

Mitsubishi Electric AC Servo System

MELSERVO-(

Safety Instructions and Precautions for AC Servos (Safety Sub-Function)

Tel:+1-847-478-2100 Mitsubishi Electric Automation, Inc. 500 Corporate Woods Parkway, Vernon Hills, IL 60061, U.S.A. Tel:+49-2102-486-0 Mitsubishi Electric Europe B.V. German Branch Mitsubishi-Electric-Platz 1, 40882 Ratingen, Germany Mitsubishi Electric Automation (China) Ltd. Mitsubishi Electric Automation Center, No.1386 Hongqiao Road, Shanghai, China China Tel: +86-21-2322-3030 Tel:+82-2-6103-9474 Mitsubishi Electric Automation Korea Co., Ltd. 7F to 9F, Gangseo Hangang Xi-tower A, 401, Yangcheon-ro, Gangseo-Gu, Seoul, Korea Mitsubishi Electric Corporation Tokyo Building, 2-7-3, Marunouchi, Chiyoda-ku, Tokyo 100-8310, Japan Tel: +81-3-3218-2111

MITSUBISHI ELECTRIC CORPORATION

IB(NA)-0300516-F(2309)MEE

F

Copyright@2020 Mitsubishi Electric Corporation All Rights Reserved

Contents of the package	
Packed articles	Quantity
Servo amplifier or drive unit	1
MR-J5 Safety Instructions and Precautions for AC Servos	1
MR-J5 Safety Instructions and Precautions for AC Servos (Safety Sub-Function) (this guide)	1

1. About the manuals
To use the MELSERVO-J5 series safely, read MR-J5 User's Manuals carefully.

Purpose of this guide

Purpose of this guide

S guide is subject to engineers of machine manufacturers and operators of machines, and explains functional safety

he MR-J5 service amplifiers/MR-J5D drive units (hereafter "MR-J5"). For detailed information of the products, refer to

LJ5 User's Manual. This guide does not explain how to operate equipment that incorporates an MR-J5.

Item	Detailed explanation
STO (Safe torque off)	Shuts off servo motor drive energy electronically based on an input signal from an external device (secondary- side output shut-off). This corresponds to stop category 0 of IEC/EN 60204-1.
SS1 (Safe stop 1)	Starts deceleration based on an input signal from an external device (EMZ). After a specified time to confirm that the motor has stopped, the STO function will be activated (SS1-1). Alternatively, the SS1 function monitors whether the servo motor decelerates according to the deceleration time constant (SS1-r). This corresponds to stop category of I EIC/EN 60204-1.
SS2 (Safe stop 2)	Starts deceleration based on an input signal from an external device (EMZ). After a specified time to confirm that the motor has stopped, the SOS function will be activated (SS2-1). Alternatively, the SS2 function will be activated (SS2-1). Alternatively, the SS2 function monitors whether the servo motor decelerates according to the deceleration time constant (SS2-r). This corresponds to stop category 2 of IEC/EN 60204-1.
SOS (Safe operating stop)	This is a function to monitor whether the servo motor stops within the prescribed range for the stop position. The power is supplied to the servo motor.
SLS (Safely-limited speed)	This is a function to observe whether the speed is within a regulated speed limit value. When the speed is over a specified speed, energy will be shut off by STO.
SSM (Safe speed monitor)	Outputs a safety output signal when the servo motor speed is within a regulated speed.
SBC (Safe brake control)	Outputs a safety output signal for an external brake control.
SDI (Safe direction)	Monitors whether the travel direction of the servo motor is as specified. The STO function shuts off the energy if the direction is different from the specified direction.
SLI (Safely-limited increment)	Monitors whether the travel distance of the servo motor is within the specified range. The STO function shuts off the energy if the travel distance exceeds the specified range.
SLT (Safely-limited torque)	Monitors whether the torque exceeds the specified torque. The STO function shuts off the energy if the torque exceeds the specified torque.
Status monitor (SM)	Outputs a signal that indicates the status of the safety sub-function. This is an original function of the MR-J5 and is not defined in IEC/EN 61800-5-2.

2 About safety

ains safety of users and machine operators. Please read the chapter carefully before mounting the guide, the specific warnings and caution levels are classified as follows.

_ 1 1	, 1
_ WARNIN	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
 CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight injury.

2.1 Professional engineer
Only professional engineers should mount this to MR-J5.
Here, professional engineers should meet all the conditions below.
(1) Persons who took a proper training of related work of electrical equipment or persons who can avoid risk based on nast experience. (2) Persons who have read and familiarized himself/herself with this installation guide and operating manuals for the protective devices (e.g. light curtain) connected to the safety control system

2.2 Conditions of use for the product

(1) MR-J5 complies with a safety standard, but this fact does not guarantee that MR-J5 will be free from any
malfunction or failure. The user of this product shall comply with any and all applicable safety standard, regulation
or law and take appropriate safety measures for the system in which the product is installed or used and shall take
the second or third safety measures other than the product. Our company is not liable for damages that could have
been prevented by compliance with any applicable safety standard, regulation or law.

veem ресчетног by competence with any applicable safety standard, regulation or law.

