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, which comes first, one (1) year of shipment or 2400 total operation hours. 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 1997-2000 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.

“MEGATORQUE” is a registered trademark of NSK Ltd. in Japan and that of NSK Corp. in the United States of America.
Contents

1. Notes to Users ----------------------------- 1-1
   1.1. About This Manual ---------------------- 1-1
   1.2. Notes for Safety ----------------------- 1-1
   1.3. Operational Remarks ------------------- 1-2

2. System Outline --------------------------- 2-1
   2.1. System Configuration ------------------- 2-1
   2.2. Reference Number Configuration --------- 2-2
      2.2.1. Motor ----------------------------- 2-2
      2.2.2. Driver Unit ----------------------- 2-2
      2.2.3. Cable Set -------------------------- 2-2
      2.2.4. Handy Terminal -------------------- 2-2
   2.3. Standard Combination ------------------ 2-3
      2.3.1. YS Series Motor ------------------- 2-3
         2.3.1.1. Motor and Driver Unit ------- 2-3
         2.3.1.2. Cable Set --------------------- 2-3
      2.3.2. JS Series Motor ------------------- 2-4
         2.3.2.1. Motor and Driver Unit ------- 2-4
         2.3.2.2. Cable Set --------------------- 2-4

3. Specification ----------------------------- 3-1
   3.1. Motor Specification --------------------- 3-1
      3.1.1. YS Series Motor ------------------- 3-1
         3.1.1.1. Name of Parts --------------- 3-1
         3.1.1.2. Specification --------------- 3-2
         3.1.1.3. Dimensions ------------------ 3-5
      3.1.2. JS Series Motor ------------------- 3-11
         3.1.2.1. Name of Parts --------------- 3-11
         3.1.2.2. Specification --------------- 3-11
         3.1.2.3. Dimensions ------------------ 3-13
   3.2. Driver Unit ---------------------------- 3-15
      3.2.1. Name of Parts --------------------- 3-15
      3.2.2. General Specification -------------- 3-16
      3.2.3. Functional Specification ---------- 3-17
      3.2.4. Jumper ---------------------------- 3-19
      3.2.5. Dimensions ------------------------- 3-20
   3.3. Cable Set ------------------------------ 3-21
      3.3.1. Cable Set for YS Motor ------------- 3-21
      3.3.2. Cable Set for YS Motor with Brake 3-21
      3.3.3. Cable Set for JS Motor ----------- 3-22
   3.4. Handy Terminal ------------------------- 3-23
      3.4.1. Name of Parts and Dimensions ------ 3-23
      3.4.2. Specification ---------------------- 3-24

4. Connector Specification ------------------ 4-1
   4.1. CN1: RS-232C Serial Communication Connector 4-1
      4.1.1. CN1 Pin-Out ----------------------- 4-1
      4.1.2. CN1 Signal List ------------------- 4-1
      4.1.3. Sample Wiring Diagram ------------- 4-2
   4.2. CN2, CN5: Control I/O Signal Connectors 4-3
      4.2.1. Pin-Out (CN2, CN5) --------------- 4-3
      4.2.2. Signal Name and Function (CN2, CN5) 4-4
      4.2.3. Setting the Polarity (A or B contact) 4-6
   4.2.4. Signal Specification ---------------- 4-8
      4.2.4.1. General Input ------------------- 4-8
      4.2.4.2. Pulse Train Input --------------- 4-8
      4.2.4.3. General Output ------------------ 4-8
      4.2.4.4. Alarm Output --------------------- 4-9
      4.2.4.5. Position Feed Back --------------- 4-9
      4.2.4.6. Analog Command Input -------------- 4-10
      4.2.4.7. Analog Monitor Output -------------- 4-10
   4.2.5. Wiring Example (CN2, CN5) ------------ 4-11
      4.2.5.1. Position Control Mode Wiring Example 4-11
      4.2.5.2. Wiring Example of Velocity Control/ Torque Control Mode 4-12
   4.2.5.3. Wiring Example of YS Series Motor with Brake 4-13
   4.3. CN3: Resolver Cable Connector ---------- 4-16
      4.3.1. CN3 Pin-out ----------------------- 4-16
      4.3.2. CN3 Signal List ------------------- 4-16
   4.4. CN4: Motor Cable Connector ------------ 4-17
      4.4.1. CN4 Pin-out ----------------------- 4-17
      4.4.2. CN4 Signal List ------------------- 4-17
   4.5. TB: Terminal Block for Power Supply ---- 4-18
      4.5.1. Terminal List ---------------------- 4-18
      4.5.2. Wiring Diagram (TB) --------------- 4-18
9. Operation

9.1. Preparation

9.1.1. Wiring Check

9.1.2. Procedure

9.2. Position Control Mode Operation

9.2.1. Home Return

9.2.1.1. Home Return Parameter List

9.2.1.2. Adjusting Home Position Switch and Home Offset Value

9.2.2. Programmable Indexer

9.2.2.1. Programmable Indexer Channel Switching

9.2.3. Pulse Train Command Operation

9.2.3.1. Pulse Train Signal Format

9.2.3.2. Pulse Train Resolution

9.2.3.3. Input Timing

9.2.4. RS-232C Position Commands

9.2.5. Jog Operation

9.3. Velocity Control Mode Operation

9.3.1. RS-232C Communication Command

9.3.2. Analog Velocity Command

9.4. Torque Control Mode Operation

9.4.1. RS-232C Communication Command

9.4.2. Analog Torque Command

10. Programming

10.1. Commands and Parameters

10.2. Program Editing Command

10.3. Inputting a Program

10.4. Sample Program

11. Command and Parameter

11.1. List of Command and Parameter

11.2. Glossary

12. Maintenance

12.1. Precautions

12.2. Maintenance Check

12.2.1. Motor

12.2.2. Driver Unit and Cable Set

12.3. Periodical Replacement of Parts

12.3.1. Motor

12.3.2. Driver Unit

12.4. Storing

12.5. Limited Warranty

13. Alarm

13.1. Identifying Alarm

13.1.1. LED Alarm Indicator

13.1.2. Using TA Command

13.1.3. Alarm Code List

13.2. Details of Alarm

13.2.1. Normal State

13.2.2. Alarms Related to Power Amplifier

13.2.2.1. Heat Sink Overheat or Regeneration Resistor Overheat

13.2.2.2. Abnormal Main AC Line Voltage

13.2.2.3. Over Current

13.2.2.4. Control AC Line Under-Voltage

13.2.3. Alarms Related to Motor

13.2.3.1. Resolver Circuit Error

13.2.3.2. Software Thermal Sensor

13.2.4. Alarms Related to Control

13.2.4.1. Memory Error

13.2.4.2. CPU Error

13.2.4.3. Interface Error

13.2.4.4. Analog Command Error

13.2.4.5. Excess Position Error

13.2.4.6. Software Over Travel Limit

13.2.4.7. Hardware Over Travel Limit

13.2.4.8. Emergency Stop

13.2.4.9. Software Over Travel Limit

13.2.4.10. Program Error

13.2.4.11. Automatic Tuning Error

14. Troubleshooting

14.1. Identifying Problem

14.2. Troubleshooting

14.2.1. Power Trouble

14.2.2. Motor Trouble

14.2.3. Command Trouble

14.2.4. Terminal Trouble

Appendix

Appendix 1: How to Check Motor Condition
Appendix 2: Initializing Driver Unit
Appendix 3: How to Replace ESA25 Driver Unit
Appendix 4: Regenerative Dump Resistor
Appendix 5: Brake Built in YS Series Motor
Appendix 6: Parameter · Program Setting List
1. Notes to Users

1.1. About This Manual

- This manual describes the interface, function, and operation of the Megatorque Motor System with the ESA25 Driver Unit.

- Before operating the Megatorque Motor System for the first time, this manual should be read thoroughly.

- Motors, Driver Units and Cable sets described in this manual are interchangeable.

- For motors, this manual describes the standard Motor of YS and JS series only. If your motor is not one of these, please refer to the respective specification document to which the priority is given.

1.2. Notes for Safety

- Following notice is added to the clause of safety precautions to get your attention.

  - **Danger**: Might cause serious injuries
  - **Warning**: Might result in injuries
  - **Caution**: Might damage the equipment (machine) and/or the load attached to the motor (work or end effector), or might cause malfunction of the system.
1.3. Operational Remarks

- Pay special attention to the following precautions when installing, adjusting, checking and trouble-shooting Megatorque Motor System.

**Caution**: Make sure that Motor size and maximum torque number of Motor and Driver Unit are the same. Refer to “2.3. Standard Combination” for the details.

- Parameters of Driver Unit are set to Motor size and maximum torque before shipped.
- If the numbers are different, the system does not operate properly.

**Caution**: Do not make Cable Set shorter or longer. Changing the length may worsen Motor and Driver Unit performance.

**Caution**: Do not disassemble the Motor since it is precisely adjusted and assembled. If disassembled, it may cause abnormalities such as deterioration in accuracy and rigidity as well as noise.

**Caution**: Do not touch Driver Unit. Touching the Driver Unit just after the power is turned off may cause electric shock.

- Driver Unit has high capacity conductors in its internal circuits and there is high residual voltage for few minutes after the power is turned off.
- Do not detach Driver Unit cover unless it is necessary. When the cover has to be removed, follow procedures described below.

1. Turn off the control and main power. If only main power has been turned on, turn the control power on for more than 5 seconds, then turn off both powers.

   Neglecting this procedure is very dangerous. The procedure is to reduce residual voltage of capacitors.

2. Wait for 5 minutes or more, then remove the cover.
Figure 1-1

**Caution**: Using an optional regenerative dump resistor shall be considered for heavy duty operation.

- When Motor is decelerating, rotational energy is dissipated by internal dump resistor. Excessive rotational energy causes very high regeneration of Motor, the dump resistor is overheated, then the alarms goes off and Motor stops.
- Gentler deceleration rate or decreasing duty cycle prevents overheating of the dump resistor.
- If heavy duty operation is still needed, installation of optional “Regenerative Dump Resistor” is recommended. Refer to “Appendix 4” for the details.

**Danger**: Never apply any water or oil to Driver Unit. Take appropriate measures to protect Driver Unit from water, oil, slag, dust and corrosive gas.

**Warning**: Do not conduct an “Isolation test” or “Megger test” on Driver Unit. It may damage the internal circuit.

**Caution**: Be sure to adjust the servo parameters according to conditions of actual use. In most cases, the Direct Drive Motor System cannot exhibit its full performance unless the shipping set of these parameters are not altered. Refer to “7. Tuning and Trial Running” for the details of parameter setting.
2. System Outline

2.1. System Configuration

Figure 2-1: System configuration (without brake)

Figure 2-2: System configuration with brake
2.2. Reference Number Configuration

2.2.1. Motor

*Megatorque Motor series
1 Motor size
2 Maximum torque (Unit: N•m)
3 FN : Standard
4 FG : With brake
5 Design number

*M Brake is only available for YS series.

2.2.2. Driver Unit

1 ESA Driver Unit
2 Motor series and size
3 Maximum torque (Unit: N•m)
4 Main power supply
C: AC100V
A: AC200V
5 Denotes ESA25 standard (25)

2.2.3. Cable Set

1 Megatorque Motor Cable Set
2 Cable length (Unit: m)
Refer to “2.3. Standard Combination” for standard length
3 Cable Set for ESA25 Driver Unit
4 Cable design number
YS motor : 31 (Standard), 32 (With brake)
JS motor : 26 (Standard)

2.2.4. Handy Terminal

1 Handy Terminal
2 Design number
2.3. Standard Combination

- This section describes “Standard Combination” of the Motor, ESA25 Driver Unit and Cable set.
- Make sure to select right combination of each parts when ordering.

2.3.1. YS Series Motor

2.3.1.1. Motor and Driver Unit

Table 2-1

<table>
<thead>
<tr>
<th>Motor Reference No.</th>
<th>ESA25 Driver Unit Reference No.</th>
<th>Power Supply Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-YS2005FN001</td>
<td>M-ESA-Y2005C25</td>
<td>AC100V</td>
</tr>
<tr>
<td></td>
<td>M-ESA-Y2005A25</td>
<td>AC200V</td>
</tr>
<tr>
<td>M-YS2020FN001</td>
<td>M-ESA-Y2020C25</td>
<td>AC100V</td>
</tr>
<tr>
<td></td>
<td>M-ESA-Y2020A25</td>
<td>AC200V</td>
</tr>
<tr>
<td>M-YS3008FN001</td>
<td>M-ESA-Y3008C25</td>
<td>AC100V</td>
</tr>
<tr>
<td></td>
<td>M-ESA-Y3008A25</td>
<td>AC200V</td>
</tr>
<tr>
<td>M-YS3040FN501</td>
<td>M-ESA-Y3040C25</td>
<td>AC100V</td>
</tr>
<tr>
<td></td>
<td>M-ESA-Y3040A25</td>
<td>AC200V</td>
</tr>
<tr>
<td>M-YS4080FN001</td>
<td>M-ESA-Y4080C25</td>
<td>AC100V</td>
</tr>
<tr>
<td></td>
<td>M-ESA-Y4080A25</td>
<td>AC200V</td>
</tr>
<tr>
<td>M-YS5120FN001</td>
<td>M-ESA-Y5120C25</td>
<td>AC100V</td>
</tr>
<tr>
<td></td>
<td>M-ESA-Y5120A25</td>
<td>AC200V</td>
</tr>
<tr>
<td>M-YS5240FN001</td>
<td>M-ESA-Y5240A25</td>
<td>AC200V</td>
</tr>
</tbody>
</table>

2.3.1.2. Cable Set

Table 2-2: Standard

<table>
<thead>
<tr>
<th>Reference No.</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-C002SS31</td>
<td>2m</td>
</tr>
<tr>
<td>M-C004SS31</td>
<td>4m</td>
</tr>
<tr>
<td>M-C008SS31</td>
<td>8m</td>
</tr>
<tr>
<td>M-C015SS31</td>
<td>15m</td>
</tr>
<tr>
<td>M-C030SS31</td>
<td>30m</td>
</tr>
</tbody>
</table>

Table 2-3: Motor with brake

<table>
<thead>
<tr>
<th>Reference No.</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-C002SS32</td>
<td>2m</td>
</tr>
<tr>
<td>M-C004SS32</td>
<td>4m</td>
</tr>
<tr>
<td>M-C008SS32</td>
<td>8m</td>
</tr>
<tr>
<td>M-C015SS32</td>
<td>15m</td>
</tr>
<tr>
<td>M-C030SS32</td>
<td>30m</td>
</tr>
</tbody>
</table>
2.3.2. JS Series Motor

2.3.2.1. Motor and Driver Unit

<table>
<thead>
<tr>
<th>Motor Reference No.</th>
<th>ESA25 Driver Unit Reference No.</th>
<th>Power Supply Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-JS0002FN001</td>
<td>M-ESA-J0002C25</td>
<td>AC100V</td>
</tr>
<tr>
<td></td>
<td>M-ESA-J0002A25</td>
<td>AC200V</td>
</tr>
<tr>
<td>M-JS1003FN001</td>
<td>M-ESA-J1003C25</td>
<td>AC100V</td>
</tr>
<tr>
<td></td>
<td>M-ESA-J1003A25</td>
<td>AC200V</td>
</tr>
<tr>
<td>M-JS2006FN001</td>
<td>M-ESA-J2006C25</td>
<td>AC100V</td>
</tr>
<tr>
<td></td>
<td>M-ESA-J2006A25</td>
<td>AC200V</td>
</tr>
<tr>
<td>M-JS2014FN001</td>
<td>M-ESA-J2014C25</td>
<td>AC100V</td>
</tr>
<tr>
<td></td>
<td>M-ESA-J2014A25</td>
<td>AC200V</td>
</tr>
</tbody>
</table>

2.3.2.2. Cable Set

<table>
<thead>
<tr>
<th>Reference No.</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-C002SS26</td>
<td>2m</td>
</tr>
<tr>
<td>M-C004SS26</td>
<td>4m</td>
</tr>
<tr>
<td>M-C008SS26</td>
<td>8m</td>
</tr>
<tr>
<td>M-C015SS26</td>
<td>15m</td>
</tr>
<tr>
<td>M-C030SS26</td>
<td>30m</td>
</tr>
</tbody>
</table>
3. Specification

3.1. Motor Specification

3.1.1. YS Series Motor

3.1.1.1. Name of Parts

Figure 3-1

Rotor
Through Hole
Dust Cover
Motor / Resolver Connector
Housing
Mounting Base
3.1.2. Specification

- There are three types of motor in YS series.
  1. Standard
  2. Motor with brake
  3. Low profile type

- YS Series Motor can be run on either 100V/110V or 200V/220V AC.

- The unit is in SI unit system
  
  \[
  1\text{N} = 0.102\ \text{kgf} = 0.225\text{lb}
  \]

  \[
  1\text{N} \cdot \text{m} = 0.102\ \text{kgf} \cdot \text{m} = 0.738\ \text{ft} \cdot \text{lb}
  \]

(1) **Standard**

<table>
<thead>
<tr>
<th>Item (Unit)</th>
<th>M-YS2020FN001</th>
<th>M-YS3040FN501</th>
<th>M-YS4080FN001</th>
<th>M-YS5120FN001</th>
<th>M-YS240FN001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor reference No.</td>
<td>M-YS2020FN001</td>
<td>M-YS3040FN501</td>
<td>M-YS4080FN001</td>
<td>M-YS5120FN001</td>
<td>M-YS240FN001</td>
</tr>
<tr>
<td>Maximum current/phase (A)</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable axial load (N)</td>
<td>3700</td>
<td>4500</td>
<td>9500</td>
<td>19600</td>
<td>19600</td>
</tr>
<tr>
<td>Allowable moment load (N·m)</td>
<td>60</td>
<td>80</td>
<td>160</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Axial rigidity (mm/N)</td>
<td>4.0 × 10⁻⁴</td>
<td>3.0 × 10⁻⁴</td>
<td>1.4 × 10⁻⁴</td>
<td>1.0 × 10⁻⁴</td>
<td>1.0 × 10⁻⁴</td>
</tr>
<tr>
<td>Moment rigidity *1 (rad/N·m)</td>
<td>3.5 × 10⁻⁶</td>
<td>2.5 × 10⁻⁶</td>
<td>1.5 × 10⁻⁶</td>
<td>3.0 × 10⁻⁷</td>
<td>3.0 × 10⁻⁷</td>
</tr>
<tr>
<td>Maximum stall torque (N·m)</td>
<td>15</td>
<td>35</td>
<td>70</td>
<td>105</td>
<td>198</td>
</tr>
<tr>
<td>Rotor moment of inertia (kg·m²)</td>
<td>0.0070</td>
<td>0.020</td>
<td>0.065</td>
<td>0.212</td>
<td>0.255</td>
</tr>
<tr>
<td>Rotor inertia GD² (kgf·m²)</td>
<td>0.028</td>
<td>0.080</td>
<td>0.26</td>
<td>0.85</td>
<td>1.020</td>
</tr>
<tr>
<td>Mass (kg)</td>
<td>10</td>
<td>16</td>
<td>29</td>
<td>55</td>
<td>95</td>
</tr>
<tr>
<td>Operating condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum speed (s⁻¹ (r.p.s.))</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolver resolution (p/rev)</td>
<td></td>
<td></td>
<td>614400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positioning accuracy (sec)</td>
<td></td>
<td></td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeatability (sec)</td>
<td></td>
<td></td>
<td>±2.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compatible Driver Unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 These value assume that the Motor is mounted on a rigid base.
### (1) Motor with brake

**Table 3-2: Motor with brake**

<table>
<thead>
<tr>
<th>Item (Unit)</th>
<th>Motor reference No.</th>
<th>M-Y2005FG001</th>
<th>M-Y3008FG001</th>
<th>M-Y4080FG001</th>
<th>M-Y5120FG001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum torque (N·m)</td>
<td></td>
<td>20</td>
<td>40</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>Maximum current/phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Allowable axial load (N)</td>
<td></td>
<td>3700</td>
<td>4500</td>
<td>9500</td>
<td>19600</td>
</tr>
<tr>
<td>Allowable moment load (N·m)</td>
<td></td>
<td>60</td>
<td>80</td>
<td>160</td>
<td>400</td>
</tr>
<tr>
<td>Axial rigidity (mm/N)</td>
<td></td>
<td>4.0 × 10^6</td>
<td>3.0 × 10^6</td>
<td>1.4 × 10^6</td>
<td>1.0 × 10^6</td>
</tr>
<tr>
<td>Moment rigidity *1 (rad/N·m)</td>
<td></td>
<td>3.5 × 10^6</td>
<td>2.5 × 10^6</td>
<td>1.5 × 10^6</td>
<td>3.0 × 10^6</td>
</tr>
<tr>
<td>Maximum stall torque (N·m)</td>
<td></td>
<td>15</td>
<td>35</td>
<td>70</td>
<td>105</td>
</tr>
<tr>
<td>Rotor moment of inertia (kg·m²)</td>
<td></td>
<td>0.008</td>
<td>0.023</td>
<td>0.072</td>
<td>0.240</td>
</tr>
<tr>
<td>Rotor inertia GD² (kgf·m²)</td>
<td></td>
<td>0.032</td>
<td>0.092</td>
<td>0.288</td>
<td>0.96</td>
</tr>
<tr>
<td>Brake torque (N·m)</td>
<td></td>
<td>20</td>
<td>40</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>Mass (kg)</td>
<td></td>
<td>12</td>
<td>20</td>
<td>36</td>
<td>66</td>
</tr>
<tr>
<td>Operating condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Temperature: 0<del>40°C, Humidity: 20</del>80 %, Use indoors in a dust-free condition.</td>
</tr>
<tr>
<td>Maximum speed (s⁻¹(rps))</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolver resolution (p/rev)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>614400</td>
</tr>
<tr>
<td>Positioning accuracy (sec)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>Repeatability (sec)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>± 2.1</td>
</tr>
</tbody>
</table>

*1 These values assume that the Motor is mounted on a rigid base.

### (1) Low profile type

**Table 3-3: YS low profile type**

<table>
<thead>
<tr>
<th>Item (Unit)</th>
<th>Motor reference No.</th>
<th>M-Y2005FN001</th>
<th>M-Y3008FN001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum torque (N·m)</td>
<td></td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Maximum current/phase (A)</td>
<td></td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Allowable axial load (N)</td>
<td></td>
<td>3700</td>
<td>4500</td>
</tr>
<tr>
<td>Allowable moment load (N·m)</td>
<td></td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>Axial rigidity (mm/N)</td>
<td></td>
<td>4.0 × 10^6</td>
<td>3.0 × 10^6</td>
</tr>
<tr>
<td>Moment rigidity *1 (rad/N·m)</td>
<td></td>
<td>3.5 × 10^6</td>
<td>2.5 × 10^6</td>
</tr>
<tr>
<td>Maximum stall torque (N·m)</td>
<td></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Rotor moment of inertia (kg·m²)</td>
<td></td>
<td>0.003</td>
<td>0.006</td>
</tr>
<tr>
<td>Rotor inertia GD² (kgf·m²)</td>
<td></td>
<td>0.012</td>
<td>0.024</td>
</tr>
<tr>
<td>Mass (kg)</td>
<td></td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Operating condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum speed (s⁻¹(rps))</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Resolver resolution (p/rev)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positioning accuracy (sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeatability (sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 These values assume that the Motor is mounted on a rigid base.

*2 Differs with main power voltage.
How to calculate axial and moment load

(Caution) : • Do not apply excessive load to the Motor.
An excessive load more than specified in Table 3-2 may result in premature Motor failure.

• Followings show how to calculate the loads.

Figure 3-2: How to calculate loads

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Dimension A (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>46.5</td>
</tr>
<tr>
<td>M-YS2020FN001</td>
<td></td>
</tr>
<tr>
<td>M-YS3030FN001</td>
<td>53.5</td>
</tr>
<tr>
<td>M-YS4080FN001</td>
<td>54.0</td>
</tr>
<tr>
<td>M-YS5120FN001</td>
<td>58.5</td>
</tr>
<tr>
<td>M-YS5240FN001</td>
<td>58.5</td>
</tr>
<tr>
<td>Motor with brake</td>
<td></td>
</tr>
<tr>
<td>M-YS2020FG001</td>
<td></td>
</tr>
<tr>
<td>M-YS3040FG001</td>
<td></td>
</tr>
<tr>
<td>M-YS4080FG001</td>
<td></td>
</tr>
<tr>
<td>M-YS5120FG001</td>
<td></td>
</tr>
<tr>
<td>Low profile type</td>
<td></td>
</tr>
<tr>
<td>M-YS2005FN001</td>
<td></td>
</tr>
<tr>
<td>M-YS3008FN001</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimension A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>46.5</td>
</tr>
<tr>
<td></td>
<td>53.5</td>
</tr>
<tr>
<td></td>
<td>54.0</td>
</tr>
<tr>
<td></td>
<td>58.5</td>
</tr>
<tr>
<td></td>
<td>58.5</td>
</tr>
</tbody>
</table>
3.1.1.3. Dimensions

(1) Standard

Figure 3-3: M-YS2020FN001

Figure 3-4: M-YS3040FN501
Figure 3-5: M-YS4080FN001

Figure 3-6: M-YS5120FN001
(2) Motor with brake

Figure 3-8: M-YS2021FG001

Figure 3-9: M-YS3040FG001
(3) Low profile type

Figure 3-12: M-YS2005FN001

Figure 3-13: M-YS3008FN001
3.1.2. JS Series Motor

3.1.2.1. Name of Parts

Figure 3-14

3.1.2.2. Specification

- JS series Motor can be run on either 100V/110V or 200V/220V AC.

Table 3-4: Specification

<table>
<thead>
<tr>
<th>Item (unit)</th>
<th>Motor reference No.</th>
<th>M-JS0002FN001</th>
<th>M-JS1003FN001</th>
<th>M-JS2006FN001</th>
<th>M-JS2014FN001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor outside diameter (mm)</td>
<td></td>
<td>75</td>
<td>100</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>Maximum torque (N·m)</td>
<td></td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Maximum current/phase (A)</td>
<td></td>
<td>1.5</td>
<td>1.5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Allowable axial load (N)</td>
<td></td>
<td>950</td>
<td>1960</td>
<td>3700</td>
<td></td>
</tr>
<tr>
<td>Allowable moment load (N·m)</td>
<td></td>
<td>10</td>
<td>40</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Axial rigidity (mm/N)</td>
<td></td>
<td>1.6 × 10^5</td>
<td>1.4 × 10^6</td>
<td>7.4 × 10^6</td>
<td></td>
</tr>
<tr>
<td>Moment rigidity (rad/N·m)</td>
<td></td>
<td>2.8 × 10^5</td>
<td>1.4 × 10^6</td>
<td>4.8 × 10^6</td>
<td></td>
</tr>
<tr>
<td>Maximum stall torque (N·m)</td>
<td></td>
<td>1.4</td>
<td>2.1</td>
<td>4.2</td>
<td>9.8</td>
</tr>
<tr>
<td>Rotor moment of inertia (kg·m^2)</td>
<td></td>
<td>0.002</td>
<td>0.00375</td>
<td>0.00525</td>
<td>0.0095</td>
</tr>
<tr>
<td>Rotor inertia GD^2 (kgf·m^2)</td>
<td></td>
<td>0.008</td>
<td>0.015</td>
<td>0.021</td>
<td>0.038</td>
</tr>
<tr>
<td>Mass (kg)</td>
<td></td>
<td>2.4</td>
<td>3.2</td>
<td>4.8</td>
<td>5.5</td>
</tr>
<tr>
<td>Operating conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum speed (S⁻¹ (r.p.s.))</td>
<td></td>
<td>4.5</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Resolution (p/rev)</td>
<td></td>
<td>409600</td>
<td></td>
<td>614400</td>
<td></td>
</tr>
<tr>
<td>Positioning accuracy (sec)</td>
<td></td>
<td>300</td>
<td></td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Repeatability (sec)</td>
<td></td>
<td>±3.2</td>
<td></td>
<td>±2.1</td>
<td></td>
</tr>
<tr>
<td>AC200V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 These values assume that the Motor is mounted on a rigid base.

SI unit system

1N = 0.102 kgf = 0.225lb
1N·m = 0.102 kgf·m = 0.738 ft·lb
How to calculate axial and moment load

(Caution) : Do not apply excessive load to the Motor. An excessive load more than specified in Table 3-2 may result in premature Motor failure.

Followings show how to calculate the loads.

Figure 3-15

If $F$ is an external force, then
- Axial load $F_a = F + \text{weight of payload}$
- Moment load $M = 0$

If $F$ is an external force, then
- Axial load $F_a = F + \text{weight of payload}$
- Moment load $M = F \times L$

If $F$ is an external force, then
- Axial load $F_a = \text{weight of payload}$
- Moment load $M = F \times (L + A)$

<table>
<thead>
<tr>
<th>Motor reference number</th>
<th>JS0002FN001</th>
<th>JS1003FN001</th>
<th>JS2006FN001</th>
<th>YS2014FN001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension A (mm)</td>
<td>31</td>
<td>32</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>
3.1.2.3. Dimensions

Figure 3-16: M-JS0002FN001

- 3-M2 small panhead screws
- PCD20 (120° equal pitch)
- Rotor side

- 4-M4x0.7x6
- PCD68 (90° equal pitch)
- Rotor side

- 104-M4
- PCD68 (90° equal pitch)
- Rotor side

- 3-M2 small panhead screws
- PCD22 (90° equal pitch)
- Fix side

- 4-M4x0.7x6
- PCD42 (60° equal pitch)
- Fix side

Unit: mm

Figure 3-17: M-JS1003FN001

- 3-M2 small panhead screws
- PCD40 (120° equal pitch)
- Rotor side

- 4-M4x0.7x6
- PCD94 (60° equal pitch)
- Rotor side

- 104-M4
- PCD92.5
- Rotor side

- 3-M2 small panhead screws
- PCD42 (60° equal pitch)
- Fix side

- 4-M4x0.7x6
- PCD42 (60° equal pitch)
- Fix side

Unit: mm
Figure 3-18: M-JS2006FN001

3-M2 small panhead screws
PCD44.5 (120° equal pitch)

6-M5×0.8×8
PCD115 (60° equal pitch)
(Rotor side)

6-M5 small panhead screws
PCD44.5
(Fix side)

Connector (JST Corp. ELR-15V)

Unit : mm

Figure 3-19: M-JS2014FN001

3-M2 small panhead screws
PCD44.5 (120° equal pitch)

6-M5×0.8×8
PCD115 (60° equal pitch)
(Rotor side)

5-M3 small panhead screws
PCD115.8

Connector (JST Corp. ELR-15V)

Unit : mm
3.2. Driver Unit

3.2.1. Name of Parts

Figure 3-20

Brackets can be removed to this position.

Brackets can be removed to this position.

1. 7 segments LED (7 seg)
2. CN1 (9 pins) : RS-232C serial communication connector
3. CN2 (25 pins) : Control Input/Output signal connector (I/O-1)
4. CN3 : Resolver cable connector
5. Serial number plate
6. Reference number plate
7. Terminal block for power supply
8. Fuse 1 and 2
9. CN4 : Motor cable connector
10. Analog monitor pins
11. CN5 (37 pins) : Control Input/Output signal connector (I/O-2)
12. Analog monitor terminal
13. Adjusting pod of analog input offset (VR1)
3.2.2. General Specification

Control mode

- Closed loop, P·PI position control

Operation mode

- Pulse train position command
- RS-232C serial communication command
- Programmable control
- Return Home operation
- Jog

Power supply capacity

(1) AC200V/220V ± 10%

Table 3-5: Power supply capacity

<table>
<thead>
<tr>
<th>Driver Unit Reference No.</th>
<th>Main power Max. (exclude surge current)</th>
<th>Control power Max. (exclude surge current)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-ESA-Y2005A25</td>
<td>0.5 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y2020A25</td>
<td>1.0 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y3008A25</td>
<td>0.6 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y3040A25</td>
<td>1.2 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y4080A25</td>
<td>1.4 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y5120A25</td>
<td>1.5 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y5240A25</td>
<td>2.0 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-J0002A25</td>
<td>0.7 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-J1003A25</td>
<td>0.7 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-J2006A25</td>
<td>0.9 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-J2014A25</td>
<td>1.0 kVA</td>
<td></td>
</tr>
</tbody>
</table>

50 VA

* For the power supply capacity of RS and SS series motors, refer to their specification document.

Table 3-6: Surge and leakage current

<table>
<thead>
<tr>
<th>Surge current</th>
<th>Control power</th>
<th>Main power</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14A</td>
<td>140A</td>
</tr>
<tr>
<td>Leakage current</td>
<td>5 mA r.m.s</td>
<td>50 VA</td>
</tr>
<tr>
<td>(~1 MHz)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(2) AC100V/110V ± 10%

Table 3-7: Power supply capacity

<table>
<thead>
<tr>
<th>Driver Unit Reference No.</th>
<th>Main power Max. (exclude surge current)</th>
<th>Control power Max. (exclude surge current)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-ESA-Y2005C25</td>
<td>0.3 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y2020C25</td>
<td>0.7 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y3008C25</td>
<td>0.3 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y3040C25</td>
<td>0.9 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y4080C25</td>
<td>1.0 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-Y5120C25</td>
<td>1.0 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-J0002C25</td>
<td>0.4 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-J1003C25</td>
<td>0.4 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-J2006C25</td>
<td>0.7 kVA</td>
<td></td>
</tr>
<tr>
<td>M-ESA-J2014C25</td>
<td>0.7 kVA</td>
<td></td>
</tr>
</tbody>
</table>

50 VA

* For the power supply capacity of RS and SS series motors, refer to their specification document.

Table 3-8: Surge and leakage current

<table>
<thead>
<tr>
<th>Surge current</th>
<th>Control power</th>
<th>Main power</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7A</td>
<td>80A</td>
</tr>
<tr>
<td>Leakage current</td>
<td>3 mA r.m.s</td>
<td>20 mA r.m.s</td>
</tr>
<tr>
<td>(~1 MHz)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Environmental specification

Table 3-9

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration resistance</td>
<td>0.5 G</td>
</tr>
<tr>
<td>Line noise resistance</td>
<td>1500V 1 μS (by noise simulator)</td>
</tr>
<tr>
<td>Mass</td>
<td>2.5 kg</td>
</tr>
<tr>
<td>Environmental condition</td>
<td>In operation: Temperature: 0 ~ 50°C   Humidity: 20 ~ 90 % (no condensation)</td>
</tr>
<tr>
<td></td>
<td>In storage: Temperature: -20 ~ 70°C indoor condition</td>
</tr>
</tbody>
</table>

### 3.2.3. Functional Specification

- **Control mode can be selected by the parameter SL.**
  - SL1: Torque control mode
  - SL2: Velocity control mode
  - SL3: Position control mode

- **Position control mode**
  - RS-232C serial communication command
  - Programmable control (internal programmable indexer)
    - Maximum 64 channels
  - Pulse train input operation
    - CW/CCW or
    - Pulses/direction or
    - Phase A·Phase B
  - Jog operation
  - Home Return operation

- **Velocity control mode**
  - RS-232C serial communication
  - Analog ±10V

- **Torque control mode**
  - RS-232C serial communication
  - Analog ±10V

- **Position detector resolution (Resolver)**

Table 3-10

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Resolver resolution</th>
<th>Automatic resolution switching or 12-bit setting</th>
<th>10-bit setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS, JS1, JS2, RS</td>
<td>614400 pulses/rev.</td>
<td>153600 pulses/rev.</td>
<td></td>
</tr>
<tr>
<td>AS, BS, JS0</td>
<td>409600 pulses/rev.</td>
<td>102400 pulses/rev.</td>
<td></td>
</tr>
</tbody>
</table>
Maximum velocity

Table 3-11

<table>
<thead>
<tr>
<th>Resolver resolution</th>
<th>12 bit setting</th>
<th>Automatic resolution switching or 10 bit setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS, JS1, JS2, RS</td>
<td>1 r.p.s.</td>
<td>3 r.p.s.</td>
</tr>
<tr>
<td>SS</td>
<td>1.25 r.p.s.</td>
<td>3.75 r.p.s.</td>
</tr>
<tr>
<td>AS, BS, JS0</td>
<td>1.5 r.p.s.</td>
<td>4.5 r.p.s.</td>
</tr>
</tbody>
</table>

Encoder output signal: \( \varphi A \), \( \varphi B \) and \( \varphi Z \) (MSB)

- Signal output format:
  - \( \varphi A \), \( \varphi B \) : Line driver
  - \( \varphi Z \) (MSB) : Line driver/ Open corrector selectable (It can be switched by a jumper pin 1.)

Table 3-12: Resolution

<table>
<thead>
<tr>
<th>Resolver resolution</th>
<th>( \varphi A, \varphi B )</th>
<th>( \varphi Z ) (MSB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor type</td>
<td>12-bit setting</td>
<td>10-bit setting</td>
</tr>
<tr>
<td>YS, JS1, JS2, RS</td>
<td>153600 pulses/rev.</td>
<td>38400 pulses/rev.</td>
</tr>
<tr>
<td>SS</td>
<td>122880 pulses/rev.</td>
<td>30720 pulses/rev.</td>
</tr>
<tr>
<td>AS, BS, JS0</td>
<td>102400 pulses/rev.</td>
<td>21600 pulses/rev.</td>
</tr>
</tbody>
</table>

Control I/O signal

- Input signals: Emergency stop, Servo on, Home position limit, Run move, Programmable indexer channel switching (max. 64 channels) Jog and Overtravel limit
- Output signals: Driver Unit ready, In position and Brake*1
  - *1: The brake output signal is for controlling the brake. It cannot be used to supply power to an electromagnetic brake.

Alarms

- Excess position error, Software thermal over, Travel limit over, Controller error, Resolver error, Motor over current, Power amplifier overheating, Main power voltage abnormal and Control power low voltage

Monitor output

- Analog monitor, Analog velocity and RS-232C communication monitor
  - Current position, Alarm state, Servo parameters, etc.

Communication


Data back up

- Backed up by EEPROM
- 100000 times for resetting/deleting parameters
3.2.4. Jumper

- Jumper (JP1) is for selecting output format of øZ position feedback signal.

- Jumper is inside of the Driver Unit. When setting Jumper, remove the side cover of the Driver Unit. Follow the procedure in Appendix 4: How to replace ESA25 Driver Unit.

