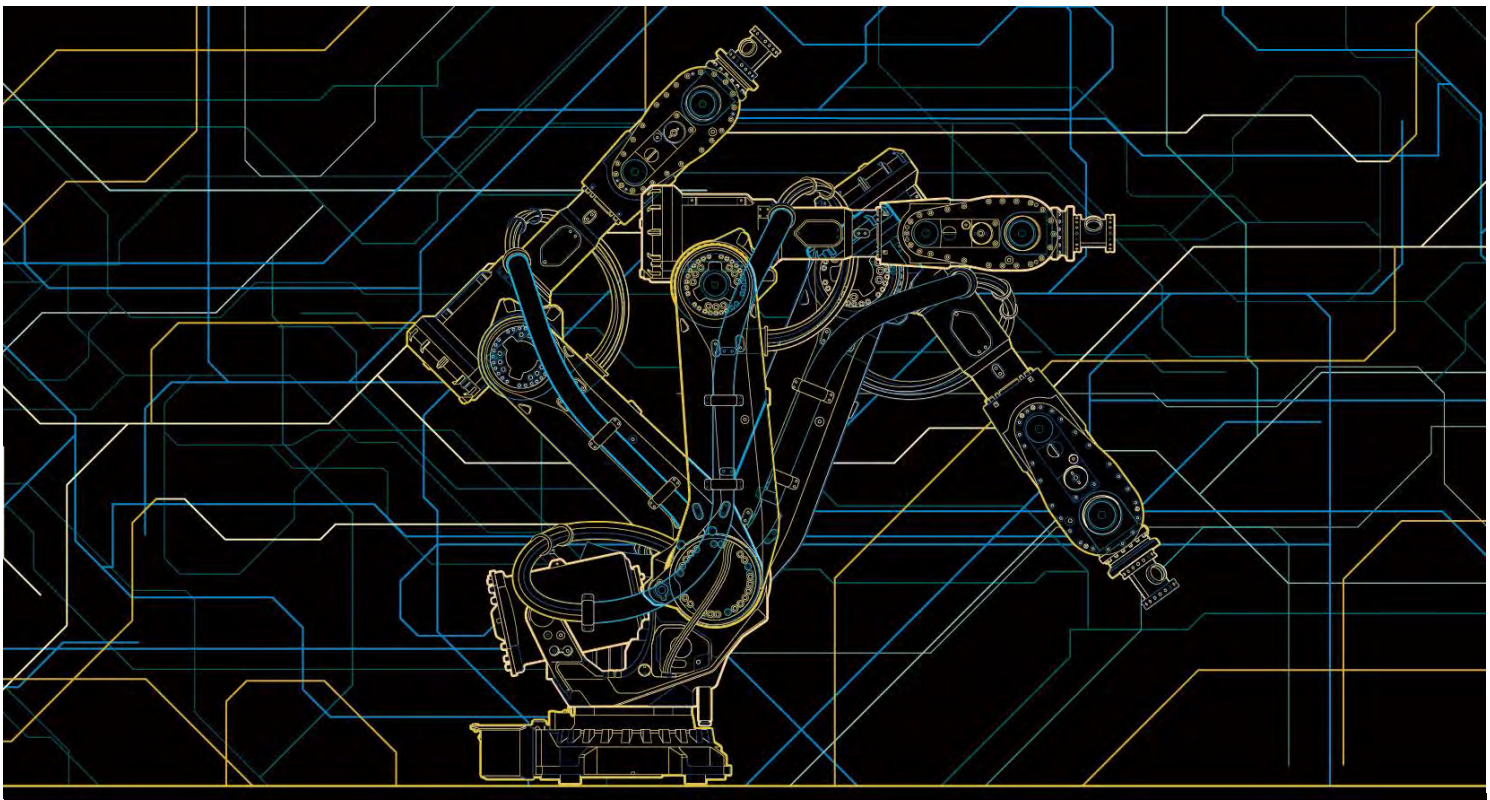

Product manual
Safety center for FlexMT

Power and productivity
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Product manual
Safety center for FlexMT

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The original language for this publication is Swedish. Any other languages that are supplied have been translated from English.

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Table of contents

Overview of this manual

About this manual

This manual describes the safety center for FlexMT.

Usage

User manuals are used to understand how to use the product, for example to install, configure, or operate.

Users

This manual is intended for:

- Personnel that are responsible for installation and configuration of robot systems
- Programmers
- Service engineers

Trademarks

FlexMT is a trademark of ABB.

PickMT is a trademark of SVIA, Svensk Industriautomation AB.

References

Reference	Document ID
Product specification - FlexMT	*3HAC049820-001*
Product manual - FlexMT	*3HAC051768-001*
Product manual - IRB 2600	*3HAC035504-001*
Product manual - IRB 4600	*3HAC033453-001*
Application manual - PickMT	*3HAC051771-001*
Application manual - PickMT with ABB robot	*3HAC051770-001*
Application manual - FeedLine Light	*3HAC052311-001*

Revisions

Revision	Description
-	First edition.

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1 Description of the product

1.1 General

WARNING

Applicable training is required in order to use the product. Incorrect use of the product can lead to personal injury and material damage.Before commissioning the product, it is your responsibility to carefully read the chapter, ”Safety precautions”, and to be familiar with the safety devices.

The safety center handles emergency stops and fence stops (auto stops) in the cells and in the interaction with external equipment in a safe and reliable manner.

Entry control manages the entry to the robot cells, e.g. by the operator.

It must be noted that the safety center and entry control must only be used in cells with intended safety classification and on the condition that the applicable safety requirements and norms are followed.

Safety functions for SVIA’s components (emergency stop and autostop) according to this description fulfils PLd in accordance with SS-EN ISO 13849:1. In certain conditions PLe can also be achieved.

