

DENSOROBOT

**XY-X ROBOT CONTROLLER MANUAL
(SMT7 T03)**

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Preface

Thank you very much for purchasing our XY-X robot controller, SMT7 T03.

The SMT7 T03 controls the YAMAHA XY-X robot.

This manual sets forth the connection with the YAMAHA XY-X robot and the specifications and installation of the SMT7 T03.

Read through this manual in conjunction with manuals contained in the manual pack CD.

Important

To ensure operator safety, be sure to read the precautions and instructions in "SAFETY PRECAUTIONS."

Cautions in handling and using the SMT7 controller

NOTES (1) If joint allocations are different between the SMT7 controller and WINCAPSIII, transferring the arm data from WINCAPSIII to the controller may cause an error. If it happens, clear the error and transfer the data again.

(2) The SMT7 controller is customized for motors specified by each customer in both hardware and software at the factory. The allowable combination of the controller's axes and motor types is printed in (2) SUBASSEMBLY on the "THE SETPRM LIST" labeled on the top of the controller.

According to the allowable combination, connect motors to the controller correctly. Incorrect connection will result in a motor malfunction, controller overheat, motor overheat, and other problems.

(3) This product is not evaluated for EMC directive. When you export this product to Europe, it needs to be compliant with EMC directive as a facility.

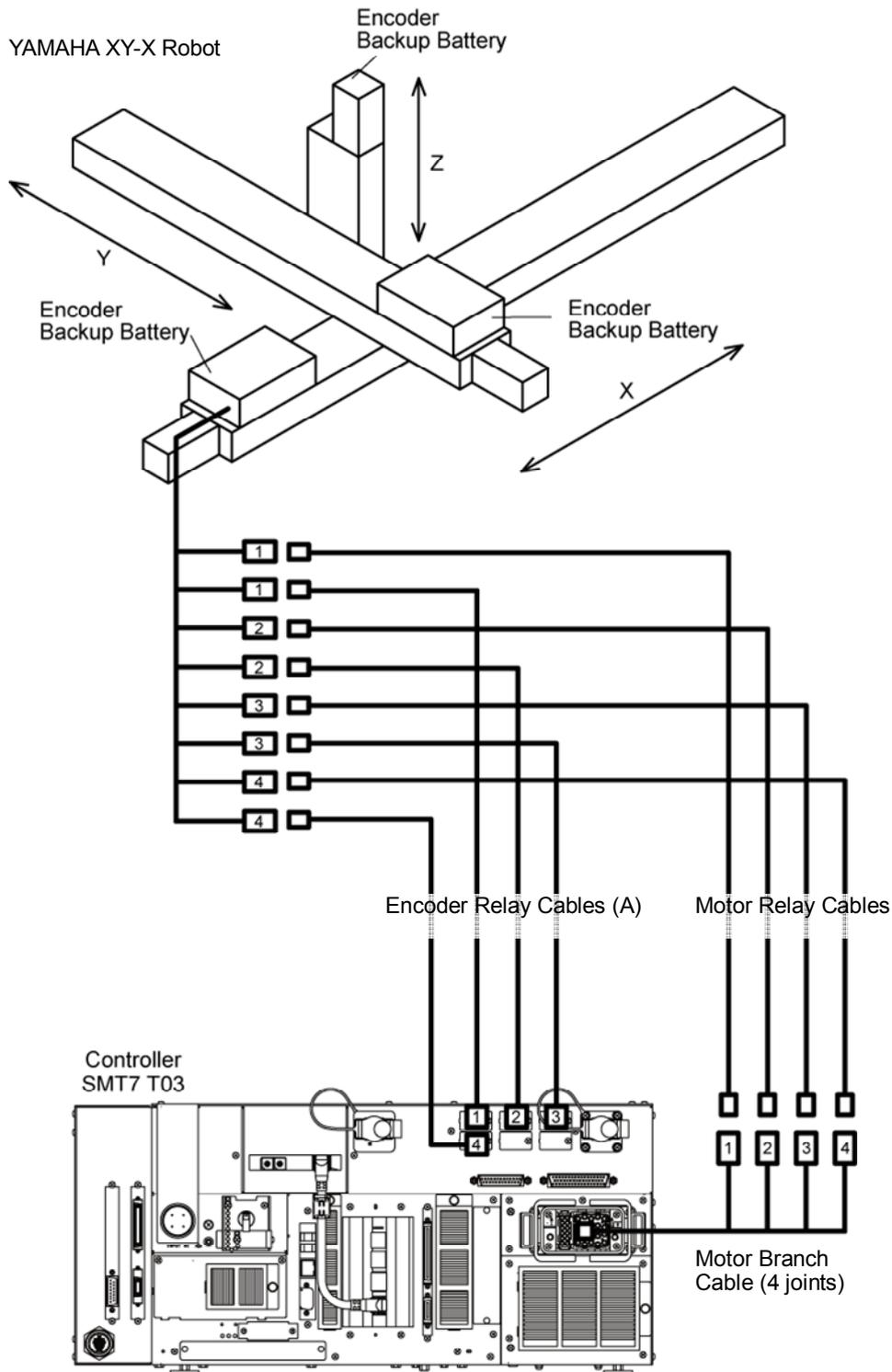
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Chapter 1 Overview

1.1 Connection between the YAMAHA XY-X Robot and SMT7 T03 Controller

Shown below is a system configuration using the SMT7 T03 controller and a YAMAHA XY-X robot.



