3.5 - SLAVE PROFILE (FSOE) M0006149.1

3.5.1 - PROFILE ACTIVATION M0004660.1

The activation of the slave profile requires:

- The safety program Initial (200.003 and next versions, 202.x), SafeCell (100.x, 102.x), or SafeCell+ (1.x, 2.x).

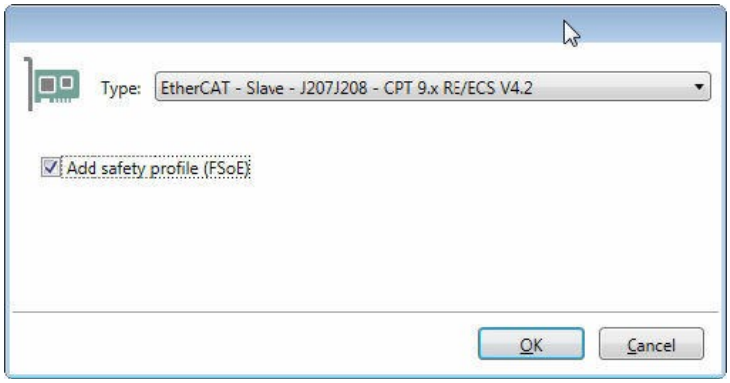
  The features available with the slave profile depend on the version of the safety program: enabling device and SS2 stop control are not available with the Initial version.

- The activation of the profile_activate safety parameter.

  By default, profile inputs and outputs are not activated.

- The configuration of the CS9 controller Ethernet slaves.

  This is described in the CS9 controller instruction manual (configuration of RT Ethernet slaves). Do not forget to select the safety profile, and to transfer the slave configuration to the CS9 controller.



I0003914

Figure 3.3

- The configuration of the FSoE master.

  The slave configuration (ESI file) can be exported from SRS Physical IOs tool.

  The worst case response time when using a FSoE communication is given by the configured watchdog time of the communication protocol (between 64 ms and 10 s). This time impacts the computation of the separation distances (see chapter 3.9).

- The configuration of the CS9 controller FSoE slave address.

  The default address is 1. The address can be changed using the profile_address safety parameter (safePMT) or Configuration / Bus Slave Address (safePMT2).

  The use of the safety profile does not inhibit the safety inputs on J100, J101 :
  - A working mode selection on J101 will collide with a working mode selection on the safety profile.
  - The safety inputs on J100 and J101 (7/8) must either be wired, or disabled in both automatic and manual modes, to prevent a systematic activation of the corresponding safety functions.

profile_activate	See chapter 6.5.2
profile_address	See chapter 6.5.2
Bus Slave Address	See chapter 6.5.2

3.5.2 - PROFILE INPUTS

M0004661.1

Profile inputs are the safety signals sent by the RSI9 to the external safe PLC.

Bit	Name	Description
0	manualSlow	ON: The current working mode is manual slow.
1	manualFast	ON: The current working mode is manual fast.
2	autoLocal	ON: The current working mode is automatic local.
3	autoRemote	ON: The current working mode is automatic remote.
4	maintenanceMode	ON: The maintenance mode is activated.
5	reducedSafety	ON: The reduced safety mode is activated (fast speed in manual fast mode).
16	safeState	ON: The robot is in safe state (motors power off, brakes closed).
17	armPower	ON: The robot motors are powered.
18	fastSpeed	ON: The robot speed limits are the automatic mode limits, or application-specific speed limits (zones or USI limits). OFF: The robot speed limits are the manual slow mode limits.
19	sosState	ON: The robot is in safe state, or stopped under power with the SOS safety sub-function activated.
20	ss2state	ON: A safety stop condition is active (SS0, SS1 or SS2).
21	ss1state	ON: A safety stop condition is active (SS0 or SS1).
22	waitingRestartAck	ON: A restart acknowledge (manual reset) will be required to restart when the safety stop condition is removed.
23	restartAck	Restart acknowledge (manual reset) signal from the robot.
24	mcpRemoval	ON: The MCP is being removed, or reconnected.
25	mcpPlug	ON: The MCP plug is connected.
26	mcpEnabling	ON: The MCP enabling device is activated. OFF: The MCP enabling device is released, or must be released for testing.
27	mcpEstop	ON: The MCP emergency stop is activated.
40	usiA	State of the USIA safe input.
41	usiB	State of the USIB safe input.
42	usiC	State of the USIC safe input.
43	usiD	State of the USID safe input.
48	zone1	ON: A robot monitoring point is within zone 1.
49	zone2	ON: A robot monitoring point is within zone 2.
50	zone3	ON: A robot monitoring point is within the USIB zone.
51	zone4	ON: A robot monitoring point is within the USIC zone.

