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SAFESMART
FailSafe Level Alarm Relay
SAFE-FS

Installation & Operation Manual

This Manual is the support documentation for the installation, commissioning and operation of the SAFE-FS Level Alarm Relay.

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Contents

1 Warnings & Cautions 5
1.1 Information to User 5
1.2 Documentation Standards 5
1.3 Installation Notes 5
2 Introduction 6
3 Specifications 7
4 Installation 7
5 Power Supply 8
6 Level Alarms 9
6.1 Level Alarm Activation Delays 9
6.2 Level Alarm Deactivation Delays 9
7 Failsafe Probe Alarm 10
8 Probe Sensitivity 10
9 LED Function 10
10 DIP Switch Settings 11
11 Example Applications 11
11.1 Example 1 – High Level Alarm with Single Sensor Probe 11
11.2 Example 2 – High Level Alarm with 10 x Sensor Probe 12
11.3 Example 3 – Low Level Alarm with Single Sensor Probe 12
11.4 Example 4 – Wiring Diagram – High Level Alarm 13
Appendix A. SafeSmart SAFE-FS Level Alarm Relay Label 15

Table of Figures

Figure 1 - Non-failsafe Probe Connection Diagram 10
Figure 2 - High Level Alarm with Single Sensor Probe 11
Figure 3 - High Level Alarm with 10 Sensor Probe 12
Figure 4 - Low Level Alarm with Single Sensor Probe 12
Figure 5 - Wiring Diagram for a High Level Alarm 14

Table of Tables

Table 1 - SAFE-FS Specifications 7
Table 2 - Current Ratings 8
Table 3 - Low Voltage Thresholds 8
Table 4 - Probe Sensitivity 10
Table 5 - LED Function 10
Table 6 - DIP Settings 11

1 Warnings & Cautions

1.1 Information to User

WARNING:

Do not use this unit in environments that may contain flammable/explosive or chemically aggressive gases or powders.

Read this manual prior to installing or operating the SafeSmart SAFE-FS Level Alarm relay. It contains all the information necessary to configure it for maximum performance for your application. After reading, place the manual in a safe place for future reference.

1.2 Documentation Standards

DANGER:
This symbol is used where non-compliance could result in injury or death.

WARNING:
This symbol is used where non-compliance could result in incorrect operation, damage to or failure of the equipment.

NOTE:
This symbol is used to highlight an issue or special case within the body of the manual.

1.3 Installation Notes

WARNING:
The SAFE-FS installation and wiring must be performed by qualified personnel.

DANGER:
The SAFE-FS has no user serviceable parts, to reduce the risk of electric shock leave all servicing to qualified Multitrode technical staff.

2 Introduction

WARNING:

Do not use this unit in environments that may contain flammable/explosive or chemically aggressive gases or powders.

The SAFE-FS is the next generation of ultra-reliable high level alarming for lift stations and pump stations. It is part of the new SafeSmart family from MultiTrode.

Failsafe probe functionality has been added – an extra wire is connected to the top most sensor in the probe and periodically the relay verifies that the high level alarm is functioning.

Main of features of the SAFE-FS relay:

- Adds failsafe test to the ultra-reliable probe
- Relay output for loss of probe - N/O or N/C
- Relay output for high or low level alarm - N/O or N/C
- LED indication for power, level alarm, loss of probe alarm

Over 100,000 pump stations around the world use MultiTrode probes for primary or backup control (or both). Utilities have moved away from ball floats because they are prone to tangle up and need frequent cleaning to avoid false readings from fats, oils and grease.

The MultiTrode single sensor probe eliminates the problems of ball floats, and the new fail-safe single-sensor probe adds an extra electrical connection to the sensor. The level alarm relay checks for continuity - so if a wire has become disconnected, or if rats have eaten the cable - an output is activated. This provides continuous verification to the utility that the probe is in operation.

The SAFE-FS Level Alarm Relay is designed to be easy to install and configure and operates from an 11 – 30 VDC power supply. All connections are clearly labelled on the side of the device and options are configured using a set of DIP switches on the front of the relay. During operation, the LEDs on the front panel indicate the current status including Probe Fault and Level Alarm.

3 Specifications

Dimensions	
Width	22.5mm (7/8”)
Height	101mm (4”)
Length (depth)	120mm (4 ¾”)
Environmental	
Ambient Temperature	-10 to 60 °C (14 to 140 °F)
Humidity	5% to 90% non-condensing
DC Power Supply	
Voltage Range	11 – 30V DC
Current	0.15A max
Relay Outputs	
Type	Form A
Current (Resistive)	5A
Current (Inductive)	2A
Voltage Rating DC	30V DC
Voltage Rating AC	250V AC

Table 1 - SAFE-FS Specifications

4 Installation

WARNING:

Do not use this unit in environments that may contain flammable/explosive or chemically aggressive gases or powders.

The SafeSmart SAFE-FS is designed to be mounted onto a standard DIN rail. All power supply, input and output connections are located on the top of the relay housing.

The features of the relay are listed below and are described in the following sections.

- Power Supply
- Level Alarms
- Failsafe Probe Alarm
- Probe Sensitivity
- LED Function
- DIP Switch Settings

5 Power Supply

The SAFE-FS requires an 11 – 30V DC power supply.

A switch or circuit-breaker and an over current protection device must be included in the installation. The protection device must be in close proximity to the equipment, within easy reach of the operator, and be marked as the protection device for the equipment. The input wiring and the switch/circuit-breaker/over current device must be rated to at least the nominal input voltage being used. The recommended current rating is listed in Table 2 below.

Unit Supply Range	Recommended Switch/Circuit-Breaker/Over current Protection Device Rating	Minimum Supply Wiring Rating
11-30V DC	0.15A	0.15A

Table 2 - Current Ratings

If the DC supply voltage drops below a threshold, the Power LED flashes. This threshold is automatically set depending on the supply voltage. See Table 3 below for threshold values.

Power Supplied	Low Voltage Alarm Threshold (Automatically Set)
< 24VDC	In the range of 11.5 -12.0
≥ 24VDC	23.0

Table 3 - Low Voltage Thresholds

NOTE:
The MultiTrode probe uses an earth/ground return path for the signal. Ensure that the GND (DC-) terminal on the SAFE-FS relay is also grounded.

6 Level Alarms

The SAFE-FS has the following alarm inputs:

A conductive level sensor is connected to the AL Probe input to detect when the liquid level has risen above or fallen below a predetermined level.

- In High Level Alarm mode, the alarm activates when the AL Probe input detects liquid (after the activation delay has expired).
- In Low Level Alarm mode, the alarm activates when the AL Probe input no longer detects liquid (i.e. the level has dropped below the sensor) and the activation delay has expired.
    - High Level Alarm - DIP Switch 1 = OFF
    - Low Level Alarm - DIP Switch 1 = ON

When a level alarm is detected, the Level Alarm contacts are activated and the Level Alarm LED flashes. The alarm contacts can be used to operate a warning light or connected to a PLC / RTU or dialler for remote monitoring.

The Level Alarm output can be configured as Normally Open (N/O) or Normally Closed (N/C) via DIP Switch 4:

- N/C Level Alarm - DIP Switch 4 = OFF
- N/O Level Alarm - DIP Switch 4 = ON

6.1 Level Alarm Activation Delays

The activation delay can be extended from 0.5 to 10s. A 10s activation delay ignores the alarm condition (high or low level) if the sensor is triggered for less than 10s. It is configured via DIP Switch 2.

There are 2 delay periods:

- 0.5 sec - DIP Switch 2 = OFF
- 10 sec - DIP Switch 2 = ON

6.2 Level Alarm Deactivation Delays

The deactivation delay can be extended from 0.5 to 10s. A 10s deactivation maintains the alarm for 10s after the alarm condition has passed. It is configured via DIP Switch 3.

There are 2 delay periods:

- 0.5 sec - DIP Switch 3 = OFF
- 10 sec - DIP Switch 3 = ON

7 Failsafe Probe Alarm

MultiTrode's Failsafe probe includes an extra connection to the top sensor which is used for failsafe detection. The SafeSmart relay utilises this connection to test the integrity of the connection to the sensor. If the cable to the sensor is broken, the relay detects this (after a short delay), the Probe LED starts flashing and the Probe Alarm contacts are activated. (The Failsafe Probe Alarm output can be configured as normally open or normally closed via DIP switch 5).

- N/C Failsafe Probe Alarm - DIP Switch 5 = OFF
- N/O Failsafe Probe Alarm - DIP Switch 5 = ON

If a standard or non-failsafe probe is used, a jumper **must** be connected between the AL Probe and Failsafe inputs to prevent probe fault alarms.

Figure 1 - Non-failsafe Probe Connection Diagram

NOTE:
The failsafe probe input must be connected to the highest probe in the system.

8 Probe Sensitivity

The relay is used in conjunction with a conductive level sensing device such as the MultiTrode probe. Conductive probes rely on conductivity through the liquid to earth in order to detect level. Highly conductive liquids such as salt water generally require the relay to be set to a lower sensitivity than for low conductivity liquids such as distilled water. For most applications, the default probe setting of 20k ohms is satisfactory but the relay allows for the operator to adjust the sensitivity as needed for specific conditions. The sensitivity is set using Dip Switches 7 and 8, (see Table 4 below).

Dip Sw 7	Dip Sw 8	Sensitivity	Typical Application
OFF	OFF	1k ohm	Concentrates Acids, Minerals, Alkalis
ON	OFF	4k ohm	Acids, Alkalis, Diluted Brine, Sea Water
OFF	ON	20k ohm	Sullage, Sewage Effluent, Town Water
ON	ON	80k ohm	Industrial Effluent, Purified Water*

Table 4 - Probe Sensitivity

* Not recommended for use with purified de-ionised water.

9 LED Function

Three LEDs on the front of the relay indicate the power and status of the level and probe alarms.

LED	Status	Indication
Power	Power On	Steady
	Low Voltage	Flashing
Level	Level Alarm Active	Flashing
Probe	Failsafe Alarm Active	Flashing

Table 5 - LED Function

10 DIP Switch Settings

The SAFE-FS is configured using the DIP switches located on the front of the relay enclosure.

DIP #	Setting	Mode Description	Section
1	OFF	High Level Alarm	6
	ON	Low Level Alarm	6
2	OFF	0.5 sec Level Alarm Activation Delay	6.1
	ON	10 sec Level Alarm Activation Delay	6.1
3	OFF	0.5 sec Level Alarm Deactivation Delay	6.1
	ON	10 sec Level Alarm Deactivation Delay	6.1
4	OFF	N/C Level Alarm	6
	ON	N/O Level Alarm	6
5	OFF	N/C Failsafe Probe Alarm	7
	ON	N/O Failsafe Probe Alarm	7
6	OFF	Not Used	-
	ON	Not Used	-
7	8	Probe Sensitivity	8
OFF	OFF	1k ohm	
ON	OFF	4k ohm	
OFF	ON	20k ohm	
ON	ON	80k ohm	

Table 6 - DIP Settings

11 Example Applications

11.1 Example 1 – High Level Alarm with Single Sensor Probe

A high level alarm is configured for a discharge/empty application. A Failsafe single sensor probe is used, (if a standard probe is used, bridge terminal 1 to 2). The Level Alarm contacts activate when the liquid level reaches the sensor.

