostatically controlled fan which is activated at a much lower heat sink temperature. Usually, this fan will prevent this condition from ever being reached. A combination of high ambient temperature and constant high torque demand may cause this alarm to be generated, however.

Remedy:

- Stop operation, check for the points show below, then cool the Motor and Driver Unit by air:
 - Check to see whether the duty cycle of the Motor is too high.
 - Check to see whether excessive load is applied to the Motor.
 - Check to see whether the ambient temperature of the Driver Unit is higher than the normal condition.
- If no troubles are found in the above check and this alarm occurs frequently, contact NSK.

Supplementary Description for Maintenance

(1) Stop the cycle immediately.

(2) If the temperature detecting sensor still remains turned on even if the alarm is reset,the alarm results again.

Before restarting leave sufficient time for cooling.

11. Regeneration Resistor Over-Temperature

Output

DRDY : open

OVER : open

BRK : open

TA Report

10000000

00000000

LED

| RDY
 ☆ ALM1
 ☆ ALM2
 ☆ ALM3
 ☆ POWER
 | OVER HEAT1
 | OVER HEAT2
 ☆ OVER HEAT3
 | UDR CVT
 | OVR VOLT
 | OVR CURR
 | UDR MVT

Motor Condition:

- Servo-off

Cause:

- The temperature of the regenerative resistor in the power amplifier exceeds 80°C due to continued heavy torque demand. Or, regenerative current cannot be processed when the Motor is decelerated rapidly.

Remedy:

- Stop operation, then cool the Driver Unit sufficiently. The rotational energy is compensated with regenerative resistance when the Motor is decelerated. Reduce the duty cycle of the Motor, etc.

Note: Regeneration occurs when the Motor direction of motion is opposite to the direction of developed torque, and both speed and torque are high enough to result in significant mechanical power being delivered to the Motor. An example of this condition is the rapid deceleration from high speed of a high inertia load. Another example is the controlled lowering of a gravity load on the end of an arm attached to the Motor output.

The Power Amp then converts the mechanical energy to DC electrical energy within the amplifier. The Power Amp contains a large dump resistor, the purpose of which is to get rid of this regenerative energy before it can damage the amplifier. If this dumping goes on continuously at a sufficiently high power level, the dumping resistor will overheat and an alarm will be generated.

Supplementary Description for Maintenance

- (1) Stop the cycle immediately.
- (2) If the temperature detecting sensor still remains turned on even if the alarm is reset, the alarm results again.
 Before restarting leave sufficient time for cooling.

12. Over-Voltage

Output

DRDY : open

OVER : open

BRK : open

TA Report

10000000

00000000

LED

| RDY
☆ ALM1
☆ ALM2
☆ ALM3
☆ POWER
| OVER HEAT1
| OVER HEAT2
| OVER HEAT3
| UDR CVT
☆ OVR VOLT
| OVR CURR
| UDR MVT

Motor Condition:

- Servo-off

Cause:

- Excessive DC voltage is applied to the main circuit when a load having a large moment of inertia is decelerated rapidly, etc. Or, the voltage of the input power (main power) of the power amplifier main circuit exceeds 290VAC due to an error in the power supply.

Remedy:

- Turn off power, check the supply voltage, then turn on power again. If the power supply is not defective, carry out the same measures as described in the section “10. Heat Sink Over-Temperature.”

Note: Regeneration occurs when the Motor direction of motion is opposite to the direction of developed torque, and both speed and torque are high enough to result in significant mechanical power being delivered to the Motor. The Power Amp then converts the mechanical energy to DC electrical energy within the amplifier. The Power Amp contains a large dump resistor, the purpose of which is to get rid of this regenerative energy before it can damage the amplifier.

However, if the rate of regeneration is more than the resistor can handle, the excess energy appears as excess HVDC supply voltage. The amplifier then protects itself from even higher voltage by refusing to generate torque against the opposing load. An alarm is generated at that time. An example of this condition is the rapid deceleration from high speed of a high inertia load. Another example is the controlled lowering of a gravity load on the end of an arm attached to the Motor output.

Supplementary Description for Maintenance

- (1) When regenerative energy cannot be absorbed completely by the internal resistor, the main circuit DC voltage increases and an alarm occurs.
- (2) Lower acceleration/deceleration slope for use.

13. Control AC Line Under-Voltage

Output

DRDY : open
OVER : open
BRK : open

TA Report

10000000
00000000

LED

| RDY
☆ ALM1
☆ ALM2
☆ ALM3
☆ POWER
| OVER HEAT1
| OVER HEAT2
| OVER HEAT3
☆ UDR CVT
| OVR VOLT
| OVR CURR
| UDR MVT

Motor Condition:

- Servo-off

Cause:

- The voltage of the input power (control power) for the power amplifier control circuit falls below 70VAC due to an error in the power supply.

