Model FL3112

Digital Frequency Infra-Red (DFIR)
Flame Detector

Instruction Manual 09/09

Part No. MANFL3112-EU
Revision H/09-09

Warranty Statement

General Monitors warrants the Model FL3112 to be free from defects in workmanship or material under normal use and service within two years from the date of shipment.

General Monitors will repair or replace without charge any equipment found to be defective during the warranty period. Full determination of the nature of, and responsibility for defective or damaged equipment will be made by General Monitors' personnel.

Defective or damaged equipment must be shipped prepaid to General Monitors' plant or representative from which shipment was made. In all cases this warranty is limited to the cost of the equipment supplied by General Monitors.

The customer will assume all liability for the misuse of this equipment by its employees or other personnel. All warranties are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without General Monitors' approval or which have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered.

Except for the express warranty stated above, General Monitors disclaims all warranties with regard to the products sold, including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of General Monitors for damages including, but not limited to, consequential damages arising out of/or in connection with the use or performance of the product.

Warnings

WARNING - Installation and Maintenance must be carried out by suitably skilled and competent personnel only.

E C Declaration of Conformity in accordance with EC & ATEX Directives

We at General Monitors Ireland Ltd., Ballybrit Business Park, Galway, Republic of Ireland, hereby declare that the equipment described below, both in its basic design and construction, and in the version or versions marketed by us, conforms to the relevant safety and health related requirements of the appropriate EC Directives, only as follows:

a) Conforms with the protection requirements of Council Directive 89/336/EEC, + Amd 92/31 EEC + Amd 92/68 EEC relating to Electromagnetic Compatibility, by the application of:

A Technical Construction File No. GM 99010 and Competent Body Report No. 4473/1P7, Issue 1

And

b) Conforms with the protection requirements of IEC 1010-1: 1990 + Amd 1:1992 +Amd 2: 1995 relating to safety by the application of:

A Technical Construction File No. GM 99010 and Competent Body Certificate No. 85EA1460A/5726 issued by:
ERA Technology Ltd. Cleeve Road, Leatherhead Surrey KT22 7SA, England. Tel: +44 1372 367000

This declaration shall cease to be valid if modifications are made to the equipment without our approval.

PRODUCT: FL3112 (DFIR) Flame Detector

It is ensured through internal measures and our ISO9001: 1994 certifications, that series production units conform at all times to the requirements of these current EC Directives and relevant standards.

General Monitors Ireland Ltd. in order to comply with ATEX, will provide this Instruction Manual in a European Language required to operate the product upon request. Should this be necessary, General Monitors Ireland Ltd. should be notified of this request to allow adequate time to process the request.

ATEX Certificate Markings.

DEMKO 00 ATEX 127595

CE 0518	Ex II 2 G
EExed IIC T5	EExed IIC T6
-40ºC to +75ºC	-40º C to +65ºC

Responsible Person: Date: 01-02-03

Denis Connolly
General Manager European Operations

The signatory acts on behalf of company management, and with full power of attorney

Table of Contents

1.0 Introduction

1.1 General Description

Fire is a phenomenon of combustion. Combustion is the continuous chemical reaction of a reducing agent (*fuel*) and an oxidizing agent (*oxygen, etc*.) with the evolution of thermal energy (*heat*). Fire is usually manifested in heat (*IR*), smoke, light (*visible*), and flame (*UV*). Flame is the gaseous region of a fire where vigorous combustion chain reactions take place. These reactions emit radiation covering the Infrared, Ultraviolet and the Visible Spectral Regions.

The General Monitors Model FL3112 is a Digital Frequency Infrared (DFIR) Flame Detector. The Model FL3112 detects the Infrared spectral regions of flame to produce a system which is highly immune to false alarms caused by lightning, arc-welding, hot objects, and other sources of radiation. In addition, the FL3112 can see through most smoky type fires such as diesel, rubber, etc.

The Model FL3112 features include:

- Compact unitized design.
- Continuous optical path monitoring.
- Wide field of view.
- High false alarm immunity.
- 0-20mA, Relays, Field Loop and Modbus RTU RS-485 serial communications output versions.

1.2 Principle of Operation

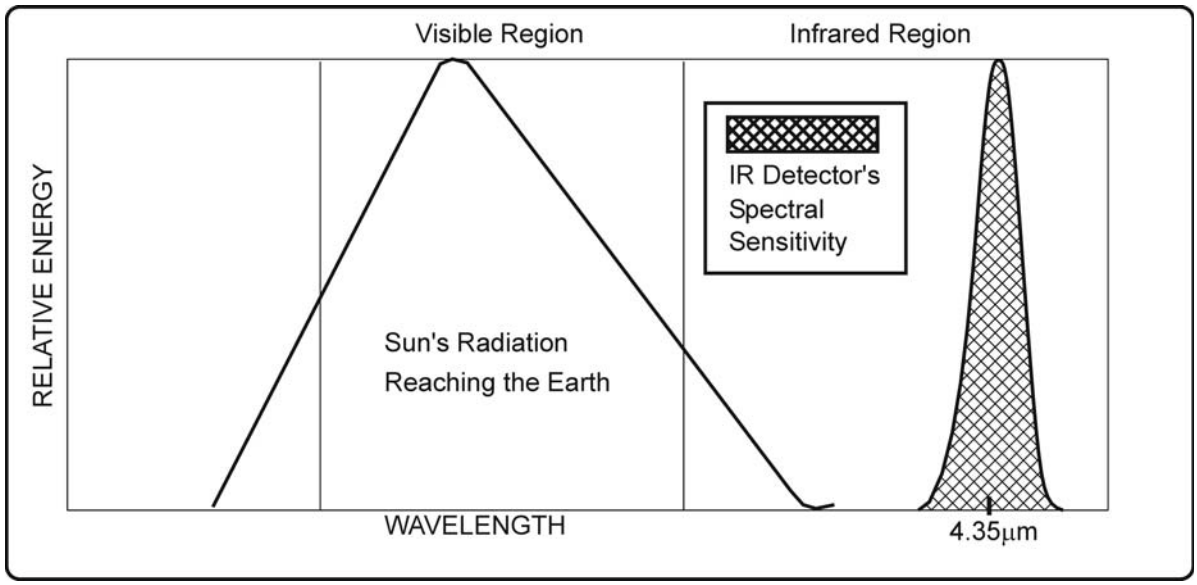
IR Flame Detector
The Model FL3112 is a discriminating Digital Frequency Infra-Red Detector which makes use of infrared detectors of different IR wavelengths and characteristics. This combination provides a flame detection system which is highly immune to false alarms.

Incorporated in the IR circuitry is a flicker discrimination circuit. This permits the detector to ignore steady state IR sources such as hot objects. The inherent flickering of a flame provides the necessary modulation to activate the IR circuit.

The Model FL3112 Flame Detector processes these IR signals with a microcomputer and, depending on the version, produces the following outputs:

- 0 to 20 milliampere signal.
- Immediate WARN relay contacts.
- Time delayed ALARM relay contacts.
- FAULT relay contacts.
- RS-485 MODBUS RTU serial communications ports.