- Figure 3-14 indicates the Jumper location.

![Diagram of Jumper location]

Table 3-13: Jumper setting.

<table>
<thead>
<tr>
<th>Setting</th>
<th>øZ output format</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD-Out short</td>
<td>Line driver (Shipping set)</td>
</tr>
<tr>
<td>OC-Out short</td>
<td>Open collector</td>
</tr>
</tbody>
</table>
3.2.5. Dimensions

Figure 3-22

Bracket can be removed to here.

Bracket can be removed to here.

Bracket

Heat sink

Unit: mm
3.3. Cable Set

- This section shows Cable Set for YS and JS series Motor.
- Refer to respective specification for SS and RS series Motor.
- For reference number and cable length, see “2.3. Standard Combination.”

3.3.1. Cable Set for YS Motor

Figure 3-23

3.3.2. Cable Set for YS Motor with Brake

Figure 3-24
3.3.3. Cable Set for JS Motor

Figure 3-25

Unit: mm

Connector (JST Corp., MLP-15V)  To Motor

Resolver Cable

Motor Cable

Connector Shell (JAE, DA-C1-J10)

Connector (JAE, DA-15P-N)

CN3  To ESA25 Driver Unit Connector

CN4  To ESA25 Driver Unit Connector

Connector (AMP, 172495-1)
3.4. Handy Terminal

- FHT11 Handy Terminal is an easy to use handheld terminal with an RS-232C communication interface for Megatorque Motor System Driver Unit. FHT11 terminal connects directly to the CN1 connector on the ESA25 Driver Unit.

3.4.1. Name of Parts and Dimensions

Figure 3-26

Note:
(1) **SHIFT**: Press the code key while holding “SHIFT” key. (Small characters)

(2) **BS**: When correcting logged-in mistakes, press “BS” key.

(3) **SP**: Press “SP” key to have space between characters.

(4) **ENT**: Press “ENT” key at the end of the command or the parameter setting.
### 3.4.2. Specification

**Table 3-14**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power source voltage</td>
<td>DC 5V ±5%</td>
</tr>
<tr>
<td>Power consumption</td>
<td>200 mW</td>
</tr>
<tr>
<td>Environment</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>Operating : 0~50°C</td>
</tr>
<tr>
<td></td>
<td>Storage : -10~+65°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>35~85% (Non condensing)</td>
</tr>
<tr>
<td>RS-232C Interface</td>
<td></td>
</tr>
<tr>
<td>Data code</td>
<td>ASCII code</td>
</tr>
<tr>
<td>Communication speed</td>
<td>9600 b.p.s</td>
</tr>
<tr>
<td>Data bit</td>
<td>8 bit</td>
</tr>
<tr>
<td>Stop bit</td>
<td>2 bit</td>
</tr>
<tr>
<td>Start bit</td>
<td>1 bit</td>
</tr>
<tr>
<td>Parity check</td>
<td>None</td>
</tr>
<tr>
<td>Mass</td>
<td>250g (exclude cable)</td>
</tr>
</tbody>
</table>
4. Connector Specification

4.1. CN1: RS-232C Serial Communication Connector

- NSK’s Handy Terminal FHT11 (sold separately) can be used as an RS-232C terminal.

| Table 4-1 |
|------------------|------------------|-------------------|
| **Driver Unit connector** | **Mating connector type** (user device side) | **Mating connector shell type** (user device side) |
| Japan Aviation Electronics Industry, Limited DBLC-J9SAF-13L6 | Japan Aviation Electronics Industry, Limited DE-9P-N (to be prepared by the user)* | Japan Aviation Electronics Industry, Limited DE-C2-J6 (to be prepared by the user)* |

* These connectors are not necessary if NSK Handy Terminal FHT11 is used.

4.1.1. CN1 Pin-Out

![Figure 4-1: CN1 Pin-out](image)

4.1.2. CN1 Signal List

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Name</th>
<th>I/O</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TXD</td>
<td>Output</td>
<td>Transmit data</td>
</tr>
<tr>
<td>2</td>
<td>CTS</td>
<td>Input</td>
<td>Clear to send</td>
</tr>
<tr>
<td>3</td>
<td>RXD</td>
<td>Input</td>
<td>Receive data</td>
</tr>
<tr>
<td>4</td>
<td>DSR</td>
<td>Input</td>
<td>Data set ready</td>
</tr>
<tr>
<td>5</td>
<td>DTR</td>
<td>Output</td>
<td>Data terminal ready</td>
</tr>
<tr>
<td>6</td>
<td>SG</td>
<td>–</td>
<td>Digital signal ground</td>
</tr>
<tr>
<td>7</td>
<td>RTS</td>
<td>Output</td>
<td>Ready to send</td>
</tr>
<tr>
<td>8</td>
<td>+5V</td>
<td>Output</td>
<td>Never connect</td>
</tr>
<tr>
<td>9</td>
<td>FG</td>
<td>–</td>
<td>Frame ground (shield)</td>
</tr>
</tbody>
</table>
4.1.3. Sample Wiring Diagram

- Connect the ESA25 Driver Unit with the controller (e.g., personal computer) in accordance with its RS-232C control signal specification.

** RTS Control / CTS Monitoring Active (standard wiring) **

*Figure 4-2*

![Diagram of RTS Control / CTS Monitoring Active](image)

** RTS Control / CTS Monitoring Inactive **

*Important*: When wired as shown below, always confirm the echo-back from Driver Unit or send the data slowly. With this wiring, Driver Unit may not accept the whole data when data is sent at high speed and large amount.

*Figure 4-3*

![Diagram of RTS Control / CTS Monitoring Inactive](image)
4.2. CN2, CN5: Control I/O Signal Connectors

- Table 4-3 shows connector types of CN2 and CN5.

<table>
<thead>
<tr>
<th>Driver Unit side connector</th>
<th>CN2</th>
<th>CN5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan Aviation Electronics Ltd.</td>
<td>DBLC-J25SAF-13L6</td>
<td>DCLC-J37SAF-13L9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mating connector (user device side)</th>
<th>CN2</th>
<th>CN5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan Aviation Electronics Ltd.</td>
<td>DB-25P-N '1'</td>
<td>DC-37P-N '1'</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mating connector shell type</th>
<th>CN2</th>
<th>CN5</th>
</tr>
</thead>
<tbody>
<tr>
<td>(user device side)</td>
<td>Japan Aviation Electronics Ltd.</td>
<td>DC-C2-J9 '1'</td>
</tr>
</tbody>
</table>

* '1: Provided with Driver Unit

- Wiring precautions for CN2 and CN5 connectors are described below.
  1. Use shielded cable for CN2 and CN5 connectors and a twisted pair cables must be used for the pulse train input and position feed back signals.
  2. These cables should be laid in an independent duct separate from the power line.
  3. Connect one end of the cable shield to the frame ground.

(Caution): Check for wiring mistake of external power supply polarity and shorting between connector pins.

4.2.1. Pin- Out (CN2, CN5)

Figure 4-4

![Diagram of CN2 and CN5 pin-out connections]
4.2.2. Signal Name and Function (CN2, CN5)

Table 4-4: CN2

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Name</th>
<th>I/O</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COM</td>
<td>Output</td>
<td>Output COMMON</td>
</tr>
<tr>
<td>2</td>
<td>DRDY–</td>
<td>Output</td>
<td>Driver Unit ready (–)</td>
</tr>
<tr>
<td>3</td>
<td>BRK</td>
<td>Output</td>
<td>Brake control signal (normally closed)</td>
</tr>
<tr>
<td>4</td>
<td>CHZ*</td>
<td>Output</td>
<td>Position feedback øZ/digital position data MSB*</td>
</tr>
<tr>
<td>5</td>
<td>CHB</td>
<td>Output</td>
<td>Position feedback øB</td>
</tr>
<tr>
<td>6</td>
<td>CHA</td>
<td>Output</td>
<td>Position feedback øA</td>
</tr>
<tr>
<td>7</td>
<td>CCWP+</td>
<td>Input</td>
<td>Counter clockwise pulse (+)</td>
</tr>
<tr>
<td>8</td>
<td>CWP+</td>
<td>Input</td>
<td>Clockwise pulse (+)</td>
</tr>
<tr>
<td>9</td>
<td>OTP</td>
<td>Input</td>
<td>+ direction overtravel limit switch (CW direction)</td>
</tr>
<tr>
<td>10</td>
<td>CLR</td>
<td>Input</td>
<td>Clear</td>
</tr>
<tr>
<td>11</td>
<td>HLS</td>
<td>Input</td>
<td>Home limit switch</td>
</tr>
<tr>
<td>12</td>
<td>EMST</td>
<td>Input</td>
<td>Emergency stop</td>
</tr>
<tr>
<td>13</td>
<td>DC24</td>
<td>Input</td>
<td>24 VDC external supply</td>
</tr>
<tr>
<td>14</td>
<td>IPOS</td>
<td>Output</td>
<td>In-position</td>
</tr>
<tr>
<td>15</td>
<td>DRDY+</td>
<td>Output</td>
<td>Driver Unit ready (+)</td>
</tr>
<tr>
<td>16</td>
<td>SGND</td>
<td>—</td>
<td>Signal ground</td>
</tr>
<tr>
<td>17</td>
<td>CHZ*</td>
<td>Output</td>
<td>Position feedback øZ/digital position data MSB*</td>
</tr>
<tr>
<td>18</td>
<td>CHB</td>
<td>Output</td>
<td>Position feedback øB</td>
</tr>
<tr>
<td>19</td>
<td>CHA</td>
<td>Output</td>
<td>Position feedback øA</td>
</tr>
<tr>
<td>20</td>
<td>CCWP–</td>
<td>Input</td>
<td>Counter clockwise pulse (–)</td>
</tr>
<tr>
<td>21</td>
<td>CWP–</td>
<td>Input</td>
<td>Clockwise pulse (–)</td>
</tr>
<tr>
<td>22</td>
<td>OTM</td>
<td>Input</td>
<td>– direction overtravel limit switch (CCW direction)</td>
</tr>
<tr>
<td>23</td>
<td>HOS</td>
<td>Input</td>
<td>Home return start</td>
</tr>
<tr>
<td>24</td>
<td>IOFF</td>
<td>Input</td>
<td>Integration off</td>
</tr>
<tr>
<td>25</td>
<td>SVON</td>
<td>Input</td>
<td>Servo-on</td>
</tr>
</tbody>
</table>

* The parameter FZ (RS-232C communication interface) is used to select between the position feedback signal ø Z and the digital position signal Ø MSB.
Table 4-5: CN5

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Name</th>
<th>I/O</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COM</td>
<td>Output</td>
<td>Output COMMON</td>
</tr>
<tr>
<td>2</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>3</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>4</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>5</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>6</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>7</td>
<td>AIN-</td>
<td>Input</td>
<td>Analog command (-)</td>
</tr>
<tr>
<td>8</td>
<td>AIN+</td>
<td>Input</td>
<td>Analog command (+)</td>
</tr>
<tr>
<td>9</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>10</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>11</td>
<td>PRG0</td>
<td>Input</td>
<td>Internal program channel selection bit 0</td>
</tr>
<tr>
<td>12</td>
<td>PRG1</td>
<td>Input</td>
<td>Internal program channel selection bit 1</td>
</tr>
<tr>
<td>13</td>
<td>PRG2</td>
<td>Input</td>
<td>Internal program channel selection bit 2</td>
</tr>
<tr>
<td>14</td>
<td>PRG3</td>
<td>Input</td>
<td>Internal program channel selection bit 3</td>
</tr>
<tr>
<td>15</td>
<td>PRG4</td>
<td>Input</td>
<td>Internal program channel selection bit 4</td>
</tr>
<tr>
<td>16</td>
<td>PRG5</td>
<td>Input</td>
<td>Internal program channel selection bit 5</td>
</tr>
<tr>
<td>17</td>
<td>RUN</td>
<td>Input</td>
<td>Start internally programmed operation</td>
</tr>
<tr>
<td>18</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>19</td>
<td>DC24</td>
<td>Input</td>
<td>DC 24V external power supply</td>
</tr>
<tr>
<td>20</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>21</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>22</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>23</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>24</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>25</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>26</td>
<td>MON-</td>
<td>Output</td>
<td>Analog monitor output (-)</td>
</tr>
<tr>
<td>27</td>
<td>MON+</td>
<td>Output</td>
<td>Analog monitor output (+)</td>
</tr>
<tr>
<td>28</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>29</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>30</td>
<td>JOG</td>
<td>Input</td>
<td>Jogging</td>
</tr>
<tr>
<td>31</td>
<td>DIR</td>
<td>Input</td>
<td>Jog direction</td>
</tr>
<tr>
<td>32</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>33</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>34</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>35</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>36</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
<tr>
<td>37</td>
<td>—</td>
<td>—</td>
<td>Do not connect</td>
</tr>
</tbody>
</table>

(Caution) : For the Input / Output signals of special-order Driver Unit, refer to its special document.
4.2.3. Setting the Polarity (A or B contact) of the Input Ports

- The shipping set of polarity for all CN2 input signal ports is A contact.
- The polarity of some input signal ports can be changed to B contact in an ESA25 Driver Unit.
- The ports of which the polarity can be changed are only four signals below. The other ports are fixed to A contact.
  
  EMST : Emergency stop
  HLS : Home limit switch
  OTP : + direction overtravel limit switch (CW direction)
  OTM : - direction overtravel limit switch (CCW direction)

- The polarity can be changed with the parameter AB.
- The password input is necessary before inputting AB parameter.
- Table 4-6 shows the data and port. Refer to “Setting Example” below and the explanation of AB parameter.

<table>
<thead>
<tr>
<th>Table 4-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data digit</td>
</tr>
<tr>
<td>CN2 Pin No.</td>
</tr>
<tr>
<td>Signal name</td>
</tr>
</tbody>
</table>

- Explanation of data
  
  0 = A contact (normally open)
  1 = B contact (normally closed)
  X = At the time of input : The port set to X does not change polarity.
  = At the time of read-out : For the port which is shown as “X”, the polarity can not be changed.
  (fixed to A contact)

Setting Example

(1) **SHIFT** 0 ?
Press the code key while holding down the **SHIFT** key.

(2) **A** **B** **ENT**
Input the command to read the setting of the AB parameter. Check the present polarity setting (in this example, all the input ports are set to A contact).

(3) **/** **N** **S** **K** **SP**
**O** **N** **ENT**
Input the password.
The password acknowledgment message appears on the display.

(4) **A** **B** **X** 1 # **X** **X**
**X** **X** **X** **X** **ENT**
The second bit following AB represents EMST. Set this bit to “1”, and the other bits to “X” (no change).

● Thus, the polarity of EMST input signal port has been changed to B contact.
4.2.4. Signal Specification

4.2.4.1. General Input

Applied Inputs: SVON, EMST, PRG0~5, RUN, HOS, HLS, JOG, DIR, OTP, OTM, CLR, IOFF

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>24 VDC ±10%</td>
</tr>
<tr>
<td>Input impedance</td>
<td>3.3 kΩ</td>
</tr>
<tr>
<td>Maximum current</td>
<td>10 mA (per input)</td>
</tr>
</tbody>
</table>

* The polarity of DC24V external supply may be reversed.

4.2.4.2. Pulse Train Input

Applied Inputs: CWP+, CWP-, CCWP+, CCWP-

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>5 VDC ±10%</td>
</tr>
<tr>
<td>Input impedance</td>
<td>240 Ω</td>
</tr>
<tr>
<td>Maximum current</td>
<td>25 mA</td>
</tr>
</tbody>
</table>

4.2.4.3. General Output

Applied Outputs: BRK, IPOS

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum load capacity</td>
<td>24 VDC/100 mA</td>
</tr>
<tr>
<td>Maximum saturated voltage</td>
<td>2 V or less</td>
</tr>
</tbody>
</table>
### 4.2.4.4. Alarm Output

**Applied Outputs: DRDY+, DRDY-**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum load capacity</td>
<td>24 VDC/100 mA</td>
</tr>
<tr>
<td>Maximum saturated voltage</td>
<td>2 V or less</td>
</tr>
</tbody>
</table>

#### Table 4-10

**Figure 4-8**

![Diagram](image)

#### 4.2.4.5. Position Feed Back


<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output format</td>
<td>Line driver (CHA, CHB, *CHA, *CHB)</td>
</tr>
<tr>
<td></td>
<td>Line driver or open collector (CHZ, *CHZ)</td>
</tr>
<tr>
<td></td>
<td>(Can be selected by Jumper 1. Refer to &quot;3.2.4. Jumper&quot;)</td>
</tr>
<tr>
<td>Output device</td>
<td>Texas Instruments SN75ALS192</td>
</tr>
<tr>
<td>Recommended Line Driver</td>
<td>Texas Instruments SN75ALS193 or AM26LS32 or equivalent</td>
</tr>
<tr>
<td>Maximum Line Receiver</td>
<td>100mA</td>
</tr>
<tr>
<td>Maximum collector voltage</td>
<td>24V</td>
</tr>
<tr>
<td>Saturated voltage</td>
<td>1V or less</td>
</tr>
</tbody>
</table>

**Table 4-11**

**Figure 4-9**

![Diagrams](image)
4.2.4.6. Analog Command Input

Applied Inputs: AIN+, AIN-

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. input voltage</td>
<td>± 10VDC</td>
</tr>
<tr>
<td>Input impedance</td>
<td>20 kΩ</td>
</tr>
<tr>
<td>Max. input current</td>
<td>0.5 mA</td>
</tr>
</tbody>
</table>

4.2.4.7. Analog Monitor Output

Applied Outputs: MON+, MON-

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output format</td>
<td>Op-amp</td>
</tr>
<tr>
<td>Max. input voltage</td>
<td>± 10V ±10%</td>
</tr>
<tr>
<td>Saturated voltage</td>
<td>4mA or less</td>
</tr>
</tbody>
</table>
## 4.2.5. Wiring Example (CN2, CN5)

### 4.2.5.1. Position Control Mode Wiring Example

**Caution:**
- When using an inductive switch (e.g., relay), be sure to insert a surge killer circuit.
- When the user installs sensors as the Home position limit switch, + direction overtravel limit and - direction overtravel limit switch, connect sensor output directory with the input port of the Driver Unit, not via the master controller.

<table>
<thead>
<tr>
<th>CN2</th>
<th>DC24V</th>
<th>SVON</th>
<th>EMST</th>
<th>HLS</th>
<th>IOFF</th>
<th>OTP</th>
<th>OTM</th>
<th>CLR</th>
<th>HOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>18</td>
<td>25</td>
<td>12</td>
<td>11</td>
<td>24</td>
<td>9</td>
<td>22</td>
<td>10</td>
<td>23</td>
</tr>
</tbody>
</table>

**DC24V**
- Servo-on
- Emergency stop
- Home limit switch
- Integration off
- + direction overtravel limit
- - direction overtravel limit
- Clear
- Home Return start

**DC5V**
- CW pulse train
- CCW pulse train

**Driver Unit ready**
- In-position
- Brake control signal

**Position feedback signal øA**
- Position feedback signal øB
- Position feedback signal øZ

**Signal ground**
- Polarity of DC24V external power may be reversed and used as "minus-common".

**Programmed operation start**
- Internal program selection bit 5
- Internal program selection bit 4
- Internal program selection bit 3
- Internal program selection bit 2
- Internal program selection bit 1
- Internal program selection bit 0
- Jog operation
- Jog direction select

**Polarity of DC24V external power may be reversed and used as "minus-common".**
Caution: When using an inductive switch (e.g. relay), be sure to install a surge killer circuit.

- When the user installs sensors as the + direction overtravel limit switch and - direction overtravel limit switch, connect sensor output directory with the input port of the Driver Unit, not via the master controller.
4.2.5.3. Wiring Example of YS Series Motor with Brake

- The brake built in the YS series motors with brake is an electromagnetic type of negative action (brake to be released when the coil is turned on, and to be applied when the coil is turned off), being a non-backlash type.

- It is designed to provide security in case of power interruption, or to supply holding rigidity when the Motor is stopping.

- Use a dedicated brake power supply because the brake is designed to operate on a power supply of overexcitation system switching between full-wave and half-wave. [full-wave rectifying during overexcitation, half-wave rectifying during holding (rated excitation).]

  ○ Reference number of the brake power supply: M-FZ063

<table>
<thead>
<tr>
<th>Table 4-14: Main specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power voltage</td>
</tr>
<tr>
<td>Output voltage/current</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Overexcitation time</td>
</tr>
<tr>
<td>Ambient temperature</td>
</tr>
</tbody>
</table>

**Figure 4-14: Terminal block wiring**

- For brake on/off, use contacts with a capacity of more than 10 times the inductive load current at 180 VDC.

- Do not short-circuit No.4 and No.5 terminals with power on.

- Be sure to use No.6 and No.7 terminals to turn on/off the brake.

- Never open/close No.6 and No.7 terminals with AC power applied.

<table>
<thead>
<tr>
<th>Table 4-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor size</td>
</tr>
<tr>
<td>YS2020</td>
</tr>
<tr>
<td>YS3040</td>
</tr>
<tr>
<td>YS4080</td>
</tr>
<tr>
<td>YS5120</td>
</tr>
</tbody>
</table>
- The brake signal must be controlled through the user's sequence.

Figure 4-15: Recommended sequence diagram

Table 4-16

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Brake type</th>
<th>Static friction torque (N·m)</th>
<th>Torsional rigidity (sec./N·m)</th>
<th>Brake releasing time (msec)</th>
<th>Brake engaging time (msec)</th>
<th>Capacity (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS2020</td>
<td>RNB2K</td>
<td>20</td>
<td>4.5</td>
<td>26</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>YS3040</td>
<td>RNB4K</td>
<td>40</td>
<td>4.9</td>
<td>62</td>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>YS4080</td>
<td>RNB8K</td>
<td>80</td>
<td>1.3</td>
<td>66</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>YS5120</td>
<td>RNB12K</td>
<td>120</td>
<td>1.9</td>
<td>78</td>
<td>9</td>
<td>33</td>
</tr>
</tbody>
</table>
Figure 4-16: Wiring example with brake

- Connect CN2 and CN5 wiring as required.
- Do not use the brake output signal as direct power supply to the magnetic brake.

Power supply unit for the magnetic brake.
M-FZ063

Driver Unit ready
brake output
In position
4.3. CN3: Resolver Cable Connector

- Since the resolver cable supplied with the Megatorque Motor System should always be used, you need only plug the resolver cable connector into CN3. Knowledge of the pin assignment or signal names is not necessary. This section is offered for reference.

(Caution): • Do not change the length of the cable.

- Do not use other connector between the Resolver cable and CN3.

(Danger): • Never connect pins not listed below.

- Insert the connector being careful of its orientation. Tighten the screws for fastening the connector so that it will not be loosened by shock.

- Never insert/remove the CN3 connector with the Driver Unit power turned on.

Table 4-17

| Driver Unit connector          | Japan Aviation Electronics Industry, Limited | DALC-J15SAF-13L9 |
| Mating connector type          | Japan Aviation Electronics Industry, Limited | DA-15P-N         |
| Mating connector shell type    | Japan Aviation Electronics Industry, Limited | DA-CI-110        |

4.3.1. CN3 Pin-out

(Figure 4-17: CN3 Pin-out)

4.3.2. CN3 Signal List

Table 4-18: CN3 Signal List

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>REA</td>
<td>Resolver signal phase A</td>
</tr>
<tr>
<td>7</td>
<td>REB</td>
<td>Resolver signal phase B</td>
</tr>
<tr>
<td>15</td>
<td>REC</td>
<td>Resolver signal phase C</td>
</tr>
<tr>
<td>4</td>
<td>COMMON</td>
<td>Common</td>
</tr>
<tr>
<td>10</td>
<td>FG</td>
<td>Frame ground</td>
</tr>
</tbody>
</table>
4.4. CN4: Motor Cable Connector

- Since the Motor cable supplied with the Megatorque Motor System should always be used, you need only plug the Motor cable connector into CN4. Knowledge of the pin assignment or signal name is not necessary. This section is offered for reference.

(Caution) :  • Do not change the cable length.

- Do not use other connector between the Motor cable and CN4.

(Danger) :  • Insert the connector being careful of its orientation. The connector is of a self-locking type. Insert the connector until it bottoms; otherwise, it will not lock.

- Never insert/remove the CN4 connector with the Driver Unit power turned on.

- A high voltage is applied to this connector after the power is turned on. Be very careful not to cause short-circuit.

<table>
<thead>
<tr>
<th>Table 4-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Unit connector</td>
</tr>
<tr>
<td>Mating connector type (user device side)</td>
</tr>
<tr>
<td>Mating connector shell type (user device side)</td>
</tr>
</tbody>
</table>

4.4.1. CN4 Pin-out

(Figure 4-18: CN4 Pin-out)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A+</td>
<td>Motor winding phase A (+)</td>
</tr>
<tr>
<td>2</td>
<td>A–</td>
<td>Motor winding phase A (–)</td>
</tr>
<tr>
<td>3</td>
<td>B+</td>
<td>Motor winding phase B (+)</td>
</tr>
<tr>
<td>4</td>
<td>B–</td>
<td>Motor winding phase B (–)</td>
</tr>
<tr>
<td>5</td>
<td>C+</td>
<td>Motor winding phase C (+)</td>
</tr>
<tr>
<td>6</td>
<td>C–</td>
<td>Motor winding phase C (–)</td>
</tr>
<tr>
<td>7</td>
<td>E</td>
<td>Motor grounding wire</td>
</tr>
</tbody>
</table>

4.4.2. CN4 Signal List

(Figure 4-20: Signal Name and Function)
4.5. TB: Terminal Block for Power Supply

4.5.1. Terminal List

<table>
<thead>
<tr>
<th>Terminal Label</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONT</td>
<td>Control power input</td>
</tr>
<tr>
<td>MAIN</td>
<td>Main power input</td>
</tr>
<tr>
<td>FGND</td>
<td>Frame ground</td>
</tr>
</tbody>
</table>

4.5.2. Wiring Diagram (TB)

*The following are labeled on the 100 VAC system.

**Caution:** Do not connect this terminal.

---

*Use the R-S terminals when connecting single phase 200 VAC. Surge current becomes larger when the R-T terminals are in use.*
Additional Notes

- When the power is turned on, an inrush current will occur because the capacitive load is connected to the power supply. If circuit breaker and fuse are affected by the inrush current, install the inrush current control circuit to the power supply circuit as shown in the figures below.

- The inrush current varies with the source impedance. When an inrush current is over 300A, the Driver Unit may be damaged. We recommend to install the circuit to protect the Driver Unit.

- When the power is turned on in the inrush current control circuit, the current is being charged initially to a capacitor of the Driver Unit through R1 and R2 resistors for 9 ~ 20 msec, which is required time to close the contact of magnetic switch, and thus, the inrush current is reduced.

- When a magnet switch CR1 is failed (failed to contact), the resistor R1 may overheat and result in a fire. We recommend to take the countermeasures by installing the thermal sensor circuit to turn main power off.

- Example of circuit to reduce inrush current

Figure 4-20

Resistor R1 • R2 : Cement resistor 15 ~ 20W 10Ω
or ceramic resistor (Koa Ltd. HPC5 or equivalent)
Magnetic switch CR1 : Contact point capacity 200V 20A or more
(SC-03 type or equivalent, recommended manufacturer; Fuji Electric)

- The optional “inrush current control circuit” is available. (Reference number M-FZ077)

[Checking Inrush Current]

Follow the instructions below to check the maximum inrush current.

1. Set the current probe to phase S of the Driver Unit power supply.
   (Response frequency of the monitor shall be 10 K Hz or more.)
2. Inrush current shall be checked at the timing of A or B of the voltage wave form between phase R and S of power supply.
3. The maximum current reading of phase R just after the power supply is turned on is the inrush current.

Figure 4-21

- When the dump resistor overheat alarm (Overheat 3: OH3) is detected, make sure to turn off the main power to protect the internal dump resistor from burning due to the defective Driver Unit or abnormal source voltage.
5. Unpacking, Installing, Wiring

5.1. Unpacking and Inspection

5.1.1. Unpacking

- Make sure that you have received following units.
  1. Megatorque Motor
  2. Driver Unit
  3. Cable Set (Motor Cable and Resolver Cable)
  4. Accessories
     - CN2 and CN5 control input/output signal connector
     - Fuse (2 sets)
     - These are packed with the Driver Unit.

- Inspect shipping containers for damage as an indication that the System might have been mishandled in transit.

- When unpacking the System, save all packing materials for reuse in the event that the System needs to be shipped or require service.

[Danger]: Inspect the Motor and the Driver Unit very closely for damage which might have occurred in shipment. The Driver Unit is particularly fragile and should be inspected for warped or bent sheet metal, broken standoffs, and loose or damage electric components.

- Rotate Motor’s rotor by hand, without AC power. The rotation should be smooth.

- If you suspect damage, do not apply power to the System, since this can cause immediate catastrophic damage to the Driver Unit. Furthermore, a damaged system could be a potential electric shock hazard. Notify the carrier immediately, and call your NSK representative.
5.1.2. Motor and Driver Unit Combination

(Caution) Make sure that the combination of Motor and Driver Unit conforms to your requirements.

Check and record the Motor and Driver Unit reference number and serial number.

- Standard Combination
  - The Motor series, size and maximum torque numbers in both Motor and Driver Unit reference number must be same.

- Special-order Combination
  - Refer to the respective specification document.

- Even when the Motor and Driver Unit are in an interchangeable combination, check reference number in same manner as Standard combination. If the combination is not interchangeable, serial numbers of Motor and Driver Unit must be same.

- A nameplate is attached to individual Motor and Driver Unit. Configuration of each plates are shown in Figure 5-1. Refer to “2.2. Reference Number Configuration” for the more details.

Figure 5-1

![Motor and Driver Unit Nameplate Configuration](image-url)
5.2. Installation

5.2.1. Motor

5.2.1.1. Motor Mounting

- The high acceleration/deceleration characteristic of a direct drive mechanism requires the system to have high mechanical rigidity. Therefore, it is essential to maximize rigidity of the Motor and the load system.

- The Motor will work best if all of the elements have a natural frequency between them of at least 100 Hz, and preferably more than 200 Hz.

**Warning**: Fully fasten all the mounting holes (mounting tap holes) of the Motor.

- Fasten a load using all of the tapped holes of the rotor.

- Eliminate play between the load and the rotor.

- Eliminate play in the mechanism as much as possible.

**Warning**: The flatness of the surface where the Motor is mounted affects Motor operation. Approximately less than 0.02 mm flatness is needed for smooth operation. When mounting, minimize the looseness between Motor and the mounting surface.

*Figure 5-2: Motor Mounting*
5.2.1.2. Load Inertia

- Generally, the load inertia is much bigger than the rotor inertia of the Motor. Table 5-1 shows the approximate inertia capacity of Motor. (Inertia is shown as J in kgm$^2$.)

**Table 5-1: Inertia capacity**

<table>
<thead>
<tr>
<th></th>
<th>High speed positioning</th>
<th>General use</th>
<th>Large inertia (Low speed positioning)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS2005</td>
<td>0.006 ~ 0.25</td>
<td>0.25 ~ 0.5</td>
<td>–</td>
</tr>
<tr>
<td>YS2020</td>
<td>0.025 ~ 1</td>
<td>1 ~ 2</td>
<td>–</td>
</tr>
<tr>
<td>YS3008</td>
<td>0.01 ~ 0.4</td>
<td>0.4 ~ 0.8</td>
<td>–</td>
</tr>
<tr>
<td>YS3040</td>
<td>0.05 ~ 2</td>
<td>2 ~ 4</td>
<td>–</td>
</tr>
<tr>
<td>YS4080</td>
<td>0.1 ~ 4</td>
<td>4 ~ 8</td>
<td>–</td>
</tr>
<tr>
<td>YS5120</td>
<td>0.15 ~ 6</td>
<td>6 ~ 12</td>
<td>12 ~ 30</td>
</tr>
<tr>
<td>YS5240</td>
<td>0.3 ~ 12</td>
<td>12 ~ 24</td>
<td>24 ~ 125</td>
</tr>
<tr>
<td>JS0002</td>
<td>0.003 ~ 0.1</td>
<td>0.1 ~ 0.2</td>
<td>–</td>
</tr>
<tr>
<td>JS1003</td>
<td>0.004 ~ 0.15</td>
<td>0.15 ~ 0.3</td>
<td>–</td>
</tr>
<tr>
<td>JS2006</td>
<td>0.008 ~ 0.3</td>
<td>0.3 ~ 0.6</td>
<td>–</td>
</tr>
<tr>
<td>JS2014</td>
<td>0.018 ~ 0.7</td>
<td>0.7 ~ 1.4</td>
<td>–</td>
</tr>
</tbody>
</table>

(Warning): Make sure that the actual moment load and thrust load are less than the allowable load capacity. Refer to YS and JS Motor specifications.
5.2.2. Driver Unit Mounting

(Caution) : Cooling the Driver Unit relies on natural convection. For proper air circulation, clearance is required above and below the Unit (see Figure 5-3).

- Clearance is not necessary in the back of the Unit.

(Caution) : When installing two or more Driver Unit for multi-axis combination, give a space approximately 10 cm between adjacent Driver Unit.

- When installing the Driver Unit in the control panel, keep the panel internal temperature from 0 °C to 50 °C. If the heat sink over-heat alarm arises frequently, cool the heat sink using a fan etc.

- ESA25 Driver Unit has a bracket for easy fixing to the control panel or enclosure.

Figure 5-3

- Maximum power dissipation of ESA25 Driver Unit is 100W.
5.3. Wiring

5.3.1. Connecting Motor and Driver Unit

**Caution**: Do not make the Cable Set length longer or shorter. Changing cable length may worsen Motor and Driver Unit performances, typically resolver and resolver repeatability. When changing the length, the Motor and the Driver Unit must be returned to the manufacturer. Contact your local NSK representative.

**Caution**: Do not place the power lines (AC power supply and Motor cable) and the signal lines (CN2 and Resolver cable) in close proximity. Do not tie wrap them and not put in the same duct.

Figure 5-4: YS Motor

Figure 5-5: JS Motor
5.3.2. Connecting Power

- Refer to “4.5. TB: Terminal Block of Power Supply.”
- Use 2.0 mm² or larger wire with heat-proof vinyl for power line.
- Do not place the main power AC line supplies and signal wires in close proximity. Do not tie wrap them and not to put in a same duct.
- The noise filter and the isolation transformer must be installed between main power supply and the Driver Unit for the protection from electrical noise.

<table>
<thead>
<tr>
<th>Table 5-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Unit AC Line</td>
</tr>
<tr>
<td>220VAC, 3ø</td>
</tr>
<tr>
<td>220VAC, 1ø</td>
</tr>
<tr>
<td>110VAC, 1ø</td>
</tr>
<tr>
<td>Control Power</td>
</tr>
</tbody>
</table>

- The primary and secondary wires of a noise filter and an isolation transformer must not be in close proximity. Do not put them in a same duct.
- The Driver Unit and the noise filters must be close to each other and wiring must be of minimal length. Do not insert contacts like a magnetic switch and relay between them as much as possible.
- Install a surge killer circuit for magnetic switches, relays and solenoids.
- When the main power is turned on, an inrush current to the circuit will arise due to the capacitive load connected to the main power supply circuit. Use contacts, like a magnetic switch and a relay, which have a enough capacity shown in Table 5-3 and Table 5-4.

<table>
<thead>
<tr>
<th>Table 5-3: Contact requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contacts</td>
</tr>
<tr>
<td>No-Fuse Breaker</td>
</tr>
<tr>
<td>Short-Circuit Breaker</td>
</tr>
<tr>
<td>Magnetic Switch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5-4: Inrush-current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
</tr>
<tr>
<td>AC100v</td>
</tr>
<tr>
<td>Control Power</td>
</tr>
<tr>
<td>Main Power</td>
</tr>
</tbody>
</table>

(Caution) • Use the R-S terminals when connecting single-phase 200 VAC for the main power supply. Surge current becomes larger when the R-T terminals are in use.

- During wiring, be careful not to loose terminal block screws.
5.3.3. Connector Wiring

- Refer to “4. Connector Specification.”

5.3.4. Ground Connection and Wiring

- For grounding Driver Unit, use heavy gage cable as possible, such as a flat braided copper cable or a wire 3.5mm² (AWG 10) or larger.

**Warning**: All the ground lines must be connected at one point and the line resistance must be under or equal to 100Ω.

**Caution**:
- Connect the shield of the signal shielded cable (CN2) to the FG terminals (or SG terminals) of the user’s controller. If runaways are caused by noise, connect the shield to the FG terminal of the Driver Unit.

- If the Motor is isolated from the mother machine, then ground the Motor separately.

- Figure 5-6 shows the wiring example. (This is provided as an example, not the instruction.)

*Figure 5-6: Ground wiring example*
5.4. Turning on Power

5.4.1. Precautions

(Caution) : Before turning on the main power, check the following.

1. Wiring of connectors
2. Connecting Cable of Motor and Driver unit.
3. Safety
4. A wrong connection may damage the Driver Unit.

(Danger) : Always stay in a safe place.

(Warning) : Confirm that the Motor is securely fixed to the mounting base and the load is fixed to the Motor. Fully fasten all the mounting bolts.

(Danger) : If the Motor is fitted with an arm or a work, make sure that no obstacles are around in the operating area.

5.4.2. Turning Power on

(1) Turn on the power

(2) Make sure that the LED of the Driver Unit and the Handy Terminal display are indicating that the system is ready for operation.
   1. Normal state
      ○ Figure 5-7 shows the LED indicator in normal condition.

   Figure 5-7

   ① Abnormal

   Figure 5-8

   - Green LED: Illuminates when the power is turned on.
   - 7-segment LED display: Indicate the type of alarm.
     - The alarm is normally indicated by a 2-digit code. Two characters are displayed alternately at certain intervals.
     - When two or more alarms are detected, their codes are also indicated alternately at certain intervals.

   ○ Refer to “13. Alarms” for the description of alarms.

   ③ Handy Terminal display

   Figure 5-9: Handy Terminal display in normal state

   ○ If a message “NSK MEGA....” is displayed on the Handy Terminal, the system is ready for operation. A colon (:) indicates that a command be entered.
5.4.3. Servo On

(1) Turn main power on.