1.2 Standard Items Contained in the Package

The items listed in the table below are contained in the product package.

Standard Items

No.	Item	Qty.
(1)	Robot unit	1
(2)	SMT7 controller (Note 1)	1
(3)	Power supply cable (5m)	1
(4)	Manuals (T03) ("Manual Pack CD" and "Safety Precautions")	1 set
(5)	WINCAPSⅢ INSTALL CD (T03 TRIAL VERSION)	1
(6)	Spare fuse for controller	3
(7)	Pendantless connector (Dummy connector)	1
(8)	Spare output IC for controller	1
(9)	Short socket for controller	2

1.3 Encoder Cables and Motor Cables

The tables below list cables for connecting the SMT7 T03 controller with the XY-X robot.

NOTE : The total length of encoder relay cables (A) and encoder cables (A) for all joints should be 48 m or less.

The total length of the encoder relay cable (A) and encoder cable (A) per joint should be 24 m or less.

The encoder cables (A) of the XY robot are laid inside the robot. The cable length should be counted as 1 m for the X-axis, 2 m for the Y-axis, and 3 m for the Z-axis, except specially configured robots.

Parts Name	Specifications	Parts Number
Encoder relay cable (A)	4 m	410141-4840
Encoder relay cable (A)	6 m	410141-4850
Encoder relay cable (A)	8 m	410141-4860
Encoder relay cable (A)	12 m	410141-4870
Motor relay cable (750 W or below)	4 m	410141-4990
Motor relay cable (750 W or below)	6 m	410141-5000
Motor relay cable (750 W or below)	8 m	410141-5010
Motor relay cable (750 W or below)	12 m	410141-5020
Motor branch cable (4 joints)		410141-4030
Motor branch cable (6 joints) for connecting an extended-joint option(s)		410141-4040

Chapter 1 Overview

The following cables are laid inside the XY-X robots.

Parts Name	Specifications	Parts Number
Encoder cable (A)	1 m	410141-5030
Encoder cable (A)	2 m	410141-5040
Encoder cable (A)	3 m	410141-5050
Encoder cable (A)	4 m	410141-5060
Encoder cable (A)	6 m	410141-5070
Encoder cable (A)	8 m	410141-5080
Encoder cable (A)	12 m	410141-5090
Encoder cable (A)	20 m	410141-5100
Motor cable (750 W or below)	1 m	410141-4960
Motor cable (750 W or below)	2 m	410141-4970
Motor cable (750 W or below)	3 m	410141-4980
Motor cable (750 W or below)	4 m	410414-4100
Motor cable (750 W or below)	6 m	410141-4110
Motor cable (750 W or below)	8 m	410141-4820
Motor cable (750 W or below)	12 m	410141-4120
Motor cable (750 W or below)	20 m	410141-4830
Encoder backup battery	1 piece	410611-0030

1.4 Optional Items

For options, refer to the option list contained in the manual pack CD and purchase necessary options.

Chapter 1 Overview

1.5 Controller Specification

Item		Specifications	
Applicable motor		YAMAHA XY-X robot	
Controller model		RC7M-SMT6BA-FP-3AD-E	
Number of controllable axes		Max. 6 axes (incl. optional extended-joints)	
Control system		PTP, CP 3-dimensional linear, 3-dimensional circular	
Drive system		All axes: Full-digital AC servo	
Language used		TOYOTA robot language DENSO robot language (conforming to SLIM)	
Memory capacity		3.25 MB (equivalent to 10,000 steps, 30,000 points)	
Teaching system		1) Remote teaching 2) Numerical input (MDI) 3) Direct teaching	
External signals (I/O)	Standard I/O	Mini I/O	Input: 8 user open points Output: 8 user open points
		HAND I/O	Input: 8 user open points Output: 8 fixed system points
	PLC	PLC I/O	Available with FL remote I/O
		DLNK-M2	Available with extension unit
		FL-net	Built in TOYOPUC PC10P
	CMP-LNK	Available with extension unit	
External communication		RS-232C: 1 line Ethernet: 1 line USB: 2 lines (Supporting flash memory)	
Extension slot		1 (Two out of three extension slots have been occupied)	
Self-diagnosis function		Overrun, servo error, memory error, input error, etc.	
Timer function		0.02 to 10 sec. (in units of 1/60 sec.)	
Error display		Error codes will be outputted on the external I/O. Error messages will be displayed in English on the teach pendant.	
Cables	Motor cable, encoder cable (option)	Refer to "Encoder Cables and Motor Cables."	
	I/O cable (option)	8 m, 15 m (For Mini I/O, HAND I/O, Optional board for parallel I/O and SAFETY I/O)	
	Power supply cable	5 m	
Environmental conditions (in operation)		Temperature: 0 to 40°C Humidity: 90% RH or less (no condensation allowed)	
Power source (at full IPM boards)		Three-phase, 200 VAC-15% to 230 VAC+10%, 50/60 Hz, 3.3KVA Single-phase, 230 VAC-10% to 230 VAC+10%, 50/60 Hz, 3.3KVA	
I/O power source		A 24 VDC ±10% should be supplied from external equipment.	
Degree of protection		IP20	
Weight (at full IPM boards)		Approx. 33 kg (73 lb.)	