(See Sections 2 & 3 for more information on detector outputs)



COPM Circuitry
A self-testing feature called Continuous Optical Path Monitoring (*COPM*) checks the optical path, the detector(s), and the related electronic circuitry once every minute. If foreign material impairs the optical path of the infrared detector for two consecutive checks, the unit will indicate FAULT. The optical FAULT outputs are, depending on the version, a 2.0 mA signal or de-energizing of the FAULT relay. The FAULT status is available via the RS-485 serial communications port. (*see Section 3-4 Terminal Connections*). After a COPM FAULT, a COPM check is performed every ten seconds until the obstruction is removed. Then the COPM check will resume checking once per minute.

WARNING – A dirty or partially blocked lens can significantly reduce the detector's field of view and detection distance.

NOTE: Since the optical path is checked once per minute and it requires two check failures to produce a FAULT, it may take up to two minutes for the unit to detect an obstruction.

Alarm Test

The Model FL3112 Flame Detector has a built-in Alarm Test feature. This test may be activated via the serial communications port (*see Section 3-4 Terminal Connections*).

The Flame Detector will immediately go into WARN and then into the time delayed ALARM. After two to ten seconds the Flame Detector will activate the ALARM. A latching WARN and/or ALARM will remain latched until reset.

Visual Indicators

Two light emitting diodes (*LEDs*) are visible through the window. LEDs are provided for a visual indication that corresponds with the detectors' outputs. The following blinking sequence indicates the operating condition:

- Timeout (2 minutes when the unit is first powered) – Green and red LEDs blinking alternately.
- Ready – Green LED that flashes off 1 second, every 5 seconds.
- WARNing – Slow blinking red LED.
- ALARM – Fast blinking red LED.
- COPM FAULT – Slow blinking green LED.
- Low Voltage FAULT – Fast blinking green LED.

2.0 Specifications

2.1 System Specifications

Certification:
EExed – IIC T5 -40ºC TO +75ºC
EExed – IIC T6 -40ºC TO +65ºC
IP66/67

IR Detector center wavelength: (*figure 1-B*)
4.35 microns

Typical Response Time*:
< 3 sec. @ 50 ft.

Minimum Response Time:
< 500 ms.

Field of Vision*: (*figure 3-A*)
120° maximum

Sensitivity:
50 feet (15.2m); Maximum distance for a 1 square foot (*.092m^2*) gasoline fire to be reliably detected.

Maximum Cable Parameters:
4-20mA Output Signal
9000 feet (2750 m), maximum 50 Ohms loop, with maximum 250 Ohms input impedance of readout unit.

Remote power supply
3000 feet (930 m), maximum 20 Ohms loop and 24 VDC minimum. (*See Section 3-4 Terminal Connections*)

Approvals:
ATEX & CE Mark

Warranty:
Two Years

*** NOTE:**

1. *Response Times and Field of View data have been derived by testing the Model FL3112 Flame Detector with a 1 square foot gasoline fire. One cup of unleaded gasoline on top of a one inch layer of water was ignited for each test. These are typical values and different results may occur depending on the variation of each fire.*

2. *To meet the directional dependence requirements of EN 54-10 the horizontal viewing angle must not exceed ±30°.*

2.2 Mechanical Specifications

Enclosure material

Material:	Bronze AB2 or Stainless Steel
Colour:	Natural

Dimensions:

Diameter	3.3 in (8.4 cm)
Length	5.4 in (13.7 cm)
Weight	5 lbs (2.3 kg)

Cable Entries: 2 x M20 or 2 x PG13.5

2.3 Electrical Specifications

Supply voltage range:	20 to 36 VDC
Nominal supply voltage:	24VDC
Maximum supply current:	150mA

Maximum output signal
Load @ 24 VDC: 600 Ohms

Output signal range:	0 to 20mA
FAULT signal:	0 to 0.2mA
COPM fault signal:	2.0mA ± 0.2 mA
Ready signal:	4.0 ± 0.2 mA
WARN signal:	16.0 ± 0.2 mA
ALARM signal:	20.0 ± 0.2 mA

Relay Contact Ratings:
1A MAX @ 30VRMS/42.2 VPK,
Resistive.

RS-485 Serial Communications Port:
Modbus RTU Protocol
128 units MAX. (247 units with repeaters)
Baud Rate: 2400, 4800, 9600 or 19200

RFI/EMI Protection
Complies with EN50081-2, EN50082-2

Status Indicator:
Two LED's indicate status, fault conditions.

2.4 Environmental Specifications

Operating temperature range: -40°F to 176°F	-40°C to 75°C
Storage temperature range: -40°F to 176°F	-40°C to 75°C
Humidity range: non-condensing	0 to 100% RH

2.5 Modbus RTU Protocol

For detailed information on data format, read commands, write commands, register details, register locations, refer to the Serial Communications section in this manual.

3.0 Installation

WARNING - Installation and Maintenance must be carried out by suitably skilled and competent personnel only.

3.1 Upon Receipt of Your Equipment

All items shipped by General Monitors are packed in shock absorbing containers which affords a considerable degree of protection against physical damage. When received, the contents should be carefully removed and checked against the enclosed packing slip. All subsequent correspondence with General Monitors must specify the equipment part number and serial number.

3.2 Choosing Detector Locations

Several variables are involved in selecting the locations to install detectors to ensure proper flame detection. There are no hard and fast rules defining the optimum location. There are some general suggestions that should be considered in regard to particular conditions at the site where the unit(s) are being installed:

Detector Field of View
Each Model FL3112 Flame Detector has a 120° maximum Cone of Vision. (*This Cone has its vertex at the center of the detector, see figure 3-A).*

Optical Sensitivity Range
The distance at which the detector will respond to a flame is a function of the intensity of that flame. The maximum distance is 50 feet (15.2m) for a gasoline fire with a surface area of 1 square foot (0.92m^2).

1. Environmental Factors

2. Mounting should be as free from shock and vibration as possible and convenient for visual inspection and cleaning.

3. Detectors mounted in dirty atmospheric conditions will require more frequent inspection, cleaning, and sensitivity checking.

4. Observe the ambient temperature range for the specific model (*see section 2-4 Environmental Specifications*). For outdoor installations or other areas exposed to intense, direct solar radiation, the detector may reach temperatures well above specifications. For this condition, a cover for shade may be required to bring the detector temperature within specifications. As with any cover or object near by, make sure the field-of-view of the detector is not obstructed.

5. Avoid conditions of ice build up on the optical detector windows. Complete icing over of the IR detector window can result in fault conditions.

3.3 Detector Installation

The Model FL3112 Detector should be mounted pointing downward so that dust/moisture will not accumulate on the IR window. The detector(s) should be mounted in locations which will inhibit people or objects from obscuring the detector's Cone of Vision.

Cable glands and stopping plugs should be installed with the o-rings supplied with the FL3112. It is recommended to fit boots over cable glands to prevent water ingress at the cable-to-gland junction.

Mounting hardware should be used as shown in figure 3-B. The overall dimensions of the detector and mounting hardware is also shown.

