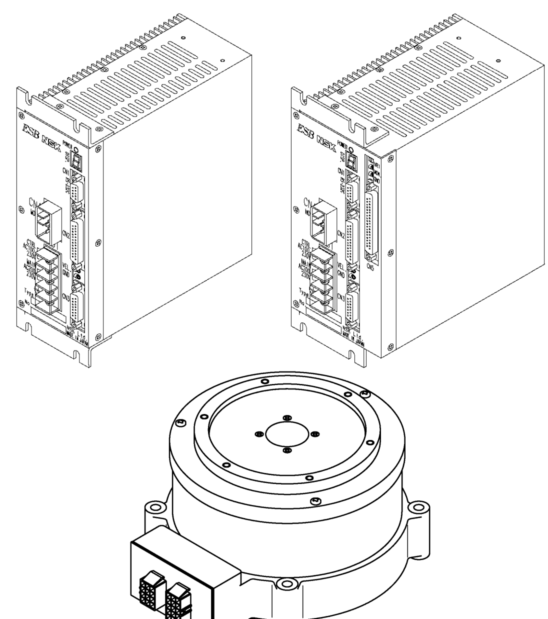
NSK

MEGATORQUE® MOTOR SYSTEM

User's Manual

(ESB Driver Unit System)



NSK Ltd.

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

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

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

1 Temperature

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

2 Protection against contamination and water

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

3 Wiring / Ground

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

4 Storing

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

5 Limited number of times for overwriting data

- The Driver Unit uses an EEPROM for backup of the data and programs. Though the number of times to overwrite the EEPROM is guaranteed to 500 000, it is still possible that the Driver Unit may be disabled by an alarm for “EEPROM error (E2)” that is triggered by exceeded limits of the number of times for overwriting because of frequent changes of the parameters and programs through master controllers.
In such a case, change setting of the parameter WM to 1 from 0 (initial setting) to kill the backup function after setting basic parameters such as I/O and servo parameters.

6 Handling of In-position (IPOS) output signal

- Different from the conventional EE/EK, EM/EP and ESA Driver Units, IPOS output of ESB Driver Unit opens when the following conditions are met under the IPOS mode (FW0).

  1) Motor servo is off.

  2) An alarm is on.

- Be sure to check the master controller so that its controlling function will not be affected when replacing the conventional Driver Unit with ESB Driver Unit.

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

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

1 Dustproof and Waterproof of the Motor

- Make sure how your Motor is graded for dust-proof and/or waterproof. You cannot use the Megatorque Motor in the environment where chemicals or paint fumes exist.
  - ◊ Standard Megatorque Motors (RS, AS, BS, JS, SS and YSB Series)

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

    Some part of the Motor is not completely waterproofed. Confirm what part is not waterproofed with the specification document, and then take appropriate measures to the part against water and dust if necessary. For a long time use of the Motor, we recommend making sure of its aging trend of the Motor with the periodical insulation test approximately once in every half year. You cannot use this type of Motors unless you take the measures against the environment with water or oil.
  - ◊ Waterproof Motor (RZ series: IP65 equivalent)

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

2 Use condition

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

3 About Motors equipped with brake

- The brake is power off activated type electromagnetic brake.
- The user shall provide 24 VDC power source. You cannot use power source unit for YS Megatorque Motor (M-FZ063-1 90VDC).
- Be sure to keep the friction plate of brake free from iron powder or oil.
- The brake may not function if iron made member exists near the brake. Please provide 15 mm or more clearance between the brake and other members.

4 Periodical check

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

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

1 Alarm arises

- Did you check state of alarm and take proper action to it? Refer to the manual again for required action for the alarm.

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

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

3 The Motor does not function.

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

4 Uncontrollable Driver Unit

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

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

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

6 Breaker trip occurs frequently.

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

4. Others

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

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Conformity to the International Safety Regulations

The Megatorque Motor Systems conform to the EC Directives (CE Marking) and Underwriters' Laboratory (UL) regulations.

1. Conformity to the EC Directives

The Megatorque Motor System is a machine component that 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 the Megatorque Motor System is incorporated.

1.1. Conformity to Electromagnetic Compatibility Directive

A sample of the Megatorque Motor System has been tested under specific conditions of the Motor and the Driver Unit in terms of their combination, installing distance and wiring routing. 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 the Megatorque Motor System.

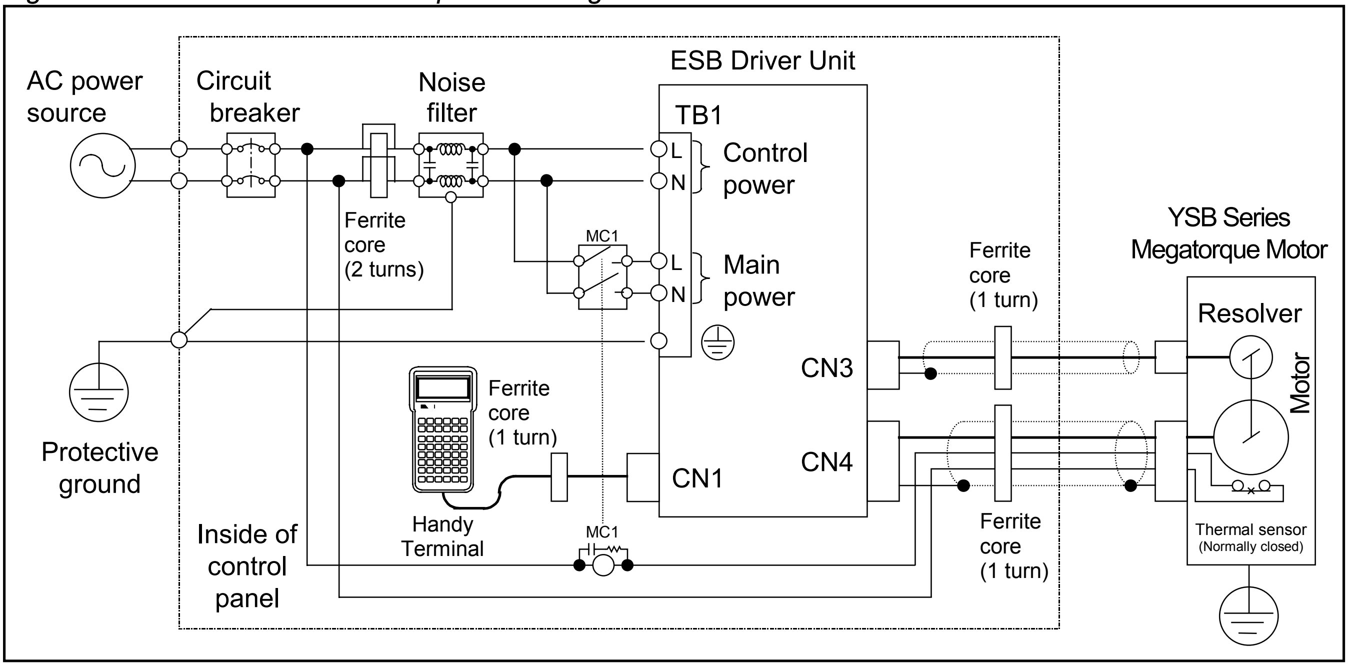
■ List of relevant standards

Item	Conformity with European standards	Relevant EC Directive
Megatorque Motor	EN60034-1	Low Voltage Directive
Motor / Driver Unit	EN50178	
	EN61800-3 : Adjustable speed electrical power drive system	Electromagnetic Compatibility Directive
	EN61000-3-3 : Class5 Harmonic voltage and fluctuation	
	EN61000-4-2 : Electro static discharge	
	EN61000-4-3 : Radio-frequency electromagnetic field	
	EN61000-4-4 : Electric fast transit burst	
	EN61000-4-5 : Lightening surges	
	EN61000-4-6 : Radiofrequency conducted disturbance	

1.2. Conditions to Conform With EC Directives

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

Figure 1: Recommendation example for wiring



◆ **Environmental conditions**
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 ESB 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**
Be sure to ground the protective grounding terminal of the ESB Driver Unit to the protective ground (PE) of the control panel for a measure against electrical shock

Table 1: List of recommended part

Item	Specification	Manufacturer	Remarks
Circuit breaker	Rated current: 10A	Single phase: EA32AC-10 (Fuji Electric)	Conforms to IEC regulations and approved by UL
Noise filter	Single phase: 250 VAC, 10A	FN2070-10/06 (SHAFFNER)	
Ferrite core 1	—	E04SR301334 (Seiwa Electric MFG)	
Ferrite core 2	—	E04SR170730A (Seiwa Electric MFG)	For the Handy Terminal
Magnetic switch	Rated current: 10A	SC-03 (Fuji Electric)	

2. Conformity to Underwriters Laboratories Standards

The Megatorque Motor and the ESB Driver Unit are qualified products for the following UL Standard for safety.

Table 2

Subject	Qualified regulation	File No.
Megatorque Motor	UL1004	E216970
Driver Unit	UL508C	E216221

2.1. Conditions to Meet UL Standards

Be sure to meet the following as they are the supplementary conditions the qualification.

◆ **Environmental conditions**
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 ESB 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 the UL safety standard between the power source and the Driver Unit.

◆ **Protective Grounding**
Be sure to ground the protective grounding terminal of the ESB Driver Unit to the protective ground (PE) of the control panel for a measure against electrical shock.

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Appendix

1. Introduction

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

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

- For specifications of Motors described in “2.5. Motor Specifications,” we only describe the standard YSB series Motors. If your Motor is not one of these, please refer to the attached specification document to the Motor to which the priority is given.

- On the upper part of each page (header), type codes of ESB Driver Unit to which the description on the page is applicable are indicated. Confirm if the description on the page matches to your Driver Unit type referring to Table 1-1 in “1.2. Terminology.”

B3 type *B5 type*
23 type *25 type*

  ◊ In a case shown above, the description on the page supports the B3 and 23 type Driver Units, and does not support the B5 and 25 type Driver Units.

1.1. Notes to Users

1.1.1. Notes for Safety

- For your safety, you should read this manual thoroughly and understand the contents before operating the Megatorque Motor System.

- Following notice is added to each clause for safety precaution to get your attention.

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

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

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

1.1.2. Operational Remark

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

⚠ *Caution: When making a combination of a Motor and a Driver Unit, confirm that their specifications for Motor size and maximum Motor torque match each other.*

◊ Refer to "2.4.Standard Combination List" for the combination.

◊ This is because the Driver Unit holds the unique parameter settings for the Motor in it.

◊ Confirm that the reference numbers on each identification plate of a Motor and a Driver Unit indicate the sane Motor size code, Motor maximum torque and position sensor code.

◊ If the numbers are different, the System will lose its accuracy, and emit noise, and furthermore, the Motor won't move, or may lose control.

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

◊ If the cable is modified, it may cause inaccurate positioning or noise emission.

⚠ *Caution: Never disassemble the Motor since it has been precisely assemble and tuned.*

◊ If disassembled, it may cause abnormalities such as deterioration in rigidity and positioning accuracy as well as increase in noise.

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

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

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

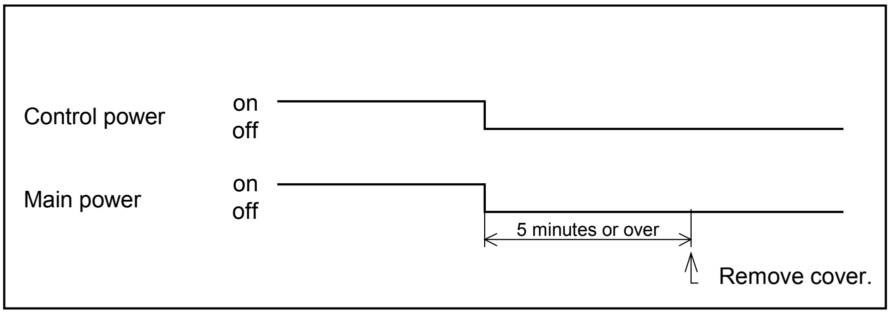
◊ The Driver Units have high capacity conductors in its internal circuits, thus resulting in high residual voltage of the capacitors for few minutes after the main power is turned off.

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

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

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

Figure 1-1



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

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

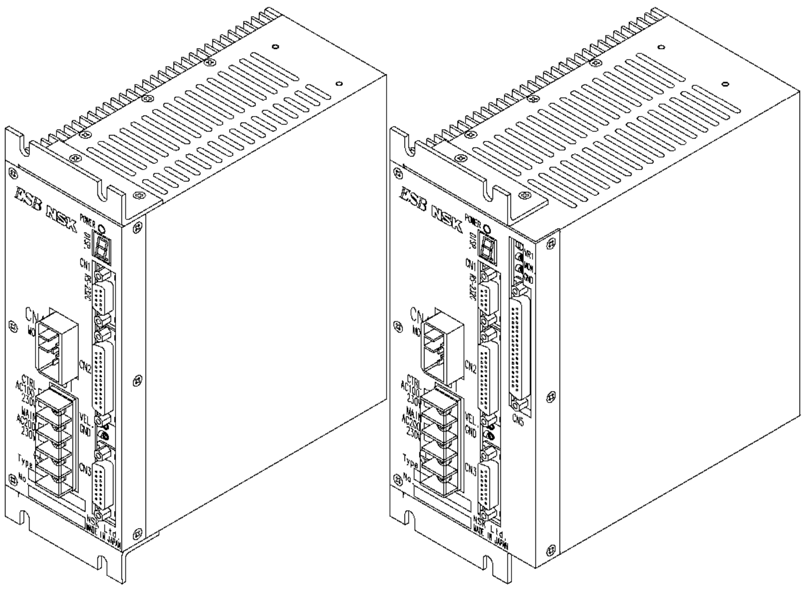
◊ An internal dump resistor dissipates the regeneration. However, when high and continuous regeneration is applied, it won't dissipate excessive regeneration fully, and it will overheat, and then the Motor will eventually stop under "Abnormal main power voltage" alarm state.

◊ In such a case, you need to decrease velocity, deceleration rate, and operation duty cycle, or, you require an external high capacity regenerative dump resistor.
Refer to "Appendix 5. Regeneration Dump Resistor."

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

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

Figure 1-2



⚠ *Warning: Do not test the insulation of the Driver Unit. The high voltage used in the test may destroy the Driver Unit circuit. Refer to "Appendix2. How to Check Motor Condition" for checking insulation resistance of the Motor.*

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

1.1.3. Interchangeability of Motor and Driver Unit

Interchangeable types

- The standard ESB Driver Units have interchangeability with the standard Motors. You may have a combination of a Motor and a Driver Unit that have different serial number.

- However, please refer to “2.4. Standard Combination List” for combination of reference numbers of the Motors, the Driver Units and the Cable Sets.

Non-interchangeable types

- The interchangeability of a Motor and a Driver Unit won’t be applicable if the Megatorque Motor Systems are made to special orders. In such a case please refer to respective specification documents.

- Be sure to make a combination of a Motor and a Driver Unit with the same serial number when they are not interchangeable. Moreover, you shall use the specified Cable Set.

- Please be aware that the Megatorque Motor System won’t fully exhibit its performance as described in its specifications if a Motor and a Driver Unit are matched with different serial number or if you change length of the Cable Set. Especially in case of a System that incorporates an absolute position resolver, you may lose positioning repeatability to the Home position.

1.2. Terminology

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

◆ Classification of Driver Unit [23 type, 25 type, B3 type, etc.]

We classify the Driver Units along the function. They are distinguished by coding. Refer to the table below for combinations of function and coding.

Table 1-1

Function				Functional code of Driver Unit
Type of position sensor	Code	Input / Output	Code	
Absolute position resolver	B	Basic type	3	B3 type
		Extended I/O type (with analog input)	5	B5 type
Incremental position resolver	2	Basic type	3	23 type
		Extended I/O type (with analog input)	5	25 type

- ◊ Absolute position sensor : Home Return is not necessarily every time when the power is turned on.
- ◊ Incremental position sensor : Home Return is required every time the power is turned on.
- ◊ Basic type : A type of Driver Unit that does not have extended I/O ports. Parameters set the required I/O signals.
- ◊ Extended I/O type : A type of Driver Unit that has extended I/O ports.
  You can use multiple functions simultaneously.
  This type can be operated by the analog command input.

◆ Reference Number of ESB Driver Unit for YSB Motor

Figure 1-1: Reference number of ESB Driver Unit for YSB Motor

M-ESB–YSB2020AB300

Driver Unit functional code

- ◊ Refer to “2.2.2. ESB Driver Unit for YSB Motor” for more details.

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2. Specifications

2.1. System Configuration

2.1.1. Control Modes

- The ESB Driver Unit is compatible with several interface devices.

Table 2-1: List of control input

Control mode	Way of command input	Devices to be used	Application
Position control mode	<Programmable Indexer> • Stores positioning programs to internal channels. • Performs a positioning by the inputs of channel selection and starting command. • The command will be the absolute positioning or the incremental positioning format.	• Sequencer (Input/Output unit) • NC controller (Provided with Inputs/Outputs of M function)	• Various types of indexing application • Intermittent positioning control
	<Pulse train command> • Number of input pulses governs the positioning.	• Sequencer (Positioning control unit) • Pulse train position controller	
	<RS-232C serial communication> • The master controller outputs directly the position command. • The command is in absolute positioning or incremental positioning format.	• Sequencer (Serial communication unit) • RS-232C communication terminal (Personal computer, etc.)	
Velocity control mode	<Analog command (± 10V)> • Motor rotates accordingly to input voltage.	• Sequencer (Analog command output) • Servo motor controller • Additional controlling axis of NC controller	• Rolling and winding mechanism • Velocity control
	<RS-232C serial communication> • The master controller outputs a velocity command.	• Sequencer (Serial communication unit) • RS-232C communication terminal (Personal computer, etc.)	
Torque control mode	<Analog command (± 10V)> • The Motor outputs a torque corresponding to an input voltage to the Driver Unit.	• Sequencer (Analog command output) • Additional control axis of NC controller	• Adjusts tensile force by controlling torque
	<RS-232C serial communication> • The master controller outputs a torque command.	• Sequencer (Serial communication unit) • RS-232C communication terminal (Computer, etc.)	

Table 2-2

Interface	Position control mode	Velocity control mode*	Torque control mode*
Programmable Indexer	✓		
Pulse train command	✓		
RS-232C communication	✓	✓	✓
Analog command		✓	✓

* Velocity and Torque control modes are not available to the B3 and 23 type Driver Units.

2.1.2. Functional Setting of Driver Unit (Only for B3 and 23 Types)

- Function of Input / Output ports for B3 and 23 type Driver Units requires the settings according to the operation mode because they do not have extended I/O ports. (Setting options of Types 1 to 4, 7, and 8 are available. The shipping set is Type 1.)

- The B5 and 25 type Driver Units do not require the settings.

- The parameter TY selects the setting options of Input/Output ports.

Table 2-3

I/O type	Parameter	Operational function	Recommended operation mode
Type 1	TY1	Pulse train command. 16 program channels	• Programmable Indexer
Type 2	TY2	Pulse train command. 4 program channels. Jog.	
Type 3	TY3	Pulse train input. 4 program channels. Hardware over travel limit	• Programmable Indexer • RS-232C communication
Type 4	TY4	Pulse train command. 1 program channel*1. Home Return start. Clear position error. Hardware over travel limit.	• Pulse train command
Type 7	TY7	Pulse train command. 1 program channel*1. Jog. Hardware over travel limit	• RS-232C communication
Type 8	TY8	Pulse train command. Eight program channels. Position loop integrator frequency OFF*2.	• Programmable Indexer • RS-232C communication

*1. Input for channel selection is not available. Start command RUN input uses the channel 0.

*2. When using the YSB Motor equipped with brake, the function of integration frequency OFF (IOFF) will be a function for canceling brake clump by selecting the brake sequence function. Moreover, ON/OFF of brake control and integral control can be done automatically. Refer to “7.1.10. Brake” for more details of brake sequence.

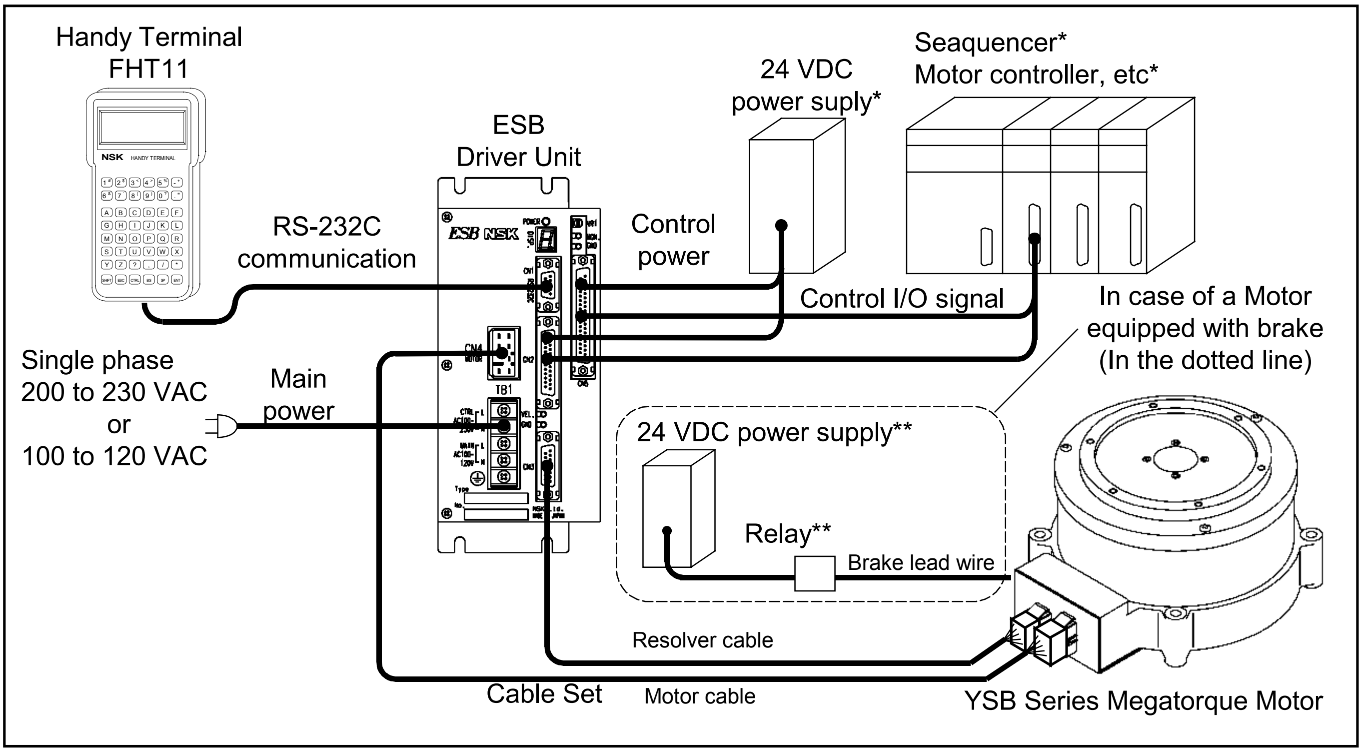
Caution: Use function of “Position loop integrator frequency OFF” of Type 8 in the following cases. When the Motor is locked by external force while the integral control is being ON, the Motor heats up and the Driver Unit will give “software thermal” alarm.

- If a holding brake is required while the Motor is stationary.
- If a locating pin or other mechanical locking device is required while the Motor is stationary.
- If it requires applying a mechanical stopper while the Motor is stationary.

2.1.3. Example of System Configuration

◆ **System configuration of Programmable Indexer**

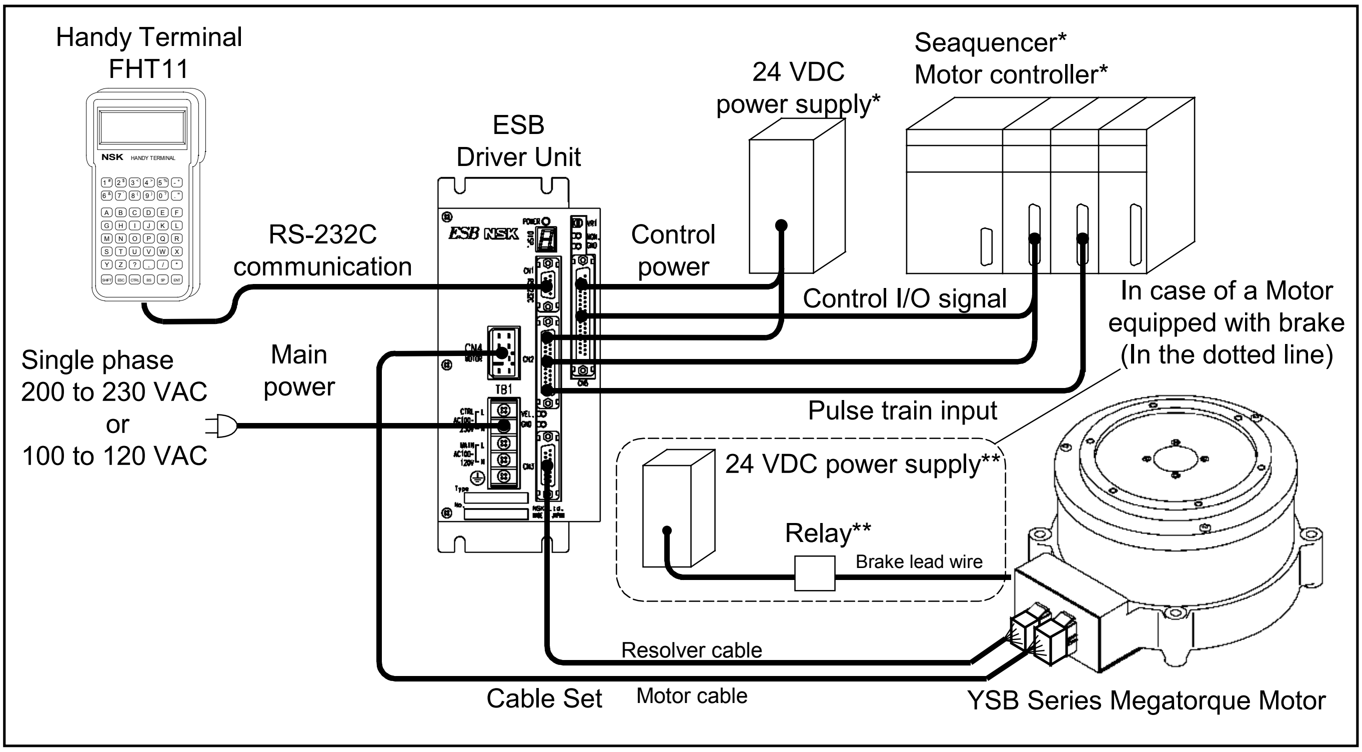
Figure 2-1



*The user shall provide these devices.
** In case of using a Motor equipped with brake, the user shall provide these devices.

◆ **System configuration of pulse train command positioning**

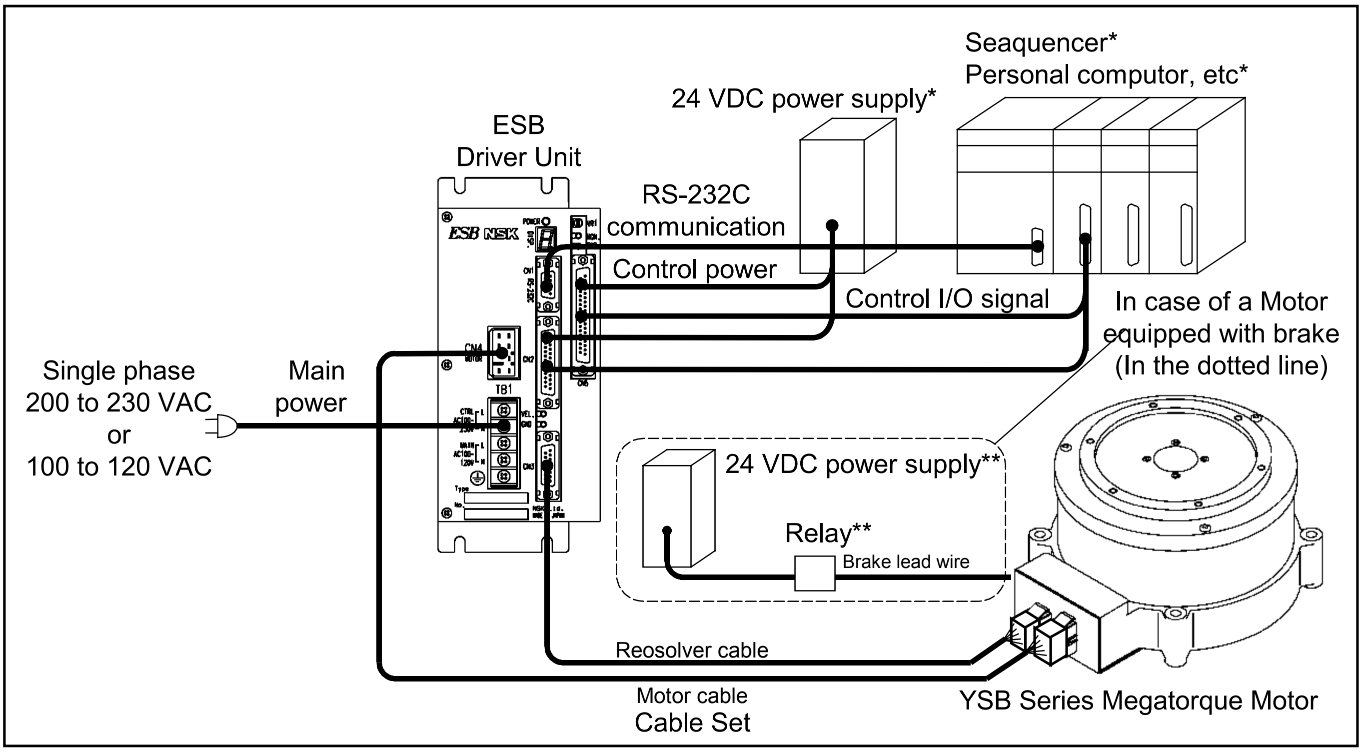
Figure 2-2



* The user shall provide these devices.
** In case of using a Motor equipped with brake, the user shall provide these devices.

◆ System configuration of RS-232C serial communication command positioning

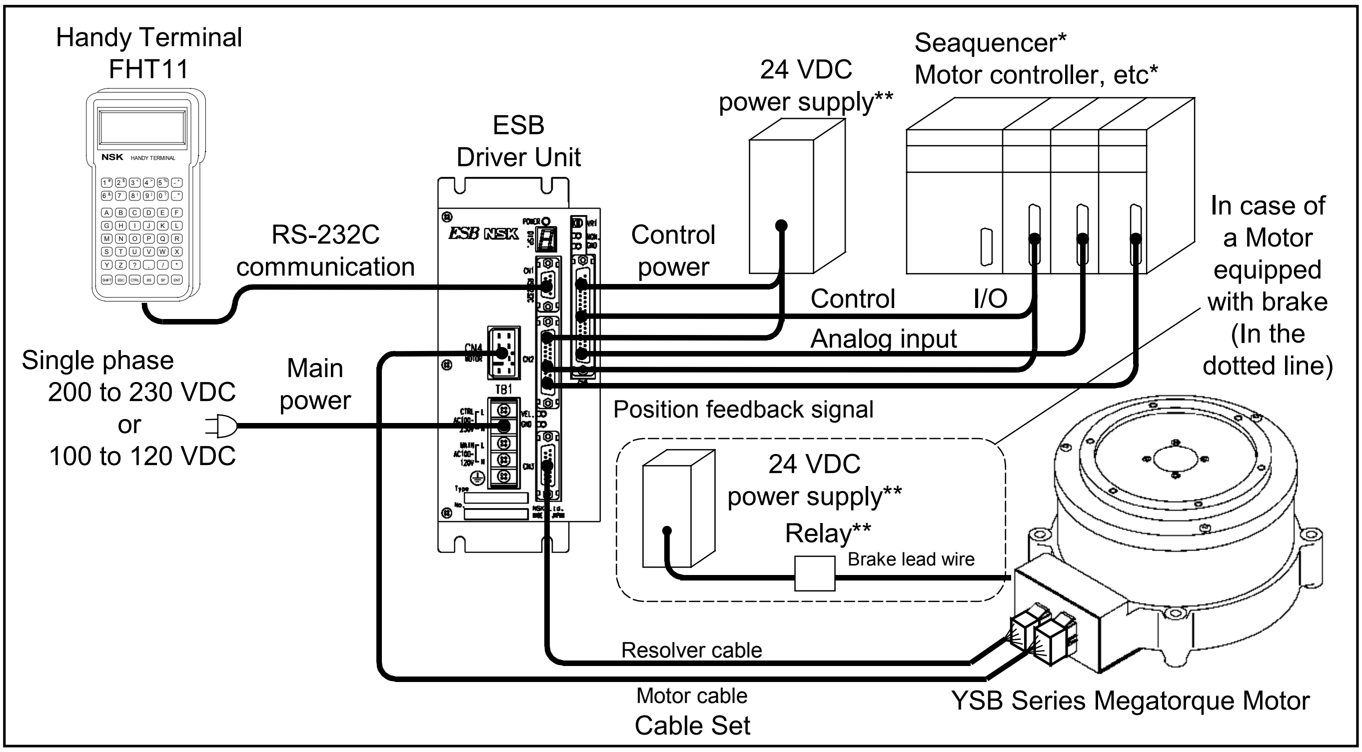
Figure 2-3



* The user shall provide these devices.
** In case of using a Motor equipped with brake, the user shall provide these devices.

◆ System configuration of analog command positioning

Figure 2-4

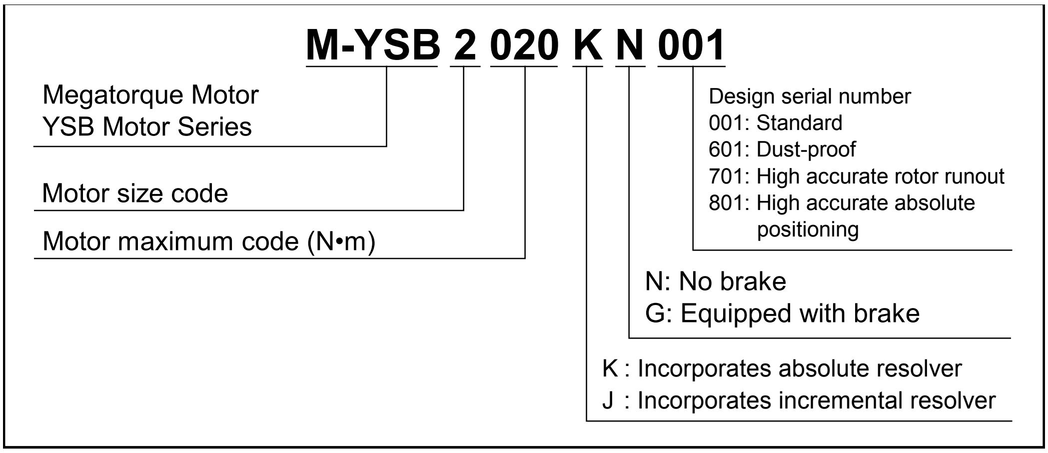


* The user shall provide these devices.
** In case of using a Motor equipped with brake, the user shall provide these devices.

2.2. Coding for Reference Number

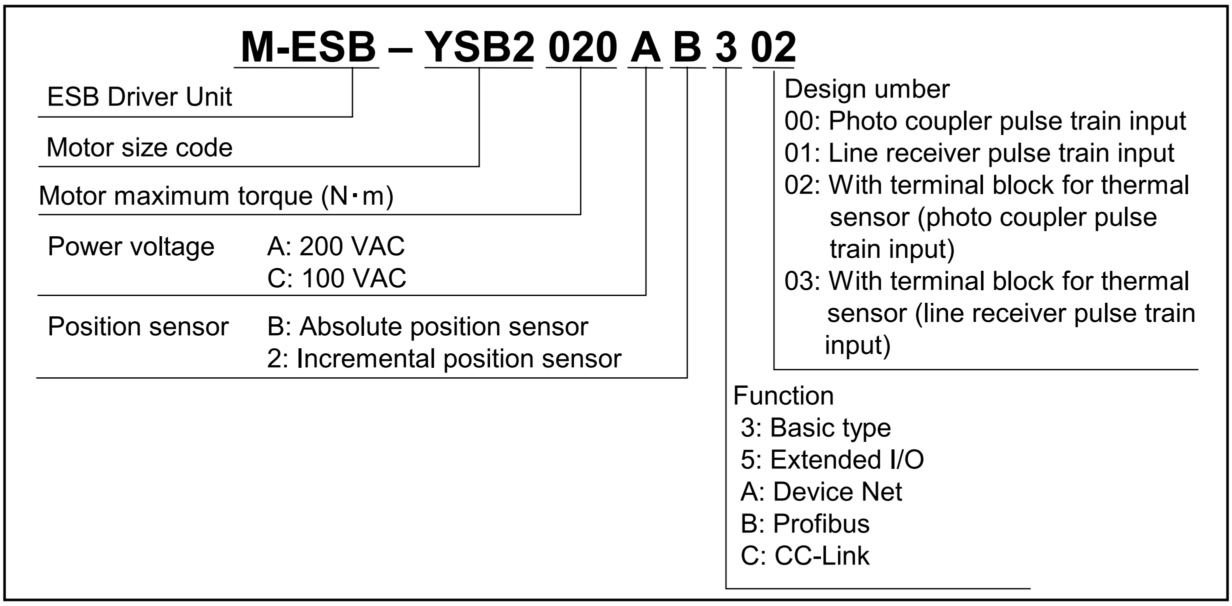
2.2.1. YSB Motor

Figure 2-5



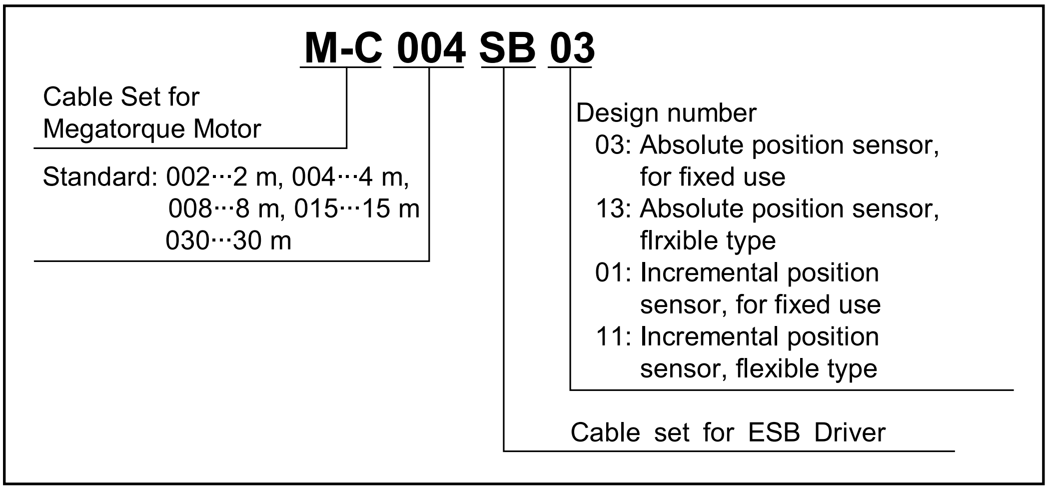
2.2.2. ESB Driver Unit for YSB Motor

Figure 2-6



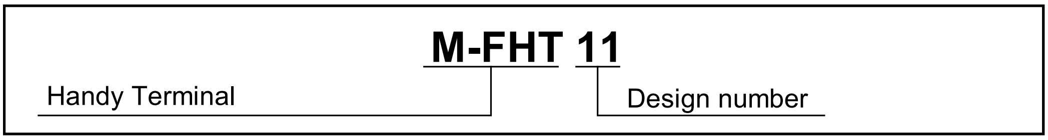
2.2.3. Cable Set for ESB Driver Unit

Figure 2-7



2.2.4. Handy Terminal

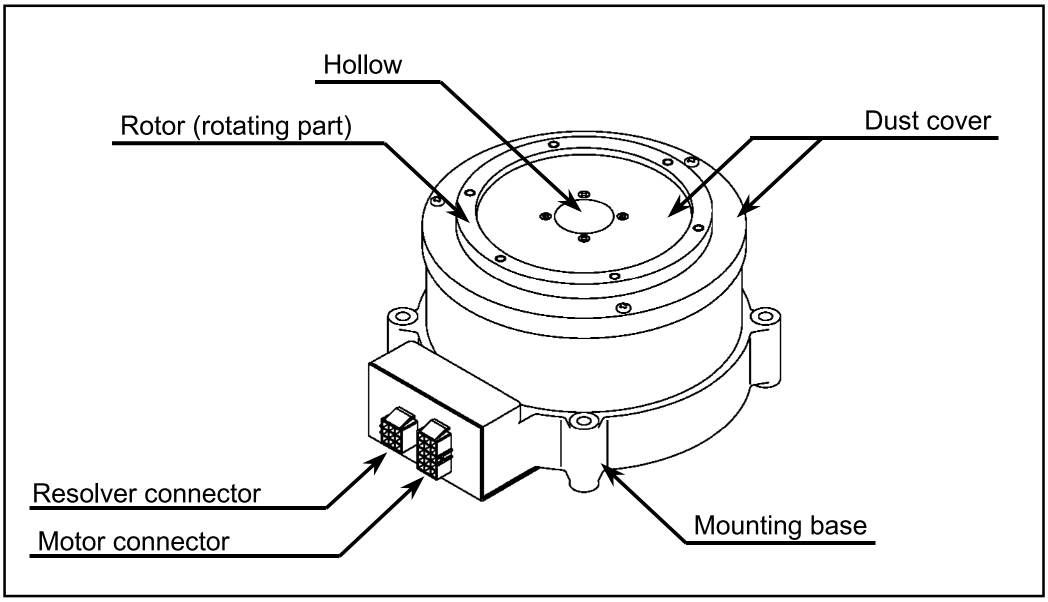
Figure 2-8



2.3. Name of Parts

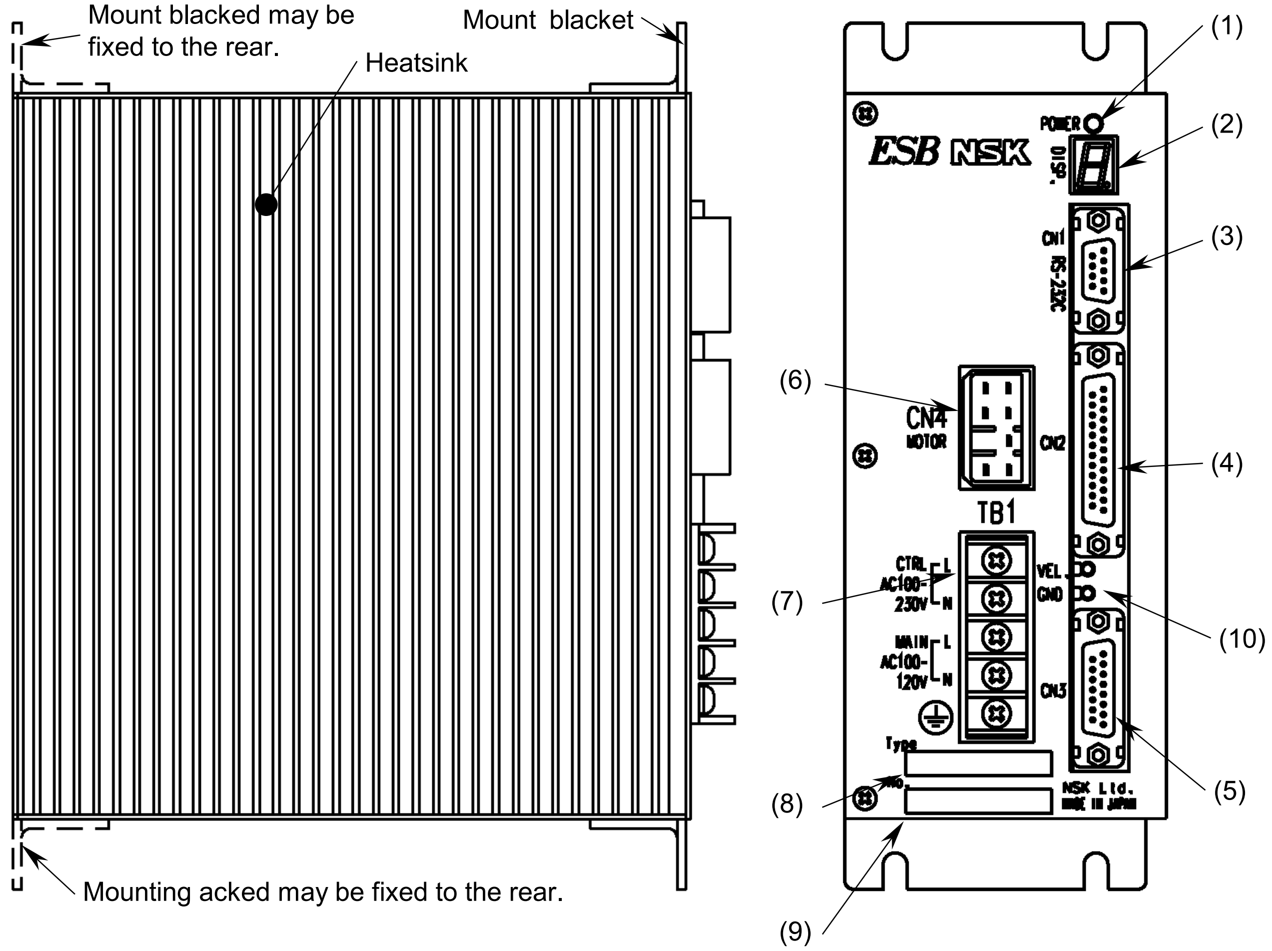
2.3.1. YSB Series Megatorque Motor

Figure 2-9



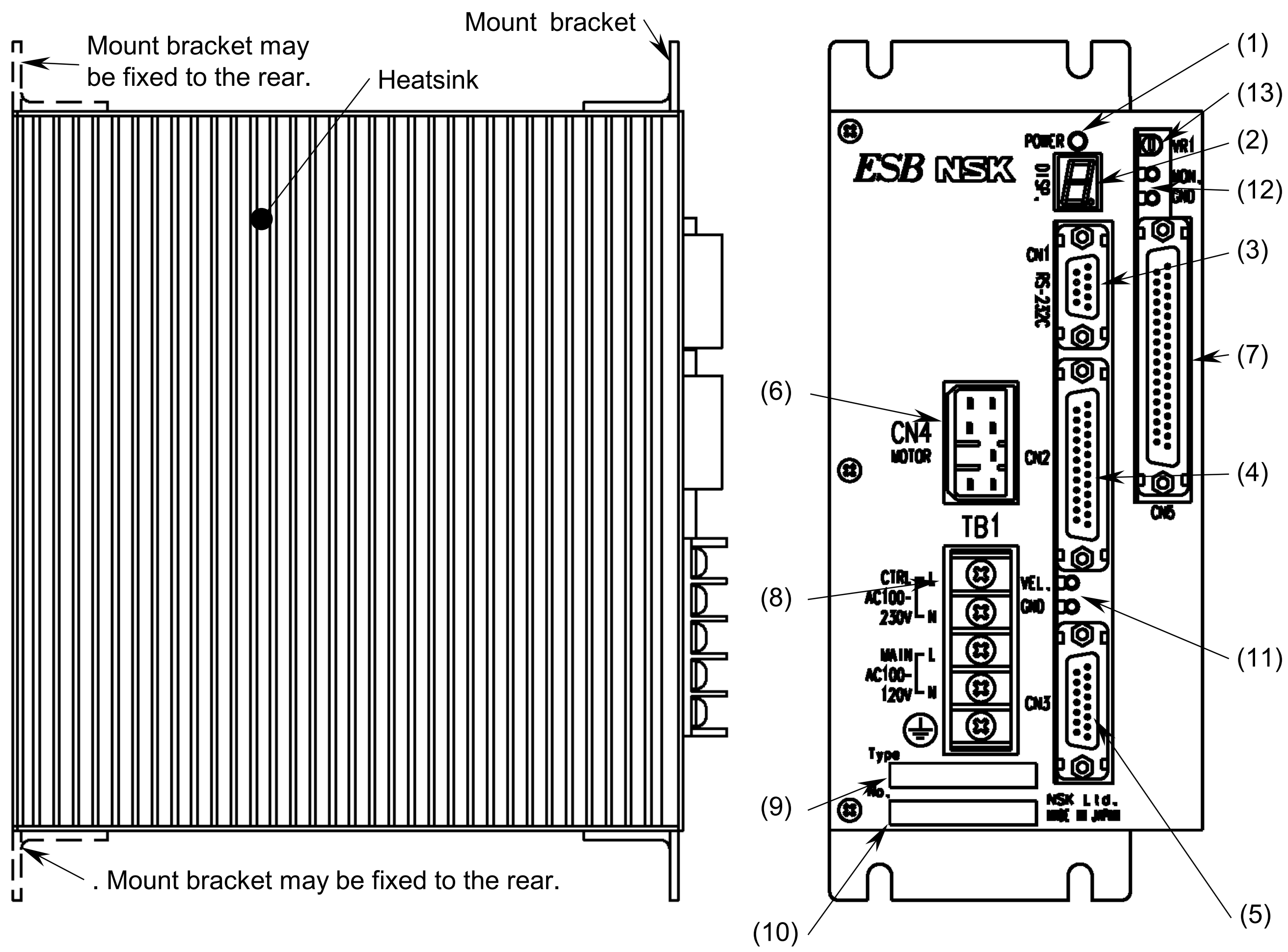
2.3.2. ESB Driver Unit

Figure 2-10: ESBB3 and ESB23 type



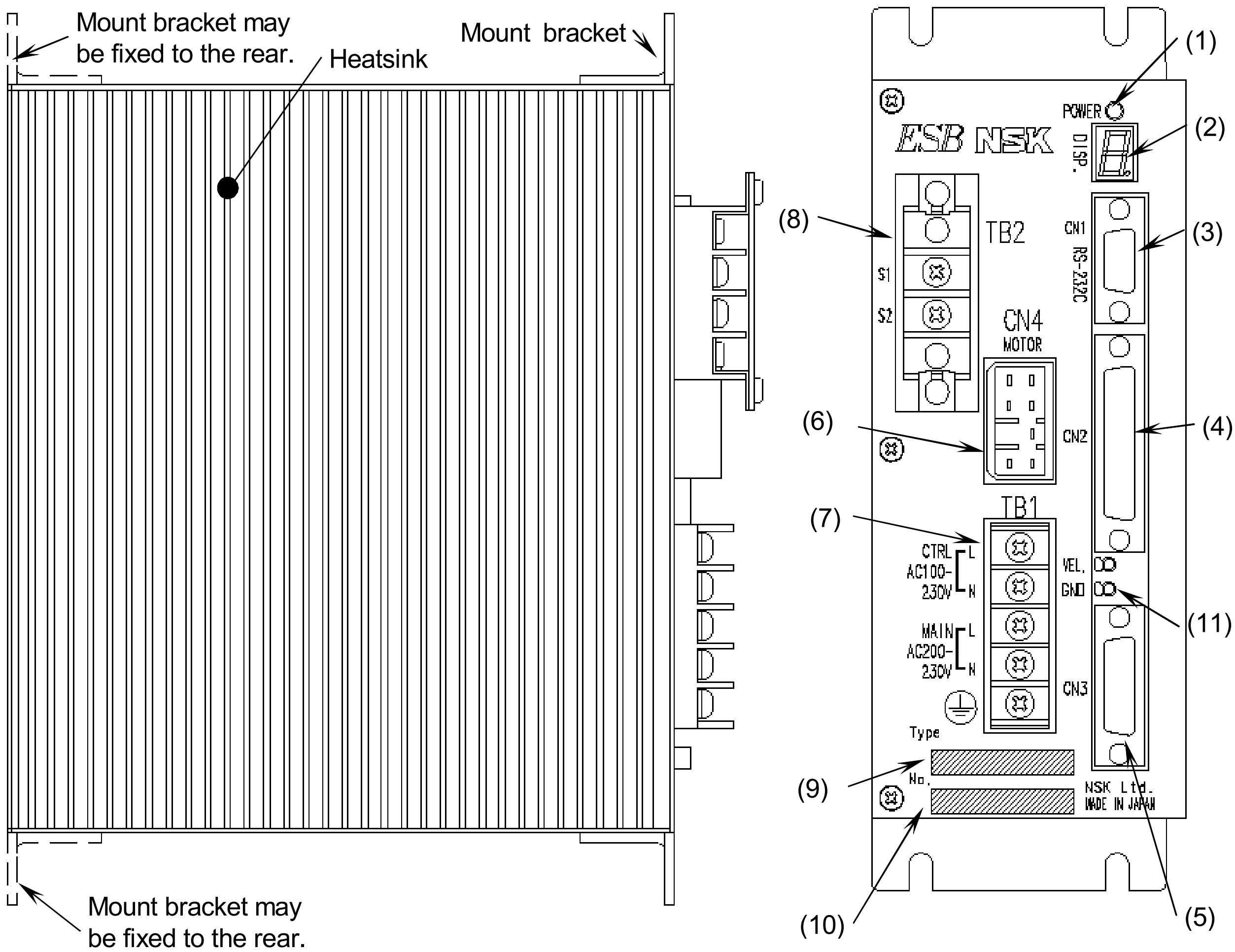
(1) Main power LED
(2) 7 segments LED
(3) CN1 (9 pins)
RS-232C serial communication connector
Connect the optional Handy Terminal FHT11.
(4) CN2 (25 pins)
Motor control Input / Output (I/O) signal connector
(5) CN3 (15 pins)
Resolver cable connector
Connect the exclusive resolver cable.
(6) CN4
Connector for the Motor cable
Connect the exclusive Motor cable.
(7) TB1
Terminal block for power input
(8) Type
Reference number plate
(9) No.
Serial number plate
(10) Velocity waveform monitor pins

Figure 2-11: ESBB5 and ESB25 type



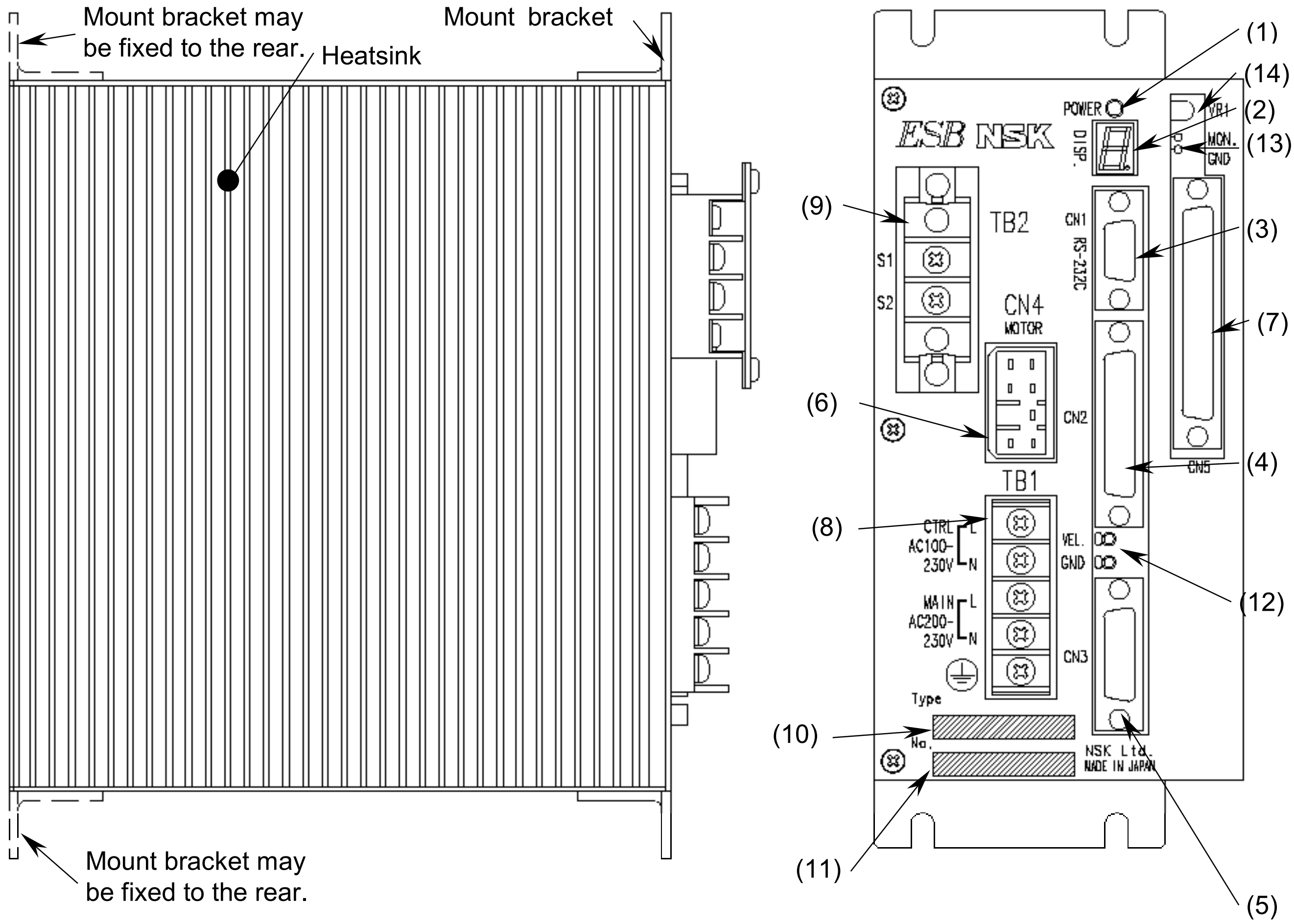
(1) Main power LED
(2) 7 segments LED
(3) CN1 (9pins)
RS-232C serial communication connector
Connect optional Handy Terminal FHT11.
(4) CN2 (25 pins)
Motor control signal Input / Output (I/O) connector
(5) CN3（15pin）
Resolver cable connector
Connect the exclusive resolver cable.
(6) CN4
Motor cable connector
Connect the exclusive Motor cable.
(7) CN5 (37 pins)
Motor control signal Input / Output (I/O2) connector
(8) TB1: Power source terminal block
(9) Type
Reference number plate
(10) No.
Serial number plate
(11) Analog waveform monitor pins
(12) Analog signal monitor pins
(13) VR1
Adjusting pod for analog input offset.

Figure 2-12: ESBB3 and ESB23 type with thermal sensor block terminal



(1) Main power LED
(2) 7 segments LED
(3) CN1 (9 pins)
RS-232C serial communication connector
Connect optional Handy Terminal FHT11.
(4) CN2 (25 pins)
Motor control signal Input / Output (I/O) connector
(5) CN3 (15 pins)
Resolver cable connector
Connect the exclusive resolver cable.
(6) CN4
Motor cable connector
Connect the exclusive Motor cable.
(7) TB1
Power source terminal block
(8) TB2
Thermal sensor terminal block
(9) Type
Reference number plate
(10) No.
Serial number plate
(11) Velocity waveform monitor pins

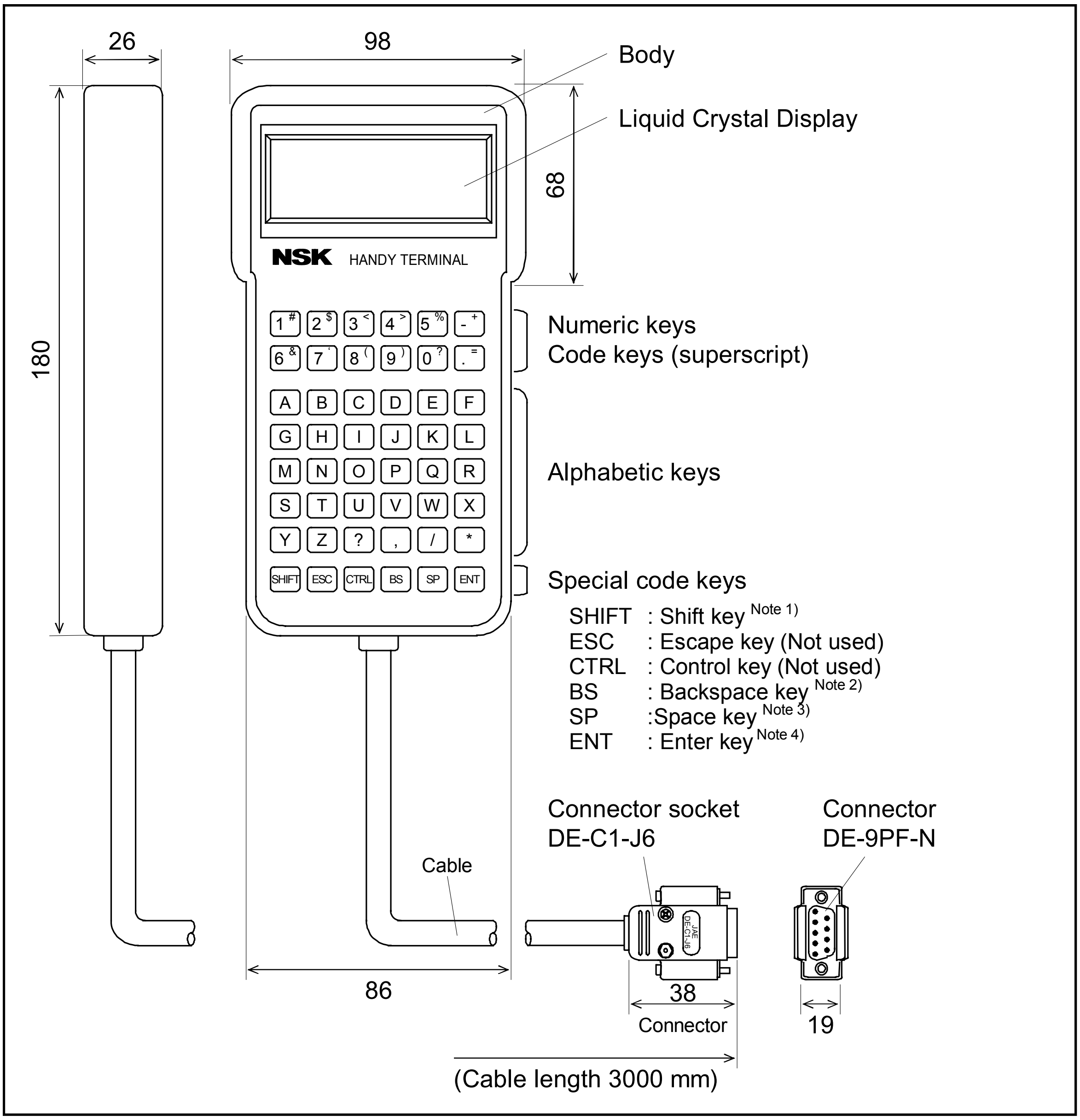
Figure 2-13: ESBB5 and ESB25 type with thermal sensor terminal block



(1)	Main power LED	(7)	CN5 (37 pins) Motor control signal Input / Output connector（I/O5）
(2)	7 segments LED	(8)	TB1 Power source terminal block
(3)	CN1 (9 pins) RS-232C serial communication connector Connect optional Handy Terminal FHT11.	(9)	TB2 Thermal sensor terminal block
(4)	CN2 (25 pins) Motor control signal Input / Output (I/O) connector	(10)	Type Reference number plate
(5)	CN3 (15 pins) Resolver cable connector Connect the exclusive resolver cable	(11)	No. Serial number plate
(6)	CN4 Motor cable connector Connect the exclusive resolver cable.	(12)	Velocity waveform monitor pin
		(13)	Analog signal monitor pin
		(14)	VR1 Adjusting pod for analog input offset

2.3.3. Handy Terminal

Figure 2-14: Handy Terminal M-FHT11



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

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

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

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

2.4. Standard Combination List

2.4.1. Combination of Motor and Driver Unit

Table 2-4

Function			Reference number of ESB Driver Unit	Reference number of Motor
Position sensor	Input/Output	Power voltage		
Absolute position sensor	Basic	200 VAC	M-ESB-YSB2020AB300	M-YSB2020KN001
		100 VAC	M-ESB-YSB2020CB300	
	Extended I/O	200 VAC	M-ESB-YSB2020AB500	
		100 VAC	M-ESB-YSB2020CB500	
	Basic	200 VAC	M-ESB-YSB3040AB300	M-YSB3040KN001
		100 VAC	M-ESB-YSB3040CB300	
	Extended I/O	200 VAC	M-ESB-YSB3040AB500	
		100 VAC	M-ESB-YSB3040CB500	
Incremental position sensor	Basic	200 VAC	M-ESB-YSB2020A2300	M-YSB2020JN001
		100 VAC	M-ESB-YSB2020C2300	
	Extended I/O	200 VAC	M-ESB-YSB2020A2500	
		100 VAC	M-ESB-YSB2020C2500	
	Basic	200 VAC	M-ESB-YSB3040A2300	M-YSB3040JN001
		100 VAC	M-ESB-YSB3040C2300	
	Extended I/O	200 VAC	M-ESB-YSB3040A2500	
		100 VAC	M-ESB-YSB3040C2500	

2.4.2. Cable Set

Table 2-5

Function	Cable length	Reference number of cable set	
		Fixed use (Connecting to fixed part)	Flexible type (Connecting to moving part)
Absolute position sensor	2 m	M-C002SB03	M-C002SB13
	4 m	M-C004SB03	M-C004SB13
	8 m	M-C008SB03	M-C008SB13
	15 m	M-C015SB03	M-C015SB13
	30 m	M-C030SB03	M-C030SB13
Incremental position sensor	2 m	M-C002SB01	M-C002SB11
	4 m	M-C004SB01	M-C004SB11
	8 m	M-C008SB01	M-C008SB11
	15 m	M-C015SB01	M-C015SB11
	30 m	M-C030SB01	M-C030SB11

2.4.3. Handy Terminal

- Handy Terminal is required for inputting parameters and programs.

Table 2-6: Reference number of Handy Terminal

Reference number
M-FHT11

2.5. Motor Specifications

2.5.1. YSB Series

Table 2-7: Specifications of YSB2020 and YSB3040 types

Characteristics \ Motor reference number		M-YSB2020KN001 M-YSB2020JN001	M-YSB2020KG001 M-YSB2020JG001	M-YSB3040KN001 M-YSB3040JN001	M-YSB3040KG001 M-YSB3040JG001
Maximum output torque	[N·m]	20		40	
Max. current / phase	[A]	6			
Allowable axial load	[N]	3 700		4 500	
Allowable moment load	[N·m]	60		80	
Axial rigidity*(1)	[mm/N]	4.0×10^{-6}		3.0×10^{-6}	
Moment rigidity*(1)	[rad/N·m]	3.5×10^{-6}		2.5×10^{-6}	
Max. stall torque	[N·m]	15		35	
Moment of inertia, rotor	[kg·m^2]	0.009	0.011	0.025	0.031
Brake torque	[N·m]	No brake	18	No brake	36
Brake voltage	[V]	No brake	24 VDC	No brake	24 VDC
Brake power capacity	[W]	No brake	24	No brake	26
Brake releasing time	[ms]	No brake	50	No brake	90
Brake engaging time	[ms]	No brake	30	No brake	30
Mass	[kg]	10	14	18	22
Environmental conditions		Ambient temperature: 0 to 40°C, Humidity: 20 to 80%, Indoor use only. Free from dust, condensation and corrosive gas.			
Max. speed	[s^{-1}(rps)]	3			
Resolution of position sensor	[pulse/r]	819 200			
Absolute positioning accuracy	[sec]	150			
Repeatability	[sec]	±1.6			
Compatible Driver Unit	200 VAC	M-ESB-YSB2020A****		M-ESB-YSB2020A****	
	100 VAC	M-ESB-YSB2020C****		M-ESB-YSB2020C****	

*(1) These specification values are assumed that a Motor is fixed on a sufficiently rigid base.

SI Unit system: 1N = 0.102 kgf
1N·m = 0.102 kgf·m

- The YSB Series Motors are common to all ESB Driver Units regardless of difference in 100 and 200 VAC power source voltages.

Table 2-8: Specifications of YSB4080 and YSB5120 types

Characteristics \ Motor reference number		M-YSB4080KN001 M-YSB4080JN001	M-YSB4080KG001 M-YSB4080JG001	M-YSB5120KN001 M-YSB5120JN001	M-YSB5120KG001 M-YSB5120JG001
Maximum output torque	[N·m]	80		120	
Max. current/ phase	[A]	6			
Allowable axial load	[N]	9 500		19 600	
Allowable moment load	[N·m]	160		400	
Axial rigidity(1)	[mm/N]	1.4×10^{-6}		1.0×10^{-6}	
Moment rigidity(1)	[rad/N·m]	1.5×10^{-6}		3.0×10^{-6}	
Max. stall torque	[N·m]	70		105	
Moment of inertia, rotor	[kg·m^2]	0.065	0.088	0.209	0.300
Brake torque	[N·m]	No brake	72	No brake	145
Brake voltage	[V]	No brake	24 VDC	No brake	24 VDC
Brake power capacity	[W]	No brake	40	No brake	50
Brake releasing time	[ms]	No brake	140	No brake	190
Brake engaging time	[ms]	No brake	50	No brake	80
Mass	[kg]	32	40	58	75
Environmental conditions		Ambient temperature: 0 to 40°C, Humidity: 20 to 80%, Indoor use only. Free from dust, condensation and corrosive gas.			
Max. speed	[s^{-1}(rps)]	3			
Resolution of position sensor	[pulse/r]	819 200			
Absolute positioning accuracy	[sec]	150			
Repeatability	[sec]	± 1.6			
Compatible Driver Unit	200 VAC	M-ESB-YSB4080A****		M-ESB-YSB5120A****	
	100 VAC	M-ESB-YSB4080C****		M-ESB-YSB5120C****	

*(1) These specification values are assumed that a Motor is fixed on a sufficiently rigid base.

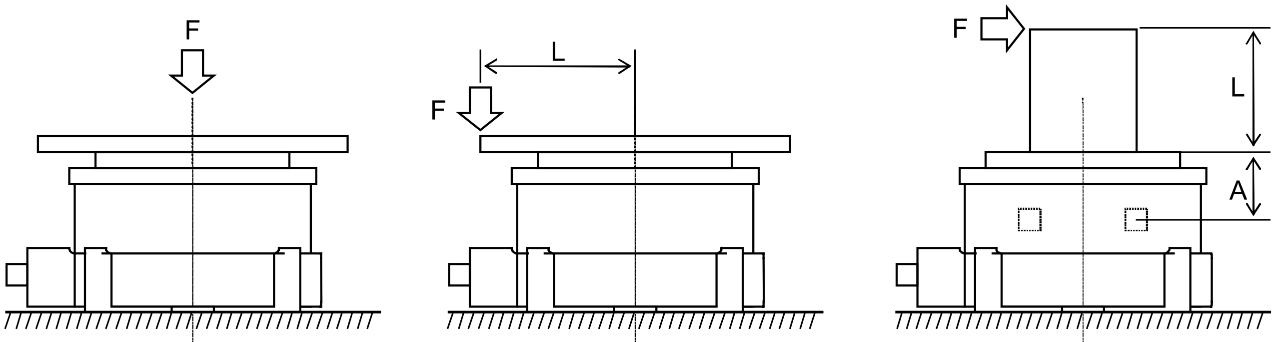
SI Unit system: 1N = 0.102 kgf
1N·m = 0.102 kgf·m

- The YSB Series Motors are common to all ESB Driver Units regardless of difference in 100 and 200 VAC power source voltages.

2.5.2. Axial Load and Moment Load

- Followings show how to calculate axial and moment loads.

Figure 2-15



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

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

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

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

Table 2-9: Dimension A (Distance between the bearing and the rotor surface)

Motor reference number	M-YSB2020KN001 M-YSB2020JN001 M-YSB2020KG001 M-YSB2020JG001	M-YSB3040KN001 M-YSB3040JN001 M-YSB3040KG001 M-YSB3040JG001	M-YSB4080KN001 M-YSB4080JN001 M-YSB4080KG001 M-YSB4080JG001	M-YSB5120KN001 M-YSB5120JN001 M-YSB5120KG001 M-YSB5120JG001
Dimension A [mm]	61.5	72.5	46	46.5

2.6. Dimensions

2.6.1. Motors

Figure 2-16: M-YSB2020KN001 and M-YSB2020JN001

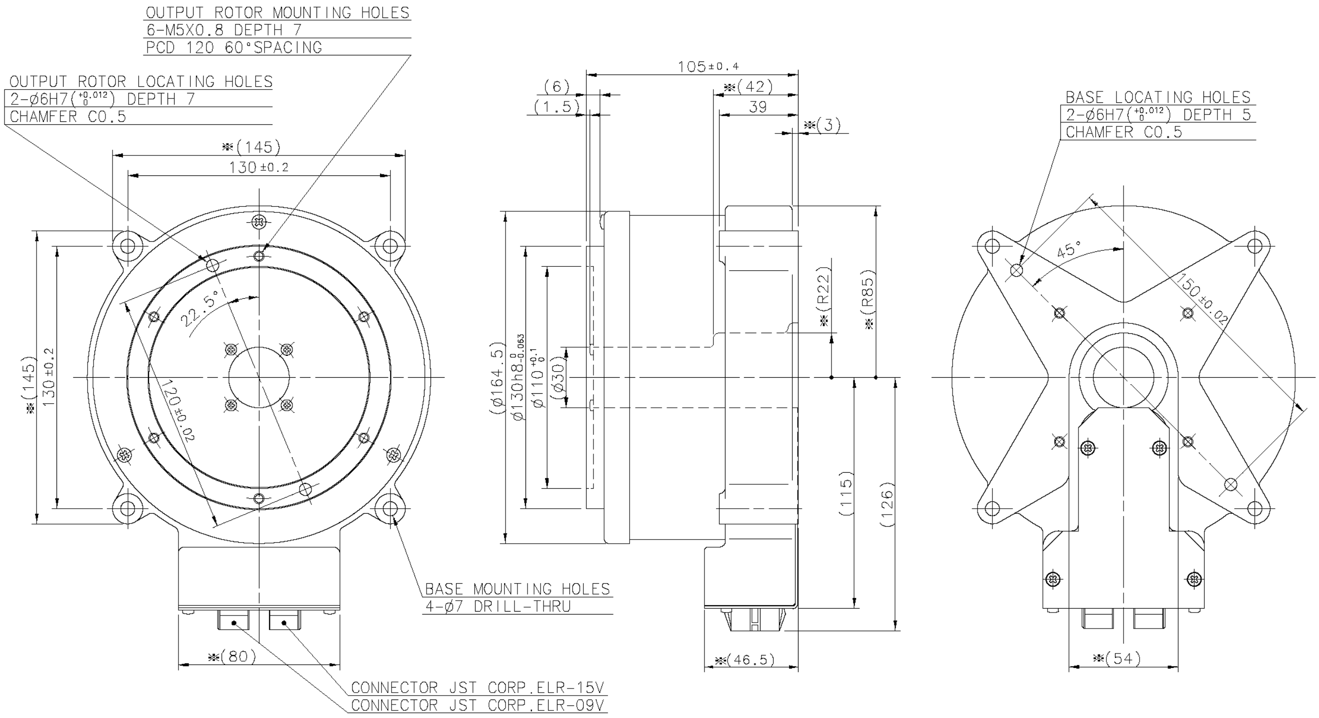


Figure 2-17: M-YSB2020KG001 and M-YSB2020JG001

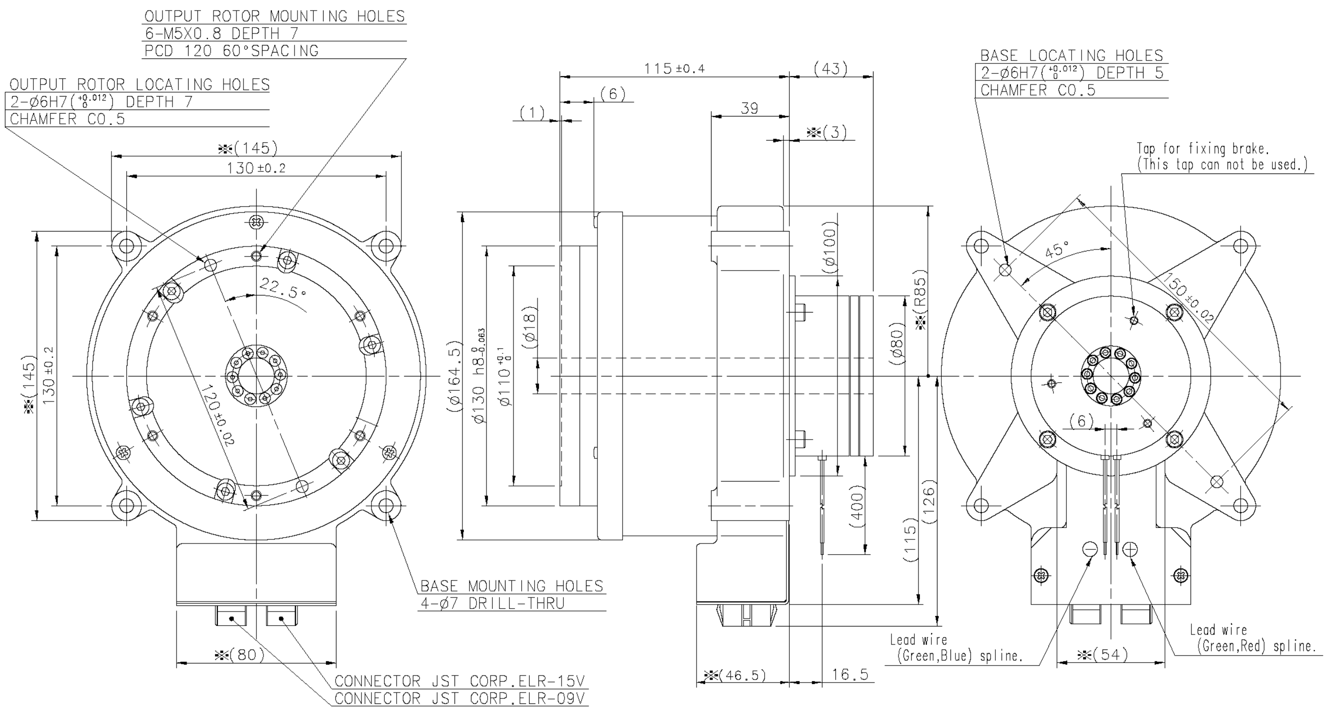


Figure 2-18: M-YSB3040KN001 and M-YSB3040JN001

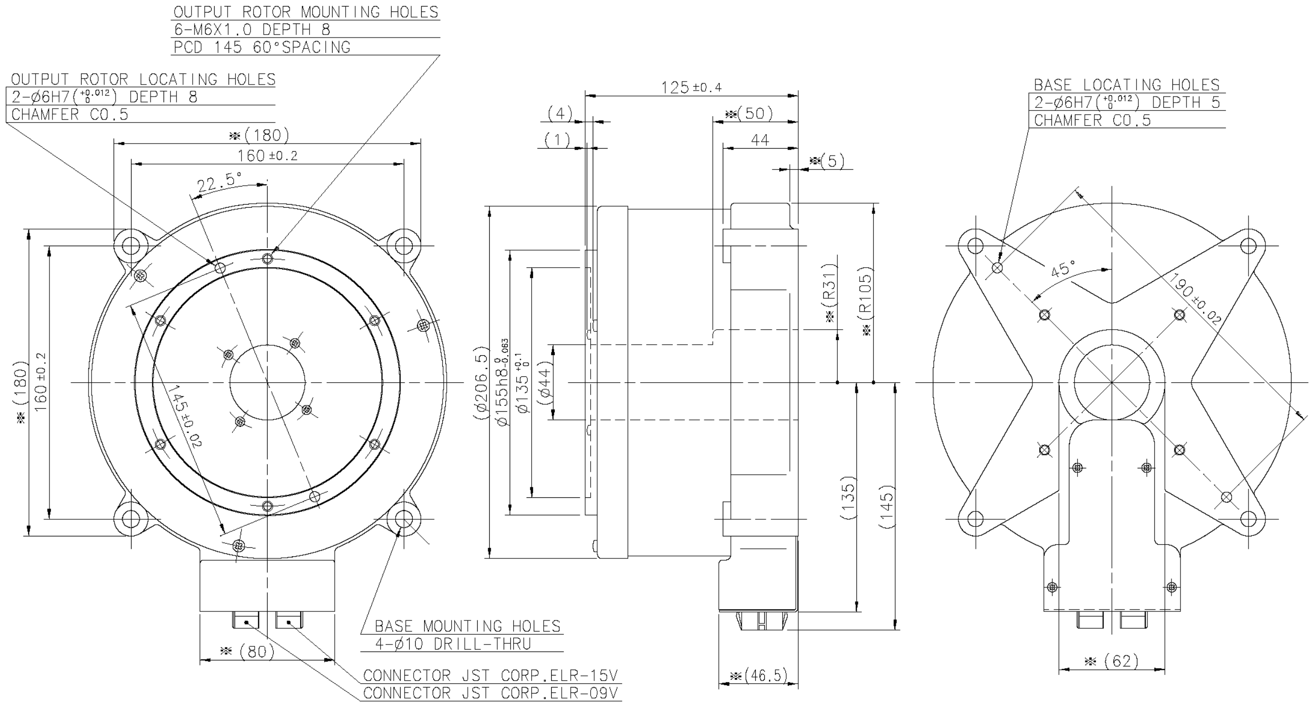


Figure 2-19: M-YSB3040KG001 and M-YSB3040JG001

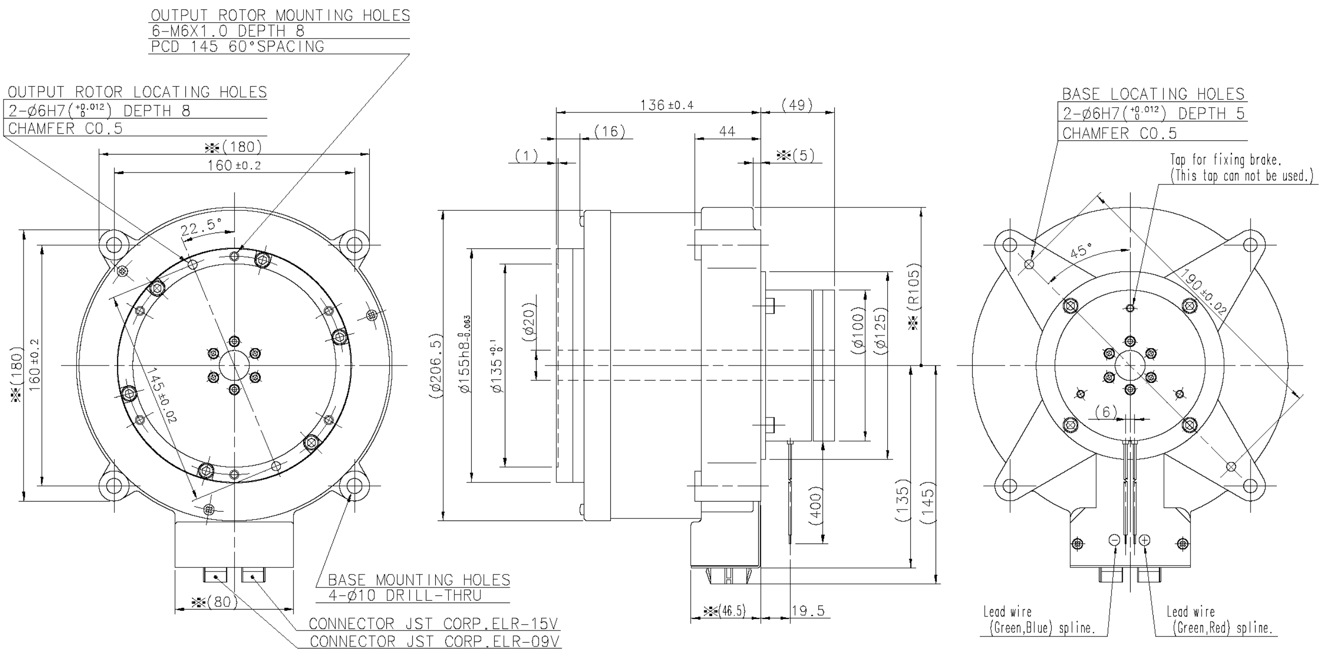


Figure 2-20: M-YSB4080KN001 and M-YSB4080JN001

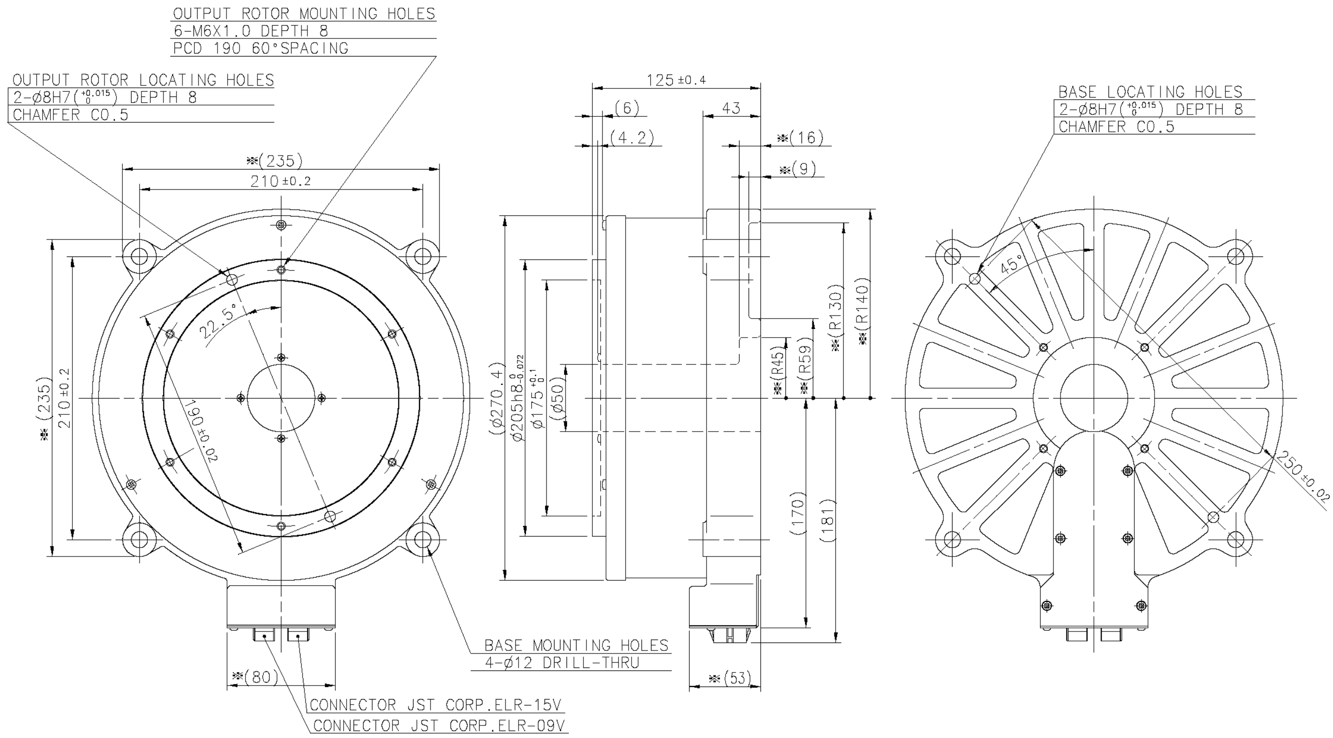


Figure 2-21: M-YSB4080KG001 and M-YSB4080JG001

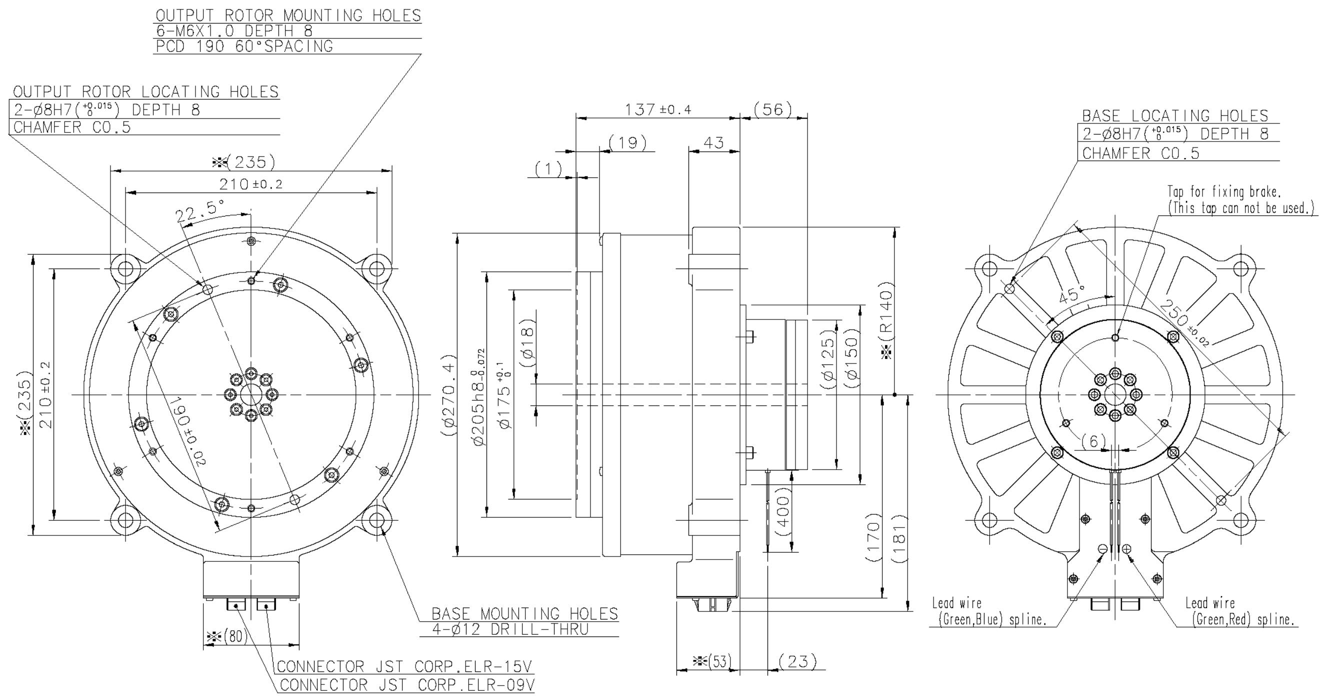


Figure 2-22: M-YSB5120KN001 and YSB5120JN001

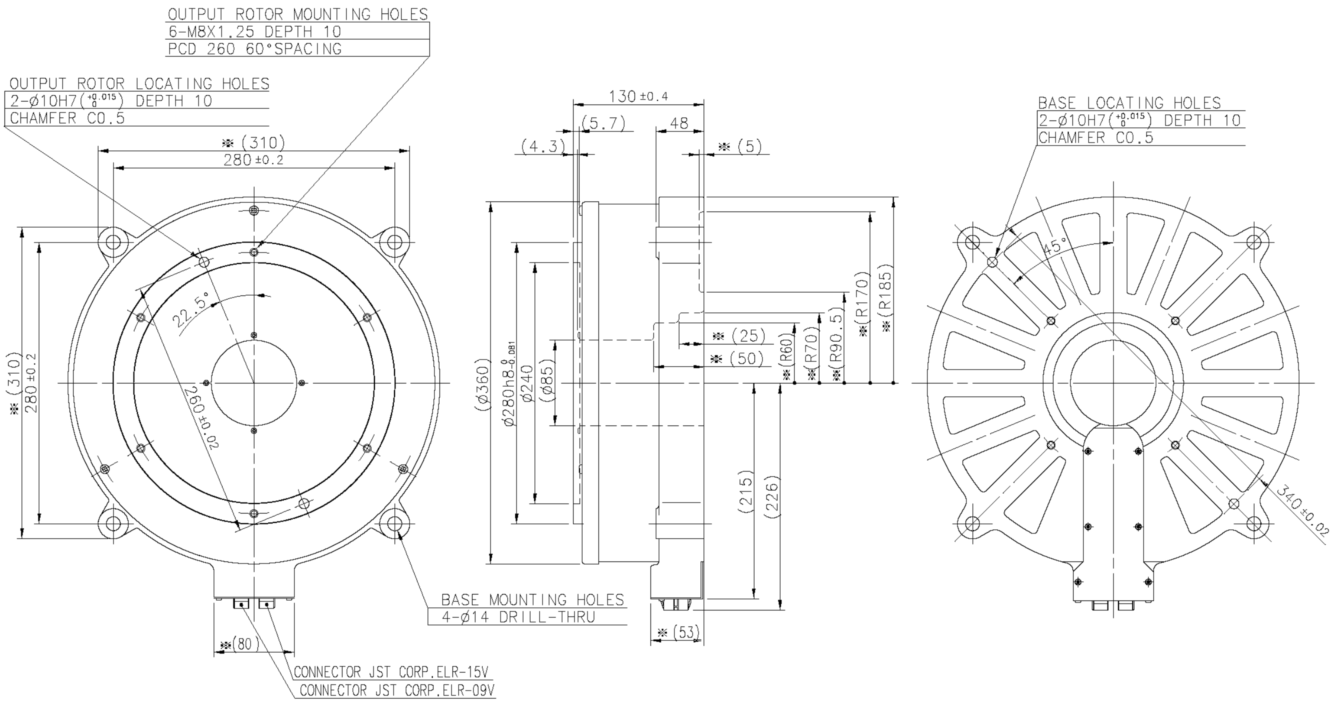
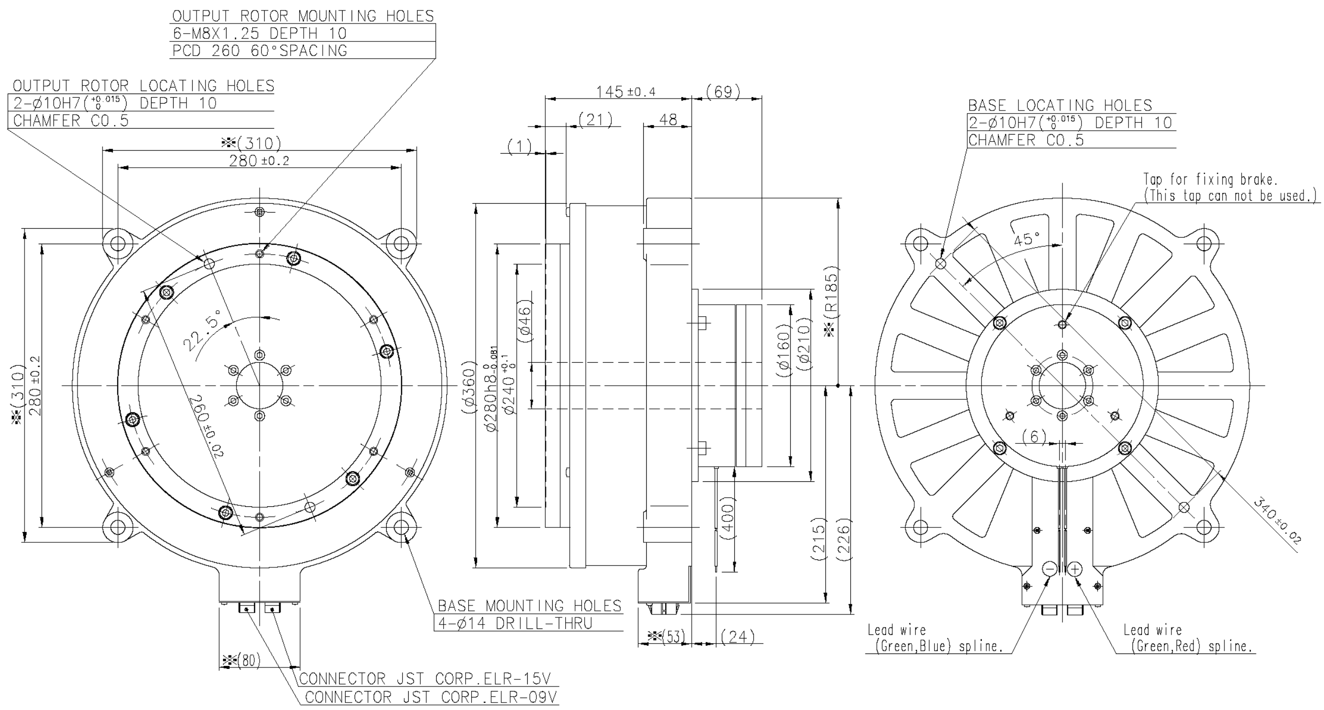