Remedy:

- Turn off power, check the power supply and power cable, then turn on power again.

14. Main AC Line Under-Voltage

Caution: A blown front panel fuse indicates a very serious problem and should be thoroughly investigated before replacing the fuse and re-applying power. The primary reason for the front panel fuses is to limit the extent of damage in the event of power circuit failure. If the PA has failed, re-applying power may only widen the extent of the damage and increase repair cost.

Output

DRDY : open
 OVER : open
 BRK : open

TA Report

10000000
 00000000

LED

| RDY
 ☆ ALM1
 ☆ ALM2
 ☆ ALM3
 ☆ POWER
 | OVER HEAT1
 | OVER HEAT2
 | OVER HEAT3
 | UDR CVT
 | OVR VOLT
 | OVR CURR
 ☆ UDR MVT

Motor Condition:

- Servo-off

Cause:

- The fuse has blown. The voltage of the power amplifier main circuit power lowers below 40VAC due to an error in the power supply.

Remedy:

- Check the fuse, supply voltage, and power supply wiring, then turn on power again.
- If the fuse blows out frequently, contact NSK.

Note:

- 2 fuses are supplied with the System.

● Fuse Specification:

Manufacturer — BUSSMDA
 Model — MDA20A
 Capacity — 20A

Supplementary Description for Maintenance

The following causes are likely.

#	Cause	Situation	Remedy
1	The supply voltage is too high.	A rush charge current is excessive and the fuse is gone.	Set the voltage appropriately.
2	The main circuit was shorted due to Motor or cable trouble.	Short-circuit of the main circuit system. The final stage FET of the Driver Unit may have deteriorated.	Motor O.K./N.G. judgment is required including the cable.
3	The main circuit was shorted due to trouble inside the Driver Unit.		It is necessary to eliminate the foreign substances inside the Driver Unit or replace the parts.

15. Internal Fuse Blown

Output	LED	Motor Condition:
DRDY : open	RDY	● Servo-off
OVER : open	ALM1	Cause:
BRK : open	ALM2	
TA Report Not available	ALM3	● The Driver Unit uses a power fuse in order to prevent affects upon the primary side (control power) in case an error (such as burn-out) in the Driver Unit. If this fuse blows, no LEDs turn on and the Driver Unit ceases to function.
	POWER	
	OVER HEAT1	
	OVER HEAT2	
	OVER HEAT3	
	UDR CVT	
	OVR VOLT	
	OVR CURR	
	UDR MVT	Remedy:
		● User repair is not recommended. Contact NSK.

16. TB Connection Error

Output	LED	Motor Condition:
DRDY : open	RDY	● Servo-off
OVER : open	☆ ALM1	Cause:
BRK : open	☆ ALM2	
TA Report 10000000 00000000	☆ ALM3	● Power is turned on under the condition where the shorting bracket which is attached to the NC terminal of the front panel TB in the factory, is removed.
	☆ POWER	
	OVER HEAT1	
	☆ OVER HEAT2	
	OVER HEAT3	
	UDR CVT	
	OVR VOLT	
	OVR CURR	
	UDR MVT	Remedy:
		● Turn off power, connect the shorting bracket to the NC terminal, then turn on power again.
		Note:
		● The user may use this alarm as “Motor over-temperature” alarm if the user equips the Motor with a thermostat and connect it to the NC terminal of TB.

17. Overload

Output

DRDY : open
OVER : open
BRK : open

TA Report

00000010
00000000

LED

| RDY
☆ ALM1
☆ ALM2
| ALM3
☆ POWER
| OVER HEAT1
| OVER HEAT2
| OVER HEAT3
| UDR CVT
| OVR VOLT
| OVR CURR
| UDR MVT

Motor Condition:

- Servo-off

Cause:

- The Motor is restrained mechanically in operation, and an internal coil current command value accumulated in the software exceeds the set value. The value specified by OL serves as the detection criterion.

Remedy:

- Activate the CLR input or issue a CL command to cancel the alarm. If the Motor is hot, wait until it becomes cool, then return to normal use.