3.4 Interconnecting cable Guidelines

- The FL3112 requires an interconnecting cable with an overall screen (shield) and armour. Cables to BS5308 Part 2, Type 2 or equivalent are suitable.

- Interconnecting cables should be segregated from power and other "noisy" cables. Avoid proximity to cables associated with radio transmitters, welders, switched mode power supplies, inverters, battery chargers, ignition systems, generators, switch gear, arc lights and other high frequency or high power switching process equipment. In general, maintain a separation of at least 1m between instrument and other cables. Greater separation is required where long parallel cable runs are unavoidable. Avoid running instrument cable trenches close to lightning conductors earthing pits.

- Complete all cable insulation tests before connecting the cable at either end.

- General Monitors do not recommend the use of cable shoes or crimps on any junction box or housing wiring terminals. Poor crimping can cause bad connection when unit experiences temperature variations. We therefore recommend good practice is to just terminate cable.

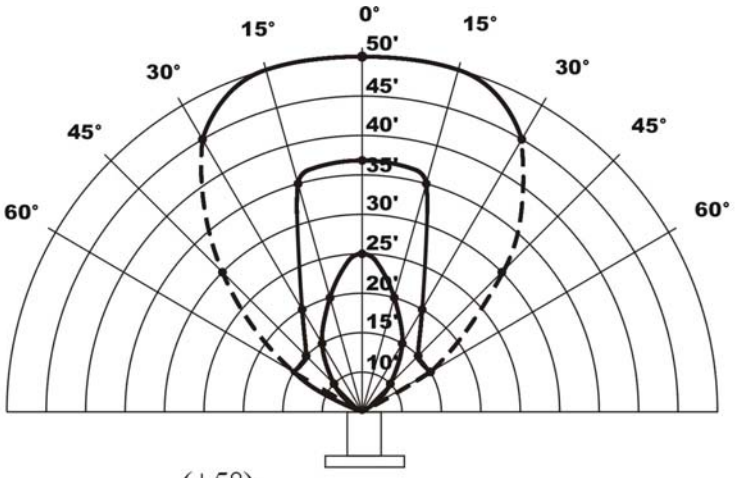
3.5 Installation Instructions

3.5.1 FL3112 Cable Termination

- The FL3112 should be installed in accordance with the certification documents and the relevant regulations of the country concerned.
- Ensure that approved Exe cable glands are used and installed according to the manufacturer's instructions.
- The cable armour must be terminated in the gland to ensure a positive electrical connection.
- The cable screens (drain wires) must not be connected electrically to the electronic circuitry of the FL3112.
- Connect Safety Earth to the chassis grounding screw available on the rear exterior of the base assembly. This Safety Earth wire should have a wire gauge of at least 22 AWG (0.33mm^2) and be no longer than 3 meters in length.

3.5.2 Cable Termination in Safe Area

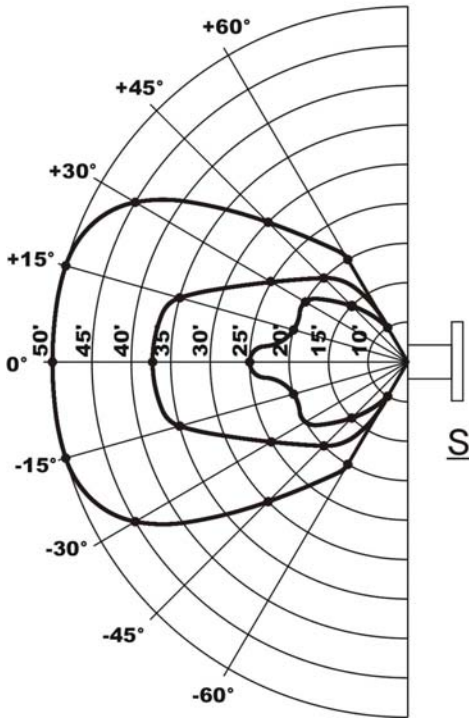
- The cable armour must be connected to Safety Earth.
- The cable screens (drain wire) and power supply return (OV) must be connected to Instrument Earth.
- The power supply or power distribution system employed should meet the requirements of EN50081- 1/2 and EN60101-1.



(±5°)
HORIZONTAL
SENSITIVITY

100%
75%
50%

TABLE CHART			
HORIZONTAL	100%	75%	50%
0°	50"	37.5"	25"
±15°	50"	35"	20"
±30°	45"	20"	15"
±45°	30"	15"	10"
±60°	15"	15"	5"

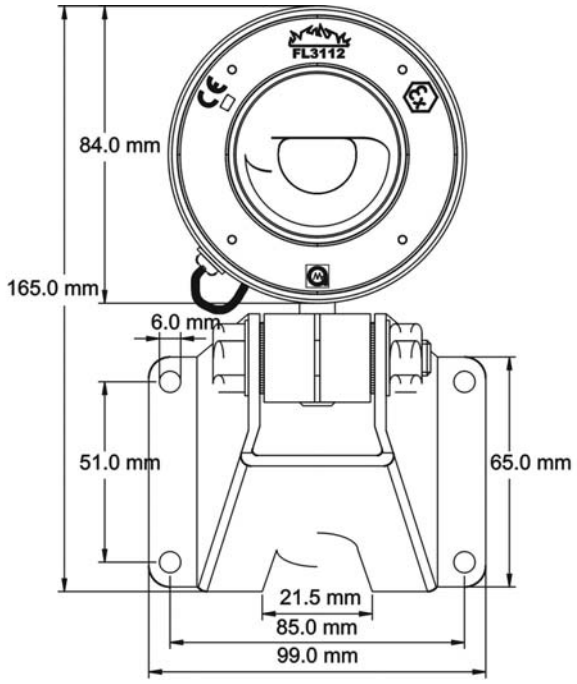


(±5°)
VERTICAL
SENSITIVITY

100%
75%
50%

TABLE CHART			
VERTICAL	100%	75%	50%
0°	50"	37.5"	25"
±15°	50"	35"	20"
±30°	45"	25"	20"
±45°	30"	20"	15"
±60°	20"	10"	10"