(2) Our company prohibits the use of Products with or in any application involving, and we shall not be liable for a default, a liability for defect warranty, a quality assurance, negligence or other tort and a product liability in these applications.

applications.

a) Power plants
b) Trains, railway systems, airplanes, airline operations, and other transportation systems
c) Hospitals, medical care, dialysis and life support facilities or equipment
d) Amusement equipment
e) Incineration and fuel devices
f) Handling of nuclear or hazardous materials or chemicals
g) Mining and drilling
f) Other applications where the level of risk to human life, health or property are elevated.

CAUTION Off you need to get close to the moving parts of the machine for inspection or other purposes, ensure safety by confirming the power off, etc. Otherwise, it may cause an accident.

Point ●The safety sub-function complies with the immunity-relating basic specifications required for functional safety, and fulfills requirements for industrial uses. The safety sub-function is not for general use.

Only professional engineers can use control systems relating to the safety sub-function that are configured with an MR-J5. Additionally, only when a professional engineer installed, performed test operations, and adjusted a machine following the MR-J5 user's Manuals, an operator can use the machine. 2.4 Safety sub-function compatible unit The safety sub-function is executed by writing parameters and programs to systems configured with the MR-J5 and the safety programmable controllers in the following table. Set the safety sub-function parameters of the MR-J5 correctly for proper operation of the safety sub-function. Protective functions such as the safety sub-function may not work due to an incorrect setting. Refer to the MR-J5 User's Manuals for the parameter setting details.

(1) List of safety sub-function compatible unit

Product name	Model					
Servo amplifier/drive unit	MR-J5G(4)-RJ(N1), MR-J5WG(-N1), MR-J5DG_(-N1)					
Programmable controller *1	R SFCPU					
*1 For using the safety sub-function via CC-Link IE TSN						

(2) List of safety sub-function compatible units

_	Function			Salety sub-function (IEC/EN 61600-5-2)									
Servo amplifier/ drive unit	(wiring	Servo motor type	STO	SS1-t	S1 SS1-r ¹³	SS2 *3 SS2-t,	SOS *3	SBC	SLS *3	SSM *3	SDI "3	SLI *3	SLT
MR-J5G(4) (-N1) MR-J5A(4) (-RJ)	DI/O connection (CN8)	FS/RO/LI/DD	Cat. 3 PL e, SIL 3	_ '9	-	SS2-r	-	-	-	-	-	-	-
MR-J5G(4) -RJ(N1) MR-J5W G(-N1) '4- MR-J5D1- _G_(-N1) MR-J5D2- _G_(-N1) '10- MR-J5D3-	connection	FS	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 3 PL d, SIL 2
	12 16 (CN8)	RO/LI/DD	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 3 PL d, SIL 2	-	-	Cat. 4 PL e, SIL 3	Cat. 3 PL d, SIL 2	Cat. 3 PL d, SIL 2	Cat. 3 PL d, SIL 2	-	Cat. 3 PL d, SIL 2
	Network connection	FS	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 3 PL d, SIL 2
	(CN1A/ CN1B)	RO/LI/DD	Cat. 4 PL e, SIL 3	Cat. 4 PL e, SIL 3	Cat. 3 PL d, SIL 2	-	-	Cat. 4 PL e, SIL 3	Cat. 3 PL d, SIL 2	Cat. 3 PL d, SIL 2	Cat. 3 PL d, SIL 2	-	Cat. 3 PL d, SIL 2

Fully closed loop control systems do not support SS1+, SS2, SOS, SLS, SSM, SDI, and SLI.
The safety sub-function is supported by the MR-LSW.—G manufactured in November 2019 or later STO can be set separately for each axis.
For DIIO connection (CNS), a diagnosis using test pulses is required to satisty Category 4 PL e, SiL 3.
e.g.: Category 4 fit he SIG-Output test pulse is valid, Category 3 fit is not.
For information on the firmware versions of the MR-JS with which the safety sub-function can be used, refer to the User's Manual (Introduction).
ES Serve motion with functional safety, RO: Rolly serve motion; LI linear serve motior, DD: Direct drive motior
STO can be set separately for each axis.

2.5 General cautions for safety protection and protective measures

Point

Observe the cautions for safety protection and protective measures.

Observe the items in this section for proper use of the safety sub-function.

Observe the items in this section for proper use of the safety sub-function.

(1) When mounting, installing, and using the safety sub-function, always observe the standards and directives applicable in the respective countries.

(2) The manufacturer and owner of machines for which the safety sub-function of MR-J5 is used should be familiarized with all the applicable laws and regulations and should be responsible to observe them. For Declaration of Conformity (DoC), our company declares that the MR-J5 is in compliance with the necessary requirements and standards (2006/42/EC, 2014/30/EU, 2014/35/EU, 2011/65/EU, and (EU)2015/663). For the copy of Declaration of Conformity, contact your local sales office.