(2) Check DRDY output 2 seconds after the power is on.

(3) If the system is normal, input SVON signal.

(4) Then input necessary commands.
   ○ If an alarm is detected, refer to “13. Alarms” and take a proper remedy.

Figure 5-10: Power "ON" sequence

Caution: Turn on the main power supply first, then the SVON input, when turn off the main power supply, turn off SVON first. If the main power supply is turned off in the servo-on state, the Driver Unit outputs the AC Line under-voltage alarm. Once this alarm occurs it will not recover unless the power is turned on again.
6. Handy Terminal Communication

- Setting of various parameters, trial running, and adjustment are enabled by issuing commands to the Driver Units through NSK Handy Terminal FHT11. (i.e., communication through the RS-232C interface).

- The Driver Unit has CN1 as the Input/Output ports for RS-232C communication.

- FHT11 Terminal can be a daisy chain communication terminal. Refer to “8.3.4. Daisy Chain Communication” for details.

(Caution): Always turn off the Driver Unit when plugging on/off the CN1 connector.

- Turn off the Driver Unit, if it has been turned on.
- Connect FHT11 and the Driver Unit at connector CN1.
- The communication will automatically begin when you turn on the control power of the Driver Unit.

6.1. When Power is Turned on

- If the terminal (NSK Handy Terminal FHT11) is connected to CN1 and the Driver Unit power is turned on, the message shown below is displayed.

- The contents (and the number of characters) of this message may differ with Driver Unit setting and system versions.

- When the Driver Units are initialized, a colon (:) is displayed and the system waits for a command to be entered. The colon (:) is called a prompt. If the colon (:) is not displayed, press [ENT] key.

Figure 6-1: Power-On Message

| NSK MEGATORQUE | Slightly differs with system configurations. |
| MS1A00_XXXX | Indicates that internal initialization is completed and a command may be accepted. |
6.2. Command Entry

- Refer to “3.4. Handy Terminal” for the function of the keys.

- Communication command shall consist of “a command (character string) + data (if necessary) + [ENT]

- If the velocity gain is to be set to 0.5, for example, “VG0.5” should be entered by adding data of 0.5 to a VG command.

- Every time a character is input, the Driver Unit echoes the character back to the terminal. (The Driver Unit returns same character it receives.)

- When [ENT] code is input, the Driver Unit decodes a character string which it has received (VG0.5 in the example above) and executes it. Therefore, a command is not executed unless it ends with [ENT].

  **Caution**: When turn off the Driver Unit power, make sure that a colon (:) is displayed. If not, an alarm “Memory error” might be detected when you turn on the power next time.

6.2.1. Password

- Among the communication commands used for this System, some special commands (such as AB, PA, SL, etc.) require password entry for preventing erroneous entries. These commands cannot be entered in the same manner as other commands.

- The password is /NSK ON (a space between K and O) as shown below. If the Driver Unit accepts it, it returns an “NSK ON” message. Refer to “11. Command and Parameter” for details.

- A command requiring password entry may only be executed immediately after the password is entered.

  **Figure 6-2: Password Input**

<table>
<thead>
<tr>
<th>Entered password</th>
<th>Return message</th>
<th>Waiting for a command to be entered</th>
</tr>
</thead>
<tbody>
<tr>
<td>:/NSK ON</td>
<td>NSK ON</td>
<td>:—</td>
</tr>
</tbody>
</table>

Input (To Driver Unit)

/ N S K SP O N ENT
6.2.2. Canceling Command

- To cancel a command which has been entered halfway, enter a backspace code.
- For example, when the backspace code is input following VG0.5, the cursor moves one space back to the position where 5 was input and thereby deletes 5.

Figure 6-3: Cancelling Example

```
:VG0.5_  → Input BS Key →  :VG0._
```

6.2.3. Error

- Note that an error occurs in any of the following cases:
  1. If a nonexistent command (i.e., character string) is entered (If an entered character string cannot be decoded).
  2. If data or subscript out of the allowable range is entered.
  3. If a command requiring the password is entered without the password.
- In any of these cases, the entered character string with a ‘?’ mark is returned as an error message.

For example,

Figure 6-4: Input Error Example 1

```
:ABCDE
ABCDE?  :_
```

If ABCDE is entered, an error message is returned since this character string is not a command.
6.2.4. Entering Parameter

(1) When entering parameter, make sure that a colon (:) is displayed on the screen. (If the colon is not displayed, press the enter key once.)

(2) As an example, set the parameter “Move Velocity MV” (revolution speed) to 0.5 r.p.s. Enter the parameter as shown below.

\[
\begin{align*}
\text{M} & \quad \text{V} & \quad 0 \uparrow & \quad \cdot & \quad 5 \% & \quad \text{ENT}
\end{align*}
\]

The colon (:) appears to confirm the entry.

- As shown above, inputting “the parameter command + numeric value + ENT key” completes the parameter entry. (Entering the space key between the parameter and numeric values is not necessary.)

6.2.5. Entering Parameter Requiring Entry of Password

(1) When entering parameter, make sure that a colon (:) is displayed on the screen. (If the colon is not displayed, press the enter key once.)

(2) Enter the password referring to “6.2.1. Password.”

\[
\begin{align*}
\text{/} & \quad 
\text{N} & \quad 
\text{S} & \quad 
\text{K} & \quad 
\text{SP} & \quad 
\text{ON} & \quad \text{ENT}
\end{align*}
\]

The message confirming the entry of password is displayed and the colon (:) appears on the screen.

(3) Enter the parameter as described in “6.2.4. Entering Parameter” above. The parameter entry requiring password may only be executed immediately after the password is inputted.
6.3. Readout Command

- If a command for reading initial setting or current state is entered, the Driver Unit returns data.
- The following is an example for checking “Jog Velocity JV” set value.

6.3.1. “TS” Command for Reading Set Value

1. When entering the command, make sure that a colon (:) is displayed on the screen.
   (If the colon is not displayed, press the enter key once.)

2. Refer to “11. Command and Parameter TS”. “JV” command is in the group of TS7, input:
   :TS7
   MV1.00;
   MA1.00;
   JV0.10;
   MV1.00
   MA1.00;
   JV0.10;
   :_;
   :TS7
   MV1.00;
   MA1.00;
   JV0.10;
   :_;

When entering the command, make sure that a colon (:) is displayed on the screen.
(If the colon is not displayed, press the enter key once.)

3. Refer to “11. Command and Parameter TS”. “JV” command is in the group of TS7, input:
   :TS7
   MV1.00;
   MA1.00;
   JV0.10;
   The setting value of MV (Move Velocity) is displayed first.

4. Press the space key to scroll display to find out JV value.
   SP
   SP
   ...

5. To finish the read out, keep pressing the space key until display stops scrolling or press the back space key.
   BS
   MV1.00
   MA1.00;
   JV0.10;
   :_

6. The colon (:) is displayed to indicate the system is waiting for next command.
6.3.2. “?” Reading Function Command for Set Value

(1) When entering the command, make sure that a colon (:) is displayed on the screen.
(If the colon is not displayed, press the enter key once.)

(2) Enter “?” before inputting the command. In case of this example, input “JV” after “?”.

(3) The colon (:) is displayed to indicate the system is waiting for next command.

(Caution): When reading out set value, using TS command is recommended.

When using “?” command, make sure to input “?” command before parameter characters. If not, and pressing [ENT] key after the characters may change the set value.
7. Tuning and Trial Running

- Gain adjustment is necessary for the position control mode and the velocity control mode.
- In the torque control mode, the noise filter adjustment may be required.

7.1. Tuning Sequence

Figure 7-1: Tuning Sequence

Install Motor and wire Driver Unit.

\[\text{Caution:} \quad \bullet \text{Make sure that the LED of the Driver Unit is indicating } \square \text{ (normal).} \]
\[\bullet \text{Turn control power "ON" and confirm that Handy Terminal display shows the message as shown below.}\]

NSK MEGATORQUE
MS1A00_***
E*********
:_

Initialize servo parameters.

- Execution of automatic tuning.
  - Automatic estimation of load inertia and automatic servo-parameters setting will be executed in this stage.
- Trial running
  - Confirm the parameter set values obtained from automatic tuning. You may refer to the setting for Level 2 and Level 3 adjustment.

<table>
<thead>
<tr>
<th>Tuning Level 1</th>
<th>Tuning Level 2</th>
<th>Tuning Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic function of Automatic tuning.</td>
<td>Execute additional adjustment to the Level 1 when trial running is not satisfactory.</td>
<td>Execute final adjustment manually when Level 1 and 2 are not successful.</td>
</tr>
</tbody>
</table>

Make sure that the LED of the Driver Unit is indicating \(\square\) (normal).

Turn control power "ON" and confirm that Handy Terminal display shows the message as shown below.

Tuning Level 1

7.2.2. Initialize Servo Parameters

7.2.3. Execution of Automatic Tuning

7.2.4. Trial Running

- Operating OK
- YES
- NO

7.2.5. Minor Servo Gain Adjustment

- Operating OK
- YES
- NO

7.4. Setting Filters

- Operating OK
- YES
- NO

7.3. Manual Tuning

- Operating OK
- YES
- NO

End (Trial Running)
7.2. Automatic Tuning

(Caution) : Automatic tuning cannot be performed if the following conditions are not met.

- The load inertia must be under the limit of the Motor. (Refer to “3.1. Motor Specification”)
- The Motor axis must be vertical. (The load conditions to the Motor must not be affected by the gravity.)
- Mechanical rigidity of the Motor mounting base and attached load is sufficient enough.
- There must be no backlash or play caused by gears and couplings.
- Frictional load to the Motor shall be minimal.

7.2.1. Precautions

(Danger) : Wire “EMST” (Emergency Stop, CN2) signal to stop the Motor immediately when an accident is foreseen.

- If the Motor rotation range is restricted, set overtravel limits (OTP, OTM).

- The Motor rotates ±20° (degree) when executing automatic tuning. Always stay in safe position.

(Caution) : If mechanical rigidity of the load (work) is not sufficient enough, the Motor may vibrate. Turn “SVON” signal off or turn off the power when the Motor starts to vibrate. Execute manual tuning in chapter 7.3 or increase the rigidity of the load.

(Caution) : The automatic tuning is valid in the position control mode and the velocity control mode. It is not necessary for the torque control mode.
Figure 7-2: Wiring Diagram Example of Automatic Tuning Preparation

- CN1
- CN2
- CN3
- CN4
- TB
- Noise filter
- AC power
- DC24V (External power supply)
- Handy terminal (FHT11)
- Mounting base
- Motor
- Cable Set
- Work (Load inertia)
- Control power
- Main power
- FGND
- CONT.
- MAIN
- DC24 13
- SVON 25
- EMST 12
- OTP 9
- OTM 22
- : Over Travel Limit Sensor
7.2.2. Initialize Servo Parameters

(1) Turn off the servo-on (SVON, CN2) signal.

(2) Enter T S 1 # ENT and T S 2 $ ENT to check the parameter settings. Note down all values.

(3) Log in the password.

$/NSK ON
NSK ON
:_

Display indicates the confirmation.

(4) Log in SI (Set Initial Parameters) command.

$SI
INITIALIZE
:_

“INITIALIZE” is displayed as the confirmation, and the initializing parameter begins. It takes few seconds and a colon “:” is displayed for next command.

Caution: When “SVON” signal (CN2) is “ON” and “SI” command is input, Driver Unit rejects to execute the command. “SI INHIBITED” message will appear in the display.

Table 7-1: Servo Parameter List

<table>
<thead>
<tr>
<th>Parameter</th>
<th>TS1 Reading</th>
<th>TS2 Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial Setting</td>
<td>Set Value</td>
</tr>
<tr>
<td>PG</td>
<td>0.100</td>
<td>FO*</td>
</tr>
<tr>
<td>VG</td>
<td>1.0</td>
<td>FP</td>
</tr>
<tr>
<td>VI</td>
<td>1.00</td>
<td>FS</td>
</tr>
<tr>
<td>VM</td>
<td>1</td>
<td>NP</td>
</tr>
<tr>
<td>LG*</td>
<td>50</td>
<td>DBP*</td>
</tr>
<tr>
<td>TL*</td>
<td>100</td>
<td>ILV*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FF*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FC*</td>
</tr>
</tbody>
</table>

* These parameters are not necessary to adjust in Level 1 and 2 adjustment.
7.2.3. Execution of Automatic Tuning (Tuning Level 1)

Caution: Make sure the work (or Motor) does not hit any obstacle when the Motor makes a full turn. Always stay in safe position.

- The Motor needs to rotate at least ±20° when executing the automatic tuning. If the application restricts the Motor rotation, keep room for ±20° Motor rotation. The overtravel limits (OTP, OTM) must be used to restrict the Motor rotation range.

1. Turn SVON (CN2) signal “ON” and inputting “SV” command makes the Motor in servo-on states.

   ![SV](SV)

2. Confirm that Driver Unit’s “LED” is indicating “ ” for normal condition.

3. Input “Automatic Tuning” command.

   ![AT](AT)

   If a message is different from the display shown right, try procedures (1) and (2) again.

4. Confirm the message “AT ready OK” then input “OK”.

   ![OK](OK)

   The Motor rotates 10~20° back and forth to estimate the load inertia. When executing estimation, a dot ( . ) keeps appearing in the display till the Motor stops.

5. After the estimation of load inertia, the display indicates the inertia value “LO”.

   (Way of displaying “.”, and the value of LO differ with the condition of load inertia.)

Caution: When executing the automatic tuning, if an error message is “ON”, refer to “13. Alarm” and take a proper remedy. Driver Unit’s LED indicates “F8” for “AT” error in an example display shown right.
7.2.4. Trial Running (Tuning Level 1)

Danger: Confirm that the work (or Motor) does not hit any obstacle when the Motor makes a full turn. Always stay in safe position.

- For this adjustment, ESA25 Driver Unit’s demonstration program is used as an example. The program is originally set before it is shipped.

1. Turn SVON (CN2) signal “ON” and inputting “SV” command makes the Motor in servo-on states.

   ![SV](image)

2. Confirm that Driver Unit’s “LED” is indicating “ ” for normal condition.

3. Confirm an emergency stop (ESTM) and over travel limits (OTP, OTM) are “OFF”.

4. After the automatic tuning the rotational speed “MV” has been initialized to 1 rps. Change “MV” to 0.1 rps for trial running.

   ![MV0.1](image)

Note: After the adjustment, change “MV” to the actual use.

5. Display the demonstration program.

   ![SP/AJ](image)

   The message indicates the conditions of positioning and rotation angle.
   - IN: In-position, IS: In-position stability timer.
   - FW: FIN Width.
   - ID: Incremental Positioning, Degree.
   (Refer to “11. Command and Parameter”)

6. To make the adjustment simple, set IN “10” (pulse) and IS “50” (m sec).

   ![IS0.5](image)

   Check the display for confirmation.
(7) When rotational angle (ID) 9000 (90 degrees) is feasible, input “OK”.

The motor starts the cycles as soon as “OK” is logged in. (Firstly the Motor rotates clockwise (CW).)

For changing rotational angle (ID) while “?” prompt is displayed, input desired ID, then input “OK”.

[Example for rotational angle: 30° (degree)]

(8) When the trial running is completed, type

\[
\begin{array}{c}
\text{M} \quad \text{S} \quad \text{ENT}
\end{array}
\]

to stop the Motor.

- If the Motor is operating satisfactorily, complete the trial running.
- When the Motor operation is not stable, try further adjustment in chapter 7.2.5 and 7.3.
- If you want to get out from the demonstration program, press the enter key after “?”.
7.2.5. Servo Gain Minor Adjustment (Tuning Level 2)

**Danger**: Confirm that the work (or Motor) does not hit any obstacle when the Motor makes a full turn. Always stay in safe position.

- This section describes minor servo-gain adjustment as the next step when the Motor operation is not satisfactory with the automatic tuning.
- Servo-gain can be adjusted by the parameter “SG”.
  - Setting higher “SG” value improves response to the programmed motion profile. However, if “SG” is too high, the Motor starts to vibrate.
- The same demonstration program in chapter 7.2.4 is used as the example for adjusting “SG” value. (Execute same procedure (1) ~ (7) in chapter 7.2.4 and keep operate the Motor.)

1. Start “SG” adjusting program.

```
SG / AJ ENT
```

The message is displayed as shown below. Press plus (+) or minus (key) to change “SG” value. (The display shown below is an example. Those values shall be set to the conditions for actual use.)

**Explanation of the messages**

1. Key function
   - **SHIFT** and **+** : Pressing key one time increases 1 resolution of “SG”.
   - **-** : Pressing key one time decreases 1 resolution of “SG”.
   - **ENT** : Store “SG” value to the memory.

2. Indicates present “SG” value.
3. Indicates “SG” value changed by pressing plus (+) or minus (−) key.
4. Response index number: The lower numbers denotes better response.
5. Positioning index number: The lower number denotes quicker response.

Note: Do not use space key or back space key. When it is used, the “SG” changing resolution (3) may be altered.
(2) Observing the Motor operation, press the plus (+) key several times.

Pressing \( \text{SHIFT}, \quad (\_+ \_+) \ldots \)

As the response index decreases, the movement of the Motor is getting crisply.

(3) Keep pressing the plus (+) key, eventually the Motor starts hunting and stops.

Pressing \( \text{SHIFT}, \quad (+ +) \ldots \)

(4) Keep pressing the minus (–) key until the Motor stops hunting and starts moving.

\( (– +) \ldots \)

(5) Set “SG” value 80% of “SG” value at when the Motor stopped hunting. The Motor operates stable in any position.

(6) Type the enter key to complete the adjustment.

\( \text{ENT} \)
7.3. Manual Tuning

[**Danger**]: Confirm that the work (or Motor) does not hit any obstacle when the Motor makes a full turn. Always stay in safe position.

- Manual tuning is needed when the automatic tuning did not work.

7.3.1. Precautions

1. Initialize servo parameters. Follow procedures in “7.2.2. Initialize Servo Parameters”.

2. Execute the demonstration program referring to “7.2.4. Trial Running (Tuning Level 1)”. At the beginning, Motor operation is unstable due to insufficient tuning.

7.3.2. Adjustment of the Velocity Gain (VG)

(1) Start “VG” adjusting program.

![Diagram showing VG adjustment process]

- The display shows the message as shown on the left.

**Explanation of the messages**

1. **Key function**
   - **SHIFT** and **+** : Pressing key one time increases 1 resolution of “VG”.
   - **-** : Pressing key one time decreases 1 resolution of “VG”.
   - **ENT** : Store “VG” value in the memory and completes the adjustment.

2. Indicates present “VG” value.
3. Indicates “VG” value changed by pressing plus (+) or minus (−) key.
4. Response index number: The lower number denotes better response.
5. Positioning index number: The lower number denotes quicker positioning.

**Note**: Changing “VG” step (③).

If you want to change the resolution of step, press space key or back space key.

- **Space key**: Changes the step to 1/10 of present resolution.
  (Pressing twice makes 1/100.)

- **Back space key**: Changes the step to 10 times of present resolution.
  (Pressing twice makes 100 times.)
(2) Observing the Motor operation, press the plus (+) key several times.

Pressing \( \text{SHIFT} \), \( - + - + \) ..

As the response index decreases, the movement of the Motor is getting crisply.

(3) Keep pressing the plus (+) key, eventually the Motor starts hunting and stops.

Pressing \( \text{SHIFT} \), \( - + - + \) ..

(4) Keep pressing the minus (–) key until the Motor stops hunting and starts moving.

\( - + - + \) ..

(5) Set the “VG” value to 80% of displayed “VG” when a hunting is stopped.

\( 4 \times 0.8 = 3.2 \)

(6) Press the space key to change the resolution of “VG” setting value from 1.0 to 0.1.

\( \) SP \( \)

(7) Press the minus key till “VG” value reaches to 3.2.

\( - + - + \) ..

(8) Press the enter key to store the “VG” value.

\( \) ENT \( \)

A colon (:) will appear to confirm the input.
7.3.3. Adjustment of Velocity Integrator Frequency (VI)

- The adjustment of velocity integrator frequency (VI) shall be conducted after the velocity gain (VG) is adjusted.

(1) Start “VI” adjusting program.

```
  V  I  /  A  J  ENT
```

- The messages are shown on the left.
- Inputting the plus (+) or minus (–) key changes “VI” value
  (The “VI” value varies with an actual load inertia and revolution speed.)

- Explanation of the messages

  ① Key function
  - Pressing key one time increases 1 resolution of “VI”.
  - Pressing key one time decreases 1 resolution of “VI”.
  - Store “VI” value in the memory and completes the adjustment.

  ② Indicates present “VI” value.
  ③ Indicates “VI” value changed by pressing plus (+) or minus (–) key.
  ④ Response index number: The lower number denotes better response.
  ⑤ Positioning index number: The rower number denotes quicker positioning.

Note: Changing “VI” step (③).

If you want to change the resolution of step, press space key or back space key.

- Space key: Changes the step to 1/10 of present resolution.
  (Pressing twice makes 1/100.)
- Back space key: Changes the step to 10 times of present resolution.
  (Pressing twice makes 100 times.)
(2) Observing the Motor operation, press the plus (+) key several times.

Pressing `SHIFT` + `+` + `+` ···

As the response index decreases, the movement of the Motor is getting crisply.

(3) Keep pressing the plus (+) key, till the Motor starts hunting and stops.

Pressing `SHIFT` + `+` + `+` ···

(4) Keep pressing the minus (–) key until the Motor stops hunting and starts moving.

– + – + ···

(5) Set the “VI” value to 80% of displayed “VI” when a hunting us stopped.

\[ 4 \times 0.8 = 3.2 \]

Input the space key to change the resolution of “VI” setting value from 1.0 to 0.1.

(6) Press the minus key till “VI” value reaches to 3.2.

– + – + ···

(7) Input the enter key to store the “VI” value.

(8) A colon ( : ) will appear to confirm the input.
7.4. Setting Filters (Tuning Level 2)

- When positioning, the Motor may resonate mechanically and generate a noise of certain frequency. Using Megatorque Motor’s software “low-pass filters” (Parameter FP and FS), the noise level can be reduced. The unit of parameters of FP and FS is cycles / second (HZ).
  - If low frequency less than 100Hz is set to parameters “FP” and “FS”, hunting or unstable positioning may occur.

- Before using filters, make sure that all adjustments of gain (VG) and integrator frequency (VI) are completed.

- Use same demonstration program (SA/AJ) for adjusting filters. Follow the procedures (1) ~ (7) in “7.2.4. Trial Running (Tuning Level 1)”.

1. Start “FP” adjusting program.

   
   
   
   

   The message is displayed as shown below. Press plus (+) or minus (−) key to change “FP” value. (The display shown below is an example. Those values shall be set to the conditions for actual use.)

   

- Explanation of the messages

  ① Key function

  _ [SHIFT] _ and _ [+] _ : Pressing key one time increases 10 resolution of “FP”.

  _ [−] _ : Pressing key one time decreases 10 resolution of “FP”.

  _ [ENT] _ : Store “FP” value in the memory and completes the adjustment.

  ② Indicates present “FP” value.

  ③ Indicates “FP” value changed by pressing plus (+) or minus (−) key.

  ④ Response index number: The lower number denotes better response.

  ⑤ Positioning index number: The lower number denotes quicker positioning.

Note: Changing “FP” step (③).

If you want to change the resolution of step, press space key or back space key.

Space key : Changes the step to 1/10 of present resolution.

(Pressing twice makes 1/100.)

Back space key : Changes the step to 10 times of present resolution.

(Pressing twice makes 100 times.)
(2) Decrease low-pass filter frequency (FP) to lower noise level by typing minus (–) key several times.

\[ \text{[+], [-], [ENT]} \] 333 (222)
STEP10
_FP500

(3) If the Motor starts to work unstably, increase “FP” value by typing plus (+) key several times.

Pressing \[ \text{SHIFT} , \text{ [+], [-]} \] 233 (123)
STEP1
_FP120

(4) Type the enter key to complete the adjustment.

\[ \text{ENT} \]

Note: To deactivate the filter, input the filter command with “0” data. For example type as:

\[ \text{F P 0? ENT} \]

Note: Setting “Notch Filter”

- When setting notch filter, you can connect the oscilloscope to monitor pins on Driver Unit front panel to know the resonance frequency.

  - Example
    ① Check the resonance frequency as shown in Figure 7-3.
    ② If the resonance frequency is 200Hz, input
      \[ \text{N P 2$ 0? 0? ENT} \]
      to set notch filter frequency.
8. Operational Function

8.1. General Operation and Function

8.1.1. Servo “ON”

- After the Driver Unit power is turned on and its DRDY output circuit becomes closed, making SVON input ON should make motor servo-on.
- The position error counter will be cleared when SVON input is OFF.
- When SVON input is ON, the “MO” command results in servo–off.
- The “SV” or “MS” command will cancel this “MO” command effect.

![Figure 8-1](image)

- Take the following precaution when turning ON/OFF the main power supply and the control power supply separately:
  - When turning on the main power supply with the control power supply turned on: Turn on the main power supply first, then the SVON input.
  - When turning off the main power supply with the control power supply turned on: Turn off the SVON input first, then the main power supply.
* When the main power supply is turned off in the servo-on state, the Driver Unit outputs the AC Line under–voltage alarm. (Once this alarm occurs, it will not recover unless the power is turned on again.)

![Figure 8-2](image)
8.1.2. Emergency Stop

- Turning on the EMST input stops the position loop control function and stops the Motor in the servo-lock state* under velocity loop control.

- No motion commands will be accepted while EMST input is on.

- In the EMST state, the LED on the front panel indicates “F4”. The DRDY output remains unchanged (closed).

- The polarity of the EMST signal input port is set to A contact before shipment, but it can be changed to B contact (refer to the AB parameter).
  * Position loop control is not performed this time. If the possibility exists of an external force being applied to the Motor in this state, use a mechanical brake. When the SVON input is OFF after EMST input is ON, the Motor remains servo–on for one second after the EMST input went on. If the EMST input is ON when the SVON input off, motor will be servo–off.

Figure 8-3

The Driver Unit may not accept EMST input unless it stays on for 10 ms or longer.
8.1.3. Clearing Position Error Counter

- If the CLR input is on, position loop error will be cleared.
- When the excess position error alarm occurs, turning on the CLR input clears the position error counter and recovers from the alarm state.

* The Driver Unit detects the rising edge of the CLR input pulse and clears the position error counter to zero. Then, the counter continues its operation regardless of the state of the CLR input (even when it remains on).

![Figure 8-4](image)

- Software thermal and program error alarms can be cleared by inputting “CLR” on. (Other alarms cannot be cleared using “CLR”.)

8.1.4. Integration off (IOFF)

- Parameter VI (Velocity Integrator Frequency) will be invalidated when IOFF input is activated. Simultaneously, VG (Velocity Gain) will be lowered according to LG (Gain lowering coefficient) setting. \((VG \times LG)\)
- VI is validated when IOFF input is turned off.

![Figure 8-5](image)
8.1.5. Overtravel Limit Switch

8.1.5.1. Hardware Overtravel Limit Switch

- Use the OTP and OTM inputs to restrict the range of Motor rotation.

- If the OTP input is activated, the Motor motion will stop immediately and remain in servo–on. The Motor can be rotated counter clockwise only.

- If the OTM input is activated, the Motor motion will stop immediately and remain in servo–on. The Motor can be rotated clockwise only.

* The polarity of the OTP and OTM input ports is set to A contact before shipment. It can be changed to B contact (refer to the section on the AB parameter).

* Besides the OTP and OTM inputs, the Motor rotation can also be limited by software (software overtravel limit function) in the Driver Unit. Refer to “8.1.5.2. Software Overtravel Limit Switch”.

○ When the overtravel error occurs, the DRDY output will be open and LED on the front panel indicates the following alarms.

  OTA or OTM limit : F3
  Software overtravel limit : F2

![Diagram](image)

* When the OTP or OTM input works in the middle of Home Return operation, the Motor completes the Home Return operation after performing the following:

1) **When the Motor is turning CCW**

  ![Caution](image) : ● The OTP input is invalid (the Motor continues rotation).

  ● Turning on the OTM input makes the Motor decelerate, then rotate in reverse.

2) **When the Motor is turning CW**

  ![Caution](image) : ● Turning on the OTP input makes the Motor decelerate, then rotate in reverse.

  ● The OTM input is invalid (the Motor continues rotation).
Notes to be taken in overtravel limit setting

**Caution**: ① The overtravel area should be 1000 [pulses] or wider. When the overtravel area is too narrow the Motor may turn through the prohibited area.

② Set the overtravel limits with ample margin, giving consideration to the overshoot of the mechanism controlled by the Motor.

③ When the command to take the shortest route to destination is executed, the Motor takes the shortest rout regardless of the software overtravel limit setting.

- This function becomes valid after the Home position is determined by Home Return or AZ command.
- Use the OTP and OTM commands to set the overtravel limit values.

**<Operation> Setting by teaching**

1. Turn off the Motor servo.
   
   ![MO ENT]

2. Move the Motor’s rotor manually to a point to be the overtravel limit on the plus side.

3. Input the password.
   
   ![NSK ON ENT]

4. Register the present position as the overtravel limit on the plus side. The registered overtravel limit value appears on the display.
   
   ![OTP/ST ENT]

5. Move the Motor’s rotor manually to a point to be the overtravel limit on the minus side.

6. Input the password.
   
   ![NSK ON ENT]

7. Register the present position as the overtravel limit on the minus side. The registered overtravel limit value appears on the display.
   
   ![OTM/ST ENT]

8. Move the Motor’s rotor into the overtravel area. Check that the Driver Unit outputs the F2 alarm (check the alarm indicated on the LED or input the TA command).
After the Home Return is completed, take the following steps:

- If the F2 alarm is not output this time, check the following:
  - Is the position scale home position located between OTP and OTM?
  - In the single rotation position scale: is OTP < OTM?
  - In the Linear position scale: Is OTP a positive value, and OTM a negative value?

### Setting by position scale data

- When the overtravel limit values are already known, users can directly set these values in the OTP and OTM command parameters.

#### 8.1.6. Alarm Output

- After the power is on and “CPU” is initialized, “DRDY” output is closed when alarms are not detected.
- The “DRDY” output opens when the alarm is detected.
- Alarm signal shall be connected to “alarm input” of user’s controller.

**Figure 8-7**

<table>
<thead>
<tr>
<th>Power supply</th>
<th>DRDY output</th>
</tr>
</thead>
<tbody>
<tr>
<td>on</td>
<td>close</td>
</tr>
<tr>
<td>off</td>
<td>open</td>
</tr>
</tbody>
</table>

**Figure 8-7**

#### 8.1.7. Brake Signal Output

- The BRK output circuit opens in the following states:
  1. SVON input : off
  2. Occurrence of an alarm which causes the Motor servo to turn off (example: memory error, etc.).
  3. During system initialization after the power is turned on
  4. EMST input : on

* This signal can be used to control negative (normally on) brake, which activates the external brake when the Motor servo goes off or the EMST is input.
8.1.8. In-Position Output

- In-Position output condition is determined by the following parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Function (Name)</th>
<th>Shipping set</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW</td>
<td>IPOS outputting time range (Output mode)</td>
<td>FW1</td>
</tr>
<tr>
<td>IN</td>
<td>In-Position limit value</td>
<td>IN100</td>
</tr>
<tr>
<td>IS</td>
<td>In-Position stability timer</td>
<td>ISO</td>
</tr>
</tbody>
</table>

**Figure 8-9**

- RS-232C communication command or RUN input
- Position error
- IPOS output (FW = 0)
- IPOS format
- FW value
- Example FW1: 100 ms
- Determined by the IS set value
- Example IS1: 0.1 sec
- IN value

- Pulse command

- Position error

- IPOS output (FW = 0)

- IN set value

- Close

- Open
8.1.8.1. Output Signal Format

- The output signal format --- either IPOS format or FIN format --- can be selected by setting the FW parameter.
  - FW data : FIN format is selected when data ≠ 0 (shipping set: FW1)
  - FW0 : IPOS format

(1) When data of parameter “FW” is not “0” (Zero) (FIN format)

- “IPOS” output indicates that the positioning has completed.
- IPOS will be output for every positioning start command such as [RUN] and [HOS].
- Output format
  - IPOS output is always open and it closes only for the moment set by “FW” when completion of positioning. (Closing time unit in “FW” is 100m sec. Shipping set FW1: 100m sec.)

Recommendation

We recommend to use FIN format when you use the programmable indexer in the Driver Unit.

- “IPOS” will not be output for pulse train operation and jog operation.
- When the positioning is stopped in the middle of operation by the emergency stop or overtravel limit switch, “IPOS” will not be output.

(2) When “data” of parameter “FW” is 0 (Zero) (IPOS format)

- The format is to indicate if there is an error between position command and present position.
- Basically “IPOS” output will be closed only when residual pulses in the position error counter is within the range set by “IN” parameter. In other state, it is open.
- However, even residual pulses in the position error counter is within the “IN” value, output is forced to open during pulses are generated internally when executing programmable indexer, Home Return, jog and operations via RS-232C.

Recommendation

Select “IPOS” format for pulse train operation or RS-232C operation.

- When the positioning is stopped in the middle of the operation by emergency stop or overtravel limit signal, IPOS output will stay closed if residual pulses of position error counter are within the “IN” value.
- When executing pulse train input operation, even pulses are being input, IPOS output is closed if residual pulses in the position error counter are within “IN” value.
  [This state tends to occur when executing low speed operation or feed forward compensation is applied (“FF” parameter).]
8.1.8.2. Parameter “IN”

- Parameter “IN” is to decide positioning accuracy.
- “IPOS” output will be closed when residual pulses of position error counter are within the range of “IN” parameter.
- The unit of parameter “IN” value is the maximum resolution (pulses) of the motion detector (resolver).

<table>
<thead>
<tr>
<th>Motor Series</th>
<th>Resolution (pulses/revolution)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS, JS1, JS2, RS</td>
<td>614400</td>
</tr>
<tr>
<td>SS</td>
<td>491520</td>
</tr>
<tr>
<td>AS, BS, JS0</td>
<td>409600</td>
</tr>
</tbody>
</table>

Example (YS series)

Desired positioning accuracy (repeatability): ±100 sec.

\[
\text{“IN” set value} = \left( \frac{\text{resolver resolution}}{360} \right) \times \text{repeatability (degree)}
\]

\[
= \left( \frac{614400}{360} \right) \times \left( \frac{100}{3600} \right)
\]

\[
= 47 \text{ pulses}
\]

8.1.8.3. Parameter “IS”

- “IS” is to confirm the stability of the positioning. When the in-position output signal is IPOS format, if the parameter “IN” value is smaller (roughly less than FN10), “IPOS” output will be instable in the moment of positioning settling, even all servo gains are adjusted properly.
- “IS” parameter should be set to eliminate above instability.
- When “IPOS” output is in “FIN” format, “IS” parameter prevents to output IPOS signal before the Motor complete the positioning.
- “IS” parameter is not effective for pulse train input operation and jog operation.
8.1.8.4. “IPOS” Output in Special Occasion.

1) When 0 (Zero) movement operation is executed.

Example

When [AD0] or [AR0] is executed even the Motor is in the Home position, movement of the Motor is 0 (Zero). Followings show “IPOS” output states.

① “IPOS” format IS = 0
   ○ There is no internal pulse output and “IPOS” output remains close if residual pulse of position error counter are within “IN” value.

② “IPOS” format IS ≠ 0
   ○ Even no pulse is internally generated, “IPOS” output will be opened for the moment set by “IS” value to check positioning stability.

③ “FIN” format
   ○ Even no pulse is generated internally, “IPOS” output signal shall always be returned for positioning start command.

2) Sequential operation (BCD mode) for Programmable Indexer.

① “IPOS” format
   ○ After the positioning is completed, execute next channel program, while “IPOS” output remains open.

② “FIN” format
   ○ After the positioning is completed, “IPOS” output closes for the moment which is set by the parameter “FW”, then execute the next channel’s program after “IPOS” output is opened again.
8.1.9. Position Feedback Signal

- Resolution
  Set the $\phi_A/\phi_B$ resolution using the FR parameter (via RS-232C).

<table>
<thead>
<tr>
<th>Motor series</th>
<th>Feedback signal</th>
<th>$\phi_A, \phi_B$</th>
<th>$\phi_Z$</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS, JS1, JS2, RS</td>
<td>FR1</td>
<td>153600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FR0</td>
<td>38400</td>
<td></td>
</tr>
<tr>
<td>SS</td>
<td>FR1</td>
<td>122880</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FR0</td>
<td>30720</td>
<td></td>
</tr>
<tr>
<td>AS, BS, JS0</td>
<td>FR1</td>
<td>153600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FR0</td>
<td>38400</td>
<td></td>
</tr>
</tbody>
</table>

When the resolver resolution is set to the automatic resolution switching or 10-bit setting, set the FR parameter to FR0. When it is set to FR1, $\phi_A/\phi_B$ will not be output.

- Output timing

The phase can be reversed by the FD parameter (set via RS-232C).
- FD0: Standard; at CW rotation, $\phi_A$ becomes ON before $\phi_B$
- FD1: Reverse; at CW rotation, $\phi_B$ becomes ON before $\phi_A$

The output specification of the $CHZ$ signal—whether to output $\phi_Z$ or MSB—is selected by the FZ parameter (set via RS-232C).
- FZ0: $\phi_Z$
- FZ1: MSB
### 8.1.10. Monitor Functions

- The Motor operation can be monitored by using the analog velocity monitor pins, which are provided in the front panel of Driver Unit, and RS-232C communication.