Figure 3-A FL3112 Field of View



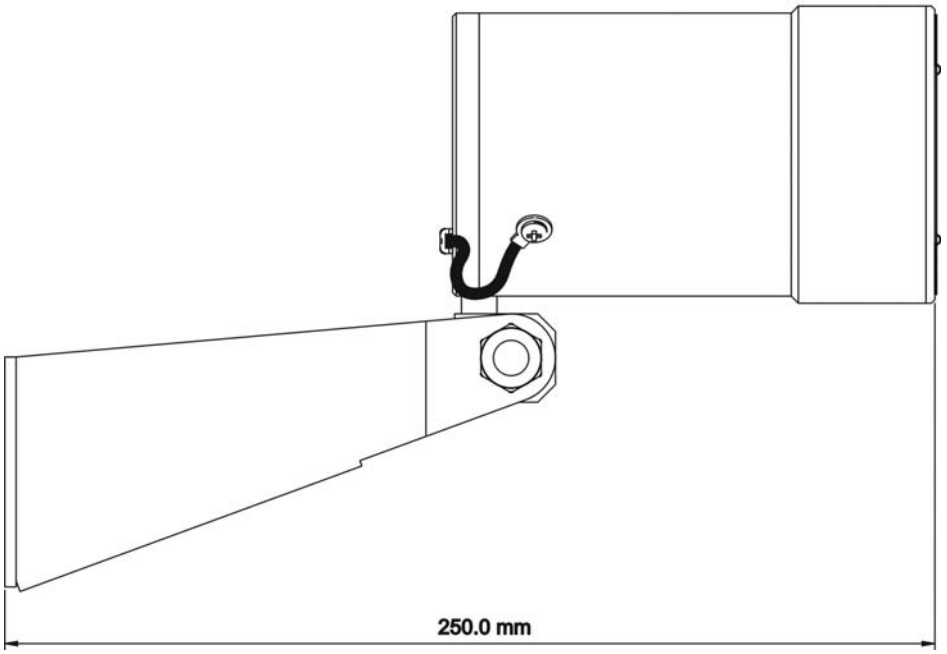


Figure 3-B Outline Drawing

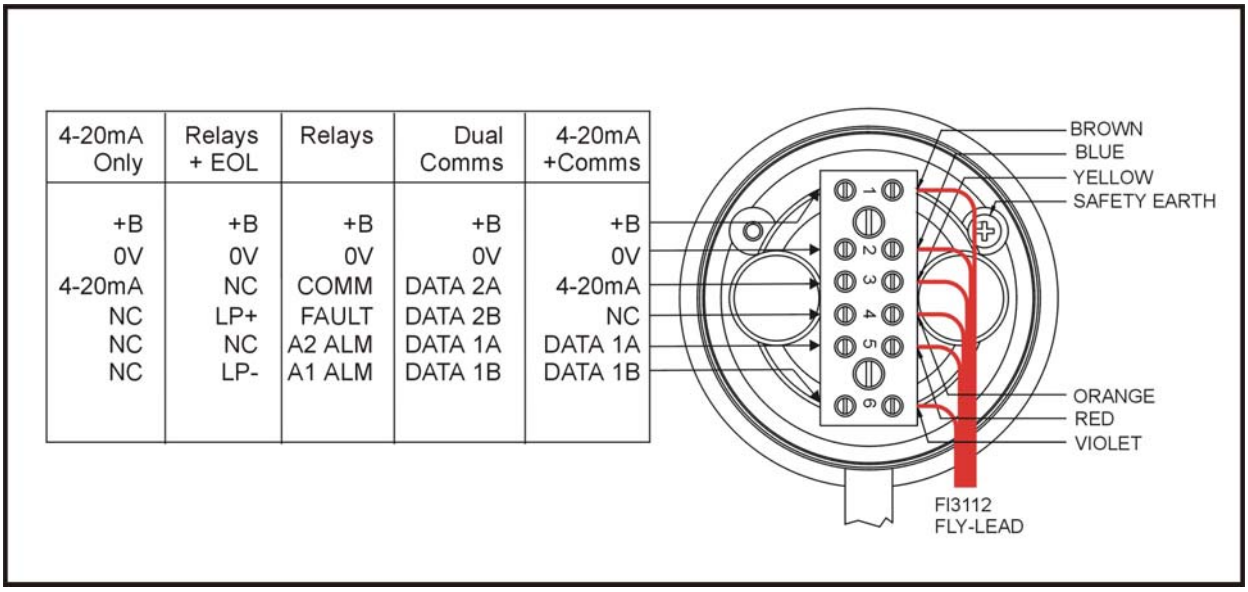


Figure 3-C Base Assembly with Terminal Block

3.6 Terminal Connections

The Terminal Block is located on the Base Assembly (*See figure 3-C*) and accepts 12 AWG (3.31 mm^2) to 22 AWG (0.33 mm^2) stranded or solid core wire. Each wire should be stripped as shown in figure 3-D.

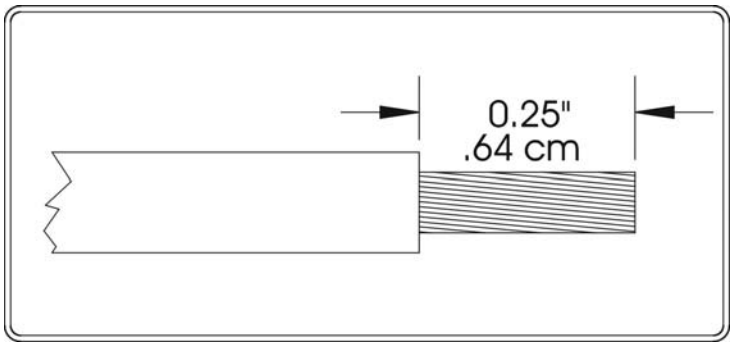


Figure 3-D Strip Length

Four of the six positions on the terminal block have functions which depend on the FL3112 version selected. The remaining two positions are reserved for the power connections. Figure 3-C outlines the terminal block connections by version.

On this and the following pages is a description and specification for each of the signals shown in figure 3-C.

POWER INPUTS
+B and 0V

These are the power connections. The supply voltage range is 20 to 36 VDC at the detector (*low voltage is detected at 18.5 VDC*). The following maximum cable lengths apply for a +24VDC supply (*maximum 20 ohm loop*):

AWG	mm^2	FEET	METRES
14 AWG	2.08	4500	1370
16 AWG	1.31	2340	715
18 AWG	0.82	1540	470
20 AWG	0.52	970	300
22 AWG	0.33	670	205

ANALOGUE OUTPUT
4 – 20mA

The 4 to 20mA output is a current signal that corresponds to the following specification:

FAULT signal:	0 to 0.2mA
COPM Fault signal:	2.0 ± 0.2mA
Ready signal:	4.0 ± 0.2mA
WARN signal:	16.0 ± 0.2mA
ALARM signal:	20.0 ± 0.2mA
Output Load Max.:	600 ohms

For interfacing with 250 ohm input impedance devices, the following maximum cable lengths apply (*maximum 50 ohm loop*):

AWG	mm^2	FEET	METRES
14 AWG	2.08	9000	2750
16 AWG	1.31	5800	1770
18 AWG	0.82	3800	1160
20 AWG	0.52	2400	730
22 AWG	0.33	1700	520

COMMUNICATIONS OUTPUTS
DATA 1A
DATA 1B
DATA 2A
DATA 2B

These are the connections for the RS-485 serial communications ports 1 & 2. The RS-485 connection is used to either query the unit's status or to configure the unit. See Section 7 for detailed information on Modbus RTU protocol.

RELAY OUTPUT (Figure 3-E)
A1 ALM
Description: This connection is the WARN relay contact. The WARN output is immediate on the Model FL3112. The WARN output can be normally energized or normally de-energized, latching or non-latching.
WARN relay contact rating is 1A @ 30VRMS/42.2VPK Resistive.