Figure 2-23: M-YSB5120KG001 and M-YSB5120JG001



2.6.2. ESB Driver Units

Figure 2-24: ESBB3 Type

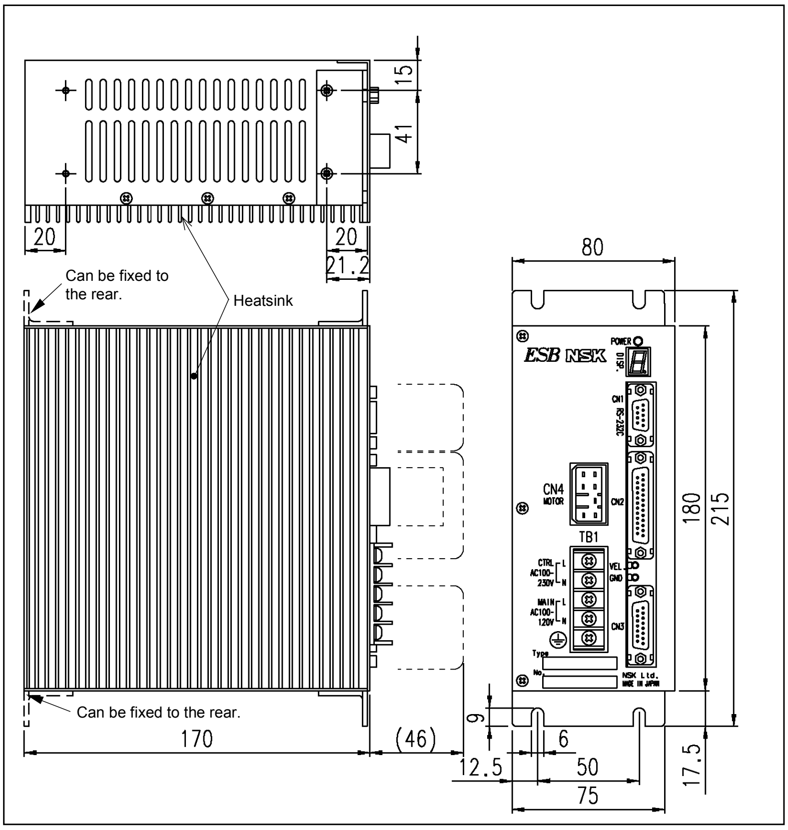


Figure 2-25: ESB23 Type

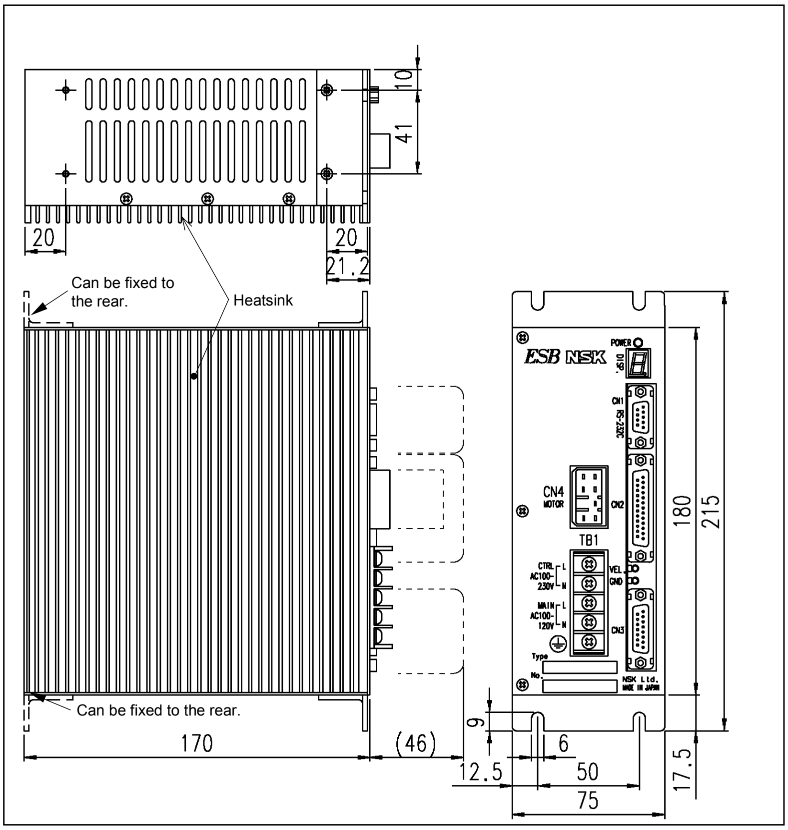
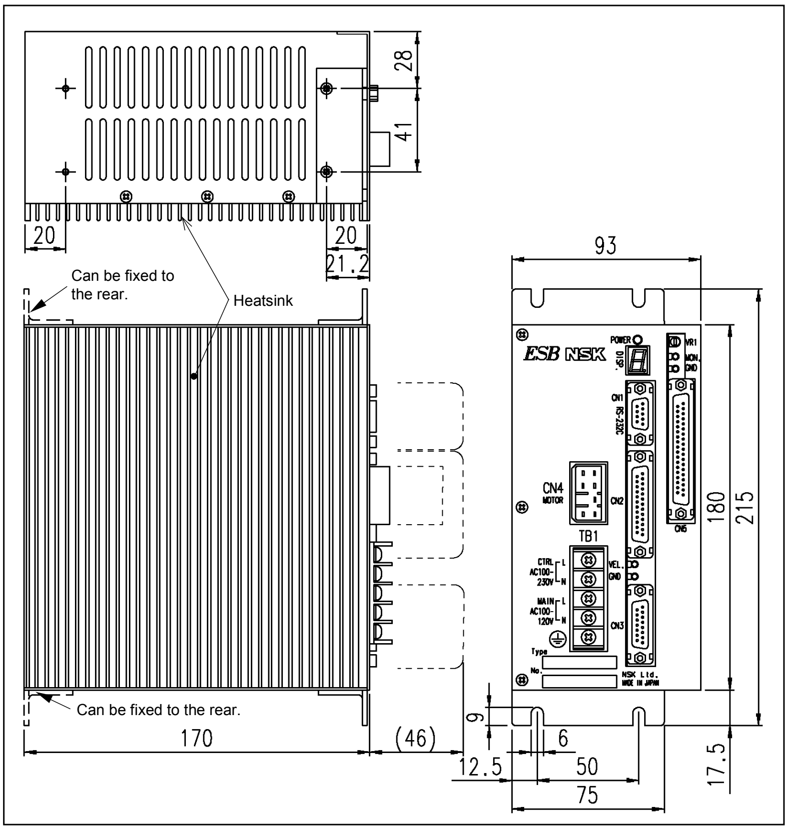


Figure 2-26: ESBB5 type, and ESB25 type



2.6.3. Dimensions of Cable Set

Figure 2-27: Cable Set for absolute position sensor (M-CXXXSB03 and M-CXXXSB13)

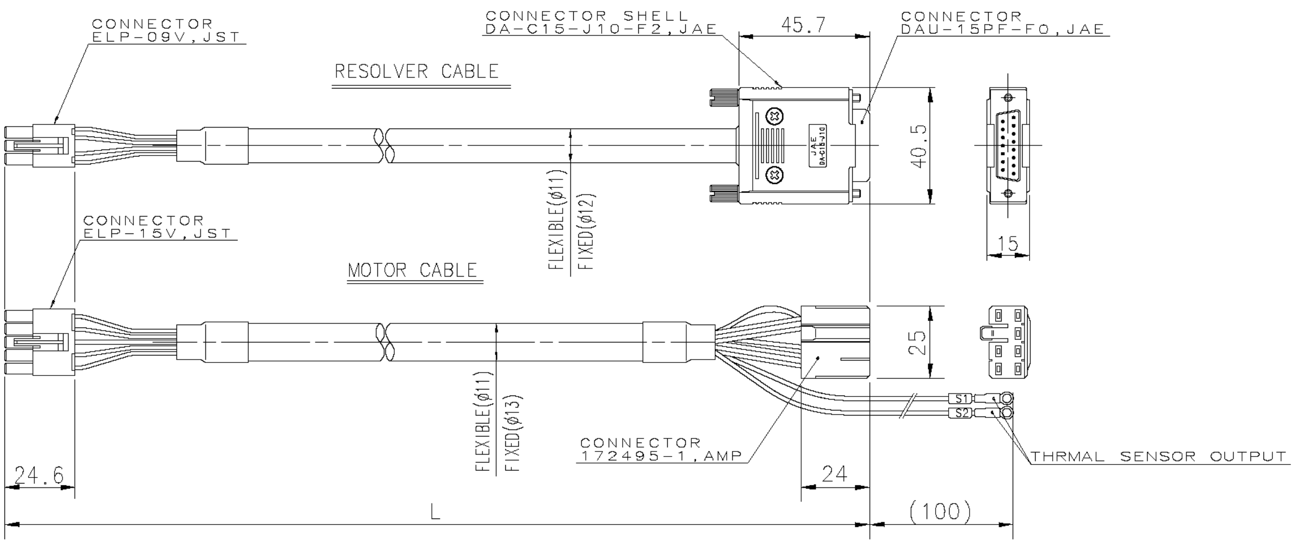
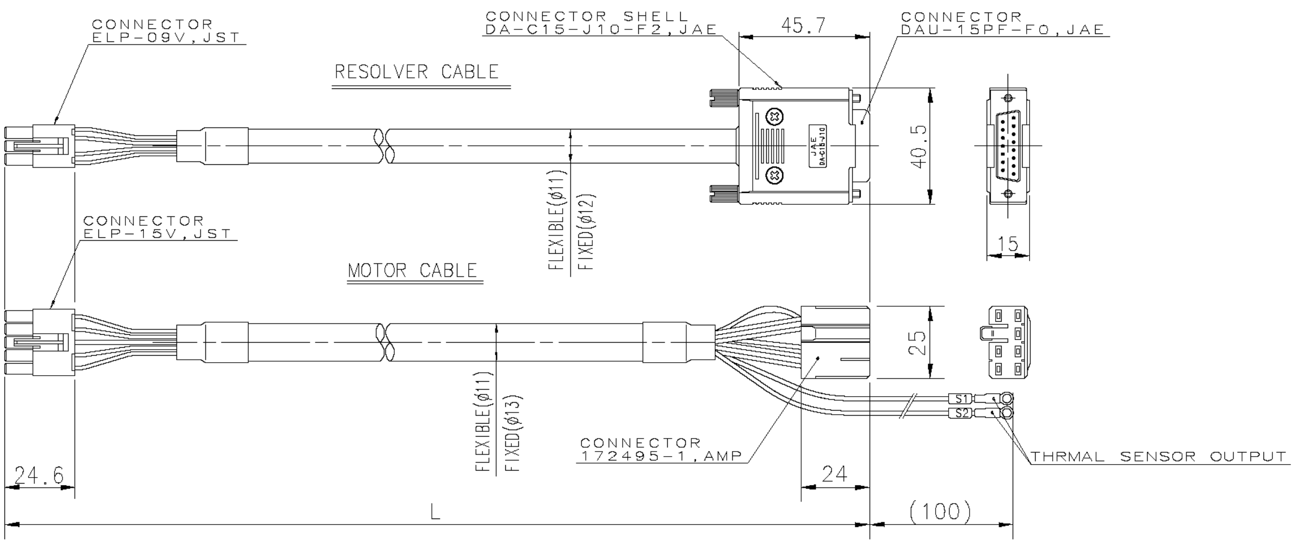


Figure 2-28: Cable Set for incremental position sensor (M-CXXXSB01 and M-CXXXSB11)



⚠ *Caution: If you connect the cables to moving parts, be sure to use the flexible type cables.*

⚠ *Caution: Bending radius of the Motor Cable shall be 135 mm or over.*

⚠ *Caution: Bending radius of the Resolver Cable shall be 110 mm or over.*

2.7. Specifications of Driver Unit

2.7.1. General Specifications

Table 2-10

<table>
<tr><th colspan="3">Item</th><th colspan="2">Specification</th></tr>
<tr><td colspan="3">Control system</td><td colspan="2">Full closed loop. P·PI position control</td></tr>
<tr><td colspan="3">Operation mode</td><td colspan="2">Pulse train position command, RS-232C serial communication, Programmable Indexer (Internal capability for programmed operation), Jog, Home Return</td></tr>
<tr><td rowspan="7">Power input</td><td rowspan="3">Control power</td><td>Spec.</td><td colspan="2">100 to 230 VAC ± 10%, 50/60 Hz single phase</td></tr>
<tr><td>Capacity</td><td colspan="2">Max. 50 VA (Excludes inrush current)</td></tr>
<tr><td>Inrush current</td><td colspan="2">When input is 200 VAC: 15 A maximum
When input is 100 VAC: 7.5 A maximum</td></tr>
<tr><td rowspan="3">Main power</td><td>Spec.</td><td>200 to 230 VAC ±10%
50/60 Hz single phase</td><td>100 to 120 VAC ± 10%
50/60 Hz single phase</td></tr>
<tr><td>Capacity (Inrush current excluded.)</td><td><table><tr><th>Motor size</th><th>Maximum capacity</th></tr><tr><td>YSB2020</td><td>1.0 KVA</td></tr><tr><td>YSB3040</td><td>1.2 KVA</td></tr><tr><td>YSB4080</td><td>1.4 KVA</td></tr><tr><td>YSB5120</td><td>1.5 KVA</td></tr></table></td><td><table><tr><th>Motor size</th><th>Maximum capacity</th></tr><tr><td>YSB2020</td><td>0.7 KVA</td></tr><tr><td>YSB3040</td><td>0.9 KVA</td></tr><tr><td>YSB4080</td><td>1.0 KVA</td></tr><tr><td>YSB5120</td><td>1.0 KVA</td></tr></table></td></tr>
<tr><td>Inrush current</td><td>20 A max.</td><td>10 A max.</td></tr>
<tr><td colspan="2">Leakage current</td><td colspan="2">3 mA rms (40Hz to 100Hz)</td></tr>
<tr><td colspan="3">Vibration resistance</td><td colspan="2">1.0 G (Conforms to JIS-C0911.)</td></tr>
<tr><td colspan="3">Line noise resistance</td><td colspan="2">1500 V 1μs (By a noise simulator)</td></tr>
<tr><td colspan="3">Mass</td><td colspan="2">B3 and 23 types; 2.4 Kg: B5 and 25 types; 2.5 Kg</td></tr>
<tr><td colspan="2" rowspan="4">Environmental conditions</td><td>Operation</td><td colspan="2">Ambient temperature: 0 to 50°C, Humidity: 20 to 90%
(Free from condensation, dust and corrosive gas)</td></tr>
<tr><td>Storage</td><td colspan="2">Temperature: 20 to 70°C, Indoor storage
(Free from condensation, dust and corrosive gas)</td></tr>
<tr><td>Installation</td><td colspan="2">Contamination degree 2 or 1 (IEC60664-1)</td></tr>
<tr><td>Power source</td><td colspan="2">Overvoltage category III (IEC60664-1)</td></tr>
<tr><td colspan="2" rowspan="2">Safety regulation</td><td>UL</td><td colspan="2">UL508C</td></tr>
<tr><td>CE</td><td colspan="2">Low Voltage Directive: EN50178
Electro Magnetic Compatibility: EN61800-3</td></tr>
</table>

2.7.2. Functional Specification

Table 2-11

<table>
<tr><th colspan="2">Items</th><th>Specifications</th></tr>
<tr><td rowspan="3">Control mode</td><td>Position control [*1]</td><td>Programmable Indexer (64 channels[*2])
Pulse train position command[*4] (CW/CCW, Pulse and direction, and quadrature)
RS-232C serial communication, Jog, Home Return operation</td></tr>
<tr><td>Velocity control[*1]</td><td>RS-232C serial communication, Analog velocity command[*3]: ± 10 V</td></tr>
<tr><td>Torque control[*1]</td><td>RS-232C serial communication, Analog torque command [*3]: ± 10 V</td></tr>
<tr><td colspan="2">Resolution of position sensor (Resolver)</td><td>819 200 [pulse/rev]</td></tr>
<tr><td colspan="2">Maximum velocity</td><td>3 [s^{-1}]</td></tr>
<tr><td colspan="2">Position feed back output signal</td><td>Output format
ø A • ø B : Line driver
ø Z : Line driver/Open collector, selectable
[Unit: pulse/rev]<table><tr><th>ø A • ø B</th><th>ø Z (MSB)</th></tr><tr><td>51 200[*5]</td><td>50</td></tr></table></td></tr>
<tr><td rowspan="2">Control signal</td><td>Input</td><td>Emergency stop, Servo ON, Internal program channel switching[*2]
Programmable Indexer start, Jog[*2], Home Return start[*2], Select rotational direction[*2], Interruption of Programmable Indexer[*2], Home position limit sensor, Clear[*2], Over travel limit[*2], Velocity loop integration OFF[*2], Velocity loop lower gain[*2], Prohibition of pulse train/analog command input[*2]</td></tr>
<tr><td>Output</td><td>Driver Unit ready, Home Return completed/Home position detected, In-Position,
Warning[*3], Brake / Brake control[*2], Home position defined[*2], Velocity threshold[*2], Target proximity/In target[*2]</td></tr>
<tr><td colspan="2">Alarm</td><td>Excess position error, Velocity error over, Software thermal sensor, RS-232C error, Travel limit over, CPU error, Resolver circuit error, Over current, Heat sink overheat, Abnormal main AC line voltage, Control AC line under voltage</td></tr>
<tr><td colspan="2">Monitors</td><td>Analog velocity monitor, Analog velocity control monitor[*3], RS-232C communication monitor, (Current position, Alarm state, Servo parameter, etc.)</td></tr>
<tr><td colspan="2">Communication</td><td>Asynchronous RS-232C serial communication, Baud rate: 9 600bps</td></tr>
<tr><td colspan="2">Data backup</td><td>EEPROM (500 000 times of erasing/overwriting data is possible.)</td></tr>
</table>

*1: The parameter SL sets control mode.

◊ SL1: Torque control mode

◊ SL2: Velocity command

◊ SL3: Position control mode

*2: These functions have some limitation for B3 and 23 type Driver Units.

◊ Refer to “2.7.3. Function List of Respective Driver Unit Types.”

*3: Function of B5 and 25 types Driver Unit.

*4: Pulse train or line receiver inputs are available.
(Please specify either one of them when ordering.)

*5: Quadruple multiplication of this value is 204 800 [pulse/rev]. This is equivalent to a quarter of position sensor resolution.

2.7.3. Function List of Respective Driver Unit Types

Table 2-12

<table>
<tr><th colspan="2" rowspan="2">Items</th><th colspan="2">Type of Driver Unit</th></tr>
<tr><th>B3 and 23 type</th><th>B5 and 25 type</th></tr>
<tr><td colspan="2">Control mode</td><td>• Exclusive for position control</td><td>• Position control
• Velocity control
• Torque control</td></tr>
<tr><td rowspan="2">Control signal</td><td>Input</td><td>• Emergency stop
• Servo ON
• Start Programmable Indexer
• Home position limit sensor
◊ Select applicable input combination by parameters
<table>
<tr><th>Setting</th><th>Control signal</th><th>Number of channels available</th></tr>
<tr><td>TY1</td><td>----</td><td>16</td></tr>
<tr><td>TY2</td><td>Jog, Select direction of rotation</td><td>4</td></tr>
<tr><td>TY3</td><td>Over travel</td><td>4</td></tr>
<tr><td>TY4</td><td>Home Return start, Clear, Over travel</td><td>1</td></tr>
<tr><td>TY7</td><td>Jog, Select direction of rotation, Over travel</td><td>1</td></tr>
<tr><td>TY8</td><td>Integration OFF/Lower gain or release brake clumping</td><td>8</td></tr>
</table></td><td>• Emergency stop
• Servo ON
• Selection of internal program (64 channels)
• Start Programmable Indexer (Internal program)
• Jog operation
• Home Return start
• Select direction of rotation
• Interruption of Programmable Indexer
• Home position limit sensor
• Over travel limit
• Clear
• Velocity loop, integration OFF
• Lower velocity loop gain,
• Input command prohibited, pulse train input / analog command</td></tr>
<tr><td>Output</td><td>• Driver Unit ready
• In-Position
◊ Select a combination by following parameters
<table>
<tr><th>Setting</th><th>Control signal</th></tr>
<tr><td>OM0</td><td>Brake</td></tr>
<tr><td>OM1</td><td>Velocity detection</td></tr>
<tr><td>OM2</td><td>Target proximity/In target</td></tr>
<tr><td>OM3</td><td>Warning</td></tr>
</table></td><td>• Driver Unit ready
• Home return completed/ Home position detected
• Warning
• Brake
• Home position defined
• Velocity threshold
• Target proximity/In target</td></tr>
<tr><td colspan="2">Analog monitor</td><td>• Velocity monitor</td><td>• Velocity monitor
• Control monitor
[Velocity
Velocity command
Velocity deviation
Output torque command
ø C driving current command
Position command
Position deviation
ø C thermal load]</td></tr>
<tr><td colspan="2">Pulse train input</td><td colspan="2">Photo coupler or line driver input</td></tr>
<tr><td colspan="2">Analog command</td><td>None</td><td>Available</td></tr>
</table>

2.8. RS-232C Interface Specifications

- Refer to “7.3. RS-232C Serial Communication” for specifications of RS-232C communication.
- Refer to “Appendix 6. Wiring of RS-232C Communication Cable” for connecting with a control device such as a personal computer.

2.8.1. CN1: RS-232C Serial Communication Connector

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

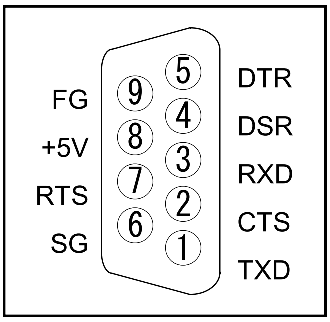
Table 2-13

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

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

2.8.1.1. CN1 Pin-Out

Figure 2-29: CN1 Pin-out



2.8.1.2. CN1 Signal List

Table 2-14: Signal name and function (CN1)

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

2.9. Control Input / Output Interface Specifications

2.9.1. CN2 and CN5 Connectors: Control I/O Signal Connectors

- Table 2-15 shows types of connectors that are used for connectors CN2 and CN5, and connectors for user side devices.

Table 2-15

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

* These connectors will be provided with the Driver Unit.

◊ B3 and 23 type Driver Units do not have connector CN5.

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

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

2.9.2. Control I/O Signal Specifications of B3 and 23 Type Driver Units

- B3 and 23 type Driver Units do not have the connector CN5.
- Follow the respective specification documents in case of a custom made Megatorque Motor System and whose specifications of Input / Output signal are unique.

2.9.2.1. Selection of I/O Signal Combination Types

- You may select function of a part of Input/Output Signals of the connector CN2 of B3 and 23 type Driver Units.
- Refer to "3.4.3.1. Selection of I/O Combination Type" for selecting I/O combination type.

1 Input port

- A combination type of CN2 I/O signals shall be specified from among Type 1 to 4, 7 and 8 combination types in accordance with required functions.
- For the Megatorque Motor System, the shipping set is Type 1.
- The parameter TY sets a combination type of I/O signal function.
- The parameter TY requires entry of the password before its input.
- Input of the parameter TY clears all polarity of the input ports to the normally closed contact. (A contact)

2 Output Port

- A function among Brake, Velocity threshold, Target proximity/In target, and Warning shall be set to the output OUT1 (pin #3).
- The shipping set is "Brake" output.
- The parameter OM selects an I/O type.
- The password is required prior to input the parameter OM.

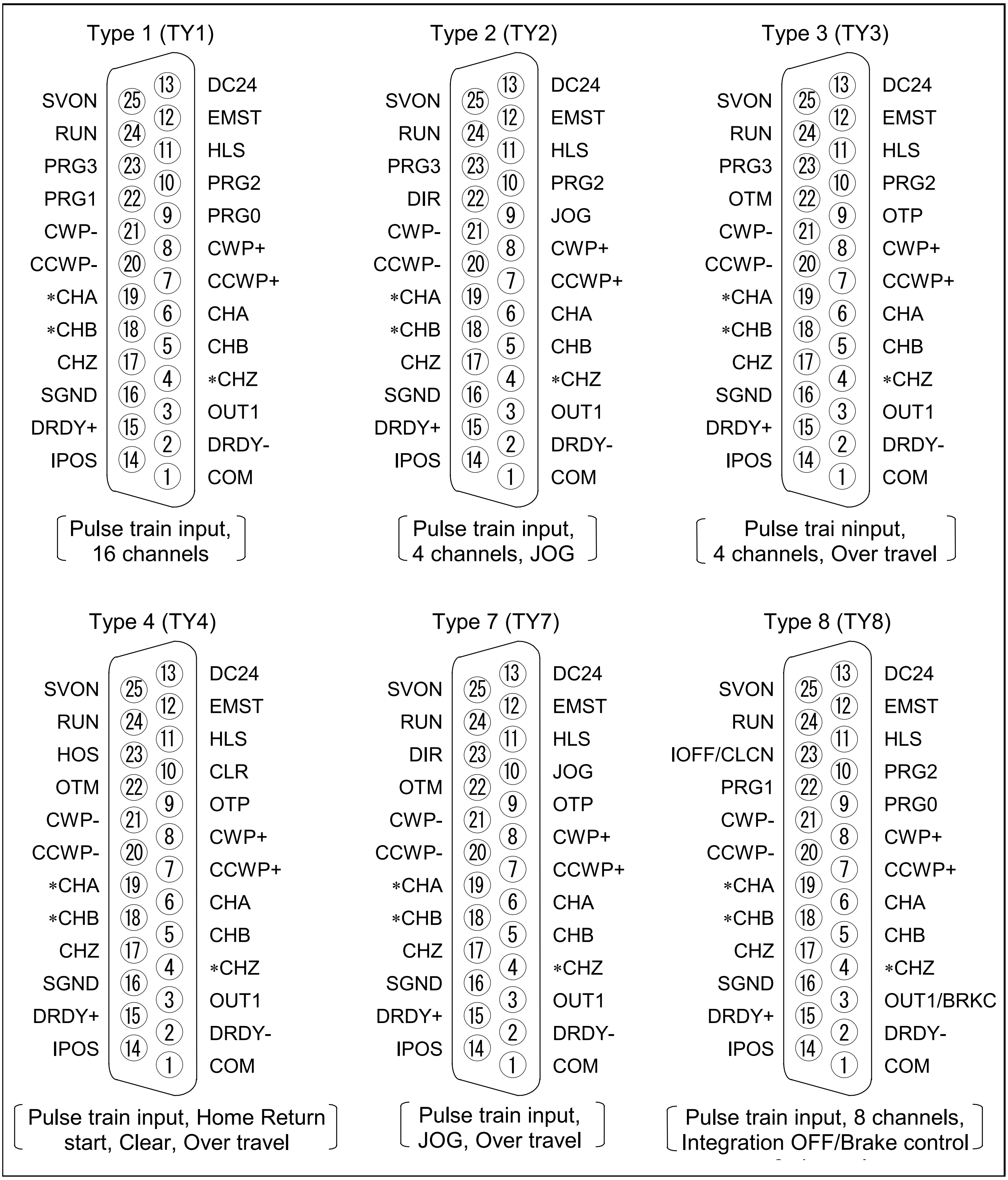
2.9.2.2. Polarity of Input Port (Normally Open and Normally Closed Contact)

- You can change polarity of some of the CN2 input signals.
- The shipping set is set to the normally open contact for all input ports.
- The parameter AB sets the polarity of the input ports.
- The password is required before inputting the parameter AB.
- The signals of which polarity you can change are limited to EMST, HLS, OTP, and OTM. (For B3 and 23 type Driver Units, polarity change of OTP and OTM signals are only available in 3, 4, and 7 types.)
- Refer to "3.4.3.2. Setting of Input Port Polarity" polarity setting.

2.9.2.3. Pin-Out (CN2: B3 and 23 type Driver Units)

- I/O signal combinations in connector CN2 is available in 6 types shown below. You may select one of these by the parameter TY. The shipping set is TY1.

Figure 2-30



∗ The parameter OM selects one of the functions among BRK, SPD, NEAR, and OVER, and sets to the OUT1 output signal. The shipping set is BRK. However, the shipping set will be BRKC output when brake sequence function is selected in Type 8 (TY8) setting.

2.9.2.4. CN2 Signal List (B3 and 23 Type Driver Units)

Table 2-16: Type1 (TY1)

<table>
<tr><th>Pin</th><th>Signal Name</th><th>I/O</th><th colspan="3">Function</th></tr>
<tr><td>1</td><td>COM</td><td>Output</td><td colspan="3">Output COMMON</td></tr>
<tr><td>2</td><td>DRDY–</td><td>Output</td><td colspan="3">Driver Unit ready (–)</td></tr>
<tr><td rowspan="5">3</td><td rowspan="5">OUT1[*1]</td><td rowspan="5">Output</td><td>Parameter</td><td>Signal name</td><td>Function</td></tr>
<tr><td>OM0</td><td>BRK</td><td>Brake</td></tr>
<tr><td>OM1</td><td>SPD</td><td>Velocity threshold</td></tr>
<tr><td>OM3</td><td>NEARA</td><td>Target proximity / In target</td></tr>
<tr><td>OM4</td><td>OVER</td><td>Over</td></tr>
<tr><td>4</td><td>∗CHZ[*2]</td><td>Output</td><td colspan="3">Position feedback signal ∗øZ /Digital position signal ∗MSB[*2]</td></tr>
<tr><td>5</td><td>CHB</td><td>Output</td><td colspan="3">Position feedback signal øB</td></tr>
<tr><td>6</td><td>CHA</td><td>Output</td><td colspan="3">Position feedback signal øA</td></tr>
<tr><td>7</td><td>CCWP+</td><td>Input</td><td colspan="3">Counter clockwise pulse train (+) (CCW)</td></tr>
<tr><td>8</td><td>CWP+</td><td>Input</td><td colspan="3">Clockwise pulse train (+) (CW)</td></tr>
<tr><td>9</td><td>PRG0</td><td>Input</td><td colspan="3">Internal program channel selection 0</td></tr>
<tr><td>10</td><td>PRG2</td><td>Input</td><td colspan="3">Internal program channel selection 2</td></tr>
<tr><td>11</td><td>HLS</td><td>Input</td><td colspan="3">Home position limit sensor</td></tr>
<tr><td>12</td><td>EMST</td><td>Input</td><td colspan="3">Emergency stop</td></tr>
<tr><td>13</td><td>DC24</td><td>Input</td><td colspan="3">24 VDC external power supply</td></tr>
<tr><td>14</td><td>IPOS</td><td>Output</td><td colspan="3">In-position (positioning completed)</td></tr>
<tr><td>15</td><td>DRDY+</td><td>Output</td><td colspan="3">Driver Unit ready (+)</td></tr>
<tr><td>16</td><td>SGND</td><td>–</td><td colspan="3">Signal ground</td></tr>
<tr><td>17</td><td>CHZ[*2]</td><td>Output</td><td colspan="3">Position feedback signal øZ /Digital position signal MSB[*2]</td></tr>
<tr><td>18</td><td>∗CHB</td><td>Output</td><td colspan="3">Position feedback signal ∗øB</td></tr>
<tr><td>19</td><td>∗CHA</td><td>Output</td><td colspan="3">Position feedback signal ∗øA</td></tr>
<tr><td>20</td><td>CCWP–</td><td>Input</td><td colspan="3">Counter clockwise pulse train (–) (CCW)</td></tr>
<tr><td>21</td><td>CWP–</td><td>Input</td><td colspan="3">Clockwise pulse train (–) (CW)</td></tr>
<tr><td>22</td><td>PRG1</td><td>Input</td><td colspan="3">Internal program channel selection 1</td></tr>
<tr><td>23</td><td>PRG3</td><td>Input</td><td colspan="3">Internal program channel selection 3</td></tr>
<tr><td>24</td><td>RUN</td><td>Input</td><td colspan="3">Start positioning (RUN move)</td></tr>
<tr><td>25</td><td>SVON</td><td>Input</td><td colspan="3">Servo ON</td></tr>
</table>

*1. The parameter OM (RS-232C communication) selects function of OUT1 output. The shipping set is BRK output.

*2. The parameter FZ (RS-232C communication) selects either “Position feedback signal øZ” or “Digital position signal MSB.” The shipping set is “Position feedback signal øZ.”

Table 2-17: Type 2 (TY2)

<table>
<tr><th>Pin</th><th>Signal Name</th><th>I/O</th><th colspan="3">Function</th></tr>
<tr><td>1</td><td>COM</td><td>Output</td><td colspan="3">Output COMMON</td></tr>
<tr><td>2</td><td>DRDY–</td><td>Output</td><td colspan="3">Driver Unit ready (–)</td></tr>
<tr><td rowspan="5">3</td><td rowspan="5">OUT1[*1]</td><td rowspan="5">Output</td><td>Parameter</td><td>Signal name</td><td>Function</td></tr>
<tr><td>OM0</td><td>BRK</td><td>Brake</td></tr>
<tr><td>OM1</td><td>SPD</td><td>Velocity threshold</td></tr>
<tr><td>OM2</td><td>NEARA</td><td>Target proximity / In target</td></tr>
<tr><td>OM3</td><td>OVER</td><td>Over</td></tr>
<tr><td>4</td><td>∗CHZ [*2]</td><td>Output</td><td colspan="3">Position feedback signal ∗øZ / Digital position signal ∗MSB[*2]</td></tr>
<tr><td>5</td><td>CHB</td><td>Output</td><td colspan="3">Position feedback signal øB</td></tr>
<tr><td>6</td><td>CHA</td><td>Output</td><td colspan="3">Position feedback signal øA</td></tr>
<tr><td>7</td><td>CCWP+</td><td>Input</td><td colspan="3">Counter clockwise pulse train (+) (CCW)</td></tr>
<tr><td>8</td><td>CWP+</td><td>Input</td><td colspan="3">Clockwise pulse train (+) (CW)</td></tr>
<tr><td>9</td><td>JOG</td><td>Input</td><td colspan="3">Jog</td></tr>
<tr><td>10</td><td>PRG2</td><td>Input</td><td colspan="3">Internal program channel selection 2</td></tr>
<tr><td>11</td><td>HLS</td><td>Input</td><td colspan="3">Home position limit sensor</td></tr>
<tr><td>12</td><td>EMST</td><td>Input</td><td colspan="3">Emergency stop</td></tr>
<tr><td>13</td><td>DC24</td><td>Input</td><td colspan="3">24 VDC external power supply</td></tr>
<tr><td>14</td><td>IPOS</td><td>Output</td><td colspan="3">In-position (positioning completed)</td></tr>
<tr><td>15</td><td>DRDY+</td><td>Output</td><td colspan="3">Driver Unit ready (+)</td></tr>
<tr><td>16</td><td>SGND</td><td>–</td><td colspan="3">Signal ground</td></tr>
<tr><td>17</td><td>CHZ [*2]</td><td>Output</td><td colspan="3">Position feedback signal øZ /Digital position signal MSB[*2]</td></tr>
<tr><td>18</td><td>∗CHB</td><td>Output</td><td colspan="3">Position feedback signal ∗øB</td></tr>
<tr><td>19</td><td>∗CHA</td><td>Output</td><td colspan="3">Position feedback signal ∗øA</td></tr>
<tr><td>20</td><td>CCWP–</td><td>Input</td><td colspan="3">Counter clockwise pulse train (–) (CCW)</td></tr>
<tr><td>21</td><td>CWP–</td><td>Input</td><td colspan="3">Clockwise pulse train (–) (CW)</td></tr>
<tr><td>22</td><td>DIR</td><td>Input</td><td colspan="3">Jog direction</td></tr>
<tr><td>23</td><td>PRG3</td><td>Input</td><td colspan="3">Internal program channel selection 3</td></tr>
<tr><td>24</td><td>RUN</td><td>Input</td><td colspan="3">Start positioning (Run move)</td></tr>
<tr><td>25</td><td>SVON</td><td>Input</td><td colspan="3">Servo ON</td></tr>
</table>

*1. The parameter OM (RS-232C communication) selects function of OUT1 output. The shipping set is BRK output.

*2. The parameter FZ (RS-232C communication) selects either “Position feedback signal øZ” or “Digital position signal MSB.” The shipping set is “Position feedback signal øZ.”

Table 2-18: Type 3 (TY3)

<table>
<tr><th>Pin</th><th>Signal Name</th><th>I/O</th><th colspan="3">Function</th></tr>
<tr><td>1</td><td>COM</td><td>Output</td><td colspan="3">Output COMMON</td></tr>
<tr><td>2</td><td>DRDY–</td><td>Output</td><td colspan="3">Driver Unit ready (–)</td></tr>
<tr><td rowspan="5">3</td><td rowspan="5">OUT1[*1]</td><td rowspan="5">Output</td><td>Parameter</td><td>Signal name</td><td>Function</td></tr>
<tr><td>OM0</td><td>BRK</td><td>Brake</td></tr>
<tr><td>OM1</td><td>SPD</td><td>Velocity threshold</td></tr>
<tr><td>OM2</td><td>NEARA</td><td>Target proximity / In target</td></tr>
<tr><td>OM3</td><td>OVER</td><td>Over</td></tr>
<tr><td>4</td><td>∗CHZ [*2]</td><td>Output</td><td colspan="3">Position feedback signal ∗øZ /Digital position signal ∗MSB[*2]</td></tr>
<tr><td>5</td><td>CHB</td><td>Output</td><td colspan="3">Position feedback signal øB</td></tr>
<tr><td>6</td><td>CHA</td><td>Output</td><td colspan="3">Position feedback signal øA</td></tr>
<tr><td>7</td><td>CCWP+</td><td>Input</td><td colspan="3">Counter clockwise pulse train (+) (CCW)</td></tr>
<tr><td>8</td><td>CWP+</td><td>Input</td><td colspan="3">Clockwise pulse train (+) (CW)</td></tr>
<tr><td>9</td><td>OTP</td><td>Input</td><td colspan="3">Over travel limit switch (+) direction (clockwise)</td></tr>
<tr><td>10</td><td>PRG2</td><td>Input</td><td colspan="3">Internal program channel selection 2</td></tr>
<tr><td>11</td><td>HLS</td><td>Input</td><td colspan="3">Home position limit sensor</td></tr>
<tr><td>12</td><td>EMST</td><td>Input</td><td colspan="3">Emergency stop</td></tr>
<tr><td>13</td><td>DC24</td><td>Input</td><td colspan="3">24 VDC external power supply</td></tr>
<tr><td>14</td><td>IPOS</td><td>Output</td><td colspan="3">In-position (positioning completed)</td></tr>
<tr><td>15</td><td>DRDY+</td><td>Output</td><td colspan="3">Driver Unit ready (+)</td></tr>
<tr><td>16</td><td>SGND</td><td>–</td><td colspan="3">Signal ground</td></tr>
<tr><td>17</td><td>CHZ [*2]</td><td>Output</td><td colspan="3">Position feedback signal øZ /Digital position signal MSB[*2]</td></tr>
<tr><td>18</td><td>∗CHB</td><td>Output</td><td colspan="3">Position feedback signal ∗øB</td></tr>
<tr><td>19</td><td>∗CHA</td><td>Output</td><td colspan="3">Position feedback signal ∗øA</td></tr>
<tr><td>20</td><td>CCWP–</td><td>Input</td><td colspan="3">Counter clockwise pulse train (–) (CCW)</td></tr>
<tr><td>21</td><td>CWP–</td><td>Input</td><td colspan="3">Clockwise pulse train (–) (CW)</td></tr>
<tr><td>22</td><td>OTM</td><td>Input</td><td colspan="3">Over travel limit switch (–) direction (counter clockwise)</td></tr>
<tr><td>23</td><td>PRG3</td><td>Input</td><td colspan="3">Internal program channel selection 3</td></tr>
<tr><td>24</td><td>RUN</td><td>Input</td><td colspan="3">Start positioning (RUN move)</td></tr>
<tr><td>25</td><td>SVON</td><td>Input</td><td colspan="3">Servo ON</td></tr>
</table>

*1. The parameter OM (RS-232C communication) selects function of OUT1 output. The shipping set is BRK output.

*2. The parameter FZ (RS-232C communication) selects either “Position feedback signal øZ” or “Digital position signal MSB.” The shipping set is “Position feedback signal øZ.”

Table 2-19: Type 4 (TY4)

<table>
<tr><th>Pin</th><th>Signal Name</th><th>I/O</th><th colspan="3">Function</th></tr>
<tr><td>1</td><td>COM</td><td>Output</td><td colspan="3">Output COMMON</td></tr>
<tr><td>2</td><td>DRDY–</td><td>Output</td><td colspan="3">Driver Unit ready (–)</td></tr>
<tr><td rowspan="5">3</td><td rowspan="5">OUT1[*1]</td><td rowspan="5">Output</td><td>Parameter</td><td>Signal name</td><td>Function</td></tr>
<tr><td>OM0</td><td>BRK</td><td>Brake</td></tr>
<tr><td>OM1</td><td>SPD</td><td>Velocity threshold</td></tr>
<tr><td>OM2</td><td>NEARA</td><td>Target proximity / In target</td></tr>
<tr><td>OM3</td><td>OVER</td><td>Over</td></tr>
<tr><td>4</td><td>∗CHZ [*2]</td><td>Output</td><td colspan="3">Position feedback signal ∗øZ /Digital position signal ∗MSB[*2]</td></tr>
<tr><td>5</td><td>CHB</td><td>Output</td><td colspan="3">Position feedback signal øB</td></tr>
<tr><td>6</td><td>CHA</td><td>Output</td><td colspan="3">Position feedback signal øA</td></tr>
<tr><td>7</td><td>CCWP+</td><td>Input</td><td colspan="3">Counter clockwise pulse train (+) (CCW)</td></tr>
<tr><td>8</td><td>CWP+</td><td>Input</td><td colspan="3">Clockwise pulse train (+) (CW)</td></tr>
<tr><td>9</td><td>OTP</td><td>Input</td><td colspan="3">Over travel limit (+) direction (clockwise)</td></tr>
<tr><td>10</td><td>CLR</td><td>Input</td><td colspan="3">Clear input</td></tr>
<tr><td>11</td><td>HLS</td><td>Input</td><td colspan="3">Home position limit sensor</td></tr>
<tr><td>12</td><td>EMST</td><td>Input</td><td colspan="3">Emergency stop</td></tr>
<tr><td>13</td><td>DC24</td><td>Input</td><td colspan="3">24 VDC external power supply</td></tr>
<tr><td>14</td><td>IPOS</td><td>Output</td><td colspan="3">In-position (positioning completed)</td></tr>
<tr><td>15</td><td>DRDY+</td><td>Output</td><td colspan="3">Driver Unit ready (+)</td></tr>
<tr><td>16</td><td>SGND</td><td>–</td><td colspan="3">Signal ground</td></tr>
<tr><td>17</td><td>CHZ [*2]</td><td>Output</td><td colspan="3">Position feedback signal øZ /Digital position signal MSB[*2]</td></tr>
<tr><td>18</td><td>∗CHB</td><td>Output</td><td colspan="3">Position feedback signal ∗øB</td></tr>
<tr><td>19</td><td>∗CHA</td><td>Output</td><td colspan="3">Position feedback signal ∗øA</td></tr>
<tr><td>20</td><td>CCWP–</td><td>Input</td><td colspan="3">Counter clockwise pulse train (–) (CCW)</td></tr>
<tr><td>21</td><td>CWP–</td><td>Input</td><td colspan="3">Clockwise pulse train (–) (CW)</td></tr>
<tr><td>22</td><td>OTM</td><td>Input</td><td colspan="3">Over travel limit switch (–) direction (counter clockwise)</td></tr>
<tr><td>23</td><td>HOS</td><td>Input</td><td colspan="3">Home Return start</td></tr>
<tr><td>24</td><td>RUN</td><td>Input</td><td colspan="3">Start positioning (RUN move)</td></tr>
<tr><td>25</td><td>SVON</td><td>Input</td><td colspan="3">Servo ON</td></tr>
</table>

*1. The parameter OM (RS-232C communication) selects function of OUT1 output. The shipping set is BRK output.

*2. The parameter FZ (RS-232C communication) selects either “Position feedback signal øZ” or “Digital position signal MSB.” The shipping set is “Position feedback signal øZ.”

Table 2-20: Type 7 (TY 7)

<table>
<tr><th>Pin</th><th>Signal Name</th><th>I/O</th><th colspan="3">Function</th></tr>
<tr><td>1</td><td>COM</td><td>Output</td><td colspan="3">Output COMMON</td></tr>
<tr><td>2</td><td>DRDY–</td><td>Output</td><td colspan="3">Driver Unit ready (–)</td></tr>
<tr><td rowspan="5">3</td><td rowspan="5">OUT1[*1]</td><td rowspan="5">Output</td><td>Parameter</td><td>Signal name</td><td>Function</td></tr>
<tr><td>OM0</td><td>BRK</td><td>Brake</td></tr>
<tr><td>OM1</td><td>SPD</td><td>Velocity threshold</td></tr>
<tr><td>OM2</td><td>NEARA</td><td>Target proximity / In target</td></tr>
<tr><td>OM3</td><td>OVER</td><td>Over</td></tr>
<tr><td>4</td><td>*CHZ [*2]</td><td>Output</td><td colspan="3">Position feedback signal *øZ /Digital position signal *MSB[*2]</td></tr>
<tr><td>5</td><td>CHB</td><td>Output</td><td colspan="3">Position feedback signal øB</td></tr>
<tr><td>6</td><td>CHA</td><td>Output</td><td colspan="3">Position feedback signal øA</td></tr>
<tr><td>7</td><td>CCWP+</td><td>Input</td><td colspan="3">Counter clockwise pulse train (+) (CCW)</td></tr>
<tr><td>8</td><td>CWP+</td><td>Input</td><td colspan="3">Clockwise pulse train (+) (CW)</td></tr>
<tr><td>9</td><td>OTP</td><td>Input</td><td colspan="3">Over travel limit switch (+) direction (clockwise)</td></tr>
<tr><td>10</td><td>JOG</td><td>Input</td><td colspan="3">Jog</td></tr>
<tr><td>11</td><td>HLS</td><td>Input</td><td colspan="3">Home position limit sensor</td></tr>
<tr><td>12</td><td>EMST</td><td>Input</td><td colspan="3">Emergency stop</td></tr>
<tr><td>13</td><td>DC24</td><td>Input</td><td colspan="3">24 VDC external power supply</td></tr>
<tr><td>14</td><td>IPOS</td><td>Output</td><td colspan="3">In-position (positioning completed.)</td></tr>
<tr><td>15</td><td>DRDY+</td><td>Output</td><td colspan="3">Driver Unit ready (+)</td></tr>
<tr><td>16</td><td>SGND</td><td>–</td><td colspan="3">Signal ground</td></tr>
<tr><td>17</td><td>CHZ [*2]</td><td>Output</td><td colspan="3">Position feedback signal øZ /Digital position signal MSB[*2]</td></tr>
<tr><td>18</td><td>*CHB</td><td>Output</td><td colspan="3">Position feedback signal *øB</td></tr>
<tr><td>19</td><td>*CHA</td><td>Output</td><td colspan="3">Position feedback signal *øA</td></tr>
<tr><td>20</td><td>CCWP–</td><td>Input</td><td colspan="3">Counter clockwise pulse train (–) (CCW)</td></tr>
<tr><td>21</td><td>CWP–</td><td>Input</td><td colspan="3">Clockwise pulse train (–) (CW)</td></tr>
<tr><td>22</td><td>OTM</td><td>Input</td><td colspan="3">Over travel limit switch (–) (counter clockwise)</td></tr>
<tr><td>23</td><td>DIR</td><td>Input</td><td colspan="3">Jog direction</td></tr>
<tr><td>24</td><td>RUN</td><td>Input</td><td colspan="3">Start positioning (RUN move)</td></tr>
<tr><td>25</td><td>SVON</td><td>Input</td><td colspan="3">Servo ON</td></tr>
</table>

*1. The parameter OM (RS-232C communication) selects function of OUT1 output. The shipping set is BRK output.

*2. The parameter FZ (RS-232C communication) selects either “Position feedback signal øZ” or “Digital position signal MSB.” The shipping set is “Position feedback signal øZ.”

Table 2-21: Type 8 (TY8)

<table>
<tr><th>Pin</th><th>Signal Name</th><th>I/O</th><th colspan="4">Function</th></tr>
<tr><td>1</td><td>COM</td><td>Output</td><td colspan="4">Output COMMON</td></tr>
<tr><td>2</td><td>DRDY–</td><td>Output</td><td colspan="4">Driver Unit ready (–)</td></tr>
<tr><td rowspan="6">3</td><td rowspan="6">OUT1[*1]</td><td rowspan="6">Output</td><td colspan="2">Parameter</td><td>Signal name</td><td></td></tr>
<tr><td rowspan="4">BF0</td><td>OM0</td><td>BRK</td><td>Brake</td></tr>
<tr><td>OM1</td><td>SPD</td><td>Velocity threshold</td></tr>
<tr><td>OM2</td><td>NEARA</td><td>Target proximity / In target</td></tr>
<tr><td>ON3</td><td>OVER</td><td>Over</td></tr>
<tr><td colspan="2">BF1</td><td>BRKC</td><td>Brake control</td></tr>
<tr><td>4</td><td>∗CHZ [*2]</td><td>Output</td><td colspan="4">Position feedback signal ∗øZ /Digital position signal ∗MSB[*2]</td></tr>
<tr><td>5</td><td>CHB</td><td>Output</td><td colspan="4">Position feedback signal øB</td></tr>
<tr><td>6</td><td>CHA</td><td>Output</td><td colspan="4">Position feedback signal øA</td></tr>
<tr><td>7</td><td>CCWP+</td><td>Input</td><td colspan="4">Counter clockwise pulse train (+) (CCW)</td></tr>
<tr><td>8</td><td>CWP+</td><td>Input</td><td colspan="4">Clockwise pulse train (+) (CW)</td></tr>
<tr><td>9</td><td>PRG0</td><td>Input</td><td colspan="4">Internal program channel selection 0</td></tr>
<tr><td>10</td><td>PRG2</td><td>Input</td><td colspan="4">Internal program channel selection 2</td></tr>
<tr><td>11</td><td>HLS</td><td>Input</td><td colspan="4">Home position limit sensor</td></tr>
<tr><td>12</td><td>EMST</td><td>Input</td><td colspan="4">Emergency stop</td></tr>
<tr><td>13</td><td>DC24</td><td>Input</td><td colspan="4">24 VDC external power supply</td></tr>
<tr><td>14</td><td>IPOS</td><td>Output</td><td colspan="4">In-position (positioning completed)</td></tr>
<tr><td>15</td><td>DRDY+</td><td>Output</td><td colspan="4">Driver Unit ready (+)</td></tr>
<tr><td>16</td><td>SGND</td><td>–</td><td colspan="4">Signal ground</td></tr>
<tr><td>17</td><td>CHZ [*2]</td><td>Output</td><td colspan="4">Position feedback signal øZ /Digital position signal MSB[*2]</td></tr>
<tr><td>18</td><td>∗CHB</td><td>Output</td><td colspan="4">Position feedback signal ∗øB</td></tr>
<tr><td>19</td><td>∗CHA</td><td>Output</td><td colspan="4">Position feedback signal ∗øA</td></tr>
<tr><td>20</td><td>CCWP–</td><td>Input</td><td colspan="4">Counter clockwise pulse train (–) (CCW)</td></tr>
<tr><td>21</td><td>CWP–</td><td>Input</td><td colspan="4">Clockwise pulse train (–) (CW)</td></tr>
<tr><td>22</td><td>PRG1</td><td>Input</td><td colspan="4">Internal program channel selection 1</td></tr>
<tr><td>23</td><td>IOFF[*3]
/ CLCN[*4]</td><td>Input</td><td colspan="4">When parameter BF0 is specified: IOFF[*3] (Integration OFF/Lower gain)
When parameter BF1 is specified: CLCN[*4] (Brake-off)Integration off/ Lower gain [*3]</td></tr>
<tr><td>24</td><td>RUN</td><td>Input</td><td colspan="4">Start positioning (RUN move)</td></tr>
<tr><td>25</td><td>SVON</td><td>Input</td><td colspan="4">Servo ON</td></tr>
</table>

*1. The parameter OM (RS-232C communication) selects function of OUT1 output. The shipping set is BRK output.

*2. The parameter FZ (RS-232C communication) selects either “Position feedback signal øZ” or “Digital position signal MSB.” The shipping set is “Position feedback signal øZ.”

*3. The parameter IM (RS-232C communication) selects the function of the Integration OFF (IOFF) input. The shipping set is “Integration OFF.

*4. For a Motor equipped with brake, you may use the OUT1 signal as the BRKC signal and the IOFF signal as the CLCN signal by selecting Type 8 I/O combination (TY8) and activating the brake sequence function (BF1).

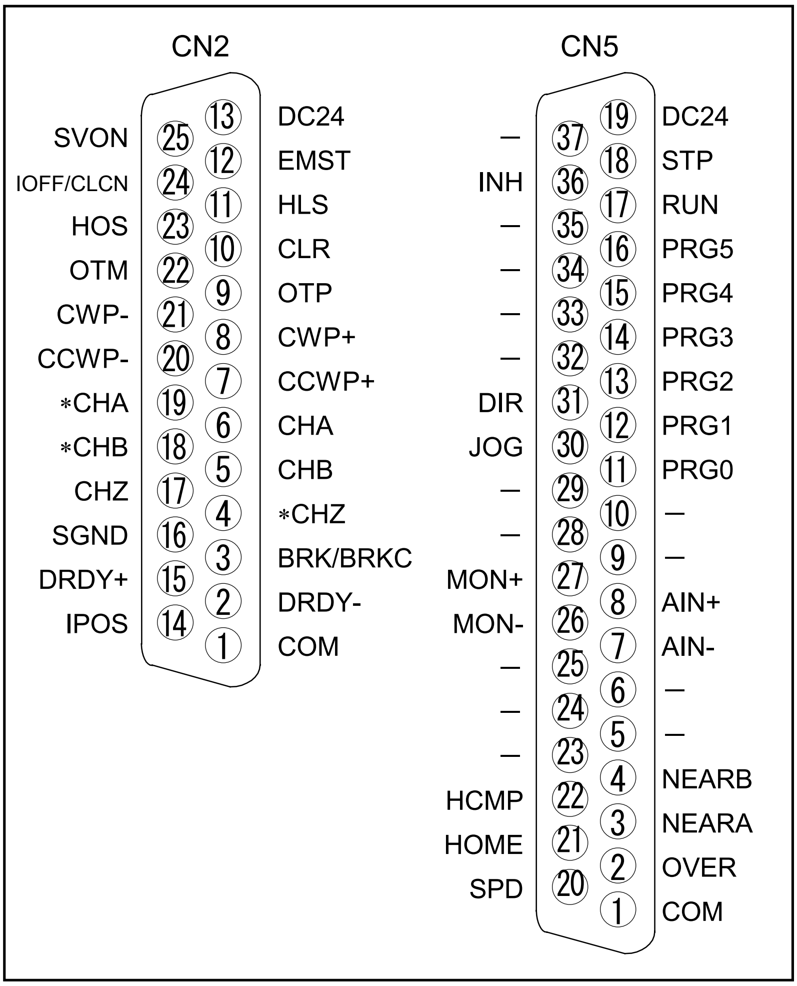
2.9.3. Control I/O Signal Specifications of B5 and 25 Type Driver Units

2.9.3.1. Polarity of Input Port (Normally Open or Closed Contact)

- You may change polarity of some CN2 input ports.
- The shipping set is set to the normally open contact for all input ports.
- The parameter AB sets the polarity of the input ports.
- The password is required before inputting the parameter AB.
- The signals whose polarity can be changed are limited to EMST, HLS, OTP, and OTM.
  (For B3 and 23 type Driver Units, polarity change of OTP and OTM signals are only available in 3, 4, and 7 types.)
- Refer to “3.4.3.2. Setting of Input Port Polarity” for setting polarity.

2.9.3.2. Pin-Out (CN2 and CN5: B5 and 25 type Driver Units)

Figure 2-31



2.9.3.3. Signal List (CN2 and CN5: B5 and 25 type Driver Units)

Table 2-21: CN2

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

*1. The parameter FZ (RS-232C communication) selects either “Position feedback signal øZ” or “Digital position signal MSB.” The shipping set is “Position feedback signal øZ.”

*2. Parameter IM (RS-232C communication) selects “Integration off” or “Lower gain.” The shipping set “Integration off.”

*3. When using a Motor equipped with brake, you may set the BRK signal to the BRKC signal, and IOFF signal to CLCN signal by activating the brake sequence function (BF1).

Table 2-23: CN5

Pin	Signal Name	I／O	Function
1	COM	Output	Output COMMON
2	OVER	Output	Warning
3	NEARA*1	Output	Target proximity A /In target A*1
4	NEARB*1	Output	Target proximity B / In target B*1
5	–	–	Never connect!
6	–	–	Never connect!
7	AIN–	Input	Analog command input (–)
8	AIN+	Input	Analog command input (+)
9	–	–	Never connect!
10	—	—	Never connect!
11	PRG0	Input	Internal program channel selection 0
12	PRG1	Input	Internal program channel selection 1
13	PRG2	Input	Internal program channel selection 2
14	PRG3	Input	Internal program channel selection 3
15	PRG4	Input	Internal program channel selection 4
16	PRG5	Input	Internal program channel selection 5
17	RUN	Input	RUN move
18	STP	Input	Stop
19	DC24	Input	24 VDC external power supply
20	SPD	Output	Velocity threshold
21	HOME*2	Output	Home Return completed / Home Position detected*2
22	HCMP	Output	Home position defined
23	–	–	Never connect!
24	–	–	Never connect!
25	–	–	Never connect!
26	MON–	Output	Analog monitor output (–)
27	MON+	Output	Analog monitor output (+)
28	–	–	Never connect!
29	–	–	Never connect!
30	JOG	Input	Jog
31	DIR	Input	Jog direction
32	–	–	Never connect!
33	–	–	Never connect!
34	–	–	Never connect!
35	–	–	Never connect!
36	INH	Input	Inhibit pulse train input or analog input.
37	–	–	Never connect!

*1. Select either "Target proximity x" or "In target " with the parameter NMx (RS-232Ccommunication). The shipping set is "Target proximity x" output.

*2. Select either "Home Return completed" or "Home position detected" with the parameter HW (RS-232C communication). Shipping set is "Home Return completed" output.

⚠ *Caution: Follow respective specification documents of a custom made Megatorque Motor System whose Input / Output signal settings are unique.*

2.9.4. CN2 and CN5 Connectors: Interfacing

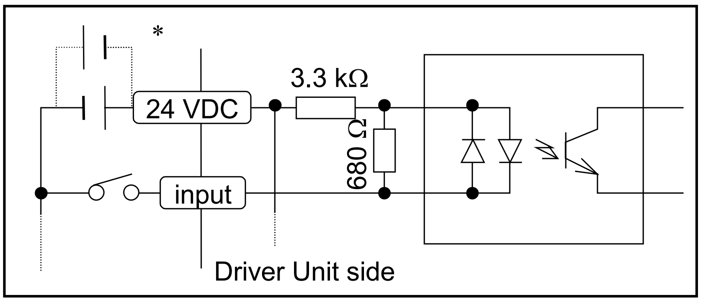
2.9.4.1. General Input

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

Table 2-24

Item	Specification
Input voltage	24 VDC ± 10%
Input impedance	3.3 kΩ
Maximum current	10 mA or less (per input)

Figure 2-32



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

2.9.4.2. Pulse Train Input

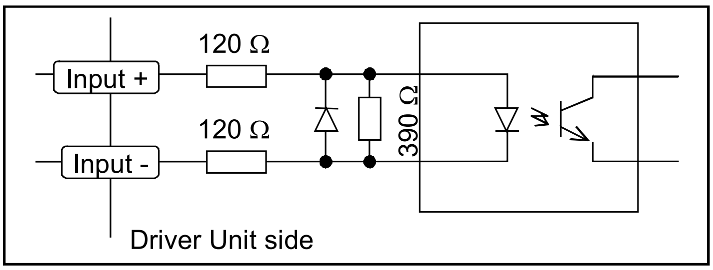
Applicable inputs: CCWP +, CCWP -, CWP +, and CWP -

(1) Photo coupler specification (Driver Unit reference number: M-ESB-YSB☐-00, and M-ESB-YSB☐-02)

Table 2-25

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

Figure 2-33: Photo coupler specification

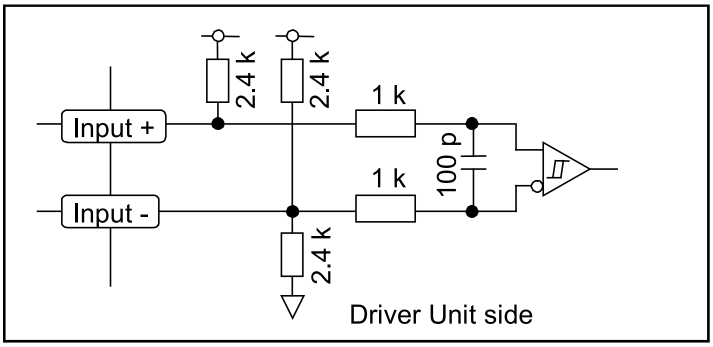


(2) Line receiver specification (Driver Unit reference number: M-ESB-YSB☐-01 and M-ESB-YSB☐-03)

Table 2-26: Line receiver specification

Item	Specification
Input format	Deferential line receiver
Line receiver spec.	Japan Texas Instruments: μA9637AC
Recommended line receiver	Japan Texas Instruments: μA9638C or AM26LS31 equivalent

Figure 2-34



2.9.4.3. General Output

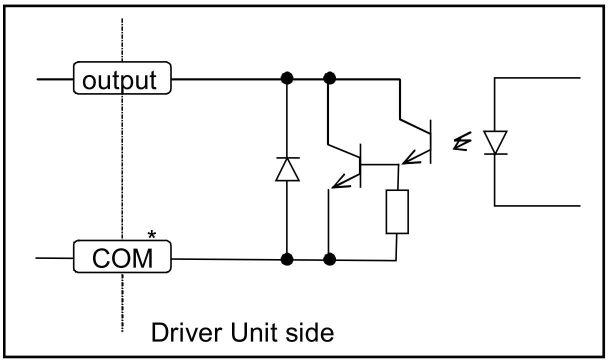
Applicable output: BRK, IPOS, OVER, HOME, HCMP, SPD, NEARA, and NEARB

(1) Photo coupler specification (Driver Unit reference number: M-ESB-YSB☐-00, and M-ESB-YSB☐-01)

Table 2-27: General output photo coupler specification

Item	Specification
Maximum load capacity	24 VDC/50 mA
Maximum saturated voltage	2 V or less

Figure 2-35



* Connect a corresponding output signal of connectors CN2 and CN5 to output COMMON.

(2) Photo MOS FET specification
(Driver Unit reference number: M-ESB-YSB□02, and M-ESB-YSB□03)

Table 2-28: General output (Photo MOS FET)

Item	Specification
Max. load capacity	±24 VDC/50mA
Max. saturated voltage	2 V or less
Max. on resistance	25 Ω

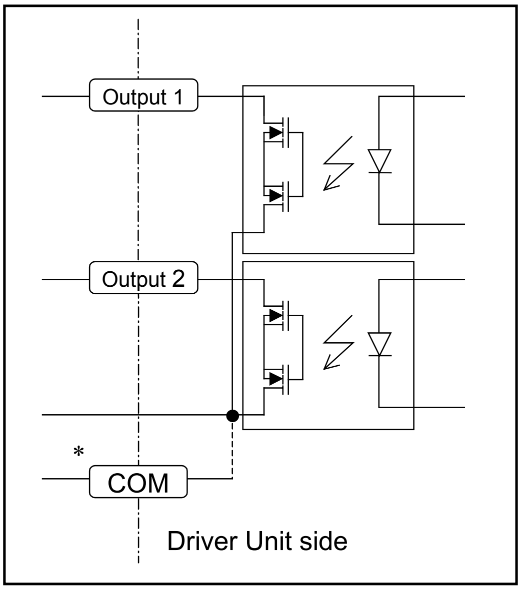


Figure 2-36: General output (Photo MOS FET)

* Connect a corresponding output signal of connectors CN2 and CN5 to output COMMON.

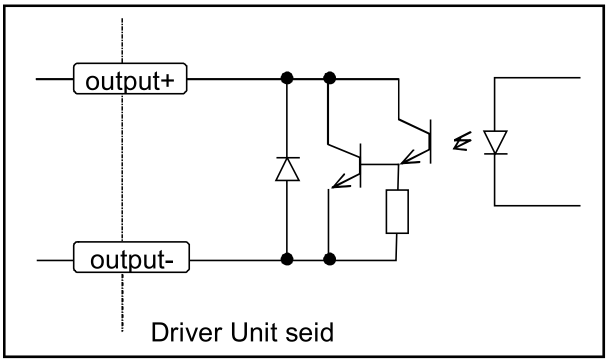
2.9.4.4. Alarm Output

Applicable output: DRDY +, and DRDY –

Table 2-29: Alarm output specification

Item	Specification
Max. load capacity	24 VDC / 50 mA
Max. saturated voltage	2 V or less

Figure 2-3



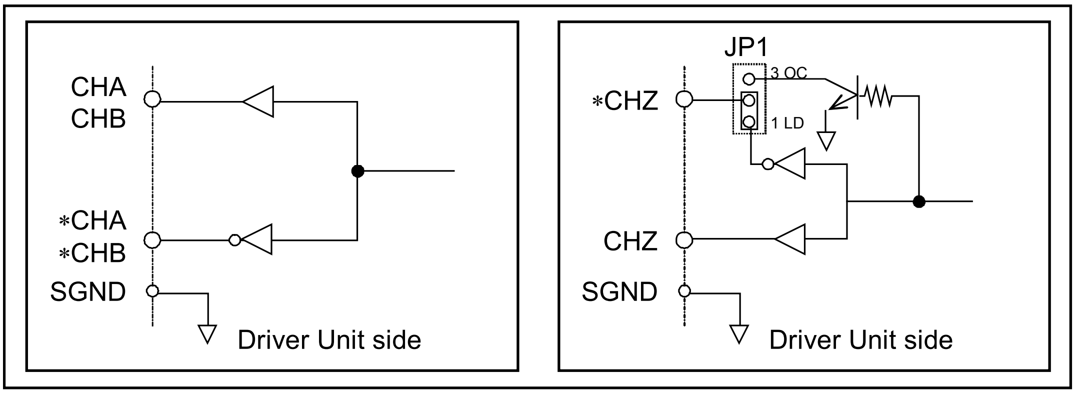
2.9.4.5. Position Feedback Signal Output

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

Table 2-30: Specifications of position feedback output signal

Item	Specification	
Output format	• Line driver (CHA, CHB, *CHA, and *CHB) • Line driver or open collector (CHZ, and *CHZ) (May be selected by Jumper pin P1. Refer to “2.14.1. JP1.”	
Line driver	Texas Instruments: SN75ALS192	
Recommended line receiver	Texas Instruments: SN75ALS192 or AM26LS32 equivalent	
Max. collector current	100 mA	When signal format is open collector
Max. collector voltage	24 V	
Saturated voltage	1 V or less	

Figure 2-38



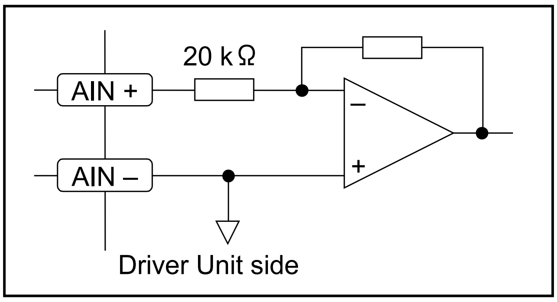
2.9.4.6. Analog Command Input

Applied input: AIN +, and AIN –

Table 2-31: Specifications of analog command input

Item	Specification
Max. input voltage	± 10 VDC
Input impedance	20 kΩ
Maxi. input current	0.5 mA

Figure 2-39



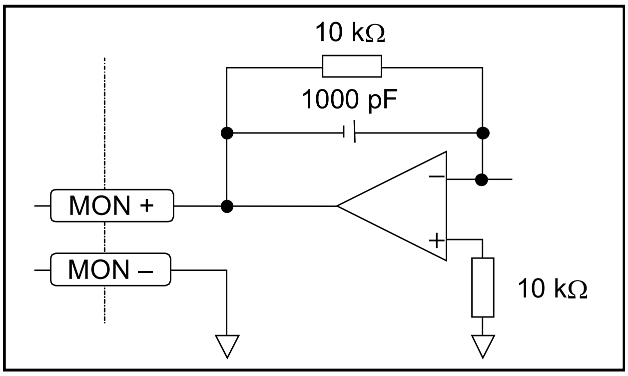
2.9.4.7. Analog Control Monitor

Applicable output: MON+, and MON–

Table 2-32: Analog control monitor

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

Figure 2-40



2.10. CN3: Resolver Cable Connector

Caution : Connect the Cable Set provided with the Driver Unit. Do not shorten or cut the cable as it is uniquely made for the resolver.

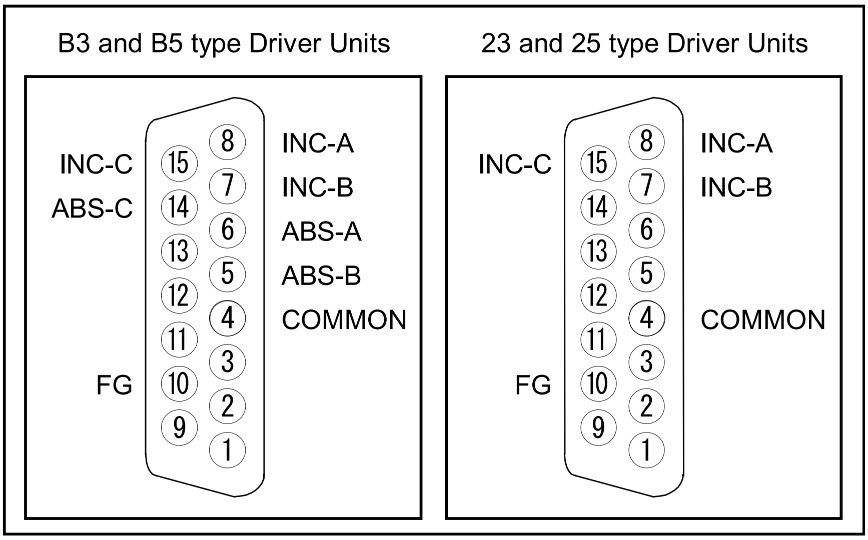
Table 2-33

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

* Provided with the Cable Set.

2.10.1. Pin-out

Figure 2-41: Pin-out



2.10.2. Signal List

Table 2-34: Signal list

Pin	Signal name	Function
8	INC-A	Incremental resolve signal øA
7	INC-B	Incremental resolver signal øB
15	INC-C	Incremental resolver signal øC
6	ABS-A	Absolute resolver signal øA+
5	ABS-B	Absolute resolver signal øB+
14	ABS-C	Absolute resolver signal øC+
4	COMMON	Common
10	FG	Frame ground

Caution : Never connect pins not listed above.

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

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

2.11. CN4: Motor Connector

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

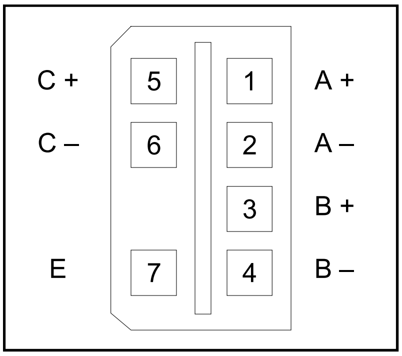
Table 2-35

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

* Provided with the Driver Unit.

2.11.1. Pin-out

Figure 2-42: Pin-out



2.11.2. Signal List

Table 2-36: Signal list

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

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

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

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

2.12. TB: Terminal Block for Power Supply

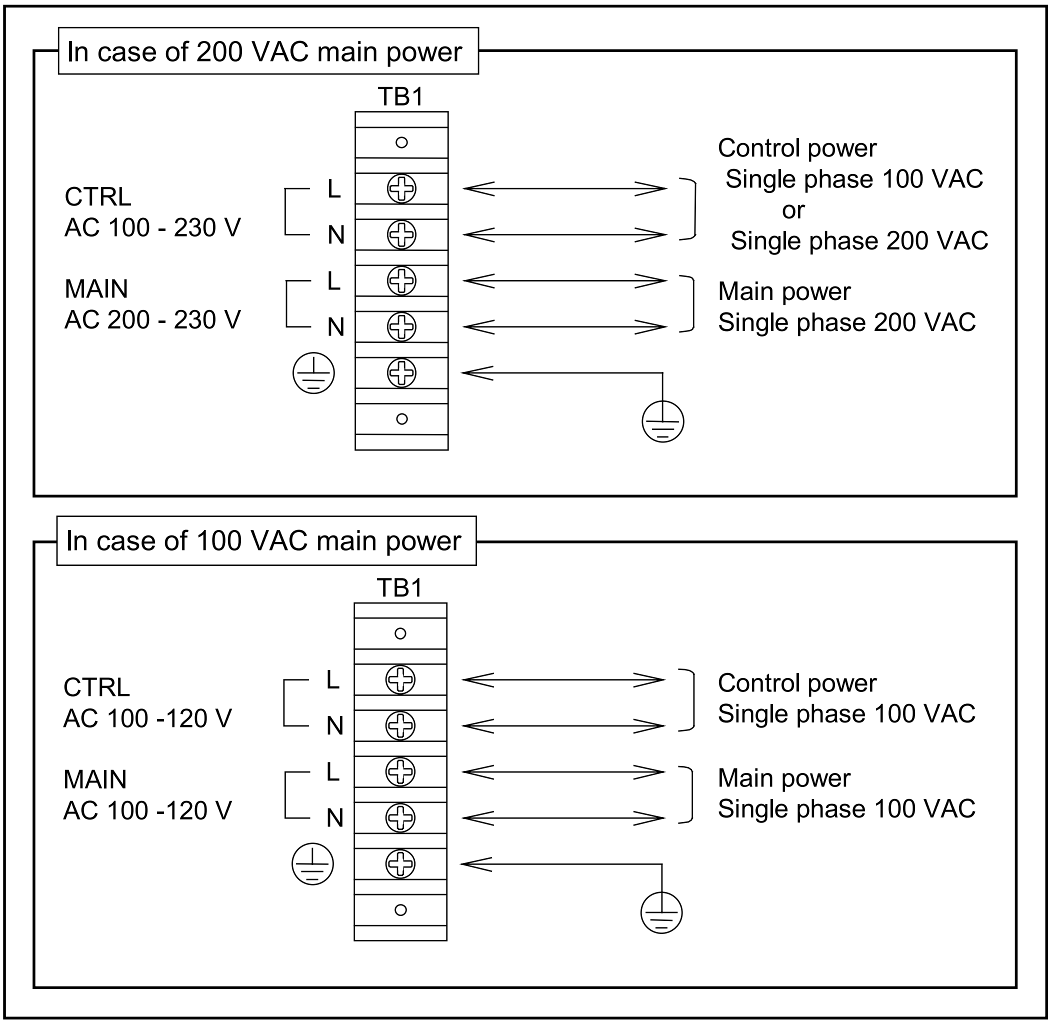
2.12.1. Terminal List

Table 2-35: Terminal code and function

Terminal Code	Function
CONT	Control power input
MAIN	Main power input
GND	Frame ground

2.12.2. Wiring Diagram

Figure 2-36: Wiring diagram



2.13. TB2: Terminal Block for Thermal

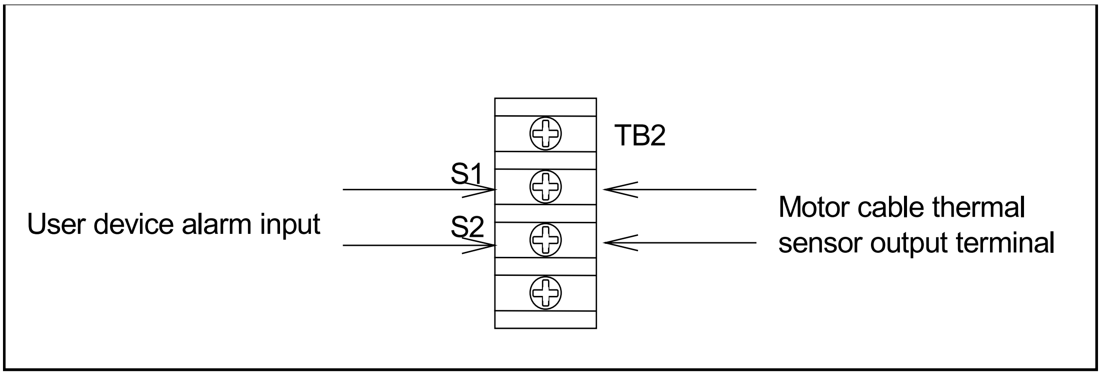
2.13.1. Terminal Code and Function

Table2-38:TB2 terminal code and function

Terminal code	Function
S1	Terminal for thermal sensor output
S2	Terminal for thermal sensor output

2.13.2. Wiring Diagram

Figure 2-44: TB2 wiring diagram



2.14. Jumper Pin

2.14.1. JP1 (Output Mode Selection of øZ)

Figure 2-45: Position of jumper pins

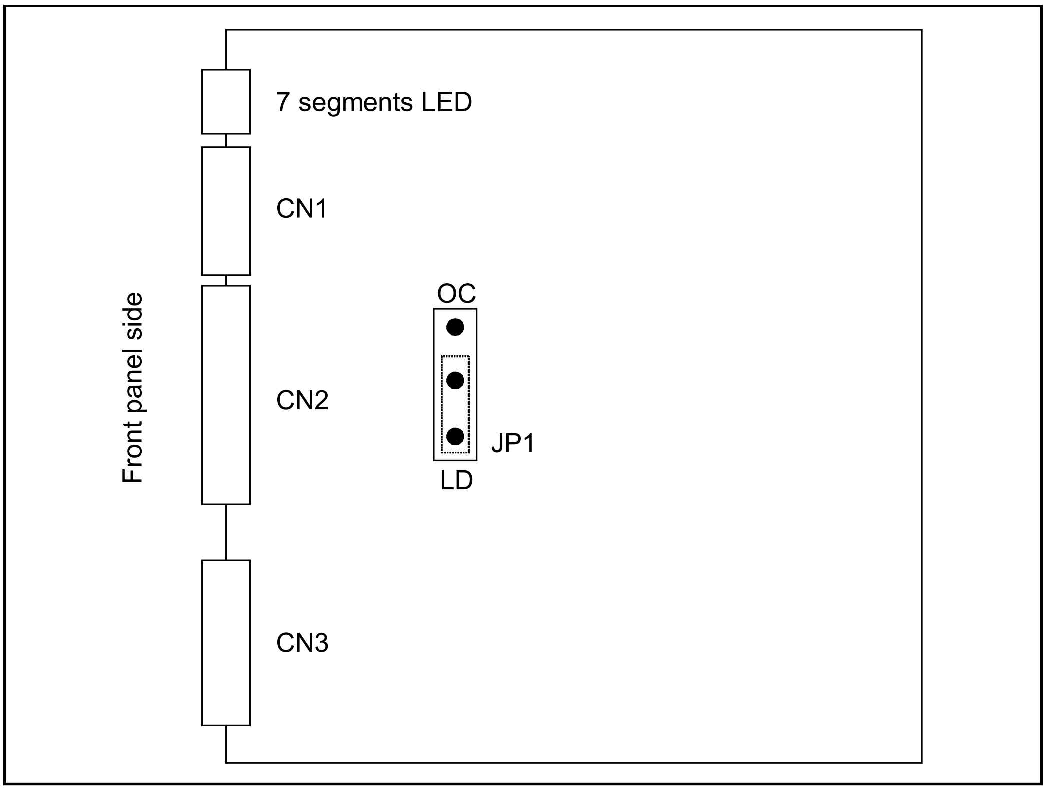


Table 2-39

Pin setting	Output mode of øZ
LD short (shipping set)	Line driver
OC short	Open collector

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

3. Unpacking • Installation • Wiring

3.1. Unpacking

3.1.1. Receiving Check

- Make sure that you have received the following units.
  1) Megatorque Motor
  2) Driver Unit
     - ◊ Driver Unit
     - ◊ CN2 and CN5 mating connectors for control I/O signal
  3) Cable Set (Motor and Resolver cable)

3.1.2. Combination of Motor and Driver Unit

⚠ Caution: Confirm that the Motor series code, size code and maximum torque code of both the Motor and the Driver Unit indicated on the respective nameplates conform to each other. The figure below shows the coding and numbering system of the reference number of Motor and Driver Unit.

Figure 3-1: Indication on the nameplate of Motor

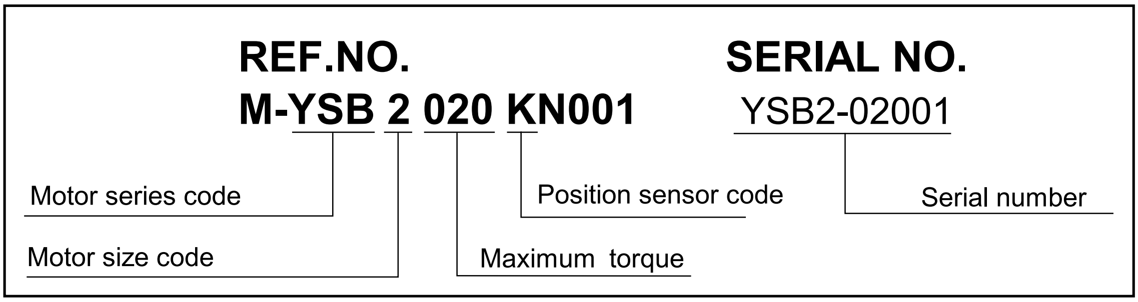
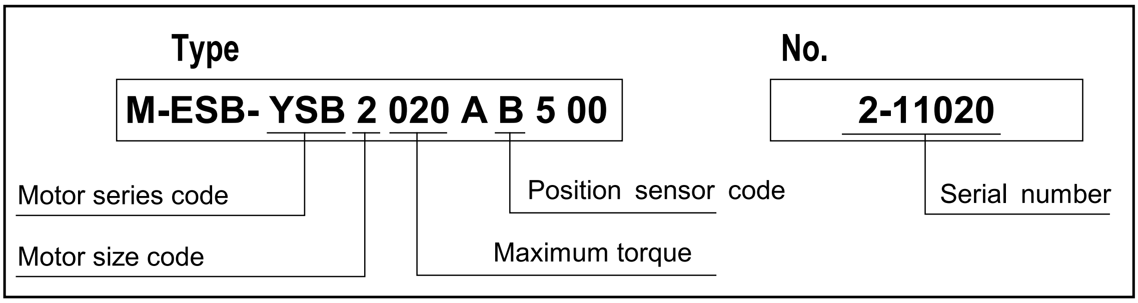


Figure 3-2: Indication on the nameplate of Driver Unit



- See Table 3-1 for the position sensor code.

Table 3-1

Position sensor type	Position sensor code of Motor	Position sensor code of Driver Unit	Cable reference No.
Absolute position sensor	K	B	M-CXXXSB03 M-CXXXSB13
Incremental position sensor	J	2	M-CXXXSB01 M-CXXXSB11

3.2. Installation

3.2.1. Motor Mounting

◊ Megatorque Motor YSB Series

The standard series is neither dust-proof nor waterproof (IP30 equivalent).

The area where the Motor is used must be free of oil vapor and water.

3.2.1.1. Fixing Motor

⚠ *Warning: Use the boltholes on the flange of Motor mounting base or the tapped holes on its bottom, and fully fasten all bolts.*

- The flatness of Motor mounting surface shall be 0.02mm or less.

⚠ *Danger: When installing a Motor equipped with brake, be sure to keep the friction plate of brake free from iron powder or oil.*

⚠ *Danger: The brake may not function if iron made member exists near the brake. Please provide 15 mm or more clearance around the Motor.*

3.2.1.2. Loading Attachment (Work) to Motor

⚠ *Warning: Use all of the tapped holes on the rotor of Motor to fix an attachment. Fasten the bolts securely so that there will be no play between the rotor and the attachment (load).*

3.2.1.3. Checking Load Inertia

- The load inertia is generally much bigger than the rotor inertia in the Megatorque Motor System. The measures of allowable load inertia for each Motor size are shown in Table 3-2.

Table 3-2 *[Unit: $kg \cdot m^2$]*

	High speed positioning	For general use
YSB2020	0.025 to 1	1 to 2
YSB3040	0.05 to 2	2 to 4
YSB4080	0.1 to 4	4 to 8
YSB5120	0.15 to 6	6 to 12

⚠ *Warning: Check the use conditions if the load is under the allowable thrust load and moment load of the Motor.*

- Refer to the specifications of Motors.

3.2.2. Driver Unit Mounting

⚠ *Caution: (1) Ambient temperature*

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

(2) Dust-proof • Waterproof

Put the Driver Unit in an enclosure of which protection code is IP54 or better.

Protect the Driver Unit from oil-mist, cutting oil, metallic chips and paint fume etc. Otherwise it may result in failure of electric circuits of the Driver Unit because of the contaminant through the openings of the Driver Unit.

- IP code is specified in IEC standard and classifies the protection level of enclosures from solid contaminant and water.

  Protection against external solid contaminant (5): Dust-proof

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

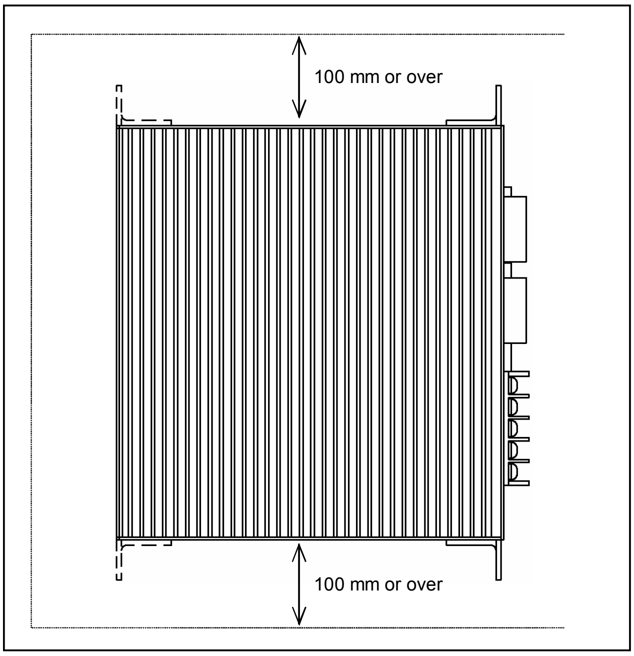
⚠ *Caution: When installing two or more Driver Units for multi-axis combinations, provide a100 mm or more space between adjacent Driver Units.*

- Maintain inside temperature of the enclosure into which the Driver Unit is installed between 0 to 50°C. If the Driver Unit frequently gives "Heat sink over temperature" alarm, provide a forced cooling to the heat sink. (Refer to "10. Alarm" for more details.

- You may use a bracket to fix an ESB Driver Unit to the enclosure.

- When you use open collector for output signal format for position feedback signal phase Z, change it before the Driver Unit is fixed. Refer to "2.14. Jumper Pin" for position of the jumper pin.

Figure 3-3



3.3. Wiring

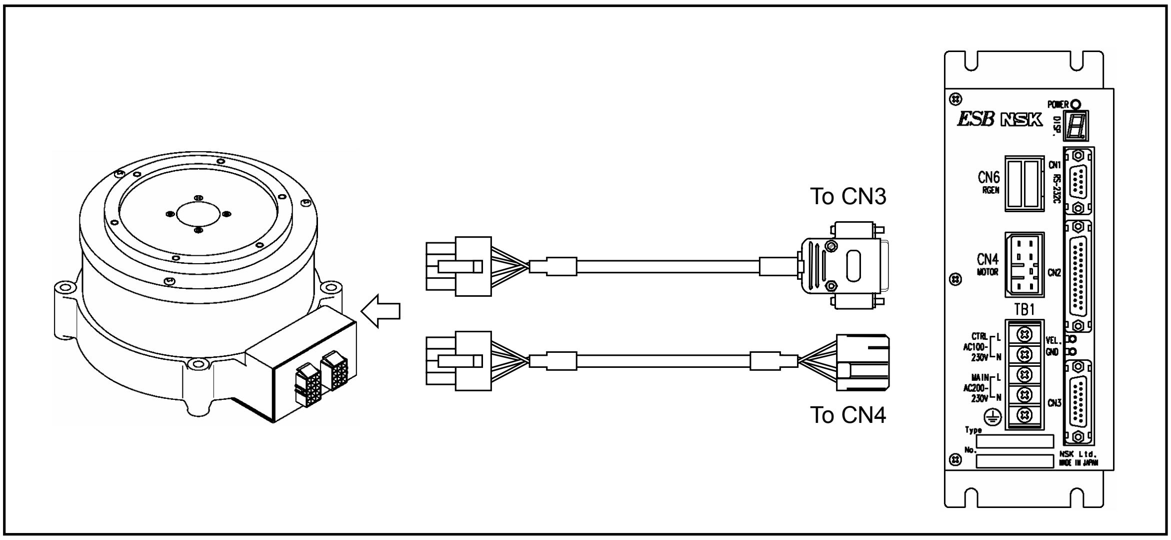
3.3.1. Motor Wiring

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

- The cable length is available in 2, 4, 8, 15, and 30 m.

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

Figure 3-4: YSB type Megatorque Motor



3.3.2. Connecting Power

- Refer to “2.12. TB: Terminal Block for Power Supply” for more details.
- Provide anti-heat vinyl AWG16 cables for the power supply cable.
- Do not place the main power AC line cable and the signal wires in close proximity. Do not bundle up them and not put in the same duct.
- Install a noise filter between the power source and the Driver Unit to protect the System from the external noises.

Table 3-3: Noise filter requirement [Recommended manufacturer: Schaffner]

Power source	Type	Rated voltage	Rated current
Single phase 100VAC, 200VAC	FN2070-40	250 VAC	AC10A

- Separate the wiring s of the primary and the secondary noise filters, and take different routing.
- The Driver Unit and the noise filter shall be close to each other.
- Be sure to install the surge killer circuit to the coils of magnetic switch, relay and solenoid.
- An inrush current flows when the power is turned on because the capacitive load is connected to the main power supply circuit. For this reason, use the contacts, if necessary, such as magnetic switch that have higher rated current as shown below.

Table 3-4

Contacts	Rated current
Non-fuse breaker	10 A
Short circuit breaker	10 A, Sensitivity: 15 mA
Magnetic switch	10 A

Table 3-5: Inrush current

Item	Inrush current (Typical)		Time
	Power supply 100 VAC	Power supply 200 VAC	
Control power	7.5 A	15 A	10 msec
Main power	10 A	20 A	10 msec

⚠ *Caution: Do not lose the screws for the terminal when wiring the Terminal block.*

- Refer to Figure 3-5 for wiring the power.

3.3.3. Prevent Overheating of Motor

- Provide a main power shutdown circuit using the thermal sensor to prevent overheats of the Motor.

- YSB Series Motor is equipped with a thermal sensor, and its output is provided to the Motor cable. Refer to "2.6.3. Dimensions of Cable Set."

- The power shutdown circuit is to shut down the power for the primary circuit when the thermal sensor activates. Refer to a wiring example (Figure 3-5) and provide the power shutdown circuit using 2 lead wires S1 and S2 of the Motor cable set.

- Thermal sensor specifications
  - ◊ Contact : Normally closed.
  - ◊ Capacity : Maximum 250 VAC, 3.5 A
    Minimum 6 V, 0.15 A
  - ◊ Model : T100R1U1N (Matsushita Electric Industrial Co., Ltd.)
    (Set temperature: 100℃)
  - ◊ Conforms to VDE.
  - ◊ The sensor is an auto-regression type. It returns to normal state when the temperature becomes 15°C lower than set temperature. Turn on the main power 30 minutes after the shutdown circuit activated.

3.3.4. Ground Connection

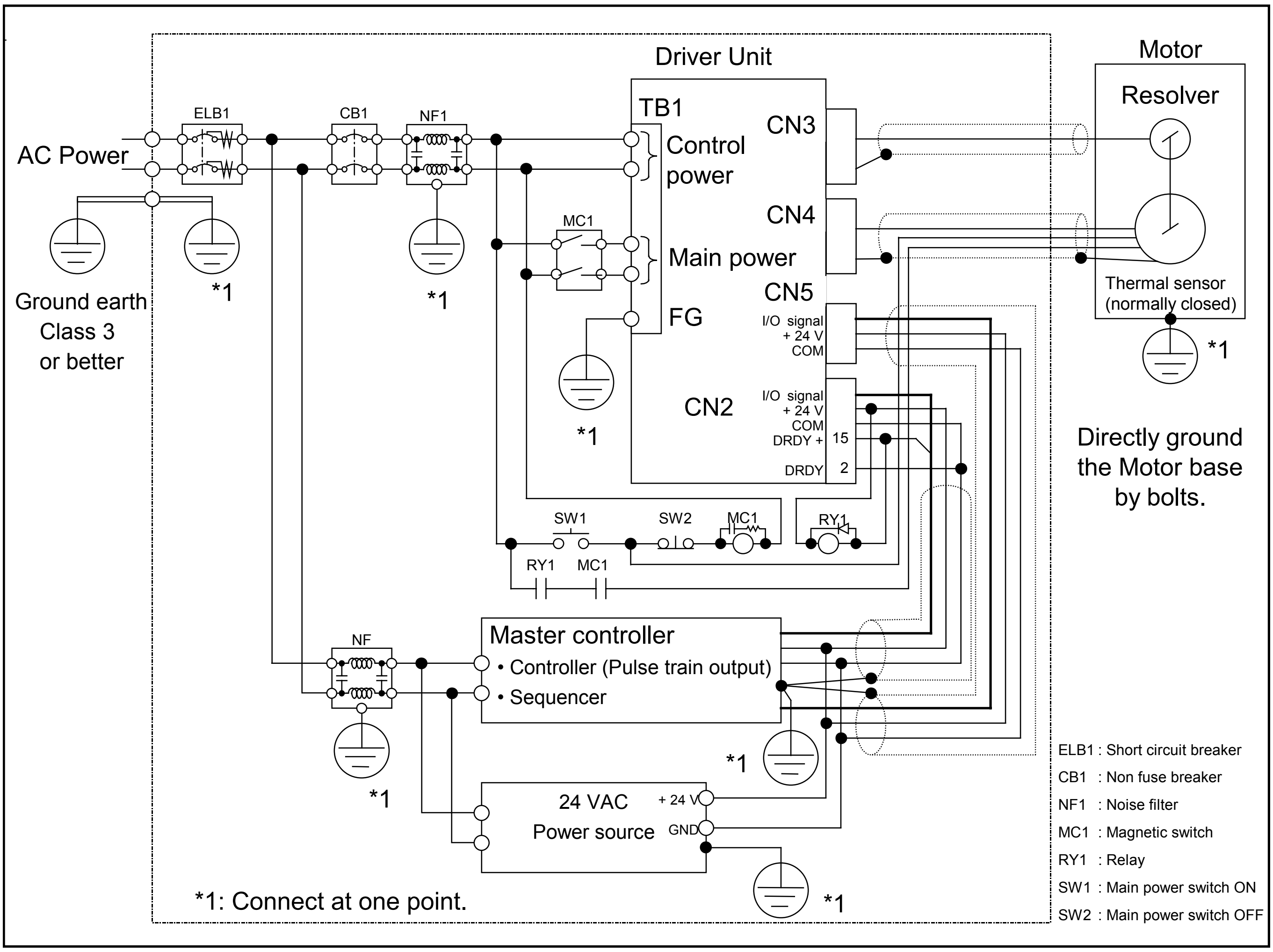
⚠ *Caution : Connect the shield of the signal shielded cables (CN2) to the FG or SG terminal of the master controller. If a malfunction occurs, connect it to the FG terminal of the terminal block of Driver Unit.*

- For grounding the Driver Unit, use heavy gage cable as possible such as braided copper cable or AWG12 or better.