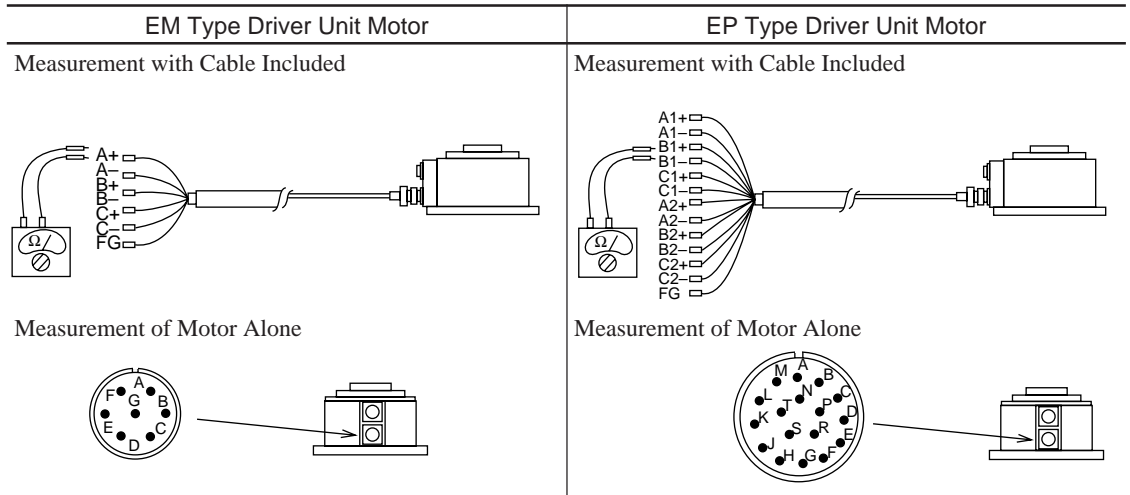
Note:

- The OL parameter is factory-set according to the Motor size. Do not change it.
- If it should be changed, a higher OL causes an overload alarm to occur less frequently. If OL is zeroed, no alarm occurs.

APPENDIX 4: ASSESSMENT OF MOTOR USEABILITY

- In order to judge whether the Motor is normal or not, measure the winding resistance of the motor and the insulation resistance of the winding. It is judged normal if both measured results are within their allowable values.
- Make measurement with the cable included first. If any abnormalities are found in this measurement, measure the Motor alone.

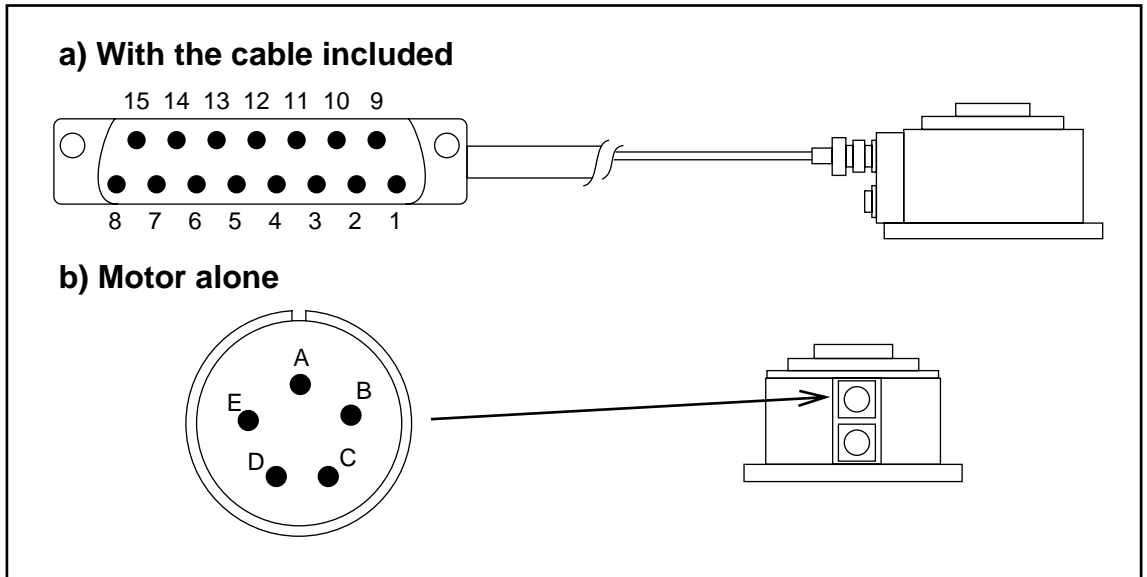
4.1. Resistance measurement of the motor windings



Driver Unit Type	Cable Pins	Motor Pins	Measured Value	Allowable Value
EM type	A+ ↔ A-	Ⓒ ↔ Ⓓ		Value below $\pm 4.0\Omega$ Variation of each phase is within 1.0Ω
	B+ ↔ B-	Ⓑ ↔ Ⓔ		
	C+ ↔ C-	Ⓐ ↔ Ⓕ		
EP type	A1+ ↔ A1-	Ⓜ ↔ Ⓐ		4-inch Motor 3Ω
	B1+ ↔ B1-	Ⓝ ↔ Ⓑ		6-inch Motor 8Ω
	C1+ ↔ C1-	Ⓟ ↔ Ⓒ		8-inch Motor 8Ω
	A2+ ↔ A2-	Ⓕ ↔ Ⓖ		10-inch Motor 4.5Ω
	B2+ ↔ B2-	Ⓢ ↔ Ⓗ		14-inch Motor 3.5Ω
	C2+ ↔ C2-	Ⓣ ↔ Ⓙ		

