SH035D051D

Sanmei Invention Servo

Si servo

Operation Manual

Main Part

Revision 2007.8.20

sanmei

Contents

1. Before being Used

- Si Servo is a fully digital position control stepping servo drive equipment with a high- speed CPU which has been conbined with a stepping motor.
- Before using this product, carefully read this manual and the bookmarks attached to the driver, the motor and ensure that you understand correct procedures to use this product.
- Take care to understand and remember the note in this manual. Take care to use the correct procedures when using this product. In the worst case, serious accidents may occure including fatal accidents.
- Keep this manual and the bookmareks attached to the driver and the motor where they can be viewed at all times.

This manual applies to the following servo drivers formats:

Si servo	**Si-02LDE** **Si-02DE** **Si-05LDE** **Si-05DE**

2. Notes

Note the following points about using this driver safely and correctly. Althugh all care is taken to inspect this product before shipment and normal operations are tested, the chance of initial failure not occurring or the driver not operating correctly are not zero. To prevent accidents or mulfunctions take all safety precautions with this company's products and other companies' products.

2-1. Warning symbols in this manual

Note the following warning symbols used in this manual. The warning symbols have been classified into "Danger" and "Caution".

This symbol refers to situations where mistakes in handling may damage to the product, which may lead to serious accidents causing fatalities or serious injury.

This symbol refers to situations where mistakes in handling may damage to the product, which may lead to serious injury. Depending on the situation, it may lead to a serious accident.

2-2. Notes about Insurance

Wiring:

- Be sure to earth with a D rank grounding and to ground the driver terminal with a one-point grounding.

  The possibility of electric shock and fire exists.

Operation:

- Do not touch any of the rotating parts of the motor under any circumstances.

  The possibility of injury exists.

Maintenance:

- Do not edit the driver core under any circumstances when electricity if running.

  The possibility of electric shock exists.

⚠ Caution

Attachment place:

- Do not use the product in environments with a lot of dust, iron filings, extreme temperatures, high humidity, high moisture, corrosive or inflammable gas, or inflammable objects.

  The possibility of failure, electric shock, fire, or explosions exists.

Wiring:

- Do not supply a commercial power supply to all the motor and drive connectors.

  The possibility of failure exists.

Operation:

- To avoid unexpected accidents, use simple motor substances when executing a test run.

  The possibility of injury exists.

- Place the emergency stop switch where it can be easily reached if needed before starting operations.

  The possibility of injury exits.

- Allow adequate space for misalignment of the product caused by shimmying.

  The possibility of injury exits.

- Do not touch the driver's heat sink or motor when electricity is running.

  Because of high temperatures, the possibility of burning exists.

Maintenance Check:

- Decomposition or reorganization is prohibited. Be sure to carry to regular maintenance to avoid breakdowns.

  The possibility of damage exists.

- Do not work on the wiring when the electricity is running.

  The possibility of electric shock, injury, or damage exists.

2-3. Safety Standards

This product is affixed CE marking and is safety checked under the test conditions below. Be sure to meet all these conditions when using a system conforming to the CE standard and containing this product.

Overvoltage Category:

- Because this product supports over voltage category 1, the driver's power source must use double insulation or a power unit with reinforced insulation with a commercial power supply. Also be sure that the fuses used between power units are slow blow type fuses that have been tested to UL safety standard. The fuses must have the following ratings

In the case of Si-02DE or Si-02LDE

Rated current 5A and more than rated voltage 32V

In the case of Si-05DE or Si-05LDE

Rated current 15A and more than rated voltage 32V

Degree of Contamination:

- Because this product environmental pollution degree 2, do not use it in environments with a high conductivity. The possibility of failure exists.

2-4. General Notes

Note the following general notes about this product to avoid malfunctions.

2-4-1. Notes about the Driver

- To avoid exceeding the maximum specified temperature, devise a cooling method, layout or size of the box incruding the control panel to keep the core temperature down.
- In environments with vibration, devise shock absorbers to avoid exceeded the maximum level of vibrations for the driver.
- Multiple drivers must be separated by at least 50mm horizontally and by 20mm vertically. If this cannot be done, the drivers must be, for example, cooled by fans.
- When re-closing the driver's power source, you must check that the driver's Power-Source LED has completely gone out before re-closing and turning off the power. If the power source is re-closed too any times in a short time, the encoder memory for data will be lost.

2-4-2. Notes about the Motor

- It is recommended to use hexagon screws to secure the motor attachments.
- All lead wires must be fixed. Do not use moveable objects.
- Some lead wires have sections that are vulnerable to damage from static electricity. (Static Electricity Cure Mark Portion). Take care that these sections do not come into contact with static electricity and that workers are aware of this. The possibility of failure or malfunction exists.

2-4-3. Notes about Wiring

- The type, size, and maximum length of electric wires must conform to the appropriate standards.
- Note the following noise counter-measures:
  1). Be sure to attach surge absorbers to coils and such things as relays, electromagnetic contacts, and solenoids.
  2) Separate power lines (such as AC lines and motor lines) from signal lines (and wires) by at least 30cm. Do not put them in the same duct.
  3) Whether or not the same power source is used for such things as electric welders or electrical discharge machines, if there is an RF noise source in the environment, attach a noise filter to the power source and input circuits.
  4) Because the driver is using a switching amplifier, there may be noise in the signal line.
- Because there are no measures against radio interference, a line filter must be put on the source line in environments with radio interference or private houses are a concern.
- Because the cable width for the signal line is 0.08 to 0.2 mm, the cable must not be under tension and wrapped around a wire.

3. General Specifications

3-1. Driver Specifications and Characteristics

Driver specifications and characteristics table

Model			Si-02LDE	Si-02DE	Si-05LDE	Si-05DE
Application Motor Model			TS3692N61S02	TS3641N61S02 TS3617N370S04 TS3617N371S04 TS3653N324S04 TS3653N325S04	TS3653N325S04	TS3653N327S04
Rated Output Current (A0-p)			0.35	2.0	2.0	5.0
Max. Output Current (A0-p)			1.05	6.0	6.0	13.0
Control Method			Transistor PWM (sine-wave driven)			
Allowable Load Inertia			20 times of motor inertia			
Feedback			Incremental encoder 200ppr (motor model tail S02) Incremental encoder 400ppr (motor model tail S04)			
Approx. Dimensions (mm)			39(W) X70(H) X55 (D) of 39		58.2(W) X76(H) X98 (D) of 58.2	
Approx. Mass (kg)			0.18		0.34	
Input Power Supply	Supply Voltage (V)	Main Circuit	DC24V+-10% or DC36V+-10%			
		Control Circuit	DC24V+-10%			
	Rated Input Current (A)		0.35	2.0	2.0	5.0
	Max. Input Current (A)		1.05	6.0	6.0	13.0
Position Reference Input Method			3 mode pulse train, serial communication by RS485, control input signals.			
Conditions	Ambient Temperature		0 ~ +50 (degrees centigrade)			
	Storage Temperature		-20 ~ +85 (degrees centigrade)			
	Ambient/Preservation Humidity		Below 90% RH (with no condensation)			
	Vibration Resistance		0.5 G			
	Shock Resistance		2 G			
Internal Functions	Dynamic Brake		None			
	Regenerative Processing		External regenerative processing circuit			
	Over Travel Stop		Hardware OT, software OT (select permitted/prohibited by parameter)			
	Reference Pulse Resolution		1/ 65,535 - 65,535			
	Internal Speed Setting		Point-table speed, JOG speed, zero-point-return speed			
	Display		LED (alarm indication)			

Continued on next page.

Model			Si-02LDE	Si-02DE	Si-05LDE	Si-05DE
Input / Output	Input	Control Input Signals	5 points (signal allocations can be modified by parameter)			
		Reference Pulse Train	CW/CCW, PULSE/SIGN, and A/B phase train Maximum frequency 750k pps			
	Output	Control Output Signals	3 points (signal allocations can be modified), brake release signal			
Protection			Main EEPROM Alarm Motor EEPROM Alarm Encoder Alarm System Alarm Position Error Pulse Overflow Phase-A Overcurrent Phase-B Overcurrent Temperature/Motor Cable Alarm Overload Shortage of Accel/Decel Serial Communication Alarm Main Circuit Overvoltage Main Circuit Undervoltage Control Circuit Overvoltage Control Circuit Undervoltage			
Zero-Point-Return Method			Zero-point limit-switch signal input or machine edge push reliance (7 Systems)			
Multi-Axis Connect Function			Maximum 15 axes multidrop connection by RS485			
Setting System			Setting parameter which uses personal-computer (RS485 converter is required)			
Standards, Environmental Conformity, Protection Class			UL conformity/CE (self-declaration) / lead -freelancer/IP40 (only motor)			

3-2. Motor Specifications and Characteristics

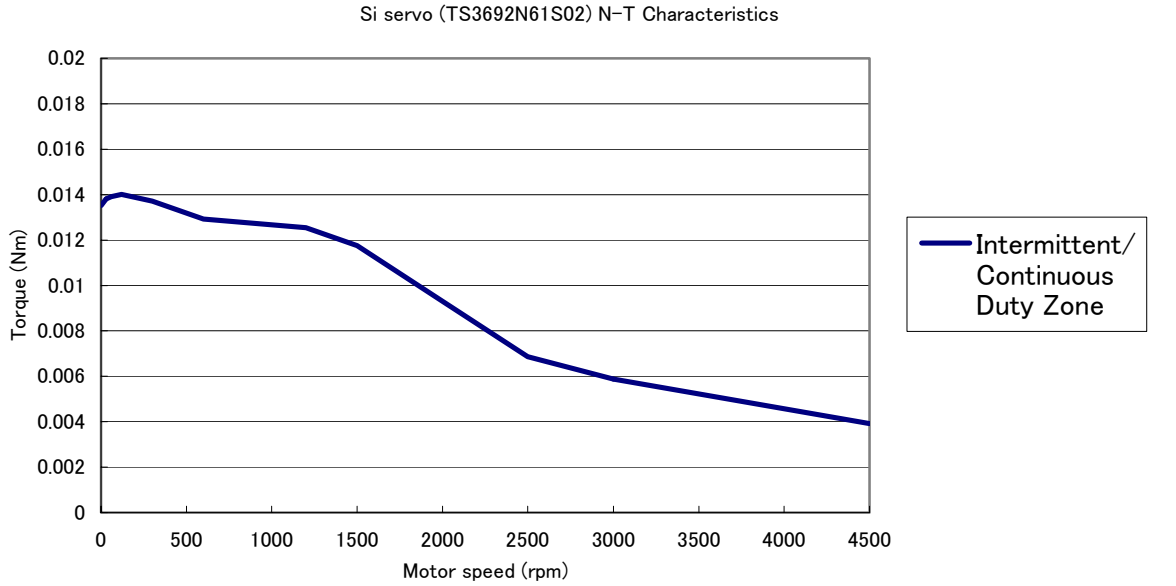
Motor specifications and characteristics table

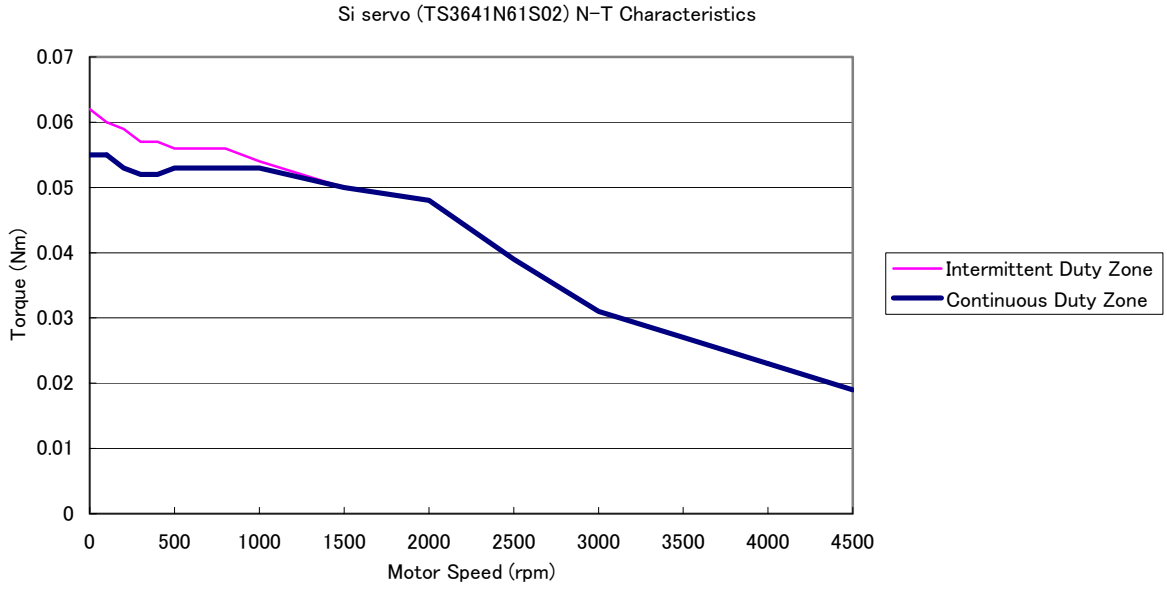
Model		TS3692 N61S02	TS3641 N61S02	TS3617 N370S04	TS3617 N371S04	TS3653 N324S04	TS3653 N325S04	TS3653 N327S04
Maximum Output Torque	N-m	0.017	0.062	0.24	0.44	0.87	1.8	2.3
The Maximum Speed	rpm	4500	4500	4500	3000	2000	800/ 2000 (see note below)	2000
Rated Current	A0-p	0.35	1.5	2.0	2.0	2.0	2.0	5.0
Rated Voltage	V	3.0	1.0	2.2	2.8	2.1	4.5	2.2
Winding Resistor	Ohm	8.5+-15%	0.7+-15%	1.1+-15%	1.4+-15%	1.05+-15%	1.7+-15%	0.44+-15%
Winding Inductance	mH	3.4+-20%	0.55+-20%	1.4+-20%	2.4+-20%	1.5+-20%	5.8+-20%	1.4+-20%
Rotor Inertia	10^{-7}kg-m^2	1.9	8	35	68	260	430	520
Axial Deflection	mm T.I.R	0.05						
Radial Play	mm MAX	0.03	0.02					
Thrust Play	mm MAX	0.075						
Max. Overhang Load	N	17.6	21.6	20.6		52.9		
Max. Thrust Load	N	2.9	4.9	9.8		19.6		
Winding System	-	2 Phase Hybrid Stepping Motor Bipolar Winding Wire						
Insulated Class	-	CLASS B						
Insulation Resistance	M Ohm min	100(at DC500V)						
Dielectic Strength	V	500(at AC 1MIN)						
Operating Temperature Range	Degree	-20---+50						
Operating Relative Humidity Range	%RH	5---95						
Storage Temperature Range	Degree	-40---+70						
Mass	kg	0.08	0.14	0.27	0.40	0.72	1.08	1.38

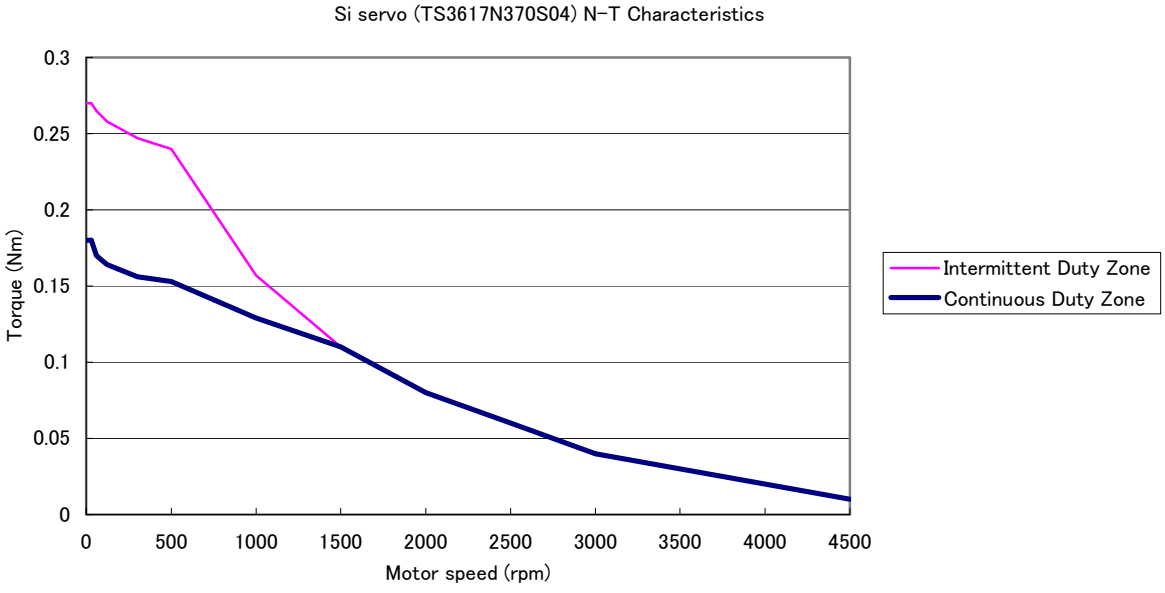
Note: If the Si-05LDE driver is used, this is set at 2,000 rpm.

If the Si-02DE driver is used, this is set to 800rpm.

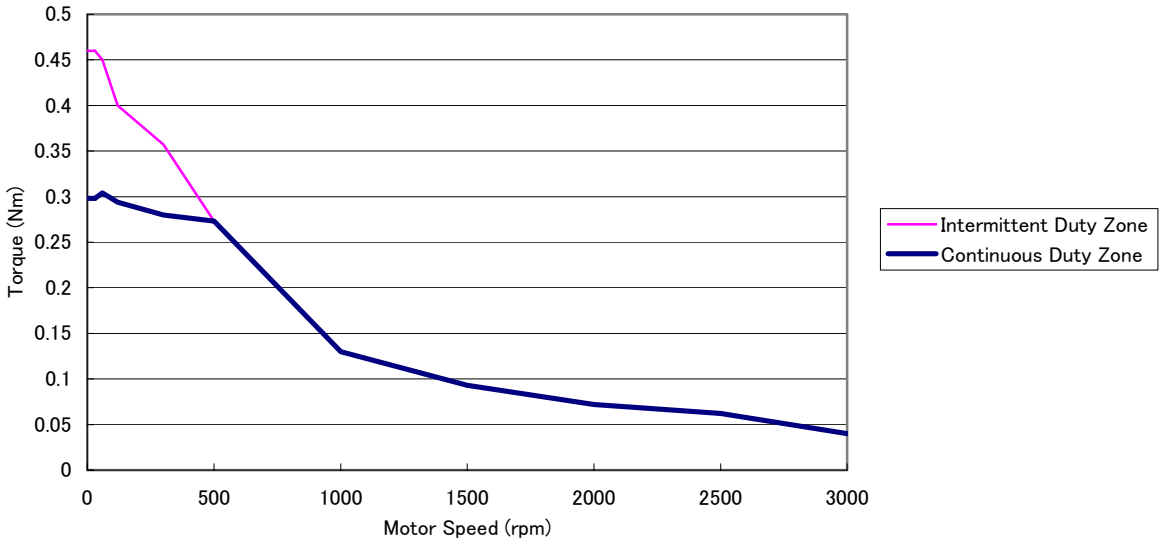
3-3. N-T Characteristics



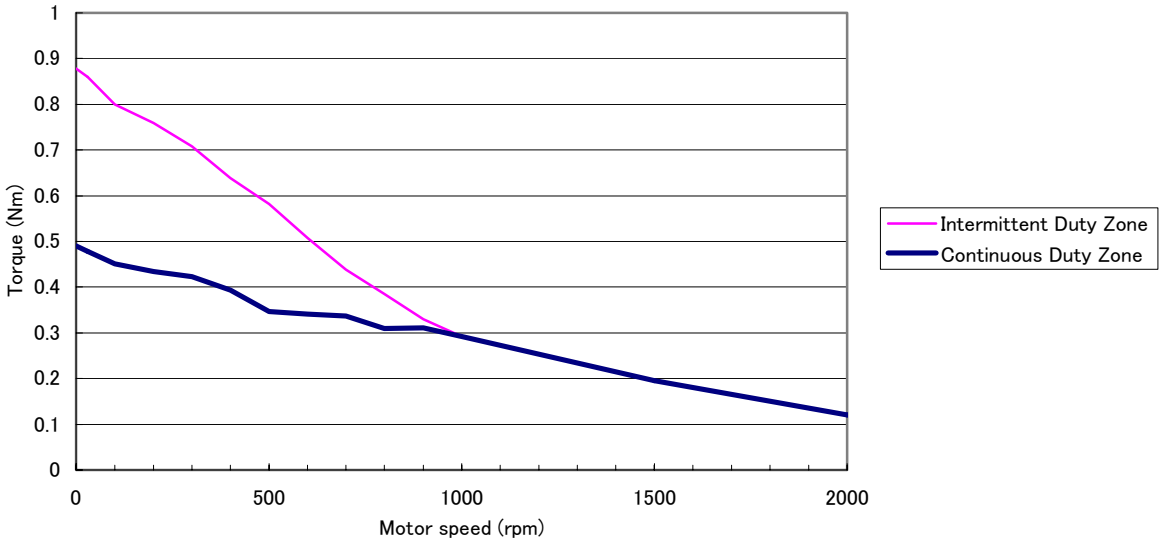




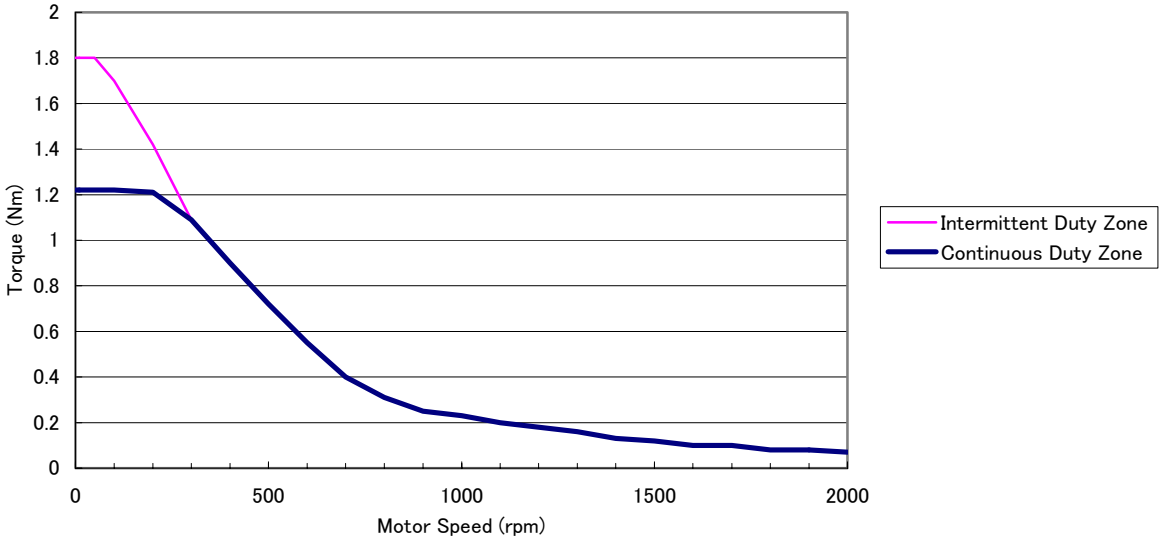
Si servo (TS3617N371S04) N-T Characteristics

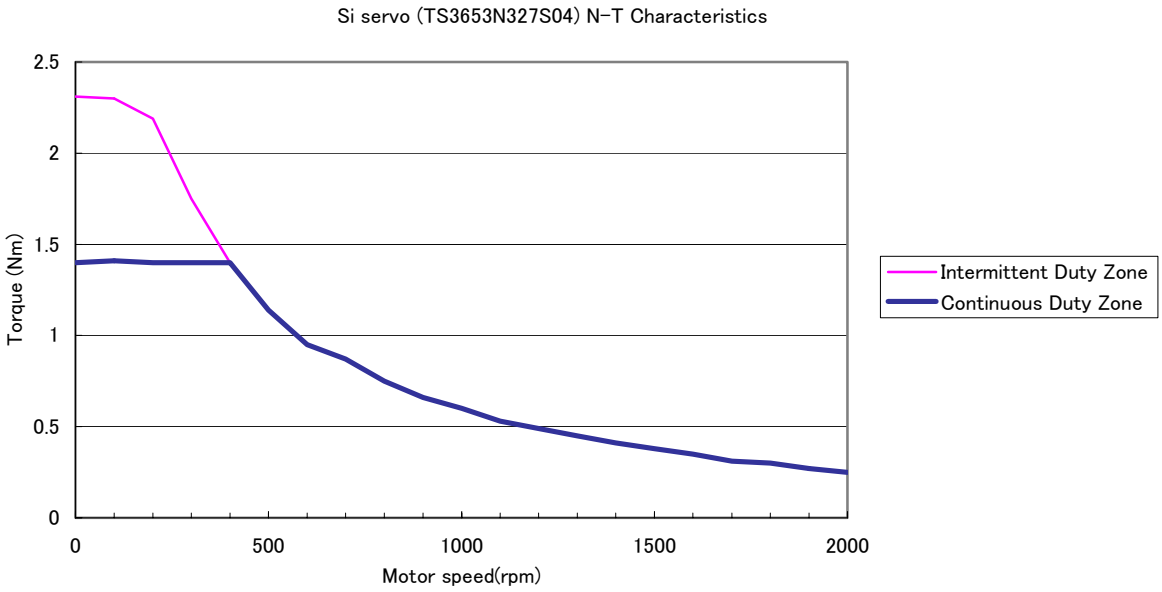


Si servo (TS3653N324S04) N-T Characteristics

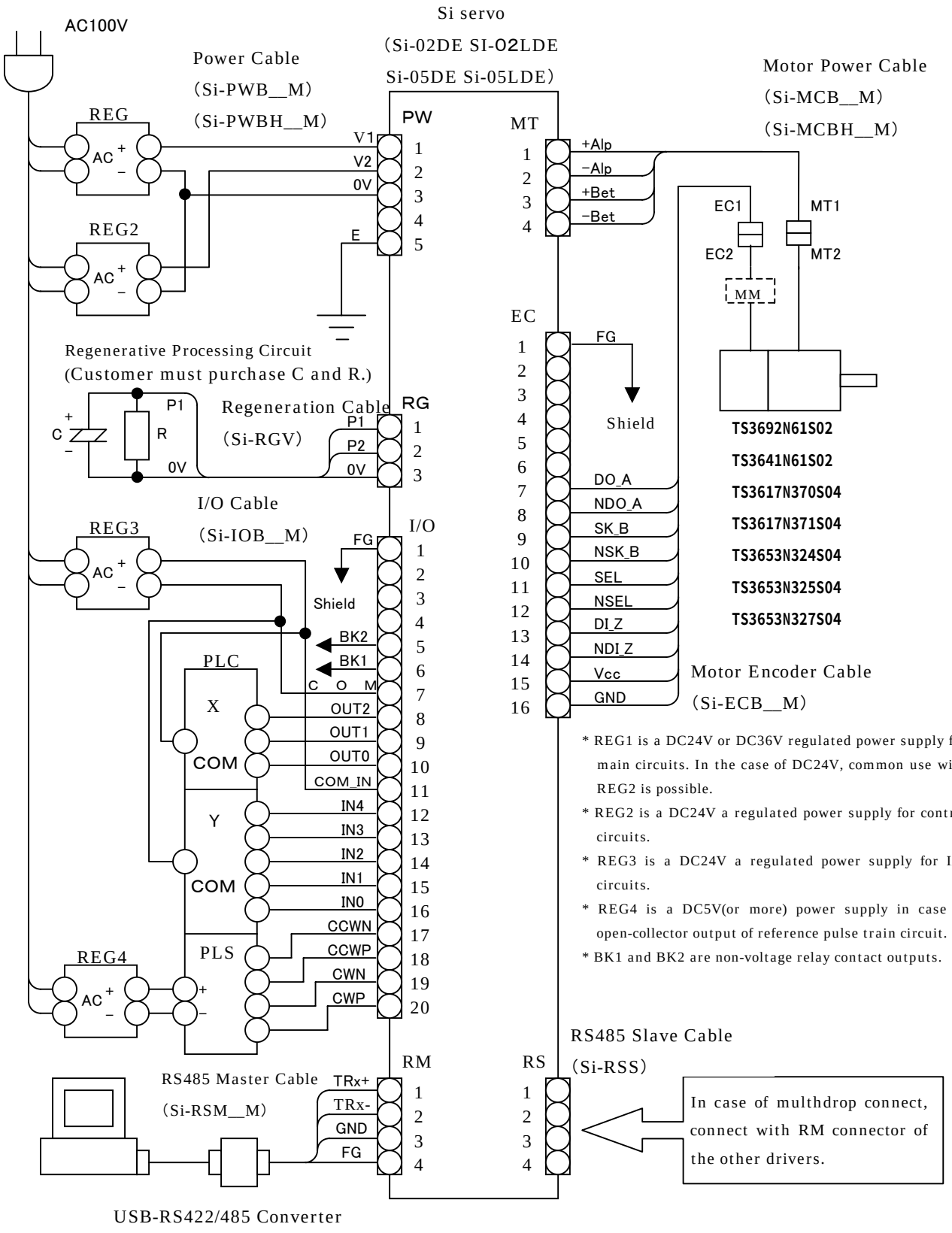


Si servo (TS3653N325S04) N-T Characteristics




Si servo (TS3653N327S04) N-T Characteristics
Torque (Nm)
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
Motor speed(rpm)
Intermittent Duty Zone
Continuous Duty Zone

4. Wiring Diagram



* REG1 is a DC24V or DC36V regulated power supply for main circuits. In the case of DC24V, common use with REG2 is possible.

* REG2 is a DC24V a regulated power supply for control circuits.

* REG3 is a DC24V a regulated power supply for I/O circuits.