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

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

Figure 3-5: Wiring example in case of a Driver Unit without TB2 for thermal sensor



⚠ *Caution : We recommend the following noise filter for an measures against EMC Directive.*

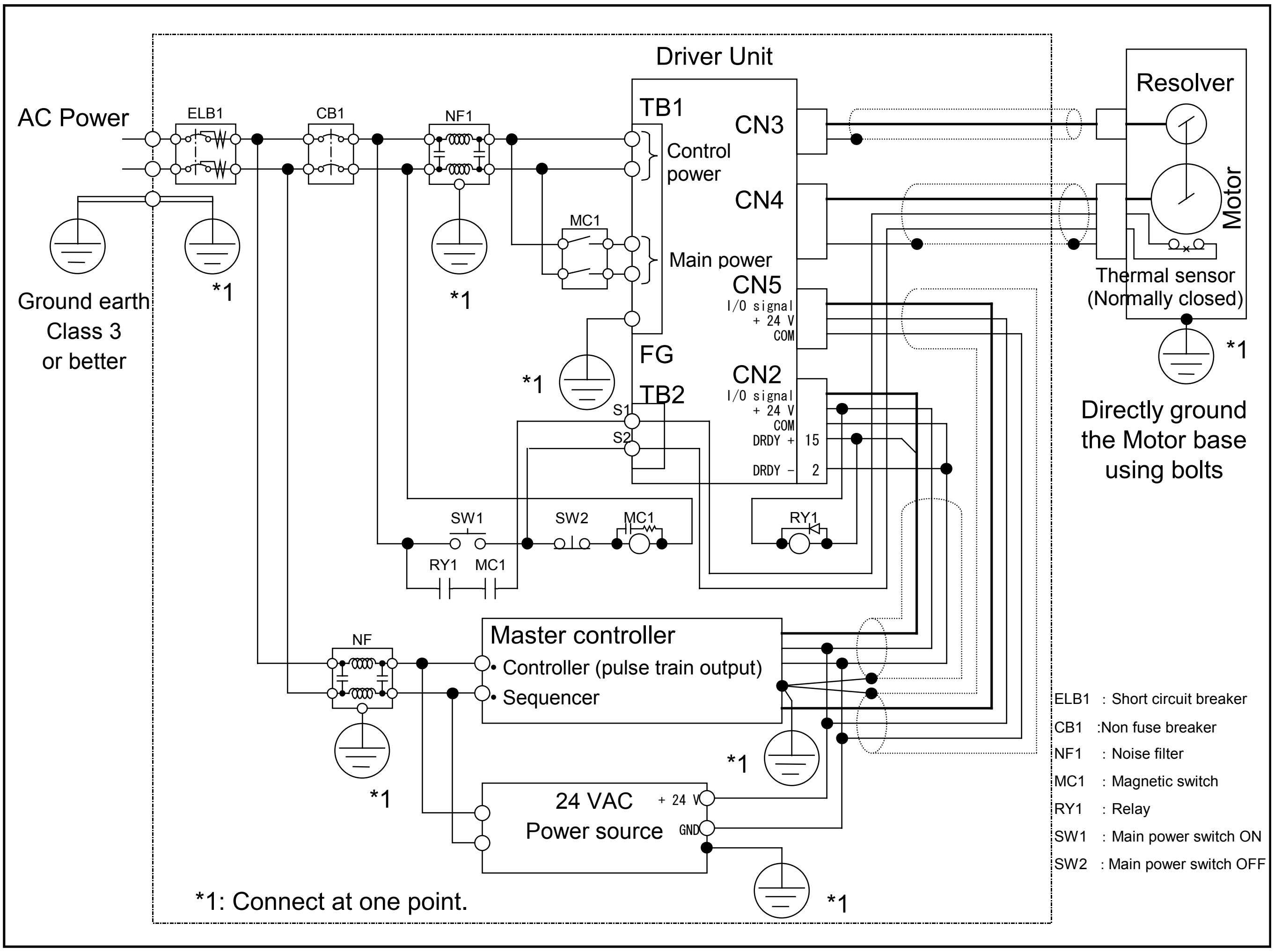
◊ PN2070-10/06 (Schaffner) equivalent
(Use a breaker compatible with the European Safety Directives.)

⚠ *Caution : Provide a circuit to shutdown the main power by an output of an alarm.*

◊ When an alarm is given, #2 and #15 of CN2 for DRDY (Driver Unit ready) outputs open.

- Alarm of “Main AC Line Trouble” will be given when the main power is turned off while the servo is on. This alarm cannot be cleared until the control power is turned on again. (Refer to “7-1.1. Servo on.”)

Figure 3-6: Wiring example in case of a Driver Unit with TB2 for thermal sensor



⚠ *Caution : We recommend the following noise filter for an measures against EMC Directive.*

◊ PN2070-10/06 (Schaffner) equivalent
(Use a breaker compatible with the European Safety Directives.)

⚠ *Caution : Provide a circuit to shutdown the main power by an output of an alarm.*

◊ When an alarm is given, #2 and #15 of CN2 for DRDY (Driver Unit ready) outputs open.

- Alarm of "Main AC Line Trouble" will be given when the main power is turned off while the servo is on. This alarm cannot be cleared until the control power is turned on again. (Refer to "7-1.1. Servo on.")

3.3.5. Wiring of Connector

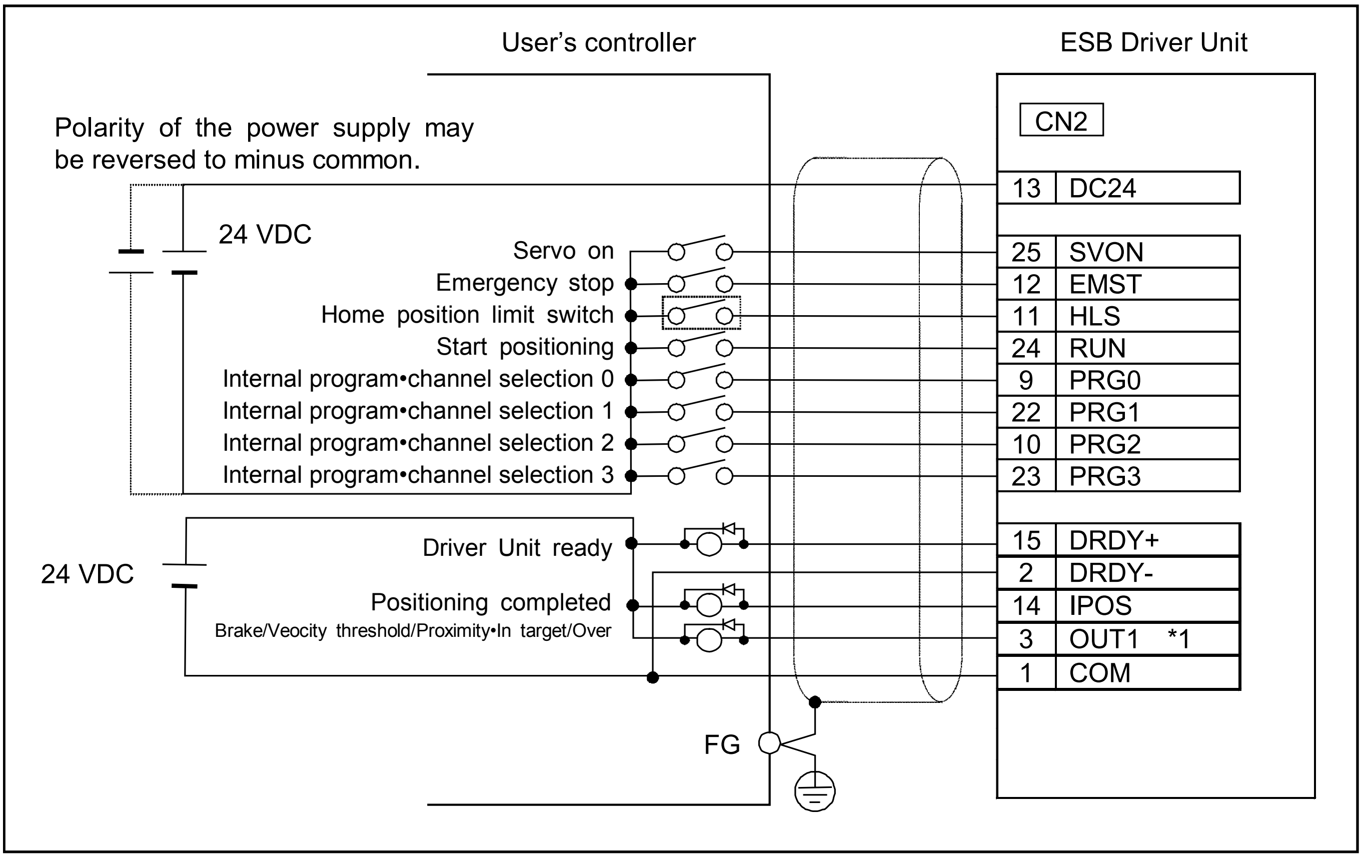
⚠ *Caution: • Be sure to install a serge killer circuit when inductive switches, such as relays, are used.*

⚠ *Caution: • When you install sensors such as "Home position limit switch," "+ direction sensor of over travel limit switch" and "- direction of over travel limit switch," connect output of those sensors directly, not via the controller. (Those outputs are shown as in Figure 3-6 below.)*

3.3.5.1. Example of B3 and 23 Driver Units (CN2)

Type 1 (TY1): Selection of sixteen internal program channels

Figure 3-7

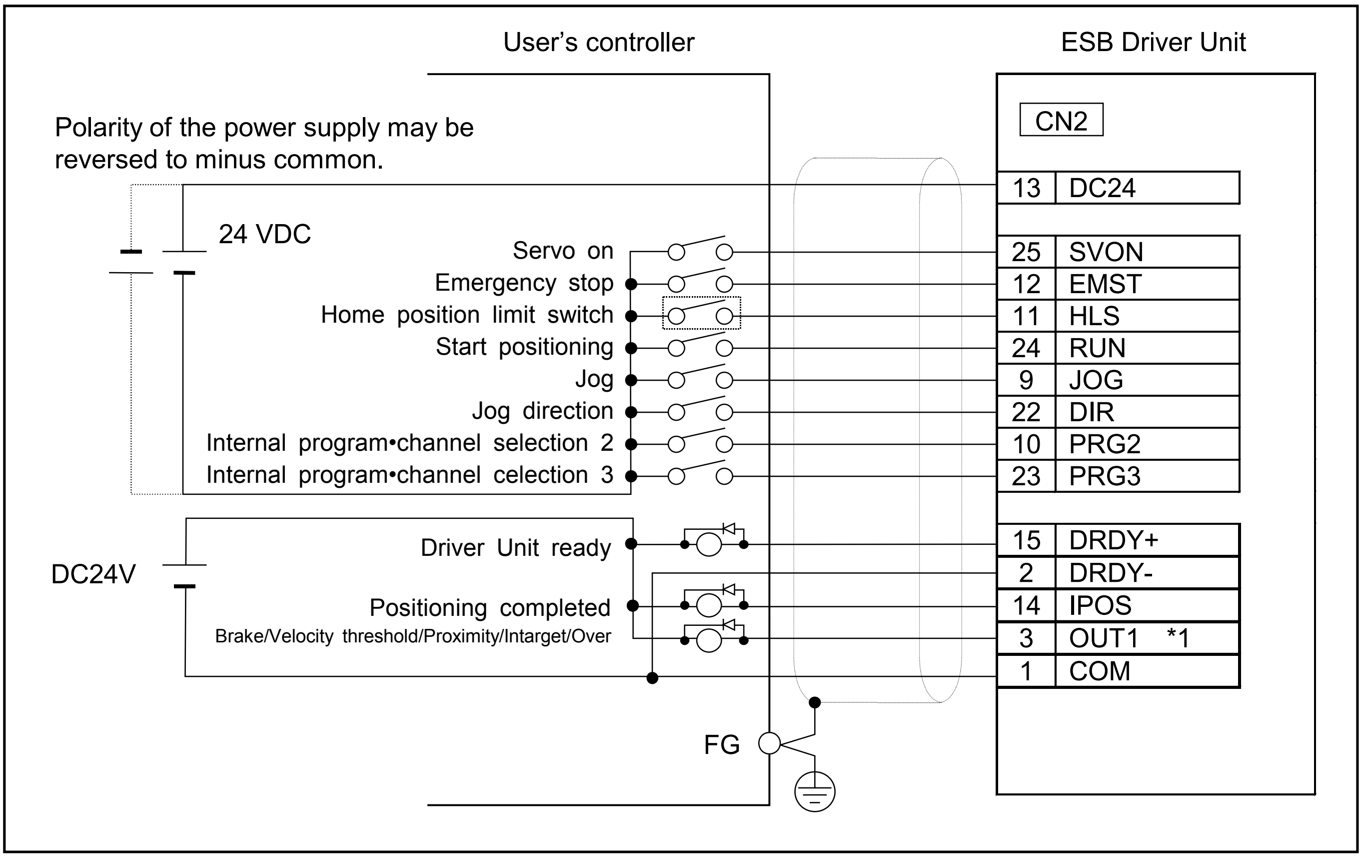


- Home Return
  - ◊ For an example, write HS command to channel CH0 and then;
  - ◊ Select the CH0 to start the Home Return (RUN input ON) after turning on the power and complete the Home Return.
- Pulse train command operation
  - ◊ When control the System by the pulse train input command, add connections to CWP ± and CCWP ± signals.

*1: The parameter OM selects one of outputs from among BRK (Brake), SPD (Velocity threshold), NEARA (Near proximity/In target), and OVER (Warning) for OUT1. The shipping set is BRK.

Type 2 (TY2): Selection of Jog and four internal program channels

Figure 3-8

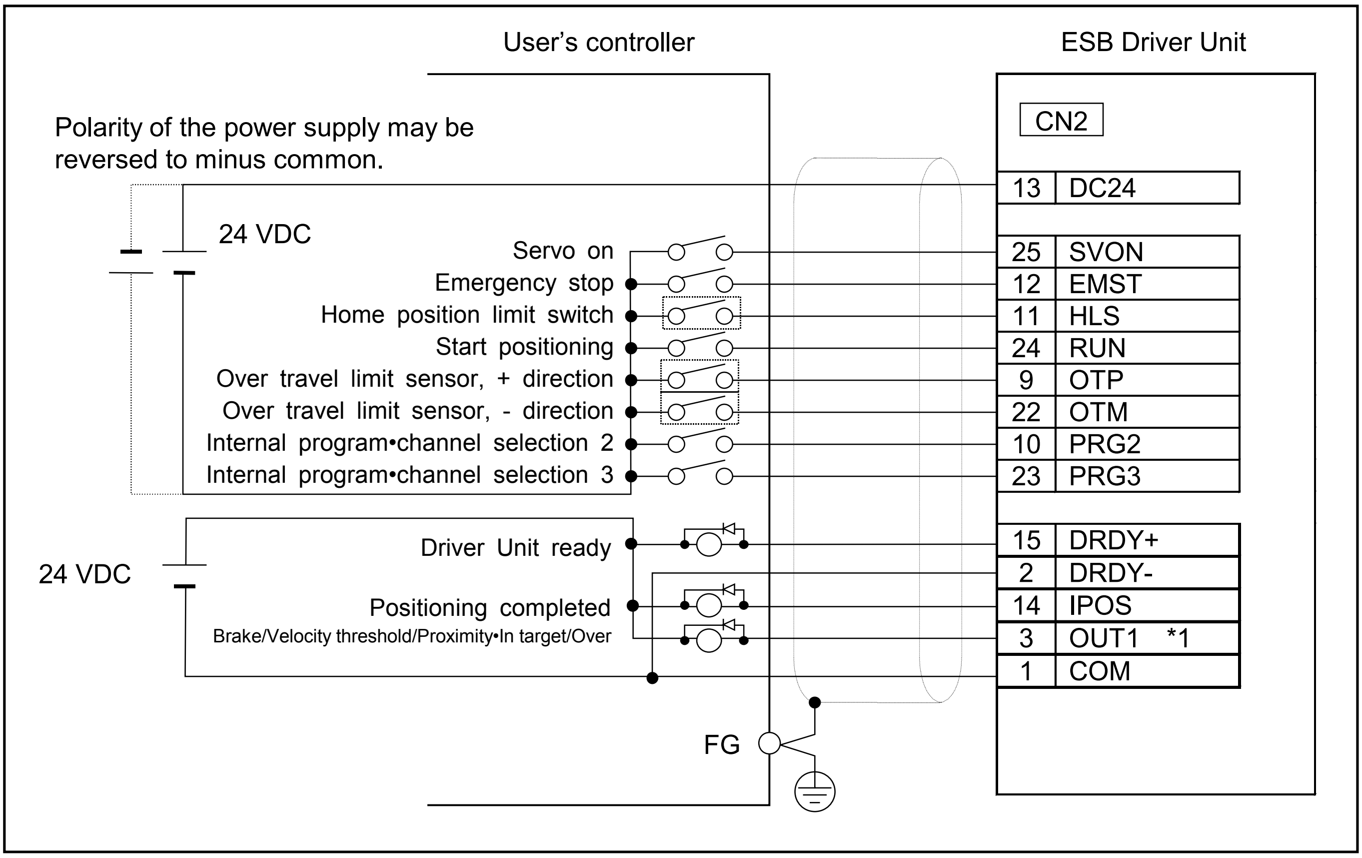


- Home Return
  - ◊ For an example, write HS command to channel CH0 and then;
  - ◊ Select the CH0 to start the Home Return (RUN input ON) after turning on the power and complete the Home Return.
- Pulse train command operation
- When control the System by the pulse train input command, add connections to CWP ± and CCWP ± signals.

*1: The parameter OM selects one of outputs from among BRK (Brake), SPD (Velocity threshold), NEARA (Near proximity/In target), and OVER (Warning) for OUT1. The shipping set is BRK.

Type 3 (TY3): Selection of Off-limits zone setting and four internal program channels

Figure 3-9

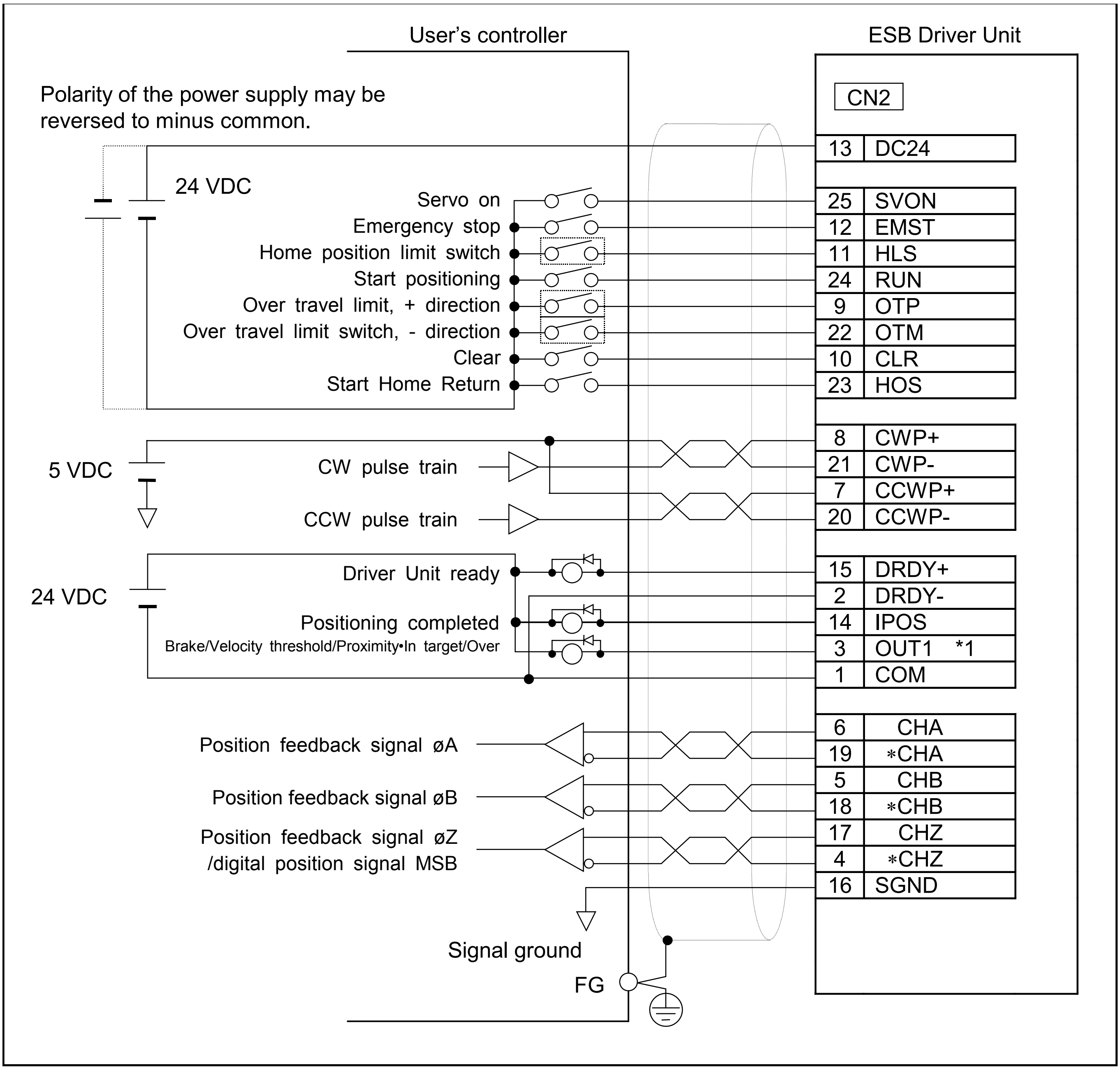


- Home Return
  - ◊ For an example, write HS command to channel CH0 and then;
  - ◊ Select the CH0 to start the Home Return (RUN input ON) after turning on the power and complete the Home Return.
- Pulse train command operation
  - ◊ When control the System by the pulse train input command, add connections to CWP ± and CCWP ± signals.

*1: The parameter OM selects one of outputs from among BRK (Brake), SPD (Velocity threshold), NEARA (Near proximity/In target), and OVER (Warning) for OUT1. The shipping set is BRK.

Type 4 (TY4): Selection of Pulse train input, Off-limits zone setting, Home Return and Clear signal

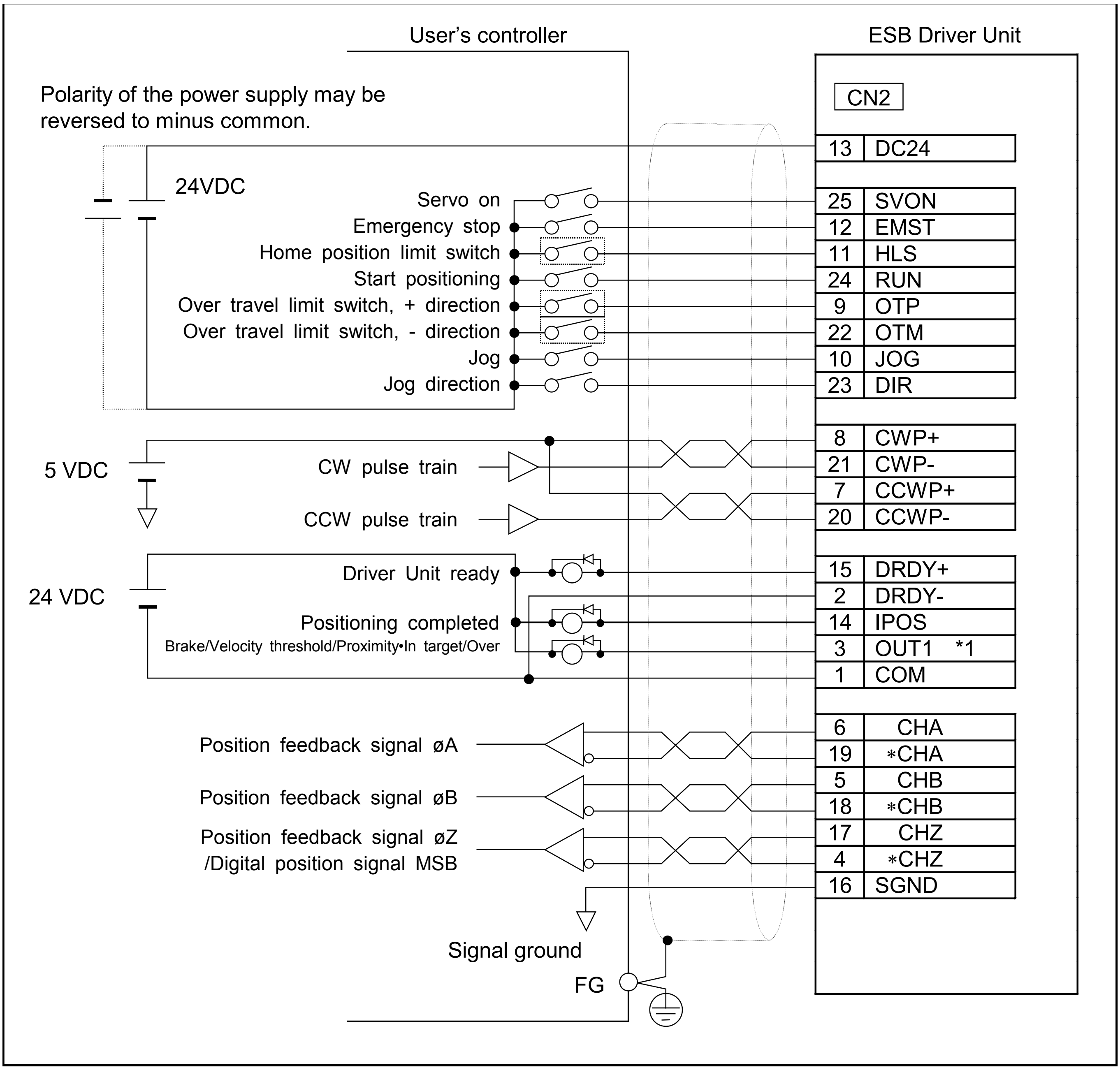
Figure 3-10



*1: For OUT1 output, the parameter OM selects one of outputs from among BRK (Brake), SPD (Velocity threshold), NEARA (Near proximity/In target), and OVER (Warning). The shipping set is BRK.

Type 7 (TY7): Selection of Pulse train input, Off-limits zone setting and Jog

Figure 3-11

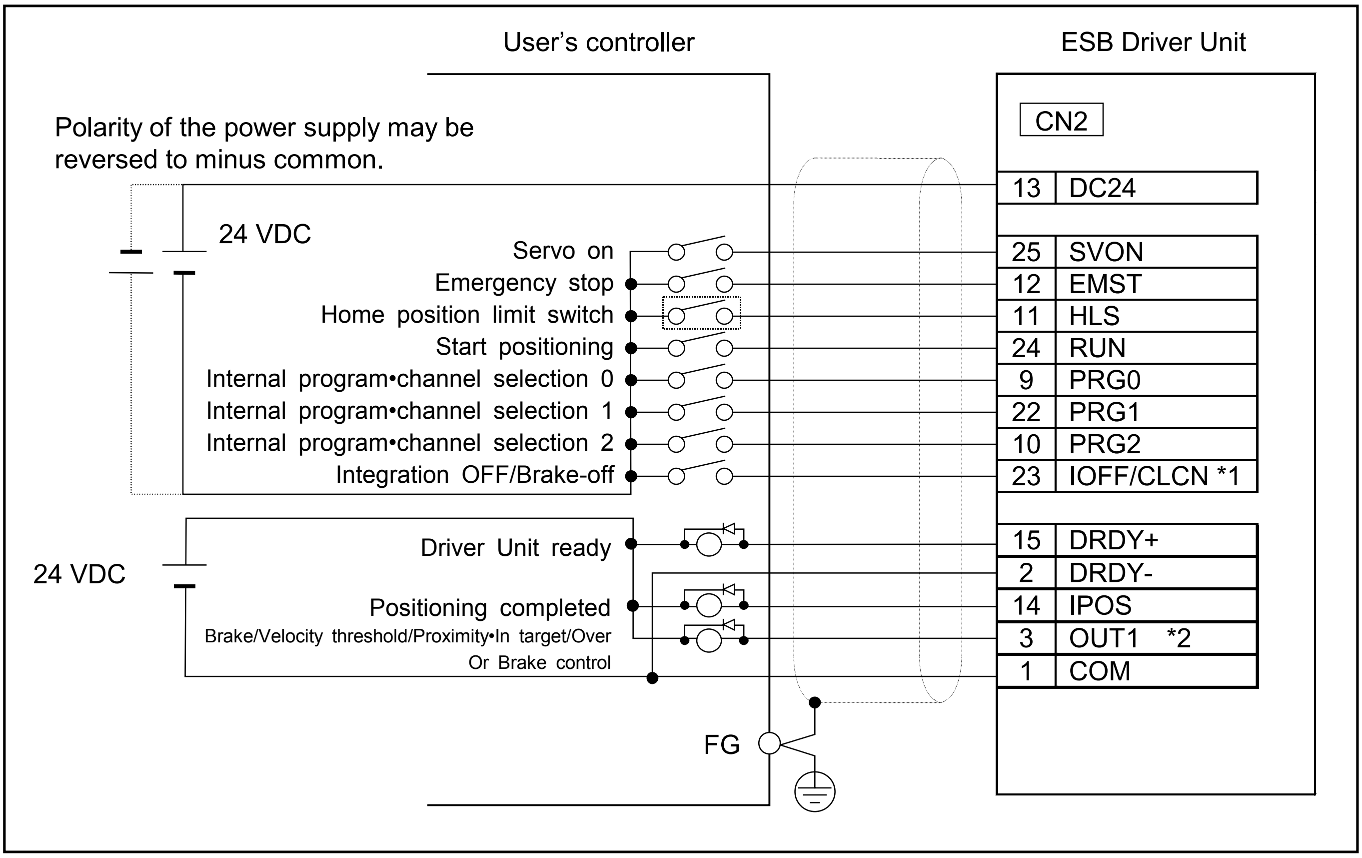


- Home Return
  - ◊ For an example, write HS command to channel CH0 and then;
  - ◊ Select the CH0 to start the Home Return (RUN input ON) after turning on the power and complete the Home Return.

*1: For OUT1 output, the parameter OM selects one of outputs from among BRK (Brake), SPD (Velocity threshold), NEARA (Near proximity/In target), and OVER (Warning). The shipping set is BRK.

Type 8 (TY8): Selection of Integration OFF and 8 internal program channels

Figure 3-12



- Home Return
  - ◊ For an example, write HS command to channel CH0 and then;
  - ◊ Select the CH0 to start the Home Return (RUN input ON) after turning on the power and complete the Home Return.
- Pulse train command positioning
  - ◊ When you control the System by the pulse train command, add connections to CWP ± and CCWP ± signals.

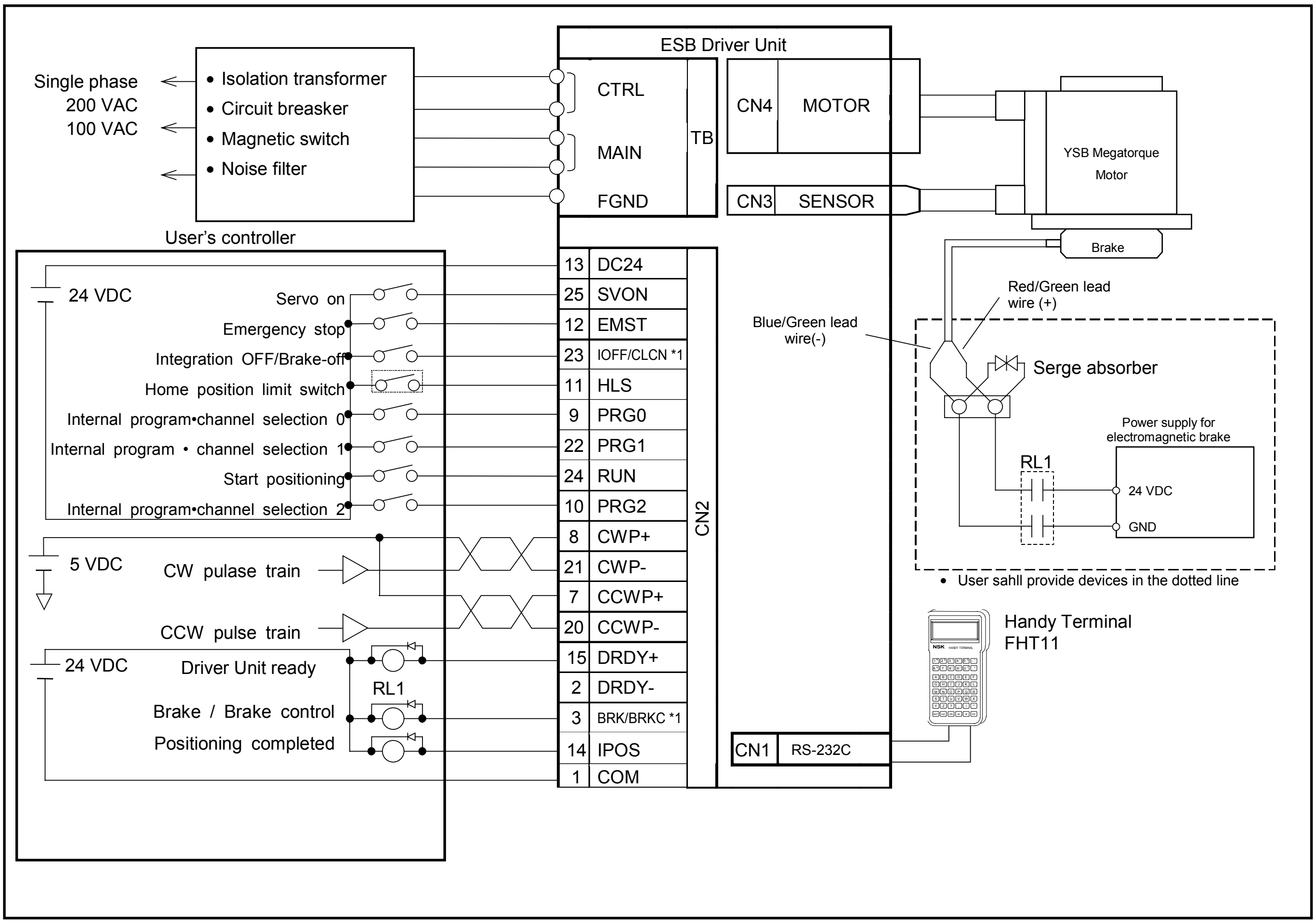
*1: Integration OFF (IOFF) input is changed to Brake-off (CLCN) input when the parameter BF0 (brake sequence invalid) is specified. The shipping set is IOFF.

*2: The parameter OM specifies the function of OUT1 output as follows when the parameter BF0 (brake sequence invalid) is activated.

- OM0: BRK (Brake)
- OM1: SPD (Velocity threshold)
- OM2: NEARA (Target proximity / In target)
- OM3: OVER (Warning)

Type 8 (TY 8): Wiring example when the brake is used

Figure 3-13

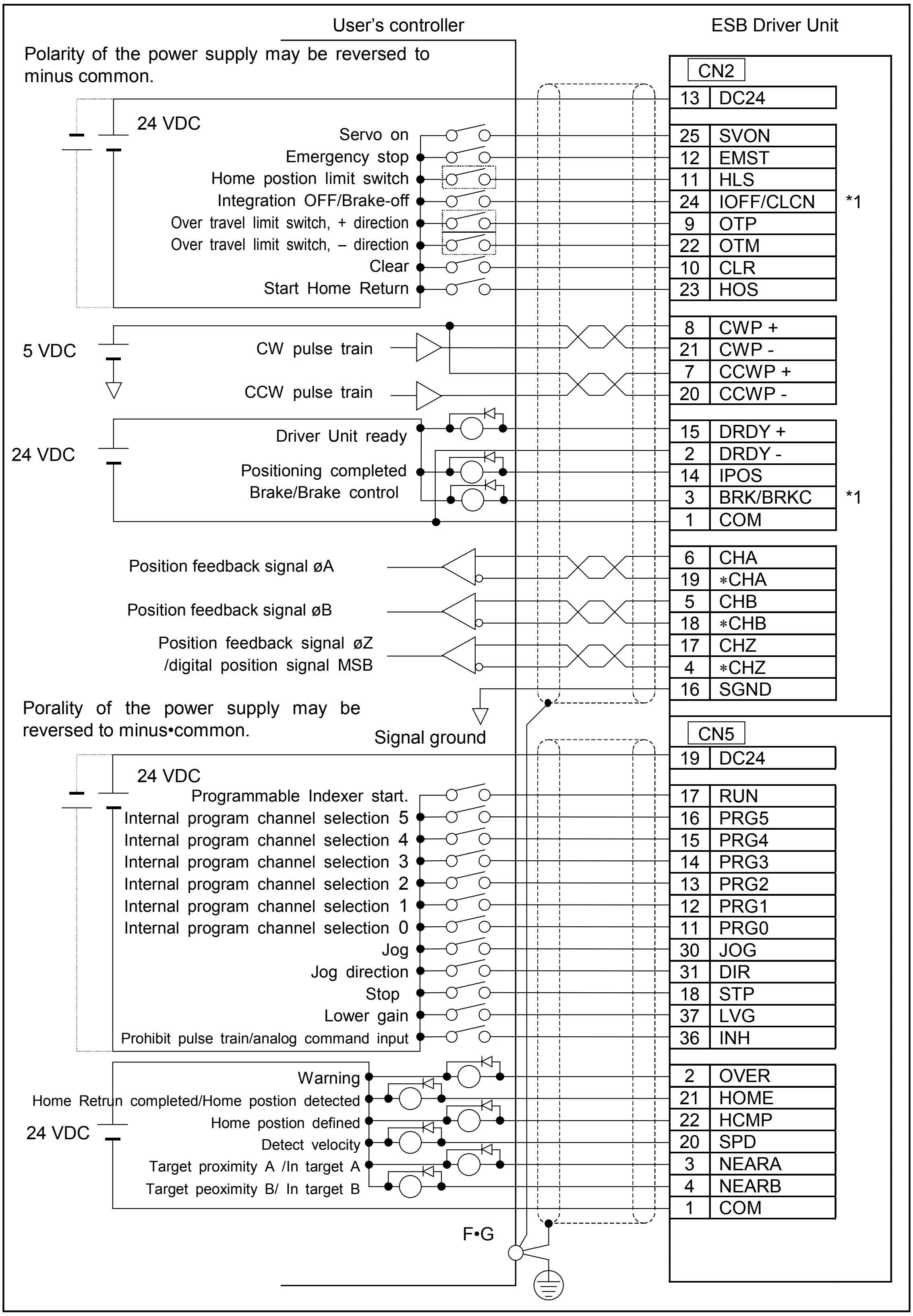


*1: When the brake sequence is active by the parameter BF1, the input of IOFF (Integration OFF) changes to the CLCN (Brake-off) input and the BRK (Brake) output changes to the BRKC (Brake control) output.

3.3.5.2. Wiring Example of B5 and 25 Driver Units (CN2 and CN5 Connectors)

Example 1: In case of position control mode

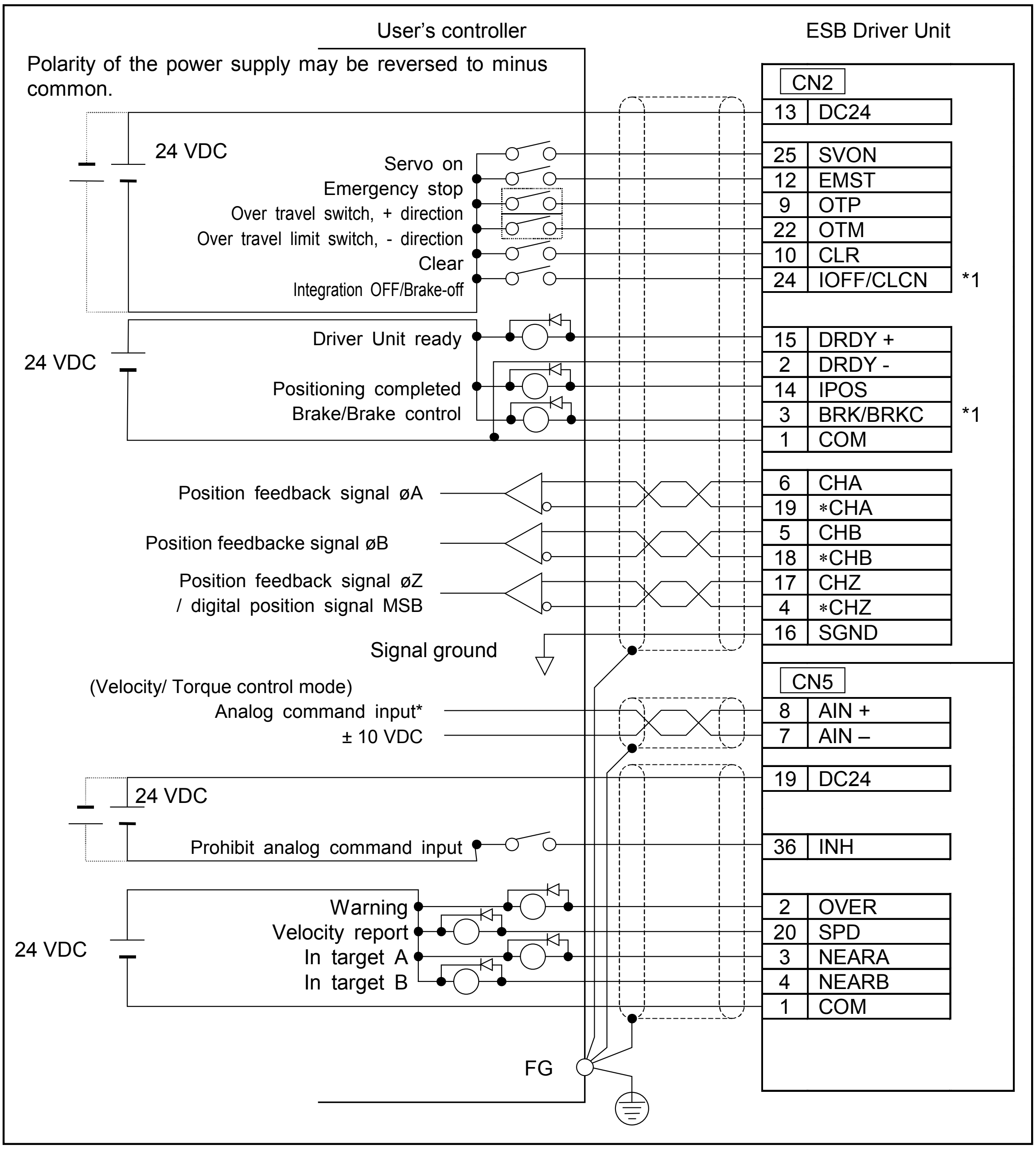
Figure 3-14



*1: When the brake sequence function is active by the parameter BF1, the input of IOFF (Integration OFF) changes to the CLCN (Brake-off) input and the BRK (Brake) output changes to the BRKC (Brake control) output.

Example 2: Velocity / Toque control mode by analog command positioning

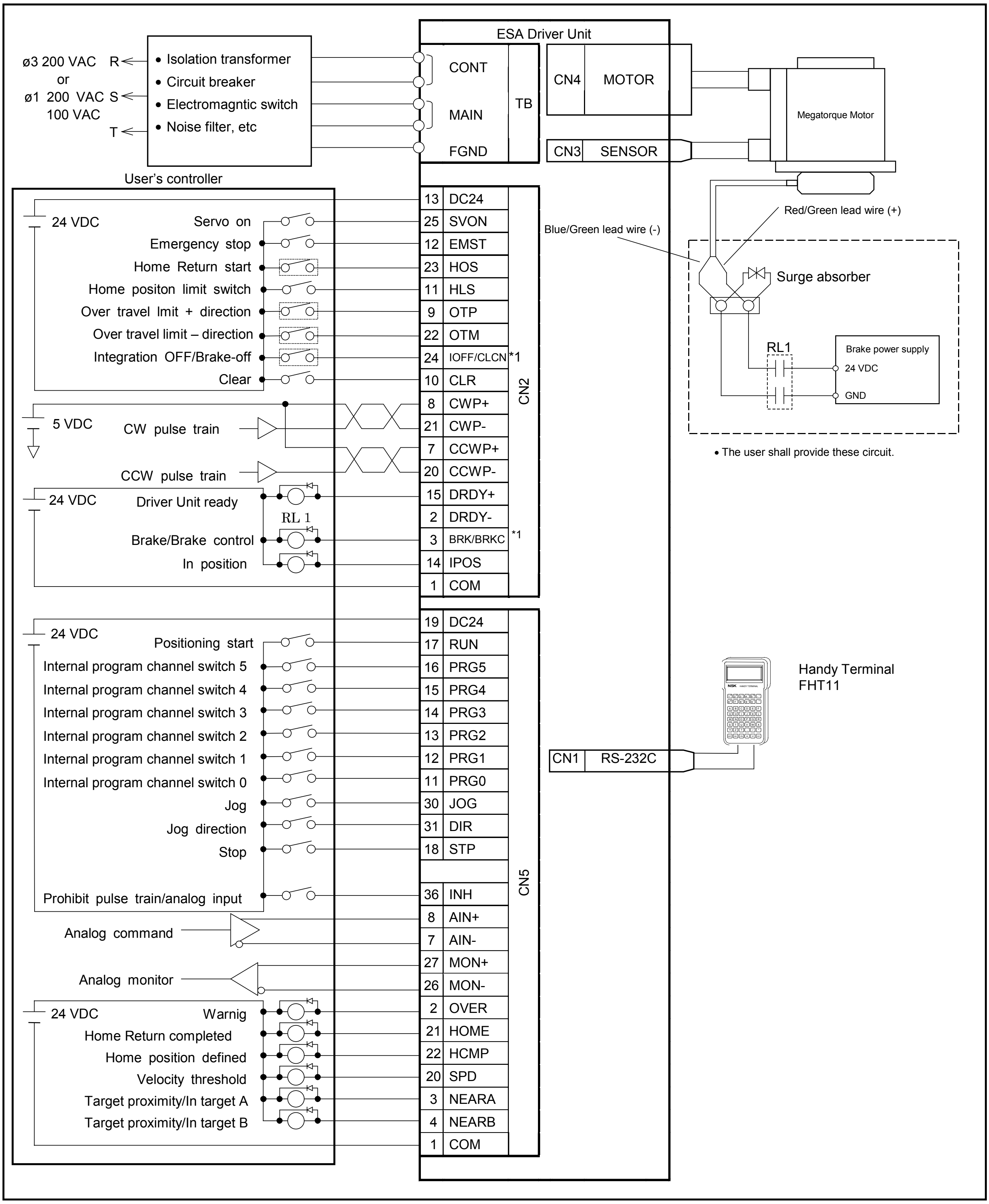
Figure 3-15



*1: When the brake sequence function is active by the parameter BF1, the input of IOFF (Integration OFF) changes to the CLCN (Brake-off) input and the BRK (Brake) output changes to the BRKC (Brake control) output.

◆ Example 3: When using a Motor equipped with brake

Figure 3-16



*1: When the brake sequence function is active by the parameter BF1, the input of IOFF (Integration OFF) changes to the CLCN (Brake-off) input and the BRK (Brake) output changes to the BRKC (Brake control) output.

3.4. Turning on Main Power

3.4.1. Precautions

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

(1) Connections of each cable.

(2) Connection of the Handy Terminal

(3) Confirm the safe conditions.

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

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

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

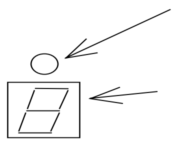
⚠ *Danger: There shall be no mechanical interference when the Motor makes a full turn*

⚠ *Caution: For a System that equips with absolute position sensor, be sure to turn on the power when the Motor is stationary. Otherwise it may alter the setting of the coordinates.*

3.4.2. Indication of Power on

(1) Turn on the power and make sure that the LED on the front panel of the Driver Unit is indicating normal state.

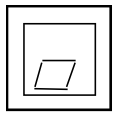
Figure 3-17: In a state of alarm



Power LED: It is on when the power is on.
Normal: Grenn
Abnormal: Orange

7 segments LED: Identifies a type of alarm.
- It indicates a type of alarm in 2 digits. The numbers will be shown in time-sharing.
- If two or more alarms are repoted, the report will be made in time shareing.

Figure 3-18: In the normal state



(2) Be sure if the Emergency stop (CN2, #12: EMST) input is activated.

◊ When the emergency stop input is ON, the 7 segments LED on the front panel indicates the alarm code in the order of $\boxed{F} \rightarrow \boxed{4} \rightarrow \boxed{-}$. If not, refer to "10. Alarm."

⚠ *Danger : Be sure to connect the emergency stop (EMST) input.*

(3) The System is in the normal state when the display shows the colon ":" after the message of "NSK MEGATORQUE."

Figure 3-19: Indication of the display of the Handy Terminal

```
NSK MEGATORQUE
MS1A50-*****
E*****
:_
```

Differs with the System type.

3.4.3. Selection of Control I/O Signal Ports

3.4.3.1. Selection of Input/Output Combination Type (CN2: B3 and 23 Driver Units)

- ESBB5 and 25 Driver Units do not require this procedure.

1 Input port

- For ESBB3 and 23 Driver Units you may change functions of some CN2 Input/Output signals. (Combination types 1 to 4, 7, and 8 are available.)
- Type 1 is the shipping set in case of the Megatorque Motor System.
- The parameter TY selects a type of I/O signal combination. You need to enter the password for inputting the parameter TY.
- Input of the TY parameter will clear polarity of all input ports to the normally open contact. (However, if you set the same parameter data to the TY parameter as before, the Driver Unit maintains the current polarity setting.) Data indication of polarity (AB) is bit map format and its order and relation between the TY and I/O combination type are listed on Table 3-6 below.

◆ **Selecting example**

- Set the I/O signal combination of connector CN2 to type 2.

(1) Input the password. The Driver Unit eccoes back the acknowledgement.

/ N S K SP
O N ENT

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

(2) Type the setting command “TY2.”

T Y 2# ENT

```
NSK ON
:TY2
ABX0X0XXXX
:_
```

The display indicates that the polarity of all input ports is set to the normally open contact. (Refer to “3.4.3.2. Polarity Setting of Input Port.”)

- This completes the setting of TY2.

Table 3-6: Parameter TY and I/O signal combination

CN2 No.	25	12	24	11	23	10	22	09
TY1	SVON	EMST	RUN	HLS	PRG3	PRG2	PRG1	PRG0
TY2	SVON	EMST	RUN	HLS	PRG3	PRG2	DIR	JOG
TY3	SVON	EMST	RUN	HLS	PRG3	PRG2	OTM	OTP
TY4	SVON	EMST	RUN	HLS	HOS	CLR	OTM	OTP
TY7	SVON	EMST	RUN	HLS	DIR	JOG	OTM	OTP
TY8	SVON	EMST	RUN	HLS	IOFF [*2]	PRG2	PRG1	PRG0
AB※	x	0	x	0	x	x	x (0)	x (0)

*1: Selection of polarity (Normally open/closed contact) is only available to the input signals MST, HLS, OTP and OTM.
*2: In case of the Motor equipped with brake, this input will be the CLCN (Brake-off) input when the brake sequence function (BF1) is activated under the I/O type 8 (TY8).

2 Output port

- A function among Brake (BRK), Brake control (BRKC), Velocity threshold (SPD), Target proximity/In target (NEARA), and Warning (OVER) shall be set to the OUT1 (pin #3) output of CN2 connector..
- The shipping set is "Brake (BRK)" output.
- The parameter OM sets the function of output port for the I/O types excluding TY8.
- In case of TY8, the function of output ports may be set by the parameters BF and OM.
- The password is required prior to input the parameter OM.

◆ Setting Example

- The following shows an example for setting Warning (OVER) to the OUT1.

(1) Input the password. An acknowledgment of password will be on the display.

[/] [N] [S] [K] [SP] [O] [N] [ENT] ➡

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

(2) Input OM3 setting command.

[O] [M] [3] [ENT] ➡

```
 NSK ON
:OM3
:_
```

- This completes the setting of warning output.

Table 3-7: OM parameter to set function of OUT1 output (TY1 to 4, and 7')

Parameter	Signal code	Function
OM0	BRK	Brake
OM1	SPD	Velocity threshold
OM2	NEAR	Target proximity/ In target
OM3	OVER	Warning

Table 3-8: OM parameter to set function of OUT1 output (TY8)

Parameter BF	Parameter OM	Signal name	Function
BF1	—	BRKC	Brake control
BF0	OM0	BRK	Brake
	OM1	SPD	Velocity threshold
	OM2	NEAR	Target proximity/In target
	OM3	OVER	Warning

3.4.3.2. Setting Polarity of Input Port (Normally Open or Normally Closed Contact)

- The polarity of some input signal ports may be set either the normally open or closed contact.
- The shipping set of polarity for all the CN2 input ports is the normally open contact. .
- Parameter AB sets the polarity of input ports.
- You need the password before inputting the parameter AB.
- The signals that can select the polarity are limited to EMST, HLS, OTP and OTM.
  (OTP and OTM inputs are only available for the types of 3, 4 and 7 in case of B3 and 23 Driver Units.)

Table 3-8: Data order of parameter AB

Data digit (from left)	1	2	3	4	5	6	7	8
Signal Name	SVON	EMST	IOFF	HLS	HOS	CLR	OTM	OTP

- Meaning of data
  0 = normally open contact: 1 = normally closed contact
  X = When inputting X, X denotes "no polarity change." When it is indicated on the display, the X denotes "inhibit switching polarity."

◆ Setting Example

- This example shows to set the normally closed contact for EMST (Emergency stop).

(1) Input a code key while pressing SHIFT key.

SHIFT 0 ?

```
:
:?_
```

(2) Input readout command for the parameter AB inorder to check current polarity setting.
(The example shows the all input ports are set to the normally open contact.

A B ENT

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

(3) Input the password. The display indicates the acknowledgement.

/ N S K SP
O N ENT

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

(4) Input “1” to the second bit that correspondin, and then input x for other ports.

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

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

- Polarity of EMST (Emergency stop) port is thus set to the normally closed contact.

3.4.4. Turn the Power and the Servo on.

(1) Turn on the power.

(2) The System checks DRDY output after 2 seconds.

(3) If the System is in normal state, turn ON the SVON input. The System gets in Servo ON state.

(4) Then input a necessary operation command.

◊ If the System does not outputs the DRDY output normally, take appropriate measures referring to “10. Alarm.”

Figure 3-20: Flow of Power on and Servo ON.

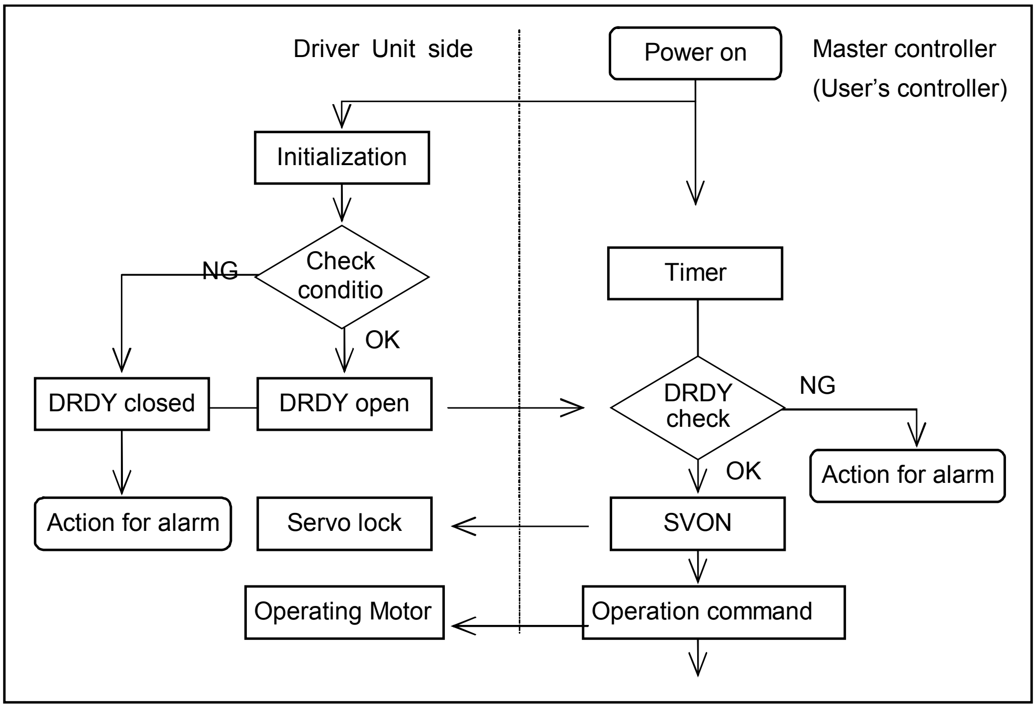
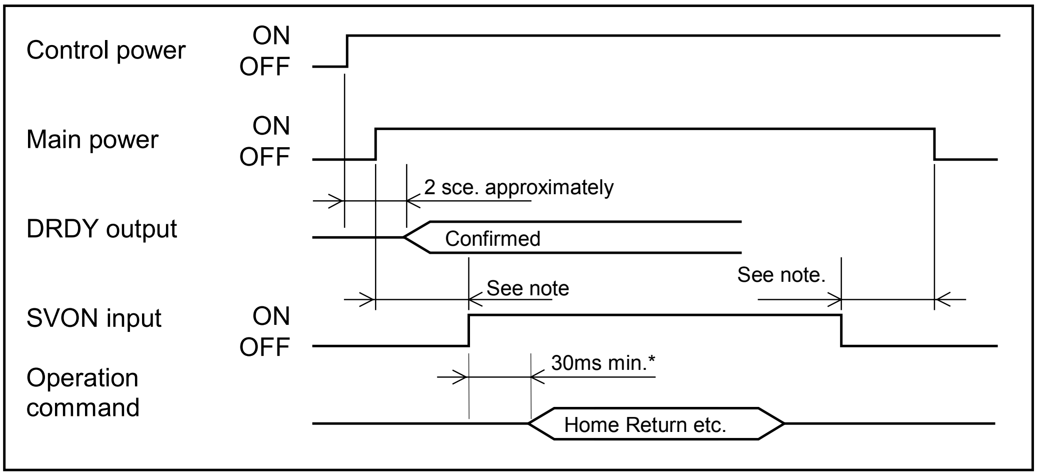


Figure 3-21: Timing for Power and Servo ON.



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

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

4. Handy Terminal Communication

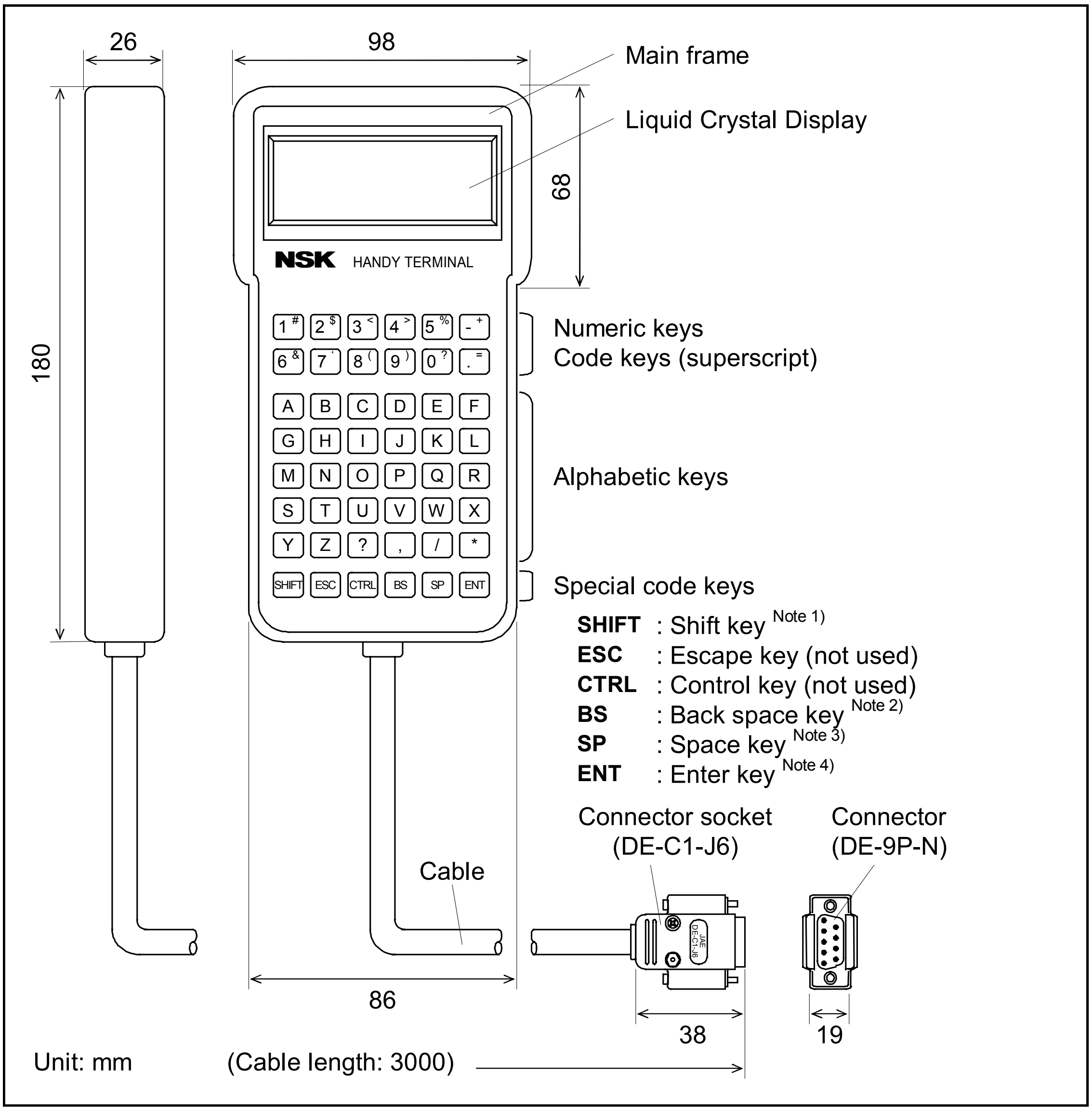
◆ Function of handy Terminal

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

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

◆ Appearance and function of each part

Figure 4-1



Note: 1) SHIFT : Press the code key while holding the SHIFT key. You may use the subscript of each code key.

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

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

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

4.1. Setting Parameters

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

4.1.1. Setting Without the Password

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

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

ENT

→
```
:_
```

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

M V 0 ? . = 5 % ENT

→
```
:MV0.5
:_
```

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

- Input “parameter code + data+ ENT ” to set the parameter.
(No space is required between the parameter code and the data.)

4.1.2. Setting With the Password

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

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

ENT

→
```
:_
```

(3) Enter the Password.

/ N S K SP
O N ENT

→
```
:/NSK ON
 NSK ON
:_
```

The acknowledgment appears on the screen, and the colon appears for the command entry.

(4) Set the parameter as shown in the step (3) in the above example for a parameter that does not require the password (4.1.1.). However, only one parameter can be set right after the entry of the password in case of a parameter that requires the password.

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

4.2. Readout of Parameter

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

4.2.1. TS Command

- Refer to “8. Glossary of Command and Parameter” for the details of TS command.

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

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

ENT

```
:_
```

(3) As an example, let’s read out the setting of parameter JV for Jog velocity.
The parameter JV belongs to a group of TS7 according to the description of TS command shown in “8. Glossary of Command and Parameter.” Enter as shown below to the Handy Terminal.

T S 7 ENT

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

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

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

SP SP •••

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

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

BS

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

4.2.2. Use of "?" to Read out Parameter Setting

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

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

ENT

```
:_
```

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

? J V ENT

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

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

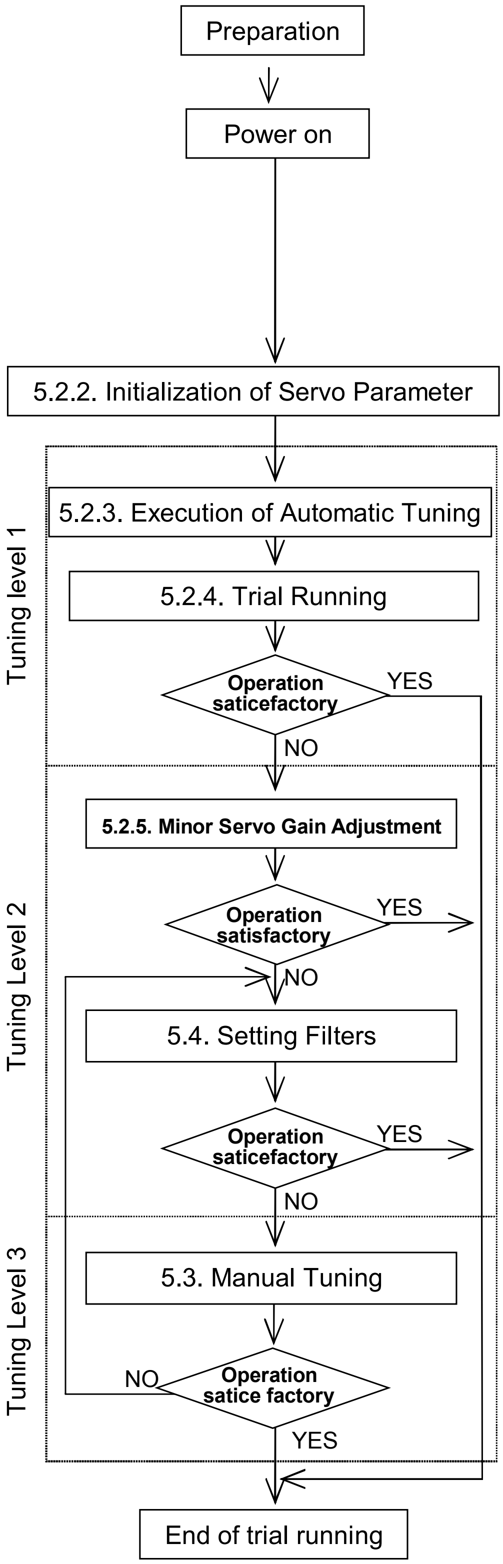
⚠ *Caution : Though we have two ways for reading out the settings of parameters as shown above, we recommend using the TS command as much as possible to prevent inputting errors.*

5. Tuning and Trial Running

- Gain adjustment is necessary if the System is set to either the position control or the velocity control mode.
- The System may require the adjustment of low pass filter when it is in the torque control mode.

5.1. Tuning Sequence

Figure 5-1: Tuning procedure



- Install the Motor and wire the Driver Unit.

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

```
NSK MEGATORQUE
MS1A50 ***
E*********
:_
```

- Initialize the servo parameters.
- Execution of automatic tuning
  Automatic estimation of load inertia and automatic setting of servo parameters will be done in this stage.
  (Automatic setting of PG, VG, VIMA and MA parameters)
- Trial running
  Confirm the results of tuning level 1.
  The trial runnings in tuning level 2 and 3 will also use the results of these settings.

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

5.2. Automatic Tuning

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

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

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

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

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

◊ Frictional load to the Motor shall be minimal.

◆ Preparation

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

◊ Installation of the Motor.

◊ Fixing load to the rotor of the Motor.

◊ Installation of the Driver Unit.

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

◊ Connection of the Handy Terminal.

◊ Connection of AC power source.

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

5.2.1. Precautions

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

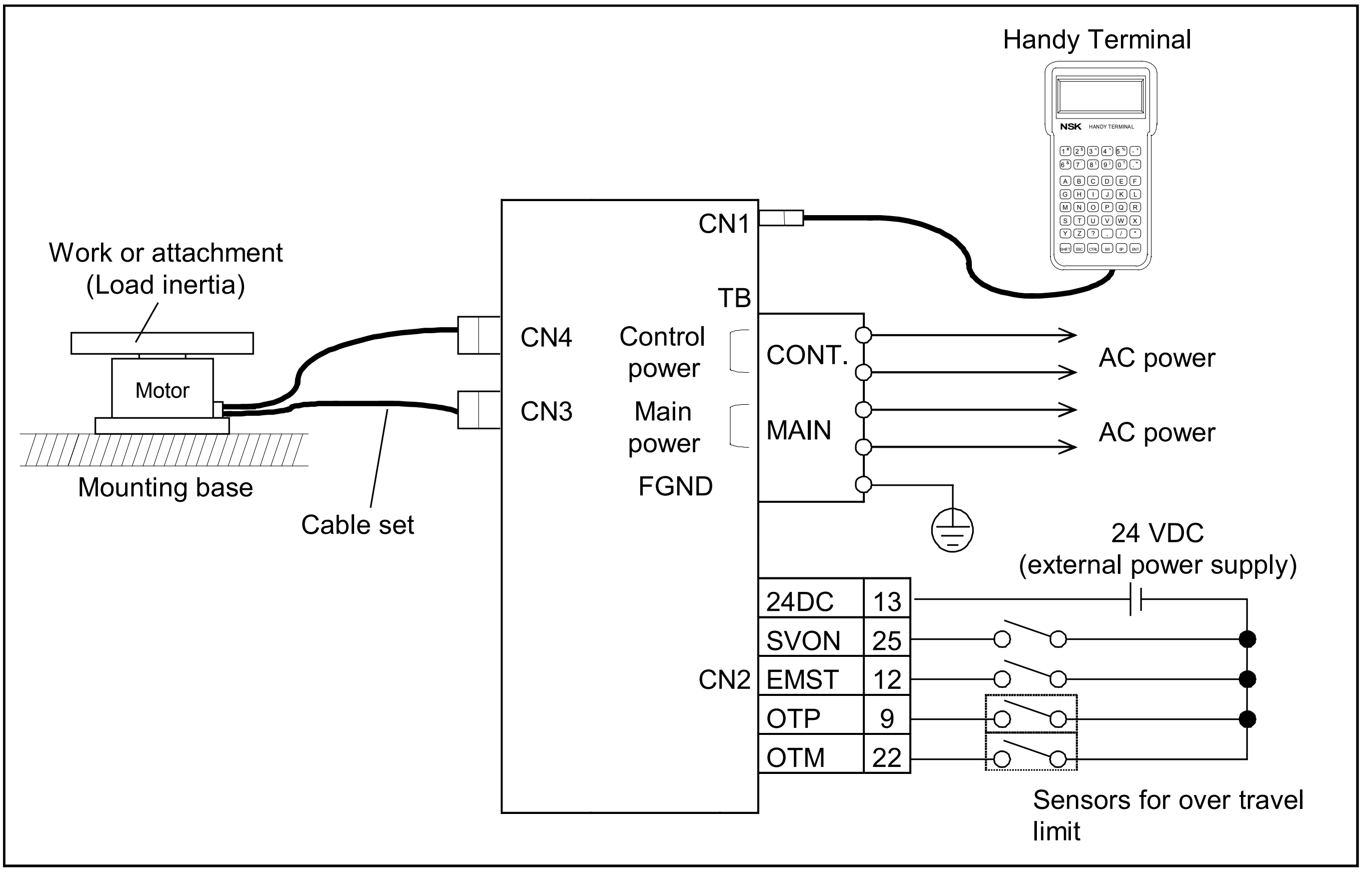
⚠ *Danger: The Motor will rotate for ± 20°in the process of the automatic tuning in order to estimate the load inertia. Do not enter the range of Motor rotations.*

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

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

⚠ *Caution: In case of a Motor equipped with brake, be sure to make possible to release the brake by using the brake control signal and the external brake power source.*

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



5.2.2. Initialize Servo Parameter

- The parameters had been initialized when it was shipped. You do not require the initialization at first operation after you received it.

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

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

T S 1 # ENT and T S 2 $ ENT

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

/ N S K SP
O N ENT

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

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

S I ENT

```
:SI
 INITIALIZE
:_
```

⚠ *Caution: Be careful that the System won't accept the SI command if the (SVON) signal remains ON. The message "SI INHIBITED" will appear on the screen.*

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

Table 5-1: Servo parameter list

Readout by TS1			Readout by TS2		
Parameter	Initial setting	Current setting	Parameter	Initial setting	Current setting
PG	0.100		FO*	0	
VG	1.0		FP	0	
VGL*	1.0		FS	0	
VI	1.00		NP	0	
VIL*	1.00		DBP*	0	
VM	1		NS	0	
LG*	50		NQ	0.25	
TL*	100		ILV*	100.0	
GP*	0		FF*	0	
GT*	5		FC*	0	

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

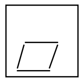
5.2.3. Execution of Automatic Tuning (Tuning Level 1)

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

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

S V ENT →

```
:SV
:_
```

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

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

A T ENT →

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

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

O K ENT →

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

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

→

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

Estimation of load inertia

⚠ *Caution: Take an action against an alarm referring to "10. Alarm" when an error message shown below appears during the automatic tuning.*
The LED on the front panel of Driver Unit indicates F8 for the automatic tuning error.

→

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

Error number

5.2.4. Trial Running (Tuning Level 1)

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

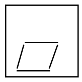
- Use a demonstration program of the ESB Driver Unit for checking the tuning result

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

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

[S] [V] [ENT] ➡

```
:SV
:_
```

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

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

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

[M] [V] [0 ?] [. =] [1 #] [ENT] ➡

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

5) Display a menu screen of the demonstration program.

[S] [P] [/] [A] [J] [ENT] ➡

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

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

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

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

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

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

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

O K ENT

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

The Motor starts cyclic motions in CW and CCW directions as soon as “OK” is typed. (The Motor moves in CW direction first.)
Execute the ID command instead of inputting “OK” to change the rotation angle when the prompt is “?.”
Example: Change the rotation angel to 30°.
Type as

I D 3 < 0 ? 0 ? 0 ? ENT

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

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

M S ENT

```
:MS
:_
```

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

S P / A J ENT

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

When quitting the demonstration without performing the cyclic motion, press the $\boxed{\text{ENT}}$ key following the prompt “?.”

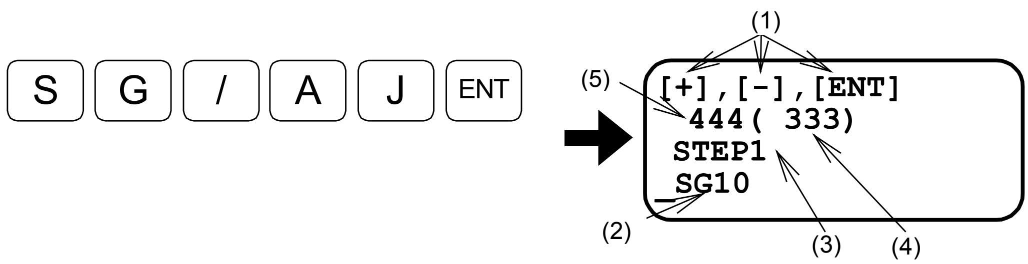
- If the Motor is operating normally complete the trial running.
- When the Motor motion is unstable, tune the System referring to “5.2.5. Minor Servo Adjustment (Tuning Level2)” or “5.3. Manual Tuning.”
- Increase the MV setting to actual use velocity if the motion of the Motor is stable.

5.2.5. Minor Servo Adjustment (Tuning Level 2)

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

- Perform the minor adjustment of servo gain when the automatic tuning by the AT command (Tuning Level 1) is not successful.
- Use the SG parameter for the minor adjustment of servo gain.
  - ◊ Higher SG setting will result in better response for positioning commands. However, the Motor tends to vibrate when the SG is set too high.
- Adjust the SG parameter operating the Motor by the demonstration program (SP/AJ).
  (Follow the procedures 1) to 7) in "5.2.4. Trial Running (Tuning Level 1)" to operate the Motor.)
- Input the commands for adjustment through the master controller in case of the velocity control mode.

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



- Explanation of the message (screen)
  (1) Key function
  SHIFT and -/+ : Pressing the key one time increases 1 resolution of "SG."
  -/+ : Pressing the keys one time decreases 1 resolution of "SG."
  ENT : Press the key to store the "SG" setting.
  (2) This part indicates the current setting of SG.
  (3) This part indicates the changing resolution of SG data when the (+) or (-) key is pressed.
  (4) Response index number: An index number denoting a result of positioning under current servo gain setting. Smaller number denotes better response to position commands.
  (5) Positioning index number: An index number denoting a result of positioning under the current servo gain (SG) setting. Smaller number requires less time to complete a positioning.

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

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

Pressing SHIFT , -+ -+ …

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

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

3) Keep pressing the (+) key, and eventually the Motor will start hunting, and then stop reciprocating motion.

Pressing SHIFT , -+ -+ …

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

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

-+ -+ …

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

5) Decrease the SG to 80 % of SG value at where the Motor stopped hunting, and the Motor shows stable motion in any position.

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

6) Press the ENT key to complete the adjustment.

ENT

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

5.3. Manual Tuning

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

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

5.3.1. Precautions for Manual Tuning

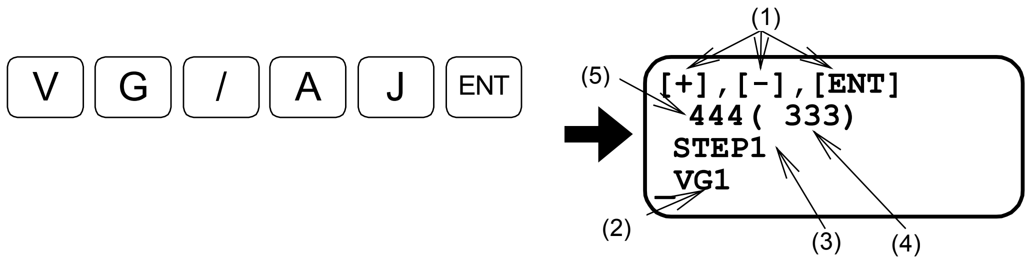
1) Initialize the parameters following the procedure described in "5.2.2. Initialization of Servo Parameters."

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

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

5.3.2. Adjustment of Velocity Loop Proportional Gain (VG)

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



- Explanation of the message (screen)

(1) Key function

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

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

ENT : Press the key to store the VG setting.

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

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

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

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

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

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

Pressing SHIFT, [- +] [- +] ...

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

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

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

Pressing SHIFT, [- +] [- +] ...

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

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

[- +] [- +] ...

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

5) Obtain a SG setting that is 80 % of the SG at where the hunting stopped.
If the hunting stopped at VG4 calculate as
$4 \times 0.8 = 3.2$
This data shall be set to the parameter VG.

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

SP

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

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

[- +] [- +] ...

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

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

ENT

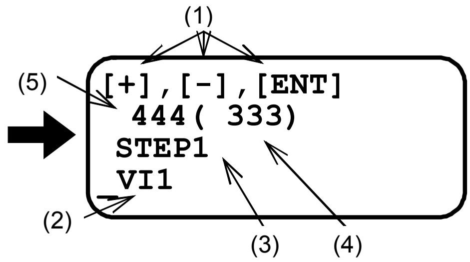
```
 263( 156)
STEP0.1
VG3.2
:_
```

5.3.3. Adjustment of Velocity Loop Integration Frequency (VI)

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

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

[V] [I] [/] [A] [J] [ENT]



- Explanation of the message (screen)

(1) Key function

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

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

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

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

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

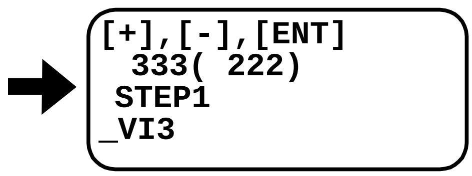
(4) Response index number: Small number denotes better response to the command.

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

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

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

Pressing [SHIFT], [- +] [- +] ···



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

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

Pressing SHIFT , [- +] [- +] ...

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

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

[- +] [- +] ...

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

4) Obtain a VI data that is 80% of VI at where the hunting stopped.
If the hunting stopped at VI4 calculate as
$4 \times 0.8 = 3.2$
This data shall be set to VI.

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

SP

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

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

[- +] [- +] ...

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

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

ENT

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

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

ENT

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

5.4. Setting Filters (Tuning Level 2)

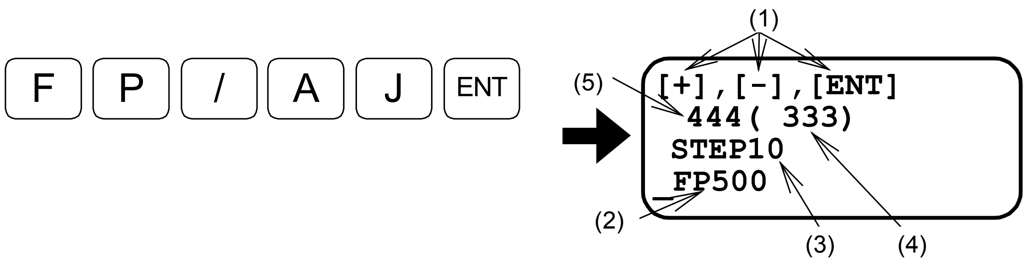
- Setting low-pass filter (Parameters FP and FX) will decrease resonant noise level. Unit of the setting data of the parameters of FP and FS is frequency [Hz]. If the parameters of FP and FS are set under 100 [HZ], the servo may become unstable, thus resulting Motor hunting or adverse effect on positioning.

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

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

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

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



- Explanation of the message (screen)

  (1) Key function

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

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

  ENT : Press the key to store the FP setting.

  (2) This part indicates the current FP setting.

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

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

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

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

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

- + - + …

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

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

Pressing SHIFT, - + - + …

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

4) Press the ENT to complete the setting.

ENT

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

[Reference] When terminate the low-pass filter:

F P 0 ? ENT

```
:FP0
:_
```

[Reference] Adjusting notch filter

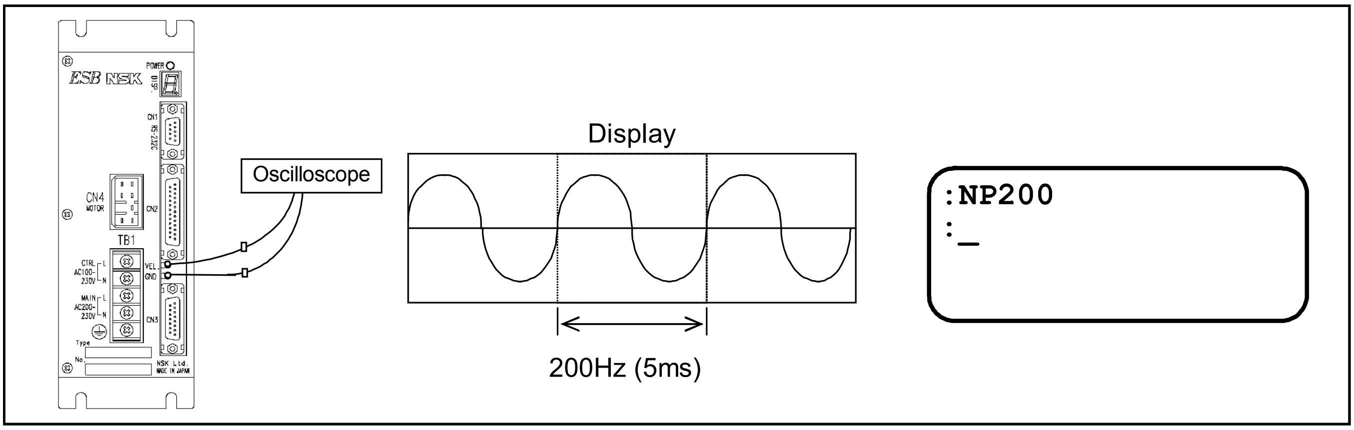
- When setting the notch filters (NP and NS), you need to measure the resonant frequency by checking voltage between the analog velocity monitor pins (VELOCITY-GND terminals) on the front panel of Driver by means of an oscilloscope, etc.

  ◊ Check the resonant frequency as show in Figure5-3. If the frequency is 200 Hz, type as

  N P 2 $ 0 ? 0 ? ENT

  to set the notch filter to 200 Hz.

Figure 5-3: Measuring resonant frequency



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6. Operation

6.1. Preparation

6.1.1. Wiring Check

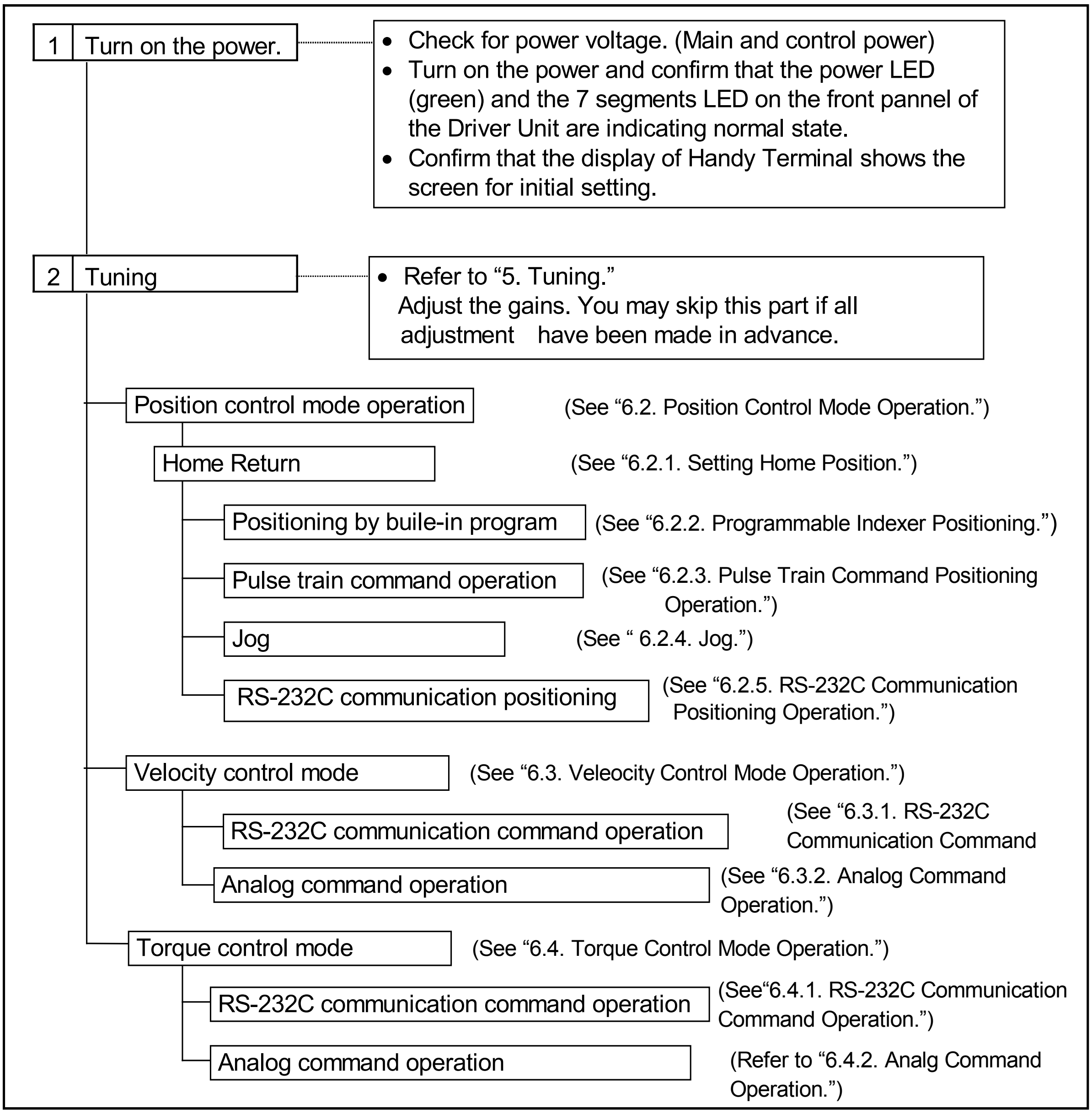
⚠ *Caution: On completion of wiring the ESB Driver Unit, check items listed in Table 6-1 before operating the Megatorque Motor System.*

Table 6-1

No.	Items to be checked	Points to be checked
1	Connection of main power and Input/Output signal cables	• Check if the wiring is properly done. • Check if the screws of the terminal block are securely fastened. • Check if the connectors are properly connected and secured.
2	Connecting cables	• Check if the cable sets (Motor cable and resolver cable) are properly connected and locked to the connectors.
3	Handy Terminal	• Check if the Handy Terminal is connected properly and locked to the CN2 connector.

6.1.2. Operation Procedure

Figure 6-1



- Velocity and torque control modes are not available to the B3 and 23 type Driver Units.
- Parameter SL selects the control mode of the B5 and 25 type Driver Units.

  SL1: Torque control mode

  SL2: Velocity control mode

  SL3: Position control mode

- For the B3 and B5 type Driver Units, which equip with the absolute position sensor, you require Home Return operation only once when the power is turned on for the first time, and from then on you do not require it.
- For the 23 and 25 type Driver Units, you require Home Return operation every time the power is turned on.

6.2. Position Control Mode Operation

- The parameter SL selects the control mode of B5 and 25 type Driver Units.

  SL1: Torque control mode

  SL2: Velocity control mode

  SL3: Position control mode

- Following operations are available in the position control mode.
  - ◊ Home Return
  - ◊ Programmable Indexer
  - ◊ Pulse train command
  - ◊ Positioning via RS-232C serial communication
  - ◊ Jog

6.2.1. Setting Home Position

- You cannot define the zero position of the position scale unless the Home Return is performed for the 23 and 25 type Driver Units because they are for the Motors with incremental position sensor. Be sure to execute the Home return unless the master controller controls the position scale.

- For the B3 and B5 type Driver Units, execute the Home Return only when you need to change the home position because they are for the Motors with the absolute position sensor.

- The positioning and setting of software over travel limits depend on these position scales.

- There are two ways of setting the home position. One is to set the current position as the home position (work origin) by the RS-232C communication command, and the other is Home Return using external Home limit sensor.
  - ◊ The external limit sensor is not necessary if the Home Return is performed with Home Return mode 6.

Figure 6-2

Set the home position.
- Setting with RS-232C communication — See "6.2.1.1. Setting the Home Position by AZ Command."
- Setting with Home Return. — See "6.2.1.2. Setting the Home Position by Home Return."

  - ◊ We recommend using the RS-232C communication to set the home position of B3 and B5 type Driver Units.
  - ◊ We recommend setting the home position (origin) with the Home Return for 23 and 25 type Driver Unit.

6.2.1.1. Setting Home Position by AZ Command

- The current position of Motor is set to the user home position by the AZ command.
- The following show how to set the user home position by the AZ command.

(1) Set the Motor servo free.

M O ENT

```
:MO
:_
```

(2) Rotate the Motor to the position to be the user home position and hold the position.

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

/ N S K SP
O N ENT

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

(4) Input of the AZ command sets the user home position and resets AO value (offset from the zero position).

A Z ENT

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

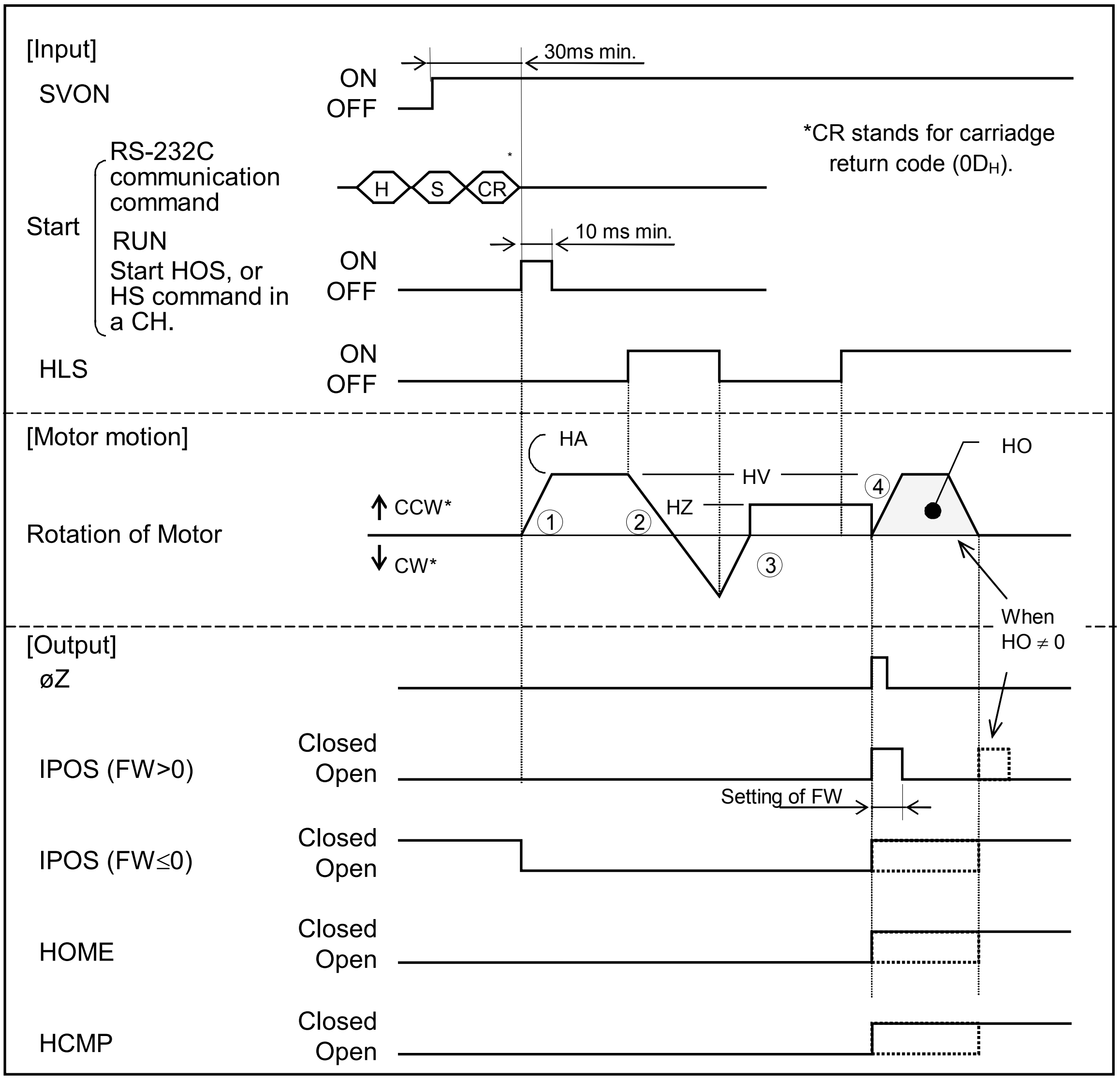
* The user home position can be set while the Motor servo is on. The AO value will not be indicated for ESB23 and ESB25 Driver Units.

