Honeywell

FF-SRS5988

Dual Channel Emergency Stop Module

Instructions for use

(pending)

⚠ WARNING

IMPROPER INSTALLATION

- Consult with US and/or European safety agencies and their requirements when designing a machine control, interface and all control elements that affect safety.
- Strictly adhere to all installation instructions.

Failure to comply with these instructions could result in death or serious injury.

PRODUCT DESCRIPTION

The FF-SRS5988 Emergency Stop modules are designed to be used in emergency stop circuits when danger to personnel or machinery is present. This device, offering six NO and one NC closed contact, has two internal safety relays with positive-guided contacts to ensure redundancy.

This safety control module provides an emergency stop signal to the machine control circuitry. FF-SRS5988 helps to create a control reliable safety solution by providing redundancy and self-checking circuitry. Other features include high current capability, a great number of contacts as well as an automatic or manual start mode, cross fault monitoring, and external relays monitoring.

APPROVALS

CE	The product, packaging and documentation of FF-SR Series products carry the CE mark, following the examination by BG (German Berufsgenossenschaft E+MIII). The CE declaration of conformity is available upon request.
cULus (pending)	This product is pending approval by Underwriters Laboratories Inc. according to Canadian and U.S. safety requirements.

DIRECTIVES COMPLIANCE

Machine Directive 89/392 EEC
Low Voltage Directive 73/23 EEC
Electromagnetic Compatibility Directive 89/336

REGULATIONS COMPLIANCE

Regulation	Title
OSHA 29 CFR 1910.212	General Requirements for (guarding of) All Machines
OSHA 29 CFR 1910.217	(Guarding of) Mechanical Power Presses

STANDARDS COMPLIANCE

Standard	Title
EN 292	Safety of Machinery - Basic Concepts, General Principles for Design
EN 60204-1	Safety of Machinery - Electrical Equipment of Machines
EN 954-1	Safety of Machinery - Safety related parts of control system
ANSI B11.1	Mechanical Power Presses
ANSI B11.2	Hydraulic Power Presses
ANSI B11.19	Safeguarding when Referenced by the Other B11 Machine Tool Safety Standards
ANSI/RIA R15.06	Safety Requirements for Industrial Robots and Robot Systems
UL508	Underwriters Laboratories

107018-04 EN FR26 GLO 1198 Printed in Germany

SPECIFICATIONS

Input	
Nominal voltage (Dual voltage device)	120 Vac (-20%, +10%) / 24Vdc (-10%, +20%) 230 Vac (-20%, +10%) / 24Vdc (-10%, +20%)
Nominal power consumption	DC: 3 W; AC: 6 VA
Nominal frequency	50 to 60 Hz
Start time	Manual START function: 30ms Automatic START function: 1 s
Nominal voltage at S11 at S21	24 Vdc (provided by control module) 0 V
Input current between S11/S12 and S21/S23	110 mAdc
Minimum voltage at S12/A4 and at S22/A4	21 Vdc when activated
Cable resistance between S11/S12 and S21/S23	68 Ω (max.)
Output	
Contact complement	6 NO, 1 NC contacts
Response time	Opening of inputs (S11/S12; S21/S23): 30 ms; Opening in supply circuit: 50 ms
Contact type	Safety relay, positive-guided
Switching Capability **Current Range (min. to max.)** **Voltage Range (min. to max.)** **Switching Capability per AC15 (EN 60 947-5-1)**	Power factor = 1 with resistive load 1 mA to 10A (see Caution) 0.1 to 250 Vac/dc NO contact: 5 A/ 230 V NC contact: 2A / 230 V
Typical Electrical Life Expectancy 3A **5A** **10A**	Power factor = 1 at 230 Vac/dc (see fig. 1, note 1) 1,000,000 operations 500,000 operations 220,000 operations
Typical Power Factor (cos φ) **0.3** **0.5** **0.7** **1.0**	Limitation Factor (see fig. 2, note 2) 0.45 0.70 0.85 1.00
Operating frequency	600 switching cycles/hour
Output contact fuse rating	Time delay 6 A (max.)
Mechanical life	Thirty million switching operations
General	
Temperature range	-15°C to + 55°C (5°F to 131°F) at 90% humidity (max.)
Sealing	Housing IP 40; Terminals IP 20
Housing material	Thermoplastic
Vibration resistance	Amplitude 0.35 mm; Frequency 10 to 55 Hz
Wire/connector connection	1 x 4 mm^2 solid (max.) [12 AWG] or 2 x 1.5 mm^2 (max.) [16 AWG] stranded wire with sleeve DIN 46288
Wire/connector attachment	**Removable terminals block** with M3.5 screws; wire contacts are enclosed to prevent electrical shock
Mounting	Quick install rail mounting EN 50022-35; width: 35 mm (1.38 in.)
Weight	840 g (1.85 lb.)

NOTE 1: Install arc suppression device across load to avoid module contact arcing and ensure specified relay life expectancy.

NOTE 2 Total operations = operations at power factor 1 multiplied by the limitation factor. If the power factor is 0.5 at 230 Vac, 3A (1,000,000 operations), the limitation factor is 0.70. 1,000,000 x 0.70 = 700,000 total operations.

