

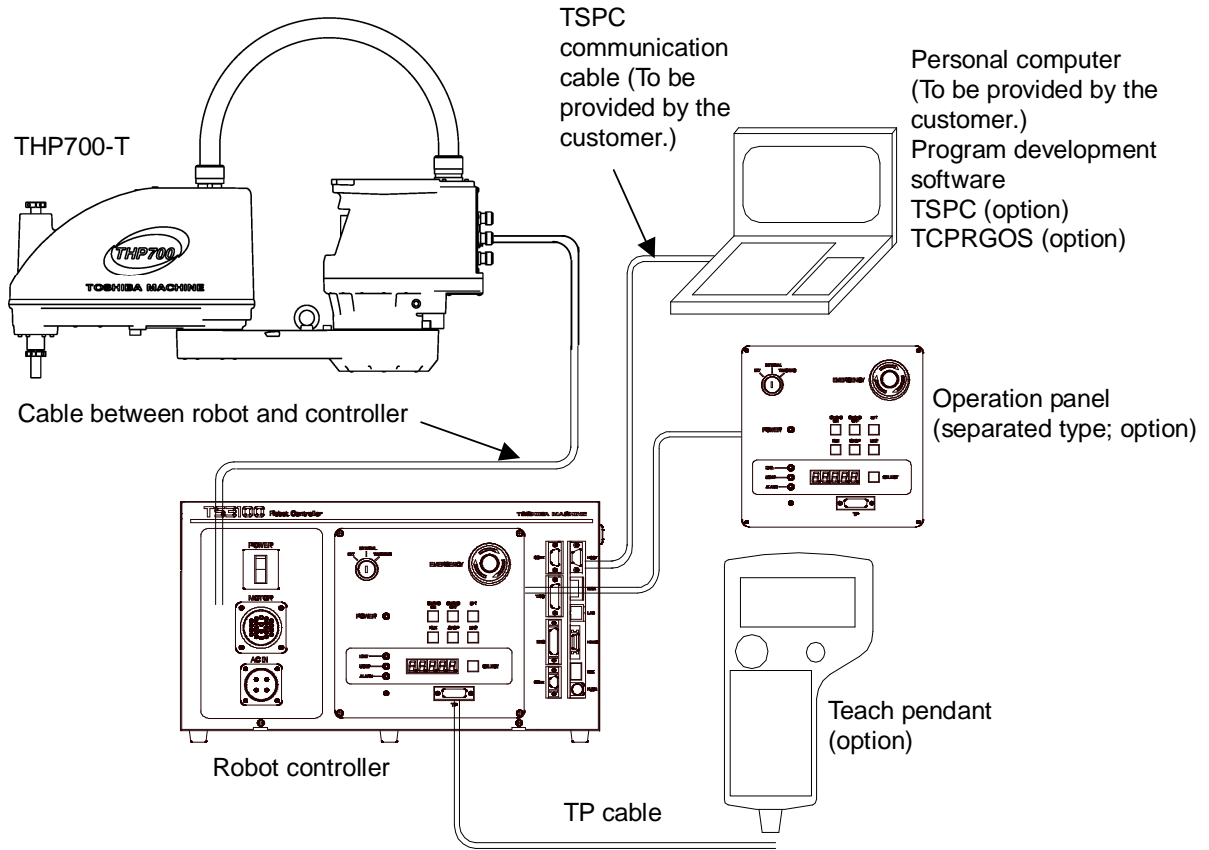
SCARA ROBOT SPECIFICATIONS

THP700-T/TS3100

March 2011

TOSHIBA MACHINE CO., LTD.

1. Structure of Robot Equipment



Structural drawing of robot equipment

[Standard equipment]

No.	Name of Equipment	Type	Q'ty	Remarks
1	Robot Body	THP700-T	1	
2	Cable between robot and controller	(5 m)	1	
3	Robot controller	TS3100	1	
4	SYSTEM connector	SYSTEM	1	Standard accessory
5	EMS connector	EMS	1	Standard accessory
6	Dummy plug for teach pendant		1	Standard accessory
7	System disk (CD)		1	Standard accessory
8	Master mode selector key		1	Standard accessory
9	Power connector (with clamp)	ACIN	1	Standard accessory
10	Arm clamp		1	Standard accessory
11	Character specification	Japanese version		
12				

* Input and output connectors are not included.

[Robot Mechanical Option]

No.	Name of Equipment	Type	Q'ty	Remarks
1	Z-axis long stroke	300 mm		
2	Specifications pursuant to CE marking			
3	Backup battery: Lithium specifications			
4				
5				

[Optional specifications (dust-proof and clean specifications)]

No.	Name of Equipment	Type	Q'ty	Remarks
1	Clean Z-axis grease			Under development
2	Z-axis bellows			Under development
3	Z-axis upper cap for second arm			Under development
4				
5				
6				

[Optional equipment (Electrical side)]

No.	Name of Equipment	Type	Q'ty	Remarks
1	Teach pendant (5 m)	TP1000		
2	Extended cable for Teach pendant			10 m/15 m
3	Polarity of controller			Plus (+) common
4	Cable between robot and controller			8 m/10 m/15 m/25 m
5	External input signal cable	INPUT		Cable length: 6 m
6	External output signal cable	OUTPUT		Cable length: 6 m
7	External I/O signal cable	SYSTEM		Cable length: 6 m
8	I/O signal connector	SYSTEM		Separate item
9				

[Controller Option]

No.	Name of Equipment	Type	Q'ty	Remarks
1	Separated operation panel			
2	Controller side bracket			2 pcs. per set
3	Controller (longitudinal)			
4	Addition of extension I/Os	TR48DIOCN		
5	TSPC Program development software	TSPC		With instruction manual
6	TSPC cable			
7	TCPRGOS program development software	TCPRGOS		With instruction manual
8	TCPRGOS cable			
9	Network function	Profibus		
10	Network function	DeviceNet		
11	Network function	CC-Link		
12	Safety box for control category3	TS3SFB		ISO13849-1

[Documents]

No.	Name of Equipment	Type	Q'ty	Remarks
1	Specifications manual		1	This manual
2	Complete instruction manual (CD)		1	Japanese version
3	Complete instruction manual (CD)		1	English version
4				
5				

* Complete instruction manual: Operation manual, Robot language manual, Interface manual, Transportation and installation manual, Maintenance manual, Communication manual, Safety manual, User parameter manual and Alarm manual.

2. Robot Specifications

2.1 Robot THP700 Specification*1

No	Item	Specification	Remarks	
1	Type	Horizontal multi-joint		
2	No. of controlled axes	4 axes		
3	Arm length	Full length	700 (mm)	
		Arm 1	350 (mm)	
		Arm 2	350 (mm)	
4	Working envelope	Axis 1	±120 (deg)	
		Axis 2	±145 (deg)	
		Axis 3	0 to 150 (mm)	Option: 300 mm
		Axis 4	±360 (deg)	
5	Maximum speed	Axis 1	340 (deg/sec)	
		Axis 2	600 (deg/sec)	
		Axis 3	2050 (mm/sec)	
		Axis 4	1800 (deg/sec)	
		Composite	7.8 (m/sec)	Axes 1 and 2 composition
6	Maximum payload mass	10 (kg)	*2	
7	Cycle time (2 kg at transfer)	0.345 (sec)	*3	
8	Permissible load inertia	0.1 (kgm ²)	*2	
9	Positioning repeatability	X-Y	±0.03 (mm)	
		Z (axis 3)	±0.02 (mm)	
		C	±0.02 (deg)	
10	Drive system	AC Servo Motor for all axis		
11	Robot body	Mass	57 (kg)	
		Painting color	Body: Light-gray Arm cover: White	

*1 : The values herein are subject to change because the product(s) are under development.

*2 : The speed and acceleration rates are limited depending on motion patterns, payload mass, and offset value.

*3 : 120 cycles per minute, 24-hour operation.

Continuous operation of standard cycle motion pattern is not possible beyond the effective load ratio. (Horizontal 300 mm, vertical 25 mm, round-trip, coarse positioning)

*4 : The values are effective when the environment temperature is kept constant at 20°C.

**CAUTION**

If possible, movement of Axes 1, 2, and 4 should be performed while the Z-axis (Axis 3) is raised.

Moving Axis 1, 2, or 4 while the Z-axis is lowered can result in premature damage to the ball screw spline (Z-axis shaft).

If Axis 1, 2, or 4 must be moved while the Z-axis is lowered due to unavoidable circumstances, use the SPEED command and ACCEL/DECEL/PAYLOAD commands to adjust the operation speed and acceleration so that the ball screw spline does not vibrate.

When moving Axis 1, 2, or 4 while the Z-axis is lowered, pay careful attention to ensure that no collision occurs with obstacles or other objects.

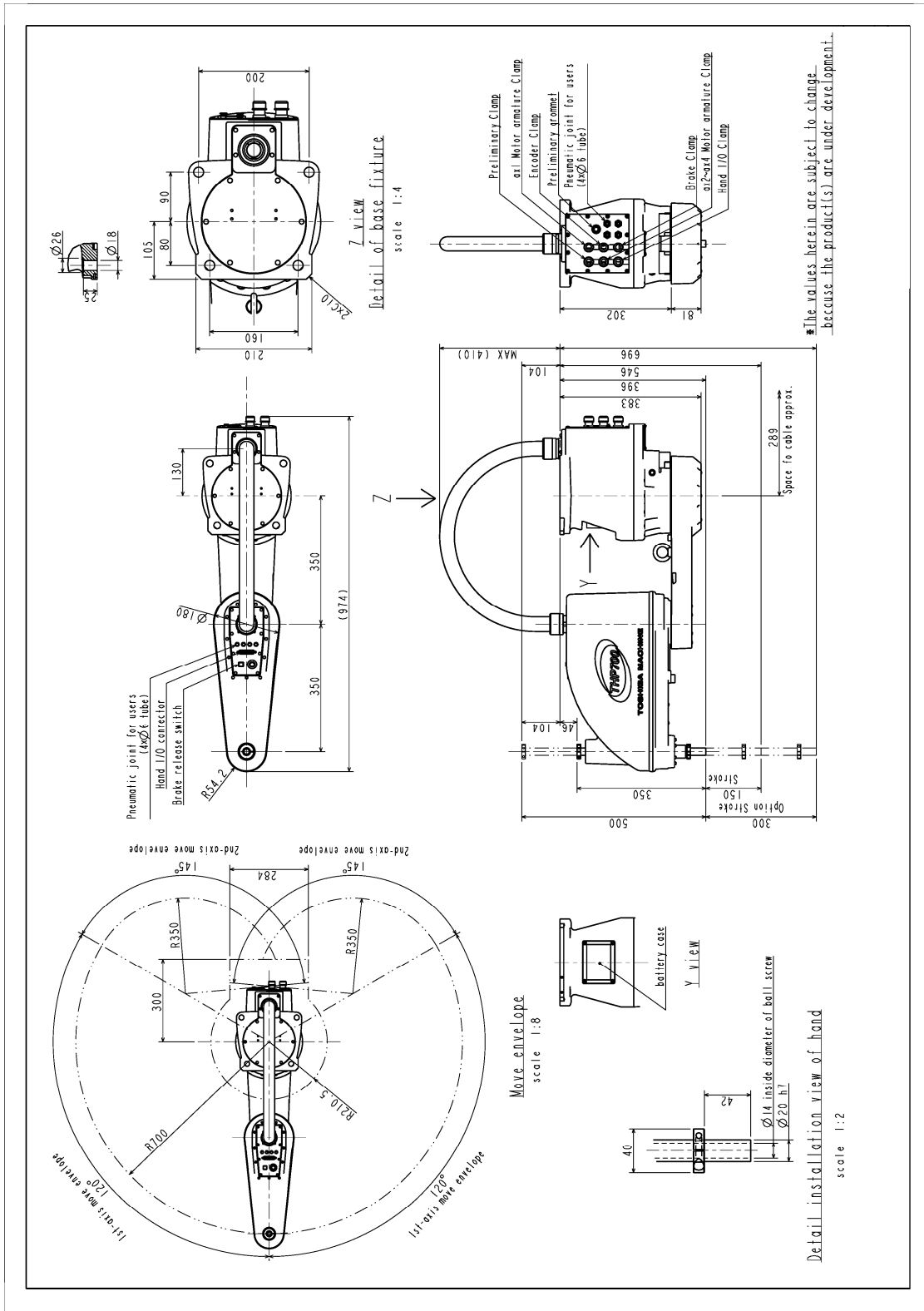
Even if Axis 1, 2, or 4 is moved at low speed, a collision with an obstacle or other mishap can cause damage to the ball screw spline (Z-axis shaft) before an alarm occurs.

