NSK

MEGATHRUST® MOTOR SYSTEM
(EDB Driver Unit)

User's Manual

M–E099DB0T2–002

NSK Ltd.

Document Number: T20022-01

EC-T

Limited Warranty

NSK Ltd. warrants its products to be free from defects in material and/or workmanship which NSK Ltd. is notified of in writing within, which comes first, one (1) year of shipment or 2400 total operation hours. NSK Ltd., at its option, and with transportation charges prepaid by the claimant, will repair or replace any product which has been proved to the satisfaction of NSK Ltd. to have a defect in material and/or workmanship.

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

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

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

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 side of the Driver Unit when it is installed in the enclosure. If heat is build up on upper side of the Driver Unit, provide the ventilation openings on the top of the Driver Unit 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 of which protection code is IP54 or better. 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 in IEC standard. This is to specify the protection level of enclosures from solid contamination and water.)

3 Wiring / Ground

- Refer to 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 ambient temperature and humidity as specified.

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

- The Megathrust Motor uses a very strong permanent magnet. Please take precautions against handling the Motor as it may give serious adverse effect for medical equipment including a cardiac pacemaker.

1 Dustproof and Waterproof of the Motor

- You cannot use the Megathrust Motor in atmosphere at where paint fumes or chemicals exist.

  The Motor is not made for dust-proof or waterproof. You cannot use the Motor in humid or oily atmosphere.

2 Use condition

- Keep the ambient temperature of the Motor between 0 to 40°C. Install thermal sensor circuit to turn off the main AC power when temperature exceeds the limit.
- The allowable load mass and the transportable moment load differ depending on the Motor size. Reconfirm that the using conditions are in the specified limits of the Motor.
- An excessive offset load or load mass may cause permanent deflection on a part of Motor body, slider, and Linear Guides. Be careful not to give a shock to the Motor caused by an external interference in transit or in the process of installation.
- Do not collide the slider to the stroke ends. We recommend to provide over travel limit switches with the stroke ends.
- Install shock absorber to protect the work that is put on the slider.

- Flatness of the Motor mounting surface shall be 0.05 mm or less
- Take sufficient measures not to dry up the Linear Guides. We recommend to replenish the grease periodically. (Dried up Linear Guides may result in unstable operation.)
- The Linear Guides equip with NSK K1 lubrication unit. Life of K1 lubrication is 5 years or 10 000 km running, whichever comes first. Be sure to give periodical replenishment thereafter.
- It is possible to replace the K1 lubrication unit when it comes to its life.

3 Periodical check

- Puncture of the Motor, cable shorting or snapping 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 the trouble of the Driver Unit. We recommend the periodical check in order to detect the problem in its early stage.

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

1 Alarm arises.

- Did you take proper action to the alarm? Refer to the manual for the remedy again.

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

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

3 The Motor does not function.

- Turn the power off, disconnect the connector CN4 of the Driver Unit, and then move the slider manually. Does it operate smoothly? Any stickiness in motion? (Never disassemble the Motor.)

  (If the connector CN4 remains connected, the motion of the slider will be heavier due to dynamic brake.)
- Are the control Input/Output signals functioning properly?
  → Monitor status of SVON, RUN and IPOS signals by I/O command through the Handy Terminal.
  → Check if the voltage of input signal and 24 V power source are stable using an oscilloscope etc.

4 Uncontrollable Driver Unit

- Compare the current setting of parameters with the original setting at the installation.

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

- Are servo parameters VG, VI, PG, FP and NP adjusted properly
- Do you fasten the fixing bolts of load and the Motor 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 to the direction of motion in Servo lock state? (It leads to the Motor overheat if external force is applied to the Motor in servo lock state.)
- Do you use shielded cable for input signals? Is the shield perfect?

6 Fuses are blown. Breaker trip occurs frequently.

- When the system recovers by remaking the power, take the following action.
  ◊ We recommend you to install a delay type breaker for a measure against breaker trip.
  (Select the breaker that has enough capacity for power consumption of the Driver Unit.)

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. (the Motor, the Driver Unit and Cable set for replace)
- Use isoplopyl alcohol for cleaning. Do not apply the thinner.

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Megathrust Motor System (PM Series)
Conformity to EC Directives (CE Marking) and UL Safety Standard

1. Conformity to EC Directives

1.1. EC Declaration of Incorporation

NSK Ltd. declares that "Megathrust Motor System (PM Series)" is a machine component that is to be incorporated into a machine. It must not be operated until it is incorporated into the machine and the machine has been declared in conformity with the provisions of the EC Directives. (EC Declaration of Incorporation)

However, the PM Series Megathrust Motor System conforms to provisions of the EC Low Voltage Directive. This will help a user in easy conformity with the EC Directives (CE marking) of a machine into which it is incorporated.

1.2. Conformity to Electromagnetic Compatibility Directive

A sample of Megathrust Motor System of PM Series has been tested under specific conditions of the Motor and the Driver Unit in terms of their combination, installing distance and wiring routing. The competent body has confirmed that the tested sample conforms to requirements relevant to the Electromagnetic Compatibility Directive under the specific conditions. However, your actual use conditions for wiring and installations won't be the same as our tested sample, and because of this reason, you have to check your machine, especially on electro-radiation disturbance and terminal distance voltage, for the conformity to EMC Directive as a complete machine after installation of Megathrust Motor System.

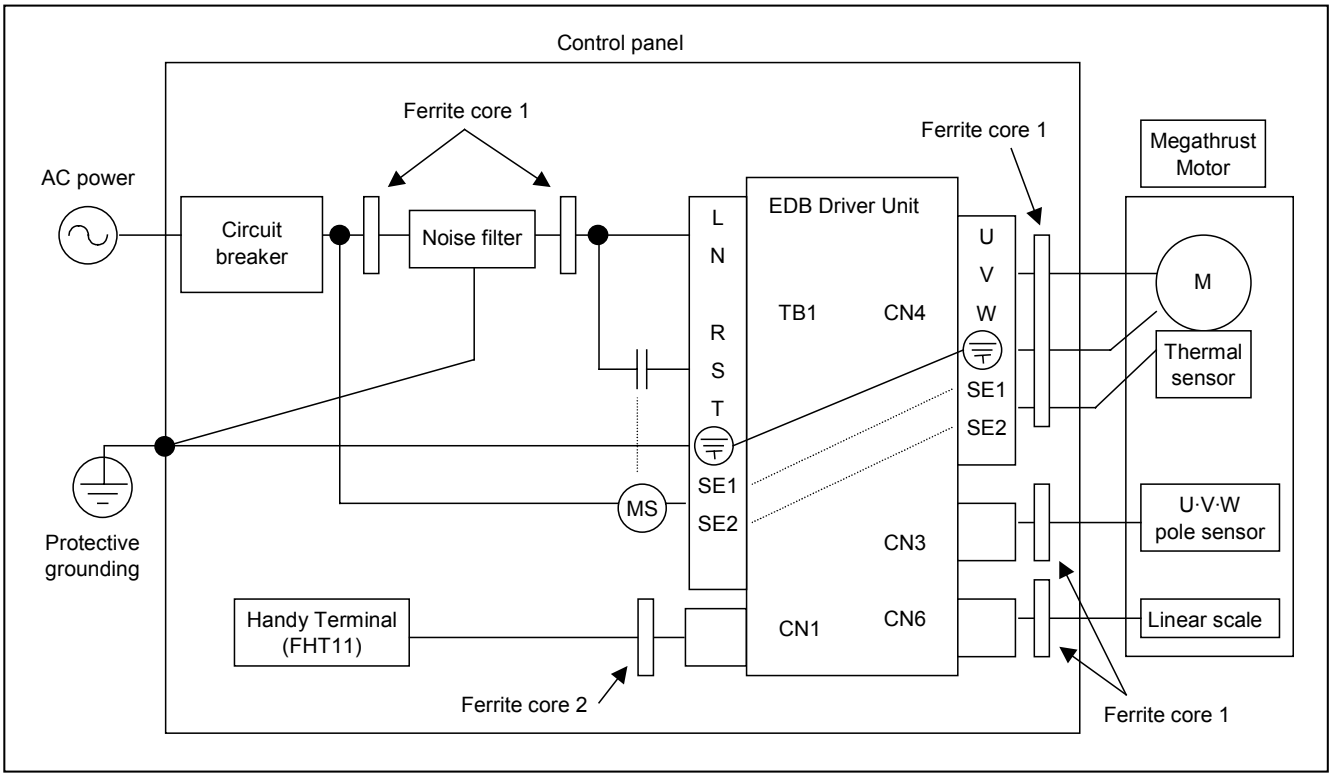
1.3. Conformity to Standards Relevant to EC Directives

List of standards

Item	Standard Being Conformed	Relevant EC Directive
Motor	EN60034-1	Low Voltage Directive
Motor and Driver Unit	EN50178	
	EN61800-3 Adjustable speed electrical power drive systems ◊ EN55011 : Group 1, Class A Terminal disturbance voltage ◊ EN55011 : Group 1, Class A Electro radiation disturbance ◊ EN61000-3-3 : Clause 5 Harmonic voltage and fluctuation ◊ EN61000-4-2 : Electrostatic discharge ◊ EN61000-4-3 : Radio-frequency electromagnetic field ◊ EN61000-4-4 : Electrical fast transient burst ◊ EN61000-4-5 : Lightening surges ◊ EN61000-4-6 : Radio-frequency conducted disturbance	Electromagnetic Compatibility Directive

1.4. Conditions to Conform with EC Directives

The wiring example shown below should be referred for the conformity to the EC Directives.



The following notes shall be observed for the conformity.

◆ **Environment for installation**

The Driver Unit must be used in the environmental condition of Pollution Degree1 or 2 as specified on IEC60664-1. The Driver Unit shall be installed into a control panel with the structure that does not allow penetration of water, oil or dust (IP54).

◆ **Power source**

The EDB Driver Unit shall be used in environmental condition of "Over-voltage category III" as specified on IEC60664-1.

◆ **Circuit breaker**

Install a circuit breaker that conforms to IEC standard and UL safety standard between the power source and the Driver Unit.

◆ **Noise filter**

Install a noise filter between the power source and the Driver Unit.

◆ **Ferrite core**

Ferrite cores for signal cable shall be set to the power cable, the Motor cable and the sensor cable.

◆ **Protective Grounding**

For a measure against electrical shock, be sure to ground the protective grounding terminal of the EDB Driver Unit to the protective ground (PE) of the control panel.

List of recommended component

Item	Specification	Model (Manufacturer)	Remarks
Circuit breaker	Rated current: 20A	Single phase : EA32A-20 3 phase : EA33A-20 (Fuji Electric)	Conforms to IEC and UL safety standard
Noise filter	Single phase : AC250V, 10A	FN2070-10 (Shaffner)	
	3 phase : AC250V, 16A	FN258-16 (Shaffner)	
Ferrite core 1	--	E04SR301334 (Seiwa Electric MFG)	
Ferrite core 2	--	E04SR170730A (Seiwa Electric MFG)	For Handy Terminal
Magnetic switch	Rated current: 20A	SC-4-1 (Fuji Electric)	

2. Conformity to UL Safety Standard

The Motor and the EDB Driver Unit are qualified products of UL safety standard as shown below.

List of standards

Item	Safety standard number	File number
Motor	UL1004	E216970
EDB Driver Unit	UL508C	E216221

Conditions for conformity

The following notes shall be observed for conformity to the UL safety standards.

◆ **Environment for installation**
The Driver Unit must be used in the environmental condition of Pollution Degree1 or 2 as specified on IEC60664-1. The Driver Unit shall be installed into a control panel with the structure that does not allow penetration of water, oil or dust (IP54).

◆ **Power source**
The EDB Driver Unit shall be used in environmental condition of "Over-voltage category III" as specified on IEC60664-1.

◆ **Circuit breaker**
Install a circuit breaker that conforms to the UL safety standard between the power source and the Driver Unit.

◆ **Grounding**
For a measure against electrical shock, be sure to ground the protective grounding terminal of the EDB Driver Unit to the protective ground (PE) of the control panel.

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9. Command and Parameter ---------- 9-1

1. Introduction

- This manual describes the interface, function and operation of EDB Driver Unit. This manual provides information on the standard products. If your model is not standard, please contact NSK for supplemental information.

1.1. Safety Precautions

1.1.1. Notes for Safety

- Before operating the Megathrust Motor System, you should first thoroughly read this manual. The Megathrust Motor System is a unique devise, so "common sense" based upon experience with servo motors may not directly apply here.

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

⚠ *Danger* : *Might cause serious injury.*

⚠ *Warning* : *Might result in injury.*

⚠ *Caution* : *Might damage the equipment (machine) and/or the load (work) that is fixed to the slider.*

1.1.2. Operational Remark

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

⚠ *Caution* : *The Motor and the Driver Unit of the Megathrust Motor System are marked with model number and serial number that identify them. When make a combination of Motor and Driver Unit, make sure that their specifications for Motor size and serial numbers are the same.*

◊ *Parameters of Driver Unit are set to Motor size and maximum thrust force before it is shipped.*

◊ *If the serial numbers of the Motor and the Driver Unit are different, the system does not operate properly.*

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

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

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

◊ *Make sure that the system stops immediately in case of an emergency.*

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

◊ *The Driver Unit has high capacity conductors in its internal circuits. There is high residual voltage for few minutes after the power is turned off.*

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

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

- ◊ *When the Motor is decelerating, the internal regenerative dump resistor dissipates inertial energy. If an excessive inertial energy, which is over the dissipating capability of the dump resistor, is applied, an alarm for "abnormal main power voltage" or "dump regeneration resistor overheat" will arise and then the Motor will stop.*
- ◊ *In such a case, review the operational conditions. Lower velocity, gentler deceleration rate or decreasing duty cycle may prevent overheating of the dump resistor.*
- ◊ *If heavy duty operation is still needed, we recommend to install an optional "Regenerative Dump Resistor."*

⚠ Warning : *The Motor assembly shall be grounded at one point individually.*

⚠ Warning : *Be sure to provide protective covers to the moving part of the Motor.*

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

⚠ Caution : *Do not conduct "Megger test" on the Driver Unit. It may damage the internal circuit.*

⚠ Caution : *Be sure to adjust the servo parameters according to conditions of actual use. Refer to "5. Trial Running and Adjustment" for more details and be sure to carry out the alteration of parameters.*

1.2. Terminology

Motor ---------- : Means Megathrust Motor System's motor when capitalized. A unit consists of high thrust motor, position monitor and linear guide way bearings.

Slider---------- : Moving part of the Megathrust Motor.

Driver Unit--------- : Means Megathrust Motor System's driver unit when capitalizes. Equipped with unique controller for the Megathrust Motor.

Cable Set ---------- : Set of cables which connect the Motor and the Driver Unit.

Handy Terminal -- : Means Megathrust Motor System's handy terminal when capitalized. This is an RS-232C communication terminal for setting parameters and programming.

VG---------- : Velocity loop gain

Velocity deviation, which is the difference between velocity command and velocity feedback signal, is amplified by parameter VG setting and is changed to an output of thrust force command.

VI ---------- : Velocity loop integrator frequency

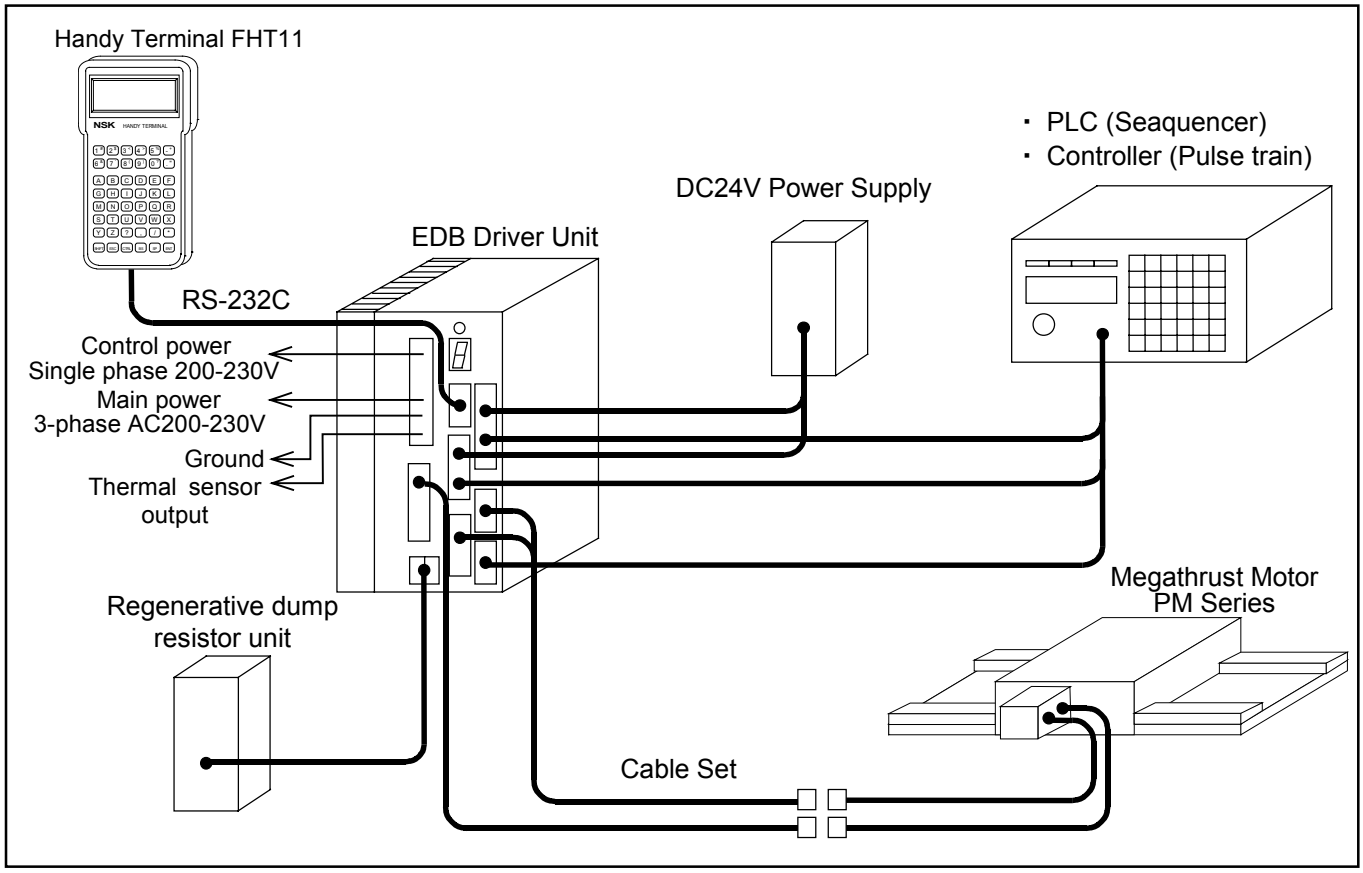
Integral control is to output thrust force command that is a time quadrature of signals, which is an amplified velocity deviation by proportional gain. The higher VI gives higher output command for the same level of velocity deviation and time. It is hard to achieve positioning deviation less than ±1 pulse without integral control.

2. System Outline

2.1. System Configuration

2.1.1. Example of System Setup

Figure 2-1 : System Setup (Example)

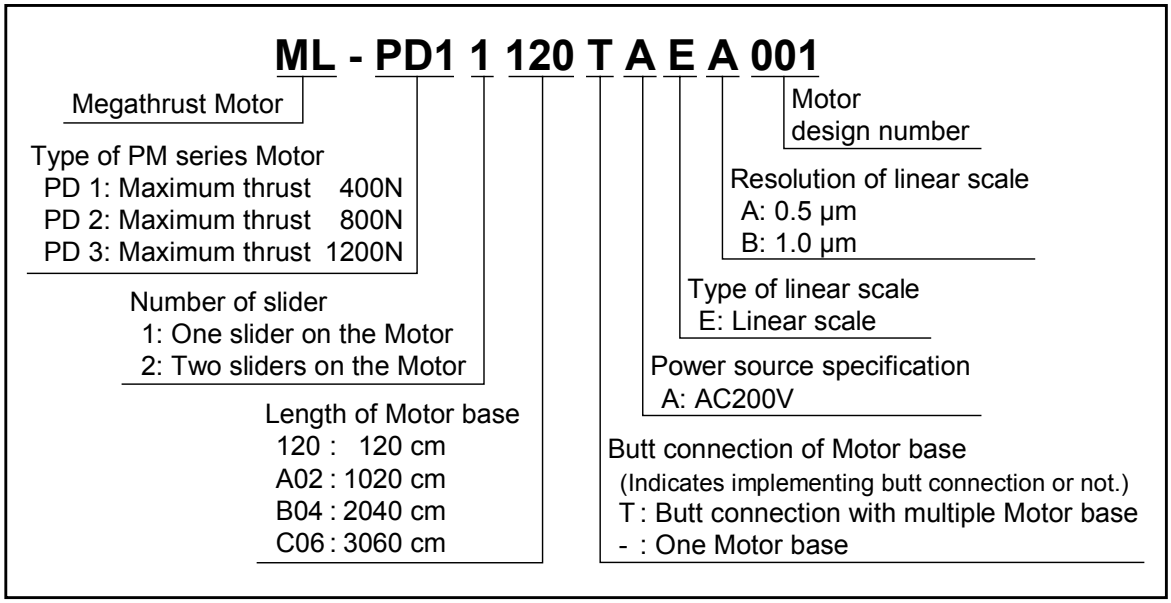


2.1.2. Configuration of Reference Number

The Megathrust Motor System consists of Megathrust Motor, Driver Unit, Cable set and optional parts such as a cable track assembly and covers. Each part has individual configuration of reference number to identify its peculiarity.

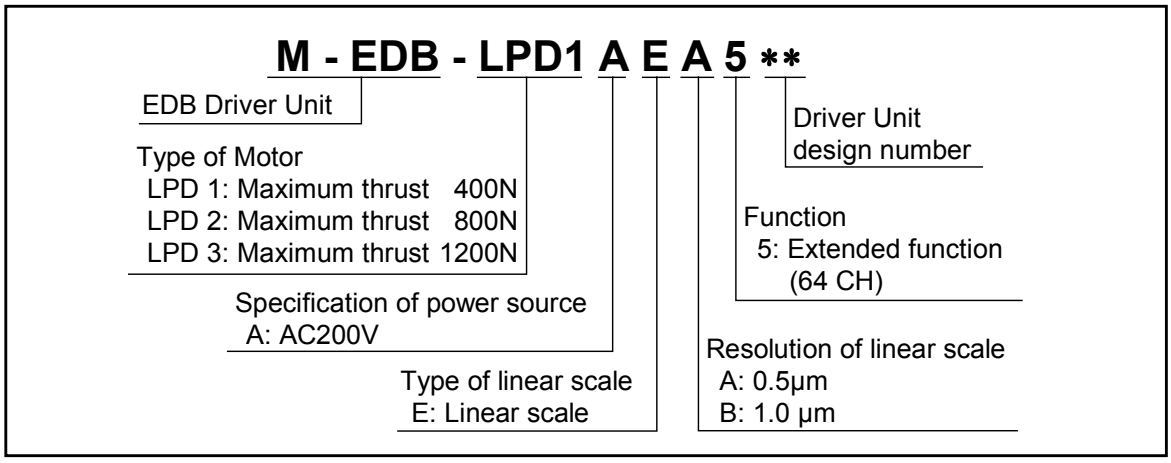
2.1.2.1. Megathrust Motor

Figure 2-2



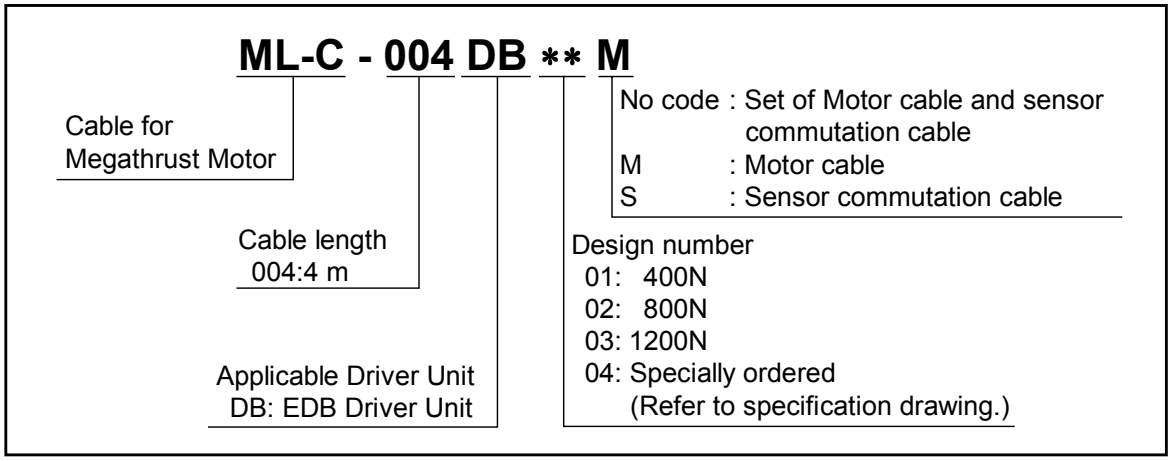
2.1.2.2. Driver Unit

Figure 2-3



2.1.2.3. Cable Set

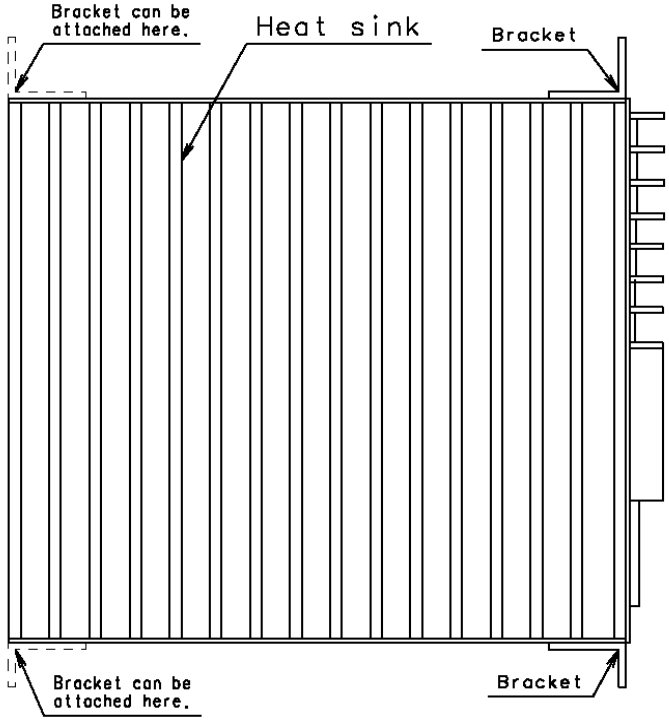
Figure 2-4

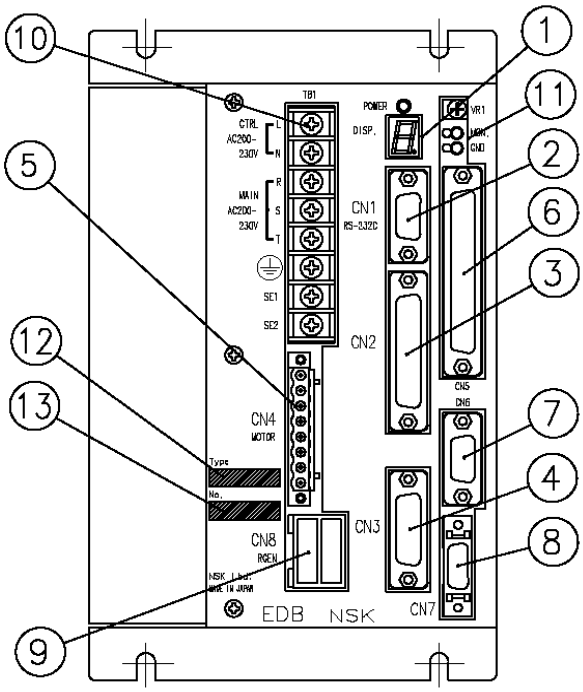


2.2. Name of Part

2.2.1. EDB Driver Unit

Figure 2-5

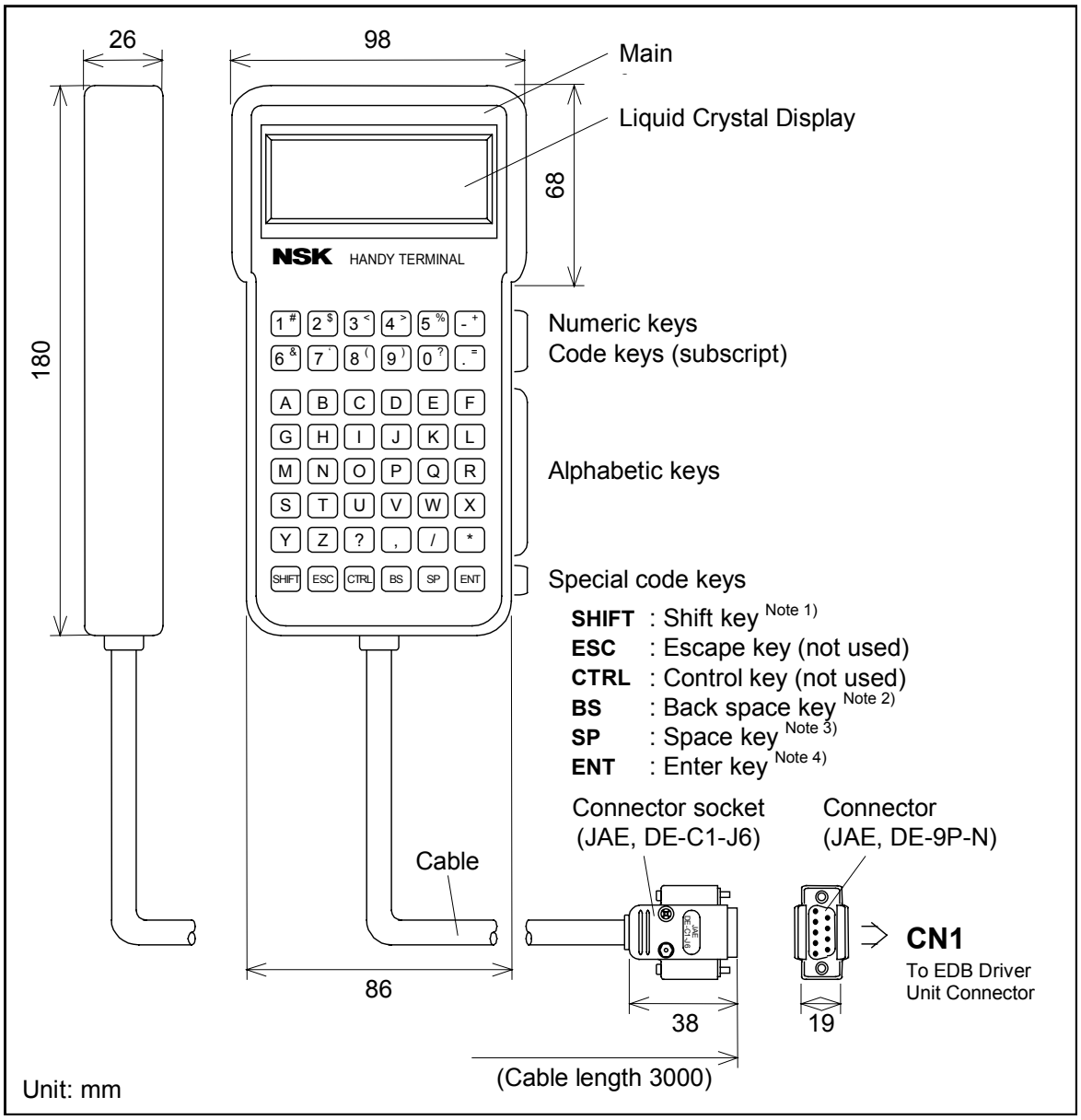




① 7 segments LED
② CN1 (9pin)
RS-232C serial communication connector
Connector for FH11 Handy Terminal (optional)
③ CN2 (25pin)
Connector for Motor control Input/Output signal (I/O)
④ CN3 (15pin)
Connector for sensor cable
Connect the exclusive use sensor cable
⑤ CN4 (I/O2)
Connector for Motor
Connect the exclusive use Motor cable.
⑥ CN5 (37pin)
Connector for Motor control Input / Output signal
⑦ CN6 (15pin)
Connector for cable of linear scale
Connect the exclusive use linear scale cable.
⑧ CN7 (20pin)
Output connector of position feedback signal
⑨ CN8
Connector for regeneration resistor unit
Connect optional regeneration resister unit.
⑩ TB
Terminal block for power supply
⑪ Monitor pins for analog signal
⑫ Name plate (Motor type)
⑬ Serial number plate

2.2.2. Handy Terminal

Figure 2-6. Handy Terminal: FHT 11



Note: (1) SHIFT: Press the code key while holding [SHIFT] key. (subscript)

(2) BS: When correcting logged-in mistakes, press [BS] key.

(3) SP: Press [SP] key to insert a space between characters.

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

Handy Terminal (For parameter setting and program editing)

Table 2-1: Reference number of Handy Terminal M-FHT11

Reference number of Handy Terminal
M-FHT11

2.3. Motor Specification

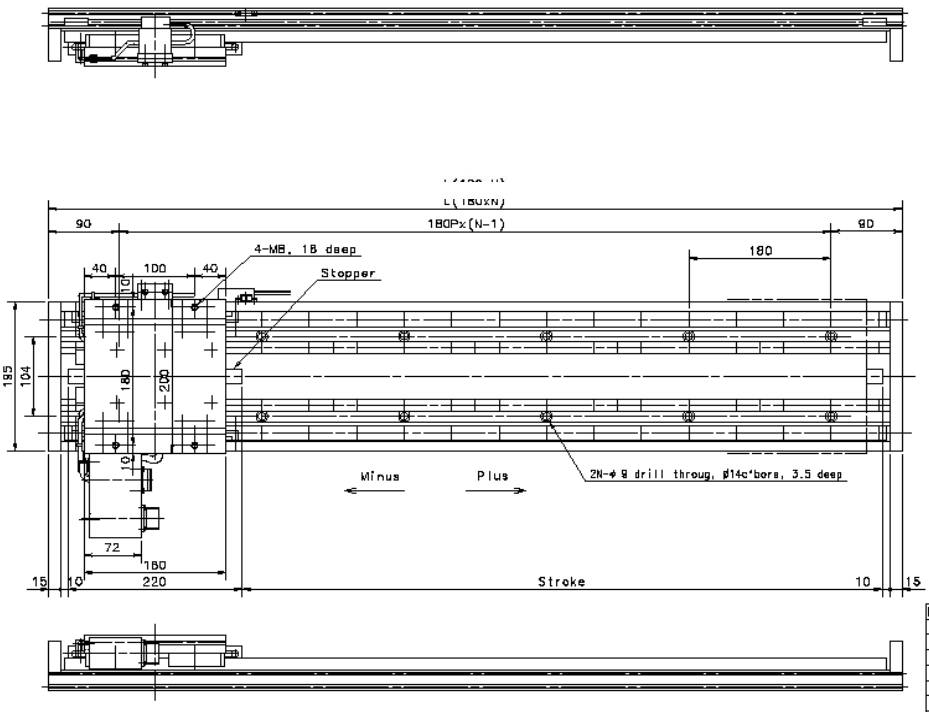
Table 2-2 : Specification

Motor type		PD1	PD2	PD3
Rated thrust [N]		150	300	450
Maximum thrust [N]		400	800	1200
Allowable load mass [kg]		40	80	120
Slider mass [kg]		7	14	21
Relation of base length and stroke [mm]				
	Stroke / Base length			
	540	270	150	30
	720	450	330	210
	900	630	510	390
	1080	810	690	570
	1260	990	870	750
	1440	1170	1050	930
	1620	1350	1230	1110
	1800	1530	1410	1290
	1980	1710	1590	1470
	2160	1890	1770	1650
Transportable moment				
	Rolling [N·m]	50	80	120
	Pitching [N·m]	70	150	220
	Yawing [N·m]	80	160	240
Maximum velocity [mm/s]		2000/1500		
Resolution [μm]		1/0.5		
Repeatability [μm]		±1		
Position monitor		Optical linear scale		
Environmental condition		IP20		
		Operating temperature: 0 ~ 40°C, Humidity : 20 ~ 90 % Indoor use only, free from dust.		

∗ Stroke up to 30m is available by implementing butting bases.

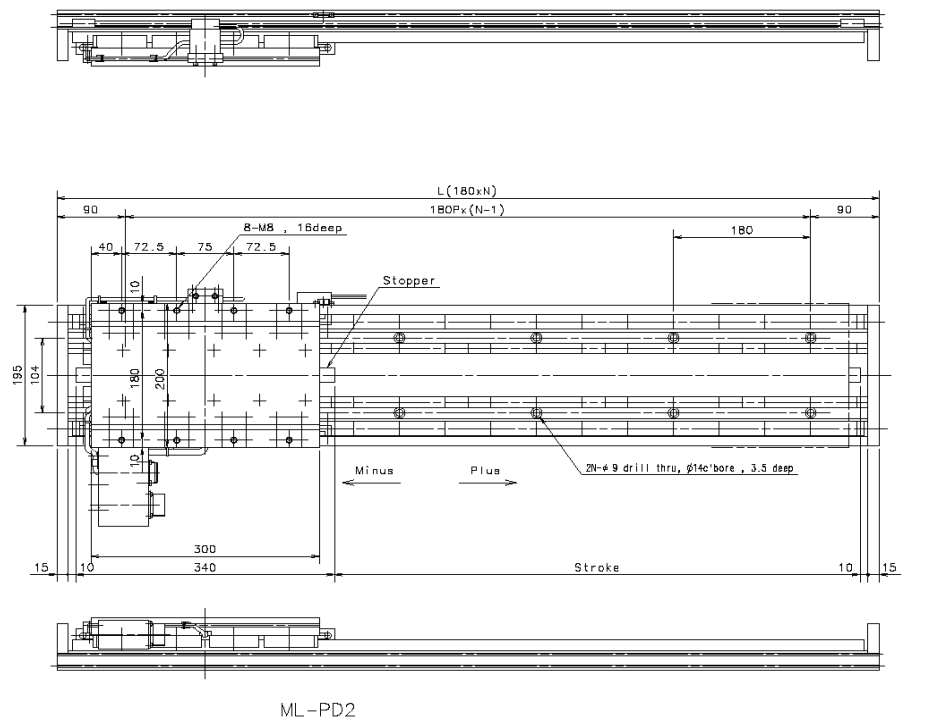
2.4.1. Motor Dimension

Figure 2-7 : PD1 type



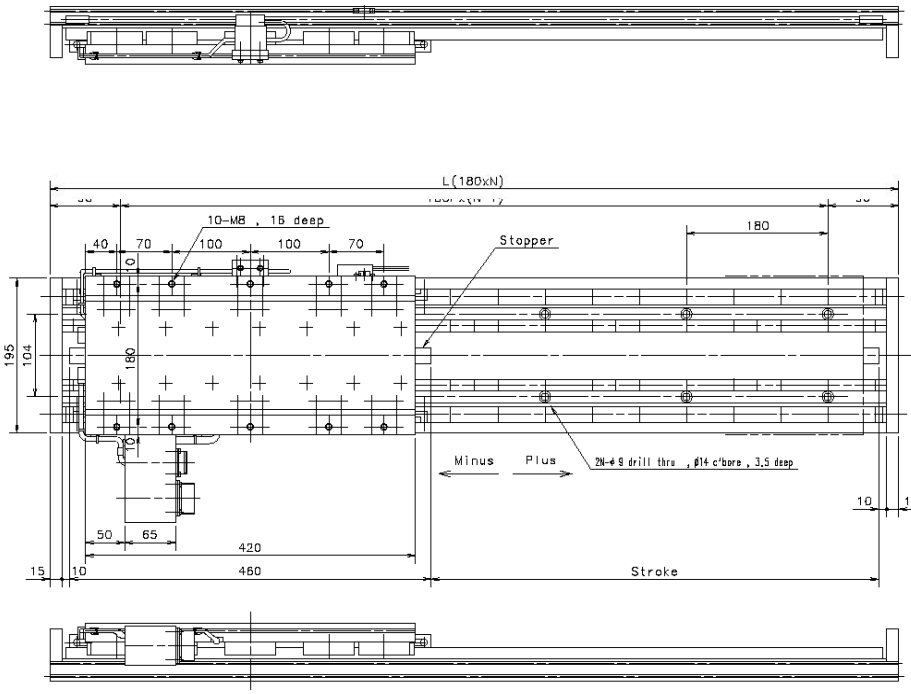
Reference number of standard product	Base length L (mm)	Stroke (mm)	Mass (kg)
ML-PD11054-AEB001	540	270	18
ML-PD11072-AEB001	720	450	21
ML-PD11090-AEB001	900	630	25
ML-PD11108-AEB001	1080	810	29
ML-PD11126-AEB001	1260	990	32
ML-PD11144-AEB001	1440	1170	36
ML-PD11162-AEB001	1620	1350	39
ML-PD11180-AEB001	1800	1530	43
ML-PD11198-AEB001	1980	1710	47
ML-PD11216-AEB001	2160	1890	50

Figure 2-8 : PD2 type



Reference number of standard product	Base length L (mm)	Stroke (mm)	Mass (kg)
ML-PD21054-AEB001	540	150	25
ML-PD21072-AEB001	720	330	28
ML-PD21090-AEB001	900	510	32
ML-PD21108-AEB001	1080	690	36
ML-PD21126-AEB001	1260	870	39
ML-PD21144-AEB001	1440	1050	43
ML-PD21162-AEB001	1620	1230	46
ML-PD21180-AEB001	1800	1410	50
ML-PD21198-AEB001	1980	1590	54
ML-PD21216-AEB001	2160	1770	57

Figure 2-9 : PD3 type

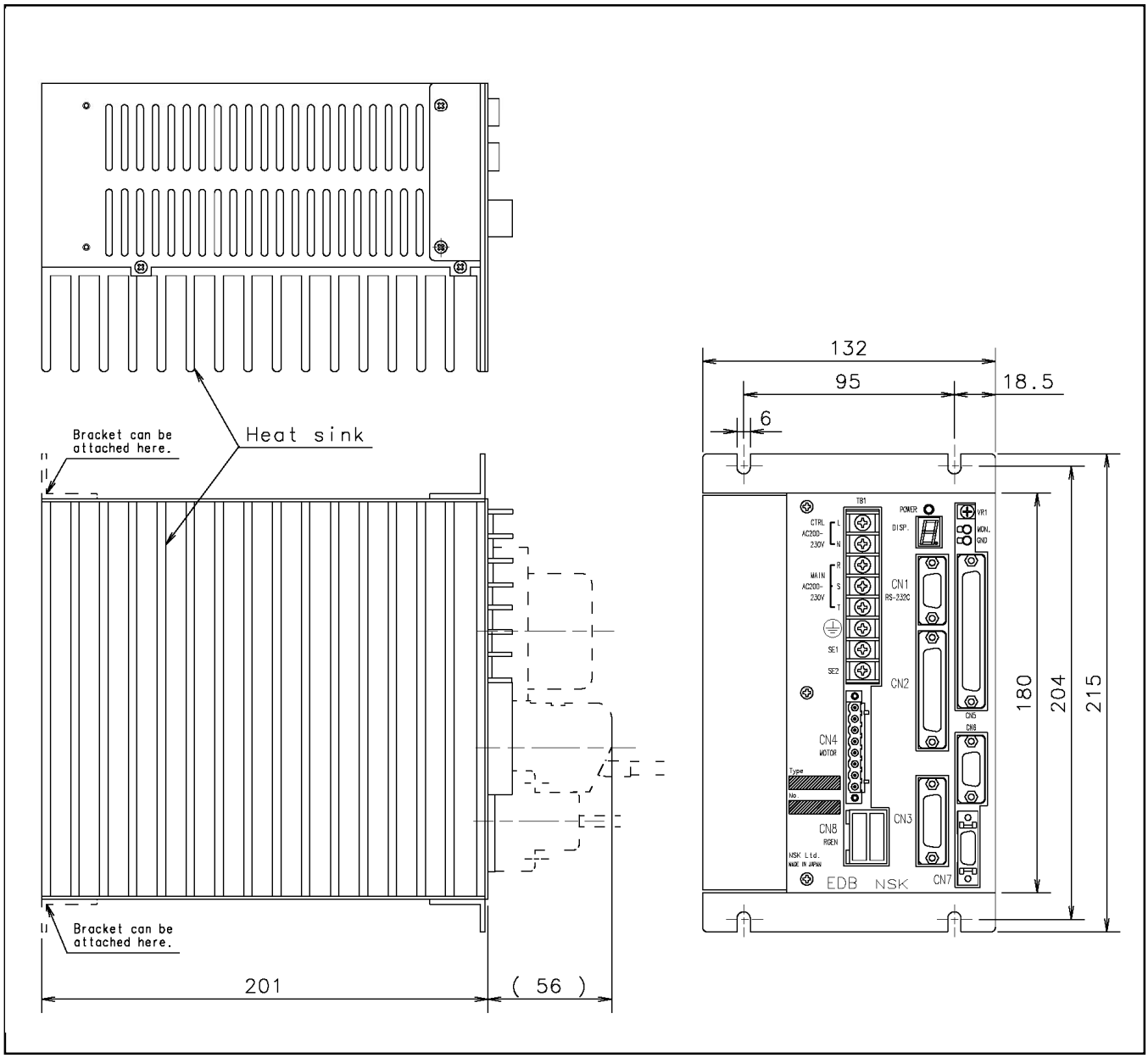


ML-PD3

Reference number of standard product	Base length L (mm)	Stroke (mm)	Mass (kg)
ML-PD31072-AEB001	720	210	35
ML-PD31090-AEB001	900	390	39
ML-PD31108-AEB001	1080	570	43
ML-PD31126-AEB001	1260	750	46
ML-PD31144-AEB001	1440	930	50
ML-PD31162-AEB001	1620	1110	53
ML-PD31180-AEB001	1800	1290	57
ML-PD31198-AEB001	1980	1470	61
ML-PD31216-AEB001	2160	1650	64

2.4.2. Dimension of Driver Unit

Figure 2-10 : EDB type



2.5. Specification of Driver Unit

2.5.1. General Specification

◆ Control mode

- Full closed loop; P•PI position control
- Velocity control mode
- Thrust control mode

◆ Operation mode of position control

- Pulse train position command, RS-232C communication control, Internal programmed operation

◆ Operation mode of velocity control

- Analog velocity command, RS-232C communication command

◆ Operation mode of thrust control

- Analog thrust command, RS-232C communication command

◆ Power supply

(1) AC200V–230V±10%

Table 2-3 : Power supply capacity

Motor type	Rated capacity	Maximum
PD1 type	0.6 kVA	1.8 kVA
PD2 type	1.2 kVA	3.4 kVA
PD3 type	1.8 kVA	5.0 kVA

Table 2-4

		Control power	Main poser
Surge current		15A	20A
Leakage current	(40Hz~100Hz)	5 mA rms	

◆ Environmental conditions

Table 2-5

Vibration resistance		0.5G (conforms to JIS–C0911)
Noise resistance		1500V 1μS (by noise simulator)
Mass		4.0kg
Environmental condition	Operation	Temperature: 0 ~ 50℃; Humidity: 20～90 % (No condensation)
	Store	Temperature: -20 ~ 70℃, In-door condition (free from dust)

2.5.2. Functional specification

◆ Position control specification

- Maximum input pulse frequency: 800kpps
- Input pulse train format is selectable by parameter.
  - ◊ PLSP & MNSP
  - ◊ Pulse and direction
  - ◊ øA / øB quadrature pulse

◆ Velocity control specification

- Voltage of analog command: ±10VDC

◆ Thrust control specification

- Voltage of analog command: ±10VDC

◆ Resolution of position monitor and maximum velocity

Table 2-6

Type of Drover Unit	Resolution of position monitor	Maximum velocity
M-EDB-LPD□AEA5□□	0.5 [μm/pulse]	1500 [mm/s]
M-EDB-LPD□AEB5□□	1.0 [μm/pulse]	2000 [mm/s]

◆ Encoder feedback output øA, øB, øZ

- Output signal format: Line driver
- Resolution

Table 2-7

Type of Driver Unit	øA / øB resolution	øZ
M-EDB-LPD□AEA5□□	2 [μm/pulse]; 0.5 [μm/pulse] by the quadruple	Depending on linear scale specification
M-EDB-LPD□AEB5□□	4 [μm/pulse]; 1 [μm/pulse] by the quadruple	

◆ Control Input / Output Signal

- Input signal : Emergency stop, Servo on, Home limit switch,, Run move, Internal program channel select (64 channel), Over travel limit, Home Return start, Clear, Jog, Jog direction
- Output signal : Driver Unit ready, Servo state, In-position, Velocity check Home Return complete, Home position defined

◆ Alarms

- Excessive position error, Velocity error, Software thermal limit, Overt travel limit, Control circuit error, RS-232C error, Linear scale error, Main AC line over/under voltage, Control power line under-voltage, Pole sensor error, Power module error, Regeneration resistor overheat,

◆ Monitor output

- Analog velocity, RS-232C communication, Current position, alarm status, Servo parameter

◆ Communication

- Asynchronous RS232C communication, Baud rate: 9600bps

◆ Data backup

- Backup by EEPROM
  - ◊ Lasting 500 000 times of resetting / deleting parameters

2.6. Interface Specification

- Refer to “6.3. RS-232Ccommunication.”

2.6.1. CN1: Connector for RS-232C Serial Communication

* Handy Terminal FHT11 is available for RS-232C terminal from NSK Ltd. (optional)

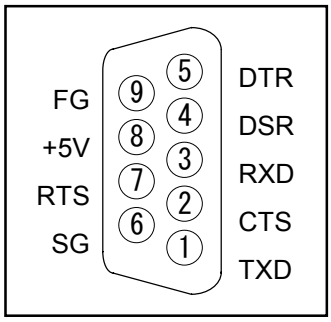
Table 2-8

Driver Unit connector	Japan Aviation Electronics Industry, Ltd.	DELC-J9SAF-13L6
Mating connector type* (user device side)		DE-9PF-N
Mating connector shell type* (User device side)		DE-C1-J6

* The user shall provide theses connector parts.
These connector parts are not necessary when FHT11 Handy Terminal is used.

2.6.1.1. Pin Out (CN1)

Figure 2-11 : Pin out (CN1)



2.6.1.2. CN1 Signal List

Table 2-9 : Signals and function (CN1)

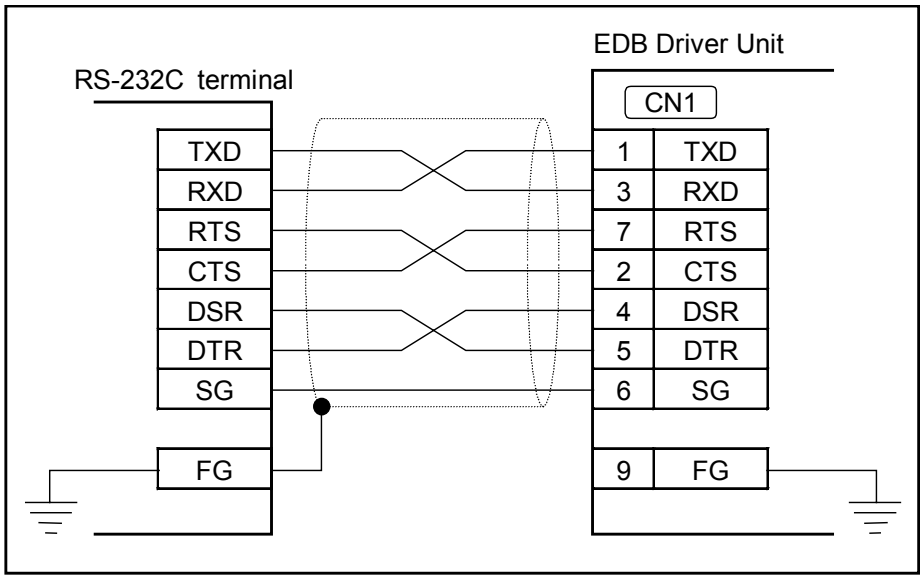
Pin	Signal name	I / O	Function
1	TXD	Output	Transmit data
2	CTS	Input	Clear to send
3	RXD	Input	Receive data
4	DSR	Input	Data set ready
5	DTR	Input	Data terminal ready
6	SG	–	Digital signal ground
7	RTS	Output	Ready to send
8	+5V	Output	(Do not connect.)
9	FG	–	Frame ground (Shield)

2.6.1.3. Sample Wiring Diagram (CN1)

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

◆ RTS control / CTS Monitoring Active (standard wiring)

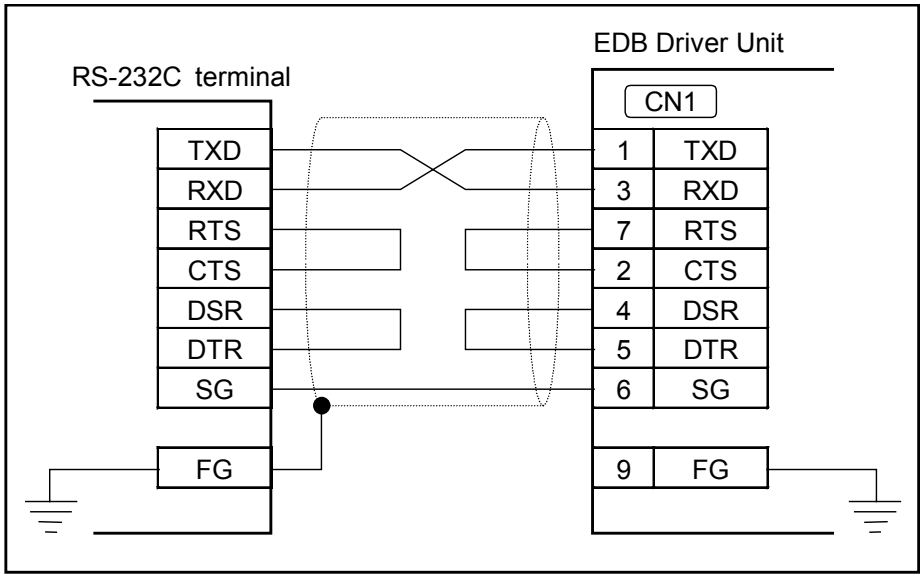
Figure 2-12



◆ 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 2-13



2.7. CN2, CN5, CN7 : Control I/O Signal Connector

- The table 2-10 below is the list of connector and part used for CN2, CN5 and CN7 of the Driver Unit and for the master device of user side.

Table 2-10

Connectors; (EDB Driver Unit)	CN2	Japan Aviation Electronics Industry, Ltd.	DBLC-J25SAF-13L**9**
	CN5		DBLC-J37SAF-13L9
	CN7	Hirose Electric Co. Ltd.	DX10GM-20SE
Mating connector* (User device side)	CN2	Japan Aviation Electronics Industry, Ltd.	DB-25PF-N
	CN5		DC-37PF-N
	CN7	Hirose Electric Co. Ltd.	DX40M-20P
Mating connector, shell type* (User device side)	CN2	Japan Aviation Electronics Industry, Ltd.	DB-C15-J10-F2
	CN5		DC-C8-J13-F1-1
	CN7	Hirose Electric Co. Ltd.	DX30M-20-CV

* Will be provided with the Driver Unit.

- Followings are wiring precautions for CN2, CN5 and CN7 connectors.

  1) Use shielded cables for wiring of the connectors.

  2) Twisted cables must be used for the pulse train input and the feedback output signal. Make the cable length short as possible. (Maximum 2m)

  3) The cables should be laid in an independent duct separate from the power line.

  4) Connect one end of the shield to the frame ground. Refer to "3.3.4. Ground Connection and Wiring."

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

2.7.1. Setting Polarity (A or B contact) of Input Ports

- For the CN2 connector of EDB Driver Unit, you can switch the polarity of some input signal ports.
- The shipping set of these input ports are set to A contact.
- Parameter AB sets the polarity of the input ports.
- You require the password to input the parameter AB.
- The input ports whose polarity may be switched are limited to EMST, HLS, OTP and OTM.
- Table 2-11 shows the data and port arrangement. (EMST: the 2nd from left; HLS: the 4th from left; OTM: the 7th from left; Otp: the 8th from left.)
- Meaning of the data
  0 = Set to A contact (Normally open)
  1 = Set to B contact (Normally closed)
  X = Input of X denotes no change of the polarity. Indication of X means that changing polarity is prohibited. (The port is set to A contact.)

Table 2-11

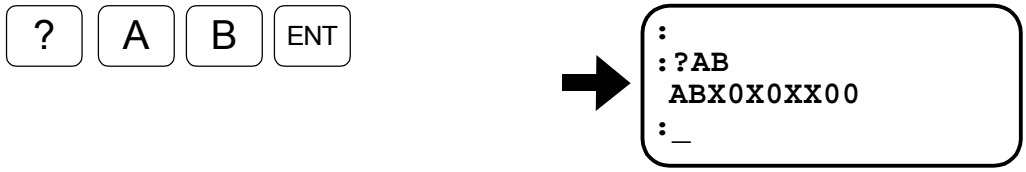
CN2 No.	25	12	24	11	23	10	22	09
Signal name	SVON	EMST	IOFF	HLS	HOS	CLR	OTM	OTP
Shipping set	X	0	X	0	X	X	0	0

◆ Setting example

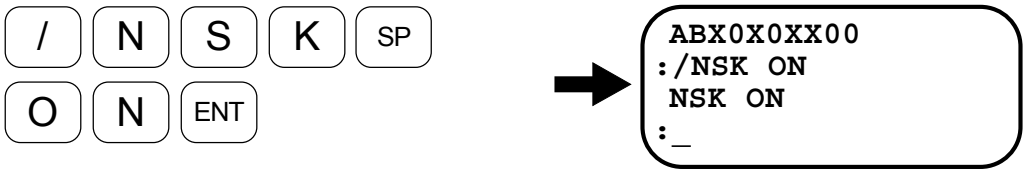
- The following example shows how to set the B contact to EMST (Emergency stop) input port.

1) Input a command "?AB" to read out the current polarity setting.

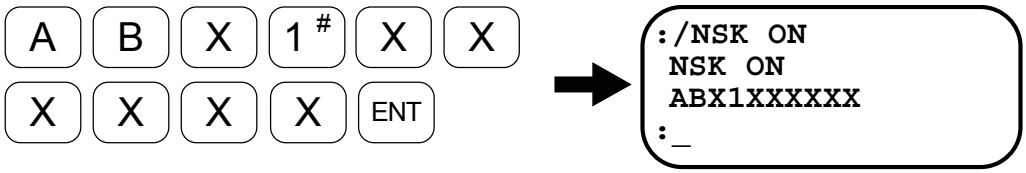
(For this example, all polarity setting is A contact.)



2) Input the password. The display indicates confirmation of the password entry.



3) Set 1 to the second bit that is for EMST port and leave the other bits X.

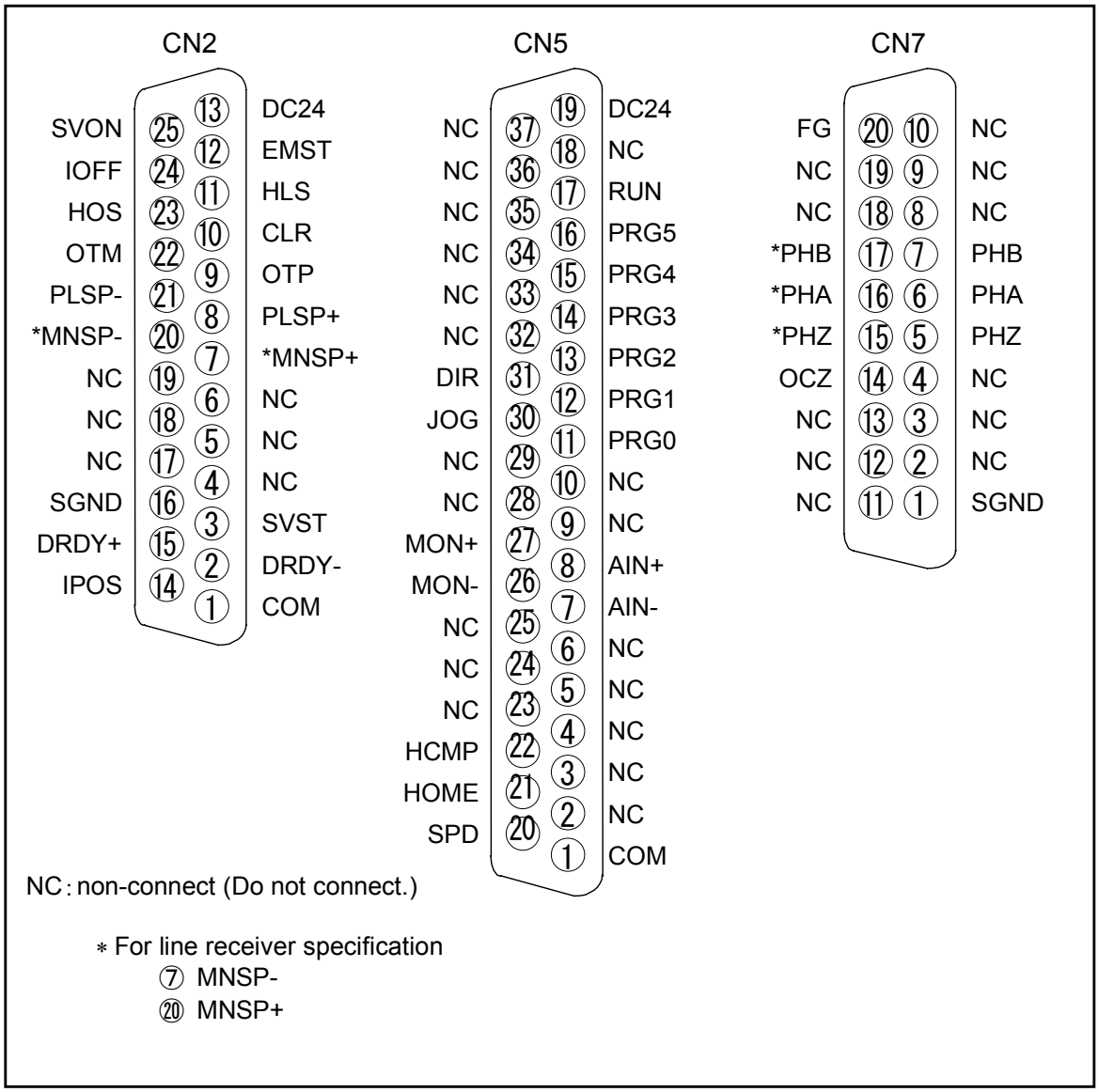


- The procedures above complete the setting of EMST port to the B contact.

2.7.2. Pin Out (CN2, CN5 and CN7)

- Input / Output signals of CN2, CN5 and CN7connectorsare shown in the following figures.