FIG 1. CONTACT LIFE FOR 100% RESISTIVE LOAD (typical) (note 1)
power factor = 1 (cos φ)

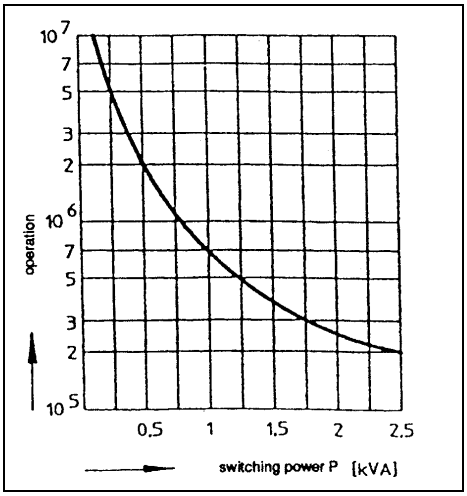
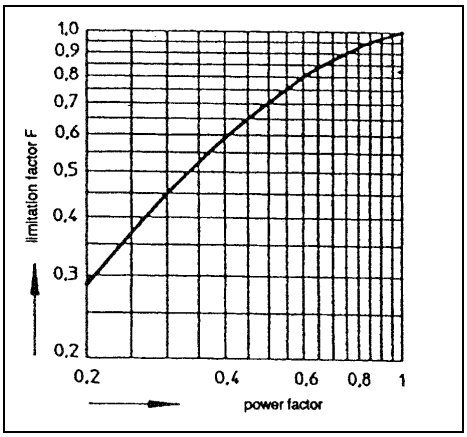


FIG 2. LIMITATION FACTOR FOR INDUCTIVE LOADS (note 2)
power factor < 1 (cos φ)



CAUTION

CONTACT DAMAGE

To ensure the 1 mA capability during the lifetime of the contact, NEVER exceed 300 mA and 60V.

Failure to comply with these instructions will result in loss of low current switching capability.

FIG 3. QUADRATIC TOTAL CURRENT LIMIT

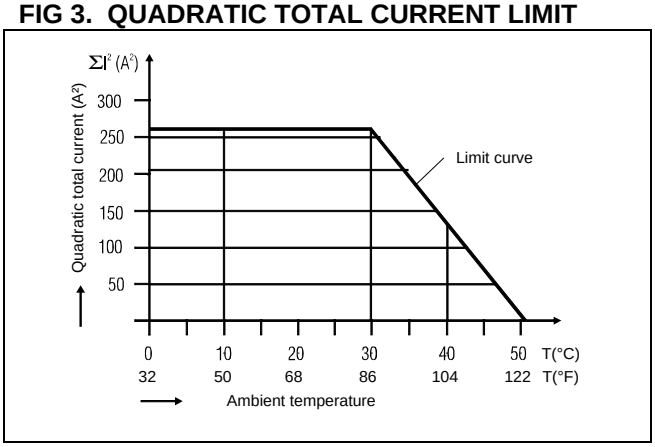


Figure 3. displays the maximal recommended external temperature versus the total load of all the safety module contacts. To use this curve, do the following:

(1) Square the current in each contact branch, then sum all the results to obtain the vertical axis value.
(2) Follow the horizontal line from the obtained value and note intersection of the appropriate curve.
(3) Follow the intersection point down to determine the maximal recommended external temperature. (Ex: $\sum I^2 = 200\ A^2$ current inside safety contacts, then T = 35 °C (95 °F).

If the module is located in a higher temperature environment, the lifetime of the electronic components may be reduced. Ventilation of the cabinet may be required.

MECHANICAL INSTALLATION

The FF-SRS5988 must be installed inside a NEMA 3 (IEC IP54) rating enclosure or better. The module can be clipped easily onto a 35 mm (1.38 in.) width DIN rail (see figures 5 and 6 for installation and removal). Specific features of this product include removable terminal strips. This feature provides easy access to wiring during installation and reduces machine downtime during maintenance.

FIG 4. MOUNTING DIMENSIONS (for reference only)

a Width: 100 mm 3.93 in.
b Height: 74 mm 2.91 in.
c Depth: 121 mm 4.76 in.

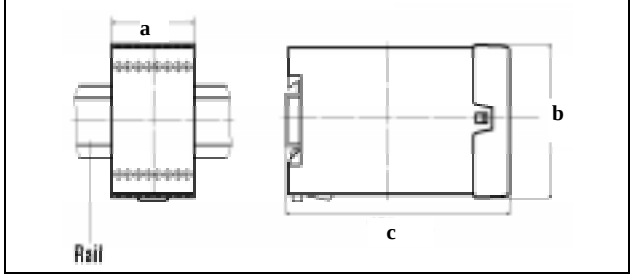


FIG 5. INSTALLATION DIAGRAM

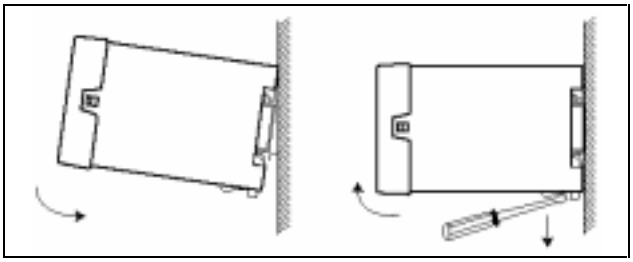
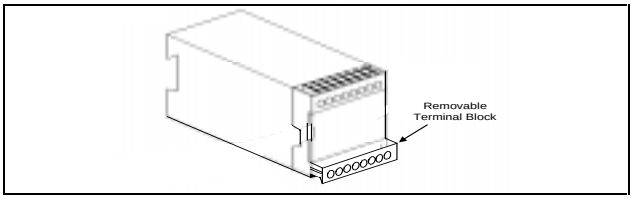


FIG 6. REMOVABLE TERMINAL BLOCKS



CONTROL RELIABILITY

"Control Reliability" means that "the device, system or interface shall be designed, constructed and installed such that a single component failure within the device, interface or system shall not prevent normal stopping action from taking place but shall prevent a successive machine cycle." (ANSI B11.19-1990, 5.5)

OSHA 29 CFR 1910.217 states that "the control system shall be constructed so that a failure within the system does not prevent the normal stopping action from being applied to the press when required, but does prevent initiation of a successive stroke until the failure is corrected. The failure shall be detectable by a simple test, or indicated by the control system."

SAFETY LEVEL OF INTERFACES

The safety function of the FF-SRS5988 Safety control module relies on dual channel safety inputs. Therefore this module can be used in interfaces up to Category 4 per EN 954-1 European norm.

