MEGATORQUE® MOTOR SYSTEM

User's Manual

(ESA35/ESAC5 Driver Unit System)

NSK Ltd.

Document Number: C20137-01

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In order to use the Megatorque Motor System properly, observe the following notes.

1. Matters to be attended to use the Driver Unit of the Megatorque Motor System

------ For prolonged use of the Driver Unit ------

1 Temperature

- Keep the ambient temperature of the Driver Unit within 0 to 50°C. You cannot put the Driver Unit in an atmosphere over 50°C. Keep a clearance of 100 mm in upper and lower sides of the Driver Unit when it is installed in an enclosure. If heat is build up on upper side of the Driver Unit, provide the ventilation openings on the top, or equip an air cool unit to take the heat out of the Driver Unit.
(Measures against contamination are required for the ventilation openings.)

2 Protection against contamination and water

- Put the Driver Unit in an enclosure that complies with IP54 or better protection code. Protect the Driver Unit from oil-mist, cutting oil, metal chips, and paint fume etc. Otherwise it may result in failures of electric circuits of the Driver Unit.
(IP code is specified in IEC standard. This is to classify the protection level of enclosures from solid contamination and water.)

3 Wiring / Ground

- Refer to the User's Manual for proper wiring.
- Take appropriate measures not to contaminate the Driver Unit when wiring or installing it.

4 Storing

- Store the Driver Unit in a place at where it is not exposed to rain, water and harmful gas or liquid.
- Store the Driver Unit in a place at where it is not exposed to direct sun light. Keep the ambient temperature and humidity as specified.

2. Matters to be attended to use the Motor of the Megatorque Motor System

------ For prolonged use of the Megatorque Motor ------

1 Dustproof and Waterproof of the Motor

- Make sure that how your Motor is graded for dust-proof and/or waterproof. You cannot use the Megatorque Motor in the environment where chemicals or paint fumes exist.
  - ◊ Standard Megatorque Motors (RS, AS, BS, JS, SS and YSB Series)
    They are not made to dustproof or waterproof specification. (Equivalent to IP20, IP30 or IP40) You may not expose them to humid or oily environment.
  - ◊ Simple waterproof Motor (RW Series)
    Some part of the Motor is not completely waterproofed. Confirm what part is not waterproofed with the specification document, and then take appropriate measures to the part against water and dust if necessary. For a long time use of the Motor, we recommend making sure of its aging trend of the Motor with the periodical insulation test approximately once in every half year. You cannot use this type of Motors unless you take the measures against the environment with water or oil.
  - ◊ Waterproof Motor (RZ series: IP65 equivalent)
    Use this type of Motor when continually splash water or oil on it. Provide air purge when you use the Motor in IP66 or equivalent condition. Be sure to supply a dry air. The user shall take the measures against dust. For a long term use, check the Motor for its aging by insulation test (approximately once in every half year).

2 Use condition

- The allowable moment load and axial load differ with Motor size. Reconfirm that the using conditions are in the specified limits of the Motor.
- An excessive offset load or heavy load will cause permanent deflection of the rotor and the bearing abnormality. Be sure not to give excessive impact to the Motor that is caused by external interference in transit or at installation.
- The flatness of the Motor mounting surface shall be 0.02 mm or less.

3 Periodical check

- Puncture of the Motor and shorting or breakage of cable may occur depending on using condition and environment. If the Motor is left in such conditions, it cannot exhibit its capability 100 % and will lead to a problem of the Driver Unit. We recommend conducting the periodical check in order to detect the problem.

3. Before concluding that the system is faulty, check the matters again.

1 Alarm arises

- Did you take proper action to the alarm? Check the action for an alarm described in the manual again.

2 Power does not turn on. Indication lamp does not turn on.

- Check voltage of main and control power sources by a tester if the voltage is in the specification described in the User’s manual.

3 The Motor does not function.

- Is rotation of the Motor smooth when it is turned manually with power off? Any stickiness in motion? Does the rotation axis have any axial play?
  (Never disassemble the Motor.)
- Are the control Inputs and Outputs functioning properly?
  → Monitor status of SVON, RUN and IPOS signals by I/O command through handy terminal.
  → Check if the voltage of input signal, and 24 V power source are stable with an oscilloscope, etc.

4 Uncontrollable Driver Unit

- Compare the current setting of parameters with the original setting at the installation. Does the PA data (unique to individual Motor) change?

5 The Motor vibrates. Positioning is inaccurate. Alarm of software thermal arises frequently.

- Are servo parameters VG, VI, PG, FP and NP adjusted?
- Do you fasten the fixing bolts of load and the Motor mounting securely? Check and fasten them tightly if necessary.
- Connect FG terminal of the Driver Unit to one point grounding. Ground the Motor and the Driver Unit respectively. (Refer to User’s Manual for wiring.)
- Is any external interference with rotation in Servo lock state? (It leads the Motor to overheat if external force is applied to it in servo lock state.)

6 Breaker trip occurs frequently.

- When the system recovers by remaking the power, take the following action.
  - ◊ We recommend installing a delay type breaker for a measure against breaker trip.

4. Others

- Combination of the Motor and the Driver Unit shall conform to the specification.
- Be sure to write down the setting of parameters.
- Never modify the cable set.
- Lock the connectors securely, and check for loose fixing screw(s).
- Please keep expendable parts, and backup parts in stock. (Fuses, Motor, Driver Unit, and Cable set for replace)
- Use alcohol for cleaning. Do not apply thinner.

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Contents

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1. Introduction

- This manual describes the interface, function, and operation of the Megatorque Motor System with ESA35 or ESAC5 Driver Unit.
- Before operating the Megatorque Motor System, this manual should be read thoroughly.
- For specifications of Motors described in "2.5. Motor Specifications," we only describe the standard Motors of AS, BS and RS type Motors. If your Motor is not one of these, please refer to the specification document provided with the Motor.

1.1. Notes to Users

1.1.1. Notes for Safety

- For your safety, you should read this manual thoroughly and understand the contents before operating the Megatorque Motor System.
- Following notice is added to each clause for safety precaution to get your attention.

⚠ *Danger : Matters which may cause serious injuries if you don't follow the notes.*

⚠ *Warning : Matters which may result in injuries if you don't follow the notes.*

⚠ *Caution : Matters which may damage the equipment (machine) and/or the work attached to the Motor (jigs or end effector), or may cause malfunction of the Motor System, if you don't follow the notes.*

1.1.2. Operational Remarks

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

⚠ *Caution : When making a combination of a Motor and a Driver Unit, confirm that their production numbers are the same.*

◊ This is because the Driver Unit keeps the unique parameter settings of the Motor.

◊ Make sure that the serial numbers for the Motor and the Driver Unit are the same.

◊ If their serial numbers are different, it may cause deterioration in precision as well as increase in noise.

⚠ *Caution : Do not cut the Cable Set to shorten it, not to make it longer with another extending cable or do not to connect it to another routing with other means.*

⚠ *Caution : Never disassemble the Motor since it has been precisely assembled and tuned. If disassembled, it may cause abnormalities such as deterioration in rigidity and positioning accuracy as well as increase in noise.*

⚠ *Danger : Be sure to connect the Emergency stop signal circuit to the EMST port of the control I/O connector.*

◊ Please set the System so that you can immediately stop the Motor in case of an emergency.

Caution : Follow the notes below to avoid an electric shock.

◊ The Driver Units have high capacity conductors in its internal circuits, thus resulting in high residual voltage of the capacitors for few minutes after the power is turned off.

◊ Do not detach a cover of Driver Unit unless it is necessary.

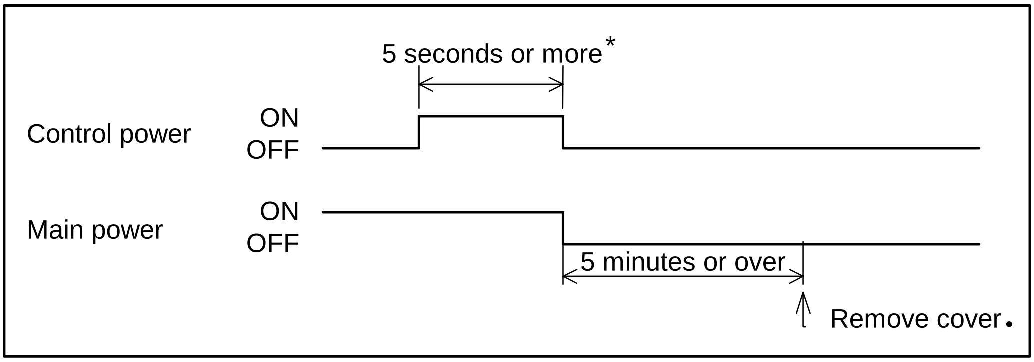
◊ When the cover has to be removed, follow the procedures bellow.

1) Turn off the control and main power.

* If only main power has been turned on, turn the control power on for 5 seconds or more, and then turn off both of them. Neglect of this procedure is very dangerous because you cannot discharge residual voltage of capacitors.

2) Wait for 5 minutes or more after the control and main powers were turned off, and then remove the cover.

Figure 1-1



Caution : Use of an optional regenerative dump resistor shall be considered for heavy-duty operation.

◊ Megatorque Motors regenerate when they decelerate carrying heavy load inertia.

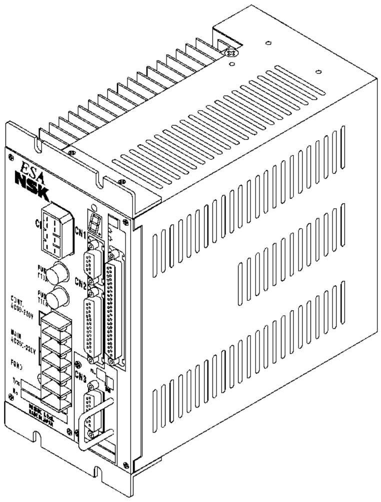
◊ An internal dump resistor dissipates the regeneration. However, when high and continuous regeneration is applied, it won't dissipate excessive regeneration fully, and it will overheat, and then the Motor will eventually stop under "Abnormal main power voltage" alarm state.

◊ In such a case, you need to decrease velocity, deceleration rate, and operation duty cycle, or, you require an external high capacity regenerative dump resistor.

Danger : Never apply water or oil to the Driver Unit.

◊ Take appropriate measures to protect the Driver Unit from water, oil, slag, dust, and corrosive gas.

Figure 1-2



⚠ *Caution : Do not conduct a megger test on the Driver Unit. (It may damage the internal circuit.)*

⚠ *Caution : In most cases, the Direct Drive Motor System cannot exhibit its full performance unless the shipping set of the parameters is altered. Refer to “5. Tuning and Trial Running” for the detail of parameter setting, and be sure to tune the servo parameters to actual use conditions.*

1.1.3. Interchangeability of Motor and Driver Unit

- The interchangeability of a Motor and a Driver Unit won’t be applicable to ESA35 and ESAC5 Driver Units. Be sure to make a combination of a Motor and a Driver Unit with the same serial number. Use the specified cable provided wit the Driver Unit.

- Please be advised that the Megatorque Motor System won’t fully exhibit its performance as described in its specifications if a Motor and a Driver Unit matched with different serial number, or if you change length of a Cable Set. Especially repeatability of Home Return deteriorates in case of the System with absolute position sensor.

1.2. Terminology

b.p.s.	bit per second; the unit of communication speed.
CCW	Motor rotating direction, counterclockwise; seen from the outside of rotor.
closed	Logic output state; output current will flow.
CW	Motor rotating direction, clockwise; seen from the outside of rotor.
Driver Unit	Means Megatorque Motor System's driver unit when capitalized.
Home Return	A built-in sequence program for setting the home position.
kpps	kilo pulse per second; the unit of pulse frequency.
Motor	Means Megatorque Motor System's motor when capitalized.
OFF (all capital)	Logic input state; input will see an open circuit.
ON (all capital)	Logic input state; there will be a current path to the common DC supply.
open	Logic output state; no output current
P control	Proportional-only control; the servo algorithm.
PI control	Proportional and integral control; the servo algorithm.
position gain	Shorter name for position loop proportional gain
position integrator frequency	Shorter name for position loop integrator cutoff frequency
position loop control mode	A control mode within the position control loop; P control or PI control available.
Programmable Indexer	Driver Unit's built-in indexing ability.
pulse train	A series of pulses used as a position command.
quadrature output	Two pulse train outputs with 90° phase difference.
rated stall torque	The rated torque available at zero speed.
rated torque	The torque not to exceed the maximum Motor winding temperature.
s^{-1}	Revolution per second; the unit of velocity.
s^{-2}	s^{-1} per second; the unit of acceleration.
servo-lock	One typical state of servo-on; the Motor provides torque and remains in position.
servo-off	The state where the Driver Unit provides no current to the Motor, and the Motor provides no torque. The Motor rotor can be rotated easily.
servo-on	The state that the Driver Unit is ready to control the Motor, or is controlling the Motor.
shipping set	A parameter setting or a Driver Unit function setting at shipping.
stall torque	The torque available at zero speed.
System	Means Megatorque Motor System when capitalized.
velocity gain (VG)	Shorter name for velocity loop proportional gain. Velocity deviation, which is the difference between velocity command and velocity feedback signal, is amplified by the amount of parameter VG setting and changed to an output of torque command.
velocity integrator frequency (VI)	Shorter name of velocity loop integrator frequency. Integral control is to output torque command that is a time quadrature of signals that is an amplified velocity deviation by proportional gain. The higher VI gives higher output command than the same level of velocity deviation and time. It is hard to achieve positioning deviation less than ±1 pulse without the integral control.
velocity loop control mode	A control mode within the velocity control loop; P control or PI control available.

2. Specifications

2.1. System Configuration

Figure 2-1: System configuration (Without brake)

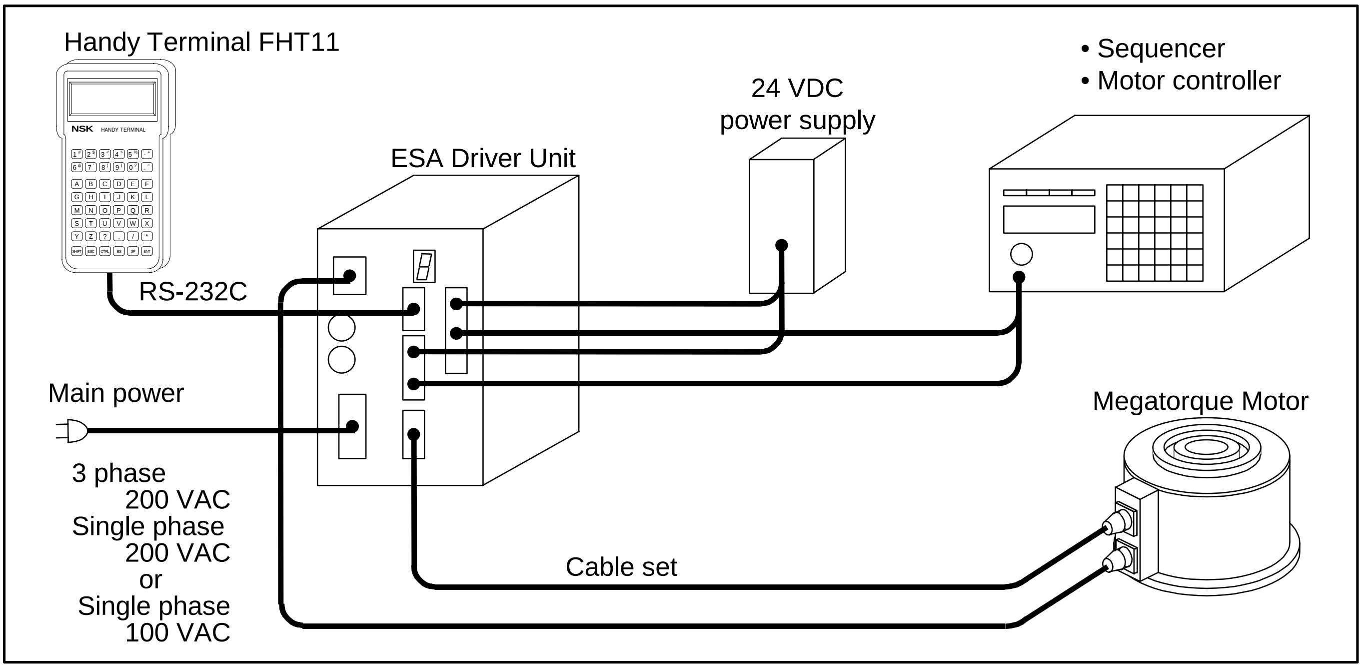
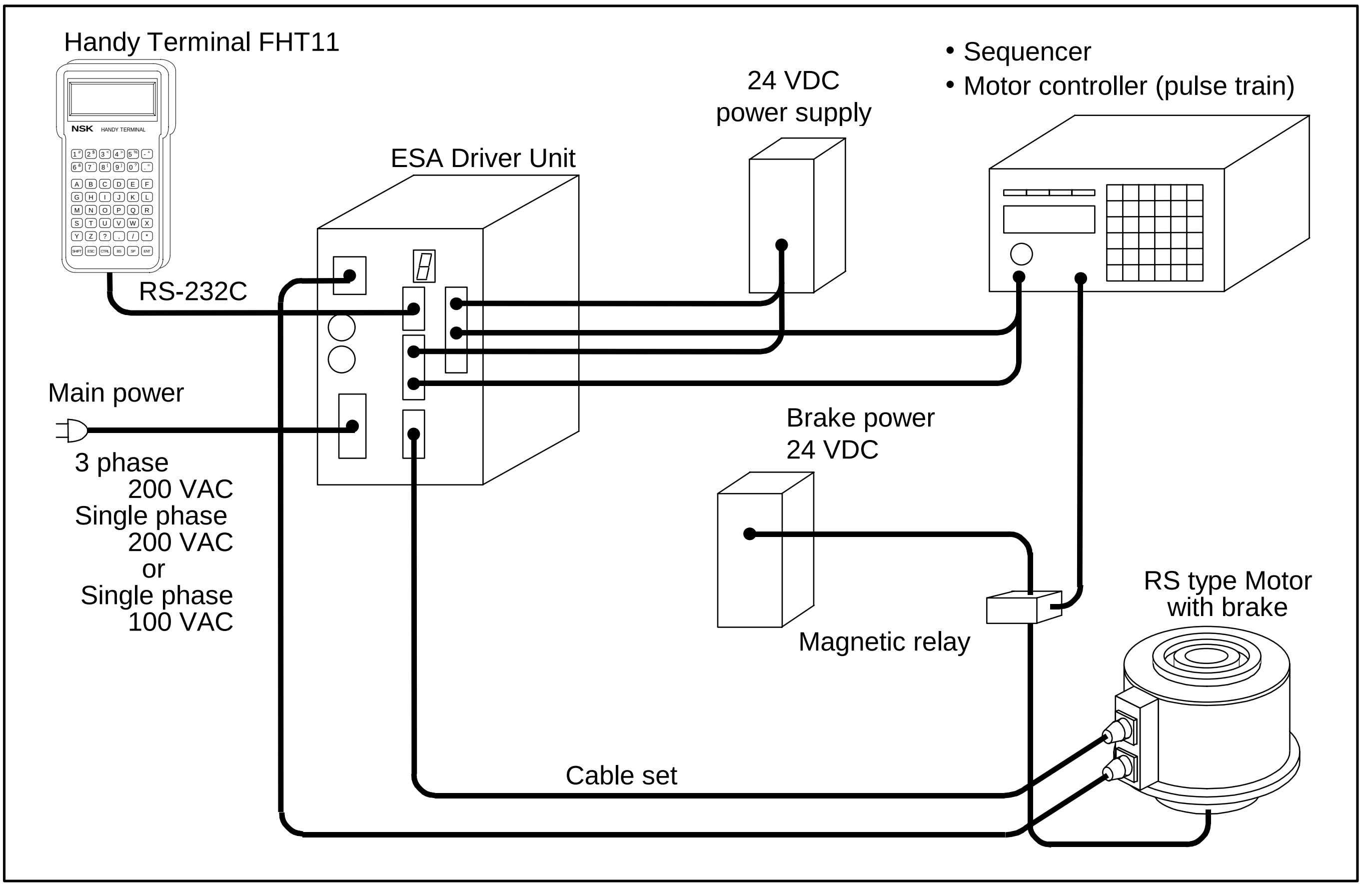


Figure 2-2: System configuration (With break)



2.2. Coding for Reference Number

2.2.1. System Reference Number

Figure 2-3

M-R S 14 10 F N 001 A A 35 C

Megatorque Motor

R : Standard (Base mount)
A : Low friction type (Flange mount)

S: Standard
W: Simple waterproof type
Z: Reiforced waterproof type

Motor outside diameter code
(In inches)

Motor stack height code

F : Standard (without absolute positioning resolver)
C: Absolute positioning resolver

N : Standard (No barake)
C : Electromagnetic brake (Power on activated non-backlash type)
D : Electromagnetic brake (Power off activated type)
G : Electromagnetic brake (Power off activated non-backlash type)

Motor design number (standard: 001)

A: ESA Driver Unit

A: Main power source 200/220 VAC
C: Main power source 100/110 VAC

35: Standard
C5 : Absolute positoin resolver
F* : Special Driver Unit

C: Standard cable (4 m long)
No code: Cables are optional

2.2.2. RS Type Megatorque Motor

Figure 2-4

M-R S 14 10 F N 001

Megatorque Motor

R : Standard (Base mount)
A : Low friction type (Flange mount)

S: Standard
W : Simple waterproof type
Z: Reinforced waterproof type

Code for Motor outside diameter
(In inches)

Code for Motor stack height

F: Standard (without absolute positioning resolver
C: Absolute positioning resolver

N : Standard (No barake)
C : Electromagnetic brake (Power on activated non-backlash type)
D : Electromagnetic brake (Power off activated type)
G : Electromagnetic brake (Power off activated non-backlash type)

Motor design number (Standard: 001)

Note: Generally you cannot order RS sereis Motors by this reference number because they are sold as a combination with Driver Unit. Refer to the System reference number.

2.2.3. ESA Driver Unit for RS Type Motors

Figure 2-5

M-ESA-1410 A 35

ESA Driver Unit for Megatorque Motor

Motor size

35: Standard
C5: Absolute positoning resolver
F*: Special Driver Unit

A: Main power source 200/220 VAC
C: Main power source 100/110 VAC

Note: Generally you cannot purchase Driver Units with this reference number because they are sold as a combination with Motor. Refer to the System reference number.

2.2.4. Cable Set for RS Type Megatorque Motor

Figure 2-6

M-C 004 S S R 05

Cable set for Mgatorque Motor

Cable length (in units of meter)
Max. length: 30 m (Consult with NSK for longer cables)

S: Standard
W: Waterproof

ESA Driver Unit

05: Standard (Straight plug)
03: Angle plug
07: Standard straight plug for absolute positioning resolver
10: Angle plug for absolute positioning resolver

For RS sereis Megatorque Motor

2.2.5. Handy Terminal

Figure 2-7

M-FHT 11

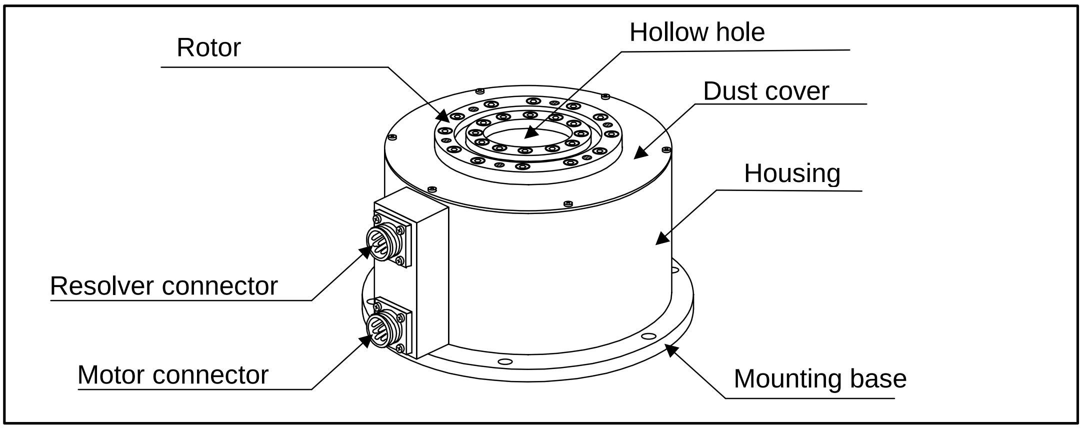
Handy Terminal

Handy Terminal design number

2.3. Name of Parts

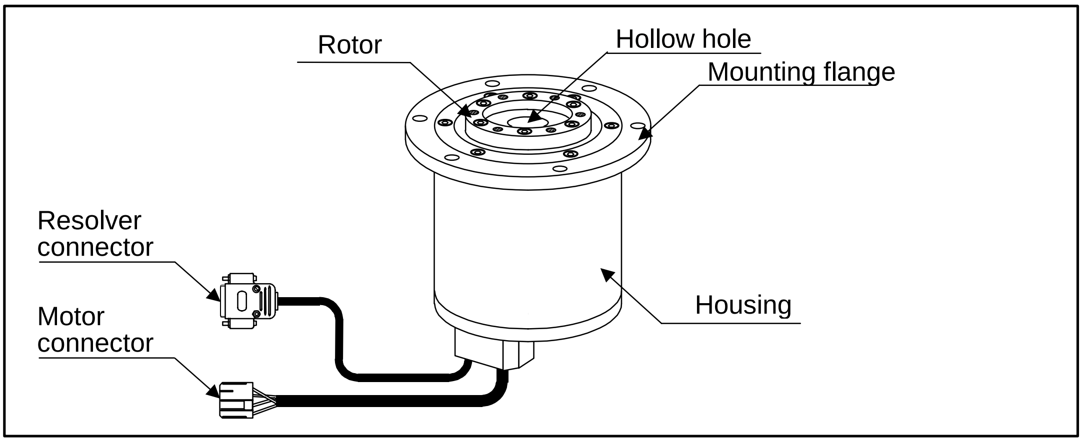
2.3.1. RS Type Motor

Figure 2-8



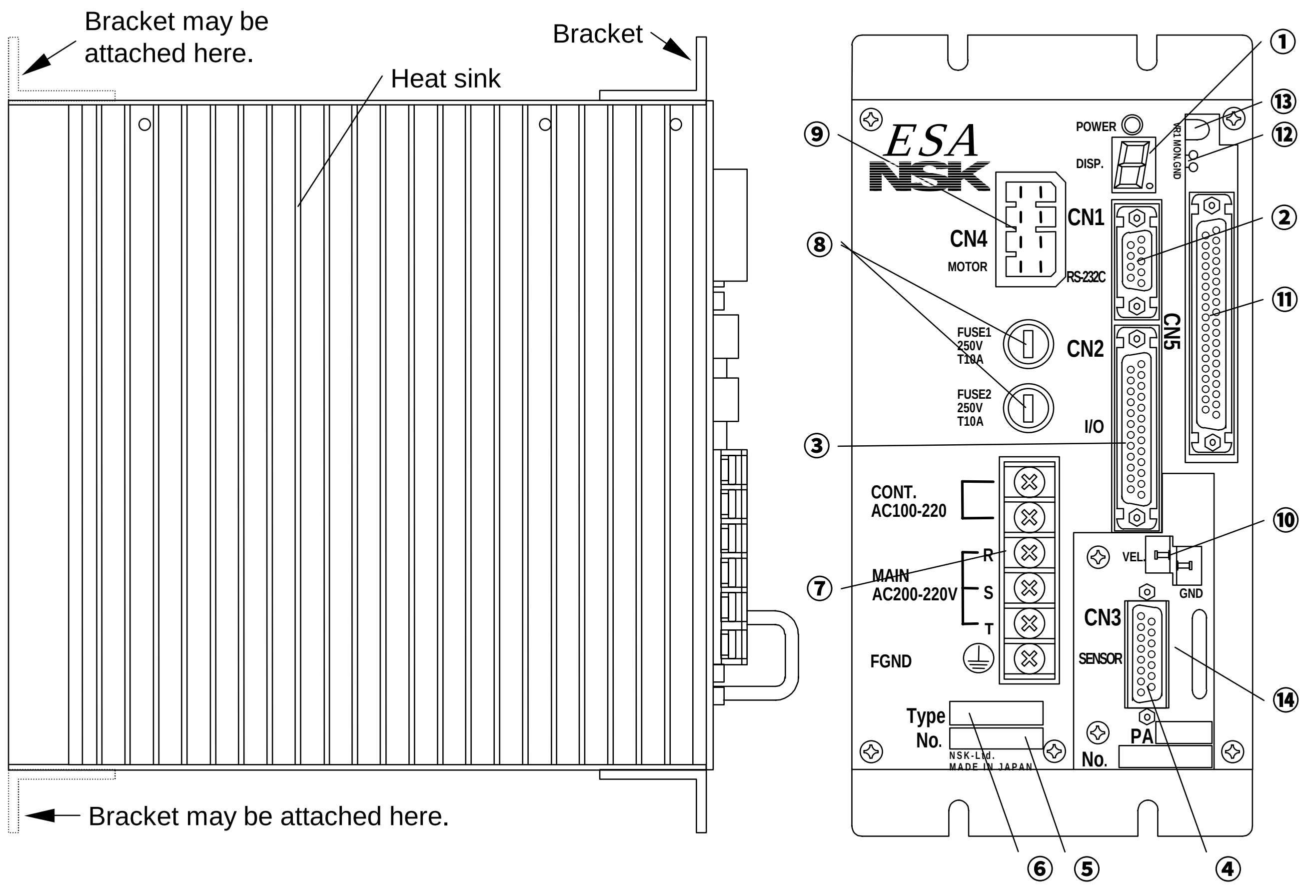
2.3.2. AS Type Motor

Figure 2-9



2.3.3. ESA Driver Unit

Figure2-10



① 7 segmetns LED

② CN1 (9 pins)
RS-232C serial communication connector
Connect optionla Hnady Terminal FHT11.

③ CN2 (25 pins)
Motor control Input/Output (I/O) signal connector

④ CN3 (15 pins)
Resolver cable connector
Connect the exclusive resolver cable.

⑤ No.
Serial number plate

⑥ Type
Reference number plate

⑦ TB
Terminal block for power input

⑧ FUSE 1 and 2
Fuse holder

⑨ CN4
Motor cable connector
Connect the exclusive Motor cable.

⑩ Anaog velocity monitor pins

⑪ CN5 (37 pins)
Motor control Input/Output signal connector (I/O2)

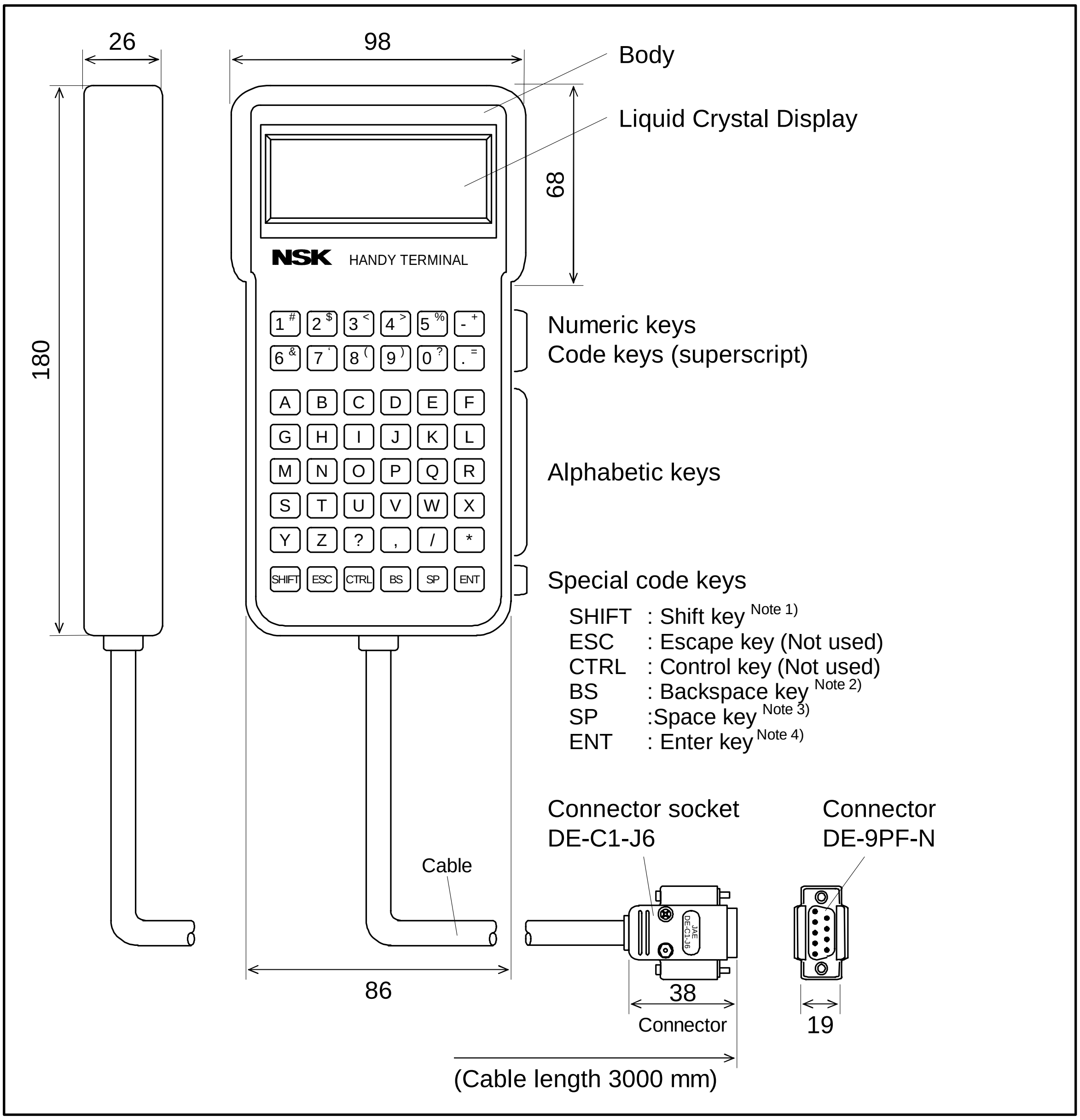
⑫ Analog signal monitor pins

⑬ VR1
Adujsting pod for analog input offset

⑭ Compensation data board unit
Signature board for peculiar characteristics of a Motor

2.3.4. Handy Terminal

Figure 2-11: Handy terminal M-FHT11



Note: 1) SHIFT : Press a numeric key while pressing the SHIFT key to enter a code key.
A superscript of the numeric keys will be entered.

2) BS : Press the BS key when correcting logged in mistakes.

3) SP : Use this key to input a blank between letters.

4) ENT : Press the key at the end of a command or the parameter setting

2.4. Standard Combination of Motor and Driver Unit

2.4.1. Combination of ESA Driver Unit and Motor

2.4.1.1. Standard Motor

Table 2-1

System reference number	Motor reference number	Driver Unit reference number	Power voltage
M-AS0408FN048AA35	AS0408FN048	ESA-0408A35	200 VAC
M-AS0408FN049AC35	AS0408FN049	ESA-0408C35	100 VAC
M-RS0608FN001AA35	RS0608FN001	ESA-0608A35	200 VAC
M-RS0608FN001AC35		ESA-0608C35	100 VAC
M-RS0810FN001AA35	RS0810FN001	ESA-0810A35	200 VAC
M-RS0810FN001AC35		ESA-0810C35	100 VAC
M-RS1010FN001AA35	RS1010FN001	ESA-1010A35	200 VAC
M-RS1010FN001AC35		ESA-1010C35	100 VAC
M-RS1410FN001AA35	RS1410FN001	ESA-1410A35	200 VAC
M-RS1410FN001AC35		ESA-1410C35	100 VAC

- The Megatorque Motor System that has a letter C on the end of the reference number will come with a 4 m long standard cable.

2.4.1.2. Motor Equipped With Absolute Position Sensor

Table 2-2

System reference number	Motor reference number	Driver Unit reference number	Power voltage
M-BS0408CN501AAC5	BS0408CN501	ESA-0408AC5	AC200V
M-BS0408CN503ACC5	BS0408CN503	ESA-0408CC5	AC100V
M-RS0608CN001AAC5	RS0608CN001	ESA-0608AC5	AC200V
M-RS0608CN001ACC5		ESA-0608CC5	AC100V
M-RS0810CN001AAC5	RS0810CN001	ESA-0810AC5	AC200V
M-RS0810CN001ACC5		ESA-0810CC5	AC100V
M-RS1010CN001AAC5	RS1010CN001	ESA-1010AC5	AC200V
M-RS1010CN001ACC5		ESA-1010CC5	AC100V
M-RS1410CN001AAC5	RS1410CN001	ESA-1410AC5	AC200V
M-RS1410CN001ACC5		ESA-1410CC5	AC100V

- The Megatorque Motor System that has a letter C on the end of the reference number will come with a 4 m long standard cable.

2.4.1.3. Cable Set

Table 2-3

Cable set reference number	Applicable Motor	Type of Motor connector
M-CXXXSSR05	Standard	Straight
M-CXXXSSR03		Angle
M-CXXXSSR07	Absolute position sensor (resolver)	Straight
M-CXXXSSR10		Angle

- Three figures of XXX indicate the cable length. (In units of meter, 1 to 30 m)

- A Cable Set includes a Motor cable and a Resolver cable.

2.4.2. Handy Terminal (For inputting parameters and programs)

Table 2-4: Reference number

Handy Terminal reference number
M-FHT11

2.5. Motor Specifications

2.5.1. Standard Motor

Table 2-5: Specifications

Items [Unit] \ Motor number		AS0408	RS0608	RS0810	RS1010	RS1410
Maximum output torque	[N•m]	9.8	39.2	88.2	147	245
Maximum current/phase	[A]	3（200V） 6（100V）	6	7.5	7.5	7.5
Allowable axial load	[N]	1 760	3 729	4 500	9 500	19 600
Allowable moment load	[N•m]	19	58	78	156	392
Axial rigidity(1)	[mm/N]	2.55×10^{-6}	4.08×10^{-6}	3.06×10^{-6}	1.42×10^{-6}	1.01×10^{-6}
Moment rigidity(1)	[rad/N•m]	3.06×10^{-6}	3.57×10^{-6}	2.55×10^{-6}	1.53×10^{-6}	3.06×10^{-7}
Maximum stall torque	[N•m]	7.8	33.3	78.5	137（114(2)）	196
Rotor moment of inertia	[kg•m^2]	0.0023	0.0075	0.020	0.075	0.27
Maximum starting torque	[N•m]	1	3	4.5	5.4	7.9
Mass	[kg]	6.5	14	24	40	73
Environmental condition		Ambient temperature: 0 to40℃. Humidity: 20 to 80%. Indoor use. Free from dust, condensation and corrosive gas.				
Maximum velocity	[s^{-1}(rps)]	4.5	3			
Position sensor resolution	[pulse/r]	409 600	614 400			
Absolute positioning accuracy	[sec]	120	60			
Repeatability	[sec]	±3.2	±2.1			

2.5.2. Motor With Absolute Position Sensor

Table 2-6: Specifications

Item [Unit] \ Motor number		BS0408	RS0608	RS0810	RS1010	RS1410
Maximum output torque	[N•m]	9.8	39.2	88.2	147	245
Maximum current/phase	[A]	3（200 V） 6（100 V）	6	7.5	7.5	7.5
Allowable axial load	[N]	1 760	3 729	4 500	9 500	19 600
Allowable moment load	[N•m]	19	58	78	156	392
Axial rigidity(1)	[mm/N]	2.55×10^{-6}	4.08×10^{-6}	3.06×10^{-6}	1.42×10^{-6}	1.01×10^{-6}
Moment rigidity(1)	[rad/N•m]	3.06×10^{-6}	3.57×10^{-6}	2.55×10^{-6}	1.53×10^{-6}	3.06×10^{-7}
Maximum stall torque	[N•m]	7.8	33.3	78.5	137（114(2)）	196
Rotor moment of inertia	[kg•m^2]	0.0023	0.01	0.024	0.088	0.31
Maximum starting torque	[N•m]	1	3	4.5	5.4	7.9
Mass	[kg]	7.5	20	33.5	61	98
Environmental condition		Ambient temperature: 0 to40℃. Humidity: 20 to 80%. Indoor use. Free from dust, condensation and corrosive gas.				
Maximum velocity	[s^{-1}(rps)]	4.5	3			
Position sensor resolution	[pulse/r]	409 600	614 400			
Absolute positioning accuracy	[sec]	120	60			
Repeatability	[sec]	±3.2	±2.1			

* (1) This value is assumed that the Motor is fixed on an ideally solid base.

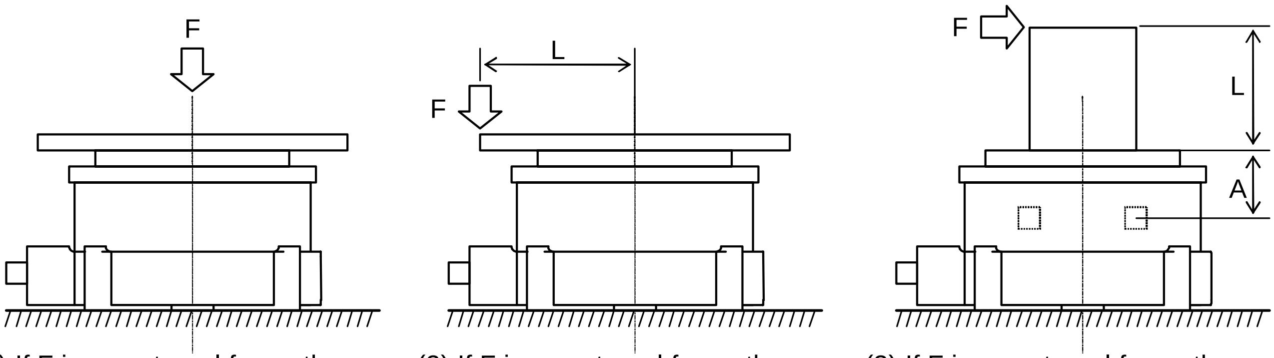
(2) When the power voltage is 100/110 VAC.

SI unit system 1N = 0.102kgf

1N•m = 0.102kgf•m

2.5.3. How to Calculate Axial Load and Moment Load

Figure 2-12



(1) If F is an external force, then
- Axial load Fa = F + weight of payload
- Moment load M = 0

(2) If F is an external force, then
- Axial load Fa = F + weight of payload
- Moment load M = F × L

(3) If F is an external force, then
- Axial load Fa = F + weight of pauload
- Moment load M = F × (L + A)

⚠ *Caution : Axial load Fa and Moment load M shall be les than allowable axial load and moment load respectively.*

Table 2-7: Dimension A (Unit: mm)

Motor number	AS (BS) 0408	RS0608	RS0810	RS1010	RS1410
Standard	25.8	18.5	18.5	27.5	30.0
With absolute position sensor	40.4	38.5	38.5	47.5	50

2.6. External Dimensions

2.6.1. External Dimensions of Standard Motor

Figure 2-13: M-AS0408FN048 (200/220 VAC) and M-AS0408FN049 (100/110 VAC)

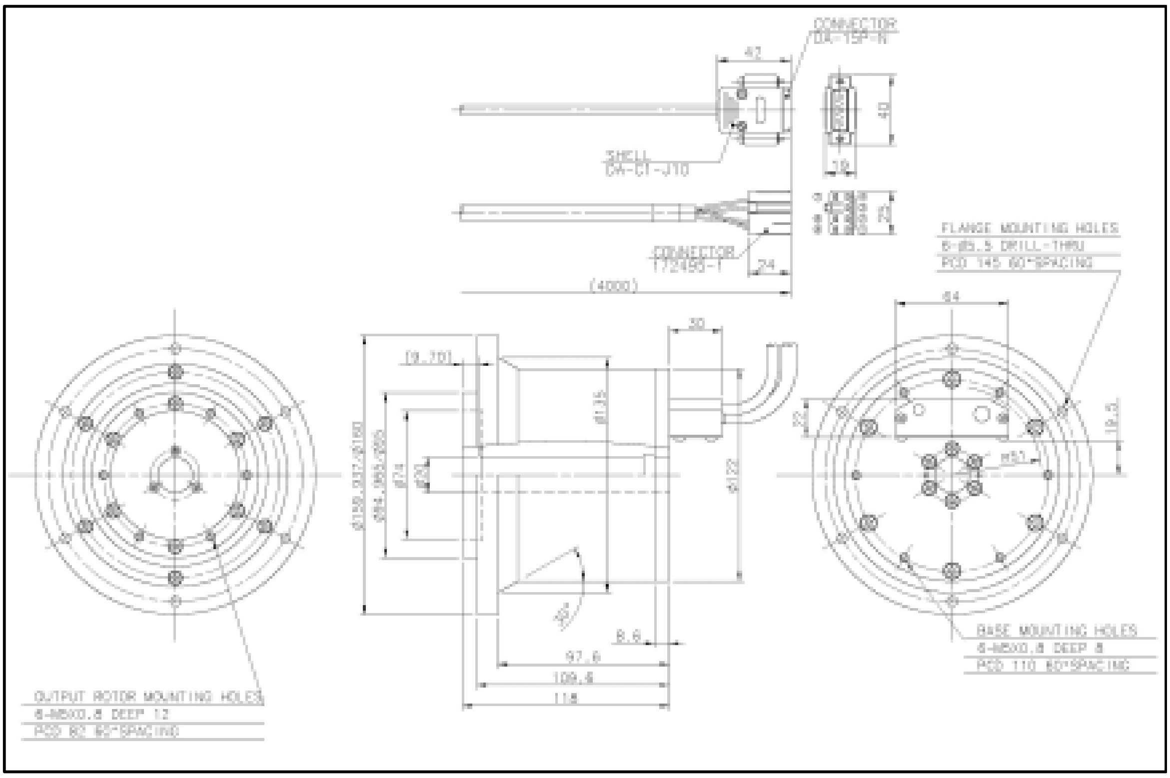


Figure 2-14: M-RS0608FN001

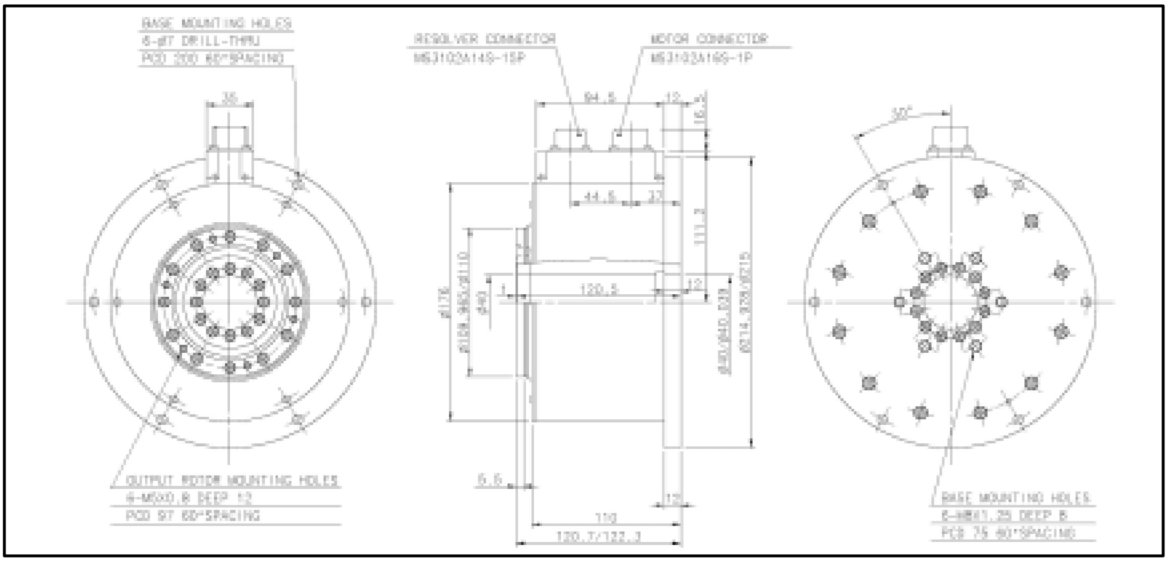


Figure 2-15: M-RS0810FN001

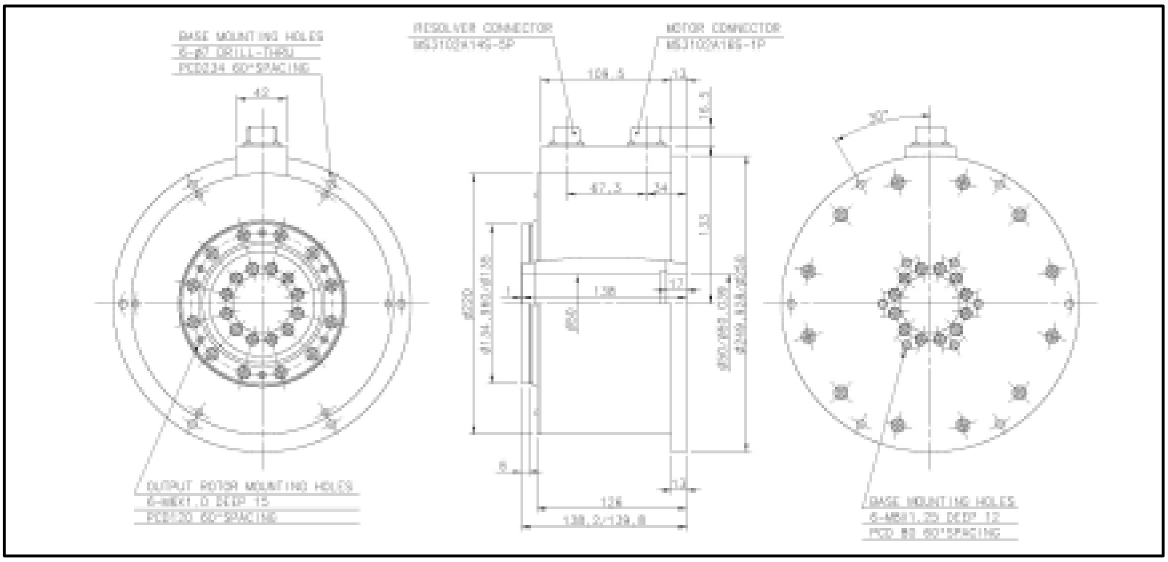


Figure 2-16: M-RS1010FN001

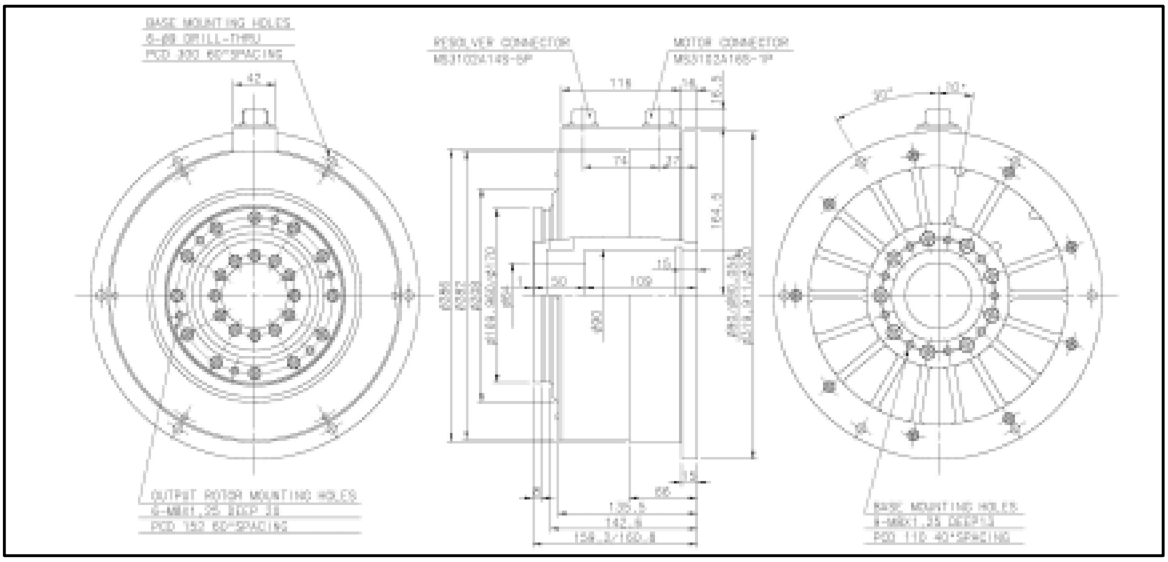
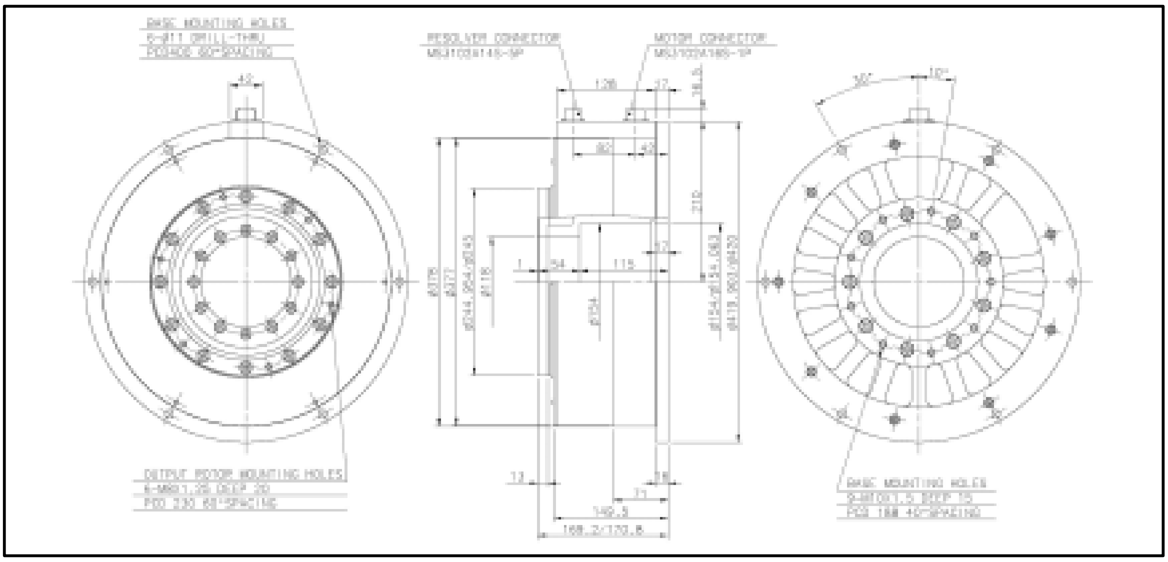


Figure 2-17: M-RS1410FN001



2.6.2. External Dimensions of Motor Equipped With Absolute Position Sensor

Figure 2-18: M-BS0408CN501 (200/220 VAC) and M-BS0408CN503 (100/110 VAC)

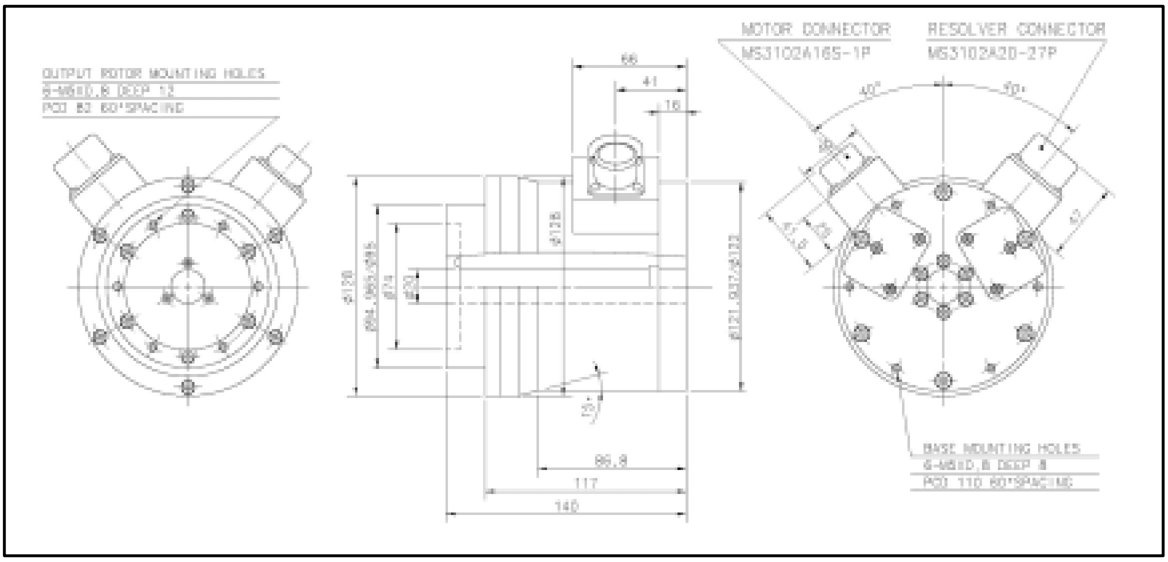


Figure 2-19: M-RS0608CN001

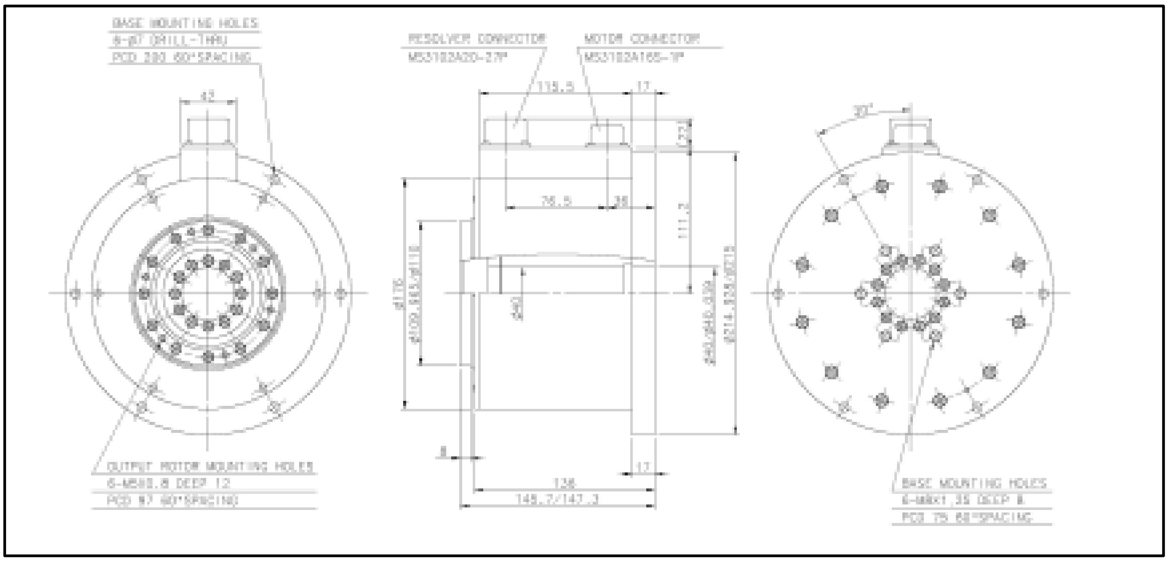


Figure 2-20: M-RS0810CN001

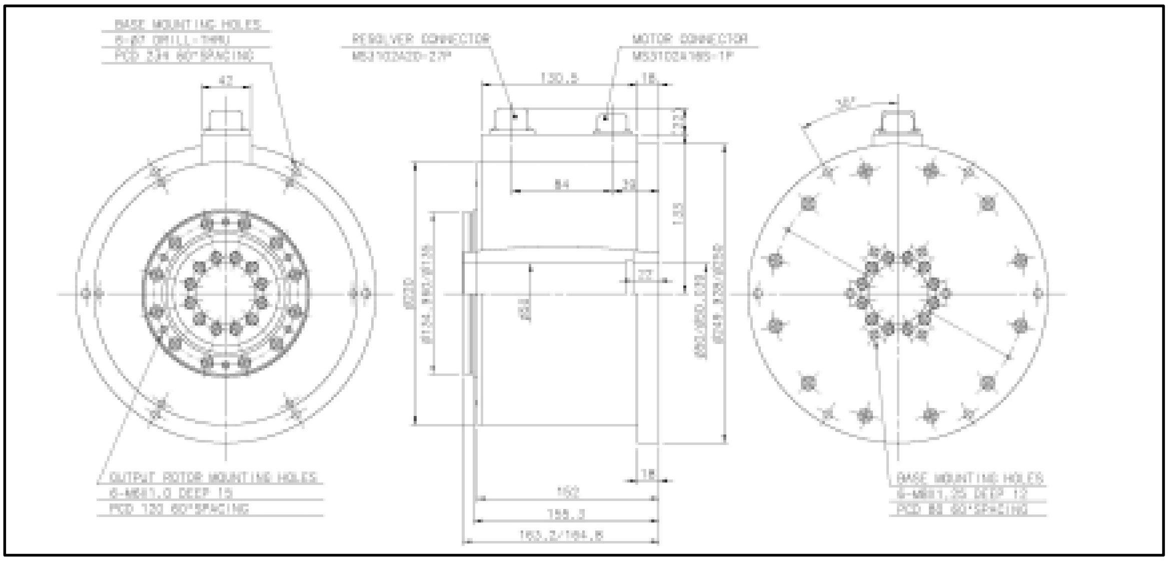


Figure 2-21: M-RS1010CN001

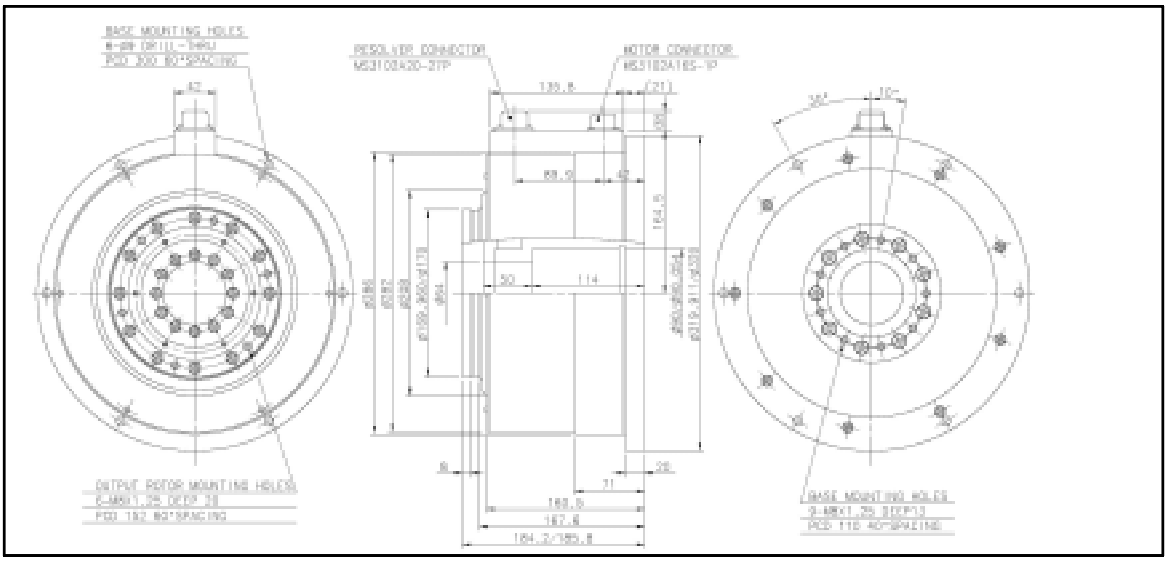
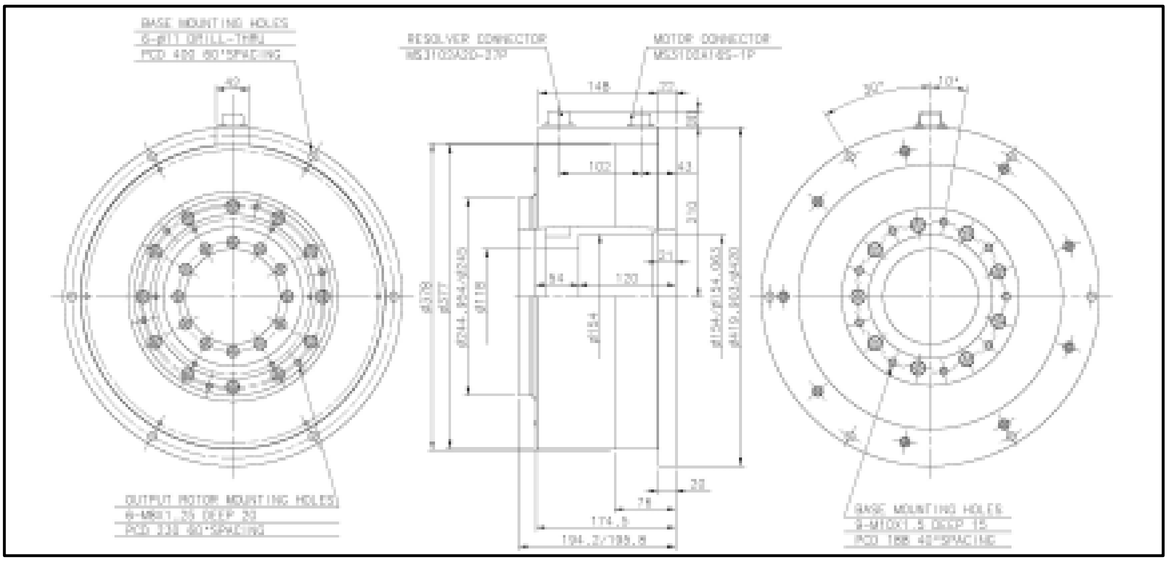


Figure 2-22: M-RS1410CN001



2.6.3. Dimensions of Driver Unit

Figure 2-23: External dimensions of standard ESA Driver Unit

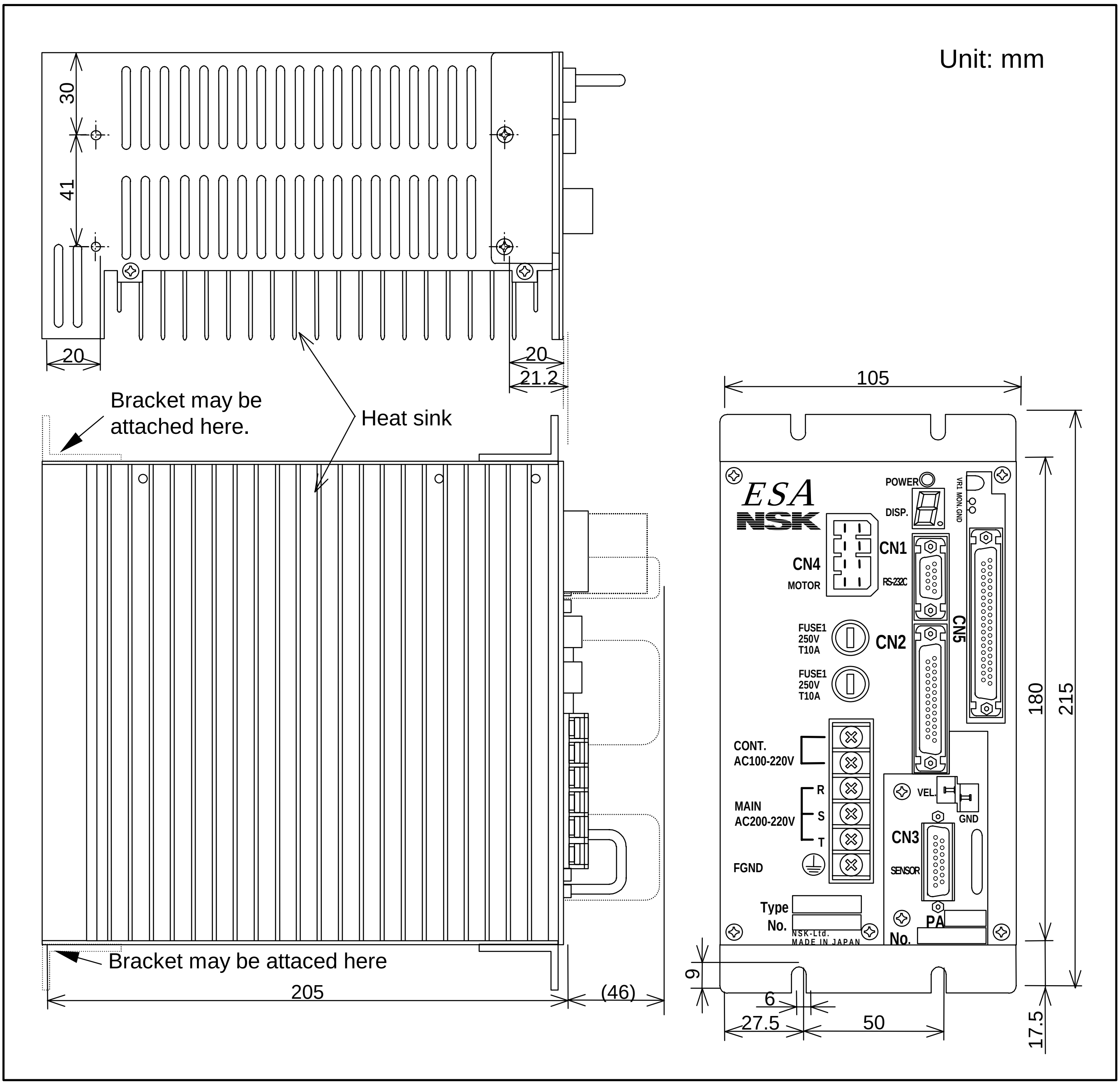
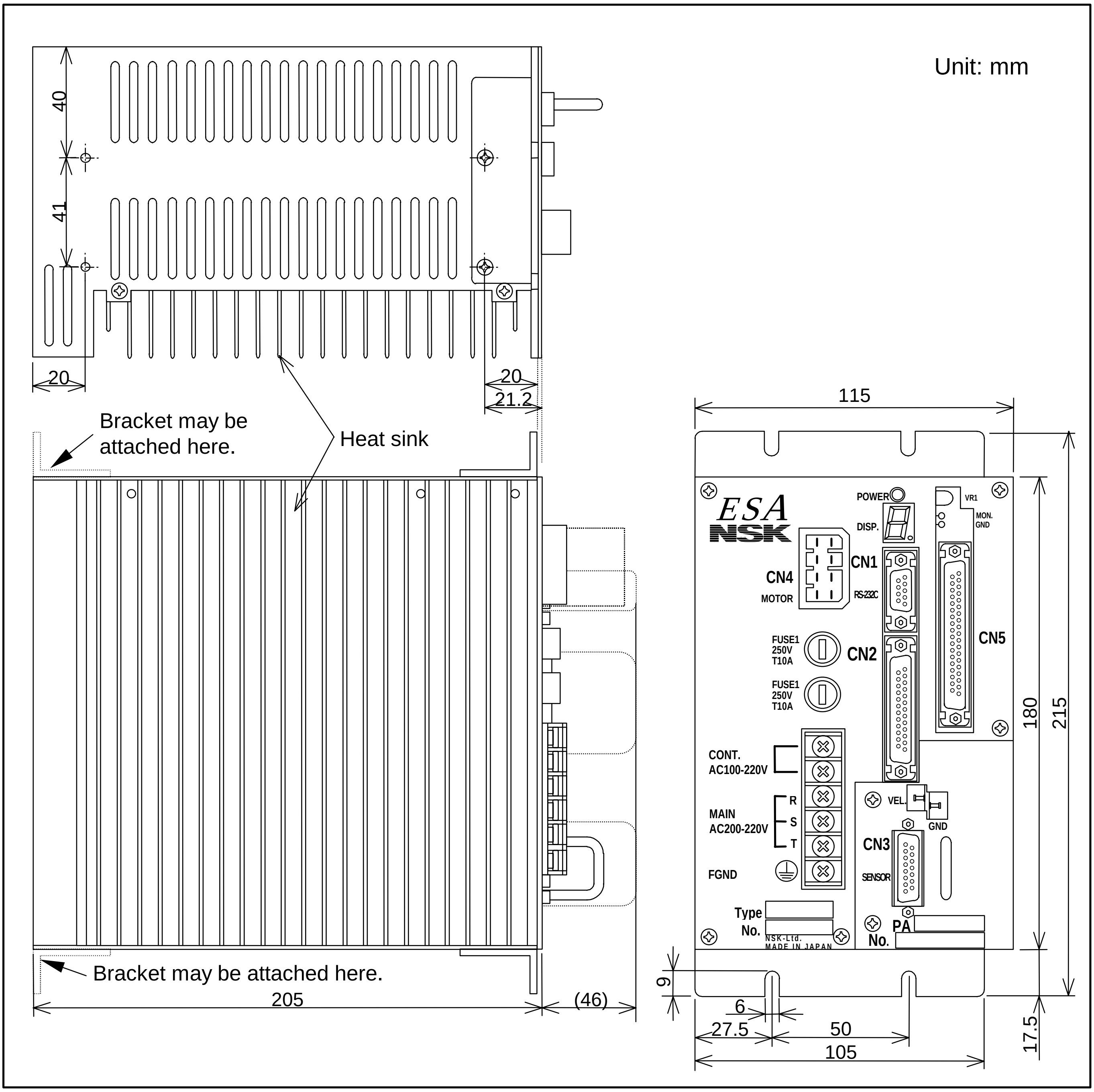


Figure 2-24: ESA Driver Unit with absolute positioning function



2.7. General Specifications of Driver Unit

2.7.1. General Specifications

Table 2-8

<table>
<tr><th colspan="3">Item</th><th colspan="2">Specification</th></tr>
<tr><td colspan="3">Control system</td><td colspan="2">Full closed loop P • PI positioning control</td></tr>
<tr><td colspan="3">Operation mode</td><td colspan="2">Pulse train position command, RS-232C serial communication,
Programmable Indexer, Jog, Home Return</td></tr>
<tr><td rowspan="8">Power input</td><td rowspan="3">Control power</td><td>Spec.</td><td colspan="2">100 to 220 VAC ± 10%, 50/60Hz, single phase</td></tr>
<tr><td>Capacity</td><td colspan="2">Max 50 VA(excludes inrush current)</td></tr>
<tr><td>Inrush current</td><td colspan="2">200 VAC: 14A
100 VAC: 7A</td></tr>
<tr><td rowspan="4">Main power</td><td>Spec</td><td>200 to 220 VAC ± 10%
50/60Hz, single or Three phase</td><td>100 to 110 VAC ± 10%
50/60Hz, single phase</td></tr>
<tr><td>Capacity
(Excludes inrush current)</td><td><table><tr><th>Motor number</th><th>Capacity Max.</th></tr><tr><td>0408, 0608</td><td>2.0KVA</td></tr><tr><td>0810, 1010, 1410</td><td>2.5KVA</td></tr></table></td><td><table><tr><th>Motor number</th><th>Capacity Max.</th></tr><tr><td>0408, 0608</td><td>1.0 KVA</td></tr><tr><td>0810, 1010, 1410</td><td>1.5 KVA</td></tr></table></td></tr>
<tr><td>Inrush current</td><td>140 A</td><td>8 0A</td></tr>
<tr><td colspan="2">Leakage current</td><td><table><tr><td>40 Hz to 1KHz</td><td>5 mA rms</td></tr><tr><td>1KHz to 1MHz</td><td>35 mA rms</td></tr></table></td><td><table><tr><td>40 Hz to 1 KHz</td><td>3 mA rms</td></tr><tr><td>1 KHz to 1 MHz</td><td>20 mA rms</td></tr></table></td></tr>
<tr><td colspan="3">Vibration resistance</td><td colspan="2">0.5 G (Conforms to JIS-C0911)</td></tr>
<tr><td colspan="3">Line noise resistance</td><td colspan="2">1500 V, 1μs (By a noise simulator)</td></tr>
<tr><td colspan="3">Mass</td><td colspan="2">Standard 2.9Kg / Absolute position sensor function 3.0Kg</td></tr>
<tr><td colspan="2" rowspan="2">Environmental condition</td><td>Operating</td><td colspan="2">Ambient temperature: 0 to 50°C. Humidity: 20 to 90%
(Free from condensation, dust, and corrosive gas, etc.)</td></tr>
<tr><td>Storage</td><td colspan="2">Ambient temperature: 20 to 70°C. Indoor condition.
(Free from condensation, dust and corrosive gas, etc.)</td></tr>
</table>

2.7.2. Functional Specifications

Table 2-9

<table>
<tr><th colspan="2">Item</th><th>Specification</th></tr>
<tr><td rowspan="3">Control mode</td><td>Position control</td><td>Programmable Indexer: 64 channels
Pulse train position command: CW/CW, Step and direction, and quadrature)
RS-232C serial communication, Jog, home Return</td></tr>
<tr><td>Velocity control</td><td>Analog velocity command: ± 10V, RS-2332C serial communication</td></tr>
<tr><td>Torque control</td><td>Analog torque command: ± 10V, RS-232C serial communication</td></tr>
<tr><td colspan="2">Resolution of position sensor (resolver)</td><td>[Unit: pulse/rev]
<table>
<tr><th>Resolver resolution / Motor number</th><th>Automatic resolution switching or 12 bit setting</th><th>10 bit setting</th></tr>
<tr><td>04xx</td><td>409 600</td><td>102 400</td></tr>
<tr><td>06xx to 14xx</td><td>614 400</td><td>153 600</td></tr>
</table></td></tr>
<tr><td colspan="2">Maximum velocity</td><td>[Unit: s^{-1}]
<table>
<tr><th>Resolver resolution / Motor size</th><th>12 bit setting</th><th>Automatic res0lution switching or 10 bit setting</th></tr>
<tr><td>04xx</td><td>1.5</td><td>4.5</td></tr>
<tr><td>06xx to 14xx</td><td>1</td><td>3</td></tr>
</table></td></tr>
<tr><td colspan="2">Position feedback output signal</td><td>Output signal format
øA • øB: Line driver
øZ: Line driver/Open collector selectable.
[Unit: pulse/rev]
<table>
<tr><th rowspan="2">Motor size</th><th colspan="2">øA • øB</th><th rowspan="2">øZ (MSB)</th></tr>
<tr><th>12 bit setting</th><th>10 bit setting</th></tr>
<tr><td>04xx</td><td>102 400</td><td>25 600</td><td>100</td></tr>
<tr><td>06xx to 14xx</td><td>153 600</td><td>38 400</td><td>150</td></tr>
</table></td></tr>
<tr><td rowspan="2">Control signal</td><td>Input</td><td>Emergency stop, servo On, Internal program channel switching (64 channels) Programmable Indexer start, Jog, Home Return start, Select rotational direction, Interruption of Programmable Indexer, Home position limit switch, Over travel limit, alarm clear, Velocity loop integration OFF, Lower velocity loop gain, Prohibition of pulse train/analog command input</td></tr>
<tr><td>Output</td><td>Driver Unit ready, Warning, Brake, In-position, Home position defined, Home Return completed/Home position detected, Velocity threshold, Target proximity/In target area</td></tr>
<tr><td colspan="2">Alarm</td><td>Excessive position error, Velocity abnormal, Overload, Over-travel, CPU error, RS-232C error, Resolver circuit error, Over current, Overheat, Main AC line trouble, Control AC line under voltage</td></tr>
<tr><td colspan="2">Monitoring</td><td>Analog monitor, Analog velocity monitor, and RS-232C communication monitor (Current position, Alarm state, Servo parameter setting, etc.)</td></tr>
<tr><td colspan="2">Communication</td><td>Asynchronous RS-232C serial communication, Baud rate: 9 600 bps</td></tr>
<tr><td colspan="2">Data backup</td><td>EEPROM (500 000 times of overwriting/erasing data is possible.)</td></tr>
</table>

- The parameter SL sets the control mode.
  - ◊ SL1: Torque control mode
  - ◊ SL2: Velocity control mode
  - ◊ SL3: Position control mode
- The parameter RR sets the resolution of position sensor.
  - ◊ RR−1: 10/12 bit automatic resolution switching
  - ◊ RR0 : 10 bit
  - ◊ RR1 : 12 bit
- The parameter FR sets the resolution of position feedback output signal.
  - ◊ FR0: 10bit. ◊ FR1: 12bit

2.8. RS-232C Interface Specifications

- Refer to “6.3. RS-232C Communication” for the specifications of communication.

2.8.1. CN1: RS-232C Serial Communication Connector

* Optional Handy Terminal FHT 11 is available for the RS-232C communication terminal.

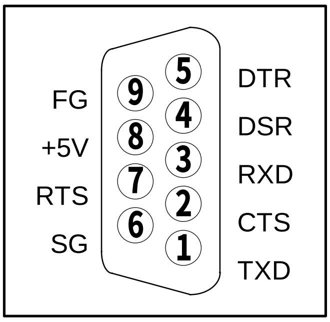
Table 2-10

Driver Unit connector	Japan Aviation Electronics Industry, Ltd.	DELC-J9SAF-13L9
Mating connector type (User device side)	Japan Aviation Electronics Industry, Ltd. (To be prepared by the user)*	DE-9PF-N
Mating connector shell type (user device side)	Japan Aviation Electronics Industry, Ltd. (To be prepared by the user)*	DE-C2-J6

* The user shall provide these connectors. They are not necessary if NSK Handy Terminal FHT 11 is used.

2.8.1.1. CN1 Pin-Out

Figure 2-25: CN1 Pin-out



2.8.1.2. CN1 Signal List

Table 2-11: Signal name and function (CN1)

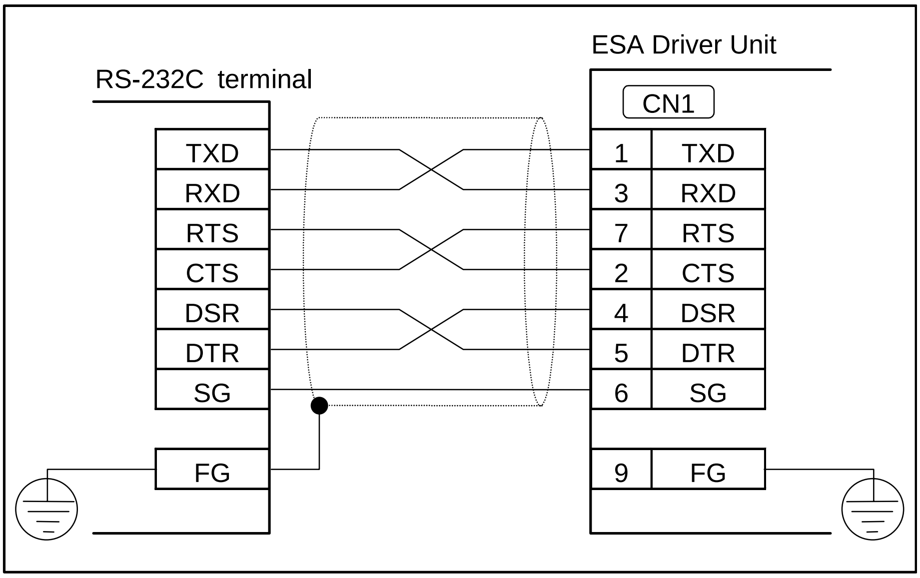
Pin	Signal name	I／O	Function
1	TXD	Output	Transmit data
2	CTS	Input	Clear to send
3	RXD	Input	Receive data
4	DSR	Input	Data set ready
5	DTR	Output	Data terminal ready
6	SG	–	Digital signal ground
7	RTS	Output	Ready to send
8	+5V	Output	Never connect
9	FG		Frame ground (shield)

2.8.1.3. Sample Wiring Diagram (CN1)

- Connect the ESA Driver Unit with the master controller (personal computer, etc.) in accordance with its RS-232C control signal specification.