1.2 Requirements for external equipment

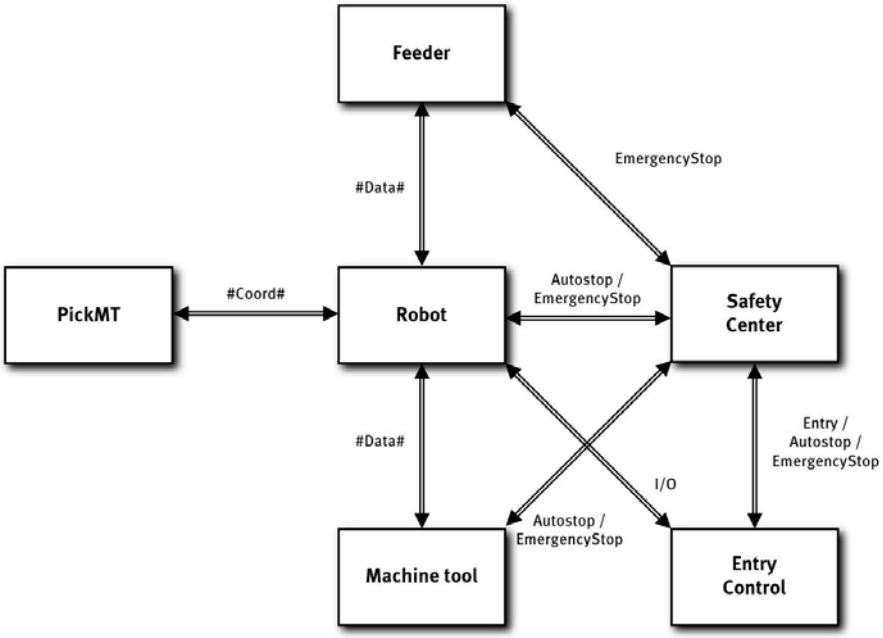
Safety functions for external equipment are dependent on the design of that equipment. General safety related information is transmitted and received in such a way that PLd can also be fulfilled for the combined system, on the condition that the external equipment at least fulfils PLd.

In order for external equipment in the safety function ”emergency stop of all equipment” to fulfil the PLd, the equipment must fulfil all PLd requirements.

In order for external equipment in the safety function ”autostop of all equipment” to fulfil the PLd, the equipment must fulfil all PLd requirements.

1.3 Typical integration example

The equipment can be integrated in several different ways. Below is a typical example of how the safety center and entry control can be integrated with other equipment. The example shows a feeder with a robot, a machine tool, and PickMT as vision system.



Typical automation cell

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2 CE reference

Supplied equipment must NOT be operated until the machine/system in which the equipment is included, has been determined to be in accordance with the machinery directive 2006/42/EG with addition.

All relevant other national and local laws and regulation must be followed, even if machinery directive 2006/42/EG is not applicable.

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3 Safety precautions

This sections covers safety precautions regarding the equipment as well as options that are not included in all installations. If the installation contains further parts, safety instruction may also be found in other documentation.

Equipment that is part of a fully or semi automatic system must always be treated with care regarding safety during the installation phase and during operation.

Continues on next page

3.1 Safety signals in the manual

Introduction to safety signals

This section specifies all dangers that can arise when doing the work described in this manual. Each danger consists of:

- A caption specifying the danger level (DANGER, WARNING, or CAUTION) and the type of danger.
- A brief description of what will happen if the operator/service personnel **do not** eliminate the danger.
- Instruction about how to eliminate danger to simplify doing the work.

Danger levels

The table below defines the captions specifying the danger levels used throughout this manual.

Symbol	Designation	Significance
 xx0200000022	DANGER	Warns that an accident *will* occur if the instructions are not followed, resulting in a serious or fatal injury and/or severe damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, and so on.
 xx0100000002	WARNING	Warns that an accident *may* occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, etc.
 xx0200000024	ELECTRICAL SHOCK	Warns for electrical hazards which could result in severe personal injury or death.
 xx0100000003	CAUTION	Warns that an accident may occur if the instructions are not followed that can result in injury and/or damage to the product. It also applies to warnings of risks that include burns, eye injury, skin injury, hearing damage, crushing or slipping, tripping, impact, fall from height, etc. Furthermore, it applies to warnings that include function requirements when fitting and removing equipment where there is a risk of damaging the product or causing a breakdown.
 xx0200000023	ELECTROSTATIC DISCHARGE (ESD)	Warns for electrostatic hazards which could result in severe damage to the product.

Continues on next page

Symbol	Designation	Significance
 xx0100000004	NOTE	Describes important facts and conditions.
 xx0100000098	TIP	Describes where to find additional information or how to do an operation in an easier way.

3.2 Safety when handling, at installation and when commissioning

Carefully read the safety precautions, before unpacking and installing the equipment.

3.3 Safety during electrical work, setup and maintenance

Work on electrical systems or operating material must only be carried out by an qualified electrician or by an instructed person under guidance and supervision of a qualified electrician according the applicable electrical technical regulations.

DANGER

The following must be carried out before commencing work:

- Emergency stop must be depressed (machine stationary)
- Machine voltage must be disconnected

DANGER

The safety center performs a personal protection function. Incorrect installation or tampering can lead to severe injuries to personnel.

DANGER

Safety functions must not be bypassed, turned away, removed or otherwise rendered ineffective.

Before integration, a risk assessment must be performed on the machine in accordance with:

- EN ISO 13849-1 ”Safety of machinery. Safety related parts of control systems. General principles for design.” Annex C (previously EN 954-1)
- SS-EN ISO 12100 ”Safety of machinery - General principles for design -- Risk assessment and risk reduction”
- EN 62061 ”Safety of machinery - Functional safety of safety-related electric, electronic and programmable electronic control systems.”