**CAUTION**

- When alkaline batteries are used under high temperatures, there is a high risk of battery overheating, leakage, or rupture. Also, these conditions can reduce battery performance and lifespan.

If using this robot in high-temperature environments, please consult with Toshiba Machine.

2.2 External view THP700-T



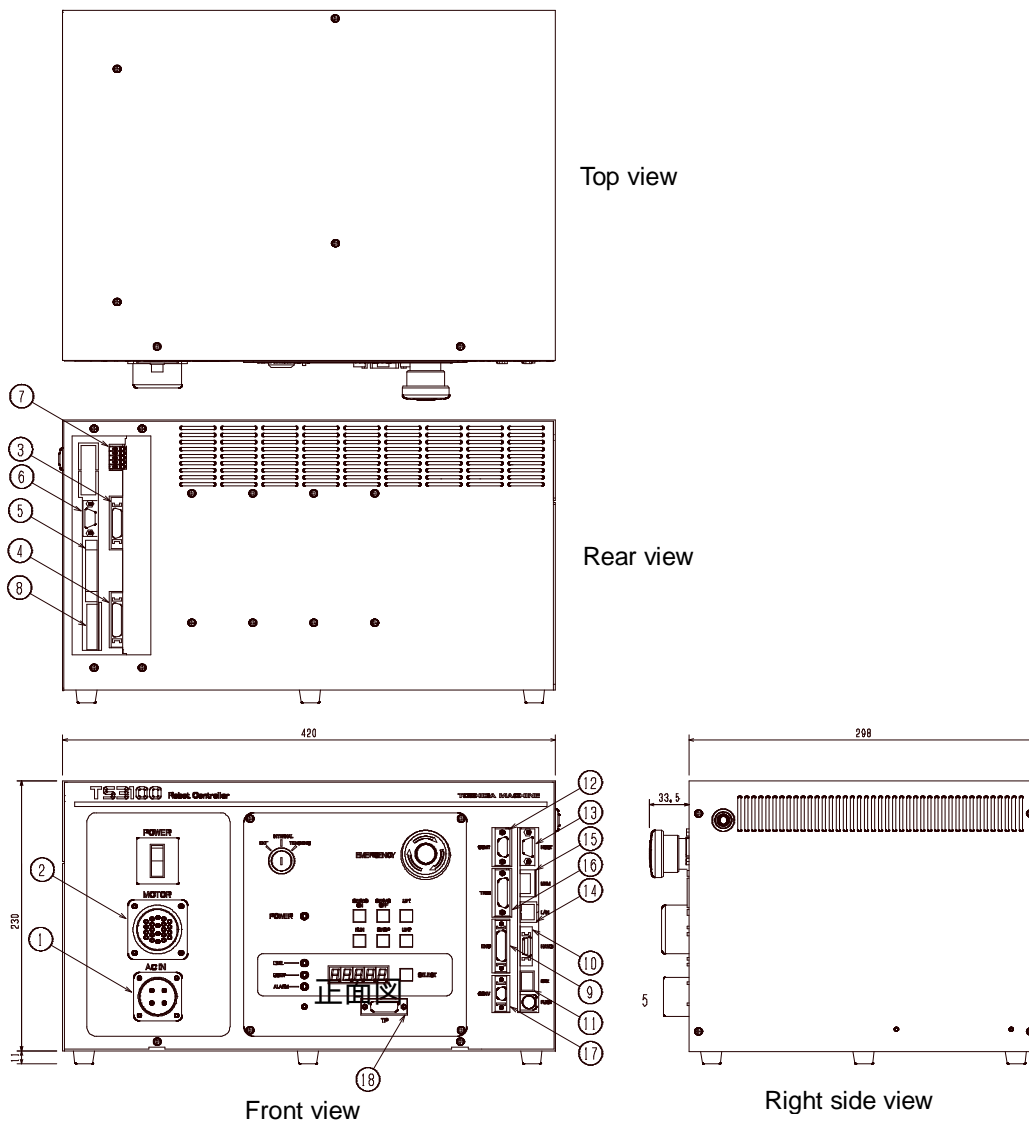
3. Controller Specifications

3.1 Controller TS3100 Specifications

No.	Item	Specification	Remarks
1	No. of controlled axes	No. of simultaneously controlled axes: 8 axes (2 additional axes under development)	
2	Motion mode	PTP (point-to-point), CP (continuous path; straight line, circular), short-cut, arch	
3	Servo system	Digital servo	
4	Storage capacity	Total: Approx. 12,800 points + 25,600 steps 1 program: Approx. 2,000 points + 3,000 steps	1.5 M bytes
5	No. of registrable programs	Max. 256 (User file: 247, system file: 9)	
6	Auxiliary memory	USB memory	
7	Storage	Battery backup RAM	
8	Position detection	By absolute encoder	
9	Teaching method	Teaching points	Remote: To be guided through the teach pendant.
			Coordinate: Coordinates X, Y, Z, C and T are entered through the teach pendant.
	Program input	Servo-free: Arms are moved by operator's hands.	
10	External input/output signals	32 inputs/32 outputs	
11	Hand control signal	8 inputs and 8 outputs	
12	External control signal	Input	Program selection, start, stop, program reset, etc.
		Output	Servo ON, operation ready, fault, cycle stop, etc., etc.
13	Serial communication port	RS232C: 2 ports (general for HOST, COM1) RS232C: 1port (exclusive for TCPRG, and POD) RS485: 1 port (exclusive for extended I/O) RS422: 1 port (exclusive for TP1000) Ethernet: 1port	
14	Speed setting	Override /speed limit /program command: 0 ~ 100% each	
15	Acceleration setting	Program command: 1 ~ 100%	
16	Torque limit	Program command: 1 ~ 100%	
17	Teaching unit	Teach pendant	
18	Coordinate system	World, work, tool, base (Base, work and tool coordinate systems can be set separately.)	

No.	Item	Specification	Remarks
19	Motion limit	Soft limit	
20	Self-diagnostic function	Detection of various errors, etc.	
21	Interruptive function	Start of interruptive program by input signal	
22	Operation mode	Internal auto, external auto (I/O), external communication	
23	Operation method	Internal operation mode	Continuous, cycle, step, motion step, machine lock
		External operation mode	Cycle, continuous
24	Controller	Outer dimensions	420(W)×230(H)×298(D)
		Mass	17 (kg)
		Painting color	White
25	Power supply	Single-phase, AC200 V ~ 240 V, 50/60 Hz	4.8 kVA
26	Personal computer software TSPC	Program creation/ teaching, remote operation, etc.	
27	Program language	SCOL	

3.2 External View of Controller TS3100

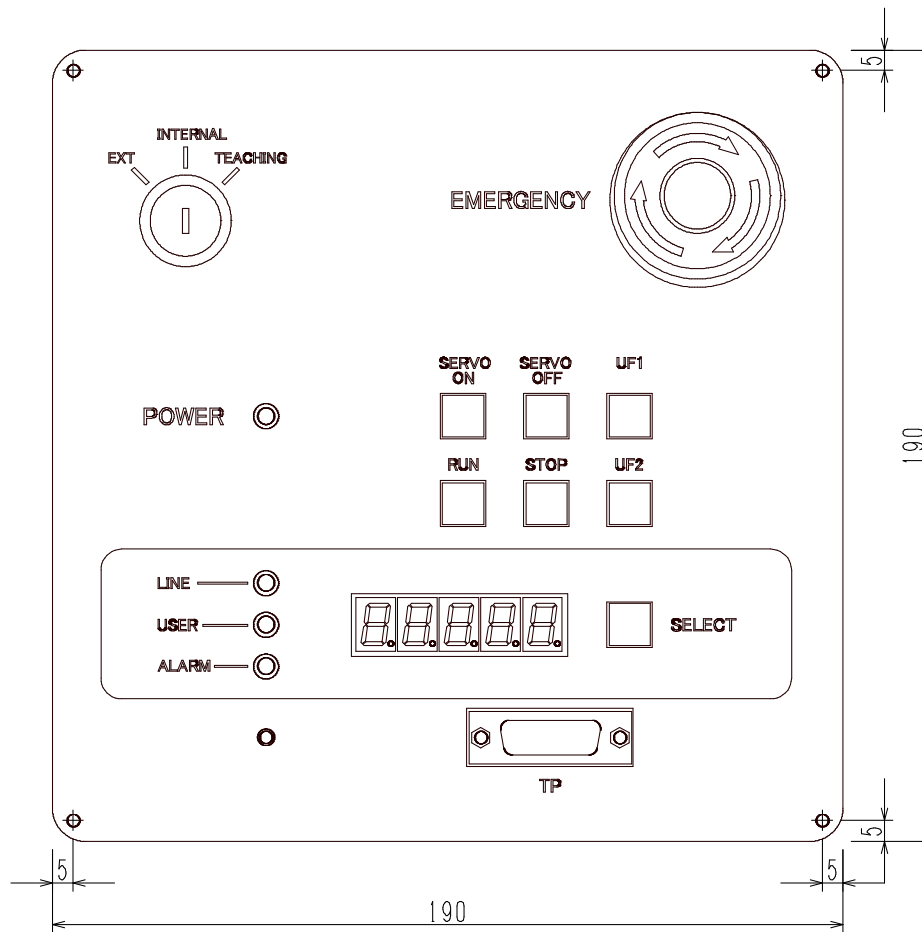


External interface

- | | | |
|------|---------|--|
| [1] | AC IN | : Power supply |
| [2] | MOTOR | : Robot motor drive cable |
| [3] | INPUT | : External control input signal |
| [4] | OUTPUT | : External control output signal |
| [5] | SYSTEM | : External operation input/output signal |
| [6] | TCPRG | : Port for editing sequence program/touch panel |
| [7] | EXT I/O | : RS485 port for connecting TC200/terminal block I/O |
| [8] | EMS | : Safety signal cable |
| [9] | ENC | : Robot encoder cable |
| [10] | HAND | : Robot hand control signal |
| [11] | BRK | : Brake signal |
| [12] | COM1 | : Serial communication port for external equipment |

- [13] HOST : Serial communication port for user
- [14] LAN : TCP/IP port
- [15] MEM : Auxiliary memory port
- [16] TRIG : High-speed input signal cable
- [17] CONV : Conveyor encoder cable
- [18] TP : Exclusive serial port for teach pendant