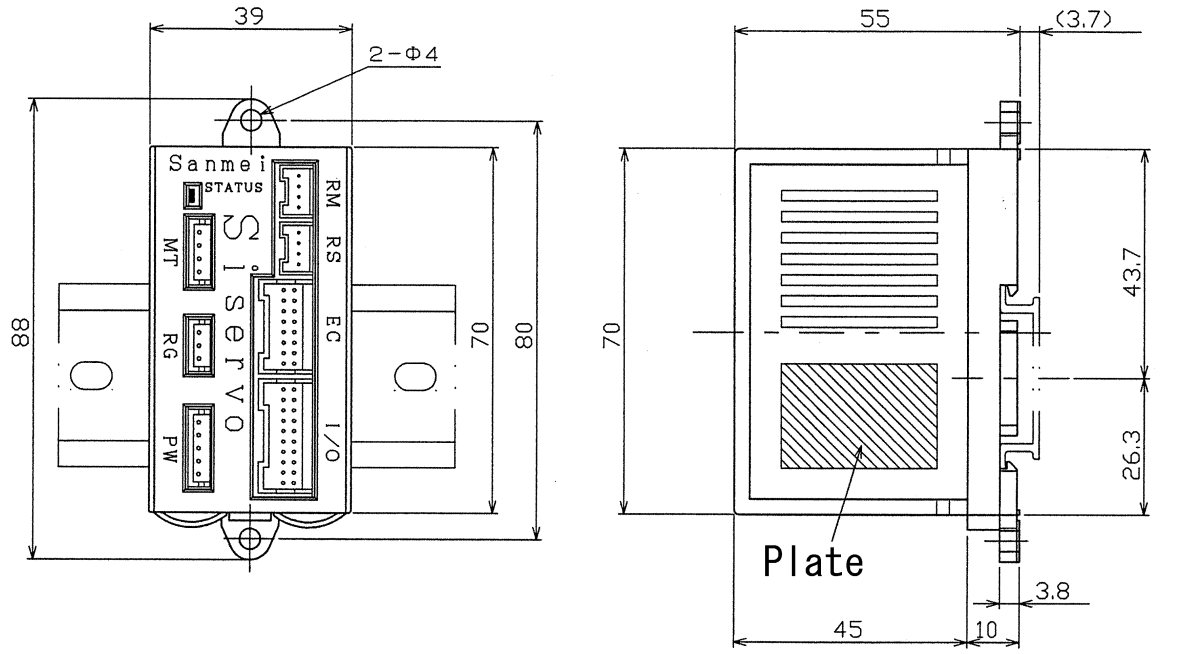
* REG4 is a DC5V(or more) power supply in case of open-collector output of reference pulse train circuit.

* BK1 and BK2 are non-voltage relay contact outputs.

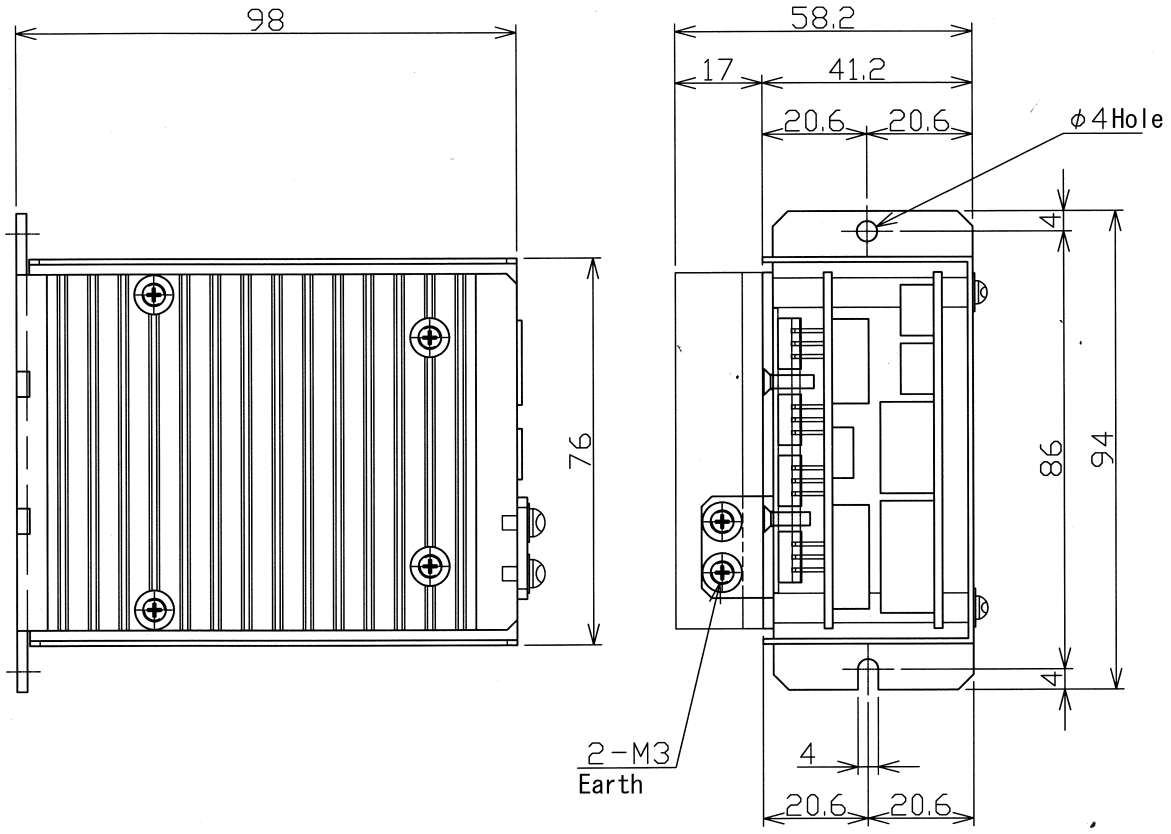
5. Dimensional Drawing

5-1. Driver Parts

Si-02DE and Si-02LDE

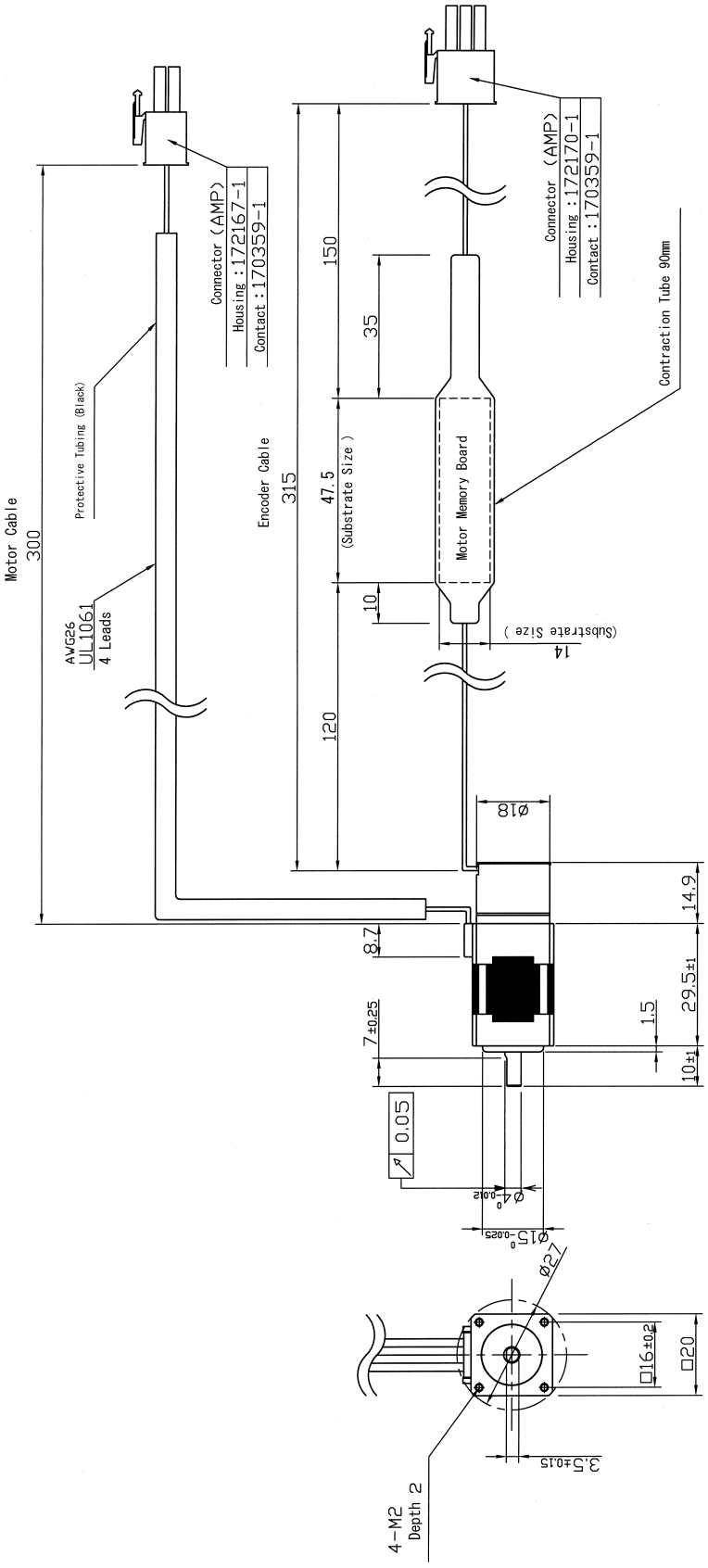


Si-05DE and Si-05LDE

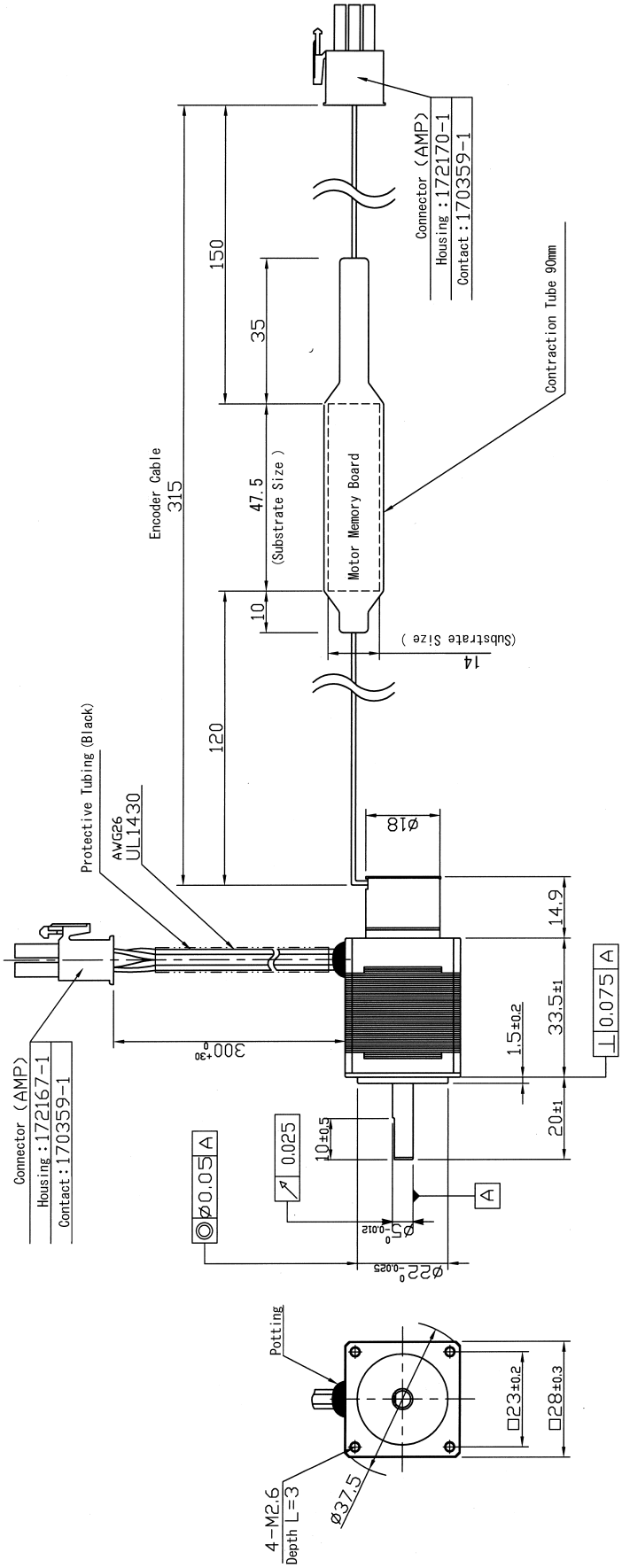


5-2. Motor Parts

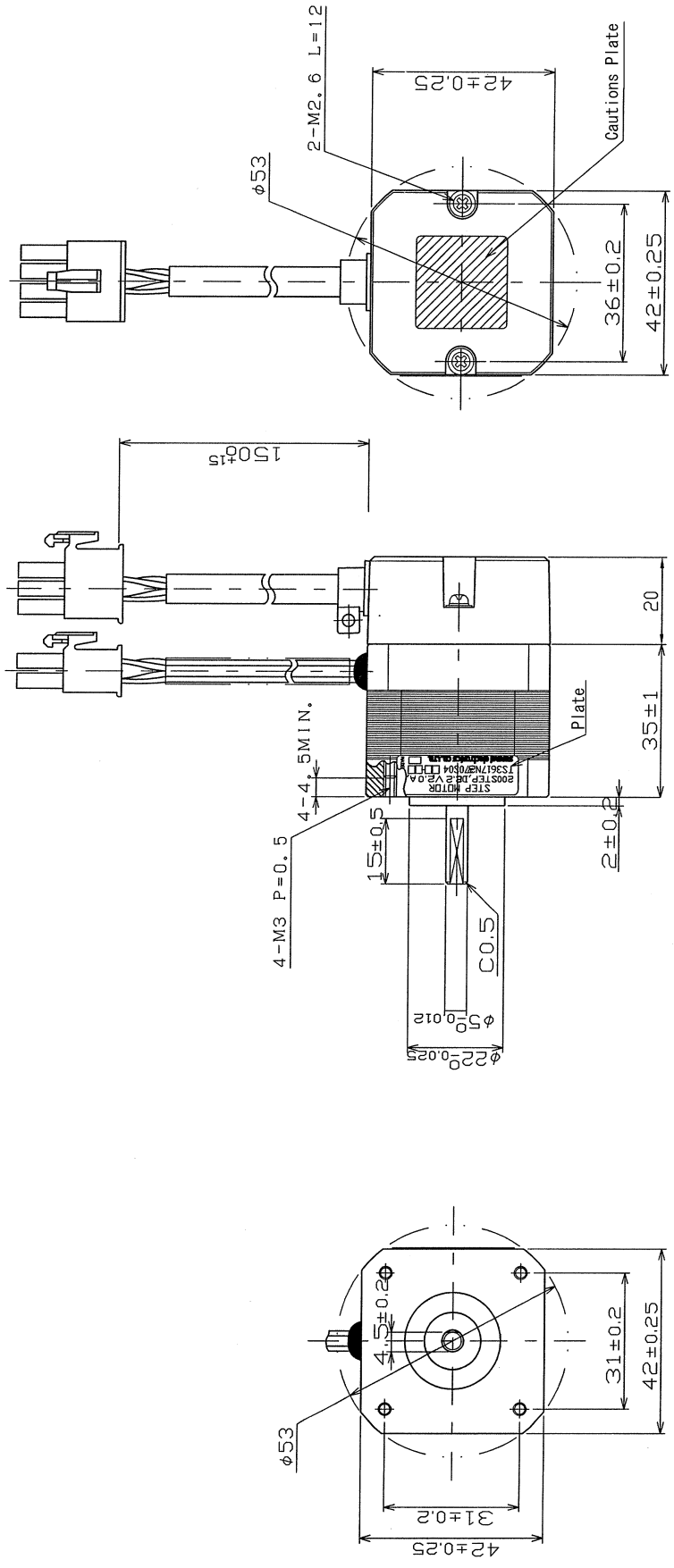
-TS3692N61S02



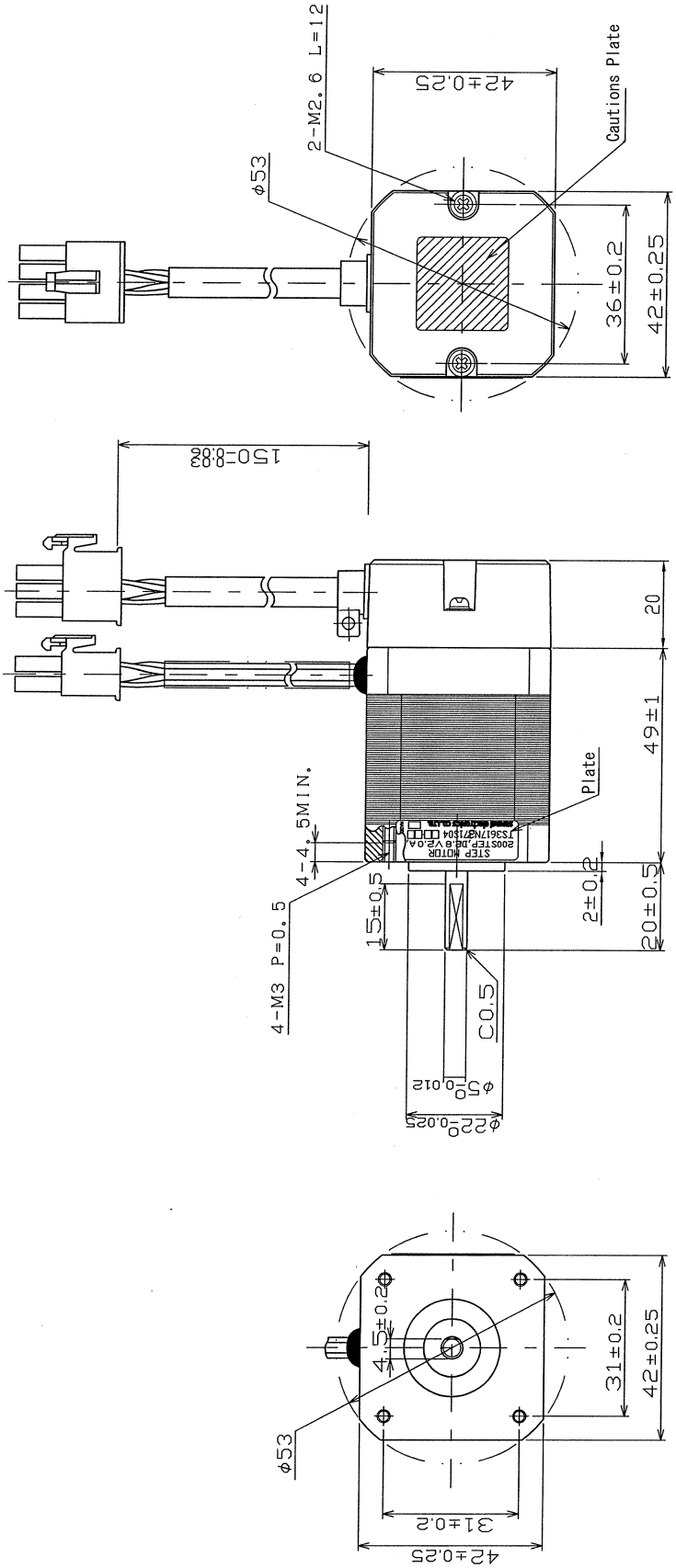
-TS3641N61S02



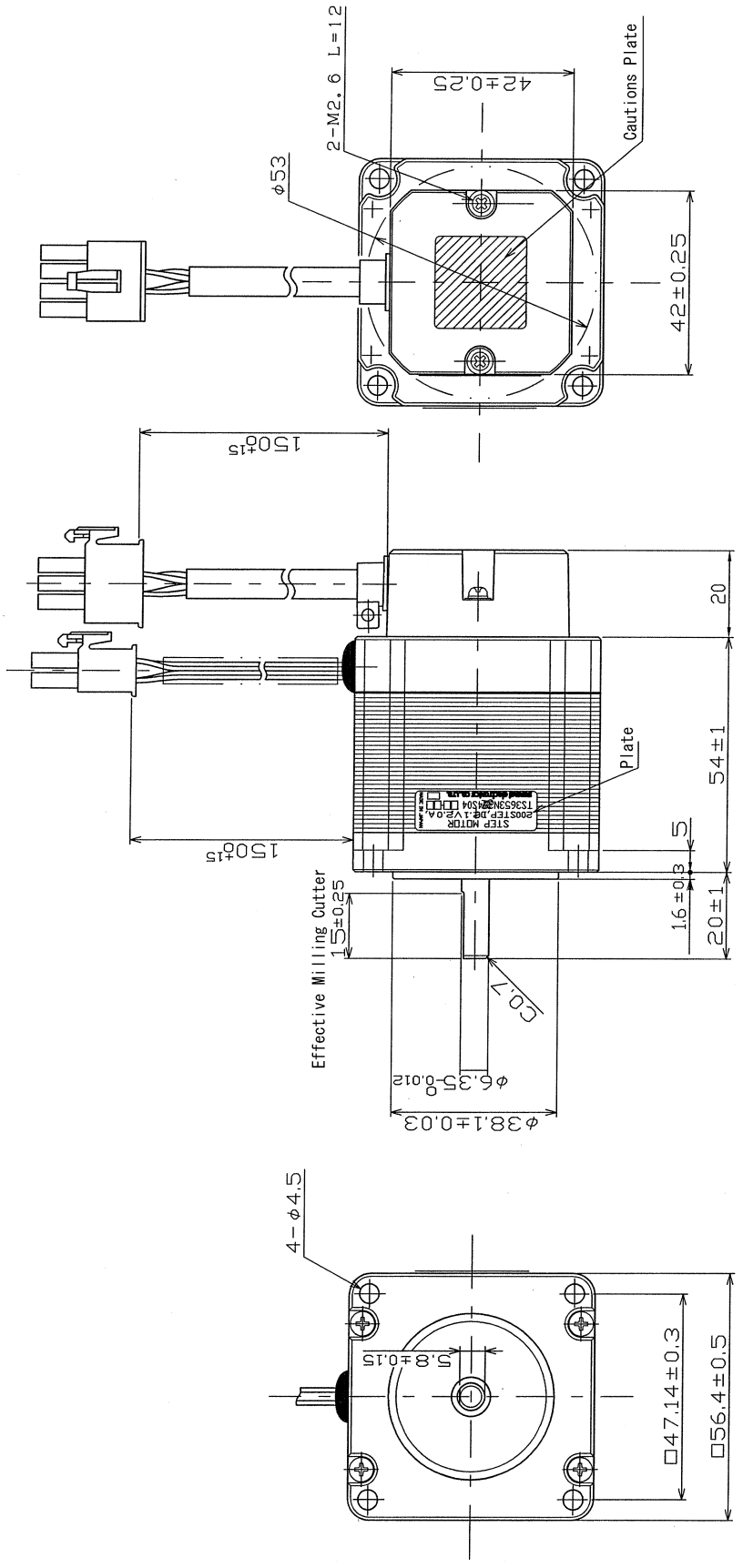
-TS3617N370S04



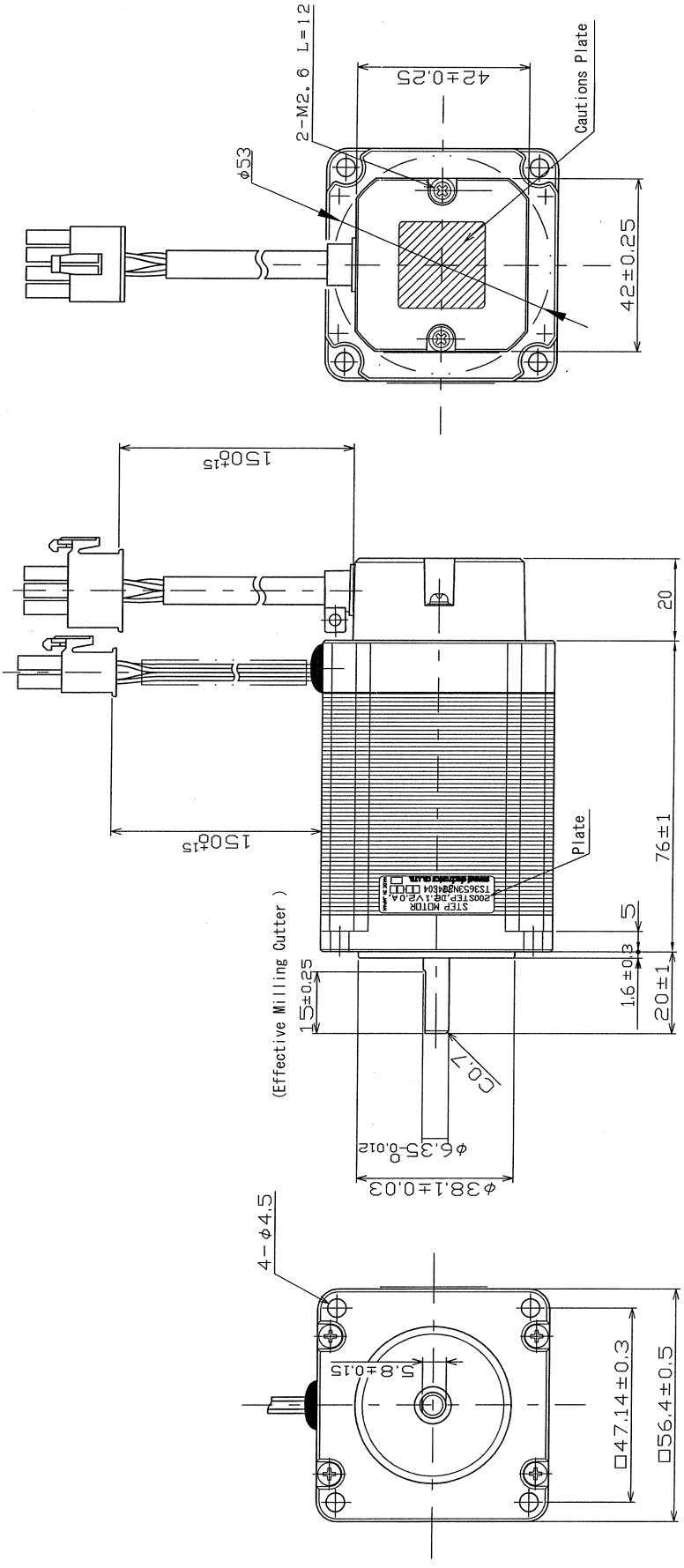
-TS3617N371S04



-TS3653N324S04



-TS3653N325S04



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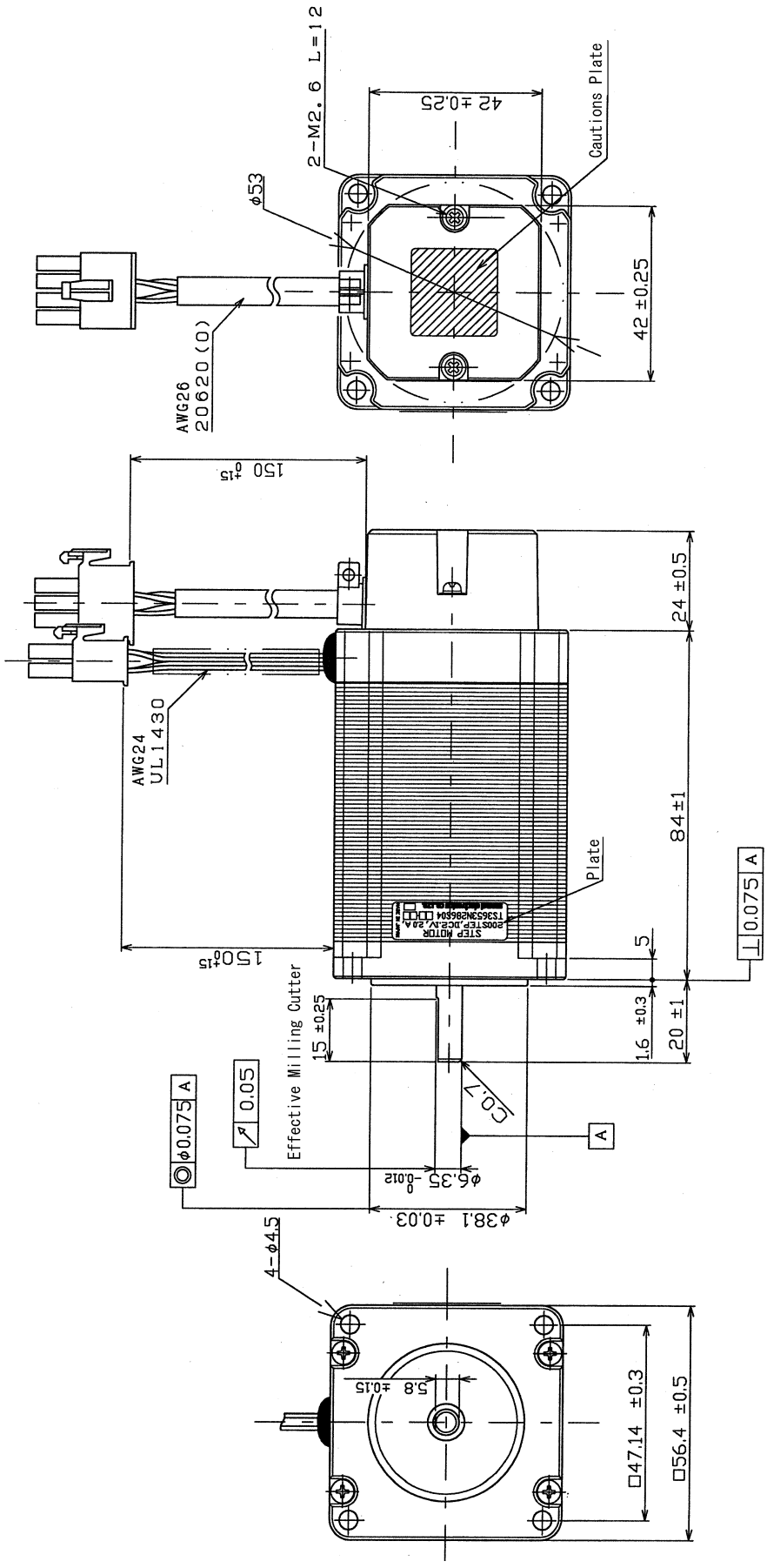


6. Connector Configuration

6-1. PW Power Supply Input Connector Terminal Layout

Supplying main and control circuits power to driver.

PW Power supply input Connector

Pin No	Signal Name	Function
1	V1	Main circuit power supply input terminal DC24V+-10% or DC36V+-10%
2	V2	Control circuit power supply input terminal DC24V+-10%
3	0V	Common terminal of V1 and V2 (0V).
4	NC	With no internal connection
5	E	Earth terminal

1) Applicable terminal model for cables

Item	Si-02LDE,Si-02DE	Si-05LDE,Si-05DE
Housing	EHR-5(JST)	XW4B-05B1-H1(OMRON)
Contact	SEH-001T-P0.6L(JST)	-
Applicable wire sizes	AWG22	AWG20

6-2. MT Motor Power Connector Terminal Layout

Supplying power to motor.

MT Motor power connector

Pin No	Signal Name	Function
1	+Alpha	Phase-A (+) terminal
2	-Alpha	Phase-A (-) terminal
3	+Beta	Phase-B (+) terminal
4	-Beta	Phase-B (-) terminal

1) Applicable terminal model for cables (the driver side)

Item	Si-02LDE,Si-02DE	Si-05LDE,Si-05DE
Housing	EHR-4(JST)	XW4B-04B1-H1(OMRON)
Contact	SEH-001T-P0.6L(JST)	-
Applicable wire sizes	AWG22	AWG20

2) Applicable terminal model for cables (the motor side)

Item	Si-02LDE,Si-02DE	Si-05LDE,Si-05DE
Housing	172159-1(AMP)	
Contact	170361-1(AMP)	170362-1(AMP)
Applicable wire sizes	AWG22	AWG20

3) Maximum wire length:

10m

6-3. EC Motor Encoder Connector Terminal Layout

The encoder reads motor characteristics data from the non-volatile memory next to the motor when Si servo starts up. After the data is read, the encoder inputs the feed-back-pulse.

EC Motor encoder connector (the driver side)

Pin Number	Signal Name	Function
1	FG	Frame ground
2	NC	Not connected
3	NC	
4	NC	
5	NC	
6	NC	
7	DO_A	Encoder phase-A input/data output
8	NDO_A	Encoder phase-A input/data output reversal
9	SK_B	Encoder phase-B input/clock output
10	NSK_B	Encoder phase-B input/clock output reversal
11	SEL	Encoder/EEPROM access select
12	NSEL	Encoder/EEPROM access select reversal
13	DI_Z	Encoder phase-Z input/data input
14	NDI_Z	Encoder phase-Z input/ data input reversal
15	VCC	+5 V power supply
16	GND	Signal ground

EC1 Motor encoder connector (the motor side)

Pin Number	Signal Name	Function
1	FG	Frame ground
2	NC	Not connected
3	DO_A	Encoder phase-A input/data output
4	NDO_A	Encoder phase-A input/data output reversal
5	SK_B	Encoder phase-B input/clock output
6	NSK_B	Encoder phase-B input/clock output reversal
7	SEL	Encoder/EEPROM access select
8	NSEL	Encoder/EEPROM access select reversal
9	DI_Z	Encoder phase-Z input/data input
10	NDI_Z	Encoder phase-Z input/data input reversal
11	VCC	+5 V power supply
12	GND	Signal ground

1) Applicable terminal model for cables (the driver side):

Housing: PADP-16V-1-S (JST)

Contact: SPH-001 T-P 0.5L (JST)

2) Applicable terminal model for cables (the motor side):

Housing: 172162-1 (AMP)

Contact: 170361-1 (AMP)

3) Applicable wire sizes:

AWG24 twist shield electric wire

4) Maximum wire length:

10m

6-4. I/O External I/O Connector Terminal Layout

Connector for control signal input/output and reference pulse train input.

I/O External I/O connector

	No.	Signal Name		Function
	1	FG	Frame Ground	Connect shield wire.
	2	NC	-	Not connected
	3	NC		
	4	NC		
Control Output	5	BK2	Brake Power Supply 2	Non-voltage contact output (voltage 24V and up to 1A current).
	6	BK1	Brake Power Supply 1	Connect brake power supply. When motor is executed, being shorted BK1 and BK2.
	7	COM_OUT	Output Common	Common terminal of control output signal. Connect 0V.
	8	OUT2	Control Output 2	Control output signal terminals. Signal allocations can be modified by parameter 63 "Extended Output Setup 1" (Refer to 7-2. Control Output Signals.)
	9	OUT1	Control Output 1	
	10	OUT0	Control Output 0	
Control Input	11	COM_IN	Input Common	Common terminal of control input signal. Connect DC24V.
	12	IN4	Control Input 4	Control signal input terminals. Signal allocations can be modified by parameter 60 "Extended Input Setup 1" and parameter61 "Extended Input Setup 2" (Refer to 7-1. Control Input Signals.)
	13	IN3	Control Input 3	
	14	IN2	Control Input 2	
	15	IN1	Control Input 1	
	16	IN0	Control Input 0	
Reference Pulse Train Input	17	CCWN	CCW Pulse (-)	Input CCW/SIGN/phase-B pulse of a position reference pulse train (set with parameter). Input pulse of 5V into the P side to the N side.
	18	CCWP	CCW Pulse (+)	
	19	CWN	CW Pulse (-)	Input CW/PULSE/phase-A pulse of a position reference pulse train (set with parameter). Input pulse of 5V into the P side to the N side.
	20	CWP	CW Pulse(+)	

1) Applicable terminal model for cables

Housing: PADP-20V-1-S (JST)

Contact: SPH-001 T-P 0.5L (JST)

2) Applicable wire sizes:

AWG24 twist shield electric wire

3) Maximum wire length:

10m

(This is 3m for the open collector output of reference pulse)

6-5. RM/RS RS485 Connector-Terminal Layout

RM RS485 master connector

Pin Number	Signal Name	Function
1	TRx+	Positive transmitted and received data
2	TRx-	Negative transmitted and received data
3	GND	Signal ground
4	FG	Frame ground

Connect communication cable shield wire to the fourth pin [FG:Frame Ground].

RS RS485 slave connector

Pin Number	Signal Name	Function
1	TRx+	Positive transmitted and received data
2	TRx-	Negative transmitted and received data
3	GND	Signal ground
4	FG	Frame ground

Connect communication cable shield wire to the fourth pin [FG:Frame Ground].

1) Applicable terminal model for cables:

Housing: PAP-04 V-S (JST)

Contact: BPHD-001 T-P0.5L (JST)

2) Applicable wire sizes:

AWG24 twist shield electric wire

3) Maximum wire length:

The sum total length from the host controller to a terminating device in case of multidrop connect:

20m

6-6. RG External Regenerative Processing Circuit Connector Terminal Layout

RG External regenerative processing circuit connector

Pin Number	Signal Name	Function
1	P1	Main circuit output terminal
2	P2	Control circuit output terminal
3	0V	Common terminal of P1 and P2 (0V).

1) Applicable terminal model for cables:

Housing: EHR-3 (JST)

Contact: SEH-001 T-P 0.6L (JST)

2) Applicable wire sizes:

AWG22 twist shield electric wire

7. Control Input/Output Signal

7-1. Control Input Signal

The signals in the following table are available as control input signals. Signal allocations can be modified to five points of IN0, and 1, 2, 3, and 4.

Control input selection table

Code	Signal	Name	Function
01	SVON	Servo-ON	Turns ON the motor when this signal is ON. Turns OFF the motor when OFF.
02	PJOG	Forward JOG	Runs forward at the speed of parameter 21 "JOG Speed" when this signal is ON. Decelerates to a stop at the falling edge of this signal.
03	NJOG	Reverse JOG	Runs reverse at the speed of parameter 21 "JOG Speed" when this signal is ON. Decelerates to a stop at the falling edge of this signal.
04	ARST	Alarm Reset	At the rising edge of this signal, resets resettable alarms that occur at that time.
05	STR	Start	Executes specfied point-table at the rising edge of this signal. Decelerates at the falling edge, and the point-table execution is discontinued after the motor stops.
06	ZSTR	Zero Start	Executes the zero-point-return sequence at the riding edge of this signal. Decelerates to a stop at the falling edge.
07	DEC	Zero Slowdown LS	Connect with zero point slowdown limit switch (LS) in zero-point-return sequence.
08	HOLD	Hold	Suspends the point-table run started by STR at the rising edge of this signal. At the falling edge, restarts from the state where remaining move pulse count was held.
09	P0_IN	Point Number Input	Specifies that the point-table number is executed.
0A	P1_IN		
0B	P2_IN		
30	P3_IN		
31	P4_IN		
32	P5_IN		
33	P6_IN		
34	P7_IN		
0C	TDIN	Teaching	At the rising edge of this signal, memorizes current position to position the point-table data specified at that time.

Code	Signal	Name	Function
12	POT	Forward Overtravel	While this signal is ON, prohibits forward run of motor. Connect the (+) side limit signal. Point-table run start instructions are disregarded when this signal is ON.
13	NOT	Reverse Overtravel	While this signal is ON, prohibits reverse run of motor. Connect the (-) side limit signal. Point-table run start instructions are disregarded when this signal is ON.
18	SBK	Single Block	Executes the next point-table at the rising edge of this signal.
1C	EXIN	Input Branch	When the input of a rising edge of this signal has been generated during a point-table run, diverges to a point different from the point-table data "normal branching destination".
20	EMCE	Emergency Stop (Control Damping)	Emergency stops. Control damping: emergency stops by servo control.
21	EMCF	Emergency Stop (Servo-free)	Emergency stops. Servo-free: emergency stops by turning off the motor.
23	EXIN2	Input Branch 2	When the input of a rising edge of this signal has been generated during a point-table run, diverges to a point different from the point-table data "normal branching destination".
24	EXIN3	Input Branch 3	When the input of a rising edge of this signal has been generated during a point-table run, diverges to a point different from the point-table data "normal branching destination".
25	STRP	Start (One Shot Input)	Executes the specified point-table at the rising edge of this signal. The STP signal is input to discontinue driving.
26	ZSTRP	Zero Start (One Shot Input)	Executes the zero-point-return sequence at the riding edge of this signal. The STP signal is input to discontinue driving.
27	ERST	Positional Error Clear	Clears positional error at the rising edge of this signal.
28	MFIN	M Completion	Turns OFF the M-code output signals at the rising edge of this signal.
29	SENS	Sensor Positioning	When sensor positioning is running, decelerates motor at the rising edge of this signal.
2A	STP	Stop (One Shot Input)	Operation by STRP and ZSTRP signal is discontinued.
38	RSEL	Resolution Select	Selects resolution a motor rotation (the number of position reference pulse corresponding to a motor rotation).

Code	Signal	Name	Function
39	TSEL0	Torque Select	Selects torque limitation value. The torque limitation value of the signal of turning on is applied among five signals. When two signals or more are turning on at the same time, the torque limitation value of the signal turned on at the end is applied.
3A	TSEL1		
3B	TSEL2		
3C	TSEL3		
3D	TSEL4		
2E	VDIR	Rotation Direction	Selects direction of rotation in speed control mode. Forward direction is selected in OFF and reverse direction is selected by ON.
Other	-	With No Setup	No signal is allocated.

7-1-1. Allocating Control Input Signals

To allocate control input signal, select the functional code from the avobe table and specify it for the input terminal of parameter 60 "Extended Input Setup 1 (bit)" and parameter 61 "Extended Input Setup 2 (bit)".

Extended input setting table

Parameter 60	IN3	IN2	IN1	IN0
Parameter 61	-	-	-	IN4

Parameter 60 and 61 assume the HEX data in 32 bits, delimits to 8 bits, and sets the code of each input signal function. When the function is set, the specified pertinent terminal is allocated in the set function.

If input of either terminal is turned on, the function is turned on when the same function is allocated to more than one terminal.

Set "00" in "-" for parameter 61.

Example: The following example allocates SVON (code:01) for IN0, PJOG (code:02) for IN1, no setup (code:00) for IN2, STP (code:2A) for IN3, and STR (code:05) for IN4:

Parameter 60	2A000201h
Parameter 61	00000005h

7-1-2. Presetting Control Input Signal Functions

The following table shows the value to set the parameter 1 "Control Input Preset Setup", automatically to allocate the control input signal terminal function. This sets the input function of the customer who shifts from model "Si-02D".

Control input signal functional presetting

Control input	Parameter 1 "Control Input Preset Setup"		
	"0" (mode 0)	"1" (mode 1)	"2" (mode 2)
IN0	Resolution Select	Forward JOG	Point Number Input 0
IN1	Torque Select 0	Reverse JOG	Start
IN2	Torque Select 1	Forward Overtravel	Forward Overtravel
IN3	Torque Select 2	Reverse Overtravel	Reverse Overtravel
IN4	Positional error Clear	Zero slowdown LS	Alarm Reset

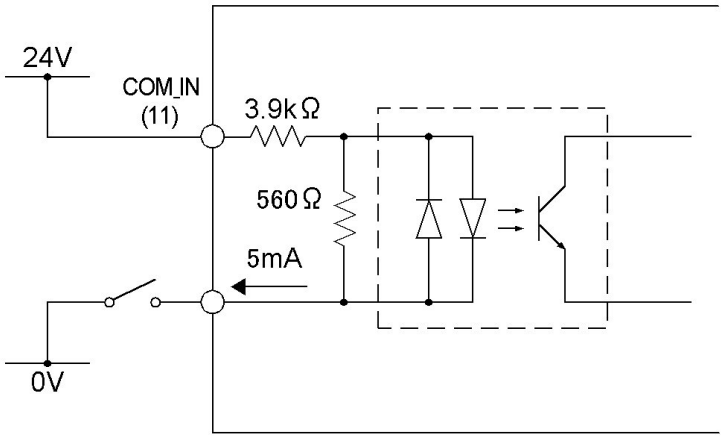
If parameter 1 is changed, the value of the parameter 60 "Extended Input Setup 1" and parameter 61 "Extended Input Setup 2" will be replaced with the values in the above table.

Although parameters 60 and 61 can be changed and the function of each control input terminal can be changed, the relationship between a parameter 1 and parameters 60 and 61 might not correspond to the values in the above table in that case.

7-1-3. Connection

An input circuit power supply should be prepared separately DC24V+-10%.

The consumed electric current is about 5mA/circuit.



7-2. Control Output Signal

The following table lists the signals available as control output signals. The signal allocations can be modified to three points of OUT0, and 1, and 2.

Control output selection table

Code	Signal	Name	Function
01	RDY	Servo Ready	Turns ON when the motor turns ON. It can be used as a signal for brake release.
02	INP	In Position	Turns ON when the number of positional error pulses are within the value of parameter 18 "In-Position Area".
03	ALM	Alarm	Turns ON if abnormalities occur in the driver.
11	PRG	Under Program Execution	Turns ON while executing the point-table operation.
12	FIN	Completion	Turns ON when positioning is completed.
1A	VCMP	Speed Coincidence	In speed control mode, turns ON when absolute value of motor speed error is the same or lower than the parameter 55 "VCMP Output Range" or less.
1B	VZR	Zero Speed	In speed control mode, turns ON when motor speed is the same or lower than the parameter 19 "TFIN/VZR Output Range" or less.
1C	TFIN	Torque Completion	Turns ON when torque completion (refer to 9-2. Pressing Operation).
1D	FIN+TFIN	Completion + Torque Completion	Turns ON in the positioning completion or the torque is completed.
30	M0	M Output	7 kinds of M codes are output by two kinds of methods.
31	M1		
32	M2		
38	TLMT	Torque Limit	Turns ON when the limitation of torque occurs.
39	SLMT	Speed Limit	Turns ON when the limitation of speed occurs.
3A	POTOUT	Forward Overtravel Output	Turns ON while the instruction of the movement in forward direction is disregarded.
3B	NOTOUT	Reverse Overtravel Output	Turns ON while the instruction of the movement in reverse direction is disregarded.
3C	ZFIN	Zero-Point-Return completion	Turns ON when zero-point-return is completed.
3D	ZERO	Zero Position Output	Turns ON when is at zero-point.
04	P0_OUT	Current Point Output	The number of the point-table being executing now or stopping is output.
05	P1_OUT		
06	P2_OUT		
20	P3_OUT		
21	P4_OUT		
22	P5_OUT		
23	P6_OUT		
24	P7_OUT		

Continued on the next page.

Code	Signal	Name	Function
14	P0_FIN	The Completion Output of a Point	The number of the point table that does the movement completion is output.
15	P1_FIN		
16	P2_FIN		
28	P3_FIN		
29	P4_FIN		
2A	P5_FIN		
2B	P6_FIN		
2C	P7_FIN		
3E	ZPLS	Z phase signal output	Phase-Z signal of the motor encoder is output.
Other	-	With no setup	No signal is allocated.

7-2-1. Method of Allocating Control Output Signals

To allocate a control output signal, specify a function code from the above table as the value for the output terminal of parameter 63 "Extended Output Setup 1 (bit)".

Extended output setting table

Parameter 63	-	OUT2	OUT1	OUT0

Parameter 63 assumes HEX data in 32 bits, delimits to 8 bits, and sets the code of each output signal function. When the function is set, the specified terminal is allocated in the set function.
Set "00" in "-" of parameter 63.

Exaple: The following example allocates ZFIN (code: 3C) for OUT0, no setup (code: 00) for OUT1, and TLMT (code:38) for OUT2.

Parameter 63	0038003Ch

7-2-2. Connection

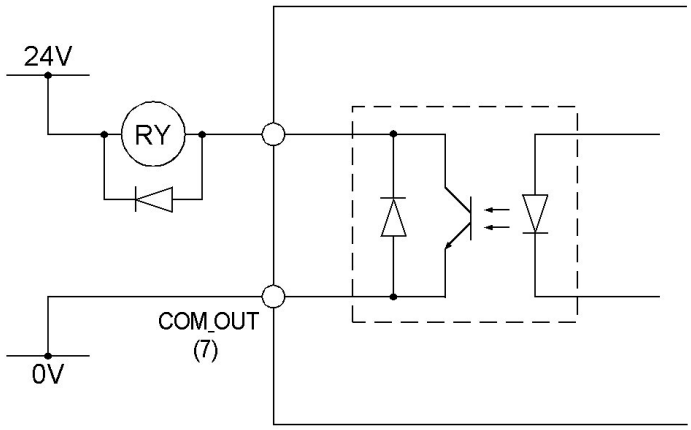
1) Outputs of OUT0, OUT1 and OUT2.

The power supply for the output circuit should be prepared separately. Although it is also possible to be share a power source with the input circuit, to do so the power supply capacity must be added to the capacity for the output to the capacity for the input.

It is necessary to put the serge absorption elements, such as diodes, in the inductive load to prevent malfunction.

The impressed voltage and the power supply capacity a control output terminal are as follows:

- Impressed voltage <= 30V
- Turning-on-electricity current <= 50mA



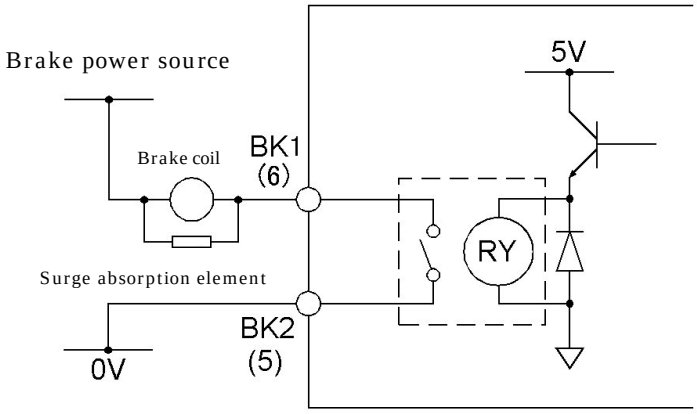
2) Outputs of BK1 and BK2

A non-voltage contact output (1a) is available for a brake release signal. Since it is automatically adjusted to the motor excitation timing and output, it can be used to operate the brake release. The point of contact between B1 and B2 is short-circuited if motor is excited. The impressed voltage and the power supply capacity output terminal are as follows.

If timing with the motor excitation operation is inapposite when this relay point of contact output is not used and the brake is opened by the sequence of the customer, an "Encoder Alarm" may occur when the driver is started-up. Also, when the motor is running, an alarm such as "Position Error Pulse Overflow" may occur. For this reason, it is recommended that the brake release that uses this relay point of contact is used.

A serge absorption element such as varistors that correspond to the specification of the brake coil must be inserted in the brake coil. If this is not inserted, the relay point of contact may break down.

- Impressed voltage: less than AC125V or DC60V.
- Turning-on-electricity current: below 1A.



8. Operation

8-1. Timing of Main Circuit Supply

⚠ Caution

You must apply the control circuit (V2) and the main circuit(V1) at the same time or apply control circuit at first. If a main circuit is supplied before the control circuit, a possibility to damage the driver exists.

Supply of a control circuit will output ON to control output terminal OUT1 (disregarding the setting for parameter 63 "Extended Output Setup 1") as the control start signal. This signal can be used for the timing adjustment when turning on the main circuit. When the main circuit is switched on, the control start signal turns off, and the preparation for accepting the servo-on instruction was complete is displayed.

8-2. Initializing Operation at the First Servo-On after the Driver Starts up

At the first servo-on after the driver starts up, the positioning is executed at the nearest motor mechanical-oriented reference point of magnetization (7.2 degrees of every motor rotation angles) for initialization of internal control software. Depending on the positioning of the reference point, the axis of the motor rotates by ±3.6 degrees at maximum from the location of the motor before servo-on. A brake release signal is output 500 ms after the motor excitation start, the excitation at the motor reference point continues for the time set as the parameter 53 "Startup Hold Time". After that, a signal of the positioning completion (FIN) signal or the in position (INP) signal is output.

⚠ Caution

One of the following situations leads to an unexpected operation, such as vibration, rotation in the opposite direction by the instruction, reckless driving.

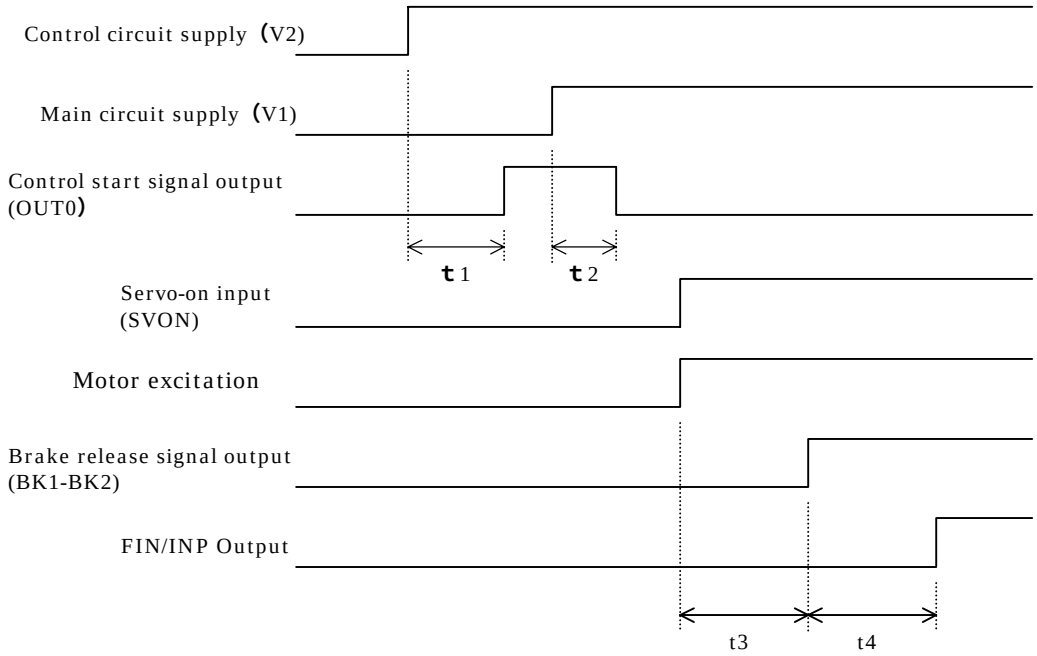
- **Machine system that is pressured from the outside torque to motor axis such as vertical axes**
- **The motor cannot rotate becase the brake of the machine system is saved when excitation of the motor is started**
- **An extremely big load is connected with the motor and the vibration occurs when executing the motor**
- **The viscosity of the machine is extremely large**

Controlling of the motor cannot be executed properly if the motor rotor is not in the right position when the positioning completion signal is output because of above reasons.

In this case, specifies a larger value for the parameter 53 "Startup Hold Time" or specifyies "1" for the parameter 58 "Machine Edge Detection Sequence" to execute the machine edge detection. This is because to operate the initialization of the control coordinates properly.

Machine breaks must be adjusted timing to release brake at the time reffered in t3 of the timing chart on the next page, or connect the brake coil with this driver's brake supply terminals(BK1, BK2). Refer to "2. Outputs of BK1 and BK2" in "7-2-2. Connection" for the details about the brake of the machine system.

Timing of power supply and the initialization at the first servo-on



Power supply switch on timing (see notes after the table)

	Meaning	Time	Unit
t1	Control circuit supply - control start signal output delay time	1,000	ms
t2	Main circuit supply - servo-on preparation-completion delay time	50	ms
t3	Motor excitation start - brake release signal output delay time	500	ms
t4	Brake release signal output - positioning completion signal throughput time (startup hold time)	Sets up with parameter 53. (min. 500)	ms

Note: These values do not take into consideration the rise time of the control circuit and the main circuit supply. If the automatic servo-on function is effective, motor execution is started simultaneously with OFF of a control start signal (OUT0) output.

When parameter 58 "Machine Edge Detection Sequence" is set as 1, start machine edge detection sequence after the end of t4, and after the machine edge detection is finished, FIN/INP signal is output.

8-3. Automatic Servo-On Function and Servo-On Operation

8-3-1. Automatic Servo-On Function

When automatic servo-on function is active, it turns on the servo-on automatically at the same time power is supplied to the main circuit. It also turns on servo-on automatically when the alarm is released or if an emergency stop in servo-off state by the alarm/emergency-stop occures.

The default setting for this parameter is for the automatic servo-on function to be active.

8-3-2. Setup of Servo-On Operation

A control input signal SVON and a serial communication command [SVON], [SVOFF] are available for the servo-on/off operation from host controller. Specify whether a control input signal or serial communication command is used to servo-on/off operation by parameter 45 “Input Method Select” (Bit0, Bit1).

If either the following conditions are approved, the automatic servo-on function is released and the servo-on/off operation can be set.

(1) The parameter 45 "Input Method select" is specified to use a serial communication command for the servo-on operation ("01" for Bit0, Bit1).

(2) The control input signal SVON is set as the either control input terminal IN0-4 for the parameter 60 "Extended Input Setup 1" and parameter 61 "Extended Input Setup 2".

Setup of parameter 45 "Input Method Select" servo-on operation

Function	BIT	Value	Device
SVON	BIT1 BIT0	11	None (do not set up)
		10	
		01	Communication command [SVON][SVOFF] (note)
		00	Control input SVON

note) The servo-on instruction by the serial communication command [SVON] is saved in the driver. Note that in case the motor turns on by [SVON] and turns off by an alarm or emergency stop and then the alarm and an emergency stop is released, the motor turns on again because the servo-on insuruction is still available.

If the serial communication command [SVOFF] is executed during servo-off state, the motor remains the servo-off state even if any alarms or the emergency stop are released because the servo-on instruction saved in the driver is turned off.

8-3-3. Servo-On Operation by Main Circuit Supply
(Software version 2.20 or later.)

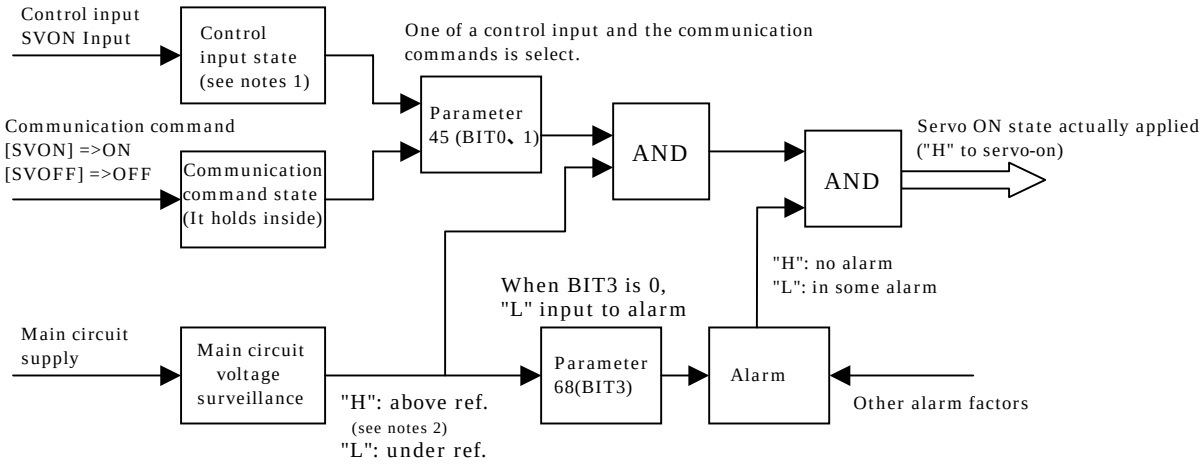
If “1” is specified for the value for Bit 3 of the parameter 68 "Alarm Output Protect Setup" you can specify that the alarm 13: "Main Circuit Undervoltage" is not output even if the main circuit supply voltage (input into V1 terminal of the power supply connector) falls. If this is used, the servo-on/off operation by main circuit supply can be executed.

The servo-on/off operation by main circuit supply procedure:

1. Set the value for Bit 3 of the parameter 68 "Alarm Output Protect Setup" as "1" (output of alarm 13: "Main Circuit Undervoltage" prohibited).
2. The Automatic servo-on function is effective or whether the servo-on operation is done by the control input signal or the serial communication command and the parameter 45 "Input Method Select", parameter 60 "Extended Input Setup 1", and 61 "Extended Input Setup 2" are set. (Refer to above for more details).
3. Supply main circuit voltage (value specified for the parameter 49 "Main Circuit Voltage"), turns servo-on using by the method to select process 2.
4. Turns servo-off if the supplied voltage of the main circuit is below the reference value. (20 V)
5. Turns servo-on again if the supplied voltage of the main circuit recovers to above the reference value.

The state of servo-on applied to AND operation with the state of the power supply of a main circuit and with either the automatic servo-on function, the state of control input signal or the input of servo-on by the serial communication command.
The following is a diagram of the servo-on states:

(Servo-on control block diagram)



Note 1: If the control input signal SVON is not set as neither of control input IN0~IN4, it is always set to H.
(Automatic servo-on function)

Note 2: Reference value: 20V

8-4. Operation Mode

The driver has the following two models avairable:

-Point-table mode : the position control mode is determined by a point-table and reference pulse train.

-Speed control mode : the speed control is determined by the specified point-table.

To switch modes, change the value for the parameter 38 "Operation Mode". (To apply the change, you must reboot the driver).

8-5. Point-Table Mode

In the point-table mode, the following three kinds of position control operation can be used: control input/output signals, serial communication commands, and reference pulse train. (Refer to the separate volumes "Operation Manual Serial Communication Part" and "Operation Manual Point-Table Part" for more details about point-table settings.)

-Using control input/output signals for position control:

The driver can use I/O signals from a host controller to control the position. This is done by executing a point table according to instruction from I/O signals.

-Using serial communication commands for position control:

The driver can use positioning operation by serial communication commands from a host controller to control a position.

This is done by executing a point-table according to serial communication commands.

-Using reference pulse train for position control:

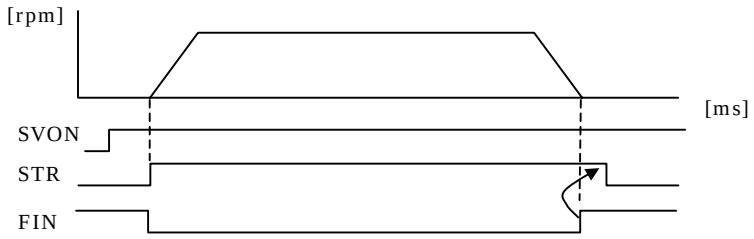
The position reference pulse train from a host controller can be used for position control.

8-5-1. Procedure to Use the Point-Table Operation

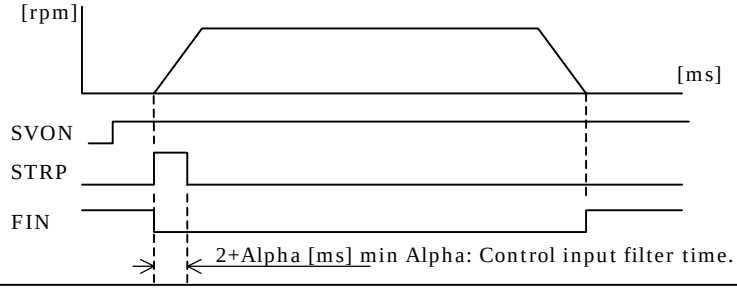
Use the following procedure to continuously run a point-table according to I/O signal instructions or serial communication commands:

1. The parameter 45 "Input Method Select" -- "SVON", "STR", and "point specification" specify the control input signal or serial communication command respectively.
2. Set the point-table number to use either control input signal P0_IN-P7_IN or serial communication command [PNT].
3. When motor is off, the control input signal SVON or the serial communication command [SVON] turns on the motor.
4. The specified point-table is executed at the rising edge of control input signal STR or STRP starts, or the serial communication command [STRON] or [STRP].

You must turn OFF the STR signal after confirming the FIN signal is turned ON. This is because positioning is canceled when the STR signal is turned off and it might cause desregistration at the time of an incremental point-table positioning.

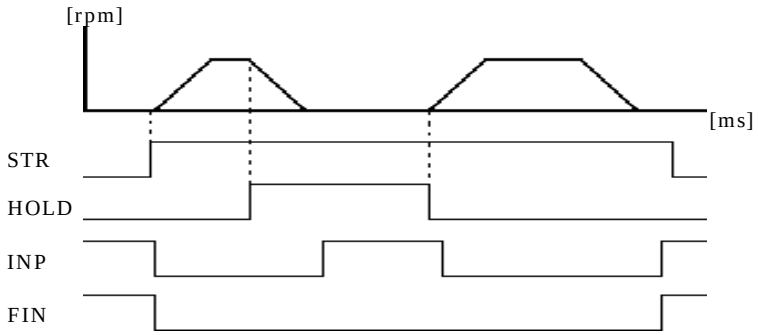


When the start instruction of the point-table is input by the one-shot, the STRP signal is used.



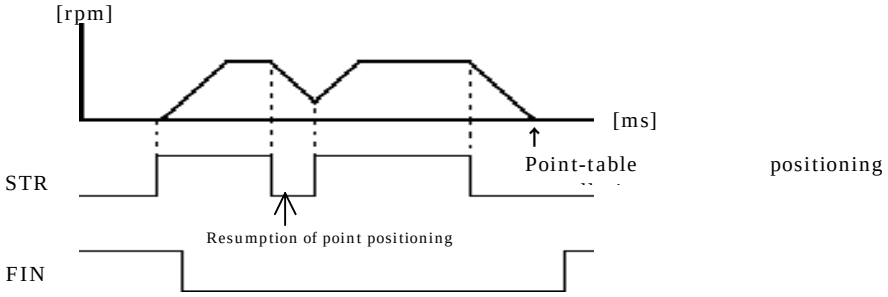
8-5-2. HOLD of Point-Table Operation

When the HOLD signal is turned ON or the serial communication command [HOLDON] is received during a point-table run, the driver decelerates to a stop according to the acceleration-and-deceleration time constant of the point-table holding the remaining move pulse count. Operation is resumed by turning OFF the HOLD signal or receiving the serial communication command [HOLDOFF].

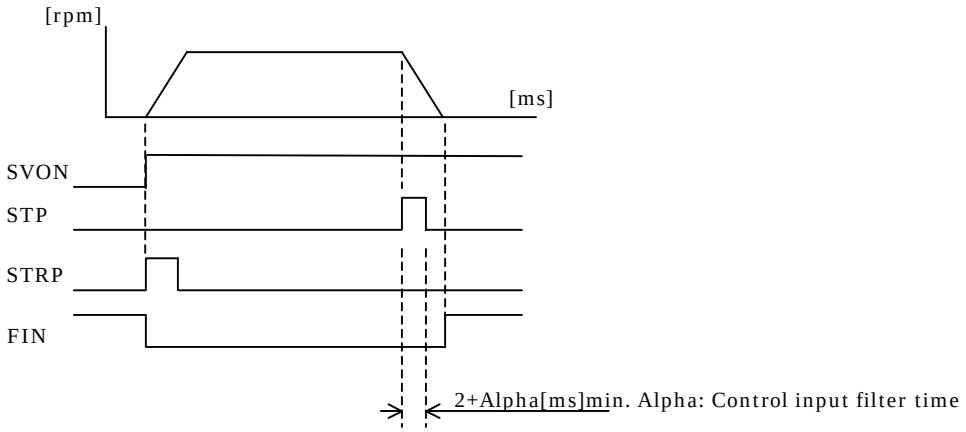


8-5-3. Cancelling of Point-Table Operation

When the STR signal is turned OFF during point-table positioning operation, the driver decelerates to a stop, the point-table execution is discontinued, and the remaining move pulse count after the motor stops. When the STR signal is again turned ON before motor stops, point-table positioning operation is not cancelled and resumed.



When the STRP (one-shot) signal is used for the start instruction, the STP signal is used to cancel the point-table operation.



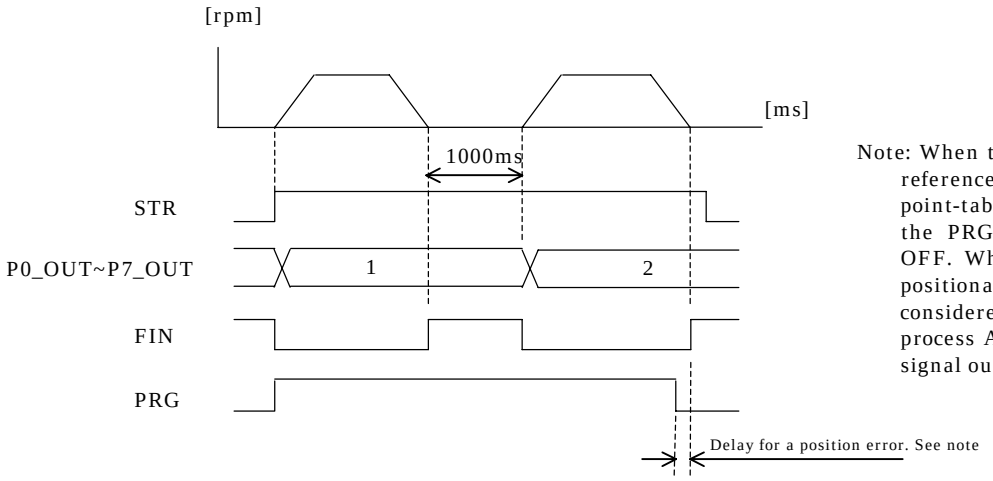
8-5-4. Executing Point-Table Number Output and PRG Output

The currently executing point-table number is output by the control output signal P0_OUT--P7_OUT and data number "0A" of the serial communication command [MON].

The PRG signal can be used as the program executing signal or the program end signal.

Example: The following example starts point no.1 in the following setup:

Point No.	Wait time [ms]	Branching destination
1	1000	2
2	0	256



Note: When the movement of a reference position of the point-table is completed, the PRG signal is turned OFF. When the follow for positional error is considered, you must process AND with the FIN signal output.

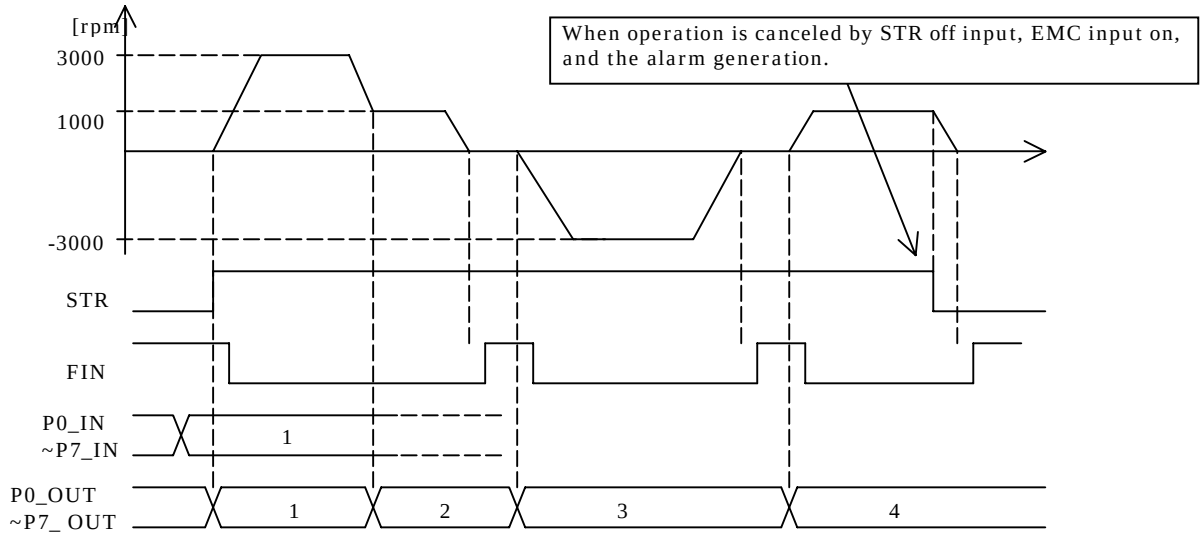
8-5-5. Completed Point-Table Number Output

To output the number of the point-table in which execution is completed set P0_FIN-P7_FIN for the parameter 63 "Extended Output Setup 1".

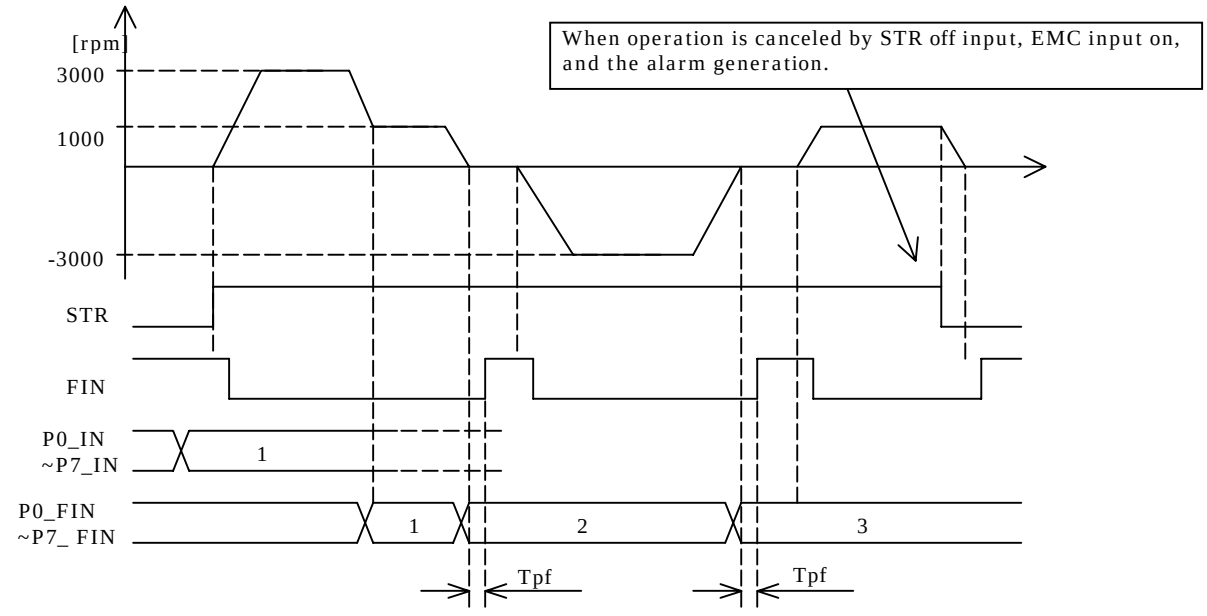
The following table lists the settings to output the numbers of the point-table number output (P0_OUT-P7_OUT) and the completed point-table number output (P0_FIN-P7_FIN):

No.	Abs/Inc	Move count	Speed	Wait time	Branching destination	Cont-inuation	---
:	:	:	:	:	:	:	
1	0	16,000	3,000	0	2	1	
2	0	24,000	1,000	500	3	0	
3	0	0	3,000	500	4	0	
4	0	20,000	1,000	0	256	0	

The following is an example of the output for the executing point-table number P0_OUT~P7_OUT:



The following is an example of the output of completed point-table number P0_FIN~P7_FIN:



Tpf：Delay for a position error. See note

Note: When the movement of a reference position of the point-table is completed, the P0_FIN~P7_FIN signals change. When the follow for positional error is considered, you must process AND with the FIN signal output.

8-5-6. Teaching Function

The control input signal TDIN or the serial communication command [TDIN] can be used to store the current position in the specified point-table. (This is refered to as teaching) Moreover, the data of "abs/inc" of the point-table that did the teaching is automatically set to 0 (absolute).

1. How to Rewrite Only Data on RAM

Use the procedure below to write the limit frequency of EEPROM (non-volatile memory) when data is frequently rewritten while operating. The content of the data rewritten by this method is cleared by the driver's power-off or serial communication command [RESET].

a) To execute teaching with the serial communication command:

1. Set the parameter 45 "Input Method Select" as shown in the table on the right. (Set the communication command [PNT] as a point specification device.)
2. Move the motor to the position at which it is to be stored.
3. Specify the number of the point-table to execute teaching as the value for the command [PNT].
4. Take in the current position data by the command [PNT].

Function	BIT	Value	Device
Point specification	BIT9	0	Communication command [PNT]
	BIT8	1	
ZSTR	BIT7	-	-
	BIT6	-	
STR	BIT5	-	-
	BIT4	-	
JOG	BIT3	-	-
	BIT2	-	
SVON	BIT1	-	-
	BIT0	-	

b) To execute teaching with the control input signal:

1. Set the parameter 45 "Input Method Select" as shown in the table on the right. (Set the control input signal P0_IN-P7_IN as the point specification device.)
2. Move the motor the position at which it is to be stored.
3. Specify the number of the point-table to execute teaching as the value for the control input signal P0_IN-P7_IN.
4. Take in the current position data at the rising edge of control input signal TDIN.
5. Control input signal TDIN is turned OFF within two seconds (writes the data in EEPROM when turns ON for 2 seconds or more).

Function	BIT	Value	Device
Point specification	BIT9	0	Control input signal P0_IN-P7_IN
	BIT8	0	
ZSTR	BIT7	-	-
	BIT6	-	
STR	BIT5	-	-
	BIT4	-	
JOG	BIT3	-	-
	BIT2	-	
SVON	BIT1	-	-
	BIT0	-	

Note: The point-table specification when the teaching is executed by serial communication command [TDIN] can only be executed by the command [PNT]. (The control input signal P0_IN-P7_IN cannot be used.)
When the teaching is executed by control input signal TDIN, the point-table can be specified by serial communication command [TDIN] if Bit8 and Bit9 of parameter 45 "Input Method Select" are set to "01".

2. How to Rewrite Data on RAM, and Data of EEPROM

If the teaching is executed by the following way, the rewritten value is saved even after the driver is powered-off.

a) To execute the teaching with the serial communication command:

1. Set the parameter 45 "Input Method Select" as shown in the table on the right. (Set the communication command [PNT] as a point specification device.)
2. Move the motor to the position at which it is to be saved.
3. The point-table number which executes teaching is specified by the command [PNT].
4. Take in the current position data by the command [PNT].
5. The data of RAM is written in EEPROM by the command [FLASH].

Function	BIT	Value	Device
Point specification	BIT9	0	Communication command [PNT]
	BIT8	1	
ZSTR	BIT7	-	-
	BIT6	-	
STR	BIT5	-	-
	BIT4	-	
JOG	BIT3	-	-
	BIT2	-	
SVON	BIT1	-	-
	BIT0	-	

b) To execute the teaching with the control input signal.

1. Set the parameter 45 "Input Method Select" as shown in the table on the right. (Set the control input signal P0_IN-P7_IN as a point specification device.)
2. Move the motor to to the position at which it is to be saved.
3. The point-table number which executes teaching is specified by the control input signal P0_IN-P7_IN.
4. Control input signal TDIN is turned ON for two seconds or more. Data that the teaching is executed is written in EEPROM.

Function	BIT	Value	Device
Point specification	BIT9	0	Control input signal P0_IN-P7_IN
	BIT8	0	
ZSTR	BIT7	-	-
	BIT6	-	
STR	BIT5	-	-
	BIT4	-	
JOG	BIT3	-	-
	BIT2	-	
SVON	BIT1	-	-
	BIT0	-	

Note: The point-table specification when the teaching is executed by serial communication command [TDIN] can only be executed only by the command [PNT]. (The control input signal P0_IN-P7_IN cannot be used.) When the teaching is executed by control input signal TDIN, the point-table can be specified by serial communication command [TDIN] if Bit8 and Bit9 of parameter 45 "Input Method Select" are set to "01".

8-5-7. Position Control Operation by Reference Pulse Train

To execute positioning with the reference pulse train from a host controller, parameter 38 "Operation Mode" is set to the point-table mode. Positioning with the pulse train and with the point-table can be used. (It is not necessary to reboot the driver and executed the zero-point-return operation.)

However, if the pulse train input is used for the point-table operation, the zero-point-return operation, and Jog driving is disregarded. In this case, input the pulse train after each operation is completed.

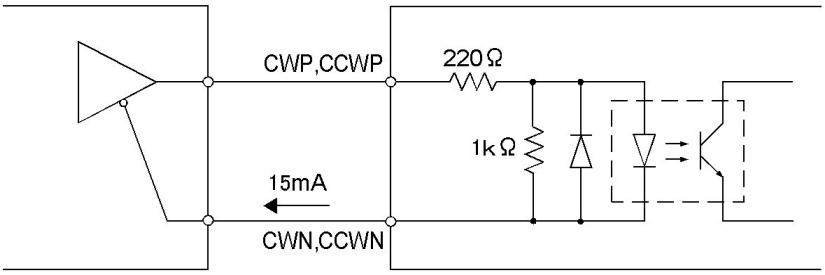
(1) Connection

Operation using 5 V line-driver output or +5 V open-collector output is possible.

The required electronic current is about 15 mA per circuit.

A power supply besides the control I/O must be prepared to prevent mistakes in the pulse count because of noise.

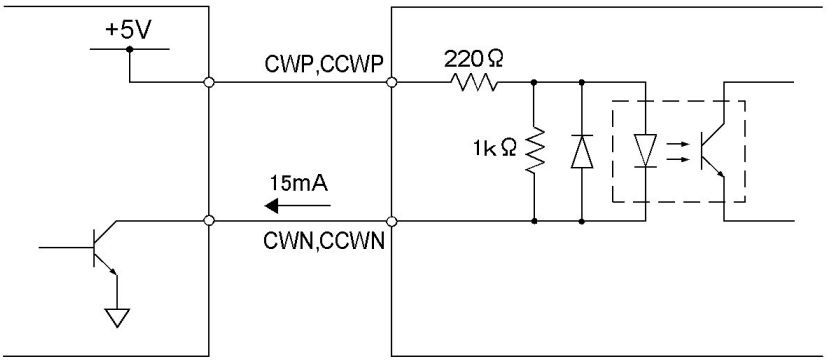
A) In the case of 5V line-driver output



Applicable line-driver
TI AM26C31(or compatible)

The pair of P and N of the same signal name is required twist-pair wires.

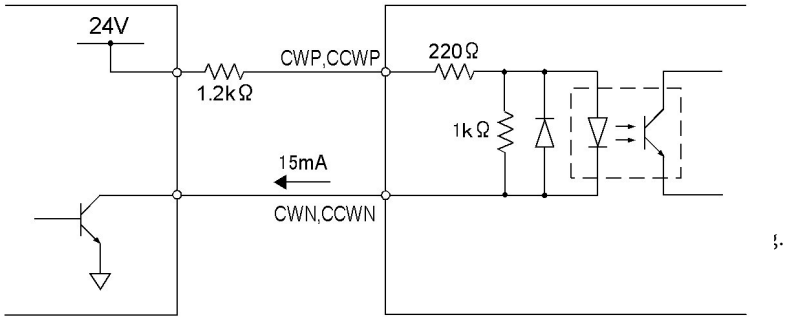
B) In the case of 5V open-collector output



The pair of P and N of the same signal name is required twist-pair wires.

C) In the case of 24V open collector output:

To connect with the open collector output in the power source beyond 5V, you must add a current limiting resistor and restrict current to 15mA.



The pair of P and N of the same signal name is required twist-pair wires.

(2) Reference pulse train input format:

The three kinds of input forats are follows:

- CW/CCW pulse input
- PULSE/SIGN input,
- A/B phase (90-degree phase difference) input can be selected by setting the parameter 20 "Reference Pulse Train Form".

Value	Forward instructions	Reverse instructions
0	CWInput (CW) CCWInput (CCW)	CWInput (CW) CCWInput (CCW)
1	CWInput (Pulse) CCWInput (SIGN)	CWInput (Pulse) CCWInput (SIGN)
2	CWInput (Phase-A) CCWInput (Phase-B)	CWInput (Phase-A) CCWInput (Phase-B)

Note: All are shapes of low-active shapes.

Current flows into the photo-coupler primary side LED at the time of display "L".

(3) Setup of reference pulse resolution

The reference pulse resolution (the number of position reference pulse corresponding to a motor rotation) is specified by parameter 3 "Resolution Numerator" and by parameter 2 "Resolution Denominator" as follow.

$$\text{One motor rotation} = \frac{\text{Resolution Numerator}}{\text{Resolution Denominator}} \quad \text{[pulse]}$$

For example, if the set resolution is 3,200 (resolution molecule = 3200, resolution denominator = 1) , the motor makes one forward ("forward" direction is selected by parameter 48 "Rotation Direction") rotation and positions it by inputting +3200 reference pulse train.

(4) Limitation of reference resolution setup

Set the values for the parameter 2 "Resolution Molecule" and parameter 3 "Resolution Denominator" within the following range:

[parameter 2] x [parameter 3] x 25600 < 2^{31} (2,147,483,648)

If this range is exceeded, it may become impossible to operate normally.

8-6. Speed Control Mode

The speed control mode is secified by setting "1" for the parameter 38 "Operation Mode". (To apply any changes you must reboot the driver.) The driver is controlled by the control input signal STR and P0_IN-P7_IN at the speed set to "Speed" item of the point-table. The signal of VZR (zero speed) and VCMP (speed compliance) is the speed control output. Positions at the position considering the motor stop by the VZR output (changes to position control and the current position is held).

In the speed control mode, a point-table positioning operation and a sensor positioning operation cannot be used. Moreover, the reference pulse train input from a host controller is not performed (the input pulse train is disregarded).

8-6-1. Point-Table Settings in Speed Control Mode

In speed control mode, only three items of "speed", "accel/decel", and "abs/inc" (specification of direction of rotation) for each point-table 0-255 are used. Other settings are disregarded.

Item	The contents of a setting	Setting range
Abs/Inc	In speed control mode, this is used to specify the motor rotation direction.	0: Forward 1: Reverse
Speed	Speed is set.	1---4500 [rpm]
Accel/Decel	Acceleration-and-deceleration time constant (time to 3000rpm acceleration) is set.	1---9999 [ms]

When VDIR (direction-of-rotation selection input) is set as the control input signal, the "abs/inc" setup is invalid, and the direction of rotation is specified by a control input signal VDIR.

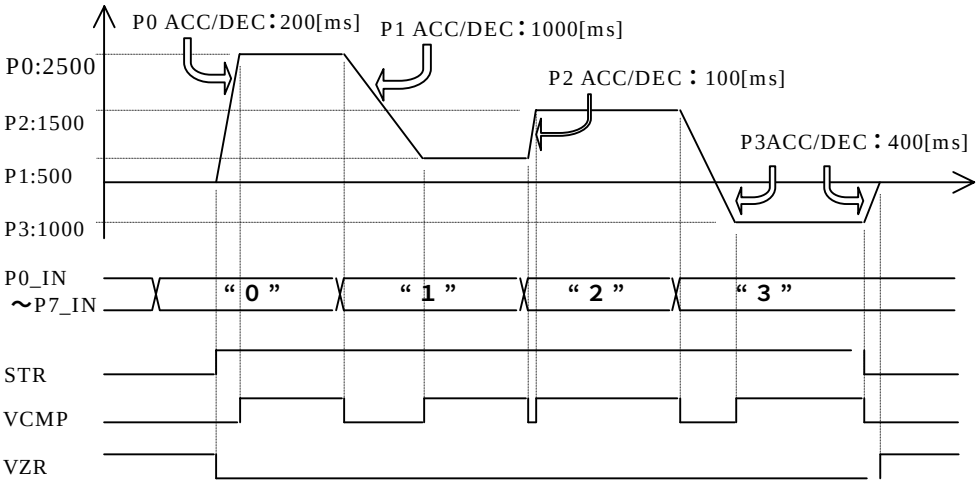
8-6-2. Operating Examples

1) Normal operation:

In the following example, a point number is specified for P0_IN---P7_IN inputs and the speed control operation is executed in an STR input:

Point-table settings

Point	Abs/Inc	Speed	Accel/Decel
0	0	2500	200
1	0	500	1000
2	0	1500	100
3	1	1000	400
	:	:	:
	:	:	:

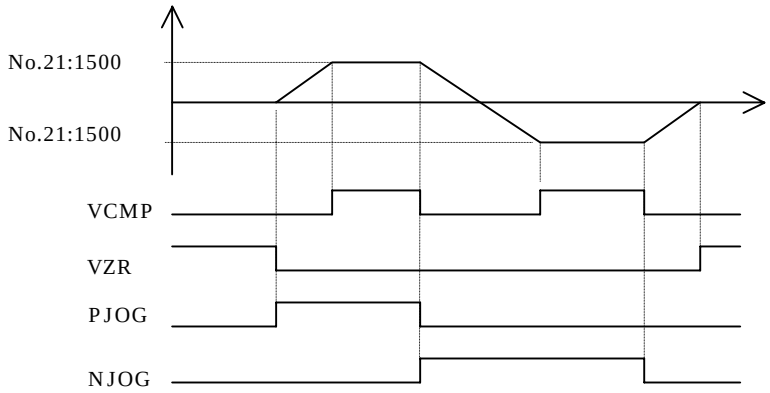


2) JOG operation

In the following example, a A PJOG/ NJOG signal input executes speed control operation at the speed specified by the parameter.

Parameter setup:

No.	Parameter name	Value	Unit
21	JOG Speed	1500	Rpm
22	JOG Accel/Decel Time Const.	1000	ms



9. Other Functions

9-1. Sensor Positioning Operation

Sensor positioning can be performed by connecting an external sensor to the terminal of the external I/O connector (I/O) terminal that allocates the control input signal SENS. The sensor positioning becomes effectivive for the point-table that sets the "Sensor" item. To execute the sensor positioning operation, specify the parameters with the following procedures:

(1) Parameter 38 "Operation Mode":
Set this parameter to "0" (point-table mode).

(2) Parameter 60 "Extended Input Setup 1" and 61 "Extended Input Setup 2":
Allocate the SENS signal to the control input terminal that connects to the sensor.

(3) The settings for (1) and (2) are applied by rebooting the driver.

(4) Parameter 45 "Input Method Select"
Select the method to input the necessary inputs ("SVON", "STR", and "point-specification") for the sensor positioning. Select whether the control input signal or the serial communication command is used for each input.

(5) Set a "sensor" item for the point-table which executes sensor positioning operation (refer to the "Sensor Positioning" clause of the separate volume "Operation Manual Point-Table Part" for the details about point-table setting).

9-2. Pressing Operation (Torque Limitation)

This driver can execute the pressing operation by torque limitation.

(1) To execute torque limitation in the operation by reference pulse train:
Specify the torque limitation value for the parameter 70 "Torque Select 0"- parameter 74 "Torque Select 4" beforehand by control input signal TSEL0-TSEL4 or serial communication command [TSEL0ON]-[TSEL4ON]. If the use of torque limitation is detected, the control output signal TFIN (torque completion) will be output.

(2) To excecute torque limitation in the point-table positioning operation:
The torque is limited by setting the value to the point table while executing the point in the point-table that torque is specified.

In this section, "(1) to execute torque limitation is performed in the operation by reference pulse train" is explained. Regarding “(2) To excecute torque limitation in the point-table positioning operation”, refer to the "Torque Limitation" clause of a separate volume "Operation Manual Point-Table Part".

9-2-1. Setting the Torque Limitation Values

The torque limitation value in operation to reference pulse train input is set by the parameter 70 "Torque Select 0"- parameter 74 "Torque Select 4". The set torque limitation value corresponds to the serial communication command [TSEL0ON]-[TSEL4ON] respectively with the input signal TSEL0-TSEL4.

The torque limitation value sets up an output torque which executes pressing operation in a unit (a percentage of the rated torque of the motor). The rated torque is an output torque in rotational speed 0rpm of the curve of "Continuous Duty Zone" of N-T charactereristics.

Torque limitation value setting parameters

Item	TSEL input (see note 1)	Communication command (see note 1)	Unit	Min	Max
Parameter 70	TSEL0	TSEL0ON	%	0	300
Parameter 71	TSEL1	TSEL1ON	%	0	300
Parameter 72	TSEL2	TSEL2ON	%	0	300
Parameter 73	TSEL3	TSEL3ON	%	0	300
Parameter 74	TSEL4	TSEL4ON	%	0	300

Note1: Select one of the TSEL inputs and the communication command with a parameter 45 "Input Method Select".

9-2-2. Setting the Pressing Operation Parameters

To use the pressing operation, set the following parameters.

(1) Parameter 38 "Operation Mode":
Set "0" (point-table mode).

(2) Parameter 60 "Extended Input Setup 1" and 61 "Extended Input Setup 2"
Allocate the signal used from among TSEL0-TSEL4 to the control input terminal.

(3) Parameter 63 "Extended Output Setup 1":
Allocate the TFIN (torque completion) signal the control output terminal.

(4) The settings for (1) to (3) are applied by rebooting the driver.

(5) Parameter 19 "TFIN/VZR Output Range":
The output width of the TFIN signal in the pressing operation is set to this parameter by the units of rpm. The output torque (the torque instruction) of the motor is limited by the torque limitation value, and the rotational speed of the motor axis is a value smaller than the one set for this parameter, and control output TFIN (torque completion) is output.

(6) Parameter 34 "Press Mode Speed Limit":
The speed limitation in pressing operation is set in units of rpm.

(7) Parameter 35 "Press Escape Speed Limit"
The speed limitation at the period until it shifts from pressing operation to normal positioning operation and positioning is completed at the reference position is set in units of rpm. This prevents excessively rapid rotation of the motor because of a positional error when shifting to the positioning operation is prevented.

(8) Parameter 36 "Press Mode Speed Limit ATC"
Specify a time constant "time to 3000-rpm acceleration"that accelerates and decrelates a the speed limitation that is set parameter 34 and 35 in units of ms.

(9) Parameter 37 "Press Trq Inc/Dec TC"
"Time required to increase and decrease between 0% and 100% torque limitation" is set in units of ms as a time constant of the increase and decrease of an actual torque limitation value when the time that shifted from the normal positioning operation to the pressing operation and the torque limitation value is changed while pressing operation.

(10) Parameter 70 "Torque Select 0"- parameter 74 "Torque Select 4":
The torque limitation value used is set according to the table Torque limitation value setting parameters in 9-2-1. Setting of Torque Limitation Values.

(11) Parameter 45 "Input Method Select"
Specify the input method for the necessary inputs ("SVON", "STR", and "torque selection") for the pressing operation is selected. Specify whether the control input signal or the serial communication command is used for each input.

9-2-3. Outline of Operation

When the torque limitation value is set by control input signal TSEL0-TSEL4 or serial communication command [TSEL0ON]-[TSEL4ON], the pressing operation is used.

In the pressing operation, though the positioning operation is done by positional error counter caused by reference pulse train input, the output torque (the torque instruction) is limited by the selected torque limitation value. Moreover, position error pulse overflow alarm is not generated even if the value specified by the positioning error counter is reached.

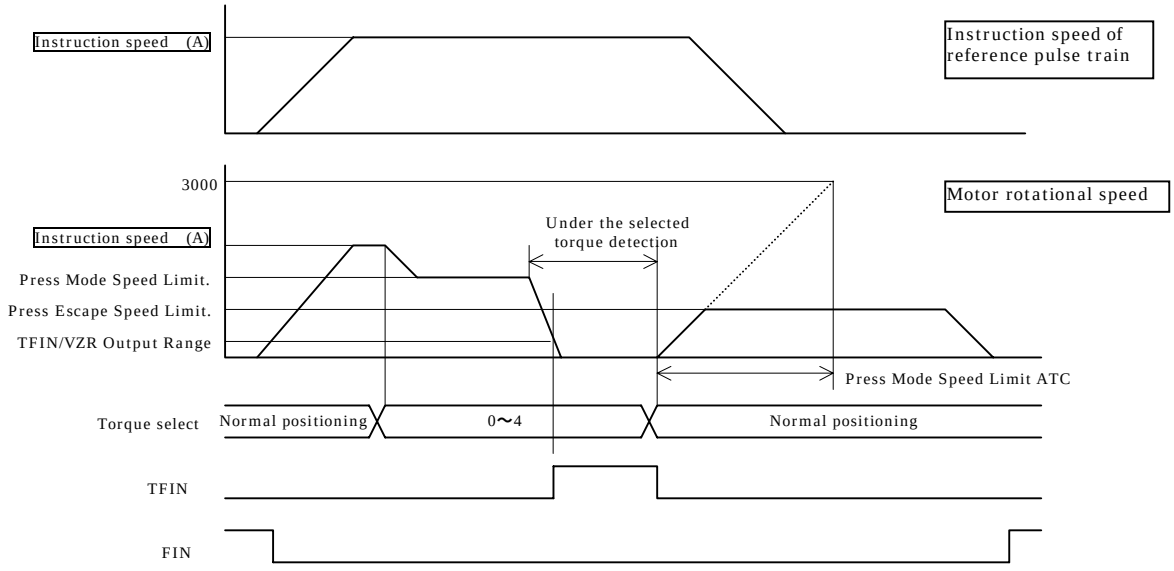
At the same time, the rotational speed of the motor is limited at speed at set by the parameter 34 "Press Mode Speed Limit".

The output torque (the torque instruction) of the motor is limited by the torque limitation value and the rotational speed of the motor axis is a value smaller than a set for the parameter 19 "TFIN/VZR Output Range", and control output TFIN (torque completion) is output.

9-2-4. Procedure of Pressing Operation

Execute the following procedure to use the pressing operation:

1. When the torque limitation value is set by control input signal TSEL0-TSEL4 or serial communication command [TSEL0ON]-[TSEL4ON], the pressing operation is used with the arbitrary timing specified by the positioning operation by the reference pulse train input.
2. When a momentary rotational speed of the motor that shifts to the pressing operation is larger than that specified by parameter 34 "Press Mode Speed Limit", the motor decelerates to "Torque Mode Speed Limit" by the constant set when setting it by parameter 36 "Press Mode Speed Limit ATC".
3. When positioning is completed at the reference position by the reference pulse traininput, control output signal FIN is output.



Note: This timing-chart is used as follows:

If the machine bumps to the load while limiting the torque, it stops, and the torque limitation is released afterwards, it is possible to rotate in the same direction after the load is removed.

9-2-5. Limitation of Pressing Operation

1) In the pressing operation, the specified value of output tourque is output only when the rotation of the motor has stopped. The output torque if the motor axis rotates reaches the value that decreases gradually from the torque instruction value corresponding to the speed of the rotation.
2) When the torque is output continuously in the intermittent duty zone (refer to N-T characteristics), the "overload" alarm may occur and the motor and the driver may occasionally generate a lot of heat remarkably occasionally. Therefore, set the parameter below 100%.

9-3. Zero-Point-Return

Servo driver's coordinate system is set to ”0” by executing zero-point-return sequence with the driver inside and it enters to the state of the zero point returen completion. The instruction method for zero-point-return sequence can be either the control input signal or the serial communication command.

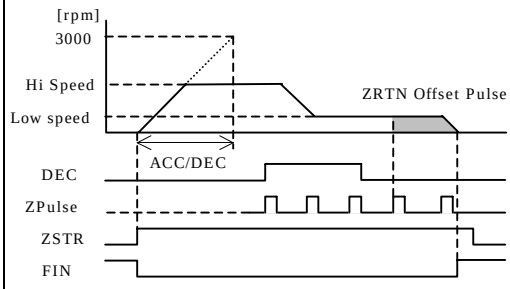
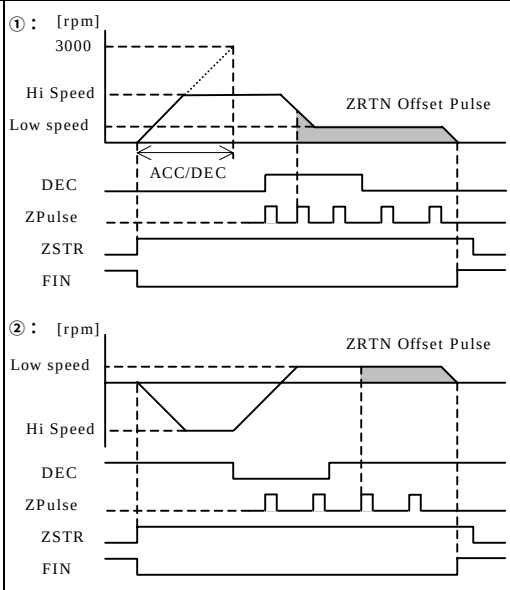
The output of the zero-point-return completion usually uses a FIN output and positions completion output simultaneously. If a zero-point-return completion othe than the positioning the completion output FIN is output, set up a ZFIN output with parameters 60 and 61 "Extended Input Setup 1 and 2".

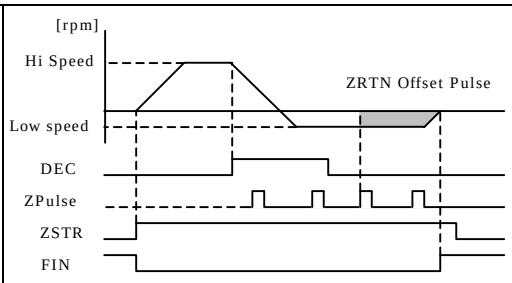
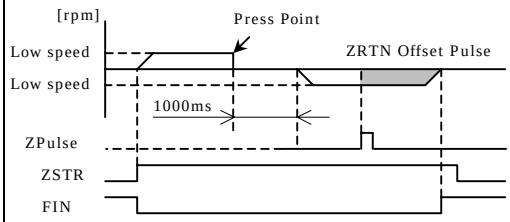
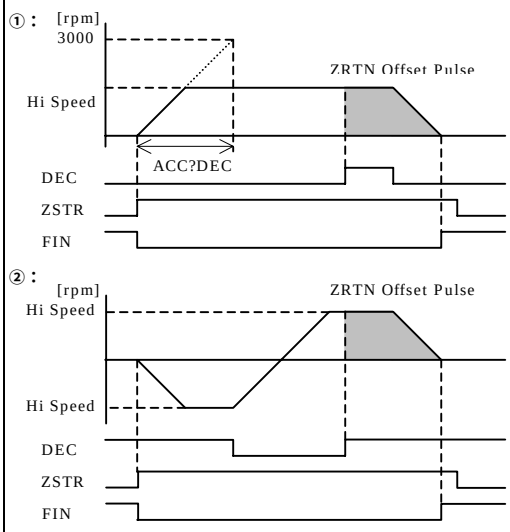
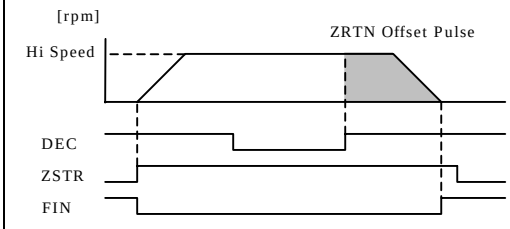
9-3-1. Setting Parameters for Zero-Point-Return

Use the following procedure to set the parameters for zero-point return.

1. Parameter 27 "Zero-Point-Return Form":
   Select one of the six kinds of zero-point-return forms according to this parameter.
   To apply any changes to this parameter, you must reboot the driver.

Zero-point-return form list

Number: Explanation	Timing
0: LS passage The position at which the distance of "ZRTN Offset Pulse" is moved from the first Z pulse after DEC turns OFF is made a zero point.	
1: LS running aground (1) If DEC is OFF at the time of starting: The position at which the distance of "ZRTN Offset Pulse" is moved from the first Z pulse after DEC turns ON is made a zero point. (2) If DEC is ON at the time of starting: Rotates contrary to the "Zero-Point-Return Direction", and if it detects OFF of DEC, the motor reverses. It moves to the "Zero-Point-Return Direction" at a "ZRTN Low Speed", and the position in which the distance of "ZRTN Offset Pulse" is moved from the first Z pulse after DEC turns ON again is made a zero point.	

2: LS reverse The motor reverses with DEC detect, and the position at which the distance of "ZRTN Offset Pulse" is moved from the first Z pulse after DEC turns OFF is made a zero point.	
3: Pressing The position at which the distance of "ZRTN Offset Pulse" moved from the first Z pulse after reversing it pressing the motor to the machine edge is made a zero point. It presses in the torque set to parameter 33 "ZRTN Press Torque" in units of (% to rated torque of the motor). When the state which the rotation stops by pushing to the machine edge continues 1000ms, the motor reverses.	
4: No zero-point-return The start-up position is made a zero-point. ZSTR instruction is disregarded (it enters the state of the zero-point-return completion at the same time as starting the driver).	
5: Z-phase pulse disregard -- sensor positioning 1 (1) If DEC is OFF at the time of starting The position at which distance of "ZRTN Offset Pulse" is moved from the point that DEC turns ON is made a zero point (Z-phase pulse is not seen). (2) If DEC is ON at the time of starting After it moves contrary to the "Zero-Point-Return Direction" to come off the state of turning ON of the DEC signal, moves to the "Zero-Point-Return Direction", and detects the rising edge of DEC signal.	
6: Z-phase pulse disregarded -- sensor positioning 2 The position at which the distaice of "ZRTN Offset Pulse" is moved from the point that DEC turns ON is made a zero point (Z-phase pulse is not seen). (It moves in the direction of the "Zero-Point-Return Direction" regardless of the state of the DEC signal when starting)	

2. Parameter 28 "ZRTN Direction"
   Set the rotation direction when the zero-point-return sequence is begun. If LS (machine edge in case of pressing) is in the forward direction specify “0”, specify “1” if it is in the reverse direction.
   To apply any changes to this parameter, you must reboot the driver

3. Parameter 29 "ZRTN High Speed"
   Specifies the maximum revolution speed for the zero-point-return is set.

4. Parameter 30 "ZRTN Low Speed"
   Specifies the minimum revolution speed for the zero-point-return is set.

5. Parameter 31 "ZRTN Accel Time Const."
   Specifies the "Time to 3000-rpm acceleration" is set for the acceleration-and-deceleration time constant in the zero-point-return sequence in units of ms.

6. Parameter 32 "ZRTN Offset Pulse"
   Specifies the distance from the position where Z-phase pulse is detected (LS detect position in case of form 5 and 6) to the zero point.

7. Parameter 33 "ZRTN Press Torque"
   Specifies the pressing torque in the zero-point-return form 3 "pressing" is set in units if a percentage of the rated torque of the motor.
   The rated torque is the output torque in rotational speed 0 rpm of the curve of "Continuous Duty Zone" of N-T characteristics.
   This parameter is only used for the "pressing" method.

8. Parameter 45 "Input Method Select"
   Specifies the method for the input of necessary inputs ("SVON", "ZSTR") for the zero-point-return is selected. Whether the control input signal or the serial communication command is used is specified according to each input.

9. Parameter 59 "Grid-Mask Pulse" (version 2.20 or later)

The Z-pulse pulse of the motor encoder between the distances of the number of pulses (motor encoder pulse unit) set by this parameter from LS is disregarded (grid-mask function).

When 0 is set, the grid-mask function becomes invalid.

The base point of the grid-mask pulse number count is as follows in each zero- point-return form:

Parameter 27	Zero Return Type	Base point
0	LS passage	LS falling
1	LS running aground	LS rising
2	LS reverse	LS falling
3	Pressing	Machine edge
4	No zero-point-return	None
5	Z-phase pulse disregard -- sensor positioning 1	
6	Z-phase pulse disregarded -- sensor positioning 2	

Because Z pulse is not used in the zero-point-return form 4-6, the setting of parameter 59 is disregarded.

9-3-2. Procedure of Zero-Point-Return

Execute following procedures to use zero-point-return.

(1) If using LS, connect with the control input signal DEC. DC24V external power supply is required like other control input signals (refer to 7-1-3.Connection).

(2) Specify the necessary parameters for the zero-point-return as in 9-3-1.Setting Parameters for Zero-Point-Return.

(3) If the servo-off, turn servo-on with the control input signal SVON or the serial communication command [SVON].

(4) Starts the zero-point-return sequence at the rising edge of control input signal ZSTR or ZSTRP, or the serial communication command [ZSTRON] or [ZSTRP].

If the zero-point-return is started with the control input signal ZSTR, you must turn OFF after confirming the FIN or ZFIN signal is turned ON (if started with the serial communication command [ZSTRON], send command [ZSTROFF]).

9-3-3. Cancelling of Zero-Point-Return

When the ZSTR signal is turned OFF during zero-point-return sequence, decelerates to a stop according to the time constant set in "ZRTN Accel/Decel Time Const.", and the zero-point-return execution is discontinued.

When the ZSTRP (one-shot) signal is used for the start instruction, the STP signal is used for the cancellation of zero-point-return.

When the zero-point-return is cancelled, the machine starting point is not updated and the zero-point-return is not completed.

If the zero-point-return is started with the serial communication command [ZSTRON] by setting parameter 45 "Input Method Select", you must use the command [ZSTROFF] to cancel the zero-point-return.

9-3-4. Zero-Point-Return Completion Output

The completion of the zero-point-return operation can be ascertained by the control output signal ZFIN and by the bit that corresponds to the serial communication command of numerical monitor [MON]. When zero-point-return sequence is being executed, ZFIN turns OFF, and turns ON when zero-point-return is completed.

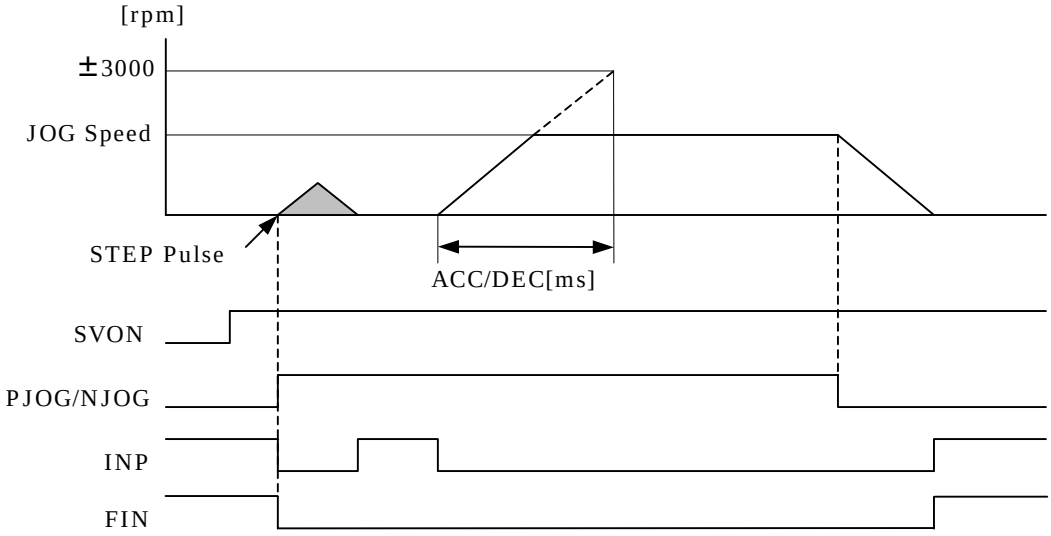
9-4. JOG Operation

JOG operation can be used by setting the speed at the parameter.

9-4-1. Settng up the JOG Operation

Set the following parameters to use the JOG operation:

1. Parameter 21 "JOG Speed"
   Specify the rotational speed of the JOG operation in units of rpm.
2. Parameter 22 "JOG Accel/Decel Time Constant"
   Specify the "Time to 3000-rpm acceleration from 0-rpm" for the acceleration-and-deceleration time constant in the JOG operation in units of ms.
3. Parameter 23 "STEP Pulse 0"
   Specify this parameter as in the figure below to specify two-step feed JOG operation. This is convenient if the position of the machine is fine-tuned manually.



9-4-2. Instruction Method

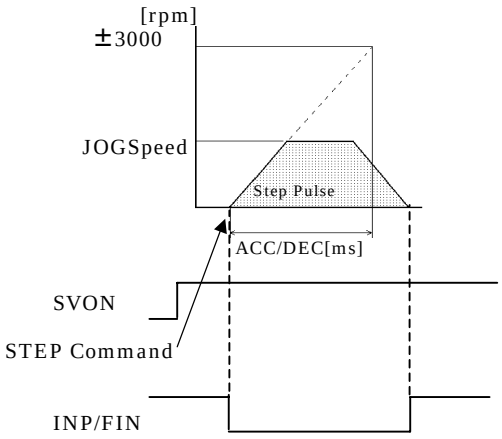
The instruction of the JOG operation is given by the following two methods:

-The control input signals PJOG and NJOG.

-The serial communication commands [PJOG], [NJOG], and [JOGOFF].

9-5. Step Feed Operation

The serial communication command can operate the step feed operation where the pulse number set to the parameter moves. The rotational speed is the JOG speed.



9-5-1. Instruction Method

The instruction of the step feed operation is given by the following method:

-The serial communication commands [STEPON], [STEPOFF], [STEP0ON], [STEP1ON], [STEP2ON], and [STEP3ON].

9-6. Emergency Stop

The emergency stop instruction can be input by two methods: the control input signal and the serial communication command.

There are two kinds of emergency stop: control damping and servo-free.

In control damping, the motor is stopped by the servo control in the place.

In servo-free, the motor is turned off and stops by the free run.

Both the control dampinbg and servo-free methods cancel point-table, zero-point-return, and JOG operation. The reference pulse train input in an emergency stop is disregarded.

9-6-1. Emergency Stop with the Control Input Signal

If the control input signal triggers an emergency stop, EMCE (control damping) or EMCF (servo-free) is set to the control input terminal by parameters 60 "Extended Input Setup 1" and 61 "Extended Input Setup 2".

9-6-2. Emergency Stop with the Serial Communication Command

If the serial communication command triggers an emergenc stop, the commands [EMCON] and [EMCOFF] are used.

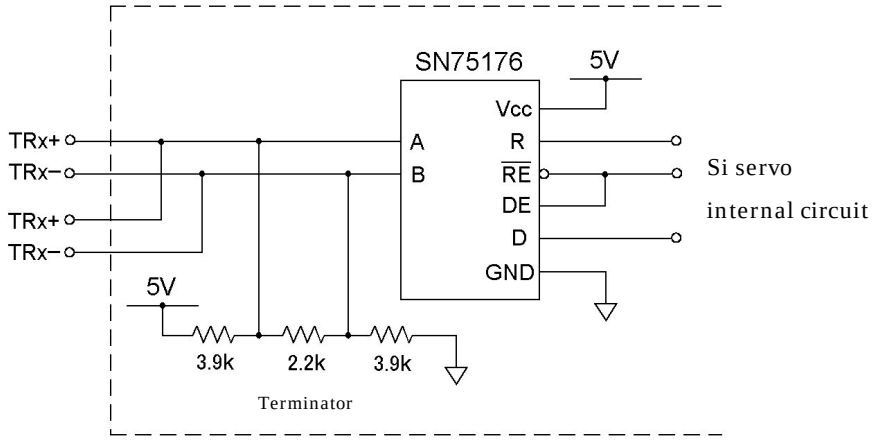
Whether control damping or servo-free is used is specified by the argument of the [EMCON] command (refer to a separate volume "Operation Manual Serial Communication Part").

10. Serial Communication Function

The multidrop link of RS485 can be used to control up to 15 axis.

10-1. Serial Communication Interface Circuit

The following is an example of the input and output circuit of the RS485 communication-interface signal:

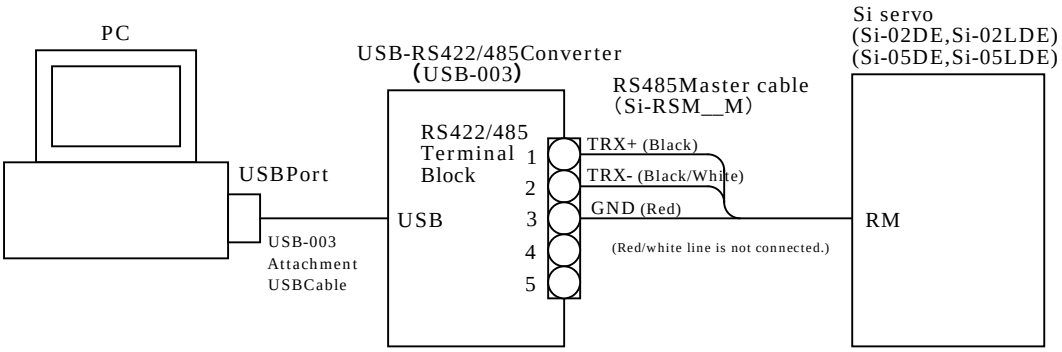


Si servo usually maintains the reception waiting state and only transmits while replying/receiving the command from a host controller. Switch the host controller's sending and receiving in accordance with this.

10-2. Example of Connection with a Personal Computer

To use RS485 to communicate between a personal computer (PC) and Si servo, the USB-RS422/485 converter must be inserted and connected.

The following is a wiring diagram to use the USB-RS422/485 converter USB-003 (a product made by HUMANDATA):



Recommended peripherals:

USB-003 (product made by HUMANDATA)

Internal jumper pins: In the remainder with the default settings, and 1-3 of the configuration switches is set on (below), and wire and use it as shown in figure above.

Operation Mode	Switch state			
RS485	1	2	3	4
with terminator	ON	ON	ON	OFF

Refer to the user's manual of USB-003 for details.

Refer to the separate volume "Operation Manual Serial Communication Part" for detail about serial communication function.

11. Protection

11-1. Alarm List

The following is the alarm table:

Alarm table

Number	Alarm name	Contents
1	Main EEPROM Alarm	Output if the reading/writing the driver EEPROM fails.
2	Motor EEPROM Alarm	Output if the reading/writing the motor EEPROM fails.
3	Encoder Alarm	Output if an encoder cable disconnection is detected at startup.
4	System Alarm	Output if the system cannot work normally. Output is the combination of the motor model and the driver model is abnormal.
5	Position Error Pulse Overflow	Output the amount between the reference position and the feed-back position (the positional error pulse) set by the parameter is exceeded.
6	Phase-A Overcurrent	Output if the flowing current output to phrase-A is more than 5 ms above the maximum widing of the motor. (Si-02LDE:1.1A/ Si-02DE:6.2A/ Si-05LDE:6.2A/ Si-05DE:13A)
7	Phase-B Overcurrent	Output if the flowing current output to phrase-B is more than 5 ms above the maximum winding of the motor. (Si-02LDE:1.1A/ Si-02DE:6.2A/ Si-05LDE:6.2A/ Si-05DE:13A)
8	Temperature / Motor Cable Alarm	Output if the temperature of the power-transistor junction or the temperature inside of the driver exceeds the maximum value (70 degrees), or when the motor power line is disconnected.
9	Overload	Output if an electronic terminal detects an overload state.
10	Shortage of Accel/Decel	Output if necessary moved distance for the acceleration and deceleration cannot be taken in the point-table operation.
11	Serial Communication Alarm	Output if a serial communication error is detected.
12	Main Circuit Overvoltage	Output if the main circuit voltage is higher than the maximum value allowed. This can happen if the voltage input to the main circuit is more than the maximum value allowed or if the voltage of a driver's internal circuit rises because of regenerations and exceeds the maximum value allowed.
13	Main Circuit Undervoltage	Output if the main circuit voltage falls below the minimum value allowed. This can happen if the voltage input to main circuit is at or below 20V or the lack of the DC power supply's capacity.
14	Control circuit Overvoltage	Output if a control circuit voltage is higher than the maxium value allowed. This can happen if the voltage input to a control circuit is at or above 28V.
15	Control circuit Undervoltage	Output if a control circuit voltage falls below the minimum value allowed. This can happen if the voltage input to a control circuit is at or below 20V or the lack of the DC power supply's capacity.

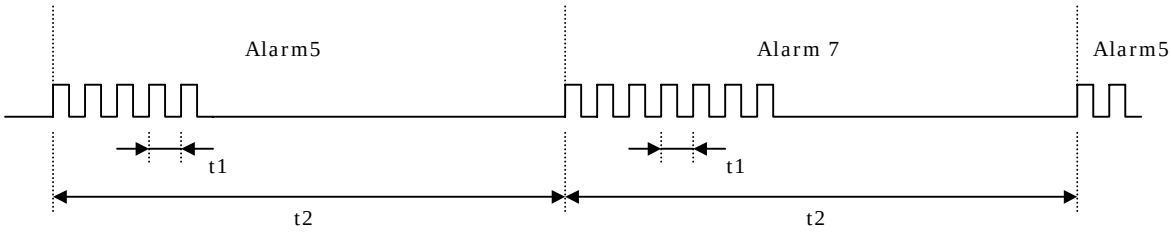
11-2. Acquiring Alarm Information

If an alarm occurs, the motor is turned off, and stops by the free running. The control output signal ALM is output at the same time.

If parameter 39 "Alarm Output Time Const." is "0", and ALM enters the ON state when an alarm occurs, the ALM output is a level output.

If parameter 39 "Alarm Output Time Const." has a value other than "0", the ALM signal repeats ON and OFF according to the timing that assumed by the value of parameter 39 as shown in the figure below. The number of the current alarm is sequentially output from lowest to highest. If maximum number of alarms is output, it returns to the minimum number and the cysle is repeated.

Example: Alarm 5: “Position Error Pulse Overflow" and alarm 7 ”Phase-B Overcurrent” occurring:



Sign	Meaning	Value	Unit
t1	Output unit time	Value parameter 39	ms
t2	One alarm output unit time	t1x16	

11-3. Alarm Reset

After the cause of occurrence is removed, you must reset the alarm. Use the following method to reset the alarm:

-The control input signal ARST

-The serial communication command [ARST]

-Turn the power supply off once and back on again.

The following table lists the reset for each alarm. Note that the alarms with “Invalid” in the Reset column cannot be reset by swiching the power supply off.

Alarm reset method

No.	Alarm name	Contents check	Reset
1	Main EEPROM Alarm	Contact the manufacturer (see Note 1 below).	Invalid
2	Motor EEPROM Alarm	Check wiring for the motor encoder line (for example: disconnections or loose connections.).	Invalid
3	Encoder Alarm	Check wiring for the motor encoder line (for example: disconnections or loose connections.).	Invalid
4	System Alarm	Check that the combination of the motor model and the driver model is compatible.	Invalid
5	Position Error Pulse Overflow	Check the parameter settings, the load state of the machine (for example, whether the machine edge is collideing with something), and the frequency of the reference pulse train.	Effective
6	Phase-A Overcurrent	Check the parameter settings, the load state of the machine (for example, whether the machine edge is collideing with something), and the frequency of the reference pulse train.	Effective
7	Phase-B Overcurrent	Check the parameter settings, the load state of the machine (for example, whether the machine edge is collideing with something), and the frequency of the reference pulse train.	Effective
8	Temperature / Motor Cable Alarm	Check the load state of the machine, the driver's installation situation, and the ambient temperature. Chcek the motor power line wiring (for example: disconnections or loose connections.)	Effective
9	Overload	Check the parameter settings, the load state of the machine (for example, whether the machine edge is collideing with something), and the speed of the frequency of the reference pulse train.	Effective
10	Shortage of Accel/Decel	Check whether the amount of movement and the speed are appropriate.	Effective
11	Serial Communication Alarm	Check the parameter settings and wiring for the serial communication line.	Effective
12	Main Circuit Overvoltage	Check whether the voltage input to the main circuit is an appropriate value. Check whether the usage condition exceeds the driver's regenerative proccessing ability. When exceeding it, connect the external regenerative proccessing circuit.	Effective
13	Main Circuit Undervoltage	Check whether the voltage input to the main circuit is an appropriate value. Check whether the capacity of the power supply is insufficient. (see Note 2 below)	Effective
14	Control circuit Overvoltage	Check whether the voltage input to the control circuit is an appropriate value.	Effective
15	Control circuit Undervoltage	Check whether the voltage input to the control circuit is an appropriate value. Check whether the capacity of the power supply is insufficient. (see Note 2 below)	Effective

Note1: When the driver starts, the data for the parameters and the point-tables are read from the driver's EEPROM. If an abnormality is found in the read data, the alarm 1 "main EEPROM alarm" occurs, and the value of the type (parameter or point-table) in which the abnormality is found is initialized to the default settings. If the alarm cannot be reset by turning the power off and back on or it occurs frequently, contact the manufacture.

note2: The current consumption of the power supply can be controlled by setting the maximum limit of output torque in parameter 75 "Forward Torque Limit" or parameter 76 "Reverse Torque Limit". However, if output torque is limited, the decrease of the control characteristics (over-shoot at accel/decel, vibration) might happen.

11-4. Alarm History

Si servo stores the information generated by the last 8 times.

11-4-1. Acquiring Alarm History

The alarm history can be viewed by the executing the serial communication command [ALM].

11-4-2. Clearing an Alarm History

The alarm history can be cleared by excecuting the serial communication command [HCL].

12. Parameter

12-1. Parameter list

Number	Name	Reboot	Unit	Minimum	Maximum	Factory setting
0	Axis Address	O	-	0	14	0
1	Control Input Preset Setup	O	-	0	2	0
2	Resolution Numerator	O	Pulse	1	65535	12800
3	Resolution Denominator	O	Pulse	1	65535	1
4	Reference Pulse Multiplier	O	-	1	65535	4
5						
6	Forward Software OT		Pulse	-99999999	99999999	0
7	Reverse Software OT		Pulse	-99999999	99999999	0
8	Save Current		mA	0	8000	note 1
9	Current Save Time		ms	0	999999	100
10	Preset Servo Tuning		-	0	15	0
11	Position Loop P Gain		-	0	9999	50
12	Position Loop FFD Gain		-	0	9999	0
13	Speed Loop P Gain		-	0	9999	5
14	Speed Loop D Gain		-	0	9999	15
15	Speed Loop I Gain		-	0	9999	70
16	Hold State IG Enable		-	0	1	1
17	Maximum Position Error		Encoder pulse	0	99999	6000
18	In-Position Area		Encoder pulse	0	99999	2
19	TFIN/VZR Output Range		rpm	0	4500	0
20	Reference Pulse Train Form	O	-	0	2	0
21	JOG Speed		rpm	1	4500	300
22	JOG Accel/Decel Time Const.		ms	1	999999	10
23	STEP Pulse 0		Pulse	-99999999	99999999	0
24	STEP Pulse 1		Pulse	-99999999	99999999	0
25	STEP Pulse 2		Pulse	-99999999	99999999	0
26	STEP Pulse 3		Pulse	-99999999	99999999	0
27	Zero-Point-Return Form	O	-	0	6	0
28	ZRTN Direction	O	-	0	1	0
29	ZRTN High Speed		rpm	1	4500	300
30	ZRTN Low Speed		rpm	1	4500	180
31	ZRTN Accel Time Const.		rpm	1	999999	500

Number	Name	Reboot	Unit	Minimum	Maximum	Factory setting
32	ZRTN Offset Pulse		Pulse	-99999999	99999999	12800
33	ZRTN Press Torque		%	0	300	50
34	Press Mode Speed Limit		rpm	1	4500	4500
35	Press Escape Speed. Limit		rpm	1	4500	4500
36	Press Mode Speed Limit ATC		ms	1	999999	10
37	Press Trq Inc/Dec TC		ms	1	999999	100
38	Operation Mode	O	-	0	1	0
39	Alarm Output Time Const.		ms	0	1000	100
40	Z Pulse Output Time		ms	1	1000	10
41	Input Filter Time Const.		ms	0	999	5
42	Pulse Smoothing TC		ms	0	9999	0
43	COM Format	O	-	0h	1Fh	0h
44	COM Reply Wait Time		ms	0	999	50
45	Input Method Select		-	0h	FFFFh	0h
46						
47	ServoFree Delay Time		ms	0	9999	0
48	Rotation Direction	O	-	0	1	0
49	Main Circuit Voltage	O	V	24	36	24
50	Open-Loop Max. Speed		rpm	0	4500	15
51	Open-Loop Drive Area		Encoder pulse	0	999	1
52	INP-Out Sample Time		ms	0	9999	0
53	Startup Hold Time		ms	500	999999	500
54	PointNumber Multiplier		-	0	63	0
55	VCMP Output Range		rpm	0	4500	10
56	Auto Tuning		-	0	1	0
57	Rotating System Pulse	O	Pulse	0	99999999	0
58	Machine Edge Detection Sequence	O	-	0	1	0
59	Grid-Mask Pulse		Encoder pulse	0	99999999	0
60	Extended Input Setup 1	O	-	0h	FFFFFFFFh	3B3A3938h
61	Extended Input Setup 2	O	-	0h	FFFFFFFFh	27h
62	ZRTN Offset Pulse					

Number	Name	Reboot	Unit	Minimum	Maximum	Factory setting
63	Extended Output Setup 1	O	-	0h	FFFFFFFFh	3E031Dh
64						
65	Control Input Logic Setup	O	-	0h	1Fh	0h
66	Control Output Logic Setup	O	-	0h	7h	0h
67						
68	Alarm Output Protect Setup		-	0h	Fh	0h
69						
70	Torque Select 0		%	0	300	300
71	Torque Select 1		%	0	300	300
72	Torque Select 2		%	0	300	300
73	Torque Select 3		%	0	300	300
74	Torque Select 4		%	0	300	300
75	Forward Torque Limit		%	0	300	0
76	Reverse Torque Limit		%	0	300	0

To apply any changes to any of the parameters with “O” in the reboot column, you must reboot the driver (turn off the power supply and turn it on again).

Note 1: The default setting of parameter 8 "Save Motor Current" is as follows.

Si-02LDE:200 Si-02DE:500

Si-05LDE:500 Si-05DE:2000

12-2. Parameter Details

<table>
<tr><th>No.</th><th>Contents</th><th>Unit</th><th>Min.</th><th>Max.</th><th>Factory setting</th></tr>
<tr><td>0</td><td>Axis Address
Specifies the axis address in case of multidrop communication by RS485. If the axis address overlaps, communication will not be performed correctly.

* To apply any chages to this parameter, you must reboot the driver.</td><td>-</td><td>0</td><td>14</td><td>0</td></tr>
<tr><td>1</td><td>Control Input Preset Setup
If this parameter is changed, the values for parameter 60 "Extended Input Setup 1" and "Extended Input Setup 2" is changed is synchronization, and the control input function can be changed collectively.
0:
<table>
<tr><th></th><th>Value</th><th>IN4</th><th>IN3</th><th>IN2</th><th>IN1/ 5</th></tr>
<tr><td>Parameter 60</td><td>3B3A3938h</td><td>TSEL2</td><td>TSEL1</td><td>TSEL0</td><td>RSEL</td></tr>
<tr><td>Parameter 61</td><td>27h</td><td></td><td></td><td></td><td>ERST</td></tr>
</table>
1:
<table>
<tr><th></th><th>Value</th><th>IN4</th><th>IN3</th><th>IN2</th><th>IN1/ 5</th></tr>
<tr><td>Parameter 60</td><td>13120302h</td><td>NOT</td><td>POT</td><td>NJOG</td><td>PJOG</td></tr>
<tr><td>Parameter 61</td><td>7h</td><td></td><td></td><td></td><td>DEC</td></tr>
</table>
2:
<table>
<tr><th></th><th>Value</th><th>IN4</th><th>IN3</th><th>IN2</th><th>IN1/ 5</th></tr>
<tr><td>Parameter 60</td><td>13120509h</td><td>NOT</td><td>POT</td><td>STR</td><td>P0_IN</td></tr>
<tr><td>Parameter 61</td><td>4h</td><td></td><td></td><td></td><td>ARST</td></tr>
</table>
The group of each control input function corresponds to the "command mode" in Si servo before version 2.
Although parameters 60 and 61 can be changed after that and the function of each control input terminal can be changed, the relationship between a parameter 1 and parameters 60 and 61 may not correspond as above.
* To apply any chage to this parameter, you must reboot the driver.</td><td>-</td><td>0</td><td>2</td><td>0</td></tr>
<tr><td>2
3</td><td>Resolution Numerator
Resolution Denominator
The number of position reference pulse corresponding to a motor rotation is set.
One motor rotation = $\frac{\text{Resolution Numerator}}{\text{Resolution Denominator}}$ [pulse]
* The values must be within the range where relation of
[Parameter 2] x [parameter 3] x 25600 < 2^{31} (2,147,483,648)
works out.
* To apply any chages to this parameter, you must reboot the driver.</td><td>Pulse</td><td>1</td><td>65535</td><td>12800
1</td></tr>
</table>

No.	Contents	Unit	Min.	Max.	Factory setting
4	Reference Pulse Multiplier If the contol input signal RSEL or the serial communication command [RSELON] is input, the value of this parameter is multiplied by the number of the pulses of reference pulse train input from the outside and it is assumed the internal position reference. Example: parameters 2 and 3, respectively "10000" and "1" (motor one revolution = 10000 pulse), this parameter is "4", and when the reference pulse train of +10000 pulse is input from the outside with control input signal RSEL has been turned ON, the motor makes 4 rotations (internal position reference pulse is +40000 pulses).	-	1	65535	4
6	Forward Software OT	Pulse	-99999999	99999999	0
7	Reverse Software OT The position reference is clamped when the reference position set by the reference pulse train input or the point-table operation, or JOG operation exceed this setting. If the current position is larger than the value set to the Forward Software OT, the operation to only reverse rotation is possible. If the current position is smaller than the value set to the Reverse Software OT, only forward operation is possible. When an OT occurs during point-table operation and JOG operation, point-table operation and JOG operation are cancelled. Moreover, the reference pulse train input from the outside while rotation has stopped by OT is disregarded. The soft OT function is invalid in the following cases: 1. If "0" is set for both Forward and Reverse. 2. If zero-point-return has not been completed (between from the startup of the driver to the zero-point-return completion when zero-point-return form is set besides "4: no zero-point-return"). note) When setting the rotation coordinate system (if parameter 57 " Rotating System Pulse" has a value other than "0"), software OT function might not operate normally. To prevent this, set "0" to both parameter 6 and parameter 7 to invalidate software OT function.				0

<table>
<tr><th>No.</th><th>Contents</th><th>Unit</th><th>Min.</th><th>Max.</th><th>Factory setting</th></tr>
<tr><td>8</td><td>Save Current
The current thrown to the motor for positional hold after the time passes set by parameter 9 "Current Save Time" after positioning is completed is set (current-down operation).
Driver's firmware limits the maximum value of the current that actually flows to the motor according to the model of the connected motor (see following table).

Maximum current according to motor model
<table><tr><th>Motor model</th><th>Max. current (mA)</th></tr><tr><td>TS3692N61S02</td><td>550</td></tr><tr><td>TS3641N61S02</td><td rowspan="5">3000</td></tr><tr><td>TS3617N370S04</td></tr><tr><td>TS3617N371S04</td></tr><tr><td>TS3653N324S04</td></tr><tr><td>TS3653N325S04</td></tr><tr><td>TS3653N327S04</td><td>8000</td></tr></table>Example) The current of 3000mA flows to the motor when TS3617N370S04 is connected and "5000" is set to this parameter.

In Si-02DE and Si-05DE, the driver generates heat if the current is set more than the rated current of the driver (It is 2000mA in Si-02DE, and 5000mA in Si-05DE). In this case to cool down the driver, air cooling with blower is required.
Si-02LDE and Si-05LDE does not need air cooling with blower because of relationship between the motor and the driver.
The factory settings are as follows:
Si-02LDE:200 Si-02DE:500
Si-05LDE:500 Si-05DE:2000</td><td>mA</td><td>0</td><td>8000</td><td>*</td></tr>
<tr><td>9</td><td>Current Save Time
The time thrown continuing the positioning current (rated current of the motor) after positioning is completed is set. If "0" is set, the positioning current keeps flowing without current-down operation.</td><td>ms</td><td>0</td><td>999999</td><td>100</td></tr>
</table>

<table>
<tr><th>No.</th><th>Contents</th><th>Unit</th><th>Min.</th><th>Max.</th><th>Factory setting</th></tr>
<tr><td>10</td><td>Preset Servo Tuning
Si servo has pre-created a group of the servo-gain group for various internal machine loads.
Groups from 0 to 7 can be used for the smooth low speed drive conditions and the groups from 8 - 15 can be used for high speed and high hit-rate drive condition. The set value is increases as the load grows for each drive condition.
If this parameter is changed, the number from parameter 11 "Position Loop P Gain" to parameter 16 "Hold State IG Enable" will automatically change according to the following.

<table>
<tr><td></td><td colspan="6">ParameterNo.</td></tr>
<tr><td>Value</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td></tr>
<tr><td>0</td><td>50</td><td>0</td><td>5</td><td>15</td><td>70</td><td>1</td></tr>
<tr><td>1</td><td>50</td><td>0</td><td>10</td><td>20</td><td>100</td><td>1</td></tr>
<tr><td>2</td><td>50</td><td>0</td><td>15</td><td>30</td><td>200</td><td>1</td></tr>
<tr><td>3</td><td>50</td><td>0</td><td>25</td><td>40</td><td>300</td><td>1</td></tr>
<tr><td>4</td><td>50</td><td>0</td><td>40</td><td>60</td><td>300</td><td>1</td></tr>
<tr><td>5</td><td>50</td><td>0</td><td>50</td><td>100</td><td>350</td><td>1</td></tr>
<tr><td>6</td><td>50</td><td>0</td><td>75</td><td>150</td><td>400</td><td>1</td></tr>
<tr><td>7</td><td>50</td><td>0</td><td>100</td><td>200</td><td>500</td><td>1</td></tr>
<tr><td>8</td><td>200</td><td>100</td><td>5</td><td>15</td><td>70</td><td>1</td></tr>
<tr><td>9</td><td>200</td><td>100</td><td>10</td><td>20</td><td>100</td><td>1</td></tr>
<tr><td>10</td><td>200</td><td>100</td><td>15</td><td>30</td><td>200</td><td>1</td></tr>
<tr><td>11</td><td>200</td><td>100</td><td>25</td><td>40</td><td>300</td><td>1</td></tr>
<tr><td>12</td><td>200</td><td>100</td><td>40</td><td>60</td><td>300</td><td>1</td></tr>
<tr><td>13</td><td>200</td><td>100</td><td>50</td><td>100</td><td>350</td><td>1</td></tr>
<tr><td>14</td><td>200</td><td>100</td><td>75</td><td>150</td><td>400</td><td>1</td></tr>
<tr><td>15</td><td>200</td><td>100</td><td>100</td><td>200</td><td>500</td><td>1</td></tr>
</table>
.</td><td>-</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>11</td><td>Position Loop P Gain
Specifies the proportional gain of the positional loop. If set too large, the overshoot and the hunting is generated. If set too small, the "position error pulse overflow" alarm occurs easily. Consider the rigidity of the machine when specifying his value.</td><td>-</td><td>0</td><td>9999</td><td>50</td></tr>
<tr><td>12</td><td>Position Loop FFD Gain
Specifies the coefficient at which the first differentiation of movement speed of reference position is given to the speed instruction. If set too large, vibration occurs.</td><td>-</td><td>0</td><td>9999</td><td>0</td></tr>
<tr><td>13</td><td>Speed Loop P Gain
Specifies the proportional gain of the speed loop. If this is set too large or too small, vibration occures. Consider the inertia and the rigidity of the load and the relation between the other servo gains when specifying this.</td><td>-</td><td>0</td><td>9999</td><td>5</td></tr>
</table>

No.	Contents	Unit	Min.	Max.	Factory setting
14	Speed Loop D Gain Specifies the proportional gain of the speed loop. If this is set too large or too small, vibration occures. Consider the inertia and the rigidity of the load and the relation between the other servo gains when specifying this.	-	0	9999	15
15	Speed Loop I Gain Specifies the integration gain of the speed loop. If this is too large, vibration occurs, and if it is too small, positioning may take too long.	-	0	9999	70
16	Hold State IG Enable Specifies whether speed loop's internal control operation is executed if a position shifts because an external force causes the reference position to stop. Specify "0", to stop while maintaining stability within the gap corresponding to the external force. If this is specified as "0" for a strong viscous machine, the motor may not arrive at the reference point depends on the settings for other servo-gains.	-	0	1	1
17	Maximum Position Error The maximum positional error is set in the unit of motor encoder pulses (motor encoder is 800 ppr in the motors TS3692N61S02 and TS3641N61S02 and is 1600 ppr in other motors). If the absolute value of the positional error pulse exceeds the value set for this parameter, the "position error pulse overflow" (alarm 5) occurs.	Encoder Pulse	0	99999	6000
18	In-Position Area The in-position area is set in units of the unit of motor encoder pulses (motor encoder is 800 ppr in motors TS3692N61S02 and TS3641N61S02 , and is 1600 ppr in other moters). The control output signal INP is turned ON if the absolute value of the positional error pulse is below the value set for this parameter. The control output signal FIN is turned ON if the automatic operation (point-table, zero-point-return, and JOG opelations) completes the movement of the reference position and the absolute value of the positional error pulse is below the value set for this parameter.	Encoder Pulse	0	99999	2
19	TFIN/VZR Output Range Specifies the signal output range of TFIN (torque completion) in the pressing operation and VZR (zero speed) in the speed control mode in the units of rpm. In the pressing mode, the control output signal TFIN is turned ON if the output torque (the torque instruction) of the motor is limited by the torque limitation value and the rotational speed of the motor axis is smaller than the value set for this parameter. In the speed control mode, the control output signal VZR is turned ON if the rotational speed of the motor axis is smaller than the value set for this parameter.	rpm	0	4500	0

No.	Contents	Unit	Min.	Max.	Factory setting
20	Reference Pulse Train Form 0: CW/CCW input Forward rotation (CW) pulse is input into Phase-A, reverse rotation (CCW) pulse is input into Phase-B. 1: PULSE/SIGN input Pulses are input into Phase-A and the sign of direction of rotation is input into Phase-B. 2: A/B phase (90-degree phase difference) input * To apply any chage to this parameter, you must reboot the driver.	-	0	2	0
21	JOG Speed Specifies the rotational speed of JOG operation in units of rpm.	rpm	1	4500	300
22	JOG Accel/Decel Time Const. Specifies the "Time to 3000-rpm acceleration from 0-rpm" is set for the acceleration-and-deceleration time constant in the JOG operation in units of ms.	ms	1	999999	10
23	STEP Pulse 0	Pulse	-99999	99999999	0
24	STEP Pulse 1		999		0
25	STEP Pulse 2				0
26	STEP Pulse 3 Specifies the signed number of pulses that moves for the STEP operation. A positive number specifies forward direction. A negative number specifies reverse direction. The absolute value of STEP Pulse 0 is used also as a step feed pulse of two step feed JOG operations.				0
27	Zero-Point-Return Form Specifies the Zero-point-return form. 0: LS passage 1: LS running aground 2: LS reverse 3: Pressing 4: No zero-point-return 5: Z-phase pulse disregarded -- sensor positioning 1 6: Z-phase pulse disregarded -- sensor positioning 2 * To apply any chage to this parameter, you must reboot the driver.	-	0	5	0
28	ZRTN Direction Specifies the direction rotation for zero-point-return starts. 0: forward 1: reverse * To apply any chage to this parameter, you must reboot the driver.	-	0	1	0
29	ZRTN High Speed Specifies the high revolution speed for the zero-point-return in units of rpm.	rpm	1	4500	300
30	ZRTN Low Speed Specifies the low revolution speed for the zero-point-return in units of rpm.	rpm	1	4500	180
31	ZRTN Accel Time Const. Specifies the "Time to 3000-rpm acceleration" for the acceleration-and-deceleration time constant in the zero-point-return sequence in units of ms.	ms	1	999999	500

No.	Contents	Unit	Min.	Max.	Factory setting
32	ZRTN Offset Pulse The distance from the position where Z-phase pulse is detected (LS detect position in case of form 5 and 6) to the zero point is set.	Pulse	-99999999	99999999	12800
33	ZRTN Press Torque Pressing torque in the zero-point-return form 3 "pressing" is set in units of a percentage of the rated torque of the motor.	%	0	300	50
34	Press Mode Speed Limit Specifies the speed limitation for the pressing operation in units of rpm.	rpm	1	4500	4500
35	Press Escape Speed Limit Specifies the speed limit at during the period operation is being shifted from the pressing operation to normal positioning operation and positioning is completed at the reference position in units of rpm.	rpm	1	4500	4500
36	Press Mode Speed Limit ATC Specifies the speed limit during the period operation is being shifted from the pressing operation to normal positioning operation and positioning is completed at the reference position is accelerated and decelerated, "time to 3000-rpm acceleration" is set as a time constant in units of ms.	ms	1	999999	10
37	Press Trq Inc/Dec TC Specifes the "Time required to increase and decrease between 0% and 100% torque limitation" in units of ms as a time constant of the increase and decrease of an actual torque limitation value.	ms	1	999999	100
38	Operation Mode Specifies the operation mode. 0: point-table mode 1: speed control mode * To apply any chage to this parameter, you must reboot the driver.	-	0	1	0
39	Alarm Output Time Const Specifies the unit time to output the control output signal ALM if an alarm occurs. If “0” is set, the ALM output becomes a level output (ALM outputs ON if an alarm occurs).	ms	0	1000	100
40	Z pulse Output Time Specifies the minimum output time of the control output signal ZPLS is set in units of ms. The control output signal ZPLS turns ON for the period of value (ms) set to this parameter from the time that detects ON edge of Z-phase pulse of motor encoder. The output of ZPLS is continued when the motor is at the position of Z-phase pulse after the set time passes.	ms	1	1000	10

<table>
<tr><th>No.</th><th>Contents</th><th>Unit</th><th>Min.</th><th>Max.</th><th>Factory setting</th></tr>
<tr><td>41</td><td>Input Filter Time Const.
Specifes the time constant for the software low-pass-filter applied to the signal of a control input terminal in unit of ms.
The logic of the signal input to driver internal CPU is fixed when the state of the control input terminal is stable during the period that is specified to the parameter. Note that a set value of this parameter is the delay time until the signal input from the outside is transmitted to internal CPU.</td><td>ms</td><td>0</td><td>999</td><td>5</td></tr>
<tr><td>42</td><td>Pulse Smoothing TC
Specifies the acceleration-and-deceleration time constant of smoothing filter to the position reference by reference pulse train in units of ms.
If this parameter is set to 100 and the reference pulse train of 1kHz is input without the accel/decel time, the movement speed in a internal reference position accelerates to 63.2% (from 0 to 632Hz) by 100ms, and decelerates to 36.8% (from 1kHz to 368Hz) by 100ms after the input of the reference pulse train from the outside stops.</td><td>ms</td><td>0</td><td>9999</td><td>0</td></tr>
<tr><td>43</td><td>COM Format (bit)
Specifies the baud rate, and the termination character (EOT[04h]/ETX[03h]) of the character string answered from servo, and small/capital character of hexadecimal notation of a reply data in RS485 serial communication are set by bit.

<table>
<tr><th>Setting item</th><th>BIT</th><th>0</th><th>1</th></tr>
<tr><td>Baud rate</td><td>0--2</td><td colspan="2">Following table</td></tr>
<tr><td>HEX</td><td>3</td><td>Small letter</td><td>Capital letter</td></tr>
<tr><td>Termination character</td><td>4</td><td>EOT</td><td>ETX</td></tr>
</table>

Baud rate (BIT0---2)
<table>
<tr><th>BIT 2</th><th>BIT 1</th><th>BIT 0</th><th>Baud rate (bps)</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>9600</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>19200</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>38400</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>57600</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>115200</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td rowspan="3">9600</td></tr>
<tr><td>1</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
</table>

* To apply any chage to this parameter, you must reboot the driver.</td><td>-</td><td>0</td><td>31(1Fh)</td><td>0</td></tr>
<tr><td>44</td><td>COM Reply Wait Time
In RS485 serial communication, after a servo receives a character string and executes a command, time until it starts a reply is set by the unit of ms.</td><td>ms</td><td>0</td><td>999</td><td>50</td></tr>
</table>

<table>
<tr><th>No.</th><th>Contents</th><th>Unit</th><th>Min.</th><th>Max.</th><th>Factory setting</th></tr>
<tr><td>45</td><td>Input Method Select (bit)
- Torque select
- Reference pulse multiply
- Point-specification
- ZSTR (start/stop of zero-point-return)
- STR (start/stop of point-table operation)
- JOG
- SVON
Specifies the input device of the instruction for the above-mentioned in units of bits (a couple by two bits).
00: Serial communication command
01: Control input signal
Only the device specified by this parameter is effected, instructions from other deviceses are disregarded. ("ERR04" is sent a reply if a serial communication command is disregarded).
<table>
<tr><th>Function</th><th>BIT</th><th>Value</th><th>Device</th></tr>
<tr><td rowspan="4">Torque selection</td><td rowspan="4">BIT13
BIT12</td><td>11</td><td rowspan="2">None (do not set up)</td></tr>
<tr><td>10</td></tr>
<tr><td>01</td><td>Communication command [TSEL0ON] [TSELOFF] etc.</td></tr>
<tr><td>00</td><td>Control input TSEL0 --- TSEL4</td></tr>
<tr><td rowspan="4">Reference pulse multiply</td><td rowspan="4">BIT11
BIT10</td><td>11</td><td rowspan="2">None (do notset up)</td></tr>
<tr><td>10</td></tr>
<tr><td>01</td><td>Communication command [RSELON] [RSELOFF]</td></tr>
<tr><td>00</td><td>Control input RSEL</td></tr>
<tr><td rowspan="4">Point specification</td><td rowspan="4">BIT9
BIT8</td><td>11</td><td rowspan="2">None (do notset up)</td></tr>
<tr><td>10</td></tr>
<tr><td>01</td><td>Communication command [PNT]</td></tr>
<tr><td>00</td><td>Control input P0_IN---P7_IN</td></tr>
<tr><td rowspan="4">ZSTR</td><td rowspan="4">BIT7
BIT6</td><td>11</td><td rowspan="2">None (do notset up)</td></tr>
<tr><td>10</td></tr>
<tr><td>01</td><td>Communication command [ZSTRON] [ZSTROFF] [ZSTRP]</td></tr>
<tr><td>00</td><td>Control inputs ZSTR and ZSTRP</td></tr>
<tr><td rowspan="4">STR</td><td rowspan="4">BIT5
BIT4</td><td>11</td><td rowspan="2">None (do notset up)</td></tr>
<tr><td>10</td></tr>
<tr><td>01</td><td>Communication command [STRON] [STROFF] [STRP]</td></tr>
<tr><td>00</td><td>Control inputs STR and STRP</td></tr>
<tr><td rowspan="4">JOG</td><td rowspan="4">BIT3
BIT2</td><td>11</td><td rowspan="2">None (do not set up)</td></tr>
<tr><td>10</td></tr>
<tr><td>01</td><td>Communication command [PJOGON] [NJOGON] [JOGOFF]</td></tr>
<tr><td>00</td><td>Control input PJOG, NJOG</td></tr>
<tr><td rowspan="4">SVON</td><td rowspan="4">BIT1
BIT0</td><td>11</td><td rowspan="2">None (do not set up)</td></tr>
<tr><td>10</td></tr>
<tr><td>01</td><td>Communication command [SVON] [SVOFF]</td></tr>
<tr><td>00</td><td>Control input SVON</td></tr>
</table>
.</td><td>-</td><td>0h</td><td>FFFFh</td><td>0h</td></tr>
<tr><td>47</td><td>ServoFree Delay Time
Specifies the time from the servo-off instruction to of the time the motor is actually turned off in units of ms. You can use this delay time for the timing adjustment when the pair of BK1 and BK2 is used as a signal of the brake release.</td><td>ms</td><td>0</td><td>9999</td><td>0</td></tr>
</table>

<table>
<tr><th>No.</th><th>Contents</th><th>Unit</th><th>Min.</th><th>Max.</th><th>Factory setting</th></tr>
<tr><td>48</td><td>Rotation Direction
Specifies the direction of motor rotation is set.
0: Forward instruction, the motor rotates clockwise as viewed from the motor shaft side.
1: Forward instruction, the motor rotates counter-clockwise as viewed from the motor shaft side.

* To apply any chage to this parameter, you must reboot the driver.</td><td>-</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>49</td><td>Main Circuit Voltage
Specifies the voltage input to the main circuit (V1 terminal of power supply input connector) in units of V.

* To apply any chage to this parameter, you must reboot the driver.</td><td>V</td><td>24</td><td>36</td><td>24</td></tr>
<tr><td>50</td><td>Open-Loop Max Speed
Specifies that the open-loop control is used if the movement speed of the reference position is smaller than the value set for this parameter (unit of rpm) and the positional error pulse is smaller than the value set for parameter 51 "Open-Loop Drive Area".</td><td>rpm</td><td>0</td><td>4500</td><td>15</td></tr>
<tr><td>51</td><td>Open-Loop Drive Area
Specifies that open-loop control is used if the positional error pulse is smaller than the value set for this parameter (unit of encoder pulse: motor encoder is 800ppr in the motor TS3692N61S02 and TS3641N61S02 and 1600 ppr in other moters) and the movement speed of reference position is smaller than the value set to parameter 50 "Open-Loop Max. Speed", it drives with the open-loop control.

(Cautions about a setup of parameters 50 and 51)
<table>
<tr><th>Movement speed</th><th>Positional error</th><th>Control state</th></tr>
<tr><td>Movement speed >= parameter 50</td><td>Not concerned with a positional error.</td><td>Closed-loop control</td></tr>
<tr><td rowspan="2">Movement speed < parameter 50</td><td>Positional error >= parameter 51</td><td>Closed-loop control</td></tr>
<tr><td>Positional error < parameter 51</td><td>Open-loop control</td></tr>
</table>
If using the open-loop control, smooth rotations are more likely than the usual closed-loop controls, but when positional error is generated in the machine system with, for example, strong viscosity, vibrations may be generated by the switching of open-loop and the closed-loop (two lines under the above table). In that case, set parameter 50 to a value that is smaller than the movement speed of reference position, and use closed loop control.
The offset proportional to the movement speed of reference position and Position Loop P Gain occurs to control by the encoder feedback in the closed-loop control when the motor is rotating. On the other hand, since open-loop control synchronizes with reference position completely and a motor rotates, there is no offset. Since the difference of this offset turns into difference in a sensor detection position when executing positioning by an external sensor input, set parameters in consideration of this respect.</td><td>Encoder Pulse</td><td>0</td><td>999</td><td>1</td></tr>
</table>

No.	Contents	Unit	Min.	Max.	Factory setting
52	INP-Out Sample Time In operation by the external pulse train input, when the time set to this parameter is passed over without the input of pulse train, the control output signal INP (in-position signal) is permitted. It can be used not to output the in-position signal if positional error is small during a refernce pulse input	ms	0	9999	0
53	Startup Hold Time. Specifies the time to continue the excitation at the motor reference point after a brake release signal is output if the first servo-on after the driver starts up. Refer to 8-2. Initializing Operation at the First Servo-On after the Driver Starts up for more details.	ms	500	999999	500
54	PointNumber Multilplier If the control input signal P0_IN-P7_IN specifies the point-table number, the number in which the value of this parameter is multiplied by the number input by P0_IN-P7_IN (0-255) is assumed to be an executed point-table number. If this value is more than 256, 0 is specified for the point-table number. If this parameter is "0", the number input by P0_IN-P7_IN is assumed the specification of the point-table number as they are (the same meaning as set value is "1").	-	0	255	0
55	VCMP Output Range Specifies the VCMP (speed compliance signal) output range of speed control mode is units of rpm. VCMP turns ON if the absolute value of motor speed error is the same or less than this parameter.	rpm	0	4500	10
56	Auto Tuning Specifies the execution of real-time auto-tuning of servo-gain. 0: Auto-tuning is not executed. 1: Auto-tuning mode 1 (position loop gain not included) 2; Auto-tuning mode 2 (position loop gain included) The auto-tuning of servo-gain with the internal auto-tuning algorithm is excuted by specifying this parameter. In the auto-tuning mode 1 (set value "1"), only speed loop gain (parameter 13-15) is automatically adjusted. Rewriting parameter 13-15 from the outside is disregarded. In the auto-tuning mode 2 (set value "2"), all of servo-gain (parameter 11-15) is automatically adjusted. Rewriting parameter 11-15 from the outside is disregarded.	-	0	2	0
57	Rotating System Pulse If the rotation coordinate system is set to the point-table, this specifies the number of pulses that corresponds to one rotation. Specify "0" to set a straight line coordinate system usual set. note) When the rotation coordinate system is set (if this parameter has a value other than "0"), software OT function might not operate normally. To prevent this, set "0" to both parameter 6 "Forward Software OT" and parameter 7 "Reverse Software OT" to invalidate software OT function. * To apply any chage to this parameter, you must reboot the driver.	Pulse	0	99999999	0

No.	Contents	Unit	Min.	Max.	Factory setting
58	Machine Edge Detection Sequence If "1" is specified, the machine edge detection sequence is excuted. In the first servo-on after the driver starts up, when the motor is in the machine edge, initialization of internal motor control software cannot be completed normally, and the motor control afterwards might not be able to be done normally. To avoid this, an automatic sequence that detects the existence of the machine edge is done by automatically rotating the motor. The motor rotates from the position before servo-on in the maximum +-about 15.3 degrees.	-	0	1	0
59	Grid-Mask Pulse (version 2.20 or later) Z-phase pulse of the motor encoder between the distances of the number of pulses (motor encoder pulse unit) set to this parameter from LS or machine edge is disregarded. Specify "0" to make the grid-mask function invalid.	Encoder Pulse	0	99999999	0
60	Extended Input Setup 1 (bit) Specifies the control input signal allocations for IN0, IN1, IN2, and IN3. Refer to 7-1.Control Input Signal for more details. * To apply any chage to this parameter, you must reboot the driver.	-	0h	FFFF FFFFh	3B3A 3938h
61	Extended Input Setup 2 (bit) Specifies the control input signal allocation for IN4. Refer to 7-1.Control Input Signal for more details. * To apply any chage to this parameter, you must reboot the driver.	-	0h	FFFF FFFFh	27h
63	Extended Output Setup 1 (bit) Specifies the control output signal allocation for OUT0, OUT1, and OUT2. Refer to 7-2.Control Output Signal for more details. * To apply any chage to this parameter, you must reboot the driver.	-	0h	FFFF FFFFh	3E 031Dh
65	Control Input Logic Setup (bit) Specifies the polarity of control input terminals. If each BIT is "0", CLOSE turns it ON. If each BIT is "1", OPEN turns it ON. BIT0:IN0 BIT1:IN1 BIT2:IN2 BIT3:IN3 BIT4:IN4 * To apply any chage to this parameter, you must reboot the driver.	-	0h	1Fh	0h
66	Control Output Logic Setup (bit) Specifies the polarity of control output terminals. If each BIT is "0", ON turns it CLOSE. If each BIT is "1", ON turns it OPEN. BIT0:OUT0 BIT1:OUT1 BIT2:OUT2 BIT3:BK * To apply any chage to this parameter, you must reboot the driver.	-	0h	Fh	0h

<table>
<tr><th>No.</th><th>Contents</th><th>Unit</th><th>Min.</th><th>Max.</th><th>Factory setting</th></tr>
<tr><td>68</td><td>Alarm Output Protect Setup (software version 2.20 or later)
alarm 5: Position Error Pulse Overflow
Alarm 10: Shortage of Accel/Decel
Alarm 11: Serial Communication Alarm
Alarm 13: Main Circuit Undervoltage
Specifies whether or not the alarm occurrence (and, servo-off) for the above alarms are permitted.
An alarm occurrence is permitted by "0" and is prohibited by "1".
<table>
<tr><th>Alarm</th><th>BIT</th><th>0</th><th>1</th></tr>
<tr><td>Positional Error Pulse Overflow</td><td>0</td><td>Permitted</td><td>Prohibited</td></tr>
<tr><td>Shortage of Accel/Decel</td><td>1</td><td>Permitted</td><td>Prohibited</td></tr>
<tr><td>Serial Communication Alarm</td><td>2</td><td>Permitted</td><td>Prohibited</td></tr>
<tr><td>Main Circuit Undervoltage</td><td>3</td><td>Permitted</td><td>Prohibited</td></tr>
</table>
.</td><td>-</td><td>0h</td><td>Fh</td><td>0h</td></tr>
<tr><td>70</td><td rowspan="5">Torque Select 0
Torque Select 1
Torque Select 2
Torque Select 3
Torque Select 4
Specify the torque limitation values of being specified by the control input signal TSEL0-TSEL4 or the serial communication command [TSEL0ON]-[TSEL1ON] in units of a percentage of the rated torque of the motor.</td><td rowspan="5">%</td><td rowspan="5">0</td><td rowspan="5">300</td><td>300</td></tr>
<tr><td>71</td><td>300</td></tr>
<tr><td>72</td><td>300</td></tr>
<tr><td>73</td><td>300</td></tr>
<tr><td>74</td><td>300</td></tr>
<tr><td>75</td><td rowspan="2">Forward Torque Limit (version 2.20 or later)
Reverse Torque Limit (version 2.20 or later)
The maximum value of the motor output torque (limitation value) at the time of usual driving each forward direction and reverse direction is set in units of a percentage of the rated torque of the motor.
Specify "0" to operate the same way as meaning (300 %) as set value "300".</td><td></td><td>0</td><td>300</td><td>0</td></tr>
<tr><td>76</td><td>0</td></tr>
</table>

13. Status Display LED

13-1. State of Driver, and the Display of LED

The driver LED (red) of driver displays the state as follows:

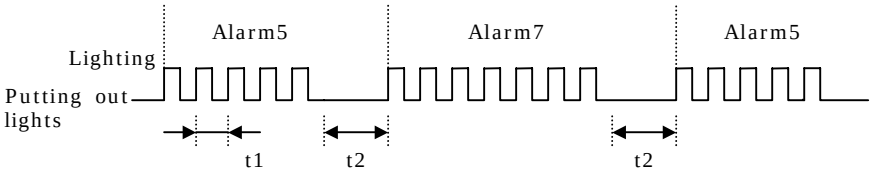
Thedriver state and the LED display.

LED display	Driver state	Contents
Not lit	None	No power is supplied to the control circuit, and the driver does not operate.
Lit	Normal	Power is supplied to the control circuit, and the driver is operating normally.
Blink (1)	Alarm	Alarm occurs. Refer to 13-2.Alarm Display
Blink (2)	Under EPROM writing	Data is written in EEPROM (non-volatile memory) in the driver. Refer to 13-3.EEPROM Writing Display
Blink(3)	CPU error	CPU error occurs. Refer to 13-4.CPU Error Display

13-2. Alarm Display

The LED displays alarms by blinking according to timing displayed in the figure below. The number of an alarm currently occurring is displayed sequentially from lowest to highest number. If the maximum number of alarm is output, it returns to the minimum number and the cycle is repeated.

Example: Alarm 5: “Position Error Pulse Overflow" and alarm 7 ”Phase-B Overcurrent” occur



Sign	Meaning	Value	Unit
t1	Blink unit time	400	ms
t2	Quiescent time between alarms	800	

13-3. EEPROM Writing Display

If a serial communication command [FLASH] is received, or when teaching operation by a control input signal is executed, the parameter and point-table in the driver are written in EEPROM (non-volatile memory). While executing this writing, status display LED blinks with the cycle of 1 Hz (500 ms lit, 500 ms not lit).

Note that if the control circuit power supply is turned off while executing this writing, writing is not completed normally and the alarm 1 "main EEPROM alarm" occurs at the next startup of driver.

The time requied to write all parameter and all point-table (256 points) is about 13 seconds.

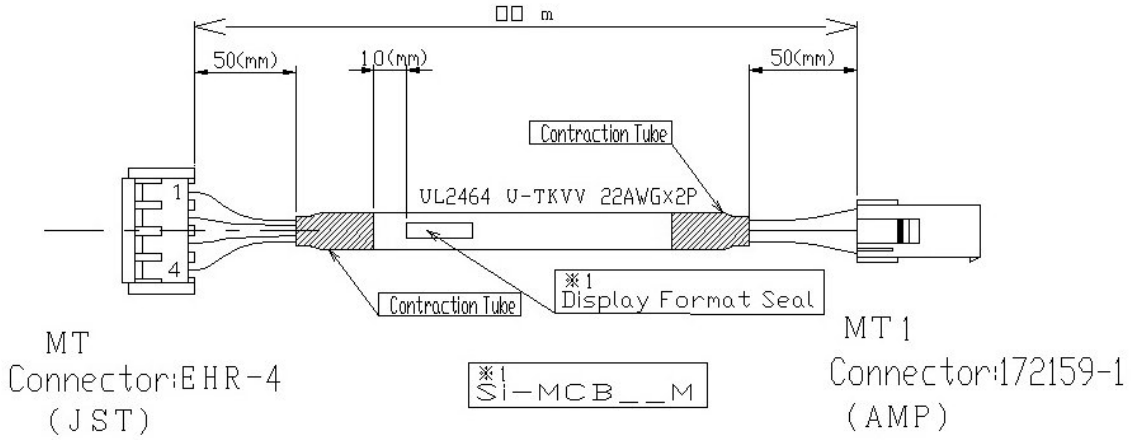
If an alarm occurs, the EEPROM writing display is displayed in order of priority.

13-4. CPU Error Display

If the driver system cannot cotinbue control because of, for example, noise, the LED blinks at high speed (about 4 Hz), and all the operations become invalid. At this time, the output by the ALM signal is not done. If the driver reboots and is not released, contact the manufacturer for more details.

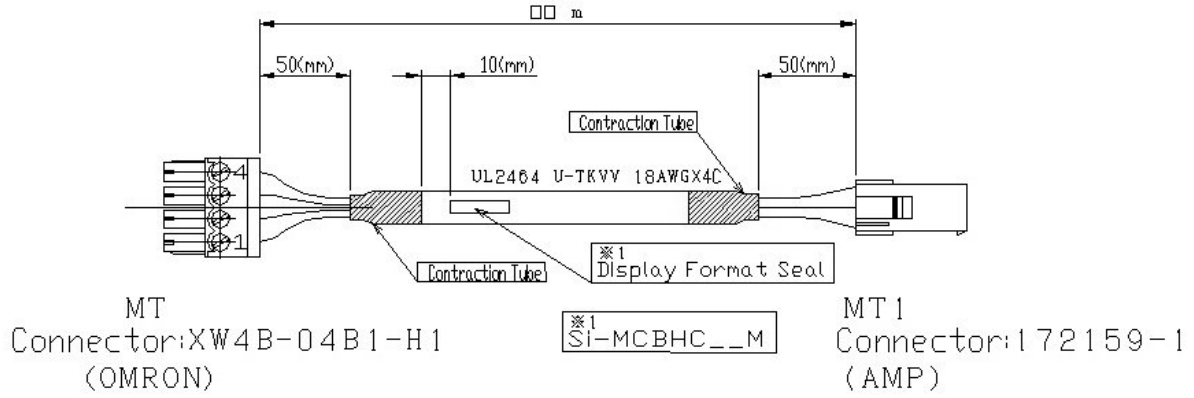
14. Option

14-1. Motor Cable Si-MCB__M (Si-02LDE,Si-02DE)



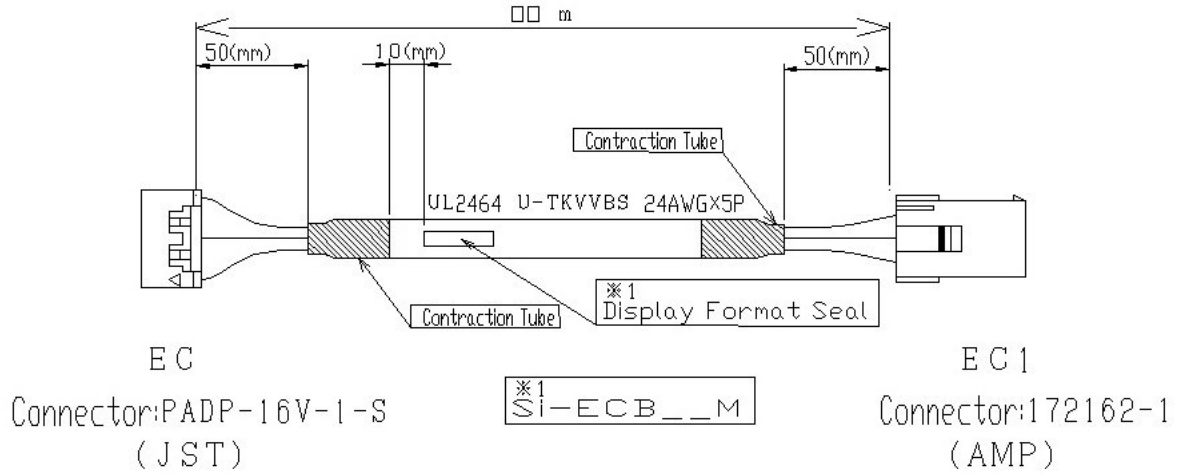
Connector Name	MT		Connector Name	MT1	
Terminal Number	Signal Name	Color of Line	Terminal Number	Signal Name	Color of Line
1	+Alpha	Black	1	+Alpha	Black
2	-Alpha	Black/White	2	-Alpha	Black/White
3	+Beta	Red	3	+Beta	Red
4	-Beta	Red/White	4	-Beta	Red/White

14-2. Motor Cable Si-MCBHC__M (Si-05LDE,Si-05DE)



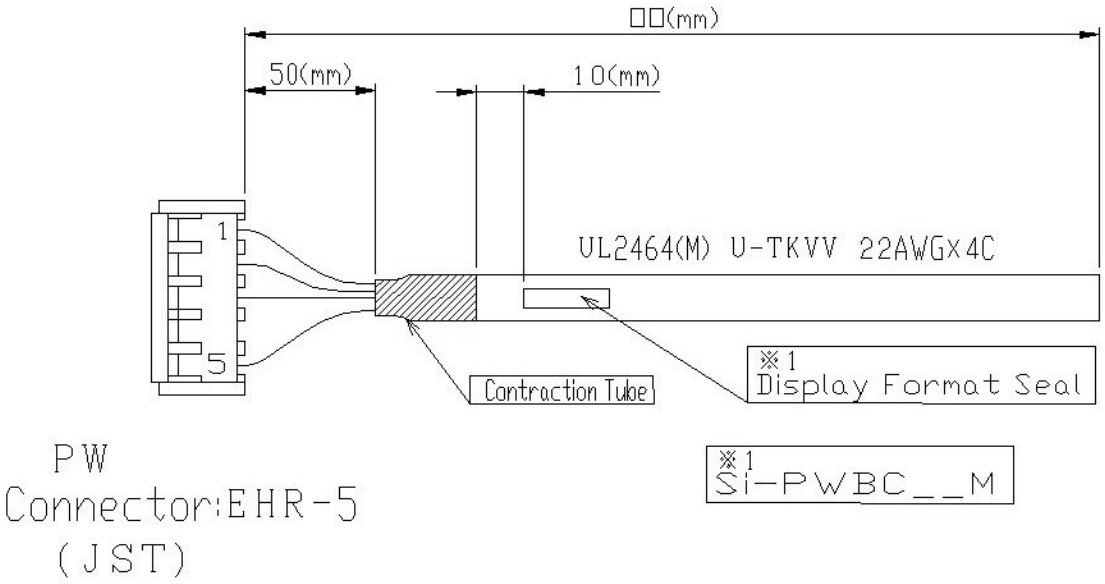
Connector Name	MT		Connector Name	MT1	
Terminal Number	Signal Name	Color of Line	Terminal Number	Signal Name	Color of Line
1	+Alpha	Red	1	+Alpha	Red
2	-Alpha	White	2	-Alpha	White
3	+Beta	Black	3	+Beta	Black
4	-Beta	Green	4	-Beta	Green

14-3. Encoder Cable Si-ECB__M



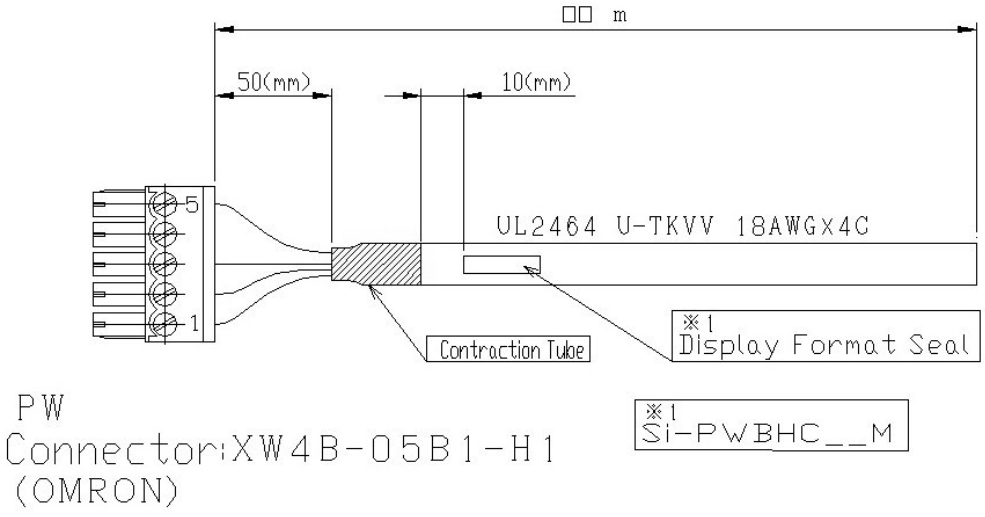
Connector Name	EC		Connector Name	EC1	
Terminal Number	Signal Name	Color of Line	Terminal Number	Signal Name	Color of Line
1	FG	Shield	1	FG	Shield
2-6	-	-	2	-	-
7	DO-A	Black	3	DO-A	Black
8	NDO-A	Black/White	4	NDO-A	Black/White
9	SK-B	Red	5	SK-B	Red
10	NSK-B	Red/White	6	NSK-B	Red/White
11	SEL	Green	7	SEL	Green
12	NSEL	Green /White	8	NSEL	Green /White
13	DI-Z	Yellow	9	DI-Z	Yellow
14	NDI-Z	Yellow /White	10	NDI-Z	Yellow /White
15	Vcc	Brown	11	Vcc	Brown
16	GND	Brown/White	12	GND	Brown/White

14-4. Power Cable Si-PWBC__M (Si-02LDE,Si-02DE)



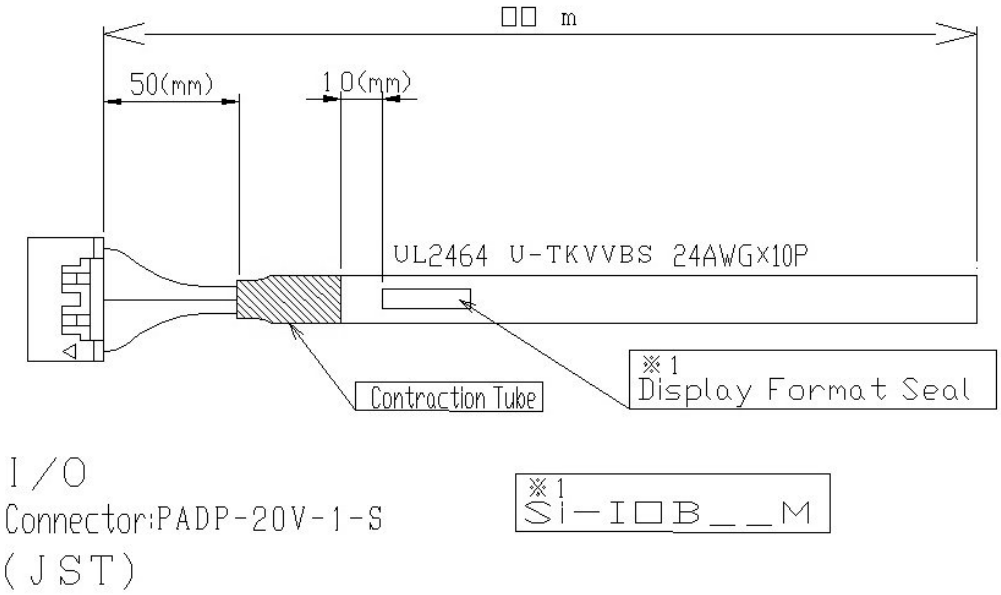
Connector Name	PW	
Terminal Number	Signal Name	Color of Line
1	V1	Red
2	V2	White
3	0V	Black
4	-	-
5	E	Green

14-5. Power Cable Si-PWBHC__M (Si-05LDE,Si-05DE)



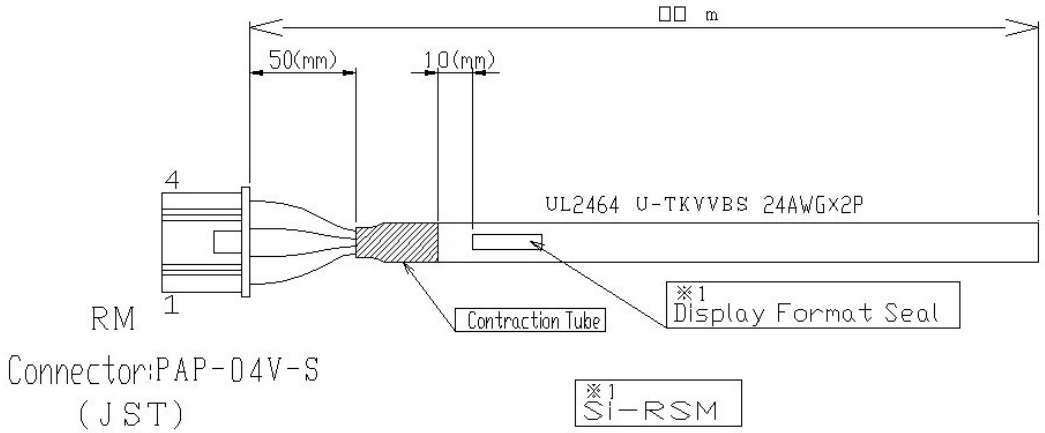
Connector Name	PW	
Terminal Number	Signal Name	Color of Line
1	V1	Red
2	V2	White
3	0V	Black
4	-	-
5	E	Green

14-6. I/O Cable Si-IOB__M



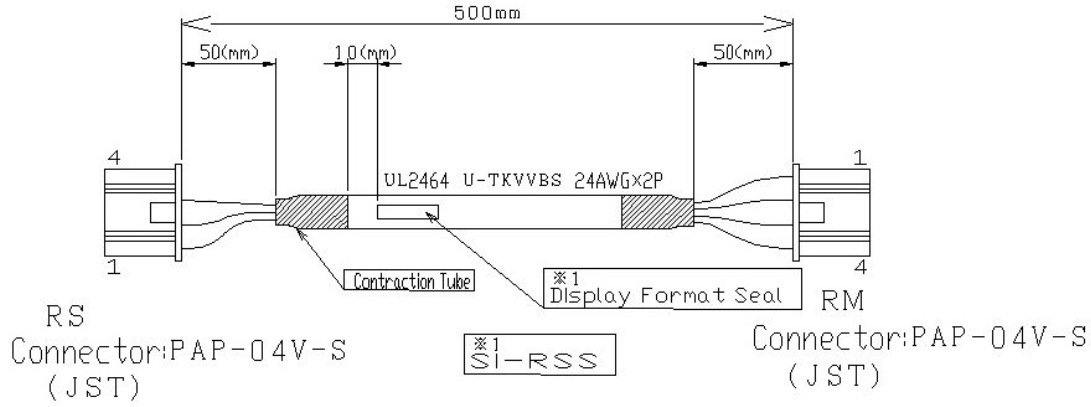
Connector Name	I/O	
Terminal Number	Signal Name	Color of Line
1	FG	Shield
2-4	-	-
5	BK2	Black
6	BK1	Black/White
7	COM-OUT	Red
8	OUT2	Red/White
9	OUT1	Green
10	OUT0	Green /White
11	COM-IN	Yellow
12	IN4	Yellow /White
13	IN3	Brown
14	IN2	Brown/White
15	IN1	Blue
16	IN0	Blue/White
17	CCWN	Gray
18	CCWP	Gray /White
19	CWN	Orange
20	CWP	Orange/White

14-7. RS485 Master Cable Si-RSM__M



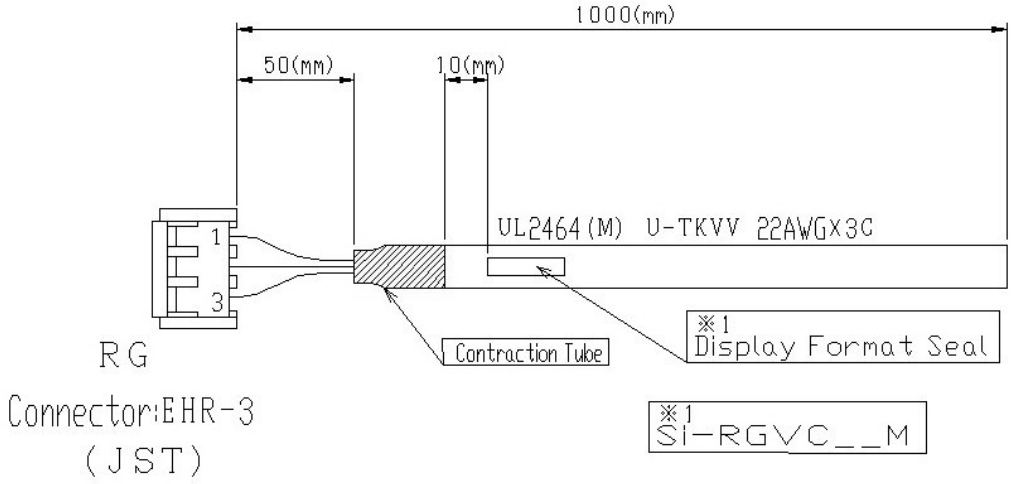
Connector Name	RM	
Terminal Number	Signal Name	Color of Line
1	TRX+	Black
2	TRX-	Black/White
3	GND	Red
4	FG	Shield

14-8. RS485 Slave Cable Si-RSS



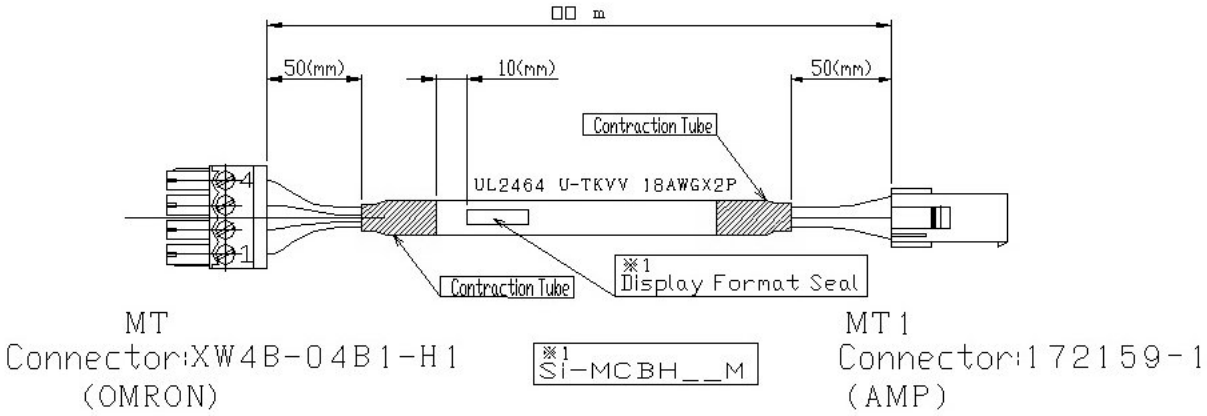
Connector Name	RS		Connector Name	RM	
Terminal Number	Signal Name	Color of Line	Terminal Number	Signal Name	Color of Line
1	TRX+	Black	1	TRX+	Black
2	TRX-	Black/White	2	TRX-	Black/White
3	GND	Red	3	GND	Red
4	FG	Shield	4	FG	Shield

14-9. Regeneration Cable Si-RGVC



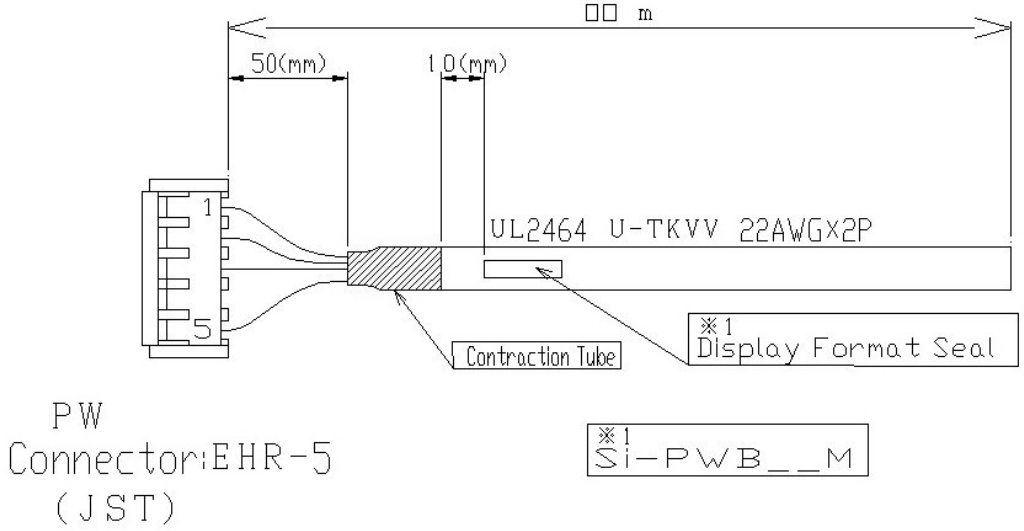
Connector Name	RG	
Terminal Number	Signal Name	Color of Line
1	P1	Red
2	P2	White
3	0V	Black

14-10. (Old type) Motor Cable Si-MCBH__M (Si-05LDE,Si-05DE)



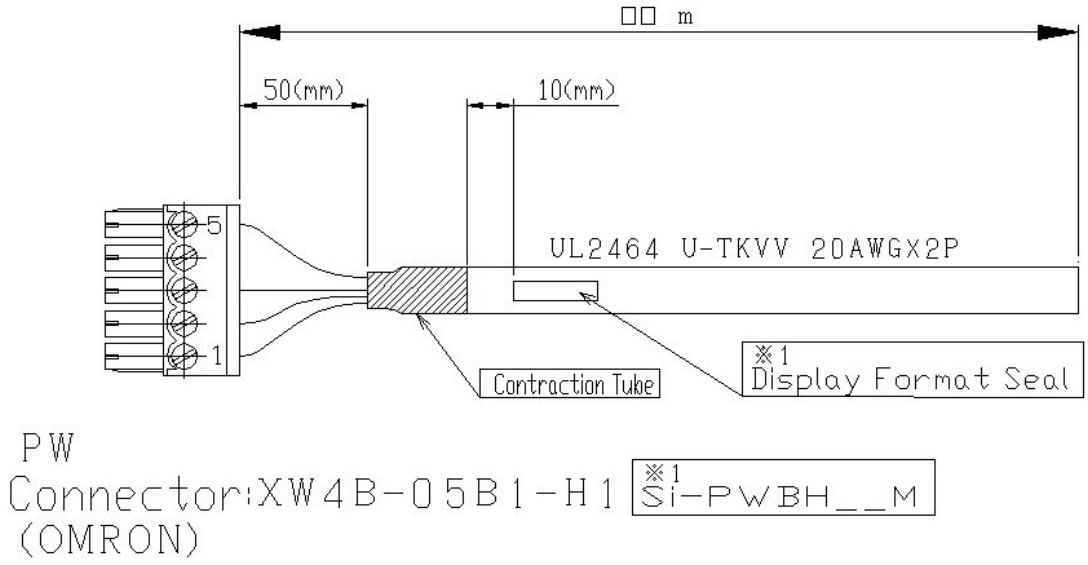
Connector Name	MT		Connector Name	MT1	
Terminal Number	Signal Name	Color of Line	Terminal Number	Signal Name	Color of Line
1	+Alpha	Black	1	+Alpha	Black
2	-Alpha	Black/White	2	-Alpha	Black/White
3	+Beta	Red	3	+Beta	Red
4	-Beta	Red/White	4	-Beta	Red/White

14-11. (Old type) Power Cable Si-PWB__M (Si-02LDE,Si-02DE)



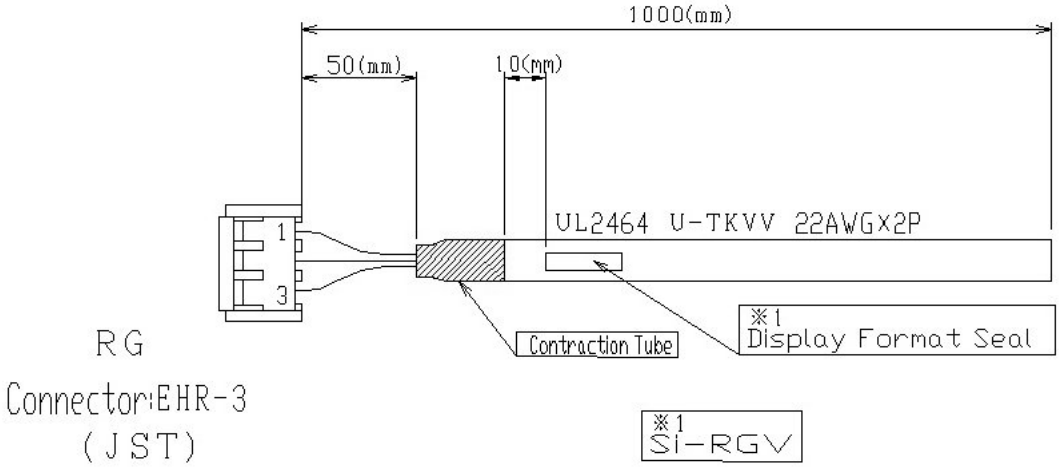
Connector Name	PW	
Terminal Number	Signal Name	Color of Line
1	V1	Black
2	V2	Black/White
3	0V	Red
4	-	-
5	E	Red/White

14-12. (Old type) Power Cable Si-PWBH__M (Si-05LDE,Si-05DE)



Connector Name	PW	
Terminal Number	Signal Name	Color of Line
1	V1	Black
2	V2	Black/White
3	0V	Red
4	-	-
5	E	Red/White

14-13. (Old type) Regeneration Cable Si-RGV



Connector Name	RG	
Terminal Number	Signal Name	Color of Line
1	P1	Black
2	P2	Black/White
3	0V	Red

14-14. Connecter Kit Si-CNK02 (Si-02LDE, Si-02DE)

Name	Model	Amount	Maker
Connecter (RG)	EHR-3	1	JST
Pin (RG)	SEH-001T-P0.6L	4	JST
Connecter (MT)	EHR-4	1	JST
Pin (MT)	SEH-001T-P0.6L	5	JST
Housing (PW)	EHR-5	1	JST
Pin (PW)	SEH-001T-P0.6L	5	JST
Housing (RS,RM)	PAP-04V-S	2	JST
Pin (RS,RM)	BPHD-001T-P0.5L	10	JST
Housing (IO)	PADP-20V-1-S	1	JST
Pin (IO)	SPH-001T-P0.5L	18	JST
Housing (EC)	PADP-16V-1-S	1	JST
Pin (EC)	SPH-001T-P0.5L	12	JST
Housing (MT1)	172159-1	1	AMP
Pin (MT1)	170361-1	5	AMP
Connecter (EC1)	172162-1	1	AMP
Pin (EC1)	170361-1	12	AMP

14-15. Connecter Kit Si-CNK05 (Si-05LDE, Si-05DE)

Name	Model	Amount	Maker
Connecter (RG)	EHR-3	1	JST
Pin (RG)	SEH-001T-P0.6L	4	JST
Connecter (MT)	XW4B-04B1-H1	1	OMRON
Pin (MT)	216-203	5	WAGO
Housing (PW)	XW4B-05B1-H1	1	OMRON
Pin (PW)	216-203	5	WAGO
Housing (RS,RM)	PAP-04V-S	2	JST
Pin (RS,RM)	BPHD-001T-P0.5L	10	JST
Housing (IO)	PADP-20V-1-S	1	JST
Pin (IO)	SPH-001T-P0.5L	18	JST
Housing (EC)	PADP-16V-1-S	1	JST
Pin (EC)	SPH-001T-P0.5L	12	JST
Housing (MT1)	172159-1	1	AMP
Pin (MT1)	170362-1	5	AMP
Connecter (EC1)	172162-1	1	AMP
Pin (EC1)	170361-1	12	AMP

(Si-MCBHC__M,Si-PWBHC__M correspondence article)

14-16. Regenerative Capacitor Kit Si-RGVCK

Name	Model	Amount	Maker
Electrolytic capacitor	KMH63LGSN4700MB (63V, 4700uF)	1	Japam Chemi-con
Resistor	S`R2C222J (1W, 2.2kohm)	1	KOA

15. Regenerative Processing Circuit

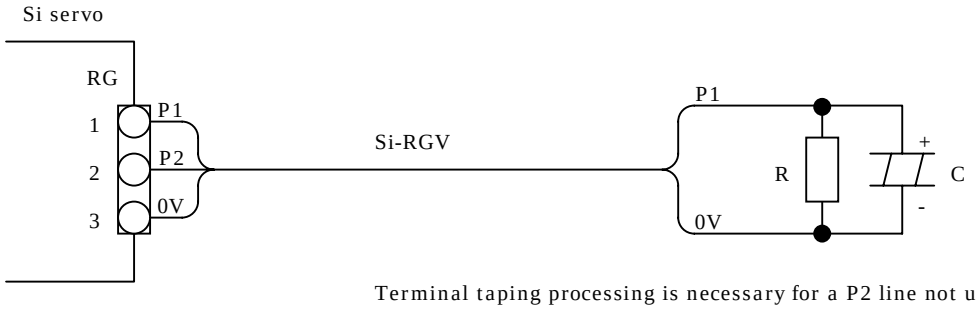
Regenerative processing circuit is not built by Si servo. For this reason, if the main circuit voltage inside the driver is higher than the value regulated by regeneration, the "Main Circuit Overvoltage" (Alarm 12) occurs. In such a case, an external regenerative processing circuit is needed to connect to RG connector on driver.

The capacitor and the resistor are connected with RG: regenerative processing circuit connector with the regeneration cable (Si-RGV). The regenerative energy "W" that can be absorbed with capacitor when the main circuit supply voltage is 24V is W = 962C [J], when the capacitance is "C" [F]. Therefore, select a capacitor that dees not allow regenerative energy in one cycle operation to exceed "W".
It is recommended to use a lomg life, large-scale aluminum electrolytic capacitor "C" rated voltage 63V, 105 degrees, with high ripple characteristics. For example: NIPPON CHEMI-CON LXA series.
Resistor R has aimed at the discharge of the capacitor. Usually, using 1W and about 2.2kohm.
Regeneration cable Si-RGV is an optional cable. A resistor and the capacitor can be prepared or the "regenerative capacitor kit" (Si-RGVCK) can be used.

Regenerative capacitor kit Si-RGVCK

Electrolytic capacitor: KMH63LGSN4700MB (NIPPON CHEMI-CON, 63V, 4700 uF)

Resistor: SPR2C222J (KOA, 1W, 2.2kohm)

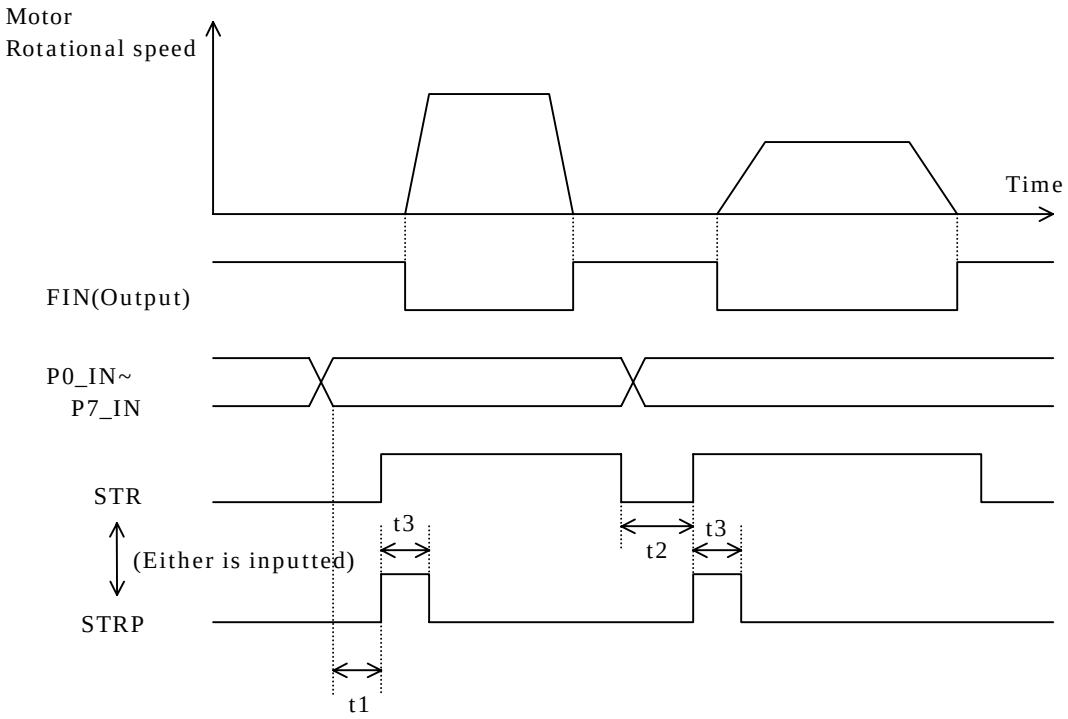


Terminal taping processing is necessary for a P2 line not used.

16. Additional Data

16-1. Control Input Signal P0_IN~P7_IN, STR, STRP Timing

When the point-table operation is performed by control input signal, the point specification has to be set up before the point starting signal as “STR” or “STRP” is inputted. If it is not performed as the following operating timing, it is possible to perform the wrong point number.



Point-table operation signal timing (notes)

Sign	Meaning	Min.	Max.	Unit
t1	Point number input - start setup time	500	-	ms
t2	Start OFF - start-ON width	3	-	ms
t3	STRP pulse width	2	-	ms

Note: The logic waveform of a timing chart are all a high if they are active and displayed.

A numeric value is a value which does not take into consideration the time constant set up with the parameter 41 " Input Filter Time Const."

ZSTRP in Home Reset starting (zero start one shot input) is also the same pulse width as t3.

16-2. Details about Over Travel (Hardware OT, Software OT)

This section is explained about details of OT operations and the method of recovery from OT (hardware OT, software OT) state.

16-2-1. Hardware OT

-If the forward hardware OT signal (control input POT) is inputted when Si servo is given forward instructions by reference pulse train from a host controller, positioning is completed in the current position. And then, FIN/INP is output. The reference pulse train of forward instruction is disregarded, while the forward hardware OT signal is inputted.

-In the same way, if the reverse hardware OT signal (control input NOT) is inputted when Si servo is given reverse instructions by reference pulse train from a host controller, positioning is completed in the current position. And then, FIN/INP is outputted. The reference pulse train of reverse instruction is disregarded, while the reverse hardware OT signal is inputted.

-The automatic operation is interrupted when hardware OT signal (control input POT or NOT) is inputted during the automatic operation (point-table, zero-point-return, JOG operations, Step operation). And then positioning is completed in the current position, a motor stops. Finally, control output signal FIN/INP is outputted.

-Point-table operation and Zero-Point-Return cannot be started, while the forward or the reverse hardware OT signal is inputted. It can be started that JOG operation or Step operation which rotates in the opposite direction of OT signal. If reference pulse train which is opposite direction of OT signal is inputted, it can be available.

16-2-2. Software OT

-If position reference which is pulse train from a host controller or automatic operation (point-table, zero-point-return, JOG operations, Step operation) is less than parameter 6 “Forward Software OT” or more than parameter 7 “Reverse Software OT”, position reference is clamped to the value of software OT. If the value of inputted pulse train is more than that of software OT, it is disregarded.

-If software OT would be occurred, automatic operation is interrupted. After that, motor stops at the software OT position, contorol output FIN/INP is outputted. And then, next automatic operation can be started.

-If forward or reverse software OT would be occurred, Point-Table operation cannot be started. It can be started that JOG operation or Step operation which rotates in the opposite direction of software OT signal. If reference pulse train which is opposite direction of software OT signal is inputted, it can be available.

16-2-3. The check of OT state

-If forward hardware or software OT would be occurred, control output POTOUT turns ON. And Bit 24 [+OT] in status of servo in serial communication command [MON] becomes “1”.

-If reverse hardware or software OT would be occurred, control output NOTOUT turns ON. And Bit 24 [-OT] in status of servo in serial communication command [MON] becomes “1”.

16-2-4. OT under the speed control mode

When setting the parameter 38 "Operation Mode" to "1" as speed control mode, all the OT (hardware OT, software OT) become invalid.

16-2-5. OT operation classification

The following contents are shown in a table.

(a) The stop of operation by hardware or software OT during reference pulse train operation or automatic operation.

(b) Starting of automatic operation to the reverse direction of OT.

	Stop by hardware OT	Starting to the reverse direction of hardware OT	Stop by software OT	Starting to the reverse direction of hardware OT
Pulse train	Stop	Effective	Stop	Effective
Point-table	Stop *1	Invalid	Stop	Invalid
Zero-point-return	Stop *1	Invalid	Don't stop *2	---*2
JOG operation	Stop	effective	Stop	Effective
Step operation	Stop	effective	Stop	Effective
Point-table [speed control mode]	Don't stop *3	---	Don't stop *3	---
JOG operation [speed control mode]	Don't stop *3	---	Don't stop *3	---

*1) When reverse hardware OT is inputted under Point-table operation or Zero-point-return for forward rotation direction performing or forward hardware OT is inputted under Point-table operation or Zero-point-return for reverse rotaion direction performing, motor stops.

*2) When Zero-Point-Return is started up, it becomes uncompleted state of ZRTN. Software OT is invalid under that.

*3) Under the speed control mode, all the OT (hardware OT / software OT) become invalid.

16-2-6. The cautions about a software OT setup

-When setting both forward software OT "parameter 6" and reverse software OT "parameter 7", software OT are invalid.

-When position reference is the same of setting value of software OT, software OT is also occurred. And when Zero-point-return is completed, position reference is automatically set "0". So when forward software OT or reverse software OT is set "0", be careful not to start Point-table operation with Zero-point-return completed.

16-3. Details of torque limit operation and of application of torque limit value

This section is explained about the details of a torque set up of a point table, torque limit operation with a parameter, and the priority of application of torque limit value.

16-3-1. Related setting items and Related parameters

-Setting item of point-table “ Torque “.

-Parameter 33 “ ZRTN Press Torque ”.

-Parameter 70 “ Torque Select 0 ” - Parameter 74 “Torque Select 4 “

-Parameter 75 “ Forward Torque Limit ” Parameter 76 “Reverse Torque Limit “

16-3-2. The priority of a application of torque limit value

There are three kinds of cases which apply a torque limit value. The priority is as follows.

(1) The case that a point table with a torque setup or ZRTN is operating. [the priority level : high]

A priority becomes the highest at the following.

(a)Under execution of the point table with “Torque” set up except for "0".

(b)Torque limited period from ZRTN operation started to motor reversimg at the machine end in the parameter 27 “ 3 : Pressing ”.

Point table operation with “Torque” set up except for “0” is performed within the set-up torque limit value. And then, special operation, for example, the FIN output by torque completion and error clearance, is performed. [Please refer to the "Torque Limitation" section of a separate volume "Operation Manual- Point-Table Part-" for details]

A torque reference value is limited with the value of a parameter 33 "ZRTN Press Torque" from ZRTN operation started to motor reverseing at the machine end in parameter 27 “Zero Point Return Function 3 : Pressing. The torque limit with a parameter 33 are canceled during the period from the point of reversal moving started to the completion of positioning. Torque limit value is determined under the following (2). In this case, if position error pulse is more than the value of parameter 17 “Maximum Position Error”, the alarm 5 “Position Error Pulse Overflow” is not occurred.

(2) The case that torque is limited by control input “TSEL0”-“TSEL4” and serial communication command [TSEL0ON]-[TSEL4ON]. [the priority level : middle]

If the control input “TSEL0”-“TSEL4” or serial communication comman [TSEL0ON]-[TSEL4ON] is selected in the case except for above (1), torque limit value is effective. In this case, if position error pulse is more than the value of parameter 17 “Maximum Position Error”, the alarm 5 “Position Error Pulse Overflow” is not occurred. Selection of Torque Select 0 – Torque Select 4 is effctive under the all following case.

- While stopping the operation (servo is locked)
- While pulse train operating from a host controller
- While Point table operating with “Torque” set up except “0”
  (point-table mode , speed control mode)
- While ZRTN operating except for Zero-Point -Return Function 3 : Pressing.
- While JOG operation (Point-table mode, Speed control mode)
- While stepping operation

(3) Usual state (All the state except for above (1) (2)). [the priority level : low]

Torque limitation value except for above (1) (2) (especially Torque select is not effective under the (2)) is determined by the parameter 75 “Forward Torque Limit” and the parameter 76 “Reverse Torque Limit”.

16-3-3. The cautions about torque limitation value

Voltage given the motor is limited under the torque limited. So if the motor speed increases, the current which flows into the motor decreases and torque is decrease, too. It is only a time of the motor having stopped that the torque set up the torque limitation value is outputted.

16-4. Details about Control Output TFIN, FIN+TFIN

This section is explained about each function of control output signal TFIN (code:1C) and FIN+TFIN (code:1D).

16-4-1. Control output signal TFIN (code:1C)

When torque instruction is limited by torque limitation value and the case that rotational speed of motor is less than parameter 19 “ TFIN / VZR Output Range ” is turned TFIN ON.

In spite of the state of pulse train operation from a host controller or automatic operation (Point-table operation, JOG operation, Step operation), TFIN is effective signal under the all state.

16-4-2. Control Output FIN+TFIN (code:1D)

(1)Under point-table execution

Control output FIN+TFIN is treated as a signal to the control output FIN. Refer to “ 8-5 Point-Table Mode ” or the separate volume " Operation Manual - Point-Table Part -" for the output logic and timing of the control output FIN.

(See Note) If Point-table operation is performed under the speed control mode, both control output FIN and FIN+TFIN output ON.

(2)All the states except for Point-table execution

The logical sum of the control output FIN and the control output TFIN is outputted.

16-5. About the compatibility of Cuty3

In Cuty3 and Si servo2, it has compatibility in functional sides, such as a point table. However, the methods of setting up or the details of function are different in parts. The details of different parts are shown.

- About the automatic servo-ON

  Si servo automatically carries out servo ON at the time of supplying power source, if control input “SVON” is not selected. But Cuty3 does not have that function. So control “SVON” or “EMCSV” needs to be selected if servo-ON is performed by the serial communication or the digital operator.

- About the logic of PRG output

  The logic of a control output signal "PRG" differs in Cuty3 and Si servo2. Control output “PRG” becomes OFF under automatic operation in Cuty3, but “PRG” becomes ON in Si servo. If the logic is changed, “PRG” bit you set in parameter 39 ”Control Output Logic Setup” in Cuty3 or in parameter 66 “Control Output Logic Setup” in Si servo is set as “1”.

- About the open collector input by the pulse train input

  Si servo2 is supported by both line-driver input and open-collector input, but Cuty3 is supported by only line-driver input.

- About Pos.reference Multiply

  The amount of movements per one pulse in an external reference unit is decided by parameter 10 “Pos.reference Multiply (Numerator)” and parameter 11” Pos.reference Multiply (Denominator)” in Cuty3. But in Si servo, that is decided by parameter 2 “Resolution Numerator” and parameter 3 “Resolution Denominator” The number of external reference pulses of motor 1 rotationIt is as follows. (Manual pulsar magnification is a case of "1.")

  [Cuty3]

$$\text{One motor rotation} = \frac{\text{Reference Multiply Numerator} * 131072}{\text{Reference Multiply Denominator}}\text{[pulse]}$$

  [Si servo2]

$$\text{One motor rotation} = \frac{\text{Resolution Numerator}}{\text{Resolution Denominator}}\text{[pulse]}$$

- About Operation Mode

  The point-table mode, the speed control mode or the sensor positioning mode is able to be selected by parameter 43 in Cuty3 or parameter 38 in Si servo “Operation Mode”. (Refer to following table.)

Setting value	Cuty3	Si servo2
0	Point-table mode	Point-table mode
1	Sensor positioning mode*1)	Speed control mode
2	Speed control mode	-

*1)Sensor positioning is effective only when Cuty3 is treated as Cuty2 in point-table operation.

- About Grid-Mask Function

  Although Si servo2 has a grid mask function as a function at the time of ZRTN,There is no grid mask function in Cuty3.

- Control output “ALM”

  Si servo2 can output both lebel output and alarm number output, but Cuty3 can output only level output.

- Reference Pulse Train Form

  Input pulse train form is selected by parameter 31 in cuty3 or parameter 20 in Si servo “Reference Pulse Train Form”. But the meaning of setting value differs in Cuty3 and Si servo.

Setting value	Cuty3	Si servo2
0	Phase A/Phase B	CW/CCW
1	Pulse/Sign	Pulse/Sign
2	CW/CCW	Phase A/Phase B

- About Selection of resolution

  It is possible.that the change of the magnification to a reference pulse train input according to control input “RSEL”. But the function differs in Cuty3 and Si servo as following contents.

  - RSEL is OFF

  In Cuty3, the value of parameter 32 “Manual Pulser Multiply”” is multiplied by the number of reference pulse train. In Si servo, “1” is multiplied by the number of reference pulse train.

  - RSEL is ON

  In Cuty3, the value of parameter 77 “Manual Pulser Multiply 2”” is multiplied by the number of reference pulse train. In Si servo, the value of parameter 4 “Reference Pulse Multiplier” is multiplied by the number of reference pulse train.

  .

++Reference +++

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Nagoya Office	: Post No. 465-0096	Life Maison Zuiko-en 1F	
		1, Sakuragaoka, Meito-ku, Nagoya-shi, Aichi-ken	
		TEL +81-52-783-3927	FAX +81-52-783-5134
Osaka Office	: Post No. 532-0011	The 3rd Nakajima building 10F	
		5-11-10, Nishi-nakajima, Yodogawa-ku, Osaka-shi, Osaka	
		TEL +81-6-6309-5123	FAX +81-6-6305-0326
Hachinohe Office	: Post No. 031-0811	Yawata gyogyou building 1F	
		3-8-8, Shimminato, Hachinohe-shi, Aomori-ken	
		TEL +81-178-31-4170	FAX +81-178-31-4180
Nagano Office	: Post No. 381-0036	1-22-3-201, Hirabayashi, Nagano-shi, Nagano-ken	
		TEL +81-26-251-6422	FAX +81-26-251-6466
Yamagata Office	: Post No. 990-0023	Chitose Clean Heights no. 101	
		4-6-5, Matsunami, Yamagata-shi, Yamagata-ken	
		TEL +81-23-629-6455	FAX +81-23-629-6456
Hokuriku Office	: Post No. 930-0966	Hirota building 1F	
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The content of this guide may be changed without notice due to product improvement.