6.2.1.2. Setting Home Position by Home Return

- The position at where the Home Return completed will be defined as the home position.

Caution: Perform the Home Return every time the power is turned on for ESB23 and 25 Driver Units. They don't store the home position.

Figure 6-3: Signal timing of Home Return



- Make the Motor servo on. (SVON input is ON.)
- The Home Return starts when the HOS input turns ON. (①)

Table 6-2: Control Input / Output related to Home Return operation

Signal	Function	I/O	Chapter to be referred.
SVON	Servo ON	Input	"7.1.1. Servo ON"
RUN	Start positioning	Input	"6.2.2. Positioning With Programmable Indexer"
HLS	Home position limit sensor	Input	—
CHZ	Position feedback signal øZ	Output	"7.1.16. Position Feedback Signal"
IPOS	Positioning completed	Output	"7.1.11. Completion of Positioning"
HOME	Home Return completed / Home position detected	Output	"7.1.12. Completion of Home Return /Detection of Home Position"
HCMP	Home position defined	Output	"7.1.13. Definition of Home Position"

- The Motor starts in CCW* direction, decelerates and stops when it enters the HLS range (② Home position proximity), and then reverses its direction (③). The Motor goes out the HLS range once, then reverses again and enters the HLS range with the Home position Near-Zero velocity (④). It moves to the point at where the position sensor value becomes 0 for the first time (= rising edge of the øZ), and thus completes the Home Return.

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

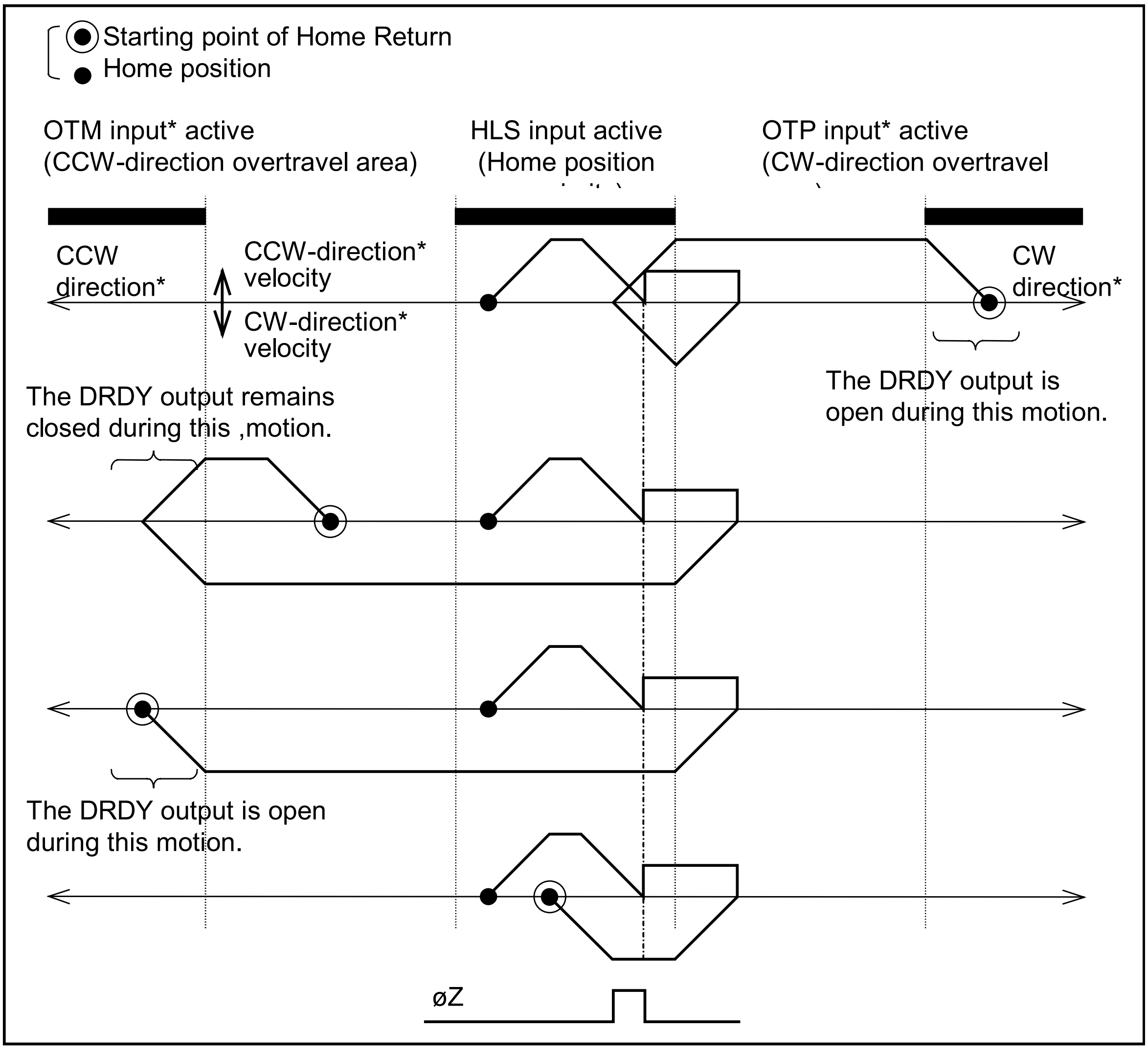
  HD0: CW
  HD1: CCW (Shipping set)

- If the Home offset value HO is specified this time, the Motor moves further for the offset value from the 0 point of the position sensor, then completes Home Return operation.

- The Home Return can be also executed with the following ways.
  - ◊ Select t a channel where the HS command is set, and then input the RUN command.
  - ◊ Execute the HS command through the RS-232C communication.

- The Home Return sequence differs by the starting point of Home Return as shown in Figure 6-4.

Figure 6-4: Different Home Return sequence by starting point



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

Table 6-3: Parameters related to Home Return

Item	RS-232C parameter	Unit	Input data range	Initial setting
Home Return acceleration	HA	s^{-2}	0.01 to 1 280.00	1.00
Home Return velocity	HV	s^{-1}	0.0001 to 3.0000	0.2
Home position offset	HO	pulse	0 to ± 802 816	0
Home Return direction	HD	–	0: CW direction; 1: CCW direction	1
Home Return Near-Zero velocity	HZ	s^{-1}	0.0001 to 0.2000	0.0100

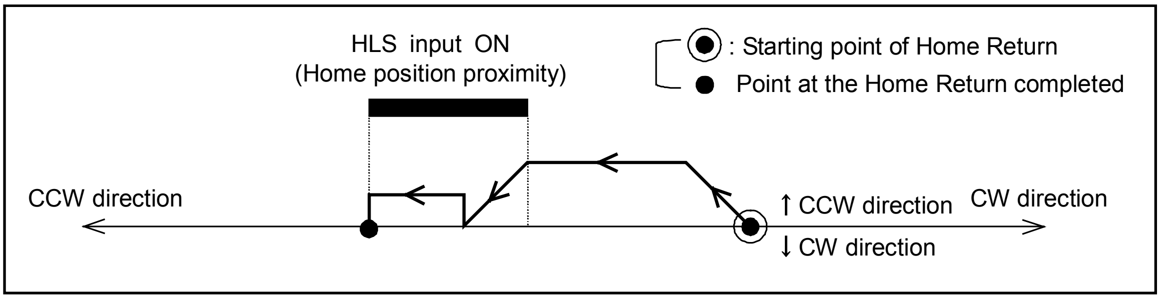
1 Operation mode of Home Return

- The parameter OS sets the Home Return operation mode.

1) Mode 1: OS1

- Home return velocity changes to “Near-Zero velocity” (creeping speed) when the home limit sensor (HLS) is ON.
- Home position is set on the point at where the home limit sensor is off.

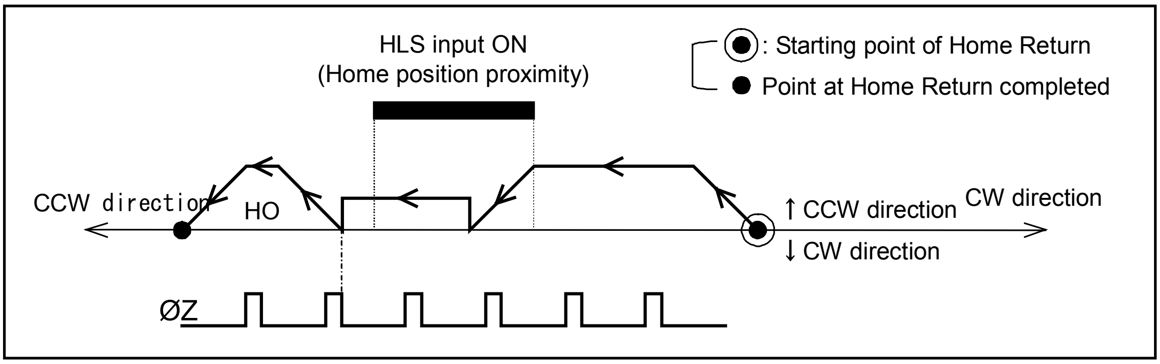
Figure 6-5: Mode1: OS1



2) Mode 3: OS3

- Home Return velocity changes to “Near-Zero” velocity when the home limit sensor is on.
- Position of the first rise of øZ signal after the home limit sensor is off will be defined as the home position.
- If the Home position offset (HO) is set, the Motor goes on by the HO setting after the first rise of øZ signal and stops, and thus sets the home position.

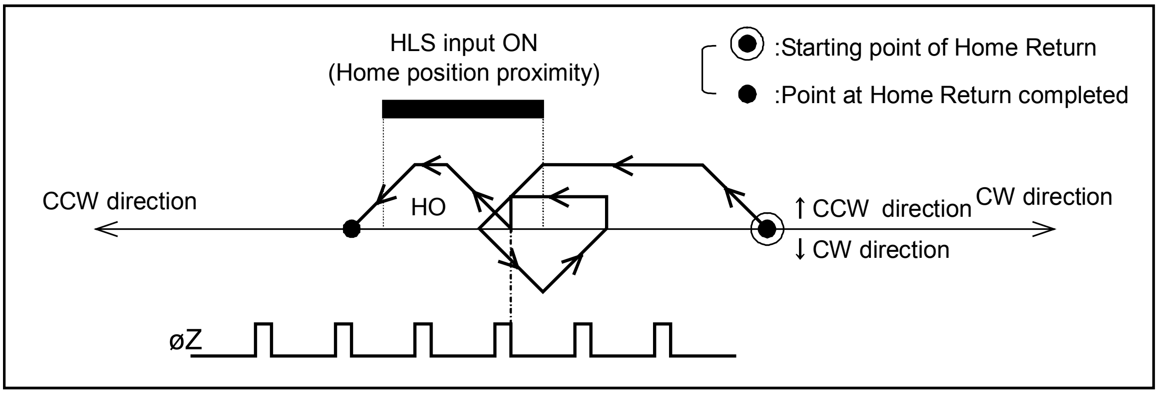
Figure 6-6: Mode 3: OS3



3) Mode 4: OS4 (The shipping set)

- The Motor slows down and reverses its motion at where the home limit sensor is on. Then it reverses its motion again with the "Near-Zero velocity" after the Motor gets out the proximity range of home position and searches the position of the limit.
- The position of the first rise of øZ signal after the home limit sensor is on will be defined as the home position.
- If the Home position offset HO is set, the Motor goes further by the setting value, and thus sets the home position.

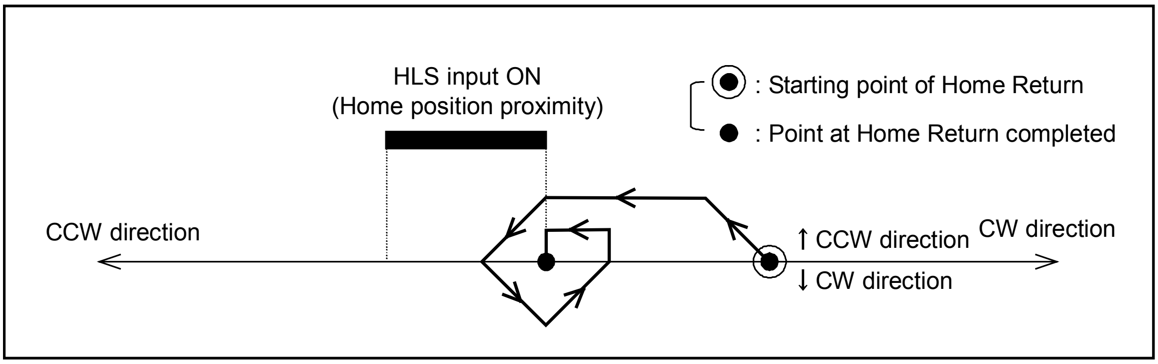
Figure 6-7: Mode 4: OS4



4) Mode 5: OS5

- The Motor slows down and reverses its motion when the home limit sensor is on. Then it reverses its motion with "Near –Zero" velocity after getting out the home position proximity range and searches the position of the limit sensor.
- The Home position will be set on the point at where the home limit sensor is on.

Figure 6-8: Mode 5: OS5



5) Mode 6: OS6

- The Home position will be set on the point at where the Home Return started.
- Though the Motor does not move, the servo has to be turned on at the moment.

2 Adjusting home limit sensor position and Home offset value

- For an accurate Home Return, it requires position adjustment of the home limit sensor (a sensor or a dog).
- The home position will be set on the point at where the position counter becomes 0 after rises the rising edge of HLS input signal is detected while the Motor is moving under "Near-Zero" velocity. (When the parameter HO setting is a number other than 0, the home position is offset to the MO setting from the above position.)
- The position sensor has many teeth and the rising edge of HLS input signal is to identify a tooth among those. Position adjustment of the limit sensor shall be made so that the position is on the center of the tooth width for accurate identification. Design the position of the home limit sensor so that it can be adjusted within ± 3.6°, which corresponds to the width of a tooth.
- The following are the procedures for adjusting the home limit sensor.

◆ Adjusting procedure: Adjusting position of the home limit sensor

1) Temporally set the limit sensor. The position shall be slightly preceding a point to be the home position.

2) Check wiring of the home limit sensor. Check if the ESB Driver Unit is reading the HLS input normally with execution of the IO command.

3) Adjust position of the home limit sensor. Turn the Motor servo on, and then execute HS/LS command. Be careful when the Motor starts Home Return. Execute the procedures below using the Handy Terminal.

(1) Execute HS/LS command.

H S / L S →

```
:HS/LS_
```

(2) The Motor starts rotation by an input of the ENT key.

ENT →

```
:HS/LS
 TR8006
 OK
:_
```

The Motor stops as soon as the home position limit is ON, and the TR (number of pulses from the closest øZ signal) appears on the screen. Check if the value of TR is within 4000 to 12000.
If it is not in the range loosen the position limit sensor and move it to CW or CCW direction. Repeat (1) and (2) steps till the TR is within the range.

⚠ *Caution: When the position of home limit sensor is used, be sure to adjust the TR reading. Otherwise positioning may not be performed correctly.*

- The above procedures complete the position adjustment of the home limit sensor. Follow the procedures below if you require offsetting the home position.

(3) The MO command is for "Servo off."

M O →

```
:HS/LS
 TR8006
 OK
:MO_
```

(4) Pressing the ENT key will turn the Motor sevo off.

ENT →

```
 TR8006
 OK
:MO
:_
```

The Motor can be turned easily. Rotate the Motor to the desired position. However do not turn it more than one revolution.

(5) Input the password.

/ N S K SP
O N →

```
:TR8006
 OK
:MO
:/NSK ON_
```

(6) Press the ENT key.

ENT →

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

(7) The position sensor will automatically detect and store the Home position offset value HO by HO/ST command.

H O / S T →

```
:MO
:/NSK ON
 NSK ON
:HO/ST_
```

(8) Execute the command by entering the ENT key.

":_" appears on the screen indicating that the HO from the current position is automatically set.

ENT →

```
 NSK ON
:HO/ST
 HO1234
:_
```

(9) The SV command is to make the Servo on.

S V

```
 NSK ON
:HO/ST
 HO1234
:SV_
```

(10) Entering the ENT key turns the Motor servo on.
":_" indicates the acceptance of the command.

ENT

```
:HO/ST
 HO1234
:SV
:_
```

(11) The HS command is for execution of Home Return.

H S

```
:HO/ST
 HO1234
:SV
:HS_
```

(12) Entering the ENT key starts the Home Return.

ENT

```
 HO1234
:SV
:HS
:_
```

Check if the Motor stops at the point as desired.

2 Program the Home Return command to internal channel 0 (CH0)

- Follow the instructions below for setting the Home Return command to a specified program channel and execute it by the starting command of Programmable Indexer (RUN).

  (1) Input CH0 to start editing the channel 0.

  C H 0? ENT

  ```
  :
  :
  :CH0
  ?_
  ```

  The prompt changes to "?" and the Driver Unit waits for input of the data. If data have been programmed in the CH0 at this moment, it will be indicated on the screen.

  (2) Input the command for Home Return.

  H S ENT

  ```
  :
  :CH0
  ?HS
  ?_
  ```

  (3) Input of the ENT key following the prompt completes programming to the CH0.

  ENT

  ```
  :CH0
  ?HS
  ?
  :_
  ```

- Following instructions show a trial running to check Motor motion when Home Return acceleration HA, Home Return velocity HV, and home position offset HO are changed.

  (1) Activate the Motor servo.

  (2) Input of the command to execute intarnal channel program starts the Home Return when the prompt is " : " on the screen.

  S P 0? ENT

  ```
  :
  :
  :SP0
  :_
  ```

6.2.2. Programmable Indexer Positioning

- Programmable Indexer Positioning means executing an indexing motion program that is stored in program channels of the Driver Unit. The RUN input starts an indexing motion programmed in a channel specified by the PRG0 to PRG5 inputs.

- Activate the Motor servo. (SVON input is ON.)

- Select a channel to be executed. (Input of PRG0 to PRG5 signals)

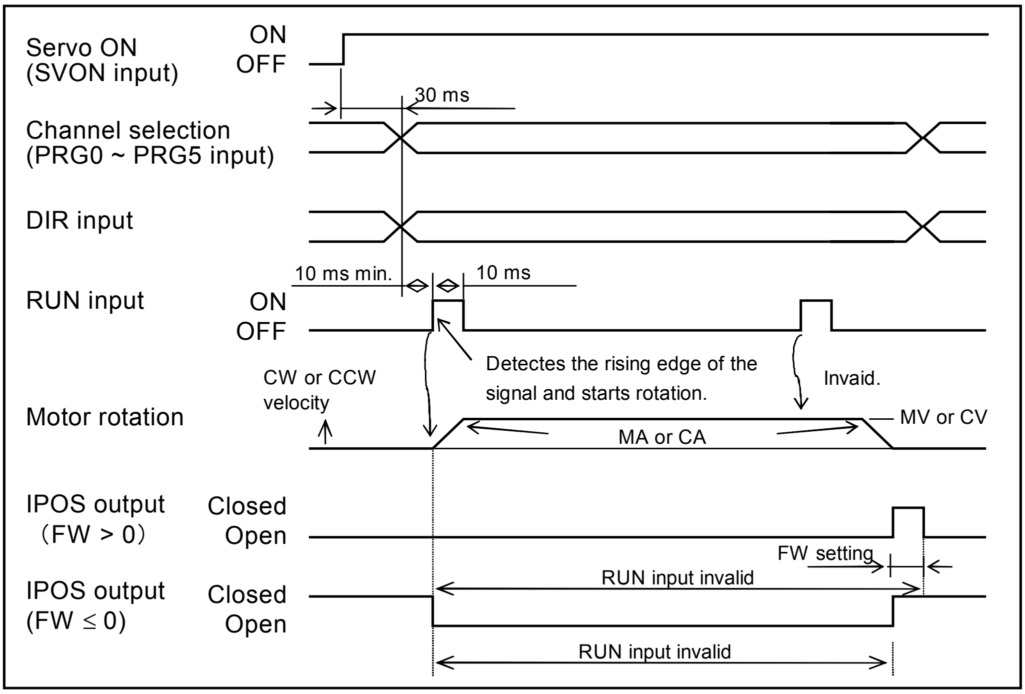
- Turning the RUN input ON executes the program of selected channel while the IPOS output is being closed.

- During positioning of the Motor, another input of RUN command will not be accepted.

- Execution of the SP command may start the built-in program. (The same function as RUN input ON)

  Inputting SPm $\boxed{\text{ENT}}$ (m--- program channel number) will start the program of Channel m.

Figure 6-9: Command timing of Programmable Indexer (In case of BF0: brake sequence invalid)



- “Program error” alarm will be given if an empty channel is selected and executed. (Refer to “10. Alarm.”)

- The number of selectable channels by PRGx differs with the type of Driver Unit and its parameter setting. See Table 6-5 for the selectable number of channels.

- When the brake sequence function BF1 is set, the brake control in accordance with the Motor motion will be performed.

Figure 6-10: Timing of Programmable Indexer (In case of BF1: Brake sequence active)

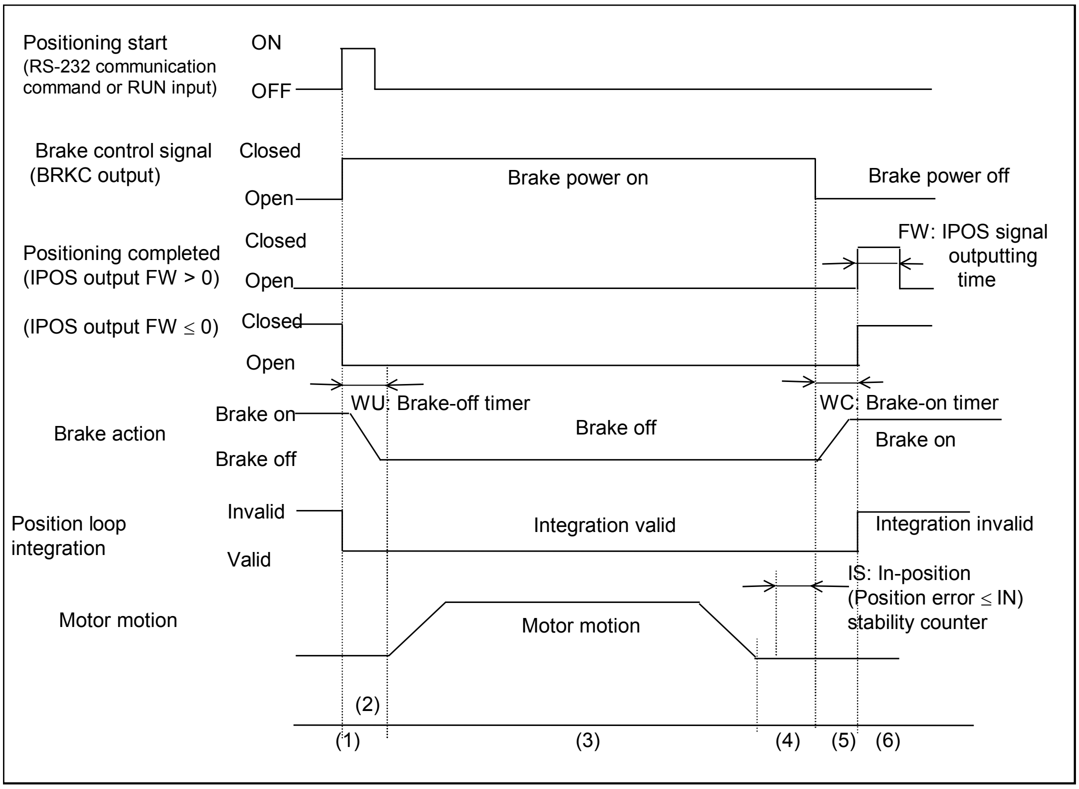


Table 6-4: Control signal related to the Programmable Indexer

Signal name	Function	Input Output	Referring chapter
SVON	Servo on	Input	"7.1.1. Servo ON
PRG0 to 5	Channel selection	Input	—
DIR	Set rotational direction	Input	—
RUN	Start internal program	Input	—
IPOS	Completion of positioning	Output	"7.1.11. In-Position Output"

6.2.2.1. Internal Program Channel Selection

- The B5 and 25 type Driver Units specify a program channel to be executed by combinations of ONs and OFFs of PRG0 to 5 inputs.
- The B3 and 23 Driver Units specify a program channel to be executed by combinations of PRG0 to 3 input signals. Furthermore, the number of selectable channels depends on settings of the input signals of parameter TY.

Table 6-5: Channel selection

Channel number	B5 and 25 Driver Units PRGx ON/OFF combination					
	PRG5	PRG4	PRG3	PRG2	PRG1	PRG0
0	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF	ON	ON
12	OFF	OFF	ON	ON	OFF	OFF
13	OFF	OFF	ON	ON	OFF	ON
14	OFF	OFF	ON	ON	ON	OFF
15	OFF	OFF	ON	ON	ON	ON
16	OFF	ON	OFF	OFF	OFF	OFF
17	OFF	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON	OFF
19	OFF	ON	OFF	OFF	ON	ON
20	OFF	ON	OFF	ON	OFF	OFF
21	OFF	ON	OFF	ON	OFF	ON
22	OFF	ON	OFF	ON	ON	OFF
23	OFF	ON	OFF	ON	ON	ON
24	OFF	ON	ON	OFF	OFF	OFF
25	OFF	ON	ON	OFF	OFF	ON
26	OFF	ON	ON	OFF	ON	OFF
27	OFF	ON	ON	OFF	ON	ON
28	OFF	ON	ON	ON	OFF	OFF
29	OFF	ON	ON	ON	OFF	ON
30	OFF	ON	ON	ON	ON	OFF
31	OFF	ON	ON	ON	ON	ON
32	ON	OFF	OFF	OFF	OFF	OFF
33	ON	OFF	OFF	OFF	OFF	ON
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
59	ON	ON	ON	OFF	ON	ON
60	ON	ON	ON	ON	OFF	OFF
61	ON	ON	ON	ON	OFF	ON
62	ON	ON	ON	ON	ON	OFF
63	ON	ON	ON	ON	ON	ON

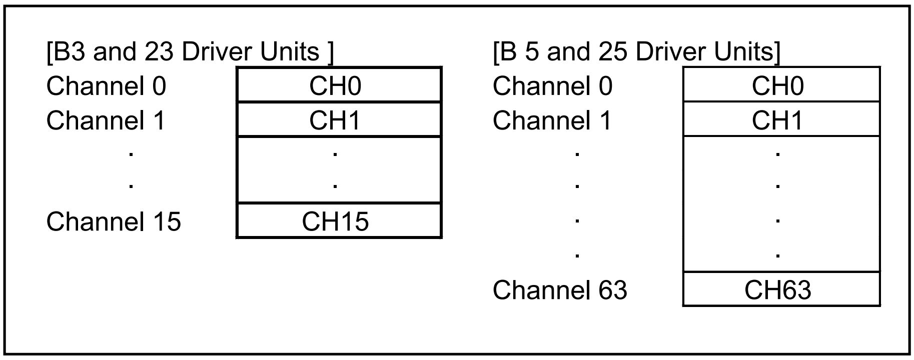
B3 and 23 Driver Units Channel number	Selectable channel by I/O type					
	TY1	TY2	TY3	TY4	TY7	TY8
0	✓	✓	✓	✓	✓	✓
1	✓					✓
2	✓					✓
3	✓					✓
4	✓	✓	✓			✓
5	✓					✓
6	✓					✓
7	✓					✓
8	✓	✓	✓			
9	✓					
10	✓					
11	✓					
12	✓	✓	✓			
13	✓					
14	✓					
15	✓					
Available number of channels	16	4	4	1	1	8

1) PRGx input ON/OFF combinations are the same as those corresponding channel numbers of the B5 and 25 type Driver Units.
2) The maximum number of channels for B3 and 23 type Driver Units are limited to 16.

6.2.2.2. Programming

- Programming for Programmable Indexer positioning shall be executed through the RS-232C communication. Execute programming while stopping the programmed positioning.
- For the B3 and 23 type Driver Units, there are 16 (0 to 15) channels of program area.
- There are 64 (0 to 63) channels of program area for the B5 and 25 type Driver Units.

Figure 6-11: Program area



1 Parameters for command and condition setting

◆ Home Return

Command : HS
Condition parameter : None

- Programs the Home Return.
- Command format : HS seq
  seq: Sequence code (*, &)
- The Motor rotates along the set condition such as Home Return velocity (HV), Home Return acceleration (HA), and Home Return Near-Zero velocity (HZ).

⚠ *Caution: Parameter HD changes direction of the Home return.*

◊ HD0: CW direction

◊ HD1: CCW direction (shipping set)

* Program example

```
:CH0
HS
```

◆ Positioning

Command : AD, AR, ID and IR
Condition parameter : CV and CA (Default available)

- Programs the Indexing motion profile.

Table 6-6

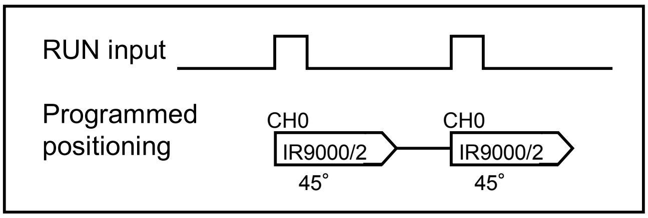
Command format	Outline	Option
AD d1 d3 seq	• Absolute position command in the unit of degree. • The Motor rotates to position d1 (unit: 0.01°) of the User Absolute Position Scale.	Option code d3 /PL: Clockwise /MI: Counterclockwise /EX: Follows the DIR input. • In case of default the Motor takes the shortest direction. (Refer to "8. Glossary of Command and Parameter" for more details.)
AR d1 d3 seq	• Absolute position command in the unit of pulse. • The Motor rotates to position d1 (unit: pulse) of the User Absolute Position Scale.	
ID d1 d2 d3 seq	• Incremental position command in the unit of degree. • The Motor rotates the distance of d1 (unit: 0.01°) from the current position.	(1) Option code d2 /n: (n ≤ 99) • Divides the d1 by the data "n" and makes the quotient a step of positioning distance. The default does not divide the d1. (2) Optional code d3 /EX: Follows the DIR input. • Error notice will be given when attaching /EX option while the sign of the d1 is " – (minus)." • Follows the sign of the d1 in case of default.
IR d1 d2 d3 seq	• Incremental position command in the unit of pulse. • The Motor rotates the distance of d1 (unit: pulse) from the current position.	

- "seq" denotes a sequence code. The seq codes (*) and (&) can specify the positioning condition of the following channel.
- Rotational velocity (CV) and rotational acceleration (CA) may be specified on the same channel. In case of default of these parameters, the Motor rotates in accordance with the MV and MA settings respectively.

* Program example

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

Figure 6-12



◆ Timer

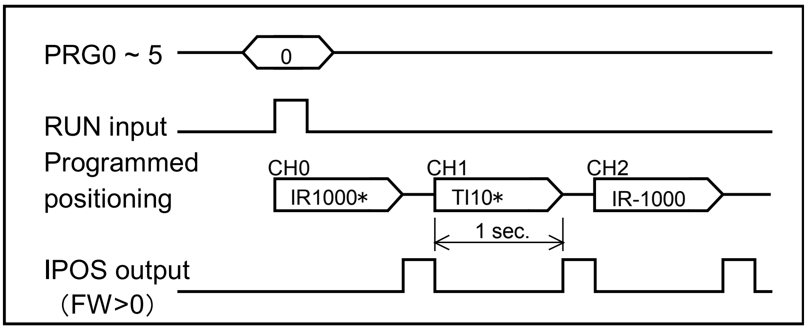
Command : TI
Condition setting : None

- Command format: TI d
  d: 0.3 to 100.0 [× 0.1 sec.]
- This is to set dwell timer.

* Program example

```
:CH0
 IR1000*
:CH1
 TI10*
:CH2
 IR-1000
```

Figure 6-13



◆ Jump

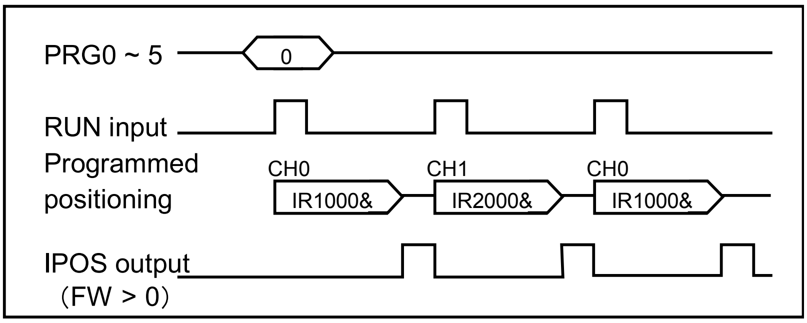
Command : JP
Condition setting : None

- This command sets unconditional jump.
- Command format: JP m
  m: Channel number to jump. (Default: 0)
- The program sequence jumps to a specified channel and executes its program.

* Program example

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

Figure 6-14



◆ Sequence code

Related Command : (HS), (AD), (AR), (ID) and (IR)
Condition parameter : CV, * and &

- If a sequence code is added to a command, the following channel may be executed without selecting the channel externally.

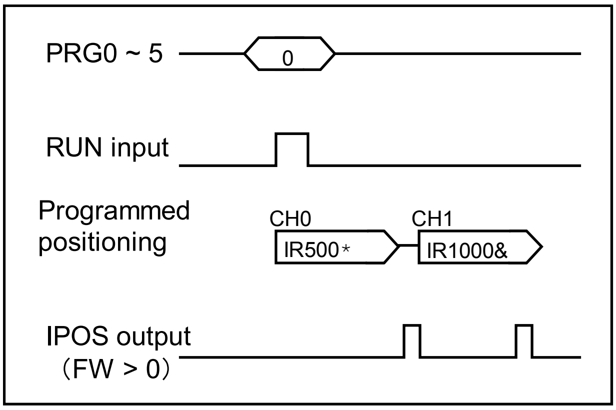
Table 6-7

Sequence code	IPOS output	Executing condition for the next channel
* : Asterisk	Available	Continue to execute after the positioning
& : Ampersand	Available	Stops after the positioning and waits for RUN input.

* Program example

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

Figure 6-15



◆ Changing sequence code

Condition parameter : OE

- OE seq can change a sequence code currently specified.

* Program example

```
:CH0 --------------      Specify the channel whose sequence code has to be changed.
 AR9000& ----------
 CV0.5000 ---------
?OE* --------------      Input as  O  E  *  ENT .
? -----------------
:TC0 --------------      Check the channel for the change.
 AR9000* ----------      "&" has been changed to " *."
 CV0.5000 ---------
```

2 Command list for editing program

Table 6-8

Editing point	Command	Outline of function
Channel to be programmed	CH	• CHm ENT (m: channel number) specifies a channel to program • Input of CHm shows present program set in selected channel if it is not empty, and waits for new input. (The prompt is "?.") • The last program is valid when the change has been made.
Readout of channel program	TC	• Input TCm ENT (M: channel number) and press the SP key to scroll for reading out program set in the channel number m. • Input TC/AL ENT and press the SP key to scroll all channel for readout of programs.
Delete program	CC	• Input CCm ENT (m: program channel number) to erase a program in channel number m.
Delete channel	CD	• Input CDm ENT (m: program channel number) to delete channel number m.
Insert channel	CI	• Input CIm ENT (m: program channel number) to insert a channel to position of channel of number m. • This will delete channel of the last channel number.

3 Editing program

◆ Programming

(1) Specify a program channel number.

C H 1# 0?

```
:CH10_
```

(2) Press the ENT key to execute. The display shows a program in the channel if it is not empty. The prompt "?" appears to indicate the Driver Unit waits for input of new command.

ENT

```
 AR18000
 CV0.9000
 CA2.00,2.00
?_
```

(3) Input commands.

I R 9) 0? 0? 0?
/ 1# 0?

```
 AR18000
 CV0.9000
 CA2.00,2.00
?IR9000/10_
```

(4) Press the ENT key to set the commands. The next prompt "?" appears on the screen when the ENT key is pressed.

ENT

```
 CV0.9000
 CA2.00,2.00
?IR9000/10
?_
```

(5) Set the condition parameters related to the commands.

C V 0? .= 5%

```
 CV0.9000
 CA2.00,2.00
?IR9000/10
?CV0.5_
```

(6) Press the ENT key to set the parameters.

ENT

```
 CA2.00,2.00
?IR9000/10
?CV0.5
?_
```

* When input an incorrect command, reenter correct one. If the command is duplicated, the last command will be valid.

(7) Input “0” to cancel the condition.

[C] [V] [0 ?] [ENT] →

```
?CV0
?_
```

(8) Press the [ENT] key only and the prompt returns to “:,” thus completes programming.

[ENT] →

```
?
:_
```

◆ **Reading channel program**

(1) Specify a channel to read out.

[T] [C] [1 #] [0 ?] →

```
:TC10_
```

(2) Press the [ENT] key to execute. Program set in the channel is on the screen.

[ENT] →

```
:TC10
 IR9000/10
 CV0.5000
:_
```

◆ **Deleting program**

(1) Specify an objective channle number.

[C] [C] [1 #] [0 ?] →

```
:CC10_
```

(2) Press the [ENT] key to execute. The program in the channel is erased.

[ENT] →

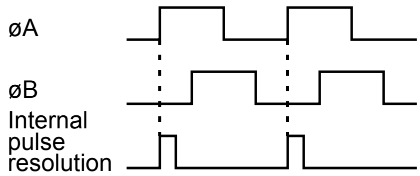
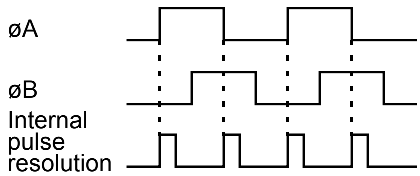
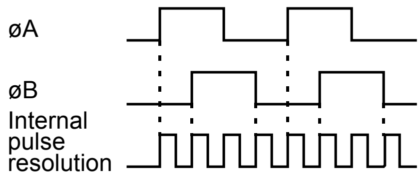
```
:CC10
:_
```

6.2.3. Pulse Train Command Positioning Operation

6.2.3.1. Pulse Train Command Format

- Input the pulse train command through CWP and CCWP ports of the connector CN2.
- Select format of the command with parameter PC (RS-232C communication).
  (Entry of the password is required for setting the parameter PC.)

Table 6-9: Pulse train command format

PC Parameter	CWP input	CCWP input	Function
PC0 (Shipping set)	• Inputs CW pulse.	• Inputs CCW pulse.	CW & CCW format
PC1	• Inputs the direction. ON : CCW OFF : CW	• Inputs pulse train.	Step & direction format
PC2			øA/øB format (× 1) 
PC3	• Input øB.	• Input øA.	øA/øB format (× 2) 
PC4			øA/øB format (× 4) 

6.2.3.2. Pulse Train Resolution

- The parameter CR (RS-232C communication) sets the resolution of pulse train command.
- In addition to the angle magnification with the parameter PC, another angle magnification may be selected with the parameter CR for øA/øB input.
- Refer to Table 6-10 for the concrete example of resolution.

Table 6-16

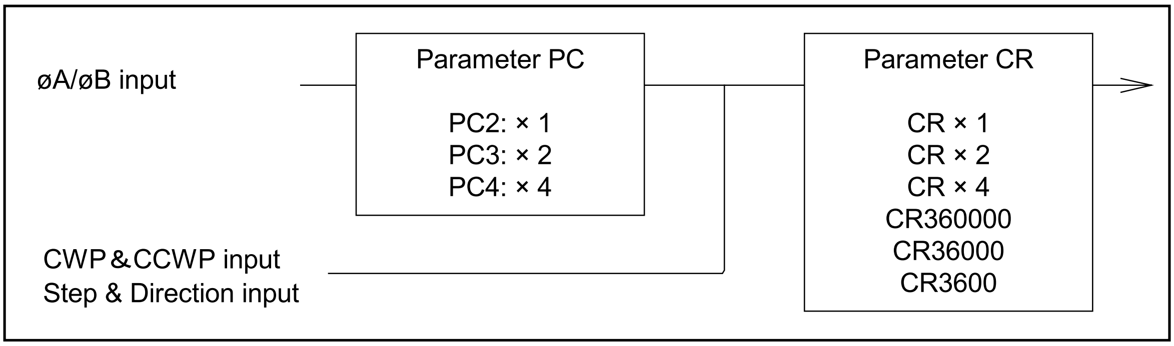
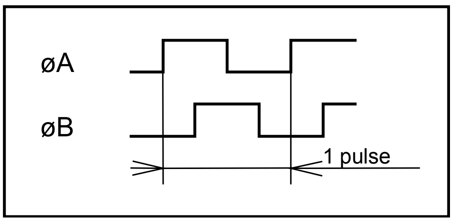


Table 6-10: Pulse train command resolution

CR Parameter	Resolution (pulse/360°) = The number of pulses to make the Motor one revolution.		
	CW&CCW or Pulse & Direction f	øA/øB	
CR × 1 (Shipping set)	819 200	× 1	819 200
		× 2	409 600
		× 4	204 800
CR × 2	409 600	× 1	409 600
		× 2	204 800
		× 4	102 400
CR × 4	204 800	× 1	204 800
		× 2	102 400
		× 4	51 200
CR360000	360 000	× 1	360 000
		× 2	180 000
		× 4	90 000
CR36000	36 000	× 1	36 000
		× 2	18 000
		× 4	9 000
CR3600	3 600	× 1	3 600
		× 2	1 800
		× 4	900

- Each cycle of phase A or B serves as a count if the øA/øB format is used.

Figure 6-17



6.2.3.3. Pulse Train Input Timing

⚠ *Caution: The following show the timing of accepting pulses. In addition to the conditions shown below, the maximum velocity places restrictions. The pulse frequency should not exceed the maximum velocity of the Motor.*

Figure 6-18: When the parameter is set to PC0.

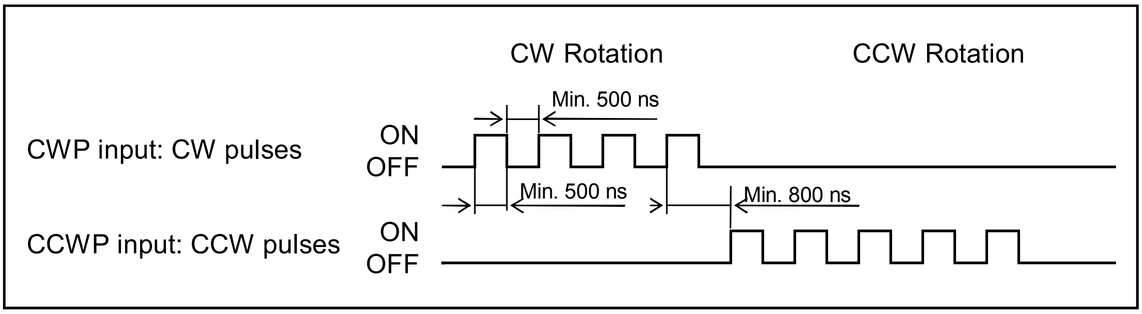


Figure 6-19: When the parameter is set PC1.

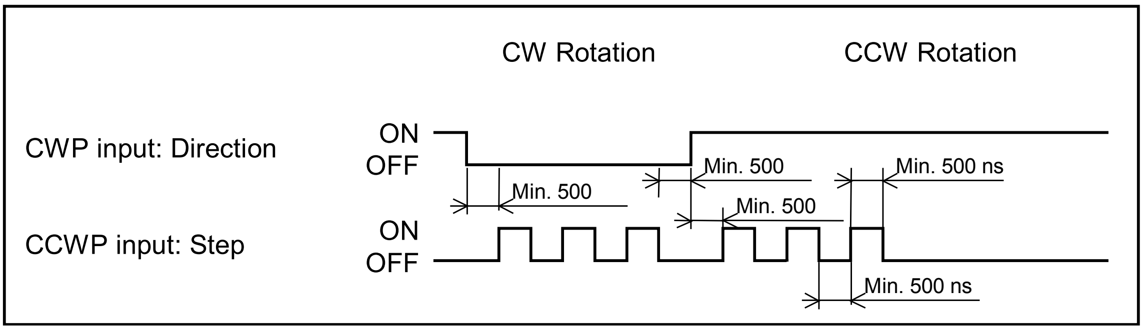
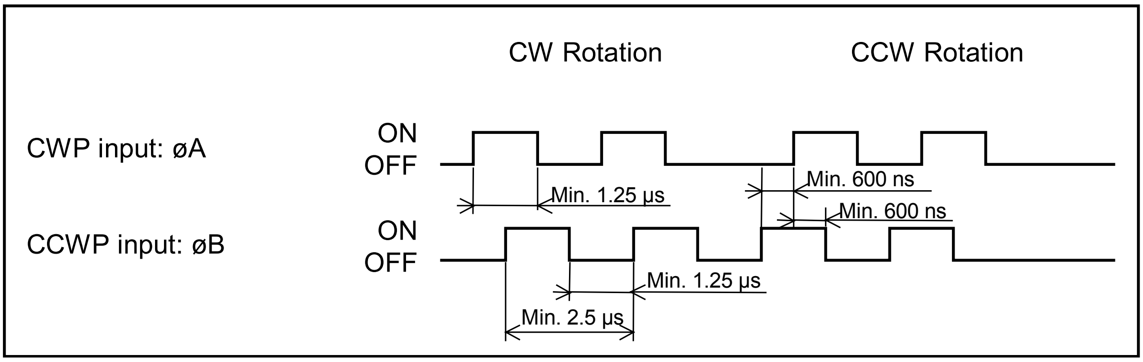


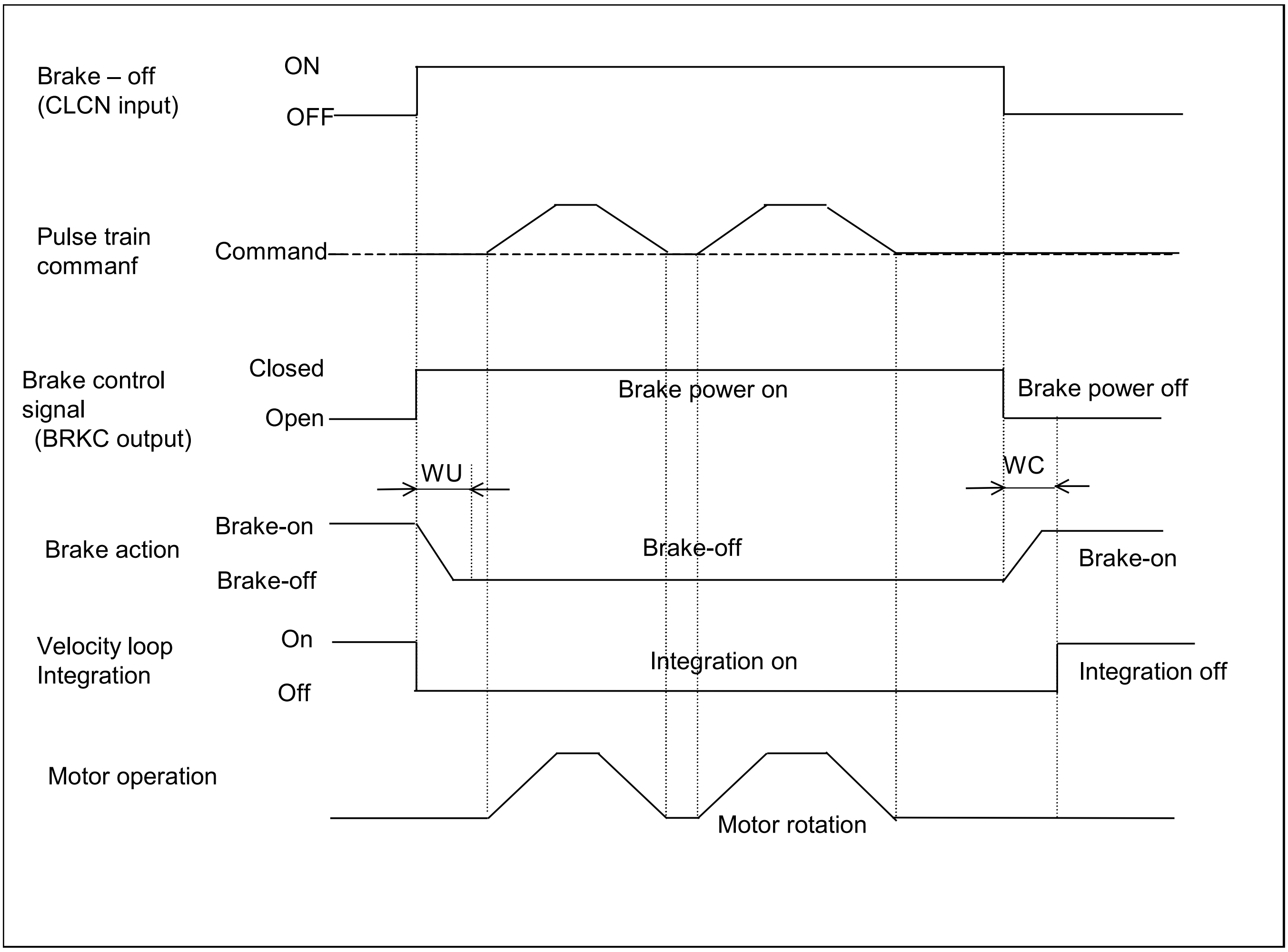
Figure 6-20: When the parameter is set to PC2 to 4.



- When the brake sequence is activated (BF1) for the Motor equipped with brake, CLCN input must be ON to release the brake before performing a pulse train command positioning.

- Inputting pulse train command before releasing the brake activates the Brake Error alarm (A8).

Figure 6-21: Operation Timing of pulse train command positioning when brake sequence is ON



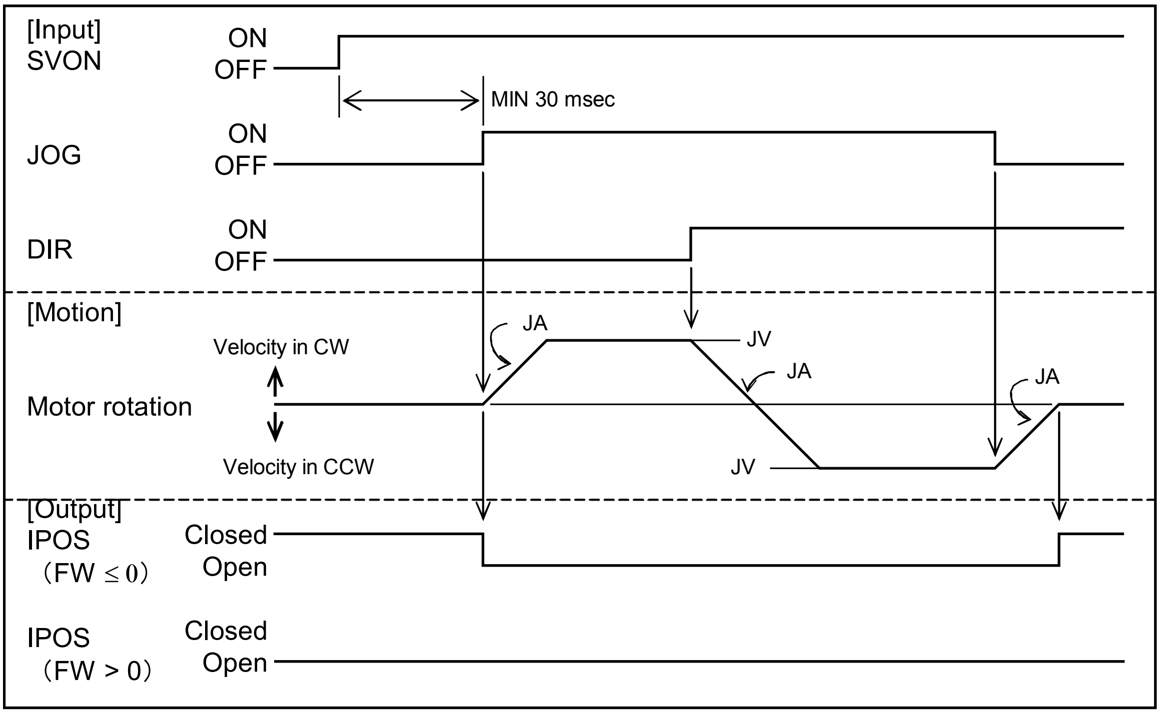
6.2.4. Jog

- Jog function is available in TY2 or TY7 of Input/Output combination parameter TY of the B3 or 23 Driver Unit.
- Put the Motor in Servo on state. (SVON input ON.)
- Turning JOG input ON makes the Motor to rotate. The Motor keeps rotating while the JOG input is ON. If it goes inactive, the Motor decelerates and then stops.
- The Motor rotates in CW direction when the DIR input is OFF, and it rotates to CCW direction while the DIR input is ON.

Table 6-11: List of parameter related to Jog operation

Item	RS-232C parameter	Unit	Data range	Initial setting
Jog acceleration	JA	s^{-2}	0.01 to 1 280.00	1.00
Jog velocity	JV	s^{-1}	0.0001 to 3.0000	0.1

Figure 6-22: Signal timing of Jog operation



⚠ *Caution: When the DIR input is switched during rotation as shown in the above chart, the Motor decelerates and reverses its motion.*

- When the brake sequence is activated (BF1) for the Motor equipped with brake, CLCN input must be ON to release the brake before performing a pulse train command positioning.
- Inputting pulse train command before releasing the brake activates the Brake Error alarm (A8).

Figure 6-23: Signal timing of Jog (Brake sequence is active: BF1)

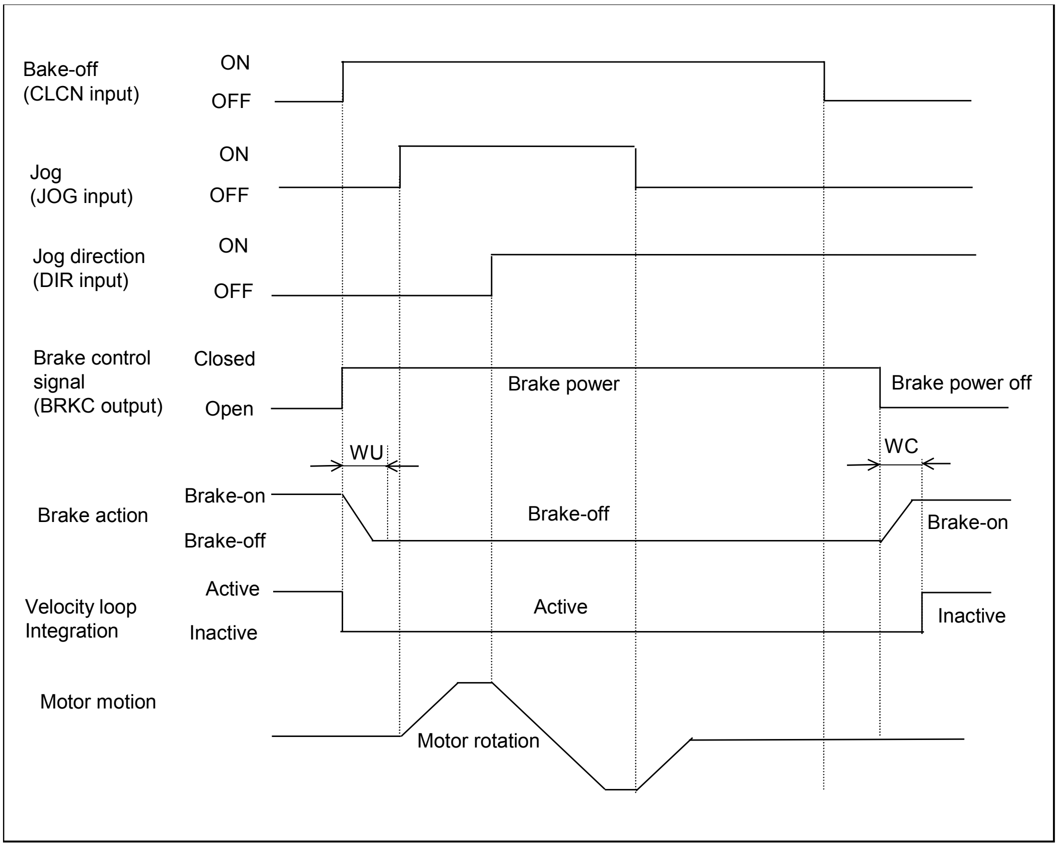


Table 6-13: List of control signal related to Jog operation

Signal name	Function	I/O	Chapter for be referred.
SVON	Servo ON	Input	"7.1.1. Servo ON"
JOG	Jog	Input	—
DIR	Specifies Jog direction.	Input	—
IPOS	Positioning completed.	Output	"7.1.11. In-Position Output"

6.2.5. RS-232C Communication Positioning Operation

- Positioning may be executed directly through the RS-232C interface. Commands and parameters are listed in Table 6-13. Refer to “8. Glossary of Command and Parameter” for the details.

Table 6-13

Command/Parameter	Function
ID command	Sets the motion distance and executes positioning. (Incremental/in units of degree)
IR command	Sets the motion distance and executes positioning. (Incremental/in units of pulse)
AD command	Sets the motion distance and executes positioning. (Absolute/in units of degree)
AR command	Sets the motion distance and executes positioning. (Absolute/in units of degree)
HS command	Starts Home Return.
HV parameter	Sets Home Return velocity.
HA parameter	Sets Home Return acceleration.
HO parameter	Sets Home Return offset.
HD parameter	Sets Home Return direction.
MA parameter	Sets rotational acceleration.
MV parameter	Sets rotational velocity.
SE parameter	RS-232C error alarm output format

* The number of pulse for AR or IR command will be 819 200 pulses per revolution.

◊ Refer to “7.3. RS-232C Communication” for the details of RS-232C communication with the master controller.

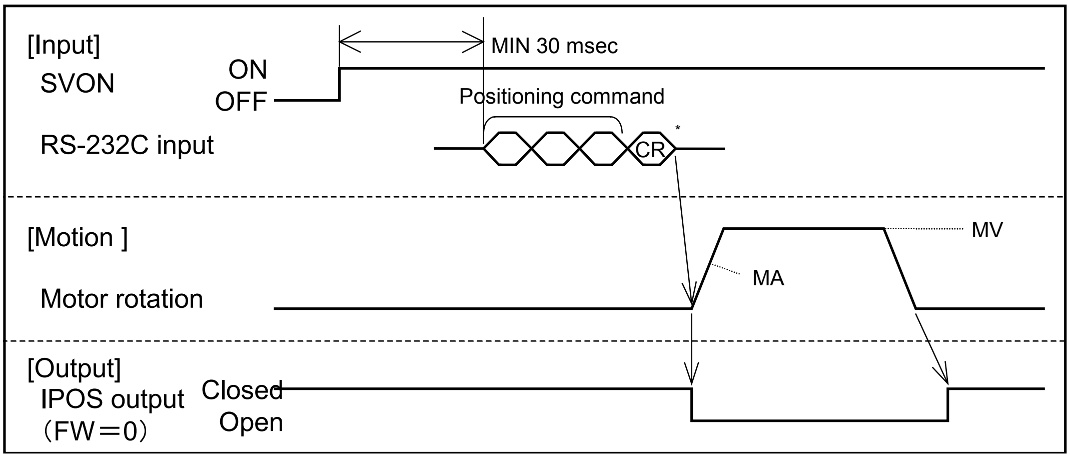
◊ In case of the positioning with RS-232C position command, be sure to set the parameter SE to SE1 or SE2 in order to notify outside of abnormality of RS-232C communication.

⚠ *Caution: Please note that there is the limit of the number of times of overwriting the parameters to the memory.*

◊ The Driver Unit has an EEPROM for the data backup. The EEPROM has the limitation on the number of times for writing/deleting the data. (Approximately 500 000 times) Therefore, we recommend setting the parameter WM to prohibit writing to the EEPROM when the internal parameters are frequently changed from the master controller during operation. However, frequent changes in parameters that do not require the backup will not affect the life of the EEPROM.

◆ ON Signal timing for positioning with RS-232C position command

Figure 6-24: Signal timing



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

- The Motor executes a positioning as soon as an input of the command in Servo on state that is activated by SVON input ON. In that event, acceleration and velocity of the motion profile shall follow MA and MV settings respectively.

- The Driver Unit outputs the IPOS signal when position errors in the error counter fall below the threshold for outputting a signal of completion of positioning (parameter IN).

6.3. Velocity Control Mode Operation

- Positioning with velocity control mode is not available to the B3 and 23 type Driver Units.

- The parameter SL sets the positioning with velocity control mode.
  SL1: Torque control mode
  SL2: Velocity control mode
  SL3: Position control mode

- Either one of positioning with the RS-232C analog command or the analog velocity command may be selected in the velocity control mode.
  The parameter AC selects the way of positioning.
  AC0 : Analog command invalid. DC command is valid.
  AC1 : Analog command valid. When analog velocity command is +: CCW direction
  AC–1 : Analog command valid. When analog velocity command is –: CW direction

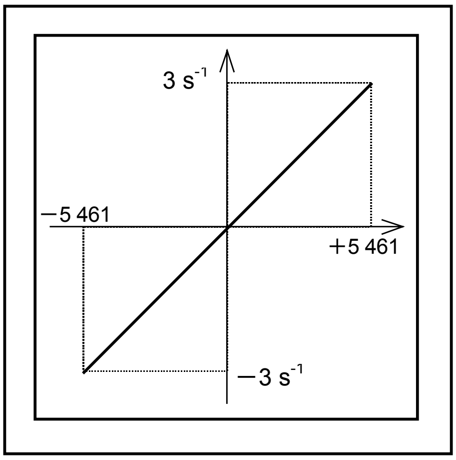
6.3.1. RS-232C Position Communication Command Operation

- Motor velocity may be controlled directly through the RS-232C command in the velocity control mode.

- The parameter AC (AC0) sets validity of DC command.
  Inputting as
  D C (data) ENT
  will make the Motor controlled with the velocity that is proportional to the data.

- Relation between the data of DC command and the velocity is shown in Figure 6-25.

Figure 6-25



Caution: When the DI parameter reverses the sign of coordinate, the polarity of the DC command is reversed as well.

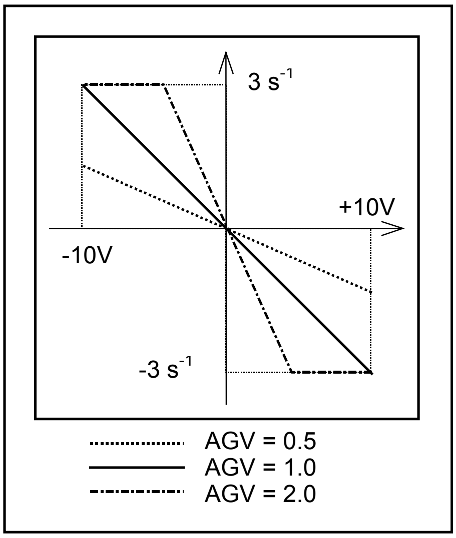
6.3.2. Analog Velocity Command Operation

- Velocity of the Motor may be directly controlled with the analog velocity command in the velocity control mode.
  - ◊ Voltage range of the analog command is ± 10V. Offset adjustment is possible using the adjusting pod (VR1) on the front panel of the Driver Unit or setting the parameter AF. (Refer to "6.3.2.2. Offsetting Analog Command.")
  - ◊ It is possible to set dead band of command voltage. (Refer to "6.3.2.1. Dead Band Set to Command Voltage.")
  - ◊ The parameter AC selects the polarity of command voltage. (Refer to Table 6-14.)
  - ◊ Relation between the command voltage and the velocity may be selected with the parameter AGV. (See Figure 6-23.)
  - ◊ You may set a limit to steep changes in acceleration and deceleration induced by velocity commands. (Refer to "6.3.3. Function to Limit Acceleration / Deceleration."

Table 6-14

DI setting	AC setting	Command voltage	Rotating direction
0	1	+	CCW
0	1	–	CW
0	– 1	+	CW
0	– 1	–	CCW
1	1	+	CW
1	1	–	CCW
1	– 1	+	CCW
1	– 1	–	CW

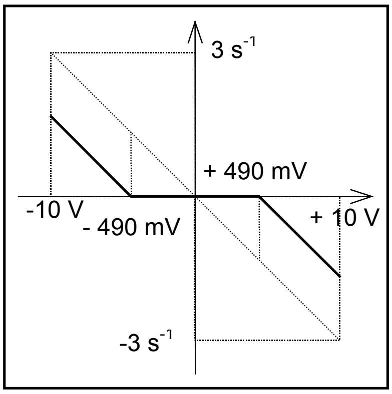
Figure 6-26: Command voltage and velocity (AC1)



6.3.2.1. Dead Band Set to Command Voltage

- You may set a dead band to the analog command.
  (The parameter DBA sets ± 4.9mV per parameter data.)

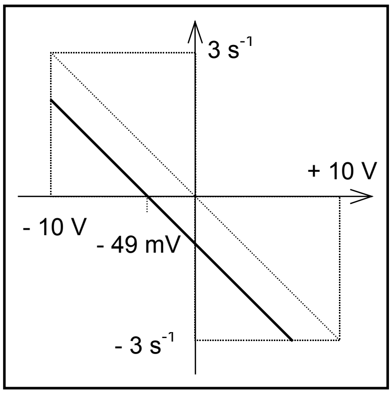
Figure 6-27: Example: DBA100 (AC1)



6.3.2.2. Offsetting Analog Command

- You may adjust offset value of command voltage with the parameter AF.
- Parameter AF sets the offset value by "– 4.9 mV" per parameter data in the range of AF -63 to AF63.

Figure 6-25: Example: Setting AF10 (AC1)



(1) Automatic setting of offset value

- Set the offset value automatically to make the current analog input to 0 (zero).

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

(2) Input the password. The acknowledgement will be returned.

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

→

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

(3) Input as

[A] [F] [/] [S] [T]

→

```
:AF/ST_
```

(4) Pressing the [ENT] key sets the offset value automatically. The set value of AF will be on the screen.

[ENT]

→

```
:AF/ST
 AFxx
:_
```

◊ The unit of setting value is [– 4.9mV].

◊ If the offset value is too much, it indicates “AFxx?.” However, the offset value won’t be changed.

◊ If the automatic offsetting is disabled because of abnormality of A/D converter, an error alarm “E9>ADC READ Error” will be given.

(2) Manual offset setting

- Set the offset value with the analog command monitor.

(1) Take a note of setting on the dead band DBA and the polarity of the analog command AC, and then change those settings to DBA0 and AC1.

(2) Connect the master controller and the Driver Unit and input the velocity command of 0 (zero).

(3) Type as shown below and monitor the analog command.

R A / R P →

```
:RA/RP_
```

(4) When the ENT key is pressed, the current analog command due to the drifting will be shown in the screen repeatedly. Indication of 2, as shown in the screen below, denotes that the offset to the command voltage shall be – 9.8 mV (– 4.9[mV] × 2). (Since the polarity of the analog command voltage and the internal commad is reversed, the sign of the setting shall be regareded as reversed also.)

ENT →

```
:RA/RP
    2_
```

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

BS →

```
:RA/RP
    2
:_
```

(6) Input the password. The acknowledgement will on the display.

/ N S K SP O N ENT →

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

(7) Execute the following commands. Be sure to input the same sign as it was monitored by the RA command.

A F 2 $ ENT →

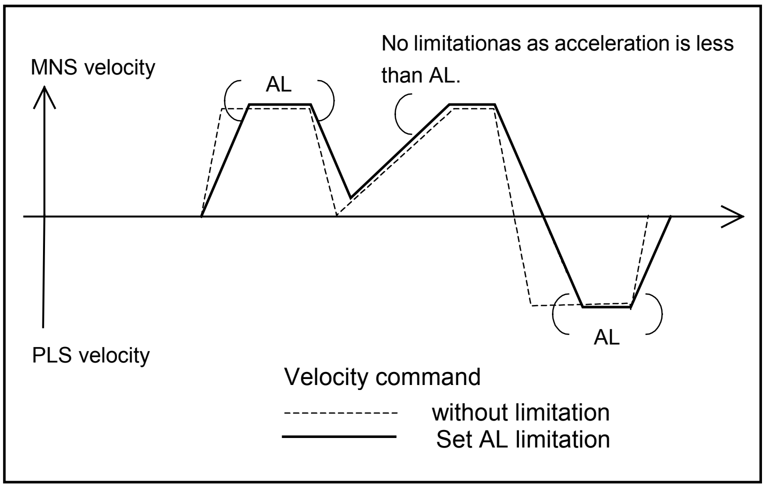
```
:AF2
:_
```

(8) Reset the dead band DBA and the analog command polarity AC to the setting as noted at the step (1).

6.3.3. Function to Limit Acceleration / Deceleration

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

Figure 6-29: Limiting function of acceleration/deceleration



However, the function of limiting acceleration /deceleration is not valid in the following cases.

◊ When the Motor is stopping due to the EMST input or the MS command.

◊ When the control mode is position control or velocity control.

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

6.4. Torque Control Mode Operation

- Torque control mode is not available to the B3 and 23 type Driver Units.

- The parameter SL selects the torque control mode.
  SL1: Torque control mode
  SL2: Velocity control mode
  SL3: Position control mode

- You may select either positioning with RS-232C position command or analog torque command in the torque control mode. The parameter AC selects the way of positioning.
  AC0 : Analog command invalid. DC command is valid.
  AC1 : Analog command valid. When analog torque command is +: CCW rotation
  AC–1 : Analog command valid. When analog torque command is –: CW rotation

6.4.1. RS-232C Communication Command Operation

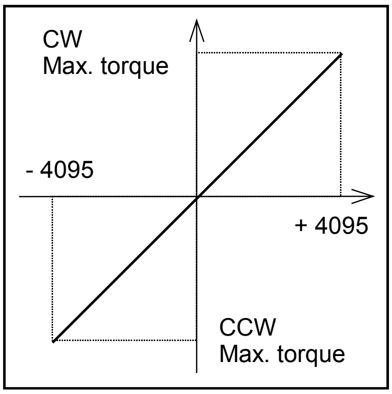
- You may control directly the Motor output torque with RS-232C communication command in the torque control mode.

- Set the parameter AC (AC0) to make the DC command valid.

  Input as
  D C (data) ENT
  to control the Motor with torque proportional to the parameter data.

- Relation between the data of DC command and the Motor output torque is shown in Figure 6-30.

Figure 6-30



- Output torque of the Motor depends on the Motor type.

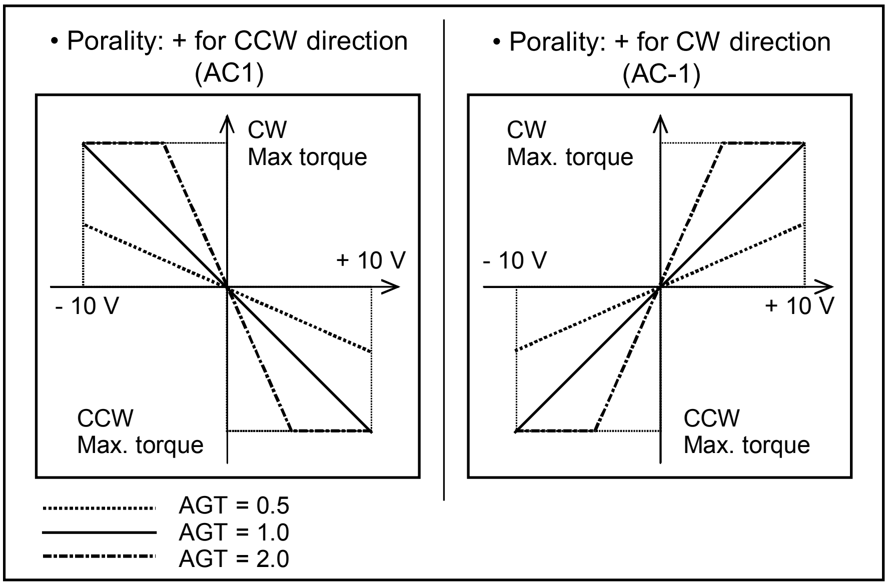
6.4.2. Analog Torque Command Operation

- You may control directly the output torque of the Motor with analog torque command in the torque control mode.
  - ◊ You may set dead band to the command voltage.
    (Refer to "6.4.2.1. Dead Band Set to Analog Command.")
  - ◊ Voltage of analog torque command is ± 10V. Offsetting analog command is possible using an adjusting pod (VR1) on the front panel of the Driver Unit or setting parameter AF. (Refer to "6.4.2.2. Offsetting Analog Command."
  - ◊ The parameter AC selects the polarity of command voltage. (See Table 6-15.)
  - ◊ Relation between the command voltage and the output torque of the Motor may be changed with parameter AGT.
    (Refer to Figure 6-28.)

Table 6-15

DI setting	AC setting	Command voltage	Rotational direction
0	1	+	CCW
0	1	–	CW
0	-1	+	CW
0	-1	–	CCW
1	1	+	CW
1	1	–	CCW
1	-1	+	CCW
1	-1	–	CW

Figure 6-31: Command voltage and output torque

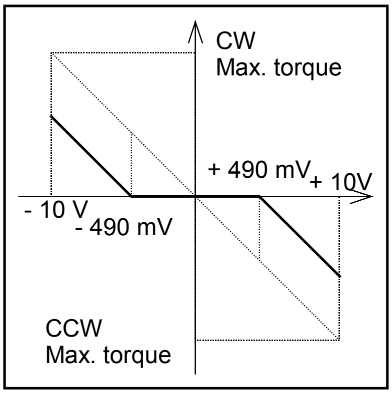


- Output torque of the Motor depends on the Motor type.

6.4.2.1. Dead Band Set to Command Voltage

- You may set dead band to the analog command voltage.
  (Parameter DBA: ± 4.9mVper parameter data.)

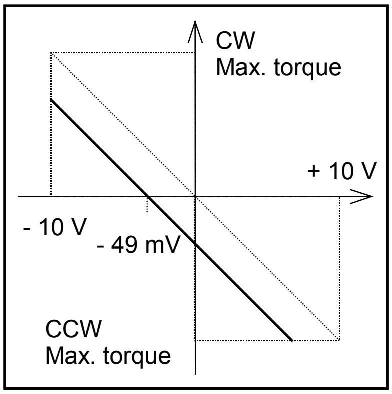
Figure 6-32: Example: DBA100 (AC1)



6.4.2.2. Offsetting Analog Command

- You may adjust offset value of command voltage with the parameter AF.
- Offset adjustment of the Driver Unit has been made at the shipping. With the parameter AF, reset the offset in accordance with the master controller.
- The parameter AF sets the offset value by -4.9 mV per parameter data in the range of AF -63 to AF 63.

Figure 6-33: Example: AF10 (AC1)



(1) Automatic offset setting

- Set the offset value automatically to make the current analog input to 0 (zero).
- Refer to (1) Automatic offset setting in “6.3.2.2.Offsetting Analog Command.”

(2) Manual offset setting

- Adjust offsetting manually with the analog command monitor.
- Refer to (2) Manual offset setting in “6.3.2.2. Offsetting Analog Command.”

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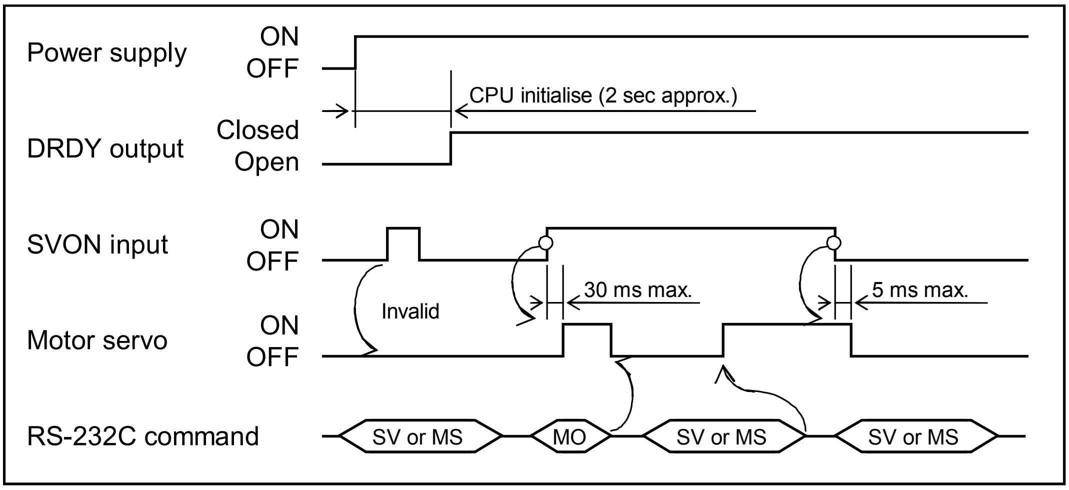
7. Operational Function

7.1. General Operation and Function

7.1.1. Servo ON (SVON) Input

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

Figure 7-1

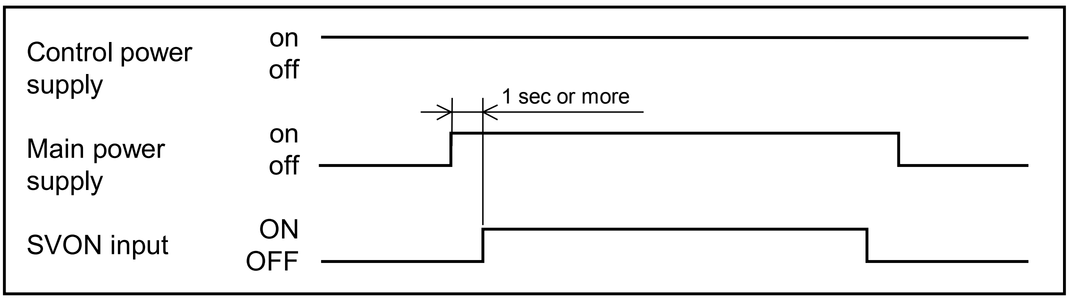


◆ **Precaution when turning on or off the main power supply and the control power supply separately:**

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

* When the main power supply is turned off in the servo-on state, the Driver Unit outputs the AC Line under-voltage alarm. (Once this alarm occurs, it will not recover unless the power is turned on again.)

Figure 7-2

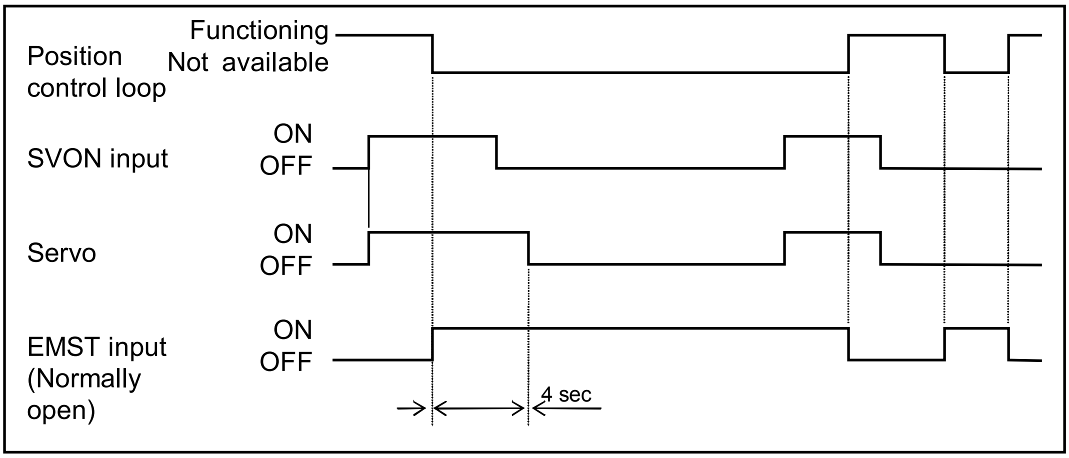


7.1.2. Emergency Stop (EMST) Input

- Turning ON the EMST input terminates the position loop control function and stops the Motor in the servo-lock state* under velocity loop control mode.
- No motion commands will be accepted while the EMST input is ON.
- In the state of emergency stop, the LED on the front panel indicates “F4.” The DRDY output remains unchanged (closed).
- The shipping set of the EMST signal polarity is the normally open contact (A contact). However, you may change it to the normally closed contact (B contact). (Refer to the AB parameter.)

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

Figure 7-3



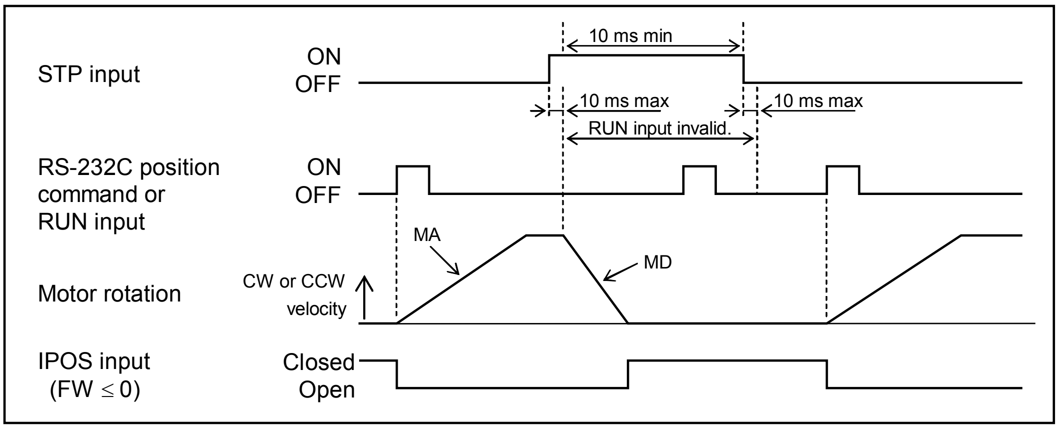
◊ The Motor gets in Servo lock state in velocity loop control for 4 seconds after EMST input is ON even though the SVON input is OFF.

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

7.1.3. Interruption of Positioning (STP)

- Turning ON the STP input will stop the Motor in the middle of a positioning with the RS-232C position command, Programmable Indexer, and Jog.
- Though the shipping set of deceleration of the STP input is to bring a sudden stop, you may alter the its deceleration setting. (Refer to the parameter MD.)
- The STP input is only effective for positioning operations in the RS-232C position command, Programmable Indexer and Jog. It is ineffective for the operation by the pulse train command input or the analog command.

Figure 7-4



◊ The start commands for positioning such as RUN (Positioning start), HOS (Home Return) and JOG (Jog) are ineffective while the STP input is ON.

◊ The STP input may not be accepted when the signal does not remain ON for 10 ms or longer.

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

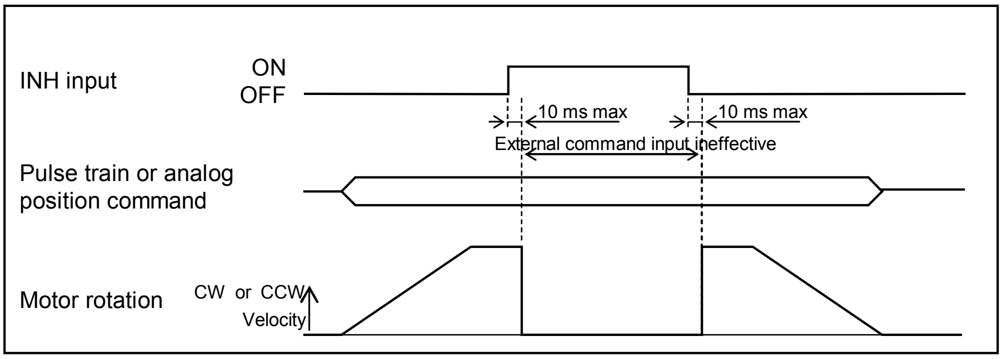
◊ When the acceleration set by the parameter MD is less than the parameter MA, the Motor decelerates along the parameter MA.

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

7.1.4. Making Pulse Train Command or Analog Command Ineffective (INH)

● In case of operation under pulse train position command or analog command, input of the INH signal ON will make an input of external command ineffective.

Figure 7-5



◊ The INH input is only effective on the pulse train and analog position commands.

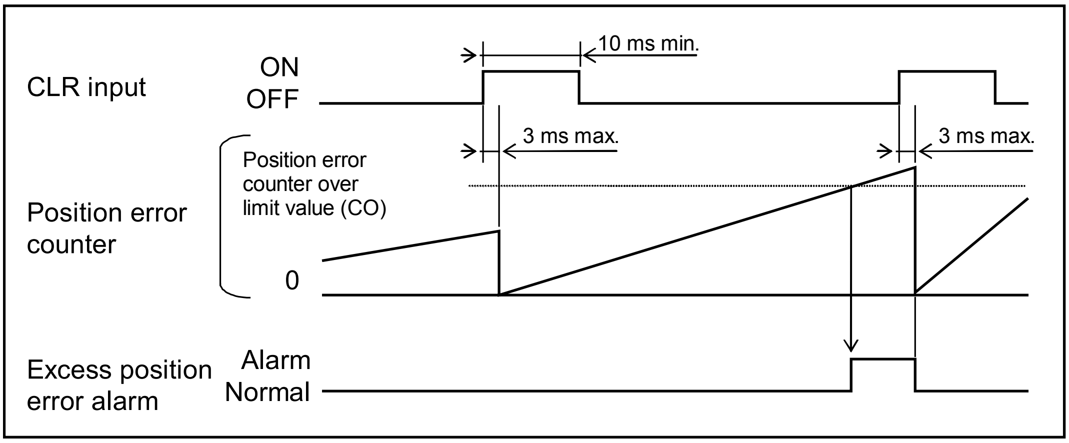
◊ Input command voltage of analog position command will be regarded as 0 volts when the INH input is ON.

7.1.5. Clearing Position Error Counter (CLR)

- In case of the B3 and 23 Driver Units, this function is available to the Input/Output combination type TY4.
- The CLR (clear) input clears the internal position error counter.
- When performing Home Return with a sequence of the master controller, inputting the CLR signal to clear the position error counter simultaneously with detection of øZ signal will help to attain high repeatability of the home position.
- When the excess position error alarm occurs, turning ON the CLR input clears the position error counter and thereby recovering the System from the alarm state.

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

Figure 7-6



- Inputting the CLR ON signal or execution of the CL command can clear some alarms. Refer to “10. Alarms” for those alarms.

7.1.6. Integration OFF/Lower Gain (IOFF) Input

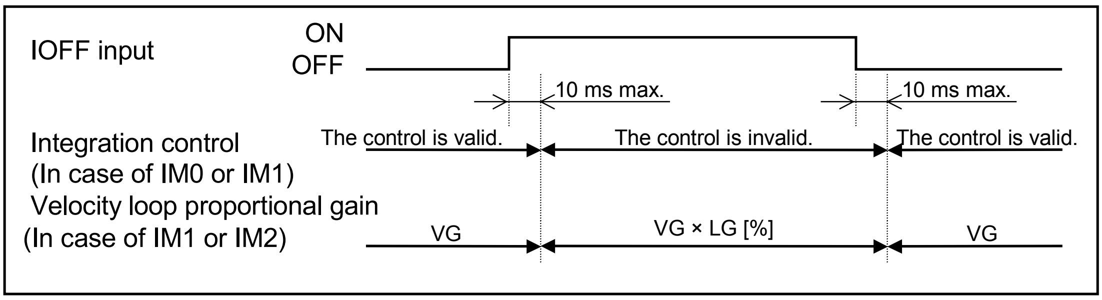
- This function is useful when the brake sequence, that is to say, the case the parameter setting is BF0, is not in use.
- This function switches ON and OFF of the velocity loop integration frequency and lowering velocity loop proportional gain.
- Integral control is essential to obtain the minimum (zero) position error (position deviation) against the objective position. However, if a brake is applied to the Motor when it is stopping, the Driver Unit gives excessive current to the Motor to reach the objective position. If this state unchanged, the Motor eventually will heat up. For this reason, the integration control shall be off when the Motor is mechanically locked.
- Lowering gain is effective in the following case.
  - ◊ The load condition fluctuates greatly during positioning.
  - ◊ The Motor vibrates during stopping because of external force or effect of rigidity.
- The IOFF input controls the integration OFF and the lowering gain function. In addition, parameter IM selects the function when the IOFF input is ON.

Table 7-1

IM setting	Function of IOFF input	Shipping set
IM0	Integration OFF + Lower gain	✓
IM1	Integration OFF	
IM2	Lower gain	

- The integration control (VI) will be invalidated with turning the IOFF input ON when the parameter IM is set to IM0. In addition, the velocity loop proportional gain (VG) will be lowered as well. (VG × LG)
- The integration control (VI) will be invalidated with turning the IOFF input ON when the parameter IM is set to OM1. At this time the velocity loop proportional gain won't lower.
- The velocity loop proportional gain (VG) will lower with turning the IOFF parameter ON when the parameter IM is set to IM2. However the integration control (VI) remains validated. (VG × LG
- It returns in normal state when the input of IOFF is OFF.

Figure 7-7



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

7.1.7. Brake-off (CLCN) Input

- This is a function for a Motor equipped with brake. Refer to “7.1.10. Brake” for the brake.
- This function is effective when the brake sequence is selected, that is to say, when the parameter settings are TY8 and BF1 for the B3 and 23 type Driver Units. This function is also effective for the B5 and 25 type Driver Units when the parameter BF1 is specified.
- The brake is off when the CLCN input is ON, thus closing the BRKC output.
- The brake must be off by activating the CLCN signal ON before performing Jog, pulse train command or analog command operations. The brake error (A8) alarm arises when one of above operations starts leaving the CLCN input is OFF (brake-on).
- When the CLCN input is changed to OFF from ON in the middle of above operations, the System interrupts the operation, the Motor brakes, and then the brake error alarm arises.
- The CLCN input does not need to be ON in case of Home Return, Programmable Indexer positioning operation or RS-232C communication positioning operation. The System controls the brake sequence function along the Motor motion.

Figure 7-8: CLCN input signal timing in Jog operation

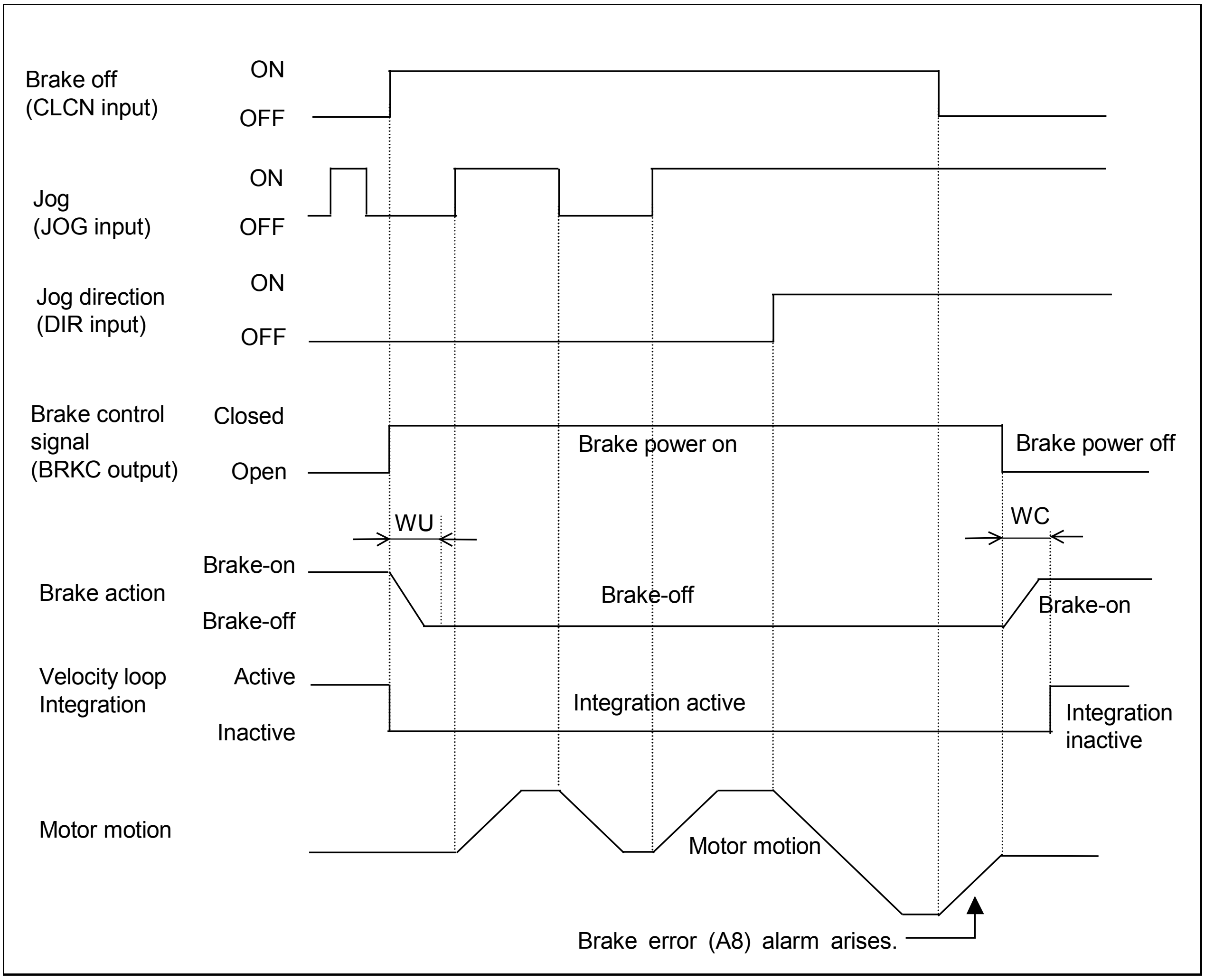
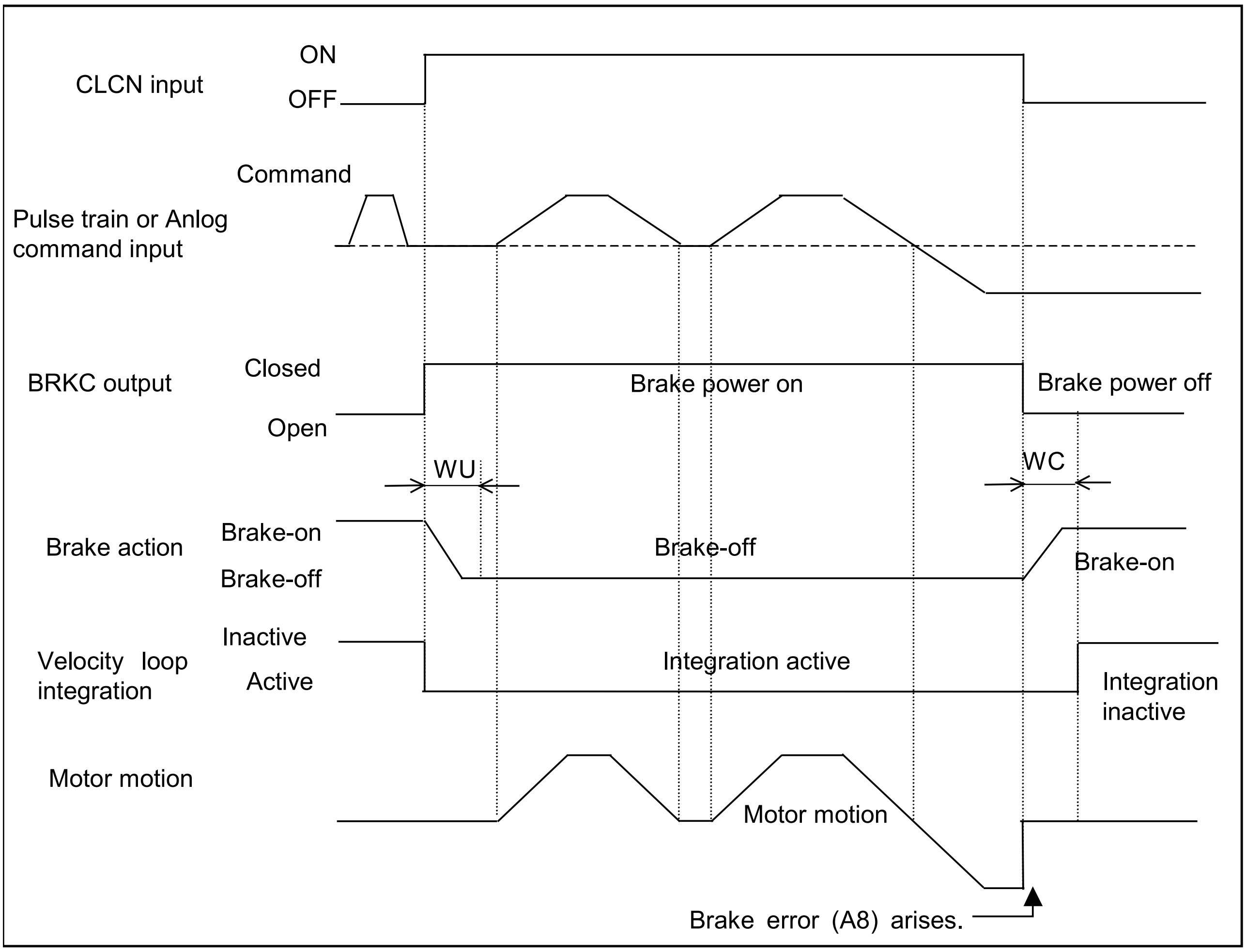


Figure 7-9: CLCN input signal timing in pulse train command operation and analog command operation



7.1.8. Over Travel Limit

7.1.8.1. Hardware Over Travel Limit Sensor (DTP and OTM) Input

- In case of the B3 and 23 Driver Units, this function is available to the Input/Output combination of TY3, TY4 and TY7 types.
- Use the OTP and OTM inputs to provide off-limits zone for the Motor rotation range.
- If the OTP input is activated, the Motor will stop immediately in the servo lock state. The Motor may be rotated counterclockwise only.
- If the OTM input is ON, the Motor will stop immediately in the servo lock state. The Motor may be rotated clockwise only.