(3) The contents of the MR-J5 User's Manuals must be observed. When using an encoder manufactured by another company that complies with Mitsubishi Electric Serial ENC communication or ABZ-pulse (TTL), also according to the manual for that encoder, estimate the PFH for the whole safety system according to the diagnostic coverage (DC) of the encoder given in specifications under the responsibility of the customer. All the encoder for PDS should comply IEC/EN 61800-5-1 and 5-2 including environmental and EMC.

When there is no PFH value of encoder, it should be calculate from based MTBF (acceptable range of failure rate of encoder λd = 50 %, λdu = (1-DC)* λd). And at least PFH < 9E-7 (for SIL2), PFH < 9E-8 (for SIL3) or less.

(4) Tests should be performed by professional engineers, especially qualified and responsible personnel, and should be recorded/documented for a third party to rebuild and confirm the tests.

(5) An external power supply of equipment should have resistance to Instantaneous power failure for 20 ms according to the specifications of IEC/EN 60204-1.

2.6 Disposal of unusable or irreparable devices should always occur in accordance with the applicable country-specific waste disposal regulations.

waste disposal regulations.

2.7 Risk assessment
To ensure safety, users should decide all the risk assessments and residual risks in the entire machine equipment. A company and/or individual who constructed the safety related system must take full responsibility for installation and commissioning of the system. Additionally, when complying with a European machinery directive, the system must acquire safety standards certification as a whole.

Perform all risk assessments and safe level certification to the machine or the system as a whole. It is recommended that a Certification Body final safety certification of the system be used.

The following shows residual risks oncenning the safety sub-function of this product.

2.7.1 Common residual risks in each function

(1) At the shipment to end-users, check the settings of safety related components with programming tools and monitored/displayed contents on display and record and save the setting data concerning the safety sub-function and the programming tools you used. Perform them using a check sheet, etc.

(2) The safety will not be ensured such as in assembling machine until installing, wiring, and adjustment are completed properly. Install, wire, and adjust your system referring to installation guide for each unit.

(3) Only qualified personnel are authorized to install, slattup, repair or adjust the machines in which the components are installed. Only trained engineers should install and operate the equipment. (ISO 13849-1:2015 Table F.1 No. 5)

are installed. Only trained engineers should install and operate the equipment. (ISO 13049-1.2015 ratio F.1 No. 1)

(4) Separate the wiring for the safety sub-function from other signal wirings. (ISO 13849-1:2015 Table F.1 No. 1)

(5) Protect the cables with appropriate ways (routing them in a cabinet, using a cable guard, etc.).

(6) We recommend using a switch, relay, sensor, etc. which comply with safety standards. When using a switch, relay, sensor, etc. which do not comply with safety standards, perform a safety standards. (Neep the required clearance/creepage distance depending on voltage you use.

(8) The time to detect a safety observation error depends on the parameter setting.

2.7.2 Residual risks specific to each function

(1) Speed monitoring (SLS)

(a) Speed monitoring function guarantees the servo motor speed, but it does not guarantee the actual machine safety speed. Set parameters so that the safe speed of the machine is the same as the safety speed of the specified motor.

safety speed. Set parameters so that the sale speed of the head as the same as the actual speed by using a tachometer, etc. considering the speed includes an error caused by the command and encoder resolution.

(c) The defect of the mechanical section such as slid of shaft and wanting of a timing belt, etc. is not covered. Be sure to eliminate the risk of mechanical section before operation.

(d) Speed monitoring error detection time is set to 1 ms. Errors in shorter than this time are not detected.

(e) After speed is over the limit, a safety observation error (shut-off signal off) does not occur during the speed error detection time set by parameters. Make sure that safety can be ensured during this period.

(2) Safe speed monitor (SSM)
When SSM is used as a restart trigger, perform it according to IEC/EN 60204-1.

When SSM is used as a restart trigger, perform a according to the control (SBC)
This function guarantees only that power to mechanic break is properly supplied and abrasion of the brake cannot be detected. Check this function regularly that the mechanic brake can operate.

(S Safe stop holding (SOS)
If the motor remains at the same stop position for a long time, move the motor slightly from time to time to prevent a cumulative malfunction.

If the motor shaft (or a coil, if a linear servo motor is used) remains at a stop for a long time after the motor has raveled as specified, switch the function to the SOS function.

(6) Safe rotation direction limit (SDI)
If the motor shaft (or a coil, if a linear servo motor is used) remains at a stop for a long time after the motor has traveled as specified, switch the function to the SOS function.