Figure 2-14



2.7.3. Signal and Function (CN2, CN5, CN7)

Table 2-12 : CN2

Pin	Signal name	I / O	Function
1	COM	Output	Output COMMON
2	DRDY－	Output	Driver Unit ready (–)
3	SVST	Output	Servo status
4	NC	–	Do not connect.
5	NC	–	Do not connect.
6	NC	–	Do not connect
7	MNSP+	Input	Pulse train MNS (+) For line receiver input, this shall be MNSP–.
8	PLSP+	Input	Pulse train PLS (+)
9	OTP	Input	Over travel limit +
10	CLR	Input	Clear input
11	HLS	Input	Home position limit
12	EMST	Input	Emergency stop
13	DC24	Input	DC24V external power supply
14	IPOS	Output	In-position
15	DRDY＋	Output	Driver Unit ready (+)
16	SGND	–	Signal ground
17	NC	–	Do not connect.
18	NC	–	Do not connect.
19	NC	–	Do not connect.
20	MNSP－	Input	Pulse train MNS (–) For line receiver, it shall be MNSP+.
21	PLSP－	Input	Pulse train PLS (–)
22	OTM	Input	Over travel limit (–)
23	HOS	Input	Home Return start
24	IOFF	Input	Integrator OFF
25	SVON	Input	Servo on

Table 2-13 : CN5

Pin	Signal	I / O	Function
1	COM	Output	Output COMMON
2	NC	–	Do not connect.
3	NC	–	Do not connect.
4	NC	–	Do not connect.
5	NC	–	Do not connect.
6	NC	–	Do not connect.
7	AIN–	Input	Analog input GND (–)
8	AIN+	Input	Analog input (+)
9	NC	–	Do not connect.
10	NC	–	Do not connect.
11	PRG0	Input	Internal program • Channel select 0
12	PRG1	Input	Internal program • Channel select 1
13	PRG2	Input	Internal program • Channel select 2
14	PRG3	Input	Internal program • Channel select 3
15	PRG4	Input	Internal program • Channel select 4
16	PRG5	Input	Internal program • Channel select 5
17	RUN	Input	Positioning start
18	NC	–	Do not connect.
19	DC24	Input	DC24V power supply
20	SPD	Output	Velocity check
21	HOME	Output	Home Return complete
22	HCMP	Output	Home position defined
23	NC	–	Do not connect.
24	NC	–	Do not connect.
25	NC	–	Do not connect.
26	MON－	Output	Analog monitor output GND (–)
27	MON＋	Output	Analog monitor output (+)
28	NC	–	Do not connect.
29	NC	–	Do not connect.
30	JOG	Input	JOG
31	DIR	Input	Jog direction
32	NC	–	–
33	NC	–	–
34	NC	–	–
35	NC	–	–
36	NC	–	–
37	NC	–	–

⚠ *Caution* *: If your Motor System is a custom made and Input / Output signal specifications do not conform to the standard series as described above, follow the unique specification sheet for your specially made Motor System.*

Table 2-14 : CN7

Pin	Signal	I / O	Function
1	SGND	–	Signal ground
2	NC	–	Do not connect.
3	NC	–	Do not connect.
4	NC	–	Do not connect.
5	PHZ	Output	Position feedback signal, øZ
6	PHA	Output	Position feedback signal, øA
7	PHB	Output	Position feedback signal, øB
8	NC	–	Do not connect.
9	NC	–	Do not connect.
10	NC	–	Do not connect.
11	NC	–	Do not connect.
12	NC	–	Do not connect.
13	NC	–	Do not connect.
14	OCZ	Output	Position feedback signal, øZ (Open collector)
15	∗PHZ	Output	Position feedback signal, øZ*
16	*PHA	Output	Position feedback signal, øA*
17	*PHB	Output	Position feedback signal, øB*
18	NC	–	
19	NC	–	Do not connect.
20	FG	–	Frame ground

2.7.4. Electrical Specification (CN2, CN5, CN7)

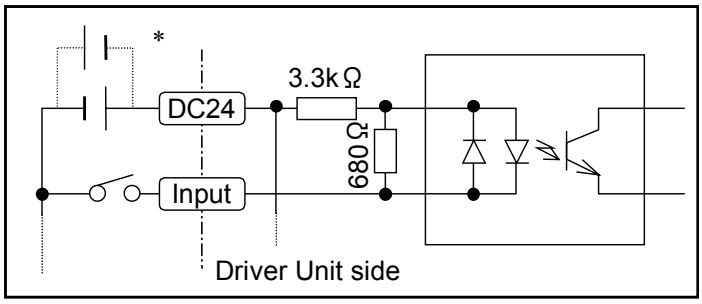
2.7.4.1. General Input Signal

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

Table 2-15

item	Specification
Input voltage	DC24V±10%
Input impedance	3.3kΩ
Maximum current	10mA (per one point)

Figure 2-15



∗ The polarity of DC12V power supply may be reversed and can be connected as Minus common.

2.7.4.2. Pulse Train Input

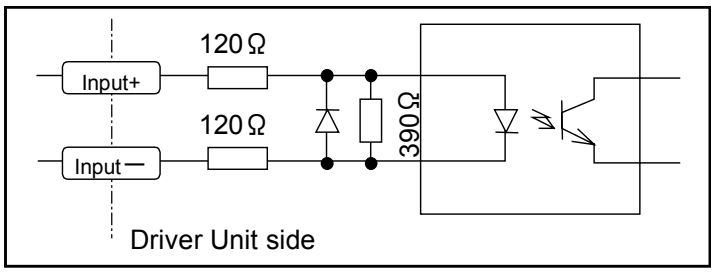
Applied inputs: MNSP+, MNSP–, PLSP+, PLSP–

(1) Photocoupler input specification (Reference number of Driver Unit: M-EDB-LPD□AE□5<u>00</u>)

Table 2-16

Item	Specification
Input voltage	DC5V ±10%
Input impedance	240Ω
Maximum current	25mA

Figure 2-16

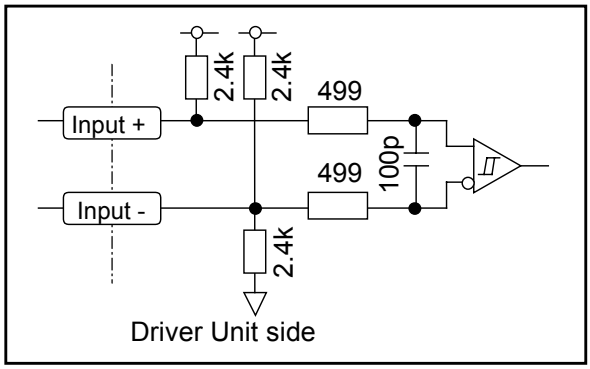


(2) Line receiver specification (Reference number of Driver Unit : M-EDB-LPD□AE□501)

Table 2-17

Item	Specification
Input format	Deferential line receiver
Use line receiver	Japan Texas Instrument, μA9637AC
Recommended line receiver	Japan Texas Instrument, μA9638C or AM26LS31 equivalent

Figure 2-17



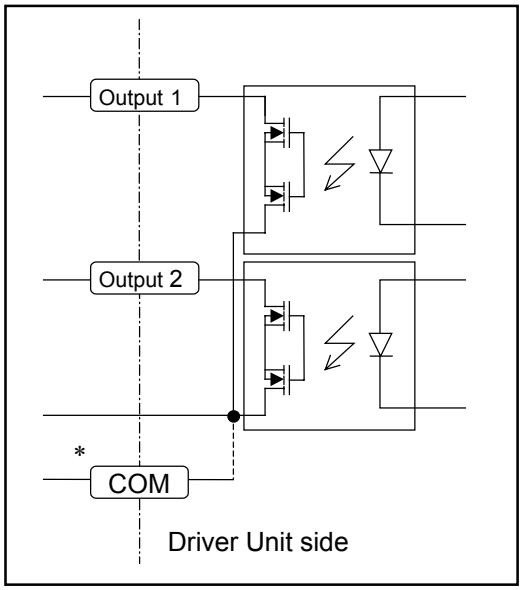
2.7.4.3. General Output Signal

Applied inputs: SVST, IPOS, SPD, HOME, HCMP

Table 2-18

Item	Specification
Maximum open /close capability	DC±24V /120mA
Maximum ON resistance	25 Ω

Figure 2-18



∗ Connect relative signals of CN2 and CN5 to output COMMON.

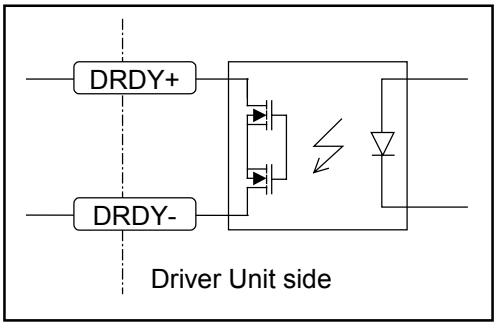
2.7.4.4. Output Related to Alarm

Applied outputs: DRDY+, DRDY-

Table 2-19

Item	Specification
Maximum open/close capability	DC ±24V / 120mA
Maximum ON resistance	25Ω

Figure 2-19



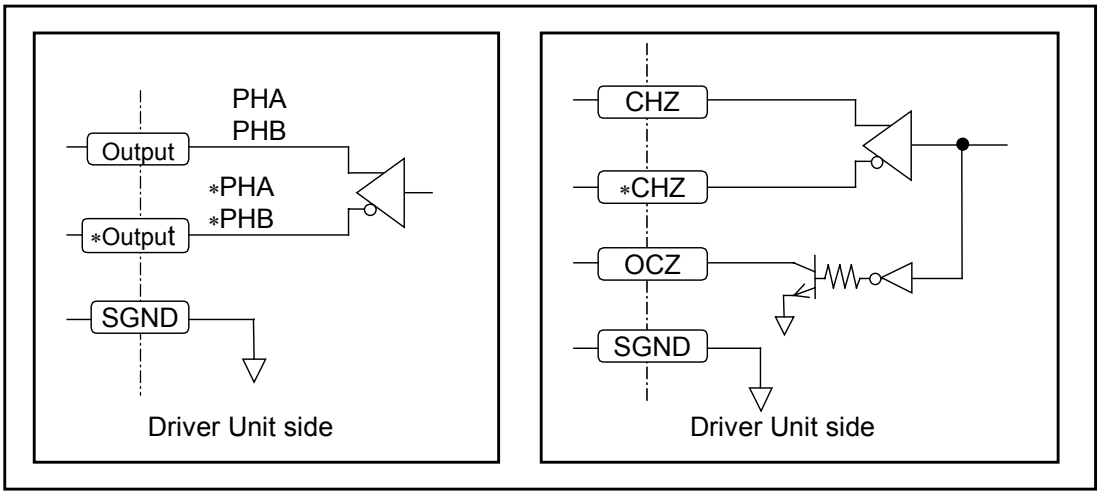
2.7.4.5. Position Feedback Output

Applied output: PHA, PHB, PHZ, * PHA, *PHB, *PHZ

Table 2-20

Item	Specification	
Output format	• Line driver (PHA/*PHA, PHB/*PHB, PHZ/*PHZ) • Open collector (OCZ)	
Used line driver	Japan Texas Instrument : AM26C31	
Recommended line receiver	Japan Texas Instrument : AM26C32 or equivalent	
Maximum collector current	100 mA	øZ open collector output (OCZ)
Maximum collector voltage	24 V	
Saturation voltage	1 V maximum	

Figure 2-20



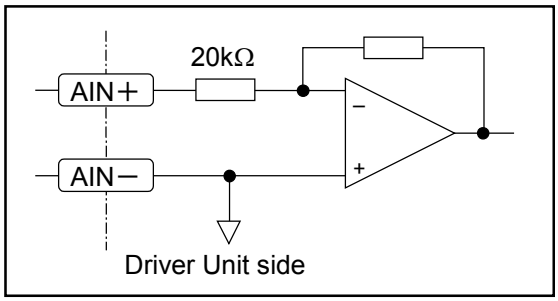
2.7.4.6. Analog Output

Applied inputs: AIN+, AIN-

Table 2-21

Item	Specification
Maximum input voltage	± 10VDC
Input impedance	20 kΩ
Maximum input current	0.5 mA

Figure 2-21



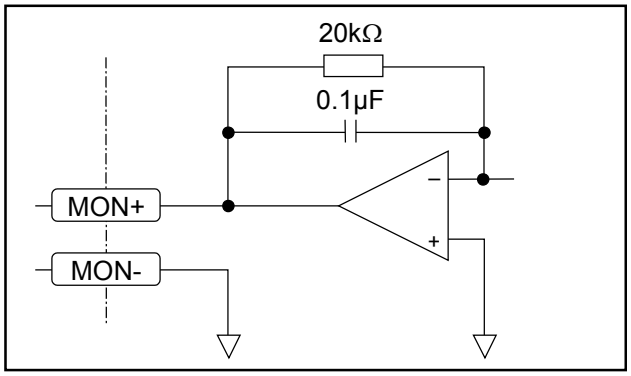
2.7.4.7. Analog Output

Applied outputs: MON+, MON-

Table 2-22

Item	Specification
Output device	Operational amplifier
Maximum output voltage	±10V ± 10%
Saturation current	4 mA

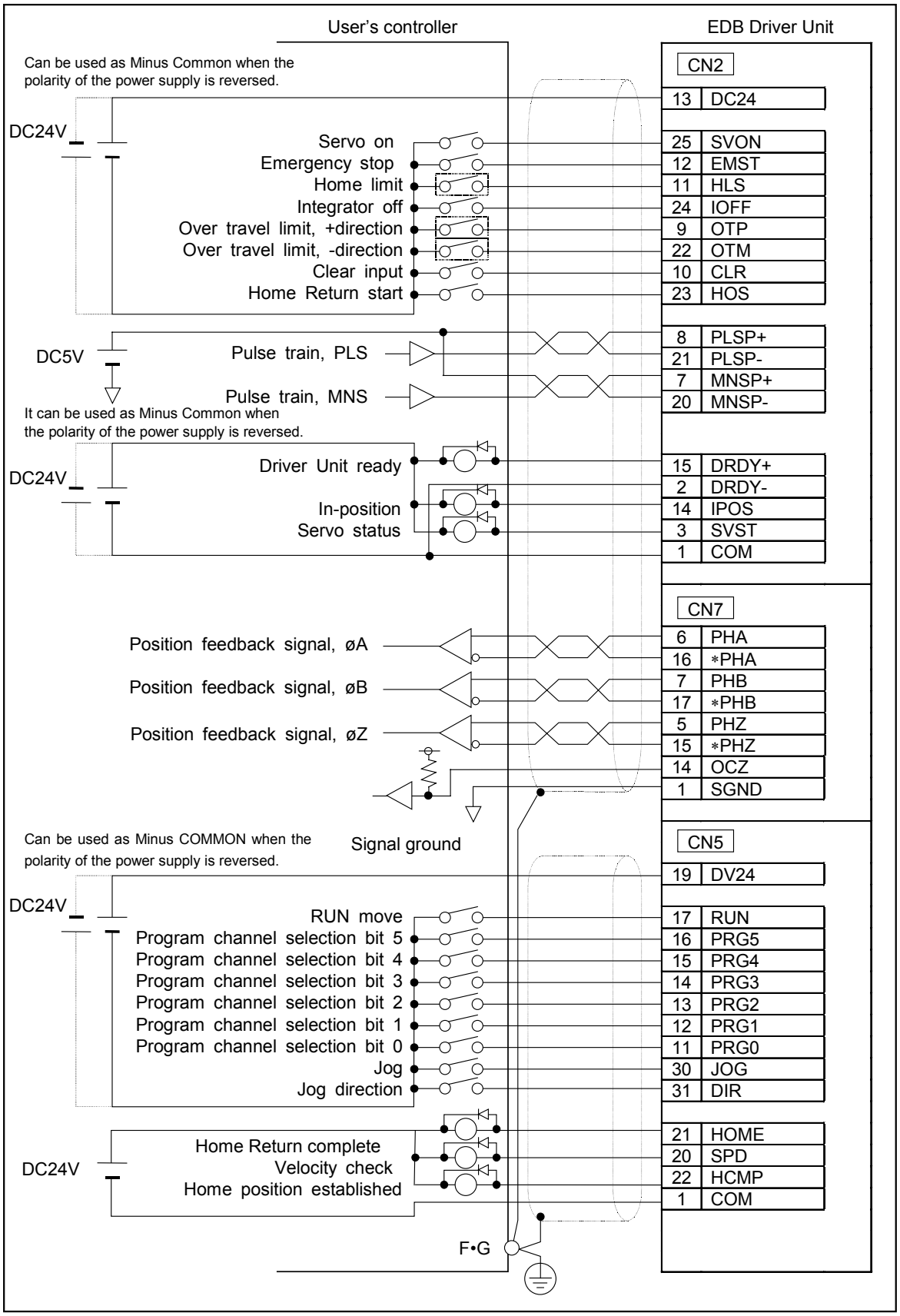
Figure 2-22



2.7.4.8. Wiring Diagram (CN2, CN5, CN7)

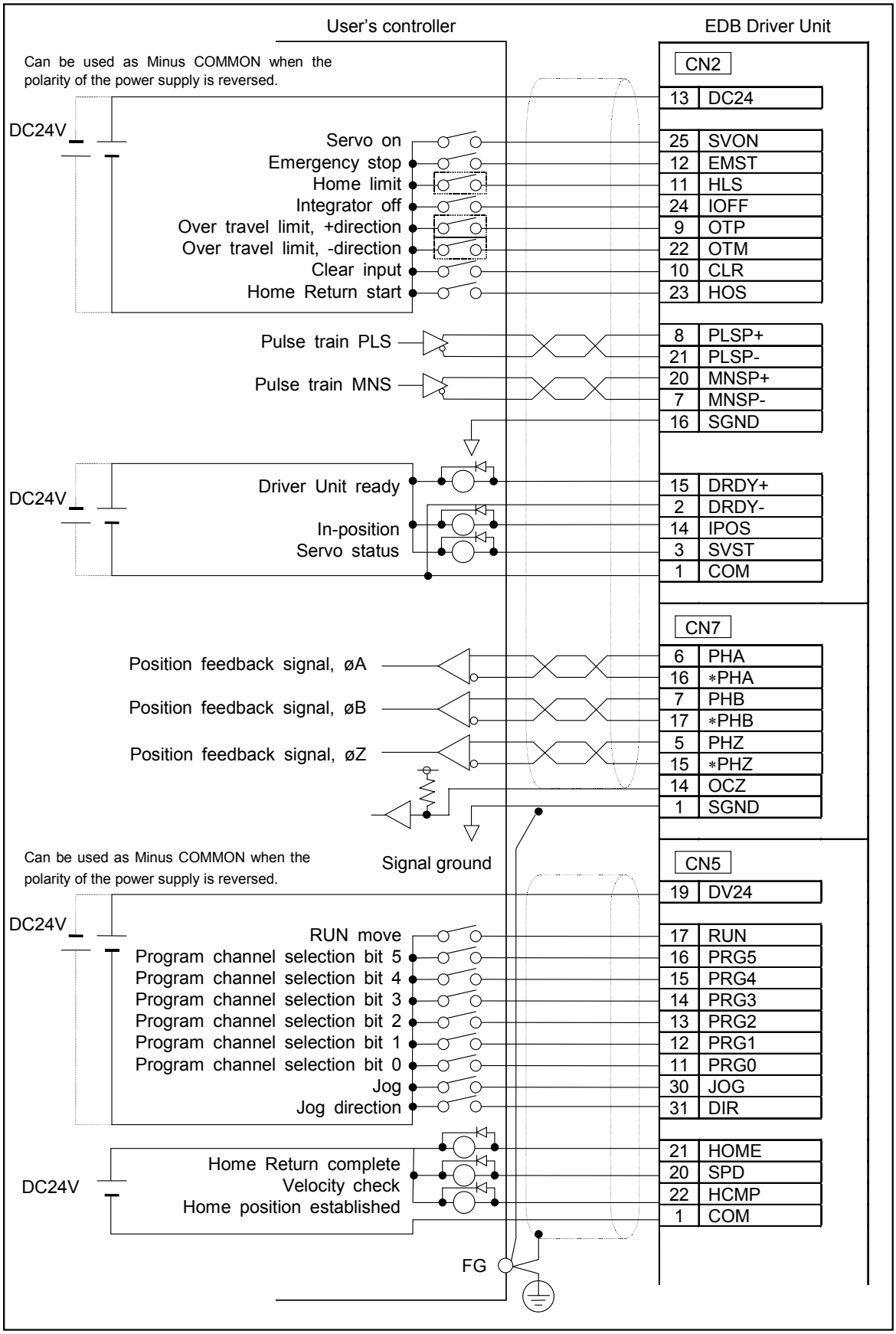
◆ Connection example for position control (Photocoupler)

Figure 2-23



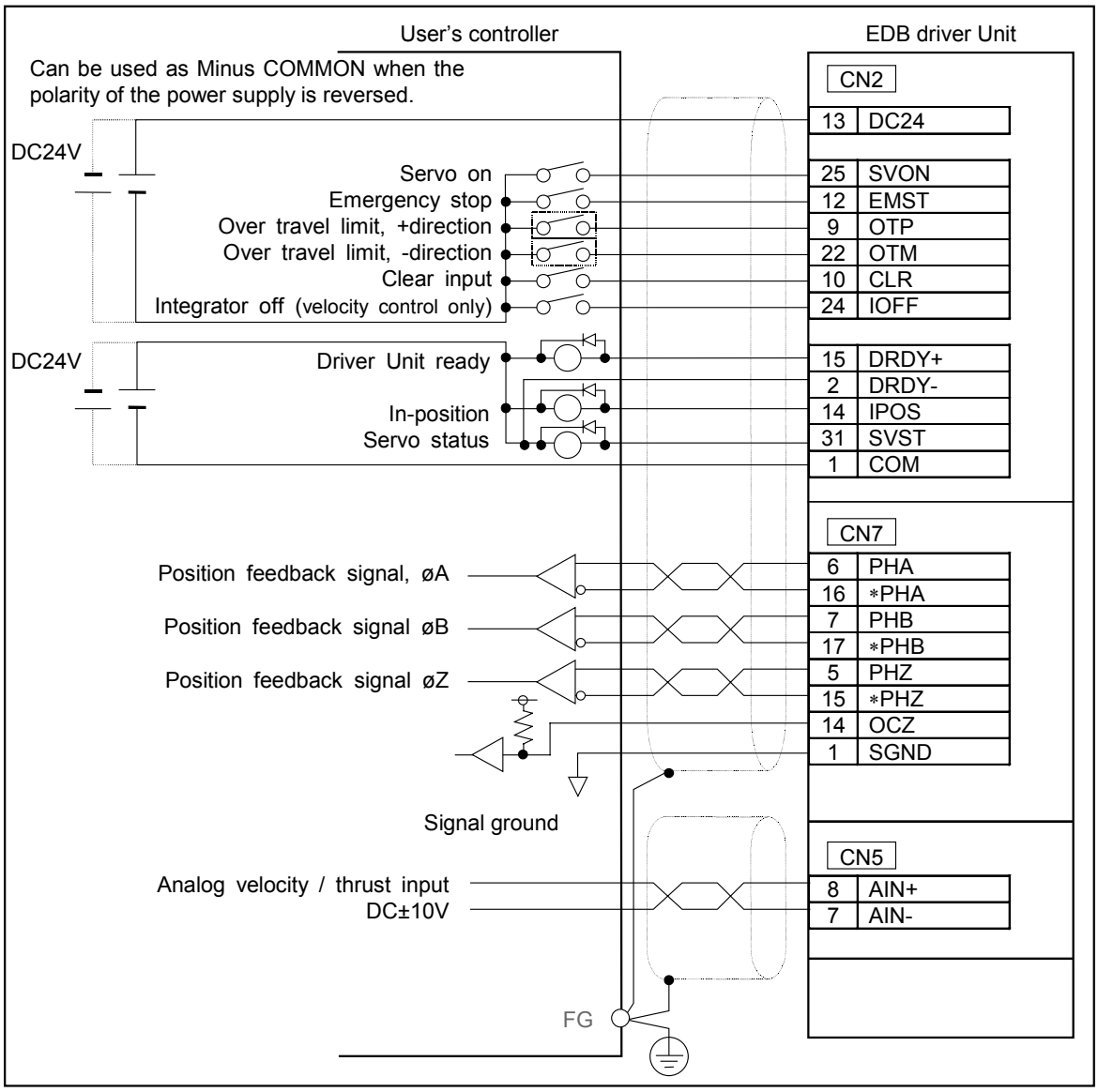
◆ Connection example for position control (Line driver)

Figure 2-24



◆ Connection example for velocity control / thrust control

Figure 2-25



⚠ *Caution* *: (1) When an inductive switch, such as a relay, is installed to the circuit, be sure to provide a surge killer circuit.*

(2) When the user install Home position limit switch, over travel limit switches (plus and minus), connect those output signals directly with the input ports of EDB Driver Unit, not via the user's controller.

2.8. CN3 : Connector for Position Monitor

⚠ *Caution* : *Use the exclusive cable set for the position monitor. Never modify the cable set. Never use relay box or any means that require cutting the cable set.*

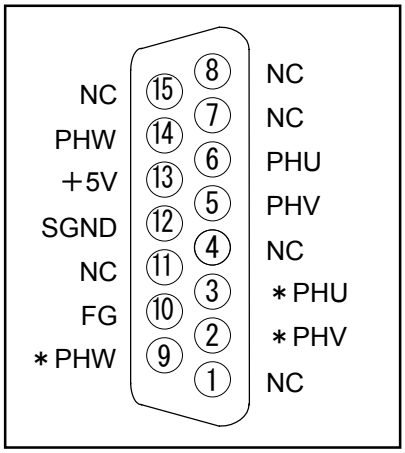
Table 2-23

Driver Unit connector	Japan Aviation Electronics Industry, Limited	DALC-J15SAF-13L9
Mating connector type*		DA-15PF-N
Mating connector shell type*		DA-C8-J10-F1-1

* Shall be provided with the cable set.

2.8.1. Pin Out (CN3)

Figure 2-26 : Pin out



2.8.2. Signal List (CN3)

Table 2-24 : Signal list

Pin	Signal	Function
1	NC	Do not connect.
2	*PHV	Sensor signal, øV* (reverse)
3	*PHU	Sensor signal, øU* (reverse)
4	NC	Do not connect.
5	PHV	Sensor signal, øV (non-reverse)
6	PHU	Sensor signal, øU (non-reverse)
7	NC	Do not connect.
8	NC	Do not connect.
9	*PHW	Sensor signal, øW* (reverse)
10	FG	Frame ground
11	NC	Do not connect.
12	SGND	Signal ground
13	＋5V	DC+5V output
14	PHW	Sensor signal, øW (non-reverse)
15	NC	Co not connect.

⚠ *Caution* *: (1) Use the exclusive Cable Sets. Never use other cables.*

(2) Be careful for orientation of the connector when inserting it. Fasten fixing screws securely so that the connector won't be loosened by vibration or shock.

(3) Never insert or remove the CN3 connector when the power of the Driver Unit is turned on.

2.9. CN4 : Connector for Motor

⚠ Caution : *Use the exclusive cable set for the Motor. Never modify the cable set. Never use relay box or any means that require cutting the cable set.*

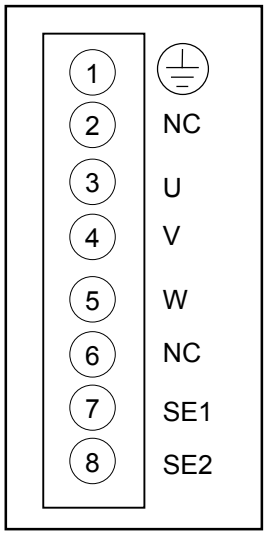
Table 2-25

Driver Unit Connector	Phoenix Contact Co. Ltd	IC2,5/8-GF-5,08
Mating connector*		IC2,5/8-STF-5,08
Mating connector shell type*		KGS-MSTB2, 5/8

* These connector parts shall be provided with the Megathrust Motor.

2.9.1. Pin Out (CN4)

Figure 2-27 : Pin out



2.9.2. Wire List (CN4)

Table 2-26 : Signal List

Pin	Wire	Function
1	⏚	Motor ground
2	NC	Do not connect.
3	U	Motor winding, øU
4	V	Motor winding, øV
5	W	Motor winding, øW
6	NC	Do not connect.
7	SE1	Thermal input 1
8	SE2	Thermal input 2

⚠ Caution : *(1) Do not insert or remove the connector when the power of the Driver Unit is on.*

(2) High voltage is applied to the connector after the main power is on. Be most careful not to short wires or pins.

(3) Be careful for the connector orientation when inserting it. Secure the connector fixing screw tightly so that the connector won't be loosened by vibration or shock.

2.10. TB : Terminal Block for Power Supply

2.10.1. Terminal List

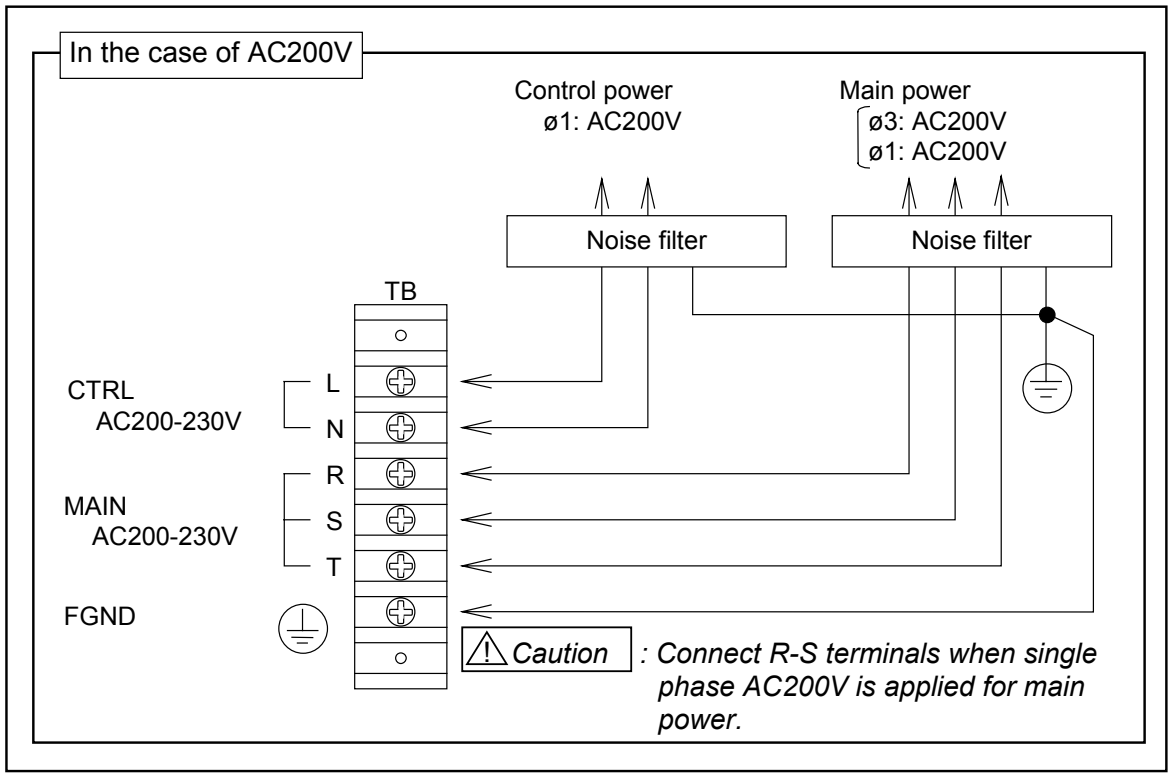
Table 2-27 : Terminal code and function

Code	Function
CTRL	Control power input
MAIN	Main power input
⏚	Safety frame ground

2.10.2. Wiring diagram of TB

- Tightening torque of the screw shall be 1.0 [Nm].

Figure 2-28 : Wiring diagram of Terminal Block



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3. Installation

3.1. Unpacking

3.1.1. Product List

(1) Megathrust Motor

(2) EDB Driver Unit

(3) Cable Set (Motor cable and Sensor Cable)

(4) Accessories

◊ Connectors CN2, CN5 and CN7 for control Input / Output signal (for the user side)

3.1.2. Combination of Megathrust Motor and EDB Driver Unit

⚠ *Caution* : *Please confirm that* the type code of reference number *of the Motor and the Driver Unit is identical.*

Figure 3-1

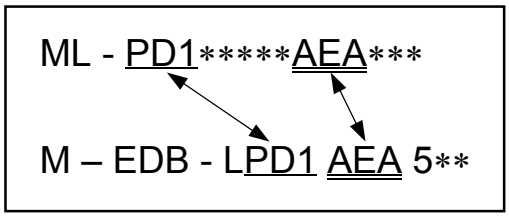
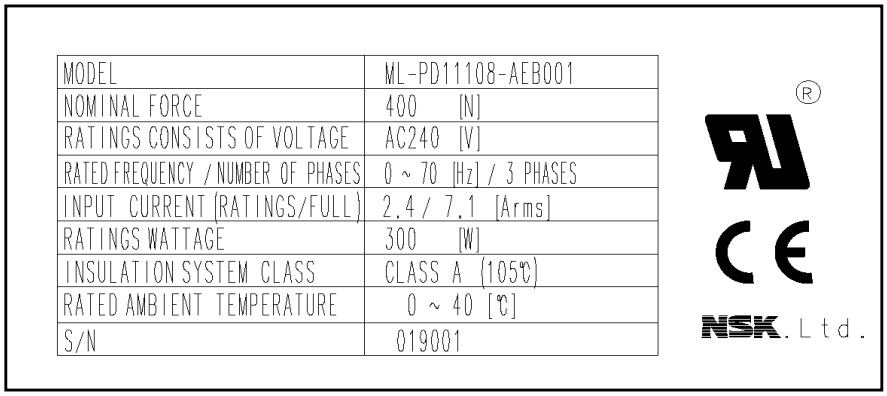
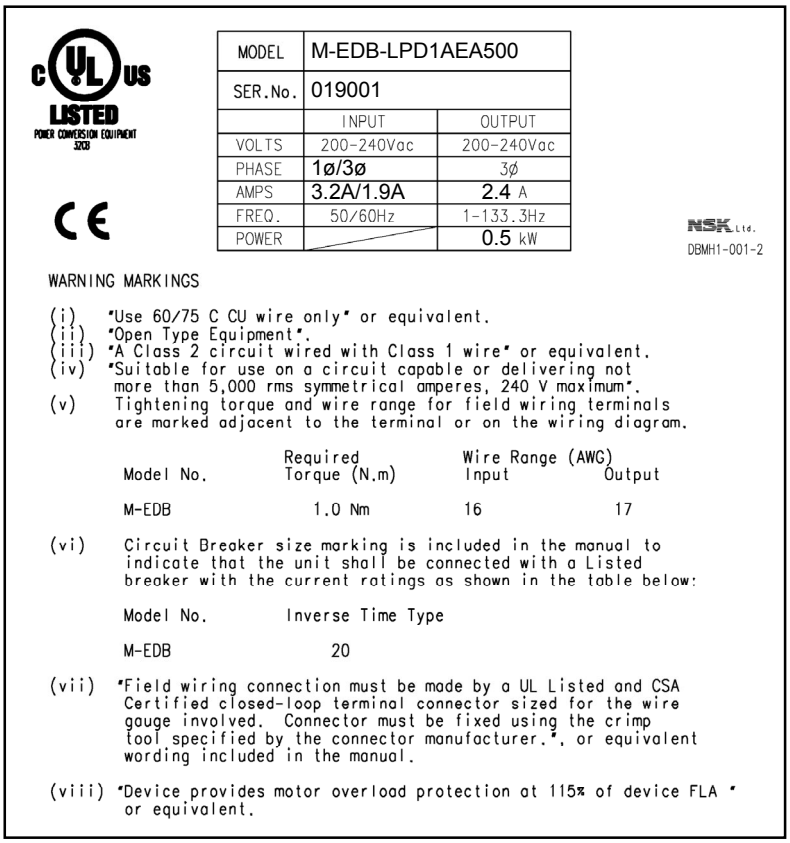


Figure 3-2 : Nomenclature plate affixed to the Motor



MODEL	ML-PD11108-AEB001
NOMINAL FORCE	400 [N]
RATINGS CONSISTS OF VOLTAGE	AC240 [V]
RATED FREQUENCY / NUMBER OF PHASES	0 ~ 70 [Hz] / 3 PHASES
INPUT CURRENT (RATINGS/FULL)	2.4 / 7.1 [Arms]
RATINGS WATTAGE	300 [W]
INSULATION SYSTEM CLASS	CLASS A (105℃)
RATED AMBIENT TEMPERATURE	0 ~ 40 [℃]
S/N	019001

Figure 3-3 : Nomenclature plate affixed to the Driver Unit



c UL us LISTED
POWER CONVERSION EQUIPMENT
3Z08

CE

MODEL	M-EDB-LPD1AEA500	
SER.No.	019001	
	INPUT	OUTPUT
VOLTS	200-240Vac	200-240Vac
PHASE	1ø/3ø	3ø
AMPS	3.2A/1.9A	2.4 A
FREQ.	50/60Hz	1-133.3Hz
POWER		0.5 kW

NSK Ltd.
DBMH1-001-2

WARNING MARKINGS

(i) "Use 60/75 C CU wire only" or equivalent.
(ii) "Open Type Equipment".
(iii) "A Class 2 circuit wired with Class 1 wire" or equivalent.
(iv) "Suitable for use on a circuit capable or delivering not more than 5,000 rms symmetrical amperes, 240 V maximum".
(v) Tightening torque and wire range for field wiring terminals are marked adjacent to the terminal or on the wiring diagram.

Model No.	Required Torque (N.m)	Wire Range (AWG) Input	Output
M-EDB	1.0 Nm	16	17

(vi) Circuit Breaker size marking is included in the manual to indicate that the unit shall be connected with a Listed breaker with the current ratings as shown in the table below:

Model No.	Inverse Time Type
M-EDB	20

(vii) "Field wiring connection must be made by a UL Listed and CSA Certified closed-loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.", or equivalent wording included in the manual.

(viii) "Device provides motor overload protection at 115% of device FLA" or equivalent.

3.2. Installation

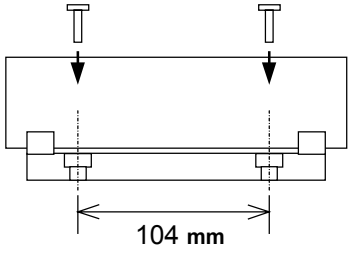
3.2.1. Environmental Condition

- The Megathrust Motor is supposed to be operated in indoor environment. Confirm that the environmental conditions conform to the following notes.
  - ◊ Ambient temperature: 0 ~ 40℃
  - ◊ Indoor condition, no corrosive gas
  - ◊ Clean environment with low dust and the product shall be protected from splashing water and oil, contaminating metal cutting chips.

3.2.2. Mounting Motor

- Mount the Motor referring to Table 3-1.

Table 3-1 : Way of Mounting

Motor type	PD1, PD2, PD3
Mounting direction	
Fixing bolt size	M8
Pitch of bolt holes	180 mm

- Provide enough space for the machine base for solid mounting of Motor base. (The mounting surface of the Motor base shall have full contact to the machine surface.)
- Insert the bolt to all mounting holes and fasten them securely.
- Flatness of the mounting surface of the machine shall be [0.05 mm / **1 m**] or less.
- If your Motor slider does not have the connector box, fix the connectors and the cables to the slider or the work to prevent them from disconnection or snap when they are forcedly pulled or bent.

3.2.3. Driver Unit Mounting

- The EDB Driver Unit may be mounted by the holes in brackets.

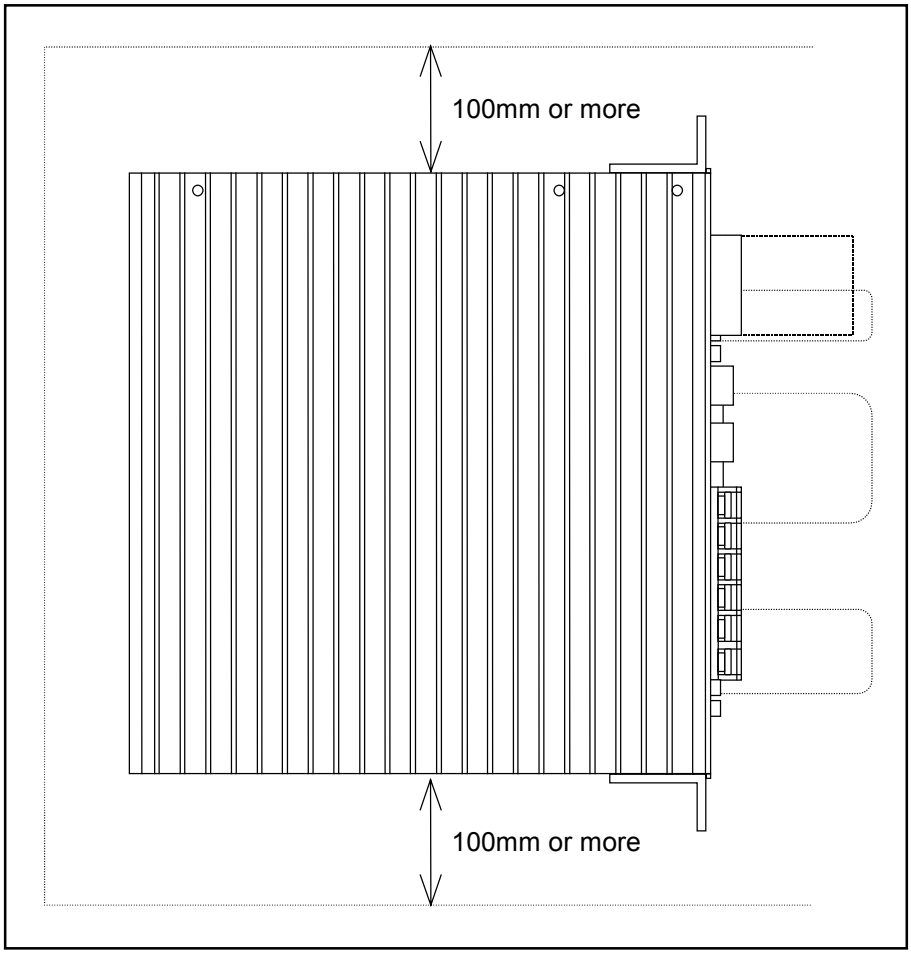
⚠ Caution : *For proper air circulation, clearance is required above and below of the Driver Unit. See Figure 3-7 below. There is no need to provide clearance to the back of the Driver Unit.*

- Use the Driver Unit in the environmental condition of Installation Category I and Pollution Degree 2. The covers of the Driver Unit do not work as an enclosure against flame or electric shock. Install the Driver Unit into an enclosure and keep the internal temperature of the enclosure within 0 to 50°C. If the heat sink overheat alarm arises frequently, provide an air-cooling measures such as a fan. (See "11. Alarm.")
  For some environmental condition it might be necessary to prepare the enclosure of which protection degree is IP 54 or better.

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

- EDB Driver Unit has brackets for easy fixing to the control box or enclosure.

Figure 3-4



3.3. Connecting Power

3.3.1. Motor Wiring

⚠ Caution : *Do not modify the MotorCcable longer or shorter. Please consult with NSK representative in your area when you require modification of the cable.*

⚠ Caution : *Do not place the main power AC line supplies and signal wires in close proximity. Do not tie wrap them and not put in the same duct.*

- When ordering the Motor Cable, you may specify the length up to 30m in the unit of 1m.

3.3.2. Power Wiring

- Refer to "2.10. TB : Terminal Block for Power supply.
- Use 2.0 mm^2 (AWG16) or larger wire with heatproof vinyl for the power line.
- Do not place the main power AC line and signal wire in close proximity. Do not tie wrap them and not to put in the same duct.
- Install an isolation transformer and a noise filter between the power supply and the Driver Unit to prevent external noise

Table 3-2: Recommended noise filter (Schaffner EMC Ltd.))

Power supply	Model	Rated voltage	Rated current
ø1 AC200V	FN2070-10	AC250V	AC10A
ø3 AC200V	FN258-16		AC16A

- Separate the primary and secondary wiring of the isolation transformer and the noise filter and wire them in a different routing.
- Place the noise filter and the Driver Unit closely as much as possible.
- Be sure to insert a surge killer circuit for coils of magnetic switch, relay and solenoid.
- An inrush current will occur when the main power is on as a capacitive load is connected to the main power supply circuit. For this reason, the magnetic switch or other contacts which are installed to the main power supply line shall have greater capacity than the following specification.
- Install a circuit breaker between the power supply and the Driver Unit.

Table 3-3

Contacts	For EDB Driver Unit
No-Fuse breaker	Rated current: 20A
Short circuit breaker	Rated current: 20A, Sensibility: 15mA
Magnetic switch	Rated current: 20A

Table 3-4: Inrush current

Item	Inrush current (TYP)
	AC200V
Control power	15A
Main power	20A

⚠ *Caution* : ・ *Use the R-S terminals when connecting single phase 200 VAC for the main power supply. The inrush current becomes higher and may cause breakage of the Driver Unit when R~T terminals are used.*

・ *During wiring, be careful not to loose screws of the terminal block.*

3.3.3. Connector Wiring

- Refer to "2.6. Interface Specification."

3.3.4. Prevention of Motor Overheat

- The Motor slider gets hot because of overheat of the Motor winding if the Motor is operated in a high duty cycles. Overheating of the Motor will break the control device, such as the scale head and UVW sensor and will loose the function of NSK K1 lubrication Unit. For the measure of overheating thermal sensor is installed to the Motor. Please provide the thermal protection circuit that turns off the main power using the output of the thermal sensor. In a case that a cover shall be attached to the Motor in a way that the heat will be build up inside, take measure to air-cool the Motor.

Specification of the thermal sensor

Plastic type thermal protector
T100AR1U1N Matsushita Electric Co. Ltd.

Table 3-5

Electrical specification	Max. rated load	Inductive load	AC250V/5A AC125V/8A
		Resistance load (50%)	AC250V/3.5A AC125V/5A
	Min. rated load		6V-150mA

3.3.5. Ground

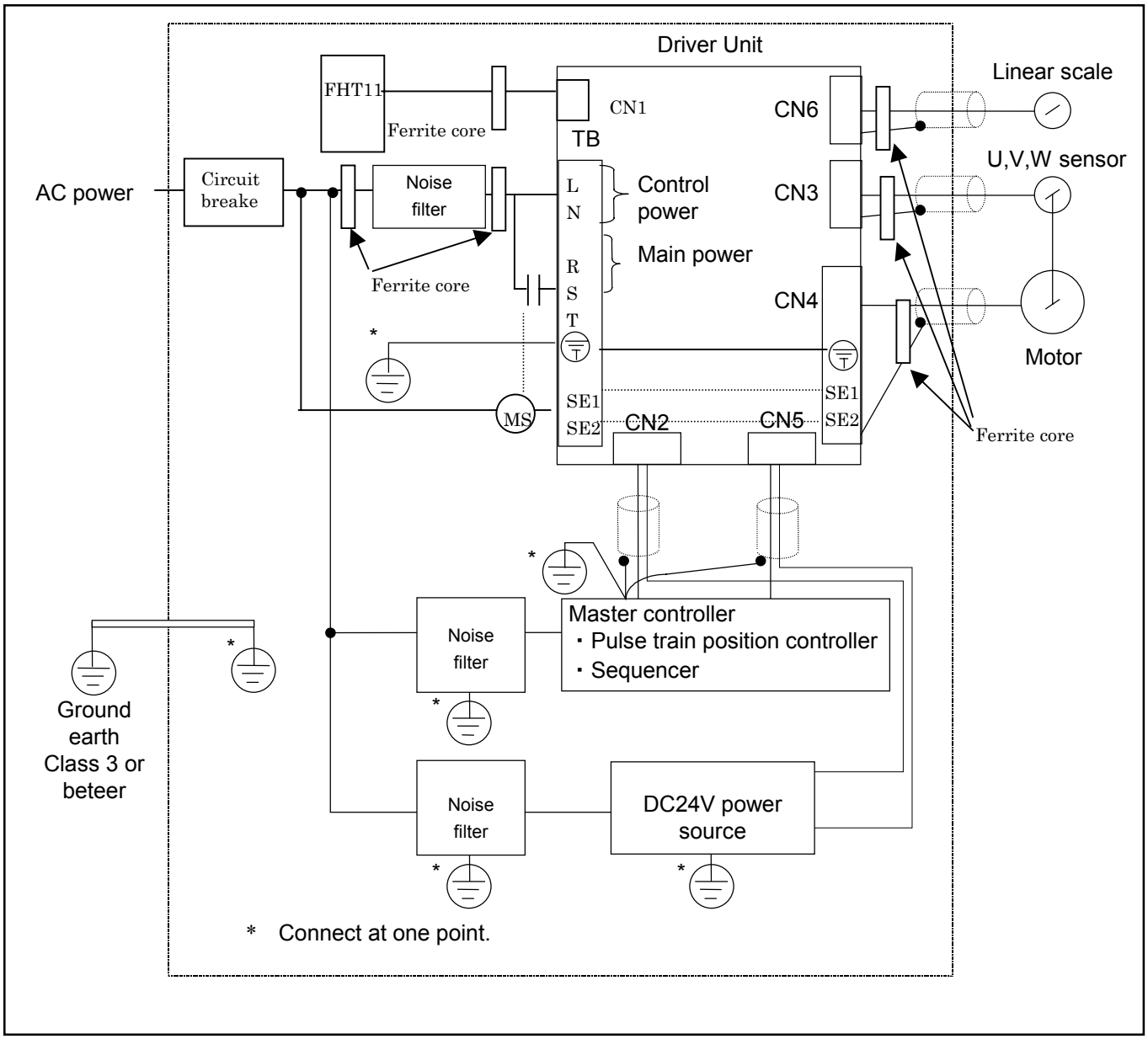
⚠ Caution : *Connect the shield of the signal shielded cables (CN2) to the FG terminal (or SG terminal) of the master controller. If the problems because of external noise occurs, connect it to the FG of TB of the Driver Unit.*

- Use heavy gage cable as possible for grounding the Driver Unit such as a flat braided copper cable or a wire 3.5 mm^2 (AWG 10) or larger.

⚠ Caution : *If the Motor is isolated from the machine base, ground the Motor.*

⚠ Warning : *All the ground lines must be connected at one point and the grounding resistance shall under or equal to 100 □□. (Class 3 or better)*

Figure 3-5



3.4. Power on and Servo on

3.4.1. Checking before Turning on Power

⚠ Caution : *Wiring mistake and misconnection of connectors may lead to damage to the Driver Unit.*

(1) Check wiring of the connecting cables.

(2) Connection of the Handy Terminal

(3) Other precautions for safety.

⚠ Danger : *The operator must stay out of operation range of the Motor.*

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

⚠ Warning : *The load to Motor (work or fixture) is firmly fixed to the Motor slider.*

3.4.2. Turning Power on

1 Turn on the power. Make sure that the LED of the Driver Unit indicates that the system is ready for operation.

Figure 3-6: In case of alarm

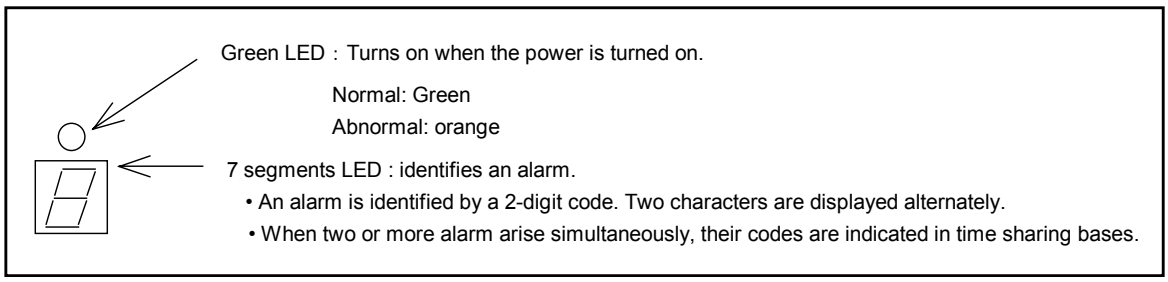
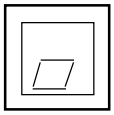
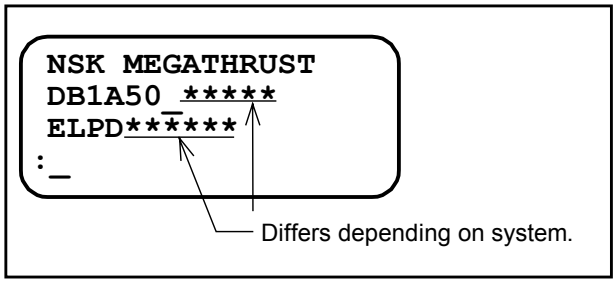


Figure 3-7 : In case of normal



2 In normal conditions, the terminal of Handy Terminal indicates the message "**NSK MEGA…"** and a colon ":" appear.

Figure 3-8 : Indication of Handy Terminal



3 Refer to " 11. Alarm" when an alarm arises.

3.4.3. Power on and Servo on

(1) Turn on the power.

(2) 2 seconds later, the system checks DRDY output.

◊ If the DRDY output does not ON normally, take appropriate remedy referring to "11. Alarm."

(3) When it is normal, turn the SVON input ON. The Driver Unit starts preparation for Servo on.

(4) SVST output closes when the Servo is on.

(5) Input the instruction when the Servo on.

Figure 3-9

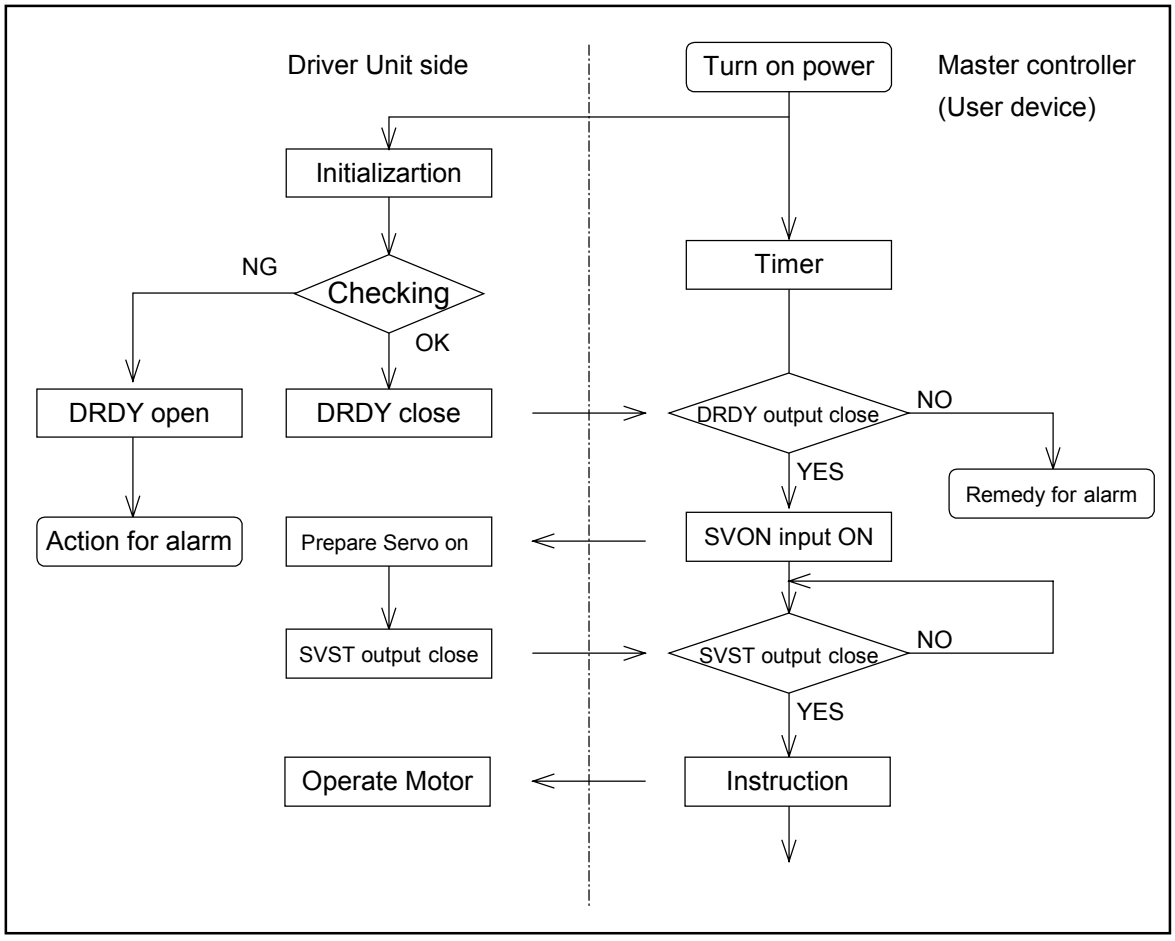
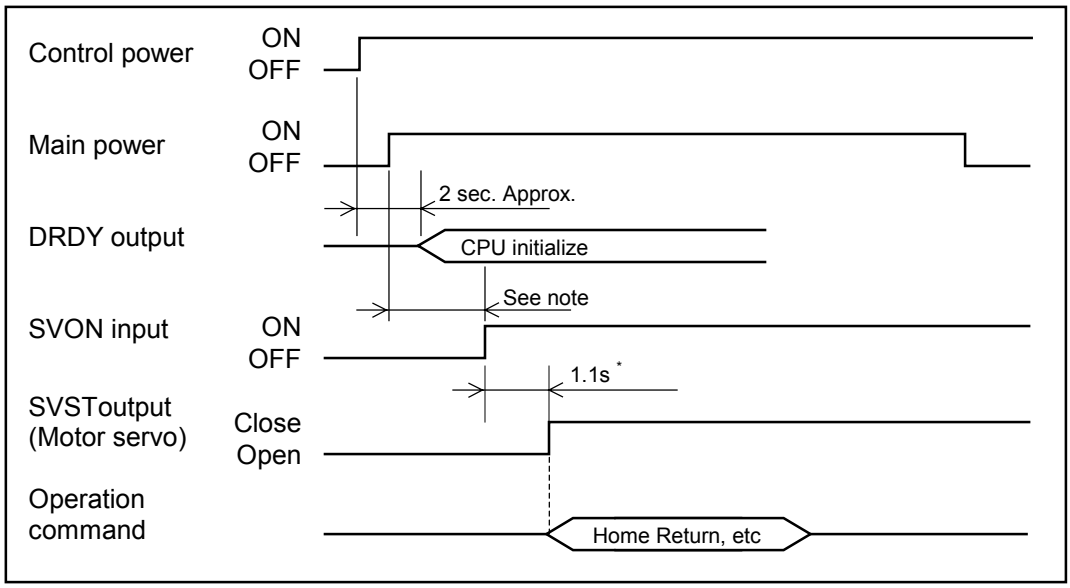


Figure 3-10



* It takes 1.1 seconds to make the Servo on after inputting SVON. Input operation command after 1.1 the Servo is on.

⚠ *Caution* *: Make the SVON active after the main power is turned on. When turning off the main power be sure to turn SVON off first. Otherwise alarm for "main power low voltage" will arise.*

4. Handling of Handy Terminal

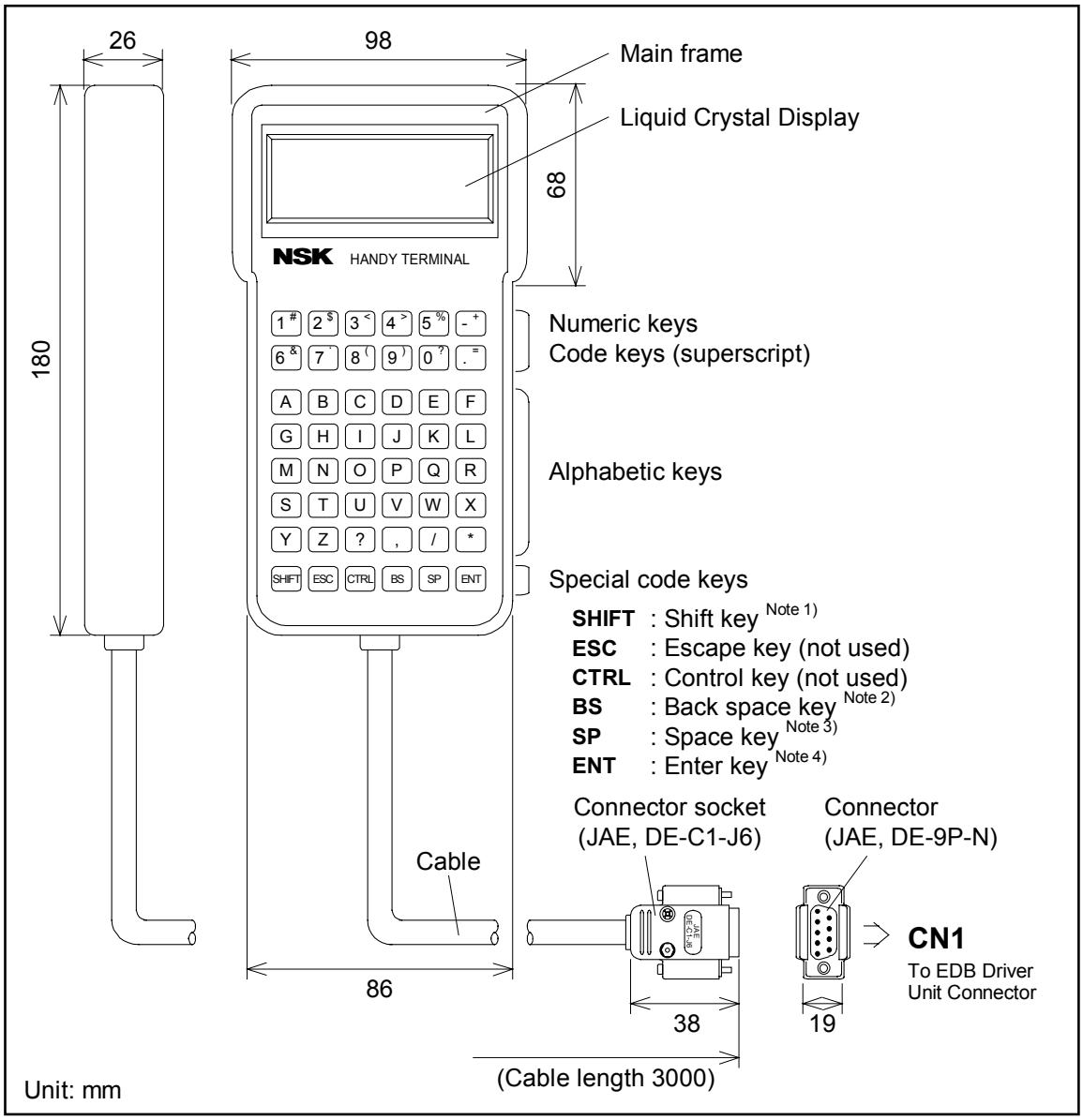
- Function of the Handy Terminal

  ◊ Simply connect the Handy Terminal to CN1 connector of the Driver Unit. Parameter setting, programming to internal channel and monitoring setting are easily enabled via the RS-232C communication. (No need to conduct any setting, such as the baud rate, etc.)

- Appearance and function of the Handy Terminal

⚠ *Caution* *: Turn off the power of Driver Unit when connecting or disconnecting the CN1 communication cable. Otherwise it may lead to abnormality of the RS-232C communication and/or failure of the system.*

Figure 4-1



Note: (1) SHIFT: Press the code key while holding [SHIFT] key. (for superscript)

(2) BS: When correcting logged-in mistakes, press [BS] key.