INTERNAL DESIGN

The *internal* design of this device also meets the highest requirements (Category 4 as described in the EN 954-1 European norm).

Category 4 safety control modules are designed and manufactured in such a way that a single breakdown or an accumulation of internal failures does not lead to the loss of the safety function when a dangerous situation arises.

The FF-SRS5988 safety control modules function with dual channel redundancy and positive self-checking monitoring. This means that a faulty component in our system will make the safety control modules fail in a safe mode.

The safety function is maintained on a permanent basis.

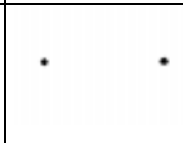
MODE SETTING

⚠ WARNING

ELECTRICAL SHOCK

- Remove power from FF-SR Series control modules and machine during installation and before setup.
- **Failure to comply with these instructions could result in death or serious injury.**

This module offers the possibility to function in the automatic start mode or manual start mode. To set the desired mode of operation, insert the start push-button between terminals S33/S34 **for manual start mode** or insert a jumper between X1/X2 for **automatic start mode** to function (see table below)

Mode	Start push-button between S33/S34	Jumper between X1/X2
Manual start mode		not connected
Automatic start mode		connected

ELECTRICAL INSTALLATION

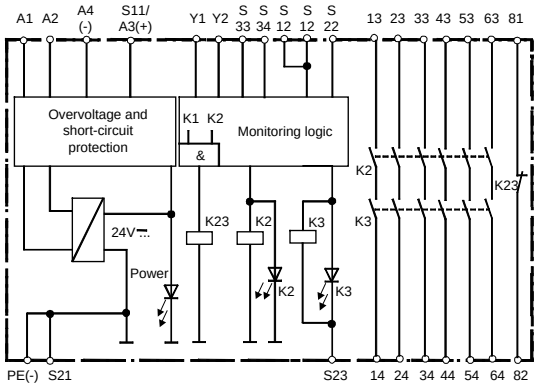
Multiple wiring configurations are possible for the FF-SRS5988 dual channel emergency stop module. General guidelines are provided because there are various ways to interface the module to machine control circuitry. Refer to the important warnings (page 6) and the application examples (pages 7 through 9).

CAUTION

SAFETY CONTROL MODULE DAMAGE

- Do not supply any current/voltage to the FF-SRS5988 safety module control inputs (S11/S12 S21/S22). These inputs receive their voltage (24 vdc under a 110 mA current) from external power via pins A1/A2 or via A3(+)/A4(-)
- **Failure to comply with these instructions will result in product damage.**

FIG 7. BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

In the **manual start mode**, the module accepts input from the safety device (light curtain, safety mat, safety switches, etc.) between S11/S12 and S21/S23 after activation of the start push button between S33 and S34. The two internal safety relays (K2, K3) will then energize and the normally open safety contacts (13/14...63/64) will close and the normally closed contact (81/82) will open

In the **automatic start mode**, the module accepts immediate input from the safety device (light curtain, mat, safety switches, etc.) between S11/S12 and S21/S23 (Y1 and Y2 are jumpered if external relay monitoring is not needed). The two internal safety relays (K2, K3) will then energize and the normally open safety contacts (13/14...63/64) will close and the normally closed contact (81/82) will open.

In either mode, if the safety device is actuated (emergency stop condition occurs), the normally open contact will open immediately and the normally closed contacts will close. This emergency stop condition is relayed via the safety contacts of the module to the machine control circuitry to arrest dangerous motion and/or remove power.

NOTICE

INPUT SIGNAL SEQUENCE

- The voltage at terminal S23 must be applied before terminal S12, in order to let the automatic start function work properly.
- In the manual start mode the input signal sequence order has no impact.

EXTENSION MODULES AND EXTERNAL CONTACTORS

One or more FF-SRE3081 Extension Modules or external contactors with positively driven contacts can be used to multiply the number of contacts of the FF-SRS5988 Emergency Stop Module. If multiple safety contacts are used in parallel with one load, the maximum allowed current can be increased.

For connection of the FF-SRE 3081 to the FF-SRS 5988 module, see the Installation Instructions for the FF-SRE 3081 Extension Module.

⚠ WARNING

CONTACT MULTIPLICATION VIA EXTERNAL RELAYS

- If contact multiplication via external safety relays (or the FF-SRE3081 Extension module) is necessary, connect one normally closed contact of each relay (or 81/82 of the Extension module) in series into the Final Switching device monitoring loop (terminals Y1/Y2).

Failure to comply with this instruction could result in death or serious injury.

LED INDICATORS

The FF-SRS5988 module has three green LED status indicators (Power, K2 and K3) as illustrated below.

The Power LED indicates power is applied to the safety control module. Illuminated K2 and/or K3 LED's indicate(s) that the corresponding internal safety relay is energized. Both K2 and K3 relays must be energized to have the normally open contacts 13/14...63/64 in a closed position. If one of the safety relays de-energizes, the normally closed contact will close.