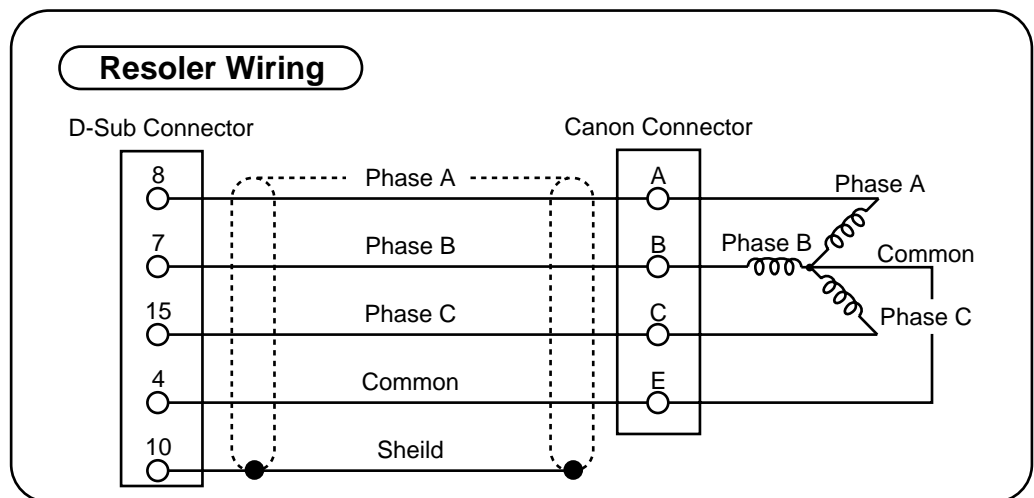
- When using a Motor with special windings or a cable of 4 m or longer, refer to our office.

4.2. Resistance measurement of the resolver windings



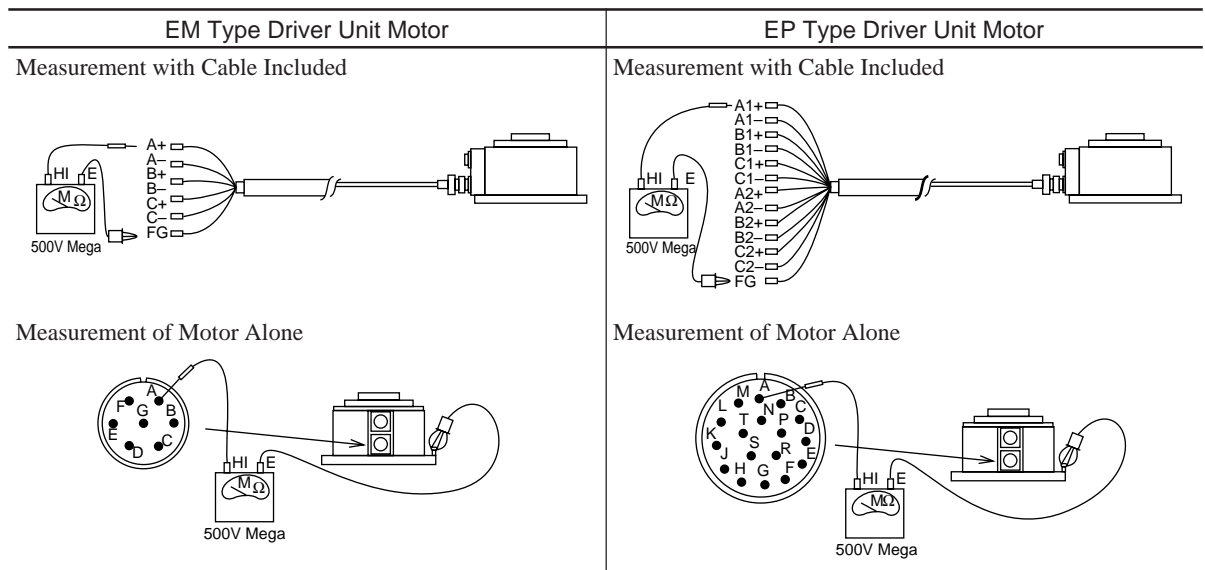
Cable Pins	Motor Pins	Measured Value	Allowable Value
8 ↔ 4	(A) ↔ (E)		Variation of each phase is within 1.0Ω
7 ↔ 4	(B) ↔ (E)		
15 ↔ 4	(C) ↔ (E)		
10 ↔ 4	—		1MΩ

- When the cable is 4 m or longer, refer to our office.



