

Σ -X-Series AC Servo Drive

Σ -XW/ Σ -XT SERVOPACK

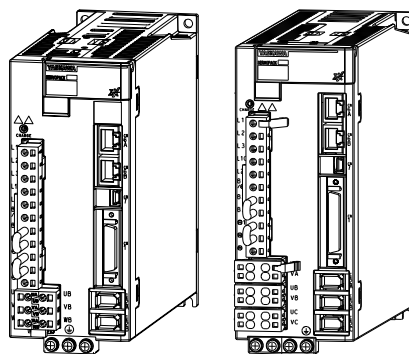
Hardware Option

Specifications

HWBB Function

Product Manual

Model: SGDXW-□□□□□□□□1000
SGDXT-□□□□□□□□1000



Basic Information on SERVOPACKs

1

Selecting a SERVOPACK

2

SERVOPACK Installation

3

Wiring and Connecting SERVOPACKs

4

Safety Functions

5

Maintenance

6

Appendices

7



Table of Contents

i.	Preface and General Precautions	7
i.1	About this Manual	8
i.2	Finding Information	9
i.3	Related Documents	12
i.3.1	Related Documents	13
i.4	Using This Manual	17
i.4.1	Technical Terms Used in This Manual	17
i.4.2	Differences in Terms for Rotary Servomotors and Linear Servomotors	17
i.4.3	Notation Used in this Manual	18
i.4.4	Trademarks	18
i.4.5	Visual Aids	18
i.5	Safety Precautions	19
i.5.1	Safety Information	19
i.5.2	Safety Precautions That Must Always Be Observed	19
i.6	Warranty	30
i.6.1	Details of Warranty	30
i.6.2	Limitations of Liability	30
i.6.3	Suitability for Use	31
i.6.4	Specifications Change	31
i.7	Compliance with UL Standards and EU Directives	32
i.7.1	North American Safety Standards (UL)	32
i.7.2	EU Directives	32
i.7.3	Safety Standards	33
1.	Basic Information on SERVOPACKs	35
1.1	SERVOPACKs with HWBB Function	36
1.2	Interpreting the Nameplate	37
1.3	Part Names	38
1.4	Interpreting Model Numbers	41

2. Selecting a SERVOPACK	43
2.1 Specification	44
2.1.1 Environmental Conditions	44
2.1.2 I/O Signals	44
2.1.3 Functions: SERVOPACK with MECHATROLINK-4/III Communications References	46
2.1.4 Functions: SERVOPACK with EtherCAT Communications References	47
2.1.5 Option	49
2.2 Internal Block Diagrams	50
2.2.1 SGDXW-1R6A, 2R8A	50
2.2.2 SGDXW-5R5A, 7R6A	51
2.2.3 SGDXT-1R6A, -2R8A	52
2.3 External Dimensions	53
2.3.1 Front Cover Dimensions and Connector Specifications	53
2.3.2 SERVOPACK External Dimensions	54
2.4 Examples of Standard Connections between SERVOPACKs and Peripheral Devices	56
2.4.1 Rotary Servomotor	57
2.4.2 Linear Servomotor	58
3. SERVOPACK Installation	59
3.1 Mounting Types and Orientation	60
3.2 EMC Installation Conditions	61
4. Wiring and Connecting SERVOPACKs	63
4.1 Wiring and Connecting SERVOPACKs	64
4.2 Basic Wiring Diagrams	67
4.3 Connecting Safety Function Signals	69
4.3.1 Safety Function Connector (CN8) Pin Arrangement	69
4.3.2 I/O Circuits	69
4.3.3 Diagnostic Output Circuits	70
5. Safety Functions	71
5.1 Introduction to the Safety Functions	73
5.1.1 Safety Functions	73
5.1.2 Precautions for Safety Functions	73
5.2 Hard Wire Base Block (HWBB)	74
5.2.1 Risk Assessment	74

5.2.2	SERVOPACK with MECHATROLINK Communications References: Hard Wire Base Block (HWBB) State	75
5.2.3	SERVOPACK with MECHATROLINK Communications References: Resetting the HWBB State	76
5.2.4	SERVOPACK with MECHATROLINK Communications References: Related Commands	77
5.2.5	SERVOPACK with EtherCAT Communications References: Hard Wire Base Block (HWBB) State	78
5.2.6	SERVOPACK with EtherCAT Communications References: Resetting the HWBB State	79
5.2.7	Detecting Errors in HWBB Signal	82
5.2.8	HWBB Input Signal Specifications	82
5.2.9	HWBB Input Signal Waveform Trace	83
5.2.10	Operation without a Host Controller	83
5.2.11	/S-RDY (Servo Ready Output) Signal	83
5.2.12	/BK (Brake Output) Signal	84
5.2.13	Stopping Methods	84
5.2.14	ALM (Servo Alarm) Signal	85
5.3	EDM1 (External Device Monitor)	86
5.3.1	EDM1 Output Signal Specifications	86
5.4	Applications Examples for Safety Functions	87
5.4.1	Connection Example	87
5.4.2	Failure Detection Method	87
5.4.3	Procedure	88
5.5	Validating Safety Functions	89
5.6	Connecting the Safety Function Device	90
6.	Maintenance	91
6.1	Inspections	92
6.2	Alarm Displays	93
6.2.1	Alarms Related to the HWBB Function	93
6.2.2	Troubleshooting Alarms Related to the HWBB Function	93
6.3	Troubleshooting Based on the Operation and Conditions of the Servomotor	95
6.3.1	Servomotor Does Not Start	95
7.	Appendices	97
7.1	Interpreting Panel Displays	98
7.1.1	Panel Display during the HWBB State	98
7.2	Corresponding SERVOPACK and SigmaWin+ Function Names	99
7.2.1	Corresponding SERVOPACK Monitor Display Function Names	99

Index..... 100

Revision History..... 101



Preface and General Precautions

i.1	About this Manual	8
i.2	Finding Information	9
i.3	Related Documents	12
	i.3.1 Related Documents	13
i.4	Using This Manual.....	17
	i.4.1 Technical Terms Used in This Manual.....	17
	i.4.2 Differences in Terms for Rotary Servomotors and Linear Servomotors	17
	i.4.3 Notation Used in this Manual	18
	i.4.4 Trademarks	18
	i.4.5 Visual Aids	18
i.5	Safety Precautions	19
	i.5.1 Safety Information	19
	i.5.2 Safety Precautions That Must Always Be Observed.....	19
i.6	Warranty	30
	i.6.1 Details of Warranty	30
	i.6.2 Limitations of Liability	30
	i.6.3 Suitability for Use	31
	i.6.4 Specifications Change.....	31
i.7	Compliance with UL Standards and EU Directives	32
	i.7.1 North American Safety Standards (UL).....	32
	i.7.2 EU Directives	32
	i.7.3 Safety Standards	33

i.1 About this Manual

This manual describes the following two types of SERVOPACKs that are equipped with the HWBB safety function.

Σ -X-Series	Model Name	Communications References	Hardware Option Specifications	Model
Σ -X-Series	Σ -XW	MECHATROLINK-4/III	HWBB Function	SGDXW-□□□□40□1000
		EtherCAT		SGDXW-□□□□A0□1000
	Σ -XT	MECHATROLINK-4/III		SGDXT-□□□□40□1000
		EtherCAT		SGDXT-□□□□A0□1000

The differences in specifications from Σ -XW/ Σ -XT SERVOPACKs not equipped with the HWBB are given in this manual.

Refer to the following manual that corresponds to your SERVOPACK for other product information.

- 📖 Σ -X-Series AC Servo Drive Σ -XW SERVOPACK with MECHATROLINK-4/III Communications References Product Manual (Manual No.: SIEP C710812 04)
- 📖 Σ -X-Series AC Servo Drive Σ -XW SERVOPACK with EtherCAT Communications References Product Manual (Manual No.: SIEP C710812 05)
- 📖 Σ -X-Series AC Servo Drive Σ -XT SERVOPACK with MECHATROLINK-4/III Communications References Product Manual (Manual No.: SIEP C710812 16)
- 📖 Σ -X-Series AC Servo Drive Σ -XT SERVOPACK with EtherCAT Communications References Product Manual (Manual No.: SIEP C710812 17)

Read and understand this manual and the above manual to ensure correct usage of the Σ -X-series AC servo drives.

Keep this manual and the manual in a safe place so that it can be referred to whenever necessary.

i.2 Finding Information

The contents of the chapters of this manual are described in the following table.

To use this product, read this manual together with the manuals listed below.

Item		This Document	Used Together with Product Manual for			
			Σ-XW SERVOPACK		Σ-XT SERVOPACK	
			with MECHATROLINK-4/III Communications References	with EtherCAT Communications References	with MECHATROLINK-4/III Communications References	with EtherCAT Communications References
			(Manual No.: SIEP C710812 04)	(Manual No.: SIEP C710812 05)	(Manual No.: SIEP C710812 16)	(Manual No.: SIEP C710812 17)
Basic Information on SERVOPACKs	The Σ-X Series		–	1.1		
	SERVOPACKs with HWBB Function		1.1	–		
	Interpreting the Nameplate		1.2	–		
	Part Names		1.3	–		
	Interpreting Model Numbers	Interpreting SERVOPACK Model Numbers	1.4	–		
		Interpreting Servomotor Model Numbers	–	1.4.2		
	Combinations of SERVOPACKs and Servomotors		–	1.5		
	Functions		–	1.6		
Selecting a SERVOPACK	Ratings and Specifications	Ratings	–	2.1.1		
		SERVOPACK Overload Protection Characteristics	–	2.1.2		
		Specification	2.1	–		
	Internal Block Diagrams		2.2	–		
	External Dimensions		2.3	–		
	Examples of Standard Connections between SERVOPACKs and Peripheral Devices		2.4	–		
SERVOPACK Installation	Mounting Types and Orientation		3.1	–		
	EMC Installation Conditions		3.2	–		
	Other Installation Information		–	Chapter 3		

Continued on next page.

Item		This Document	Used Together with Product Manual for			
			Σ -XW SERVOPACK		Σ -XT SERVOPACK	
			with MECHATROLINK-4/III Communications References	with EtherCAT Communications References	with MECHATROLINK-4/III Communications References	with EtherCAT Communications References
			(Manual No.: SIEP C710812 04)	(Manual No.: SIEP C710812 05)	(Manual No.: SIEP C710812 16)	(Manual No.: SIEP C710812 17)
Wiring and Connecting SERVO-PACKs	General Precautions	4.1	-			
	Countermeasures against Noise	-	4.1.2			
		-	4.1.3			
	Basic Wiring Diagrams	4.2	-			
	Wiring the Power Supply to the SERVOPACK	-	4.3			
	Wiring Servomotors	-	4.4			
	I/O Signal Connections	-	4.5			
	Connecting Safety Function Signals	4.3	-			
	Connecting MECHATROLINK Communications Cables	-	4.6	-	4.6	-
	Connecting EtherCAT Communications Cables	-	-	4.6	-	4.6
Connecting the Other Connectors	-	4.7 to 4.9				
Basic Functions That Require Setting before Operation	-	Chapter 5				
Application Functions	-	Chapter 6				
Trial Operation and Actual Operation	-	Chapter 7				
Tuning	-	Chapter 8				
Monitoring	-	Chapter 9				
Σ -LINK II Function	-	Chapter 10				
Safety Functions	Chapter 5	-				
EtherCAT Communications	-	-	Chapter 11	-	Chapter 11	
CiA402 Drive Profile	-	-	Chapter 12	-	Chapter 12	
Object Dictionary	-	-	Chapter 13	-	Chapter 13	

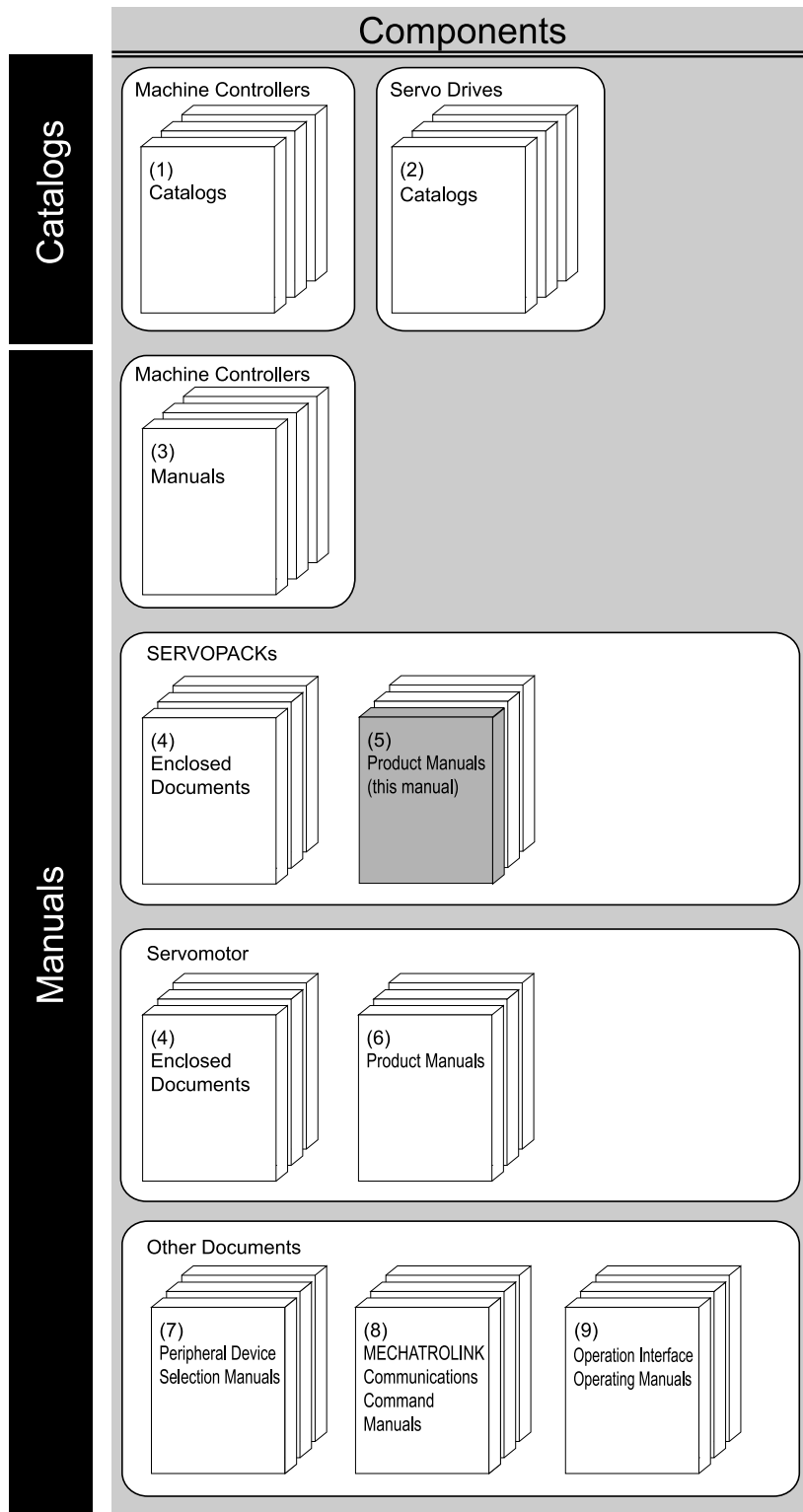
Continued on next page.

Continued from previous page.

Item		This Document	Used Together with Product Manual for				
			Σ-XW SERVOPACK		Σ-XT SERVOPACK		
			with MECHATROLINK-4/III Communications References	with EtherCAT Communications References	with MECHATROLINK-4/III Communications References	with EtherCAT Communications References	
			(Manual No.: SIEP C710812 04)	(Manual No.: SIEP C710812 05)	(Manual No.: SIEP C710812 16)	(Manual No.: SIEP C710812 17)	
Maintenance	Inspections	6.1	-				
	Part Replacement	-	10.1.2, 10.1.3	14.1.2, 14.1.3	10.1.2, 10.1.3	14.1.2, 14.1.3	
	Alarm Displays	Alarms Related to the HWBB Function	6.2.1	-			
		Other Alarms	-	11.2.1	14.2.1	11.2.1	14.2.1
		Troubleshooting Alarms Related to the HWBB Function	6.2.2	-			
		Troubleshooting Other Alarms	-	11.2.2	14.2.2	11.2.2	14.2.2
		Resetting Alarms	-	11.2.3	14.2.3	11.2.3	14.2.3
		Displaying the Alarm History	-	11.2.4	14.2.4	11.2.4	14.2.4
		Clear Alarm History	-	11.2.5	14.2.5	11.2.5	14.2.5
		Resetting Motor Type Alarms	-	11.2.6	14.2.6	11.2.6	14.2.6
	Warning Displays	-	11.3	14.3	11.3	14.3	
	Monitoring Communications Data during Alarms or Warnings	-	11.4	-	11.4	-	
	Troubleshooting Based on the Operation and Conditions of the Servomotor	Troubleshooting Problem Related to the HWBB Function	6.3	-			
		Troubleshooting other problems	-	11.5	14.4	11.5	14.4
	Parameter Lists	-	Chapter 12	-	Chapter 12	-	
Parameter and Object Lists	-	-	Chapter 15	-	Chapter 15		
Appendices	Interpreting LED Displays	-	13.1	16.1	13.1	16.1	
	Interpreting Panel Displays	Panel Display during the HWBB State	7.1	-			
		Other Panel Display	-	13.2	16.2	13.2	16.2
	Corresponding SERVOPACK and SigmaWin+ Function Names	Corresponding SERVOPACK Utility Function Names	-	13.3.1	16.3.1	13.3.1	16.3.1
		Corresponding Monitor Display Function Names Related to the HWBB Function	7.2	-			
Other Corresponding SERVOPACK Monitor Display Function Names		-	13.3.2	16.3.2	13.3.2	16.3.2	

i.3 Related Documents

The relationships between the documents that are related to the servo drives are shown in the following figure. The numbers in the figure correspond to the numbers in the table on the following pages. Refer to these documents as required.



i.3.1 Related Documents

(1) Machine Controllers Catalogs

You can check for products related to YASKAWA machine controllers. Refer to these documents as required.

(2) Servo Drives Catalogs

Document Name	Document No.	Description
AC Servo Drives Sigma-X Series	KAEP C710812 03	Provides detailed information on Σ -X-series AC servo drives, including features and specifications.

(3) Machine Controllers Manuals

The machine controller to use depends on the SERVOPACK that is used. Refer to the manual for the machine controller as required.

(4) Enclosed Documents

Document Name	Document No.	Description
Σ -X-Series AC Servo Drive Σ -XS/ Σ -XW SERVOPACK Safety Precautions	TOMP C710812 00	Provides detailed information for the safe usage of Σ -X-series SERVOPACKs.
Σ -X-Series AC Servo Drive Σ -XT SERVOPACK Safety Precautions	TOMP C710812 16	
Σ -X-Series AC Servo Drive Σ -LINK II Sensor Hub Instructions	TOMP C710812 06	Provides detailed information for the safe usage of the Σ -LINK II sensor hub, as well as specifications, installation, and connection information.
Σ -X-Series AC Servo Drive Σ -LINK II Booster Unit Instructions	TOMP C710812 08	Provides detailed information for the safe usage of the Σ -LINK II booster unit, as well as specifications, installation, and connection information.
Σ -V-Series/ Σ -V-Series for Large-Capacity Models/ Σ -7-Series/ Σ -X-Series Installation Guide Fully-closed Module	TOBP C720829 03	Provides detailed procedures for installing the fully-closed module in a SERVOPACK.
AC Servo Drive Rotary Servomotor Safety Precautions	TOBP C230260 00	Provides detailed information for the safe usage of rotary servomotors and direct drive servomotors.

(5) SERVOPACK Product Manuals

Document Name	Document No.	Description
Σ-X-Series AC Servo Drive Σ-XS SERVOPACK with MECHATROLINK-4/III Communications References Product Manual	SIEP C710812 01	Provide detailed information on selecting Σ-X-series Σ-XS or Σ-XW SERVOPACKs; installing, connecting, setting, testing in trial operation, tuning, monitoring, and maintaining servo drives; and other information.
Σ-X-Series AC Servo Drive Σ-XS SERVOPACK with EtherCAT Communications References Product Manual	SIEP C710812 02	
Σ-X-Series AC Servo Drive Σ-XS SERVOPACK with Analog Voltage/Pulse Train References Product Manual	SIEP C710812 03	
Σ-X-Series AC Servo Drive Σ-XW SERVOPACK with MECHATROLINK-4/III Communications References Product Manual	SIEP C710812 04	
Σ-X-Series AC Servo Drive Σ-XW SERVOPACK with EtherCAT Communications References Product Manual	SIEP C710812 05	
Σ-X-Series AC Servo Drive Σ-XT SERVOPACK with MECHATROLINK-4/III Communications References Product Manual	SIEP C710812 16	Provide detailed information on selecting Σ-X-series Σ-XT SERVOPACKs; installing, connecting, setting, testing in trial operation, tuning, monitoring, and maintaining servo drives; and other information.
Σ-X-Series AC Servo Drive Σ-XT SERVOPACK with EtherCAT Communications References Product Manual	SIEP C710812 17	
Σ-X-Series AC Servo Drive Σ-XW/Σ-XT SERVOPACK Hardware Option Specifications HWBB Function Product Manual	SIEP C710812 13	Provides information on servo drives equipped with the HWBB safety function (SGDXW-□□□□40□1000, SGDXW-□□□□A0□1000, SGDXT-□□□□40□1000, and SGDXT-□□□□A0□1000)). The differences in specifications from SERVOPACKs not equipped with the HWBB are given in this manual.
Σ-X-Series AC Servo Drive Σ-XS/Σ-XW/Σ-XT SERVOPACK Hardware Option Specifications Dynamic Brake Product Manual	SIEP C710812 14	Provides information on Σ-X-series AC servo drives (SGDX□-□□□□□□0020) with the dynamic brake option. The differences in specifications from SERVOPACKs without the dynamic brake option are given in this manual.

Continued on next page.

Continued from previous page.

Document Name	Document No.	Description
Σ -X-Series AC Servo Drive Σ -XS/ Σ -XW SERVOPACK with MECHATROLINK-4/III Communications References FT Specification for Gantry Applications Product Manual	SIEP C710812 19	Provide information on the gantry application function and torque/force assistance in the Σ -X-series Σ -XS/ Σ -XW SERVOPACK.
Σ -X-Series AC Servo Drive Σ -XS/ Σ -XW SERVOPACK with EtherCAT Communications References FT Specification for Gantry Applications Product Manual	SIEP C710812 20	
Σ -X-Series AC Servo Drive Σ -XS SERVOPACK with MECHATROLINK-4/III Communications References FT Specification for Press and Injection Molding Applications Product Manual	SIEP C710812 22	Provide information on the press and injection molding function in the Σ -X-series Σ -XS SERVOPACK.
Σ -X-Series AC Servo Drive Σ -XS SERVOPACK with EtherCAT Communications References FT Specification for Press and Injection Molding Applications Product Manual	SIEP C710812 23	
Σ -X-Series AC Servo Drive Σ -XS SERVOPACK with FT Specification Customized Sensing Data Function Option Product Manual	SIEP C710812 18	Provides information on the customized sensing data function in the Σ -X-series Σ -XS SERVOPACK.
Σ -X-Series AC Servo Drive Σ -XS SERVOPACK with FT Specification Customized Sensing Data Function Option (with Custom Motion Function) Product Manual	SIEP C710812 21	Provides information on the customized sensing data function (with custom motion function) in the Σ -X-series Σ -XS SERVOPACK.

(6) Servomotor Product Manuals

Document Name	Document No.	Description
Σ -X-Series AC Servo Drive Rotary Servomotor Product Manual	SIEP C230210 00	Provides detailed information on selecting, installing, and connecting the Σ -X-series servomotors.

(7) Peripheral Device Selection Manual

Document Name	Document No.	Description
Σ -X-Series AC Servo Drive Peripheral Device Selection Manual	SIEP C710812 12	Provides the following information in detail for Σ -X-series servo systems. <ul style="list-style-type: none"> • Cables: Models, dimensions, wiring materials, connector models, and connection specifications • Peripheral devices: Models, specifications, diagrams, and selection (calculation) methods

(8) MECHATROLINK Communications Command Manuals

Document Name	Document No.	Description
Σ -7/ Σ -X-Series AC Servo Drive MECHATROLINK-III Communications Standard Servo Profile Command Manual	SIEP S800001 31	Provides detailed information on the MECHATROLINK-III communications standard servo profile commands that are used for a Σ -7/ Σ -X-series servo system.
Σ -7/ Σ -X-Series AC Servo Drive MECHATROLINK-4 Communications Standard Servo Profile Command Manual	SIEP S800002 32	Provides detailed information on the MECHATROLINK-4 communications standard servo profile commands that are used for a Σ -7/ Σ -X-series servo system.