◆ RTS Control / CTS Monitoring active (standard)

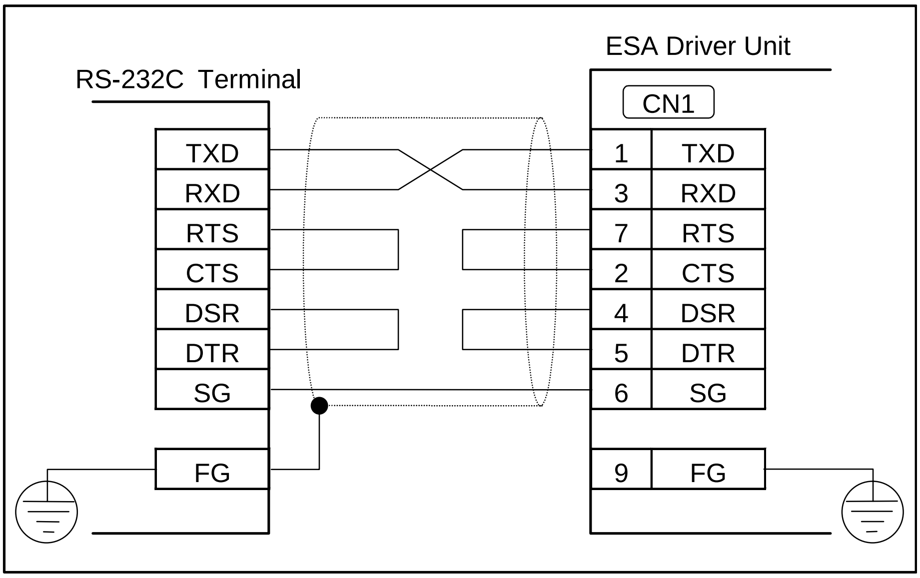
Figure 2-26



◆ RTS control/CTS Monitoring inactive

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

Figure 2-27



2.9. CN2 and CN5: Control I/O Signal Connector

- Table 2-14 shows types of connectors that are used for connectors CN2 and CN5 and connectors for user side devices.

Table 2-12

Connectors for Driver Unit	CN2	Japan Aviation Electronics Industry, Ltd.	DBLC-J25SAF-13L9
	CN5		DCLC-J37SAF-13L9
Mating connectors (User device side)	CN2	Japan Aviation Electronics Industry, Ltd.	DB-25PF-N*
	CN5		DC-37PF-N*
Mating connector shell type (User device side)	CN2	Japan Aviation Electronics Industry, Ltd.	DB-C15-J10-F2*
	CN5		DC-C8-J13-F1-1*

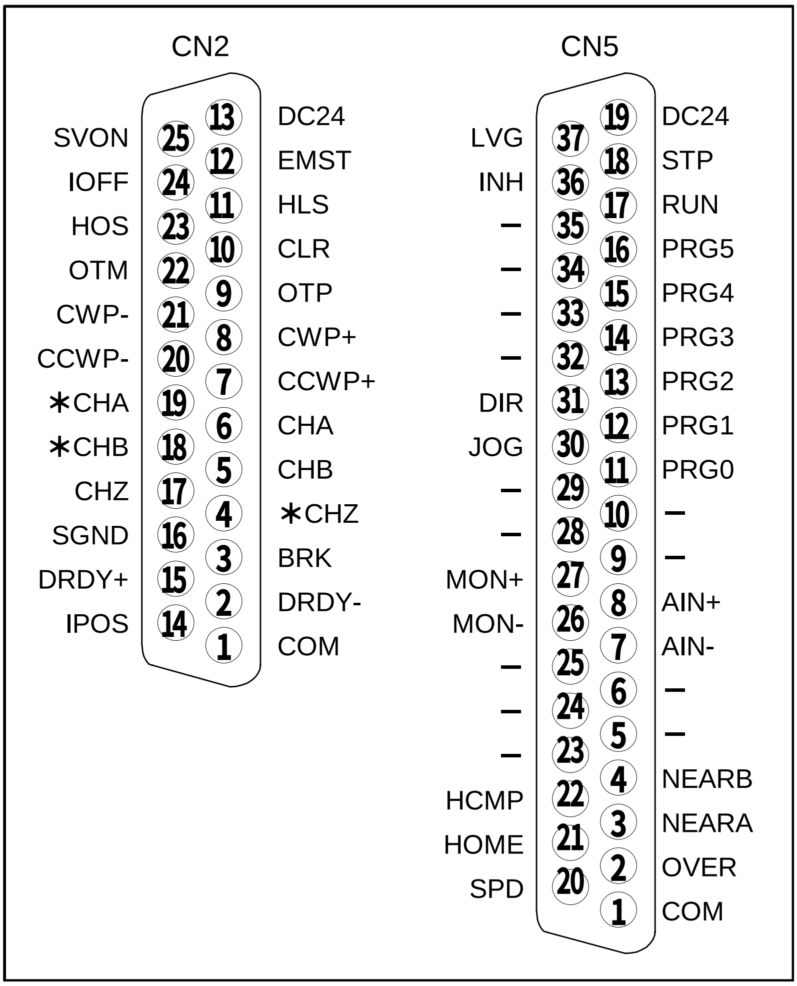
* These connectors shall be provided with the Driver Unit.

- The followings are the wiring precautions for connectors CN2 and CN5.
  1) Use shielded cable for wiring the connectors CN2 and CN5.
  2) Twisted cables must be used for the pulse train input and the position feedback signal.
  3) These cables should be laid separately from the power line. Wiring length shall be short as possible. (2 m maximum)
  4) Connect one end of shield to the frame ground. Refer to “3.3.4. Ground Connection and Wiring.”

⚠ *Caution : Check for wiring mistake in the polarity of external power supply, and shorting between connector pins.*

2.9.1. Pin-out (CN2 and CN5)

Figure 2-28



2.9.2. Signal Name and Function (CN2 and CN5)

Tale 2-13: CN2

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

* The parameter FZ (RS-232C communication interface) selects the position feedback signal øZ or the digital position signal ∗MSB.

Table 2-14: CN5

Pin	Signal name	I/O	Function
1	COM	Output	Output COMMON
2	OVER	Output	Warning
3	NEARA	Output	Target proximity A/In target A(1)
4	NEARB	Output	Target proximity B/In target B(1)
5	―	―	Do not connect
6	―	―	Do not connect
7	AIN－	Input	Analog command input (-)
8	AIN＋	Input	Analog command input (+)
9	―	―	Do not connect
10	―	―	Do not connect
11	PRG0	Input	Programmed move • Channel switch 0
12	PRG1	Input	Programmed move • Channel switch 1
13	PRG2	Input	Programmed move • Channel switch 2
14	PRG3	Input	Programmed move • Channel switch 3
15	PRG4	Input	Programmed move • Channel switch 4
16	PRG5	Input	Programmed move • Channel switch 4
17	RUN	Input	RUN move
18	STP	Input	Stop
19	DC24	Input	24 VDC external power supply
20	SPD	Output	Velocity threshold
21	HOME	Output	Home Return completed/ Home position detected(1)
22	HCMP	Output	Home position defined
23	―	―	Do not connect
24	―	―	Do not connect
25	―	―	Do no connect
26	MON－	Output	Analog monitor output (-)
27	MON＋	Output	Analog monitor output (+)
28	―	―	Do not connect.
29	―	―	Do not connect.
30	JOG	Input	Jog
31	DIR	Input	Jog direction
32	―	―	Do not connect.
33	―	―	Do not connect.
34	―	―	Do not connect.
35	―	―	Do not connect.
36	INH	Input	Inhibit pulse train / Analog command input
37	LVG	Input	Lower velocity loop proportional gain.

* (1) A parameter selects the function.

⚠ *Caution : Follow respective specification documents of a custom made Megatorque Motor System for specially arranged Input/Output signals.*

2.9.3. Setting the Polarity of the Input Ports (Normally open or closed contacts)

- You may change the polarity of some CN2 input ports.
- The all input polarity is set to the normally open contact for shipping set.
- The parameter AB sets the polarity of input ports.
- You require entry of the password before inputting the parameter AB.
- Polarity change is only available for signals EMST, HLS, OTP, and OTM.
- Refer to Table 2-15 for arrangement of the signal names. (From left, EMST is on the second signal, HLS on the fourth, OTM on the seventh, and OTP on the eighth.)

Table 2-15

CN2 No.	25	12	24	11	23	10	22	9
Signal name	SVON	EMST	IOFF	HLS	HOS	CLR	OTM	OTP

- Meaning of data

  0 = Normally open (A contact)
  1 = Normally closed (B contact
  X = The port indicated by X does not need to change the polarity when setting signal polarity. In case of reporting the status of polarity of signals, you cannot change the polarity of a signal that coded to X. The polarity of the signal indicated by X is set to “normally open contact (A contact).”

◆ Example of polarity setting

- Set the polarity of the signal EMST (Emergency stop) to the normally closed contact (B contact).

(1) Input the code key while pressing the shift key.

SHIFT 0 ?

```
:
:?_
```

(2) Input the readout command AB and confirm the current polarity setting. (The example below shows that the polarity of all signals is the normally open contact (A contact.)

A B ENT

```
:
:?AB
 ABX0X0XX00
:_
```

(3) Input the password. The acknowledgement will be on the screen.

/ N S K SP
O N ENT

```
 ABX0X0XX00
:/NSK ON
 NSK ON
:_
```

(4) Input “1” to the EMST (the second one) and remain X (unchanged) for the other signals. Thus the polarity of EMST signal is changed to the normally closed contact.

A B X 1 # X X
X X X X ENT

```
:/NSK ON
 NSK ON
 ABX1XXXXXX
:_
```

2.9.4. Electrical Specifications of Signals (CN2 and CN5)

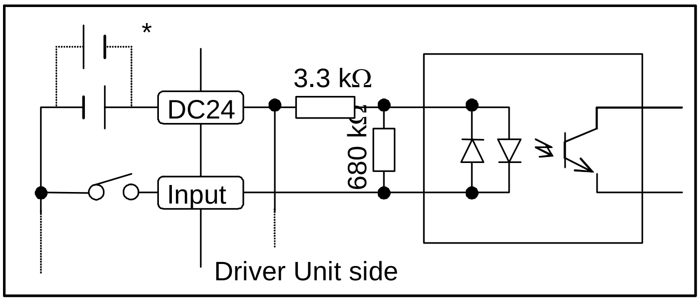
2.9.4.1. General Input Signals

Applicable inputs: SVON, EMST, PRG0 to 5, RUN, HOS, HLS, JOG, DIR, OTP, OTM, CLR, IOFF, LVG, STP, and INH

Table 2-16

Item	Specification
Input voltage	24 VDC ±10%
Input impedance	3.3 kΩ
Maxi. current	10 mA or less (per one contact)

Figure 2-29



* You may reverse the polarity of 24 VDC external supply and connect as "minus common."

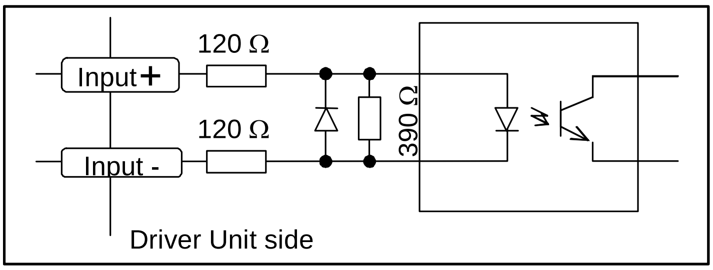
2.9.4.2. Pulse Train Command

Applicable inputs: CCWP＋, CCWP－, CWP＋, and CWP－

Table 2-17

Item	Specification
Input voltage	5 VDC ±10%
Input impedance	240 Ω
Max. current	25 mA or less

Figure 2-30



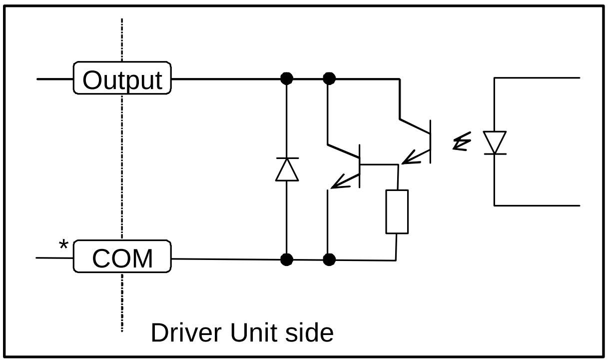
2.9.4.3. General Output Signal

Applicable outputs: BRK, IPOS, OVER, HOME, HCMP, SPD, NEARA, and NEARB

Table 2-18

Item	Specification
Max. load capacity	24 VDC/100mA
Maxi, saturated voltage	2 V or less

Figure 2-31



* Connect a corresponding output signal connectors CN2 and CN5 for the output COMMON.

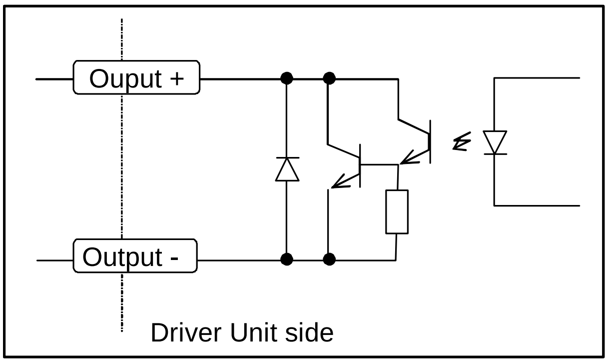
2.9.4.4. Alarm Output

Applicable outputs: DRDY+ , and DRDY-

Table 2-19

Item	Specification
Max. load capacity	24 VDC/100mA
Maxi. saturated voltage	2 V or less

Figure 2-32



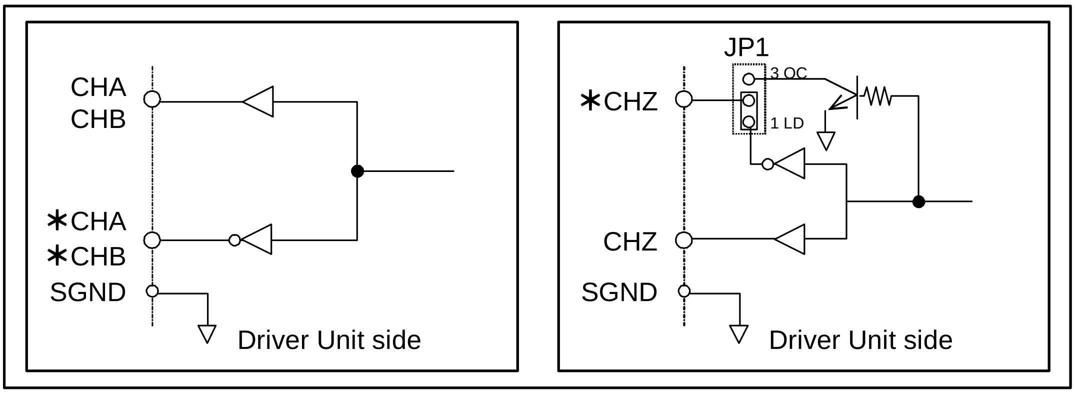
2.9.4.5. Position Feedback Signal Output

Applicable outputs: CHA, CHB, CHZ, *CHA, *CHB, and *CHZ

Table 2-20

Item	Specification	
Output format	• Line driver (CHA, CHB, *CHA, and *CHB) • Line driver or Open collector (CHZ, and *CHZ) (May be selected by Jumper JP1: Refer to "2.13.1. JP1.")	
Line driver	Texas Instruments: SN75ALS192	
Recommended line receiver	Texas Instruments: SN75ALS193 or AM26LS32 equivalent	
Max. collector current	100 mA	When the signal format is open collector,
Max. collector voltage	24 V	
Saturated voltage	1 V or less	

Figure 2-33



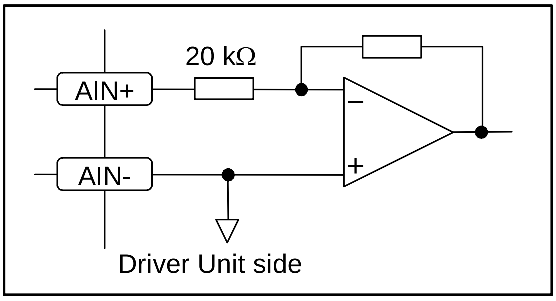
2.9.4.6. Analog Command Input

Applicable inputs: AIN+, and AIN-

Table 2-21

Items	Specification
Max. input voltage	± 10 V
Input impedance	20 kΩ
Max. input current	0.5 mA

Figure 2-34



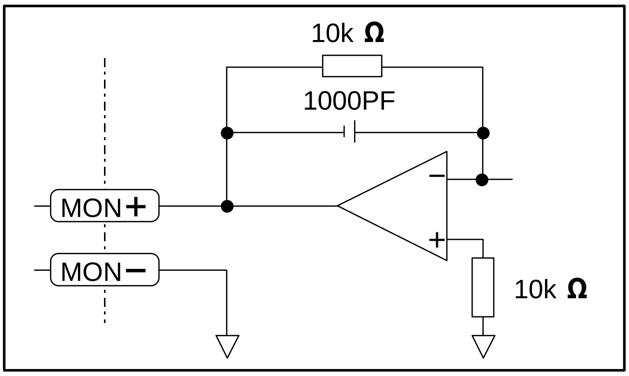
2.9.4.7. Analog Monitor

Applicable outputs: MON+, and MON-

Table 2-22

Item	Specification
Output format	Ope-amp
Max. output voltage	± 10 V ±10%
Saturated current	4 mA or less

Figure 2-35



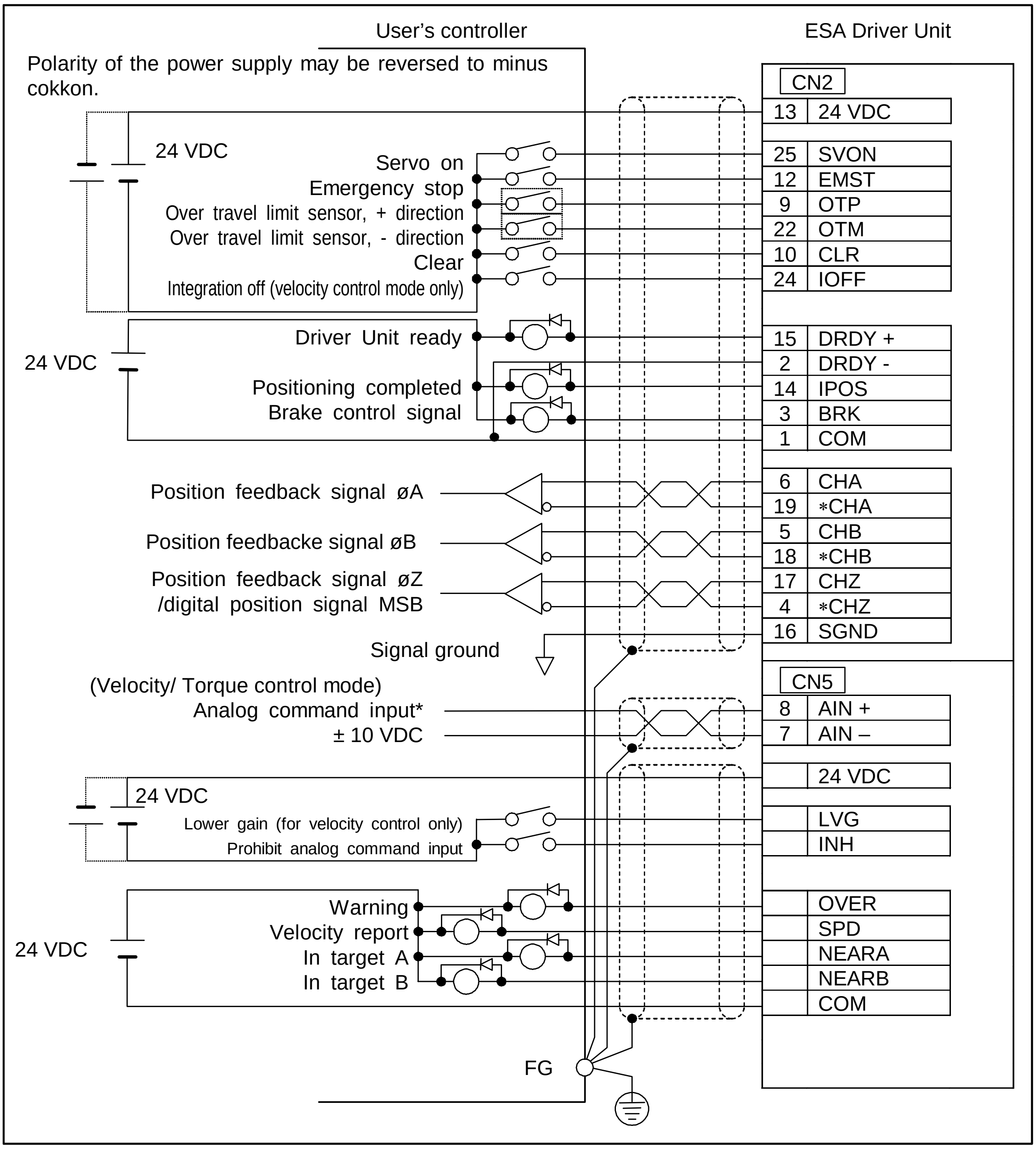
2.9.5. Wiring Connectors (CN2, and CN5)

⚠ *Caution : • Be sure to install a surge killer circuit when inductive switches, such as relays, are used.*

• When you install sensors such as "Home position limit switch," "+ direction sensor of over travel limit switch" and "- direction of over travel limit switch," connect output of those sensors directly, not via a controller. (Those outputs are shown as [symbol] in the following figures.)

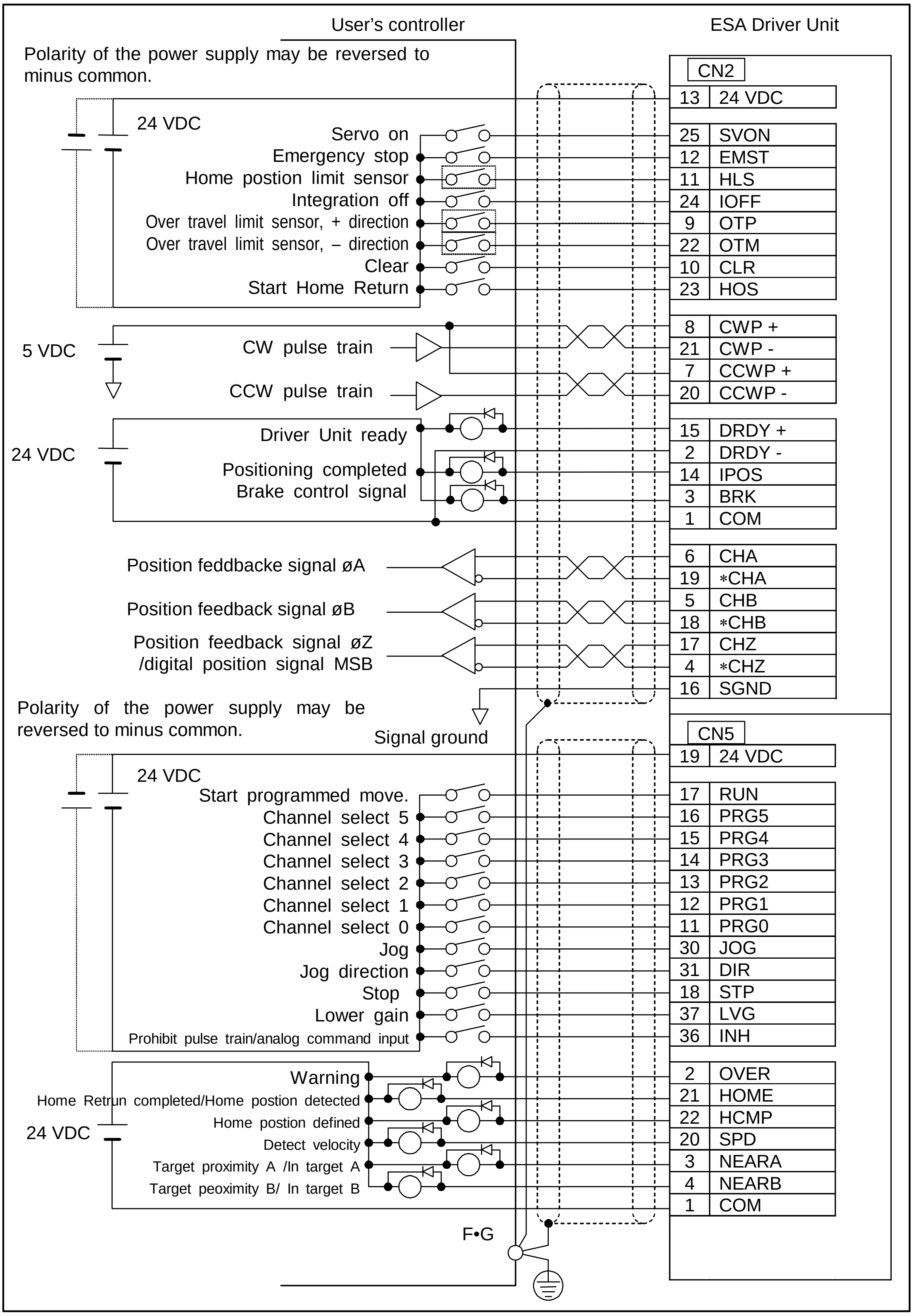
2.9.5.1. Example of Velocity/Torque Control Mode

Figure 2-36



2.9.5.2. Example of Position Control Mode

Figure 2-37



2.9.5.3. Application of Mechanical Brake

- A brake unit for RS series Motors is an electromagnetic brake that functions by the application of current to its coil. There are two types of brake: power-on activated electromagnetic brake that functions by tuning on the power to the coil, and power-off activated brake that functions by turning off the current to the coil.

Table 2-23: Electromagnetic brake for RS series Motors

Type	Function
Power-on activated type (Non-backlash)	・High braking power holds the Motor position tightly when external force in rotational direction is applied in case of machining, etc.
Power-off activated type	・Brake for power shut down or emergency stop. ・High braking power.
Power-off activated type (Non-backlash)	・Brake for power shut dawn or emergency stop. ・Suites for application that requires accurate position holding.

◊ The brake must be kept in completely dry condition. Be sure to maintain the friction plate absolutely free from oil so that not to lose braking torque.

◊ The electromagnetic brake uses a lot of soft materials. Hammering, dropping, or application of excessive external force may create internal damage or deformation. This may result in a brake malfunction or a drop of braking torque.

Table 2-24: Specifications of power-on activated electromagnetic brake

Motor reference number	Static friction torque [N•m]	Torsion rigidity [arc-sec/N・m]	Engaging time [sec]	Releasing time [sec]	Power voltage	Capacity [W]
M-RS0608FC001	49	0.66	0.031	0.049	24 VDC	36
M-RS0810FC001	88.2	0.70	0.035	0.093	24 VDC	40
M-RS1010FC001	147	0.54	0.053	0.081	24 VDC	46
M-RS1410FC001	245	0.33	0.053	0.121	24 VDC	64

Table 2-25: Specifications of power-off activated electromagnetic brake

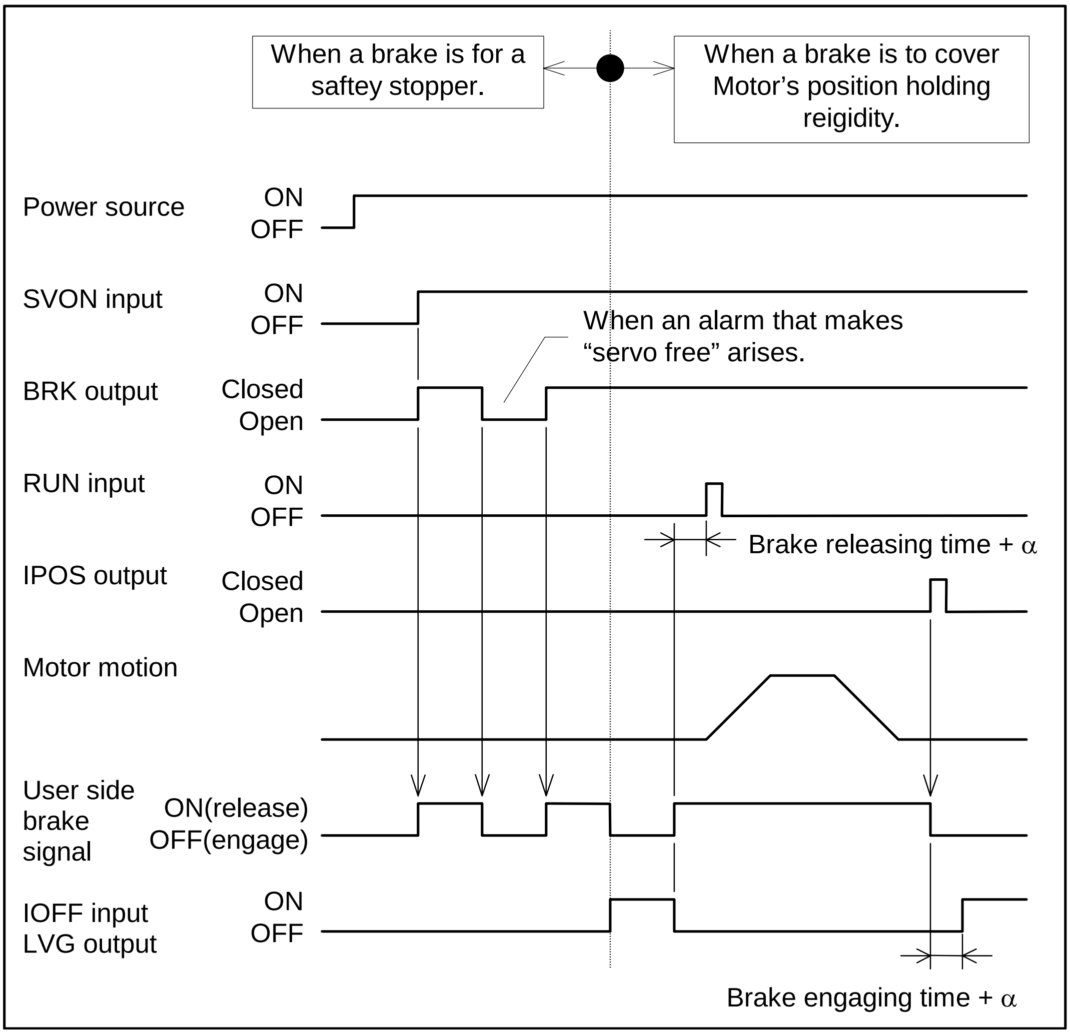
Motor reference number	Static friction torque [N•m]	Torsion rigidity [arc-sec/N・m]	Engaging time [sec]	Releasing time [sec]	Power voltage	Capacity [W]
M-RS0608FD001	49	6	0.135	0.102	24 VDC	36
M-RS0810FD001	88.2	6	0.220	0.020	24 VDC	40
M-RS1010FD001	147	7	0.240	0.038	24 VDC	46
M-RS1410FD001	245	6	0.280	0.092	24 VDC	64

Table 2-26: Specifications of power-off activated non-backlash electromagnetic brake

Motor reference number	Static friction torque [N•m]	Torsion rigidity [arc-sec/N・m]	Engaging time [sec]	Releasing time [sec]	Power voltage [V]	Capacity [W]
M-RS0608FG001	29.4	0.51	0.158	0.036	24 VDC	36
M-RS0810FG001	49	0.31	0.164	0.030	24 VDC	40
M-RS1010FG001	88.2	0.15	0.257	0.044	24 VDC	46
M-RS1410FG001	147	0.13	0.295	0.074	24 VDC	64

● The user's master controller must control the brake control circuit.

Figure 2-38: Recommended sequence

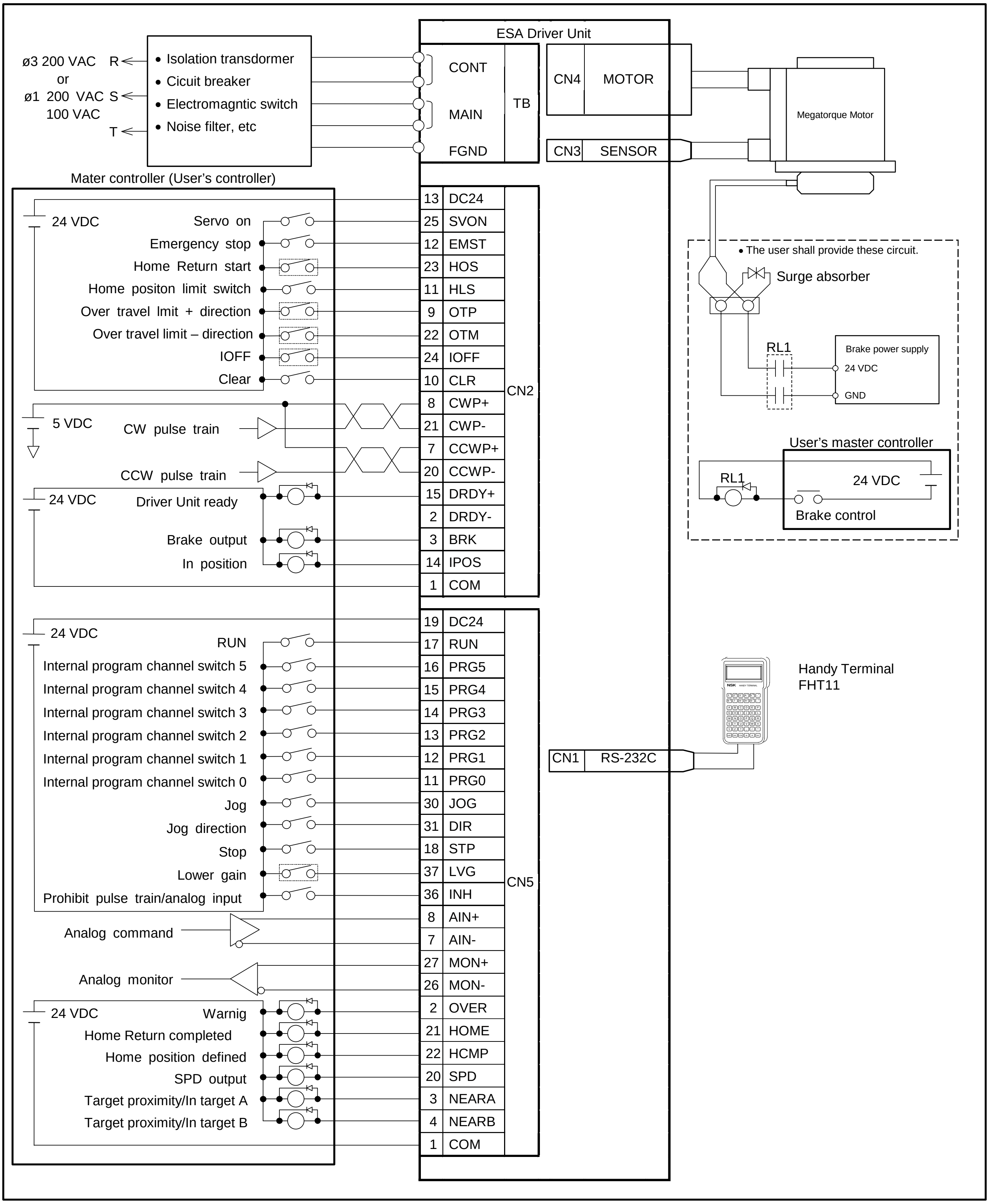


⚠ *Caution : • When braking the Motor under the servo lock state, be sure to deactivate integration control in velocity loop (IOFF input ON). Otherwise the Motor will overheat and create a dangerous situation.*

- *Take an enough time for locking the Motor by brake when deactivate the integration control in velocity loop. If you deactivate the integration control before locking the Motor, stopping accuracy of the Motor will deteriorate.*

- *Do not turn the servo OFF when locking the Motor by the brake in the pulse train command operation. Otherwise accuracy of stopping position error will be accumulated because errors in the position error counter are cleared every time the brake is on.*

Figure 2-39: Wiring example for a Motor equipped with brake



2.10. CN3: Resolver Cable Connector

⚠ *Caution : Use the Cable Set provided with the Driver Unit. Do not cut the cable shorter or hookup another cable because it is uniquely made for the resolver.*

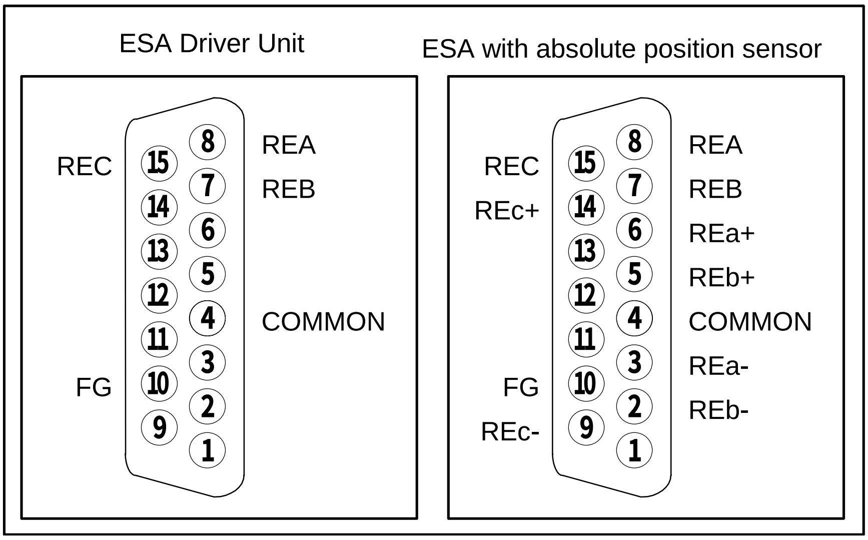
Table 2-27

Driver Unit connector	Japan Aviation Electronics Industry	DALC-J15SAF-13L9
Mating connector type* (user side)	Japan Aviation Electronics Industry	DA-15P-N*
Mating connector shell type* (user side)	Japan Aviation Electronics Industry	DA-C1-J10*

* Provided with the Cable Set.

2.10.1. Pin-Out (CN3)

Figure 2-40: Pin-out



2.10.2. Signal List (CN3)

Table 2-28: Signal list

Pin No.	Signal name	Function
8	REA	Resolver signal øA
7	REB	Resolver signal øB
15	REC	Resolver signal øC
4	COMMON	Common
10	FG	Frame ground

Pin No.	Signal name	Function
6	REa+	Absolute resolver signal øa +
3	REa-	Absolute resolver signal øa -
5	REb+	Absolute resolver signal øb +
2	REb-	Absolute resolver signal øb -
14	REc+	Absolute resolver signal øc +
9	REc-	Absolute resolver signal øc -

⚠ *Caution : Never connect pins not listed above.*

⚠ *Caution : Check orientation of the connector when inserting it. Tighten the screws to secure the connector so that it does not disconnect because of shock or pulling.*

⚠ *Caution : Do not connect or disconnect the connecter when the power of the Driver Unit is on.*

2.11. CN4: Motor Connector

⚠ *Caution : Use the Cable Set provided with the Driver Unit. You cannot cut the cable or hookup to other cable as the Cable Set is specially made for the Megatorque Motor.*

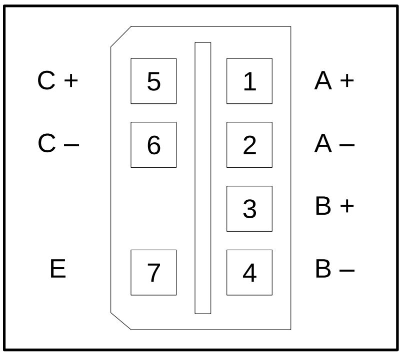
Table 2-39

Connector of Driver Unit	Tyco Electronics AMP K.K.	172039-1
Mating connector (user side)	Tyco Electronics AMP K.K.	172495-1*
Mating connector shell type (user side)	Tyco Electronics AMP K.K.	172774-1*

* Provided with the Driver Unit.

2.11.1. CN4 Pin-Out

Figure 2-41: Pin-out



2.11.2. CH4 Signal List

Table 2-30: Signal list

Pin	Signal Name	Function
1	A+	Motor winding øA (+)
2	A–	Motor winding øA (–)
3	B+	Motor winding øB (+)
4	B–	Motor winding øB (–)
5	C+	Motor winding øC (+)
6	C–	Motor winding øA (–)
7	E	Motor winding ground

⚠ *Danger : Do not connect or disconnect the connector if the power of Driver Unit is on.*

⚠ *Danger : A high voltage is applied to the connector after the power is turned on. Be sure not to shorten the pins.*

⚠ *Danger : Check the orientation of the connector when inserting it. Though the connector is self-lock type, be sure to insert it to the bottom. Otherwise you cannot secure the connector.*

2.12. TB: Terminal Block for Power Supply

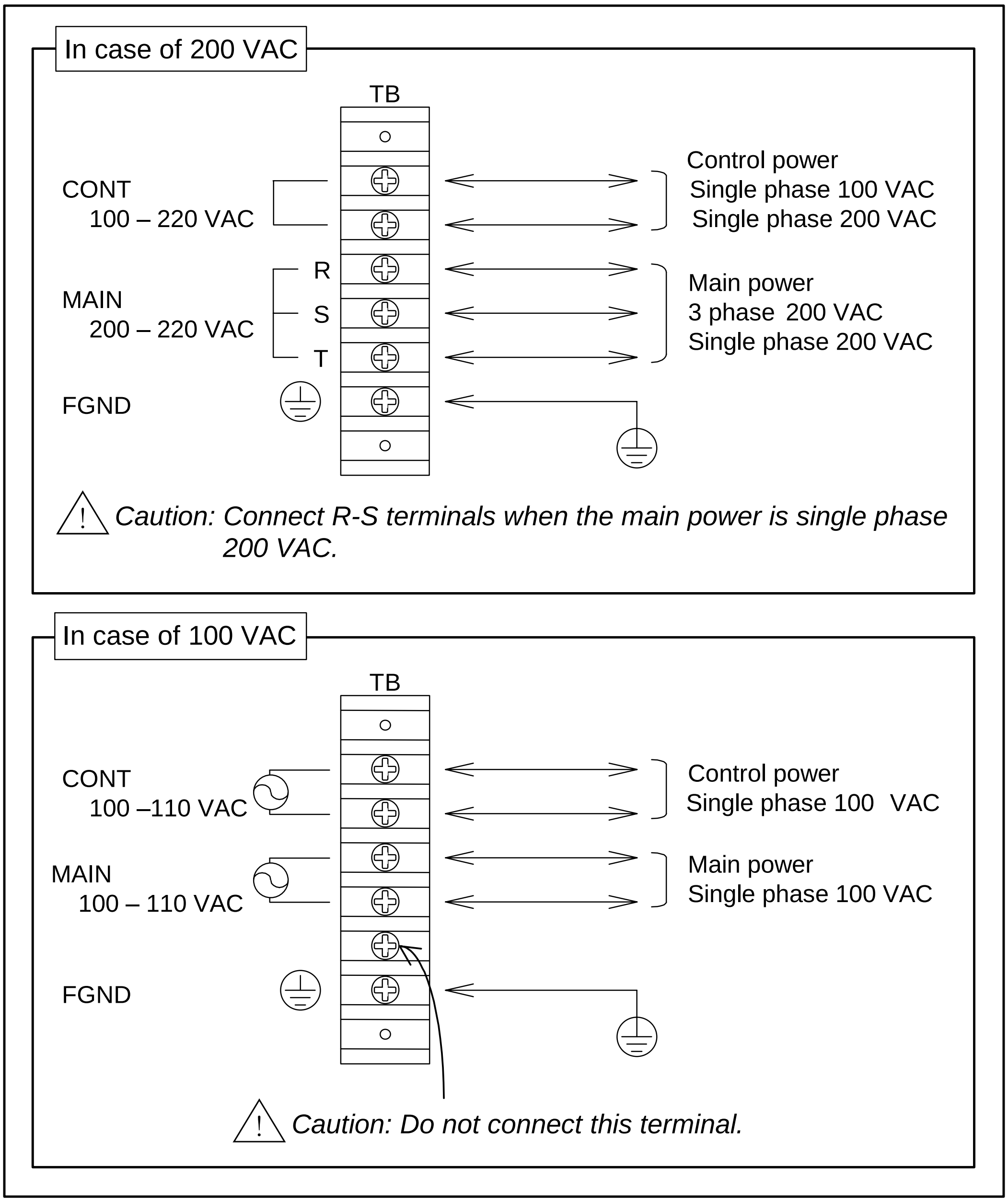
2.12.1. Terminal List

Table 2-31: Terminal code and function ***端子記号と機能***

Terminal code	Function
CONT	Control power input
MAIN	Main power input
FGND	Frame ground

2.12.2. Wiring Diagram

Figure 2-42: wiring diagram



2.13. Jumper Pin

2.13.1. JP1 (Selection of øZ output signal format)

Figure 2-43: Arrangement of jumper pins

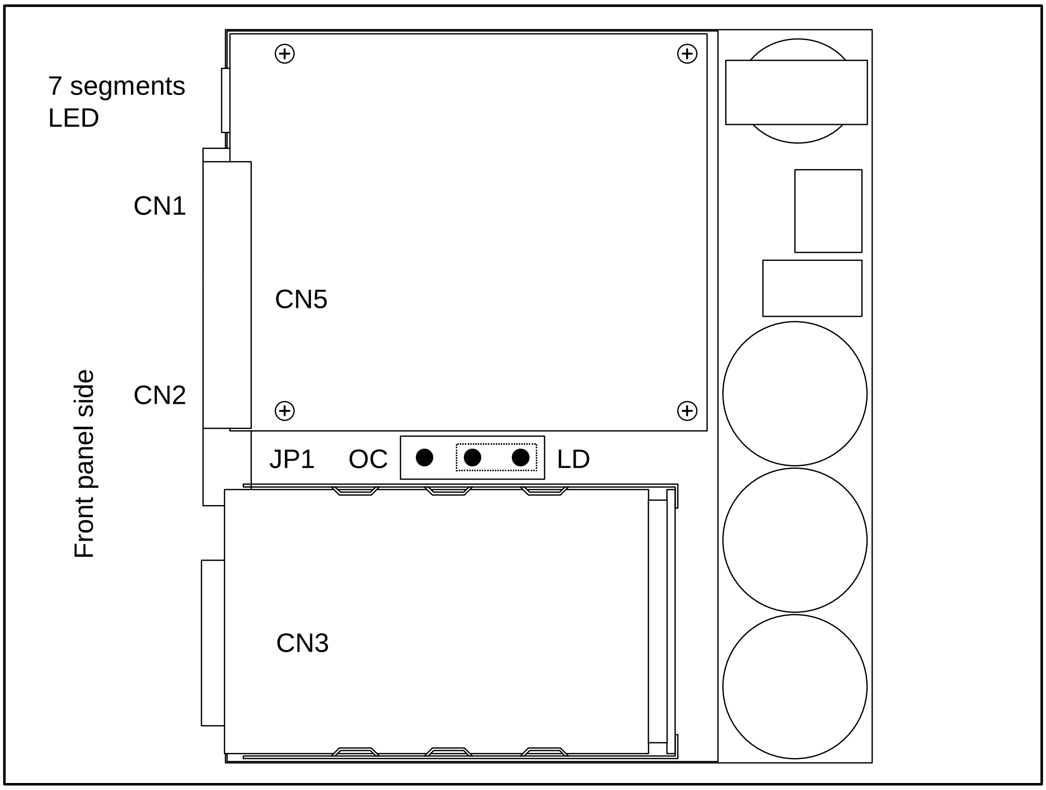


Table 2-32

Pin setting	ø Z output signal format
LD short (shipping set)	Line driver
OC short	Open collector

⚠ *Caution : Remove the panel referring to “Appendix 4. How to Replace the ESA Driver Unit” when changing the setting of the jumper.*

2.14. Dimensions of Cable Set

Figure 2-44: Standard cable (M-CXXXSSR05)

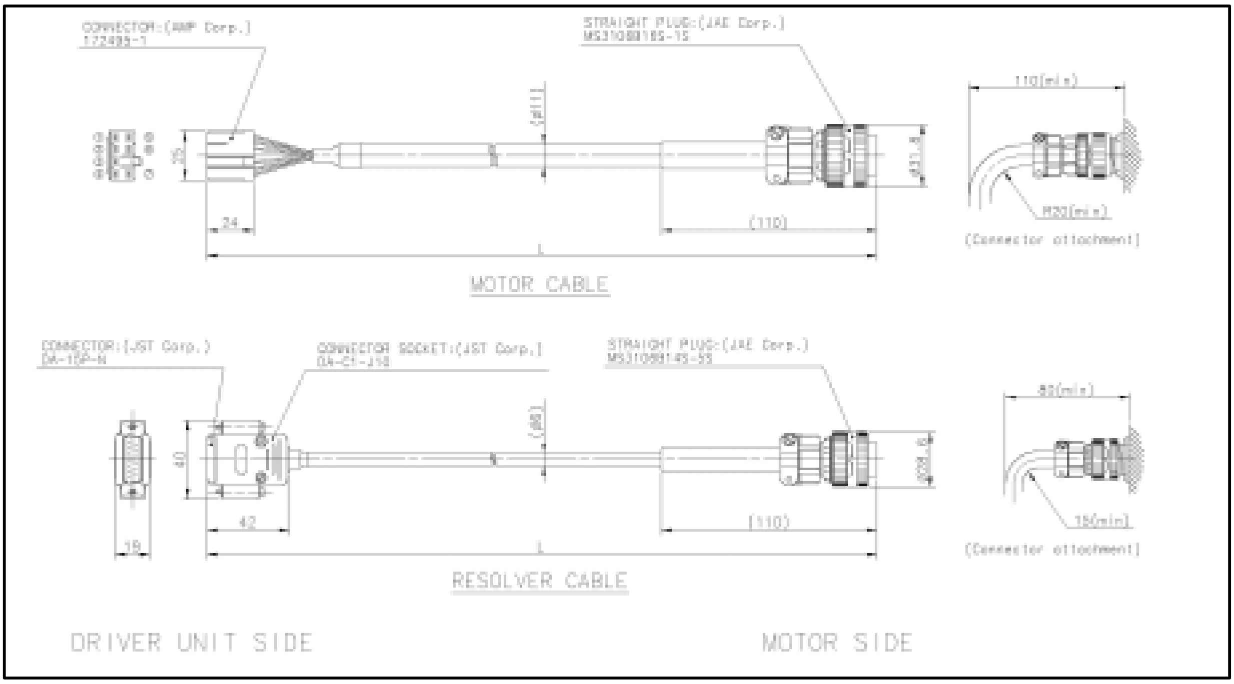
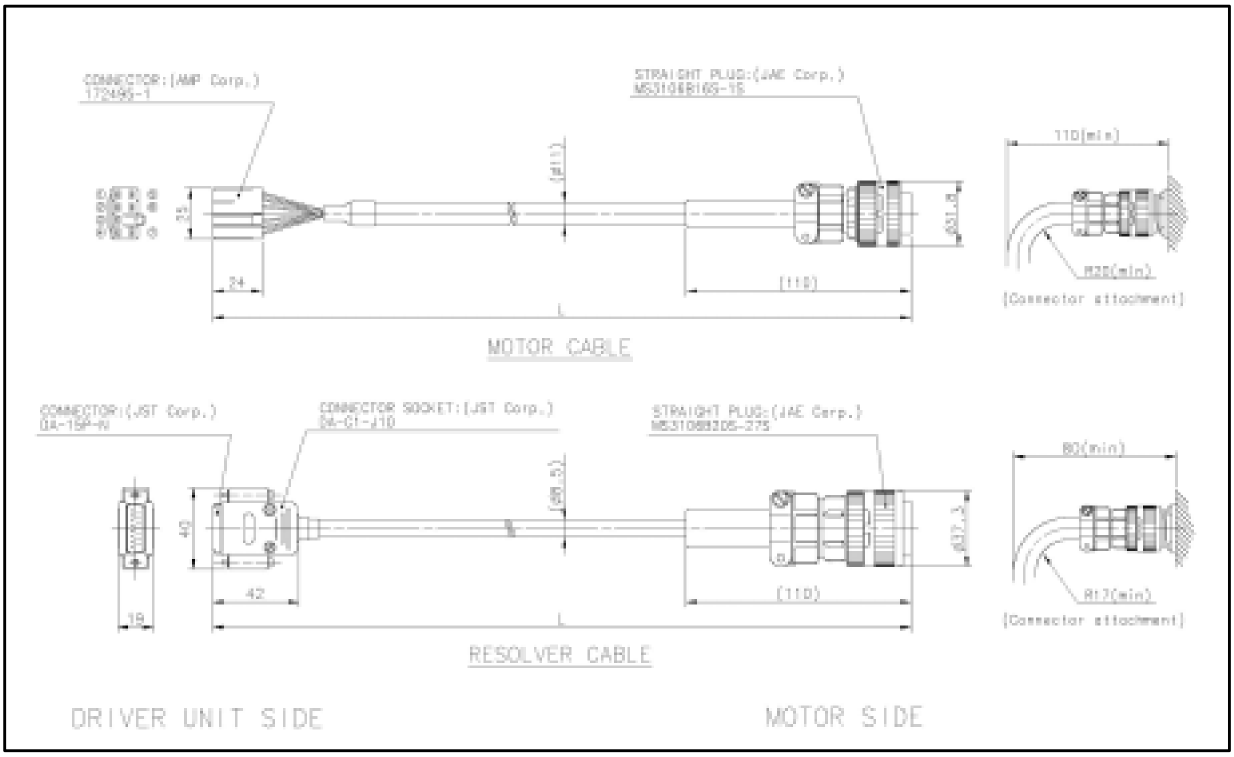


Figure 2-45: Cables for the system with function of absolute positioning (M-CXXXSSR07)



3. Unpacking • Installation • Wiring

3.1. Unpacking

3.1.1. Receiving Check

1) Megatorque Motor
2) Driver Unit
3) Cable Set (Motor and resolver cables)
4) Accessories
   - ◊ CN2 and CN5 mating connectors for control I/O signals (for user devices)
   - ◊ Fuse (2 sets)

3.1.2. Combination of Motor and Driver Unit

⚠ Caution : Confirm that the serial numbers of Motor and Driver Unit indicated on respective nameplates are the same.

Figure 3-1: Nameplate of Motor

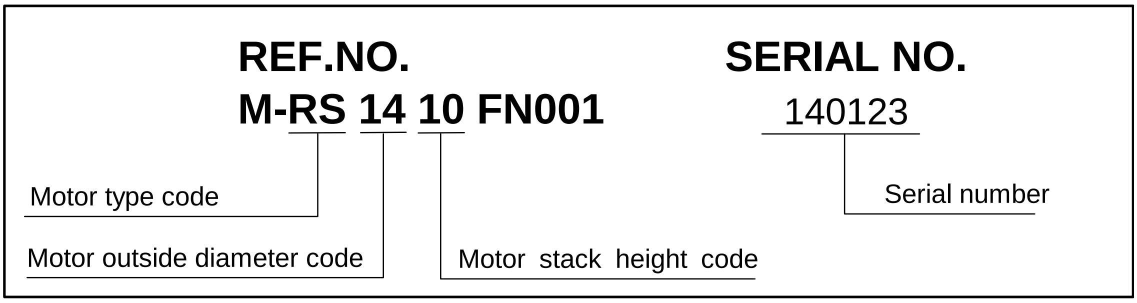
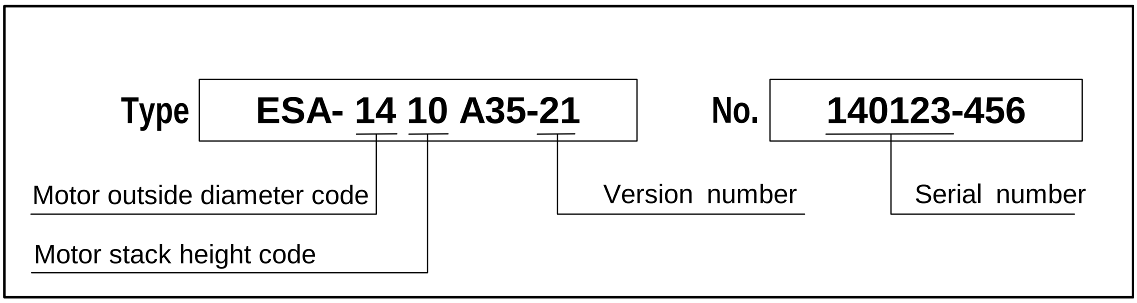


Figure 3-2: Nameplate of Driver Unit



3.2. Installation

3.2.1. Motor

⚠ *Caution : Confirm that how your Motor is graded for dustproof and waterproof. You cannot use the Megatorque Motor in the environment with chemicals or paint fumes.*

◊ Standard Megatorque Motors (RS, AS, and BS types)

They are not made to dustproof or waterproof specification. (Equivalent to IP20, IP30 or IP40) You may not expose them to humid or oily environment.

◊ Simple waterproof Motor (RW type)

Some part of the Motor is not completely waterproofed. Confirm what part is not waterproofed with the specification document, and then take appropriate measures to the part against water and dust if necessary. For a long time use of the Motor, we recommend checking the aging trend of Motor with periodical insulation test approximately once in every half year. You cannot use this type of Motors unless you take the measures against the environment with water or oil.

◊ Waterproof Motor (RZ type: IP65 equivalent)

Use this type of Motor when continually splash water or oil on it. Provide air purge when you use the Motor in IP66 or equivalent condition. Be sure to supply a dry air. The user shall take the measures against dust. For a long term use, check the Motor for its aging by insulation test (approximately once in every half year).

3.2.1.1. Mounting Motor

⚠ *Caution : Fix the Motor to the mounting base using the bolt holes on the Motor flange or the tap holes on the bottom of Motor.*

- Flatness of the mounting surface shall be 0.02 mm or less.

3.2.1.2. Attaching Load (Work) to Motor

⚠ *Warning : Use the tap holes on the rotor to fix an attachment. Fasten the bolts securely so that there is no looseness between the rotor and the attachment (work).*

3.2.1.3. Confirmation of Load Inertia

- The load inertia is generally much higher than the rotor inertia in the Megatorque Motor System. The measures of allowable load inertia for each Motor size are shown in Table 3-1.

Table 3-1 *[Unit: kgm^2]*

Motor size	High speed positioning	General use	High inertia (Low speed)
0408	0.01 to 0.05	0.05 to 0.5	0.5 to 1
0608	0.05 to 0.2	0.2 to 2	2 to 2.5
0810	0.11 to 0.45	0.45 to 4.5	4.5 to 5
1010	0.18 to 0.75	0.75 to 7.5	7.5 to 37.5
1410	0.31 to 1.25	1.25 to 12.5	12.5 to 125

⚠ *Caution : Check the maximum thrust and moment loads.*

- Refer to the specifications of Motor for more details.

3.2.2. Driver Unit Mounting

⚠ *Caution : (1) Ambient temperature*

Keep the ambient temperature of the Driver Unit between 0 to 50°C. You cannot use the Driver Unit in an atmosphere over 50°C. Keep a clearance of 100 mm in upper and lower sides of the Driver Unit when it is installed in an enclosure. If the heat is built up at the upper side of the Driver Unit, provide ventilation openings on the top of it or equip an air cool unit to take the heat out of the Driver Unit. (Measures against contamination are required for the ventilation openings.)

(2) Dust-proof • Waterproof

Put the Driver Unit in an enclosure of which protection code is the IP54 or better. Protect the Driver Unit from oil-mist, cutting oil, metallic chips and paint fumes etc. Otherwise it may result in failure of electric circuits of the Driver Unit because of contamination through the opening of the Driver Unit.

• The IP code is specified in the IEC standard and classifies the protection level of enclosures from solid contamination and water.

Protection against external solid contamination (5): Dustproof

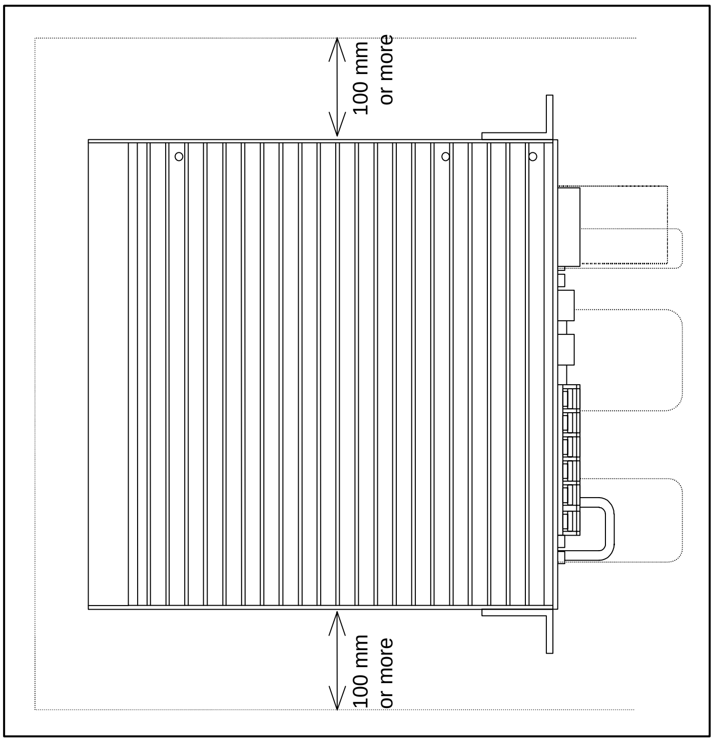
Protection against water (4): Must not be affected by water splash in any direction.

⚠ *Caution : When installing two or more Driver Units for multi-axis combinations, provide a space of approximately 100 mm between adjacent Driver Units.*

- Inside temperature of the enclosure into which the Driver Unit is installed shall be maintained between 0 to 50°C. If the Driver Unit frequently gives “Heat sink over temperature” alarm, provide a forced cooling to the heat sink. (Refer to “11. Alarm” for more details.

- You may use brackets to fix an ESA Driver Unit to the enclosure.

Figure 3-3



3.3. Wiring

3.3.1. Motor Wiring

⚠ *Caution : Do not make the Motor cable shorter or longer. You need to purchase separately the cable with specified length if necessary. Ask your local NSK representative for more details.*

⚠ *Caution : Do not place the power lines (AC main power and Motor cable) and the signal lines in close proximity. Do not tie wrap them, and not to put in the same duct.*

Figure 3-4: AS type Megatorque Motor

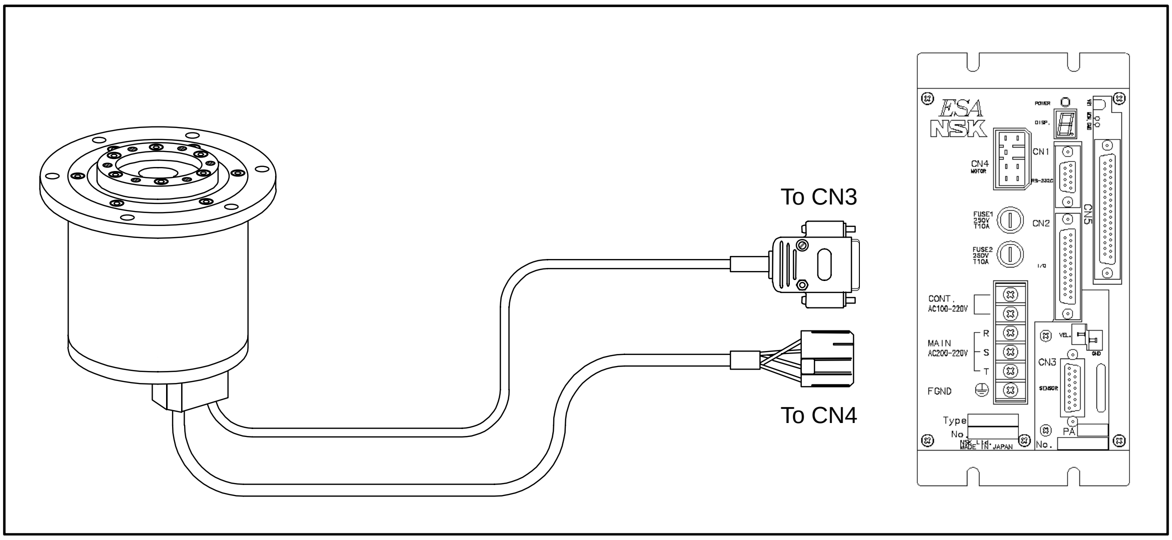
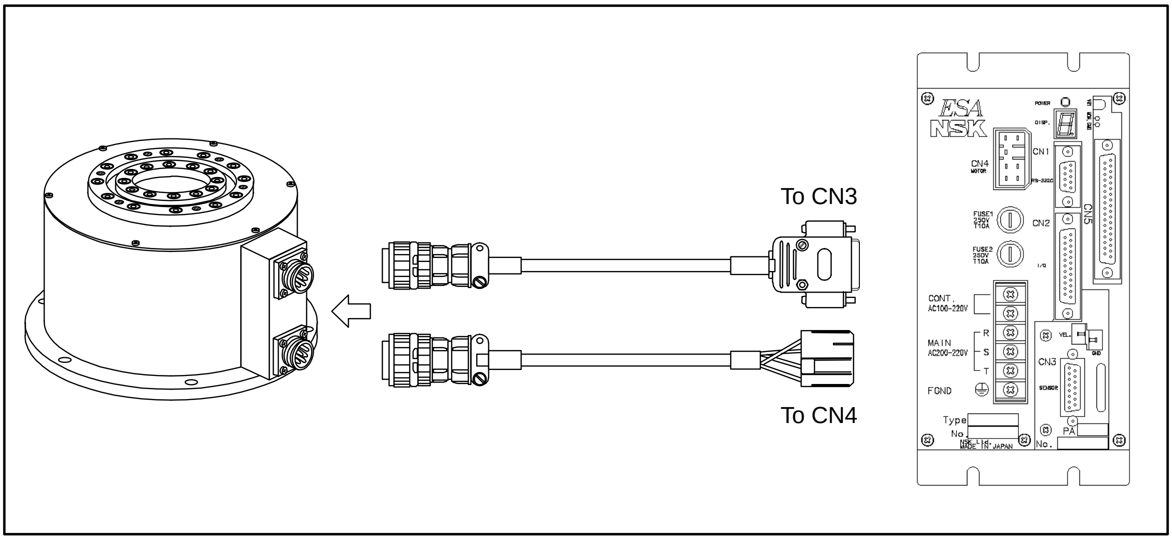


Figure 3-5: RS type Megatorque Motor



3.3.2. Connecting Main Power

- Refer to “2.12. TB: Terminal Block for Power Supply” for more details.
- Provide anti-heat vinyl cables with the size of 2 mm^2 or larger for the main power supply.
- Do not place the main power line cables and the signal wires in close proximity. Do not tie wrap them, and not put them in the same duct.
- Install a noise filter between the power source and the Driver Unit to protect the System from the external noises.

Table 3-2: [Reference] Recommended noise filter for main power [Manufacturer: Tokin]

Power source	Type	Rated voltage	Rated current
Single phase: 100 and 200 VAC	LF-215	250 V AC/DC	15 A AC/DC
Three phase: 200 VAC	LF-310		

Table 3-3[Reference] Recommended noise filter for control power [Manufacturer: Tokin]

Type	Rated voltage	定格電流
GT-2050	250 V AC/DC	5 A AC/DC

- Separate the wiring of the transformer, the primary and the secondary noise filters, and take different routing.
- The Driver Unit and the noise filter shall be close to each other. Do not install magnetic switches or relays between them.
- Be sure to install the surge killer circuit to the coils of magnetic switches, relays and solenoids.
- An inrush current flows when the power is turned on because the capacitive load is connected to the main power supply circuit. For this reason, use the contacts, if necessary, such as magnetic switch that have higher rated current as shown below.

Table 3-4

Contacts	For ESB23
Non-fuse breaker	Rated current: 15 A
Short circuit breaker	Rated current: 15 A, Sensitivity: 15 mA
Magnetic switch	Rated current: 15 A (Mesh current: 15 times or more of rated current)

Table 3-5: Inrush current

Item	Inrush current (Typical		Time
	Power source 100 VAC	Power source 200 VAC	
Control power	7 A	14 A	10 msec
Main power	80 A	140 A	10 msec

Caution : • Connect R-S terminals for single phase 200 VAC main power source. Connection of R-T terminals will induce higher inrush current.

• Do not lose the screws for the terminals when wiring the Terminal block.

3.3.3. Connector Wiring

- Refer to "2.8. RS-232C Interface Specifications."

3.3.4. Ground Connection

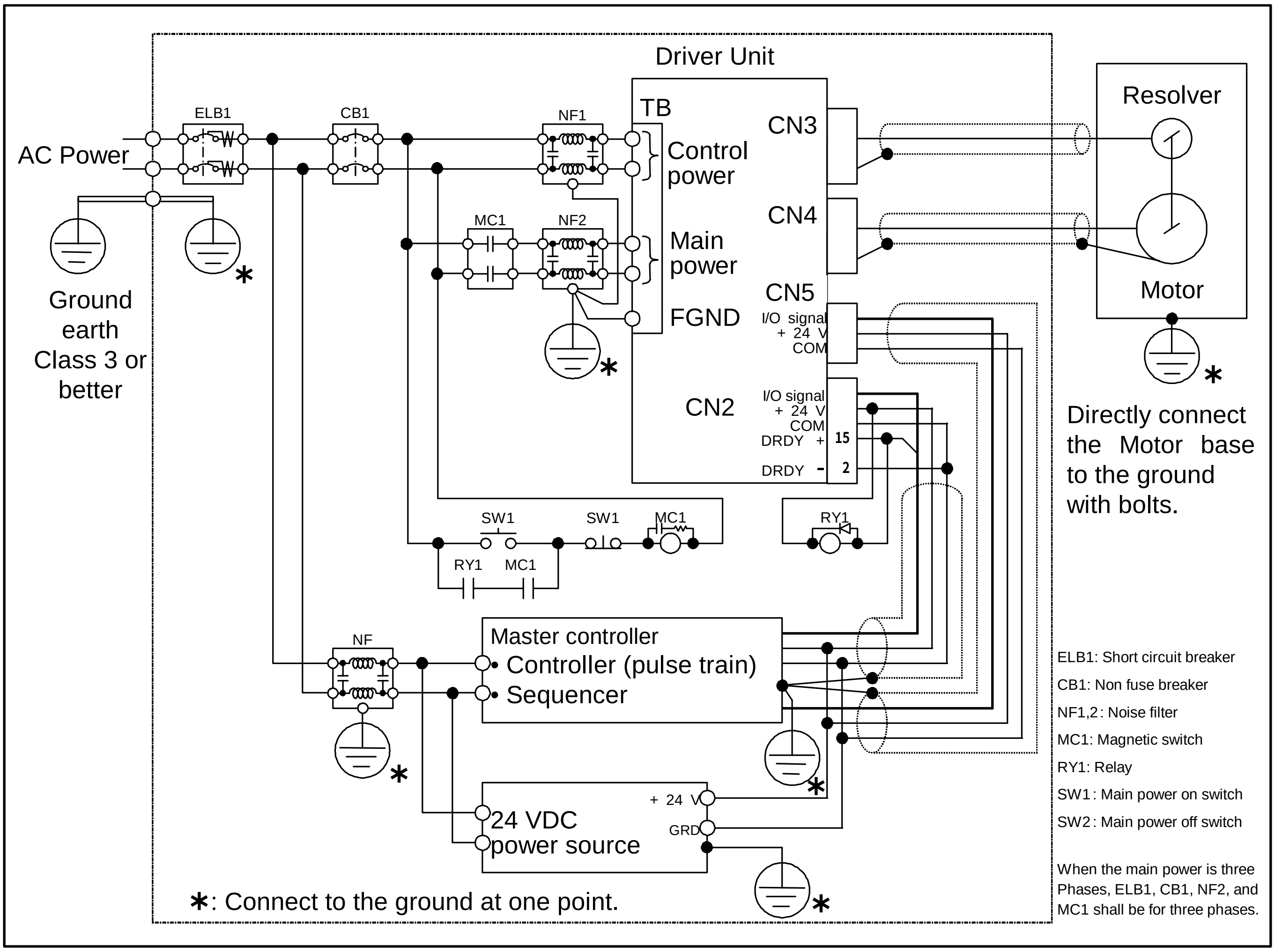
⚠ *Caution : Connect the shield of the signal shielded cables (CN2) to the FG or SG terminal of the master controller. If a malfunction occurs, connect it to the FG terminal of the terminal block of Driver Unit.*

- For grounding the Driver Unit, use heavy gage cable as possible such as braided copper cable or a cable of 3.5 mm^2 or larger.

⚠ *Caution : Ground the Motor separately when it is isolated from the machine.*

⚠ *Warning : All the ground lines must be connected at one point and the grounding resistance shall be 100Ω or less.*

Figure 3-6



⚠ *Caution : Provide a circuit to shutdown the main power by an alarm output. When an alarm occurs, the DRDY (Driver Unit ready) outputs of #2 and #15 will open.*

3.4. Turning on the Main Power

3.4.1. Precautions

⚠ *Caution : Before tuning on the power check the following. Misconnection may result in a breakage of the Driver Unit.*

(1) Connections of each cable.

(2) Connection of the Handy Terminal

(3) Confirm the safe conditions.

⚠ *Danger : The operator is out of the Motor motion range.*

⚠ *Warning : The Motor is securely fixed to the machine base.*

⚠ *Warning : The load (work) is securely fixed to the Motor.*

⚠ *Danger : There shall be no mechanical interference when the Motor makes a full turn*

⚠ *Caution : In case of the System equipped with the absolute position sensor, be sure to turn on the power when the Motor is stopping. Otherwise it may alter the setting of coordinates.*

3.4.2. Indication of Power on

(1) Turn on the power and check the LED on the front panel of the Driver Unit for normal state.

Figure 3-7: In the state of alarm

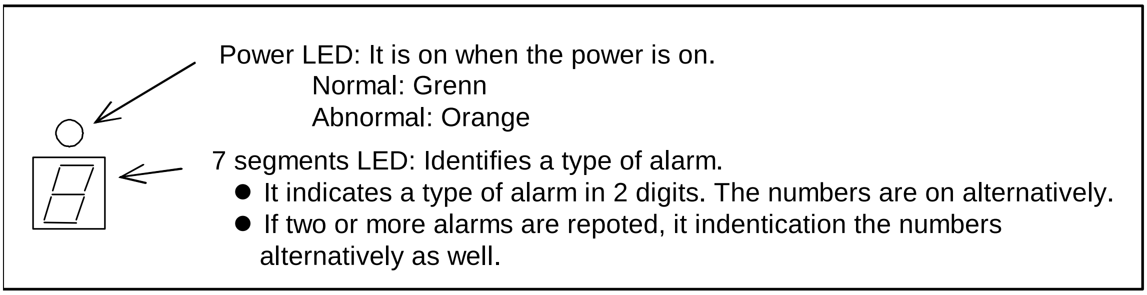
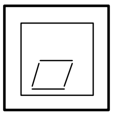
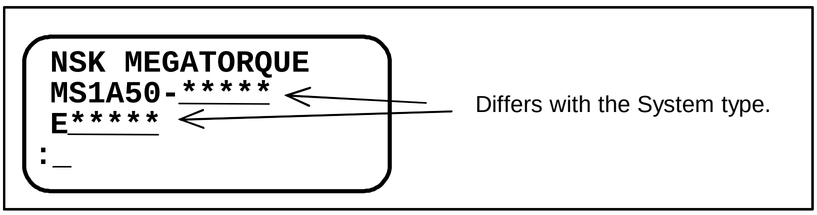


Figure 3-8: In the normal state



(2) If the screen of the Handy terminal displays a message "NSK MEGA••• "and " : " on the end of the message, the System is in normal state.

Figure 3-9:



(3) Refer to "11. Alarm" when an alarm occurs.

3.4.3. Power on and Servo ON.

(1) Turn on the power.

(2) The System checks the DRDY output after 2 seconds of turning the power on.

(3) If the System is in normal condition, turn ON the SVON input. The Motor servo will be ON.

(4) Then input a necessary operation command.

◊ If the System does not outputs the DRDY output normally, take appropriate measures referring to “11. Alarm.”

Figure 3-10

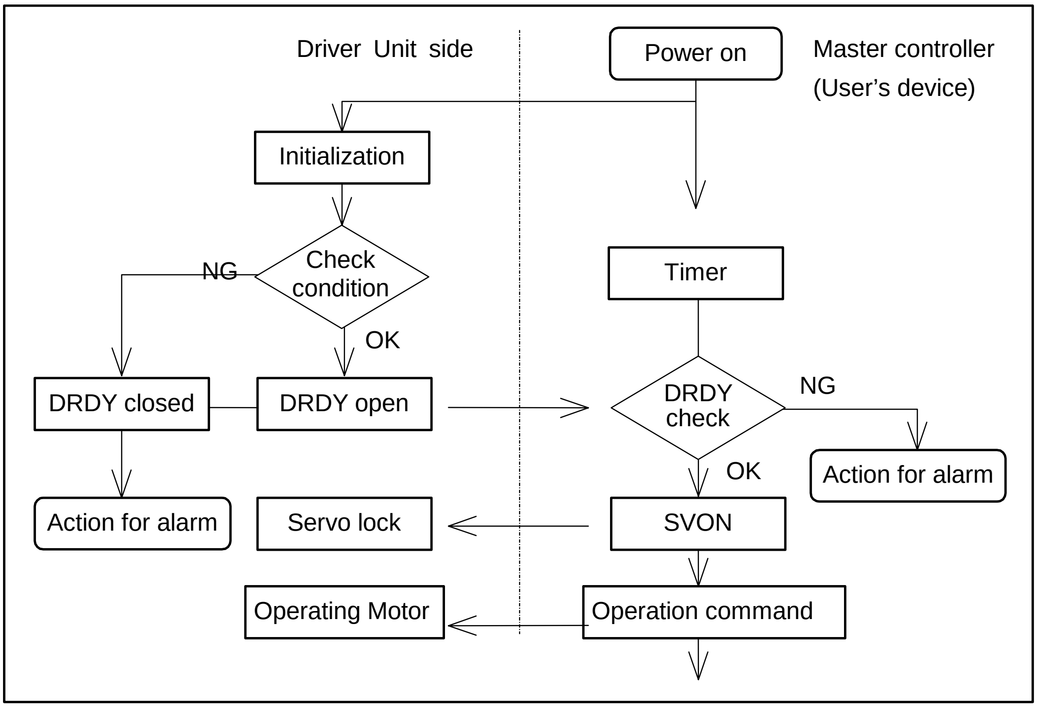
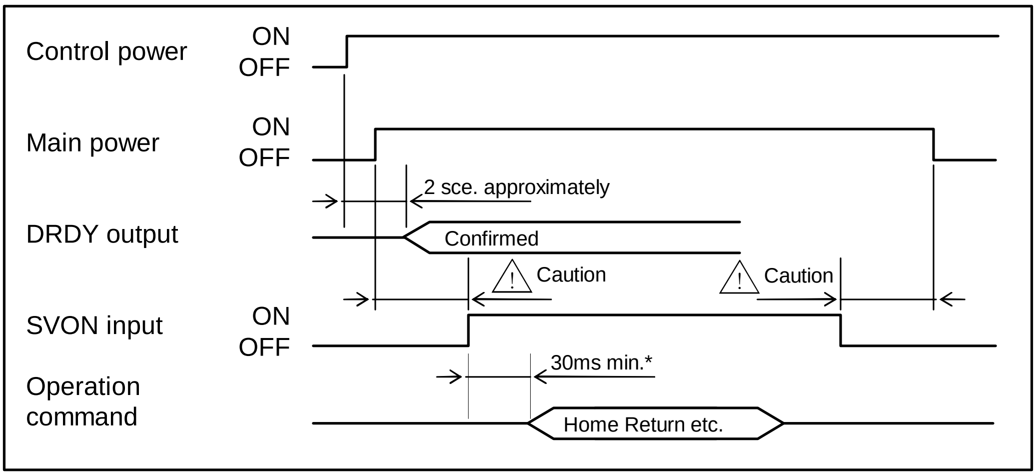


Figure 3-11



* It takes approximately 30 ms to turn the servo on after SVON input is activated. Start the operation after 30 ms after the SVON input is ON.

⚠ *Caution : Turn SVON input ON after the main power is turned on. Turn OFF the SVON input before the main power is turned off. If the main power is turned off leaving the SVON input ON, the Driver Unit will give “Main power low voltage” alarm.*

4. Handy Terminal Communication

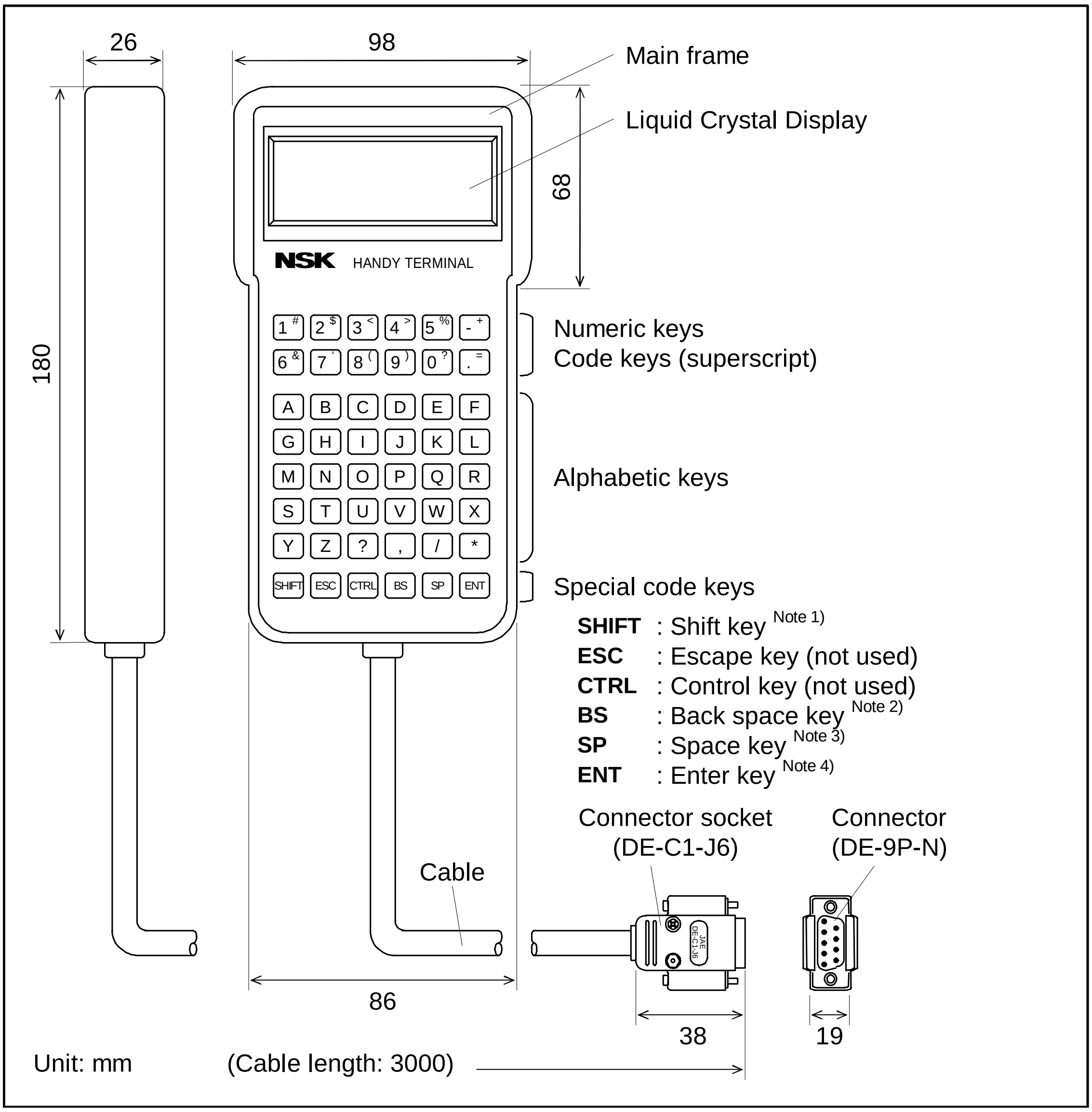
◆ **Function of Handy Terminal**

- Monitoring the Motor conditions, internal channel programming and setting parameters with the RS-232C communication interface can be done easily by connecting the FHT11 Handy Terminal to connector CN1 of the ESA Driver Unit. (No setting such as baud rate is required.)

