

SCARA ROBOT SPECIFICATIONS

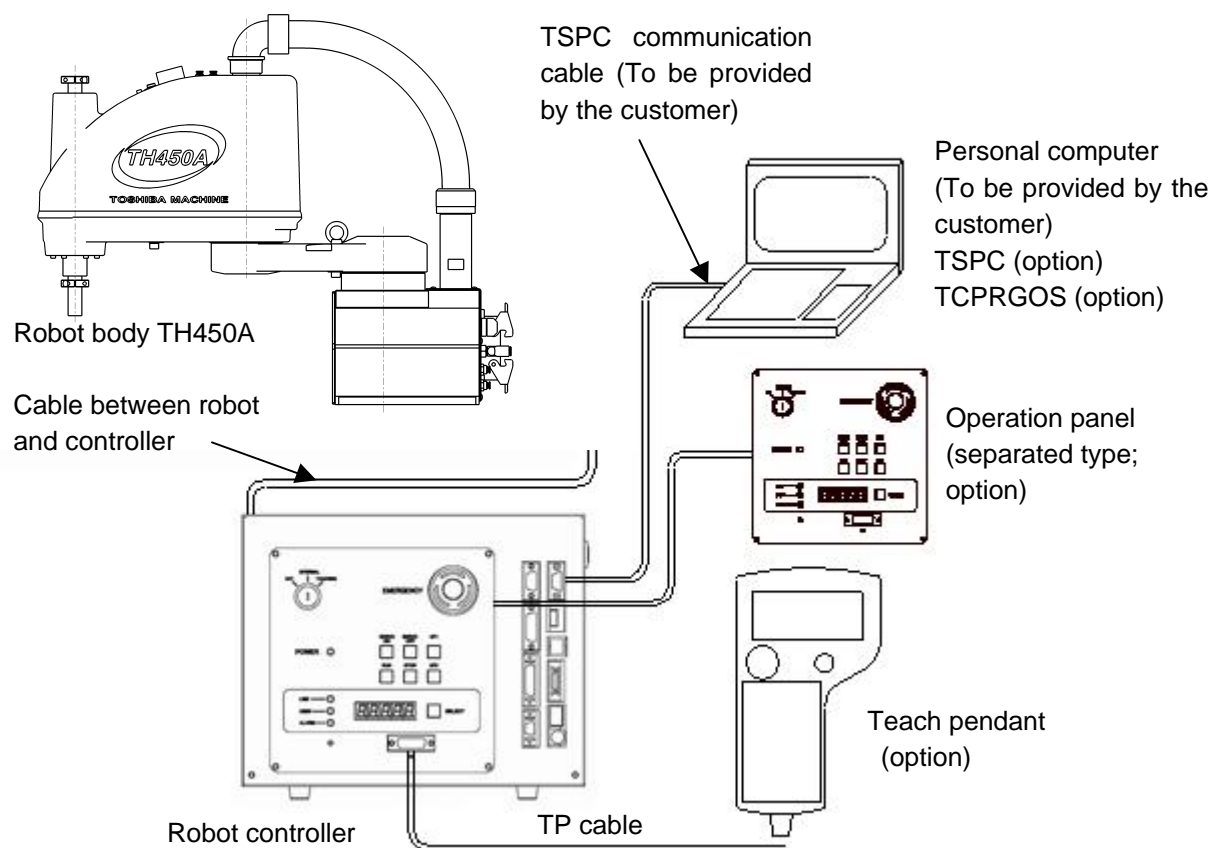
TH450A / TS3000

October 2009

TOSHIBA MACHINE CO., LTD.

NUMAZU, JAPAN

1. Structure of Robot Equipment



Structural drawing of robot equipment

[Standard Equipment and Accessories]

No.	Name of Equipment	Type	Q'ty	Remarks
1	Robot Body	TH450A	1	
2	Cable between robot and controller	(Standard 5m)	1	
3	Robot controller	TS3000	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		2	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	English		
12	Polarity of controller	Minus (-) common		

[Robot Mechanical Option]

No.	Name of Equipment	Type	Q'ty	Remarks
1	Z-axis long stroke	300mm		
2	Specifications pursuant to CE marking			
3	Dustproof and splashproof construction (IP65)			
4	Ceiling suspension type			

[Optional equipment (Electrical side)]

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

[Controller Option]

No.	Name of Equipment	Type	Q'ty	Remarks
1	Separated operation panel			
2	Controller side bracket			2 pcs. per set
3	Vertical mount controller			
4	Addition of extension I/Os	TR48DICN		
5	Program development software	TSPC		With instruction manual
6	TSPC cable			
7	RS-232C Port	COM2		
8	Program development software	TCPRGOS		With instruction manual
9	TCPRGOS cable			
10	Safety box for control category3	TS3SFB		ISO13849-1
11	Conveyor synchronization function			
12	Latch function			
13	Network function	Profibus		
14	Network function	DeviceNet		
15	Network function	CCLink		
16	Network function	Ethernet		

[Documents]

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

Complete instruction manual: Startup manual, Operation manual, Robot language manual, Interface manual, Transportation and installation manual, Maintenance manual, Communication manual, Safety manual, User parameter manual, Total of nine documents

2. Robot Specifications

2.1 Robot TH450A Standard Specifications

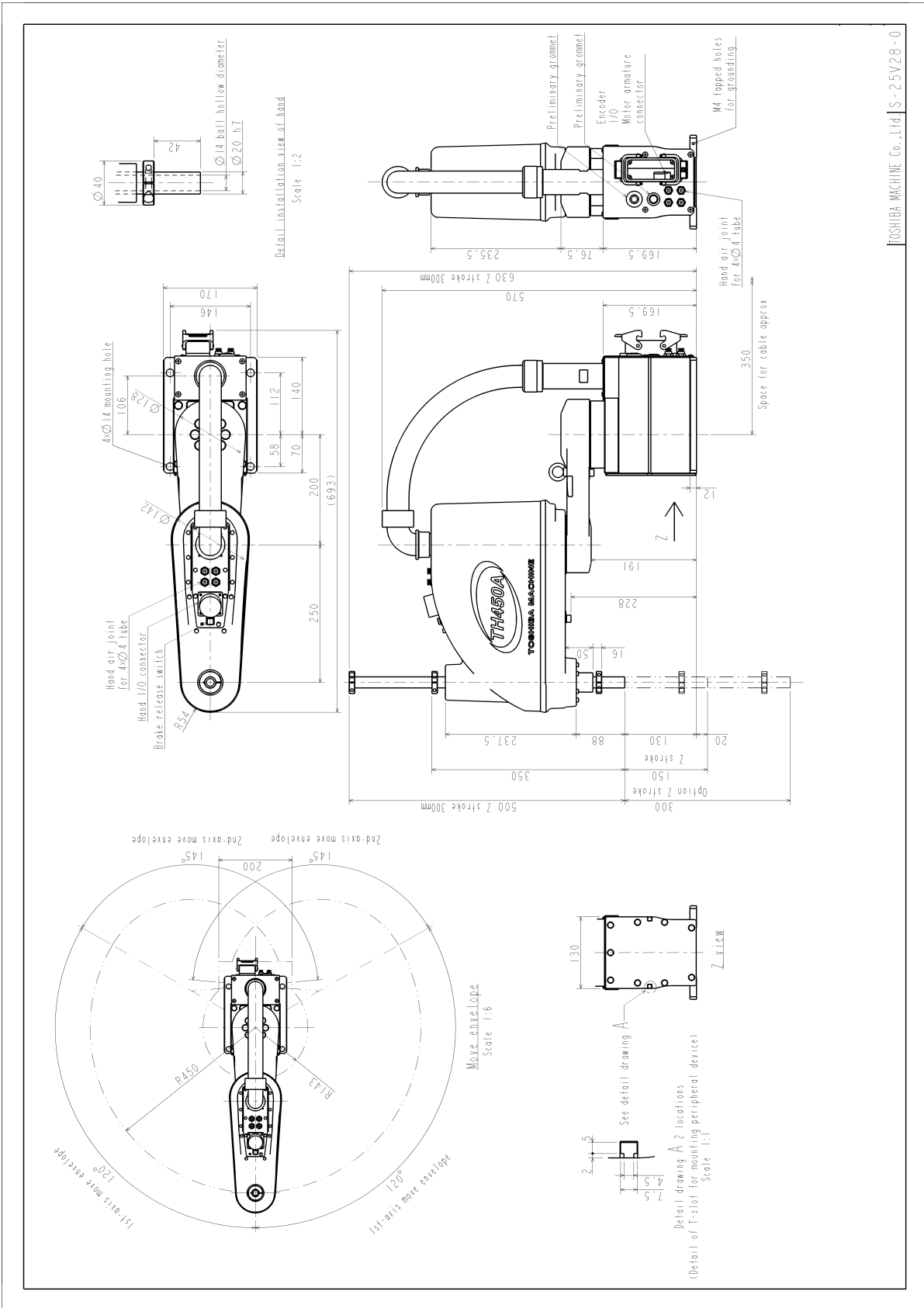
No	Item	Specification	Remarks
1	Type	Horizontal multi-articulation	
2	No. of controlled axes	4 axes	
3	Arm length	Full length	450(mm)
		Arm 1	200(mm)
		Arm 2	250(mm)
4	Working envelope	Axis 1	±120(deg)
		Axis 2	±145(deg)
		Axis 3	0 to 150(mm)
		Axis 4	±360(deg)
5	Maximum speed	Axis 1	600(deg/sec)
		Axis 2	600(deg/sec)
		Axis 3	2,000(mm/sec)
		Axis 4	2,000(deg/sec)
		Composite	7.3(m/sec)
6	Maximum payload mass	5(kg)	*1
7	Standard cycle time (when transferring 2 kg)	0.30(sec)	*2
8	Permissible load inertia	0.06(kg•m ²)	*1
9	Positioning repeatability	X-Y	±0.01(mm)
		Z (axis 3)	±0.01(mm)
		C	±0.005(deg)
10	Drive system	AC servo motor for all axes	
11	Robot body	Mass	26(kg)
		Painting color	Body: White alumite treated Arm cover: White

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

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

*3 : When the environment temperature is constant.

2.2 External View of TH450A



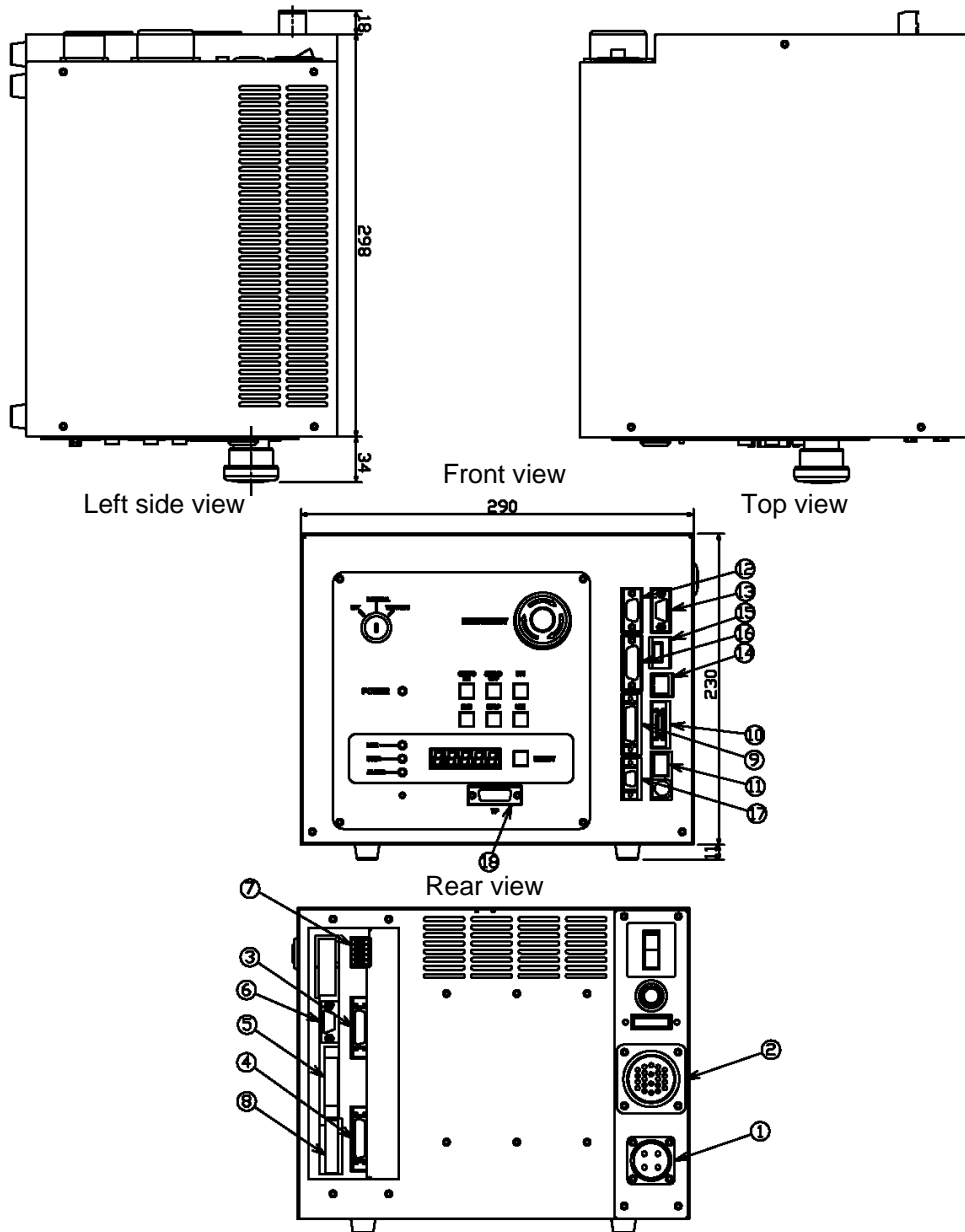
TOSHIBA MACHINE Co., Ltd. | S-25V28-0

3. Controller Specifications

3.1 Controller TS3000 Standard Specifications

No	Item		Specification	Remarks
1	No. of controlled axes		Standard 4 axes (No. of simultaneously controlled axes: 5 axes)	
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 (1 port)	
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. Servo-free: Arms are moved by operator's hands.	
		Program input	Input through the teach pendant.	
10	External input/output signals		32 inputs and 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.	
13	Serial communication port		RS232C: General for HOST and COM1 RS232C: Exclusive for TCPRG and POD RS485: Exclusive for additional I/O (Max. 64 inputs and outputs) RS422: Exclusive for teach pendant Ethernet: 10 Mbps	
14	Fieldbus (option)		DeviceNet, PROFIBUS, CC-Link	
15	Speed setting		Override/speed limit /program command: 1 ~ 100 % each	
16	Acceleration setting		Program command: 1 ~ 100 %	
17	Torque limit		Program command: 1 ~ 100 %	
18	Teaching unit		Teach pendant	
19	Coordinate system		World, work, tool, base (Base, work and tool coordinate systems can be set separately.)	
20	Motion limit		Soft limit	
21	Self-diagnostic function		Detection of various errors, etc.	
22	Interruptive function		Start of interruptive program by input signal, timer, etc.	
23	Operation mode		Internal auto, external auto (I/O), external communication	
24	Operation method	Internal operation mode	Continuous, cycle, step, motion step, machine lock	
		External operation mode	Cycle, continuous	
25	Controller	Outer dimensions	290(W)×230(H)×298(D)	
		Mass	13(kg)	
		Painting color	White	
26	Power supply		Single-phase, 200 ~ 240 VAC, 50/60 Hz	2.3kVA
27	Computer software (option)		TSPC: Program creation/teaching, remote control, etc. TCPRGOS: Sequence program creation	
28	Program language		Robot language SCOL (similar to BASIC)	

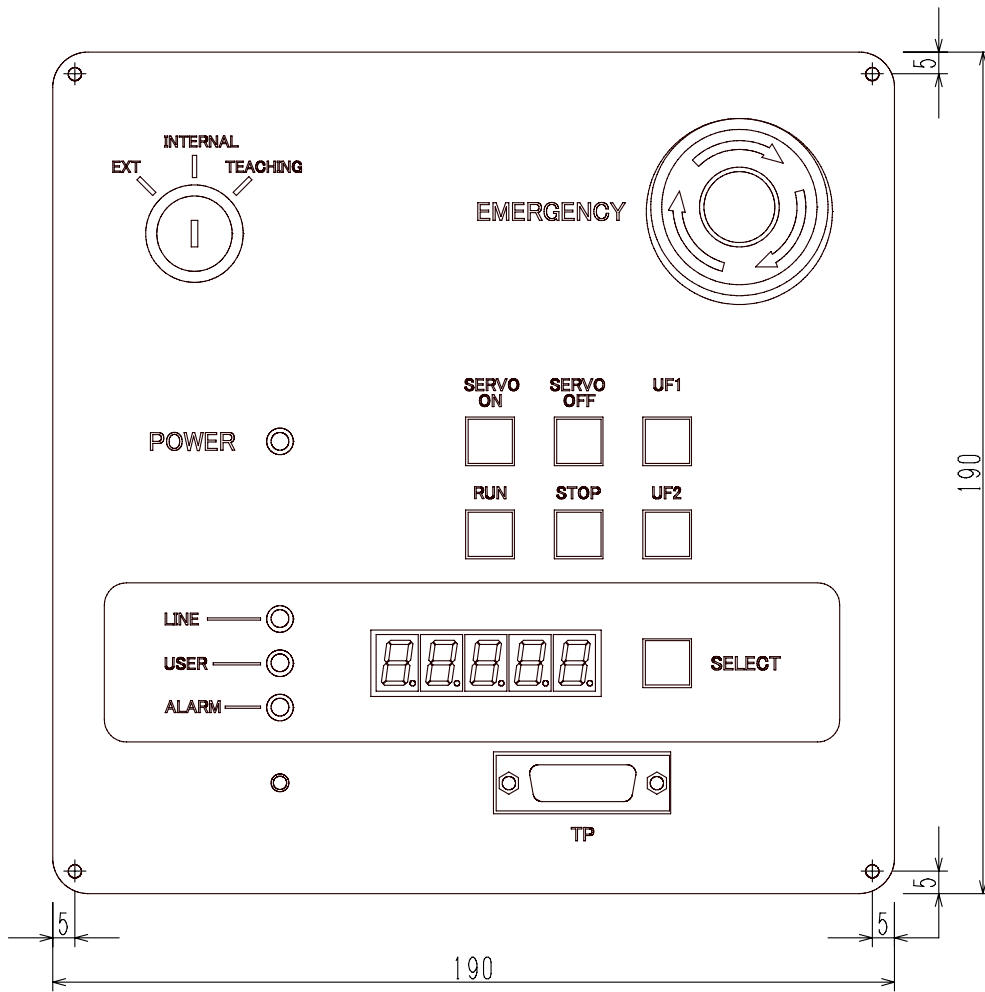
3.2 External View of Controller TS3000



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 input/output signal |
| 6 | TCPRG | Port for sequence program editing/touch panel |
| 7 | EXT I/O | RS485 port for connecting TC200/terminal block I/O |
| 8 | EMS | Safety signal line |
| 9 | ENC | Robot encoder cable |
| 10 | HAND | Robot hand control signal |
| 11 | BRK | Brake control signal |
| 12 | COM1 | Serial communication port for external equipment |
| 13 | HOST | Serial communication port for user |
| 14 | LAN | TCP/IP communication 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 TS3000 operation panel

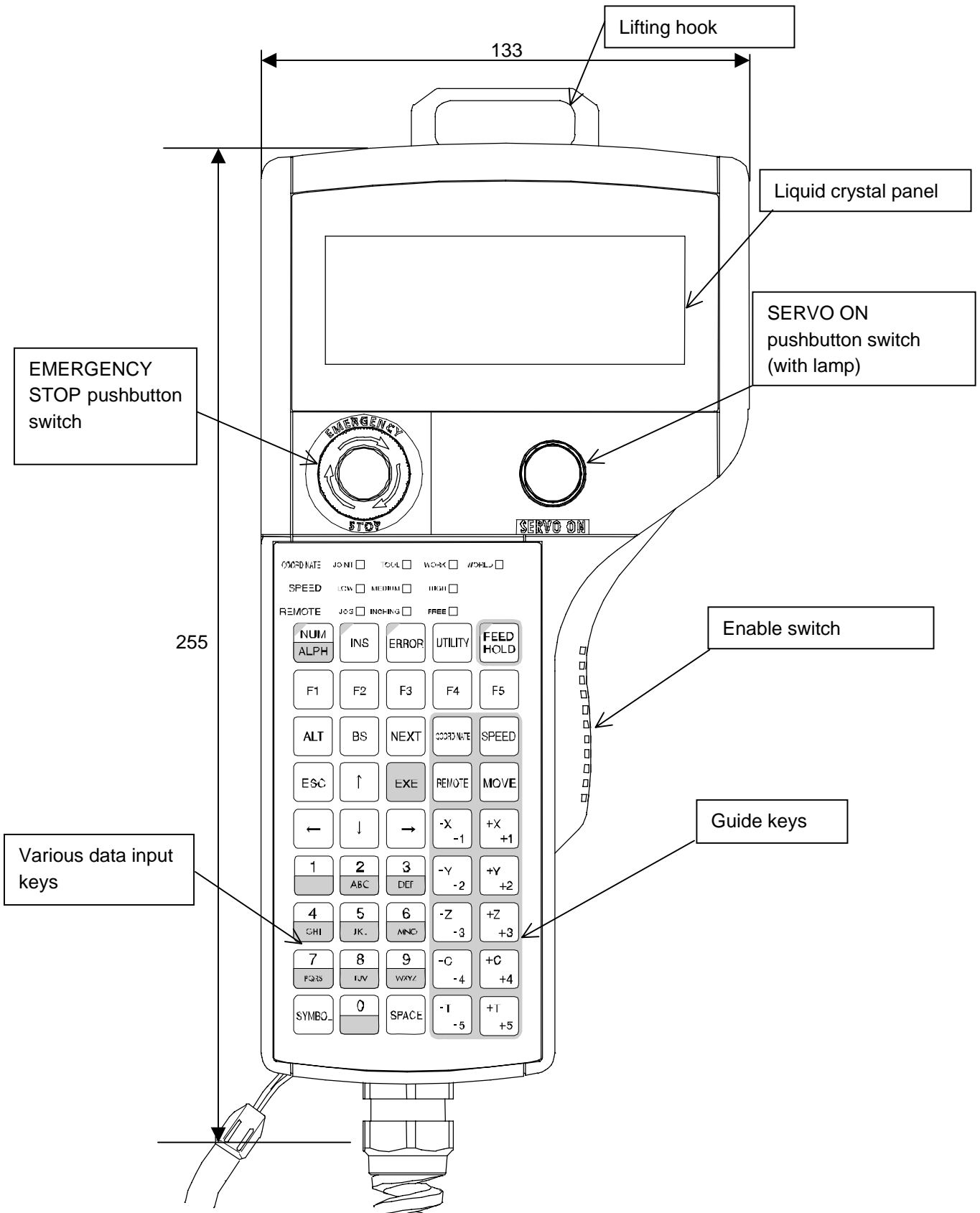
3.4 Outline Drawing of Teach Pendant

Teach Pendant (Model TP1000)

Body thickness: 48mm (including EMERGENCY STOP button 56mm)

Weight: 600g (not including cable)

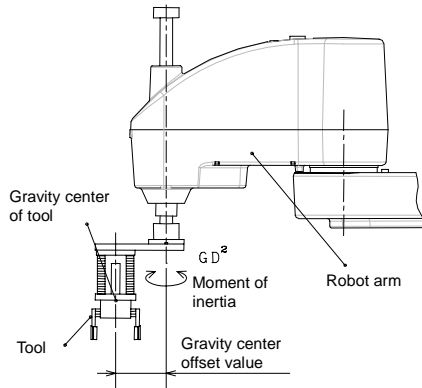
Cable length: Standard 5m



*This teach pendant can be used together with the TS1000, TS2000, TS2100, TS3000, and TS3100.

4. Permissible Load Specifications

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 TH-A 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.

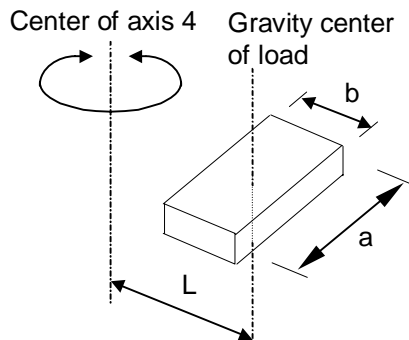


Permissible load conditions

Conditions	Allowance
Mass	Rated 2 kg (Max. 5 kg)
Moment of inertia	Max 0.06(kg•m ²)
Gravity center offset	Max 100mm

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)

$$\begin{aligned} \text{Moment of inertia (kg}\cdot\text{m}^2) \\ &= \frac{M}{12}(a^2 + b^2) + ML^2 \end{aligned}$$

5. General Specifications

- a) Applicable standards
In principle, material, design and test of the equipment stipulated in this specifications shall be pursuant to the JIS, JEC 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 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, 200 ~ 240 VAC, 50/60 Hz ±1 Hz
Instantaneous power failure: Within 20 msec
Grounding: D-class grounding (ground resistance of 100 Ω 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 this 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. Toshiba Machine will not be liable for any secondary or incidental damage that occurs as a result of a failure in this 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	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.
Program control commands	END KILL MAXTASK REMARK SWITCH TASK TID	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 DOUT HEXIN HEXOUT PULOUT	Inputs a BCD signal. Outputs a BCD signal. Outputs a CR code Reads an input signal. Outputs a signal. Reads signals in hexadecimal notation. Outputs signals in hexadecimal notation. Outputs a pulse signal.

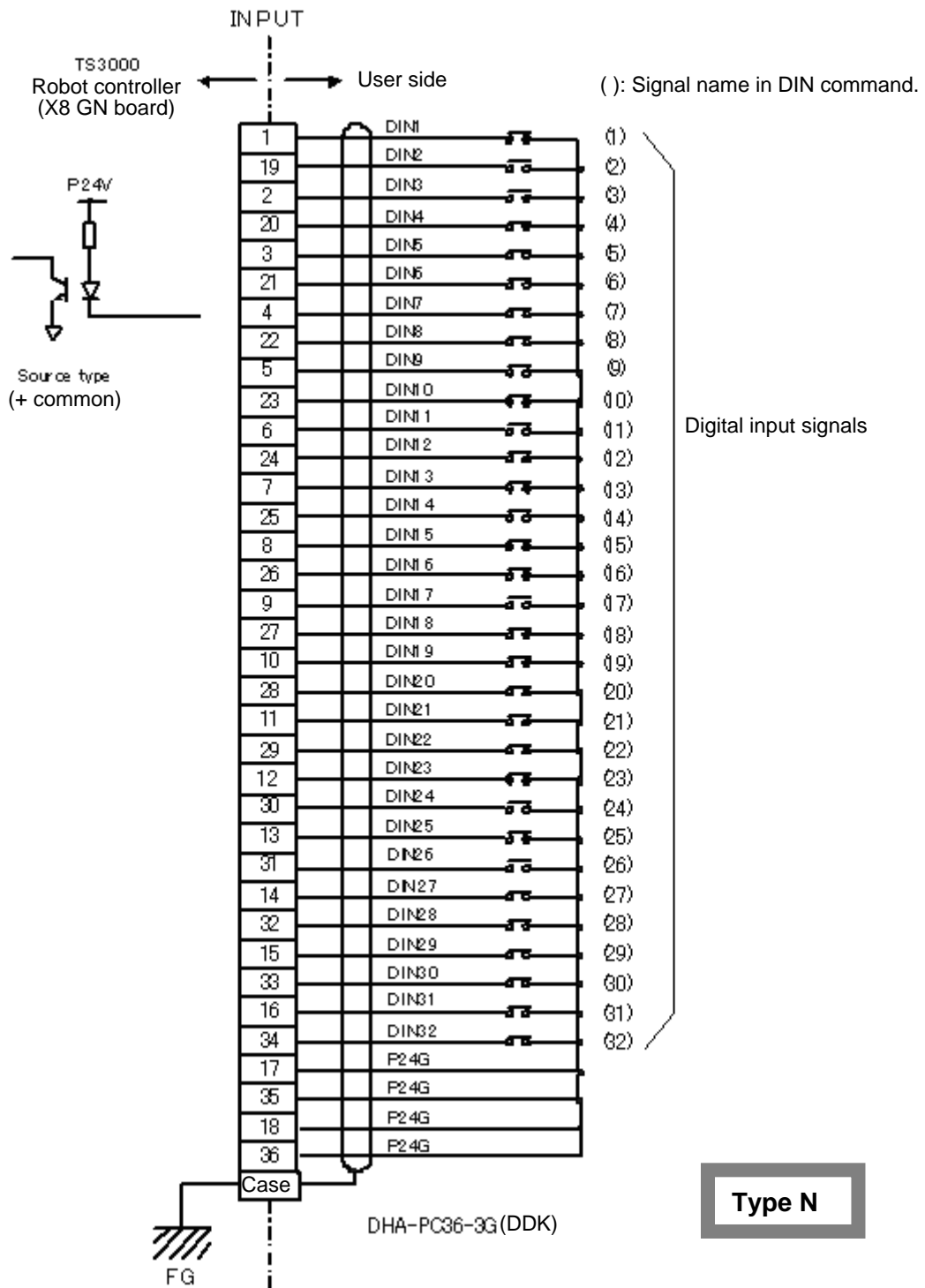
	RESET PRINT INPUT	Resets the controller. Outputs communication data. Inputs communication data.
Movement condition commands	ACCEL ACCUR CONFIG DECEL DISABLE ENABLE FREELOAD GAIN ONGAIN OFFGAIN NOWAIT PASS PAYLOAD SETGAIN SMOOTH (option) SPEED MOVESYNC SWITCH TORQUE WITH	Specifies acceleration (during 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 EXP HERE INT LN LOG10 MOD NOT OR POINT REAL SGN	Cosine. Sine. Tangent. Absolute value. Arccosine. Logical product. Arcsine. Arctangent. Arctangent. Destination position. Exponent to power e. 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.
	SQRT	Square root.

	TRANS	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 functions (TS2000 option)	LATCH LATCHTRG1 to 8 LATCHSIG1 to 8 LATCHPSN1 to 8	Enables/disables the position latch function. Detection edge direction. Signal status. Latched position.
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	PLCDATAR 1 ~ 8 PLCDATAW 1 ~ 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.

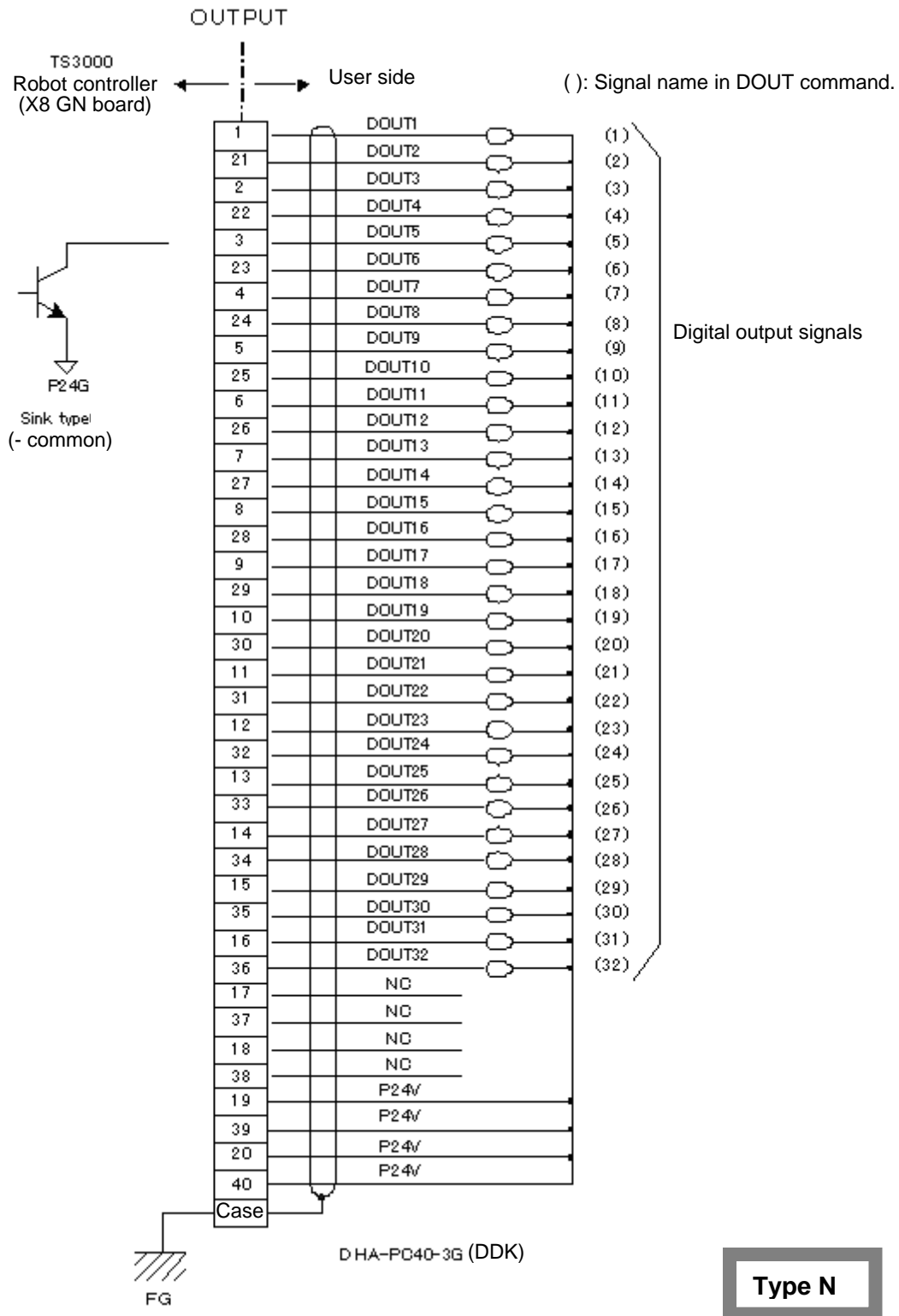
7. External Interface

7.1 External Input Signals



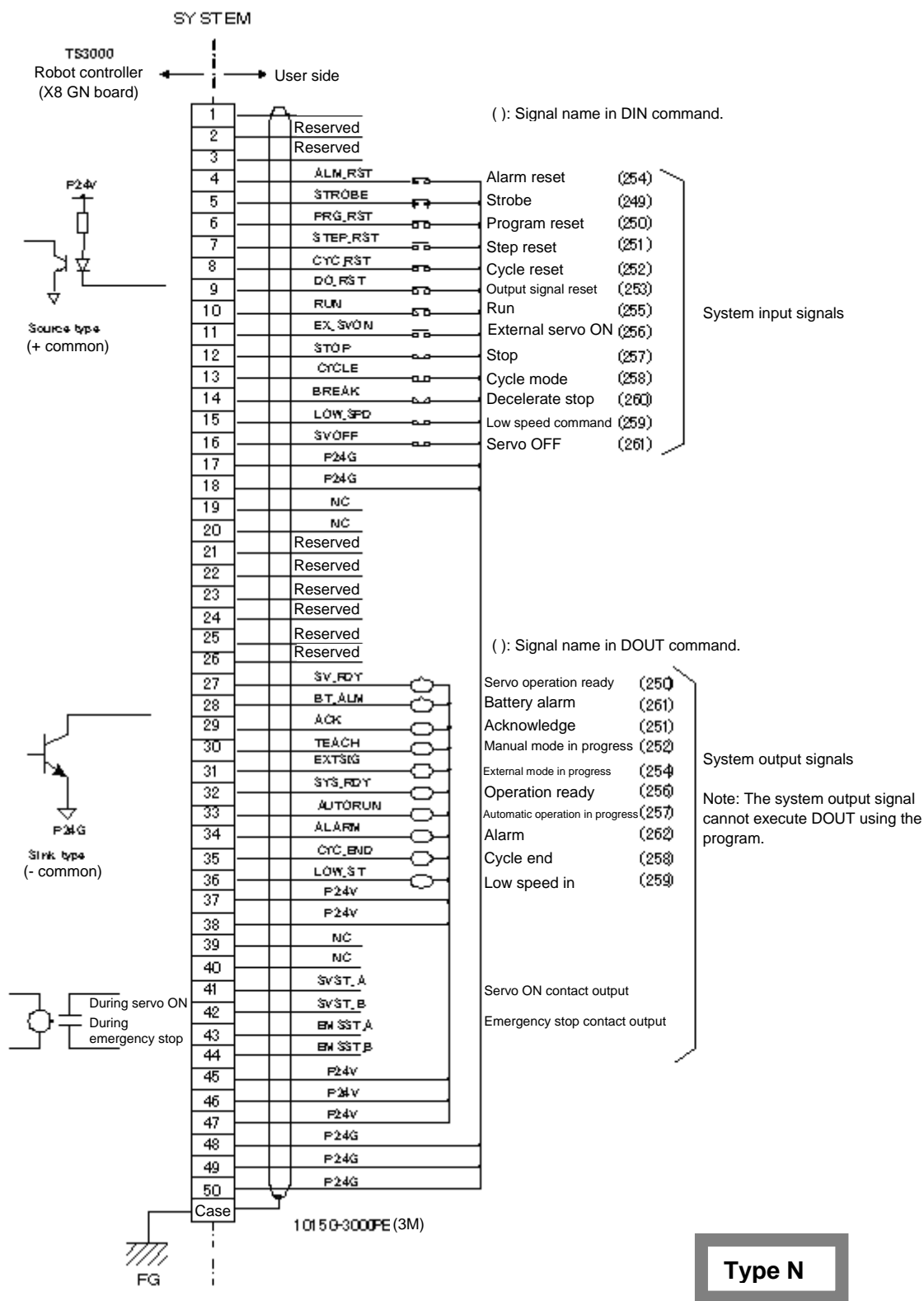
* This drawing refers to the source type (Type N).
The sink type (Type P) inputs can also be selected optionally.

7.2 External Output Signals

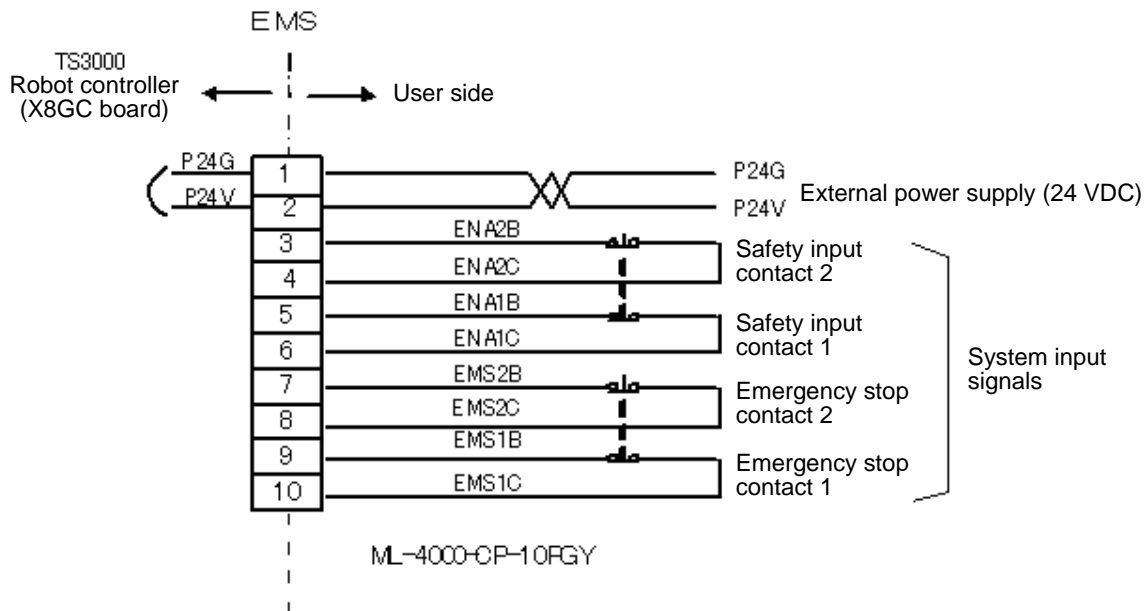


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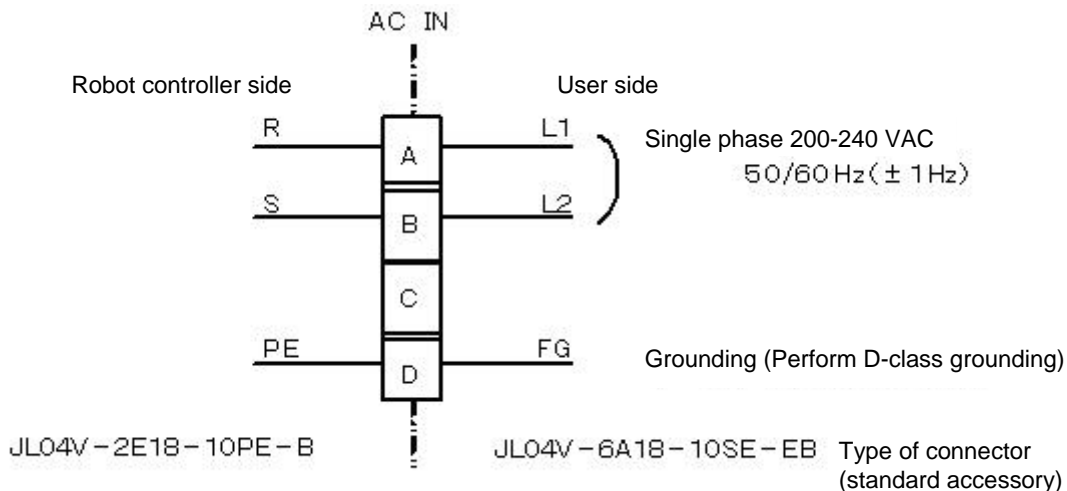
7.3 External Input/Output Signals



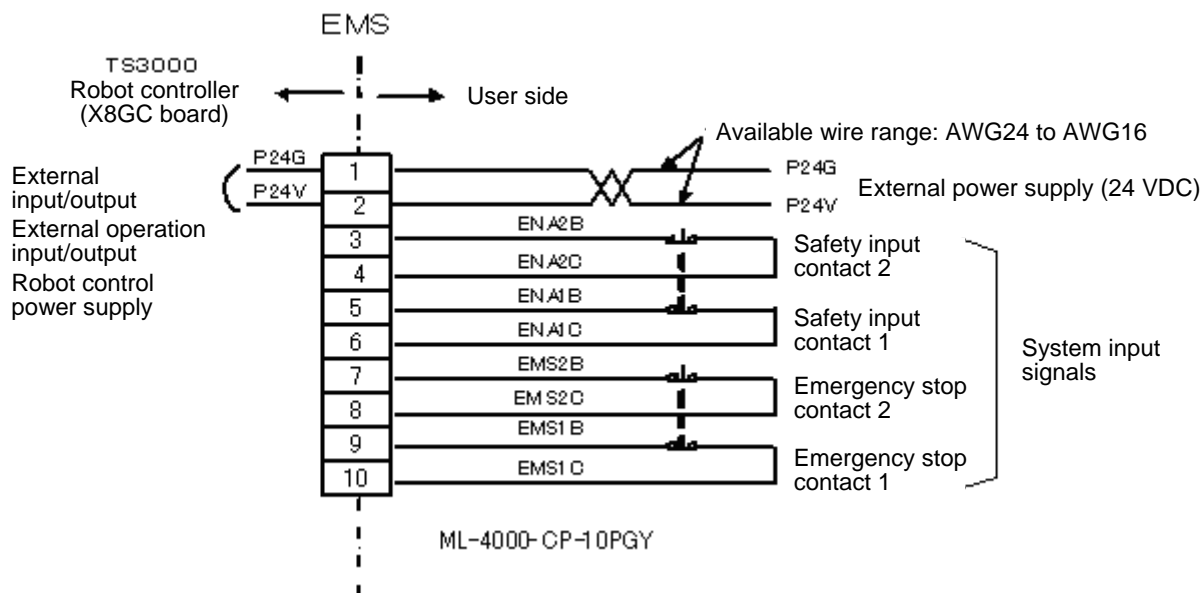
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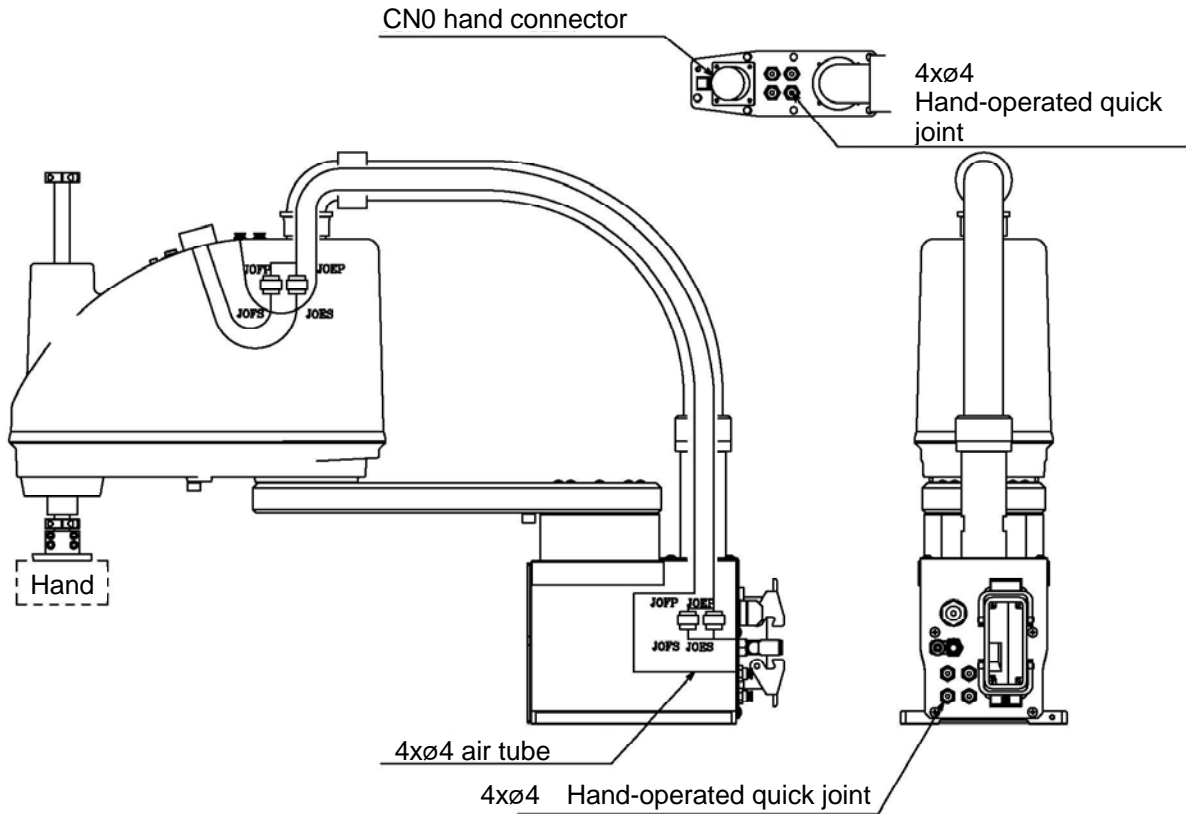


