EPSON

Robot Controller Safety Function Manual

Original instructions Control Unit RC700-E

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1. Introduction

1.1 Introduction

Thank you for purchasing this Epson robot system.

This manual provides the information necessary for correctly using the Robot Controller safety functions.

Before using the system, please read this manual and related manuals to ensure correct use.

After reading this manual, store it in an easily accessible location for future reference.

Epson conducts rigorous testing and inspection to ensure that the performance of our robot systems meets our standards. Please note that if the Epson robot system is used outside the operating conditions described in the manual, the product will not perform up to its basic performance.

This manual describes potential hazards and problems that are foreseen. To use the Epson robot system safely and correctly, be sure to follow the safety information contained in this manual.

1.2 Trademarks

Microsoft, Windows, the Windows logo, Visual Basic, and Visual C++ are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries. All other company names, brand names, and product names are registered trademarks or trademarks of their respective companies.

1.3 Notation

Microsoft® Windows® 8 operating system Japanese version Microsoft® Windows® 10 operating system Japanese version Microsoft® Windows® 11 operating system Japanese version In this manual, the above operating systems are referred to as Windows 8, Windows 10, and Windows 11, respectively. Windows 8, Windows 10, and Windows 11 are sometimes collectively referred to as Windows.

1.4 Terms of Use

No part of this instruction manual may be reproduced or reprinted in any form without express written permission. The information in this document is subject to change without notice.

Please contact us if you find any errors in this document or if you have any questions about the information in this document.

1.5 Manufacturer

SEIKO EPSON CORPORATION

1.6 Contact Information

For contact information details, refer to the "Supplier" section in the following manual. "Safety Manual"

1.7 Before Use

Before using this manual, be sure that you understand the following information.

Safety precautions

Only qualified personnel should transport and install the robot and the related equipment. Also, the laws and regulations of the

Rev.5

Before use, please carefully read this manual and other related manuals to ensure correct use. After reading this manual, store it in an easily accessible location for future reference.

Meaning of symbols

MWARNING

This symbol indicates an imminently hazardous situation which, if operation is not performed properly, will result in death or serious injury.

AUTION

This symbol indicates a potentially hazardous situation which, if operation is not performed properly, may result in an injury or in property damage only.

1.8 Training

Personnel using the safety functions of the Robot Controller must undergo the "installation training" or "maintenance training" conducted by Epson. To ensure that our customers understand our products, Epson provides training on a regular or ad hoc basis.

Undergoing formal training will allow you to properly use the product and increase productivity. For details on training, please contact the supplier.

2. Overview of the Robot Controller Safety Functions

2.1 Explanation of Robot Controller Safety Functions

The Robot Controller safety functions can be used to set safety inputs and safety outputs, and to create applications that link to safety devices.

Also, the safety function options support functions that safely control the operating speed and operating range of the robot. You can set the robot's Maximum Speed and monitoring area to achieve an application for safely controlling the robot.

\Lambda CAUTION

The safety performance of the Robot Controller safety functions is Category 3, PLd (Reference standard: ISO 13849-1: 2015).

Please ensure the safety of the robot system in light of the safety performance of the Robot Controller safety functions. Also, please refer to and observe the safety standards of the respective country and region.

The following describes the types and characteristics of the Robot Controller safety functions.

Controller Safety Function standard functions:

Safe Torque OFF (STO)

A signal input from the Robot Controller opens a relay to cut off the power supply to the motors and stop the robot. This is a safe state for the Robot Controller.

STO is operated indirectly from an emergency stop or protective stop. It cannot operate directly.

Emergency Stop

This function allows the robot to perform an emergency stop by a signal input from a safety relay or from an emergency stop switch attached to the emergency stop input connector or safety I/O connector. After the signal is input, an SS1 is executed, and after the motor stops, the robot is in an emergency stop status. During the emergency stop status, EP is displayed on the 7-segment LED of the Robot Controller.

There are three emergency stop circuits for the Robot Controller:

- Emergency stop input connector (E-Stop)
- Port of the safety I/O connector configured for the emergency stop (Safety Input)
- Emergency stop switch attached to Teach Pendant (E-Stop, TP)

Safeguard (SG) (protective stop)

This function allows the robot to perform a protective stop by a signal input from a safety peripheral device attached to the safety I/O connector. After the signal is input, the SS1 is executed, and after the motor stops, the robot is in a protective stop status. SO is displayed on the 7-segment LED of the Robot Controller. The Robot Controller safeguard (SG) circuit is as follow:

• Port of the safety I/O connector configured for the safeguard (SG)

Enable

Enable is the path connected to the enable switch when the Teach Pendant is connected. Only Epson Teach Pendants can be connected, and customer enable switches cannot be connected.

When the system detects that the enable switch of the Teach Pendant is not in the middle position, the SS1 is executed, and the robot is in an STO state.

Soft Axis Limiting

This monitors that each axis of the robot is within its operating range. If the system detects that an axis of the robot exceeded the limiting range, the robot emergency stop and STO are immediately executed, putting the Robot Controller in the emergency stop status.

The restricted range for each axis of the robot is set in the dedicated software (Safety Function Manager).

Safety outputs

External safety devices can be connected to the safety outputs of the Robot Controller to perform notifications of the ON/OFF status of the safety functions.

By assigning settings in the dedicated software (Safety Function Manager), the following safety signals can be output:

- STO state
- Status of the emergency stop switch
- Status of the enable switch
- Enabled/disabled status of the Safety Limited Speed (SLS)
- Enabled/disabled status of the Safety Limited Position (SLP)

Controller Safety Function charged optional functions:

Safety Limited Speed (SLS)

This monitors the operating speed of the robot. If the system detects that the robot exceeded the Maximum Speed, the robot emergency stop and STO are immediately executed, putting the Robot Controller in the emergency stop status. The safety speed limit of the robot is set in the dedicated software (Safety Function Manager).

KEY POINTS

The speed monitoring function during teaching can be used as a standard function.

Safety Limited Position (SLP)

This monitors the robot's position and joint angles. If the system detects that the robot exceeded the monitored areas or joint angle limit, the robot emergency stop and STO are immediately executed, putting the Robot Controller in the emergency stop status.

The Monitored Areas and Joint Angle Limit of the robot are set in the dedicated software (Safety Function Manager).

Reference

For details on each function, refer to the following sections.

Standard functions:

- Safe Torque OFF (STO)
- Safe Stop 1 (SS1)
- Emergency Stop
- Enable
- Soft Axis Limiting
- Safety Inputs
- Safety Outputs

Paid option functions:

- Safety Limited Speed (SLS)
- Safety Limited Position (SLP)
- Joint Angle Limit

KEY POINTS

For details on the "Safety Function Manager," refer to the following section. Setting Safety Functions (Setting Software: Safety Function Manager)

2.2 Required Knowledge

2.2.1 Undergoing Training

Personnel using the safety functions of the Robot Controller must undergo the "installation training" or "maintenance training" conducted by Epson.

2.2.2 Basic Knowledge of EPSON RC+

Use of the safety functions of the Robot Controller requires knowledge of the software used to develop programs for the Robot Controller, EPSON RC+, as well as EPSON robots. The contents of this manual are intended for persons who are knowledgeable about the following:

- Concept of EPSON RC+ project management, and how to use it
- How to create and edit SPEL+ programs in EPSON RC+
- How to execute the SPEL+ program from the Run window
- Basic language structure and functionality of SPEL+, and how to use it

Personnel using EPSON RC+ for the first time must undergo the "installation training" conducted by Epson.

2.3 Precautions for Using the Robot Controller Safety Functions

When using the Robot Controller safety functions, follow the safety precautions described below.

\Lambda WARNING

- Be sure to check the safety function parameter settings when operating a Robot Controller in its initial state or when operating a Robot Controller with unknown safety function parameter settings. Also, operate the Manipulator after understanding the operation of the safety functions.
- Be sure to check that the intended operation is achieved when changing from the previous state of use, such as when safety function parameters are changed or when parts are replaced for maintenance.
- When checking operation, use low power mode.
 Reducing the motor output ensures operator safety and reduces the risk of destruction and damage to peripheral equipment due to careless operation.
- Before beginning full operation, check that the safety function parameters are set as intended. The parameter checksum of the safety functions is calculated from the safety function parameters. If the parameter checksum of the safety functions is changed, it means that the safety function parameters have been changed. Incorrectly set safety functions may cause serious safety problems.
- Before beginning full operation, make sure that the safety devices such as the emergency stop switch and safeguard switch operate. Operation without the switches functioning properly may result in the safety functions failing to operate during an emergency, which is extremely hazardous and may result in serious injury and/or severe damage to the robot system.

2.4 Terminology

Safety device

This refers to a device that is connected to a safety I/O connector of the Robot Controller.

Dry run

This refers to the status when a Robot Controller that is not connected to a Manipulator is used to check the operation of the robot program.

Operation mode

This refers to either AUTO mode (including PROGRAM mode), TEACH mode, TEST T1 mode, or TEST T2 mode. This can be changed using the Teach Pendant.

Hofs

This refers to the offset value of the robot's joint axes.

Safety board

This refers to the board for monitoring the robot system. It is built into the Robot Controller.

Tool coordinate tip point (TCP)

This refers to the point of contact between the hand and the workpiece. Set this according to the hand.

2.5 System Overview

Safety devices can be connected to the safety I/O connectors of the Robot Controller.

- Connect the safety outputs of safety devices to the safety inputs of the safety I/O connectors.
- Connect the safety inputs of safety devices to the safety outputs of the safety I/O connectors.



Example of system configuration using the Robot Controller safety functions:



For details on how to connect safety devices and the Robot Controller, refer to the following manual. "Robot Controller RC700-E Manual"

3. Details of Robot Controller Safety Functions

3.1 Main Functions

Refer to the following section for details. Explanation of Robot Controller Safety Functions

For details on each function, refer to the following sections. **Standard functions:**

- Safe Torque OFF (STO)
- Safe Stop 1 (SS1)
- Emergency Stop
- Enable
- Soft Axis Limiting
- Safety Inputs
- Safety Outputs

Paid option functions:

- Safety Limited Speed (SLS)
- Safety Limited Position (SLP)
- Joint Angle Limit

3.2.1 Outline and Operation Patterns for Safe Torque OFF (STO)

Safe Torque OFF (STO) is a function that opens the relay and disconnects the power supply to the motors when a monitoring value of a safety function is exceeded.

Safe Torque OFF (STO) is equivalent to stop category 0. (Reference standard: IEC 60204-1)



3.3 Safe Stop 1 (SS1)

3.3.1 Outline and Operation Patterns for Safe Stop 1 (SS1)

Safe Stop 1 (SS1) is a function that monitors whether the robot decelerates and stops normally when there is an emergency stop or a protective stop. If an abnormal deceleration of TCP speed is detected during stop control, Safe Torque OFF (STO) is immediately executed.

Safe Stop 1 is equivalent to stop category 1. (Reference standard: IEC 60204-1)

Relationship between Safe Stop 1 (SS1) and the STO statement (normal state)

If stop control is normal, Safe Torque OFF (STO) is executed after stop control is completed.



Relationship between Safe Stop 1 (SS1) and the STO statement (when deceleration abnormality is detected)

If an abnormal deceleration of TCP speed is observed during stop control, Safe Torque OFF (STO) is immediately executed.



Relationship between Safe Stop 1 (SS1) and the STO statement (after the monitoring time)

If the TCP speed does not decelerate to 1 [mm/sec] or less even after a certain period of time from the start of stop control, Safe Torque OFF (STO) is immediately executed.



3.4 Emergency Stop

3.4.1 Outline and Operation Patterns for the Emergency Stop

When the emergency stop switch is turned ON (is pressed), Safe Stop 1 (SS1) is executed and then Safe Torque OFF (STO) is executed, putting the Robot Controller in the emergency stop status.

Relationship between the emergency stop and the STO statement



3.5 Enable

3.5.1 Outline and Operation Patterns for Enable

When the enable switch is OFF (is in a position other than the middle position), Safe Stop 1 (SS1) is executed and then Safe Torque OFF (STO) is executed, performing a protective stop.

Relationship between Enable and the STO statement



3.6 Safety Limited Speed (SLS)

3.6.1 Outline and Operation Patterns for Safety Limited Speed (SLS)

Safety Limited Speed (SLS) is a function that monitors the robot's operating speed. If, during operation, the robot exceeds the Maximum Speed, Safe Torque OFF (STO) is immediately executed, putting the Robot Controller in the emergency stop status.

\land WARNING

Please set the Maximum Speed considering the stopping distance. For the stopping distance, refer to the following manual.

"Manipulator Manual - Appendix B: Stopping Time and Stopping Distance at Emergency Stop"

Operation modes and enabling/disabling Safety Limited Speed (SLS)

When the operation mode is TEACH or TEST T1, the Safety Limited Speed pattern SLS_T is always enabled. Safety Limited Speed SLS_T is a standard function.

When the operation mode is TEST T2, the Safety Limited Speed pattern SLS_T2 is always enabled. Safety Limited Speed pattern SLS_T2 is a standard function.

When the operation mode is AUTO, TEST T1, or TEST T2, the safety inputs can be used to enable or disable Safety Limited Speed (SLS). In these operation modes, three patterns of Maximum Speeds, SLS_1, SLS_2, and SLS_3, can be set. Safety Limited Speed patterns SLS_1, SLS_2, and SLS_3 are safety function options.

Safety Limited Speed (SLS) patterns		Enable or disable for each operation mode A: Always enable B: Enable or disable based on safety inputs -: Always disable			
		AUTO	TEACH	TEST T1	TEST T2
Standard functions	SLS_T*	-	А	А	-
	SLS_T2	-	-	-	А
Optional safety functions	SLS_1	В	-	В	В
	SLS_2	В	-	В	В
	SLS_3	В	-	В	В

*: For details on the Safety Limited Speed pattern SLS_T, refer to the following section.

Safety Limited Speed (SLS) for a SCARA Manipulator

Safety Limited Speed (SLS) for a 6-Axis Manipulator

Relationship between Safety Limited Speed (SLS) and the STO statement

If, during robot operation, the system detects that the Maximum Speed was exceeded, Safe Torque OFF (STO) is immediately executed, putting the Robot Controller in the emergency stop status.



3.6.2 Safety Limited Speed (SLS) for a SCARA Manipulator

When using Safety Limited Speed (SLS) for a SCARA Manipulator, there are six locations that are monitored at the Maximum Speed. The speed (rotation or up/down) of each joint is expressed as a percentage of the maximum speed (rotation or up/down) of that joint.

- Speed (rotation) at Joints #1, #2, and #4 [%]
- Speed (up/down) of Joint #3 (ball screw linear motion mechanism) [%]
- Speed at Joint #2 (translation) [mm/sec]
- TCP speed [mm/sec]

The TCP offset from the tip of the ball screw linear motion mechanism to the TCP is set in Safety Function Manager. With Safety Limited Speed (SLS) using the Safety Limited Speed pattern SLS_T, the TCP speed and Joint #2 speed (translation) limit is 250 [mm/sec].

ACAUTION

The TCP offset setting set in Safety Function Manager is not linked to the setting parameters set in the "Tool Settings" section of the "EPSON RC+ User's Guide". Make sure that these settings are consistent.





3.6.3 Safety Limited Speed (SLS) for a 6-Axis Manipulator

When using Safety Limited Speed (SLS) for a 6-Axis Manipulator, there are 10 locations that are monitored at the Maximum Speed. The rotation speed of each joint is expressed as a percentage of the maximum rotation speed of the corresponding joint.

- Speed at Joint (rotation) #1 to #6 [%]
- Speed at Joint #2 (translation) [mm/sec]
- Speed at Joint #3 (translation) [mm/sec]
- Speed at Joint #5 (translation) [mm/sec]
- TCP speed [mm/sec]

The TCP offset from the tip of Joint #6 to the TCP is set in Safety Function Manager. With Safety Limited Speed (SLS) using the Safety Limited Speed pattern SLS_T, the TCP speed and Joint #2, Joint #3, and Joint #5 speed (translation) limit is 250 [mm/sec].





For details on the Tool 0 coordinate system for a celling mounting or wall mounting, refer to the following manual.

"EPSON RC+ User's Guide - 6.16.4 Tool Coordinate System"

3.7 Safety Limited Position (SLP)

3.7.1 Outline and Operation Patterns for Safety Limited Position (SLP)

Safety Limited Position (SLP) is a function that monitors the robot's operating position. If the system detects that, during robot operation, the robot monitored range has entered the monitored area, then Safe Torque OFF (STO) is immediately executed, putting the Robot Controller in the emergency stop status.

Safety Limited Position (SLP) is a safety function option.

\land WARNING

 Please set the motion range considering the stopping distance. For the stopping distance, refer to the following manual.

"Manipulator Manual - Appendix B: Stopping Time and Stopping Distance at Emergency Stop"

 If the robot speed is limited by the Safety Limited Speed (SLS), the restricted area can be determined based on the stopping distance calculated from the speed set by the Safety Limited Speed (SLS). If you are not using the Safety Limited Speed (SLS) function, determine the restricted area considering the stopping distance calculated from the robot's maximum speed.

Operation modes and enabling/disabling Safety Limited Position (SLP)

When the operation mode is AUTO, TEST T1, or TEST T2, the safety inputs can be used to enable or disable the Monitored Areas and Joint Angle Limit.

KEY POINTS

- For details on monitoring area, refer to the following section.
 - Monitoring Areas for a SCARA Manipulator
 - Monitoring Areas for a 6-Axis Manipulator
- For details on the Joint Angle Limit, refer to the following section.
 Joint Angle Limit

When the operation mode is TEACH, Safety Limited Position (SLP) is always disabled.

Safety Limited Position (SLP) patterns		Enable or disable for each operation mode B: Enable or disable based on safety inputs -: Always disable			
		AUTO	TEACH	TEST T1	TEST T2
Optional safety functions	SLP_A	В	-	В	В
	SLP_B	В	-	В	В
	SLP_C	В	-	В	В

Relationship between Safety Limited Position (SLP) and the STO statement

If the system detects that, during robot operation, the robot monitored range has exceeded the monitored area, then Safe Torque OFF (STO) is immediately executed, putting the Robot Controller in the emergency stop status.



3.7.2 Robot Monitoring Range for a SCARA Manipulator

The robot monitoring ranges for the Safety Limited Position of a SCARA Manipulator are in two locations: a circle centered on Joint #2 (J2, Robot Monitored Range 1) and a circle centered on Joint #3 (J3, Robot Monitored Range 2). These robot monitoring ranges are set in Safety Function Manager. The minimum values that can be set are defined by the type of Manipulator.

Safety Limited Position (SLP) monitors whether the set monitoring range exceeds the Monitored Areas set by the coordinate system in which the robot is installed.



With Safety Limited Position (SLP) of a SCARA Manipulator, the robot installation position offset (X_{ofs} , Y_{ofs}) in the robot coordinate system X_R - Y_R and the robot installation plane rotation U_{rot} are set based on the coordinate system X_W - Y_W where the robot is installed.



3.7.3 Monitoring Areas for a SCARA Manipulator

The monitoring areas for a SCARA Manipulator are specified within the restricted range of a X_W - Y_W plane in the coordinate system X_W - Y_W where the robot with Safety Limited Position is installed. There are 16 configurable restricted range patterns, (a) through (p).

These monitored areas are set as the positions $(X_1, 0), (X_2, 0), (0, Y_1), (0, Y_2)$ that intersect with the coordinate system X_W - Y_W where the robot is installed. The robot monitoring range is monitored to ensure that it does not enter the monitoring areas.



3.7.4 Robot Monitoring Range for a 6-Axis Manipulator

The robot monitoring ranges for the Safety Limited Position of a 6-Axis Manipulator are in four locations: a sphere centered on Joint #2 (J2, Robot Monitored Range 1), a sphere centered on Joint #3 (J3, Robot Monitored Range 2), a sphere centered on Joint #5 (J5, Robot Monitored Range 3), and a sphere centered on Joint #6 (J6, Robot Monitored Range 4). These robot monitoring ranges are set in Safety Function Manager. The minimum values that can be set are defined by the type of Manipulator.

Safety Limited Position (SLP) monitors whether the set monitoring range exceeds the Monitored Areas set by the coordinate system in which the robot is installed.



With Safety Limited Position (SLP) of a 6-Axis Manipulator, the robot installation position offset (X_{ofs} , Y_{ofs} , Z_{ofs}) in the robot coordinate system X_R - Y_R - Z_R and the robot installation plane rotation (U_{rot} , V_{rot} , W_{rot}) are set based on the coordinate system X_W , Y_W - Z_W where the robot is installed.



3.7.5 Monitoring Areas for a 6-Axis Manipulator

The monitoring areas for a 6-Axis Manipulator are specified based on a combination of the restricted range pattern of a X_W - Y_W plane and the restricted range pattern in the Z_W direction in the coordinate system X_W - Y_W - Z_W where the robot with Safety Limited Position is installed. There are 16 configurable restricted range patterns on a X_W - Y_W plane, (a) through (p). These monitored areas are set as the positions (X_1 , 0), (X_2 , 0), (0, Y_1), (0, Y_2) that intersect with the coordinate system X_W - Y_W where the robot is installed. The robot monitoring range is monitored to ensure that it does not enter the monitoring areas.



There are three configurable restricted range patterns in the Z_W direction, (q) through (s). These monitored areas are set as the positions (Z_1 , Z_2) in the Z_W direction in the coordinate system where the robot is installed. The robot monitoring range is monitored to ensure that it does not enter the monitoring areas.



3.8 Joint Angle Limit

3.8.1 Outline and Operation Patterns for Joint Angle Limit

When the operation mode is TEACH, Joint Angle Limit is always disabled.

Joint Angle Limit is a function that monitors the robot's joint angles. If the system detects that the robot exceeded the motion range, Safe Torque OFF (STO) is immediately executed, putting the Robot Controller in the emergency stop status.

Joint Angle Limit is a safety function option.

Operation modes and enabling/disabling Joint Angle Limit

When the operation mode is AUTO, TEST T1, or TEST T2, patterns* that use the narrow range based on the rotation angle or vertical movement of an axis of the robot as the operating range can be assigned.

*: When using SLS_1 as the Joint Angle Limit

Joint Angle Limit Pattern		Enable or disable for each operation mode B: Enable or disable based on safety inputs -: Always disable				
		AUTO	TEACH	TEST T1	TEST T2	
Optional safety functions	SLS_1 *	В	-	В	В	

*: Case where a pattern setting the narrow range based on the rotation angle or vertical movement of an axis of the robot as the operating range for monitoring is assigned to SLS_1.

Relationship between Joint Angle Limit and the STO statement

If the system detects that either the rotation angle or vertical movement of an axis of the robot exceeded the motion range, Safe Torque OFF (STO) is immediately executed, putting the Robot Controller in the emergency stop status.



3.8.2 Joint Angle Limit for the Manipulator

With a SCARA Manipulator, Joint #1 (rotation), Joint #2 (rotation), Joint #3 (up/down), and Joint #4 (rotation) are all subject to the Joint Angle Limit, which sets the narrow range based on the rotation angle or vertical movement of an axis of the robot as the operating range.



With a 6-Axis Manipulator, Joint #1 (rotation), Joint #2 (rotation), Joint #3 (rotation), Joint #4 (rotation), Joint #5 (rotation), and Joint #6 (rotation) are all subject to the Joint Angle Limit, which sets the narrow range based on the rotation angle of an axis of the robot as the operating range.


3.9 Soft Axis Limiting

3.9.1 Outline and Operation Patterns for Soft Axis Limiting

Soft Axis Limiting is a function that monitors the robot's joint operating range. If the system detects that either the rotation angle or vertical movement of an axis of the robot exceeded the motion range of an axis, the robot emergency stop and STO are executed, putting the Robot Controller in the emergency stop status.

Operation modes and enabling/disabling Soft Axis Limiting

When the operation mode is AUTO, TEST T1, or TEST T2, Soft Axis Limiting is always enabled. When the operation mode is TEACH, Soft Axis Limiting is always disabled.

Soft Axis Limiting	Enable or disable for each operation mod A: Always enable -: Always disable			ation mode
	AUTO	TEACH	TEST T1	TEST T2
Standard functions	А	-	A	А

Relationship between Soft Axis Limiting and the STO statement

If the system detects that either the rotation angle or vertical movement of an axis of the robot exceeded the motion range, the robot emergency stop and STO are immediately executed, putting the Robot Controller in the emergency stop status.



3.9.2 Manipulator Operating Range

With a SCARA Manipulator, Joint #1 (rotation), Joint #2 (rotation), Joint #3 (up/down), and Joint #4 (rotation) are all subject to monitoring by Soft Axis Limiting.



With a 6-Axis Manipulator, Joint #1 (rotation), Joint #2 (rotation), Joint #3 (rotation), Joint #4 (rotation), Joint #5 (rotation), and Joint #6 (rotation) are all subject to monitoring by Soft Axis Limiting.



The rotation angle or motion range for vertical motion of an axis of the robot can be set to a value at or below the pulse range set for each robot model. For details on the configurable pulse range, refer to the following manual.

"Manipulator Manual - Operation Area Settings"

Motion range settings are made in Safety Function Manager.

A CAUTION

The operating range set in Safety Function Manager is not linked to the setting parameters set in the "Tool Settings" section of the "EPSON RC+ User's Guide". Make sure that these settings are consistent.



When using only Soft Axis Limiting



\land WARNING

 When designing a robot system and restricting the robot motion area, perform restrictions using Soft Axis Limiting or the mechanical stop. However, due to robot safety standard requirements, a single-axis mechanical stop cannot be replaced by Soft Axis Limiting. For details on restriction using a mechanical stop, refer to the following manual.

"Manipulator Manual"

- If the robot speed is limited by the Safety Limited Speed (SLS), the restricted area can be determined based on the stopping distance calculated from the speed set by the Safety Limited Speed (SLS). If you are not using the Safety Limited Speed (SLS) function, determine the restricted area considering the stopping distance calculated from the robot's maximum speed.
- When using the mechanical stop and Soft Axis Limiting together, there is no need to set the motion range considering the stopping distance, because the mechanical stop is the limit.
- If using only the Soft Axis Limiting, set the motion range considering the stopping distance. For the stopping distance, refer to the following manual.
 "Manipulator Manual Appendix B: Stopping Time and Stopping Distance at Emergency Stop"

3.10 Safety Inputs

3.10.1 Outline and Operation Patterns for Safety Inputs

The safety inputs are functions that execute safety functions assigned to the safety inputs according to the output signal of the safety device connected to the safety inputs of safety I/O connectors.

The safety I/O connectors have five ports for safety inputs.

The safety functions that can be assigned to the safety inputs are as follows:

- Emergency Stop (ESTOP)
- Safeguard (SG)
- Safety Limited Speeds (SLS) SLS_1, SLS_2, and SLS_3 Refer to the following section for details.
 Safety Limited Speed (SLS)
- Safety Limited Positions (SLP) SLP_A, SLP_B, SLP_C, and SLS_1* Refer to the following section for details.
 Safety Limited Position (SLP)

*: Case where Joint Angle Limit is enabled in SLS_1 settings. Refer to the following section for details. Joint Angle Limit

Operation modes and enabling/disabling safety inputs

Emergency Stop (ESTOP) can be executed in any operation mode. Safeguard (SG) can be executed in the AUTO operation mode.

Safe Stop 1 by Safety Input 1		Enable or disable for each operation mode B: Enable or disable based on safety inputs -: Always disable				
		AUTO	TEACH	TEST T1	TEST T2	
Standard functions	ESTOP	В	В	В	В	
Standard functions	SG	В	-	-	-	

Multiple safety functions can be assigned to a single safety input port. Multiple safety functions are prioritized in the following order:

- Priority: High Emergency Stop (ESTOP) Safeguard (SG)
- Priority: Low Safety Limited Speed (SLS) Safety Limited Position (SLP) Joint Angle Limit

Relationship between safety inputs and the STO statement (when ESTOP or SG is assigned)

Safety inputs to which the Emergency Stop (ESTOP) or Safeguard (SG) are assigned execute Safe Stop 1 (SS1) when the signal level is "Low."

Safety Input Signal Level	Safety Function Operation
High	Does not execute Safe Stop 1 (SS1)
Low	Executes Safe Stop 1 (SS1)



Relationship between safety inputs and the STO statement (when SLS is assigned)

The safety input to which Safety Limited Speed (SLS) is assigned disables Safety Limited Speed (SLS) when the signal level is "High" and enables Safety Limited Speed (SLS) when the signal level is "Low."

The delay time for enabling/disabling Safety Limited Speed (SLS) is set in Safety Function Manager.

Safety Input Signal Level	Safety Function Operation
High	Disables Safety Limited Speed (SLS)
Low	Enables Safety Limited Speed (SLS)



Relationship between safety inputs and the STO statement (when SLP is assigned)

The safety input to which Safety Limited Position (SLP) is assigned disables Safety Limited Position (SLP) when the signal level is "High" and enables Safety Limited Position (SLP) when the signal level is "Low."

Safety Input Signal Level	Safety Function Operation
High	Disables Safety Limited Position (SLP)
Low	Enables Safety Limited Position (SLP)



3.11 Safety Outputs

3.11.1 Outline and Operation Patterns for Safety Outputs

Safety outputs are functions that output information related to the safety functions of the Robot Controller to the safety devices connected to the safety outputs of the safety I/O connectors.

The Robot Controller has three ports for safety outputs.

The information that can be assigned to safety outputs is as follows:

- Whether the STO statement is being issued or not
- Whether the emergency stop switch is On or Off (emergency stop switch connected to the EMERGENCY connector, emergency stop switch attached to Teach Pendant)
- Whether the enable switch is on or off
- Whether Safety Limited Speed (SLS) is enabled or disabled (SLS_1, SLS_2, SLS_3, SLS_T, and SLS_T2)
- Whether Safety Limited Position (SLP) is enabled or disabled (SLP_A, SLP_B, and SLP_C)

Multiple pieces of information related to safety functions can be assigned to a single safety output port. When making multiple assignments, the signal level of the safety outputs becomes Low if the STO statement is issued (signal level is Low), the emergency stop is turned on (signal level is Low), the enable switch is turned off (signal level is Low), the Safety Limited Speed (SLS) is enabled (signal level is Low), or the Safety Limited Position (SLP) is enabled (signal level is Low).

Safety output status and output signal level

The safety output to which whether the STO statement is being issued or not is assigned outputs a signal on the Low level if the STO statement is being issued, and a signal on the High level if the STO statement is not being issued.

Assignment to Safety Outputs		Output Signal Level	
STO Stateme	ent	High	Low
Standard functions	STO	Statement not being issued	Statement being issued

The safety output to which whether the emergency stop switch is on or off is assigned outputs a signal on the Low level if the switch is on, and a signal on the High level if the switch is off.

Assignment to Safety Outputs		Output Signal Level		
Emergency Stop	Switch	High	Low	
Standard functions	EP_RC *	Switch off	Switch on	
Standard functions	EP_TP*	Switch off	Switch on	

*: EP_RC: Emergency stop switch connected to the EMERGENCY connector, EP_TP: Emergency stop switch attached to Teach Pendant

The safety output to which whether the enable switch is on or off is assigned outputs a signal on the Low level if the switch is off, and a signal on the High level if the switch is on.

Assignment to Safety Outputs		Output Signal Level	
Enable Swit	ch	High	Low
Standard functions	EN_SW	Switch on (Middle position)	Switch off (Not middle position)

▲ CAUTION

SLS and SLP output whether the monitoring function is enabled.

The signal does not switch even if the Manipulator exceeds speed limits or enters a restricted area. Therefore, to make a trigger when the Manipulator exceeds speed limits or enters a restricted area, use the STO output signal as well.

The safety output to which whether the Safety Limited Speed (SLS) is enabled or disabled is assigned outputs a signal on the Low level if the Safety Limited Speed (SLS) is enabled, and a signal on the High level if it is disabled.

Assignment to Safety (Outputs	Output Sig	gnal Level	
Safety Limited Speed	(SLS)	High	Low	
Standard functions	SLS_T	Output Sig High Limitation disabled Limitation disabled	Limitation enabled	
Standard functions	SLS_T2			
	SLS_1			
Optional safety functions	SLS_2	Limitation disabled	Limitation enabled	
	SLS_3			

The safety output to which whether the Safety Limited Position (SLP) is enabled or disabled is assigned outputs a signal on the Low level if the Safety Limited Position (SLP) is enabled, and a signal on the High level if it is disabled.

Assignment to Safety Outputs		Output Signal Level		
Safety Limited Position (SLP)		High	Low	
Optional safety functions	SLP_A		Limitation enabled	
	SLP_B	Limitation disabled		
	SLP_C			

Time from safety function information input until safety output signal is issued





4. Setting Safety Functions (Setting Software: Safety Function Manager)

4.1 What is Safety Function Manager?

4.1.1 What Safety Function Manager Can Do

Safety Function Manager allows you to check and change the following settings related to Robot Controller safety functions:

- Making dry run settings Refer to the following section for details.
 Making Dry Run Settings
- Checking the robot model, Hofs data, and safety board setting change dates
- Checking and changing safety function parameters (Robot Controller safety function parameters)
- Changing the password for the safety board

The language displayed is automatically switched according to the language of EPSON RC+.

<u> WARNING</u>

If you change the safety parameters for a safety function in the Safety Function Manager, be sure to verify that function and check its validity before use.

4.1.2 Operating Environment

Safety Function Manager can be used in the following operating environment:

EPSON RC+ 7.0: Ver. 7.5.4 or later Robot Controller: RC700-E Manipulator/Application:

- For GX4-B/GX8-B: PC with EPSON RC+7.0 Ver. 7.5.4 or later installed
- For GX10-B/GX20-B:
 PC with EPSON RC+7.0 Ver.7.5.4 A or later installed
- For C4-B/C8-B/C12-B:
 PC with EPSON RC+7.0 Ver.7.5.4 C or later installed

4.1.3 Installation

Safety Function Manager is installed automatically when installing EPSON RC+.

For the supported versions of EPSON RC+, refer to the following section. **Operating Environment**

4.1.4 How to Check the Version (Version Info)

You can check the versions of Safety Function Manager and the safety board firmware.

Select the [Version Info] tag and check the displayed versions.

Safety Function Manager: 1.0.0 or later Safety board version: Rel. 02.00.0031 or later

Safety Function Manager	-	×
Safety Function Settings Basic Settings Version Info Maintenance		
Version Info		
Safety Function Manager		
Safety board version		

Some of the settings in Safety Function Manager are safety function options. Please contact the supplier if you require safety function options.

 \checkmark : Available for use

-: Not available for use

Setting		Standard Functions	Safety Function Options
Dry Run Settings	-	\checkmark	\checkmark
Safety Inputs	ESTOP SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C	✓ ✓ - - - - -	✓
Safety Outputs	STO EP_RC EP_TP EN_SW SLS_T SLS_T2 SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C	V V V V V - - - - -	V
Safety Limited Speed (SLS)	SLS_T SLS_T2 SLS_1 SLS_2 SLS_3	✓ ✓ - -	\checkmark
Safety Limited Position (SLP)	SLP_A SLP_B SLP_C SLS_1 *	-	\checkmark
Soft Axis Limiting	-	✓	✓
Factory Settings	-	✓	✓
Password Management	-	\checkmark	\checkmark

*: Case where Joint Angle Limit is enabled in SLS_1 settings.

4.2 Flow from Startup to Finish

4.2.1 Operation Flow

Changes to the safety function parameters of the safety board are performed as follows:

- 1. Start "Safety Function Manager" Refer to the following section for details. Starting Safety Function Manager
- 2. Change settings Refer to the following section for details. Changing Settings
- 3. Apply settings Refer to the following section for details. Applying Settings

4.2.2 Starting Safety Function Manager

In EPSON RC+, select [Setup] - [System Configuration], and then under [Controller] - [Safety Functions], click [Safety Function Manager].

ools Setun Window Heln	System Configuration	?)	×
PC to Controller Communications PC to Configuration Preferences Options	⊕ Startup General Safety Functions □ - Configuration Preferences Safety board installed: Yes □ Simulator Safety board version: Rel.02.00.00.0031 Jan 17 2023 13:54:01 ⊕ Protots 0 00.00.0121 ⊕ Robots 0 0 ⊕ Stafety Functions 0 0 ⊕ Stafety Functions 0 0 ⊕ Security Safety Function Manager Safety Function Manager	Close Apply Restore	

KEY POINTS

- Safety Function Manager must be started for the first time by the safety manager.
- The following dialog box appears when starting up for the first time. Follow the on-screen instructions and change the password. The initial password is "EpsonSafety."

Safety Board Password Se	tting ×
A factory default passv Please set a new passv	vord is set. vord.
Current Password	*****
New Password	
Confirm Password	
C	ancel Update

- The display language of Safety Function Manager is automatically switched according to the language set in the EPSON RC+.
- If you cannot perform startup, check the following conditions:
 - A Robot Controller equipped with safety functions must be connected.
 - The EPSON RC+ start mode must be in program mode.
 - The control device for the Robot Controller must be a PC.

4.2.2.1 Checking Settings When Starting up Safety Function Manager

When starting up Safety Function Manager, in the [Basic Settings] tab, check the settings of the safety board and make sure that they are the same as those of the Robot Controller.

It is recommended to keep a record of the [Parameter Checksum] of [Robot] and the [Parameter Checksum] of [Safety Functions] as displayed in the Safety Function Manager.

asic Settings	5				
Confirm that the	controller settings and th	e safety board settings ha	ve same values.		
			Controller Settings	Safety Board Settings	
	Robot	Model	GX8-B552S	GX8-B552S	
		Parameter Checksum	0xb7ca	0xb7ca	
	Hofs	J1	86631	86631	
		J2	-688318	-688318	
		J3	-6259	-6259	
		J4	-146	-146	
		Last Modified	-	2022/11/15 18:20:05	
	Safety Functions	Parameter Checksum	-	Oxfeea	
		Last Modified	-	2022/11/15 14:57:12	

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Setting Item		Function	Remarks
Robot	Model	Robot model name	-
Robot	Parameter Checksum	Parameter checksum for robot settings (hidden)	Robot model specific values.
	J1	Hofs value for Joint #1	
	J2	Hofs value for Joint #2	
Hofs	J3	Hofs value for Joint #3	Value for correcting the origin of the joint axis. These values may vary by individual machine even within the same model.
	J4	Hofs value for Joint #4	(Unit: Pulse) The Hofs value for Joint #5 and Joint #6 are only displayed for a 6-Axis robot.
	J5	Hofs value for Joint #5	
	J6	Hofs value for Joint #6	
	Last Modified	Date and time Hofs was modified	-
Safety	Parameter Checksum	Parameter checksum for safety function parameters	Specific value calculated from the safety function parameters for safety inputs, safety outputs, Safety Limited Speed (SLS), Safety Limited Position (SLP), Joint Angle Limit, Soft Axis Limiting, and Dry Run, as well as the safety function parameters last modified value.
Functions	Last Modified	Date and time safety parameters were modified	-

If an error is displayed when starting up Safety Function Manager

An error screen may be displayed when Safety Function Manager is started. Follow the instructions on each screen and take the following measures.

• If the robot model or robot parameter checksum is different Click the [OK] button.

Click [Send robot parameters to the Safety Board]. Follow the on-screen instructions and change the settings.



 If the Hofs value is different Click the [OK] button.

Click [Send Hofs to the Safety Board].

Follow the on-screen instructions, enter the [Password], and change the settings.



 If the Dry Run settings are different Click the [OK] button to restart the Robot Controller.

Safety Fu	nction Manager	×
×	The dry run setting differs between the controller and the Safety board. Use the settings on the Safety board.	
	ОК	

4.2.3 Changing Settings

1. Select the [Safety Function Settings] tab to display the [Safety Function Settings] screen.

Safety Function Settings ask Settings Version laffs Maintenanck Safety Function Settings . Edit safety function parameters. 2. Click Confirm in "Sofety Board Communications". The sety function parameters are sent to the temporary area of the safety board. 3. Make sure that the set value and the response value match. The response values from the safety board are displayed in the safety function manages. 4. Click Apply in "Safety Board Communications". The temporary settings are applied to the safety board. Dry Run "Inable Dry Run" changes dry run for both the controller and the safety board. When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Enable Dry Run "Inable Dry Run" the tractions to be enabled for each safety board input. Safety Inputs Safety Inputs Safety Function Options ESTOP Safety Function Options ESTOP Safety Function Options ESTOP Safety Function Options SAFETY_IN2 Image: Safety Function Options SAFETY_IN2 Image: Safety Function Options SAFETY_IN3 Image: Safety Function Options SAFETY_IN3 Image: Safety Function Parameter Safety Safety Safety Safety Safety Safety Safety Safety Safety Function Options	Safety Function Manage	7										-		×
Safety Function Settings	Safety Function Settings	asic Settings	Version	n Info Main	tenance									
	Safety Function	n Setting	s											^
Dry Run "Enable Dry Run" changes dry run for both the controller and the safety board. When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Enable Dry run Safety Inputs Assign the functions to be enabled for each safety board input. SLS_A. 2. 3. SLP_A. B. C require the safety board input. SLS_1.2. 3. SLP_A. B. C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safery input. If the intended setting cannot be performed, cancel the assigned function. ESTOP : sG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 Safety Input SAFETY_IN2 Image: Safety Input SAFETY_IN3 Image: Safety Input SAFETY_IN4 Image: Safety Input SAFETY_IN5 Image: Safety Input	 Edit safety functions Click Confirm in " The safety functions Make sure that the The response values Click Apply in "Sate The temporary set 	Edit safety function parameters. Click Confirm in "Safety Board Communications". The safety function parameters are sent to the temporary area of the safety board. Make sure that the set value and the response value match. The response values from the safety board communications". A. Click Apply in "Safety Board Communications". The temporary settings are applied to the safety board.												
"Enable Dry Run" changes dry run for both the controller and the safety board. When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Enable Dry run Safety Inputs Safety Inputs Site, 1, 2, 3, SIP, A, B, C require the safety board input. SIS, 1, 2, 3, SIP, A, B, C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP : emergency stop. SG SLS_1 SLS_2 SLS_3 SLP_A SLP_2 SLP_C SAFETY_IN1 Safety Runction Options SAFETY_IN2 SIS SAFETY_IN3 SIS SAFETY_IN3 SIS SAFETY_IN4 SIS SAFETY_IN5 SIS	Dry Run													
Enable Dry run Safety Inputs Assign the functions to be enabled for each safety board input. SL5_1.2.3.SLP_A.B.C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP SG SL5_1 SL5_2 SL5_3 SLP_A SLP_B SLP_C SAFETY_IN1 SAFETY_IN2 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5 S	"Enable Dry Run" When dry run is e	changes dr mabled, rob	y run foi iot contr	r both the o rol by the o	ontroller a	and the s and monit	afety boar toring by t	d. he safety	oard are disabled.					
Safety Inputs Safety Inputs Assign the functions to be enabled for each safety board input. SLE_1.2.3.SUP_A.B.C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP SG SLS_1 Safety Function Options ESTOP SG SLS_1 SAFETY_IN1 SAFETY_IN1 SAFETY_IN2 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3	Enable Dry	run												
Safety Inputs Assign the functions to be enabled for each safety board input. SL5_1, 2, 3, SLP, A, B, C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. Three are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP : emergency stop. SG: protective stop. ESTOP SG SL5_1 SAFETY_IN1 Safety Function Options SAFETY_IN2 Safety SAFETY_IN3 Safety Representation SAFETY_IN4 Safety_IN5	Safety Inputs													
Assign the functions to be enabled for each safety board input. SLS_12.3.5.10P.A.B.C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP : emergency stop. SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1	Safety Inputs													
ESTOP SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 Image: Safety_IN2 Image: Safety_IN3	Assign the function SLS_1. 2. 3. SLP_A. E There are restriction ESTOP : emergency	s to be enal 3. C require ns on the co stop. SG : p	bled for the safe mbinati rotectiv	each safety ty function on of assig e stop.	board in option to nments fo	put. be enabl « a safety	ed. If thes input. If t	e are enat he intende	ed. you can set saf d setting cannot be	ety outputs an e performed, c	d monitoring ancel the assi	their st gned fu	atus. Inction.	
ESTOP SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 Image: Safety_IN2 Image: Safety_IN3 Image: Safety_IN3 Image: Safety_IN4 Image: Safety_IN5					Saf	ety Func	tion Opti	ons						
SAFETY_IN1 Image: Constraint of the		ESTOP	SG	SLS_1	SLS_2	SLS_3	SLP_A	SLP_B	SLP_C					
SAFETY_IN2 Image: Constraint of the second	SAFETY_IN1	~												
SAFETY_IN3 SAFETY_IN4 SAFETY_IN5	SAFETY_IN2		1											
SAFETY_IN4	SAFETY_IN3													
SAFETY_INS	SAFETY_IN4													
×	SAFETY_IN5													~

2. Select the items for which you want to change the settings.



For details on settings, refer to the following section.

Safety Function Parameters

KEY POINTS

Parameters whose settings have been changed are displayed with a blue background. After applying the settings to the safety board, the display returns to normal.





4.2.4 Applying Settings

Finish editing the safety function parameters and display the confirmation screen.

1. Click the [Confirm] button.

Safety Board Communications			
Click Confirm and then Apply to set the safety functions.			
	Confirm	Apply	Cancel

2. Enter the password on the password entry screen and then click the [Confirm] button.



KEY POINTS

 If an incorrect password is entered three times, Safety Function Manager shuts down and the Robot Controller is restarted. Settings are not changed.

3. On the confirmation screen that appears, confirm the changed safety function parameters.

KEY POINTS

- Settings cannot be changed on the confirmation screen. If you need to continue to make changes, click the [Cancel] button.
- If a setting item is displayed in yellow after clicking the [Confirm] button, an error in communication with the safety board has occurred. Restart both the Robot Controller and the PC on which Safety Function Manager is operating, and then perform the setting again. If the problem is still not improved, stop use of the robot system and contact the supplier.

4. Click the [Apply] button.

Safety Function Manager shuts down and the Robot Controller is restarted.

Safety Board Communications			ľ
Click Confirm and then Apply to set the safety functions.			
	Confirm	Apply	Cancel
			1

5. After the Robot Controller restarts, EPSON RC+ will connect automatically.

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6. Start Safety Function Manager and check to see if the parameters you changed have been applied.

🖋 KEY POINTS

 Safety function parameters should be applied to the safety board only after the safety manager has thoroughly checked the contents.

Cancelling

This cancels changes to safety function parameters.

Safety Board Communications		
Click Confirm and then Apply to set the safety functions.		
	Confirm	Cancel

Canceling before clicking the [Confirm] button will close Safety Function Manager without changing the safety function parameters of the safety board. The Robot Controller is not restarted at this time.

Canceling after clicking the [Confirm] button will close Safety Function Manager without changing the safety function parameters of the safety board. The Robot Controller is also restarted.

4.2.5 Saving Settings (Performing a Backup)

The settings of Safety Function Manager can be saved using "Controller Backup" in EPSON RC+. Backing up your settings allows you to restore the saved settings if you make a mistake when performing settings or if the safety board malfunctions. Be sure to perform a backup when changing the safety board settings, after teaching, and before performing maintenance.

KEY POINTS

Depending on the status of the device, backing up may not be available before maintenance. Be sure to always back up your latest settings.

Data that can be backed up

The backup saves the safety function parameters and the safety parameter last modified value.

- Safety inputs
- Safety outputs
- Safety Limited Speed (SLS)
- Safety Limited Position (SLP)
- Joint Angle Limit
- Soft Axis Limiting
- Dry Run

KEY POINTS

For details on backup data other than the safety function parameters, refer to the following manual. "EPSON RC+ User's Guide"

Backup procedure

The backup is performed using "Controller Backup" in EPSON RC+. For details, refer to the following manual. "EPSON RC+ User's Guide"

For the restoration method, refer to the following section. Restoring Saved (Backed-up) Settings

4.2.6 Confirming Saved Information (Saved States Viewer)

You can refer to Safety Function Manager settings using the backup data saved with "Controller Backup" in EPSON RC+. In EPSON RC+ 7.0, open the [Controller] dialog box, and then select [View Controller Status]. For details, refer to the following manual.

"EPSON RC+ User's Guide"

Refer to the SF_GetParam function in the manual below for an explanation of the displayed setting values. "EPSON RC+ SPEL+ Language Reference"

atus Folder: B_RC700-E_	E7EA000010_2023-07-04_082001	Status Date / Time: 2023-07-04 08:20:01	
⊡ Input / Output			
Tasks	ltem	Value	^
⊡ Robots	Operation Mode	Program	
System History	Control Device	PC	
Program Files	Display Device	PC	
Debet Deiete	Controller Preferences		
Endot Foints	Safety Board Configuration		
Port Forder	SF_TOOLVERSION	0	
Maintenance	SF_CHECKSUM	4F3	
Maintenance	SF_LAST_MODIFIED	2023/07/03 20:07:55	
	SF_ROBOT_MODEL_NAME	GX10-B651S	
	SF_ROBOT_CHECKSUM	E4CB	
	SF_HOFS	0,0,0,0,0	
	SF_HOFS_LAST_MODIFIED	2023/07/03 20:06:19	
	DRYRUNOFF	1	
	SLS_1_HAND_EN	0	
	SLS_1_SPEED	250	
	SLS_1_ELBOW_EN	0	
	SLS_1_JOINT_EN	0	
	SLS_1_JOINTSPEED	7	
	SLS 2 HAND EN	0	

4.3 Safety Function Parameters

This section describes the safety function parameters that set the Robot Controller safety functions.

4.3.1 Setting Safety Function Parameters Related to Safety Inputs and Safety Outputs

These settings are used by the safety input and safety output functions.

Safety Function Manage	ſ												-		×
Safety Function Settings	Basic Setting	s Version	Info Main	tenance											
Enable Dry	run														^
Cabe Innuts															
Safety Inputs															
Assign the functions	s to be ena	bled for e	ach safet	/ board in;	put.										
SLS_1, 2, 3, SLP_A, B	, C require	the safety	/ function	option to	be enabl	ed. If these	e are enab	led, you c	an set sat	fety outp	outs and	monitori	ng their st	atus.	
ESTOP : emergency	stop. SG : j	protective	stop.	ninents io	r a salety	input ii u	le miende	a setting	cannot b	e periori	neu, cai	icei trie a	ssigned it	netion.	
				Saf	etv Func	tion Opti	ons								
	ESTOP	SG	SLS_1	SLS_2	SLS_3	SLP_A	SLP_B	SLP_C							
SAFETY_IN1	✓														
SAFETY_IN2		~													
SAFETY_IN3															
SAFETY_IN4															
SAFETY_IN5															
														_	
Safety Outputs															
Safety Outputs															
Assign conditions fo	or safety bo	oard outpu	uts.	aditions a											
STO : Safe Torque O	ff. EP_RC :	emergeno	y stop on	robot cor	troller po	ort. EP_TP :	emergen	cy stop on	TP. EN_S	W : enab	oling swi	tch on TF	SLS_T : S	LS on	
teach mode. SLS_T2	: SLS on Te	est_T2 mo	de.												
	STO	EP_RC	EP_TP	EN_SW	SLS_T	SLS_T2	SLS_1	SLS_2	SLS_3	SLP_A	SLP_B	SLP_C			
SAFETY_OUT1															
SAFETY_OUT2															
CAFETY OUT?															\sim

Safety input settings

These settings assign a function to be enabled for the safety inputs. For example, if you want to perform an emergency stop when a signal is input to SAFETY_IN1, enable the checkbox at the intersection of SAFETY_IN1 and ESTOP.

No	Name	Function	Notes				
1. Safet	1. Safety Input Settings						
1.1	SAFETY_IN1	Function setting for SAFETY_IN1					
1.2	SAFETY_IN2	Function setting for SAFETY_IN2					
1.3	SAFETY_IN3	Function setting for SAFETY_IN3	Set the function for each safety input by assigning one of the "A. Safety Functions That Can Be Assigned" in the table below.				
1.4	SAFETY_IN4	Function setting for SAFETY_IN4					
1.5	SAFETY_IN5	Function setting for SAFETY_IN5					

	1	1	
No	Name	Function	Notes
A. Safety Fur	nctions That Ca	an Be Assigned	
Standard	ESTOP	Emergency stop	ESTOP is assigned to SAFETY_IN1 by factory default.
Functions	SG	Protective stop	SG is assigned to SAFETY_IN2 by factory default.
Safety Function Options	SLS_1, SLS_2, SLS_3	Safety Limited Speed (SLS)	 SLS_1, 2, and 3 can be assigned to safety inputs to set the safety outputs and the safety speed limit. Refer to the following section for details. Setting Safety Function Parameters Related to Safety Limited Speed (SLS) SLS_T and SLS_T2 monitoring is enabled in the prescribed operation modes without having to be assigned to a safety input. Refer to the following section for details. Safety Limited Speed (SLS)
	SLP_A, SLP_B, SLP_C	Safety Limited Position (SLP)	 SLP_A, B, and C can be assigned to safety inputs to set the safety outputs and monitored areas. Refer to the following section for details. Robot Installation Position Settings for Safety Limited Position (SLP)

- If ESTOP is not set for SAFETY_IN, an emergency stop switch must be connected to the emergency stop input connector or a Teach Pendant must be connected.
- SG should be set to one or more SAFETY_IN.

Settings for the safety inputs are divided into three groups.

	Grop1	Grop2	Grop3					
	ESTOP	SG	SLS_1	SLS_2	SLS_3	SLP_A	SLP_B	SLP_C
SAFETY_IN1								

- Any single group of safety functions can be selected for one SAFETY_IN.
- Group 3 allows a combination of functions to be selected.
 - For SLS options, one can be selected.
 - For SLP options, an arbitrary combination can be selected. When SAFETY_IN is turned ON, all combined functions will be enabled.

SAFETY_IN5												
afety Outputs												
Assign conditions for S	Safety Board o	utputs.										
Each signal becomes a STO : Safe Torque Off.	EP_RC : eme	rgency sto	conditions	s are met. s controller po	rt. EP_TP	: emerge	ency sto	o on TP.	EN_SW	/: enablin	g switch o	n '
SLS_T : SLS on teach	mode. SLS_T	2: SLS on	Test_T2 m	node.		-					-	
s	TO EP_RC	EP_TP E	EN_SW SL	_S_T_SLS_T2	SLS_1	SLS_2	SLS_3	SLP_A	SLP_B	SLP_C		
SAFETY_OUT1 [
SAFETY_OUT2												
SAFETY_OUT3												
	ceu											
Enter the hand tip or	sition (farthe	t nart) in t	the tool 0 c	coordinate sv	tem							_
		in party in t		sooramace sys							(X,Y,Z)	•
X_TCP 0	mm										×	у
Y_TCP 0	mm										¥ z	
Z_TCP 0	mm										-	v
											- 🗧	•
											(X,Y,Z)	
												-
Sefety Lingthed Core												

Safety outputs settings

These settings assign conditions for when the safety outputs output a signal. For example, if you want to output a signal from SAFETY_OUT1 when STO is executed, enable the checkbox at the intersection of SAFETY_OUT1 and STO.

No	Name	Function	Notes				
2. Safet	2. Safety Output Ports						
2.1	SAFETY_OUT1	Function setting for SAFETY_OUT1					
2.2	SAFETY_OUT2	Function setting for SAFETY_OUT2	Set the function for each safety output port by assigning one of the "B. Safety Functions That Can Be Assigned" in the table below.				
2.3	SAFETY_OUT3	Function setting for SAFETY_OUT3					

No	Name	Function	Notes	
B. Safety F	unctions That Can Be	Assigned		
	STO	Outputs a signal when a Safe Torque OFF is executed.	Refer to the following section for details. Safe Torque OFF (STO)	
	EP_RC	Outputs whether the emergency stop button connected to the emergency stop input connector of the Robot Controller is On or Off.	Refer to the following section for details. Emergency Stop	
Standard functions	EP_TP	Outputs whether the emergency stop button on the Teach Pendant is On or Off.	Refer to the following section for details. Emergency Stop	
	EN_SW	Outputs whether the enable switch on the Teach Pendant is On or Off.	Refer to the following section for details. Enable	
	SLS_T	Outputs whether Safety Limited Speed (SLS_T) is enabled or disabled.	Refer to the following section	
	SLS_T2	Outputs whether Safety Limited Speed (SLS_T2) is enabled or disabled.	Safety Limited Speed (SLS)	
Optional safety functions	SLS_1,SLS_2,SLS_3	Outputs whether Safety Limited Speed (SLS) is enabled or disabled.	Safety Function options. A function can only be assigned to a safety output if it is assigned to a safety input. Refer to the following section for details. Safety Limited Speed (SLS)	
	SLP_A,SLP_B,SLP_C	Outputs whether Safety Limited Position (SLP) is enabled or disabled.	Safety Function options. A function can only be assigned to a safety output if it is assigned to a safety input. Refer to the following section for details. Safety Limited Position (SLP)	

Multiple functions can be selected. When even one of the selected functions operates, a signal is output from the SAFETY_OUT.

4.3.2 Setting Safety Function Parameters Related to Safety Limited Speed (SLS)

These settings are used by the Safety Limited Speed (SLS) function. Set the following items:

- TCP Offset
- Safety Limited Speed

🕂 WARNING

Be sure to set TCP Offset to properly operate Safety Limited Speed.

The TCP offset setting set in Safety Function Manager is not linked to the setting parameters set in the "Tool Settings" section of the "EPSON RC+ User's Guide". Make sure that these settings are consistent.

- SLS_1, SLS_2, and SLS_3 can be edited only when a function is assigned to the safety input.
- The TCP Offset should be set to the hand tip position* using the Tool 0 coordinate system as a reference.
 *: The position where the hand moves at its fastest during robot operation. Or, the position farthest from the tip of the ball screw linear motion mechanism.
- To achieve control that does not exceed the Safety Limited Speed (SLS), it must be explicitly set using the SPEL+ command.

The robot makes an emergency stop if Safety Limited Speed (SLS) is enabled and the robot speed exceeds the monitoring speed.

- If SLS_1, SLS_2, and SLS_3 are enabled, the next SPEL+ command is automatically set when the controller starts up.
 - SLS number set in SF_LimitSpeedS, 0
 - SLS number set in SF_LimitSpeedSEnable, On
- SF_LimitSpeedS and SF_LimitSpeedSEnable are functions that adjust the speed at the tool position selected by the Tool command. For details, refer to the following manual.
 "SPEL+ Language Reference"
- The speed of Monitored Joints can be acquired with SF_PeakSpeedS/SF_RealSpeedS. In addition, the joint speed of Monitored Joints can be acquired with PeakSpeed. For details, refer to the following manual.
 "SPEL+ Language Reference"



a: Control using SPEL+ to ensure that the Maximum Speed (mm/s) is not exceeded referring to the SF_PeakSpeedS command value.

b: Referring to the PeakSpeed con	nmand values, control with SPEL+	to avoid exceeding the Maximum.	Joint Speed (%)	1.
-----------------------------------	----------------------------------	---------------------------------	-----------------	----

No	Name	Function	Notes	
1. TCP Offset Settings		These set the TCP Offset [mm].		
1.1	X_TCP	Setting for the offset position [mm] of the X axis	-	
1.2	Y_TCP	Setting for the offset position [mm] of the Y axis	-	
1.3	Z_TCP	Setting for the offset position [mm] of the Z axis	-	

No	Name	Function	Notes	
2. Joint Angle Limit		These configure settings related to the .	Joint Angle Limit.	
2.1	Check box	Setting for whether to execute Joint Angle Limit	This is a function of SLS_1 (safety function option).	
2.2	Maximum Joint Angle	Setting for the limit angle $[\times 0.1 \text{ deg}]$	To use this, enable SLS_1 in the safety input settings.	

No	Name	Function	Notes
3	SLS_T Settings	Setting for Maximum Speed in TEACH mode and TEST T1 mode	 The following settings are available: Maximum Speed setting (required) Set at 250 [mm/sec] or less. Maximum Joint Speed setting (optional) This is always enabled for the Monitored Joints other than the Maximum Joint Speed. This cannot be disabled.
4	SLS_T2 Settings	Setting for Maximum Speed in TEST T2 mode	 The following settings are available: Maximum Speed setting (required) Maximum Joint Speed setting (optional) This is always enabled for the Monitored Joints other than the Maximum Joint Speed. This cannot be disabled.
5	SLS_1 Settings	Setting for Maximum Speed in SLS_1	Safety Function options. The following settings are available:
6	SLS_2 Settings	Setting for Maximum Speed in SLS_2	 Maximum Speed setting (required) Delay Time (optional) Monitored Joints (At least one must be selected, including
7	SLS_3 Settings	Setting for Maximum Speed in SLS_3	the Maximum Joint Speed) - Maximum Joint Speed setting (required)

No	Name	Function	Notes
А	Maximum Speed (mm/s)	Setting for Maximum Speed [mm/sec] in each limit	Make this setting based on the speeds that can be obtained with the SF_PeakSpeedS command and SF_RealSpeedS command.
В	Delay Time (msec)	Setting for Delay Time [ms] in each limit	-
С	Monitored Joints	Settings for Monitored Joints in each limit	Be sure to set up at least one joint.
C.1	J2	Setting for whether to monitor J2 (shoulder) speed	-
C.2	J3	Setting for whether to monitor J3 (elbow) speed	This can only be set for a 6-Axis robot.
C.3	J5	Setting for whether to monitor J5 (wrist) speed	This can only be set for a 6-Axis robot.
C.4	Hand	Setting for whether to monitor hand speed (TCP speed)	-
D	Joint rotation setting	Setting for joint speed monitoring in each limit	-
D.1	Joints	Setting for whether to monitor joint speed	-
D.2	Maximum Joint Speed [%]	Setting for Maximum Speed of joint axis rotation or vertical motion [%]	Set this as a percentage [%] of the maximum speed. Set this using the PeakSpeed command referring to the absolute obtainable peak speed value.

4.3.3 Robot Installation Position Settings for Safety Limited Position (SLP)

Set the robot installation position for using the Safety Limited Position (SLP) function. Set the following items:

- Installation Position
- Installation Plane Rotation

WARNING

Be sure to set the Installation Position and the Installation Plane Rotation in order for the Safety Limited Position to operate properly.

Safety Function Manager						
fety Function Settings Bas	ic Settings Version Info N	faintenance				
SLS_3	250	500			7	
afety Limited Posi	ition					
Installation Position						
Enter the robot insta	allation position in the ro	bot coordinate syst	em.			
X OES	0 [mm]				Уţ	
X_OFS	0 [mm]					
7.055	0 [mm]				Urot	
					Yofs	
nstallation Plane Ro	tation					
Enter the rotation ar	ngle of the robot installa	tion plane to the rol	oot coordinate sy:	stem.	Xots	
U_ROT	0 [deg]					
Appitored Areas						
Sot the grage for restr	icted robot onto:					
Enable one or more n	nonitored areas located	between X1 and X2,	Y1 and Y2, Z1 an	d Z2.		
	XV	Plane				
	• Wall	riune -				
	Restriction	cted Area				
	¥2					
	У					

No	Name	Function	Notes
1. Installation Position		Set the robot offset position [mm].	
1.1	X_OFS	Setting for the offset position in the X direction	-
1.2	Y_OFS	Setting for the offset position in the Y direction	-
1.3	Z_OFS	Setting for the offset position in the Z direction	This can only be set for a 6-Axis robot.

No	Name	Function	Notes			
2. Installation	Plane Rotation	Set the robot offset angle [deg].				
2.1	U_ROT	Setting for the offset angle around the U axis	-			
2.2	V_ROT	Setting for the offset angle around the V axis	This can only be set for a 6-Axis robot.			
2.3	W_ROT	Setting for the offset angle around the W axis	This can only be set for a 6-Axis robot.			

4.3.4 Setting Safety Limited Position (SLP)

Perform settings to use the Safety Limited Position (SLP) function. Set the following items:

- Robot Monitored Range
- Monitored Areas

- SLP_A, SLP_B, and SLP_C can only be edited if they are assigned to safety inputs.
- This does not perform control to prevent entry into the monitored areas. Perform the following settings as necessary.
 - Set the XYZ limits (XYLim) so that the robot does not enter the monitored areas.
 - Set the entry detection area (Box) or the entry detection plane (Plane) considering the stopping distance around the monitored areas, and perform appropriate control when an entry is detected.
 For details on XYZ limits (XYLim), entry detection area (Box), and entry detection plane (Plane), refer to the following manual.

"EPSON RC+ User's Guide", "SPEL+ Language Reference"

- For SCARA Manipulators, set the J3 axis monitoring radius to a value that encompasses the hand (end
 effector). This value is used to determine if the hand has entered the monitored areas.
- For 6-Axis Manipulators, set the J6 axis monitoring radius to a value that encompasses the hand (end
 effector). This value is used to determine if the hand has entered the monitored areas.

fety Funct	tion Settings	Basic Settings	Version Info	Maintenance							
lobot N	Nonitored	Range									
Enter t monito	the radius of pred positior	the joint mo n.	nitoring ra	nge used to determine th	e entry into tl	he		60	ŀ		
	Monitorir	ig Range R	adius					L.			
J2		79 (mn	n)						- C		
J3		56 (mn	n)					H H H			
								J3 J2			
J6		0 (mn	n)							J	
J6 oft Ax Enter t This se	is Limiting the limit range tting is not a Min (pulse)	0 (mn ge of joint m associated w Ma (pu	n) otion. ith the Rob ax ulse)	ot Manager "Range" sett	ing. Minimum (Joint)	Maximum (Joint)]	
J6 oft Axi Enter t This se	is Limiting the limit rang titing is not a Min (pulse) -18058	0 (mn e of joint m associated w Ma (pu 31 7	n) otion. ith the Rob ax ilse) 048761	ot Manager "Range" sett •1805881 To 7048761	ing. Minimum (Joint) -62.000	Maximum (Joint) 242.000	(deg)]	
J6 oft Axi Enter t This se J1 J2	is Limiting the limit rangetting is not a Min (pulse) -180586 -27761	0 (mn ge of joint m associated w Ma (pu 81 7 78 2	n) otion. ith the Rob Ilse) 048761 776178	ot Manager "Range" sett -1805881 To 7048761 -2776178 To 2776178	ing. Minimum (Joint) -62.000 -152.500	Maximum (Joint) 242.000 152.500	(deg) (deg)		J4		
J6 oft Ax Enter t This se J1 J2 J3	is Limiting the limit rangetting is not a Min (pulse) -18058 -27761 -8110	0 (mn ge of joint m associated w Ma (pu 31 7 78 2 08	n) otion. iith the Rob IX IISe) 048761 .	ot Manager "Range" sett -1805881 To 7048761 -2776178 To 2776178 -811008 To 0	Minimum (Joint) -62.000 -152.500 -150.000	Maximum (Joint) 242.000 152.500 0.000	(deg) (deg) (mm)	J1	J4		
J6 Enter t This se J1 J2 J3 J4	is Limiting the limit rang titting is not a Min (pulse) -18058 -27761 -81100 -19515	o (mn ge of joint m sssociated w Ma (pt 31 7 78 2 38 2 38 2 38 2 39 3	n) otion. ith the Rob ix ise) 048761	ot Manager "Range" sett -1805881 To 7048761 -2776178 To 2776178 -811008 To 0 -1951517 To 1951517	Minimum (Joint) -62.000 -152.500 -150.000 -360.000	Maximum (Joint) 242.000 152.500 0.000 360.000	(deg) (deg) (mm) (deg)	J1 -55	J4		
J6 oft Axi Enter t This se J1 J2 J3 J4 J5	is Limiting the limit rang ttting is not a Min (pulse) -18058 -27761 -81100 -19515	0 (mm ge of joint m sssociated w Ma (pL 311 7 78 2 88 1 17 1 0	n) otion. ith the Rob itse) 048761 776178 951517	ot Manager "Range" sett -1805881 To 7048761 -2776178 To 2776178 -811008 To 0 -1951517 To 1951517	ing. Minimum (Joint) -62.000 -152.500 -150.000 -360.000 0.000	Maximum (Joint) 242,000 152,500 0.000 360,000 0.000	(deg) (deg) (mm) (deg) (deg)	1 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 -	EL		



No	Name	Function	Notes		
1. Robot Monitored Range		Set the safety monitoring radius [mm] for each joint.			
1.1	J2	Setting for the monitoring radius for J2 axis	-		
1.2	J3	Setting for the monitoring radius for J3 axis	-		
1.3	J5	Setting for the monitoring radius for J5 axis	This can only be set for a 6-Axis robot.		
1.4	J6	Setting for the monitoring radius for J6 axis	This can only be set for a 6-Axis robot.		
2	SLP_A	SLP_A-related settings	-		
3	SLP_B	SLP_B-related settings	-		
4	SLP_C	SLP_C-related settings	-		

No	Name	Function	Notes
А	XY plane settings	Setting for XY plane in each function	-
A.1	Enable setting	Setting for whether to execute monitoring of the XY plane	-
A.2	Range selection	Selection of setting range - Wall - Restricted Area	This can only be set if "A.1 Enable setting" is enabled.
В	Enable XY plane range	Setting for whether to execute monitoring in each XY direction	This can only be set if "A.1 Enable setting" is enabled.
B.1	X1	Setting for whether to execute monitoring in the X1 direction	
B.2	X2	Setting for whether to execute monitoring in the X2 direction	This can only be set when Wall is
B.3	Y1	Setting for whether to execute monitoring in the Y1 direction	Be sure to enable at least one location.
B.4	Y2	Setting for whether to execute monitoring in the Y2 direction	
С	XY plane range input	Setting for monitoring range in the XY direction	This can only be set if "A.1 Enable setting" is enabled.
C.1	X1	Setting for range in the X1 direction	
C.2	X2	Setting for range in the X2 direction	Set V2 to a value greater than V1
C.3	Y1	Setting for range in the Y1 direction	Set A2 to a value greater than A1.
C.4	Y2	Setting for range in the Y2 direction	
D	Setting for the Z direction	Setting for monitoring in the Z direction	
D.1	Enable setting	Setting for whether to execute monitoring in the Z direction	Only Wall (floor, ceiling) can be set for the Z direction.
Е	Enable Z direction range	Setting for whether to execute monitoring in the Z direction	
E.1	Z1	Setting for whether to execute monitoring in the Z1 direction	This can only be set if "D.1 Enable
E.2	Z2	Setting for whether to execute monitoring in the Z2 direction	setting" is enabled.
F	Z direction range input	Setting for monitoring range in the Z direction	
F.1	Z1	Setting for range in the Z1 direction	Set this to a value smaller than the robot
F.2	Z2	Setting for range in the Z2 direction	position.
		-	-

Difference between a "Wall" and a "Restricted Area"

Wall

The upper and lower limits of the robot's operating area are set, and if the robot moves from inside the set area to outside,

then Safe Torque OFF (STO) is executed, putting the Robot Controller in the emergency stop status. Please set the monitoring range considering the stopping distance. For the stopping distance, refer to the following manual. "Manipulator Manual - Appendix B. Stopping Time and Stopping Distance at Emergency Stop, Appendix C: Stopping

Time and Stopping Distance When Safeguard Is Open"

Example of use: Preventing collisions with safety barriers

Refer to the following section for details.

Monitoring Areas for a SCARA Manipulator

Monitoring Areas for a 6-Axis Manipulator

For a SCARA Manipulator, 15 patterns, (a) through (o) can specified for the restricted range on the XY plane, which correspond to Walls.

For a 6-Axis Manipulator, there are a total of 18 patterns, including three patterns, (q) through (s) for the monitored position in the Z direction, in addition to those specified for the restricted range on the XY plane, which correspond to Walls.

Restricted Area

A prohibited area is set within the robot's operating area, and if the robot moves from outside the set area to inside, then Safe Torque OFF (STO) is executed, putting the Robot Controller in the emergency stop status. Please set the monitored areas considering the stopping distance. For the stopping distance, refer to the following manual.

"Manipulator Manual - Appendix B. Stopping Time and Stopping Distance at Emergency Stop, Appendix C: Stopping Time and Stopping Distance When Safeguard Is Open"

Example of use: Preventing collisions with structures near the robot

Refer to the following section for details.

Monitoring Areas for a SCARA Manipulator

Monitoring Areas for a 6-Axis Manipulator

Pattern (p) corresponds to the Restricted Area.

4.3.5 Setting Soft Axis Limiting

Perform settings to use the Soft Axis Limiting function.

The setting range of Soft Axis Limiting is displayed to the right of the Soft Axis Limiting setting value. This setting range varies depending on the robot model.

🕂 WARNING

The operating range set in Safety Function Manager is not linked to the setting parameters set in the "Tool Settings" section of the "EPSON RC+ User's Guide". Set the operating range referring to the following.

✗ KEY POINTS

- The Soft Axis Limiting function is always enabled, except in TEACH mode.
- If any axis moves out of the motion range, Safe Torque OFF (STO) is executed, putting the Robot in the emergency stop status.
- The [Soft Axis Limiting] setting set in Safety Function Manager and the [Range] set in EPSON RC+ can be set separately. We recommend setting [Range] to values equal to or narrower than those of [Soft Axis Limiting].

Robot: 1, Robo	ot1, GX8-B452S			▼ To	ol: 0 🔻	Arm: 0	•	ECP: 0	-	🖻 Ŋ 🕯	00	
Arch Locals	Range		Define limi	ts for eac	ch robot joint							
Tools												
Arms		$\left(\right)$	Values a	are in end	coder pulses							
Pallets		J1:	-1128676	То	4405476						Apply	
ECP		12.	-2685156		2685156						Restore	
Boxes		VZ.	2000100		2000100						11001010	
Planes		J3:	-1092267	To	0						Defaults	
Weight		J4:	-1668189	To	1668189					1.1	Clear	
Inertia		J5:		То								
XYZ Limits		J6:		То)					
Range		~										
Home Config			Re	ead J1 M	inimum							
^												

								_	
afety Functi	ion Settings Bas	ic Settings Version	Info Maintenance						
Robot N	Ionitored Ra	inge							
Enter ti monito	he radius of th pred position.	e joint monitoring	range used to determine the	e entry into t	he				
	Monitoring	Range Radius					L_		
J2	7	9 (mm)					44		
J3	5	6 (mm)							
							J3 J2		
	is Limiting								
Enter ti This se	he limit range tting is not ass Min (nulse)	of joint motion. ociated with the R Max (nulse)	lobot Manager "Range" setti	ng. Minimum (loint)	Maximum				
Enter ti This se J1	IS Limiting he limit range tting is not ass Min (pulse) -1805881	of joint motion. ociated with the R Max (pulse) 7048761	lobot Manager "Range" setti -1805881 To 7048761	ng. Minimum (Joint) -62.000	Maximum (Joint) 242.000	(deg)			
Enter ti This se J1 J2	Is Limiting he limit range tting is not ass Min (pulse) -1805881 -2776178	of joint motion. ociated with the R Max (pulse) 7048761 2776178	lobot Manager "Range" settii -1805881 To 7048761 -2776178 To 2776178	ng. Minimum (Joint) -62.000 -152.500	Maximum (Joint) 242.000 152.500	(deg)	12 14		
Enter ti This se J1 J2 J3	IS Limiting he limit range tting is not ass Min (pulse) -1805881 -2776178 -811008	of joint motion. ociated with the F Max (pulse) 7048761 2776178 0	Nobot Manager "Range" setti -1805881 To 7048761 -2776178 To 2776178 -811008 To 0	Minimum (Joint) -62.000 -152.500 -150.000	Maximum (Joint) 242.000 152.500 0.000	(deg) (deg) (mm)	J1 J2 J4		
Enter ti This se J1 J2 J3 J4	IS Limiting he limit range tting is not ass Min (pulse) -1805881 -2776178 -811008 -1951517	of joint motion. ociated with the R Max (pulse) 7048761 2776178 0 1951517	Nobot Manager "Range" setti -1805881 To 7048761 -2776178 To 2776178 -811008 To 0 -1951517 To 1951517	Minimum (Joint) -62.000 -152.500 -150.000 -360.000	Maximum (Joint) 242.000 152.500 0.000 360.000	(deg) (deg) (mm) (deg)	J1 J2 J4		
Enter ti This se J1 J2 J3 J4	IS Limiting he limit range titing is not ass Min (pulse) -1805881 -2776178 -811008 -1951517	of joint motion. ociated with the R Max (pulse) 7048761 2776178 0 1951517 0	oboot Manager "Range" settii -1805881 To 7048761 -2776178 To 2776178 -811008 To 0 -1951517 To 1951517	Minimum (Joint) -62.000 -152.500 -150.000 -360.000	Maximum (Joint) 242.000 152.500 0.000 360.000	(deg) (deg) (mm) (deg)	J1		
Enter ti This se J1 [J2] J3 [J4] J5]	In the limit range - titing is not ass Min (pulse) -1805881 -2776178 -811008 -19515177	of joint motion. ociated with the R Max (pulse) 7048761 2776178 0 1951517 0	obot Manager "Range" setti -1805881 To 7048761 -2776178 To 2776178 -811008 To 0 -1951517 To 1951517	Minimum (Joint) -62.000 -152.500 -150.000 -360.000 0.000	Maximum (Joint) 242.000 152.500 0.000 360.000 0.000	(deg) (deg) (mm) (deg) (deg)	J1 4 5 1 3		

No	Name	Function	Notes
1. Soft Axis Limiting		Set the movement range monitoring value for each join	nt.
5.1	J1	Set the movement range monitoring value for each joint.	-
5.2	J2	Setting for the operating range monitoring value for J2 axis	-
5.3	J3	Setting for the operating range monitoring value for J3 axis	-
5.4	J4	Setting for the operating range monitoring value for J4 axis	-
5.5	J5	Setting for the operating range monitoring value for J5 axis	This can only be set for a 6-Axis robot.
5.6	J6	Setting for the operating range monitoring value for J6 axis	This can only be set for a 6-Axis robot.

No	Name	Function	Notes
А	Minimum (pulse)	Setting for the minimum value of the limit range	-
В	Maximum (pulse)	Setting for the maximum value of the limit range	-
С	-	Display of minimum Acceptable Range	-
D	-	Display of maximum Acceptable Range	-
Е	Minimum (joint)	Display of minimum Acceptable Range	0 [pulse] is displayed as 0 [°].
F	Maximum (joint)	Display of maximum Acceptable Range	0 [pulse] is displayed as 0 [°].

4.3.6 SLP Viewer

This allows you create a 3D model to visualize the Monitored Areas and Robot Monitored Range edited in Safety Function Manager to check settings.

SLP Viewer is started by clicking the [Start SLP Viewer] button. With SLP Viewer running, click the [Start SLP Viewer] button to update the display.




No	Name	Function	Notes
1	3D model display section	Visualization of the Safety Restricted Area and Robot Monitored Range	There is no collision detection function.
2	Operation panel of the Robot Monitored Range	Select the monitoring area of the robot axis to be visualized	-
3	Operation panel of the Safety Restricted Area	Select the safety area to be visualized	-

Moving robot joints

Drag the joints of the robot to move each joint of the robot. Selected joints are displayed in blue.

Changing viewpoint

Drag the 3D model display screen with the left mouse button to rotate the viewpoint. Drag the 3D model display screen with the right mouse button to move the viewpoint up, down, left, or right.

Zooming in or out

Move the scroll wheel to zoom in or out on the 3D display.

- The Monitored Areas and Robot Monitored Range displayed in SLP Viewer are the values being edited in Safety Function Manager. The setting values may differ from those of the safety board.
- The robot posture displayed when SLP Viewer is started reflects the actual posture of the robot.
- The SLP Viewer is not linked to the actual robot motion.

4.3.7 Applying Safety Function Parameters

Apply the safety function parameters you changed to the safety board.

ty Functi	ion Settings Basi	Settings Version	Info Maintenance						
obot N	Aonitored Rai	ige							
Enter t monito	he radius of the pred position.	joint monitoring	range used to determine the	e entry into tl	he		¢ ¢		
	Monitoring I	lange Radius					L.		
J2	84	(mm)					92	- C	
J3	54	(mm)					нн		
							J3 J2		
Enter t This se	he limit range c etting is not asso	f joint motion. ciated with the R	lobot Manager "Range" setti	ng.					
Enter ti This se J1	he limit range c tting is not asso Min (pulse) -1128676 -2685156	f joint motion. ciated with the R Max (pulse) 4405476 2685156	obot Manager "Range" setti	ng. Minimum (Joint) -62.000	Maximum (Joint) 242.000	(deg)			
Enter ti This se J1 J2	he limit range of tting is not asso Min (pulse) -1128676 -2685156 -1802240	f joint motion. ciated with the R Max (pulse) 4405476 2685156	obot Manager "Range" setti -1128676 To 4405476 -2685156 To 2685156	ng. Minimum (Joint) -62.000 -147.500	Maximum (Joint) 242.000 147.500	(deg) (deg)	22	2 J4	
Enter ti This se J1 J2 J3	Initiang is Limiting he limit range c titing is not asso Min (pulse) -1128676 -2685156 -1802240 -1668189	f joint motion. ciated with the R Max (pulse) 4405476 2685156 0 1668180	obot Manager "Range" setti -1128676 To 4405476 -2685156 To 2685156 -1802240 To 0	Minimum (Joint) -62.000 -147.500 -330.000	Maximum (Joint) 242.000 147.500 0.000	(deg) (deg) (mm)	تر J1	2 J4	
Enter ti This se J1 J2 J3 J4	Min United is Control is	f joint motion. ciated with the R Max (pulse) 4405476 2685156 0 1668189	obot Manager "Range" setti -1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189	ng. Minimum (Joint) -62.000 -147.500 -330.000 -360.000	Maximum (Joint) 242.000 147.500 0.000 360.000	(deg) (deg) (mm) (deg)	, r	2 J4	
Inter the service of	Selection Selection he limit range c difference tting is not asso Min (pulse) -1128676 -2685156 -1802240 -1668189 0	f joint motion. ciated with the R Max (pulse) 4405476 2685156 0 1668189 0	obot Manager "Range" setti -1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189	ng. Minimum (Joint) -62.000 -147.500 -330.000 -360.000 0.000	Maximum (Joint) 242.000 147.500 0.000 360.000 0.000	(deg) (deg) (mm) (deg) (deg)	tr The second se		
J1 J2 J3 J4 J5 J6	Is Limiting on the limit range of the limit range o	f joint motion. ciated with the R Max (pulse) 4405476 2685156 0 1668189 0	obot Manager "Range" setti -1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189	ng. (Joint) -62.000 -147.500 -330.000 -360.000 0.000	Maximum (Joint) 242.000 147.500 0.000 360.000 0.000	(deg) (deg) (mm) (deg) (deg)			
J1 [J2 [J3 [J4 [J5 [J6]	Selimiting Initing of the limit range of the limi	f joint motion. ciated with the R Max (pulse) 4405476 2685156 0 1668189 0 0 1668189	obot Manager "Range" setti -1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189	Minimum (Joint) -62.000 -147.500 -330.000 -360.000 0.000	Maximum (Joint) 242.000 147.500 0.000 360.000 0.000	(deg) (deg) (mm) (deg) (deg) (deg)		2 .4	
Inter the second	A Limiting of the limit range of	f joint motion. ciated with the R Max (pulse) 4405476 2685156 0 1668189 0 1668189 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189	Minimum (Joint) -62.000 -147.500 -330.000 -360.000 0.000	Maximum (Jeint) 242.000 147.500 0.000 360.000 0.000	(deg) (deg) (deg) (deg) (deg)		2 .4	

No	Name	Function	Notes
1	Confirm	Send the safety function parameters to the safety board and display response values from the safety board	Edit the necessary items before selecting this.
2	Apply	Apply the safety function parameters to the safety board	Make sure there are no abnormalities in the response values before selecting this.
3	Cancelling	Cancel changes	Clicking [Cancel] after clicking [Confirm] will cancel the changes and restart the Robot Controller.

When dry run is enabled, the Robot Controller can be executed without connecting it to a Manipulator.

Safety Function Manager provides dry run settings for both the Robot Controller and the safety board.

When switching between enabling and disabling dry run, the relationship between robot operation and the operation of safety functions by the safety board is as follows:

Dry Run Settings	Robot Operation	Safety Functions
Enabled	Stopped	Stopped
Disabled	Operating*	Operating

*: Be careful of the robot's operations.

How to set dry run

On the [Safety Function Settings] tab, select [Enable Dry run].

Safety Function Manage	a e											-	-		×
Safety Function Settings	Basic Settings	Version	Info Maint	tenance											
Draw Dura	ettings are a	pplied to	o the salety	board.											
Dry Run															
"Enable Dry Run" When dry run is a	changes dr	y run for	both the o	ontroller	and the s	afety boar oring by t	d. he safety	hoard are	disabled						
Enable Dry		or contro	or by the c	ontroller		oning by t	ne surcey	bound unc	and and the case						
	run														
Safety Inputs															
Safety Inputs															
SLS_1, 2, 3, SLP_A, E There are restriction ESTOP : emergency	s to be enait 6, C require 1 ns on the co stop. SG : p	mbinatic rotective	y function on of assign stop.	option to nments fo	be enable r a safety	ed. If these input. If tl	e are enab he intende	ed, you ca d setting	an set safety cannot be pi	r outputs erformed	and moni , cancel th	toring the ie assigne	ir sta d fur	atus. nction.	
				Saf	ety Func	tion Opti	ons								
	ESTOP	SG	SLS_1	SLS_2	SLS_3	SLP_A	SLP_B	SLP_C							
SAFETY_IN1	~														
SAFETY_IN2		~													
SAFETY_IN3															
SAFETY_IN4															
SAFETY_IN5															
Safety Outputs															
Safety Outputs															
Assign conditions for Each signal become STO : Safe Torque C teach mode. SLS_T2	or safety bo s active who off. EP_RC : e SLS on Te	ard outp en one o emergene st_T2 mo	uts. r more cor cy stop on ode.	nditions ar robot cor	re met. itroller po	rt. EP_TP :	emergen	cy stop on	TP. EN_SW :	enabling	switch or	n TP. SLS_T	: SL	S on	
															~

KEY POINTS

- Safety function parameters cannot be changed until dry run is disabled. However, the set values of the safety
 function parameters are retained.
- Dry run cannot be set with EPSON RC+ for a Robot Controller equipped with safety functions.

4.5 Outputting the Safety Function Parameters to Text

To output the configured safety function parameters to the Robot Controller as text, implement the SPEL program as shown in the example below.

```
Function main
        Integer fileNum, i, j
        fileNum = FreeFile
        WOpen "c:\EpsonRC70\SFParam.csv" As #fileNum
        ' Outputs parameters acquired by the SF_GetParam$ function as text
        Print #fileNum, "index,value"
        For i = 1 To 7
        Print #fileNum, Str$(i) + "," + SF_GetParam$(i)
        Next i
        ' Outputs parameters acquired by the SF_GetParam function as text
        Print #fileNum, "index,value"
        For j = 1 To 174
        Print #fileNum, Str$(j) + "," + Str$(SF GetParam(j))
        Next j
        Close #fileNum
Fend
```

✗ KEY POINTS

For details on the SF_GetParam\$ function, which returns safety function parameters, and the SF_GetParam function (index corresponding to each safety function parameter), refer to the following manual. "EPSON RC+ Language Reference"

4.6 Safety Board Maintenance

You can restore the safety function parameters to their factory defaults and change the password for the Safety Board.

4.6.1 Restoring Factory Default Settings

This function restores the safety function parameters set on the safety board to their factory default settings.

1. On the [Maintenance] screen, select [Defaults] to display the Safety Function Settings screen with default values added.

🖬 Safely Function Manager 🛛 — 🔲 🗙	🖹 Safety function Manager – 🖸 🗙
Saley Function Settings Basic Settings Weston Info Meintenence	Safety Function Settings Basic Settings Version Info Maintenance
Maintenance	Safety Function Settings
Definition Recall factory default setting (excluding the parseord). Parseord Charge safety loard parseord.	1. did steph function parenters. 2. Cold Coldmin Trans Refs Dead Communications'. The kerley function parenters are asset to the temporary area of the Selety Board. 3. Data a root that the carbina and the regroups transf. 3. Cold Apply in "Selety Board Communications". 4. Cold Apply in "Selety Board Communications". 4. Cold Apply in "Selety Board Communications". 4. Cold Apply in "Selety Board Communications".
	Dry Run "Install you" changes day on Iro both the controller and the Safety Board. When dry on an endiad, tobic control by the controller and monitoring by the Safety Board are disabled. If totally Dry on
	Safety inputs Analgoe the truthers to be enabled for each Safety Basel erout. SSL1.2.3.1.52,A.E.C. expanse the safety basels appendix of these are enabled you can set safety outputs and monitoring their status. These are enablesed on the combination of an appendix the safety upped. If the intended setting cannot be performed, cannot the assigned functions. USIOP: emergency status. Solid protective status.
	Safety Function Options
	ESTOP SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C
	SAFETY INS
	SAFETY JAH

2. Use [Confirm] or [Apply] to set factory set Safety Function parameters for the Safety Board.

Safety Board Communications			
Click Confirm and then Apply to set the safety functions.			
	Confirm	Apply	Cancel

This function does not change the password. To change the password, refer to the following section. **Changing the Password**

4.6.2 Changing the Password

This function changes the password on the safety board.

- The password must be changed by the safety manager.
- 1. On the [Maintenance] screen, select [Password].

Safety Function Manager	- 0	×
Safety Function Settings Basic Settings Versi	on Info Maintenance	
Maintenance		
Defaults	Recall factory default settings (excluding the password).	
Password	Recall factory default settings (excluding the password). Change safety board password.	

2. Enter the current password in [Current Password] and the new password you want to set in [New password] and [Confirm Password], and then click [Update].

The Robot Controller is restarted.

Safety Board Password Setting	ng	×
Current Password New Password	*********	
Confirm Password	****	
	Cancel	Update

The password must be eight characters or longer, but no more than 15 characters long. The characters that can be used are as follows:

Half-width uppercase alphabetic characters: A to Z Half-width lowercase alphabetic characters: a to z Half-width numbers: 0 to 9 Half-width symbols: (space) ! " # \$ % & ' () * + , - . / : ; < = > ? @ [] ^ {| } ~

3. After the Robot Controller has restarted, start Safety Function Manager.

KEY POINTS

- If an incorrect password is entered three times, Safety Function Manager shuts down and the Robot Controller is restarted. At this time, the settings are not changed.
- The password is always required when using Safety Function Manager. Please keep it in a safe place so that you do not forget it.
- If you need to reset the password, contact your safety manager or the supplier.

4.6.3 Restoring Saved (Backed-up) Settings

Restoration procedure

A restoration can be performed using the [Restore Controller] in EPSON RC+.

ACAUTION

Be sure to perform the restoration on the same Robot Controller for which the data backup was performed. Also, do not rewrite the contents of the backup data. Operation of the robot system cannot be guaranteed if a restoration is performed using the data of a different Robot Controller or with rewritten data.

- 1. From the EPSON RC+ menu, select [Tools] [Controller] to display the [Controller Tools] dialog box.
- 2. Click the [Restore Controller...] button to display the [Browse For Folder] dialog box.
- Specify the folder where the backup data is stored.
 B_RC700-E_Serial number_Date and time the backup was performed Example: B_RC700-E_12345_2011-04-03_092941
- 4. Click the [OK] button and select [Safety board configuration].For other selection items, refer to the following manual."EPSON BC+ User's Cuide".



5. Click the [OK] button, and restore the settings of the safety function.

Restore backup data saved in the backup of Robot Controller settings on the same system.
 If you try to restore information from a different system, the following warning dialog box appears.



Except in special cases such as replacing a Robot Controller, click the [No] button.

 Restoring backup data from a system with safety function options enabled to a system with safety function options disabled does not set the option functions.

4.7 How to Reset the Robot When It Stopped due to a Safety Function

If the robot was stopped due to a safety function, it must be reset to a status where it can operate again. Refer to the "How to reset" sections below and reset the robot.

- If the robot stopped due to a safety input: Example of Using Safety Input Functions
- If the robot stopped due to Safety Limited Speed (SLS): Example of Using Safety Limited Speed (SLS)
- If the robot stopped due to Joint Angle Limit: Example of Using Joint Angle Limit
- If the robot stopped due to Safety Limited Position (SLP): Example of Using Safety Limited Position (SLP)
- If the robot stopped due to Soft Axis Limiting: Example of Using Soft Axis Limiting

5. Example of Using Safety Functions

This section describes how to use each safety function, showing a simple example. For a detailed description of each function, refer to the Safety Function Manager screen.

5.1 Environment Required to Check Operation

The following describes the environment required to check operation.

Equipment configuration and applications

Please prepare the following equipment and applications:

- Manipulator: GX-B Series, C-B Series
- Robot Controller: RC700-E
- Safety PLC
- For GX4-B/GX8-B: PC with EPSON RC+7.0 Ver.7.5.4 or later installed For GX10-B/GX20-B: PC with EPSON RC+7.0 Ver.7.5.4A or later installed For C4-B/C8-B/C12-B: PC with EPSON RC+7.0 Ver.7.5.4C or later installed
- Emergency stop switch
- Teach Pendant*
 *: Can be used when using the Safety Limited Position (SLP) and Soft Axis Limiting.

Equipment and wiring methods



For the specific connection methods, refer to the following manual. "Robot Controller RC700-E Manual"

5.2 Example of Using Safety Input Functions

The following describes an example of using safety inputs.

In this example, an Emergency Stop (ESTOP) function is assigned to SAFETY_IN1, an emergency stop switch is connected to the SAFETY_IN1 port, and the emergency stop switch is operated to confirm the safety input.

How to set

Follow the procedure below to set the safety function parameters.

1. In EPSON RC+, select [Setup] - [System Configuration], and then start Safety Function Manager under [Controller] - [Safety Functions].

oole Saturi Mindow Heln	Image: System Configuration	? ×
ools Setup Window Help PC to Controller Communications System Configuration Preferences Options	Safety Functions Safety board installed: Yes Controller Configuration Preferences Simulator Drive Units Probots Probots Probots Procentrol R5232 FTCP / IP Converse Functions Safety function Safety Function Manager Safety Function Safety F	Close Apply Restore
	Convey Functions Safety Functions @-Security B-Vision	

2. For [SAFETY_IN1], select [ESTOP].

The temporary settings are applied to the safety board. / Run "Enable Dry Run" changes dry run for both the controller and the safety board. When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Enable Dry run icty Inputs fety Inputs safety Function option to be enabled for each safety board input. IS_1, 2, 3, SLP, A, B, C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. here are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function STOP : emergency stop. SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 SAFETY_IN2 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN5 SAFETY_IN5 Safety board outputs. ach signal becomes active when one or more conditions are met. To : Safe Torque Off. EP_RC : emergency stop on rDe torce Controller port. EP_TP : emergency stop on TP.EN_SW : enabling switch on TP.SLS_T : SLS on whore mode STD 2.SIS and FT TO PROFERED AND AND AND AND AND AND AND AND AND AN	y Function Settings	Basic Setting	s Version	Info Main	tenance							
*Kun "Enable Dry Run" changes dry run for both the controller and the safety board. When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Enable Dry run exty Inputs Safety Inputs Sign the functions to be enabled for each safety board input. S.1, 2, 3, SLPA, B. C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. here are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function STOP : emergency stop. SG : protective stop. SafetY_IN1 SAFETY_IN1 SAFETY_IN3 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5 Safety Outputs stdy Gutputs sign conditions for safety board outputs. sch signal becomes active when one or more conditions are met. TO : Safe Torque Off. EP_RC : emergency stop on robot controller port. EP_TP : emergency stop on TP. EN_SW : enabling switch on TP. SLS_T : SLS on two more conditions are met.	The temporary s	ettings are	applied to	o the safet	y board.							
"Enable Dry Run" changes dry run for both the controller and the safety board. When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Enable Dry run exty Inputs fety Inputs saign the functions to be enabled for each safety board input. IS,1,2,3,SLP,A, B, C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. here are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function STOP : emergency stop. SG : protective stop. SAFETY_IN1 S S [S, SLS_1] SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN3 G	/ Run											
When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Enable Dry run Extrop SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN5 SAFET	"Enable Dry Run"	changes d	ry run for	both the	controller	and the s	afety boar	d.				
Enable Dry run Explose the functions to be enabled for each safety board input. IS.1.2.3.2.8.2.P.A. B.C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. here are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function STOP : emergency stop. SG : protective stop. SAFETY_IN1 SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5 SAFETY_IN5 Safety Function options SAFETY_IN5 <	When dry run is e	nabled, rol	oot contr	ol by the c	ontroller a	and monit	oring by t	he safety	board are	isabled.		
ety Inputs fety Inputs ssign the functions to be enabled for each safety board input. IS_1 2 3, SUP.A. B. C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. here are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function STOP : emergency stop. SG : protective stop. SAFETY_IN1 SAFETY_IN1 SAFETY_IN3 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5 SAFETY_IN5 SAFETY_IN5 SAFETY_IN5 SAFETY_IN5 SAFETY_IN5	Enable Dry	run										
fety Inputs ssign the functions to be enabled for each safety board input. LS_1, 2, 3, SLP_A, B, C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. here are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function STOP : emergency stop. SG : protective stop. Safety Function Options SAFETY_IN1 SAFETY_IN1 SAFETY_IN3 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5 SAFETY_IN5 SAFETY_IN5 SAFETY_IN5 SAFETY_IN5 SAFETY_IN5 Safety Outputs sign conditions for safety board outputs. ath signal becomes active when one or more conditions are met. TO: Safe Torque Off. EP_RC: emergency stop on robot controller port. EP_TP : emergency stop on TP. EN_SW : enabling switch on TP. SLS_T : SLS on type mode not T3 using an output T3 using an ou	ety Inputs											
ssign the functions to be enabled for each safety board input. LS_1, 2, 3, SLP_A_B, C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. here are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function STOP : emergency stop. SG : protective stop. Safety Function Options ESTOP SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 SAFETY_IN2 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5 SAFETY_IN5 SAFETY_IN5 SIDE SAFETY_IN5 SAFETY_IN5 SAFETY_IN5 SIDE SAFETY_IN5 SIDE SAFETY_IN5 SAFETY_IN5 SAFETY_IN5 SIDE SAFETY_IN5 SAFETY_IN5 SIDE SAFETY_IN5 SIDE SAFETY	fety Inputs											
LS_1, 2, 3, 5, SLP, A, B, C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. here are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function STOP : emergency stop. SG : protective stop. SAFETY_IN1 SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN2 SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN3	ssign the function	s to be ena	bled for e	each safety	/ board in	put.						
AFETY_IN1 SG SLS_1 SLS_2 SLS_3 SLP_A SLP_C SAFETY_IN1 SAFETY_IN3 SLS_1 SLS_2 SLS_3 SLP_A SLP_C SAFETY_IN3 SAFETY_IN3 SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN3 SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN3 SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN3 SLS_1 SLS_2 SLS_3 SLS_1 SLS_2 SLS_3 SLS_1 SLS_2 SLS_3 SLS_1	LS_1, 2, 3, SLP_A, I	3, C require	the safet	y function	option to	be enable	ed. If these	e are enab	led, you c	set safety outputs and monitoring 1	their stat	tus.
SAFETY_IN1 S SAFETY_IN2 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5 SAFETY_IN	here are restriction	ns on the co	ombinatio	on of assig	nments fo	r a safety	input. If t	he intende	ed setting	annot be performed, cancel the assig	ned fun	ction.
ESTOD SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options SAFETY_IN1 Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options SAFETY_IN2 Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options SAFETY_IN3 Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options SAFETY_IN3 Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options SAFETY_IN4 Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options Image: Safety Functions SAFETY_IN5 Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options Image: Safety Function Options Safety Outputs Image: Safety Functions Image: Safety Functions Image: Safety Functions Image: Safety Functions Safety Outputs	STOP : emergency	stop. SG : J	protective	e stop.								
SAFETY_IN1 SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 SAFETY_IN3					Saf	ety Func	tion Opti	ions				
SAFETY_IN1 SAFETY_IN2 SAFETY_IN3 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5		FSTOP	SG	SLS_1	SLS_2	SLS_3	SLP_A	SLP_B	SLP_C			
SAFETY_IN3	SAFETY_IN1	~										
SAFETY_IN3 SAFETY_IN4 SAFETY_IN4 SAFETY_IN5 SAFETY_IN5 SAF	SAFETY_IN2											
SAFETY_IN4	SAFETY_IN3											
SAFETY_IN5	SAFETY_IN4											
ety Outputs ty Outputs sign conditions for safety board outputs. ach signal becomes active when one or more conditions are met. TO : Safe Torque Off. EP_RC : emergency stop on robot controller port. EP_TP : emergency stop on TP. EN_SW : enabling switch on TP. SLS_T : SLS on upda mode SLT 22: SLS on Ext T2 mode												
ety Outputs ety Outputs sign conditions for safety board outputs. ach signal becomes active when one or more conditions are met. TO : Safe Torque Off. EP_RC : emergency stop on robot controller port. EP_TP : emergency stop on TP. EN_SW : enabling switch on TP. SLS_T : SLS on update mode SC T2 : SLS on Ext T2 mode	SAFETY_IN5											
ty Outputs ssign conditions for safety board outputs. ach signal becomes active when one or more conditions are met. TO : Safe Torque Off. EP_RC : emergency stop on robot controller port. EP_TP : emergency stop on TP. EN_SW : enabling switch on TP. SLS_T : SLS on up to mode SLT 2. SLS on Exect T2 mode	SAFETY_IN5											_
ach signal becomes active when one or more conditions are met. TO : Safe Torque Off. EP_RC : emergency stop on robot controller port. EP_TP : emergency stop on TP. EN_SW : enabling switch on TP. SLS_T : SLS on up to mode SLT 2: SLS on Ext T2 mode	SAFETY_IN5											
ach signal becomes active when one or more conditions are met. TO : Safe Torque Off. EP_RC : emergency stop on robot controller port. EP_TP : emergency stop on TP. EN_SW : enabling switch on TP. SLS_T : SLS on up to mode SLS T2 : SLS on Ext T2 mode	SAFETY_IN5											
to share lorque on a time, energency stop on robot controller port arg r r energency stop on the times we enabling switch on TR SLS_1: SLS on test stop on the times are stop on the times and the stop of the sto	SAFETY_IN5 fety Outputs ety Outputs ussign conditions f	or safety bo	ard outp	uts.								
SOULTINGER ALA LA VILLEAL LA TINUE.	SAFETY_IN5 fety Outputs ety Outputs ussign conditions f ach signal become	or safety bo	pard outp	iuts. ir more co	nditions a	re met.			outon on	'D EN CM/, cooking quitch on TD Cl	с т. сіс	

3. Apply settings.

How to check operation

Follow the procedure below to check the operation.

1. In EPSON RC+, select [Tools] - [I/O Monitor], and then select [Safety Board].

Safety Bo	ard			
Inputs	and Outputs:	States		
Statu	Signal	Statu	Signal	
0	SAFETY_IN1	0	SLS_1	
0	SAFETY_IN2	0	SLS_2	
0	SAFETY_IN3	0	SLS_3	
0	SAFETY_IN4	0	SLP_A	
0	SAFETY_IN5	0	SLP_B	
0	SAFETY_OUT1	0	SLP_C	
0	SAFETY_OUT2	۲	SLP_J	
0	SAFETY_OUT3	0	FAIL	

2. Press the emergency stop switch connected to SAFETY_IN1 to enable the emergency stop function.

✗ KEY POINTS

As the safety inputs use negative logic, the Low level (0 V) is the ON status.

3. Confirm that SAFETY_IN1 turns ON (white).

Standard \ Safety Br	/iew Custom View 1 bard	Safety Board		
Inputs	and Outputs:	States:		
Statu	Signal	Statu	Signal	
0	SAFETY_IN1	0	SLS_1	
÷	UMI ETT_INA	0	SLS_2	
0	SAFETY_IN3	0	SLS_3	
0	SAFETY_IN4	0	SLP_A	
0	SAFETY_IN5	0	SLP_B	
0	SAFETY_OUT1	0	SLP_C	
0	SAFETY_OUT2	۲	SLP_J	
0	SAFETY_OUT3	0	FAIL	

- 4. Confirm that the [EStop] displayed in the lower right corner of EPSON RC+ lights up.
- 5. Release the emergency stop switch connected to SAFETY_IN1 to disable the emergency stop function.
- 6. Confirm that SAFETY_IN1 turns OFF (green).

afety Bo	ard	·		
Inputs a	and Outputs:	States:		
Statu	Signal	Statu	Signal	
۲	SAFETY_IN1	0	SLS_1	
÷		- 0	SLS_2	
0	SAFETY_IN3	0	SLS_3	
0	SAFETY_IN4	0	SLP_A	
0	SAFETY_IN5	0	SLP_B	
0	SAFETY_OUT1	0	SLP_C	
0	SAFETY_OUT2	۲	SLP_J	
0	SAFETY_OUT3	0	FAIL	

How to reset

Follow the procedure below to reset the emergency stop status.

- 1. Release the emergency stop switch.
- 2. In EPSON RC+, select [Robot Manager] [Control Panel], and then perform the error reset operation.
- 3. Confirm that the [EStop] displayed in the lower right corner of EPSON RC+ turns off.

5.3 Example of Using Safety Output Functions

The following describes an example of using safety outputs.

In this example, the Safe Torque OFF (STO) function is assigned to SAFETY_OUT1. By operating the emergency stop switch used to check the safety input, the safety output is confirmed by the status of the SAFETY_OUT1 display on the Safety Board tab in the I/O monitor.

How to set

Follow the procedure below to set the safety function parameters.

1. In EPSON RC+, select [Setup] - [System Configuration], and then start Safety Function Manager under [Controller] -

[Safety	Functions].

ols Setup Window Help	📖 Sy	stem Configuration			?	×
PC to Controller Communications PC to Configuration Preferences Options		Rartup Controller - General - Configuration - Preferences - Simulator - Drive Units - Robots - Inputs / Outputs - Remote Control - RS232 - TCP / IP - Conveyor Encoders - Staffy Functions - Staffy Functions	Safety Functions Safety board installed: Safety board version: Safety Fu	Yes Rel 02.00 00.0031 Jan 17 2023 13:54:01 00.00.0121 0	Close Apply Restore	

2. For [SAFETY_OUT1], select [STO].

afety Inputs Assign the functions to be enabled for each safety board input. SLS_1, 2, 3, SLP_A, B, C require the safety function option to be enabled There are restrictions on the combination of assignments for a safety i ESTOP : emergency stop. SG : protective stop. Safety_IN1 SAFETY_IN1 SAFETY_IN2 SAFETY_IN3 SAFETY_IN3 SAFETY_IN5 SAFET	ed. If these are input. If the int	enabled, you tended setting	u can set safety outputs and monitoring their stat. ng cannot be performed, cancel the assigned funci
Asign the functions to be enabled for each safety board input. SLS_1, 2, 3, SLP, A, B, C require the safety function option to be enabled There are restrictions on the combination of asignments for a safety in ESTOP : emergency stop. SG : protective stop. Safety Function ESTOP SG SLS_1 SLS_2 SLS_3 SAFETY_IN1 SAFETY_IN2 SAFETY_IN3	ed. If these are 4 input. If the int	P_B SLP_C	u can set safety outputs and monitoring their stat. ng cannot be performed, cancel the assigned funci
SAFETY_IN1 SG SLS_1 SLS_2 SLS_3 SAFETY_IN1 SI Image: Signal state s	SLP_A SLF	P_B SLP_C	c
ESTOP SG SLS_1 SLS_2 SLS_3 SAFETY_IN1 Image: Safety_IN2 Image: Safety_IN3 Image: Safety_IN3 <th>SLP_A SLF</th> <th>P_B SLP_C</th> <th>c</th>	SLP_A SLF	P_B SLP_C	c
SAFETY_IN1			
SAFETY_IN2 SAFETY_IN3			
SAFETY_IN3			
SAFETY_IN4			
SAFETY_INS			
fety Outputs			
fety Outputs			
Assign conditions for safety board outputs. Each signal becomes active when one or more conditions are met. STO: Safe Torque Off. EP, RC: emergency stop on robot controller por teach mode. SLS_T2 : SLS on Test_T2 mode.	rt. EP_TP : eme	ergency stop o	on TP. EN_SW : enabling switch on TP. SLS_T : SLS (
STO EP_RC EP_TP EN_SW SLS_T	SLS_T2 SLS	S_1 SLS_2	2 SLS_3 SLP_A SLP_B SLP_C

3. Apply settings.

How to check operation

Follow the procedure below to check the operation.

- 1. Press the emergency stop switch.
- 2. Confirm that the [EStop] displayed in the lower right corner of EPSON RC+ lights up.

3. In EPSON RC+, select [Tools] - [I/O Monitor], and then select the [Safety Board] tab, and confirm that SAFETY_OUT1 is ON (white).

andard V Safety Bo	iew Custom View 1	Safety Board		
Inputs a	and Outputs:	States:		
Statu	Signal	Statu	Signal	
0	SAFETY_IN1	0	SLS_1	
0	SAFETY_IN2	0	SLS_2	
0	SAFETY_IN3	0	SLS_3	
0	SAFETY_IN4	0	SLP_A	
0	SAFETY_IN5	0	SLP_B	
0	SAFETY_OUT1	0	SLP_C	
0	SAFETY_OUT2	۲	SLP_J	
0	SAFETY_OUT3	0	FAIL	

- 4. Release the emergency stop switch.
- 5. Confirm that SAFETY_OUT1 turns OFF (green).

ndard V	fiew Custom View 1	Safety Board	
afety Bo	ard		
Inputs	and Outputs:	States	
Statu	Signal	Statu	Signal
۲	SAFETY_IN1	0	SLS_1
0	SAFETY_IN2	0	SLS_2
0	SAFETY_IN3	0	SLS_3
0	SAFETY_IN4	0	SLP_A
0	SAFETY IN5	0	SLP_B
۲	SAFETY_OUT1	0	SLP_C
0	SAFETY_OUT2	۲	SLP_J
0	SAFETY_OUT3	0	FAIL

How to reset

Follow the procedure below to reset the emergency stop status.

- 1. Release the emergency stop switch.
- 2. In EPSON RC+, select [Robot Manager] [Control Panel], and then perform the error reset operation.
- 3. Confirm that the [EStop] displayed in the lower right corner of EPSON RC+ turns off.

5.4 Example of Using Safety Limited Speed (SLS)

The following describes an example of using the Maximum Speed of Safety Limited Speed (SLS). In this example, SLS_1 is assigned to SAFETY_IN3 and the Maximum Speed of SLS_1 is set to 1000 [mm/sec].

How to set

Follow the procedure below to set the safety function parameters.

1. In EPSON RC+, select [Setup] - [System Configuration], and then start Safety Function Manager under [Controller] -

[Safety Functions].

	System Configurat	ion		?	\times
ools Setup Window Help Constraints PC to Controller Communications P PC to Controller Communications Preferences Options	 G-Startup Controller General Configuration Preferences Simulator Drive Units Remote Control Res232 TCP / IP Conveyor Enco Setev Function Security Vision 	Safety Functions Safety board installed: Safety board version: s Safety Functions Safety Functions	Yes Rel.02.00.00.0031 Jan 17 2023 13:54:01 00.00.0121 0 nction Manager	Close Apply Restore	

2. For [SAFETY_IN3], select [SLS_1].

Safety Function Settings is is Settings version the Maintenance Safety Function Settings	Safety Function Manage									- 0	×
Safety Function Settings 1. Edit safety function parameters. 2. Cick Confirm in "Safety Board Communications". The safety function parameters are sent to the temporary area of the safety board. 3. Make sure that the set value and the response value match. The response values from the safety board are displayed in the safety function manager. 4. Cick Apply in "Safety Board Communications". The temporary settings are applied to the safety board. VP Run * Click Apply in "Safety Board Communications". The temporary settings are applied to the safety board. When dry run is enabled, robot control by the controller and the safety board. When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Enable Dry run Safety Inputs Safety Inputs Assign the functions to be enabled for each safety board input. SIS_1, 2, 3, SIP_A, B, C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP 's emergency stop. SG : protective stop. SafetY_IN1 Safety Function Options SafetY_IN2 Safety Input SAFETY_IN3 Safety Input SAFETY_IN3 Safety Input	Safety Function Settings	Basic Settings	Version	n Info Main	tenance						
 1. Edit safety function parameters. 2. Cick Confirm in "Safety Board Communications". The safety function parameters are sent to the temporary area of the safety board. 3. Make sure that the set value and the response value match. The response values from the safety board are displayed in the safety function manager. 4. Click Apply in "Safety Board Communications". The temporary settings are applied to the safety board. Or Run *Chable Dry Run" changes dry run for both the controller and the safety board. When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Enable Dry run Safety Inputs Safety Inputs Safety Inputs. Safety Function options on the compliance of a safety input. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP: emergency stop. SG : protective stop. Safety Function Options Safety VIN1 Safety VIN2 Safety VIN3 Safety VIN3 Safety VIN3 Safety VIN4 Safety VIN3 Safety VIN4 Safety VIN4 Safety VIN4 Safety VIN5 Safety VIN5 Safety VIN4 Safety VIN4 Safety VIN5 Safety VIN5<	Safety Function	n Setting	S								
Dry Run "Enable Dry Run" changes dry run for both the controller and the safety board. When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Enable Dry run Safety Inputs Assign the functions to be enabled for each safety board input. SL5_1.2.3. SLP_A. B. C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP SG SAFETY_IN1 Safety Inputs SAFETY_IN2 Safety Inputs SAFETY_IN3 SAFETY_IN4 SAFETY_IN5 SAFETY_IN5	 Edit safety functi Click Confirm in The safety functi Make sure that til The response val Click Apply in "Sa The temporary si 	on paramete "Safety Boar on paramete he set value lues from th afety Board ettings are a	ers. d Comn ers are s and the e safety Commu pplied t	nunications ent to the response board are nications". o the safet	temporary value mate displayed y board.	r area of ti ch. in the safe	he safety l ety functio	ooard. on manag	er.		
"Enable Dry Run" changes dry run for both the controller and the safety board. When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. □ Enable Dry run Safety Inputs Assign the functions to be enabled for each safety board input. SIS_1.2.3. SUP_A. B. C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP : SG SIS_1 SIS_2 SIS_3 SLP_A SLP_B SLP_C SAFETY_IN1 SIS_1.2.3 SLP_A SLP_B SLP_C SAFETY_IN2 SAFETY_IN3 SIS_1 SIS_2 SIS_3 SLP_A SLP_B SLP_C SAFETY_IN4 SAFETY_IN5 SIS_1 SIS_2 SIS_3 SLP_A SLP_B SLP_C SAFETY_IN5 SIS_1 SIS_3 SLP_A SLP_B SLP_C SAFETY_IN5 SIS_1 SIS_3 SLP_A SLP_A SLP_B SLP_C SAFETY_IN5 SIS_1 SIS_3 SLP_A SL	Dry Run	-									
When dry run is enabled, robot control by the controller and monitoring by the safety board are disabled. Image:	"Enable Dry Run"	changes dr	v run foi	r both the	controller	and the s	afety boar	d.			
	When dry run is e	enabled, rob	ot contr	ol by the c	ontroller a	and monit	oring by t	he safety	board are	disabled.	
Safety Inputs Assign the functions to be enabled for each safety board input. SLS_1. 2, 3, SLP_A. B. C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP : emergency stop. SG : protective stop. Safety Function Options ESTOP SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 SAFETY_IN2 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5	Enable Dry	run									
Safety Inputs Safety Inputs Safety Inputs Safety Inputs Safety Inputs Safety Inputs Subject 2 and 2 an											-
Asign the functions to be enabled for each safety board input. SLS_1, 2, 3, SLP_A, B, C require the safety function option to be enabled. If these are enabled, you can set safety outputs and monitoring their status. There are restrictions on the combination of assignments for a safety input. If the intended setting cannot be performed, cancel the assigned function. ESTOP : emergency stop. SG : protective stop. Safety Function Options ESTOP SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 SAFETY_IN2 SAFETY_IN3 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5	Safety Inputs										
SAFETY_IN1 SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN2 SAFETY_IN3 SAFETY_IN4 SAFETY_IN4 SAFETY_IN5 SAFETY	Assign the function SLS_1, 2, 3, SLP_A, I There are restriction ESTOP : emergency	ns to be enal B, C require ns on the co v stop. SG : p	oled for the safe mbinati rotectiv	each safety ty function on of assig e stop.	/ board in option to nments fo	put. be enable or a safety	ed. If these input. If tl	e are enal he intend	oled, you c ed setting	an set safety outputs and monitoring their status. cannot be performed, cancel the assigned functio	n.
ESTOP SG SLS_1 SLS_2 SLS_3 SLP_A SLP_B SLP_C SAFETY_IN1 SAFETY_IN2 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5					Saf	ety Func	tion Opti	ons			
SAFETY_IN1		ESTOP	SG	SLS_1	SLS_2	SLS_3	SLP_A	SLP_B	SLP_C		
SAFETY_IN2	SAFETY_IN1	\checkmark									
SAFETY_IN3	SAFETY_IN2		~								
SAFETY_IN4	SAFETY_IN3										
SAFETY_IN5	SAFETY_IN4										
	SAFETY IN5										

3. For the TCP offset, enter [X_TCP:0mm], [Y_TCP:0mm], [Z_TCP:0mm].

In this example, confirmation is performed without the hand attached. If 0 mm is entered for all the TCP Offset, a warning message will be displayed when you click the [Confirm] button. However, you can continue as-is.

	a a a a a a a a a a a a a a a a a a a	- seconds	version mio	maintenance	_					-		-	-		
SAFETY_C			L) L											 	
lety Limit	ted Spee	a													1
P Offset															
Enter the h	and tip po:	sition (far	thest part) in	the tool 0 coo	rdinate	system.									
X_TCP	0	mm													
Y_TCP	0	mm													
Z_TCP	0	mm													
fety Limite	ed Speed														
Set the ma	ximum sp	ed and c	ne or more	monitored joint	ts of the	robot.									
Det the file	with a large state of the	cea arra e	ine of more	nonicorea joini	0 01 010	10000									
Joints : Mo	onitor all jo	ints with	the maximur	n joint speed.											
Joints : Mo	onitor all jo	ints with	the maximur	n joint speed.											
Joints : Mo	nitor all jo t Angle Li	ints with mit	the maximur Maximum	n joint speed. Joint Angle		10 (x	0.1 deç	g)							
Joints : Mo	onitor all jo t Angle Li	ints with mit	the maximur Maximum	n joint speed. Joint Angle		10 (x Mor	0.1 deq	g) Joints							
Joints : Mo	nitor all jo t Angle Li Maxin	ints with mit num Spe	the maximur Maximum ed (mm/s)	n joint speed. Joint Angle Delay Time]2	10 (x Mor J3	0.1 deç itored	g) Joints Hand	Joints	Maxi	mum Jo	oint Spe	eed (%)		
Joints : Mo	mitor all jo t Angle Li Maxin	ints with mit num Spe	Maximum Maximum ed (mm/s)	n joint speed. Joint Angle Delay Time (msec)	J2	10 (x Mor J3	0.1 deg itored J5	g) Joints Hand	Joints	Maxi	mum Jo	oint Spe	eed (%)		
Joints : Mo	mitor all jo t Angle Li Maxim	ints with mit num Spe	ed (mm/s)	n joint speed. Joint Angle Delay Time (msec)	J2	10 (x Mor J3	0.1 deg itored J5	g) Joints Hand	Joints	Maxi	mum Jo	oint Spe 7	eed (%)		
Joints : Mo Join SLS_T SLS_T2	mitor all jo t Angle Li Maxim	ints with mit num Spe	Maximum Maximum ed (mm/s) 250 250	n joint speed. Joint Angle [Delay Time (msec)	J2	10 (x Mor J3	0.1 deg itored J5	g) Joints Hand	Joints	Maxi	mum Jo	oint Spe 7 7	eed (%)		
Joints : Mo Join SLS_T SLS_T2 SLS_1	mitor all jo t Angle Li Maxim	ints with mit num Spe	Maximum Maximum ed (mm/s) 250 250	n joint speed. Joint Angle Delay Time (msec)	J2	10 (x Mor J3	0.1 deg itored J5	g) Joints Hand	Joints	Maxi	mum Jo	oint Spe 7 7 7	eed (%)		
Joints : Mo Join SLS_T SLS_T2 SLS_1 SLS_2	mitor all jo t Angle Li Maxim	ints with mit num Spe	the maximum Maximum ed (mm/s) 250 250 250	n joint speed. Joint Angle Delay Time (msec) 0	J2	10 (x Mor J3	0.1 deg itored J5	g) Joints Hand	Joints	Maxi	mum Jo	oint Spe 7 7 7 7	eed (%)		
Joints : Mo Joint SLS_T SLS_T2 SLS_1 SLS_2 SLS_3	mitor all jo t Angle Li Maxim	num Spe	the maximum Maximum ed (mm/s) 250 250 250 250 250	n joint speed. Joint Angle Delay Time (msec) 0 500 500	J2	10 (x Mor J3	0.1 deg itored J5	g) Joints Hand	Joints	Maxi	mum Jo	7 7 7 7 7 7 7	eed (%)		
Joints : Mo Joint SLS_T SLS_T2 SLS_1 SLS_2 SLS_3 fety Limit	mitor all jo t Angle Li Maxim	ints with mit num Spe	ed (mm/s) 250 250 250 250	n joint speed. Joint Angle Delay Time (msec) 0 500 500	J2	10 (x Mor J3	0.1 deg itored J5	a) Joints Hand	Joints	Maxi	mum Jo	7 7 7 7 7 7	eed (%)		
Joints : Mo Join SLS_T SLS_T2 SLS_1 SLS_2 SLS_3 ety Limit	nitor all jo t Angle Li Maxim ted Position	ints with mit num Spe	ed (mm/s) 250 250 250	n joint speed. Joint Angle Delay Time (msec) 0 500 500	J2	10 (x Mor J3	0.1 deg itored J5	a) Joints Hand	Joints	Maxi	mum Jo	7 7 7 7 7 7	eed (%)		

5. Apply settings.

How to check operation

Follow the procedure below to check the operation.

- 1. Turn SAFETY_IN3 ON (0V) to enable the speed monitoring function.
- 2. In EPSON RC+, operate the robot at a speed of 500 mm/sec.

Sample program to operate at 500 mm/sec:

```
Function SLS Test 500
                              'Sets the speed limit to 500 mm/s when SLS_1 is enabled
    SF LimitSpeedS SLS 1, 500
    SF LimitSpeedSEnable SLS 1, On 'Enables speed control when SLS 1 is enabled.
       Motor On
    Power Low
    Go Pl
                       'Moves in PTP mode to the operation start position (P1).
    Power High
    Speed 100
    Accel 100, 100
    SF PeakSpeedSClear 'Clears the peak speed value.
    Go P2
    SF PeakSpeedS
                       'Displays the peak speed value.
   Motor Off
```

```
Fend
```

KEY POINTS

The safety functions do not operate because the operating speed is less than the Maximum Speed (1000 mm/sec).

3. In EPSON RC+, change the speed to 1500 mm/sec and then operate the robot.

Sample program to operate at 1500 mm/sec:

```
Function SLS Test 1500
        SF LimitSpeedS SLS 1, 1500 'Sets the limit speed to 1500 mm/s when SLS 1 is en
    SF LimitSpeedSEnable SLS 1, On 'Enables speed control when SLS 1 is enabled.
   Motor On
    Power Low
    Go Pl
                       'Moves in PTP mode to the operation start position (P1).
    Power High
    Speed 100
    Accel 100, 100
    SF PeakSpeedSClear 'Clears the peak speed value.
    Go P2
    SF_PeakSpeedS
                       'Displays the peak speed value.
   Motor Off
Fend
```

4. Confirm that an emergency stop occurs and the robot operation stops.

How to reset

Follow the procedure below to reset the emergency stop status.

- 1. Release the emergency stop switch.
- 2. In EPSON RC+, select [Robot Manager] [Control Panel], and then perform the error reset operation.
- 3. Confirm that the [EStop] displayed in the lower right corner of EPSON RC+ turns off.

5.5 Example of Using Joint Angle Limit

The following describes how to use Joint Angle Limit using SLS_1.

In this example, SLS_1 is assigned to SAFETY_IN3 to enable the Joint Angle Limit. Set the Maximum Joint Angle to 15 deg, and the SLS_1 Maximum Speed to 1000[mm/sec]. Confirm that the Manipulator continues to operate as long as it does not violate the Maximum Joint Angle, and that any violation of Joint Angle Limit results in an emergency stop.

For details on the Joint Angle Limit, refer to the following section. Joint Angle Limit

How to set

Follow the procedure below to set the safety function parameters.

1. In EPSON RC+, select [Setup] - [System Configuration], and then start Safety Function Manager under [Controller] - [Safety Functions].

ools Setup Window Help	📟 System Configuration	? ×
Point PC to Controller Communications Pictic System Configuration Preferences Options	Image: Startup Safety Functions Controller - General - Configuration - Preferences - Smulator Safety board installed: Yes Safety board version: Rel 02 00 00 0031 ID Three Units Jan 17 2023 13:54:01 ID Three Units 0 ID Prote Vortos 0 ID Remote Control 0 ID Remote Control Safety Function Manager ID Safety Functione Safety Function Manager	Close Apply Restore

2. For [SAFETY_IN3], select [SLS_1].

Safety Function Manage	r								-		×
Safety Function Settings	Basic Settings	Version	Info Maint	enance							
Safety Function	Setting	s									^
Edit safety function parameters. Click Confirm in "Safety Board Communications". The safety function parameters are sent to the temporary area of the safety board. Make sure that the set value and the response value match. The response values from the safety board are displayed in the safety function manager. Click Apply in "Safety Board Communications". The temporary settings are applied to the safety board.											
Dry Run											
"Enable Dry Run"	changes dr	y run for	both the c	ontroller	and the sa	fety boar	d.		disciple of		
When dry run is e	nabled, rob	ot contr	ol by the co	ontroller a	ind monit	oring by t	ne safety	board are	disabled.		
Enable Dry	run										
Safety Inputs											
Assign the function SLS_1, 2, 3, SLP_A, E There are restriction ESTOP : emergency	s to be enab , C require t ns on the co stop. SG : p	oled for o the safet mbinatio rotective	each safety y function on of assigr e stop.	board in option to nments fo	out. be enable r a safety	ed. If these input. If th	e are enab ne intende	led, you c d setting	an set safety outputs and monitoring their statt cannot be performed, cancel the assigned funct	ıs. tion.	
				Saf	ety Funct	ion Opti	ons				
	ESTOP	SG	SLS_1	SLS_2	SLS_3	SLP_A	SLP_B	SLP_C			
SAFETY_IN1	✓										
SAFETY_IN2		~									
SAFETY_IN3											
SAFETY_IN4											
SAFETY_IN5											
											\sim

Select the [Joint Angle Limit].
 When the [Joint Angle Limit] is selected, the [SLS_1] delay time is fixed to 0.

- 4. Enter 150 for [Maximum Joint Angle], and 1000 for [Maximum Speed] in [SLS_1].
- 5. Apply settings.

ty Function Se	ttings Basi	: Settings	Version Info		ce										
SAFETY_C	DUT3								[
fety Limit	ted Spee	d													
P Offset															
Enter the ha	and tip pos	ition (fa	rthest part)	in the tool 0) coordii	inate sy	/stem.								
X_TCP	0	mm													
Y_TCP	0	mm													
Z_TCP	0	mm													
fety Limite	ed Speed														
Joints : Mo	onitor all jo t Angle Li	ints with mit	the maximu Maximun	um joint spe n Joint Ang	gle	1	1 <mark>50</mark> (x 0).1 deg)							
Joints : Mo	nitor all jo t Angle Li	ints with mit	the maximu Maximun	um joint spe n Joint Ang	gle	1	150 (x 0 Monit).1 deg) tored J	oints						
Joints : Mo	nitor all jo t Angle Li Maxim	ints with mit	the maximu Maximun eed (mm/s	um joint spe n Joint Ang Delay T (msec)	gle	1 J2	I <mark>50</mark> (x 0 Monit J3).1 deg) tored Jo J5	oints Hand	Joints	Maxim	ium Jo	int Spe	ed (%)	
Joints : Mo	nitor all jo t Angle Li Maxim	ints with mit	Maximun Maximun eed (mm/s 250	um joint spe n Joint Ang Delay T (msec)	gle	1 	ISO (x 0 Monit J3	0.1 deg) tored Jo J5	oints Hand	Joints	Maxim	num Jo	int Spe 7	ed (%)	
Joints : Mo	nitor all jo t Angle Li Maxim	mit num Spo	Maximun Maximun eed (mm/s 250 250	um joint spe n Joint Ang Delay T (msec)	gle	1 J2	J3).1 deg) tored Ju J5	oints Hand I	Joints	Maxim	ium Jo	int Spe 7 7	ed (%)	
SLS_T SLS_T SLS_1	nitor all jo t Angle Li Maxim	ints with mit ium Spe	Maximun Maximun eed (mm/s 250 250	um joint spe n Joint Ang Delay T (msec)	gle	1 J2	50 (x 0 Monit J3).1 deg) tored Jo J5	oints Hand 2	Joints	Maxim	ium Jo	int Spe 7 7 7	ed (%)	
SLS_T SLS_T SLS_1 SLS_2	nitor all jo t Angle Li Maxim	ints with mit ium Spe	Maximun Maximun 250 250	um joint spe n Joint Ang) Delay T (msec)	gle	1 J2	50 (x 0 Monit J3).1 deg) Itored Ja J5	oints Hand I	Joints	Maxim	ium Jo	int Spe 7 7 7 7 7	ed (%)	
Joints : Mo Joints : Mo SLS_T SLS_T SLS_1 SLS_2 SLS_3	t Angle Li Maxim	ints with mit uum Spo	Maximun Maximun 250 250 250 250 250 250	um joint spe n Joint Ang) Delay T) (msec)	gle Time	1 J2	50 (x 0 Monit J3).1 deg) tored J J5	oints Hand	Joints	Maxim	ium Jo	int Spe 7 7 7 7 7 7	ed (%)	
Joints : Mo Joints : Mo SLS_T SLS_T SLS_T SLS_1 SLS_2 SLS_3 fety Limit	t Angle Li Maxim	ints with num Spo	Maximun Maximun 250 250 250 250	um joint spe n Joint Ang) Delay T (msec)	gle Fime	1 J2	50 (x 0 Monit J3).1 deg) Itored Ju J5	oints Hand	Joints	Maxim		int Spe 7 7 7 7 7 7	ed (%)	

How to check operation

Follow the procedure below to check the operation.

- 1. Turn SAFETY_IN3 ON (0V) to enable the Joint Angle Limit.
- 2. In EPSON RC+, select [Tools] [Robot Manager] [Control Panel], and then turn the mode on.
- 3. In EPSON RC+, select [Tools] [Robot Manager] [Jog & Teach], and then set [Jog Distance] for J1 axis to 10 deg.
- 4. Click [+J1] to rotate 10 deg at low speed.

Kobot: 1, robo	ot1, GX8-B653S	▼ L0	ocal: 0 🔻 To	ol: 0 - Arm: (0 ▼ ECP: 0	▼ 🛄 ∑ :	88
Control Panel	Jogging			Current Position	12 (4)	12 ()	
Jog & Teach	Mode: Joint	Speed:	Low ~	10.000	J2 (deg)	0.000) O World
Points			Û	J4 (deg)	J5 (deg)	J6 (deg)	Joint
Hands	-J1	-J2	+J3	0.000			
Arch				Current Arm Orient	ation		l1Eag
Locals	لب الب	+J2	-J3	Hand Righty	Elbow	Wrist	J4Flag
Tools							Jonay
Arms	-√- √-4	- ∽] - √5	~J6	Jog Distance J1 (deg)	J2 (deg)	J3 (mm) (Continuous
Pallets				10.000	1.000	1.000) Long
ECP	~	2	5	J4 (deg)	J5 (deg)	J6 (deg)	Medium
Boxes	+J4	+J5	+J6	1.000) Short
Planes	Teach Points	Execute Motion					
Weight	Point File:		Point:				
	robot1.pts		✓ P0: (und	efined)	✓ Te	each	Edit

As the jog distance (angle) is equal to or less than the limit angle (15 deg), the motor stays on without triggering the Safety Function.

- 5. Set [Jog Distance] for the J1 axis to 20 deg.
- 6. Click [+J1] to rotate 20 deg at low speed.

Robot: 1 robot	
1,10000	:1, GX8-B653S ▼ Local: 0 ▼ Tool: 0 ▼ Arm: 0 ▼ ECP: 0 ▼ 💼 ∑ 👯
Control Panel Jog & Teach	Jogging Current Position Mode: Joint Speed: Low J1 (deg) J2 (deg) J3 (mm) 30.000 0.000 0.000 0.000 0.000 0.000
Points Hands	↓1 ↓2 ↓1 ↓4 (deg) ↓5 (deg) ↓6 (deg) ● Joint ↓1 ↓2 ↓3 ↓
Arch	Current Am Orientation
Locals	+J1 +J2 J3 Rghty J4Hag J6Rag
Arms	→14 →15 →16 →12 (deg) →13 (mm) ○ Continuous
ECP	20000 1.000 ○ Long 14(4 +15 +16 1000 0 C m i
Boxes	Short
Planes	Teach Points Execute Motion
Weight	Point File: Point:
Inertia	robot1.pts V P0: (undefined) V Teach Edit

7. Confirm that an emergency stop occurs and the robot operation stops.

How to reset

Follow the procedure below to reset the emergency stop status.

- 1. In EPSON RC+, select [Robot Manager] [Control Panel], and then perform the error reset operation.
- 2. Confirm that the [EStop] displayed in the lower right corner of EPSON RC+ turns off.

5.6 Example of Using Safety Limited Position (SLP)

The following describes an example of using Safety Limited Position (SLP). In this example, SLP_A is assigned to SAFETY_IN3 to confirm that an emergency stop occurs when the robot enters the restricted area. This example uses a GX8-B653S as the SCARA Manipulator and a C4-B901S as an the 6-Axis Manipulator.

5.6.1 Safety Limited Position (SLP) Settings for a SCARA Manipulator

Follow the procedure below to set the safety function parameters for the Safety Board.

1. In EPSON RC+, select [Setup] - [System Configuration], and then start Safety Function Manager under [Controller] - [Safety Functions].

ools Setup Window Help		-	
C to Controller Communications C to Configuration C to Conf	⊕-Startup Safety ⊕-Controller -General ⊢-Configuration -Preferences →-Simulator Browe Units ⊕-Robots ⊕-Inputs / Outputs ⊕-RS232 ⊕-TCP / IP <u>Conveyor Encoders</u>	Functions Safety board installed: Yes Safety board version: Rel.02.00.00.0031 Jan 17.2023 13:54:01 00.00.0121 Safety Function Manager	Close Apply Restore

2. For [SAFETY_IN3], select [SLP_A].

Safety Function Manage	er								- 0	×
Safety Function Settings	Basic Settings	Version	n Info Main	tenance						
Safety Function	n Setting	s								^
 Edit safety function Click Confirm in " The safety function Make sure that the The response valid Click Apply in "Sa The temporary set 	on paramete 'Safety Boar on paramete ne set value ues from the ofety Board of ettings are a	ers. d Comn ers are s and the e safety Commu pplied t	nunications ent to the response board are nications". to the safet	;". temporary value mate displayed y board.	r area of ti ch. in the safe	he safety t	ooard. on manage	er.		
Dry Run										
"Enable Dry Run" When dry run is e	changes dr nabled, rob	y run fo ot contr	r both the o rol by the c	controller ontroller a	and the s and monit	afety boar toring by t	d. he safetv	board are	disabled.	
Enable Dry	run									
Safety Inputs										
Safety Inputs										
Assign the function SLS_1, 2, 3, SLP_A, B There are restriction ESTOP : emergency	s to be enab 8, C require ns on the co stop. SG : p	oled for the safe mbinati rotectiv	each safety ty function on of assig e stop.	v board in option to nments fo	put. be enable er a safety	ed. If these input. If th	e are enab he intende	iled, you c ed setting	an set safety outputs and monitoring their status. cannot be performed, cancel the assigned function	۱.
				Saf	ety Func	tion Opti	ons			
	ESTOP	SG	SLS_1	SLS_2	SLS_3	SLP_A	SLP_B	SLP_C		
SAFETY_IN1	~									
SAFETY_IN2		~								
SAFETY_IN3						~				
SAFETY_IN4										
SAFETY_IN5										
										~

3. In [Robot Monitored Range], enter 100 (mm) for [J2] and 80 (mm) for [J3].

Safety Fur	nction Manager						C) ×
fety Funct	tion Settings Basic	Settings Version Int	fo Maintenance					
							SLP Viewer	ĺ
Robot N	Monitored Rang	ge						_
Enter t	the radius of the j	oint monitoring ra	ange used to determine the e	entry into the monito	red position.		.	ьİ
_	Monitoring Ra	ange Radius						_
J2		100 mi	m					
J5		0 m	m				J3 J2	
oft Ax	is Limitina							
Enter t	the limit range of	joint motion.	hat Managar "Panga" satting					
1115 56	Min (Dulue)	Mary (Dulas)	bor manager kange setting	• • • • • • • • • • • • • • • • • • • •	Marian (Inlas)			
J1	-1128676	4405476	(-1128676 To 4405476)	-62.000	242.000	(dea)		-
J2	-2685156	2685156	(-2685156 To 2685156)	-147.500	147.500	(deg)	J2	J4
J3	-928427	0	(-928427 To 0)	-170.000	0.000	(mm)	J1	• • •
J4	-1668189	1668189	(-1668189 To 1668189)	-360.000	360.000	(deg)	25	T ₁ .
				0.000	0.000		- 1	13
				0.000	0.000			
afetv E	Board Comm	unications						

- 4. Select the XY Plane in SLP_A, and then select [Wall].
- 5. Enable the checkboxes for [X1], [X2], [Y1], and [Y2], then enter -700 (mm) for [X1], 700 (mm) for [X2], -700 (mm) for [Y1], and 700 (mm) for [Y2] as the positions of each Wall.



6. Check the set range in SLP Viewer.



7. Apply settings.

5.6.2 Safety Limited Position (SLP) Settings for a 6-Axis Manipulator

Follow the procedure below to set the safety function parameters for the Safety Board.

1. In EPSON RC+, select [Setup] - [System Configuration], and then start Safety Function Manager under [Controller] - [Safety Functions].

Jerren epsenneren rejeren eentresteerret		2
Setup Window Help P PC to Configuration Image: System Configuration Preferences Options	System Configuration Safety Functions Safety Functions Safety board installed: Yes Safety board version: Rel.02.00.00.0031 Jan 17 2023 13:54:01 00.00.0121 0 Safety Function Resolution Safety Function Sa	? × Close Apply Restore
	Herrore Control Herrore Control Herrore Control Safety Function Manager Safety Function Security Herrore Control Security	

2. For [SAFETY_IN3], select [SLP_A].

											-	U	
afety Function Settings	Basic Settings	Version	Info Main	tenance									
afety Functio	n Setting	s											
 Edit safety functi Click Confirm in The safety functi Make sure that t The response va Click Apply in "S The temporary s 	ion paramete "Safety Boar ion paramete he set value lues from the afety Board (settings are a	ers. ers are se and the e safety l Commur opplied to	ent to the tresponse of board are of the safet	temporary value mate displayed v board.	area of ti :h. in the safe	he safety t	ooard. n manage	er.					
rv Run	ettings are a	ippnea a	o ene sureç	y boardi									
"Enable Day Rup"	· changes de	v run for	both the	controller	and the c	sfaty boar	4						Ī
When dry run is	enabled, rob	y run tor ot contri	ol by the c	ontroller a	and the si and monit	oring by t	a. he safety	board are	disabled.				
	000000000000000000000000000000000000000	or control	or by the t	ontroller		oning by t	ne sorety	board are	angalarican				
Enable Dry	run												
afety Inputs													l
Safety Inputs													
Assign the function SLS_1, 2, 3, SLP_A, There are restrictio ESTOP : emergency	ns to be enab B, C require t ns on the co y stop. SG : p	bled for e the safet mbinatio protective	each safety y function on of assig e stop.	/ board inj option to nments fo	put. be enable r a safety	ed. If these input. If th	are enab ne intende	oled, you c ed setting	an set safety outp cannot be perforr	uts and mon ned, cancel ti	itoring their s he assigned fu	tatus. Inction	۱.
Assign the function SLS_1, 2, 3, SLP_A There are restrictio ESTOP : emergency	ns to be enail B, C require ns on the co y stop. SG : p	bled for e the safet mbinatio protective	each safety y function on of assig e stop.	y board inj option to nments fo Saf	put. be enable r a safety ety Funct	ed. If these input. If these tion Opti	e are enab ne intende ons	oled, you c ed setting	an set safety outp cannot be perforr	uts and mon ned, cancel ti	itoring their s he assigned fu	tatus. Inction	۱.
afety Inputs Assign the functior SLS_1, 2, 3, SLP_A There are restrictio ESTOP : emergency	ns to be enail B, C require t ns on the co y stop. SG : p ESTOP	bled for e the safet mbinatio protective SG	each safety y function on of assig e stop. SLS_1	y board inj option to nments fo Saf	put. be enable r a safety ety Funct SLS_3	ed. If these input. If th tion Opti SLP_A	e are enab ne intende ons SLP_B	oled, you c ad setting SLP_C	an set safety outp cannot be perforr	uts and mon ned, cancel tl	itoring their s he assigned fu	tatus. unction	1.
afety Inputs Assign the function SLS_1, 2, 3, SLP_A, There are restrictio ESTOP : emergency SAFETY_IN1	ns to be enail B. C require to ns on the co y stop. SG : p ESTOP	bled for e the safet orbinatio protective SG	each safety y function on of assig e stop. SLS_1	y board inj option to nments fo Saf SLS_2	put. be enable r a safety ety Funct SLS_3	ed. If these input. If the tion Opti SLP_A	e are enab ne intende ons SLP_B	oled, you c ed setting SLP_C	an set safety outp cannot be perforr	uts and mon ned, cancel ti	itoring their s he assigned fu	tatus. unction	1.
SAFETY_INPUTS Assign the function SLS_1, 2, 3, SLP_A, There are restrictio ESTOP : emergency SAFETY_IN1 SAFETY_IN2	ns to be enal B. C require t ns on the co y stop. SG : p ESTOP	bled for e the safet ombinatio protective SG	each safety y function on of assig a stop. SLS_1	y board inj option to nments fo Safi SLS_2	ety Funct	ed. If these input. If the tion Opti SLP_A	e are enable intende ons SLP_B	SLP_C	an set safety outp cannot be perforr	uts and mon ned, cancel ti	itoring their s	tatus. unction	1.
SAFETY_INPUTS Assign the function SLS_1, 2, 3, SLP_A There are restrictio ESTOP : emergency SAFETY_IN1 SAFETY_IN2 SAFETY_IN3	esto be enail B. C require t ns on the co y stop. SG : p ESTOP	sG	each safety y function on of assig e stop. SLS_1	y board inj option to nments fo SLS_2	ety Funct	ed. If these input. If the tion Opti SLP_A	e are enab e intende ons SLP_B	SLP_C	an set safety outp cannot be perform	uts and mon ned, cancel tl	itoring their s	tatus. Inction	1.
Safety Inputs Assign the function SIS_1, 2, 3, SIP_A. There are restrictio ESTOP : emergency SAFETY_IN1 SAFETY_IN2 SAFETY_IN2 SAFETY_IN3 SAFETY_IN4	ns to be enail B. C require to ns on the co y stop. SG : p ESTOP	SG	each safety y function on of assig e stop. SLS_1	y board ing option to nments fo SLS_2	ety Funct	ed. If these input. If the tion Option SLP_A	ons SLP_B	SLP_C	an set safety outp cannot be perform	uts and mon ned, cancel ti	itoring their s	tatus. Inction	1.
Safety Inputs Assign the function SLS_1.2.3.SLP_A. There are restrictio ESTOP : emergency SAFETY_IN1 SAFETY_IN2 SAFETY_IN2 SAFETY_IN3 SAFETY_IN4 SAFETY_IN5	ts to be enal B, C require ins on the co y stop. SG : p ESTOP	SG	each safety y function on of assig e stop. SLS_1	staf	ety Funct	ed. If these input. If these tion Opti SLP_A	SLP_B	SLP_C	an set safety outp cannot be perforr	uts and mon	itoring their s he assigned fu	tatus. unction	.

3. In [Robot Monitored Range], enter 99 (mm) for [J2], 99 (mm) for [J3], 48 (mm) for [J5], and 30 (mm) for [J6].

Functi	ion Settings Basic	Settings Version I	nfo Maintenance						
	Annite and Desice	Jettings Version I	ino mainenance						
DOT IV	Nonitored Rang	je							
inter t nonito	he radius of the jo pred position.	oint monitoring	range used to determine the	entry into the	2		J6 J5 J3/J2		
_	Monitoring Ba	ngo Padius							
	Monitoring Ra	inge kadius					EL - J3		
J2	99	(mm)					J2		
J3	99	(mm)							
J5	48	(mm)					-		
16	20								
10	50	(mm)							
10	50	(mm)							
t Axi	is Limiting	(mm)							
t Axi	is Limiting	(mm) joint motion.							
t Axi Inter ti	is Limiting he limit range of itting is not assoc	(mm) joint motion. iated with the Re	obot Manager "Range" setting	g.					
t Axi	is Limiting he limit range of j tting is not associ Min	(mm) joint motion. iated with the Re Max	obot Manager "Range" setting	g. Minimum	Maximum				
t Axi	is Limiting he limit range of titing is not associ Min (pulse)	(mm) joint motion. iated with the Re Max (pulse)	obot Manager "Range" setting	g. Minimum (Joint)	Maximum (Joint)				
t Axi inter ti 'his se	is Limiting he limit range of J ttting is not assoc Min (pulse) -8102633	(mm) joint motion. iated with the Re Max (pulse) 8102633	obot Manager "Range" setting -8102633 To 8102633	g. Minimum (Joint) -170.000	Maximum (Joint) 170.000	(deg)			
t Axi Inter ti This se	is Limiting he limit range of titing is not associ Min (pulse) -8102633 -7626008	(mm) joint motion. iated with the Re Max (pulse) 8102633 3098066	obot Manager "Range" setting -8102633 To 8102633 -7626008 To 3098066	J. Minimum (Joint) -170.000 -160.000	Maximum (Joint) 170.000 65.000	(deg) (deg)	3 4 J5		
it Axi inter ti his se J1 J2 J3	is Limiting he limit range of titing is not assoc Min (pulse) -8102633 -7626008 -2310751	(mm) joint motion. iated with the Ro Max (pulse) 8102633 3098066 10194489	obot Manager "Range" setting -8102633 To 8102633 -7626008 To 3098066 -2310751 To 10194489	Minimum (Joint) -170.000 -160.000 -51.000	Maximum (Joint) 170.000 65.000 225.000	(deg) (deg) (deg)	20 1 1 1 1 1 1 1 1 1 1	1 6	
Jo inter ti ihis se J1 J2 J3 J4	is Limiting he limit range of titing is not associ (pulse) -8102633 -7626008 -2310751 -4723316	(mm) joint motion. iated with the R Max (pulse) 8102633 3098066 10194489 4723316	-8102633 To 8102633 -7626008 To 3098066 -2310751 To 10194489 -4723316 To 4723316	Minimum (Joint) -170.000 -160.000 -51.000 -200.000	Maximum (Joint) 170.000 65.000 225.000 200.000	(deg) (deg) (deg)	33 4 4 55 13 4 4 5 12	J6	
Jo inter ti his se J1 J2 J3 J4 J5	is Limiting he limit range of titing is not assoc -8102633 -7626008 -2310751 -4723316 -3188238	(mm) joint motion. iated with the Ro Max (pulse) 8102633 3098066 10194489 4723316 3188238	-8102633 To 8102633 -7626008 To 3098066 -2310751 To 10194489 -4723316 To 4723316 -3188238 To 3188238	Minimum (Joint) -170.000 -160.000 -51.000 -200.000 -135.000	Maximum (Joint) 170.000 65.000 225.000 200.000 135.000	(deg) (deg) (deg) (deg)	33 4 4 4 37 4 4 31 4 4 31 4 4	Jo	

4. Select the XY Plane in SLP_A, and then select [Wall]. Select the Z Direction as well.

5. Enable the checkboxes for [X1], [X2], [Y1], and [Y2], then enter -700 (mm) for [X1], 700 (mm) for [X2], -700 (mm) for [Y1], and 700 (mm) for [Y2] as the positions of each Wall. Enable the checkboxes for [Z1] and [Z2], then enter -700 (mm) for [Z1], and 700 (mm) for [Z2] as the positions of each Wall.



6. Check the set range in SLP Viewer.



7. Apply settings.

5.6.3 Confirming the Operation of the Safety Limited Position (SLP)

Follow the procedure below to check the operation.

- 1. Turn [SAFETY_IN3] ON (0V) to enable the Safety Limited Position.
- 2. In EPSON RC+, select [Tools] [Robot Manager] [Jog & Teach], and then move the robot to outside the wall (restricted area).

obot: 1, robot	1, GX8-B653S	✓ Lo	ocal: 0 🔻 To	ol: 0 - Arm: 0	▼ ECP: 0	▼ 💼 Σ i	• · · · · · · · · · · · · · · · · · · ·
ontrol Panel og & Teach Points	Jogging Mode: Joint	✓ Speed:	Low ~	Current Position X (mm) 650.000 U (deg) 0.000	Y (mm) 0.000 V (deg)	Z (mm) 0.000 W (deg)	 World Joint Pulse
Arch Locals	51 5 14	√J2 ↓J2	-13 1	Current Am Orienta Hand Righty	Elbow	Wrist	J1Flag J4Flag J6Flag
Arms Pallets ECP	₹ 5	(7 5	₹ 56	Jog Distance J1 (deg) 1.000 J4 (deg)	J2 (deg) 1.000 J5 (deg)	J3 (mm) (1.000 (J6 (deg) () Continuous) Long) Medium
Boxes Planes	+J4 Teach Points Ex	+J5 ecute Motion	+J6	1.000		0) Short
Weight	Point File: robot1.pts		Point:	efined)	∼ Tea	ach	Edit

3. Confirm that an emergency stop occurs and the robot operation stops.

How to reset

The following three methods can be used to reset an emergency stop.

- Method using safety inputs
- Method using the motor brake release
- Method using the Teach Pendant

Method using safety inputs

- 1. Set [SAFETY_IN3] to the OFF status (24 V) to disable Safety Limited Position.
- 2. In EPSON RC+, select [Tools] [Robot Manager] [Control Panel], and then perform the error reset operation.
- 3. Confirm that the [EStop] displayed in the lower right corner of EPSON RC+ turns off.
- 4. In EPSON RC+, select [Robot Manager] [Control Panel], and then click the [MOTOR ON] button.

5. In EPSON RC+, select [Tools] - [Robot Manager] - [Jog & Teach], and then move the robot to inside the wall (outside the restricted area).

obot: 1, robot	1, GX8-B653S	▼ L	ocal: 0 👻 To	ol: 0 👻 Arm: 0		▼ i ≥ iii	
Control Panel og & Teach Points	Jogging Mode: Joint	✓ Speed:	Low ~	Current Position X (mm) 650.000 U (deg)	Y (mm) 0.000 V (deg)	Z (mm) 0.000 W (deg)	World Joint Rules
Hands	-J1	-J2	+J3	0.000			U T dise
Arch Locals	د (<mark>∛</mark> +J2	↓3	Current Arm Orienta Hand Righty	Elbow	Wrist	J1Flag J4Flag J6Flag
	\sim	<u>a</u>	~	Jog Distance			
Arms	-J4	-J5	-J6	J1 (deg)	J2 (deg)	J3 (mm)	Continuous
Pallets				1.000	1.000	1.000	Long
ECP	S	5	2	J4 (deg)	J5 (deg)	J6 (deg)	Medium
Boxes	+J4	-tl+	+J6	1.000		0	Short
Planes	Teach Points E	xecute Motion					
Weight	Point File:		Point:				
Inertia	robot1.pts		✓ P0: (und	efined)	∼ Te	ach	Edit

Method using the motor brake release

How to Reset a SCARA Manipulator

1. In the EPSON RC+ control panel, under [Free Joints], click the [Free All] button to release the motor brake on each axis.

.,	-							-	
Control Panel	Status				_			_	
Jog & Teach	Emergency S	op: OFF	Safe	guard: OF	F	Mot	tors: OFF		Power: LOW
Points	Motors			Free Joints					
Hands									
Arch	MOTOR	MOTOR							
Locals	OTT			🗆 J					
Tools				🗆 J	2	Free	All		Reset
Arms	Power			🗌 J:	3				
Pallets				🗌 J4	ı.	Lock	All		Home
ECP	POWER	POWER							
Boxes	2011	man							
Planes									
Weight									
Inertia									

- 2. Move the robot by hand to outside the restricted area.
- 3. In EPSON RC+, select [Robot Manager] [Control Panel], and then perform the error reset operation.
- 4. Confirm that the [EStop] displayed in the lower right corner of EPSON RC+ turns off.

How to Reset a 6-Axis Manipulator

One way is by using the brake release unit (option). For details, refer to the following manual. "Manipulator Manual – Safety - How to Move Arms with the Electromagnetic Brake"

Method using the Teach Pendant

1. Attach the Teach Pendant to the Robot Controller and set the Robot Controller to TEACH mode.

ACAUTION

When in TEACH mode, Safety Limited Position is disabled. Be careful of the robot's operations.

- 2. Operate the Teach Pendant to move the robot to outside the restricted area.
- 3. Change to AUTO mode and perform the error reset operation using the Teach Pendant or EPSON RC+.
- 4. Use the Teach Pendant or EPSON RC+ to confirm that [EStop] is turned off.

5.7 Example of Using Soft Axis Limiting

The following describes an example of using the Soft Axis Limiting. This example uses a SCARA Manipulator as the robot. Note that the same procedure applies when using a 6-Axis Manipulator.

This example confirms that if the J1 axis moves outside the limit range, the robot enters the emergency stop status.

How to set

Follow the procedure below to set the safety function parameters.

1. In EPSON RC+, select [Setup] - [System Configuration], and then start Safety Function Manager under [Controller] - [Safety Functions].

pols Setup Window Help	🛤 System Configuration	? ×
PC to Controller Communications PC to Controller Communications Preferences Options	Startup Controller General Configuration Preferences Safety board installed: Yes Safety board version: Rel 02 00 00 0031 Jan 17 2023 13:54:01 00.00.0121 0 Proto / Outputs Prenote Control Pris232 Or CP / IP Conveyor Encoder Safety Function Security Vision	Close Apply Restore

2. Enter a limit range value of each joint [J1] to [J4] set using Soft Axis Limiting as follows:

Min [pulse]

J1:-1100000, J2:-2200000, J3:-1500000, J4:-1000000

Max [pulse]

J1:4400000, J2:2200000, J3:0, J4:1000000

ety Functi	ion Settings	Basic Settir	ngs Version Int	fo Maintenance						
Enter the monito	he radius o pred positio	f the joint n.	monitoring ra	ange used to determine th	ne entry into ti	he				
	Monitori	ng Range	e Radius					I.		
J2		84 (1	nm)					.	<u> </u>	
J3		54 (1	nm)							
								J3 J2		
- ft A.v.	ia Linaitin	~								
This set	tting is not	accoriator	d data a Data							
	Min	associated	Max	bot Manager Kange sett	Minimum	Maximum				
J1	Min (pulse) -11000	000	Max (pulse) 4400000	-1128676 To 4405476	Minimum (Joint) -60.425	Maximum (Joint) 241.699	(deg)			
J1 J2	Min (pulse) -11000 -22000	000	Max (pulse) 4400000 2200000	-1128676 To 4405476 -2685156 To 2685156	Minimum (Joint) -60.425 -120.850	Maximum (Joint) 241.699 120.850	(deg) (deg)	J2	J4	
J1 J2 J3	Min (pulse) -11000 -22000 -15000	000 000	Max (pulse) 4400000 2200000 0	-1128676 To 4405476 -2685156 To 2685156 -1802240 To 0	Minimum (Joint) -60.425 -120.850 -274.658	Maximum (Joint) 241.699 120.850 0.000	(deg) (deg) (mm)	J1	J4	
J1 J2 J3 J4	Min (pulse) -11000 -22000 -15000 -10000	000 000 000	Max (pulse) 4400000 2200000 0 1000000	-1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189	Minimum (Joint) -60.425 -120.850 -274.658 -215.803	Maximum (Joint) 241.699 120.850 0.000 215.803	(deg) (deg) (mm) (deg)	J1	J4	
J1 J2 J3 J4	Min (pulse) -11000 -22000 -15000 -10000	000 000 000 000	Max (pulse) 4400000 2200000 0 1000000	-1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189	Minimum (Joint) -60.425 -120.850 -274.658 -215.803 0.000	Maximum (Joint) 241.699 120.850 0.000 215.803 0.000	(deg) (deg) (mm) (deg) (deg)	J2	J4 1 1 J3	
J1 J2 J3 J4 J5 J6	Min (pulse) -11000 -22000 -15000 -10000	2000 2000 2000 2000 2000 2000 2000 200	Max (pulse) 4400000 2200000 0 1000000	-1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189	Minimum (Joint) -60.425 -120.850 -274.658 -215.803 0.000 0.000	Maximum (Joint) 241.699 120.850 0.000 215.803 0.000	(deg) (deg) (mm) (deg) (deg)	11 L		
J1 J2 J3 J4 J5 J6	Min (pulse) -11000 -22000 -15000 -10000		Max (pulse) 4400000 2200000 0 1000000	-1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189	Minimum (Joint) -60.425 -120.850 -274.658 -215.803 0.000 0.000	Maximum (Joint) 241.699 120.850 0.000 215.803 0.000 0.000	(deg) (deg) (mm) (deg) (deg) (deg)	J2	^{J4} ↓J3	
J1 J2 J3 J4 J5 J6	Min (pulse) -11000 -22000 -15000 -10000		Max (pulse) 4400000 2200000 0 1000000 0 1000000 0 0 0	-1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189	Minimum (Joint) -60.425 -120.850 -274.658 -215.803 0.000 0.000	Maximum (Joint) 241.699 120.850 0.000 215.803 0.000	(deg) (deg) (mm) (deg) (deg)	J1	J4 ↓ ↓ J3	
J1 J2 J3 J4 J5 J6	Min (pulse) -11000 -22000 -15000 -10000 Board Co	2000 2000 2000 2000 2000 2000 2000 200	Max (pulse) 4400000 2200000 0 1000000 0 0 0 0 0 0 0 0	-1128676 To 4405476 -2685156 To 2685156 -1802240 To 0 -1668189 To 1668189 afety functions.	Minimum (Joint) -60.425 -120.850 -274.658 -215.803 0.000 0.000	Maximum (Joint) 241.699 120.850 0.000 215.803 0.000 0.000	(deg) (deg) (deg) (deg) (deg)	J1	J4	

3. Apply settings.

How to check operation

Follow the procedure below to check the operation.

🖗 Robot Manag	er					
Robot: 1, robot	1, GX8-B653S 🔹 Local:	0 🔻 Too	ol: 0 🔻 Arm: 0	▼ ECP: 0	▼ iii > iii	
Control Panel Jog & Teach	Jogging Mode: Joint V Speed: Low	~	Current Position X (mm) 650.000	Y (mm)	Z (mm)	World
Points		\mathbf{A}	U (deg)	V (deg)	W (deg)	 Joint
Hands	-J1 -J2	+J3	0.000			O Pulse
Arch		Ţ	Current Arm Orienta	tion	Mint	J1Flag
Locals	+J1 +J2	- J 3	Righty	LDOW	VVIISL	J4Flag
Tools						J6Flag
Arms	<u>∽</u>	∽1 -J6	Jog Distance J1 (deg)	J2 (deg)	J3 (mm)	Continuous
Pallets			1.000	1.000	1.000	Long
ECP	5	5	J4 (deg)	J5 (deg)	J6 (deg)	Medium
Boxes	+ J4 +J5	+Jb	1.000		0	Short
Planes	Teach Points Execute Motion					
Weight	Point File:	Point:				
Inertia	robot1.pts ~	P0: (unde	fined)	∼ Te	ach	Edit
~						

2. Confirm that an emergency stop occurs and the robot operation stops.

How to reset

The following two procedures can reset the emergency stop status.

- Method using the motor brake release
- Method using the Teach Pendant

Method using the motor brake release

How to Reset a SCARA Manipulator

1. In the EPSON RC+ control panel, under [Free Joints], click the [Free All] button to release the motor brake on each axis.

1,1000					
ontrol Panel	Status				,
Jog & Teach	Emergency Stop: O	FF Safe	eguard: OFF	Motors: OFF	Power: LOW
Points	Motors		Free Joints		
Hands					
Arch	MOTOR M	DTOR			
Locals	OFF	UN	□ J 1		
Tools			□ J2	Free All	Reset
Arms	Power				
Pallets			J4	Lock All	Home
ECP	POWER PO	WER			
Boxes		lian			
Planes					
Weight					
Inertia					

- 2. Move the robot by hand to inside the operating range.
- 3. In EPSON RC+, perform the error reset operation.
- 4. Confirm that the emergency stop state is reset.

Use the brake release unit (option) or the Brake command of the software. For details, refer to the following manual. "Manipulator Manual – Safety - How to Move Arms with the Electromagnetic Brake"

Method using the Teach Pendant

1. Attach the Teach Pendant to the Robot Controller and set the Robot Controller to TEACH mode.

ACAUTION

When in TEACH mode, Soft Axis Limiting is disabled. Be careful of the robot's operations.

- 2. Operate the Teach Pendant to move the robot to inside the operating range.
- 3. Change to AUTO mode and perform the error reset operation.