⚠ *Caution : When connecting or disconnecting the connector CN1, be sure the power of the Driver Unit is turned off. Otherwise it may cause a breakdown of the System or abnormality of the RS-232C communication.*

◆ **Appearance and function of each part**

Figure 4-1



Note: 1) SHIFT : Press the code key while holding the SHIFT key. The subscripts are used for code keys.

2) BS : When correcting logged-in mistakes, press the BS key.

3) SP : Press the SP key to put a space between characters.

4) ENT : Press the ENT key at the end of the command or the parameter setting.

4.1. Setting Parameters

- This section describes the procedures how to enter the parameters using the Handy Terminal.

4.1.1. Setting Without the Password

(1) Connect the Handy Terminal to the CN1 connector of the ESA Driver Unit, and then turn on the power.

(2) Be sure that the colon (:) is on the display. (Press the ENT key once if the colon is not on the display.)

ENT

```
:_
```

(3) For an example, set the parameter MV (Motor velocity) to 0.5 [s^{-1}].
Enter to the Handy Terminal as shown below.

M V 0 ? . = 5 % ENT

```
:MV0.5
:_
```

The inputting completes when the colon (:) appears on the screen.

- Input "parameter code + data+ ENT " to set the parameter. No space is required between the parameter code and the data.

4.1.2. Setting With the Password

(1) Connect the Handy Terminal to the CN1 connector of the ESA Driver Unit and turn on the power.

(2) Confirm that the colon (:) is on the screen. (Press the ENT key once if the colon is not on the screen.)

ENT

```
:_
```

(3) Enter the Password.

/ N S K SP
O N ENT

```
:/NSK ON
 NSK ON
:_
```

The acknowledgment appears on the screen then the colon appears for the command entry.

(4) Set the parameter as shown in the step (3) in the above example for a parameter that does not require the password. However, only one parameter can be set right after the entry of the password.

⚠ *Caution : Make sure that the colon (:) is on the screen when turning off the power of the Driver Unit after the setting of parameters. Otherwise an alarm of "Memory error" may be given when the power is on for the next time.*

4.2. Readout of Parameter

- This section describes the procedures to read out current setting of parameters using the Handy Terminal.

4.2.1. TS Command

- Refer to “9. Glossary of Command and Parameter” for the details of TS command.

(1) Connect the Handy Terminal to the CN1 connector of the ESA Driver Unit, and then turn on the power.

(2) Make sure that the colon (:) is displayed on the screen. (Press the ENT key once if the colon is not on the screen.)

ENT →

```
:_
```

(3) As an example, let’s read out the setting of parameter JV that sets the Jog velocity. The parameter JV belongs to a group of the TS7 according to the description of TS command shown in “9. Glossary of Command and Parameter.” Enter as shown below to the Handy Terminal.

T S 7 ENT →

```
:TS7
 MV1.00;
```

The screen will show firstly the setting of the parameter MV for the velocity of the Motor.

(4) Press the SP key to scroll the display until it spots the setting of JV.

SP SP ••• →

```
:TS7
 MV1.00;
 MA1.00,1.00;
 JV0.10;
```

(5) To quit the readout, keep pressing the SP key until the display stops scrolling or enter the BS key. The colon will appear on the screen to indicate the completion of readout.

BS →

```
 MV1.00;
 MA1.00,1.00;
 JV0.10;
:_
```

4.2.2. Use of “?” to Read out Parameter Setting

(1) Connect the Handy Terminal to the CN1 connector of the ESA Driver Unit, and then turn on the power.

(2) Make sure that the colon (:) is on the screen. (Press the ENT key once if the colon is not on the screen.)

ENT

```
:_
```

(3) As an example, let’s read out current setting of the parameter JV for the Jog velocity. Add “?” before the parameter code that is to be read out, then enter to the Handy Terminal as follow for the example.

? J V ENT

```
:?JV
 JV0.10
:_
```

* The screen indicates the setting of the parameter JV and the colon appears on the screen as the indication that the Driver Unit is ready for an entry of new command.

⚠ *Caution : Though we have two ways for reading out the settings of parameters as shown above, we recommend using the TS command as much as possible to prevent inputting errors.*

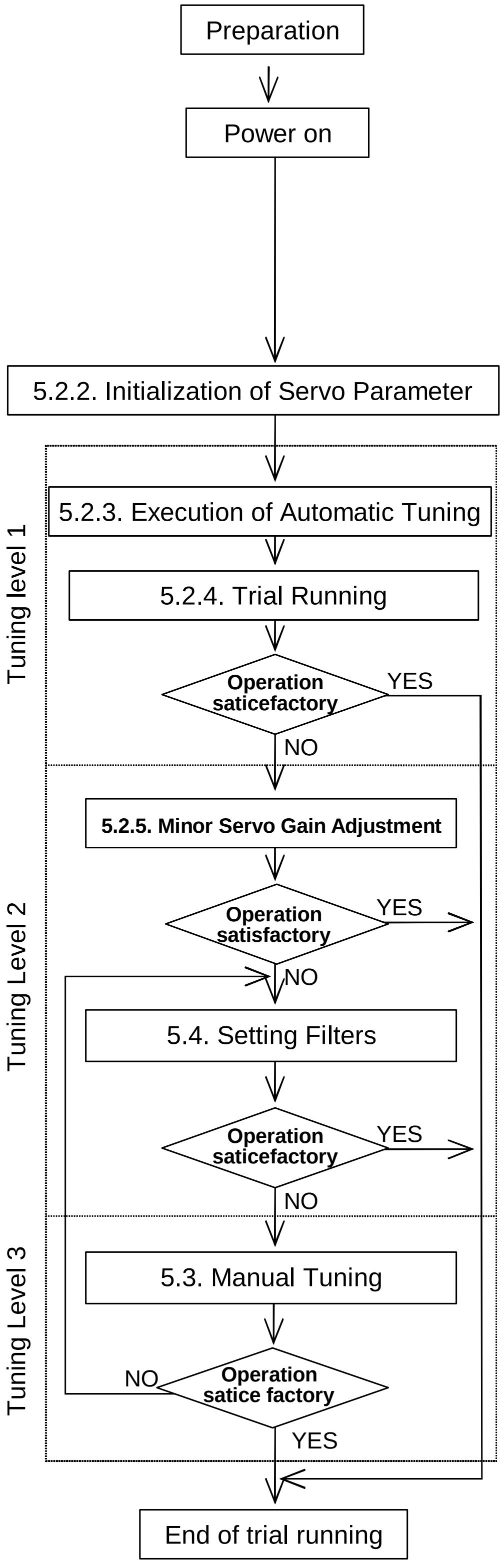
5. Tuning and Trial Running

- Gain adjustment is necessary if the System is set to either the position control or the velocity control mode.

- The System may require the adjustment of low pass filter when it is in the torque control mode.

5.1. Tuning Sequence

Figure 5-1: Tuning procedure



- Install the Motor and wire the Driver Unit.

⚠ *Caution : Make sure that the LED shows normal state. Turn on the power of the Driver Unit and confirm that the screen of Handy Terminal displays a message shown below.*

```
NSK MEGATORQUE
MS1A50_***
E*********
:_
```

- Initialize the servo parameters.

- Execution of automatic tuning
  Automatic estimation of load inertia and automatic setting of servo parameters will be done in this stage.
  (Automatic setting of PG, VG, VIMA and MA parameters)

- Trial running
  Confirm the results of tuning level 1.
  The trial runnings in tuning level 2 and 3 will also use the results of these settings.

Tuning level 1	This is the basic function of automatic tuning. If the operation of Motor is saticefactory the tuning completes at this stage.
Tuning level 2	This step is an additional tuning to the level 1 when the trail running is not saticefactory.
Tuning level 3	It requires conventional manual tuning when the tuning level 1 and 2 are not saticefactory.

5.2. Automatic Tuning

⚠ *Caution : The automatic tuning does not function if the following conditions are not met. Confirm them before performing the tuning.*

◊ The load inertia must be in the allowable range of the Motor.

◊ The Motor is set horizontally. (The load conditions of the Motor must not be affected by the gravity.)

◊ Mechanical rigidity of the Motor mounting base and an attached load to the Motor is sufficient enough.

◊ There must be no backlash or play caused by gears and couplings.

◊ Frictional load to the Motor shall be minimal.

◆ Preparation

- You need to prepare the following for the automatic tuning.

◊ Installation of the Motor.

◊ Fixing load to the rotor of the Motor.

◊ Installation of the Driver Unit.

◊ Connection of the Motor and the Driver Unit. Use the cable set provided with the Driver Unit.

◊ Connection of the Handy Terminal.

◊ Connection of AC power source.

◊ Wiring of the signals of Servo ON (SVON) and Emergency stop (EMST). (Connector CN2)

5.2.1. Precautions

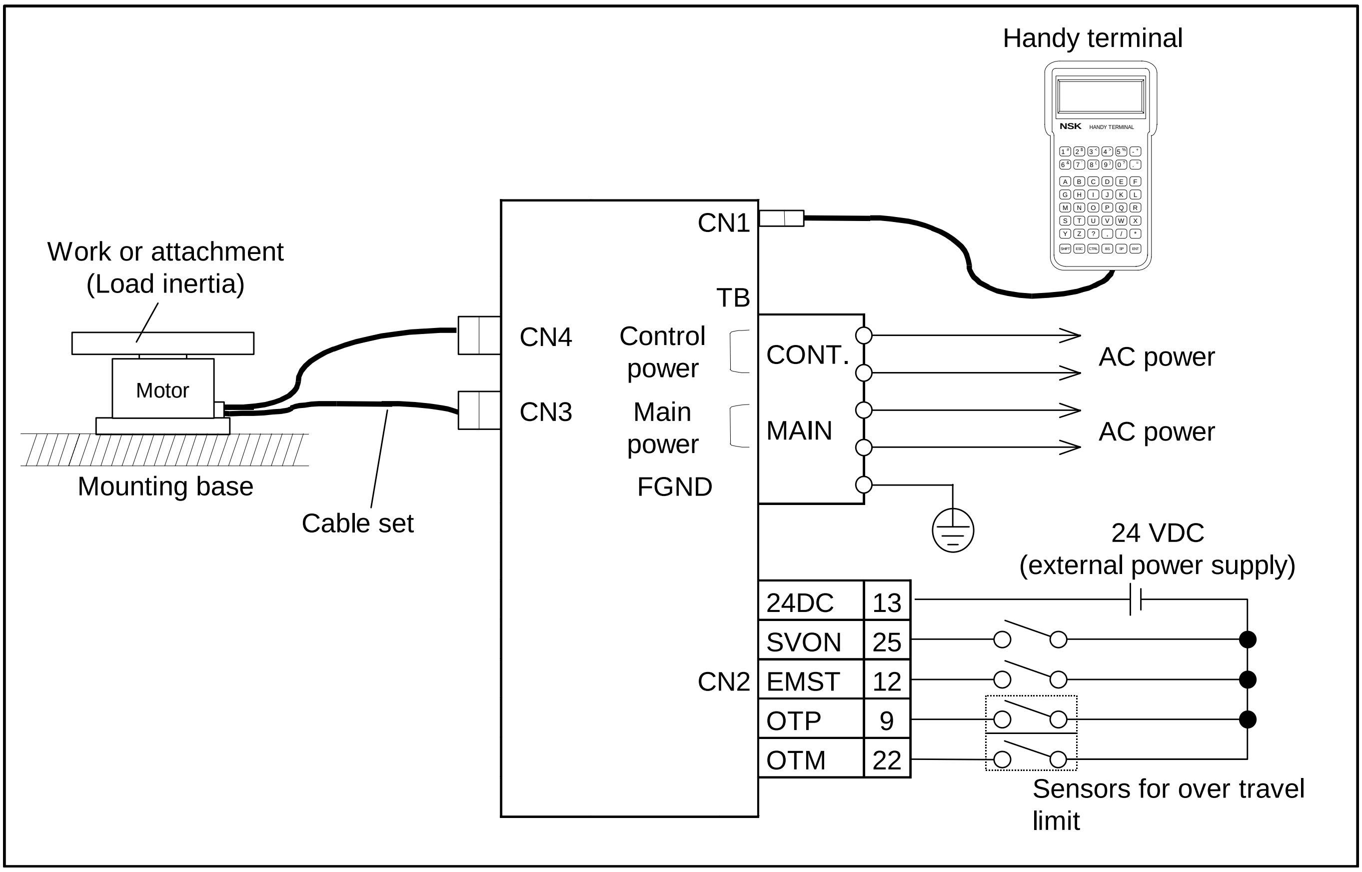
⚠ *Danger : Be sure to wire an input of the Emergency stop (EMST) and an input of the Over Travel limit switch (OTP, OTM) if the off-limits zone is set so that the Motor can stop immediately in a case of emergency.*

⚠ *Danger : The Motor will rotate for ± 20°in the process of the automatic tuning in order to estimate the load inertia. Do not enter the range of Motor rotations.*

⚠ *Caution : The Motor may vibrate at the end of automatic tuning if rigidity of the load is insufficient. In such a case turn the SVON signal OFF, or turn the power off. Perform the manual tuning or increase its rigidity and then execute the automatic tuning again.*

⚠ *Caution : The automatic tuning is effective when the System is set to the position control or the velocity control mode. In the torque control mode, you do not need the automatic tuning.*

Figure 5-2: Wiring example of automatic tuning setup.



5.2.2. Initialization of Servo Parameter

1) Turn the Servo ON (SVON, the connector CN2) signal to OFF.

2) Execute the TS command and record the current settings of parameters.

T S 1 # ENT and T S 2 $ ENT

3) Enter the password. The screen displays the acknowledgment.

/ N S K SP O N ENT

```
:/NSK ON
 NSK ON
:_
```

4) Input the SI command to initialize the parameters.
The screen displays the acknowledgment “INITIALIZE” and the System starts the parameter initialization. It requires few seconds to complete. The colon (:) will appear on the screen when the initialization completes.

S I ENT

```
:SI
 INITIALIZE
:_
```

Caution : Be careful that the System won’t accept the SI command if the (SVON) signal remains ON. The message “SI INHIBITED” appears on the screen.

```
:SI
 SI INHIBITED
:_
```

Table 5-1: Servo parameter list

Read out by TS1			Read out by TS2		
Parameter	Initial setting	Current setting	Parameter	Initial setting	Current setting
PG	0.100		FO*	0	
VG	1.0		FP	0	
VGL*	1.0		FS	0	
VI	1.00		NP	0	
VIL*	1.00		DBP*	0	
VM	1		ILV*	100.0	
LG*	50		FF*	0	
TL*	100		FC*	0	
GP*	0				
GT*	5				

* Adjustment of these parameters are not necessary in Lvel 1 and Lvel 2 tuinig.

5.2.3. Execution of Automatic Tuning (Tuning Level 1)

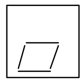
⚠ *Danger : • Take the safety precaution for a full turn of the Motor.*

• When the Motor cannot make a full turn because of setting way of the load or the attachment, keep a room so that the Motor can rotate approximately ± 20°. In such a case, make sure to set the over travel limit switches (OTP and OTM) for the off-limits zone.

1) Turn ON the Servo on (SVON) signal of the connector CN2, and then input the SV command to put the Motor in the servo-on state.

S V ENT

```
:SV
:_
```

2) Confirm that the LED indicates that the System is in the normal state. 

3) Enter the command for execution of the automatic tuning.
If the message on the screen is not the same as shown below, follow the procedures in 1) and 2).

A T ENT

```
:AT
 AT ready OK
?_
```

4) Confirm the message, and then input "OK."
The Motor rotates 10 to 20° after the input, and then an estimation of the inertia starts.
The screen displays a dot (•) every time the Motor rotates during the estimation of load inertia.

O K ENT

```
:AT
 AT ready OK
?OK
 ...
```

5) The screen displays the estimated load inertia (LO) as shown below when the estimation completes successfully.
(Number of dots (•) and the data of LO are depending on the condition of load inertia.)

```
?OK
 .......
 LO****
:_
```

Estimation of load inertia

⚠ *Caution : Take an action against an alarm referring to "11. Alarm" when an error message shown below appears during the automatic tuning.*
The LED on the front of Driver Unit indicates F8 for the automatic tuning error.

```
?OK
 .......
 AT Error*
:_
```

Error number

5.2.4. Trial Running (Tuning Level 1)

⚠ *Caution : Take a safety precaution for a full turn of the Motor.*

- Use a demonstration program of the ESA Driver Unit for checking the tuning result

⚠ *Caution : The following steps are only applicable for the position control mode. In case of the velocity control mode, connect the Driver Unit to the master controller, and then execute the tuning.*

1) Turn ON the Servo ON (SVON) signal of the connector CN2, and then input the SV command to put the Motor in the servo-on state.

   [S] [V] [ENT] ➜

```
:SV
:_
```

2) Confirm that the LED indicates the System is in the normal state.

3) Confirm that the Emergency stop (EMST) and the Over travel limit (OTP and OTM) of the CN2 connector are not inputted.

4) The Motor velocity is initialized to 1 [s^{-1}]. Decrease the velocity MV to 0.1 [s^{-1}] for the trial running.

   [M] [V] [0 ?] [. =] [1 #] [ENT] ➜

```
:MV0.1
:_
```

5) Display a menu screen of the demonstration program.

   [S] [P] [/] [A] [J] [ENT] ➜

```
:SP/AJ
 IN100,IS0.0,FW1.0
 ID9000/OK
?_
```

   It indicates the conditions for completion of positioning and rotation angle for the trial running.
   The parameters indicated on the screen are

   IN : In-Position limit: (Threshold to output IPOS signal)
   IS : In-Position stability timer (Stabilizing timer for In-Position output)
   FW : FIN Width (Outputting time of In-Position signal)
   ID : Rotation angel

6) Set 10 [pulse] for the threshold of positioning signal output, and 50 [msec] to the stabilizing time for easy checking of tuning condition.
   Confirm that the screen displays as shown below.

   [I] [N] [1 #] [0 ?] [ENT]
   [I] [S] [0 ?] [. =] [5 %] [ENT] ➜

```
?IS0.5
 IN10,IS0.5,FW1.0
 ID9000/OK
?_
```

7) Input “OK” if the rotation angle of ID9000 (rotation of 90 degrees) is feasible.

O K ENT

```
 IN10,IS0.5,FW1.0
 ID9000/OK
?OK
:_
```

The Motor starts cyclic motions in CW and CCW directions as soon as “OK” is typed. (The Motor moves in CW direction first.)
Execute the ID command instead of inputting “OK” to change the rotation angle when the prompt is “?.”

Example: Change the rotation angel to 30°.
Type as

I D 3 < 0 ? 0 ? 0 ? ENT

```
?ID3000
 IN10,IS0.5,FW1.0
 ID3000/OK
?_
```

8) Input MS command to stop the Motor after the result of trial running is confirmed.

M S ENT

```
:MS
:_
```

9) Display the demonstration program screen to quit the trial running.

S P / A J ENT

```
 IN10,IS0.5,FW1.0
 ID3000/OK
?
:_
```

When quitting the demonstration without performing the cyclic motion, press the ENT key following the prompt “?.”

- If the Motor is operating normally complete the trial running.
- When the Motor motion is unstable, tune the System referring to “5.2.5. Minor Servo Adjustment (Tuning Level2)” or “5.3. Manual Tuning.”
- Increase the MV setting to actual use velocity if the motion of the Motor is stable.

5.2.5. Minor Servo Adjustment (Tuning Level 2)

⚠ *Danger : Take safety measures for a full turn of the Motor.*

- Perform the minor adjustment of servo gain when the automatic tuning by the AT command (Tuning Level 1) is not successful.

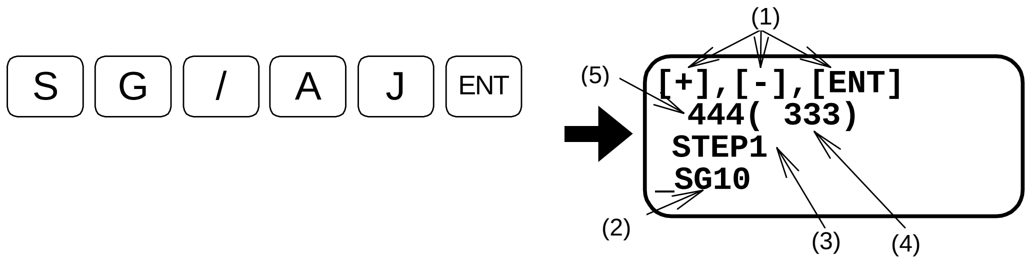
- Use the SG parameter for the minor adjustment of servo gain.

  ◊ Higher SG setting will result in better response for positioning commands. However, the Motor tends to vibrate when the SG is set too high.

- Adjust the SG parameter operating the Motor by the demonstration program (SP/AJ). Follow the procedures 1) to 7) in “5.2.4. Trial Running (Tuning Level 1)” to operate the Motor.

- Input the commands for adjustment through the master controller in case of the velocity control mode.

1) Start the adjusting program of SG parameter.
The screen displays the message as shown below, and you can change SG setting up and down using the (+) and the (-) keys.
(Actually the SG parameter differs with the load inertia and the rotation angel.)



- Explanation of the message (screen)

  (1) Key function

  SHIFT and -/+ : Pressing the key one time increases 1 resolution of “SG.”

  -/+ : Pressing the keys one time decreases 1 resolution of “SG.”

  ENT : Press the key to store the “SG” setting.

  (2) This part indicates the current setting of SG.

  (3) This part indicates the changing resolution of SG data when the (+) or (-) key is pressed.

  (4) Response index number: An index number denoting a result of positioning under current servo gain setting. Smaller number denotes better response to position commands.

  (5) Positioning index number: An index number denoting a result of positioning under the current servo gain (SG) setting. Smaller number requires less time to complete a positioning.

⚠ *Caution : Do not press the SP key or the BS key, otherwise the changing resolution of SG data (2) when the (+) key or the (-) key is pressed will be altered.*

2) Press the (+) key several times observing motion of the Motor.

Pressing SHIFT, - + - + •••

```
[+],[-],[ENT]
  333( 222)
 STEP1
_SG13
```

Observe how the motion of Motor gets crisper as the response index decreases.

3) Keep pressing the (+) key further until the Motor starts hunting and stops reciprocating motion.

Pressing SHIFT, - + - + •••

```
[+],[-],[ENT]
  233( 123)
 STEP1
_SG18
```

4) Press the (-) key several times to lower the SG setting until the Motor stops hunting and starts reciprocating motion again.

- + - + •••

```
[+],[-],[ENT]
  253( 145)
 STEP1
_SG16
```

5) Decrease the SG to 80 % of SG data at where the Motor stopped hunting so that the Motor shows stable motion in any position.

```
[+],[-],[ENT]
  263( 156)
 STEP1
_SG13
```

6) Press the ENT key to complete the adjustment.

ENT

```
  263( 156)
 STEP1
 SG13
:_
```

5.3. Manual Tuning

⚠ *Caution : Take a safety measure for a full turn of the Motor.*

- Perform the manual tuning when the automatic tunings are not successful.

5.3.1. Precautions for Manual Tuning

1) Initialize the parameters following the procedure described in "5.2.2. Initialization of Servo Parameters."

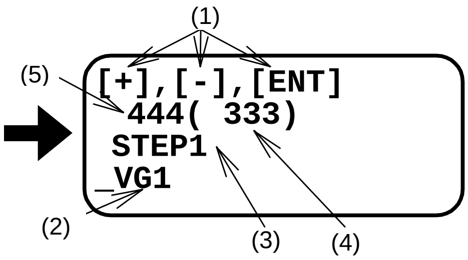
2) Operate the Motor with the demonstration program referring to "5.2.4. Trial Running (Tuning Level 1)." The Motor demonstrates unnatural motion at the beginning, which is not abnormal, because it is poorly tuned.

3) Use the master controller to operate the Motor when the System is set to the velocity control mode.

5.3.2. Adjustment of Velocity Loop Proportional Gain (VG)

1) Start the adjusting program for the VG parameter.
The screen displays the message as shown below, and you can change VG setting up and down using the (+) and the (-) keys.
(Actually the VG parameter differs with a load inertia and rotation angel.)

[V] [G] [/] [A] [J] [ENT]



- Explanation of the message (screen)

(1) Key function

[SHIFT] and [- +] : Pressing the key one time increases 1 resolution of the VG.

[- +] : Pressing the key one time decreases 1 resolution of the VG.

[ENT] : Press the key to store the VG setting.

(2) This part indicates current setting of the VG parameter.

(3) This part indicates the changing resolution of VG data when the (+) or the (-) key is pressed.

(4) Response index number: Smaller number denotes better response to the position commands.

(5) Positioning index number: Smaller number requires less time to complete a positioning.

⚠ *Caution : Input of the* [SP] *key will alter the changing resolution of the VG for one press of the (+) or the (-) key to 1/10 of the current setting.*
Input of the [BS] *key will alter the changing resolution of VG for one press of the (+) or the (-) key to 10 times of the current setting.*

2) Press the (+) key several times observing motion of the Motor.

Pressing [SHIFT], [- +] [- +] •••

```
[+],[-],[ENT]
 333( 222)
STEP1
_VG3
```

Observe how the motion of Motor gets crisper as the response index decreases.

3) Keep pressing the (+) key further until the Motor starts hunting and stops reciprocating motion.

Pressing [SHIFT], [- +] [- +] •••

```
[+],[-],[ENT]
 233( 123)
STEP1
_VG5
```

4) Press the (-) key several times to lower the VG setting until the Motor stops hunting and starts reciprocating motion.

[- +] [- +] •••

```
[+],[-],[ENT]
 253( 145)
STEP0.1
_VG4
```

5) Obtain a SG setting that is 80 % of the SG at where the hunting stopped.
If the hunting stopped at VG4 calculate as

$$4 \times 0.8 = 3.2$$

This data shall be set to the parameter VG.

6) Press the [SP] key once to make the changing resolution of VG for one press of the (+) or (-) key to 0.1.

[SP]

```
[+],[-],[ENT]
 263( 156)
STEP0.1
_VG4
```

7) Press the (-) key several times until the data changes to the new VG setting.

[- +] [- +] •••

```
[+],[-],[ENT]
 263( 156)
STEP0.1
_VG4
```

8) Press the [ENT] key to complete the tuning. The prompt ":" appears on the screen for the acknowledgment.

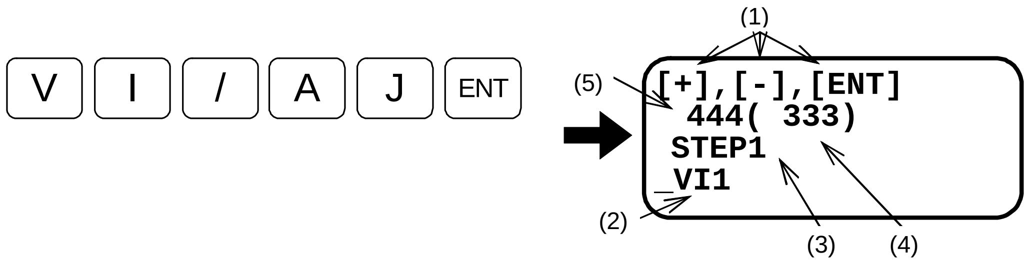
[ENT]

```
 263( 156)
STEP0.1
VG3.2
:_
```

5.3.3. Adjustment of Velocity Loop Integration Frequency (VI)

- Perform the adjustment of velocity loop integration frequency (VI) after the adjustment of the velocity loop proportional gain (VG).

1) Start the program for adjusting the parameter VI.
The screen displays the message as shown below and you can change the VI setting up and down using the (+) and the (-) keys.
(Actually the VI parameter differs with a load inertia and rotation angel.)



- Explanation of the message (screen)

(1) Key function

[SHIFT] and [- +] : Pressing the key one time increases 1 resolution of the VI.

[- +] : Pressing the key one time decreases 1 resolution of the VI.

[ENT] : Press the key to store the VI setting.

(2) This part indicates the current setting of VI.

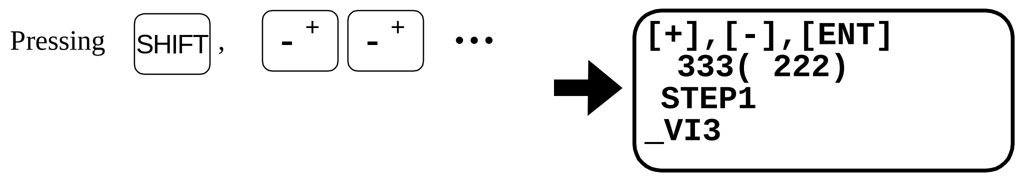
(3) This part indicates the changing resolution of VI data when the (+) or the (-) key is pressed. (VI changing resolution)

(4) Response index number: Small number denotes better response to the command.

(5) Positioning index number: Smaller number requires less time to complete a positioning.

⚠ *Caution : Pressing the* [SP] *key will alter the changing resolution of VG for one press of the (+) or the (-) key to 1/10 of the current setting.*
Pressing the [BS] *key will alter the changing resolution of VG for one press of the (+) or the (-) key to 10 times of the current setting.*

2) Press the (+) key several times observing motion of the Motor.



Observe how the motion of Motor gets crisper as the response index decreases.

3) Keep pressing the (+) key further until the Motor starts hunting and stops reciprocating motion.

Pressing SHIFT , - + - + •••

```
[+],[-],[ENT]
  233( 123)
 STEP1
_VI5
```

4) Press the (–) key several times to lower the VI until the Motor stops hunting and starts reciprocating motion.

- + - + •••

```
[+],[-],[ENT]
  253( 145)
 STEP0.1
_VI4
```

5) Obtain a VI data that is 80% of VI at where the hunting stopped.
If the hunting stopped at VI4 calculate as

$$4 \times 0.8 = 3.2$$

This data shall be set to VI.

6) Press the SP key once to make the changing resolution of VI for one press of the (+) or (–) key to 0.1.

SP

```
[+],[-],[ENT]
  263( 156)
 STEP0.1
_VI4
```

7) Press the (–) key several times until the VI data changes to the new setting.

- + - + •••

```
[+],[-],[ENT]
  263( 156)
 STEP0.1
_VI3.2
```

8) Press the ENT key to complete the tuning. The prompt ":_ " appears on the screen for the acknowledgment.

ENT

```
  263( 156)
 STEP0.1
 VI3.2
:_
```

5.4. Setting Filters (Tuning Level 2)

- Setting low-pass filter (Parameters FP and FX) will decrease resonant noise level. Unit of the setting data of the parameters of FP and FS is frequency [Hz]. If the parameters of FP and FS are set under 100 [HZ], the servo may become unstable, thus resulting Motor hunting or adverse effect on positioning.

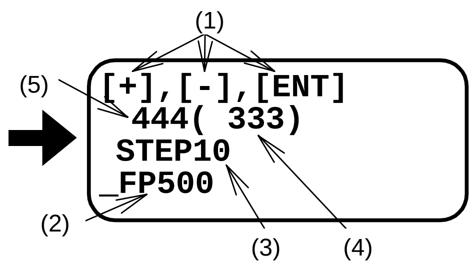
- The low-pass filters shall be set after adjusting the gains (after the automatic tuning or the manual tuning).

- Operate the Motor by the demonstration program (SP/AJ) for setting the low-pass filters. [Follow the procedure 1] to 7] described in "5.2.4. Trial Running (Tuning Level 1)" to operate the Motor.]

- A master controller shall be used to give the command when the system is in the torque or the velocity control mode.

1) Start the adjusting program of the parameter FP.
The screen displays the message as shown below and you can change the FP setting up and down using the (+) and the (-) keys. (Actually the FP parameter differs with a load inertia and rotation angel.)

F P / A J ENT



- Explanation of the message (screen)

(1) Key function

SHIFT and - + : Pressing the key one time increases 10 units of FP resolution.

- + : Pressing the key one time decreases 10 units of FP resolution.

ENT : Press the key to store the FP setting.

(2) This part indicates the current FP setting.

(3) This part indicates the changing resolution of FP data when the (+) or the (-) key is pressed. (VI changing resolution)

(4) Response index number: Smaller number denotes better response.

(5) Positioning index number: Smaller number requires shorter time to complete a positioning.

⚠ *Caution : Input of the* SP *key will alter the changing resolution of FP for one press of the (+) or the (-) key to 1/10 of current setting.*
Input of the BS *key will alter the changing resolution of VG for one press of the (+) or the (-) key to 10 times of current setting.*

2） Keep pressing the (–) key several times to lower the frequency of low-pass filter (FP setting) until rotation of noise of the Motor decreases.

[- +] [- +] …

```
[+],[-],[ENT]
  333( 222)
 STEP10
_FP500
```

3） If motion of the Motor becomes unstable press the (+) key several times to increase the low-pass filter frequency (FP setting) until it becomes stable.

Pressing [SHIFT], [- +] [- +] …

```
[+],[-],[ENT]
   233( 123)
 STEP1
_FP120
```

4） Press the [ENT] to complete the setting.

[ENT]

```
  233( 123)
 STEP1
 FP120
:_
```

[Reference] When terminate the low-pass filter:

[F] [P] [0 ?] [ENT]

```
:FP0
:_
```

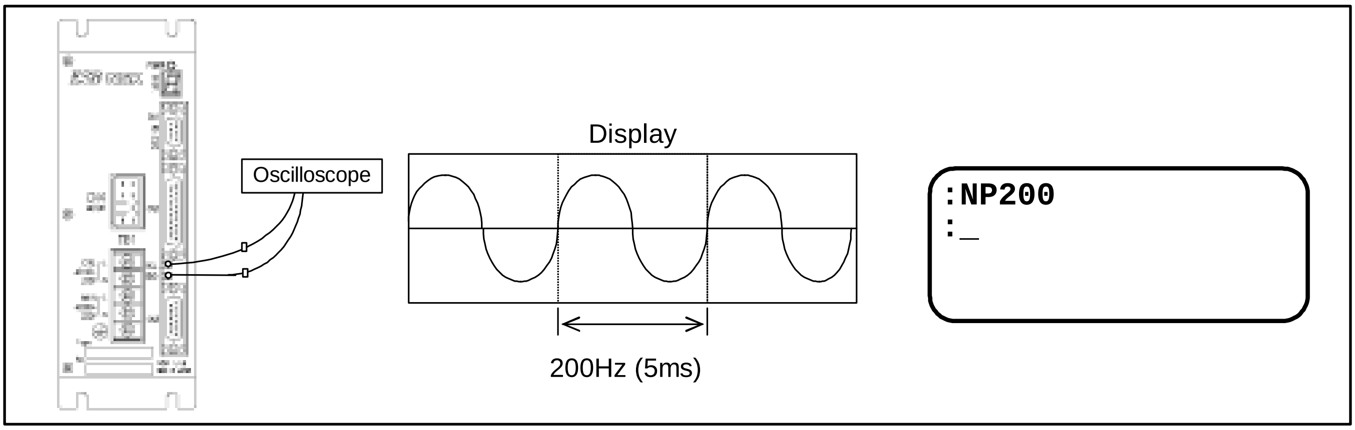
[Reference] Adjusting notch filter

- When setting the notch filters (NP and NS), you need to measure the resonant frequency by checking voltage between the analog velocity monitor pins (VELOCITY-GND terminals) on the front panel of Driver by means of an oscilloscope, etc.
  - ◊ Check the resonant frequency as show in Figure5-3. If the frequency is 200 Hz, type as

    [N] [P] [2 $] [0 ?] [0 ?] [ENT]

    to set the notch filter to 200 Hz.

Figure 5-3



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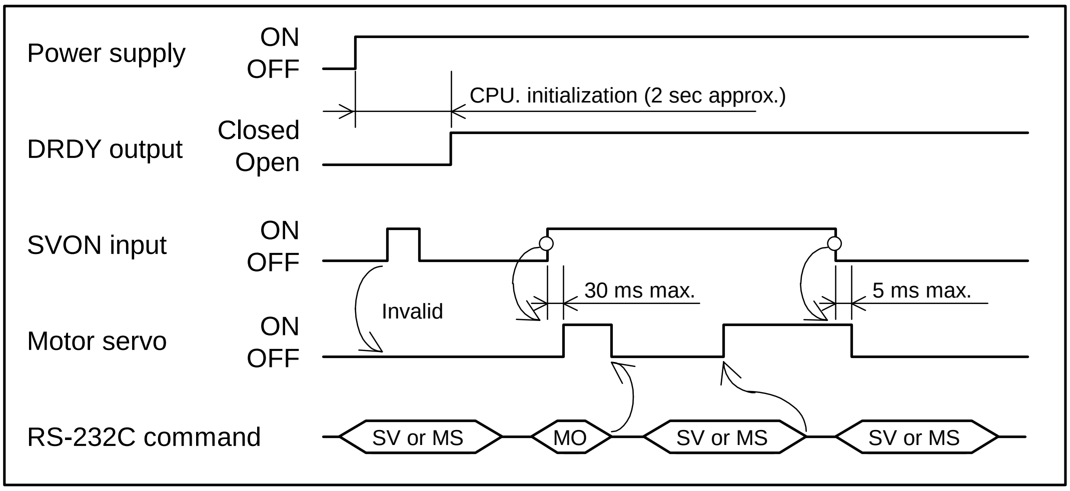
6. Operational Function

6.1. General Operation and Function

6.1.1. Servo "ON"

- Turn on the power, thus the DRDY output circuit is closed, then making the SVON input ON should make the Motor servo-on.
- The position error counter will be cleared when the SVON input is OFF.
- When the SVON input is ON, the MO command will turn the servo-off.
- The SV or MS command will turn the servo ON when the servo is off by the MO command.

Figure 6-1

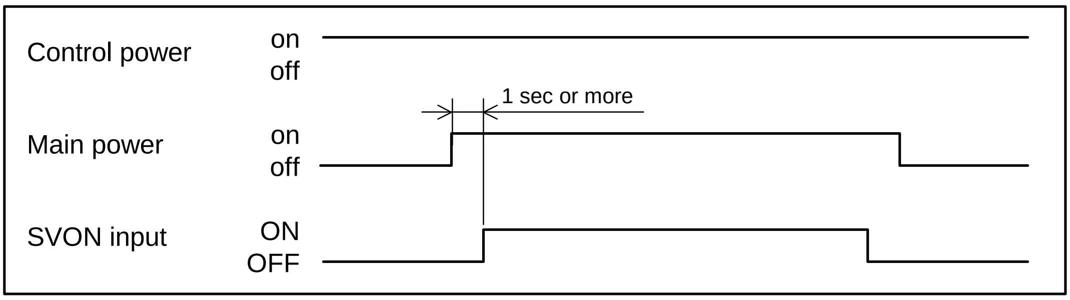


◆ **Precautions when turning on or off the main power supply and the control power supply separately:**

- When turning on the main power after the control power was turned on:
  Turn on the main power first, and then make the SVON input ON.
- When turning off the main power remaining the control power turned on:
  Turn OFF the SVON input first, and then turn off the main power.

* When the main power 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 6-2



6.1.2. Emergency Stop

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

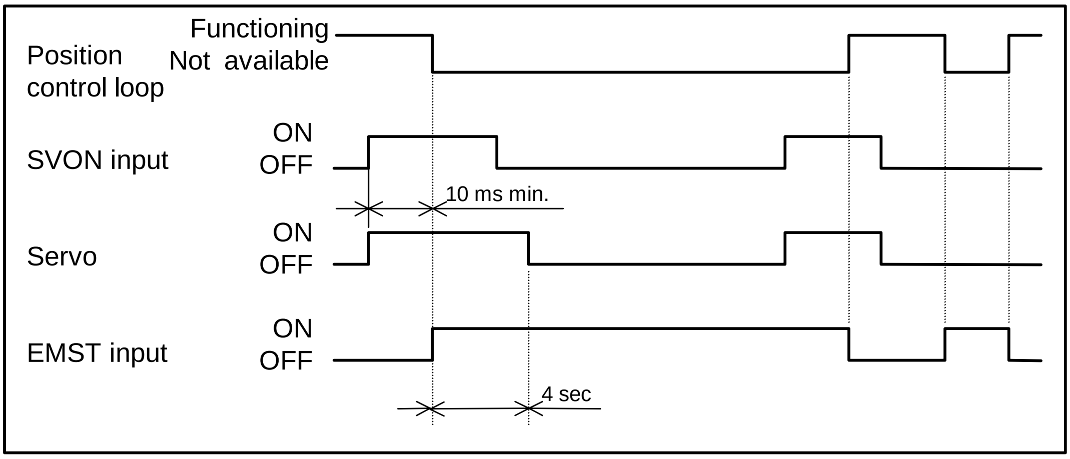
- No motion commands will be accepted while the EMST input is ON.

- In the state of emergency stop, 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 the normally open contact before shipment. However, it can be changed to the normally closed contact (B contact). (Refer to the AB parameter.)

  * Provide a mechanical brake when an external force is applied to the Motor because the position loop control is not performed in this state. The servo-off state cannot be established for 4 seconds after the EMST input is ON even the SVON input is OFF. The servo-lock state won’t be established even though the EMST input is turned ON if the SVON input is OFF.

Figure 6-3



◊ The Motor gets in the servo-lock state in the velocity loop control mode for 4 seconds after the EMST input is ON even though the SVON input is OFF.

◊ The Driver Unit may not accept the EMST input unless it stays ON for 10 ms or longer.

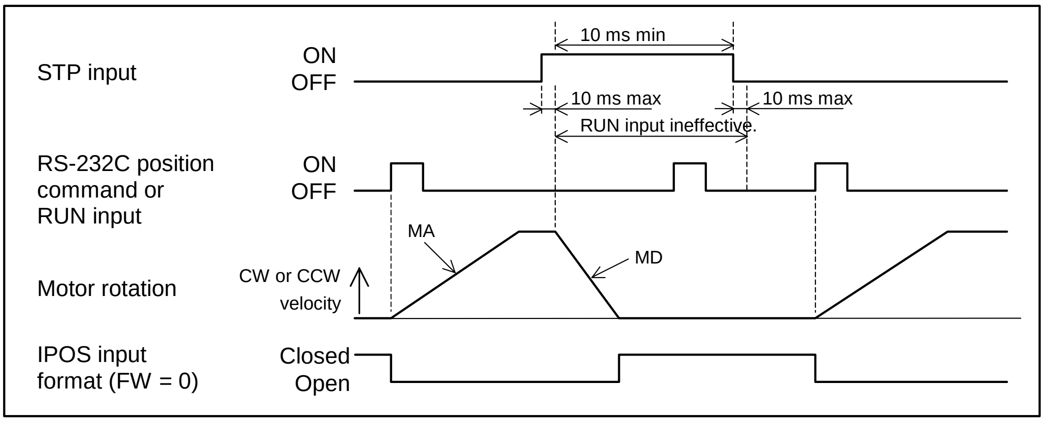
6.1.3. Interruption of Positioning With STP Input

- Turning ON the STP input will stop the Motor in the middle of positioning with the RS-232C position command, Programmable Indexer, and Jog.

- Though the shipping set of deceleration of the STP input is to bring a sudden stop, you may alter the acceleration setting of the STP input. (Refer to the parameter MD.)

- The STP input is only effective when the Motor is positioning with RS-232C position command, Programmable Indexer or Jog.

Figure 6-4



◊ The start commands for positioning such as Home Return or Jog are ineffective while the STP input is ON.

◊ The STP input may not be accepted when the signal does not remain ON for 11ms.

◊ When the Motor stops by the STP input, the IPOS output does not close in the FIN format (parameter FW> 0).

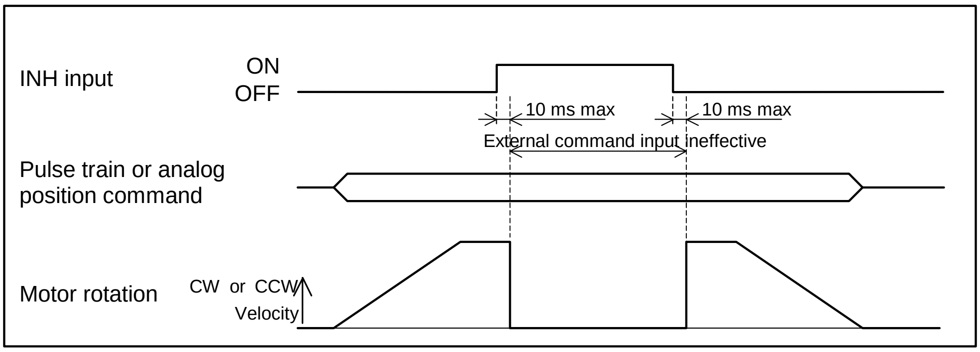
◊ When the Motor reaches the destination of positioning before it cannot stop because the MD setting is too low, the Motor stops immediately at the position.

◊ In case of positioning with the RS-232C analog velocity or torque command, the DC command will be cleared to zero when the STP input is ON.

6.1.4. Making Pulse Train Position Command or Analog Command Ineffective

- When the Motor is positioning with the pulse train position command or the analog command, input of the INH signal ON will make the external command input ineffective.

Figure 6-5



◊ The INH input is only effective on the pulse train and the analog command inputs.

◊ Input of the analog command voltage will be regarded as 0 volts when the INH input is ON.

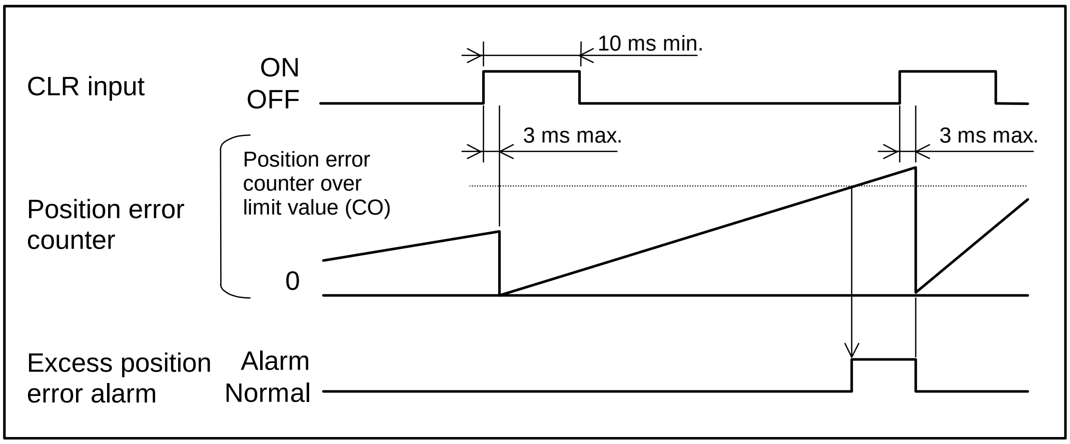
6.1.5. Clearing Position Error Counter

- The CLR (clear) input clears the internal position error counter of position loop.

- When the excess position error alarm occurs, turning ON the CLR input clears the position error counter, thereby recovering the System from the alarm state.

* The CLR signal is an edge-triggered input. Therefore, the function of error counter is active even the CRL input remains ON once it cleared the errors.

Figure 6-6



- Only the following alarms may be cleared by the CLR input. (Other alarms cannot be cleared by the CLR input.)

  - `A3>Overload` (Software thermal sensor)
  - `A4>Velocity Abnormal` (Velocity error over)
  - `F5>Program Error` (Program error)
  - `C2>RS-232C Error` (RS-232C error)
  - `A5>Origin Undefined` (Home position undefined)
  - `F8>AT Error` (Automatic tuning error)

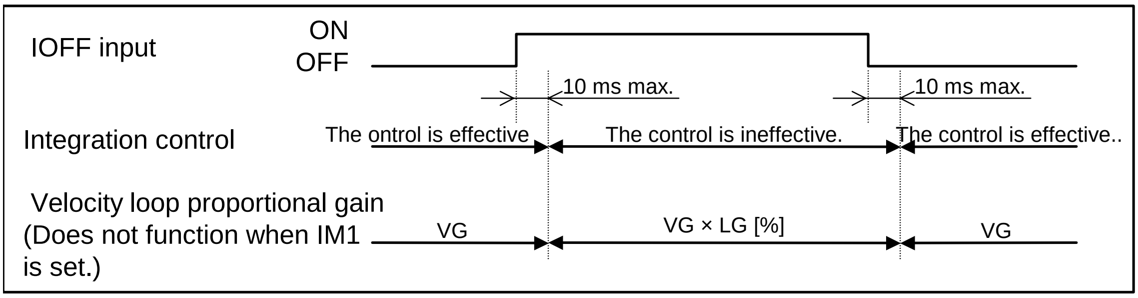
6.1.6. Integration OFF

- When the IOFF input is ON, the integral control will be disabled. The velocity loop proportional gain (VG) will be simultaneously lowered.

- The IOFF input is OFF in the normal state.

- The IOFF input will become an exclusive input to determine effectiveness of the integration control by settings of the parameter (IM1). This makes the IOFF input functions independently regardless of the effectiveness of lowering the position loop control proportional gain input.

Figure 7-7



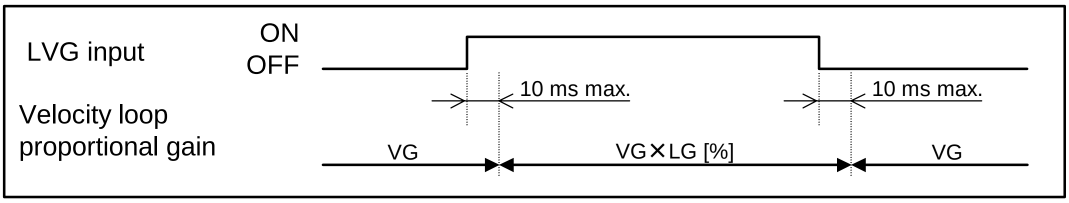
◊ The gain won’t lower even the IOFF input turns ON during the automatic tuning.

6.1.7. Lowering Velocity Loop Proportional Gain

- When the LVG input is ON, the velocity loop proportional gain (VG) will be lowered in accordance with the setting of the lowering gain parameter (LG). (VG × LG)

- The LVG input is OFF for the normal state.

Figure 6-8



◊ The gain won’t lower even the LVG input turns ON during the automatic tuning.

6.1.8. Over Travel Limit

6.1.8.1. Hardware Over Travel Limit

- Use the OTP and OTM inputs to set the off-limits zone in the Motor rotation range.

- If the OTP input is ON, the Motor will stop immediately in the servo-lock state. The Motor may rotate in counterclockwise only.

- If the OTM input is ON, the Motor will stop immediately in the servo-lock state. The Motor may rotate in clockwise only.

* The shipping set of the polarity of OTP and OTM input ports is the normally open contact. It may be changed to the normally closed contact. (Refer to the section of the AB parameter.)

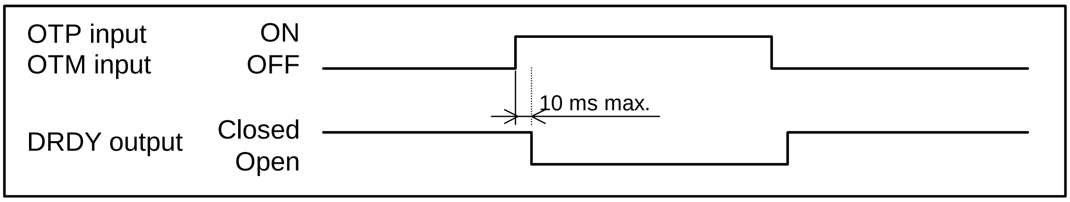
* Besides the OTP and OTM inputs, the Motor rotation can also be limited by software (software over travel limit function) in the Driver Unit. Refer to “6.1.8.2. Software Over Travel Limit.”

◊ When the over travel limit is ON, the DRDY output closes, and the LED on the front panel indicates as shown below. The parameters HT and TO may change the reporting state of control output.

Table 6-1: Alarm

Over Travel Alarm	Parameter setting (✓: shipping set)	Control output		Indicator on front pannel
		DRDY	OVER	
Activation of OTP or OTM sensor	HT0	Not available	Not available	F3
	HT1	Open	Not available	
	HT2 (✓)	Not available	Closed	
Software limit over	TO1	Open	Not available	F2
	TO2 (✓)	Not available	Closed	

Figure 6-9



- When the OTP or OTM input is activated in the middle of Home Return operation, the Motor completes the Home Return operation after performing the following. Refer to “7.2.1. Home Return” for the detail.

1 When rotating in CCW

Caution : The Motor decelerates, and then reverses rotation when the OTM input is turned ON.

2 When rotating CW

Caution : The Motor decelerates, and then reverses rotation when the OTP input is ON.

6.1.8.2. Software Over Travel Limit

⚠ *Caution : (1) The over travel zone should be 1000 [pulses] or wider. When the over travel zone is too narrow the Motor may turn through the "off-limits" zone.*

(2) Set the over travel limits with ample margin, giving consideration to the overshoot of the mechanism controlled by the Motor.

(3) Even a short cut positioning is set with AD or AR command, the Motor rotates the direction to avoid the off-limits zone regardless of moving distance if the software over travel limit specifies the off-limits zone.

- This function becomes effective when Home Return or AZ command specifies the home position. (For the ESA Driver Unit equipped with absolute position sensor, this function becomes effective as soon as the power is turned on.)

- Use the OTP and OTM commands to set the over-travel limit data.

Way of setting: Setting with teaching

- Sets the software over travel limit with the following procedure when the Home Return is completed.

(1) Turn off the Motor servo.

M O ENT

```
:MO
:_
```

(2) Move the Motor's rotor manually to a point to be the over travel limit on the plus side.

(3) Input the password.

/ N S K SP
O N ENT

```
:MO
:/NSK ON
 NSK ON
:_
```

(4) Register the current position as the over travel limit on the plus side. The registered over travel limit position appears on the display.

O T P / S T
ENT

```
:OTP/ST
 OTP123456
 OTM0
:_
```

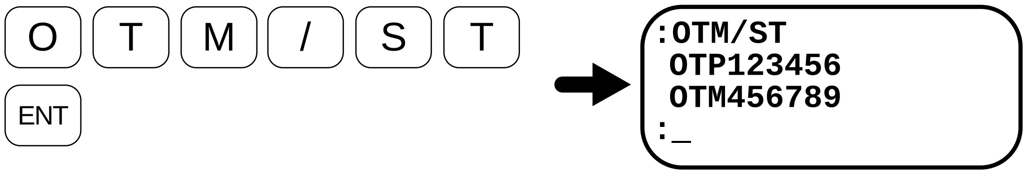
(5) Move the Motor's rotor manually to a point to be the over-travel limit on the minus side.

(6) Input the password.

/ N S K SP
O N ENT

```
:MO
:/NSK ON
 NSK ON
:_
```

(7) Register the current position as the over travel limit on the minus side. The registered over travel limit data appears on the display.



(8) Move the Motor's rotor into the over travel range. Check that the Driver Unit outputs the F2 alarm. (Check with the alarm indicated on the LED or input the TA command.)

- If the F2 alarm is not outputted, check the following:
  - ◊ Check if the home position is between OTP and OTM?.
  - ◊ In case of single rotation position scale: Is OTP < OTM?
  - ◊ In case of linear position scale: Is OTP a positive data? Is OTM a negative data?

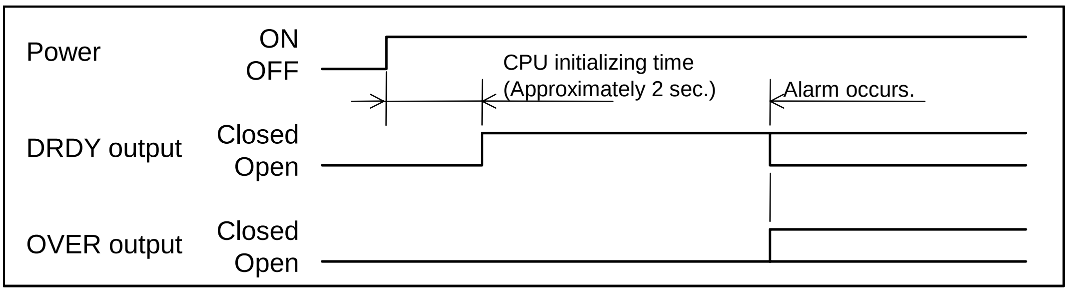
◆ Setting by position scale data

- When the over travel limit data are already known, user can directly set these data to the OTP and OTM parameters.

6.1.9. Alarm Output

- After the power is on, following completion of initialization of the CPU, the DRDY output closes and the OVER output opens if the Driver Unit is in normal state.
- When an alarm occurs, the status of DRDY and OVER outputs will change. Way of change depends on the contents of alarm. (Refer to "11. Alarm.")
- Connect the alarm signals to the alarm inputs of the master controller.

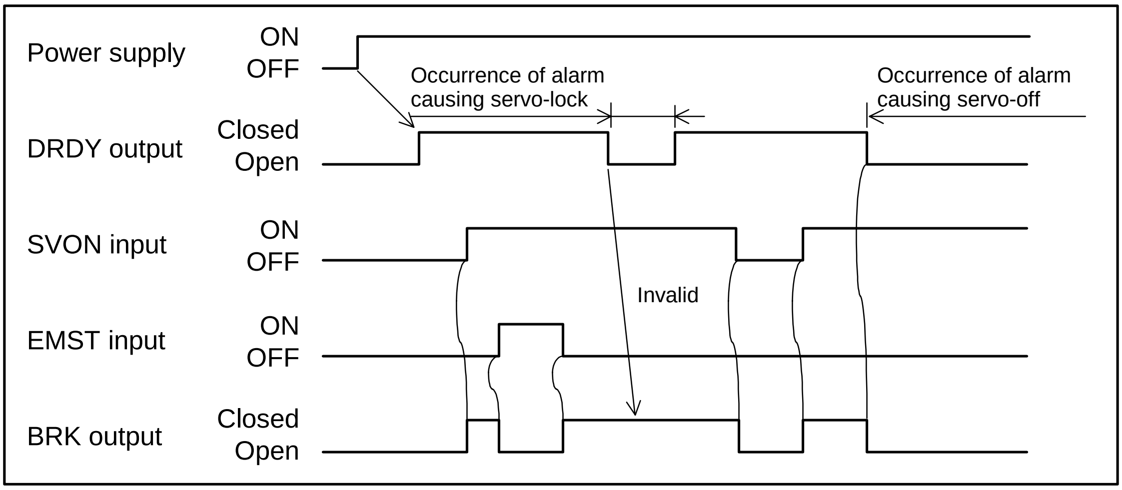
Figure 6-10



6.1.10. Brake Output

- The BRK output opens in the following states.
  - (1) The SVON input: OFF.
  - (2) Occurrence of an alarm that makes the Motor servo OFF. (Example: Memory error)
  - (3) During intialising the system after turning on the poewer.
  - (4) The EMST input: ON

Figure 6-11

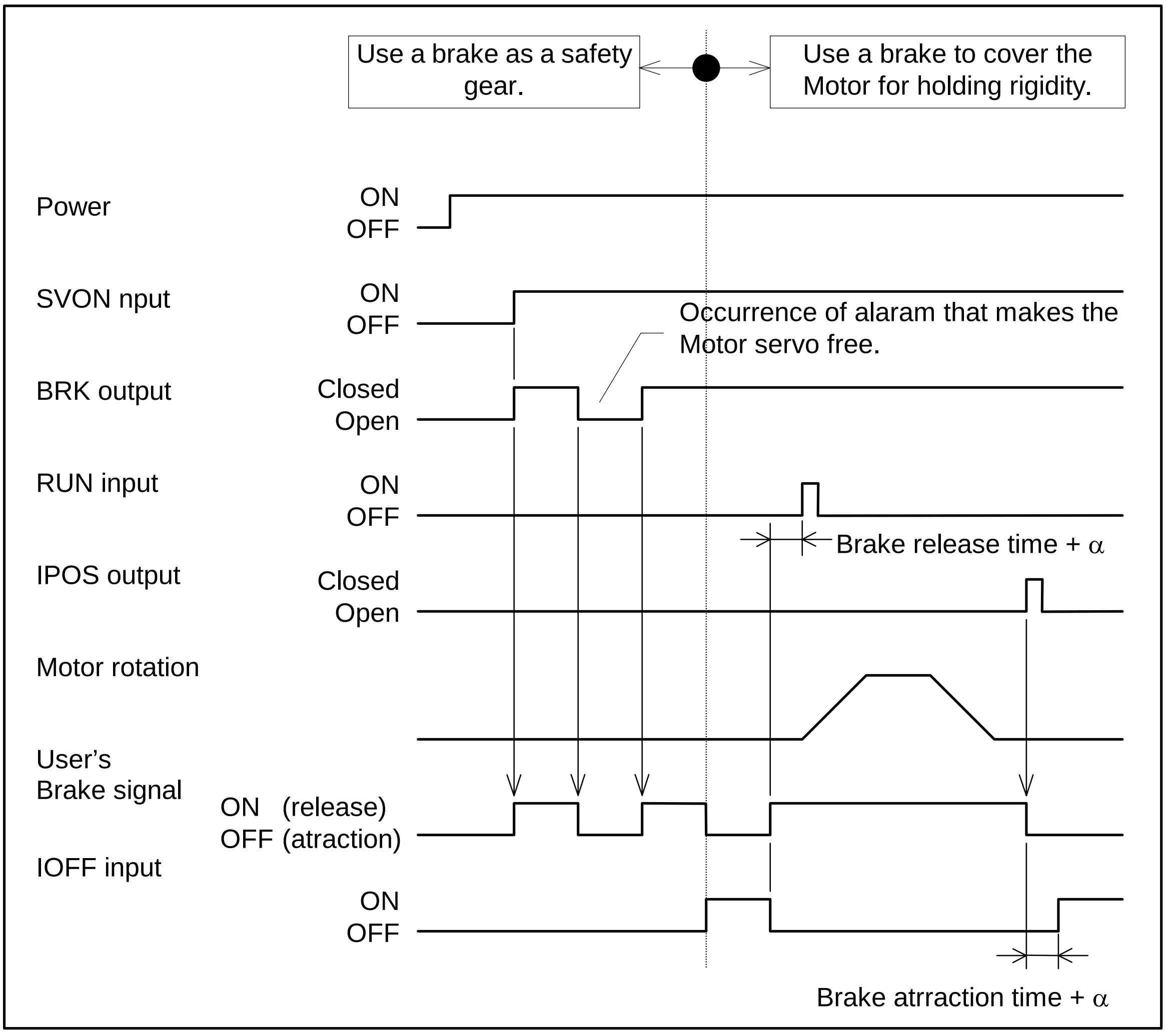


* This signal can be used to control the power off activated type brake, which activates the external brake when the Motor servo goes OFF or the EMST input is ON. .

6.1.10.1. Control of Brake

- If a brake mechanism or an arresting mechanism with locating pin is provided externally, control them referring recommended sequence below.

Figure 7-11: Recommended sequence (Controlling negative action brake)



Caution : • Be sure to deactivate the velocity loop integration frequency (IOFF input ON) when braking the Motor during its servo lock state.

◊ Otherwise the Motor will eventually heat up, thus the Driver Unit may give the overload alarm

• Set enough time to lock the Motor with brake when deactivating the velocity loop integration frequency.

◊ It worsens the positioning accuracy when deactivate the integration control before locking the Motor.

• Do not turn the servo OFF when locking the Motor with brake in the positioning with the pulse train command.

◊ The position errors of position error counter are cleared and the errors will be accumulated.

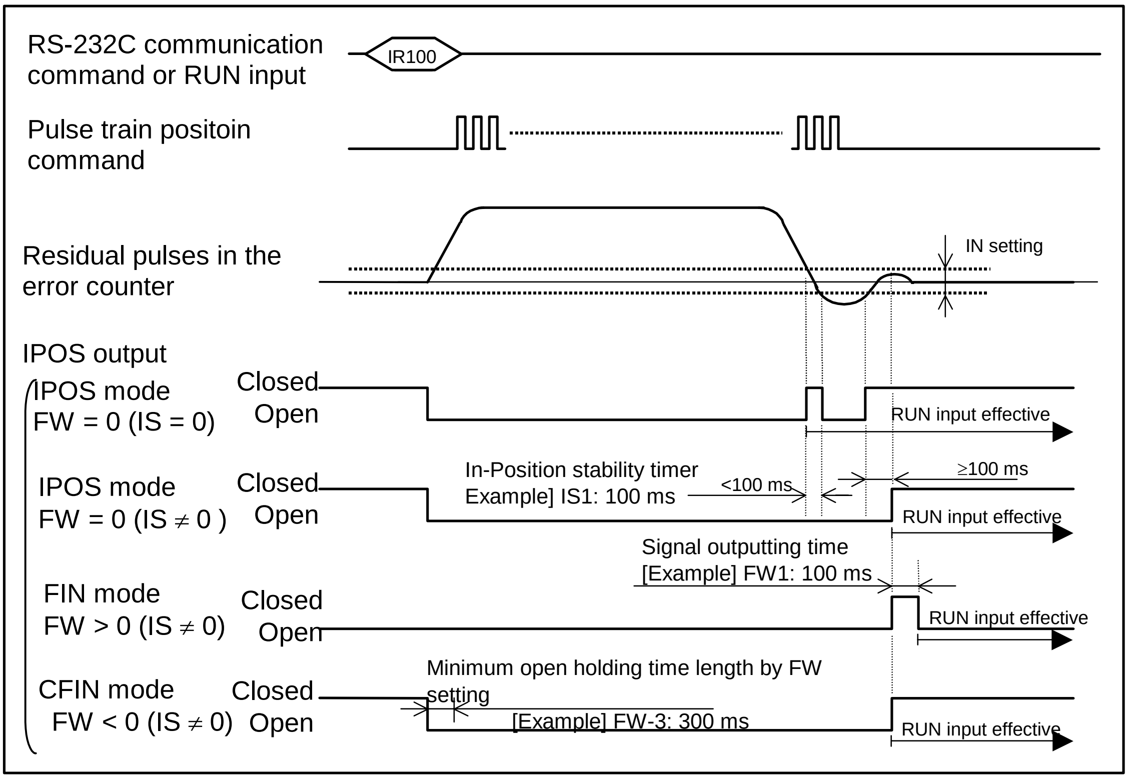
6.1.11. In-Position Output

- The following parameters define the condition to output the In-Position (IPOS) signal.

Table 6-2

Parameter	Signal name and function	Shipping set
FW	• FIN Width Outputting time of In-Position signal (Output mode)	FW1
IN	• In-Position limit Threshold to output the In-Position signal	IN100
IS	• In-Position stability timer Stabilizing timer for In-Position output	IS0

Figure 6-12



◊ In case of the FIN mode, the IPOS output does not close at the completion of positioning with the pulse train position command or Jog operation.

◊ In case of positioning with the pulse train position command, the IPOS output does not change its state in the FIN or CFIN mode. Select the IPOS mode.

6.1.11.1. Output Signal Format

1 IPOS mode (when the data of parameter is set to “zero”: FW0)

- The format is to indicate if there is a difference between the position command and the current position.
- The IPOS output will close only when the residual pulses in the position error counter are equal or under the range set by the parameter IN, it is on in other states.
- However, even the residual pulses in the position error counter is equal or under the IN data, the output is forced to open while the pulses are generated internally in positioning with the Programmable Indexer, Home Return, Jog, and positioning via the RS-232C communication.
- In positioning with the pulse train command, the IPOS output closes when the residual pulses are equal or under the IN data even the pulses are being input.
  (In the low velocity operation or the feed forward control [parameter FF], the IPOS signal tends to close.)
- The IPOS output won’t close when the positioning is interrupted by the following causes.
  - The EMST input is ON.
  - An alarm occurs.

2 FIN Mode (when the data of parameter FW is set to a positive integer: FW>0)

- The IPOS output indicates that a positioning with given command has completed.
- The IPOS signal will be outputted as one to one correspondence for every starting command such as RUN or HOS command.
- The state of the output is always open, and it closes only for a time set by the parameter FW when the positioning completes.
  (The data is in a unit of 100 [ms]. The shipping set of FW1.0 means that the closing time is 100 ms.)
- The IPOS signal won’t be outputted for positioning with the pulse train command and the JOG.
- The IPOS output won’t close when the positioning is interrupted by the following causes.
  - The EMST input is ON.
  - An alarm occurs.

3 CFIN Mode (when the data of parameter is set to a negative integer: FW<0)

- The IPOS output reports that a positioning has completed.
- The IPOS output opens when the pulses are generated internally by the start positioning command, and it closes when completion of the positioning is detected.
- It is possible to set a minimum holding time to the parameter FW to make sure the IPOS signal remains open even in a very short time positioning. (The data is in a unit of 100 [ms]. The FW-1 means that the time is 100 ms.)

6.1.11.2. Parameter IN

- The parameter IN is to decide the positioning accuracy.
- The IPOS output will close when the residual pulses of position error counter are within the range of the parameter IN.
- The unit of data of the parameter IN is the maximum resolution (pulses) of the position detector.

Table 7-4 *[Unit: pulse/r]*

Motor type	Resolution
RS	614 400
AS and BS	409 600

◊ For example, the following calculation shows conversion of the unit of repeatability of ± 100 seconds into the unit of pulse for an RS type Motor.

$$\text{IN data} = \frac{\text{Resolution}}{360} \times \text{Repeatability [degree]}$$

$$= \frac{614\,400}{360} \times \frac{100}{3600} = 63 \text{ [pulse]}$$

6.1.11.3. Parameter IS

- The parameter IS is to confirm the stability of the positioning. In case of in-position output signal is the IPOS format, the IPOS output will be instable in a moment of positioning settling even all the servo gains are adjusted properly, if the parameter IN data is smaller (roughly IN10 or less).
- The parameter IS should be set to eliminate above instability. In addition, the parameter prevents from outputting the IPOS signal before the Motor settles its motion in the FIN mode

6.1.11.4. IPOS Output in Special Occasion

1 When 0 (Zero) movement operation is executed.

- When [AD0] or [AR0] is executed even the Motor is on the home position, movement of the Motor is 0 (Zero). The following show the IPOS output states in such a case.

1) When IS = 0 in case of the IPOS mode

◊ The IPOS output remains closed because there is no internal pulse, if residual pulses of position error counter are within data of the parameter IN.

2) When IS ≠ 0 in case of the IPOS mode

◊ Even no pulse is generated internally the IPOS output will open for the moment set by data of the parameter IS to check the positioning stability.

3) In case of the FIN mode

◊ Even no internal pulse is generated, the IPOS output signal is always closed for a time set by the parameter FW for the RUN command.

4) In case of the CFIN mode

◊ Even no internal pulse is generated, the IPOS output signal always opens for a time set by the parameter FW for the RUN command.

2 Sequential operation in Programmable Indexer by Sequence Code (∗)

1) In case of the IPOS mode

◊ After completion of positioning, the System executes the next channel program while the IPOS output remains open.

2) In case of the FIN mode

◊ After completion of positioning, the IPOS output closes for a moment set by the parameter FW, and then the System executes the next channel's program after the IPOS output opens again.

3) In case of the CFIN mode

◊ After completion of positioning, the System executes the next channel's program keeping the IPOS signal remains open.

6.1.12. Definition of Home Position

- This is a control signal to inform externally that the home position is defined.
- The HCMP output closes when the Home Return or other means has defined the home position.
- The System equipped with the absolute position sensor closes the HCMP output as soon as the DRDY signal outputs after the power is turned on.
- Even the home position has been defined, the HCMP output closes if the Home Return is interrupted, or the parameters to set the coordinate system (DI or PS) are changed.

■ Refer to "7.2.1. Home Return" for the sequential timing.

6.1.13. Completion of Home Return / Detection of Home Position

- This is a control signal to notify completion of the Home Return or detection of the home position.
- The parameter HW selects reporting mode in completion of the Home Return or the detection of home position.

6.1.13.1. Signal Output Mode

1 Report mode in completion of Home Return (When the parameter HW is set to HW0)

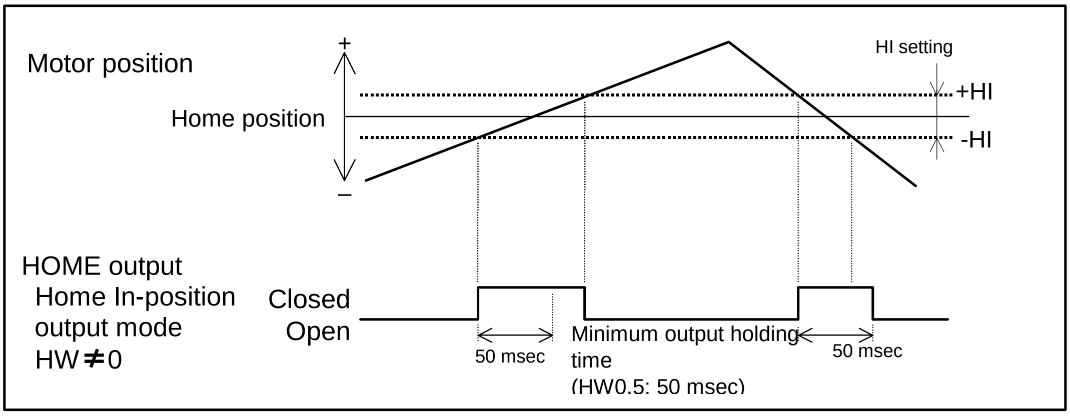
- This mode is to report completion of Home Return.
- The HOME output closes when the Home Return completes.
- After completion of the Home Return, the Home output opens when the Motor is off the Home position by a moving command.
- Once the HOME output has opened, it remains open until the next completion of the Home Return.

■ Refer to "7.2.1. Home Return" for the sequential timing.

2 Report mode in detection of the home position (Parameter HW is set to other setting besides HW0.)

- This mode is to repot that the Motor is on the home position.
- The HOME output closes when the Motor is in the range set by the parameter HI. It opens when the Motor is out of the range.
- If the Motor passes the set range in high speed, the HOME output keeps closing for a time set by the parameter HW.

Figure 6-13

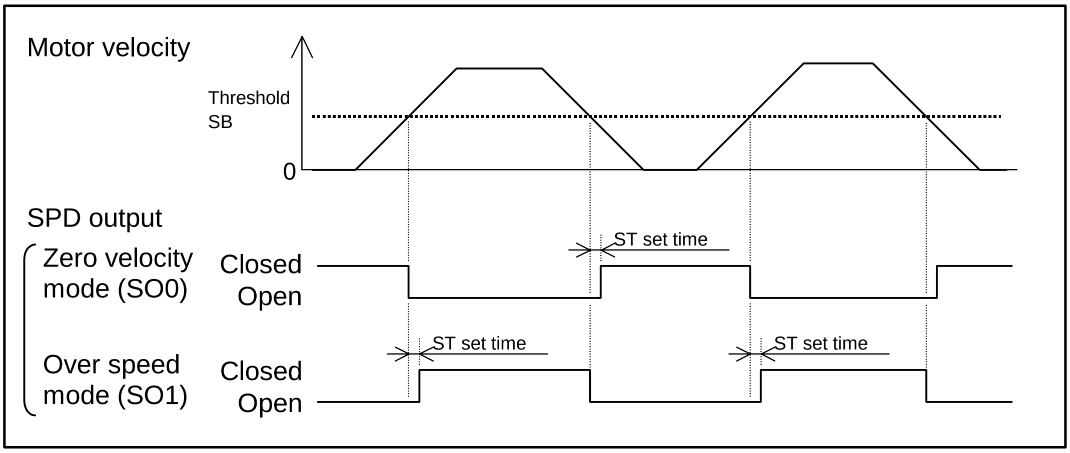


◊ The HOME output won't close if the home position was not defined.

6.1.14. Velocity Report

- This is a control signal to report the Motor velocity.
- The SPD output closes if the velocity is higher (over speed) or lower (zero speed) than the threshold set by the parameter SB
- The parameter SO selects the over speed mode or the zero speed mode.
- The parameter ST checks state of stability of the detected velocity against the threshold. (The SPD output closes when the detected velocity is in the threshold for a time set by the parameter ST.) The parameter ST confirms the velocity stability against the criterion.

Figure 6-14



6.1.15. Target Proximity / In target

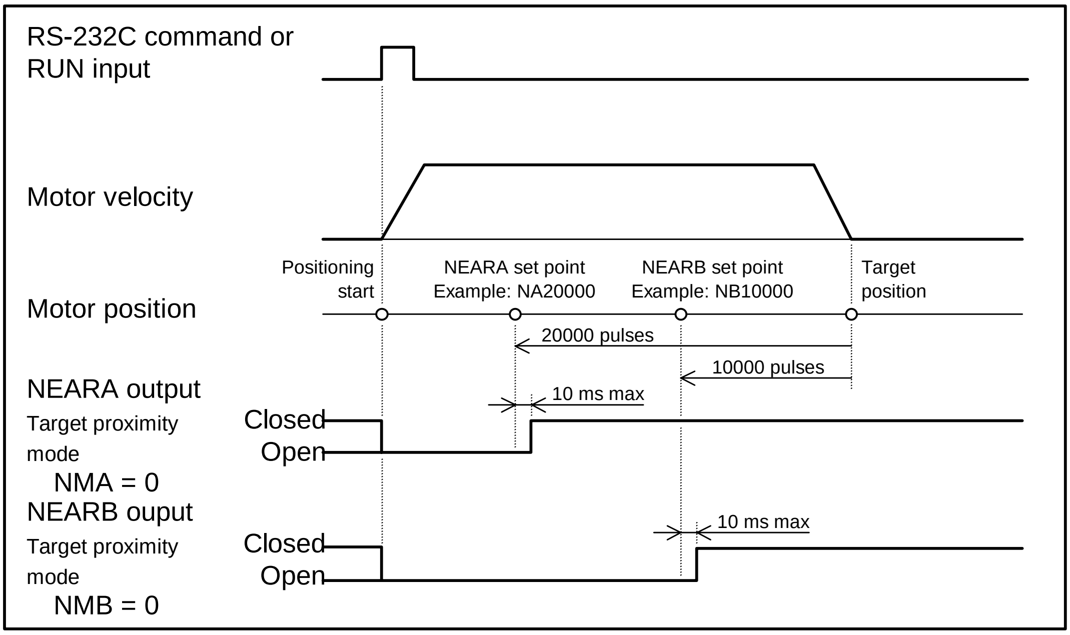
- This is a control signal that reports the Motor is nearing, or in the target zone.
- The parameter NMA and NMB select the target proximity mode or the In-target mode for the two points of NEARA and NEARB respectively.

Output	Parameter	Mode	Setting
NEARA output	NMA = 0	Target proximity mode	Sets distance to output the target proximity signal.
	NMA ≠ 0	In target mode	Sets holding time to the paramter NMA. Sets output point to the parameter ZAS. Sets end of output point to the parameter ZAE.
NEARB output	NMB = 0	Target proximity mode	Sets distance to output the target proximity signal.
	NMB ≠ 0	In-target mode	Sets holding time to paramter NMAB. Sets output point to parameter ZBS. Sets end of output point to parameter ZBE.

1 Target proximity mode (The parameter NMA or NMB is set to NMA0 or NMB0)

- This is to report that the Motor is nearing a target position in positioning with Programmable Indexer or the RS-232C communication.
- The criterion of the proximity will be set by the NA or NB in the unit of pulse.

Figure 6-15



◊ The NEARA or NEARB signal outputs only when one of the positioning command of AD, AR, ID or IR is executed by the Programmable Indexer or the RS-232C communication.

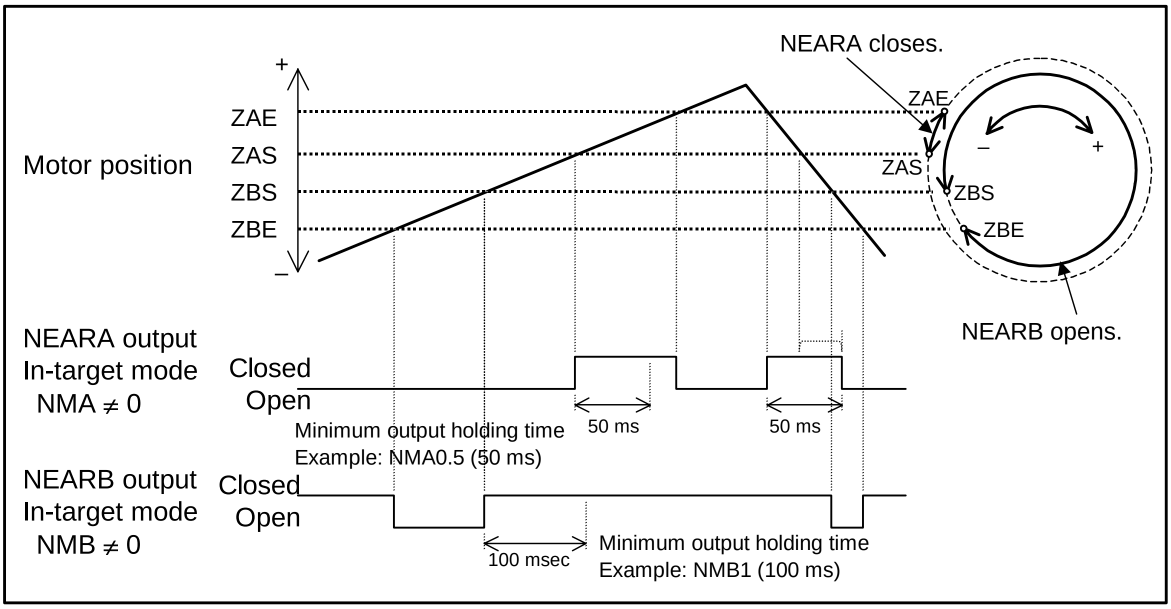
◊ When the Motor gets in the target area and then the output once closed, it holds closed state until the next positioning command is inputted.