3.3 Detailed Drawing of Operation Panel



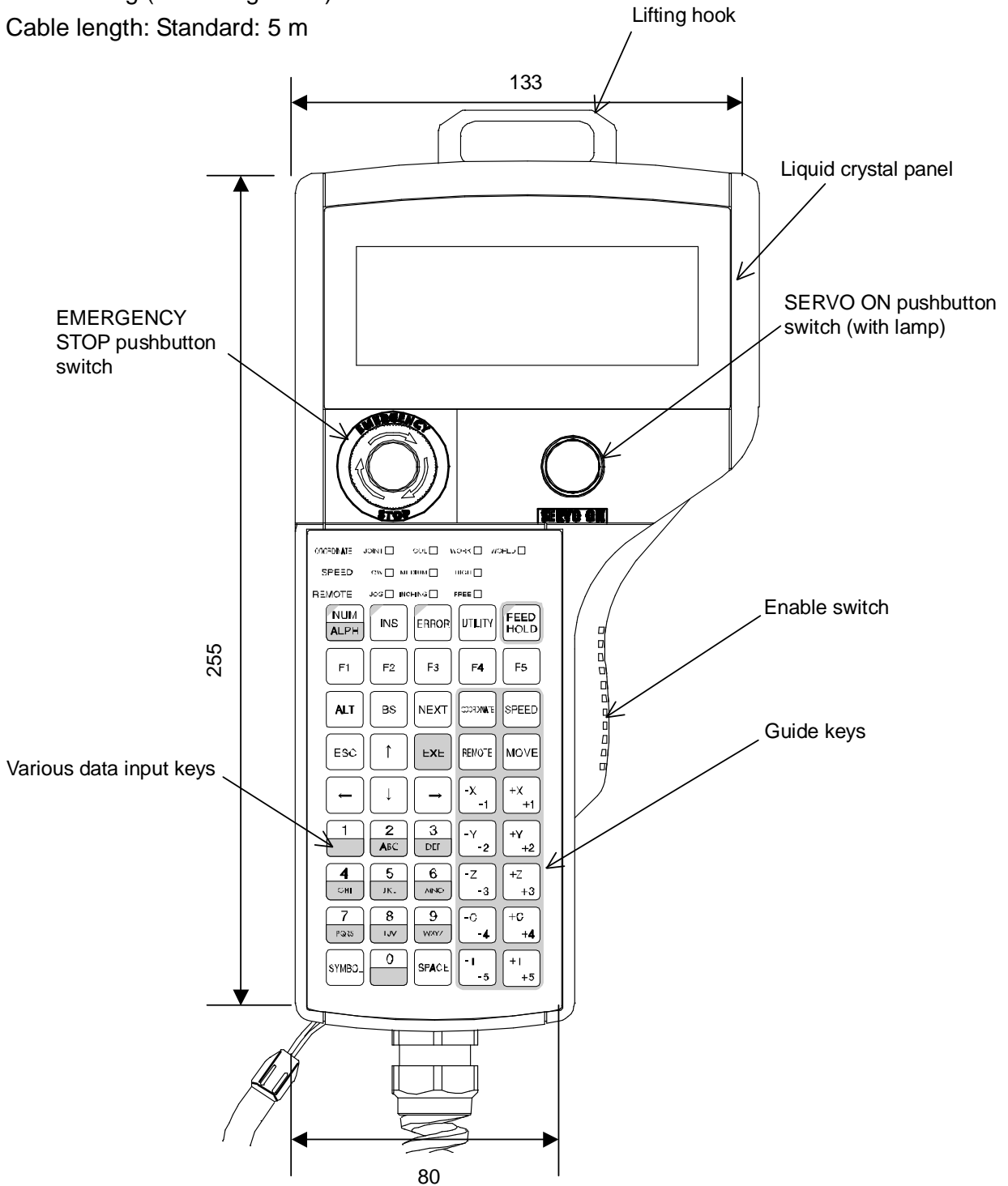
Controller TS3100 operation panel

3.4 Teach Pendant (Model TP1000)

Thickness: 48 mm (56 mm when the EMERGENCY STOP pushbutton switch is included)

Mass: 600 g (Excluding cable)

Cable length: Standard: 5 m



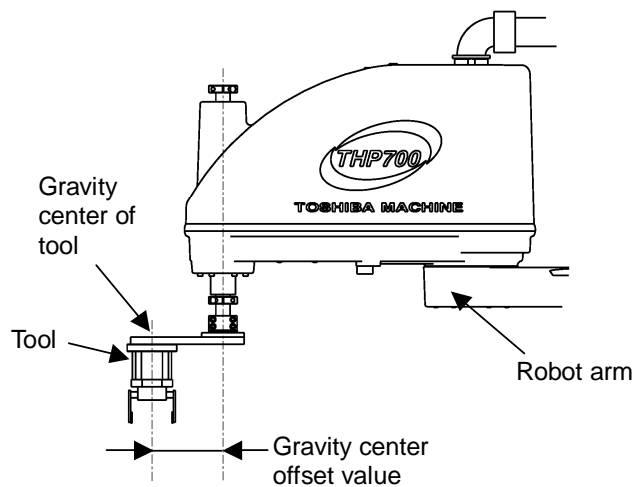
* This teach pendant can be shared among the models of TS1000, TS2000, TS2100, and TS3100.

4. Specification of Permissible Load Conditions

4.1 Permissible Load Conditions

Load on the robot's end effectors should always fall under the values given in the table below.

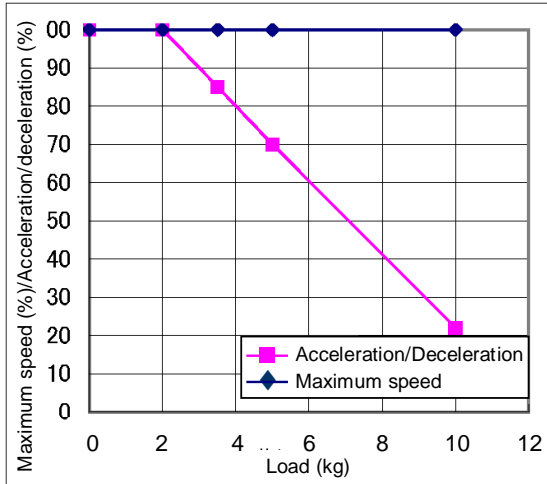
As the maximum speed and acceleration/deceleration time of the robot vary with the load conditions, the mass and offset value should be set by using the payload command in the program. Because the THP series is adjusted more precisely to realize high-speed operation, compared with the previous series, be sure to use the payload command. If the robot is operated, exceeding the permissible load conditions, or if the payload command is not used, the robot may operate improperly and the robot service life may be shortened. Shown below are the relationships between the acceleration and permissible load conditions.



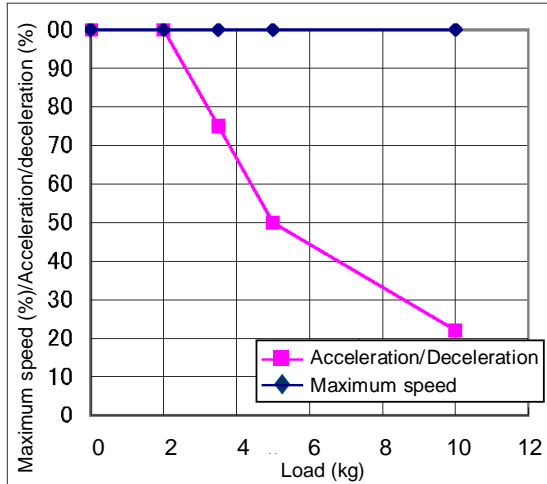
Conditions	Allowance
Mass	Rated: 2 kg (max. 10 kg) Setting of maximum acceleration when load mass is under 2 kg.
Load inertia	Max 0.1 kg • m ²
Gravity center offset	Max 100 mm (load ≤ 10 kg)

The values herein are subject to change because the product(s) are under development.

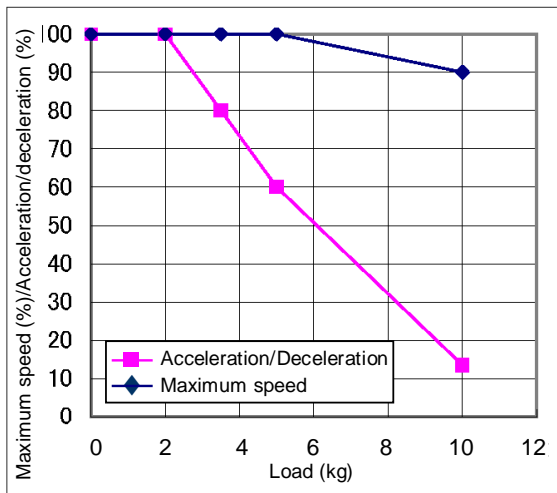
a) Unless the load offset is present, the maximum speed and acceleration/deceleration time in relation to the mass of load should be set as shown below.



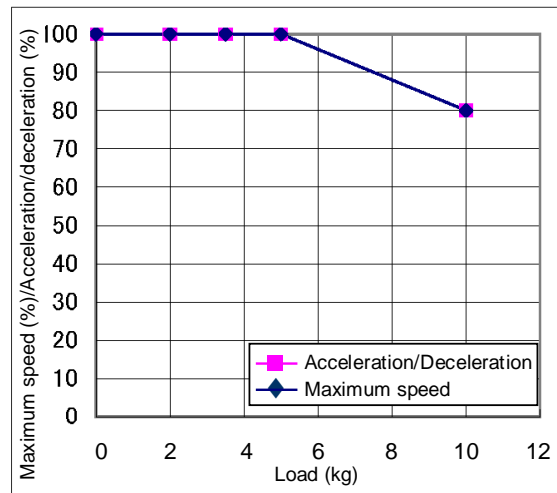
Setting of maximum speed and acceleration/deceleration in relation to load mass (Axis 1)



Setting of maximum speed and acceleration/deceleration in relation to load mass (Axis 2)

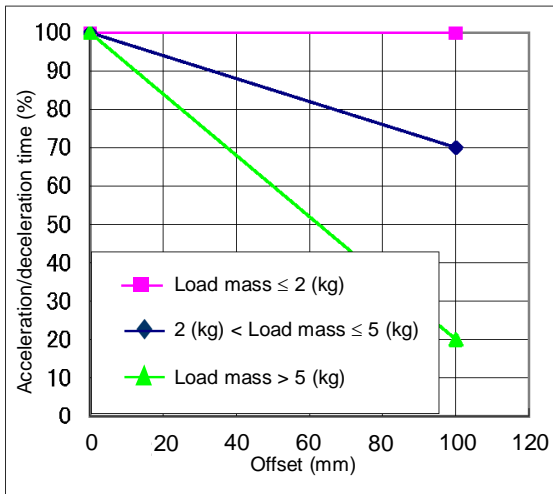


Setting of maximum speed and acceleration/deceleration in relation to load mass (Axis 3)

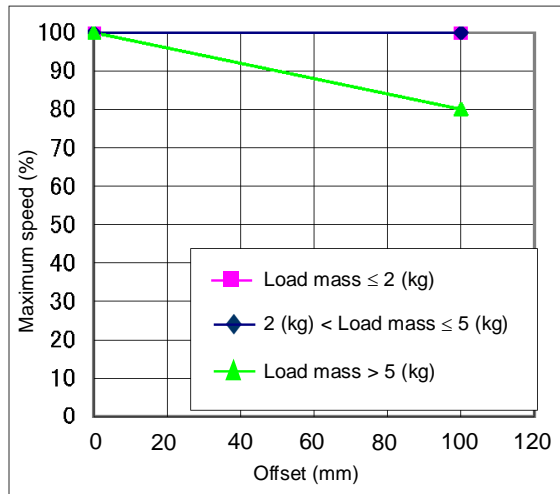


Setting of maximum speed and acceleration/deceleration in relation to load mass (Axis 4)

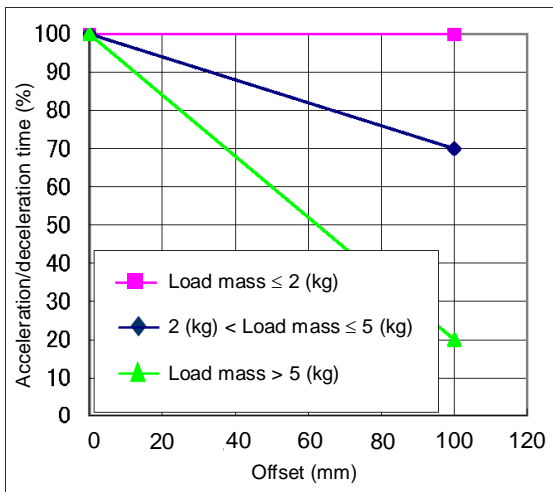
b) If the load offset is present, the offset is further limited in addition to Para. a) above. The maximum speed and acceleration/deceleration time in relation to the offset are shown below.



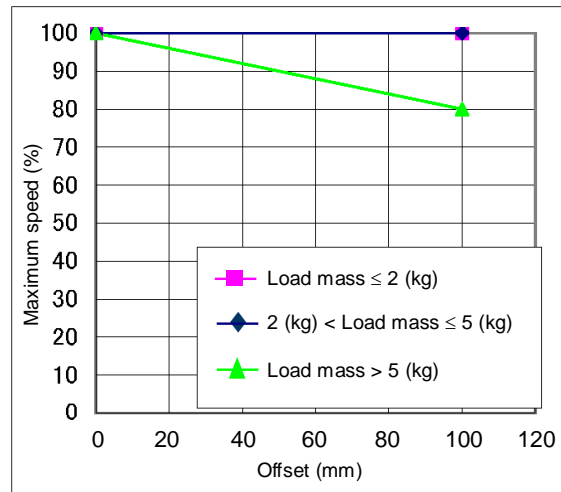
Setting of acceleration/deceleration time in relation to offset value (Axis 1)



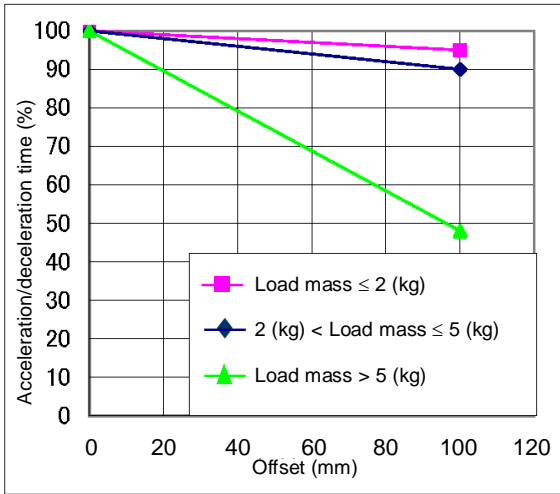
Setting of maximum speed in relation to offset value (Axis 1)



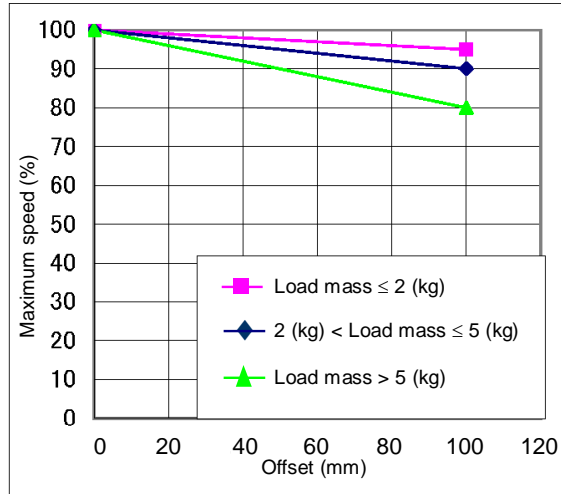
Setting of acceleration/deceleration time in relation to offset value (Axis 2)



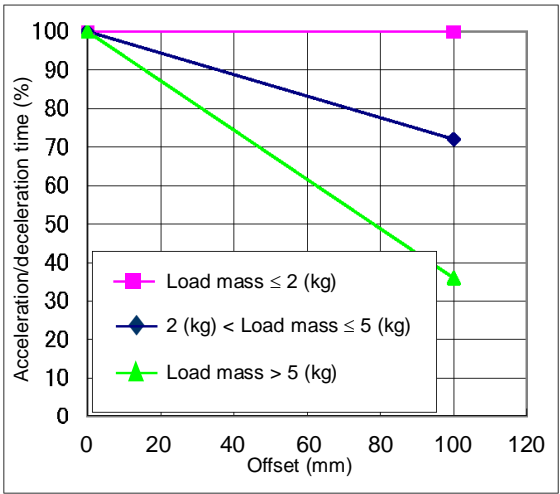
Setting of maximum speed in relation to offset value (Axis 2)



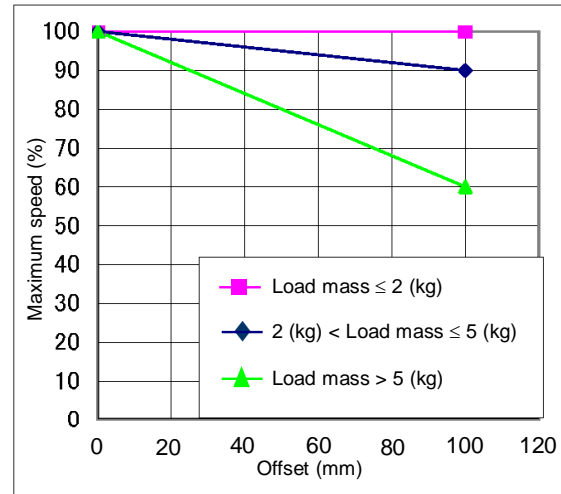
Setting of acceleration/deceleration time in relation to offset value (Axis 3)



Setting of maximum speed in relation to offset value (Axis 3)



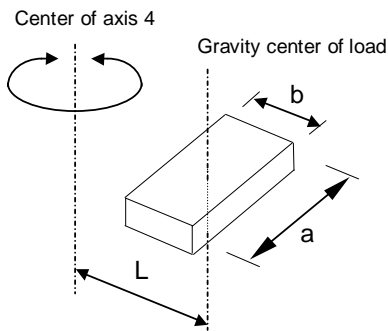
Setting of acceleration/deceleration time in relation to offset value (Axis 4)



Setting of maximum speed in relation to offset value (Axis 4)

c) Moment of inertia

Shown below is a model simplifying the robot and load, and arithmetic expression of moment of inertia of load.



L : Distance from axis 4 center to gravity center of load (m)

a : Width of load (m)

b : Length of load (m)

M : Mass of load (kg)

Moment of inertia ($\text{kg} \cdot \text{m}^2$)

$$= \frac{M}{12}(a^2 + b^2) + ML^2$$

5. General Specifications

a) Applicable standards

In principle, material, design and test of the equipment stipulated in these specifications shall be pursuant to the JIS, JES and JEM standards.

b) Environmental conditions

Ambient temperature, operating temperature: 0 ~ 40°C (Mean value around-the-clock is 35°C or less.)

Temperature under transport and storage: -20 ~ 55°C

Humidity: 20 ~ 90% (non-condensing)

Height above sea level: 1,000 m or less

Vibration: 0.98 m/s² or less

Dust: No conductive contaminant shall be contained.

Note: No special dust-proof measures are taken on the controller. When using the controller in a heavily contaminated environment, house it in a dust-proof cabinet.

Gas: No corrosive and flammable gas shall be contained.

Magnetic field: A magnetic source shall not exist nearby.

c) In-house test

We carry out severe in-house inspection on all finished products.

d) Power supply, etc.

Power supply: Single-phase, AC 200 ~ 240 V, 50/60 Hz ±1 Hz

Instantaneous power failure: Within 40 msec

Grounding: Grounding with grounding resistance of 100 W or less

e) Installation, piping and wiring

If the work of installation, piping and wiring is required, it shall be decided at a separate meeting.

f) Site adjustment and teaching

If the site adjustment and teaching are required, they shall be decided at a separate meeting.

If they are to be executed by Toshiba Machine, we will dispatch an experienced engineer or engineers.

Then, the customer shall provide test work pieces, parts, material, power, etc., required for the operation and adjustment of the robot system by an operator, and secure an all-out cooperative relationship with the equipment furnished by Toshiba Machine.

g) Acceptance

When visual appearance and quantities of the equipment delivered to the customer as described in these specifications have been tested, the equipment shall be regarded as having been accepted finally by the customer.

h) Warranty

1. Warranty period

Toshiba Machine agrees to repair or replace as necessary all defective material or workmanship up to the period shown below, whichever comes first.

- 1) Twenty-four (24) months from the date of dispatch from our plant.
- 2) Eighteen (18) months from the date of machine installation at customer's job site.
- 3) 4,000 running hours from the date of initial machine operation.

2. Contents of warranty

- 1) Only the product delivered to the customer is subject to Toshiba Machine's Guarantee. Such Guarantee covers the specifications and functions as defined in the product specifications manual, catalog, instruction manual, etc. In no event does the Guarantee cover any damage caused by malfunction of the delivered product.
- 2) Toshiba Machine repairs the product free of charge only when it malfunctioned after handling or use according to the instruction manual attached to the product within the specified warranty period.

3. Exemption from responsibility

Toshiba Machine's Guarantee shall not cover the following cases.

- 1) Incorrect use not described in the instruction manual, and trouble or damage caused by negligent use.
- 2) Inconvenience caused by aged deterioration or long-term usage (natural fading of coating or painting, deterioration of consumable parts, etc.).
- 3) Inconvenience caused by sensuous phenomena (noise generation, etc. which will not affect the function).
- 4) Remodeling or disassembly which Toshiba Machine will not permit.

- 5) Trouble and damage caused by insufficient maintenance/inspection or improper repair.
- 6) Trouble and damage caused by disaster, fire or other external factor.
- 7) Internal data such as program and point which were created by the customer.
- 8) When the robot purchased in Japan was shipped overseas.

4. Precautions

- 1) Unless the robot was used pursuant to its specifications, Toshiba Machine will not guarantee the basic performance of the robot.
- 2) If the customer did not observe the warnings and cautions described in this manual, Toshiba Machine will not assume the responsibility for any consequential accident resulting in injury or death, damage or trouble.
- 3) Please note that the warnings, cautions and other descriptions stipulated in this manual are only those which can be assumed by Toshiba Machine as of now.

6. Robot Language SCOL

Type	Command	Purpose
Movement control commands	BREAK CLOSE1, CLOSE2 CLOSEI1, CLOSEI2 DELAY MOVE MOVES MOVEC MOVEA MOVEI MOVEJ OPEN1, OPEN2 OPENI1, OPENI2 PAUSE READY RESUME	Suspends movement immediately. Closes hand after completion of movement. Closes hand. Closes hand. Pauses for specified time. Synchronous movement. Linear interpolation movement. Circular interpolation movement. Absolute single axis movement. Relative single axis movement. Arch movement Opens hand after completion of movement. Opens hand. Suspends a movement. Moves to machine coordinate origin. Restarts an interrupted movement.
Program control commands	FOR~TO~STEP~ GOTO GOTO () IGNORE IF~THEN~ELSE~ NEXT ON~DO~ PROGRAM RCYCLE RETURN STOP WAIT END KILL MAXTASK REMARK SWITCH TASK TID	Repeats an operation. Branches unconditionally. Branches in accordance with the value of an expression Cancels monitoring. Judges conditions. Repeats an operation. Registers conditions monitor. Marks beginning of program. Label for cycle reset. Returns to main program. Stops the program. Waits for establishment of conditions. End of program. Task standstill. Maximum number of tasks. Comments. Task change-over. Task start. Task ID.
I/O control commands	BCDIN BCDOUT CR DIN	Inputs a BCD signal. Outputs a BCD signal. Outputs a CR code Reads an input signal.

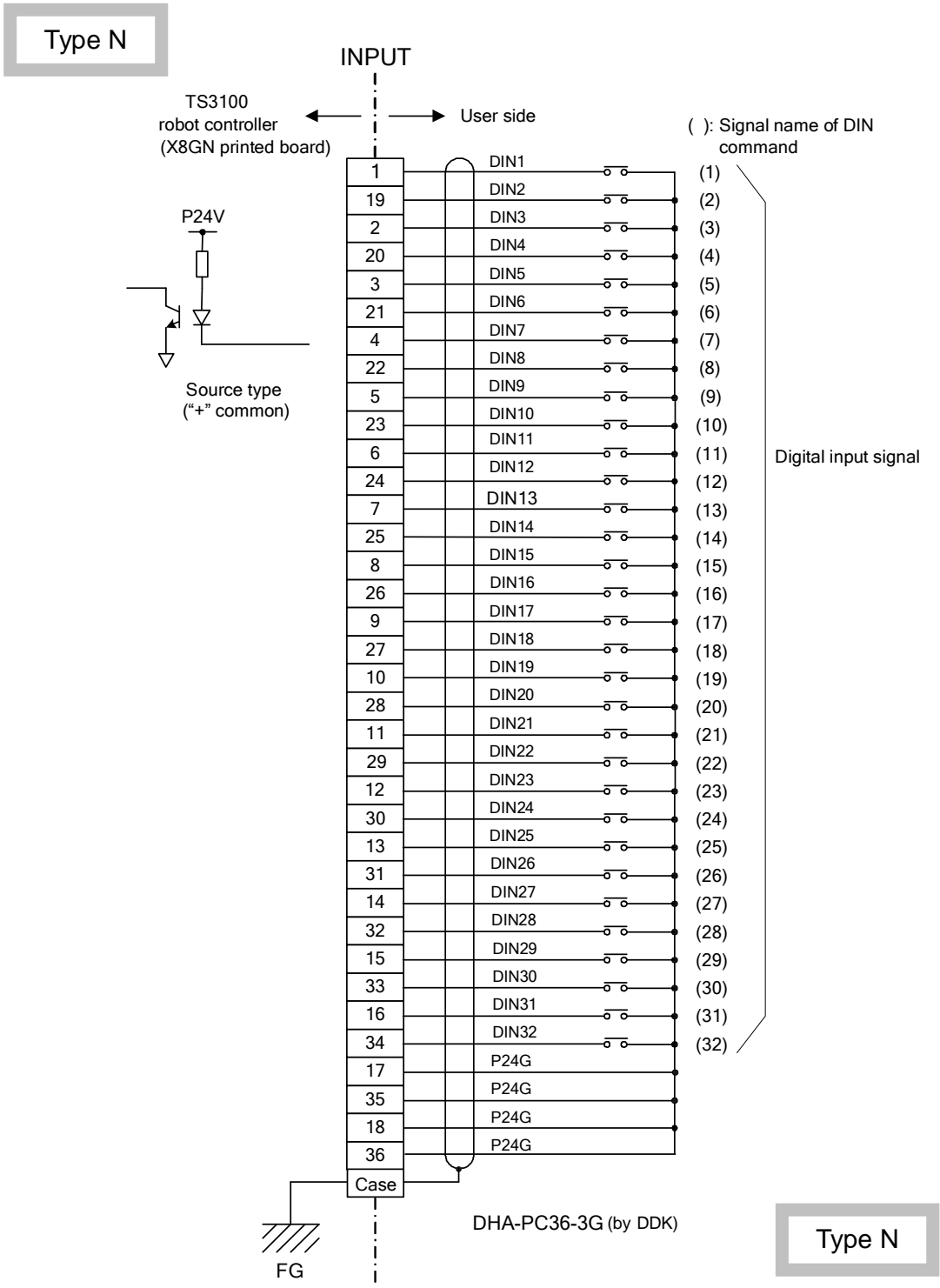
Type	Command	Purpose
	DOUT HEXIN HEXOUT PULOUT RESET PRINT INPUT	Outputs a signal. Reads signals in hexadecimal notation. Outputs signals in hexadecimal notation. Outputs a pulse signal. Resets the controller. Outputs communication data. Inputs communication data.
Movement condition commands	ACCEL ACCUR CONFIG DECEL DISABLE ENABLE FREELoad GAIN ONGAIN OFFGAIN NOWAIT PASS PAYLOAD SETGAIN SMOOTH (option) SPEED MOVESYNC SWITCH TORQUE WITH	Specifies acceleration (during acceleration). Specifies positioning accuracy. Specifies configuration. Specifies acceleration (during deceleration). System switch off. System switch on. Cancels load data. Each axis gain. Each axis gain ON. Each axis gain OFF. Does not wait for the completion of positioning for previous movement. Short-cut movement parameter. Sets load data. Gain of each axis. Smooth movement. Specifies speed. Specifies movement command synchronization/unsynchronization mode. Prohibits or allows task change-over. Torque on each axis. Specifies operating conditions.
Calculator commands	COS SIN TAN ABS ACOS AND ASIN ATAN ATAN2 DEST	Cosine. Sine. Tangent. Absolute value. Arccosine. Logical product. Arcsine. Arctangent. Arctangent. Destination position.
Calculator commands	EXP	Exponent to power e.

Type	Command	Purpose
	HERE INT LN LOG10 MOD NOT OR POINT REAL SGN SQRT TRANS	Present position. Changes number to an integer. Natural logarithm. Common logarithm. Remainder. Negation. Logical sum. Creates positional type data. Changes number to a real number. Extracts and returns the sign. Square root. Creates coordinate type data.
Movement reference commands	BASE MODE MOTION MOTIONT REMAIN REMAINT TIMER TOOL WORK	Base coordinate system. System operating mode. Amount of movement which has been executed. Time expended for a motion. Amount of movement remaining to be executed. Time remaining for a motion. Timer. Tool coordinate system. Work coordinate system.
Data definition commands	DATA DIM~AS GLOBAL RESTORE SAVEEND	Starts data definition. Array variable definition. Global variable definition. Saves an initial value of the global variable to a file. Saves data at power OFF.
Palletize command	INITPLT MOVEPLT	Initializes a pallet. Moves to pallet specified position.
Position data latch function (Options of TS2000)	LATCH LATCHTRG1~8 LATCHSIG1~8 LATCHPSN1~8	Position latch function ON/OFF. Detected edge direction. Signal state. Latched position.

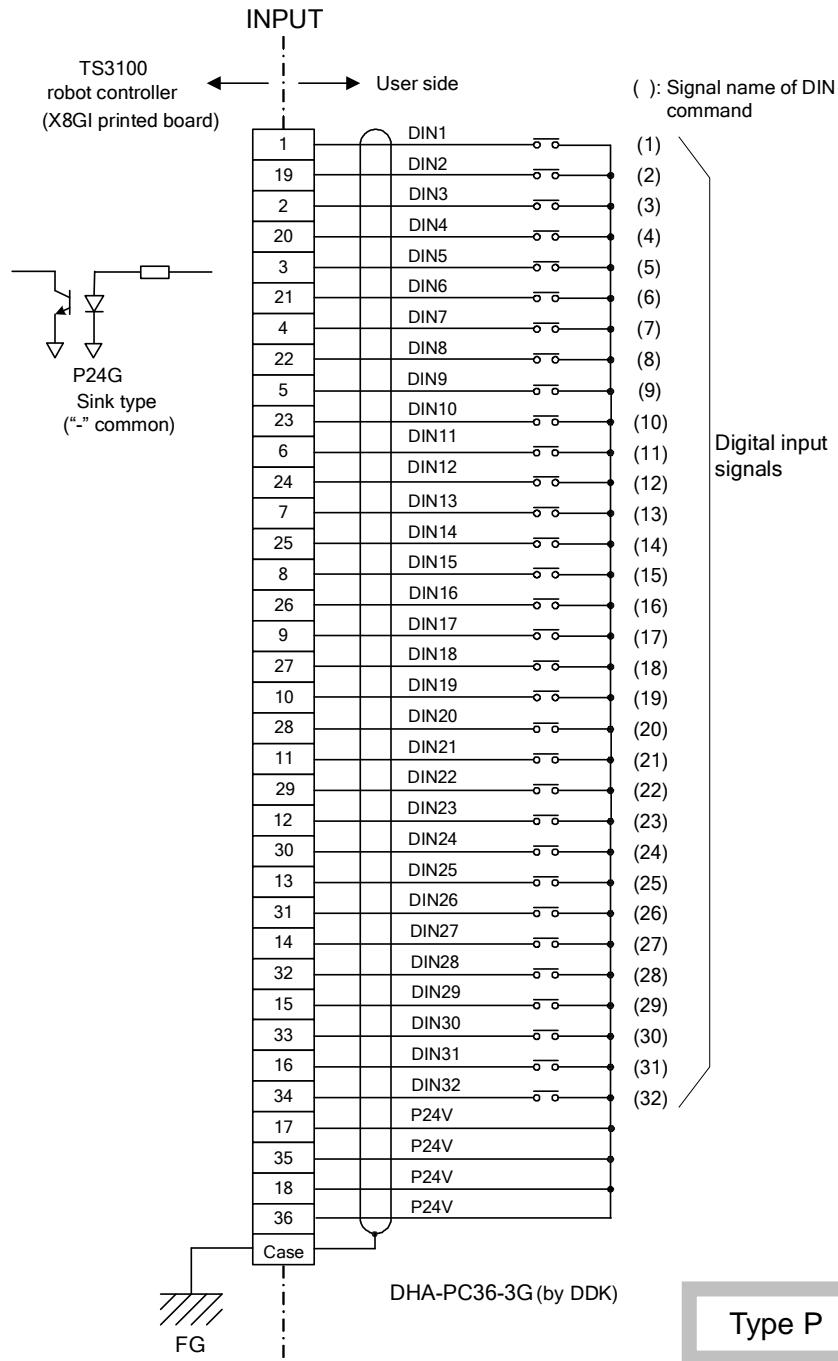
Type	Command	Purpose
System constants	COARSE COM0, TP COM1 CONT CYCLE FINE FREE LEFTY OFF ON PAI RIGHTY SEGMENT	Coarse positioning accuracy. Communication channel (teach pendant). Communication channel 1. Continuous operation mode. Cycle operation mode. Fine positioning accuracy. Undefined configuration. Left hand configuration. Each axis gain OFF. Each axis gain ON. Pi. Right hand configuration. Segment operation mode.
Simplified PLC	PLCDATAR1~8 PLCDATAW1~8	Simplified PLC interface Simplified PLC interface
Mathematical symbols	^ - *, / +, - = == < >, > < < > < =, = < > =, = > '	Exponentiation. Negative sign. Multiplication and division. Addition and subtraction. Substitution. Equal. Not equal. Less than. Greater than. Less than or equal. Greater than or equal. Comments.

7. External Interface

7.1 External Input Signals



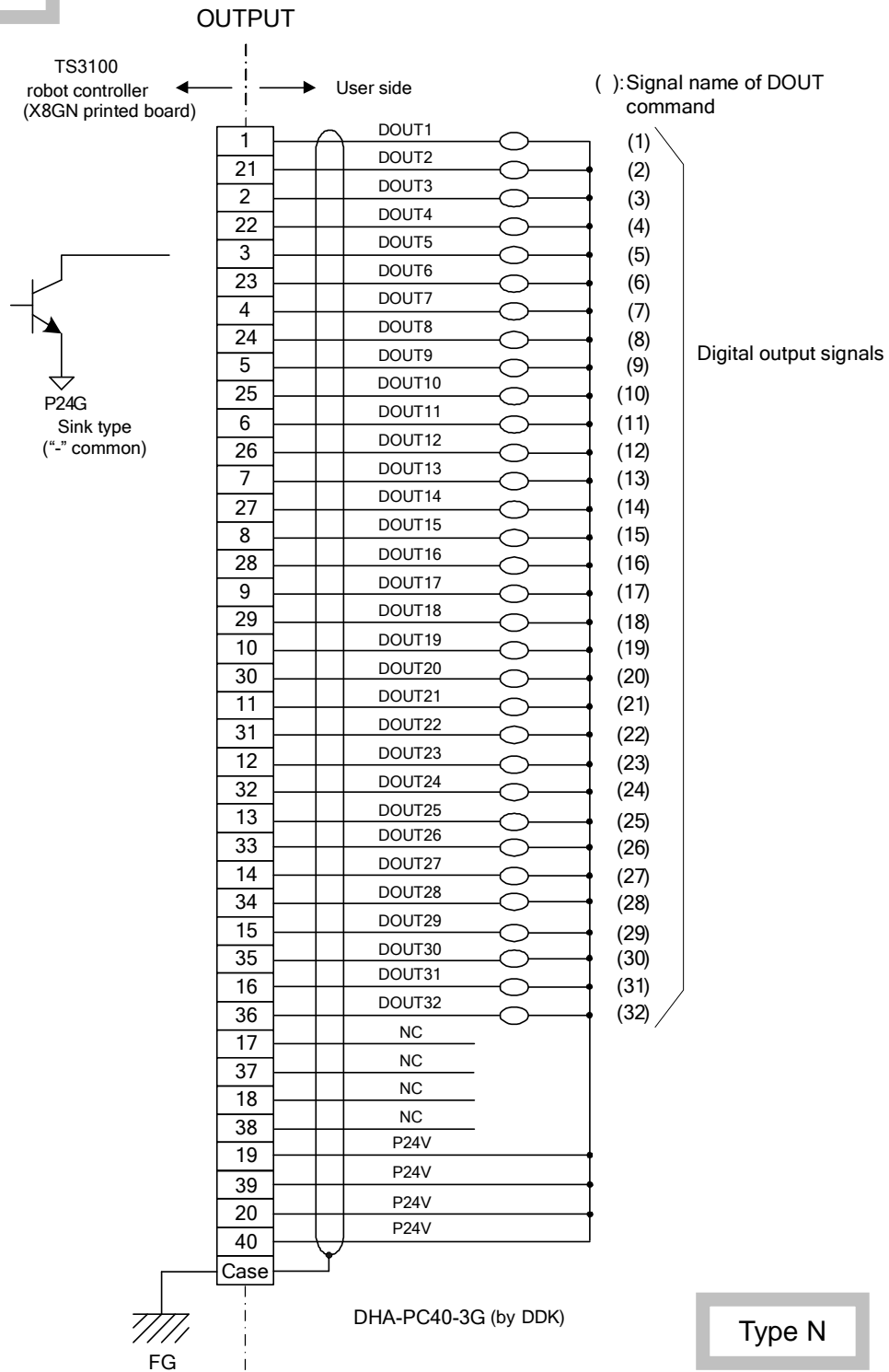
Type P



Type P

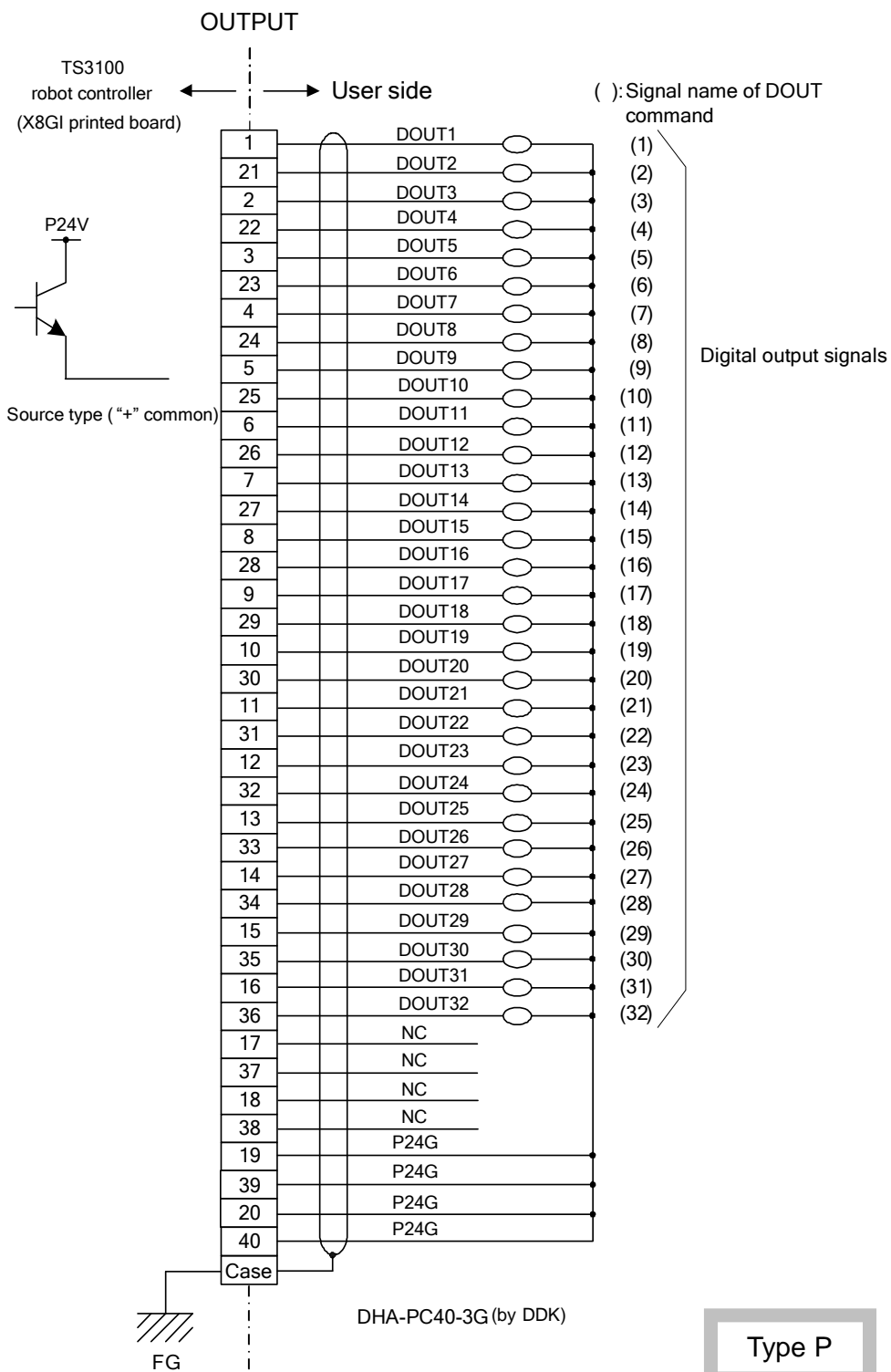
7.2 External Output Signals

Type N



Type N

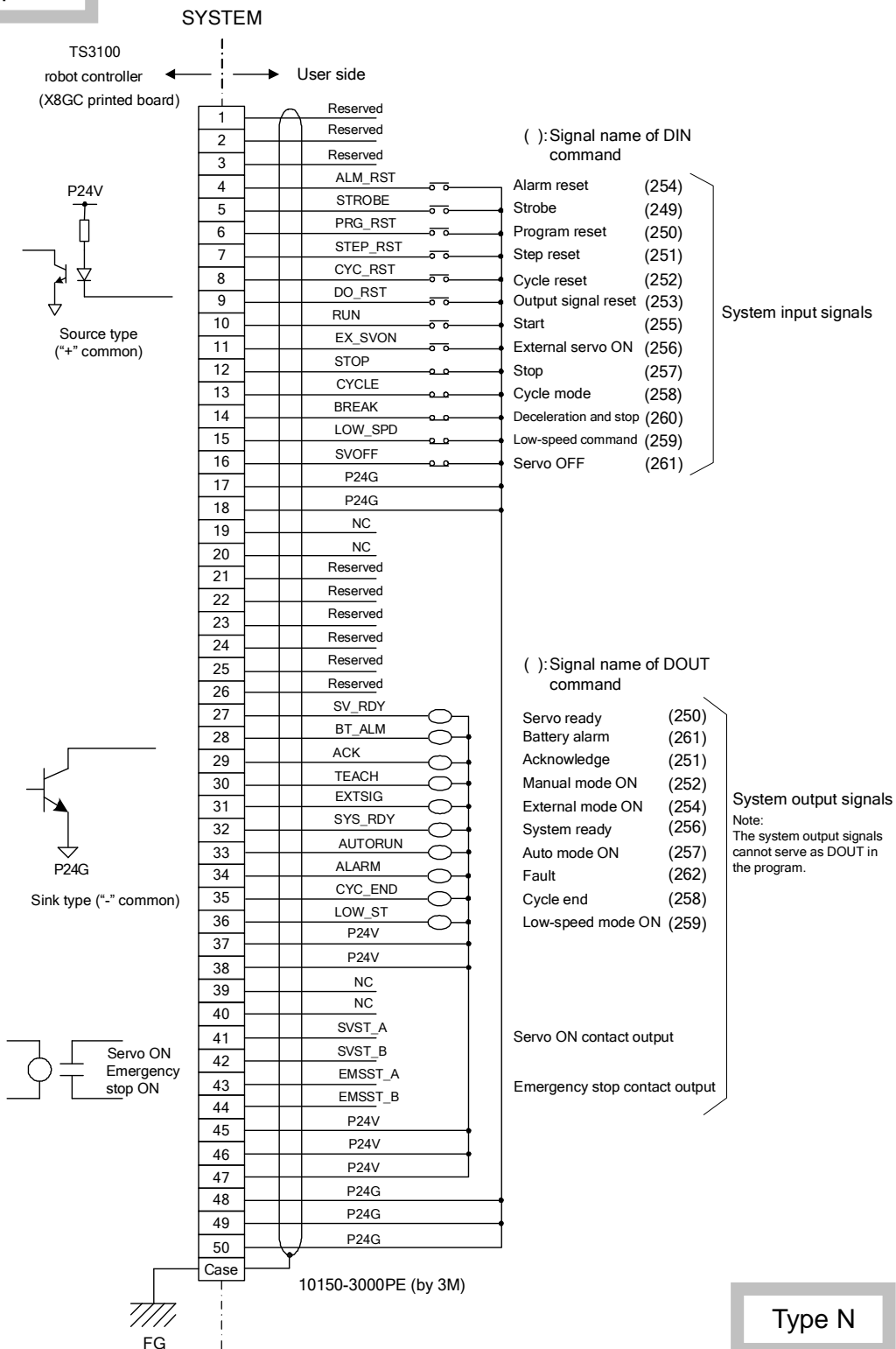
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Type P