3. Using safety sub-functions and block diagram

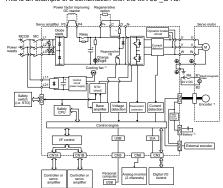
3.1 Using safety sub-functions are be used on the This is an example of a combination with the MR-J5-G-RJ. MR-J5-G/-RJ. MR-J5-G/-RJ. MR-J5-G/-RJ. MR-J5-G-RJ. MR-J

methods of the functions.

(1) Using safety sub-functions by MR-J5 itself The safety sub-functions (STO, SLS, etc.) can be used by being assigned to [Pr. PSD02 Input device selection D11] from the input device of CNB without depending on a controller. Using safety sub-functions by combining with safety programmable controllers.

combining with safety programmable controllers. The MR-J5- G(4) _ RI, MR-J5W_ - G and MR-J5D_ - G_ are used to establish a safe communication with safety programmable controllers via CC-Link IE TSN. This enables the electrical wirings (for example STO) to the MR-J5 to be omitted. Using safety sub-functions by combining with FSOE master The MR-J5- G(4) = RJN1, MR-J5W_ - G-N1, and MR-J5D_ - G_ - N1 are used to establish safe communication

used to establish safe communication with the FSoE master via FSoE. This example STO) to the MR-J5 to be



11 The built-in regenerative resistor is not used for MR-J5-10G .
12 Servo amplifiers with the rated output symbol of 70 (MR-J5-70G) or greater have a cooling fan.
13 To configure an absolute position detection system by using a direct drive motor, the batter js required. To configure the absolute position detection system by using the HK series servo motor, the battery is not required.

required.
Support encoder type are OSBA/OBSA/CBW/
CSW, another company encoder that complies with Mitsubishi Electric
Serial ENC communication and ABZ-pulse.

4. Technical specifications Servo amplifier/drive unit speci

Mean time to dangerous failure (MTTF) Diagnostic coverage (DC)
Probability of dangerous Failure per Hou

ary. For example, on IEC 61800-5-2:2016,

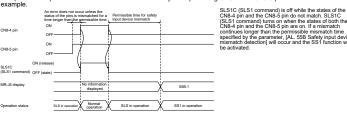
		Model	MR-J5G(4)-RJ(N1)/MR-J5WG(-N1)/MR-J5DG_(-N1)
	STO	Shut-off response time (STO input off → energy shut off)	8 ms or less (when an input device is used) 60 ms or less (with CC-Link IE TSN) ^{3 2 77} 60 ms or less (with EtherCAT) ^{2 77} 8
	SS1	Deceleration delay time	0 ms to 60000 ms (set by functional safety parameters)
	SS2	Deceleration delay time	0 ms to 60000 ms (set by functional safety parameters)
	SOS	Observation position	0 rev to 1000 rev (set by functional safety parameters)
Safety sub- function "1"2	SBC	Shut-off response time	8 ms or less (when an input device is used) 60 ms or less (with CC-Link IE TSN) ^{3,4,7} 60 ms or less (with EtherCAT) ^{4,7,8}
	SLS1/2/3/4	Observation speed	0 r/min (mm/s) to 10000 r/min (mm/s) (set by functional safety parameters) "5
	SSM	Observation speed	0 r/min (mm/s) to 10000 r/min (mm/s) (set by functional safety parameters)
	SDI	Direction monitor delay time	0 ms to 60000 ms (set by functional safety parameters)
	SLI	Observation position	0 rev to 1000 rev (set by functional safety parameters)
l	SLT	Observation torque	-1000.0 % to 1000.0 % (set by functional safety parameters)

		Model	MR-J5G(4)-RJ(N1)/MR-J5WG(-N1)/MR-J5DG_(-N1)
		Number of input points	1 point × 2 systems
		Mismatched permissible time of redundant input mismatch detection	0 ms to 60000 ms (set by functional safety parameters)
	Input device	Noise eliminating filter	1.000 ms to 32.000 ms (set by functional safety parameters)
O function		Test pulse off time *6	Within 1 ms
		Test pulse interval "	1 Hz to 25 Hz
	Output device	Number of output points	1 point × 2 systems
		Test pulse off time *6	0.500 ms to 2.000 ms (set by functional safety parameters)
	device	Test pulse interval "	Within 1 s
afe communication unction		Response time	250 ms (Transmission interval monitor time within 64 ms) (with CC-Link IE TSN) 250 ms (FSoE Watchdog Time within 60 ms) (with EtherCAT)
		Transmission interval monitor time	16.0 ms to 1000.0 ms (set by functional safety parameters) (with CC-Link IE TSN) 7
		FSoE Watchdog Time	16.0 ms to 65534.0 ms (set by objects) (with EtherCAT) 7
		Safe communication delay time	60 ms or less (with CC-Link IE TSN) "3"7 60 ms or less (with EtherCAT) "7"8

