

Robot Safety Module Datasheet

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Overview

The Robot Safety Module CE-SA-016-0001, is intended to interface with a robot and with the MachineMotion V2. The Safety IN port and the Reduced port are connected to safety modules which change the state of the robot and the MachineMotion. A Robot Safety Module (no MachineMotion) CE-SA-016-0002 is also available when there is a need for a heads up signal to place Cobot in collaborative mode. The Robot Safety Module (no MachineMotion) CE-SA-016-0002 can be used when our Safety Module features are considered for an application (muting, mode-switching or auto-reset).

Features

- Compatible with MachineMotion V2
- Configuration-free: plug & play
- Modules can be daisy-chained
- Support robot reduced/collaborative mode
- Configurable heads-up delay
- Compatible with most robot brands
- Five port Ethernet switch (safety IN, safety OUT, reduced, to robot, internal mcu)
- On-board LED for power, fuse, and communication status indication, located on the bottom of the module
- LED indicator displaying power status, fault alerts, safety status, and activation of an emergency stop triggered by the module
- Publishes safety state to MachineMotion V2

Included cables

- 1x Safety Extension cable - CE-CA-102-5001__2
- 1x Robot Safety Module "TO ROBOT" cable - CE-SA-111-0001
- 1x MachineMotion 2 Safety IN Pigtail cable - CE-CA-105-2000
- 1x Safety Jumper - CE-SA-102-0001

Safety



Vention's safety modules perform safety functions as a part of a whole installation or machine. A complete safety system normally includes sensors or input units, logic units and contactors or output units. The manufacturer of the installation or machine is responsible for ensuring proper functioning of the whole system. The total concept of the control system into which the safety module is integrated must be validated by the user. Vention cannot guarantee all specifications of an installation or a machine without being responsible for the risk assessment and the design of the safety system. Vention takes over no liability for recommendations which are given or implied in the following description.

The following items must be taken into consideration during the design, risk assessment & installation of the safety system :

- The Safety Modules shall be put into operation only after the safety functions have been tested during the commissioning.
- According to EN IEC 60204-1:2018 and EN ISO 10218-1:2011 it is not allowed to restart automatically after emergency stop. Therefore the control systems of the connected devices have to disable the automatic start after emergency stop.
- Opening the Safety Module or implementing unauthorized changes voids any warranty.



Functional error! Danger to life, risk of serious injuries or property damage

- The Robot Safety Module may only be connected to the equipment listed in this manual;
- The Robot Safety Module should be the last equipment in the safety chain. i.e. the device connected to the MachineMotion. If this recommendation is not respected, the safety devices connected downstream of the Safety OUT port of the Robot Safety Module won't stop the robot;
- When several Robot Safety Modules are connected on the same safety chain, if a robot goes to an emergency stop, all robots connected to a Robot Safety Module located upstream in the safety chain won't stop.
- The Robot Safety Module shall be connected to a Robot according to its specific wiring diagram.
- No emergency stop button shall be connected to the safety chain of the Reduced port;
- The Robot Safety Module does not monitor the input redundant signals at the From Robot and Reduced ports. If the connected devices do not have monitoring of its output signals, the performance level of the safety function can be reduced;
- As per IEC 60204-1:2018 and ISO 13850:2015, if an emergency stop button is connected to the safety chain of the Safety IN port, the STO_To-Robot signals of the To Robot port shall be connected to a safe input that brings the robot in a stop category 0 or 1;
- The Smart Robot Safety Module is designed to operate in indoor environments without dust or high humidity. Dust and dampness may lead to malfunction. Do not install or operate the Safety Module outdoors;

Technical specs

General Specifications

Item	Specification
Part Number	<ul style="list-style-type: none">• CE-SA-016-0001• CE-SA-016-0002 (No MachineMotion)
Weight	0.8kg
Dimensions	19.0 x 15.0 x 9.0mm
Material	<ul style="list-style-type: none">• Bottom enclosure: Aluminum• Top enclosure: Aluminum

Item	Specification
Operating Temp	0 to 40°C

Electrical Specifications

Item	Specification
Nominal input voltage	24 VDC (Class 2 or SELV power supply)*
Input voltage range	19.2 ~ 26.4 VDC
Operating power consumption	8.4 W
Short circuit protection	Internal E-FUSE IC
Max current allowed	2 A
Post-short current	250 mA
Release delay at 24 V	< 40 ms

- Note: In North America the Safety Module shall be supplied by a certified class 2 power supply. In Europe, the Safety Module must be supplied by an SELV circuit. When powered by the MachineMotion those requirements are met.

Physical Interface



Figure 1: Physical Interface

LED Indicators

Name	LED Color	Indicated (when ON)
POWER	White	24 VDC supplied to module
COMM	White	EtherNet communication functional
FUSE	Red	Module internal fuse tripped
STATUS	Off	Disconnected
STATUS	Green	Connected
STATUS	White	Communication issue
STATUS	Orange	Error
STATUS	Red	E-Stop
STATUS	Blinking Red	User triggered E-Stop
STATUS	Blinking Blue	Reduced/Collaborative mode

Functionality

The Robot Safety Module is an easy way to interface almost any robot brand with Safety equipment and a MachineMotion V2. The cables are connected to the robots interface to enable the Emergency stop and Reduced speed safety functions. This makes it so that the estop button on the robot pendant will stop the MachineMotion and that the estop from the MachineMotion module will also stop the robot.

The Connectivity of the Smart Robot Safety Module consists of a 5 port ethernet switch that connects the robot to the MachineMotion. The subnet of the safety in port is 192.168.5.0/24 and the address of the MachineMotion is 192.168.5.1. One reserved ip address in that subnet is 192.168.5.2 for the pendant, the rest is free to be used.

The reduced mode is optional. It can be implemented if the robot needs to go at a slower speed during an intervention by an individual.

A safeguard stop can be implemented using the reduced port and by wiring the robot differently. It is important to not put an emergency stop button on a safeguard stop line.

For Applications where reduced and safeguard stop would be needed, it would be possible with 2 Smart Robot Safety modules. No estop+reset module can be plugged into the reduced line/safeguard line.

Port definitions



Figure 2: Robot Safety Module ports

Safety OUT - Pin-out - M12, male, 12-pin, A-Keyed

The Safety OUT port connects to the SAFETY IN port of another Safety Module (if daisy-chaining multiple safety modules) or to a MachineMotionV2.

Pin	Function
Pin 1	24 VDC
Pin 2	0V
Pin 3	SAFETY OUT 11
Pin 4	SAFETY OUT 12
Pin 5	SAFETY OUT 21
Pin 6	SAFETY OUT 22

Pin	Function
Pin 7	RESET +(24V)
Pin 8	RESET - (OUTPUT)
Pin 9	ETHERNET TX+ (auto-MDIX)
Pin 10	ETHERNET TX- (auto-MDIX)
Pin 11	ETHERNET RX+ (auto-MDIX)
Pin 12	ETHERNET RX- (auto-MDIX)

Safety IN - Pin-out - M12, female, 12-pin, A-Keyed

The Safety IN port connects to the SAFETY OUT port of another Safety Module (if daisy-chaining multiple safety modules) or to an E-Stop and Reset Module (CE-SA-007-0000). IMPORTANT: If the SAFETY IN port is not used, insert the included yellow jumper.

Pin	Function
Pin 1	24 VDC
Pin 2	0V
Pin 3	SAFETY IN11
Pin 4	SAFETY IN 12
Pin 5	SAFETY IN 21
Pin 6	SAFETY IN 22
Pin 7	RESET +(24V)
Pin 8	RESET - (INPUT)
Pin 9	ETHERNET TX+ (auto-MDIX)
Pin 10	ETHERNET TX- (auto-MDIX)
Pin 11	ETHERNET RX+ (auto-MDIX)
Pin 12	ETHERNET RX- (auto-MDIX)

To Robot - Pin-out - M12, male, 12-pin, A-Keyed

Pin	Function
Pin 1	NC
Pin 2	NC
Pin 3	STO_TO_ROBOT 11

Pin	Function
Pin 4	STO_TO_ROBOT 12
Pin 5	STO_TO_ROBOT 21
Pin 6	STO_TO_ROBOT 22
Pin 7	RESET 11 DRY contact
Pin 8	RESET 12 DRY contact
Pin 9	ETHERNET TX+ (auto-MDIX)
Pin 10	ETHERNET TX- (auto-MDIX)
Pin 11	ETHERNET RX+ (auto-MDIX)
Pin 12	ETHERNET RX- (auto-MDIX)

From Robot - Pin-out - M12, female, 12-pin, A-Keyed

Pin	Function
Pin 1	STO_IN (24V)
Pin 2	STO_IN (24V)
Pin 3	unplanned stop
Pin 4	delay reduced
Pin 5	0V
Pin 6	REDUCED OUT 11
Pin 7	REDUCED OUT 12
Pin 8	REDUCED OUT 21
Pin 9	REDUCED OUT 22
Pin 10	NC
Pin 11	NC
Pin 12	NC

Reduced - Pin-out - M12, female, 12-pin, A-Keyed

Pin	Function
Pin 1	24V (fused)
Pin 2	0V

Pin	Function
Pin 3	REDUCED IN 11
Pin 4	REDUCED IN 12
Pin 5	REDUCED IN 21
Pin 6	REDUCED IN 22
Pin 7	RESET + (24V)
Pin 8	RESET - (RESET SIGNAL)
Pin 9	ETHERNET TX+ (auto-MDIX)
Pin 10	ETHERNET TX- (auto-MDIX)
Pin 11	ETHERNET RX+ (auto-MDIX)
Pin 12	ETHERNET RX- (auto-MDIX)

Mounting

Install the module mounting bracket (CE-HW-005-1002) to the extrusion with the screws provided (HW-FN-003-0018). Install the module onto the mounting bracket as illustrated below.

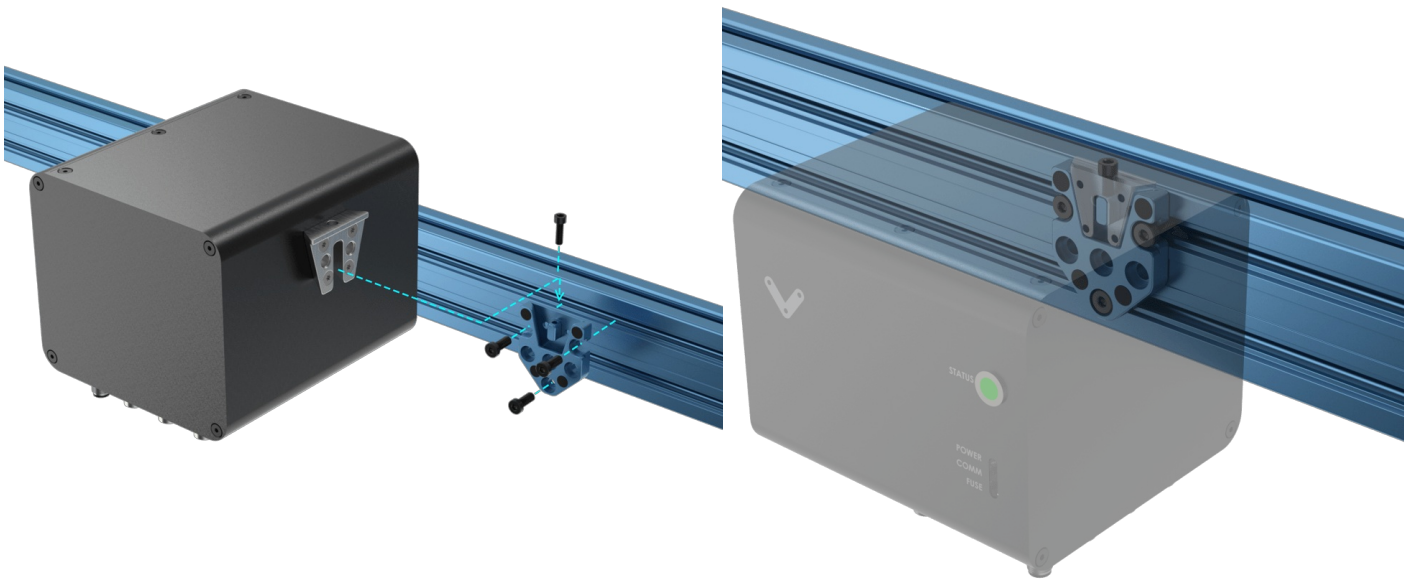
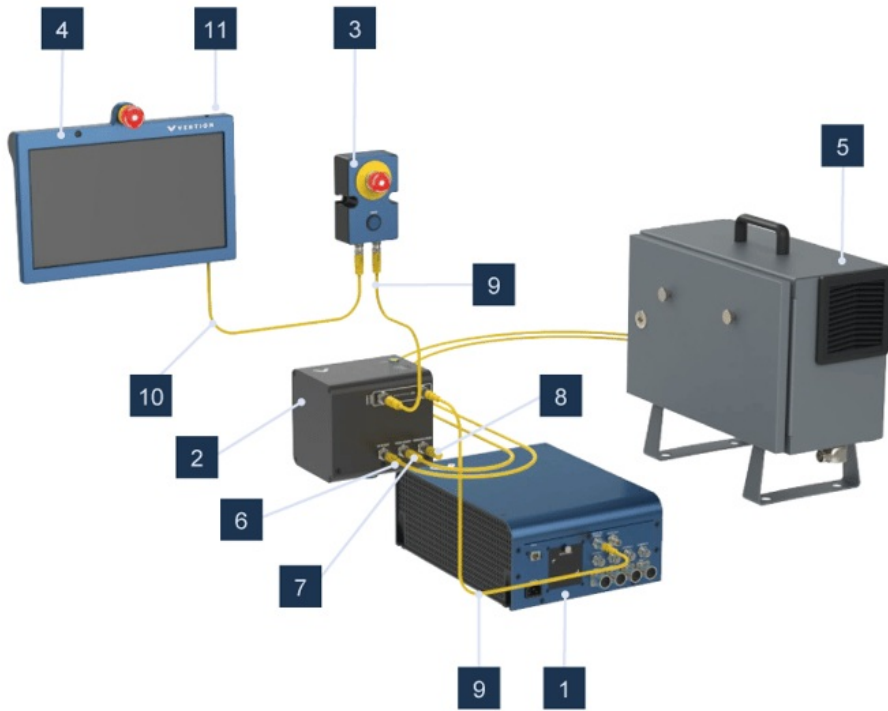


Figure 3: Module Mounting

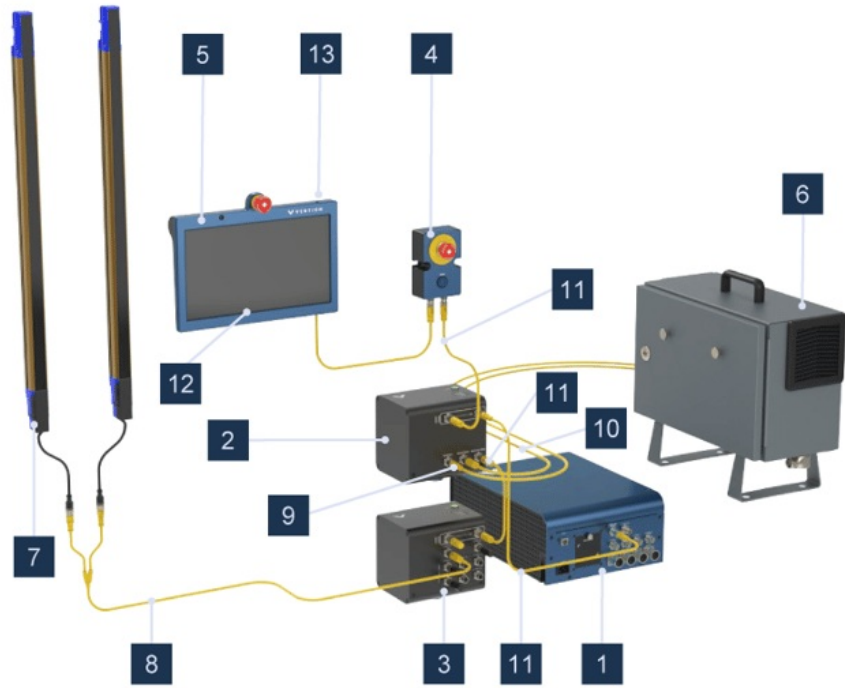
Figure 3: Module Mounting

Wiring Diagrams with MachineMotion



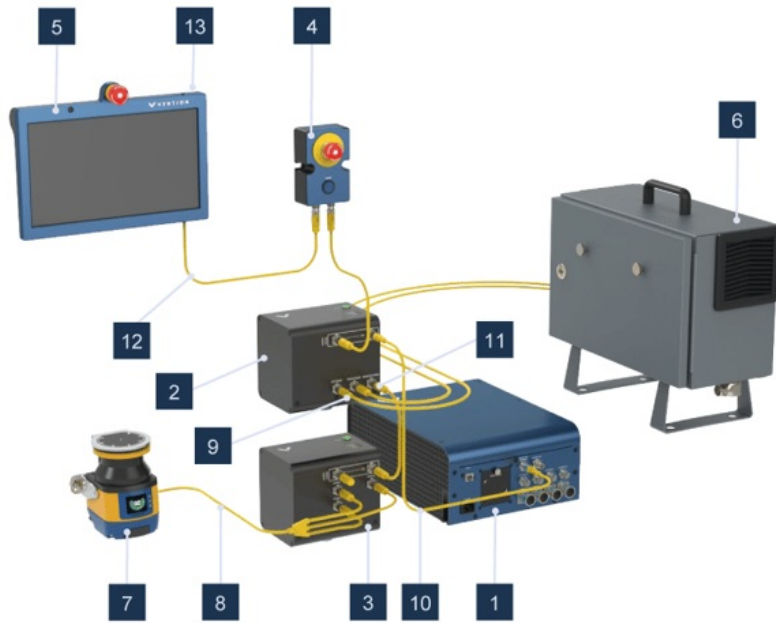
- | | |
|--|---|
| 1. MachineMotion - CE-CL-010-0004 | 7. Safety IN Pigtail Cable - CE-CA-105-2000 |
| 2. Robot Safety Module - CE-SA-016-0001 | 8. Safety Jumper - CE-SA-102-0001 |
| 3. E-Stop Module - CE-SA-007-0000 | 9. Safety Extension Cable - CE-SA-102-5001__2 |
| 4. Pendant V3 - CE-TP-014-0001 | 10. Pendant V3 cable - CE-CA-109-5000 |
| 5. Robot Controller | 11. Pendant Safety Jumper - CE-SA-102-0001 |
| 6. Robot Safety Module "TO ROBOT" Cable - CE-SA-111-0001 | |

Figure 4: Robot Safety Module wiring diagram



- | | |
|---|--|
| 1. MachineMotion - CE-CL-010-0004 | 8. Light Curtain Cable - CE-SA-106-0001 |
| 2. Robot Safety Module - CE-SA-016-0001 | 9. Robot Safety Module "TO ROBOT" Cable - CE-SA-111-0001 |
| 3. Auto-Reset Module - CE-SA-019-0001 | 10. Safety IN Pigtail Cable - CE-CA-105-2000 |
| 4. E-Stop Module - CE-SA-007-0000 | 11. Safety Extension Cable - CE-SA-102-5001__2 |
| 5. Pendant V3 - CE-TP-014-0000 | 12. Pendant V3 cable - CE-CA-109-5000 |
| 6. Robot Controller | 13. Pendant Safety Jumper - CE-SA-102-0001 |
| 7. Datalogic Light Curtains | |

Figure 5: Robot Safety Module wiring diagram with Muting Safety Module (CE-SA-015-0001)

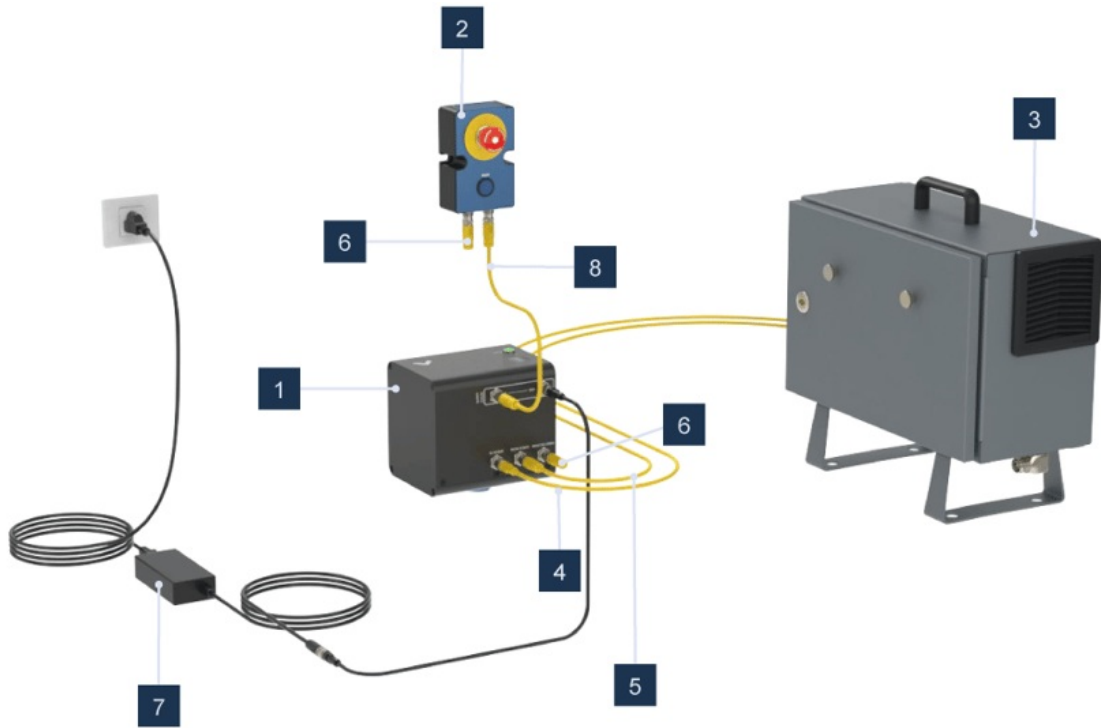


- | | |
|---|---|
| 1. MachineMotion - CE-CL-010-0004 | 8. Area Scanner 3 Output Cable - M12 17pin to 3x M12 12pin - CE-SA-126-0001 |
| 2. Robot Safety Module - CE-SA-016-0001 | 9. Robot Safety Module "TO ROBOT" Cable - CE-SA-111-0001 |
| 3. Auto-Reset Module - CE-SA-019-0001 | 10. Safety IN Pigtail Cable - CE-CA-105-2000 |
| 4. E-Stop Module - CE-SA-007-0000 | 11. Safety Extension Cable - CE-SA-102-5001__2 |
| 5. Pendant V3 - CE-TP-014-0000 | 12. Pendant V3 cable - CE-CA-109-5000 |
| 6. Robot Controller | 13. Pendant Safety Jumper - CE-SA-102-0001 |
| 7. Datalogic Laser Area Scanner - 3 OSSD Parent (auto-reset) - PR-DA-201-0489 | |

Figure 6: Robot Safety Module wiring diagram with Auto-Reset Module (CE-SA-019-0001)

Wiring Diagram without MachineMotion

The Robot Safety Module (no MachineMotion) CE-SA-016-0002 can be used when there is a need for a heads up signal to place Cobot in collaborative mode. The Robot Safety Module (no MachineMotion) CE-SA-016-0002 can be used when our Safety Module features are considered for an application (muting, mode-switching or auto-reset).



- | | |
|--|---|
| 1. Robot Safety Module - CE-SA-016-0001 | 5. Safety IN Pigtail Cable - CE-CA-105-2000 |
| 2. E-Stop Module - CE-SA-007-0000 | 6. Safety Jumper - CE-SA-102-0001 |
| 3. Robot Controller | 7. 24V Power Supply - CE-PS-024-0094 |
| 4. Robot Safety Module "TO ROBOT" Cable - CE-SA-111-0001 | 8. Safety Extension Cable - CE-SA-102-5001__2 |

Figure 7: Robot Safety Module without MachineMotion

Robot Controller wiring diagrams

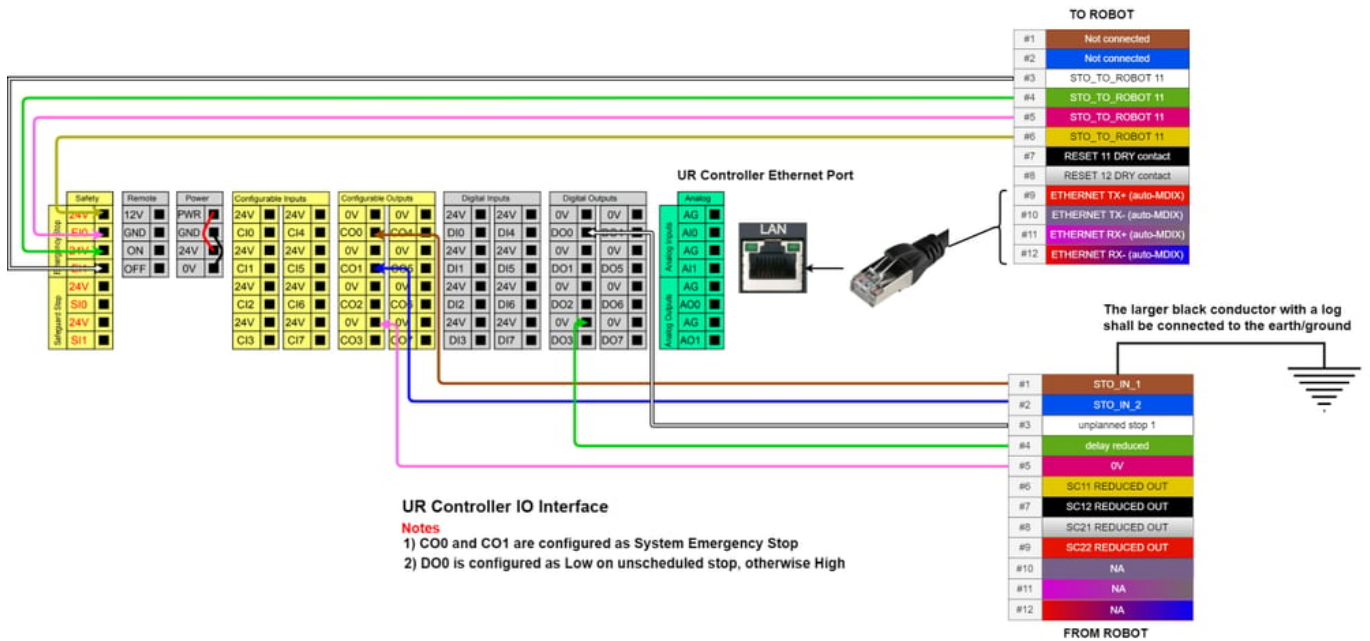


Figure 8: Robot Safety Module with UR Controller wiring diagram

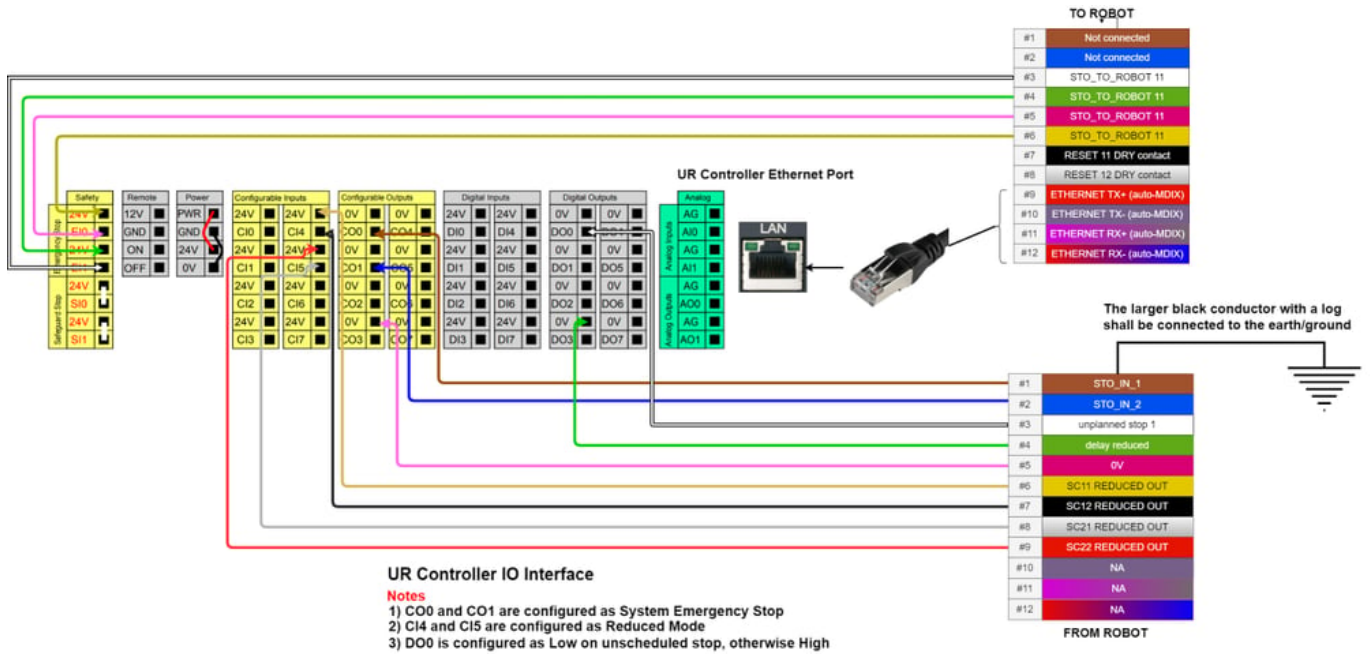


Figure 9: Robot Safety Module with UR Controller wiring diagram (reduced optional)

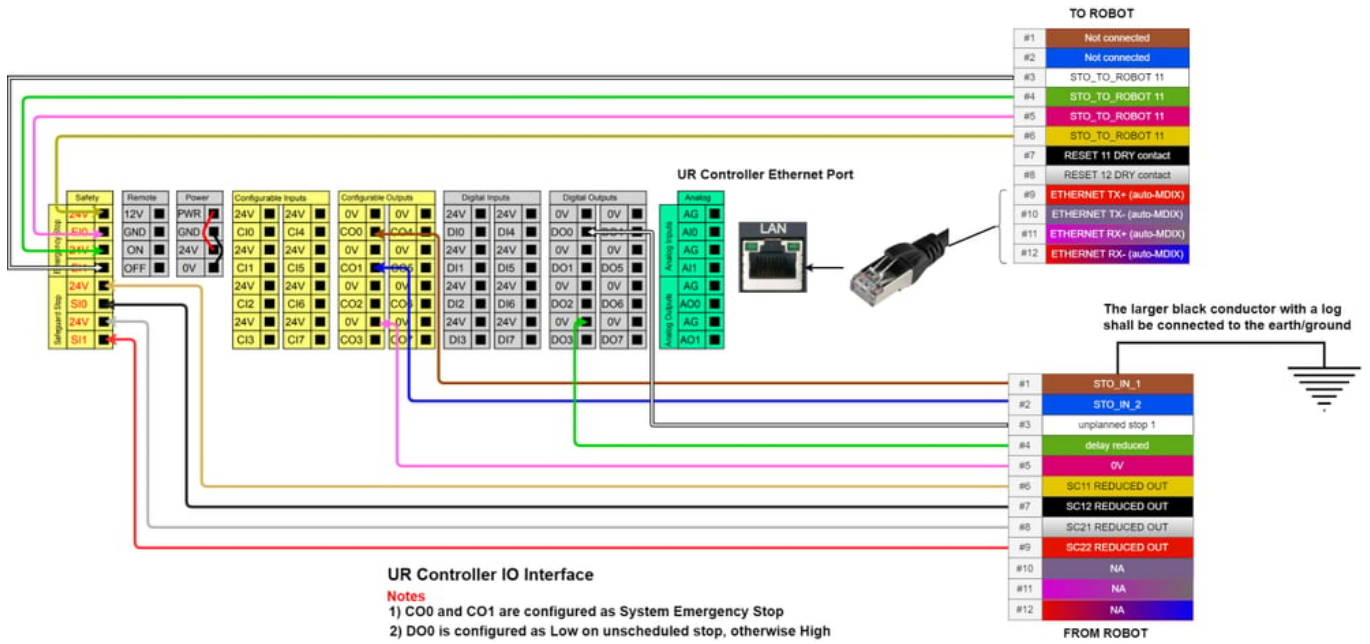


Figure 10: Robot Safety Module with UR Controller wiring diagram (estop+safeguard)

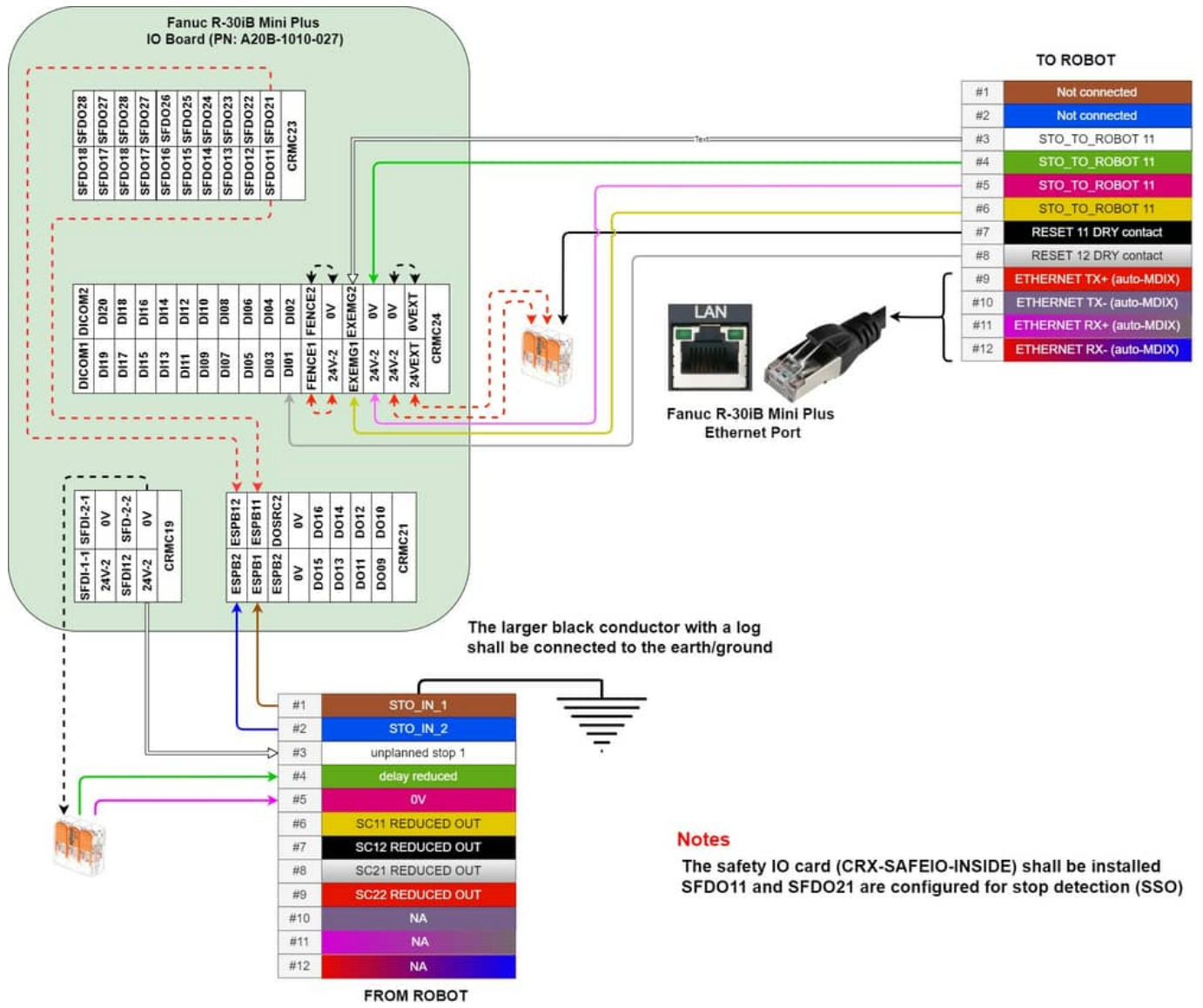


Figure 11: Robot Safety Module with Fanuc R-30iB Mini plus controller wiring diagram

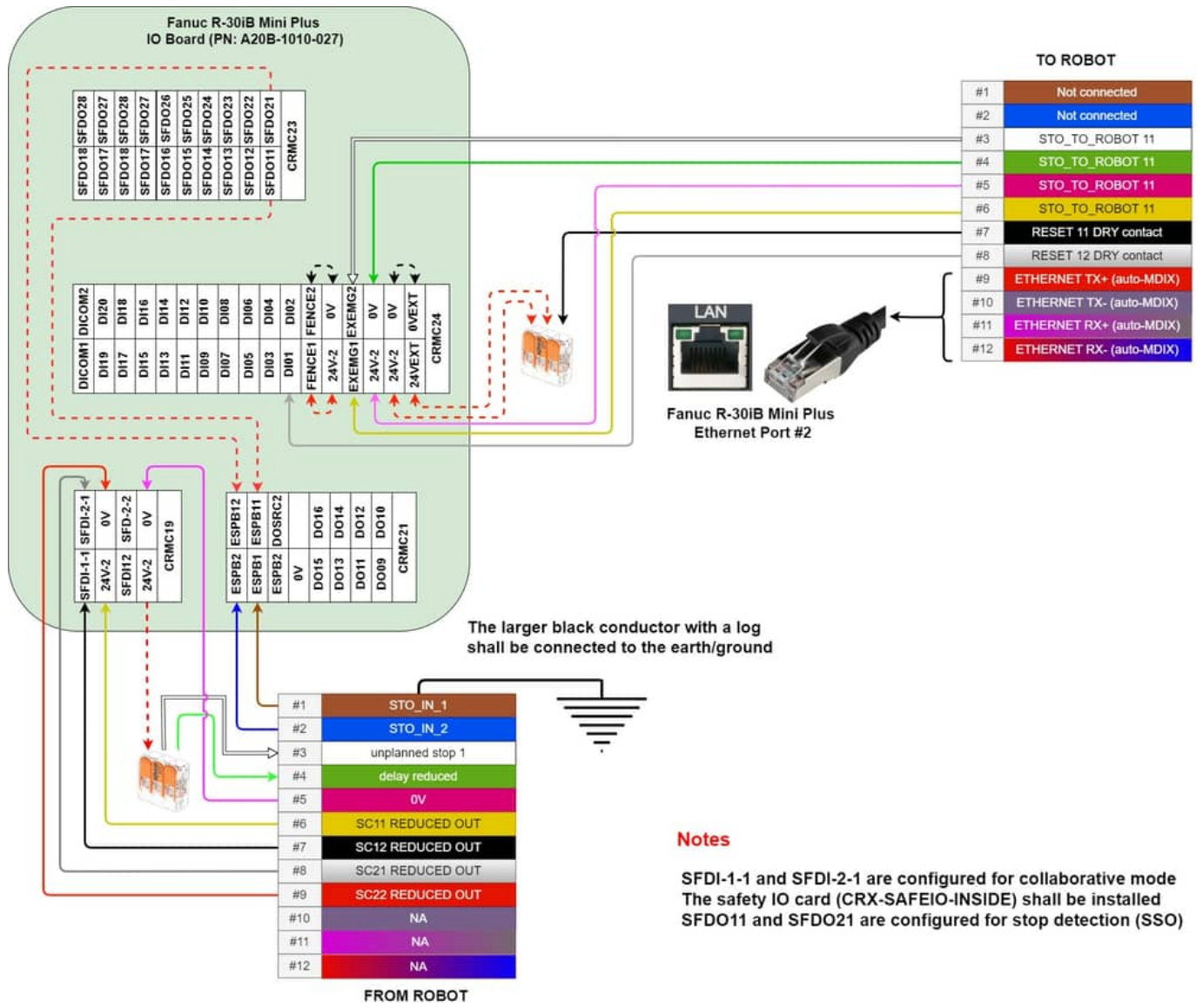


Figure 12: Robot Safety Module with Fanuc R-30iB Mini plus controller wiring diagram (Reduced)

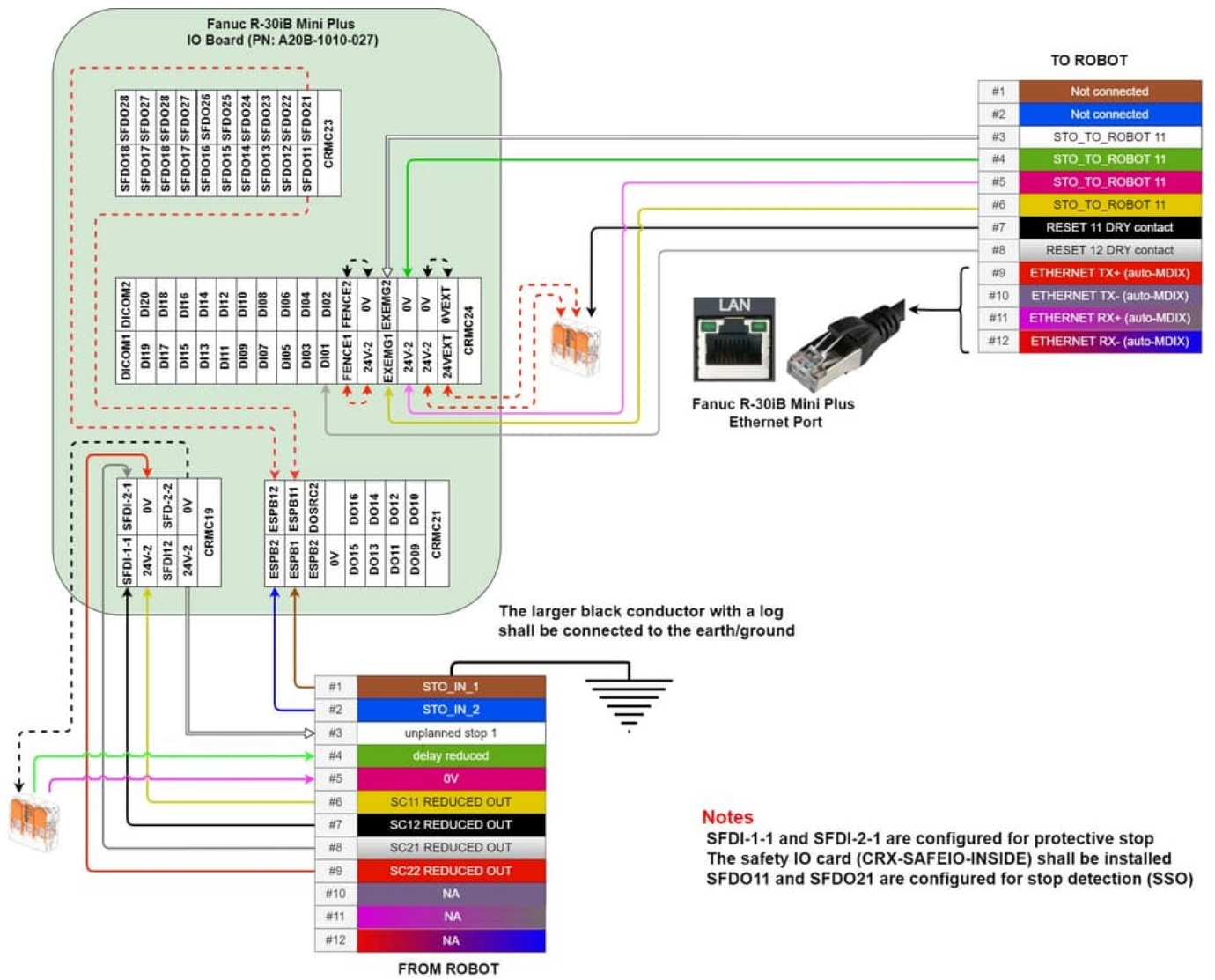


Figure 13: Robot Safety Module with Fanuc R-30iB Mini plus controller wiring diagram (Protective stop)

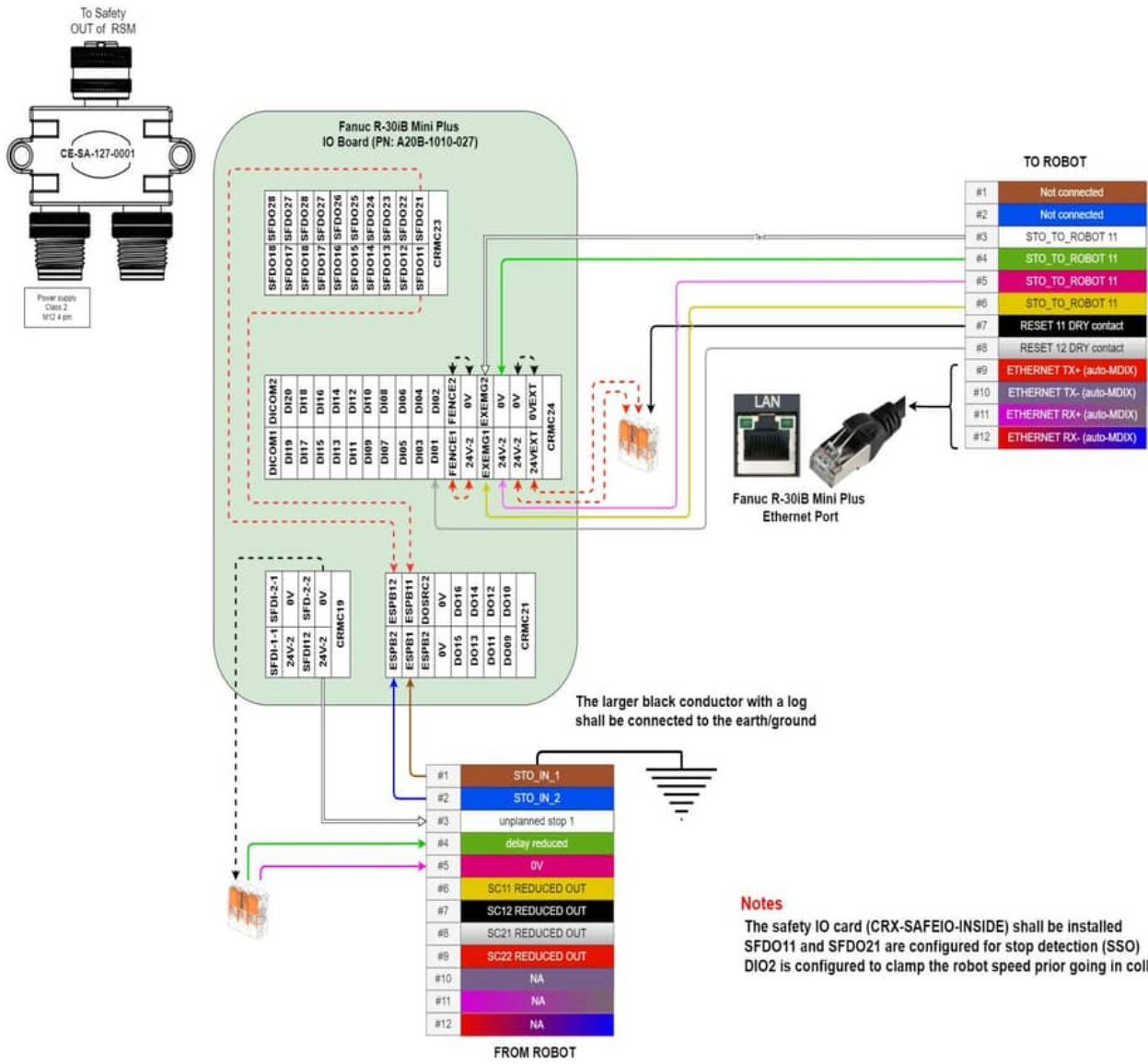


Figure 14: Standalone Robot Safety Module with Fanuc R-30iB Mini plus controller wiring diagram

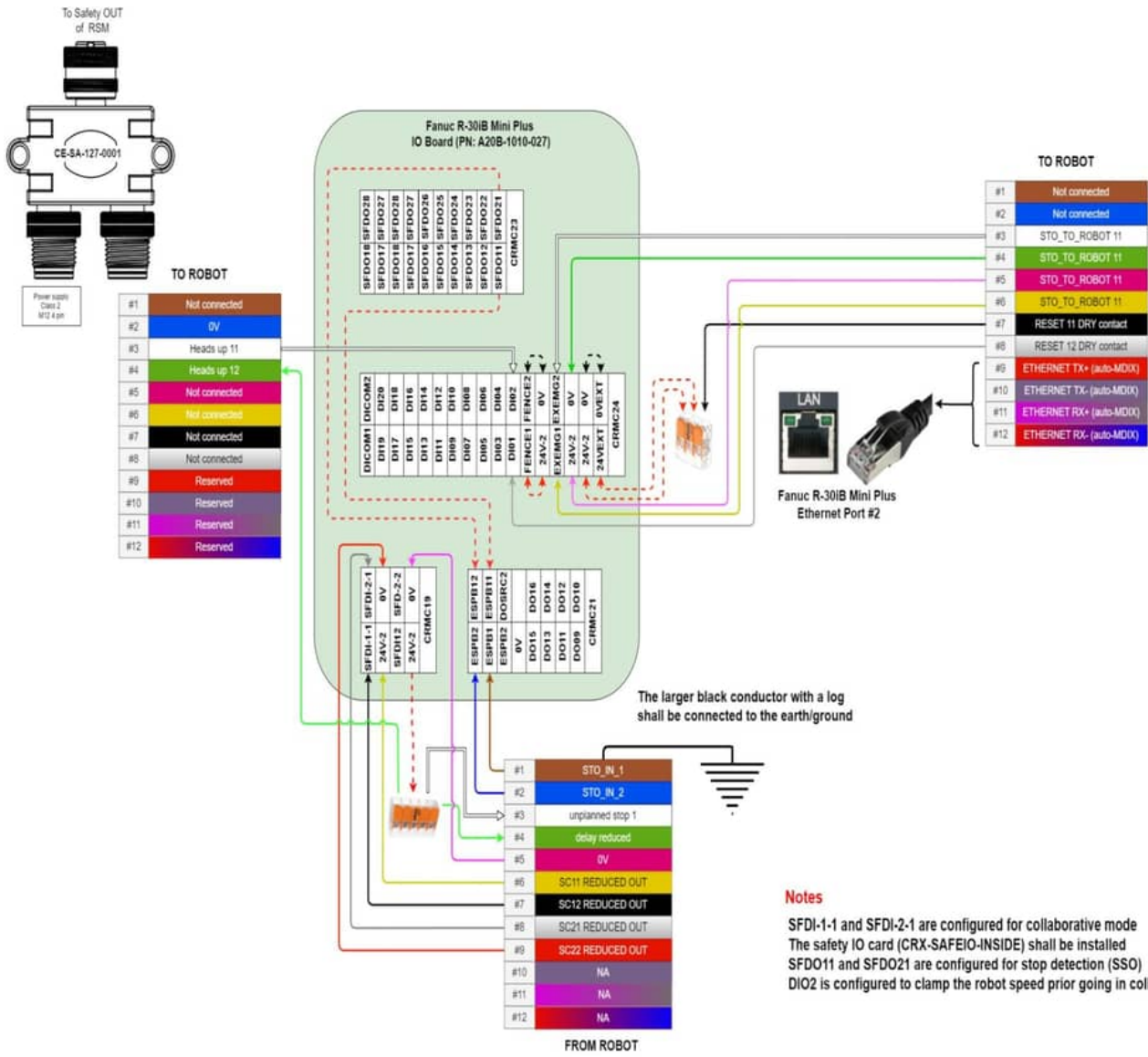


Figure 15: Standalone Robot Safety Module with Fanuc R-30iB Mini plus controller wiring diagram (Reduced)

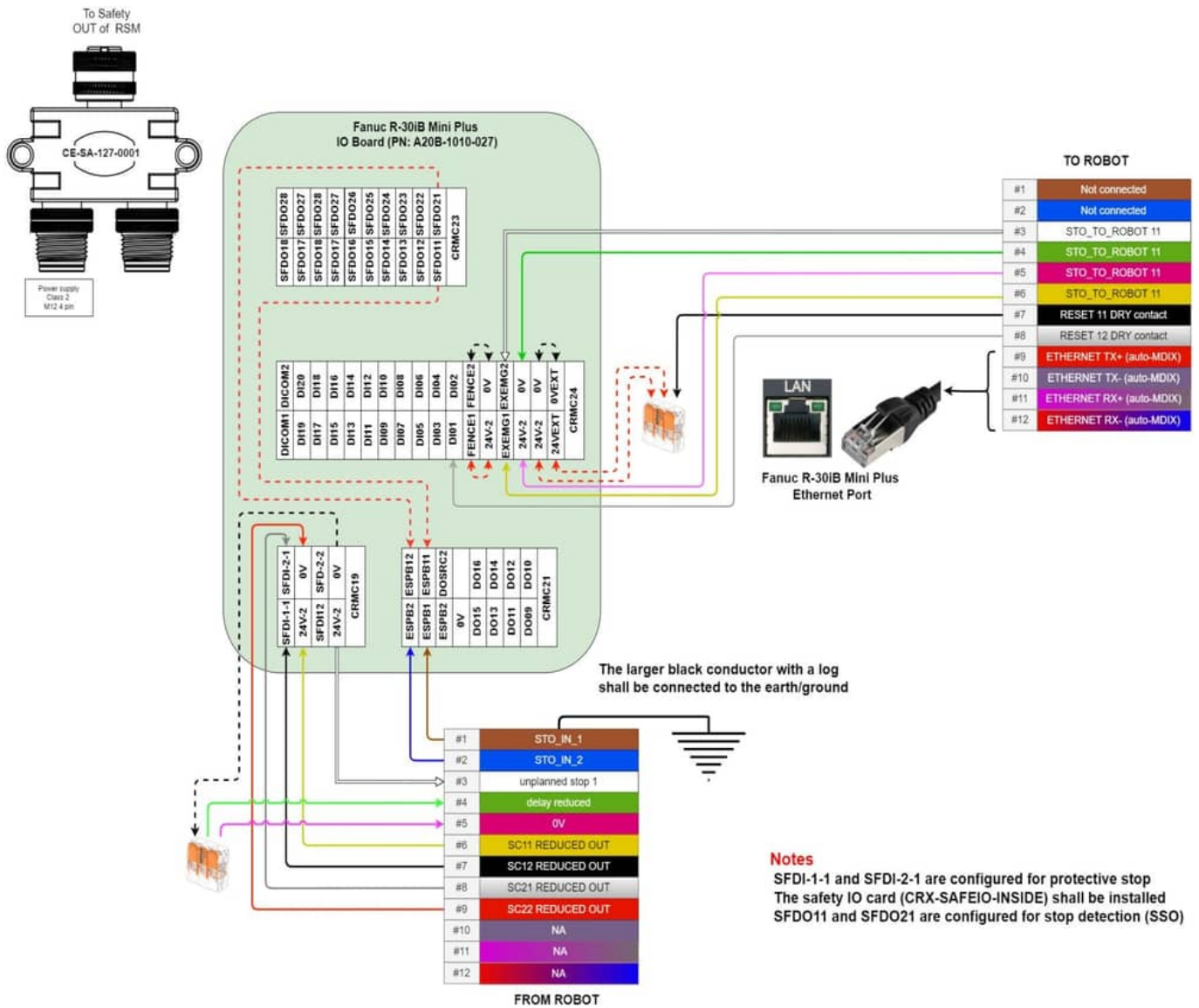


Figure 16: Standalone Robot Safety Module with Fanuc R-30iB Mini plus controller wiring diagram (Protective stop)

Important information

- Shorting or overloading the reduced port could trip the electronic fuse. To reset the fuse, a power cycle is needed.
- No emergency stop button should be placed on the reduced port.

Safety Data

The Robot Safety Module realizes the following safety functions :

- System emergency stop output at the Safety OUT port from the Safety IN port (Estop_SafetyIN-to-SafetyOUT);
- System emergency stop output at the To Robot port from the Safety IN port (Estop_SafetyIN-to-Robot);
- System emergency stop output at the Safety OUT port from the From Robot port (Estop_FromRobot);
- Redundant safe signal at the From Robot port from the Reduced port (Reduced_FromRobot);
- System reset propagation from the Safety IN port to the Safety OUT port (Reset_SafetyOUT); and
- System reset propagation from the Safety IN port to the To Robot port (Reset_ToRobot).

For each of these functions, safety data can be found in the following table.

Safety Function	PL	Cat.	MTTF _d	DC _{avg}	PFH _d
E-stop_SafetyIN-to-SafetyOUT	e	3	186	99%	4.29E-08

Safety Function	PL	Cat.	MTTF	DC	PFH
Estop_SafetyIN-to-Robot	e	3	186	99%	4.29E-08
Estop_FromRobot	e	3	186	99%	4.29E-08
Reduced_FromRobot	e	3	186	99%	4.29E-08
Reset_SafetyOUT	c	1	>100	N/A	1.14E-06
Reset_ToRobot	c	1	>100	N/A	1.14E-06

The above information have been calculated based on the following operation conditions:

Data	Value	Unit
d _{op}	365	days/years
h _{op}	24	hours/days
t _{cycle}	8640	s/cycle