A2 ALM
Description: This connection is the ALARM relay contact. The ALARM output is time delayed for 10, 2, 4 or 8 seconds. The ALARM output can be normally energized or normally de-energized, latching or non-latching.
ALARM relay contact rating is 1A @ 30VRMS/42.2VPK Resistive.

FAULT
Description: This connection is the FAULT relay contact. The FAULT output configuration is normally energized and non-latching. This is the standard output configuration and it cannot be changed. The FAULT circuit will be activated during the time-out function, a low power or loss of power condition, and during a failed COPM check. During these conditions the FAULT relay will de-energize and the analogue output signal will drop to 0 mA (2mA for COPM Faults) for the duration of the FAULT.
FAULT relay contact rating is 1A @ 30VRMS/42.2VPK Resistive.

COMM
Description: This is the common connection of the WARN, ALARM and FAULT relay contacts.

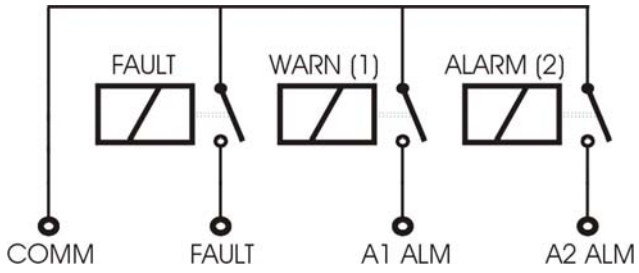


Figure 3-E Relay Outputs

FIELD LOOP OUTPUTS (Figure 3 – F)
LP+ and LP-
Description: These are the field loop connections to a fire card such as General Monitors' IN042.
The FAULT relay, when energized, inserts a 5600ohms, 2Watt End-Of-Line resistor across these connections.
The ALARM relay, when energized, inserts a 560ohms, 2Watt resistor across the End-Of-Line resistor. The WARN relay has no effect.
For a description of relay functionality refer to the section RELAY OUTPUTS above.

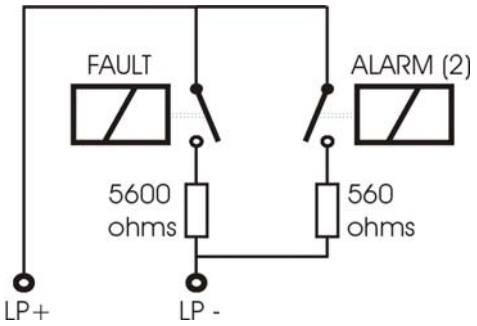


Figure 3-F Field Loop Outputs

RESET
All versions of the FL3112 may be reset by interrupting the power supply for a minimum of two seconds. Versions with serial communications can also be reset by using the Remote Reset command. Refer to section 7 for details.

SAFETY EARTH
This connects the FL3112 enclosure to Safety Earth. An alternative connection is available on the rear exterior of the base assembly. The Safety Earth wire should have a wire gauge of at least 22 AWG (0.33mm^2) and be no longer than 3 meters in length.

WARNING:	**Under no condition should the retaining strap screws be used for Safety Earth purposes**

3.7 User Selectable Options

All user selectable option settings on the Model FL3112 are held in EEPROM. It is recommended the option settings be specified when ordering the FL3112.

Versions with serial communications capabilities can be (re)programmed via the communications port(s). Refer to section 7 for details. Other versions can be (re)programmed with the Program Card accessory if necessary.

PROGRAM CARD ACCESSORY
The Program Card is a small module with a DIP switch which can be read by the FL3112 microprocessor.
DIP switch positions 5 to 8 select the options being programmed, such as Sensitivity and Alarm-time-delay, Relay or Return to Factory Default settings. DIP switch positions 1 to 4 determine the actual parameter settings. Refer to the following tables for details:

SENSITIVITY and ALARM-TIME-DELAY Options

	Sensitivity (%)			Alarm-time-delay (sec)			
DIP	**100**	**75**	**50**	**10**	**2**	**4**	**8**
1				OFF	OFF	ON	ON
2				OFF	ON	OFF	ON
3	OFF	OFF	ON				
4	OFF	ON	OFF				
5	OFF	OFF	OFF	OFF	OFF	OFF	OFF
6	OFF	OFF	OFF	OFF	OFF	OFF	OFF
7	ON	ON	ON	ON	ON	ON	ON
8	ON	ON	ON	ON	ON	ON	ON

WARN and ALARM Relay Options

	WARN (1) Relay				ALARM (2) Relay			
DIP	**LA**	**NL**	**EN**	**DE**	**LA**	**NL**	**EN**	**DE**
1	ON	OFF						
2			ON	OFF				
3					ON	OFF		
4							ON	OFF
5	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
6	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
7	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
8	ON	ON	ON	ON	ON	ON	ON	ON

LA = Latching **NL** = Non Latching
EN = Energized **DE** = De-Energized

The above options have been represented pictorially on the label attached to the Program Card

Return to FACTORY DEFAULT settings

DIP	**Default**
5	ON
6	ON
7	OFF
8	ON

DIP switch positions 1 to 4 are not relevant here

WARNING: During the following steps proper anti-static procedures must be observed. Failure to do so may permanently damage the FL3112 electronic circuits and void the warranty.

To (re)program, remove the detector from the Base Assembly, disconnect the fly-lead and disconnect the retainer strap at the rear of the Base only.

1. Refer to figure 3-G and remove the five screws securing the front cap assembly to the FL3112 enclosure.
2. Remove the front cap assembly.
3. Disconnect the fly-lead connector from the power supply board.
4. Insert the Program Card with the required DIP switch settings into connector J3 on the microprocessor board.

5. Apply +24VDC to connector J3 pins 1 and 2, as shown in the figure, for a minimum of five seconds. This step allows the FL3112 to read the DIP switch settings on the Program Card.

6. Disconnect the +24VDC power supply.

If more programming is required, adjust the DIP switch settings and re-apply +24VDC for a minimum of five seconds. Steps 4 to 6 may be repeated as required.
When programming is completed, remove the +24VDC power supply and the Program Card.

7. Inspect the o-ring on the front cap assembly for damage and the flame path surfaces for contamination. If necessary replace or clean and re-apply a suitable grease to the o-ring and flame path surfaces.

8. Re-connect the fly-lead connector to the power supply board. Insert the front cap assembly into the FL3112 enclosure, ensuring the o-ring does not snag and secure with the five screws.

Inspect the o-ring on the Base assembly for damage and the corresponding surfaces for contamination. If necessary clean or replace and re-apply a suitable grease to the o-ring and corresponding surfaces.

Re-connect the retainer strap at the rear of the Base assembly and re-connect the fly-leads as shown in figure 3-C. Mount the detector on the Base assembly ensuring the o-ring does not snag.