3.5.3 - PROFILE OUTPUTS

M0004662.1

Profile outputs are the safety signals sent by the external safe PLC to the RSI9.

Bit	Name	Description
0	manualSlow	ON: Selects the manual slow working mode(1).
1	manualFast	ON: Selects the manual fast working mode(1).
2	autoLocal	ON: Selects the automatic local working mode(1).
3	autoRemote	ON: Selects the automatic remote working mode(1).
8	ss1Ctrl	When the safety profile is activated, ss1Ctrl must stay ON to allow robot movements: OFF triggers a SS1 stop. No restart acknowledge is requested after the stop. When the safety profile is not activated, ON triggers a SS1 stop.
9	enablingDeviceCtrl (2)	ON: An enabling deviceis activated, movements are allowed in manual modes. OFF: The SP2 enabling device must be activated to allow movements in manual mode.
10	ss2Ctrl (3)	When the safety profile is activated, ss2Ctrl must stay ON to allow robot movements: OFF triggers a SS2 (versions 2.x 102.x) or SS1 (version 202.x) stop. No restart acknowledge is requested after the stop.
12	restartAck	A falling edge ON↓OFF triggers a restart acknowledge (manual reset).
13	referencing	ON: A referencing sensor detects the robot at one of the referencing positions (see chapter 3.11.3).
24	monitoringA	ON: The safety function configured for USIA is activated(4).
25	monitoringB	ON: The safety function configured for USIB is activated(4).
26	monitoringC	ON: The safety function configured for USIC is activated(4).
27	monitoringD	ON: The safety function configured for USID is activated(4).

(1) Effective only if the working mode is not selected from SP2: when mode_MCP=0, or (with versions 1.x, 100.x, 200.x) mode_WMS = 1.

The manualSlow, autoLocal and autoRemote outputs can also be used to enter the maintenance mode (see chapter 3.7.3).

(2) Not available with the Initial safety versions 200.004 and earlier.

enablingDeviceCtrl allows the use of an external enabling device to control the robot, or to force the simultaneous use of two enabling devices (see chapter 3.6.2).

(3) The ss2Ctrl profile output is ignored with the safety programs 200.x.

(4) The activation is effective whatever the working mode, independently of the USIx working mode configuration. See Caution note in chapter 3.5.1.

mode_WMS	See chapter 6.4.1
mode_MCP	See chapter 6.4.2

3.6 - SAFETY STOPS

M0006150.1

3.6.1 - EMERGENCY VS. PROTECTIVE STOPS

M0004663.1

Emergency stops are specific safety stops, easily recognizable (red push button on a yellow background), always effective when pressed, and that suppress the driving power of the robot actuators and of the other actuators in the cell. Therefore the signal of the emergency stop devices connected to the robot shall be propagated to the rest of the cell, using a safe output (see chapter 3.2.5).

Protective stops are safety stops that can be configured, depending on the risks that they are controlling: effective in manual mode, automatic modes, or both; with or without restart control (manual reset); SS1 or SS2 stop; propagation to other device, or limited to the robot...

By default, the CS9 controller is configured so that the USIA safe input is connected to an emergency stop device, and the USOA safe output propagates the emergency stop signal to other devices in the cell.

USIB, USIC and USID are configured by default as SS1 protective stops, respectively in manual modes only, automatic modes only, and all working modes.

Only USIA can be configured as an emergency stop. When the WMS interface is not used, USIA can be configured as a protective stop.

The WMS emergency stop uses internally the same contacts as the USIA safe input. When the WMS interface is used, USIA shall always be configured as an emergency stop (see chapter 6.4.1)

SAFETY

The SP2 and WMS emergency stop devices shall be tested either yearly (SIL2/Cat3-PLd), or monthly (SIL3/Cat4-PLe).

3.6.2 - ENABLING DEVICE

M0005311.1

The enabling device is a protective stop that is triggered, in manual modes, when the enabling device is released, or fully pressed. It is configured by default as a SS1 protective stop. It can be configured as a SS2 protective stop using the enabling_SS2 safety parameter. The slave profile on safety bus allows an advanced control of the enabling device from an external safe PLC:

- The state of the SP2 enabling device (pressed / released) can be read.
- The enabling device protective stop can be controlled.

This makes it possible to share an enabling device between several devices; or to force the simultaneous use of several enabling devices, to protect several persons in the cell.

With the safety programs 2.x, 102.x, 202.x, the enabling device command from the external safety PLC is operational only when the SP2 enabling device is not in use. An additional enabling device must then be linked to a SS1 or SS2 protective stop to force the use of both enabling devices simultaneously.

With the safety programs 1.x, 100.x, 200.x, the enabling device command from the external safety PLC can be used independently of the state of the SP2 enabling device.

SAFETY

If two independent enabling devices are possibly accessible at the same time, the external safety PLC shall ensure that they are used either always together, or always exclusively.

enabling_SS2	See chapter 6.2.2

3.6.3 - PRIORITY BETWEEN SAFETY STOPS

M0006119.1

When two safety stops are activated simultaneously, the most demanding safety conditions of each safety stop are always met:

- The maximum stopping times of both safety stops are respected.
- Arm power is shutdown immediately if one stop is a SS0 (uncontrolled) stop.
- Arm power is shutdown if one stop is a SS1 stop.
- A manual acknowledge is required if one stop is configured so.

3.6.4 - SAFETY STOP STATUS

M0004664.1

The safety controller defines different safety stop statuses, that are accessible in VAL 3, or using a safety output:

Stop status	Description
ES-OUT	An emergency stop device connected to the robot is pressed.
ES-RST-OUT	An emergency stop device connected to the robot is either pressed, or is released but not yet acknowledged (waiting for a manual reset).
SS2-OUT	A safety stop is active; this includes any safety stop condition (SS1 or SS2). In manual mode, it can be used as an image of the state of the enabling device.
SOS-OUT	A safety stop is active, and robot standstill monitoring is activated. While the SS2 state signal is enabled when the robot is stopping, but not stopped yet, the SOS state can be used to allow an action only when the robot is really stopped.

3.6.5 - DEADLOCK LOOPS PREVENTION

M0004665.1

When a robot safety stop status is used as stop signal for other devices in the cell, it must be ensured that such a stop signal is not looped back into the robot controller as safety stop input: this would result in a deadlock loop, making it impossible to leave the robot safe stop state.

When a safe PLC is responsible for the control of the cell emergency stop:

- The robot emergency stop output USOA, configured as ES-OUT, must be connected to the safe PLC so that it can stop all other devices in the cell.
- The emergency stop safety acknowledge (manual reset) must be handled by the safe PLC, not by the robot. Do not use the ES-RST-OUT configuration of USOA !
- The safe PLC must use a SS1 protective stop input of the robot, and not its emergency stop input, to stop the robot when a cell emergency stop is activated.

The robot emergency stop input USIA can possibly be reconfigured as a SS1 protective stop, if it is not connected to an emergency stop device, and the robot WMS is not used.

USIA, configured as an emergency stop input, shall be connected to an emergency stop device, not to an external safe PLC. Reconfigure it as a protective stop to connect it to an external safe PLC.
USOA connected to a safe PLC shall be configured as ES-OUT; the ES-RST-OUT configuration is meant to control standalone equipment.