During integration applicable safety requirements and norms must be observed, in particular:

- EN ISO 13849-1 ”Safety of machinery. Safety related parts of control systems. General principles for design.” (previously EN 954-1)
- SS EN 1088 ” Safety of machinery - Interlocking devices associated with guards - Principles for design and selection”
- EN 60204-1 ”Safety of machinery. Electrical equipment of machines. General requirements.”

3.4 Safety when installing and removing

Ensure that safety devices function according to the applicable regulations. Always check that there are no local regulations that you must also adhere to in individual cases.

4 Installation

This section describes installation of the equipment. If the installation contains further parts, safety instructions may also be found in other documentation.

Connection to the principal machine and subordinate components in the cells must be carried out according to the wiring diagram. All safety functions must be tested after installation before the machine is used for the first time.

DANGER

Mounting and electrical connection of safety devices must be performed only by authorized personnel.

DANGER

Safety switches and actuators must not be used as an end stop.

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5 Maintenance

5.1 General

This sections covers both maintenance of equipment and options that are not included in all installations. If the installation contains further parts, maintenance instruction may also be found in other documentation.

Below is a summary of maintenance intervals and corresponding corrective actions.

Maintenance intervals	Corrective action
Every week	Checking for dirt
Every month	Checking safety functions Checking attachment
Every 3 months	Checking cables and cable racks

5.2 Maintenance

DANGER

Service of safety devices must be performed only by authorized personnel.

The safety components must be checked regularly regarding:

Continues on next page

5.2.1 Checking safety functions

What: Testing all safety functions.

When: Every 3 months

How: Go through all safety functions, that is all emergency stop buttons, all door switches, and any other safety devices.

5.2.2 Checking attachment

What: Checking attachment.

When: Every month

How: In the event of wear or damage, the breaker, key device, magnetic lock or other safety relevant parts must be replaced in its entirety.

5.2.3 Checking for dirt

What: Checking for dirt.

When: Every week

How: Breakers, key device, magnetic lock and other safety relevant parts must be clean. Remove any dirt.

5.2.4 Checking cables and cable racks

What: Checking cables and cable racks

When: Every 3 months

How: Inspect the entire cable rack (mounting points, dirt deposits, wear) and remedy any breaks. Check all cables. Replace damaged cables. Extend cables that rub against sharp edges.

6 Interface

The electrical interface means has the following functions:

- Safety interface for principal system
- Safety interface for SVIA's feed system and as an option for other subordinate systems
- Interface for one or more operator units with door open request and confirmation for fences.
- Interface for one or more fence circuit breakers with lock or without lock (option)

Continues on next page

6.1 Safety interface for principal machine

The principal system is, for example, the customer's processing machine or main safety system in the robot cells. As a rule the principal machine is the master of the safety system and SVIA's safety centre's slave.

SVIA's equipment can also function as master in the safety system, either to other slaves or as a master among several other masters.

The supervising system is responsible for the supervision and control of connection, for example monitoring short-circuits. Necessary PL must be achieved.

To achieve the necessary PL for all affected safety functions the supervising system must achieve sufficiently high PFH values.

It is generally recommended that all protective functions are internally monitored and doubled.

Continues on next page

6.1.1 The principal system is master

6.1.1.1 Emergency stop

Emergency stop is transmitted via a potential free, two-channel signal to the principal safety system using an emergency stop button.

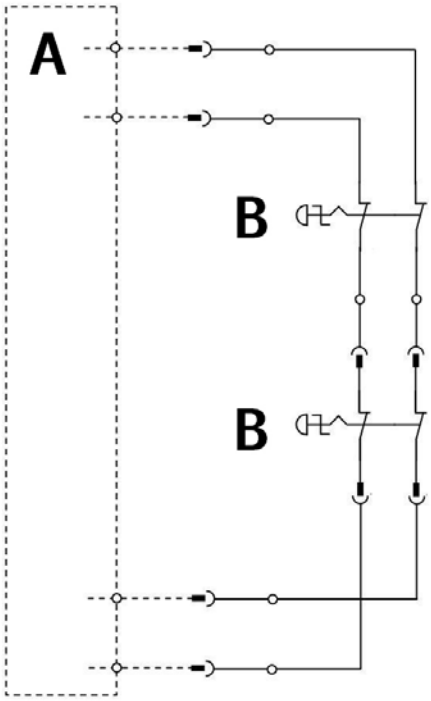

Diagram for connection of emergency stop to master

A: Emergency stop master, B: Emergency stop button

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6.1.1.1 Emergency stop
Continued

The principal system transmits emergency stop via a two-channel, potential free signal from the safety relay to the safety centre.

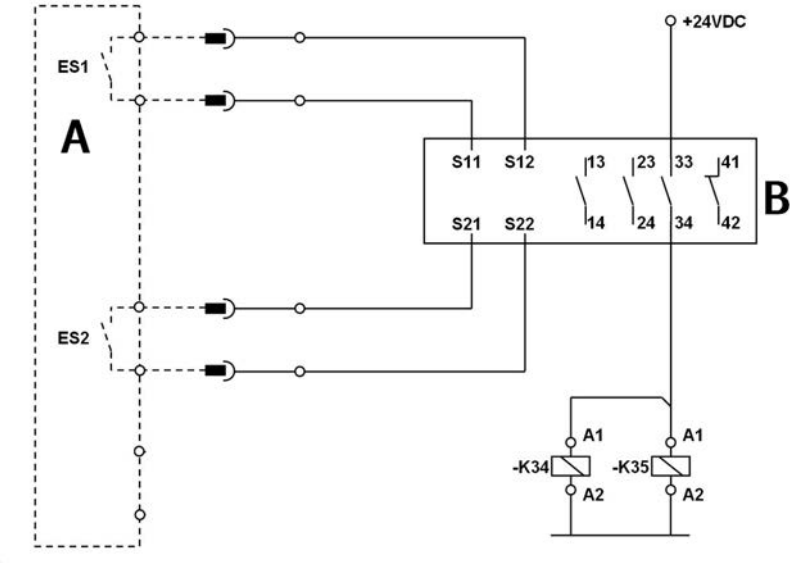

Diagram for connection of emergency stop from master

A: Emergency stop master, B: Safety relay or safety PLC

The principal system is responsible for resetting the emergency stop. The safety centre resets the emergency stop automatically.