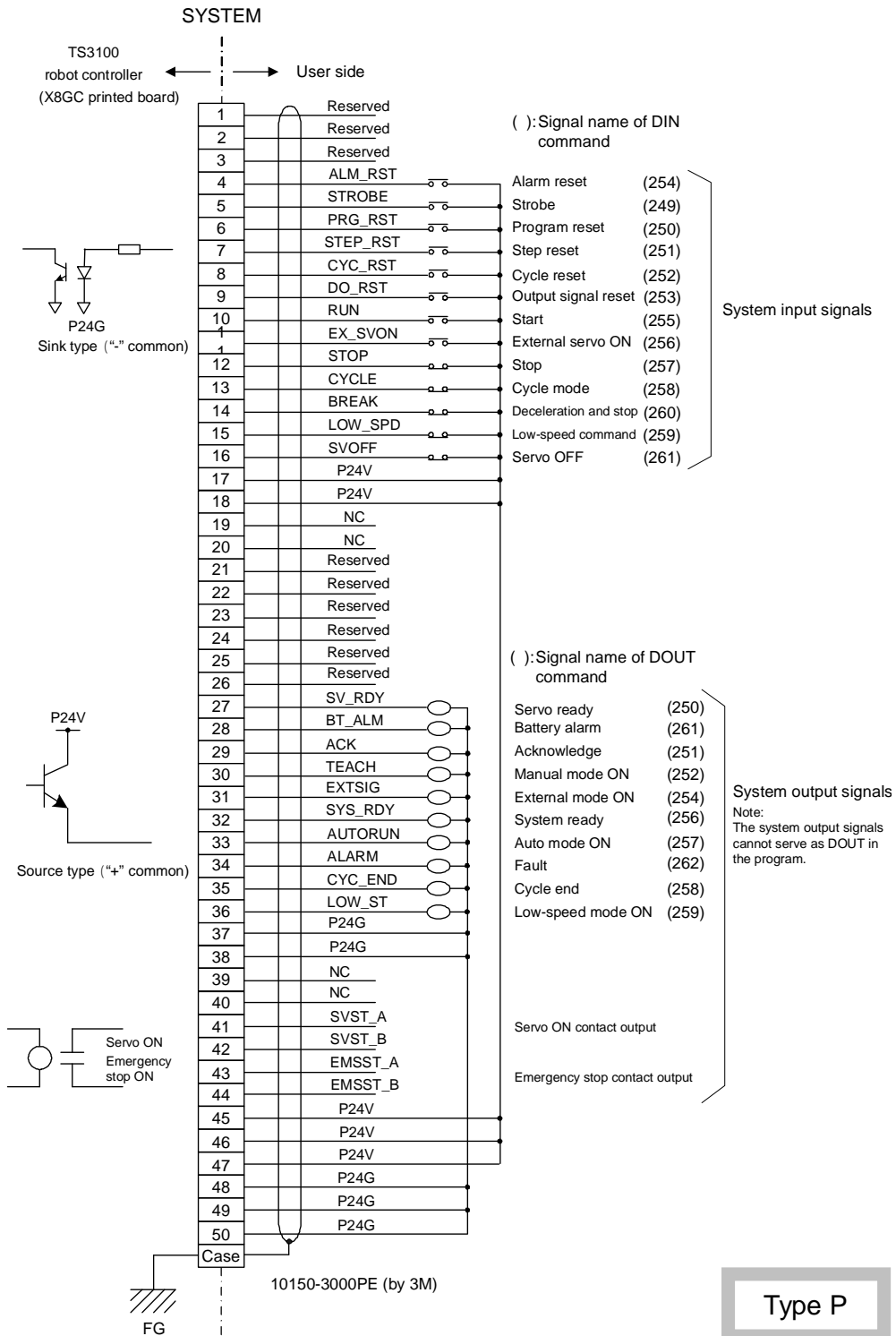
7.3 External Input/Output Signals

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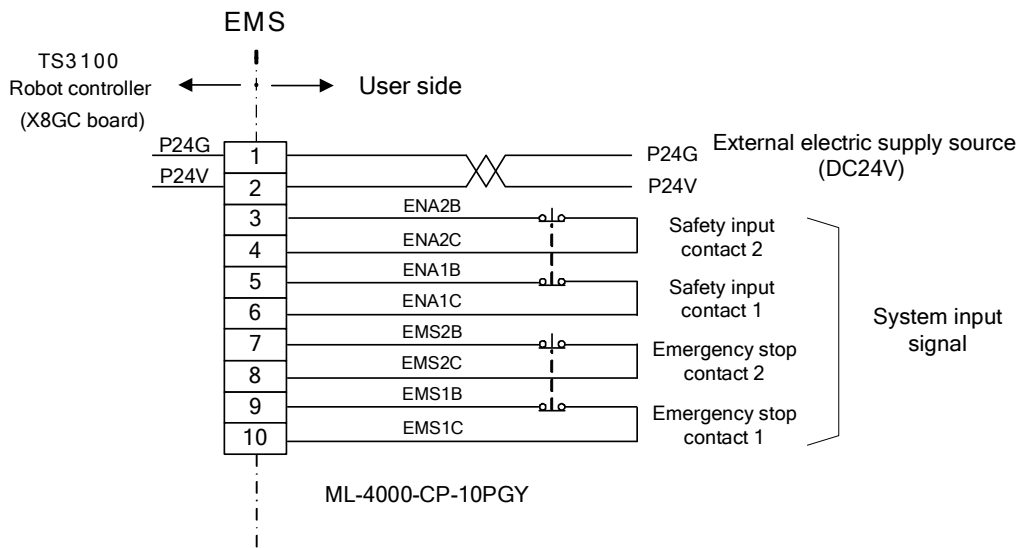


Type N

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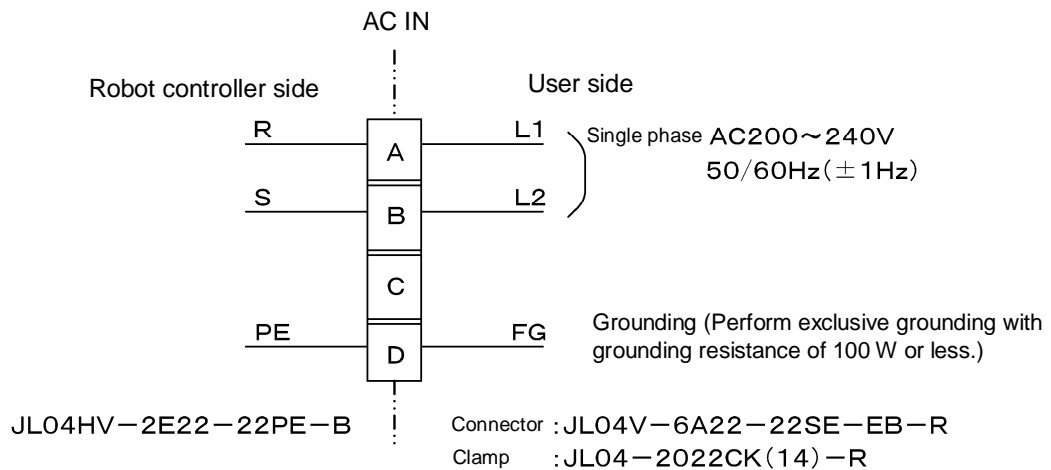


Type P

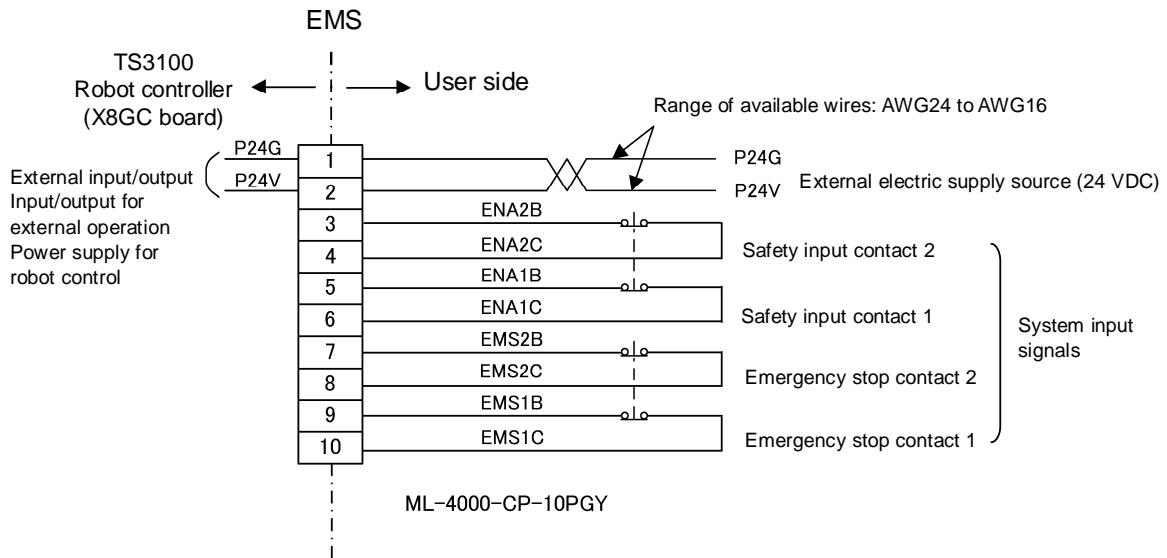


7.4 Power Supply

7.4.1 Power supply

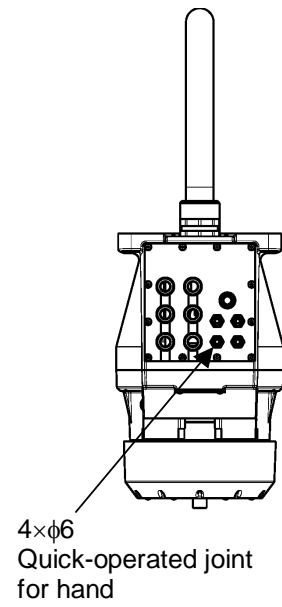
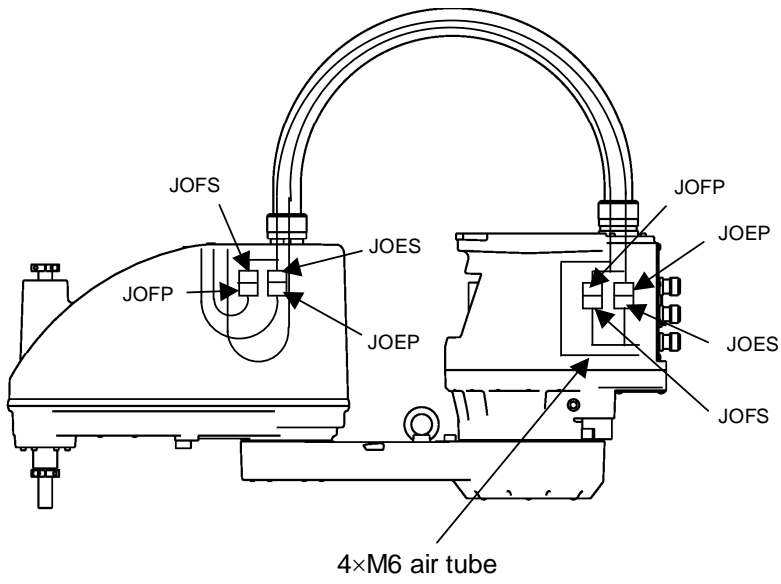
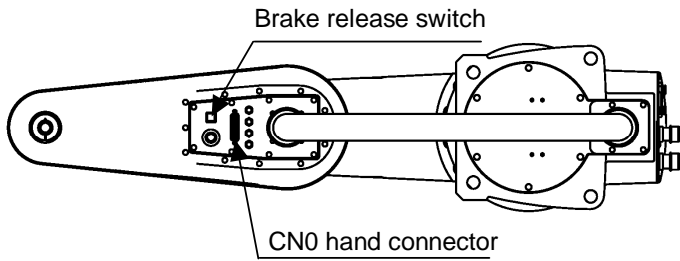


7.4.2 External Electric Supply Source



Select the most suitable power supply in accordance with the user's specification (power capacity).

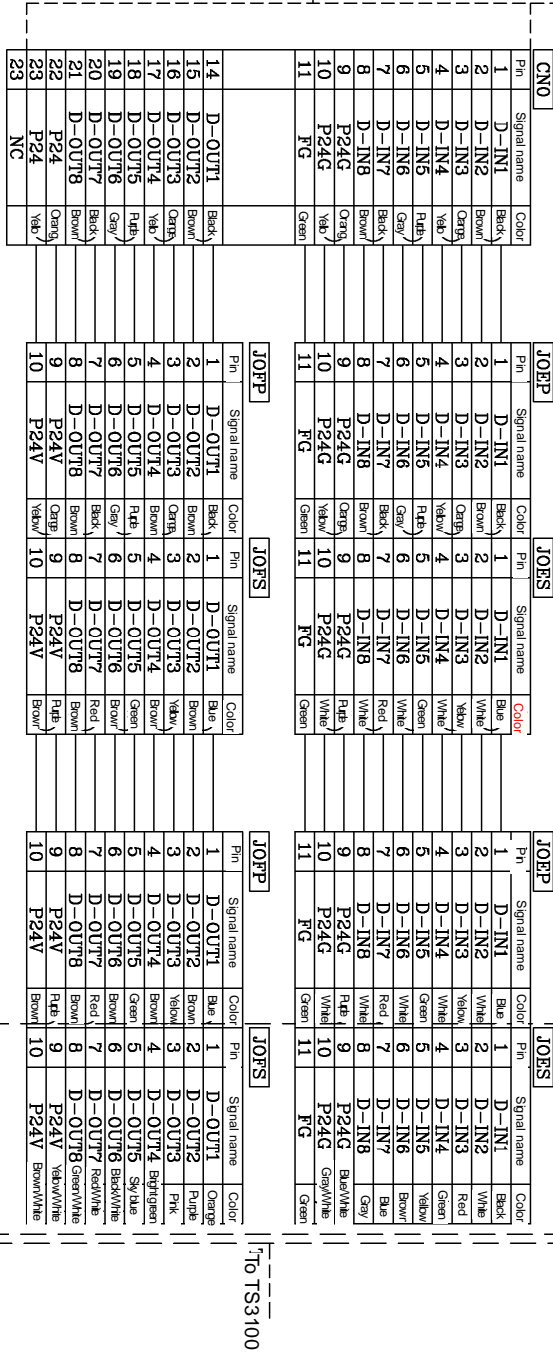
7.5 Wiring and Piping for Hand Control



Type N

To robot hand
(To be connected by
customer)

Update of the second robot arm



To brake OFF switch
To motor brake

Pin	Signal name	Color	Pin	Signal name	Color
1	BRAKE	Blue	1	BRAKE	Red/Black/White
2	P24	Red	2	P24	Black
3	PGND	Yell	3	PGND	Red/White

Robot base section

ロボットの第二アーム (お客様配線)

Customer's side: Plastic connector
 JOES: SMP-11V-BC*JST
 JOFS: SMP-10V-BC*JST
 Contact: BHF-001T-0.8SS*JST

To PLC
 (To be connected by customer)

To brake OFF switch
To motor brake

Robot base section

BRS		BRP			
Pin	Signal name	Color	Pin	Signal name	Color
1	BRAKE	Red	1	BRAK	Red/Black/White
2	P24	Red	2	P24	Black
3	PGND	Yellow	3	PGND	Red/White

Update of the second
robot arm

CNO			JOEP			JOES			JOEP			JOES		
Pin	Signal name	Color	Pin	Signal name	Color	Pin	Signal name	Color	Pin	Signal name	Color	Pin	Signal name	Color
1	D-IN1	Black	1	D-IN1	Black	1	D-IN1	Blue	1	D-IN1	Blue	1	D-OUT1	Blue
2	D-IN2	Brown	2	D-IN2	Brown	2	D-IN2	White	2	D-IN2	White	2	D-OUT2	Brown
3	D-IN3	Orange	3	D-IN3	Orange	3	D-IN3	Yellow	3	D-IN3	Yellow	3	D-OUT3	Yellow
4	D-IN4	Yellow	4	D-IN4	Yellow	4	D-IN4	White	4	D-IN4	White	4	D-OUT4	Brown
5	D-IN5	Red	5	D-IN5	Red	5	D-IN5	Green	5	D-IN5	Green	5	D-OUT5	Green
6	D-IN6	Grey	6	D-IN6	Grey	6	D-IN6	White	6	D-IN6	White	6	D-OUT6	Brown
7	D-IN7	Black	7	D-IN7	Black	7	D-IN7	Red	7	D-IN7	Red	7	D-OUT7	Red
8	D-IN8	Brown	8	D-IN8	Brown	8	D-IN8	White	8	D-IN8	White	8	D-OUT8	Brown
9	P24V	Orange	9	P24V	Orange	9	P24V	Red	9	P24V	Red	9	P24G	Yellow/White
10	P24V	Yellow	10	P24V	Yellow	10	P24V	White	10	P24V	White	10	P24G	Brown/White
11	FG	Green	11	FG	Green	11	FG	Green	11	FG	Green	11	FG	Green

To robot hand
(To be connected by
customer)

To TS3100

Customer's side: Plastic connector
JOES: SMP-11V-BC*JST
JOFS: SMP-10V-BC*JST
Contact BHF-001T-0.8SS*JST

To PLC
(To be connected by
customer)

Type P

For the hand wiring, eight (8) input signals for sensor, etc., eight (8) control signals for solenoid valve, etc., and DC24 V signal (total 2A or less) are provided. Connection on the hand side is performed by using connectors on the rear side at the top of the arm 2. If controlling using a separately-installed sequencer or other device, separate the JOES and JOFS connectors inside the base, and connect the cable from the sequencer or other device.

For the hand piping, a total of four (4) lines ($\phi 6 \times 4$) are provided. Connections are made on the base rear side and upper side of the arm 2.

8. Safety Precautions

8.1 General Items

- 1) Transport, installation, wiring, operation, inspection and maintenance should be performed by qualified personnel well versed in the equipment. Otherwise, an electric shock, injury or fire may be caused.
- 2) Install safety fences so that anyone cannot approach the dangerous area. This dangerous area is the area around the robot's operating range where a person may face a dangerous condition if he or she has entered.
- 3) When you have to enter the dangerous area, the robot should be emergency-stopped beforehand. Install an emergency stop circuit after you have fully read and understood the controller instruction manual.
- 4) Provide a necessary space in the dangerous area to perform the work with safety.
- 5) Install the controller at a place outside the dangerous area, where an operator can watch the entire robot movements.
- 6) NEVER use the equipment at a place where it is exposed to water splash, in a corrosive atmosphere, in an atmosphere containing inflammable gas or metal chip, or near combustibles. Otherwise, a fire or equipment failure may be caused.
- 7) DO NOT place the robot near a combustible material. If it ignites due to a fault, etc., a fire will break out.
- 8) DO NOT operate the robot if any part is damaged or missing. Otherwise, an electric shock, fire or fault will be caused.
- 9) NEVER replace or modify parts other than those described in the instruction manual. Otherwise, the robot performance will deteriorate, or a fault or accident will be caused.
- 10) Completely connect the grounding cable. Otherwise, an electric shock or fire will be caused if a fault or fault current occurs. Also, it could cause miss-operation by noise.
- 11) DO NOT incinerate, disassemble or charge the battery. Otherwise, it will rupture.
- 12) DO NOT change the data of the system configuration file. Otherwise, the robot will operate abnormally, resulting in a damage or accident.

8.2 Storage

- 1) When storing the robot, firmly secure it to the base while securing the arm and base with the clamps provided as accessories.
If the robot is just placed on the floor, it becomes unstable and will fall down.
- 2) DO NOT store the robot at a place where it is exposed to direct rain or water splash, or at a place containing any toxic gas or liquid.
- 3) Store the robot at a place where it is not directly exposed to sunlight and both the temperature and humidity are kept as specified.
- 4) DO NOT store the robot which has not been used for a long period of time after unpacked. If the robot has been stored over a long period of time, be sure to consult with us before operation.

8.3 Transportation and Installation

- 1) When installing the robot, secure it to the base completely. If it is installed incompletely, a fault or injury may be caused.
- 2) At the time of robot operation, sudden acceleration or deceleration is caused. When the robot is to be installed on a stand, therefore, it should be sufficiently rigid. If the robot is installed on a less rigid stand, vibration will be caused during robot operation, resulting in a fault.
- 3) Install the robot at a well leveled place. Otherwise, the robot performance will deteriorate, or a fault will be caused.
- 4) For the controller, keep a specified ample space for ventilation. Otherwise, the controller will heat and go wrong.
- 5) Take all necessary measures not to impose an impact on the robot during transportation. Otherwise, a fault or injury will be caused.
- 6) Be sure to secure the robot with attached clamps before transportation. Otherwise, you will be injured if the arm moves when the robot is lifted.
- 7) NEVER lift the robot by the arm. Otherwise, an excessive force will be exerted on the robot mechanism, resulting in damage of the robot.
- 8) When lifting the robot, lift it up slowly as the robot will tilt slightly. If it is lifted up suddenly, it will cause a very hazardous situation.

8.4 Wiring

- 1) Electric work should be done by a qualified electric engineer. Otherwise, a fire or electric shock will be caused.
- 2) Wire the robot after installation. Otherwise, an electric shock or injury will be caused.
- 3) Always use the master power voltage and power capacity designated by Toshiba Machine. Otherwise, the equipment will be damaged or a fire will break out.
- 4) Always use the designated power cables. If a cable other than the designated is used, a fire or fault will be caused.

8.5 Operation

- 1) DO NOT enter the dangerous area of the robot during operation. Otherwise, you will be seriously injured.
- 2) DO NOT leave any obstacle in the job space. If the equipment went wrong, a worker may be injured, or other serious accident may be caused.
- 3) Anyone other than the workers MUST NOT approach the equipment. Should he or she negligently touch a dangerous part of the equipment, he or she will get injured or involved in a serious accident.
- 4) NEVER perform an inappropriate operation which is not described in the instruction manual. Otherwise, the equipment will start by mistake, resulting in a personal injury or serious accident.
- 5) If you feel even a little that you are exposed to danger or the equipment works abnormally, press the EMERGENCY stop pushbutton switch to stop the equipment.
If the equipment is used as it is, you will be injured or involved in a serious accident.
- 6) During operation, be sure to close the equipment cover. Should the cover be opened during operation, you will be struck by an electric shock or get injured.
- 7) Only a well-trained and qualified person is allowed to perform the operation. Should the equipment be operated improperly, it will start by mistake, causing a personal injury or serious accident.
- 8) If the equipment has malfunctioned, turn the power off, identify and remove the cause of the abnormality, maintain the peripheral equipment and completely

restore the malfunctioned equipment. Then start the equipment at a low speed. If the equipment starts, leaving the abnormality, you will be involved in a serious accident.

- 9) In principle, teaching operation should be performed outside the dangerous area of the robot. If it should be performed inevitably within the dangerous area, strictly observe the following matters.
 - [1] The teaching operation should always be performed by two (2) persons. One person performs the job and the other person watches outside the dangerous area. Also, both persons should try to prevent miss-operation with each other.
 - [2] The operator should do the job in an attitude ready to press the EMERGENCY stop pushbutton switch at any time. Also, he or she should perform the job at a position from which he or she can evacuate immediately at the time of an emergency after confirming the robot's operating range and shields in the surroundings.
 - [3] The supervisor should keep watch on the job at a position where he or she can see the entire robot system and operate the EMERGENCY stop pushbutton switch at the time of an emergency. Also, he or she should keep anyone from entering the dangerous area. If the worker or other person will not follow the instructions of the supervisor, he or she will be involved in a serious accident.
- 10) If an abnormality has generated or the POWER LED lamp on the control panel remains off after the main power switch of the equipment was turned on, turn off the main power immediately and confirm the wiring. Otherwise, you will be struck by an electric shock or a fire will break out.
- 11) Unless the robot operates toward a designated direction at manual guide, turn off the servo power. Otherwise, the robot will be damaged or you will be involved in an accident.
- 12) Pushbutton operations of the control panel and teach pendant should be confirmed visually. Otherwise, you will be involved in an accident due to miss-operation.
- 13) After the power is turned on or before the start of an automatic operation, be sure to reset a relevant program beforehand. If the continuous mode is selected for the program execution environment, the robot will collide with the peripheral equipment, resulting in a damage or accident of both.
- 14) Before operating the equipment, perform the following inspection.

- [1] Make sure that visual appearance of the robot, controller, peripheral equipment and cables is in good condition.
- [2] Make sure that no obstacle stands in or near the operating range of the robot and peripheral equipment.
- [3] Make sure that the emergency stop and other safety devices operate properly.
- [4] Make sure that no abnormal noise or vibration is involved in the robot operation.

If the above prior inspection is skipped, the equipment will be damaged or you will be involved in an accident.

- 15) The speed of test operation is initially set at 20% of the maximum robot speed.
- 16) The speed of automatic operation is initially set at 100% of the maximum robot speed.

8.6 Maintenance and Inspection

- 1) Anyone other than the qualified engineer should not perform inspection.
- 2) Be sure to turn off the main power of the controller before starting inspection or maintenance.
- 3) Perform maintenance and inspection regularly. Otherwise, the equipment will go wrong or you will be involved in an accident.

8.7 Waste Disposal

- 1) This equipment should be disposed of as industrial wastes. When disposing of the battery, follow the user's provided regulations.

APPROVED BY: *F. Uehara.*

CHECKED BY: *K. Kido*

PREPARED BY: *Y. Nakai*

TOSHIBA MACHINE Co., Ltd.