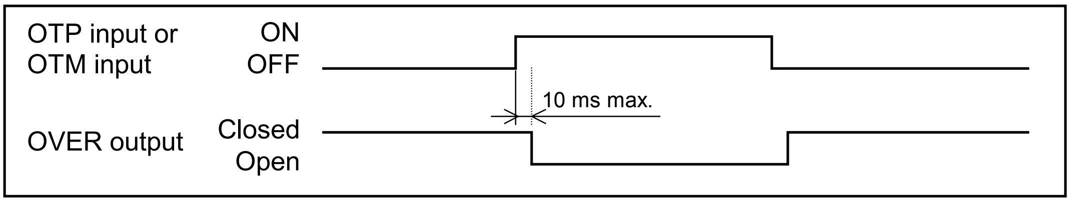
* The shipping set of polarity of the OTP and OTM input ports is the normally open contact. It may be changed to the normally closed contact. (Refer to the section of the AB parameter.)

- The parameters HT and TO specify the state of alarm when the over travel limit activates as shown Table 7-2 below.

Table 7-2: Alarm

Over Travel Limit	Parameter setting (✓: shipping set)	Alarm output		Indicator on front pannel
		DRDY	OVER	
Hardware over travel limit	HT0	Not available	Not available	F3
	HT1	Open	Not available	
	HT2 ✓	Not available	Closed	
Software over travel limit	TO1	Open	Not available	F2
	TO2 ✓	Not available	Closed	

Figure 7-10



⚠ *Caution: When the OTP or OTM input is activated in the middle of Home Return operation, the Motor exceptionally decelerates and reverses its motion normally without interrupting the operation. Refer to “6.2.1.2. Setting Home Position by Home Return” for the detail.*

7.1.8.2. Software Over Travel Limit

⚠ *Caution: The over travel zone should be 10000 [pulses] or wider. When the over-travel zone is too narrow the Motor may turn through the off-limits zone. Set the over travel limits with ample margin, giving consideration to the overshoot of the mechanism controlled by the Motor.*

⚠ *Caution: In case of a short cut positioning that is set with the AD or the AR command, the Motor rotates in the direction to avoid the off-limits zone regardless of moving distance if the software over travel limit specifies the off-limits zone.*

- This function becomes valid when Home Return or the AZ command specifies the home position. For the B3 and B5 type Driver Units, however, this function is effective as soon as the power is turned on because they are compatible with the absolute position sensor.
- Use the OTP and the OTM commands to specify the position data of over-travel limit.

◆ **Way of setting: Setting by teaching**

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

(1) Turn off the Motor servo.

M O ENT

```
:MO
:_
```

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

(3) Input the password.

/ N S K SP
O N ENT

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

(4) Input the present position as the over travel limit on the plus side. The position data of over travel limit appears on the display.

O T P / S T
ENT

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

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

(6) Input the password.

/ N S K SP
O N ENT

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

(7) Input the present position as the over travel limit on the minus side. The position data of the over travel limit appears on the display.

O T M / S T ENT →

```
:OTM/ST
 OTP123456
 OTM456789
:_
```

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

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

◆ Setting by position data

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

/ N S K SP O N ENT →

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

O T P 1 2 3 4 5 6 ENT →

```
:/NSK ON
 NSK ON
:OTP123456
:_
```

/ N S K SP O N ENT →

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

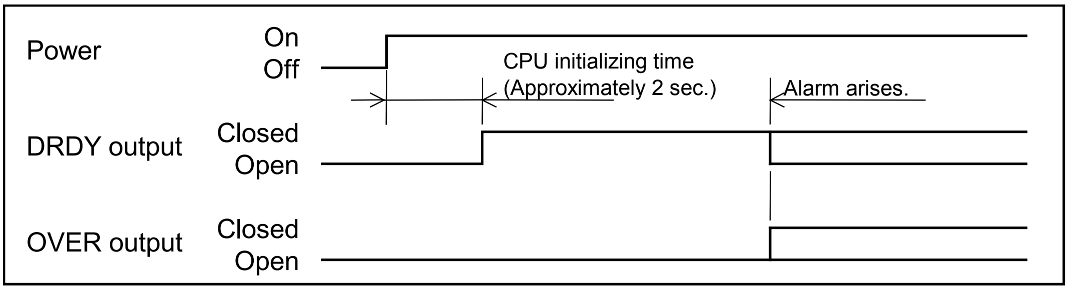
O T M 4 5 6 7 8 9 ENT →

```
:/NSK ON
 NSK ON
:OTM456789
:_
```

7.1.9. Alarm Output (DRDY and OVER)

- Following completion of initialization of the CPU after the power is on, the DRDY output closes and the OVER output opens if the Driver Unit is in normal state.
- When an alarm arises, the status of the DRDY and the OVER outputs will change. Way of change depends on the contents of alarm. (Refer to “10. Alarm.”)
- Connect alarm signals to the alarm input ports of the master controller.

Figure 7-11:



- In case of the B3 and the 23 Driver Unit, the BF and the OM parameters set an output among OVER, BRK/BRKC, NEARA, and SPD to OUT1 output.
- The OUT1 output will be set as the OVER output by the setting of BF0 and OM3 parameters if the I/O combination type is TY8.
- The OUT1 output will be set as the OVER output by the setting of OM3 parameter if the I/O combination type is other than TY8.

7.1.10. Brake

7.1.10.1. YSB Series Megatorque Motor Equipped With Brake

- The brake for YSB series Motor is an electromagnetic type that activates when current to a coil is off (power-off activated type). The brake features non-backlash.

- You may use the brake to stop the Motor in case of an emergency such as sudden power shutdown or occurrence of serious error alarm when the Motor is in motion.

  ⚠ *Caution: Use of the brake to stop the Motor is for the emergency only. You may not use the brake for frequent everyday operation.*

- The brake can be used as an auxiliary measure for the position holding rigidity when the Motor is stationary under positioning operation. In such a case use the brake control (BRKC) output for the brake control signal.

7.1.10.2. Brake Output (BRK)

- This is the output signal for emergency stop of the Motor when sudden shutdown of the power or serious alarm occurs. Use this signal to control ON/OFF of brake power.

- For the B5 and the 25 Driver Units, the BF0 parameter makes the BRK output effective.

- When the I/O combination type is other than TY8 for the B3 and the 23 Driver Units, the OM0 parameter makes the BRK output effective.

- When the I/O combination type is TY8 for the B3 and the 23 Driver Units, the parameters BF0 and OM0 make the BRK output effective.

- The BRK output is a normally closed output, but it opens in the following cases to prevent racing of the Motor.

  (1) SVON input: OFF.

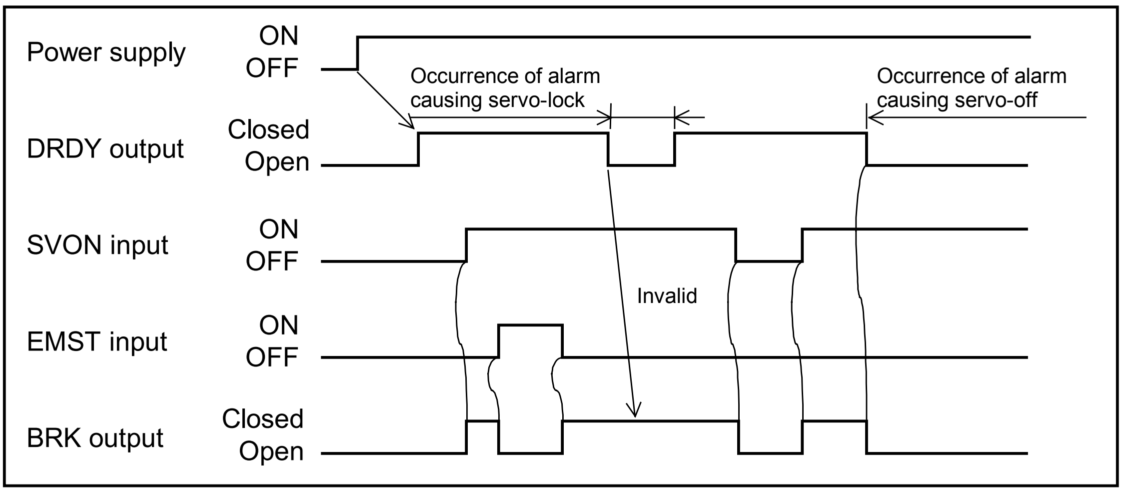
  (2) Initilizing the System after the power is turned on.

  (3) When SVON input is OFF or the servo is off because of the MO command input.

  (4) Occurrence of alarm that makes the servo off.

  (5) EMST input is ON.

Figure 7-12: Signal timing of BRK output



7.1.10.3. Brake Control Output (BRKC)

- This is an output signal to control the brake for an auxiliary measure for the position holding rigidity when the Motor is stationary under positioning operation. Use the output to control on and off of the brake power.
- For the B5 and the 25 Driver Units, the BF0 parameter makes the BRKC output effective.
- When the I/O combination type of the B3 and the 23 Driver Units is other than TY8, the BRKC output is not available.
- When the I/O combination type of the B3 and the 23 Driver Units is TY8, the parameters BF1 makes the BRKC output effective.
- The brake sequence function, which is shown in he following paragraph, changes the BRKC output along with the positioning operation of the Motor.

7.1.10.4. Brake Sequence Function

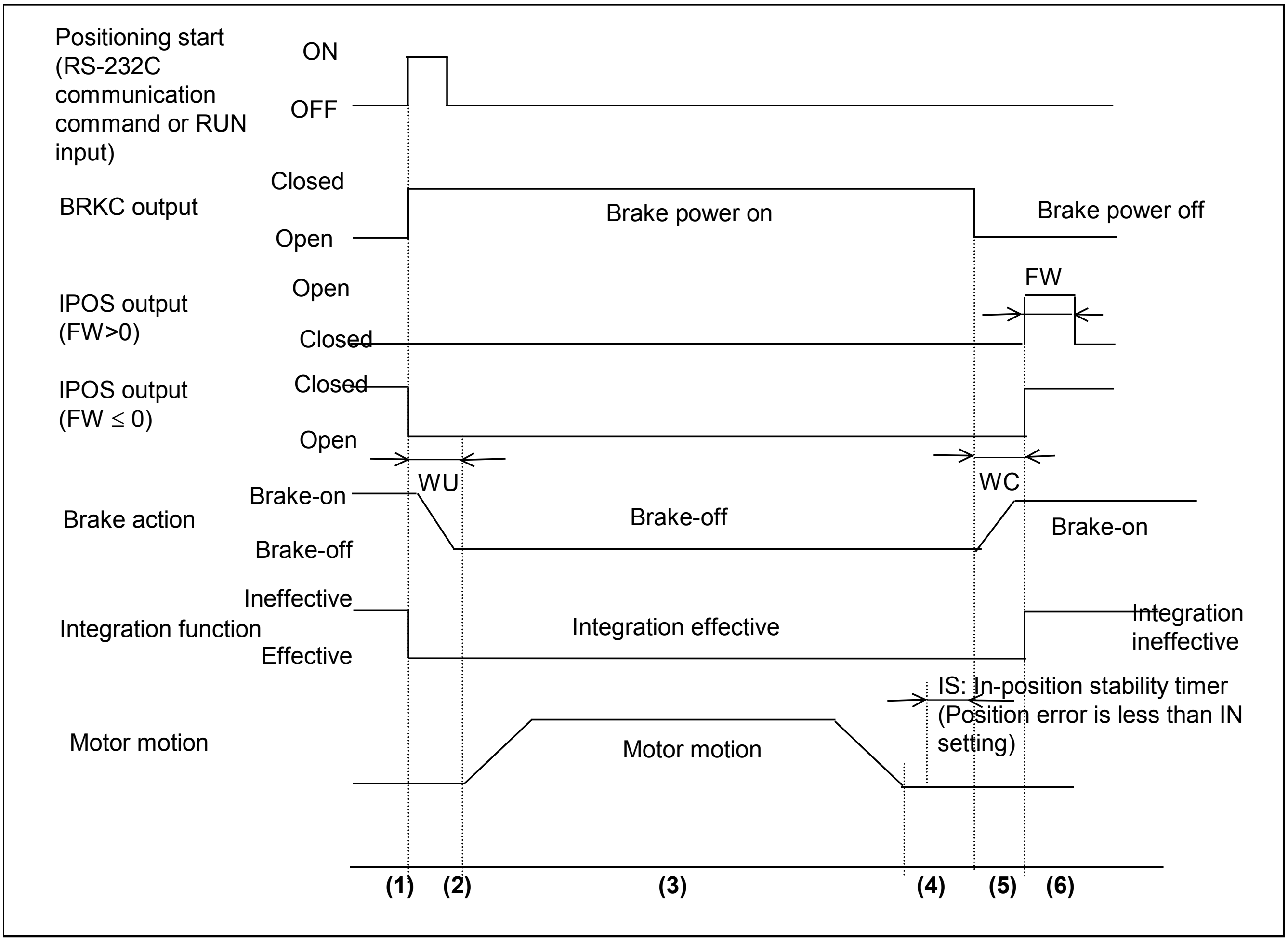
- This function makes the Driver Unit possible to process automatically the brake control such as Brake on/off and Integration ON/OFF that is required for positioning operation of the Motor equipped with the brake.
- The conditions that make the function effective are the same as those of the BRKC output.
- This function is effective for Programmable Indexer positioning, RS-232C communication command positioning and Home Return.
- This function is not effective for pulse train command operation, and velocity/torque control mode operation. Make the brake off by the CLCN input ON when performing those operations.
- The commands and parameters, and Input/Output signals related to the brake sequence are listed in Table 7-3 below.

Table 7-3: Command/parameter and Input/Output signal related to brake sequence

Item	Function
Parameter BF	Selects function of brake sequence.
Parameter WC	Sets time delay for brake-on.
Parameter WU	Sets time delay for brake-on.
Command KB	* For maintenance only: Makes the brake sequence ineffective and unconditionally release the brake.
CLCN input	Input signal for releasing brake
BRKC output	Output signal to control ON/OFF of the brake power.

● Figure 7-13 below shows basic signal timing of the brake sequence.

Figure 7-13: Signal timing of brake sequence



(1) The Motor starts rotation by the RUN input or the HOS input.

(2) • The BRKC output opens and releasing brake action starts.
• The integration function becomes effective.
• The IPOS output changes to open state from closed state when the IPOS mode or CFIN mode (FW ≤ 0) is specified.
• Start of the Motor is delayed for a set time by the parameter WU.

(3) The Motor performs the positioning operation.

(4) Confirms completion of positioning in accordance with settings of the parameters IN and IS. (Refer to "7.1.11. In-position Output.")

(5) The BRKC output opens from closed state and starts braking Motor.
The integration function remains effective for a time set by the parameter WC.

(6) The integration function becomes ineffective.

• The IPOS output is closed for a time set by the parameter FW in case of the FIN mode (FW > 0).
• The IPOS output changes to closed state from open state in the IPOS or CFIN (FW ≤ 0) mode.

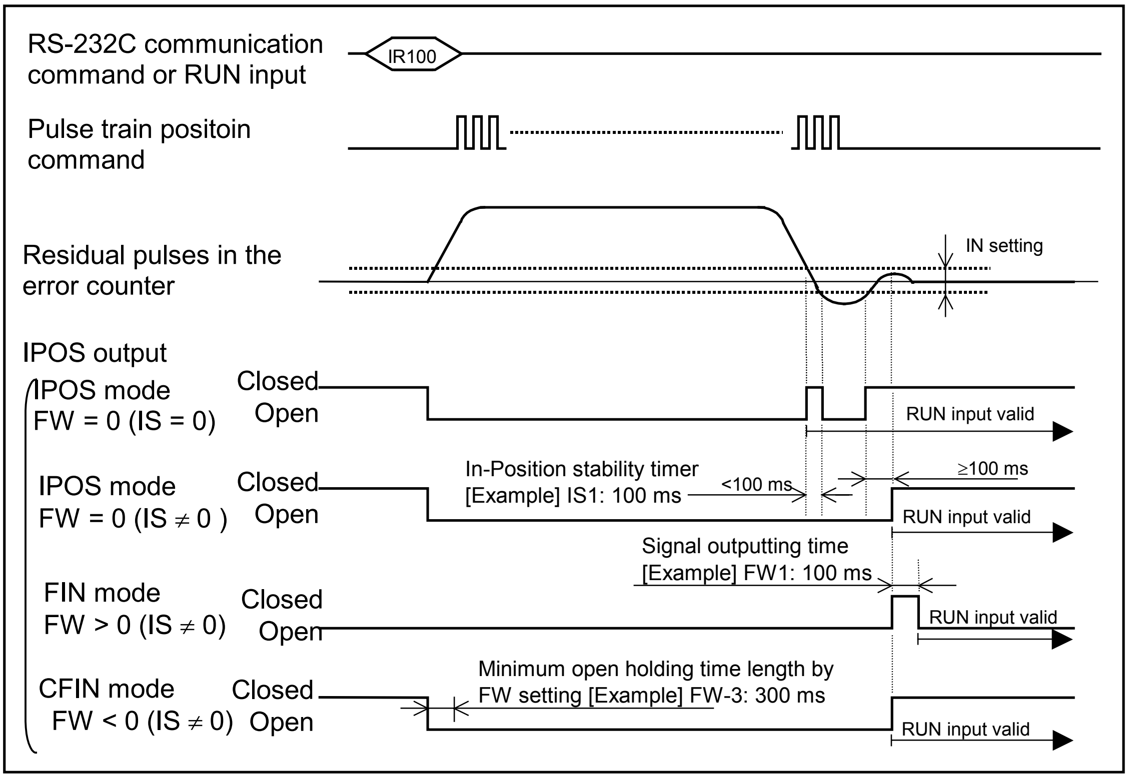
7.1.11. In-Position Output (IPOS)

- The following parameters set conditions to output the In-Position (IPOS) signal.

Table 7-4: Parameters related to IPOS output

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

Figure 7-14: IPOS output signal timing



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

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

⚠ *Caution: The Motor equipped with brake stops at the position few pulses off from a programmed position due to the braking action. When IPOS mode is selected and a small data is set to the parameter IN, the IPOS may change to open from closed state at the moment of brake-on. If this becomes a problem, select the CFIN mode.*

7.1.11.1. Output Signal Format

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

- The format is to indicate if there is a difference between the position command and the current position.
- The IPOS output will close only when the residual pulses in the position error counter are equal or under the range set by the parameter IN, it is on in other states.
- However, the IPOS output is forcibly opened in the following cases even the residual pulses in the error counter are equal or under the range set by the parameter IN.
  - ◊ Positioning operations by Programmable Indexer, Home Return, Jog, and RS-232C communication positioning.
  - ◊ The EMST input is ON.
  - ◊ The Motor servo is off.
- In case of positioning by the pulse train command input, the IPOS output closes when the residual pulses are equal or under the IN data even the pulses are being input.
  (In the low velocity operation or the feed forward control [parameter FF], the IPOS signal tends to close.)
- The IPOS output won't close when the positioning is interrupted by the following causes.
  (The IPOS output closes when the following state is cleared.)
  - ◊ The EMST input is ON.
  - ◊ The Motor servo is off.
  - ◊ An alarm occurs.

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

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

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

- The IPOS output reports that a positioning has completed.
- The IPOS output opens when the pulses are generated internally by the start positioning command, and it closes when completion of the positioning is detected.

- It is possible to set a minimum holding time to the parameter FW to confirm the IPOS signal remains open even in a very short time positioning. (The data is in unit of 100 [ms]. The FW-1 means that the time is 100 ms.)

7.1.11.2. Parameter IN

- The parameter IN is to decide positioning accuracy.
- The IPOS signal closes if the residual pulses of error counter are in the range of value of the IN.
- The unit of data of the parameter IN is the resolution (pulses) of the position sensor.

Table 7-5 *[Unit: pulse/r]*

Motor series	Resolution
YSB	819 200

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

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

$$= \frac{819\ 200}{360} \times \frac{100}{3600} = 63\ \text{[pulse]}$$

7.1.11.3. Parameter IS

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

7.1.11.4. IPOS Output in Special Occasion

1 When 0 (Zero) movement operation is executed.

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

1) IPOS mode IS = 0

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

2) IPOS mode IS ≠ 0

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

3) FIN mode

◊ Even no internal pulse is generated, the IPOS output signal always opens for a time set by the parameter FW in case of a positioning caused by the start command.

4) CFIN node

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

2 Sequential operation* for Programmable Indexer

1) IPOS mode

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

2) FIN mode

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

3) CFIN mode

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

7.1.12. Completion of Home Return / Detection of Home Position (HOME)

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

1 Report mode for completion of Home Return (Parameter HW is set to HW0.)

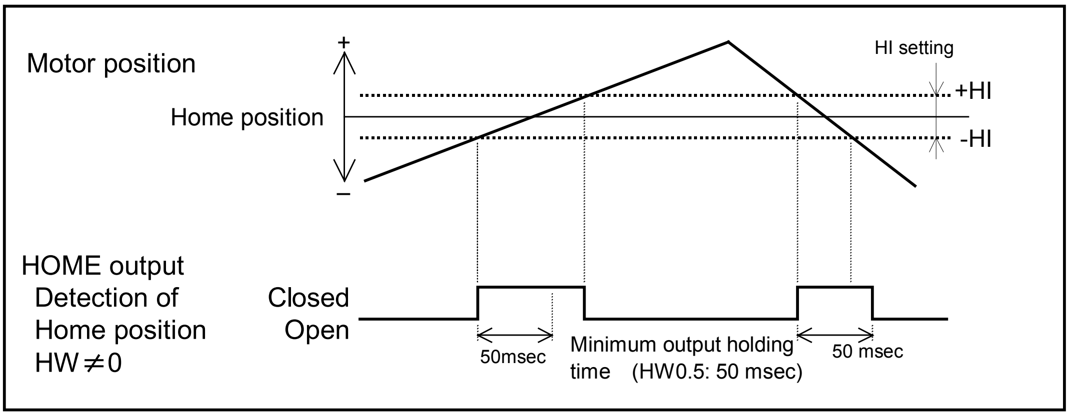
- This mode is to report completion of Home Return.
- The HOME output closes when Home Return completes.
- After completion of Home Return, the Home output opens when the Motor is off the Home position by a moving command.
- Once the HOME output opens, it remains open by the moment of the next Home Return.

■ Refer to “6.2.1.2. Setting Home Position by Home Return” for the operational timing.

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

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

Figure 7-15: Sequential timing of HOME output



◊ The HOME output won’t close if the Home position is not defined.

7.1.13. Definition of Home Position (HCMP)

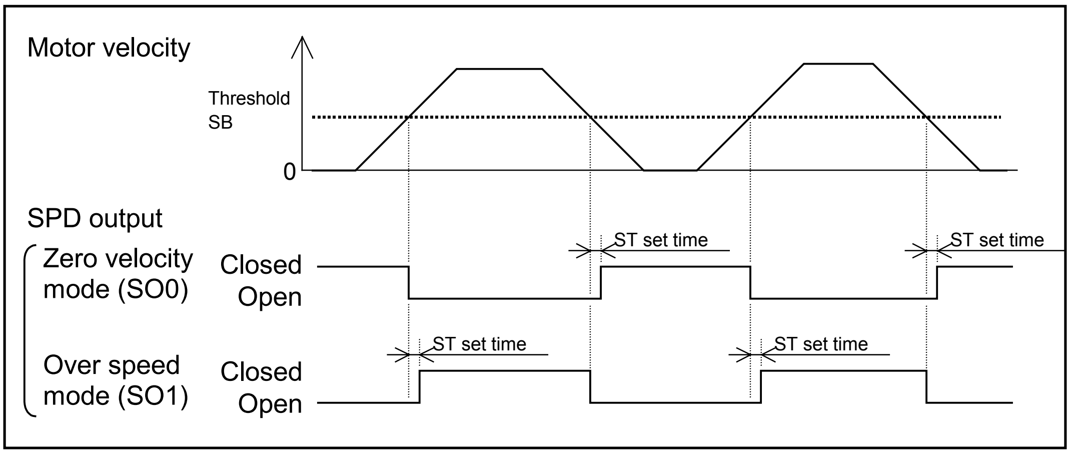
- This is a control signal to inform externally that the home position is defined.
- The HCMP output closes when the home position is defined with Home Return, etc.
- The System corresponding to absolute position sensor closes the HCMP output as soon as the DRDY signal outputs after the power is turned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

■ Refer to "6.2.1.2. Definition of Home Position by Home Return" for sequential timing.

7.1.14. Velocity Threshold (SPD)

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

Figure 7-16: Sequential timing of SPD output

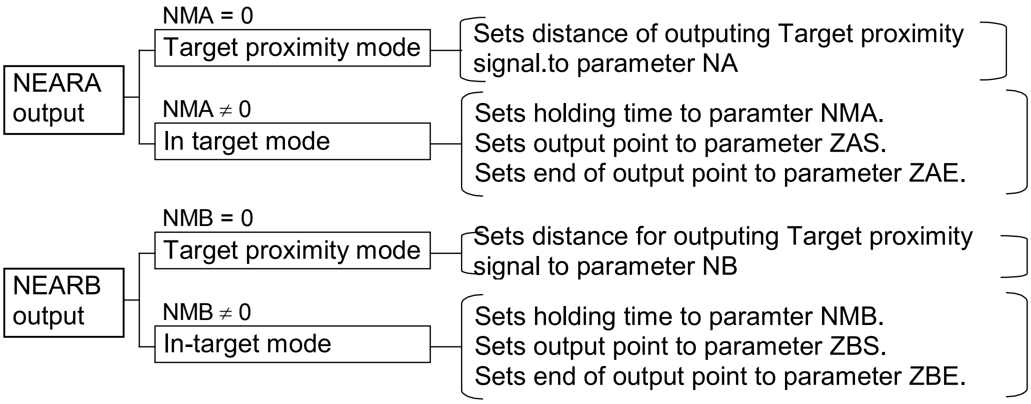


- For the B3 and 23 Driver Units, the SPD output has the following restrictions.
  - ◊ In case of I/O combination type is besides TY8, the output signal is valid when the output port setting parameter is OM1.
  - ◊ In case of I/O combination type is TY8, the output signal is valid when the parameters are BF0 and OM1.
  - ◊ It cannot be used with the outputs of BRK/BRKC, NEARA and OVER.

7.1.15. Target Proximity/In Target (NEARA and NEARB)

- These are control signals that report the Motor is nearing, or in the target zone.

- The parameters NMA and NMB select the target proximity mode or the In-target mode for two points of NEARA and NEARB respectively.



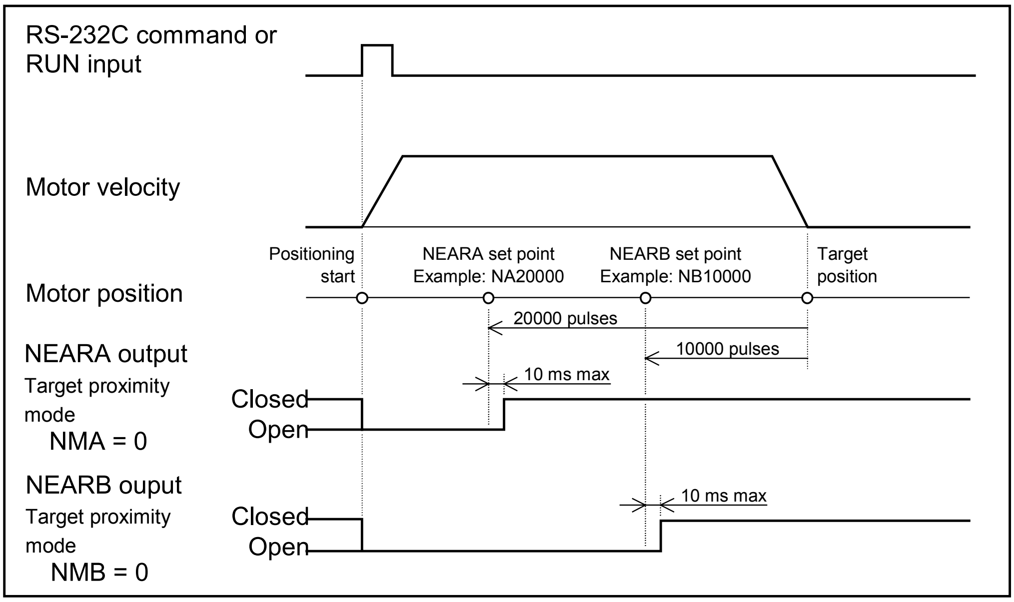
- For the B3 and 23 Driver Units, there are following restrictions for the NEAR output.
  - ◊ In case of I/O combination type is besides TY8, the output signal is valid when the output port setting parameter is OM2.
  - ◊ In case of I/O combination type is TY8, the output signal is valid when the parameters are BF0 and OM2.
  - ◊ It cannot be used with the outputs of BRK/BRKC, NEARA and OVER.
  - ◊ The output is limited to NEARA only.

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

- This is to report that the Motor is nearing a target position in positioning with Programmable Indexer or the RS-232C communication command.

- The criterion of the proximity will be set by NA or NB in unit of pulse.

Figure 7-17: Sequential timing of NEARA and NEARB output (Target proximity mode)



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

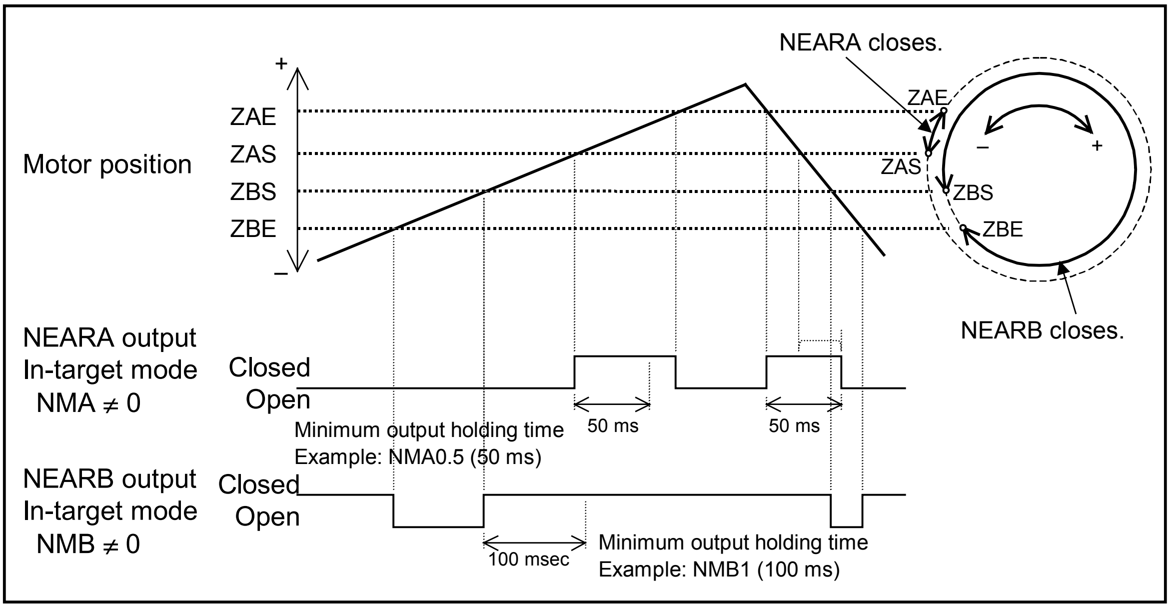
◊ When the Motor gets in the target area and then the output once closed, it remains closed until an input of next positioning command.

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

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

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

Figure 7-18: Sequential timing of NEARA and NEARB outputs



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

◊ If the coordinate data of ZAS and ZAE, or ZBS and ZBE are the same, the signal outputs for only one point on the coordinate.

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

Setting of In-target output:

◆ Setting in teaching

- Follow the procedure below after completion of Home Return.

Set the NEAR output to In-target mode. It will be set to the In-target mode if the settiing of minimum output holding time NMA is besides 0 (zero).
(Example: Set to 100msec.)

/ N S K SP
O N ENT

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

N M A 1 # ENT

```
:NMA1
:_
```

2) Turn the Motor servo OFF.

M O ENT

```
:MO
:_
```

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

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

Z A S / S T
ENT

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

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

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

Z A E / S T
ENT

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

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

◆ Setting with the coordinate data

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

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

/ N S K SP
O N ENT

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

N M A 1 ENT

```
:NMA1
:_
```

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

Z A S 1 2 3
4 5 6 ENT

```
:ZAS123456
:_
```

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

Z A E 4 5 6
7 8 9 ENT

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

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

7.1.16. Position Feedback Signal

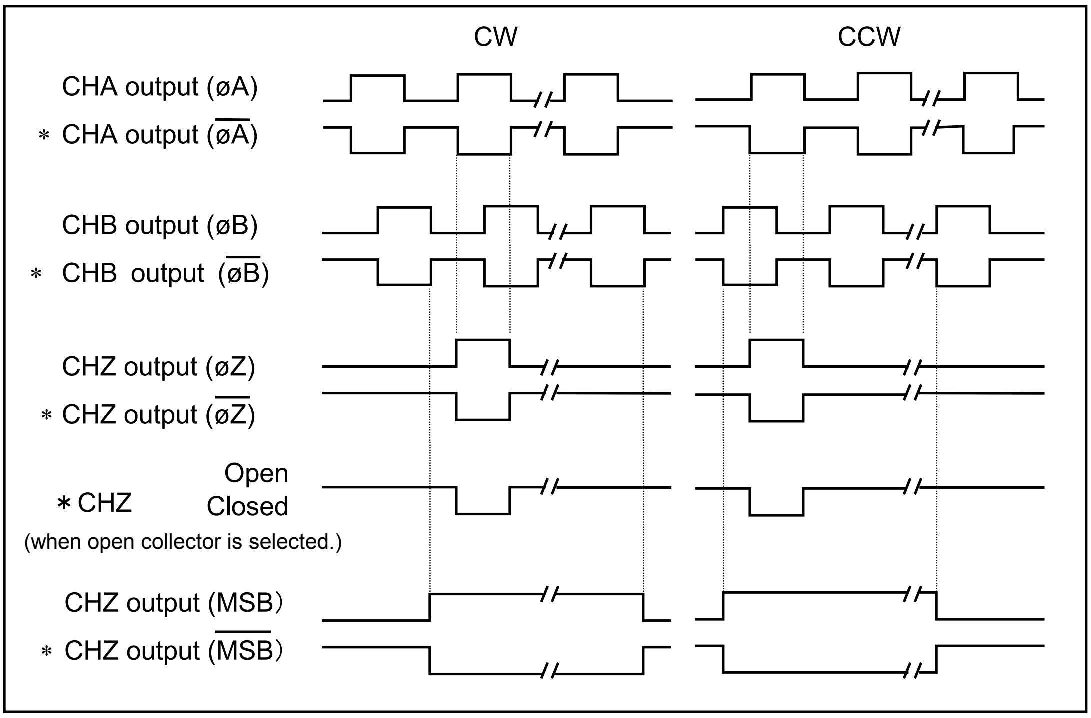
● Resolution

Table 7-6 *[Unit: Pulses/rev.]*

øA and øB	øZ
51 200	50

● Output timing

Figure 7-19: Timing of position feedback signal



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

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

7.1.17. Analog Velocity Monitor

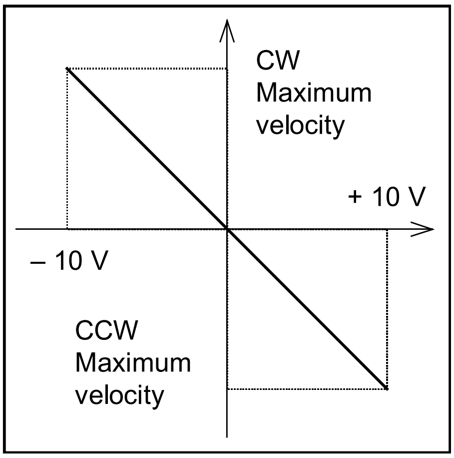
- The voltage between check pins VEL and GND provided on the front panel of ESB Driver Unit monitors velocity of the Motor.

Table 7-7

Item	Monitor output	Description
Analog velocity monitor	Front panel VEL (GND) terminal	• Velocity of the Motor may be monitored by the analog waveform.

- ±10V is only a typical value and actual reading may slightly vary. Analog waveform does not precisely represent the velocity.

Figure 7-20: Analog velocity monitor



7.1.18. Monitoring via RS-232C Communication

- Several monitoring can be done via the RS-232Ccommunication.

Table 7-8: Monitor function by RS-232C communication command

Item	RS-232C command	Description
Control Input/Output	IO	• Monitors state of control Input/Output (ON and OFF) of CN2 and CN5connectors.
Pulse train input counter	RP	• Monitors real time data in hardware counter of pulse train input.
Current position	TP	• Reports real time readout of current position in the absolute coordinate system.
Position error counter	TE	• Monitors real time data of the position error counter.
Motor velocity	TV	• Monitors real time Motor velocity.
Torque / Thermal loading	TT	• Monitors the torque command and data of thermal loading in real time.
State of automatic gain switching	TG	• Monitors real time state of automatic gain switching function between the VG and the VGL gains.
Setting of parameters	TS	• Monitors settings of servo parameters and positioning parameters.
Identification of alarm	TA	• Identifies an alarm.
Contents of a channel	TC	• Reads out the contents of a program channel.
State of program execution	DP	• Checks changes in control Inputs/Outputs and history of program execution.

* Refer to "8. Glossary of Command and Parameter" for details of the RS-232C communication command.

7.1.18.1. Monitoring Control Input/Output Signals (B3 and 23 Driver Units)

- State of Input and Output signal of CN2 connector can be monitored by the IO command
- This function is useful for checking the wiring.
- Input format: IO/RP
  /RP default: Monitors the I/O state only once.
  /RP attached: Monitors the I/O state in real time.
- Readout format: Bit map representing Input/Output in 1 line. (See Table 7-9 below.)

Figure 7-21: Monitoring example by IO command

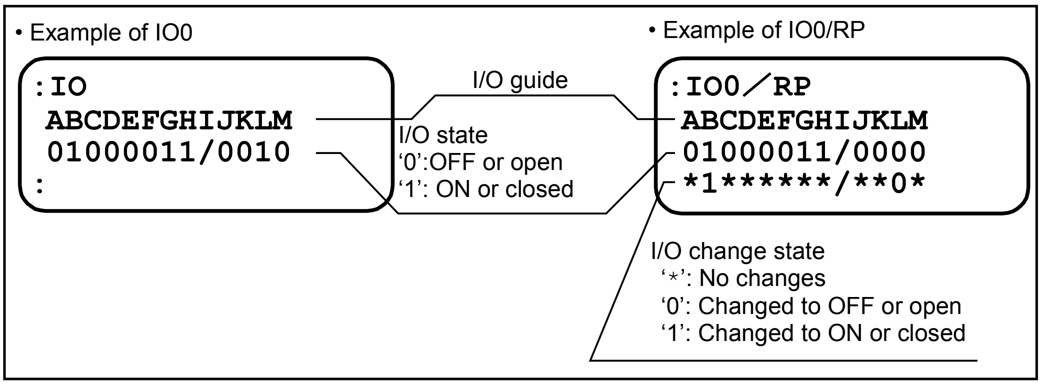


Table 7-9: Readout format (B3 and 23 type Driver Units)

Parameter TY	A	B	C	D	E	F	G	H	I	J	K	L	M
1	SVON	EMST	RUN	HLS	PRG3	PRG2	PRG1	PRG0	/				
2	SVON	EMST	RUN	HLS	PRG3	PRG2	DIR	JOG	/				
3	SVON	EMST	RUN	HLS	PRG3	PRG2	OTM	OTP	/	DRDY	OUT1 *2	IPOS	Reserved
4	SVON	EMST	RUN	HLS	HOS	CLR	OTM	OTP	/				
7	SVON	EMST	RUN	HLS	DIR	JOG	OTM	OTP	/				
8	SVON	EMST	RUN	HLS	IOFF *1	PRG2	PRG1	PRG0	/				

*1: Changes to the CLCN when the parameter is set to BF1 (brake sequence).
*2: OUT1 corresponds to one of outputs among BRK, BRKC, OVER and SPD.

Table 7-10: Meaning of data

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

7.1.18.2 Monitoring Control Input/Output Signals (B5 and 25 Driver Units)

- State of Input and Output signals of connector CN2 can be monitored by the IO command.
- This function is useful for checking the wiring.
- Input format
  IO0/RP: Monitors general I/O state.
  IO2/RP: Monitors I/O state related to positioning with Programmable Indexer.
  IO3/RP: Monitors I/O state related to positioning in general.
  /RP default: Monitors in one shot.
  /RP attached: Monitors in real time.
- Readout format: Bit map representing Input/Output in 1 line.
  (See Table 7-11.)
  - ◊ The readout is the current Input/Output state.
  - ◊ The line of "I/O change state" on the display in Figure 7-22 holds the first readout state on each Input/Output to indicate that this part was changed at least once before.
  - ◊ Press the BS key to terminate the real time monitoring (IO*/RP).
  - ◊ Press the R key to reset the monitored state in the Input/Output changing state.

Figure 7-22: Monitoring example by IO command

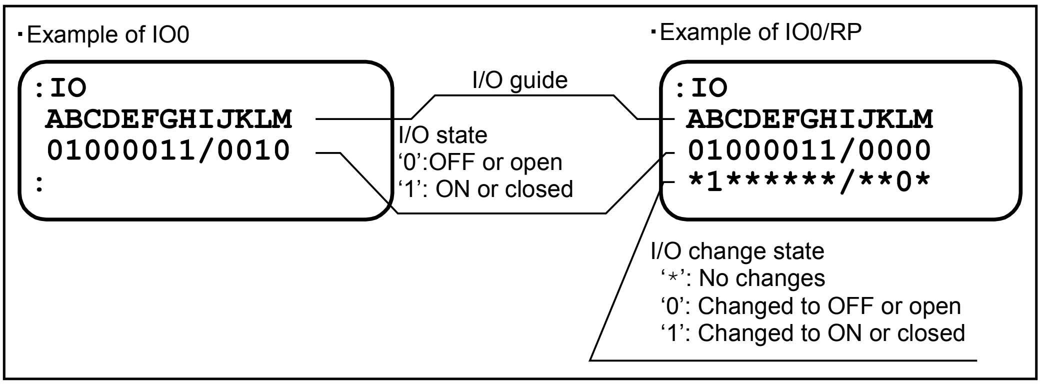


Table 7-11: Contents of I/O command readout (B5 and 25 type Driver Units)

IOn	A	B	C	D	E	F	G	H	I	J	K	L	M	N
0	SVON	EMST	IOFF *1	HLS	HOS	CLR	OTM	OTP	/	DRDY	BRK *2	IPOS	HOME	-
2	PRG5	PRG4	PRG3	PRG2	PRG1	PRG0	RUN	STP	Re-served	Re-served	/	IPOS	NEAR A	NEAR B
3	JOG	DIR	RUN	HOS	STP	INH	Re-served	/	DRDY	OVER	IPOS	SPD	HOME	HCMP

*1: Changes to the CLCN when the parameter is set to BF1 (brake sequence).
*2: OUT1 corresponds to one of outputs among BRK, BRKC, OVER and SPD.

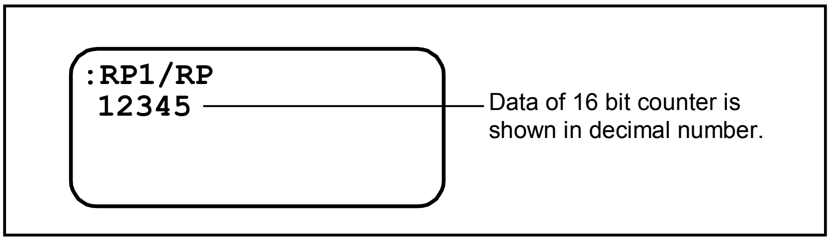
Table 7-12: Meaning of data

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

7.1.18.3. Monitoring Pulse Train Input Counter

- The RP command monitors state of the pulse train command input.
- The data in 16-bit counter will be shown.
- This is useful to check the wiring and the programs in the controller that generates pulse train.
  - ◊ Input format
    - RP0/RP: In decimal number (0 to 65 535)
    - RP1/RP: In hexadecimal number (0000 to FFFF)
    - /RP default: Reads out in one shot.
    - /RP attached: Real time readout.
  - ◊ Press the BS key to terminate the real time readout (RP*/RP).
  - ◊ Reported number cannot be reset because it is the data in hardware counter.

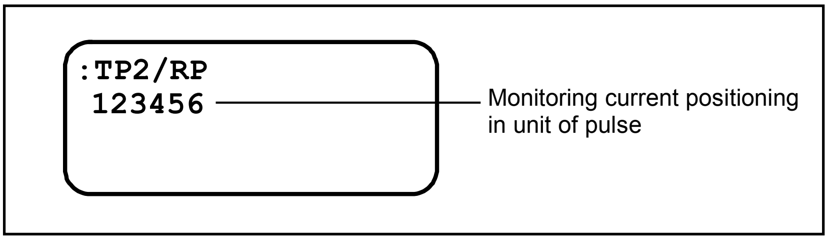
Figure 7-23: Monitor example: RP1/RP



7.1.18.4. Monitoring Current Position

- The TP command monitors the coordinate data of current position.
- This is useful to check the stopping position of the Motor, or to confirm coordinate data that is set by direct teaching.
  - ◊ Input format
    - TP0/RP: Readout of the Motor position scale in unit of pulse. (Available for the B3 and B5 Driver Units only)
    - TP2/RP: Readout of the user position scale in unit of pulse.
    - TP5/RP: Readout of the user position scale in unit of angle degree. (1/100 degree)
    - TP6/RP: Simultaneous readout of the user position scale in unit of pulse (Upper line) and position error (Lower line)
    - /RP default: One shot readout
    - /RP Attached: Real time readout.
  - ◊ Press the BS key to terminate the real time monitoring (TP*/RP).
  - ◊ You may not rest the readout because it is the data in the hardware counter

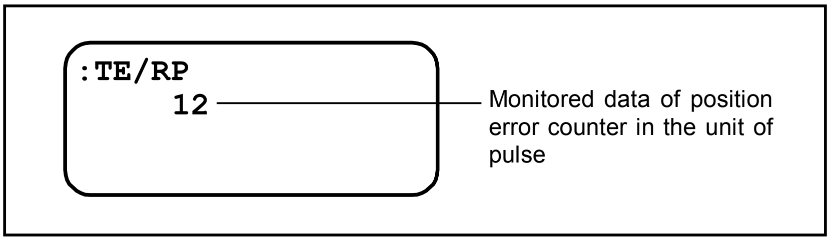
Figure 7-24: Example of monitoring current position (TP2/RP)



7.1.18.5. Monitoring Position Error Counter

- The command TE reads out the data in the position error counter.
- This is useful to check the settling state in positioning (state in approaching a target position).
  - ◊ Input format
    TE/RP
    /RP default : One shot readout
    /RP attached: Real time readout
  - ◊ Press the BS key to terminate the real time readout (TE/RP).

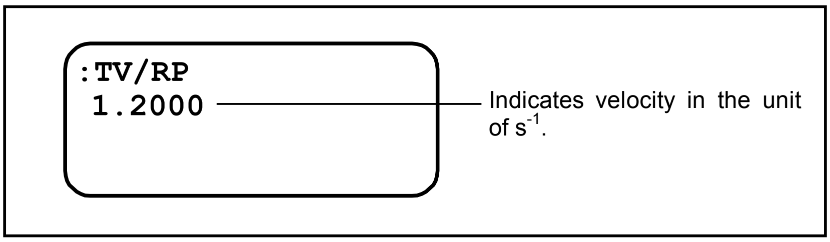
Figure 7-25: Monitoring example (TE/RP)



7.1.18.6. Monitoring Motor Velocity

- The TV command monitors velocity.
  - ◊ Input format
    TV/RP
    /RP default : One shot readout
    /RP attached: Real time readout
  - ◊ Press the BS key to terminate the real time monitoring (TV/RP).

Figure 7-26: Monitoring example (TV/RP)



7.1.18.7. Monitoring Torque Command and Software Thermal Loading

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

◊ Input format

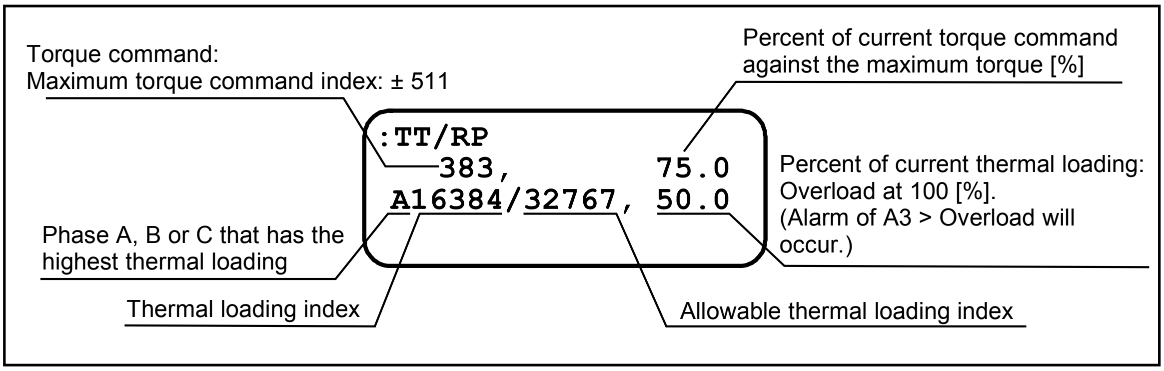
TT/RP

/RP default : Reads out only once.

/RP attached: Real time readout

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

Figure 7-27: Monitoring example (TT/RP)



7.1.18.8. Monitoring State of Automatic Gain Switching

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

◊ Input format

TG/RP

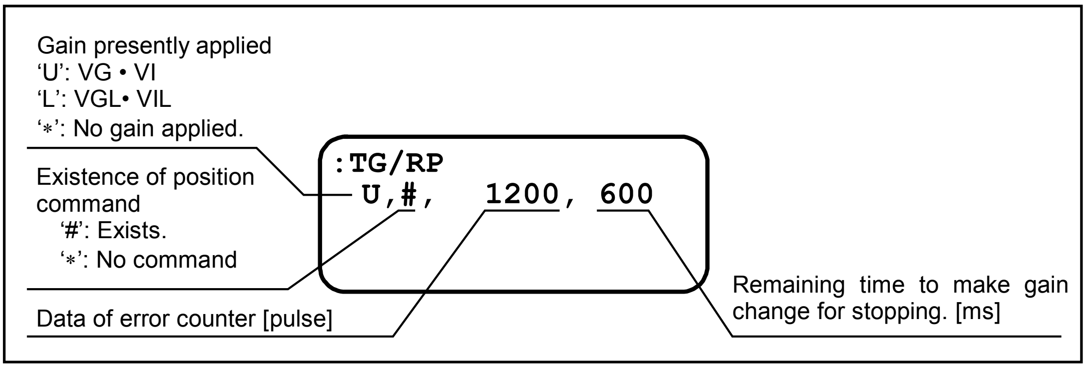
/RP default : One shot monitoring.

/RP attached: Real time monitoring.

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

◊ Refer to “7.2.7. Automatic Gain Switching” for more details.

Figure 7-28: Monitoring example (TG/RP)



7.1.18.9. Monitoring Parameter Setting

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

◊ Input format

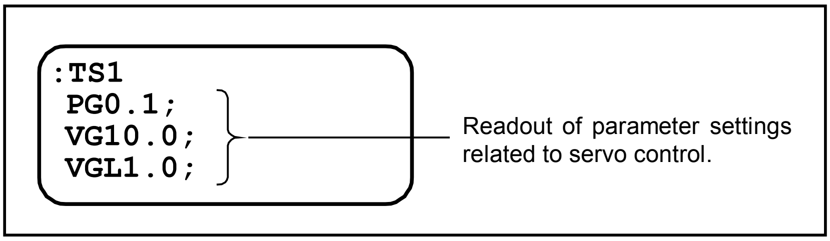
TS0 : Reads out all parameter settings of TS1 to TS15.

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

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

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

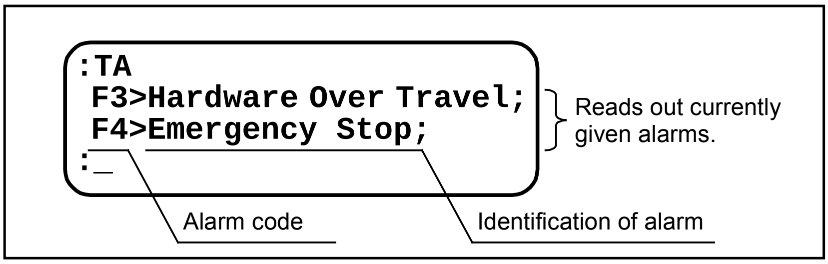
Figure 7-29: Monitoring example (TS1)



7.1.18.10. Monitoring Alarm Identification

- The TA command identifies currently given alarms.
  - ◊ Input format: TA
  - ◊ When the parameter MM is set to MM1, the ";" appears on the end of alarm identification line and the System waits for the next key entry. Pressing the SP key, or the BS key will terminate the monitoring. However, when two or more alarms are occurring, pressing the SP key will identify the next alarm.
  - ◊ When the parameter MM is set to MM0, the System reads out all alarms together and then gets out the monitoring. This function may be used to monitor the alarm with a personal computer.
  - ◊ When no alarm is reported, the System terminates the monitoring and shows no readout on the screen.
  - ◊ Refer to "10. Alarm" for more details.

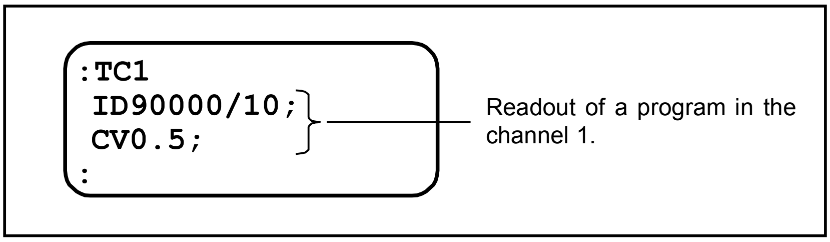
Figure 7-30: Monitoring example (TA)



7.1.18.11. Monitoring Contents of Channel

- The TC command monitors internal program settings of channels.
- This function can be used to check the program contents of each channel.
  - ◊ Input format:
    - TC/AL: Reads out setting of the parameter PH and program contents of all channels.
    - TC0 to TC63: Reads out program contents of each channel.

Figure 7-31: Monitoring example: (TC1)



- ◊ When the parameter MM is set to MM1, the ";" appears on the end of program contents and the System waits for the next key entry. Pressing the SP key will read out the next program contents. Pressing the BS key terminates the monitoring.
- ◊ When the parameter MM is set to MM0, the System reads out the program contents of all channels and then terminates the monitoring. This function may be used to monitor programs with a personal computer.

7.1.18.12. Monitoring Histories of Program Execution and Changes on Control I/O

- The DP command monitors executing history of a program and history of changes on the control Inputs and Outputs.
- The System stores the history of starts, completions and interruptions of a channel program, and history of changes on control Input/Output in the order of occurrence. The maximum store capacity is sixty-four histories.
- This function can be used for checking the programs of the host controller.
  - ◊ Input format: DP
  - ◊ When the parameter MM is set to MM1, the prompt ";" appears on the end of history readout and the System waits for the next key entry. Pressing the SP key reads out history that goes one step in the past. Every one press of the R key monitors a current history of execution. The BS key terminates the monitoring.
  - ◊ When the parameter MM is set to MM0, the System monitors all histories together, and then gets out the monitoring. This function is for checking histories with a personal computer.

Figure 7-32: Monitoring example (DP)

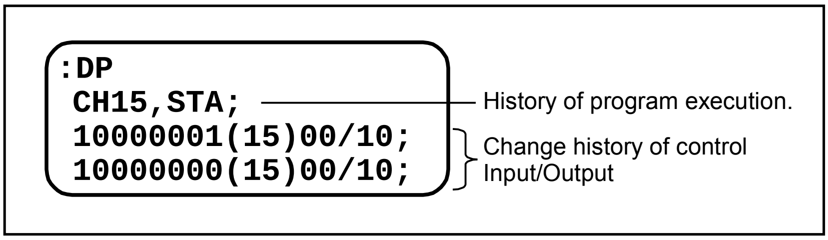


Figure 7-33: Format for monitors of control Input/Output

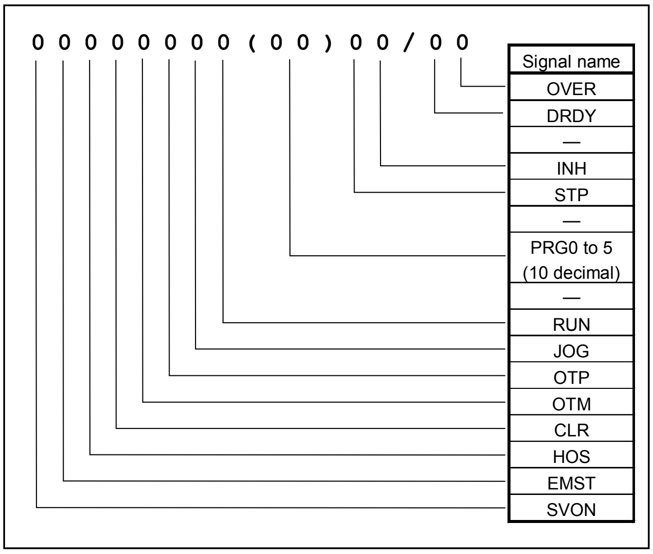


Figure 7-34: History readout of program execution

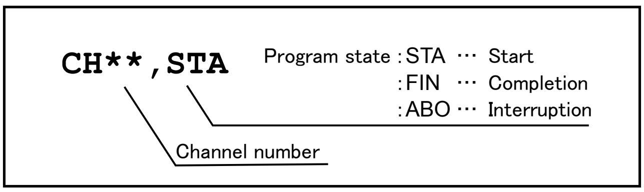


Figure 7-35: Monitoring example

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

7.1.19. Monitoring Analog Control

- The user may monitor the control states of Driver Unit shown in Table 7-13 below by the voltage between the analog monitor pins (MON) and the analog ground (GND) on the front panel or the voltage between MON+ and MON- pins of connector C5 monitors.

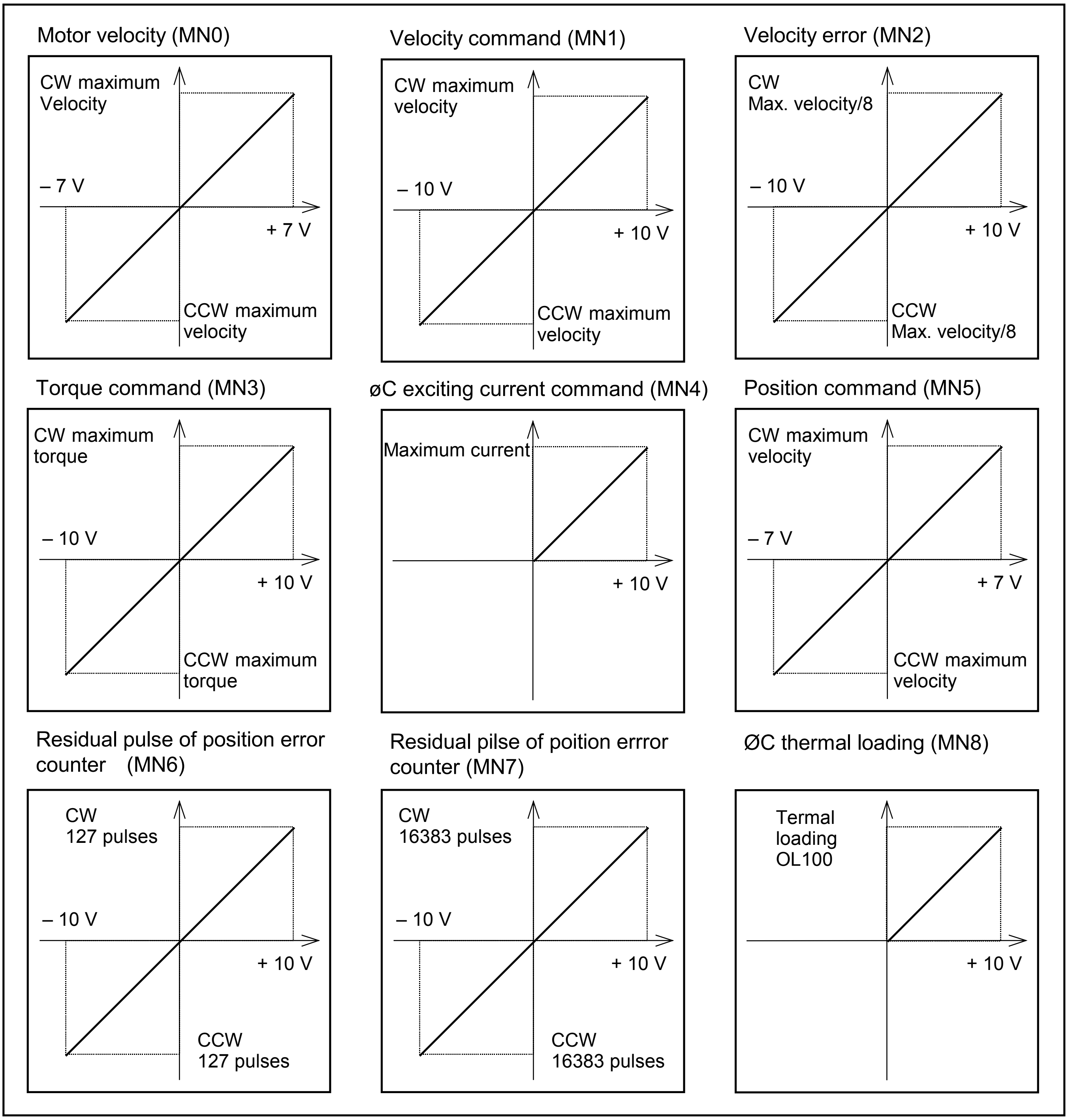
- The MN command selects a monitoring output.

Table 7-13

Item	RS-232C Communication	Monitor output	Description
Motor velocity	MN0	Front panel MON (GND) terminal	• Monitors current velocity.
Velocity command	MN1		• Monitors velocity command given to the Motor.
Velocity error	MN2		• Monitors errors between velocity command and actual velocity. (per one sampling)
Torque command	MN3		• Monitors torque command.
øC exciting current	MN4		• Monitors exciting command given to ø C of the Motor.
Moving distance command	MN5		• Monitors moving distance command given to the Motor.
Data of position error counter 1	MN6		• Monitors residual pulses of the position error counter. (in magnified scale)
Data of position error counter 2	MN7		• Monitors residual pulses of the position error counter.
øC thermal loading	MN8		• Monitors estimated temperature of ø C thermal loading.

- The monitor output scale is shown in Figure 7-36.

Figure 7-38


Motor velocity (MN0)
CW maximum Velocity
– 7 V
+ 7 V
CCW maximum velocity
Velocity command (MN1)
CW maximum velocity
– 10 V
+ 10 V
CCW maximum velocity
Velocity error (MN2)
CW Max. velocity/8
– 10 V
+ 10 V
CCW Max. velocity/8
Torque command (MN3)
CW maximum torque
– 10 V
+ 10 V
CCW maximum torque
øC exciting current command (MN4)
Maximum current
+ 10 V
Position command (MN5)
CW maximum velocity
– 7 V
+ 7 V
CCW maximum velocity
Residual pulse of position error counter (MN6)
CW 127 pulses
– 10 V
+ 10 V
CCW 127 pulses
Residual pilse of poition errror counter (MN7)
CW 16383 pulses
– 10 V
+ 10 V
CCW 16383 pulses
ØC thermal loading (MN8)
Termal loading OL100
+ 10 V

7.2. For More Advanced Operation

7.2.1. Absolute Position Scale (For Absolute Position Sensor)

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

- The Megatorque Motor System has its own position scale for the positioning operation and the control of software over travel limit.
- Once the home position is defined, this System does not require the Home Return every time the power is turned on because of the built in absolute position sensor.
- Follow the procedure below to set the position scale.
  (1) Direction of position scale -----Refer to "7.2.1.1. Direction of Position Scale."
  (2) User home position --------------Refer to "7.2.1.5. Setting User Home Position."
  (3) Software over travel limit--------"7.1.8.2. Software Over Travel Limit"

7.2.1.1. Direction of Position Scale

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

Caution: Even the sign of plus/minus of the position scale are reversed, the direction of hardware over travel limit, and the output phase of position feedback signal remain unchanged.

- You may reverse the sign of position scale not to hinder operations when the Motor mounting direction is reversed.
  - ◊ CW or CCW is a direction when you look the Motor from the Motor output axis (rotor).
  - ◊ The DI data (DI command) defines counting direction of the coordinate.
  - ◊ Relation between the DI data and the mounting direction is shown below.

Table 7-14

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

- When the sign of the position scale is reversed, the sign of following functions will be reversed as well.
  - ◊ Direction of all positioning operations
  - ◊ Setting direction of software over travel limit
  - ◊ Detecting absolute position
  - ◊ Absolute home position offset (Offset by AO data)

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

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

/ N S K SP
O N ENT

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

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

D I 1# ENT

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

7.2.1.2. Resolution of Position Scale

- There are fifty teeth inside the Motor to define the position, and each tooth is divided into 16 384 with digital signal processing. Therefore the resolution for one revolution of the Motor shall be obtained as follow.

  16 384 × 50 = 819 200 [pulse/revolution]

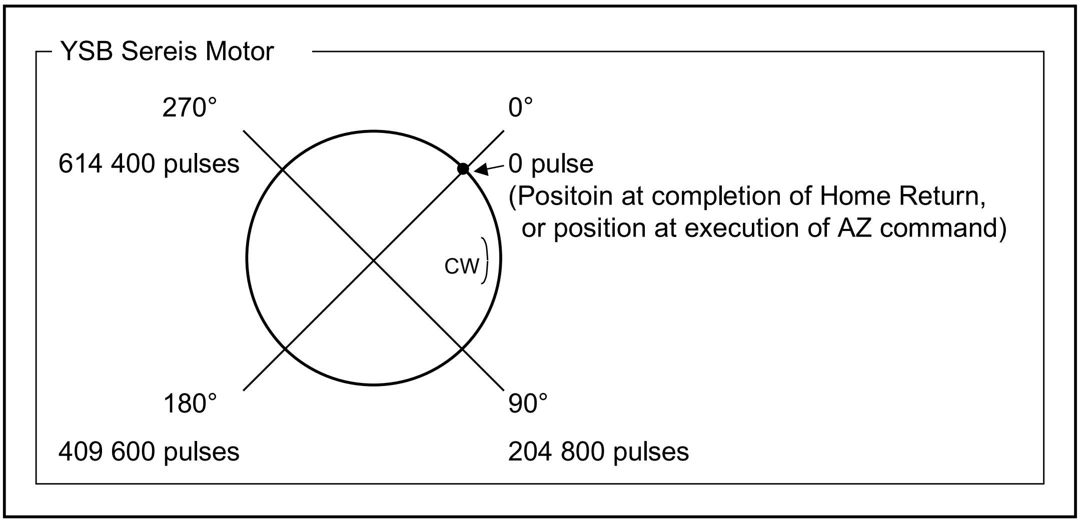
- Unit of positioning distance in positioning operation (caused by AR, AD, IR and ID commands), and position of software over travel limit will be set in the unit of position scale resolution.

Table 7-15

Resolution of position scale	
Unit of count [pulse/rev]	Unit of degree [0.01°/rev]
819 200	36 000

* However setting value of the software over travel limit cannot be in unit of degree.

Figure 7-37: Absolute position scale



7.2.1.3. Offsetting Position Data

- This System provides the position scale (user absolute position scale) along which every positioning operation and setting of over travel limit shall be controlled. The user absolute position scale is defined by offsetting position on the position scale that is unique to each Motor (Motor absolute position scale) by use of the built in "one revolution absolute position sensor."

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

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

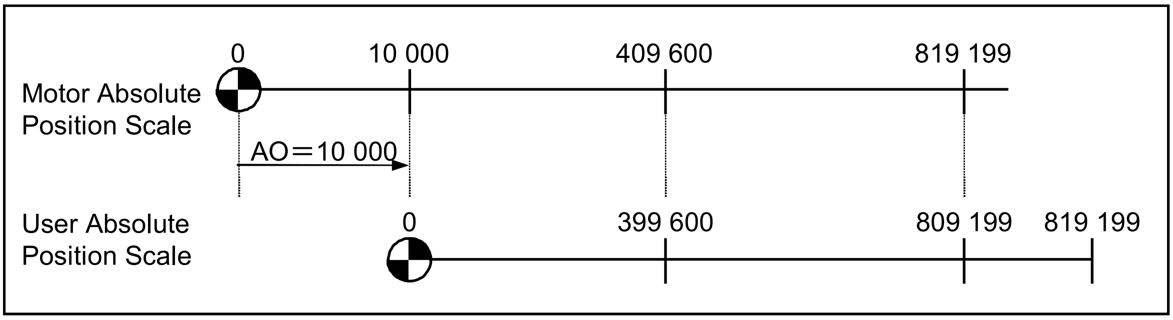
- The AO data will be automatically set when the home position is defined by the AZ command.

- Relations between the Motor absolute position scale, the user absolute position scale and the AO data shall be;

  User absolute position data = Motor absolute position data – the AO data

[Example] AO data = 10 000 [pulse]

Figure 7-38



7.2.1.4. Monitoring Position Data

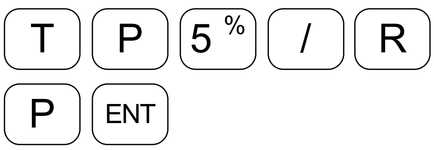
- The TP command reports the current position data.

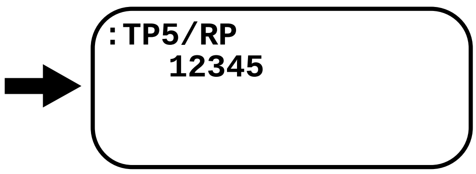
Table 7-16

Motor Absolute Position data in pulse	TP0 command
User Absolute Position data in pulse	TP2 command
User Absolute Position data in 1/100°	TP5 command

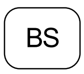
[Example] Monitor a position on the user absolute position scale in unit of 1/100°.

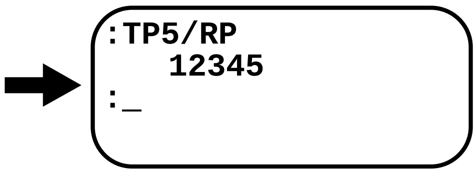
(1) Input the TP command.





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





7.2.1.5. Setting User Home Position

- The AZ command or the Home Return defines the user home position.

- The following describe the procedure to define the home position with the AZ command. Refer to “6.2.1.2. Setting Home Position With Home Return” for details.

(1) Set the Motor in servo free state.

M O ENT

```
:MO
:_
```

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

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

/ N S K SP
O N ENT

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

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

A Z ENT

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

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

7.2.2. Incremental Position Scale (For Incremental Position Sensor)

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

7.2.2.1. Resolution of Position Scale

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

  $$16\,384 \times 50 = 819\,200 \text{ [pulse/revolution]}$$

- Unit of motion distance in positioning (AR, AD, IR and ID commands) and position of software over travel limit shall be the resolution of the position scale.

Table 7-17: Resolution of position scale

Resolution of position scale	
Unit of pulse [pulse/rev]	Unit of degree [0.01°/rev]
819 200	36 000

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

7.2.2.2. Direction of Position Scale

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

- You may reverse the sign of position scale not to hinder operations when the Motor mounting direction is reversed.
  - ◊ CW or CCW is a direction when you look the Motor from the Motor output axis (rotor).
  - ◊ The DI data (DI command) defines counting direction of the coordinate.
  - ◊ Relation between the DI data and the mounting direction is shown below.

Table 7-18

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

- When the sign of position scale is reversed, the sign of following functions will be reversed as well.
  - ◊ Direction of all positioning operations
  - ◊ Software over travel limit

7.2.2.3. Type of Position Scale

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

Table 7-19: Parameter PS and type of position scale

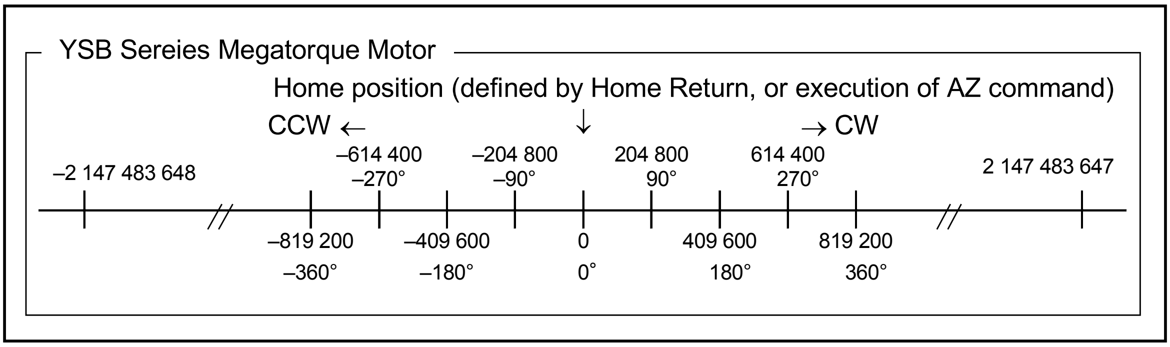
PS setting	Type of position scale	Application	Shipping set
PS0	Linear position scale	Ball screw driving, off-limits zone, etc	
PS1*	Single-rotational position scale	General indexing operation, etc.	✓
PS2 to 99	Multi-rotational position scale	Chain driving, etc.	

1 Linear position scale

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

- The position data ranges from – 2 147 483 648 to + 2 147 483 647 [pulses] with the home position at 0. In case of the counting position data increases in the plus direction, it changes to -2 147 483 648 [pulse] when it exceeds +2 147 483 647 [pulse]. In case of the counting direction decreases in the minus direction, it changes to +2 147 483 647 [pulse] when the reading exceeds -2 147 483 648 [pulse].

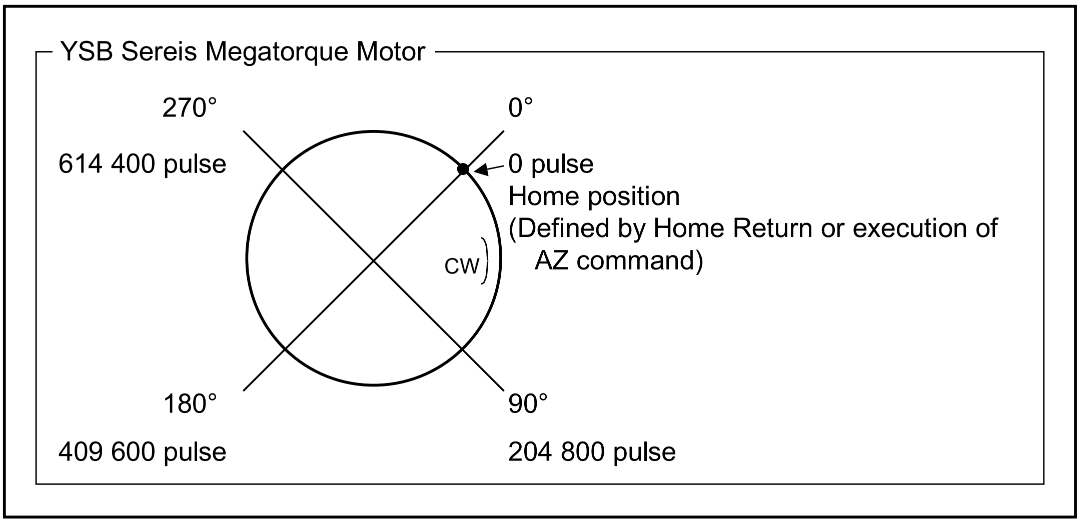
Figure 7-39: Linear position scale



2 Single rotational position scale

- The position data starts from the home position and increases when rotated to clockwise, and the position data returns to 0 when the Motor rotates one revolution.
- The position data ranges from 0 to 819 199 [pulse].

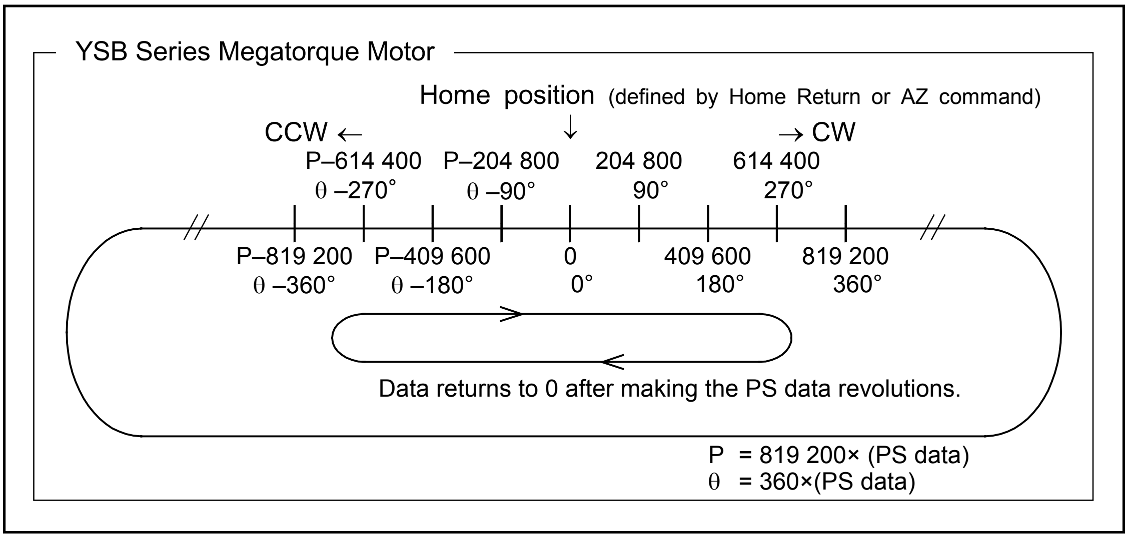
Figure 7-40: Single rotational position scale (incremental position sensor)



3 Multi-rotational position scale

- The position starts from the home position and extends to plus direction only, and returns to 0 when rotated specified revolutions by the PS command.
- The position data ranges from 0 to {819 200 × (PS data) – 1}.

Figure 7-41: Multi-rotational position scale (incremental position sensor)



7.2.2.4. Resetting Position Data

⚠ *Caution: The position data is not settled right after the power is on. Be sure to reset the position data before operating the Megatorque Motor System.*

- The position data is reset to 0 by the following.
  - ◊ Completion of Home Return
  - ◊ Execution of the AZ command.

7.2.2.5. Example of Setting Position Scale

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

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

   / N S K SP
   O N ENT

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

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

   D I 1 # ENT

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

2) Select the linear position scale.

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

   / N S K SP
   O N ENT

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

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

   P S 0 ? ENT

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

3) Reset the position data.

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

   / N S K SP
   O N ENT

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

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

   A Z ENT

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

7.2.3. Digital Filter

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

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

Parameter: FP, FS, NP and NS

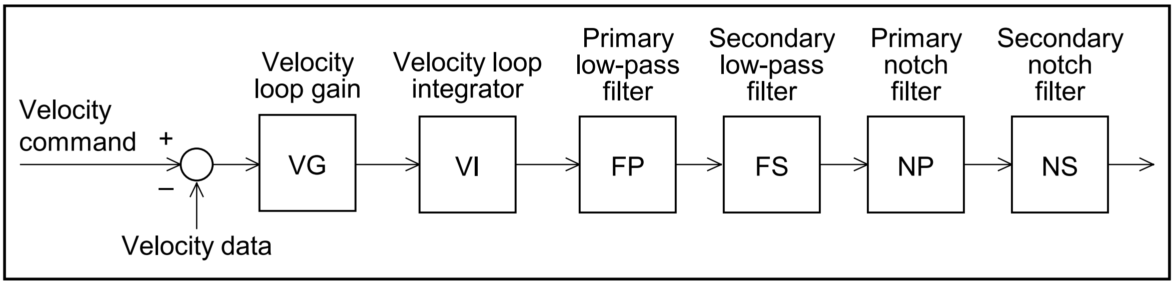
- Sets the filters in the velocity loop.
- This is effective in reducing noise caused by resonance and vibrations.

Table 7-20

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

- Sets the filter frequency in the velocity loop.
- Refer to “8. Glossary of Command and Parameter” for details.

Figure 7-42



7.2.4. Feed Forward Compensation: FF

Parameter: FF (The password is necessary.)

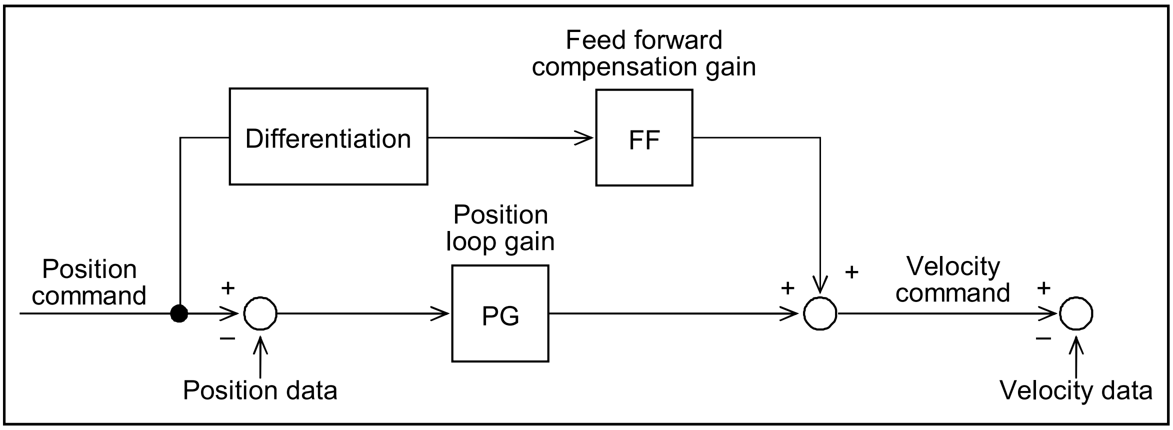
- A velocity command created by differentiating a position command may be fed to the velocity loop in the forward direction.
- The feed forward compensation improves the tracing delay in acceleration and deceleration.

Table 7-21

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

- The parameter FF sets the feed forward compensation gain.
- If a large parameter data is specified, overshoot may occur frequently though the tracing delay is improved. The proper data of the FF parameter is approximately 0.5 or less in general.

Figure 7-43



7.2.5. Integration Limiter: ILV

Parameter: ILV (The password is necessary.)

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

Table 7-22

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

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

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

* For more details about the parameter, refer to "8. Glossary of Command and Parameter."

Figure 7-44

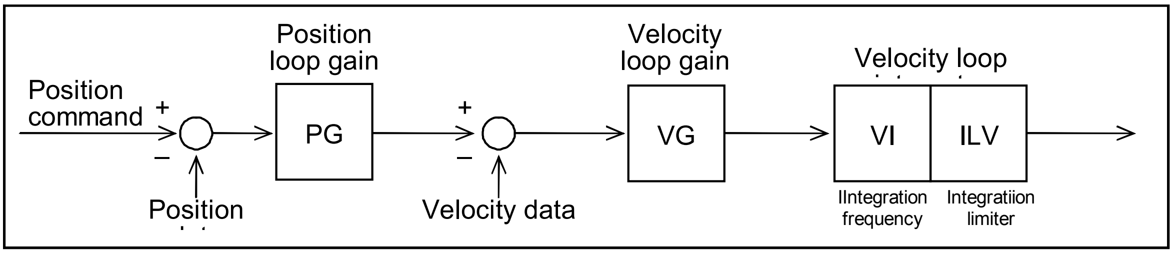
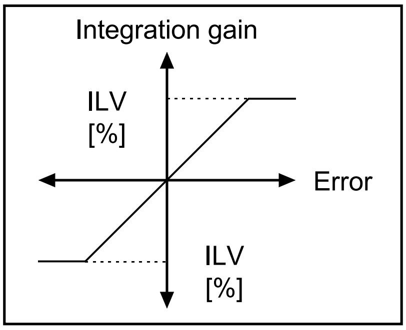


Figure 7-45



7.2.6. Dead Band: DBP

Parameter: DBP (The password is necessary.)

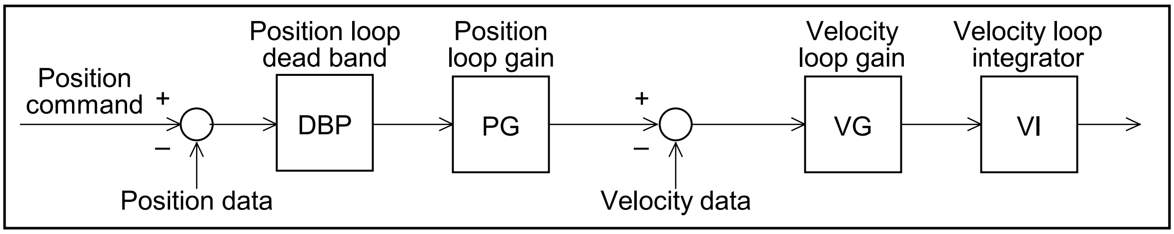
- The parameter DBP is used to specify a dead band for the deviation of position loop; the deviation will be zeroed when it is under the set data of the parameter DBP.
- This eliminates problems of small vibration after completion of positioning.

Table 7-23

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

- The DBP parameter specifies a dead band on the position loop deviation in both sides of 0 (zero) and zeroes the deviation when it is under the DBP setting.
- In some use conditions, slight vibration may be caused due to minute deviation. Provision of a dead band eliminates such slight vibration.
- If a dead band is specified, repeatability of positioning accuracy will be deteriorated by the amount of the dead band, though small vibration may be eliminated.
- Unit of a dead band is the pulse. (Corresponds to the resolution of position sensor. Refer to "2.7.2. Functional Specifications" for the resolution of position sensor.)

Figure 7-46



7.2.7. Automatic Gain Switching

- This function is to switch the servo gain for positioning or stopping along the error of position error counter.

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

- In addition, it will ensure minimum vibration in positioning by lowering the gain, and shorter settling time by increase in the gain at stopping positioning.

Table 7-24: Parameters related to automatic gain switching

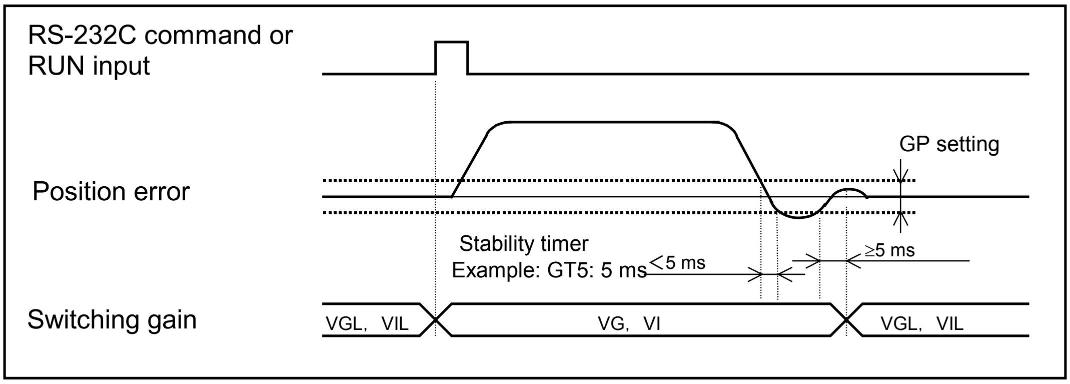
Parameter	Function	Sipping set
GP	Threshold to switch gain	GP0
GT	Timer to check stability for switching	GT5
VG	Velocity loop proportional gain in positioning	VG1.0
VI	Velocity loop Integrator frequency in positioning	VI1.00
VGL	Velocity loop proportional gain in stopping state	VGL1.0
VIL	Velocity loop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

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

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

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

Figure 7-47: Timing of switching gain



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

◊ In case of a positioning with external pulse train command, the System will regard the low frequency pulse input fewer than 2 Kpps as no input of command, and thus causing frequent switching of the gain. In such a cases, setting timer for stabilizing switching gain GT helps to control frequent gain switching.

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

◊ The TG command reports the state of gain switching. Refer to “7.1.18.8. Monitoring State of Automatic Gain Switching” for more details.

7.2.8. Acceleration Profiling

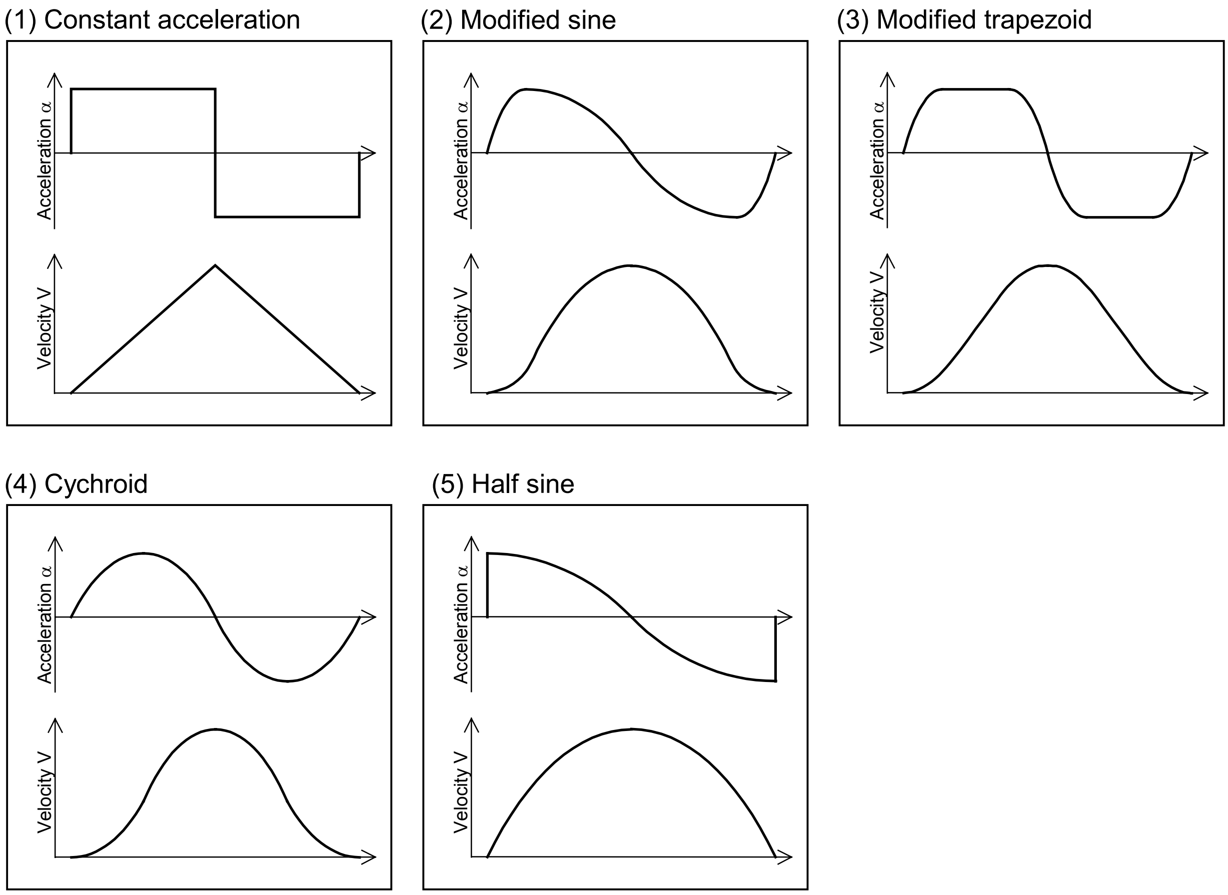
- In addition to usual constant accelerating velocity profile, another four types of acceleration profiling are available.

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

Table 7-25: Parameters for acceleration profiling

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

Figure 7-48: Patterns of acceleration profiling



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

- The parameter CS selects a pattern of acceleration profiling. A pattern may be programmed on each Programmable Indexer channel.