(3) SP: Press [SP] key to insert a space between characters.

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

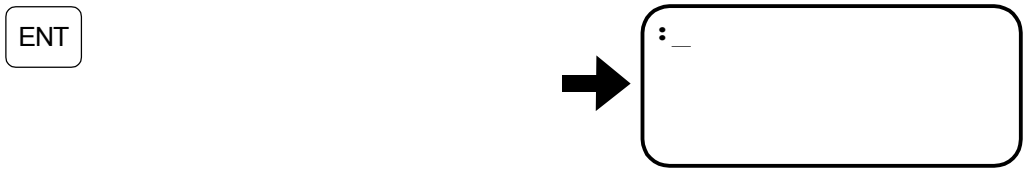
4.1. Setting Parameter

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

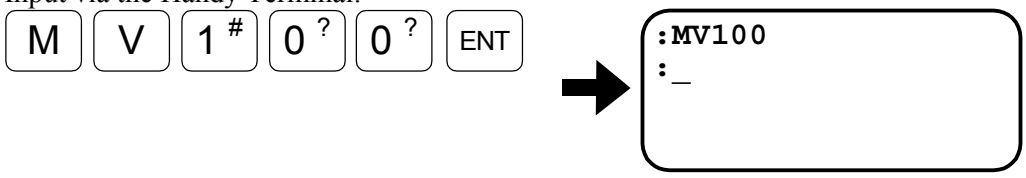
4.1.1. Parameter That Does Not Require Password Entry

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

(2) Confirm that the display screen of Handy Terminal indicated a colon (:).
(Press [ENT] key once if the (:) does not appear.



(3) For an exercise, let's set the parameter MV of velocity setting to 100 mm / s.
Input via the Handy Terminal:



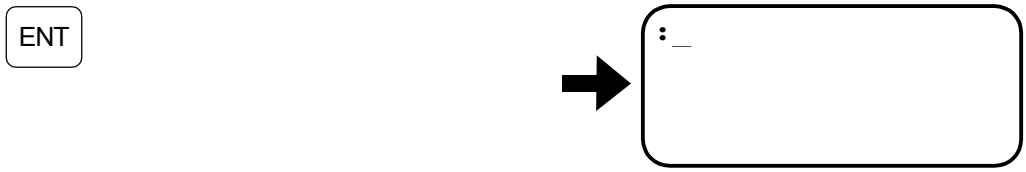
The (:) colon appears on the screen to indicate completion of the setting.

- As shown in the above example, input [Parameter code + data + [ENT]] for the setting.(A space is not necessary between the parameter code and the data.)

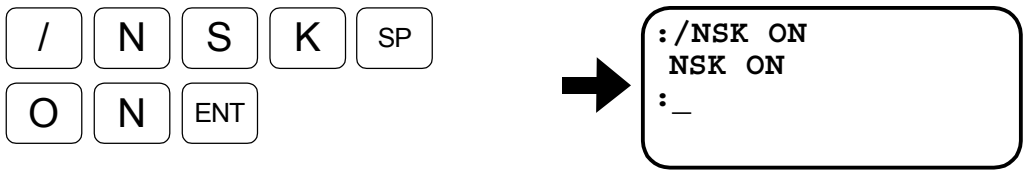
4.1.2. Parameter That Requires Password Entry

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

(2) Confirm that the screen of the Handy Terminal shows the colon (:).
(Press [ENT] key once if the colon is not shown on the screen.)



(3) In put the password.



The screen displays the colon (:) as the acknowledgment of acceptance of the password.

(3) Set the parameter same as the procedure (3) as described in "4.1.1. Parameter That Does Not Require Password Entry." However the password is effective only once for a setting right after the entry.

⚠ *Caution* *: Make sure that the colon is on the screen after the parameter setting when turning off the power of the Driver Unit. Otherwise "Memory error alarm" may arise when turning on the power next time.*

4.2. Readout of Parameter

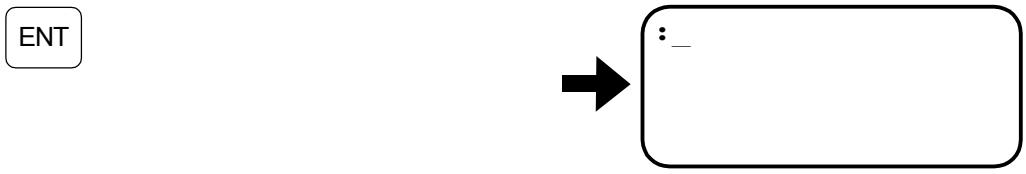
- This section describes the procedure to read out setting s of the parameters.

4.2.1. Readout by TS Command

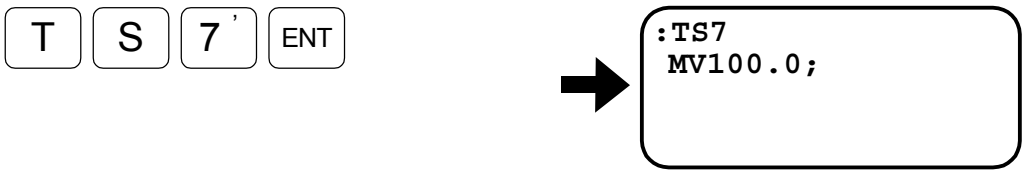
- Refer to "9. Command and Parameter" for the details of the command TS.

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

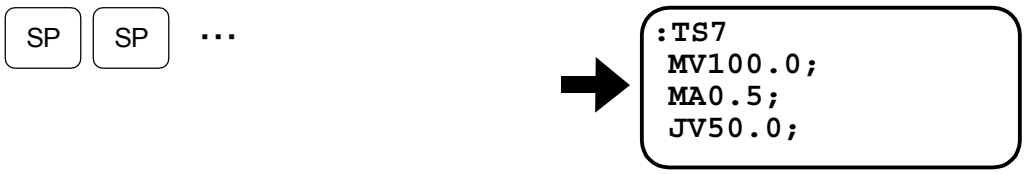
(2) Confirm that the colon (:) is on the screen.
(Press [ENT] key once if the coon (:) is not on the screen.



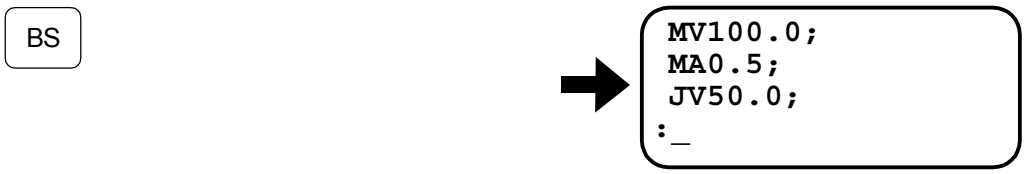
(3) Let's read out setting of parameter JV for Jog velocity an example.
The parameter JV belongs to TS7 as described in the description of TS command of "9. Command and Parameter." Input as shown below with the Handy Terminal.
Firstly setting of parameter MV to set slider velocity on the screen.



(3) Pressing the [SP] key on the Handy Terminal will indicate the parameter setting that belongs to TS7 group. Press the [SP] several times to scroll to JV setting.



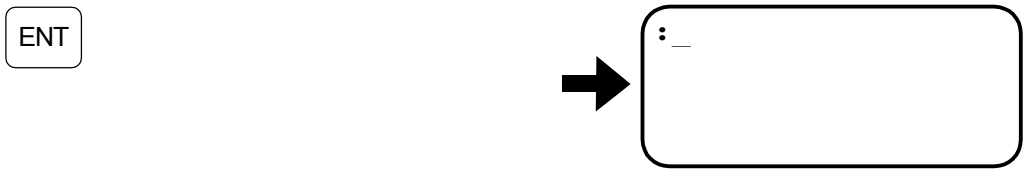
(5) To quit the readout, keep pressing the [SP] key to the end or press the [BS] key. The colon (:) appears indicating readout completion.



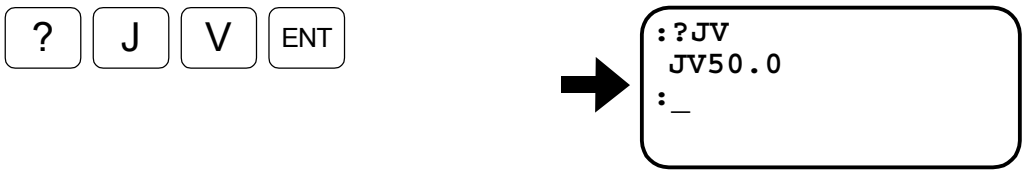
4.2.2. Readout by "?" Command

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

(2) Confirm that the colon (:) is on the screen of the Handy Terminal.
(Press the [ENT] key once when the colon is not on the screen.)



(3) As an example, let's read out a parameter JV for setting Jog motion velocity.
Firstly write " ? " before a parameter to be read out. For this example input as shown below for this example.



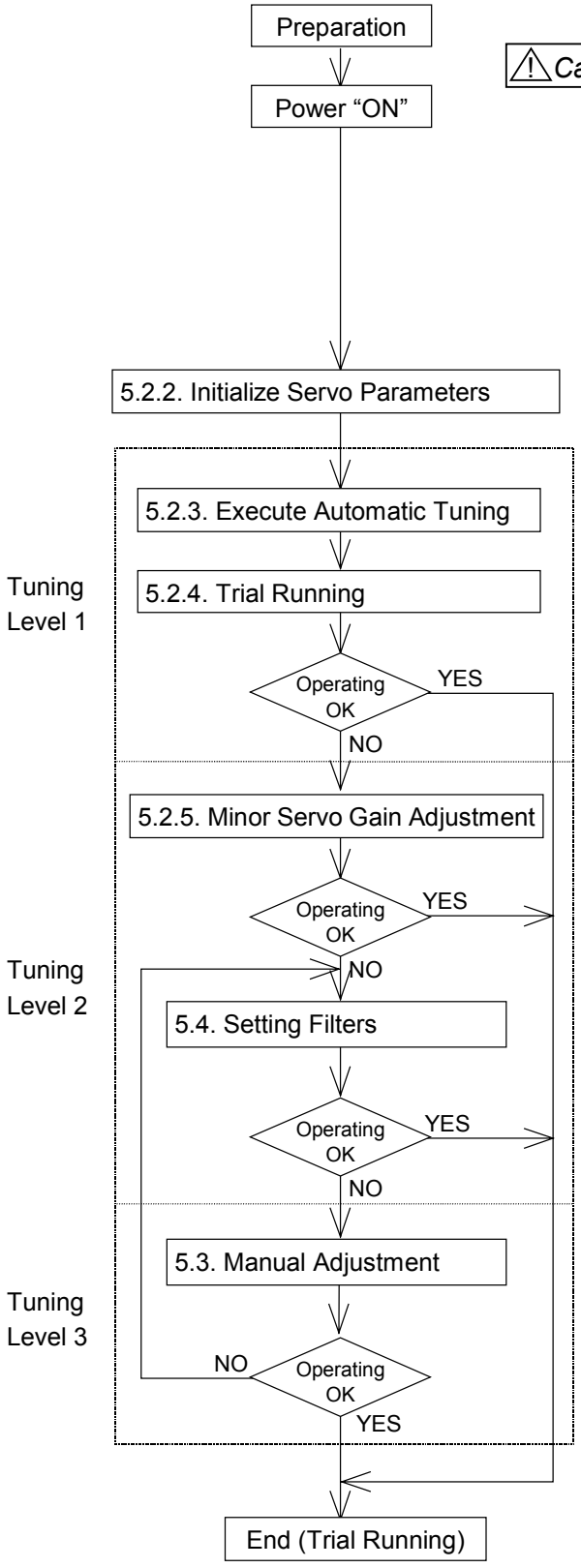
The screen indicates the current setting of JV parameter and the colon (:) appears.

⚠ *Caution* *: Two ways are available to read out parameter setting, one is TS command and the other is attaching "?." We recommend to use TS command as much as possible to prevent incorrect input.*

5. Tuning and Trial Adjustment

5.1. Tuning Sequence

Figure 5-1: Tuning Sequence



● Install the Motor and wire the Driver Unit.

⚠ *Caution* : • *Make sure that the LED of the Driver Unit is indicating* ▱ *(normal).*

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

```
NSK MEGATHURUST
DB1A50_***
ELPD**¯****
:_
```

● Initialize servo parameters.

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

● Trial running
◊ Confirm the parameter set values obtained from automatic tuning. You may refer to the setting for Level 2 and Level 3 adjustment.

Tuning Level 1	• Basic function of Automatic tuning. • The adjustment is completed if trial running is satisfactory.
Tuning Level 2	• Execute additional adjustment to the Level 1 when trial running is not satisfactory.
Tuning Level 3	• Execute final adjustment manually when Level 1 and 2 are not successful.

5.2. Automatic Tuning (Tuning Level 1)

⚠ Caution : *Automatic tuning cannot be performed if the following conditions are not met.*

- ◊ *The load inertia must be under the limit of the Motor.*
- ◊ *The Motor axis must be horizontal. (The load conditions to the slider must not be affected by external force such as the gravity.)*
- ◊ *Mechanical rigidity of the Motor mounting base and attached load is sufficient enough.*
- ◊ *There must be no backlash or play.*
- ◊ *Frictional load to the Motor shall be minimal.*

◆ Preparation

● Following preparations are required to execute the automatic tuning.

- ◊ Fix the Motor base to the mounting surface of the machine.
- ◊ Attach the load to the slider of Motor.
- ◊ Installation of the Driver Unit.
- ◊ Wiring AC power line.
- ◊ Wiring the SVON (Servo on) and the EMST (Emergency stop). (CN2 connector)
- ◊ Connection of the Driver Unit and the Motor. (Use the optional cable set from NSK.)
- ◊ Connection of the Handy Terminal to the Driver Unit.

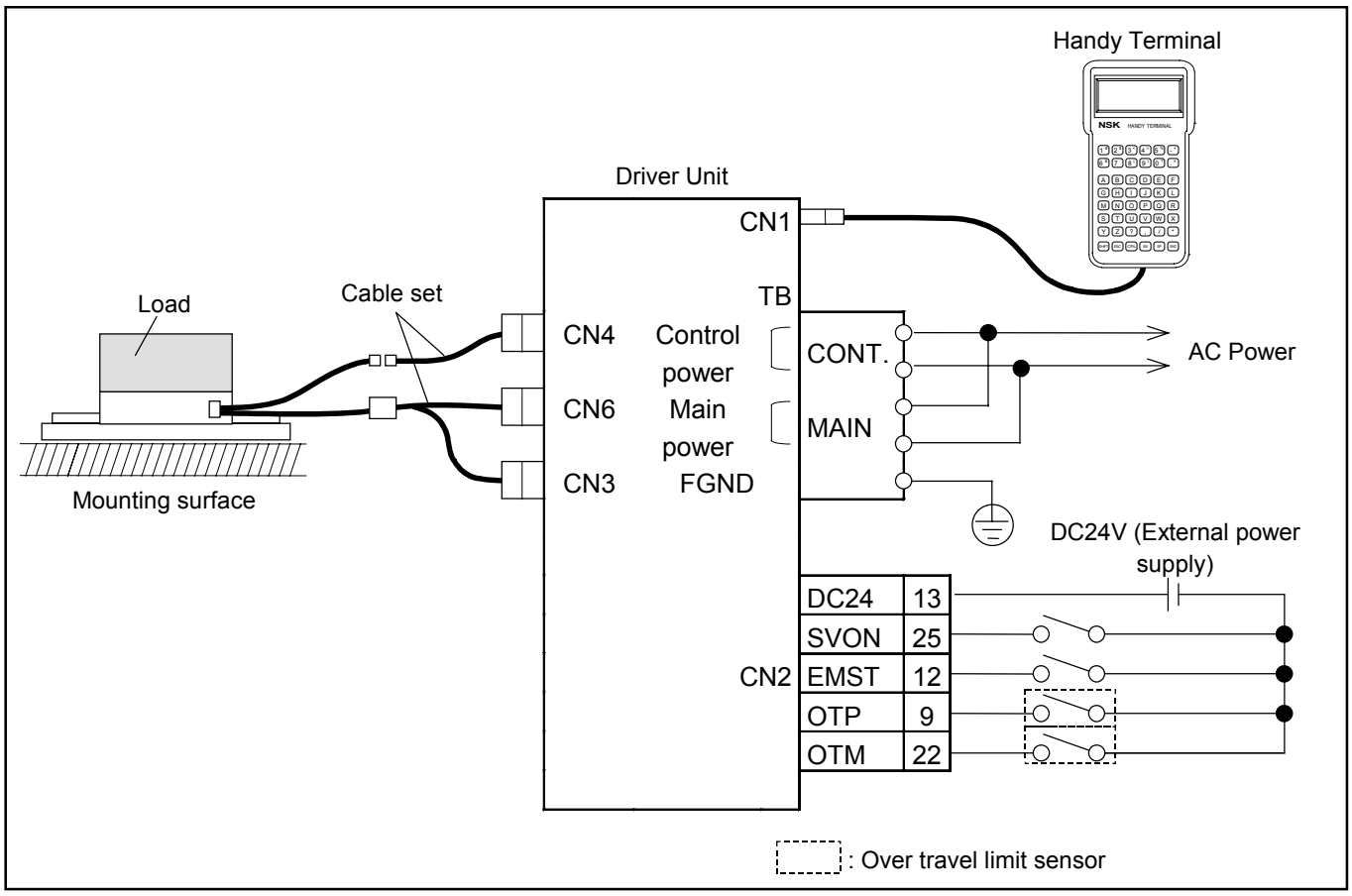
5.2.1. Precaution

⚠ Danger : *(1) Before execute automatic tuning, be sure to wire "EMST" (Emergency Stop, CN2) signal and over travel limit (OTP and OTM), if off-limit are of the Motor slider is set, to stop the Motor immediately when an accident is foreseen.*

(2) The Motor rotates ±20 mm when executing automatic tuning. Always stay in safe position.

⚠ Caution : *If mechanical rigidity of the load (work) is not sufficient enough, the Motor may vibrate. Turn "SVON" signal off or turn off the power when the Motor starts to vibrate. To rectify the problem, execute manual adjustment or try automatic tuning again after increasing the rigidity of the load.*

Figure 5-2 : Example of preparation of automatic tuning



5.2.2. Initialize Servo Parameters

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

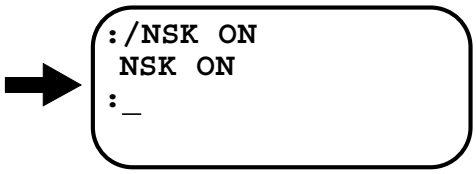
2) Enter

[T] [S] [1 #] [ENT] and [T] [S] [2 $] [ENT]

to check the parameter settings. Note down all values.

3) Log in the password.

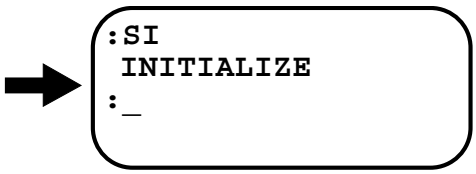
[/] [N] [S] [K] [SP]
[O] [N] [ENT]



The display indicates the confirmation.

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

[S] [I] [ENT]



"INITIALIZE" is displayed as the confirmation and the initializing parameter begins. It takes few seconds and then, after completion, the colon ":" is displayed for next command.

⚠ *Caution* : *When "SVON" signal (CN2) is "ON" and "SI" command is input, the Driver Unit rejects to execute the command. "SI INHIBITED" message will appear on the display.*

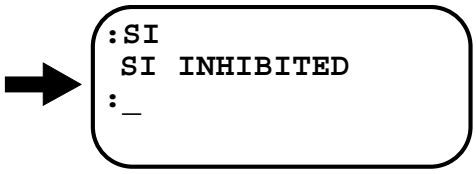


Table 5-1 : Servo parameter list

Readout by TS1			Readout by TS2		
Parameter	Initial setting	Set value	Parameter	Initial setting	Set value
PG	0.100		FO*	0	
VG	1.0		FP	0	
VGL*	1.0		FS	0	
VI	1.00		NP	0	
VIL*	1.00		NS	0	
VM	1		DBP*	0.0	
LG*	50		DBA*	0	
TL*	100		ILV*	100.0	
GP*	0		FF*	0.0000	
GT*	5		FC*	0	

* These parameters are not necessary to adjust in Level 1 and Level 2.

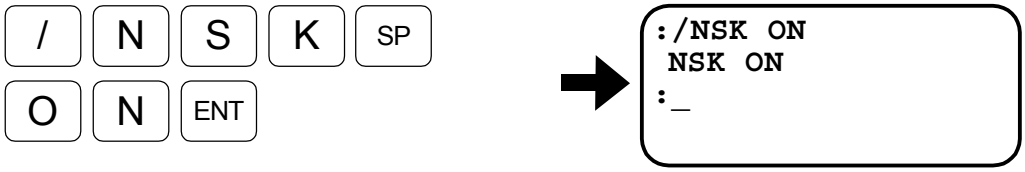
5.2.3. Automatic Tuning (Tuning level 1)

- Procedure of automatic tuning differs with the situation if you know the load inertia or not.

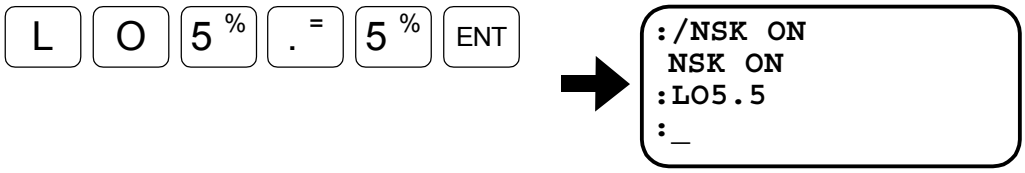
5.2.3.1. Procedure for Known Load Inertia

- Set the load inertia to a parameter LO. Unit of the parameter LO is [kg] in a step of 0.1 kg.
- Following is an example to set the load inertia to 5.5 [kg].

(1) Input the password. The screen indicates the acknowledgment.



(2) Set the load inertia.



Input a different parameter value from the initial setting to execute the automatic tuning. The automatic tuning won't function if the setting of LO does not change from the initial setting.

5.2.3.2. Procedure for Unknown Load Inertia

⚠ Danger : *Provide ±20 [mm] or more slider stroke for automatic tuning. The over travel limit (OTP and OTM) switches must be used if restriction (off limit area) of slider stroke exists.*

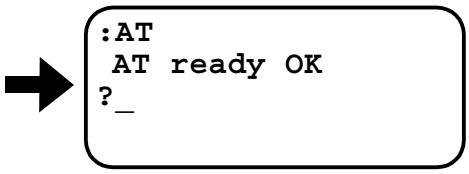
1) Turn on a CN2 signal of servo-on (SVON) to make the Motor servo on.

S V ENT

2) Confirm that the LED on the front panel of Driver Unit indicates  (normal).

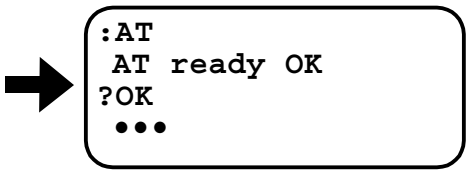
3) Input command to execute the automatic tuning.
If the screen does not display as shown below, check procedures (1) and (2) again.

A T ENT

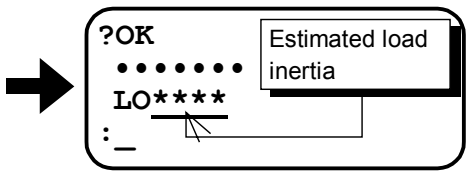


4) Input "OK" if every thing is normal.
Estimation of load inertia starts as the slider moves 10 ~ 20 mm.
The screen shows "•" for every step while estimating the load inertia.

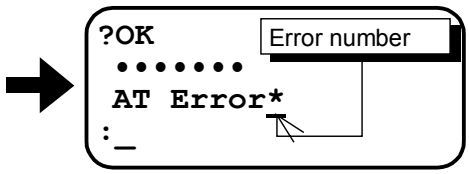
O K ENT



5) The message including estimated load inertia (LO) appears on the screen when the estimation of load inertia completes successful.
(Indication of "•" and LO value depends on condition of load inertia.)



⚠ Caution : *When error message as shown below appears in the middle of automatic tuning, refer to "11. Alarm" and take appropriate action.*
LED on the front panel of the Driver Unit indicates F8 for automatic tuning.



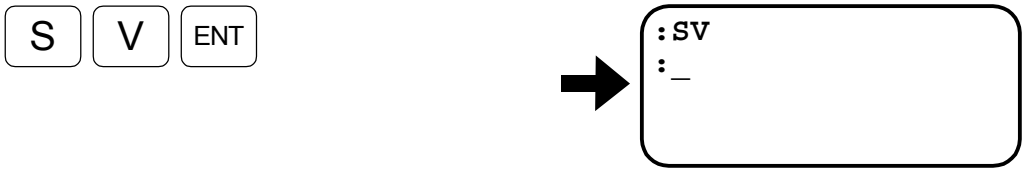
5.2.4. Trial Running (Tuning Level 1)

⚠ *Danger* : *Do not enter operating area of the Motor.*

- Use the demonstration program of EDB Driver Unit for trial running.

1) Move the slider to the middle of its stroke.

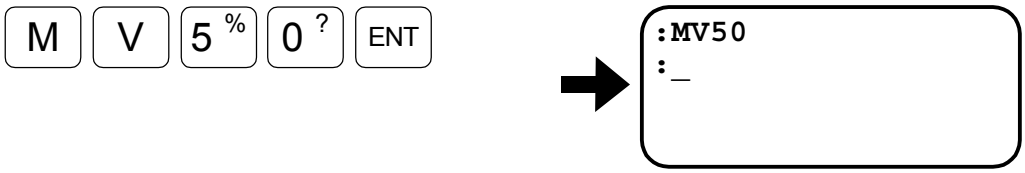
2) Turn (SVON) signal of CN2 connector to make the Motor servo on.



3) Confirm that the LED on the front panel of Driver Unit indicates ▱ (normal).

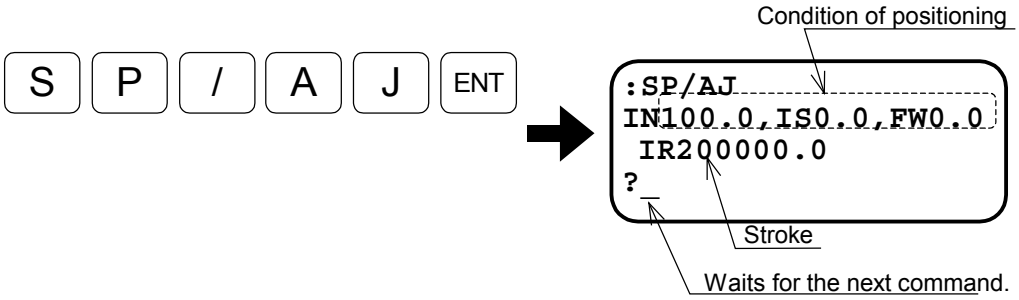
4) Make sure that Emergency stop (EMST) of CN2 connector and over travel limits (OTP and OTM) are not on.

5) Velocity of the Motor (MV) has been initialized to 500mm s^{-1} after automatic tuning. Decrease velocity to 50 mm s^{-1} for trial running.



Change the velocity (MV) appropriate value to actual use condition when the trial running completes successfully.

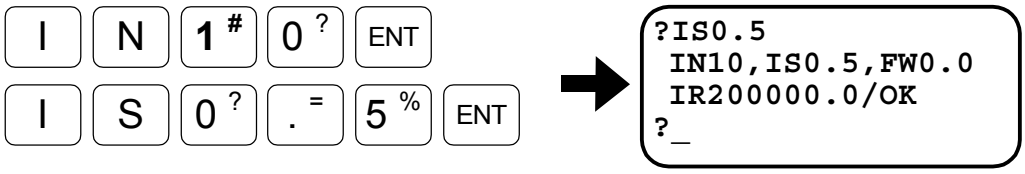
6) Display the demonstration program on the screen.



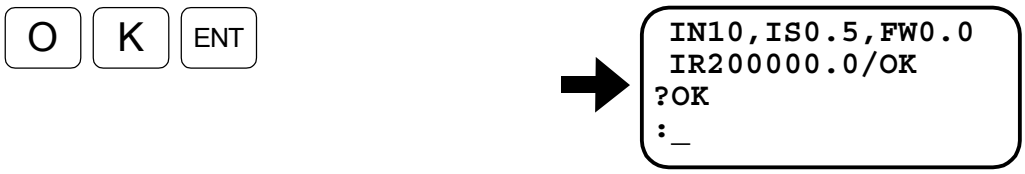
The condition indicates positioning and running stroke of trial running.
Instructed parameters are;

IN : In-position
IS : In-position stability timer
FW: FIN width
IR : Stroke

7) To make the adjustment simple, set IN-position to "10" μm and IS timer to "50 ms." Check if the screen is indicating as follows.



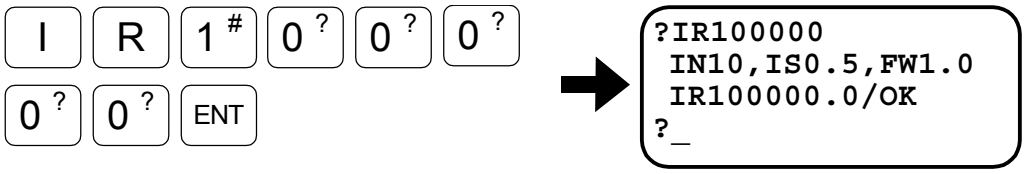
8) Indicated stroke (IR200000.0) denotes 200 mm. If it is acceptable input "OK."



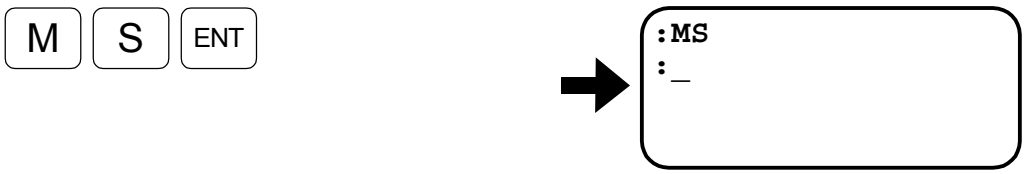
The slider starts reciprocating motion as soon as "OK" is inputted.
(It moves to plus direction first.)

[Reference] When the stroke has to be changed, set IR command instead of inputting "OK" when the prompt is "?."

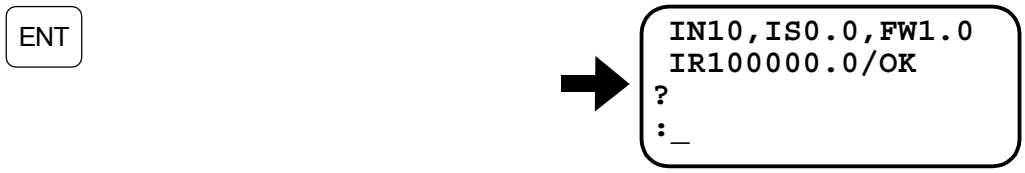
Example: When the stroke is to be 100 mm, input



9) Input MS command to stop the slider when checking of adjustment completes.



[Reference] To quit the operation of demonstration program without reciprocating motion, press ENT key after "?" without entering any command.



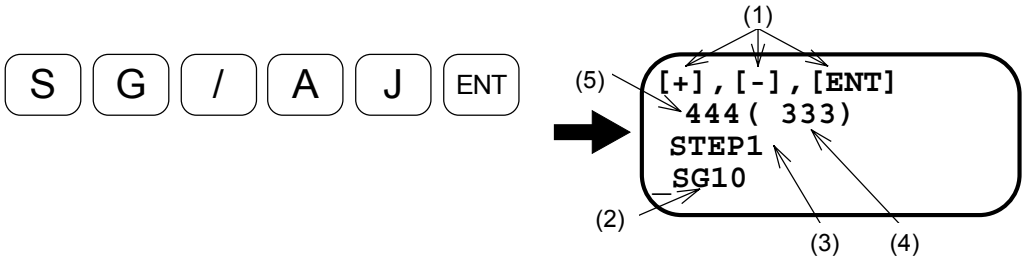
- This completes the trial running if the motion of the Motor is satisfactory.
- Try further adjustment in "5.2.5. Servo Gain Adjustment (Tuning Level 2)" or "5.3. Manual Tuning" if the trial running is not successful.

5.2.5. Minor Servo Gain Adjustment (Tuning level 2)

⚠ Danger : *Do not enter operating area of the Motor.*

- This section describes minor servo-gain adjustment as the next step when the Motor operation is not satisfactory with the automatic tuning.
- Servo-gain can be adjusted by the parameter "SG".
  - ◊ Setting higher "SG" value improves response to the programmed motion profile. However, if "SG" is too high, the Motor tends to vibrate.
- The same demonstration program (SP/AJ) on "Chapter 5.2.4" is used as the example for adjusting "SG" value. (Follow the same procedures (1) ~ (7) in chapter 8.2.4 and keep operating the Motor.)

1) Start "SG" adjusting program.



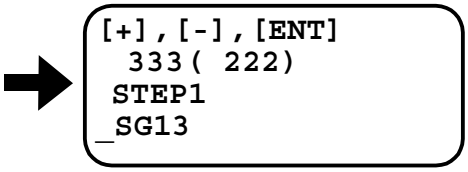
The message is displayed as shown below. Press plus (+) or minus (-) key to change "SG" value. (The display shown above is an example. Those values differ depending on actual load inertia and stroke.)

- Explanation of message
  - (1) Key function
    - SHIFT and - + : Pressing key one time increases 1 resolution of "SG."
    - - + : Pressing key one time decreases 1 resolution of "SG."
    - ENT : Pressing key one time stores "SG" value to the memory.
  - (2) Indicates present "SG" value.
  - (3) Indicates "SG" value changed by pressing plus (+) or minus (-) key.
  - (4) Response index number: The lower numbers denotes better response.
  - (5) Positioning index number: The lower number denotes quicker response.

⚠ Danger : *Do not use space key or backspace key. When it is used, the "SG" changing resolution set by above procedure ((2)) is altered.*

2) Observing the Motor operation, press the plus (+) key several times.

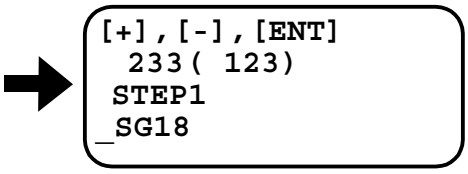
Pressing SHIFT , - + - + •••



As the response index decreases, confirm that the movement of the Motor is getting crispier..

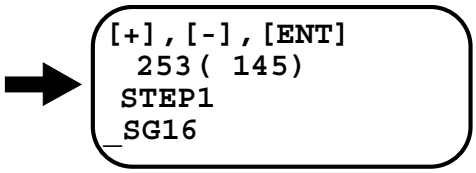
3) Keep pressing the plus (+) key. Eventually the slider starts hunting and stops reciprocating motion.

Pressing [SHIFT] , [- +] [- +] •••

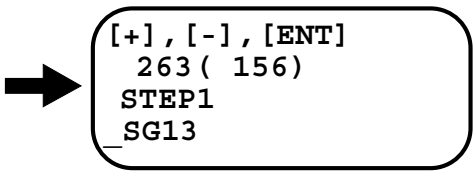


4) Keep pressing the minus (-) key until the slider stops hunting and starts the reciprocating motion.

[- +] [- +] •••

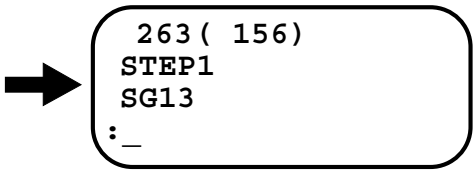


5) Set “SG” value to 80% of displayed “SG” when the slider stopped hunting. The slider will operate smoothly in any position.



6) Type the enter key to complete the adjustment.

[ENT]



5.3. Manual Tuning

⚠ Caution : *Do not enter operating area of the Motor.*

- Manual tuning is necessary when the automatic tuning has not been successful.

5.3.1. Precautions

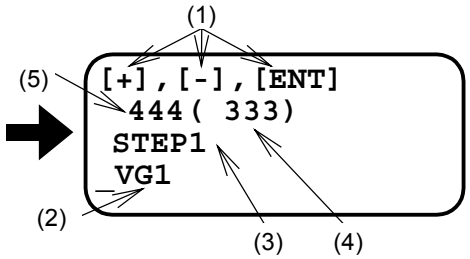
(1) Initialize the servo parameter referring to procedures in "5.2.2. Initialize Servo Parameters."

(2) Execute the demonstration program referring to "5.2.4. Trial Running (Adjustment Level 1)." At the beginning, motion of the slider is unstable due to insufficient adjustment.

5.3.2. Adjustment of Velocity Gain (VG)

(1) Start "VG" adjusting program. Messages will appear on the screen as shown below. Press plus (+) or (-) key to change "VG" value. (This screen shown below is an example. Those values differ depending on actual load inertia and stroke.)

V G / A J ENT



The display shows the message as shown on the left.

- Explanation of the messages

(1) Key function

SHIFT and - + : Pressing key one time increases 1 resolution of "VG".

- + : Pressing key one time decreases 1 resolution of "VG"

ENT : Stores "VG" value in the memory and completes the adjustment.

(2) Indicates present "VG" value.

(3) Indicates "VG" value changed by pressing plus (+) or minus (-) key.

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

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

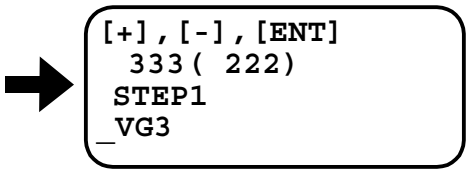
⚠ Caution : *Changing "VG" step ((3)).*
If you want to change the resolution of step, press space key or backspace key.

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

Backspace key : Changes the step to 10 times of present resolution.
(Pressing twice makes 100 times.)

2) Observing the slider operation, press the plus (+) key several times.

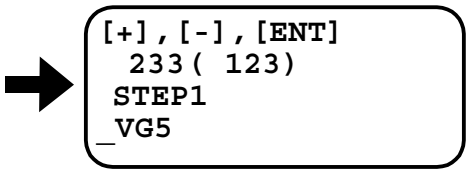
Pressing SHIFT , - + - + •••



As the response index decreases, the movement of the slider is getting crispier.

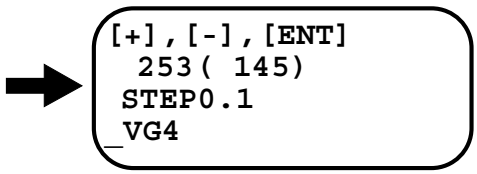
3) Keep pressing the plus (+) key. Eventually the slider starts hunting and stops reciprocating motion.

Pressing SHIFT , - + - + •••



4) Keep pressing the minus (-) key until the slider stops hunting and starts reciprocating motion again.

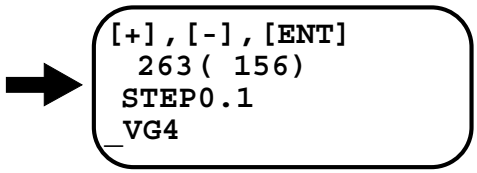
- + - + •••



5) Set the "VG" value to 80% of displayed "VG" when the hunting stopped.
$4 \times 0.8 = 3.2$

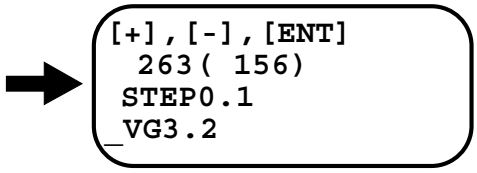
6) Press the space key to change the resolution of "VG" setting value from 1.0 to 0.1.

SP



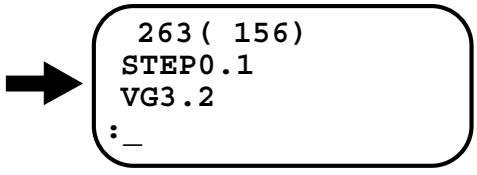
7) Press the minus key till "VG" value reaches to 3.2.

- + - + •••



8) Press the enter key to store the "VG" value.

ENT

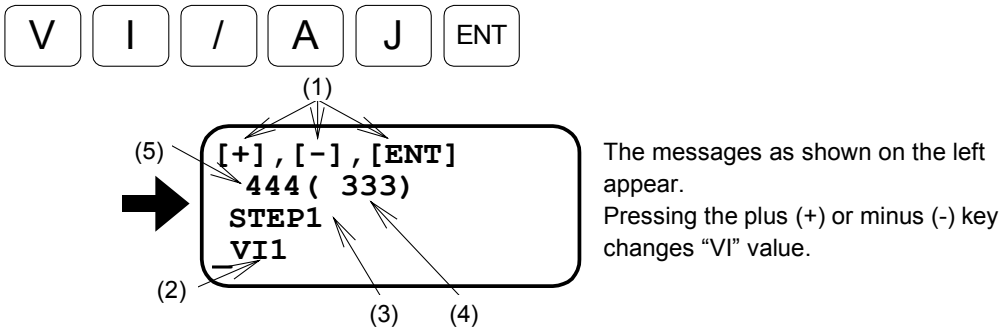


A colon (:) will appear to confirm the input.

5.3.3. Adjustment of Velocity Integrator Frequency (VI)

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

1) Start "VI" adjusting program. Messages will appear on the screen as shown below. Press plus (+) or (-) key to change "VI" value. (This screen shown below is an example. Those values differ depending on actual load inertia and the stroke.)



- Explanation of the messages

(1) Key function

SHIFT and - + : Pressing key one time increases 1 resolution of "VI."

- + : Pressing key one time decreases 1 resolution of "VI."

ENT : Stores "VI" value in the memory and completes the adjustment.

(2) Indicates present "VI" value.

(3) Indicates "VI" value changed by pressing plus (+) or minus (-) key.

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

(5) Positioning index number: The rower number denotes quicker positioning.

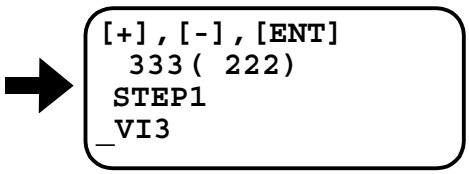
⚠ *Caution* *: Changing "VI" step ((3)).*
If you want to change the resolution of step, press space key or backspace key.

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

Backspace key : Changes the step to 10 times of present resolution. (Pressing twice makes 100 times.)

2) Observing the Motor operation, press the plus (+) key several times.

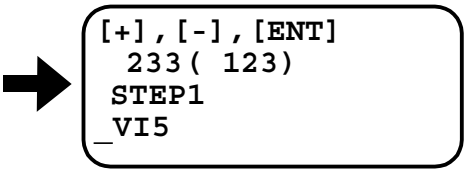
Pressing SHIFT , - + - + •••



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

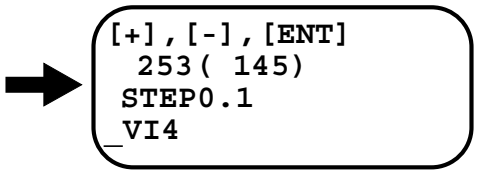
3) Keep pressing the plus (+) key, till the slider starts hunting and stops reciprocating motion.

Pressing [SHIFT] , [- +] [- +] •••



4) Keep pressing the minus (-) key until the slider stops hunting and starts reciprocating motion again.

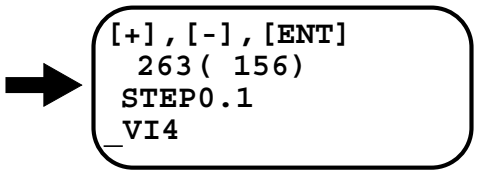
[- +] [- +] •••



5) Set the "VI" value to 80% of displayed "VI" when the hunting stopped.
$4 \times 0.8 = 3.2$
Input the space key to change the resolution of "VI" setting value from 1.0 to 0.1.

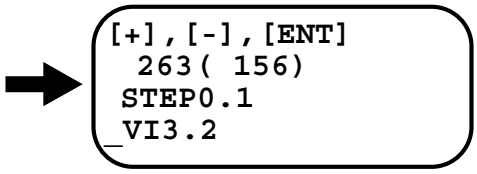
6) Press the minus key till "VI" value reaches to 3.2.

[SP]



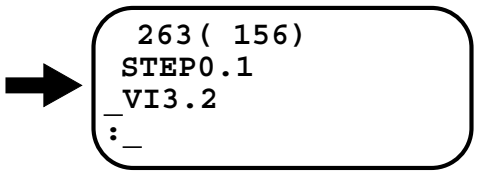
7) Input the enter key to store the "VI" value.

[- +] [- +] •••



8) A colon (:) will appear to confirm the input.

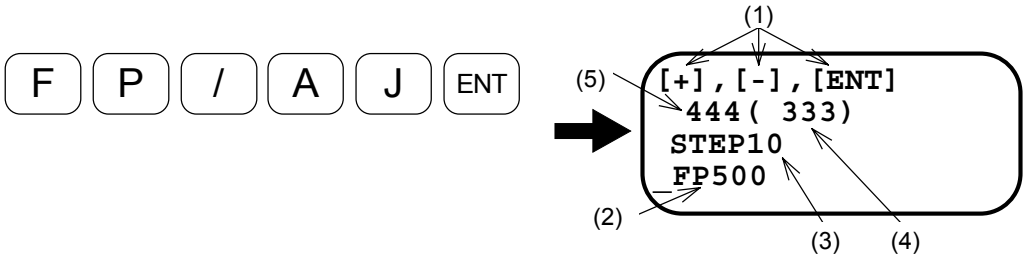
[ENT]



5.4. Setting Filters (Tuning Level 2)

- You can reduce resonance noise by setting "low-pass filter (parameter FP and FS)." The unit of FP and FS is cycle / second (HZ).
  - ◊ Be aware if low frequency less than 100 HZ is set to parameters "FP" and "FS," the servo system becomes unstable and hunting or unstable positioning may occur.
- Before using filters, make sure that all adjustments of gain (VG) and integrator frequency (VI) are completed.
- Use the same demonstration program (SA/AJ) for adjusting filters. Follow the procedures 1) ~ 7) in "5.2.4. Trial Running (Adjustment Level 1)."

1) Start "FP" adjusting program.



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

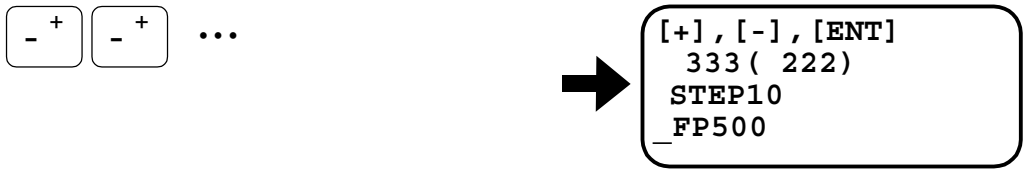
- Explanation of the messages
  - (1) Key function
    - SHIFT and - + : Pressing key one time increases 10 resolution of "FP."
    - - + : Pressing key one time decreases 10 resolution of "FP."
    - ENT : Pressing key one time stores "FP" value in the memory and completes the adjustment.
  - (2) Indicates present "FP" value.
  - (3) Indicates "FP" value changed by pressing plus (+) or minus (-) key.
  - (4) Response index number: The lower number denotes better response.
  - (5) Positioning index number: The lower number denotes quicker positioning.

⚠ *Caution* *: Changing "FP" step ((3)).*
If you want to change the resolution of step, press space key or backspace key.

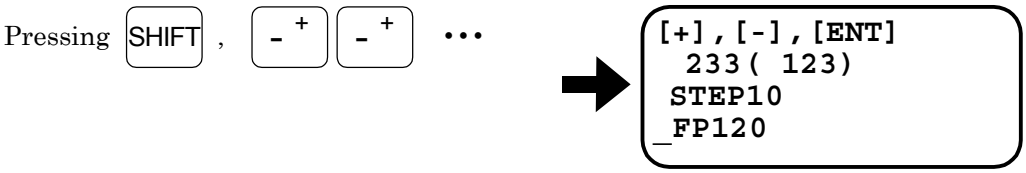
Space key : Changes the step to 1/10 of present resolution. (Pressing twice makes 1/100.)

Backspace key : Changes the step to 10 times of present resolution. (Pressing twice makes 100 times.)

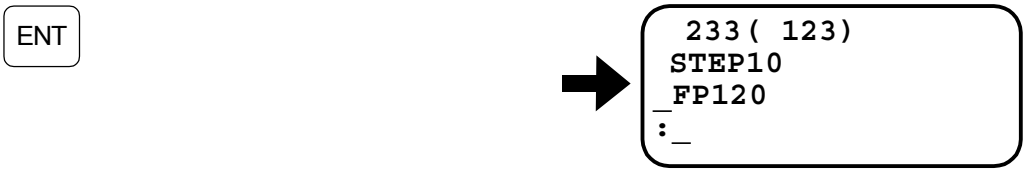
2) Decrease low-pass filter frequency (FP) to lower noise level by typing minus (-) key several times.



3) If motion of the slider becomes unstable, increase "FP" value by typing plus (+) key several times.

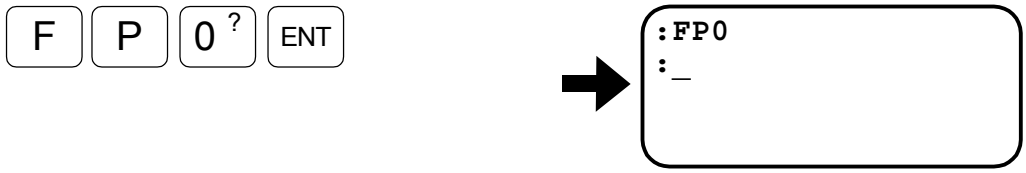


4) Type the enter key to complete the adjustment.



Note : To deactivate the filter, input the filter command with "0" data.

For example type as:



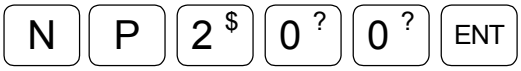
Note : Setting "Notch Filter"

◊ When setting notch filter, you need to check the resonance frequency.

• Example

(1) Check the resonance frequency by an oscilloscope.

(2) If the resonance frequency is 200Hz, input



to set the notch filter frequency.

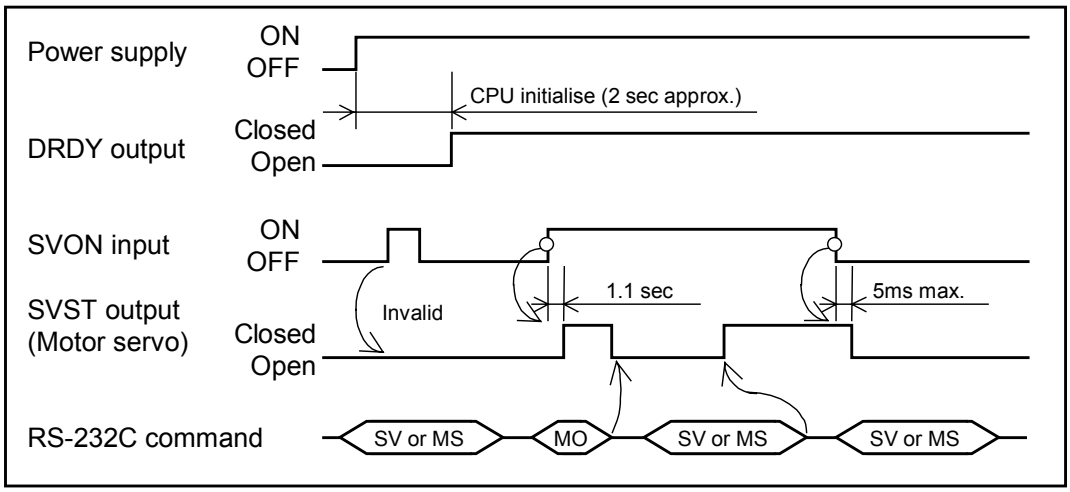
6. Operational Function

6.1. General Operation and Function

6.1.1. Servo "ON"

- The Motor gets in Servo-on state by inputting SVON signal when the power has been turned on and DRDY output has closed.
- It requires 1.1 seconds to turn the servo-on after SVON command is given to the Motor. Output SVST closes when the Motor gets in servo-on state.
- Output SVST opens when the Motor gets in servo-off state. Dynamic brake functions when the Motor is in servo-off state.
- When the Motor is in servo-on state by SVON input, MO command will make servo-off state.
- Instruction of SV or MS command will make servo-on state when the Motor is in servo-off state made by MO command.

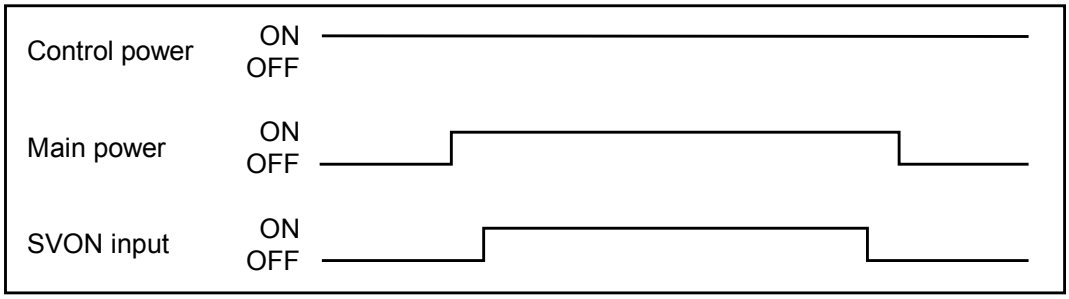
Figure 6-1



◆ Points to notice when turning ON/OFF the main power and control power respectively

- When turning on the main power after the control power is on: Turn on SVON input after the main power is on.
- When turning off the main power when the control power remains on: Turn off SVON input first and then turn off the main power.
- * An alarm for "AC line under voltage" arises when the main power is off under servo-on state. This alarm won't be reset till the power is turned on again.

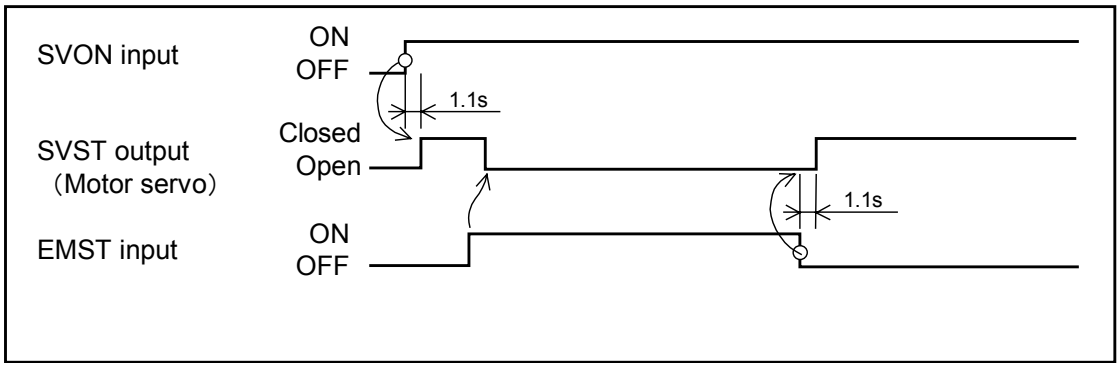
Figure 6-2



6.1.2. Emergency Stop

- The Motor will get in servo-off sate when EMST input is on. The dynamic brake functions to stop the Motor.
- The system does not accept any motion command while the EMST input is on.
- At this moment the LED of the front panel indicates “F4.” Output of DRDY remains unchanged. (It remains being closed.)
- Input of EMST can be changed to B contact though it has been set to A contact as the shipping set. (Refer to description of parameter AB.)

Figure 6-3



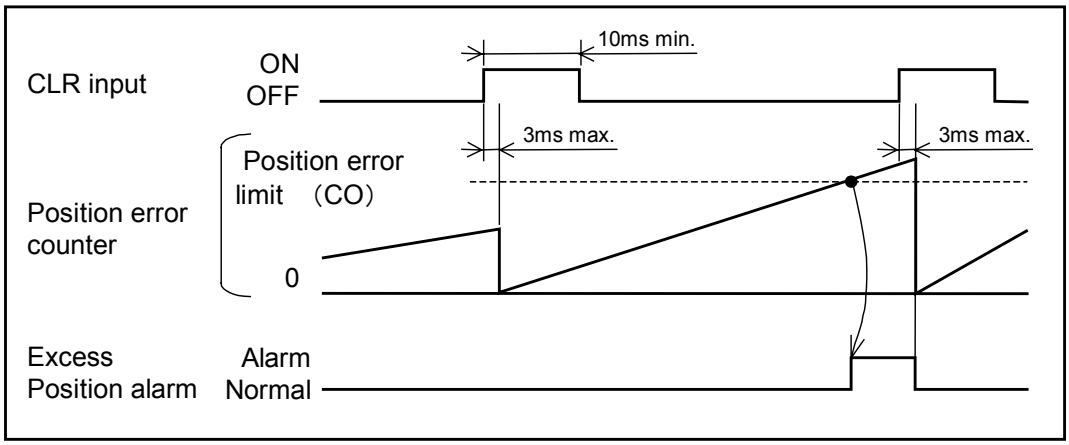
◊ The system may not recognize an input of EMST unless it stays on for 10 ms or longer.

6.1.3. Clearing Position Error Counter

- Input of CLR clears the errors in position error counter of position loop.

* CLR input is detected by its rising edge of signal. When the position error counter is cleared once, it works normally even the CLR input remains on.

Figure 6-4



- CLR input will clear following alarms when they are active.

Table 6-1

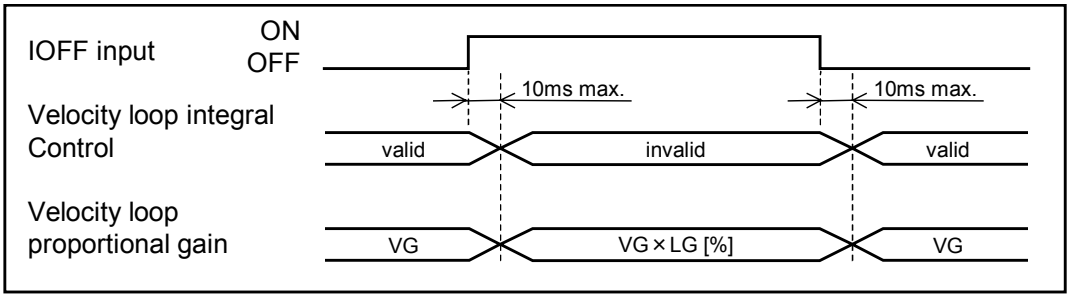
Alarm	7 seg LED	Indication by TA
Excess position error	F1	**F1>Excess Position Error**
Programa error	F5	**F5>Program Error**
Auto tuning error	F8	**F8>AT Error**
RS-232C error	C2	**C2>RS232C Error**
Software thermal	A3	**A3>Overload**
Velocity error	A4	**A4>Over Speed**
Home position not defined	A5	**A5>Origin undefined**

6.1.4. Integrator OFF

- Turning ON of IOFF input makes integral control (VI) invalid. Velocity proportional gain (VG) will be decreased simultaneously. (VG×LG [%])

- The system is in normal state when input of IOFF is OFF.

Figure 6-5



6.1.5. Over Travel Limit Switch

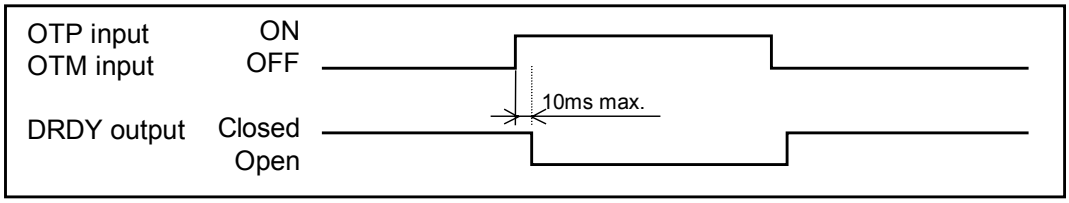
6.1.5.1. Hardware Over Travel Limit

- OTP and OTM inputs may be used for restriction of Motor stroke.
- When OTP input is ON, the Motor will stop immediately with its servo-on. You can move the slider only to MNS direction in this state.
- When OTM input is ON, the Motor stops immediately with its servo-on. You can move the slider only to PLS direction.
- * Both inputs of OTP and OTM are set to A contact as the shipping set. However the polarity may be changed to B contact. (Refer to description of parameter AB.)
- * Limit switch by internal software of the Driver Unit is provided as "software limit switch" besides the OTP and OTM input. Refer to "6.1.5.2. Software Over Travel Limit."

  ◊ DRDY output opens when the over travel alarm arises and the LED on the front panel indicates as follow.

  Activation of OTP or OTM sensor : F3
  Software over travel limit : F2

Figure 6-6



- The slider reacts as described below if OTP or OTM input is on in the middle of the Home Return operation.

(1) When the slider is moving toward to MNS direction:

⚠Caution *: The slider decelerates and reverses the motion when OTM input is on.*

◊ The system ignores OTP input. (The slider moves continuously.)

(2) When the slider is moving to PLS direction:

⚠Caution *: The slider decelerates and reverses the motion when OTP input is on.*

◊ The system ignores OTM input. (The slider moves continuously.)

6.1.5.2. Software Over Travel Limit Switch

⚠ Caution : *Set the over travel limit switch with ample margin in expectation of overshoot of the slider.*

- These limits are effective when the coordinates are defined by the completion of Home Return or AZ command.
  You may confirm the state of coordinates system by HCMP output.

- Over travel limits are set by OTP and OTM commands.

<Operation > Setting by teaching

- Set the software over travel limits by following procedure after completion of Home Return.

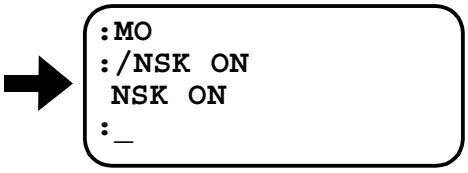
(1) Turn off the Motor serve.

M O ENT

(2) Move the slider manually to the position to be the over travel limit on the plus side.

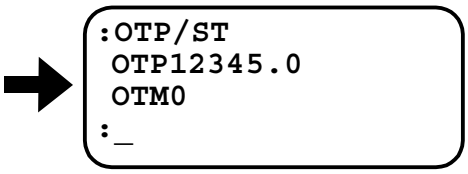
(3) Input the password.

/ N S K SP
O N ENT



(4) Set the current position as the over travel limit for the plus side.
The screen indicates the set value of over travel limit.

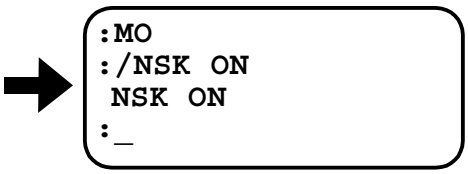
O T P / S T
ENT



(5) Move the slider manually to the point to set the to over travel limit of minus side.

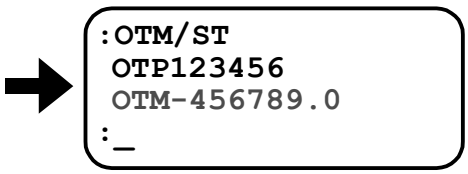
(6) Input the password.