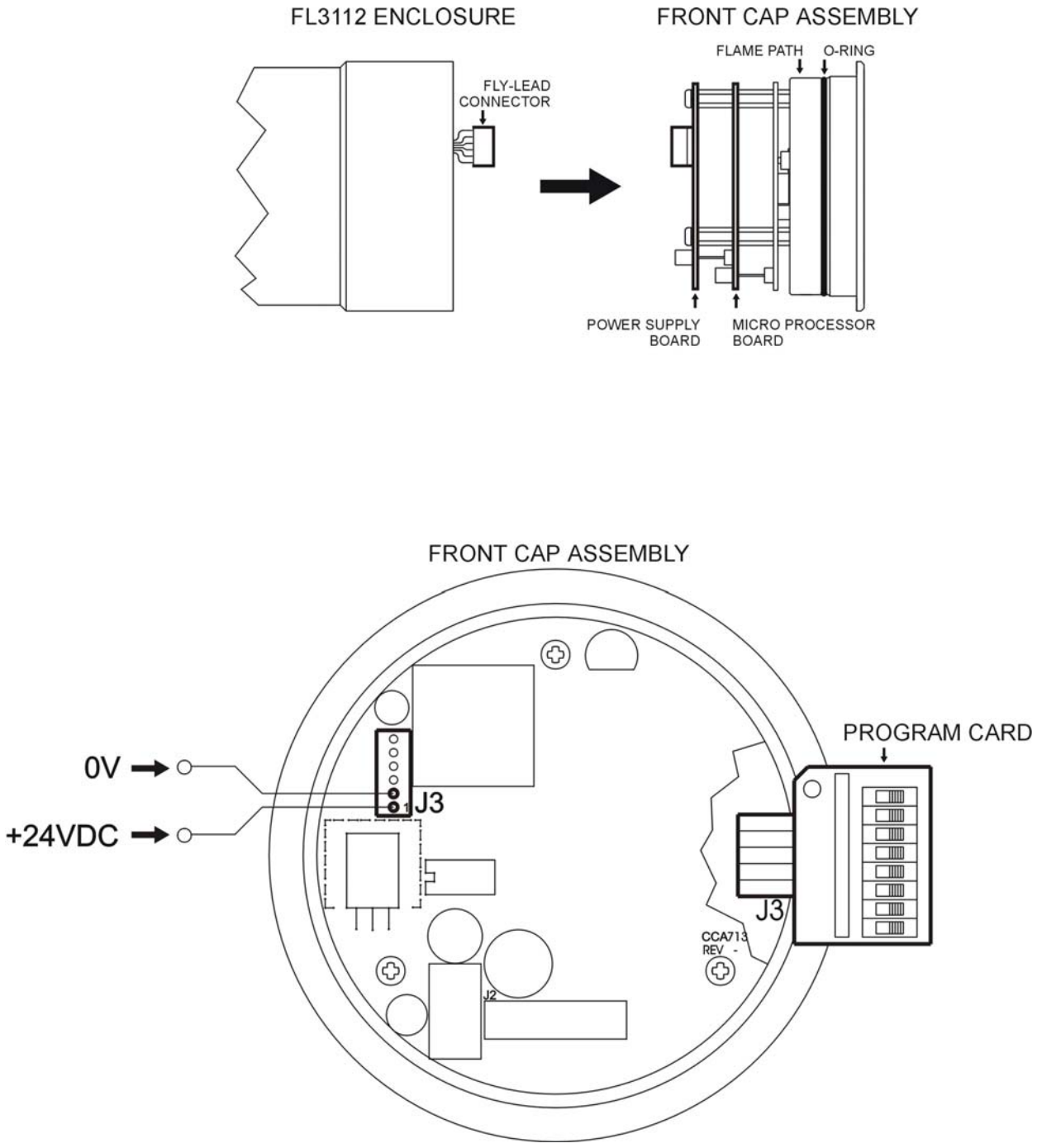
3.8 Factory Default Settings

Return to Factory Default settings only affects FL3112 versions with serial communications capabilities. It provides a mechanism to restore the communications parameters, should they be unknown or corrupted. The Factory Default settings are:

Parameter	**Setting**
Address	1 (Decimal)
Baud Rate	19200
Data Format	8-N-1

Refer to section 7 for details

Figure 3-G Front Cap Assembly



4.0 Maintenance

WARNING – Installation and Maintenance must be carried out by suitably skilled and competent personnel only.

4.1 General Maintenance

Once correctly installed, the unit requires very little maintenance other than regular sensitivity checks and cleaning of the lens and reflector. General Monitors recommends that a schedule be established and adhered to.

Warning: Disconnect or inhibit external devices, such as automatic extinguishing or fire suppression systems before performing any maintenance.

4.2 Cleaning the Lens

A clean, soft, lint-free cloth, tissue or cotton swab should be used to apply the cleaning solution. Do not touch the lens with fingers.

a) Wet the lens with the solution.

b) Rub with a dry, unsoiled cloth until clean.

c) Completely dry the lens.

d) Repeat steps a, b and c for the reflector.

NOTE: The removal of particulate matter and any film build-up on the lens and reflector is necessary to ensure proper sensitivity of the system. It is recommended that the lens and reflector be cleaned at least every 30 days or more often if the detector is located in a particularly dirty environment.

Warning: A dirty or partially blocked lens can significantly reduce the detector's field of view and detection distance

DO NOT USE A COMMERCIAL GLASS CLEANER OTHER THAN "INDUSTRIAL STRENGTH WINDEX® with Ammonia D":
The lens material is sapphire. The cleaning solution should be General Monitors' P/N 10272-1 (Industrial Strength Windex® with Ammonia D).

4.3 Sensitivity Check

To verify that each detector is functioning correctly, a General Monitors' Test Lamp and/or the ALARM TEST function (*see section 1-2 Principle of Operation – Alarm Test*) should be used. See Section 6, Spares & Accessories for details on test lamps.

4.4 Storage

These Flame Detectors should be stored in a clean, dry area and within the temperature and humidity ranges quoted in Section 2-4 Environmental Specifications.

5.0 Trouble Shooting

WARNING - Installation and Maintenance must be carried out by suitably skilled and competent personnel only.

5.1 Trouble Shooting Chart

This section is intended to be a guide in correcting problems which may arise in the field. This section is not all-inclusive, and General Monitors should be contacted for assistance if the corrective actions listed do not eliminate the problem. If equipment or qualified personnel required for various tests are not available it is recommended that the defective unit be returned to General Monitors for repair.

A complete written description of the problem should be included. Be sure to inhibit or disconnect external alarm wiring before making any checks which might send the unit into alarm, if an alarm condition will create problems.

NOTE: If the equipment is under warranty, any repairs performed by persons other than General Monitors' authorized personnel may void the warranty. Please read the warranty statement carefully.

Problem	Possible Cause	Corrective action
• No output signal and green LED is off	• No DC power to the unit	• Ensure +24VDC is applied and with correct polarity
• No output signal and green LED is blinking rapidly	• Low voltage FAULT (18.5VDC approx. at unit)	• Ensure voltage at unit is at least 20VDC under load
• No output signal and green LED is blinking slowly	• COPM FAULT, dirty or obscured optical path	• Clean lens and reflector

6.0 Spares & Accessories

6.1 Spare Parts

When ordering Spare Parts and/or Accessories please contact your nearest General Monitors' Representative or General Monitors directly and give the following information.