◊ The NEARx output opens if the target position and stopped position of the Motor are different because of an interruption of positioning or the servo-off, etc.

2 In-target mode (Data other than 0 is set to the parameter NMA or NMB)

- This is a control signal to report that the Motor is in or has passed through the specified position zone.
- The parameter ZAS or ZBS sets the point to start outputting the NEARx, while the ZAE or ZBE sets the point to stop outputting the signal.
- NEARx output opens from the beginning to the end of counting up the position data, while it closes in the other zone.
- The output signal may be held for a time set by the parameter NMA or NMB when the target zone is too narrow and the velocity is too high.

Figure 6-16



◊ The NEARx output does not close if the home position has not been defined.

◊ If the position data of ZAS and ZAE, or ZBS and ZBE are the same, the report will be made at the point.

◊ If the positive and negative direction of position scale is reversed by the parameter DI1, the CCW will be the direction for counting up.

Setting:

◆ Setting with teaching

- Follow the procedure below after completion of the Home Return.

1) Set the NEAR output to the In-target mode. It will be set to the In-target mode if the setting of minimum output holding time NMA is not set to 0 (zero). (Example: Set to 100msec.)

N M A 1 # ENT

```
:NMA1
:_
```

2) Turn the Motor servo OFF.

M O ENT

→

```
:MO
:_
```

3) Move manually the rotor of Motor to the point to start outputting the NEARA signal.

4) Set the starting point for outputting the In-target signal.
The coordinate of the point will be indicated in the screen in the unit of pulse.

Z A S / S T
ENT

→

```
:ZAS/ST
 ZAS123456
 ZAE0
:_
```

5) Move manually the rotor of Motor to the point to stop outputting the NEARA signal.

6) Set the end position outputting the In-target signal.
The coordinate of the point will be indicated in the screen in the unit of pulse.

Z A E / S T
ENT

→

```
:ZAE/ST
 ZAS123456
 ZAE456789
:_
```

7) Move the Motor in the In-target area and check if the NEARA output closes.

◆ Setting with the position data

- If the position data of the In-target area are known beforehand, you may set the data directly to the parameters ZAS and ZAE, or ZBS and ZBE.

1) Set the NEARA output to the In-target mode. It will be set to the In-target mode if the minimum holding time NMA is set othe rthan 0 (zero).
(Example: Set to 100 msec.)

N M A 1 # ENT

→

```
:NMA1
:_
```

2) Input the position data of the point to start outputting the In-target signal.

Z A S 1 # 2 $ 3 <
4 > 5 % 6 & ENT

→

```
:ZAS123456
:_
```

3) Input the position data of the point to stop outputting the In-target signal.

Z A E 4 > 5 % 6 &
7 ' 8 (9) ENT

→

```
:ZAS123456
:ZAE456789
:_
```

4) Move the Motor in the In-target area and check if the NEARA output closes.

6.1.16. Position Feedback Signal

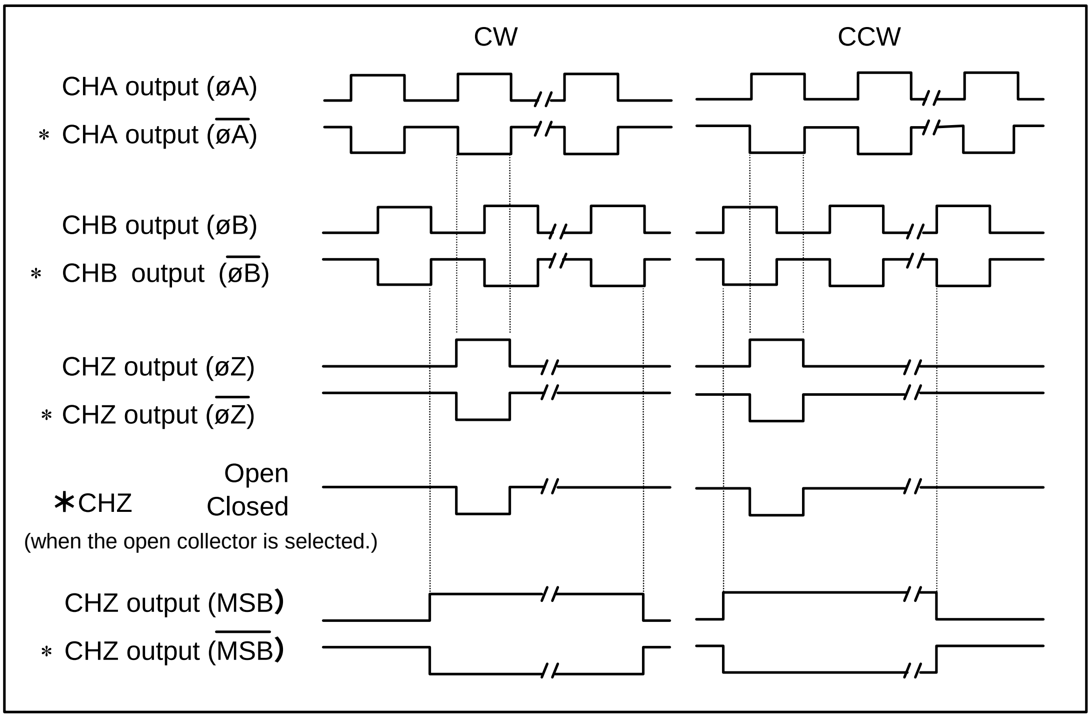
- Resolution

Table 6-4 *[Unit: Pulses/rev.]*

øA and øB	øZ
51 200	50

- Output timing

Figure 6-17



* The phase may be reversed with the FD parameter. (Set via the RS-232C communication.)
FD0: Standard : Leading phase is øA in the CW rotation.
FD1: Reversed : Leading phase is øB in the CW rotation.

* The FZ parameter selects øZ or MSB of CHA. (Set via the RS-232C communication.)
FZ0: øZ
FZ1: MSB

6.1.17. Monitor Functions

- Several monitoring functions are available with the analog signal monitor pins on the front panel of the ESA Driver Unit and the RS-232C communication.

Table 6-4

Item	RS-232C communication command	Monitor output	Description
Velocity (analog signal)	–	Front panel VEL (GND) monitor pins	• Monitors the Motor velocity in forms of analog voltage output.
Input/Output	IO	RS-232C communication terminal	• Monitors the input/output status (ON/OFF) of CN2.
Pulse train input counter	RP		• Monitors real time data in the hardware counter of pulse train input
Current position	TP		• Reports real time readout of current position in the absolute coordinate system.
Position error counter	TE		• Monitors error of the position error counter in real time.
Velocity	TV		• Monitors the Motor velocity in real time.
Torque/ thermal loading	TT		• Monitors the torque command and the thermal load data in real time.
State of automatic gain setting	TG		• Monitors real time state of the automatic gain switching functions for positioning and stopping.
Parameter setting	TS		• Monitors the settings of servo parameters and motion parameters.
Alarm	TA		• Monitors the alarm status.
Contents of channel program	TC		• Monitors the program stored in the channels.
State of program execution	MN		• Checks the changes in control Inputs/Outputs and the history of channel programs.
Analog monitor	MN	Front panel MON (GND) pins	• Monitors the Motor velocity and the residual pulses of position error counter in forms of analog signal.

* Refer to “9. Glossary of Command and Parameter” for more details of RS-232C communication.

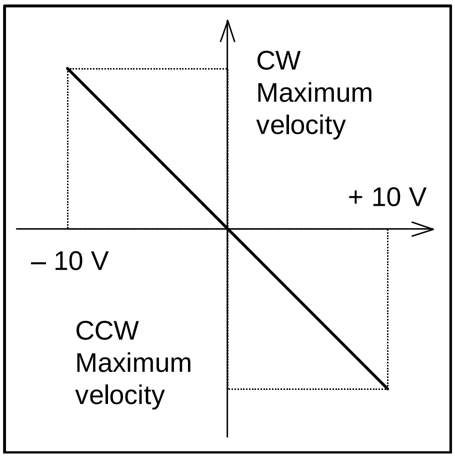
6.1.17.1. Analog Velocity Monitor

- The voltage between check pins VEL and GND provided on the front panel of ESA Driver Unit monitors velocity of the Motor.

◆ In case of 12 bit resolver resolution

- The analog signal of ±10V is only a typical value; the actual values vary slightly. The analog waveform does not precisely represent the actual velocity.

Figure 6-18



◆ In case of 10 bit resolver resolution or automatic resolver resolution switching

- The analog signal of ±7.5 V is only a typical value; the actual values vary slightly. The analog waveform does not precisely represent the actual velocity.

Figure 6-19

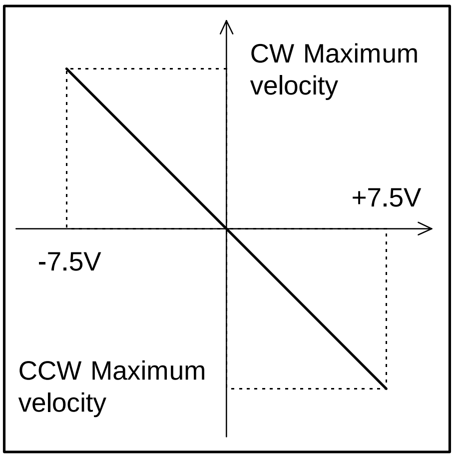


Table 6-6: Maximum velocity *[Unit: s^{-1}]*

Resolver resolution / Motor type	12-bit setting	Automatic resolution switching or 10-bit setting
RS	1	3
AS and BS	1.5	4.5

◊ The parameter RR selects the automatic resolution switching, 12-bit and 10-bit settings.

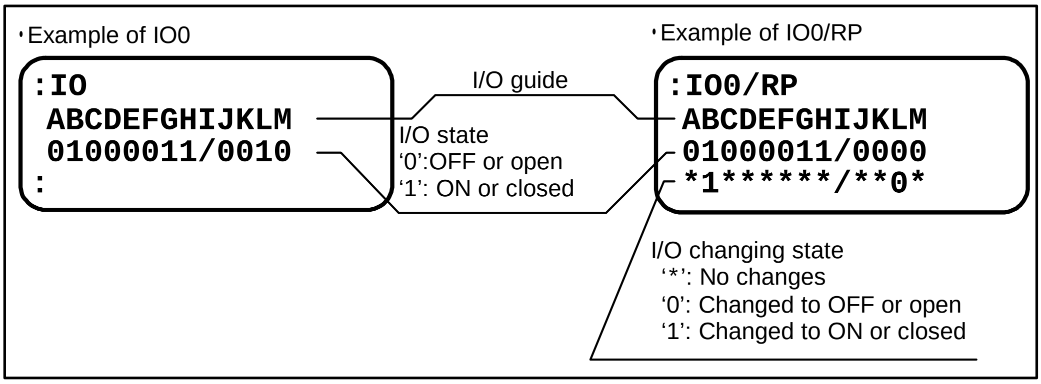
6.1.17.2 Monitoring Control Input/Output Signals

- State of the Input and Output signals of the connector CN2 can be monitored by the IO command
- This function is useful for checking the wiring.
  - ◊ Input format

IO0/RP	: Monitors the general I/O state.
IO2/RP	: Monitors the I/O state related to positioning with Programmable Indexer
IO3/RP	: Monitors the I/O state related to general positioning
/RP default	: Monitors in one shot.
/RP attached	: Monitors in real time.

  - ◊ Readout format: Bit map representing the Inputs/Outputs in 1 line. (See Figures 6-21 to 6-23.)

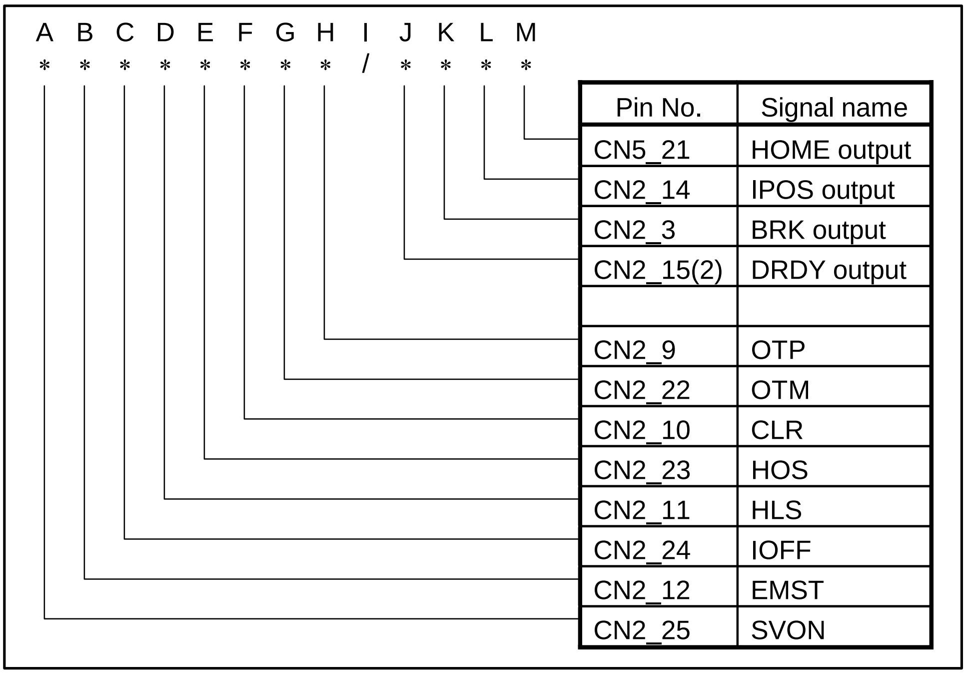
Figure 6-21: Monitoring example



◊ Press the [BS] key to terminate the real time monitoring (IO*/RP).

◊ Press the [R] key to reset the monitored state in the Input/Output changing state.

Figure 7-22: Readout format (IO0/RP: General I/O state)



Pin No.	Signal name
CN5_21	HOME output
CN2_14	IPOS output
CN2_3	BRK output
CN2_15(2)	DRDY output
CN2_9	OTP
CN2_22	OTM
CN2_10	CLR
CN2_23	HOS
CN2_11	HLS
CN2_24	IOFF
CN2_12	EMST
CN2_25	SVON

Figure 6-23: Readout format (IO2/RP: Related to positioning with Programmable Indexer)

```
A  B  C  D  E  F  G  H  I  J  K  L  M  N
*  *  *  *  *  *  *  *  0  0  /  *  *  *
```

Pin No.	Signal name
CN5_4	NEARB
CN5_3	NEARA
CN2_14	IPOS output
Reserved	Reserved
Reserved	Reserved
CN5_18	STP
CN5_17	RUN
CN5_11	PRG0
CN5_12	PRG1
CN5_13	PRG2
CN5_14	PRG3
CN5_15	PRG4
CN5_16	PRG5

Figure 6-23: Readout format (IO3/RP: Related to general positioning)

```
A  B  C  D  E  F  G  H  I  J  K  L  M  N
*  *  *  *  *  *  *  /  *  *  *  *  *  *
```

Pin No.	Signal name
CN5_22	HCMP
CN5_21	HOME
CN5_20	SPD
CN5_14	IPOS
CN5_2	OVER
CN2_15(2)	DRDY
CN5_37	LVG
CN5_36	INH
CN5_18	STP
CN2_23	HOS
CN5_17	RUN
CN5_31	DIR
CN5_30	JOG

Table 6-7: Meaning of data

	Indication: 1	Indication: 0
Input port	ON	OFF
Output port	Closed	Open

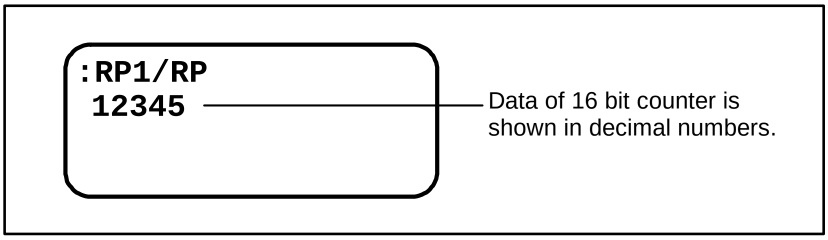
6.1.17.3. Monitoring Pulse Train Input Counter

- The RP command monitors the state of Input/Output of pulse train command.
- The data in 16bit counter will be shown.
- This is useful to check the wiring and the programs in the controller that generates pulse train.

◊ Input format

RP0/RP	: In decimal number (0 to 65 535)
RP1/RP	: In hexadecimal number (0000 to FFFF)
/RP default	: Reads out in one shot.
/RP attached	: Real time readout.

Figure 6-24: Monitoring example: RP1/RP



◊ Press the BS key to terminate the real time readout (RP*/RP).

◊ Reported number cannot be reset because it is the data in hardware counter.

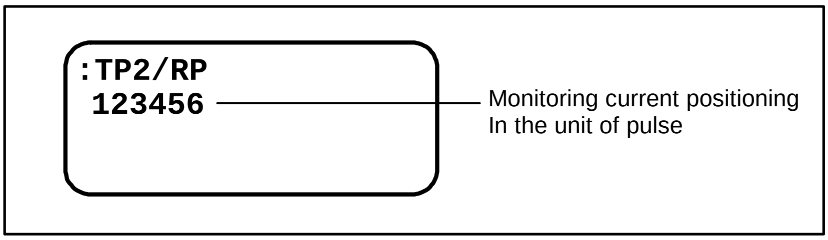
6.1.17.4. Monitoring Current Position

- The TP command monitors the position data of current position.
- This is useful to check the stopping position of the Motor and to confirm the position data that is set by the direct teaching.

◊ Input format

TP0/RP	: Monitors in the data of Motor position scale in the unit of pulse (Only available for the Motor equipped with the absolute position sensor.)
TP2/RP	: Monitors in the data of user position scale in the unit of pulse.
TP5/RP	: Monitors in the data of user position scale in the unit of angle degree (1/100 degree)
TP6/RP	:Simultaneous monitoring in the data of user position scale in the unit of pulse (upper line) and position error (lower line)
/RP default	: One shot monitoring
/RP Attached	: Real time monitoring.

Figure 6-25: Monitoring example (TP2/RP)



◊ Press the BS key to terminate the real time monitoring (TP*/RP).

6.1.17.5. Monitoring Position Error Counter (RS-232C Communication Monitor)

- The command TE monitors the data in the position error counter.
- This is useful to check the settling state of positioning (state of approaching a target position).

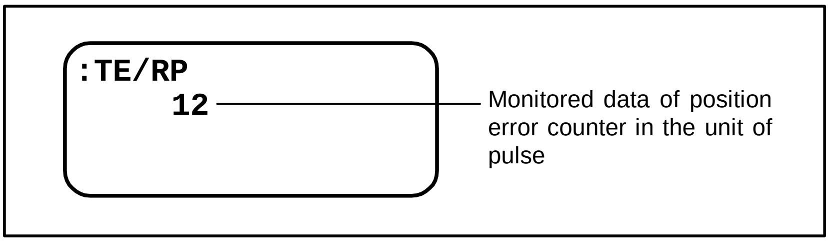
◊ Input format

TE/RP

/RP default : One shot readout

/RP attached : Real time readout

Figure 6-26: Monitoring example (TE/RP)



◊ Press the BS key to terminate the real time readout (TE/RP).

6.1.17.6. Monitoring Motor Velocity

- The TV command monitors velocity.

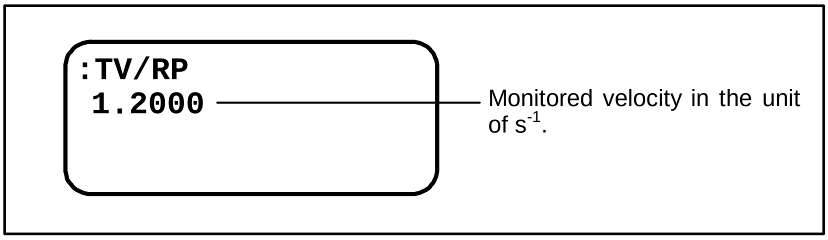
◊ Input format

TV/RP

/RP default : One shot readout

/RP attached : Real time readout

Figure 6-27: Monitoring example (TV/RP)



◊ Press the BS key to terminate the real time monitoring (TV/RP).

6.1.17.7. Monitoring Torque Command and Software Thermal Loading

- The Command TT monitors the torque command and the thermal loading.
- This is useful to check a margin of generating torque, and thermal loading in the continuous operation.

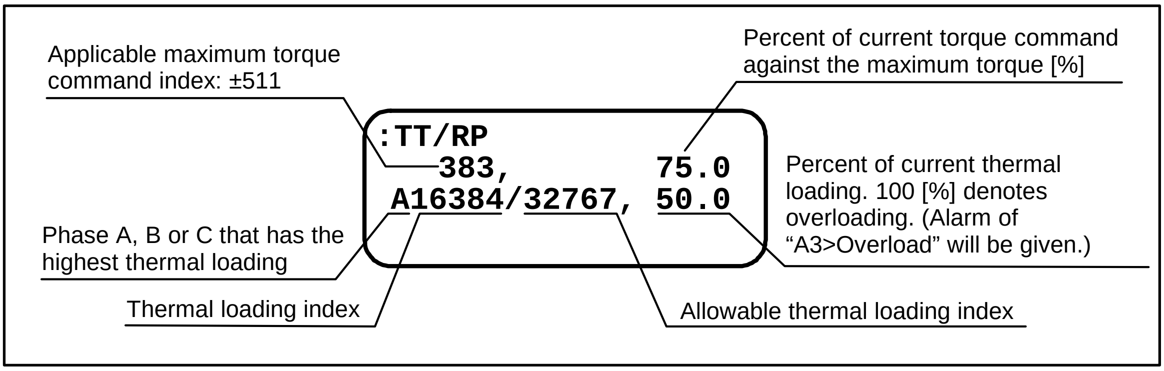
◊ Input format

TT/RP

/RP default : One shot readout

/RP attached: Real time readout

Figure 6-28: Monitoring example (TT/RP)



◊ Press the BS key to terminate the real time monitoring (TT/RP).

6.1.17.8. Monitoring State of Automatic Gain Switching

- The TG command monitors the state of automatic gain switching function.

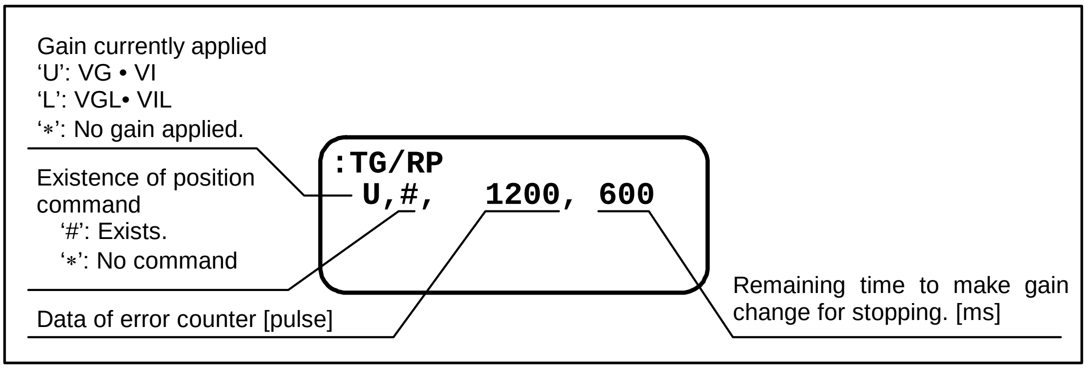
◊ Input format

TG/RP

/RP default : One shot monitoring.

/RP attached: Real time monitoring.

Figure 6-29: Monitoring example (TG/RP)



◊ Press the BS key to terminate the real time monitoring (TG/RP).

◊ Refer to "7.2.7. Automatic Gain Switching" for more details.

6.1.17.9. Monitoring Parameter Setting

- The TS command monitors parameter settings all-together.
- This is useful to make a parameter setting list.

◊ Input format

TS0 : Monitors all parameter settings of TS1 to TS1.
TS1 ~ TS15 : Monitors parameter settings in a group.
(Refer to “8. Glossary of Parameter and Command” for more details.)

Figure 6-30: Monitoring example (TS1)

```
:TS1
 PG0.1;
 VG10.0;
 VGL1.0;
```

Readout of parameter settings related to servo control.

◊ When the parameter MM is set to MM1, “;” appears on the end of readout and the System waits for the key entry. Pressing the $\boxed{\text{SP}}$ key will read out the next parameter. Pressing the $\boxed{\text{BS}}$ key terminates the monitoring.

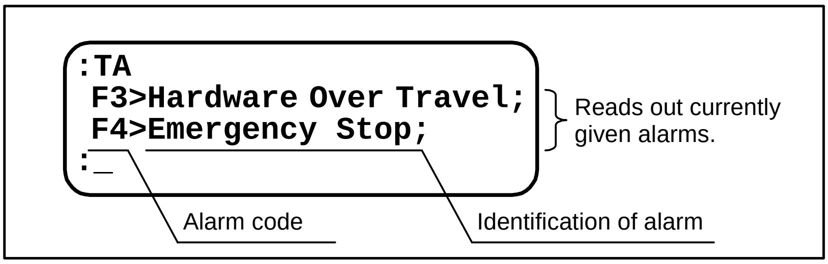
◊ When the parameter MM is set to MM0, all parameter settings are displayed at once, and then the System terminates the monitoring. This function is useful to monitor the setting with a personal computer, etc.

6.1.17.10. Monitoring Alarm Identification

- The TA command monitors contents of currently given alarms.
  - ◊ Input format

    TA

Figure 6-31: Monitoring example (TA)



- ◊ When the parameter MM is set to MM1, the System identifies an alarm, and then put the prompt “:” on the screen for the next key entry. Pressing the $\boxed{\text{SP}}$ key, or the $\boxed{\text{BS}}$ key will terminate the monitoring. However, when multiple alarms are given, pressing the $\boxed{\text{SP}}$ key will read out the next alarm.
- ◊ When the parameter MM is set to MM0, the System reads out all given alarms together and then gets out the monitoring. This function may be used to monitor the alarm with a personal computer.
- ◊ When no alarm is reported, there won’t be any readout, and the System will terminate the monitoring.
- ◊ Refer to “10. Alarm” for more details.

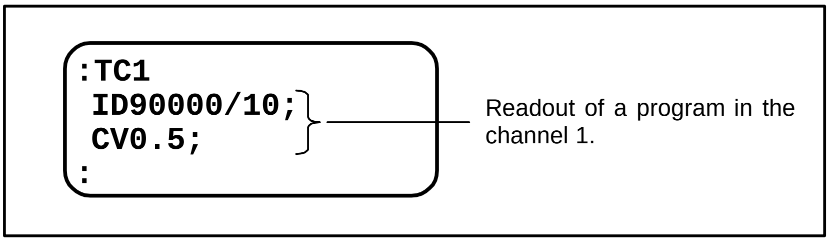
6.1.17.11. Monitoring Contents of Channel

- The TC command monitors internal program settings of channels.
- This function can be used to check the contents of each channel.
  - ◊ Input format

    TC/AL : Reads out setting of the parameter PH and all program channels.

    TC0 to TC63: Reads out the setting of each channel.

Figure 6-32: Monitoring example: (TC1)



- ◊ When the parameter MM is set to MM1, the System reports the program set in a channel, and then the colon “:” appears for the entry of the next key entry. Pressing the $\boxed{\text{SP}}$ key will read out a program set to the next channel. Pressing the $\boxed{\text{BS}}$ key will terminate the monitoring.
- ◊ When the parameter MM is set to MM0, the System reads out the setting of all channels. This function may be used to monitor program setting with a personal computer.

6.1.17.12. Monitoring Changing State of Control I/O and History of Program Execution

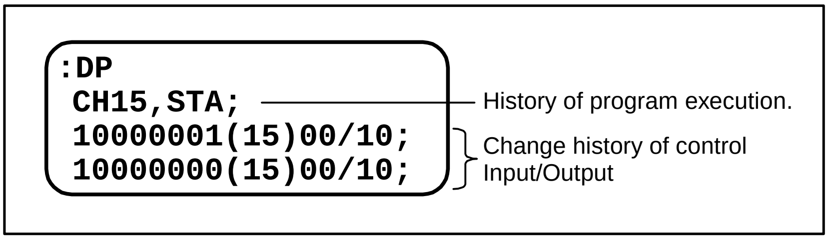
- The DP command monitors histories of program execution and changes in the control Inputs and Outputs.

- The System stores the history of starts, completions and interruptions of a channel program, and the history of changes in control Input/Output in the order of occurrence. The maximum store capacity of histories is one hundred and twenty eight.
  This function can be used for checking the programs of the master controller.

  ◊ Input format

  DP

Figure 6-33: Monitoring example (DP)



◊ When the parameter MM is set to MM1, the System reports a history and then the colon ":" appears for the next key entry. Pressing the SP key reads out a history that goes one step further into the past. The R key monitors a new history, while the BS key terminates the monitoring.

◊ If the parameter MM is set to MM0, the System monitors all histories together, and then gets out the monitoring. This function is for checking the histories of a personal computer.

Figure 6-34: Format to monitoring control Input/Output

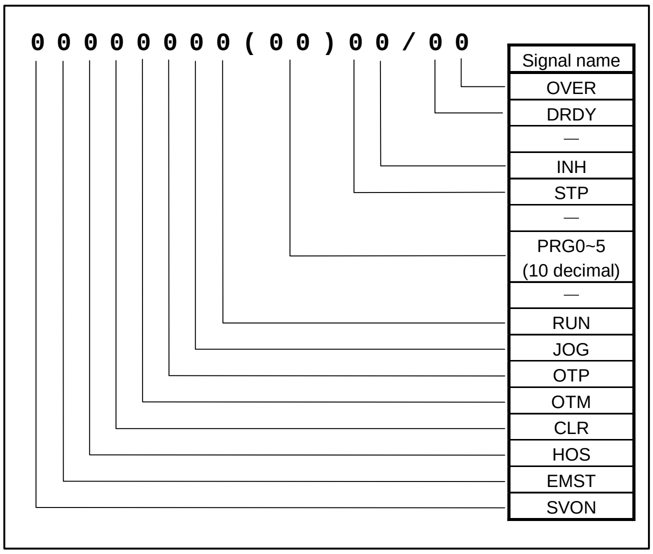


Figure 6-35: Monitoring history of program execution

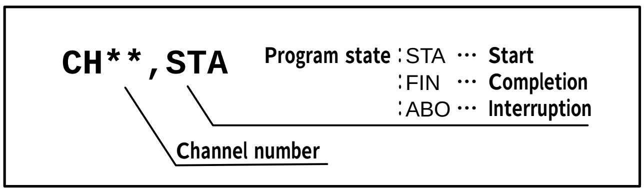


Figure 6-36: Monitoring example

	:DP	
Newer	10000011(15)00/10;	DRDY returned (Ready)
↑	10000011(15)00/00;	Avoid of over travel limit
	10001011(15)00/00;	JOG input
	10001001(15)00/00;	DRDY Open (Not Ready)
	CH15,ABO;	Interruption of channel 15
	10001001(15)00/10;	Got into over travel zone
	CH15,STA;	Stat positioning of channel 15
	10000001(15)00/10;	Start channel 15
	10000000(15)00/10;	Selection of channel numbers
	10000000(11)00/10;	
	10000000(03)00/10;	
	10000000(02)00/10;	
	CH02,FIN;	Positioning of channel 2 completed
	CH02,STA;	Start positioning of channel 2
	10000001(02)00/10;	Start channel 2
	10000000(02)00/10;	Selection of channel 2.
↓	10000000(00)00/10;	SVON input
Older	00000000(00)00/10;	DRDY confirmed (Ready)
	:	

6.1.17.13. Monitoring Analog Control

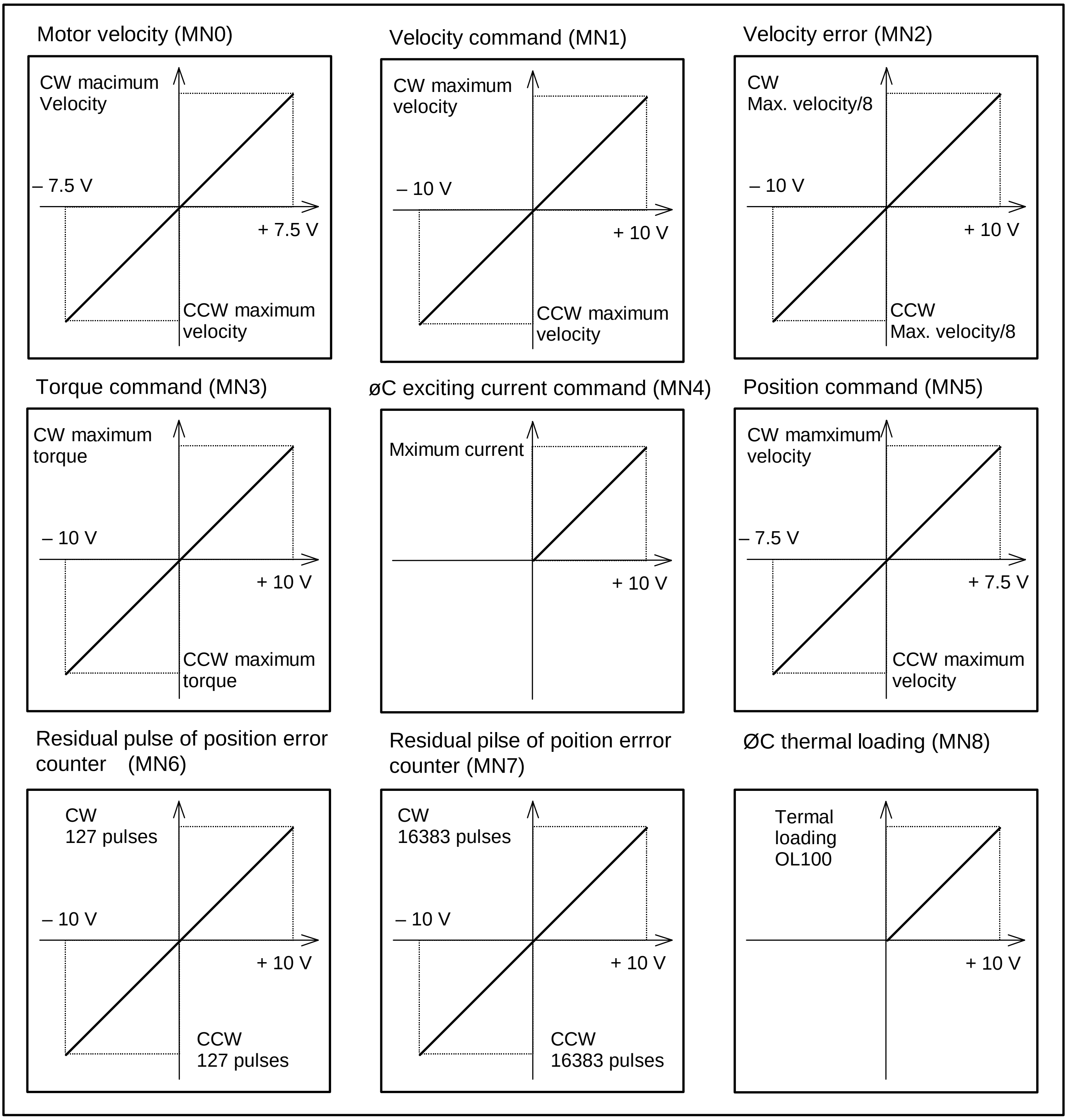
- The voltage between the analog monitor pins (MON) and (GND) on the front panel monitors the following items.
  - ◊ Motor velocity: Monitors the current velocity.
  - ◊ Velocity command: Monitors the current velocity command given to the Motor from the Driver Unit
  - ◊ Velocity error: Monitors difference between the velocity command and current velocity.(per one sampling)
  - ◊ Torque command: Monitors the torque command.
  - ◊ øC current command: Monitors the current command given to the øC of the Motor.
  - ◊ Position command: Monitors the position command (motion distance) currently given to the Motor
  - ◊ Residual pulse in the error counter: Monitors the current residual pulse of the error counter.
  - ◊ øC software thermal loading: Monitors estimated temperature of øC software thermal loading.
- The MN command selects a monitoring output.

Table 6-8

Item	MN Command
Motor velocity	MN0
Velocity command	MN1
Velocity error	MN2
Torque command	MN3
øC current command	MN4
Position command	MN5
Residual pulse of the position error counter	MN6
Residual pulse of the position error counter	MN7
øC software thermal loading	MN8

- The monitor output scale is shown in Figure 6-17.

Figure 6-37



⚠ *Caution : The maximum velocity in the above figures is for the case when the setting of resolver resolution switching is the automatic resolution switching or 10 bit.*

6.2. Functions for More Advanced Operation

6.2.1. Incremental Position Scale (Without Absolute Positioning Function)

- The ESA35 Driver Unit has its own position scale, and every positioning operations and settings of software over travel limit should be done along the position scale.

6.2.1.1. Resolution of Position Scale

- There are many teeth inside the Motor to define the position, and a tooth is divided into 16 384 with digital signal processing. Therefore the resolution for one revolution of the Motor shall be "16 384 × number of teeth."

- The type of Motor and its resolution is shown in the table below.

Table 6-9

Motor type	Number of teeth	Resolution
RS	150	614 400
AS and BS	100	409 600

6.2.1.2. Direction of Position Scale

⚠ *Caution : Signals OTP and OTM of hardware over travel limit are fixed to CW and CCW respectively regardless of the setting of DI parameter for the safety precaution.*

- The DI command can reverse the counting direction of the position scale. .

Table 6-10

DI setting	CW	CCW	Shipping set
DI0	Counting in plus direction	Counting in minus direction	✓
DI1	Counting in minus direction	Counting in plus direction	

- When the direction of the position scale is reversed, the direction of the following function will be reversed as well.
  - ◊ Positioning by the train position command
  - ◊ Positioning through the RS-232C communication (IR, ID, AR, AD and HS)
  - ◊ Positioning by the Programmable Indexer function (program operation)
  - ◊ Home Return
  - ◊ JOG
  - ◊ Software over travel limit

6.2.1.3. Type of Position Scale

- Three types of position scale are available. The user may select a type suited for own application. The PS command selects a type of the scale.

Table 6-10

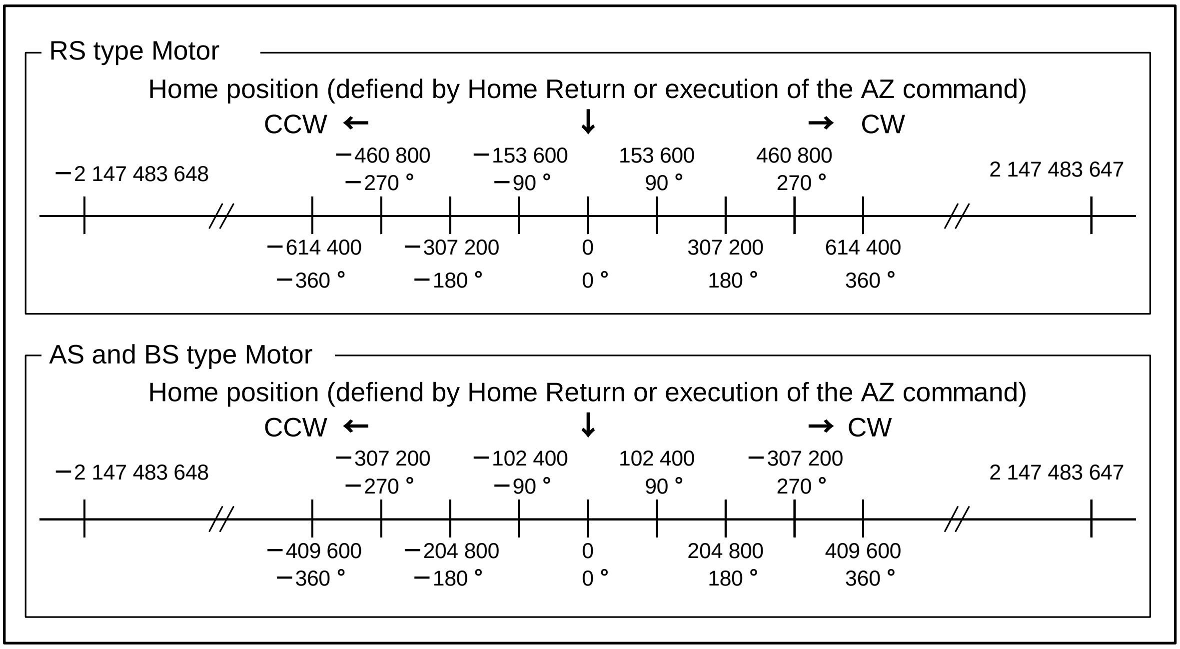
PS setting	Type of position scale	Application	Shipping set
PS0	Linear position scale	Ball screw driving, limit motion range.	
PS1*	Single-rotational position scale	General indexer, etc.	✓
PS2-99	Multi-rotational position scale	Chain driving, etc.	

1 Linear position scale

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

- The position data ranges from – 2 147 483 648 to + 2 147 483 647 [pulses] with the home position at 0. The position data increases in the plus direction and when the data exceeds +2 147 483 647 [pulses], it returns to -2 147 483 648 [pulses]. When the data is decreasing in the minus direction, and when it becomes less than -2 147 483 648 [pulses], it returns to +2 147 483 647 [pulses].

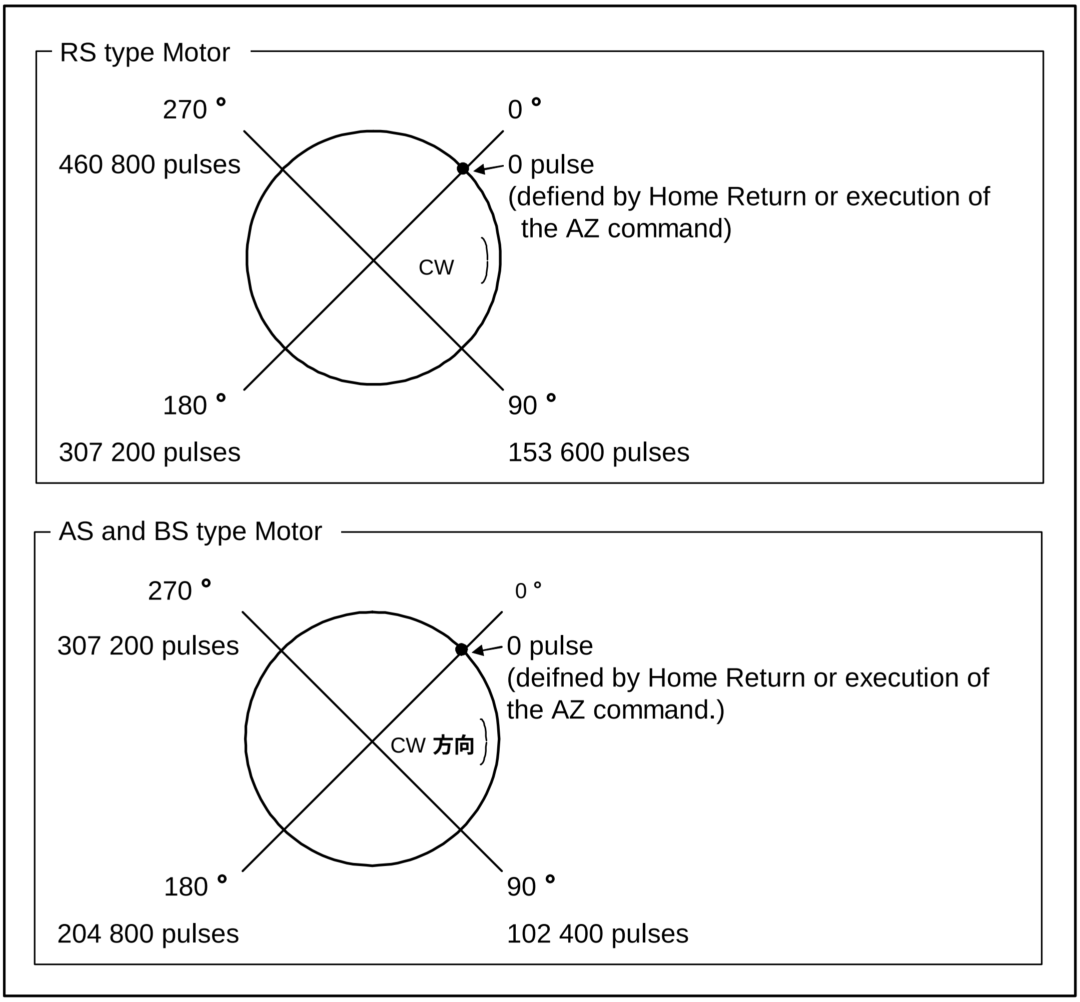
Figure 6-38: Linear position scale



2 Single rotational position scale

- The position data starts from the home position and increases when the Motor rotates in clockwise, and when the Motor rotated 360° the position data returns to 0.
- The position data ranges from 0 to 614 399 [pulse] in case of the RS type Motor.
- The position data ranges from 0 to 409 599 [pulse] in case of the AS and BS type Motor.

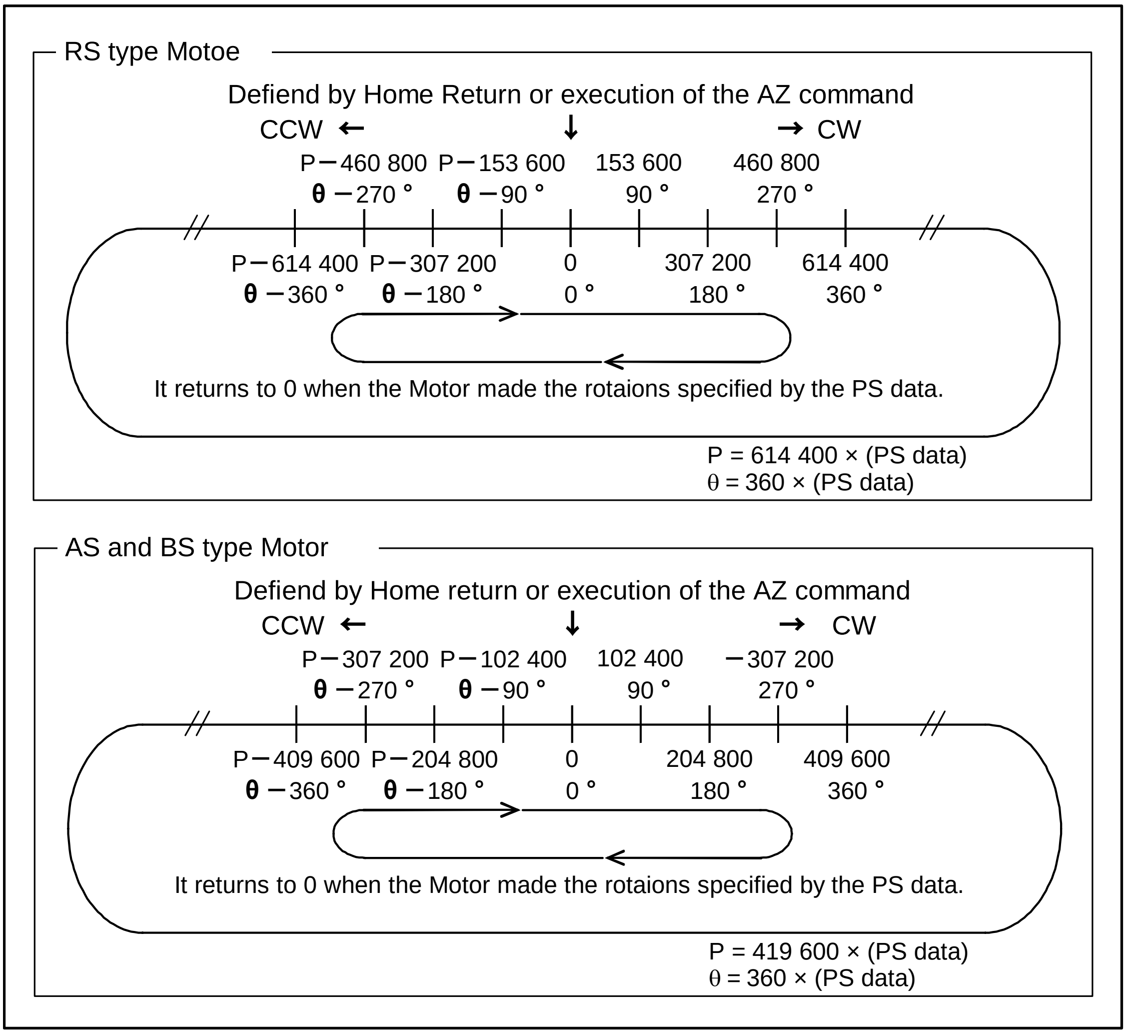
Figure 6-39: Single rotational position scale



3 Multi-rotational position scale

- The position data starts from the home position and extends to plus direction only, and returns to 0 when the Motor rotated specified revolutions by the PS command.
- The position data ranges from 0 to { 614400 × (PS data) – 1} for the RS type Motor.
- The position data ranges from 0 to { 409600 × (PS data) – 1} for the AS and BS type Motor.

Figure 6-40: Multi-rotational position scale



6.2.1.4. Resetting Home Position

⚠ *Caution : The home position is not defined right after the power is on. Be sure to reset the home position.*

- The home position is set to 0 in the following state.
  - ◊ Completion of Home Return
  - ◊ Execution of the AZ command.

6.2.1.5. Example of Setting Position Scale

1) Define the counterclockwise (CCW) as the plus sign of position data.

   (1) Input the password. The acknowledgement will appear on the screen.

   / N S K SP
   O N ENT

   ```
   :/NSK ON
    NSK ON
   :_
   ```

   (2) Input the DI command to set the direction of position scale.

   D I 1 # ENT

   ```
   :/NSK ON
    NSK ON
   :DI1
   :_
   ```

2) Select the linear position scale.

   (1) Input the password. The acknowledgement will appear on the screen.

   / N S K SP
   O N ENT

   ```
   :/NSK ON
    NSK ON
   :_
   ```

   (2) Execute the PS command to set the type of position scale.

   P S 0 ? ENT

   ```
   :/NSK ON
    NSK ON
   :PS0
   :_
   ```

3) Reset the home position.

   (1) Input the password. The acknowledgement will appear on the screen.

   / N S K SP
   O N ENT

   ```
   :/NSK ON
    NSK ON
   :_
   ```

   (2) Input the AZ command to reset the home position to 0.

   A Z ENT

   ```
   :/NSK ON
    NSK ON
   :AZ
   :_
   ```

6.2.2. Absolute Position Scale (Absolute Positioning Function)

⚠ *Caution : Always turn on the power when the Motor is completely stopping. Otherwise it may cause shifting the position data.*

- The Megatorque Motor System has its own position scales, and every positioning and controlling software over travel limit should be done along the position scales.

- The System that incorporates the absolute position sensor does not require the Home Return every time the power is turned on once the Home position is defined.

- Follow the procedure below to set the position scale.

  (1) Direction of position scale ---- Refer to “6.2.2.1. Direction of Position Scale.”

  (2) Home position ------------------ Refer to “6.2.2.5. Setting User Home Position.”

  (3) Software over travel limit------- “6.1.8.2. Software Over Travel Limit”

6.2.2.1. Direction of Position Scale

⚠ *Caution : • When the DI data is changed, turn off the power once, and then reset the home position.*

• Even the sign of plus/minus of the position scale are reversed, the direction of hardware over travel limit, and the output phase of position feedback signal won’t be reversed.

- The sign of position scale may be reversed not to hinder operations when you reversed orientation of the Motor installation.

  ◊ CW or CCW is a direction when you look the Motor from the Motor output axis (rotor).

  ◊ DI data (DI command) defines counting direction of position scale.

  ◊ Relation between DI data and counting direction is shown below.

Table 7-11

DI data	Setting	CW	CCW	Shipping set
0	Standard	Counting in plus	Counting in minus	✓
1	Reversed	Counting in minus	Counting in plus	

- When the sign of the position scale is reversed, the sign of following function will be reversed as well.

  ◊ All positioning

  ◊ Setting direction of software over travel limit

  ◊ Detecting absolute position

  ◊ Offset of the coordinate (AO data)

[Example] Set the CCW rotation in plus count direction of the scale.

(1) Input the password. The acknowledgement will appear on the screen.

/ N S K SP
O N ENT

```
:/NSK ON
 NSK ON
:_
```

(2) Input the DI command to set the direction.

D I 1 # ENT

```
:/NSK ON
 NSK ON
:DI1
:_
```

6.2.2.2. Resolution of Position Scale

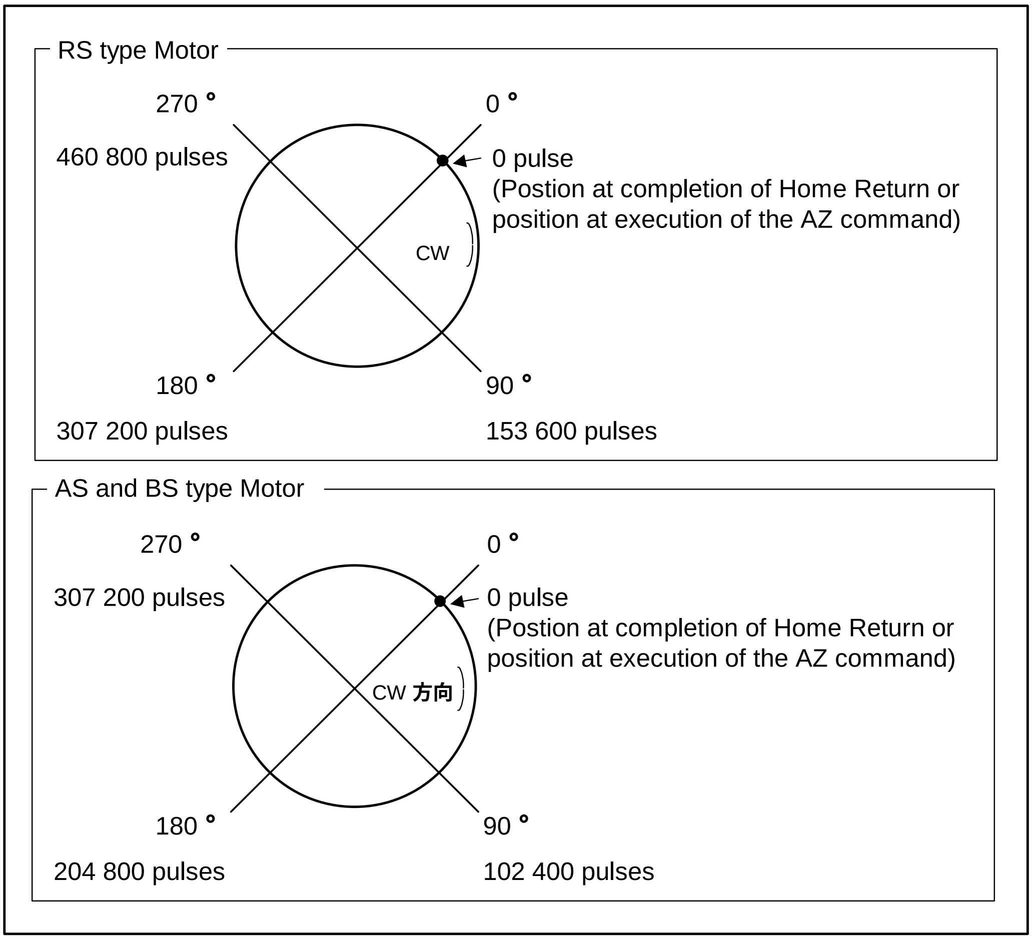
- The motion distance of position commands (AR, AD, IR and ID), and position of software over travel limit will be set by the unit of resolution of the position scale, not by the resolution of the position scale.

Table 6-13: Motor type and Resolution

Motor type	Number of teeth	Position scale resolution	
		Unit of pulse [pulse/rev]	Unit of degree [0.01°/rev]
RS	150	614 400	36 000
AS and BS	100	409 600	

* However setting data of the software over travel limit must be the unit of pulse.

Figure 6-41: Absolute position scale



6.2.2.3. Offsetting Position Data

- The Megatorque Motor System has its own position scale (Motor Absolute Position Scale) based on the one revolution absolute position sensor. You may have the user absolute position scale, along which every indexing motion and setting over travel limit should be done, by adding an offset data to this scale.

Motor Absolute Position Scale	: Absolute Position Scale unique to the Motor defined by its absolute position sensor.
User Absolute Position Scale	: Absolute position scale to control positioning and setting over travel limit.

- AO data (the AO command) sets the offset data.

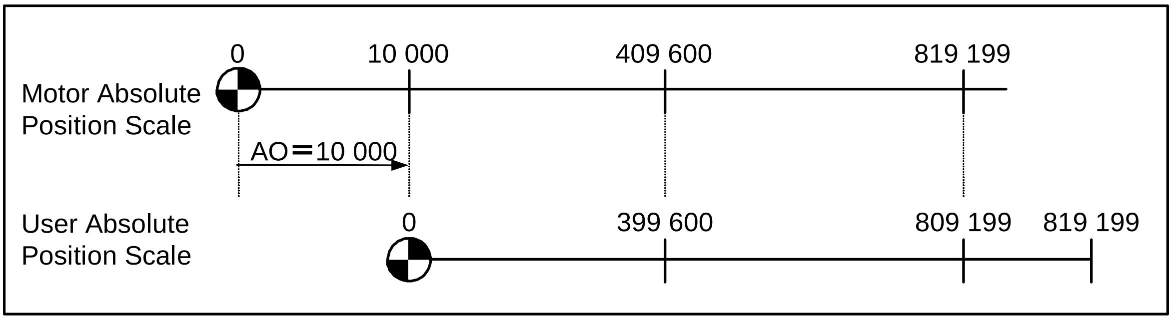
- AO data will be automatically set when the home position is defined by AZ command.

- Relations between the Motor Absolute Position Scale, User Absolute Position Scale and AO data shall be;

  User Absolute Position coordinate = Motor Absolute Position coordinate – AO data

[Example] AO data = 10 000 [pulse]

Figure 6-42



6.2.2.4. Monitoring Position Data

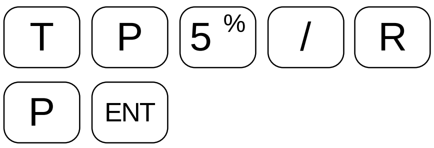
- The TP command reports the current position data.

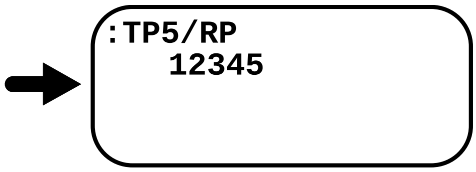
Table 6-14

Motor absolute position data in pulse	TP0 command
User absolute position data in pulse	TP2 command
User absolute position data in 1/100°	TP5 command

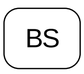
[Example] Monitor a position on the user absolute position scale in the unit of 1/100°.

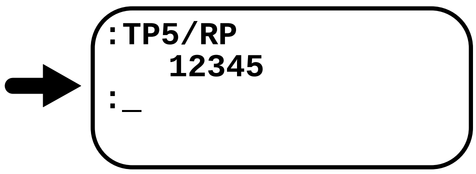
(1) Input TP command.





(2) Press the BS key to turminate the monitoring.





6.2.2.5. Setting User Home Position

- The AZ command or Home Return defines the user home position.
- The following describe the procedure to define the home position with the AZ command. Refer to “7.2. Home Return” for setting the home position with Home Return.

(1) Set the Motor in servo free state.

M O ENT

```
:MO
:_
```

(2) Turn the Motor to the position to be the home position and keep it still.

(3) Input the password. The acknowledgement appears on the screen.

/ N S K SP
O N ENT

```
:MO
:/NSK ON
 NSK ON
:_
```

(4) Input the AZ command, thus clearing the previous home position, and then AO data will be reset.

A Z ENT

```
 NSK ON
:AZ
 AO1234
:_
```

* You can set the home position with the Motor servo on.

6.2.3. Digital Filter

⚠ *Caution* : • *Use of multiple filters at the same time may cause phase inversion of the velocity loop control, and make the Motor operation unstable. .*

• *Two filters are the maximum. In addition, if low frequency filters are used, hunting or oscillation may occur. Set the filter frequency 100 [Hz] or over.*

Parameter: FP, FS, NP and NS

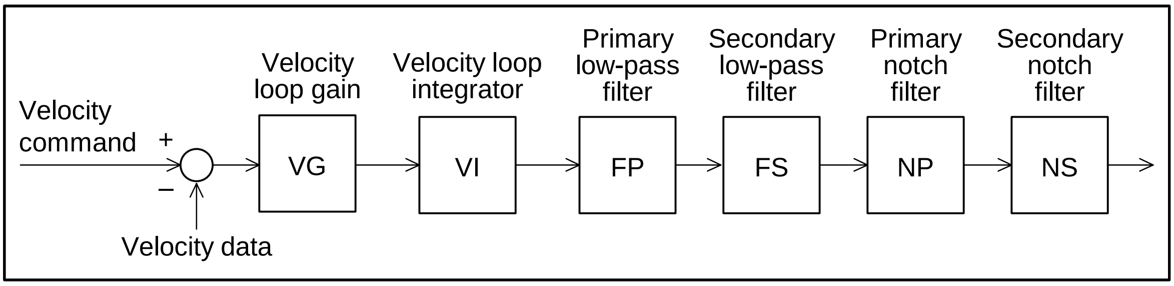
- These parameters set the filters in the velocity loop.
- This is effective in reducing noise caused by resonance and vibrations.

Table 6-15

Parameter	Function	Shipping set
FP	Sets the frequency of primary low pass filter.	FP0
FS	Sets the frequency of secondary low pass filter.	FS0
NP	Sets the frequency of primary notch filter.	NP0
NS	Sets the frequency of secondary notch filter	NS0

- Sets filter frequency in the velocity loop.
- Refer to “9. Glossary of Command and Parameter” for details.

Figure 6-43



6.2.4. Feed Forward Compensation: FF

Parameter: FF (The password is necessary.)

- A velocity command created by differentiating a position command may be fed to the velocity loop in the forward direction.

- The feed forward compensation improves the tracing delay in acceleration and deceleration.

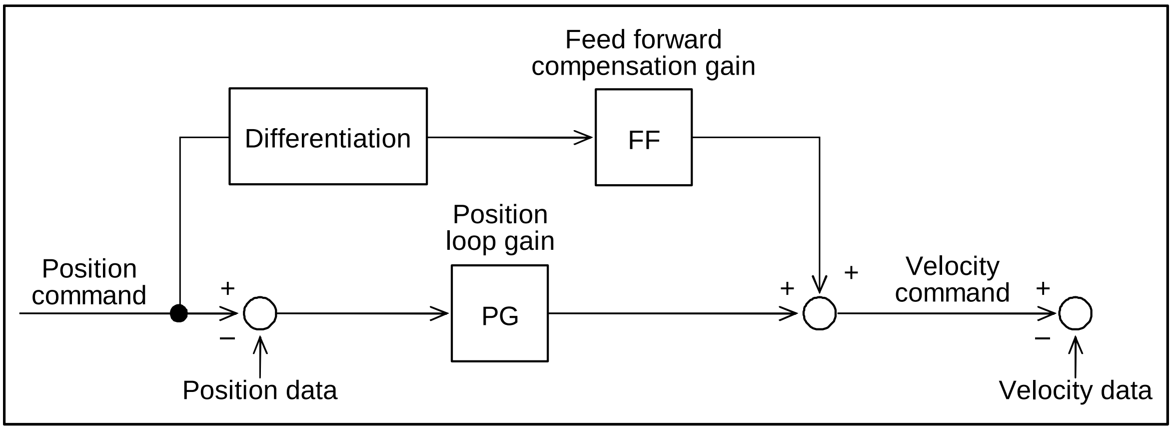
Table 6-16

Parameter	Function	Shipping set
FF	Sets the feed forward compensation gain.	FF0

- The parameter FF sets the feed forward compensation gain.

- If a larger parameter data is specified, overshoot may occur frequently though the tracing delay is improved. The proper data of the FF parameter is approximately 0.5.

Figure 6-44



6.2.5. Integration Limiter: ILV

Parameter: ILV (The password is necessary.)

- Integration limiter improves overshoot caused by integration when the Motor is accelerated and decelerated at a high rate.

Table 6-17

Parameter	Function	Shipping set
ILV	Sets the velocity loop integration limiter (%).	ILV100.0

- Use the ILV to specify the upper limit of the output of the velocity loop integration circuit.

- The integration control is inevitable for accurate positioning. However, it is subject of deviation and overshooting due to integration if the Motor is accelerated and decelerated at a high rate. To eliminate such troubles, use an integration limiter to suppress excessive integration.

* For more details about the parameter, refer to “9. Glossary of Command and Parameter.”

Figure 6-45

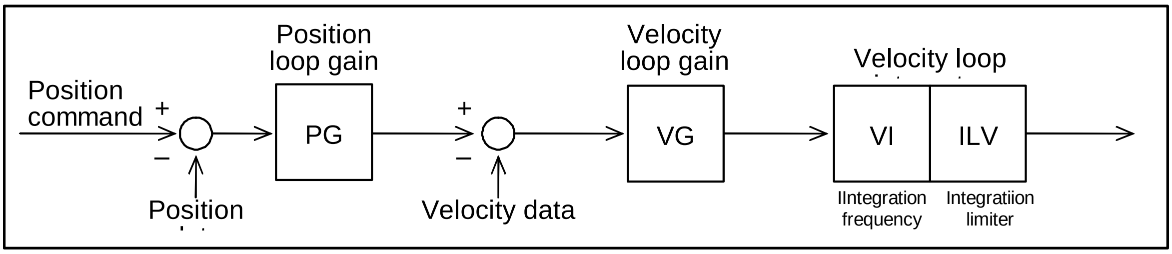
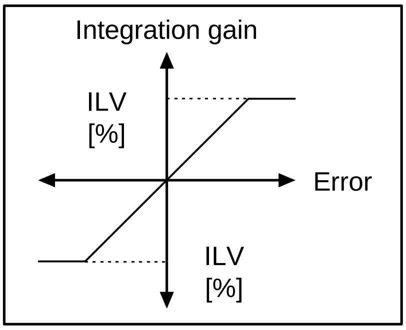


Figure 6-46



6.2.6. Dead Band: DBP

Parameter: DBP (The password is necessary.)

- The parameter DBP is used to specify a dead band for the deviation of position loop; the deviation will be zeroed when it is under the data of the parameter DBP.

- This eliminates the problems of small vibration after completion of positioning.

Table 6-18

Parameter	Function	Shipping set
DBP	Sets dead band to the position loop.	DBP0

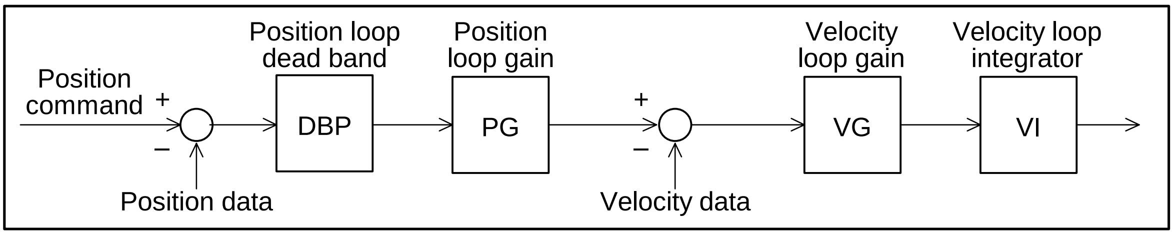
- The DBP parameter specifies the dead band on the position loop deviation in both sides of 0 (zero), and zeroes the deviation when it is under the DBP setting.

- In some use conditions, slight vibration may be caused due to minute deviation. The provision of a dead band eliminates such slight vibration.

- If a dead band is specified, repetitive positioning accuracy will be deteriorated by the amount of the dead band, though small vibration may be eliminated.

- Unit of a dead band is the pulse. (Corresponds to the resolution of position sensor. Refer to "2.7.2. Functional Specifications" for the resolution of position sensor.)

Figure 6-47



6.2.7. Automatic Gain Switching

- This function is to switch the servo gain for positioning or stopping the Motor in accordance with the error of the position error counter.

- This is useful when the servo gain cannot be increased because of vibration caused by low rigidity of the load while the Motor is stopping. This function lowers the gain automatically so that the Motor does not vibrate when it is stopping.

- In addition, the function is useful to lower the gain when positioning to keep the vibration minimum, and increase it when stopping in order to obtain shorter positioning settling time.

Table 6-19: Parameters related to automatic gain setting

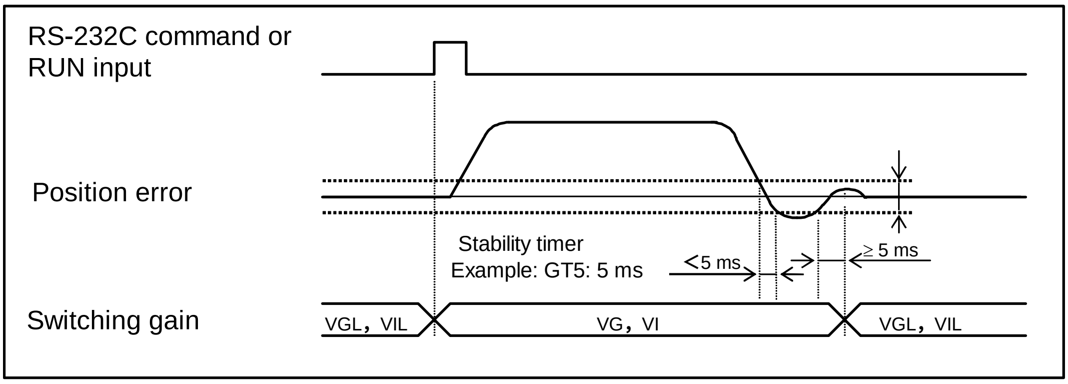
Parameter	Function	Sipping set
GP	Threshold to switch gain	GP0
GT	Timer to check stability for switching	GT5
VG	Velocity loop proportional gain in positioning	VG1.0
VI	Velocity loop Integrator frequency in positioning	VI1.00
VGL	Velocity loop proportional gain in stopping state	VGL1.0
VIL	Velocity loop integrator frequency in stopping state	VIL1.00
TG	Monitor of gain switching state	Command to read out.

- This function is disabled when setting of the GP parameter is GP0. In such a case, the gains VG and VI for positioning are always used.

- If setting of the parameter GP is other than 0, the gains VG and VI are used for positioning operation. When the error of position error counter is less than the setting of GP because the Motor has stopped, the gains VGL and VIL for stopping state are used.

- If the parameter GT is set, the gain will be switched into that of stopping state when the deviation of position error counter remains under the GP setting for a time set by the parameter GT.

Figure 6-48: Timing of switching gain



◊ The positioning gains VG and VI will be forcibly used when positioning command such as Programmable Indexer, internal pulse generation by the RS-232C communication, or pulse train command is inputted.

◊ In case of a positioning with external pulse train command, it may be regarded as the position command is coming in intermittently if the frequency of input pulse is under 2Kpps, and thus causing frequent switching of gain. In such a case, setting timer for stabilizing switching gain GT helps to control frequent gain switching.

◊ Function of lowering gain is always available. When automatic gain switching is functioning, the velocity loop gain will be lowered in accordance with the LVG input. (VG × LG, VGL × LG)

◊ The TG command reports state of gain switching. Refer to “6.1.17.8. Monitoring State of Automatic Gain Switching” for more details.

6.2.8. Acceleration Profiling

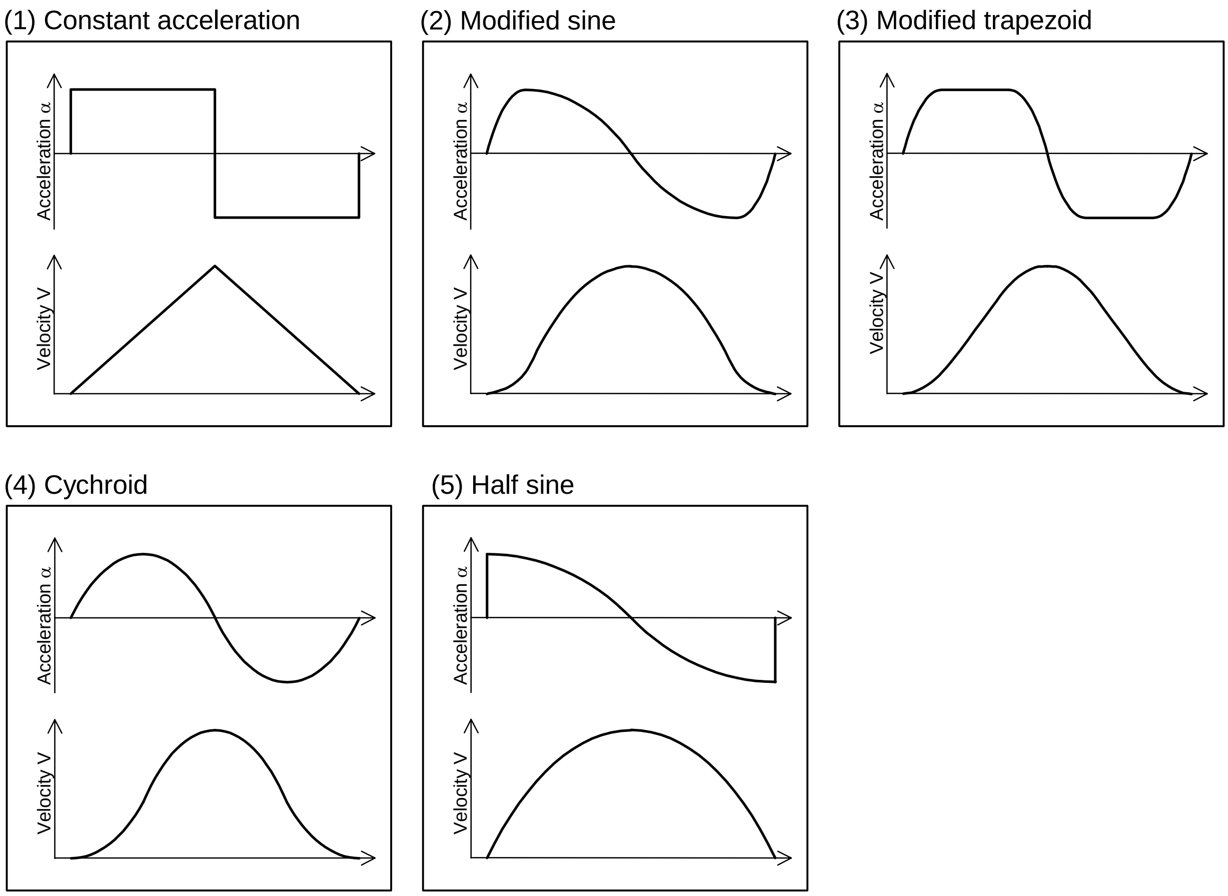
- In addition to usual constant accelerating velocity profile, another four types of acceleration profiling are available.

- You may set several patterns of acceleration and deceleration, and they are useful for wide variety of applications.

Table 6-20: Parameters for acceleration profiling

Parameter	Function	Shipping set
CX	Setting the acceleration profiling on/off	CX0
CS	Selects a pattern of acceleration profiling	CS1/1
CZ	Reads out the state of acceleration profiling.	Command to read out
CY	Acceleration threshold to apply acceleration profiling	CY1
AR	Absolute positioning with the unit of pulse	Positioning command
AD	Absolute positioning with the unit of angular degree	Positioning command
IR	Incremental positioning with the unit of pulse	Positioning command
ID	Incremental positioning with the unit of angular degree	Positioning command
MA (CA)	Sets acceleration of Motor (acceleration/deceleration)	MA1,1

Figure 6-49: Patterns of acceleration profiling



- Setting the parameter CX to CX1 activates the acceleration profiling function.

- The parameter CS selects a pattern of acceleration profiling. A pattern may be programmed on the individual Programmable Indexer channels.

Table 6-21: Selection of acceleration profiling by the CS parameter

CS setting	Pattern	Feature
CS1	Constant acceleration	• Accelerating rate is constant. • The maximum acceleration is the lowest among them, however vibration is larger.
CS2	Modified sine	• Suited for high velocity and heavy load operation. • The maximum value of factor (V $\times\alpha$) is low.
CS3	Modified trapezoid	• Suited for high velocity and light load operation • The maximum acceleration is low.
CS4	Cycloid	• Suited for high velocity and light load operation. • Low vibration.
CS5	Half sine	• Suited for high velocity and light load operation. • The maximum velocity is low, however vibration is larger.

- The acceleration profiling is applicable for the positioning commands of AR, AD, IR, and ID. It can be programmed only to the channels of CH0 to CH31 for the Programmable Indexer operation. You may set the conventional constant acceleration on the channels CH32 to CH63.

- Acceleration of the acceleration profiling will be a mean acceleration set by the parameter MA (CA).

◆ Setting the acceleration profiling

(1) Input the password. The acknowledgement will appear on the screen.

[/] [N] [S] [K] [SP] [O] [N] [ENT] ➡

```
:/NSK ON
 NSK ON
:_
```

(2) Set the acceleration profiling function active.

[C] [X] [1 #] [ENT] ➡

```
:CX1
••••••••
:_
```

(3) Select a pattern of the acceleration profiling.
(Set half sine acceleration pattern for acceleration and modified sine for deceleration.)

[C] [S] [5 %] [/] [2 $] [ENT] ➡

```
:CS5/2
••••••••
:_
```

(4) Set acceleration. (At first, set lower acceleration than usual.)
(Example: Acceleration 2 [s^{-2}], and deceleration 1 [s^{-2}])

[M] [A] [2 $] [/] [1 #] [ENT] ➡

```
:MA2/1
••••••••
:_
```

◊ In default of the part of deceleration setting following the slush (/) of the parameter CS or MA, the deceleration settings follow those of the acceleration.

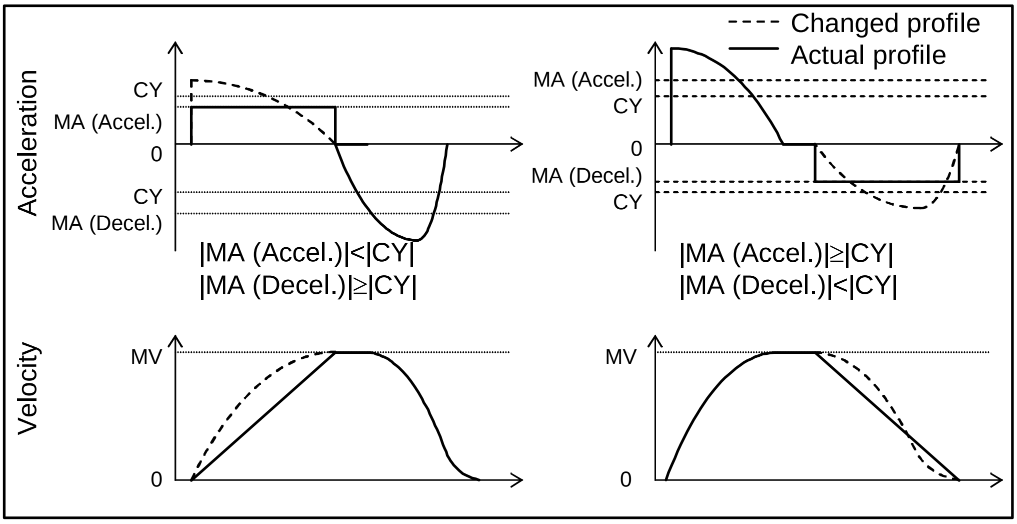
◊ The positioning command AR, AD, IR, or ID starts a positioning of Programmable Indexer or RS-232C communication with the acceleration profiling set by the above procedures.

◊ When the acceleration profiling is activated by the parameter CX1, and the parameter CS, CY, MA, or MV is changed under effective state of the function, it requires initializing the conditions of positioning. It takes a time to indicate the next prompt (:) on the screen, and a dot appears continuously on the screen while initializing.

◊ The initializing time is proportional to actual time for accelerating and decelerating. Therefore it takes longer when the acceleration is set lower. It will take few minutes depending on the number of used channels and acceleration. In such occasion, we may perform a positioning with constant acceleration profiling for the acceleration that is lower than specified in order to skip the initialization. The parameter CY sets the threshold of such acceleration. The shipping set is CY1 (1 s^{-2}).

◊ CX, CS, CY, MA and MV cannot be changed during a program operation.

Figure 6-50: Constant acceleration positioning is set when parameter MA is lower than CY.



◆ Monitor positioning state

- In some cases the selected acceleration profiling pattern won't be performed depending on specified acceleration (MA and CA), velocity (MV and CV) and position command even the function is set to active.

- The parameter CZ monitors the result of acceleration profiling executed in the latest positioning operation.

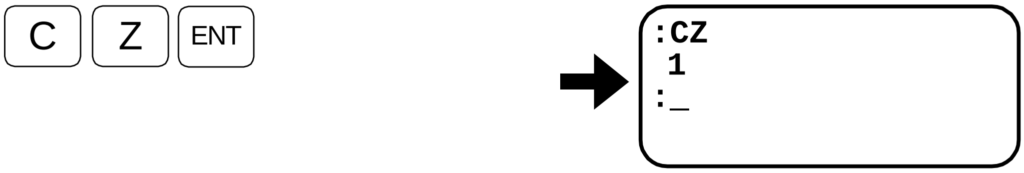


Table 6-22: Readout code by the parameter CZ

Readout code	Definition
0	The acceleration profiling is not effective. (Readout on completion of Home Return or Jog.)
1	The positioning completed with a specified acceleration profiling pattern.
2	Decelerated in the middle of positioning due to short positioning distance for the profiling.
3	Decelerated in the same pattern as acceleration due to short positioning distance.

◊ If acceleration pattern is changed to constant acceleration because the MA setting is lower than the CY setting, the readout code shall be 1 (CZ1) indicating the function worked properly.

◊ A warning message appears on the screen when the IR or the ID position command is set so that a specified acceleration profiling cannot be performed due to short positioning distance.