**Table 8-4**

<table>
<thead>
<tr>
<th>Item</th>
<th>RS-232C communication command</th>
<th>Monitor output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity</td>
<td>—</td>
<td>VELOCITY check pin on the front panel</td>
<td>• Monitors the Motor velocity in forms of analog voltage output.</td>
</tr>
<tr>
<td>Position error</td>
<td>TE</td>
<td>—</td>
<td>• Monitors value of the position error counter.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• For the details, refer to “11. Commands and Parameters.”</td>
</tr>
<tr>
<td>Input/output</td>
<td>IO</td>
<td>—</td>
<td>• Monitors the input/output status (on/off) of CN2.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• For the details, refer to “11. Commands and Parameters.”</td>
</tr>
<tr>
<td>Current position</td>
<td>TP</td>
<td>CN1 via RS-232C terminal</td>
<td>• Monitors the current position in the absolute position scale.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• For the details, refer to “11. Commands and Parameters.”</td>
</tr>
<tr>
<td>Parameter value</td>
<td>TS</td>
<td>—</td>
<td>• Monitors the set values of parameters.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• For the details, refer to “11. Commands and Parameters.”</td>
</tr>
<tr>
<td>Alarm</td>
<td>TA</td>
<td>—</td>
<td>• Monitors the alarm status.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• For the details, refer to “13.1.2. TA Command.”</td>
</tr>
<tr>
<td>Channel program</td>
<td>TC</td>
<td>—</td>
<td>• Monitors the program stored in the channels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• For the details, refer to “11. Commands and Parameters.”</td>
</tr>
</tbody>
</table>
8.1.10.1. Velocity Monitor

- The user can monitor the velocity of the Motor by measuring the voltage between VELOCITY and GND check pins on the front panel.

**When the resolver is set to 12-bit resolution**

Note: ±10 V is only a typical value; actual values vary slightly. The voltage is not a precise representation of the velocity.

![Figure 8-11](image)

**When the resolver is set to 10-bit resolution or automatic resolution switching**

Note: ±7.5 V is only a typical value; actual values vary slightly. The voltage is not a precise representation of the velocity.

![Figure 8-12](image)

**Table 8-5: Maximum velocity**

<table>
<thead>
<tr>
<th>Motor series</th>
<th>Resolver resolution</th>
<th>12-bit setting</th>
<th>Automatic resolution switching or 10-bit setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS, JS1, JS2, RS</td>
<td></td>
<td>1 r.p.s.</td>
<td>3 r.p.s.</td>
</tr>
<tr>
<td>SS</td>
<td></td>
<td>1.25 r.p.s.</td>
<td>3.75 r.p.s.</td>
</tr>
<tr>
<td>AS, BS, JS0</td>
<td></td>
<td>1 r.p.s.</td>
<td>3 r.p.s.</td>
</tr>
</tbody>
</table>

- Automatic resolution switching, 12-bit setting and 10-bit setting are selected by the RR parameter.
8.1.10.2. Monitoring I/O State (IO)

- The Input/Output signal state of CN2 and CN5 connectors can be monitored using “IO” command.
- This is useful to check the wiring.
  - Input format
    - IO0/RP : Monitor CN2 I/O state
    - IO2/RP : Monitor the I/O related to programmable indexer
    - IO3/RP : Monitor the I/O related to Jog operation
  - Note: /IP is to set the frequency of the monitoring.
    - Without /IP : One-shot monitoring
    - With /IP : Real-time monitoring (Repeats monitoring)
  - Display format
    - Bit map representing Input/Output in 1 line (See Figure 8-13 to 8-15.)
- The status is displayed on the Handy Terminal screen.

Figure 8-13: IO0/RP (Monitor CN2 I/O state)
Figure 8-14: IO2/RP (Monitor I/O related to programmable indexer)

Figure 8-15: IO3/RP (Monitor the I/O related to Jogging operation)

Table 8-6: Meaning of display data

<table>
<thead>
<tr>
<th>Input port</th>
<th>Display: 1</th>
<th>Display: 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>OFF</td>
<td></td>
</tr>
</tbody>
</table>

| Output port | Close | Open |

Figure 8-16: Example of monitoring

EMST, OTP, and OTM are input from CN2 connector. Output: DRDY ---- open  BRK ---- open  IPOS ---- close
Press BS key to exit the monitoring.
[Example] Verify the Programmable Indexer start command “RUN” is ON.

(1) 

(2) I O 

(3) / R P 

(4) ENT 
Press the enter key to execute.
Read-out starts immediately after the input.

(5) BS 
Press the back space key to discontinue read out. If it is not pressed, read out will be repeated and the next command cannot be accepted.

Above example shows that read out of RUN input is “1”, which indicates “RUN” input is ON.

[Reference]
- Read-out follows the changes of signal status while repeating reading-out.
  (Signals ON and OFF are followed by 1 and 0 in the display.)
- If the option code “/RP” is not entered, the read-out at the moment will be displayed for only once.
8.1.10.3. Reading Current Position

(1) Reading the position scale current value in the units of pulse

1. \[
\begin{array}{cccc}
T & P & 2 & \$ \\
\hline
\end{array}
\]

ENT

The position scale value is displayed continuously in the units of pulse. Moving the Motor’s rotor changes the value on the display.

2. BS

Press the BS key to end the display.

(2) Reading the position scale current value in the units of 1/100 degree

1. \[
\begin{array}{cccc}
T & P & 5 & \% \\
\hline
\end{array}
\]

ENT

The position scale value is displayed continuously in the units of 1/100 degree. Moving the Motor’s rotor changes the value on the display.

2. BS

Press the BS key to end the display.
8.1.10.4. Analog Monitor

- The voltage between analog output pin (MON) and analog ground pin (GND) on the front panel of the Driver Unit monitors one of the following Motor and Driver Unit conditions.
  - Velocity ------------------------ actual velocity of the Motor
  - Velocity command ------------ velocity command given to the Motor from the Driver Unit
  - Velocity error ------------------ error between velocity command and actual velocity, per one sampling instant
  - Torque command -------------- torque command given to the Motor from the Driver Unit
  - Phase C current command --- current command given to the Motor phase C from the Driver Unit
  - Position command ------------ position command given to the Motor from the Driver Unit
  - Position error counter -------- error between position command and actual position

- MN command select one of the conditions to be monitored as shown in Table 8-7.

Table 8-7

<table>
<thead>
<tr>
<th>Monitoring condition</th>
<th>MN command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity</td>
<td>MN 0</td>
</tr>
<tr>
<td>Velocity command</td>
<td>MN 1</td>
</tr>
<tr>
<td>Velocity error</td>
<td>MN 2</td>
</tr>
<tr>
<td>Torque command</td>
<td>MN 3</td>
</tr>
<tr>
<td>Phase C current command</td>
<td>MN 4</td>
</tr>
<tr>
<td>Position command</td>
<td>MN 5</td>
</tr>
<tr>
<td>Position error</td>
<td>MN 6</td>
</tr>
<tr>
<td>Position error</td>
<td>MN 7</td>
</tr>
</tbody>
</table>

- The monitor output scale is shown below.

Figure 8-17: Velocity (MN0)

Figure 8-18: Velocity command (MN1)

Figure 8-19: Velocity error (MN2)

Figure 8-20: Torque command (MN3)
Figure 8-21: Phase C current command (MN4)

Figure 8-22: Position command (MN5)

Figure 8-23: Position error (MN6)

Figure 8-24: Position error (MN7)

Caution: The maximum velocity shown in above figures is for the cases when the selection of resolver resolution is automatic or 10 bit setting.
8.2. For More Advanced Operation

8.2.1. Position Scale

- The ESA25 Driver Unit has a position scale for positioning and overtravel limit.

8.2.1.1. Resolution

- The Motor resolver has teeth for detecting its position, and each tooth is digitally divided into 4096. In other words, the resolution of Motor position detection is $4096 \times \text{number of teeth per turn}$.

- Table 8-8 lists Motor series and the resolution.

<table>
<thead>
<tr>
<th>Motor series</th>
<th>Number of teeth</th>
<th>Resolution [pulses / rotation]</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS, JS1, JS2, RS</td>
<td>150</td>
<td>614400</td>
</tr>
<tr>
<td>SS type</td>
<td>120</td>
<td>491520</td>
</tr>
<tr>
<td>AS, BS, JS0</td>
<td>150</td>
<td>614400</td>
</tr>
</tbody>
</table>

8.2.1.2. Direction of Position Scale

(Caution): For your safety, the direction of the hardware overtravel limit switches are fixed to the Motor as follow regardless of the DI setting:

- OTP: CW direction
- OTM: CCW direction

- The direction of position scale counting can be switched by the DI command.

<table>
<thead>
<tr>
<th>DI setting</th>
<th>CW direction</th>
<th>CCW direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>DI0*</td>
<td>Plus direction</td>
<td>Minus direction</td>
</tr>
<tr>
<td>DI1</td>
<td>Minus direction</td>
<td>Plus direction</td>
</tr>
</tbody>
</table>

* : Shipping set

- When the position scale direction is set, the directions of operations performed by the following functions are also determined.
  - Pulse train operation
  - Positioning via communication (IR, ID, AR, AD, HS)
  - Programmable indexer
  - Home Return
  - Jog
  - Software overtravel limit switch
8.2.1.3. Types of Position Scale

- Three types of position scale are available for the user to select the appropriate type for each purpose. Position scale type can be switched by setting the PS command.

<table>
<thead>
<tr>
<th>PS setting</th>
<th>Type of position scale</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS0</td>
<td>Linear position scale</td>
<td>Ball screw driving, limited motion range.</td>
</tr>
<tr>
<td>PS1*</td>
<td>Single-rotation position scale</td>
<td>General indexer, etc.</td>
</tr>
<tr>
<td>PS2-99</td>
<td>Multi-rotation position scale</td>
<td>Chain driving, etc.</td>
</tr>
</tbody>
</table>

* : Shipping set

1) Linear Position Scale

- This position scale extends linearly from the Home position in both plus and minus directions.

- Scale values range from \(-2,147,483,648 \text{ [pulses]}\) to \(+2,147,483,647 \text{ [pulses]}\) with the Home position at 0. The coordinate value increases in the plus direction. When it exceeds \(+2,147,483,647 \text{ [pulses]}\), the value returns to \(-2,147,483,648 \text{ [pulses]}\). Falling below \(-2,147,483,648 \text{ [pulses]}\), the value returns to \(+2,147,483,647 \text{ [pulses]}\).

Figure 8-25: Linear position scale

Motor series: YS, JS1, JS2, RS

<table>
<thead>
<tr>
<th>Home position (origin) or AZ command execution point</th>
<th>CCW direction</th>
<th>CW direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-2147483648)</td>
<td>(-614400)</td>
<td>(-614400)</td>
</tr>
<tr>
<td>(-270°)</td>
<td>(-307200)</td>
<td>(-307200)</td>
</tr>
<tr>
<td>(-90°)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>(90°)</td>
<td>(153600)</td>
<td>(153600)</td>
</tr>
<tr>
<td>(270°)</td>
<td>(460800)</td>
<td>(460800)</td>
</tr>
<tr>
<td>(360°)</td>
<td>(2147483647)</td>
<td>(2147483647)</td>
</tr>
</tbody>
</table>

Motor series: SS

<table>
<thead>
<tr>
<th>Home position (origin) or AZ command execution point</th>
<th>CCW direction</th>
<th>CW direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-2147483648)</td>
<td>(-491520)</td>
<td>(-491520)</td>
</tr>
<tr>
<td>(-270°)</td>
<td>(-245760)</td>
<td>(-245760)</td>
</tr>
<tr>
<td>(-90°)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>(90°)</td>
<td>(122880)</td>
<td>(122880)</td>
</tr>
<tr>
<td>(270°)</td>
<td>(368640)</td>
<td>(368640)</td>
</tr>
<tr>
<td>(360°)</td>
<td>(2147483647)</td>
<td>(2147483647)</td>
</tr>
</tbody>
</table>

Motor series: AS, BS, JS0

<table>
<thead>
<tr>
<th>Home position (origin) or AZ command execution point</th>
<th>CCW direction</th>
<th>CW direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-2147483648)</td>
<td>(-409600)</td>
<td>(-409600)</td>
</tr>
<tr>
<td>(-270°)</td>
<td>(-204800)</td>
<td>(-204800)</td>
</tr>
<tr>
<td>(-90°)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>(90°)</td>
<td>(102400)</td>
<td>(102400)</td>
</tr>
<tr>
<td>(270°)</td>
<td>(307200)</td>
<td>(307200)</td>
</tr>
<tr>
<td>(360°)</td>
<td>(2147483647)</td>
<td>(2147483647)</td>
</tr>
</tbody>
</table>
2) Single Rotation Position Scale

- Scale starts from the Home position (origin) and extends only in the plus direction. The coordinate value returns to 0 after a 360° turn.
  - Motor Series: YS, JS1, JS2 and RS
    Coordinate values from 0–614399 [pulses]
  - Motor Series: SS
    Coordinate values from 0–491519 [pulses]
  - Motor Series: AS, BS and JS0
    Coordinate values from 0–409599 [pulses]

Figure 8-26: Single-rotation position scale

<table>
<thead>
<tr>
<th>Motor series: YS, JS1, JS2, RS</th>
</tr>
</thead>
<tbody>
<tr>
<td>270°</td>
</tr>
<tr>
<td>460800 pulses</td>
</tr>
<tr>
<td>CW direction</td>
</tr>
<tr>
<td>0°</td>
</tr>
<tr>
<td>0 pulses</td>
</tr>
<tr>
<td>Home position (origin) or AZ command executing point.</td>
</tr>
<tr>
<td>180°</td>
</tr>
<tr>
<td>307200 pulses</td>
</tr>
<tr>
<td>90°</td>
</tr>
<tr>
<td>153600 pulses</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motor series: SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>270°</td>
</tr>
<tr>
<td>368640 pulses</td>
</tr>
<tr>
<td>CW direction</td>
</tr>
<tr>
<td>0°</td>
</tr>
<tr>
<td>0 pulses</td>
</tr>
<tr>
<td>Home position (origin) or AZ command executing point.</td>
</tr>
<tr>
<td>180°</td>
</tr>
<tr>
<td>245760 pulses</td>
</tr>
<tr>
<td>90°</td>
</tr>
<tr>
<td>122880 pulses</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motor series: AS, BS, JS0</th>
</tr>
</thead>
<tbody>
<tr>
<td>270°</td>
</tr>
<tr>
<td>307200 pulses</td>
</tr>
<tr>
<td>CW direction</td>
</tr>
<tr>
<td>0°</td>
</tr>
<tr>
<td>0 pulses</td>
</tr>
<tr>
<td>Home position (origin) or AZ command executing point.</td>
</tr>
<tr>
<td>180°</td>
</tr>
<tr>
<td>204800 pulses</td>
</tr>
<tr>
<td>90°</td>
</tr>
<tr>
<td>102400 pulses</td>
</tr>
</tbody>
</table>
3) Multi-Rotation Position Scale

- Scale starts from the Home position (origin) and extends only in the plus direction. The value returns to 0 after making the number of revolutions set by “PS” command.
  - Motor Series: YS, JS1, JS2 and RS
    Coordinate values range from 0 to \(614400 \times (\text{PS data}) - 1\)
  - Motor Series: SS
    Coordinate values range from 0 to \(491520 \times (\text{PS data}) - 1\)
  - Motor Series: AS, BS and JS0
    Coordinates values range from 0 to \(409600 \times (\text{PS data} - 1)\)

*Figure 8-27: Multi-rotation position scale*
8.2.1.4. Position Scale Reset

**Caution:**
- The position scale value is not decided immediately after the power is turned on. Be sure to reset the position scale before positioning.
- The position scale value is reset to 0 by the following operations.
  - Home Return finish
  - AZ command input

8.1.2.5. Example of Position Scale Setting

1. Set the CCW direction of the position scale as the plus direction.

   ![Image](image1.png)

   Input the password.
   The password acknowledgment message appears on the display.

2. Setting the linear position scale

   ![Image](image2.png)

   Input the DI command to determine the position scale direction.

3. Resetting the position scale value

   ![Image](image3.png)

   Input the password.
   The password acknowledgment message appears on the display.

   ![Image](image4.png)

   Input the AZ command to reset the position scale value.
8.2.2. Digital Filter

**Caution**: Inserting multiple filters may cause phase inversion of velocity loop in some systems, resulting in unstable operation.

- Do not insert more than two filters. Setting a filter frequency too low may cause hunting, etc.; set the frequency to 100 Hz or above.

Parameters for digital filter setting

- Parameters: FP, FS, NP
  - Sets filter frequency in the velocity loop.
  - The filters are useful for eliminating audible noise and vibration due to mechanical resonances.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Function</th>
<th>Shipping set</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP</td>
<td>Sets the primary low-pass filter frequency</td>
<td>FP0</td>
</tr>
<tr>
<td>FS</td>
<td>Sets the secondary low-pass filter frequency</td>
<td>FS0</td>
</tr>
<tr>
<td>NP</td>
<td>Sets the primary notch filter frequency</td>
<td>NP0</td>
</tr>
</tbody>
</table>

Refer to Chapter 11 “Command and Parameter” for more details.

*Figure 8-28: Digital filter block diagram*
8.2.3. Feed Forward Compensation

- Parameter “FF” sets feed forward compensation gain. The password is necessary when setting.
- Shipping set of “FF” is FF0.
- The feed forward compensation function generates a velocity command by differentiating the position command, then adds it to the velocity loop in the forward direction.
- Feed forward compensation improves follow-up delay during acceleration/deceleration.
- Setting the FF parameter to a higher value improves follow-up delay, but overshoot becomes more likely to occur. It is generally recommended that the parameter be set to 0.5 or below.

Figure 8-29: Feed Forward Compensation Block Diagram

8.2.4. Integrator Limit : ILV

- Parameter “ILV” sets the upper limit to the velocity gain. Shipping set is ILV100.
- The password is necessary when setting “ILV”.
- Integrator limiter reduces overshoot caused by the integrator during high acceleration / deceleration.
- The integrator is indispensable for high-precision positioning. However, when a high-speed acceleration/ deceleration is specified, errors are likely to accumulate so that integration often results in an overshoot. To prevent this, an integrator limiter is provided to restrict an excessive integration.

* For more details about the parameter, refer to “11. Commands and Parameters.”

Figure 8-30: Integrator limiter block diagram

Figure 8-31
8.2.5. Dead Band Setting: DBP

- The DBP parameter sets a dead band, centered at “0” to error in the position loop. When the position error value is below the specified dead band value, the position command is set to 0.

- In some systems, slight vibration may be caused by a slight error in positioning. In this case, slight vibration can be prevented by setting a dead band.

- Setting a dead band reduces microvibrations but lowers repeatability by the set value.

- The dead band is set in the units of pulse (equivalent to the resolver resolution with 12-bit specification: refer to “3.2.3. Function Specifications, Position detector resolution”). When the resolver resolution setting is 10-bit, set the dead band value by a multiple of 4.

Figure 8-32: Dead Band Setting Block Diagram
8.3. RS-232C Communication

8.3.1. Specification of Communication

- Setting of various parameters, trial running, and adjustment are enabled by issuing commands to the Driver Units through serial communication (i.e., communication through the RS-232C interface).
- The Driver Unit has CN1 as the input/output ports for RS-232C communication.
- When the Handy Terminal (FHT11) is not in use, set the MM parameter to 0.
  MM1: Standard setting (for the Handy Terminal)
  MM0: For connection with a personal computer

Table 8-12: RS-232C communication specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission</td>
<td>Asynchronous, full duplex</td>
</tr>
<tr>
<td>Communication speed</td>
<td>9600 b.p.s.</td>
</tr>
<tr>
<td>Word length</td>
<td>8 bit</td>
</tr>
<tr>
<td>Stop bit</td>
<td>2 bit</td>
</tr>
<tr>
<td>Parity</td>
<td>No</td>
</tr>
<tr>
<td>Character code</td>
<td>ASCII code</td>
</tr>
<tr>
<td>Communication procedure</td>
<td>• X–On/Off Protocol: No</td>
</tr>
<tr>
<td></td>
<td>• RTS/CTS Control: Yes</td>
</tr>
</tbody>
</table>

8.3.2. Communication Procedure

8.3.2.1. When Power is Turned on

- If a terminal (such as NSK Handy Terminal FHT11) is connected to CN1 and the Driver Unit power is turned on, the message shown below is displayed.
- The contents (and the number of characters) of this message may differ with Driver Unit setting and system versions.
- When the Driver Units are initialized, a colon (:) is displayed and the system waits for a command to be entered. (The colon (:) is called a prompt.)

![Figure 8-33: Power-on message](image)

*Indicates that internal initialization is completed and a command may be accepted.*
8.3.2.2. Command Entry

- A communication command shall consist of “a command (character string) + data (if necessary) + carriage return code (0DH).”

- If the velocity gain is to be set to 0.5, for example, “VG0.5” should be entered by adding data of 0.5 to a VG command. The characters of this command with data are transmitted to the Driver Unit as shown below:

Figure 8-34: Example Of VG0.5

Every time a character is input, the Driver Unit echoes the character back to the terminal. (The Driver Unit returns the same character that it receives.)

However, the Driver Unit converts carriage return code to “carriage return code (0DH) + line feed code (0AH),” then returns it to the terminal.

When a carriage return code is input, the Driver Unit decodes a character string which it has received (VG0.5 in the example above) and executes it. Therefore, a command is not executed unless it ends with a carriage return code.

If the Driver Unit can decode an entered command, it returns “:” immediately after the line feed code. If it receives an internal data read command, etc., it returns the data before “:”.

Figure 8-35: Successful input example
8.3.2.3. Password

- Among the communication commands used for this System, some special commands (such as AB, PA, SI, etc.) require password entry for preventing erroneous entries. These commands cannot be entered in the same manner as other commands.

- The password is /NSK ON (a space between K and O) as shown below. If the Driver Unit accepts it, it returns an “NSK ON” message.
  - Applicable commands: DB, FC, FF, IL, OG, OL, PA, RC, SI, and ZA

- A command requiring password entry may only be executed immediately after the password is entered.

*Figure 8-36: Password Example*
8.3.2.4. Canceling Command

- A command which has been entered halfway, entering a backspace code (08H) can cancel a character or an entered full character string. Parameter “backspace mode” (BM) sets the cancelling method.
  
  BM0: a backspace code cancels an entered character string.

  BM1: a backspace code cancels a character.

[When the Handy Terminal FHT11 is used, press the backspace (BS) key.]

(1) Parameter “BM1” (Shipping set)

- For example, when the backspace code is input following VG0.5, the cursor moves one space back to the position where 5 was input and thereby deletes 5.

*Figure 8-37: Canceling example (BM1)*

(2) Parameter “BM0”

- For example, when the backspace code is input following VG0.5, a message “VG0.5?” and a colon “: ” are displayed and there by delete “VG0.5”.

*Figure 8-38: Cancelling example (BM0)*
8.3.2.5. Error

Note that an error occurs in any of the following cases:

1. If a nonexistent command (i.e., character string) is entered (If an entered character string cannot be decoded).
2. If data or subscript out of the allowable range is entered.
3. If a command requiring the password is entered without the password.
   - In any of these cases, the entered character string with a ‘?’ mark is returned as an error message.
   - For example,

   In any of these cases, the entered character string with a ‘?’ mark is returned as an error message.

For example,

Figure 8-39: Input error example 1

![Diagram showing input and error example 1](image.png)

If ABCDE is entered, an error message is returned since this character string is not a command.

(4) If the input condition is not met when entering a command.
   - In this case, the entered character string with “INHIBITED” is returned.
   - For Example,

Figure 8-40: Input error example 2

![Diagram showing input and error example 2](image.png)

If an IR command (Incremental Positioning, Resolver) is entered when the Motor is rotating, an error message is returned since the input condition is not met.
8.3.2.6. Readout Command

- If a command for reading the internal state (i.e., parameter set values, current position, etc.) of the Driver Unit among the communication commands of this system is entered, the Driver Unit returns data, etc.

- Returned data consists of “space code (20H) + read value, data + carriage return (0DH) + line feed code (0AH)”.
  
  ○ For example,

1) TS command for reading set value

*Figure 8-41: TS command example*

![Diagram of TS command example]

2) If set value reading function ? is used

*Figure 8-42: “?” function example*

![Diagram of “?” function example]
(3) TP command for reading current position data

Figure 8-43: TP command example
8.3.3. Daisy Chain Communication

- Daisy chain communication allows multiple Driver Units (up to 16 units) to be connected with a single RS-232C terminal.

**Figure 8-44: Daisy chain communication overview**

![Diagram of Daisy Chain Communication](image)

8.3.3.1. Procedure to Set Daisy chain Communication

**Figure 8-45: Daisy chain communication setting procedure**

![Flowchart for Daisy Chain Communication Procedure](image)
8.3.3.2. Initial Setting

- The password is necessary for inputting initial setting parameters.
- The initial setting values become valid when the power is turned on next time.
- Perform initial setting before making multi-axis connection.

**Table 8-13: Initial setting**

<table>
<thead>
<tr>
<th>Item</th>
<th>RS-232C parameter</th>
<th>Data range</th>
<th>Shipping set</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daisy chain communication, axis number setting</td>
<td>AN data</td>
<td>0~15</td>
<td>0</td>
<td>The set data becomes the axis number of multi-axis communication.</td>
</tr>
<tr>
<td>Daisy chain communication mode selection</td>
<td>CM data</td>
<td>0, 1</td>
<td>0</td>
<td>CM0: standard (single driver) communication, CM1: daisy-chain communication</td>
</tr>
</tbody>
</table>

8.3.3.3. Interfacing

1. **Connecting data communication lines**

- Connect data communication lines sequentially: First connect the output of the terminal with the input of axis 0, then connect the output of axis 0 with the input of axis 1 and so forth. (See Figure 8-45.)
- Connect the output of the final axis with the input of the terminal.

![Figure 8-46: Data line connection](image.png)
(2) Connecting data transmission request lines

- Connect data transmission request lines sequentially: First connect the input of the terminal with the output of axis 0, then connect the input of axis 0 with the output of axis 1 and so forth. (See Figure 8-46.)

- Connect the input of the final axis with the output of the terminal.

Figure 8-47: Request–to–send Line Connection

![Request–to–send Line Connection Diagram]

Actual Connection Example

- When NSK’s Handy Terminal is in use, connect the lines as shown in Figure 8-47.

- Refer to “4.1. CN1: RS-232C Serial Communication Connector” for the specification of CN1.

Figure 8-48: Handy Terminal Connection Example

![Handy Terminal Connection Example Diagram]

*: The communication signal name on the Handy Terminal is opposite to that on the Driver Unit (e.g. RXD—TXD).
8.3.3.4 Power on

(Caution): If the Handy Terminal is not used, turn on power in the order of the RS-232C terminal and Driver Units.

- Turn on the power for all Drivers simultaneously (if all the axes cannot be turned on at once, be sure to design the system so that the power of the Driver Unit axis No. 0 turns on at the end.)

- When the Driver Unit of axis No.0 is turned on, an AS command is executed to check for connection.

- If all the terminal and units are connected properly, the following message is displayed (the following examples show a 3-axis configuration)

Figure 8-49

![Connection State Example](image)

- If connection is improper, the following message may be displayed.

- The following message example shows a case where axis No.1 and axis No.2 are connected improperly.

Figure 8-50

![Connection State Example](image)

- If the proper message is not displayed, check for connection order, initial settings (AN parameter, CM parameter), and cable connection.
8.3.3.5. Operation

Selection of Driver Unit to be Communicated

- In daisy chain mode, the RS-232C terminal is capable of communication through a single driver unit.
- Use an AX command to select one of the Driver Units connected for daisy chain communication.

| Caution | Do not select any unit that is not connected. Otherwise, operation may hang up. To return to the normal state, press the BS key, then select the number of a connected driver unit.

Figure 8-51

![Diagram showing AX2 command](image)

Select a new axis for communication (axis No. 2).

Acknowledgment message

An axis selected for communication may be checked by issuing a ?AX command. The axis is displayed in the same manner as it is selected.

Figure 8-52

![Diagram showing ?AX command](image)

Current axis for communication

Example of Daisy-chain Communication

Figure 8-53: Example of Daisy chain Communication

![Flowchart showing daisy-chain communication](image)

- Select axis 1
- Check acknowledgment message
- Acknowledgment message ACC, AX1
- Example: IR100 (move by 100 pulses)
- Set axis 1 parameter.
- Select axis 3
- Check acknowledgment message
- Acknowledgment message ACC, AX3
- Example: IR300 (move by 300 pulses)
- Set axis 3 parameter.
- Select axis 2.
- AX2 command
9. Operation

9.1. Preparation

9.1.1. Wiring Check

(Caution): After completion of all wiring of ESA25 Driver Unit, check followings before operation.

Table 9-1

<table>
<thead>
<tr>
<th>Check item</th>
<th>Confirmation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Connection of Main power and Input/Output cables</td>
<td>● All wiring is properly arranged and completed.</td>
</tr>
<tr>
<td></td>
<td>● Terminal block screws are securely fastened.</td>
</tr>
<tr>
<td></td>
<td>● All connectors are connected and locked properly.</td>
</tr>
<tr>
<td>2 Cable Set</td>
<td>● Cable Set (Motor and Resolver cables) is connected and locked properly.</td>
</tr>
<tr>
<td>3 Handy Terminal</td>
<td>● Handy Terminal (FHT11) is connected and locked to CN1 connector.</td>
</tr>
</tbody>
</table>

9.1.2. Procedure

Figure 9-1

1 Turn power on
   ● Check power voltage (Main and Control power)
   ● After the power is turned on, make sure that the LED (green) and the 7 segments LED on the front panel of the Driver Unit are indicating normal state.
   ● Confirm the Handy Terminal display is showing completion of the Driver Unit initialization.

2 Tuning
   ● Refer to “7. Tuning and Trial Running” and tune the Megatorque Motor system.

- Position control mode operation
  - Home Return
  - Programmable indexer
  - Pulse Train Command Operation
  - RS-232C position command
  - Jog

- Analog Velocity Control Mode Operation
  - Refer to “9.3. Velocity Control Mode Operation.”

- Analog Torque Control Mode Operation
  - Refer to “9.4. Torque Control Mode Operation.”
9.2. Position Control Mode Operation

- Select a position control mode with the parameter SL.
  - SL1: Analog torque control mode
  - SL2: Analog velocity control mode
  - SL3: Position control mode

- Following operations are available in the position control mode.
  - Home Return operation
  - Programmable indexer
  - Pulse train command operation
  - RS-232C position command
  - Jog

9.2.1. Home Return

- Be sure to perform Home Return at all times except when user's controller is governing coordinate system control. The Home position (Zero position) cannot be determined unless Home Return is performed.

- The position coordinates and positions of software overtravel limit switch are set to the position scale determined by Home Return.

- The Home position (Zero position) of the position scale is set to the point at where Home Return completes.

**Caution**: Position data disappears after the power is turned off, so perform Home Return each time you turn on the Driver Unit power.

*Figure 9-2: Home Return sequence*
- Make the Motor Servo-on. (SVON input on)

- Turning the HOS input ON will start Home Return. (1)

- The Motor turns CCW*. When it enters HLS (Home position proximity) area (2), it decelerates and stops momentarily, then reverses its rotational direction. (3) The Motor goes out HLS range once, then reverses again and enters HLS area at the Home position search velocity. (4) It moves to the first point where the resolver value becomes 0 (= rising edge of øZ) and completes Home Return.

  * The direction of rotation can be changed with the parameter HD (Home Return direction).

  HD0: CW
  HD1: CCW (Shipping set)

- If the Home offset value HO is set, the Motor moves farther past the resolver 0 point by the offset value, then completes Home Return operation.

- Home Return can be also executed with the following ways.
  - Select the channel where HS command is set and input RUN command.
  - Execute RS command through RS-232 communication.

- Home Return movement differs as shown in Figure 9-3 according to the starting point of Home Return.

*When Home Return direction is reversed by the HD parameter, CW and CCW as well as OTP and OTM are reversed as follows: CW → CCW, OTP → OTM.
9.2.1.1. Home Return Parameter List

Table 9-2: Motor series: YS, JS1, JS2 and RS

<table>
<thead>
<tr>
<th>Parameter function</th>
<th>RS-232C Parameter Parameter</th>
<th>Unit</th>
<th>Data input range</th>
<th>Shipping set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Return Acceleration</td>
<td>HA</td>
<td>r.p.s/s</td>
<td>0.01~40.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Home Return Velocity</td>
<td>HV</td>
<td>r.p.s.</td>
<td>0.01~3.00</td>
<td>0.2</td>
</tr>
<tr>
<td>Home Position Offset</td>
<td>HO</td>
<td>pulse</td>
<td>0~610304</td>
<td>0</td>
</tr>
<tr>
<td>Home Return Direction</td>
<td>HD</td>
<td>—</td>
<td>0: CW, 1: CCW</td>
<td>1</td>
</tr>
<tr>
<td>Home Return Near-Zero Velocity</td>
<td>HZ</td>
<td>r.p.s.</td>
<td>0.01~0.20</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Table 9-3: Motor series: SS

<table>
<thead>
<tr>
<th>Parameter function</th>
<th>RS-232C Parameter Parameter</th>
<th>Unit</th>
<th>Data input range</th>
<th>Shipping set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Return Acceleration</td>
<td>HA</td>
<td>r.p.s/s</td>
<td>0.01~50.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Home Return Velocity</td>
<td>HV</td>
<td>r.p.s.</td>
<td>0.01~3.75</td>
<td>0.2</td>
</tr>
<tr>
<td>Home Position Offset</td>
<td>HO</td>
<td>pulse</td>
<td>0~487424</td>
<td>0</td>
</tr>
<tr>
<td>Home Return Direction</td>
<td>HD</td>
<td>—</td>
<td>0: CW, 1: CCW</td>
<td>1</td>
</tr>
<tr>
<td>Home Return Near-Zero Velocity</td>
<td>HZ</td>
<td>r.p.s.</td>
<td>0.01~0.25</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Table 9-4: Motor series: AS, BS and JS0

<table>
<thead>
<tr>
<th>Parameter function</th>
<th>RS-232C Parameter Parameter</th>
<th>Unit</th>
<th>Data input range</th>
<th>Shipping set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Return Acceleration</td>
<td>HA</td>
<td>r.p.s/s</td>
<td>0.01~60.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Home Return Velocity</td>
<td>HV</td>
<td>r.p.s.</td>
<td>0.01~4.50</td>
<td>0.2</td>
</tr>
<tr>
<td>Home Position Offset</td>
<td>HO</td>
<td>pulse</td>
<td>0~405504</td>
<td>0</td>
</tr>
<tr>
<td>Home Return Direction</td>
<td>HD</td>
<td>—</td>
<td>0: CW, 1: CCW</td>
<td>1</td>
</tr>
<tr>
<td>Home Return Near-Zero Velocity</td>
<td>HZ</td>
<td>r.p.s.</td>
<td>0.01~0.30</td>
<td>0.01</td>
</tr>
</tbody>
</table>

9.2.1.2. Adjusting Home Position Switch and Home Offset Value

- The position of the Home position sensor (a dog or a sensor) must be adjusted properly to perform Home Return accurately.

- The Home position is determined at the point at where the resolver value becomes zero after detection of HLS input rising edge when motor is running under Home Return near-zero velocity.

- The resolver has many teeth for detecting its position and the rising edge of HLS is to identify a tooth out of these teeth. To make precise detection of øZ, the Home limit switch position must be adjusted so that the HLS input goes high when the switch is at the middle center of the tooth width. Design the Home limit switch so that it can be adjusted ±1.2°” or more in relation to the tooth width.

- Take the following steps to adjust the position of the Home limit switch.
<Operation> Adjusting the Home limit switch position

(1) Loosely mount the HLS sensor (Home limit switch) slightly preceding a point to be the Home position.

(2) Check the wiring of the HLS sensor. Execute the IO command and check if the ESA25 Driver Unit is reading the HLS input correctly.

(3) Adjust the position of the Home position sensor. First, make the Motor servo-on, then execute the HS/LS command. At this time, be careful that the Motor starts Home Return operation and thereby rotates. By using Handy Terminal, take the following steps:

1. Input the HS/LS command:

   ![HS/LS Command]

2. Press the ENT key to start Motor rotation.

   The Motor stops as soon as the HLS sensor goes on. The Handy Terminal displays the TR value (i.e., number of pulses from the closest øZ rising edge) of the Motor’s present position.

   Check that this value is in the range between 1000 and 3000

   If the TR value is not in this range, loosen the HLS sensor and move it CW or CCW direction.

   Repeat steps 1 and 2 until the TR value is within the above range.

**Caution:** When installing the HLS sensor, be sure to adjust its position as mentioned above. Otherwise, positioning may not be performed correctly.

3. Input the MO command (servo-off command):

   ![MO Command]

4. Press the ENT key to execute the command and thereby turn off the Motor servo.

   At this time, the Motor can be turned easily by hand. Turn the Motor to the desired position. Do not give the Motor more than one turn.
5. Input the password.
   / N S K SP
   O N

6. ENT

7. HO / ST
   Input the HO/ST command.

8. ENT
   Press the ENT key to execute the command.
   When the ":_" colon appears on the display,
   Home offset HO value is automatically calculated and set.

9. Input the SV command (servo-on command.)
   S V

10. Press the ENT key to execute the command and thereby turn on the Motor servo.
    ENT
    The ":_" colon appears when the Driver Unit is ready to accept another input.

11. Input the HS command (Home Return start command).
    H S

12. Press the ENT key to execute the command and thereby start Home Return operation.
    ENT
    Check that the Motor stops at the desired Home position.
9.2.2. Programmable Indexer

- Positioning command can be stored to the channel of the Driver Unit. Programmable Indexer is to execute the stored positioning program by selecting the channel via PRG0~PRG3 input and RUN command.

- Set the system to servo-on. (SVON input ON)

- Select the channel. (Input PRG0~PRG3, CN2 signal)

- By inputting RUN command ON, the Motor execute stored positioning program while IPOS output is closed. (When FW=0)

- While the Motor is performing the positioning operation, the RUN input is ignored.

- Input the command “SP” to execute the Programmable Indexer. (Same function as inputting RUN command ON.)

  Type

  S  P  m  ENT

  to execute the channel “m” program. (m: channel number)

*Figure 9-4: Programmable indexer command timing*

- When a non-programmed channel is selected, the program error alarm will be ON. (Refer to “13. Alarms”)
9.2.2.1. Programmable Indexer Channel Switching

- The channel to be executed is selected by combining the on and off of the PRG0 to PRG5 input of I/O connector CN5.

<table>
<thead>
<tr>
<th>Channel input</th>
<th>PRG 5</th>
<th>PRG 4</th>
<th>PRG 3</th>
<th>PRG 2</th>
<th>PRG 1</th>
<th>PRG 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel 0</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Channel 1</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Channel 2</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Channel 61</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Channel 62</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Channel 63</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

*(○: ON  ●: OFF)*
9.2.3. Pulse Train Command Operation

9.2.3.1. Pulse Train Signal Format

- Input a pulse train from CWP and CCWP of CN2 control I/O signal connector.
- Set the pulse train input signal format with the PC parameter (via RS-232C communication). (The password must be input prior to the PC parameter setting.)