Table 7-26: Setting of parameter CS (Selection of acceleration profiling pattern)

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

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

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

◆ Setting acceleration profiling

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

/ N S K SP
O N ENT

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

(2) Set the acceleration profiling function active.

C X 1 # ENT

```
:CX1
••••••••
:_
```

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

C S 5 % , 2 $ ENT

```
:CS5、2
••••••••
:_
```

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

M A 2 $, 1 # ENT

```
:MA2、1
••••••••
:_
```

◊ In default of the part of deceleration setting following the comma (,) of parameters CS or MA, the settings on deceleration follow those of acceleration.

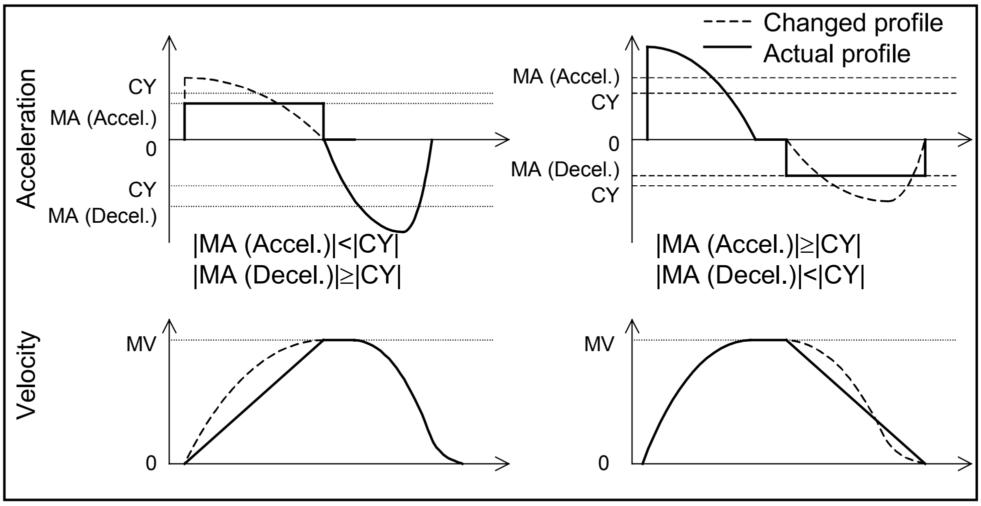
◊ Execution of AR, AD, IR, or ID command starts a Programmable Indexer or an RS-232C operation with the acceleration profiling set by the above procedures.

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

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

◊ CX, CS, CY, MA and MV cannot be changed in positioning of Programmable Indexer.

Figure 7-49: Constant acceleration is set when the parameter MA is lower than the CY.



◆ Monitor executed positioning pattern

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

- The parameter CZ monitors the result of the latest execution of acceleration profiling pattern.

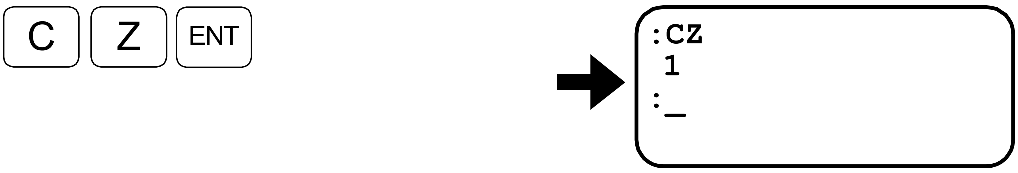


Table 7-27: Readout code by parameter CZ

Readout	Definition
0	The acceleration profiling is not set after Home Return, or Jog.
1	Positioning completed with specified acceleration profiling pattern.
2	Decelerated in the middle of positioning due to insufficient positioning distance.
3	Decelerated in the same pattern as acceleration due to insufficient positioning distance.

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

◊ When programming the IR or ID command to an internal channel, a warning message appears on the screen if a specified acceleration profiling cannot be performed due to short distance.

Triangle Pattern 1: Decelerated in the middle of positioning due to insufficient positioning distance. (Figure 7-51)

Triangle Pattern 2: Decelerated in the same pattern as acceleration due to insufficient positioning distance. (Figure 7-52)

Figure 7-50: Readout code 1: Proper acceleration profiling

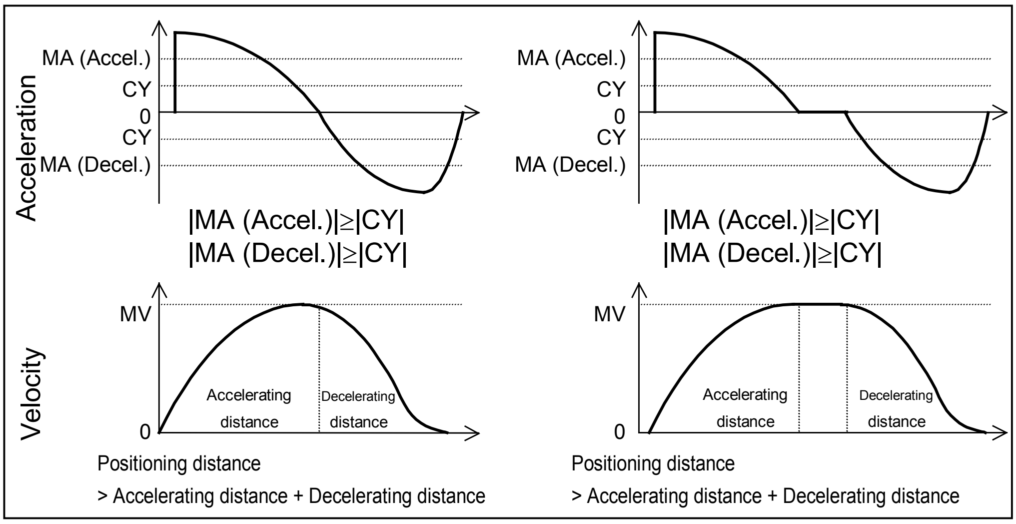


Figure 7-51: Readout code 2: Decelerated in the middle of accelerating due to insufficient positioning distance

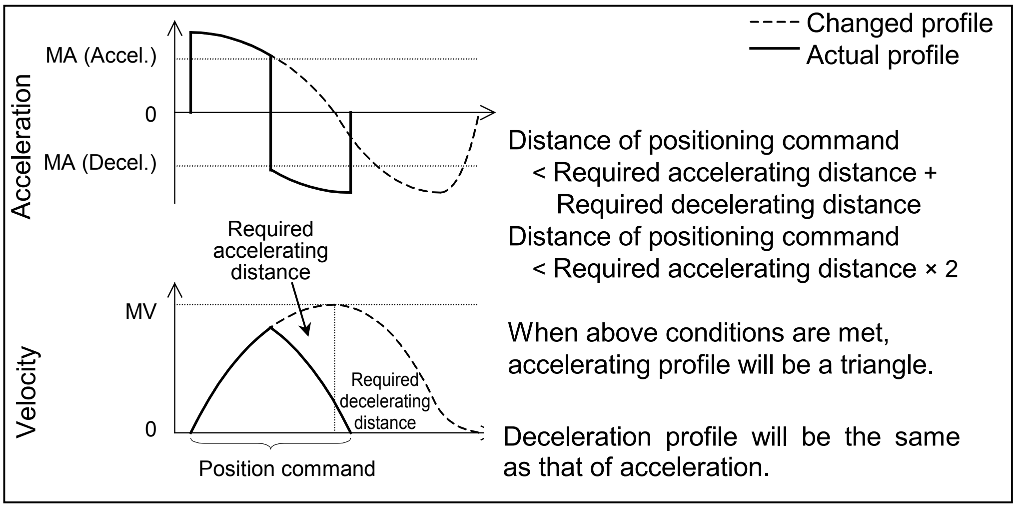
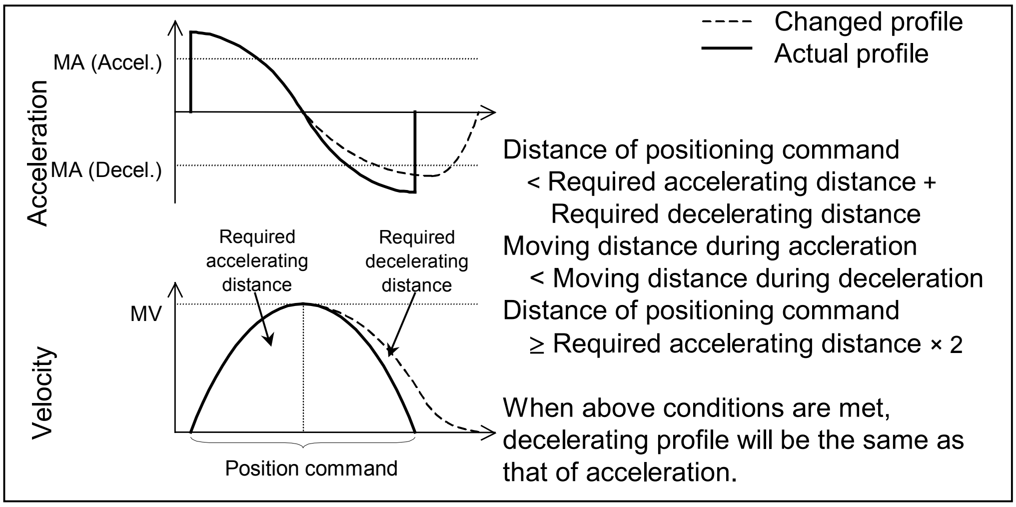


Figure 7-52: Readout code 3: Decelerated with same pattern as acceleration due to insufficient positioning distance



7.3. RS-232C Communication

⚠ *Caution: The ESB Driver Unit has an EEPROM for the data backup. The EEPROM has the limitation on the number of times for overwrite/delete the data. (Approximately 500 000 times) Therefore, we recommend setting the parameter WM that prohibits overwriting to the EEPROM when the internal parameters are frequently changed from the master controller during operation. For details about the parameter WM, refer to "8. Glossary of Command and Parameter." However, frequent changes of parameters that do not require the backup will not affect the life to EEPROM.*

7.3.1. Specifications of Communication

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

- The Driver Unit has CN1 connector for 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 7-28

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

7.3.2. Communication Procedure

7.3.2.1. Turning on Power

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

- When the Driver Units are initialized, a colon (:) is displayed and the system waits for a command to be entered. The colon (:) is called a prompt.

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

Somewhat differs with system configuration.

Indicates completion of internal initialization and may accept a command.

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

7.3.2.2. Command Entry

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

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

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

Press the $\boxed{\text{ENT}}$ key if the handy terminal FHT11 is used.

- Every time a character is input, the Driver Unit echoes the character back to the terminal. (The Driver Unit returns the same character it 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 an internal data readout command, etc., it returns the data before ": (prompt)."

```
:VG0.5
:_
```

Entered command.
Waiting for the next command.

Input (to Driver Unit)

V	G	0	.	5	0DH

Echo backe (from Driver Unit)

V	G	0	.	5	0DH	0AH	:

7.3.2.3. Password

- Among the communication commands used for the Megathurust Motor System, some special commands require password entry for preventing erroneous entries. These commands cannot be entered in the same manner as other commands.

- The password is /NSK ON (a space between K and O) as shown below. Prior to indicating the prompt (:), the Driver Unit returns an acknowledgment "NSK ON" as it receives the password.

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

```
:/NSK ON      —— Entered password
 NSK ON       —— Acknowledgement
:_            —— Waits for the next command.
```

Input (to Driver Unit)

/ N S K 20H O N 0DH

Acknowledgement (from Driver Unit)

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

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

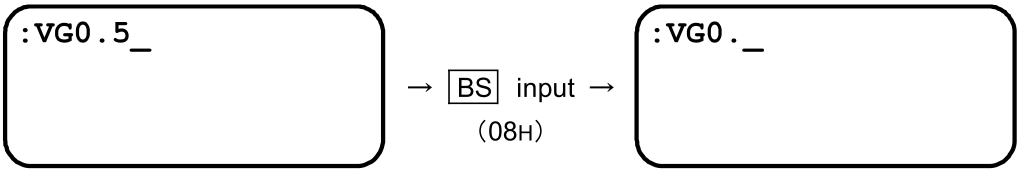
(2) :

7.3.2.4. Canceling Command

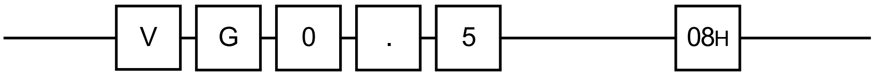
- A command that has been entered halfway, entering a backspace code (08H) can cancel a character or an entered full character string. Parameter “backspace mode” (BM) sets the canceling format. When the Handy Terminal FHT11 is used, press the BS key instead.

◆ Parameter “BM0” (Shipping set)

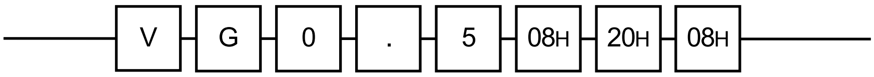
- For an example, when the backspace code (08H) is input following “VG0.5” letter string, the cursor moves one space back to the position where 5 was input and thereby deletes it.



Input (to Driver Unit)

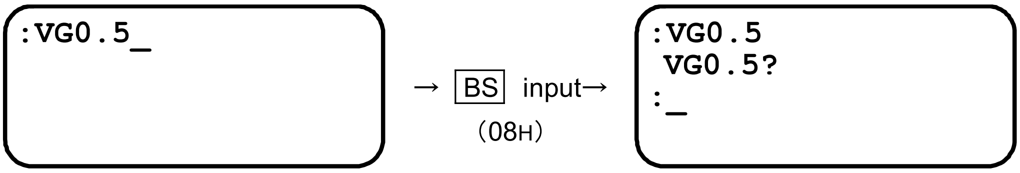


Echo back (form Driver Unit)

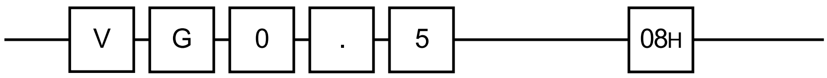


◆ Parameter “BM0”

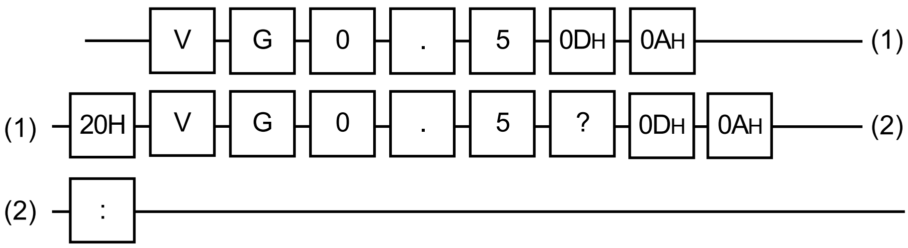
- When the backspace code (08H) is input following “VG0.5” letter string, for an example, a message “VG0.5?” and a colon “:” are displayed and thereby deletes “VG0.5.”



Input (to Driver Unit)



Echo back (from Driver Unit)



7.3.2.5. Error

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

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

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

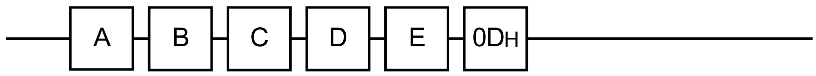
3. If a command requiring the password is entered without the password.

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

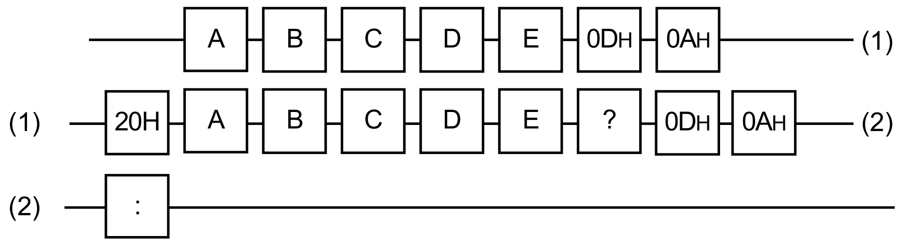
```
:ABCDE
 ABCDE?
:_
```

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

Input (fto Driver Unit)



Echo back (from Driver Unit)



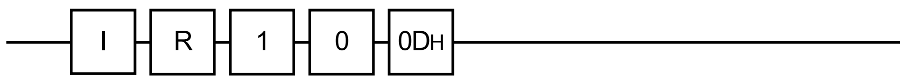
4. If the input condition is not met for entering a command

- In this case, the entered character string with "INHIBITED" is returned.

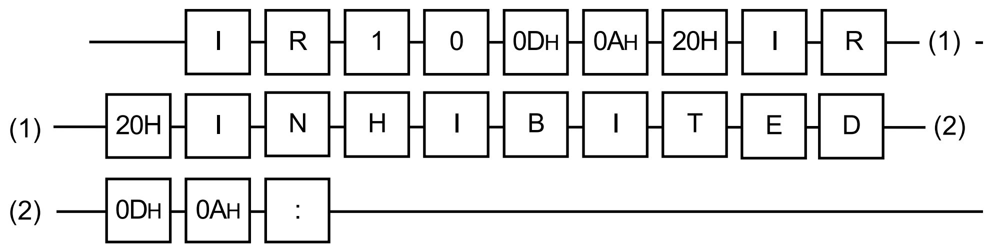
```
:IR10
 IR INHIBITED
:_
```

If IR command (Incremental positioning command) is entered when the Motor is moving, the system returns an error message since the input condition is not met.

Input (to Driver Unit)



Echo back (from Driver Unit)

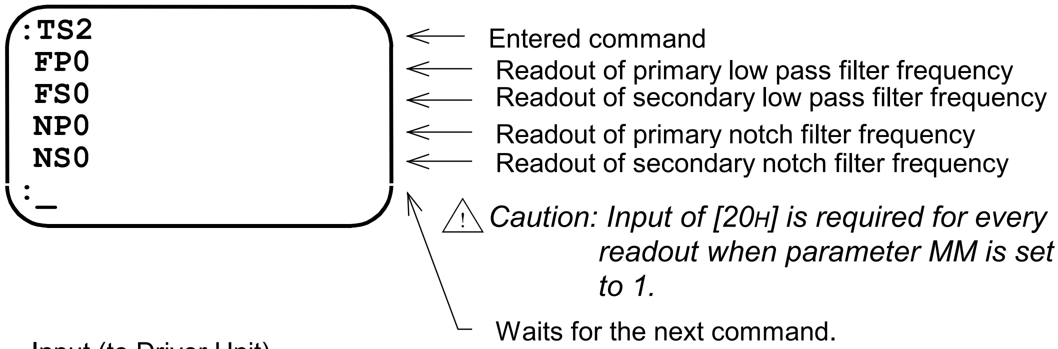


7.3.2.6. Readout Command

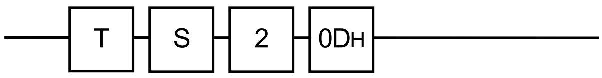
- If a command for reading the internal state (i.e., parameter set data, current position, etc.) of the Driver Unit among the communication commands of the System is entered, the Driver Unit returns current settings, etc.

- Returned data consists of
  "space code (20H) + read out data + carriage return (0DH) + line feed code (0AH)".
  The following show examples.

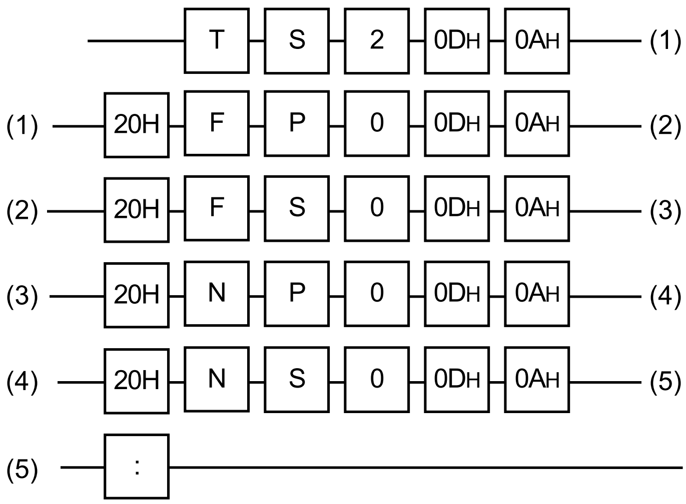
◆ **TS command to read parameter settings**



Input (to Driver Unit)



Readout (from Driver Unit)



◆ Use of reading function “?” to read parameter settings

`:?VG`	Entered command
` VG0.5`	Readout of velocity loop proprtional gain
`:_`	Waits for the next command.

Input (to Driver Unit)

?	V	G	0DH

Readout (from Driver Unit)

?	V	G	0DH	0AH	(1)

(1)	20H	V	G	0	.	5	0DH	0AH	:

◆ TP command for reading current position data

`:TP5`	Entered
` 10000`	Readout of current position data
`:_`	Waits for the next command.

Input (to Driver Unit)

T	P	5	0DH

Readout (from Driver Unit)

T	P	5	0DH	0AH	(1)

(1)	20H	1	0	0	0	0	0DH	0AH	:

7.3.3. Communication With Personal Computer

- Use NSK MegaTerm application software that is available on the web site of NSK Precision America, Incorporated (http://www.npa.nsk.com) for download. Or follow the procedure described below for communication with a personal computer.

- The following describes how to store the parameters of the ESB Driver Unit using Hyper Terminal communication software that is provided with "Windows" as a standard feature.

- The user shall provide the communication cable. Pin-out of the D-sub 9pins connector of the ESB Driver Unit is different from DOS/V machine. Refer to "2.8.1. CN1: RS-232C Serial Communication Connector" and the manual of the personal computer to be used.

7.3.3.1. Set-up of HyperTerminal

1) Start HyperTerminal.
   [(Start menu) → (Program) → (Accessory) → (HyperTerminal)]

2) The dialog box of "Setting of connection" is displayed.
   Declare the name of connection and set an icon, then press [OK] button.

3) The dialog box of "Telephone-number" is displayed.
   Select "Direct to Comx" in "the way of connection N," then press [OK] button.
   (Select Comx in accordance with the user's environment.)

4) The dialog box of "Property of Com#" is displayed.
   Follow the table bellow for input, then press [OK] button.

Table 7-29

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 ESB Driver Unit afterwards.

7.3.3.2. Store Parameters of ESB Driver Unit

1) Start the HyperTerminal.

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

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

```
:MM0
:TS
 PG0.100
 VG2.0
 VGL1.0
 (Omission of a middle part)
 HT1
 PE0
 AE0
:TC/AL
 PH0
>TC0
 AD0
 CV2.0000
 CA5.00,5.00
 (Omission of a middle part)
>TC15
:
```

4) Copy the settings shown above to a “Memo pad,” and then store it as a text file.
Edit and store the setting as described below to be able to transfer it to the ESB Driver Unit.

- ♦ Add KP1 and add one line to the top.
- ♦ 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.
- ♦ Write KP0 and add one line to the bottom.

```
KP1

PG0.100
VG2.0
 (中略)
PE0
AE0
PH0

CH0
AD0
CV2.0000
CA5.00,5.00

CH1
AR3000
 (中略)

CH15

KP0
```

Insert one line here.

7.3.3.3. Transmit Stored Parameters to ESB Driver Unit

■ Transmit the stored file to ESB Driver Unit.

1) Start HyperTerminal.

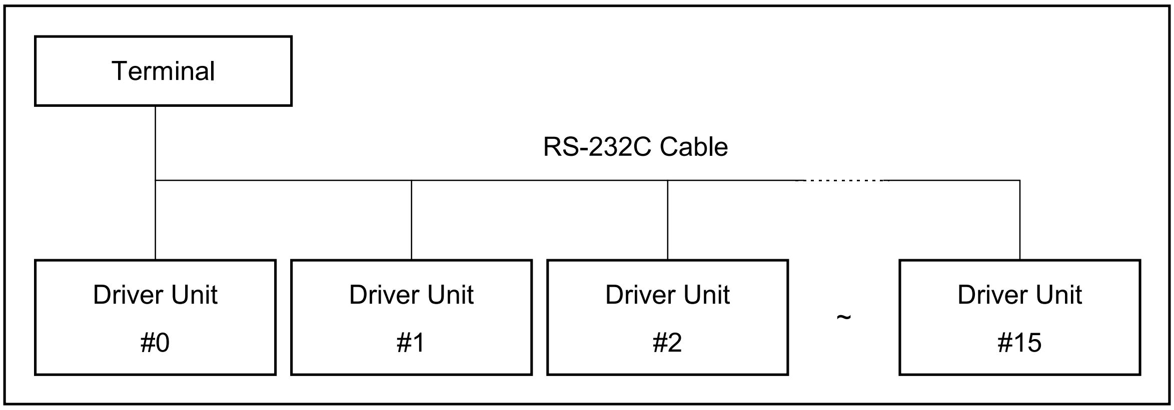
2) Transmit the file by selecting “Transfer” → “Transmit text/file.”

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

7.3.4. Daisy Chain Communication

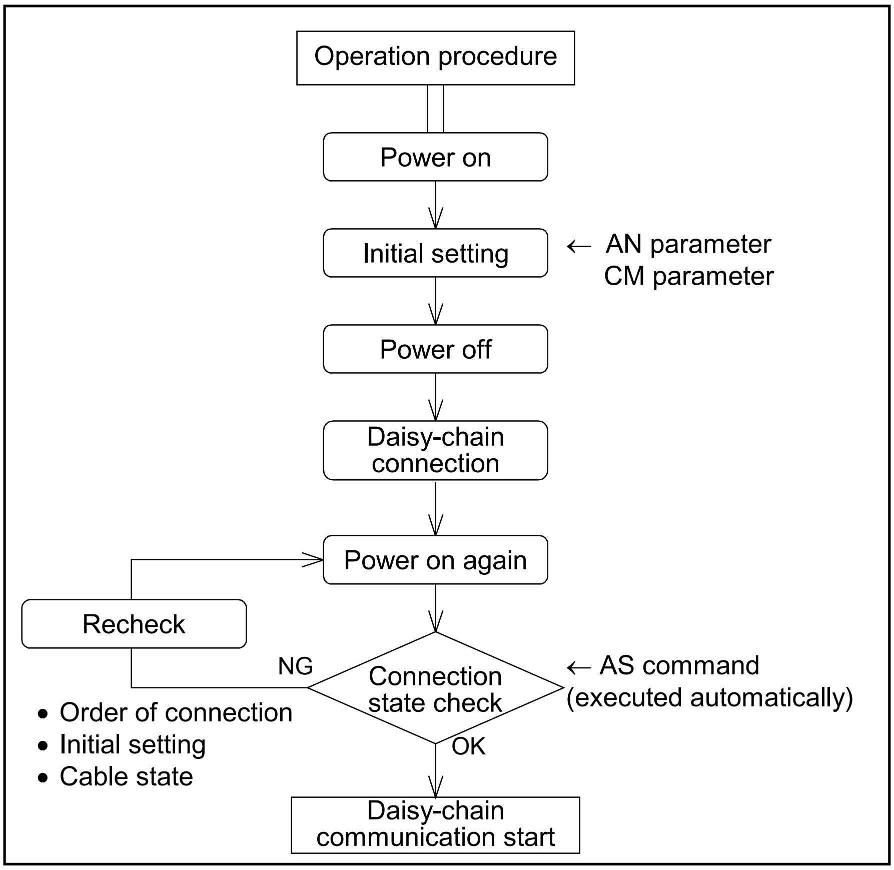
- Daisy-chain communication allows multiple Driver Units (up to 16 units) to be connected with a single RS-232C terminal and a cable set.

Figure 7-53



7.3.4.1. Procedure to Set Daisy Chain Communication

Figure 7-54: Daisy chain communication setting procedure



7.3.4.2. Initial Setting

- The password is necessary for the parameters AN and CM for the initial setting.
- The initial setting will be effective when the power is turned on next time.
- Set the AN and the CM parameters to all Driver Units.
  - ◊ Set the data of CM parameter 1 (Daisy-chain communication)
  - ◊ Set axis numbers to Driver Units. (Designate axis numbers in ascending order.)

Table 7-30: Initial setting

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

- The following show how to set the daisy chain operation mode to the axis number 1 Driver Unit.

(1) Input the password.

/ N S K SP
O N ENT

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

(2) Set the parameter CM1.

C M 1 ENT

```
:/NSK ON
 NSK ON
:CM1
:_
```

(3) Input the password.

/ N S K SP
O N ENT

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

(4) Set the paramter AN1.

A N 1 ENT

```
:/NSK ON
 NSK ON
:AN1
:_
```

7.3.4.3. Interfacing

◆ Connecting data communication lines

- Connect data communication lines sequentially: First connect the output of the RS-232C terminal with the input of axis 0, and then connect the output of axis 0 with the input of axis 1, and so forth.
- Connect the output of the final axis with the input of the terminal.

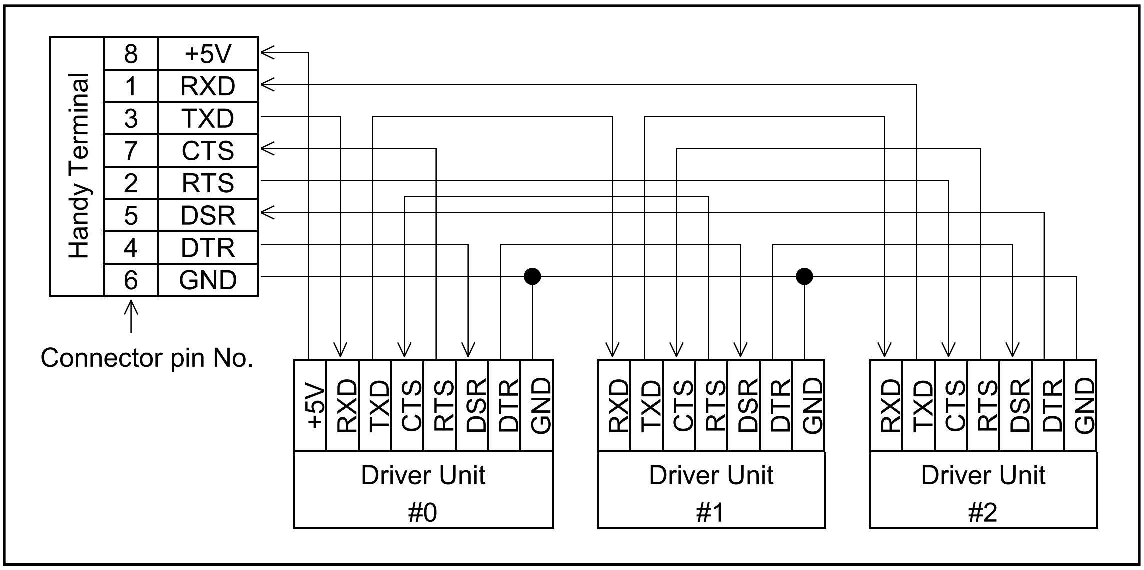
◆ Connecting data transmission request lines

- Connect data transmission request lines sequentially: First connect the input of the terminal with the output of axis 0, and then connect the input of axis 0 with the output of axis 1, and so forth.
- Connect the input of the final axis with the output of the terminal.

◆ Actual connection example

- When NSK's Handy Terminal is in use, connect the lines as shown in Figure 7-55.
- Refer to "2.8.1. CN1: RS-232C Serial Communication Connector" for the specification of CN1.

Figure 7-55: Handy Terminal connection example



* The communication signals of the Handy Terminal are opposite to those of the Driver Unit (e.g. RXD-TXD).

7.3.4.4. Power on

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

> ⚠ *Caution: Turn on the power for all Driver Units simultaneously.*
> *If all axes cannot be turned on at once, be sure to design the System so that the power is turned on from the largest number axis to the smallest number axis.*

- The command AS will be executed to check for connection as soon as the power of the axis No.0 Driver Unit is turned on.

- If the terminal and all Driver Units are connected properly, the following message is displayed. The following examples are for 3-axis configuration.

```
 NSK MEGATORQUE
 MS1A50_XXXX
 EXXXXXXXXXX
BM1
AS
   0   OK   AX0
   1   OK   AX1
  #2   OK   AX2
:_
```

Displays the connection state.

Waits for the next command.

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

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

```
 NSK MEGATORQUE
 MS1A50_XXXX
 EXXXXXXXXXX
BM1
AS
   0   OK   AX0
   1  ERR.  AX2
  #2  ERR.  AX1
:_
```

Displays the connection state.

Waits for the next command.

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

7.3.4.5. Operation

◆ Selection of Driver Unit to Communicate

- In daisy-chain mode, the RS-232C terminal is capable of communication through only one Driver Unit at a time.

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

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

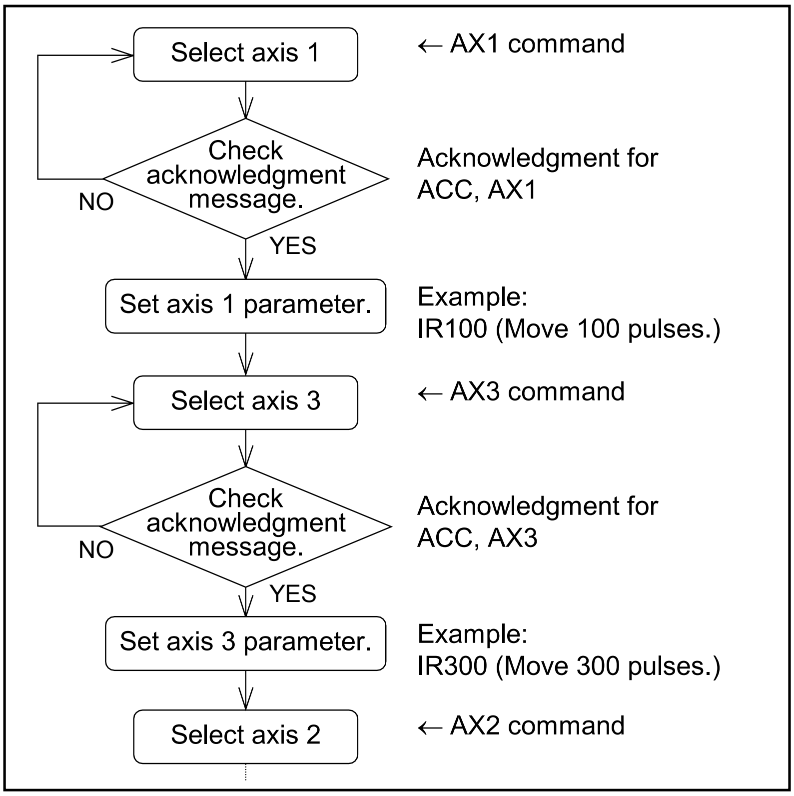
```
:AX2        ← Select a new axis for communication (axis No. 2).
 ACC. AX2   ← Acknowledgment
:_
```

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

```
:?AX
 ACC. AX2   ← Current axis for communication
:_
```

Example of Daisy-chain communication

Figure 7-56: Example of Daisy chain



7.3.4.6. Termination of Daisy Chain Mode

- The following show how to terminate the daisy chain mode when communication between the Handy Terminal and a single axis Driver Unit is necessary for maintenance.
- The following is an example for the axis number 1 Driver Unit.

(1) Connect the Handy Terminal with the connector CN1.

(2) Turn on the control power. (At this time the initial message will not be displayed.)

(3) Input the AX1 command to select the axis number 1 Driver nit. If the axis number is not clear, input in ascending order as AX0, AX1, • • • and so forth. (The colon ":" will not appear on the screen because the axis number is not matched.)

A X 0 ENT

```
AX0
```

A X 1 ENT

```
AX1
:_
```

(4) Set the parameter CM0 (standard: single Driver Unit communication mode).

/ N S K SP
O N ENT

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

C M 0 ENT

```
:/NSK ON
 NSK ON
:CM0
:_
```

(5) Turning on the control power again will set the standard single Driver Unit communication mode.

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8. Glossary of Command and Parameter

8.1. Glossary of Command and Parameter

- "Shipping set" denotes a setting of command or parameter that is set at the factory before shipment.
- "Default" denotes a value that is adopted when entering command and parameter with no data.
- The password must be entered before input of a command marked with ★. Refer to "7.3.2.3. Password."

★ AB: I/O Polarity

Format : AB d_1, d_2, d_3, d_4, d_5, d_6, d_7, and d_8
Data : d_n = 0: Normally open contact (A contact)
d_n = 1: Normally closed contact (B contact)
d_n = X: At the time of input: Polarity coded X does not change.
: At the time of reading out: Polarity of a port coded X cannot be changed. They are fixed to the normally open contact.
Shipping set : X0X0XX00 (all normally open contacts)
Default : Not available (Input all 8 digits.)

- This command sets the polarity of control input ports.
- The ports whose polarity can be changed are EMST, HLS, OTP, and OTM. The other ports are fixed to the normally open contact. (OTP and OTM are only available in types 3, 4, and 7 of Input/Output combination for the B3 and 23 type Driver Units.)
- Set "X" for the port whose polarity cannot be changed. If "0" or "1" is inputted, the display shows "?" denoting a faulty input.
- The TS or ?AB command reports the state of polarity setting.
- The table below shows the correspondence of data digit to Input / Output port.

Data digit	n1	n2	n3	n4	n5	n6	n7	n8
Signal	SVON	EMST	IOFF*[1]	HLS	HOS	CLR	OTM	OTP

*1: The IOFF input changes to the CLCN when brake sequence function is specified.

For ESBB5 and 25 type Driver Units only

★ AC: Analog Command Mode

Format : AC data
Data : -1, 0, and 1
Shipping set : 1
Default : 0

- Sets the validity (valid/invalid), and the polarity of analog command input.
  AC0 : Analog command input invalid. The DC command is valid.
  AC1 : Analog command input valid. Voltage +: CCW direction
  AC-1 : Analog command input valid. Voltage +: CW direction
- When the parameter DI is set to reverse the sign of position scale (DI1), the rotational direction of above analog command shall be reversed as well.
- The TS or ?AC command reports the current setting.

AD: Absolute Positioning, Degree

Format	: AD data1/data2
Data range (data1)	: Differs with the setting of parameter PS. [Unit: 0.01°]
Default (data1)	: 0
Data range (data2)	: PL, MI, and EX
Default (data2)	: Direction in which the move distance is shorter

- The data1 indicates the position data of the destination. This position, which may be read out by the TP5 command, complies with the position data in unit of angle. Refer to "7.2.1. Absolute Position Scale (For Absolute Position Sensor)" or "7.2.2. Incremental Position Scale (For Incremental Position Sensor)" for details.
- Range of data1 differs with the PS setting (type of position scale).

	Data range (data1)
PS0	– 9 999 999 to + 9 999 999
PSn	0 to (36 000 × *n) –1

* n = 1 to 99 (Shipping set of n = 1)

- The data2 sets the rotational direction. However, when the parameter PS is set to 0 (PS0), the setting of data2 is invalid.
  1) PL: CW direction [When the parameter DI is set to 1 (DI1), the direction is CCW.]
  2) MI: CCW direction [When the parameter DI is set to 1 (DI1), the direction is CW.]
  3) EX: Follows the DIR input.
     OFF: CW direction (When the parameter DI1 is set, the direction is CCW.)
     ON: CCW direction (When the parameter DI1 is set, the direction is CW.)
  4) Default:
     • The Motor moves to the direction in which the move distance is shorter to the destination.
     • If the position data of current position and the destination are the same, the move distance is 0 (zero).
     • If the software over travel limit sets the off-limits zone, the Motor rotates in the direction to avoid the off-limits zone regardless of the move distance.
- This command has two functions, which depend on the usage.
  1) If it is entered in the normal standby condition at where the prompt is ": __", it serves as a positioning command.
  2) If it is entered right after inputting the CH command (channel selection), and the System waits for a program input at where the prompt is "?"., it specifies the rotational amount of the Programmable Indexer channel.

★ AE: Automatic Tuning Error, Alarm Type

Format : AE data
Data : 0, and 2
Shipping set : 0
default : 0

- This parameter sets the output format of “Automatic tuning error” alarm.

Setting	DRDY output	OVER output
AE0	Does not change.	Does not change.
AE2	Does not change.	Closed.

- Regardless of the parameter setting, the alarm state will be monitored by the 7-segments LED and the TA command.

- The TS or ?AE command reports the current setting.

For ESBB5 and 25 type Driver Units only

★ AF: Analog Command Offset

Format : AF data
Data range : - 63 to 63
Shipping set : 0
Default : 0

- Sets the offset value on the input voltage of analog command.

- For more details about the parameter AF, refer to “6.3.2.2. Offsetting Analog Velocity Command” in case of the analog velocity control mode, or “6.4.2.2. Offsetting Analog Torque Command” in case of the analog torque control mode.

- The TS or ?AF command reports the current setting.

For ESBB5 and 25 type Driver Units only

★ AG: Analog Command Gain

Format : AGV data
AGT data
Data range : 0.10 to 2.00
Shipping set : 1 (Both AGV and AGT)
Default : Not available

- This parameter sets the analog command gain in the velocity or the torque control mode.
  AGV : Analog command gain in velocity control mode
  AGT : Analog command gain in torque control mode

- Actual gain value is proportional to the velocity or the torque command.

  ◊ Example
  When set to AGV0.5:
  Actual velocity command = Velocity command input × 0.5

- The TS or ?AG command reports the current setting.

For ESBB5 and 25type Driver Units only

AL: Acceleration Limiter

Format : AL data
Data range : 0, and 0.01 to 1 280.00 [s^{-2}]
Shipping : 0
Default : 0

- This command sets the limits on acceleration/deceleration caused by changes of velocity command in the velocity control mode.
- This parameter is applicable to the velocity command of both analog command input and the RS-232C communication command.
- Setting AL0 disables the function of limiting acceleration/deceleration.
- For more details, refer to “6.3.3.Function to Limit Acceleration / Deceleration.”
- The TS or ?AL command reports the current setting.

★ *AN: Axis Number*

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

- Sets the axis number to each Driver Unit in the daisy chain communication mode.
- The TS command or ?AN command reports the current setting.
- Refer to “7.3.4. Daisy Chain Communication.”

For B3 and B5 type Driver Units only

★ *AO: Absolute Position Scale Offset*

Format : AO data
Data range : 0 to 819 199 [pulse]
Shipping set : 0
Default : 0

- Sets the offset value between the Motor absolute position scale and the user absolute position scale.
- AO data = (Motor absolute position data) – (user absolute position data)
- AO data will be reset if the user absolute position scale is cleared by the AZ command.
- The TS or ?AO command reports the current setting.

AR: Absolute Positioning, Resolver

Format	: AR data1/data2
Data range (data1)	: Differs with setting of the parameter PS
Default data1	: 0
Data2	: PL, MI, and EX
Default data2	: Direction in which the move distance is shorter.

- The data1 indicates the position of the destination. The position, which may be read out by the TP2 command, complies with the user absolute position scale in unit of pulse.
  [Refer to "7.2.1. Absolute Position Scale (For Absolute Position Sensor)" or "7.2.2. Incremental Position Scale (For Incremental Position Sensor)."]

- "data1" range differs with the setting of parameter PS (type of position scale).

Setting	Data range (data1)
PS0	– 99 999 999 to＋ 99 999 999
PSn	0 to (819 200 × n) – 1

* n = 1 to 99; Shipping set: n = 1

- The data 2 indicates the rotational direction. When the PS parameter is set to "0 (zero)", the data 2 is invalid.
  1) PL: CW direction (When the parameter DI1 is set, the direction is CCW.)
  2) MI: CCW direction (When the parameter DI1 is set, the direction is CW.)
  3) EX: Follows the DIR input.
     OFF: CW direction (When the parameter DI1 is set, the direction is CCW.)
     ON : CCW direction (When the parameter DI1 is set, the direction is CW.)
  4) Default
     • The Motor moves to the direction in which the move distance is shorter to the destination.
     • If the position data of current position and the destination are the same, the move distance is 0 (zero).
     • If the software over travel limit sets the off-limits zone, the Motor rotates in the direction to avoid the off-limits zone regardless of the move distance.

- This command has two functions, which depend on the usage.
  1) If it is entered in the normal standby condition (the prompt is ": __".), it serves as a positioning command.
  2) If it is entered right after inputting the CH command (channel selection), and the System waits for a program input (the prompt is "?"), it specifies the rotational amount of the Programmable Indexer channel.

AS: Read out Daisy Chain Status

Format : AS

- The command reads out status of axis numbers of connected Driver Units in the daisy chain communication.

- The AS command will be executed automatically when the power is turned on in the daisy chain communication mode.

- When the AS command is inputted, the Driver Unit of axis number 0 will be always selected.

AT: Automatic Tuning

Format : AT

- Executes the automatic tuning to set automatically the optimum servo parameters and acceleration.

AX: Axis Select

Format : AX data
Data : 0 to 15
Shipping set : 0
Default : 0

- The AX command selects the one of the Driver Units in the daisy chain communication. Selected Driver Unit sends a confirmation signal back to the RS-232C communication terminal.

- The confirmation message is “ACC. AXn” (n = selected Driver Unit number). The Driver Unit of axis 0 is always selected when the power is turned on.

- The TS or ?AX command reports the setting. These command are only valid in the daisy chain communication.

- If AX is input when the daisy chain communication is not active, an error message will be given back.

- Also, the TS report does not include the AX setting. Inputting “?AX” will be an error.

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

★ *AZ : Absolute Zero Position Set*

Format : AZ

- If the AZ command is executed when the Motor is stationary at any position, the position is adopted as the user absolute home position.

- In case of ESB B5 type Driver Unit, execution of the AZ command will automatically reset the AO data (offset of position data).

★ *BF : Brake Sequence Function*

Format : BF
Data : 0 --- Brake sequence function inactive
1 --- Brake sequence function active
Shipping set : 0
Default : 0

- The BF commands selects the brake sequence function.
- The TS or ?BF command reports the current setting.
- Refer to “7.1.10.4. Brake Sequence Function” for details.

⚠ *Caution: A YSB Megatorque Motor equipped with brake, a power source (24 VDC) for brake-off, and wiring for brake are necessary to use the brake system.*

⚠ *Caution: For the B3 and 23 type Driver Units, the BF command is effective only for TY8 I/O combination type, while it is ineffective for other I/O combination type. When BF1 is specified, the parameter OM will be inactive.*

★ *BM: Backspace Mode*

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

- The BM command changes the function of the BS key.

BM0 : A press of the BS key cancels an entered character string on a line.

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

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

CA: Acceleration

Format : CA data1,data2
Data range : 0, and 0.01 to 1 280.00 [s^{-2}]
Default : 0

- This command is to specify the rotational acceleration of a given channel of the Programmable Indexer.
- If no setting of the CA parameter is made in a channel (or the data 0 is specified), the acceleration specified with the MA command is valid.
- The CA command may be input under the condition where a channel to be programmed is selected with a CH command, the Driver Unit outputs "?," and the System waits for a command to be entered.
- data1 sets acceleration, while data2 sets deceleration. However, if the acceleration profiling with the CX command is not functioning, the data 1 is valid for both acceleration and deceleration.
- If ,data2 is default, data1 will be applied to data2.
- The data2 is only programmable to the CH0 to CH31 for the ESB B5 and 25 type Driver Units. It cannot be set to the CH32 to CH63.
- The TC command reports the current setting.
  - ◊ However, if " 0" is set, no report will be given.

CC: Clear Channel

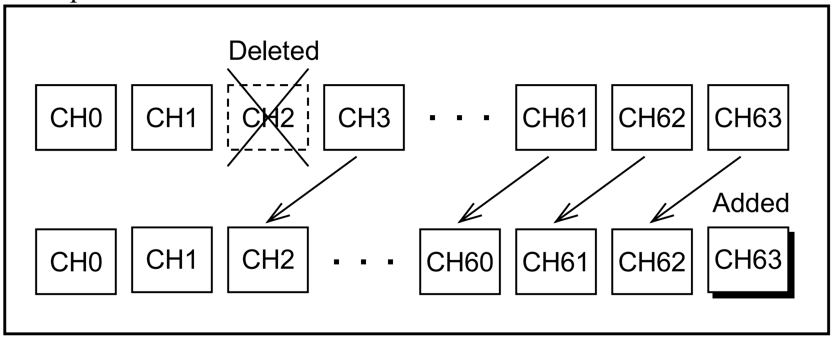
Format: : CC data
Data range
  B3 and 23 type Driver Units : 0 to 15
  B5, and 25 type Driver Units : 0 to 63
Default : 0

- The CC command deletes the program data of a channel specified in 'data.'

CD: Delete Channel

Format	: CD data	
Data range	: B3 and 23 type Driver Units	: 0 to 15
	B5 and 25 type Driver Units	: 0 to 63
Default	: 0	

- The CD command deletes an internal program channel specified by a data.
- Deletion of a channel induces changes of other channel numbers. The numbers over "m + 1" will shift one up respectively and a new program channel will be added to the end.
- Example: In case of CD2:



★ *CE: Brake-on Position Error*

Format	: CE data
Data range	: 1 to 99 999 999 [pulse]
Shipping set	: 1 000
Default	: Not available

- The parameter is for a Motor equipped with brake.
- In case that the Motor is holding its position by the brake, if the deviation of error counter exceeds the value set by the CE parameter, in other words, if the held position of the Motor by the brake shifts more than the CE value, an alarm of brake-on position error (A8) will occur.
- The parameter is active when the brake sequence function (BF1) is specified.
- The TS and ?CE command reports the current setting.

⚠ *Caution: The position of Motor held by the brake may shits for few pulses in some cases. Be aware that the alarm occurs simply because the brake is activated if extremely small data is set to the parameter CE.*

CH: Editing Program to Channel

Format	: CH data	
Data range	: B3 and 23 type Driver Units	: 0 to 15
	: B5 and 25 type Driver Units	: 0 to 63
Default	: 0	

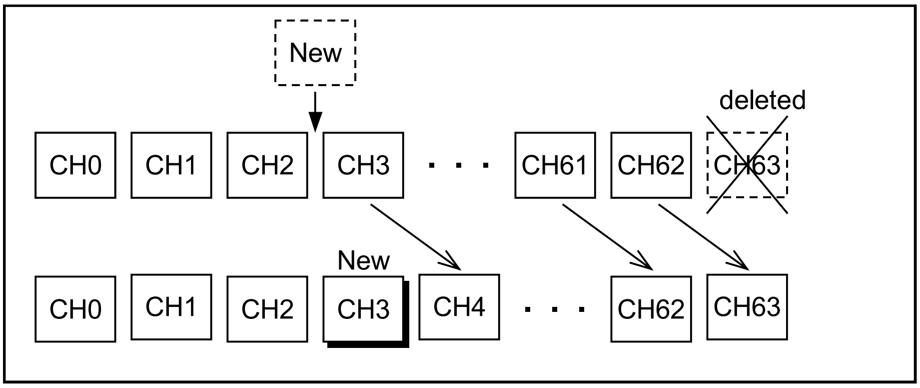
- The CH command declares an internal program channel to be edited.
- The TC command reports an edited program.

⚠ *Caution: Be sure to turn the servo OFF when editing a program.*

CI: Insert Channel

Format	: CI data
Data range	: B3 and 23 type Driver Units : 0 to 15
	: B5 and 25 type Driver Units : 0 to 63
Default	: 0

- The CI inserts a new program channel to a channel number specified by the data.
- Insertion of a new channel changes other channel numbers. The numbers after "m" will shift to downward by one respectively, and the last channel will be deleted.
- The figure below shows an example of the CH3 command.



CL: Clear Alarm

Format	: CL

- The CL command clears alarms to make the Driver Unit in normal state. Refer to "10. Alarm" for alarms that can be cleared by the CR command.

★ CM: Communication Mode

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

- The CM selects the RS-232C communication mode.
  CM0: Standard
  CM1: Daisy-chain communication
- To change the communication mode, change the CM data, turn off the power, and then restore it.
- The TS or ?CM command reports the current setting.

CO : Position Error Counter Over Limit

Format : CO data
Data : 1 to 99 999 999 [pulse]
Shipping set : 50 000
Default : Not available

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

★ *CR : Circular Resolution*

Format : CR data
Data : X1, X2, X4, 360 000, 36 000, and 3 600
Shipping set : X1
Default : Not available

- Use the CR to specify the resolution of pulse train input.
- For the details, refer to "6.2.3. Pulse Train Command Positioning Operation."
- The resolution changes immediately after the CR data command is entered.
- The TS or ?CR command reports the current setting.

CS : Acceleration Pattern Select (common setting)

Format : CS data1, data2
Data range : 1 to 5
Shipping set : 1,1
Default : Not available

- The CS command selects a pattern of the acceleration profiling.
  1: Constant acceleration
  2: Modified sine
  3: Modified trapezoid
  4: Cycloid
  5: Half sine
- data1 sets an accelerating pattern while data2 sets a deceleration pattern.
- When data2 is default, the pattern of data1 shall be applied to data2.
- The TS or ?CS command reports the current setting.

CS: Acceleration Pattern Select (set to a channel of Programmable Indexer.)

Format : CS data1, data2
Data range : 0 to 5
Default : 0

- Selects a pattern of the acceleration profiling to the channels of Programmable Indexer.
  0: Deletes the CS command programmed to a channel, and take the default setting.
  1: Constant acceleration
  2: Modified sine
  3: Modified trapezoid
  4: Cycloid
  5: Half sine
- data1 sets an acceleration pattern, while data2 sets a deceleration pattern.
- When data2 is default, the pattern of data1will be applied to data2. When either one of data1 or data2 is omitted, an error occurs.
- The CS command may be set to the channels CH0 to CH31 for the ESB B5 and 25 Driver Units. It cannot be set to CH32 to CH63 channels.
- The TC command reports the current setting.
  ◊ However when "0" is specified, no response will be returned.
- For details refer to "7.2.8. Acceleration Profiling."

CV: Channel Velocity

Format : CV data
Data range : 0, 0.0001 to 3.0000 [s^{-1}]
Default : 0

- This command specifies the velocity to the program channels of the Programmable Indexer.
- If no setting is made in a channel (or 0 is specified), a velocity specified with the MV command is valid
- The CV parameter is only valid when the CH command designates a channel to be programmed, and the Driver Unit outputs "?__" for command input.
  ◊ If it is input under normal standby state (The prompt is ":".), an error will occur.
- The TC command reports the current setting.
  ◊ If "0 (zero)" is set, no response will be returned

★ CX: Setting CS Function

Format : CX data
Data : 0 ··· Acceleration profiling inactive
: 1 ··· Acceleration profiling active
Shipping set : 1
Default : 0

- The CX command sets the acceleration profiling function.
- The TS or ?CX command reports the current setting.
- For the details, refer to “7.2.8. Acceleration Profiling.”

★ CY: Criterion to function CS

Format : CY data
Data range : 0.01 to 1 280.00 [s^{-2}]
Shipping set : 1.00
Default : Not available

- This parameter sets the threshold of acceleration to function the acceleration profiling.
- If the CY data is lower than the MA data or the CA data (MA<CY or CA<CY), the acceleration and deceleration will be constant even the acceleration profiling is active.
- The CY command is to shorten the time for calculating rotational distance when MV or MA is changed. The time is approximately 1.5 seconds per calculation when set as [MV3, MA1.0,1.0, CY1.0]. It may require two minutes and thirty seconds for a calculation if it is set to [MV3, MA0.01,0.01, CY0.01].
- The TS or ?CY command reports the current setting.
- Refer to “7.2.8. Acceleration Profiling.” for details.

CZ: Check Actual Acceleration

Format : CZ/RP

- In some conditions shown below, the acceleration profiling won’t be performed as specified with the CS command. The CZ command reports the latest state of the acceleration profiling.

Readout	Definition
0	The acceleration profiling is not set after Home Return or Jog.
1	Positioning completes with specified acceleration profiling pattern. (Normal)
2	Decelerated in the middle of acceleration due to insufficient positioning distance.
3	Decelerated in the same pattern as acceleration due to insufficient positioning distance.

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

- The readout will be automatically repeated if /RP is attached to the CZ command.
- The readout shall be one shot if /RP is not attached to the CZ command.
- For details, refer to “7.2.8. Acceleration Profiling.”

★ DB: Dead Band

Format	: DBA data (Not applicable to the B3 and 23 type Driver Units.) DBP data
Data range	: DBA : 0, and 1 to 2 047 DBP : 0, and 1 to 4 095
Shipping set	: 0 (Both of DBA and DBP)
Default	: 0

- Sets a dead band to the position loop and the analog command input.
- For more details, refer to "7.2.6. Dead Band: DBP."
- Refer to "6.3.2.1. Dead Band Setting to Velocity Command Voltage" in case of the velocity control mode, or "6.4.2.1. Dead Band Setting to Torque Command Voltage" in the torque control mode.
- The TS or ?DB command reports the current setting.

For ESBB5 and 25 type Driver Units only

DC: Digital RS-232C Command

Format	: DC data
Data range	
Torque control mode	: – 4 095 to 4 095 (CW for positive command)
Velocity control mode	: – 5 461 to 5 461 (CW for positive command)
Default	: 0

- This command is to input directly the operation command through the RS-232C communication interface in velocity or torque control mode. However, the use of this command shall be limited to an ordinal operation, or a testing operation of the Motor due to sluggish response.
- If the DC command is inputted when an analog command (AC command) is valid, "DC INHIBITED" message will be given and the command will be invalidated.
- The data of this command will be cleared to "0" in the following state.
  1) Servo off
  2) Emergency stop
  3) Over travel limit
  4) Control mode is switched.
  5) Analog command is valid.
  6) MS command is executed, or STP input is ON.

⚠ *Caution: When the sign of the position scale is reversed with DI command, the polarity of DC command to make CW or CCW rotation shall be reversed as well.*

★ DI: Direction Inversion

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

- Switches the counting direction of position scale.
- For the details, refer to "7.2.1. Absolute Position Scale (For Absolute Position Sensor)," or 7.2.2. Incremental Position Scale (For Incremental Position Sensor)."

DP: Debugger for Program

Format : DP

- The DP command monitors the changing state of control Input/Output, and histories of Start/End, and interruption of positioning in the Programmable Indexer positioning operation.
- Up to 64 latest histories can be monitored.
- The history will be revised along changes in control Input/Output and changes in the Programmable Indexer positioning operation.
- Refer to "7.1.18.12. Monitoring Histories of Program Execution and Changes on Control I/O."

DT: Direct Teaching

Format : DT data
Data range : For direct input to a channel
B3 and 23 type Driver Units: 0 to 15
B5 and 25 type Driver Units: 0 to 63
When editing program: no data
Default : 0

- The DT programs the current position as the AR command to a specified channel.
- This function is available for direct input when the prompt is ":" , and for editing program when the prompt is "?".

★ EC: End of Command Message

Format : EC data
Data : 0 ··· Deactivate (No output)
: 1 ··· Activate (output)
Shipping set : 0
Default : 0

- The EC command activates the function to output the notify signal that the Driver Unit is in standby state for another operation command in the positioning mode with Programmable Indexer or the RS-232C communication command.
- Message "!" will be outputted when the function is activated.
- When other commands or parameters are inputted during positioning, the message will be outputted after execution of these commands.
- The TS or ?EC command reports the current setting.

★ EP: Excessive Position Error, Alarm Type

Format : EP data
Data : 1, 2, 3
Shipping set : 2
Default : Not available

- The EP command sets a type of alarm output if "Excessive position error " occurs.

Setting	DRDY output	OVER output
EP1	Open	Does not change.
EP2	Does not change.	Closed
EP3	Open	Closed

- Regardless of the setting of this command, 7 segments LED and TA command will report the alarm state.
- The TS of ?EP command reports the current setting.

★ FC : Friction Compensation

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

- The FC parameter is used to specify a compensation value to cancel rotational static friction of the Motor.
- If 0 is specified in "data," the function is deactivated.
- Parameter FC can be obtained with the formula shown below.

$$\text{FC "data"} = 2\,047 \times \frac{\text{Static friction torque}}{\text{Motor maximum torque}}$$

- The TS or ?FC command reports the current setting.

★ FD: Feed Back Direction Mode

Format : FD data
Data : 0, or 1
Shipping : 0
Default : 0

- Reverses the output timing between øA and øB of the position feedback signal.
  FD0 : Standard øA is the leading phase in CW direction.
  FD1 : Reverse øB is the leading phase in CW direction.

- The TS or ?FD command reports the current setting.

★ FF: Feed Forward Gain

Format : FF data
Data : 0 to 1.0000
Shipping set : 0
Default : 0

- The FF parameter sets the feed forward compensation gain to the position loop.

- Refer to “7.2.4. Feed Forward Compensation: FF” for details

- Setting 0 cancels the feed forward compensation function.

- The TS or ?FF command reports the current setting

FO: Low-pass Filter Off Velocity

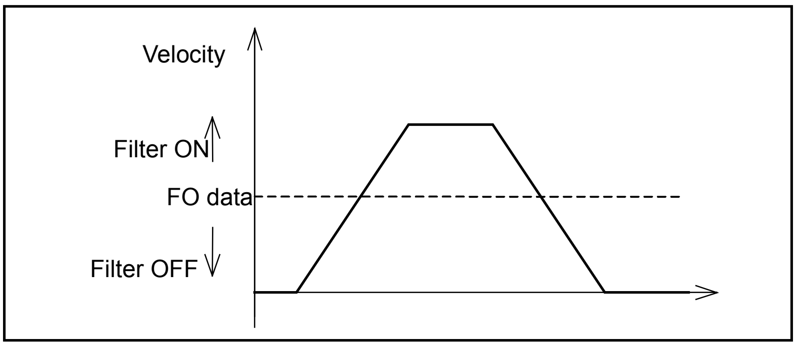
Format : FO data
Data range : 0, and 0.01 to 3.00 [s^{-1}]
Shipping set : 0
Default : 0

- Setting FO parameter will make the low pass filter (FP and FS parameters) velocity sensitive.

- The FO parameter sets the threshold that turns on and off the low-pass filter.

- When this function is set, resonating noise may be lowered without affecting on the settling time.

- Setting FO parameter to “0” will deactivate the velocity sensitive function.
  (The low-pass filters are always effective.)



FP: Low-pass Filter, Primary

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

- The FP parameter specifies the frequency of the primary low-pass filter of the velocity loop.
- When 0 is input, the velocity-loop primary low-pass filter is deactivated. In such a case, a message [PRI.LPF OFF] will be displayed.
- When a data other than 0 (i,e, 10 to 500) is entered, the data is adopted as the frequency.
- The TS or ?FP command reports the current setting.
- Inputting FP/AJ starts fine adjusting mode.

★ *FR: Feed Back Signal Resolution (Factory use only)*

Format	: FR data
Data	: 1
Shipping data	: 1
Default	: Not available

- The users cannot change the setting as it is set along the type of Driver Unit.
- The FR specifies the resolution of the position feedback signal øA and øB.
- The TS or ?FR command reports the current setting

FS : Low-pass Filter, Secondary

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

- The FS parameter specifies the frequency of the secondary low-pass filter of the velocity loop.
- When 0 is input, the velocity-loop secondary low-pass filter is deactivated. In such a case, a message [SEC.LPF OFF] will be displayed.
- When a data other than 0 (i,e, 10 to 500) is entered, the data is adopted as the frequency.
- The TS or ?FS command reports the current setting.
- Inputting FP/AJ starts the fine adjusting mode.

FW: FIN Width

Format : FW data
Data : 0, 0.3 to 100, and -0.3 to -100 [0.1 second]
Shipping set : 1
Default : 0

- Sets the time length to keep outputting IPOS signal. The unit is 0.1 sec.
- If it is set to FW1, the time length outputting the IPOS signal is 0.1 sec.
- If the data is 0, the IPOS output is in the IPOS mode, and the IPOS output is always closed while the value of the position error counter is within the range specified by the IN parameter.
- If the data is set between 0.3 and 100, the IPOS output will be in the FIN mode, and it closes for the moment specified with the FW parameter when the position error counter value enters the range specified with the IN parameter.
- If the data is set to – 0.3 to –100, the IPOS output will be in the CFIN mode, and it opens while the Driver Unit is outputting the internal pulses. It will close when the Driver Unit is in the standby state for the next positioning command after completion of a positioning.
- Refer to “7.1.11. In-Position Output” for the output timing.
- The TS or ?FW command reports the current setting.
- Set to the IPOS mode when the System is in a positioning mode with the pulse train position command. (FW0)

★ *FZ: Feedback Phase Z Configuration*

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

- The FZ command selects the output format of the position feedback signal CHZ (CN2 output).
  FZ0 : Outputs the øZ signal from CHZ.
  FZ1 : Outputs MSB of the digital position signal from CHZ.
- Refer to “7.1.16. Position Feedback Signal” for the output timing of the øZ signal or MSB.
- The TS or ?FZ command reports the current setting.

★ GP: Gain Switching Point

Format : GP data
Data range : 0, and 1 to 1 000 [pulse]
Shipping set : 0
Default : 0

- Sets the threshold of position error for the automatic gain switching function.
- It switches the gains for Motor stationary level when the absolute position error keeps clearing the parameter GP data for a time set with the stability timer GT [ms].
- Setting the data to 0 deactivates the function of automatic gain switching.
- Refer to "7.2.7. Automatic Gain Switching" for more information.
- The Ts or ?GP reports the current setting.

GT: Switching Gain Timer

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

- The gain will be switched to the stationary level if the absolute value of error pulses is within the GP setting for a time set with the stability timer GT [ms].
- Refer to "7.2.7. Automatic Gain Switching" for more details.
- TS or ?GT reports the current setting.

HA: Home Return Acceleration

Format : HA data
Data range : 0.01 to 1 280.00 [s^{-2}]
Shipping set : 1.00 [s^{-2}]
Default : Not available

- The HA command sets an acceleration of Home Return.
- The TS or ?HA reports the current setting.

★ HD: Home Return Direction

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

- Refer to "6.2.1.2. Setting Home Position by Home Return" for more details about the Home Return.
  HD0: Home Return in clockwise (CW).
  HD1: Home Return in counterclockwise (CCW).

For ESBB5 and 25 type Driver Unit only

HI: Home In-position

Format : HI data
Data : 0 to 102 400 [pulse]
Shipping set : 0
Default : 0

- The HI parameter specifies the range of home position where the HOME output signal closes if the Home Return is in reporting mode for detection of the home position (HW ≠ 0).
- The HOME output closes when the Motor is in the range set with the HI parameter centering the user home position.
- The TS or ?HI command reports the current setting.

★ HO: Home Offset

Format : HO data or /ST
Data range : – 802 816 to 802 816 [pulse]
Shipping set : 0
Default : 0

- The HO parameter sets the distance to which the Motor advances from the position, at where the detected position data becomes 0 for the first time after the input of limit switch (HLS: CN2) in Home Return. Refer to "6.2.1.2. Setting Home Position by Home Return."
- Input of the HO data sets the offset (data) from the position at where the data of position sensor becomes 0.
- When the HO/ST command is inputted, the distance to the position 0 of position sensor from the current position is set as the offset.
- The TS or ?HO command reports the current setting.

HS: Home Return Start

Format : HS opt
: opt = default -----Normal Home Return
: opt = /LS ---------Adjust limit position

- Starts Home Return.
- Input the HS/LS to adjust the position of the home position proximity sensor.
- Refer to “6.2.1.2. Setting Home Position by Home Return.”

★ *HT: Hardware Travel Limit Over, Alarm Type*

Format : HT data
Data : 0, 1, and 2
Shipping set : 2
Default : 0

- The HT command sets the format of outputting an alarm for “Hardware travel limit over.”

Setting	DRDY output	OVER output
HT0	Does not change.	Does not change.
HT1	Opens	Does not change
HT2	Does not change.	Closed

- Regardless of the setting with this command, the 7 segments LED and the TA command report an alarm status.
- The TS or ?HT command reports the current setting.

HV: Home Return Velocity

Format : HV data
Data range : 0.0001 to 3.0000 [s^{-1}]
Shipping set : 0.2000 [s^{-1}]
Default : Not available

- The HV parameter sets Home Return velocity.
- The TS or ?HV command reports the current setting.

For ESBB5 and 25 type Driver Units only

HW: HOME Signal Holding Time

Format	: HW data
Data range	: 0, and 0.3 to 100 [0.1sec]
Shipping set	: 0
Default	: 0

- Specifies the format of outputting the HOME signal.
- If the data is 0, the report mode of completion of Home Return is selected; the HOME output closes on completion of Home Return. It opens if the Motor moves away from the home position by the next positioning command or Servo off.
- If the data is set between 0.3 and 100, the report mode of detection of home position is selected; the HOME output closes if the Motor is at a position within the range specified in the HI parameter centering the user absolute home position. At this moment the HOME output closes at least a time specified in the HW parameter.
- The TS or ?HW command will report current setting.

HZ: Home Return Near-Zero Velocity

Format	: HZ data
Data	: 0.0001 to 0.2000 [s^{-1}]
Shipping set	: 0.0100 [s^{-1}]
Default	: Not available

- Sets Home Return near-zero velocity.
- The TS or ?HZ command reports the current setting.

ID: Incremental Positioning, Degree

Format	: ID data1/data2
Data range (data1)	: – 9 999 999 to + 9 999 999 [0.01°]
Default (data1)	: 0
Data range (data2)	: EX
Default (data2)	: Follows the sign of data1.

- In positioning with Programmable Indexer, or the RS-232C communication, the ID command executes incremental positioning in unit of degree.
- The data is in the unit of 0.01°.
- The data sign specifies the direction of rotation.
  data > 0 : plus direction (CW)
  data < 0 : minus direction (CCW)
  Example : ID-10000 : The Motor turns 100° in the minus direction
- The data2 selects the validity of the direction specified with the DIR input.

  /EX : Follows the DIR input. (CW if the DIR input is OFF, or CCW if the the DIR input is ON. When the settign of direction of the position scale is DI1, the dirction is CW if the DIR input is OFF, and CCW if the input is ON.)

  In this case, an error occurs if the data1 is "–."

  Default : Follows the sign of the data1.
- This command has two functions depending on the usage.
  1) If it is entered in the normal standby condition (The prompt is ":_".), it serves as a positioning command.
  2) If it is entered right after inputting CH command (channel selection), and the System is in "command receiving " state (The prompt is "?_".), it specifies the rotational amount of the Programmable Indexer channel.

★ *ILV: Integration Limit*

Format	: ILV data
Data	: 0.0 to 100.0 [%]
Shipping set	: 100

- Provides the velocity loop integrator with a limit.
- Refer to "7.2.5. Integration Limiter: ILV" for details.
- The TS or ?ILV reports current setting.

★ IM: IOFF Mode

Format : IM data
Data : 0, 1, and 2
Shipping set : 0
Default : 0

- This command selects whether to turn the velocity loop integration frequency OFF or to lower the velocity loop proportional gain, when the IOFF signal is input.
  - IM0 : Mode that has both functions of "velocity loop integration frequency OFF" and "lowering velocity loop proportional gain."
  - IM1 : Exclusive mode of velocity loop integration frequency OFF
  - IM2 : Exclusive mode to lower position loop proportional gain.
- The TS or ?IM command reports the current setting.

IN: In-position

Format : IN data
Data : 0 to 99 999 999 [pulse]
Shipping set : 100
Default : 0

- Specifies an In-position width (criteria to detect completion of positioning).
- If the position error counter reads a value below the IN data, the IPOS signal is output.
- The TS or ?IN command reports the current setting.

IO: Input/Output Monitor

Format : IO data opt
Data : data = default, or 0 Indicates Input/Output status.
B3 and 23 type Driver Units : 0, and 1
B5 and 25 type Driver Units : 0, 1, 2, 3, and 4
data = 1 : Reports Input/Output status.
(Inputs of normally closed contact will be displayed in inverted.)
data = 2 : Reports Input/Output status in Programmable Indexer positioning operation.
data = 3 : Reports Input/Output status in Jog operation.
Option code : opt = default Indicates current status in one shot.
opt = /RP Report is repeated automatically.

- Indicates the status of control Input/Output signal (ON/OFF, open/closed) by 1 or 0.
  [1: Input ON, output closed] [0: Input OFF, output opened]
- Press the BS key to terminate IO/RP repeated automatic reading,
- For more details, refer to "7.1.18.1. Monitoring Control Input/Output Signals (B3 and 23 Driver Units)," or "7.1.18.2. Monitoring Control Input/Output Signals (B5 and 25 Driver Units)."

IR: Incremental Positioning, Resolver

Format	: IR data1/data2
Data range (data1)	: – 99 999 999 to + 99 999 999 [pulse]
Default (data1)	: 0
Data (data2)	: EX
Default (data2)	: Follow the sign of the data1.

- In positioning with the RS-232C communication, the ID command executes an incremental positioning in unit of pulse.

- The Data is in unit of pulse.

- The sign of data specifies the direction of rotation.
  data > 0 : plus direction (CW)
  data < 0 : minus direction (CCW)

- The data2 selects the validity of the direction specified with the DIR input.

  /EX : Follows the DIR input. (Rotates in CW if the DIR input is OFF, or in CCW if the the DIR input is ON. When the settign of direction of the position scale is DI1, the direction is CCW if the DIR input is OFF, and CW if the input is ON.) In this case, an error occurs if the data1 is negative (–).

  Default : Follows the sign of data1.

- This command has two functions depending on the usage.
  1) If it is entered in the normal standby condition (The prompt is ":_".), it serves as a positioning command.
  2) If it is entered right after inputting CH command (channel selection) and the system is in "command receiving " state (the prompt is "?_"), it specifies the rotational amount of the Programmable Indexer channel.

IS: In-position Stability Counter

Format	: IS data
Data	: 0 or 0.3 to 100.0 [0.1 sec]
Shipping set	: 0
Default	: 0

- Specifies the output condition of the positioning completion signal (IPOS).
  IS0 : The IPOS output closes in positioning if the value of the position error counter is within the IN set range.
  IS data (data ≠ 0) : The IPOS output closes in positioning if the value of the position error counter is stable within the IN set range for ['data' × 01 seconds].

- The TS or ?IS command reports the current setting.

- The unit of data is 0.1 [s^{-1}]. The IS1 denotes that the timer is set to 100 [ms].

JA: Jog Acceleration

Format : JA data
Data range : 0.01 to 1 280.00 [s^{-2}]
Shipping set : 1.00
Default : Not available

- Sets the acceleration for Jog operation.
- The TS or ?JA command reports the current setting.

JP: Jump

Format : JP data
Data range
  B3 and 23 type Driver Units : 0 to15
  B5 and 25 type Driver Units : 0 to 63
Default : 0

- The JP command is used to specify the destination of unconditional jumping in an internal program channel.
- If a channel with JP command is executed, the currently being processed program jumps unconditionally to a channel specified by the data, and then the System executes its program.
- The JP command may be input under the condition where a channel to be programmed is selected by the CH command, and the Driver Unit outputs “?” to wait for the next command.
  - ◊ If it is entered in the normal standby state (The prompt is “:”.) an error alarm occurs.
- The TC command reports the current setting.

JV: Jog Velocity

Format : JV data
Data range : 0.0001 to 3.0000 [s^{-1}]
Shipping set : 0.1000
Default : Not available

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

★ *KB: Kill Brake*

Format : KB data
Data : 0, and 1
Shipping set : 0
Default : 0

- This is a command is used when providing a maintenance service on the Megatorque Motor equipped with brake.
- The command KB1 deactivates the function of brake sequence when the brake sequence function is active (BF1) and releases the brake. (The BRKC output closes.)

LG: Lower Gain

Format : LG data
Data : 0 to 100 (%)
Shipping set : 50
Default : 0

- Sets a lowering ratio of velocity loop proportional gain (VG) when the LVG input is ON, or the IOFF input is activated in the IM0 mode.
- However, the LG command is invalidated during the automatic tuning.

★ *LO: Load Inertia*

Format : LO data
Data range : 0.000 to 50.000 [kgm^2]
Shipping set : 0
Default : 0

- This is to set the actual load inertia.
  - ◊ An execution of the automatic tuning sets actual load inertia LO automatically.
- The TS command or ?LO reports the current setting.
- Data of PG, VG, VI, and MA will be automatically adjusted when the LO data is changed.
- Data of LO is cleared to 0 when one of the data of PG, VG, or VI is changed.

★ *LR: Low Torque Ripple*

Format : LR data
Data range : 0, and 1
Shipping set : 0
Default : 0

- Selects the characteristics of the Motor torque output.
  0: Standard
  1: Low torque ripple. (The available maximum Motor torque will be lowered.)
- The TS or ?LR command reports the current setting.

MA: Move Acceleration

Format : MA data1, data2
Data range : 0.01 to 1 280.00 [s^{-2}] or /AJ (Adjust mode)
Shipping set : 1.00 [s^{-2}]
Default : Not available

- The MA parameter sets the acceleration in the positioning with the Programmable Indexer or the RS232C communication command.
- The data1 sets the acceleration, while the data2 sets the deceleration. However, the data1 shall be applied to the acceleration and deceleration if the acceleration profiling is disabled with the CX command.
- If the data2 is default, the data1 shall be applied to the data2.
- The TS or ?MA command reports the current setting.
- An adjusting program will start with the MA/AJ command. However, the adjusting program cannot be used during a positioning with the acceleration profiling.
- The MA parameter will be automatically adjusted if the LO value is changed.

MD: Move Deceleration

Format : MD data
Data range : 0.01 to 1 280.00 [s^{-2}]
Shipping set : 0
Default : 0

- The MD parameter sets the deceleration at stopping caused by an STP input, or an MS command.
- If the data is specified to ‘0’, the Motor stops instantaneously.
- The TS or ?MD command reports the current setting.
- For more details, refer to “7.1.3. Interruption of Positioning with STP Input.”

MI: Read Motor ID

Format : MI

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

★ MM: Multi-line Mode

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

- Sets the reporting format of the command and parameter settings that are read out with the TA, TC and TS commands.
- The MM0 reports all contents continuously.
- When the MM1 is input, the display indicates the setting pausing at each item. At this time, the semicolon ";" appears on the end of command or parameter.

  [Example: MA0.01;]
- Only the space key and the backspace key are valid when the Motor is stationary. Press the space key to step to the next parameter, and press the backspace key to interrupt the readout. The colon ":" appears to wait for the next command.
- The TS or ?MM reports the current setting.

For B5 and 25 type Driver Units only

MN: Monitor Select

Format : MN data
Data : 0 to 8, or /AL
Shipping set : 0
Default : 0

- Selects and sets the conditions on the analog monitor.
- The setting is not backed-up in the memory. The MN data will be 0 when the power is turned on.
- The sawtooth waveform in – 10 [V] to + 10 [V] may be obtained with an input of MN/AL.
- Setting can be read by ?MN command.
- The analog monitor outputs are shown in the table below.

MN data	Monitor output
MN0	Velocity
MN1	Velocity command
MN2	Velocity error
MN3	Torque command
MN4	Phase C current command
MN5	Position command
MN6	Residual pulses of the position error counter (± 127 pulses / ± 10V)
MN7	Residual pulses of the position error counter (± 16 383 pulses / ± 10V)
MN8	Phase C software thermal loading

MO: Motor Off

Format : MO

- When the Motor is in the servo-on state with SVON input ON (CN2), inputting an MO command turns the Motor servo off.
- Input the SV command, or the MS command to activate the Motor servo again.
- When the Motor servo is activated with the MS command again, it clears also the previously inputted operation command.

MS: Motor Stop

Format : MS

- When the MS command is input in the middle of a positioning, the Motor abandons the programs, and stops. At this time, the Motor is in the servo-on state (servo-lock).
- The MD parameter specifies a deceleration for the MS command.
- The operation commands specified before stopping the Motor will be cleared. When the Motor servo is off with the MO command, input of the MS command activates the Motor servo again. This also clears the operation commands being executed before the input of the MO command.

★ *MT: Motor Torque (Factory use only)*

Format : MT data
Data range : 0 to 400 [N•m]
Shipping set : Optimized to individual Motors.
Default : Not available

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

- This parameter is set at the factory before shipping.
- The TS or ?MT command reports the current setting.

MV: Move Velocity

Format : MV data
Data : 0.0001 to 3.0000 [s^{-1}], or /AJ (Adjust mode)
Shipping set : 1.0000 [s^{-1}]
Default : Not available

- Sets the velocity in a positioning with the Programmable Indexer and the RS-232C communication command.
- The TS or ?MV command reports the current setting.
- The MV/AJ command sets to adjusting mode. However the MV/AJ command will be disabled during a positioning to which the acceleration profiling is specified.

NA: Near Position A
NB: Near Position B

Format : NA data
: NB data (Not applicable to ESBB3 and 23 type Driver Units.)
Data range : 1 to 99 999 999 [pulse]
Shipping set : 100
Default : Not available

- In a positioning with the Programmable Indexer or the RS-232C communication command, the NEARA or NEARB output reports that the Motor has reached the close proximity zone that is set with the NA or the NB data in unit of pulse in front of the positioning destination.
- The NA data is for the EARA output, while the NB data is for the NEARB output.
- If the NMA or the NMB parameter is 0, the NEARA or the NEARB output will be in the target proximity mode.
- The TS, ?NA, or ?NB command reports the current setting.
- For details of function, refer to "7.1.15. Target Proximity / In-target."

★ NMA: Near A Output Mode
★ NMB: Near B Output Mode

Format : NMA data
NMB data (Not applicable to ESBB3 and 23 type Driver Units.)
Data range : 0, 0.3 to 100.0 [0.1 sec]
Shipping set : 0
Default : 0

- Selects the mode of the NEARA and the NEARB outputs.
- When the data is set to 0, the outputting mode will be the Target proximity, and the outputs will report that the Motor has reached the proximity set with the NA or the NB in the unit of pulse.
- If the data is set from 0.3 to 100.0, the outputting mode will be the In-target and the outputs repot that the Motor is on a position set with the ZAS and the ZAE, or the ZBS and the ZBE on the user position scale. The data of NMA and NMB are the minimum holding time of output when the Motor passes the zone at very high velocity.
- The TS or ?NM command reports the current setting.
- For details of function, refer to "7.1.15. Target Proximity / In-target."

NP: Notch Filter, Primary

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

- The NP parameter is used to specify the frequency of the primary notch filter of the velocity loop.
- If 0 is specified, the primary notch filter of the velocity loop is deactivated. In such a case, “PRI.NF OFF” is displayed.
- If a data other than 0 (i.e., 10 to 500) is entered, the data is adopted as the frequency.
- The TS or ?NP command reports the current setting.
- The NP/AJ command sets to adjusting mode.

NQ: Notch Filter, Q Parameter

Format : NQ data
Data range : 0.10 to 5.00
Shipping set : 0.25
Default : Not available

- The NQ parameter is used to specify the Q parameter of the secondary notch filter of the velocity loop.
- The TS or ? NQ command reports the current setting.

NS: Notch Filter, Secondary

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

- The NS data is used to set the frequency of secondary notch filter.
- If 0 is specified, the 2nd stage notch filter will be set to OFF. In such a case the display shows “SEC.NF.OFF.”
- If the data other than “0” (i.e., 10 to 500) is specified, the frequency will be set to the data.
- The TS or ?NS reports the current setting.
- The NS/AJ starts adjusting program.

★ NW: Chattering Preventive Timer

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

- The RUN and the HOS are edge-triggered inputs. To protect against multiple inputs due to contact chattering, the NW sets a timer length to confirm the input as the current level detection.

  Timer = data × 2.8 [ms]

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

OE: Sequence Option Edit

Format : OE data
Data : * or &
Default : Not available

- The OE command changes the sequence code of a program previously specified in a program channel.
- If the OE command is entered under the following conditions where a channel whose sequence is code shall be changed is selected with the CH command, the Driver Unit outputs "?," and the System waits for a command to be entered, the sequence code of the program already specified in the channel is changed into the data. (An error occurs if the command is entered when the Driver Unit indicates ":" for normal standby state.)
- The data denotes the sequence code. Adding the sequence code enables to execute the positioning of the next channel without selecting it externally.

  * : After execution of the program, the System outputs the IPOS signal, and then executes the next channel's program.

  & : After execution of the program, the System outputs the IPOS signal, the Motor stops, and then the System executes the next channel's program when the RUN command is input.

★ OG: Origin Set

Format : OG

⚠ *Caution: Do not input the OG command. This is for NSK factory use only.*

★ OL: Overload Limit (Factory use only)

Format : OL data
Data : 0 to 100
Shipping set : Unique value for each System
Default : 0

- Do not change the OL setting. The OL is properly set for each System at the factory. If it needs to be changed, contact NSK.
- If 0 is specified, the Driver Unit displays "THERMAL OFF" to indicate it is deactivated.
- The TS or ?OL command reports the current setting.

For ESBB3 and 23 type Driver Units only

★ OM: Output Signal Mode

Format : OM data
Data : 0, 1, 2, and 3
Shipping set : 0
Default : 0

- The OM command selects function of the OUT1 (Pin No.3) of connector CN2.

Setting	Signal code	Function
OM0	BRK	Brake control
OM1	SPD	Monitor velocity
OM2	NEAR	Target proximity/In-target
OM3	OVER	Warning

- The TS or ?OM command reports the current setting.

⚠ *Caution: When BF1 is specified in case of the TY8 I/O combination type, the parameter OM will become inactive and the OUT1 signal will be set to the BRKC (brake control).*

★ OP: Forced Output Port Primary/Extended

Format : OPP b2 b1 b0
OPE b7 b6 b5 b4 b3 b2 b1 b0
(Not applicable to ESBB3 and 23 type Driver Units.)
Data : bn = 0 ··· open
bn = 1 ··· closed
bn = X ··· Does not change.
Default : Not available. Input all data.

- The OP command forcibly controls the control Input/Output ports.
- The OPP controls the connector CN2, and the OPE command controls the connector CN5.
- Outputs the data forcibly starting from an execution of the OP to the input of the BS key.
- The System returns to normal outputting state with the internal controller after the BS key is pressed.
- Relation between the data and the port of ESBB3 and 23 type Driver Units

Command	data	b7	b6	b5	b4	b3	b2	b1	b0
OPP (CN2)	Pin No.	–	–	–	–	–	15 (2)	14	3
	Signal code	–	–	–	–	–	DRDY	IPOS	OUT1

- Relation between the ‘data’ and the port of ESBB5 and 25 type Driver Units

Command	data	b7	b6	b5	b4	b3	b2	b1	b0
OPP (CN2)	Pin No.	–	–	–	–	–	15 (2)	14	3
	Signal code	–	–	–	–	–	DRDY	IPOS	BRK*1
OPE (CN5)	Pin No.	23	22	21	20	5	4	3	2
	Signal code	Reserved	HCMP	HOME	SPD	Reserved	NEARB	NEARA	OVER

*1: This signal will become the BRKC (brake control) when the brake sequence function is active.

★ *OR: Criterion, Overrun Alarm*

Format : OR data
Data range : 204 800 to 819 200 [pulse]
Shipping set : 409 600 [pulse]
Default : Not available

- This parameter sets the threshold of distance to report an overrun alarm.
- The overrun alarm occurs when the error in the position error counter exceeds the sum of the data of the CO and the OR parameters.
- The TS or ?OR reports the current setting.

★ *OS: Origin Setting Mode*

Format : OS data
Data

data	Position at where Home Return completes
1	Home Return completes when the Motor gets out the zone at where the home position sensor is being ON.
3	Home Return completes when the Motor advances an offset distance specified by the HO data after it got out the zone at where the home position sensor is being ON.
4	Home Return completes when the Motor advances an offset distance specified by the HO data after it gets in the zone at where the home position sensor is being ON.
5	Home Return completes as soon as the Motor gets in the zone where the home position sensor is ON.
6	Sets the current position as the home position.

Shipping set : 4
Default : Not available

- This command sets the Home Return mode.
- Refer to "6.2.1.2. Setting Home Position by Home Return" for more details.
- The TS or ?OS command reports the current setting.

★ *OTP: Over Travel Limit Switch Position*
★ *OTM: Over Travel Limit Switch Position*

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

- Sets the software over travel limit values in the position scale.
  OTP : Sets the over travel limit value in the plus direction in unit of pulse.
  OTM : Sets the over travel limit value in the minus direction in unit of pulse.
- The OTP/ST and the OTM/ST commands enable to set limit switch positions with teaching. (For more details, refer to "7.1.8.2. Software Over-travel Limit.")
- The TS or ?OT command reports the current setting.

★ OU: Origin Undefined, Alarm Type

Format : OU data
Data : 0, and 2
Shipping set : 0
Default : 0

- This command sets the format of alarm for "Home position undefined."

Setting	DRDY output	OVER output
OU0	Does not change.	Does not change.
OU2	Does not change.	Closed.

- Regardless of the setting with the OU command, the 7 segments LED and the TA command report the alarm state.

- The TS or ?OU command reports the current setting.

★ PA: Phase Adjust (Factory use only)

Format : PA data
Data : 24 to 1 048
Shipping set : 700
Default : Not available

- Sets the compensation value of installation position of the resolver.

- The TS or ?PA command reports the current setting.

⚠ *Caution : Do not change the setting as it is properly adjusted at the factory.*
If you need to change the setting, consult with NSK.

★ PC: Pulse Command

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

- Sets the format of the pulse train input.
  PC0: CW & CCW format
  PC1: Pulse & direction format
  PC2: øA/øB input, single format (× 1)
  PC3: øA/øB input, duplex format (× 2)
  PC4: øA/øB input, quadruple format (× 4)

- The TS or ?PC command reports the current setting.

★ PE: Program Error, Alarm Type

Format : PE data
Data : 0, and 2
Shipping set : 2
Default : 0

- This command sets the alarm output mode for "Program error."

Setting	DRDY output	OVER output
PE0	Does not change.	Does not change.
PE2	Does not change.	Closed.

- Regardless of the setting of the PE command, the 7 segments LED and the TA command reports the alarm state.

- The TS and ?PE command reports the current setting.

PG: Position Gain

Format : PG data
Data : 0.010 to 1.000, or /AJ (adjusting mode)
Shipping set : 0.100
Default : Not available

- Sets proportional gain of the position loop.

- The TS or ?PG command reports the current setting.

- The PG/AJ starts the adjusting program.

- It is automatically adjusted when thee LO data or the SG data is changed.

- The LO data and the SG data will be cleared to 0 when the PG data is changed.

★ PH: Program Home Return

Format : PH data
Data : 0 -----Automatic Home Return invalid
1 -----When the power is turned on, the PH executes Home Return only if the home position is undefined.
2 -----Executes automatic Home Return every time before execution of a positioning with the Programmable Indexer.
Shipping set : 0
Default : 0

- This is to execute Home Return automatically before an execution of positioning with the Programmable Indexer.

- The setting makes the HS command unnecessary, thus saves a program area equivalent to one channel.

- The TC/AL or ?PH command reports the current setting.

For ESB23 and 25 type Driver Units only.

★ PS: Position Scale Select

Format : PS data
Data : 0, 1, and 2 to 99
Shipping set : 1
Default : 0

- Specifies the internal position scale system of the Megatorque Motor System. However, this function is not available in ESBB3 and B5 type Driver Units because they have the single rotational position scale only.
  - ◊ PS0 : Linear position scale
  - ◊ PS1 : Single-rotation position scale
  - ◊ PS2 to PS99 : Multi-rotation position scale
- For more details about the position scale, refer to "7.2.1. Absolute Position Scale (For Absolute Position Sensor)," and "7.2.2. Incremental Position Scale (For Incremental Position Sensor)."
- The TS or ?PS command reports the current setting.

RA: Read Analog Command

Format : RA/RP

- Reads an analog command value when the analog command is valid.
- "RA INHIBITED" message will be returned when the analog command is invalid.
- Adding the /RP to RA command will report the reading repeatedly, while the RA input alone reports in one shot. To quit from the repetitive readings, press the BS key.
- The report is a decimal number in -2 048 to 2 047.
- The report includes the result of dead band setting when DBA (dead band) is applicable to an analog command.

★ RC: Rated Current (Factory use only)

Format : RC data
Data : 0 to 100
Shipping set : Uniquely set to each Motor.
Default : 0

- Do not change the RC setting. The RC value has been properly set for each Motor at the factory.
- If it needs to be changed, contact NSK.
- The TS or ?RC command reports the current setting.

★ *RI: Rotor Inertia (Factory use only)*

Format : RI data
Data range : 0 to 1.000 [kg・m^2]
Shipping set : Properly set to each Motor.
Default : 0

⚠ *Caution : Do not change the setting because it has been properly set to each Motor.*

- This is for the factory use only.
- The TS or ?RI command reports the current setting.

For B3 and B5 type Driver Units only

★ *RO: ABS/INC (Factory use only)*

Format : RO data
Data range : 0 to 4 095
Shipping set : 2048
Default : 0

⚠ *Caution : Do not change the setting because it is properly set to each Motor for non-interchangeable Motors and Driver Units.*

- This parameter is for the factory use only.
- TS and ?RO command reports the current setting.

RP: Read Pulse Train Command

Format : RP data／RP
Data range : 0 ··· Reads out in decimal number (0 to 65 535)
1 ··· Reads out in hexadecimal number (0000 to FFFF)
Default : 0

- This is used to read out the value of the 16-bit counter of pulse train input.
- The value will count up for CWP pulse train input, and count down in CCWP pulse train input.
- If /RP is added to the RP command, the readout will be automatic.
- If the RP command is not accompanied by the /RP, the readout will be one shot.
- Press the BS key to terminate the automatic readout.
- For the way of use of the function, refer to " 7.1.18.3. Monitoring Pulse Train Input Counter."

★ RR: Resolver Resolution（Factory use only）

Forma : RR data
Data : –3, 1
Shipping set : –3
Default : Not available

- This parameter sets resolution of the position sensor (resolver).
  RR1 : Fixed to 12bit
  RR-3 : Automatic switching, 12bit/High resolution
- Do not change the setting, as it is set along a type of the Driver Unit.
- The TS or ?RR command reports the current setting.

SB: Criterion, SPD Signal Output

Format : SB data
Data range ： data = 0 to 3.00 [s^{-1}]
Shipping set : 0
Default : 0

- This parameter is used to set the threshold to output SPD signal.
- Refer to “7.1.14. Velocity Report” for more details.
- The TS or ?SB reports the current setting.

★ SE: Serial Error

Format : SE data
Data : 0, 1, and 2
Shipping set : 0
Default : 0

- Sets the output format and Motor condition for “RS-232C error” alarm.

Setting	DRDY output	OVER output	Motor condition
SE0	Does not change.	Does not change.	Continue operation.
SE1	Opens	Does not change.	Servo lock
SE2	Does not change.	Closed	

- The TS or ?SE command reports the current setting.
- Be sure to select SE1 for a positioning with the RS-232C communication command.

SG: Servo Gain

Format : SG data
Data : 0 to 30 [HZ], or /AJ (Adjust mode)
Shipping set : 0
Default : 0

- The SG parameter sets the maximum response frequency to the velocity loop.
  - ◊ Sets position loop gain SG in the automatic tuning.
- When the SG value is changed, the parameters PG (position loop proportional gain), VG (velocity loop proportional gain) and VI (velocity loop integration frequency) settings will be automatically renewed.
- The TS or ?SG reports the current setting.
- The SG/AJ command starts the fine adjusting program.
- If PG, VG, or VI is changed, the SG data will be cleared to 0.

★ *SI: System Initialization*

Format : SI/data
Data range : No data, /AL, /SY, /YS
Default : No data

- Resets all parameters to the shipping set values. Please note that the SI command with optional data AL, SY, and YS will delete all Programmable Indexers' channel programs
- The SI command can only be inputted immediately after entering the password, and when the Motor is servo-off.
- The following show the parameters that will be initialized with the SI command.

SI : Initializes the servo-related parameters only. (PG, VG, VGL, VI, VIL, LG, TL, GP, GT, FO, FP, FS, NP, NS, NQ, DBP, DBA, ILV, FF, FC, SG, and LO)

SI/AL : Initializes all parameters.