Chapter 1 Overview

Controller Handling Notes

WARNING

- DO NOT touch fins. Their hot surfaces may cause severe burns.
- DO NOT insert fingers or foreign objects into openings. Doing so may cause bodily injury.
- Before opening the controller cover and accessing the inside of the controller for maintenance, be sure to turn off the power switch, disconnect the power cable, and wait 3 minutes or more. This is for protecting you from electric shock.
- DO NOT connect or disconnect connectors to/from the controller when the AC power or the 24 VDC power for I/O is being supplied. Doing so may cause electric shock or controller failure.

CAUTION IN INSTALLATION

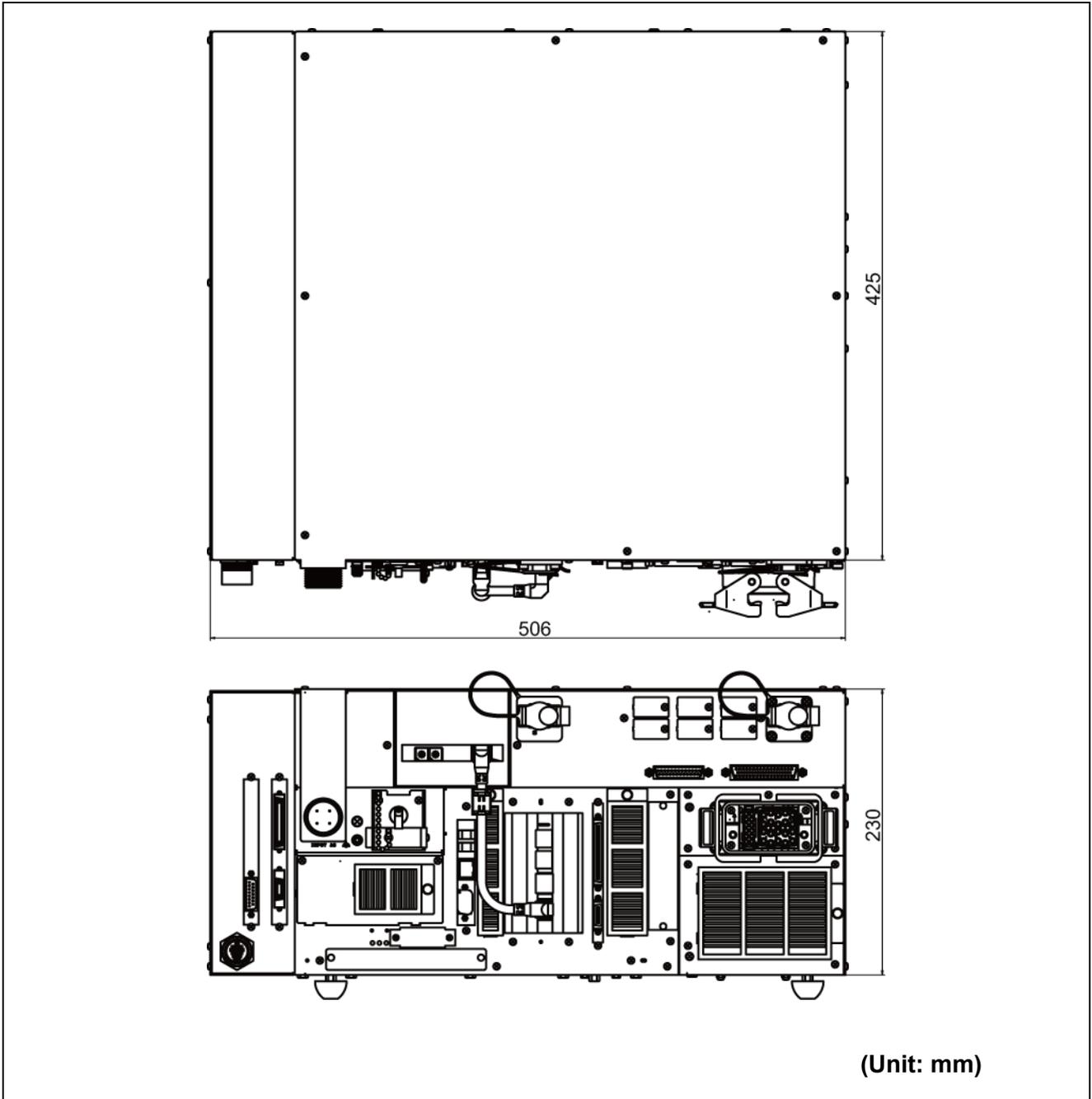
- This controller is not designed to be dust-proof, splash-proof, or explosion-proof.
- Read operation manuals before installation.
- Do not place anything on the controller.