FIG 8. MODULE FRONT PANEL

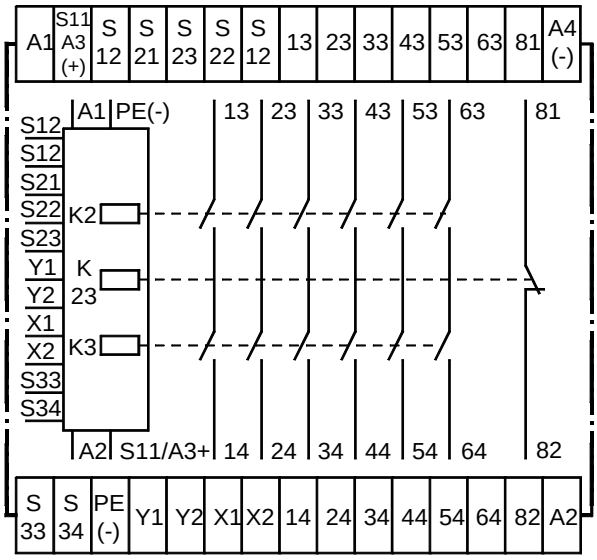
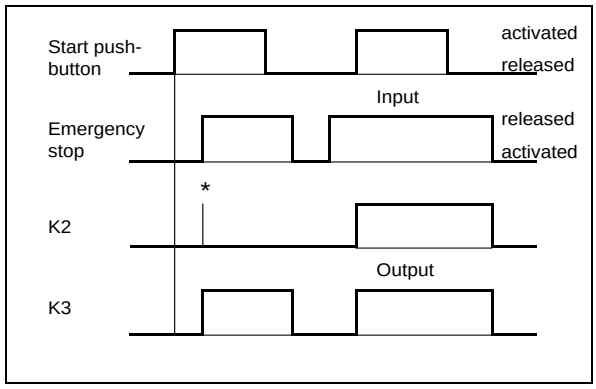


FIG 9. FUNCTIONAL DIAGRAM



*** Line fault Detection on Start push-button:**

If the start push button is closed before voltage is applied to S12 and S23 the safety contacts of the module cannot close.

This additional feature ensures the detection of a line fault via the start push-button or a blocked start push button. In case of a push-button failure the module can not be restarted.

In order to let the line fault detection work properly, the internal safety relays should have been de-energised for at least 10 seconds before.

APPLICATION WARNINGS

⚠ WARNING

IMPROPER INPUT CONNECTIONS

- To ensure the highest level of safety, connect two safety device outputs into the two input channels of the FF-SRS5988 safety module. Then, a cross fault between the two channels will shut down the module.
- If the safety device provides one safety output only (e.g., a switch driven by a direct acting mechanism like some GK, GSS, CLS or Emergency Stop push buttons), connect the FF-SRS5988 module as shown in the single input channel example To avoid any short circuit possibilities on this single input channel, use conduit to protect wiring and additional protection for the terminal strips inside the machine cabinets.
- The cable resistance between S11/S12 or S21/S23 should not exceed 68Ω and the voltage between S12/A4 and S22/A4 should not be lower than 21Vdc.

IMPROPER EMERGENCY STOP CONNECTION

- To ensure maximum safety, connect two normally closed contacts of the Emergency Stop into the input channel of the FF-SRS5988 module.

IMPROPER AUTOMATIC START MODE IN PERIMETER GUARDING APPLICATIONS

- If the module is in the automatic start mode, another part of the safety control circuitry must keep the latched function engaged.

IMPROPER PUSH BUTTON USE (MANUAL START MODE)

- To ensure maximum safety when using an external start push button, always design the circuitry for manual start mode (see Mode Setting, page 4).
- Ensure the location of the manual start function is outside of the danger zone and provides the operator with a clear view of the zone.
- For perimeter guarding solutions, the operator should not be able to reach manual start from the danger zone.
- A Programmable Logic Controller (PLC) must NOT be able to override a manual start function.

CONTACT WELDING

- Always protect all safety contacts with correctly rated fuses. These fuses must never exceed the rated FF-SRS5988 safety output capability to prevent contact welding.

IMPROPER EXTERNAL SAFETY RELAY MONITORING

- When using additional safety relays (or the FF-SRE Extension module), always connect one normally closed contact of each relay in series (or 81/82) inside the Final Switching Device (FSD) monitoring loop circuit (Y1/Y2). This connection will ensure correct operation of the external relays or the Extension module after each FF-SRS5988 activation.
- If the FF-SRS5988 is not activated often, the customer is responsible for accomplishing any additional test procedures of the external safety components. For instance, this testing can be done by removing the power from the FF-SRS5988 at machine power up every day.

IMPROPER ARC SUPPRESSOR INSTALLATION

- NEVER install an arc suppressor across the safety output contact of the safety control module.
- ALWAYS install arc suppressors across the coils of external safety relays.

IMPROPER DOOR MONITORING

- If two safety switches are used to monitor a door's closed position, connect one safety contact of the first switch between input S11/S12 and one safety contact of the second switch between S21/S23 of the FF-SRS 5988 Emergency stop module.

IMPROPER SYSTEM SAFETY LEVEL

- Several safety components can be connected to a FF-SRS5988 control module. If more than one safety output is connected to one of the two input channels of the control module, always connect these safety outputs in series. Parallel wiring of multiple outputs into a single channel can defeat the channel and cause an unsafe condition.
- Individually activate and check all of the safety devices connected to a FF-SRS5988 control module to ensure proper operation.

IMPROPER EMERGENCY STOP PUSH BUTTON

- The Emergency Stop push button must be designed according to European (EN 418) and US safety standards (NFPA 19). Under any condition, the Emergency Stop switch must be able to open its contacts when activated.

LONGER RESPONSE TIME

- The FF-SRS5988 module will have a longer response time (when the emergency push button is activated) if the emergency stop push button is connected in series with the power supply of the module. However, connecting the emergency stop push button to the safety input channels will result in a shorter response time.

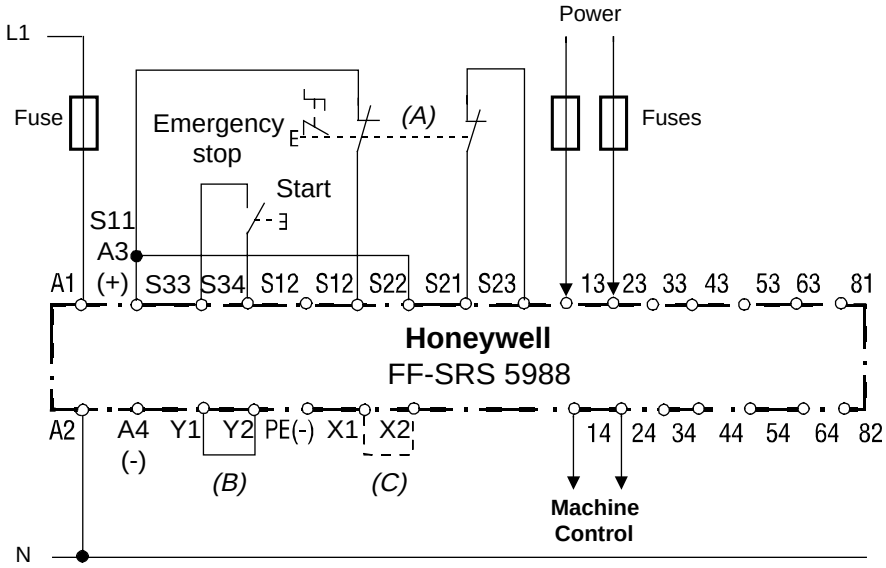
IMPROPER USE OF THE NORMALLY CLOSED OUTPUT CONTACT

- Use the normally closed output contact (81/82) for monitoring purpose only.
- Do not use this 81/82 contact in the safety control circuitry of the machine.

Failure to comply with these instructions could result in death or serious injury.

APPLICATION EXAMPLES

FIG 10. DUAL CHANNEL EMERGENCY STOP CIRCUITRY (WITH CROSS-FAULT MONITORING)



This circuit has redundancy in the emergency-stop control circuit and therefore offers the highest possible safety level.

FUNCTIONAL DESCRIPTION:

After activation of the Emergency-stop push button, the K1 and K2 LED's will turn OFF, indicating that the two internal safety relays K1 and K2 are de-energized. The normally open safety outputs 13/14... 63/64 will open.
There exist two different start modes:

Manual start mode

1. After removing the stop condition, press and release the START push button to restart the safety control module.
2. The K2 and K3 LED's will turn ON indicating that the safety relays K2 and K3 are energized. The six normally open safety contacts will close and the normally closed monitoring contact will open allowing the machine to operate.

Automatic start mode

1. After removing the stop condition, the safety control module will reset within 1 sec.

The K2 and K3 LED's will turn ON indicating that the safety relays K2 and K3 are energized. The six normally open safety contacts will close and the normally closed monitoring contact will open allowing the machine to operate.

APPLICATION NOTES:

NOTE (A): **Dual channel safety devices:**
This may be an emergency stop push button in series with dual output safety switching devices (OSSD) such as
- safety light curtains (FF-SB, FF-LS),
- safety mat (FF-SM),
- single beam (FF-SPS), modular safety light curtains (FF-SC),
- safety laser scanner (FF-SE),
- dual output safety limit or interlock switches (for example, 2CLS and GK, see fig. 12).

NOTE (B): Y1 and Y2 are jumpered if no external contactors have to be monitored
NOTE (C): **Start mode:**
Manual start mode: Insert start push-button between S33/S34; no jumper must be set between X1/X2
Automatic start mode: Insert jumper between X1/X2

⚠ WARNING

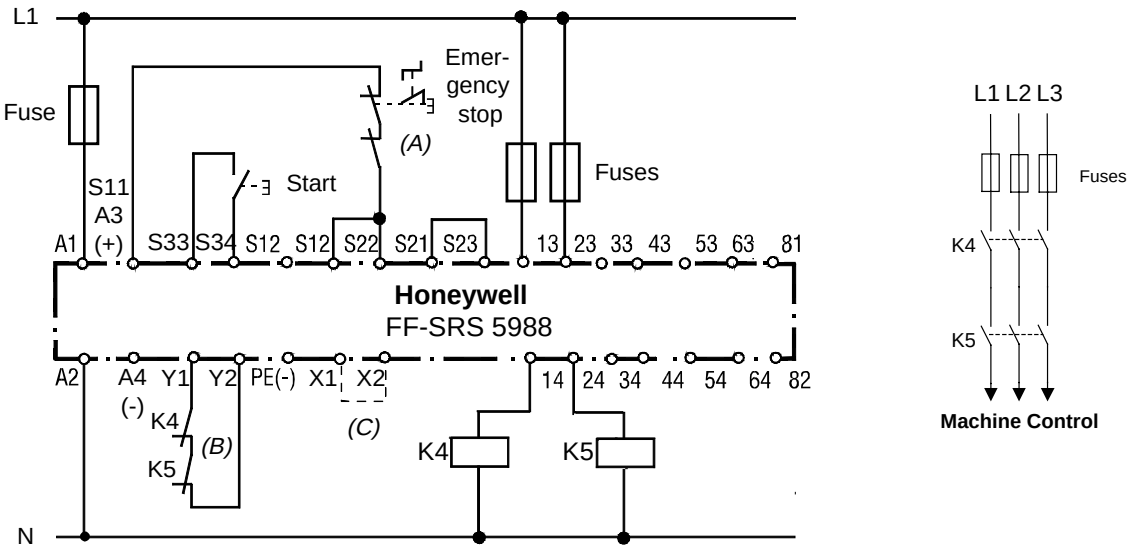
IMPROPER AUTOMATIC START MODE IN PERIMETER GUARDING APPLICATIONS

- If the module is in the automatic start mode, another part of the safety control circuitry must keep the latched function engaged.

Failure to comply with these instructions could result in death or serious injury.

APPLICATION EXAMPLES (continued)

FIG 11. SINGLE CHANNEL EMERGENCY STOP CIRCUITRY (WITH EXTERNAL CONTACTORS**)**



This circuit has no redundancy in the emergency-stop control circuit and therefore offers a minor safety level only.