DESCRIPTION	PART NR
Instruction Manual	MANFL3112
IR Detector, CO_2	71064-1
IR Detector, Sun	71064-2
Lamp, IR Source	70596-2
Program Card	71336-1
High Vacuum Grease, 150g Tube	916-078
Test Lamp:	TL105-3-2
Window Cleaning Solution	10272-1

6.2 Test Lamps

TL103 UV/IR Test Lamp

Due to the advanced discrimination in the Model FL3112, the Model TL103 Test Lamp was developed. The General Monitors' TL103 Test Lamp is a battery operated, rechargeable, test source specifically designed to test General Monitors' IR Flame Detection Systems. It consists of a high-energy broad band radiation source which emits sufficient energy in the infrared spectra to activate the IR detector. To simulate a fire, the test lamp automatically flashes at one of three DIP switch selectable rates. The Model TL103, rated explosion proof, is CSA certified for use in Class 1, Division 1, Groups C and D areas. The test lamp operates on internal lead-acid batteries which, when fully charged, will operate continuously for 25 to 30 minutes. An internal circuit will prevent operation when the batteries are low.

Operating Instructions: It is always important to start a series of TL103 checks with a fully charged unit. Stand within 10 feet of the unit to be tested and aim the TL103 squarely into the detector face. If the system is operating normally, the detector will go into a WARNing condition after a few flashes of the Test Lamp. If the lamp remains ON for the time-delayed period of the DIP switch setting, the detector will go into ALARM. To conserve charge, do not operate the Test Lamp longer than is necessary to test each detector. When the battery level drops below the level required to maintain the proper intensity of the lamp, an internal low voltage circuit will shut the lamp off until the batteries have been recharged.

Recharging Instructions: Insert the charging plug into the receptacle. Complete recharging takes a minimum of fourteen hours.

IMPORTANT*: Replace the knurled plug after charging is complete.* Charging must be carried out in a non-hazardous area. The charging receptacle is located inside the housing adjacent to the ON button. To gain access, it is necessary to unscrew the knurled plug from the body of the unit. The plug is secured to the ON button by a safety strap to keep it from being lost. It is recommended that the TL103 be kept on charge when not in use to prevent excessive battery discharge. The batteries may be charged an average of 500 times and the battery pack is replaceable.

TL105 UV/IR Test Lamp

Please refer to the TL105 Test Lamp manual for operating instructions

7.0 Modbus Serial Communications

7.1 Baud Rate

The Baud Rate is a selectable setting via the Modbus Communications Interface. The selectable baud rates are 19200, 9600, 4800 or 2400 bits per second.

7.2 Data Format

The Data Format is a selectable setting via the Modbus Communications Interface. The selectable data formats are as follows:

Data Bits	Parity	Stop Bit	Format
8	None	1	8-N-1
8	Even	1	8-E-1
8	Odd	1	8-O-1
8	None	2	8-N-2

7.3 Modbus Read Status Protocol (Query/Response)

7.3.1 Modbus Read Query Message

Byte	Modbus	Range	Referenced to FL3112
1st	Slave	1-247* (Decimal)	FL3112 ID (Address)
2nd	Function Code	03	Read Holding Registers
3rd	Register Address Hi**	00	Not Used by FL3112
4th	Register Address Lo**	00-FF (Hex)	FL3112 Command Registers
5th	No. of Registers Hi	00	Not Used by FL3112
6th	No. of Registers Lo	01	No. of 16 Bit Registers
7th	CRC Lo	00-FF (Hex)	CRC Lo Byte
8th	CRC Hi	00-FF (Hex)	CRC Hi Byte

* Note: Address 0 is reserved for broadcast mode and will not be supported at this time.
** Note: Register Address can be a maximum of 9999 Address Locations (0000-270E)

7.3.2 Modbus Read Response Message

Byte	Modbus	Range	Referenced to FL3112
1st	Slave Address	1-247* (Decimal)	FL3112 ID (Address)
2nd	Function Code	03	Read Holding Registers
3rd	Byte Count	02	No. of Data Bytes
4th	Data Hi00-FF (Hex)	FL3112 Hi Byte Status Data	
5th	Data Lo	00-FF (Hex)	FL3112 Lo Byte Status Data
6th	CRC Lo	00-FF (Hex)	CRC Lo Byte
7th	CRC Hi	00-FF (Hex)	CRC Hi Byte

* Note: Address 0 is reserved for broadcast mode and will not be supported at this time

7.4 Modbus Write Command Protocol (Query/Response)

7.4.1 Modbus Write Query Message

Byte	Modbus	Range	Referenced to FL3112
1st	Slave Address	1-247* (Decimal)	FL3112 ID (Address)
2nd	Function Code	06	Preset Single Register
3rd	Register Address Hi**	00	Not used by FL3112
4th	Register Address Lo**	00-FF (Hex)	FL3112 Command Registers
5th	Preset Data Hi	00-FF (Hex)	FL3112 Hi Byte Command Data
6th	Preset Data Lo	00-FF (Hex)	FL3112 Lo Byte Command Data
7th	CRC Lo	00-FF (Hex)	CRC Lo Byte
8th	CRC Hi	00-FF (Hex)	CRC Hi Byte

* Note: Address 0 is reserved for broadcast mode and will not be supported at this time.
** Note: Register Address can be a maximum of 9999 Address Locations (0000-270E)

7.4.2 Modbus Write Response Message

Byte	Modbus	Range	Referenced to FL3112
1st	Slave Address	1-247* (Decimal)	FL3112 ID (Address)
2nd	Function Code	06	Preset Single Register
3rd	Register Address Hi**	00	Not used by FL3112
4th	Register Address Lo**	00-FF (Hex)	FL3112 Command Register
5th	Preset Data Hi	00-FF (Hex)	FL3112 Hi Byte Command Data
6th	Preset Data Lo	00-FF (Hex)	FL3112 Lo Byte Command Data
7th	CRC Lo	00-FF (Hex)	CRC Lo Byte
8th	CRC Hi	00-FF (Hex)	CRC Hi Byte

* Note: Address 0 is reserved for broadcast mode and will not be supported at this time.
** Note: Register Address can be a maximum of 9999 Address Locations (0000-270E)

7.4.3 Function Codes Supported

Function Code 03 (Read Holding Registers) will be used to read status from the slave unit. Function Code 06 (Preset Single Register) will be used to write a command to the slave unit.

7.5 Exception Responses and Exception Codes

In a normal exchange, the master device sends a query to the FL3112. The FL3112 receives the query and returns a normal response to the master. If a communications error occurs, the FL3112 will return an exception response.

7.5.1 Exception Responses

Byte	Modbus	Range	Referenced to FL3112
1st	Slave Address	1-247* (Decimal)	FL3112 ID (Address)
2nd	Function Code	83 or 86 (Hex)	MSB is set with Function Code
3rd	Exception Code	01 – 06 (Hex) (See below)	Appropriate Exception Code
4th	CRC Lo	00-FF (Hex)	CRC Lo Byte
5th	CRC Hi	00-FF (Hex)	CRC Hi Byte

Function Code Field: In a normal response, the FL3112 echoes the function code of the original query in the function code field of the response. All the Function Codes have a most-significant bit (MSB) of zero (0).
In an exception response, the FL3112 sets the MSB of the function code to a one (1). With the function code's MSB set, the master can recognize the exception response and can process the data field for the exception code from the FL3112 response message.