SI/SY : • For ESB23 and 25 type Driver Units, this command will initialize all parameters excluding PA.

• For ESBB3 and B5 type Diver Units, this command will initialize all parameters excluding PA and RO.

SI/YS : • For ESB23 and 25 type Driver Units, this command will initialize all parameters excluding PA. The PA will be set to 700.

• For ESBB3 and B5 type Diver Units, this command will initialize all parameters excluding PA and RO. Parameters PA and RO will be set to 700 and 2048, respectively.

* Executing SI/AL entails resolver phase adjustment. Be careful not to interrupt the Motor motion by an external force. (Do not perform above initializations only to the Driver Unit.)

⚠ *Caution: It requires approximately 30 seconds to initialize the system. Do not turn off the power while initializing. Otherwise, the memory error alarm occurs.*

* When the error occurs, only the SI/AL command is valid even for the input of the SI or the SI/SY.

For ESBB5 and 25type Driver Units only.

★ *SL :Set Control Mode*

Format : SL data
Data : 1, 2, and 3
Shipping set : 3
Default : Not available

- Sets the control mode.
  SL1 : Torque control mode
  SL2 : Velocity control mode
  SL3 : Position control mode
- Position control mode is valid immediately after inputting this command.
- The TS or ?SL command reports the current setting.

For ESBB3 and 23 type Driver Units only.

★ *SM: SVON Mode (Factory use only)*

Format : SM data
Data : 1, 2, and 3
Shipping set : 1
Default : Not available

⚠ *Caution: This parameter is for the factory use only. Do not change the setting.*

★ *SO: SPD Output Mode*

Format : SO data
Data : 0, and 1
Shipping set : 0
Default : 0

- This command selects the velocity-detecting mode of the SPD output.
  SO0 : Sets to “Zero speed mode.” The SPD output will be closed when the velocity is within the SB setting longer than a time set by the ST parameter.
  SO1 : Sets to “Over speed mode.” The SPD output will be closed when the velocity is over the SB setting longer than a time set by the ST parameter.
- The TS or ?SO reports the current setting.
- For details, refer to “7.1.14. Velocity Report.”

SP: Start Program

Format : SP data
Data range
B3 and 23 type Driver Units: 0 to 15, or /AJ (Adjust mode)
B5 and 25 type Driver Units: 0 to 63, or /AJ (Adjust mode)
Default : 0

- The SP command executes the Programmable Indexer's channel program specified in the data.
- The SP/AJ enables a reciprocating positioning.

ST: Speed Stability Timer

Format : ST data
Data range : 0, 0.3 to 100.0 [0.1sec]
Shipping set : 0
Default : 0

- This parameter sets a stability timer for outputting the SPD signal when the Motor velocity is within the threshold set with the SB parameter.
- If the ST is set to 0, the SPD output will be closed without checking the stability of the velocity.
- If the ST parameter is set between 0.3 and 100.0, the SPD output will be closed after checking stability of the velocity.
- The TS or ?ST reports the current setting.
- For details, refer to "7.1.14. Velocity Report."

SV: Servo On

Format : SV

- When the Motor servo is turned off by the MO command, the SV command will turn the Motor servo on.
- To turn the Motor servo on by the SV command, the SVON input of CN2 must be ON.

TA: Tell Alarm Status

Format : TA
Data : No data /HI/ CL
Default : No data

- TA: Reports all alarms currently reported.
- TA/HI: Displays history of alarms. Refer to "10.1.3 History of Alarms."
- TA/CL: Clears history of alarms. The password is required to execute the command.
- There will be no indication when no alarm is reported.
- When an alarm is reported, it is identified as shown below.

Alarm	7 segments LED	Terminal Display
Memory error	E0	**E0>Memory Error**
EEPROM error	E2	**E2>EEPROM Error**
System error	E7	**E7>System Error**
Interface error	E8	**E8>I/F Error**
Analog command error	E9	**E9>ADC Error**
Brake-on position error	F0	**F0>Clamp Position Error**
Excess position error	F1	**F1>Excess Position Error**
Software over travel limit	F2	**F2>Software Over Travel**
Hardware over travel limit	F3	**F3>Hardware Over Travel**
Emergency stop	F4	**F4>Emergency Stop**
Program error	F5	**F5>Program Error**
Automatic Turing error	F8	**F8>AT Error**
RS-232C error	C2	**C2>RS-232C Error**
CPU error	C3	**C3>CPU Error**
Software internal error	C9	**C9>Software Internal Error**
Resolver circuit error	A0	**A0>Resolver Circuit Error**
Absolute position error	A1	**A1>Absolute Position Error**
Software thermal sensor	A3	**A3>Overload**
Velocity error over	A4	**A4>RUN away**
Home position undefined	A5	**A5>Origin Undefined**
Brake error	A8	**A8>Brake Error**
Heat sink overheat	P0	**P0>Over Heat**
Abnormal main AC line voltage	P1	**P1>Main AC Line Trouble**
Over current	P2	**P2>Over Current**
Control AC line under voltage	P3	**P3>Control AC Line Under Voltage**

- When multiple alarms are reported, each alarm is displayed on a separate line.
- Switching display format by the MM command is effective.
- Example of display: Hardware travel limit and emergency stop alarms are displayed in the MM1 format.

```
:TA
 F3>Hardware Over Travel;
 F4>Emergency Stop;
:_
```

TC: Tell Channel Program

Format : TC data
Data range
B3 and 23 type Driver Units: 0 to 15, or /AL
B5 and 25 type Driver Units: 0 to 63, or /AL
Default : 0

- Reports the program contents of a channel specified by the data.
- No data is displayed if any program is not set to the channel.
- Enter of the TC/AL command enables to scroll all channels by pressing the space key.

TE: Tell Position Error Counter

Format : TE/RP

- Reads out the value of position error counter. The reading shall be between –2 147 483 648 and +2 147 483 647. When it exceeds (or falls below) the upper (or lower) limit, the reading will change to backward counting in minus (or plus) side.
- When only the TE is entered, the display shows the current reading in one shot.
- If the /RP option is added to the TE command, reading is repeated automatically.
- In an automatic reading, a value consisting of up to six figures is read out. If a value consists of more than six figures, "*******" is displayed.
- To terminate automatic reading, press the BS key.

TG: Tell Gain Switching

Format : TG/RP

- TG command monitors state of the automatic gain switching.
- For details of the monitor, refer to "7.1.18.8. Monitoring State of Automatic Gain Switching."
- If the TG command is accompanied by /RP, the readout sill be repetitious.
- For the TG command without /RP, the readout will be one shot.
- Press the BS key to terminate automatic reading.

TI: Timer

Format : TI data
Data range : 0.3 to 100.0 [0.1 sec]
Default : Not available

- Sets a timer to an internal channel of the Programmable Indexer.
- The TI parameter can only be set under the conditions where the CH command specifies a channel to which the timer to be programmed, the Driver Unit outputs “?” indicating that the System waits for a command to be entered.
- The TC command reports the current setting.

★ *TL: Torque Limit Rate*

Fromat : TL data
Data range : 0 to 100 [%]
Shipping set : 100
Default : 0

- Sets the torque limit.
- The Motor torque will be reduced to a percentage (%) specified by the TL command as soon as it is inputted. The Motor torque will be controlled not to exceed the limit thereafter.
- The TS or ?TL command reports the current setting.

★ *TO: Software Travel Limit Over, Alarm Type*

Format : TO data
Data : 1, and 2
Shipping set : 2
Default : Not available

- Selects the format of alarm output of ‘Software over travel limit’ alarm.

Setting	DRDY output	OVER output
TO1	Open	Does not change.
TO2	Does not change.	Closed.

- Regardless of the TO setting, the 7 segments LED and a readout with the TA command reports the alarm status.
- The TS or ?TO command reports the current setting.

TP: Tell Position

Format : TP data/RP
Data range : 0 ··· Reports the current position on the Motor absolute position scale in unit of pulse.
(Applicable to ESBB3 and B5 type Driver Units only.)
2 ··· Reports the current position on the user position scale in unit of pulse.
5 ··· Reports the current position on the user position scale in unit of degree.
6 ··· Reports simultaneously the current position on the user position scale in unit of pulse (upper line) and position error (lower line)
Default : Not available

- Reports the current position in a specified poison scale with the PS command.
- If the TP command is accompanied by /RP, the readout will be repeated automatically.
- If the /RP is not set with the TP command, the readout will be one shot.
- Press the BS key to terminate the automatic readout.

  TP2/RP: Unit in pulse

  [Example] 819 200 pulses/rotation

  TP5/RP: Unit in degree

  [Example] 36000/rotation (unit of 0.01°)
- For way of monitoring, refer to "7.1.18.4. Monitoring Current Position."

TR: Tell RDC Position Data

Format : TR/RP

- The TR command reads out the RDC position data.
- The position data is between 0 and 16 383.
- If the TR command is executed with /RP option, the reading is repeated automatically.
- If the TR command is not with /RP, the readout will be one shot.
- To terminate automatic reading, press the BS key.

TS: Tell Settings

Format : TS data
Data range
B3 and 23 type Driver Units : 0 to 13
B5 and 25 type Driver Unit : 0 to 15
Default : 0

- This command is used for reporting the command and the parameter settings.
- The MM command selects the reporting format.

(1) ESBB3 Driver Unit

Command	Classification	Command / Parameter
TS0	All command/parameter	Reports all parameters listed below.
TS1	Servo parameter 1	PG, VG, VGL, VI, VIL, VM, LG, TL, GP, GT
TS2	Servo parameter 2	FO, FP, FS, NP, NS, NQ, DBP, ILV, FF, FC
TS3	Condition setting	CO, IN, IS, FW, VO, VW, OR, CE
TS4	Pulse train input	CR, PC, RR
TS5	Position feedback signal	FD, FZ, FR
TS6	Position scale	PS, DI, OTP, OTM, AO
TS7	Velocity/acceleration	MV, MA, JV, JA, HV, HA, HZ, MD, CS, CY, CX
TS8	Home Return	OS, HD, HO
TS9	Motor characteristic data	PA, OL, RC, LR, RO
TS10	Input and output	TY, AB, SM, NW, IM, OM, SO, SB, ST, NM, NA, NB, ZAS, ZAE, BF, WC, WU
TS11	Communication	MM, BM, CM, AN, WM, SE, EC
TS12	Automatic tuning	LO, SG, MT, RI, ZP, ZV
TS13	Alarm outputs	OU, EP, TO, HT, PE, AE

(2) ESB23 Driver Unit

Command	Classification	Command / Parameter
TS0	All command/parameter	All commands and parameters listed below
TS1	Servo parameter 1	PG, VG, VGL, VI, VIL, VM, LG, TL, GP, GT
TS2	Servo parameter 2	FO, FP, FS, NP, NS, NQ, DBP, ILV, FF, FC
TS3	Condition setting	CO, IN, IS, FW, VO, VW, OR,CE
TS4	Pulse train input	CR, PC, RR
TS5	Position feedback signal	FD, FZ, FR
TS6	Position scale	PS, DI, OTP, OTM
TS7	Velocity/Acceleration	MV, MA, JV, JA, HV, HA, HZ, MD, CS, CY, CX
TS8	Home Return	OS, HD, HO
TS9	Motor characteristic data	PA, OL, RC, LR
TS10	I/O	TY, AB, SM, NW, IM, OM, SO, SB, ST, NM, NA, NB, ZAS, ZAE, BF, WC ,WU
TS11	Communication	MM, BM, CM, AN, WM, SE, EC
TS12	Automatic tuning	LO, SG, MT, RI, ZP, ZV
TS13	Alarm outputs	OU, EP, TO, HT, PE, AE

(3) ESBB5 Driver Unit

Command	Classification	Command / Parameter
TS0	All commands/parameters	All commands and parameters
TS1	Servo parameter 1	PG, VG, VGL, VI, VIL, VM, LG, TL, GP, GT
TS2	Servo parameter 2	FO, FP, FS, NP, NS, NQ, DBP, DBA, ILV, FF, FC
TS3	Condition setting	CO, IN, IS, FW, VO, VW, OR, CE
TS4	Pulse train command	CR, PC, RR
TS5	Position feedback signal	FD, FZ, FR
TS6	Position scale	PS, DI, OTP, OTM, AO
TS7	Velocity/acceleration	MV, MA, JV, JA, HV, HA, HZ, MD, CS, CY, CX
TS8	Home Return	OS, HD, HO
TS9	Motor characteristic data	PA, OL, RC, LR, RO
TS10	Input/Output	AB, NW, IM, BF, WC, WU
TS11	Communication	MM, BM, CM, AN, WM, SE, EC
TS12	Automatic tuning	LO, SG, MT, RI, ZP, ZV
TS13	Analog input	SL, AC, AGV, AGT, AF, AL
TS14	Position setting/ SPD output	HW, HI, SO, SB, ST, NM, NA, NB, ZAS, ZAE, ZBS, ZBE
TS15	Alarm output	OU, EP, TO, HT, PE, AE

(4) ESB25 Driver Unit

Command	Classification	Command/Parameter
TS0	All commands/parameters	下記すべてのパラメータ
TS1	Servo parameter 1	PG, VG, VGL, VI, VIL, VM, LG, TL, GP, GT
TS2	Servo parameter 2	FO, FP, FS, NP, NS, NQ, DBP, DBA, ILV, FF, FC
TS3	Condition setting	CO, IN, IS, FW, VO, VW, OR,CE
TS4	Pulse train input	CR, PC, RR
TS5	Position feedback signal	FD, FZ, FR
TS6	Position scale	PS, DI, OTP, OTM
TS7	Velocity/acceleration	MV, MA, JV, JA, HV, HA, HZ, MD, CS, CY, CX
TS8	Home Return	OS, HD, HO
TS9	Motor characteristic data	PA, OL, RC, LR
TS10	Input / Output	AB, NW, IM, BF, WC, WU
TS11	Communication	MM, BM, CM, AN, WM, SE, EC
TS12	Automatic tuning	LO, SG, MT, RI, ZP, ZV
TS13	Analog input	SL, AC, AGV, AGT, AF, AL
TS14	Position setting SPD output	HW, HI, SO, SB, ST, NM, NA, NB, ZAS, ZAE, ZBS, ZBE
TS15	Alarm output	OU, EP, TO, HT, PE, AE

TT: Tell Torque & Thermal

Format : TT/RP

- This command monitors the value of torque command and software thermal loading.
- If the TT command is accompanied by /RP, the readout will be repeated automatically.
- If the TT command is not accompanied by /RP, the readout will be one shot.
- Press the BS key to terminate the automatic monitoring.
- For way of monitoring, refer to "7.1.18.7. Monitoring Torque Command and Software Thermal Loading."

TV: Tell Velocity

Format : TV data/RP
Data : 0 ··· in unit of [s^{-1}].
1 ··· in unit of internal setting. (0 to ± 131 071)
Default : 0

- This command is to report the velocity of the Motor.
- If the TV command is accompanied by /RP, the readout will be repeated automatically.
- If the TV command is not accompanied by /RP, the readout will be one shot.
- Press the BS key to terminate the automatic monitoring.
- For way of monitoring, refer to "7.1.18.6. Monitoring Motor Velocity."

For ESBB3, and 23 type Driver Units only

★ *TY: I/O type*

Format	: TY data
Data	: 1, 2, 3, 4, 7, and 8
Shipping set	: 1
Default	: Not available

- This command selects a signal combination type of Input/Output signal of connector CN2.
- The TS command or ?TY reports the current setting.
- Types of Input/Output signal combination

<table>
<tr><th rowspan="2">CN2
Connector
Pin No.</th><th colspan="8">Input signal</th><th colspan="3">Output signal</th></tr>
<tr><th>25</th><th>12</th><th>24</th><th>11</th><th>23</th><th>10</th><th>22</th><th>9</th><th>2
15</th><th>3</th><th>14</th></tr>
<tr><td>TY1</td><td>SVON</td><td>EMST</td><td>RUN</td><td>HLS</td><td>PRG3</td><td>PRG2</td><td>PRG1</td><td>PRG0</td><td rowspan="6">DRDY</td><td rowspan="6">OUT1[*1]</td><td rowspan="6">IPOS</td></tr>
<tr><td>TY2</td><td>SVON</td><td>EMST</td><td>RUN</td><td>HLS</td><td>PRG3</td><td>PRG2</td><td>DIR</td><td>JOG</td></tr>
<tr><td>TY3</td><td>SVON</td><td>EMST</td><td>RUN</td><td>HLS</td><td>PRG3</td><td>PRG2</td><td>OTM</td><td>OTP</td></tr>
<tr><td>TY4</td><td>SVON</td><td>EMST</td><td>RUN</td><td>HLS</td><td>HOS</td><td>CLR</td><td>OTM</td><td>OTP</td></tr>
<tr><td>TY7</td><td>SVON</td><td>EMST</td><td>RUN</td><td>HLS</td><td>DIR</td><td>JOG</td><td>OTM</td><td>OTP</td></tr>
<tr><td>TY8</td><td>SVON</td><td>EMST</td><td>RUN</td><td>HLS</td><td>IOFF[*1]</td><td>PRG2</td><td>PRG1</td><td>PRG0</td></tr>
</table>

*1: The IOFF (Integration OFF/Lower gain) changes to the Brake-off (CLCN) input and the OUT1 output becomes to the brake control (BRKC) output when the brake sequence function (BF1) is specified.

- Refer to “2.9.2.4. Signal Name and Function (CN2)” for details of Input/Output signals.
- If the TY data is changed, all settings of AB data will be cleared to normally open contacts.

VG: Velocity Gain

Format	: VG data
Data	: 0.1 to 255.0 or /AJ (Adjusting mode)
Shipping set	: 1.0
Default	: Not available

- Sets velocity loop proportional gain.
- The TS or ?VG reports the current setting.
- The VG/AJ command starts the fine adjusting program.
- When the LO and the SG data are changed, the gain will be automatically adjusted.
- When the VG data is changed, the LG and the SG data will be cleared to 0.

VGL: Velocity Gain, Lower

Format : VGL data
Data range : 0.1 to 255.0
Shipping set : 1.0
Default : Not available

- Sets the proportional gain of velocity loop when the Motor is stationary.
- The gain will be switched from the data of VG parameter to the data of VGL parameter when a position error is within the data of GP parameter longer than a time set by the GT parameter.
- If the GP setting is 0, the VGL is invalid and the data of VG will be always valid.
- The TS or ?VG reports the current setting.
- Refer to “7.2.7. Automatic Gain Switching” for switching timing.

VI: Velocity Integrator Frequency

Format : VI data
Data range : 0.10 to 63.00 [Hz], or /AJ (Adjust mode)
Shipping set : 1.00
Default : Not available

- Sets the integrator frequency of velocity loop.
- The TS or ?VI command reports the current setting.
- The VI/AJ starts the adjusting program.
- The VI data will be automatically adjusted when the LO and the SG data are changed.
- Change of the VI data will clear the LO and the VI settings to 0.

VIL: Velocity Integrator Frequency, Lower

Format : VI data
Data range : 0.10 to 63.00 [Hz]
Sipping set : 1.00
Default : Not available

- Sets the velocity integrator frequency of velocity loop when the Motor is stationary.
- The gain will be switched from the data of the VI parameter to the data of the VIL parameter when a position error is within the data of GP parameter longer than a time set by the GT parameter.
- If the GP setting is 0, the VIL is invalid and the data of VI will be always valid.
- The TS or ?VG reports the current setting.
- Refer to “7.2.7. Automatic Gain Switching” for switching timing.

★ *VM: Velocity Integrator Mode*

Format : VM data
Data range : 0, and 1
Shipping set : 1
Default : 0

- Changes the velocity loop integrator control as shown below.
  VM0 : Velocity loop P control.
  VM1 : Velocity loop PI control.

★ *VO: Velocity Error Over Limit*

Format : VO data
Data range : 1 to 5 461
Shipping set : 2 730
Default : Not available

- This is to set the error limit to report ‘Velocity error over’ alarm.
- Velocity error over alarm occurs when the velocity error exceeds the setting.
- The correspondence of the data to the velocity error depends on the Motor type.
  data = detected velocity error [s^{-1}] × (5461/3)

★ *VW: Velocity Error Over Limit Width*

Format : VW data
Data : 0 to 1 000
Shipping set : 100
Default : 0

- This parameter sets the stability timer to report “Velocity abnormal” alarm.
- When the velocity is over the limit longer than the time set by the VW parameter (ms), the “Velocity abnormal” alarm occurs.

★ *WC: Brake-on Timer*

Format : WC data
Data rang/Shipping set

Motor model	Data range [0.1s]	Shipping set [0.1s]
YSB2020	0.3 to 30.0	0.3
YSB3040	0.3 to 30.0	0.3
YSB4080	0.5 to 30.0	0.5
YSB5120	0.8 to 30.0	0.8

Default : Not available

- The WC specifies a delay time between the start to the completion of brake-on action when the brake sequence function is active. The unit of the data is 0.1[s]. When WC0.3 is specified, the delay time shall be 30 [ms].
- The TS or ?WC reports the current setting.
- Refer to “7.1.10. Brake” for the brake sequence function.

★ *WD : Write Data to EEPROM*

Format : WD

- Writes all current settings of commands, programs and parameters to the EEPROM.
- Use this command when the WM1 (data back-up invalid) is specified.

⚠ *Caution: It requires approximately 30 seconds for execution of this command. Do not turn the power off while writing data. Otherwise "Memory error" alarm may occur.*

★ *WM: Write Mode to EEPROM*

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

- The total number of overwriting times on the EEPROM to backup data are guaranteed to 500 000 times. However frequent overwriting of data to the EEPROM may easily exceed the above number of times. The WM command is to select whether store or not the inputted parameter to avoid unnecessary backup.
  WM0: Data backup
  WM1: No data backup

⚠ *Caution: • When the command is changed to WM0 (store the data) from WM1 (no-backup), it requires approximately 30 seconds to store the data as the all data currently set shall be backed up. Do not turn the power off during the execution of backup. Otherwise, memory error alarm may occur.*

• Initialized parameters will be stored every time when the SI command executes the initialization, even though "no backup data (WM1)" is set.

- The TS or ?WM reports the current setting.

★ *WU: Brake-off Timer*

Format : WU data
Data range / Shipping set

Motor model	Data range [0.1s]	Shipping [0.1s]
YSB2020	0.5 to 30.0	0.5
YSB3040	0.9 to 30.0	0.9
YSB4080	1.4 to 30.0	1.4
YSB5120	1.9 to 30.0	1.9

Default : Not available

- The WU specifies the delay time between start and completion of brake-off action when the brake sequence function is active. The unit of data is 0.1[s]. When WU0.5 is specified, the delay time is 50 [ms].
- The TS or ? WU reports the current setting.
- Refer to "7.1.10. Brake" for the brake sequence function.

ZAS: Start Point of Zone A. ZAE: End Point of Zone A
ZBS: Start Point of Zone B. ZBE: End Point of Zone B

Format	: ZAS data/ST ZAE data/ST ZBS data/ST (Not available for ESBB3 and 23 type Driver Units.) ZBE data/ST (Not available for ESBB3 and 23 type Driver Units.)
Data range	: 0 to ± 99 999 999 [pulse]
Shipping set	: 0
Default	: 0

- The ZAS and the ZBS set a point to start outputting the signal when the NEARA or the NEARB output is in the "Target proximity" mode.
- The ZAE and the ZBE set a point to terminate outputting the signal when the NEARA or the NEARB out put is in the "Target proximity" mode.
- The NEARA output closes when the Motor position data is in the zone between the ZAS and the ZAE, that is in counting up direction from the ZAS.
- The NEARB output closes when the Motor position data is in the zone between the ZBS to the ZBA, that is in counting up direction from the ZBS.
- The ZAS/ST, the ZAE/ST, the ZBS/ST, and the ZBE/ST may be set with the teaching.
- The TS, ?ZA or ?ZB reports the current setting.
- Refer to "7.1.15. Target Proximity / In-target" for details of function.

★ *ZP: Position damping (Factory use only)*

Format	: ZP data
Data range	: 0.50 to 1.80
Shipping set	: 1.00
Default	: Not available

⚠ *Caution* : • *This parameter is for the automatic tuning and is for the factory use only.*

• *Do not change the setting because it is properly set at the factory.*

•*The TS or ?ZP reports the current setting.*

★ *ZV: Velocity damping (Factory use only)*

Format	: ZV data
Data range	: 0.1 to 4.0
Shipping set	: 1.4
Default	: Not available

⚠ *Caution* : • *This parameter is for the automatic tuning, and is for the factory use only.*

• *Do not change the setting because it is properly set at the factory.*

• *The TS or ?ZV reports the current setting.*

8.2. Parameter List

- Connect the Handy Terminal FHT11 to the connector CN1of the Driver Unit, and then turn the power on. The System is in normal state if “NSK MEGA---” message is returned.

- Some parameters shown in Tables 8-1 to 8-4 must be changed to unique values from the shipping set accordingly to actual conditions.

  ◊ Parameters parenthesized are properly set at the factory. If the setting shall be changed, contact your local NSK representative.

  * : Set unique value to your application. We recommend writing down the set value for your future reference. You may need to refer to them when changing the operating conditions, or readjusting the system.

  ** : This setting differs with the Moto size.

  *** : Uniquely set to each Motor that is not interchangeable type.

Table 8-1a: Parameter setting for ESBB3 type Driver Unit (1/2)

Parameter	Name	Password	Sipping set	Data range	Current setting*
PG	Position gain	–	0.1	0.010 – 1.000	
VG	Velocity gain	–	1.0	0.1 – 255.0	
VGL	Velocity gain, lower	–	1.0	0.1 – 255.0	
VI	Velocity integrator frequency	–	1.00	0.10 – 63.00	
VIL	Velocity integrator frequency, lower	–	1.00	0.10 – 63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Lower gain	–	50	0 – 100	
TL	Torque limit rate	✓	100	0 – 100	
GP	Gain switching point	✓	0	0, 1 – 1 000	
GT	Switching gain timer	–	5	0 – 1 000	
FO	Low pass filter off velocity	–	0	0, 0.01 – 3.00	
FP	Low pass filter, primary	–	0	0, 10 – 500	
FS	Low pass filter, secondary	–	0	0, 10 – 500	
NP	Notch filter, primary	–	0	0, 10 – 500	
NS	Notch filter, secondary	–	0	0, 10 – 500	
NQ	Notch filter, Q parameter	–	0.25	0.10 – 5.00	
DBP	Dead band, position loop	✓	0	0, 1 – 4 095	
ILV	Integration limit	✓	100.0	0 – 100.0	
FF	Feed forward gain	✓	0	0 – 1.0000	
FC	Friction compensation	✓	0	0 – 2 047	
CO	Position error counter over limit	–	50 000	1 – 99 999 999	
IN	In-position	–	100	0 – 99 999 999	
IS	In-position stability counter	–	0	0, 0.3 – 100.0	
FW	FIN width	–	1.0	- 0.3 – - 100.0, 0, 0.3 – 100.0	
VO	Velocity error over limit	✓	2 730	1 – 5 461	
VW	Velocity error over limit width	✓	100	0 – 1 000	
OR	Criterion, overrun alarm	✓	409 600	204 800 – 819 200	
CE	Brake-on position error	✓	1000	1 – 99 999 999	
CR	Circular resolution	✓	× 1	× 1, × 2, × 4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0 – 4	
(RR)	Resolver resolution	✓	– 3	- 3, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
(FR)	Feedback signal resolution	✓	1	1	
PS	Position scale select	✓	1	1	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
OTM	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
AO	Absolute position scale offset	✓	0	0 – 819 199	
MV	Move velocity	–	1.0000	0.0001 – 3.0000	
MA	Move acceleration	–	1.00, 1.00	0.01 – 1 280.00	
JV	Jog velocity	–	0.1000	0.0001 – 3.0000	
JA	Jog acceleration	–	1.00	0.01 – 1 280.00	
HV	Home Return velocity	–	0.2000	0.0001 – 3.0000	
HA	Home Return acceleration	–	1.00	0.01 – 1 280.00	
HZ	Home Return near zero velocity	–	0.0100	0.0001 – 0.2000	
MD	Move deceleration	–	0	0.01 – 1 280.00	
CS	Acceleration pattern select	–	1,1	1 – 5	
CY	Criterion to function CS	✓	1.00	0.01 – 1 280.00	
CX	Setting CS function	✓	1	0, 1	

Table 8-1b: Parameter setting of ESBB3 Driver Unit (2/2)

Parameter	Name	Password	Shipping set	Data range	Current setting
OS	Origin setting mode	✓	4	1, 3, 4, 5, 6	
HD	Home Return direction	✓	1	0, 1	
HO	Home offset	✓	0	- 802 816 – 802 816	
(PA)	Phase adjust	✓	700	24 – 1 048	
(OL)	Overload limit	✓	**	0 – 100	
(RC)	Rated current	✓	**	0 – 100	
LR	Low torque ripple	✓	0	0, 1	
RO	ABS/INC	✓	2048	0 – 4095	
TY	I/O type	✓	1	1, 2, 3, 4, 7, 8	
AB	I/O polarity	✓	X0X0XX00	0, 1, X	
SM	Factory use only	✓	1	–	
NW	Chattering preventive timer	✓	2	0 – 4	
IM	IOFF mode	✓	0	0, 1, 2	
OM	Output signal mode	✓	0	0 – 3	
SO	SPD output mode	✓	0	0, 1	
SB	Criterion, SPD signal output	–	0	0 – 3.00	
ST	Speed stability timer	–	0	0, 0.3 – 100.0	
NMA	Near A output mode	✓	0	0, 0.3 – 100.0	
NA	Near position A	–	100	1 – 99 999 999	
ZAS	Start point of zone A	–	0	0 ~ ± 99 999 999	
ZAE	End point of zone A	–	0	0 ~ ± 99 999 999	
BF	Brake sequence function	✓	0	0.1	
WC	Brake-on timer	✓	**	** – 30.0	
WU	Brake-off timer	✓	**	** – 30.0	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace mode	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0 – 15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1, 2	
EC	End of command message	✓	0	0, 1	
LO	Load inertia	✓	0	0 – 50.000	
SG	Servo gain	–	0	0 – 30	
(MT)	Factory use only	✓	**	–	
(RI)	Factory use only	✓	**	–	
(ZP)	Factory use only	✓	1.00	–	
(ZV)	Factory use only	✓	1.4	–	
OU	Origin undefined, alarm type	✓	0	0, 2	
EP	Excessive position error, alarm type	✓	2	1, 2, 3	
TO	Software travel limit over, alarm type	✓	2	1, 2	
HT	Hardware travel limit over, alarm type	✓	2	0, 1, 2	
PE	Program error, alarm type	✓	2	0, 2	
AE	Automatic tuning error, alarm type	✓	0	0, 2	
PH	Program Home Return	✓	0	0, 1, 2	

Table 8-2a: Parameter setting for ESB23 Driver Unit (1/2)

Parameter	Name	Password	Sipping set	Data range	Current setting*
PG	Position gain	–	0.1	0.010 – 1.000	
VG	Velocity gain	–	1.0	0.1 – 255.0	
VGL	Velocity gain, lower	–	1.0	0.1 – 255.0	
VI	Velocity integrator frequency	–	1.00	0.10 – 63.00	
VIL	Velocity integrator frequency, lower	–	1.00	0.10 – 63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Lower gain	–	50	0 – 100	
TL	Torque limit rate	✓	100	0 – 100	
GP	Gain switching point	✓	0	0, 1 – 1 000	
GT	Switching gain timer	–	5	0 – 1 000	
FO	Low pass filter off velocity	–	0	0, 0.01 – 3.00	
FP	Low pass filter, primary	–	0	0, 10 – 500	
FS	Low pass filter, secondary	–	0	0, 10 – 500	
NP	Notch filter, primary	–	0	0, 10 – 500	
NS	Notch filter, secondary	–	0	0, 10 – 500	
NQ	Notch filter, Q parameter	–	0.25	0.10 – 5.00	
DBP	Dead band, position loop	✓	0	0, 1 – 4 095	
ILV	Integration limit	✓	100.0	0 – 100.0	
FF	Feed forward gain	✓	0	0 – 1.0000	
FC	Friction compensation	✓	0	0 – 2 047	
CO	Position error counter over limit	–	50 000	1 – 99 999 999	
IN	In-position	–	100	0 – 99 999 999	
IS	In-position stability	–	0	0, 0.3 – 100.0	
FW	FIN width	–	1.0	- 0.3 – - 100.0, 0, 0.3 – 100.0	
VO	Velocity error over limit	✓	2 730	1 – 5 461	
VW	Velocity error over limit width	✓	100	0 – 1 000	
OR	Criterion, overrun alarm	✓	409 600	204 800 – 819 200	
C E	Brake-on position error	✓	1 000	1 – 99 999 999	
CR	Circular resolution	✓	× 1	× 1, × 2, × 4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0 – 4	
(RR)	Resolver resolution	✓	- 3	- 3, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
(FR)	Feedback signal resolution	✓	1	1	
PS	Position scale select	✓	1	0, 1, 2 – 99	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
OTM	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
MV	Move velocity	–	1.0000	0.0001 – 3.0000	
MA	Move acceleration	–	1.00, 1.00	0.01 – 1 280.00	
JV	Jog velocity	–	0.1000	0.0001 – 3.0000	
JA	Jog acceleration	–	1.00	0.01 – 1 280.00	
HV	Home Return velocity	–	0.2000	0.0001 – 3.0000	
HA	Home Return acceleration	–	1.00	0.01 – 1 280.00	
HZ	Home Return near zero velocity	–	0.0100	0.0001 – 0.2000	
MD	Move deceleration	–	0	0.01 – 1 280.00	
CS	Acceleration pattern select	–	1,1	1 – 5	
CY	Criterion to function CS	✓	1.00	0.01 – 1 280.00	
CX	Setting CS function	✓	1	0, 1	

Table 8-2b: ESB23 type Driver Unit (2/2)

Parameter	Name	Password	Shipping set	Data range	Current setting
OS	Origin setting mode	✓	4	1, 3, 4, 5, 6	
HD	Home Return direction	✓	1	0, 1	
HO	Home offset	✓	0	- 802 816 – 802 816	
(PA)	Phase adjust	✓	700	24 – 1 048	
(OL)	Overload limit	✓	**	0 – 100	
(RC)	Rated current	✓	**	0 – 100	
LR	Low torque ripple	✓	0	0, 1	
TY	I/O type	✓	1	1, 2, 3, 4, 7, 8	
AB	I/O polarity	✓	X0X0XX00	0, 1, X	
SM	Factory use only	✓	1	–	
NW	Chattering preventive timer	✓	2	0 – 4	
IM	IOFF mode	✓	0	0, 1, 2	
OM	Output signal mode	✓	0	0 – 3	
SO	SPD output mode	✓	0	0, 1	
SB	Criterion, SPD signal output	–	0	0 – 3.00	
ST	Speed stability timer	–	0	0, 0.3 – 100.0	
NMA	Near A output mode	✓	0	0, 0.3 – 100.0	
NA	Near position A	–	100	1 – 99 999 999	
ZAS	Start point of zone A	–	0	0 – ± 99 999 999	
ZAE	End point of zone A	–	0	0 – ± 99 999 999	
BF	Brake sequence function	✓	0	0.1	
WC	Brake-on timer	✓	**	** – 30.0	
WU	Brake-off timer	✓	**	** – 30.0	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace mode	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0 ~ 15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1, 2	
EC	End of command message	✓	0	0, 1	
LO	Load inertia	✓	0	0 – 50.000	
SG	Servo gain	–	0	0 – 30	
(MT)	Factory use only	✓	**	–	
(RI)	Factory use only	✓	**	–	
(ZP)	Factory use only	✓	1.00	–	
(ZV)	Factory use only	✓	1.4	–	
OU	Origin undefined, alarm type	✓	0	0, 2	
EP	Excessive position error, alarm type	✓	2	1, 2, 3	
TO	Software travel limit over, alarm type	✓	2	1, 2	
HT	Hardware travel limit over, alarm type	✓	2	0, 1, 2	
PE	Program error, alarm type	✓	2	0, 2	
AE	Automatic tuning error, alarm type	✓	0	0, 2	
PH	Program Home Return	✓	0	0, 1, 2	

Table 8-3a: Parameter setting for ESBB5 Driver Unit (1/2)

Parameter	Name	Password	Sipping set	Data range	Current setting*
PG	Position gain	–	0.1	0.010 – 1.000	
VG	Velocity gain	–	1.0	0.1 – 255.0	
VGL	Velocity gain, lower	–	1.0	0.1 – 255.0	
VI	Velocity integrator frequency	–	1.00	0.10 – 63.00	
VIL	Velocity integrator frequency, lower	–	1.00	0.10 – 63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Lower gain	–	50	0 – 100	
TL	Torque limit rate	✓	100	0 – 100	
GP	Gain switching point	✓	0	0, 1 – 1 000	
GT	Switching gain timer	–	5	0 – 1 000	
FO	Low pass filter off velocity	–	0	0, 0.01 – 3.00	
FP	Low pass filter, primary	–	0	0, 10 – 500	
FS	Low pass filter, secondary	–	0	0, 10 – 500	
NP	Notch filter, primary	–	0	0, 10 – 500	
NS	Notch filter, secondary	–	0	0, 10 – 500	
NQ	Notch filter, Q parameter	–	0.25	0.10 – 5.00	
DBP	Dead band, position loop	✓	0	0, 1 – 4 095	
DBA	Dead band, analog command	✓	0	0, 1 – 2047	
ILV	Integration limit	✓	100.0	0 – 100.0	
FF	Feed forward gain	✓	0	0 – 1.0000	
FC	Friction compensation	✓	0	0 – 2 047	
CO	Position error counter over limit	–	50 000	1 – 99 999 999	
IN	In-position	–	100	0 – 99 999 999	
IS	In-position stability counter	–	0	0, 0.3 – 100.0	
FW	FIN width	–	1.0	- 0.3 – - 100.0, 0, 0.3 – 100.0	
VO	Velocity error over limit	✓	2 730	1 – 5 461	
VW	Velocity error over limit width	✓	100	0 – 1 000	
OR	Criterion, overrun alarm	✓	409 600	204 800 ~ 819 200	
C E	Brake-on position error	✓	1 000	1 – 99 999 999	
CR	Circular resolution	✓	× 1	× 1, × 2, × 4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0 ~ 4	
(RR)	Resolver resolution	✓	- 3	- 3, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
(FR)	Feedback signal resolution	✓	1	1	
PS	Position scale select	✓	1	1	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
OTM	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
AO	Absolute position scale offset	✓	0	0 – 819 199	
MV	Move velocity	–	1.0000	0.0001 – 3.0000	
MA	Move acceleration	–	1.00, 1.00	0.01 – 1 280.00	
JV	Jog velocity	–	0.1000	0.0001 – 3.0000	
JA	Jog acceleration	–	1.00	0.01 – 1 280.00	
HV	Home Return velocity	–	0.2000	0.0001 – 3.0000	
HA	Home Return acceleration	–	1.00	0.01 – 1 280.00	
HZ	Home Return near zero velocity	–	0.0100	0.0001 – 0.2000	
MD	Move deceleration	–	0	0.01 – 1 280.00	
CS	Acceleration pattern select	–	1,1	1 – 5	
CY	Criterion to function CS	✓	1.00	0.01 – 1 280.00	
CX	Setting CS function	✓	1	0, 1	

Table 8-3b: Parameter setting for ESBB5 Driver Unit (2/2)

Parameter	Name	Password	Shipping set	Data range	Current setting
OS	Origin setting mode	✓	4	1, 3, 4, 5, 6	
HD	Home Return direction	✓	1	0, 1	
HO	Home offset	✓	0	- 802 816 – 802 816	
(PA)	Phase adjust	✓	700	24 – 1 048	
(OL)	Overload limit	✓	**	0 – 100	
(RC)	Rated current	✓	**	0 – 100	
LR	Low torque ripple	✓	0	0, 1	
RO	ABS/INC	✓	2048	0 – 4095	
AB	I/O polarity	✓	X0X0XX00	0, 1, X	
NW	Chattering preventive timer	✓	2	0 – 4	
IM	IOFF mode	✓	0	0, 1, 2	
BF	Brake sequence function	✓	0	0.1	
WC	Brake-on timer	✓	**	** – 30.0	
WU	Brake-off timer	✓	**	** – 30.0	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace mode	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0 – 15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1, 2	
EC	End of command message	✓	0	0, 1	
LO	Load inertia	✓	0	0 – 50.000	
SG	Servo gain	–	0	0 – 30	
(MT)	Factory use only	✓	**	–	
(RI)	Factory use only	✓	**	–	
(ZP)	Factory use only	✓	1.00	–	
(ZV)	Factory use only	✓	1.4	–	
SL	Set control mode	✓	3	1, 2, 3	
AC	Analog command mode	✓	1	- 1, 0, 1	
AGV	Analog velocity command gain	✓	1.00	0.10 – 2.00	
AGT	Analog torque command gain	✓	1.00	0.10 – 2.00	
AF	Analog command offset	✓	0	- 63 ~ 63	
AL	Acceleration limiter	–	0	0, 0.01 – 1 280.00	
HW	Home signal holding time	–	0	0, 0.3 – 100.0	
HI	Home In-position	–	0	0 – 102 400	
SO	SPD output mode	✓	0	0, 1	
SB	Criterion, SPD signal output	–	0	0 – 3.00	
ST	Speed stability timer	–	0	0, 0.3 – 100.0	
NMA	Near A output mode	✓	0	0, 0.3 – 100.0	
NMB	Near B output mode	✓	0	0, 0.3 – 100.0	
NA	Near position A	–	100	1 – 99 999 999	
NB	Near position B	–	100	1 – 99 999 999	
ZAS	Start point of zone A	–	0	0 – ± 99 999 999	
ZAE	End point of zone A	–	0	0 – ± 99 999 999	
ZBS	Start point of zone B	–	0	0 – ± 99 999 999	
ZBE	End point of zone B	–	0	0 – ± 99 999 999	
OU	Origin undefined, alarm type	✓	0	0, 2	
EP	Excessive position error, alarm type	✓	2	1, 2, 3	
TO	Software travel limit over, alarm type	✓	2	1, 2	
HT	Hardware travel limit over, alarm type	✓	2	0, 1, 2	
PE	Program error, alarm type	✓	2	0, 2	
AE	Automatic tuning error, alarm type	✓	0	0, 2	
PH	Program Home Return	✓	0	0, 1, 2	

Table 8-4a: Parameter setting for ESB25 Driver Unit (1/2)

Parameter	Name	Password	Sipping set	Data range	Current setting*
PG	Position gain	–	0.1	0.010 – 1.000	
VG	Velocity gain	–	1.0	0.1 – 255.0	
VGL	Velocity gain, lower	–	1.0	0.1 – 255.0	
VI	Velocity integrator frequency	–	1.00	0.10 – 63.00	
VIL	Velocity integrator frequency, lower	–	1.00	0.10 – 63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Lower gain	–	50	0 – 100	
TL	Torque limit rate	✓	100	0 – 100	
GP	Gain switching point	✓	0	0, 1 – 1 000	
GT	Switching gain timer	–	5	0 – 1 000	
FO	Low pass filter off velocity	–	0	0, 0.01 – 3.00	
FP	Low pass filter, primary	–	0	0, 10 – 500	
FS	Low pass filter, secondary	–	0	0, 10 – 500	
NP	Notch filter, primary	–	0	0, 10 – 500	
NS	Notch filter, secondary	–	0	0, 10 – 500	
NQ	Notch filter, Q parameter	–	0.25	0.10 – 5.00	
DBP	Dead band, position loop	✓	0	0, 1 – 4 095	
DBA	Dead band, analog command	✓	0	0 – 2 047	
ILV	Integration limit	✓	100.0	0 – 100.0	
FF	Feed forward gain	✓	0	0 – 1.0000	
FC	Friction compensation	✓	0	0 – 2 047	
CO	Position error counter over limit	–	50 000	1 – 99 999 999	
IN	In-position	–	100	0 – 99 999 999	
IS	In-position stability counter	–	0	0, 0.3 – 100.0	
FW	FIN width	–	1.0	- 0.3 – - 100.0, 0, 0.3 – 100.0	
VO	Velocity error over limit	✓	2 730	1 – 5 461	
VW	Velocity error over limit width	✓	100	0 – 1 000	
OR	Criterion, overrun alarm	✓	409 600	204 800 – 819 200	
C E	Brake-on position error	✓	1 000	1 – 99 999 999	
CR	Circular resolution	✓	× 1	× 1, × 2, × 4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0 – 4	
(RR)	Resolver resolution	✓	- 3	- 3, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
(FR)	Feedback signal resolution	✓	1	1	
PS	Position scale select	✓	1	0, 1, 2 – 99	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
OTM	Over travel limit switch position	✓	0	- 99 999 999 – 99 999 999	
MV	Move velocity	–	1.0000	0.0001 – 3.0000	
MA	Move acceleration	–	1.00, 1.00	0.01 – 1 280.00	
JV	Jog velocity	–	0.1000	0.0001 – 3.0000	
JA	Jog acceleration	–	1.00	0.01 – 1 280.00	
HV	Home Return velocity	–	0.2000	0.0001 – 3.0000	
HA	Home Return acceleration	–	1.00	0.01 – 1 280.00	
HZ	Home Return near zero velocity	–	0.0100	0.0001 – 0.2000	
MD	Move deceleration	–	0	0.01 – 1 280.00	
CS	Acceleration pattern select	–	1,1	1 – 5	
CY	Criterion to function CS	✓	1.00	0.01 – 1 280.00	
CX	Setting CS function	✓	1	0, 1	

Table 8-4b: Parameter setting of ESB25 Driver Unit (2/2)

Parameter	Name	Password	Shipping set	Data range	Current setting
OS	Origin setting mode	✓	4	1, 3, 4, 5, 6	
HD	Home Return direction	✓	1	0, 1	
HO	Home offset	✓	0	- 802 816 – 802 816	
(PA)	Phase adjust	✓	700	24 – 1 048	
(OL)	Overload limit	✓	**	0 – 100	
(RC)	Rated current	✓	**	0 – 100	
LR	Low torque ripple	✓	0	0, 1	
AB	I/O polarity	✓	X0X0XX00	0, 1, X	
NW	Chattering preventive timer	✓	2	0 – 4	
IM	IOFF mode	✓	0	0, 1, 2	
BF	Brake sequence function	✓	0	0.1	
WC	Brake-on timer	✓	**	** – 30.0	
WU	Brake-off timer	✓	**	** – 30.0	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace mode	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0 – 15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1, 2	
EC	End of command message	✓	0	0, 1, 2	
LO	Load inertia	✓	0	0 – 50.000	
SG	Servo gain	–	0	0 – 30	
(MT)	Factory use only	✓	**	–	
(RI)	Factory use only	✓	**	–	
(ZP)	Factory use only	✓	1.00	–	
(ZV)	Factory use only	✓	1.4	–	
SL	Set control mode	✓	3	1, 2, 3	
AC	Analog command mode	✓	1	- 1, 0, 1	
AGV	Analog velocity command gain	✓	1.00	0.10 – 2.00	
AGT	Analog torque command gain	✓	1.00	0.10 – 2.00	
AF	Analog command offset	✓	0	- 63 – 63	
AL	Acceleration limiter	–	0	0, 0.01 – 1 280.00	
HW	Home signal holding time	–	0	0, 0.3 – 100.0	
HI	Home In-position	–	0	0 – 102 400	
SO	SPD output mode	✓	0	0, 1	
SB	Criterion, SPD signal output	–	0	0 – 3.00	
ST	Speed stability timer	–	0	0, 0.3 – 100.0	
NMA	Near A output mode	✓	0	0, 0.3 – 100.0	
NMB	Near B output mode	✓	0	0, 0.3 – 100.0	
NA	Near position A	–	100	1 – 99 999 999	
NB	Near position B	–	100	1 – 99 999 999	
ZAS	Start point of zone A	–	0	0 – ± 99 999 999	
ZAE	End point of zone A	–	0	0 – ± 99 999 999	
ZBS	Start point of zone B	–	0	0 – ± 99 999 999	
ZBE	End point of zone B	–	0	0 – ± 99 999 999	
OU	Origin undefined, alarm type	✓	0	0, 2	
EP	Excessive position error, alarm type	✓	2	1, 2, 3	
TO	Software travel limit over, alarm type	✓	2	1, 2	
HT	Hardware travel limit over, alarm type	✓	2	0, 1, 2	
PE	Program error, alarm type	✓	2	0, 2	
AE	Automatic tuning error, alarm type	✓	0	0, 2	
PH	Program Home Return	✓	0	0, 1, 2	

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9. Maintenance

9.1. Precautions

- Backup Motor and Driver Unit
  - ◊ We recommend keeping the backup of Motor and Driver Unit for a quick recovery in case of unexpected failure of the System.

- Parameter and program data backup
  - ◊ In case of an unexpected failure of the Driver Unit, all parameters and programs should be recorded.
  - ◊ For your convenience, we have provided the lists of parameter and program on the last pages of this manual.

    “Appendix 7: ESBB3 Driver Unit Parameter/Program Setting List”
    “Appendix 8: ESB23 Driver Unit Parameter/Program Setting List”
    “Appendix 9: ESBB5 Driver Unit Parameter /Program Setting List”
    “Appendix 10: ESB25 Driver Unit Parameter/Program Setting List”

- How to replace the Driver Unit.
  - ◊ The Driver Units listed below are interchangeable with each other. It may be replaced simply by inputting same parameter settings of the old Driver Unit.
    Following shows reference numbers of ESB type Driver Units.

    Driver Unit reference number

    M-ESB-YSB****AB3**, M-ESB-YSB****CB3**
    M-ESB-YSB****A23**, M-ESB-YSB****C23**
    M-ESB-YSB****AB5**, M-ESB-YSB****CB5**
    M-ESB-YSB****A25**, M-ESB-YSB****C25**

- For custom made Systems, please refer to the respective specification documents for the interchangeability.

- When replacing the Driver Unit, refer to “Appendix 4: How to Replace ESB Driver Unit.”

- ESB Driver Unit has EEPROM and does not need a battery for memory backup.
  (Life of the EEPROM: approximately 500 000 times of overwriting.)
  - ◊ If you require frequent parameter changes in positioning with RS-232C communication commands, etc, set the WM1 parameter to avoid unnecessary backup.
  - ◊ Commands AD, AR, ID and IR do not affect the life of the EEPROM as they won’t be backed up to the memory. However, they will be backed up if they are programmed to a channel.
  - ◊ If the EEPROM reaches its life, the alarm of “E2>EEPROM Error” will occur.

9.2. Periodical Check

9.2.1. Motor

Caution: Do not disassemble the Motor and the resolver. If disassembling the Motor is necessary, contact your local NSK representative.

- Since the Megatorque Motors do not have any parts that will wear out, a daily maintenance check should be enough. The table below shows the maintenance check and intervals. The checking interval shown in the table is reference only. It should be decided according to the actual use conditions.

Table 9-1

Item	Checking interval	How to check	Remarks
Vibration/Noise	Daily	Touching and hearing	Watch daily changes.
Appearance	According to environment	Wipe off dust and slag. Blow off slag.	–
Motor insulation	Once/year	Resistance test (Disconnect the Driver Unit, and then check the resistance between the Motor coil and the ground earth with 500V Megohmmeter.)	Resistance $\geq$ 10 MΩ
Full check	According to Motor condition	Overhaul (NSK)	–

9.2.2. Driver Unit and Cable Set

- Because the Driver Unit does not have any contact point, and highly reliable semiconductors are used, the daily check is not necessary. Checks shown in Table 9-2 are necessary at least once a year.

Table 9-2

Item	Interval	Checking point	Remarks
Retighten screws	Once/year	Terminal block screws. Connector fixing screws.	–
Cleaning	Once/year	Remove dust or contaminants inside of Driver Unit.	–
Cable check	Once/year	Check for damages and cracks of cables.	When the cable is forced to bend or twist, checking frequency should be increased.

9.3. Periodical Replacement of Parts

9.3.1. Motor

- There is no part that requires periodical replacement.
- Refer to “9.2. Maintenance Check.”

9.3.2. Driver Unit

- Electrolytic condenser
  - ◊ The gradual chemical change of electrolytic condensers will deteriorate the System function and may result in the System failure.

Table 9-3

Parts	Function	Life	How to replace
Electrolytic condenser	Equalize power voltage	10 years	Replace *PCB. Replace whole unit.

*PCB: Printed circuit board

- Life of the electrolytic condenser relies on the operating conditions. The ten years of life is rough estimation under continuous operation in normal room environment.

9.4. Storing

- Store the Motors and the Driver Units in clean and dry indoor condition.
- The Driver Units have a lot of ventilation openings. They should be covered properly to protect from dust.

Table 9-4

Storing condition		Remarks
Temperature	- 20°C to + 70°C	–
Humidity	20 to 80%	No condensation

9.5. Warranty Period and Covering Range

9.5.1. Warranty Period

- The warranty period is one year from the date of delivery of the product, or 2 400 working hours, whichever comes first.

9.5.2. Limited Warranty

- The items to be warranted shall be the supplied products by NSK Ltd.
- The supplier will repair the supplied products free of charge within the warranty period.
- The supplied products will be repaired with cost and fees paid by the customer after the warranty period.

9.5.3. Immunities

- The product is not warranted in one of the following cases even within the warranty period:
    - ◊ Failure of the unit due to installation and operation not in accordance with the instruction manual specified by the supplier.
    - ◊ Failure of the unit due to improper handling and use, modification and careless handling by the user.
    - ◊ Failure of the unit due to the causes other than those attributable to the supplier.
    - ◊ Failure of the unit due to modification or repair that is conducted by a person(s) or party (ies) other than the supplier.
    - ◊ Other types of failures due to natural disasters and accidents (causes not attributable to the responsibility of the supplier).
    - ◊ Designated consumables (fuses for ESB Driver Unit).
- Damages induced by a failure of the supplied unit are not covered.

9.5.4. Service Fee

- NSK Ltd. reserves the right to charge to a user for the service such as dispatch of engineer(s).
- Startup, maintenance and adjusting of the unit under the supervision of our engineer(s) are the paid service even if it is to be provided during the warranty period.
- Service fees shall be billed to the customer according to the rules on the paid service.

10. Alarm

10.1. Identifying Alarm

- The DRDY output opens when an error occurs in the ESB Driver Unit.
- A 7-segment LED is provided on the front panel of the Driver Unit to identify the alarm. The TA command can be used to identify alarms with the RS-232C communication.

10.1.1. LED Alarm Indicator

Figure 10-1

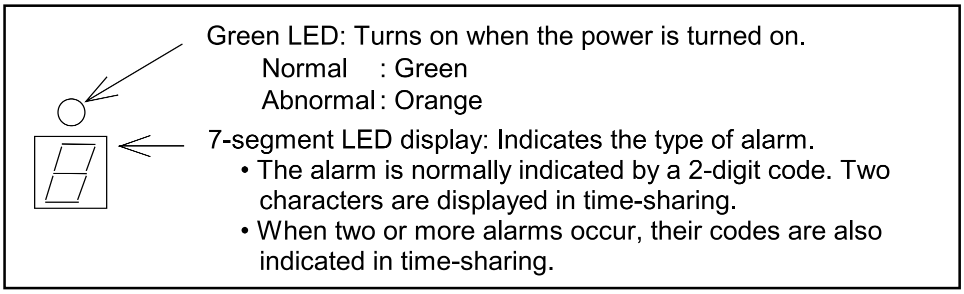
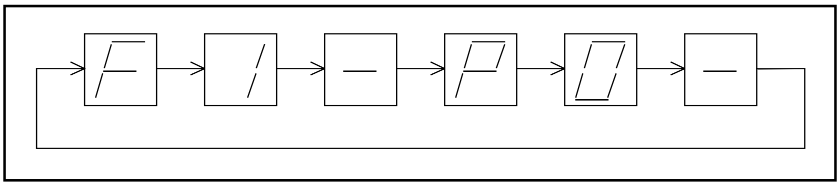
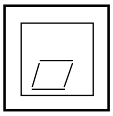


Figure 10-2: Abnormal (example)



(Example) Excess position error F1 + Heat Sink Over-Temperature P0

Figure 10-3: The LED is indicating normal state.



10.1.2. Using TA Command

TA: Tell Alarm Status

Format : TA $\boxed{\text{ENT}}$

- The TA command reports an alarm status.
- The same contents of alarm identification, which is indicated on the 7-segment LED on the front panel, will be displayed on the screen.
- However, the readout is not indicated in time-sharing like the LED.

*Example: Excess position error and heat sink overheat alarms

```
:TA
 F1>Excess Position Error
 P0>Over Heat
:_
```

F1: Excessive position error alarm
P0: Heat sink overheat alarm

[Example 1] Identify an alarm as the warning lamp of ALARM is on.

(1) Confirm that the display of Handy Terminal shows the colon ": ."

(If the colon ":" is not shown in the display, press the ENTER key once.)

```
:_
```

(2) Input the TA command.

T A

```
:TA_
```

(3) Press the $\boxed{\text{ENT}}$ key and the display identifies the alarm.

ENT

```
:TA
 F1>Excess Position Error
:_
```

- Thus the alarm is identified as "Excess position error."

10.1.3. Alarm History

- The System stores the history of alarm occurrences to the EEPROM.
- It keeps the record up to thirty-two alarm histories that have occurred. When the stored histories reach to thirty-two, the oldest history will be deleted and the new history will be added to the EEPROM.
- This history records occurrences of alarms that make the DRDY output open or the OVER output close.
- Contents of the history record are as follows.
  - (i) Alarm code that was shown on the LED.
  - (ii) Details of alarm for failure analysis of the manufacturer.
  - (iii) The number of times the power is turned on.

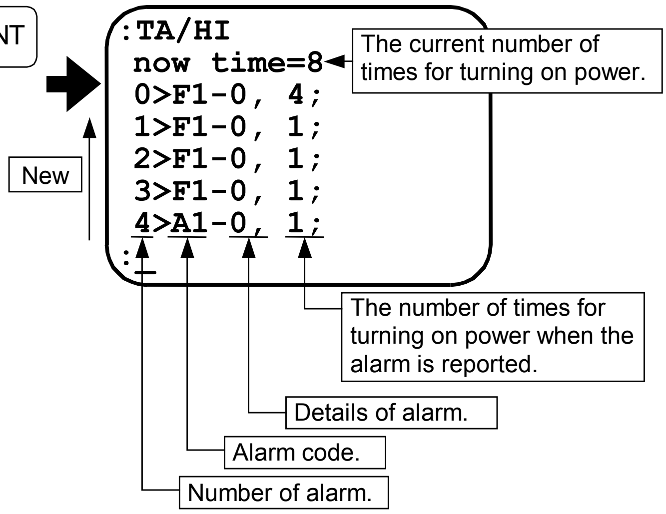
⚠ *Caution: History of alarm may not be stored properly when the power is shut off right after the alarm is reported.*

◆ Indication of Alarm History

(1) Input the TA command. Press the SP key to scroll the next line up.

T A / H I ENT

SP ...



◆ Clear Alarm History

(1) Input the password.

/ N S K SP O N ENT

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

(2) Input the TA command.

T A / C L ENT

```
:/NSK ON
 NSK ON
:TA/CL
:_
```

10.2. Alarm List

⚠ *Caution: • The DRDY output is normally closed and it opens on abnormal condition. The OVER output is normally open and it will be closed in abnormal condition.*

⚠ *Caution: For the B3 and the 23 type Driver Units, the OVER signal outputs only when the output signal format is set to OM3.*

10.2.1. Normal State

Table 10-1

Power LED	7-seg.LED	DRDY	OVER	Motor
Green	o	Closed	Open	Servo-on

- If the Motor does not operate even in the normal state, the following described in Table 10-2 might be the cause.

Table 10-2

Power LED	7-seg. LED	DRDY output	OVER output	Motor	Meaning of Indication	Cause	Remedy
Off	Off	Open	Open	Servo-off	Power off	The power is not turned on.	Turn on the power.
Orange	Off	Open	Open	Servo-off	Initializing CPU	CPU is being initialized.	Wait for a while.
Green	o	Closed	Open	Servo-off	SVON input OFF	SVON input is not ON.	Make SVON input ON.

◊ If initializing the CPU takes a time (10 seconds or more) when the power is turned on, some part of the controller is defective. Refer to “10.3. CPU Error” for cause and remedy.

10.2.2. Alarm State

- When an alarm occurs, the power LED turns to orange, and the conditions of the output signals and the Motor will be in the state shown in the table below.

Table 10-3: Alarm list

Alarm	Error level setting (✓: Initial setting:)	How to clear	Servo state	DRDY output	OVER output	(BF0) BRK output	(BF1) BRKC output CLCN : OFF	(BF1) BRKC output CLCN : ON	7-seg LED	Readout by TA command
Normal state	–	–	Servo -on	Closed	Open	Closed	Open	Closed	o	`None`
CPU disabled	–	N/A	Servo-off	Open	Open	Open	Open	Open	off	`Not available`
Memory error	–	N/A	Servo-off	Open	Open	Open	Open	Open	E0	`E0>Memory Error`
EEPROM error	–	N/A	Servo-off	Open	Open	Open	Open	Open	E2	`E2>EEPROM Error`
System error	–	N/A	Servo-off	Open	Open	Open	Open	Open	E7	`E7>System Error`
Interface error	–	N/A	Servo-off	Open	Open	Open	Open	Open	E8	`E8>I/F Error`
Analog command error	–	N/A	Servo-off	Open	Open	Open	Open	Open	E9	`E9>ADC Error`
Brake-on position error	–	CLCN /CLR	Servo-lock	Open	Open	–	Open	Closed	F0	`F0>Clamp Position Error`
Excessive position error	EP1	CLR/ CR	Servo-lock *1	Open	Open	Closed	Open	Closed	F1	`F1>Excess Position Error`
	EP2 (✓)			Closed	Closed					
	EP3			Open	Closed					
Software over travel limit	TO1	Rmd	Servo-lock *2	Open	Open	Closed	Open	Closed	F2	`F2>Software Over Travel`
	TO2 (✓)			Closed	Closed					
Hardware over travel limit	HT0	Rmd	Servo-lock *2	Closed	Open	Closed	Open	Closed	F3	`F3>Hardware Over Travel`
	HT1			Open	Open					
	HT2 (✓)			Closes	Closed					
Emergency stop	–	Rmd	Servo-lock *1	Closed	Open	Open	Open	Open	F4	`F4>Emergency Stop`
Program error	PE0	CLR/ CR	Normal	Closed	Open	Closed		Closed	F5	`F5>Program Error`
	PE2 (✓)			Closes	Closed					
Automatic tuning error	AE0 (✓)	○	Normal	Closed	Open	Closed		Closed	F8	`F8>AT Error`
	AE2			Closed	Closed					
RS-232C error	SE0 (✓)	CLR/ CR	Normal	Closed	Open	Closed		Closed	C2	`C2>RS232C Error`
	SE1		Servo-lock *1	Open	Open					
	SE2		Normal	Closed	Closed					
CPU error	–	N/A	Servo-off	Open	Open	Open	Open	Open	C3	`C3>CPU Error`
Software internal error	–	CLR/ CR	Servo-lock	Open	Open	Closed	Open	Closed	C9	`C9>Software Internal Error`
Resolver circuit error	—	N/A	Servo-off	Open	Open	Open	Open	Open	A0	`A0>Resolver Circuit Error`
Absolute position error (*For absolute position sensor only)	–	N/A	Servo-off	Open	Open	Open	Open	Open	A1	`A1>Absolute Position Error`
Software thermal sensor	–	CLR/ CR	Servo-off	Open	Open	Open	Open	Open	A3	`A3>Overload`
Velocity error	Minor	CLR/ CR	Servo-lock	Closed	Closed	Closed	Open	Closed	A4	`A4>Velocity Abnormal`
	Serious		Servo-off	Open	Closed	Open	Open	Open		
Home position undefined	OU0 (✓)	CLR/ CR	Position lock	Closed	Open	Closed	Open	Closed	A5	`A5>Origin Undefined`
	OU2			Closed	Closed					
Brake error	–	Rmd	Servo-lock *1	Closed	Closed	–	Open	Closed	A8	`A8>Brake Error`
Heat sink overheat	–	N/A	Servo-off	Open	Open	Open	Open	Open	P0	`P0>Over Heat`
Abnormal main AC line voltage	–	N/A	Servo-off	Open	Open	Open	Open	Open	P1	`P1>Main AC Line Trouble`
Over current	–	N/A	Servo-off	Open	Open	Open	Open	Open	P2	`P2>Over Current`
Control AC line under voltage	–	N/A	Servo-off	Open	Open	Open	Open	Open	P3	`P3>Control AC Line Under Voltage`

- Error level setting (Table 10-3)
  - ◊ Use of parameters enables to change the state alarms to the same specifications with other existing Driver Units.

- How to clear alarm
  In the alarm list (Table 10-3) on the above page, the way to clear an alarm is described as follows.
  - ◊ Rmd: The alarm can be cleared when its cause is removed.
  - ◊ CLR/CR: The command CLR or CR clears the alarm.
  - ◊ CLCN/CLR: After the brake-off action (The CLCN input activated.), the commands CLR or CR clears the alarm.
  - ◊ N/A: You cannot clear the alarm.

- Servo state
  *1: Servo-lock state in the velocity loop.
  *2: If an error occurs in the position control mode, the servo is servo is locked in the position loop control mode, while the servo is locked in velocity loop control mode when an alarm occurs in torque control mode.

- Alarms for interface error(E8) and analog command error (E9) are not available for the B3 and 23 type Driver Units, to which the extended inputs and outputs and input are not provided.

- The absolute position error won't occur on the 23 and 25 type Driver Units: they are for the incremental position sensor.

- The B3 and 23 type Driver Units, which are not have extended inputs and outputs, adopts a function among several functions to the OUT1 output using the parameters TY, BP and OM. Settings of the BRK, BRKC, and OVER functions follow the table below.

Table 10-4: Adopting a function to OUT1

Parameter			OUT1 output
TY	BF	OM	
Other than 8	–	0	BRK
	–	3	OVER
8	0	0	BRK
		3	OVER
	1	–	BRKC

10.2.3. Interchangeable Setting of Alarm Output

- Use of the error level parameters (OU, EP, TO, HT, PE, AE, and SE) classifies the level of control outputs into Alarm (DRDY), Warning (OVER), and No report.

- The level of control outputs for alarm in the ESB Driver Unit can be set as the same level of other Driver Unit Series of Megatorque Motor System.

Table 10-5: Setting of error level parameters and state of the error report.

Setting value of parameter	Error level	DRDY output	OVER output
0	No report	No report	No report
1	Alarm	Open	No report
2	Warning	No report	Closed
3	Alarm and warning	Open	Closed

Table 10-6: Parameter setting list

Alarm	Error level parameter [✓:Shipping set]	Alarm output		Other Driver Unit			Your set
		DRDY	OVER	ESA	EM, EP	EE, EK	
Home position undefined	OU0 ✓	Closed	Open	✓	No function	No function	
`A5>Origin undefined`	OU2	Closed	Closed				
Excessive position error	EP1	Open	Open	✓			
`F1>Excess Position Error`	EP2 ✓	Closed	Closed				
	EP3	Open	Closed		✓	✓	
Software over travel limit	TO1	Open	Open	✓			
`F2>Software Over Travel`	TO2 ✓	Closed	Closed		✓	✓	
Hardware over travel limit	HT0	Closed	Open		✓	✓	
`F3>Hardware Over Travel`	HT1	Open	Open	✓			
	HT2 ✓	Closed	Closed				
Program error	PE0	Closed	Open	✓		No function	
`F5>Program Error`	PE2 ✓	Closed	Closed		✓		
Automatic tuning error	AE0 ✓	Closed	Open	✓	No function	No function	
`F8>AT Error`	AE2	Closed	Closed				
RS-232C error	SE0 ✓	Closed	Open	✓	No function	No function	
`C2>RS232C Error`	SE1	Open	Open				
	SE2	Closed	Closed				

◊ The DRDY output will be closed to indicate the normal state, while it opens for an error.

◊ The EE and EK Driver Units report an alarm with the outputs of DRDY, ALO1 and ALO2. The output ports of these parameters are closed in normal state, while they open for an error.

10.3. Cause of Alarm and Remedy

◆ CPU Error

Cause	Remedy
(1) CPU is out of control due to noise.	• Turn the power on again. • The alarm is deactivated when the power is turned on again. If the alarm occurs frequently, contact NSK.
(2) Defective PCB. (If the alarm is not deactivated after the power is turned on.)	• Replace Driver Unit referring to "Appendix 4. How to Replace ESB Driver Unit."

Note: 1) The CPU is not functioning, thus the RS-232C communication and other controls are disabled because the CPU is not functioning.

2) Contact NSK if the alarm occurred.

◆ Heat Sink Overheat or Regeneration Resistor Overheat: P0

Cause	Remedy
(1) Duty cycle of the Motor is too high. (2) Excessive load is applied.	• Reduce the load and/or operation duty. Readjust acceleration/deceleration. (Stop operation, and then air-cool the Driver Unit and the Motor.)
(3) Ambient temperature of the Driver Unit exceeds 50°C. (4) Heat sink temperature exceeds 90°C due to continued heavy torque demand.	• Check surrounding condition of the Driver Unit. • Stop the operation, and air-cool the Motor and Driver Unit. Then check the following. ◊ If the duty cycle is too high. ◊ If an excessive load is applied. ◊ If the ambient temperature of the Driver Unit is too high. • If no trouble is found in the above check and this alarm occurs frequently, contact NSK.
(5) Defective PCB. (As soon as the control power is turned on, the alarm occurs.)	• Replace the Driver Unit referring to "Appendix 4. How to Replace ESB Driver Unit."

- Even the alarm output is cleared; it will be on again when the thermal sensor remains on.
  - ◊ Take enough time to air-cool the Motor and the Driver Unit.

◆ Abnormal Main AC Line Voltage (Excessive voltage/Low voltage): P1

Cause	Remedy
(1) Abnormal power supply voltage. (2) ◊ Main circuit voltage is excessive due to high acceleration/deceleration under heavy load inertia. ◊ The voltage of the input power of the power amplifier exceeds 250 VAC due to error in the power supply. (3) The voltage of the power amplifier main circuit lowers below 70 VAC.	• Check the main power supply. (Excessive voltage, low voltage and power source capacity.) • Check fuse, power source and the cable, and then turn power on again.
(4) Blown fuse. (Motor over temperature, error in power supply wiring, Driver Unit abnormal.)	• Refer to “Appendix 4. How to Replace ESB Driver Unit.”
(5) Excessive regeneration voltage.	• Readjust operation duty; reduce the load, and acceleration/deceleration.
(6) Defective PCB. (When the alarm is on after the Motor stops even power source and fuse are normal.)	• Refer to “Appendix 4. How to Replace ESB Driver Unit.”

Note: 1) When the regeneration dump resistor cannot process regenerative current, the voltage of direct current to main circuit will be too high, and, eventually, the alarm will be on.

2) Decrease acceleration/deceleration.

◆ Over Current: P2

Cause	Remedy
(1) Poor insulation of the Motor. (Refer to “Appendix 2. How to Check Motor Condition.”)	• Replace the Motor.
(2) Defective Motor Cable. (Refer to “Appendix 2. How to Check Motor Condition.”)	• Replace the Cable.
(3) Defective FET of Power Amplifier. (When the alarm is on even the Motor and Motor cable are normal.)	• Refer to “Appendix 4. How to Replace ESB Driver Unit.”

- The alarm may be accompanied by “Abnormal main AC line voltage (blown fuse)” alarm due to excessive current flow.

◆ Control AC Line Under Voltage: P3

Cause	Remedy
(1) Low voltage of control power input.	• Check the control power voltage. (Low voltage due to over current or output shorting.)
(2) Control circuit voltage for the power amplifier falls below 70VAC due to inferior power supply.	• Turn off power, check the power supply and power cable, and then turn on power again.
(3) Defective PCB. (When the alarm is on after control power is turned on.)	• Refer to “Appendix 4. How to Replace ESB Driver Unit.”

◆ Resolver Circuit Error: A0

Cause	Remedy
(1) Resolver cable disconnected. Refer to "Appendix 2. How to Check Motor Condition.")	• Turn off power, check the resolver cable and the connector.
(2) Breakage of resolver cable. (Refer to "Appendix 2. How to Check Motor Condition.")	• Replace the resolver cable.
(3) Defective resolver. (Refer to "Appendix 2. How to Check Motor Condition.")	• Replace the Motor.
(4) Defective PCB. (When the alarm occurs even the resolver and the cable are normal, and the connector is properly secured.)	• Replace the Driver Unit referring to "Appendix 4, How to Replace ESB Driver Unit."

Note : 1) Check the resolver cable for breaking and short of wires.

2) Check the connector for contact failure.

3) When the resolver cable is forced to bend repeatedly, the bending radius and frequency will affect on the life of the cable. It is necessary to check insulation and continuity of the cable periodically.

4) When an excessive current applied to the resolver due to internal contact between the rotor and the stator, or collision of Motor, the fuse protecting the exciting circuit of resolver may blow out. It requires replacing of the Motor and the Driver Unit in such a case.

◆ Absolute Position Error (In use of an absolute position sensor only): A1

Cause	Remedy
1) The motor moved when the power is on.	• Turn on the power again.
2) Defective printed circuit board.	• Replace the Driver Unit referring to "Appendix4. How to Replace ESB Driver Unit."

- The Motor absolute position scale is defined at the moment of initialization of the Driver Unit when the power is turned on. At this moment, if the Motor moves because of external force or vibration, it cannot define the correct position scale, and this leads to the alarm. Therefore, change the timing of power-on if the alarm occurs because of the motion of other unit when the power is on.

◆ Software Thermal Sensor: A3

Cause	Remedy
(1) Excessive Motor duty cycle.	• Reduce duty cycle and the load. Re-adjust acceleration/deceleration. • Air-cool the Motor as it is overheated after it has stopped. Then turn on the power again. (After stopping operation, keep the control power on.)
(2) Mechanical restraint to the Motor such as brake or an obstacle.	• Remove mechanical obstacle.
(3) Poor gain setting.	• Readjust the gain. (Refer to "8. Tuning and Trial Running.")
(4) Unmatched combination of Motor and Driver Unit.	• Check the combination. • (Reference number of Motor and Driver Unit.)

Note: Do not change the setting of parameter OL. It is properly set at the factory for each Motor size.

◆ Velocity Error Over: A4

Cause	Remedy
(1) Velocity of Motor has reached to the limit due to external disturbance.	• Clear the alarm.
(2) Velocity of Motor has reached to the limit due to overshooting.	• Reduce the setting of acceleration rate. • Reduce the rotational speed.
(3) Motor tends to vibrate due to poor servo tuning.	• Tune the Motor properly.
(4) Motor is out of control.	• Confirm the PA data for abnormality. • Replace the Driver Unit referring to "Appendix 4. How to Replace ESB Driver Unit."

◆ Home Position Undefined: A5

Cause	Remedy
(1) An absolute positioning command is inputted after the power is turned on before the Home position is defined.	• Complete Home Return. • Clear alarm.
(2) Home position of the absolute position sensor is lost because of a change in the position scale setting	• Turn on the power again.

◆ Brake Error: A8

Cause	Remedy
(1) Did not input the brake-off signal (CLCN signal ON) before execution of Jog, or the brake-off action is lifted (CLCN signal OFF) during Jog.	• Activate the CLCN signal ON (Brake-off) before Jog, or maintain the CLCN signal ON during Jog.
(2) The System detected pulse train signal while the brake-off signal (CLCN) being OFF, or the brake-off signal (CLCN) was OFF while pulse train was being inputted.	• Activate the CLCN signal ON (Brake-off) before inputting a pulse train command, or keep the CLCN signal ON while inputting a pulse train command.
(3) The System detected an analog command while the brake-off signal (CLCN) being OFF, or the brake-off signal (CLCN) was OFF while an analog command was being inputted.	• Activate the CLCN signal ON (Brake-off) before inputting an analog command, or keep the CLCN signal ON while inputting an analog command.
(4) The DC command for velocity/torque control mode is inputted while the brake-off signal (CLCN) being OFF, or the brake-off signal (CLCN) was OFF while an operation by the DC command.	• Make the CLCN signal (Brake-off) ON before input of DC command, or maintain the CLCN signal ON while operation caused by the DC command.

◆ **Memory Error: E0**

Cause	Remedy
(1) Parameters stored in the memory have been rewritten by noise or other cause.	• Initialize the memory, and then reenter the parameters. • (Refer to "8. Glossary of Command and Parameter.")
(2) Defective PCB. (If the memory is not functioning after initialized.)	• Replace Driver Unit referring to "Appendix 4. How to Replace ESB Driver Unit.)

◊ The SI command (RS-232C communication) initializes the memory. After initializing, some parameters will be reset to the shipping set. Resetting parameters to actual use condition are necessary.

◆ **EEPROM Error: E2**

Cause	Remedy
(1) Defective EEPROM of control circuit.	• Turn the power on again. • Replace Driver Unit referring to "Appendix 4. How to Replace ESB Driver Unit."

◆ **System Error: E7**

Cause	Remedy
(1) Defective ROM on PCB. (2) Defective EEPROM on PCB.	• Replace the Driver Unit referring to "Appendix 4. How to Replace ESB Driver Unit."

◆ **Interface Error: E8**

Cause	Remedy
(1) Defective I/O board in Driver Unit	• Replace Driver Unit referring to "Appendix 4. How to Replace ESB Driver Unit."

◆ **Analog Command Error: E9**

Cause	Remedy
(1) Defective circuit of analog command input	• Replace Driver Unit referring to "Appendix 4: How to Replace ESB Driver Unit."

◆ Excessive Position Error: F1

Cause	Remedy
(1) The Motor did not move normally because of a mechanical interference such as a brake, and thus position error of error counter exceeds the CO setting.	• Remove mechanical interference.
(2) Error in position error counter exceeds the CO setting due to poor servo gain tuning.	• Readjust gain. (Refer to "5. Tuning and Trial Running.")
(3) Position error in error counter exceeds the CO setting because of high acceleration/deceleration (MA).	• Decrease acceleration/deceleration (MA).
(4) Position error in error counter exceeds due to low setting of the CO data..	• Increase the CO setting. • Activate the CLR input to cancel alarm. At this moment the position error counter will be cleared to 0 (Zero). • Adjust servo parameters (VG, VI, and PG). • Adjust acceleration/deceleration (MA). • Reset the CO setting. • Check the applied load.
(5) Unmatched combination of the Motor and the Driver Unit.	• Check reference number of the Motor and the Driver Unit.
(6) Improper PA setting.	• Execute the OG command (automatic position adjustment of position sensor).
(7) Defective PCB. (If the alarm occurs even though the RUN command is not executed.)	• Replace the Driver Unit referring to "Appendix 4: How to Replace ESB Driver Unit."

◆ Software Over Travel Limit: F2

Cause	Remedy
(1) The Motor enters the off-limits zone set by the OTP and the OTM parameters.	• Back the Motor out of the software over travel limit. • Move the Motor out the off-limits zone.

- The off-limits zone shall be set so that the Motor can stop with this alarm at where it won't be mechanically locked or interfered.

◆ Hardware Over Travel Limit: F3

Cause	Remedy
(1) Motor activated the limit switch.	• Move the Motor out of the off-limit zone.
(2) Mistaken setting of the input port polarity.	• Confirm the AB parameter.
(3) Defective travel limit switch or faulty wiring.	• Check for defective travel limit switch and faulty wiring.

◆ Emergency Stop: F4

Cause	Remedy
(1) Mistaken setting of input port polarity.	• Confirm the parameter "AB."
(2) The EMST is input. (In case of normally open contact.)	• Input the EMST OFF after the Motor stops.
(3) The EMST (CN2) is OFF. (In case of normally closed contact.)	• Input the EMST ON after the Motor stops.
(4) Faulty wiring.	• Check wiring.

◆ Program Error: F5

Cause	Remedy
(1) A channel that does not have a program is selected.	• Check the contents of a program. • Check wirings of inputs of PRG0 to PRG5. • Check the sequence.

◆ Automatic Tuning Error: F8

Cause	Remedy	Terminal display
(1)The System got in the servo-off state in the middle of automatic tuning. (2) The EMST" or The Over Travel Limit signal was inputted in the middle of automatic tuning.	• Check input signal, and then execute the automatic tuning again.	AT Error 1
(3) Automatic tuning cannot be executed due to unbalanced load.	• Check the loading condition. • Set the parameters manually.	AT Error 2
(4) Automatic tuning cannot be executed due to excessive load.	• Check the load or the mounting base. Increase rigidity. • Set parameters manually.	AT Error 3
(5) Resonant occurred due to low rigidity of the load or the mounting base.		AT Error 4

◆ RS-232C Error: C2

Cause	Remedy
(1) The communication cable was connected or disconnected when the power was on.	• Be sure to connect or disconnect the communication cable when the power is off.
(2) Attempted to transmit large volume of data without the flow control with the CTS or the RTS command.	• Wire the CTS and the RTS signals, and apply the flow control.
(3) Wrong communicating specification is set to the terminal.	• Refer to "7.3.1. Specifications of Communication" and review the communication specifications of the terminal.
(4) Defective RS-232C communication.	• Replace Driver Unit referring to "Appendix 4. How to Replace ESB Driver Unit."

● You may cancel the alarm of "RS-232C error" with CLR ON signal or CL command.

◆ CPU Error: C3

Cause	Remedy
(1) A wrong program is called due to noise.	• Take a measure against noise.
(2) The memory is defective.	• Replace the Driver Unit referring to "Appendix 4. How to Replace ESB Driver Unit."
(3) The CPU is defective.	

◆ Internal Error: C9

Cause	Remedy
(1) The Driver Unit malfunctions internally.	• Please consult with NSK.

11. Troubleshooting

11.1. Identifying Problem

- If problems do occur, check the items shown in Table 11-1.
- When reporting problems to the manufacturer, explanation of the items in Table 11-1 will help to identify the problem.

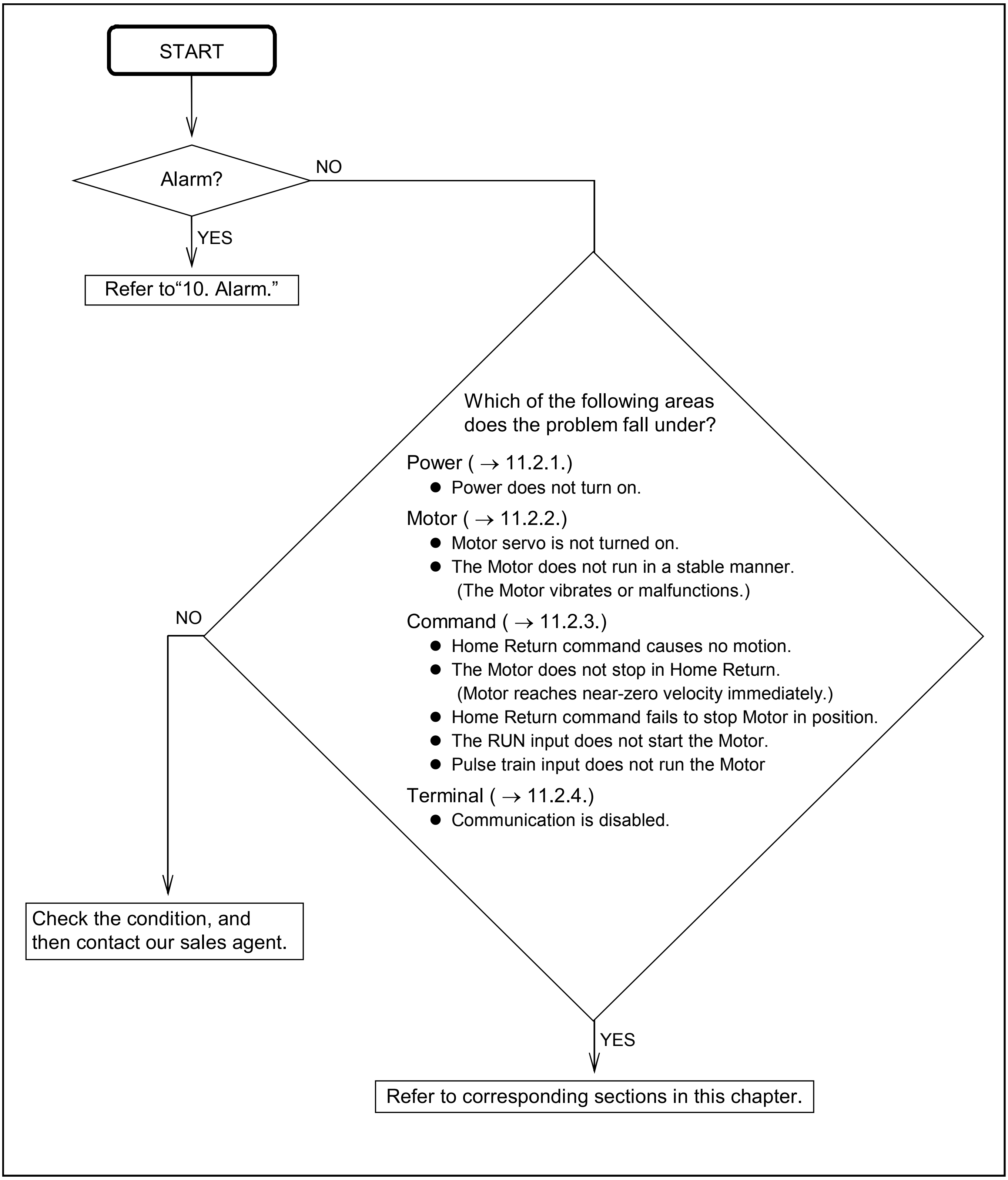
Table 11-1

No.	Items	Point to be checked
1	Combination of the Motor and the Driver Unit	Check if the Motor series code, Motor size number and the Maximum torque code conform to the indication of the nameplates of the Motor and the Driver Unit. Refer to “3.1.2. Combination of Motor and Driver Unit” for details.
2	Power supply voltage	Check if the voltage variation of power source is in specification.
3	Trouble recurrence	Frequency of occurrence.
4	Occurrence in special occasion	If it occurs only when a particular command is executed, or only when particular equipment is in operation.
5	Occurrence under a particular operation	It occurs in the same position and/or direction. If the problem due occur in accelerating or decelerating.
6	Alarm Code	Check alarm code by the TA command. (Refer to “10.1.2. Using TA Command.”)

11.2. Troubleshooting

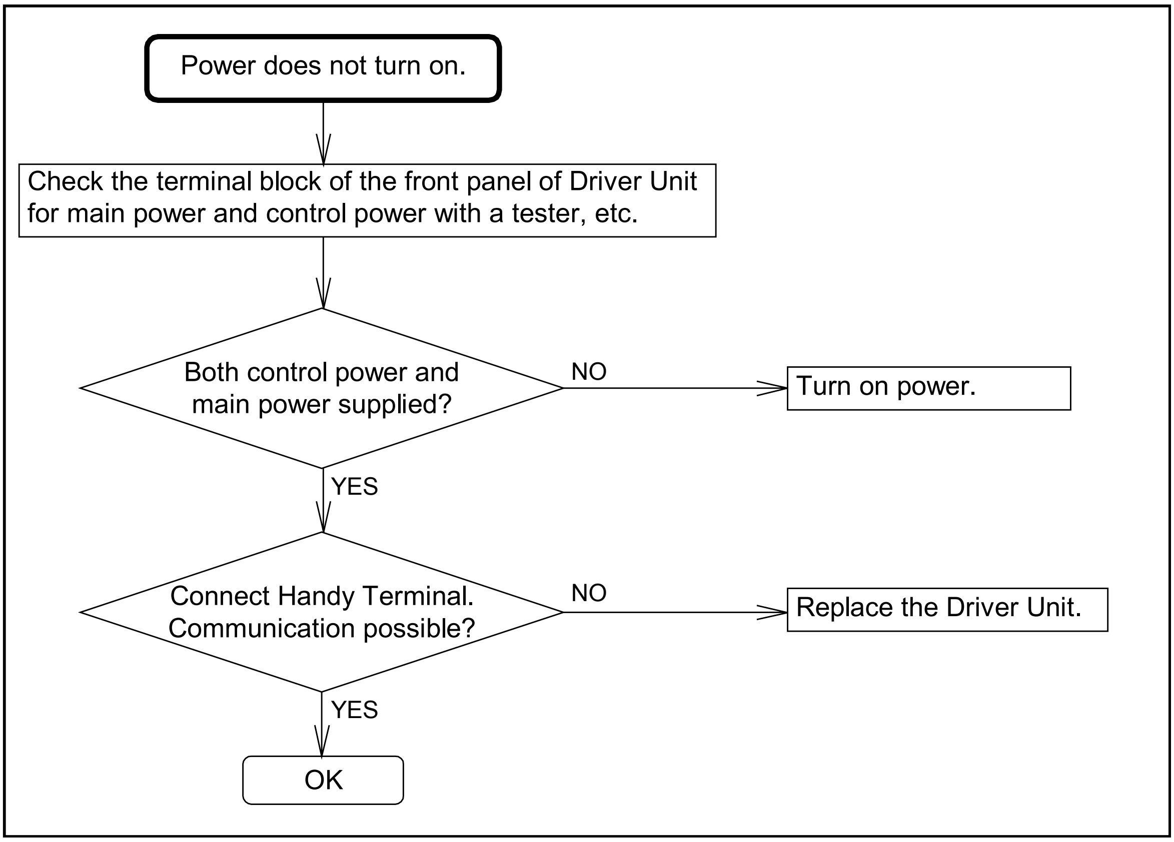
- When troubleshooting, refer to the flow chart shown below.

Figure 11-1: Troubleshooting flow



11.2.1. Power Trouble

Figure 11-2: Power trouble



11.2.2. Motor Trouble

Figure 11-3: Motor trouble

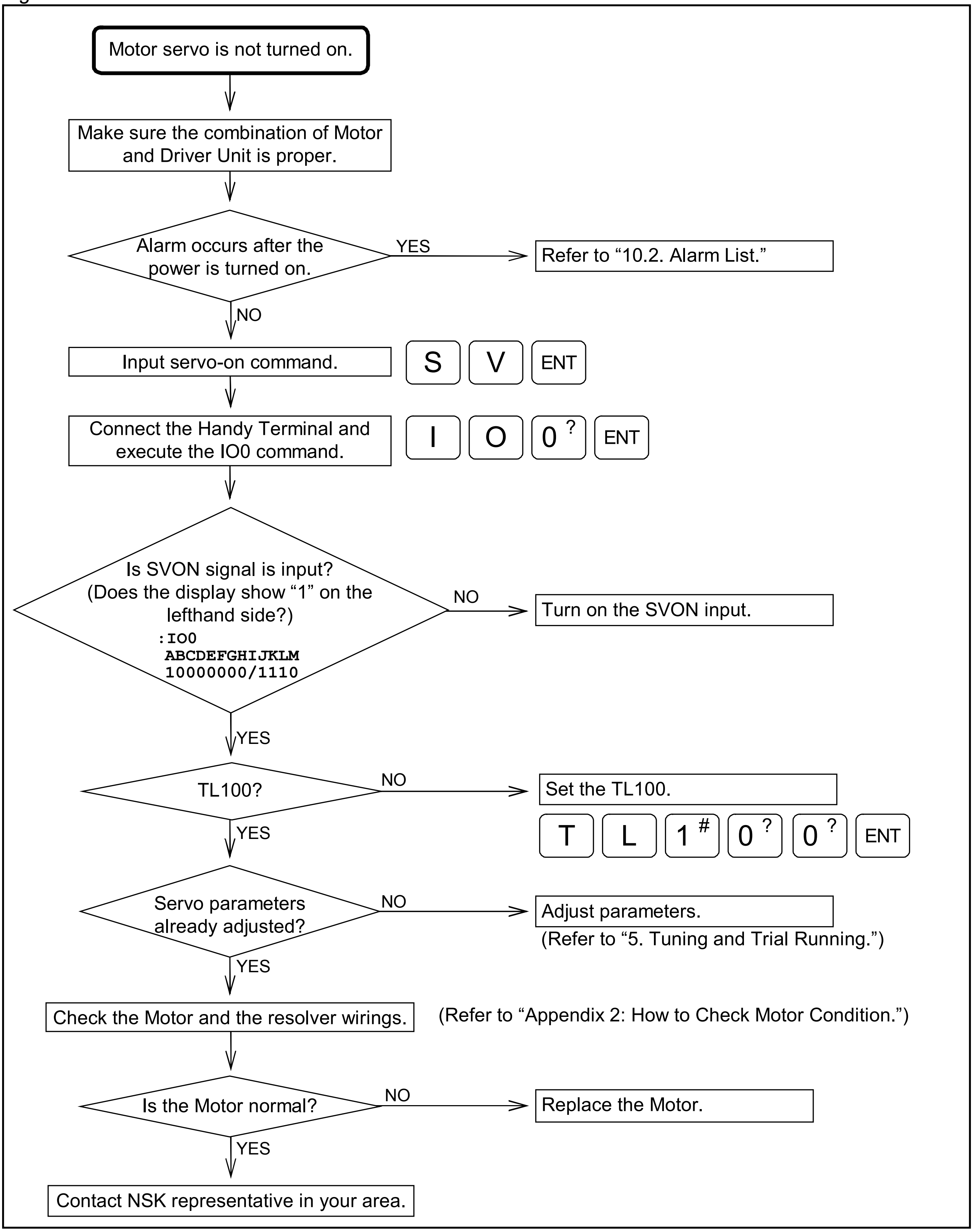
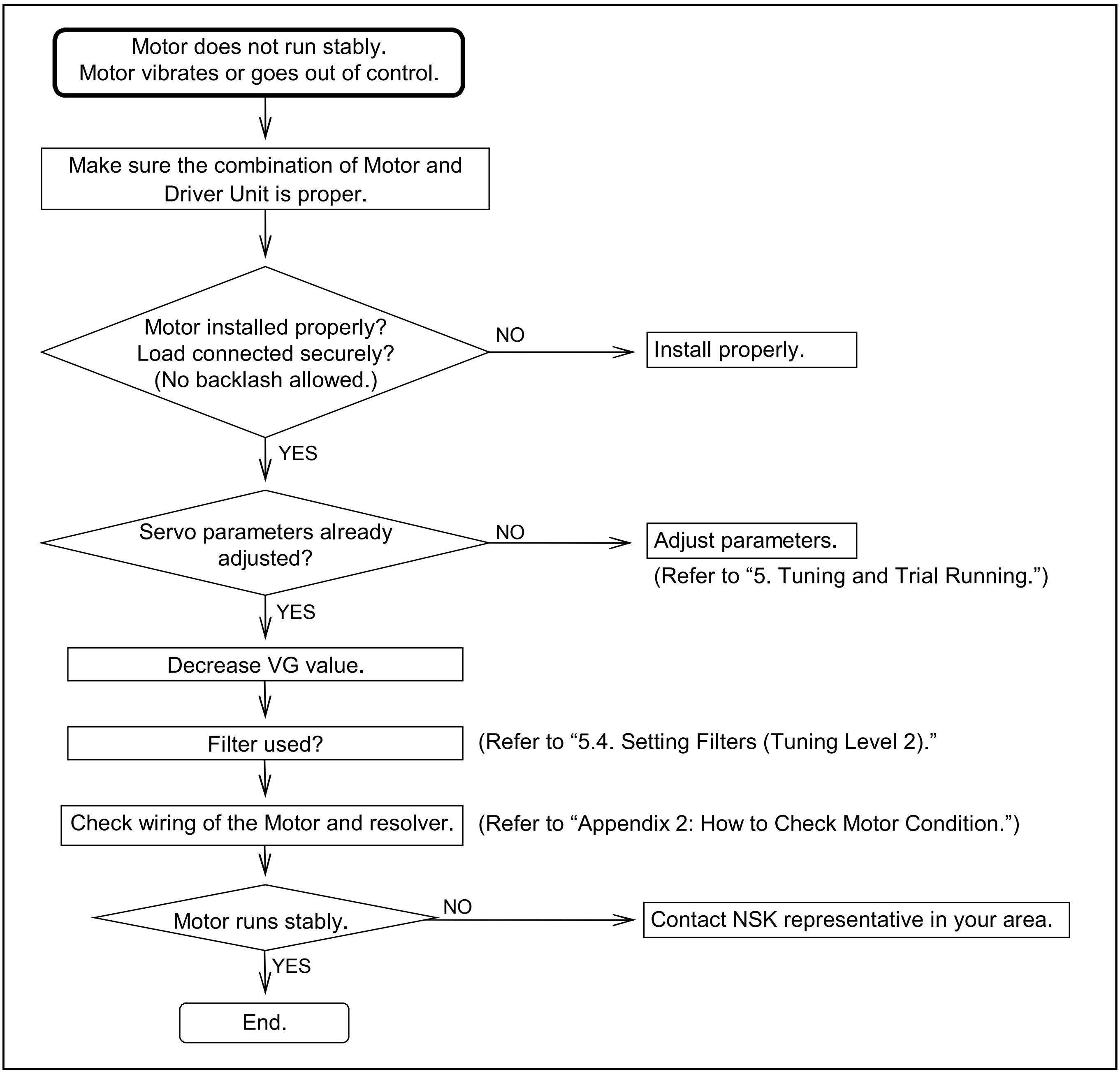


Figure 11-4: The Motor vibrates or goes out of control.