/ N S K SP
O N ENT



(7) Set the current position to the over travel limit for minus side.
The screen indicates the set value of over travel limit for minus side.

O T M / S T
ENT



(8) Make sure that F2 alarm arises when the slider gets in the range of over travel limit.
(LED or TA command reports the status.)

- If the F2 alarm does not arise, check if;
    - ◊ OTP is set to a positive number and OTM is set to a negative number.

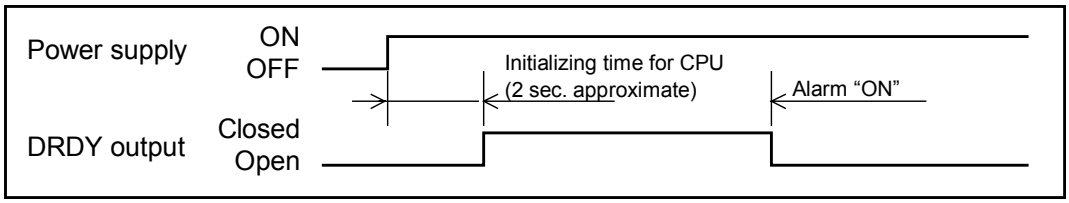
<Operation> Setting by position data

- If the position data of over travel limits are already known, the user can set these data directly to the OTM and OTP parameters.
- The unit of over travel limit position is [μm].

6.1.6. Alarm Output

- After the power is on, following initialization of "CPU" completes, "DRDY" output closes when alarms are not reported.
- DRDY output opens when an alarm arises.
- Connect alarm signals to "alarm inputs" of the master controller.

Figure 6-7



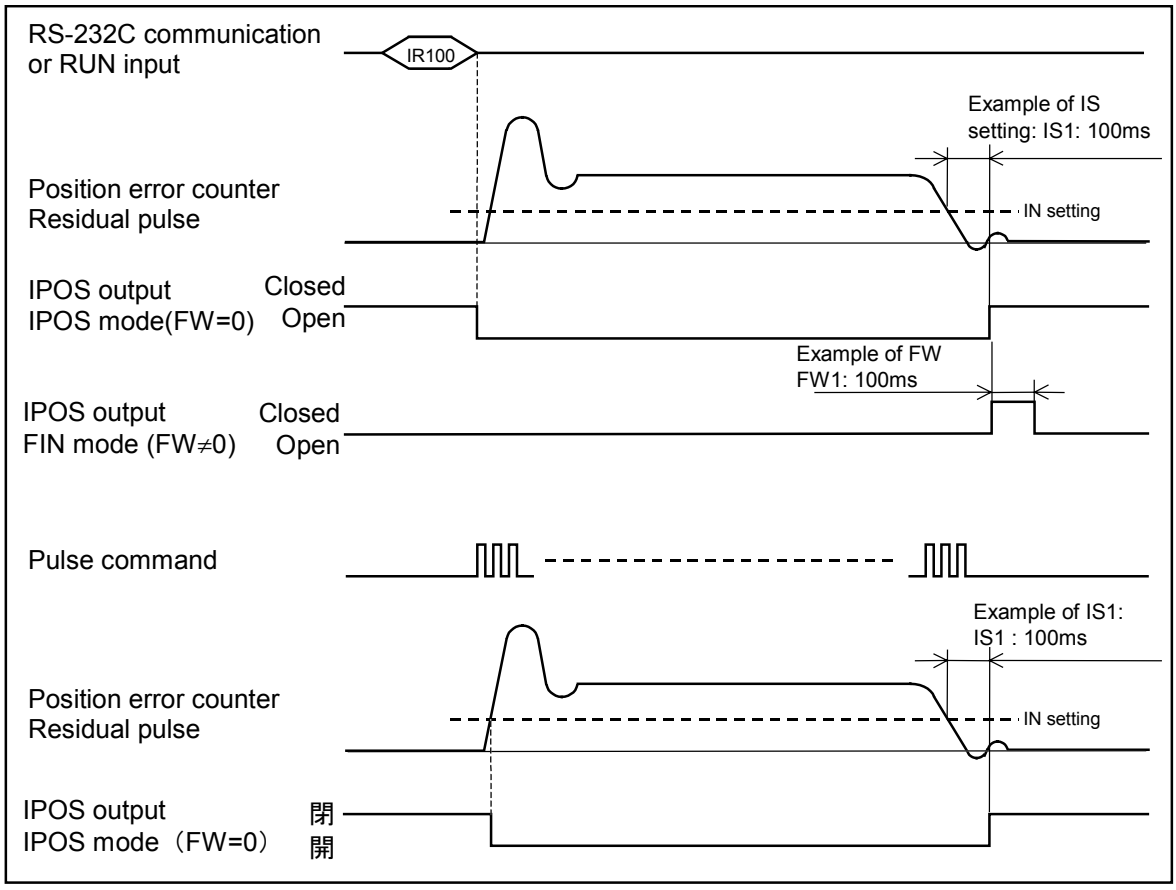
6.1.7. In-Position Output

- Following parameters in Table 6-2 set condition In-Position output.

Table 6-2

Parameter	Function	Shipping set
FW	Time range for IPOS output (Output mode)	FW0
IN	In-position limit value	IN100.0
IS	In position signal stability timer	IS0

Figure 6-8



6.1.7.1. Output Signal Format

1 When data of parameter FW is not 0 (Zero) (FIN mode)

- IPOS output indicates that a positioning for given command has completed.
- IPOS shall be outputted as one to one correspondence for every starting command such as RUN or HOS command.
- Output form:
  - ◊ IPOS output is always open and closes only for a time set by parameter FW when positioning completes. (Time setting is in a unit of 100 [ms]. Shipping set FW1.0 means that the closing time is 100 ms.)

Our recommendation: We recommend FIN mode for programmed operation.

- IPOS won't be outputted for pulse train command operation and JOG operation.
- IPOS won't be outputted when a positioning has interrupted in the middle of operation by Emergency stop or the over travel alarm.

2 When data of parameter FW is set to 0 (Zero) (IPOS mode)

- This mode is to indicate if there is a different between position command and current position.
- Basically IPOS output closes when
  [Residual pulses in position error counter ≤ Setting value of parameter IN] and it opens in other state.
- However internal pulse train operation, such as programmed operation, Home Return, Jog operation and positioning through communication command, is exceptional. IPOS output is forced to open even the condition is [Residual pulses in position error counter ≤ Setting value of parameter IN].

Our recommendation: We recommend IPOS mode for operations by pulse train and positioning via RS-232C communication.

- Basically IPOS output closes when
  [Residual pulses in position error counter ≤ Setting value of parameter IN], even the slider stops due to the input of emergency stop or over travel limit alarm.
- In pulse train input operation, IPOS output closes when
  [Residual pulses in position error counter ≤ Setting value of parameter IN], even in the middle of inputting the pulse train. [It tends to occur in low velocity operation or when the feed forward compensation (parameter FF) is set.]

6.1.7.2. Parameter IN

- Parameter IN controls positioning accuracy.
- IPOS output closes when residual pulses in the position error counter are within the range of IN parameter.
- Setting unit is [μm].

6.1.7.3. Parameter IS

- This is to confirm stability of positioning. In IPOS mode, IPOS signal flutters in the settling time of positioning if setting of parameter IN is too low (Criteria is IIN20 or less.) even adjusting servo gain is appropriate.

- Set parameter IS to prevent the flutter. This also prevents outputting of IPOS signal, even in FIN mode, before the Motor settles completely.

6.1.7.4. IPOS Output in Special Occasion

1 When 0 (zero) motion positioning is executed

- For an example, when [AR0] is instructed even the slider is on the Home position, the moving distance is 0 (zero). The following show IPOS output state in such a case.

(1) IPOS mode, IS=0

◊ If the condition is [Residual pulses in position error counter ≤ Setting value of parameter IN], IPOS output remains closed as there will be no internal pulse output.

(2) IPOS mode, IS≠0

◊ Even no internal pulse output, IPOS output opens for the moment of IS setting to check stability of positioning.

(3) FIN mode,

◊ IPOS output is returned for motion command even the internal pulse output is 0 (zero).

2 *Sequential processing of programmed operation

(1) IPOS mode

◊ After positioning completes, the system executes an operation of the next channel while IPOS remains open.

(2) FIN mode

◊ After completion of positioning, IPOS output closes for a time set by parameter FW, and then execute an operation of the next channel when IPOS output opens again.

6.1.8. Velocity Report

- This function is to report current velocity status of the Motor based on a criterion set by parameter SB.
- Parameter ST confirms velocity stability against the criterion.
- You may select output mode of the velocity report from either “Zero velocity” or “Over velocity” mode.
- In case of the “Zero velocity” mode, SPD output (out put of velocity report) closes when the velocity is less than or equal to the criterion set by SB for a time set by parameter ST.
- In case of the “Over velocity” mode, SPD output (output of velocity report) closes when the velocity is faster than or equal to the criterion set by SB for a time set by parameter ST.

Table 6-3 : Parameter SO: SO0 [Zero velocity] mode

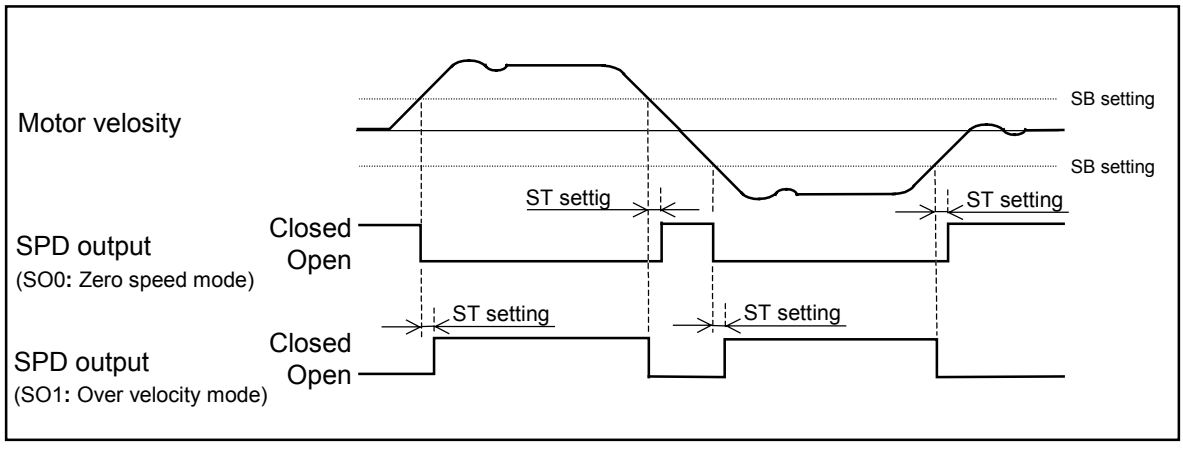
State	Status of velocity
Open	Velocity of the Motor is over the criterion set by the parameter SB.
Closed	Velocity of the Motor is less than or equal to the criterion set by the parameter SB for longer than the time set by the parameter ST.

Table 6-4 : Parameter SO: SO1[Over velocity] mode

State	Status of velocity
Open	Velocity of the Motor is less than the criterion set by the parameter.
Closed	Velocity of the Motor is faster than or equal to the criterion set by the parameter SB for longer than the time set by the parameter ST.

- The over velocity mode is not a reversed logic of the zero velocity mode. In case of the zero velocity mode, the velocity stability is checked for the velocity under or equal to the criterion. The velocity stability in the over velocity mode is checked for the velocity over than or equal to the criterion.

Figure 6-9



6.1.9. Home Position Defined

- This output reports that the home position is defined by Home Return operation or other ways.
- HCMP output closes when the home position is defined by Home Return operation or AZ command.
- HCMP output opens when the home position is not defined. The following are situations that make the home position undefined.

  (1) Home Return has never been completed after the power is on. .
  (2) Home Return was attempted but not completed. (= interrupted).
  (3) The sign of the coordinates is reversed by DI command.
  (4) SI or AL command has initialized the system parameters.
  (5) The system has detected alarm “A0>Encoder Circuit Error.”
  (6) The system has detected alarm “A4>Over Speed.”
  (7) The system has detected alarm “E0>Memory Error.”
  (8) The system has detected alarm “C3>CPU Error.”

⚠ *Caution* *: Function of software over travel limit is invalid when the home position is not defined.*

- This output closes also when operation of HS or LS command completes.

■ Refer to “7.2.1. Home Return” for the operating timing.

6.1.10. Position Feedback Signal

◆ Resolution

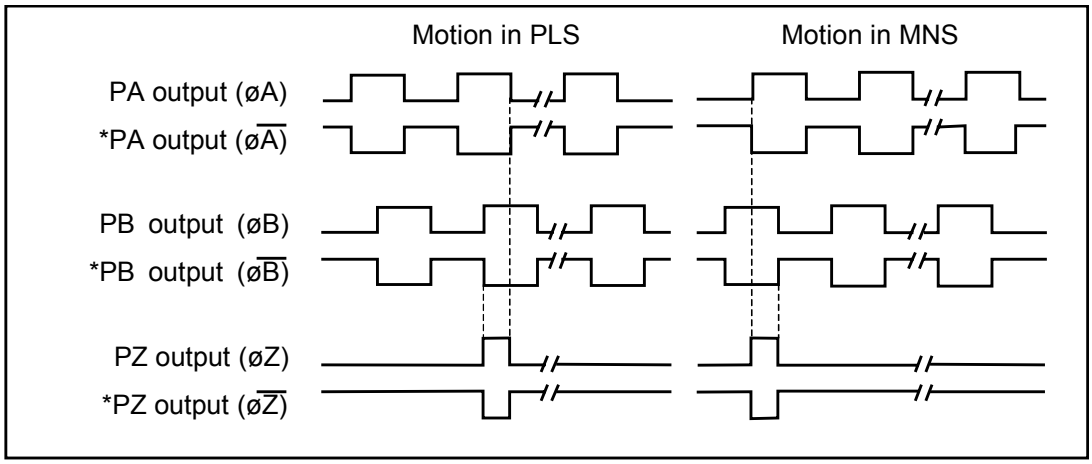
- Resolution of øA/øB depends on the resolution of the linear position scale.

Table 6-5

Linear position scale [µm]	øA/øB resolution [µm/pulse]
0.5	2.0
1.0	4.0

◆ Output Timing

Figure 6-10



- * Repeatability of output timing of øZ is assured only in the direction either one of PLS or MNS that is determined by adjusting reference mark.

6.1.11. Monitor Function

- Operation of the Motor can be monitored through check pins on the front panel of Driver Unit and RS-232C communication.

Table 6-6

Item	RS-232C Communication command	Monitor output	Description
Position error counter	TE	RS-232C communication terminal	• Monitors position error counter in real time bases. • Refer to "9. Command and Parameter" for more details.
Input/Output	IO		• Monitors status (ON/OFF) of control I/O of CN2 connector. • Refer to "9. Command and Parameter" for more details.
Current position	TP		• Monitors current position of absolute coordinates in real time. • Refer to "9. Command and Parameter" for more details.
Thrust command & Thermal loading	TT		• Monitors thrust command to Motor and thermal loading. • Refer to "6.1.11.3. Monitor of Thrust Command" and Thermal Loading" for more information.
Parameter setting	TS		• Monitors current setting of servo parameters and operation parameters. • Refer to "9. Command and Parameter" for more details.
Alarm	TA		• Monitors alarm status. • Refer to "11.2.5. Readout of Alarm Status by TA Command" for more details.
Channel program	TC		• Monitors contents of channel program. • Refer to "9. Command and Parameter" for more details.
Analog monitor	MN	Front panel MON (GND) terminal	• Monitors velocity and residual pulse of error counter in analog data.

6.1.11.1. How to Monitor Control Input / Output Signal

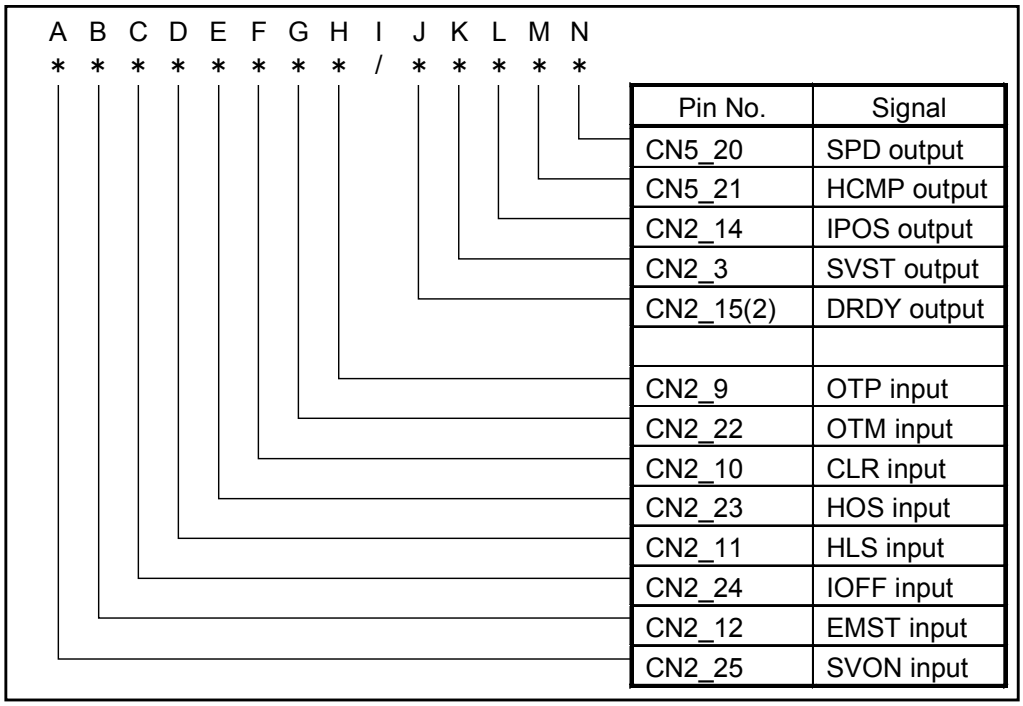
- State of Input / Output of CN2 and CN5 connectors can be monitored by command IO.

- This is useful for wiring check.

  Input format : IO0/RP : Reports I/O signal state.
  : IO2/RP : Reports state of I/O signal of internal program command.
  : IO3/RP : Reports state of Jog operation I/O.
  : Without /RP : Reports only once.
  : With /RP : Reports state of I/O in real time basis.

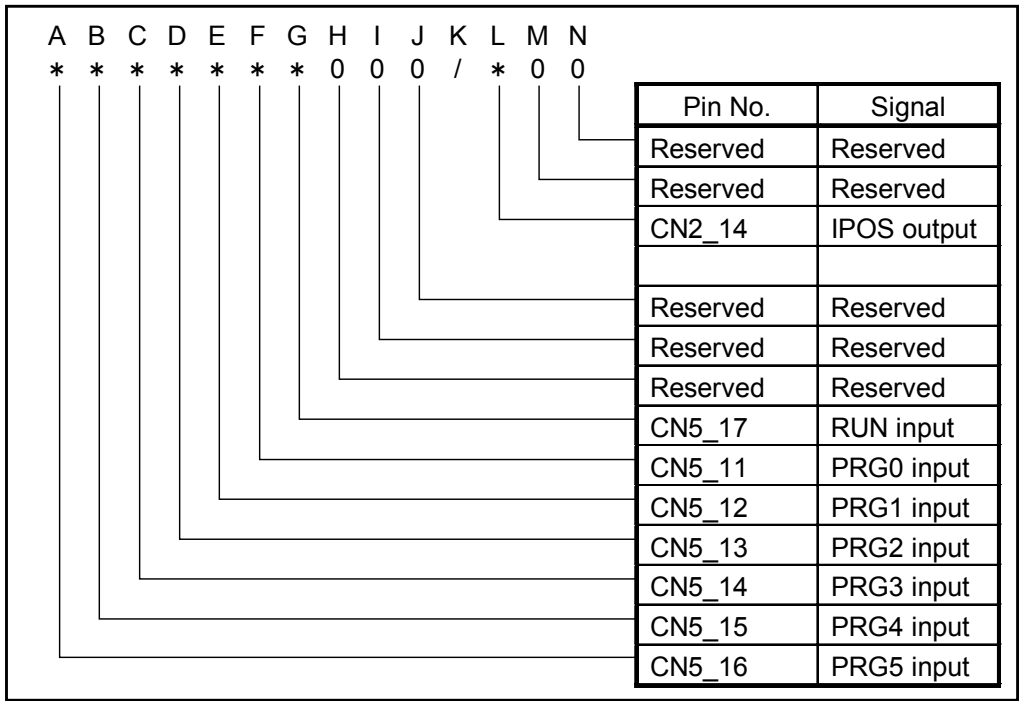
  ◊ Display format : Bit map representing I/O on one line (See Figures 6-11～13.)

Figure 6-11 : Format of IO0/R



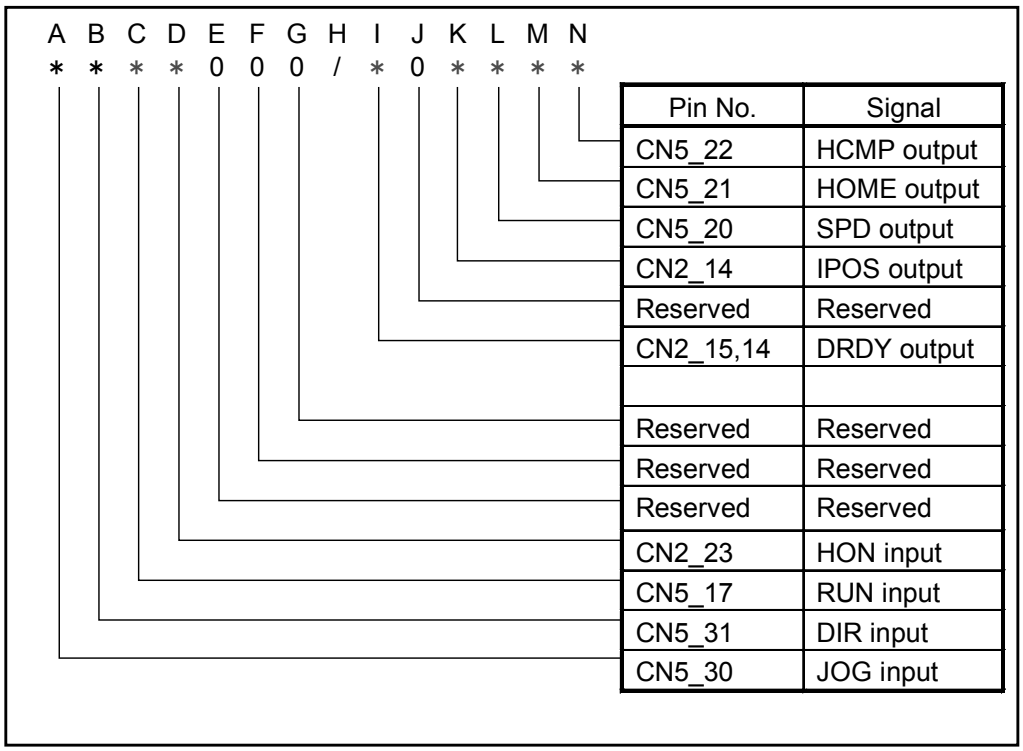
Pin No.	Signal
CN5_20	SPD output
CN5_21	HCMP output
CN2_14	IPOS output
CN2_3	SVST output
CN2_15(2)	DRDY output
CN2_9	OTP input
CN2_22	OTM input
CN2_10	CLR input
CN2_23	HOS input
CN2_11	HLS input
CN2_24	IOFF input
CN2_12	EMST input
CN2_25	SVON input

Figure 6-12 : Format IO2/RP



Pin No.	Signal
Reserved	Reserved
Reserved	Reserved
CN2_14	IPOS output
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
CN5_17	RUN input
CN5_11	PRG0 input
CN5_12	PRG1 input
CN5_13	PRG2 input
CN5_14	PRG3 input
CN5_15	PRG4 input
CN5_16	PRG5 input

Figure 6-13 : Format IO3/RP



Pin No.	Signal
CN5_22	HCMP output
CN5_21	HOME output
CN5_20	SPD output
CN2_14	IPOS output
Reserved	Reserved
CN2_15,14	DRDY output
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
CN2_23	HON input
CN5_17	RUN input
CN5_31	DIR input
CN5_30	JOG input

Table 6-7 : Meaning of displayed data

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

Figure 6-14 : Monitor example

```
:IO0/RP ENT
 ABCDEFGHIJKLMN
 01000011/00101
```

From CN2 connector: Inputs of EMST, OTP, OTM are ON.
Outputs: DRDY is open. SVST is open. IPOS is closed.
HCMP is open. ZSPD is closed.
Press [BS] key to quit monitoring.

6.1.11.2. Analog Monitor

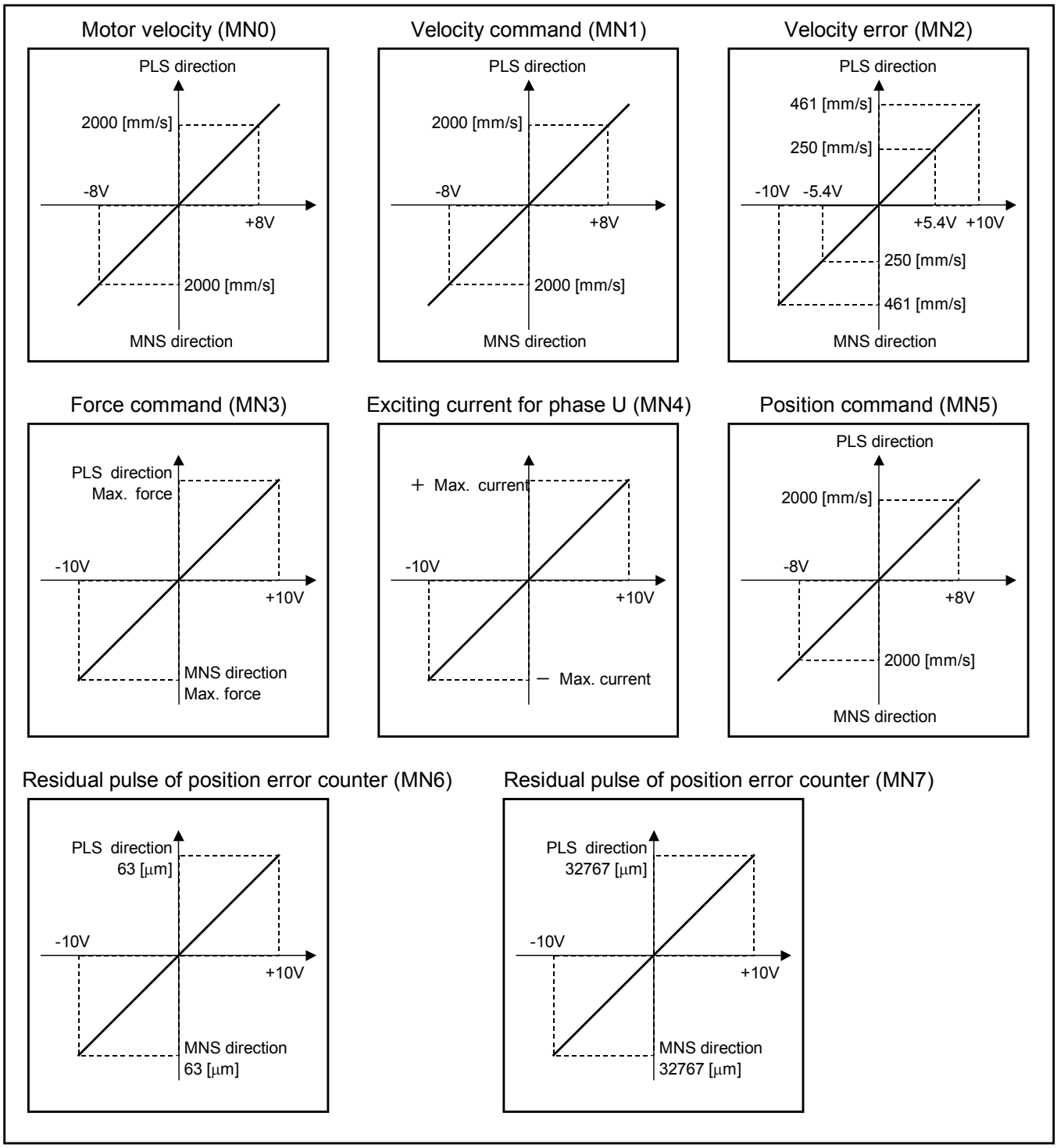
- Voltage between monitor outputs (MON +) and GND (MON-) on the front panel monitors following items.
  - ◊ Motor velocity ---------- Actual velocity of the Motor
  - ◊ Velocity command ---------- Command value for velocity
  - ◊ Velocity error ---------- Error between velocity command and actual velocity. (per 1 sampling)
  - ◊ Thrust command ---------- Thrust command value
  - ◊ Exciting current command for phase U ----- Actual current value for phase U
  - ◊ Residual pulse of position error counter----- Actual residual pulses of position error counter
- Select monitoring characteristics by MN command.

Table 6-8

Monitor output	MN command
Motor velocity	MN0
Velocity command	MN1
Velocity error	MN2
Thrust command	MN3
Exciting current command for phase U	MN4
Position command	MN5
Residual pulses of position error counter	MN6
	MN7

● Followings are specifications of the analog monitors.

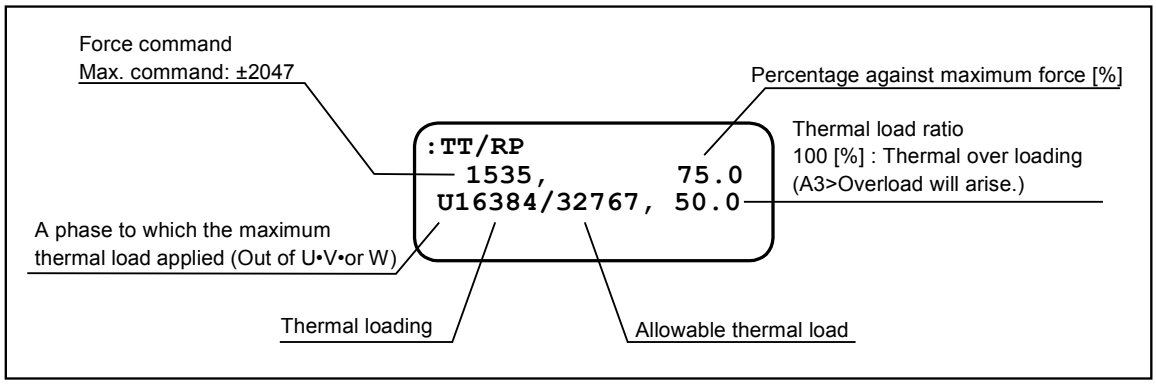
Figure 6-15



6.1.11.3. Thrust Command and Thermal Loading

- You can monitor thrust command and thermal loading by TT command.
- This function is useful for a check if operation duty is appropriate.

Figure 6-16 : Indication of display（TT/RP）



6.2. For More Advanced Operation

6.2.1. Coordinates

- EDB Driver Unit provides coordinate system to control positioning or the over travel limit.

6.2.1.1. Resolution

- Counting unit of coordinate data and software over travel limit position is [μm].

6.2.1.2. Direction of Coordinate

- Standard setting of positive and negative signs is shown in Figure 6-17. When you look down the Motor, the positive side is right and the negative side is left when you put the pole sensor, which is installed to the slider and is protruded from it, on your left. However you may reverse the direction by parameter DI.

Figure 6-17 : Setting of DI0

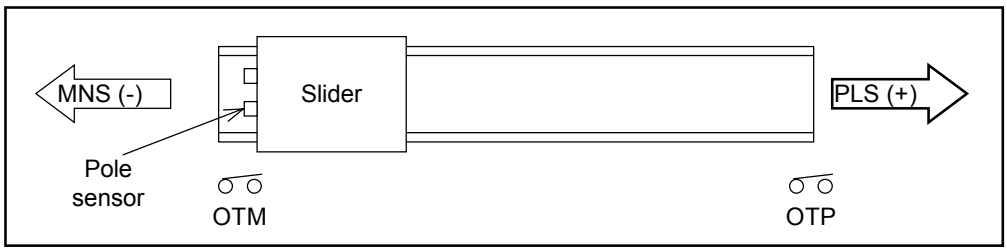
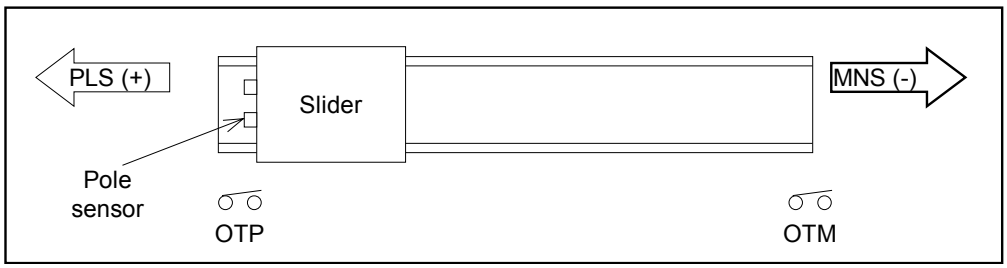


Figure 6-18 : Setting DI1



- The negative and positive direction of following function is also decided by this setting.
  - ◊ Pulse train command operation
  - ◊ Operation through communication (IR, AR, HS)
  - ◊ Programmed operation
  - ◊ Home Return
  - ◊ Software over travel limit

- DI setting does not change the direction of the signs of hardware over travel limit. Be careful when you set DI1.

6.2.1.3. Reset of Coordinate

- Coordinate data will be reset to 0 (zero) in the following operations.
  - ◊ Completion of Home Return
  - ◊ Input of AZ command (It requires the password to input AZ command.)
- Coordinate data is unsettled right after the power is turned on. Be sure to execute a positioning operation after you reset the coordinate.

6.2.1.4. Readout of Coordinate Data

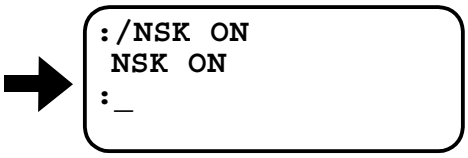
- You can read out the current position through an RS-232C terminal by imputing TP command. 。
  - ◊ Format : TP2/RP [ENT] : Read out in the unit of [μm]
    - Without /RP1 : One shot readout
    - With /RP : Real time readout

6.2.1.5. Setting Example of Coordinate system

(1) Reverse negative/ positive direction

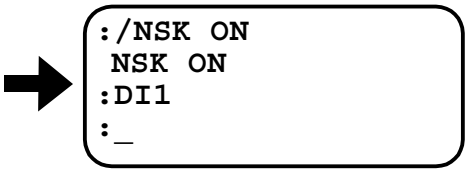
(1) Input the password. The acknowledgement appears on the screen.

/ N S K SP
O N ENT



(2) Input DI command to set the direction of coordinate signs.

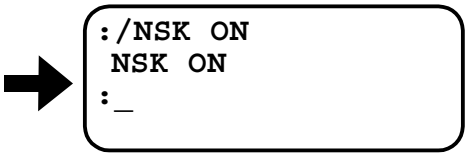
D I 1 # ENT



(2) Reset coordinate data

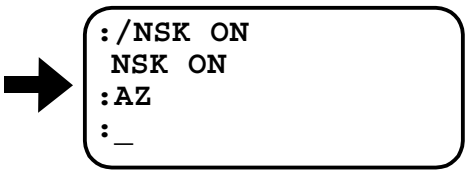
(1) Input the password. The acknowledgement appears on the screen.

/ N S K SP
O N ENT



(2) Input AZ command to reset the coordinate data.

A Z ENT



(3) Read out current position

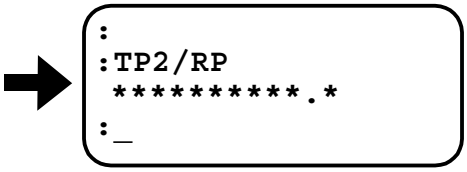
- Read out the coordinate data in real time.

(1) The coordinate data is read out in the unit of [μm] in real time basis. The data changes when the slider moves.

T P 2 $ / R P
ENT

(2) Press BS key to quit read out.

BS



6.2.2. Digital Filter

⚠ *Caution* : *• Inserting multiple filters may cause phase inversion in velocity loop, resulting in unstable operation.*

• Do not insert three or more filters. Setting a filter frequency too low may cause hunting of the slider. Set the frequency to 100 Hz or above.

Parameters for digital filter setting

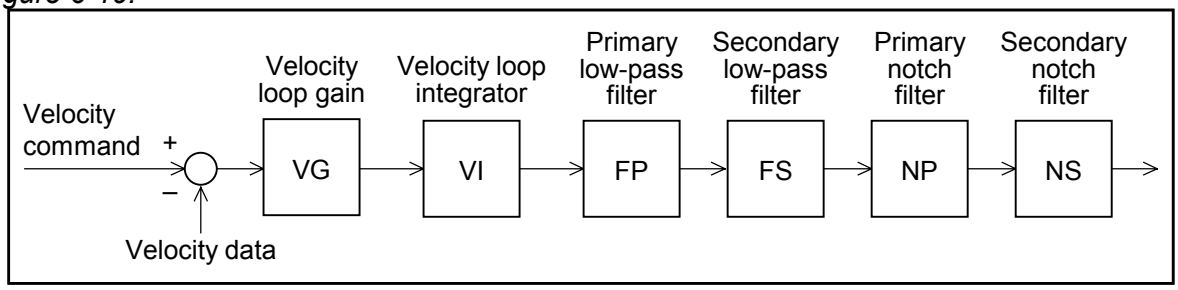
- Parameters: FP, FS, NP, NS
  - ◊ Insert filters in the velocity loop.
  - ◊ The filters are useful for eliminating audible noise and vibration due to mechanical resonance.

Table 6-9: Parameter function

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

- Sets frequency to the filters in velocity loop.
- Refer to "9. Command and Parameter" for more details.

Figure 6-19:



6.2.3. Feed Forward Compensation

◆ Parameter FF (Entry of the password is necessary for setting.)

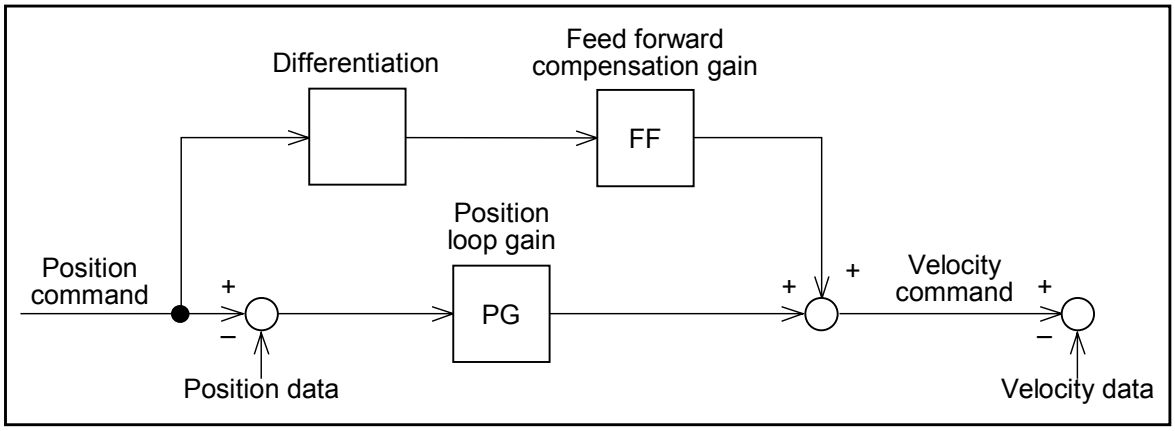
- This function adds velocity command, that is made by differentiation of position command, to forward direction of velocity loop.
- It improves tracking error in the state of acceleration and deceleration.

Table 6-10

Parameter	Function	Shipping set
FF	Sets feed forward compensation gain.	FF0.0000

- This function creates velocity command by differentiating position command and adds it to forward direction of velocity loop. Parameter FF sets the gain of feed forward compensation.
- Setting the parameter FF to a higher value improves the tracking error but overshoot becomes more likely to occur when it is set too high. Practically the parameter shall be set to 0.5 or less.

Figure 6-20



6.2.4. Integrator Limiter : ILV

◆ Parameter ILV (Entry of the password is necessary for setting.)

- Integrator limiter reduces overshooting caused by integral action when high acceleration/deceleration are set.

Tale 6-11

Parameter	Function	Shipping set
ILV	Sets the limit of integrator of velocity loop [Unit: %]	ILV100.0

- This sets the upper limit of integrator of velocity loop.
- Integrator is indispensable for highly accurate positioning. However, when high acceleration / deceleration is specified, errors are likely to accumulate so that integration often results in an overshooting. To prevent this, an integrator limiter is provided to restrict an excessive integration.
- * Refer to “9. Command and Parameter” for the parameter.

Figure 6-21

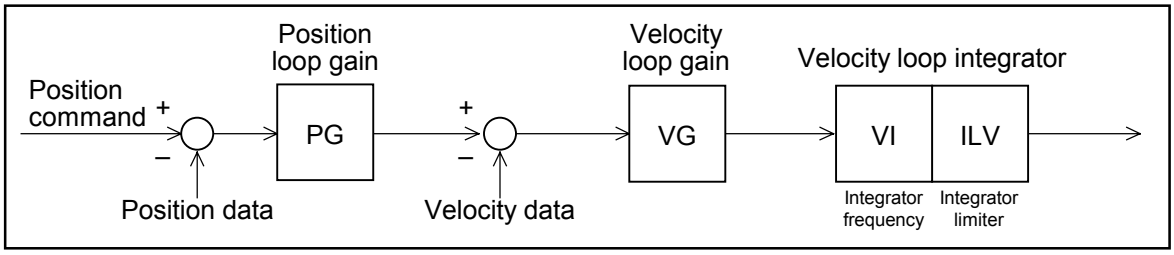
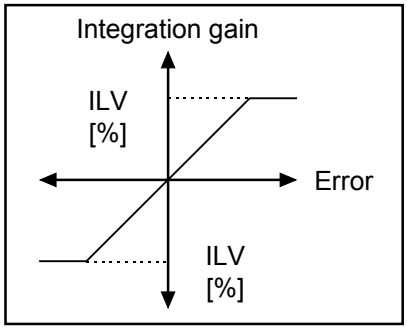


Figure 6-22



6.2.5. Setting Dead Band : DBP

◆ Parameter DBP (It requires the password for setting.)

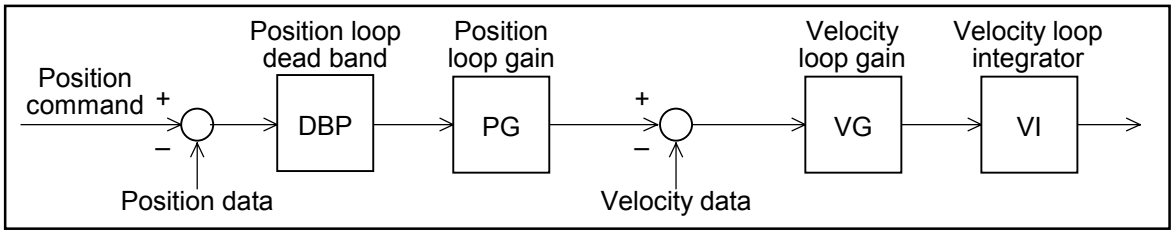
- This function sets dead band to error of position loop. The system disregards position error when it is under the setting of parameter DBP.
- This function reduces micro-vibration at the end of positioning.

Table 6-12

Parameter	Function	Shipping set
DBP	Sets dead band on position loop.	DBP0.0

- Sets dead band, which is centered at 0, to position loop and makes the system disregard the command that is less than the setting.
- In some applications, micro-vibration may be caused after positioning by a slight positioning error. In such a case, setting dead band will decrease the micro-vibration.
- The dead band reduces micro-vibration, however, lowers repeatability adversely to the set value of dead band.
- Unit of dead band is [μm].

Figure 6-23:



6.2.6. Function to Switch Gain

- This function is to switch the gain of moving or stopping Motor according to the deviation of the position error counter.

- This is useful when you cannot increase servo gain 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.

- Furthermore, this function is effective to lower the gain in operation and to increase it in decelerating-stopping state in order to keep the vibration minimum in operation and attain short settling time in positioning.

Table 6-13

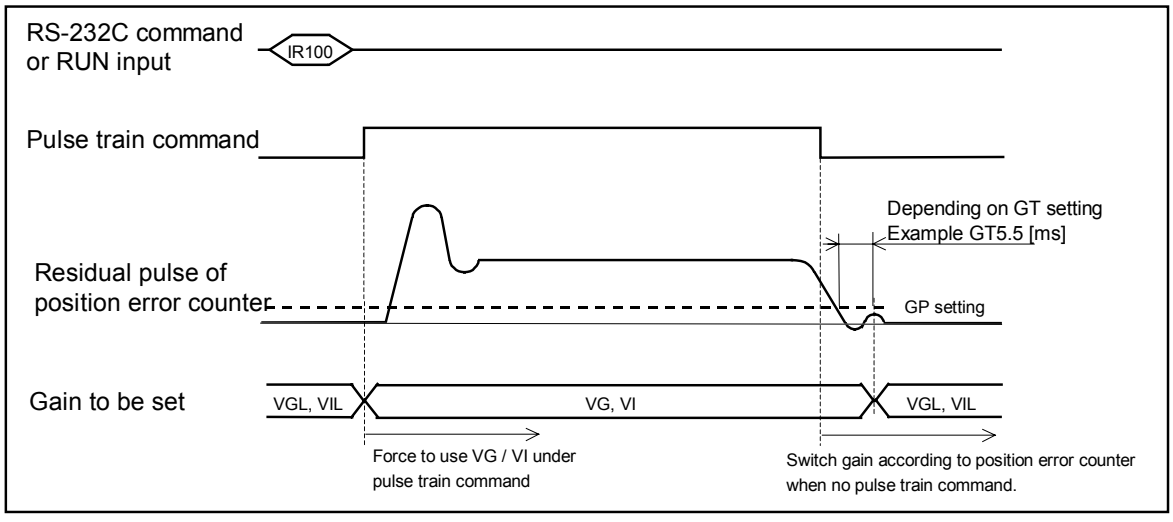
Parameter	Function	Sipping set
GP	Threshold to switch gain	GP0.0
GT	Timer to check stability of deviation for switching	GT5
VG	Velocity loop proportional gain for operation	VG1.0
VI	Velocity loop Integrator frequency for operation	VI1.00
VGL	Velocity loop proportional gain for stopping state	VGL1.0
VIL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

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

- If setting of the parameter GP is other than 0, the gains VG and VI for operating state are used for positioning operation. When the deviation 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 applicable.

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

Figure 6-24



- The Motor starts positioning operation under gain for motion VG / VI when positioning command, such as a programmed operation, internal pulse generation by RS-232C communication and pulse train command, is inputted.

- The gain for parameters VGL and VI for the stopping Motor are applied when the error of the position error counter reaches less than the parameter GP due to completion of internal pulse generation or stopping pulse train input of position command.
  (If parameter GT is set, it confirms that deviation of position error counter is less than GP setting for a time set by parameter GT.)

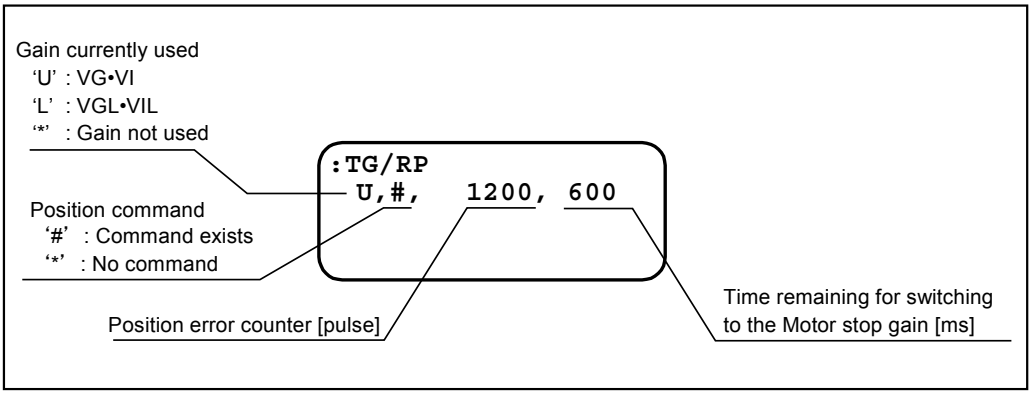
- In case of an operation by pulse train command, input of the position command is checked in every 556 [μs]. This may cause frequent switching of gain as it is regarded that the position command is coming in intermittently when the velocity is less than the value shown in Table 6-14 below. For these cases, setting timer for stabilizing switching gain GT helps to control frequent gain switching.

Table 6-14

Resolution of position sensor [μm]	Command [mm/s]
0.5	0.9
1.0	1.8

- TG command monitors the status of gain switching function.

Figure 6-25 : Monitor by TG/RP



6.3. RS-232C Communication

6.3.1. Communication Specification

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

- The Driver Unit has CN1 as the input/output ports for 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 6-15 : RS-232C communication specification

Item	Specification
Transmission	Asynchronous, full duplex
Communication speed	9600 b.p.s.
Word length	8 bit
Stop bit	2 bit
Parity	No
Character code	ASCII code
Communication procedure	• X–On/Off Protocol : None • RTS/CTS Control : Yes

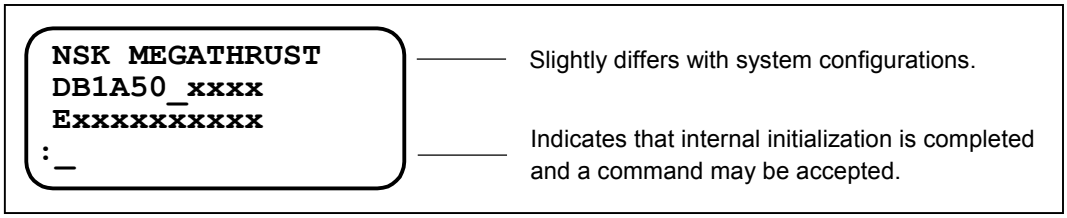
6.3.2. Communication Procedure

6.3.2.1. When Power is Turned ON

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

Figure 6-26 : Power-on message



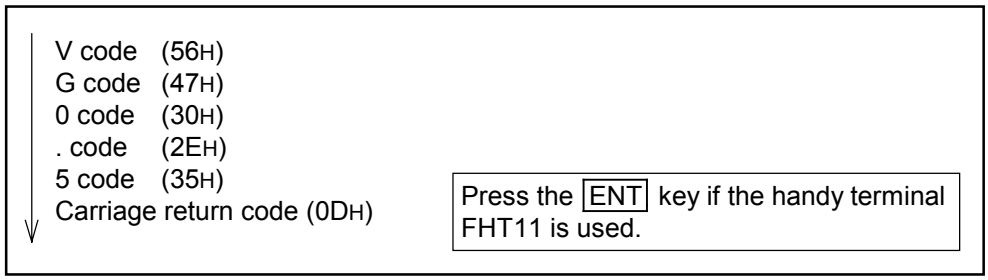
⚠ *Caution* *: Be sure to turn the power to the Driver Unit off when connect or disconnecting the communication cable (CN1). Unit is off. Otherwise it may lead to an alarm of communication error and system breakdown.*

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:

Figure 6-27 : Example Of VG0.5



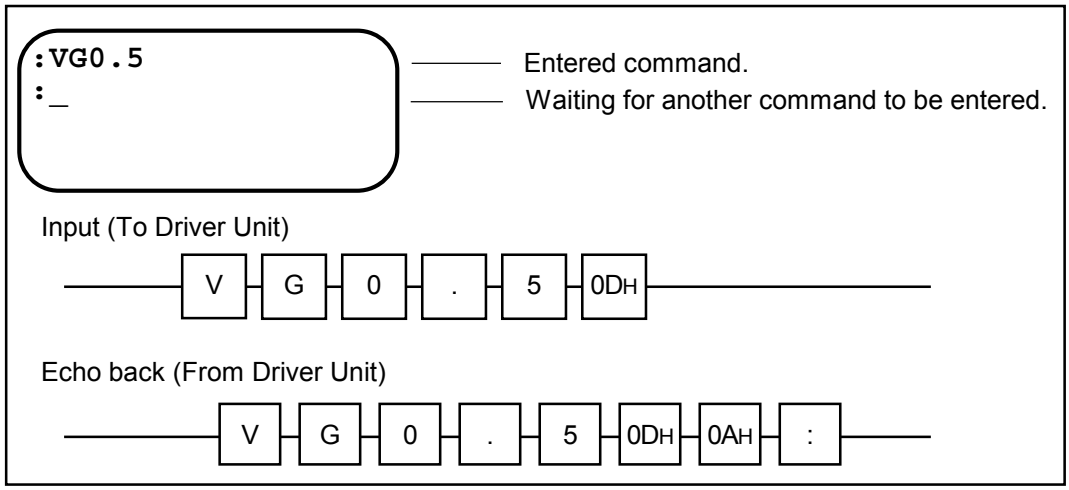
- Every time a character is input, the Driver Unit echoes the character back to the terminal. (The Driver Unit returns the same character that it has received.)

- 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 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 a internal data readout command, etc., it returns the data before ": (prompt)."

Figure 6-28 : Successful input example



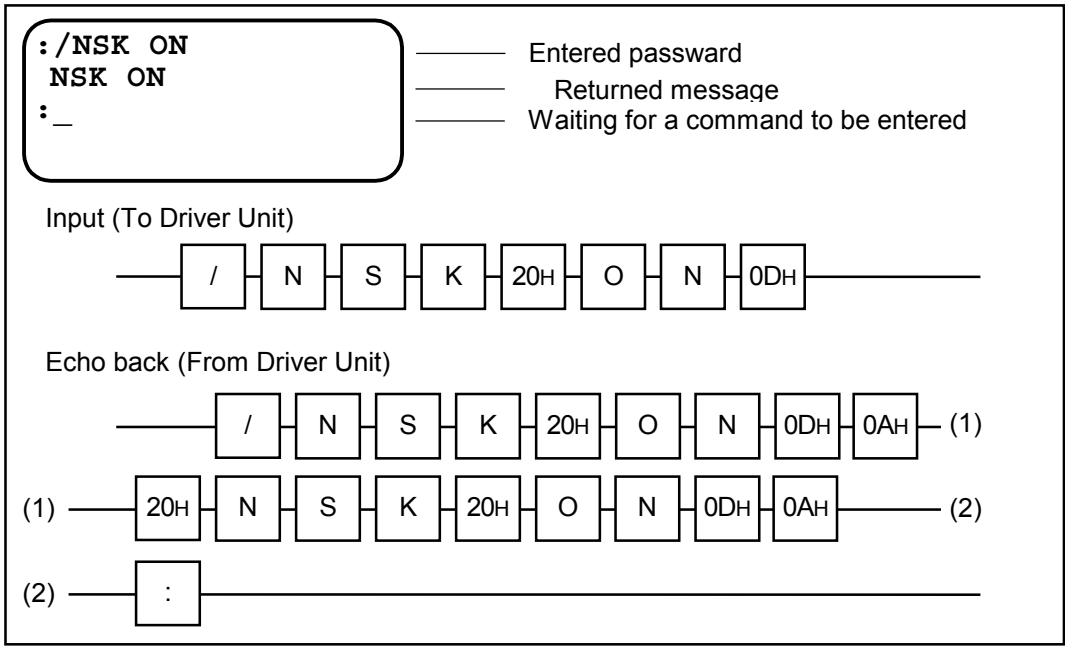
6.3.2.3. Password

- 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.

Figure 6-29: Password Example



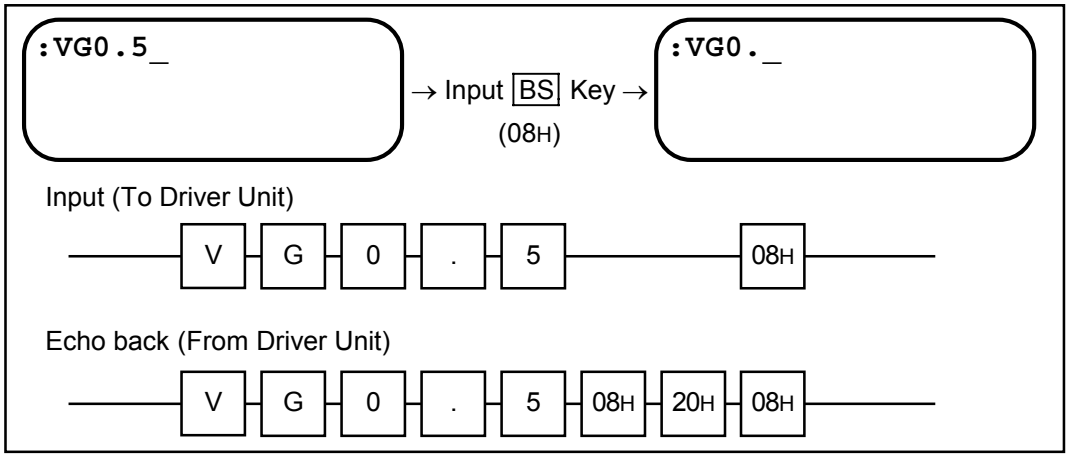
6.3.2.4. Canceling Command

- 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 [BS] key instead.

[1] Parameter "BM1" (Shipping set)

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

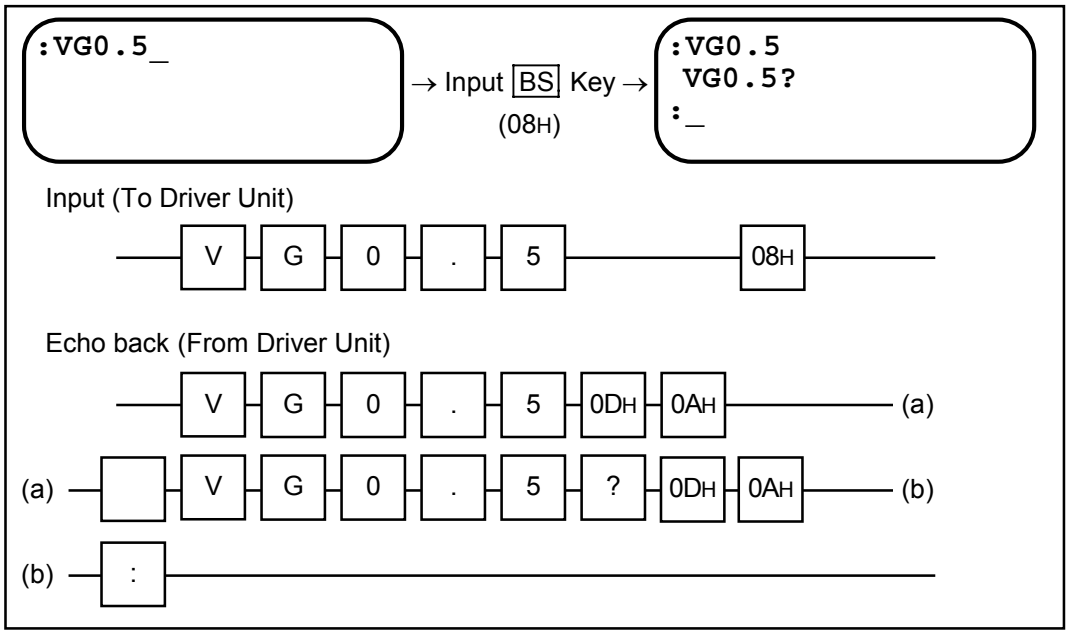
Figure 6-30 : Canceling example (BM1)



[2] Parameter "BM0"

- When the backspace code is input following "VG0.5" letter string, for an example, a message "VG0.5?" and a colon ":" are displayed and thereby delete "VG0.5".

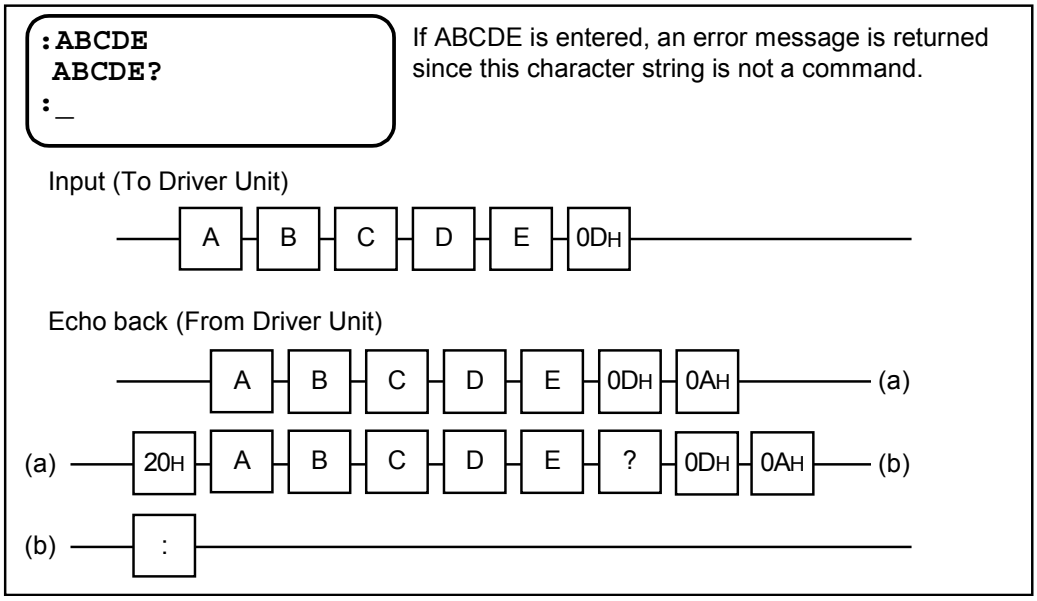
Figure 6-31: Canceling example (BM0)



6.3.2.5. Error

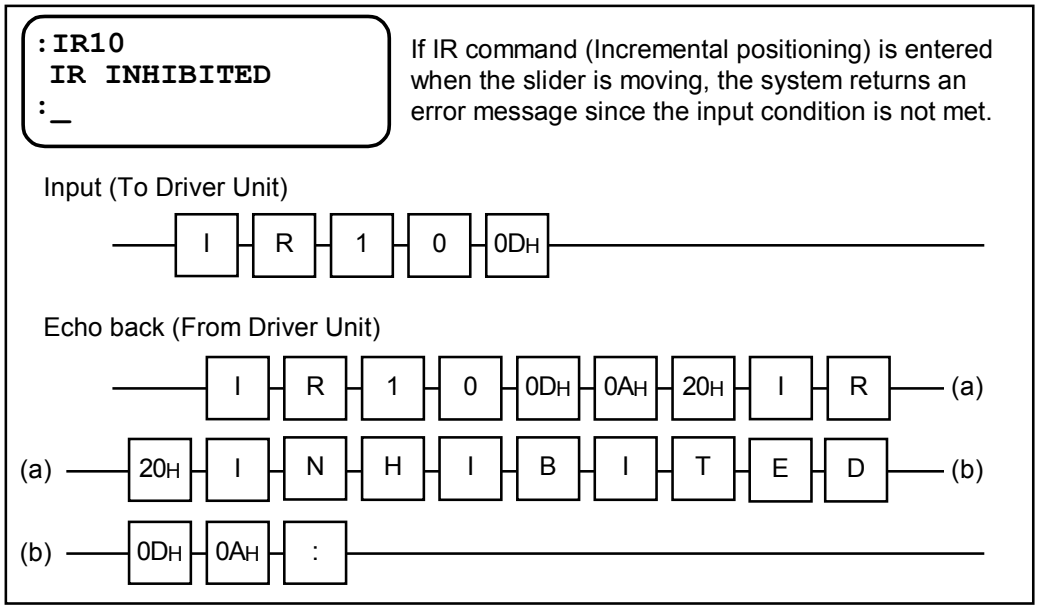
- Note that the following cases will be recognized as errors.
  1) If a command (i.e., character string) that does not exist is entered. (If an entered character string cannot be decoded.)
  2) If data or subscripts that are out of the allowable range are entered.
  3) If a command requiring the password is entered without it.
     - ◊ In any of these cases, the entered character string with a "?" code is returned as an error message. The figure below shows an example.