7.4 Power Supply

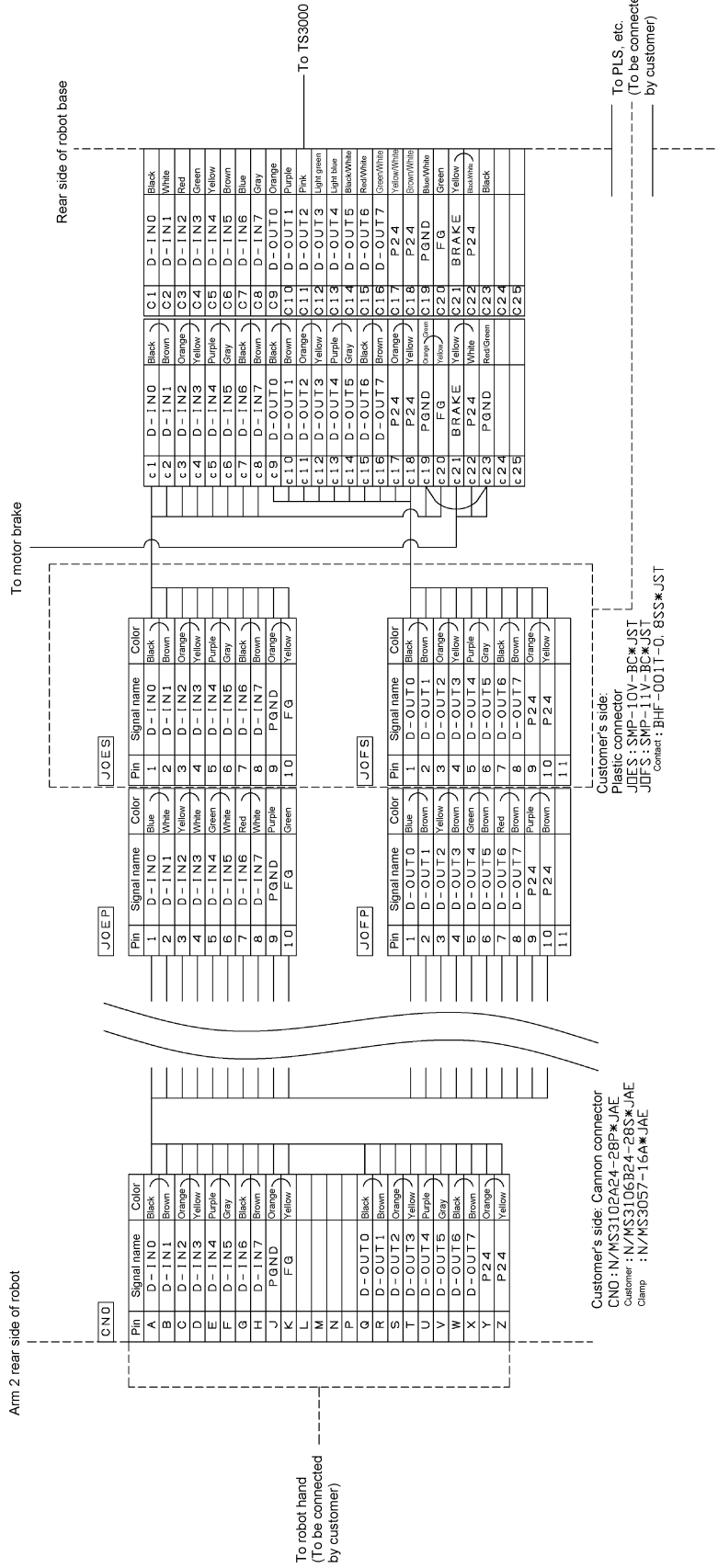


7.5 External Power Supply



7.6 Wiring and Piping for Hand Control

For the hand wiring, eight (8) input signals for sensor, etc., eight (8) control signals for solenoid valve, etc., and 24 VAC signal (total 2A or less) are provided. Connection on the hand side is performed by using connectors on the upper side of the arm 2. To control from the separate PLC, etc., separate connectors JOES and JOFS in the base and connect the cable running from the PLC, etc. For the hand piping, a total of four (4) lines ($\phi 4 \times 4$) 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, use the supplied fixtures to secure the arm and base, and then firmly secure the mounting sections. The robot can fall down if the proper securing methods are not used.
- 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) Do not transport the robot with the arm raised. 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 equipment.
- 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.

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