Triangle Pattern 1: Decelerated in the middle of positioning due to short positioning distance. (Figure 6-52)

Triangle Pattern 2: Decelerated with the same pattern as acceleration due to short positioning distance. (Figure 6-53)

Figure 6-51: Readout code 1: Proper acceleration profiling

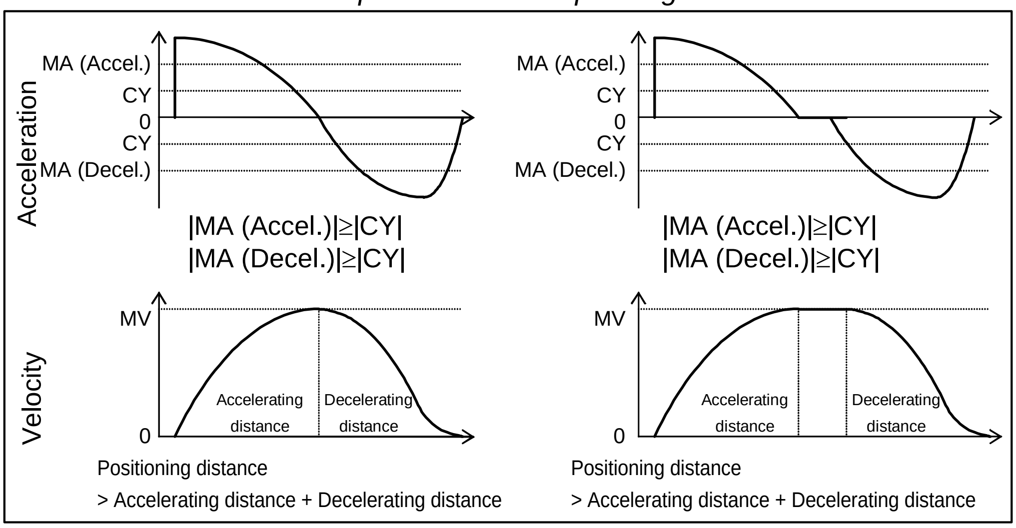
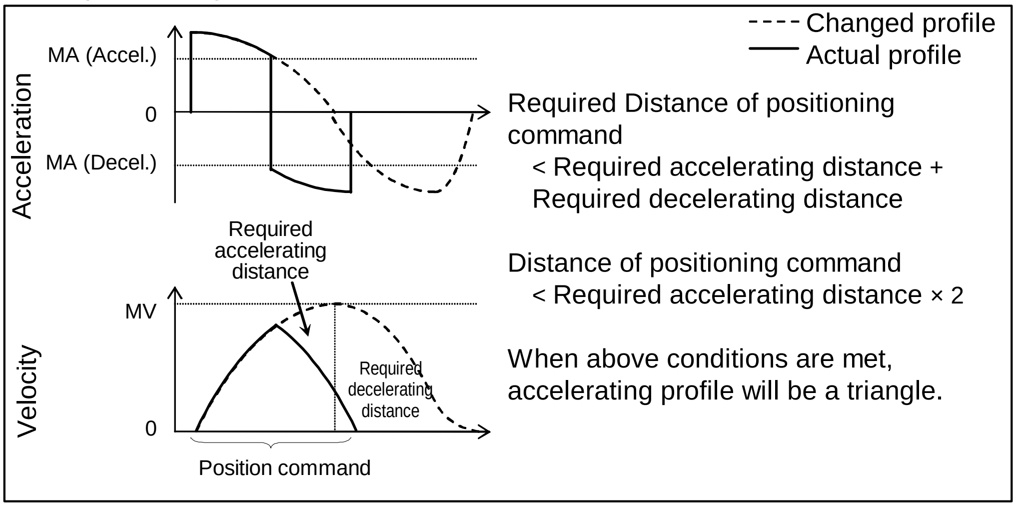
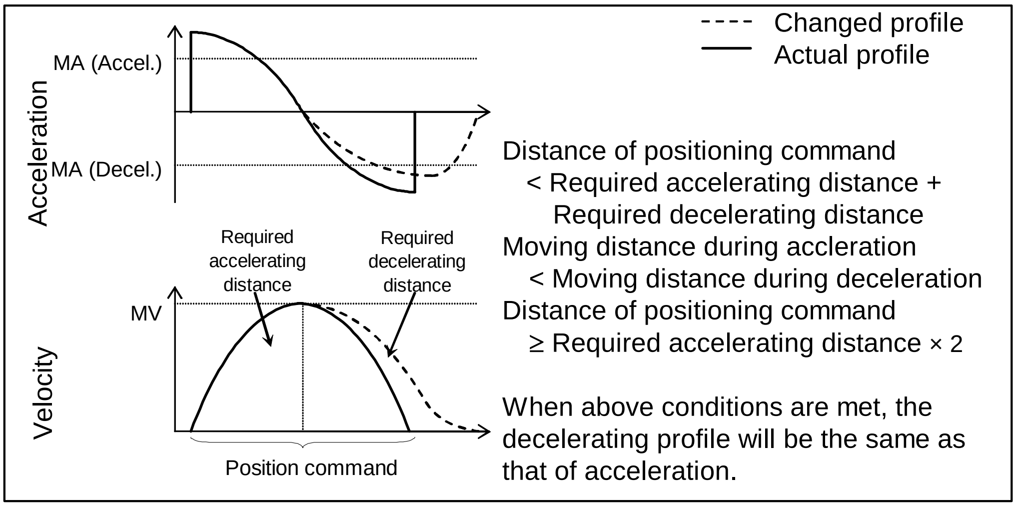


Figure 6-52: Readout code 2: Decelerated in the middle of accelerating due to insufficient positioning distance



◊ Pattern of deceleration will be the same as that of acceleration.

Figure 6-53: Readout code 3: Decelerated with the same pattern as that of acceleration due to insufficient positioning distance



◊ Pattern of deceleration will be the same as that of acceleration.

6.3. RS-232C Communication

Caution : ESA35 Driver Unit has an EEPROM for the data backup. The EEPROM has the limitation on the number of times for writing/deleting the data. (Approximately 500 000 times) Therefore, we recommend setting the parameter WM, which prohibits writing to the EEPROM, when the internal parameters are frequently changed from the master controller during operation. For details about the parameter WM, refer to '9. Glossary of Command and Parameter." However, frequent changes of parameters that do not require the backup will not affect the life to EEPROM.

6.3.1. Specifications of Communication

- Setting of various parameters, trial running, and servo adjustment are enabled by issuing commands to the Driver Unit through serial communication (Communication with the RS-232C interface).

- The Driver Unit has CN1 connector as the input/output ports for the 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 6-23

Item	Specification
Transmission	Asynchronous, full duplex
Communication speed	9 600 b.p.s.
Word length	8 bit
Stop bit	2 bit
Parity check	None
Character code	ASCII code
Communication procedure	X–On/Off Protocol : Not available RTS/CTS Control : Available

6.3.2. Communication Procedure

6.3.2.1. Turning on Power

- If a terminal (such as NSK Handy Terminal FHT11) is connected to the CN1 connector and the Driver Unit power is turned on, the message shown below appears on the screen. The contents (and the number of characters) of this message may differ with setting condition of the Driver Unit 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.)

```
 NSK MEGATORQUE
 MS1A50_xxxx
 Exxxxxxxxxx
:_
```

Message may somewhat differs with system configuration.

Indicates completion of internal initialization and the System is ready for an entry of command.

Caution : Be sure to turn the power to the Driver Unit off when connecting or disconnecting the communication cable (CN1). Otherwise it may lead to an alarm of communication error and the System breakdown.

6.3.2.2. 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 will be transmitted to the Driver Unit as shown below:

V code (56H)
G code (47H)
0 code (30H)
. code (2EH)
5 code (35H)
Carriage return code (0DH)

Press the ENT key if the handy terminal FHT11 is used.

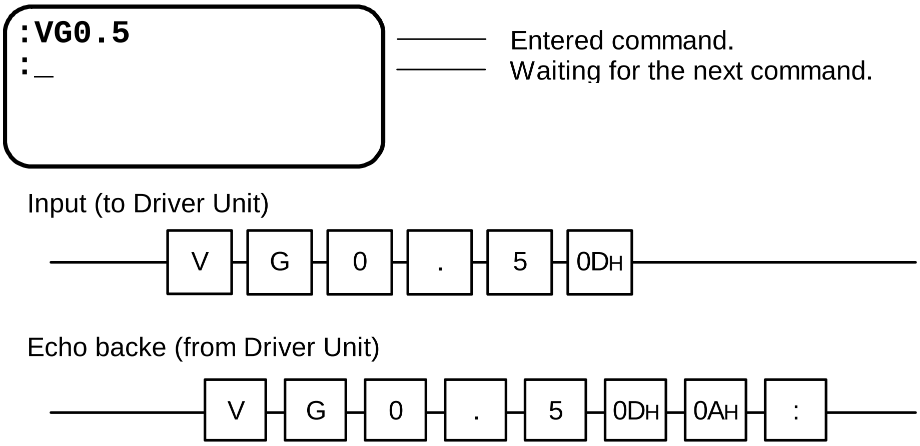
- Every time a character is input, the Driver Unit echoes the character back to the terminal. (The Driver Unit returns the same character that it receives.)

- 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 that it has received (VG0.5 in the example above) and executes it. Therefore, a command won’t be executed unless it ends with a carriage return code.

- If the Driver Unit can decode an entered command, it returns “: (prompt)” immediately after the line feed code.

- If it receives an internal data readout command, etc., it returns the data before “: (prompt).”



6.3.2.3. Password

- Among the communication commands used for the Megathurust Motor System, some special commands 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. Prior to indicating the prompt (:), the Driver Unit returns an acknowledgment "NSK ON" as it receives the password.

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

```
:/NSK ON
 NSK ON
:_
```

Entered password
Acknowledgement
Waits for the next command.

Input (to Driver Unit)

/ | N | S | K | 20H | O | N | 0DH

Acknowledgement (from Driver Unit)

/ | N | S | K | 20H | O | N | 0DH | 0AH — (1)

(1) — 20H | N | S | K | 20H | O | N | 0DH | 0AH — (2)

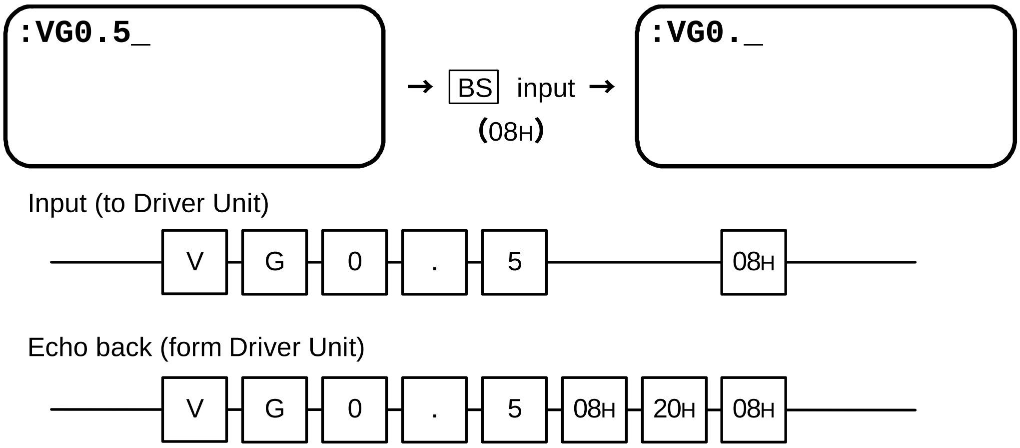
(2) — :

6.3.2.4. Canceling Command

- A command that 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 canceling format. When the Handy Terminal FHT11 is used, press the backspace $\boxed{\text{BS}}$ key instead.

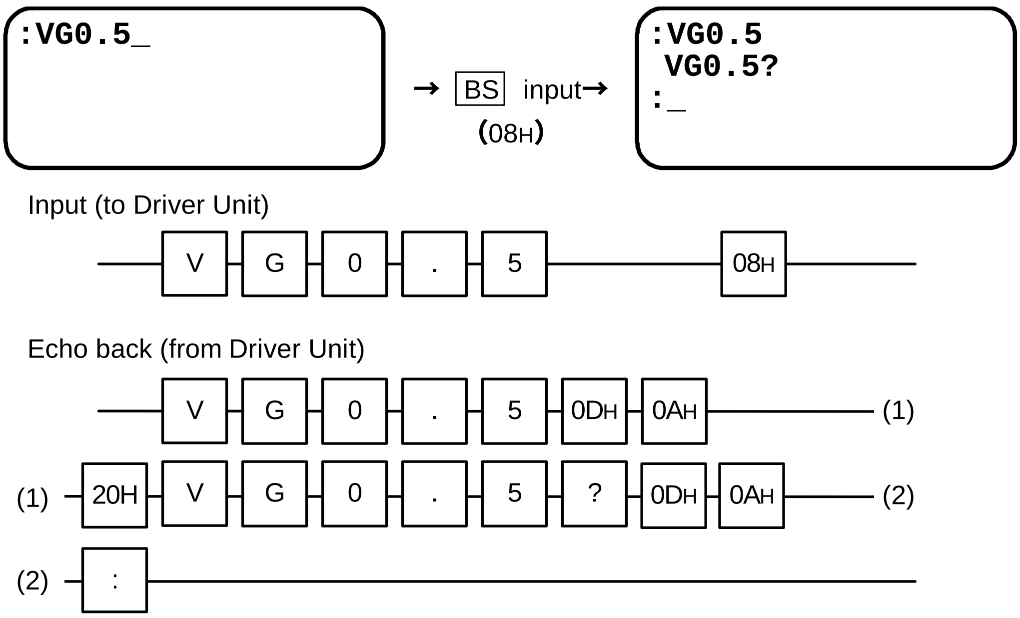
◆ **Parameter “BM0” (Shipping set)**

- For example, when the backspace code (08H) is input following “VG0.5” letter string, the cursor moves one space back to the position where 5 was input and thereby deletes 5.



◆ **Parameter “BM0”**

- When the backspace code (08H) is input following “VG0.5” letter strings, for an example, a message “VG0.5?” and a colon “:” are displayed and thereby delete “VG0.5.”



6.3.2.5. Error

■ Note that an error occurs in any of the following cases.

1 If a nonexistent command (character string) is entered. (If an entered character string cannot be decoded.)

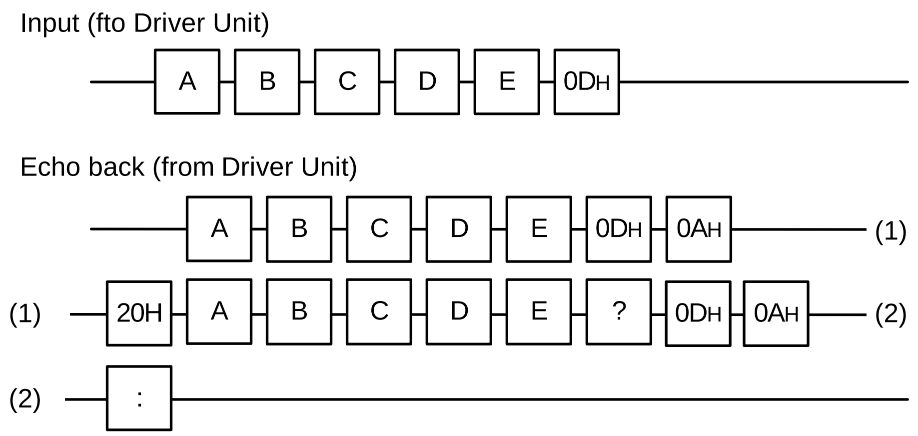
2 If data or subscripts that are out of the allowable range are entered.

3 If a command requiring the password is entered without the password.

- In any of these cases, the entered character string with a "?" code is returned as an error message. The figure below shows an example.

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

If "ABCDE" is entered, the Driver Unit returns an error message since the character string is not a command.



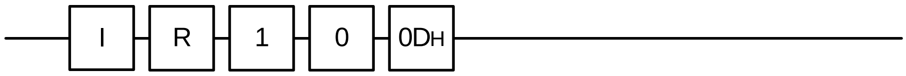
4 If the input condition is not met when entering a command

- In this case, the entered character string with “INHIBITED” is returned.

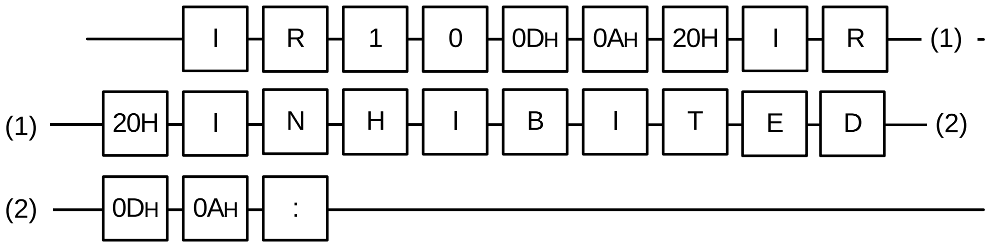
```
:IR10
 IR INHIBITED
:_
```

If IR command (Incremental positioning command) is entered when the Motor is rotating, the System returns an error message since the input condition is not met.

Input (to Driver Unit)



Echo back (from Driver Unit)



6.3.2.6. Monitoring Command

- If a monitor command, which is one of the communication command provided with the System, is entered to report the internal state (i.e., parameter set data, current position, etc.) of the Driver Unit, the Driver Unit returns current setting or data, etc.

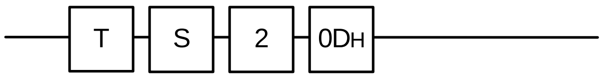
- Returned data consists of "space code (20H) + read out value (or data) + carriage return (0DH) + line feed code (0AH)".
  For example:

◆ TS command for monitoring set data

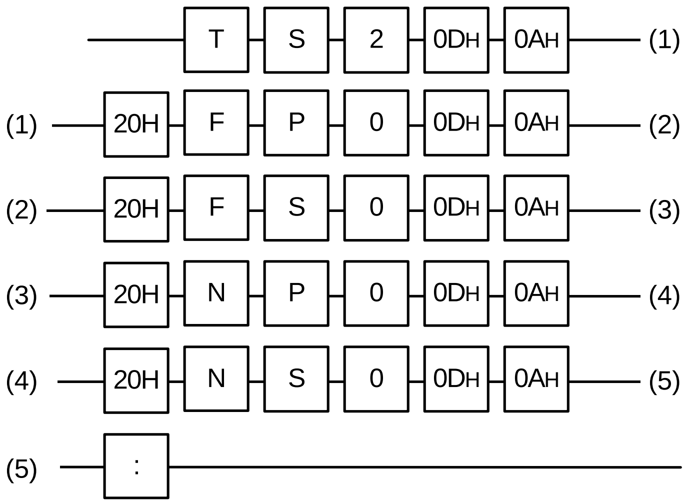
```
:TS2     ← Entered command
 FP0     ← Readout of primary low pass filter frequency
 FS0     ← Readout of secondary low pass filter frequency
 NP0     ← Readout of primary notch filter frequency
 NS0     ← Readout of secondary notch filter frequency
:_       ← Waits for the next command.
```

⚠ *Caution: Input of [20H] is required for every readout when parameter MM is set to 1.*

Input (fo Driver Unit)



Readout (from Driver Unit)



◆ If set data monitoring function “?” is used

```
:?VG
 VG0.5
:_
```

← Entered command
← Readout of velocity loop proprtional gain
← Waits for the next command.

Input (to (Driver Unit)

| ? | V | G | 0DH |

Readout (from Driver Unit)

| ? | V | G | 0DH | 0AH | (1)

(1) | 20H | V | G | 0 | . | 5 | 0DH | 0AH | : |

◆ TP command for reading current position data

```
:TP5
 10000
:_
```

← Entered
← Readout of current position coordinate
← Waits for the next command.

Input (to Driver Unit)

| T | P | 5 | 0DH |

Readout (from Driver Unit)

| T | P | 5 | 0DH | 0AH | (1)

(1) | 20H | 1 | 0 | 0 | 0 | 0 | 0DH | 0AH | : |

6.3.3. Communication with Personal Computer

- This section describes how to store the parameters of the ESA35 Driver Unit using Hyper Terminal of communication software, which is provided with “Windows” as a standard feature.

- The user shall provide the communication cable. Pin-out of the D-sub 9pins connector of the ESA35 Driver Unit is different from DOS/V machine. Refer to “2.8.1. CN1: RS-232C Serial Communication Connector” and the manual of the personal computer to be used.

6.3.3.1. Set-up of HyperTerminal

1) Start HyperTerminal.
   [(Start menu) → (Program) → (Accessory) → (HyperTerminal)]

2) Dialog of “Setting of connection” is displayed.
   Declare the name of connection and set an icon, then press [OK] button.

3) Dialog of “Telephone-number” is displayed.
   Select “Direct to Com#” in “the way of connection N,” then press [OK] button.

4) Dialog box of “Property of Com#” is displayed.
   Follow the table bellow for input, then press [OK] button.

Table 6-24

Bit/sec.	9 600
Data bit (D)	8
Parity (P)	None
Stop bit (S)	2
Flow control (F)	Hardware

5) Select the menu “File (F)” → “Property (P).”
   Dialog of “Property of xxxx” is shown in the display.
   [xxxx is the name of connection declared in the procedure 1).]

6) End of HyperTerminal.

   The dialog box stating “Do you store the session xxxx ?” is displayed. Press [Yes (Y)] button and store the session. Use the session to communicate with ESA35 Driver Unit afterwards.

6.3.3.2. Store Parameters of ESA35 Driver Unit

1) Start the HyperTerminal.

2) Set the MM data to MM0 for continuous monitoring mode.

3) Execute the TS command and the TC/AL to read out the setting.

```
:MM0
:TS
 PG0.100
 VG2.0
 VGL1.0
 (Omission of a middle part)
 HT1
 PE0
 AE0
:TC/AL
 PH0
>TC0
 AD0
 CV2.0000
 CA5.00,5.00
 (Omission of a middle part)
>TC15
:
```

4) Copy the setting shown above to a "Memo pad," then store it as a text file.
Edit and store the setting as described below to be able to transfer it to the ESA35 Driver Unit.

- ♦ Add "KP1" to the top line.
- ♦ Delete unnecessary character strings such as ":TS" or ":TC/AL."
- ♦ Delete all spaces of the head of lines.
- ♦ Change "> TC" to "CH."
- ♦ Add a line to each end of a channel program and the end of setting.

```
KP1

PG0.100
VG2.0
VGL1.0
 (Omitted partially.)
HT1
PE0
AE0

CH0
AD0
CV2.0000
CA5.00,5.00

CH1
AR3000
 (Omitted partially.)

CH15
```

Add a line.

6.3.3.3. Transmit Stored Parameters to ESA35 Driver Unit

■ Transmit the stored file to the ESA35 Driver Unit.

1) Start HyperTerminal.

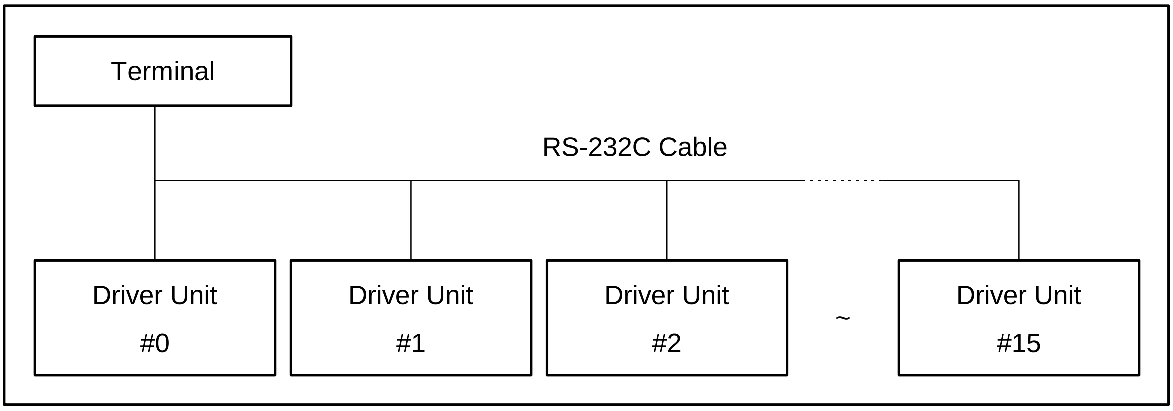
2) Transmit the file by selecting "Transfer" → "Transmit text/file."

3) Execute the TS or the TC/AL command to confirm that the transmission of data is successful.

6.3.4. Daisy Chain Communication

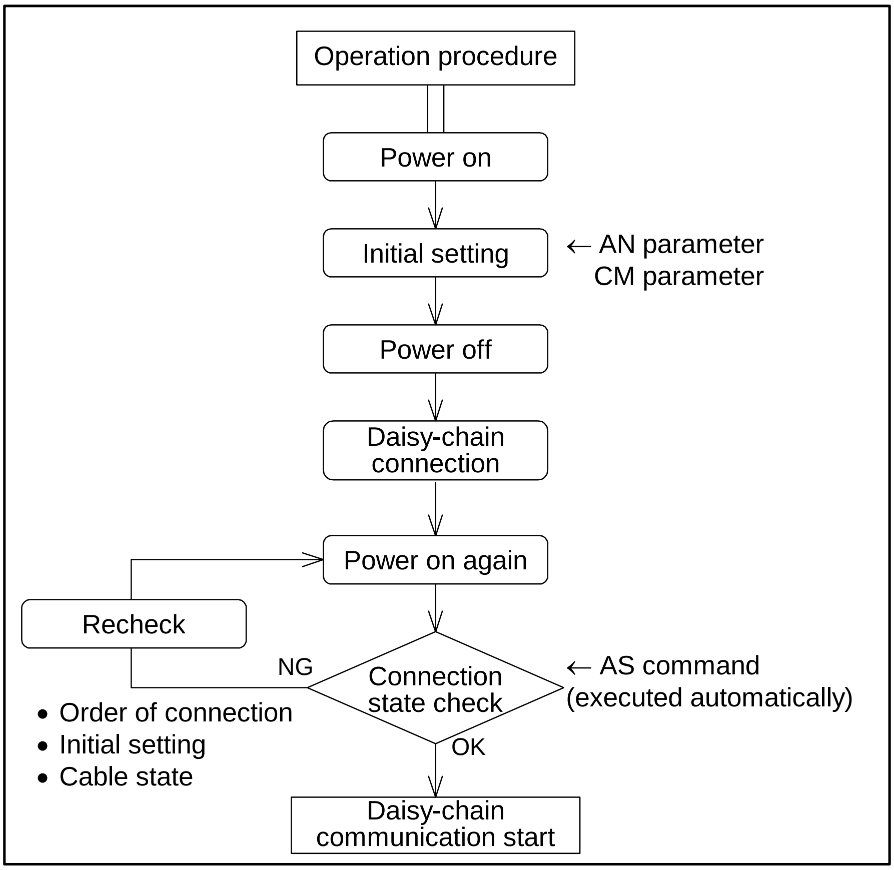
- Daisy-chain communication allows multiple Driver Units (up to 16 units) to be connected with a single RS-232C terminal and a cable set.

Figure 6-54



6.3.4.1. Procedure to Set Daisy Chain Communication

Figure 6-55: Daisy chain communication setting procedure



6.3.4.2. Initial Setting

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

Table 6-25: Initial setting

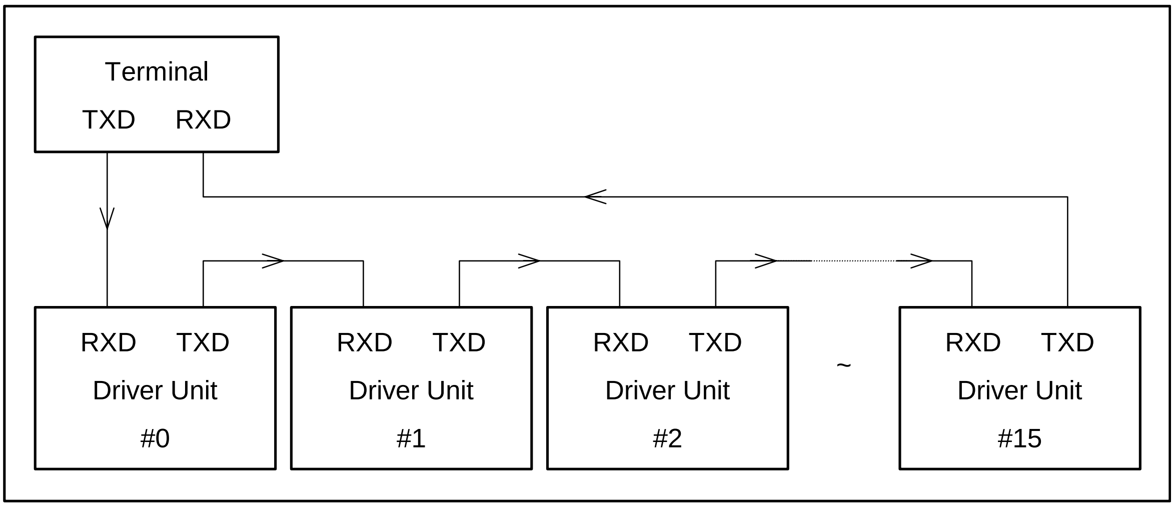
Item	RS-232C parameter	Data range	Shipping set	Function
Daisy-chain communication, axis number setting	AN data	0 to 15	0	The set data becomes the axis number of a daisy-chain communication.
Daisy-chain communication mode selection	CM data	0 and 1	0	CM0: Standard (single driver) communication, CM1: Daisy-chain communication

6.3.4.3. Interfacing

◆ Connecting data communication lines

- Connect data communication lines sequentially: First connect the output of the terminal with the input of axis 0, and then connect the output of axis 0 with the input of axis 1, then one after the other. (See Figure 6-56.)
- Connect the output of the final axis with the input of the terminal.

Figure 6-56

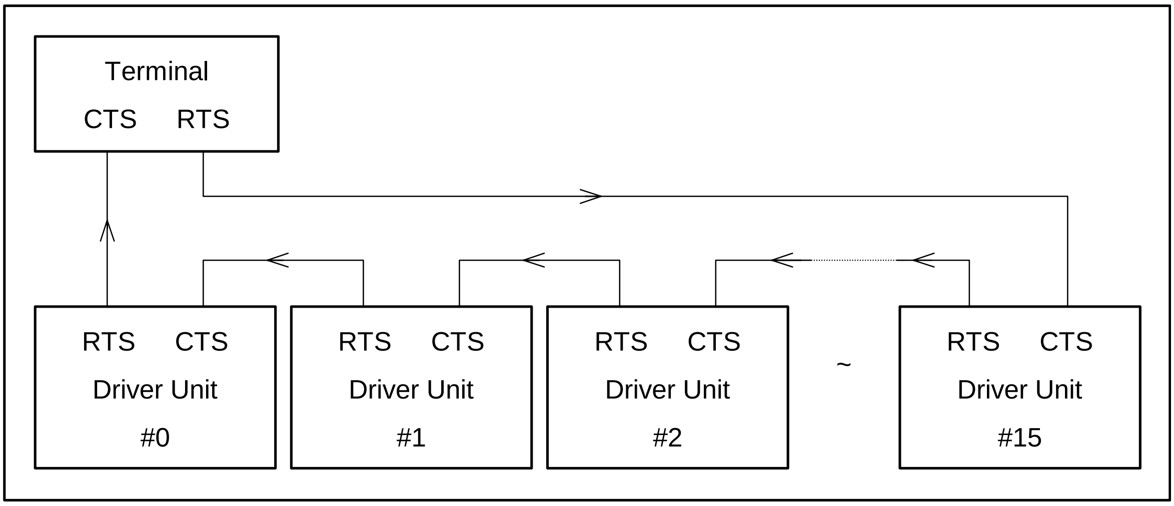


◆ Connecting data transmission request lines

- Connect data transmission request lines sequentially: First connect the input of the terminal with the output of axis 0, and then connect the input of axis 0 with the output of axis 1, then one after the other. (See Figure 6-57.)

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

Figure 6-57

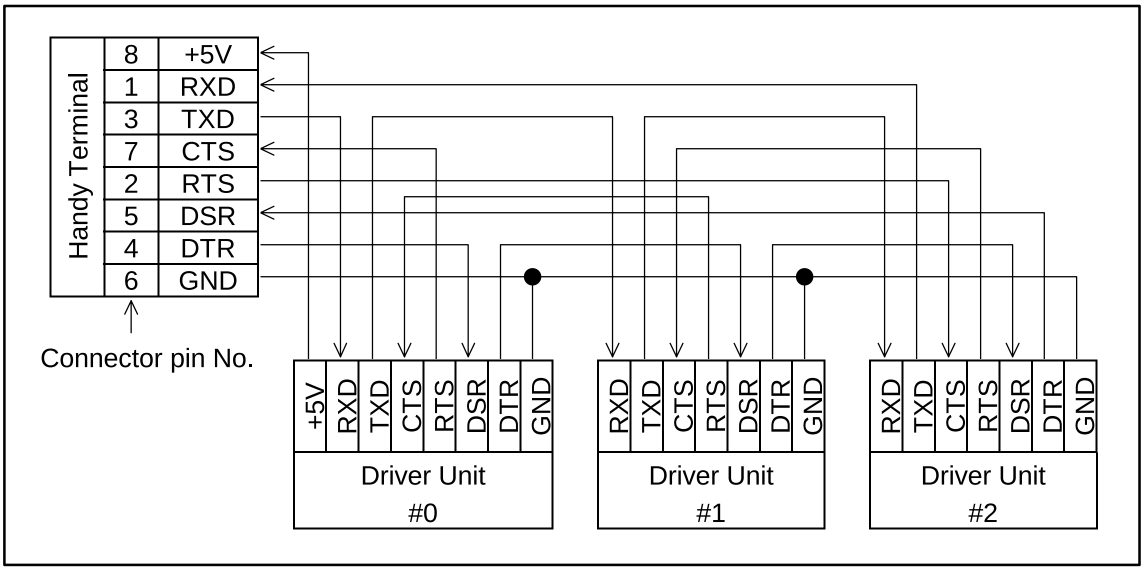


◆ Actual connection example

- When NSK's Handy Terminal is in use, connect the lines as shown in Figure 6-58.

- Refer to "2.8.1. CN1: RS-232C Serial Communication Connector" for the specification of CN1.

Figure 6-58: Handy Terminal connection example



* The communication signal name on the Handy Terminal is opposite to that of the Driver Unit (e.g. RXD-TXD).

6.3.4.4. Power on

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

⚠ *Caution : 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 axis No. 0 Driver Unit is turned on lastly.)*

- The command AS will be executed to check for connection as soon as the power of the Driver Unit of axis No.0 is turned on.

- If the entire connections are normal, the following message is displayed. (The following examples show a 3-axis configuration.)

```
 NSK MEGATORQUE
 MS1A50_XXXX
 EXXXXXXXXXX
BM1
AS
   0   OK  AX0
   1   OK  AX1    ── Displays the connection state.
  #2   OK  AX2
:_                ── Waits for the next command.
```

- 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 switched in connection

```
 NSK MEGATORQUE
 MS1A50_XXXX
 EXXXXXXXXXX
BM1
AS
   0   OK  AX0
   1  ERR. AX2    ── Displays the connection state.
  #2  ERR. AX1
:_                ── Waits for the next command.
```

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

6.3.4.5. Operation

Selection of Driver Unit to Communicate

- In daisy-chain mode, the RS-232C terminal is capable of communication through one Driver Unit only at a time.

- Use the AX command to select one of Driver Units connected for daisy-chain communication.

  ⚠ *Caution : Do not select any Drive Unit that is not connected. Otherwise, operation may hang up. To return to the normal state in such a case, press the* BS *key, then select the number of a connected Driver Unit.*

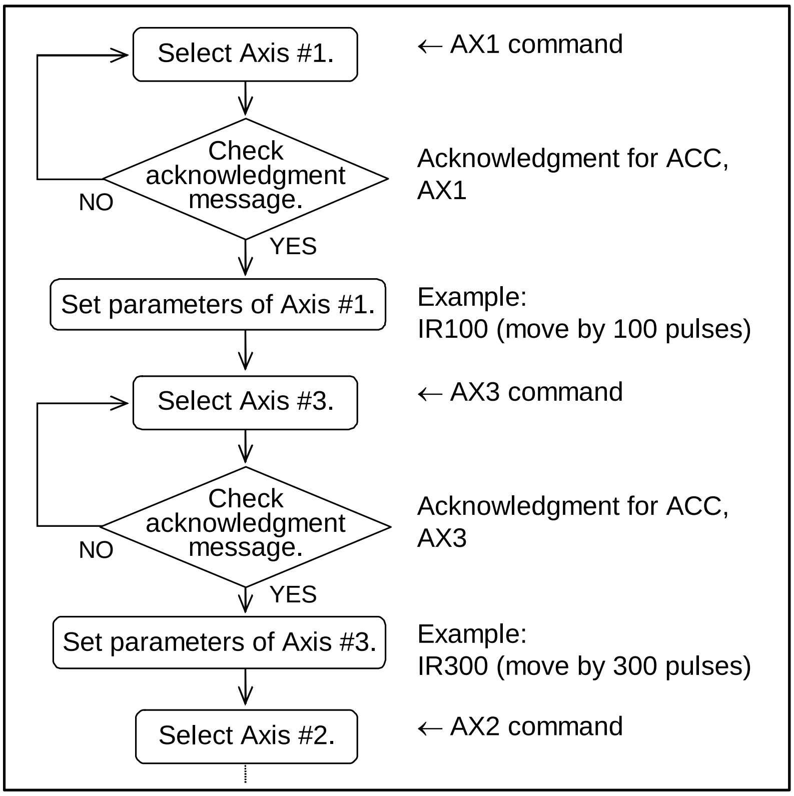
```
:AX2        ← Select a new axis for communication (axis No. 2).
 ACC. AX2   ← Acknowledgment
:_
```

- 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.

```
:?AX
 ACC. AX2   ← Current axis for communication
:_
```

Example of Daisy-chain communication

Figure 6-59: Example of Daisy chain



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7. Operation

7.1. Preparation

7.1.1. Wiring Check

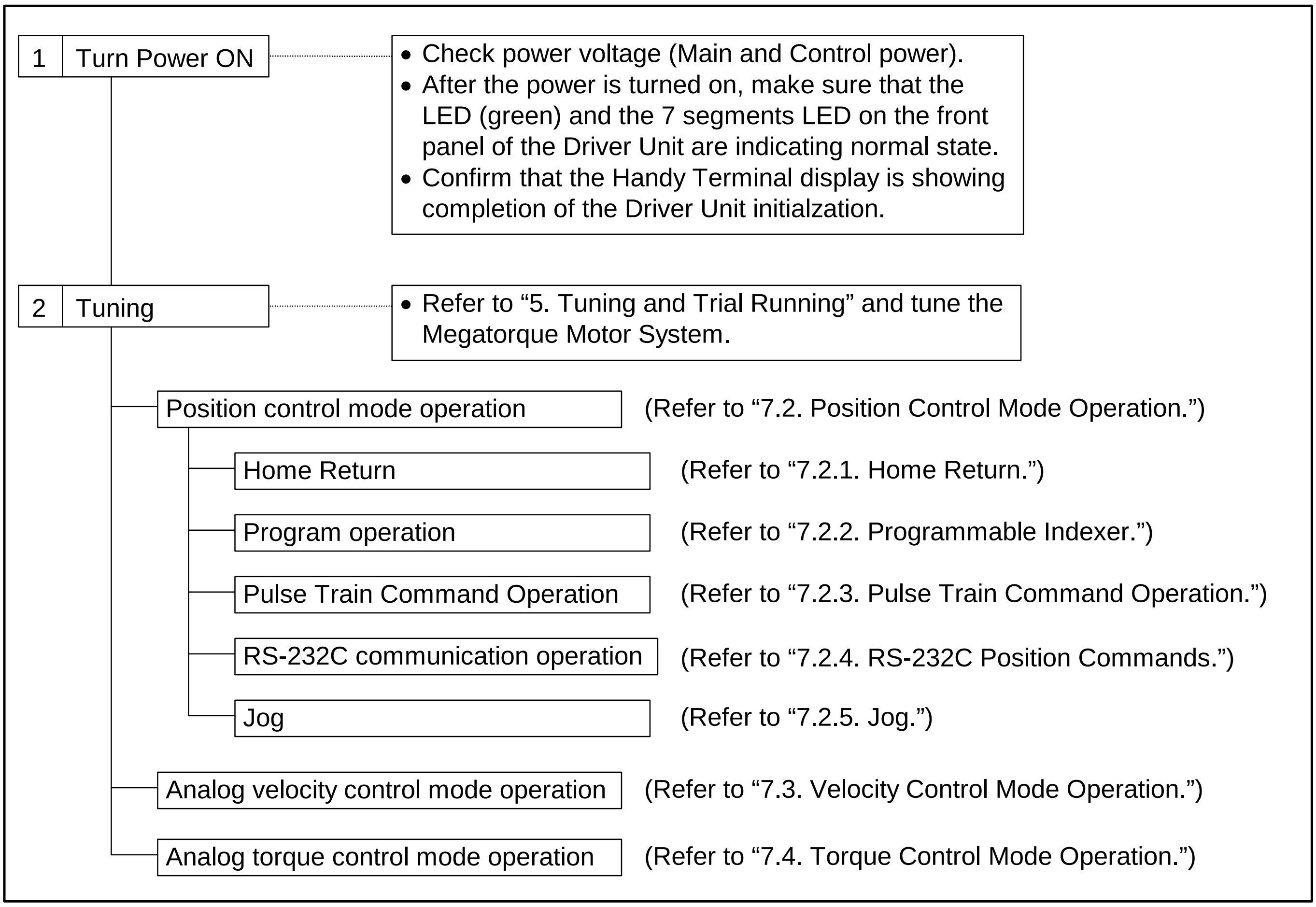
⚠ *Caution : On completion of wiring the ESA35 Driver Unit, check items listed in Table 7-1 before operating the Megatorque Motor System.*

Table 7-1

No.	Items to be checked	Points to be checked
1	Connection of main power and Input/Output signal cables	• Check if the wiring is properly done. • Check if the screws of the terminal block are securely fastened. • Check if the connectors are properly connected and secured.
2	Connecting cables	• Check if the cable sets (Motor cable and resolver cable) are properly connected and locked to the connectors.
3	Handy Terminal	• Check if the Handy Terminal is connected properly and locked to the CN2 connector.

7.1.2. Operation Procedure

Figure 7-1



7.2. 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
  - ◊ Programmable Indexer
  - ◊ Pulse train command
  - ◊ RS-232C position command
  - ◊ Jog

6.2.1. Home Return

- Be sure to execute the Home Return for the ESA35 Driver Units unless the master controller controls the position scale. Otherwise the home position (zero position) of the position scale cannot be defined.

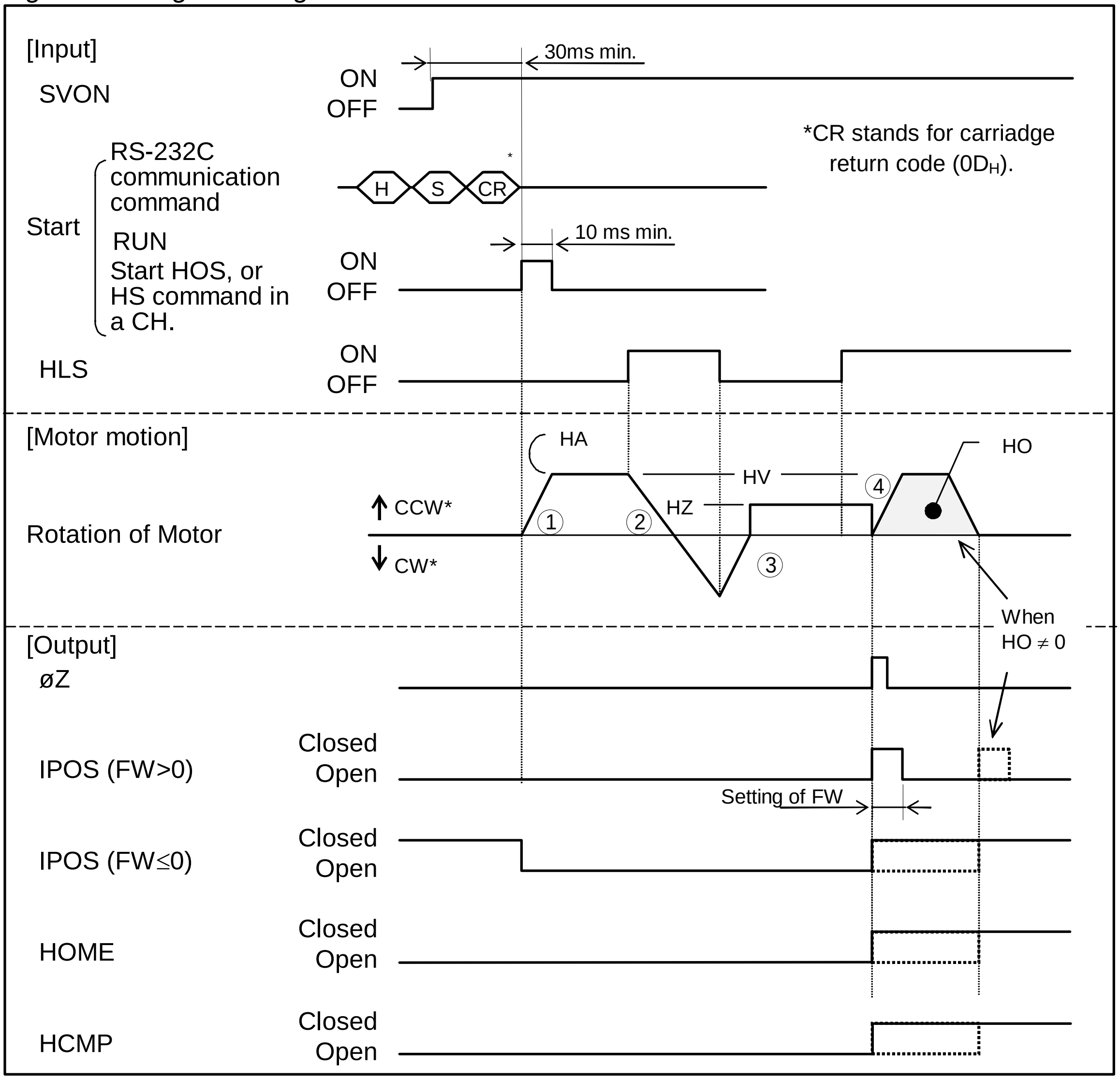
- For Driver Units equipped with the absolute resolver, execute the Home Return only when you need to change the user absolute home position.

- The positioning and setting of software over travel limits depend on the position scale set by the Home Return.

- The home position is the point at where the Home Return has completed.

  ⚠ *Caution : ESA Driver Units require the Home Return every time the power is turned on because it doesn't store the home position when the power is turned off.*

Figure 6-2: Signal timing of Home Return



- Make the Motor servo on. (SVON input is ON.)
- The Home Return starts when the HOS input is ON.
- Refer to the following chapters for signal specifications of IPOS, HOME and HCMP outputs.
  - ◊ IPOS : 6.1.11. Output Signal Format
  - ◊ HOME : 6.1.13. Completion of Home Return/Detection of Home Position
  - ◊ HCMP : Definition of Home Position
- The Motor turns in CCW* and then decelerates and stops when it enters HLS range (② Home position proximity), then reverses its direction. (③) The Motor goes out HLS range once, then reverses again and enters HLS range with the Home position Near-Zero velocity. (④) It moves to the first point where the position sensor data becomes 0 (= rising edge of the øZ) and completes the Home Return.

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

  HD0: CW

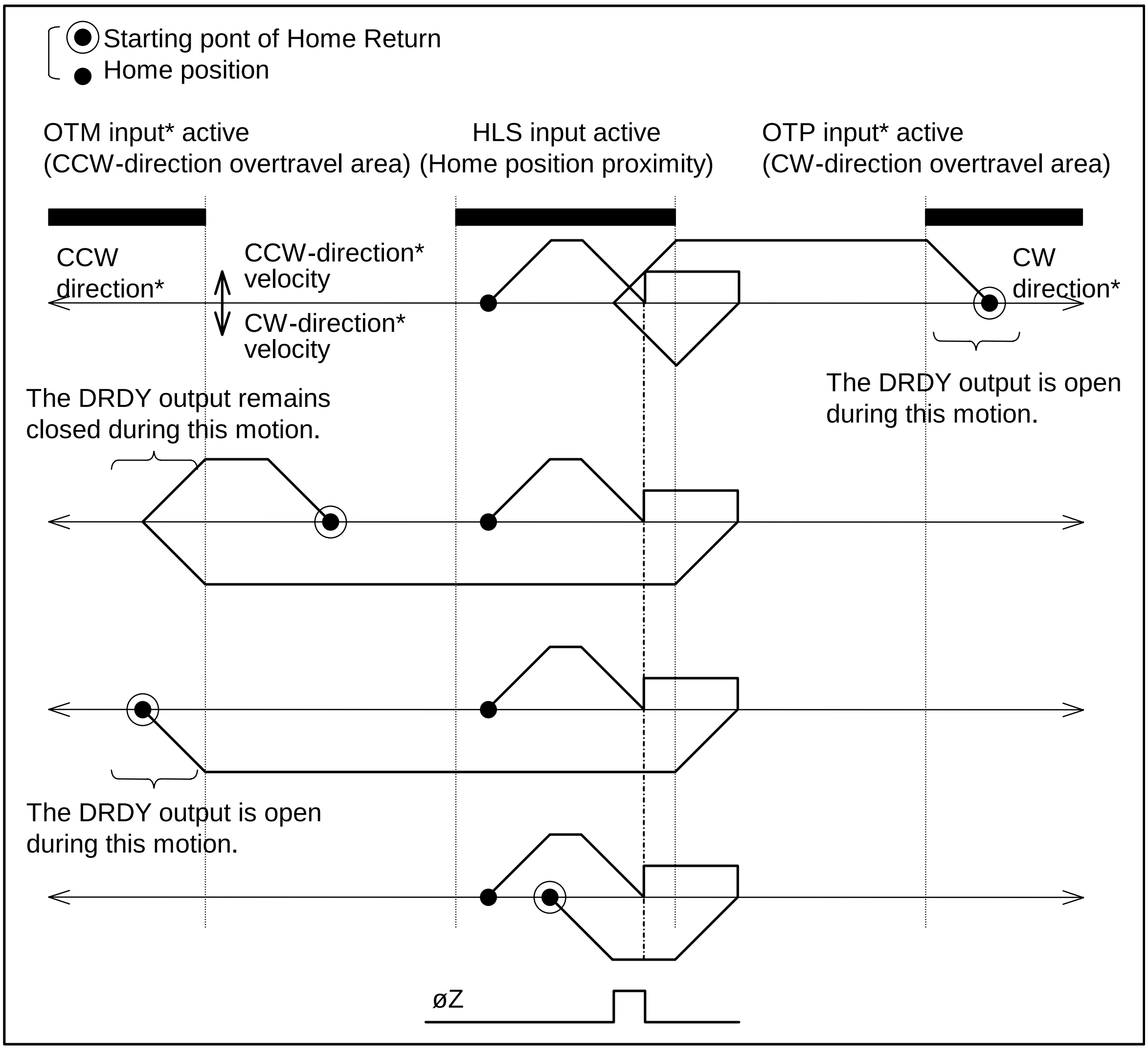
  HD1: CCW (Shipping set)

- If the Home offset data HO is specified, the Motor moves farther past the 0 point of the position sensor by the offset data, then completes the Home Return operation.

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

- Home Return sequence differs as shown in Figure 7-3 according to the starting point of Home Return.

Figure 7-3



*: When Home Return direction is reversed by the HD parameter, CW and CCW as well as OTP and OTM are reversed:

- ◊ CW → CCW
- ◊ OTP → OTM.

7.2.1.1. List of Parameters Related to Home Return

Table 7-2: Parameters related to Home Return (RS type Motor)

Item	RS-232C parameter	Unit	Input data range	Initial setting
Home Return acceleration	HA	s^{-2}	0.01 to 80.00	1.00
Home Return velocity	HV	s^{-1}	0.0001 to 3.0000	0.2
Home position offset	HO	pulse	0 to 610 304	0
Home Return direction	HD	–	0: CW direction; 1: CCW direction	1
Home Return Near-Zero velocity	HZ	s^{-1}	0.0001 to 0.20	0.0100

Table 7-3: Parameters related to Home Return (AS and BS type Motors)

Item	RS-232C parameter	Unit	Input data range	Initial setting
Home Return acceleration	HA	s^{-2}	0.01 to 120.00	1.00
Home Return velocity	HV	s^{-1}	0.0001 to 4.5000	0.2
Home position offset	HO	pulse	0 to 405 504	0
Home Return direction	HD	–	0: CW direction; 1: CCW direction	1
Home Return Near-Zero velocity	HZ	s^{-1}	0.0001 to 0.30	0.0100

7.2.1.2. Adjusting Home Limit Sensor Position and Home Offset Data

- For an accurate Home Return, it requires position adjustment of the home limit sensor (a sensor or a dog).

- The home position will be set on the point at where the position sensor count becomes 0 for the first time after the rising edge of HLS input signal is detected while the Motor is moving under "Near-Zero" velocity. (When the parameter HO setting is a number other than 0, the home position is offset to the MO setting from the above position.)

- The position sensor has many teeth and the rising edge of HLS input signal is to identify a tooth among those. Position adjustment of the limit sensor shall be made so that the position is on the center of the tooth width for accurate identification. Design the position of the home limit sensor so that it can be adjusted within ± 1.2°, which corresponds to the width of a tooth.

- Following is the procedure for adjusting the position of home limit sensor.

◆ **Adjusting procedure: Adjusting position of the home limit sensor**

1) Temporally set the limit sensor. The position shall be slightly preceding a point to be the home position.

2) Check wiring of the home limit sensor. Check if the ESA Driver Unit is reading the HLS input normally by an input of the IO command.

3) Perform minor adjustment of the home limit sensor position. Turn the Motor servo on, and then execute the HS/LS command. Be careful as the Motor starts Home Return. Follow the procedure below using the Handy Terminal.

   (1) Execute HS/LS command.

H S / L S →

```
:HS/LS_
```

(2) The Motor starts rotation by an input of the $\boxed{\text{ENT}}$ key.

ENT

```
:HS/LS
 TR2003
 OK
:_
```

The Motor stops as soon as the home position limit is ON, and the TR (number of pulses from the closest øZ signal) appears on the screen. Check that the data of TR is between 1000 and 3000.
If it is not in the range loosen the position limit sensor and move it to CW or CCW direction. Repeat (1) and (2) steps till the TR is set in the range.

⚠ *Caution : When the position of home limit sensor is adjusted, be sure to adjust the TR reading. Otherwise positioning may not be performed correctly.*

- The above procedures complete the position adjustment of the home limit sensor. Follow the procedures below if you require offsetting the home position.

(3) The MO command is for "Servo off."

M O

```
:HS/LS
 TR2003
 OK
:MO_
```

(4) Pressing the $\boxed{\text{ENT}}$ key will turn the Motor servo-off.

ENT

```
 TR2003
 OK
:MO
:_
```

The Motor can be turned easily. Rotate the Motor to the desired position. However do not turn it more than one revolution.

(5) Input the password.

/ N S K SP
O N

```
:TR2003
 OK
:MO
:/NSK ON_
```

(6) Press the $\boxed{\text{ENT}}$ key.

ENT

```
:MO
:/NSK ON
 NSK ON
:_
```

(7) The position sensor will automatically detect and store the Home position offset value HO by the HO/ST command.

H O / S T

```
:MO
:/NSK ON
 NSK ON
:HO/ST_
```

(8) Execute the command by entering the ENT key.

"':_ " appear on the screen indicating that the HO from the current position is automatically set.

ENT

```
 NSK ON
:HO/ST
 HO1234
:_
```

(9) The SV command is to make the servo-on.

S V

```
 NSK ON
:HO/ST
 HO1234
:SV_
```

(10) Entering the ENT key turns the Motor servo-on.

":_ " indicate the acceptance of the command.

ENT

```
:HO/ST
 HO1234
:SV
:_
```

(11) The HS command is for execution of Home Return.

H S

```
:HO/ST
 HO1234
:SV
:HS_
```

(12) Entering the ENT key starts the Home Return.

ENT

```
 HO1234
:SV
:HS
:_
```

Check that the Motor stops at the point as desired.

7.2.1.1. Setting Home Position With AZ Command

- AZ command sets the current position of the Motor as the user home position.
- The following show how to set the user home position with the AZ command.

(1) Set the Motor servo free.

M O ENT

```
:MO
:_
```

(2) Rotate the Motor to the position to be the user home position and hold the position.

(3) Input the password. The acknowledgement appears on the display.

/ N S K SP
O N ENT

```
:MO
:/NSK ON
 NSK ON
:_
```

(4) Input of the AZ command sets the user home position and resets AO value (offset from the zero position). (The user home position can be set while the Motor servo is on.)

A Z ENT

```
 NSK ON
:AZ
 AO1234
:_
```

7.2.1.3. Example of Setting Home Return Operation

1 Program the Home Return command to the internal channel 0 (CH0)

- Follow the instructions below to program the Home Return command to the channel and execute it by the starting command of programmed positioning (RUN).

(1) Input CH0 to start editing the channel 0.

C H 0 ? ENT

```
:
:
:CH0
?_
```

The prompt changes to “?” and the Driver Unit waits for input of the data. At this moment, if data have been programmed in the CH0, it will be indicated on the screen.

(2) Input the command for Home Return.

H S ENT

```
:
:CH0
?HS
?_
```

(3) Input of the ENT key following the prompt completes programming to the CH0.

ENT

```
:CH0
?HS
?
:_
```

2 Perform Home Return.

- Following instructions show a trial running to check Motor motion when the Home Return acceleration HA, the Home Return velocity HV, and the home position offset HO are changed.

  (1) Activate the Motor servo.

  (2) Input of the command to execute an internal channel program starts the Home Return when the prompt is “ : ” on the screen.

S P 0 ? ENT

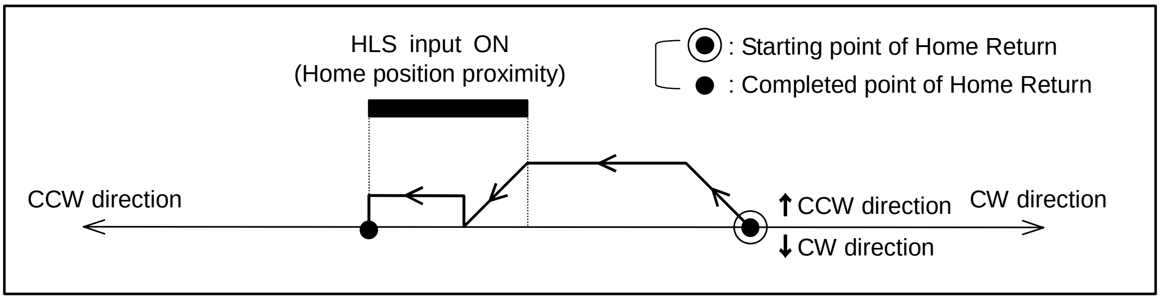
```
:
:
:SP0
:_
```

7.2.1.4. Operation Mode of Home Return

1 Mode 1

- Home return velocity changes to “Near-Zero velocity” when the home limit sensor (HLS) is ON.
- The home position is set on the point at where the home limit sensor is OFF.

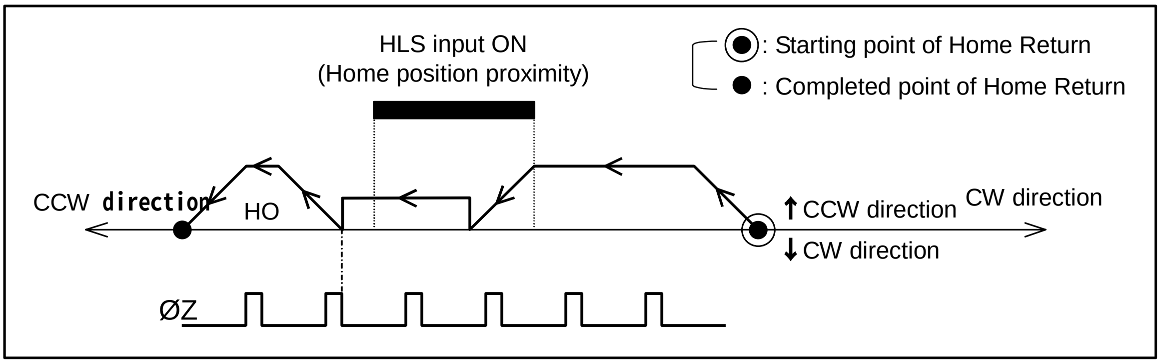
Figure 7-4



2 Mode 3

- The Home Return velocity changes to “Near-Zero” velocity when the home limit sensor is ON.
- Position of the first rise of øZ signal after the home limit sensor is OFF will be defined as the home position.
- If the Home position offset (HO) is set, the Motor goes on by the HO setting after the first rise of øZ signal and stops, thus setting the home position.

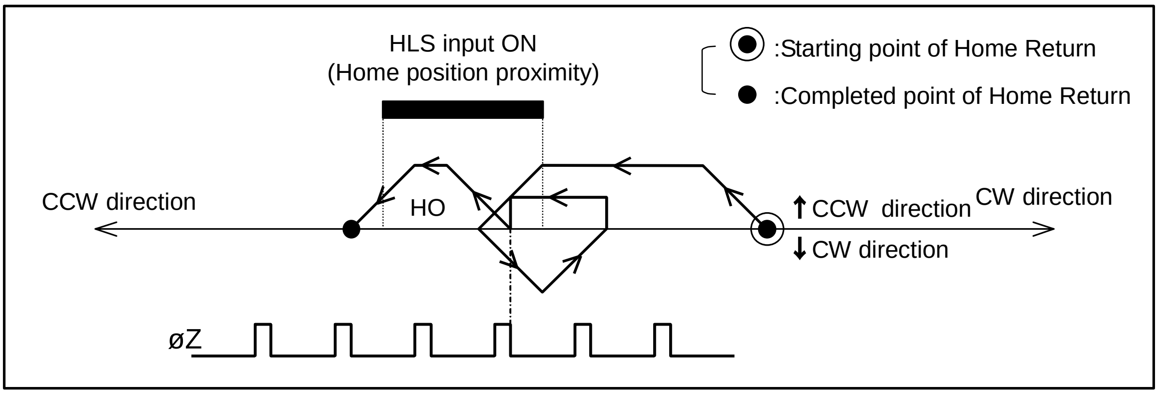
Figure 7-5



3 Mode 4 (The shipping set)

- The Motor slows down and reverses its motion at where the home limit sensor is ON. Then it reverses its motion again with the "Near-Zero velocity" after the Motor gets out the proximity range of home position and searches the position of the limit.
- The position of the first rise of øZ signal after the home limit sensor is ON will be defined as the home position.
- If the Home position offset HO is set, the Motor goes further by the setting value, thus sets the home position.

Figure 7-6

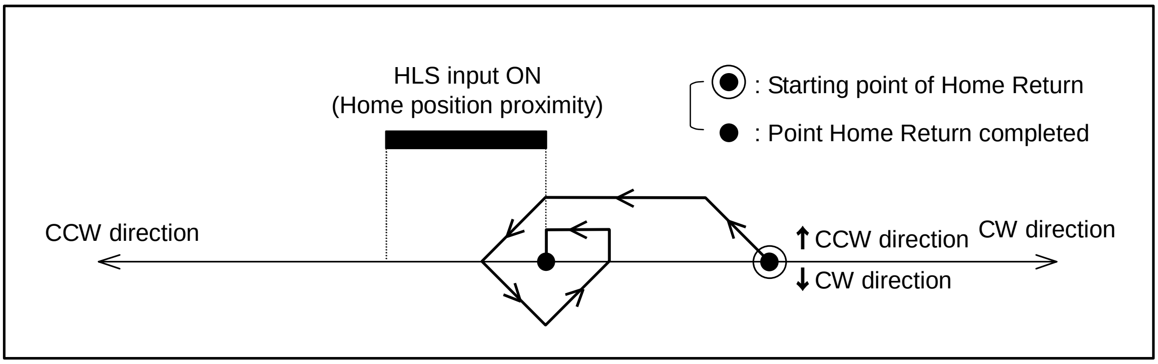


4 Mode 5

- The Motor slows down and reverses its motion when the home limit sensor is ON. Then it reverses its motion with "Near –Zero" velocity after getting out the home position proximity range and search the position of the limit sensor.

- The Home position will be set on the point at where the home limit sensor is ON.

Figure 7-7



5 Mode 6

- The Home position will be set on the point at where the Home Return started.

- Though the Motor does not move, the servo has to be turned on at the moment.

7.2.2. Positioning With Programmable Indexer

- Positioning with Programmable Indexer means to select a positioning program, which has been programmed in the Driver Unit, by the PRG0 to PRG5 inputs, and to execute it by issuing the RUN input.

- Activate the Motor servo. (SVON input ON)

- Select a channel to be executed. (PRG0 to PRG5 input)

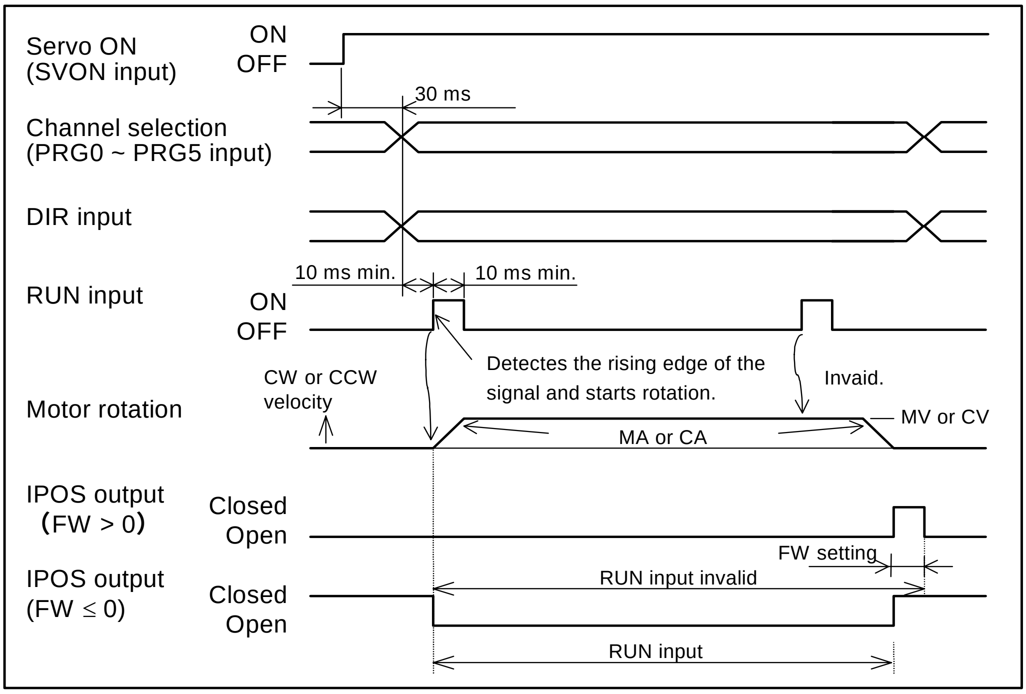
- Inputting the RUN command ON executes the program of the selected channel while the IPOS output is closed.

- During positioning of the Motor, another RUN input will be invalidated.

- Execution of the SP command may start the internal program. (The same function as the RUN input ON)

  Inputting SPm ENT (m--- program channel number) will start the program of Channel m.

Figure 7-8: Command timing of the Programmable Indexer



- “Program error” alarm will be given if an empty channel is selected and executed. (Refer to “11. Alarm.”)

7.2.2.1. Internal Program Channel Selection

- Combination of ONs and OFFs of PRG0 to 5 inputs selects an internal program channel to be executed.

Table 7-4: List of 64 channels

Channel number	State of PRGx inputs					
	PRG5	PRG4	PRG3	PRG2	PRG1	PRG0
0	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF	ON	ON
12	OFF	OFF	ON	ON	OFF	OFF
13	OFF	OFF	ON	ON	OFF	ON
14	OFF	OFF	ON	ON	ON	OFF
15	OFF	OFF	ON	ON	ON	ON
16	OFF	ON	OFF	OFF	OFF	OFF
17	OFF	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON	OFF
19	OFF	ON	OFF	OFF	ON	ON
20	OFF	ON	OFF	ON	OFF	OFF
21	OFF	ON	OFF	ON	OFF	ON
22	OFF	ON	OFF	ON	ON	OFF
23	OFF	ON	OFF	ON	ON	ON
24	OFF	ON	ON	OFF	OFF	OFF
25	OFF	ON	ON	OFF	OFF	ON
26	OFF	ON	ON	OFF	ON	OFF
27	OFF	ON	ON	OFF	ON	ON
28	OFF	ON	ON	ON	OFF	OFF
29	OFF	ON	ON	ON	OFF	ON
30	OFF	ON	ON	ON	ON	OFF
31	OFF	ON	ON	ON	ON	ON
32	ON	OFF	OFF	OFF	OFF	OFF
33	ON	OFF	OFF	OFF	OFF	ON
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
59	ON	ON	ON	OFF	ON	ON
60	ON	ON	ON	ON	OFF	OFF
61	ON	ON	ON	ON	OFF	ON
62	ON	ON	ON	ON	ON	OFF
63	ON	ON	ON	ON	ON	ON

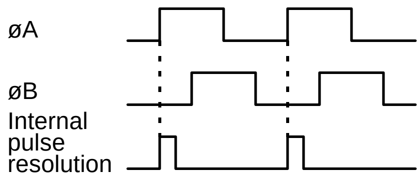
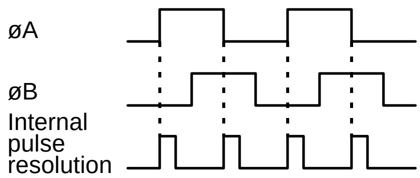
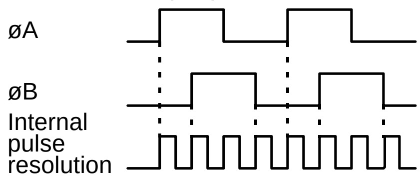
7.2.3. Positioning with Pulse Train Command

7.2.3.1. Pulse Train Command Format

- Input the pulse train command through CWP and CCWP ports of the connector CN2.

- Select a format of pulse train input signal with the parameter PC (RS-232C communication). (Entry of the password is required for setting the parameter PC.)

Table 7-5

PC Parameter	CWP input	CCWP input	Function / Description
PC0 (shipping set)	• Input the CW pulse.	• Input the CCW pulse.	CW & CCW format
PC1	• Input the direction. ON : CCW OFF : CW	• Input the pulse train.	Step & direction format
PC2			øA/øB format (× 1) 
PC3	• Input øB.	• Input øA.	øA/øB format (× 2) 
PC4			øA/øB format (× 4) 

7.2.3.2. Pulse Train Resolution

- The rotational angle per input pulse may be selected using the parameter CR (RS-232C communication).
- In addition to the angle magnification with the parameter PC, the parameter selects further angle magnification for the øA/øB input.
- Refer to Tables 7-6 and 7-7 for the concrete example of resolution.

Figure 7-8

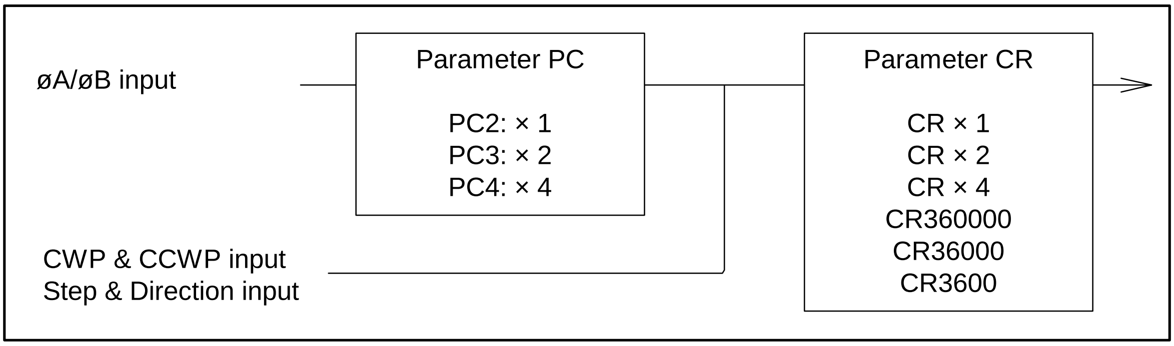


Table 7-6: Pulse train command resolution (RS type Motor)

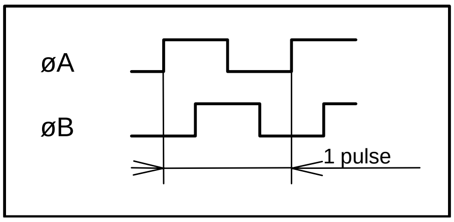
CR parameter	Resolver resolution	Resolution (pulses/360°) = Pulse count to make one rotation of Motor.		
		CW & CCW, Pulse & Direction	øA/øB	
CR × 1 (Shipping set)	12 bit or automatic switching	614 400	× 1	614 400
			× 2	307 200
			× 4	153 600
	10 bit	153 600	× 1	153 600
			× 2	76 800
			× 4	38 400
CR × 2	12 bit or automatic switching	307 200	× 1	307 200
			× 2	153 600
			× 4	76 800
	10 bit	76 800	× 1	76 800
			× 2	38 400
			× 4	19 200
CR × 4	12 bit or automatic switching	153 600	× 1	153 600
			× 2	76 800
			× 4	38 400
	10 bit	38 400	× 1	38 400
			× 2	19 200
			× 4	9 600
CR360000	12 bit/10 bit automatic switching	360 000		360 000
				180 000
				90 000
CR36000	12 bit/10 bit automatic switching	36 000		36 000
				18 000
				9 000
CR3600	12 bit/10 bit automatic switching	3 600		3 600
				1 800
				900

Table 7-7: Pulse train command resolution (AA and BS type Motors)

CR parameter	Resolver resolution	Resolution (pulses/360°) = Pulse count to make one rotation of Motor. CW & CCW, Pulse & Direction	øA/øB	
CR × 1 (Shipping set)	12 bit or automatic switching	409 600	× 1	409 600
			× 2	204 800
			× 4	102 400
	10 bit	102 400	× 1	102 400
			× 2	51 200
			× 4	25 600
CR × 2	12 bit or automatic switching	204 800	× 1	204 800
			× 2	102 400
			× 4	51 200
	10 bit	51 200	× 1	51 200
			× 2	25 600
			× 4	12 800
CR × 4	12 bit or automatic switching	102 400	× 1	102 400
			× 2	51 200
			× 4	25 600
	10 bit	25 600	× 1	25 600
			× 2	12 800
			× 4	6 400
CR360000	12 bit/10 bit automatic switching	360 000	× 1	360 000
			× 2	180 000
			× 4	90 000
CR36000	12 bit/10 bit automatic switching	36 000	× 1	36 000
			× 2	18 000
			× 4	9 000
CR3600	12 bit/10 bit automatic switching	3 600	× 1	3 600
			× 2	1 800
			× 4	900

- Each cycle of phase A or B serves as a count if the øA/øB format is used.

Figure 7-10



- The parameter RR (RS-232C communication) sets the resolver resolution.

7.2.3.3. Pulse Train Input Timing

⚠ *Caution : The following specify the conditions of accepting timing of pulses. In addition to the conditions shown below, the maximum velocity places restrictions.*
The pulse frequency should not exceed the maximum velocity of the Motor.

Figure 7-11: When the parameter is set to PC0.

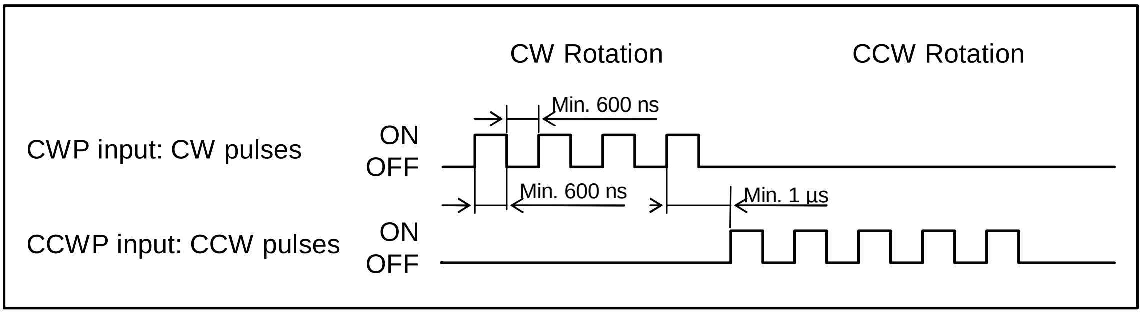


Figure 7-12: When the parameter is set to PC1.

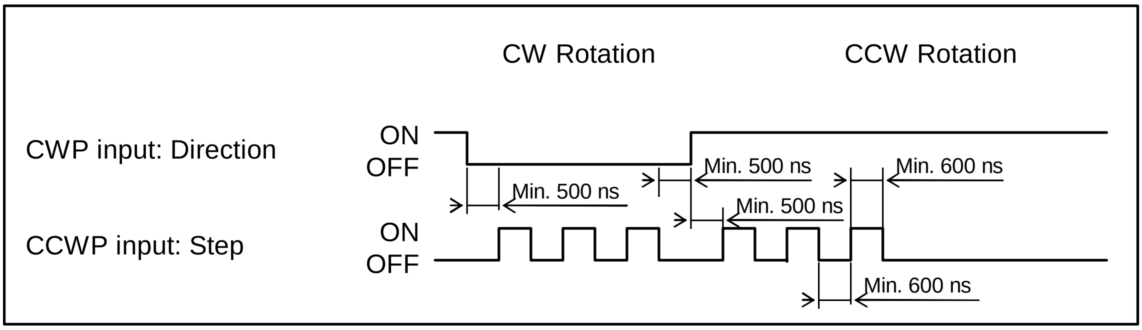
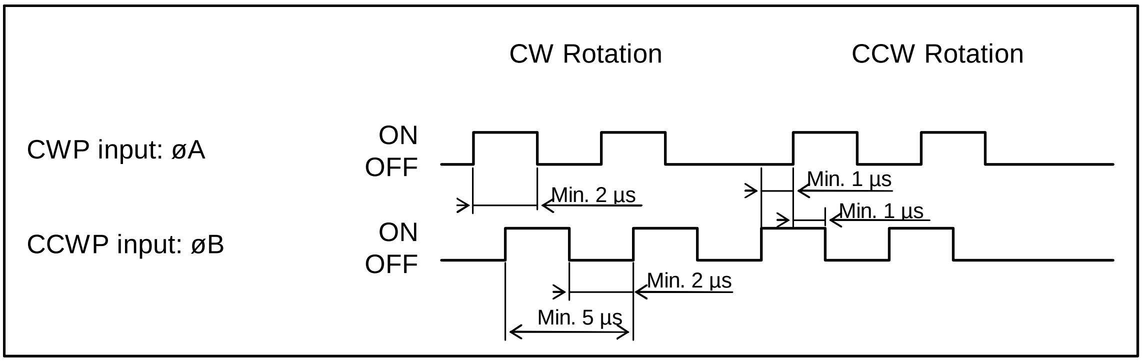


Figure 7-13:When the parameter is set to PC2 to 4.



7.2.4. Positioning With RS-232C Position Command

- Positioning may be executed directly with the RS-232C interface. Commands and parameters are listed in Table 7-8. Refer to "9. Glossary of Command and Parameter" for the details.

Table 7-8

Command/Parameter	Function
ID command	Sets the motion distance and executes positioning. (Incremental/in units of degree)
IR command	Sets the motion distance and executes positioning. (Incremental/in units of pulse)
AD command	Sets the motion distance and executes positioning. (Absolute/in units of degree)
AR command	Sets the motion distance and executes positioning. (Absolute/in units of degree)
HS command	Starts Home Return.
HV parameter	Sets Home Return velocity.
HA parameter	Sets Home Return acceleration.
HO parameter	Sets Home Return offset.
HD parameter	Sets Home Return direction.
MA parameter	Sets rotational acceleration.
MV parameter	Sets rotational velocity.
SE parameter	RS-232C error alarm output format

* The unit of pulse of the IR command is shown Table 7-9 below.

Table 7-9: unit of pulse for Motor type *[Unit: pulses/revolution]*

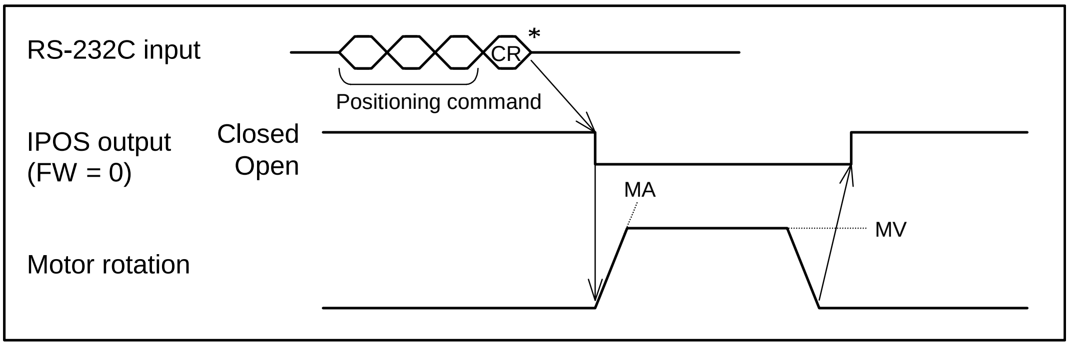
Motor type	Resolution
RS	614 400
AS and BS	409 600

◊ The Driver Unit has an EEPROM for the data backup. The EEPROM has the limitation on the number of times for writing/deleting the data. (Approximately 500 000 times) Therefore, we recommend setting the parameter WM, which prohibits writing to the EEPROM, when the internal parameters are frequently changed from the master controller during operation. However, parameters that do not require the backup will not affect the life to EEPROM.

◊ Be sure to set the parameter SE to SE1 in order to report the alarm of RS-232C communication error when operating through the RS-232C communication command.

◆ Signal timing for positioning

Figure 7-14: Timing of positioning



* "CR" denotes a carriage return code (0DH).

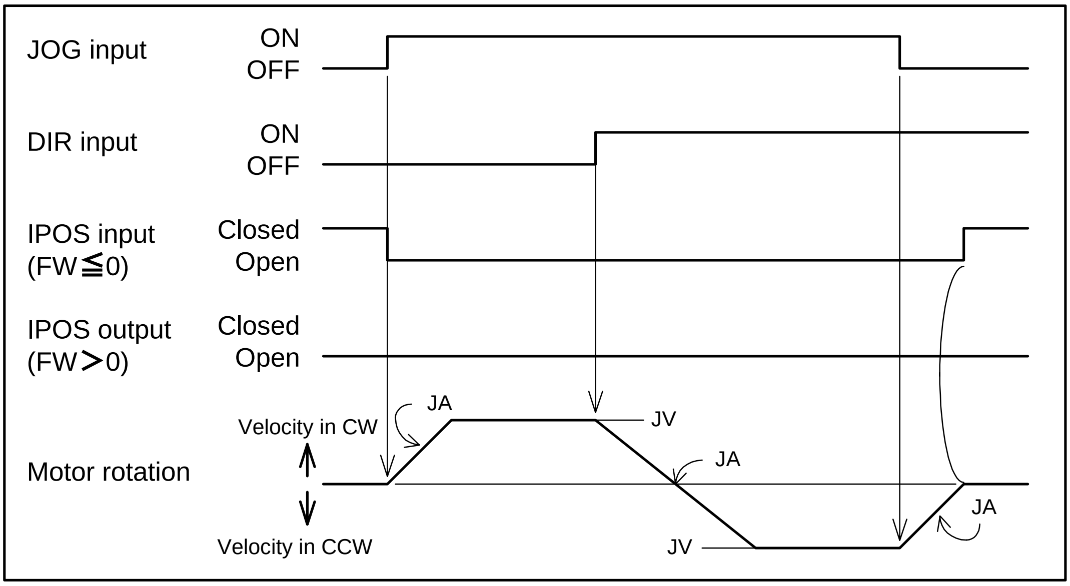
- The Motor executes a positioning immediately for an input of a command in servo-on state that is activated by SVON input ON. In that event, the acceleration and velocity of the motion profile shall follow the MA and MV settings respectively.