The emergency stop connection on SVIA's side fulfils requirements according to category 3 and PLd.

6.1.1.2 Autostop

Autostop is transmitted via a potential free, two-channel signal to the principal safety system from the safety centre's safety relay.

Option: The principal system transmits autostop via a potential free, two-channel signal to the safety centre using a fence circuit breaker.

The autostop function on SVIA's side fulfils requirements according to category 3 and PLd.

6.1.2 The principal system is slave (option)

6.1.2.1 Emergency stop

The principal safety system transmits emergency stop via a potential free, two-channel signal to the safety center using an emergency stop button.

The safety centre transmits emergency stop via a two-channel, potential free signal from the safety relay to the principal system.

The safety center is responsible for resetting the emergency stop. The principal system resets the emergency stop automatically.

The emergency stop connection on SVIA’s side fulfils requirements according to category 3 and PLd.

6.1.2.2 Autostop

Autostop is transmitted via a potential free, two-channel signal to the principal safety system from the safety centre's safety relay.

Option: The principal system transmits autostop via a potential free, two-channel signal to the safety centre using a fence circuit breaker.

The autostop function on SVIA's side fulfils requirements according to category 3 and PLd.

6.1.3 Several systems are master (option)

DANGER

This operating mode should be avoided because there can be residual risks in the communication between the masters. If possible select a system where only one of the systems is master.

Continues on next page

6.1.3.1 Emergency stop

The safety centre transmits emergency stop via a two-channel, potential free signal to other systems. Emergency stop is transmitted as long as the safety centre emergency stop button is pressed, the emergency stop signal then returns to its normal operating mode again.

The safety centre is responsible for resetting its own emergency stop. Other masters reset their emergency stops themselves.

Other masters transmit the emergency stop via a two-channel, potential free signal to the safety centre. Emergency stop for further masters in the system is transmitted by signalling a 2 second emergency stop. This is to avoid the locking modes in the emergency stop circuits.

In a system with several masters, each master is responsible for resetting its own emergency stop circuit.

The emergency stop connection on SVIA's side fulfils requirements according to category 3 and PLd.

DANGER

Restart of the whole installation may not occur until all masters are reset.

6.1.3.2 Autostop

Autostop is transmitted via a potential free, two-channel signal to the principal safety system from the safety centre's safety relay.

Option: The principal system transmits autostop via a potential free, two-channel signal to the safety centre using a fence circuit breaker.

The autostop function on SVIA's side fulfils requirements according to category 3 and PLd.

6.2 Safety interface for subordinate machine

The subordinate system is, for example, a MultiFlex, a FeedLine, a smaller processing station or another subordinate safety relevant component in the robot cell.

Continues on next page

6.2.1 Emergency stop

Emergency stop is transmitted via a two-channel, potential free signal from the safety relay to the subordinate machine.

6.2.2 Autostop

Autostop is transmitted via a two-channel, potential free signal from the safety relay to the subordinate machine (option). No autostop to SVIA's feeder systems (e.g. MultiFlex, FeedLine).

6.3 Interface for operator unit

The cables for each operator unit are connected in the controller cabinet with terminals.

For more detailed information surrounding the connection, see the wiring diagram.

6.4 Safety interface for fence openings

The cables for each fence circuit breaker are connected in the controller cabinet with terminals.

For more detailed information surrounding the connection, see the wiring diagram.

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7 Function description

7.1 Entry

The entry request and management of locking are not safety classed functions which are normally checked and controlled by the robot.

The EntryRequest button, the EntryButtonButtonLamp and ResetAutostopp are connected to I/O devices in the robot's control system. The robot is responsible for managing these signals appropriately.

In the event of a door open request, the robot programme must perform a safety and processed stop. The door is then unlocked by the robot programme. When the programme is started, the door must be locked automatically.

The door is also unlocked when there is no robot programme running.

Option: In cells where locking occurs in the safety relevant section the locking logic is positioned in the safety centre (typical in the Pluto program).

The robot is still responsible for managing these signals and giving permission to unlock the door at the appropriate moments. The locking logic in the safety centre does however prevent unlocking in inappropriate circumstances.

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8 Operation

DANGER

The machine may only be operated by trained operators with the required knowledge of the installation’s functions and risks.

Continues on next page

8.1 Entry

Entry to the cells during operation occurs as follows: The operator stops the system in a controlled way by pressing the button for the door open request at the fence. The green lamp starts to flash. The system stops so that restart can occur without problem. As soon as entry is permitted, the door is unlocked and the green lamp illuminates continuously.

The operator takes the key with them and carries out work in the cell.

DANGER

When the operator enters the machine's work area, the operator must, under all circumstances, take the key that is used for the confirmation of the protection door with them. This is to prevent unintentional confirmation and restart of the machine. There must only be one key for the entire cell.

After work has been carried out in the cell, the operator closes the fence and confirms using the key switch. The system can then be restarted, e.g. from the robot's control panel. In the event of a restart, the fence locks again.

DANGER

Before making an acknowledgment with the key and restarting the system, the operator must be sure that nobody is in the cell and that restart can occur without the risk of injury.

The lock opens even in the event of manual operation when the robot programme has stopped. As soon as the door is unlocked, the green lamp illuminates continuously.

8.2 Special operational instances

8.2.1 Operation with open protective door

Pressing the push button on the robot's control panel activates the robot's motors.

Option: Other equipment that is affected by the autostop can also be activated.

Option: There may be special dangerous equipment in the cell that is deactivated at autostop. If this equipment must be activated for test operation this is possible using a special procedure:

The operator presses the enabling device on the robot's control panel. The robot can now be started. The key to reset autostop, which the operator has with them in the cell, is used to start special dangerous equipment. The reset key is turned slightly, special dangerous equipment can then be started.

When the operator releases the enabling device on the robot's control panel the special dangerous equipment also stops.

8.2.2 Starting from a non-powered status

A function check of the safety circuits should always be carried out after starting from a non-powered status.

After starting from a non-powered status, the emergency stop circuit and autostop circuit must always be tested to be able to restart the robot cell.

This occurs through any internal emergency stop button being pressed and pulled out, and any door is opened and closed. Then autostop and emergency stop are both reset in the normal way.

8.3 Opening door in machine protection without lock (option)

A door without a lock in the machine protection is intended for sporadic entry of the work area. The door is not locked and can always be opened.

When the door is opened, all relevant equipment is switched off, as with autostop.

Controlled stop: The operator stops the system by pressing the stop button in PickMT, or requests cell entry at one of the doors. Control the stops the system so that that restart can occur without problem. The operator can then open the door. Restart in the normal way.

Uncontrolled stop: If the unlocked door should open during operation, the system stops immediately. After an uncontrolled stop, the system must be reset manually to its start position, i.e. robot and other processing equipment must be operated to their start positions manually before the system can be restarted for automatic operation.

For operation with open door, the same rules apply as for operation with open protection door.

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9 Removal

Follow the relevant country's regulations for removing and recycling mechanical, electrical and electronic material. Take into account oils that can be found around the equipments moving parts.

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10 Appendix

10.1 CPU Configuration and expansion units

Standard safety centre

Pluto S20 (same program can be run in B20, S46, B46 if the I/O configuration is retained).

Large robot cells

In larger cells an appropriate pluto, for example B46-6, is used, with or without Gateway for signal exchange with the robot for example.

10.2 Safety precautions

DANGER

The Pluto program is a critical part of the automation cell's safety system. No changes may be carried out without qualified inspection and verification of the safety risks and the behaviour of the safety system as a whole.

10.3 Function description

10.3.1 General

Pluto in SVIA's safety centre takes care of the overall safety of the cell. Emergency stop and autostop to and from SVIA's equipment are gathered in one place and evaluated and managed according to the configuration at commissioning.

Operation as both safety slave and safety master is possible.

The following function description applies to all basic functions of the cells. In more complex automation cells several functions may occur and are described in a separate document.

There are two basic versions of the Pluto program: One for an even number of serially connected Eden switches in the autostop chain (PlutoStandardEven), and another for an odd number of serially connected Eden switches in the autostop chain (PlutoStandardOdd),

In the following function description ”internal” refers to a component or machine that is part of SVIA's base machine (for example robot, MultiFlex, rotation unit, similar). While ”external” in a typical case refers to the customer's processing machine(s) (for example a transfer machine, lathe, press or similar).

10.3.2 Basic configurations

When transferring the Pluto program to Pluto, ONE of the following options must be given (checked):

- Pluto is emergency stop slave (IsEmergencyStopSlave)
- Pluto is emergency stop master (IsEmergencyStopMaster)
- Pluto is emergency stop master among other emergency stop masters (ManyEmergencyStopMasters)

SVIA' safety centre is always autostop master, that is resetting of autostop is carried out at SVIA's doors.

The following additional options can be stated for special needs:

- In single cases external autostop is communicated via single channel with dynamic signal (Eden or similar) (IsDynamicExternalAutostop). In this case the correct polarity on input I0.2 is defined in the I/O configuration.
- If necessary, controlled exit of the cell is required (IsControlledExit). In which case the signal must ControlledExitButton be pulsed by pressing the button and ResetAutostop is activated within a suitable time (30s).

10.3.3 Normal operation

10.3.3.1 Normal operation - Pluto is slave

In this operating mode the safety centre emergency stop reacts to external equipment as emergency stop buttons.

Emergency stops from external equipment are expected to come from the emergency stop relays. The emergency stops must be reset on the external equipment.

Regardless of the external equipment SVIA's equipment continues in emergency stop on activation of our internal emergency stop buttons.

Safety function emergency stop:

At internal emergency stop, that is InEmergencyStopInternalChA/B becomes ”0”, all safe outputs, that is OutEmergencyStopExternal, OutEmergencyStopInternal, OutAutoStopInternalRiskComponents, and OutAutoStopInternalExternal, are set to ”0”.

At external emergency stop, that is InEmergencyStopExternalChA/B becomes ”0”, all safe outputs, that is OutEmergencyStopInternal, OutAutoStopInternalRiskComponents and OutAutoStopInternalExternal, are set to ”0”.

At emergency stop the autostop function is also forcibly activated.

Resetting safety function emergency stop:

If there is an internal emergency stop, that is InEmergencyStopInternalChA/B is ”0”, the cause of the internal emergency stop cause must be rectified. It requires a check of the supervision signal (from the expansion relay), that is SupervisionEmergencyStopExternal is ”1”, and that InEmergencyStopInternalChA/B then turns to ”1”. The safe output OutEmergencyStopExternal is then reset to ”1”.

When the supervision signal (from the expansion relay) SupervisionEmergencyStopInternal is ”1” and the external emergency stop cause is rectified, that is InEmergencyStopExternalChA/B is ”1”, the emergency stop output OutEmergencyStopInternal is reset to ”1”.

Autostop is then reset according to the regulations for autostop.

Safety function autostop:

If any of the signals InAutoStopExternalChA /B (not always used) or AutoStopDoorChain are ”0” the safe outputs OutAutoStopInternalExternal and OutAutoStopInternalRiskComponents are set to ”0”.

Autostop is also activated by emergency stop (see above).

If external Autostop is communicated via a single channel dynamic signal (IsDynamicExternalAutostop) only InAutoStopExternalChB is evaluated.

Continues on next page

10.3.3.1 Normal operation - Pluto is slave
Continued

Resetting safety function autostop:

When the first supervision signal (from the expansion relay) SupervisionAutoStop is ”1” and both InAutoStopExternalChA/B and AutoStopDoorChain are ”1” the safe output OutAutoStopInternalExternal and OutAutoStopInternalRiskComponents are reset as soon as input ResetAutostop has been set to ”1”.

If controlled exit of the cell is activated (IsControlledExit) the ControlledExitButton signal must have been pulsed to ”1” (and returned to ”0”) within 30s before ResetAutostop is set to ”1”.

LockDoor:

If any of the safe outputs is set to ”0” the output LockDoor is also set to ”0”. LockDoor is only set to ”1” when all safe outputs are set to ”1”. LockDoor is a signal that permits locking of the door through the robot, and which ensures that the door always unlocks regardless of the robot’s lock command.

Safety function autostop of dangerous equipment:

During ongoing autostop the output OutAutoStopInternalRiskComponents is set to ”1” when MotorsOnChA/B are both ”1” and ResetAutostop is pulsed to ”1”. As soon as one of the signals MotorsOnChA/B is ”0” OutAutoStopInternalRiskComponents is set to ”0”.

Note that no monitoring occurs on the function which is tied to OutAutoStopInternalRiskComponents, meaning that the function must have its own monitoring.

10.3.3.2 Normal operation - Pluto is master

In this operating mode the external emergency stop is evaluated as if it was an emergency stop button.

The emergency stop for external equipment comes from the emergency stop relays outputs. The emergency stop must be reset on SVIA's equipment.

Safety function emergency stop:

If an external or internal emergency stop is made, that is if one of the signals InEmergencyStopInternalChA/B or InEmergencyStopExternalChA/B becomes ”0”, all safe outputs, that is OutEmergencyStopExternal, OutEmergencyStopInternal, OutAutoStopInternalRiskComponents and OutAutoStopInternalExternal, are set to ”0”. The output ResetEmergencyStopLamp is set to ”1”.

At emergency stop the autostop function is also forcibly activated.

Resetting safety function emergency stop:

When all emergency stop inputs, that is InEmergencyStopInternalChA/B and InEmergencyStopExternalChA/B are ”1” the output ResetEmergencyStopLamp starts to ”flash”.

Before resetting, both supervision signals (from expansion relay) SupervisionEmergencyStopInternal and SupervisionEmergencyStopExternal must be ”1”. When the ResetEmergencyStop signal displays a negative flank (”1” -> ”0”) all safe emergency stop outputs, that is OutEmergencyStopExternal and OutEmergencyStopInternal, are reset to ”1”.

Autostop is then reset according to the regulations for autostop.

Safety function autostop:

Same as for Pluto as slave.

Resetting safety function autostop:

Same as for Pluto as slave.

LockDoor:

Same as for Pluto as slave.

Safety function autostop of dangerous equipment

Same as for Pluto as slave.

10.3.3.3 Normal operation - Pluto is master among other masters

Safety function emergency stop:

If an internal emergency stop is made, that is if the signals InEmergencyStopInternalChA/B become ”0”, all safe outputs, that is OutEmergencyStopExternal, OutEmergencyStopInternal, OutAutoStopInternalRiskComponents and OutAutoStopInternalExternal, are set to ”0”. The output ResetEmergencyStopLamp is set to ”1”.

If an external emergency stop is made, that is if the signals InEmergencyStopExternalChA/B become ”0”, all safe outputs, that is OutEmergencyStopInternal and OutAutoStopInternalExternal, are set to ”0”. The safe output OutEmergencyStopExternal is set to ”0” for 2 seconds. The output ResetEmergencyStopLamp is set to ”1”.

Resetting signals to other masters:

As soon as the internal emergency stop cause is rectified, when the signals InEmergencyStopExternalChA/B become ”1” again, the safe outputs, OutEmergencyStopInternal can be reset to ”1”.

A condition for the safe outputs OutEmergencyStopExternal to be returned to ”1” is that the supervision signal (from the expansion relay) SupervisionEmergencyStopExternal is ”1”.

OutEmergencyStopExternal must be ”0” for at least 2 seconds, even if the internal emergency stop cause is rectified before this.

Resetting safety function emergency stop:

When all emergency stop inputs, that is InEmergencyStopInternalChA/B and InEmergencyStopExternalChA/B are ”1” the output ResetEmergencyStopLamp starts to ”flash”.

Before resetting, the supervision signal (from expansion relay) SupervisionEmergencyStopInternal must be ”1”. When the ResetEmergencyStop signal displays a negative flank (”1” -> ”0”) OutEmergencyStopInternal is reset to ”1”.

Autostop is then reset according to the regulations for autostop.

Safety function autostop:

Same as for Pluto as slave.

Resetting safety function autostop:

Same as for Pluto as slave.

LockDoor:

Same as for Pluto as slave.

Safety function autostop of dangerous equipment

Same as for Pluto as slave.

10.3.4 Error messages

The following error codes are used in Pluto's display ("UE" followed by the error code). These can be added together if several conditions are met.

1: An external emergency stop is activated

2: An internal emergency stop is activated

4: An internal autostop is activated

8: An external autostop is activated

16: Supervision emergency Stop (internal or external) gives incorrect signal

32: Supervision autostop gives incorrect signal

64: Safety circuit ready for resetting, for example after door opening

Example:

Error code 6 is displayed. A door to the cell is open and an internal emergency stop is pressed.

Error code 5: External emergency stop is active and the autostop circuit is broken.

77: Error when selecting basic configuration. None or several of the basic configurations have been selected. Only select one during transfer.

In the event of a two channel fault in one of the two channel inputs, one of the associated inputs flashes. Two channel faults occur when, for example, a channel is broken and then reset.

All two channel inputs have concurrency requirements, meaning that the signal in both channels must switch signal within 0.2s.

If the two channel requirement is not fulfilled the associated input LED on Pluto flashes twice. Two channel faults can be rectified by opening both channels and then closing them again.

10.3.5 Starting from a non-powered status

For more instructions refer to the section about operation.

When starting from a non-powered status the safety functions must be checked. All safe outputs are set to “0”. Message 94, 95, 96, 97, 98 or 99 is displayed (see below).

Before a safe output can be set to ”1” it must be verified that the internal emergency stop and autostop function. This occurs by both InEmergencyStopInternalChA/B and AutoStopDoorChain having been set to ”0” and then returned to ”1”.

94,95,96: Pluto is configured for an odd numbers of doors/switches. Pluto is in the initiation sequence after start from non-powered status. The autostop chain and internal emergency stop chain must be interrupted once and reset. The value indicates Pluto’s basic configuration. 94=Pluto as slave, 95=Pluto as master, 96= Pluto as Master among other masters.

97,98,99: Pluto is configured for an even number of doors/switches. Pluto is in the initiation sequence after start from non-powered status. The autostop chain and internal emergency stop chain must be interrupted once and reset. The value indicates Pluto’s basic configuration. 97=Pluto as slave, 98=Pluto as master, 99= Pluto as Master among other masters.

10.4 Pluto I/O

		Designation	Comments
I 0		InEmergencyStopInternalChA	Emergency stop In (SVIA's buttons and Robot) (static)
I 1		InEmergencyStopInternalChB	Emergency stop In (SVIA's buttons and Robot) (DynA Non_inv)
I 2		InAutoStopExternalChA	Autostop In (from external machine, option) (static, bridged to 24V if not used)
I 3		InAutoStopExternalChB	Autostop In (from external machine, option) (DynA Non_inv, bridged to DynA if not used). Option: Can be configured as sole dynamic input, set correct inversion.
I 4		InEmergencyStopExternalChA	Emergency stop In (from external machine) (static, bridged to 24V if not used)
I 5		InEmergencyStopExternalChB	Emergency stop In (from external machine) (DynA Non_inv, bridged to DynA if not used)
I 6		InMotorsOnChA	MotorsOn signal from robot's teach pendant through the motor contactors (static, bridged to 24V if not used)
I 7		InMotorsOnChB	MotorsOn signal from robot's teach pendant through the motor contactors (DynA Non_inv, bridged to DynA if not used)
IQ10		ResetAutoStop	Reset Autostop (static)
IQ11	IQ 11	ResetEmergencyStop ResetEmergencyStopLamp	Reset Emergency stop (DynA NonInv, option) Lamp in reset button (static, option)
IQ12		AutoStopDoorChain	Autostop in door chain (Even numbers of doors: DynA Noninv, odd numbers of doors: DynA)
IQ13		SupervisionAutoStop	Supervision Expansion Autostop (static)
IQ14		SupervisionEmergencyStopInternal	Supervision Expansion Emergency Stop internal (static)
IQ 15	IQ 15	ControlledExitButton LockDoor	Push button inside the cell that must be activated within the correct time window before ResetAutostop is accepted. Doubling signal that indicates that the doors can be locked. Activated as soon as neither autostop nor emergency stop are active.
IQ 16		SupervisionEmergencyStopExternal	Supervision Expansion Emergency Stop external (static, option)
	IQ 17	DynA	Generates signal DynA
	Q 0	OutEmergencyStopExternal	Emergency stop for external equipment via expansion relay E1T

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		Designation	Comments
	Q 1	OutAutoStopInternalRiskComponents	Autostop for internal equipment that requires a three position device on the robot's teach pendant and deliberate resetting, via expansion relay BT51
	Q 2	OutAutoStopInternalExternal	Autostop for both internal and external equipment via expansion relay E1T
	Q 3	OutEmergencyStopInternal	Emergency stop for internal equipment via expansion relay E1T

All inputs have filtering activated.

10.5 Password

Two passwords are used in SVIA's safety centre:

- The main password with full access to the Pluto program is "main123"
- The password for changing the configuration settings is "config123"
- The password for downloading to Pluto is "svia"

10.6 Checksum

10.6.1 Current version

The following values apply to version 0.7 of the Pluto program:

The Checksum value (CRC) for SVIA's original Pluto program should be (IsDynamicExternalAutoStop=0, IsControlledExit=0)

PlutoStandardOdd, IsEmergencyStopSlave: CRC = 1378

PlutoStandardOdd, IsEmergencyStopMaster: CRC = 82C1

PlutoStandardOdd, IsManyEmergencyStopMaster: CRC = 420D

PlutoStandardEven, IsEmergencyStopSlave: CRC = 2B5B

PlutoStandardEven, IsEmergencyStopMaster: CRC = BAE2

PlutoStandardEven, IsManyEmergencyStopMaster: CRC = 7A2E

In event of a deviating program the checksum value (CRC) below is given:

CRC of modified program: .....

No IDFIX used.

10.6.2 Earlier versions

The following values apply to version 0.5 of the Pluto program:

The Checksum value (CRC) for SVIA's original Pluto program should be

PlutoStandardOdd, IsEmergencyStopSlave: CRC = 56A8

PlutoStandardOdd, IsEmergencyStopMaster: CRC = F70A

PlutoStandardOdd, IsManyEmergencyStopMaster: CRC = A7DB

PlutoStandardEven, IsEmergencyStopSlave: CRC = 179B

PlutoStandardEven, IsEmergencyStopMaster: CRC = B639

PlutoStandardEven, IsManyEmergencyStopMaster: CRC = E6E8

In event of a deviating program the checksum value (CRC) below is given:

CRC of modified program: .....

No IDFIX used.

The following values apply to version 0.6 of the Pluto program:

The Checksum value (CRC) for SVIA's original Pluto program should be (IsDynamicExternalAutoStop=0, IsControlledExit=0)

PlutoStandardOdd, IsEmergencyStopSlave: CRC = 6193

PlutoStandardOdd, IsEmergencyStopMaster: CRC = 2F5A

PlutoStandardOdd, IsManyEmergencyStopMaster: CRC = 802E

PlutoStandardEven, IsEmergencyStopSlave: CRC = 62B2

PlutoStandardEven, IsEmergencyStopMaster: CRC = 2C7B

PlutoStandardEven, IsManyEmergencyStopMaster: CRC = 830F In event of program deviation the checksum value (CRC) below is entered:

CRC of modified program: .....

No IDFIX used.

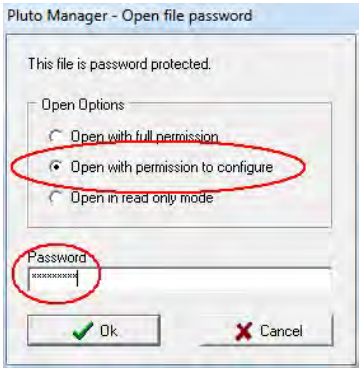
10.7 Installation guide

10.7.1 Working method

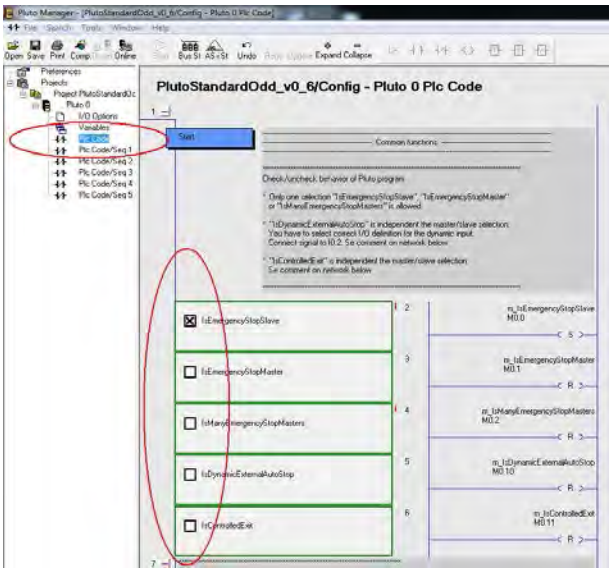
- Configure the appropriate Pluto program according to instructions in the wiring diagram.
- Check the checksum for the program.
- Load the program to Pluto.
- Carry out the test for start up from current free status.

10.7.2 Configuring

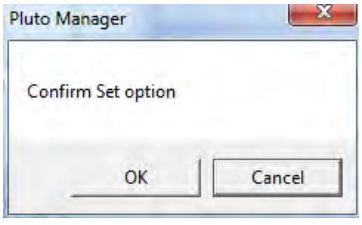
- Ensure that the programming cable is connected between the computer and Pluto.
- Open the appropriate program in PlutoManager (Even/Odd).



- Highlight the line ‘Open with permission to configure’ and enter the password ‘config123’. Then press OK.



- Open the Pluto project and highlight ’PLC Code’. Then check for suitable Pluto behaviour according to information on the wiring diagram.



- Confirm your selection of Pluto behaviour by pressing ’OK’. Repeat until all options are set according to specification.

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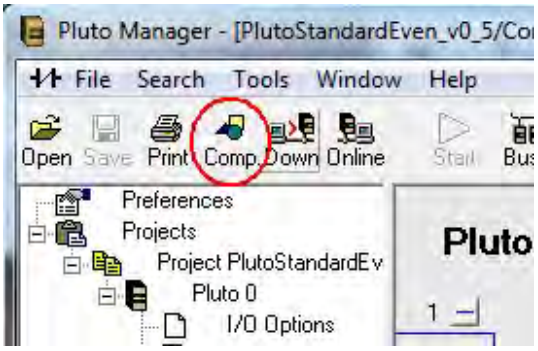
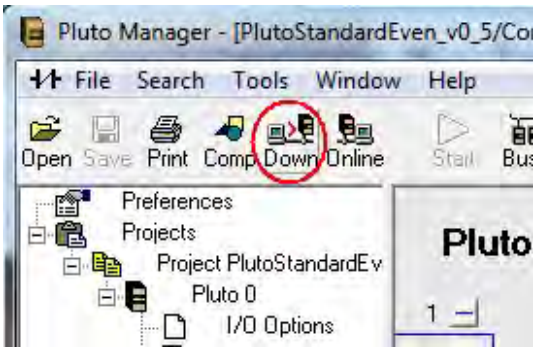
10.7.2 Configuring
Continued



- Next step is to compile the program. Press the ’Comp.’ button

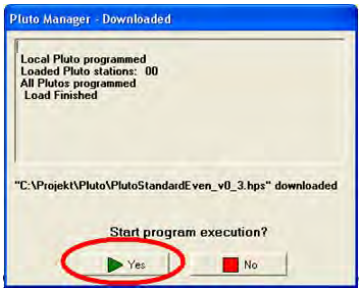
- Note the CRC code and compare with the codes in the documentation. Each deviation must be traced and corrected.
- Confirm the successful compilation by pressing ’OK’.

10.7.3 Downloading



- Start by pressing the 'Down' button, see figure 3.1, to commence downloading the Pluto program.

- Then enter a password for downloading twice at the first download. Always enter the password 'svia' when downloading. For later downloading the correct password must be used to download a new program in Pluto.



- When downloading programs in Pluto execution of program operation is stopped, therefore press the 'Yes' button to restart execution.
- Pluto must then undergo the same sequence as at restart from unpowered status.

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11 Own notes

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