(9) Operation Interface Operating Manuals

Document Name	Document No.	Description
System Integrated Engineering Tool MPE720 Ver.7 User's Manual	SIEP C880761 03	Describes in detail how to operate MPE720 version 7.
Σ -7/ Σ -X-Series AC Servo Drive Digital Operator Operating Manual	SIEP S800001 33	Describes the operating procedures for a digital operator for a Σ -7/ Σ -X-series servo system.
AC Servo Drive Engineering Tool SigmaWin+ Operation Manual	SIET S800001 34	Provides detailed operating procedures for the SigmaWin+ engineering tool for a Σ -7/ Σ -X series servo system.

i.4 Using This Manual

i.4.1 Technical Terms Used in This Manual

The following terms are used in this manual.

Term	Meaning
servomotor	A generic term for a rotary servomotor or linear servomotor that can be driven by this SERVOPACK.
rotary servomotor	A generic term used for a Σ -X-series or Σ -7-series rotary servomotor (SGMXJ, SGMXA, SGMXP, SGMXG, SGM7M) or a Σ -7-series direct drive servomotor (SGM7D, SGM7E, SGM7F). The descriptions will specify when direct drive servomotors are excluded.
linear servomotor	A generic term used for a Σ -7-series linear servomotor (SGLG, SGLF, SGLT).
SERVOPACK	A Σ -X-series Σ -XW/ Σ -XT servo amplifier with MECHATROLINK-4/III communications references. or A Σ -X-series Σ -XW/ Σ -XT servo amplifier with EtherCAT communications references.
servo drive	The combination of a servomotor and SERVOPACK.
servo system	A servo control system that includes the combination of a servo drive with a host controller and peripheral devices.
servo ON	Supplying power to the motor.
servo OFF	Not supplying power to the motor.
base block (BB)	Shutting OFF the power supply to the motor by shutting OFF the base current to the power transistor in the SERVOPACK.
servo lock	A state in which the motor is stopped and is in a position loop with a position reference of 0.
HWBB function	An abbreviation for hard wire base block, which is a safety function that is designed to shut OFF the current to the motors with a hardwired circuit.
main circuit cable	One of the cables that connect to the main circuit terminals, including the main circuit power supply cable, control power supply cable, and servomotor main circuit cable.
SigmaWin+	The engineering tool for setting up and tuning servo drives or a computer in which the engineering tool is installed.

i.4.2 Differences in Terms for Rotary Servomotors and Linear Servomotors

There are differences in the terms that are used for rotary servomotors and linear servomotors. This manual primarily describes rotary servomotors. If you are using a linear servomotor, you need to interpret the terms as given in the following table.

Rotary Servomotor	Linear Servomotor
torque	force
moment of inertia	mass
rotation	movement
forward rotation and reverse rotation	forward movement and reverse movement
CW + CCW pulse trains	forward and reverse pulse trains
rotary encoder	linear encoder
absolute rotary encoder	absolute linear encoder
incremental rotary encoder	incremental linear encoder

Continued on next page.

Rotary Servomotor	Linear Servomotor
unit: min ⁻¹	unit: mm/s
unit: N·m	unit: N

i.4.3 Notation Used in this Manual

(1) Notation for Reverse Signals

The names of reverse signals (i.e., ones that are valid when low) are written with a forward slash (/) before the signal abbreviation.

Notation Example

\overline{BK} is written as /BK.

i.4.4 Trademarks

- QR code is a trademark of Denso Wave Inc.
- MECHATROLINK is a trademark of the MECHATROLINK Members Association.
- Σ -LINK is a trademark of the MECHATROLINK Members Association.
- Other product names and company names are the trademarks or registered trademarks of their respective companies. "TM" and the ® mark do not appear with product or company names in this manual.

i.4.5 Visual Aids

The following aids are used to indicate certain types of information for easier reference.



Important

Indicates precautions or restrictions that must be observed.

Also indicates alarm displays and other precautions that will not result in machine damage.



Term

Indicates definitions of difficult terms or terms that have not been previously explained in this manual.

Information

Indicates supplemental information to deepen understanding or useful information.

i.5 Safety Precautions

i.5.1 Safety Information

To prevent personal injury and equipment damage in advance, the following signal words are used to indicate safety precautions in this document. The signal words are used to classify the hazards and the degree of damage or injury that may occur if a product is used incorrectly. Information marked as shown below is important for safety. Always read this information and heed the precautions that are provided.

DANGER

Indicates precautions that, if not heeded, are likely to result in loss of life, serious injury, or fire.

WARNING

Indicates precautions that, if not heeded, could result in loss of life, serious injury, or fire.

CAUTION

Indicates precautions that, if not heeded, could result in relatively serious or minor injury, or in fire.

NOTICE

Indicates precautions that, if not heeded, could result in property damage.

i.5.2 Safety Precautions That Must Always Be Observed

(1) General Precautions

DANGER

Read and understand this manual to ensure the safe usage of the product.

Keep this manual in a safe, convenient place so that it can be referred to whenever necessary. Make sure that it is delivered to the final user of the product.

Do not remove covers, cables, connectors, or optional devices while power is being supplied to the SERVOPACK.

There is a risk of electric shock, operational failure of the product, or burning.

WARNING

Use a power supply with specifications (number of phases, voltage, frequency, and AC/DC type) that are appropriate for the product.

There is a risk of burning, electric shock, or fire.

Connect the ground terminals on the SERVOPACK and servomotor to ground poles according to local electrical codes (100 Ω max).

There is a risk of electric shock or fire.

 **WARNING**

Do not attempt to disassemble, repair, or modify the product.

There is a risk of fire or failure. The warranty is void for the product if you disassemble, repair, or modify it.

The installation must be suitable and it must be performed only by an experienced technician.

There is a risk of electric shock or injury.

Before connecting the machine and starting operation, make sure that an emergency stop procedure has been provided and is working correctly.

There is a risk of injury.

Do not touch anything inside the product.

There is a risk of electric shock.

 **CAUTION**

The SERVOPACK heat sinks, regenerative resistors, external dynamic brake resistors, servomotors, and other components can be very hot while power is ON or soon after the power is turned OFF. Implement safety measures, such as installing covers, so that hands and parts such as cables do not come into contact with hot components.

There is a risk of burning.

For a 24-VDC power supply, use a power supply device with double insulation or reinforced insulation.

There is a risk of electric shock.

Do not damage, pull on, apply excessive force to, place heavy objects on, or pinch cables.

There is a risk of failure, damage, or electric shock.

The person who designs the system that uses the safety function must have a complete knowledge of the related safety standards and a complete understanding of the instructions in this document.

There is a risk of injury, product damage, or machine damage.

Do not place the product in locations where it is subject to water, corrosive gases, flammable gases, potentially explosive atmospheres, or near flammable materials.

There is a risk of electric shock or fire.

NOTICE

Do not attempt to use a SERVOPACK or servomotor that is damaged or that has missing parts.

Install external emergency stop circuits that shut OFF the power and stops operation immediately when an error occurs.

In locations with poor power supply conditions, install the necessary protective devices (such as AC reactors) to ensure that the input power is supplied within the specified voltage range.

There is a risk of damage to the SERVOPACK.

Use a noise filter to minimize the effects of electromagnetic interference.

Electronic devices used near the SERVOPACK may be affected by electromagnetic interference.

Always use a servomotor and SERVOPACK in one of the specified combinations.

Do not touch a SERVOPACK or servomotor with wet hands.

There is a risk of product failure.

(2) Storage Precautions



CAUTION

Do not place an excessive load on the product. (Follow all instructions on the packages.)

There is a risk of injury or damage.

NOTICE

Do not install or store the product in any of the following locations.

- **Locations that are subject to direct sunlight**
- **Locations that are subject to surrounding temperatures that exceed product specifications**
- **Locations that are subject to relative humidities that exceed product specifications**
- **Locations that are subject to condensation as the result of extreme changes in temperature**
- **Locations that are subject to corrosive or flammable gases**
- **Locations that are near flammable materials**
- **Locations that are subject to dust, salts, or iron powder**
- **Locations that are subject to water, oil, or chemicals**
- **Locations that are subject to vibration or shock that exceeds product specifications**
- **Locations that are subject to radiation**

If you store or install the product in any of the above locations, the product may fail or be damaged.

(3) Transportation Precautions



CAUTION

Transport the product in a way that is suitable to the mass of the product.

Do not use the eyebolts on a SERVOPACK or servomotor to move the machine.

There is a risk of damage or injury.

When you handle a SERVOPACK or servomotor, be careful of sharp parts, such as the corners.

There is a risk of injury.

Do not place an excessive load on the product. (Follow all instructions on the packages.)

There is a risk of injury or damage.

NOTICE

Do not hold onto the front cover or connectors when you move a SERVOPACK.

There is a risk of the SERVOPACK falling.

SERVOPACK or servomotor is a precision device. Do not drop it or subject it to strong shock.

There is a risk of failure or damage.

Do not subject connectors to shock.

There is a risk of faulty connections or damage.

Never subject the SERVOPACK to an atmosphere containing halogen (fluorine, chlorine, bromine, or iodine) during transportation.

There is a risk of failure or damage.

NOTICE

If disinfectants or insecticides must be used to treat packing materials such as wooden frames, plywood, or pallets, use a method other than fumigation. For example, use heat sterilization (core temperature of 56°C or higher for 30 minutes or longer). Treat the packing materials before the product is packaged instead of using a method that treats the entire packaged product.

If the electronic products, which include stand-alone products and products installed in machines, are packed with fumigated wooden materials, the electrical components may be greatly damaged by the gases or fumes resulting from the fumigation process. In particular, disinfectants containing halogen, which includes chlorine, fluorine, bromine, or iodine can contribute to the erosion of the capacitors.

Do not overtighten the eyebolts on a SERVOPACK or servomotor.

If you use a tool to overtighten the eyebolts, the tapped holes may be damaged.

(4) Installation Precautions



CAUTION

Install the servomotor or SERVOPACK in a way that will support the mass given in technical documents.

Install SERVOPACKs, servomotors, regenerative resistors, and external dynamic brake resistors on nonflammable materials.

Installation directly onto or near flammable materials may result in fire.

Provide the specified clearances between the SERVOPACK and the control panel as well as with other devices.

There is a risk of fire or failure.

Install the SERVOPACK in the specified orientation.

There is a risk of fire or failure.

Do not step on or place a heavy object on the product.

There is a risk of failure, damage, or injury.

Do not allow any foreign matter to enter the SERVOPACK or servomotor.

There is a risk of failure or fire.

NOTICE

Do not install or store the product in any of the following locations.

- **Locations that are subject to direct sunlight**
- **Locations that are subject to surrounding temperatures that exceed product specifications**
- **Locations that are subject to relative humidities that exceed product specifications**
- **Locations that are subject to condensation as the result of extreme changes in temperature**
- **Locations that are subject to corrosive or flammable gases**
- **Locations that are near flammable materials**
- **Locations that are subject to dust, salts, or iron powder**
- **Locations that are subject to water, oil, or chemicals**
- **Locations that are subject to vibration or shock that exceeds product specifications**
- **Locations that are subject to radiation**

If you store or install the product in any of the above locations, the product may fail or be damaged.

Use the product in an environment that is appropriate for the product specifications.

If you use the product in an environment that exceeds product specifications, the product may fail or be damaged.

NOTICE

SERVOPACK or servomotor is a precision device. Do not drop it or subject it to strong shock.

There is a risk of failure or damage.

Always install a SERVOPACK in a control panel.

Do not allow any foreign matter to enter a SERVOPACK or a servomotor with a cooling fan and do not cover the outlet from the servomotor's cooling fan.

There is a risk of failure.

Never install the SERVOPACK in an atmosphere containing halogen (fluorine, chlorine, bromine, or iodine).

There is a risk of failure or damage.

(5) Wiring Precautions



DANGER

Do not change any wiring while power is being supplied.

There is a risk of electric shock or injury.



WARNING

Wiring and inspections must be performed only by qualified engineers.

There is a risk of electric shock or product failure.

Check all wiring and power supplies carefully.

Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures. If a short-circuit failure occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident that may result in death or injury. There is also a risk that some parts damaged by the short-circuit failure may fall from the SERVOPACK.

Connect the AC or DC power supplies to the specified SERVOPACK terminals.

- **Connect an AC power supply to the L1, L2, and L3 terminals and the L1C and L2C terminals on the SERVOPACK.**
- **Connect a DC power supply to the B1/⊕ and ⊖ 2 terminals and the L1C and L2C terminals on the SERVOPACK.**

There is a risk of failure or fire.

If you use a SERVOPACK with the dynamic brake hardware option, connect an external dynamic brake resistor that is suitable for the machine and equipment specifications to the specified terminals.

There is a risk of unexpected operation, machine damage, burning, or injury when an emergency stop is performed.



CAUTION

Wait for at least 20 minutes (or 100 minutes when using DC power supply input) after turning OFF the power and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the main circuit terminals while the CHARGE indicator is lit because high voltage may still remain in the SERVOPACK even after turning OFF the power.

There is a risk of electric shock.

Observe the precautions and instructions for wiring and trial operation precisely as described in this document.

Failures caused by incorrect wiring or incorrect voltage application in the brake circuit may cause the SERVOPACK to fail, damage the equipment, or cause an accident resulting in death or injury.

Check the wiring to be sure it has been performed correctly. Connectors and pin layouts are sometimes different for different models. Always confirm the pin layouts in technical documents for your model before operation.

There is a risk of failure or malfunction.

Connect wires to main circuit terminals and motor connection terminals securely with the specified methods and tightening torque.

Insufficient tightening may cause wires and terminal blocks to generate heat due to faulty contact, possibly resulting in fire.

Use shielded twisted-pair cables or screened unshielded multi-twisted-pair cables for I/O signal cables and encoder cables.

The maximum wiring length is 3 m for I/O signal cables and 50 m for servomotor main circuit cables and encoder cables.

Observe the following precautions when wiring the SERVOPACK's main circuit terminals.

- Turn ON the power to the SERVOPACK only after all wiring, including the main circuit terminals, has been completed.
- If a connector is used for the main circuit terminals, remove the main circuit connector from the SERVOPACK before you wire it.
- Insert only one wire per insertion hole in the main circuit terminals.
- When you insert a wire, make sure that the conductor wire (e.g., whiskers) does not come into contact with adjacent wires and cause a short-circuit.

Install molded-case circuit breakers and other safety measures to provide protection against short circuits in external wiring.

There is a risk of fire or failure.

In places with poor power supply conditions, ensure that the input power is supplied within the specified voltage range.

There is a risk of equipment damage.

Provide sufficient shielding when using the product in the following locations.

- Locations that are subject to noise, such as from static electricity
- Locations that are subject to strong electromagnetic or magnetic fields
- Locations that are subject to radiation
- Locations that are near power lines

There is a risk of equipment damage.

Provide emergency stop circuits, interlock circuits, limit circuits, and any other required safety measures in control circuits outside of the SERVOPACK.

There is a risk of injury or device damage.

If you use MECHATROLINK I/O modules, use the establishment of MECHATROLINK communications as an interlock output condition.

There is a risk of equipment damage.

CAUTION

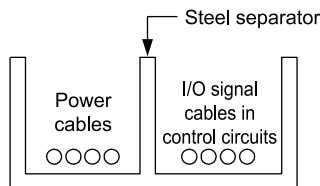
Select the I/O signal wires for external wiring to connect the product to external devices based on the following criteria:

- **Mechanical strength**
- **Noise interference**
- **Wiring distance**
- **Signal voltage**

Separate the I/O signal cables for control circuits from the power cables both inside and outside the control panel to reduce the influence of noise from the power cables.

If the I/O signal lines and power lines are not separated properly, malfunction may occur.

Example of Separated Cables



NOTICE

Whenever possible, use the cables specified by Yaskawa. If you use any other cables, confirm the rated current and application environment of your model and use the wiring materials specified by Yaskawa or equivalent materials.

Securely tighten connector screws and lock mechanisms.

Insufficient tightening may result in connectors falling off during operation.

Do not bundle power lines (e.g., the main circuit cable) and low-current lines (e.g., the I/O signal cables or encoder cables) together or run them through the same duct. If you do not place power lines and low-current lines in separate ducts, separate them by at least 30 cm.

If the cables are too close to each other, malfunctions may occur due to noise affecting the low-current lines.

Install a battery at either the host controller or on the encoder cable.

If you install batteries both at the host controller and on the encoder cable at the same time, you will create a loop circuit between the batteries, resulting in a risk of damage or burning.

When connecting a battery, connect the polarity correctly.

There is a risk of battery rupture or encoder failure.

(6) Operation Precautions

WARNING

Before starting operation with a machine connected, change the settings of the switches and parameters to match the machine.

Unexpected machine operation, failure, or personal injury may occur if operation is started before appropriate settings are made.

Do not radically change the settings of the parameters.

There is a risk of unstable operation, machine damage, or injury.

Install limit switches or stoppers at the ends of the moving parts of the machine to prevent unexpected accidents.

There is a risk of machine damage or injury.

For trial operation, securely mount the servomotor and disconnect it from the machine.

There is a risk of injury.


WARNING

Forcing the motor to stop for overtravel is disabled when the Jog, Origin Search, or Easy FFT utility function is executed. Take necessary precautions.

There is a risk of machine damage or injury.

When an alarm occurs, the servomotor will coast to a stop or stop with the dynamic brake according to the SERVOPACK option and settings. The coasting distance will change with the moment of inertia of the load and the external dynamic brake resistance. Check the coasting distance during trial operation and implement suitable safety measures on the machine.

Do not enter the machine's range of motion during operation.

There is a risk of injury.

Do not touch the moving parts of the servomotor or machine during operation.

There is a risk of injury.


CAUTION

Design the system to ensure safety even when problems, such as broken signal lines, occur. For example, the P-OT and N-OT signals are set in the default settings to operate on the safe side if a signal line breaks. Do not change the polarity of this type of signal.

When overtravel occurs, the power to the motor is turned OFF and the brake is released. If you use the servomotor to drive a vertical load, set the servomotor to enter a zero-clamped state after the servomotor stops. Also, install safety devices (such as an external brake or counterweight) to prevent the moving parts of the machine from falling.

Always turn OFF the servo before you turn OFF the power. If you turn OFF the main circuit power or control power during operation before you turn OFF the servo, the servomotor will stop as follows:

- **If you turn OFF the main circuit power during operation without turning OFF the servo, the servomotor will stop abruptly with the dynamic brake.**
- **If you turn OFF the control power without turning OFF the servo, the stopping method that is used by the servomotor depends on the model of the SERVOPACK. For details, refer to the manual for the SERVOPACK.**
- **If you use a SERVOPACK with the dynamic brake hardware option, the servomotor stopping methods will be different from the stopping methods used without the option or with other hardware options.**

Do not use the dynamic brake for any application other than an emergency stop.

There is a risk of failure due to rapid deterioration of elements in the SERVOPACK and the risk of unexpected operation, machine damage, burning, or injury.

Implement interlock signals and other safety circuits external to the product to ensure safety in the overall system even if the following conditions occur.

- **Product failure or errors caused by external factors**
- **Shutdown of operation due to product detection of an error in self-diagnosis and the subsequent turning OFF or holding of output signals**
- **Holding of the ON or OFF status of outputs from the product due to fusing or burning of output relays or damage to output transistors**
- **Voltage drops from overloads or short-circuits in the 24-V output from the product and the subsequent inability to output signals**
- **Unexpected I/Os due to errors in the power supply, I/O, or memory that cannot be detected by the product through self-diagnosis**

There is a risk of injury, device damage, or burning.

NOTICE

When you adjust the gain during system commissioning, use a measuring instrument to monitor the torque waveform and speed waveform and confirm that there is no vibration.

If a high gain causes vibration, the servomotor will be damaged quickly.

Do not frequently turn the power ON and OFF. After you have started actual operation, allow at least one hour between turning the power ON and OFF (as a guideline). Do not use the product in applications that require the power to be turned ON and OFF frequently.

The elements in the SERVOPACK will deteriorate quickly.

An alarm or warning may occur if communications are performed with the host controller while the SigmaWin+ or digital operator is operating.

If an alarm or warning occurs, it may interrupt the current process and stop the system.

After you complete trial operation of the machine and facilities, use the SigmaWin+ to back up the settings of the SERVOPACK parameters. You can use them to reset the parameters after SERVOPACK replacement.

If you do not copy backed up parameter settings, normal operation may not be possible after a faulty SERVOPACK is replaced, possibly resulting in machine or equipment damage.

(7) Maintenance and Inspection Precautions

DANGER

Do not change any wiring while power is being supplied.

There is a risk of electric shock or injury.

WARNING

Wiring and inspections must be performed only by qualified engineers.

There is a risk of electric shock or product failure.

CAUTION

Wait for at least 20 minutes (or 100 minutes when using DC power supply input) after turning OFF the power and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the main circuit terminals while the CHARGE indicator is lit because high voltage may still remain in the SERVOPACK even after turning OFF the power.

There is a risk of electric shock.

Before you replace a SERVOPACK, back up the settings of the SERVOPACK parameters. Copy the backed up parameter settings to the new SERVOPACK and confirm that they were copied correctly.

If you do not copy backed up parameter settings or if the copy operation is not completed correctly, normal operation may not be possible, possibly resulting in machine or equipment damage.

Do not attempt to disassemble or repair the product.

There is a risk of electrical shock, injury, or device damage.

NOTICE

Discharge all static electricity from your body before you operate any of the buttons or switches inside the front cover of the SERVOPACK.

There is a risk of equipment damage.

(8) Troubleshooting Precautions

DANGER

If the safety device (molded-case circuit breaker or fuse) installed in the power supply line operates, remove the cause before you supply power to the SERVOPACK again. If necessary, repair or replace the SERVOPACK, check the wiring, and remove the factor that caused the safety device to operate.

There is a risk of fire, electric shock, or injury.

WARNING

The product may suddenly start to operate when the power supply is recovered after a momentary power interruption. Design the machine to ensure human safety when operation restarts.

There is a risk of injury.

CAUTION

When an alarm occurs, remove the cause of the alarm and ensure safety. Then reset the alarm or turn the power OFF and ON again to restart operation.

There is a risk of injury or machine damage.

If the Servo ON signal is input to the SERVOPACK and an alarm is reset, the servomotor may suddenly restart operation. Confirm that the servo is OFF and ensure safety before you reset an alarm.

There is a risk of injury or machine damage.

Always insert a magnetic contactor in the line between the main circuit power supply and the main circuit terminals on the SERVOPACK so that the power can be shut OFF at the main circuit power supply.

If a magnetic contactor is not connected when the SERVOPACK fails, a large current may flow continuously, possibly resulting in fire.

If an alarm occurs, shut OFF the main circuit power supply.

There is a risk of fire due to a regenerative resistor overheating as the result of regenerative transistor failure.

Install a ground fault detector against overloads and short-circuiting or install a molded-case circuit breaker combined with a ground fault detector.

There is a risk of SERVOPACK failure or fire if a ground fault occurs.

The holding brake on a servomotor will not ensure safety if there is the possibility that an external force (including gravity) may move the current position and create a hazardous situation when power is interrupted or an error occurs. If an external force may cause movement, install an external braking mechanism that ensures safety.

(9) Disposal Precautions

- Correctly discard the product as stipulated by regional, local, and municipal laws and regulations. Be sure to include these contents in all labelling and warning notifications on the final product as necessary.



(10) General Precautions

- Figures provided in this document are typical examples or conceptual representations. There may be differences between them and actual wiring, circuits, and products.
- The products shown in illustrations in this document are sometimes shown with their covers or protective guards removed to illustrate detail. Always replace all covers and protective guards before you use the product.
- If you need a new copy of this document because it has been lost or damaged, contact your nearest Yaskawa representative or one of the offices listed on the back of this document.
- This document is subject to change without notice for product improvements, specifications changes, and improvements to the manual itself. We will update the document number of the document and issue revisions when changes are made.
- Any and all quality guarantees provided by Yaskawa are null and void if the customer modifies the product in any way. Yaskawa disavows any responsibility for damages or losses that are caused by modified products.

i.6 Warranty

i.6.1 Details of Warranty

(1) Warranty Period

The warranty period for a product that was purchased (hereinafter called the “delivered product”) is one year from the time of delivery to the location specified by the customer or 18 months from the time of shipment from the Yaskawa factory, whichever is sooner.