- The Driver Unit outputs the IPOS signal when position errors in the error counter fall below the setting for outputting signal for completion of positioning (Parameter IN).

7.2.5. Jog Operation

- Put the Motor in servo-on state. (SVON input ON.)
- Turning JOG input ON makes the Motor to rotate. The Motor keeps rotating while the JOG input is active. If it goes inactive, the Motor decelerates and then stops.
- The Motor rotates in CW direction when the DIR input is OFF, and it rotates to CCW direction when the DIR input is ON.
- Parameters for Jog operation
  - ◊ JA: JOG acceleration
  - ◊ JV: JOG velocity

Figure 7-15: Signal timing of Jog operation



⚠ *Caution : When the DIR input is switched during rotation as shown in the above chart, the Motor decelerates and reverses its motion.*

7.3. Positioning With Velocity Control Mode

- The parameter SL sets the positioning with velocity control mode.
  SL1: Torque control mode
  $\boxed{\text{SL2: Velocity control mode}}$
  SL3: Position control mode

- Either one of positioning with the RS-232C analog command or the analog velocity command may be selected in the velocity control mode.

- The parameter AC selects the way of positioning.
  - ◊ AC0: Analog command is invalid. The DC command is valid.
  - ◊ AC1: Analog command is valid.
    When the analog velocity command is positive (+): CCW direction
  - ◊ AC–1: Analog command is valid.
    When the analog velocity command is negative (–): CW direction

7.3.1. Positioning With RS-232C Command

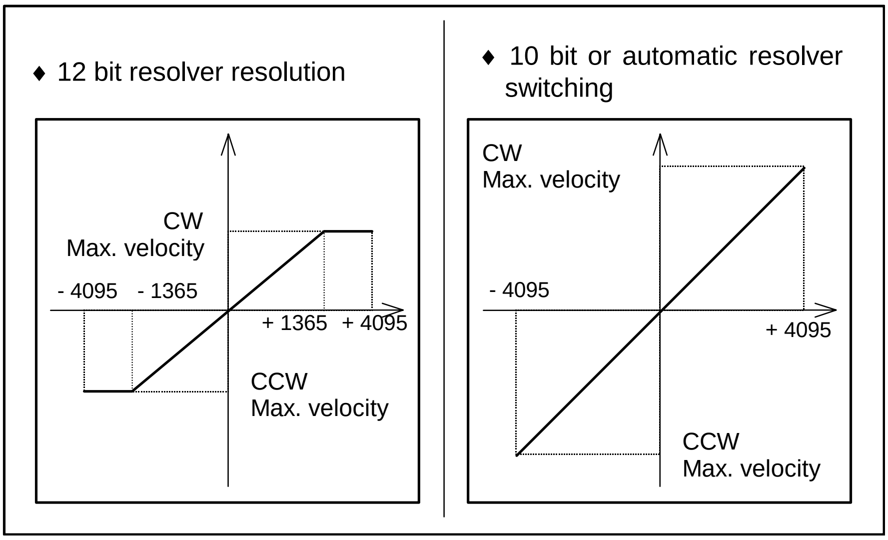
- Motor velocity may be controlled directly through the RS-232C command in the velocity control mode.

- Parameter AC (AC0) sets validity of DC command.
  Inputting will have the Motor controlled with the velocity that is proportional to the data.

  D C (data) ENT

- Relation between the data of DC command and the velocity is shown in Figure 6-22.

Figure 7-16



⚠ *Caution : When the DI parameter reverses the sign of position scale, the sign of the DC command is reversed as well.*

Table 7-10: Maximum velocity and resolver resolution setting *[Unit:s^{-1}]*

Motor type	Maximum velocity	
	12 bit resolver resolution	10bit or automatic switching
RS type	1	3
AS and BS type	1.5	4.5

7.3.2. Positioning With Analog Velocity Command

- Velocity of the Motor may be directly controlled with the analog velocity command in the velocity control mode.
    - ◊ Voltage range of the analog command is ± 10V. Offset adjustment is possible using the adjusting pod (VR1) on the front panel of the Driver Unit or the setting parameter AF. (Refer to "7.3.2.2. Offsetting Analog Command.")
    - ◊ It is possible to set dead band on the command voltage. (Refer to "6.3.2.1. Dead Band Set to Command Voltage.")
    - ◊ The parameter AC selects the polarity of command voltage. (Refer to Table 7-11.)
    - ◊ Relation between the command voltage and the velocity may be selected with the parameter AGV. (See Figure 6-23.)
    - ◊ You may set a limit to acceleration induced by changes of the velocity commands. (Refer to "7.3.3.Function to Limit Acceleration / Deceleration."

Table 7-11

DI setting	AC setting	Command voltage	Rotating direction
0	1	+	CCW
0	1	–	CW
0	– 1	+	CW
0	– 1	–	CCW
1	1	+	CW
1	1	–	CCW
1	– 1	+	CCW
1	– 1	–	CW

Figure 7-17: Command voltage and velocity (AC1)

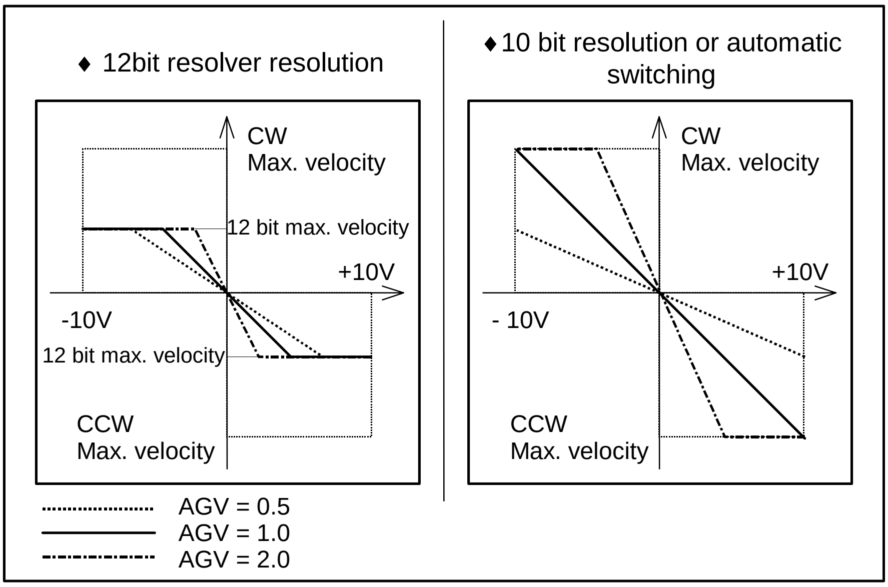


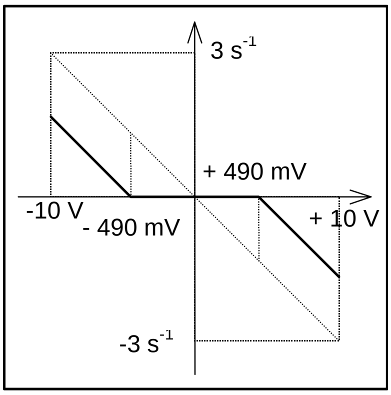
Table 7-12 *[Unit:s^{-1}]*

Motor type	Maximum velocity	
	12 bit resolver resolution	10 bit resolver resolution of automatic switching
RS type	1	3
AS and BS type	1.5	4.5

7.3.2.1. Dead Band Set to Command Voltage

- You may set the dead band to the analog command.
  (Parameter DBA sets ± 4.9 mV per parameter data.)

Figure 7-18: Example: DBA100 (AC1)

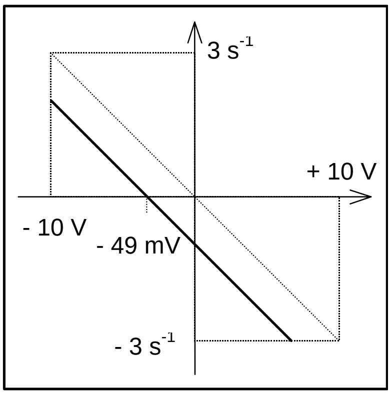


7.3.2.2. Offsetting Analog Command

- You may adjust the offset value of command voltage with the parameter AF.

- The parameter AF sets the offset value by "– 4.9 mV" per parameter data in the range of AF–63 to AF63.

Figure 7-19: Example: Setting AF10 (AC1)



(1) Automatic offset setting

- Set the offset value automatically to compensate current analog input to 0 (zero).

  (1) Connect the master controller and the Driver Unit, and then input analog velocity command 0 (zero).

  (2) Input the password. The acknowledgement will be returned.

  / N S K SP
  O N ENT

```
:/NSK ON
:_
```

  (3) Input the following command.

  A F / S T

```
:AF/ST_
```

  (4) Pressing the ENT key sets the offset value automatically. The set value of AF will be on the screen.

  ENT

```
:AF/ST
 AFxx
:_
```

◊ Unit of setting value is [– 4.9 mV].

◊ If an excessive offset value is set, the display indicates as “AFxx?.” However, the offset value won’t be changed.

◊ If the automatic offsetting is disabled because of abnormality of the A/D converter, an error alarm “E9>`ADC READ Error`” will be given.

(2) Manual offset setting

- Set offset value with the analog command monitor.

(1) Take a memo of setting on the dead band DBA and polarity of the analog command AC, and then change those settings to DBA0 and AC1.

(2) Connect the master controller and the Driver Unit and input the velocity command of 0 (zero).

(3) Type as shown below and monitor the analog command.

R A / R P →

```
:RA/RP_
```

(4) When the ENT key is pressed, the internal command by the analog command will be shown in the screen repeatedly. Indication of 2, as shown in the screen below, denotes that the offset to the command voltage shall be – 9.8 mV (– 4.9[mV] × 2). (Becasuse the polarity of the analog command voltage and the internal commad is reversed, the sign of the setting shall be regareded as it is reversed as well.

ENT →

```
:RA/RP
    2_
```

(5) Confirm the result and press the BS key. Otherwise the next command won't be accepted.

BS →

```
:RA/RP
    2
:_
```

(6) Input the password. The acknowledgement will be returned.

/ N S K SP O N ENT →

```
:/NSK ON
:_
```

(7) Execute the following commands. Be sure to input the same sign as it was monitored by the RA command.

A F 2 $ ENT →

```
:AF2
:_
```

(8) Reset the dead band DBA and the analog command polarity AC to the setting as noted at the step (1).

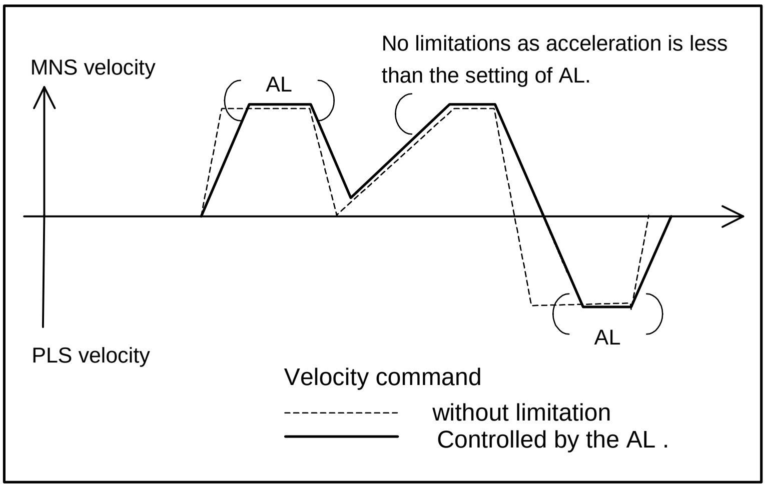
7.3.3. Function to Limit Acceleration / Deceleration

- You may set limitation of steep changes in acceleration and deceleration induced by changes of velocity commands.

- The parameter AL sets the limitation of acceleration and deceleration.

- If a command of acceleration or deceleration exceeds the setting of parameter AL, the acceleration and deceleration will be limited to AL [m/ s^{-2}].

Figure7-20: Limiting function of acceleration/deceleration



However, the limitation of acceleration /deceleration set by the parameter AL is not valid in the following cases.

◊ When a stop command by EMST or MS is entered.

◊ When the control mode is position control or velocity control.

- Limiting function of acceleration/deceleration is invalid if the parameter AL is set to 0.

7.4. Positioning With Torque Control Mode

- The parameter SL selects the torque control mode.
  SL1: Torque control mode
  SL2: Velocity control mode
  SL3: Position control mode

- You may select either positioning with the RS-232C position command or the analog torque command in the torque control mode. The parameter AC selects the way of positioning.
  AC0 : Analog command invalid. DC command is valid.
  AC1 : Analog command valid. When analog torque command is +: CCW rotation
  AC–1 : Analog command valid. When analog torque command is –: CW rotation

7.4.1. Operation by RS-232C Position Command

- You may control directly the Motor output torque with the RS-232C position command in the torque control mode.

- Set the parameter AC (AC0) to make the DC command valid.

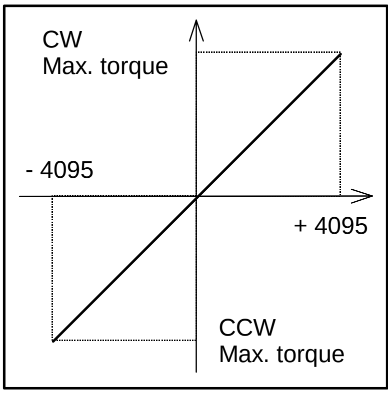
  Input as

  D C (data) ENT

  to control the Motor with the torque that is proportional to the data.

- Relation between the data of DC command and the Motor output torque is shown in Figure 7-21.

Figure 7-21



- The output torque of the Motor depends on the Motor type.

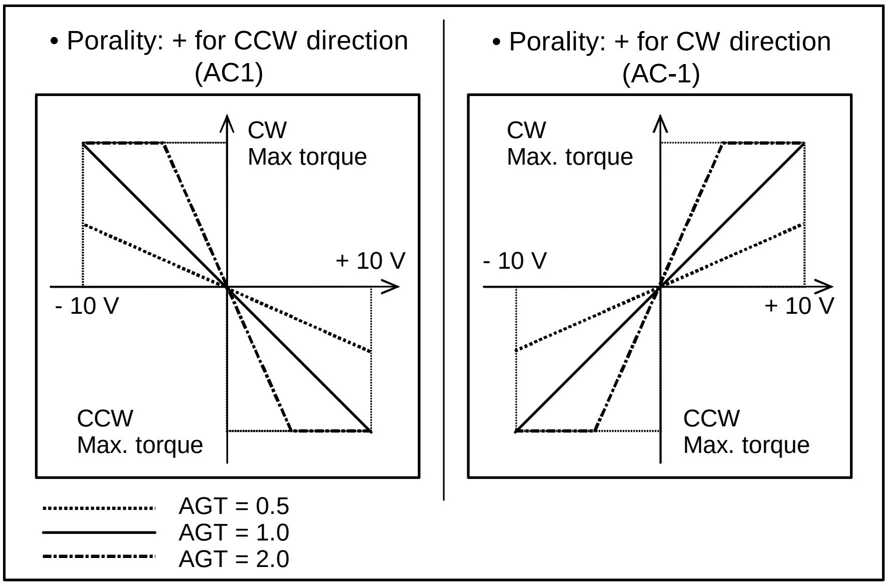
7.4.2. Positioning With Analog Torque Command

- You may control directly the output torque of the Motor with analog torque command in the torque control mode.
  - ◊ You may set the dead band to the command voltage.
    (Refer to “7.3.2.1. Dead Band Set to Analog Command.”)
  - ◊ The voltage of analog torque command is ± 10V. Offsetting analog command is possible using an adjusting pod (VR1) on the front panel of the Driver Unit or by setting parameter AF. (Refer to “7.3.2.2. Offsetting Analog Command.”)
  - ◊ The parameter AC selects the polarity of command voltage. (See Table 7-13.)
  - ◊ Relation between the command voltage and the output torque of the Motor may be changed with the parameter AGT.
    (Refer to Figure 7-22.)

Table 7-13

DI setting	AC setting	Command voltage	Rotational direction
0	1	+	CCW
0	1	–	CW
0	-1	+	CW
0	-1	–	CCW
1	1	+	CW
1	1	–	CCW
1	-1	+	CCW
1	-1	–	CW

Figure 7-22: Command voltage and output torque

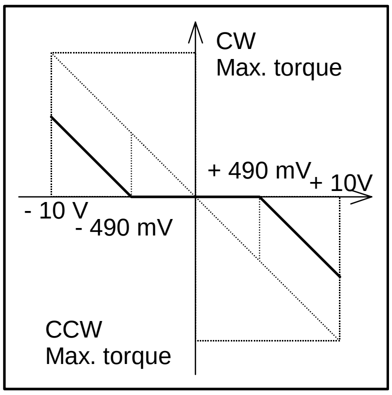


- The output torque of the Motor depends on the Motor type.

7.4.2.1. Dead Band Set to Command Voltage

- You may set the dead band to analog command voltage.
  (Parameter DBA: ± 4.9 mV per parameter data.)

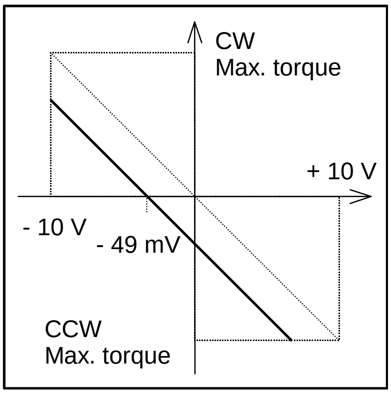
Figure 7-23: Example: DBA100 (AC1)



7.4.2.2. Offsetting Analog Command

- You may adjust the offset value of command voltage with the parameter AF.
- Offset adjustment of the Driver Unit has been made at the shipping. With the parameter AF, reset the offset along with the master controller.
- The parameter AF sets the offset value by – 4.9 mV per parameter data in the range of AF – 63 to AF 63.

Figure 7-24: Example: AF10 (AC1)



(1) Automatic offset setting

- Set the offset value automatically to compensate the current analog input to 0 (zero).
- Refer to (1) Automatic offset setting in “7.3.2.1. Offsetting Analog Command.”

(2) Manual offset setting

- Adjust the offset manually with the analog command monitor.
- Refer to (2) Manual offset setting in “7.3.2.2. Offsetting Analog command.”

8. Programming

- Programming of the program operation shall be done through the RS-232C communication. Edit the program while the program operation is not performed.

- The program area is shown in Figure 8-1. There are 64 (0 to 63) program channels.

Figure 8-1: Program area

Channel 0	CH0
Channel 1	CH1
•	•
•	•
•	•
•	•
Channel 63	CH63

8.1. Command and Parameters for Condition Setting

◆ Home Return

Command : HS
Condition parameter : None

- Programs the Home Return.

- Command format : HS seq
  seq: Sequence code (∗, &)

- The Motor rotates along the set conditions such as Home Return velocity (HV), Home Return acceleration (HA), and Home Return Near-Zero velocity (HZ).

  ⚠ *Caution : You may change the direction of the Home Return by the parameter HD.*

  ◊ HD0: CW direction

  ◊ HD1: CCW direction (shipping set)

*** Program example**

```
:CH0
 HS
```

◆ Positioning

Command : AD, AR, ID and IR
Condition parameter : CV and CA (Default available)

- These commands and parameters are for the Programmable Indexer.

Table 8-1

<table>
<tr><th>Command format</th><th>Outline</th><th>Option</th></tr>
<tr><td>AD d1 d3 seq</td><td>• Absolute position command in the unit of degree.
• The Motor rotates to the position d1 (unit: 0.01°) of the User Absolute Position Scale.</td><td rowspan="2">Option code d3
/PL: Clockwise
/MI: Counterclockwise
/EX: Follows the DIR input.
• In case of default the Motor takes the shorter direction. (Refer to “9. Glossary of Command and Parameter” for more details.)</td></tr>
<tr><td>AR d1 d3 seq</td><td>• Absolute position command in the unit of pulse.
• The Motor rotates to the position d1 (unit: pulse) of the User Absolute Position Scale.</td></tr>
<tr><td>ID d1 d2 d3 seq</td><td>• Incremental position command in the unit of degree.
• The Motor rotates to the position d1 (unit: 0.01°) from the current position.</td><td rowspan="2">(1) Option code d2
/n: (n ≤ 99)
• Divides the d1 by the data “n” and makes the quotient a step of positioning distance. When default, the d1 won’t be divided.
(2) Optional code d3
/EX: Follows the DIR input.
• Error notice will be given when attaching /EX option while the sign of the d1 is “ – (minus).”
• Follows the sign of the d1 in case of default.</td></tr>
<tr><td>IR d1 d2 d3 seq</td><td>• Incremental position command in the unit of pulse.
• The Motor rotates to the position d1 (unit: pulse) from the current position.</td></tr>
</table>

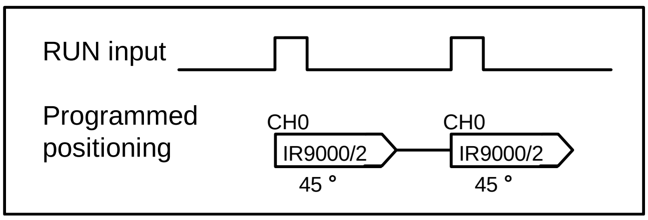
- “seq” denotes a sequence code. The seq codes (∗) and (&) can specify the executing condition for the next program channel.

- Rotational velocity (CV) and rotational acceleration (CA) may be specified on the same channel. In case of default of these parameters, the Motor rotates along the MV and MA settings.

*** Program example**

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

Figure 8-2



◆ Timer

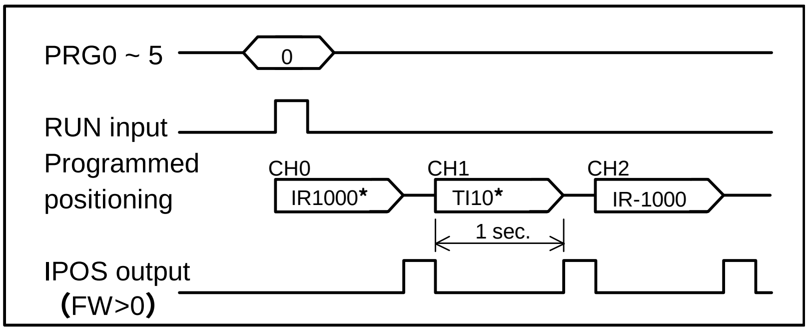
Command : TI
Condition setting : None

- Command format: TI d
  d: 0.3 to 100.0 [× 0.1 sec.]
- This is to set the dwell timer to a program.

*** Program example**

```
:CH0
 IR1000*
:CH1
 TI10*
:CH2
 IR-1000
```

Figure 8-3



◆ Jump

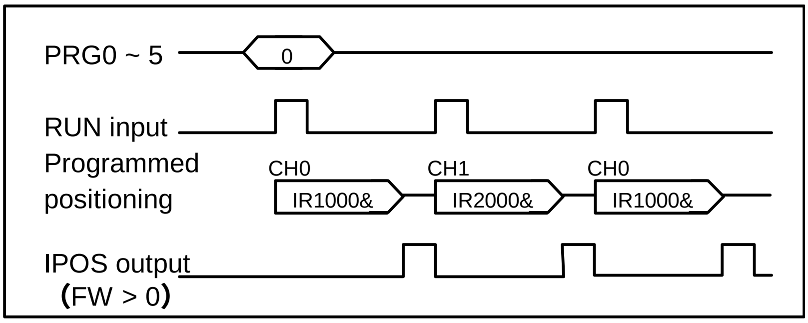
Command : JP
Condition setting : None

- This command sets unconditional jump.
- Command format: JP m
  m: Channel number to jump. (Default: 0)
- The program sequence jumps to a specified channel and executes its program.

*** Program example**

```
:CH0
 IR1000&
:CH1
 IR2000&
:CH2
 JP0
```

Figure 8-4



◆ Sequence code

Related Command : (HS), (AD), (AR), (ID) and (IR)
Condition parameter : CV, ∗ and &

- If a sequence code is added to a command, the following channel may be executed without selecting the channel externally.

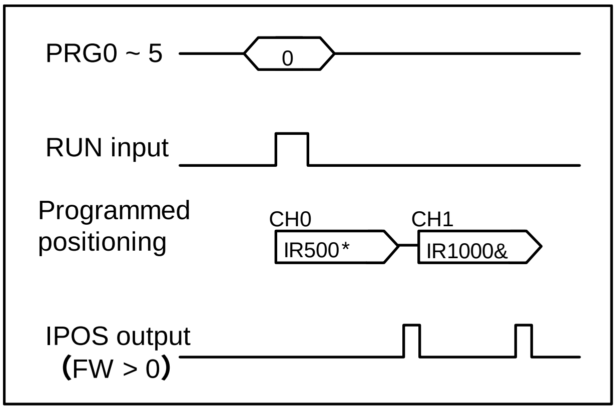
Table 8-2

Sequence code	IPOS output	Executing condition for the nest channel
∗ : Asterisk	Available	Continue to execute the next channel program on completion of the positioning.
& : Ampersand	Available	Stops on completion of the positioning and waits for the RUN input.

*** Program example**

```
:CH0
 IR500*
:CH1
 IR1000&
```

Figure 8-5



◆ Changing sequence code

Condition parameter : OE

- OE seq can change a sequence code currently specified.

*** Program example**

```
:CH0 --------------    Specify the channel whose sequence code has to be changed.
 AR9000& ----------
 CV0.5000 ---------
?OE* --------------    Input as [O] [E] [∗] [ENT].
? -----------------
:TC0 --------------    Check the channel for the change.
 AR9000* ----------    "&" has been changed to "∗."
 CV0.5000 ---------
```

8.2. Command List for Editing Program

Table 8-3

Editing item	Command	Outline of function
Program setting Change program	CH	• CHm ENT (m: channel number) specifies a channel to program. • Input of CHm shows currently set program set in selected channel, if any, and waits for new input while the prompt is "?." • The latest program is valid when the change has been made.
Readout of channel program	TC	• Input TCm ENT (m: channel number) and press the SP key to scroll for reading out program set in the channel number m. • Input TC/AL ENT and press the SP key to scroll all channel for readout of programs.
Delete program	CC	• Input CCm ENT (m: program channel number) to erase a program in channel number m.
Delete channel	CD	• Input CDm ENT (m: program channel number) to delete the channel number m.
Insert channel	CI	• Input CIm ENT (m: program channel number) to insert a channel to position of channel number m. • This will delete the channel with the last number.

8.3. Editing Program

◆ Programming

(1) Specify a program channel number.

[C] [H] [1 #] [0 ?]

```
:CH10_
```

(2) Press the [ENT] key to execute. The display shows a program in the channel, if it is not empty. The prompt "?" appears to indicate it waits for input of new command.

[ENT]

```
 AR18000
 CV0.9000
 CA2.00/2.00
?_
```

(3) Input commands.

[I] [R] [9)] [0 ?] [0 ?] [0 ?]
[/] [1 #] [0 ?]

```
 AR18000
 CV0.9000
 CA2.00/2.00
?IR9000/10_
```

(4) Press the [ENT] key to set the commands. The next prompt "?" appears on the screen when the [ENT] key is pressed.

[ENT]

```
 CV0.9000
 CA2.00/2.00
?IR9000/10
?__
```

(5) Set the condition parameters for each commands.

[C] [V] [0 ?] [. =] [5 %]

```
 CV0.9000
 CA2.00/2.00
?IR9000/10
?CV0.5_
```

(6) Press the [ENT] key to set the parameter.

[ENT]

```
 CA2.00/2.00
?IR9000/10
?CV0.5
?_
```

* When an incorrect command is inputted, reenter the correct one. If the command is duplicated, the command entered later will be valid.

(7) When canceling the condition parameter, set “0” to the condition data.

[C] [V] [0 ?] [ENT]

```
?CV0
?_
```

(8) Press the ENT key only and the prompt returns to “:,” thus completes programming.

[ENT]

```
?
:_
```

◆ Reading channel program

(1) Specify a channel to read out.

[T] [C] [1 #] [0 ?]

```
:TC10_
```

(2) Press the ENT key to execute. The program that is set in the channel is on the screen.

[ENT]

```
:TC10
 IR9000/10
 CV0.5000
:_
```

◆ Deleting program

(1) Specify an objective channel number.

[C] [C] [1 #] [0 ?]

```
:CC10_
```

(2) Press the ENT key to execute. This will erase the program in the channel.

[ENT]

```
:CC10
:_
```

8.4. Example of Programming

- Program the following command and parameters to the channel 5.
  - ◊ Rotation angle: 30.00° in CCW direction.
  - ◊ Acceleration CA: 5 [s^{-2}]
  - ◊ Velocity CV: 0.5 [s^{-1}]

(1) Check if the prompt (:) is displayed on the screen.

→
```
:_
```

(2) Input the channel number to be programmed.

[C] [H] [5 %]

→
```
:CH5_
```

(3) Press the [ENT] key to input.

The figure below shows a case when other program has been set to the channel.

[ENT]

→
```
 AD27000&
 CV1.0000
 CA20.00/20.00
?_
```

(4) Input the command and condition parameters.

[I] [D] [- +] [3 <] [0 ?] [0 ?]
[0 ?]

→
```
 AD27000&
 CV1.0000
 CA20.00/20.00
?ID-3000_
```

(5) Press the [ENT] key to set the program: thus the next prompt "?" appears on the screen.

[ENT]

→
```
 CV1.0000
 CA20.00/20.00
?ID-3000
?_
```

(6) Set the condition parameter.

[C] [A] [5 %]

→
```
 CV1.0000
 CA20.00/20.00
?ID-3000
?CA5_
```

(7) Press the ENT key to set the input: thus the next prompt “?” appears on the screen.

ENT

```
 CA20.00/20.00
?ID-3000
?CA5
?_
```

(8) Input the condition parameter.

C V 0 ? . = 5 %

```
 CA20.00/20.00
?ID-3000
?CA5
?CV0.5_
```

(9) Press the ENT key to set the input. The next prompt “?” appears on the screen.

ENT

```
?ID-3000
?CA5
?CV0.5
?_
```

(10) Press the ENT key again: thus canceling the old program. This completes the programming.

ENT

```
?CA5
?CV0.5
?
:_
```

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9. Glossary of Command and Parameter

9.1. Glossary of Command and Parameter

- “Shipping set” denotes a setting of command or parameter that is set at the factory before shipment.
- “Default” denotes a value that is adopted when entering command and parameter with no data.
- The password must be entered before inputting a command that is marked with ★.
  Refer to “6.3.2.3. Password” for entry of the password.

★ ***AB: I/O Polarity***

Format : AB n1 n2 n3 n4 n5 n6 n7 n8
Data : nn = 0: Normally open contact
nn = 1: Normally closed contact
nn = X • At the time of input: Polarity coded X does not change.
• At the time of readout: Polarity of a port coded X cannot be changed. They are fixed to the normally open contact.
Shipping set : X0X0XXXX (all normally open contacts)
Default : Not available (Input all 8 digits.)

- This command sets polarity of the control input ports.
- The ports whose polarity can be changed are EMST, HLS, OTP, and OTM. The other ports are fixed to the normally open contact.
- Set “X” for the port of which polarity cannot be changed. If “0” or “1” is inputted, the display shows “?” denoting a faulty input.
- The TS or ?AB command reports state of polarity setting.
- The table below shows the correspondence of data digit to Input / Output port.

Data digit	n1	n2	n3	n4	n5	n6	n7	n8
CN2 Pin No.	25	12	24	11	23	10	22	9
Signal	SVON	EMST	IOFF	HLS	HOS	CLR	OTM	OTP

★ ***AC: Analog Command Mode***

Format : AC data
Data : -1, 0, 1
Shipping set : 1
Default : 0

- Sets the validity (valid/invalid) and the polarity of 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 sign of position scale, above polarity shall be reversed as well.
- The TS or ?AC command reports the current setting.

AD: Absolute Positioning, Degree

Format : AD data1/data2
Data range (data1) : Differs with setting of the parameter PS. [Unit: 0.01°]
Default (data1) : 0
Data range (data2) : PL, MI and EX
Default (data2) : Direction into which the move distance is shorter

- "data1" indicates a position data of destination. This position, which can be read out by TP5 command, complies with the position data in the unit of angle. Refer to "6.2.1. Absolute Position Scale (For Driver Unit Equipped with Absolute Position Sensor)."
- "data1" range differs with the PS setting (type of position scale).

	Data range (data1)
PS0	– 9 999 999 to + 9 999 999
PSn	0 to (36 000 × n*) –1

* n = 1 to 99, (Shipping set is set to "1".

- "data2" indicates the rotational direction. However, 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 to (CCW).]
  2) MI : CCW direction [When the parameter DI is set to "1" (DI1), the direction is reversed to (CW).]
  3) Default:
     - The Motor moves to the direction that is shorter distance to the destination.
     - If position data of the current position and destination are the same, moving distance is 0 (zero).
     - If the "off-limits" zone is set by the software over travel limit, the Motor rotates in the direction to avoid the off-limits zone regardless of moving distance.
- This command has two functions depending 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 right after inputting the CH command (channel selection) and the System is in "command receiving " state (the prompt is "?"), it specifies the rotational amount of the Programmable Indexer channel.

★ *AE: Automatic Tuning Error, Alarm Type*

Format : AE data
Data : 0, 2
Shipping set : 0
default : 0

- This parameter sets the output format of "Automatic tuning error" alarm.

Setting	DRDY output	OVER output
AE0	Does not change.	Does not change.
AE2	Does not change.	Closed.

- Regardless of the parameter setting, the alarm state will be monitored by the 7-segments LED and the TA command.
- The TS or ?AE command reports the current setting.

★ *AF: Analog Command Offset*

Format	: AF data
Data range	: - 63 to 63
Shipping set	: 0
Default	: 0

- Sets the offset value on the input voltage of analog command.
- For more details about the parameter AF, refer to “7.3.4. Offsetting Analog Velocity Command” in case of the analog velocity control mode, or “7.4.4. Offsetting Analog Torque Command” in case of the analog torque control mode.
- The TS or ?AF reports the current setting.

★ *AG : Analog Command Gain : AG*

Format	: AGV data
	AGT data
Data range	: 0.10 to 2.00
Shipping set	: 1 (for both AGV and AGT)
Default	: Not available

- This parameter sets the analog command gain in the velocity or torque control mode.
  AGV : Analog command gain in velocity control mode
  AGT : Analog command gain in torque control mode
- Actual gain value is proportional to the velocity or torque command.
  ◊ Example
  When AGV0.5:
  Actual velocity command = Velocity command input × 0.5
- The TS or ?AG command reports the current setting.

AL: Acceleration Limiter

Format	: AL data
Data range	: 0, 0.01 to 1 280.00 [s^{-2}]
Shipping	: 0
Default	: 0

- This command sets the limitation on changes of velocity command (acceleration) in the velocity control mode.
- This limitation is applicable to analog command input and the RS-232C velocity command.
- Setting AL0 disables the function of limiting acceleration/deceleration.
- For more details, refer to “6.3.3.Function to Limit Acceleration / Deceleration.”
- TS or ?AL command reports the current setting.

★ *AN: Axis Number*

Format	: AN data
Data range	: 0 to 15
Shipping set	: 0
Default	: 0

- Sets the axis number in the daisy chain communication mode.
- The TS command or ?AN command reports the current setting.
- Refer to “7.3.4. Daisy Chain Communication.”

★ *AO: Absolute Position Scale Offset*

Format	: AO data
Data range	: 0 to 819 199 [pulse]
Shipping set	: 0
Default	: 0

- Sets the offset value on the Motor absolute position scale and the user absolute position scale.
- AO data: Motor position scale data – user position scale data
- The AO data will be reset if the user position data is cleared by the AZ command.
- The TS or ?AO command reports the current setting.

AR: Absolute Positioning, Resolver

Format	: AR data1/data2
Data range (data1)	: Differs with the parameter PS setting
Default data1	: 0
Data2	: PL, MI, and MI
Default data2	: Direction in which the move distance is shorter.

- "data1" indicates the position data of the destination. The position, which may be read out by the TP2 command, complies with the position scale in the unit of pulse.
  [Refer to "6.2.2. Absolute Position Scale (For Driver Unit Equipped With Absolute Position Sensor)" or "Incremental Position Scale (Fro Driver Unit Equipped with Incremental Sensor)."]

- "data1" range differs with the parameter PS setting and the Motor type.

Setting	Data range (data1)
PS0	– 99 999 999 to＋ 99 999 999
PSn	0 to (819 200 × n) – 1

- n = 1 to 99 (Shipping set is set to "1".)

- "data 2" indicates the rotational direction. When the 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 reversed to CCW.)
  2) MI: CCW direction (When the parameter DI1 is set, the direction is reversed to CW.)
  3) EX: Follows the DIR input.
     OFF: CW direction (When the parameter DI1 is set, the direction is reversed to CCW.)
     ON : CCW direction (When the parameter DI1 is set, the direction is reversed to CW.)
  4) Default
     • The Motor rotates in shorter direction to the destination.
     • If the current position is the same as the destination, the Motor does not rotate.
     • If "off-limits" zone is specified by the over travel limit, the Motor rotates in the direction not to enter the zone regardless of the position command.

- This command has two functions depending on the usage.
  1) If it is entered in the normal standby condition, it serves as a positioning command. (when the prompt is " : _ _ ")
  2) If it is entered right after inputting the CH command (channel selection) and the System is in "command receiving " state (the prompt is "?"), it specifies the rotational amount of the Programmable Indexer channel.

AS: Read out Daisy Chain Status

Format : AS

- The command reads out the status of axis numbers for connected Driver Units in daisy chain communication.

- The AS command will be executed automatically when the power is turned on in the daisy chain communication mode.

- When the AS command is inputted, the Driver Unit of axis number 0 will be always selected.

AT: Automatic Tuning

Format : AT

- Executes the automatic tuning to set automatically the servo parameters and the acceleration.

AX: Axis Select

Format : AX data
Data : 0 to 15
Shipping set : 0
Default : 0

- When communicating in the daisy chain mode, The AX command selects the one of the Driver Units. Selected Driver Unit sends a confirmation signal back to the RS-232C communication terminal.
- Confirmation message is "ACC. AXn" (n = selected Driver Unit number). The Driver Unit of axis 0 is always selected when the power is turned on.
- The TS or ?AX command reports the current setting. These command are only valid in the daisy chain communication.
- If the AX command is input when the daisy chain communication is not active, an error message will be given back.
- Also contents of the readout by the TS command do not include "AX." Inputting "?AX" will be an error as well.

⚠ *Caution : Do not select any Driver Unit that is not connected. Otherwise, operation may hang up. To return to the normal state, press the* [BS] *key first, then input a number of Driver Unit that is connected.*

★ *AZ : Absolute Zero Position Set*

Format : AZ

- When the Motor is stopping at any position, the AZ command makes the current position to the home position of user absolute position scale.
- In case of ESA type Driver Unit, execution of the AZ command will automatically reset the AO data (offset of position data).

★ *BM: Backspace Mode*

Format : BM data
Data : 0 or 1
Shipping set : 1
Default : 0

- The BM command changes the function of the [BS] key.

  BM0 : One press of the [BS] key cancels an entered character string on a line.

  BM1 : One press of the [BS] key deletes a character.

- The TS or ?BM command reports the current setting.

CA: Channel Acceleration

Format : CA data1,data2
Data range : RS type Motor 0, and 0.01 to 80 [s^{-2}]
: AS and BS type Motors: 0, and 0.1 to 120.00 [s^{-2}]
Default : 0

- This command is used to specify the rotational acceleration to the program of a given channel of the Programmable Indexer.
- If no setting is made in a channel (or 0 is specified), the acceleration specified with the MA command is valid.
- The CA command may be inputted under the condition where a channel to be programmed is selected with the CH command, the Driver Unit outputs "?", and the System waits for a command to be entered.
- "data1" sets the acceleration, while data2 sets the deceleration. However, if the acceleration profiling with the CX command is not functioning, the data 1 is valid for both acceleration and deceleration.
- If the data2 is default, the data1 will be applied to the data2.
- The TC command reports the current setting.
    - ◊ However, if " 0" is set on the CA command, no report will be given.

CC: Clear Channel

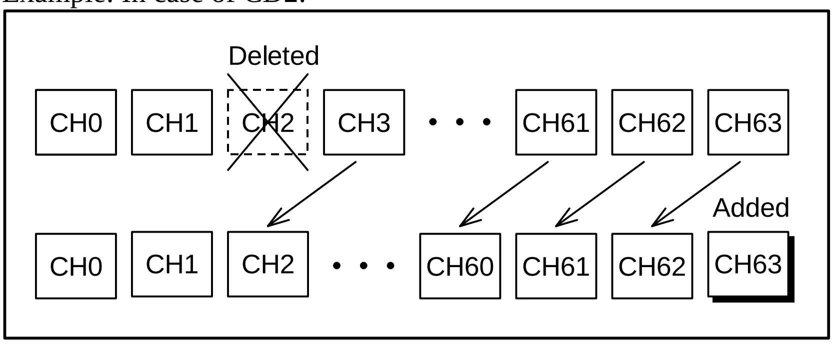
Format: : CC data
Data range : 0 to 63
Default : 0

- The CC command deletes the program data of a channel specified in ' data.'

CD: Delete Channel

Format : CD data
Data range : 0 to 63
Default : 0

- The CD command deletes a channel specified by the data.
- Deletion of a channel induces changes of other channel numbers. The numbers over "data + 1" will move one up respectively and a new channel will be added to the end.
- Example: In case of CD2:



CH: Channel Select

Format : CH data
Data range : 0 to 63
Default : 0

- The CH command declares a channel when editing a program.

- The TC command reports an edited channel.

⚠ *Caution : Be sure to turn the servo OFF when editing a program.*

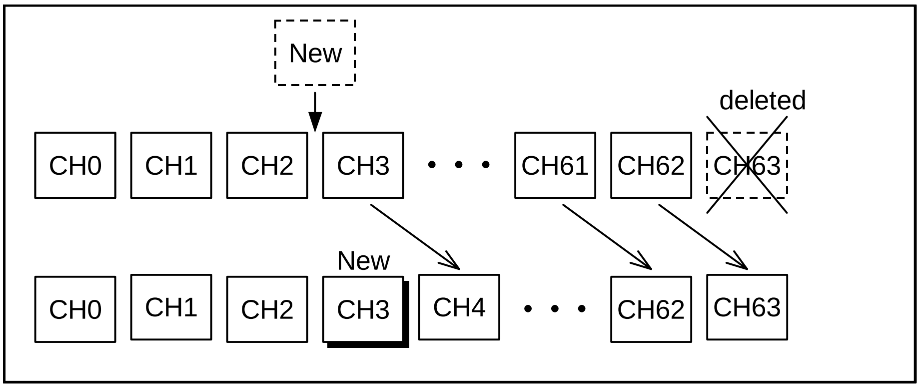
CI: Insert Channel

Format : CI data
Data range : 0 to 63
Default : 0

- "CI data" inserts a new channel to the number specified with the data.

- Insertion of a new channel changes other channel numbers. The numbers after "data" will shift to downward by one respectively and the last channel will be deleted.

- The figure below is an example of the CH3 command.



CL: Clear Alarm

Format : CL

- The CL command only clears alarms of "excess error," "velocity error over," "software thermal," "program error," "RS-232C error," "Home position undefined," and "automatic tuning error." (Other alarms cannot be cleared with the CL command.)

★ CM: Communication Mode

Format	: CM data
Data	: 0 or 1
Shipping set	: 0
Default	: 0

- The CM selects the RS-232C communication mode.
  CM0: Standard
  CM1: Daisy-chain communication

- To change the communication mode, change the CM data, turn off the power, and then turn it on again.

- The TS or ?CM command reports the current setting.

CO : Position Error Counter Over Limit

Format	: CO data
Data	: 1 to 99 999 999 [pulse]
Shipping set	: 50 000
Default	: Not available

- The CO parameter sets the threshold for “excess position error” alarm.

- When the position error exceeds the set value, the Driver Unit outputs the excess position error alarm and opens the DRDY output circuit.

- The TS or ?CO command reports the current setting.

★ CR : Circular Resolution

Format	: CR data
Data	: X1, X2, X4, 360 000, 36 000, 3 600
Shipping set	: X1
Default	: Not available

- Use to specify the pulse train input resolution.

- For the details, refer to “7.2.3. Positioning With Pulse Train Command.”

- The resolution changes immediately after the CR data command is entered.

- The TS or ?CR command reports the current setting.

CS : Acceleration Profiling Select (common setting)

Format : CS data1/data2
Data range : 1 to 5
Shipping set : 1/1
Default : Not available

- The CS command selects a pattern of the acceleration profiling.
  1: Constant acceleration
  2: Modified sine
  3: Modified trapezoid
  4: Cycloid
  5: Half sine

- The data1 sets the accelerating pattern while the data2 sets the deceleration pattern.

- When the “/data2” is default, the pattern of data1will be applied to the data2.

- The TS or ?CS command reports the current setting.

CS: Acceleration Profiling Select (set to a channel of Programmable Indexer.)

Format : CS data1/data2
Data range : 0 to 5
Default : 0

- Selects a pattern of the acceleration profiling to the channels of Programmable Indexer.
  0: Deletes the CS command programmed to a channel and take the common setting.
  1: Constant acceleration
  2: Modified sine
  3: Modified trapezoid
  4: Cycloid
  5: Half sine

- The data1 sets an acceleration pattern while the data2 sets a deceleration pattern.

- When the /data2” is default, the pattern of data1will be applied to the data2.

- The CS command may be set to the channels CH0 to CH31. It cannot be set to the CH32 to CH63 channels.

- The TC command reports the current setting.
  - ◊ However when “0” is specified, no response will be returned.

- For details refer to “6.2.8. Acceleration Profiling.”

CV: Channel Velocity

Format : CV data
Data range
  RS type Motor : 0, 0.0001 to 3.0000 [s^{-1}]
  AS and BS type Motor : 0, 0.0001 to 4.5000 [s^{-1}]
Default : 0

- This command specifies the velocity to the channels of the Programmable Indexer.
- If no setting is made in a channel (or 0 is specified), a velocity specified with the MV command is valid
- The CV command is only valid when the CH command designates a channel to be programmed, and the Driver Unit outputs "?_ _ " for command input.
  - ◊ If it is inputted under normal standby state (the prompt is ":"), an error will occur.
- The TC command reports the current setting.
  - ◊ If "0 (zero)" is set, no response will be returned

★ ***CX: Setting CS Function***

Format : CX data
Data : 0 ··· Acceleration profiling inactive
 : 1 ··· Acceleration profiling active
Shipping set : 1
Default : 0

- The CX command activates the acceleration profiling function.
- TS or ?CX command reports the current setting.
- For the details, refer to "6.2.8. Acceleration Profiling."

★ ***CY: Criterion to function CS***

Format : CY data
Data range
  RS type Motor : 0.01 to 80.00 [s^{-2}]
  AS and BS type Motor : 0.01 to 120.00 [s^{-2}]
Shipping set : 1.00
Default : Not available

- This parameter sets the threshold of acceleration to function the acceleration profiling.
- If the CY data is lower than the data of MA or CA parameter (MA< CY or CA< CY), the acceleration and deceleration will be constant even the acceleration profiling is active.
- The CY command is to shorten the time for calculating motion distances under the specified acceleration and deceleration when the MV or the MA is changed. The time is approximately 1.5 seconds per calculation where set as MV3 MA1.0/1.0 (CY1.0), while it may require two minutes and thirty seconds for a calculation if it is set to MV3 MA0.01/0.01 (CY0.01).
- The TS command reports the current setting.
- For details refer to "6.2.8. Acceleration Profiling."

CZ: Check Actual Acceleration

Format : CZ/RP

- In some conditions shown below, the acceleration profiling won't be performed as specified with the CS command. The CZ command reports how the latest acceleration profiling functioned.

Readout	Definition
0	The acceleration profiling is not effective. (Readout on completion of Home Return or Jog.)
1	Positioning completes with specified acceleration profiling pattern. (Normal)
2	Decelerated in the middle of acceleration due to short positioning distance for the profiling.
3	Decelerated in the same pattern as acceleration due to short positioning distance.

◊ If acceleration pattern is changed to constant acceleration because MA setting is lower than CY setting, the readout code shall be 1 (CZ1) indicating the function worked properly.

- The readout will be automatically repeated if the data /RP is attached to the CZ command.
- The readout shall be one shot if the data /RP is not attached to the CZ command.
- For details, refer to "6.2.8. Acceleration Profiling."

★ *DB: Dead Band*

Format : DBA data
DBP data

Data range
DBA : 0, 1 to 2 047
DBP : 0, 1 to 4 095

Shipping set : 0 (for both of DBA and DBP)

Default : 0

- Sets a dead band to the position loop and the analog command input.
- For more details, refer to "6.2.6. Dead Band: DBP."
- Refer to "7.3.2.1. Dead Band Setting to Velocity Command Voltage" in the velocity control mode, or "7.4.2.1. Dead Band Setting to Torque Command Voltage" in the torque control mode.
- The TS or ?DB command reports the current setting.

DC: Digital RS-232C Command

Format : DC data
Data range : – 4 095 to 4 095 (CW for positive data)
Default : 0

- This command is to input directly the operation command through the RS-232C communication interface in velocity or torque control mode.
  However, the use of this command shall be limited to an ordinal operation, or a testing operation of the Motor due to sluggish response.

- If the DC command is inputted when an analog command (AC command) is valid, "DC INHIBITED" message will be given and the command will be invalidated.

- The data of this command will be cleared to "0" in the following state.
  1) Servo off
  2) Emergency stop
  3) Over travel limit
  4) Control mode is switched.
  5) Analog command is valid.

⚠ *Caution : When the sign of the position scale is reversed with the DI command, the sign of DC command will be reversed as well.*

★ DI: Direction Inversion

Format : DI data
Data : 0 or 1
Shipping set : 0
Default : 0

- Switches the counting direction of position scale.

- For the details, refer to "6.2.1. Incremental Position Scale (For Driver Unit Equipped With Incremental Position Sensor)," or 6.2.2. Absolute Position Scale (For Driver Unit Equipped With Absolute Position Sensor)."

DP: Debugger for Program

Format : DP

- The DP command monitors the history in changing state of control Input/Output, Start/End, and interruption of positioning in Programmable Indexer operation

- Approximately 128 latest histories can be monitored.

- The history will be revised along changes of control Input/Output, or changes in Programmable Indexer operation.

- Refer to "6.1.17.12. Monitoring Changing State of Control I/O and History of Program Execution."

★ *EC: End of Command Message*

Format : EC data
Data : 0 ··· Deactivate (No output)
: 1 ··· Activate (output)
Shipping set : 0
Default : 0

- The EC command activates the function to output the message signal that indicates the Driver Unit is in standby state for another operation command in the positioning mode with Programmable Indexer or the RS-232C communication command.
- Message "! "will be outputted for selection of outputting message function.
- When other commands or parameters are inputted during positioning, the message will be outputted on completion of these commands.
- The TS or ?EC command reports the current setting.

★ *EP: Excessive Position Error, Alarm Type*

Format : EP data
Data : 1, 2, and 3
Shipping set : 2
Default : Not available

- The EP command sets a type of alarm output for "Excessive position error. "

Setting	DRDY output	OVER output
EP1	Open	Does not change.
EP2	Does not change.	Closed
EP3	Open	Closed

- Regardless of the setting of this command, 7 segments LED and TA command will report the alarm state.
- The TS of ?EP command reports the current setting.

★ *FC : Friction*

Format : FC data
Data range : 0 to 2 047
Shipping set : 0
Default : 0

- The FC parameter 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.
- The parameter FC can be obtained with the formula shown below.

$$\text{FC "data"} = 2\,047 \times \frac{\text{Static friction torque}}{\text{Motor maximum torque}}$$

- The setting can be read with the TS or ?FC command.

★ *FD: Feed Back Direction Mode*

Format : FD data
Data : 0, 1
Shipping : 0
Default : 0

- Reverses the output timing between øA and øB of the position feedback signal.
  FD0 : Standard øA is the leading phase in CW direction.
  FD1 : Reverse øB is the leading phase in CW direction.

- The TS or ?FD command reports the current setting.

★ *FF: Feed Forward Gain*

Format : FF data
Data : 0 to 1.0000
Shipping set : 0
Default : 0

- The FF parameter sets the feed forward compensation gain to the position loop.

- Refer to “6.2.4. Feed Forward Compensation: FF” for more details

- Setting 0 to the data cancels the feed forward compensation function.

- The TS or ?FF command reports the current setting

FO: Low-pass Filter Off Velocity

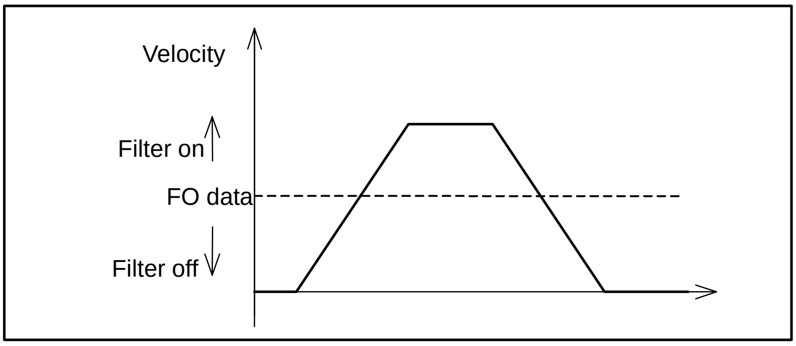
Format : FO data
Data range : 0, 0.01 to 3.00 [s^{-1}]
Shipping set : 0
Default : 0

- Setting the FO parameter will make the low pass filter (the FP and FS parameters) velocity sensitive.

- The FO parameter sets the threshold for turning ON and OFF the low-pass filter.

- When this function is set, resonating noise may be lowered without influence on the settling time.

- Setting the FO parameter to “0” will deactivate the velocity sensitive function.
  (However. the low-pass filters are always effective.)



FP: Low-pass Filter, Primary

Format	: FP data
Data	: 0, 10 to 500 [Hz] or /AJ (Adjusting mode)
Shipping set	: 0
Default	: 0

- The FP parameter sets the frequency of the primary low-pass filter of the velocity loop.
- When the data 0 is input, the velocity-loop primary low-pass filter is deactivated. In such a case a message [PRI.LPF OFF] will be displayed.
- When the data other than 0 (i,e, 10 to 500) is entered, the value is adopted as the frequency.
- The TS or ?FP command reports the current setting.
- Inputting FP/AJ starts fine adjusting mode.

★ *FR: Feed Back Signal Resolution (Factory use only)*

Format	: FR data
Data	: 1
Shipping data	: 1
Default	: 0

- Sets the resolution specification of the position feedback signal øA and øB.

  FR0: 10bit resolution

  FR1: 12bit resolution
- Refer to "2.7.2. Functional Specifications" for more details.
- When the position sensor resolution is set in "10bit or automatic switching," be sure to set the parameter to FR0. Phase A and B won't be output if FR1 is set.
- The settings of FR0 and FR1 are both effective when the position sensor resolution is set to 10bit by the RR parameter.
- The TS or ?FR command reports the current setting

FS : Low-pass Filter, Secondary

Format	: FS data
Data	: 0, 10 to 500 [Hz], or /AJ (Adjusting mode)
Shipping set	: 0
Default	: 0

- The FS parameter sets the frequency of the secondary low-pass filter of the velocity loop.
- When the data 0 is input, the velocity-loop secondary low-pass filter is deactivated. In such a case, a message [SEC.LPF OFF] will be displayed.
- When the data other than 0 (i,e, 10 to 500) is entered, the value is adopted as the frequency.
- The TS or ?FS command reports the current setting.
- Inputting FP/AJ starts fine adjusting mode.

FW: FIN Width

Format	: FW data
Data	: 0 or 0.3 to 100 [0.1 second]
Shipping set	: 1
Default	: 0

- Sets the time length to keep outputting the IPOS signal. The unit is 0.1 sec.
- If it is set to FW1, the time length outputting the IPOS signal will be 0.1 sec.
- If ‘data’ is 0, the IPOS output will be in the IPOS mode and the IPOS output is always closed while the value of the position error counter is within the range specified by the IN parameter.
- If ‘data’ is set between 0.3 and 100, the IPOS output will be in the FIN mode and it closes for the moment specified with the FW parameter when the position error counter value enters the range specified with the IN parameter.
- If ‘data’ is set between – 0.3 and –100, the IPOS output will be in CFIN mode, and it opens while the Driver Unit is outputting the internal pulses. It will close when the Driver Unit is in the standby state for the next positioning command on completion of positioning. .
- Refer to “7.1.11. In-Position Output” for the output timing.
- The TS or ?FW command reports the current setting.
- Set the IPOS output to the IPOS mode when the System is in the pulse train position command operation. (FW0)

★ *FZ: Feedback Phase Z Configuration*

Format	: FZ data
Data	: 0 or 1
Shipping set	: 0
Default	: 0

- The FZ command selects the output format of the position feedback signal CHZ (CN2 output).
  FZ0 : Outputs the øZ signal from CHZ.
  FZ1 : Outputs MSB of the digital position signal from CHZ.
- Refer to “6.1.16. Position Feedback Signal” for the output timing of each signal.
- TS or ?FZ command reports the current setting.

★ *GP: Gain Switching Point : GP*

Format : GP data
Data range : 0, 1.0 to 1 000 [pulse]
Shipping set : 0
Default : 0

- Sets the threshold of position error of the position error counter for the automatic gain switching function.
- It switches to the gain at stopping when the absolute position error in the position error counter keeps clearing the parameter GP setting for a time set by the timer GT [ms].
- Setting the data to 0 disables the function of automatic gain switching.
- Refer to “6.2.7. Automatic Gain Switching” for more information.
- The TS or ?GP reports the current setting.

GT: Switching Gain Timer

Format : GT data
Data Range : 0 to 1 000 [ms]
Shipping set : 5
Default : 0

- The gain will be switched to the stopping level if the absolute value of error is within the GP value for a time set by the stability timer GT [ms].
- Refer to “6.2.7. Automatic Gain Switching” for more details.
- The TS or ?GT reports the current setting.

HA: Home Return Acceleration

Format : HA data
Data range
RS type Motor : 0.01 to 80.00 [s^{-2}]
AS and BS type Motor : 0.01 to 120.00 [s^{-2}]
Shipping set : 1.00 [s^{-2}]
Default : Not available

- The HA command sets an acceleration of Home Return.
- The TS or ?HA reports the current setting.

★ *HD: Home Return Direction*

Format : HD data
Data : 0, 1
Shipping set : 1
Default : 0

- Refer to “7.2.1. Setting Home Position With Home Return” for more details.
  HD0: Home Return in clockwise (CW).
  HD1: Home Return in counterclockwise (CCW).

HI: Home In-position

Format : HO data or /ST
Data : 0 to 102 400 [pulse]
Shipping set : 0
Default : 0

- The HI parameter sets the outputting range at where the HOME output signal closes when Home Return is in reporting mode of detection of the home position (HW ≠ 0).

- The HOME output closes when the Motor is in the range set by the HI parameter centering the user home position.

- The TS or ?HO command reports the current setting.

★ *HO: Home Offset*

Format : HO data or ST
Data range
  RS type Motor : – 610 304 to 610 304 [pulse]
  AS and BS type Motor : – 405 504 to 405 504 [pulse]
Shipping set : 0
Default : 0

- The HO parameter specifies an offset to where the Motor advances from the point where the detected position data becomes 0 for the first time after the input of limit switch (HLS: CN2) in Home Return. Refer to “7.2.1. Setting Home Position With Home Return.”

- Input of the HO data sets the offset data from the position at where the data of position sensor becomes 0.

- When the HO/ST command is inputted, the distance to the position 0 of position sensor from the current position will be set as the offset value.

- The TS or ?HO command reports the current setting.

HS: Home Return Start

Format : HS opt
: opt = default ----- Normal Home Return
: opt = /LS --------- Adjust limit position

- Starts Home Return.
- Input HS/LS to adjust the position of the home position proximity sensor.
- Refer to “7.2.1.2. Setting Home Position With Home Return.”

★ *HT: Hardware Travel Limit Over, Alarm Type*

Format : HT data
Data : 0, 1, and 2
Shipping set : 2
Default : 0

- The HT command sets the format of outputting an alarm for “Hardware travel limit over.”

Setting	DRDY output	OVER output
HT0	Does not change.	Does not change.
HT1	Open	Does not change
HT2	Does not change.	Closed

- Regardless of the setting with this command, the 7 segments LED and TA command report the alarm status.
- The TS or ?HT command reports the current setting.

HV: Home Return Velocity

Format : HV data
Data range
  RS type Motor : 0.0001 to 3.0000 [s^{-1}]
  AS and BS type Motor : 0.0001 to 4.5000 [s^{-1}]
Shipping set : 0.2000 [s^{-1}]
Default : Not available

- The HV parameter sets Home Return velocity.
- The TS or ?HV command reports the current setting.

HW: HOME Signal Holding Time

Format	: HW data
Data range	: 0, 0.3 to 100 [0.1sec]
Shipping set	: 0
Default	: 0

- Specifies the format of outputting the HOME signal.
- If the data is set to 0, “Home Return complete output” is selected; the HOME output closes on completion of Home Return. It opens when the Motor moves away from the home position by the next positioning command or servo-off.
- If the data’ is set between 0.3 and 100, the report mode of detection of home position is selected; the HOME output closes if the Motor is within the range specified by the HI parameter centering the user absolute home position. At this moment the HOME output closes at least for a time specified by the HW parameter.
- The TS or ?HW command will report the current setting.

HZ: Home Return Near-Zero Velocity

Format	: HZ data
Data	: 0.0100 to 0.2000 [s^{-1}]
Shipping set	: 0.0100 [s^{-1}]
Default	: Not available

- Sets Home Return near-zero velocity.
- The TS or ?HZ command reports the current setting.

ID: Incremental Positioning, Degree

Format	: ID data1/data2
Data range (data1)	: – 9 999 999 to + 9 999 999 [0.01°]
Default (data1)	: 0
Data range (data2)	: EX
Default (data2)	: Follows the sing of data1.

- In positioning with Programmable Indexer or the RS-232C communication, the ID command executes incremental positioning in the unit of degree.

- The data is in the unit 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

- The data2 selects the validity of the direction specified with the DIR input.

  /EX : Follows the DIR input. (CW if the DIR input is OFF, or CCW if the the DIR input is ON. When the settign of direction of the position scale is DI1, the dirction is CW if the DIR input is OFF, and CCW if the input is ON.)

  In this case, an error occurs if the data1 is negative (–).

  Default : Follows the sign of the data1.

- This command has two functions depending 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 right after inputting the CH command (channel selection), and the System is in “command receiving ” state (the prompt is “?”), it specifies the rotational amount of the Programmable Indexer channel.

★ *ILV: Integration Limit*

Format	: ILV data
Data	: 0.0 to 100.0 [%]
Shipping set	: 100

- Provides the velocity loop integrator with a limit.

- Refer to “6.2.5. Integration Limiter: ILV” for the details.

- The TS or ?ILV reports current setting.

★ IM: IOFF Mode

Format : IM data
Data : 0, 1
Shipping set : 0
Default : 0

- This command specifies the function of the velocity loop integration frequency OFF or to lower the velocity loop proportional gain, when the IOFF signal is input.
  IM0 : Mode that has both functions of "velocity loop integration frequency OFF" and "lowering velocity loop proportional gain."
  IM1 : Exclusive mode of velocity loop integration frequency OFF

- The TS or ?IM command reports the current setting.

IN: In-position

Format : IN data
Data : 0 to 99 999 999 [pulse]
Shipping set : 100
Default : 0

- Specifies the In-position width (criteria to detect completion of positioning).

- If the position error counter reaches a value below the IN data, the IPOS signal is output.

- The TS or ?IN command reports the current setting.

IO: Input/Output Monitor

Format : IO data opt
Data : data = default, or 0 Indicates Input/Output status.
data = 1 : Indicates Input/Output status.
(Inputs of normally closed contact will be highlighted in reverse video.)
data = 2 : Indicates Input/Output status of Programmable Indexer operation.
data = 3 : Indicates Input/Output status of Jog operation.
Option code : opt = default Indicates current status in one shot.
opt = /RP Reading is repeated automatically.

- Indicates the status of control Input/Output signals (ON/OFF, open/closed) of the CN2 and CN5 connectors by 1s or 0s.
  [1: Input ON, output closed] [0: Input OFF, output opened]

- Press the BS key to terminate the IO/RP repetitive automatic reading,

- For more details, refer to "6.1.17.1. Monitoring Control Input/Output Signals."

IR: Incremental Positioning, Resolver

Format : IR data1/data2
Data range (data1) : – 99 999 999 to + 99 999 999 [pulse]
Default (data1) : 0
Data (data2) : EX
Default (data2) : Follows the sign of the data1.

- In positioning with the Programmable Indexer or the RS-232C communication, the ID command executes incremental positioning in the unit of pulse.

- The data sign specifies the direction of rotation.
  data > 0 : plus direction (CW)
  data < 0 : minus direction (CCW)

- The data2 selects the validity of the direction specified with the DIR input.

  /EX : Follows the DIR input. (CW if the DIR input is OFF, or CCW if the the DIR input is ON. When the direction of position scale is set to DI1, the dirction is CW if the DIR input is OFF, and CCW if the input is ON.)
  In this case, an error occurs if the data1 is negative (–).

  Default : Follows the sign of the data1.

- This command has two functions depending 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 right after inputting the CH command (channel selection) and the System is in “command receiving ” state (the prompt is “?”), it specifies the rotational amount to a program of designated Programmable Indexer channel.

IS: In-position Stability Counter

Format : IS data
Data : 0 or 0.3 to 100.0 [0.1 sec]
Default : 0

- Specifies the output condition of the positioning completion signal (IPOS).
  IS0 : The IPOS output closes in positioning if the data of the position error counter is within the setting of the IN parameter.
  IS data (data ≠ 0) : The IPOS output closes in positioning if the data of the position error counter is stable within the setting of the IN parameter for [’data’ × 01 seconds].

- The TS or ?IS command reports the current setting.

JA: Jog Acceleration

Format : JA data
Data range
  RS type Motor : 0.01 to 80.00 [s^{-2}]
  AS and BS type Motor : 0.01 to 120.00 [s^{-2}]
Shipping set : 1.00
Default : Not available

- Sets the acceleration for Jog operation.
- The TS or ?JA command reports the current setting.

JP: Jump

Format : JP data
Data range : 0 to 63
Default : 0

- The JP command is used to specify the destination of unconditional jumping in an internal program.
- If a channel with JP command is executed, the currently processed program jumps to a channel specified by the data unconditionally, and then the System executes the program of specified channel.
- The JP command can be inputted only when a channel to be programmed is selected by the CH command, and the Driver Unit outputs "?" to wait for the next command.
- If it is entered in the normal standby state (the prompt ":" is on the screen.), an error alarm arises.
- The TC command reports the current setting.

JV: Jog Velocity

Format : JV data
Data range RS type Motor: 0.0001 to 3.0000 [s^{-1}],
  AS and BS type Motor : 0.0001 to 4.5000 [s^{-1}]
Shipping set : 0.1000
Default : Not available

- Sets the velocity for Jog operation.
- The TS or ?JV command reports the current setting.

LG: Lower Gain

Format : LG data
Data : 0 to 100 (%)
Shipping set : 50
Default : Not available

- Sets a lowering ratio of velocity loop proportional gain (VG) when LVG input is ON, or IOFF input is activated in the IM0 mode.
- However, the LG command is invalid during the automatic tuning.

★ *LO: Load Inertia*

Format	: LO data
Data range	: 0 to 50.000 [kgm^2]
Shipping set	: 0
Default	: 0

- This is to set the actual load inertia.
  - ◊ The execution of automatic tuning sets the actual load inertia LO automatically.
- The TS command or ?LO reports the current setting.
- The data of PG, VG, VI, and MA will be automatically adjusted when the LO data is changed.
- The data of LO is cleared to 0 when one of the data of PG, VG or VI is changed.

★ *LR: Low Torque Ripple*

Format	: LR data
Data range	: 0, 1
Shipping set	: 0
Default	: 0

- Selects the characteristics of the Motor torque output.
  0 : Standard
  1 : Low torque ripple. (The available maximum Motor torque will be lowered.)
- The TS or ?LR command reports the current setting.

MA: Move Acceleration

Format	: MA data1,data2	
Data range	RS type Motor	: 0.01 to 80.00 [s^{-2}], or /AJ (Adjust mode)
	AS and BS type Motor	: 0.01 to 120.00 [s^{-2}], or /AJ (Adjust mode)
Shipping set	: 1.00 [s^{-2}]	
Default	: Not available	

- The MA parameter sets the acceleration in the positioning with the Programmable Indexer or the RS232C communication command.
- The data1 sets the acceleration, while data2 sets the deceleration. However, data1 shall be applied to the acceleration and deceleration if the acceleration profiling is disabled with the CX command.
- If the data2 is default, the data1 shall be applied to the data2.
- The TS or ?MA command reports the current setting.
- An adjusting program will start with the MA/AJ command. However, the adjusting program cannot be used during a positioning with the acceleration profiling.
- The MA parameter will be automatically adjusted if the LO data is changed.

MD: Move Deceleration

Format	: MD data	
Data range	RS type Motor	: 0.01 to 80.00 [s^{-2}]
	AS and BS type Motor	: 0, 0.01 to 120 [s^{-2}]
Shipping set	: 0	
Default	: 0	

- The MD parameter sets the deceleration for stopping caused by the STP input or the MS command.
- If the data is specified to ‘ 0,’ the Motor stops instantaneously.
- The TS or ?MD command reports the current setting.
- For more details, refer to “6.1.3. Interruption of Positioning With STP Input.”

MI: Read Motor ID

Format : MI

- This command is used to monitor reference numbers of the system ROM and the torque ROM.

★ *MM: Multi-line Mode*

Format	: MM data
Data	: 0, 1
Shipping set	: 1
Default	: 0

- Sets the display format of commands and parameters to be read out with the TA, TC and TS commands.
- Inputting “MM0” reports all contents continuously.
- When “MM1” is input, the display reports the setting pausing at each item. At this time, the semicolon “;” appears the end of command or parameter.

  [Example: MA0.01;]
- Only the space key and backspace key are valid when the Motor is pausing. Press the space key to step to the next parameter, and press the backspace key to interrupt the readout. The colon " :" appears to wait for the next command.
- The TS or ?MM reports the current setting.

MN: Monitor Select

Format : MN data
Data : 0 to 8, or /AL
Shipping set : 0
Default : 0

- Selects and sets the type of analog monitor.
- The setting is not backed-up in the memory. The MN data will be 0 when the power is turned on.
- The saw-tooth waveform in – 10 [V] to + 10 [V] may be obtained with the input of MN/AL.
- Setting can be read by ?MN command.
- The analog monitor outputs are shown in the table below.

MN data	Monitor output
MN0	Velocity
MN1	Velocity command
MN2	Velocity error
MN3	Torque command
MN4	Phase C current command
MN5	Position command
MN6	Residual pulses of the position error counter (± 127 pulses / ± 10V)
MN7	Residual pulses of the position error counter (± 16 383 pulses / ± 10V)
MN8	Phase C software thermal loading

MO: Motor Off

Format : MO

- When the Motor is in the servo-on state with SVON input ON (CN2), the MO command turns the Motor servo off right after its input.
- To activate the Motor servo again, input the SV or the MS command.
- When the Motor servo is activated with the MS command again, it clears the previously inputted operation command.

MS: Motor Stop

Format : MS

- When the MS command is input in the middle of a positioning, the Motor abandons the programs, and stops. At this time, the Motor is in the servo-on state (servo-lock).
- The MD parameter specifies the deceleration for MS command.
- The operation commands specified before the Motor stops will be cleared. When the Motor servo is off with the MO command, an input of the MS command activates the Motor servo again. This also clears the operation commands being executed before the input of MO command.

★ *MT: Motor Torque (Factory use only)*

Shipping set : Optimized to individual Motors when shipping..

⚠ *Caution : Do not change the setting since the parameter is properly set to each Motor.*

- This parameter is set at the factory before shipping.
- The TS or ?MT command reports the current setting.

MV: Move Velocity

Format : MV data
Data
RS type Motor : 0.0001 to 3.0000 [s^{-1}], or /AJ (Adjust mode)
AS and BS type Motor : 0.0001 to 4.5000 [s^{-1}], or /AJ (Adjust mode)
Shipping set : 1.0000 [s^{-1}]
Default : Not available

- Sets the velocity of the RS-232C communication command operation.
- The TS or ?MV command reports the current setting.
- The MV/AJ command sets to adjusting mode. However, the MV/MJ command will be disabled during a positioning to which the acceleration profiling is specified.

NA: Near Position A
NB: Near Position B

Format : NA data, NB data
Data range : 1 to 99 999 999 [pulse]
Shipping set : 100
Default : Not available

- In the positioning with the Programmable Indexer or the RS-232C communication command, the NEARA or the NEARB output reports that the Motor has reached the proximity zone set by the NA or the NB data in the unit of pulse in front of the destination (target) of positioning.
- The NA data is for the EARA output, and the NB data is for the NEARB output.
- If the NMA or the NMB parameter is 0, the NEARA or the NEARB output will be in the target proximity mode.
- The TS, ?NA, or ?NB command reports the current setting.
- For details of function, refer to “6.1.15. Target Proximity / In-target.”

★ NMA: Near A Output Mode
★ NMB: Near B Output Mode

Format	: NMA data NMB data
Data range	: 0, 0.3 to 100.0 [0.1 sec]
Shipping set	: 0
Default	: 0

- Selects the mode of NEARA and NEARB outputs.
- When the data is set to 0, the outputting mode will be the target proximity, and the outputs will report that the Motor has reached near the proximity zone set by the NA or the NB in the unit of pulse.
- If the data is set between 0.3 and 100.0, the outputting mode will be the In-target and the outputs report that the Motor is on a position set by the ZAS and the ZAE or the ZBS and the ZBE on the user position scale. The data of NMA and NMB are the minimum holding time of output when the Motor passes the zone at very high velocity.
- The TS or ?NM command reports the current setting.
- For details of function, refer to "6.1.15. Target Proximity / In-target."

NP: Notch Filter, Primary

Format	: NP data
Data	: 0 or 10 to 500 [Hz] or /AJ (Adjusting mode)
Shipping set	: 0
Default	: 0

- The NP parameter 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 data other than 0 (i.e., 10 to 500) is entered, the data is adopted as the frequency.
- The TS or ?NP command reports the current setting.
- The NP/AJ command sets to adjusting mode.

NS: Notch Filter, Secondary

Format : NS data
Data : 0, 10 to 500 [HZ], or /AJ (adjust mode)
Shipping set : 0
Default : 0

- The NS data sets the frequency of secondary notch filter.
- If 0 is specified, the 2nd stage notch filter will be set to OFF. In such a case the display shows "SEC.NF.OFF."
- If the data other than "0" (i.e., 10 to 500) is specified, the frequency will be set to the data.
- The TS or ?NS reports the current setting.
- The NS/AJ starts adjusting program.

★ *NW: Chattering Preventive Timer*

Format : NW data
Data : 0 to 4
Shipping set : 2
Default : 0

- The RUN and the HOS signals are edge-triggered inputs. To protect against multiple inputs due to contact chattering, the NW timer sets a time to confirm the edge-triggered input later as the level triggered input.

  Timer = data × 2.8 [ms]

- The TS or ?NW command reports the current setting.

OE: Sequence Option Edit

Format : OE data
Data : * or &
Default : Not available

- The OE command changes the sequence code of a program previously specified in a channel.
- When this command is entered under the following conditions, the sequence code previously set to the specified channel will be changed to the data of this command.
  - ◊ The CH command specifies a channel to be programmed.
  - ◊ The Driver Unit outputs "?" indicating that it is ready for an input of command. (An error arises if the command is entered when the Driver Unit indicates ":" for normal standby state.)
- The data denotes the sequence code. Adding the sequence code enables to execute the positioning program of the next channel without selecting it externally.

  ∗ : After execution of the program, outputs IPOS signal , and then execute the next channel's program.

  & : After execution of the program, the IPOS signal outputs, the Motor stops, and then executes the next channel's program when the RUN command is input.

★ OG: Origin Set

Format : OG

⚠ *Caution : This is for NSK factory use only. Do not input the OG command.*

★ OL: Overload Limit (Factory use only)

Format : OL data
Data : 0 to 100
Shipping set : Unique value for each Motor
Default : 0

- Do not change the OL setting. OL is properly set for each Motor at the factory. If it requires to change, contact NSK.
- If 0 is specified, the Driver Unit displays "THERMAL OFF" to indicate it is deactivated.
- The TS or ?OL command reports the current setting.

★ OP: Forced Output Port Primary/Extended

Format : OPP b2 b1 b0
OPE b7 b6 b5 b4 b3 b2 b1 b0
Data : bn = 0 ··· open
bn = 1 ··· closed
bn = X ··· Does not change.
Default : Not available. Input all data.

- The OP command forcibly controls the control Input/Output ports.
- The OPP command controls the connector CN2, and the OPE command controls the connector CN5.
- This command outputs forcibly the input data after its execution until you press the BS key.
- The System returns to normal outputting state by the internal controller after the BS key is pressed.
- Relation between the data and the signal

Command	data	b7	b6	b5	b4	b3	b2	b1	b0
OPP (CN2)	Pin No.	–	–	–	–	–	15 (2)	14	3
	Signal code	–	–	–	–	–	DRDY	IPOS	BRK
OPE (CN5)	Pin No.	23	22	21	20	5	4	3	2
	Signal code	Reserved	HCMP	HOME	SPD	Reserved	NEARB	NEARA	OVER

★ *OR: Criterion, Overrun Alarm*

Format	: OR data	
Data range	RS type Motor	: 153 600 to 614 400 [pulse]
	AS and BS type Motor	: 102 400 to 409 600 [pulse]
Shipping set	RS type Motor	: 307 200 [pulse]
	AS and BS type Motor	: 204 800 [pulse]
Default	: Not available	

- This parameter sets the threshold of distance to report an overrun alarm.
- The overrun alarm occurs when the error in the position error counter exceeds the sum of the data of the CD and the OR.
- The TS or ?OR reports the current setting.

★ *OS: Origin Setting Mode*

Format	: OS data
Data	: data = 1 ··· Completes Home Return when the Motor got out the zone, where the home position sensor is being ON.
	data = 3 ··· Completes Home Return at where the Motor advanced the HO data offset after going out the zone, where the home position sensor is being ON.
	data = 4 ··· Completes Home Return at where the Motor advanced the HO data offset after it entered the zone, where the home position sensor is being ON.
	data = 5 ··· Completes Home Return when the Motor gets in the zone, where the home position sensor is being ON.
	data = 6 ··· Sets the current position as the home position.
Shipping set	: 4
Default	: Not available

- This command sets the mode of Home Return.
- Refer to “7.2.1.4. Setting Home Position With Home Return” for more details.
- The TS or ?OS command reports the current setting.

★ *OTP: Over Travel Limit Switch Position : OTP*
★ *OTM: Over Travel Limit Switch Position : OTM*

Format	: OTP data, OTM data
Data	: - 99 999 999 to + 99 999 999 [pulse], or /ST (teaching mode)
Shipping set	: 0 (OTP, OTM)
Default	: 0

- Sets the software over travel limit data in the position scale.
  OTP : Sets the over travel limit data in the plus direction in the unit of pulse.
  OTM : Sets the over travel limit data in the minus direction in the unit of pulse.
- OTP/ST and OTM/ST commands enable to set the positions with teaching.
  (For more details, refer to “6.1.8.2. Software Over-travel Limit.”)
- The TS or ?OTP command reports the current setting.

★ *OU: Origin Undefined, Alarm Type*

Format : OU data
Data : 0, 2
Shipping set : 0
Default : 0

- This command sets the alarm mode of “Home position undefined.”

Setting	DRDY output	OVER output
OU0	Does not change.	Does not change.
OU2	Does not change.	Closed.

- Regardless of the setting with the OU command, the 7 segments LED and the TA command reports the alarm state.

- The TS or ?OU command reports the current setting.

★ *PA: Phase Adjust (Factory use only)*

Format : PA data
Data : 24 to 1 048
Shipping set : Depending on each Motor
Default : Not available

- Sets the compensation value of the resolver installation position.

- The TS or ?PA command reports the current setting.

⚠ *Caution : Do not change the setting as it is properly adjusted at the factory. If you need to change the setting, consult with NSK.*

★ *PC: Pulse Command*

Format : PC data
Data : 0 to 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, single format
  PC3 : øA/øB input, duplex format
  PC4 : øA/øB input, quadruple format

- The TS or ?PC command reports the current setting.

★ PE: Program Error, Alarm Type

Format : PE data
Data : 0, 2
Shipping set : 2
Default : 0

- This command sets the alarm mode of "Program error."

Setting	DRDY output	OVER output
PE0	Does not change.	Does not change.
PE2	Does not change.	Closed.

- Regardless of the setting of the PE command, 7 segments LED and the TA command reports the alarm state.
- The TS or ?PE command reports the current setting.

PG: Position Gain

Format : PG data
Data : 0.010 to 1.000, or /AJ (adjusting mode)
Shipping set : 0.100
Default : Not available

- Sets the position loop proportional gain.
- The TS or ?PG command reports the current setting.
- The PG/AJ starts the adjusting program.
- The gain setting is automatically adjusted when the LO data or the SG data is changed.
- Change of the PG data clears the LO data and the SG data to 0 (zero).

★ PH: Program Home Return

Format : PH data
Data : 0 ----- Automatic Home Return invalid
1 ----- Execute the automatic Home Return only once when the power is turned on if the Home position is undefined.
2 ----- Execute the automatic Home Return every time before a program operation.
Shipping set : 0
Default : 0

- This is to execute Home Return automatically before an execution of positioning with the Programmable Indexer.
- The setting makes the HS command unnecessary, thus saves a program area for one channel.
- The TC/AL or ?PH command reports the current setting.