4.3. Insulation resistance measurement of the motor windings

<When conducting a mega test, disconnect the wiring from the Driver Unit.>



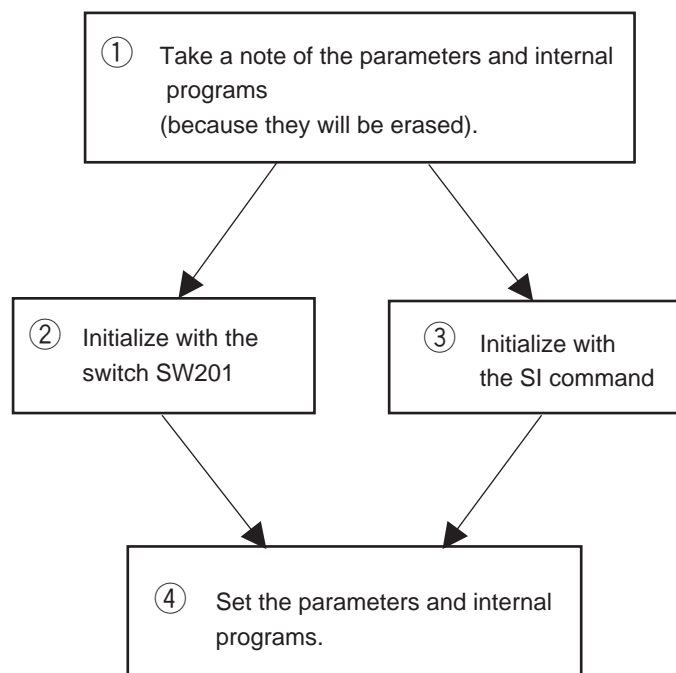
Driver Unit Type	Cable Pins	Motor Pins	Measured Value	Allowable Value
EM type	A+ ↔ FG	Ⓒ ↔ Ⓔ		Cable pins : 1 MΩ or more
	B+ ↔ FG	Ⓑ ↔ Ⓔ		
	C+ ↔ FG	Ⓐ ↔ Ⓔ		
	A+ ↔ B+	Ⓒ ↔ Ⓑ		Motor pins : 2 MΩ or more
	B+ ↔ C+	Ⓑ ↔ Ⓐ		
	C+ ↔ A+	Ⓐ ↔ Ⓒ		
EP type	A1+ ↔ FG	Ⓜ ↔ Earth		
	B1+ ↔ FG	Ⓝ ↔ Earth		
	C1+ ↔ FG	Ⓟ ↔ Earth		
	A1+ ↔ B1	Ⓜ ↔ Ⓝ		
	B1+ ↔ C1	Ⓝ ↔ Ⓟ		
	C1+ ↔ A1	Ⓟ ↔ Ⓜ		
	A2+ ↔ FG	ⓕ ↔ Earth		
	B2+ ↔ FG	Ⓢ ↔ Earth		
	C2+ ↔ FG	Ⓣ ↔ Earth		
	A2+ ↔ B2+	ⓕ ↔ Ⓢ		
	B2+ ↔ C2	Ⓢ ↔ Ⓣ		
	C2+ ↔ A2+	Ⓣ ↔ ⓕ		

4.4. Appearance check of the Motor and cable

- Check the Motor for any damage, and the cable for any tear of insulation coating.

APPENDIX 5: INITIALIZATION OF DRIVER UNIT

- When it is necessary to initialize the Driver Unit in the troubleshooting processes or at the time of replacing the Motor/Driver Unit, follow the instructions below.
 - Initialization requires three processes as shown in the figure. Initialization can be done in two ways; using the switch SW201 or the SI command.
 - Prepare the parameter I/O terminal (Handy Terminal FHT10 or FHT11).
 - In the following, initialization is described in the order of the numbers shown in the figure.



- ① First, monitor and record through the Handy Terminal the parameters and internal programs of the Driver Unit which have been used.**

The PA value is particularly important.

- Connect the Handy Terminal to the connector CN1 and turn on the control power (90 to 220 V AC) only.



- The parameters can be monitored with the commands TS1 through TS6.

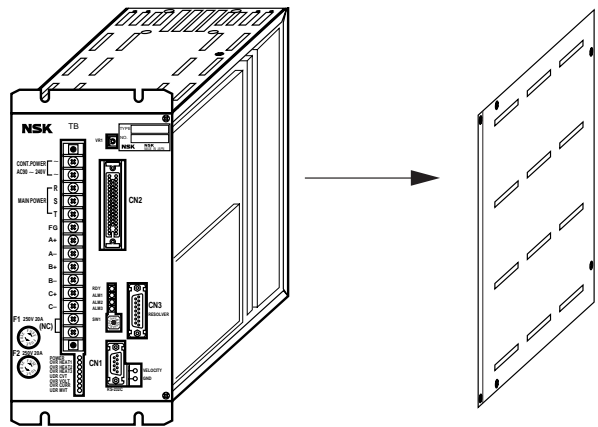


- After monitoring them, turn off the power.

② Initialize the internal data of the Driver Unit with the switch SW201.

Viewing from the front of the Driver Unit, remove the right side panel.

- Shift down (OFF) the No.1 switch of the internal switch SW201.
- ↓
- Connect the Handy Terminal to the connector CN1.
- ↓
- Turn on the control power (90 to 220 V AC) only.
- ↓
- Initialization is completed in about 20 seconds. It is completed if “PA ---” is displayed on the Handy Terminal screen.
- ↓
- Turn off the control power.
- ↓
- Shift up (ON) the No.1 switch of the internal switch SW201.
- ↓
- Remount the side panel.



③ Initialize the internal data of the Driver Unit with the SI command.

- Connect the Handy Terminal to the connector CN1.
- ↓
- Turn on the control power (90 to 220 V AC) only.
- ↓
- Input a password. That is, when “:” is being displayed, enter the following;

/ N S K SP O N ENT

- It is all right if “NSK ON” is echoed back enter the following;

- Input the SI command. That is, enter the following;

S I ENT

- Initialization is completed if “:” is displayed after “INITIALIZE” is echoed back.

④ **Enter the internal parameters and internal programs.**

- Connect the Handy Terminal to CN1 and turn on the control power.



- Before entering the parameters which have been recorded, enter the PA value first.

From the terminal, enter the following;

“NSK ON” is displayed.

Next, enter the following;

“PAxx” is displayed.

After that, enter the other parameters and internal programs.

⑤ **Confirm the parameters and internal programs.**

- Confirm the internal parameters and internal programs at the Handy Terminal. You can confirm them with the commands TS1 through TS6, or TC *n* (*n*: Channel No.).

⑥ **Turn off the power to complete the operation.**

APPENDIX 6: HOW TO EXCHANGE EM DRIVER UNIT

1. Before exchanging Driver Units

- Check the type of Driver Unit. The new Driver Unit type should be of the same type as the unit being replaced.
- Record current parameters and channel programs.

Note: It is important to keep parameters such as PA, VG, VI, PG, CO, MA, MV, HO and data of channel program.

(To read parameters and channel programs, enter TS1~6 and TC0~63 .)

2. Summary of exchange procedure

- This work consists of two tasks:
 - (1) “Transfer of RDC board”
 - (2) “Write parameters and channel programs”

Note: Please set switches and jumper pins on the new CB board to be same as the unit being replaced.

6.1. Transfer of RDC board

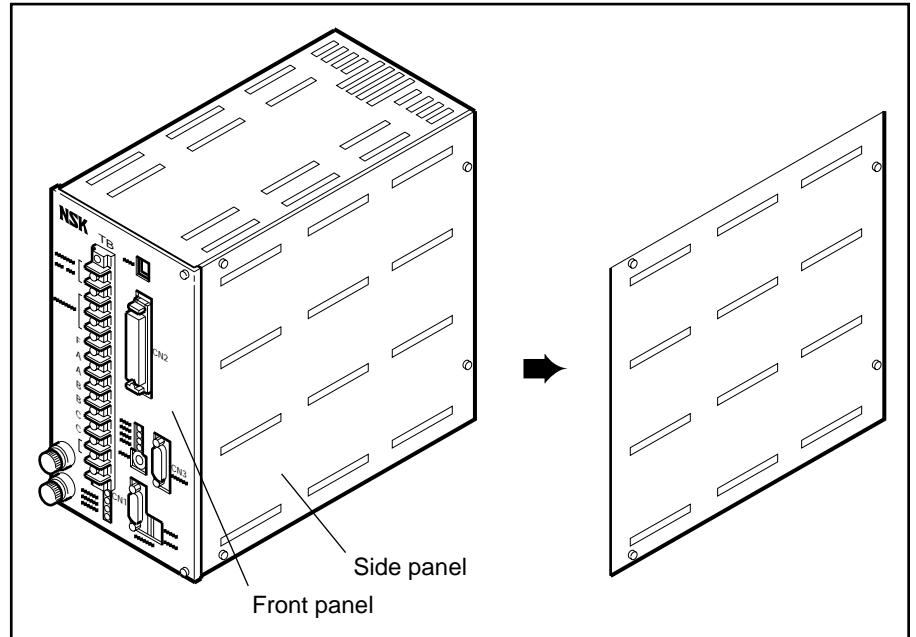
- ① Remove front and side panels from EM Driver Unit.