(2) Warranty Scope

Yaskawa shall replace or repair a defective product free of charge if a defect attributable to Yaskawa occurs during the above warranty period. This warranty does not cover defects caused by the delivered product reaching the end of its service life and replacement of parts that require replacement or that have a limited service life.

This warranty does not cover failures that result from any of the following causes.

- Improper handling, abuse, or use in unsuitable conditions or in environments not described in product catalogs or manuals, or in any separately agreed-upon specifications
- Causes not attributable to the delivered product itself
- Modifications or repairs not performed by Yaskawa
- Use of the delivered product in a manner in which it was not originally intended
- Causes that were not foreseeable with the scientific and technological understanding at the time of shipment from Yaskawa
- Events for which Yaskawa is not responsible, such as natural or human-made disasters

i.6.2 Limitations of Liability

- Yaskawa shall in no event be responsible for any damage or loss of opportunity to the customer that arises due to failure of the delivered product.
- Yaskawa shall not be responsible for any programs (including parameter settings) or the results of program execution of the programs provided by the user or by a third party for use with programmable Yaskawa products.
- The information described in product catalogs or manuals is provided for the purpose of the customer purchasing the appropriate product for the intended application. The use thereof does not guarantee that there are no infringements of intellectual property rights or other proprietary rights of Yaskawa or third parties, nor does it construe a license.
- Yaskawa shall not be responsible for any damage arising from infringements of intellectual property rights or other proprietary rights of third parties as a result of using the information described in catalogs or manuals.

i.6.3 Suitability for Use

- It is the customer's responsibility to confirm conformity with any standards, codes, or regulations that apply if the Yaskawa product is used in combination with any other products.
- The customer must confirm that the Yaskawa product is suitable for the systems, machines, and equipment used by the customer.
- Consult with Yaskawa to determine whether use in the following applications is acceptable. If use in the application is acceptable, use the product with extra allowance in ratings and specifications, and provide safety measures to minimize hazards in the event of failure.
 - Outdoor use, use involving potential chemical contamination or electrical interference, or use in conditions or environments not described in product catalogs or manuals
 - Nuclear energy control systems, combustion systems, railroad systems, aviation systems, vehicle systems, medical equipment, amusement machines, and installations subject to separate industry or government regulations
 - Systems, machines, and equipment that may present a risk to life or property
 - Systems that require a high degree of reliability, such as systems that supply gas, water, or electricity, or systems that operate continuously 24 hours a day
 - Other systems that require a similar high degree of safety
- Never use the product for an application involving serious risk to life or property without first ensuring that the system is designed to secure the required level of safety with risk warnings and redundancy, and that the Yaskawa product is properly rated and installed.
- The circuit examples and other application examples described in product catalogs and manuals are for reference. Check the functionality and safety of the actual devices and equipment to be used before using the product.
- Read and understand all use prohibitions and precautions, and operate the Yaskawa product correctly to prevent accidental harm to third parties.

i.6.4 Specifications Change

The names, specifications, appearance, and accessories of products in product catalogs and manuals may be changed at any time based on improvements and other reasons. The next editions of the revised catalogs or manuals will be published with updated code numbers. Consult with your Yaskawa representative to confirm the actual specifications before purchasing a product.

i.7 Compliance with UL Standards and EU Directives

Certification marks for the standards for which the product has been certified by certification bodies are shown on nameplate. Products that do not have the marks are not certified for the standards.

Refer to the servomotor manual for compliant standards of servomotors.

i.7.1 North American Safety Standards (UL)



Product	Model	North American Safety Standards (UL File No.)
SERVOPACK	SGDXW SGDXT	UL 61800-5-1 (E147823), CSA C22.2 No.274

i.7.2 EU Directives



Product	Model	EU Directives	Harmonized Standards
SERVOPACK	SGDXW SGDXT	Machinery Directive 2006/42/EC	EN 62061 EN 61800-5-2
		EMC Directive 2014/30/EU	EN 55011 group 1, class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Low Voltage Directive 2014/35/EU	EN 61800-5-1
		RoHS Directive 2011/65/EU (EU)2015/863	EN IEC 63000
		WEEE Directive 2012/19/EU	—

Note:

- We declared the CE Marking based on the harmonized standards in the above table. These products complied with the corresponding IEC standards. For the edition of each standard, refer to declaration of conformity.
- These products are for industrial use. In home environments, these products may cause electromagnetic interference and additional noise reduction measures may be necessary.

i.7.3 Safety Standards

Product	Model	Standards
SERVOPACK	SGDXW SGDXT	EN ISO13849-1 : 2015 EN 62061 EN 61800-5-2 EN 61000-6-7 EN 61326-3-1 EN 61508 series

Note:

These products complied with the corresponding IEC standards. For the edition of each standard, refer to declaration of conformity.

- Safety Parameters

Item	Standards	Performance Level
Safety Integrity Level	IEC 61508	SIL3
	IEC 62061	SILCL3/maximum SIL3
Mission Time	EN ISO 13849-1	20 years
Probability of Dangerous Failure per Hour	IEC 61508	– SGDXW: PFH = 1.09×10^{-8} [1/h] (10.86% of SIL3)
	IEC 62061	– SGDXT: PFH = 1.32×10^{-8} [1/h] (13.19% of SIL3)
Performance Level	EN ISO 13849-1	PL e (Category 3)
Mean Time to Dangerous Failure of Each Channel	EN ISO 13849-1	MTTFd: High
Average Diagnostic Coverage	EN ISO 13849-1	DCavg: Medium
Stop Category	IEC 60204-1	Stop category 0
Safety Functions	IEC 61800-5-2	STO
Hardware Fault Tolerance	IEC 61508	HFT = 1
Subsystem	IEC 61508	B

Note:

Mission time is a parameter used for the statistical calculation required by functional safety standards and this is not linked to the warranty/guarantee period.

Basic Information on SERVOPACKs

This chapter provides basic information on SERVOPACKs that have the HWBB function.

1.1	SERVOPACKs with HWBB Function	36
1.2	Interpreting the Nameplate	37
1.3	Part Names	38
1.4	Interpreting Model Numbers.....	41

1.1 SERVOPACKs with HWBB Function

Some SERVOPACKs are equipped with an HWBB function.

Refer to the following chapter for details on the HWBB function.

 [5 Safety Functions on page 71](#)

1.2 Interpreting the Nameplate

The following basic information is provided on the nameplate.

設置、運転前に必ず取扱説明書を読むこと。请务必熟读使用说明书，并按其规定进行操作。
 See "Safety Precautions" before installing.
 Consultez les "Précautions de sécurité" avant l'installation.
 本製品は内部にモータ過熱保護回路を備えていません。/本产品没有内置电机过热保护回路。
 Motor overtemperature protection is not provided.
 Protection contre une température excessive du moteur non fournie.

警告 感電の恐れあり。通電中および電源オフ後 20 分 (DC 電源入力時は 100 分) 以内は端子部に触れないこと。/小心触电! 通电中以及切断电源 20 分钟内 (使用直流电源时, 100 分钟之内), 请勿触摸接线端子部位。
 WARNING Risk of electric shock. After disconnecting power supply, wait 20 min (100 min when DC power) for capacitors to discharge before servicing.
 AVERTISSEMENT Risque de décharge électrique. Après avoir déconnecté l'alimentation, patientez 20 min (100 min pour l'alimentation CC) avant de procéder à l'entretien.

注意 高温注意。ヒートシンクに触らないこと。/请勿触摸散热片。有烫伤的危险。
 CAUTION Hot surface - risk of burn. Do not touch heatsink.
 ATTENTION Surface chaude - risque de brûlure. Ne touchez pas le dissipateur thermique.

SERVOPACK model → **SERVOPACK MODEL SGDXW-1R6A** ← Degree of protection **IP20**

INPUT	MAIN	1PH/3PH AC200-240V 50/60Hz 1PH: 5.5A 3PH: 2.5A DC270-324V 3A
	CONT.	AC200-240V 50/60Hz 0.25A DC270-324V 0.25A
OUTPUT		3PH 0-240V 0-590Hz 1.6A 200W/axis x2

Ambient operating temperature → **SURROUNDING AIR TEMP. -5to55°C**

BTO information → **BTOxNo. x1234567890123**

Order number → **xxxxNOTE1234567890123456**

Serial number → **xxxxAXIS1234567890123456**
xxxxxxx1234567890123456
O/N xxxxxxxxxxxxxx
S/N xxxxxxxxxxxxxx

← Certification marks



MAC-ADD: 00-20-B5-**-**→X-YZ

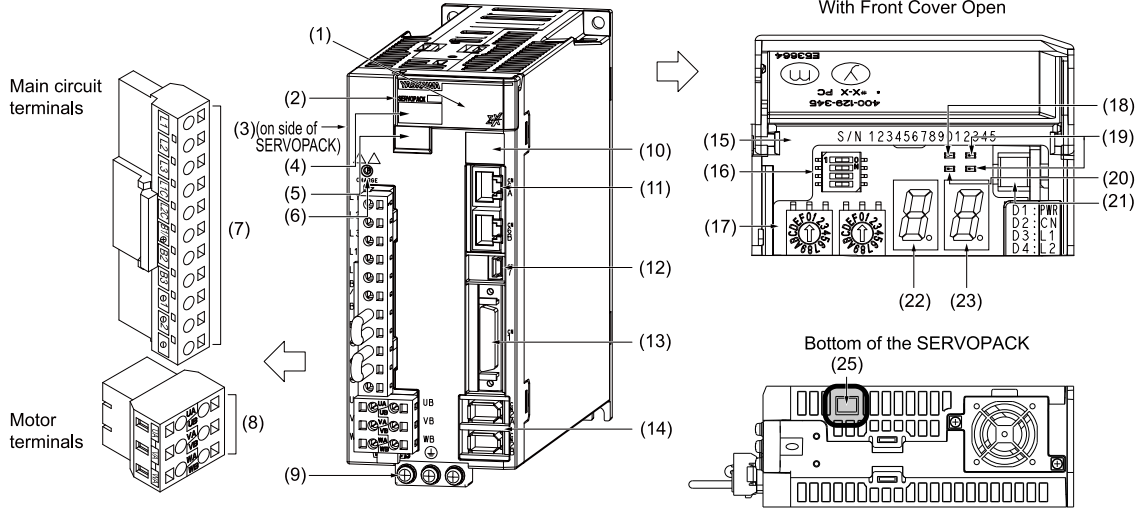
D

YASKAWA ELECTRIC CORPORATION
 2-1 Kurosakishiroishi, Yahatanishi-ku,
 Kitakyushu 806-0004 Japan **MADE IN JAPAN**

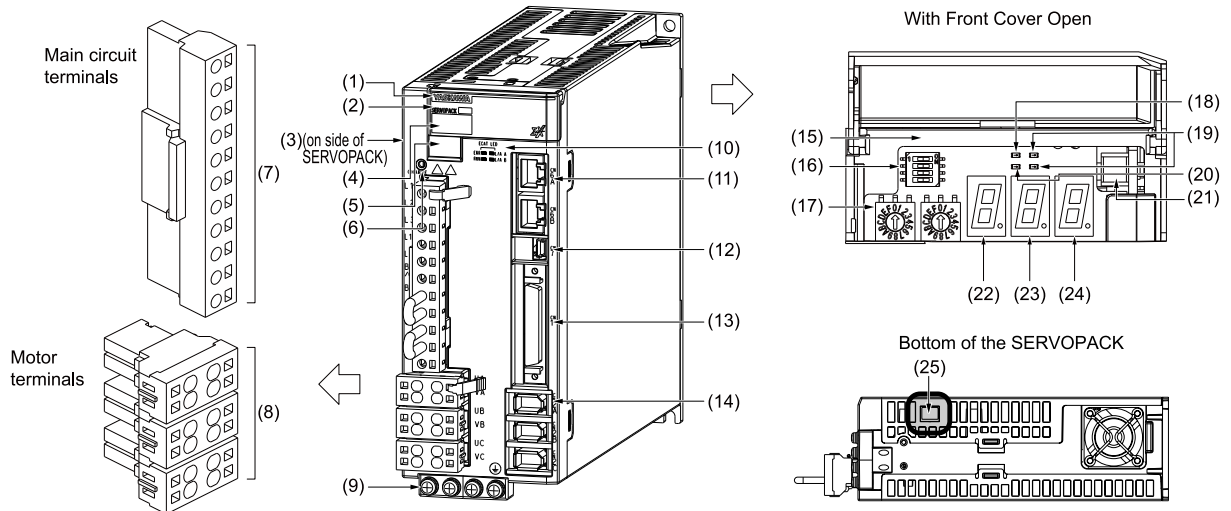
1.3 Part Names

The part names of the SERVOPACK are given below.

 Parts that are indicated by or  are unique to the SERVOPACKs with the HWBB function.
 <Σ-XW SERVOPACKs>



<Σ-XT SERVOPACKs>



No.	Name	Description	Reference
(1)	Front Cover	—	—
(2)	Input Voltage	—	—
(3)	Nameplate	Indicates the SERVOPACK model and ratings.	—
(4)	Model	The model of the SERVOPACK.	—
(5)	QR Code	The QR code that is used by the MechatroCloud service.	—
(6)	CHARGE	Lits while the main circuit power is being supplied. Note: Even if you turn OFF the main circuit power supply, this indicator will be lit as long as the internal capacitor remains charged. Do not touch the main circuit or motor terminals while this indicator is lit. Doing so may result in electric shock.	—
(7)	Main Circuit Terminals	The terminals depend on the main circuit power supply input specifications of the SERVOPACK.	—

Continued on next page.

Continued from previous page.

No.	Name	Description	Reference
(8)	Servomotor Terminals (Axis A: UA, VA, and WA, Axis B: UB, VB, and WB, Axis C <i>*1</i> : UC, VC, and WC)	The connection terminals for the servomotor main circuit cable (power line).	—
(9)	Ground Terminal (⊕)	The ground terminals to prevent electric shock. Always connect this terminal.	—
(10)	Communications LED Indicator Array	Displays the LED indicator array for EtherCAT communications inside the front cover. Displayed only on the SERVOPACK with EtherCAT communications references.	—
(11)	<SERVOPACK with MECHATROLINK-4/III communications references> MECHATROLINK-4 Communications Connectors (Input: CN6A, Output: CN6B)	Connects to MECHATROLINK-4/MECHATROLINK-III-compatible devices.	—
	<SERVOPACK with EtherCAT communications references> EtherCAT Communications Connectors (Input: CN6A, Output: CN6B)	Connects to EtherCAT devices.	
(12)	Personal Computer Connector (CN7)	A USB connector to connect a personal computer. The digital operator can also be connected.	—
(13)	I/O Signal Connector (CN1)	Connects to sequence I/O signals.	—
(14)	Encoder Cable Connectors (Axis A: CN2A, Axis B: CN2B, Axis C <i>*1</i> : CN2C)	This connector is used for the following purposes. <ul style="list-style-type: none"> Rotary servomotor: Connects to the encoder in the servomotor. Linear servomotor: Connects to the serial converter unit or linear encoder. Connects to Σ-LINK-II-compatible sensors and the Σ-LINK II sensor hub. 	—
(15)	Serial Number	—	—
(16)	DIP Switch (S3)	<SERVOPACK with MECHATROLINK-4/III communications references> <ul style="list-style-type: none"> Used to switch between MECHATROLINK-III and MECHATROLINK-4 communications. Used to set the number of transmission bytes in MECHATROLINK-III communications. <SERVOPACK with EtherCAT communications references> Not used.	—
(17)	<SERVOPACK with MECHATROLINK-4/III communications references> Rotary Switches (S1 and S2)	Used to set the MECHATROLINK station address.	—
	<SERVOPACK with EtherCAT communications references> ID Selectors (S1 and S2)	Used to identify the EtherCAT slave devices.	
<SERVOPACK with MECHATROLINK-4/III communications references>			
(18)	PWR	Lits while the control power is being supplied.	—
(19)	L1, L2	Lits during MECHATROLINK communications.	
(20)	CN	Lits when the CONNECT (Request for Establishing Connection) command is received correctly.	
<SERVOPACK with EtherCAT communications references>			

Continued on next page.

Continued from previous page.

No.	Name	Description	Reference
(18)	ERR	Shows the error status of EtherCAT communications.	—
(19)	L/A A	Shows whether communications cable is connected to the CN6A connector and whether communications are active.	
	L/A B	Shows whether communications cable is connected to the CN6B connector and whether communications are active.	
(20)	RUN	Shows the status of EtherCAT communications.	
(21)	Analog Monitor Connector (CN5)	You can use a special cable (peripheral device) to monitor the motor speed, torque reference, or other values.	—
(22)	Panel Display for Axis A	Displays the servo status with a seven-segment LED.	—
(23)	Panel Display for Axis B		
(24)	Panel Display for Axis C <i>*1</i>		
(25)	Safety Connector (CN8)	Connects to a safety function device.	69

*1 The Σ -XW SERVOPACK does not include an axis C. It is included when using the Σ -XT SERVOPACK.

1.4 Interpreting Model Numbers

SGDX □ - 1R6 A 40 A 1000 00 B

Σ-X-Series
SERVOPACKs
Model
name
1st+2nd+3rd
digits
4th
digit
5th+6th
digits
7th
digit
8th+9th+10th+11th
digits
12th+13th
digits
14th
digit

Model name

Code	Specification
W	Σ-XW model
T	Σ-XT model

1st+2nd+3rd digits Maximum Applicable Motor Capacity per Axis

Voltage	Code	Specification
Three-Phase, 200 VAC	1R6*1	0.2 kW
	2R8*1	0.4 kW
	5R5*1, *2, *3	0.75 kW
	7R6*3	1.0 kW

4th digit Voltage

Code	Specification
A	AC200 V

5th+6th digits Interface*3

Code	Specification
40	MECHATROLINK-4/III communications references
A0	EtherCAT communications reference

7th digit Design Revision Order

A

8th+9th+10th+11th digits Hardware Options Specification

Code	Specification	Applicable Models
1000	HWBB function	All models

12th+13th digits FT Specification

Code	Specification
None	None
00	

14th digit BTO Specification (currently in development)

Code	Specification
None	None
B	BTO specification

*1 You can use these models with either a single-phase or three-phase input.

*2 If you use the SERVOPACK with a single-phase 200-VAC power supply input, derate the load ratio to 65%. An example is given below.

If the load ratio of the first axis is 90%, use a load ratio of 40% for the second axis so that average load ratio for both axes is 65%.
 $((90\% + 40\%) / 2 = 65\%)$

*3 This specification is not available in the Σ-XT model.

*4 The same interface is used for both rotary servomotors and linear servomotors.

Selecting a SERVOPACK

This chapter provides information required to select SERVOPACKs, such as general specifications, block diagrams, connector specifications, external dimensions, and connection examples.

2.1	Specification	44
2.1.1	Environmental Conditions	44
2.1.2	I/O Signals	44
2.1.3	Functions: SERVOPACK with MECHATROLINK-4/III Communications References	46
2.1.4	Functions: SERVOPACK with EtherCAT Communications References	47
2.1.5	Option	49
2.2	Internal Block Diagrams	50
2.2.1	SGDXW-1R6A, 2R8A	50
2.2.2	SGDXW-5R5A, 7R6A	51
2.2.3	SGDXT-1R6A, -2R8A	52
2.3	External Dimensions	53
2.3.1	Front Cover Dimensions and Connector Specifications	53
2.3.2	SERVOPACK External Dimensions	54
2.4	Examples of Standard Connections between SERVOPACKs and Peripheral Devices	56
2.4.1	Rotary Servomotor	57
2.4.2	Linear Servomotor	58

2.1 Specification

This section gives the general specifications of SERVOPACKs.

2.1.1 Environmental Conditions

Item	Specification
Surrounding Air Temperature	-5°C to 55°C (With derating, usage is possible between 55°C and 60°C.)
Storage Temperature	-20°C to 85°C
Surrounding Air Humidity	95% relative humidity max. (with no freezing or condensation)
Storage Humidity	95% relative humidity max. (with no freezing or condensation)
Vibration Resistance	When there is continuous vibration: 10 Hz to 55 Hz, acceleration amplitude 5.9 m/s ² (0.6G)
Impact Resistance	19.6 m/s ²
Degree of Protection	IP20
Pollution Degree	2 <ul style="list-style-type: none"> • Must be no corrosive or flammable gases. • Must be no exposure to water, oil, or chemicals. • Must be no dust, salts, or iron dust.
Altitude	1000 m max. (With derating, usage is possible between 1000 m and 2000 m.)
Others	Do not use the SERVOPACK in the following locations: Locations subject to static electricity noise, strong electromagnetic/magnetic fields, or radioactivity

2.1.2 I/O Signals

Item	Specification
Overheat Protection Input: Σ -XW SERVOPACKs only	Number of input points: 2 Input voltage range: 0 V to +5 V
Outputs for Triggers at Preset Positions	Normal Output Signal for Triggers at Preset Positions 1 to 3 (/NSO1 to 3) Photocoupler Output
	High-Speed Output Signal for Triggers at Preset Positions 1 to 3 (HSO1 to 3): Σ -XT SERVOPACKs only
	Line-Driver Output

Continued on next page.

Continued from previous page.

Item		Specification
Sequence Input Signals	Input Signals That Can Be Allocated	Allowable voltage range: 24 VDC \pm 20% Number of input points: <ul style="list-style-type: none"> • Σ-XW SERVOPACK: 12 • Σ-XT SERVOPACK: 16 Input method: sink inputs or source inputs
		<SERVOPACK with MECHATROLINK-4/III communications references> <ul style="list-style-type: none"> • P-OT (Forward Drive Prohibit Input) and N-OT (Reverse Drive Prohibit Input) signals • /P-CL (Forward External Torque Limit Input) and /N-CL (Reverse External Torque Limit Input) signals • /DEC (Origin Return Deceleration Switch) signal • /EXT1 to /EXT3 (External Latch Input 1 to 3) signals • FSTP (Forced Stop Input) signal A signal can be allocated and the positive and negative logic can be changed.
		<SERVOPACK with EtherCAT communications references> <ul style="list-style-type: none"> • P-OT (Forward Drive Prohibit Input) and N-OT (Reverse Drive Prohibit Input) signals • /Probe1 (Probe 1 Latch Input) signal • /Probe2 (Probe 2 Latch Input) signal • /Home (Home Switch Input) signal • /P-CL (Forward External Torque Limit Input) and /N-CL (Reverse External Torque Limit Input) signals • FSTP (Forced Stop Input) signal A signal can be allocated and the positive and negative logic can be changed.
Sequence Output Signals	Fixed Output	Allowable voltage range: 5 VDC to 30 VDC Number of output points: <ul style="list-style-type: none"> • Σ-XW SERVOPACK: 2 • Σ-XT SERVOPACK: 3 Output method: a photocoupler output (isolated) Output signal: ALM (Servo Alarm Output) signal
	Output Signals That Can Be Allocated	Allowable voltage range: 5 VDC to 30 VDC Number of output points: 5 (output method: a photocoupler output (isolated)) <ul style="list-style-type: none"> • /COIN (Positioning Completion Output) signal • /V-CMP (Speed Coincidence Detection Output) signal • /TGON (Rotation Detection Output) signal • /S-RDY (Servo Ready Output) signal • /CLT (Torque Limit Detection Output) signal • /VLT (Speed Limit Detection Output) signal • /BK (Brake Output) signal • /WARN (Warning Output) signal • /NEAR (Near Output) signal A signal can be allocated and the positive and negative logic can be changed.