★ PS: Position Scale Select

Format : PS data
Data : 0, 1, and 2 to 99
Shipping set : 1
Default : 0

- Switches the internal position scale system of the Megatorque Motor System. However, this function is not available in the ESA Driver Units equipped with absolute position sensor.
  - ◊ PS0 : Linear position scale
  - ◊ PS1 : Single-rotation position scale
  - ◊ PS2 to 99 : Multi-rotation position scale
- For more details about the position scale, refer to "6.2.1. Incremental Position Scale (For Driver Unit Equipped with Incremental Position Sensor)," and "6.2.2. Absolute Position Scale (For Driver Unit Equipped with Absolute Position Sensor)."
- The TS or ?PS command reports the current setting.

RA: Read Analog Command

Format : RA/RP

- Reads an analog command value when the analog command is valid.
- "RA INHIBITED" message will be returned when the analog command is invalid.
- The report is a decimal number in -2 048 to 2 047.
- Addition of /RP data to the RA command is to report the reading repeatedly, while RA input alone reports in one shot. To quit from the repetitive readings, press the BS key.
- The report includes the result of dead band setting when the DBA (dead band) is set to the analog command.

★ RC: Rated Current (Factory use only)

Format : RC data
Data : 0 to 100
Shipping set : Uniquely set to each Motor.
Default : 0

- Do not change the RC setting. The RC value has been properly set to each Motor at the factory.
- If it requires changing the setting, contact NSK.
- The TS or ?RC command reports the current setting.

★ *RI: Factory use only.*

⚠ *Caution : Do not change the setting. It has been properly set to each Motor.*

- This is for the factory use only.
- The TS or ?RI command reports the current setting.

★ *RO: Factory use only.*

Format : RO data
Data range : 0 to 4 095 (pulse)

⚠ *Caution : Do not change the setting because it is properly set to each Motor at the plant.*

- This parameter is for the factory use only.
- The TS and ?RO command reports the current setting.

RP: Read Pulse Train Command

Format : RP data／RP
Data range : 0 ··· Readout in decimal number (0 to 65 535)
1 ··· Readout in hexadecimal number (0000 to FFFF)
Default : 0

- This is used to read out the value of the 16bit counter of pulse train input.
- The value will count up for CWP pulse train input, and count down in CCWP pulse train input.
- If the /RP data is added to the RP command, the readout will be automatically repeated.
- If the RP command is not accompanied by /RP, the readout will be just one time.
- Press the BS key to terminate automatic readout.
- For the way of using the function, refer to " 6.1.17.3. Monitoring Pulse Train Input Counter."

★ *RR: Resolver Resolution （Factory use only）*

Forma : RR data
Data : 0, 1, –1
Shipping set : –1
Default : Not available

- This parameter sets resolution of the position sensor (resolver).
  RR0 : 10bit
  RR1 : 12bit
  RR-1 : Automatic resolution switching
- Do not change the setting as it is properly set in accordance with the type of Driver Unit.
- The TS or ?RR command reports the current setting.

SB: Criterion, SPD Signal Output

Format : SB data
Data range
  RS type Motor : data = 0 to 3.00 [s^{-1}]
  AS and BS type Motor : data = 0 to 4.50 [s^{-1}]
Shipping set : 0
Default : 0

- This parameter is used to set the threshold to output the SPD signal.
- Refer to “6.1.14. Velocity Report” for more details.
- The TS or ?SB reports the current setting.

★ *SE: Serial Error*

Format : SE data
Data : 0, 1, and 2
Shipping set : 0
Default : 0

- Sets the output format and controlling state for the alarm of “RS-232C error.”

Setting	DRDY output	OVER output	Motor condition
SE0	Does not change.	Does not change.	Normal
SE1	Open	Does not change.	Servo-lock
SE2	Does not change.	Closed	

- The TS or ?SE command reports the current setting.
- Be sure to select the SE1 for a positioning with the RS-232C communication command.

SG: Servo Gain

Format : SG data
Data : 0 to 30 [HZ], or /AJ (Adjust mode)
Shipping set : 0
Default : 0

- The SG parameter sets the maximum response frequency to the velocity loop.
  - ◊ Sets the position loop gain SG during the automatic tuning.
- When the SG value is changed, the parameters PG (position loop proportional gain), VG (velocity loop proportional gain) and VI (velocity loop integration frequency) settings will be automatically renewed.
- The TS or ?SG reports the current setting.
- The SG/AJ command starts the fine adjusting program.
- If PG, VG, or VI is changed, the SG setting will be cleared to 0 (zero).

★ *SI: System Initialization*

Format : SI/data
Data range : No data, /AL, /SY, /YS
Default : No data

- Resets all parameters to the shipping set values.

- The SI command can only be inputted immediately after the entry of the password, and when the Motor is servo-off state.

- The following shows the parameters that will be initialized by the SI command.

  SI : Initializes the servo-related parameters only. (PG, VG, VGL, VI, VIL, LG, TL, GP, GT, FO, FP, FS, NP, NS, DBP, DBA, ILV, FF, FC, SG, and LO)

  SI/AL : Initializes all parameters.

  SI/SY : • For the ESA35 type Driver Unit, this command will initialize all parameters excluding PA.

  • For the ESA type Driver Unit equipped with the absolute sensor, this command will initialize all parameters excluding PA and RO.

  SI/YS : • This command will initialize all parameters. The PA will be set to 700.

  * Execution of the SI/AL entails resolver phase adjustment. Be careful not to interrupt the Motor motion by an external force.
  (Do not perform above initializations on the Driver Unit only.)

⚠ *Caution : It requires approximately 30 seconds for initialization of the system. Do not turn off the power while initializing. Otherwise, the memory error alarm occurs.*

◊ * When the error occurs, only the SI/AL command is executed even for the input of SI or SI/SY.

★ *SL : Set Control Mode*

Format : SL data
Data : 1, 2, and 3
Shipping set : 3
Default : Not available

- Sets the control mode.
  SL1 : Torque control mode
  SL2 : Velocity control mode
  SL3 : Position control mode

- The position control mode is valid immediately after an entry of this command.

- The TS or ?SL command reports the current setting.

★ SO: SPD Output Mode

Format : SO data
Data : 0, 1
Shipping set : 0
Default : 0

- This command selects the velocity-detecting mode of the SPD output.
  - SO0 : Sets to "Zero speed mode." The SPD output will be closed when the velocity is within the SB setting longer than a time set by the ST parameter.
  - SO1 : Sets to "Over speed mode." The SPD output will be closed when the velocity is over the SB setting longer than a time set by the ST parameter.
- The TS or ?SO reports the current setting.
- For details, refer to "6.1.14. Velocity Report."

SP: Start Program

Format : SP data
Data range : 0 to 63, or /AJ (Adjust mode)
Default : 0

- The SP command executes the Programmable Indexer's channel program specified by the data.
- The SP/AJ enables a to-and-fro operation.

ST: Speed stability Timer

Format : ST data
Data range : 0, 0.3 to 100.0 [0.1sec]
Shipping set : 0
Default : 0

- The ST parameter sets a stability timer for outputting the SPD signal. The SPD signal outputs when the Motor velocity stays below the threshold set with the SB parameter for a time set by the ST parameter.
- If the ST is set to 0, the SPD putout will be closed without checking the stability of the velocity.
- If the ST parameter is set between 0.3 and 100.0, the SPD output will be closed after checking stability of the velocity.
- The TS or ?ST reports the current setting.
- For details, refer to "7.1.13. Velocity Report."

SV: Servo On

Format : SV

- When the Motor servo has been turned off by the MO command, the SV command turns 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
Data : No data /HI/ CL
Default : No data

- TA : Reports alarms currently given.
- TA/HI : Displays the history of alarms. Refer to "11.2.6. History of Alarms."
- TA/CL : Clears the history of alarms. The password is required to execute the command.
- There will be no indication when no alarm is reported.
- When an alarm is reported, it is identified as shown below.

Alarm	7 segments LED	Terminal Display
Memory error	E0	`E0>Memory Error`
EEPROM error	E2	`E2>EEPROM Error`
System error	E7	`E7>System Error`
Interface error	E8	`E8>I/F Error`
Analog command error	E9	`E9>ADC Error`
Excess position error	F1	`F1>Excess Position Error`
Software over travel limit	F2	`F2>Software Over Travel`
Hardware over travel limit	F3	`F3>Hardware Over Travel`
Emergency stop	F4	`F4>Emergency Stop`
Program error	F5	`F5>Program Error`
Automatic Turing error	F8	`F8>AT Error`
RS-232C error	C2	`C2>RS-232C Error`
CPU error	C3	`C3>CPU Error`
Resolver circuit error	A0	`A0>Resolver Circuit Error`
Absolute position error	A1	`A1>Absolute Position Error`
Software thermal sensor	A3	`A3>Overload`
Velocity error over	A4	`A4>RUN away`
Home position undefined	A5	`A5>Origin Undefined`
Heat sink overheat	P0	`P0>Over Heat`
Abnormal main AC line voltage	P1	`P1>Main AC Line Trouble`
Over current	P2	`P2>Over Current`
Control AC line under voltage	P3	`P3>Control AC Line Under Voltage`

- When multiple alarms are reported, each alarm is displayed on a separate line.
- Switching display format by the MM command is effective.
- Example of display: "Hardware travel limit" and "Emergency stop" alarms are displayed in the MM1 format.

```
:TA
 F3>Hardware Over Travel;
 F4>Emergency Stop;
:_
```

TC: Tell Channel Program

Format : TC data
Data range : : 0 to 63, or /AL
Default : 0

- Reports the program contents of a channel specified by the data.
- Nothing is displayed if program is not set to the channel.
- Enter of the TC/AL command is to scroll all channels by pressing the space key.

TE: Tell Position Error Counter

Format : TE/RP

- Reads out the data of position error counter. The reading shall be between –2 147 483 648 and +2 147 483 647. When it exceeds (or falls below) the upper (or lower) limit, the reading will change to backward counting in the minus (or the plus) side.
- When only the TE is entered, the display shows the current reading just once.
- If the /RP option is added to the TE command, the reading is repeated automatically.
- In an automatic reading, a data consisting of up to six figures is read out. If a data consists of more than six figures, "*******" is displayed.
- To terminate the automatic reading, press the BS key.

TG: Tell Gain Switching

Format : TG/RP

- The TG command monitors state of the automatic gain switching.
- For details of the monitor, refer to "6.1.17.8. Monitoring State of Automatic Gain Switching."
- If the TG command is accompanied by the /RP, the readout will be repeated.
- For the TG command without the /RP, the readout will be just once.
- Press the BS key to quit repeating readout.

TI: Timer

Format : TI data
Data range : 0.3 to 100.0 [0.1 sec]
Default : Not available

- Sets the timer to a channel of the Programmable Indexer.
- The TI parameter can only be set under the conditions where the CH command specifies a channel to which the timer to be programmed, and the Driver Unit outputs “?,” indicating that the System waits for a command to be entered.
- The TC command reports the current setting.

★ *TL: Torque Limit Rate*

Format : TL data
Data range : 0 to 100 [%]
Shipping set : 100
Default : 0

- Sets the torque limit.
- The Motor torque will be reduced to a percentage (%) of the data immediately after the TL is inputted, and the Motor torque will be controlled not to exceed the limit thereafter.
- The TS or ?TL command reports the current setting.

★ *TO: Software Travel Limit Over, Alarm Type*

Format : TO data
Data : 1, 2
Shipping set : 2
Default : Not available

- Selects the format of alarm output of “Software over travel limit,”

Setting	DRDY output	OVER output
TO1	Open	Does not change.
TO2	Does not change.	Closed.

- Regardless of the TO setting, 7 segments LED and a readout with the TA command reports the alarm status.
- The TS or ?TO command reports the current setting.

TP: Tell Position

Format : TP data/RP

Data range : 0 ··· Reports the current position on the Motor absolute position scale in the unit of pulse.
(Applicable to the ESA Driver Unit with absolute sensor only.)
2 ··· Reports the current position on the user position scale in the unit of pulse.
5 ··· Reports the current position on the user position scale in the unit of degree.
6 ··· Reports simultaneously the current position on the user position scale in the unit of pulse (upper line) and position error (lower line)

Default : Not available

- Reports the current position in a specified poison scale by the PS command.
- If the TP command is accompanied by the /RP, the readout will be automatic and repetitious.
- If the /RP is not set with the TP command, the readout will be just once.
- Press the $\boxed{\text{BS}}$ key to terminate the automatic read out.

  TP2/RP: Unit in pulse

  [Example] RS type Motor ---------------- 614 400 pulses/revolution

  AS and BS type Motor ------ 409 600 pulses/revolution

  TP5/RP: Unit in degree

  [Example] 36000/revolution (unit of 0.01°)
- For way of monitoring, refer to “7.1.17.4. Monitoring Current Position.”

TR: Tell RDC Position Data

Format : TR/RP

- The TR command reads out the RDC position data.
- The data is between 0 and 4 095.
- If the TR command is accompanied with the /RP option, the reading is repeated automatically.
- If the TR command is not accompanied with the /RP, the readout will be just once.
- To terminate the automatic reading, press the $\boxed{\text{BS}}$ key.

TS: Tell Settings

Format : TS data
Data range : 0 to 15
Default : 0

- This command is used for reporting settings of the command and the parameter.

(1) ESA35 Driver Unit

TS0 : Reports all commands and parameters below.
TS1 : PG, VG, VGL, VI, VIL, VM, LG, TL, GP, GT
TS2 : FO, FP, FS, NP, NS, DBP, ILV, FF, FC
TS3 : CO, IN, IS, FW, VO, VW, OR
TS4 : CR, PC, RR
TS5 : FD, FZ, FR
TS6 : PS, DI, OTP, OTM
TS7 : MV, MA, JV, JA, HV, HA, HZ, MD, CS, CY, CX
TS8 : OS, HD, HO
TS9 : PA, OL, LR, RO
TS10 : TY, AB, SM, NW, IM, OM, SO, SB, ST, NM, NA, NB, ZAS, ZAE
TS11 : MM, BM, CM, AN, WM, SE, EC
TS12 : LO, SG, MT, RI, ZP, ZV
TS13 : OU, EP, TO, HT, PE, AE

(2) ESAC5 Driver Unit (Equipped with absolute sensor)

TS0 : Reports all commands and parameters below.
TS1 : PG, VG, VGL, VI, VIL, VM, LG, TL, GP, GT
TS2 : FO, FP, FS, NP, NS, DBP, ILV, FF, FC
TS3 : CO, IN, IS, FW, VO, VW, OR
TS4 : CR, PC, RR
TS5 : FD, FZ, FR
TS6 : PS, DI, OTP, OTM, AO
TS7 : MV, MA, JV, JA, HV, HA, HZ, MD, CS, CY, CX
TS8 : OS, HD, HO
TS9 : PA, OL, RC, LR, RO
TS10 : TY, AB, SM, NW, IM, OM, SO, SB, ST, NM, NA, NB, ZAS, ZAE
TS11 : MM, BM, CM, AN, WM, SE, EC
TS12 : LO, SG, MT, RI, ZP, ZV
TS13 : OU, EP, TO, HT, PE, AE

- The MM command selects the readout format.

TT: Tell Torque & Thermal

Format : TT/RP

- This command monitors the value of torque command and software thermal loading.
- If the TT command is accompanied by /RP, the readout will be repeated automatically.
- If the TT command is not accompanied by /RP, the readout will be just once.
- Press the $\boxed{\text{BS}}$ key to quit the automatic monitoring.
- For way of monitoring, refer to “6.1.17.7. Monitoring Torque Command and Software Thermal Loading.”

TV: Tell Velocity

Format : TV data/RP
Data : 0 ··· in the unit of [s^{-1}].
1 ··· in the unit of internal setting. (0 to ± 8 191)
Default : 0

- This command is to report the velocity of the Motor.
- If the TV command is accompanied by /RP, the readout will be repeated automatically.
- If the TV command is not accompanied by /RP, the readout will be just once.
- Press the BS key to terminate the automatic monitoring.
- For way of monitoring, refer to “6.1.17.6. Monitoring Motor Velocity.”

VG: Velocity Gain

Format : VG data
Data : 0.1 to 255.0 or /AJ (Adjusting mode)
Shipping set : 1.0
Default : Not available

- Sets the velocity loop proportional gain.
- The TS or ?VG reports the current setting.
- The VG/AJ command starts the fine adjusting program.
- When the data of LO and SG are changed, the gain will be automatically adjusted.
- When VG data is changed, the data of LG and SG will be cleared to 0 (zero).

VGL: Velocity Gain, Lower

Format : VGL data
Data range : 0.1 to 255.0
Shipping set : 1.0
Default : Not available

- Sets the proportional gain of velocity loop for when the Motor is stopping.
- The gain will be switched from the data of the VG parameter to the data of the VGL parameter when a position error is within the data of the GP parameter longer than a time set by the GT parameter.
- If the GP data is 0, the VGL is invalidated, and the VG will be always effective.
- The TS or ?VG reports the current setting.
- Refer to “6.2.7. Automatic Gain Switching” for timing of functioning.

VI: Velocity Integrator Frequency

Format : VI data
Data range : 0.10 to 63.00 [Hz], or /AJ (Adjust mode)
Shipping set : 1.00
Default : Not available

- Sets the integrator frequency of velocity loop.
- The TS or ?VI command reports the current setting.
- The VI/AJ starts the adjusting program.
- The VI data will be automatically adjusted when the data of LO and SG are changed.
- Change of the VI data will clear the data of LO and VI to 0.

VIL: Velocity Integrator Frequency, Lower

Format : VI data
Data range : 0.10 to 63.00 [Hz]
Sipping set : 1.00
Default : Not available

- Sets the velocity integrator frequency of velocity loop for when the Motor is stopping.
- The gain will be switched from the data of VI parameter to the data of VIL parameter when a position error is within the data of GP parameter longer than a time set by the GT parameter.
- If the GP data is 0, the VIL is invalid and the setting of VI will be always valid.
- The TS or ?VG reports the current setting.
- Refer to “6.2.7. Automatic Gain Switching” for timing of functioning.

★ *VM: Velocity Integrator Mode*

Format : VM data
Data range : 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.

★ *VO: Velocity Error Over Limit*

Format : VO data
Data range : 1 to 4 095
Shipping set : 2 047
Default : Not available

- This is to set the error limit to report ‘ Velocity error over’ alarm
- “Velocity error over alarm” will be given when the velocity error exceeds the setting.
- The correspondence of the data to the velocity error depends on the Motor type.

Motor type	Number of teeth	Data
RS	150	Data = Detected velocity [s^{-1}] × (4 095/3)
AS and BS	100	Data = Detected velocity [s^{-1}] × (4 095/4.5)

★ *VW: Velocity Error Over Limit Width*

Format : VW data
Data : 0 to 1 000 [ms]
Shipping set : 100
Default : 0

- This parameter sets the stability timer to report “Velocity abnormal” alarm.
- When the velocity is over the limit continuously exceeding the time set by the VW parameter (in unit of ms), the “Velocity abnormal” alarm will be given.

★ *WD : Write Data to EEPROM*

Format : WD

- Writes all current settings of commands, programs and parameters to the EEPROM.
- Use this command when the WM1 (data back-up invalid) is set.

⚠ *Caution : It requires approximately 30 seconds for execution of this command. Do not turn the power off while writing data. Otherwise “Memory error” alarm may occur.*

★ *WM: Write Mode to EEPROM*

Format : WM data
Data range : 0, 1
Shipping set : 0
Default : 0

- The total number of overwriting times on the EEPROM to backup data are guaranteed to 500 000. However frequent writing of data to the EEPROM may easily exceed the above number of times. This WM command is to select whether store or not the inputted parameter to avoid unnecessary backup.
  WM0: Data backup
  WM1: No data backup

  ⚠ *Caution* : • *When the command is changed to WM0 (store the data) from WM1 (no-backup), it requires approximately 30 seconds to store the data as the all data currently set shall be backed up. Do not turn the power off during the execution of backup. Otherwise, memory error alarm may be given.*

  • *Initialized parameters will be stored every time when the SI command executes the initialization, even though "no backup data (WM1)" is set.*

- The TS or ?WM reports the current setting.

ZAS: Start Point of Zone A
ZAE: End Point of Zone A
ZBS: Start Point of Zone B
ZBE: End Point of Zone B

Format : ZAS data/ST
ZAE data/ST
ZBS data/ST
ZBE data/ST
Data range : 0 to ± 99 999 [pulse]
Shipping set : 0
Default : 0

- The ZAS and the ZBS parameters set a point to start outputting the signal when the NEARA or the NEARB output is set to the "Target proximity" mode.

- The ZAE and the ZBE parameters set a point to terminate outputting the signal when the NEARA or the NEARB output is in the "Target proximity" mode.

- The NEARA output is closed while the position data of the Motor is in the zone between the ZAS and the ZAE, which is in the counting up direction.

- The NEARB output is closed while the position data of the Motor is in the zone between the ZBS and the ZBA, which is in the counting up direction.

- The commands ZAS/ST, ZAE/ST, ZBS/ST, and ZBE/ST make possible to set the respective points by teaching.

- The TS, ?ZA or ?ZB command reports the current setting.

- Refer to "6.1.15. Target Proximity / In-target" for details of function.

★ ZP: Factory use only

Shipping set : 1.00

⚠ *Caution : • This parameter is for the automatic tuning. This is the factory use only.*

• Do not change the setting because it is properly set at the factory.

• The Ts or ?ZP reports the current setting.

★ ZV: Factory use only

Shipping set : 1.4

⚠ *Caution : • This parameter is for the automatic tuning, and for the factory use only.*

• Do not change the setting because it is properly set at the factory.

• The Ts or ?ZP reports the current setting.

9.2. Parameter List

- Connect the Handy Terminal FHT11 to connector CN1of the Driver Unit, and then turn the power on. The system is normal when the message “NSK MEGA---” appears on the display. .

- Some parameters shown in Tables 9-1 to 9-4 must be changed to unique values from the shipping set accordingly to the actual conditions.

  ◊ Parameters parenthesized are properly set at the factory. If the setting shall be changed, contact your local NSK representative.

  * : Set unique value to your application. We recommend writing down the set value for your future reference. You may need to refer to them when changing the operating conditions, or readjusting the system.

  ** : This setting differs with the Moto size.

  *** : Uniquely set to each Motor that is not interchangeable type.

Table 9-1a: Parameter setting for RS type Motor (1/2)

Parameter	Nome	Password	Sipping set	Data range	Current setting*
PG	Position gain	–	0.100	0.010 – 1.000	
VG	Velocity gain	–	1.0	0.1 – 255.0	
VGL	Velocity gain, lower	–	1.0	0.1 – 255.0	
VI	Velocity integrator frequency	–	1.00	0.10 – 63.00	
VIL	Velocity integrator frequency, lower	–	1.00	0.10 – 63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Position gain, lower	–	50	0 – 100	
TL	Torque limit rate	✓	100	0 – 100	
GP	Gain switching point	✓	0	0, 1 – 1 000	
GT	Switching gain timer	✓	5	0 – 1 000	
FO	Low pass filter off velocity	–	0	0, 0.01 – 3.00	
FP	Low pass filter, primary	–	0	0, 10 – 500	
FS	Low pass filter, secondary	–	0	0, 10 – 500	
NP	Notch filter, primary	–	0	0, 10 – 500	
NS	Notch filter, secondary	–	0	0, 10 – 500	
DBP	Dead band, position loop	✓	0	0, 1 – 4 095	
DBA	Dead band, analog command input	✓	0	0 to 2 047	
ILV	Integration limit	✓	100.0	0 – 100.0	
FF	Feed forward gain	✓	0	0 – 1.0000	
FC	Friction compensation	✓	0	0 – 2 047	
CO	Position error counter over limit	–	50 000	1 – 99 999 999	
IN	In-position	–	100	0 – 99 999 999	
IS	In-position stability timer	–	0	0, 0.3 – 100.0	
FW	FIN width	–	1.0	- 0.3 – - 100.0, 0, 0.3 – 100.0	
VO	Velocity over error limit	✓	2 047	1 – 4 095	
VW	Velocity over error limit width	✓	100	0 – 1 000	
OR	Criterion, overrun alarm	✓	307 200	153 600 – 614 400	
CR	Circular resolution	✓	× 1	× 1, × 2, × 4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0 – 4	
RR	Resolver resolution	✓	– 1	- 1, 0, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
FR	Feedback signal resolution	✓	1	0, 1	
PS	Position scale	✓	1	0, 1, 2 – 99	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
OTM	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
MV	Move velocity	–	1.0000	0.0001 – 3.0000	
MA	Move acceleration	–	1.00	0.01 – 80.00	
JV	Jog velocity	–	0.1000	0.0001 – 3.0000	
JA	Jog acceleration	–	1.00	0.01 – 80.00	
HV	Home Return velocity	–	0.2000	0.0001 – 3.0000	
HA	Home Return acceleration	–	1.00	0.01 – 80.00	
HZ	Home Return / near zero velocity	–	0.0100	0.0001 – 0.2000	
MD	Move deceleration	–	0	0, 0.01 – 80.00	
CS	Acceleration pattern select	–	1/1	1 – 5	
CY	Criterion to function CS	✓	1.00	0.01 – 80.00	
CX	Setting CS function	✓	1	0, 1	

Table 9-1b: Parameter setting for RS type Motor (2/2)

Parameter	Name	Password	Shipping set	Data range	Current setting
OS	Origin setting mode	✓	4	1, 3, 4, 5, 6	
HD	Home Return direction	✓	1	0, 1	
HO	Home position offset	✓	0	- 610 304 – 610 304	
(PA)	Origin setting mode	✓	***	24 – 1 048	
(OL)	Overload limit	✓	**	0 – 100	
(RC)	Rated current	✓	**	0 – 100	
LR	Low torque ripple	✓	0	0, 1	
AB	I/O polarity	✓	X0X0XX00	0, 1, X	
NW	Chattering preventive timer	✓	2	0 – 4	
IM	IOFF mode	✓	0	0, 1	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace mode	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0 – 15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1	
EC	End of command message	✓	0	0, 1	
LO	Load inertia	✓	0	0 – 50.000	
SG	Servo gain adjust, minor	–	0	0 – 30	
(MT)	Factory use only.	✓	**	–	
(RI)	Factory use only.	✓	**	–	
(ZP)	Factory use only.	✓	1.00	–	
(ZV)	Factory use only	✓	1.4	–	
SL	Set control mode	✓	3	1, 2, 3	
AC	Analog command mode	✓	1	- 1, 0, 1	
AGV	Analog velocity command gain	✓	1.00	0.10 – 2.00	
AGT	Analog torque command gain	✓	1.00	0.10 – 2.00	
AF	Analog command offset	✓	0	- 63 ~ 63	
AL	Acceleration limiter	–	0	0, 0.01 – 80.00	
HW	Home signal holding time	–	0	0, 0.3 – 100.0	
HI	Home In-position	–	100	0 – 102 400	
SO	SPD output mode	✓	0	0, 1	
SB	Criterion, SPD signal output	–	0	0 – 3.00	
ST	Speed stable timer	–	0	0, 0.3 – 100.0	
NMA	Near A output mode	✓	0	0, 0.3 – 100.0	
NMB	Near B output mode	✓	0	0, 0.3 – 100.0	
NA	Near position A	–	100	1 – 99 999 999	
NB	Near position B	–	100	1 – 99 999 999	
ZAS	Start point of zone A	–	0	0 – ± 99 999 999	
ZAE	End point of zone A	–	0	0 – ± 99 999 999	
ZBS	Start point of zone B	–	0	0 – ± 99 999 999	
ZBE	End point of zone B	–	0	0 – ± 99 999 999	
OU	Origin undefined, alarm type	✓	0	0, 2	
EP	Excessive position error, alarm type	✓	2	1, 2, 3	
TO	Software travel limit over, alarm type	✓	2	1, 2	
HT	Hardware travel limit over, alarm type	✓	2	0, 1, 2	
PE	Program error, alarm type	✓	2	0, 2	
AE	Automatic tuning error, alarm type	✓	0	0, 2	
PH	Program Home Return	✓	0	0, 1, 2	

Table 9-2a: Parameter setting for AS and BS type Motor (1/2)

Parameter	Nome	Password	Sipping set	Data range	Current setting*
PG	Position gain	–	0.100	0.010 – 1.000	
VG	Velocity gain	–	1.0	0.1 – 255.0	
VGL	Velocity gain, lower	–	1.0	0.1 – 255.0	
VI	Velocity integrator frequency	–	1.00	0.10 – 63.00	
VIL	Velocity integrator frequency, lower	–	1.00	0.10 – 63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Position gain, lower	–	50	0 – 100	
TL	Torque limit rate	✓	100	0 – 100	
GP	Gain switching point	✓	0	0, 1 – 1 000	
GT	Switching gain timer	✓	5	0 – 1 000	
FO	Low pass filter off velocity	–	0	0, 0.01 – 4.50	
FP	Low pass filter, primary	–	0	0, 10 – 500	
FS	Low pass filter, secondary	–	0	0, 10 – 500	
NP	Notch filter, primary	–	0	0, 10 – 500	
NS	Notch filter, secondary	–	0	0, 10 – 500	
DBP	Dead band, position loop	✓	0	0, 1 – 4 095	
DBA	Dead band, analog command input	✓	0	0 to 2 047	
ILV	Integration limit	✓	100.0	0 – 100.0	
FF	Feed forward gain	✓	0	0 – 1.0000	
FC	Friction compensation	✓	0	0 – 2 047	
CO	Position error counter over limit	–	50 000	1 – 99 999 999	
IN	In-position	–	100	0 – 99 999 999	
IS	In-position stability timer	–	0	0, 0.3 – 100.0	
FW	FIN width	–	1.0	- 0.3 – - 100.0, 0, 0.3 – 100.0	
VO	Velocity over error limit	✓	2 047	1 – 4 095	
VW	Velocity over error limit width	✓	100	0 – 1 000	
OR	Criterion, overrun alarm	✓	204 800	102 400 – 409 600	
CR	Circular resolution	✓	× 1	× 1, × 2, × 4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0 – 4	
RR	Resolver resolution	✓	– 1	- 1, 0, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
FR	Feedback signal resolution	✓	0	0, 1	
PS	Position scale	✓	1	0, 1, 2 – 99	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
OTM	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
MV	Move velocity	–	1.0000	0.0001 – 4.5000	
MA	Move acceleration	–	1.00	0.01 – 120.00	
JV	Jog velocity	–	0.1000	0.0001 – 4.5000	
JA	Jog acceleration	–	1.00	0.01 – 120.00	
HV	Home Return velocity	–	0.2000	0.0001 – 4.5000	
HA	Home Return acceleration	–	1.00	0.01 – 120.00	
HZ	Home Return / near zero velocity	–	0.0100	0.0001 – 0.2000	
MD	Move deceleration	–	0	0, 0.01 – 120.00	
CS	Acceleration pattern select	–	1/1	1 – 5	
CY	Criterion to function CS	✓	1.00	0.01 – 120.00	
CX	Setting CS function	✓	0	0, 1	

Table 9-2b: Parameter setting for AS and BS type Motor (2/2)

Parameter	Name	Password	Shipping set	Data range	Current setting
OS	Origin setting mode	✓	4	1, 3, 4, 5, 6	
HD	Home Return direction	✓	1	0, 1	
HO	Home position offset	✓	0	- 405 504 – 405 504	
(PA)	Origin setting mode	✓	***	24 – 1 048	
(OL)	Overload limit	✓	**	0 – 100	
(RC)	Rated current	✓	**	0 – 100	
LR	Low torque ripple	✓	0	0, 1	
AB	I/O polarity	✓	X0X0XX00	0, 1, X	
NW	Chattering preventive timer	✓	2	0 – 4	
IM	IOFF mode	✓	0	0, 1	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace mode	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0 – 15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1	
EC	End of command message	✓	0	0, 1	
LO	Load inertia	✓	0	0 – 50.000	
SG	Servo gain adjust, minor	–	0	0 – 30	
(MT)	Factory use only.	✓	**	–	
(RI)	Factory use only.	✓	**	–	
(ZP)	Factory use only.	✓	1.00	–	
(ZV)	Factory use only	✓	1.4	–	
SL	Set control mode	✓	3	1, 2, 3	
AC	Analog command mode	✓	1	- 1, 0, 1	
AGV	Analog velocity command gain	✓	1.00	0.10 – 2.00	
AGT	Analog torque command gain	✓	1.00	0.10 – 2.00	
AF	Analog command offset	✓	0	- 63 ~ 63	
AL	Acceleration limiter	–	0	0, 0.01 – 120.00	
HW	Home signal holding time	–	0	0, 0.3 – 100.0	
HI	Home In-position	–	100	0 – 102 400	
SO	SPD output mode	✓	0	0, 1	
SB	Criterion, SPD signal output	–	0	0 – 4.50	
ST	Speed stable timer	–	0	0, 0.3 – 100.0	
NMA	Near A output mode	✓	0	0, 0.3 – 100.0	
NMB	Near B output mode	✓	0	0, 0.3 – 100.0	
NA	Near position A	–	100	1 – 99 999 999	
NB	Near position B	–	100	1 – 99 999 999	
ZAS	Start point of zone A	–	0	0 – ± 99 999 999	
ZAE	End point of zone A	–	0	0 – ± 99 999 999	
ZBS	Start point of zone B	–	0	0 – ± 99 999 999	
ZBE	End point of zone B	–	0	0 – ± 99 999 999	
OU	Origin undefined, alarm type	✓	0	0, 2	
EP	Excessive position error, alarm type	✓	2	1, 2, 3	
TO	Software travel limit over, alarm type	✓	2	1, 2	
HT	Hardware travel limit over, alarm type	✓	2	0, 1, 2	
PE	Program error, alarm type	✓	2	0, 2	
AE	Automatic tuning error, alarm type	✓	0	0, 2	
PH	Program Home Return	✓	0	0, 1, 2	

Table 9-3a: Parameter setting for RS type Motor equipped with absolute sensor (1/2)

Parameter	Nome	Password	Sipping set	Data range	Current setting*
PG	Position gain	–	0.100	0.010 – 1.000	
VG	Velocity gain	–	1.0	0.1 – 255.0	
VGL	Velocity gain, lower	–	1.0	0.1 – 255.0	
VI	Velocity integrator frequency	–	1.00	0.10 – 63.00	
VIL	Velocity integrator frequency, lower	–	1.00	0.10 – 63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Position gain, lower	–	50	0 – 100	
TL	Torque limit rate	✓	100	0 – 100	
GP	Gain switching point	✓	0	0, 1 – 1 000	
GT	Switching gain timer	✓	5	0 – 1 000	
FO	Low pass filter off velocity	–	0	0, 0.01 – 3.00	
FP	Low pass filter, primary	–	0	0, 10 – 500	
FS	Low pass filter, secondary	–	0	0, 10 – 500	
NP	Notch filter, primary	–	0	0, 10 – 500	
NS	Notch filter, secondary	–	0	0, 10 – 500	
DBP	Dead band, position loop	✓	0	0, 1 – 4 095	
DBA	Dead band, analog command input	✓	0	0 to 2 047	
ILV	Integration limit	✓	100.0	0 – 100.0	
FF	Feed forward gain	✓	0	0 – 1.0000	
FC	Friction compensation	✓	0	0 – 2 047	
CO	Position error counter over limit	–	50 000	1 – 99 999 999	
IN	In-position	–	100	0 – 99 999 999	
IS	In-position stability timer	–	0	0, 0.3 – 100.0	
FW	FIN width	–	1.0	- 0.3 – - 100.0, 0, 0.3 – 100.0	
VO	Velocity over error limit	✓	2 047	1 – 4 095	
VW	Velocity over error limit width	✓	100	0 – 1 000	
OR	Criterion, overrun alarm	✓	307 200	153 600 – 614 400	
CR	Circular resolution	✓	× 1	× 1, × 2, × 4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0 – 4	
RR	Resolver resolution	✓	– 1	- 1, 0, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
FR	Feedback signal resolution	✓	1	0, 1	
PS	Position scale	✓	1	0, 1, 2 – 99	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
OTM	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
AO	Absolute position offset	✓	0	0 – 614 399	
MV	Move velocity	–	1.0000	0.0001 – 3.0000	
MA	Move acceleration	–	1.00	0.01 – 80.00	
JV	Jog velocity	–	0.1000	0.0001 – 3.0000	
JA	Jog acceleration	–	1.00	0.01 – 80.00	
HV	Home Return velocity	–	0.2000	0.0001 – 3.0000	
HA	Home Return acceleration	–	1.00	0.01 – 80.00	
HZ	Home Return / near zero velocity	–	0.0100	0.0001 – 0.2000	
MD	Move deceleration	–	0	0, 0.01 – 80.00	
CS	Acceleration pattern select	–	1/1	1 – 5	
CY	Criterion to function CS	✓	1.00	0.01 – 80.00	
CX	Setting CS function	✓	1	0, 1	

Table 9-3b: Parameter setting for RS type Motor equipped with absolute sensor (2/2)

Parameter	Name	Password	Shipping set	Data range	Current setting
OS	Origin setting mode	✓	4	1, 3, 4, 5, 6	
HD	Home Return direction	✓	1	0, 1	
HO	Home position offset	✓	0	- 610 304 – 610 304	
(PA)	Origin setting mode	✓	***	24 – 1 048	
(OL)	Overload limit	✓	**	0 – 100	
(RC)	Rated current	✓	**	0 – 100	
LR	Low torque ripple	✓	0	0, 1	
RO	ABS/INC	✓	***	0 – 4 095	
AB	I/O polarity	✓	X0X0XX00	0, 1, X	
NW	Chattering preventive timer	✓	2	0 – 4	
IM	IOFF mode	✓	0	0, 1	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace mode	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0 – 15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1	
EC	End of command message	✓	0	0, 1	
LO	Load inertia	✓	0	0 – 50.000	
SG	Servo gain adjust, minor	–	0	0 – 30	
(MT)	Factory use only.	✓	**	–	
(RI)	Factory use only.	✓	**	–	
(ZP)	Factory use only.	✓	1.00	–	
(ZV)	Factory use only	✓	1.4	–	
SL	Set control mode	✓	3	1, 2, 3	
AC	Analog command mode	✓	1	- 1, 0, 1	
AGV	Analog velocity command gain	✓	1.00	0.10 – 2.00	
AGT	Analog torque command gain	✓	1.00	0.10 – 2.00	
AF	Analog command offset	✓	0	- 63 ~ 63	
AL	Acceleration limiter	–	0	0, 0.01 – 80.00	
HW	Home signal holding time	–	0	0, 0.3 – 100.0	
HI	Home In-position	–	100	0 – 102 400	
SO	SPD output mode	✓	0	0, 1	
SB	Criterion, SPD signal output	–	0	0 – 3.00	
ST	Speed stable timer	–	0	0, 0.3 – 100.0	
NMA	Near A output mode	✓	0	0, 0.3 – 100.0	
NMB	Near B output mode	✓	0	0, 0.3 – 100.0	
NA	Near position A	–	100	1 – 99 999 999	
NB	Near position B	–	100	1 – 99 999 999	
ZAS	Start point of zone A	–	0	0 – ± 99 999 999	
ZAE	End point of zone A	–	0	0 – ± 99 999 999	
ZBS	Start point of zone B	–	0	0 – ± 99 999 999	
ZBE	End point of zone B	–	0	0 – ± 99 999 999	
OU	Origin undefined, alarm type	✓	0	0, 2	
EP	Excessive position error, alarm type	✓	2	1, 2, 3	
TO	Software travel limit over, alarm type	✓	2	1, 2	
HT	Hardware travel limit over, alarm type	✓	2	0, 1, 2	
PE	Program error, alarm type	✓	2	0, 2	
AE	Automatic tuning error, alarm type	✓	0	0, 2	
PH	Program Home Return	✓	0	0, 1, 2	

Table 9-4a: Parameter setting for AS and BS type Motor equipped with absolute sensor (1/2)

Parameter	Nome	Password	Sipping set	Data range	Current setting*
PG	Position gain	–	0.1	0.010 – 1.000	
VG	Velocity gain	–	1.0	0.1 – 255.0	
VGL	Velocity gain, lower	–	1.0	0.1 – 255.0	
VI	Velocity integrator frequency	–	1.00	0.10 – 63.00	
VIL	Velocity integrator frequency, lower	–	1.00	0.10 – 63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Position gain, lower	–	50	0 – 100	
TL	Torque limit rate	✓	100	0 – 100	
GP	Gain switching point	✓	0	0, 1 – 1 000	
GT	Switching gain timer	✓	5	0 – 1 000	
FO	Low pass filter off velocity	–	0	0, 0.01 – 4.50	
FP	Low pass filter, primary	–	0	0, 10 – 500	
FS	Low pass filter, secondary	–	0	0, 10 – 500	
NP	Notch filter, primary	–	0	0, 10 – 500	
NS	Notch filter, secondary	–	0	0, 10 – 500	
DBP	Dead band, position loop	✓	0	0, 1 – 4 095	
DBA	Dead band, analog command input	✓	0	0 to 2 047	
ILV	Integration limit	✓	100	0 – 100.0	
FF	Feed forward gain	✓	0	0 – 1.0000	
FC	Friction compensation	✓	0	0 – 2 047	
CO	Position error counter over limit	–	50 000	1 – 99 999 999	
IN	In-position	–	100	0 – 99 999 999	
IS	In-position stability timer	–	0	0, 0.3 – 100.0	
FW	FIN width	–	1.0	- 0.3 – - 100.0, 0, 0.3 – 100.0	
VO	Velocity over error limit	✓	2 047	1 – 4 095	
VW	Velocity over error limit width	✓	100	0 – 1 000	
OR	Criterion, overrun alarm	✓	204 800	102 400 – 409 600	
CR	Circular resolution	✓	× 1	× 1, × 2, × 4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0 – 4	
RR	Resolver resolution	✓	– 1	- 1, 0, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
FR	Feedback signal resolution	✓	0	0, 1	
PS	Position scale	✓	1	0, 1, 2 – 99	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
OTM	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
AO	Absolute position offset	✓	0	0 – 409 599	
MV	Move velocity	–	1.0000	0.0001 – 4.5000	
MA	Move acceleration	–	1.00	0.01 – 120.00	
JV	Jog velocity	–	0.1000	0.0001 – 4.5000	
JA	Jog acceleration	–	1.00	0.01 – 120.00	
HV	Home Return velocity	–	0.2000	0.0001 – 4.5000	
HA	Home Return acceleration	–	1.00	0.01 – 120.00	
HZ	Home Return / near zero velocity	–	0.0100	0.0001 – 0.2000	
MD	Move deceleration	–	0	0, 0.01 – 120.00	
CS	Acceleration pattern select	–	1/1	1 – 5	
CY	Criterion to function CS	✓	1.00	0.01 – 120.00	
CX	Setting CS function	✓	0	0, 1	

Table 9-4b: Parameter setting for AS and BS type Motor equipped with absolute sensor (2/2)

Parameter	Name	Password	Shipping set	Data range	Current setting
OS	Origin setting mode	✓	4	1, 3, 4, 5, 6	
HD	Home Return direction	✓	1	0, 1	
HO	Home position offset	✓	0	- 405 504 – 405 504	
(PA)	Origin setting mode	✓	***	24 – 1 048	
(OL)	Overload limit	✓	**	0 – 100	
(RC)	Rated current	✓	**	0 – 100	
LR	Low torque ripple	✓	0	0, 1	
RO	ABS/INC	✓	***	0 – 4 096	
AB	I/O polarity	✓	X0X0XX00	0, 1, X	
NW	Chattering preventive timer	✓	2	0 – 4	
IM	IOFF mode	✓	0	0, 1	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace mode	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0 – 15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1	
EC	End of command message	✓	0	0, 1	
LO	Load inertia	✓	0	0 – 50.000	
SG	Servo gain adjust, minor	–	0	0 – 30	
(MT)	Factory use only.	✓	**	–	
(RI)	Factory use only.	✓	**	–	
(ZP)	Factory use only.	✓	1.00	–	
(ZV)	Factory use only	✓	1.4	–	
SL	Set control mode	✓	3	1, 2, 3	
AC	Analog command mode	✓	1	- 1, 0, 1	
AGV	Analog velocity command gain	✓	1.00	0.10 – 2.00	
AGT	Analog torque command gain	✓	1.00	0.10 – 2.00	
AF	Analog command offset	✓	0	- 63 ~ 63	
AL	Acceleration limiter	–	0	0, 0.01 – 120.00	
HW	Home signal holding time	–	0	0, 0.3 – 100.0	
HI	Home In-position	–	100	0 – 102 400	
SO	SPD output mode	✓	0	0, 1	
SB	Criterion, SPD signal output	–	0	0 – 4.50	
ST	Speed stable timer	–	0	0, 0.3 – 100.0	
NMA	Near A output mode	✓	0	0, 0.3 – 100.0	
NMB	Near B output mode	✓	0	0, 0.3 – 100.0	
NA	Near position A	–	100	1 – 99 999 999	
NB	Near position B	–	100	1 – 99 999 999	
ZAS	Start point of zone A	–	0	0 – ± 99 999 999	
ZAE	End point of zone A	–	0	0 – ± 99 999 999	
ZBS	Start point of zone B	–	0	0 – ± 99 999 999	
ZBE	End point of zone B	–	0	0 – ± 99 999 999	
OU	Origin undefined, alarm type	✓	0	0, 2	
EP	Excessive position error, alarm type	✓	2	1, 2, 3	
TO	Software travel limit over, alarm type	✓	2	1, 2	
HT	Hardware travel limit over, alarm type	✓	2	0, 1, 2	
PE	Program error, alarm type	✓	2	0, 2	
AE	Automatic tuning error, alarm type	✓	0	0, 2	
PH	Program Home Return	✓	0	0, 1, 2	

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10. Maintenance

10.1. Precautions

- Backup Motor and Driver Unit
  - ◊ We recommend keeping the backup of Motor and Driver Unit for a quick recovery in case of unexpected failure of the System.

- Parameter and program data backup
  - ◊ For an unexpected failure of the Driver Unit, all parameters and programs should be recorded.
  - ◊ For your convenience, we have provided the lists of parameter and program on the last pages of this manual.

    "Appendix 5: ESA35 Driver Unit Parameter/Program Setting List"

    "Appendix 6: ESAC5 Driver Unit (Equipped with absolute sensor) Parameter/Program Setting List"

- When replacing the Driver Unit, refer to "Appendix 4: How to Replace the ESA35 or the ESAC5 Driver Units."

- ESA35 and ESAC5 Driver Units have the EEPROM for backup of the program and parameter settings; thus they do not need a battery for memory backup.
  (Life of the EEPROM: approximately 500 000 times of overwriting.)
  - ◊ If you require frequent parameter changes in positioning with the RS-232C communication operation etc, set the WM1 parameter to avoid unnecessary backup.
  - ◊ Commands AD, AR, ID and IR do not affect the life of the EEPROM as they won't be backed up to the memory. However, they will be backed up to the EEEPROM if they are programmed to a channel.
  - ◊ The alarm of "E2> EEPROM Error" occurswhen the EEPROM reaches the end of its usefulness.

10.2. Periodical Check

10.2.1. Motor

⚠ *Caution : Do not disassemble the Motor and the resolver. If disassembling the Motor is necessary, contact your local NSK representative.*

- Since the Megatorque Motors do not have any parts that 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 according to the actual use conditions.

Table 10-1

Item	Checking interval	How to check	Remarks
Vibration/Noise	Daily	Touching and hearing	Watch daily changes.
Appearance	According to environment	Wipe off dust and slag. Blow off dust.	–
Insulation	Once/year	Resistance test (Disconnect the Driver Unit, and then check the resistance between the Motor coil and the ground earth with 500V Megohmmeter.)	Resistance ≥ 10 MΩ
Full check	According to Motor condition	Overhaul by the manufacturer. (NSK)	–

10.2.2. Driver Unit and Cable Set

- Because the Driver Unit uses highly reliable semiconductors and it does not have any mechanical contact point, the daily check is not necessary. Checks shown in Table 10-2 are necessary at least once a year.

Table 10-2

Item	Interval	Checking point	Remarks
Retighten screws	Once/year	Terminal block screws. Connector fixing screws.	–
Cleaning	Once/year	Remove dust or contaminants inside of Driver Unit.	–
Cable check	Once/year	Check for damages and cracks of cables.	When the cable is forced to bend or twist, checking frequency should be increased.

10.3. Periodical Replacement of Parts

10.3.1. Motor

- There is no part that requires periodical replacement.
- Refer to “10.2. Maintenance Check.”

10.3.2. Driver Unit

- Electrolytic condenser
  - ◊ The gradual chemical change of electrolytic condensers will deteriorate the System function and may result in the System failure.

Table 10-3

Parts	Function	Life	How to replace
Electrolytic condenser	Equalize power voltage	10 years	Replace *PCB. Replace whole unit.

*PCB: Printed circuit board

- Though the operating conditions of the System dominate the life of electrolytic condenser, the ten years of life is rough estimation under continuous operation in normal room environment.

10.4. Storing

- Store the Motors and the Driver Units in clean and dry indoor condition.
- The Driver Units have a lot of ventilation holes, and they should be covered properly to protect from dust.

Table 10-4

Storing condition		Remarks
Temperature	- 20°C to + 70°C	–
Humidity	20 to 80%	No condensation

10.5. Warranty Period and Coverage

10.5.1. Warranty Period

- The warranty period is one year from the date of delivery of the product, or 2 400 working hours, whichever comes first.

10.5.2. Limited Warranty

- The items to be warranted shall be the supplied products by NSK Ltd.
- The supplier will repair the supplied products free of charge within the warranty period.
- The supplied products will be repaired with cost and fees paid by the customer after the warranty period.

10.5.3. Immunities

- The product is not warranted in one of the following cases even within the warranty period:
  - ◊ Failure of the unit due to installation and operation not in accordance with the instruction manual specified by the supplier.
  - ◊ Failure of the unit due to improper handling and use, modification and careless handling by the user.
  - ◊ Failure of the unit due to the causes other than those attributable to the supplier.
  - ◊ Failure of the unit due to modification or repair that is conducted by a person(s) or party (ies) other than the supplier.
  - ◊ Other types of failures due to natural disasters and accidents (causes not attributable to the responsibility of the supplier).
  - ◊ Designated consumables (fuses for ESA Driver Unit.).
- Damage induced by a failure of the supplied unit is not covered.

10.5.4. Service Fee

- NSK Ltd. reserves the right to charge to a user for the service such as dispatch of engineer(s).
- Startup, maintenance and adjusting of the unit under the supervision of our engineer(s) are the paid service even if it is to be provided during the warranty period.
- Service fees shall be billed to the customer according to the rules on the paid service.

11. Alarm

11.1. Identifying Alarm

- The DRDY output opens when an error occurs in the ESA Driver Unit.

- 7-segemnt LED is provided on the front panel of the Driver Unit to identify the alarm. The TA command can be used to identify alarms with the RS-232C communication.

11.1.1. LED Alarm Indicator

Figure 11-1

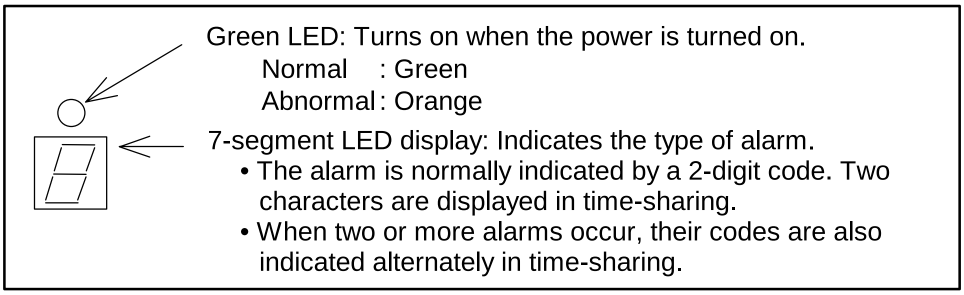
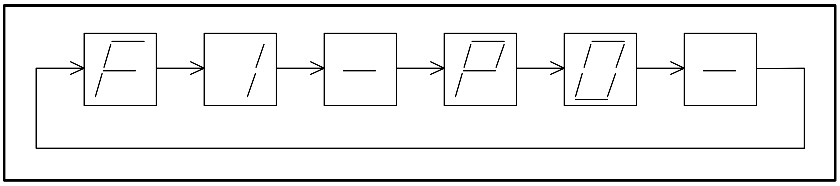
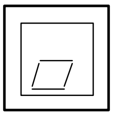


Figure 11-2: Abnormal (example)



(Example) Excess position error F1 + Heat Sink Over-Temperature P0

Figure 11-3: The LED is indicating normal state.



11.1.2. Using TA Command

TA: Tell Alarm Status

Format : TA [ENT]

- The TA command reports an alarm status.
- The same contents of alarm identification, which is displayed on the 7-segment LED on the front panel, will be displayed on the screen.
- However, the readout is not indicated in time-sharing like the LED.

*Example: Excess position error and heat sink overheat alarms

```
:TA
 F1>Excess Position Error
 P0>Over Heat
:_
```

F1: Excessive position error alarm
P0: Heat sink overheat alarm

[Example 1] Identify an alarm as the warning lamp of ALARM is on.

1) Confirm that the display of Handy Terminal shows the colon ": ".
(If the colon ":" is not shown in the display, press the ENTER key once.)

```
:_
```

2) Input the TA command.

T A

```
:TA_
```

3) Press the [ENT] key and the display identifies the alarm.

ENT

```
:TA
 F1>Excess Position Error
:_
```

- Thus the alarm is identified as "Excess position error."

11.2. Alarm List

⚠ *Caution* : • *The DRDY output is normally closed and it opens on abnormal condition.*

• *The OVER output is normally open and it will be closed in abnormal condition.*

11.2.1. Normal State

Table 11-1

Power LED	7-seg.LED	DRDY	OVER	Motor
Green	o	Closed	Open	Servo-on

● If the Motor does not operate even in the normal state, the following described in Table 11-2 may be the cause.

Table 11-2

Power LED	7-seg. LED	DRDY output	OVER output	Motor	Meaning of Indication	Cause	Remedy
Off	Off	Open	Open	Servo-off	Power off	The power is not turned on.	Turn on the power.
Orange	Off	Open	Open	Servo-off	Initializing CPU	CPU is being initialized.	Wait for a while.
Green	o	Closed	Open	Servo-off	SVON input OFF	SVON input is not ON.	Make SVON input ON.

◊ If initializing CPU takes a time (10 seconds or more) when the power is turned on, the part of the controller may be defective. Refer to “11.2.4.4. CPU Error” for cause and remedy.

11.2.1.1. Alarm State

- When an alarm occurs, the power LED turns to orange and the conditions of the output signals and the Motor will be in the state shown the table below.

Table 11-3 Alarm list

Alarm	7-seg. LED	DRDY output	OVER output	BRK output	Motor	Readout with TA command
Memory error	E0	Open	Open	Open	Servo-off	**E0>Memory Error**
EEPROM error	E2	Open	Open	Open	Servo-off	**E2>EEPROM Error**
System error	E7	Open	Open	Open	Servo-off	**E7>System Error**
Interface error	E8	Open	Open	Open	Servo-off	**E8>I/F Error**
Analog command error	E9	Open	Open	Open	Servo-off	**E9>ADC Error**
Excess position error	F1	Closed	Closed	Closed	Servo-lock	**F1>Excess Position Error**
Software over travel limit	F2	Closed	Closed	Closed	Servo-lock	**F2>Software Over Travel**
Hardware over travel limit	F3	Closed	Closed	Closed	Servo-lock	**F3>Hardware Over Travel**
Emergency stop	F4	Closed	Open	Open	Servo-lock	**F4>Emergency Stop**
Program error	F5	Closed	Open	Closed	Servo-lock	**F5>Program Error**
Automatic tuning error	F8	Closed	Open	Closed	Normal	**F8>AT Error**
RS-232C error	C2	Closed	Open	Closed	Normal	**C2>RS232C Error**
CPU error	C3	Open	Open	Open	Servo-off	**C3>CPU Error**
Resolver circuit error	A0	Open	Open	Open	Servo-off	**A0>Resolver Circuit Error**
Absolute position error	A1	Open	Open	Open	Servo-off	**A1>Absolute Position Error**
Software thermal sensor	A3	Open	Open	Open	Servo-off	**A3>Overload**
Velocity error over (serious)	A4	Open	Closed	Open	Servo-off	**A4>Velocity Abnormal**
Velocity error over (minor)	A4	Closed	Closed	Closed	Servo-lock	**A4>Velocity Abnormal**
Home position undefined	A5	Closed	Open	Closed	Normal	**A5>Origin Undefined**
Heat sink overheat	P0	Open	Open	Open	Servo-off	**P0>Over Heat**
Abnormal main AC line voltage	P1	Open	Open	Open	Servo-off	**P1>Main AC Line Trouble**
Over current	P2	Open	Open	Open	Servo-off	**P2>Over Current**
Control AC line under voltage	P3	Open	Open	Open	Servo-off	**P3>Control AC Line Under Voltage**

11.2.2. Alarms Related to Power Amplifier

11.2.2.1. Heat Sink Overheat or Regeneration Resistor Overheat

[Output]	DRDY: Open
	OVER: Open
[TA]	P0 > Over Heat
[LED]	P0
[Motor Condition]	Servo-off

Table 11-4: Cause and remedy: Overheat of heat sink or regeneration resistor.

Cause	Remedy
(1) Duty cycle of the Motor is too high. (2) Excessive load is applied.	Reduce the load and/or operation duty. Readjust acceleration/deceleration. (Stop the operation, and then air-cool the Driver Unit.)
(3) Ambient temperature is above 50°C. (4) Heat sink temperature exceeds 90°C due to continued heavy torque demand.	• Check surrounding condition of the Driver Unit. • Stop the operation, and air-cool the Motor and Driver Unit. Then check the following. ◊ If the duty cycle is too high. ◊ If an excessive load is applied. ◊ If the ambient temperature of the Driver Unit is too high. • If no trouble is found in the above check and still this alarm occurs frequently, contact NSK.
(5) Defective PCB. (As soon as the control power is turned on, the alarm occurs.)	• Replace the Driver Unit referring to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit."

- Even the alarm output is cleared; it will be on again when the thermal sensor remains on.
  - ◊ Take enough time to air-cool the Motor and the Driver Unit.

11.2.2.2. Abnormal Main AC Line Voltage

[Output]	DRDY: Open
	OVER: Open
[TA]	P1 > Main AC Line Trouble
[LED]	P1
[Motor Condition]	Servo-off

Table 11-5: Cause and remedy: Abnormal main AC line voltage (Over/Under)

Cause	Remedy
(1) Abnormal power supply voltage. (2) ◊ Main circuit voltage is excessive due to high acceleration/deceleration under heavy load inertia. ◊ Inferior power source gives over 250 VAC power to the main power supply for power amplifier main circuit. (3) Inferior power source gives under 70 VAC to power amplifier main circuit.	• Check the main power supply. (Excessive voltage, low voltage and power source capacity.) • Check fuse, power source and the cable, and then turn power on again.
(4) Blown fuse. (Motor over temperature, abnormal power supply wiring, Driver Unit abnormal.)	• Refer to “Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit.”
(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.)	• Refer to “Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit.”

Note : 1) When the regeneration dump resistor cannot process regenerative current, the voltage of direct current to main circuit will be too high, and, eventually, the alarm will be on.

2) Decrease acceleration/deceleration.

11.2.2.3. Over Current

[Output]	DRDY: Open
	OVER: Open
[TA]	P2 > Over Current
[LED]	P2
[Motor Condition]	Servo-off

Table 11-6: Cause and remedy: Over current

Cause	Remedy
(1) Poor insulation of the Motor. (Refer to "Appendix 2. How to Check Motor Condition.")	• Replace the Motor.
(2) Defective Motor Cable. (Refer to "Appendix 2. How to Check Motor Condition.")	• Replace the Cable.
(3) Defective FET of Power Amplifier. (When the alarm is on even the Motor and Motor cable are normal.)	• Refer to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit."

- The alarm may be accompanied by "Abnormal main AC line voltage (blown fuse)" alarm due to excessive current flow.

11.2.2.4. Control AC Line Under Voltage

[Output]	DRDY: Open
	OVER: Open
[TA]	P3 > Control AC Line Under Voltage
[LED]	P3
[Motor Condition]	Servo-off

Table 11-7: Cause and remedy: Control AC line under voltage

Cause	Remedy
(1) Low voltage of control power input.	• Check the control power voltage. (Low voltage due to over current or output shorting.)
(2) Control circuit voltage for the power amplifier falls below 70VAC due to inferior power supply.	• Turn off power, check the power supply and power cable, and then turn on power again.
(3) Defective PCB. (When the alarm is on after control power is turned on.)	• Refer to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit."

11.2.3. Alarms Related to Motor

10.2.3.1. Resolver Circuit Error

[Output]	DRDY: Open OVER: Open
[TA]	A0 > Resolver Circuit Error
[LED]	A0
[Motor Condition]	Servo-off

Table 11-8: Cause and remedy: Resolver circuit error

Cause	Remedy
(1) Resolver cable disconnected. (Refer to "Appendix 2. How to Check Motor Condition.")	• Turn off power, check the resolver cable and the connector.
(2) Breakage of resolver cable. (Refer to "Appendix 2. How to Check Motor Condition.")	• Replace the resolver cable.
(3) Defective resolver. (Refer to "Appendix 2. How to Check Motor Condition.")	• Replace the Motor.
(4) Defective PCB. (When the alarm is on even the resolver and the cable are normal, and the connector is properly secured.)	• Replace the Driver Unit referring to "Appendix 4, How to Replace ESA35 or ESAC5 Driver Unit."

Note : 1) Check the resolver cable for breaking and short of wires.

2) Check the connector for contact failure.

3) When the resolver Cable is forced to bend repeatedly, the bending radius and frequency will affect on the life of the cable. It is necessary to check insulation and continuity of the cable periodically.

4) When an excessive current applied to the resolver due to internal contact between the rotor and the stator, or collision of Motor, the fuse protecting the exciting circuit of resolver may blow out. It requires replacing of the Motor and the Driver Unit in such a case.

11.2.3.2. Absolute Position Error (For Driver Unit equipped with absolute position sensor) only)

[Output]	DRDY: Open
	OVER: Open
[TA]	A1>Absolute Position Error
[LED]	A1
[Motor condition]	Servo-off.

Table 11-9: Cause and remedy: Absolute position error

Cause	Remedy
(1) The motor moved when the power is on.	• Turn on the power again.
(2) Defective printed circuit board.	• Replace the Driver Unit referring to "Appendix4. How to Replace ESA35 or ESAC5 Driver Unit."

- The Motor absolute position scale is defined at the moment of initialization of the Driver Unit when the power is turned on. If the Motor moves because of external force or vibration, it cannot define the correct position scale, and this leads to the alarm. Therefore, change the timing of power-on if the alarm occurs because of the motion of other unit when the power is on.

10.2.3.3. Software Thermal Sensor

[Output]	DRDY: Open
	OVER: Open
[TA]	A3 > Overload
[LED]	A3
[Motor Condition]	Servo-off

Table 11-10: Cause and remedy: Overload

Cause	Remedy
(1) Excessive Motor duty cycle.	• Reduce duty cycle and the load. Re-adjust acceleration/deceleration. • Air-cool the Motor as it is overheated after it has stopped. Then turn on the power again. (After stopping operation, keep the control power on.)
(2) Mechanical restraint to the Motor such as brake or an obstacle.	• Remove mechanical obstacle.
(3) Poor gain setting.	• Readjust the gain. (Refer to "5. Tuning and Trial Running.")
(4) Unmatched combination of Motor and Driver Unit.	• Check the combination. (Reference number of Motor and Driver Unit.)

Note: Do not change the setting of OL parameter. It is properly set at the factory.

11.2.3.4. Velocity Error Over

[Output]	DRDY: Open OVER: Closed
[TA]	A4> Velocity Abnormal
[LED]	A4
[Motor Condition]	Servo-lock

Table 11-11: Cause and remedy: Velocity error over

Cause	Remedy
(1) Velocity of Motor has reached to the limit due to external disturbance.	• Clear the alarm.
(2) Velocity of Motor has reached to the limit due to overshooting.	• Reduce setting of acceleration rate. • Reduce rotational speed.
(3) Motor tends to vibrate due to poor servo tuning.	• Tune Motor properly.
(4) Motor is runaway. (Out of control)	• Confirm the PA data for abnormality. • Replace Driver Unit referring to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit."

10.2.3.5. Home Position Undefined

◆ **When the parameter OU is set to "0" (shipping set)**

[Output]	DRDY: Closed OVER: Open
[TA]	A5>Origin Undefined
[LED]	A5
[Motor condition]	Normal

◆ **When the parameter OU is set to "2"**

[Output]	DRDY: Closed OVER: Closed
[TA]	A5>Origin Undefined
[LED]	A5
[Motor condition]	Normal

Table 11-12: Cause and remedy: Home position undefined

Cause	Remedy
(1) An absolute positioning command is inputted after the power is turned on before the Home position is defined.	• Perform Home Return. • Clear alarm.
(2) Home position of the absolute position sensor is lost because of a change in the position scale setting	• Turn on the power again.

11.2.4. Alarms Related to Control

10.2.4.1. Memory Error

[Output]	DRDY: Open
	OVER: Open
[TA]	E0 > Memory Error
[LED]	E0
[Motion Condition]	Servo-off

Table 11-13: Cause and remedy: Memory error

Cause	Remedy
(1) Parameters stored in the memory have been rewritten by noise or other cause.	• Initialize the memory then reenter the parameters. (Refer to "9. Glossary of Command and Parameter.")
(2) Defective PCB. (If the memory is not functioning after initialized.)	• Replace Driver Unit referring to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit.)

◊ The SI command (RS-232C communication) initializes the memory. On completion of initialization of the memory, the backed-up parameters will be reset to the shipping set. Reset the parameters to actual use condition again.

11.2.4.2. EEPROM Error

[Output]	DRDY: Open
	OVER: Open
[TA]	E2 > EEPROM Error
[LED]	E2
[Motor Condition]	Servo-off

Table 11-14: Cause and remedy: EEPROM error

Cause	Remedy
(1) Defective EEPROM of control circuit.	• Turn the power on again. • Replace Driver Unit referring to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit."

10.2.4.3. System Error

[Output]	DRDY: Open
	OVER: Open
[TA]	E7>System Error
[LED]	E7
[Motor Condition]	Servo-off

Table 11-15: Cause and remedy: System Error

Cause	Remedy
(1) Defective ROM on PCB. (2) Defective EEPROM on PVB.	• Replace the Driver Unit referring to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit."

11.2.4.4. CPU Error

[Output]	DRDY: Open
	OVER: Open
[TA]	Disabled
[LED]	Uncertain
[Motor Condition]	Servo-off

Table 11-16: Cause and remedy: CPU error

Cause	Remedy
(1) CPU is out of control due to noise.	• Turn the power on again. • The alarm is deactivated when the power is turned on again. If the alarm occurs frequently, contact NSK.
(2) Defective PCB. (If the alarm is not deactivated after the power is turned on.)	• Replace Driver Unit referring to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit."

Note: 1) The RS-232C communication and other controls are disabled because the CPU is not functioning.

2) Contact NSK if the alarm occurred.

10.2.4.5. Interface Error

[Output]	DRDY: Open
	OVER: Open
[TA]	E8 > I/F Error
[LED]	E8
[Motor Condition]	Servo-off

Table 11-17: Cause and remedy: Interface error

Cause	Remedy
(1) Defective I/O board in Driver Unit	• Replace Driver Unit referring to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit."

10.2.4.6. Analog Command Error

[Output]	DRDY: Open
	OVER: Open
[TA]	E9 > ADC Error
[Motor Condition]	Servo-off

Table 11-18: Cause and remedy: Analog command error

Cause	Remedy
(1) Defective circuit of analog command input	• Replace Driver Unit referring to "Appendix 4: How to Replace ESA35 or ESAC5 Driver Unit."

11.2.4.7. Excessive Position Error

◆ **Parameter EP1**

[Output]	DRDY: Open OVER: Open
[TA]	F1>Excess Position Error
[LED]	F1
[Motor condition]	Servo-lock

◆ **Parameter EP2 (shipping set)**

[Output]	DRDY: Closed OVER: Closed
[TA]	F1>Excess Position Error
[LED]	F1
[Motor condition]	Servo-lock

◆ **Parameter EP3**

[Output]	DRDY: Open OVER: Closed
[TA]	F1>Excess Position Error
[LED]	F1
[Motor condition]	Servo-lock

Table 11-19: Cause and remedy: Excess position error

Cause	Remedy
(1) Position error counter value exceeds CO setting due to mechanical interference such as brake.	• Remove mechanical interference.
(2) Error in position error counter exceeds CO setting due to poor servo gain tuning.	• Readjust gain. (Refer to “5. Tuning and Trial Running.”)
(3) Position error in error counter exceeds CO setting because of high acceleration/deceleration (MA).	• Decrease acceleration/deceleration (MA).
(4) Position error in error counter exceeds because CO is set too low.	• Increase the CO setting. • Input the CLR clears the alarm. This time the position error counter is cleared to 0 (Zero). • Adjust servo parameters (VG, VI, and PG). • Adjust acceleration/deceleration (MA). • Check the applied load.
(5) Unmatched combination of the Motor and the Driver Unit.	• Check reference number of the Motor and the Driver Unit.
(6) Improper PA setting.	• Execute the OG command (automatic position adjustment of position sensor).
(7) Defective PCB. (If the alarm is on even “RUN” command is not executed.)	• Replace the Driver Unit referring to “Appendix 4: How to Replace ESA35 or ESAC5 Driver Unit.”

11.2.4.8. Software Over Travel Limit

- **Parameter TO1.**

[Output] DRDY: Open
OVER: Open
[TA] F2>Software Over Travel
[LED] F2
[Motor condition] Position control mode: Servo-lock in one direction.
(The Motor rotates only in a direction to get out the off-limit zone.)
Velocity or Torque control mode: Velocity control servo-lock.

- **Parameter TO2. (Shipping set)**

[Output] DRDY: Closed
OVER: Closed
[TA] F2>Software Over Travel
[LED] F2
[Motor condition] Position control mode: Servo-lock in one direction.
(The Motor rotates only in a direction to get out the off-limit zone.)
Velocity or Torque control mode: Servo-lock in velocity control

Table 11-20: Cause and remedy: Software over travel limit over

Cause	Remedy
(1) The Motor enters the off-limit zone set by OTP and OTM	• Move the Motor out of the software over travel limit. • Get out the off-limits zone.

- The off-limits zone shall be set so that the Motor can stop with this alarm at where it won't be mechanically locked or interfered.

11.2.4.9. Hardware Over Travel Limit

◆ **Parameter HT0**

[Output] DRDY: Closed
OVER: Open
[TA] F3>Hardware Over Travel
[LED] F3
[Motor condition] Servo-lock in one direction
(The Motor rotates only in the direction to get out the off-limits zone.)

◆ **Parameter HT1**

[Output] DRDY: Open
OVER: Open
[TA] F3>Hardware Over Travel
[LED] F3
[Motor condition] Servo-lock in one direction
(The Motor rotates only in the direction to get out the off-limits zone.)

◆ **Parameter HT2 (Shipping set)**

[Output] DRDY: Closed
OVER: Closed
[TA] F3>Hardware Over Travel
[LED] F3
[Motor condition] Servo-lock in one direction
(The Motor rotates only in the direction to get out the off-limits zone.)

Table 11-21: Cause and remedy: Hardware over travel limit

Cause	Remedy
(1) Motor activated the limit switch.	• Move the Motor out of the off-limit zone.
(2) Mistaken setting of the input port polarity.	• Confirm the AB parameter.
(3) Defective travel limit switch or faulty wiring.	• Check for defective travel limit switch and faulty wiring.

10.2.4.10. Emergency Stop

[Output] DRDY: Closed
OVER: Open
[TA] F4 > Emergency Stop
[LED] F4
[Motor Condition] Servo-lock

Table 11-22: Cause and remedy: Emergency stop

Cause	Remedy
(1) Mistaken setting of input port polarity.	• Confirm the parameter “AB.”
(2) EMST is input. (In case of A contact)	• Input EMST OFF after the Motor stops.
(3) EMST (CN2) is OFF. (In case of B contact)	• Input EMST ON after the Motor stops.
(4) Faulty wiring.	• Check the wiring.

11.2.4.11. Program Error

◆ **Parameter PE0**

[Output]	DRDY: Closed
	OVER: Open
[TA]	F5>Program Error
[LED]	F5
[Motor condition]	Servo-lock

◆ **Parameter PE 2 (Shipping set)**

[Output]	DRDY: Closed
	OVER: Closed
[TA]	F5>Program Error
[LED]	F5
[Motor condition]	Servo-lock

Table 11-23: Cause and remedy: Program error

Cause	Remedy
(1) A channel that does not have a program is selected.	• Check the contents of a program. • Check wirings of inputs PRG0 to PRG. • Check the sequence.

10.2.4.12. Automatic Tuning Error

◆ **Parameter AE0 (Shipping set)**

[Output]	DRDY: Closed
	OVER: Open
[TA]	F8>AT Error
[LED]	F8
[Motor condition]	Normal servo condition

◆ **Parameter AE2**

[Output]	DRDY: Closed
	OVER: Closed
[TA]	F8>AT Error
[LED]	F8
[Motor condition]	Normal servo condition

Table 11-24: Cause and remedy: Automatic tuning error

Cause	Remedy	Terminal display
(2) The System is in servo-off in the middle of automatic tuning. (2) “EMST” or “Over Travel Limit” signal is input in the middle of automatic tuning.	• Check input signal, and then execute the automatic tuning again.	AT Error 1
(3) Automatic tuning cannot be executed due to unbalanced load.	• Check the load condition. • Set parameters manually.	AT Error 2
(4) Automatic tuning cannot be executed due to excessive load.	• Check the load or the mounting base. Increase rigidity. • Set parameters manually.	AT Error 3
(5) Resonant occurs due to low rigidity of the load or the mounting base.		AT Error 4

11.2.4.13. RS-232C Error

◆ **Parameter SE0 (Shipping set)**

[Output]	DRDY: Closed OVER: Open
[TA]	C2>RS232C Error
[LED]	C2
[Motor condition]	Normal

◆ **Parameter SE1**

[Output]	DRDY: Open OVER: Open
[TA]	C2>RS232C Error
[LED]	C2
[Motor condition]	Servo-lock

◆ **Parameter SE2**

[Output]	DRDY: Closed OVER: Closed
[TA]	C2>RS232C Error
[LED]	C2
[Motor condition]	Servo-lock

Table 11-25: Cause and remedy: RS-232C error

Cause	Remedy
(1) The communication cable was connected or disconnected then the power was on.	• Be sure to connect or disconnect the communication cable when the power is off.
(2) Attempted to transmit a large volume of data without the flow control with CTS or RTS command.	• Wire CTS and RTS signals, and apply the flow control.
(3) Wrong baud rate is set to the terminal.	• Set the baud rate to 9 600 bps.
(4) Defective RS-232C communication.	• Replace Driver Unit referring to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit."

- You may cancel the alarm of "RS-232C error" by inputting the CLR input or the CL command.

10.2.4.14. CPU Error

[Output]	DRDY: Open OVER: Open
[TA]	C3>CPU Error
[LED]	C3
[Motor condition]	Servo-off

Table 11-26: Cause and remedy: CPU error

Cause	Remedy
(1) A wrong program is called due to noise.	• Take a measure against noise.
(2) The memory is defective.	• Replace the Driver Unit referring to "Appendix 4. How to Replace ESA35 or ESAC5 Driver Unit."
(3) CPU is defective.	

11.2.5. Readout of Alarm With TA Command

- The TA command reports the state of alarms.
- There will be no indication when no alarm is reported.
- When an alarm is reported, it is identified as shown below.

Table 11-27

Alarm	7 segments LED	Terminal Display
Memory error	E0	`E0>Memory Error`
EEPROM error	E2	`E2>EEPROM Error`
System error	E7	`E7>System Error`
Interface error	E8	`E8>I/F Error`
Analog command error	E9	`E9>ADC Error`
Excess position error	F1	`F1>Excess Position Error`
Software over travel limit	F2	`F2>Software Over Travel`
Hardware over travel limit	F3	`F3>Hardware Over Travel`
Emergency stop	F4	`F4>Emergency Stop`
Program error	F5	`F5>Program Error`
Automatic tuning error	F8	`F8>AT Error`
RS-232C error	C2	`C2>RS-232C Error`
CPU error	C3	`C3>CPU Error`
Resolver circuit error	A0	`A0>Resolver Circuit Error`
Absolute position error	A1	`A1>Absolute Position Error`
Software thermal sensor	A3	`A3>Overload`
Velocity error over	A4	`A4>RUN away`
Home position undefined	A5	`A5>Origin Undefined`
Heat sink overheat	P0	`P0>Over Heat`
Abnormal main AC line voltage	P1	`P1>Main AC Line Trouble`
Over current	P2	`P2>Over Current`
Control AC line under voltage	P3	`P3>Control AC Line Under Voltage`

- When multiple alarms are reported, each alarm is displayed on a separate line.
- Switching display format by MM command is effective.
- Example of display: Hardware travel limit and emergency stop are displayed in MM1 format.

```
:TA
 F3>Hardware Over Travel;
 F4>Emergency Stop;
:_
```

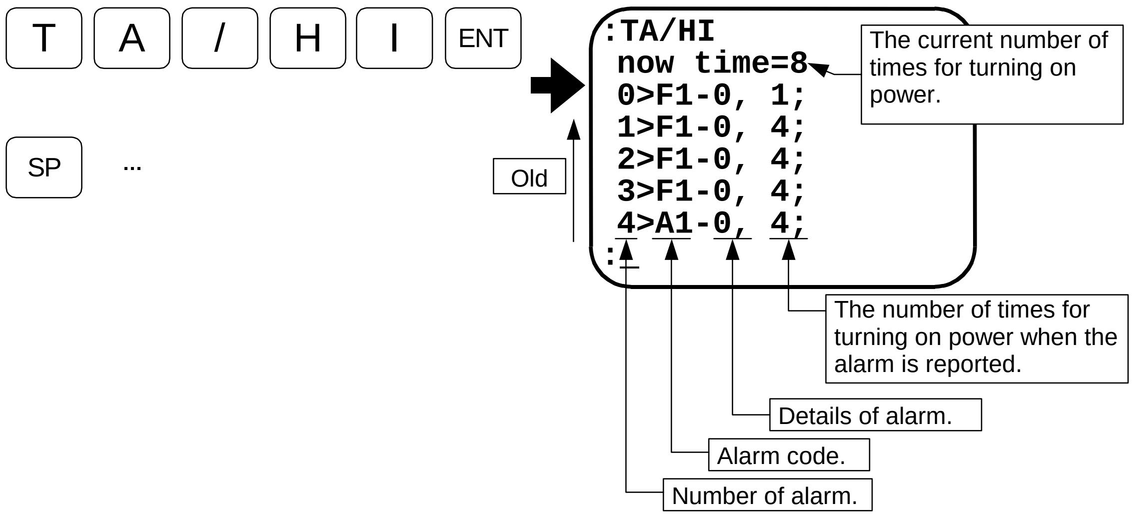
11.2.6. History of Alarm

- The System stores the history of alarm occurrences to EEPROM.
- It keeps the record up to 32 alarm histories that have occurred. When the stored histories reach to 32, the oldest history will be cleared and it will be replaced with the new one.
- This history records the alarm that makes the DRDY output open.
- The following are the contents of record.
  - (i) Alarm code that is shown on the LED.
  - (ii) Details of alarm for failure analysis of the manufacturer.
  - (iii) The number of times the power is turned on.

⚠ *Caution : History of alarm may not be stored properly when the power is shut off right after the alarm is reported.*

11.2.6.1. Indication of History of Alarm

(1) Input TA command. Press the SP key to scroll the next line up.



11.2.6.2. Clear History of Alarm

(1) Input the password.

/ N S K SP O N ENT

```
:/NSK ON
 NSK ON
:_
```

(2) Input the TA command.

T A / C L ENT

```
:/NSK ON
 NSK ON
:TA/CL
:_
```

11.2.7. Interchangeable Setting of Alarm Output With Other Drive Unit Series

- Use of the error level parameters (OU, EP, TO, HT, PE, AE, and SE) may classify the state of control outputs into Alarm (DRDY), Warning (OVER), and No report.

- The state of control outputs for alarm in ESA Driver Unit can be set as the same level of other Driver Unit Series of Megatorque Motor System.

Table 11-28: Setting of error level parameters and state of the error report.

Setting value of parameter	Error level	DRDY output	OVER output
0	No report	No report	No report
1	Alarm	Open	Open
2	Warning	No report	Closed
3	Alarm and warning	Open	Close

Table 11-29: Parameter setting list

Alarm	Error level parameter [✓:Shipping set]	Alarm output		Other Driver Unit			Your set
		DRDY	OVER	ESA	EM, EP	EE, EK	
Home position undefined **A5>Origin undefined**	OU0 ✓	Closed	Open	✓	No function	No function	
	OU2	Closed	Closed				
Excessive position error **F1>Excess Position Error**	EP1	Open	Open	✓			
	EP2 ✓	Closed	Closed				
	EP3	Open	Closed		✓	✓	
Software over travel limit **F2>Software Over Travel**	TO1	Open	Open	✓			
	TO2 ✓	Closed	Closed		✓	✓	
Hardware over travel limit **F3>Hardware Over Travel**	HT0	Closed	Open		✓	✓	
	HT1	Open	Open	✓			
	HT2 ✓	Closed	Closed				
Program error **F5>Program Error**	PE0	Closed	Open	✓		No function	
	PE2 ✓	Closed	Closed		✓		
Automatic tuning error **F8>AT Error**	AE0 ✓	Closed	Open	✓	No function	No function	
	AE2	Closed	Closed				
RS-232C error **C2>RS232C Error**	SE0 ✓	Closed	Open	✓	No function	No function	
	SE1	Closed	Closed				
	SE2	Closed	Closed				

◊ The DRDY output is closed to indicate the normal state, while it opens for an abnormal state. The OVER output is closed to indicate the normal state, while it opens for an abnormal .

◊ The EE and the EK Driver Units report an alarm with the outputs of DRDY, ALO1 and ALO2. The output ports of these parameters are closed in normal state, while it will open for an error.

12. Troubleshooting

12.1. Identifying Problem

- If problems do occur, check the items shown in Table 11-1.
- When reporting problems to the manufacturer, explanation of the items in Table 11-1 will help to identify the problem.