Front panel : M3×6, Flat head screw×2, Binding screw×2

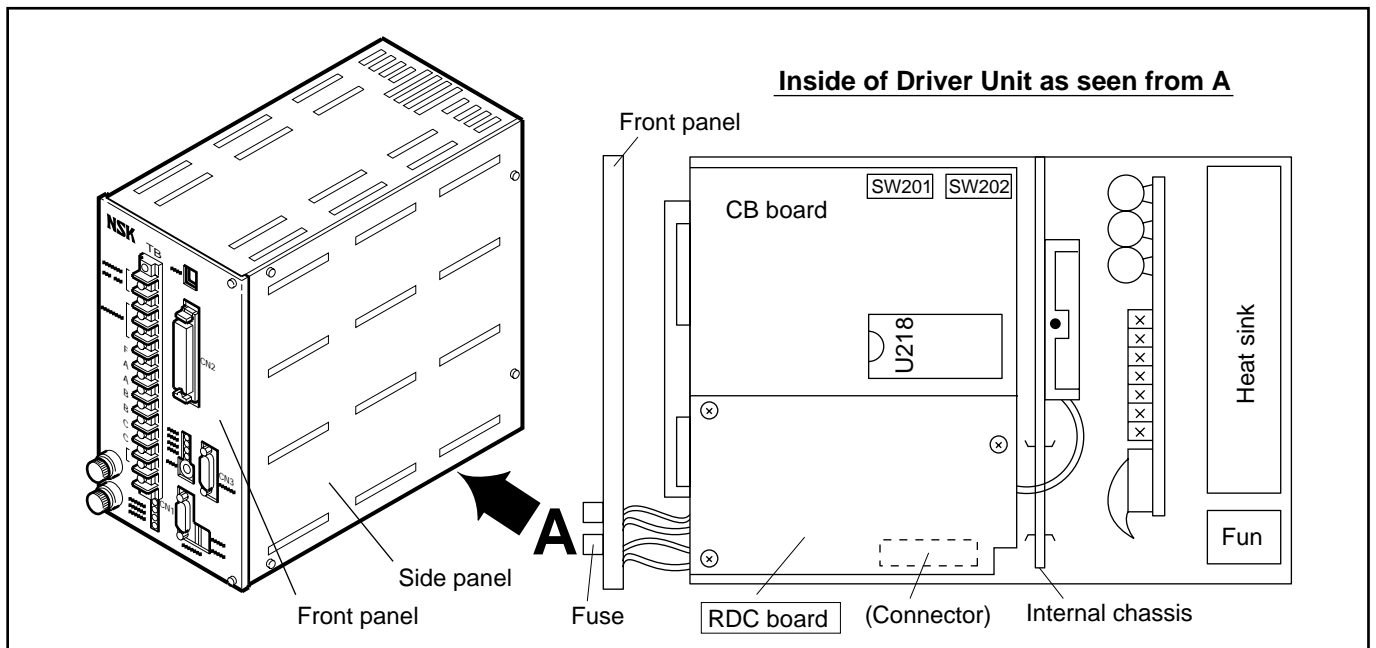
Side panel : M3×6, Flat head screw×4

- ② Remove RDC board

M3×6, Sems screw×3



Note: RDC board is fixed with CB board not only by screws but also by a connector. DO NOT bend the RDC board.



- ③ Attach RDC board to new Driver Unit.
- ④ Replace front and side panels of Driver Unit.

6.2. Write parameters and channel programs

(1) Initialization

- ① Connect controller power cables.
- ② Set SW201 switch 1 to OFF.
- ③ Set CN1 to FHT01 or FHT11.
- ④ Turn control power ON.
(Wait for “NSK MEGATORQUE•••” message on FHT01 or FHT11 about 10 sec.)
- ⑤ Set SW201switch 1 to ON after “NSK MEGATORQUE•••” message appears.
- ⑥ Enter the following using FHT01 or FHT11.

[/] [N] [S] [K] [SP] [O] [N] [ENT]

- ⑦ Enter the parameter PA as shown below.

[P] [A] [] [] [ENT]

- ⑧ Confirm the parameter PA as shown below.

(Enter [SHIFT] [0 ?] [P] [A] [ENT])

(2) Input previously recorded parameters

- ① Enter all parameters using FHT01 or FHT11.
- ② After entering all parameters, check parameters using “MM1 [ENT]” and “TS1 [ENT] ~ TS6 [ENT]”.
- ③ If internal channels are used, enter the previously recorded data.
- ④ Turn control power OFF.
- ⑤ Connect main power cables, motor cables and connections to other devices.

Internal parameter data chart

	Function	Setting
PG	Position gain	
PI	Position integrator	
VG	Velocity gain	
VI	Velocity integrator	
LG	Lower gain percentage	
FP	Filter, primary	
FS	Filter, secondary	
NP	Notch filter, primary	
NS	Notch filter, secondary	
IN	In-position limit	
CO	Error counter over limit	
TL	Torque limit	
DB	Dead band	
FC	Friction compensation	
ZA	Zero-speed offset for analog command	
IL/VL	Integration limit (Velocity loop)	
IL/PL	Integration limit (Position loop)	
FF	Feed forward gain	
AO	Absolute position offset	
RP	Run pre-input	
MM	Multi-line mode	
EC	End of command	
CR	Circular resolution	
LR	Low torque ripple	
VR	Velocity range	
PA	Phase Adjust	
MA	Move acceleration	
MV	Move velocity	
HP	Home position	
HO	Home offset	
HA	Home Return acceleration	
HV	Home Return velocity	
HZ	Home Return near-zero velocity	
OS	Origin setting mode	
JA	Jog acceleration	
JV	Jog velocity	

*Initial parameter values are set at factory.

Internal program data chart

CH	Positioning Command	Velocity	Acceleration
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

CH	Positioning Command	Velocity	Acceleration
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
51			
52			
53			
54			
55			
56			
57			
58			
59			
60			
61			
62			
63			

Blank Page

World-wide Manufacturing and Marketing Organization

NSK Ltd. INTERNATIONAL DIVISION

JAPAN: Tokyo Phone: 03-3779-7120

NSK CORPORATION

U.S.A.: Ann Arbor Phone: 313-761-9500

[Precision Products Business Unit]

U.S.A. : Chicago Phone: 630-924-8000
: Los Angeles Phone: 562-926-3578
: Ann Arbor Phone: 761-761-9500

NSK CANADA INC.

CANADA : Toront Phone: 905-890-0740
: Montreal Phone: 514-633-1240
: Vancouver Phone: 800-663-5445

NSK RODAMIENTOS MEXICANA, S.A. DE C.V.

MEXICO: Mexico City Phone: 5-301-2741,5-301-3115

NSK DO BRASIL INDUSTRIA E COMÉRCIO DE ROLAMENTOS LTDA.

BRASIL : São Paulo Phone: 001-269-4700
: Porto Alegre Phone: 051-222-1324
: Belo Horizonte Phone: 031-224-2508

NSK UK LTD

ENGLAND : Ruddington Phone: 0115-936-6600

NSK DEUTSCHLAND G.m.b.H

GERMANY : Düsseldorf Phone: 02102-4810
: Stuttgart Phone: 0711-79082-0
: Leipzig Phone: 0341-5631241

NSK FRANCE S.A.

FRANCE : Paris Phone:1.30.57.39.39
: Lyon Phone: 72.15.29.00

NSK NETHERLANDS B.V.

NETHERLAND: Amsterdam Phone: 020-6470711

NSK ITALIA S.p.A.

ITALIA: Milano Phone: 02-995191

NSK IBERICA, S.A.

SPAIN: Barcelona Phone: 93-575-1662

NSK AUSTRALIA PTY, LTD.

AUSTRALIA : Melbourne Phone: 03-9764-8302
: Sydney Phone: 02-9893-8322
: Brisbane Phone: 07-3393-1388
: Adelaide Phone: 08-8373-4811
: Perth Phone: 089-434-1311

NSK BEARINGS NEW ZEALAND LTD.

NEW ZEALAND: Auckland Phone: 09-276-4992

NSK KOREA CO., LTD.

KOREA: Seoul Phone: 02-3287-6001

NSK SINGAPORE (PRIVATE) LTD.

SINGAPORE: Singapore Phone: 2781711

NSK BEARINGS (THAILAND) CO., LTD.

THAILAND : Bangkok Phone: 2-6412150-60
: Chiang mai Phone: 053-246993-4

TAIWAN NSK PRECISION CO., LTD.

TAIWAN: Taipei Phone: 02-591-0656

MEGATORQUE® MOTOR

MAINTENANCE MANUAL (EM/EP Driver Unit)

Document Number: C20026-03

April 26th, 1995

1st Edition, 1st Printing

January 20th, 1996

2nd Edition, 1st Printing

October 23th, 2001

3rd Edition, 1st Printing

NSK Ltd.

NSK