Table 9-6: Signal format

<table>
<thead>
<tr>
<th>PC Parameter</th>
<th>CWP input</th>
<th>CCWP input</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC0 (shipping set)</td>
<td>• Input CW pulse.</td>
<td>• Input CCW pulse.</td>
<td>CW &amp; CCW format</td>
</tr>
<tr>
<td>PC1</td>
<td>• Input the direction. ON : CCW OFF : CW</td>
<td>• Input pulse train</td>
<td>Pulse &amp; direction format</td>
</tr>
<tr>
<td>PC2</td>
<td></td>
<td></td>
<td>øA/øB format (× 1)</td>
</tr>
<tr>
<td>PC3</td>
<td>• Input øB</td>
<td>• Input øA</td>
<td>øA/øB format, doubled (× 2)</td>
</tr>
<tr>
<td>PC4</td>
<td></td>
<td></td>
<td>øA/øB format, quadrupled (× 4)</td>
</tr>
</tbody>
</table>
9.2.3.2. Pulse Train Resolution

- Set the resolution of the pulse train with the CR parameter (via RS-232C).
- In the case of øA/øB input, the pulse train resolution is multiplied by the PC parameter value, then by the CR parameter value.
- Refer to Table 9-7 for the concrete data of resolution.

Figure 9-5: Pulse train resolution setting

<table>
<thead>
<tr>
<th>øA/øB input</th>
<th>PC parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWP &amp; CCWP input</td>
<td>PC2: × 1</td>
</tr>
<tr>
<td></td>
<td>PC3: × 2</td>
</tr>
<tr>
<td></td>
<td>PC4: × 4</td>
</tr>
<tr>
<td>Pulse &amp; direction input</td>
<td>CR parameter</td>
</tr>
<tr>
<td></td>
<td>CR × 1</td>
</tr>
<tr>
<td></td>
<td>CR × 2</td>
</tr>
<tr>
<td></td>
<td>CR × 4</td>
</tr>
<tr>
<td></td>
<td>CR360000</td>
</tr>
<tr>
<td></td>
<td>CR36000</td>
</tr>
<tr>
<td></td>
<td>CR3600</td>
</tr>
</tbody>
</table>

Table 9-7: Pulse train resolution (YS, JS1, JS2 and RS Motor series)

<table>
<thead>
<tr>
<th>CR Parameter</th>
<th>Resolver resolution</th>
<th>Resolution (pulses/360°) = number of pulses necessary for giving the Motor one turn</th>
<th>CW &amp; CCW format, Step &amp; Direction format</th>
<th>øA/øB format</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR × 1 (Shipping set)</td>
<td>12–bit or automatic resolution switching</td>
<td>614400</td>
<td>× 1</td>
<td>614400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>307200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>153600</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10bit</td>
<td>× 1</td>
<td>153600</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>76800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>38400</td>
</tr>
<tr>
<td>CR × 2</td>
<td>12-bit or automatic resolution switching</td>
<td>307200</td>
<td>× 1</td>
<td>307200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>153600</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>76800</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10bit</td>
<td>× 1</td>
<td>76800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>38400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>19200</td>
</tr>
<tr>
<td>CR × 4</td>
<td>12-bit or automatic resolution switching</td>
<td>153600</td>
<td>× 1</td>
<td>153600</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>76800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>38400</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10bit</td>
<td>× 1</td>
<td>38400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>19200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>9600</td>
</tr>
<tr>
<td>CR360000</td>
<td>12-bit/10-bit automatic resolution switching</td>
<td>360000</td>
<td>× 1</td>
<td>360000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>180000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>90000</td>
</tr>
<tr>
<td>CR36000</td>
<td>12-bit/10-bit automatic resolution switching</td>
<td>36000</td>
<td>× 1</td>
<td>36000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>18000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>9000</td>
</tr>
<tr>
<td>CR3600</td>
<td>12-bit/10-bit automatic resolution switching</td>
<td>3600</td>
<td>× 1</td>
<td>3600</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>1800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>900</td>
</tr>
</tbody>
</table>
### SS Motor series

Table 9-8: Pulse train resolution (SS Motor series)

<table>
<thead>
<tr>
<th>CR Parameter</th>
<th>Resolver resolution</th>
<th>Resolution (pulses/360°) = number of pulses necessary for giving the Motor one turn</th>
<th>CW &amp; CCW format, Step &amp; Direction format</th>
<th>øA/øB format</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR × 1</td>
<td>12-bit or automatic resolution switching</td>
<td>491520</td>
<td>× 1</td>
<td>491520</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>245760</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>122880</td>
</tr>
<tr>
<td></td>
<td>10bit</td>
<td>122880</td>
<td>× 1</td>
<td>122880</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>61440</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>30720</td>
</tr>
<tr>
<td>CR × 2</td>
<td>12-bit or automatic resolution switching</td>
<td>245760</td>
<td>× 1</td>
<td>245760</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>122880</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>61440</td>
</tr>
<tr>
<td></td>
<td>10bit</td>
<td>61440</td>
<td>× 1</td>
<td>61440</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>30720</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>15360</td>
</tr>
<tr>
<td>CR × 4</td>
<td>12-bit or automatic resolution switching</td>
<td>122880</td>
<td>× 1</td>
<td>122880</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>61440</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>30720</td>
</tr>
<tr>
<td></td>
<td>10bit</td>
<td>30720</td>
<td>× 1</td>
<td>30720</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>15360</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>7680</td>
</tr>
<tr>
<td>CR360000</td>
<td>12-bit/10-bit automatic resolution switching</td>
<td>360000</td>
<td>× 1</td>
<td>360000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>180000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>90000</td>
</tr>
<tr>
<td>CR36000</td>
<td>12-bit/10-bit automatic resolution switching</td>
<td>36000</td>
<td>× 1</td>
<td>360000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>180000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>90000</td>
</tr>
<tr>
<td>CR3600</td>
<td>12-bit/10-bit automatic resolution switching</td>
<td>3600</td>
<td>× 1</td>
<td>36000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>18000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>9000</td>
</tr>
</tbody>
</table>
### Table 9-9: Pulse train resolution (AS, BS and JS0)

<table>
<thead>
<tr>
<th>CR Parameter</th>
<th>Resolver resolution</th>
<th>Resolution (pulses/360°) = number of pulses necessary for giving the Motor one turn</th>
<th>CW &amp; CCW format, Step &amp; Direction format</th>
<th>øA/øB format</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR × 1</td>
<td>12-bit or automatic resolution switching</td>
<td>409600</td>
<td>× 1</td>
<td>409600</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>204800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>102400</td>
</tr>
<tr>
<td>(Shipping set)</td>
<td>10bit</td>
<td>102400</td>
<td>× 1</td>
<td>102400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>51200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>25600</td>
</tr>
<tr>
<td>CR × 2</td>
<td>12-bit or automatic resolution switching</td>
<td>204800</td>
<td>× 1</td>
<td>204800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>102400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>51200</td>
</tr>
<tr>
<td></td>
<td>10bit</td>
<td>51200</td>
<td>× 1</td>
<td>51200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>25600</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>12800</td>
</tr>
<tr>
<td>CR × 4</td>
<td>12-bit or automatic resolution switching</td>
<td>102400</td>
<td>× 1</td>
<td>102400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>51200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>25600</td>
</tr>
<tr>
<td></td>
<td>10bit</td>
<td>25600</td>
<td>× 1</td>
<td>25600</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>12800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>6400</td>
</tr>
<tr>
<td>CR360000</td>
<td>12-bit/10-bit automatic resolution switching</td>
<td>360000</td>
<td>× 1</td>
<td>3600000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>1800000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>900000</td>
</tr>
<tr>
<td>CR36000</td>
<td>12-bit/10-bit automatic resolution switching</td>
<td>36000</td>
<td>× 1</td>
<td>36000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>18000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>9000</td>
</tr>
<tr>
<td>CR3600</td>
<td>12-bit/10-bit automatic resolution switching</td>
<td>3600</td>
<td>× 1</td>
<td>3600</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 2</td>
<td>1800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>× 4</td>
<td>900</td>
</tr>
</tbody>
</table>

**Note:** In the øA/øB format, one cycle of either øA or øB is defined as “one pulse”.

**Figure 9-6**

- The resolver resolution is set by the RR parameter (via RS-232C).
9.2.3.3. Input Timing

**Caution**: The following specifies the conditions of pulse acceptance timing. Besides these conditions, the Motor operation is restricted by the maximum velocity. Do not input pulses faster than Motor’s maximum velocity.

(1) When PC is set to “0” (PC0)

*Figure 9-7*

```
<table>
<thead>
<tr>
<th></th>
<th>CW Rotation</th>
<th>CCW Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWP input: CW pulses</td>
<td>on</td>
<td>Min. 600ns</td>
</tr>
<tr>
<td></td>
<td>off</td>
<td>Min. 600ns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Min. 1µs</td>
</tr>
</tbody>
</table>
```

(2) When PC is set to 1 (PC1)

*Figure 9-8*

```
<table>
<thead>
<tr>
<th></th>
<th>CW Rotation</th>
<th>CCW Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWP input: Direction</td>
<td>on</td>
<td>Min. 500ns</td>
</tr>
<tr>
<td></td>
<td>off</td>
<td>Min. 500ns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Min. 500ns</td>
</tr>
<tr>
<td>CCWP input: Step</td>
<td>on</td>
<td>Min. 600ns</td>
</tr>
<tr>
<td></td>
<td>off</td>
<td>Min. 600ns</td>
</tr>
</tbody>
</table>
```

(3) When PC is set to 2~4 (PC2~PC4)

*Figure 9-9*

```
<table>
<thead>
<tr>
<th></th>
<th>CW Rotation</th>
<th>CCW Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWP input: øA</td>
<td>on</td>
<td>Min. 2µs</td>
</tr>
<tr>
<td></td>
<td>off</td>
<td>Min. 2µs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Min. 5µs</td>
</tr>
<tr>
<td>CCWP input: øB</td>
<td>on</td>
<td>Min. 1µs</td>
</tr>
<tr>
<td></td>
<td>off</td>
<td>Min. 1µs</td>
</tr>
</tbody>
</table>
```
9.2.4. RS-232C Position Commands

- You can execute indexing using RS–232C commands. The commands/parameters are shown below. Refer to “13. Commands and Parameters” for more details.

Table 9-10
<table>
<thead>
<tr>
<th>Command/parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID command</td>
<td>Sets the target and executes rotation (incremental/in the units of degree)</td>
</tr>
<tr>
<td>IR command</td>
<td>Sets the target and executes rotation (incremental/in the units of pulse)*</td>
</tr>
<tr>
<td>AD command</td>
<td>Sets the target and executes rotation (absolute/in the units of degree)</td>
</tr>
<tr>
<td>AR command</td>
<td>Sets the target and executes rotation (absolute/in the units of pulse)*</td>
</tr>
<tr>
<td>HS command</td>
<td>Starts Home Return.</td>
</tr>
<tr>
<td>HV parameter</td>
<td>Sets Home Return velocity.</td>
</tr>
<tr>
<td>HA parameter</td>
<td>Sets Home Return acceleration.</td>
</tr>
<tr>
<td>HO parameter</td>
<td>Sets the home offset value.</td>
</tr>
<tr>
<td>HD parameter</td>
<td>Specifies Home Return direction.</td>
</tr>
<tr>
<td>MA parameter</td>
<td>Sets the acceleration, for indexing.</td>
</tr>
<tr>
<td>MV parameter</td>
<td>Sets the velocity, for indexing.</td>
</tr>
</tbody>
</table>

*: The table below lists the number of pulses per rotation of the IR command.

Table 9-11: Motor type and resolution
<table>
<thead>
<tr>
<th>Motor series</th>
<th>Resolution [pulses/rotation]</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS, JS1, JS2, RS</td>
<td>614400</td>
</tr>
<tr>
<td>SS</td>
<td>491520</td>
</tr>
<tr>
<td>AS, BS, JS0</td>
<td>614400</td>
</tr>
</tbody>
</table>

Indexing Timing

Figure 9-10: Indexing timing

*: CR stands for the carriage return code (0DH).

- Under SVON state, as soon as the command is input, the Motor starts indexing. The acceleration and velocity follow the settings of parameters “MA” and “MV”.
- If the position error counter value is within the in–position limit (set by IN parameter) after indexing, the IPOS output should be closed.
9.2.5. Jog Operation

- Set system to servo-on. (SVON input ON)

- Turning on the Jog input makes the Motor start acceleration and rotation. The Motor keeps rotating while the Jog input remains on. When the Jog input is off, the Motor starts decelerating, then stops.

- When the DIR input is off, the Motor turns CW. When the DIR input is on, it turns CCW.

- Jog operation parameter
  - JA: Jog acceleration
  - JV: Jog velocity

Figure 9-11: Jog operation timing

Note: When the DIR input is switched during Motor rotation as shown in the above chart, the Motor decelerates, then reverses the direction of rotation.
9.3. Velocity Control Mode Operation

- Velocity control mode can be set with the SL parameter.
  SL1: Torque control mode
  SL2: Velocity control mode
  SL3: Position control mode

- Velocity control mode is available in the analog command input or RS-232C command input.

- The mode is switched by the parameter AC.
  AC0: Analog command input invalid. DC command becomes valid.
  AC1: Analog command input valid.
  When input voltage polarity is + (positive): CCW direction
  AC-1: Analog command input valid
  When input voltage polarity is - (negative): CW direction

9.3.1. RS-232C Communication Command

- In the velocity control mode, the operation of the Motor can be executed through RS-232C communication command.

- Setting the parameter AC (AC0) makes the DC command valid.
  Then input
  \[
  \text{D C} \quad \text{(data)} \quad \text{ENT}
  \]
  to control the Motor under the proportional speed to the command data value.

- The relation between the command DC data and velocity is shown in Figure 9-12.

Figure 9-12

(Caution): When the polarity of the position scale is reversed by setting DI parameter, the polarity of DC command is also reversed.

Table 9-12

<table>
<thead>
<tr>
<th>Motor series</th>
<th>Maximum velocity (Resolver resolution: 12 bit)</th>
<th>Maximum velocity (Resolver resolution: 10 bit or automatic switching)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS, JS1, JS2, RS</td>
<td>1 r.p.s.</td>
<td>3 r.p.s.</td>
</tr>
<tr>
<td>SS</td>
<td>1.25 r.p.s.</td>
<td>3.75 r.p.s.</td>
</tr>
<tr>
<td>AS, BS, JS0</td>
<td>1.5 r.p.s.</td>
<td>4.5 r.p.s.</td>
</tr>
</tbody>
</table>
9.3.2. Analog Velocity Command

- In the velocity control mode operation, the Motor may be controlled directly by inputting analog command.
  - Voltage range of analog command is ±10V. The offset adjustment may be performed with VR1 pod on the front panel of a Driver Unit.
  - Setting the parameter AC reverses the polarity of analog command voltage.
    - AC1 : Analog voltage + : CCW
    - AC -1 : Analog voltage + : CW
  - The parameter AGV changes the relation between analog voltage and velocity.

Figure 9-13

<table>
<thead>
<tr>
<th>AC1: CCW when polarity is positive (+)</th>
<th>AC -1: CW when polarity is negative (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Graph 1" /></td>
<td><img src="image2.png" alt="Graph 2" /></td>
</tr>
<tr>
<td>AGV = 0.5</td>
<td>AGV = 1</td>
</tr>
<tr>
<td>AGV = 1</td>
<td>AGV = 2</td>
</tr>
<tr>
<td>CCW maximum velocity</td>
<td>CCW maximum velocity</td>
</tr>
<tr>
<td>+10V</td>
<td>+10V</td>
</tr>
<tr>
<td>-10V</td>
<td>-10V</td>
</tr>
</tbody>
</table>

Table 9-13

<table>
<thead>
<tr>
<th>Motor series</th>
<th>Resolver resolution: 12 bit</th>
<th>Resolver resolution: 10 bit or automatic switching</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS, JS1, JS2, RS</td>
<td>1 r.p.s.</td>
<td>3 r.p.s.</td>
</tr>
<tr>
<td>SS</td>
<td>1.25 r.p.s.</td>
<td>3.75 r.p.s.</td>
</tr>
<tr>
<td>AS, BS, JS0</td>
<td>1.5 r.p.s.</td>
<td>4.5 r.p.s.</td>
</tr>
</tbody>
</table>
The parameter DBA sets the dead band for analog command input. One unit of data sets ±4.9mV dead band.

Figure 9-14: Example DBA100 (AC1)
9.4. Torque Control Mode Operation

- Torque control mode can be set with the SL parameter.
  - SL1: Torque control mode
  - SL2: Velocity control mode
  - SL3: Position control mode

- Torque control mode is available in the analog command input or RS-232C command input.

- The mode is switched by the parameter AC.
  - AC0: Analog command input invalid. DC command becomes valid.
  - AC1: Analog command input valid.
    - When input voltage polarity is + (positive): CCW direction
  - AC-1: Analog command input valid
    - When input voltage polarity is - (negative): CW direction

9.4.1. RS-232C Communication Command

- In the torque control mode, the operation of the Motor can be executed through RS-232C communication command.

- Setting the parameter AC (AC0) makes the DC command valid.
  Then input
  
  ![button_image]

  to control the Motor under the proportional speed to the command data value.

- The relation between the command DC data and torque is shown in Figure 9-15.

*Figure 9-15*

- Torque output varies with the Motor type.
9.4.2. Analog Torque Command

- In the torque control mode operation, the Motor may be controlled directly by inputting analog command.
  - Voltage range of analog command is ±10V. The offset adjustment may be performed with VR1 pod on the front panel of a Driver Unit.
  - Setting the parameter AC reverses the polarity of analog command voltage.
    - AC1 : Analog voltage + : CCW
    - AC -1 : Analog voltage + : CW
  - The parameter AGT changes the relation between analog voltage and torque.

*Figure 9-16*

- The parameter DBA sets the dead band for analog command input.
  One unit of data sets ±4.9mV dead band.

*Figure 9-17: Example of DBA100 (AC1)*
10. Programming

- The Driver Unit can store indexing profiles in its memory. To index along the stored indexing motion profile, external input (CN5 connector signal) is used. This function is called “Programmable Indexer”.

- The program of an indexing motion profile can be done via RS-232C communication. (Handy Terminal FHT11 or a personal computer.) The programming can be input only when the Motor is not indexing.

- The program area is shown in Figure 10-1. There are 64 channels ranging from channel 0 to 64.

\[\text{Figure 10-1}\]

<table>
<thead>
<tr>
<th>Channel 0</th>
<th>CH0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel 1</td>
<td>CH1</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Channel 64</td>
<td>CH64</td>
</tr>
</tbody>
</table>
10.1. Commands and Parameters

**Home Return**

Command : HS  Condition setting : None

- Program Home Return operation.

- Command format : HS seq
  seq : sequence code (*, &) Refer to “Sequence Code” in next page.

- The Motor rotates according to the values set by Home Return velocity HV, Home Return acceleration HA, Home Return near-zero velocity HZ, and to the direction set by Home Return direction HD.

(Caution) : Direction of Home Return may be reversed using HD parameter.

- HD0 : CW direction
- HD1 : CCW detection (Shipping set)

*Program example

: CH0
  HS

**Positioning**

Command : AD  Condition setting : CV

AR  CA
ID  Can be omitted
IR

- Program the Indexing motion profile.

<table>
<thead>
<tr>
<th>Command format</th>
<th>Outline</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD d1 d3 seq</td>
<td>• Absolute indexing, in the units of degree.</td>
<td>Option code d3</td>
</tr>
<tr>
<td></td>
<td>• The Motor turns to reach the d1 [× 0.01°] position of position scale.</td>
<td>/PL: CW direction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>/MI: CCW direction</td>
</tr>
<tr>
<td>AR d1 d3 seq</td>
<td>• Absolute indexing in the units of pulse.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The Motor turns to reach the d1 [pulse] position of position scale.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• When d3 is omitted, the Motor turns in the shortest-distance direction to reach the d1 position.</td>
</tr>
<tr>
<td>ID d1 d2 seq</td>
<td>• Incremental indexing, in the units of degree.</td>
<td>Option code d2</td>
</tr>
<tr>
<td></td>
<td>• The Motor makes a d1 [× 0.01°] turn from the present position.</td>
<td>/n: (n &lt;= 99)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• When d2 is specified, the d1 value is equally divided by n. Single RUN input will make motor rotate by the divided amount.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• When d2 is omitted, the d1 value will not be divided.</td>
</tr>
<tr>
<td>IR d1 d2 seq</td>
<td>• Incremental indexing in the units of pulse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The Motor makes a d1 [pulse] turn from the present position.</td>
<td></td>
</tr>
</tbody>
</table>
seq stands for the sequence code (*, &), which sets the execution condition of the next channel in the sequence.

- Velocity CV and acceleration CA can be set in the same channel. When CV and CA are omitted, the Motor operates according to the values set by MV and MA, respectively.

*Program example

```plaintext
:CH0
IR9000/2
CV1.5
CA5
```

**Jump**

Command : JP  Condition setting : None

- Unconditional jump command
- Control jumps to the specified channel, and it’s program will be executed continuously.
- Command format JPm
  m : Jump destination channel No. (default: 0).

*Program example

```plaintext
:CH0
IR1000&
:CH1
IR2000&
:CH2
JP0
```
## Sequence Code

**Command :** (HS)  
**Condition setting :** \*  
(AD)  
(AR)  
(ID)  
(IR)

- Add a sequence code to the command to continuously execute the next channel. In this case, you do not have to externally select a channel.

### Table 10-2

<table>
<thead>
<tr>
<th>Sequence code</th>
<th>IPOS output</th>
<th>Execution of the next channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>* : asterisk</td>
<td>Yes</td>
<td>Executes next program continuously after positioning is over.</td>
</tr>
<tr>
<td>&amp; : ampersand</td>
<td>Yes</td>
<td>Stops after indexing, then waits for RUN command.</td>
</tr>
</tbody>
</table>

*Program example*

:CH0
IR500*
:CH1
IR1000&

### Figure 10-4

![Figure 10-4](image)

### Changing Sequence Code

**Condition setting :** OE

- OEseq changes the presently set sequence code.

* Program example

:CH0
AR9000&
CV0.5
?OE*
?
:TC0
AR9000*
CV0.5
:

1. Declare the channel whose sequence code is to be changed.
2. Input.
3. Check the new data programmed in this channel.
4. The sequence code has changed from \& to \*\*.
## 10.2. Program Editing Command

Table 10-3: Program editing command

<table>
<thead>
<tr>
<th>Editing</th>
<th>Command</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing Program Settings</td>
<td>CH</td>
<td>● Typing [\text{CH m ENT}] declares the channel to be changed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(m: desired channel number)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● The display shows the present program and waits for the changes.</td>
</tr>
<tr>
<td>Display Program</td>
<td>TC</td>
<td>(The prompt is in “?” state.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● The last input program or data always becomes valid.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Typing [\text{TC m ENT}] displays the program in desired channel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(m: desired channel number)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● When checking the program in all channels, type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[\text{TC AL ENT}].</td>
</tr>
<tr>
<td>Deleting Program</td>
<td>CC</td>
<td>● Typing [\text{TC m ENT}] deletes the program in the desired channel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(m: desired channel number)</td>
</tr>
</tbody>
</table>
10.3. Inputting a Program

**Programming**

(1) **C H 1 # 0 ?**
Select a channel to be programmed.

(2) **ENT**
Press the enter key to execute a command.
The motion profile presently programmed in the channel appears on the display.
The prompt “?” appears to wait for an input.

(3) **I R 9 0 ? 0 ? 0 ?**

(4) **ENT**
Enter a command. Press the enter key to set the command.

(5) **C V 0 ? . = 5 %**
Set conditions according to the command.

(6) **ENT**
Press the enter to get the prompt “?” for next command. When incorrect data is input, reenter the correct data. When the same command with different data is input twice, the last input becomes valid.

**Reading channel program**

(1) **T C 1 # 0 ?**
Declare the channel to be read and press the enter key.

(2) **ENT**
The display shows the motion profile of the selected channel.
Deleting the program

(1) `C C 1 # 0 ?`
Declare the channel whose data is to be deleted.

(2) `ENT`
Pressing the enter key deletes the data programmed in the channel.
10.4. Sample Program

- Write the following motion profile in Channel 5.
  - Travel angle 30.00 degrees in the CCW direction
  - Acceleration CA: 5 [r.p.s/s]
  - Velocity CV: 0.5 [r.p.s]

1. Check that the “:” prompt is displayed on the screen.

2. **C H 5 %**

3. **ENT**
   After pressing the ENT key, the data presently programmed in Channel 5 will be shown on the display.

4. **I D - +**
   3 < 0 ? 0 ? 0 ?

5. **ENT**
   Press the ENT key to input value, and the “?” prompt appears again.

6. **C A 5 %**

7. **ENT**
   Press the ENT key to input value, and the “?” prompt appears again.

8. **C V 0 ? . = 5 %**

9. **ENT**
   Press the ENT key to input value, and the “?” prompt appears again.

10. **ENT**
    Press the ENT key again to escape programming. This completes programming.
11. Command and Parameter

- Connect Handy Terminal FHT11 to CN1 connector of the Driver Unit, then turn the power on. The system is in normal state if “NSK MEGA---” message is returned.
- Refer to “6. Handy Terminal Communication” for details.

11.1. List of Command and Parameter

- Tables 11-1, 11-2 and 11-3 are the lists of commands and parameters.
- Some parameters shown in the tables must be changed to unique values according to actual condition from the shipping set.
- Parameters parenthesized are properly set at the factory. If Changing is necessary, contact your local NSK representative.
  * : (Current Setting) Set unique value to your application. We recommend to write down the set value for your future reference. You may need to refer to them when changing the operating conditions or readjusting the system. For your convenience, a parameter and program setting list is provided in Appendix 6 of this manual.
  ** : Setting differs with the Motor type and size.
### Table 11-1: YS, JS1, JS2 and RS Motor standard setting

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Name</th>
<th>Password</th>
<th>Shipping set</th>
<th>Data range</th>
<th>Current setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG</td>
<td>Position gain</td>
<td>×</td>
<td>0.1</td>
<td>0.010 ~ 1.000</td>
<td></td>
</tr>
<tr>
<td>VG</td>
<td>Velocity gain</td>
<td>×</td>
<td>1.0</td>
<td>0.10 ~ 255.0</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Velocity integrator frequency</td>
<td>×</td>
<td>1.0</td>
<td>0.10 ~ 63.00</td>
<td></td>
</tr>
<tr>
<td>VM</td>
<td>Velocity integrator mode</td>
<td>○</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>LG</td>
<td>Low-velocity gain</td>
<td>×</td>
<td>50</td>
<td>10 ~ 100</td>
<td></td>
</tr>
<tr>
<td>TL</td>
<td>Torque limit</td>
<td>○</td>
<td>100</td>
<td>0 ~ 100</td>
<td></td>
</tr>
<tr>
<td>FO</td>
<td>Low-pass filter off velocity</td>
<td>×</td>
<td>0</td>
<td>0, 0.001 ~ 3.000</td>
<td></td>
</tr>
<tr>
<td>FP</td>
<td>Low-pass filter, Primary</td>
<td>×</td>
<td>0</td>
<td>0, 10 ~ 500</td>
<td></td>
</tr>
<tr>
<td>FS</td>
<td>Low-pass filter, Secondary</td>
<td>×</td>
<td>0</td>
<td>0, 10 ~ 500</td>
<td></td>
</tr>
<tr>
<td>NP</td>
<td>Notch filter, Primary</td>
<td>×</td>
<td>0</td>
<td>0, 10 ~ 500</td>
<td></td>
</tr>
<tr>
<td>DBP</td>
<td>Position loop dead band</td>
<td>○</td>
<td>0</td>
<td>0, 1 ~ 4095</td>
<td></td>
</tr>
<tr>
<td>DBA</td>
<td>Analog command input dead band</td>
<td>○</td>
<td>0</td>
<td>0, 1 ~ 2047</td>
<td></td>
</tr>
<tr>
<td>ILV</td>
<td>Integration limit</td>
<td>○</td>
<td>100</td>
<td>0 ~ 100</td>
<td></td>
</tr>
<tr>
<td>FF</td>
<td>Feed forward gain</td>
<td>○</td>
<td>0</td>
<td>0 ~ 1.0000</td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td>Friction compensation</td>
<td>○</td>
<td>0</td>
<td>0 ~ 2047</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>Position error counter over limit</td>
<td>×</td>
<td>50000</td>
<td>0, 1 ~ 99 999 999</td>
<td></td>
</tr>
<tr>
<td>IN</td>
<td>In–position</td>
<td>×</td>
<td>100</td>
<td>0 ~ 99 999 999</td>
<td></td>
</tr>
<tr>
<td>IS</td>
<td>In-position stability timer</td>
<td>×</td>
<td>0</td>
<td>0, 0.3 ~ 100</td>
<td></td>
</tr>
<tr>
<td>FW</td>
<td>FIN width</td>
<td>×</td>
<td>1</td>
<td>0, 0.3 ~ 100</td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>Circular resolution</td>
<td>○</td>
<td>×1</td>
<td>×1, ×2, ×4, 360000, 3600, 3600</td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>Pulse command</td>
<td>○</td>
<td>0</td>
<td>0 ~ 4</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>Resolver resolution</td>
<td>○</td>
<td>-1</td>
<td>-1, 0, 1</td>
<td></td>
</tr>
<tr>
<td>FD</td>
<td>Feedback direction mode</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>FZ</td>
<td>Feedback phase Z configuration</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>FR</td>
<td>Feedback signal resolution</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>PS</td>
<td>Position scale</td>
<td>○</td>
<td>1</td>
<td>0, 1, 2 ~ 99</td>
<td></td>
</tr>
<tr>
<td>DI</td>
<td>Direction inversion</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>OTP</td>
<td>Overtravel limit switch position</td>
<td>○</td>
<td>0</td>
<td>-999999999 ~ 999999999</td>
<td></td>
</tr>
<tr>
<td>OTM</td>
<td>Overtravel limit switch position</td>
<td>○</td>
<td>0</td>
<td>-999999999 ~ 999999999</td>
<td></td>
</tr>
<tr>
<td>MV</td>
<td>Move velocity</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 3</td>
<td></td>
</tr>
<tr>
<td>MA</td>
<td>Move acceleration</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 40</td>
<td></td>
</tr>
<tr>
<td>JV</td>
<td>Jog velocity</td>
<td>×</td>
<td>0.10</td>
<td>0.01 ~ 3</td>
<td></td>
</tr>
<tr>
<td>JA</td>
<td>Jog acceleration</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 40</td>
<td></td>
</tr>
<tr>
<td>HV</td>
<td>Home Return velocity</td>
<td>×</td>
<td>0.2</td>
<td>0.01 ~ 3</td>
<td></td>
</tr>
<tr>
<td>HA</td>
<td>Home Return acceleration</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 40</td>
<td></td>
</tr>
<tr>
<td>HZ</td>
<td>Home Return near-zero velocity</td>
<td>×</td>
<td>0.01</td>
<td>0.01 ~ 0.2</td>
<td></td>
</tr>
<tr>
<td>OS</td>
<td>Origin setting mode</td>
<td>○</td>
<td>4</td>
<td>1, 3, 4, 5</td>
<td></td>
</tr>
<tr>
<td>HD</td>
<td>Home Return direction</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>HO</td>
<td>Home offset</td>
<td>○</td>
<td>0</td>
<td>-610 304 ~ 610 304</td>
<td></td>
</tr>
<tr>
<td>(PA)</td>
<td>Phase adjust</td>
<td>○</td>
<td>700</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(OL)</td>
<td>Overload limit</td>
<td>○</td>
<td>**</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>(RC)</td>
<td>Rated current</td>
<td>○</td>
<td>**</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>LR</td>
<td>Low torque ripple</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td>I/O polarity</td>
<td>○</td>
<td>X0X0XX00</td>
<td>0, 1, X</td>
<td></td>
</tr>
<tr>
<td>NW</td>
<td>Neglect width</td>
<td>○</td>
<td>2</td>
<td>0 ~ 4</td>
<td></td>
</tr>
<tr>
<td>MM</td>
<td>Multi-line Mode</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>BM</td>
<td>Backspace mode</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>CM</td>
<td>Communication mode</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>AN</td>
<td>Axis number</td>
<td>○</td>
<td>0</td>
<td>0 ~ 15</td>
<td></td>
</tr>
<tr>
<td>WM</td>
<td>Write mode to EEPROM</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>LO</td>
<td>Load inertia</td>
<td>×</td>
<td>0</td>
<td>0.000 ~ 50.000</td>
<td></td>
</tr>
<tr>
<td>SG</td>
<td>Servo gain</td>
<td>×</td>
<td>0</td>
<td>0 ~ 30</td>
<td></td>
</tr>
<tr>
<td>(MT)</td>
<td>Factory use only</td>
<td>○</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(RI)</td>
<td>Factory use only</td>
<td>○</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(ZP)</td>
<td>Factory use only</td>
<td>○</td>
<td>1.00</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(ZV)</td>
<td>Factory use only</td>
<td>○</td>
<td>1.4</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>SL</td>
<td>Set serve loop</td>
<td>○</td>
<td>3</td>
<td>1, 2, 3</td>
<td></td>
</tr>
<tr>
<td>AC</td>
<td>Analog command mode</td>
<td>○</td>
<td>1</td>
<td>-1, 0, 1</td>
<td></td>
</tr>
<tr>
<td>AGV</td>
<td>Velocity command gain</td>
<td>○</td>
<td>1</td>
<td>0.10 ~ 2.00</td>
<td></td>
</tr>
<tr>
<td>AGT</td>
<td>Torque command gain</td>
<td>○</td>
<td>1</td>
<td>0.10 ~ 2.00</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Name</td>
<td>Password</td>
<td>Shipping set</td>
<td>Data range</td>
<td>Current setting</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>----------</td>
<td>--------------</td>
<td>------------</td>
<td>----------------</td>
</tr>
<tr>
<td>PG</td>
<td>Position gain</td>
<td>×</td>
<td>0.1</td>
<td>0.010 ~ 1.000</td>
<td></td>
</tr>
<tr>
<td>VG</td>
<td>Velocity gain</td>
<td>×</td>
<td>1.0</td>
<td>0.10 ~ 255.0</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Velocity integrator frequency</td>
<td>×</td>
<td>1.0</td>
<td>0.10 ~ 63.00</td>
<td></td>
</tr>
<tr>
<td>VM</td>
<td>Velocity integrator mode</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>LG</td>
<td>Low-velocity gain</td>
<td>×</td>
<td>50</td>
<td>10 ~ 100</td>
<td></td>
</tr>
<tr>
<td>TL</td>
<td>Torque limit</td>
<td>○</td>
<td>100</td>
<td>0 ~ 100</td>
<td></td>
</tr>
<tr>
<td>FO</td>
<td>Low-pass filter off velocity</td>
<td>×</td>
<td>0</td>
<td>0, 0.001 ~ 3.000</td>
<td></td>
</tr>
<tr>
<td>FP</td>
<td>Low-pass filter, Primary</td>
<td>×</td>
<td>0</td>
<td>0, 10 ~ 500</td>
<td></td>
</tr>
<tr>
<td>FS</td>
<td>Low-pass filter, Secondary</td>
<td>×</td>
<td>0</td>
<td>0, 10 ~ 500</td>
<td></td>
</tr>
<tr>
<td>NP</td>
<td>Notch filter, Primary</td>
<td>×</td>
<td>0</td>
<td>0, 10 ~ 500</td>
<td></td>
</tr>
<tr>
<td>DBP</td>
<td>Position loop dead band</td>
<td>○</td>
<td>0</td>
<td>0, 1 ~ 4095</td>
<td></td>
</tr>
<tr>
<td>DBA</td>
<td>Analog command input dead band</td>
<td>○</td>
<td>0</td>
<td>0, 1 ~ 2047</td>
<td></td>
</tr>
<tr>
<td>ILV</td>
<td>Integration limit</td>
<td>○</td>
<td>100</td>
<td>0 ~ 100</td>
<td></td>
</tr>
<tr>
<td>FF</td>
<td>Feed forward gain</td>
<td>○</td>
<td>0</td>
<td>0 ~ 1.0000</td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td>Friction compensation</td>
<td>○</td>
<td>0</td>
<td>0 ~ 2047</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>Position error counter over limit</td>
<td>×</td>
<td>50000</td>
<td>0, 1 ~ 99 999 999</td>
<td></td>
</tr>
<tr>
<td>IN</td>
<td>In–position</td>
<td>×</td>
<td>100</td>
<td>0 ~ 99 999 999</td>
<td></td>
</tr>
<tr>
<td>IS</td>
<td>In-position stability timer</td>
<td>×</td>
<td>0</td>
<td>0, 0.3 ~ 100</td>
<td></td>
</tr>
<tr>
<td>FW</td>
<td>FIN width</td>
<td>×</td>
<td>1</td>
<td>0, 0.3 ~ 100</td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>Circular resolution</td>
<td>○</td>
<td>×1</td>
<td>×1, ×2, ×4, 360000, 36000, 3600</td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>Pulse command</td>
<td>○</td>
<td>0</td>
<td>0 ~ 4</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>Resolver resolution</td>
<td>○</td>
<td>-1</td>
<td>-1, 0, 1</td>
<td></td>
</tr>
<tr>
<td>FD</td>
<td>Feedback direction mode</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>FZ</td>
<td>Feedback phase Z configuration</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>FR</td>
<td>Feedback signal resolution</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>PS</td>
<td>Position scale</td>
<td>○</td>
<td>1</td>
<td>0, 1, 2 ~ 99</td>
<td></td>
</tr>
<tr>
<td>DI</td>
<td>Direction inversion</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>OTP</td>
<td>Overtravel limit switch position</td>
<td>○</td>
<td>0</td>
<td>-9999999900 ~ 9999999990</td>
<td></td>
</tr>
<tr>
<td>OTM</td>
<td>Overtravel limit switch position</td>
<td>○</td>
<td>0</td>
<td>-9999999990 ~ 9999999999</td>
<td></td>
</tr>
<tr>
<td>MV</td>
<td>Move velocity</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 3.75</td>
<td></td>
</tr>
<tr>
<td>MA</td>
<td>Move acceleration</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 50</td>
<td></td>
</tr>
<tr>
<td>JV</td>
<td>Jog velocity</td>
<td>×</td>
<td>0.10</td>
<td>0.01 ~ 3.75</td>
<td></td>
</tr>
<tr>
<td>JA</td>
<td>Jog acceleration</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 50</td>
<td></td>
</tr>
<tr>
<td>HV</td>
<td>Home Return velocity</td>
<td>×</td>
<td>0.2</td>
<td>0.01 ~ 3.75</td>
<td></td>
</tr>
<tr>
<td>HA</td>
<td>Home Return acceleration</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 50</td>
<td></td>
</tr>
<tr>
<td>HZ</td>
<td>Home Return near-zero velocity</td>
<td>×</td>
<td>0.01</td>
<td>0.01 ~ 0.2</td>
<td></td>
</tr>
<tr>
<td>OS</td>
<td>Origin setting mode</td>
<td>○</td>
<td>4</td>
<td>1, 3, 4, 5</td>
<td></td>
</tr>
<tr>
<td>HD</td>
<td>Home Return direction</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>HO</td>
<td>Home offset</td>
<td>○</td>
<td>0</td>
<td>-487 424 ~ 487 424</td>
<td></td>
</tr>
<tr>
<td>(PA)</td>
<td>Phase adjust</td>
<td>○</td>
<td>700</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(OL)</td>
<td>Overload limit</td>
<td>○</td>
<td>**</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>(RC)</td>
<td>Rated current</td>
<td>○</td>
<td>**</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>LR</td>
<td>Low torque ripple</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td>I/O polarity</td>
<td>○</td>
<td>X0X0XX00</td>
<td>0, 1, X</td>
<td></td>
</tr>
<tr>
<td>NW</td>
<td>Neglect width</td>
<td>○</td>
<td>2</td>
<td>0 ~ 4</td>
<td></td>
</tr>
<tr>
<td>MM</td>
<td>Multi–line Mode</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>BM</td>
<td>Backspace mode</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>CM</td>
<td>Communication mode</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>AN</td>
<td>Axis number</td>
<td>○</td>
<td>0</td>
<td>0 ~ 15</td>
<td></td>
</tr>
<tr>
<td>WM</td>
<td>Write mode to EEPROM</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>LO</td>
<td>Load inertia</td>
<td>×</td>
<td>0</td>
<td>0,000 ~ 50,000</td>
<td></td>
</tr>
<tr>
<td>SG</td>
<td>Servo gain</td>
<td>×</td>
<td>0</td>
<td>0 ~ 30</td>
<td></td>
</tr>
<tr>
<td>(MT)</td>
<td>Factory use only</td>
<td>○</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(RI)</td>
<td>Factory use only</td>
<td>○</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(ZP)</td>
<td>Factory use only</td>
<td>○</td>
<td>1.00</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(ZV)</td>
<td>Factory use only</td>
<td>○</td>
<td>1.4</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>SL</td>
<td>Set serve loop</td>
<td>○</td>
<td>3</td>
<td>1, 2, 3</td>
<td></td>
</tr>
<tr>
<td>AC</td>
<td>Analog command mode</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td>AGV</td>
<td>Velocity command gain</td>
<td>○</td>
<td>1</td>
<td>0.10 ~ 2.00</td>
<td></td>
</tr>
<tr>
<td>AGT</td>
<td>Torque command gain</td>
<td>○</td>
<td>1</td>
<td>0.10 ~ 2.00</td>
<td></td>
</tr>
</tbody>
</table>
## Table 11-3: AS, BS and JS0 Motor standard setting