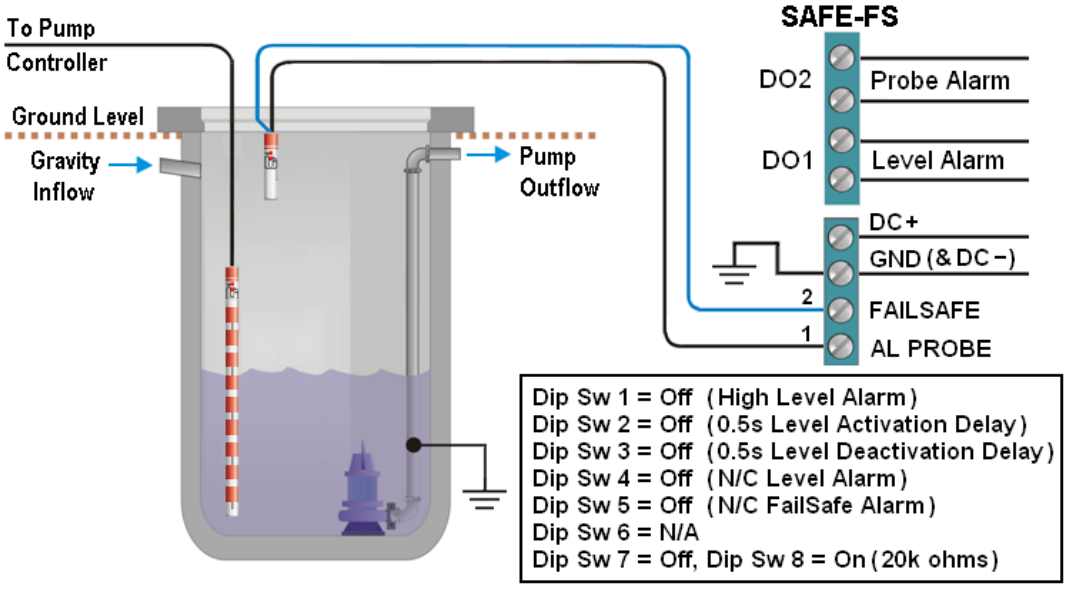


Figure 2 - High Level Alarm with Single Sensor Probe

11.2 Example 2 – High Level Alarm with 10 x Sensor Probe

A high level alarm is configured for a discharge/empty application. A Failsafe ten (10) sensor probe is used. The Level Alarm contacts activate when the liquid level reaches the highest sensor. The probe sensors can not be connected in parallel to two devices, so the highest sensor only goes to the SAFE-FS relay.

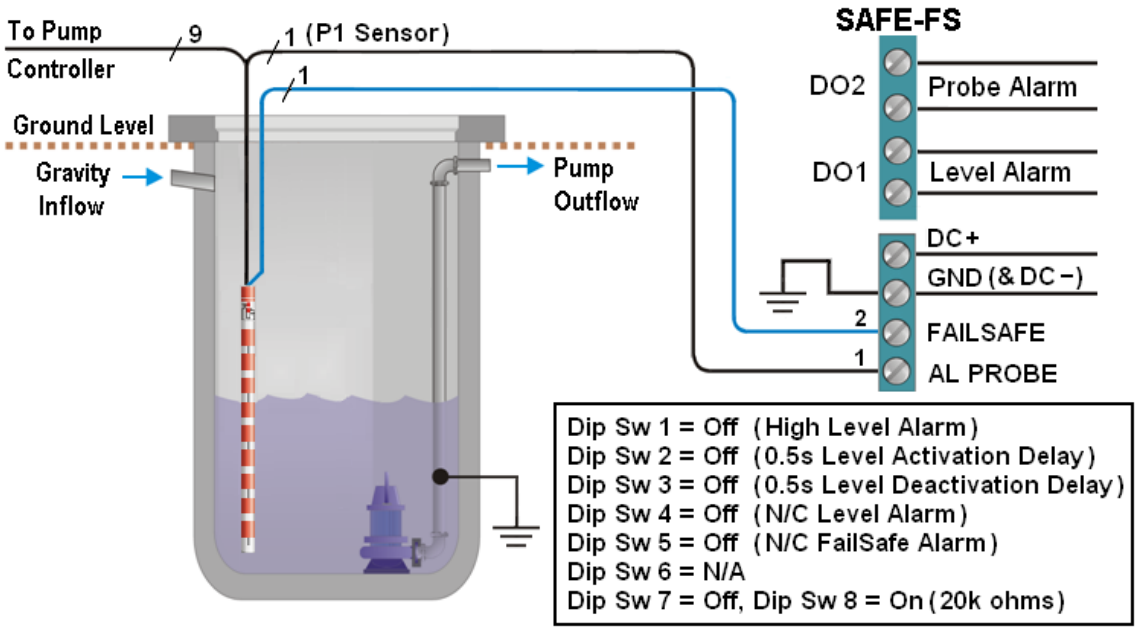


Figure 3 - High Level Alarm with 10 Sensor Probe

11.3 Example 3 – Low Level Alarm with Single Sensor Probe

A low level alarm is configured for a charge/fill application. The Level Alarm contacts activate when the liquid level falls just below the sensor.

A standard probe is used as there is little advantage in using a Failsafe probe as a low level sensor. While a Failsafe probe could be used to detect a connection failure to the sensor, in a charge/fill application the failure of the sensor would generate a low level alarm regardless due the nature of the probe. (Open circuit connection is equivalent to sensor uncovered).

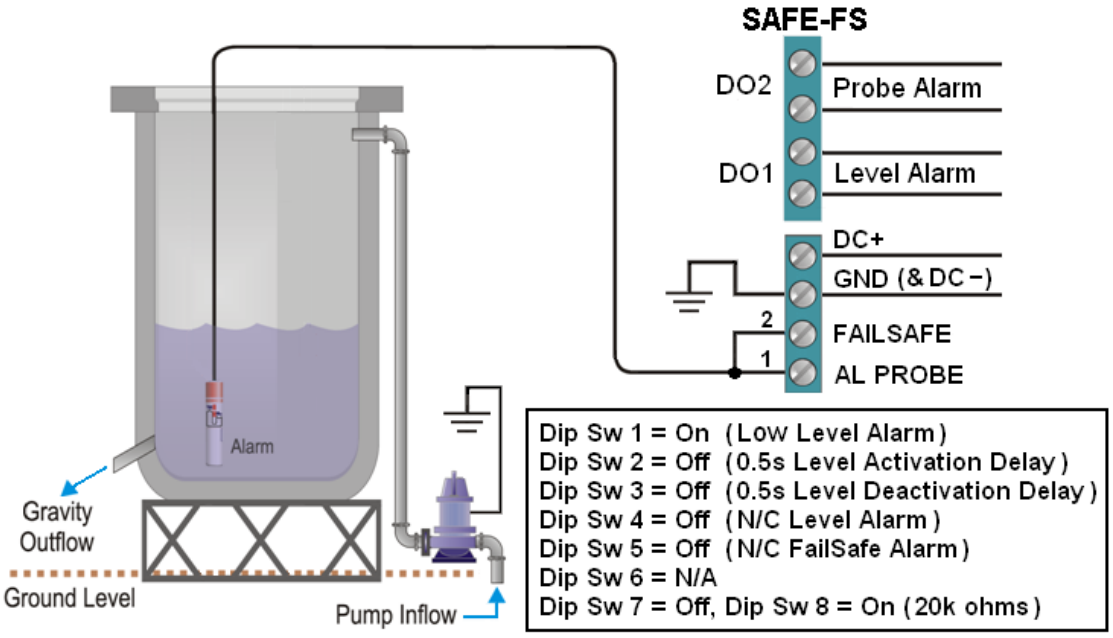


Figure 4 - Low Level Alarm with Single Sensor Probe

11.4 Example 4 – Wiring Diagram – High Level Alarm

General precautions

Electrical Hazard:

- A certified electrician must supervise all electrical work. Comply with all local codes and regulations.
- Before starting work on the unit, make sure that the unit is isolated from the power supply and cannot be energized.
- Make sure that all unused conductors are insulated.
- There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out or if there is fault or damage on the product.

WARNING:

Do not use this unit in environments that may contain flammable/explosive or chemically aggressive gases or powders.

Requirements

These general requirements apply for electrical installation:

- The mains voltage and frequency must agree with the specifications for the product.
- Circuit breakers must be installed between the main voltage line and this unit.
- All fuses and circuit breakers must have the proper rating, and comply with local regulations.
- The cables must be in accordance with the local rules and regulations.

Cables

These are the requirements to follow when you install cables:

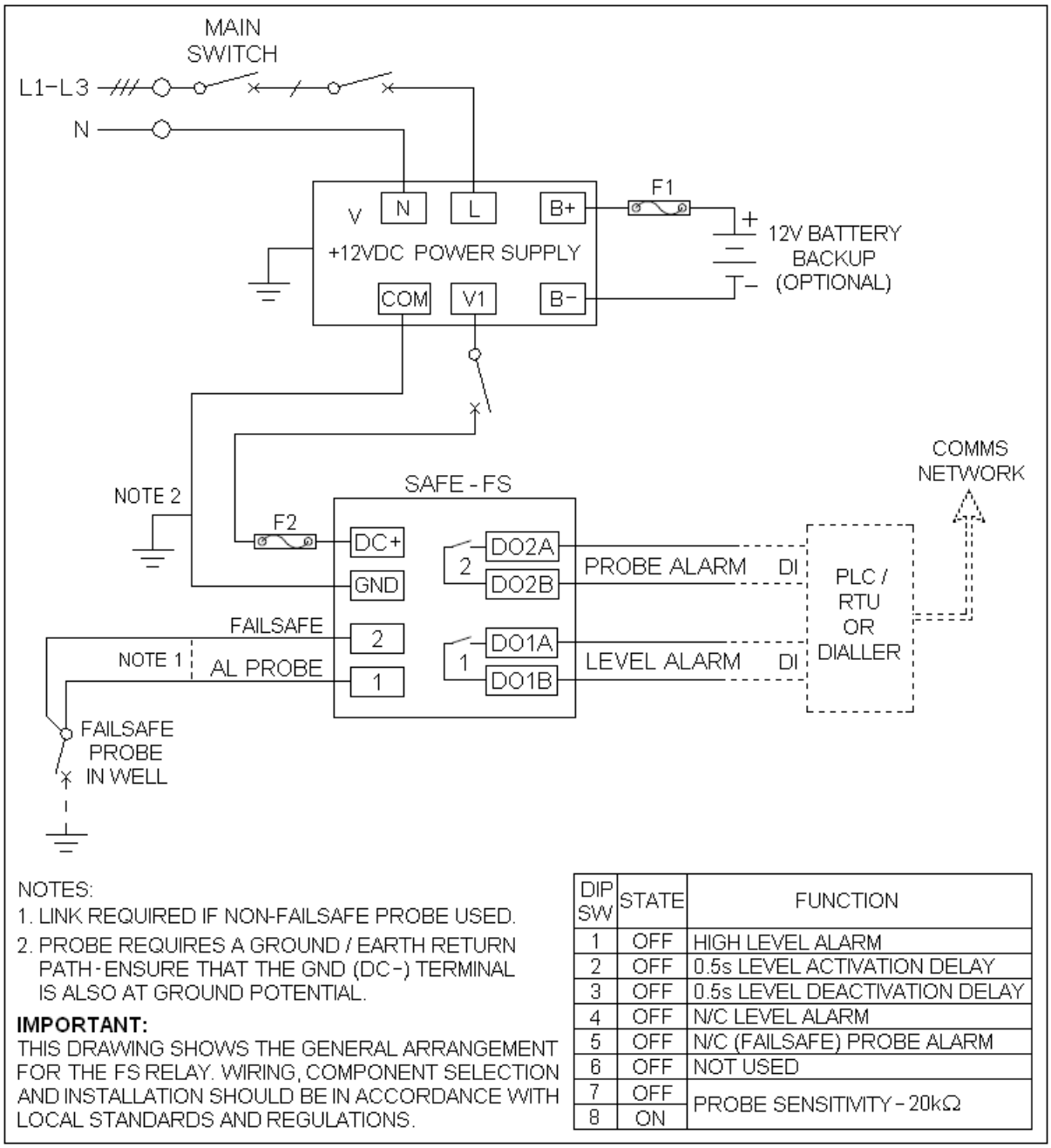
- The cables must be in good condition, not have any sharp bends, and not be pinched.
- The sheathing must not be damaged and must not have indentations or be embossed (with markings, etc.) at the cable entry.
- The minimum bending radius must not be below the accepted value.

Earthing (Grounding)

Electrical Hazard:

- You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.
- If the power cable is jerked loose by mistake, the earth (ground) conductor should be the last conductor to come loose from its terminal. Make sure that the earth (ground) conductor is longer than the phase conductors. This applies to both ends of the power cable.

The following wiring diagram illustrates the SAFE-FS configured for a high level alarm, with connections to a PLC / RTU or dialler (to transmit alarms via SMS).



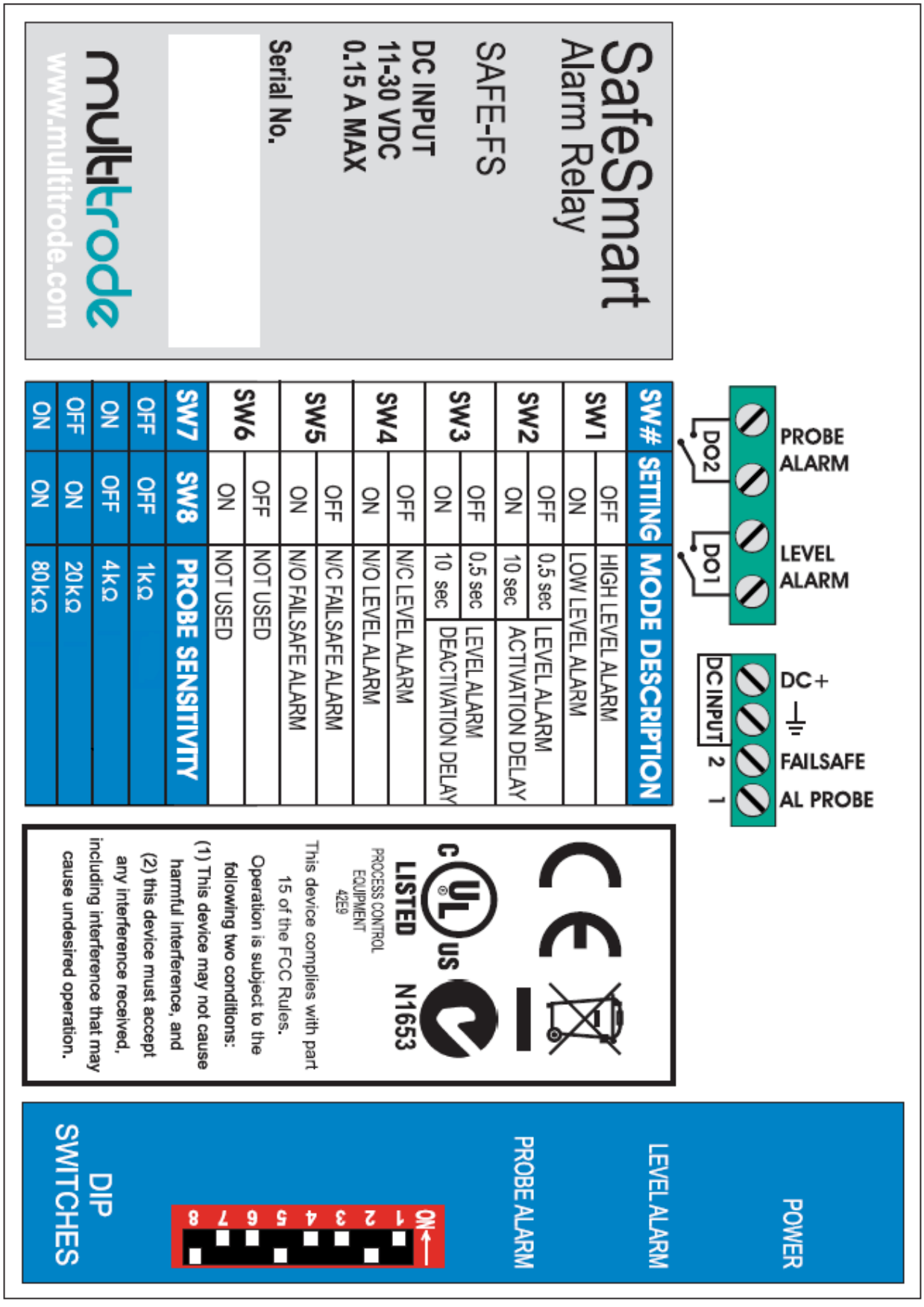
NOTES:
1. LINK REQUIRED IF NON-FAILSAFE PROBE USED.
2. PROBE REQUIRES A GROUND / EARTH RETURN PATH - ENSURE THAT THE GND (DC-) TERMINAL IS ALSO AT GROUND POTENTIAL.

IMPORTANT:
THIS DRAWING SHOWS THE GENERAL ARRANGEMENT FOR THE FS RELAY. WIRING, COMPONENT SELECTION AND INSTALLATION SHOULD BE IN ACCORDANCE WITH LOCAL STANDARDS AND REGULATIONS.

DIP SW	STATE	FUNCTION
1	OFF	HIGH LEVEL ALARM
2	OFF	0.5s LEVEL ACTIVATION DELAY
3	OFF	0.5s LEVEL DEACTIVATION DELAY
4	OFF	N/C LEVEL ALARM
5	OFF	N/C (FAILSAFE) PROBE ALARM
6	OFF	NOT USED
7	OFF	PROBE SENSITIVITY - 20kΩ
8	ON	

Figure 5 - Wiring Diagram for a High Level Alarm

Appendix A. SafeSmart SAFE-FS Level Alarm Relay Label



MultiTrode Pty Ltd—UK Operations
Ivybridge, Devon

Tel: +44 1752 547355
Fax: +44 1752 894615

E-mail:UKsales@multitrode.com

MultiTrode Pty Ltd—Head Office
Brisbane Technology Park
18 Brandl Street

PO Box 4633
Eight Mile Plains Qld 4113

Ph: +61 7 3340 7000
Fx: +61 7 3340 7077
E-mail: AUsales@multitrode.com

MultiTrode Inc—USA
Unit 3, 990 South Rogers Circle
Boca Raton Florida 33487

Tel: +1 561 994 8090
Fax: +1 561 994 6282

E-mail: USsales@multitrode.net

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