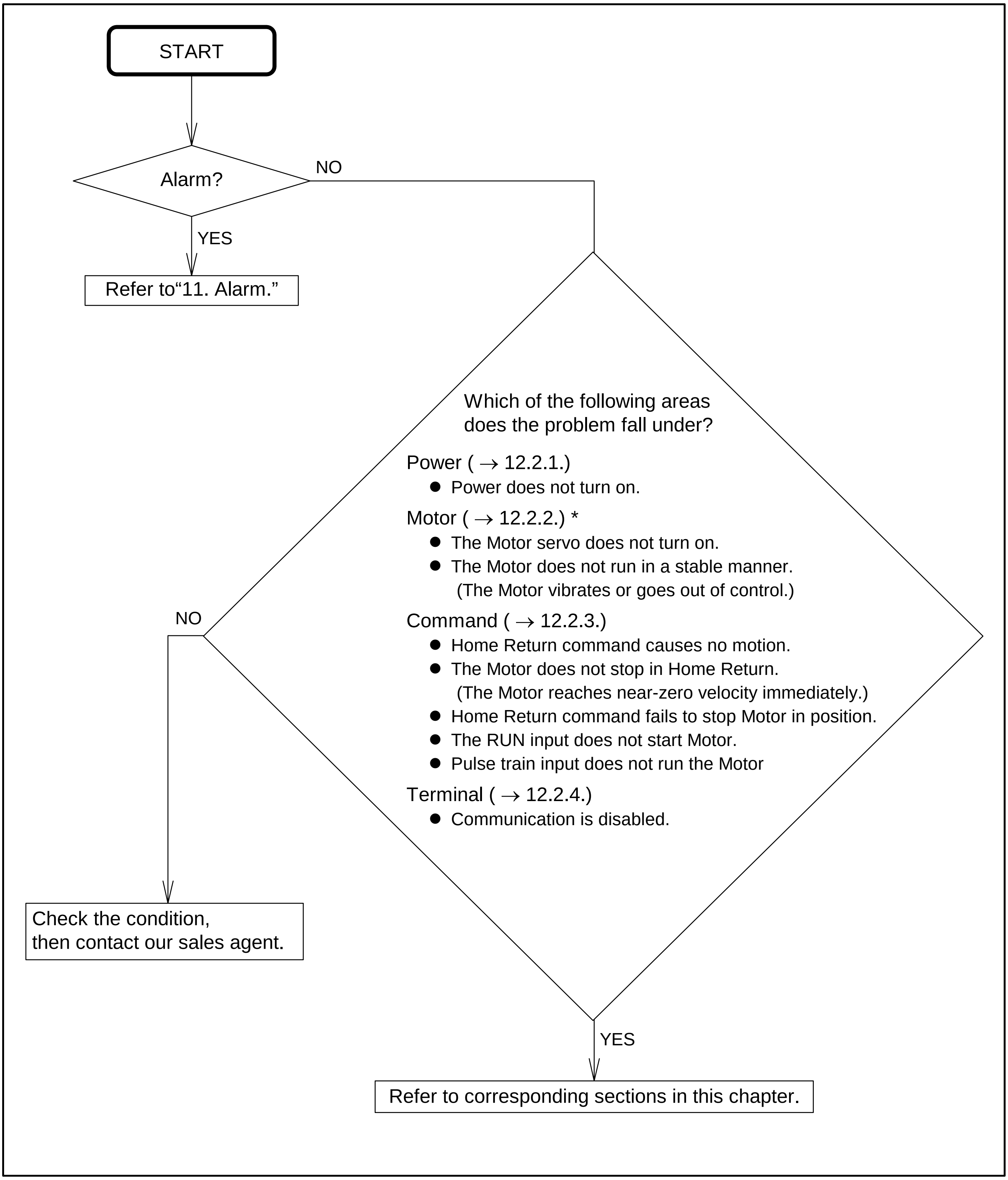
Table 11-1

No.	Items	Point to be checked (How it occurs.)
1	Product serial number	Check if serial numbers of the Motor and the Driver Unit are identical.
2	Power supply voltage	Check if voltage variation of power source is in the specification.
3	Trouble recurrence	Frequency
4	Occurrence in special occasion	Check if the problem occurs only when a particular command is executed or only when particular equipment is in operation.
5	Occurrence under a particular operation	Same position/direction ? At the moment of accelerating/decelerating ?
6	Alarm Code	Check alarm code by the TA command. (Refer to "11.1.2. Using TA Command.")

12.2. Troubleshooting

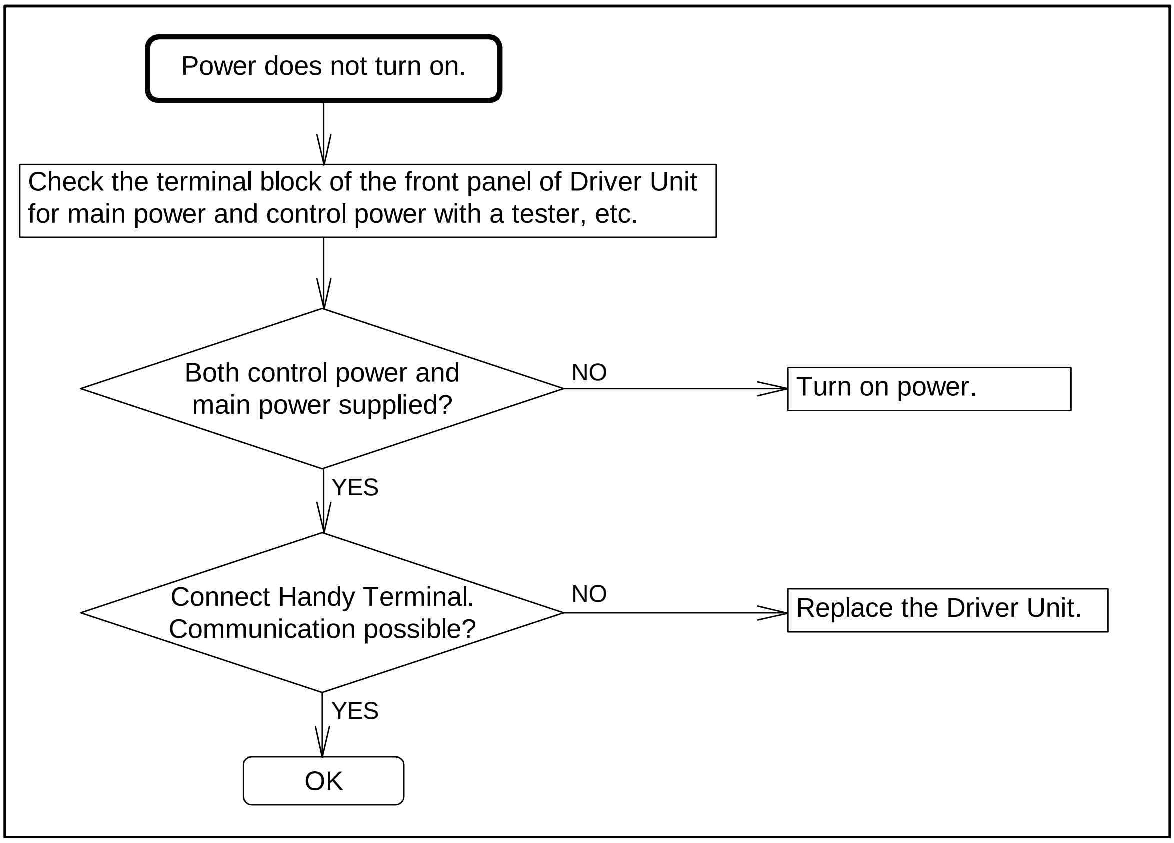
- When troubleshooting, refer to the flow chart shown below.

Figure 12-1: Troubleshooting flow



12.2.1. Power Trouble

Figure 12-2: Power trouble



12.2.2. Motor Trouble

Figure 12-3: Motor trouble

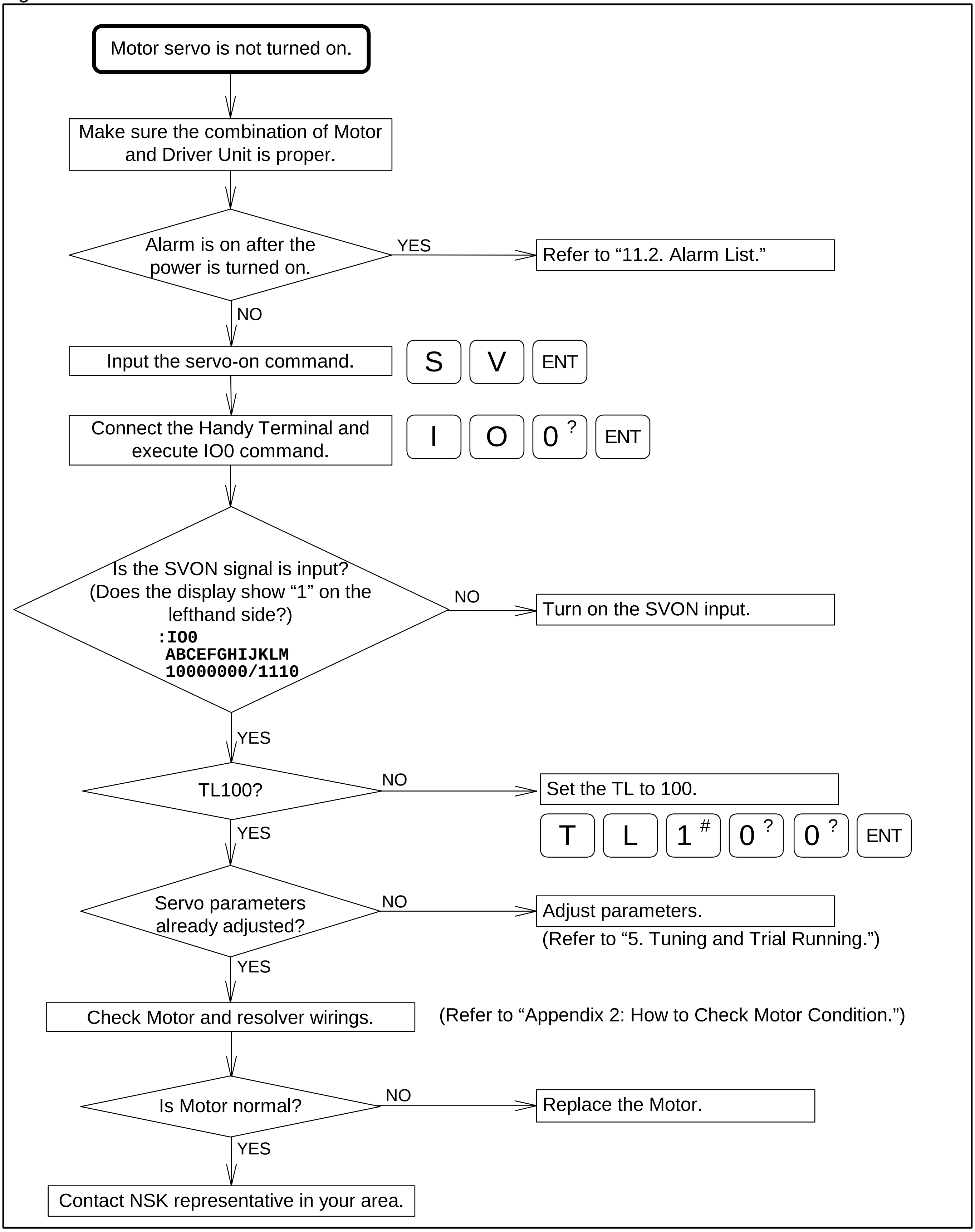
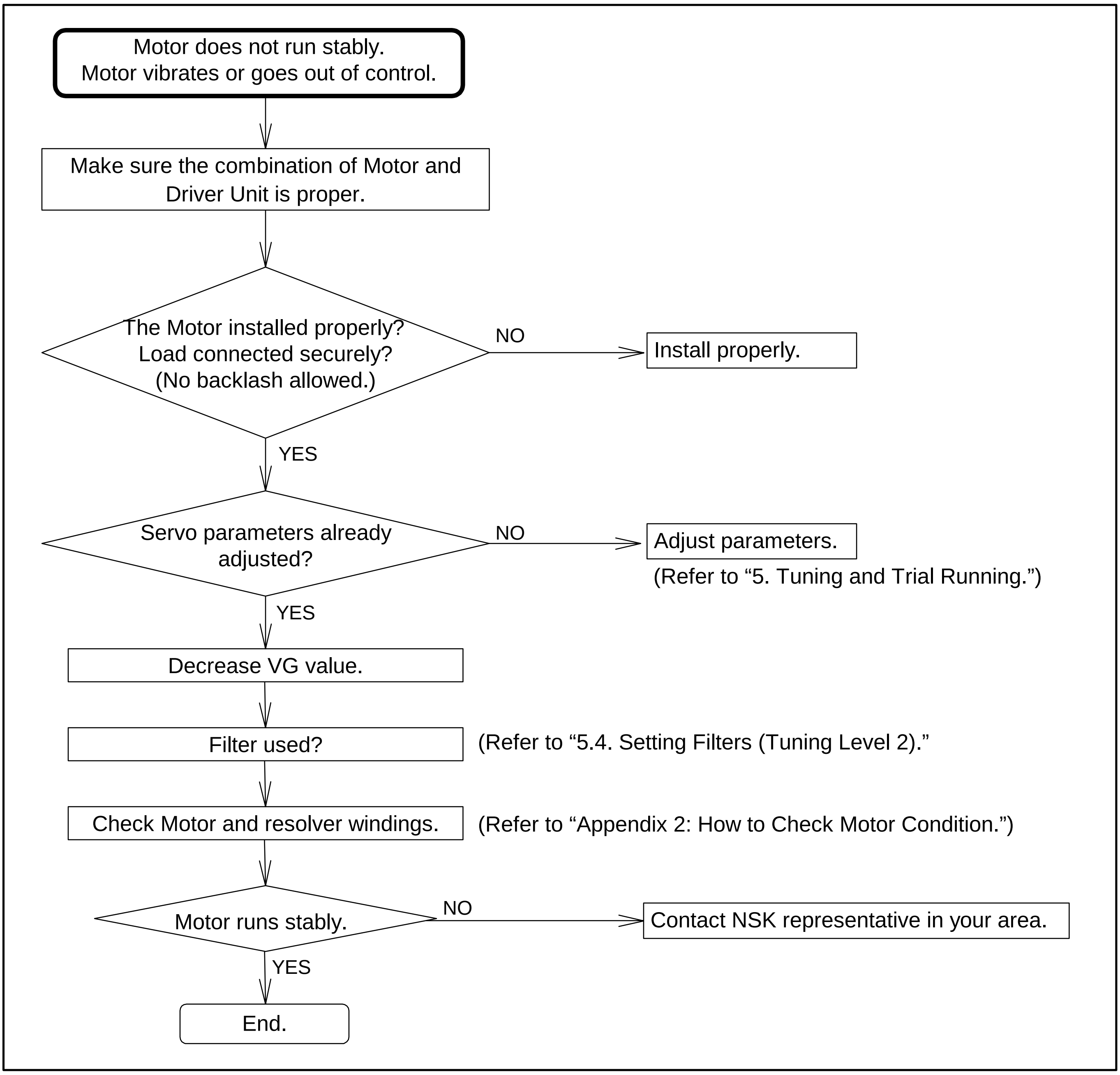


Figure 12-4



Motor does not run stably.
Motor vibrates or goes out of control.
Make sure the combination of Motor and Driver Unit is proper.
The Motor installed properly?
Load connected securely?
(No backlash allowed.)
NO
Install properly.
YES
Servo parameters already adjusted?
NO
Adjust parameters.
(Refer to "5. Tuning and Trial Running.")
YES
Decrease VG value.
Filter used?
(Refer to "5.4. Setting Filters (Tuning Level 2)."
Check Motor and resolver windings.
(Refer to "Appendix 2: How to Check Motor Condition.")
Motor runs stably.
NO
Contact NSK representative in your area.
YES
End.

12.2.3. Command Trouble

Figure 12-5: Command trouble

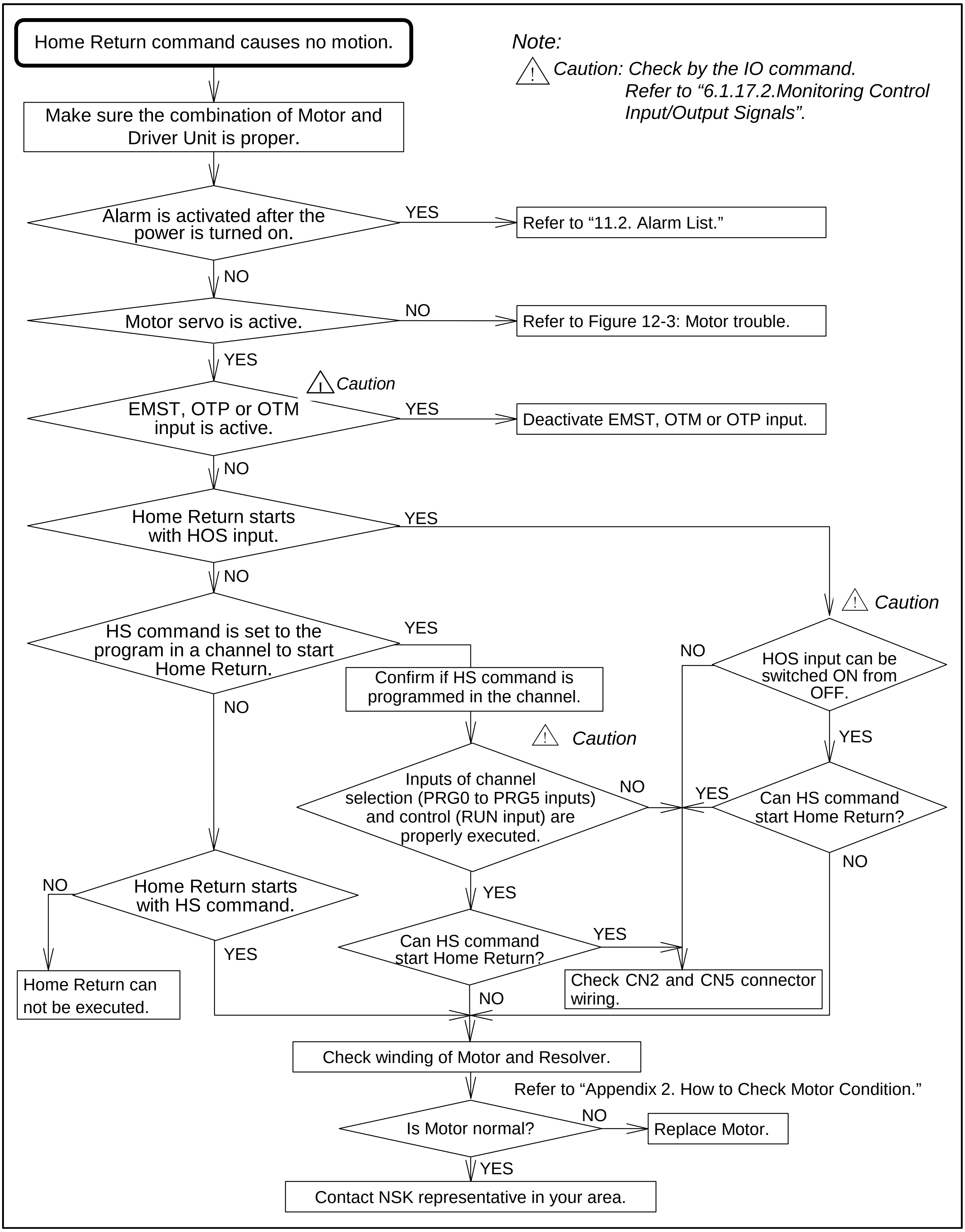


Figure 12-6

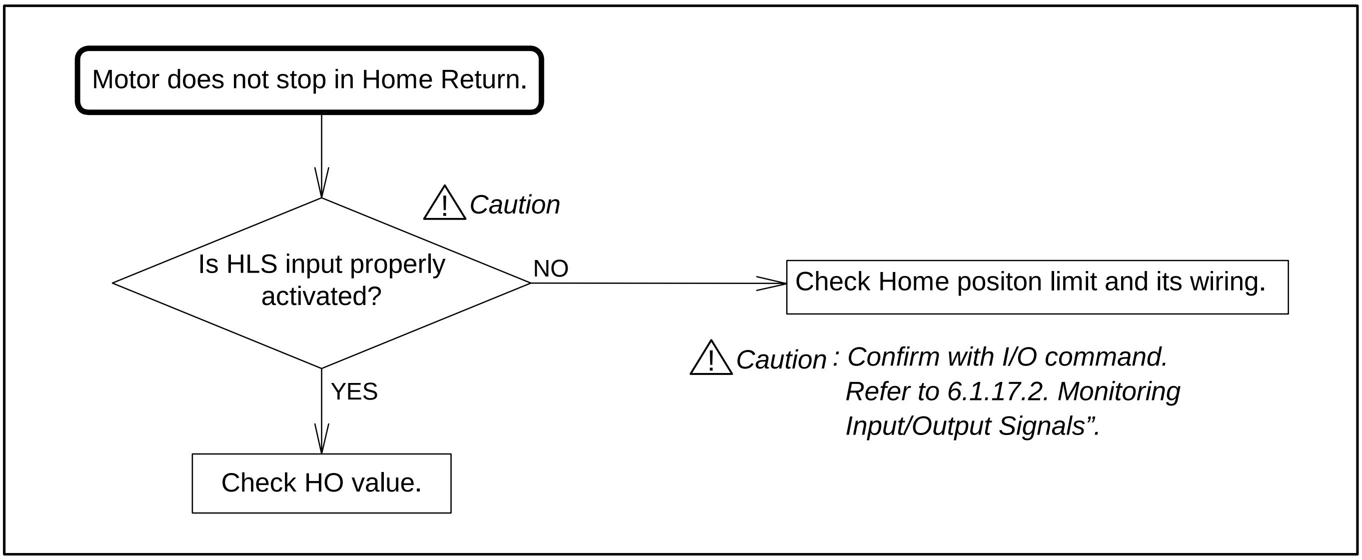


Figure 12-7

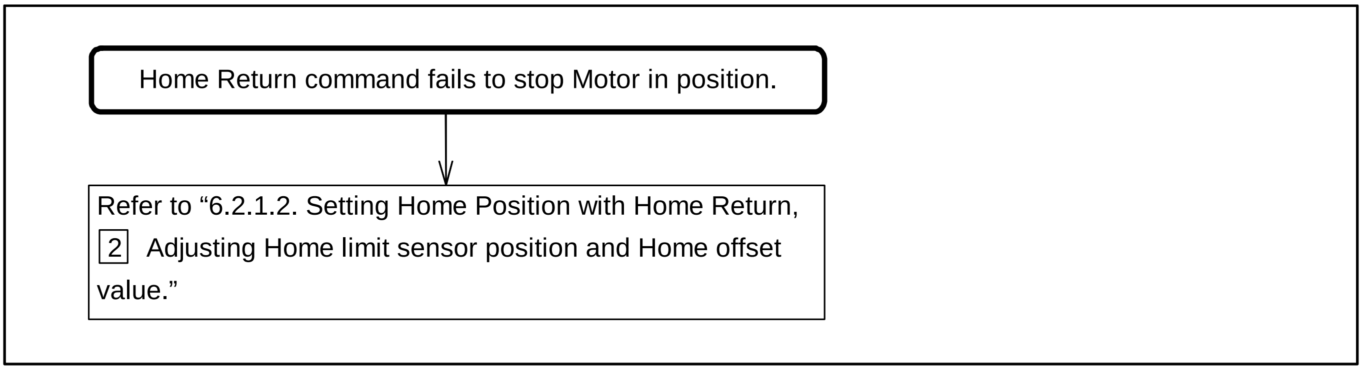


Figure 12-8

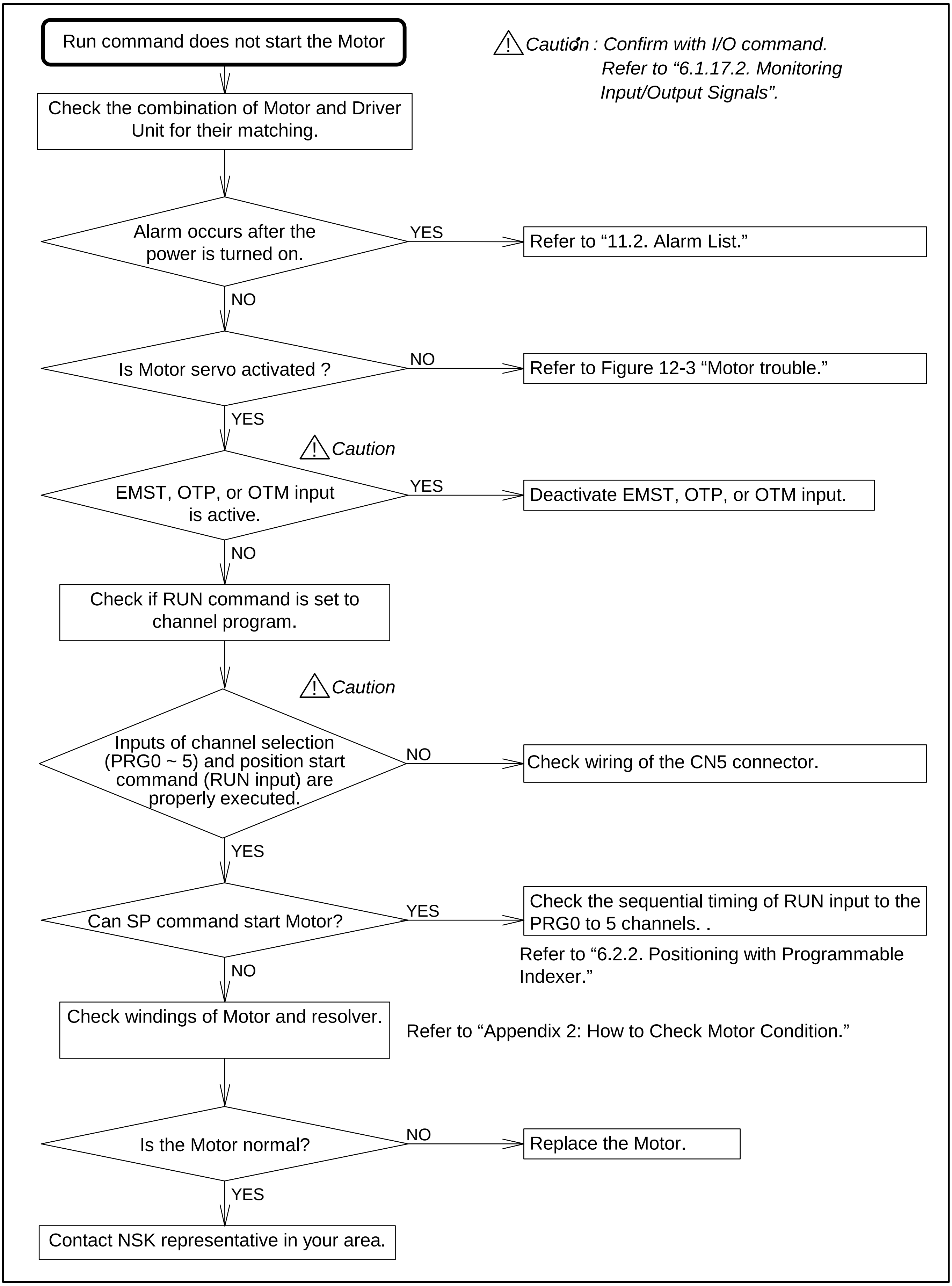
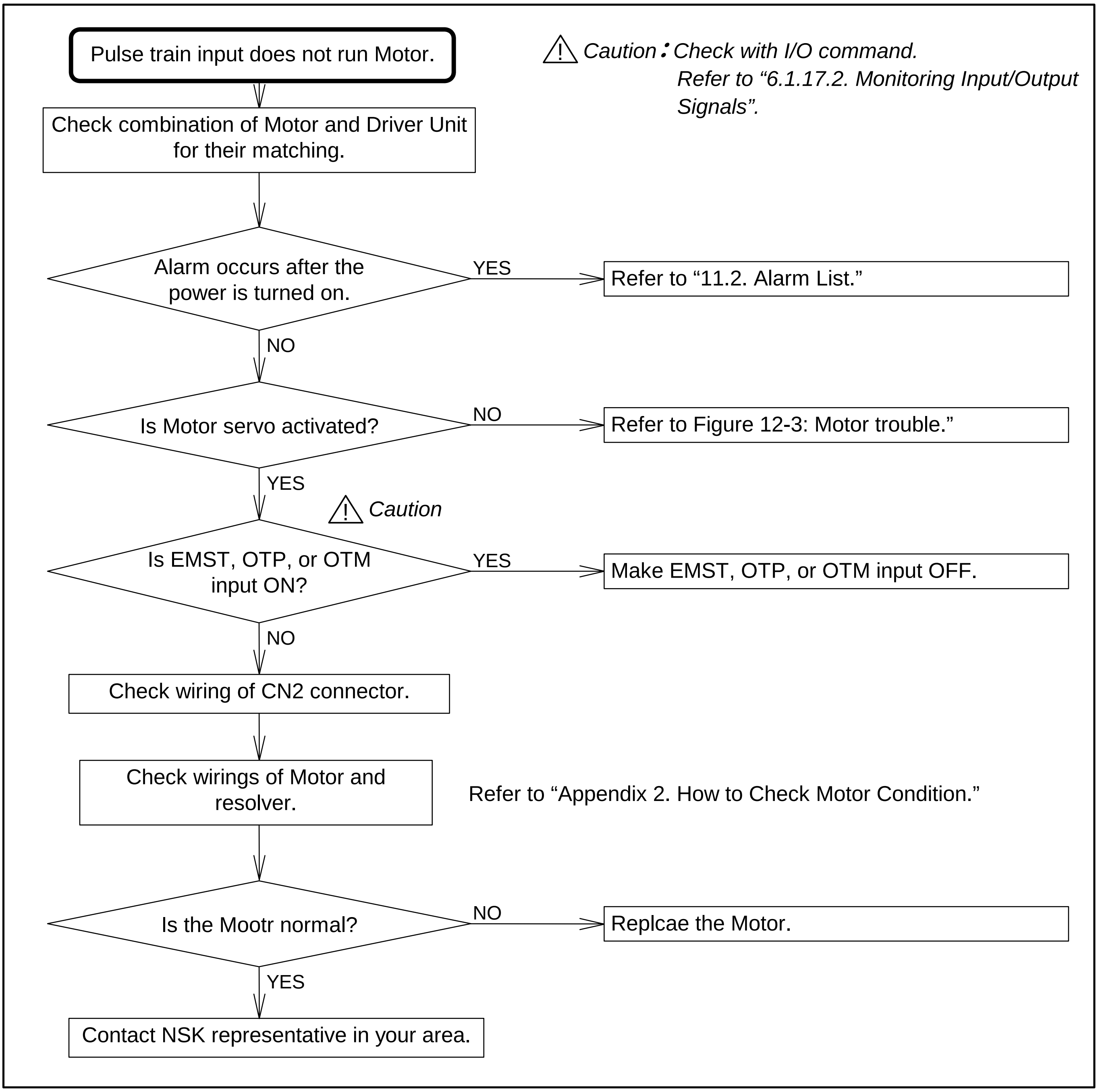
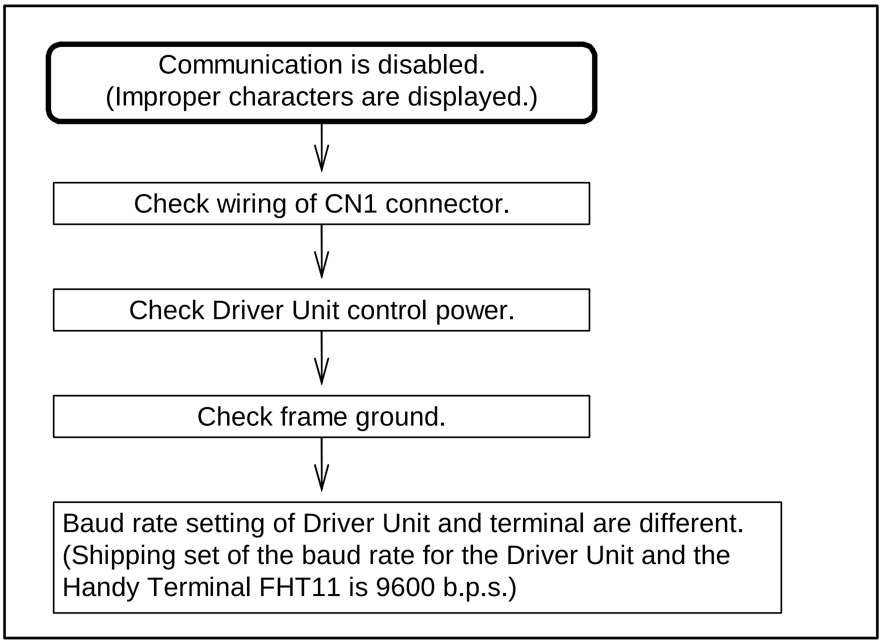

Run command does not start the Motor
Caution : Confirm with I/O command.
Refer to "6.1.17.2. Monitoring Input/Output Signals".
Check the combination of Motor and Driver Unit for their matching.
Alarm occurs after the power is turned on.
YES
Refer to "11.2. Alarm List."
NO
Is Motor servo activated ?
NO
Refer to Figure 12-3 "Motor trouble."
YES
Caution
EMST, OTP, or OTM input is active.
YES
Deactivate EMST, OTP, or OTM input.
NO
Check if RUN command is set to channel program.
Caution
Inputs of channel selection (PRG0 ~ 5) and position start command (RUN input) are properly executed.
NO
Check wiring of the CN5 connector.
YES
Can SP command start Motor?
YES
Check the sequential timing of RUN input to the PRG0 to 5 channels. .
Refer to "6.2.2. Positioning with Programmable Indexer."
NO
Check windings of Motor and resolver.
Refer to "Appendix 2: How to Check Motor Condition."
Is the Motor normal?
NO
Replace the Motor.
YES
Contact NSK representative in your area.

Figure 12-9


Pulse train input does not run Motor.
⚠ Caution: Check with I/O command.
Refer to “6.1.17.2. Monitoring Input/Output Signals”.
Check combination of Motor and Driver Unit for their matching.
Alarm occurs after the power is turned on.
YES
Refer to “11.2. Alarm List.”
NO
Is Motor servo activated?
NO
Refer to Figure 12-3: Motor trouble.”
YES
⚠ Caution
Is EMST, OTP, or OTM input ON?
YES
Make EMST, OTP, or OTM input OFF.
NO
Check wiring of CN2 connector.
Check wirings of Motor and resolver.
Refer to “Appendix 2. How to Check Motor Condition.”
Is the Mootr normal?
NO
Replcae the Motor.
YES
Contact NSK representative in your area.

12.2.4. Terminal

Figure 12-10: Terminal trouble



Appendix 1: Monitoring Input/Output Signals

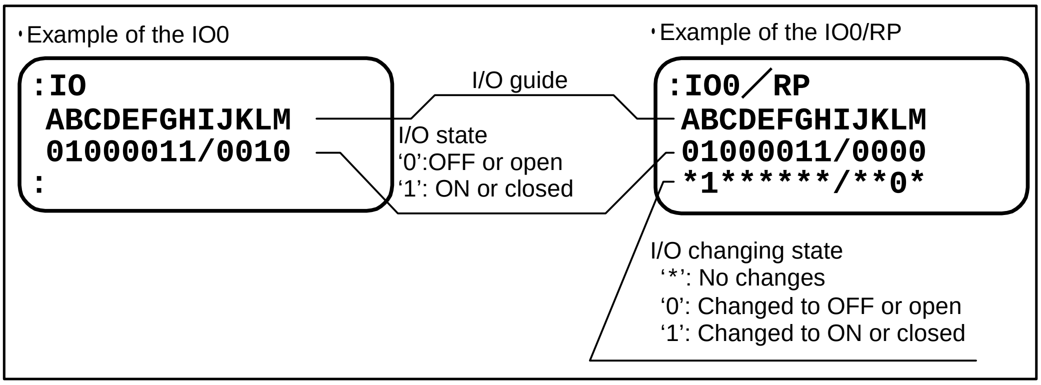
IO: Input/Output Monitor

- The IO command monitors state of Input/Output signals of CN2 and CN5 connectors.
- This is useful for the wiring check.
  - ◊ Input format

IO0/RP	: Reports the state of general Input/Output
IO2/RP	: Reports the state of Input/Output related to Programmable Indexer operation.
IO3/RP	: Reports the state of Input/Output related to operations in general.
/RP default	: Reports the state just once.
With /RP	: Reports the state in real time basis.

  - ◊ Readout format: Bitmap representing Input/Output in 1 line. (Figures A-4 to A-6)

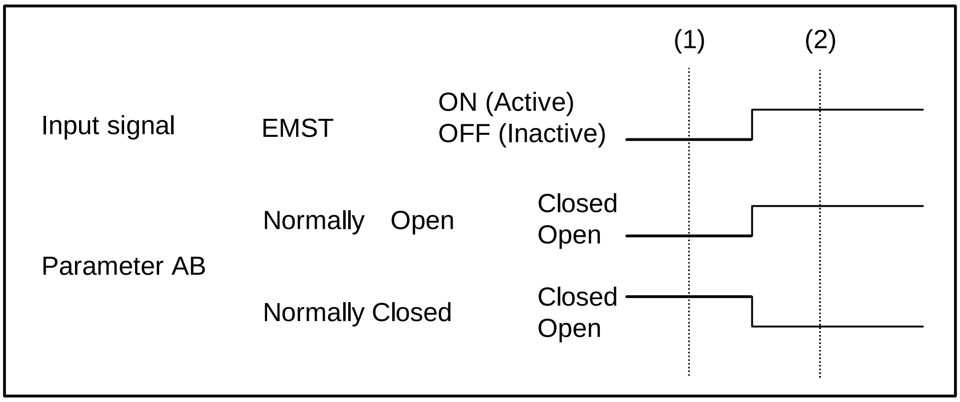
Figure A-1: Example of readout



- ◊ Press the BS key to terminate real time readout (IO*/RP).
- ◊ Press the R key to reset the changing state of Input/Output.

- The readout of Input/Output with IO command differs with the polarity setting by the AB parameter as well.
  Difference of ON/OFF signals and the polarity (AB parameter) of the emergency stop (EMST) input are shown in Figure A-1.
  IO0: Reports the state of circuit in regard to input signal.
  IO1: Reports the state of execution of the function (in this case EMST) in regard to input. [ON (active) or OFF (inactive)]

Figure A-2



◆ When the EMST input is set to normally open contact (ABX0XXXXXX)

If the EMST input is set to the normally open contact, the readouts of IO0 and IO1 are the same in both timings of (1) or (2).

Table A-1

	IO data	Readout
(1)	IO0	A B C D E F G H I J K * 0 * * * * * * / * *
	IO1	A B C D E F G H I J K * 0 * * * * * * / * *
(2)	IO0	A B C D E F G H I J K * 1 * * * * * * / * *
	IO1	A B C D E F G H I J K * 1 * * * * * * / * *

◆ When EMST input is set to normally closed contact (ABX1XXXXXX)

If the EMST input is set to the normally closed contact, the readouts of IO0 and IO1 are opposite in both timings of (1) and (2).

Table A-2

	IO data	Readout
(1)	IO0	A B C D E F G H I J K * 0 * * * * * * / * *
	IO1	A B C D E F G H I J K * 1 * * * * * * / * *
(2)	IO0	A B C D E F G H I J K * 1 * * * * * * / * *
	IO1	A B C D E F G H I J K * 0 * * * * * * / * *

In this example as shown above, the readout with IO1 will show that the EMST signal is functionally ON or OFF regardless of the setting to the normally open or closed contact.

Figure A-3: Readout format (IO0/RP: General I/O state)

```
A B C D E F G H I J K L M
* * * * * * * * / * * * *
```

Pin No.	Siganl name
CN5_21	HOME output
CN2_14	IPOS output
CN2_3	BRK output
CN2_15(2)	DRDY output
CN2_9	OTP
CN2_22	OTM
CN2_10	CLR
CN2_23	HOS
CN2_11	HLS
CN2_24	IOFF
CN2_12	EMST
CN2_25	SVON

Figure A-4: Readout format (IO2/RP: I/O of positioning with Programmable Indexer)

```
A B C D E F G H I J K L M N
* * * * * * * * 0 0 / * 0 0
```

Pin No.	Signal name
CN5_4	NEARB
CN5_3	NEARA
CN2_14	IPOS output
Reserved	Reserved
Reserved	Reserved
CN5_18	STP
CN5_17	RUN
CN5_11	PRG0
CN5_12	PRG1
CN5_13	PRG2
CN5_14	PRG3
CN5_15	PRG4
CN5_16	PRG5

Figure A-5: Readout format (IO3/RP: General I/O for positioning)

A B C D E F G H I J K L M N
* * * * * * 0 / * * * * * *

Pin No.	Signal name
CN5_22	HCMP
CN5_21	HOME
CN5_20	SPD
CN5_14	IPOS
CN5_2	OVER
CN2_15(2)	DRDY
CN5_37	LVG
CN5_36	INH
CN5_18	STP
CN2_23	HOS
CN5_17	RUN
CN5_31	DIR
CN5_30	JOG

[Example 1] Check if the start command RUN for positioning with Programmable Indexer is inputted.

(1) Be sure that the colon (:) is on the display of the Handy Terminal.
(If the colon (:) is not on the display, press the [ENT] key once.)

```
:_
```

(2)

[I] [O] [2 #]

```
:IO2_
```

(3)

[/] [R] [P]

```
:IO2/RP_
```

(4) Press the [ENT] key for execution, then the readout will be on the display.

[ENT]

```
:IO2/RP
 ABCDEFGHIJKLMN
 0000001000/000
 **********/***
```

RUN

(5) Press the [BS] key after checking the readout. The readout remains on the screen and other command won't be accepted unless the [BS] key is pressed.

[BS]

```
 ABCDEFGHIJKLMN
 0000001000/000
 **********/***
:_
```

Explanation

- The checking procedures described above confirm that the RUN input, the start command for positioning with Programmable Indexer, is ON because the readout of the signal is 1.
  - ◊ In case of above [Example 1], the readout of Input/Output signals will be observed and displayed on the screen until the [BS] key is pressed.
  - ◊ If the signal changes ON and OFF (ON↔OFF) while monitoring the state of Input/Output signals, the readout will follow the changes with 1 and 0 (1↔0) as well.
  - ◊ However, if the step (3) of the procedure of [Example 1] is omitted, the readout will be just once right after the [ENT] key is pressed.

Appendix 2: How to Check Motor Condition

- Examine resistance and insulation resistance of Motor winding to check if the Motor is in normal condition. It can be regarded as normal if all check results are within the specification.
- Firstly, check the Motor with the Motor and Resolver cables. If the result is not satisfactory, check the Motor only.

1 *Check resistance of the Motor winding*

Figure A-6: Check with the cables

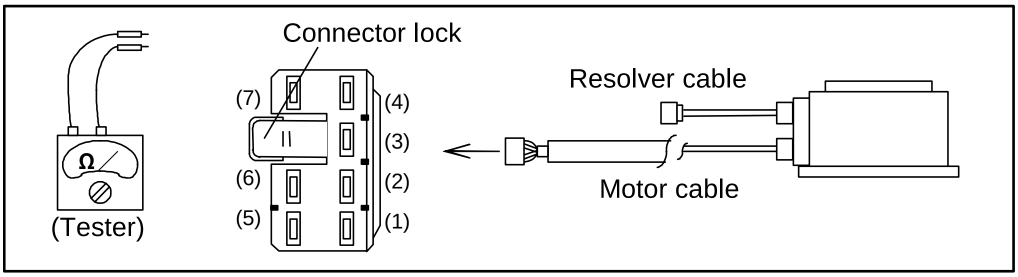


Figure A-7: Check the Motor only

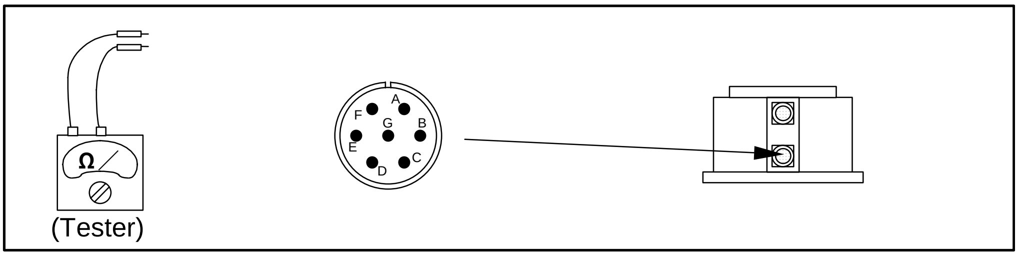


Table A-3: Checking points

	Cable connector	Motor connector	Result
Phase A	(1) ↔ (2) (A+) (A-)	C ↔ D (A+) (A-)	
Phase B	(3) ↔ (4) (B+) (B-)	B ↔ E (B+) (B-)	
Phase C	(1) ↔ (2) (C+) (C-)	C ↔ D (C+) (C-)	

Table A-4: Resistance specification

Motor size	Motor winding resistance (Ω)	Acceptable value
0408	3	1. Shall be in ±30 % 2. Variation between Phases A, B, and C shall be 1.0 Ω or less.
0608	8	
0810	8	
1010	4.5	
1410	3.5	

- For the Motor with special winding or a long cable over 4 m, please consult with NSK.

2 Check the resolver winding resistance.

Figure A-6: Check with the cable

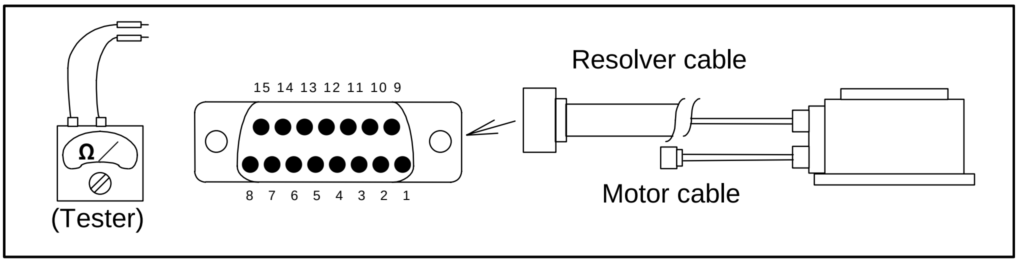


Figure A-7: Check the Motor only.

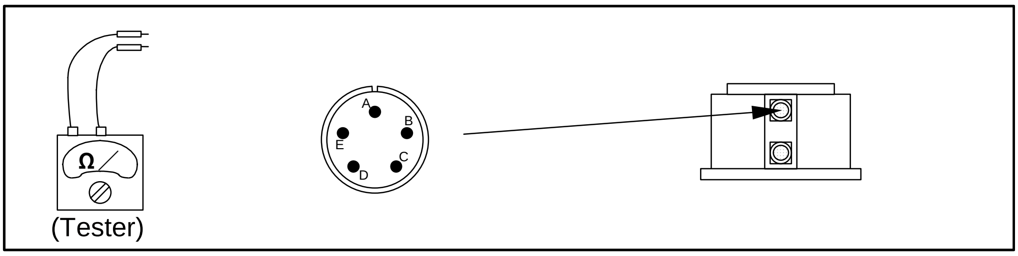


Table A-5: Checkpoints for incremental resolver

	Cable connector	Motor connector	Result	Acceptable value
REA	(8) ↔ (4) (REA) (COM)	A ↔ E (REA) (COM)		1. 3.0 Ω ±2Ω 2. Variation between the phases A, B and C shall be 1.0 Ω or less.
REB	(7) ↔ (4) (REB) (COM)	B ↔ E (REB) (COM)		
REC	(15) ↔ (4) (REC) (COM)	C ↔ E (REC) (COM)		

● For Motor with special winding or a long cable exceeding 4 m, please consult with NSK.

Table A-6: Checkpoints of absolute position resolver and resistance specification

	Cable connector	Motor connector	Result	Acceptable value
REa+	(6) ↔ (4) (REa+) (COM)	J ↔ E (REa+) (COM)		1. 3.0 ±2 Ω 2. Variation between the phases A, B and C shall be 1.0 Ω or less.
REa-	(3) ↔ (4) (REa-) (COM)	K ↔ E (REa-) (COM)		
REb+	(5) ↔ (4) (REb+) (COM)	I ↔ E (REb+) (COM)		
REb-	(2) ↔ (4) (REb-) (COM)	N ↔ E (REb-) (COM)		
REc+	(14) ↔ (4) (REc+) (COM)	H ↔ E (REc+) (COM)		
REc-	(9) ↔ (4) (REc-) (COM)	G ↔ E (REc-) (COM)		

● For the Motor with special winding or a long cable exceeding 4 m, consult with NSK.

Figure A-10: [Reference] Standard resolver winding

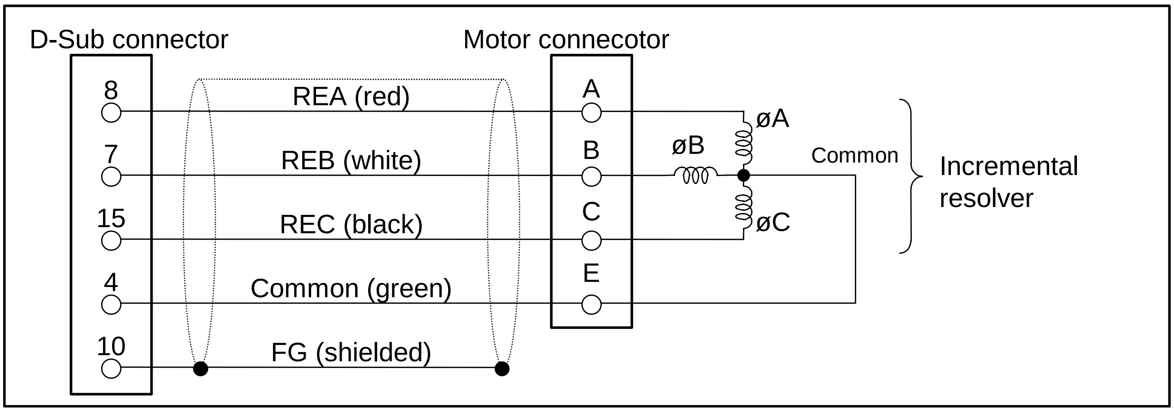
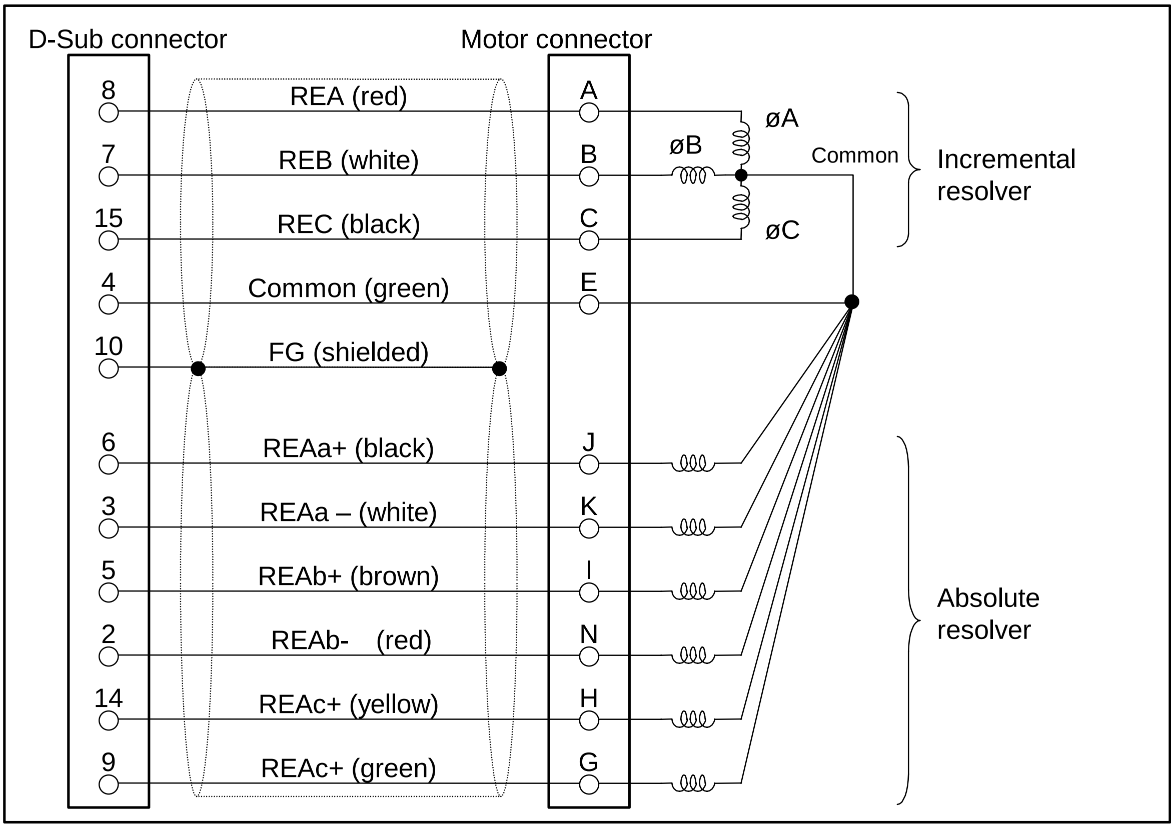


Figure A-11: [Reference] Wiring of absolute resolver



3 Insulation resistance check of Motor winding

⚠ *Caution : Disconnect the Motor from the Driver Unit when checking insulation resistance of the Motor.*

⚠ *Caution : Never apply more than 500 VAC.*

Figure A-12: Check with the cables

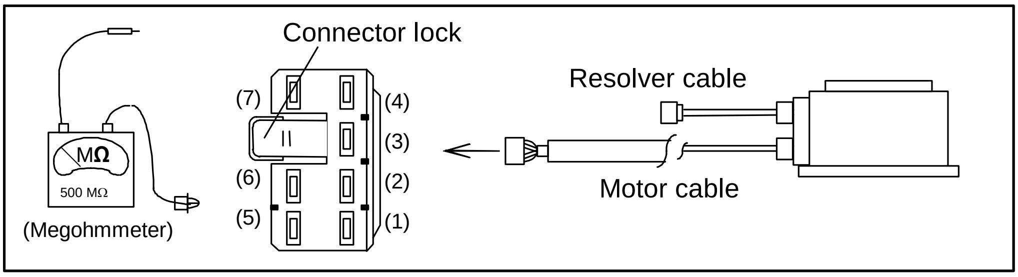


Figure A-13: Check the Motor only.

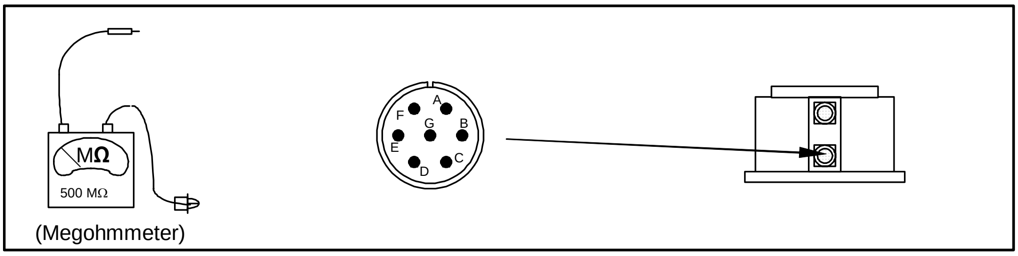


Table A-17: Checking points

	Cable connector	Motor connector	Result
øA – FG	(1) ↔ (7) (A+) (FG)	C ↔ E (A+) (FG)	
øB – FG	(3) ↔ (7) (B+) (FG)	B ↔ E (B+) (FG)	
øC – FG	(5) ↔ (7) (C+) (FG)	A ↔ E (C+) (FG)	
øA – øB	(1) ↔ (3) (A+) (B+)	C ↔ B (A+) (B+)	
øB – øC	(3) ↔ (5) (B+) (C+)	B ↔ A (B+) (C+)	
øC – øA	(5) ↔ (1) (C+) (A+)	A ↔ C (C+) (A+)	

Table A-8: Insulation resistance specification (Common to all Motors)

	Specification
With cables	1 MΩ or over
Motor only	2 MΩ or over

4 Appearance check on Motor and Cables

- Check the Motor for damage.
- Check the Cables for cable insulation.

Appendix 3: Initialization of Driver Unit

- Follow the procedures described in this section when initialization of the Driver Unit is required during troubleshooting or replacing the Motor or the Driver Unit.

- Procedures for initialization require three steps as shown in Figure A-14. The SI command executes the initialization.

- Use Handy Terminal FHT11 for inputting the commands and the parameters.

- The description follows as shown in Figure A-14.

Figure A-14

(1) Record the parameters and the programs.

(2) Initialization with the SI command.

(3) Setting the paramters and the programs again.

1 **Monitor the parameters and the channel programs and note down them.**

* Especially the PA data (or the PA and RO data of Driver Unit for the Motor equipped with absolute position sensor) is very important.

- Connect the Handy Terminal FHT11 to the connector CN1, and then turn on the control power (100 to 220 VAC) only.

↓

- The TS0 command monitors the parameters.

↓

- The channel programs can be monitored with the TC/AL command.

↓

- Turn off the control power after the monitoring.

2 **Initialize the internal data of the Driver Unit with SI command.**

- Connect the Handy Terminal to the CN1connector.

↓

- Turn on the control power (100 to 230 VAC) only.

↓

- Input the password when the colon “:” is on the screen.

/ N S K SP O N ENT

- The Driver Unit will accept the command if the echo-back “NSK ON” appears on the serene.

↓

- Input the SI/SY command.

S I / S Y

↓

- The initialization has completed when the colon “:” appears on the screen after the echo-back “INITIALIZE.”

3 **Input the parameters and the channel programs.**

- Connect the Handy Terminal FHT11 to connector CN1, and then turn on the control power (100 to 220 VAC) only.

↓

- Firstly input the password before setting the parameters that have noted down.

| / | N | S | K | SP | O | N | ENT |

- The echo-back " NSK ON" will be on the screen.

↓

- Then input the PA value.

| P | A | | | ENT |

↓

[In case of ESA Driver Unit for the Motor equipped with absolute position sensor.]

◊ Input the password.

| / | N | S | K | SP | O | N | ENT |

◊ The echo-back "NSK ON" will be on the screen.

↓

◊ Then enter the RO data.

| R | O | | | ENT |

↓

- Then input other parameters and channel programs.

| V | G | | | ENT |

4 **Confirm the inputted parameters and the channel programs.**

- Monitor the parameters and the programs with the Handy Terminal.

◊ The TS0 or The TC commands report the settings.

5 **Turn off the power for the completion of initialization.**

Appendix 4: How to Replace ESA35 or ESAC5 Driver Unit

⚠ *Danger : Be sure to turn off the power, and then follow the procedure for replacing the Driver Unit.*

- It requires replace of the compensation board on the front panel for the ESA35 and ESAC5 Driver Units. Follow the procedures described in this section for replacing the Driver Unit.

- Before replacing the Driver Unit, be sure to note down the settings of parameters and channel programs to the setting lists in "Appendix 5: ESA35 Driver Unit Parameter/Program Setting List" and "Appendix 6: ESAC5 Driver Unit (equipped with absolute sensor) Parameter/Program Setting List" provided to the last pages of this manual.

- Be sure to note down the data of parameters PA, VG, VI, PG, CO, MA, MV, and HO, and the data set to the internal program channels.

- In case of the Driver Unit for absolute resolver, be sure to record the data of parameters PA, RO, VG, VI, PG, CO, MA, MV, AO and HO, and the data set to the internal program channels

- Replacing the Driver Unit requires the following tools.

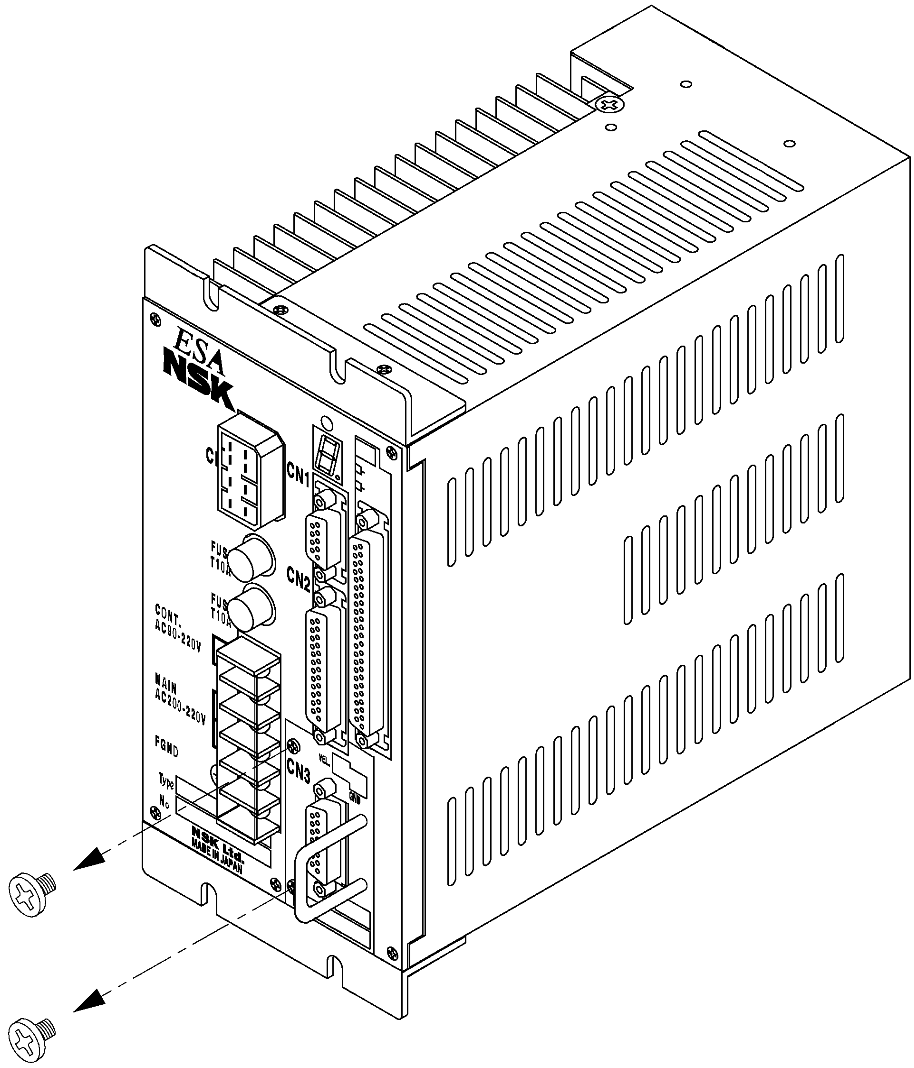
  (1) A Philips screw driver (4 mm)

  (2) Handy Terminal HTF11.

1. Unfasten screws on the front panel of the ESA Driver Unit that fix the compensation board unit.

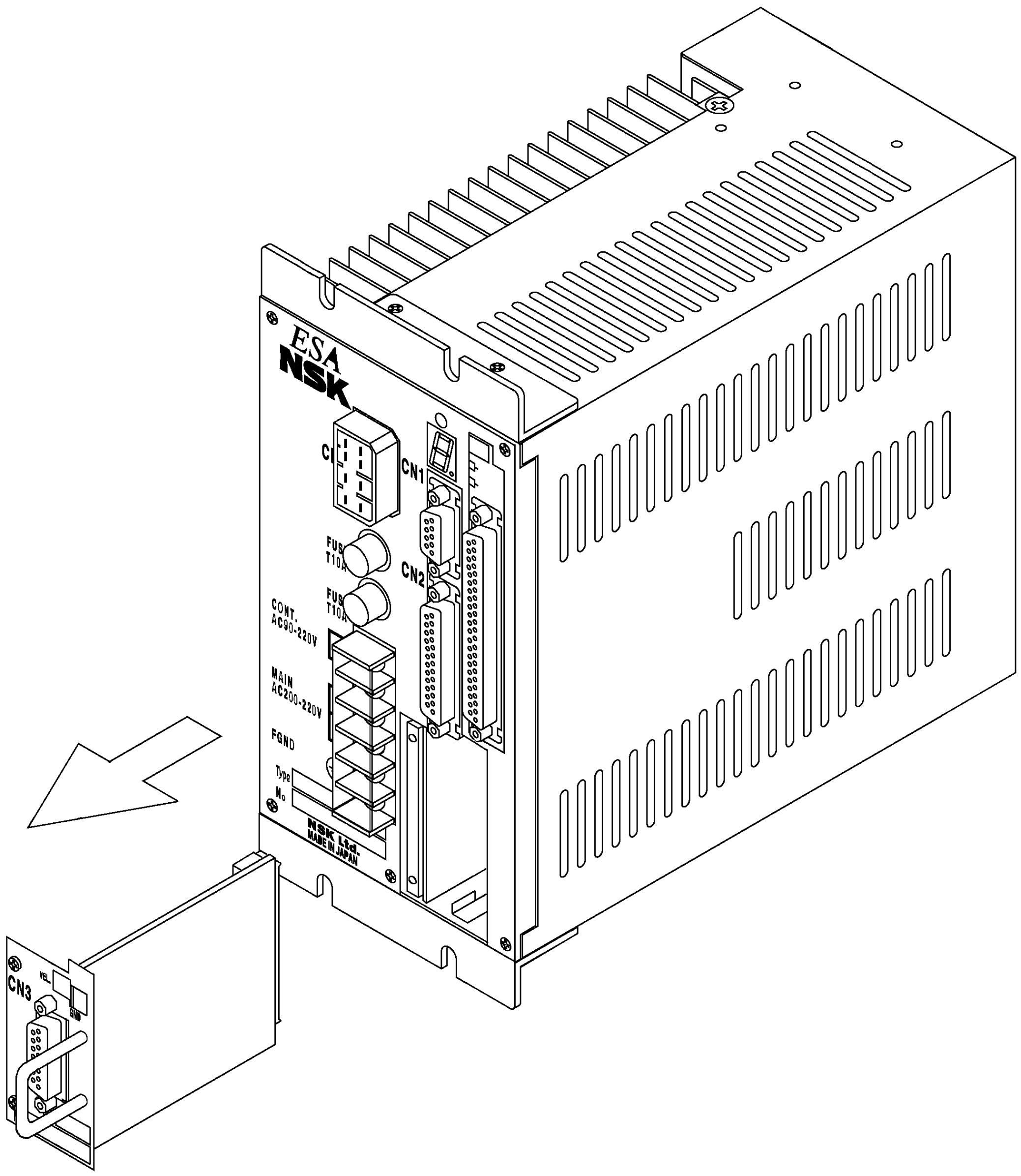
Front panel: M3 × 6 2 screws (Black oxide pan head machine screw)

Figure A-15



2. Pull out the compensation board unit from the front side of the Driver Unit.

Figure A-16

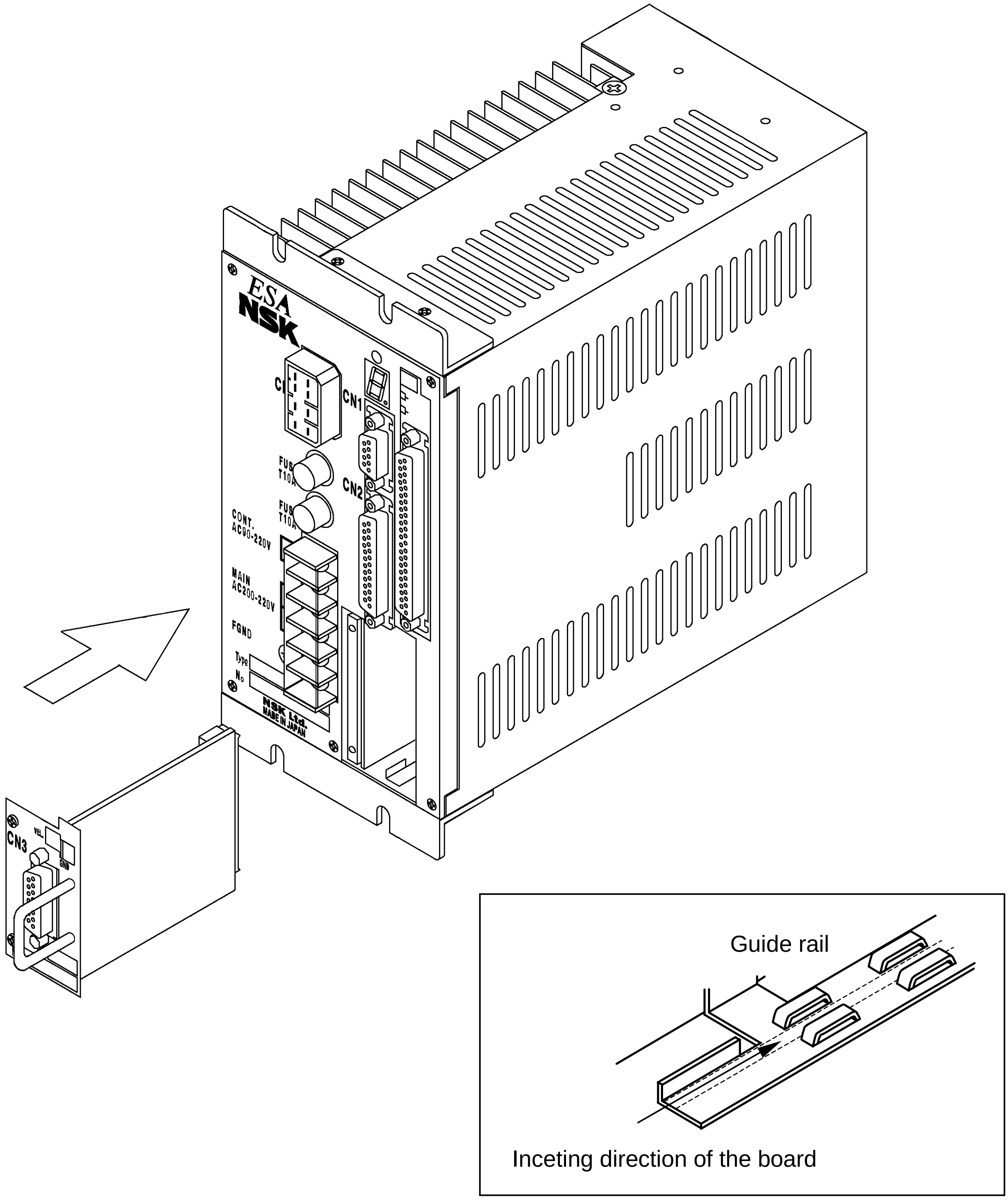


⚠ *Caution : Hold the handle and pull out gently the compensation board unit not to give jerks.*

⚠ *Caution : Do not touch the electronic components mounted on the compensation board. The board is precisely adjusted to each Motor. Touching these components may alert the setting and the Motor may not exhibit its full performance.*

3. Install the compensation board unit to the new ESA Driver Unit.

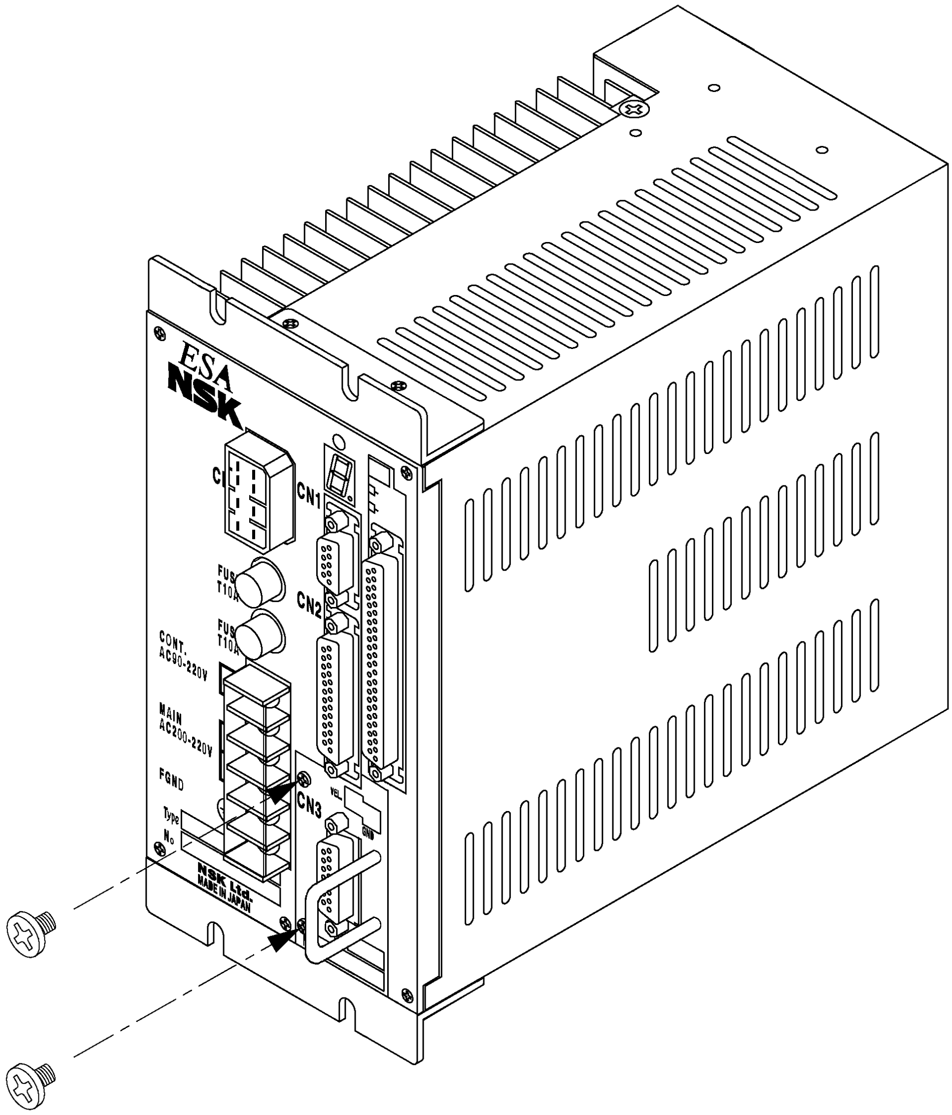
Figure A-17



⚠ *Caution : Insert the board unit along fold and tabs of the guide rail. Be careful not to contact the electronic components with the Driver Unit and not to jerk the board unit when it got held up.*

4. **Fix the compensation board unit to the Driver Unit.**

Figure A-18



6. On completion of transfer of the compensation board unit, input the parameters and the internal channel program.

1 Connect the Handy Terminal to the connector CN1.

2 Turn on the control power only. (Upper two terminals indicated as CONT of the Terminal block.)

- If you cannot turn on the main power and the control power separately by the wiring, turn on the power disconnecting the CN2 connector.
- Be sure to observe the above procedure. Otherwise the Motor may be out of control because the parameters won't be properly set.

3 A message " NSK MEGATORQUE••• " appears on the display of Handy Terminal when the power is on.

- Input as shown below when the colon ":" appears on the display of Handy Terminal.

/ N S K SP O N ENT

- Then input as follows for the initialization. (It will take approximately 30 seconds.)

S I / S Y ENT

4 Copy the noted data of parameters and internal program channels to the new Driver Unit when the colon ":" appears on the display of Handy Terminal.

Appendix 5: ESA35 Driver Unit Parameter/ Program List

Reference No.
S/N：

Parameter setting List

• The left blank column of the user setting denotes the shipping set. Data:

Parameter	Setting		Parameter	Setting		Parameter	Setting	
	Shipping set	User setting		Shipping set	User setting		Shipping set	User setting
PG	0.100		PS	1		SG	0	
VG	1.0		DI	0		MT	＊	
VGL	1.0		OTP	0		RI	＊	
VI	1.00		OTM	0		ZP	1.00	
VIL	1.00		MV	1.0000		ZV	1.4	
VM	1		MA	1.00		SL	3	
LG	50		JV	0.1000		AC	1	
TL	100		JA	1.00		AGV	1.00	
GP	0		HV	0.2000		AGT	1.00	
GT	5		HA	1.00		AF	0	
FO	0		HZ	0.0100		AL	0	
FP	0		MD	0		HW	0	
FS	0		CS	1／1		HI	100	
NP	0		CY	1.00		SO	0	
NS	0		CX	0		SB	0	
DBP	0		OS	4		ST	0	
DBA	0		HD	1		NMA	0	
ILV	100.0		HO	0		NMB	0	
FF	0		PA	∗∗		NA	100	
FC	0		OL	∗		NB	100	
CO	50 000		RC	∗		ZAS	0	
IN	100		LR	0		ZAE	0	
IS	0		AB	X0X0XX00		ZBS	0	
FW	1.0		NW	2		ZBE	0	
VO	2 047		IM	0		OU	0	
VW	100		MM	1		EP	1	
OR	∗		BM	1		TO	2	
CR	X1		CM	0		HT	2	
PC	0		AN	0		PE	2	
RR	－1		WM	0		AE	0	
FD	0		SE	0		PH	0	
FZ	0		EC	0				
FR	0		LO	0				

∗ Setting data siffers with the Motor size.

∗∗ Setting data differs with each interchangeable Motor.

● Notes for resetting and copying the data of parameters.

◊ Parameters LO and SG are for automatic tuning of the parameters PG, VG, VI, and MA. You do not need to set the data to LO and SG parameters.

Reference No. ______________
S/N : ______________

Program Setting List

• The left blank column denotes that the channel is not in use. Date: ______________

CH	Program	CH	Program	CH	Program	CH	Program
0	Command: : :	16	Command: : :	32	Command: : :	48	Command: : :
1	Command: : :	17	Command: : :	33	Command: : :	49	Command: : :
2	Command: : :	18	Command: : :	34	Command: : :	50	Command: : :
3	Command: : :	19	Command: : :	35	Command: : :	51	Command: : :
4	Command: : :	20	Command: : :	36	Command: : :	52	Command: : :
5	Command: : :	21	Command: : :	37	Command: : :	53	Command: : :
6	Command: : :	22	Command: : :	38	Command: : :	54	Command: : :
7	Command: : :	23	Command: : :	39	Command: : :	55	Command: : :
8	Command: : :	24	Command: : :	40	Command: : :	56	Command: : :
9	Command: : :	25	Command: : :	41	Command: : :	57	Command: : :
10	Command: : :	26	Command: : :	42	Command: : :	58	Command: : :
11	Command: : :	27	Command: : :	43	Command: : :	59	Command: : :
12	Command: : :	28	Command: : :	44	Command: : :	60	Command: : :
13	Command: : :	29	Command: : :	45	Command: : :	61	Command: : :
14	Command: : :	30	Command: : :	46	Command: : :	62	Command: : :
15	Command: : :	31	Command: : :	47	Command: : :	63	Command: : :

Appendix 6: ESAC5 Driver Unit Parameter/Program List (Equipped With Absolute Sensor)

Reference No.: ____________

S/N: ____________

Parameter List

Date ____________

• The left blank column denotes that no program is set.

Parameter	Setting		Parameter	Setting		Parameter	setting	
	Shipping set	User setting		Shipping	User setting		Shipping	User setting
PG	0.1		PS	1		EC	0	
VG	1.0		DI	0		LO	0	
VGL	1.0		OTP	0		SG	0	
VI	1.00		OTM	0		MT	＊	
VIL	1.00		AO	0		RI	＊	
VM	1		MV	1.0000		ZP	1.00	
LG	50		MA	1.00		ZV	1.4	
TL	100		JV	0.1000		SL	3	
GP	0		JA	1.00		AC	1	
GT	5		HV	0.2000		AGV	1.00	
FO	0		HA	1.00		AGT	1.00	
FP	0		HZ	0.0100		AF	0	
FS	0		MD	0		AL	0	
NP	0		CS	1／1		HW	0	
NS	0		CY	1.00		HI	100	
DBP	0		CX	0		SO	0	
DBA	0		OS	4		SB	0	
ILV	100.0		HD	1		ST	0	
FF	0		HO	0		NMA	0	
FC	0		PA	∗∗		NMB	0	
CO	50 000		OL	∗		NA	100	
IN	100		RC	∗		NB	100	
IS	0		LR	0		ZAS	0	
FW	1.0		RO	∗∗		ZAE	0	
VO	2 047		AB	X0X0XX00		ZBS	0	
VW	100		NW	2		ZBE	0	
OR	∗		IM	0		OU	0	
CR	X1		MM	1		EP	1	
PC	0		BM	1		TO	2	
RR	−1		CM	0		HT	2	
FD	0		AN	0		PE	2	
FZ	0		WM	0		AE	0	
FR	0		SE	0		PH	0	

∗ Setting data siffers with the Motor size.

∗∗ Setting data differs with each interchangeable Motor.

- Notes for resetting and copying the data of parameters.
  - ◊ Parameters LO and SG are for automatic tuning of the parameters PG, VG, VI, and MA. You do not need to set the data to LO and SG parameters.

Reference No. ____________

S/N: ____________

Program setting list

• The left blank column denotes that the channel is not in use. Date: ____________

CH	Program	CH	Program	CH	Program	CH	Program
0	Command: : :	16	Command: : :	32	Command: : :	48	Command: : :
1	Command: : :	17	Command: : :	33	Command: : :	49	Command: : :
2	Command: : :	18	Command: : :	34	Command: : :	50	Command: : :
3	Command: : :	19	Command: : :	35	Command: : :	51	Command: : :
4	Command: : :	20	Command: : :	36	Command: : :	52	Command: : :
5	Command: : :	21	Command: : :	37	Command: : :	53	Command: : :
6	Command: : :	22	Command: : :	38	Command: : :	54	Command: : :
7	Command: : :	23	Command: : :	39	Command: : :	55	Command: : :
8	Command: : :	24	Command: : :	40	Command: : :	56	Command: : :
9	Command: : :	25	Command: : :	41	Command: : :	57	Command: : :
10	Command: : :	26	Command: : :	42	Command: : :	58	Command: : :
11	Command: : :	27	Command: : :	43	Command: : :	59	Command: : :
12	Command: : :	28	Command: : :	44	Command: : :	60	Command: : :
13	Command: : :	29	Command: : :	45	Command: : :	61	Command: : :
14	Command: : :	30	Command: : :	46	Command: : :	62	Command: : :
15	Command: : :	31	Command: : :	47	Command: : :	63	Command: : :

World-wide Manufacturing and Marketing Organization

NSK Ltd. Headquarters, Tokyo, Japan
Americas & Europe Department
Phone: 03-3779-7120
Asian Marketing & Sales Department
Phone: 03-3779-7121

NSK Corporation
U.S.A. : Ann Arbor Phone: 734-761-9500

NSK Precision America, Inc.
U.S.A. : Chicago Phone: 630-620-8500
: Los Angeles Phone: 562-926-3578
: Ann Arbor Phone: 761-761-9500

NSK Canada Inc.
CANADA : Toronto Phone: 905-890-0740
: Montreal Phone: 514-633-1240
: Vancouver Phone: 800-663-5445

NSK Rodamientos Mexicana, S.A. de C.V.
MEXICO : Mexico City Phone: 5-301-2741,5-301-3115

NSK Brasil Ltda.
BRASIL : São Paulo Phone: 001-3269-4700

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

NSK France S.A.
FRANCE : Paris Phone:1.30.57.39.39
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SPAIN : Barcelona Phone: 93-575-1662

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KOREA : Seoul Phone: 02-3287-6001

NSK Singapore (Pte) Ltd.
SINGAPORE : Singapore Phone: (65) 2781 711

NSK Bearing (Thailand) Co., Ltd.
THAILAND : Bangkok Phone: 02-6412150-60

Taiwan NSK Precision Co., Ltd.
TAIWAN : Taipei Phone: 02-591-0656

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