2.1.3 Functions: SERVOPACK with MECHATROLINK-4/III Communications References

Item		Specification
Communications	USB Communications (CN7)	Interfaces
		Communications Standard
		Personal computer (with SigmaWin+), digital operator (JUSP-OP07A-E)
		Conforms to USB2.0 standard (12 Mbps).
Displays/Indicators		CHARGE, PWR, CN, L1, L2, seven-segment LED <ul style="list-style-type: none"> Σ-XW SERVOPACKs: one-digit × 2 Σ-XT SERVOPACKs: one-digit × 3
MECHATROLINK-4 Communications ^{*1}	Communications Protocol	MECHATROLINK-4
	Station Address Settings	01h to FFh (maximum number of slaves: 127) The rotary switches (S1 and S2) are used to set the station address.
	Extended Address Settings	Axis A: 00h, Axis B: 01h, Axis C: 02h ^{*2}
	Transmission Speed	100 Mbps
	Transmission Cycle	62.5 μs, 125 μs, 250 μs, 500 μs, 750 μs, 1.0 ms to 4.0 ms (multiples of 0.5 ms)
	Number of Transmission Bytes	16 to 80 bytes/station
Reference Methods for MECHATROLINK-4 Communications	Performance	Position, speed, or torque control with MECHATROLINK-4 communications
	Reference Input	MECHATROLINK-4 commands (sequence, motion, data setting, data access, monitoring, adjustment, etc.)
	Profile	MECHATROLINK-4 standard servo profile MECHATROLINK-III standard servo profile
MECHATROLINK-III Communications ^{*1}	Communications Protocol	MECHATROLINK-III
	Station Address Settings	03h to EFh (maximum number of slaves: 62) The rotary switches (S1 and S2) are used to set the station address.
	Extended Address Settings	Axis A: 00h, Axis B: 01h, Axis C: 02h ^{*2}
	Transmission Speed	100 Mbps
	Transmission Cycle	250 μs, 500 μs, 750 μs, 1.0 ms to 4.0 ms (multiples of 0.5 ms)
	Number of Transmission Bytes	32 or 48 bytes/station A DIP switch (S3) is used to select the transmission bytes.
Reference Methods for MECHATROLINK-III Communications	Performance	Position, speed, or torque control with MECHATROLINK-III communications
	Reference Input	MECHATROLINK-III commands (sequence, motion, data setting, data access, monitoring, adjustment, etc.)
	Profile	MECHATROLINK-III standard servo profile
MECHATROLINK-4 and MECHATROLINK-III Communications Setting Switches		Rotary switch (S1 and S2) positions: 16 Number of DIP switch (S3) pins: 4
Analog Monitor (CN5)		Number of points: 2 Output voltage range: ±10 VDC (effective linearity range: ±8 V) Resolution: 16 bits Accuracy: ±20 mV (Typ) Maximum output current: ±10 mA
Dynamic Brake (DB)		Activated when a servo alarm or overtravel (OT) occurs, or when the power to the main circuit or servo is OFF.
Regenerative Processing		Built-in

Continued on next page.

Continued from previous page.

Item		Specification
Overtravel (OT) Prevention		Stopping with dynamic brake, deceleration to a stop, or coasting to a stop for the P-OT (Forward Drive Prohibit Input) or N-OT (Reverse Drive Prohibit Input) signal
Protective Functions		Overcurrent, overvoltage, undervoltage, overload, regeneration error, etc.
Utility Functions		Gain tuning, alarm history, jogging operation, origin search, etc.
Safety Functions *3	Inputs	/HWBB1 and /HWBB2: Base block signals for power modules
	Output	EDM1: Monitors the status of built-in safety circuit (fixed output) *4
	Applicable Standards *5	ISO13849-1 PLe (Category 3), IEC61508 SIL3

*1 Use the DIP switch S3 to switch the communications protocol.

*2 The Σ -XW SERVOPACK does not include an axis C. It is included when using the Σ -XT SERVOPACK.

*3 This is unique to the SERVOPACKs with the HWBB function.

*4 Whether or not you use the EDM1 signal does not affect the performance level of safety parameters.

*5 Always perform risk assessment for the system and confirm that the safety requirements are met.

2.1.4 Functions: SERVOPACK with EtherCAT Communications References

Item			Specification
Communications	USB Communications (CN7)	Interfaces	Personal computer (with SigmaWin+), digital operator (JUSP-OP07A-E)
		Communications Standard	Conforms to USB2.0 standard (12 Mbps).
Displays/Indicators		CHARGE, RUN, ERR, L/A A, L/A B, and one-digit seven-segment LED <ul style="list-style-type: none"> • Σ-XW SERVOPACKs: one-digit \times 2 • Σ-XT SERVOPACKs: one-digit \times 3 	
EtherCAT Communications Setting Switches		ID Selectors (S1 and S2), 16 positions	

Continued on next page.


Item		Specification
EtherCAT Communications	Applicable Communications Standards	IEC 61158 Type 12, IEC 61800-7 CiA402 drive profile
	Physical Layer	100BASE-TX (IEEE802.3)
	Communications Connectors	CN6A (RJ45): EtherCAT signal input connector CN6B (RJ45): EtherCAT signal output connector
	Cable	Category 5, 4 shielded twisted pairs The cable is automatically detected with AUTO MDIX.
	SyncManager	SM0: Mailbox output, SM1: Mailbox input, SM2: Process data output, and SM3: Process data input
	FMMU	FMMU 0: Mapped in process data output (RxPDO) area. FMMU 1: Mapped in process data input (TxPDO) area. FMMU 2: Mapped to mailbox status.
	EtherCAT Commands (Data Link Layer)	APRD, APWR, APRW, FPRD, FPWR, FPRW, BRD, BWR, BRW, LRD, LWR, LRW, ARMW, FRMW
	Process Data	Assignments can be changed with PDO mapping.
	Mailbox	Emergency messages, SDO requests, SDO responses, and SDO information (TxPDO/RxPDO and remote TxPDO/RxPDO are not supported.)
	Distributed Clocks	Free-run mode and DC mode (can be switched.) Applicable DC cycles: 125 μ s to 4 ms in 125- μ s increments
	Slave Information IF	4 KB
LED Indicator	During EtherCAT communications: L/A x 2 EtherCAT communications status: RUN x 1 EtherCAT error status: ERR x 1	
CiA402 Drive Profile	<ul style="list-style-type: none"> • Homing Mode • Profile Position Mode • Interpolated Position Mode • Profile Velocity Mode • Profile Torque Mode • Cyclic Synchronous Position Mode • Cyclic Synchronous Velocity Mode • Cyclic Synchronous Torque Mode • Touch Probe Function • Torque Limit Function 	
Analog Monitor (CN5)	Number of points: 2 Output voltage range: ± 10 VDC (effective linearity range: ± 8 V) Resolution: 16 bits Accuracy: ± 20 mV (Typ) Maximum output current: ± 10 mA	
Dynamic Brake (DB)	Activated when a servo alarm or overtravel (OT) occurs, or when the power to the main circuit or servo is OFF.	
Regenerative Processing	Built-in	
Overtravel (OT) Prevention	Stopping with dynamic brake, deceleration to a stop, or coasting to a stop for the P-OT (Forward Drive Prohibit Input) or N-OT (Reverse Drive Prohibit Input) signal	
Protective Functions	Overcurrent, overvoltage, undervoltage, overload, regeneration error, etc.	
Utility Functions	Gain tuning, alarm history, jogging operation, origin search, etc.	

2.1.5 Option

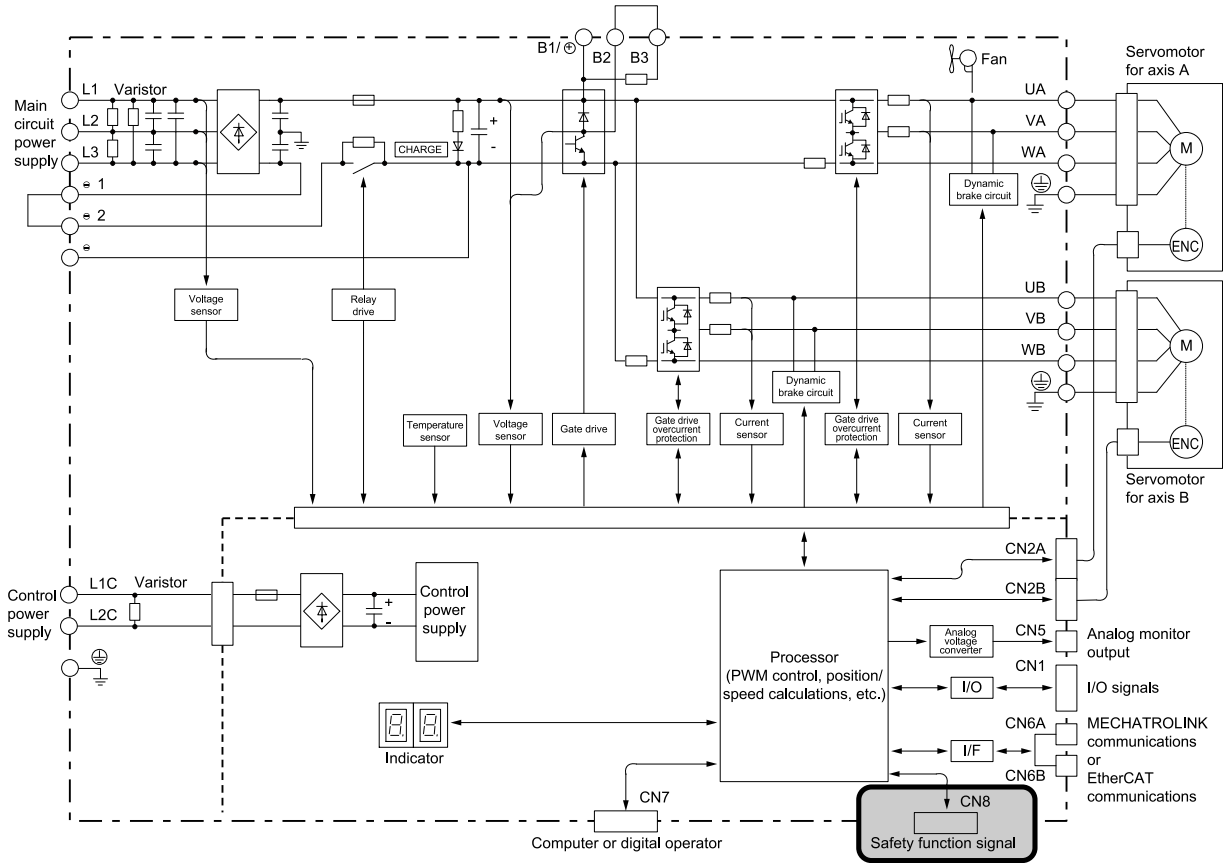
Item	Specification
Applicable Option Modules	None

2.2 Internal Block Diagrams

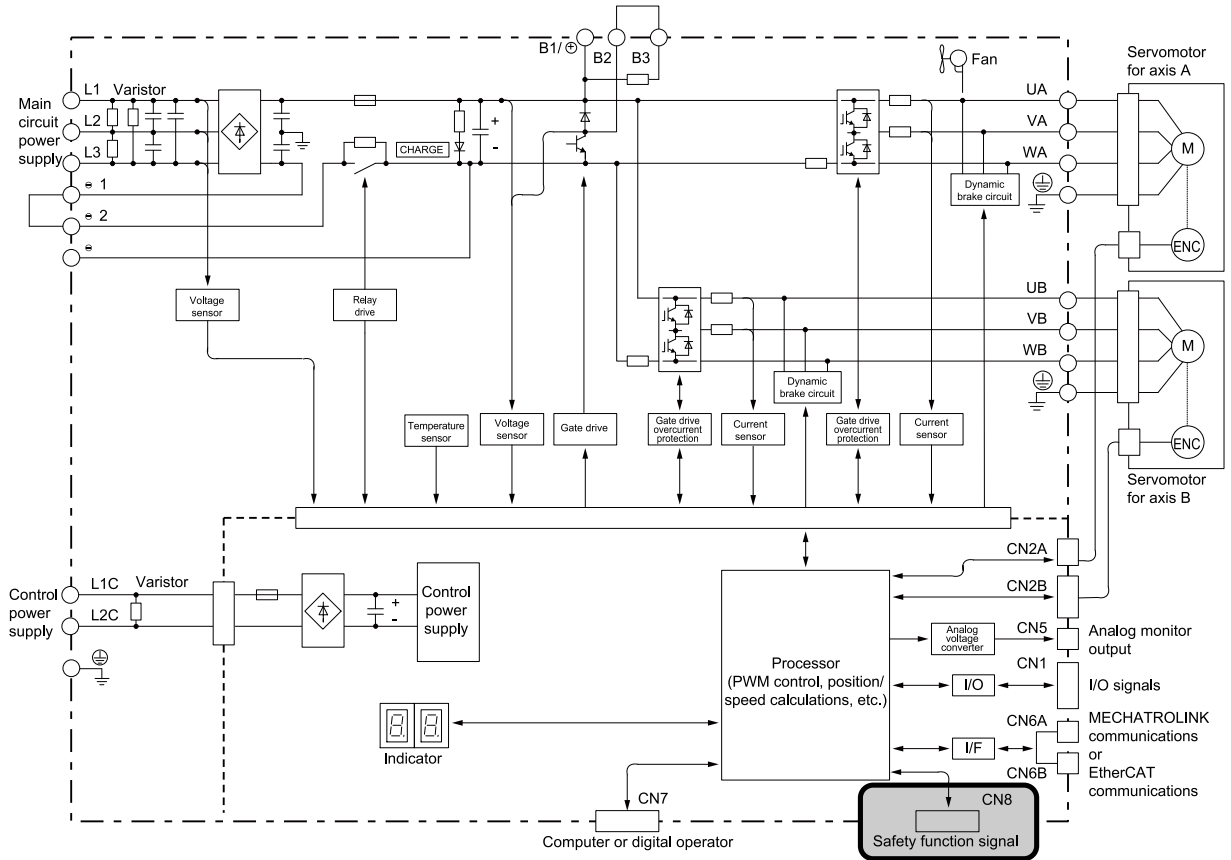
This section gives the internal block diagrams of SERVOPACKs with the HWBB function.

Parts that are indicated by  are unique to the SERVOPACKs with the HWBB function.

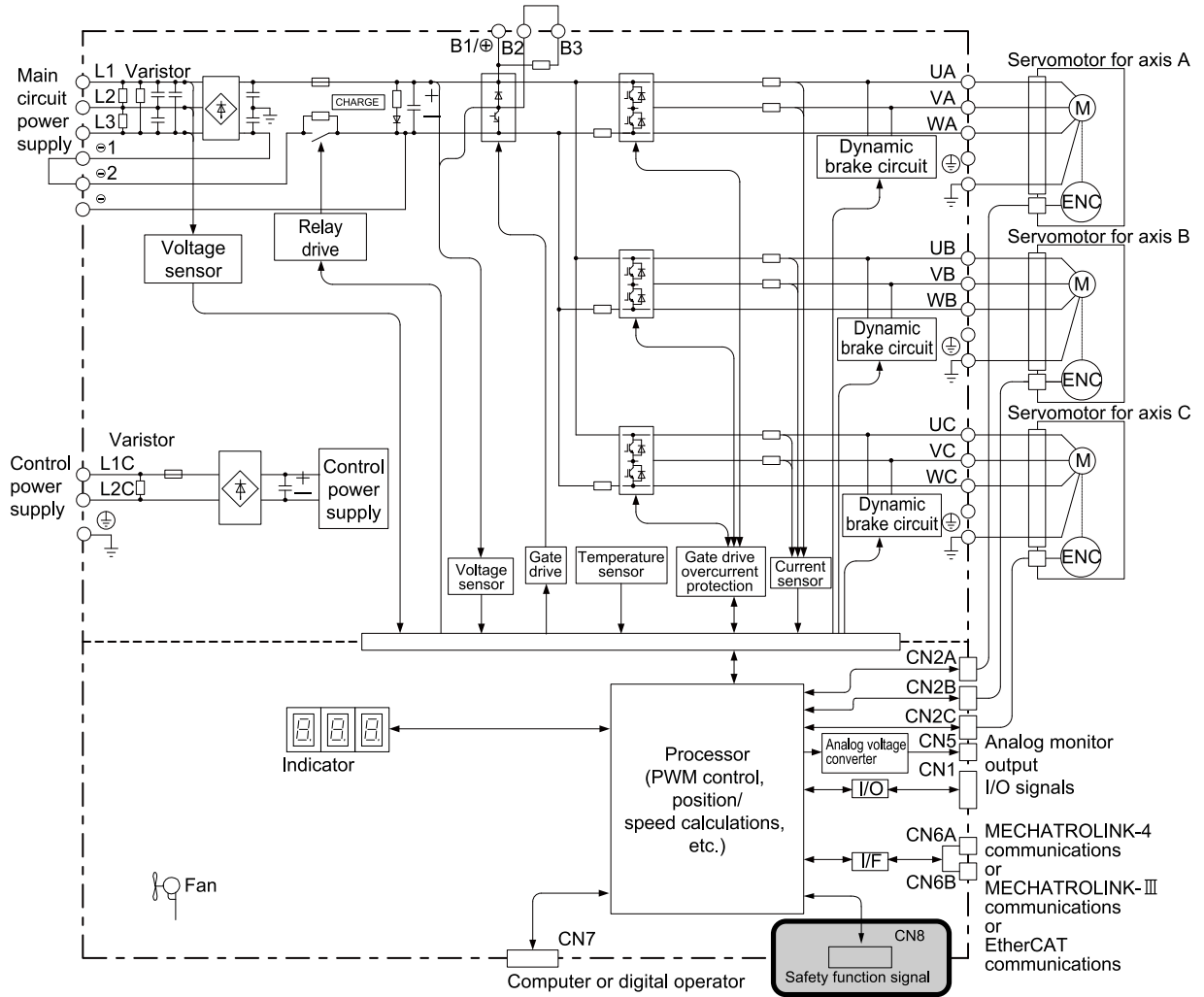
2.2.1 SGDXW-1R6A, 2R8A



2.2.2 SGDXW-5R5A, 7R6A



2.2.3 SGDXT-1R6A, -2R8A




2.3 External Dimensions

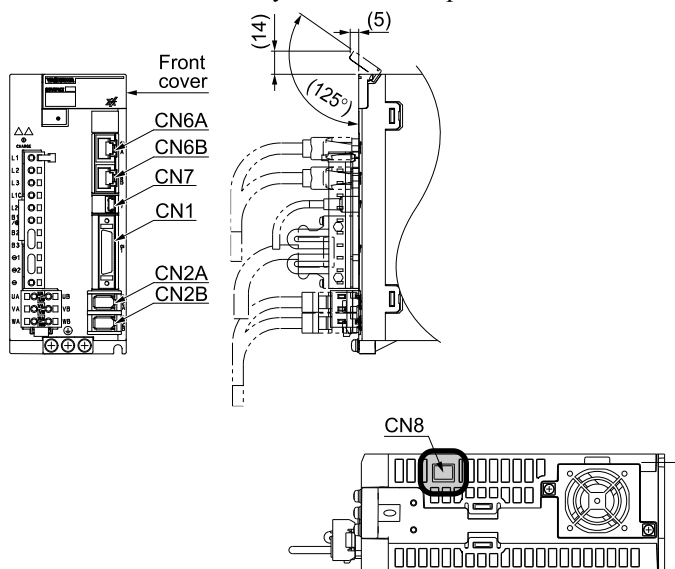
2.3.1 Front Cover Dimensions and Connector Specifications

This section gives the front cover dimensions and connector specifications.

(1) Front Cover Dimensions

The front cover dimensions are the same for all models.

Parts that are indicated by  are unique to the SERVOPACKs with the HWBB function.



(2) Connector Specifications

Connector No.	Model	Number of Pins	Manufacturer
CN1: Σ -XW SERVOPACKs	10236-59A3MB	36	3M Japan Limited
Σ -XT SERVOPACKs	10250-52A2PL	50	
CN2A, CN2B, CN2C *1	53460-0669	6	Molex Japan Co., Ltd.
CN6A, CN6B	3-1734579-4	8	Tyco Electronics Japan G.K.
CN7	2342993-1	5	Tyco Electronics Japan G.K.
CN8 *2	2294415-1	8	Tyco Electronics Japan G.K.

*1 The Σ -XW SERVOPACK does not include CN2C. It is included when using the Σ -XT SERVOPACK.

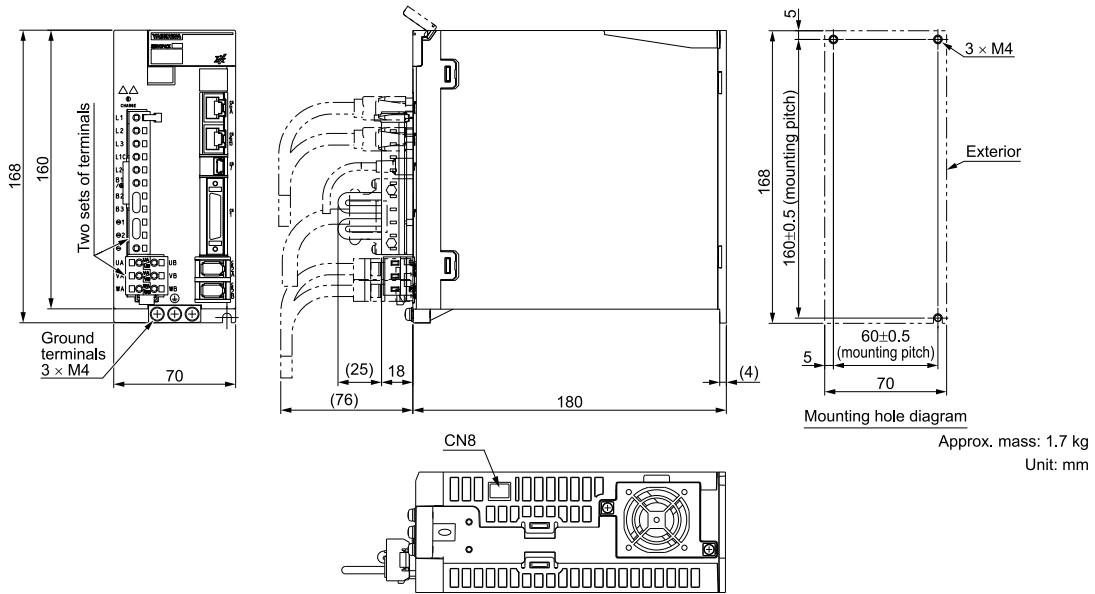
*2 This is unique to the SERVOPACKs with the HWBB function.

Note:

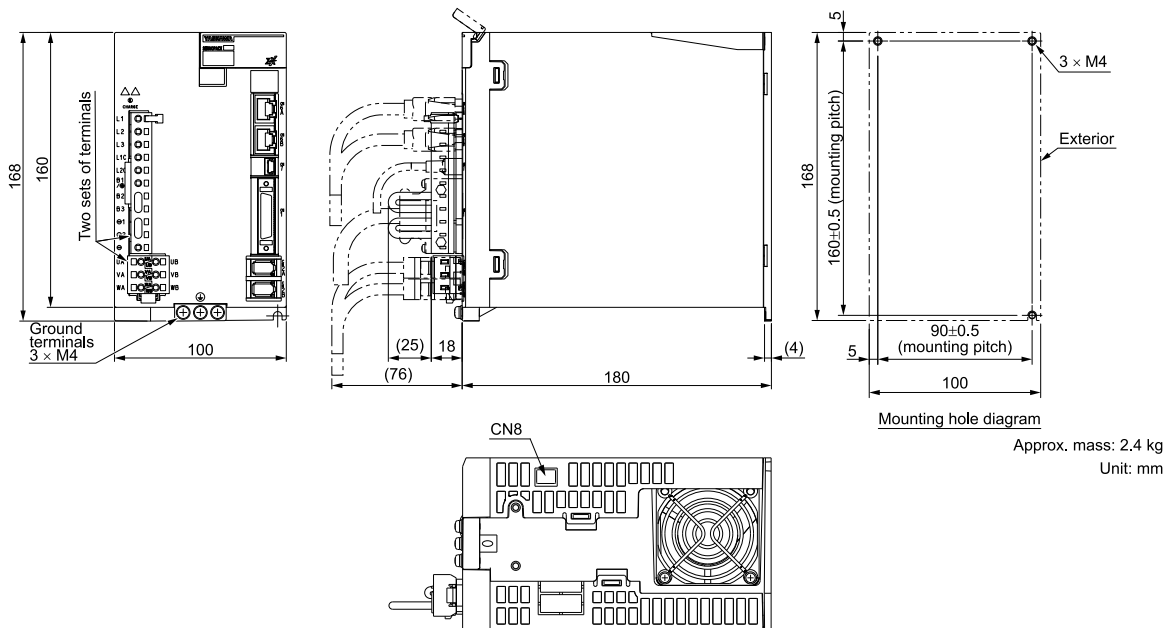
The above connectors or their equivalents are used for the SERVOPACKs.