CAUTION

- The controller connectors are of a screw-lock type or ring-lock type. Lock the connectors securely. If even one of the connectors is not locked, weak contact may result thereby causing an error.
- Be sure to turn the controller OFF before connecting/ disconnecting the power connector or motor connector. Otherwise, the internal circuits of the controller may be damaged.

1.6 Outer Dimensions of the Controller

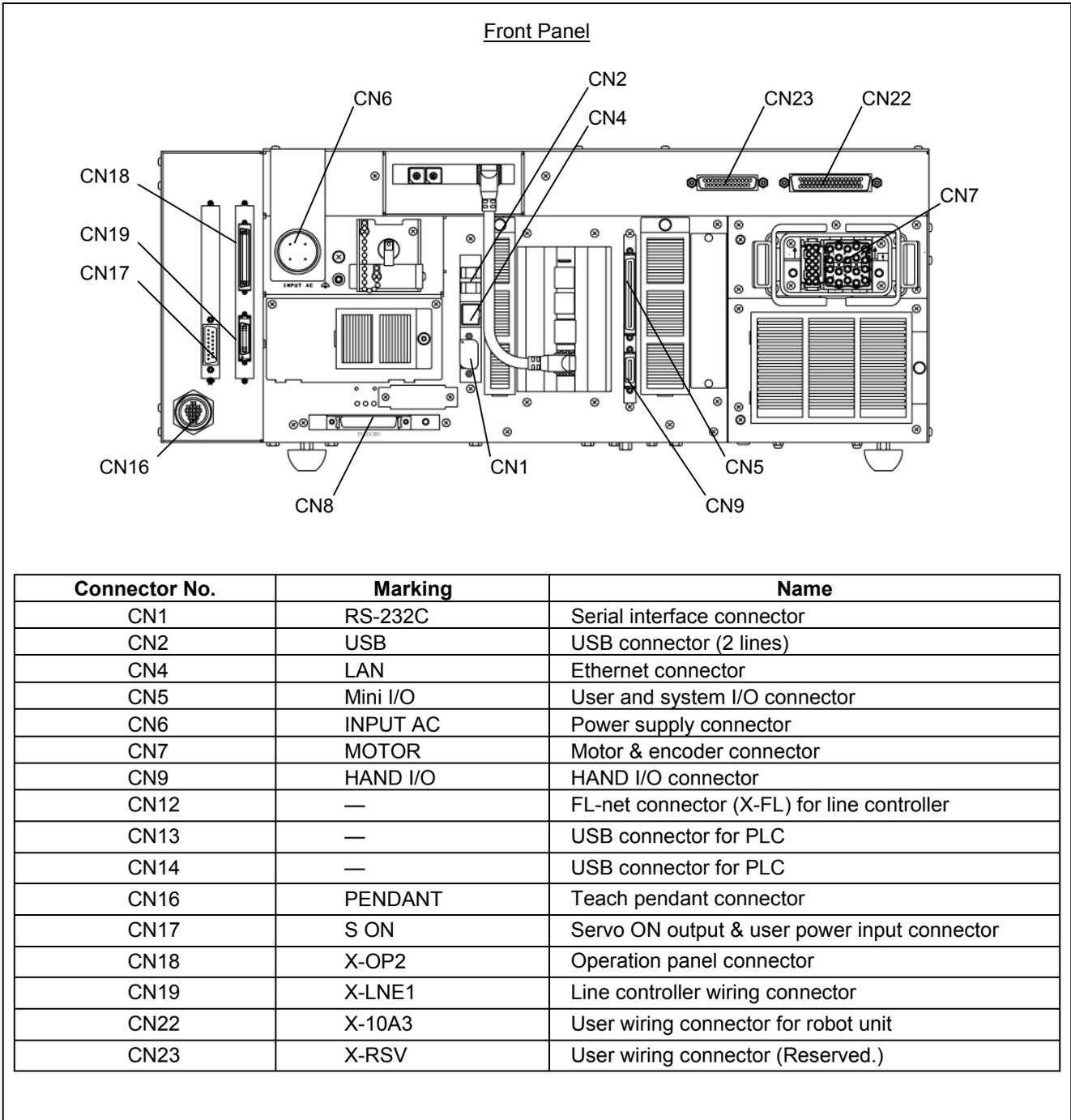
The figure below shows the outer dimensions of the SMT7 T03



Outer dimensions

1.7 Names of the Controller Components

The following figures show the names of the SMT7 T03 components.



Names of SMT7 Components

1.8 "THE SETPRM LIST" of the SMT7

The SMT7 T03 controller is customized for motors of the XY-X robot in both hardware and software at the factory. The allowable combination of the controller's axes and motor types is printed in (2) SUBASSEMBLY on the "THE SETPRM LIST" labeled on the top of the controller.

According to the allowable combination, connect motors to the controller correctly. Incorrect connection will result in a motor malfunction, controller overheat, motor overheat, and other problems.

Note: When shipped from the factory, IPM boards suited to AC servomotors to be connected will be built into the controller for 1 to 6 axes.

Motor capacity	50 W	100 W	200 W	400 W	750 W
IPM board type	SS	SS	S	S	M

Controller Configuration Table (SETPRM LIST)

The diagram shows the top panel of the SMT7 controller. A red dashed box highlights the 'Controller Configuration Table (SETPRM LIST)' on the left side. This table includes fields for 'Controller Parameter', 'IPM Board Type', 'Date of Shipping List', 'Type', and 'Subassembly'. The 'Subassembly' section is circled in red and contains a table with columns for 'Axis' and 'IPM Board Type'. Below this is the 'Robot Controller' section with fields for Model No., Part No., Power, Capacity, Typ Output, Weight, Condition, and Serial No. To the right of the SETPRM LIST table is a table of 'Item' and 'Specification' for various power sources. The top right of the panel features several warning labels in Japanese and English, including 'CAUTION', 'WARNING', and '警告'. A line points from the text 'The IPM board mounted and the motor(s) connected are listed in this area.' to the circled 'Subassembly' section of the SETPRM LIST table.

The IPM board mounted and the motor(s) connected are listed in this area.

SETPRM LIST

1.9 Precautions for Safe Use of the Robot System

NOTE: This section provides safety precautions to be taken when you configure the robot system with the SMT7 controller. For details, refer to the ISO 10218-1:2006, Safety Requirements.

[1] For the mechanism to be driven

- (1) If the mechanism involves a risk of bodily injury to workers, set up a safety fence to prevent danger.
- (2) When the joint(s) in the mechanism has the largest motion range in all joints, prepare mechanical stops with sufficient rigidity.
- (3) When the joint(s) in the mechanism has the 2nd or 3rd largest motion range in all joints, prepare joint limiters with sufficient rigidity.
- (4) If the mechanism involves a risk of bodily injury to workers when the brakes are released, use warning labels to alert workers to danger.
- (5) If it is not easy to carry the mechanism, prepare any measures for hoisting it.
- (6) Provide markings (e.g. labels) on the driven mechanisms to show which axis corresponds to which mechanism.

[2] When connecting motors

- (1) When connecting the motors using cables, protect those cables from electrical noise.

[3] When mounting motors

- (1) If the motor surface gets hot and the workers are at risk of touching the heated surface, attach a warning label, alerting them to the high temperature.

[4] For providing data to the user

- (1) When the motion range of the joint in the mechanism is 3rd largest or below in all joints, provide the user with the maximum stop time and distance of that joint, using instruction manuals, etc.

Chapter 2 Installation of Controller for SMT7 T03 Controller

2.1 Installation of Controller

2.1.1 Installation Site Conditions

Install the controller in conditions as shown in the table below.

Installation Site Condition Requirements

Item	Requirements
Ambient temperature	0 to 40°C during operation -10 to 60°C during storage
Humidity	90% or less during operation (Condensation not allowed) 75% or less during storage (Condensation not allowed)
Environmental safety	This controller has not been designed to withstand explosions, dust-proof, nor is it splash-proof. Therefore, it should not be installed in any environment where: (1) there are flammable gases or liquids, (2) there are any shavings from metal processing or other conductive material flying about, (3) there are any acidic, alkaline or other corrosive material, (4) there is a mist, or (5) there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise.
Work space	Adequate space should be allowed around the controller for inspection, overhaul and maintenance work.
Grounding resistance	The grounding resistance of the power supply should not be more than 100Ω.

2.1.2 Installing the Controller

The controller should be secured to the controller mounting panel and installed as a stand-alone unit.

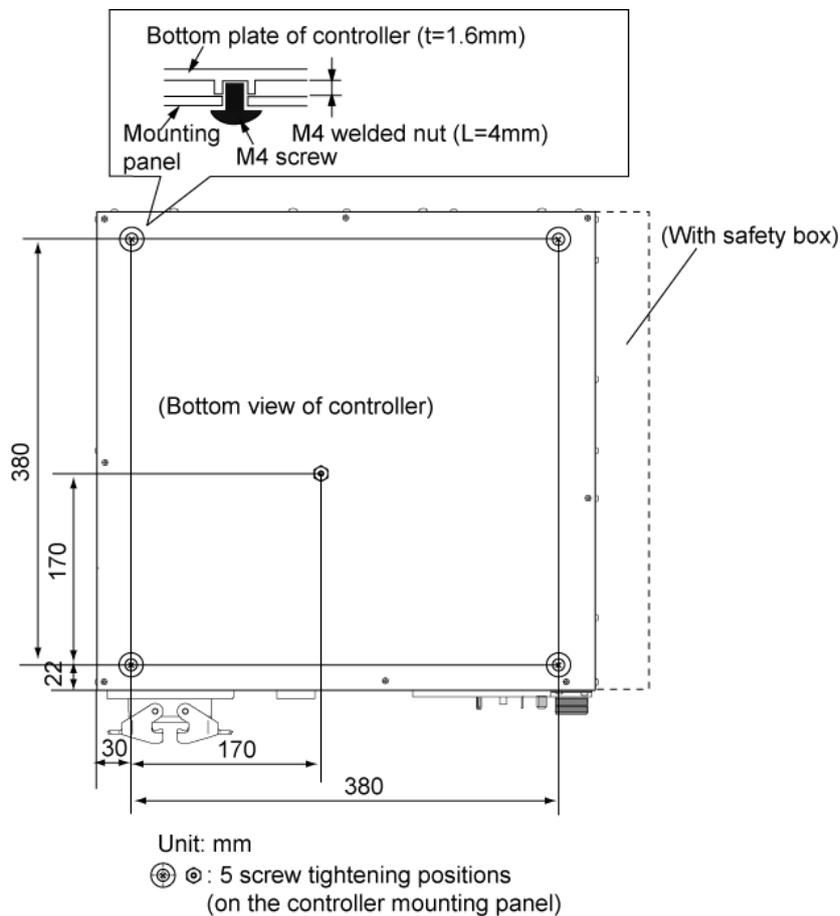
⚠ Caution: The controller is not a dust- or splash-proof structure. Therefore, when using the controller in an environment exposed to mist, put it in an optional protective box.

(1) Securing the controller to the controller mounting panel

- 1) The figure below shows the bottom view of the controller.
Five M4-nut welded holes may be used for securing the controller to the mounting panel.
- 2) Prepare a mounting panel large enough for mounting the controller and secure the controller onto the mounting panel using five screws.

⚠ Caution: (1) The controller mounting screws must not be more than the thickness of the mounting panel plus 4 mm in length. If they exceed 4 mm, the nut-welded holes may be damaged.

- (2) Fix the controller at all of the five nut-welded holes.

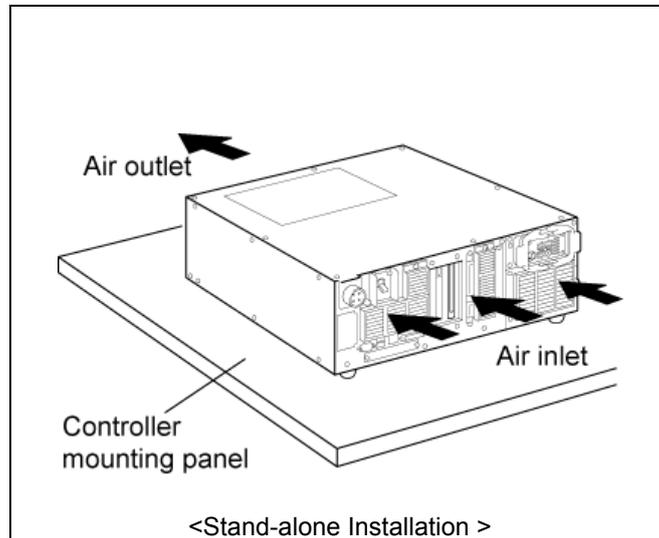


Location of Mounting Screw Holes (on the bottom of the SMT7 controller)

(2) Installing the controller

The controller is a stand-alone unit. It cannot be mounted on a wall.

⚠ Caution: Do not place anything within 200 mm from the air inlet and air outlet on the controller.



Installation of SMT7

2.2 Wiring of Primary Power Source

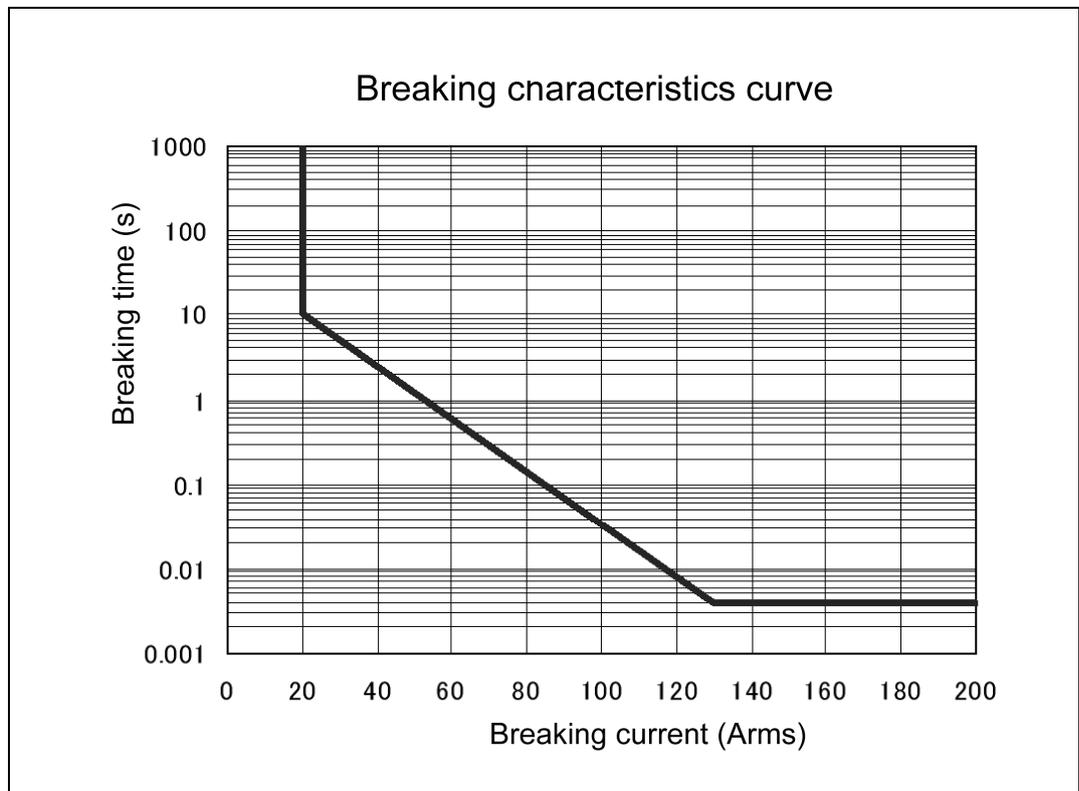
Observe the following precautions when wiring the primary power source of the controller:

- (1) Connect the robot power cable to a power source separate from the welder power source.
- (2) Ground the protective grounding wire (green/yellow) of the robot power cable securely.
- (3) Ground the functional grounding terminal of the robot controller using a wire of 1.25 mm² or more in size.
- (4) For the robot power supply, use a protective grounding wire with grounding resistance of 100Ω or less.
- (5) If the supply power source for the controller requires a leakage breaker, use a high frequency-proof leakage breaker for inverters.
- (6) When inserting a circuit breaker between the robot and the AC input power supply, select the circuit breaker with breaking capacity higher than the following specification.

Recommended circuit breaker example:

CP33V/20 (Fuji Electric FA Components & Systems Co., Ltd.)

Caution: Using a circuit breaker with breaking capacity lower than the following specification may cause the circuit breaker to be shut down due to robot operation.

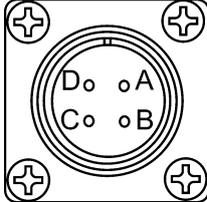
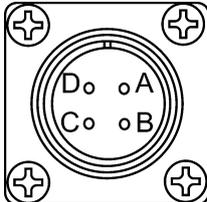


Circuit Breaker Characteristics

Chapter 2 Installation of Controller for SMT7 T03 Controller

- (7) Prepare wires of an appropriate capacity for the 200VAC main line and other cables according to the tables given below.

Power Supply Specifications of the SMT7 Controller (at full IPM boards)

Item		Specifications	Pin assignment on power connector (CN6) (View from the pin face of cable)
Power supply	Three-phase, 200 VAC	Three-phase, 200 VAC -15% to 230 VAC +10%, 50/60 Hz, 3.3 KVA	 <ul style="list-style-type: none"> A: 200 VAC, phase R B: 200 VAC, phase S C: 200 VAC, phase T D: Protective ground
	Single-phase, 200 VAC	Single-phase, 230 VAC -10% to 230 VAC +10%, 50/60 Hz, 3.3 KVA	 <ul style="list-style-type: none"> A: 200 VAC, phase R B: 200 VAC, phase S D: Protective ground
Max. rush current when the power is turned ON		40 A (for 1/50 or 1/60 second)	

Caution: If ERROR6102 (power voltage drop) occurs when the robot is in operation, then it may be due to an insufficient capacity of the primary power source.

Chapter 3 Extended-joint Options for SMT7 T03 Controller

For details about the extended-joint function of the SMT7 T03 controller or the motor selection, refer to the "Extended-Joints Support (T03)," a supplement to the Denso user manuals.

The connection of the motors is described below.