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Name</th>
<th>Password</th>
<th>Shipping set</th>
<th>Data range</th>
<th>Current setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG</td>
<td>Position gain</td>
<td>×</td>
<td>0.1</td>
<td>0.010 ~ 1.000</td>
<td>0.010 ~ 1.000</td>
</tr>
<tr>
<td>VG</td>
<td>Velocity gain</td>
<td>×</td>
<td>1.0</td>
<td>0.10 ~ 255.0</td>
<td>0.10 ~ 255.0</td>
</tr>
<tr>
<td>VI</td>
<td>Velocity integrator frequency</td>
<td>×</td>
<td>1.0</td>
<td>0.10 ~ 63.00</td>
<td>0.10 ~ 63.00</td>
</tr>
<tr>
<td>VM</td>
<td>Velocity integrator mode</td>
<td>○</td>
<td>1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>LG</td>
<td>Low-velocity gain</td>
<td>×</td>
<td>50</td>
<td>10 ~ 100</td>
<td>10 ~ 100</td>
</tr>
<tr>
<td>TL</td>
<td>Torque limit</td>
<td>○</td>
<td>100</td>
<td>0 ~ 100</td>
<td>0 ~ 100</td>
</tr>
<tr>
<td>FO</td>
<td>Low-pass filter off velocity</td>
<td>×</td>
<td>0</td>
<td>0, 0.001 ~ 3.000</td>
<td>0, 0.001 ~ 3.000</td>
</tr>
<tr>
<td>FP</td>
<td>Low-pass filter, Primary</td>
<td>×</td>
<td>0</td>
<td>0.1, 0.10 ~ 500</td>
<td>0.1, 0.10 ~ 500</td>
</tr>
<tr>
<td>FS</td>
<td>Low-pass filter, Secondary</td>
<td>×</td>
<td>0</td>
<td>0.1, 0.10 ~ 500</td>
<td>0.1, 0.10 ~ 500</td>
</tr>
<tr>
<td>NP</td>
<td>Notch filter, Primary</td>
<td>×</td>
<td>0</td>
<td>0.1, 0.10 ~ 500</td>
<td>0.1, 0.10 ~ 500</td>
</tr>
<tr>
<td>DBP</td>
<td>Position loop dead band</td>
<td>○</td>
<td>0</td>
<td>0.1, 0.10 ~ 500</td>
<td>0.1, 0.10 ~ 500</td>
</tr>
<tr>
<td>DBA</td>
<td>Analog command input dead band</td>
<td>○</td>
<td>0</td>
<td>0, 0.1 ~ 2047</td>
<td>0, 0.1 ~ 2047</td>
</tr>
<tr>
<td>ILV</td>
<td>Integration limit</td>
<td>○</td>
<td>100</td>
<td>0 ~ 100</td>
<td>0 ~ 100</td>
</tr>
<tr>
<td>FF</td>
<td>Feed forward gain</td>
<td>○</td>
<td>0</td>
<td>0 ~ 1.0000</td>
<td>0 ~ 1.0000</td>
</tr>
<tr>
<td>FC</td>
<td>Friction compensation</td>
<td>○</td>
<td>0</td>
<td>0 ~ 2047</td>
<td>0 ~ 2047</td>
</tr>
<tr>
<td>CO</td>
<td>Position error counter over limit</td>
<td>×</td>
<td>50000</td>
<td>0, 1 ~ 99 999 999</td>
<td>0, 1 ~ 99 999 999</td>
</tr>
<tr>
<td>IN</td>
<td>In–position</td>
<td>×</td>
<td>100</td>
<td>0 ~ 99 999 999</td>
<td>0 ~ 99 999 999</td>
</tr>
<tr>
<td>IS</td>
<td>In-position stability timer</td>
<td>×</td>
<td>0</td>
<td>0, 0.3 ~ 100</td>
<td>0, 0.3 ~ 100</td>
</tr>
<tr>
<td>FW</td>
<td>FIN width</td>
<td>×</td>
<td>1</td>
<td>0, 0.3 ~ 100</td>
<td>0, 0.3 ~ 100</td>
</tr>
<tr>
<td>CR</td>
<td>Circular resolution</td>
<td>○</td>
<td>x1</td>
<td>x1, x2, x4, 360000, 36000, 3600</td>
<td>x1, x2, x4, 360000, 36000, 3600</td>
</tr>
<tr>
<td>PC</td>
<td>Pulse command</td>
<td>○</td>
<td>0</td>
<td>0 ~ 4</td>
<td>0 ~ 4</td>
</tr>
<tr>
<td>RR</td>
<td>Resolver resolution</td>
<td>○</td>
<td>-1</td>
<td>-1, 0, 1</td>
<td>-1, 0, 1</td>
</tr>
<tr>
<td>FD</td>
<td>Feedback direction mode</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td>0, 1</td>
</tr>
<tr>
<td>FZ</td>
<td>Feedback phase Z configuration</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td>0, 1</td>
</tr>
<tr>
<td>FR</td>
<td>Feedback signal resolution</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td>0, 1</td>
</tr>
<tr>
<td>PS</td>
<td>Position scale</td>
<td>○</td>
<td>1</td>
<td>0, 1, 2 ~ 99</td>
<td>0, 1, 2 ~ 99</td>
</tr>
<tr>
<td>DI</td>
<td>Direction inversion</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td>0, 1</td>
</tr>
<tr>
<td>OTP</td>
<td>Overtravel limit switch position</td>
<td>○</td>
<td>0</td>
<td>-999999999 ~ 999999999</td>
<td>-999999999 ~ 999999999</td>
</tr>
<tr>
<td>OTM</td>
<td>Overtravel limit switch position</td>
<td>○</td>
<td>0</td>
<td>-999999999 ~ 999999999</td>
<td>-999999999 ~ 999999999</td>
</tr>
<tr>
<td>MV</td>
<td>Move velocity</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 4.5</td>
<td>0.01 ~ 4.5</td>
</tr>
<tr>
<td>MA</td>
<td>Move acceleration</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 60</td>
<td>0.01 ~ 60</td>
</tr>
<tr>
<td>JV</td>
<td>Jog velocity</td>
<td>×</td>
<td>0.10</td>
<td>0.01 ~ 4.5</td>
<td>0.01 ~ 4.5</td>
</tr>
<tr>
<td>JA</td>
<td>Jog acceleration</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 60</td>
<td>0.01 ~ 60</td>
</tr>
<tr>
<td>HV</td>
<td>Home Return velocity</td>
<td>×</td>
<td>0.2</td>
<td>0.01 ~ 4.5</td>
<td>0.01 ~ 4.5</td>
</tr>
<tr>
<td>HA</td>
<td>Home Return acceleration</td>
<td>×</td>
<td>1</td>
<td>0.01 ~ 60</td>
<td>0.01 ~ 60</td>
</tr>
<tr>
<td>HZ</td>
<td>Home Return near-zero velocity</td>
<td>×</td>
<td>0.01</td>
<td>0.01 ~ 0.2</td>
<td>0.01 ~ 0.2</td>
</tr>
<tr>
<td>OS</td>
<td>Origin setting mode</td>
<td>○</td>
<td>4</td>
<td>1, 3, 4, 5</td>
<td>1, 3, 4, 5</td>
</tr>
<tr>
<td>HD</td>
<td>Home Return direction</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td>0, 1</td>
</tr>
<tr>
<td>HO</td>
<td>Home offset</td>
<td>○</td>
<td>0</td>
<td>405 504 ~ 405 504</td>
<td>405 504 ~ 405 504</td>
</tr>
<tr>
<td>[PA]</td>
<td>Phase adjust</td>
<td>○</td>
<td>700</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>[OL]</td>
<td>Overload limit</td>
<td>○</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>[RC]</td>
<td>Rated current</td>
<td>○</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>LR</td>
<td>Low torque ripple</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td>0, 1</td>
</tr>
<tr>
<td>AB</td>
<td>I/O polarity</td>
<td>○</td>
<td>X0X0XX00</td>
<td>0, 1, X</td>
<td>X0X0XX00</td>
</tr>
<tr>
<td>NW</td>
<td>Neglect width</td>
<td>○</td>
<td>2</td>
<td>0 ~ 4</td>
<td>0 ~ 4</td>
</tr>
<tr>
<td>MM</td>
<td>Multi–line Mode</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td>0, 1</td>
</tr>
<tr>
<td>BM</td>
<td>Backspace mode</td>
<td>○</td>
<td>1</td>
<td>0, 1</td>
<td>0, 1</td>
</tr>
<tr>
<td>CM</td>
<td>Communication mode</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td>0, 1</td>
</tr>
<tr>
<td>AN</td>
<td>Axis number</td>
<td>○</td>
<td>0</td>
<td>0 ~ 15</td>
<td>0 ~ 15</td>
</tr>
<tr>
<td>WM</td>
<td>Write mode to EEPROM</td>
<td>○</td>
<td>0</td>
<td>0, 1</td>
<td>0, 1</td>
</tr>
<tr>
<td>LO</td>
<td>Load inertia</td>
<td>×</td>
<td>0</td>
<td>0.000 ~ 50.000</td>
<td>0.000 ~ 50.000</td>
</tr>
<tr>
<td>SG</td>
<td>Servo gain</td>
<td>×</td>
<td>0</td>
<td>0 ~ 30</td>
<td>0 ~ 30</td>
</tr>
<tr>
<td>(MT)</td>
<td>Factory use only</td>
<td>○</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(RI)</td>
<td>Factory use only</td>
<td>○</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(ZP)</td>
<td>Factory use only</td>
<td>○</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(ZV)</td>
<td>Factory use only</td>
<td>○</td>
<td>1.4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SL</td>
<td>Set serve loop</td>
<td>○</td>
<td>3</td>
<td>1, 2, 3</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>AC</td>
<td>Analog command mode</td>
<td>○</td>
<td>1</td>
<td>-1, 0, 1</td>
<td>-1, 0, 1</td>
</tr>
<tr>
<td>AGV</td>
<td>Velocity command gain</td>
<td>○</td>
<td>1</td>
<td>0.10 ~ 2.00</td>
<td>0.10 ~ 2.00</td>
</tr>
<tr>
<td>AGT</td>
<td>Torque command gain</td>
<td>○</td>
<td>1</td>
<td>0.10 ~ 2.00</td>
<td>0.10 ~ 2.00</td>
</tr>
</tbody>
</table>
11.2. Glossary

- This section provides description and specifications of commands and parameters.

- “Shipping set” denotes a value which is set at the factory before shipment.

- “Default” denotes a value which is adopted by entering a command and parameter with no data. For example, if you input “DC” only, it will be recognized and executed as “DC0”, because the default set of the “DC” command data is 0. If the command does not have a default set, then you cannot execute the command without data.

- The password must be entered before inputting a command marked with ★. Refer to “6.2.1. Password” for more details.

<table>
<thead>
<tr>
<th>★</th>
<th><strong>AB</strong></th>
<th><strong>I/O polarity</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td>AB n1 n2 n3 n4 n5 n6 n7 n8</td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>nn=0 A contact (Normally open)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>nn=1 B contact (Normally closed)</td>
<td></td>
</tr>
</tbody>
</table>
| | nn=X  
  ○ At the time of input: The port set to X does not change polarity. |
| | ○ At the time of read-out: For the port which is shown as “X”, the polarity can not be change. (A contact is fixed.) |
| Shipping set | ABX0X0XX00 (all A contacts) |
| Default | Not omissible (input all 8 digits) |

- Set the polarity of input command port.

- The ports of which the polarity can be changed are EMDT, HLS, OTP and OTM. The other ports are fixed to A contact.

- Set “X” for the port of which polarity can not be changed. If “0” or “1” is input, the display shows “?” indicating the fault input.

- Polarity setting can be read by “TS” or “?AB” command.

- The table below shows the data and port.

<table>
<thead>
<tr>
<th>Data digit</th>
<th>n1</th>
<th>n2</th>
<th>n3</th>
<th>n4</th>
<th>n5</th>
<th>n6</th>
<th>n7</th>
<th>n8</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN2 pin No.</td>
<td>25</td>
<td>12</td>
<td>24</td>
<td>11</td>
<td>23</td>
<td>10</td>
<td>22</td>
<td>9</td>
</tr>
<tr>
<td>Signal name</td>
<td>SVON</td>
<td>EMST</td>
<td>IOFF</td>
<td>HLS</td>
<td>HOS</td>
<td>CLR</td>
<td>OTM</td>
<td>OTP</td>
</tr>
</tbody>
</table>
**AC : Analog Command Mode**

Format : AC data

Data range : -1, 0, 1

Shipping set : 1

Default : 0

- Set the validity (valid/invalid) and polarity of the analog command input.
  - AC0 : Analog command input invalid. DC command is valid.
  - AC1 : Analog command input valid. Voltage + : CCW direction
  - AC-1 : Analog command input valid. Voltage + : CW direction

- When the parameter DI is set to reverse the polarity, above polarity is reversed.

- Setting of “AC” command can be read by “TS” or “?AC” command.

**AD: Absolute Positioning, Degree**

Format : AD data1/data2

Data1 : Differ with parameter “PS” [0.01°]

Default data1 : 0

Data2 : PL, MI

Default data2 : direction in which the move distance is shortest

- “data1” indicates the position of the destination. This position complies with user absolute position scale (which may be read out by issuing TP5). Refer to “8.2.1. Position Scale” for more details.

- “data1” range differs with “PS” setting.

<table>
<thead>
<tr>
<th>Data range (data1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS0</td>
</tr>
<tr>
<td>-99 999 999 ~ +99 999 999</td>
</tr>
<tr>
<td>PSn</td>
</tr>
<tr>
<td>0 ~ (36000 × n) -1</td>
</tr>
</tbody>
</table>

n: n=1-99, Shipping set: n=1

- “data2” indicates the rotational direction. When the parameter “PS” is set to “0” (PS0), “data2” setting is invalid.
  1. PL: CW direction [When the parameter “DI” is set to “1” (DI1), the direction is reversed. (CCW)]
  2. DI: CCW direction [When the parameter “DI” is set to “1” (DI1), the direction is reversed. (CW)]
  3. If the “data2” is omitted, the Motor moves to the direction in which the shortest distance to the destination. (If the present position and the destination is same, the movement is “0”.)

- This command has two functions, which depend on the usage.
  1. If it is entered in the normal standby condition (the prompt is “:”), it serves as a positioning command.
  2. If it is entered under the condition where a channel to be programmed is selected with a CH command, the Driver Unit outputs “?” and the system waits for a command to be entered, it specifies the rotational amount data to the channel.
**AG : Analog Command Gain**

- **Format**: AGV data, AGT data
- **Data range**: 0.10 ~ 2.00
- **Shipping set**: 1 (both AGV and AGT)
- **Default**: Not omissible

- This command sets the analog command gain in the velocity and torque control mode.
  
  **AGV**: Analog command gain in velocity control mode
  
  **AGT**: Analog command gain in torque control mode

- Actual gain value is in proportion to the velocity or torque command.

  - **Example**
    
    When AGV 0.5:
    
    Actual velocity command = Velocity command input × 0.5

- “TS” or “?AG” command reports the current setting.

---

**AN : Axis Number**

- **Format**: AN data
- **Data range**: 0 ~ 15
- **Shipping set**: 0
- **Default**: 0

- Sets the axis number in the daisy chain communication mode.

- “TS” command or “?AN” command reports the current setting.

- Refer to “8.3.3. Daisy Chain Communication”.

---
**AR : Absolute Positioning, Resolver**

Format : AR data1/data2
Data1 : Differs with the parameter “PS” setting.
Default data1 : 0
Data2 : PL, MI
Default data2 : Direction in which the move distance is shortest

- “data1” indicates the position of the destination. This position complies with user absolute position scale (which may be read out by issuing “TP2”). Refer to “8.2.1. Position Scale”.

- Format of “data1” differs with the parameter “PS” setting and the Motor series.

<table>
<thead>
<tr>
<th>n=1~99, Shipping set: n=1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data format (data1)</td>
</tr>
<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>YS, JS1, JS2, RS</td>
</tr>
<tr>
<td>SS</td>
</tr>
<tr>
<td>AS, BS, JS0</td>
</tr>
<tr>
<td>PS0</td>
</tr>
<tr>
<td>PSn</td>
</tr>
</tbody>
</table>

- “data 2” indicates the rotational direction. When PS parameter is set to “0 (zero)”, the “data 2” is invalid.
  1. PL: CW direction (When the parameter “DI1” is set, the direction is CCW.)
  2. MI: CCW direction (When the parameter “DI1” is set, the direction is CW.)
  3. If the “data 2” is omitted, the Motor rotates to the shortest direction to the destination. (If the current position is the same as the destination, the Motor does not rotate.)

- This command has two functions, which depend on the usage.
  1. If it is entered under the condition where a channel to be programmed is selected with a CH command, the Driver Unit outputs “?,” and the system waits for a command to be entered, it specifies the rotational amount of the Programmable Indexer channel.
  2. If it is entered in the normal standby condition, it serves as a positioning command.

**AS : Ask Daisy Chain Status**

Format : AS

- When communication in daisy chain style, AS reads out the status of each axis connected to Driver Units.
- The “AS” command is executed automatically when power is turned on in the daisy chain communication mode.
- After the “AS” command is executed, the Driver Unit of axis 0 is always selected.

**AT : Automatic Tuning**

Format : AT

- Execute “automatic tuning” to set proper servo parameters and acceleration.
**AX : Axis Select**

Format : AX data  
Data : 0 ~ 15  
Shipping set : 0  
Default : 0

- When communicating in daisy chain, AX selects the one of the Driver Unit. Selected Driver Unit sends a confirmation signal back to the RS-232C terminal.
- Confirmation message “ACC. AXn ” (n = selected Driver Unit number). The Driver Unit of axis 0 is always selected when power is turned on.
- Report command “TS” or “?AX” is valid when daisy chain communication is active.
- If “AX” is input when daisy chain is not active, an error message will be given back.
- Also if “TS” or “?AX” command is input when daisy chain is not active, an error message will be given.

(Caution) : Do not select any unit that is not connected. Otherwise, operation may hang up. To return to the normal state, press the [BS] key first, then the number of a connected Driver Unit.

**AZ : Absolute Zero Position Set**

Format : AZ  

- If the “AZ” command is executed with the Motor stationary at any position, the position is adopted as user absolute Home position.

**BM : Backspace Mode**

Format : BM data  
Data : 0 or 1  
Shipping set : 1  
Default : 0

- BM changes the function of the [BS] key.  
  - BM0: A press of the [BS] key cancels an entered character string.  
  - BM1: A press of the [BS] key deletes a character.
- TS or “?BM” command reports the current setting.
### CA : Channel Acceleration

**Format** : CA data

**Data** : Motor series

- YS, JS1, JS2, RS : 0, 0.01~40.00 [r.p.s/s]
- SS : 0, 0.01~50.00 [r.p.s/s]
- AS, BS, JS0 : 0, 0.01~60.00 [r.p.s/s]

**Default** : 0

- This command is used to specify the rotational acceleration of a given channel of the internal program.

- The “CA” command may be input under the condition where a channel to be programmed is selected with a “CH” command, the Driver Unit outputs “?,” and the system waits for a command to be entered. If it is entered in the normal stand-by state, an error occurs.

- If no setting is made in a channel (or 0 is specified), the rotational acceleration specified with an “MA” command is valid.

- “TC” command reports the current setting.
  - If “0 (zero)” is set, no response is displayed.

### CC : Clear Channel

**Format** : CC data1

**Data1** : 0 ~ 15

**Data1 default** : 0

- CC deletes the program data of a channel specified in “data.”

### CH : Channel Select

**Format** : CH data

**Data1** : 0 ~ 15

**Data1 default** : 0

- This command is to select the channel to be programmed.

- The input program can be read with “TC” command.

**Caution** : Input program when the system is servo-off state.

### CL : Clear Alarm

**Format** : CL

- “CL” command clears “excess error”, “software thermal” and “program error” alarms. (Other alarms can not be cleared with “CL” command.)
### CM : Communication Mode

<table>
<thead>
<tr>
<th>Format</th>
<th>CM data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>0 or 1</td>
</tr>
<tr>
<td>Shipping set</td>
<td>0</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- CM Selects the RS-232C communication mode.
  - CM0: Standard
  - CM1: Daisy chain communication
- The CM parameter set at the time of power-on is valid.
- To change the communication mode, change the CM parameter, turn off the power, then turn it on again.
- “TS” or “?CM” command reports the current setting.

### CO : Position Error Counter Over Limit

<table>
<thead>
<tr>
<th>Format</th>
<th>CO data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>0 or 1~99999999 [pulse]</td>
</tr>
<tr>
<td>Shipping set</td>
<td>50000</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- CO Sets the position error counter value at which the excess position error alarm is to be detected.
- When the position error exceeds the set value, the Driver Unit outputs the excess position error alarm and opens the DRDY output circuit.
- If 0 is specified, the excess position error alarm detection is invalidated (i.e., no alarm function).
- “TS” or “?CO” command reports the current setting.

### CR : Circular Resolution

<table>
<thead>
<tr>
<th>Format</th>
<th>CR data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>X1, X2, X4, 360000, 36000, 3600</td>
</tr>
<tr>
<td>Shipping set</td>
<td>X1</td>
</tr>
<tr>
<td>Default</td>
<td>Not omissible</td>
</tr>
</tbody>
</table>

- Use to specify the pulse train input resolution.
- For the details, refer to “9.2.3. Pulse Train Command Operation”.
- The resolution changes immediately after CR data is specified.
- “TS” or “?CR” command reports the current setting.
**CV : Channel Velocity**

<table>
<thead>
<tr>
<th>Format</th>
<th>CV data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>Motor series</td>
</tr>
<tr>
<td></td>
<td>YS, JS1, JS2, RS : 0, 0.01~3.00 [r.p.s]</td>
</tr>
<tr>
<td></td>
<td>SS : 0, 0.01~3.75 [r.p.s]</td>
</tr>
<tr>
<td></td>
<td>AS, BS, JS0 : 0, 0.01~4.50 [r.p.s]</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- This command is used to specify the rotational velocity of each channel of the Programmable Indexer.
- The “CV” command may be input under the condition where a channel to be programmed is selected with a “CH” command, the Driver Unit outputs “?,” and the system waits for a command to be entered. If it is entered in the normal stand-by state, an error occurs. (normal stand-by state: when the colon “:” is displayed while waiting for input.)
- If no setting is made in a channel (or 0 is specified), the rotational velocity specified with an “MV” command is valid
- “TC” command reports the current setting.
  - If “0 (zero)” is set, no response is displayed.

**DB : Dead Band**

<table>
<thead>
<tr>
<th>Format</th>
<th>DBA data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DBP Data</td>
</tr>
<tr>
<td>Data DBA</td>
<td>0, 1 ~ 2047</td>
</tr>
<tr>
<td>Data DBP</td>
<td>0.1 ~ 4095</td>
</tr>
<tr>
<td>Shipping set</td>
<td>0 (for both DBA and DBP)</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- Sets a dead band for the position loop and analog command input.
  - DBP: Position loop dead band
  - DBA: Analog command input dead band
- “TS” or “?DB” command reports current setting.
- For the details, refer to “8.2.5. Dead Band Setting : DBP”.
- For the details of DBA, refer to “9.3.2. Analog Velocity Command” or “9.4.2. Analog Torque Command”.
- For the details, refer to “8.2.5. Dead Band Setting : DBP”.
- For the details of DBA, refer to “9.3.2. Analog Velocity Command” or “9.4.2. Analog Torque Command”.
**DC : Digital RS-232C Command**

<table>
<thead>
<tr>
<th>Format</th>
<th>DC data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>-4095 ~ 4095 (data polarity in + value: CW direction)</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- This command is to directly input the operation command through RS-232C communication interface in velocity or torque control mode.
  However, the use of this command is limited to an ordinal operation or a testing operation of the Motor due to sluggish response.
- If “DC” command is input when an analog command (“AC” π command) is valid, “DC INHIBITED” message is given and the command is invalidated.
- The data of this command is cleared to “0” in following state.
  1. Servo off
  2. Emergency stop
  3. Overtravel limit
  4. Control mode selection
  5. Analog command is valid.

(Caution) : When the coordinate polarity is reversed by the parameter DI, data polarity of DC command is also reversed.

**☆ DI : Direction Inversion**

<table>
<thead>
<tr>
<th>Format</th>
<th>DI data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>0 or 1</td>
</tr>
<tr>
<td>Shipping set</td>
<td>0</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- Switches the position scale coordinate counting direction.
- For the details, refer to “8.2.1. Position Scale”.

**☆ FC : Friction Compensation**

<table>
<thead>
<tr>
<th>Format</th>
<th>FC data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>0 ~ 2047</td>
</tr>
<tr>
<td>Shipping set</td>
<td>0</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- “FC” is used to specify a compensation value to cancel rotational static friction of the Motor.
- If 0 is specified in “data”, the function is deactivated.
- Parameter FC can be obtained with the formula shown below.

\[
FC \text{ “data” } = 2047 \times \frac{\text{Static friction torque}}{\text{Motor maximum torque}}
\]

- The setting can be read with “TS” or “?FC” command.
**FD : Feed Back Direction Mode**

Format: FD data  
Data: 0, 1  
Shipping set: 0  
Default: 0  

- Reverses the output timing between φA and φB of the position feedback signal.  
  FD0: Standard; φA signal is always ahead of φB signal.  
  FD1: Reverse; φB signal is always ahead of φA signal.  
- “TS” or “?FD” command reports the current setting.

**FF : Feed Forward Gain**

Format: FF data  
Data: 0.0000 ~ 1.0000  
Shipping set: 0  
Default: 0  

- FF sets the feed forward compensation gain.  
- Setting 0 cancels the feed forward compensation function.  
- “TS” or “?FF” command reports the current setting.

**FO : Low-pass Filter OFF Velocity**

Format: FO data  
Data: Motor series  
YS, JS1, JS2, RS : 0, 0.01~3.00 [r.p.s]  
SS : 0, 0.01~3.75 [r.p.s]  
AS, BS, JS0 : 0, 0.01~4.50 [r.p.s]  
Shipping set: 0  
Default: 0  

- Sets the low pass filters (parameter FP and FS), depending upon velocity.  
- FO data sets the velocity threshold which turns ON and OFF the low pass filters.  

- When this function is set, it is possible to lower the resonance noise level without affecting on the settling time.  
- When “FO” is set to 0, the function is invalid. (The low-pass filters are always active.)
**FP : Low-pass Filter, Primary**

- Format : FP data
- Data : 0, 10 ~ 500 [Hz] or /AJ (Adjusting mode)
- Shipping set : 0
- Default : 0

- FP sets the frequency of the primary low-pass filter of the velocity loop.

- When 0 is input, the velocity-loop primary low-pass filter is set to “off”. At this time, [PRI.LPF OFF] appears on the display.

- When data other than 0 (i.e., 10 ~ 500) is input, the frequency specified by the data is set.

- The set value can be read by the “TS” command and “?FP”.

- Inputting FP/AJ can set to adjusting mode.

**FR : Feed Back Signal Resolution**

- Format : FR data
- Data : 0 or 1
- Shipping set : 0
- Default : 0

- Sets the resolution specification of the position feedback signal øA and øB.
  - FR0: 10-bit resolution specification
  - FR1: 12-bit resolution specification

- For more details, refer to “3.2.3. Functional Specification”.

- Set FR0 when the resolver resolution is set to 10-bit or automatic resolution switching by the RR parameter. If FR1 is set, øA and øB will not be output.

- Both FR0 and FR1 can be selected when the resolver resolution is set to 12-bit specification by the RR parameter.

- “TS” or “?FR” command reports the current setting.

**FS : Low-pass Filter, Secondary**

- Format : FS data
- Data : 0, 10 ~ 500 [Hz] or /AJ (Adjusting mode)
- Shipping set : 0
- Default : 0

- Sets the frequency of the secondary low-pass filter of the velocity loop.

- When 0 is input, the velocity-loop secondary low-pass filter is set to “off”. At this time, [SEC.LPF OFF] appears on the display.

- When data other than 0 (i.e., 10~500) is input, the frequency specified by the data is set.

- The set value can be read by the “TS” command and “?FS”.

- Inputting FS/AJ can set to adjusting mode.
**FW : FIN Width**

<table>
<thead>
<tr>
<th>Format</th>
<th>: FW data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>: 0 or 0.3 ~ 100 [0.1 second]</td>
</tr>
<tr>
<td>Shipping set</td>
<td>: 1</td>
</tr>
<tr>
<td>Default</td>
<td>: 0</td>
</tr>
</tbody>
</table>

- Sets the width (length) of IPOS output. Unit is 0.1 sec.
- If it is set to FW1, the time length of the IPOS output will be 0.1 sec.
- If it is set to FW0, IPOS output is in standard state and always closed when the position error counter value is less than the “IN” setting.
- When it is set to FW0.3 ~ FW100, IPOS output is closed for the moment as set when the position error counter value is less than the “IN” value.
- Refer to “8.1.8. In-Position Output” for the output timing.
- “TS” or “?FW” command reports the current setting.

**H : Home Return Acceleration**

<table>
<thead>
<tr>
<th>Format</th>
<th>: HA data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>: Motor series</td>
</tr>
<tr>
<td></td>
<td>YS, JS1, JS2, RS : 0, 0.01 ~ 40 [r.p.s/s]</td>
</tr>
<tr>
<td></td>
<td>SS : 0, 0.01 ~ 50 [r.p.s/s]</td>
</tr>
<tr>
<td></td>
<td>AS, BS, JS0 : 0, 0.01 ~ 60 [r.p.s/s]</td>
</tr>
<tr>
<td>Shipping set</td>
<td>: 1.00 [r.p.s/s]</td>
</tr>
<tr>
<td>Default</td>
<td>: Not omissible</td>
</tr>
</tbody>
</table>

- Sets Home Return acceleration.
- “TS” or “?HA” command reports the current setting.
**HD : Home Return Direction**

- **Format**: HD data
- **Data**: 0 or 1
- **Shipping set**: 1
- **Default**: 0
  - HD0: Home Return in the CW direction
  - HD1: Home Return in the CCW direction

**HO : Home Offset**

- **Format**: HO data
- **Data**: Motor series
  - YS, JS1, JS2, RS: -610304 ~ 610304 (pulse)
  - SS: -487424 ~ 487424 (pulse)
  - AS, BS, JS0: -405504 ~ 405504 (pulse)
- **Shipping set**: 0
- **Default**: 0
  - Specifies an offset value from the point where the RDC position data reaches 0 for the first time, after the Home position limit switch input (HLS on CN2) goes inactive, to the point where the Motor stops.
  - “TS” or “?HO” command reports the current setting.

**HS : Home Return Start**

- **Format**: HS
  - Starts Home Return.
  - Input HS/LS to adjust the installation position of the home limit switch (sensor).
  - For more details, refer to “9.2.1.2. Adjusting Home Limit Switch and Home Offset Value”.

**HV : Home Return Velocity**

- **Format**: HV data
- **Data**: Motor series
  - YS, JS1, JS2, RS: 0.01~3.00 [r.p.s]
  - SS: 0.01~3.75 [r.p.s]
  - AS, BS, JS0: 0.01~4.50 [r.p.s]
- **Shipping set**: 0.2
- **Default**: 0
  - Sets Home Return velocity.
  - “TS” or “?HV” command reports the current setting.
**HZ** : *Home Return Near-Zero Velocity*

- **Format**: HZ data
- **Data**: 0.01 ~ 0.20 [r.p.s.]
- **Shipping set**: 0.01 [r.p.s.]
- **Default**: Not omissible

- Sets Home Return near-zero velocity.
- “TS” or “?HZ” command reports the current setting.

**ID** : *Incremental Positioning, Degree*

- **Format**: ID data
- **Data**: –99999999 ~ +99999999 [0.01°]
- **Default**: 0

- Executes the incremental positioning command (in units of degrees) in the RS-232C communication operation.
- Data is in the units of 0.01°.
- The data sign specifies the direction of rotation.
  - data > 0: plus direction (CW)
  - data < 0: minus direction (CCW)

Example: ID-10000: The Motor turns 100° in the minus direction

**ILV** : *Integration Limit*

- **Format**: ILV data
- **Data**: 0.0 ~ 100.0 [%]
- **Shipping set**: 100

- Provides the velocity loop integration with a limiter.
- For more details, refer to “8.2.4. Integrator Limit : ILV”.
- “TS” or “?ILV” command reports the current setting.

**IN** : *In-position*

- **Format**: IN data
- **Data**: 0 ~ 99 999 999 [pulse]
- **Shipping set**: 100
- **Default**: 0

- Specify an in-position width (criterion of detecting completion of positioning). If the position error counter reads a value below the IN set value, the IPOS is output.
- “TS” or “?IN” command reports the current setting.
- When the resolver is set to 10-bit resolution, the resolution becomes one-fourth of the 12-bit setting. Therefore, only a multiple of 4 can be set (valid) as IN data.
### IO: Input /Output Monitor

**Format**: IO data opt

**Data**
- data = default or 0  --- Indicates CN2 input/output status.
- data = 1  ---------- Indicates CN2 input/output status.
  (B contact input indication is reversed.)
- data = 2  ---------- Indicates input/output status in programmed operation.
- data = 3  ---------- Indicates input/output status in Jog operation.

**Option code**
- opt = default  --------- Indicates current status.
- opt = /RP  ---------- Reading is repeated automatically.

- Indicates the status of control input/output signal (on/off, open/closed) by 1s and 0s.
  1 : Input on, output closed
  0 : Input off, output open

- To terminate IO/RP repeated automatic reading, press [BS] key.

- For more details, refer to “8.1.10.2. Monitoring I/O State”.

### IR: Incremental Positioning, Resolver

**Format**: IR data

**Data**
- 0

- Executes the incremental positioning command (in the units of pulse) in the RS-232C communication operation.

- The data sign specifies the direction of rotation (movement).
  data > 0: plus direction (CW direction)
  data < 0: minus direction (CCW direction)

### IS: In-position Stability Timer

**Format**: IS data

**Data**
- 0 or 0.3 ~ 100.0 [0.1 sec]

- Specifies the output condition of the positioning completion signal (IPOS).

- ISO0 : The IPOS output closes in positioning if the value of the position error counter is within the IN set range.
- IS data (data ≠ 0) : The IPOS output closes in positioning if the value of the position error counter is stable within the IN set range for the time specified in IS. The timer value is specified in “data” in units of 0.1 second. It may be 0.03 to 10 seconds if data is specified as 0.3 to 100.

- “TS” or “IS” command reports the current setting.

- This parameter is invalid in the pulse train operation mode.
**JA : Jog Acceleration**

Format : JA data  
Data : Motor series  
- YS, JS1, JS2, RS : 0.01~40 [r.p.s/s]  
- SS : 0.01~50 [r.p.s/s]  
- AS, BS, JS0 : 0.01~60 [r.p.s/s]  

Shipping set : 1  
Default : Not omissible

- Sets the acceleration for Jog operation.  
- “TS” or “JA” command reports the current setting.

---

**JP : Jump**

Format : JP data  
Data : 0 ~ 63  
Default : 0

- “JP” is used to specify the destination channel of unconditional jumping in an internal program.  
- If a channel with a “JP” command is executed, processing jumps to channel “data” unconditionally.  
- The “JP” command may be input under the condition where a channel to be programmed is selected with a “CH” command, the Driver Unit outputs “?,” and the system waits for a command to be entered. If it is entered in the normal stand-by state, an error occurs. (normal stand-by state: a colon “:” is displayed)  
- “TC” command reports current setting.

---

**JV : Jog Velocity**

Format : JV data  
Data : Motor series  
- YS, JS1, JS2, RS : 0.01~3.00 [r.p.s]  
- SS : 0.01~3.75 [r.p.s]  
- AS, BS, JS0 : 0.01~4.50 [r.p.s]  

Shipping set : 0.1  
Default : 0

- Sets the velocity for Jog operation.  
- “TS” or “JV” command reports the current setting.

---

**LG : Lower Velocity Gain**

Format : LG data  
Data : 0 ~ 100 (%)  
Shipping set : 0  
Default : 0

- Sets velocity loop proportional gain (VG) lowering ratio when IOFF input is activated.  
- However, LG is invalidated when an excessive position error alarm is issued.
### LO : Load Inertia

<table>
<thead>
<tr>
<th>Format</th>
<th>LO data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data range</td>
<td>0.000 ~ 50.000 [kgm²]</td>
</tr>
<tr>
<td>Shipping set</td>
<td>0</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- This sets the actual load inertia automatically when the automatic tuning is performed.
- “TS” or “?LO” command reports the current setting.

### LR : Low Torque Ripple

<table>
<thead>
<tr>
<th>Format</th>
<th>LR data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data range</td>
<td>0, 1</td>
</tr>
<tr>
<td>Shipping set</td>
<td>0</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- Selects the characteristics of the Motor torque output.
  - 0: Standard
  - 1: Low torque ripple. (the maximum Motor torque will be lowered)
- “TS” or “?LR” command reports the current setting.

### MA : Move Acceleration

<table>
<thead>
<tr>
<th>Format</th>
<th>MA data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>Motor series</td>
</tr>
<tr>
<td></td>
<td>YS, JS1, JS2, RS : 0.01~40 [r.p.s/s] or /AJ (Adjust mode)</td>
</tr>
<tr>
<td></td>
<td>SS : 0.01~50 [r.p.s/s] or /AJ (Adjust mode)</td>
</tr>
<tr>
<td></td>
<td>AS, BS, JS0 : 0.01~60 [r.p.s/s] or /AJ (Adjust mode)</td>
</tr>
<tr>
<td>Shipping set</td>
<td>1.00 [r.p.s/s]</td>
</tr>
<tr>
<td>Default</td>
<td>Not omissible</td>
</tr>
</tbody>
</table>

- Sets the rotational acceleration of the RS-232C communication positioning.
- “TS” or “?MA” command reports the current setting.
- “MA/AJ” command gets into adjusting mode.

### MI : Read Motor ID

<table>
<thead>
<tr>
<th>Format</th>
<th>MI</th>
</tr>
</thead>
</table>

- MI indicates the system ROM ID No. and the torque ROM ID No.
**MM : Multi-line Mode**

<table>
<thead>
<tr>
<th>Format</th>
<th>MM data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>0, 1</td>
</tr>
<tr>
<td>Shipping set</td>
<td>1</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- Sets the display format of commands or parameters settings with “TA”, “TC” and “TS” commands.

- “MM0” reports all contents continuously.

- When “MM1” is input, the display reports the setting pausing at each item. At this time, the colon “ : ” appears the end of command or parameter.

  [Example: MA0.01:]
  - To step to the next report, press the space key.
  - To quit from the report, press the backspace key. The colon “ : ” appears in the display and the system waits for next command.

- “TS” or “?MM” reports the current setting.

---

**MN : Monitor**

<table>
<thead>
<tr>
<th>Format</th>
<th>MN data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>0 ~ 7</td>
</tr>
<tr>
<td>Shipping set</td>
<td>0</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- Selects and sets the condition of the analog monitor.

- The setting is not backed-up in the memory. “MN” command must be entered when monitoring is required.

- Setting can be read by “?MN” command.

- The condition of monitor is shown in the table below.

<table>
<thead>
<tr>
<th>MN data</th>
<th>Monitor output</th>
</tr>
</thead>
<tbody>
<tr>
<td>MN 0</td>
<td>Velocity</td>
</tr>
<tr>
<td>MN 1</td>
<td>Velocity command</td>
</tr>
<tr>
<td>MN 2</td>
<td>Velocity error</td>
</tr>
<tr>
<td>MN 3</td>
<td>Torque command</td>
</tr>
<tr>
<td>MN 4</td>
<td>Phase C current command</td>
</tr>
<tr>
<td>MN 5</td>
<td>Position command</td>
</tr>
<tr>
<td>MN 6</td>
<td>Position error (± 127 pulses / ± 10V)</td>
</tr>
<tr>
<td>MN 7</td>
<td>Position error (± 1638 pulses / ± 10V)</td>
</tr>
</tbody>
</table>

---

**MO : Motor Off**

<table>
<thead>
<tr>
<th>Format</th>
<th>MO</th>
</tr>
</thead>
</table>

- When the SVON input (CN2) is ON and the Motor is in the servo-on state, inputting the “MO” command turns the Motor servo off.

- To activate the Motor servo, input the “SV” command or the “MS” command.

- When the “MS” command is input, the Motor stops in the servo-on state. This also clears the previously input operation command.
**MS : Motor Stop**

Format : MS

- When the “MS” command is input during the execution of an operation, the Motor abandons the programs and stops. At this time, the Motor is in the servo-on state.

- The programs specified before the Motor stop is cleared. If the “MO” command is input to turn off the Motor servo, inputting the MS command sets the Motor to servo-on again. This also clears the programs executed preceding the input of the “MO” command.

**MT : Factory Use Only**

Shipping set : Already set properly for every system.

(Caution) : Do not change the setting since the parameter is properly set at the plant.

- “TS” or “?MT” command reports the current setting.

**MV : Move Velocity**

Format : MV data

Data : Motor series

Ys, JS1, JS2, RS : 0.01~3.00 [r.p.s] or /AJ (Adjust mode)
SS : 0.01~3.75 [r.p.s] or /AJ (Adjust mode)
AS, BS, JS0 : 0.01~4.50 [r.p.s] or /AJ (Adjust mode)

Shipping set : 1.00 [r.p.s.]
Default : Not omissible

- Sets the rotational velocity of the Motor in the RS-232C communication positioning command.

- “TS” or “?MV” command reports the current setting.

- “MV/AJ” command sets to adjusting mode.

**NP : Notch Filter, Primary (primary notch filter frequency)**

Format : NP data

Data : 0 or 10 ~ 500 [Hz] or /AJ (Adjusting mode)

Shipping set : 0
Default : 0

- NP is used to specify the frequency of the primary notch filter of the velocity loop.

- If 0 is specified, the primary notch filter of the velocity loop is deactivated. In such a case, “PRI.NF OFF” is displayed.

- If a value other than 0 (i.e., 10~500) is entered, the value is adopted as the frequency.

- “TS” or “?NP” command reports the current setting.

- “NP/AJ” command sets to adjusting mode.
**NW : Neglect Width**

<table>
<thead>
<tr>
<th>Format</th>
<th>: NW data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>: 0 ~ 4</td>
</tr>
<tr>
<td>Shipping set</td>
<td>: 2</td>
</tr>
<tr>
<td>Default</td>
<td>: 0</td>
</tr>
</tbody>
</table>

- RUN and HOS are edge-triggered inputs. To protect against multiple inputs due to contact chattering, the NW parameter sets a timer length to confirm the receipt of that input; when NW data is specified, the input pulse is detected a specified time after it initially went high (rising edge).
  
  Timer = data × 2.8 [ms]

- “TS” or “?NW” command reports the current setting.

---

**OE : Sequence Option Edit**

<table>
<thead>
<tr>
<th>Format</th>
<th>: OE data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>: * or &amp;</td>
</tr>
<tr>
<td>Default</td>
<td>: Not omissible</td>
</tr>
</tbody>
</table>

- OE changes the sequence code of a program already specified in a channel.

- If this command is entered under the condition where a channel whose sequence code shall be changed is selected with a “CH” command, the Driver Unit outputs “?,” and the system waits for a command to be entered, the sequence code of the program already specified in the channel is changed into “data.” If OE is entered in the normal stand-by state, an error occurs.

- “Data” indicates the sequence code. Adding the sequence code enables to execute the positioning of next channel without selecting channel externally.
  
  - * After the positioning is over, “IPOS” signal is output and execute next channel’s program.
  - & After the positioning is over, output “IPOS” signal and stops. Then execute the next channel’s program when “RUN” command is input.

---

**OG : Origin Set**

<table>
<thead>
<tr>
<th>Format</th>
<th>: OG</th>
</tr>
</thead>
</table>

(Caution) : This “OG” command is for factory use only. Do not change the setting.

---

**OL : Overload Limit**

<table>
<thead>
<tr>
<th>Format</th>
<th>: OL data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>: 0 ~ 100</td>
</tr>
<tr>
<td>Shipping set</td>
<td>: Unique value for each System</td>
</tr>
<tr>
<td>Default</td>
<td>: 0</td>
</tr>
</tbody>
</table>

- Do not change the OL setting. OL is properly set for each System. If it needs to be changed, contact NSK.

- If 0 is specified, “THERMAL OFF” is displayed and this function is deactivated.

- “TS” or “?OL” command reports the current setting.
**OS : Home Return Setting Mode**

<table>
<thead>
<tr>
<th>Format</th>
<th>OS data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>1, 3, 4, 5</td>
</tr>
<tr>
<td>Shipping set</td>
<td>4</td>
</tr>
<tr>
<td>Default</td>
<td>Not omissible</td>
</tr>
</tbody>
</table>

- Sets the “Home Return” mode.
  - OS1: Completes “Home Return” at where “HLS” input goes OFF after entering “HLS” ON range.
  - OS3: Completes “Home Return” at where the Motor advances “HO” value after going out from “HLS” ON range.
  - OS4: Completes “Home Return” at where the Motor advances for “HO” value after entering “HLS” ON range.
  - OS5: Completes “Home Return” at where “HLS” input goes ON.

- Refer to “9.2.1. Home Return” for OS4 sequential chart.
- The Home Return setting can be checked with “TS” or “?OS” command.

**OTP/OTM : Overtravel Limit Switch Position**

<table>
<thead>
<tr>
<th>Format</th>
<th>OTP data, OTM data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>-999999999 ~ +999999999 [pulse]</td>
</tr>
<tr>
<td>Shipping set</td>
<td>OTP0, OTM0</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- Sets the software overtravel limit values in the position coordinate.
  - OTP : Sets the overtravel limit value in the plus direction in the units of pulse.
  - OTM : Sets the overtravel limit value in the minus direction in the units of pulse.

- “OTP/ST” and “OTM/ST” command enables to set the position by teaching.
  (For more details, refer to “8.1.5.2. Software Overtravel Limit Switch”.)

- “TS” or “?OTP”, “?OTM” command reports the current setting.

**PA : Phase Adjust**

<table>
<thead>
<tr>
<th>Format</th>
<th>PA data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>24 ~ 1048</td>
</tr>
<tr>
<td>Shipping set</td>
<td>700</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- Sets the compensation value of the resolver installation position.
- The resolver is set to the optimum installation position before shipment. Do not input PA in normal use.
- “TS” or “?PA” command reports the current setting.
**PC** : Pulse Command

- **Format**: PC data
- **Data**: 0 ~ 4
- **Shipping set**: 0
- **Default**: 0

- Sets the format of the pulse train input.
  - **PC0**: CW & CCW format
  - **PC1**: Pulse & direction format
  - **PC2**: øA/øB input × 1 format
  - **PC3**: øA/øB input × 2 format
  - **PC4**: øA/øB input × 4 format

- "TS" or "?PC" command reports the current setting.

---

**PG** : Position Gain

- **Format**: PG data
- **Data**: 0.010 ~ 1.000 or /AJ (adjusting mode)
- **Default**: Not omissible

- Sets proportional gain of the position loop.
- "TS" or "?PG" command reports the current setting.
- "PG/AJ" command sets to the adjusting mode.

---

**PH** : Programmed Home Return

- **Format**: PH data
- **Data**: 0 ----- Automatic Home Return invalid
  - 1 ----- Execute Home Return only once when the power is turned on and the Home position is not certain.
  - 2 ----- Execute Home Return every time before execution of the programmed operation.
- **Shipping set**: 0
- **Default**: 0

- This is to execute Home Return operation automatically before the programmed operation is performed.
- The setting makes "HS" command unnecessary and can save one channel program area.
- "TC/AL" or "?PH" command reports the current setting.
**PS** : *Position Scale*

Format: PS data  
Data: 0, 1, 2 ~ 99  
Shipping set: 1  
Default: 0

- Specifies the internal position scale type of the Megatorque Motor system.  
  - PS0: Linear position scale  
  - PS1: Single-rotation position scale  
  - PS2 to 99: Multi-rotation position scale

- “For more details, refer to “8.2.1. Position Scale”.

- “TS” or “?PS” command reports the current setting.

**RA** : *Read Analog Command*

Format: RA  
RA/RP

- Reads the analog command value when an analog command is valid.

- “RA” input reports reading only once. “RA/RP” reports the reading continuously. To quit from the continuous reading, press BS key.

- “RA INHIBITED” message will be returned when an analog command is invalid.

- The report is a decimal number in -2048 ~ 2047.

- The report includes the result of dead band setting when “DBA” (dead band) is set to an analog command.

**RC** : *Rated Current (Software Thermal)*

Format: RC data  
Data: 0 ~ 100  
Shipping set: Unique value for each Motor  
Default: 0

- Do not change the RC setting. RC is properly set for each Motor. If it needs to be changed, contact NSK.

- “TS” or “?RC” command reports the current setting.

**RI** : *Factory Use Only*

Shipping set: Set properly to each Motor.  

*Caution*: Do not change setting. It is properly set for each Motor at the factory.

- “TS” or “?RI” reports the current setting.
**RR** : Resolver Resolution

Format : RR data
Data : 0, 1, –1
Shipping set : –1
Default : 0

- Sets the resolution of the resolver.
  - RR0 : 10-bit setting
  - RR1 : 12-bit setting
  - RR–1 : Automatic resolution switching

- For details of resolution, refer to “3.2.3. Functional Specification”.

- “TS” or “?RR” command reports the current setting.

---

**SG** : Servo Gain Adjust, Minor

Format : SG data
Data : 0 ~ 30 [HZ] or /AJ (Adjust mode)
Shipping set : 0
Default : Not omissible

- Sets position loop gain in the automatic tuning minor adjustment.

- When “SG” value is changed, “PG” (position loop proportional gain), “VG” (velocity loop proportional gain) and “VI” (velocity loop integration frequency) parameter settings will be automatically revised.

- “SG/AJ” command sets to the adjusting mode.

- “TS” or “?SG” reports the current setting.

---

**SI** : Set Initial Parameters

Format : SI/data
Data range : None, AL, SY
Default : None

- Resets parameters to the shipping set value.

- The “SI” command can be input only immediately after inputting the password and when the Motor is servo-off.

- The following parameters will be initialized by SI:
  - SI : Initializes servo-related parameters (PG, VG, VI, DBP, ILV, FF, FP, FS, NP, LG, TL, SG, LO, FO, FC))
  - SI/AL : Initializes all the parameters.
  - SI/SY : Initializes all the parameters excluding PA.

* Executing “SI/AL” entails resolver phase adjustment. Be careful that the Motor is not locked by an external force. Do not perform initializing only to the Driver Unit.

(Caution) : System initialization takes about 30 seconds. Do not turn off the power while initialization is being performed. Otherwise, the memory will become faulty.

* When the memory is faulty, SI/AL will be executed even if SI or SI/SY is input.
### SL : Set Servo Loop

<table>
<thead>
<tr>
<th>Format</th>
<th>SL data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Shipping set</td>
<td>3</td>
</tr>
<tr>
<td>Default</td>
<td>Not omissible</td>
</tr>
</tbody>
</table>

- Sets the control mode.
  - SL1: Torque control mode
  - SL2: Velocity control mode
  - SL3: Position control mode

- Position control mode is valid immediately after inputting this command.

- “TS” or “?SL” command reports the current setting.

### SP : Start Program

<table>
<thead>
<tr>
<th>Format</th>
<th>SP data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data range</td>
<td>0 ~ 15 or /AJ (Adjust mode)</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

- Executes the program of a channel specified on “data”.

- “SP/AJ” command executes the demonstration program (back and forth operation).

### SV : Servo-on

<table>
<thead>
<tr>
<th>Format</th>
<th>SV</th>
</tr>
</thead>
</table>

- When the Motor servo is turned off by “MO” command, executing the “SV” command will turn the Motor servo on.

- To turn the Motor servo on by the “SV” command, the SVON input of CN2 must be on.
**TA : Tell Alarm Status**

**Format : TA**

- Reports alarm status.
- No display is shown when any alarm is not issued.
- When an alarm is detected, the display identifies an alarm as shown in the table below.

<table>
<thead>
<tr>
<th>Alarm</th>
<th>7 segments LED</th>
<th>Terminal Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory Error</td>
<td>E0</td>
<td>E0&gt;Memory Error</td>
</tr>
<tr>
<td>EEPROM Error</td>
<td>E2</td>
<td>E2&gt;EEPROM Error</td>
</tr>
<tr>
<td>Interface error</td>
<td>E8</td>
<td>E8&gt;I/F Error</td>
</tr>
<tr>
<td>Analog command error</td>
<td>E9</td>
<td>E9&gt;ADC Error</td>
</tr>
<tr>
<td>Excess Position Error</td>
<td>F1</td>
<td>F1&gt;Excess Position Error</td>
</tr>
<tr>
<td>Software Over Travel Limit</td>
<td>F2</td>
<td>F2&gt;Software Over Travel</td>
</tr>
<tr>
<td>Hardware Over Travel Limit</td>
<td>F3</td>
<td>F3&gt;Hardware Over Travel</td>
</tr>
<tr>
<td>Emergency Stop</td>
<td>F4</td>
<td>F4&gt;Emergency Stop</td>
</tr>
<tr>
<td>Program Error</td>
<td>F5</td>
<td>F5&gt;Program Error</td>
</tr>
<tr>
<td>Automatic Turing Error</td>
<td>F8</td>
<td>F8&gt;AT Error</td>
</tr>
<tr>
<td>Resolver Circuit Error</td>
<td>A0</td>
<td>A0&gt;Resolver Circuit Error</td>
</tr>
<tr>
<td>Software Thermal Sensor</td>
<td>A3</td>
<td>A3&gt;Overload</td>
</tr>
<tr>
<td>Heat Sink Overheat or</td>
<td>P0</td>
<td>P0&gt;Over Heat</td>
</tr>
<tr>
<td>Regeneration Resistor Overheat</td>
<td>P1</td>
<td>P1&gt;Over Heat</td>
</tr>
<tr>
<td>Abnormal Main AC Line Voltage</td>
<td>P2</td>
<td>P2&gt;Over Current</td>
</tr>
<tr>
<td>Over Current</td>
<td>P3</td>
<td>P3&gt;Control AC Line Under Voltage</td>
</tr>
</tbody>
</table>

- When two or more alarms are detected, each alarm is displayed on a separate line.
- Display mode set by “MM” parameter is valid.
- Display example (Emergency stop and hardware over travel limit alarm are detected in MM1 setting.)

```
:TA
F3>Hardware Over Travel;
F4>Emergency Stop;
```

**TC : Tell Channel Program**

**Format : TC data**

**Data : 0 ~ 15 or /AL**

**Default : 0**

- Reports the program contents of a channel specified on “data”.
- No data is displayed if program is not set to the channel.
- “TC/AL” command is to scroll all channels with pressing the space key.
**TE : Tell Position Error Counter**

Format : TE/RP

- Reads the value of the position error counter. The displayed value is between \(-2,147,483,648\) and \(+2,147,483,647\). If it exceeds or lowers below the upper or lower limit, it is changed into the lower or upper limit with a reversed sign.

- When only “TE” is entered, the display shows the value at the moment.

- If an /RP option is added to a “TE” command, reading is repeated automatically.

- In automatic reading, a value consisting of up to six figures is read out. If a value consists of more than six figures, “*******” is displayed.

- To terminate automatic reading, press the BS key.

**TL : Torque Limit Rate**

Format : TL data

Data : 0 ~ 100 [%]

Shipping set : 100

Default : 0

- Sets the torque limit.

- The Motor torque will be reduced to a percentage (%) of the maximum torque immediately after “TL” is input and the Motor torque is controlled not to exceed the limit.

- “TS” or “?TL” reads the current setting.

**TP : Tell Position**

Format : TP data/RP

Data : 2, 5

Shipping set : None

Default : Not omissible

- “TP” command reads the current position of the Motor in the position coordinate set by PS parameter.

- If /RP is executed with an /RP option, reading is repeated automatically.

- If only “TP data” is executed, the display shows the position at the moment.

- To terminate automatic reading, press the BS key.

- TP2/RP: in the units of pulse
  - YS, JS1, JS2, RS : 614400 pulses/revolution
  - SS : 491250 pulses/revolution
  - AS, BS, JS0 : 409600 pulses/revolution

- TP5/RP: in the units of 0.01°
  - 36000/revolution
**TR : Tell RDC Position Data**

Format : TR/RP

- TR reads data of RDC position data.
- Data is between 0 and 4095.
- If TR command is executed with /RP option, reading is repeated automatically.
- To terminate automatic reading, press the [BS] key.
- “TR” command reads out the status at the moment.

**TS : Tell Settings**

Format : TS data
Data : 0 ~ 12
Default : 0

- Reads the parameters. The parameters to be read vary with data.
  - TS0: All the following parameters
  - TS1: PG, VG, VI, VM, LG, TL
  - TS2: FO, FP, FS, NP, DBP, DBA, ILV, FF, FC
  - TS3: CO, IN, IS, FW
  - TS4: CR, PC, RR
  - TS5: FD, FZ, FR
  - TS6: PS, DI, OTP, OTM
  - TS7: MV, MA, JV, JA, HV, HA, HZ
  - TS8: OS, HD, HO
  - TS9: PA, OL, RC, LR
  - TS10: AB, NW
  - TS11: MM, BM, CM, AN, WM
  - TS12: LO, SG, MT, RI, ZP, ZV
  - TS13: SL, AC, AGV, AGT

- “MM” sets the display mode.

**VG : Velocity Gain**

Format : VG data
Data : 0.1 ~ 255.0 or /AJ (Adjusting mode)
Shipping set : 1.0
Default : Not omissible

- Sets velocity loop proportional gain.
- “VG/AJ” command sets to adjusting mode.
- “TS” or “?VG” reports the current setting.
**VI** : Velocity Integrator Frequency

- **Format**: VI data
- **Data**: 0.10 ~ 63.00 [Hz] or /AJ (Adjusting mode)
- **Shipping set**: 1.00
- **Default**: Not omissible

- Sets the integration frequency of velocity loop.
- “VI/AJ” sets to adjusting mode.
- “TS” or “?VI” reports the current setting.

**VM** : Velocity Integrator Mode

- **Format**: VM data
- **Data**: 0, 1
- **Shipping set**: 1
- **Default**: 0

- Changes the velocity loop integrator control as shown below.
  - VM0: Velocity loop P control.
  - VM1: Velocity loop PI control.

**WD**: Write Data to EEPROM

- **Format**: WD

- Writes all current settings of programs and parameters to EEPROM.
- Use this command when “WM1” (data back-up invalid) is set.

**Caution**: Approximately 30 seconds are required to execute this command.

- Do not turn the power off while executing the command.
- Otherwise, memory error alarm may be issued.
WM : Write Mode to EEPROM

Format : WM data
Data : 0 or 1
Shipping set : 0
Default : 0

- 100000 times of resetting/deleting parameters to EEPROM are possible as data back-up. However, frequent resetting/deleting of parameters may exceed the expected life of EEPROM. “WM” is to select data back-up mode to reduce frequency of parameter resetting/deleting.

  WM0: Data back-up valid
  WM1: Data back-up invalid

(Caution) : ● When the setting is changed from “WM1” to “WM0”, it takes approximately 30 seconds for storing all data.
  ● Do not turn the power off while executing the command.
  ● If the power is turned off, memory error alarm may be issued.

- When “SI” is executed, all initialized parameters are stored to EEPROM even “WM” command is set to invalid.
- “TS” or “?WM” reports the current setting.

ZP : Factory Use Only

Shipping set : 1.00

(Caution) : ● The parameter is for the automatic tuning function and is set at the factory.
  ● Do not change the setting.
  ● “TS” or “?ZP” command reports the current setting.

ZV : Factory Use Only

Shipping set : 1.4

(Caution) : ● The parameter is for automatic tuning function and to be set at the factory
  ● Do not change the setting.
  ● “TS” or “?ZP” command reports the current setting.
12. Maintenance

12.1. Precautions

- Back up Motor and Driver Unit
  - We recommend to have a back up Motor and Driver Unit for unexpected shut down of the system.

- Parameter and program back up
  - For an unexpected shut down of the Driver Unit, all parameters and programs should be recorded.
  - For your convenience, the list of parameter and program is provided in the last page of this manual.

- How to replace the driver Unit.
  - Standard ESA25 Driver Units are interchangeable with each other. It may be replaced simply by inputting same parameter settings of old Driver Unit. Following shows reference number of standard ESA25 Driver Unit.
    - M-ESA-*****A25
    - M-ESA-***** C25
    (***** represents Motor number. The Driver Unit to be replaced must have same number.)

- If your Driver Unit is not standard, refer to the specification documents for interchangeability.

- When replacing the Driver Unit, refer to “Appendix 3. How to replace ESA25 Driver Unit”.

- ESA25 Driver Unit has EEP-ROM and does not need a battery for memory back up.
  (Life of EEP-ROM: approximately 100000 cycles of writing on and off.)
12.2. Maintenance Check

12.2.1. Motor

- Since a Megatorque Motor does not have any parts which will wear out, a daily maintenance check should be enough.

- The table below shows the maintenance check and intervals. The checking interval shown in the table is reference only. It should be decided accordingly to the actual use conditions.

(Caution): Do not disassemble the Motor and resolver. If disassembling Motor is necessary, contact your local NSK representative.

Table 12-1: Motor maintenance check

<table>
<thead>
<tr>
<th>Item</th>
<th>Checking interval</th>
<th>How to check</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration/Noise</td>
<td>Daily</td>
<td>• Touching and hearing</td>
<td>• Watch daily changes</td>
</tr>
<tr>
<td>Appearance</td>
<td>According to environment</td>
<td>• Wipe off dust/slag</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Blow off slag</td>
<td></td>
</tr>
<tr>
<td>Insulation</td>
<td>Once/year</td>
<td>• Resistance test</td>
<td>• Resistance ≥ 10MΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Motor coil and ground earth)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Disconnect Driver Unit)</td>
<td></td>
</tr>
<tr>
<td>Full check</td>
<td>According to Motor condition</td>
<td>• Overhaul (NSK)</td>
<td>—</td>
</tr>
</tbody>
</table>

12.2.2. Driver Unit and Cable Set

- As a Driver Unit does not have any contact point and highly reliable semiconductors are used, the daily check is not necessary. Checking as shown in Table 12-2 are necessary at least once a year.

Table 12-2

<table>
<thead>
<tr>
<th>Item</th>
<th>Interval</th>
<th>Check point</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retighten screws</td>
<td>Once/year</td>
<td>• Terminal block screw.</td>
<td>—</td>
</tr>
<tr>
<td>Cleaning</td>
<td>Once/year</td>
<td>• Remove dust or contaminants inside of Driver Unit.</td>
<td>—</td>
</tr>
<tr>
<td>Cable check</td>
<td>Once/year</td>
<td>• Check for damages and cracks of cables.</td>
<td>• When the cable is forced to bend or twist, checking frequency should be increased.</td>
</tr>
</tbody>
</table>
12.3. Periodical Replacement of Parts

12.3.1. Motor

- There is no parts which is required to be replaced periodically.
- Refer to “12.2. Maintenance Check”.

12.3.2. Driver Unit

- Electrolytic condenser
  - The gradual chemical change of electrolytic condensers will deteriorate system function and it may result in the system failure.

\[
\begin{array}{|c|c|c|}
\hline
\text{Parts} & \text{Function} & \text{Life} & \text{How to replace} \\
\hline
\text{Electrolytic condenser} & \text{Equalize power voltage} & 10 \text{ years} & \bullet \text{Replace } \ast \text{PCB} \\
& & & \bullet \text{Replace whole unit} \\
\hline
\end{array}
\]

*PCB: Printed circuit board

Note: Life of electrolytic condenser relies on the operating conditions. The 10 years of life is rough estimation under continuous operation in normal room environment.

12.4. Storing

- Store the Motor and Driver Unit in clean and dry indoor condition.
- A Driver Unit has a lot of ventilation holes and should be covered properly to protect from dust.

\[
\begin{array}{|c|c|}
\hline
\text{Storing condition} & \text{Remarks} \\
\hline
\text{Temperature} & -20^\circ\text{C} \sim +70^\circ\text{C} \\
\text{Humidity} & 20\% \sim 80\% \\
\hline
\end{array}
\]

No condensation

12.5. 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, which comes first, one (1) year of shipment or 2400 total operation hours. 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.
13. Alarm

13.1. Identifying Alarm

- The DRDY output opens when error occurs in ESA25 Driver Unit.
- The front panel is provided with a 7-segment LED display to indicate the type of alarm. Also the “TA” command can be used to identify alarms.

13.1.1. LED Alarm Indicator

Figure 13-1

Green LED: Illuminates when the power is turned on.

7-segment LED display: Indicate the type of alarm.
- The alarm is normally indicated by a 2-digit code. Two characters are displayed alternately at certain intervals.
- When two or more alarms are detected, their codes are also indicated alternately at certain intervals.

Figure 13-2: Abnormal (example)

(Example) Excess position error F1 + Heat Sink Over-Temperature P0

Figure 13-3: The LED is indicating normal state.
13.1.2. Using TA Command

- “TA” command is to display the alarm code on the Handy Terminal screen.
- In this case, the code is not displayed at different time as the LED display.
  - Example
    - Excess position error and heat sink overheat alarms will be displayed as shown in Figure 13-4.

*Example*

Excess position error and heat sink overheat alarms will be displayed as shown in Figure 13-4.

**Figure 13-4: Alarm display**

```
:TA
F1>Excess Position Error
P0>Over Heat
:_
```

F1: Excess position error
P0: Heat sink overheat

[Example 1] Alarm is detected and identify the alarm.

1. 

2. 

3. 

   Press [ENT] key to execute and the display identifies the alarm.

- Thus the alarm is identified as “Excess position error”.
13.1.3. Alarm Code List

- Reports alarm status.
- No display is shown when any alarm is not issued.
- When an alarm is detected, the display identifies an alarm as shown in the table below.

Table 13-1: Alarm code list

<table>
<thead>
<tr>
<th>Alarm</th>
<th>7 segments LED</th>
<th>Terminal Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory Error</td>
<td>E0</td>
<td>E0&gt;Memory Error</td>
</tr>
<tr>
<td>EEPROM Error</td>
<td>E2</td>
<td>E2&gt;EEPROM Error</td>
</tr>
<tr>
<td>Interface error</td>
<td>E8</td>
<td>E8&gt;I/F Error</td>
</tr>
<tr>
<td>Analog command error</td>
<td>E9</td>
<td>E9&gt;ADC Error</td>
</tr>
<tr>
<td>Excess Position Error</td>
<td>F1</td>
<td>F1&gt;Excess Position Error</td>
</tr>
<tr>
<td>Software Over Travel Limit</td>
<td>F2</td>
<td>F2&gt;Software Over Travel</td>
</tr>
<tr>
<td>Hardware Over Travel Limit</td>
<td>F3</td>
<td>F3&gt;Hardware Over Travel</td>
</tr>
<tr>
<td>Emergency Stop</td>
<td>F4</td>
<td>F4&gt;Emergency Stop</td>
</tr>
<tr>
<td>Program Error</td>
<td>F5</td>
<td>F5&gt;Program Error</td>
</tr>
<tr>
<td>Automatic Turing Error</td>
<td>F8</td>
<td>F8&gt;AT Error</td>
</tr>
<tr>
<td>Resolver Circuit Error</td>
<td>A0</td>
<td>A0&gt;Resolver Circuit Error</td>
</tr>
<tr>
<td>Software Thermal Sensor</td>
<td>A3</td>
<td>A3&gt;Overload</td>
</tr>
<tr>
<td>Heat Sink Overheat or Regeneration</td>
<td>P0</td>
<td>P0&gt;Over Heat</td>
</tr>
<tr>
<td>Regenation Resistor Overheat</td>
<td>P1</td>
<td>P1&gt;Main AC Line Trouble</td>
</tr>
<tr>
<td>Abnormal Main AC Line Voltage</td>
<td>P2</td>
<td>P2&gt;Over Current</td>
</tr>
<tr>
<td>Over Current</td>
<td>P3</td>
<td>P3&gt;Control AC Line Under Voltage</td>
</tr>
</tbody>
</table>

- When two or more alarms are detected, each alarm is displayed on a separate line.
- Display mode set by “MM” parameter is valid.
- Display example (Emergency stop and hardware over travel limit alarm are detected in MM1 setting.)

:TA  
F3>Hardware Over Travel;  
F4>Emergency Stop; 


13.2. Details of Alarm

(Caution) : The DRDY output is normally closed. It opens on abnormal condition.

13.2.1. Normal State

- When the Motor does not operate even in normal state, following causes should be considered as shown in Table 13-2.

<table>
<thead>
<tr>
<th>Status</th>
<th>Motor condition</th>
<th>DRDY</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power-off</td>
<td>Servo-OFF</td>
<td>open</td>
<td>Power is not supplied.</td>
<td>Turn on power.</td>
</tr>
<tr>
<td>CPU Initializing</td>
<td>Servo-OFF</td>
<td>open</td>
<td>Initializing the CPU.</td>
<td>Wait for the CPU to be initialized.</td>
</tr>
<tr>
<td>SVON Input OFF</td>
<td>Servo-OFF</td>
<td>closed</td>
<td>SVON input is not active.</td>
<td>Activate the SVON input.</td>
</tr>
</tbody>
</table>

13.2.2. Alarms Related to Power Amplifier

13.2.2.1. Heat Sink Overheat or Regeneration Resistor Overheat

- [Output] DRDY: Open
- [TA] P0 > Over Heat
- [LED] P0
- [Motor Condition] Servo-OFF

Table 13-3: Cause and Remedy: Heat sink over temperature

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Duty cycles of the Motor is too high.</td>
<td>● Reduce the load and/or operation duty. Readjust acceleration/deceleration. (Stop operation, air-cool the Driver Unit.)</td>
</tr>
<tr>
<td>② Excessive load is applied.</td>
<td></td>
</tr>
<tr>
<td>③ Ambient temperature is above 50°C.</td>
<td>● Check surrounding condition of the Driver Unit.</td>
</tr>
<tr>
<td>④ Heat sink temperature exceeds 90°C due to continued heavy torque demand.</td>
<td>● Stop the operation and air-cool the Motor and Driver Unit. Then check followings.</td>
</tr>
<tr>
<td></td>
<td>○ Whether the duty cycle is too high.</td>
</tr>
<tr>
<td></td>
<td>○ Whether excessive load is applied.</td>
</tr>
<tr>
<td></td>
<td>● If no troubles are found in the above check and this alarm occurs frequently, contact NSK.</td>
</tr>
<tr>
<td>⑤ Defective PCB. (As soon as the control power is turned on, the alarm is activated.)</td>
<td>● Replace Driver Unit. (Refer to “Appendix 3. How to Replace ESA25 Driver Unit”. )</td>
</tr>
</tbody>
</table>

Notes: (1) Stop operation immediately.

(2) Even the alarm is deactivated, it is activated again when the thermal sensor is still on.

  ○ Take enough time to air-cool the Motor and Driver Unit.
13.2.2.2. Abnormal Main AC Line Voltage

[Output] DRDY: Open
[TA] P1 > Main AC Line Trouble
[LED] P1
[Motor Condition] Servo-OFF

Table 13-4: Cause and Remedy: Abnormal main AC line voltage (Over/Under)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| ① Abnormal power supply voltage. | ● Check main power supply.  
(Excessive voltage, low voltage and power source capacity.) |
| ② Main circuit voltage is excessive due to high acceleration/deceleration under heavy load. | ● Check fuse, power source and the cable, then turn power on again. |
| ○ Defective power source gives over 290V to the main power supply for power amplifier main circuit. | |
| ③ Defective power source gives under 40V to power amplifier main circuit. | |
| ④ Blown fuse.  
(Motor over temperature, abnormal power supply wiring, Driver Unit abnormal.) | ● Check blown fuse.  
● Check the fuse, power supply and cables, then turn on power again. |
| ⑤ Excessive regeneration voltage. | ● Readjust operation duty, the load and acceleration/deceleration. |
| ⑥ Defective PCB.  
(When the alarm is on after the Motor stops even power source and fuse are normal.) | ● Replace Driver Unit.  
(Refer to “Appendix 3. How to Replace ESA25 Driver Unit”.) |

Notes:(1) When the regeneration dump resistor can not process regenerative current, the voltage of direct current to main circuit will be too high and the alarm will be on.

(2) Decrease acceleration/deceleration.
13.2.2.3. Over Current

[Output] DRDY: Open
[TA] P2 > Over Current
[LED] P2
[Motor Condition] Servo-OFF

Table 13-5: Cause and Remedy: Over current

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Poor insulation of the Motor. (Refer to “Appendix 2. How to Check Motor Condition”.)</td>
<td>Replace Motor.</td>
</tr>
<tr>
<td>② Defective Motor Cable. (Refer to “Appendix 2. How to Check Motor Condition”.)</td>
<td>Replace Cable.</td>
</tr>
<tr>
<td>③ Defective FET of Power Amplifier. (When the alarm is on even the Motor and Motor cable are normal.)</td>
<td>Replace Driver Unit. (Refer to “Appendix 3. How to Replace ESA25 Driver Unit.”)</td>
</tr>
</tbody>
</table>

Note: The alarm may be accompanied with abnormal main AC line voltage (blown fuse) alarm due to excessive current flow.

13.2.2.4. Control AC Line Under-Voltage

[Output] DRDY: Open
[TA] P3 > Control AC Line Under Voltage
[LED] P3
[Motor Condition] Servo-OFF

Table 13-6: Cause and Remedy: Control AC line under-voltage

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Low voltage of control power input.</td>
<td>Check control power voltage. (Low voltage due to over current or output shorting.)</td>
</tr>
<tr>
<td>② Control circuit voltage for the power amplifier falls below 70V due to faulty power supply.</td>
<td>Turn off power, check the power supply and power cable, then turn on power again.</td>
</tr>
<tr>
<td>③ Faulty PCB. (When the alarm is on after control power is turned on.)</td>
<td>Replace Driver Unit. (Refer to “Appendix 3. How to Replace ESA25 Driver Unit”.)</td>
</tr>
</tbody>
</table>
### 13.2.3. Alarms Related to Motor

#### 13.2.3.1. Resolver Circuit Error

<table>
<thead>
<tr>
<th>[Output]</th>
<th>DRDY: Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>[TA]</td>
<td>A0 &gt; Resolver Circuit Error</td>
</tr>
<tr>
<td>[LED]</td>
<td>A0</td>
</tr>
<tr>
<td>[Motor Condition]</td>
<td>Servo-OFF</td>
</tr>
</tbody>
</table>

#### Table 13-7: Cause and Remedy: Resolver circuit error

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Resolver cable disconnected.  （Refer to “Appendix 2. How to Check Motor Condition”.)</td>
<td>• Turn off power, check the resolver cable and connector.</td>
</tr>
<tr>
<td>② Breakage of resolver cable.  （Refer to “Appendix 2. How to Check Motor Condition”.)</td>
<td>• Replace resolver cable.</td>
</tr>
<tr>
<td>③ Faulty resolver.  （Refer to “Appendix 2. How to Check Motor Condition”.)</td>
<td>• Replace Motor.</td>
</tr>
<tr>
<td>④ Faulty PCB.  （When the alarm is on even when the resolver and the cable are normal and the connector is properly secured.)</td>
<td>• Replace Driver Unit.  （Refer to “Appendix 3. How to Replace ESA25 Driver Unit”.)</td>
</tr>
</tbody>
</table>

**Note:**

1. Check the resolver cable for disconnection and shorted of wires.
2. Check the connector for contact failure.
3. When the resolver Cable is forced to move and bend, the bending radius and frequency will affect on the life of the cable. It is necessary to have a insulation and continuity tests periodically.
13.2.3.2. Software Thermal Sensor

[Output] DRDY: Open
[TA] A3 > Overload
[LED] A3
[Motor Condition] Servo-OFF

Table 13-8: Cause and Remedy: Overload

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Excessive Motor duty cycle.</td>
<td>- Reduce duty cycle and the load. Re-adjust acceleration/deceleration.</td>
</tr>
<tr>
<td></td>
<td>- The Motor is overheated and air-cooling is necessary after the Motor stops. Then turn on power. (After stopping operation, keep control power on.)</td>
</tr>
<tr>
<td>② Mechanical restraint to the Motor such as brake or an obstacle.</td>
<td>- Remove mechanical restraint.</td>
</tr>
<tr>
<td>③ Improper gain setting.</td>
<td>- Readjust gain. (Refer to “7. Tuning and Trial Running”).</td>
</tr>
<tr>
<td>④ Unmatched combination of Motor and Driver Unit.</td>
<td>- Check the combination. (Reference number of Motor and Driver Unit.)</td>
</tr>
</tbody>
</table>

Note: Do not change a parameter “CL” setting. It is properly set before shipment.

13.2.4. Alarms Related to Control

13.2.4.1. Memory Error

[Output] DRDY: Open
[TA] E0 > Memory Error
[LED] E0
[Motor Condition] Servo-OFF

Table 13-9: Cause and Remedy: Memory error

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Parameters stored in the memory have been rewritten by noise or other cause.</td>
<td>- Initialize the memory then reenter the parameters. (Refer to “11. Command and Parameter”).</td>
</tr>
<tr>
<td>② Faulty PCB. (When the memory is not functioning after initialized.)</td>
<td>- Replace Driver Unit. (Refer to “Appendix 3. How to Replace ESA25 Driver Unit”).</td>
</tr>
</tbody>
</table>

- Command “SI” initializes the memory. After initializing, some parameters are reset to shipping set. Resetting parameters are necessary.
- When the memory error occurs, read out of a parameter with “TA” command will be all “0” (Zero).
13.2.4.2. EEPROM Error

[Output] DRDY: Open
[TA] E2 > EEPROM Error
[LED] E2
[Motor Condition] Servo Free

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| 1 Faulty EEPROM of control circuit. | • Turn the power on again.  
• Replace Driver Unit.  
(Refer to “Appendix 3. How to Replace ESA25 Driver Unit.”) |

13.2.4.3. CPU Error

[Output] DRDY: Open
[TA] Disabled
[LED] Unstable
[Motor Condition] Servo-OFF

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| 1 CPU is out of control due to noise. | • Turn power on again.  
• The alarm is deactivated when the power is turned on again. If the alarm occurs frequently, contact NSK. |
| 2 Faulty PCB.  
(When the alarm is not deactivated after the power is turned on.) | • Replace Driver Unit.  
(Refer to “Appendix 3. How to Replace ESA25 Driver Unit.”) |

Note: (1) CPU is not functioning. RS-232C communication and other controls are disabled.

(2) Contact NSK if the alarm occurred.

13.2.4.4. Interface Error

[Output] DRDY : Open
[TA] E8 > I/F Error
[LED] E8
[Motor Condition] Servo-Off

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| 1 Defective I/O Board in Driver Unit | • Replace Driver Unit.  
(Refer to “Appendix 3. How to Replace ESA25 Driver Unit.”) |
### 13.2.4.5. Analog Command Error

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defective circuit of analog command input</td>
<td>Replace Driver Unit. (Refer to “Appendix 3. How to Replace ESA25 Driver Unit.”)</td>
</tr>
</tbody>
</table>

### 13.2.4.6. Excess Position Error

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position error counter value is over “CO” setting due to mechanical restraint such as brake.</td>
<td>Remove mechanical restraint.</td>
</tr>
<tr>
<td>Improper gain setting.</td>
<td>Readjust gain. (Refer to “7. Tuning and Trial Running”.)</td>
</tr>
<tr>
<td>Excessive acceleration/deceleration.</td>
<td>Decrease acceleration/deceleration.</td>
</tr>
</tbody>
</table>
| “CP” setting is too low. | Increase “CO” setting.  
Activate the “CLR” input to cancel alarm, then position error counter is cleared to 0 (Zero).  
Adjust servo parameters (VG, VI, PG).  
Adjust acceleration/deceleration (MA).  
Check the applied load. |
| Unmatched combination of Motor and Driver Unit. | Check reference number of Motor and Driver Unit. |
| Improper “PA” setting. | Set “PA” to 700. |
| Faulty PCB. (When the alarm is on even “RUN” command is not executed.) | Replace Driver Unit. (Refer to “Appendix 3. How to Replace ESA25 Driver Unit”.) |
13.2.4.7. Software Over Travel Limit

[Output] DRDY: Open
[TA] F2 > Software Over Travel
[LED] F2
[Motor Condition] Servo Lock in one direction.
(The Motor will only rotate in a direction opposite to that of the rotation limit.)

Table 13-15: Cause and Remedy: Software over travel

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>① The Motor enters the inhibited area set by OTP and OTM</td>
<td>Get out of inhibited area.</td>
</tr>
</tbody>
</table>

Note: If the Motor can not make a full turn due to obstacle or restricted area, “OTM and OTP” must be set to the point where the Motor can stop before entering the restricted area where the alarm is activated.

13.2.4.8. Hardware Over Travel Limit

[Output] DRDY: Open
[TA] F3 > Hardware Over Travel
[LED] F3
[Motor Condition] Servo Lock in one direction.
(The Motor will only rotate in the direction opposite to that of the rotation limit.)

Table 13-16: Cause and Remedy: Software over travel

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Motor activated travel limit switch.</td>
<td>Get out of the restricted area.</td>
</tr>
<tr>
<td>② Mistaken setting of input port polarity.</td>
<td>Confirm the parameter “AB”.</td>
</tr>
<tr>
<td>③ Faulty travel limit switch or wiring.</td>
<td>Check the limit switch and wiring.</td>
</tr>
</tbody>
</table>

13.2.4.9. Emergency Stop

[Output] DRDY: Closed
[TA] F4 > Emergency Stop
[LED] F4
[Motor Condition] Servo Lock

Table 13-17: Cause and Remedy: Emergency stop

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Mistaken setting of input port polarity.</td>
<td>Confirm the parameter “AB”.</td>
</tr>
<tr>
<td>② EMST is input. (A contact)</td>
<td>Clear EMST input after the Motor stops.</td>
</tr>
<tr>
<td>③ EMST is input. (B contact)</td>
<td>Input EMST on after the Motor stops.</td>
</tr>
<tr>
<td>④ Faulty wiring.</td>
<td>Check wiring.</td>
</tr>
</tbody>
</table>
13.2.4.10. Program Error

[Output] DRDY: Closed
[TA] F5 > Program Error
[LED] F5
[Motor Condition] Servo Lock

Table 13-18: Cause and Remedy: Program error

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 A non-programmed channel is started.</td>
<td>• Check the program.</td>
</tr>
<tr>
<td></td>
<td>• Check wiring of PRG0~PRG3 input.</td>
</tr>
<tr>
<td></td>
<td>• Confirm sequence.</td>
</tr>
</tbody>
</table>

13.2.4.11. Automatic Tuning Error

[Output] DRDY: Closed
[TA] F8 > AT Error
[LED] F8
[Motor Condition] Normal Servo State

Table 13-19: Cause and Remedy: Automatic tuning error

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
<th>Terminal display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 System is in Servo-OFF when executing automatic tuning</td>
<td>• Check input signal and execute automatic tuning again.</td>
<td>AT Error 1</td>
</tr>
<tr>
<td>2 EMST or Over Travel Limit is input when executing automatic tuning.</td>
<td>• Check the load condition.</td>
<td></td>
</tr>
<tr>
<td>3 Automatic tuning can not be executed due to unbalanced load.</td>
<td>• Set parameters manually.</td>
<td>AT Error 2</td>
</tr>
<tr>
<td>4 Resonant vibration occurs due to low rigidity of the load or the mounting base.</td>
<td>• Check the load or the mounting base. Increase rigidity.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Set parameters manually.</td>
<td></td>
</tr>
</tbody>
</table>
14. Troubleshooting

14.1. Identifying Problem

- If problems do occur, check the items shown in Table 14-1.
- When reporting problems to the manufacturer, explanation of the items in Table 14-1 will help to identify the problem.

<table>
<thead>
<tr>
<th>Table 14-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>1 Combination of Motor and Driver Unit</td>
</tr>
<tr>
<td>2 Power supply voltage</td>
</tr>
<tr>
<td>3 Trouble recurrence</td>
</tr>
<tr>
<td>4 Occurrence in special occasion</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>5 Occurrence under a particular operation</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>6 Alarm Code</td>
</tr>
</tbody>
</table>
14.2. Troubleshooting

- When troubleshooting, refer to the flow chart shown below.

Figure 14-1: Troubleshooting flow

START

Alarm?

no

yes

Refer to “13. Alarm.”

Which of the following areas does the problem fall under?

Power (→ 14.2.1.) *
- Power is not turned on.

Motor (→ 14.2.2.) *
- Motor servo is not turned on.
- Motor does not run in a stable manner.
  (Motor vibrates or runs away.)

Command (→ 14.2.3.) *
- Home Return command causes no motion.
- Motor does not stop in Home Return.
  (Motor reaches near-zero velocity immediately.)
- Home Return command fails to stop Motor in position.
- RUN input does not start Motor.
- Pulse train input does not run Motor.

Terminal (→ 14.2.4.) *
- Communication is disabled.
  (Improper characters are displayed.)

no

yes

Refer to corresponding sections in this chapter.

Check the condition, then contact our sales agent.

* : (→ *** ) indicates what chapter to be referred.
14.2.1. Power Trouble

Power is not turned on.

*Figure 14-2: Power trouble*

- Power is not turned on.
- Check the control power and main power on terminal block of Driver Unit front panel with tester.
  - Both control power and main power supplied? (yes or no)
    - yes: Turn on power.
    - no: Replace Driver Unit.
  - Connect Handy Terminal. Communication enable? (yes or no)
    - yes: OK
    - no: Replace Driver Unit.
14.2.2. Motor Trouble

(1) Motor servo is not turned on.

Figure 14-3: Motor trouble 1

Motor servo is not turned on.

Make sure the combination of Motor and Driver Unit is proper.

Alarm is on after the power is turned on.

Input servo-on command.

Connect Handy Terminal and execute IO1 command.

Is SVON signal is input?
(Does the display show “1” on the lefthand side?)

Turn on SVON input.

Set TL100.

Servo parameters already adjusted?

Adjust parameters.
(Refer to “7. Tuning and Trial Running”.)

Check Motor and resolver wirings.
(Refer to “Appendix 1. How to Check Motor Condition”.)

Is Motor normal?

Replace Motor.

Contact NSK representative in your area.
(2) **Motor does not run stably. / Motor vibrates or runs away.**

Figure 14-4: Motor trouble 2

- **Motor does not run stably. Motor vibrates or runs away.**
  - Make sure the combination of Motor and Driver Unit is proper.
    - **Motor installed properly?**
      - **Load connected securely?**
        - (No backlash allowed.)
        - **no**
          - Install properly.
        - **yes**
          - **Servo parameters already adjusted?**
            - **no**
              - Adjust parameters. (Refer to “7. Tuning and Trial Running”.)
            - **yes**
              - Decrease VG value.
                - **Filter used?**
                  - (Refer to “8. Operational Functions”.
                    - **Check Motor and resolver windings.** (Refer to “Appendix 1. How to Check Motor Condition”.)
                      - **Motor runs stably.**
                        - **no**
                          - Contact NSK representative in your area.
                        - **yes**
                          - End.
14.2.3. Command Trouble

(1) Home Return command causes no motion

Figure 14-5: Command trouble 1

Home Return command causes no motion.

Make sure the combination of Motor and Driver Unit is proper.

Alarm is activated after the power is turned on.

yes

no

Motor servo is active.

yes

no

EMST, OTP or OTM input is active.

yes

Deactivate EMST, OTP or OTM input.

no

Home Return starts with HOS input.

yes

no

HS command is set to the program in a channel to start Home Return.

yes

no

Confirm if HS command is programmed in the channel.

Inputs of channel selection (PRG0 ~ PRG3 inputs) and control (RUN input) are properly executed.

yes

no

Home Return starts with HS command.

yes

no

Can HS command start Home Return?

yes

no

Check CN2 connector wiring.

Check winding of Motor and Resolver.

Refer to “Appendix 1. How to Check Motor Condition”.

Is Motor normal?

yes

no

Replace Motor.

Contact NSK representative in your area.

Note 1

Verify IO state with IO command. Refer to “8.1.10.2. Monitoring I/O state”.

Note 1

Alarm is activated after the power is turned on.

Refer to “13.2. Details of Alarm”.

Note 1

Is I/O type set to TY4?

yes

no

HOS input can be switched ON from OFF.

yes

no

Can HS command start Home Return?
(2) **Motor does not stop in Home Return.**

*Figure 14-6: Command trouble 2*

Motor does not stop in Home Return.

Is “HLS” input properly activated?

*Note 1*

no → Check for the Home position limit switch and its wiring.

yes → Verify “HO” value.

*Note 1*

Verify IO state with IO command. Refer to “8.1.10.12. Monitoring I/O State”.

---

(3) **Home Return command fails to stop Motor in position.**

*Figure 14-7: Command trouble 3*

Home Return command fails to stop Motor in position.

Refer to “9.2.1.2. Adjusting Home Limit Switch and Home Offset value”.
(4) **Run input does not start Motor.**

*Figure 14-8: Command trouble 4*

- **Run input does not start Motor.**
  - Make sure combination of Motor and Driver Unit is proper.
    - Alarm is on after the power is turned on.
      - yes: Refer to “13.2. Details of Alarm”.
      - no: Refer to Figure 14-4: Motor trouble 2.
    - no: Make sure RUN command is set to channel program.
      - yes: Deactivate EMST, OTP or OTM input.
      - no: Check CN2 connector wiring.
    - yes: Inputs of channel selection (PRG0 ~ PRG5 inputs) and control (RUN input) are properly executed.
      - yes: Can “SP” command start Motor?
        - yes: Refer to “Appendix 1. How to Check Motor Condition”.
        - no: Check windings of Motor and Resolver.
      - no: Is Motor normal?
        - yes: Contact NSK representative in your area.
        - no: Replace Motor.
(5) Pulse train input does not run Motor.

Figure 14-9: Command trouble 5

Pulse train input does not run Motor.

Make sure combination of Motor and Driver Unit is proper.

Alarm is on after power is turned on. yes Refer to “13.2. Details of Alarm”.

no

Motor servo is activated. no Refer to Figure 14-4: Motor trouble 2.

yes

EMST, OTP or OTM input is active. yes Deactivate EMST, OTP or OTM input.

no

Check CN2 connector wiring.

Check windings of Motor and Resolver. Refer to “Appendix 1. How to Check Motor Condition”.


yes

Contact NSK representative in your area.
14.2.4. Terminal Trouble

Communication is Disabled

Figure 14-10: Terminal trouble

Communication is disabled. (Improper characters are displayed.)

- Check CN1 connector wiring.
- Check Driver Unit control power.
- Check frame ground.

Baud rate setting of Driver Unit and terminal is different.
(Baud rate of Driver Unit and Handy Terminal FHT11 is factory set to 9600 b.p.s.)
Appendix 1: How to Check Motor Condition

- Examine the resistance and isolation of Motor windings to find out its condition.
- Firstly conduct the checks with the Cable Set. If the result does not meet the specification, check the Motor only.

(1) Motor windings Resistance

![Figure A-1: With Cable Set](image1)

- Refer to Table A-1 for pin numbers to be checked.

![Figure A-2: Motor only](image2)

- Refer to Table A-1 for pin numbers to be checked.

<table>
<thead>
<tr>
<th></th>
<th>Cable connector</th>
<th>Motor connector</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>① ↔ ②</td>
<td>⑤ ↔ ④</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(A+) (A–)</td>
<td>(A+) (A–)</td>
<td></td>
</tr>
<tr>
<td>Phase B</td>
<td>③ ↔ ④</td>
<td>⑩ ↔ ⑨</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(B+) (B–)</td>
<td>(B+) (B–)</td>
<td></td>
</tr>
<tr>
<td>Phase C</td>
<td>⑤ ↔ ⑥</td>
<td>⑩leftrightarrow ⑪</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(C+) (C–)</td>
<td>(C+) (C–)</td>
<td></td>
</tr>
</tbody>
</table>

Table A-2: Specification

<table>
<thead>
<tr>
<th>Motor number</th>
<th>Motor winding resistance (Ω)</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS2005</td>
<td>35.0</td>
<td>1. Allowance : ±30%</td>
</tr>
<tr>
<td>YS2020</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>YS3008</td>
<td>47.0</td>
<td>2. Variations between each phase : 1Ω or less</td>
</tr>
<tr>
<td>YS3040</td>
<td>6.4</td>
<td>(øA, øB, øC)</td>
</tr>
<tr>
<td>YS4080</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>YS5120</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>JS0002</td>
<td>9.6</td>
<td></td>
</tr>
<tr>
<td>JS1003</td>
<td>15.4</td>
<td></td>
</tr>
<tr>
<td>JS2006</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>JS2014</td>
<td>14.6</td>
<td></td>
</tr>
</tbody>
</table>

- For special Motor windings or long cable (over 4m), contact NSK for specification.
(2) **Resolver windings Resistance**

*Figure A-3: With cable set*

![Diagram ofResolver windings Resistance](image)

- Refer to Table A-3 for pin numbers to be checked.

*Figure A-4: Resolver only*

![Diagram ofResolver windings only](image)

- Refer to Table A-3 for pin numbers to be checked.

**Table A-3: Pin number to be checked**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Cable connector</th>
<th>Motor connector</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>⑧ ↔ ④ (REA) (COM)</td>
<td>① ↔ ② (REA) (COM)</td>
<td></td>
</tr>
<tr>
<td>Phase B</td>
<td>⑦ ↔ ④ (REB) (COM)</td>
<td>⑥ ↔ ② (REB) (COM)</td>
<td></td>
</tr>
<tr>
<td>Phase C</td>
<td>⑬ ↔ ④ (REC) (COM)</td>
<td>⑪ ↔ ② (REC) (COM)</td>
<td></td>
</tr>
</tbody>
</table>

**Table A-4: Specification**

<table>
<thead>
<tr>
<th>Motor number</th>
<th>Resolver winding resistance (Ω)</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS2005</td>
<td>3.8</td>
<td>1. Allowance : ±30%</td>
</tr>
<tr>
<td>YS2020</td>
<td>3.8</td>
<td>2. Variations between each phase : 1.0Ω or less (øA, øB, øC)</td>
</tr>
<tr>
<td>YS3008</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>YS3040</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>YS4080</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>YS5120</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>YS240</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>JS0002</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>JS1003</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>JS2006</td>
<td>3.9</td>
<td></td>
</tr>
<tr>
<td>JS2014</td>
<td>3.8</td>
<td></td>
</tr>
</tbody>
</table>

- For special Motor windings or long cable (over 4m), contact NSK for specification.
(3) Motor Windings Isolation

**Caution**: Disconnect Driver Unit from Motor when conducting resistance test.

**Caution**: Do not apply more than DC500V.
Table A-5: Pins to be checked

<table>
<thead>
<tr>
<th></th>
<th>Cable connector</th>
<th>Motor connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A — FG</td>
<td>1 ↔ 7</td>
<td>5 ↔ 13</td>
</tr>
<tr>
<td></td>
<td>(A+) (FG)</td>
<td>(A+) (FG)</td>
</tr>
<tr>
<td>Phase B — FG</td>
<td>3 ↔ 7</td>
<td>10 ↔ 13</td>
</tr>
<tr>
<td></td>
<td>(B+) (FG)</td>
<td>(B+) (FG)</td>
</tr>
<tr>
<td>Phase C — FG</td>
<td>5 ↔ 7</td>
<td>15 ↔ 13</td>
</tr>
<tr>
<td></td>
<td>(C+) (FG)</td>
<td>(C+) (FG)</td>
</tr>
<tr>
<td>Phase A — B</td>
<td>1 ↔ 3</td>
<td>5 ↔ 10</td>
</tr>
<tr>
<td></td>
<td>(A+) (B+)</td>
<td>(A+) (B+)</td>
</tr>
<tr>
<td>Phase B — C</td>
<td>3 ↔ 5</td>
<td>10 ↔ 15</td>
</tr>
<tr>
<td></td>
<td>(B+) (C+)</td>
<td>(B+) (C+)</td>
</tr>
<tr>
<td>Phase C — A</td>
<td>5 ↔ 1</td>
<td>15 ↔ 5</td>
</tr>
<tr>
<td></td>
<td>(C+) (A+)</td>
<td>(C+) (A+)</td>
</tr>
</tbody>
</table>

Table A-6: Specification (For all Motor series)

<table>
<thead>
<tr>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>With cable : 1MΩ minimum</td>
</tr>
<tr>
<td>Motor only : 2MΩ minimum</td>
</tr>
</tbody>
</table>

(4) Motor and cables appearance check

- Check for Motor damage.
- Check for cracks of cables.
Appendix 2: Initializing Driver Unit

- When troubleshooting or replacing Motor or Driver Unit, initializing Driver Unit may be necessary.
- When initializing Driver Unit, follow procedures described hereafter.
- Use Handy Terminal FHT11 for inputting command.

**Procedures**

*Figure A-8*

<table>
<thead>
<tr>
<th></th>
<th>Note down parameter settings and channel programs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Initialize the Driver Unit with “SI” command.</td>
</tr>
<tr>
<td>3</td>
<td>Input the parameters and programs again.</td>
</tr>
</tbody>
</table>

**Explanations**

1. Read out parameter settings and channel programs and note down them. Especially “PA” value is important.

   - (i) Connect the Handy Terminal FHT11 to CN1 connector of the Driver Unit and turn on the power.
   - (ii) Monitor the parameters with “TS0” command.
   - (iii) After monitoring, turn the power off.
② Initialize the Driver Unit.

(i) Connect the Handy Terminal FHT11 to CN1 connector of the Driver Unit.

(ii) Turn on the control power only.

(iii) Input the password. When the colon “:” is displayed.

Press. / N S K S P O N ENT

(iv) The Driver Unit echoes back “NSK ON”.

(v) Input “SI/AL” command.

Press. S I / A L

(vi) The Driver Unit echoes back “INITIALIZE”. A colon “:” will be displayed to indicate completion of initializing.

③ Input the noted parameter settings and channel programs.

(i) Firstly set “PA” parameter.

   * Input the password.

   Press. / N S K S P O N ENT

   The Driver Unit echoes back “NSK ON”.

(ii) Press P A * * ENT

   (** must be the same data as noted.)

(iii) Set other parameters and programs accordingly.

(iv) Make sure that all parameters and programs are set properly.

   * Monitor the settings with “TS0” and “TC” commands.

(v) Turn off the power.
Appendix 3: How to Replace ESA25 Driver Unit

(Danger) Make sure the power is turned off when replacing ESA25 Driver Unit.

- In the reference number of ESA25 Driver Unit, second digit from the last denotes whether it is interchangeable or not.

Figure A-9

M-ESA-Y3040A 2 5

1: Not interchangeable
2: Interchangeable (Standard)
F: Special

- For interchangeable (standard) Driver Unit, replace with the Driver Unit which has same reference number. Set the same parameters to new Driver Unit.

- When replacing the Driver Unit which is not interchangeable, the compensation ROM of the old Driver Unit must be transferred to the new Driver Unit. When transferring the ROM, the Driver Unit must be disassembled. To disassemble the Driver Unit, follow the procedures described hereafter.
  - For a special Driver Unit, contact your local NSK representative.
  - Before replacing the Driver Unit, record all parameters and channel programs. The record list is provided in the last page of this manual.
  - Especially, following items shall be recorded.
    - PA, VG, VI, PG, CO, MA, MV, and HO
    - Programs and other settings in channels.
  - When replacing Driver Unit, following tools and Handy Terminal FHT11 are necessary.
    1. A screwdriver (cross recessed, 4mm)
    2. A ROM remover
Dissemble ESA25 Driver Unit

1. Remove side panel.

Figure A-10

- Unfasten screws.
  - Top and bottom (2 places each, countersunk head)
  - Front panel (2 places, countersunk head, black oxide)
• Remove side panel.

Figure A-11

Commutation board (Printed circuit board)
2. Remove the compensation ROM (U21) from the commutation board of old Driver Unit.
   (Use a ROM remover.)

   **Figure A-12**

   ![Diagram of commutation board with U21 Compensation ROM highlighted]

   **Figure A-13**

   ![Diagram showing U21 and socket connections]

3. Insert the ROM to new Driver Unit commutation board.

   ○ Be careful of the orientation of the ROM. Make sure the ROM is securely set to the socket.

   **Figure A-14**

   ![Diagram of ROM insertion with socket and pins highlighted]

   **Figure A-15**

   ![Diagram showing proper and incorrect orientations of ROM in socket]
4. Assemble the side panel

Figure A-16
Fasten all screws securely.
5. After replacing the compensation ROM, initialize new Driver Unit.

① Connect Handy Terminal FHT11 to CN1 connector.
② Turn on the control power only.
   (Control power input ports are indicated as “CONT” on the terminal block.)
   • If the main and control power can not be turned on and off separately, disconnect CN2
     connector. If CN2 connector is not disconnected, the parameters can not be input properly and
     the Motor may run away. (Make sure that CN2 connector is disconnected.)
③ When control power is turned on, Handy Terminal displays “NSK MEGATORQUE •••”.
   • After the display shows a colon “ : ”, input

```
/ NSK SP ON ENT
```

and

```
S I / AL ENT
```

Initialization will take about 30 seconds.

④ After the display shows a colon “ : ”, log in all parameters and channel program referring the
recorded value and settings.
Megatorque Motor will be a generator in following conditions. This phenomenon is called regeneration.
  - When decelerating under heavy inertia.
  - When Motor axis is horizontal, gravity is added to decelerating Motor. (In a case that an unbalanced load is attached to the load.)

Energy generated by the motor will be charged to the main power circuit condenser. If energy is more than the capacity of the condenser, a dump resistor of the Driver Unit will dissipate overflown energy.

However, when the regeneration occurs frequently, the dump register will be overheated due to its limited capacity. Eventually over-heat alarm will be on and Motor will stop.
  * Dump resistor capacity is about 2.5W.

When an over-heat alarm is detected, following remedies should be taken.
  - Reduce duty cycle
  - Decrease acceleration/deceleration.
  - Lower operation speed.

If above measures are not feasible, an optional high capacity regenerative dump register is available from NSK. It will dissipate regeneration energy without loosing speed of Megatorque Motor.

Optional regenerative dump register.

In normal positioning, the best combination of acceleration and maximum velocity exists for applied load and indexing angle.

*Figure A-18

![Diagram of Velocity-Time graph with acceleration and maximum velocity marked]

* Recommended acceleration and maximum velocity combination to realize shortest operating time without having overshoot. This can be obtained from the Velocity-Torque characteristic of Motor.

Figure A-19, as an example, shows the relation of velocity and inertial load of YS Motor series for 180° and 360° indexing.

The regeneration is observed in the area A.

Example:

- Point B
  - Moment of Inertia : 5kgm²
  - Velocity : 1.5 r.p.s.

Regeneration occurs when decelerating.

⇒ The regeneration dump resistor is not necessary when indexing angle is less than 360°.

⇒ The regeneration dump resistor may be necessary in the area A.

Contact NSK representative for more details about the regeneration dump resistor.
Figure A-19

Consult to NSK for the recommendations in other cases.
Appendix 5: Brake Built in YS Series Motor

1. Specifications

Table A-7

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Brake type</th>
<th>Static friction torque (N·m)</th>
<th>Capacity (W)</th>
<th>Coil resistance (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS2020</td>
<td>RNB2K</td>
<td>20</td>
<td>17</td>
<td>477</td>
</tr>
<tr>
<td>YS3040</td>
<td>RNB4K</td>
<td>40</td>
<td>23</td>
<td>352</td>
</tr>
<tr>
<td>YS4080</td>
<td>RNB8K</td>
<td>80</td>
<td>30</td>
<td>270</td>
</tr>
<tr>
<td>YS5120</td>
<td>RNB12K</td>
<td>120</td>
<td>33</td>
<td>245</td>
</tr>
</tbody>
</table>

Rated voltage : DC90V    
Overexertion : DC180V, 0.3 sec
Insulation class : B grade  
Friction material : None-asbestos

2. Construction and Operation

- The RNB brake comprises 12 parts as shown in Figures A-20~A-23.

- The armature assembly (③) is fixed with bolts (⑤) and (⑩) through the plate spring (④) in the field (①) incorporating the excitation coil.

- The armature assembly is supported with the plate spring, and is separated from the field by a narrow gap. Loaded with the coil spring (②) built in the field, the assembly presses the disk (⑦) to apply brake.

- When the coil is turned on, the field attracts the assembly against the coil spring pressure, thereby removing the pressure on the disk and releasing the brake.

- When the power supply is turned off, the coil spring force presses the armature assembly against the disk, quickly applying the brake.
3. Handling precautions

(1) This brake is dry type. Its torque will decrease when the friction surface is soiled with oil. Use care never to allow oil to enter it.

(2) The electromagnetic brake uses many mild materials. Use care not to hit or drop the brake, or apply excessive force to it, otherwise indented or deformed brake could malfunction or have insufficient torque.

(3) Do not pull or acutely bend the lead wire, or do not hang the brake by the lead wire.

4. Assembling precautions

(1) Mount the brake in the field with a concentricity of 0.15 TIR or less and squareness of 0.05 TIR or less, against the field coupling shaft.

(2) After installing the field, with the armature assembly attracted, adjust such that the disk is provided with equal gaps at both ends using the accompanying shims \( \frac{1}{2}, \frac{1}{2} \), and fix the assembly to the coupling shaft with bolts. Do not press the shaft excessively in the axial direction, otherwise the disk could be deformed.

(3) After mounting the disk, check that it has no backlash in the axial direction.

(4) Tighten the bolts securely so that they will not be loosened by the vibration of the machine.

(5) This brake is a dry type. Its torque will decrease when the friction surface is soiled with oil or water. Provide the brake with a cover if it is likely to be soiled with oil, water, or dust.

5. Check List before Operation

(1) Is the brake securely fastened ?

(2) Are gaps of both sides of the disk equal when the armature assembly is attracted ?

(3) Make sure that the enough power voltage is supplied.
   ○ If the power supply cable is too long, voltage may be lowered due the cable's resistance, even specified power voltage is supplied. Check voltage at the brake lead wire after power is turned on.

(4) Make sure that the armature assembly is attracted and released smoothly when the switch is on and off.

(5) RNB type brake is basically designed holding purpose only. Do not use to brake continuously rotating object, other than emergency use.
6. Maintenance

(1) This brake is intended to be used dry and, therefore never allow oil to enter it. If oil is entered, wipe it off using alcohol, wash the friction surface of disk and dry it before the use.

(2) Time of releasing brake varies with exciting voltage because this electromagnetic brake is a negative operation type (spring close type). If the voltage is too low, brake cannot be released. Make sure to supply required voltage.

(3) Check if there is a loose bolt.

(4) To release the brake in case of power failure or abnormality in the Driver Unit, use bolts to push the armature assembly.

7. Manual Release of Brake

• Insert manual brake releasing bolts to 3 tap holes of the side plate, then screw them alternatively to press the armature assembly to the field side to release the brake.

• Use a care to screw the bolts alternatively to push the armature assembly evenly.

<table>
<thead>
<tr>
<th>Table A-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Manual release bolt</td>
</tr>
</tbody>
</table>

8. Troubleshooting

• When the brake does not perform as intended, check followings.

  ★ Brake is slipping.

  (1) Is the friction plate soiled with oil?

  (2) Is temperature of the brake too high? (over 100 °C)

  (3) Is excessive load applied to the machine?

  ★ Sluggish operation of the brake

  (1) Is sufficient voltage being supplied?

  (2) Is the friction plate worn out? (too much gap)

  (3) Is brake temperature too high? (over 100 °C)

  ★ The brake does not operate entirely.

  (1) Breakage of coil and/or lead wire

  (2) Electrical circuit failure

  (3) Too much gap of the friction plate because of wear?

  (4) Is sufficient voltage being supplied?
### Appendix 6: Parameter · Program Setting List

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Shipping set</th>
<th>Current setting</th>
<th>Parameter</th>
<th>Shipping set</th>
<th>Current setting</th>
<th>Parameter</th>
<th>Shipping set</th>
<th>Current setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG</td>
<td>0.1</td>
<td></td>
<td>PC</td>
<td>0</td>
<td></td>
<td>OL</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>VG</td>
<td>1.0</td>
<td></td>
<td>RR</td>
<td>1/1</td>
<td></td>
<td>RC</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>1.0</td>
<td></td>
<td>FD</td>
<td>0</td>
<td></td>
<td>LR</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>VM</td>
<td>1</td>
<td></td>
<td>FZ</td>
<td>0</td>
<td></td>
<td>AB</td>
<td>X0X0XXXX</td>
<td></td>
</tr>
<tr>
<td>LG</td>
<td>50</td>
<td></td>
<td>FR</td>
<td>0</td>
<td></td>
<td>NW</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>TL</td>
<td>100</td>
<td></td>
<td>PS</td>
<td>1</td>
<td></td>
<td>MM</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>FO</td>
<td>0</td>
<td></td>
<td>DI</td>
<td>0</td>
<td></td>
<td>BM</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>FP</td>
<td>0</td>
<td></td>
<td>OTP</td>
<td>0</td>
<td></td>
<td>CM</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>FS</td>
<td>0</td>
<td></td>
<td>OTM</td>
<td>0</td>
<td></td>
<td>AN</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>NP</td>
<td>0</td>
<td></td>
<td>MV</td>
<td>1</td>
<td></td>
<td>WM</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>DBP</td>
<td>0</td>
<td></td>
<td>MA</td>
<td>1</td>
<td></td>
<td>LO</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>DBA</td>
<td>0</td>
<td></td>
<td>JV</td>
<td>0.1</td>
<td></td>
<td>SG</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>ILV</td>
<td>100</td>
<td></td>
<td>JA</td>
<td>1</td>
<td></td>
<td>MT</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>FF</td>
<td>0</td>
<td></td>
<td>HV</td>
<td>0.2</td>
<td></td>
<td>RI</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td>0</td>
<td></td>
<td>HA</td>
<td>1</td>
<td></td>
<td>ZP</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>50000</td>
<td></td>
<td>HZ</td>
<td>0.01</td>
<td></td>
<td>ZV</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>IN</td>
<td>100</td>
<td></td>
<td>OS</td>
<td>4</td>
<td></td>
<td>SL</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IS</td>
<td>0</td>
<td></td>
<td>HD</td>
<td>1</td>
<td></td>
<td>AC</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>FW</td>
<td>1</td>
<td></td>
<td>HO</td>
<td>0</td>
<td></td>
<td>AGV</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>X1</td>
<td></td>
<td>PA</td>
<td>700</td>
<td>AGT</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(*) Setting differs with Motor size.)
## Channel Program

- A blank part is not programmed.

<table>
<thead>
<tr>
<th>CH</th>
<th>Program</th>
<th>CH</th>
<th>Program</th>
<th>CH</th>
<th>Program</th>
<th>CH</th>
<th>Program</th>
</tr>
</thead>
</table>