Exception Code Field: In a normal response, the FL3112 returns data and status in the data field, which was requested in the query from the master. In an exception response, the FL3112 returns an exception code in the data field, which describes the FL3112 condition that caused the exception. Below is a list of exception codes that are supported by the FL3112:

Code	Name	Description
01	Illegal Function	The function code in the query is not an allowable action for the FL3112.
02	Illegal Command	The command register address received in the Register Address query is not an allowable command address for the FL3112.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the FL3112.
04	Slave Device Failure	An unrecoverable error occurred while the FL3112 was attempting to perform the requested action.
05	Acknowledge	The FL3112 has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the master.
06	Device Busy	The FL3112 is engaged in processing a long-duration program command. The master should retransmit the message later when the slave is free.

7.6 FL3112 Command Register Locations

7.6.1 Operational Mode Commands

R – indicates Read Only Access
R/W – indicates Read/Write Access
LFF – Low Frequency Fire
HFF – High Frequency Fire
LFS – Low Frequency Sun

Parameter	Function	Type	Reg Scale	Master I/O Access	Refer to Addr	Addr	Section
Analogue	4-20mA Current Output	Value	16-Bit	R	0000	40001	7-7-1
Mode	Indicates Fire Status Mode	Value	(0-11)	R	0001	40002	7-7-2
Status/Error	Indicates error	Bit	8-Bit	R	0002	40003	7-7-3
Fire Type	LFF, HFF or both	Value	(1,2,3)	R	0003	40004	7-7-4
Model Type	Identifies the Model FL3112	Value	(3112)	R	0004	40005	7-7-5
Software Rev	Indicates the SW Revision	ASCII	2-Char	R	0005	40006	7-7-6
COPM Fault	IR COPM Fault	Bit	8-Bit	R	0006	40007	7-7-7
Not Used			0007	40008			
Options	Indicates Unit Options	Bit	8-Bit	R/W	0008	40009	7-7-8
Address	Unit Address	Value	(1-247)	R/W	0009	40010	7-7-9
Not Used			000A	40011			
Baud Rate	Indicates present Baud Rate (2400, 4800, 9600, 19200)	Value	(0-3)	R/W	000B	40012	7-7-10
Data Format	Indicates Data Format (8-N-1, 8-E-1, 8-O-1, 8-N-2)	Value	(0-3)	R/W	000C	40013	7-7-11
Not Used			000D	40014			
Not Used			000E	40015			
Fire COPM Fault Total	Indicates Total No. of Fire Channel Window/Detector COPM Faults	Value	8-Bit	R	000F	40016	7-7-12
Sun COPM Fault Total	Indicates Total No. of Sun Channel Window/Detector COPM Faults	Value	8-Bit	R	0010	40017	7-7-13
Remote Reset	Remotely Resets the Alarm & Warn Condition	Bit	1-Bit	R/W	0011	40018	7-7-14

R – indicates Read Only Access
R/W – indicates Read/Write Access
LFF – Low Frequency Fire
HFF – High Frequency Fire
LFS – Low Frequency Sun

Parameter	Function	Reg Type	Master I/O Scale	Refer to Access	Addr	Addr	Section
Remote Alarm Test	Remotely Activates Alarm Test	Bit	1-Bit	R/W	0012	40019	7-7-15
Clear COPM Faults	Clears Window/Detector COPM Fault Counters	Bit	1-Bit	R/W	0013	40020	7-7-16
Total Receive Errors	Total No. of Receive Errors	Value	8-Bit	R	0020	40033	7-7-17
Bus Activity	Bus Activity Rate in % Rate % of this Addressed Node vs. Other Addressed Nodes	Dec. Hex	(0-100%) (0-64)	R	0021	40034	7-7-18
Function Code Errors	Total No. of Function Code Errors	Value	8-Bit	R	0022	40035	7-7-19
Starting Address Errors	Total No. of Starting Address Errors	Value	8-Bit	R	0023	40036	7-7-20
No. of Register Errors	Total No. of Register Errors	Value	8-Bit	R	0024	40037	7-7-21
RXD CRC Lo Errors	Total No. of RXD CRC Lo Errors	Value	8-Bit	R	0025	40038	7-7-22
RXD CRC Hi Errors	Total No. of RXD CRC Hi Errors	Value	8-Bit	R	0026	40039	7-7-23
Overrun Errors	Total No. of Overrun Errors	Value	8-Bit	R	0027	40040	7-7-24
Noise Flag Errors	Total No. of Noise Flag Errors	Value	8-Bit	R	0028	40041	7-7-25
Framing Errors	Total No. of Framing Errors	Value	8-Bit	R	0029	40042	7-7-26
Not Used		002A	40043				
Not Used		002B	40044				
SCI Interrupt Errors	Total No. of Serial Comm Interface Errors	Value	8-Bit	R	002C	40045	7-6-27
Clear Comm	Clear All Comm Errors	Bit	1-Bit	R/W	002D	40046	7-7-28

7.7 FL3112 Operational Mode Command Register Details

7.7.1 Analogue

A read returns a value, which is proportional to the 0 – 20mA output current. The current is based on a 16-bit value. The master scaling is 0 – 65535 Decimal which corresponds to the FL3112 scaling which is 0 – 20mA.

7.7.2 Mode

A read returns the fire status mode of the FL3112.

Mode	Decimal Value
Powerup Delay	1
Warn Non-latching Only	2
Warn & Alarm Non-Latching	3
Warn Latching Only	4
Alarm Latching Only	5
Warn & Alarm Latching	6
Ready State (No Fire)	7
Alarm Test	10
COPM Fault Detected	11

7.7.3 Status/Error

A read returns the errors that are occurring at the present time which are indicated by bit position.

Byte	Function	Bit Position
Low	EEPROM Checksum	8
	EEPROM Checksum	7
	RAM Test	6
Low (24V)	Voltage Check	5
	Fire Window COPM	4
	Fire Sensor COPM	3
	Sun COPM	2
Low 12 V	Voltage Check	1
High	Not Used	8-1

7.7.4 Fire Type

A read indicates the detection of LFF, HFF or a combination of both when using the Model FL3112.

LFF Only Detected	=	01 (Lo Data Byte)
HFF Only Detected	=	02 (Lo Data Byte)
Combination of Both	=	03 (Lo Data Byte)

High Data Byte Not Used.

7.7.5 Model Type

A read returns the Decimal Value 3112 which identifies the unit by model number.

Model	Version	Decimal Value
FL3112	DFIR (Digital Frequency Infra-Red)	3112

7.7.6 Software Rev

A read returns the software revision of the FL3112 in 2 ASCII characters (Usually a blank and then a letter revision ex. A, B, C etc).

7.7.7 COPM Fault

A read returns the type of Continuous Optical Path Monitoring (COPM) