- FR302

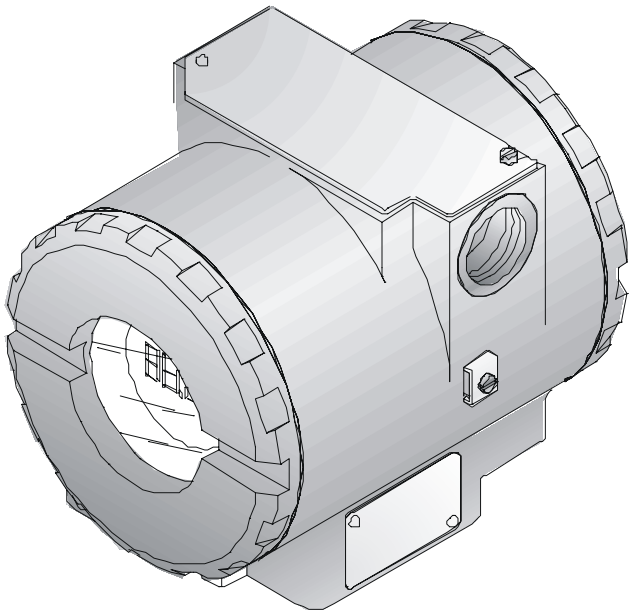
smar
FIRST IN FIELDBUS

FEB / 05
FR302
VERSION 1

FOUNDATION™

OPERATION & MAINTENANCE
INSTRUCTION MANUAL

FIELDBUS RELAY



FR302ME

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web: www.smar.com

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For the latest updates, please visit the SMAR website above.

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INTRODUCTION

The FR302 is a fieldbus device that has two built-in relays making integration of Fieldbus to conventional devices such as solenoids, on/off valves, electrical actuators, motors, pumps, starters, etc very easy. The FR302 Fieldbus Relay can be located in the field, mounted close to the conventional devices without the need to run the conventional wiring to the control room. The FR302 is an integral part of SYSTEM302 but also integrates into other systems that support FOUNDATION™ Fieldbus.

The FR302 allows that conventional discrete outputs be available, in order to make the control strategy configuration easy. Using standard FOUNDATION™ Fieldbus Function blocks, these outputs appear as regular Fieldbus devices, thus making the system homogenous. Control loops are implemented consistently.

An extensive function block library enables the FR302 to perform logic control functions in the field integrating it to its discrete outputs. Instantiated function blocks provide great flexibility in the control strategy. The FR302 is fully configured by Syscon software in SYSTEM302 or any other FOUNDATION™ Fieldbus configuration tool. “Link master” capability allows the FR302 to work as a backup LAS for greater availability of network communications.

The FR302 may be installed close to the final elements, thereby eliminating long wire runs, associated marshalling panels and cable trays for the conventional output. With subsequent savings further reducing overall system costs. The use of FR302 makes it possible to distribute outputs at various locations in the field and connect them via the H1 Fieldbus.

Get the best result of the FR302 by carefully reading these instructions.

WARNING

This Manual is compatible with version 3.XX, where 3 denotes software version and XX software release. The indication 3.XX means that this manual is compatible with any release of software version 3.

TABLE OF CONTENTS

Section 1

INSTALLATION

General

The overall reliability of actuation and control depends on several variables. Although the **Fieldbus Relay** has an outstanding performance, proper installation is essential in order to maximize its performance.
Among all factors, which may affect the accuracy, environmental conditions are the most difficult to control. There are, however, ways of reducing the effects of temperature, humidity and vibration.
Locating the **Fieldbus Relay** in areas protected from extreme environmental changes can improve its performance.
In warm environments, the **Fieldbus Relay** should be installed to avoid, as much as possible, direct exposure to the sun. Installation close to lines and vessels subjected to high temperatures also should be avoided.
Use of sunshades or heat shields to protect the **Fieldbus Relay** from external heat sources should be considered, when necessary.

Humidity is fatal to electronic circuits. A humidity proof coating protects the electronic circuit, but frequent exposures to humidity may affect the protection provided. It is also important to keep the covers tightened in place. Every time they are removed, the threads are exposed to corrosion, since painting cannot protect these parts. Code-approved sealing methods on conduit entering the converter should be employed.
For details of mounting, please, refer to Figure 1.1.

Mounting

Using the bracket, the mounting may be done in several positions, as shown on Figure 1.1 - Dimensional Drawing and Mounting Positions.
For better visibility, the digital indicator may be rotated in steps of 90° (See *Section 4 – Maintenance Procedures*).

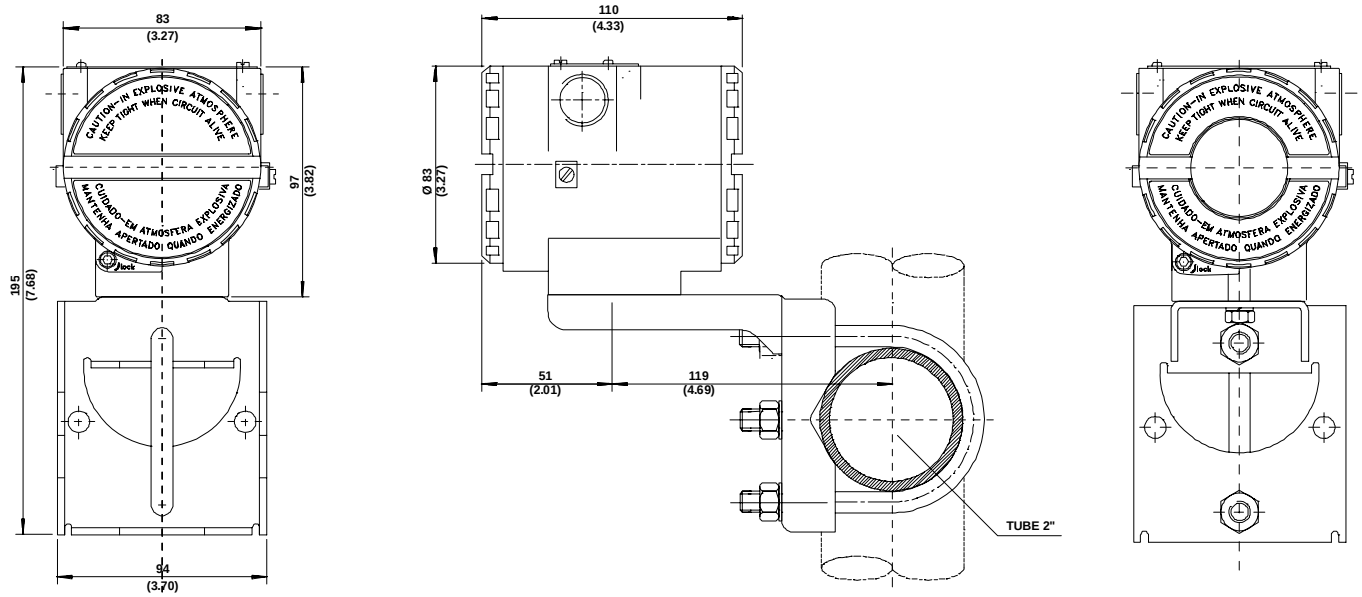


Figure 1.1 - Dimensional Drawing and Mounting Positions

Electric Wiring

Access the wiring block by removing the Electrical Connection Cover. This cover can be locked closed by the cover locking screw (See Figure 1.2 - Cover Locking). To release the cover, rotate the locking screw clockwise.

Cable access to wiring connections is obtained by one of the two conduit outlets. Conduit threads should be sealed by means of code-approved sealing methods. The unused outlet connection should be plugged accordingly.

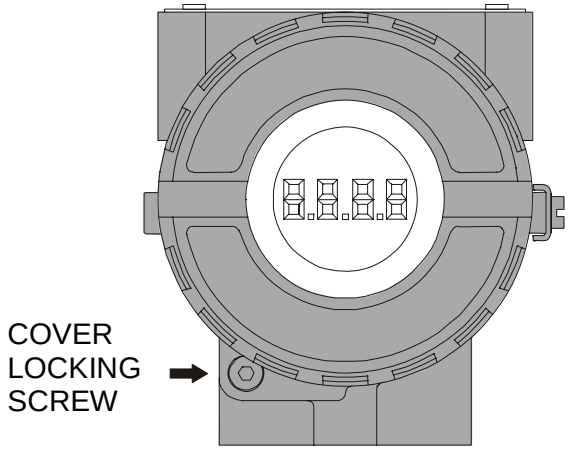


Figure 1.2 - Cover Locking

The wiring block has screws, on which fork or ring type terminals can be fastened. See Figure 1.3 – Terminal Block.

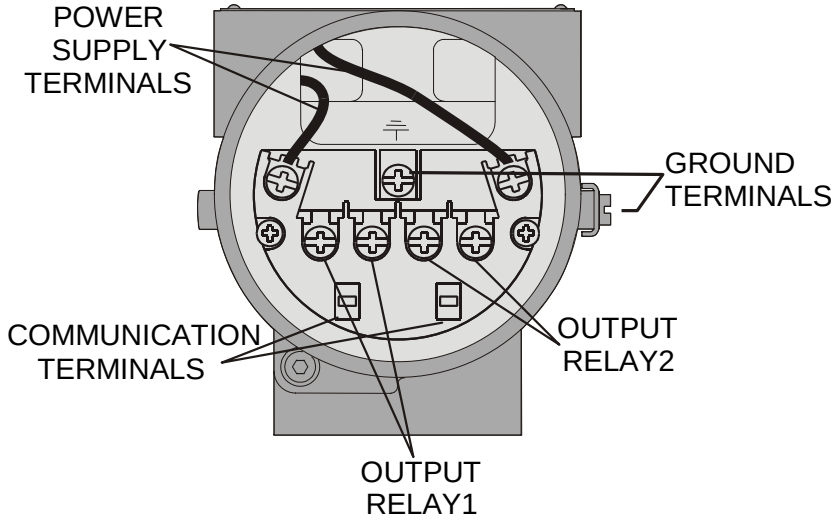


Figure 1.3 - Terminal Block

For convenience there are three ground terminals: one inside the cover and two externals, located close to the conduit entries.

The used connections should be plugged accordingly. In Figure 1.4 you can see an example of output connections.

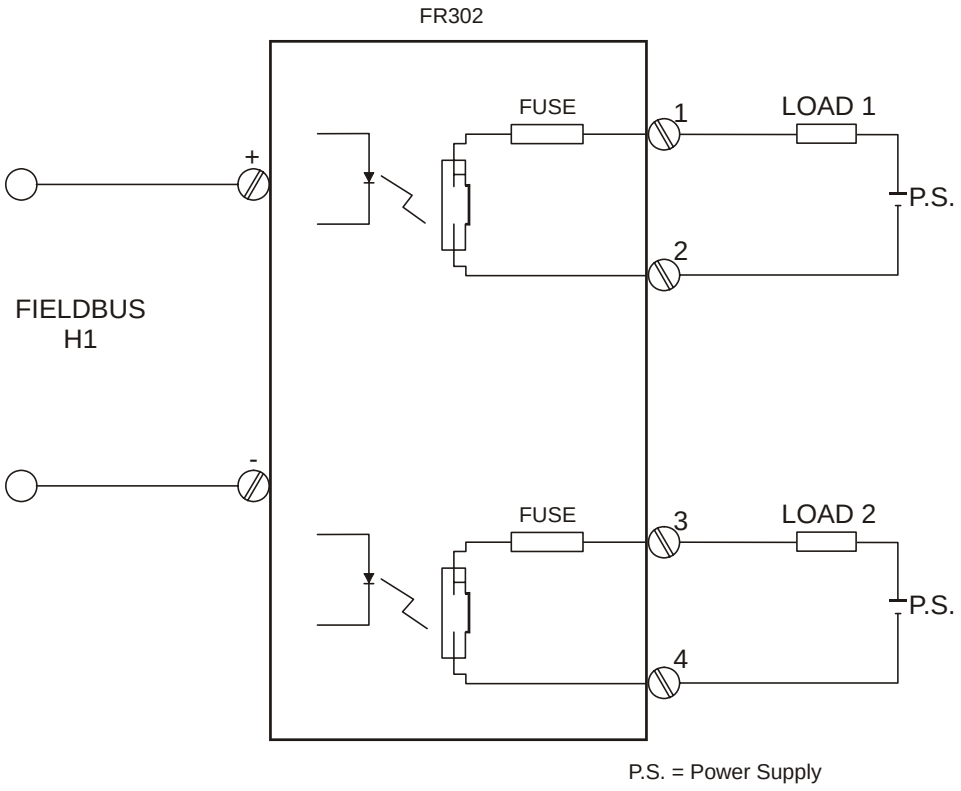


Figure 1.4 – Example of Output Connections

The **FR302** is a bus-powered device.

The **FR302** uses the 31.25 kbit/s voltage mode option for the physical signaling. Various types of Fieldbus devices may be connected on the same bus being bus-powered or non-bus-powered. When bus-powered, the devices must use the same signaling. Up to 16 devices can be connected in parallel along the same pair of wires.

In hazardous areas, the number of devices may be limited by intrinsically safe restrictions.

The **FR302** is protected against reverse polarity, and can withstand ±35 VDC without damage.

NOTE
For a DC connection it is recommended to use a protection diode and for an AC connection it is recommended to use a snubber, mainly for inductive loads.

NOTE
Please refer to the General Installation, Operation and Maintenance Manual for more details.

WARNING
In hazardous areas with explosion proof requirements, the covers must be tightened at least 8 turns. In order to avoid the penetration of moisture or corrosive gases, tighten the O'ring until it touches the housing. Then, tighten 1/3 turn (120°) more to guarantee sealing. Lock the covers using the locking screw.
In hazardous zones with intrinsically safe or nonincendive requirements, the circuit entity parameters and applicable installation procedures must be observed.
Cable access to wiring connections is obtained by one of the two conduit outlets. Conduit threads should be sealed by means of code-approved sealing methods. The unused outlet connection should be plugged and sealed accordingly.
Explosion proof, nonincendive and intrinsic safety Factory Mutual certification are standards for **FR302** (see control drawing in Appendix A).
Should other certifications be necessary, refer to the certification or specific standard for installation limitations.

The Figure 1.5 - Conduit Installation Diagram, shows the correct installation of the conduit, in order to avoid penetration of water, or other substance, which may cause malfunctioning of the equipment.

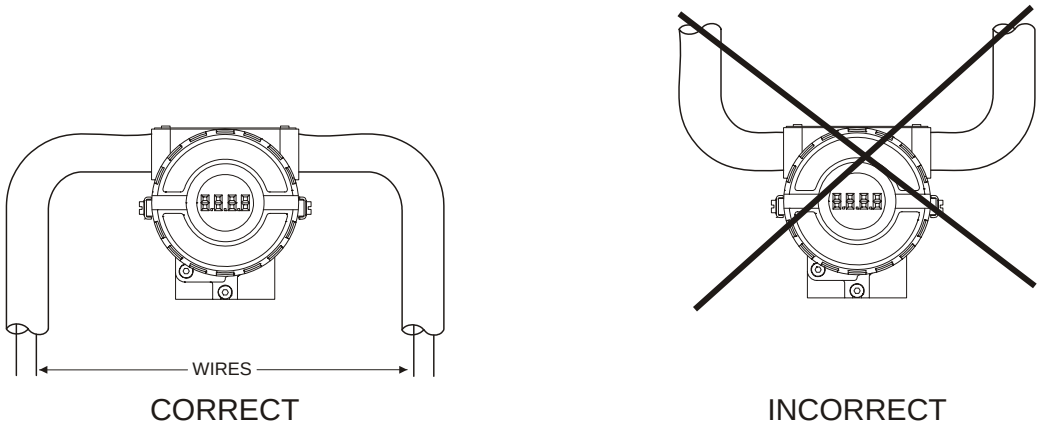


Figure 1.5 - Conduit Installation Diagram.

Topology and Network Configuration

Bus topology (See Figure 1.6 - Bus Topology) and tree topology (See Figure 1.7 - Tree Topology) are supported. Both types have a trunk cable with two terminations. The devices are connected to the trunk via spurs. The spurs may be integrated in the device giving zero spur length. A spur may connect more than one device, depending on the length. Active couplers may be used to extend spur length.

Active repeaters may be used to extend the trunk length.

The total cable length, including spurs, between any two devices in the Fieldbus should not exceed 1900m.

The connection of couplers should be kept less than 15 per 250m.

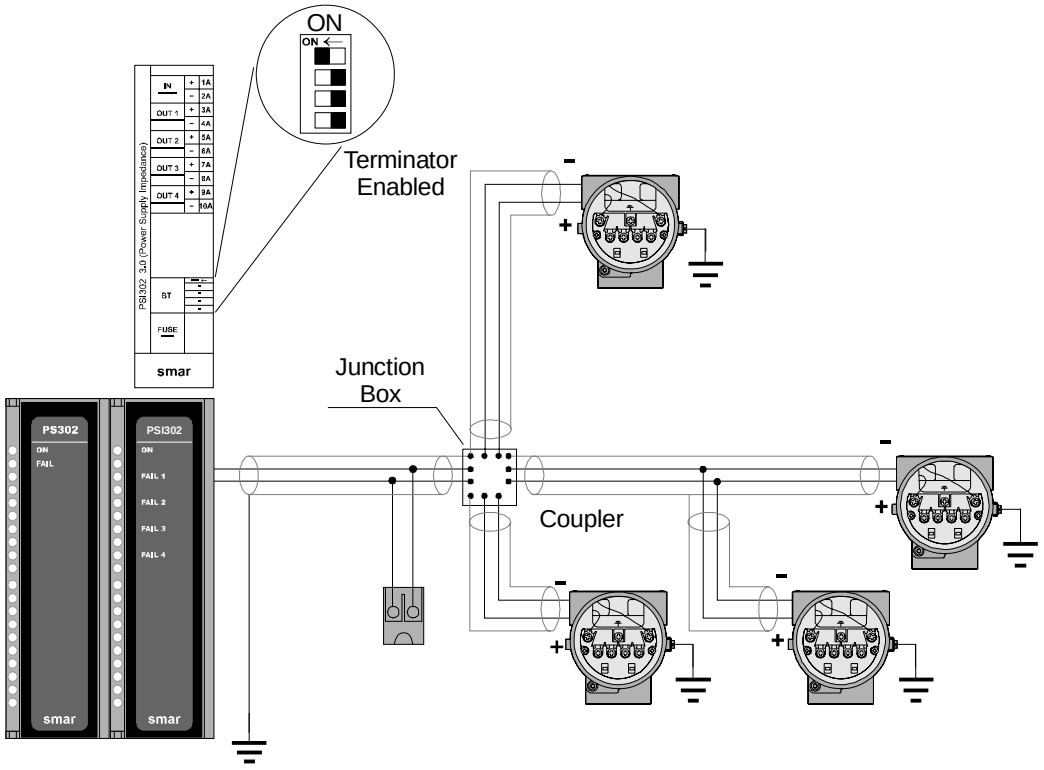


Figure 1.6 - Bus Topology

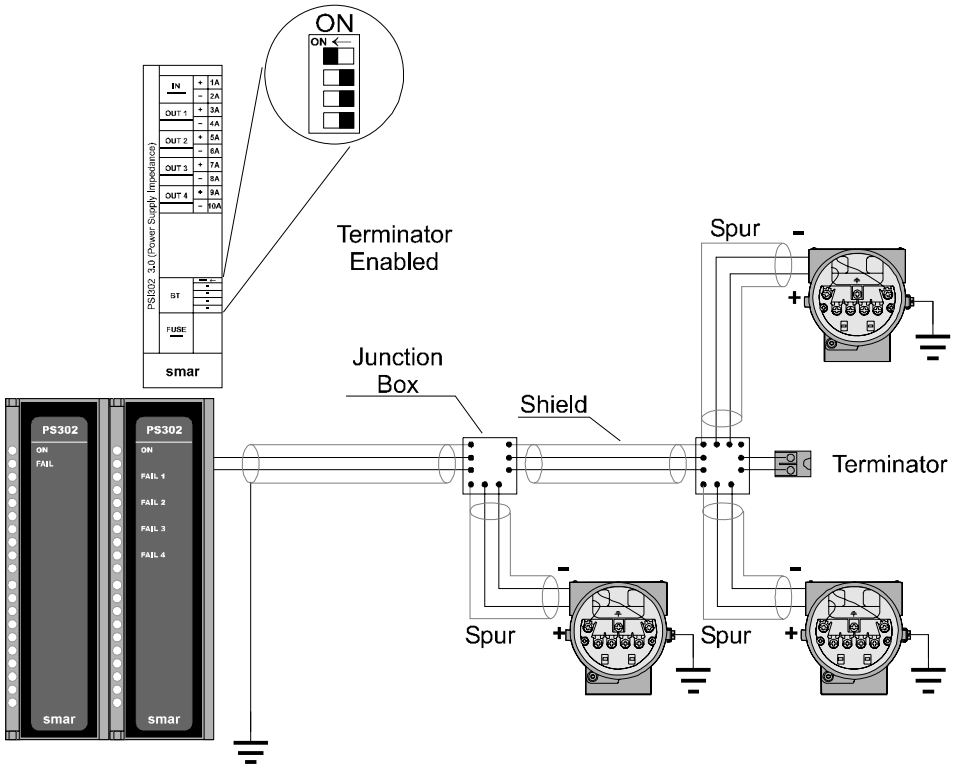
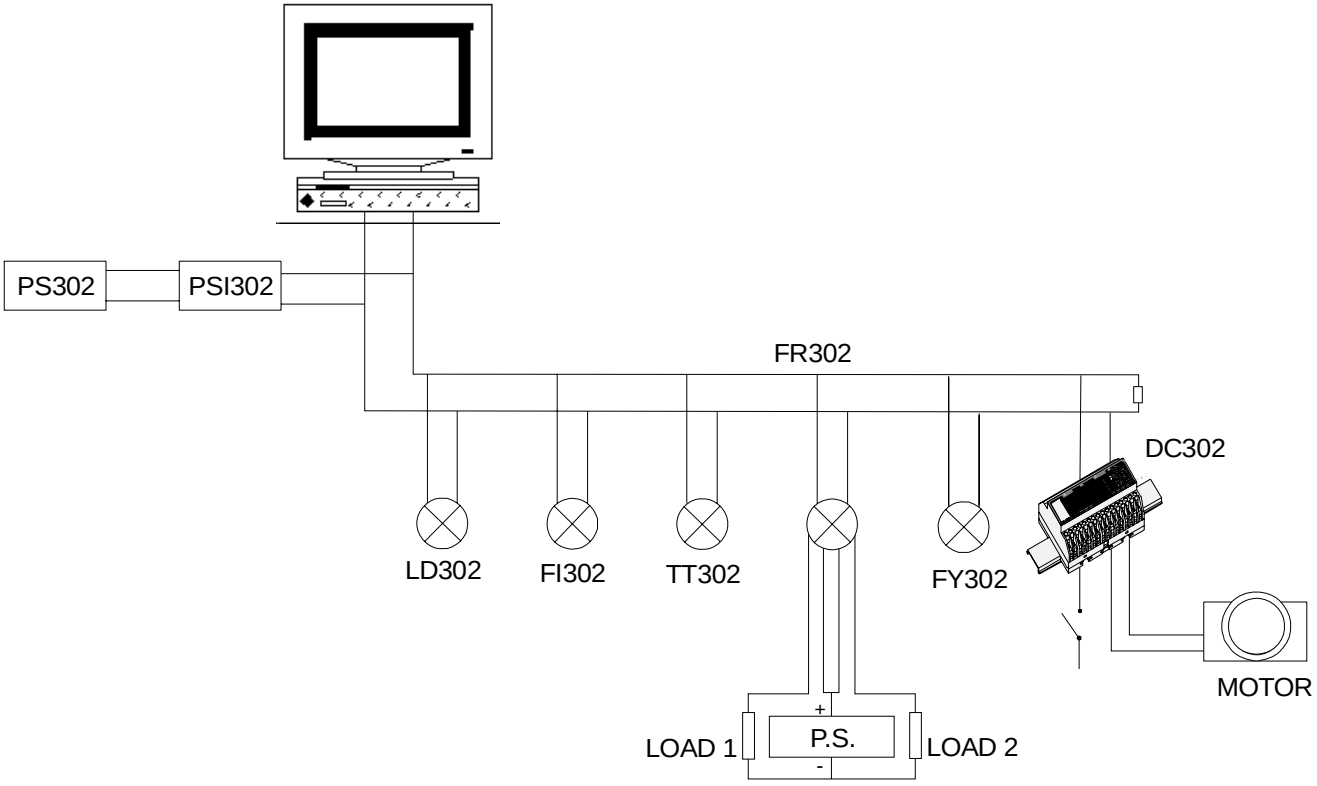


Figure 1.7 - Tree Topology

General System

According to the figure below, a general network topology can be seen where the FR302 is integrated into a simple Fieldbus network.



P.S. = Power Supply

Figure 1.8 – FR302 and a general Fieldbus System

OPERATION

The **FR302** has 2 isolated built-in relay outputs. It is therefore ideal for interfacing existing discrete devices to a Fieldbus system.
Output function blocks include standard FOUNDATION™ safety mechanisms in case of failures. Outputs are isolated from each other.

NOTE
For each output there is a 250mA protection fuse. To access them, please, remove the main electronic board and in the Relay board see the reference FU1 and FU2. The code for them is LIT 251.250 – 0.250A – from LittelFuse.

Functional Description – Electronics

Refer to the block diagram (See Figure 2.1 – *FR302 Block Diagram*). The function of each block is described below.

(CPU) Central Processing Unit, RAM and FLASH

The CPU is the intelligent portion of the Fieldbus Relay, being responsible for the management and operation of block execution, self-diagnostics and communication. The program is stored in Flash memory. For temporary storage of data there is a RAM. The data in the RAM is lost if the power is switched off. However, the device also has a nonvolatile EEPROM where data that must be retained are stored. Examples of such data are configuration and identification data.

Communication Controller
It monitors line activity, modulates and demodulates the signal from the network.

Power Supply
Takes power of the loop-line to power the converter circuitry.

Display Controller
Receives data from the CPU and drives the Liquid Crystal Display.

Local Adjustment
There are two switches that are magnetically activated. They can be activated by the magnetic tool without mechanical or electrical contact.

Optical Isolation
Optical isolation is for outputs.

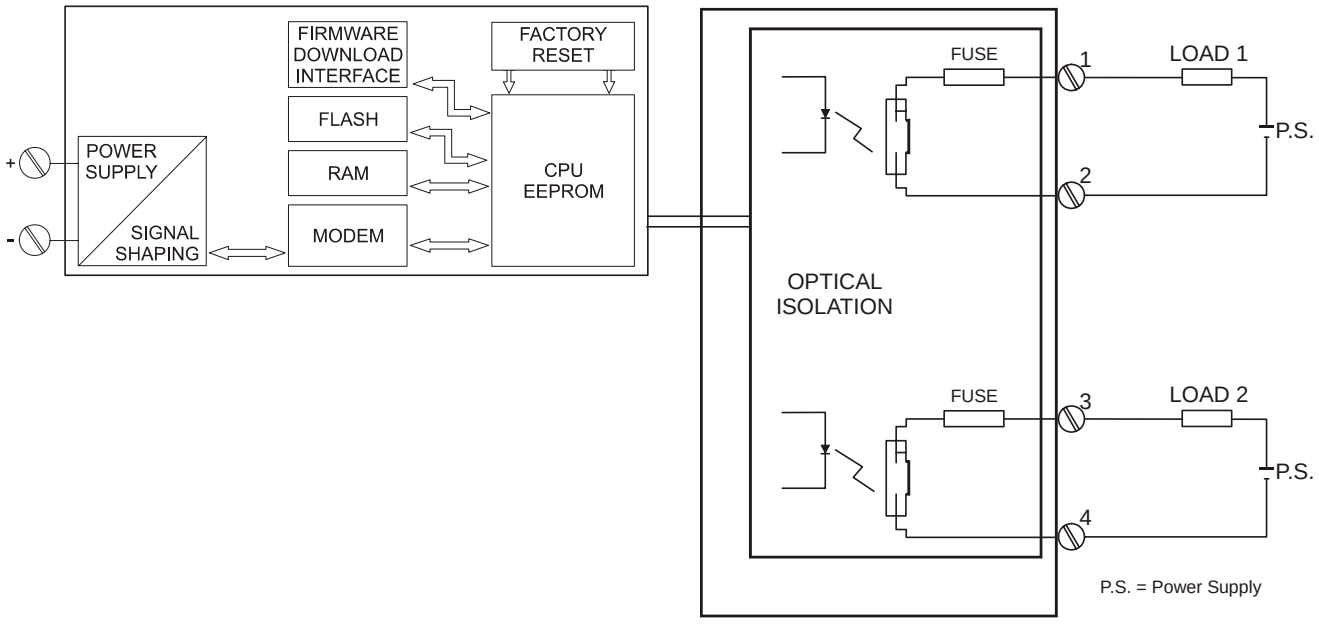


Figura 2.1 – FR302 Block Diagram

NOTE

When the FR302 has a N.O. relay and a N.C. relay, the N.O. relay is connected to terminals 1-2 and the N.C. relay in the terminals 3-4.

CONFIGURATION

One of the many advantages of Fieldbus is that device configuration is independent of the configuration tool. The **FR302** may be configured by a third party host computer using the DD (Device Description) e CFF (Capability File).

The **FR302** has several Function Blocks built in, such as Analog Alarm, Arithmetic, Discrete Output, Flip-Flop and Edge Trigger, Input Selector, PID, Step Output PID and Timer.

Function Blocks are not covered in this manual. For explanation and details of function blocks, see the *Function Blocks Manual*.

The FR302 Function Blocks can link with blocks located in other devices using SYSCON or other Fieldbus configuration tools. The relay outputs are chosen via CHANNEL parameter in the DO and PID Step blocks.

For explanation and details for using SYSCON, please see the *SYSCON Manual.*

Functional Diagram

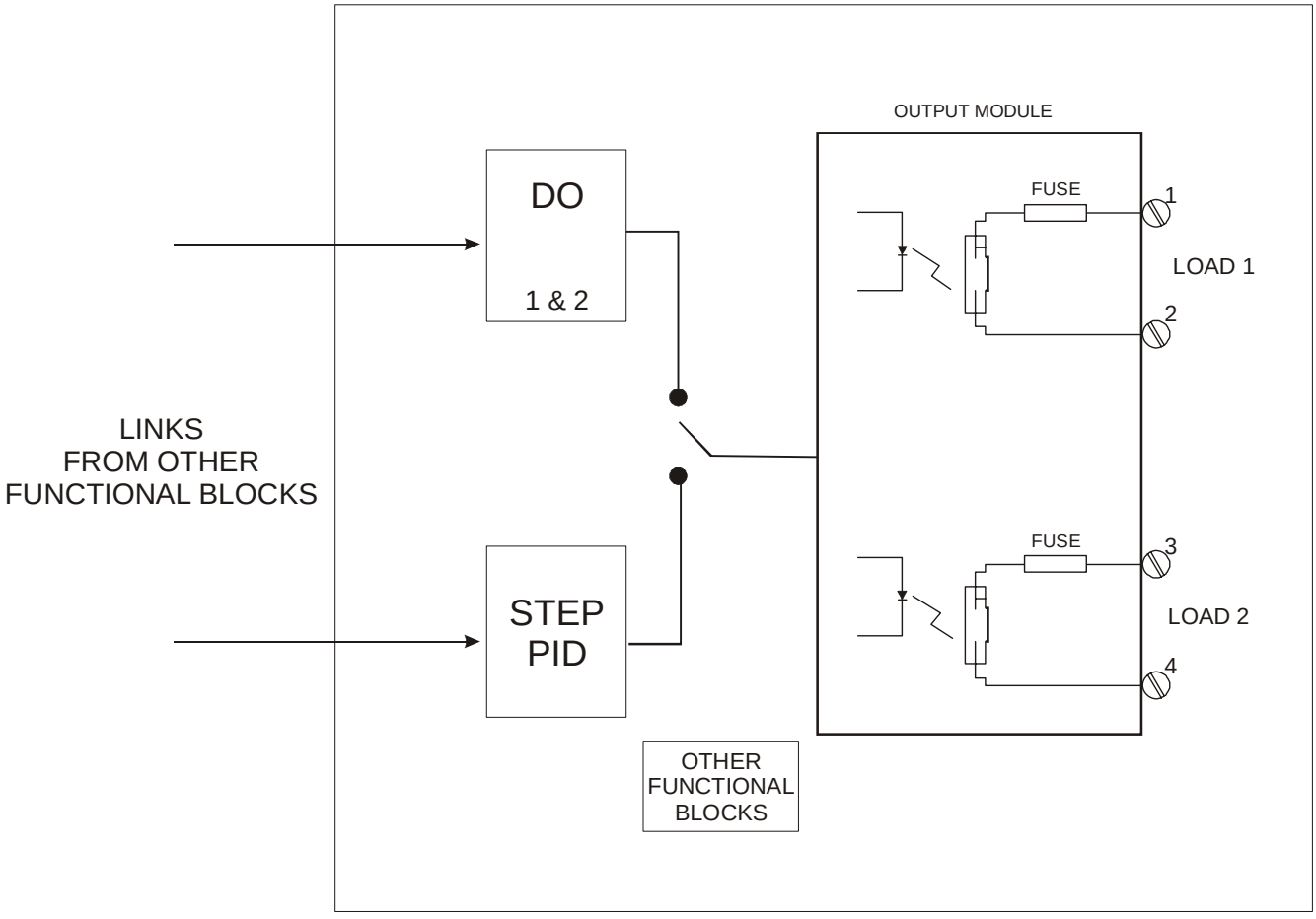


Figura 3.1 – Functional Diagram

Output Transducer Blocks

Description
Using the transducer block the user can see the output relay type definition.

Supported Modes
OOS and Auto

Parameters

Idx	Parameter	DataType	Valid Range	Default Value	Units	Store	Description
1	ST_REV	Unsigned16		0	None	S	Indicates the level of static data.
2	TAG_DESC	VisibleString		Null	Na	S	Description of Transducer Block.
3	STRATEGY	Unsigned16		0	None	S	This parameter is not checked and processed by Transducer Block.
4	ALERT_KEY	Unsigned8	1 to 255	0	None	S	Number of identification in the plant.
5	MODE_BLK	DS-69		O/S	Na	S	Indicates the operation mode of Transducer Block.
6	BLOCK_ERR	Bit String			E	D	Indicates the status associated with hardware or software in theTransducer.
7	UPDATE_EVT	DS-73	0: Serial 1: TCP/IP		Na	D	It is the alert for any static data.
8	BLOCK_ALM	DS-72	0: Master 1: Slave		Na	D	It is used for configuration, hardware and others fails.
9	TRANSDUCER_DIRECTORY	Unsigned16			None	S	A directory that specifies the number and the starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Unsigned16	Other (0xffff)	Other (0xffff)	None	S	Identifies the transducer that follows.
11	XD_ERROR	Unsigned8	Default Value Set (0x10) General Error (0x11) Calibration Error (0x12) Configuration Error (0x13) Electronics Failure (0x14) Mechanical Failure (0x15) I/O Failure (0x16) Data Integrity Error (0x17) Software Error (0x18) Algorithm Error (0x19)	Default Value Set (0x10)	None	D	Define an error code.
12	COLLECTION_DIRECTORY	Unsigned	0	0	None	S	A directory that specifies the number, the starting indices, and DD Item IDs of data collections in each transducers in the transducer block.
13	OUTPUT_RELAY_TYPE	Unsigned8	Not Initialized. (0x0) Both Normally Open. (0x1) Both Normally Closed. (0x2) One Normally Open and another Normally Closed. (0x3)	Not Initialized (0x0)	None	S	The type of each output relay.
14	SERIAL_NUMBER	Unsigned32	0 to 4294967296	0	None	S	The device serial number

15	ORDERING_CODE	Visible String[50]	-	Null	None	S	Indicates informations about the sensor and control from production factory.

Legend:
E – Enumerated parameter
Null – Blank
Na – Admensional parameter
RO – Read only
D – Dynamic
N – Non-volatile
S – Static
Sec – Seconds
CU – CAL_UNIT
PVR – PRIMARY_VALUE_RANGE
SR – SENSOR_RANGE
SVU – SECONDARY_VALUE_RANGE

Connecting physical signals to Digital Output Block

The DO block converts the value in SP_D to an on/off signal for the hardware found at the CHANNEL selection. The FR302 can have up two DO blocks. For details, please see the *Function Blocks Manual*.

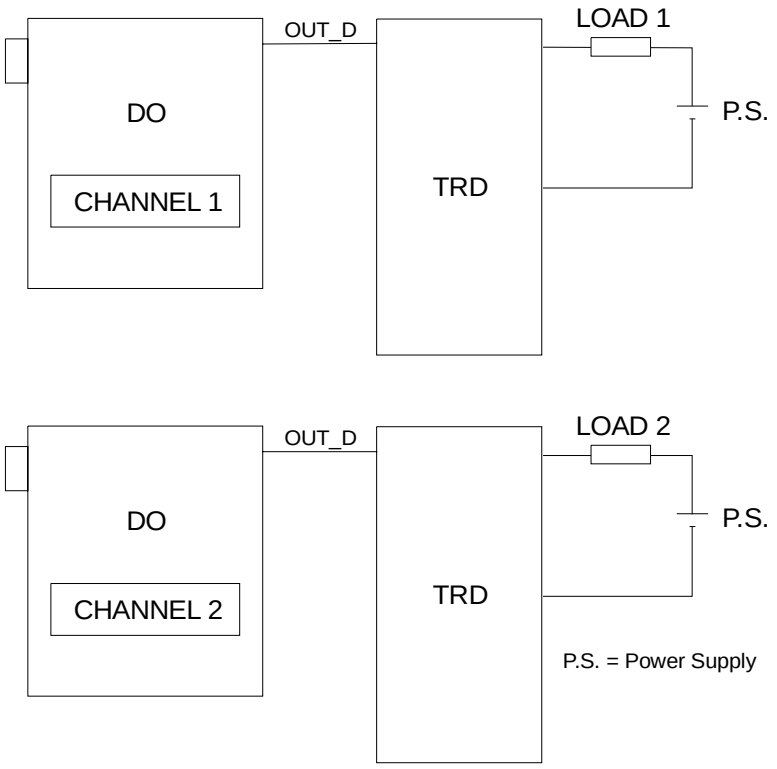


Figure 3.2 - FR302 and DO Block connections

Connecting physical signals to PID Step

A Step Control Output block is used most commonly, when the final control element has an actuator driven by an electric motor without actual position feedback. The final control element is positioned by rotating the motor clockwise or counter clockwise, which is accomplished by activating a discrete signal for each direction. A control valve, for example, needs a signal to open and another to close. If none of the signals are present, the valve stem would stay at the same position. The FR302 has one Step Control Block. For details, please see the Function Block Manual.

Please, note the limits for switching current and voltage according to FR302 technical specifications. The FR302 outputs may not be able to drive the actuator motor, but can be used as control signals.

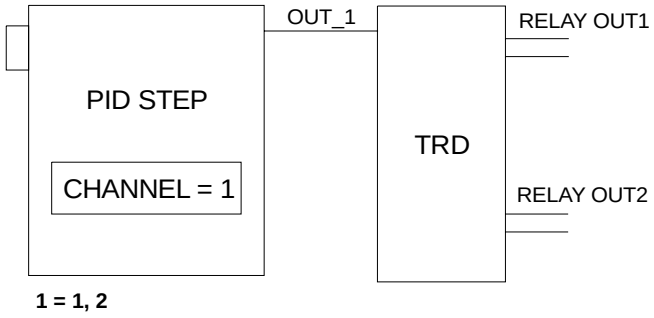


Figure 3.3 – FR302 and PID Step Block

Examples of Applications

Application 1: from the computer the outputs can be manipulated.

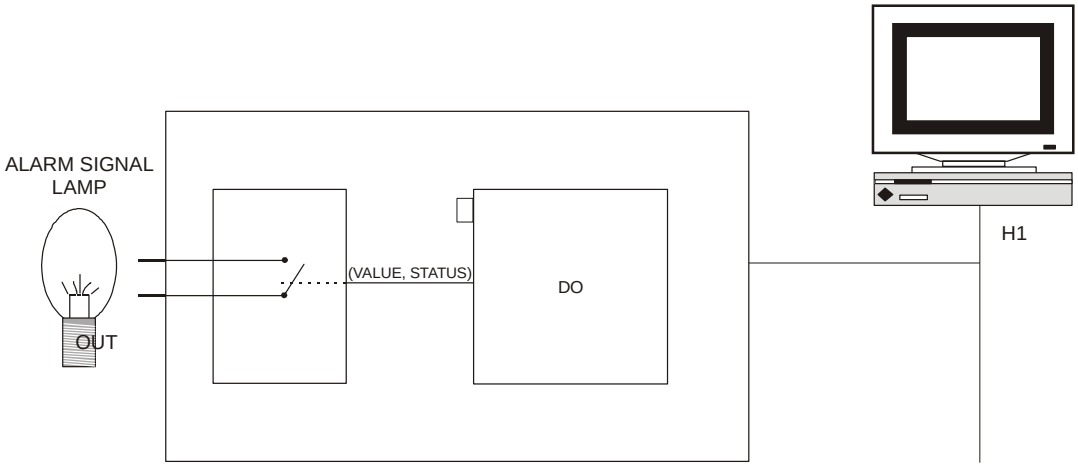


Figure 3.4 - FR302 – Application 1

Application 2: Alarm control (Level limit will turn on alarm signal lamp or a buzzer).

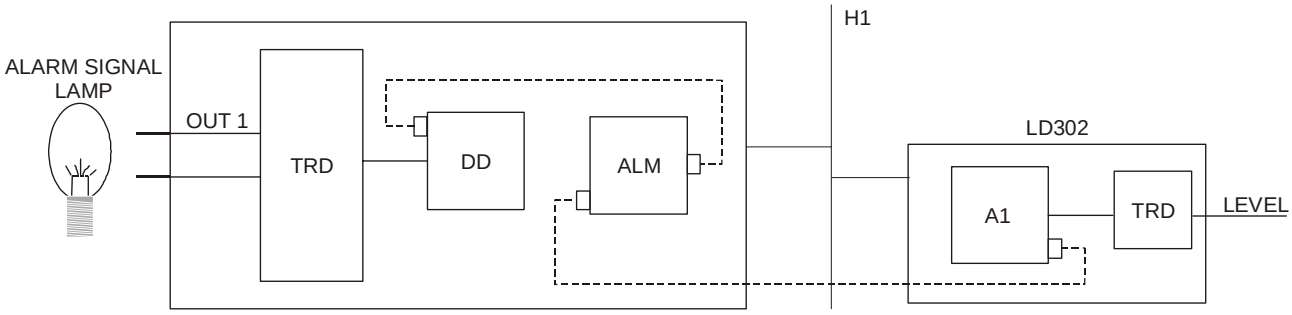


Figure 3.5 - FR302 – Application 2

NOTE

One very interesting application for **FR302** is as an interface for electrical actuators.

Any electrical actuator, including the Smar series AD/AR/AL becomes a Fieldbus actuator, making the **FR302** ideal in upgrades and plant re-instrumentations. The PID Step block is ideal in these cases since it can modulate the valve without the need for actual position feedback.

Section 4

MAINTENANCE PROCEDURES

General

SMAR **FR302** Fieldbus Relay devices are extensively tested and inspected before delivery to the end user. Nevertheless, during their design and development, consideration has been given to the possibility of repairs by the end user, when necessary.

In general, it is recommended for the end user not to try to repair printed circuit boards. Instead, spare circuit boards should be available, which may be ordered from SMAR when necessary.

Troubleshooting	
Symptom	**Probable Sources of Trouble**
No Quiescent Current	**Fieldbus Relay Connections:** Check wiring polarity and continuity. **Power Supply:** Check power supply output. The voltage at the FR302 Fieldbus terminals must be between 9 and 32 VDC. **Electronic Circuit Failure:** Check the boards for defect by replacing them with spare ones.
No Communication	**Network Connections** Check the network connections: devices, power supply, and terminators. **Network Impedance** Check the network impedance (power supply impedance and terminators). **Controller Configuration** Check configuration of communication parameters of the controller. **Network Configuration** Check communication configuration of the network. **Electronic Circuit Failure** Try to replace the controller circuit with spare parts.
Incorrect Outputs	**Output Terminals Connection** Check wiring and continuity. **Switching Current and voltage for Outputs** Check limits for the connected load according to the model for relay connections. **Output Fuse** Check the output fuses condition, removing the main electronic board.

Disassembly Procedure

Make sure to disconnect power supply before disassembling the converter.

To remove the circuit boards (5 and 7) and display (4), first loosen the cover locking (8) on the side not marked “Field Terminals”, then unscrew the cover (1).

WARNING
The boards have CMOS components, which may be damaged by electrostatic discharges. Observe correct procedures for handling CMOS components. It is also recommended to store the circuit boards in electrostatic-proof cases.

Loosen the two screws (3) that anchor the display and the main circuit board. Gently pull out the display (4), and then the main board (5). To remove the input board (7), first unscrew the two screws (6) that anchor it to the housing (9), and gently pull out the board.

Reassembly Procedure

Place the input board (7) into housing (9).

Place the main board (5) into the housing, ensuring all inter connecting pins are connected.

Place the display (4) into the housing, note the four mounting positions. "_" should point in the direction desired as UP.

Anchor main board and display with their screws (3).

Fit the cover (1) and lock it using the locking screw (8).

Returning Materials

Should it become necessary to return the converter to SMAR, simply contact your local agent or SMAR office, informing them of the defective instrument's serial number, and return it to our factory.

In order to expedite analysis and solution of the problem, the defective item should be returned with a description of the failure observed, with as many details as possible. Other information concerning to the instrument operation, such as service and process conditions, is also helpful.

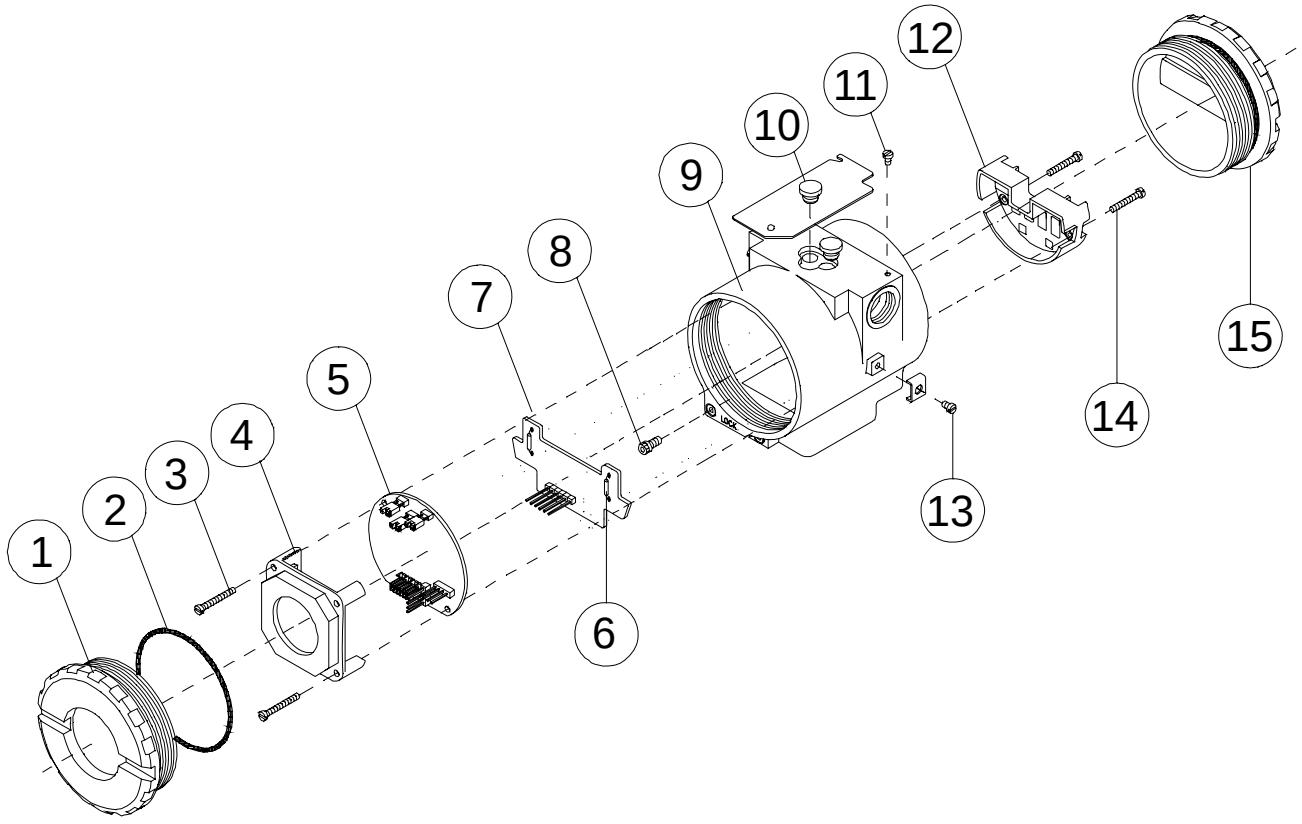


Figure 4.1 – FR302 Exploded View

ACCESSORIES	
ORDERING CODE	**DESCRIPTION**
SD1	Magnetic Tool for Local Adjustment
PS302	Power Supply
BT302	Terminator
FDI302	Field Device Interface
DF47	Intrinsic Safety Barrier
DF48	Fieldbus Repeater

SPARE PARTS LIST		
DESCRIPTION OF PARTS	**POSITION**	**CODE**
HOUSING, Aluminum (NOTE 1)		
½ - 14 NPT	9	400-0612
M20 x 1.5	9	400-613
PG 13.5 DIN	9	400-0614
HOUSING, 316 SS (NOTE 1)		
½ - 14 NPT	9	400-0615
M20 x 1.5	9	400-0616
PG 13.5 DIN	9	400-0617
COVER (INCLUDES O'RING)		
Aluminum	1 and 15	204-0102
316 SS	1 and 15	204-0105
COVER WITH WINDOW FOR INDICATION (INCLUDES O'RING)		
Aluminum	1	204-0103
316 SS	1	204-0106
Cover Locking Screw	8	204-0120
External Ground Screw	13	204-0124
Identification Plate Fixing Screw	11	204-0116
Digital Indicator	4	214-0108
Terminal Insulator	12	314-0123
Main Circuit Board Assembly	5	400-0618
Relay Circuit Board: NC Relay Output Board NO Relay Output Board NO, NC Relay Output Board	7	400-0621 400-0620 400-0622
Protection Fuse(2)(Note 4)	6	400-0619
O'RINGS (NOTE 2)		
Cover, Buna-N	2	204-0122
TERMINAL HOLDING SCREW.		
Housing in Aluminium	14	304-0119
Housing in 316 Stainless Steel	14	204-0119
MAIN BOARD SCREW HOUSING IN ALUMINUM		
Units With Indicator	3	304-0118
Units Without Indicator	3	304-0117
MAIN BOARD SCREW HOUSING IN 316 STAINLESS STEEL		
Units With Indicator	3	204-0118
Units Without Indicator	3	204-0117
RELAY BOARD SCREW		
Housing in Aluminium	-	314-0125
Housing in 316 Stainless Steel	-	214-0125
MOUNTING BRACKET FOR 2" PIPE MOUNTING (NOTE 3)		
Carbon Steel	-	214-0801
Stainless Steel 316	-	214-0802
Carbon Steel Bolts, Nuts, Washers and U-clamp in Stainless Steel	-	214-0803
Local Adjustment Protection Cap	10	204-0114

Note: 1 - It includes terminal holder insulator, bolts (cover lock, grounding and terminal holder insulator) and identification plate without certification.
2 - 0-Rings are packaged in packs of 12 units.
3 - Including U-clamp, nuts, bolts and washers.
4- For each output, there is a 250mA protection fuse. To access them, please, remove the main electronic board and in the Relay board see the reference FU1 and FU2.

Section 5

TECHNICAL SPECIFICATIONS

General

Communication	Digital only. Fieldbus, 31.25 Kbits/s voltage mode
Current consumption quiescent	17.5 mA from Fieldbus network
Turn-on Time	Approximately 10 seconds.
Update Time	Approximately 0.5 second.
Humidity Limits	0 to 100% RH.
Indication	Optional 4½ digit LCD indicator.
Temperature Limits	Operation: -40 to 85ºC (-40 to 185 ºF) Storage: -40 to 120ºC (-40 to 250 ºF) Display: -10 to 60ºC (14 to 140ºF) operation -40 to 85ºC (-40 to 185 ºF) without damage.
Vibration Effect	Meets SAMA PMC 31.1.
Electro-Magnetic Interference Effect	Designed to comply with IEC 801.
Hardware	Physical: according to IEC 61158-2 and conformity with the FISCO model.
Electrical Connection	1/2-14 NPT, Pg 13.5 or M20 x 1.5.
Material of Construction	Injected low copper aluminum with polyester painting or 316 Stainless Steel housing, with Buna N O-rings on cover (NEMA 4X, IP67).
Mounting	With an optional bracket that can be installed on a 2" pipe or fixed on a wall or panel.
Weight	Without display and mounting bracket: 0.80 kg. Add for digital display: 0.13 kg. Add for mounting bracket: 0.60 kg.

FR302 Output Relays

Description - Outputs
The outputs are designed with Solid State relays that are able to drive incandescence lamps, solenoids and other DC and AC loads.

When the output relays are N.C., if via function block is assigned a state on to the outputs, it means that the loads will be switched off.

When the output relays are N.O., if via function block is assigned a state on to the outputs, it means that the loads will be switched on.

Technical specifications for Normally Closed relays

Architecture	Number of Outputs: 2
Switching Voltage	350 Vpeak
Switching Current: AC mode	100 mA
Switching Current: DC mode	165 mA
On Resistance AC mode	18 Ω
On Resistance DC mode	4.5 Ω
Off State Resistance	Min: 0.1 GΩ Typ: 1.4 GΩ
Off State Leakage	Typ: 1.0 µA
Turn On Time	5ms
Turn Off Time	1ms
Capacitance - Across Output	20 to 200 pF
Thermal Offset Voltage	0.20mV
Output Status (load) with no power supply connected to the H1 bus	ON
Output Status (load) During: Firmware Download	ON
Output Status (load) During: Turn-on Time	ON
Output Status (load) During: Configuration Download	OFF

Technical specifications for Normally Opened relays

Architecture	Number of Outputs: 2
Switching Voltage	400 Vpeak
Switching Current: AC mode	150 mA
Switching Current: DC mode	250 mA
On Resistance AC mode	18 Ω
On Resistance DC mode	4.5 Ω
Off State Resistance	Min: 0.5 GΩ Typ: 5000 GΩ
Off State Leakage	Typ: 0.5 µA
Turn On Time	5ms
Turn Off Time	1ms
Capacitance - Across Output	10 to 95 pF
Thermal Offset Voltage	0.20mV
Output Status (load) with no power supply connected on the H1 bus	OFF
Output Status (load) During: Firmware Download	OFF
Output Status (load) During: Turn-on Time	OFF
Output Status (load) During: Configuration Download	ON

Ordering Code