2.3.2 SERVOPACK External Dimensions

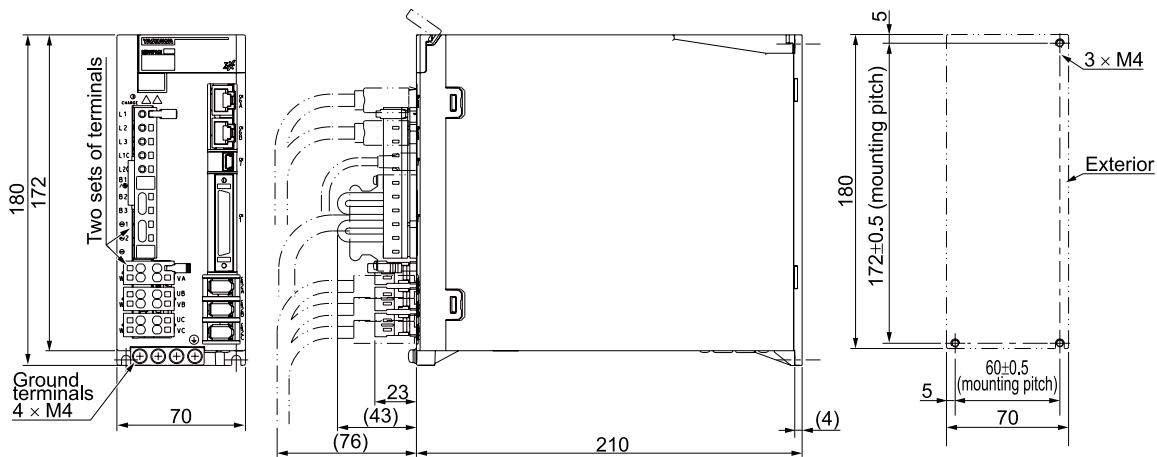
(1) SGDXW-1R6A, 2R8A



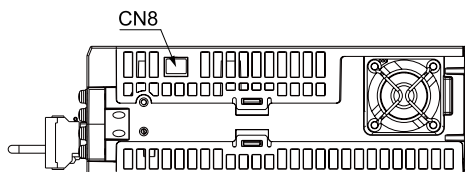
(2) SGDXW-5R5A, 7R6A



(3) SGDXT-1R6A, -2R8A




Mounting hole diagram



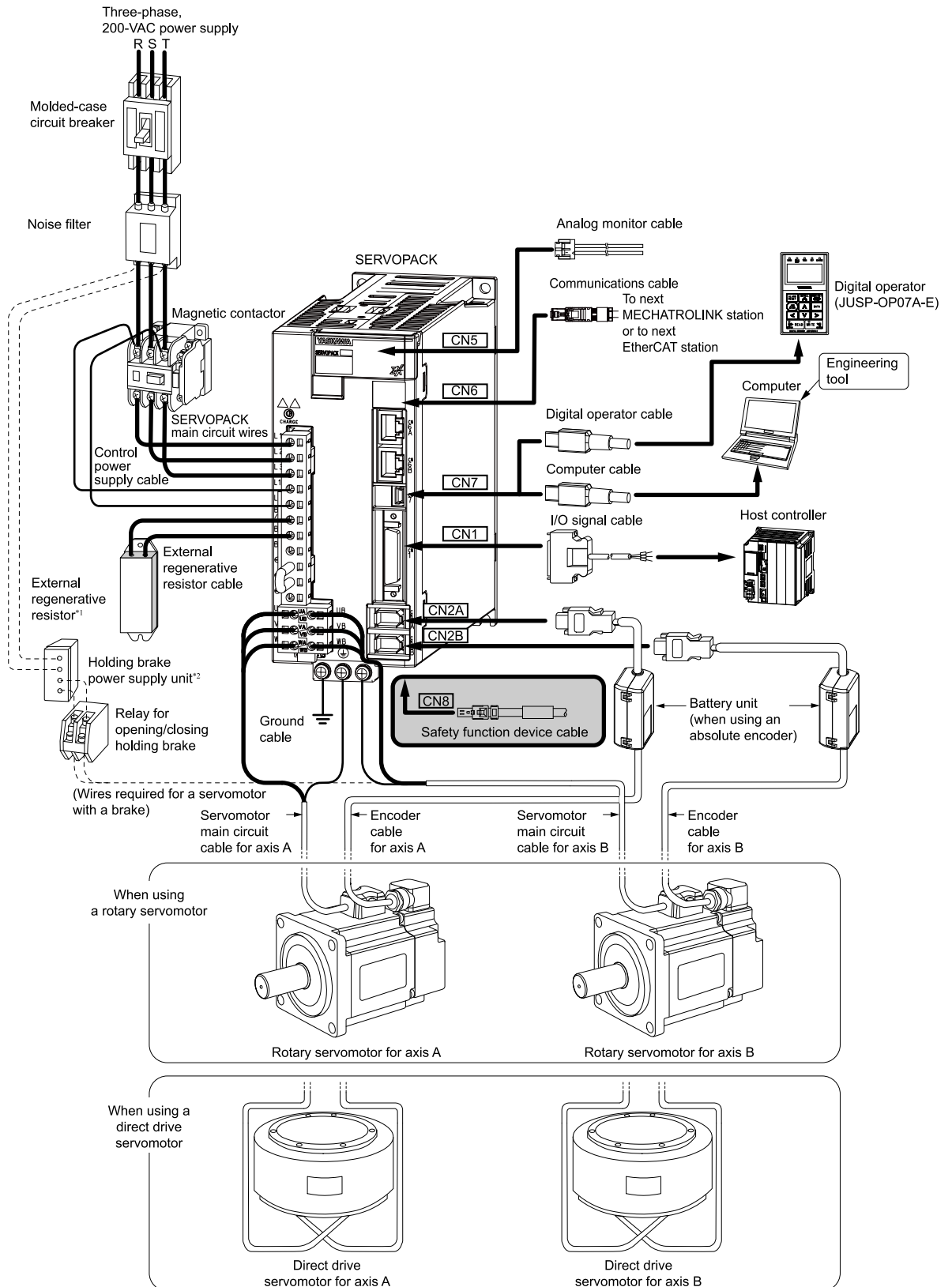
Approx. mass: 2,3 kg
Unit: mm

2.4 Examples of Standard Connections between SERVOPACKs and Peripheral Devices

This section provides connection examples between the SERVOPACK and peripheral devices.  Parts that are indicated by are unique to the SERVOPACKs with the HWBB function.

These explanations use the Σ -XW SERVOPACK as an example. If using the Σ -XT SERVOPACK, also connect the axis C in the same way as the axis A and axis B. Refer to the manual that corresponds to your SERVOPACK for details.

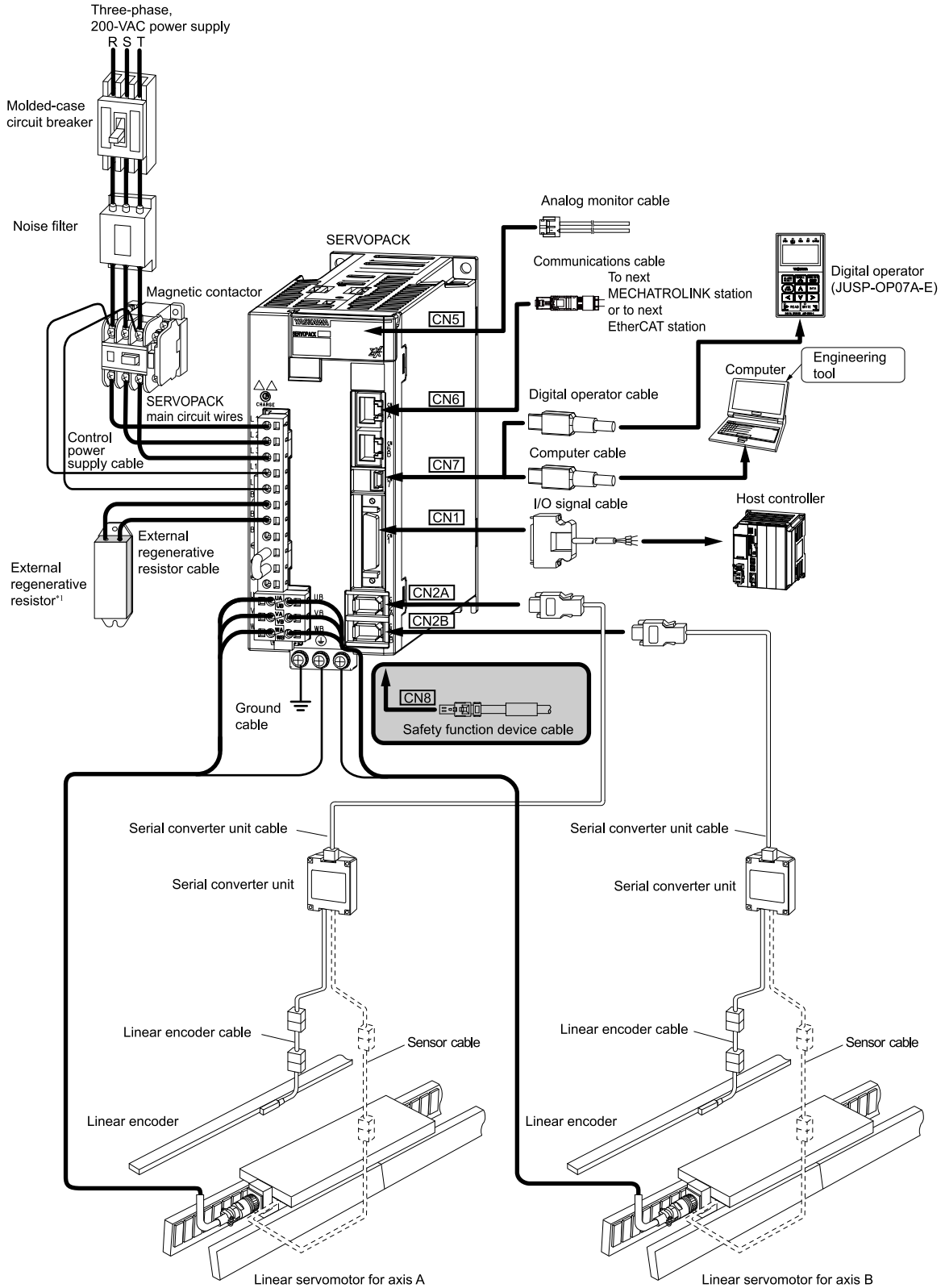
2.4.1 Rotary Servomotor



*1 External regenerative resistors are not provided by Yaskawa.

*2 The power supply for the holding brake is not provided by Yaskawa. Select a power supply based on the holding brake specifications. If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector. If the power supply is shared, the I/O signals may malfunction.

2.4.2 Linear Servomotor



*1 External regenerative resistors are not provided by Yaskawa.

SERVOPACK Installation

This chapter provides the mounting types, orientations, and EMC installation conditions for SERVO-PACKs that have the HWBB function.

3.1	Mounting Types and Orientation	60
3.2	EMC Installation Conditions	61

3.1 Mounting Types and Orientation

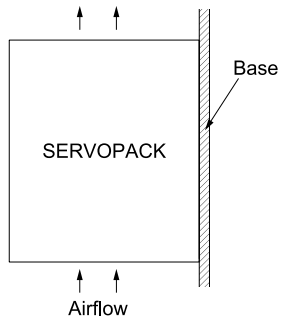
The SERVOPACKs are available in the base-mounted type only. Rack-mounted SERVOPACKs are not available.

Mount the SERVOPACK vertically, as shown in the following figures.

Also, mount the SERVOPACK so that the front panel is facing toward the operator.

Note:

Prepare three or four mounting holes for the SERVOPACK and mount it securely in the mounting holes. (The number of mounting holes depends on the capacity of the SERVOPACK.)



3.2 EMC Installation Conditions

This section gives the installation conditions that were used for EMC certification testing.

The EMC installation conditions that are given here are the conditions that were used to pass testing criteria at Yaskawa. The EMC level may change under other conditions, such as the actual installation structure and wiring conditions. These Yaskawa products are designed to be built into equipment. Therefore, you must implement EMC measures and confirm compliance for the final equipment.



The applicable standards are EN 55011 group 1 class A, EN 61000-6-2, EN 61000-6-4, and EN 61800-3 (category C2, second environment).

WARNING

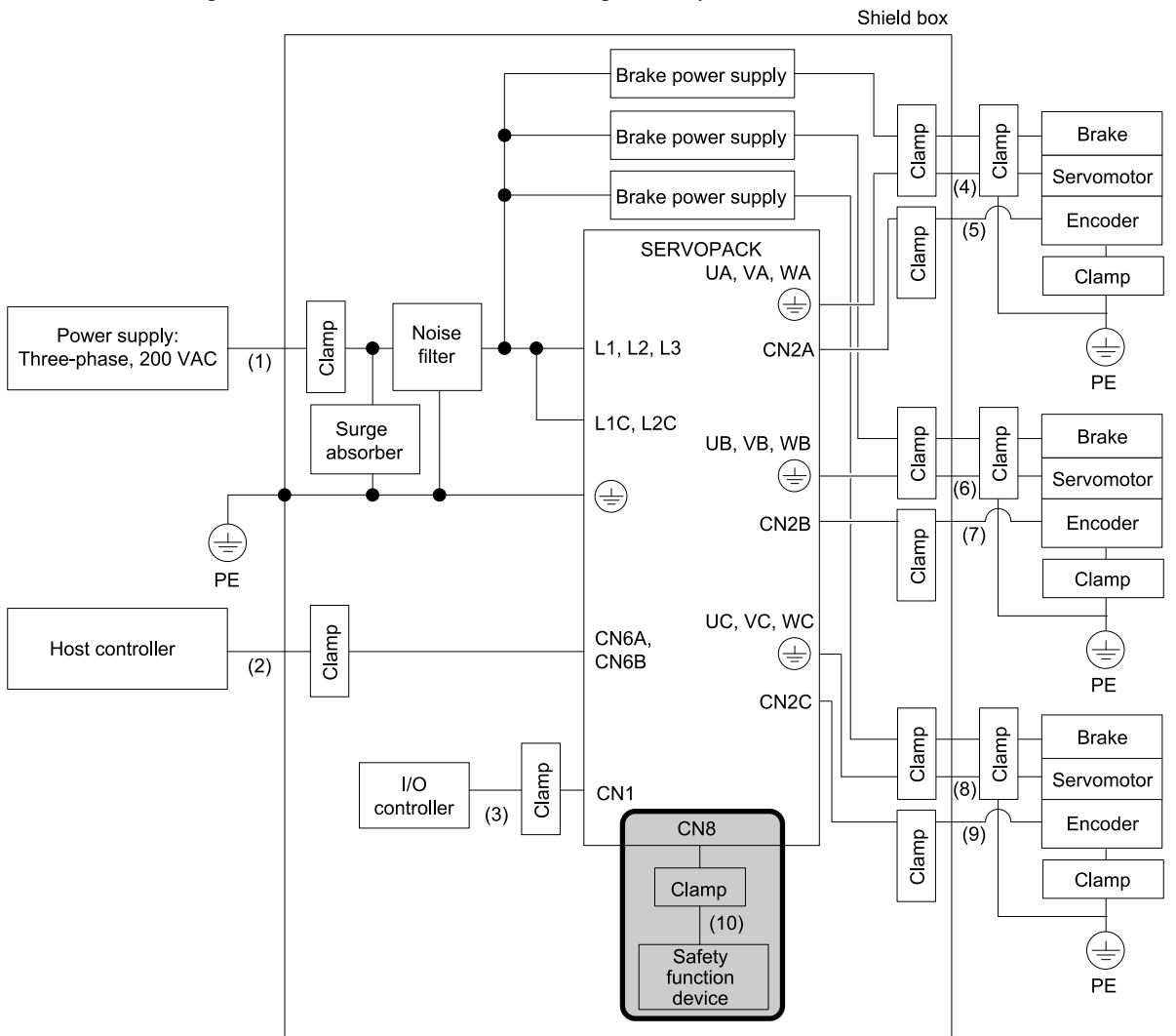
In a domestic environment, this product may cause radio interference in which case supplementary mitigation measures may be required.

CAUTION

This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

 Parts that are indicated by or  are unique to the SERVOPACKs with the HWBB function.

These explanations use the Σ -XT SERVOPACK as an example. If using the Σ -XW SERVOPACK, the wiring for the axis C is not required. Refer to the manual that corresponds to your SERVOPACK for details.



3.2 EMC Installation Conditions

No.	Cable Name	Specification
(1)	Main circuit power cable	Shield wire
(2)	Reference communications cables <ul style="list-style-type: none">• MECHATROLINK-4 cable• MECHATROLINK-III cable• EtherCAT cable	Shield wire
(3)	I/O signal cable	Shield wire
(4)	Servomotor main circuit cable for axis A	Shield wire
(5)	Encoder cable for axis A	Shield wire
(6)	Servomotor main circuit cable for axis B	Shield wire
(7)	Encoder cable for axis B	Shield wire
(8)	Servomotor main circuit cable for axis C	Shield wire
(9)	Encoder cable for axis C	Shield wire
(10)	Safety function device cable	Shield wire

Wiring and Connecting SERVOPACKs

Provides information on wiring and connecting SERVOPACKs to power supplies and peripheral devices.

4.1	Wiring and Connecting SERVOPACKs	64
4.2	Basic Wiring Diagrams	67
4.3	Connecting Safety Function Signals	69
4.3.1	Safety Function Connector (CN8) Pin Arrangement	69
4.3.2	I/O Circuits	69
4.3.3	Diagnostic Output Circuits	70

4.1 Wiring and Connecting SERVOPACKs



DANGER

Do not change any wiring while power is being supplied.

There is a risk of electric shock or injury.



WARNING

Wiring and inspections must be performed only by qualified engineers.

There is a risk of electric shock or product failure.

Check all wiring and power supplies carefully.

Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures. If a short-circuit failure occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident that may result in death or injury. There is also a risk that some parts damaged by the short-circuit failure may fall from the SERVOPACK.

Connect the AC or DC power supplies to the specified SERVOPACK terminals.

- **Connect an AC power supply to the L1, L2, and L3 terminals and the L1C and L2C terminals on the SERVOPACK.**
- **Connect a DC power supply to the B1/⊕ and ⊖ 2 terminals and the L1C and L2C terminals on the SERVOPACK.**

There is a risk of failure or fire.

If you use a SERVOPACK with the dynamic brake hardware option, connect an external dynamic brake resistor that is suitable for the machine and equipment specifications to the specified terminals.

There is a risk of unexpected operation, machine damage, burning, or injury when an emergency stop is performed.



CAUTION

Wait for at least 20 minutes (or 100 minutes when using DC power supply input) after turning OFF the power and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the main circuit terminals while the CHARGE indicator is lit because high voltage may still remain in the SERVOPACK even after turning OFF the power.

There is a risk of electric shock.

Observe the precautions and instructions for wiring and trial operation precisely as described in this document.

Failures caused by incorrect wiring or incorrect voltage application in the brake circuit may cause the SERVOPACK to fail, damage the equipment, or cause an accident resulting in death or injury.

Check the wiring to be sure it has been performed correctly. Connectors and pin layouts are sometimes different for different models. Always confirm the pin layouts in technical documents for your model before operation.

There is a risk of failure or malfunction.

Connect wires to main circuit terminals and motor connection terminals securely with the specified methods and tightening torque.

Insufficient tightening may cause wires and terminal blocks to generate heat due to faulty contact, possibly resulting in fire.

Use shielded twisted-pair cables or screened unshielded multi-twisted-pair cables for I/O signal cables and encoder cables.

! CAUTION

Observe the following precautions when wiring the SERVOPACK's main circuit terminals.

- Turn ON the power to the SERVOPACK only after all wiring, including the main circuit terminals, has been completed.
- If a connector is used for the main circuit terminals, remove the main circuit connector from the SERVOPACK before you wire it.
- Insert only one wire per insertion hole in the main circuit terminals.
- When you insert a wire, make sure that the conductor wire (e.g., whiskers) does not come into contact with adjacent wires and cause a short-circuit.

Install molded-case circuit breakers and other safety measures to provide protection against short circuits in external wiring.

There is a risk of fire or failure.

In places with poor power supply conditions, ensure that the input power is supplied within the specified voltage range.

There is a risk of equipment damage.

Provide sufficient shielding when using the product in the following locations.

- Locations that are subject to noise, such as from static electricity
- Locations that are subject to strong electromagnetic or magnetic fields
- Locations that are subject to radiation
- Locations that are near power lines

There is a risk of equipment damage.

Provide emergency stop circuits, interlock circuits, limit circuits, and any other required safety measures in control circuits outside of the SERVOPACK.

There is a risk of injury or device damage.

If you use MECHATROLINK I/O modules, use the establishment of MECHATROLINK communications as an interlock output condition.

There is a risk of equipment damage.

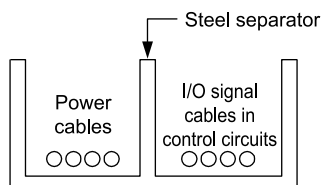
Select the I/O signal wires for external wiring to connect the product to external devices based on the following criteria:

- Mechanical strength
- Noise interference
- Wiring distance
- Signal voltage

Separate the I/O signal cables for control circuits from the power cables both inside and outside the control panel to reduce the influence of noise from the power cables.

If the I/O signal lines and power lines are not separated properly, malfunction may occur.

Example of Separated Cables



NOTICE

Whenever possible, use the cables specified by Yaskawa. If you use any other cables, confirm the rated current and application environment of your model and use the wiring materials specified by Yaskawa or equivalent materials.

Securely tighten connector screws and lock mechanisms.

Insufficient tightening may result in connectors falling off during operation.

NOTICE

Do not bundle power lines (e.g., the main circuit cable) and low-current lines (e.g., the I/O signal cables or encoder cables) together or run them through the same duct. If you do not place power lines and low-current lines in separate ducts, separate them by at least 30 cm.

If the cables are too close to each other, malfunctions may occur due to noise affecting the low-current lines.

Install a battery at either the host controller or on the encoder cable.

If you install batteries both at the host controller and on the encoder cable at the same time, you will create a loop circuit between the batteries, resulting in a risk of damage or burning.

When connecting a battery, connect the polarity correctly.

There is a risk of battery rupture or encoder failure.



Important

- Use a molded-case circuit breaker or fuse to protect the main circuit.
The SERVOPACK connects directly to a commercial power supply; it is not isolated through a transformer or other device. Always use a molded-case circuit breaker or fuse to protect the servo system from accidents involving different power system voltages or other accidents.
- Install an earth leakage breaker.
The SERVOPACK does not have a built-in ground fault protective circuit. To configure a safer system, install a ground fault detector against overloads and short-circuiting, or install a ground fault detector combined with a molded-case circuit breaker.
- Do not turn the power ON and OFF more than necessary.
 - Do not use the SERVOPACK for applications that require the power to be turned ON and OFF frequently. Such applications will cause elements in the SERVOPACK to deteriorate.
 - After you have started actual operation, allow at least one hour between turning the power ON and OFF (as a guideline).


To ensure safe, stable application of the servo system, observe the following precautions when wiring.

- Use the cables specified by Yaskawa. Design and arrange the system so that each cable is as short as possible. Refer to the following manual for information on the specified cables.

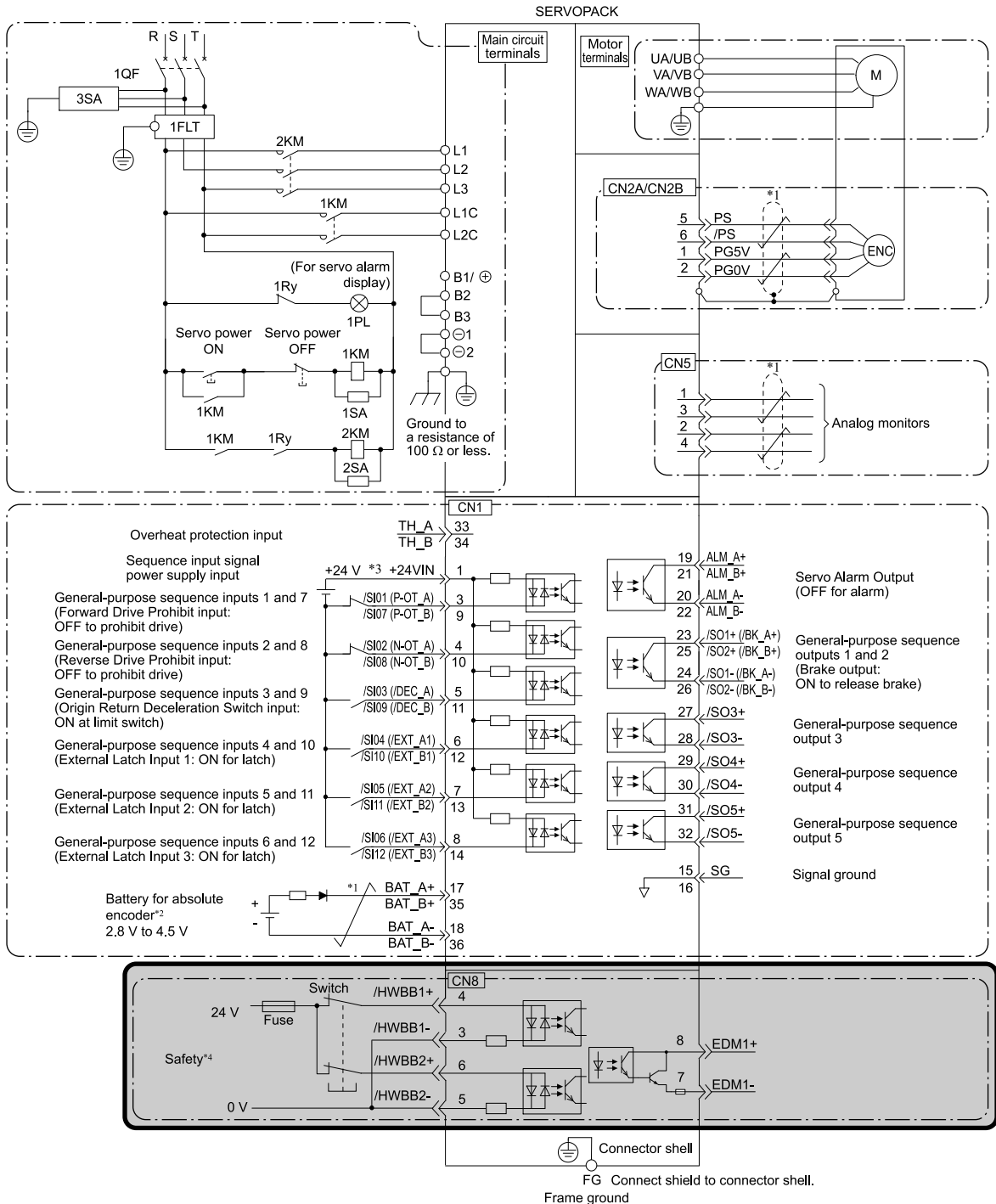
📖 Σ -X-Series Peripheral Device Selection Manual (Manual No.: SIEP C710812 12)



- The signal cable conductors are as thin as 0.2 mm² or 0.3 mm². Do not subject them to excessive bending stress or tension.