11.2.3. Command Trouble

Figure 11-5: Home Return command causes no motion.

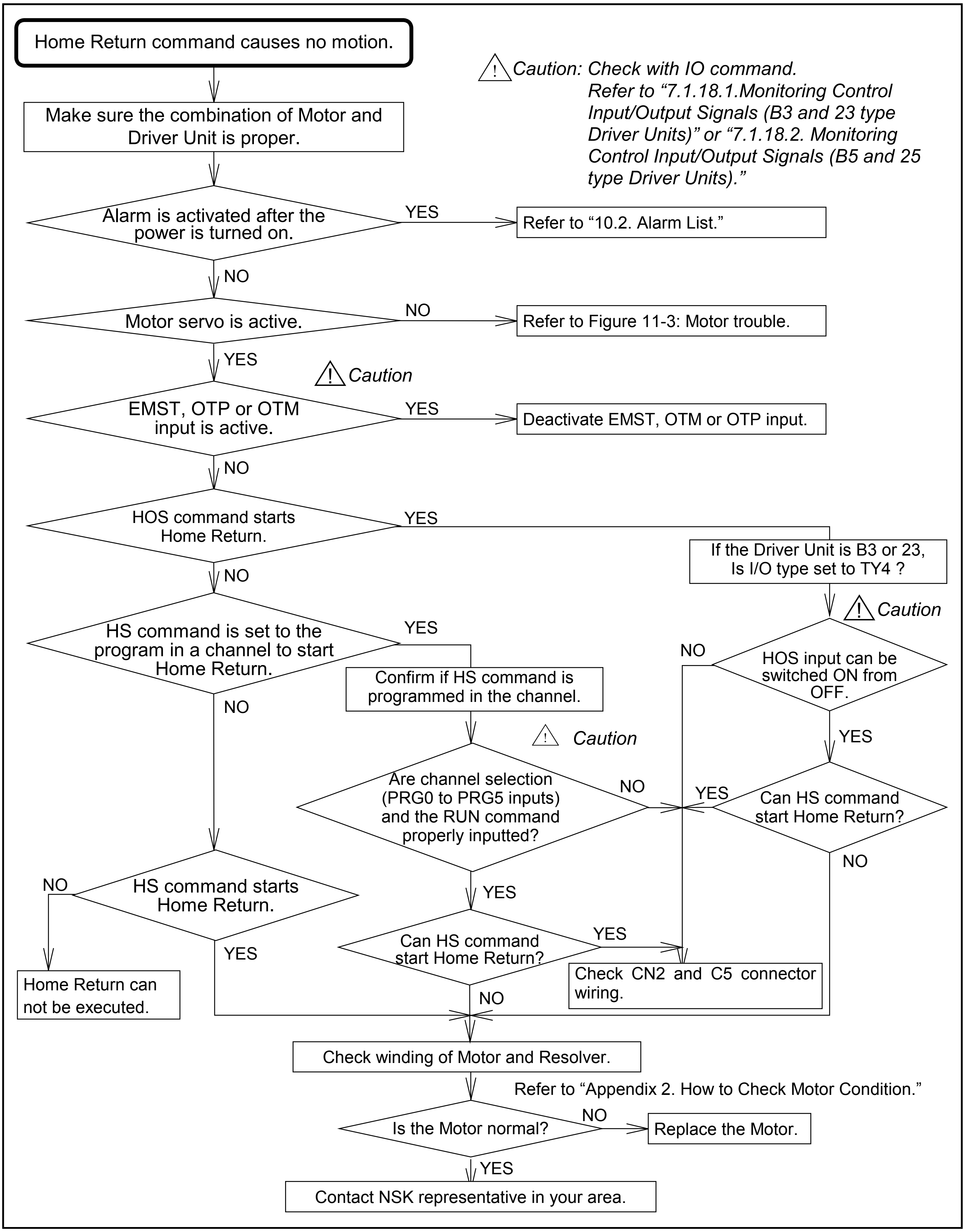


Figure 11-6: The Motor does not stop in Home Return.

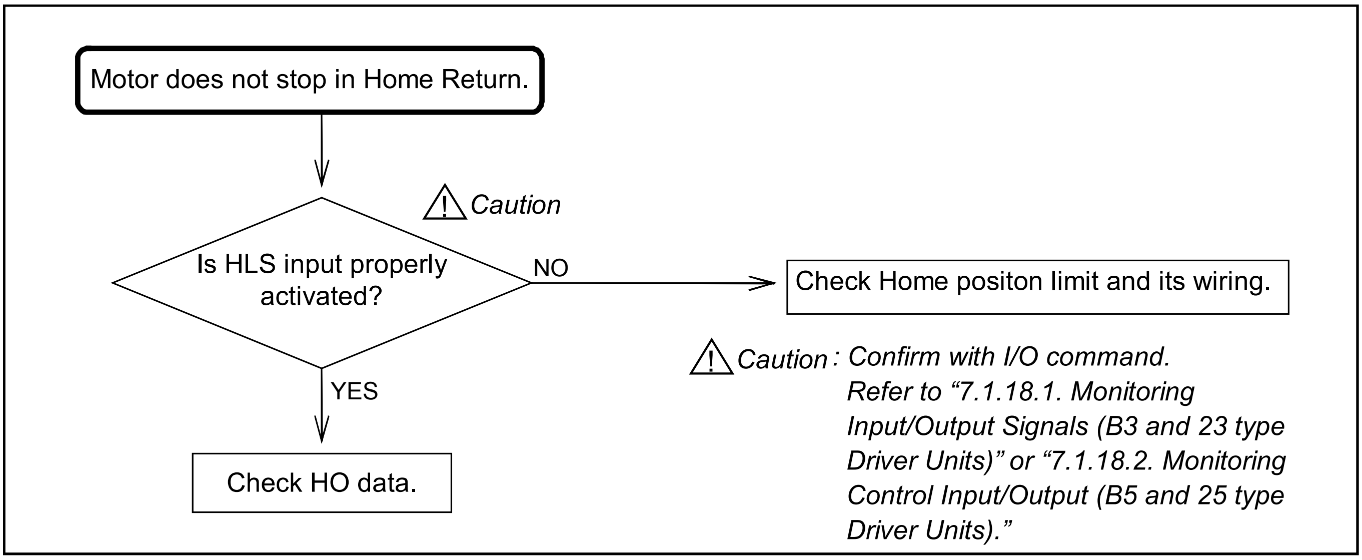


Figure 11-7: Home position is not stable at completion of Home Return.

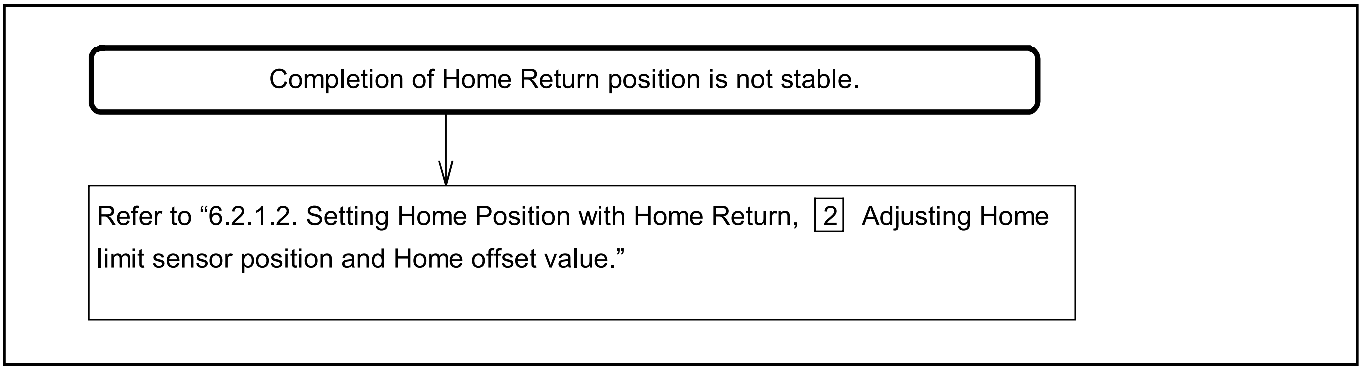


Figure 11-8: Run command does not start the Motor

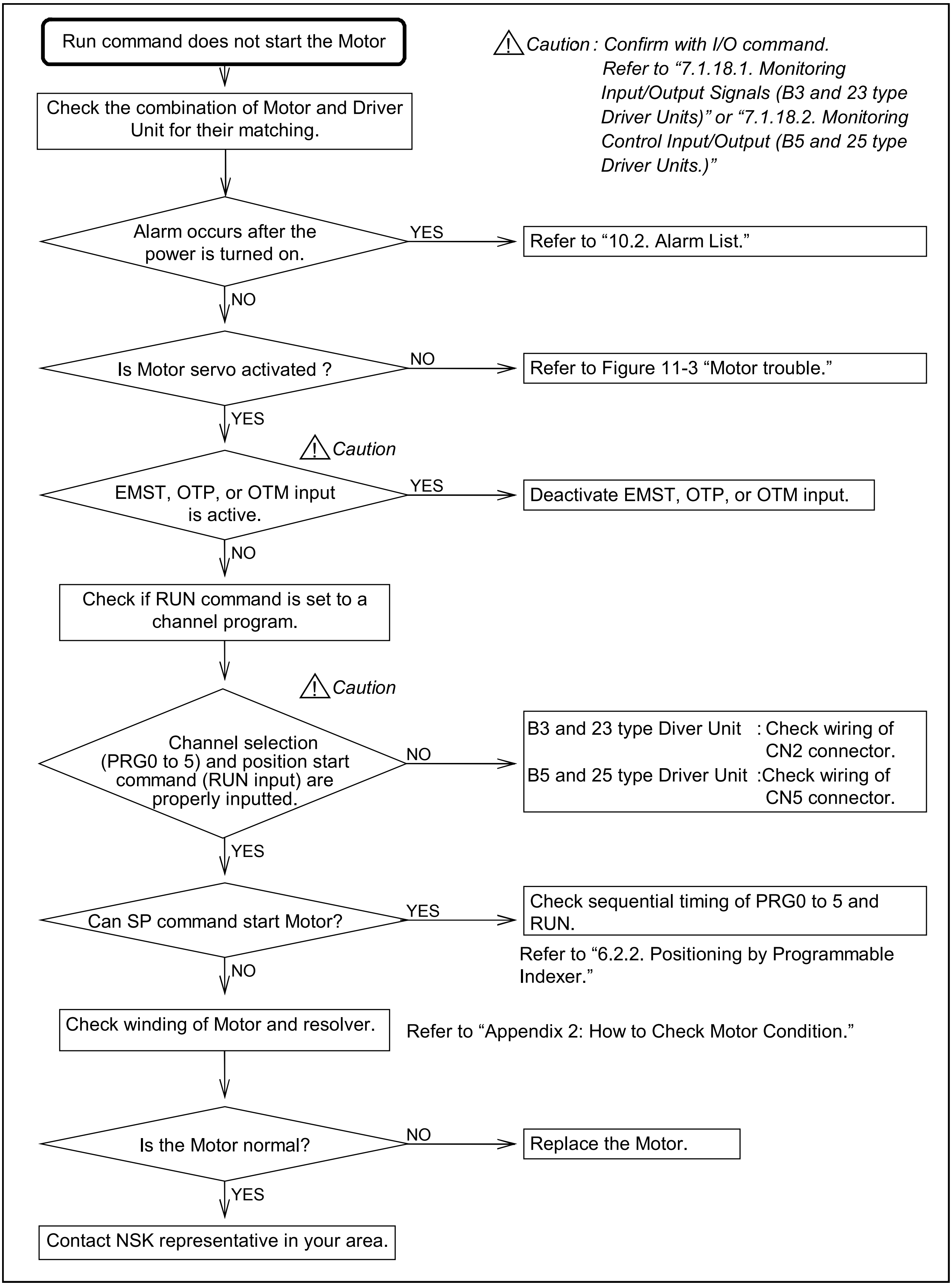
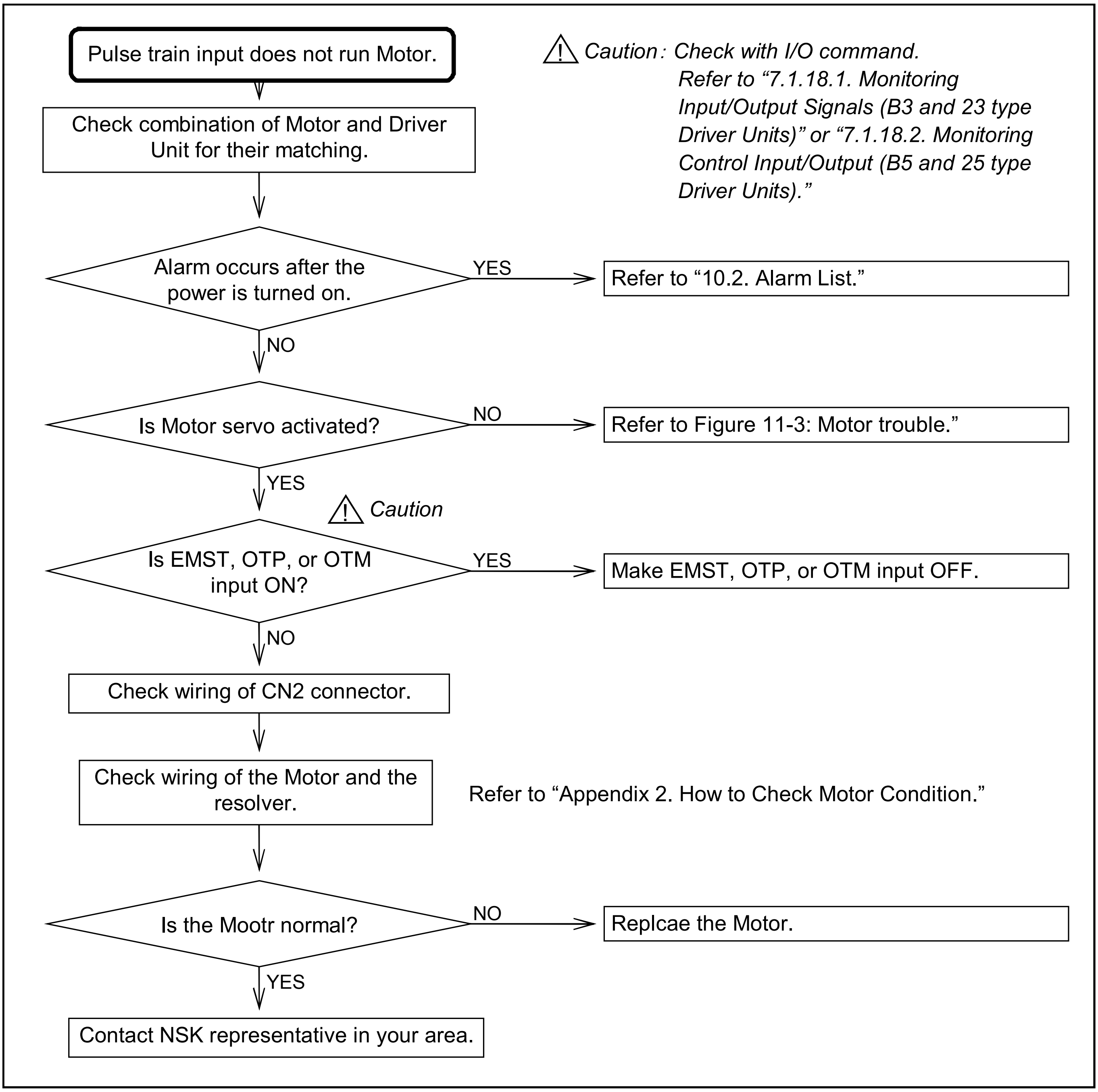


Figure 11-9: Pulse train input does not start the Motor.



11.2.4. Terminal Trouble

Figure 11-10: Communication is disabled.

Communication is disabled. (Charactors on the display is abnormal.)

↓

Alarm occurs after the power is turned on.

- YES → Refer to “7.3.4. Daisy Chain Communication.”
- NO ↓

Check wiring of CN2.

↓

Check the power source of the Driver Unit.

↓

Check the frame ground.

↓

The baud rate of the Driver Unit and the Terminal are different.
(The shipping set of communicatin baud rate is 9600bps for both the Driver Unit and the Handy Terminal.)

11.2.5. Brake Sequence Function

Figure 11-11: Brake sequence function

A start command does not release the brake.

↓

- The photocoupler for BRKC output has broken in the open mode.
- 24 VDC brake power source is off.
- The relay for brake power supply does not close.

The brake does not engage at the end of positioning.

↓

- The photocoupler has broken in the closed mode.
- The relay for the brake power source remains on.

Software thermal alarm or Motor has burnt.

↓

- The integration control is not OFF while the brake is on.
- The brake sequence function is not active.

Rigidity of servo decreases when the Motro is stationary.

↓

- The integration control is OFF when stopping because the brake sequence function has been activated even the brake is not in used.

Appendix 1: Monitoring Input/Output Signals

IO: Input/Output Monitor (B3 and 23 type Driver Units)

- State of Input and Output signal of CN2 connector can be monitored by the IO command
- This function is useful for checking the wiring.
- Input format: IO/RP
  /RP default: Monitors the I/O state only once.
  /RP attached: Monitors the I/O state in real time.
- Readout format: Bit map representing Input/Output in 1 line. (See Table A-1 below.)
  - ◊ The readout indicates the current state of the inputs and the outputs.
  - ◊ The line of "I/O change state" on the display in Figure A-1 holds the first readout state on each input and output to indicate that this part was changed at least once before.
  - ◊ Press the BS key to terminate the real time monitoring (IO*/RP).
  - ◊ Press the R key to reset the monitored state in the Input/Output changing state.

Figure A-1: Monitoring example by IO command

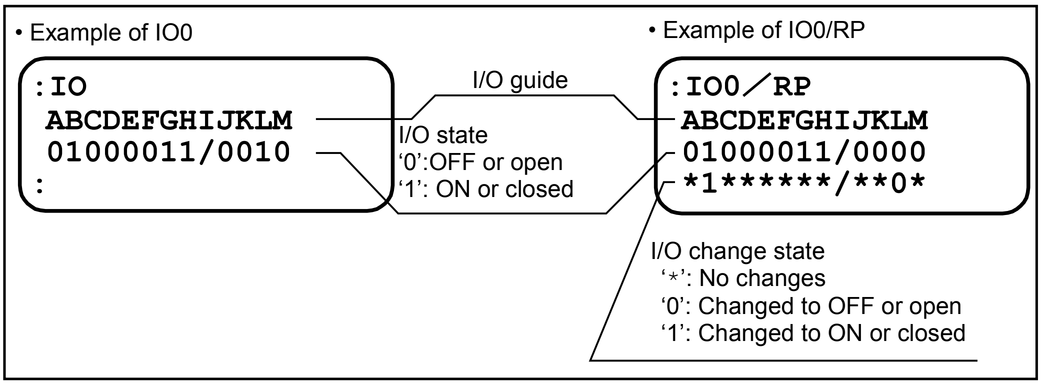


Table A-1: Input/Output signal list (B3 and 23 type Driver Units

I/O type	Input signal								/	Output signal			
	1 denotes ON for the Input signal									1 denotes 'closed' for output signal			
	0	0	0	0	0	0	0	0		0	0	0	0
TY1	SVON	EMST	RUN	HLS	PRG3	PRG2	PRG1	PRG0	Code to separate Input and Output	DRDY	OUT1 *2	IPOS	Reserved
TY2	SVON	EMST	RUN	HLS	PRG3	PRG2	DIR	JOG					
TY3	SVON	EMST	RUN	HLS	PRG3	PRG2	OTM	OTP					
TY4	SVON	EMST	RUN	HLS	HOS	CLR	OTM	OTP					
TY7	SVON	EMST	RUN	HLS	DIR	JOG	OTM	OTP					
TY8	SVON	EMST	RUN	HLS	IOFF[*1]	PRG2	PRG1	PRG0					

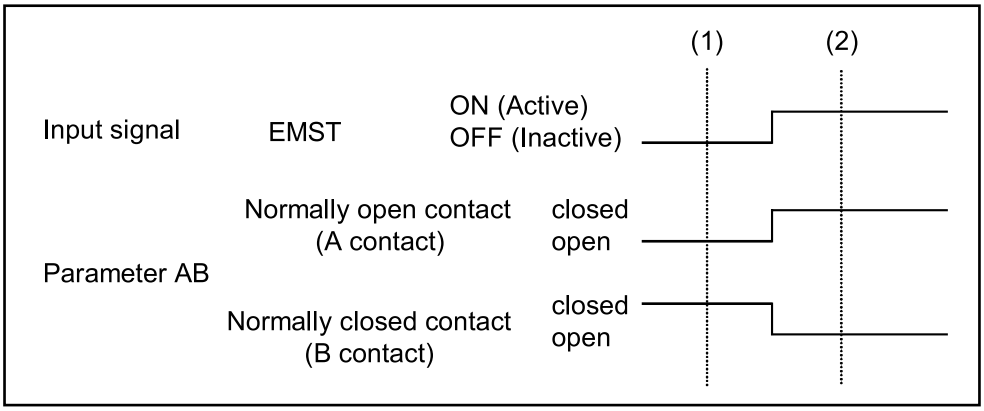
*1: The IOFF changes to the CLCN when the parameter is set to BF1 (brake sequence).
*2: OUT1 corresponds to one of outputs among BRK, BRKC, OVER and SPD.

Table A-2: Meaning of data

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

The readout of Input/Output with the IO command differs with the polarity setting by AB parameter as well.

Figure A-2



- Difference of ON/OFF signals and the polarity (AB parameter) of the emergency stop (EMST) input are shown in Figure A-2.
  IO0: Reports the state of circuit in regard to input signal.
  IO1: Reports the state of execution of the function (in this case EMST) in regard to input. [ON (active) or OFF (inactive)]

◆ If the EMST input is set to the normally open contact (ABX0XXXXXX)

If the EMST input is set to the normally open contact, the readouts of IO0 and IO1 are the same at the timing of (1) or (2).

Table A-3

	IO data	Readout
(1)	IO0	* 0 * * * * * * / * * * *
	IO1	* 0 * * * * * * / * * * *
(2)	IO0	* 1 * * * * * * / * * * *
	IO1	* 1 * * * * * * / * * * *

◆ If the EMST input is set to normally closed contact (ABX1XXXXXX)

If the EMST input is set to the normally closed contact, the readouts of IO0 and IO1 are the opposite at timing of (1) or (2).

Table A-4

	IO data	Readout
(1)	IO0	* 0 * * * * * * / * * * *
	IO1	* 1 * * * * * * / * * * *
(2)	IO0	* 1 * * * * * * / * * * *
	IO1	* 0 * * * * * * / * * * *

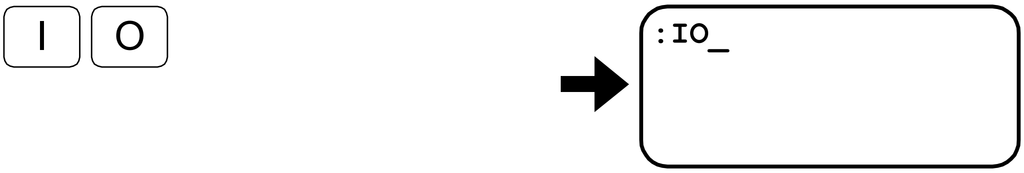
In these examples as shown above, the readout with IO1 will show that the EMST signal is functionally ON or OFF regardless of the setting to the normally open or closed contact.

[Example 1] Check if the start command RUN for positioning with Programmable Indexer is inputted.

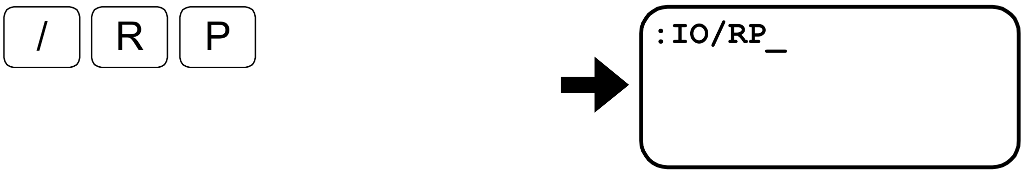
(1) Confirm that the colon (:) is on the display of the Hndy Terminal.

(If the colon (:) is not on the display, press the ENT key once.)

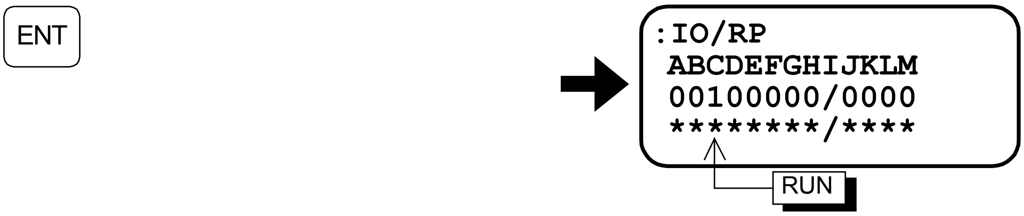
(2)



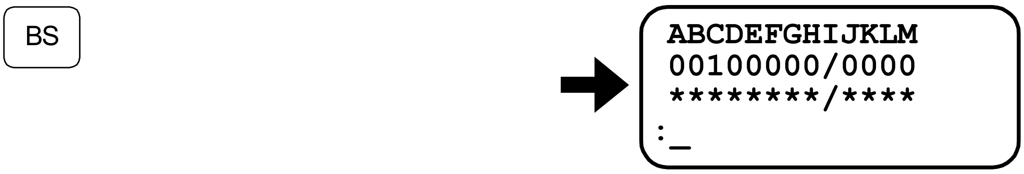
(3)



(4) Press the ENT key for execution, then the readout will be on the dixplay.



(5) Press the BS key after checking the readout. The readout remains on the screen and other command won't be accepted unless the BS is not pressed.



Explanation

- The checking procedures described above confirm that the RUN input, start command for positioning with Programmable Indexer, is ON as the readout of the signal is 1.
  - ◊ In case of above [Example 1], the readout of Input/Output signals will be observed and displayed on the screen until the BS key is pressed.
  - ◊ If the signal changes ON and OFF (ON⇔OFF) while monitoring the state of Input/Output signals, the readout will follow the changes with 1 and 0 (1⇔0) as well.
  - ◊ However, if the step (3) of the procedure of [Example 1] is omitted, the readout will be one-shot right after the ENT key is pressed.

IO: Input/Output Monitor（B5 and 25 type Driver Units）

- State of Input and Output signals of connector CN2 can be monitored by the IO command.
- This function is useful for checking the wiring.
- Input format
  IO0/RP: Monitors general I/O state.
  IO2/RP: Monitors I/O state related to positioning with Programmable Indexer.
  IO3/RP: Monitors I/O state related to positioning in general.
  /RP default: Monitors in one shot.
  /RP attached: Monitors in real time.
- Readout format: Bit map representing Input/Output in 1 line. (See Table A-5 below.)
  - ◊ The readout is the current Input/Output state.
  - ◊ The line of "I/O change state" on the display in Figure 7-22 holds the first readout state on each Input/Output to indicate that this part was changed at least once before.
  - ◊ Press the $\boxed{\text{BS}}$ key to terminate the real time monitoring (IO*/RP).
  - ◊ Press the $\boxed{\text{R}}$ key to reset the monitored state in the Input/Output changing state.

Figure A-3: Monitoring example by IO command

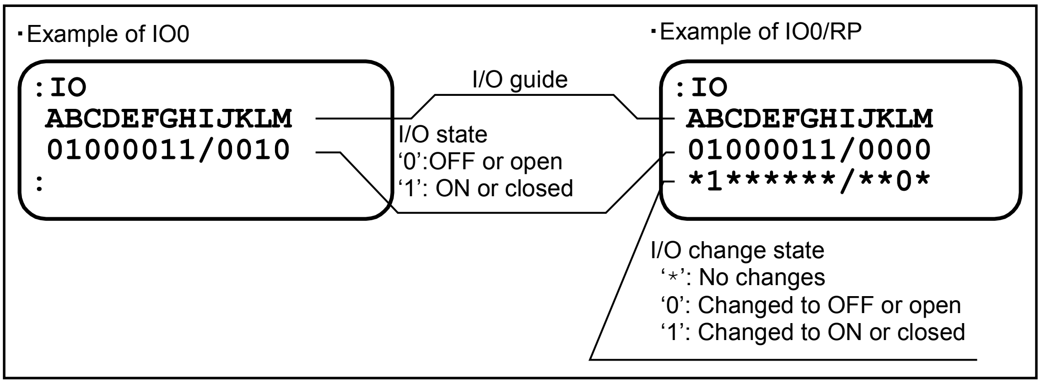


Table A-5: Contents of I/O command readout (B5 and 25 type Driver Units)

IOn	A	B	C	D	E	F	G	H	I	J	K	L	M	N
0	SVON	EMST	IOFF *1	HLS	HOS	CLR	OTM	OTP	/	DRDY	BRK *2	IPOS	HOME	-
2	PRG5	PRG4	PRG3	PRG2	PRG1	PRG0	RUN	STP	Re-served	Re-served	/	IPOS	NEAR A	NEAR B
3	JOG	DIR	RUN	HOS	STP	INH	Re-served	/	DRDY	OVER	IPOS	SPD	HOME	HCMP

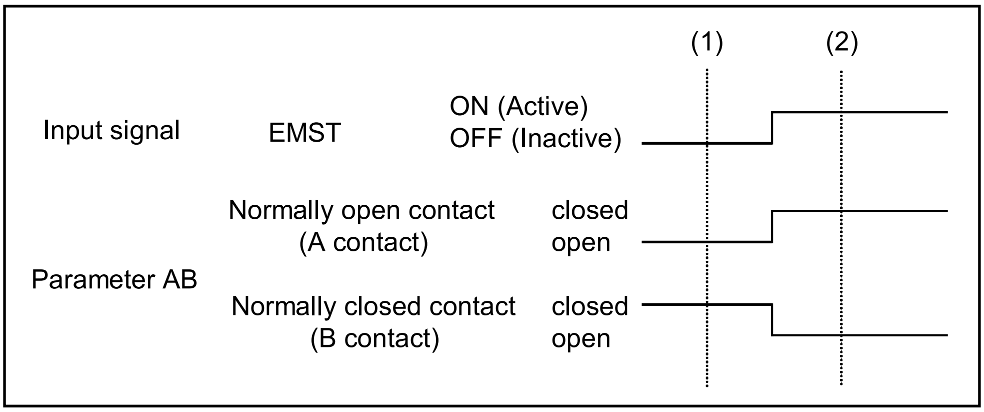
*1: Changes to the CLCN when the parameter is set to BF1 (brake sequence).
*2: OUT1 corresponds to one of outputs among BRK, BRKC, OVER and SPD.

Table A-6: Meaning of data

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

- The readout of Input/Output with the IO command differs with the polarity setting by AB parameter as well.

Figure A-4



Difference of ON/OFF signals and the polarity (AB parameter) of the emergency stop (EMST) input are shown in Figure A-3.

IO0: Reports the state of circuit in regard to input signal.
IO1: Reports the state of execution of the function (in this case EMST) in regard to input. [ON (active) or OFF (inactive)]

◆ When EMST input is set to normally open contact (ABX0XXXXXX)

If the EMST input is set to the normally open contact, the readouts of IO0 and IO1 are the same at timing of (1) or (2).

Table A-7

	IO data	Readout										
(1)	IO0	A	B	C	D	E	F	G	H	I	J	K
		*	0	*	*	*	*	*	*	/	*	*
	IO1	A	B	C	D	E	F	G	H	I	J	K
		*	0	*	*	*	*	*	*	/	*	*
(2)	IO0	A	B	C	D	E	F	G	H	I	J	K
		*	1	*	*	*	*	*	*	/	*	*
	IO1	A	B	C	D	E	F	G	H	I	J	K
		*	1	*	*	*	*	*	*	/	*	*

◆ When EMST input is set to normally closed contact (ABX1XXXXXX)

If the EMST input is set to the normally closed contact, the readouts of IO0 and IO1 are opposite at timing of (1) or (2).

Table A-8

	IO data	Readout										
(1)	IO0	A	B	C	D	E	F	G	H	I	J	K
		*	0	*	*	*	*	*	*	/	*	*
	IO1	A	B	C	D	E	F	G	H	I	J	K
		*	1	*	*	*	*	*	*	/	*	*
(2)	IO0	A	B	C	D	E	F	G	H	I	J	K
		*	1	*	*	*	*	*	*	/	*	*
	IO1	A	B	C	D	E	F	G	H	I	J	K
		*	0	*	*	*	*	*	*	/	*	*

In these examples as shown above, the readout with IO1 will show that the EMST signal is functionally ON or OFF regardless of the setting to the normally open or closed contact.

[Example 1] Check if the start command RUN for positioning with Programmable Indexer is inputted.

(1) Be wure that the colon (:) is on the display of the Hndy Terminal.
(If the colon (:) is not on the display, press the ENT key once.)

```
:_
```

(2)

I O 2 #

```
:IO2_
```

(3)

/ R P

```
:IO2/RP_
```

(4) Press the ENT key for execution, and then the readout will be on the dixplay.

ENT

```
:IO2/RP
 ABCDEFGHIJKLMN
 0000001000/000
 **********/***
```

RUN

(5) Press the BS key after checking the readout. The readout remains on the screen and other command won't be accepted unless the BS key is not pressed.

BS

```
 ABCDEFGHIJKLMN
 0000001000/000
 **********/***
:_
```

Explanation

- The checking procedures described above confirm that the RUN input, start command for positioning with Programmable Indexer, is ON as the readout of the signal is 1.
  - ◊ In case of above [Example 1], the readout of Input/Output signals will be observed and displayed on the screen until the BS key is pressed.
  - ◊ If the signal changes ON and OFF (ON↔OFF) while monitoring the state of Input/Output signals, the readout will follow the changes with 1 and 0 (1↔0) as well.
  - ◊ However, if the step (3) of the procedure of [Example 1] is omitted, the readout will be one-shot right after the ENT key is pressed.

Appendix 2: How to Check Motor Condition

- Examine resistance and insulation resistance of Motor winding to check if the Motor is in normal condition. It can be regarded as normal if all check results are within the specification.

- Firstly, check the winding resistance including the Motor cable. If the result is not satisfactory, check the Motor only.

1 Check resistance of the Motor winding

Figure A-5: Checking with the cable

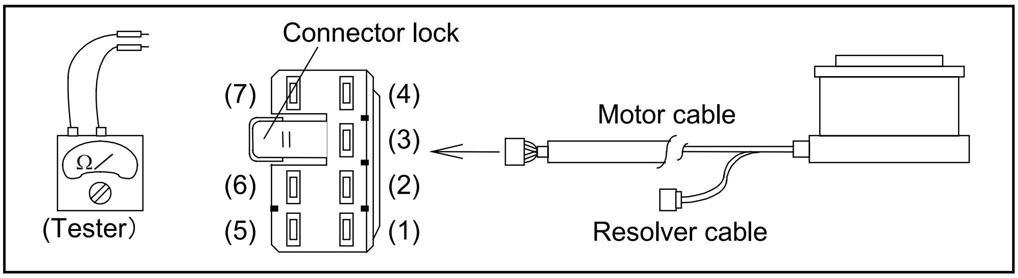


Figure A-6: Checking the Motor only

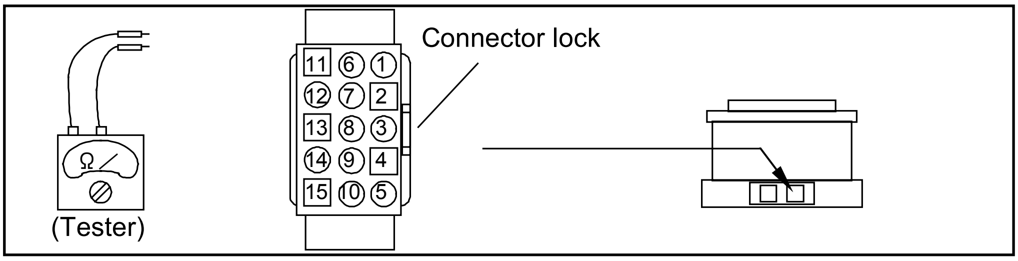


Table A-9: Checking points

	Cable connector	Motor connector	Result
Phase A	(1) ↔ (2) (A+) (A-)	(5) ↔ (4) (A+) (A-)	
Phase B	(3) ↔ (4) (B+) (B-)	(10) ↔ (9) (B+) (B-)	
Phase C	(5) ↔ (6) (C+) (C-)	(15) ↔ (14) (C+) (C-)	

Table A-10: Resistance specification

Motor model	Winding resistance (Ω)	Acceptable value
YSB2020	4.5	1. Within ± 30% 2. Variation between Phases A, B, and C: 1.0 maximum
YSB3040	6.4	
YSB4080	5.5	
YSB5120	4.7	

- For special Motor winding or long cable over 4m long, please consult with NSK.

2 Check resistance of resolver winding

Figure A-7: Check with the Cable

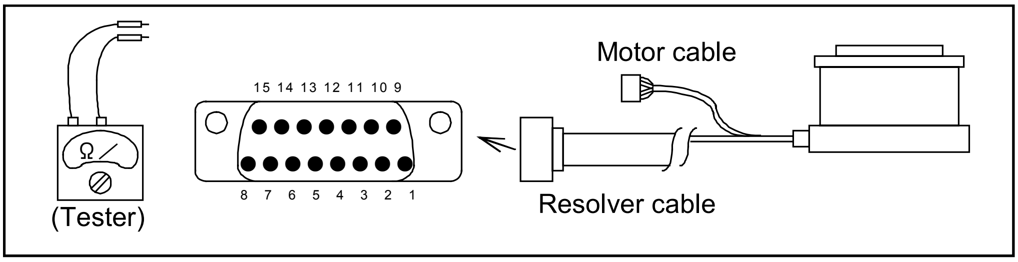


Figure A-8: Check the Motor only

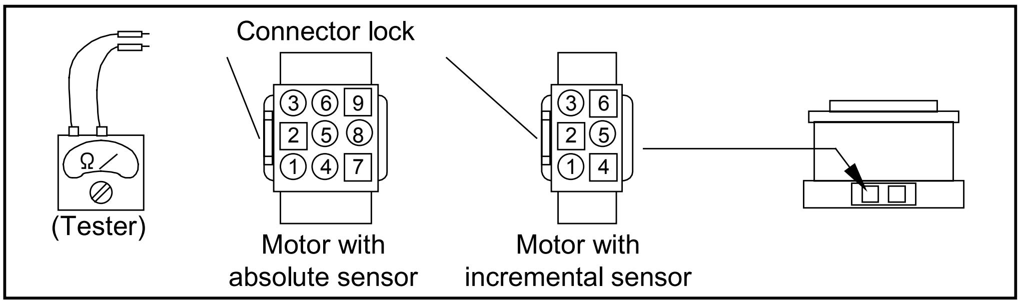


Table A-11: Checking points and resistance specification: Motor with absolute position sensor

	Cable connector	Motor connector	Result	Acceptable value
INC-A	(8) ↔ (4) (INC-A) (COM)	(1) ↔ (2) (INC-A) (COM)		1. 3.1 Ω ±1Ω 2. Variation between phases A, B, and C: Maximum 1.0 Ω
INC-B	(7) ↔ (4) (INC-B) (COM)	(4) ↔ (2) (INC-B) (COM)		
INC-C	(15) ↔ (4) (INC-C) (COM)	(7) ↔ (2) (INC-C) (COM)		
ABS-A	(6) ↔ (4) (ABS-A) (COM)	(3) ↔ (2) (ABS-A) (COM)		1. 9.4 Ω ±2Ω 2. Variation between phases A, B, and C: Maximum 1.0 Ω
ABS-B	(5) ↔ (4) (ABS-B) (COM)	(6) ↔ (2) (ABS-B) (COM)		
ABS-C	(14) ↔ (4) (ABS-C) (COM)	(9) ↔ (2) (ABS-C) (COM)		

- For special winding or long cable over 4m, please consult with NSK.

Table A-12: Checking points and resistance specification: Motor with incremental position sensor

	Cable connector	Motor connector	Result	Acceptable value
INC-A	(8) ↔ (4) (INC-A) (COM)	(1) ↔ (4) (INC-A) (COM)		1. 3.1 Ω ±1Ω 2. Variation between phases A, B, and C: Maximum 1.0Ω
INC-B	(7) ↔ (4) (INC-B) (COM)	(2) ↔ (4) (INC-B) (COM)		
INC-C	(15) ↔ (4) (INC-C) (COM)	(3) ↔ (4) (INC-C) (COM)		

- For special winding or long cable over 4m, please consult with NSK.

Figure A-9: Wiring of absolute position sensor [Reference only]

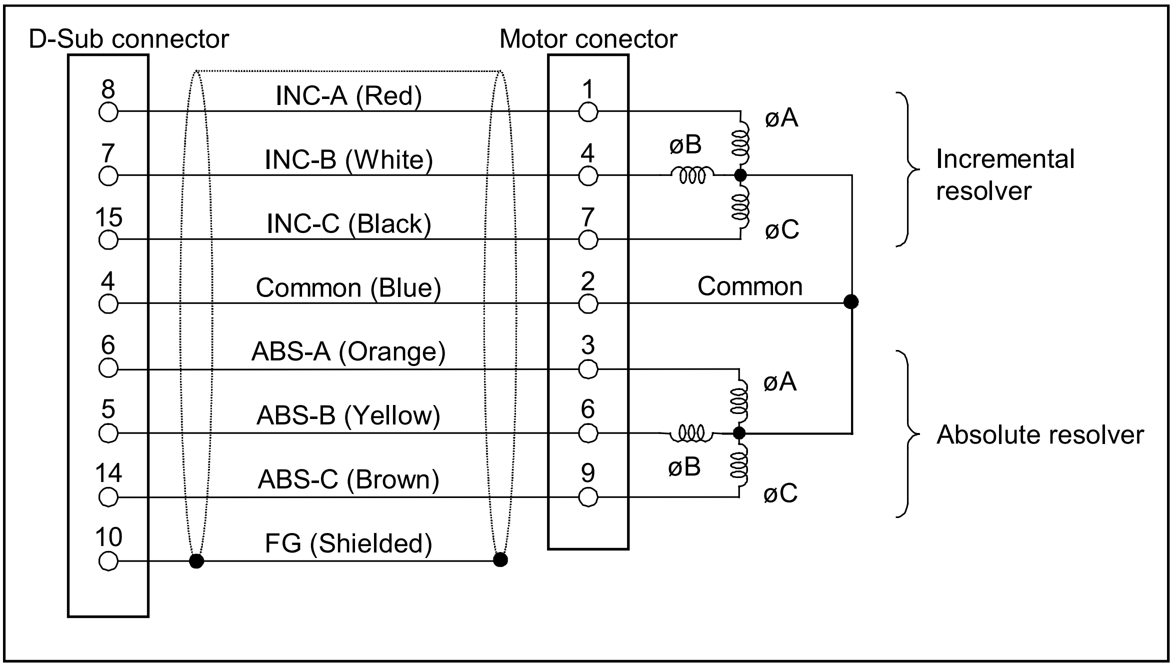
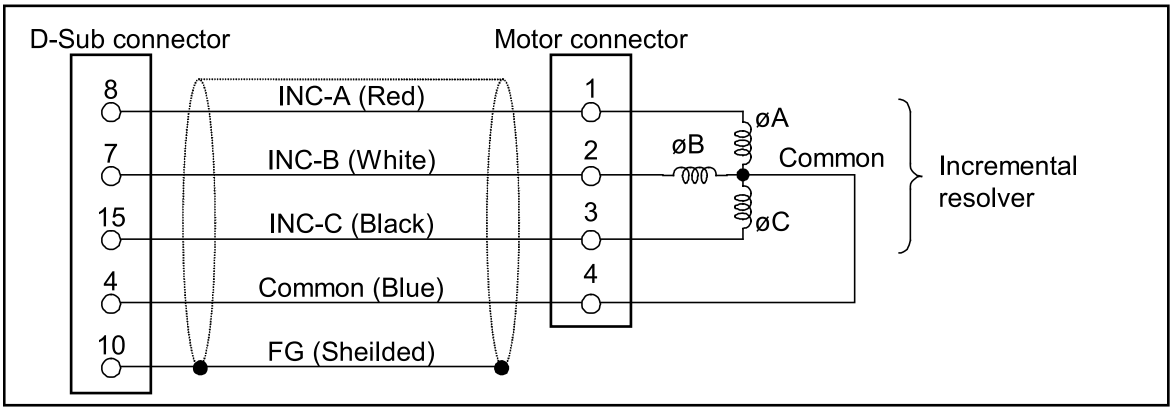


Figure A-10: Wiring of incremental position sensor [Reference only]



3 Insulation resistance check of Motor winding

⚠ *Caution: Disconnect the Motor from the Driver Unit when checking insulation resistance of the Motor.*

⚠ *Caution: Never apply more than 500 VDC.*

Figure A-11: Checking with the Cables

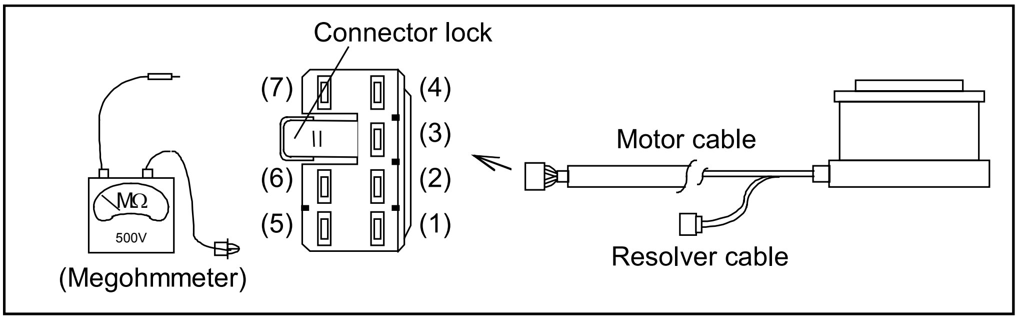


Figure A-12: Check Motor only.

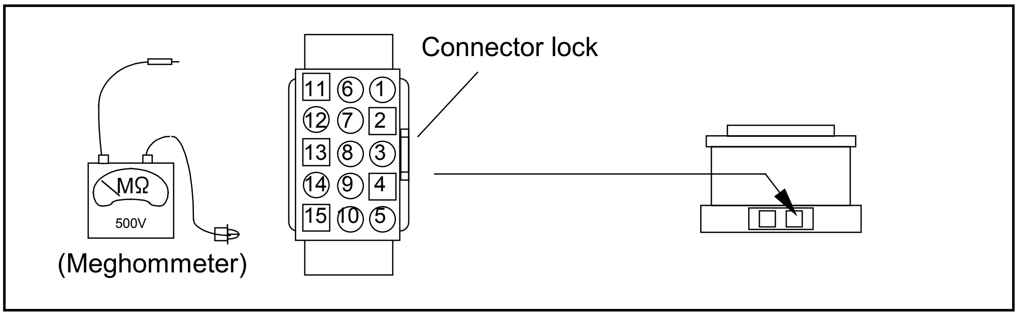


Table A-13: Checking points

	Cable connector	Motor connector	Result
øA – FG	(1) ↔ (7) (A+) (FG)	(5) ↔ (13) (A+) (FG)	
øB – FG	(3) ↔ (7) (B+) (FG)	(10) ↔ (13) (B+) (FG)	
øC – FG	(5) ↔ (7) (C+) (FG)	(15) ↔ (13) (C+) (FG)	
øA – øB	(1) ↔ (3) (A+) (B+)	(5) ↔ (10) (A+) (B+)	
øB – øC	(3) ↔ (5) (B+) (C+)	(10) ↔ (15) (B+) (C+)	
øC – øA	(5) ↔ (1) (C+) (A+)	(15) ↔ (5) (C+) (A+)	

Table A-14: Insulation resistance specification (Common to all Motors)

	Specification
With cables	1 MΩ or over
Motor only	2 MΩ or over

4 Appearance check on Motor and Cables

- Check the Motor for damage.
- Check the Cables for cable insulation.

Appendix 3: Initialization of Driver Unit

- Follow the procedures described in this section when initialization of the Driver Unit is required during troubleshooting or replacing the Motor or the Driver Unit.

- Procedures for initialization require three steps as shown in Figure A-13. SI command executes the initialization.

- Use Handy Terminal FHT11 for inputting the commands and the parameters.

- The description follows as shown in Figure A-13.

Figure A-13

(1) Record the parameters and the programs.

(2) Initialization with the SI command.

(3) Setting the paramters and the programs again.

1 Monitor the parameters and the channel programs and note down them.

* Especially the PA data (the PA and the RO data of Driver Unit for the Motor equipped with absolute position sensor) is very important.

- Connect the Handy Terminal FHT11 to the connector CN1, and then turn on the control power (100 to 230 VAC) only.

↓

- The TS0 command monitors the parameters.

↓

- The channel programs can be monitored with the TC/AL command.

↓

- Turn off the control power after monitoring.

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

- Connect the Handy Terminal to the CN1connector.

↓

- Turn on the control power (100 to 230 VAC) only.

↓

- Input the password when the colon ":" is on the screen.

/ N S K SP O N ENT

- The Driver Unit will accept the command if the echo-back "NSK ON" appears on the screen.

↓

- Input the SI/SY command.

S I / S Y

↓

- The initialization has completed when the colon ":" appears on the screen after the echo-back "INITIALIZE."

3 Input the parameters and the channel programs.

- Connect the Handy Terminal FHT11 to connector CN1, and then turn on the control power (100 to 230 VAC) only.

↓

- Firstly input the password before setting the parameters that have noted down.

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

- The echo-back "NSK ON" will be on the screen.

↓

- Then input the PA value.

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

↓

[In case of the Driver Unit for the Motor equipped with absolute position sensor.

◊ Input the password.

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

◊ The echo-back "NSK ON" will be on the screen.

↓

◊ Then enter RO value.

[R] [O] [ ] [ ] [ENT]

↓

- After that, input other parameters and channel programs.

[V] [G] [ ] [ ] [ENT]

4 Confirm the inputted parameters and the channel programs.

- Monitor the parameters and the programs with the Handy Terminal.

◊ The TS0 or the TC command reports the settings.

5 Turn off the power for the completion of initialization.

Appendix 4: How to Replace ESB Driver Unit

⚠ *Danger : Be sure to turn off the power, and then follow the procedure for replacing ESB Driver Unit.*

- The code on the reference number described on the figure below indicates that the ESB Driver Unit is interchangeable with each other.

Figure A-14

M-ESB-YSB3040A B 500

1, A: Non-interchangeable
2, B: Interchangeble

- In case of replacing the interchangeable Driver Unit, inputting the parameters and the channel programs again to the new Driver Unit that has the same reference number, will complete the replacement.
- For non-interchangeable Driver Unit, the replacement will involve the transfer of the compensation ROM. Follow the procedures described in this chapter.
- In case of specially made Driver Unit, refer to the respective specifications for the modified standard Driver Unit.

Table A-15: The parts required in replacement

Basic type	Compensation ROM	Absolute sensor board	Parameters unique to individual Motor *1
A3 type	Transfer required.	Transfer required.	PA and RO
A5 type	Transfer required.*2	Transfer required.	PA and RO
13 type	Transfer required.	Not used.	PA
15 type	Transfer required. *2	Not used.	PA
B3 and B5 types	Transfer of the parts is not necessary because interchangeable parts are used.		PA700, and RO2048
23 and 25 types			PA700

*1. The parameter data unique to individual Motor are set. Be sure to copy the parameter data to the Driver Unit for the replacement.

*2. Requires removing process of the extention boad.

- Before replacing the Driver Unit, be sure to note down the settings of the parameters and the channel programs to the setting lists provided to the last pages of this manual.
- Especially settings of VG, VI, PG, CO, MA, MV, and HO shall be carefully confirmed. In case of non-interchangeable Driver Unit, the parameters unique to individual Motor shall be closely looked.
- Following tools are required for replacing the Driver Unit.

  (1) A screw driver with 4 mm cross recessed.

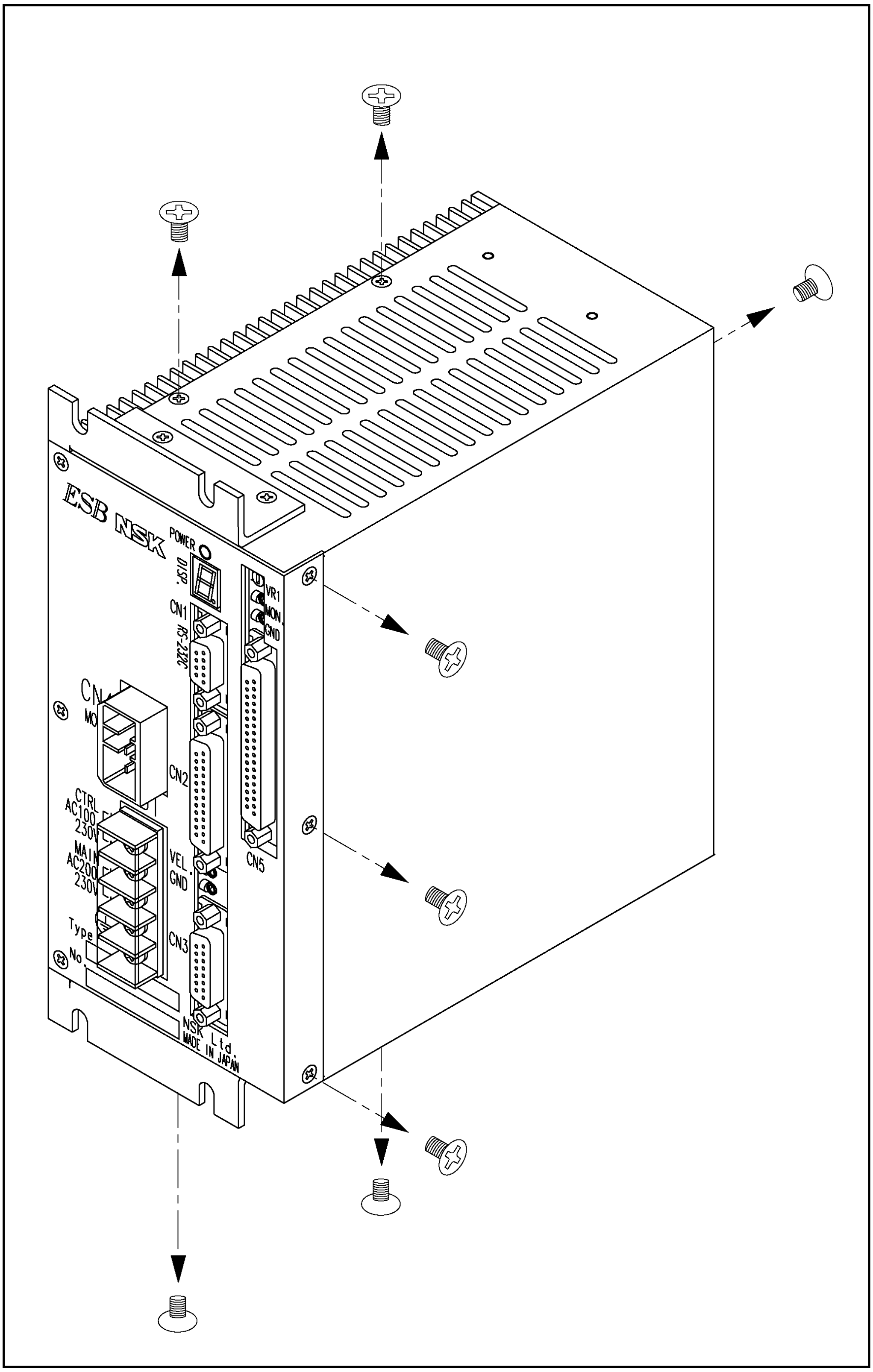
  (2) A ROM remover

  (3) Handy Terminal HTF11.

1. Remove the case of ESB Driver Unit.

Top and bottom	: 2 pieces (M3 × 6 countersunk head machine screw)
Back	: 1 piece (M3 × 6 countersunk head machine screw)
Side	: M3 × 6 (M3 × 6 countersunk head machine screw, black oxide)

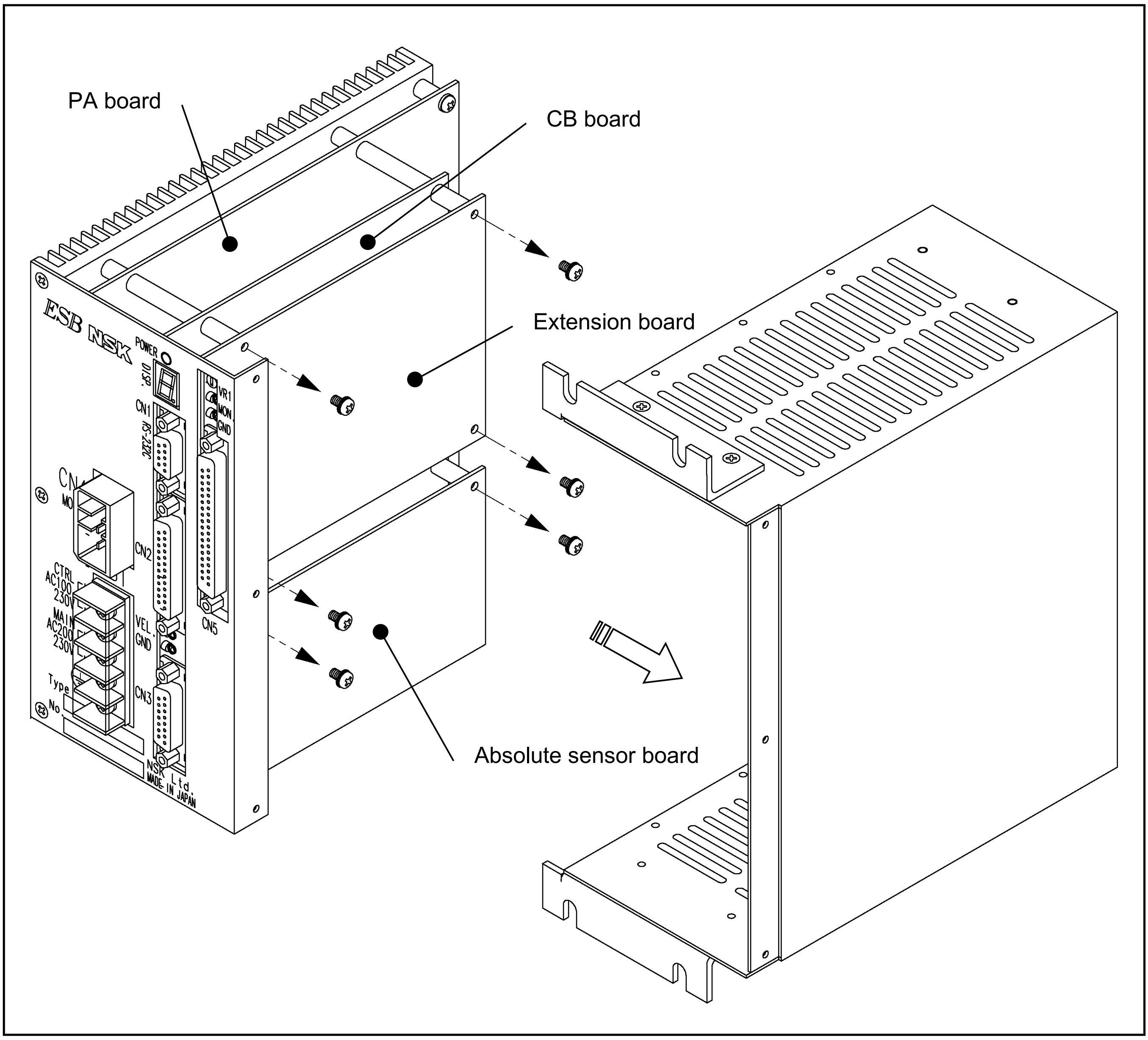
Figure A-15: Remove the case..



2. Remove the extension board and the absolute sensor board.

- The A3, B3, 13, and 23 type Driver Units do not have the extension board.
- The 13, 15, 23, and 25 type Driver Units do not have the absolute sensor board.
  - ◊ Extension board : 4 pieces (M3 × 6 Sems screw)
  - ◊ Absolute sensor board : 2 pieces (M3 × 6 Sems screw)

Figure A-16: Remove circuit boards.



3. Remove U102 on the CB board with the ROM remover.

- The B3, 23, B5, and 25 type Driver Units do not require the transfer of the ROM.

Figure A-17: Remove the U102 ROM.

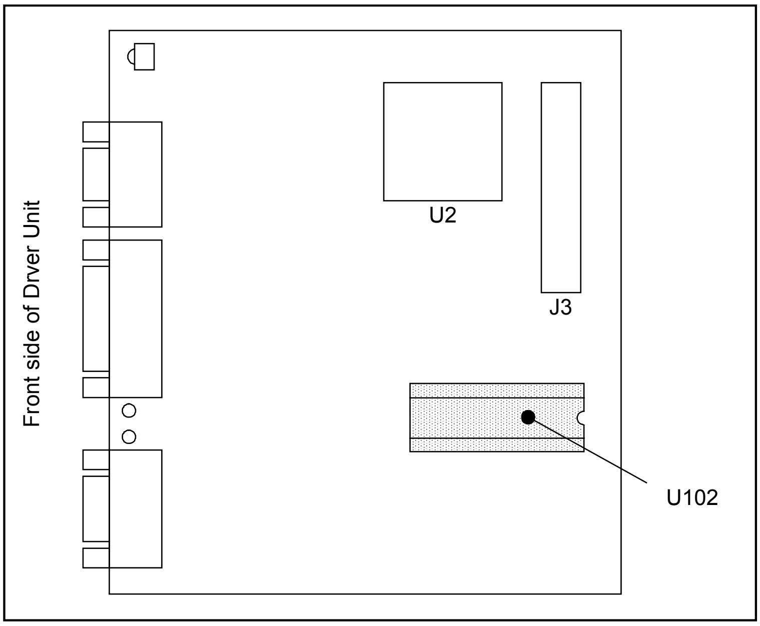
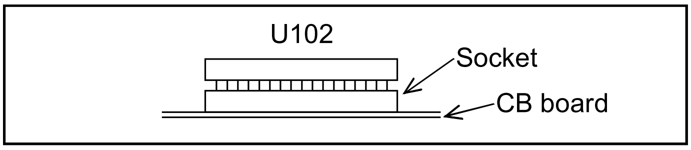


Figure A-18: Compensation ROM



4. Transfer the removed compensation ROM to the new ESB Driver Unit.

- When transferring the ROM, be careful for the orientation of the IC. Be sure to insert firmly the ROM in the socket.

Figure A-19: Note 1: For inserting the ROM into the socket.

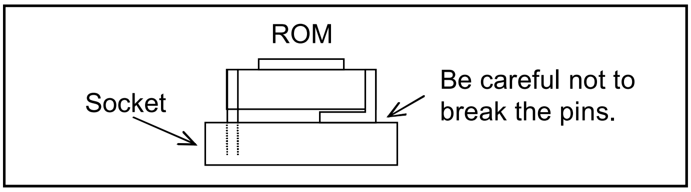
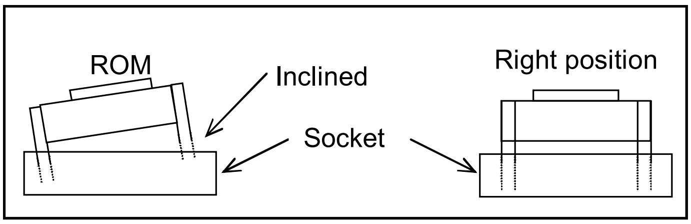


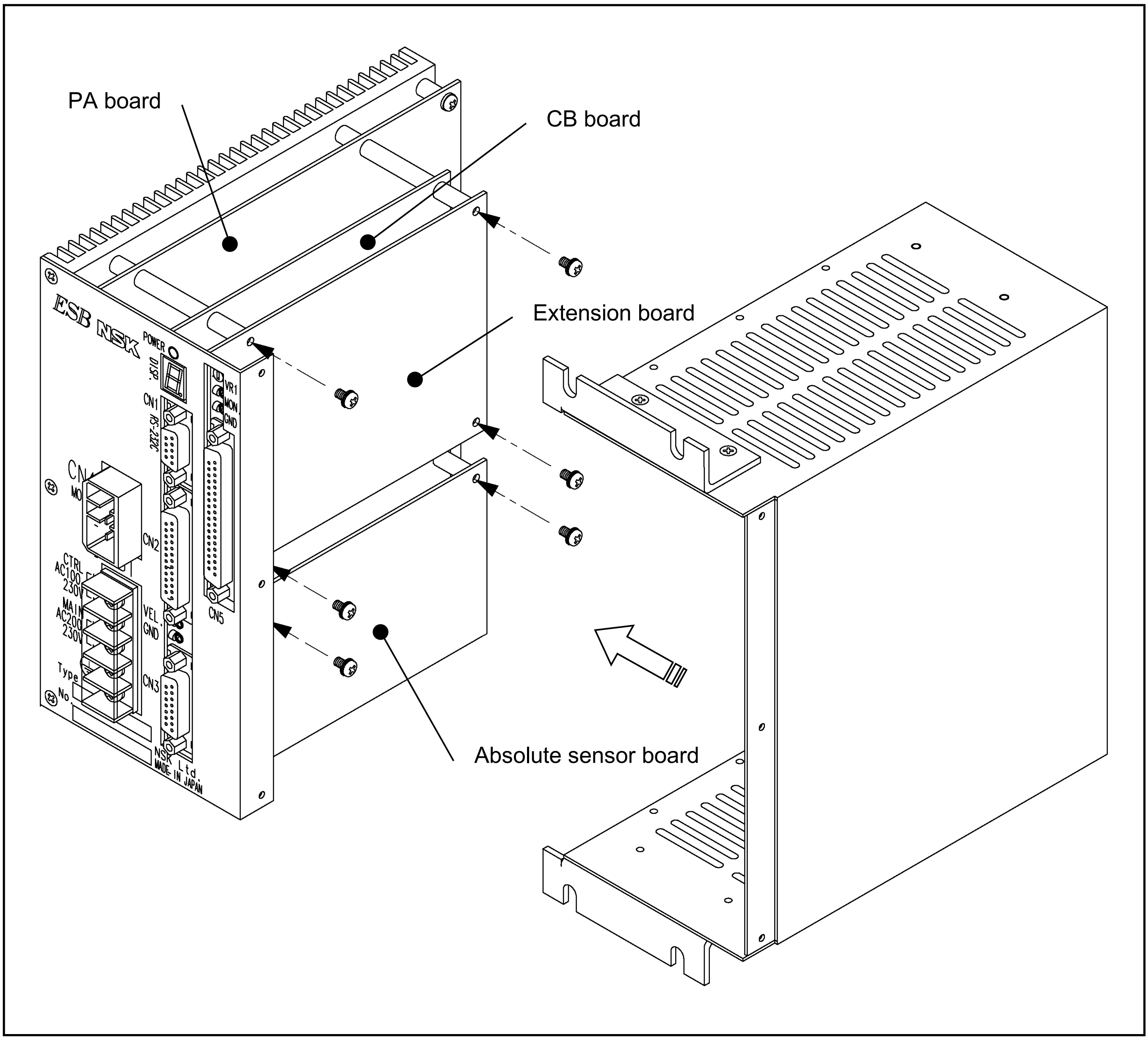
Figure A-20: Note 2: For inserting the ROM into the socket.



5. Reset the extension board of the new ESB Driver Unit, and assemble the absolute sensor board of the old Driver Unit to the new one.

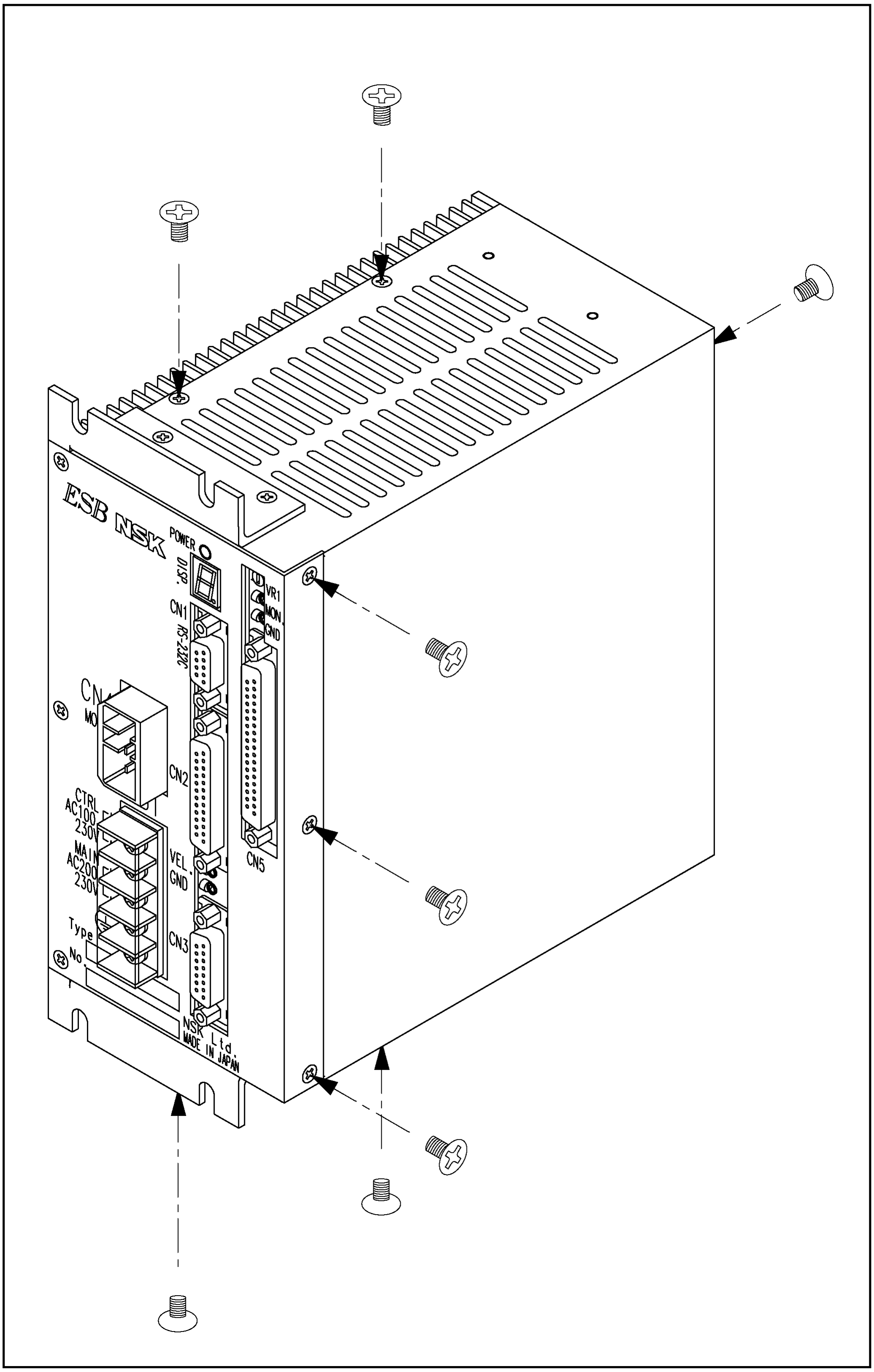
- The A3, B3, 13, and 23 type Driver Units do not have the extension board.
- 13, 15, 23, and 25 type Driver Units do not have the absolute sensor board.

Figure A-21: How to install the circuit board.



6. Attach the case to the Driver Unit, and fasten the screws.

Figure A-22: Attach the case to the Driver Unit.



7. Input all parameters and channel programs after transferring the compensation ROM.

1 Connect the Handy Terminal FHT11 to the CN1connector.

2 Turn on the control power only. (Use two terminals coded as CTRL on the TB1 connector)

- If you cannot separate wiring of the main power and the control power, disconnect the CN2 connector, and then turn on the power.
- Be sure to observe the procedure stated above. Otherwise the Motor may be out of control because the parameters are not properly set yet.

3 When the power is turned on, the message "NSK MEGATORQUE•••" will be on the screen.

- When the screen indicates the colon ":", input as shown below.

/ N S K SP O N ENT

- And then input as follows to initialize the Driver Unit. It takes approximately 30 seconds.

S I / S Y ENT

4 When the colon ":" appears on the screen of Handy Terminal, input the parameters and the channel programs sequentially that have noted down.

Appendix 5: Regeneration Dump Resistor

- The Megatorque Motor will function as a generator in the following conditions. This phenomenon is called regeneration.
  - ◊ When the Motor is decelerating under heavy load inertia.
  - ◊ When decelerating speed of the Motor is affected by the gravity.
    (Example: An unbalanced load is attached to a jig, etc.)
- Energy generated by the Motor will be charged to the main power circuit condenser. If energy is more than the capacity of the condenser, a dump resistor of the Driver Unit will dissipate overflowed energy.
- However if the regeneration occurs frequently, the dump register will be overheated due to its limited capacity and eventually, the over-heat alarm will be on, and the Motor will stop.

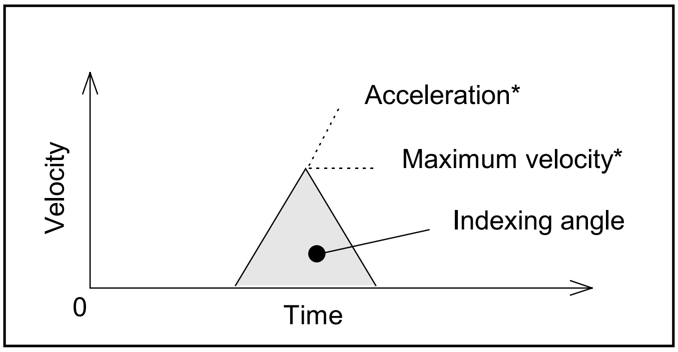
  * Capacity of the dump resistor is approximately 2.5W.
- When an over-heat alarm occurs, take the following remedies.
  - ◊ Reduce the duty cycle.
  - ◊ Decrease acceleration and deceleration.
  - ◊ Decrease operation speed.

If above measures are not feasible, an external high capacity regenerative dump resistor may be applied without compromising the use conditions of the Megatorque Motor.

1. Criterion to use the regeneration dump resistor

- In normal positioning, the best combination of acceleration and maximum velocity exists for applied load and indexing angle. If the use condition exceeds this criterion, it requires the external dump resistor.

Figure A-23



◊ * Recommended combination of acceleration and maximum velocity to realize the shortest operation time without overshooting.

- The relation of recommended maximum velocity and inertial load described above for 180° and 360° indexing is shown in Figure A-24 as an example.

- The regeneration is observed in the area A.

Example:

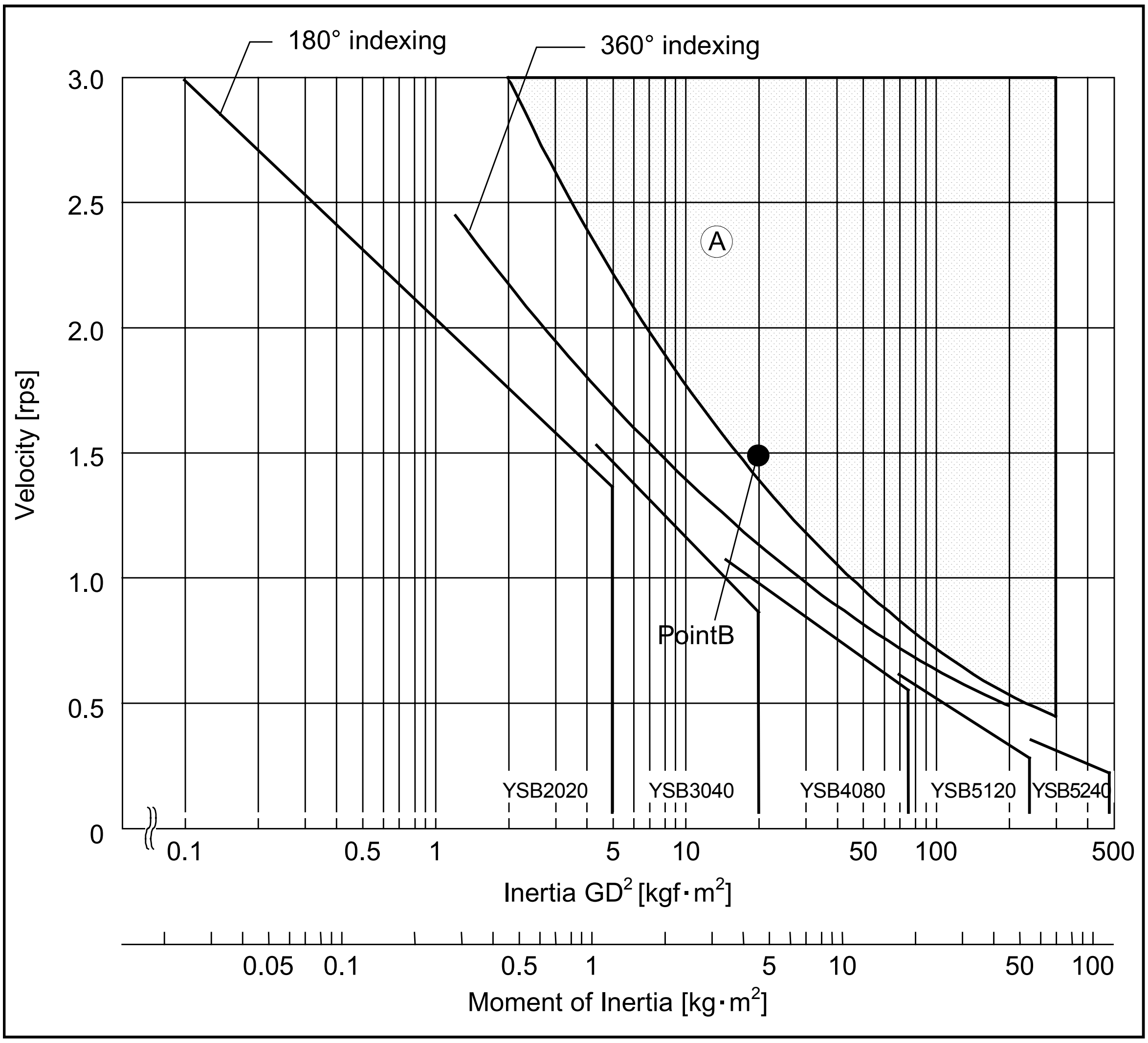
Point B Moment of Inertia : 5kgm^2
Velocity : 1.5 r.p.s.

Regeneration occurs when decelerating under above conditions.

→ The regeneration dump resistor is not necessary when indexing angle is less than 360°.

→ The external regeneration dump resistor may be necessary in the area A.
Contact NSK representative for more details about the external regeneration dump resistor.

Figure A-24: Relation between the recommended maximum velocity and load inertia.



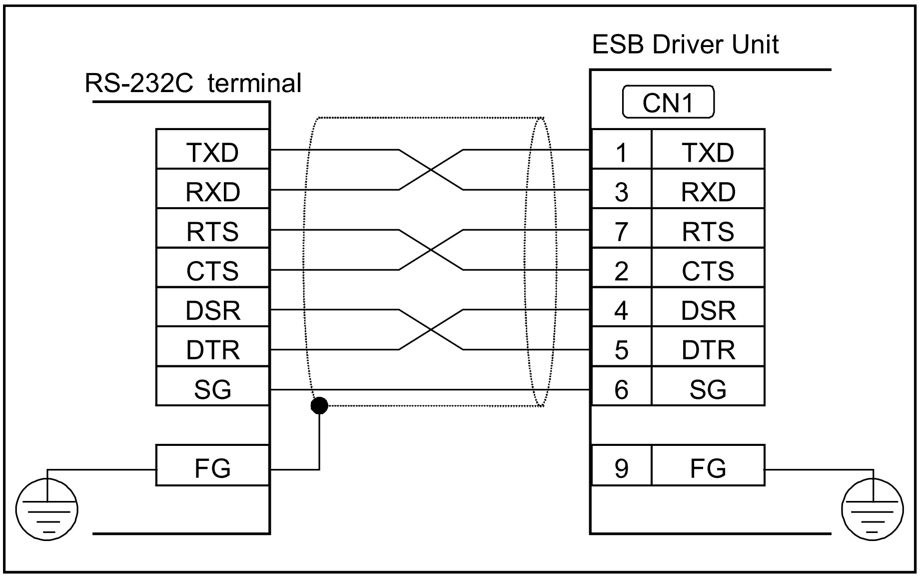
- Consult with NSK representative on the recommendation of other use conditions.

Appendix 6: Wiring of RS-232C Communication Cable

- Wiring of the RS-232C communication cable shall conform to the specifications of a personal computer connecting to the ESB Driver Unit.

◆ RTS control / CTS monitoring active (standard)

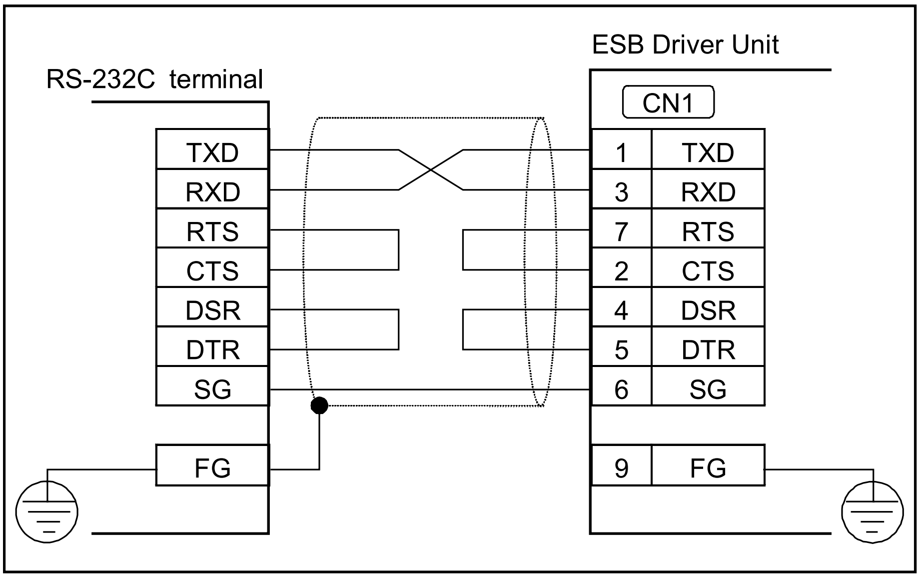
Figure A-25: When the RTS control and the CTS surveillance are active.



◆ RTS control / CTS monitoring inactive

⚠ *Caution : Since this connection applies to non-procedure communication, the ESB Driver Unit may fail to read data if a large amount of data is transmitted too quickly. Make sure that the Driver Unit echoes back, or leave space between data transmission.*

Figure A-26: Wiring of RS-232C: No flow control



Appendix 7: ESBB3 Driver Unit Parameter/Program List

Reference No. ______________

SN : ______________

Parameter Setting List

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		FD	0		OM	0	
VG	1.0		FZ	0		SO	0	
VGL	1.0		FR	1		SB	0	
VI	1.00		PS	1		ST	0	
VIL	1.00		DI	0		NMA	0	
VM	1		OTP	0		NA	100	
LG	50		OTM	0		ZAS	0	
TL	100		AO	0		ZAE	0	
GP	0		MV	1.0000		BF	0	
GT	5		MA	1.00, 1.00		WC	*	
FO	0		JV	0.1000		WU	*	
FP	0		JA	1.00		MM	1	
FS	0		HV	0.2000		BM	1	
NP	0		HA	1.00		CM	0	
NS	0		HZ	0.0100		AN	0	
NQ	0.25		MD	0		WM	0	
DBP	0		CS	1, 1		SE	0	
DBA	0		CY	1.00		EC	0	
ILV	100.0		CX	1		LO	0	
FF	0		OS	4		SG	0	
FC	0		HD	1		MT	*	
CO	50 000		HO	0		RI	*	
IN	100		PA	700		ZP	1.00	
IS	0		OL	*		ZV	1.4	
FW	1.0		RC	*		OU	0	
VO	2 730		LR	0		EP	2	
VW	100		RO	2 048		TO	2	
OR	409 600		TY	1		HT	2	
CE	1 000		AB	X0X0XX00		PE	2	
CR	X1		SM	1		AE	0	
PC	0		NW	2		PH	0	
RR	-3		IM	0				

* Setting value differs with the size of Motor.

Program Setting List

Blank channel denotes that the channel not in use. Date: ______________

CH	Program	CH	Program	CH	Program	CH	Program
0	Command: : :	4	Command: : :	8	Command: : :	12	Command: : :
1	Command: : :	5	Command: : :	9	Command: : :	13	Command: : :
2	Command: : :	6	Command: : :	10	Command: : :	14	Command: : :
3	Command: : :	7	Command: : :	11	Command: : :	15	Command: : :

Appendix8: ESB23 Driver Unit Parameter/Program List

Reference No.
S/N

Parameter Setting List

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		RR	-3		OM	0	
VG	1.0		FD	0		SO	0	
VGL	1.0		FZ	0		SB	0	
VI	1.00		FR	1		ST	0	
VIL	1.00		PS	1		NMA	0	
VM	1		DI	0		NA	100	
LG	50		OTP	0		ZAS	0	
TL	100		OTM	0		ZAE	0	
GP	0		MV	1.0000		BF	0	
GT	5		MA	1.00, 1.00		WC	*	
FO	0		JV	0.1000		WU	*	
FP	0		JA	1.00		MM	1	
FS	0		HV	0.2000		BM	1	
NP	0		HA	1.00		CM	0	
NS	0		HZ	0.0100		AN	0	
NQ	0.25		MD	0		WM	0	
DBP	0		CS	1,1		SE	0	
ILV	100.0		CY	1.00		EC	0	
FF	0		CX	1		LO	0	
FC	0		OS	4		SG	0	
CO	50 000		HD	1		MT	*	
IN	100		HO	0		RI	*	
IS	0		PA	700		ZP	1.00	
FW	1.0		OL	*		ZV	1.4	
VO	2 730		RC	*		OU	0	
VW	100		LR	0		EP	2	
OR	409 600		TY	1		TO	2	
CE	1 000		AB	X0X0XX00		HT	2	
CR	X1		SM	1		PE	2	
PC	0		NW	2		AE	0	
			IM	0		PH	0	

* Set value differs with the size of Motor..

Program Setting List

Blank column denotes that the channel is not in use. Date:

CH	Program	CH	Program	CH	Program	CH	Program
0	Command: : :	4	Command: : :	8	Command: : :	12	Command: : :
1	Command: : :	5	Command: : :	9	Command: : :	13	Command: : :
2	Command: : :	6	Command: : :	10	Command: : :	14	Command: : :
3	Command: : :	7	Command: : :	11	Command: : :	15	Command: : :

Appendix 9: ESBB5 Driver Unit Parameter/Program List

Reference No.
S/N:

Parameter Setting List

Blank column denotes the shipping set. Date:

Parameter	Setting		Parameter	Setting		Parameter	Setting	
	Shipping set	User setting		Shipping set	User setting		Shipping set	Use setting
PG	0.1		PS	1		SE	0	
VG	1.0		DI	0		EC	0	
VGL	1.0		OTP	0		LO	0	
VI	1.00		OTM	0		SG	0	
VIL	1.00		AO	0		MT	*	
VM	1		MV	1.0000		RI	*	
LG	50		MA	1.00, 1.00		ZP	1.00	
TL	100		JV	0.1000		ZV	1.4	
GP	0		JA	1.00		SL	3	
GT	5		HV	0.2000		AC	1	
FO	0		HA	1.00		AGV	1.00	
FP	0		HZ	0.0100		AGT	1.00	
FS	0		MD	0		AF	0	
NP	0		CS	1,1		AL	0	
NS	0		CY	1.00		HW	0	
NQ	0.25		CX	1		HI	0	
DBP	0		OS	4		SO	0	
DBA	0		HD	1		SB	0	
ILV	100.0		HO	0		ST	0	
FF	0		PA	700		NMA	0	
FC	0		OL	*		NMB	0	
CO	50 000		RC	*		NA	100	
IN	100		LR	0		NB	100	
IS	0		RO	2 048		ZAS	0	
FW	1.0		AB	X0X0XX00		ZAE	0	
VO	2 730		NW	2		ZBS	0	
VW	100		IM	0		ZBE	0	
OR	409 600		BF	0		OU	0	
CE	1 000		WC	*		EP	2	
CR	X1		WU	*		TO	2	
PC	0		MM	1		HT	2	
RR	−3		BM	1		PE	2	
FD	0		CM	0		AE	0	
FZ	0		AN	0		PH	0	
FR	1		WM	0				

* Set value differs with the size of Motor.

- Note for resetting or copying parameters.
  - ◊ LO and SG do not need to be reset or copied as they are the parameters to adjust automatically the parameters PG, VG, VI, and MA.

Reference No.: ____________________
S/N: ____________________

Program Setting List

Blank column denotes that the channel is not in use. Date: ____________________

CH	Program	CH	Program	CH	Program	CH	Program
0	Command: : :	16	Command: : :	32	Command: : :	48	Command: : :
1	Command: : :	17	Command: : :	33	Command: : :	49	Command: : :
2	Command: : :	18	Command: : :	34	Command: : :	50	Command: : :
3	Command: : :	19	Command: : :	35	Command: : :	51	Command: : :
4	Command: : :	20	Command: : :	36	Command: : :	52	Command: : :
5	Command: : :	21	Command: : :	37	Command: : :	53	Command: : :
6	Command: : :	22	Command: : :	38	Command: : :	54	Command: : :
7	Command: : :	23	Command: : :	39	Command: : :	55	Command: : :
8	Command: : :	24	Command: : :	40	Command: : :	56	Command: : :
9	Command: : :	25	Command: : :	41	Command: : :	57	Command: : :
10	Command: : :	26	Command: : :	42	Command: : :	58	Command: : :
11	Command: : :	27	Command: : :	43	Command: : :	59	Command: : :
12	Command: : :	28	Command: : :	44	Command: : :	60	Command: : :
13	Command: : :	29	Command: : :	45	Command: : :	61	Command: : :
14	Command: : :	30	Command: : :	46	Command: : :	62	Command: : :
15	Command: : :	31	Command: : :	47	Command: : :	63	Command: : :

Appendix 10: ESB25 Driver Unit Parameter/Program List

Reference No.:
S?N:

Parameter Setting List

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	0.1		PS	1		SE	0	
VG	1.0		DI	0		EC	0	
VGL	1.0		OTP	0		LO	0	
VI	1.00		OTM	0		SG	0	
VIL	1.00		AO	0		MT	*	
VM	1		MV	1.0000		RI	*	
LG	50		MA	1.00, 1.00		ZP	1.00	
TL	100		JV	0.1000		ZV	1.4	
GP	0		JA	1.00		SL	3	
GT	5		HV	0.2000		AC	1	
FO	0		HA	1.00		AGV	1.00	
FP	0		HZ	0.0100		AGT	1.00	
FS	0		MD	0		AF	0	
NP	0		CS	1,1		AL	0	
NS	0		CY	1.00		HW	0	
NQ	0.25		CX	1		HI	0	
DBP	0		OS	4		SO	0	
DBA	0		HD	1		SB	0	
ILV	100.0		HO	0		ST	0	
FF	0		PA	700		NMA	0	
FC	0		OL	*		NMB	0	
CO	50 000		RC	*		NA	100	
IN	100		LR	0		NB	100	
IS	0		RO	2 048		ZAS	0	
FW	1.0		AB	X0X0XX00		ZAE	0	
VO	2 730		NW	2		ZBS	0	
VW	100		IM	0		ZBE	0	
OR	409 600		BF	0		OU	0	
CE	1 000		WC	*		EP	2	
CR	X1		WU	*		TO	2	
PC	0		MM	1		HT	2	
RR	−3		BM	1		PE	2	
FD	0		CM	0		AE	0	
FZ	0		AN	0		PH	0	
FR	1		WM	0				

* Set value differs with the size of Motor.

- Note for resetting or copying parameters.
  - ◊ LO and SG do not need to be reset or copied as they are the parameters to adjust automatically the parameters PG, VG, VI, and MA.

Reference No.: ______________

S/N: ______________

Program Setting List

Blank column denotes that the channel is not in use. Date: ______________

CH	Program	CH	Program	CH	Program	CH	Ptogram
0	Command: : :	16	Command: : :	32	Command: : :	48	Command: : :
1	Command: : :	17	Command: : :	33	Command: : :	49	Command: : :
2	Command: : :	18	Command: : :	34	Command: : :	50	Command: : :
3	Command: : :	19	Command: : :	35	Command: : :	51	Command: : :
4	Command: : :	20	Command: : :	36	Command: : :	52	Command: : :
5	Command: : :	21	Command: : :	37	Command: : :	53	Command: : :
6	Command: : :	22	Command: : :	38	Command: : :	54	Command: : :
7	Command: : :	23	Command: : :	39	Command: : :	55	Command: : :
8	Command: : :	24	Command: : :	40	Command: : :	56	Command: : :
9	Command: : :	25	Command: : :	41	Command: : :	57	Command: : :
10	Command: : :	26	Command: : :	42	Command: : :	58	Command: : :
11	Command: : :	27	Command: : :	43	Command: : :	59	Command: : :
12	Command: : :	28	Command: : :	44	Command: : :	60	Command: : :
13	Command: : :	29	Command: : :	45	Command: : :	61	Command: : :
14	Command: : :	30	Command: : :	46	Command: : :	62	Command: : :
15	Command: : :	31	Command: : :	47	Command: : :	63	Command: : :

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