3.1 Connecting Motors

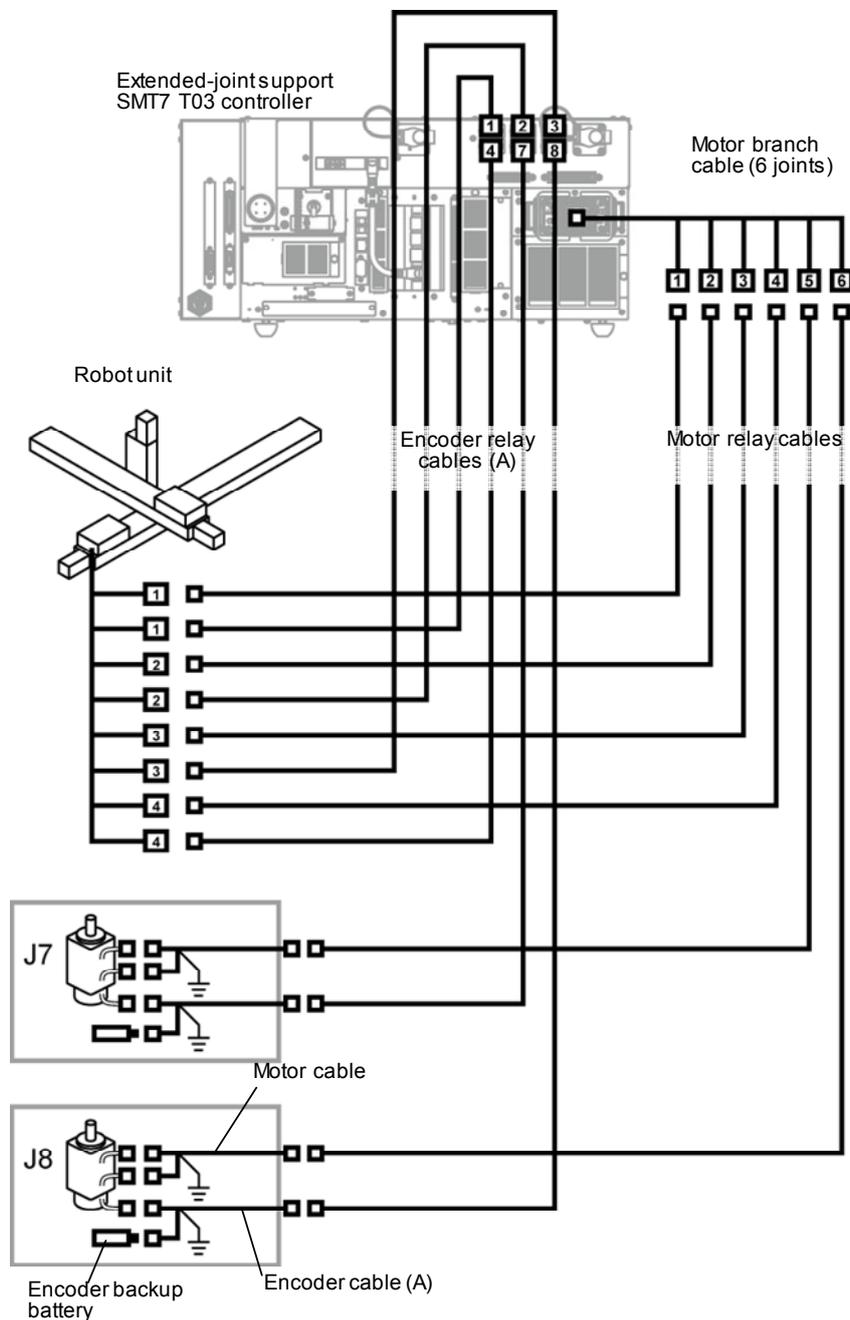
Connect the YAMAHA XY-X robot and extended-joint motors to the SMT7 T03 controller as shown below.

NOTE : When connecting an extended-joint option(s), use the motor branch cable (6 joints) (Parts number: 410141-4040).

The total length of the encoder relay cable (A) and encoder cable (A) per joint should be 24 m or less.

The total length of encoder relay cables (A) and encoder cables (A) for all joints should be 48 m or less.

When two extended-joints are connected, the total length of the encoder relay cable (A) and encoder cable (A) per extended joint should be 12 m or less.



3.2 Precautions for Installation

When installing the extended-joint support robot, configure the encoder axis number(s) *beforehand*. Connecting an extended-joint motor(s) before configuring the encoder axis number(s) may break the motor(s).

Refer to the "Extended-Joints Support (T03)," a supplement to the Denso user manuals.

XY-X ROBOT CONTROLLER MANUAL (SMT7 T03)

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DENSO WAVE INCORPORATED

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The purpose of this manual is to provide accurate information in the handling and operating of the controller. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will DENSO WAVE INCORPORATED be liable for any direct or indirect damages resulting from the application of the information in this manual.