1 Available functions and safety levels differ depending on the combination of the MR-JS and the servo motors. Refer to 2.4 (2).
2 For DIO connection (CN8), a diagnosis using lest pulses is required to safety Category 4 Pt. e, Stl. 3.
3 This value is applicable when the transmission interval monitor time is \$2.0 ms or flee, Stl. 3.
3 This value is applicable when the transmission interval monitor time is \$2.0 ms or flee, Stl. 3.
4 For the MR-JS-Q4/R4 and MR-JSD-L, or connect to a network with a communication cycle of 125 us or longer. For the MR-JS-Q4/R4 and MR-JSD-L, or connect to a network with a communication cycle of 125 us or longer. For the MR-JS-Q4/R4 is MR-JSD2-C_C(A1) and MR-JSD3-C_C(A1), MR-JSD2-C_C(A1) and MR-JSD3-C_C(A1), Connect to a network with a communication cycle of 500 µs or longer. For the MR-JS-Q4/C-Q4A1, MR-JSD2-C_C(A1) and MR-JSD3-C_C(A1) and MR-JSD3-

 $4.3\,\,$ When using the I/O of the CN8 connector of the MR-J5 This I/O function can be used when the safety sub-function control by network is not used.

4.3.1 I/O signal sequence
An operation sequence with the SLS function achieved by the input wiring CN8-4 and CN8-5 pins is shown as an



4.3.2 Selecting input devices Input devices and the assignment of the CN8-4 and CN8-5 pins by using [Pr. PSD02 Input device selection D11]. The safety sub-functions can be activated with axis-A itself by using an input signal, and also can be activated with axis-A itself by using an input signal, and also can be activated with axis-A itself by using an input signal, and also can be activated with axis-A itself by using an input signal.

A, D, and C a	t tile saille tillle.	
		Input signal
STOC (STO co command), SLI	mmand), SS1C (SS1 command), SS2C (SS2 comm C (SLI command), and SLT1C (SLT1 command)	nand), SLS1C (SLS1 command), SDIPC (SDIP command), SDINC (SDIN
4.3.3 Output An operation example.	signal sequence sequence with STOS (STO output) assig	ned to the input wiring CN8-6 and CN8-7 pins is shown as an
STOS (STO output)	OFF	Pulses to turn off the signal will be output periodically to the CN8-6 and CN8-7 pins when STOS (STO output) is turned on. The pulses to turn off the signal will be output
CN8-6 pin	ON Test pulse off time for the safety output dev	from the CN8-6 and CN8-7 pins separately at different timings, and the pulses will not be output at the same time. The length of time for outputting the pulses to turn
	OFF U	off the signal can be set in [Pr. PSD30 Output device - Test pulse off time]. Make sure that the time length for
CN8-7 pin	OFF	the output pulses to turn off the signal will not affect the external devices.

Quiput devices can be assigned to the CN8-6 and CN8-7 pins by using [Pr. PSD08 Output device selection DO1]. If a multi-axis servo amplifier/multi-axis drive unit are used, it is possible to select which axis will output a signal to the output signal. Outputting a signal only from axis-A is possible, and outputting signals from axis-A, B, and C by AND output is also possible.

STOS (STO output), SS1S (SS1 output), SS2S (SS2 output), SLS1S (SLS1 output) to SLS4S (SLS4 output), SSMS (SSM output) SOSS (SOS output), SBCS (SBC output), SDIPS (SLIP output), SDINS (SDIN output), SLIS (SL1 output), and SLT1S (SLT1 output) to SLT4S (SLT4 output) 5. Signals 5.1 Connector pin assignment of the safety sub-function I/O signals The following shows connector pin assignments of the MR-J5-10G-RJ as a typical example. Refer to "MR-J5 User's Manual (Hardware)" for precautions for wiring or other operations. 5.2 Input devices Assign devices to the CN8-4 and CN8-5 pins by using [Pr. PSD02 Input device selection DI1]. The devices can be input via network if the safety sub-function is controlled by network. FUNCTION

mmand. ne SS1 function operates by the SS1 SS1C OS functions operate by the SS2 SS2C SLS1C N8-4 and SDIPC 2 1 nand SDINC SLT1 command activates the SLT function [Pr. PSB10 SLT torque upper limit value 1 [Pr. PSB14 SLT torque lower limit value 1]

5.3 Output devices The CN8-6 and CN8-7 pins output the status monitor (SM) of the safety sub-function. Output devices can be assigned to the CN8-6 and CN8-7 pins by using [Pr. PSD08 Output device selection DO1]. The status monitor can be output via network if the safety sub-function is controlled by network. In that case, the CN8-6 and CN8-7 pins can also be used at the same time.

Open

Open

Open

Devices	Symbol	Connector- pin No.	FUNCTION	Output pin status during operation
SSM output	SSMS	CN8-6 CN8-7	Indicates that the servo motor speed is equal to or lower than the SSM speed while the speed monitoring by the SSM function is activated.	Close
SBC output	SBCS	1	Outputs a control signal of the electromagnetic brake.	Open
STO output	STOS	1	This is a monitor output signal meaning that the STO function is operating.	Open
SOS output	soss		This is a monitor output signal meaning that the SS2/SOS function monitors the servo motor is in the stop state.	Open
SS1 output	SS1S	1	This is a monitor output signal meaning that the SS1 function is operating.	Open
SS2 output	SS2S	1	This is a monitor output signal meaning that the SS2/SOS function is operating.	Open
SLS1 output to SLS4 output	SLS1S to SLS4S		This is a monitor output signal meaning that the SLS function 1 to SLS function 4 are operating.	Open
SDIP output	SDIPS	1	This is a monitor output signal indicating that the SDI function has been activated.	Open
SDIN output	SDINS	1	This is a monitor output signal indicating that the SDI function has been activated.	Open
SLI output	SLIS	1	This is a monitor output signal indicating that the SLI function has been activated.	Open
SLT1 output to SLT4 output	SLT1S to SLT4S		This is a monitor output signal indicating that the SLT function 1 to SLT function 4 has been activated.	Open

Setting method

If using the safety sub-function, follow the procedure in this chapter.

Step	Detailed explanation
Checking the wiring	Check that the CN8 connector and network have been wired correctly.
Setting functional safety parameters	Refer to information on the settings of the function and set functional safety parameters.
Setting a password	Set a password for the functional safety parameters to prevent them from being changed easily.
Verifying functional safety parameters	Read the functional safety parameters to verify that they have been set correctly.
Ensuring the correct functioning of safety sub-functions	Ensure that the safety sub-functions work correctly.

6.1 Parameter setting
The safety sub-function parameters can be set with MR Configurator2. Settings related to the safety sub-function are
configured with this group of parameters. The safety sub-function parameters have a password to prevent unintended
changes of the parameters. The password is "000000" at the factory setting.
The following parameters must be set.

Parameter	Name	Detailed explanation
PSA01.0	Safety sub-function activation setting	Set this parameter to "1" only after confirming the settings of the functional set by functional safety parameters.
PSA01.1	Input mode selection	Set the safety sub-function to be controlled either by input device or by network.
PSA02	Functional safety setting	Recommended parameter settings and achievable safety levels differ depending on the system configuration.
PSA03	SS1/SS2 deceleration monitor time	Settings of the parameters for the SS1 function are necessary as the SS1 function is to be used if a problem is found by self-diagnosis.
PSA20	Servo motor encoder resolution	Set the encoder resolution of the servo motor being connected. This parameter does not need to be set if position/speed monitoring is not performed.
PSA23	Servo motor rated speed	The rated speed of the servo motor being connected must be set if speed monitoring is performed.
PSC03	Functional safety - Rotation direction selection/Movement direction selection	Set the same value in [Pr. PSC03.0] and [Pr. PA14 Rotation direction selection/travel direction selection].
PSL02	Functional safety - Linear motor encoder resolution - Numerator	The observation direction by the SDIP command is the address increasing direction. If POL is set to *1", the observation direction is the address increasing direction (CW or negative direction).
PSL03	Functional safety - Linear motor encoder resolution - Denominator	If position/speed monitoring is performed with a linear servo motor, set this parameter to the same value as [Pr. PL02] and [Pr. PL03].

o.2 i lesi operation can be performed with the safety sub-function temporarily disabled. Set [Pr. PSA01.1 Input mode selection] to "2". Some of the diagnosis functions and the safety sub-functions are disabled in the test operation in the test operation in the set operation in the sub-disable provider and the safety sub-functions are disabled in the test operation. The test operation is deviced have not been started up. devices have not been started up.
To end the test operation, set [Pr. PSA01.1 Input mode selection] to "0" or "1" depending on the system configuration.

7. Troubleshooting

tails of main alarms related to the safety sub-function are shown in the following table.

error		enabled, STO1 was turned off (enabled) under the following speed conditions. Rotary servo motor speed: 50 r/min or higher Linear servo motor speed: 50 mm/s or higher	Review the setting of "STO timing error selection" by using any of the following parameters. [A]: [Pr. PF09.1 STO timing error selection] [G]: [Pr. PF06.1 STO timing error selection]
	063.2	Direct drive motor speed: 5 r/min or higher When detection of [AL 053 STO timing error] is enabled, STO2 was turned off (enabled) under the following speed conditions. Rotary servo motor speed: 50 r/min or higher Linear servo motor speed: 50 r/min or higher Direct drive motor speed: 5 r/min or higher the servo motor speed: 5 r/min or higher the servo.	After the servo motor stops, turn off (enable) STO2. Review the setting of 'STO timing error selection' by using any of the following parameters. (A): [Pr. FT93.1 3TO timing error selection] (b): [Pr. FP06.1 STO timing error selection]
Encoder initial communication	066.1 516.1	There is a problem with the encoder cable.	Check if the encoder cable has been disconnected or has shorted. If there is a problem with the cable, repair or replace the cable.
- Receive data error 1 (safety sub-function)		The MR-J5 has malfunctioned. The encoder has malfunctioned. There is a problem with the surrounding	Replace the MR-J5. Replace the servo motor. *1
STO diagnosis	068.1	environment. STO1 or STO2 is inputted incorrectly. The input status of STO1 and STO2 are different.	Check that STO1 and STO2 of the CN8 connector are wired correctl
diagnosis error		The setting of IPr. PF18 STO diagnosis error detection time] is incorrect. The STO circuit has malfunctioned.	If the on/off status of STO1 and STO2 are different, create the same input status for STO1 and STO2. Set a longer time in the servo parameter setting, and then check the repeatability. If the error does not repeat, review the value of the servo parameter. Replace the MR-JS.
		There is a problem with the surrounding environment.	*2
Network communication error	086.1	A network cable has been disconnected. The wiring of the network cable was incorrect. A network cable has been disconnected.	Check if the network cable is connected correctly. Check if the connection of network cable is correct. Check for disconnection in the network cable.
STO function error Voltage	168.1 510.1	An MR-J5 that is not compatible with the STO function does not have a short-circuit connector connected to its CN8 connector. The power supply connection is incorrect.	Install the short-circuit connector attached to the MR-J5 in the CN8. Check the wiring.
diagnosis error (safety sub-function)	512.2	The MR-J5 has malfunctioned. There is a problem with the surrounding environment. An internal part of the MR-J5 has malfunctioned.	Replace the MR-J5. *1 Noise from the power supply may have caused the failure. Disconner
Memory error 1 (RAM) (safety sub- function)		There is a problem with the surrounding environment.	Noise from the power supply may have caused the failure. Discome the cables except the cable for the control circuit power supply, and then check the repeatability. If the failure continues, the MR-J5 may have malfunctioned. Replace the MR-J5.
Synchronous control error (safety sub-	518.2	An internal part of the MR-J5 has malfunctioned. There is a problem with the surrounding environment.	Replace the MR-J5. *1
Position feedback	52A.1	environment. The position feedback data does not change within the time set in [Pr. PSA22 Position feedback error detection time].	Review the setting of [Pr. PSA22]. Alternatively, perform operation by the end of the time set within [Pr. PSA22].
error (safety sub-function)		The servo motor has malfunctioned.	If the position feedback does not change even though the servo motor has been driven, replace the servo motor. Replace the MR-J5.
Parameter setting range error (safety sub-function)	537.1	A functional safety parameter has been set outside of its setting range.	Check the parameter error No. on the alarm display screen of MR configurator 2 or with another method, then review the setting value of the functional safety parameter.
Parameter	537.2 53A.2	A servo parameter or a functional safety parameter has been set incorrectly. A functional safety parameter has an error.	Check the parameter error No. on the alarm display screen of MR Configurator2 or with another method, then review the setting value of the servo parameter or the functional safety parameter. Check the parameter which has an error with MR Configurator2, then set the parameter correctly.
verification error (safety sub-function)		The MR-J5 has malfunctioned.	Replace the MR-J5.
Safety software error (safety sub- function)	54F.1	The MR-J5 has malfunctioned.	Replace the MR-J5.
	555.1	There is a problem with the surrounding environment. A signal of an output device has not been output.	*1 Check if the output device cable is wired correctly. Alternatively, check if the load of the output device is within specifications.
Output device diagnosis error 1 (safety sub-function)		A signal of an output device has not been output correctly or the load of the output device is out of the specification range. Current of an output device is too large. The MR-J5 has malfunctioned.	check if the ouror the output device is within specifications. Check if the current value is within specifications. If the value is out of specifications, lower the output current. Replace the MR-J5.
		There is a problem with the surrounding environment	*2
Input device mismatch detection (safety sub- function)	557.1	The input signal mismatch between the CN8-4 pin and the CN8-5 pin continued longer than the specified time (the time set in [Pr. PSD18 Mismatch permissible time D11]). The MR-J5 has malfunctioned.	Review the wiring. Alternatively, set [Pr. PSD18 Mismatch permissible time DI1] to a longer time than the mismatched time between the CN8-4 pin and the CN8-5 pin. Replace the MR-J5.
Oten com	FC0.4	There is a problem with the surrounding	*2
Stop error (safety sub- function)	560.1	The state where the absolute value of the servo motor speed exceeds [Pr. PSA04 Safety sub-function - Stop speed] continued for longer than the time set in [Pr. PSA15 Safety sub-function - Speed detection delay time] while the SOS function is activated.	Check the parameter or the operation pattern. If the motor overshoots as it stops, reduce the overshoot by adjusting the gain, setting a longer time in [Pr. PSA15], or by other means.
		The encoder has malfunctioned. The MR-J5 has malfunctioned.	Replace the servo motor. Replace the MR-J5.
Safety speed	561.1	There is a problem with the surrounding environment. The state where the absolute value of the servo	Check the parameter or the operation pattern.
monitor error 1 (safety sub- function)		The state where the absolute value of the servo motor speed exceeds [Pr. PSA11 SLS speed 1] continued for longer than the time set in [Pr. PSA15 Speed delection delay time] while the SLS function is activated. The settings of the electronic gear are incorrect.	Take actions such as setting the speed command to a value equal to or lower than [Pr. PSA11] or setting time required for deceleration in [Pr. PSA07 SLS deceleration monitor time 1]. Check the setting value of the electronic gear.
		The servo system is unstable and oscillating. The velocity waveform overshot.	Adjust the servo gain or reduce the load. Increase the acceleration/deceleration time constant.
		The connection destination of the encoder cable is incorrect. The encoder has malfunctioned.	Check the connection destination of the encoder. Replace the servo motor.
Deceleration monitor error (safety sub- function)	563.1	The servo motor speed exceeded the speed which is determined by the observation speed of when the SS1 command has been turned off and the observation speed according to [Pr. PSA24 SS1/SS2 Deceleration observation time constant].	Check the parameter or the operation pattern. Take actions such as setting a longer time in [Pr. PSA26 SS1/SS2 deceleration monitor delay time] or adjusting the servo gains.
		The connection destination of the encoder cable is incorrect.	Check the connection destination of the encoder.
		There is a problem with the servo motor or servo motor power cable. The encoder has malfunctioned.	Replace the servo motor or servo motor power cable. Replace the servo motor.
		The MR-J5 has malfunctioned. There is a problem with the surrounding environment.	Replace the MR-J5. *2
Increment monitor error (safety sub- function)	564.1	The feedback position traveled by more than the permissible travel distance specified by the parameter (IP. PSB02 SLI permissible travel distance (positive direction)] and [Pr. PSB07 SLI permissible travel distance (negative direction)]) after the SLI function has been activated.	Check the parameter or the operation pattern. Check if the SLI command has been input before the servo motor stop has been confirmed.
Direction	565.1	Check the problem according to the corrective act	loins for [AL. 563.1]. Check the parameter or the operation pattern. Check if a command for the address increasing direction has been
monitor error (safety sub- function)		increasing direction while the SDI function is activated. The velocity waveform overshot.	Check if a command for the address increasing direction has been input. Check if the velocity waveform has overshot because of the short acceleration/deceleration time constant. If the velocity waveform has
		The connection of the servo motor is incorrect.	Check the U/V/W wiring.
Torque monitor error 1 (safety sub- function)	568.1	Check the problem according to the corrective act The torque feedback exceeded the torque specified in the parameters (IPr. PSB12 SLT1 Torque (positive direction)) and IPr. PSB16 Torque (negative direction)) after the SLT function has been activated.	ions for (AL. 563.1). Check the parameter or the operation pattern. Check if the threshold of the torque monitor is too small or if the servi motor collides with the machine.
Safety	580.3	Check the problem according to the corrective act	The controller may have been communicated with an unintended MR
communication setting error (safety sub- function) FSoE Address	584.1	the setting of IPr. PSC06 Safety verification code] do not match.	J5. Check if the IP address of the safety communication setting on the master station matches the IP address setting of the corresponding MR_16
mismatch error (safety sub-function)	564.1	FSoE Address set in FSoE Master does not match the setting of [Pr. PSC07 FSoE Address setting].	Review the setting of FSoE Address in FSoE Master or the setting of [Pr. PSC07 FSoE Address setting].
FSoE communicatio n parameter setting error (safety sub- function)	584.2	The setting value of FSoE Watchdog Timer notified from FSoE Master does not correspond to the MR-J5.	Review the setting value of FSoE Watchdog Timer set in FSoE Master.
(safety sub- function) FSoE communicatio n error 2 - Receive time- out error (safety sub- function	586.5	The safe communication update time exceeded the time set in FSoE Watchdog Time.	Review the setting value of FSoE Watchdog Time set in FSoE Master.
	ower supp bise, ambi	bly for noise. If there is noise, take countermeasures to temperature, and other conditions, and implement	I to reduce the noise. nt appropriate countermeasures for the cause. If there is noise, take
8. Mainten Refer to chap Safety Instru	ance, i oter 6 a ctions a	inspection, and environment	ecautions for AC Servos (IB(NA)0300391)" or "MR-J5D 0527)".
, OHEUN II	JE IUI L		SUBISHI
		▼ MITS	OUDIONI

MITSUBISHI

The following items must be satisfied by the initial test operation at least. The manufacturer/installer must be responsible for checking the standards in the items. Maintain and keep this checklist with related documents of machines to use this for periodic inspection.

laminari and keep into checkins with related outcomers or inscrimers to use.

I si it based on directive/standard applied to the machine?

I si directive/standard contained in Declaration of Conformity (DoC)?

Does the protection instrument conform to the category required?

Are electric shock protective measures (protective class) effective?

I sit he safety sub-function checked (test of all the shut-off wiring)?

Shecking the items will not be instead of the first test operation or periodic it.