4.2 Basic Wiring Diagrams

This section shows the basic wiring diagram for Σ -XW SERVOPACK with MECHATROLINK-4 communications references.  Parts that are indicated by are unique to the SERVOPACKs with the HWBB function.

Information If you are using a SERVOPACK with Σ -XW EtherCAT communications references or a Σ -XT SERVOPACK, refer to the manual for your SERVOPACK for details on parts that are not unique to SERVOPACKs with the HWBB function.



*1  represents twisted-pair wires.
 *2 Connect these when using an absolute encoder. If the encoder cable with a battery unit is connected, do not connect a backup battery. The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
 *3 Refer to the following chapter for details.
 *4  5 Safety Functions on page 71
 If you do not use the safety function, insert the safety jumper connector (provided as an accessory) into CN8 when you use the SERVOPACK.

Wiring and Connecting SERVOPACKs

Note:

1. You can use parameter settings to change some of the I/O signal allocations. Refer to the manual that corresponds to your SERVOPACK for details.
2. If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector. If the power supply is shared, the I/O signals may malfunction.
3. Default settings are given in parentheses.

4.3 Connecting Safety Function Signals

This section describes the wiring required to use a safety function.

Refer to the following chapter for details on the safety function.

 [5 Safety Functions on page 71](#)

4.3.1 Safety Function Connector (CN8) Pin Arrangement

Pin No.	Signal	Name	Function
1	–	– (Do not use these pins because they are connected to internal circuits.)	
2	–		
3	/HWBB1-	Hard Wire Base Block Input 1	For a hard wire base block input. The base block (motor power turned OFF) is in effect when the signal is OFF.
4	/HWBB1+		
5	/HWBB2-	Hard Wire Base Block Input 2	
6	/HWBB2+		
7	EDM1-	External Device Monitor Output	Turns ON when the /HWBB1 and the /HWBB2 signals are input and the SERVOPACK enters a base block state.
8	EDM1+		

Whether or not you use the EDM1 signal does not affect the performance level of safety parameters.

4.3.2 I/O Circuits



Important

For safety function signal connections, the input signal is the 0-V common and the output signal is a source output. This is opposite to other signals described in this manual. To avoid confusion, the ON and OFF status of signals for the Safety Function are defined as follows:

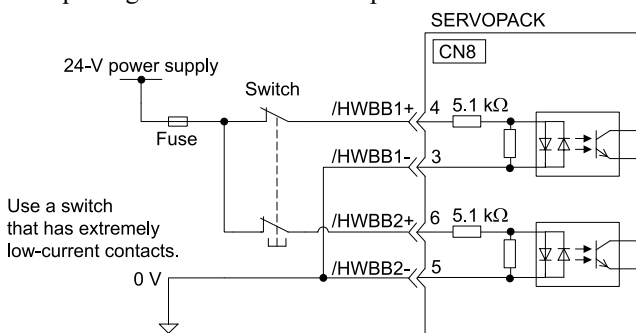
ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

(1) Safety Input Circuits

Use a 0-V common to connect the safety function signals. You must connect redundant input signals.

< Input Signal Connection Example >



(2) Input (HWBB) Signal Specifications

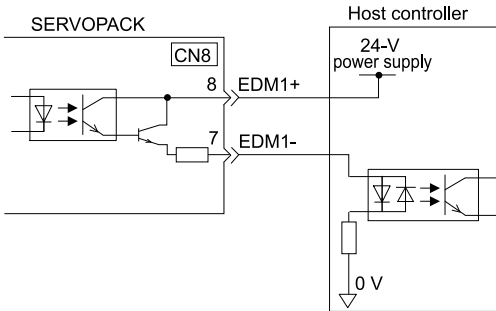
Type	Signal	Connector Pin No.	Status	Meaning
Input	/HWBB1	CN8-4	ON (closed)	Does not activate the HWBB (normal operation).
		CN8-3	OFF (open)	Activates the HWBB (motor current interruption request).
	/HWBB2	CN8-6	ON (closed)	Does not activate the HWBB (normal operation).
		CN8-5	OFF (open)	Activates the HWBB (motor current interruption request).

The input (HWBB) signals have the following electrical characteristics.

Item	Characteristics	Remarks
Internal Impedance	5.1 kΩ	—
Allowable Voltage Range	+24 V ± 20%	For the 24-V power supply, use an SELV power supply.
Response Time	4 ms	Time from /HWBB1 and /HWBB2 signals turning OFF until HWBB is activated

4.3.3 Diagnostic Output Circuits

The EDM1 output signal uses a source circuit. The following figure shows a connection example.



(1) EDM1 Output Signal Specifications

Type	Signal	Connector Pin No.	Status	Meaning
Output	EDM1	CN8-8	ON	Both the /HWBB1 and /HWBB2 signals are operating normally.
		CN8-7	OFF	The /HWBB1 signal, the /HWBB2 signal, or both are not operating.

The electrical characteristics of the EDM1 signal are as follows:

Item	Characteristics	Remarks
Maximum Allowable Voltage	30 VDC	—
Maximum Allowable Current	50 mA DC	—
Maximum ON Voltage Drop	1.0 V	Voltage between EDM1+ and EDM1- when current is 50 mA
Response Time	4 ms	Time from a change in /HWBB1 or /HWBB2 until a change in EDM1

Safety Functions

This chapter provides detailed information on the safety functions of the SERVOPACK.

5.1	Introduction to the Safety Functions	73
5.1.1	Safety Functions.....	73
5.1.2	Precautions for Safety Functions.....	73
5.2	Hard Wire Base Block (HWBB)	74
5.2.1	Risk Assessment.....	74
5.2.2	SERVOPACK with MECHATROLINK Communications References: Hard Wire Base Block (HWBB) State.....	75
5.2.3	SERVOPACK with MECHATROLINK Communications References: Resetting the HWBB State.....	76
5.2.4	SERVOPACK with MECHATROLINK Communications References: Related Commands.....	77
5.2.5	SERVOPACK with EtherCAT Communications References: Hard Wire Base Block (HWBB) State.....	78
5.2.6	SERVOPACK with EtherCAT Communications References: Resetting the HWBB State	79
5.2.7	Detecting Errors in HWBB Signal	82
5.2.8	HWBB Input Signal Specifications	82
5.2.9	HWBB Input Signal Waveform Trace.....	83
5.2.10	Operation without a Host Controller	83
5.2.11	/S-RDY (Servo Ready Output) Signal	83
5.2.12	/BK (Brake Output) Signal	84
5.2.13	Stopping Methods	84
5.2.14	ALM (Servo Alarm) Signal	85
5.3	EDM1 (External Device Monitor).....	86
5.3.1	EDM1 Output Signal Specifications	86
5.4	Applications Examples for Safety Functions.....	87
5.4.1	Connection Example.....	87
5.4.2	Failure Detection Method	87
5.4.3	Procedure.....	88
5.5	Validating Safety Functions.....	89

5.1 Introduction to the Safety Functions

5.1.1 Safety Functions

Safety functions are built into the SERVOPACK to reduce the risks associated with using the machine by protecting workers from the hazards of moving machine parts and otherwise increasing the safety of machine operation. Especially when working in hazardous areas inside guards, such as for machine maintenance, the safety function can be used to avoid hazardous moving machine parts.

Refer to the following section for information on the safety function and safety parameters.

 [i.7 Compliance with UL Standards and EU Directives on page 32](#)



Important

Products that display the TÜV mark on the nameplate have met the safety standards.

5.1.2 Precautions for Safety Functions

WARNING

To confirm that the HWBB function satisfies the safety requirements of the system, you must conduct a risk assessment of the system.

Incorrect use of the Safety Function may cause injury.

The servomotor will move if there is an external force (e.g., gravity on a vertical axis) even when the HWBB function is operating. Use a separate means, such as a mechanical brake, that satisfies the safety requirements.

Incorrect use of the Safety Function may cause injury.

While the HWBB function is operating, the motor may move within an electric angle of 180° or less as a result of a SERVOPACK failure. Use the HWBB function for an application only after confirming that movement of the motor will not result in a hazardous condition.

Incorrect use of the Safety Function may cause injury.

The dynamic brake and the brake signal are not safety-related elements. You must design the system so that SERVOPACK failures will not cause a hazardous condition while the HWBB function is operating.

Incorrect use of the Safety Function may cause injury.

Connect devices that satisfy the safety standards for the signals for Safety Functions.

Incorrect use of the Safety Function may cause injury.

The HWBB function does not shut OFF the power to the SERVOPACK or electrically isolate it. Implement measures to shut OFF the power to the SERVOPACK before you perform maintenance on it.

There is a risk of electric shock.

5.2 Hard Wire Base Block (HWBB)

A hard wire base block (abbreviated as HWBB) is a safety function that is designed to shut OFF the current to the servomotor with a hardwired circuit.

The drive signals to the power module that controls the motor current are controlled by the circuits that are independently connected to the two input signal channels to turn OFF the power module and shut OFF the motor current.

The current to the motors is simultaneously shut off for all axes. You cannot shut off the current to the motor for just one axis.



Important

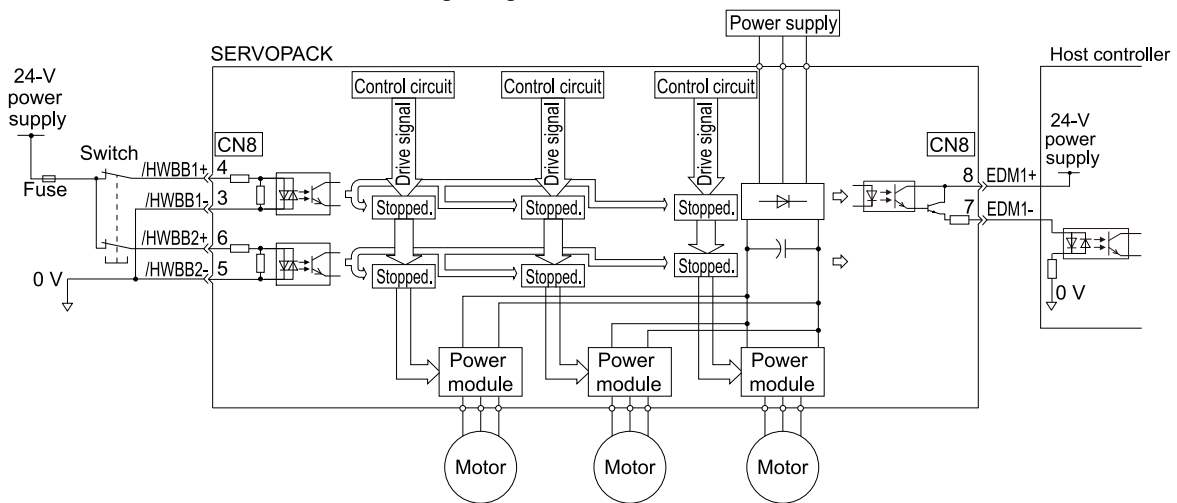
• Connect the safety function input signals (/HWBB1 and /HWBB2) as sink inputs when viewed from the SERVOPACK side. Make the connections this way because a safe failure will occur if the /HWBB1 and /HWBB2 signals are connected to 0 V. This differs from the wiring example for other input signals described in this manual.

The ON and OFF status of signals for the safety function are also defined as follows:

- ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.
- OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

• For the 24-V power supply, use an SELV power supply.

A Σ -XT SERVOPACK connection example is provided below.



Whether or not you use the EDM1 signal does not affect the performance level of safety parameters.

You can use the EDM1 signal if the system requires it, such as when a Σ -XW/ Σ -XT SERVOPACK is replacing a Σ -7 SERVOPACK in the system.

5.2.1 Risk Assessment

When using the HWBB, you must perform a risk assessment of the servo system in advance to confirm that the safety level of the standards is satisfied. Refer to the following section for details on the standards.

[i.7 Compliance with UL Standards and EU Directives on page 32](#)

The following hazards exist even when the HWBB is operating. These hazards must be included in the risk assessment.

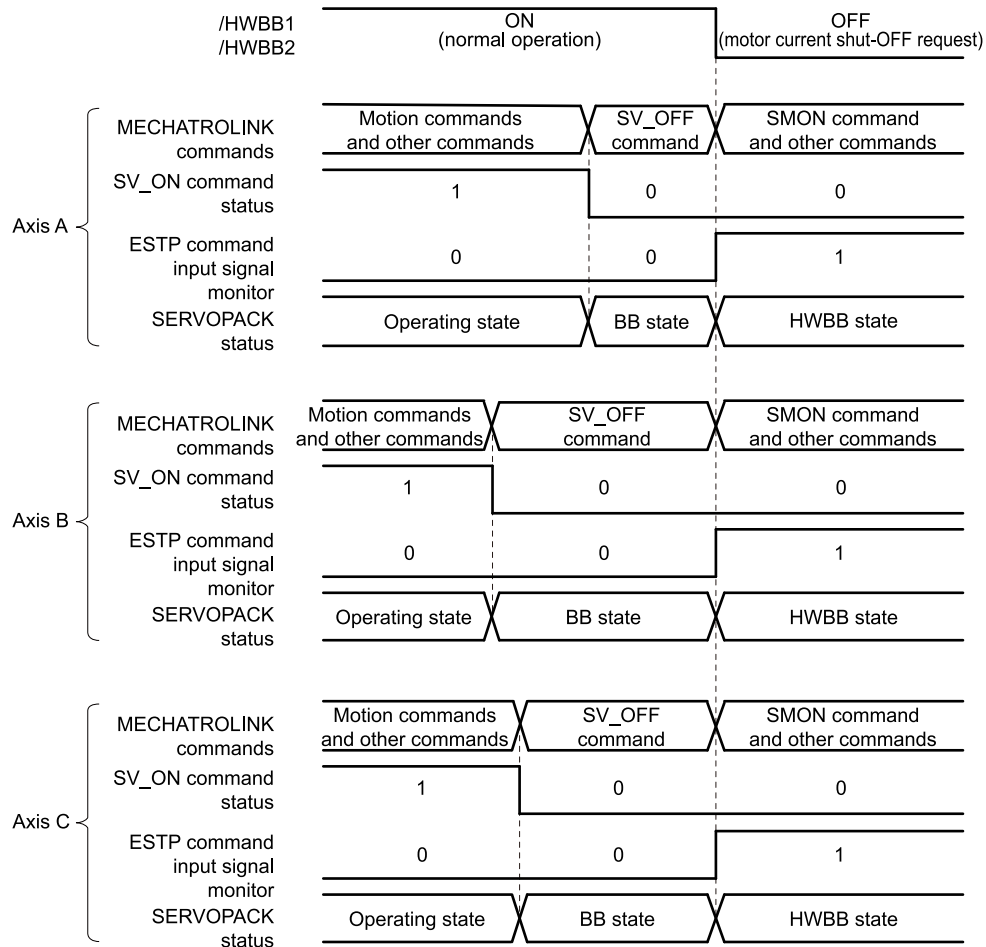
- The servomotor will move if an external force is applied to it (for example, gravity on a vertical axis). Implement measures to hold the servomotor, such as installing a separate mechanical brake.
- If a failure occurs such as a power module failure, the servomotor may move within an electric angle of 180°. Ensure safety even if the servomotor moves.
The rotational angle or travel distance depends on the type of servomotor as follows:
 - Rotary servomotor: 1/6 rotation max. (rotational angle calculated at the motor shaft)
 - Direct drive servomotor: 1/20 rotation max. (rotational angle calculated at the motor shaft)
 - Linear servomotor: 50 mm max.
- The HWBB does not shut OFF the power to the SERVOPACK or electrically isolate it. Implement measures to shut OFF the power to the SERVOPACK before you perform maintenance on it.
- The HWBB function of a Σ -XW/ Σ -XT SERVOPACK shuts off the current to the motors for all axes at the same time. You cannot shut off the current to the motor for just one axis. Build the system so that a hazardous condition will not result if the current to the motors for all axes is shut off.

5.2.2 SERVOPACK with MECHATROLINK Communications References: Hard Wire Base Block (HWBB) State

The SERVOPACK will be in the following state if the HWBB operates. If the /HWBB1 or /HWBB2 signal turns OFF, the HWBB will operate and the SERVOPACK will enter a HWBB state.

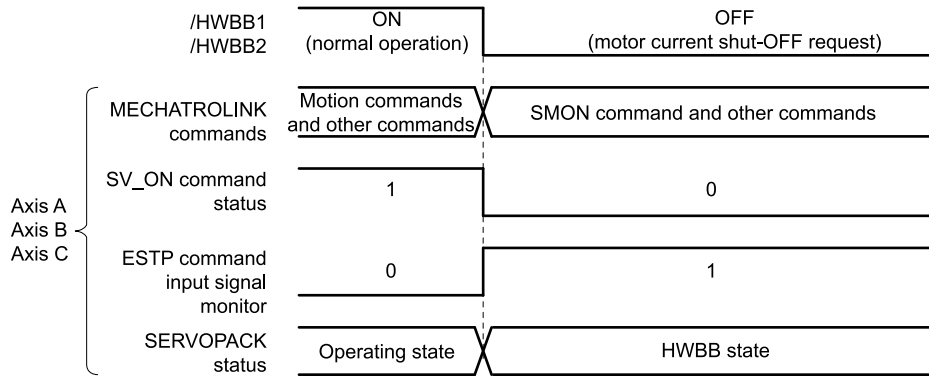
Information These explanations use the Σ -XT SERVOPACK as an example. If using the Σ -XW SERVOPACK, skip the information about the axis C when checking.

- **When HWBB Function Operates after Servo OFF (Power Not Supplied to Motor)**



• **When HWBB Function Operates While Power Is Supplied to Servomotor**

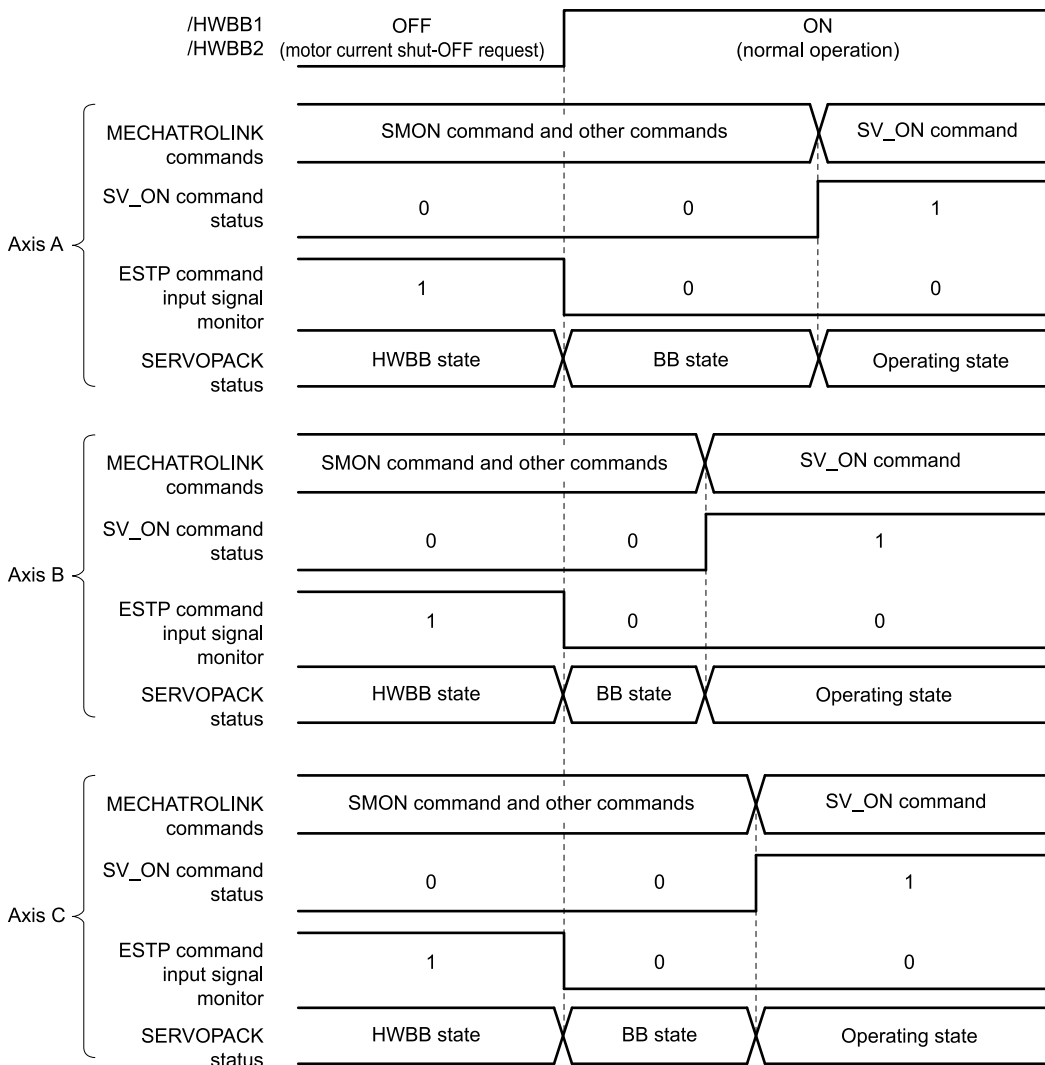
Operation is identical for all axes.



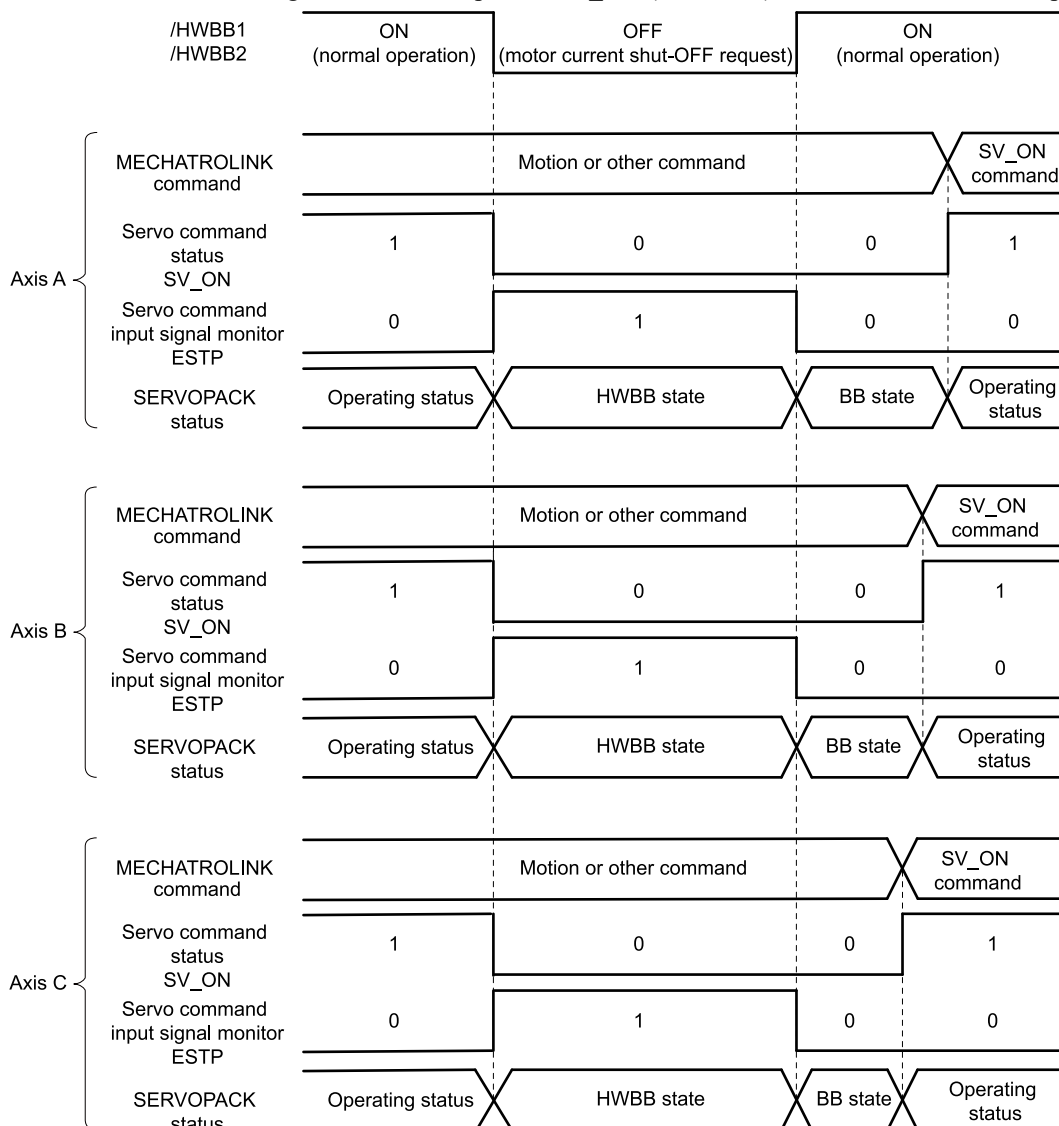
5.2.3 SERVOPACK with MECHATROLINK Communications References: Resetting the HWBB State

Normally, after the SV_OFF (Servo OFF) command is sent and power is no longer supplied to the servomotor, the /HWBB1 and /HWBB2 signals will turn OFF and the SERVOPACK will enter the HWBB state. If you turn ON the /HWBB1 and /HWBB2 signals in this state, the SERVOPACK will enter a base block (BB) state and will be ready to acknowledge the SV_ON (Servo ON) command.

Information These explanations use the Σ -XT SERVOPACK as an example. If using the Σ -XW SERVOPACK, skip the information about the axis C when checking.



If the SERVOPACK entered the HWBB state while power was supplied to the servomotor, first turn ON the /HWBB1 and /HWBB2 signals, and then input the SV_ON (Servo ON) command to restore the operating status.



If the SERVOPACK entered the HWBB state while sending the SV_ON command, first turn ON the /HWBB1 and /HWBB2 signals, send a command other than the SV_ON command (e.g., SV_OFF (Servo OFF)), and then send the SV_ON command again to restore the operating status.

5.2.4 SERVOPACK with MECHATROLINK Communications References: Related Commands

If the /HWBB1 or /HWBB2 signal turns OFF and the HWBB operates, the ESTP bit in the MECHATROLINK command SVCMD_IN */ will change to 1. The host controller can monitor this bit to determine the status.

*1 Field name of MECHATROLINK-4 communications. SVCMD_IO for MECHATROLINK-III communications.

If the state changes to the HWBB state during the execution of the next motion command, a command warning occurs. If a warning occurs, clear the alarm to return to normal operating status. Using the sequence of commands to return to the HWBB status after stopping or canceling the motion command is recommended.

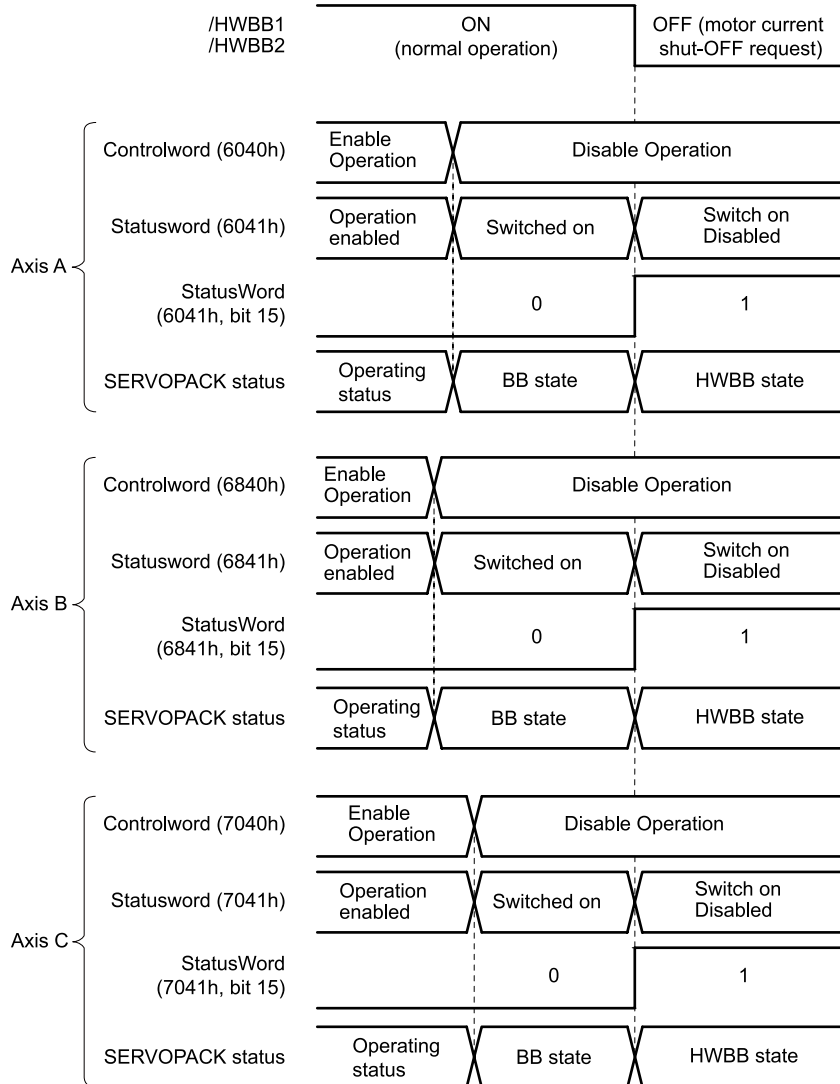
Applicable Motion Commands
SV_ON (Servo ON)
INTERPOLATE (Interpolating)
POSING (Positioning)
FEED (Constant Speed Feed)
EX_FEED (External Input Feed Command)
EX_POSING (External Input Positioning)
ZRET (Origin Return)

5.2.5 SERVOPACK with EtherCAT Communications References: Hard Wire Base Block (HWBB) State

The SERVOPACK will be in the following state if the HWBB operates. If the /HWBB1 or /HWBB2 signal turns OFF, the HWBB will operate and the SERVOPACK will enter a HWBB state.

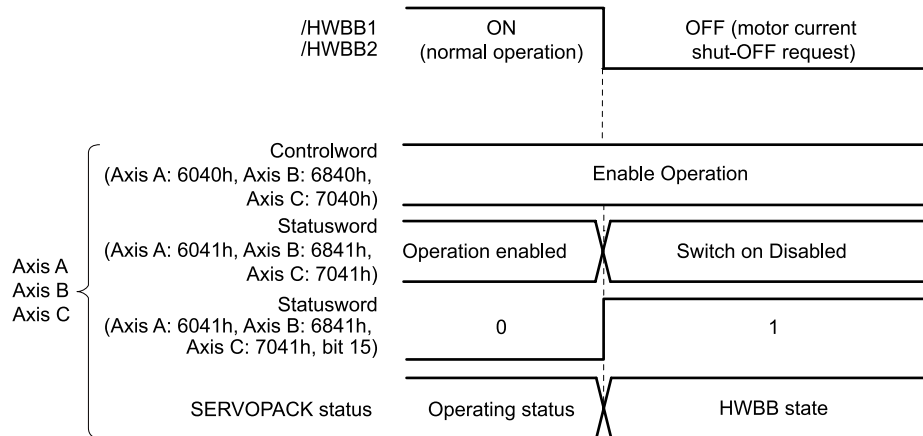
Information These explanations use the Σ -XT SERVOPACK as an example. If using the Σ -XW SERVOPACK, skip the information about the axis C when checking.

- **When HWBB Function Operates after Servo OFF (Power Not Supplied to Motor)**



- **When HWBB Function Operates While Power Is Supplied to Servomotor**

Operation is identical for all axes.



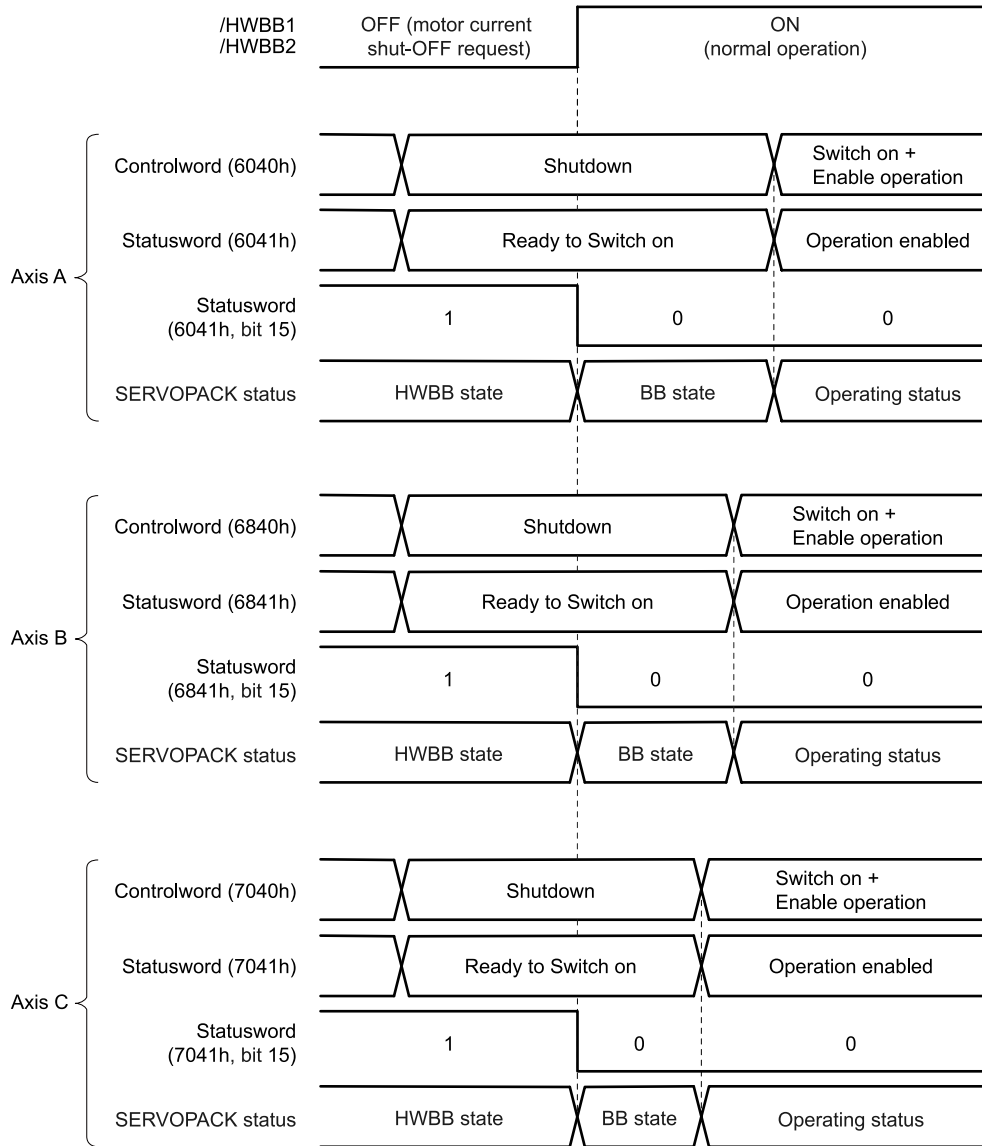
5.2.6 SERVOPACK with EtherCAT Communications References: Resetting the HWBB State

(1) Transition Diagrams

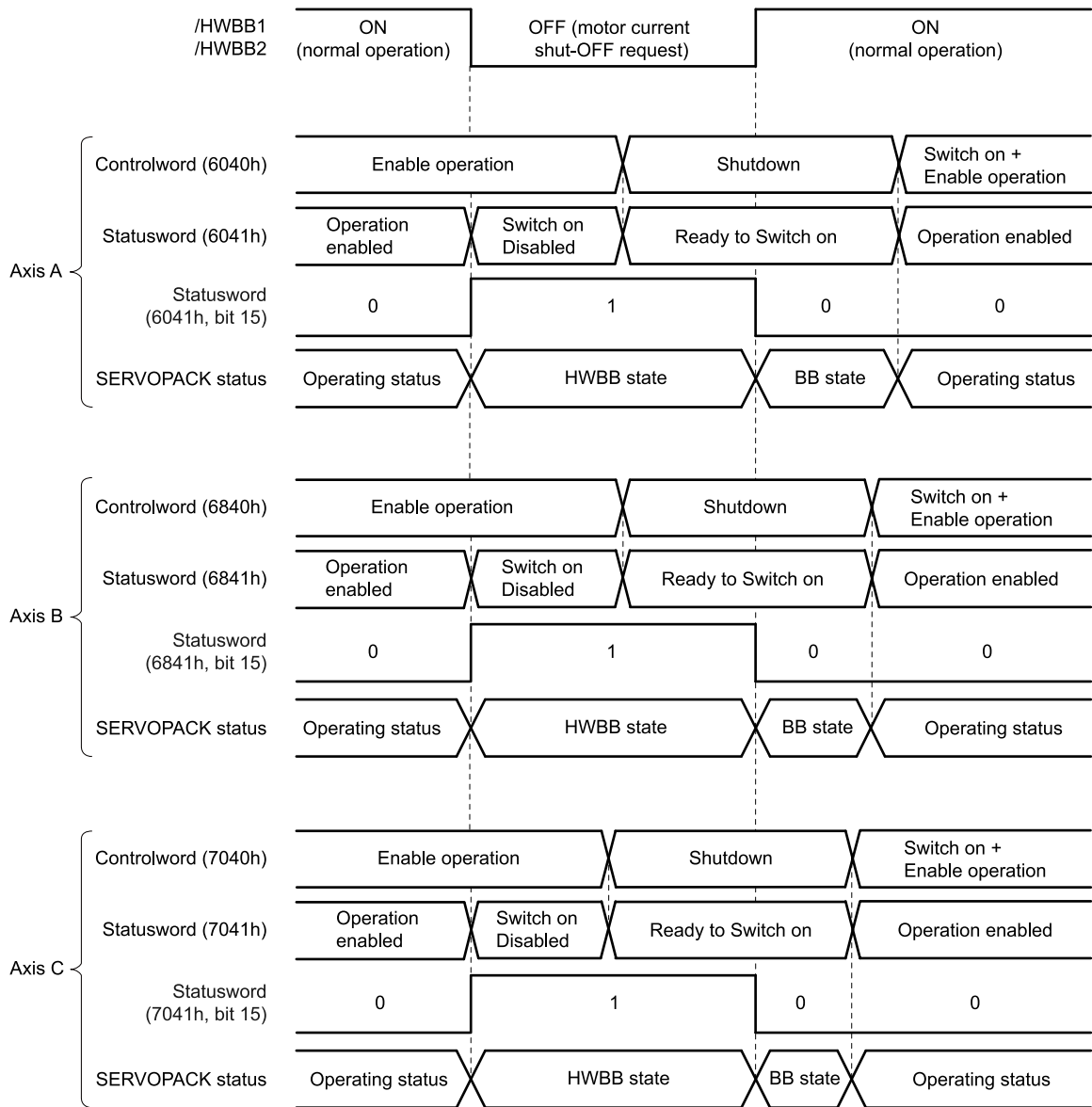
Normally, after the Shutdown command is sent and power is no longer supplied to the servomotor, the /HWBB1 and /HWBB2 signals will turn OFF and the SERVOPACK will enter the HWBB state. If you turn ON the /HWBB1 and /HWBB2 signals in this state, the SERVOPACK will enter a base block (BB) state and will be ready to acknowledge the Servo ON command (Enable Operation command).

Information These explanations use the Σ -XT SERVOPACK as an example. If using the Σ -XW SERVOPACK, skip the information about the axis C when checking.

5.2 Hard Wire Base Block (HWBB)



If the SERVOPACK entered the HWBB state while power was supplied to the servomotor, first turn ON the /HWBB1 and /HWBB2 signals, and then input the Servo ON (Enable Operation command) command to restore the operating status.



If the SERVOPACK entered the HWBB state while sending the Enable Operation command, first send the Shutdown command, and then send the Switch ON and Servo ON commands to restore the operating status.

(2) Recovery Conditions

All of the following conditions must be met.

- All safety request inputs are ON.
- The Servo ON command (Enable Operation command) was not sent.
- None of the following utility functions have been executed. (These functions execute the Servo ON command (Enable Operation command).)

The following utility functions execute the Servo ON command (Enable Operation command).

Utility Function No.	Function Name
Fn002	Jog
Fn003	Origin Search
Fn004	Program JOG Operation
Fn00E	Autotune Motor Current Detection Signal Offset
Fn080	Polarity Detection

Continued on next page.

Utility Function No.	Function Name
Fn201	Advanced Autotuning without Reference
Fn206	Easy FFT

Note:

If any of the above utility functions was executed, the utility function must be ended. Perform the operation to return to the Main Menu for the utility functions on the digital operator. Refer to the following manual for operating procedures.

📖 Σ -7/ Σ -X-Series Digital Operator Operating Manual (Manual No.: SIEP S80001 33)

(3) Recovery Procedure

Information These explanations use the Σ -XT SERVOPACK as an example. If using the Σ -XW SERVOPACK, skip the information about the axis C when checking.

1. Specify Shutdown in controlword to reset the servo drive.

The objects for setting references are as follows.

- Axis A: 6040h, bits 0 to 3
- Axis B: 6840h, bits 0 to 3
- Axis C: 7040h, bits 0 to 3

2. Specify Switch ON and the Servo ON command (Enable Operation command) in controlword.

The objects for setting references are identical to step 1.

Power is supplied to the servomotor.

5.2.7 Detecting Errors in HWBB Signal

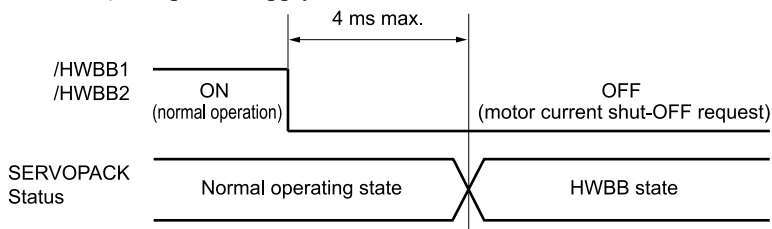
If only the /HWBB1 or the /HWBB2 signal is input, an A.Eb1 alarm (Safety Function Signal Input Timing Error) will occur unless the other signal is input within 10 seconds. This makes it possible to detect failures, such as disconnection of an HWBB signal. If the A.Eb1 alarm occurs, check the wiring.

⚠ CAUTION

The A.Eb1 alarm (Safety Function Signal Input Timing Error) is not a safety-related element. Keep this in mind when you design the system.

5.2.8 HWBB Input Signal Specifications

If an HWBB function is requested by turning OFF the two HWBB input signal channels (/HWBB1 and /HWBB2), the power supply to the servomotors for all axes will be turned OFF within 4 ms.

**Note:**

- The OFF status is not recognized if the OFF interval of the /HWBB1 or /HWBB2 signal is 0.5 ms or shorter. However, in certain situations, such as when you input test pulses and you do not want the HWBB function to respond, make the interval between OFF intervals (i.e., the ON interval) 0.5 ms or longer. The reason for this is that the OFF status may be recognized if a signal repeatedly turns OFF even though the OFF interval is 0.5 ms or shorter.
- You can check the status of the input signals by using monitor displays.

5.2.9 HWBB Input Signal Waveform Trace

You can trace the following input signals with the I/O trace function of the SigmaWin+.

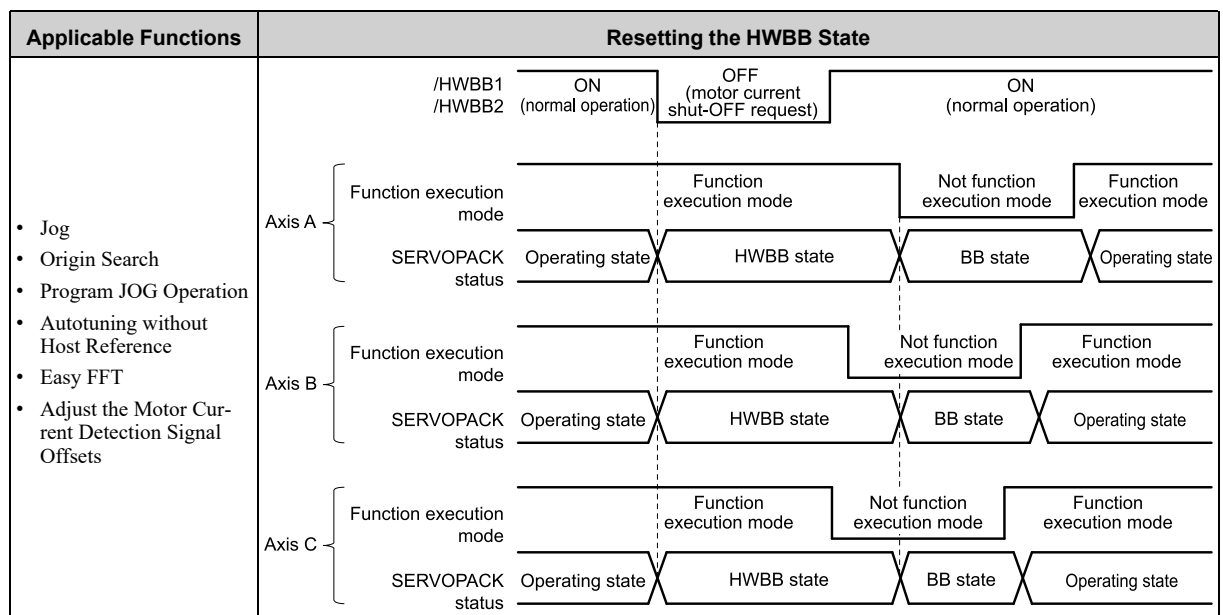
- /HWBB1 (Hard Wire Base Block Input 1) signal
- /HWBB2 (Hard Wire Base Block Input 2) signal

5.2.10 Operation without a Host Controller

The HWBB will operate even for operation without a host controller.

However, if the HWBB function operates during execution of the following functions, leave the execution mode for the function for all axes and then enter it again to restart operation. Operation will not be restarted simply by turning ON the /HWBB1 and /HWBB2 signals. All axes enter the BB state as soon as they leave the execution mode for the function.

Information These explanations use the Σ -XT SERVOPACK as an example. If using the Σ -XW SERVOPACK, skip the information about the axis C when checking.



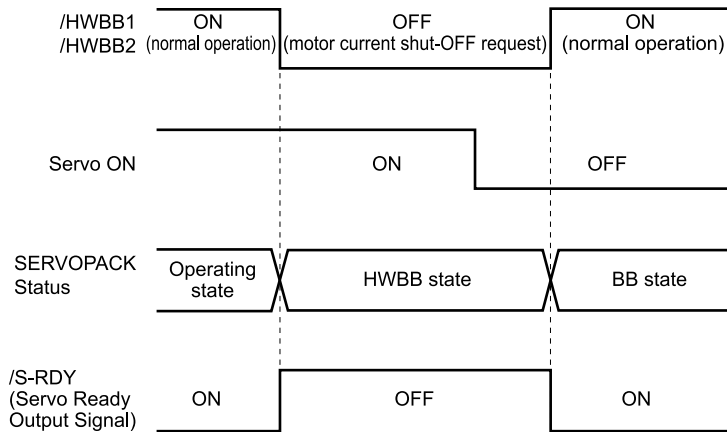
5.2.11 /S-RDY (Servo Ready Output) Signal

The SV_ON (Servo ON) command will not be acknowledged in the HWBB state. Therefore, the Servo Ready Output signal will turn OFF. The Servo Ready Output Signal will turn ON if both the /HWBB1 and /HWBB2 signals are ON and the servo is turned OFF (BB state).

Information These explanations use the Σ -XT SERVOPACK as an example. If using the Σ -XW SERVOPACK, skip the information about the axis C when checking.

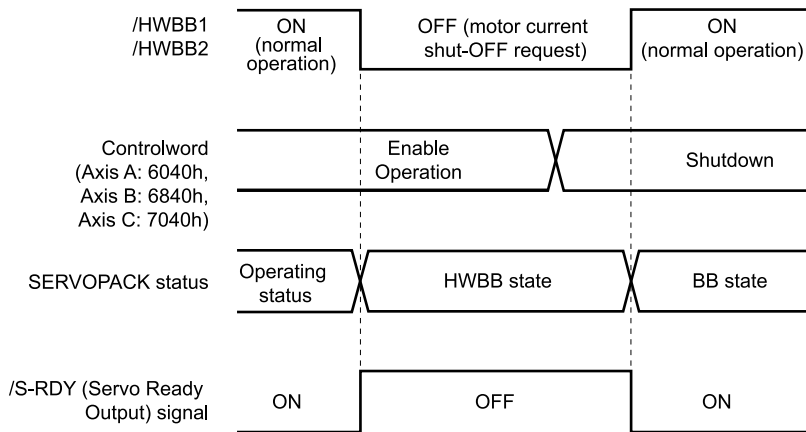
• **SERVOPACK with MECHATROLINK communications references**

An example is provided below for when the main circuit power is ON and the SENS_ON (Turn Sensor ON) command is input when there is no servo alarm. (An absolute encoder is used in this example.) Operation is identical for all axes.



• **SERVOPACK with EtherCAT communications references**

Operation is identical for all axes.



5.2.12 /BK (Brake Output) Signal

If the HWBB operates when the /HWBB1 or /HWBB2 signal is OFF, the /BK (Brake) signal will turn OFF. At that time, the setting in Pn506 (Brake Reference - Servo OFF Delay Time) will be disabled. Therefore, the servomotor may be moved by external force until the actual brake becomes effective after the /BK signal turns OFF.

CAUTION

The brake signal is not a safety-related element. You must design the system so that a hazardous condition does not occur even if the brake signal fails in the HWBB state. Also, if a servomotor with a brake is used, keep in mind that the brake in the servomotor is used only to prevent the moving part from being moved by gravity or an external force and it cannot be used to stop the servomotor.

5.2.13 Stopping Methods

If the /HWBB1 or /HWBB2 signal turns OFF and the HWBB operates, the servomotor will stop according to the stop mode that is set for Pn001 = n.□□□X (Motor Stopping Method for Servo OFF). However, if you set Pn001 = n.□□□0 or n.□□□1 (stop the motor by applying the dynamic brake), observe the following precautions.



CAUTION

The dynamic brake is not a safety-related element. You must design the system so that a hazardous condition does not occur even if the servomotor coasts to a stop in the HWBB state. Normally, we recommend that you use a sequence that returns to the HWBB state after stopping for a reference.

If the application frequently uses the HWBB, stopping with the dynamic brake may result in the deterioration of elements in the SERVOPACK. To prevent internal elements from deteriorating, use a sequence in which the HWBB state is returned to after the servomotor has come to a stop.

5.2.14 ALM (Servo Alarm) Signal

The ALM (Servo Alarm) signal is not output in the HWBB state.

5.3 EDM1 (External Device Monitor)

The EDM1 (External Device Monitor) signal is used to monitor failures in the HWBB. Connect the monitor signal as a feedback signal, e.g., to the safety unit.

Whether or not you use the EDM1 signal does not affect the performance level of safety parameters.

You can use the EDM1 signal if the system requires it, such as when a Σ -XW SERVOPACK is replacing a Σ -7 SERVOPACK in the system.

- Failure Detection Signal for EDM1 Signal

The relationship between the EDM1, /HWBB1, and /HWBB2 signals is shown below.

Detection of failures in the EDM1 signal circuit can be achieved by using the status of the /HWBB1, /HWBB2, and EDM1 signals in the following table. A failure can be detected by checking the failure status, e.g., when the power is turned ON.

Signal	Logic			
/HWBB1	ON	ON	OFF	OFF
/HWBB2	ON	OFF	ON	OFF
EDM1	OFF	OFF	OFF	ON

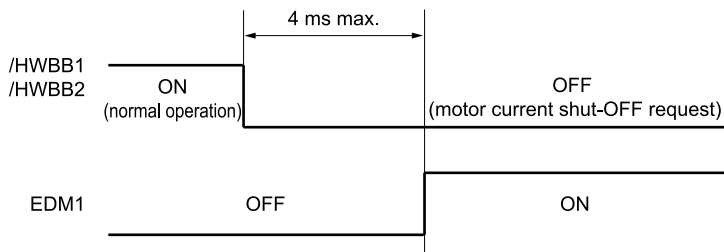


WARNING

The EDM1 signal is not a safety output. Use it only for monitoring for failures.

5.3.1 EDM1 Output Signal Specifications

If an HWBB is requested by turning OFF the two HWBB input signal channels (/HWBB1 and /HWBB2) when the safety function is operating normally, the EDM1 output signal will be turned ON within 4 ms.

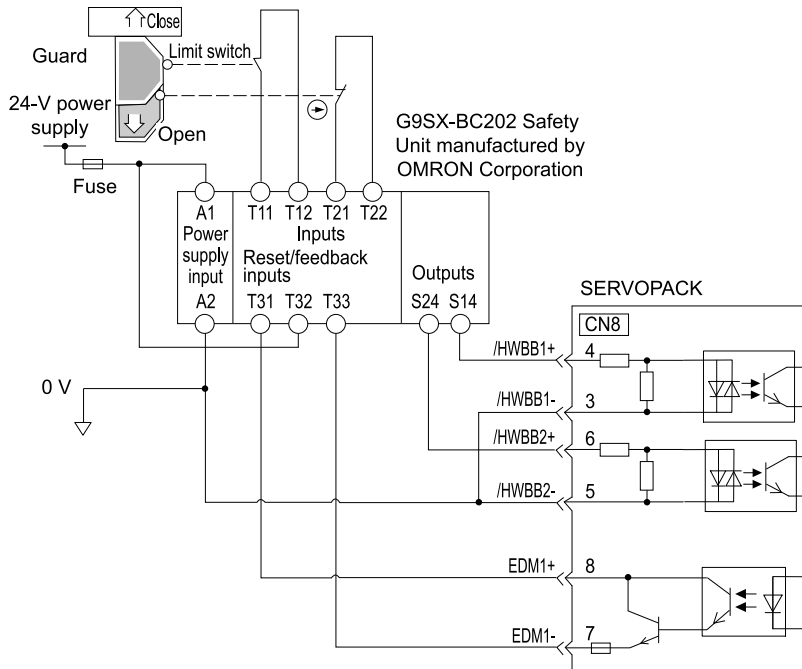


5.4 Applications Examples for Safety Functions

This section provides examples of using the safety functions.

5.4.1 Connection Example

In the following example, a safety unit is used and the HWBB operates when the guard is opened.



When the guard is opened, both the /HWBB1 and /HWBB2 signals turn OFF and the EDM1 signal turns ON, and this turns ON the feedback inputs and resets the safety unit. When the guard is closed from this state, the /HWBB1 and /HWBB2 signals turn ON and the SERVOPACK can be reset from the HWBB state.

Note:

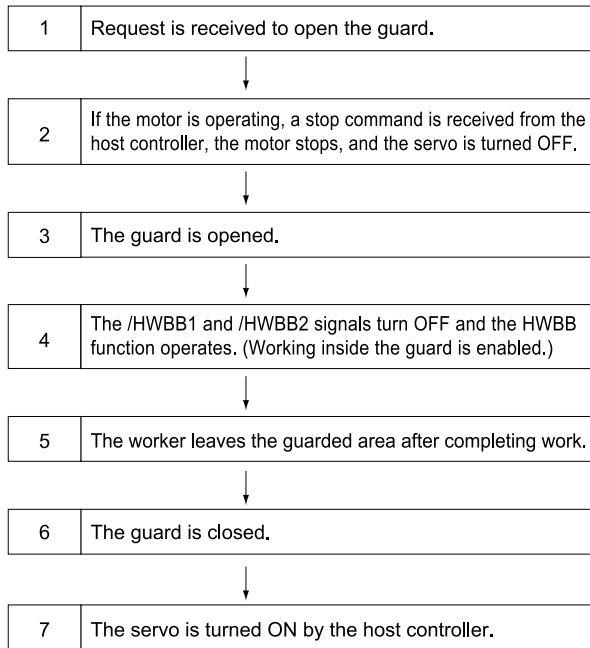
The EDM1 signal is used as a source output. Connect the EDM1 so that the current flows from EDM1+ to EDM1-.

5.4.2 Failure Detection Method

If a failure occurs (e.g., the /HWBB1 or the /HWBB2 signal remains ON), the safety unit is not reset when the guard is closed because the EDM1 signal remains OFF. Therefore starting is not possible and an error is detected.

In this case the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the SERVOPACK. Find the cause and correct the problem.

5.4.3 Procedure



5.5 Validating Safety Functions

When you commission the system or perform maintenance or SERVOPACK replacement, you must always perform the following validation test on the HWBB function after completing the wiring. (It is recommended that you keep the confirmation results as a record.)

- When the /HWBB1 and /HWBB2 signals turn OFF, confirm that the panel display or digital operator displays Hbb and that the servomotor does not operate.
If the display does not show Hbb, check the ON/OFF status of the /HWBB1 and /HWBB2 signals.
- Monitor the ON/OFF status of the /HWBB1 and /HWBB2 signals.
If the ON/OFF status of the signals do not coincide with the display, the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the SERVOPACK. Find the cause and correct the problem.
- If you use the EDM1 signal, confirm that the EDM1 signal is OFF while in normal operation by using the feedback circuit input display of the connected device.
(Whether or not you use the EDM1 signal does not affect the performance level of safety parameters.)

Information

You can use the [Status] monitor in the SigmaWin+ to check the ON/OFF status of the /HWBB1 and /HWBB2 signals. Also, the /HWBB1 and /HWBB2 signals can also be traced using the trace function in the SigmaWin+. Refer to the manual that corresponds to your SERVOPACK for details.

Based on chapter 7.3.3.4 in IEC 62061:2021, conducting a periodic validation test and keeping records of the test results is recommended to prevent the loss of the HWBB function due to accumulation of faults. The recommended intervals for conducting the periodic validation test are as follows:

- If the system safety level is SIL 3: Once or more per month
- If the system safety level is lower than SIL 3: Once or more per year



Important

If the following states occur, check if the cause is on the SERVOPACK end.

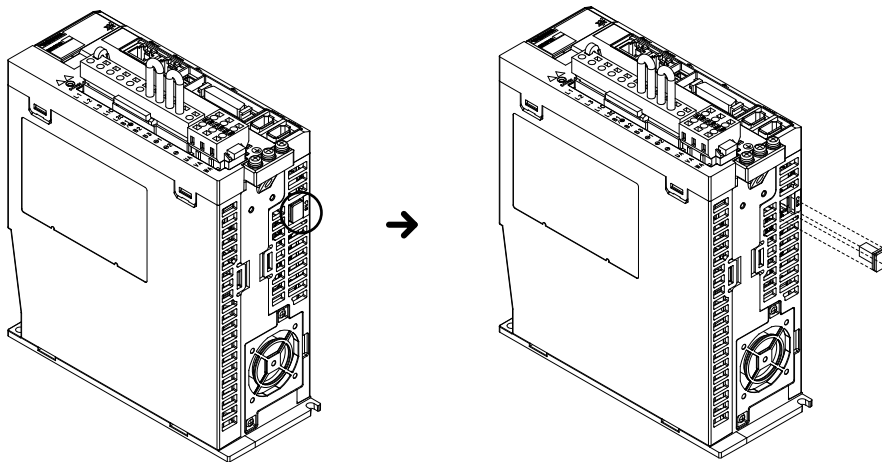
- When the /HWBB1 and /HWBB2 signals are turned OFF, the panel display or digital operator does not display Hbb.
- When the /HWBB1 and /HWBB2 signals are turned OFF, the EDM1 signal does not turn ON.

If the cause is found on the SERVOPACK end, the SERVOPACK may be faulty.

5.6 Connecting the Safety Function Device

Use the following procedure to connect a safety function device.

1. Use a pair of pliers or a similar tool to remove the safety jumper connector from the connector for the safety function device (CN8).



2. Connect the safety function device to the connector for the safety function device (CN8).

Note:

If you do not connect a safety function device, leave the safety jumper connector connected to the connector for the safety function device (CN8). If the SERVOPACK is used without the safety jumper connector connected to CN8, no current will be supplied to the servomotor and no motor torque will be output.

In this case, Hbb will be displayed on the panel display or digital operator.

Maintenance

This chapter provides information on inspections related to the HWBB function, as well as the meaning of, causes of, and corrections for alarms.

6.1	Inspections	92
6.2	Alarm Displays	93
6.2.1	Alarms Related to the HWBB Function	93
6.2.2	Troubleshooting Alarms Related to the HWBB Function	93
6.3	Troubleshooting Based on the Operation and Conditions of the Servomotor	95
6.3.1	Servomotor Does Not Start	95

6.1 Inspections

Perform the inspections given in the following table at least once every year for the SERVOPACK. Daily inspections are not required.

Item	Frequency	Inspection	Correction
Exterior	At least once a year	Check for dust, dirt, and oil on the surfaces.	Clean with pressurized air or a cloth.
Loose Screws		Check for loose terminal block and connector mounting screws and for other loose parts.	Tighten any loose screws or other loose parts.

It is recommended to inspect the safety functions of the SERVOPACK periodically. For the periodic inspections, refer to the following section.

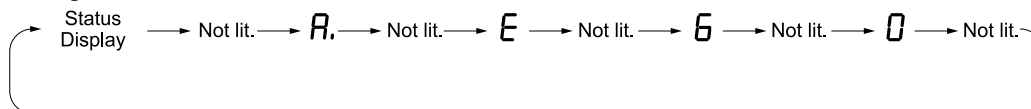
 [5.5 Validating Safety Functions on page 89](#)

6.2 Alarm Displays

If an error occurs in the SERVOPACK, an alarm number will be displayed on the panel display. However, if no alarm number appears on the panel display, this indicates a SERVOPACK system error. Replace the SERVOPACK.

If there is an alarm, the display will change in the following order.

Example: Alarm A.E60



This section provides a list of the alarms that are related to the HWBB function and the causes of and corrections for those alarms. Refer to the manual that corresponds to your SERVOPACK for information on other alarms and the causes of and corrections for them.

6.2.1 Alarms Related to the HWBB Function

The following alarm table gives the alarm name, alarm meaning, servomotor stopping method for alarms, and alarm reset possibility in order of the alarm codes for the alarms that are related to the HWBB function.

(1) Servomotor Stopping Method for Alarms

Refer to the manual that corresponds to your SERVOPACK for the servomotor stopping method for alarms.

(2) Alarm Reset Possibility

Yes: You can use an alarm reset to clear the alarm. However, this assumes that the cause of the alarm has been removed.

No: You cannot clear the alarm.

(3) Alarms for All Axes

If Common is given below the alarm number, the alarm applies to all axes. If an alarm occurs for one axis, the same alarm status will occur for all axes.

(4) List of Alarms

The following table lists the alarms.

Alarm Number	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset Possibility
A.Eb1 Common	Safety Function Signal Input Timing Error	An error occurred in the input timing of the safety function signal.	Gr.1	No
A.EC8 Common	Gate Drive Error 1	An error occurred in the gate drive circuit.	Gr.1	No
A.EC9 Common	Gate Drive Error 2	An error occurred in the gate drive circuit.	Gr.1	No

6.2.2 Troubleshooting Alarms Related to the HWBB Function

The following table describes troubleshooting alarms that are related to the HWBB function. Contact your Yasukawa representative if you cannot solve a problem with the correction given in the table.

◆ A.Eb1:Safety Function Signal Input Timing Error

Possible Cause	Confirmation	Correction	Reference
The delay between activation of the /HWBB1 and /HWBB2 input signals for the HWBB was ten second or longer.	Measure the time delay between the /HWBB1 and /HWBB2 signals.	The output signal circuits or devices for /HWBB1 and /HWBB2 or the SERVOPACK input signal circuits may be faulty. Alternatively, the input signal cables may be disconnected. Check to see if any of these items are faulty or have been disconnected.	71
A failure occurred in the SERVOPACK.	–	Replace the SERVOPACK.	–

◆ A.EC8:Gate Drive Error 1

A.EC9:Gate Drive Error 2

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

6.3 Troubleshooting Based on the Operation and Conditions of the Servomotor

This section provides troubleshooting information related to the HWBB function based on the operation and conditions of the servomotor, including causes and corrections.

Refer to the manual that corresponds to your SERVOPACK for information on the causes of and corrections for other problems.

6.3.1 Servomotor Does Not Start

Possible Cause	Confirmation	Correction	Reference
The safety input signals (/HWBB1 or /HWBB2) are still OFF.	Check the /HWBB1 and /HWBB2 input signals.	Turn ON the /HWBB1 and /HWBB2 input signals. If you are not using the safety function, connect the safety jumper connector (provided as an accessory) to CN8.	—

Appendices

This appendices provide information on interpreting panel displays that are unique to the HWBB function, and tables of corresponding SERVOPACK and SigmaWin+ function names.

7.1	Interpreting Panel Displays	98
7.1.1	Panel Display during the HWBB State	98
7.2	Corresponding SERVOPACK and SigmaWin+ Function Names	99
7.2.1	Corresponding SERVOPACK Monitor Display Function Names	99

7.1 Interpreting Panel Displays

You can check the servo drive status on the panel display of the SERVOPACK.

Also, if an alarm or warning occurs, the alarm or warning number will be displayed.

This section describes the panel displays during the HWBB state. Refer to the manual that corresponds to your SERVOPACK for other panel displays.



Important

If the displayed characters cannot be recognized, turn the SERVOPACK power OFF and ON again.

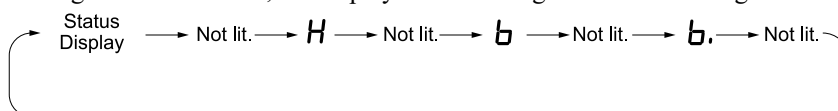
If this does not resolve the problem, check the items shown below.

- Check the input signals on the [Status] monitor of the SigmaWin+.
Refer to the manual for your SERVOPACK for details.
- Check if anything around the SERVOPACK is generating noise.

If the problem is still not resolved after checking the above items, the SERVOPACK may be faulty.

7.1.1 Panel Display during the HWBB State

During the HWBB state, the display will be changed in the following order.



7.2 Corresponding SERVOPACK and SigmaWin+ Function Names

The following table gives the corresponding monitor display names between the SERVOPACK and SigmaWin+ that are related to the HWBB function.

Refer to the manual that corresponds to your SERVOPACK for the compatibility with other monitor display names.

7.2.1 Corresponding SERVOPACK Monitor Display Function Names

If Common is given below the Un number, the monitor display applies to all axes. The total value for all axes or the contents for all axes are displayed on the monitor.

SigmaWin+		SERVOPACK	
Menu Bar Button	Name [Unit]	Un No.	Name [Unit]
Status Monitor	Safety I/O Signal Monitor	Un015 Common	Safety I/O Signal Monitor

Index

A

alarm	93
alarm reset possibility	93
troubleshooting alarms related to the HWBB function	93

B

base block (BB)	17
-----------------------	----

C

CN8	69
connecting the safety function device	90

D

diagnostic output circuits	70
----------------------------------	----

E

EDM1	86
external device monitor	86

H

hard wire base block (HWBB)	74
HWBB circuit	69
HWBB function	17, 74
detecting errors in HWBB signal	82
HWBB input signal specifications	82
HWBB input signal waveform trace	83
HWBB state	
SERVOPACK with EtherCAT communications	
references	78
SERVOPACK with MECHATROLINK communications	
references	75
HWBB1	70
HWBB2	70

I

internal block diagram	50
------------------------------	----

L

linear servomotor	17
-------------------------	----

M

main circuit cable	17
MPE720	17

R

resetting	
SERVOPACK with EtherCAT communications	
references	79
SERVOPACK with MECHATROLINK communications	
references	76
rotary servomotor	17

S

safety function signals	69
safety functions	71, 73
applications examples	87
precautions for safety functions	73
validation test	89
servo drive	17
servo lock	17
servo OFF	17
servo ON	17
servo system	17
servomotor	17
SERVOPACK	17

part names	38
SigmaWin+	17
speed regulation	44
storage humidity	44
storage temperature	44
surrounding air humidity	44
surrounding air temperature	44

T

risk assessment	74
-----------------------	----

Revision History

The date of publication, revision code, revision number, and web revision number are given at the bottom right of the back cover. Refer to the following example.

Revision number

Revision code | Web revision number

MANUAL NO. SIEP C710812 13A <0>-0

Published in Japan September 2021

Date of publication

Date of Publication	Rev. Code	Rev. No.	Web Rev. No.	Section	Revised Contents
March 2023	B	<1>	0	All chapters	Addition: Description of Σ -XT models.
				i.7.3	Partly revised.
				5.2.8	Revision: Information on OFF time
				5.5, 6.1	Addition: Description of periodic inspections
				Back cover	Revision: Address
September 2021	A	<0>	0	–	First edition

Σ-X-Series AC Servo Drive

Σ-XW/Σ-XT SERVOPACK

Hardware Option Specifications

HWBB Function

Product Manual

IRUMA BUSINESS CENTER (SOLUTION CENTER)

480, Kamifujisawa, Iruma, Saitama, 358-8555, Japan
Phone: +81-4-2962-5151 Fax: +81-4-2962-6138
www.yaskawa.co.jp

YASKAWA AMERICA, INC.

2121, Norman Drive South, Waukegan, IL 60085, U.S.A.
Phone: +1-800-YASKAWA (927-5292) or +1-847-887-7000 Fax: +1-847-887-7310
www.yaskawa.com

YASKAWA ELÉTRICO DO BRASIL LTDA.

777, Avenida Piraporinha, Diadema, São Paulo, 09950-000, Brasil
Phone: +55-11-3585-1100 Fax: +55-11-3585-1187
www.yaskawa.com.br

YASKAWA EUROPE GmbH

Hauptstraße 185, 65760 Eschborn, Germany
Phone: +49-6196-569-300 Fax: +49-6196-569-398
www.yaskawa.eu.com E-mail: info@yaskawa.eu.com

YASKAWA ELECTRIC KOREA CORPORATION

18F, Hi Investment & Securities Building, 66 Yeoui-daero, Yeongdeungpo-gu, Seoul, 07325, Korea
Phone: +82-2-784-7844 Fax: +82-2-784-8495
www.yaskawa.co.kr

YASKAWA ASIA PACIFIC PTE. LTD.

30A, Kallang Place, #06-01, 339213, Singapore
Phone: +65-6282-3003 Fax: +65-6289-3003
www.yaskawa.com.sg

YASKAWA ELECTRIC (THAILAND) CO., LTD.

59, 1F-5F, Flourish Building, Soi Ratchadapisek 18, Ratchadapisek Road, Huaykwang, Bangkok, 10310, Thailand
Phone: +66-2-017-0099 Fax: +66-2-017-0799
www.yaskawa.co.th

YASKAWA ELECTRIC (CHINA) CO., LTD.

22F, Link Square 1, No.222, Hubin Road, Shanghai, 200021, China
Phone: +86-21-5385-2200 Fax: +86-21-5385-3299
www.yaskawa.com.cn

YASKAWA ELECTRIC (CHINA) CO., LTD. BEIJING OFFICE

Room 1011, Tower W3 Oriental Plaza, No.1, East Chang An Avenue,
Dong Cheng District, Beijing, 100738, China
Phone: +86-10-8518-4086 Fax: +86-10-8518-4082

YASKAWA ELECTRIC TAIWAN CORPORATION

12F, No. 207, Section 3, Beishin Road, Shindian District, New Taipei City 23143, Taiwan
Phone: +886-2-8913-1333 Fax: +886-2-8913-1513 or +886-2-8913-1519
www.yaskawa.com.tw

YASKAWA

YASKAWA ELECTRIC CORPORATION

In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

© 2021 YASKAWA Electric Corporation

MANUAL NO. SIEP C710812 13B <1>-0
Published in Japan March 2023
22-4-18
Original instructions