CONTACT REINFORCEMENT VIA EXTERNAL CONTACTORS:

With switching current >10 A, the output contacts should be reinforced by external contactors (K4 and K5) with positive-guided contacts. (see *note (B)*)

1. After activation of the E-stop push button, the two K2 and K3 LED's will turn OFF, indicating that the two internal safety relays K2 and K3 are de-energized. The normally open safety outputs 13/14..63/64 will open and de-energize the external contactors K4 and K5. The normally closed monitoring output will also close.
2. After removing the stop condition, press and release the START push button to restart the safety control module. If the two contactors K4 and K5 are working properly, the K2 and K3 LED's will turn ON indicating that the safety relays K2 and K3 are energized. The six normally open safety contacts will close and the normally closed monitoring contacts will open allowing the machine to operate.

APPLICATION NOTES:

***Note (A):* SINGLE CHANNEL SAFETY DEVICES:**

This may be a single output safety device such as a safety limit or interlock switch (for example: CLS, GK and GSS).

***Note (B):* EXTERNAL CONTACTORS:**

If contact reinforcement via external safety relays is necessary, the output contacts should be reinforced by external safety relays. The proper operation of the external contactors must be monitored by looping the NC contacts into the Final Switching Device (FSD) monitoring loop between terminals Y1/Y2.

***Note (C):* START MODE:**

Manual start mode: Insert start push-button between S33/S34; no jumper must be set between X1/X2

Automatic start mode: Insert jumper between X1/X2

⚠ WARNING

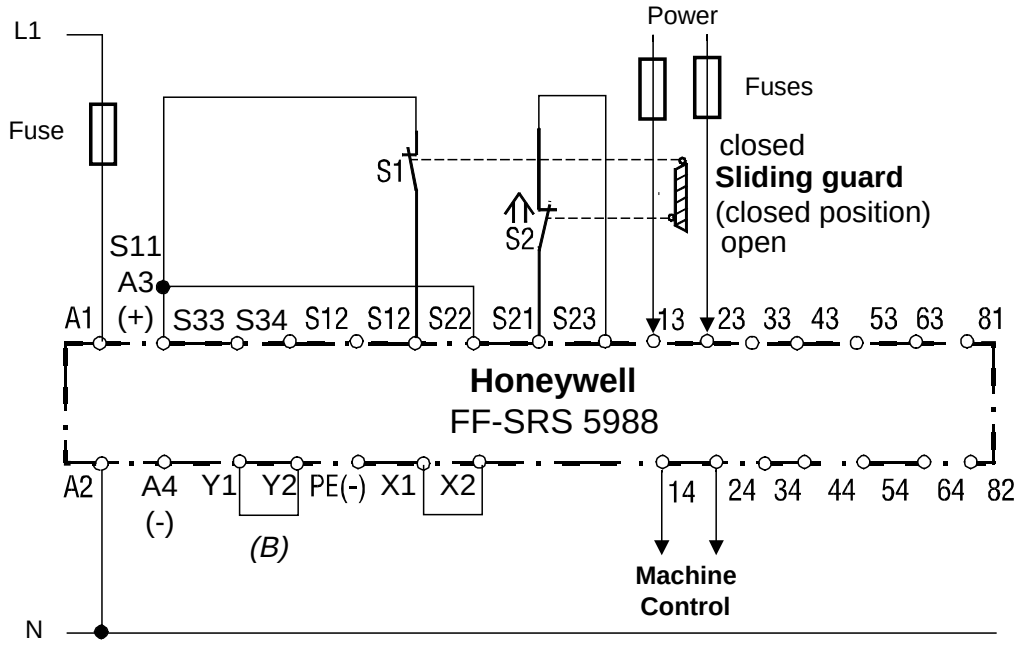
CONTACT MULTIPLICATION VIA EXTERNAL RELAYS

- If contact multiplication via external safety relays (or the FF-SRE3081 Extension module) is necessary, connect one normally closed contact of each relay (or 81/82) in series into the Final Switching Device monitoring loop (terminals Y1/Y2).
- Use two independent stop circuit safety relays with mechanically linked contacts to reliably detect a welded contact.

Failure to comply with these instructions could result in death or serious injury.

APPLICATION EXAMPLES (continued)

FIG. 12.: DUAL-CHANNEL SAFETY DOOR MONITORING
(WITH CROSS-FAULT MONITORING, AUTOMATIC START MODE)



GENERAL DESCRIPTION OF SAFETY DOOR APPLICATIONS

Protective gates are designed to limit or block access to the moving parts of dangerous machinery. These gates can be equipped with locking or interlocking devices, usually safety limit switches or any other safety sensors/switches.

The FF-SRS5988 Emergency Stop module monitors the status of these safety sensor positions. When the protective gate is open, the initiation of dangerous motion is prevented. When the door is closed again, the next machine cycle can start, but only after initiating a manual restart sequence.

FUNCTIONAL DESCRIPTION

After opening the door, the two external safety switch contacts S1 and S2 will open (as illustrated above) and the two internal safety relays K2 and K3 will de-energize. The normally open safety outputs 13/14.. 63/64 will open relaying the stop condition to the machine control circuitry. After closing the door, S1 and S2 close and the internal relays K2 and K3 will energize. The six normally open safety contacts will close and an external manual restart sequence may then be initiated (allowing the machine to operate).

IMPORTANT NOTICES

NOTICE

SAFETY LIMIT SWITCH SEQUENCE

- In order to let the module restart automatically, safety limit switch S1 must not close before switch S2. The FF-SRS5988 will only restart after the two input channels have been opened and then closed (an activation).
- In the manual start mode the safety limit switch sequence has no impact.
- In the manual start mode, closing the start push button will immediately close the normally open contacts of the safety control module and initiate a machine start cycle. The push button must be released before the next start cycle is allowed. This will prevent automatic start in case the push button is broken in the closed position.
- The cable resistance between S11/S12 and S21/S23 must be less than 68Ω (ohms) for correct operation of the safety control module.
- A minimum of 21 vdc must be present between each channel input (S11/S12 and S21/S23) to ensure the correct detection of sensor(s) outputs status.

FIG. 13. FF-SRS5988 TROUBLESHOOTING FLOW DIAGRAM (PAGE 1 OF 3)

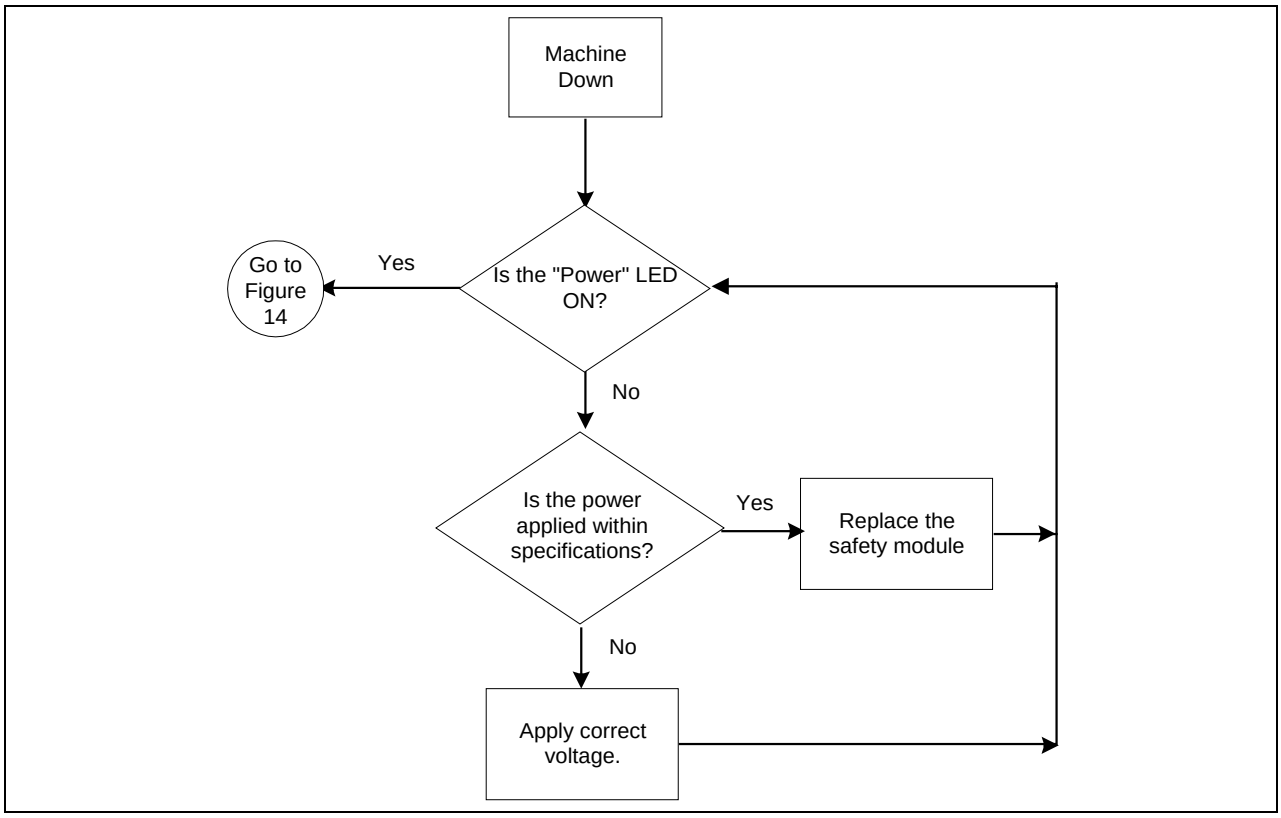


FIG. 14. FF-SRS5988 TROUBLESHOOTING FLOW DIAGRAM (PAGE 2 OF 3)

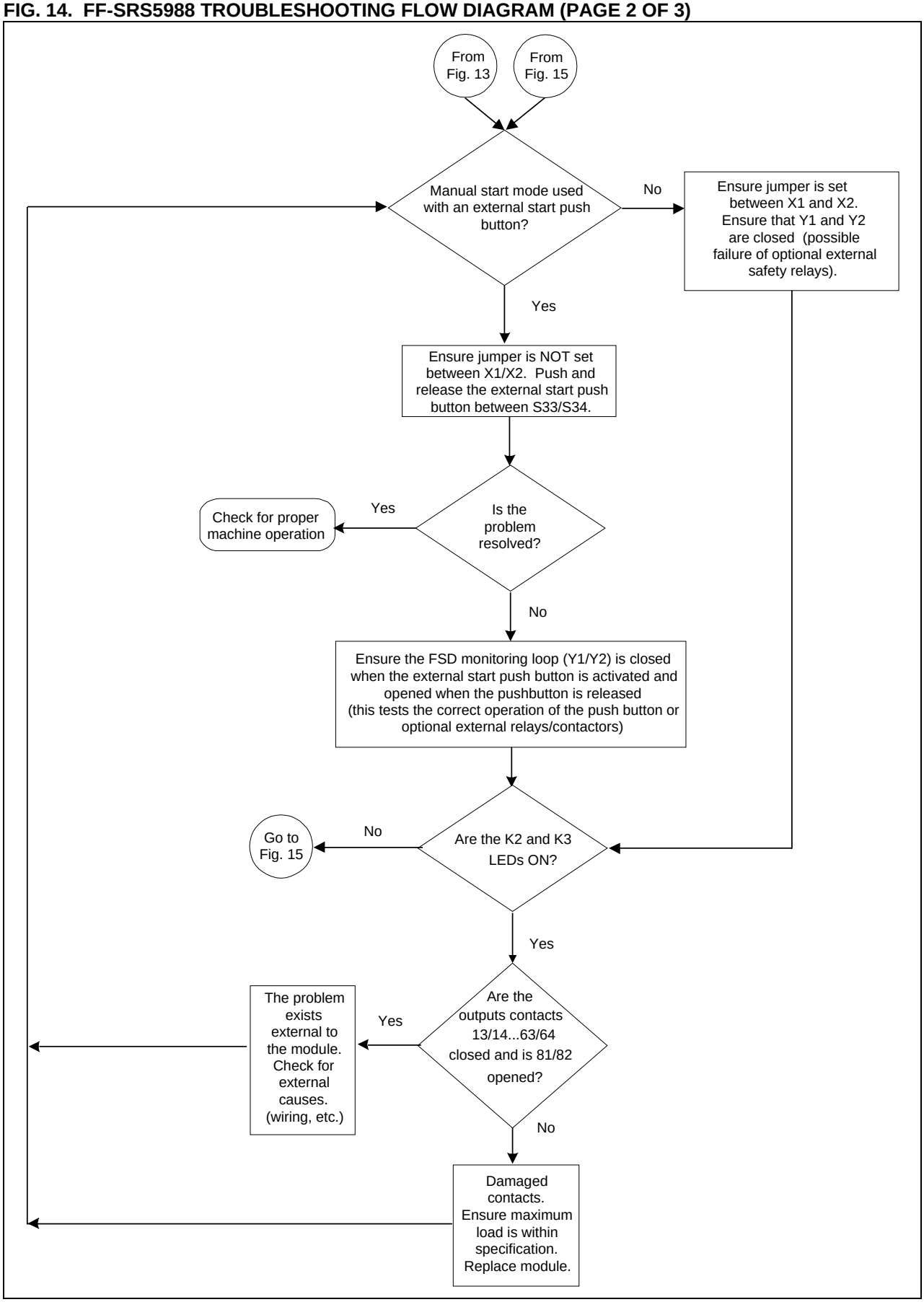
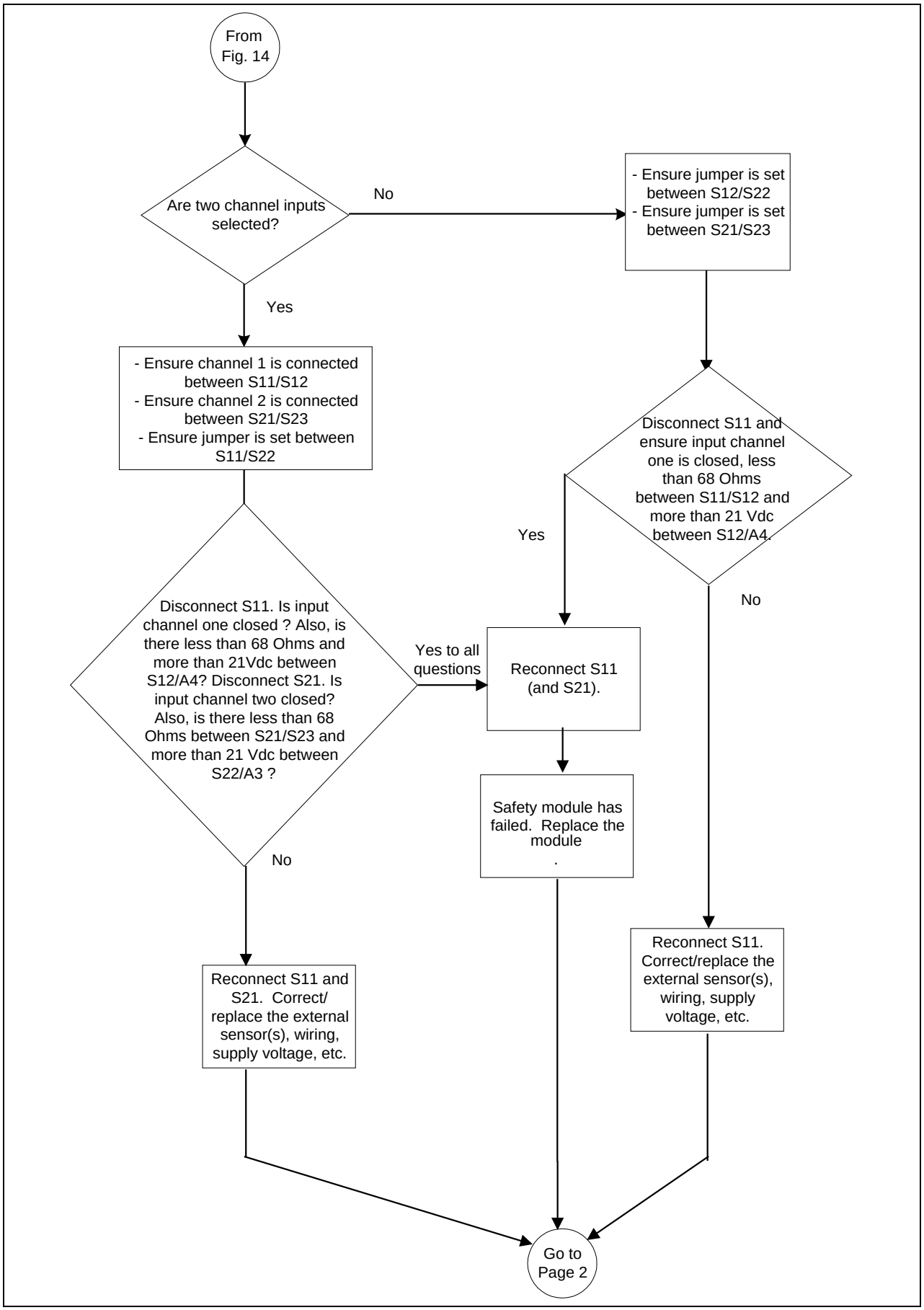


FIG. 15. FF-SRS5988 TROUBLESHOOTING FLOW DIAGRAM (PAGE 3 OF 3)



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