Figure 6-32: Input error example 1



  4) If the input condition is not met for entering a command:
     - ◊ In this case, the entered character string with "INHIBITED" is returned.

Figure 6-33: Input error example 2



6.3.2.6. Readout Command

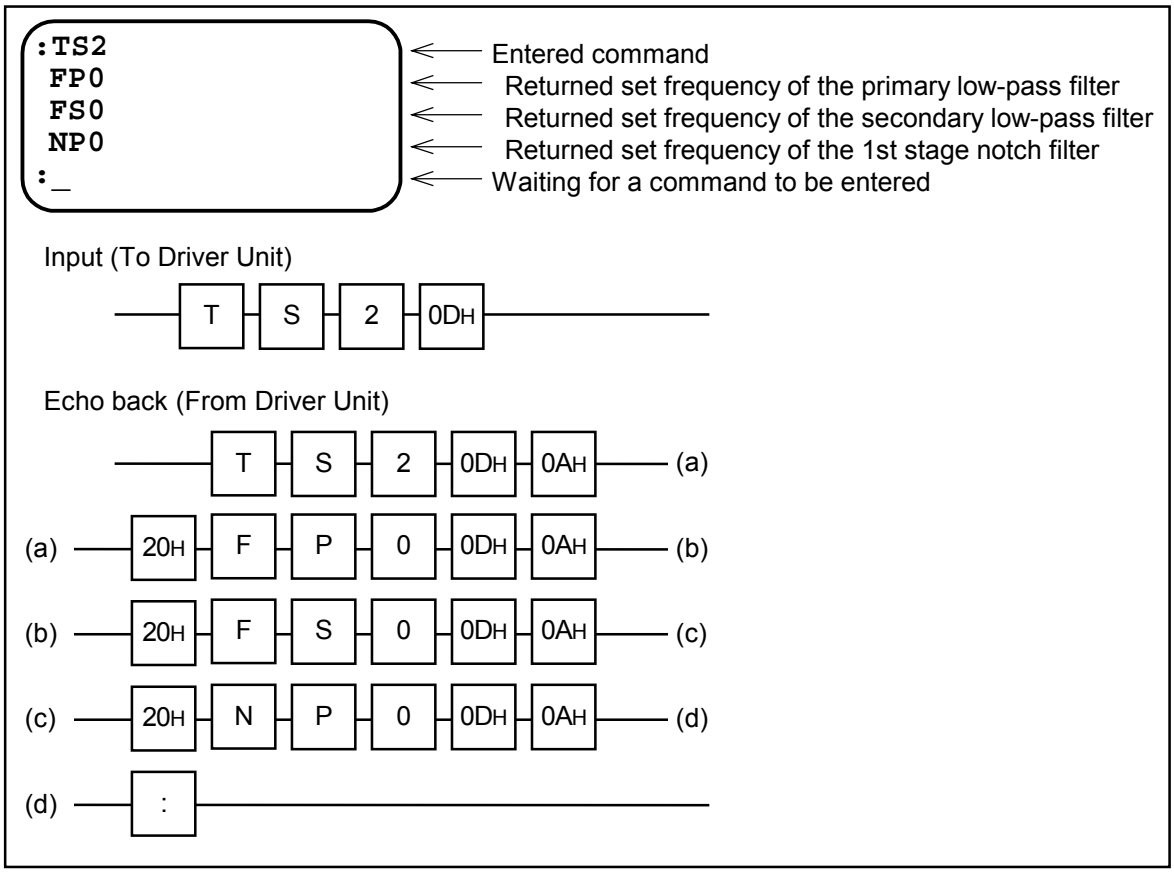
- If the readout command, which is one of the communication command provided the system, is entered to report the internal state (i.e., parameter set values, current position, etc.) of the Driver Unit, the Driver Unit returns current setting or data, etc.

- Returned data consists of "space code (20H) + read out value, data + carriage return (0DH) + line feed code (0AH)".

◆ For example;

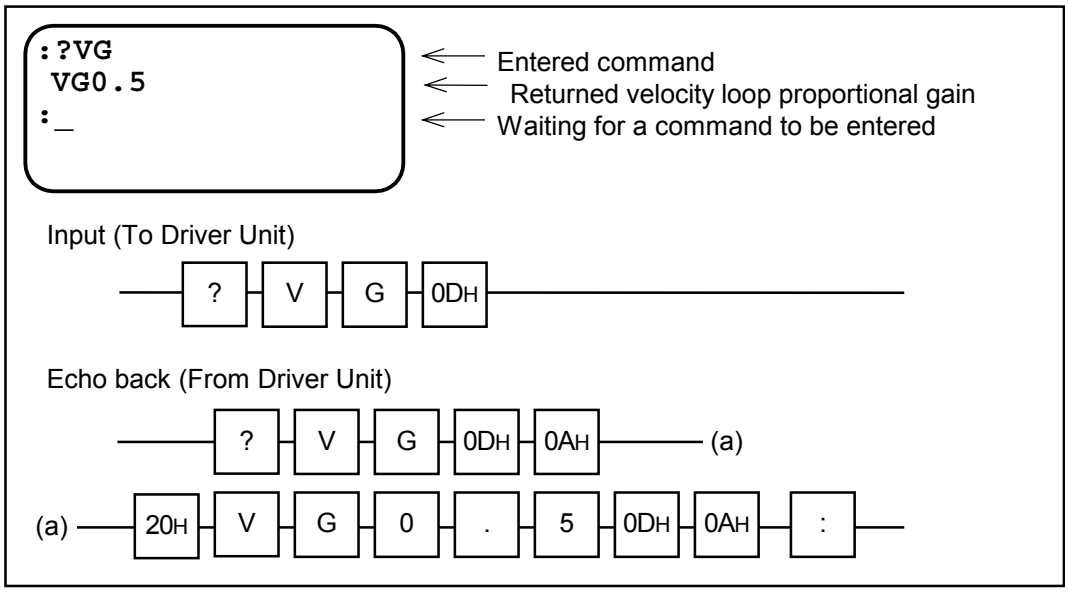
1 TS command for reading set value

Figure 6-34: TS command example



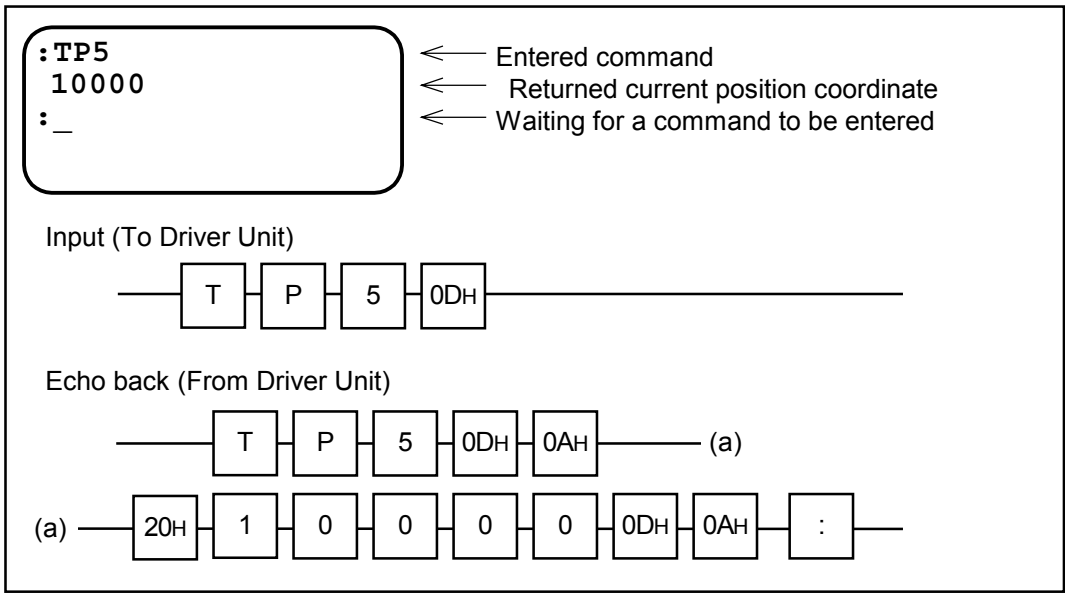
2 If set value reading function "?" is used

Figure 6-35: "?" function example



3 TP command for reading current position data

Figure 6-36: TP command example



6.3.3. Communication with Personal Computer

- This section describes how to store the parameters of Driver Unit using Hyper Terminal of communication software which is provided in *Windows 95 as standard.

- The user shall provide the communication cable. Pin-out of the D-sub 9pins connector of EDA Driver Unit is different from DOS/V machine. Refer to "2.6.1. CN1: RS-232C Serial Communication Connector" and the manual of the personal computer.

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 6-16

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 ESA Driver Unit afterwards.

*Windows is the trade mark of Microsoft Corporation for United States and other countries.

6.3.3.2. Store Parameters of ESA Driver Unit

1) Start HyperTerminal.

2) Set MM data to MM0 for continuous report mode.

3) Execute TS command and TC/AL to indicate the setting.

```
:MM0
:TS
 PG0.100
 VG2.0
 VI5.00
 (Omitted the middle part.)
 RI0.020
 ZP1.00
 ZV1.4
:TC/AL
 PH0
>TC0
 AD0
 CV2.0000
 CA5.00
 (Omitted the middle prat.)
>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 hereunder to be able to transfer it to EDB 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
VI5.00
 (Omitted partially.)
ZP1.00
ZV1.4
PH0

CH0
AD0
CV2.0000
CA5.00

CH1
AR3000
 (Omitted partially.)

CH15
```

Add a line.

6.3.3.3. Transmit Stored Parameters to ESA Driver Unit

■ Transmit the stored file to EDB Driver Unit.

1) Start HyperTerminal.

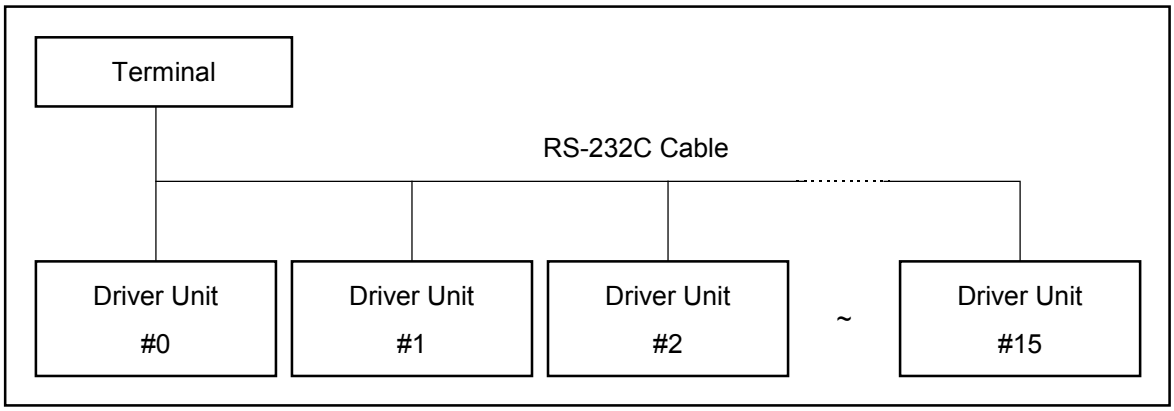
2) Transmit the file by selecting "Transfer" → "Transmit text/file."

3) Execute TS or TC/AL command to confirm that the transmission of data is successful.

6.3.4. Daisy Chain Communication

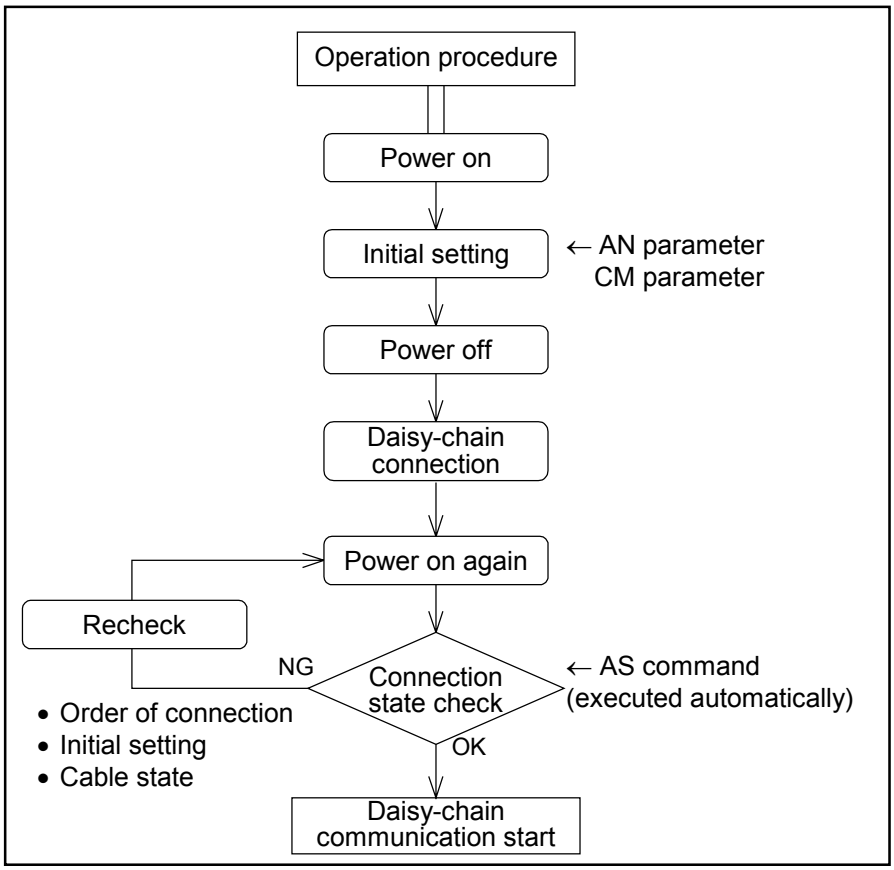
- Daisy-chain communication allows multiple Driver Units (up to 16 units) to be connected with single RS-232C terminal and a cable set.

Figure 6-37: Daisy chain communication overview



6.3.4.1. Procedure to Set Daisy Chain Communication

Figure 6-38: Daisy Chain communication setting procedure



6.3.4.2. Initial Setting

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

Table 6-13: Initial setting

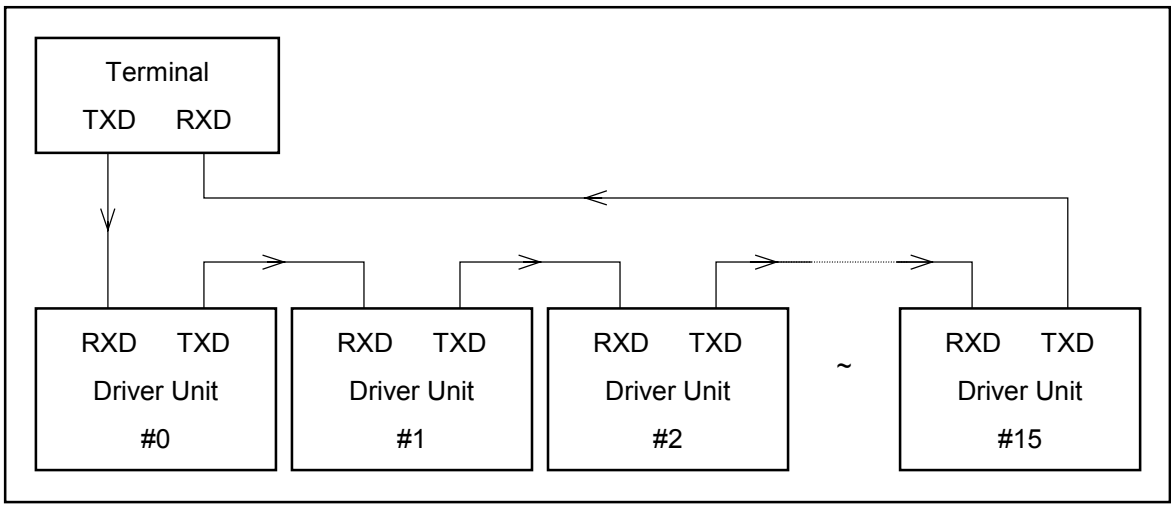
Item	RS-232C parameter	Data range	Shipping set	Function
Daisy-chain communication, axis number setting	AN data	0~15	0	The set data becomes the axis number of a daisy chain communication.
Daisy-chain communication mode selection	CM data	0, 1	0	CM0: Standard (single driver) communication, CM1: Daisy-chain communication

6.3.4.3. Interfacing

1 Connecting data communication lines

- Connect data communication lines sequentially: First connect the output of the terminal with the input of axis 0, then connect the output of axis 0 with the input of axis 1 and then one after the other. (See Figure 9-36.)
- Connect the output of the final axis with the input of the terminal.

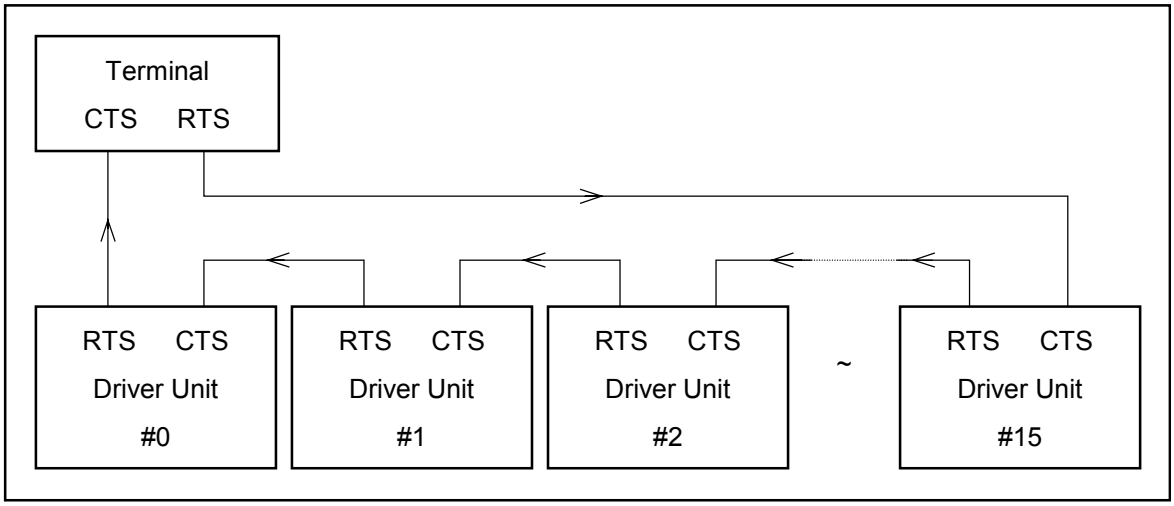
Figure 6-39: Data line connection



2 Connecting data transmission request lines

- Connect data transmission request lines sequentially: First connect the input of the terminal with the output of axis 0, then connect the input of axis 0 with the output of axis 1 and then one after the other. (See Figure 6-40.)
- Connect the input of the final axis with the output of the terminal.

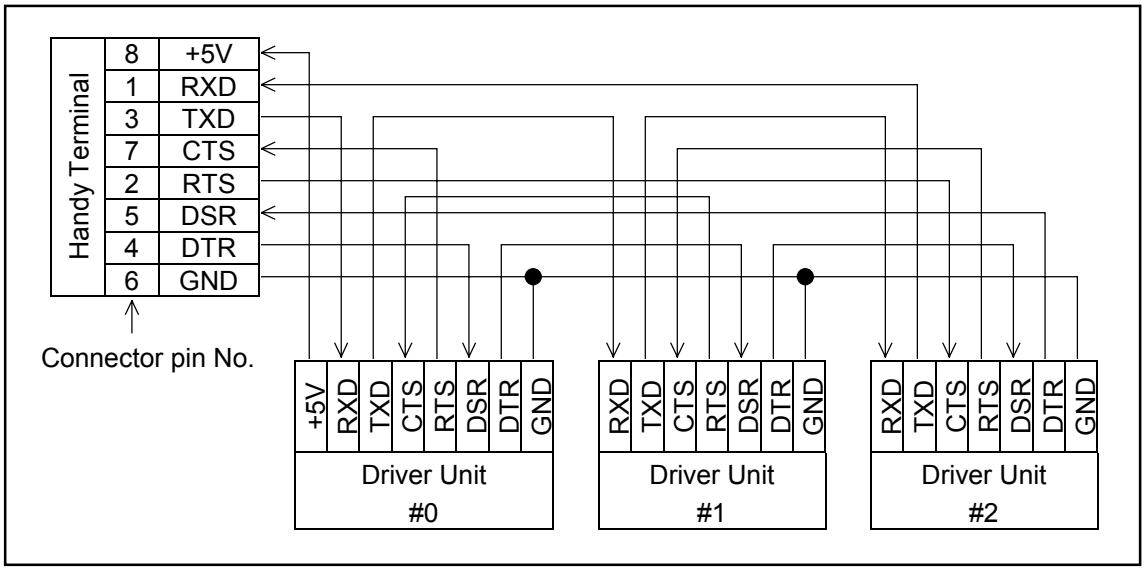
Figure 6-40: Request-to-send Line connection



◆ Actual connection example

- When NSK's Handy Terminal is in use, connect the lines as shown in Figure 6-41.
- Refer to "2.6.1. CN1: RS-232C Serial Communication Connector" for the specification of CN1.

Figure 6-41: Handy Terminal connection example



* The communication signal name on the Handy Terminal is opposite to that of the Driver Unit (e.g. RXD-TXD).

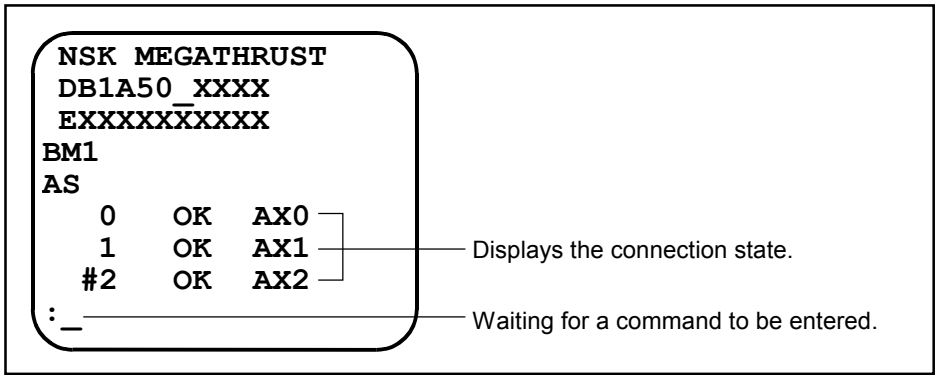
6.3.4.4. Power On

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

• *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.)*

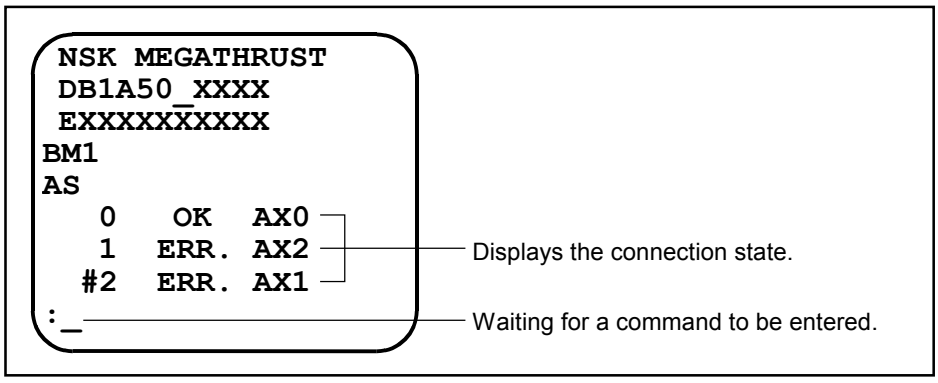
- Command AS will be executed to check for connection as soon as the power of the Driver Unit of axis No.0 is turned on.
- If all the terminal and the Driver Units are connected properly, the following message is displayed (the following examples shows a 3-axis configuration)

Figure 6-42



- 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

Figure 6-43



- If the proper message is not displayed, check for connection order, initial settings of parameters AN and CM and cable connection.

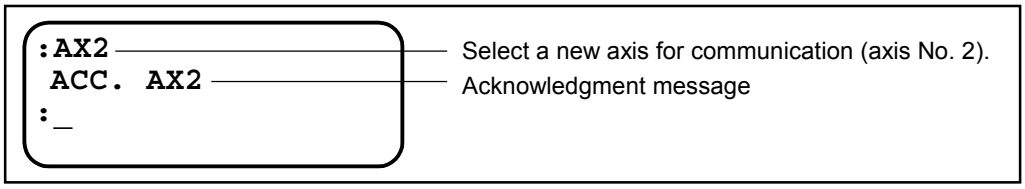
6.3.4.5. Operation

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 AX command to select one of the Driver Units connected for daisy-chain communication.

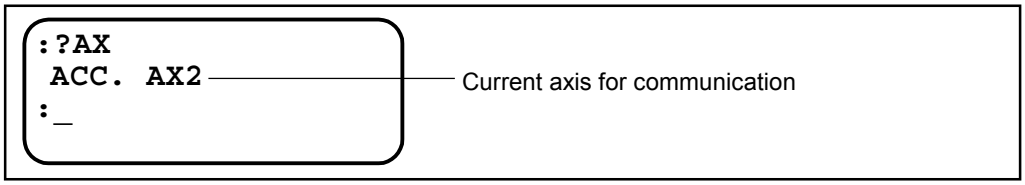
⚠ *Caution* *: Do not select any Drive Unit that is not connected. Otherwise, operation may hang up. To return to the normal state in such a case, press the* BS *key, then select the number of a connected Driver Unit.*

Figure 6-42



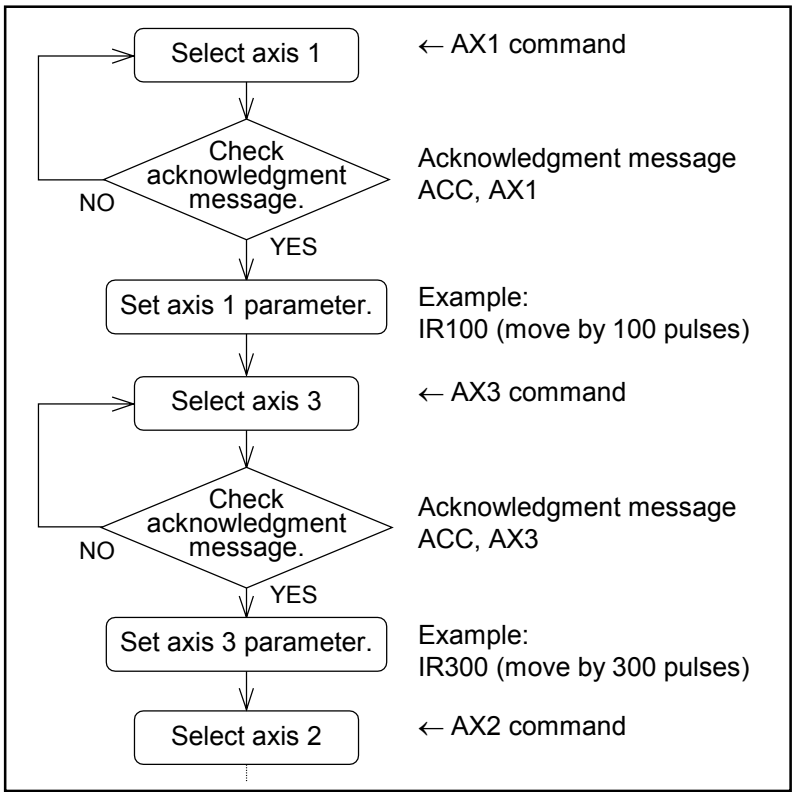
- An axis selected for communication may be checked by issuing a "?AX" command. The axis is displayed in the same manner as it is selected.

Figure 6-43



Example of Daisy-chain communication

Figure 6-44: Example of Daisy-chain communication



7.Positioning

7.1. Preparation

7.1.1. Wiring Check

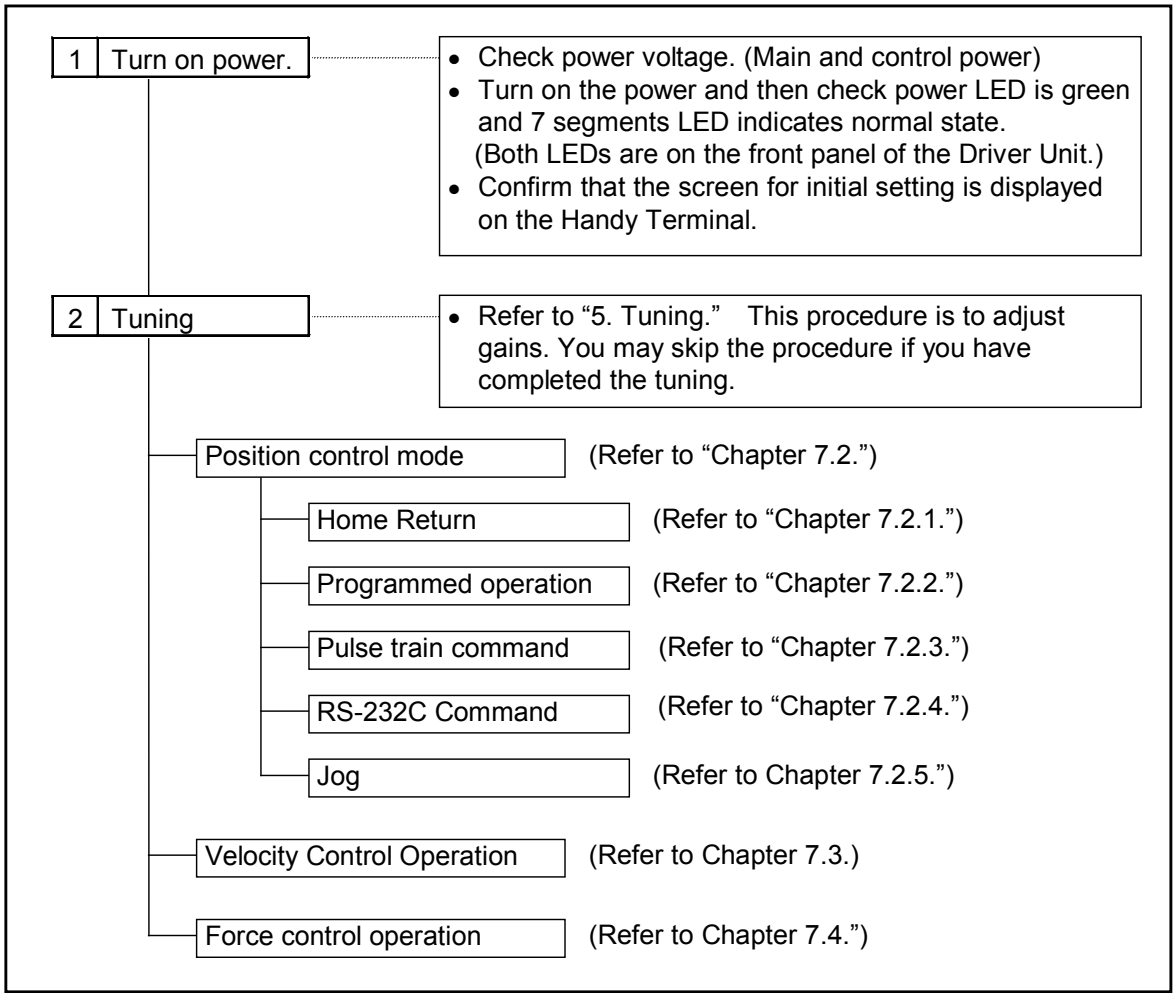
⚠ *Caution* : *When wiring of the Driver Unit completed, check items listed on Table 7-1 before operation.*

Table 7-1

No.	Check item	Description
1	Connection of main power and Input/Output circuits	• All wiring is properly arranged and completed. • If screws of the terminal block are securely fastened. • All connectors are connected and locked properly.
2	Connection cable	• Cable Set (Motor cable and Sensor cable) is connected and locked properly.
3	Handy Terminal	• The Handy Terminal (FHT –11) is connected and locked to CN1 connector.

7.1.2. Procedure for Positioning Operation

Figure 7-1



7.2. Position Control Mode Operation

- Parameter SL sets position control mode operation.
  SL1 : Thrust control mode
  SL2 : Velocity control mode
  SL3 : Position control mode

- In the position control mode, you can select following operation.
  - ◊ Home Return
  - ◊ Programmed Operation
  - ◊ Pulse train command operation
  - ◊ RS-232C communication command operation
  - ◊ Jog operation

7.2.1. Home Return

- Be sure to perform Home Return all the time except when user's master controller controls the coordinate system. Otherwise, you cannot fix the origin of the coordinate system.

- The coordinate system that is established by the Home Return will provide the position data for a positioning operation and software over travel limits.

- The origin of the position scale (Home position) will be set to the point at where the Home Return completed.

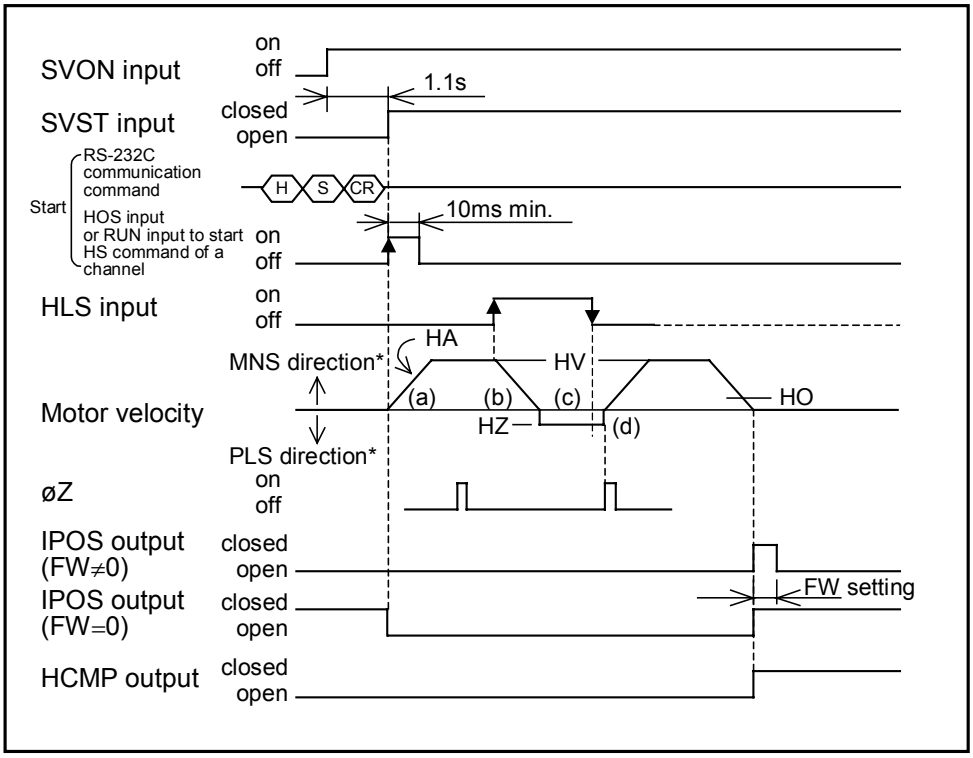
⚠ *Caution* *: Position data of the origin won't be saved at the moment of power-off. Therefore, Home Return operation is required every time the power is turned on.*

- The operation sequence of the Home Return depends on a Home Return mode.

1 Home Return Mode OS6

- Deviation of detecting position of the origin will be the minimum because the detection of home position is based on øZ of the linear scale.

Figure 7-2 : Home Return sequence



- Turn on servo of the Motor. (Input SVON ON.)
- Confirm that the servo of the Motor is on. (SVS output closed.)
- Home Return starts when HOS output is on. (a)
- The Motor starts to MNS direction* and decelerates when it enters HLS range (proximity of origin). (b)
  It reverses the moving direction and moves at the origin search velocity after deceleration. (c)
  Home Return completes when the first øZ is detected after the Motor gets out HLS (proximity of origin). (d)

  * You may change direction of Home Return motion by parameter HD.

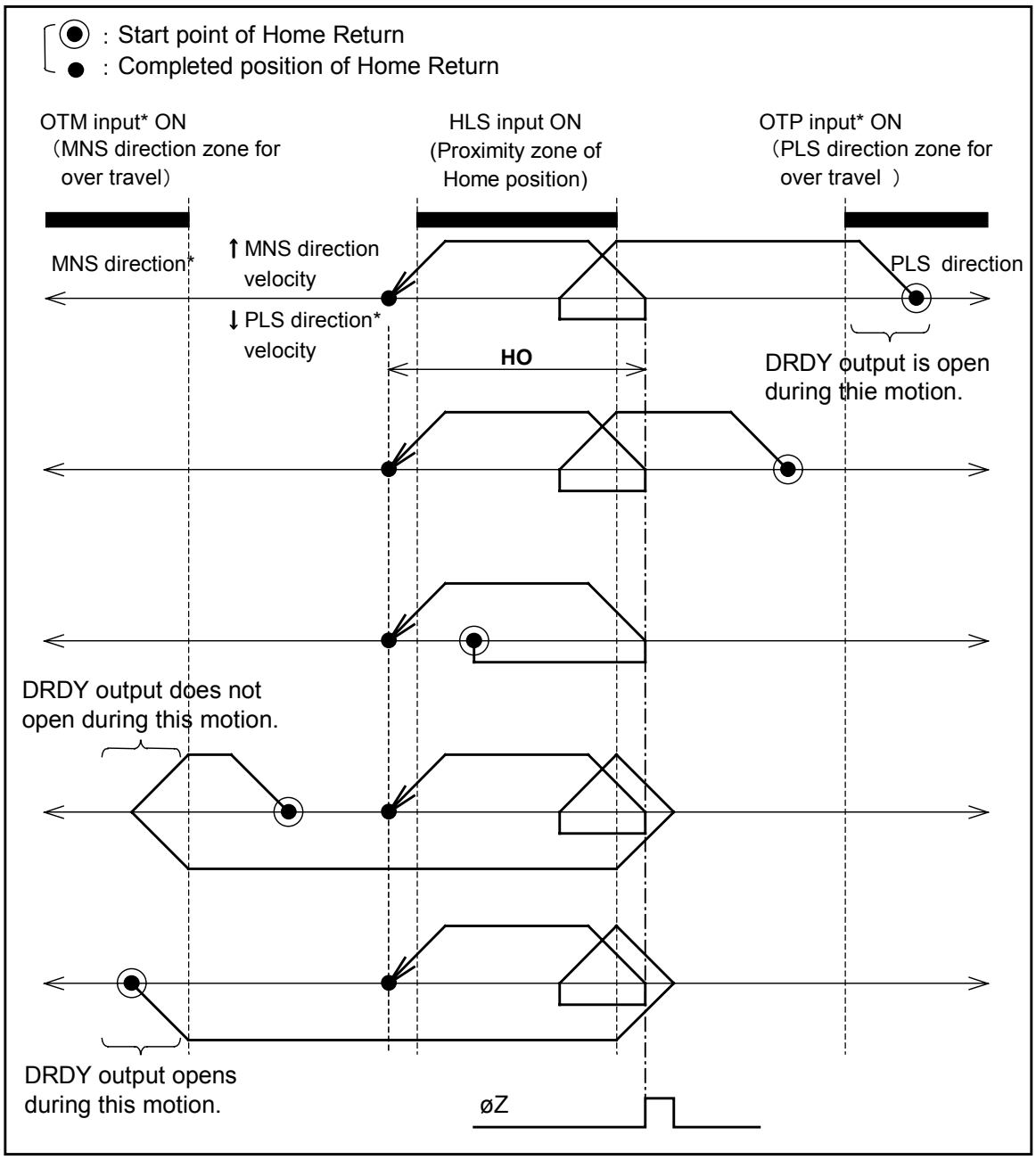
  HD0 : PLS direction

  HD1 : MNS direction (shipping set)

- If an offset value HO is set at this moment, the slider moves a distance set by HO and completes the Home Return.
- The system performs the same Home Return operation started by HOS input by inputting RUN or HS command through RS-232C terminal to a channel that is selected as it has HS command in its program.

- The sequence of Home Return operation changes as shown below depending on from where it starts.

Figure 7-3



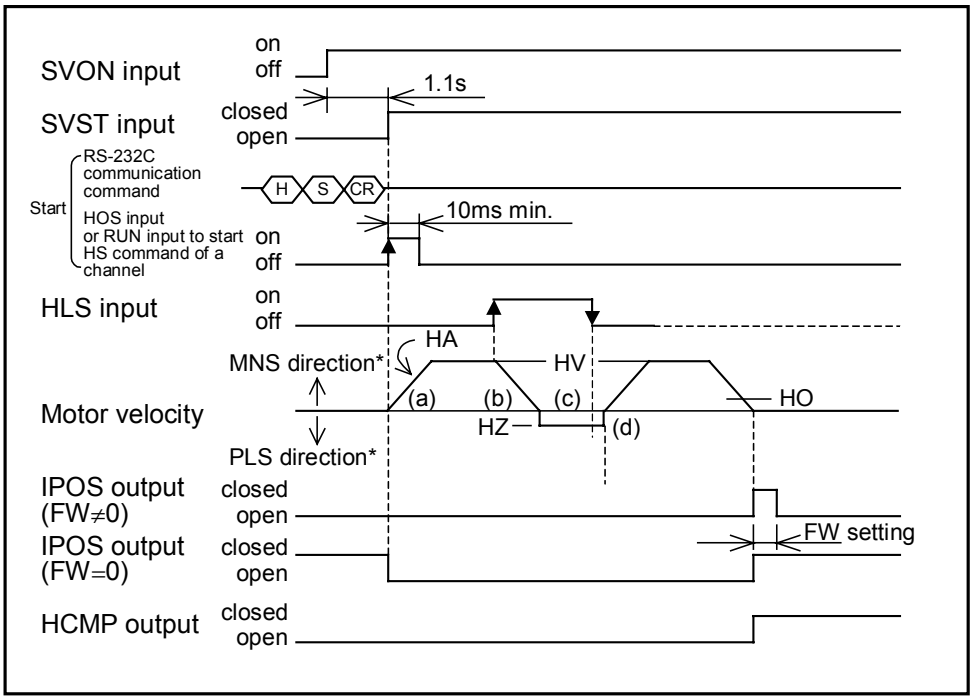
* PLS and MNS, and OTP and OTM will be switched each other respectively when parameter HD changes the direction of Home Return. [PLS → MNS and OTP → OTM]

2 Home Return Mode OS7

- This mode is to fix the Home position at where rising edge of HLS input is detected.

⚠ *Caution* : *Variation of Home position is significant because øZ is not detected. Set the Home position search velocity HZ slow as possible to make the variation minimum.*

Figure 7-4



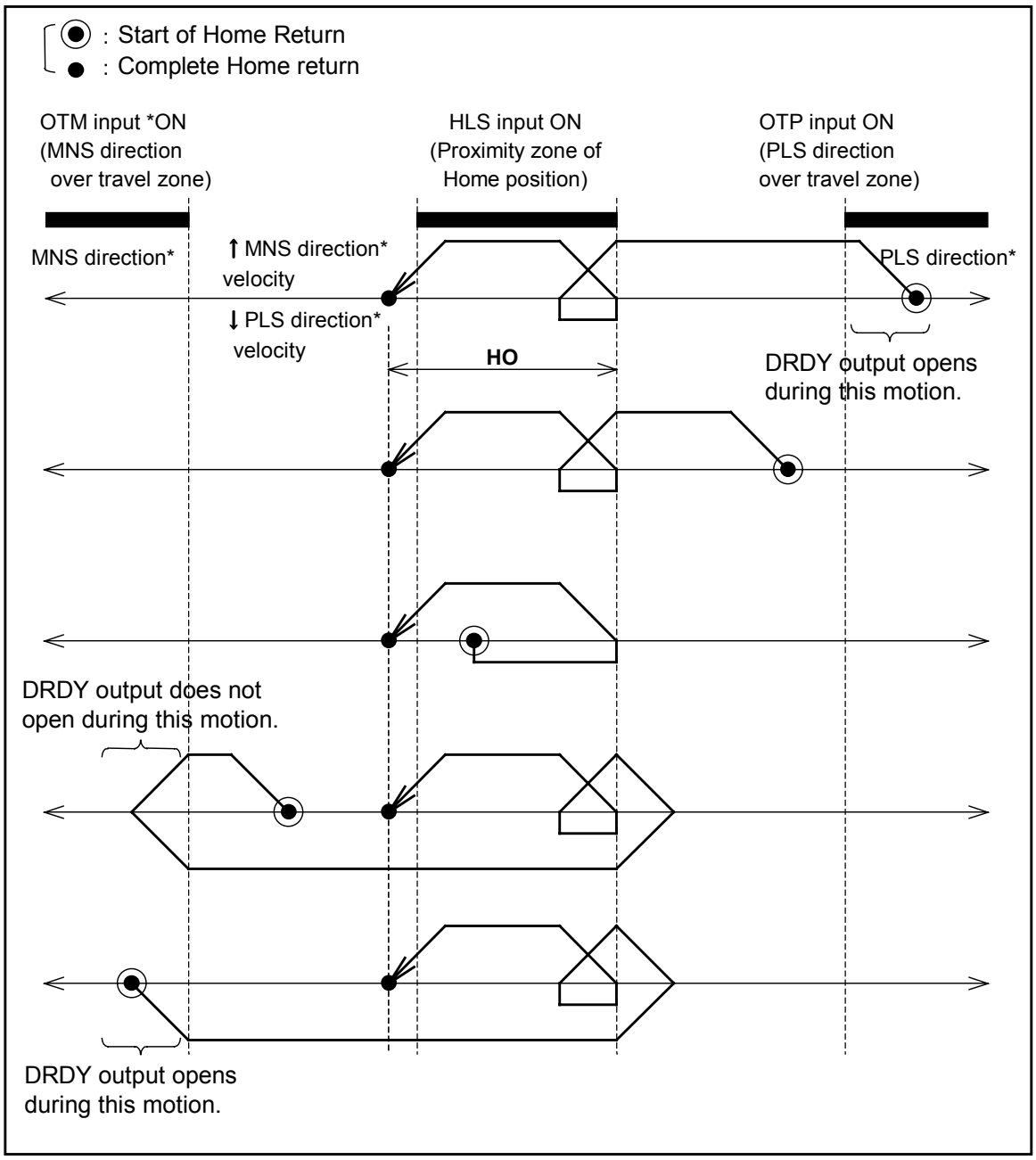
- Input servo-on command. (SVON input ON)
- Confirm that the servo is on (SVST output closed.)
- Home Return starts when HOS input is ON. (a)
- The Motor starts to MNS direction* and decelerates when it enters in HLS zone (Home position proximity zone) (b)
  It reverses moving direction and moves under Home position search velocity when deceleration completes. (c)
  Home Return completes when the Motor gets out HLS zone (proximity zone of Home position). (d)

  * Parameter HD changes moving direction.
  HD0 : PLS direction
  HD1 : MNS direction (Shipping set)

- If the Home offset HO is set, the Motor moves a distance HO from the Home position and completes the Home Return.
- The system performs the same Home Return operation started by HOS input by inputting RUN or HS command through RS-232C terminal to a channel that is selected as it has HS command in its program.

- The sequence of Home Return operation changes as shown below depending on from where it starts.

Figure 7-5



* PLS and MNS, and OTP and OTM will be switched each other respectively when parameter HD changes the direction of Home Return. [PLS → MNS and OTP → OTM]

7.2.1.1. Parameter List of Home Return

Table 7-2 : Parameter list of Home Return

Readour	Item	Parameter	Unit	Data range	Initial set	Remarks
TS7	Home Return acceleration	HA	M/s^2	0.1 ~ 50.0	HA0.5	
TS7	Home Return velocity	HV	mm/s	0.1 ~ 2000.0	HV100.0	Sensor resolution 1.0 [μm]
				0.1 ~ 1500.0		Sensor resolution 0.5 [μm]
TS7	Home Return search velocity	HZ	mm/s	0.1 ~ 100.0	HZ5.0	
TS8	Home position offset	HO	μm	–30000000.0 ~ +30000000.0	HO0.0	
TS8	Home Return direction	HD	—	0: Plus; 1: Minus	HD1	
TS8	Home return mode	OS	—	6, 7	OS6	Uses ø Z of linear scale.
				7	OS7	Does not use ø Z of scale
TC/AL	Automatic Home Return	PH	—	0:valid ; 1: invalid	PH0	

7.2.1.2. Adjustment of Home Position Limit Switch and Home Return Offset

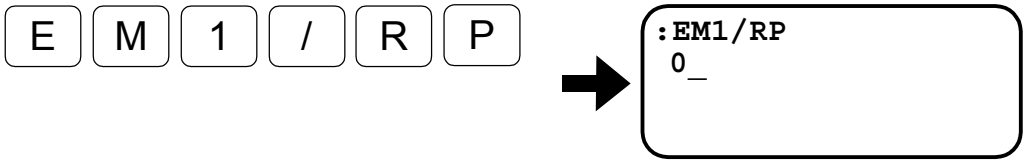
◆ Adjustment of Home Position Limit Switch (Only for Home Return mode OS6)

- When Home Return mode is OS6 (The mode uses øZ for yardstick.), it requires a minor position adjustment of Home position sensor against the reference mark.
  Follow the procedure described below to make fine adjustment of distance between detecting point of Home position sensor and detecting position of øZ by reference mark.

1) Set the reference mark to the position where the Home position is set.

2) Check that øZ is outputted normally by EM command.

(1) Execute EM1/Rpcommand.

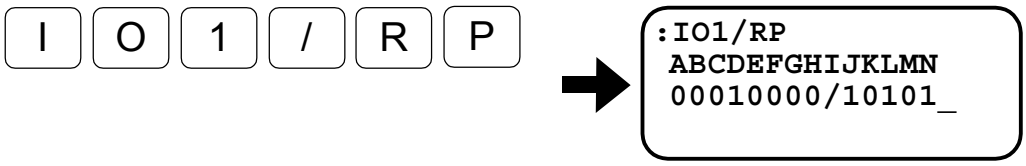


Observe that the data of readout changes 0 to 1 alternatively every time the øZ by the reference mark is detected.

3) Set the Home position sensor temporarily.

4) Check the wiring of the Home position sensor.

(1) Execute IO1/RP command.



Forth digit from the left changes to “1” when the Home position sensor is detected.

5) Make fine position adjustment of the Home position sensor. Execute HS/LS command after the power is turned on. Be careful as the Motor starts immediately the Home Return operation.

(1) Input HS/LS command.

(2) The Motor starts the Home Return as soon as ENT key is pressed.

When the Home Return completes, the screen displays distance between the detected positions of HLS and øZ, and reports you "OK" or "ERROR" as the result.

In case of "OK" : This denotes that the result is acceptable because the distance is 2000 [μm] or more and has enough clearance.

In case of "ERROR" : This denotes that the result is not acceptable because the distance is too close. Put the Home position sensor away from the reference mark, and then repeat the procedures (1) to (2) again.

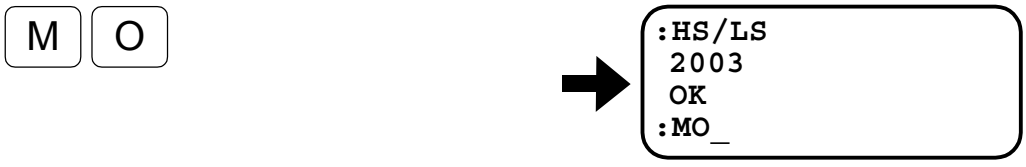
◆ Adjust Offset of Home Return

Follow the procedures to adjust an offset value of Home Return.

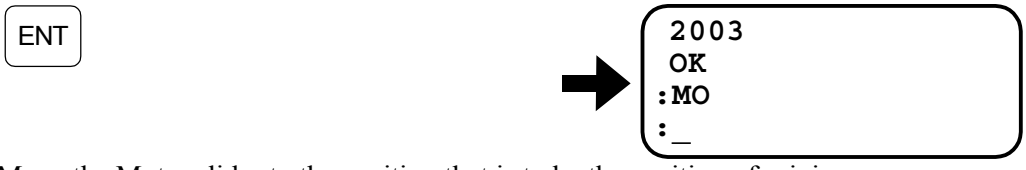
(1) Input HS／LS command.

(2) The Motor starts Home Return operation as soon as the ENT key is pressed.

(3) MO command is to make the servo off.



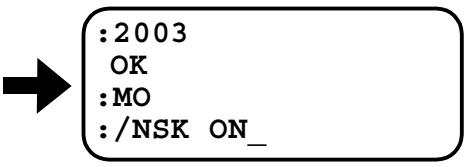
(4) The Motor servo is off as soon as the ENT key is pressed.



Move the Motor slider to the position that is to be the position of origin.

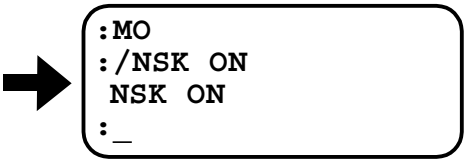
(5) Input the password.

/ N S K SP
O N



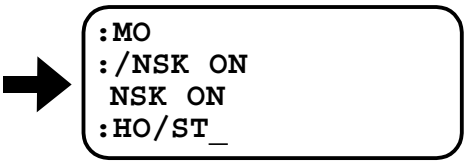
(6) Press ENT key.

ENT



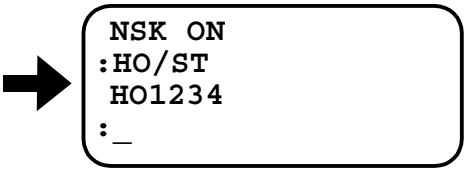
(7) HO/ST command makes to calculate automatically the offset value HO and save it.

H O / S T



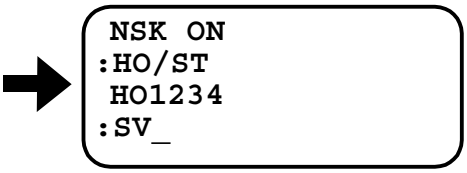
(8) Press the ENT key for execution. When ": __" appears, HO setting is automatically decided from the current position.

ENT



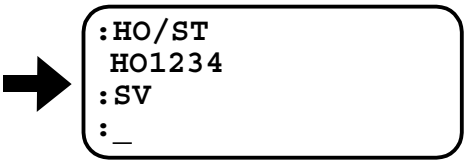
(9) SV command is to make the Motor servo on.

S V



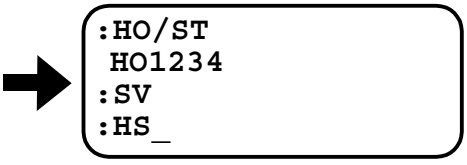
(10) The Motor servo will be on when the ENT is pressed.
":__" appears for confirmation.

ENT



(11) HS command is for the Home Return.

H S



(12) The Home Return starts with entry of ENT key.

Confirm that the Motor slider stops at the position you have set.

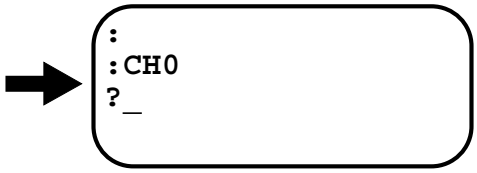
7.2.1.3. Programming Home Return Operation (example)

1 Programming Home Return command to Channel 0 (CH0)

- In this case, program the Home Return command to a program channel. This enables to start the Home Return by activating the channel program (i.e., RUN input ON).
  The "?" prompt appears to wait for data input. If you have programmed data to the channel CH0 the programmed data appears on the display.

  (1) Input CH0 for channel selection to start editing.

  C H 0 ? ENT

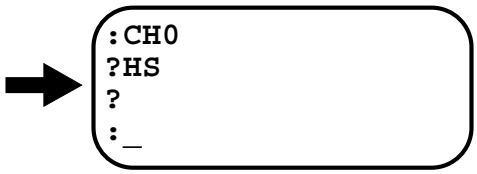
  (2) Write the Home Return start command.

  H S ENT

  (3) When the "?" prompt appears again, press the ENT key. This completes the programming CH0.

  ENT

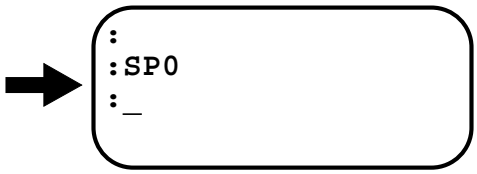
2 Home Return trial operation

- When setting of Home Return acceleration HA, Home Return velocity HV or Home Return offset HO are changed. Take the following steps to perform the trial operation.

  (1) Make the Motor servo-on.

  (2) Following the prompt (:), input the execution command of internal program.
  The Motor starts Home Return operation.

  S P 0 ? ENT

7.2.2. Programmed Operation

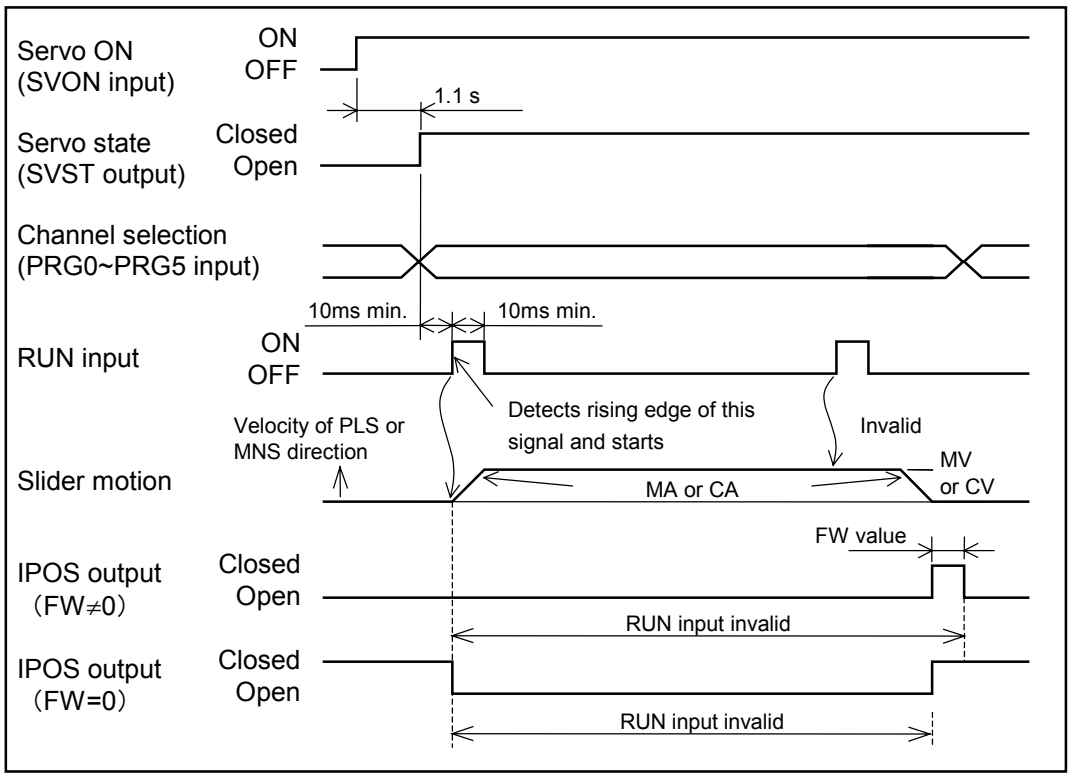
- Programmed operation is to execute programs that are stored in the Driver Unit. Input of RUN command with selecting instruction of PRG0 ~ PRG5 will start a programmed operation.
- Set the system to servo-on. (SVON input ON)
- Confirm that the servo is on.
- Select channels. (Input PRG0 ~ PRG5.)
- By inputting RUN command ON, the Motor execute stored positioning program and IPOS output is closed. (When FW=0)
- When the Motor is performing the positioning operation, another input of the RUN command will be ignored.
- Input the command "SP" to execute an internal program. (This is the same function as inputting RUN command ON.)

  Type

  [S] [P] [m] [ENT]

  to execute the channel "m" program. (m: channel number)

Figure 7-6 : Sequential timing of a programmed operation



- When an empty channel is selected, the program error alarm will be ON. (Refer to "11. Alarms.")

7.2.2.1. Internal Program Channel Selection

- Combination of ON and OFF of PRG0 to 5 inputs will select a channel to be executed.

Table 7-3 : Selection table of 62 channels

Channel input	PRG 5	PRG 4	PRG 3	PRG 2	PRG 1	PRG 0
Channel 0	ON	ON	ON	ON	ON	ON
Channel 1	ON	ON	ON	ON	ON	OFF
Channel 2	ON	ON	ON	ON	OFF	ON
•	•	•	•	•	•	•
•	•	•	•	•	•	•
•	•	•	•	•	•	•
Channel 61	OFF	OFF	OFF	OFF	ON	OFF
Channel 62	OFF	OFF	OFF	OFF	OFF	ON
Channel 63	OFF	OFF	OFF	OFF	OFF	OFF

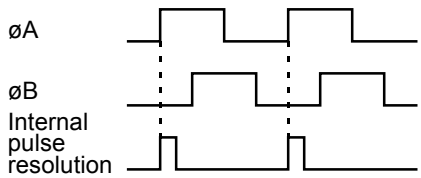
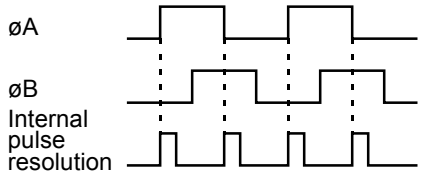
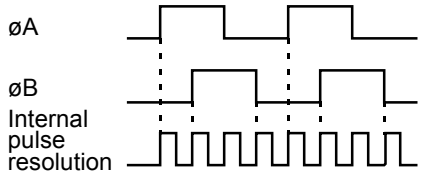
7.2.3. Pulse Train Command

7.2.3.1. Pulse Train Signal Format

- Input a pulse train through PLSP and MNSP of CN2 connector.
- Parameter PS (via RS-232C communication) sets pulse train input signal format. The password is required to set the parameter PC.)

Table 7-4

<table>
<tr><th>PC Parameter</th><th>PLSP input</th><th>MNSP input</th><th>Function</th></tr>
<tr><td>PC0
(shipping set)</td><td>• Input PLS direction pulse.</td><td>• Input MINS direction pulse.</td><td>PLS & MNS format</td></tr>
<tr><td>PC1</td><td>• Input the direction.
ON : MNS direction
OFF : PLS direction</td><td>• Input pulse train.</td><td>Pulse & direction format</td></tr>
<tr><td>PC2</td><td rowspan="3">• Input øB

Direction of motion changes depending on relation of phase øA and øB.
Leading phase øA: PLS direction
Leading phase øB: MNS direction</td><td rowspan="2">• Input øA</td><td>øA/øB format (× 1)
 
</td></tr>
<tr><td>PC3</td><td>øA/øB format (× 2)
 
</td></tr>
<tr><td>PC4</td><td></td><td>øA/øB format (× 4)
 
</td></tr>
</table>

⚠ *Caution* *: Maximum input frequency of pulse train will be:*

PLS&MNS and pulse and direction mode : 800kpps

øA/øB inputting format : 200kpps

7.2.3.2. Resolution of Pulse Train

- Set resolution of pulse train signal with parameter CR (RS-232C communication).
- In case of øA/øB input format, resolution of pulse train is duplicated by the parameter PS, and furthermore, parameter CR duplicates its result again.
- Refer to Table 7-5 for actual resolution setting.

Figure 7-7

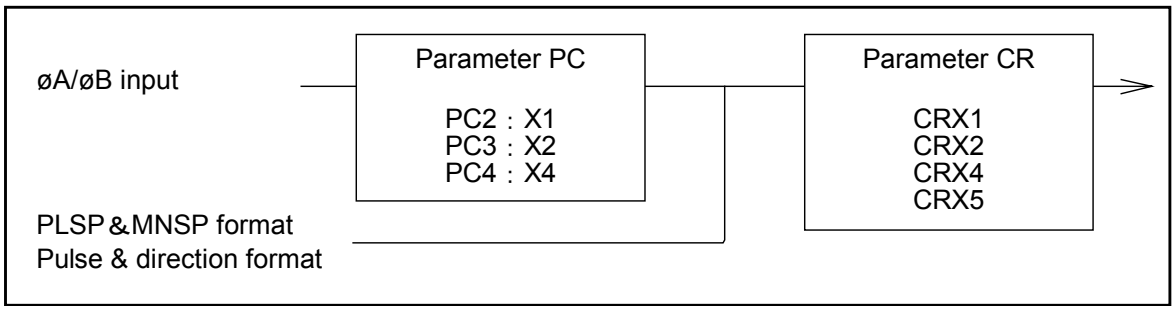
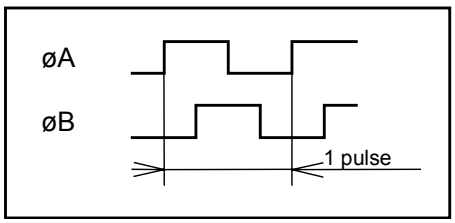


Table 7-5 : Pulse train resolution

Parameter CR	Position sensor resolution	Pulse train input format		
		PLS&MNS format (PC0) Pulse & direction (PC1)	øA/øB input format ×1 (PC2), ×2 (PC3), ×4 (PC4)	
CRX1 (Shipping set)	0.5 µm	0.5 µm/pulse	×1	0.5 µm/pulse
			×2	1.0 µm/pulse
			×4	2.0 µm/pulse
	1.0 µm	1.0 µm/pulse	×1	1.0 µm/pulse
			×2	2.0 µm/pulse
			×4	4.0 µm/pulse
CRX2	0.5 µm	1.0 µm/pulse	×1	1.0 µm/pulse
			×2	2.0 µm/pulse
			×4	4.0 µm/pulse
	1.0 µm	2.0 µm/pulse	×1	2.0 µm/pulse
			×2	4.0 µm/pulse
			×4	8.0 µm/pulse
CRX4	0.5 µm	2.0 µm/pulse	×1	2.0 µm/pulse
			×2	4.0 µm/pulse
			×4	8.0 µm/pulse
	1.0 µm	4.0 µm/pulse	×1	4.0 µm/pulse
			×2	8.0 µm/pulse
			×4	16.0 µm/pulse
CRX5	0.5 µm	2.5 µm/pulse	×1	2.5 µm/pulse
			×2	5.0 µm/pulse
			×4	10.0 µm/pulse
	1.0 µm	5.0 µm/pulse	×1	5.0 µm/pulse
			×2	10.0 µm/pulse
			×4	20.0 µm/pulse

- In case of øA/øB input format, one cycle of øA or øB is defined as “one pulse.”

Figure 7-8



7.2.3.3. Timing of Pulse Train Input

⚠ *Caution* : *The following figures show the specification of pulse acceptance timing. Besides these specifications, the Motor operation is restricted by the maximum velocity. Do not input pulses that exceed the Motor's maximum velocity.*

Figure 7-9 : When PC is set to "0" (PC0)

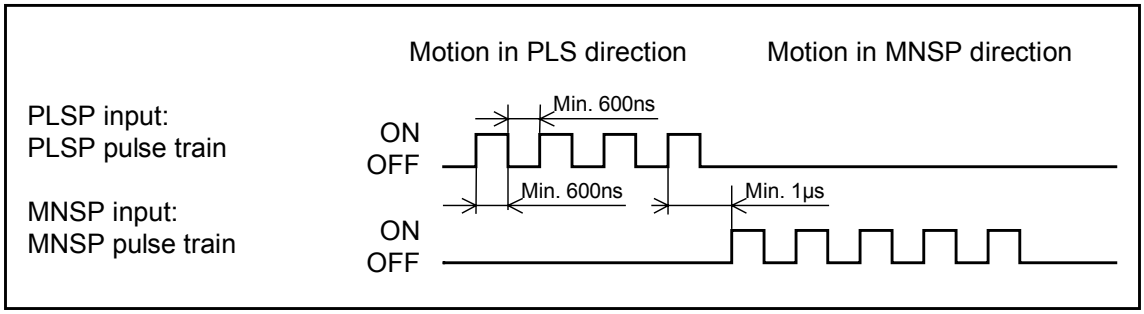


Figure 7-10 : When PC is set to 1 (PC1)

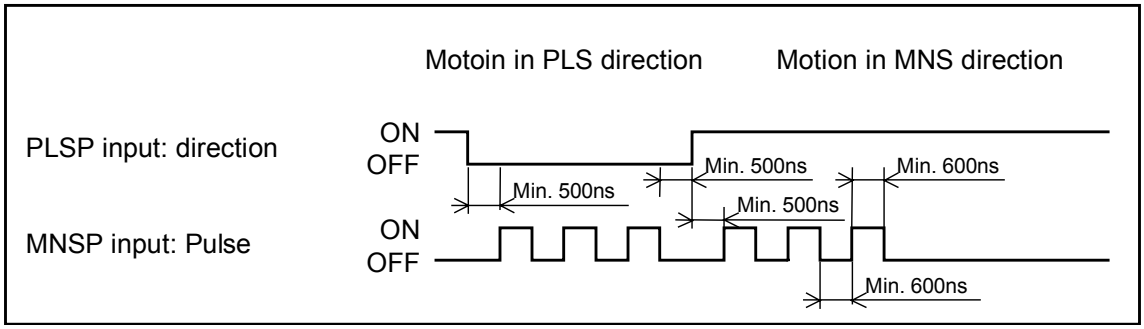


Figure 7-11: When PC is set to 2 ~ 4 (PC2 ~ PC4)

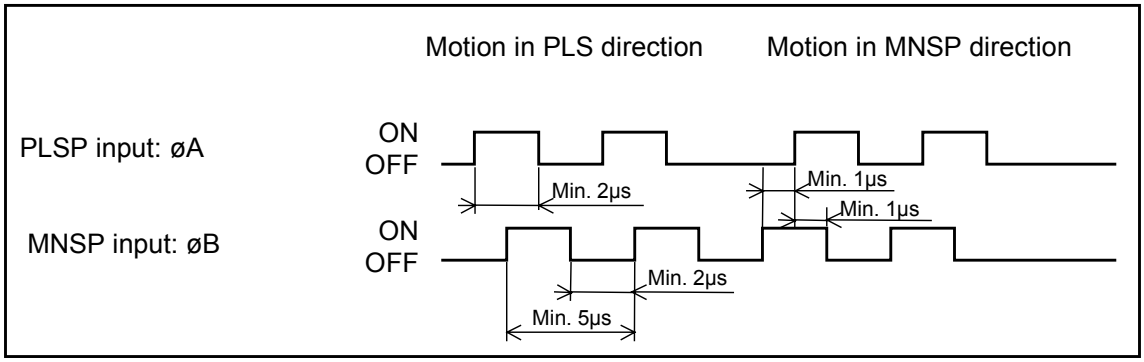


Table 7-6: Pulse train input format and velocity

Pulse train input *1	Multiplication *2	Position sensor resolution μm/pulse	Maximum Motor velocity Mm/s	Maximum input pulse frequency kpps	Maximum motion velocity mm/s
PLS & MNS format	×1	0.5	1500	800	400
	×2			800	800
	×4			750	1500
	×5			600	1500
	×1	1.0	2000	800	800
	×2			800	1600
	×4			500	2000
	×5			400	2000
Pulse & Direction format	×1	0.5	1500	800	400
	×2			800	800
	×4			750	1500
	×5			600	1500
	×1	1.0	2000	800	800
	×2			800	1600
	×4			500	2000
	×5			400	2000
øA/øB input format (×1)	×1	0.5	1500	200	100
	×2			200	200
	×4			200	400
	×5			200	500
	×1	1.0	2000	200	200
	×2			200	400
	×4			200	800
	×5			200	1000
øA/øB input format (×2)	×1	0.5	1500	200	200
	×2			200	400
	×4			200	800
	×5			200	1000
	×1	1.0	2000	200	400
	×2			200	800
	×4			200	1600
	×5			200	2000
øA/øB input format (×4)	×1	0.5	1500	200	400
	×2			200	800
	×4			187.5	1500
	×5			150	1500
	×1	1.0	2000	200	800
	×2			200	1600
	×4			125	2000
	×5			100	2000

*1: Parameter PS sets the input format.

*2: Parameter CR sets multiplication.

7.2.4. Positioning by RS-232C Communication

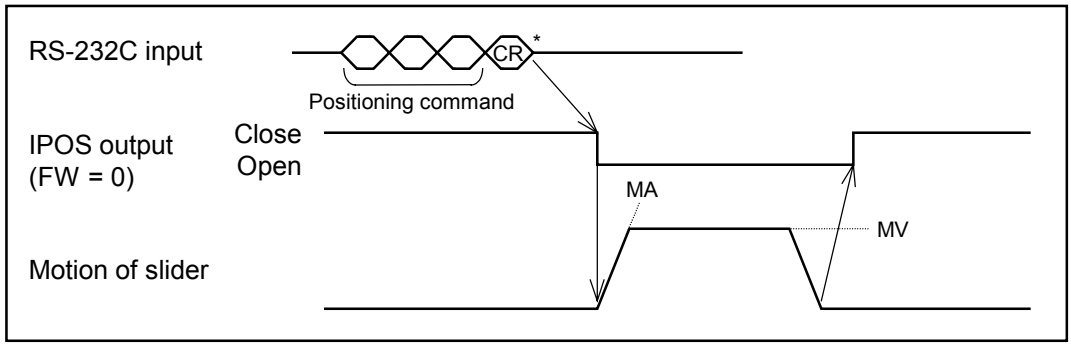
- You can operate positioning directly through the RS-232C communication commands. The table below is the list of commands and parameters related to RS-232C communication. Refer to "9.Command and Parameter" for more details.

Table 7-7

Command/Parameter	Function
IR command	Sets moving distance and execute operation. (Incremental format/Unit μm)
AR command	Sets moving distance and execute operation. (Absolute format/Unit μm)
HS command	Starts Home Return.
Parameter HV	Sets Home Return velocity.
Parameter HA	Sets Home Return acceleration.
Parameter HO	Sets Home Return offset.
Parameter HD	Specifies Home Return direction
Parameter MA	Sets positioning acceleration,
Parameter MV	Sets positioning velocity.

Timing of Positioning Operation

Figure 7-12 : Positioning signal timing



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

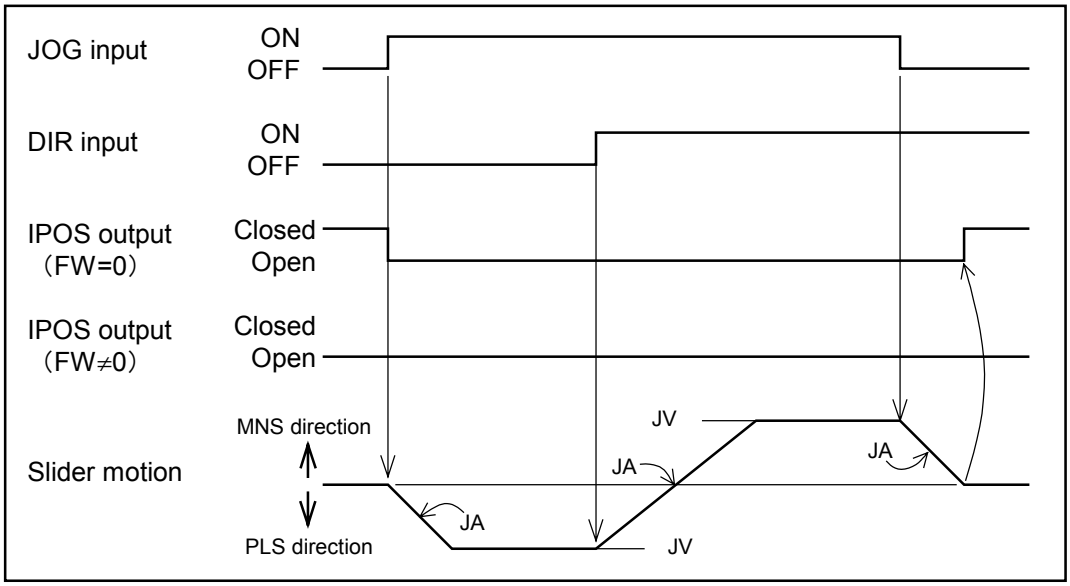
- Turn the SVON input on and then input the command. The Motor starts positioning immediately. The acceleration and velocity follow the setting of parameters "MA" and "MV."

- The Driver Unit outputs IPOS signal when variation of the position error counter is less than the In-position criterion after the positioning command stops.

7.2.5. Jog Operation

- Turn the servo on. (SVON input ON.)
- Confirm that the servo is on. (SVST output closed)
- The Motor accelerates the slider and starts its operation when JOG input is ON, and continues its motion till the JOG command is OFF. When it is turned OFF, the Motor decelerates and stops.
- The slider moves to PLS direction when DIR input is OFF, while it moves to MNS direction when DIR is ON.
- Parameters for Jog operation.
  JA : JOG acceleration
  JV : JOG velocity

Figure 7-13 : Signal timing of Jog operation



⚠ *Caution* : *When the DIR input is switched in the middle of the Motor operation as shown in the above chart, the Motor decelerates, and then reverses its moving direction.*

7.3. Operation of Velocity Control Mode

- Parameter SL sets velocity control mode.
  SL1 : Thrust control mode
  SL2 : Velocity control mode
  SL3 : Position control mode

- In the velocity control mode, you may select either RS-232C communication or analog command operation.

- Parameters select the operation.
  AC0 : Analog command is invalid.→ DC command is valid.
  AC1 : Analog command is valid. → Input polarity: "+ voltage" is for MNS direction.
  AC-1 : Analog command is valid. → Input polarity: "+ voltage" is for PLS direction.

7.3.1. Operation of RS-232C communication

- The velocity of Motor can be directly controlled by RS-232C communication command in the velocity control mode operation.

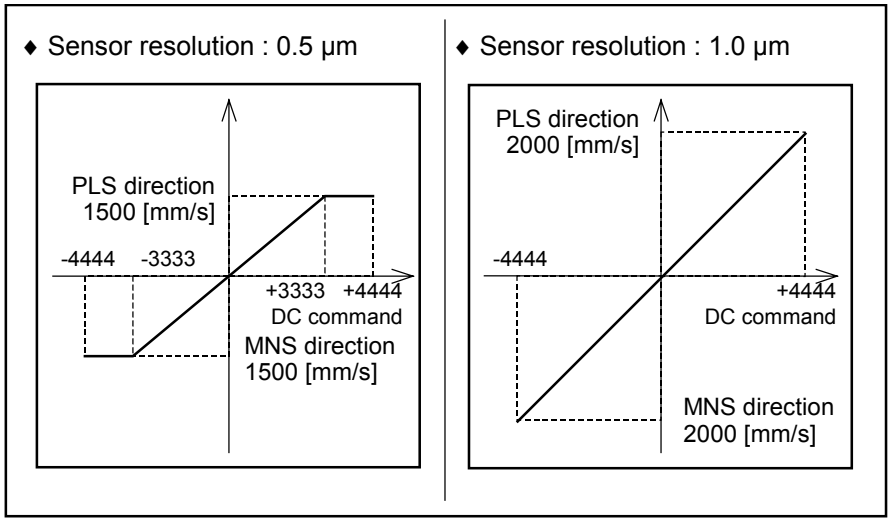
- Setting of parameter AC (AC0) will make DC command valid.
  Input the command as shown below.

  D C (data) ENT

  The command controls the velocity of the Motor proportional to the data.

- Relation between the velocity and the data of DC command is shown in the figure below.

Figure 7-14



⚠ *Caution* : *If the direction of coordinate system is reversed by parameter DI, the directional signs of the DC command will be reversed as well.*

7.3.2. Operation of Analog Command

- The velocity of Motor can be directly controlled by analog command in the velocity control mode operation.
  - ◊ Range of analog command voltage is ± 10V. You may offset the command voltage using a pot on the front panel (VR1) or setting of parameter AF. (Refer to "7.5. Set Voltage Offset of Analog Command.")
  - ◊ You may set dead band to the command voltage. (Refer to Figure 7-17.)
  - ◊ You may select polarity of command voltage using parameter AC. (Refer to Table 7-8.)
  - ◊ Relation between the command voltage and velocity may be changed by parameter AGV. (Refer to figure 7- 16.)
  - ◊ You may set limitation to steep change of acceleration and deceleration due to velocity command. (Refer to "7.3.3. Function to Limit Acceleration / Deceleration.)

Table 7-15

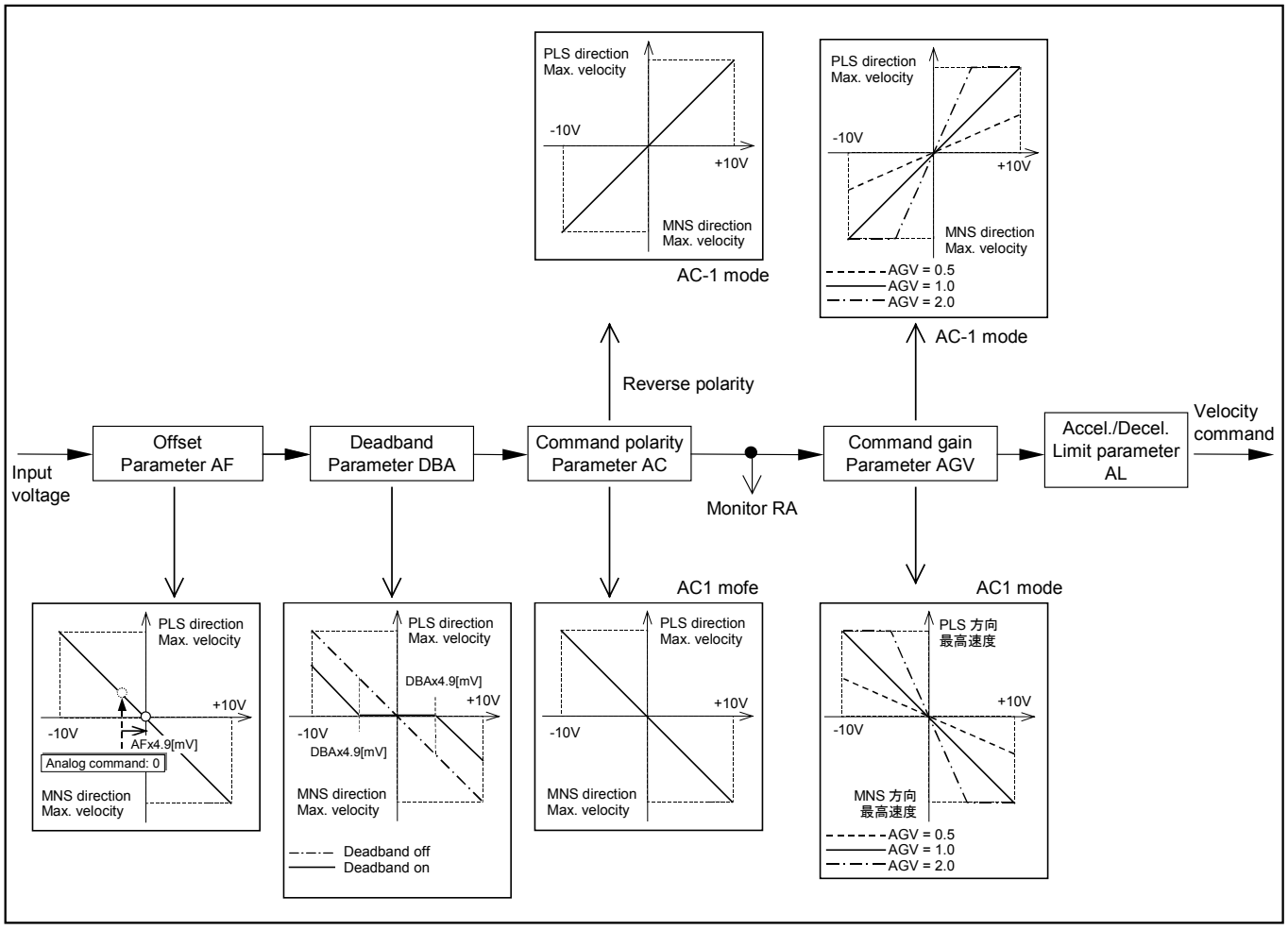
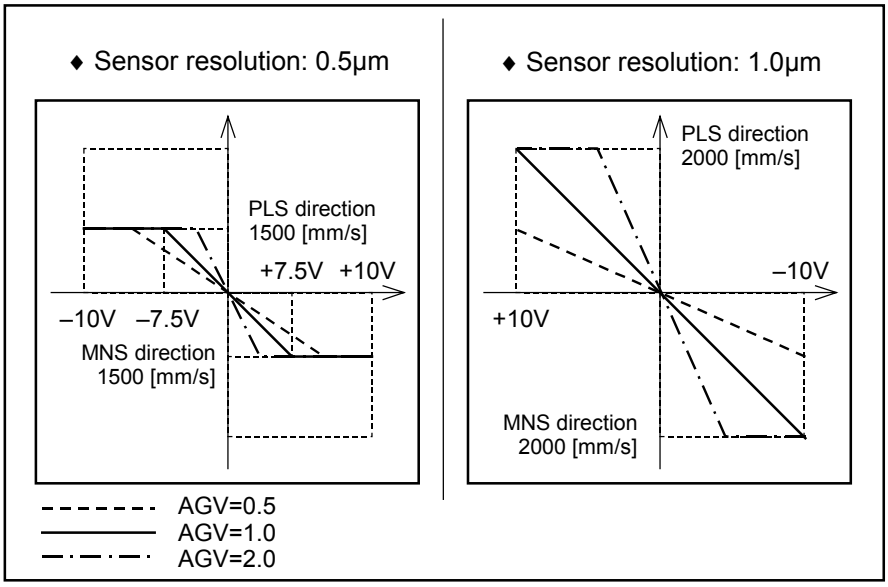


Table 7-8

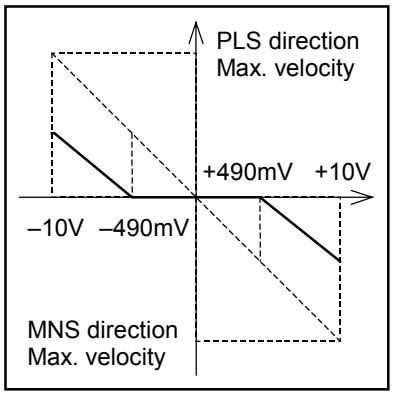
DI	AC	Command voltage	Moving direction
0	1	+	MNS
0	1	–	PLS
0	–1	+	PLS
0	–1	–	MNS
1	1	+	PLS
1	1	–	MNS
1	–1	+	MNS
1	–1	–	PLS

Figure 7-16 : Command voltage / Velocity (AC1)



- You may set dead band to the analog command input. (Parameter DBA) The unit is ± 4.9 mV per data.

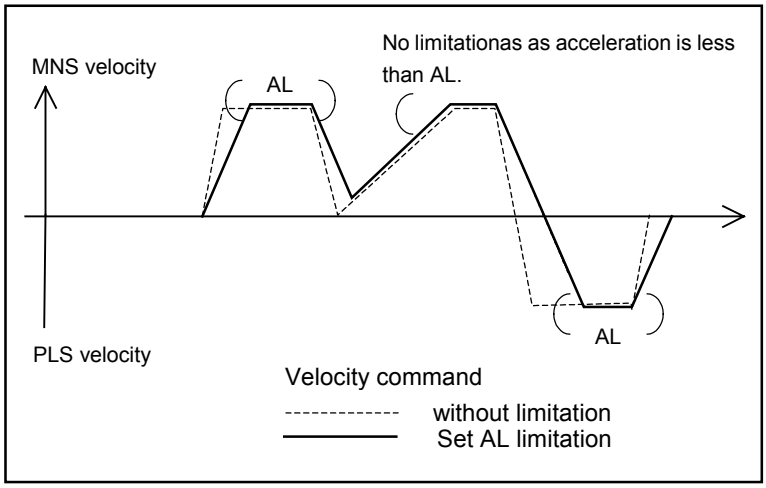
Figure 7-17 : Example: DBA100 (AC1)



7.3.3. Function to Limit Acceleration / Deceleration

- You may set limitation of steep changes in acceleration and deceleration induced by velocity commands.
- `Parameter AL sets the limitation of acceleration and deceleration.
- If command of acceleration or deceleration exceeds the setting of parameter AL, the acceleration and deceleration will be limited to AL [m/ s^2].

Figure 7-18 : Limiting function of acceleration/deceleration



However, the limitation of acceleration /deceleration is not valid in the following cases and limitation of acceleration and deceleration command won't be applied.

- ◊ When stop command by MS is entered.
- ◊ When the control mode is switched by changing parameter SL.
- ◊ When changing validity (valid/invalid) of analog command by parameter AC.

- Limiting function of acceleration/deceleration is invalid if the parameter AL is set to 0.

7.4. Operation of Thrust Control Mode

In the thrust control mode, you may select either RS-232C communication or analog command operation. The following parameters select the operation.

AC0 : Analog command is invalid.→ DC command is valid.
AC1 : Analog command is valid. → Input polarity: "+ voltage" is for MNS direction.
AC-1 : Analog command is valid. → Input polarity: "+ voltage" is for PLS direction.

7.4.1. RS232C Communication Command

- Force of the Motor can be directly controlled by RS-232C communication command in the thrust control mode operation.

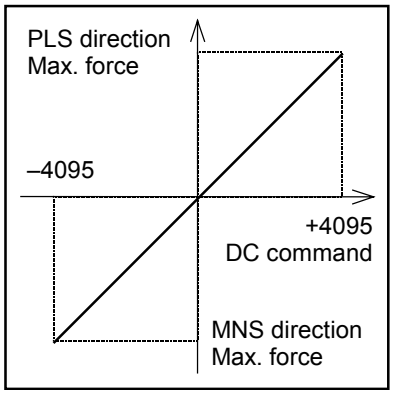
- Setting of parameter AC (AC0) will make DC command valid.
  Input the command as shown below.

  D C (data) ENT

  The command controls force of the Motor proportional to the data.

- Relation between the velocity and the data of DC command is shown in the figure below.

Figure 7-19



- Output of force differs with the Motor model.

7.4.2. Operation of Analog Command

- Force of the Motor can be directly controlled by analog command in the thrust control mode operation.
  - ◊ Range of analog command voltage is ± 10V. You may offset the command voltage using a pot on the front panel (VR1) or setting of parameter AF. (Refer to "7.5. Set Voltage Offset of Analog Command.")
  - ◊ You may set dead band to the command voltage. (Refer to Figure 7-22.)
  - ◊ You may select polarity of command voltage using parameter AC. (Refer to Table 7-9.)
- Relation between the command voltage and velocity may be changed by parameter AGT. (Refer to figure 7- 21.)

Figure 7-20

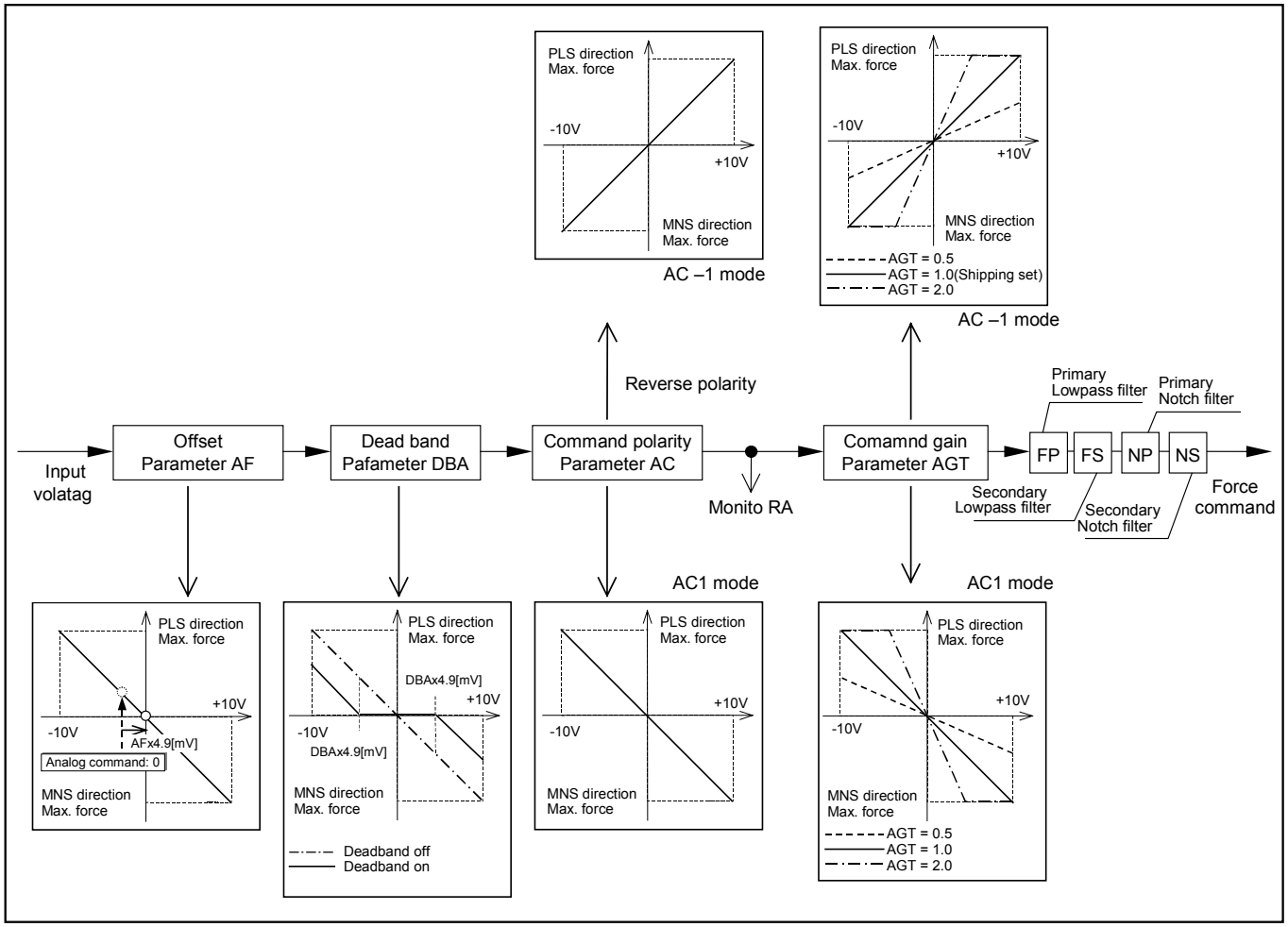
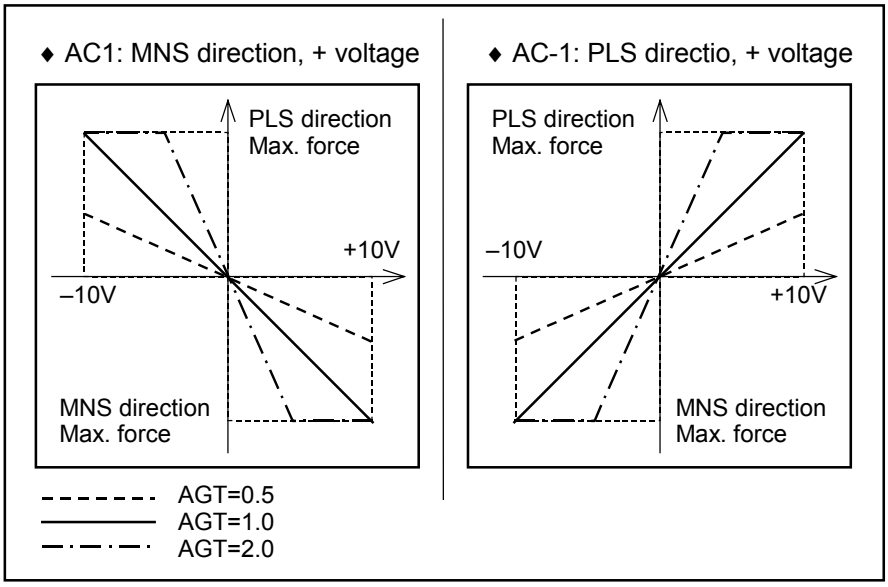


Table 7-9

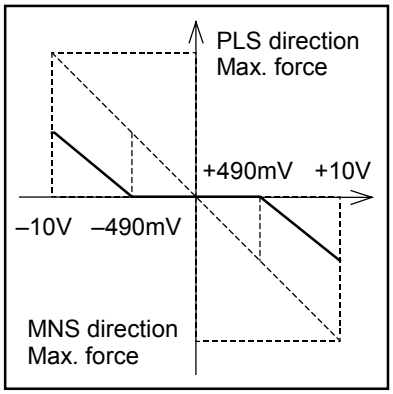
DI	AC	Command voltage	Moving direction
0	1	+	MNS
0	1	–	PLS
0	–1	+	PLS
0	–1	–	MNS
1	1	+	PLS
1	1	–	MNS
1	–1	+	MNS
1	–1	–	PLS

Figure 7-21 : Command voltage / Thrust output



- Motor output force differs with the Motor model.
- You may set dead band to the analog command input. (Parameter DBA) The unit is ± 4.9 mV per data.

Figure 7-22 : Example DBA100 (AC1)



7.5. Offset of Analog Command Voltage

- You may adjust the offset of analog command voltage by setting parameter AF.
- Unit of parameter AF is 4.9 [mV] per data and setting range is AF-63 ~ AF63.

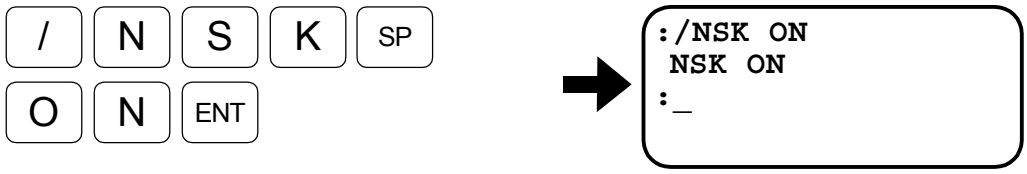
7.5.1. Offset Setting

7.5.1.1. Automatic Offset Adjustment

- The Driver Unit sets the offset automatically.

(1) Connect the master controller and the Driver Unit, then input analog command 0 (zero).

(2) Enter the password. The acknowledgment will be returned.



(3) Input following command.

(4) Pressing ENT key sets the offset automatically. The setting of FA appears on the screen.

◊ The unit of setting is 4.9 [mV].

◊ The screen indicates ”AFxx?” if the obtained offset is too high.

7.5.1.2. Manual Offset Adjustment

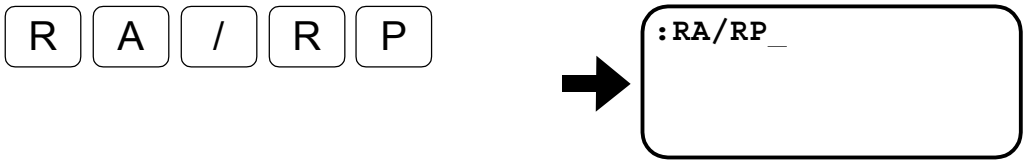
- This is to set the offset using the analog command monitor.

(1) Set parameter AF to AF0.

(2) Make a memo of settings on dead band DBA and polarity of analog command AC, and then change these to DBA0 and AC-1. (The reason to set AC-1 is to have the same direction sign on the analog command voltage and internal command.)

(3) Connect the master controller and the Driver Unit and input analog command 0 (zero).

(4) Input the following command and monitor the analog command.

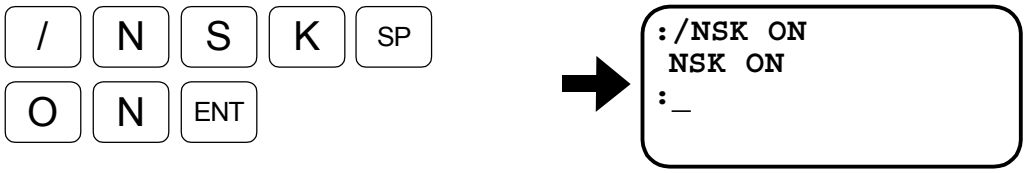


(5) Internal command value obtained by the analog command appears repeatedly on the screen as soon as the ENT key is pressed.

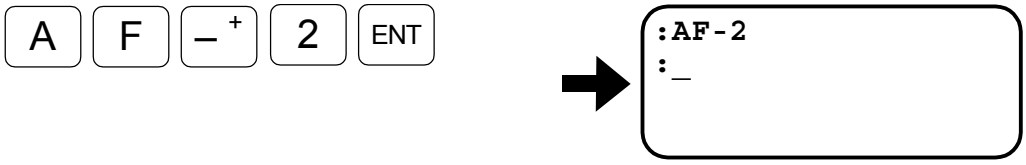
For this example the analog command voltage shall be (2×4.9=9.8[mV])

(6) Confirm the result and press BS key. Otherwise the next command won't be accepted.

(7) Input the password.



(8) Execute following command.



(9) Reset dead band DBA and AC setting to the value you have made on (2).

7.5.1.3. Offset Adjustment by Driver Unit Only

- Execute offset adjustment by the Driver Unit only.

(1) Disconnect the master controller from the Driver Unit.

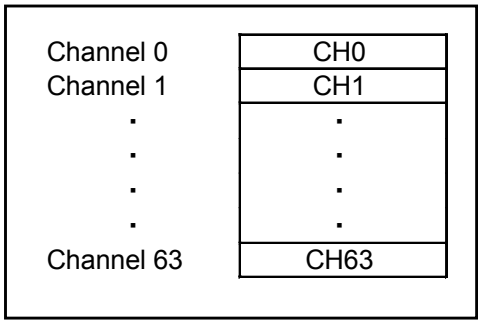
(2) Short the pins "AIN+(8)" and "AIN– (7)" of the CN5 connector.

(3) Execute automatic offset setting under this condition.

8. Programming

- You must use RS-232C communication to make operation programs. Stop all programmed operations to make programs.
- The figure below shows program area. There are 64 channels for programming area (Channel 0 to 63.).

Figure 8-1: Program area



8.1. Command and Parameter to Set Condition

◆ Home Return

Command : HS
Condition : None

- This is to set Home Return operation to a program.
- Command format : HS seq
  Seq : Sequence code (*, &)
- Parameters Velocity HV, Acceleration HA and Home position near-zero velocity HZ set conditions to operate Home Return.

  [Reference] Parameter HD switches direction of Home Return.
  HD0 : PLS direction
  HD1 : MNS direction (shipping set)

* Program example

```
:CH0
 HS
```

◆ Positioning

Command : AR, IR
Condition setting : CV, CA (Can be omitted.)

- This is to program positioning operation.

Table 8-1

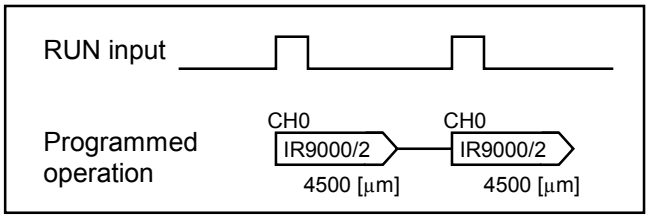
Command format	Outline	Option
AR d1 seq	• Command for absolute positioning format (unit of μm) • Moves to the position d1 (μm) on user absolute coordinate.	
IR d1 d2 seq	• Command for incremental positioning format (unit of μm) • Moves d1 (μm) from current position.	Option code: d2 /n: (n ≤ 99) • When d2 is specified, distance (d1/n) will be a step for a single RUN input. • If d2 is omitted, d1 won't be divided.

- "seq" stands for "sequence code" and sets operating conditions of the next channel by * and &.
- You may set velocity CV and acceleration CA, to the same channel. If CV and CA are not set to a channel, the Motor operates according to the settings of MV and MA.

* Program example

```
:CH0
 IR9000/2
 CV300
 CA0.5
```

Figure 8-2



◆ Jump

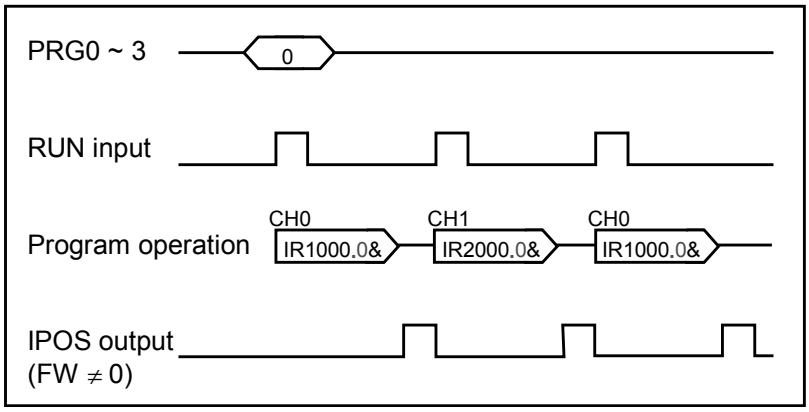
Command : JP
Condition setting : None

- Unconditional jump command
- Control jumps to a specified channel, and it's program will be executed continuously.
- Command format JPm
  m: Channel number to jump. (default: 0).

*Program example

```
:CH0
 IR1000&
:CH1
 IR2000&
:CH2
 JP0
```

Figure 8-3



◆ Sequence Code

Command : (HS), (AR), (IR)
Condition setting : ∗, &

- If this sequence code is specified, program of the next channel will be executed continuously without specifying the channel number in the program.

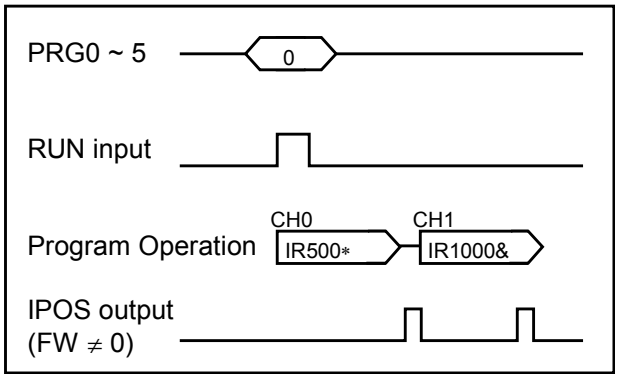
Table 10-14

Sequence code	IPOS output	Execution of the next channel
∗ : asterisk	Set	Executes next program continuously after positioning is over.
& : ampersand	Set	Stops after positioning, then waits for RUN command.

*Program example

```
:CH0
 IR500*
:CH1
 IR1000&
```

Figure 8-4



◆ Change Sequence Code

Condition setting : OE

- OEseq changes sequence code currently set.

* Program example

```
:CH0 --------------   Declare the channel whose sequence code is to be changed.
 AR9000&
 CV0.5
?OE* --------------   Input [O] [E] [*] [ENT]
?
:TC0 --------------   Check the new data programmed in this channel.
 AR9000* ----------   The sequence code has changed from "&" to "*".
 CV0.5
:
```

8.2. List of Program Editing Command

Table 8-3 : List of program editing command

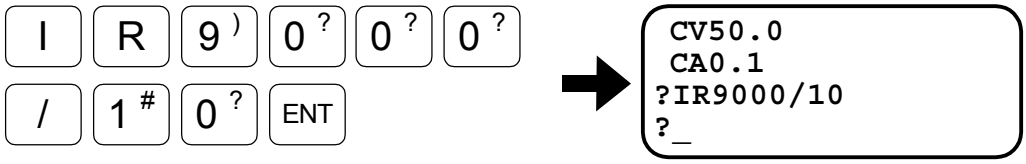
Editing	Command	Function
Change program in a channel	CH	• This is to declare a channel to change programs. CH m [ENT] (m ··· channel number). • The screen shows the currently set program of the channel, if any, and the system waits for changes. (The prompt "?" is displayed.) • The last input of the program is valid when changing program.
Readout of program	TC	• Input TC m [ENT] (m ··· channel number) and pressing [SP] key reads out programs that are set to channel m. • Input TC/AL [ENT] and pressing [SP] key reads out contents of all channel.
Delete program	CC	• Input CC m [ENT] (m ··· channel number) to delete programs of the channel m.
Delete channel	CD	• Input CD m [ENT] (m ··· channel number) to delete the channel m.
Insert channel	CI	• Input CI m [ENT] (m ··· channel number) to insert new channel to the position of channel m. • Insertion of new channel will delete the final channel.

8.3. Editing Program

◆ Programming

1) Specify a channel to which a program shall be set. The display will indicate the current program in the channel. The prompt "?" appears for the next command.

2) Input commands.



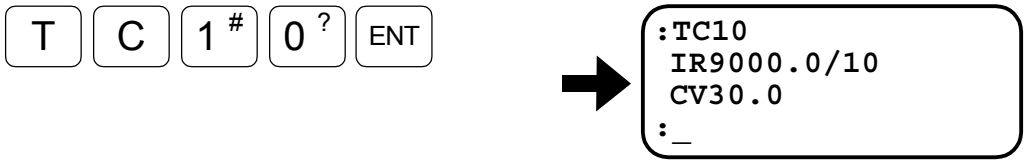
3) Set conditions according to the command.

4) Input "0" to cancel the data.
(Reset right data for miss-input. The last input becomes valid.)

5) The prompt returns to ":" when ENT key is pressed and thereby completes programming.

◆ Readout of program

1) Specify the channel to be read out. The program in the channel will be on the screen.



◆ Delete a channel

1) Specify the channel. Press ENT key to delete it.

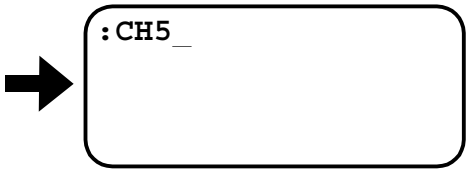
8.4. Example of Programming

- Write the following to Channel 5.
  - ◊ Travel distance : 30mm in minus direction
  - ◊ Acceleration : CA: 1.0 [m/s^2]
  - ◊ Velocity : CV: 100 [mm/s]

1) Confirm that the screen indicates the prompt as shown below.

2) Specify the channel to set program.

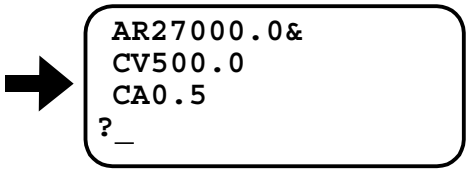
C H 5 %



3) Press ENT key for execution.

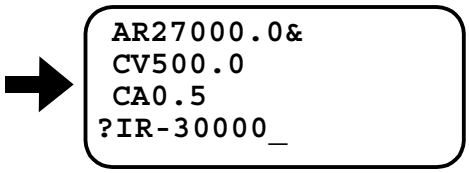
The figure below shows, for example, contents of the program currently set to the channel.

ENT



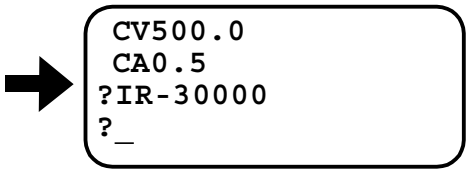
4) Input command.

I R - + 3 < 0 ? 0 ?
0 ? 0 ?



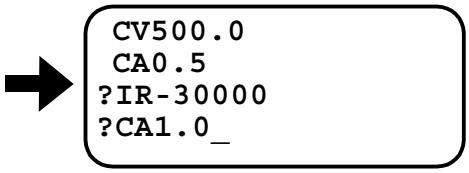
5) Press ENT key for execution. The prompt "?" appears.

ENT

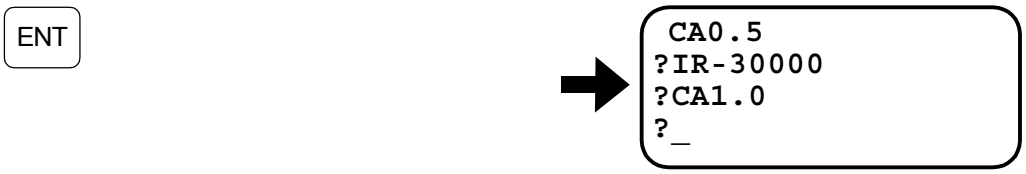


6) Set conditions according to the command.

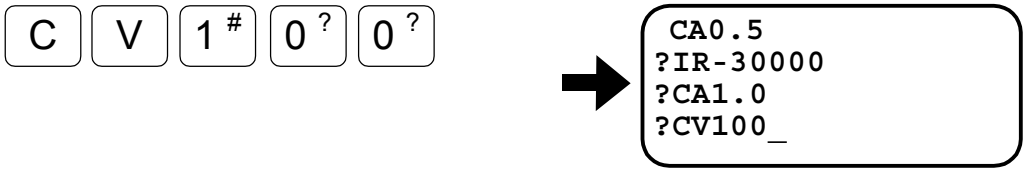
C A 1 # . = 0 ?



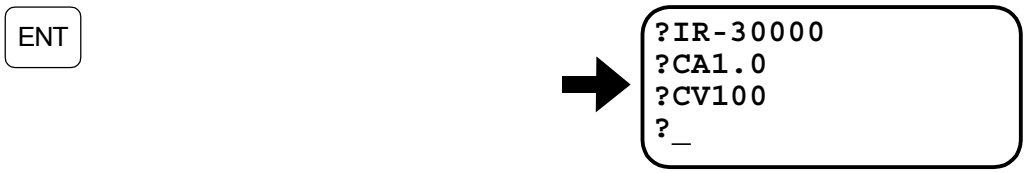
7) Press [ENT] key for execution. The next prompt "?" appears.



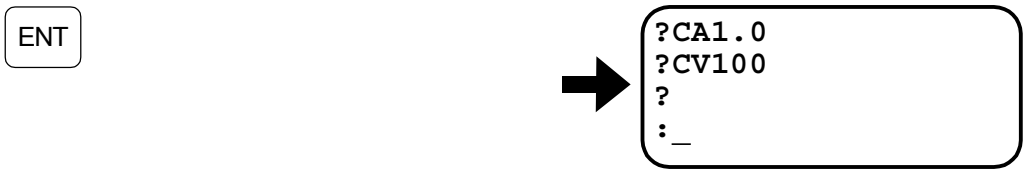
8) Set conditions according to the command.



9) Press [ENT] key for execution. The next prompt "?" appears.



10) Press [ENT] key again to cancel the input hereunder, and thereby completes programming.



9. Command and Parameter

- "Shipping set" denotes a setting of 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 details.

★ *AB : I/O Polarity*

Format : AB n1 n2 n3 n4 n5 n6 n7 n8
Data : nn= 0: A contact (Normally open)
nn=1: B contact (Normally closed)
nn=X • At the time of input: Polarity coded by X does no change.
• At the time of readout: Polarity of a port coded by X cannot be changed. They are fixed to A contact.
Shipping set : X0X0XXXX (all A contacts)
Default : Not available (input all 8 digits)

- This is to set polarity of control input for every port.
- The ports of which polarity can be changed are EMST, HLS, OTP and OTM. The other ports are fixed to A contact.
- Set "X" for the port of which polarity cannot be changed. If "0" or "1" is input, the display shows "?" indicating the fault input.
- Set the code X to the port of which polarity cannot be change. Setting "0" or "1" to theses port leads to an error. .
- Polarity setting can be read out by "TS" or "?AB" command.
- The table below shows the data and port.
- 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 range : -1, 0, 1
Shipping set : 1
Default : 0

- Sets validity (valid/invalid) of analog command and its polarity.
  AC0 : Input of analog command is invalid. DC command is valid.
  AC1 : Input of analog command is valid. ＋ voltage: MNS direction
  AC－1 : Input of analog command is valid. ＋ voltage: PLS direction
- However, if the direction of coordinate has been reversed by parameter DI, moving direction will be reversed as well.
- TS or ?AC command reports the setting.

★ *AF : Analog Command Offset*

Format :AF data
Data range : 0 ~ ± 63
or /ST (automatic adjusting mode)
Shipping set : 0
Default : 0

- Sets offset to voltage of analog command in velocity or force control mode.
- Unit of offset is 4.9[mV] /data.

  Example: In case of "AF-10"

  4.9[mV] ×-10 = -49[mV]
  -49[mV] is the offset to control voltage.
- AF/ST enables automatic offset adjustment.
- Refer to "7.5. Offset of Analog Command Voltage" for more details.
- TS or ?AF command reports setting of offset.

★ *AG : Analog Command Gain*

Format : AGV data
AGT data
Data range : 0.10 ~ 2.00
Shipping set :1.00 (for both AGV and AGT)
Default : Not available

- This is to set gains of analog command in velocity or force control mode.
  AGV : Gain of analog command in velocity control mode.
  AGT : Gain of analog command in force control mode.
- Actual velocity or force command will be proportionate to original velocity or force command.
  - ◊ Example: In case of "AGV0.5"

    [Velocity command input × 0.5] will be actual velocity.
- TS or ?AQ command reports gain setting.

AL : Acceleration / Deceleration Limiter

Format : AL data
Data range : 0, 0.1～50.0 [m/s^2]
Shipping set : 0
Default : 0

- This is to set a limit to steep changes of velocity command (acceleration/ deceleration) in velocity control mode.
- The limit applies to an analog input and the velocity control command in RS-232C communication.
- This function disabled if "AL0" is set.
- Refer to "7.3.3. Operation of Velocity Control Mode."
- TS or ?AL command reports current setting.

★ *AN : Axis Number*

Format : AN data
Data range : 0 ~ 15
Shipping set : 0
Default : 0

- Sets the axis number in the daisy-chain communication mode.
- "TS" or "?AN" command reports the current setting.
- For more details, refer to "6.4.4. Daisy-chain Communication."

AR : Absolute Positioning

Format : AR data
Data range : - 49 999 999.0 ~ + 49 999 999.0 [μm]
Default : 0

- data indicates the position to move and it shall be defined by the user's absolute coordinate system.
- Resolution of data will be the same as the position sensor (0.5/1.0 [μm]).
- AR command will function in two ways according to inputting method.
  - ◊ It sets moving distance to a channel program if it is entered under the conditions where the channel to be programmed is selected with CH command, the Driver Unit outputs "?" for the next command entry and the system waits for a command to be entered.
  - ◊ It functions as a positioning operation command when it is inputted under normal standby state.
- If the Home Position has not been defined through Home Return operation beforehand, A5 alarm (Origin undefined) arises and the AR command won't be executed.

AS : Read out Daisy Chain Status

Format : AS

- The command reads out status of axis numbers of connected Driver Units in daisy chain communication.
- "AS" command will be executed automatically when the power is turned on in a 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

- This command executes automatic tuning of servo parameters and acceleration / deceleration.

AX : Axis Select

Format : AX data
Data range : 0 ~ 15
Shipping set : 0
Default : 0

- This command selects a Driver Unit to be controlled in daisy chain communication. The selected Driver Unit returns acknowledgement.
- The Diver Unit of number 0 is always selected when the power is turned on.
- TS or ?AX reports the settings. These command are valid only when the daisy chain communication is active.
- If "AX" is inputted when daisy chain is not active, an error message will be returned.
- Readout of TS command does not include setting of AX. Input of "?AX" is invalid as well.

⚠ *Caution* *: Do not select a Driver Unit that is not connected. Otherwise, operation may hang up. To return to normal state, press* BS *key and then set Driver Unit number.*

★ *AZ : Set Home Position*

Format : AZ

- When this command is entered while the Motor is stopping, the current position is defined as the Home position.

★ *BM : Backspace Mode*

Format : BM data
Data : 0 or 1
Shipping set : 1
Default : 0

- BM changes the function of the [BS] key.

  BM0 : A press of the [BS] key cancels an entered character string.

  BM1 : A press of the [BS] key deletes a character.

- "TS" or "?BM" command reports the current setting.

CA : Channel Acceleration

Format : CA data
Data range : 0, 0.1～50.0 [m/s^2]
Default : 0

- The command sets acceleration to the internal program of a channel.
- If no CA setting is made to a channel program (or CA0 is set.), acceleration set by parameter MA shall be applied.
- Input of parameter CA is only valid under the condition where a channel is selected by CH command while the Driver Unit outputs "?" indication the system is waiting for command to be entered.
- TC command reports current setting.
  - ◊ However, there will be no indication when CA0 is set.

CC : Clear Channel Program

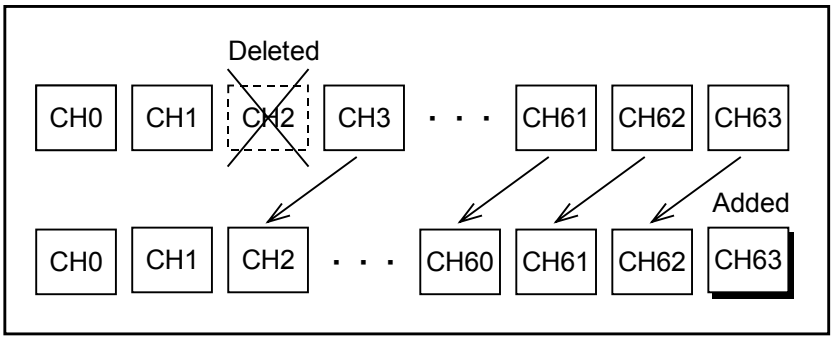
Format : CC data
Data range : 0 ~ 63
Default : 0

- It deletes the program of a channel specified by data.

CD : Delete Channel

Format : CD data
Data range : 0 ~ 63
Default : 0

- This command deletes a channel specified by data.
- Deletion of a channel induces changes of other channel numbers. The numbers over "m+1" will shift 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 ~ 63
Default : 0

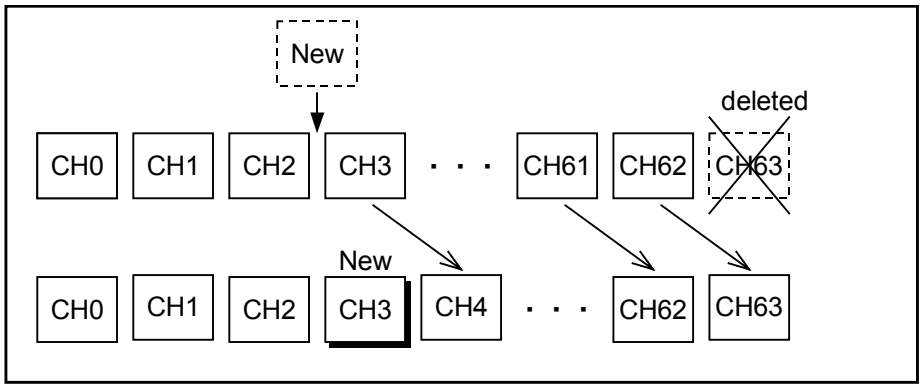
- "CH data" specifies a channel to be edited.
- TC command reports the edited programs.

⚠ *Caution* *: Edit programs when the servo is off.*

CI : Insert Channel

Data : CI data
Data range : 0 ~ 63
Default : 0

- "CI data" inserts a new channel to the number specified the data.
- Insertion of a new channel changes other channel numbers. The numbers after "m" will shift to downward by one respectively and the final channel will be deleted.



CL : Clear Alarm

Format : CL

- Clears alarms listed below.

Alarm	7seg.LED	Readout by TA
Excess position error	F1	**F1>Excess Position Error**
Program error	F5	**F5>Program Error**
Automatic tuning error	F8	**F8>AT Error**
RS-232C error	C2	**C2>RS232C Error**
Software thermal sensor	A3	**A3>Overload**
Velocity error over	A4	**A4>Over Speed**
Warning for undefined Home position	A5	**A5>Origin undefined**

★ *CM : Communication Mode*

Format : CM data
Data : 0 or 1
Shipping set : 0
Default : 0

- CM selects the RS-232C communication mode.
  CM0 : Standard
  CM1 : Daisy-chain communication
- After change of CM setting, you need to remake the Driver Unit again to make it effective.
- "TS" or "?CM" command reports the current setting.

CO : Position Error Counter Over Limit

Format : CO data
Data : 1.0 ~ 49 999 999.0 [µm]
Shipping set : 50 000.0
Default : Not available

- CO sets the criterion for excess position error alarm.
- When the position error counter exceeds the criterion, the Driver Unit outputs the excess position error alarm and opens the DRDY output circuit.
- "TS" or "?CO" command reports the current setting.

★ *CR : Pulse Train Command Resolution*

Format : CR data
Data : X1, X2, X4, X5
Shipping set : X1
Default : Not available

- Use to specify the pulse train resolution.
- For the details about the resolution, refer to "7.3.3. Pulse Train Command."
- The resolution changes immediately after CR data is specified.
- "TS" or "?CR" command reports the current setting.

CV : Channel Velocity

Format : CV data
Data range
Position sensor resolution
0.5 [µm] : 0, 0.1 ~ 1 500.0 [mm/s]
1.0 [µm] : 0, 0.1 ~ 2 000.0 [mm/s]
Default : 0

- This is used to specify the velocity to an internal program of selected channel.
- If the parameter CV is not set to a channel (or set CV0), the velocity set by MV shall be applied to the channel program.
- The parameter CV may be entered only when CH command have designated a channel to edit program and the Driver Unit outputs "?" for command input.
  - ◊ If it is input under normal standby state (the prompt is ":"), an alarm will arise.
- TC command reports the current setting.
  - ◊ However nothing will be indicated when CV0 is set.

★ *DB : Dead Band*

Format : DBA data
DBP data

Data range
DBA : 0, 1 ~ 2 047
DBP : -2047.0 ~ +2047.0 [μm]

Shipping set : 0 (both of DBA and DBP)
Default : 0

- Sets dead band to position loop and analog input command.
- Resolution of data of DBP will be that of the position sensor [0.5/1.0(μm)].
- Refer to "6.2.5. Dead Band: DBP."
- Refer to "7.3.2. Operation of Analog Command (velocity control mode)" or "7.4.2. Operation of Analog Command (Force control mode) for DBA.
- TS command reports the current setting.

DC : RS-232C Communication Command

Format : DC data
Data range : -4 444 ~ +4 444 (Velocity control mode)
: -4 095 ~ +4 095(Force control mode)
Default : 0

- This command is used to input operation command directly by RS-232C communication in the velocity control or the force control mode. However, the use of this command shall be limited only to a regular operation or a checking of the Motor operation because of its unstable response.
- Adding positive sign to the data will make PLS a motion to PLS direction, while adding negative sign will make motion to the data to MNS direction.
- Inputting DC command in analog command operation (refer to the clause for AC command.) or in position control mode will arise the message "DC INHIBITED" and, consequently, the command won't be executed.
- The following operation clears the data of this command to "0" (zero).
  (1) Servo off
  (2) Emergency stop
  (3) Over travel limit alarm
  (4) Switching control mode
  (5) Analog command operation

⚠ *Caution* : *If the sign of the coordinate system is reversed by parameter DI, the sign of DC command will be reversed as well.*

★ *DI : Direction of Position Scale*

Format : DI data
Data range : 0, 1
Shipping set : 0
Default : 0

- This is to switch counting direction of the position scale.
- Refer to "6.2.1. Coordinate System" for more details.

EM : Encoder Monitor

Format : EM data/RP
Data range : 0, 1, 2
Default : 0

EM0	Encoder counter	7 digits decimal number
EM1	øZ monitor	For every passage of øZ: Toggle of 0 and 1
EM2	Encoder alarm signal	2 digit indication Alarm = 1, Normal = 0 0 0 └ Alarm from pre-amplifier └ Alarm for cable breakage

- You may monitor continuously the encoder status if the EM command is inputted with /RP.
- If you enter the command without /RP, the monitor repots the status only one time.
- Press [BS] key to quit continuous monitoring.
- The unit of encoder counter shall be [μm].

★ *ER : Encoder Resolution*

Format : ER data
Data range
Position sensor resolution
1.0 [μm] :1.0
0.5 [μm] : 0.5
Default : Not available

⚠ *Caution* *: The resolution is set to that of the installed linear scale. Do not change the setting.*

★ *FC : Friction Compensation*

Format : FC data
Data range : 0 ~ 2 047
Shipping set : 0
Default : 0

- This parameter adds static frictional compensation to the force output.
- If data is "0" this function is disabled.
- Formula below is to calculate the setting of the parameter FC.

$$FC = 2\,047 \times \frac{\text{Static friction force}}{\text{Motor Max. force}}$$

- TS or ?FC reports the current setting.

★ *FF : Feed Forward Gain*

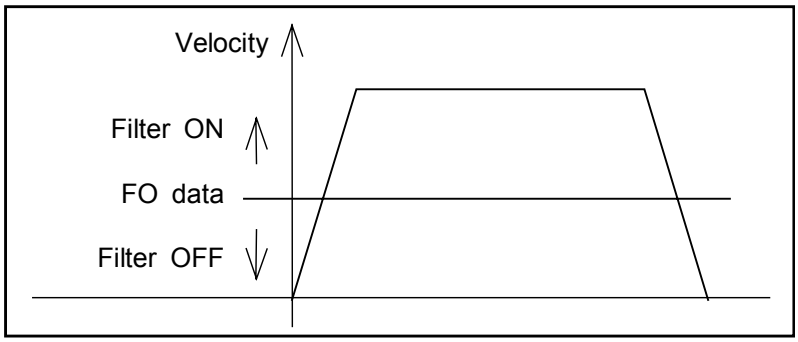
Format : FF data
Data range : 0.0000 ~ 1.0000
Shipping set : 0.0000
Default : 0.0000

- This function is to add feed forward compensation to the velocity loop.
- Refer to "6.2.3. Feed Forward Compensation."
- If you set "0" to data, this function is disabled.
- TS or ?FF reports the current setting.

FO : Low-Pass Filter Off Velocity

Format : FO data
Data range : 0, 1～2 000 [mm/s]
Shipping set : 0
Default : 0

- Parameter FO is to change the low-pass filter (parameter FP and FS) to velocity sensitive type.
- Parameter FO sets the threshold to switch on and off the low-pass filter.
- This function will make it possible to lower resonance noise without giving any adverse effect on the settling time.
- This function is disabled when you set "0" to the parameter FO. (Low-pass filter are always active.)



FP : Low-pass Filter, Primary

Format : FP data
Data : 0, 10 ~ 500 [Hz] or /AJ (Adjusting mode)
Shipping set : 0
Default : 0

- FP sets the frequency of the primary low-pass filter of the velocity loop.
- When "0" is set to the data, the primary low-pass filter velocity loop is set to "off". At this time, [PRI.LPF OFF] appears on the display.
- When data other than 0 (i,e, 10 ~ 500) is set to data, the frequency will be set to the data.
- TS or ?FP command reports the current setting.
- FP/AJ will start the adjusting program.

FS : Low-pass Filter, Secondary

Format : FS data
Data : 0, 10 ~ 500 [Hz] or /AJ (Adjusting mode)
Shipping set : 0
Default : 0

- FS data sets the frequency of the secondary low-pass filter of the velocity loop.
- When 0 is set to the data, the secondary low-pass filter of velocity loop is set to "off". At this time, [SEC.LPF OFF] appears on the display.
- When data other than 0 (i,e, 10 ~ 500) is input, the frequency specified by the data is set.
- TS or ?FS command reports the current setting.
- FS/AJ sets adjusting program.

FW : Time Setting, IPOS Output

Format : FW data
Data : 0 or 0.3 ~ 100 [0.1 second]
Shipping set : 1
Default : 0

- Sets time (time length) to output IPOS. Unit is 0.1 sec.
- If it is set to FW1, the time for activating the IPOS output will be 0.1 sec.
- If it is set to FW0, IPOS output is in standard IPOS format and always closed when the position error counter value is less than the "IN" setting.
- When it is set to FW0.3 ~ FW100, IPOS output is in FIN format and is closed for the moment as set by FW data when the position error counter value is less than the "IN" value.
- Refer to "6.1.7. In-Position Output" for the output timing.
- "TS" or "?FW" command reports the current setting.
- Set FW0 when the system is set to pulse train command operation.

★ *GP : Setting to Switch Gain*

Format : GP data
Data range : 0, 1.0 ~ 1 000.0 [μm]
Shipping set : 0.0
Default : 0.0

- Sets the threshold to the position error counter to switch gain.
- It switches to gains VGL and VIL (at stopping) when the error in position error counter clears the parameter GP setting.
- The minimum setting range of data shall be equal to the resolution of position sensor (0.5/1.0[μm]).
- Refer to "6.2.6. Function to Switch Gain" for more information.
- Setting to GP0 disables the switching gain function.
- Ts or ?GP reports the current setting.

GT : Gain Switching Timer

Format : GT data
Data Range :0 ~ 1 000 [ms]
Shipping set : 5
Default : 0

- Sets the time to check stability of the position error counter when switching gain.
- It switches the gain to VGL and VIL (gain at stopping) when error of the position error counter clears the setting of parameter GT.
- If error of the position error counter remains below the parameter GP for a time set by GT parameter, the gain will be switched to VGL and VIL.
- Refer to "6.2.6. Function to Switch Gain" for more details.
- TS or ?GT reports the current setting.

HA : Home Return Acceleration

Format : HA data
Data range : 0.1～50.0 [m/s^2]
Shipping set : 0.5 [m/s^2]
Default : Not available.

- Sets acceleration of Home Return.
- TS or ?TH reports the current setting.

★ *HD : Home Return Direction*

Format : HD data
Data range : 0, 1
Shipping set : 1
Default : 0

- Refer to "7.2.1. Home Return" for more details.
  HD0 : Home Return to PLS direction
  HD1 : Home Return to MNS direction.

★ *HO : Home Position Offset : HO*

Format : HO data
Data range : 0 ~ ±30 000 000.0 [μm]
Shipping set : 0.0
Default : 0.0

- Sets offset position from the Home position.
- Unit of the data shall be the resolution of position sensor (0.5/1.0[μm]).
- After execution of HS/LS command, move the slider to the point to be the Home position and then, inputting HO/ST command will set the HO by teaching.
- TS or ?HO reports the current setting.

HS : Home Return Start

Format : HS

- Starts the Home Return operation.
- You may adjust the position of proximity limit switch.
- Refer to " 7.2.1.2. Adjustment of Home Position Limit Switch and Home Return Offset."

HV : Home Return Velocity

Format : HV data
Data range
Resolution of position sensor resolution
1.0 [μm] : 0.1 ~ 2 000.0 [mm/s]
0.5 [μm] : 0.11 ~ 500.0 [mm/s]
Shipping set : 100.0 [mm/s]
Default : Not available

- Sets velocity of Home Return operation.
- TS or ?HV reports the current setting.

HZ : Home Return Near-Zero Velocity

Format : HZ data
Data range : 0.1 ~ 100.0 [mm/s]
Shipping set : 5.0 [mm/s]
Default : Not available

- Sets searching velocity for Home position in Home Return operation.
- TS or ?HZ command reports the current setting.

★ *ILV : Integrator Limit*

Format : IL V data
Data range : 0.0 ~ 100.0 [%]
Shipping set : 100.0

- Sets the upper limit to the function of integration.
- Refer to "6.2.4. Integrator Limit: ILV."
- TS or ?ILV reports the current setting.

IN : In-position

Format : IN data
Data range : 0.0 ~ 49 999 999.0 [μm]
Shipping set : 100.0
Default : 0.0

- Sets the criterion for completion of positioning.
- Unit of data is the resolution of position sensor. (0.5/1.0 [μm])
- When the errors of the position error counter clear the setting of parameter IN, IPOS signal is on.
- TS or ?IN command reports the current setting.

IO : Input / Output Monitor

Format : IO data opt
Data range : data = default or 0 Indication of Input / Output
data =1 ---------- Monitors Input / Output (Reverse video of B contact input)
data = 2 ---------- Monitors Input / Output related to programmed operation.
data = 3 Monitors Input / Output related to Jog operation
Option code opt = default ------ Monitors only once.
opt = /RP---------- Monitors repeatedly.

- Reports status (ON / OFF, Open / Closed) of control Input / Output of CN2 or CN5 by 0 or 1.
  In case of 1: Input [ON], Output [Closed]
  In case of 0: Input [OFF], Output [Open]

- Press BS key to terminate repetitive IO/RP readout.

- Refer to "6.1.11.1. Monitoring Control Input and Output" for way of indication.

IR : Incremental Positioning in Unit of μm

Format : IR data
Data range : -49 999 999.0 ~+49 999 999.0 [μm]
Default : 0

- Executes incremental positioning command in the unit of [μm] through the RS-232 communication operation.

- Unit of data is equal to the resolution (0.5/1.0[μm]).

- Sign of data specifies direction of motion.
  data > 0 : plus direction (PLS)
  data < 0 : minus direction (MNS)

- If the DI command reverses the sign of the coordinate system (DI1), the motion direction follows DI setting.

IS : In-position Stable Counter

Format : IS data
Data range : 0, 0.3 ~ 100.0 [0.1 sec]
Default : 0

- Specifies conditions of In-position signal (IPOS) output.
  IS0 : IPOS signal outputs when count of position error counter clears or equals the setting of parameter IN.
  IS data (data≠0) : IPOS signal outputs when count of position error counter clears or equals the IN setting for a time of [data × o.1 sec.] or longer.

- TS or ?IS reports the current setting.

JA : Jog Acceleration

Format : JA data
Data range : 0.1 ~ 50.0 [m/s^2]
Shipping set : 0.5 [m/s^2]
Default : Not available

- Sets acceleration of Jog operation.
- TS or ?JA reports the current setting.

JP : Jump

Format : JP data
Data range : 0 ~ 63
Default : 0

- JP is used to specify the destination of unconditional jumping in an internal program.
- If a channel with JP command is executed, the program processing jumps to a channel specified by "data" unconditionally.
- The "JP" command may be input under the condition where a channel to be programmed is selected by a "CH" command and the Driver Unit outputs "?" to wait for a command.
- If it is entered in the normal standby state (the prompt ":" is on the screen.), an error alarm arises.
- Only TC command reports the current setting.

JV : Jog Velocity

Format : JV data
Data range
Resolution of position sensor
1.0 [μm] : 0.1 ~ 2 000.0 [mm/s]
0.5 [μm] : 0.1 ~ 1 500.0 [mm/s]
Shipping set : 50.0
Default : Not available

- Sets the velocity of Jog operation.
- TS or ?JV command reports the current setting.

LG : Lower Gain

Format : LG data
Data range : 0 ~ 100 [%]
Shipping set : 50
Default : 0

- LG command specifies rate to lower velocity loop gain when IOFF input is ON.
- However in the event of an alarm for excess position error, this command will be invalid.

★ *LO : Load Weight*

Format : LO data
Data range : 0.0 ~ 500.0 [kg]
Shipping set : 0.0
Default : 0.0

- LO is used to set mass of the load to the Motor.
- The system sets LO data automatically when AT (Automatic tuning) command is executed.
- TS or ?LO reports the current setting.
- The system adjusts the settings of PG, VG, VI and MA automatically if the Lo is changed.
- LO setting will be cleared to 0 if PG, VG or VI is changed.

MA : Motion Acceleration

Format : MA data
Data range : 0.1 ~ 50.0 [m/s^2] or /AJ (adjust mode)
Shipping set : 0.5 [m/s^2]
Default : Not available

- Sets motion acceleration for RS-232Ccommunication operation.
- TS or ?MA reports the current setting.
- MA/AJ starts the adjusting program.
- Change of LO setting will be adjust MA setting automatically.

MI : Read Motor ID

Format : MI

- This command is used to monitor reference numbers of system ROM and force ROM.

★ *MM : Multi-line Mode*

Format : MM data
Data range : 0, 1
Shipping set : 1
Default : 0

- Defines the reporting format for readout of settings and status by TA, TC or TS command.
- MM0 reports the readouts continuously.
- MM1 reports all parameters with pausing at each parameter adding ";" to the readout, such as "MA0.1;."
- When pausing to read out, only the SP and BS keys are available. To step to the next parameter, press SP key while pressing BS key quits the readout. (":" appears on the display and waits for a command input in normal state,)
- TS or ?MM reports the current setting,

MN : Select Monitor Object

Format : MN data
Data range : 0 ~ 7
Shipping set : 0
Default : 0

- Sets the object for analog monitor output.
- The setting won't be backed up.
- ?MN reports the current setting.
- The objects of analog monitor are listed in the table below. Refer to "6.1.11.2. Analog Monitor" for more information.

MN data	Monitoring object
MN0	Motor velocity
MN1	Velocity command
MN2	Velocity error
MN3	Force command
MN4	Exciting current for phase U
MN5	Position command
MN6	Residual pulse of position error counter. (±63μm/±10V)
MN7	Residual pulse of position error counter (±16 383μm/±10V)

MO : Motor Off

Format : MO

- When the SVON input (CN2) is ON and the Motor is in the servo-on state, inputting the "MO" command turns the Motor servo off.
- To activate the Motor servo again, input the "SV" command or the "MS" command.
- When the "MS" command is input, the Motor gets in the servo-on state. This also clears the inputted operation command previously.

MS : Motor Stop

Format : MS

- When the "MS" command is input in the middle of execution of an operation, the Motor abandons the instruction and stops. At this time, the Motor is in the servo-on state.
- The operation instruction specified before the Motor stopped is cleared. If the "MO" command is input to turn off the Motor servo, inputting the "MS" command sets the Motor to servo-on again. This also clears the operation instruction executed before the input of the "MO" command.

★ *MT : Factory Use Only*

Shipping set : Already set properly for every system.

⚠ *Caution* *: Do not change the setting since the parameter is properly set at the plant.*

- This parameter is factory use only.
- "TS" or "?MT" command reports the current setting.

MV : Move Velocity

Format : MV data
Data range
Resolution of position sensor
1.0 [μm] : 0.1 ~ 2 000.0 [mm/s] or /AJ (Adjust mode)
0.5 [μm] : 0.1 ~ 1 500.0 [mm/s] or /AJ (Adjust mode)
Shipping set : 500 [mm/s]]
Default : Not available

- Sets the motion velocity of the Motor in the RS-232C communication operation.
- "TS" or "?MV" command reports the current setting.
- "MV/AJ" command starts the adjusting program.

NP : Notch Filter, Primary

Format : NP data
Data : 0, 10 ~ 500 [Hz] or /AJ (adjust mode)
Shipping set : 0
Default : 0

- NP is used to specify the frequency of the 1st stage notch filter of the velocity loop.
- If "0" is set to the data, the 1st stage notch filter of the velocity loop is deactivated. For this state, "PRI.NF OFF" is displayed on the screen.
- If a data (0 ~ 500) is entered, it is adopted as the frequency.
- "TS" or "?NP" command reports the current setting.
- "NP/AJ" command starts the adjusting program.

NS : Notch Filter, Secondary

Format : NS data
Data : 0, 10 ~ 500 [HZ] or /AJ (adjust mode)
Shipping set : 0
Default : 0

- NP data sets frequency of secondary notch filter.
- If the data is set to "0", the 2nd stage notch filter will be set to OFF. In such a state, the display shows "SEC.NF.OFF."
- If the data other than "0" (i.e., 10 ~ 500) is specified, it is adopted as the frequency.
- Command "TS" or "?NS" reports the current setting.
- "NS/AJ" starts adjusting program.

★ *NW : Timer to Prevent Chattering*

Format : NW data
Data : 0 ~ 4
Shipping set : 2
Default : 0

- RUN and HOS are the rising edge-triggered inputs. However if an Input or Output with physical contact is connected to them, the signals will be detected by the current level after a certain time, which is set by NW parameter, from the detection of rising edge to prevent chattering due to the mechanical contacts.

  Timer = data × 2.8 [ms]

- "TS" or "?NW" command reports the current setting.

OE : Sequence Option Edit

Format : OE data
Data range : *, &
Default : Not available

- OE command changes the sequence code that has set to a program in a channel.
- OE command can be inputted only when editing a channel is specified by CH command and the Drive Units outputs " ? " indicating it is ready for a command input.
  - ◊ An error arises if the command is entered when the Driver Unit indicates ":" for normal standby state.
- A sequence code is set to a data. It makes possible to execute the next channel without selecting the channel externally.
  * --- After execution of a program, the system outputs IPOS signal and executes the next channel continuously.
  & --- After execution of a program, the system outputs IPOS signal, the operation stops. .RUN command will start to execute the next channel.

★ *OL : Software Thermal Overload Limit*

Format : OL data
Data range : 0 ~ 100
Shipping set : Optimum setting to each Driver Unit
省略時 : 0

- OL is properly set for each system. If you need to change it contact NSK.
- If you set "0" to the data, the display shows "THERMAL. OFF" on the screen and the function is disabled.
- TS or ?OL command reports the current setting.

★ *OS : Home Return Mode*

Format :OS data
Phase Z of position sensor exists.
Data range : data = 6 --- Set the Phase Z to the Home position after HLS is detected.
: data = 7 --- Sets the rising edge of HLS input to the Home position.
Shipping set : OS6

Phse Z of position sensor does not exist.
Data range : data＝7 --- Sets the rising edge of HLS input to the Home position.
Shipping set : OS7

- Sets the Home Return mode.
- Refer to "7.2.1. Home Return" for the operation.
- TS or ?OS command reports the current setting.

★ *OTP : Software Over Travel Limit Switch Position (PLS)*
OTM :Software Over Travel Limit Switch Position (MNS)

Format : OTP data, OTM data
Data : -99 999 999 ~ +99 999 999 [pulse] or /ST (teaching mode)
Shipping set : OTP0.0, OTM0.0
Default : 0.0

- Sets the software overt ravel limit switch in the position scale.
  OTP : Sets the overt ravel limit switch in the plus direction in the unit of pulse.
  OTM: Sets the overt ravel limit switch in the minus direction in the unit of pulse.
- "OTP/ST" and "OTM/ST" may set the position by teaching.
- "TS" or "?OTP", "?OTM" command reports the current setting.

★ *PC : Pulse Train Command*

Format : PC data
Data : 0 ~ 4
Shipping set : 0
Default : 0

- Sets the format of the pulse train input.
  PC0 : CW & CCW format
  PC1 : Pulse & direction format
  PC2 : øA/øB input × 1 format
  PC3 : øA/øB input × 2 format
  PC4 : øA/øB input × 4 format
- "TS" or "?PC" command reports the current setting.

PG : Position Gain

Format : PG data
Data : 0.010 ~ 1.000 or /AJ (Adjust mode)
Shipping set : 0.1
Default : Not available

- Specifies a position gain.
- "TS" or "?PG" command reports the current setting.
- PG/AJ starts adjusting program.
- It is automatically adjusted when LO or SG data is changed.
- LO and SG data are cleared to 0 when PG data is changed.

★ *PH : Program Home Return*

Format : PH data
Data range : 0 --- Automatic Home Return invalid.
1 --- Execute Home Return only once when the Home position is undefined.
2 --- Execute Home Return every time a programmed operation starts.
Shipping set : 0
Default : 0

- HS is used to start Home Return operation every time a programmed operation is instructed.
  → Home Return starts automatically when the programmed operation starts.
- This command saves one channel of program area which may be consumed by setting HS command.
- TC/AL or ?PH reports the current setting.

★ *PS : Position Scale Select*

Format : PS data
Data range : 0
Shipping set : 0
Default : 0

- For the Megathrust Motor system, we cannot change the position scale system.
  PS0 : Linear motion coordinate system
- TC or ?PS reports the current setting.

RA : Read Out Analog Command

Format : RA/RP

- RA command reads out analog command input when the analog command is valid.
- The display shows a message "RA INHIBITED" when the analog command is invalid.
- Indication will be decimal numbers in -2 047 to + 2047,
- The readout will be repeated when /RP is applied, while the readout will be only once when it is omitted. Press BS to quit repeating readout.
- When a dead band is applied by the parameter DBA to analog command input, the readout will be the multiplication of the readout and the setting of dead band.

★ *RC : Rated Current (Software thermal)*

Format : RC data
Data range : 0 ~ 100
Shipping set : Optimum setting to each Driver Unit type
Default : 0

- RC is properly set to each Driver Unit properly at the factory..
- Contact NSK if the setting must be change.
- TS or ?RC command reports the current setting.

★ *RI ; Factory use only*

Shipping set : Optimum setting to each Motor.

⚠ *Caution* *: Do not change the setting as it is set properly to each Motor.*

- This parameter is for factory use only.
- TS or ?RI reports the current setting.

★ *SB : Velocity Report Criterion*

Format : SB data
Data range : 0.0 ~ 2000.0 [mm/s]
Shipping set : 0.0
Default : 0.0

- SB sets the velocity criterion for SPD output.
- The SPD output closes when the velocity is under SB setting for a time set by parameter ST in the zero velocity mode.
- The SPD output closes when the velocity is equal to or less than the setting of SB for a time set by parameter ST in the over velocity mode (Parameter SO1).
- TS or ?SB reports the current setting.

★ *SE : DRDY Output Format for RS-232C Error*

Format : SE data
Data range : 0, 1
Shipping set : 0
Default : 0

- Sets the DRDY output format when RS-232C is abnormal.
  SE0 : When RS-232C is abnormal: DRDY output closes. (Motor state Normal)
  SE1 : When RS-232C is abnormal: DRDY output opens. (Motor state: Servo lock)
- TS or ?SE command reports the current setting.
- Be sure to use “SE1” when operating the system by RS-232Ccommand.

SG : Servo Gain

Format : SG data
Data : 0 ~ 30 [Hz] or /AJ (Adjust mode)
Shipping set : 0
Default : Not available

- Sets the band of position loop.
  - ◊ Automatic tuning sets "SG" data.
- When "SG" data is changed, "PG" (position gain), "VG" (velocity gain) and VI (velocity integrator frequency) settings will be automatically renewed.
- "SG/AJ" command starts the adjusting program.
- "TS" or "?SG" reports the current setting.
- If PG, VG or VI is changed, SG setting is cleared to 0.

★ *SI : Set Initial Parameters*

Format : SI data
Data range : None, /AL
Default : None

- Resets parameters to the shipping set value.
- The SI command can be input only immediately after inputting the password and when the Motor is servo-off.
- The following parameters will be initialized by SI:
  SI : Initializes servo-related parameters.
  (PG, VG, VGE, VI, VIL, DBP, ILV, FF, FP, FS, NP, NS, LG, TL, TL, GP, GT, FC, LO, FO, FC)
  SI/AL : This command initializes all parameters.

⚠ *Caution* *: It requires approximately 30 seconds to initialize the system. Do not turn off the power while initializing. Otherwise, the memory error alarm arises.*

* If the error arises, SI/AL will be executed when SI is inputted.

★ *SL : Set Control Mode*

Format : SL data
Data range : 1, 2, 3
Shipping set : 3
Default : Not available

- Sets control mode.
  SL1 : Force control mode
  SL2 : Velocity control mode
  SL3 : Position control mode
- The control mode will be effective right after SL command is inputted.
- TS or ?SL command reports the current setting.

ST : Velocity Stable Timer

Format : ST data
Data range : 0, 0.3 ~ 100.0 [0.1sec.]
Shipping set : 0
Default : 0

- ST sets the time length to confirm stabilizing time length for SPD output.
  - ST0 : Velocity stabilization won't be checked. SPD output closes when the velocity is equal to or less than SB setting in Zero velocity mode. In Over speed mode, SPD output closes when the velocity is equal to or more than velocity SB.
  - ST data (data≠0) : SPD output closes when the velocity is equal to or less than SB setting continuously for a time set by ST. In the Over velocity mode, SPD output closes when the velocity is equal to or more than SB setting continuously for a time set by ST.
- TS or ?ST reports the current setting.

★ *SO : Velocity Report Mode*

Format : SO data
Data range : 0, 1
Shipping set : 0
Default : 0

- Sets the format of velocity report by SPD output.
  - SO0 : Zero velocity mode
  - SO1 : Over velocity mode

SP : Start Program

Format : SP data
Data range : 0 ~ 63 or /AJ (Adjust mode)
Default : 0

- Executes an internal program of the designated channel by the data.
- SP/AJ starts the demonstration operation (Reciprocating operation).

SV : Servo On

Format : SV

- Input of SV command sets the Motor servo on when the servo is off by MO command.
- SVON input of CN2 shall be ON to make the Motor servo on by SV command.

TA : Readout of Alarm

Format : TA
Data range : None, /HI. /CL
Default : Not available

- TA : Reports alarms which are currently arisen.
- TA/HI : Displays the history of alarms. Refer to "11.2.6. History of Alarm."
- TA/CL : Clears the history of alarm. Entry of the password is required to input the command.
- There will be no indication when no alarm is reported.
- The following table is to identify alarms.

Alarm	7seg.LED	Terminal display by TA command
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>RS232C Error`
CPU error	C3	TA command cannot read out.
Position scale error	A0	`A0>Encoder Circuit Error`
Software thermal	A3	`A3>Overload`
Over velocity	A4	`A4>Over Speed`
Home position not defined.	A5	`A5>Origin undefined`
Pole sensor circuit error	A8	`A8>Pole Sensor Circuit Error`
Pole sensor state error	A9	`A9>Pole Sensor State Error`
Abnormal main AC line voltage	P1	`P1>Main AC Line Trouble`
Control AC line under voltage	P3	`P3>Control AC Line Under Voltage`
Regenerative resistor overheat	P4	`P4>Over Heat (resistor)`
Power module alarm	P9	`P9>Power Module Alarm`

- When two or more alarms are detected, each alarm is displayed on a separate line.
- Display mode set by the parameter MM is valid.
- Example of display (Alarms on hardware over travel limit and emergency stop are reported in MM! Setting.)

```
:TA
 F3>Hardware Over Travel;
 F4>Emergency Stop;
:_
```

TC : Read Out Channel Program

Format : TC data
Data : 0 ~ 15 or /AL
Default : 0

- Reports the program contents of a channel specified by “data”.
- No data is displayed if program is not set to the channel.
- “TC/AL” command is to scroll all channels by pressing the space key.

TE : Read Out Error

Format : TE/RP

- Reads out the error of position error counter. The reading shall be between –2 147 483 648 and +2 147 483 647.
- The unit of readout shall be the as the resolution of the position scale (0.5/1.0 μm).
- If a /RP option is added to a “TE” command, reading is repeated automatically.
- In automatic reading, a value up to six figures is read out. If a value consists of more than six figures, “*******” is displayed.
- When only “TE” is entered, the display shows the value at the moment.
- To terminate the automatic reading, press the BS key.

TG : Monitor Gain Switching

Format : TG/RP

- Monitors switching status of the gain.
- Refer to “6.2.6. Switching Gain” for more information.
- If /RP is added as an option, the readout will be repeated continuously.
- Without /RP, the readout shall be only once.
- Press BS key to quit the repeating readout.

★ *TL : Force Limit Rate*

Format : TL data
Data : 0 ~ 100 [%]
Shipping set : 100
Default : 0

- Sets the force limit.
- The Motor force will be reduced to a percentage (%) of the maximum force immediately after TL is input and the force is controlled not to exceed the limit thereafter.
- TS or ?TL reads the current setting.

TP : Report Position

Format : TP data/RP
Data : 2, 5
Shipping set : None
Default : Not available

- TP command reads the current position of the Motor in the position scale.
- If TP is executed with an /RP option, reading is repeated automatically.
- If only "TP data" is executed, the display shows the position at the moment.
- To terminate automatic reading, press the BS key.

TR : Report Electrical Degree

Format : TR/RP

- TR command reports position data on the permanent magnets (N and S pole) that are set on the rack base. .
- Data is between 0 and 29 999.0.
- The unit of position data shall be the same as the resolution of the position scale (0.5 /1.0 [μm])
- If TR command is executed with /RP option, reading is repeated automatically.
- If TR command is without /RP option, the readout shall be only once.
- To terminate automatic reading, press the BS key.

TS : Report Parameter Setting

Format : TS data
Data range : 0 ~ 13
Default : 0

- Reads out the parameter settings. 'data' to the TS command defines parameters to be reported.

  TS0 : All parameters listed hereunder.
  TS1 : PG, VG, VGL, VI, VIL, VM, LG, TL, GP, GT
  TS2 : FO, FP, FS, NP, NS, DBP, DBA, ILV, FF, FC
  TS3 : CO, IN, IS, FW
  TS4 : CR, PC, ER
  TS5 : None
  TS6 : PS, DI, OTP, OTM
  TS7 : MV, MA, JV, JA, HV, HA, HZ
  TS8 : OS, HD, HO
  TS9 : OL, RC
  TS10 : AB, NW
  TS11 : MM, BM, CM, AN, WM, SE
  TS12 : LO, SG, MT, RI, ZP, ZV
  TS13 : SL, AC, AGV, AGT, AF, AL
  TS14 : SO, SB, ST

- MM selects the report format.

TT : Report Force & Thermal

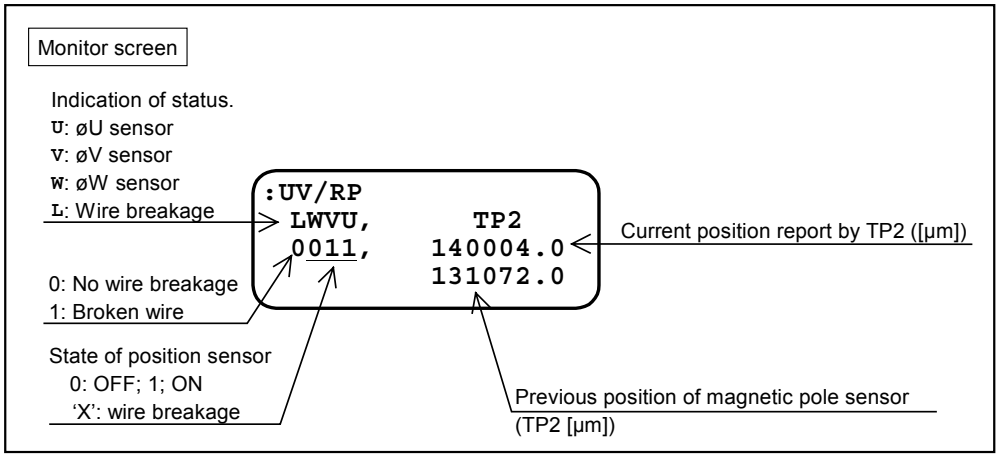
Format : TG/RP

- Monitors force command and thermal loading.
- This is useful for checking if the operation duty is adequate.
- See "6.1.11.3. Force Command and Thermal Loading" for more information.
- If /RP is added to the TT command, the readout will be displayed repeatedly.
- Without /RP, the readout shall be only once.
- Press BS key to quit the repeating readout.

UV : Monitor Magnetic Pole Sensor

Format : UV/RP

- Monitors state of magnetic pole sensor and breakage of wire.
- In addition to it, the current position is on the display.
- UV/RP will report the pole sensor position continuously.
- Press [BS] key to quit the continuous readout.
- If UV command does not accompany /RP, the readout will be only once.



VG : Velocity Gain

Format : VG data
Data range : 0.10 ~ 255.00 or /AJ (Adjust mode)
Shipping set : 1.00
Default : Not available

- Sets the proportional gain of velocity loop.
- TS or ?VG report the current setting.
- VG/AJ starts the adjusting program.
- VG setting will be automatically adjusted when settings of LO and SO are changed.
- If the setting of VG changes, the settings of LO and SG will be cleared to 0.

VGL : Velocity Gain, Lower

Format : VGL data
Data range : 0.1 ~ 255.0
Shipping set :1.0
Default : Not available

- Sets the proportional gain of velocity loop for stopping for function of switching gain.
- Refer to "6.2.6. Function to Switch Gain" for more information.
- TS or ?VG reports the current setting.

VI : Velocity Integrator Frequency

Format : VI data
Data range : 0.10 ~ 63.00 [Hz] or /AJ (Adjust mode)
Shipping set : 1.00
Default : Not available

- Sets the integrator frequency of velocity loop.
- TS or ?VI command reports the current setting.
- VI/AJ starts the adjusting program.
- VI will be automatically adjusted when LO and SG settings are changed.
- Change of VI setting will clear the LO and VI setting to 0.

VIL : Velocity Integrator Frequency, Lower

Format : VIL data
Data range : 0.10 ~ 63.00 [Hz]
Shipping set : 1.00
Default : Not available

- Sets the integrator frequency of velocity loop when the Motor is stopping for function of switching gain.
- Refer to "6.2.6. Function to Switch Gain" for more information.
- TS or ?VI command reports the current setting.

★ *VM : Velocity Integrator Mode*

Format : VM data
Data range : 0, 1
Shipping set : 1
Default : 0

- Selects the P /PI control of velocity loop.
  VM0: PI control of velocity loop
  VM1: PI control of velocity loop

★ *WD : Write Data to EEPROM*

Format : WD

- Writes the current settings of parameters and programs to the EEPROM.
- The command shall be used when the setting of parameter WM is "No data backup (WM19)."

⚠ *Caution* : *Execution of the command requires approximately 30 seconds. Do not turn the power off in the middle of the writing. Otherwise it will lead to "memory error " alarm.*

★ *WM : Write Mode to EEPROM*

Format : WM data
Data range : 0, 1
Shipping set : 0
Default : 0

- The total writing life of EEPROM to backup data is guaranteed for 500 000 times. However frequent writing of data to EEPROM may easily exceed the guaranteed life. 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 store the data (WM0) from no-backup (WM1), the data currently set shall be backed up and it require approximately 30 seconds to store the data. Do not turn the power off during the execution of backup. Otherwise, memory error alarm may be given.*

• Initialized parameters shall be stored every time when SI command executes the initialization, though "no backup data (WM1)" is set.

★ *ZP : Factory use only*

Shipping set : 0.70

⚠ *Caution* : *• ZP is a "factory use only" parameter and is used for the function of automatic tuning.*

• Do not change the setting as it has been properly set at the factory.

• TS or ?ZP command reports the current setting.

★ *ZV : Factory use only*

Shipping set : 1.4

⚠ *Caution* : *• ZV is a "factory use only" parameter and is used for the function of automatic tuning.*

• Do not change the setting as it has been properly set at the factory.

• TS or ?ZP command reports the current setting.

9.1. Parameter List

Table 9-1: List of parameter standard setting

Parameter	Name ★: Requires the password.	Shipping set	Setting range	Remarks	Current setting by user
PG	Proportional gain of position loop	0.100	0.010 ~ 1.000		
VG	Proportional gain of velocity loop	1.0	0.1 ~ 255.0		
VGL	Proportional gain of velocity loop, stopping	1.0	0.1 ~ 255.0		
VI	Integrator frequency of velocity loop	1.00	0.10 ~ 63.00		
VIL	Integrator frequency at stopping	1.00	0.10 ~ 63.00		
VM	★Velocity control mode	1	0, 1		
LG	Lower gain	50	0 ~ 100		
TL	★Force limit Rate	100	0 ~ 100		
GP	★Setting to switching gain	0.0	0.0 ~ 1 000		
GT	Gain switching timer	5	0 ~ 1 000		
FO	Low-pass filter, velocity- sensitive	0	0, 1 ~ 2 000		
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	★Position loop dead band	0.0	0 ~ ±2 047.0		
DBA	★Analog command input dead band	0	0 ~ 2 047		
ILV	★Integration limit	100.0	0.0 ~ 100.0		
FF	★Feed forward gain	0.0000	0.0000 ~ 1.0000		
FC	★Friction compensation	0	0 ~ 2 047		
CO	Position Error counter over limit	50 000.0	1 ~ 49 999 999.0		
IN	In-position	100.0	0 ~ 49 999 999.0		
IS	In-position stable timer	0	0, 0.3 ~ 100.0		
FW	Time setting, IPOS output	0	0, 0.3 ~ 100.0		
CR	★Pulse train command resolution	X1	X1, X2, X4, X5		
PC	★Pluse command	0	0, 1, 2, 3, 4		
(ER)	★Error resolution	1.0	0.5, 1.0	Scale resolution 1.0 [µm]	
		0.5	0.5, 1.0	Scale resolution 0.5 [µm]	
PS	★Position scale select	0	0		
DI	★Direction of position scale	0	0, 1		
OTP	★Software over travel limit switch position (PLS)	0.0	0.0 ~ ±49 999 999.0		
OTM	★Software over travel limit switch position (MNS)	0.0	0.0 ~ ±49 999 999.0		
MV	Move velocity	500.0	0.1 ~ 2 000.0	Scale resolution 1.0 [µm]	
			0.1 ~ 1 500.0	Scale resolution 0.5 [µm]	
MA	Motion acceleration	0.5	0.1 ~ 50.0		
JV	Jog velocity	50.0	0.1 ~ 2 000.0	Scale resolution 1.0 [µm]	
			0.1 ~ 1 500.0	Scale resolution 0.5 [µm]	
JA	Jog acceleration	0.5	0.1 ~ 50.0		
HV	Home Return velocity	100.0	0.1 ~ 2 000.0	Scale resolution 1.0 [µm]	
			0.1 ~ 1 500.0	Scale resolution 0.5 [µm]	
HA	Home return acceleration	0.5	0.1 ~ 50.0		
HZ	Home return near-zero velocity	5.0	0.1 ~ 100.0		
OS	★Home return mode	6	6, 7	Existence of phase Z exists	
		7	7	No scale pahse Z	
HD	★Home return direction	1	0, 1		
HO	★Home position offset	0.0	0.0 ~ ±30 000 000.0		
(OL)	★Software thermal overload limit	*	0 ~ 100	*Depends on Driver Unit type	
(RC)	★Rated current (software thermal)	*	0 ~ 100	*Depends on Driver Unit type	
AB	★I/O polarity	X0X0XX00	0, 1, X		
NW	★Time to prevent chattering	2	0 ~ 4		
MM	★Multi-line mofde	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		

Table 9-1: List of parameter standard setting (continued)

Parameter	Name ★Requires the password.	Shipping set	Setting range	Remarks	Current setting by user
SE	★DRDY output format for RS-232C error	0	0, 1		
LO	★Load weight	0.0	0.0 ~ 500.0		
SG	Servo gain	0	0 ~ 30		
(MT)	★Maximum force (Factory use only)	*	0 ~ 3 000	*Depends on the Motor size	
(RI)	★Set slider inertia (Factory use only)	*	0.0 ~ 100.0	*Depends on the Motor size	
(ZP)	★Velocity damping coefficient (Factory use only)	0.70	0.50 ~ 1.80		
(ZV)	★Velocity damping coefficient	1.4	0.1 ~ 4.0		
SL	★Set control mode	3	1, 2, 3		
AC	★Analog command mode	1	-1, 0, 1		
AGV	★Analog command gain, velocity control	1.00	0.10 ~ 2.00		
AGT	★Analog command gain, force control	1.00	0.10 ~ 2.00		
AF	★Analog command offset	0	0 ~ ±63		
AL	Acceleration/Deceleration limiter	0	0, 0.1 ~ 50.0		
SO	★Velocity report mode	0	0, 1		
SB	Velocity report criterion	0.0	0.0 ~ 2000.0		
ST	Velocity stability timer	0	0, 0.3 ~ 100.0		

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10. Maintenance

10.1. Precautions

- Backup Motor and Driver Unit
  - ◊ We recommend that a backup Motor and Driver Unit must be kept in stock for unexpected shut down of the system.
- Parameter and program data backup
  - ◊ For an unexpected shut down of the Driver Unit, all parameters and programs shall be noted for the reference.
  - ◊ For your convenience, the list of parameter and program is provided in the last page of this manual.
- How to replace the Driver Unit.
  - ◊ Please refer to “Appendix 4: Procedure to Replace Driver Unit.”
- EDB Driver Unit has EEPROM and it does not need a battery for memory backup. (Life of EEP-ROM: approximately 500 000 times of writing on and off.)

10.2. Periodical Check

10.2.1. Motor

⚠ *Caution* : *Never disassemble the Motor, linier scale head and U,V, and W sensors when working on maintenance and/or checking. If the case that needs to disassemble the Motor arises, please contact your local NSK Representative.*

- The Megathrust Motor consists of a base (stationary part) and a slider (moving part), which do not have mechanical contact each other. Simple daily maintenance check is enough because there is no part that will wear out, excluding the NSK linear guides.

Table 10-1

Check item	Checking interval	Points to be checked	Remarks
Appearance	According to the condition	• Wipe off dust by rags. Blow off dust/slugs.	
Check insulation resistance	Once a year	• Disconnect the Driver Unit then check insulation resistance between coils and ground earth by Megger tester under 500V.	• Refer to Figure A-4 for pin-out of the connector. • Requires 10MΩ or over.
Grease of Linear guides	Every 6 months	• Check for intrusion of dust or contamination. • Replenish the grease every 6 months through the grease fitting installed to the end of slider. Apply the grease directly to the ball grooves of rails. • Please note that the life of the "Lubrication Unit K1" is 5 years or 100 000 km total running, whichever comes first.	Standard grease: LG2 Refer to the specification drawing or sheets.
Linear scale	According to the condition	• If the linear scale is dusty, wipe off the dust from the surface of scale with soft rags using IPA (isopropyl alcohol)	If the Motor is equipped with special linear scale follow the maintenance procedure described on its operation manual.

10.2.2. Driver Unit and Cable Set

- The daily checking is not necessary for the Driver Unit because it uses highly reliable semiconductors and does not have any contacts. However, check the following items listed on the table below at least once a year.

Table 10-2

Item	Period	Points to be checked	Remarks
Retighten screws	Once a year	Terminal block TB, Screws to fix connectors.	
Cleaning	Once a year	Remove dust and contamination inside of the Driver Unit.	
Check electrical parts	Once a year	Check visually for color deterioration and damage.	

10.3. Periodical Replacement of Parts

10.3.1. Motor

- The Motor does not have any parts to be replaced periodically.
- Follow the procedure described on “10.2. Periodical Check.”

10.3.2. Driver Unit

Electrolytic condenser

- Gradual chemical change of electrolytic condenser will deteriorate the system performance and it may eventually lead to system failure.

Table 10-3

Parts	Function	Life	How to replace
Electrolytic condenser	Smoothing power voltage	5 years	• Replace the printed circuit board . • Replace the Driver Unit.

- Life of the electrolytic condenser depends heavily on the operating conditions. The 5 years life is a criterion for rated operation in the specified environment.

10.4. Storing

- Store the Motor and the Drover Unit in a clean and dry indoor condition.
- Especially, the ventilation holes of the Driver Unit shall be covered properly for protection from dust.

Table 10-4

Storing condition		Remarks
Temperature	-20 ~ +70℃	
Humidity	20 ~ 80%	No condensation

10.5. Warranty Period and Covering Range

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. Range of Warranty

1) The items to be warranted shall be the supplied products by NSK Ltd.
2) The supplier will repair the supplied products free of charge within the warranty period.
3) 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:
  1) Failure of the unit due to installation and operation not in accordance with the instruction manual specified by the supplier.
  2) Failure of the unit due to improper handling and use, modification and careless handling by the user.
  3) Failure of the unit due to the causes other than those attributable to the supplier.
  4) Failure of the unit due to modification or repair which is conducted by a person(s) or party(ies) other than the supplier.
  5) Other types of failures due to natural disasters and accidents (causes not attributable to the responsibility of the supplier).
  6) Designated consumables (fuses for EDB Driver Unit).
- Damages induced by a failure of the supplied unit are 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 paid services.

11. Alarms

11.1. How to Identify Alarm

- The DRDY output opens when error occurs in EDB Driver Unit.
- The 7-segment LED display on the front panel of the Driver Unit indicates the type of alarm. Also the “TA” command through the Handy Terminal can be used to report the faulty part.

11.1.1. Using LED

Figure 10-1

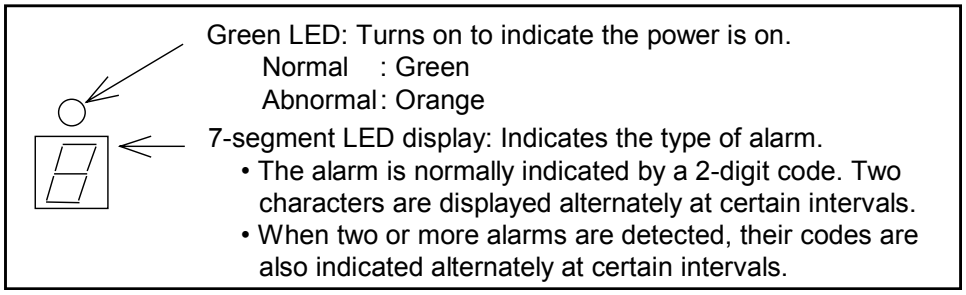
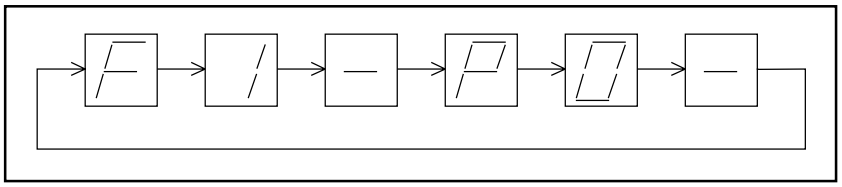
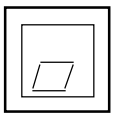


Figure 10-2: Abnormal (example)



(Example) Excess position error F1 + Heat Sink Over-Temperature P0

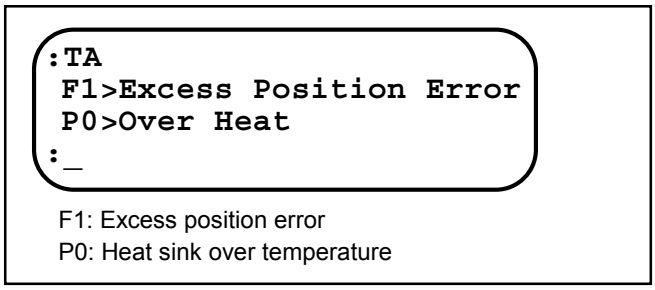
Figure 10-3: LED is indicating normal state.



11.1.2. Using TA Command

- "TA" command is to display the same alarm code that is displayed on the 7-segment LED display.
- In this case, the code is not displayed in time sharing as the LED display.
  - ◊ Example
    - Excess position error and heat sink over temperature alarms are displayed as shown in Figure 10-4.

Figure 10-4: Alarm display

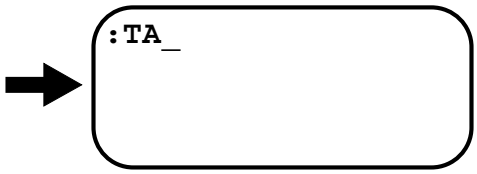


[Example 1] Identify alarm as the warning lamp of ALARM is on.

1) Confirm that the display of Handy Terminal shows the colon ": ".
(If the colon " : " is not shown in the display, press the [ENT] key once.)

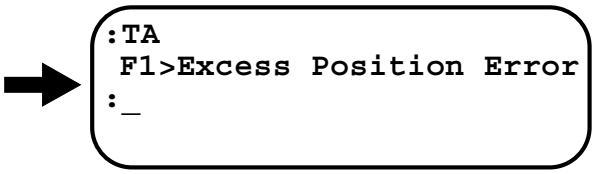
2) Input TA command.

[T] [A]



3) Press [ENT] key to execute and, thereby the display starts to identify the alarm.

[ENT]



- Thus the alarm is identified as "Excess position error".

11.2. Description of Alarms

⚠ *Caution* : *The DRDY output is normally closed. It opens on abnormal condition.*

11.2.1. Normal State

- When the Motor does not operate even in normal state, the following causes are suspected.

Table 11-1

Status	Motor condition	DRDY	Cause	Remedy
Power-off	Servo-OFF	open	Power is not on.	Turn on the power.
CPU Initializing	Servo-OFF	open	Initializing the CPU.	Wait till the initialization completes.
SVON Input OFF	Servo-OFF	closed	SVON input is not active.	Activate the SVON input.

11.2.2. Alarms Related to Power Amplifier

11.2.2.1. Abnormal Main AC Line Voltage (High or Low voltage)

[Output] DRDY : Open
[TA] P1 > Main AC Line Trouble
[LED] P1
[Motor Condition] Servo-OFF

Table 11-2: Cause and Remedy : Abnormal main AC line voltage (Over/Under)

Cause	Remedy
(1) Abnormal voltage of power supply. (2) • Main circuit voltage is excessive due to high acceleration/deceleration under heavy load. • Defective power source gives over AC250V to the main power supply for power amplifier main circuit. (3) Defective power source gives under AC70V to power amplifier main circuit.	• Check main power supply. (Excessive voltage, low voltage and power source capacity.) • Check fuse, power source and the cable, then turn power on again.
(4) Blown fuse (Motor over temperature, abnormal power supply wiring, Driver Unit abnormal.)	• Check for blown fuse. • Check the fuse, power supply and cables, then turn on power again.
(5) Excessive regenerative voltage	• Readjust operation duty, the load and acceleration/deceleration.
(6) Defective PCB. (When the alarm is on after the Motor stops even power source and fuse are normal.)	• Replace Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.")

Supplement:

1) When the regenerative dump resistor cannot dissipate regenerative current, the voltage of direct current to main circuit will increase too much and the alarm will be on.

2) Decrease acceleration/deceleration.

3) Use the optional regenerative dump resistor, if necessary.

11.2.2.2. Control AC Line Under Voltage

[Output] DRDY : Open
[TA] P3 > Control AC Line Under Voltage
[LED] P3
[Motor Condition] Servo-OFF

Table 11-3: Cause and Remedy : Control AC line under-voltage

Cause	Remedy
(1) Low voltage of control power input.	• Check control power voltage. (Low voltage due to over current or output shorting.)
(2) Control circuit voltage for the power amplifier falls below 70V due to faulty power supply.	• Turn off the power, check the power supply and power cable, then turn on the power again.
(3) Faulty PCB. (When the alarm is on after control power is turned on.)	• Replace Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.")

11.2.2.3. Overheat of Regenerative Dump Resistor

[Output] DRDY: Open
[TA] P4>Over Heat (resistor)
[7-seg.LED] P4
[Motor Condition] Servo OFF

Table 11-4 : Cause and remedy: Regenerative damp resistor overheat

Cause	Remedy
(1) Excessive duty cycle of the operation. (2) Excessive load	• Use optional regenerative dump resistor unit. • Relax operation duty, load and acceleration/deceleration. (Air cool after stopping and then turn on the power again.) • Review environmental condition of the Driver Unit.
(3) Faulty printed circuit board. (An alarm arises only the control power is turned on.)	• Replace the Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.)

Supplement:

- The alarm will be on again even it has been cleared when overheat temperature sensor is ON.
  - ◊ Please take enough time to cool off the Driver Unit.

11.2.2.4. Abnormal Power Module

[Output] DRDY: Open
[TA] P9>Power Module Alarm
[7-seg.LED] P9
[Motor condition] Servo OFF

Table 11-5 : Cause and remedy :Abnormal power module

Cause	Remedy
(1) Internal component of the power module has overheated.	• Relax operation duty, load and acceleration/deceleration. (Air-cool the Driver Unit and turn on the power again.) • Review the environmental condition of the Driver Unit.
(2) Excessive current a) Insufficient insulation of the Motor (Follow the procedure in "Appendix 2: How to Check Motor Condition.")	• Replace the Motor.
b) Faulty Motor Cable (Follow the procedure in "Appendix 2: How to Check Motor Condition.")	• Replace the Motor Cable.
(3) Failure of the power module or the control power supply of the power module.	• Replace the Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.)
(4) Faulty printed circuit board.	

11.2.3. Alarms Related to the Motor

11.2.3.1. Abnormal Position Sensor

[Output] DRDY : Open
[TA] A0>Encoder Circuit Error
[7-seg LED] A0
[Motor condition] Servo on

Table 11-6 : Cause and remedy: Abnormal Position sensor

Cause	Remedy
(1) Encoder disconnected.	• Check the encoder cable.
(2) Breakage of the encoder wire	• Replace the encoder cable.
(3) Failure of the linear scale.	• Replace the linear scale.
(3) Failure of printed circuit board (When the alarm arises even the linear scale and the encoder cable function normally and they are properly connected.)	• Replace the Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.)

Supplement:

(1) Check the cables for breakage and shorting visually.

(2) Check the connectors for contact failure

(3) If the cables are forced to move and bend, the moving condition of the cables, bending radius and bending frequency, will affect their life. It requires their insulation and continuity checks.

11.2.3.2. Software Thermal

[Output] DRDY : Open
[TA] A3 > Overload
[LED] A3
[Motor Condition] Servo-OFF

Table 11-7: Cause and Remedy : Software thermal

Cause	Remedy
(1) Excessive Motor duty cycle.	• Reduce duty cycle and the load inertia. Re-adjust acceleration/deceleration. • The Motor is overheated and air-cooling is necessary after the Motor stops. Then turn on power. (After stopping operation, keep control power on.)
(2) Mechanical obstruction of the Motor such as brake or an obstacle exists.	• Remove mechanical obstruction.
(3) Improper gain setting.	• Readjust gain. (Refer to "5. Trial Running and Adjustment.")
(4) Unmatched combination of Motor and Driver Unit.	• Check the combination. (Reference number of Motor and Driver Unit.)

Supplement:

- Do not change the setting of parameter "OL." It is properly set to each Motor before shipment.

11.2.3.3. Over Speed

[Output] DRDY: Open
[TA] A4>Over Speed
[7-seg.LED] A4
[Motor condition] Servo OFF

Table 11-8: Criterion to detect over speed

Resolution of position sensor [μm/pulse]	Criterion [mm/s]
0.5	1 650
1.0	3 300

Table 13-9: Cause and remedy: Over speed

Cause	Remedy
(1) Velocity of Motor has reached to the limit due to external disturbance.	• Clear the alarm.
(2) Motor tends to vibrate due to poor servo tuning.	• Tune the Motor properly referring to "5. Trial Running and Adjustment."
(3) Motor gets in "out of control" state.	• Confirm that the setting of parameter ER and the resolution of linear scale are the same. • Check the linear scale for abnormality. • Replace Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.)

Supplement:

- If this alarm arises, the state of the origin of coordinate changes to "undefined" and the software over travel limit switches are invalid.
- Be sure to conduct the Home Return before start operation again when the remedy on the alarm has been taken.

11.2.3.4. Warning against Undefined Home Position

[Output] DRDY: Closed
[TA] A5>Origin undefined
[7-seg. LED] A5
[Motor condition] Does not change.

Table 11-10 : Cause and remedy: Warning for undefined Home position

Cause	Remedy
(1) RUN command for the absolute scale positioning is inputted when the coordinate is not defined yet.	• Operate the Home Return to define the Home position and then, input the RUN command for absolute scale positioning.

11.2.3.5. Abnormal Pole Sensor

[Outpu] DRDY: Open
[TA] A8>Pole Sensor Circuit Error
[7-seg LED] A8
[Motor condition] Servo OFF

Table11-11: Cause and remedy: Abnormal pole sensor

Cause	Remedy
(1) Sensor Cable is not connected.	• Check the Sensor Cable.
(2) Wire breakage of the Sensor Cable.	• Replace the Sensor Cable.
(3) Failure of the pole sensor inside the Motor.	• Replace the Motor.
(4) Defective printed circuit board.	• Replace the Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.")

Supplement:

(1) Check the cables for breakage and shorting visually.

(2) Check the connectors for contact failure

(3) If the cables are forced to move and bent, the moving condition of the cables, bending radius and bending frequency, will affect their life. It requires their insulation and continuity checks.

11.2.3.6. Abnormal State of Pole Sensor

[Output] DRDY: Open
[TA] A9>Pole Sensor State Error
[7-seg.LED] A9
[Motor condition] Servo OFF

Table 11-12 : Cause and remedy : Abnormal state of pole sensor

Cause	Remedy
(1) Failure of the pole sensor inside the Motor.	• Replace the Motor.
(2) Miss-combination of the Motor and the Driver Unit.	• Confirm that the setting of parameter ER and the resolution of linear scale are the same.

11.2.4. Alarms Related to Control

11.2.4.1. Memory Error

[Output] DRDY : 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. Command and Parameter.")
(2) Defective PCB. (When the memory is not functioning after its initialization.)	• Replace Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit..")

◊ Command SI (RS-232C communication) initializes the memory. Some parameters are reset to shipping set after the initialization. Resetting parameters to the using condition is necessary.

13.2.4.2. EEPROM Error

[Output] DRDY : Open
[TA] E2 > EEPROM Error
[LED] E2
[Motor Condition] Servo OFF

Table 11-14: Cause and Remedy : EEPROM error

Cause	Remedy
(1) Faulty EEPROM of control circuit.	• Turn the power on again. • Replace the Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.")

13.2.4.3. System Error

[Output] DRDY: 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 printed circuit board. (2) Defective EEPROM on printed circuit board.	• Replace the Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit. ")

11.2.4.4. Interface Error

[Output] DRDY: Open
[TA] E8>I/F Error
[7-seg LED] E8
[Motor condition] Servo OFF

Table 11-16: Cause and remedy: Interface error

Cause	Remedy
(1) Defective Input / Output printed circuit board of the Driver Unit.	• Replace the Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.")

11.2.4.5. Analog Input Error

[Output] DRDY: Open
[TA] E9>ADC Error
[7-seg LED] E9
[Motor condition] Servo OFF

Table 11-17 : Cause and Remedy: Analog command error

Cause	Remedy
(1) Defective circuit for the analog command input	• Replace the Driver Unit. (Refer to "Appendix 4. How to Replace EDB Drive Unit.")

11.2.4.6. Excess Position Error

[Output] DRDY : Open
[TA] F1 > Excess Position Error
[LED] F1
[Motor Condition] Servo Lock

Table 11-18: Cause and Remedy : Excess position error

Cause	Remedy
(1) Error of position error counter exceeds CO setting due to mechanical obstruction such as brake.	• Remove mechanical obstruction.
(2) Improper gain setting leads to excessive position error.	• Readjust gain. (Refer to "Chapter 5 Trial Running and Adjustment.")
(3) Excessive acceleration/deceleration.	• Decrease the acceleration/deceleration.
(4) CO setting is too low.	• Increase CO setting. • Activate the "CLR" input to cancel alarm, then position error counter is cleared to 0 (Zero). • Take the following action. • Adjust servo parameters (VG, VI, PG). • Adjust acceleration/deceleration (MA). • Change CO data. • Check the applied load.
(5) Unmatched combination of Motor and Driver Unit.	• Check reference number of the Motor and the Driver Unit.
(6) Defective printed circuit board. (When the alarm is on even "RUN" command is not executed.)	• Replace the Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.")

11.2.4.7. Over Software Travel Limit

[Output] DRDY : Open
[TA] F2 > Software Over Travel
[LED] F2
[Motor Condition] Servo Lock in one direction.
(The Motor can move only in the opposite direction of the over travel limit.)

Table 11-19: Cause and Remedy : Over software travel

Cause	Remedy
(1) The Motor enters the off-limit area set by OTP and OTM	• Put back the slider out of area of the software over travel limit. • Get out of off-limit area.

Supplement:

- Range of the over travel limit shall be set to the position at where the Motor won't be mechanically locked or constrained.

11.2.4.8. Over Hardware Travel Limit

[Output] DRDY : Open
[TA] F3 > Hardware Over Travel
[LED] F3
[Motor Condition] Servo Lock in one direction.
(The Motor can move only in the opposite direction of the over travel limit.)

Table 11-20: Cause and Remedy : Over software travel limit

Cause	Remedy
(1) Motor activated travel limit switch.	• Put back the slider out of area of hardware over travel limit.
(2) Mistaken setting of input port polarity.	• Confirm the parameter "AB."
(3) Faulty travel limit switch or wiring.	• Check the limit switch and wiring.

13.2.4.8. Emergency Stop

[Output] DRDY : Closed
[TA] F4 > Emergency Stop
[LED] F4
[Motor Condition] Servo Lock

Table 11-21: Cause and Remedy : Emergency stop

Cause	Remedy
(1) Mistaken setting of input port polarity.	• Confirm the parameter "AB."
(2) EMST is input. (A contact)	• Clear EMST input after the Motor stops.
(3) EMST input (CN2) is OFF. (B contact)	• Input EMST ON when the situation have been remedied.
(4) Defective wiring.	• Check wiring.

11.2.4.10. Program Error

[Output] DRDY : Closed
[TA] F5 > Program Error
[LED] F5
[Motor Condition] Servo Lock

Table 11-22: Cause and Remedy : Program error

Cause	Remedy
(1) A non-programmed channel is started.	• Check the program. • Check wiring of PRG0~PRG3 input. • Confirm the sequence.

11.2.4.11. Automatic Tuning Error

[Output] DRDY: Closed
[TA] F8>AT Error
[7-seg. LED] F8
[Motor condition] Normal Servo state

Table 11-23 : Cause and remedy : Automatic tuning error

Indication of Terminal	Cause	Remedy
AT Error1	(1) The servo is turned off in the middle of automatic tuning. (2) Over travel limit is on in the middle of automatic tuning.	• Check the input signal and execute the automatic tuning again.
AT Error2	(3) The automatic tuning cannot be performed due to unbalanced load.	• Review the load, or perform a manual adjusting.
AT Error3	(4) The automatic tuning cannot be performed due to excessive load.	• Review the load condition or the Motor base and/or conduct manual tuning.
AT Error4	(5) Resonant vibration occurs due to low rigidity of the base in the middle of automatic tuning.	

11.2.4.12. RS-232C Error

◆ **When parameter is SE "0,"**

[Output] DRDY: Closed
[TA] C2>RS232C Error
[LED] C2
[Motor condition] Normal

◆ **When parameter is SE "1,"**

[output] DRDY: Open
[TA] C2>RS232C Error
[LED] C2
[Motor condition] Servo Lock

Table 11-24: Cause and remedy: RS-232C error

Cause	Remedy
(1) Connect and disconnect the communication cable when the power is on.	• Connect or disconnect the communication cable when the power is off.
(2) Attempted to transmit large volume of data without the flow control by 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 the Driver Unit. (Refer to "Appendix 4: Hoe to Replace EDB Driver Unit.")

Supplement:

1) Parameter SE can set DRDY output and condition of Motor servo when RS-232C communication is abnormal. (Refer to "9. Command and Parameter.")

2) RS-232C error may be cleared by input of CLR or CL command.

11.2.4.13. CPU Error

[Output] DRDY: Open
[TA] C3>CPU Error
[LED] C3
[Motor condition] Servo-OFF

Table 11-25: Cause and remedy: CPU error

Cause	Remedy
(1) A wrong program is called due to noise.	• Take measures against external noise.
(2) Memory is defective.	• Change the Driver Unit. (Refer to "Appendix 4. How to Replace EDB Driver Unit.")
(3) CPU is defective.	

11.2.5. Readout of Alarm by TA Command

- TA command reads out the alarm status.
- There is no indication on the screen when no alarm is reported.

Table 11-26: Alarm list

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 input error	E9	E9>ADC Error
Excess Position error	F1	F1>Excess Position Error
Over Software Travel Limit	F2	F2>Software Over Travel
Over Hardware 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
Position sensor error	A0	A0>Resolver Circuit Error
Software Thermal	A3	A3>Overload
Over speed	A4	A4>Over speed
Warning against undefined Home position	A5	A5>Origin undefined
Abnormal pole sensor	A8	A8>Pole Sensor Circuit Error
Abnormal state of pole sensor	A9	A9>Pole Sensor State Error
Abnormal Main AC Line Voltage	P1	P1>Main AC Line Trouble
Control AC Line Under Voltage	P3	P3>Control AC Line Under Voltage
Regenerative resistor overheated	P4	P4>Over Heat (resistor)
Power module alarm	P9	P9>Power Module Alarm

- When two or more alarms are detected, each alarm is displayed on a separate line.
- Display mode set by “MM” parameter is valid.
- Display example (Emergency stop and Over hardware travel limit alarm are detected in MM1 setting.)

```
:TA
 F3>Hardware Over Travel;
 F4>Emergency Stop;
:_
```

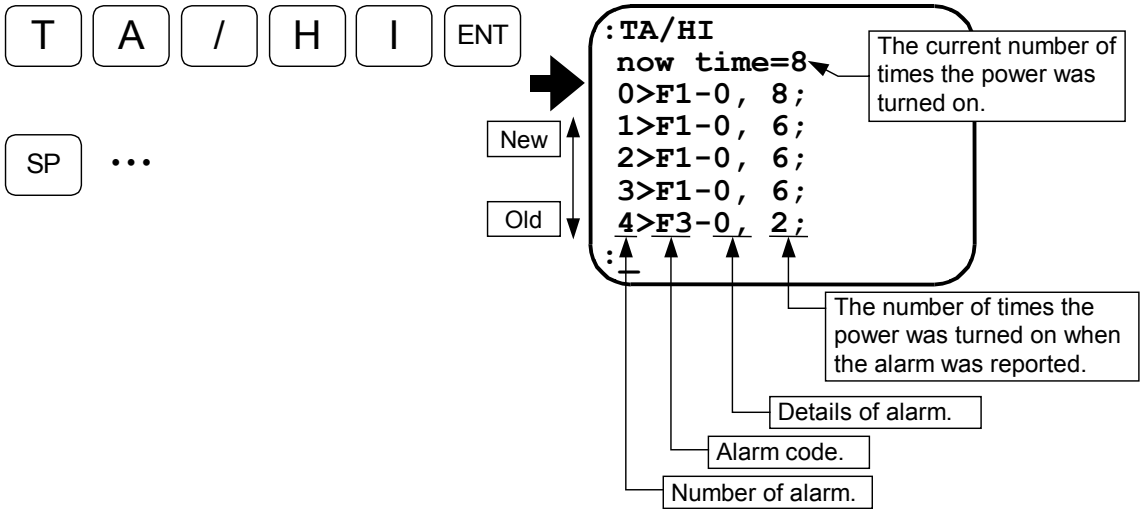
11.2.6. History of Alarm

- Store the occurrence history of alarms to EEPROM.
- It keeps the 32 alarm records previously reported. It does not overwrite more than 32 alarms. The oldest history shall be cleared when the new alarm arises and added to the record.
- The alarms on which the DRDY output opens are the subject of the list of history.
- The following is the contents of history.
    1) Alarm code that is shown on LED.
    2) Sub-code for failure analysis of manufacturer.
    3) The number of times the power is turned on for recovery.

⚠ *Caution* *: History of alarm may not be stored properly when the power is shut off right after the alarm is reported.*

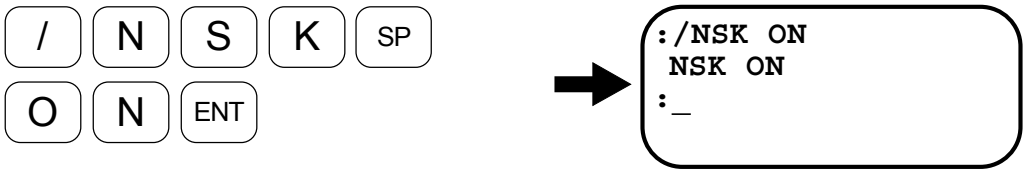
11.2.6.1. Indication of Alarm History

1) Input TA command. Press [SP] key to scroll to the next line.

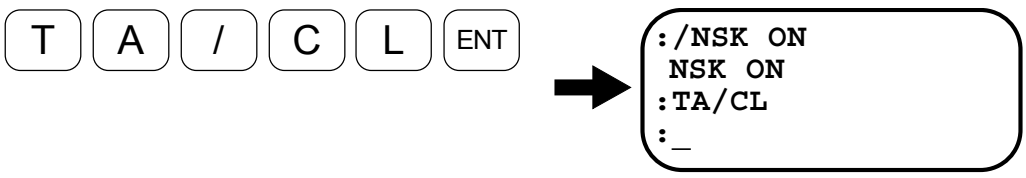


11.2.6.2. Clear History of Alarm

1) Input the password.



2) Input TA command.



12. Troubleshooting

12.1. Identify Problem

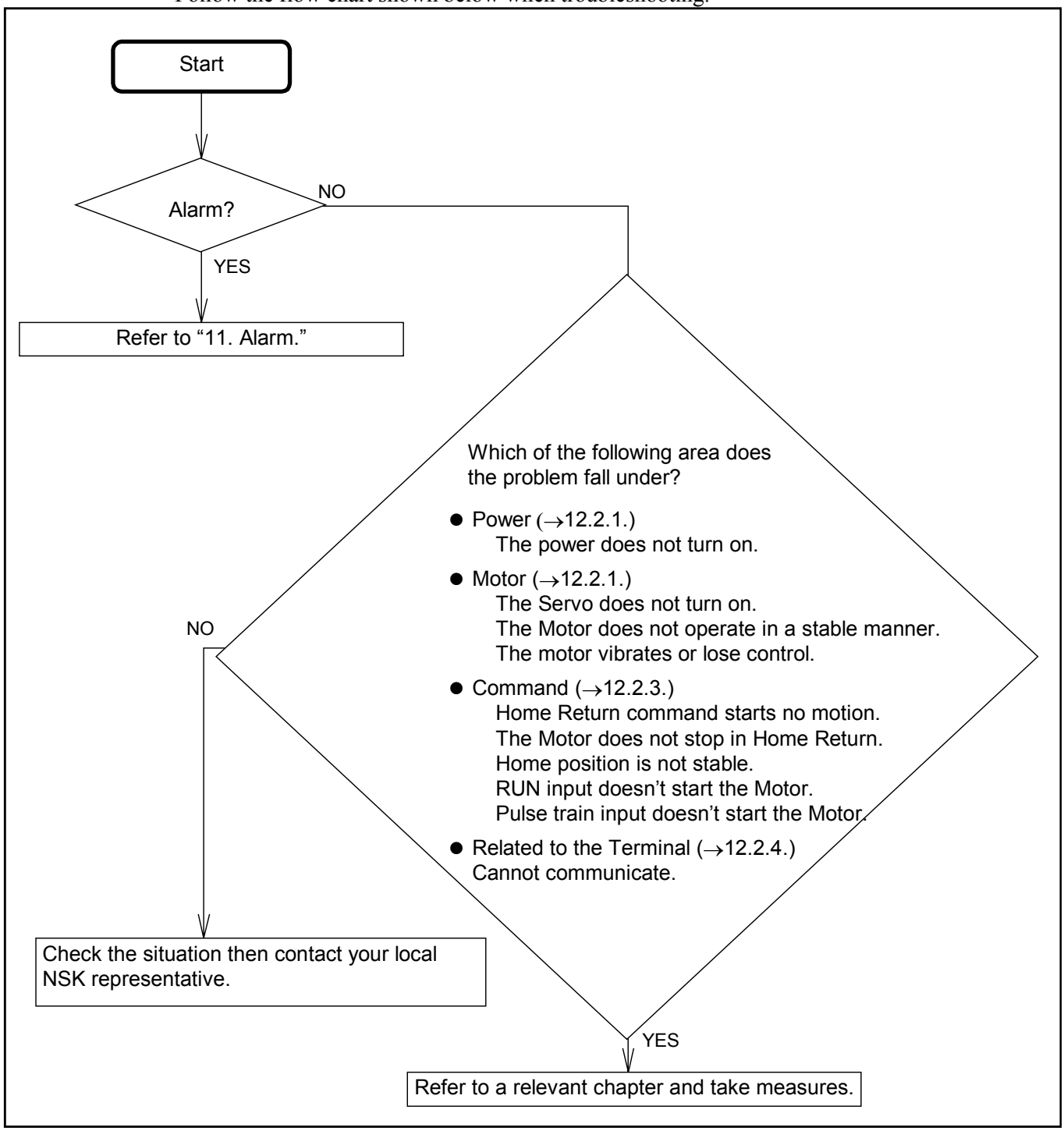
- If a problem do occur, check the items shown in Table 12-1 for the situation.
- For inquiring the manufacturer of the problem, explanation of items in Table 12-1 will help to identify the problem.

Table 12-1

No.	Items	Point to be checked
1.	Type code	The type code of the Motor and the Driver Unit shall be the same.
2.	Power supply voltage	Variation of the power voltage is in the specification.
3.	Recurrence of trouble	
4.	Occurs to special occasion.	• When controlling particular equipment. • Particular equipment is in operation.
5.	Trouble occurs to a particular internal operation.	What causes the problem? Particular position?. Moving direction? In the middle of accelerating/decelerating?
6.	Alarm code	Confirm the state of alarm by TA command. (Refer to “11.1.2. Readout of Alarm Status by TA command” for more information.)

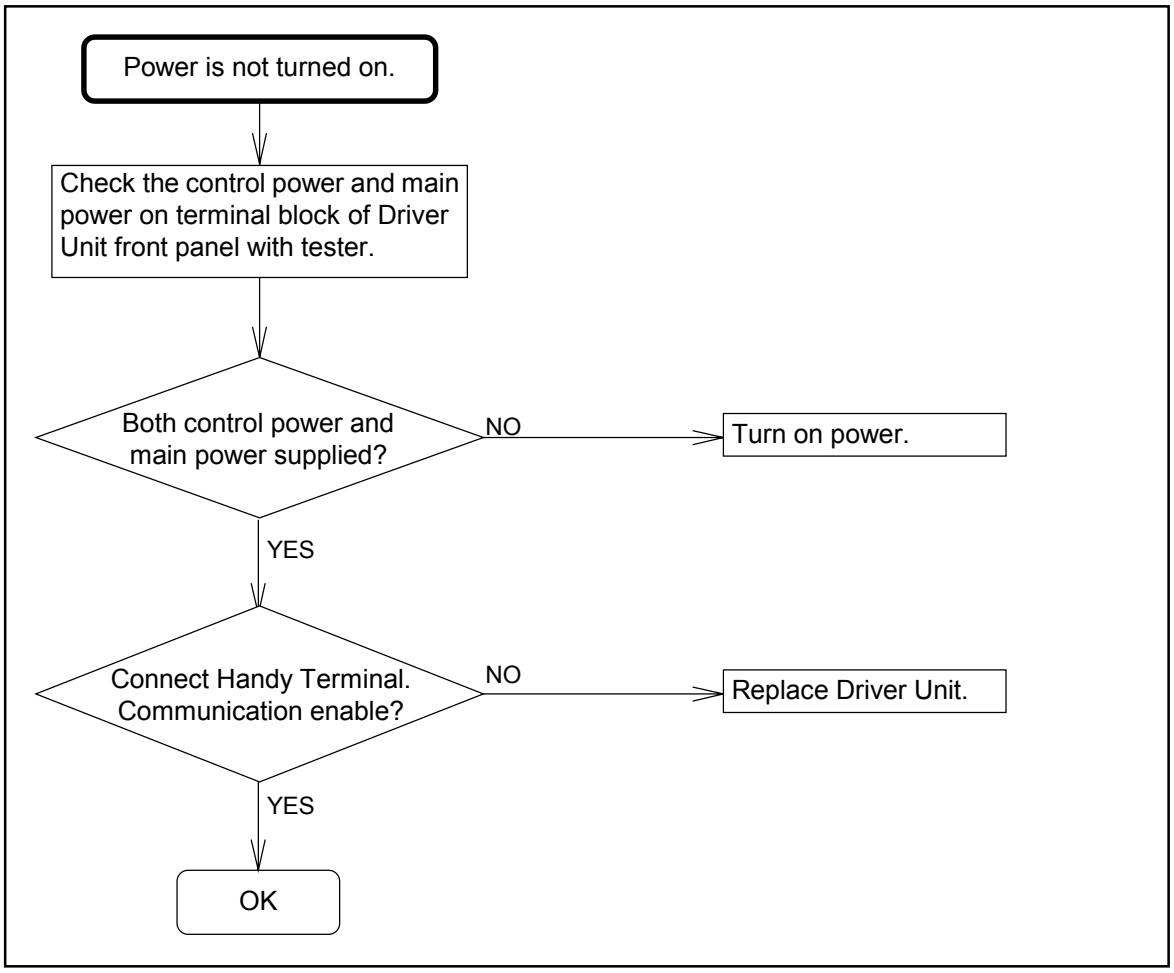
12.2. Troubleshooting

- Follow the flow chart shown below when troubleshooting.



12.2.1. Power Trouble

Figure 12-2: Power trouble



12.2.2. Motor Trouble

Figure 12-3: Motor trouble

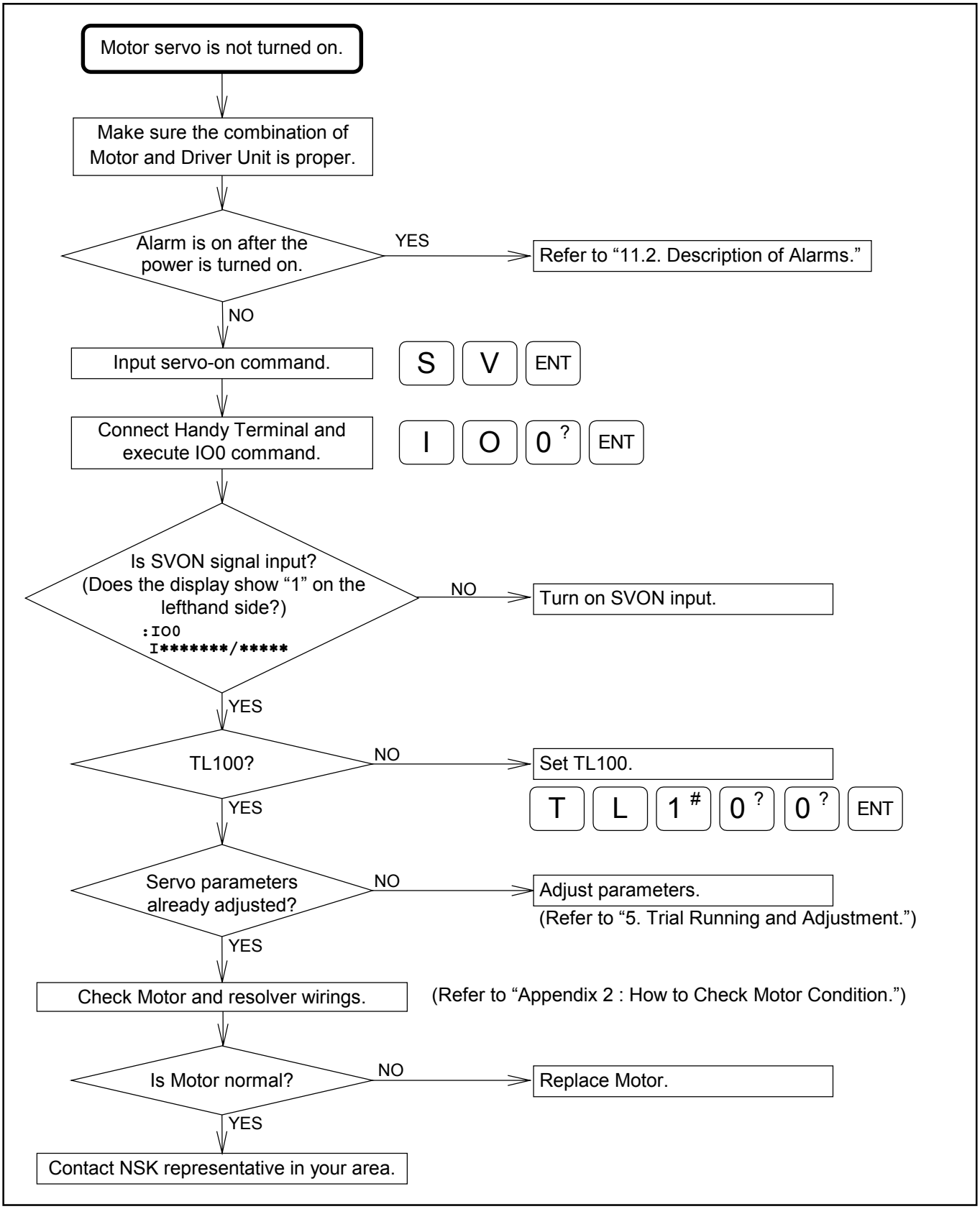
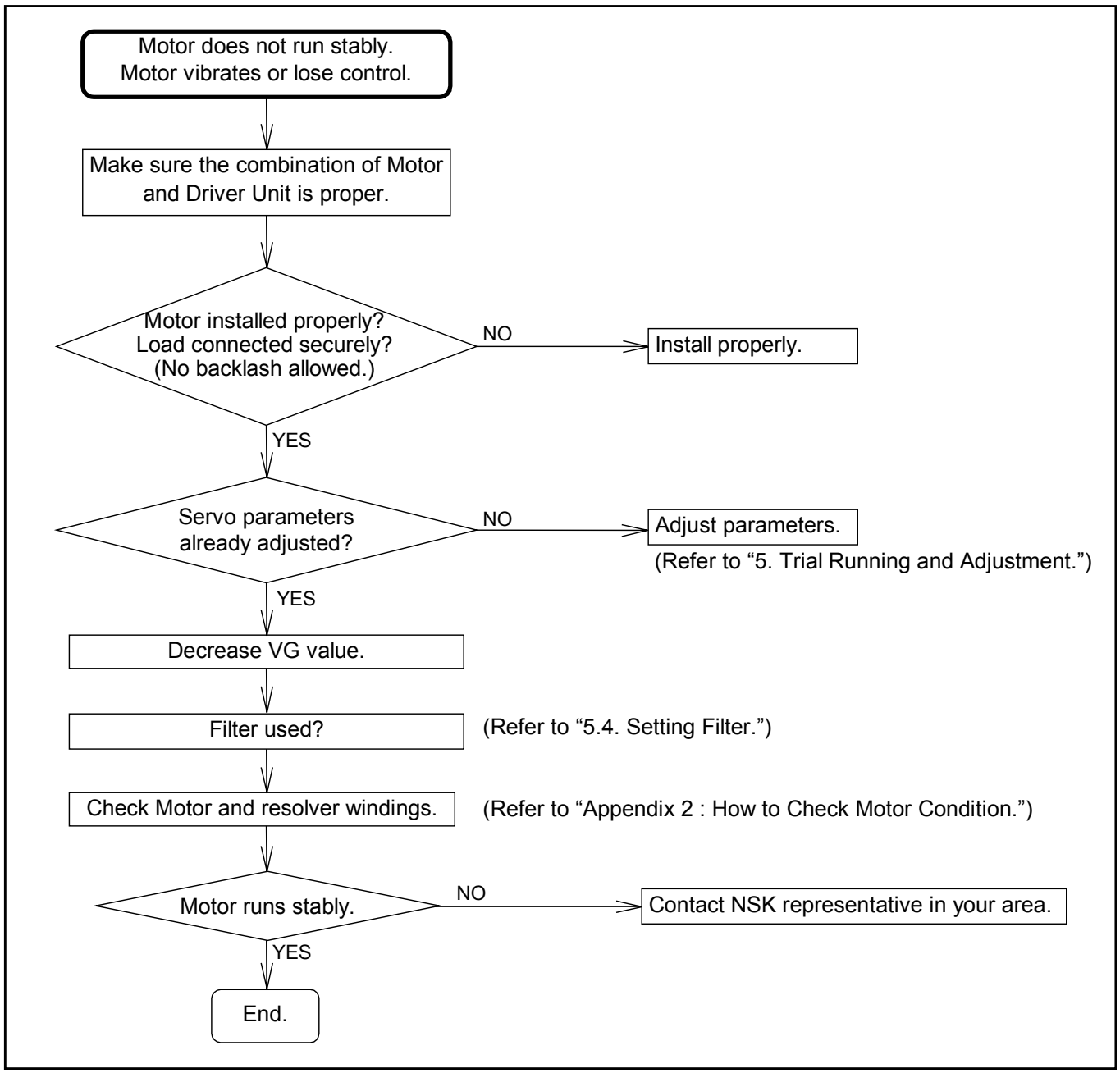


Figure 12-4


Motor does not run stably.
Motor vibrates or lose control.
Make sure the combination of Motor and Driver Unit is proper.
Motor installed properly?
Load connected securely?
(No backlash allowed.)
NO
Install properly.
YES
Servo parameters already adjusted?
NO
Adjust parameters.
(Refer to “5. Trial Running and Adjustment.”)
YES
Decrease VG value.
Filter used?
(Refer to “5.4. Setting Filter.”)
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. Trouble with Command

Figure 12-5: Command trouble

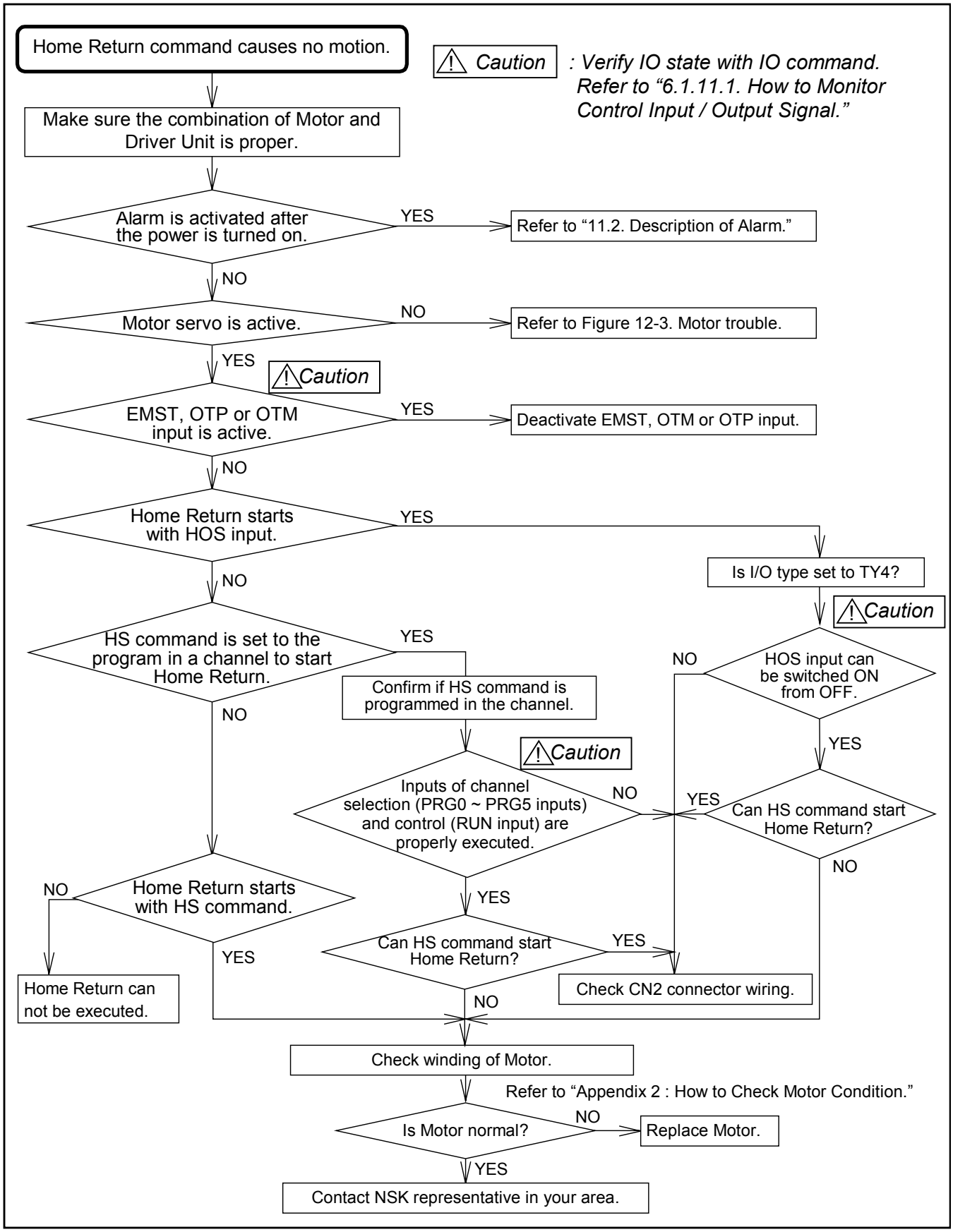


Figure 12-6

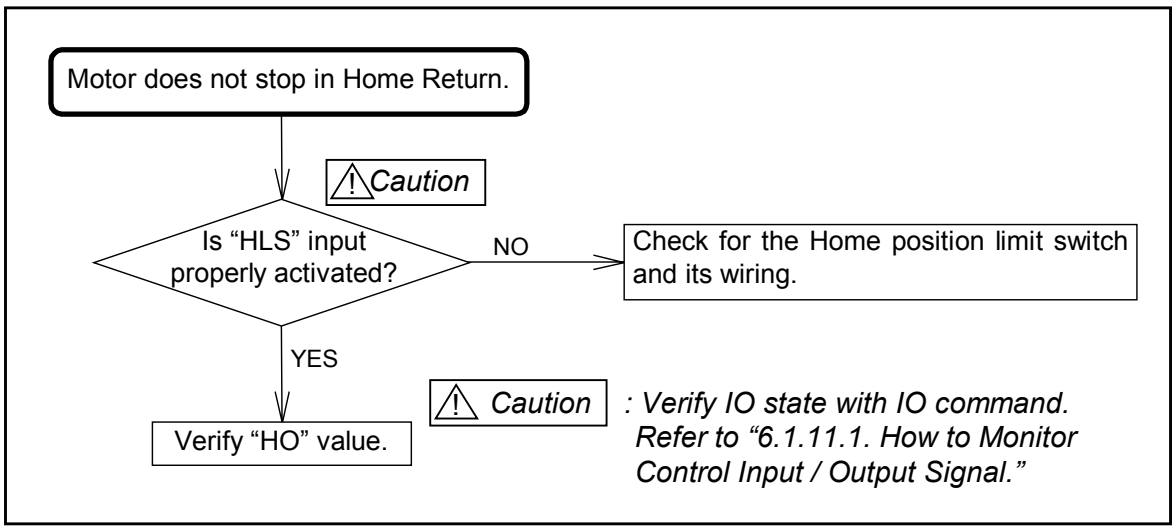


Figure 12-7:

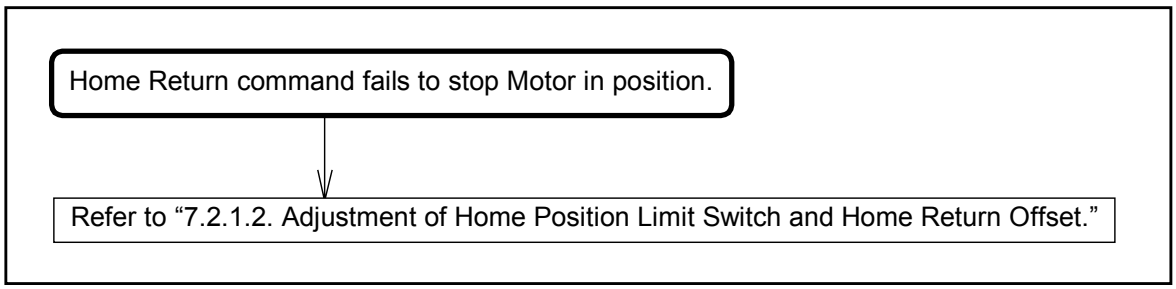


Figure 12-8

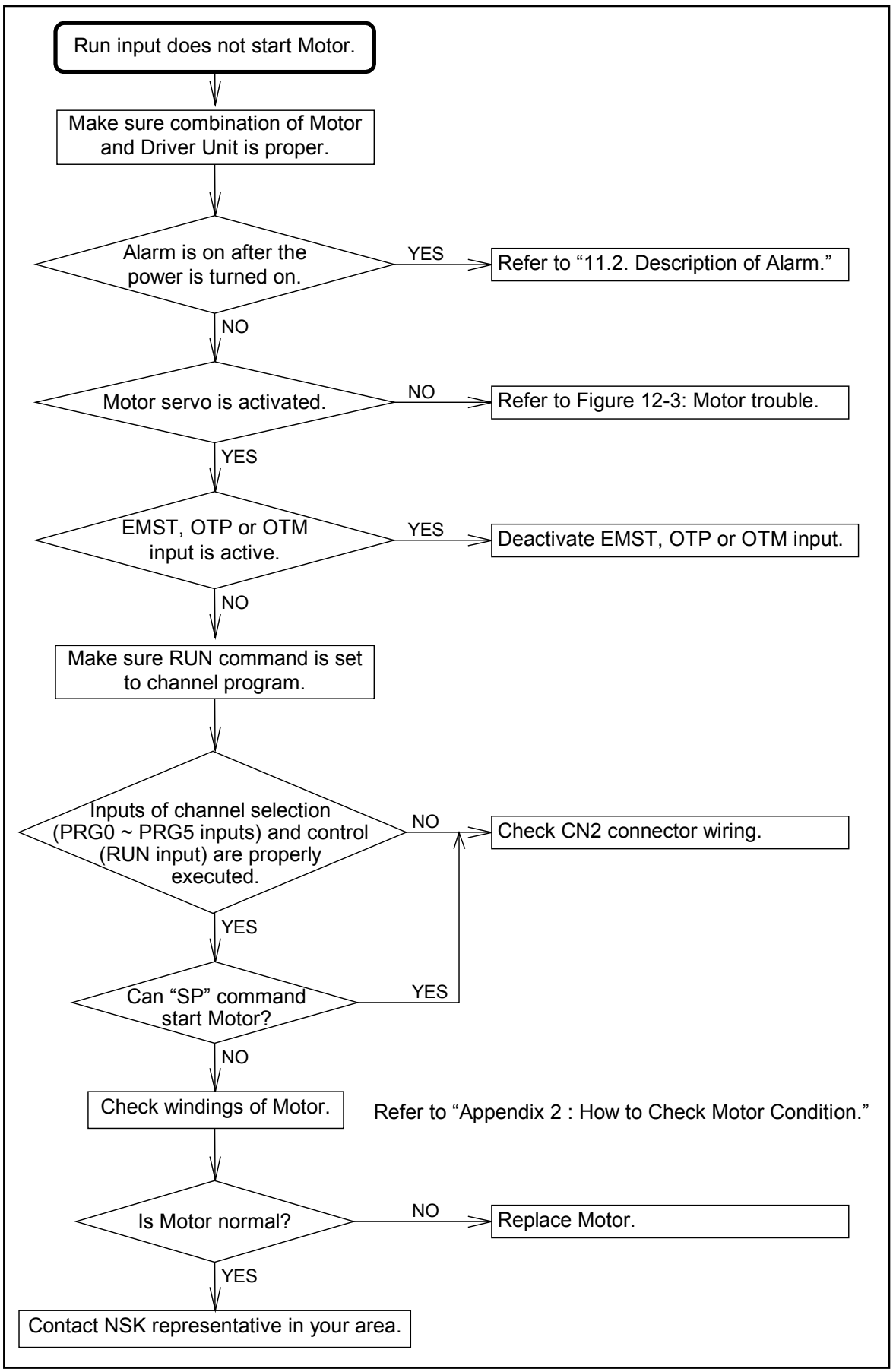
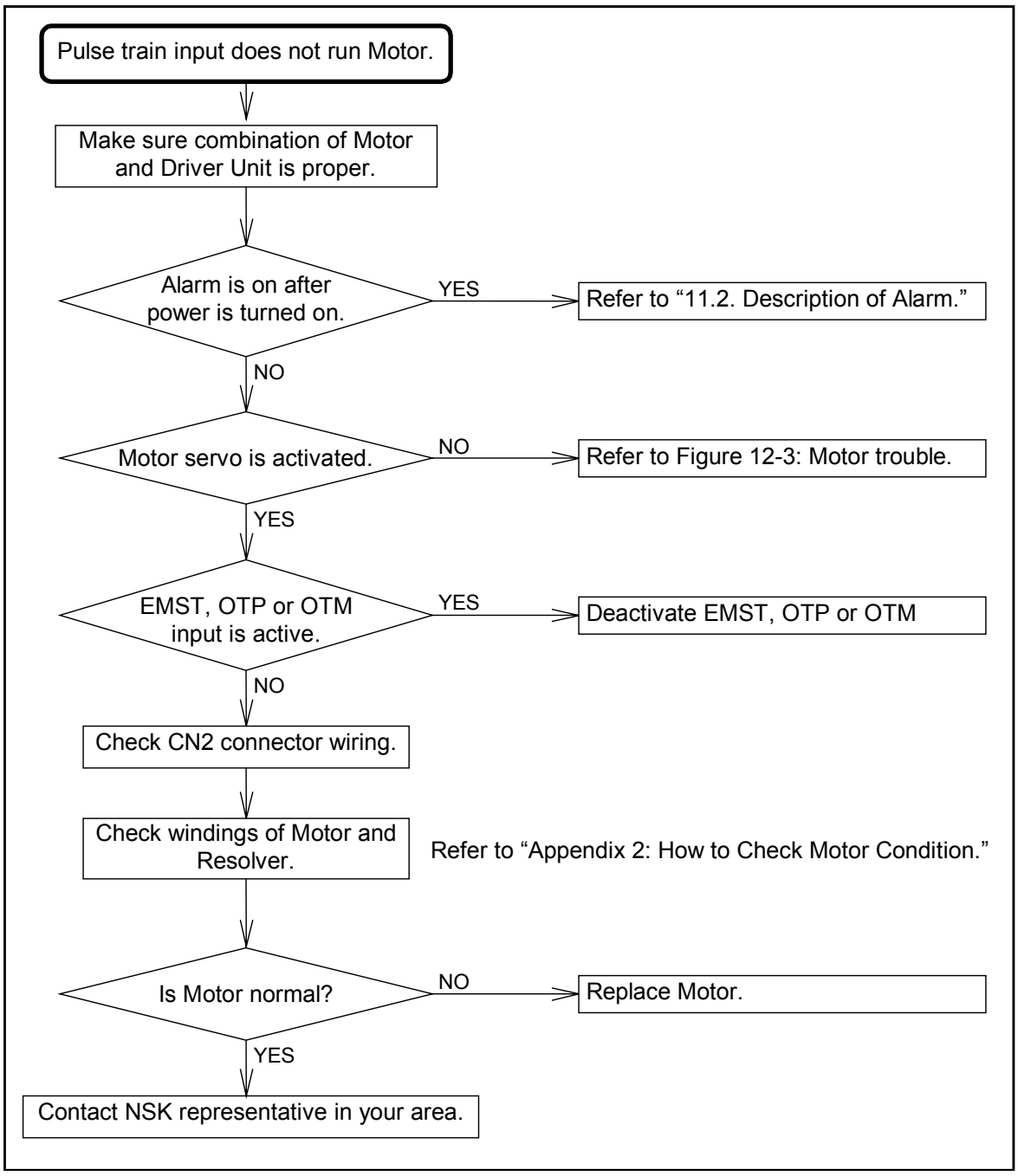
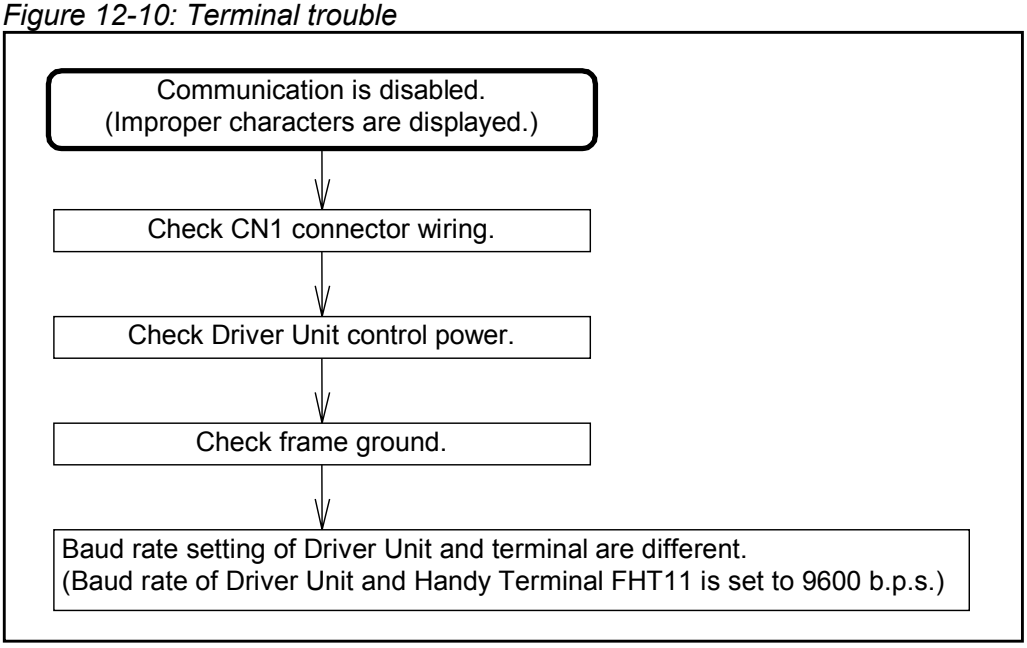

Run input does not start Motor.
Make sure combination of Motor and Driver Unit is proper.
Alarm is on after the power is turned on.
YES
Refer to “11.2. Description of Alarm.”
NO
Motor servo is activated.
NO
Refer to Figure 12-3: Motor trouble.
YES
EMST, OTP or OTM input is active.
YES
Deactivate EMST, OTP or OTM input.
NO
Make sure RUN command is set to channel program.
Inputs of channel selection (PRG0 ~ PRG5 inputs) and control (RUN input) are properly executed.
NO
Check CN2 connector wiring.
YES
Can “SP” command start Motor?
YES
NO
Check windings of Motor.
Refer to “Appendix 2 : How to Check Motor Condition.”
Is Motor normal?
NO
Replace Motor.
YES
Contact NSK representative in your area.

Figure12-9


Pulse train input does not run Motor.
Make sure combination of Motor and Driver Unit is proper.
Alarm is on after power is turned on.
YES
Refer to “11.2. Description of Alarm.”
NO
Motor servo is activated.
NO
Refer to Figure 12-3: Motor trouble.
YES
EMST, OTP or OTM input is active.
YES
Deactivate EMST, OTP or OTM
NO
Check CN2 connector wiring.
Check windings of Motor and Resolver.
Refer to “Appendix 2: How to Check Motor Condition.”
Is Motor normal?
NO
Replace Motor.
YES
Contact NSK representative in your area.

12.2.4. Terminal Trouble

Figure 12-10: Terminal trouble

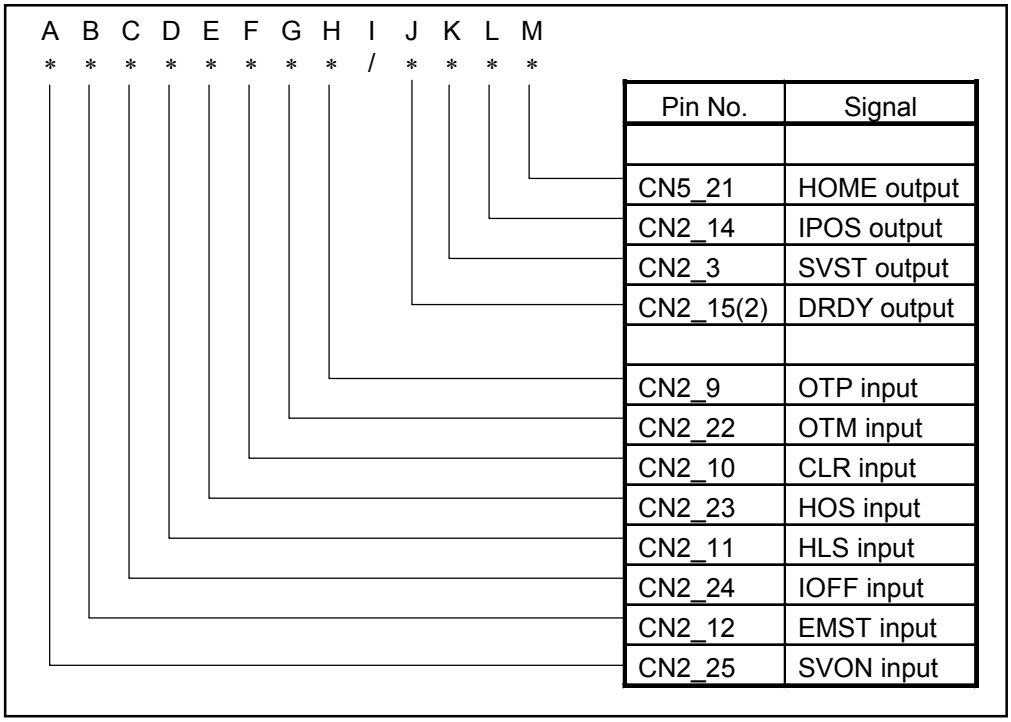


Appendix 1: Monitor Input / Output Signal

IO: Read Out Input/Output Signal

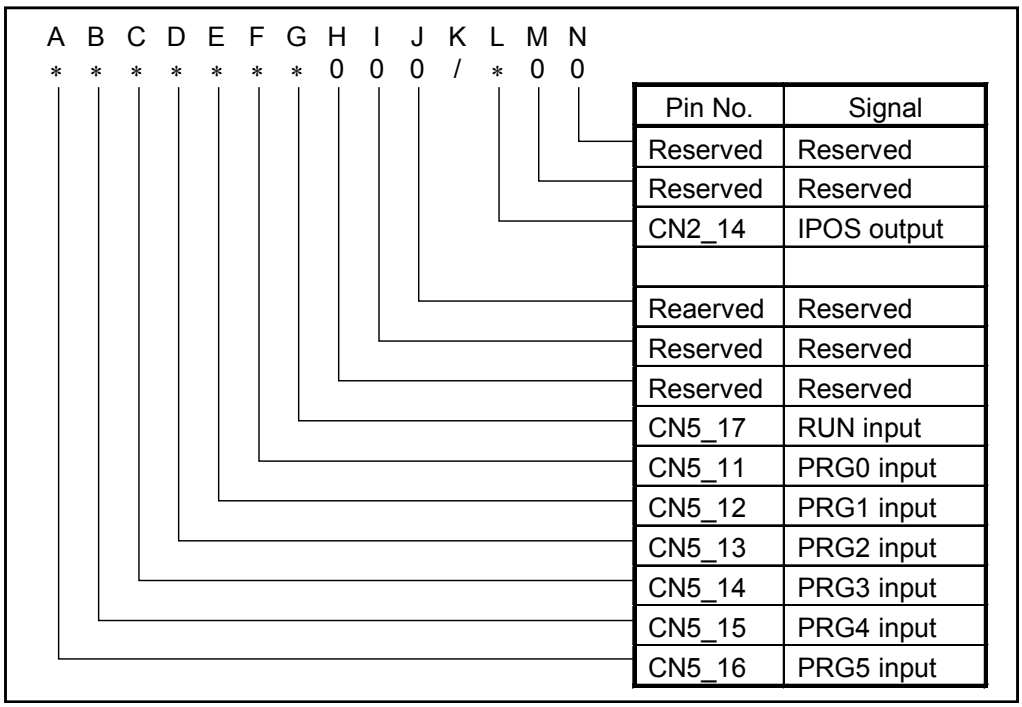
- IO command monitors the status of Input/Output signals of CN2, and CN5connectors.
- You may use the readout for checking wiring.
  - ◊ Input format: IO0/RP : Indication of I/O signals
    IO2/RP : Readout of I/O for internal program command.
    IO3/RP : Readout of I/O for Jog operation
    Without /RP : Monitors only once.
    With /RP : Monitors in real time basis.
  - ◊ Readout format: Indicates Input/Output in one digit of bitmap format. (Figure A-1 to A-3)

Figure A-1 : IO0/RP readout format



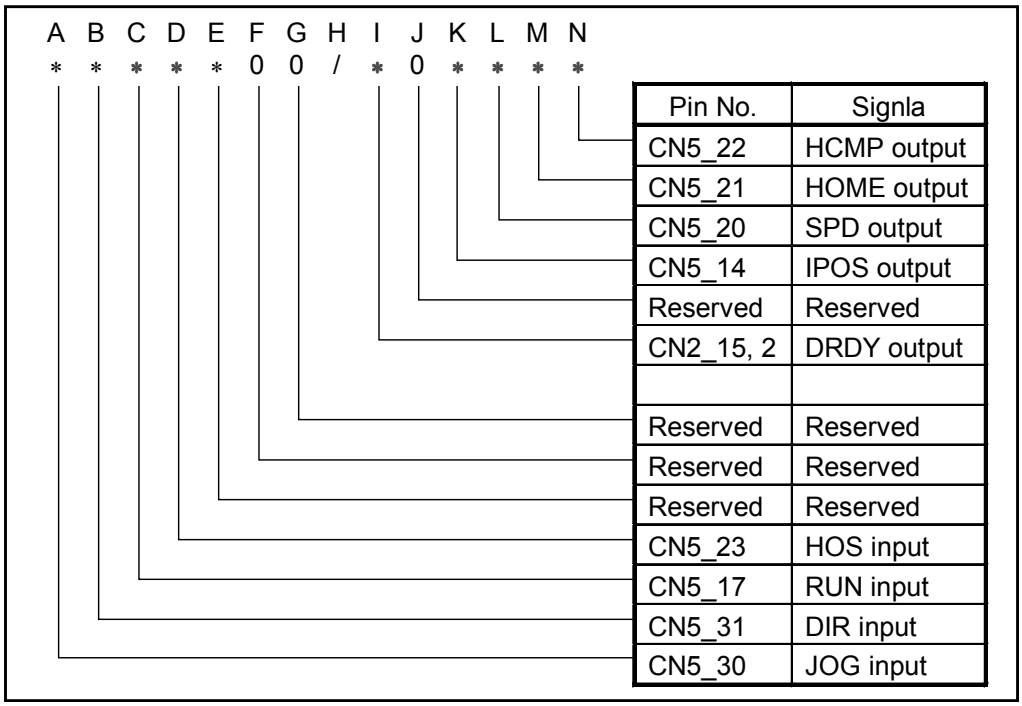
Pin No.	Signal
CN5_21	HOME output
CN2_14	IPOS output
CN2_3	SVST output
CN2_15(2)	DRDY output
CN2_9	OTP input
CN2_22	OTM input
CN2_10	CLR input
CN2_23	HOS input
CN2_11	HLS input
CN2_24	IOFF input
CN2_12	EMST input
CN2_25	SVON input

Figure A-2 : IO2/RP readout format



Pin No.	Signal
Reserved	Reserved
Reserved	Reserved
CN2_14	IPOS output
Reaerved	Reserved
Reserved	Reserved
Reserved	Reserved
CN5_17	RUN input
CN5_11	PRG0 input
CN5_12	PRG1 input
CN5_13	PRG2 input
CN5_14	PRG3 input
CN5_15	PRG4 input
CN5_16	PRG5 input

Figure A-3 : IO3/RP readout format

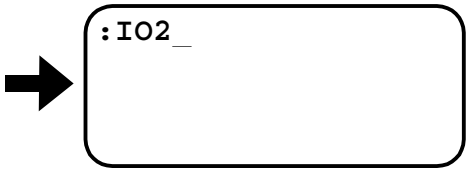


Pin No.	Signla
CN5_22	HCMP output
CN5_21	HOME output
CN5_20	SPD output
CN5_14	IPOS output
Reserved	Reserved
CN2_15, 2	DRDY output
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
CN5_23	HOS input
CN5_17	RUN input
CN5_31	DIR input
CN5_30	JOG input

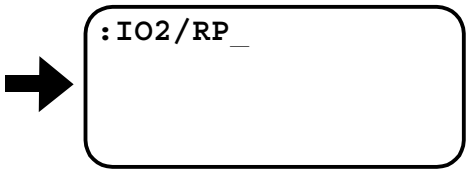
[Example] Check if "RUN" command to start channel program is on.

1) Confirm that the display of Handy Terminal indicates the colon (:).
(If the display does not show the colon press [ENT] key once.)

2) [I] [O] [2 $]

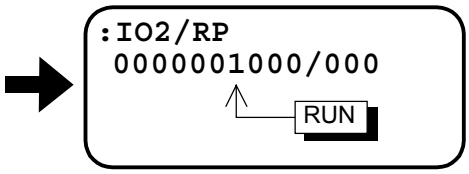


3) [/] [R] [P]



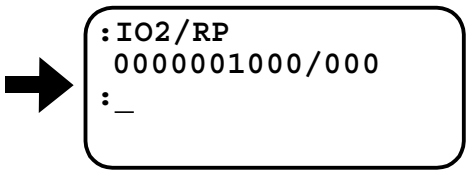
4) Press the enter key to execute.
Readout starts immediately after the input.

[ENT]



5) Press the back space key to discontinue readout. If it is not pressed, the readout will be repeated and the next commandwon't be accepted.

[BS]



[Description]

- Above example shows that the readout of RUN input is "1," which indicates "RUN" input is on.
  - ◊ In case of the above example, the indications of Input / Output signals are monitored and indicated until [BS] key is pressed.
  - ◊ Change of On and Off of the Input / Output signals will be followed during indication by changing in the reading "1" to "0."
  - ◊ However, if inputting / RP is omitted in procedure 3) in the above example, I/O status will be indicated only once just after [ENT] key is pressed.

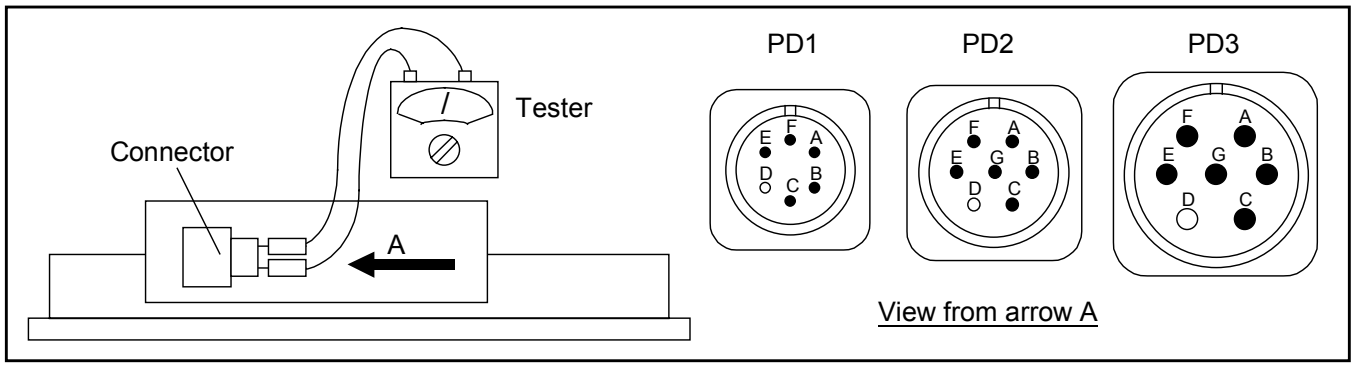
Appendix 2: How to Check Motor Condition

- Check resistance of the windings of Motor if the Motor is not functioning normally. If the result of check is in the tolerance shown below the Motor is regarded as normal.

How to measure resistance of the Motor windings

- The resistance of the Motor windings shall be checked on the pins of connector on the side of the slider using a tester.

Figure A-4



- The table below specifies the tolerance of resistance.

Table A-1

Motor type	Resistance of Motor winding (Ω)	Tolerance
PD1	5.6	1. ±30% of the specification in left.
PD2	2.8	2. Variation between U-V, V-W and W-U pins shall
PD3	1.9	be equal to or less than 1.0 Ω.

Table A-2: Pin-out of Motor connector

Motor phase	Pin number.
U	A
V	B
W	C
FG	D
Thermal protector (+)	E
Thermal protector (-)	F

- Correspondence of the Motor phase and connector pin numbers are shown in the table below.

Table A-3

Motor phase	Pin number.
U - V	A ↔ B
V - W	B ↔ C
W - U	C ↔ A

How to check insulation resistance of the Motor windings

- Check insulation resistance of the Motor windings with the pins of connector on the side of the slider using a tester. (Apply 500V. Resistance shall be 10 MΩ or over.)

- Check the insulation resistance between the pin of respective phases (A, B and C) and FG.

Inspection of Linear scale

- Check if the lamp of the scale head is green when you connect the linear scale to the Driver Unit and turn on the power. If the lamp is red when it is stopping or moving, adjust the alignment of the scale head. (If the linear scale is used in butting connection of the Motor bases, it is possible that the scale is not aligned correctly or not connected properly.) However, in the normal condition, the red lamp is on when the slider passes the magnet switch of Home position (reference mark) to confirm that the Home position signal is functioning normally.

- If the red lamp is on at a part in a motion range when checking the scale by moving the slider, inspect if the scale is not clean or has damaged. When the scale is not clean wipe it out by isopropyl alcohol. If the scale is damaged, replace it.

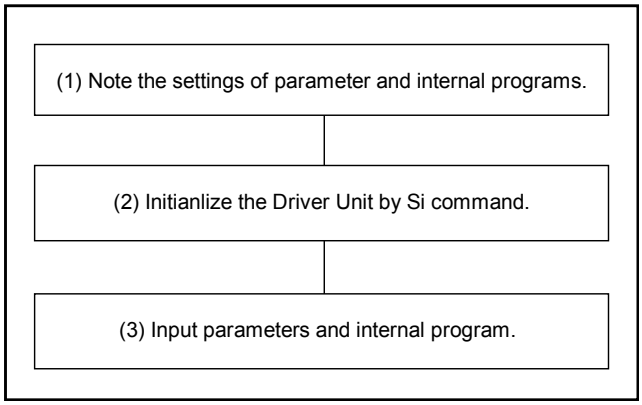
⚠ *Caution* *: Never use solvent such as thinner for cleaning the linear scale.*

- Check for breakage of the scale commutation cable when A0, A8 or A9 alarm occurs.
  Motor connector : SRCN6A25-24S
  Connector of the Driver Unit : CN3: DA-15PF-N
  CN6: D02-M15PG-N-F0

Appendix 3: Initialization of the Driver Unit

- If initializing the Driver Unit when troubleshooting or replacing the Driver Unit or the Motor, follow the procedures described hereunder.
- It requires 3 steps for initialization as shown in Figure A-5. SI command starts initialization.
- Use the terminal for inputting/outputting parameter (Handy Terminal FH11).
- The procedures are described on Figure A-5.

Figure A-5



1 Note down the parameters and the internal programs of the Driver Unit that is to be replaced using the Handy Terminal.

- Connect the Terminal to the Connector CN1 and turn on the power (AC200V - 230V).
- Command TS0 monitors the parameters.

  ↓

- Turn off the power after monitoring.

2 Initialize the internal data by the SI command.

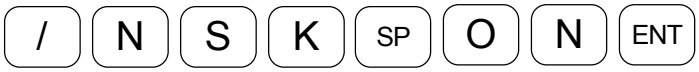
- Connect the Terminal to the CN1 connector.

↓

- Turn on the control power (AC200V－230V) only.

↓

- Input the password when the colon ":" is on the screen.



- The echo-back "NSK ON" shall be on the screen for acknowledgement.

↓

- Input the command SI/AL.

↓

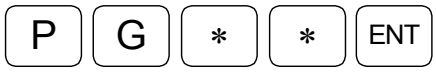
- The colon ":" will be on the screen after "INITIALIZE" as the echo-back.

3 Input the internal parameters and programs.

- Connect the terminal to the CN1connector and turn on the control power.

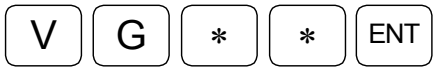
↓

- Input the parameters that have been noted down.



↓

- Input the other parameters and the internal programs thereafter.



4 Confirm the setting of the inputted parameters and programs.

- Check the internal parameters and the programs by the Terminal.
  - ◊ TS0 or TC command will monitor the current settings.

5 Turn on the power and thereby complete the initialization.

Appendix 4: How to Replace EDB Driver Unit

⚠ *Danger* *: Be sure to turn off the power and then follow the procedures described hereunder.*

- For the Driver Unit with unique specifications, please contact your local NSK representative.
- Copy the settings of parameters and position commands of internal channels to the "EDB Parameter •Program Setting List," that is provided on the end of this manual, prior to replace the Driver Unit.
- Especially, be sure to copy the parameters PG, VG, VI, CO, MA, MV and HO, and the data of internal channel.

After the Driver Unit was replaced, input the settings of parameters and the data of internal channels.

1 Connect the Terminal to the CN1 connector.

2 Turn on the control power only. (2 terminals, that are coded "CONT," on the top of the Terminal Block.)

- If the main power and the control power cannot be separated because of wiring circumstances, disconnect the CN2connector and then turn on the control power.
- If the power is turned on without observing the above notes, the Motor may be out of control as the parameters won't be set correctly. Be sure to observe the above notes.

3 When the power is turned on, the message NSK MEGATHRUST · · ·" will appear on the screen.

- When the indication of the Handy Terminal chows the prompt ":," input

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

and then input

[S] [I] [/] [A] [L] [ENT]

to initialize the Driver Unit. (It takes approximately 30 seconds."

4 Input the copied parameters and internal channel data one by one manually when the prompt ":" appears on the screen of the Handy Terminal.

EDB Parameter • Program Setting List

Reference No.:
S/N

Setting of Parameter

• Blank column denotes the shipping set. Date:

Parameter	Setting		Parameter	Setting		Parameter	Setting	
	Shipping set	User setting		Shipping set	User setting		Shipping set	User Setting
PG	0.100		IS	0		MM	1	
VG	1.0		FW	0		BM	1	
VGL	1.0		CR	×1		CM	0	
VI	1.00		PC	0		AN	0	
VIL	1.00		PS	0		WM	0	
VM	1		DI	0		SE	0	
LG	50		OTP	0.0		LO	0.0	----
TL	100		OTM	0.0		SG	0	----
GP	0.0		MV	500		MT	*	
GT	5		MA	0.5		RI	*	
FO	0		JV	50		ZP	0.70	
FP	0		JA	0.5		ZV	1.4	
FS	0		HV	100		SL	3	
NP	0		HA	0.5		AC	1	
NS	0		HZ	5		AGV	1.00	
DBP	0.0		OS	***		AGT	1.00	
DBA	0		HD	1		AF	0	
ILV	100.0		HO	0.0		AL	0	
FF	0		OL	*		SO	0	
FC	0		RC	*		SB	0.0	
CO	50 000.0		AB	X0X0XX00		ST	0	
IN	100.0		NW	2				

* Differs according to size of the Motor.

** Differs according to individual Motor.

*** Data of OS shall be 6 when the phase Z is available while 7 will be the data when the phase Z is not available.

- Notes for copying and resetting the parameters:

  ◊ LO and SG don't need the setting as they are the parameters for automatic adjustment of PG, VG, VI and MA.

Reference No. :
S/N:

Program Setting List

- Blank cannel denotes that the program is not set to it.

Date:

CH	Program	CH	Program	CH	Program	CH	Program
0	Command: CV: CA:	16	命令： CV： CA：	32	Command: CV: CA:	48	Command: CV: CA:
1	Command: CV: CA:	17	命令： CV： CA：	33	Command: CV: CA:	49	Command: CV: CA:
2	Command: CV: CA:	18	Command: CV: CA:	34	Command: CV: CA:	50	Command: CV: CA:
3	Command: CV: CA:	19	Command: CV: CA:	35	Command: CV: CA:	51	Command: CV: CA:
4	Command: CV: CA:	20	Command: CV: CA:	36	Command: CV: CA:	52	Command: CV: CA:
5	Command: CV: CA:	21	Command: CV: CA:	37	Command: CV: CA:	53	Command: CV: CA:
6	Command: CV: CA:	22	Command: CV: CA:	38	Command: CV: CA:	54	Command: CV: CA:
7	Command: CV: CA:	23	Command: CV: CA:	39	Command: CV: CA:	55	Command: CV: CA:
8	命令： CV： CA：	24	Command: CV: CA:	40	Command: CV: CA:	56	Command: CV: CA:
9	Command: CV: CA:	25	Command: CV: CA:	41	Command: CV: CA:	57	Command: CV: CA:
10	Command: CV: CA:	26	Command: CV: CA:	42	Command: CV: CA:	58	Command: CV: CA:
11	Command: CV: CA:	27	Command: CV: CA:	43	Command: CV: CA:	59	Command: CV: CA:
12	Command: CV: CA:	28	Command: CV: CA:	44	Command: CV: CA:	60	Command: CV: CA:
13	Command: CV: CA:	29	Command: CV: CA:	45	Command: CV: CA:	61	Command: CV: CA:
14	Command: CV: CA:	30	Command: CV: CA:	46	Command: CV: CA:	62	Command: CV: CA:
15	Command: CV: CA:	31	Command: CV: CA:	47	Command: CV: CA:	63	Command: CV: CA:

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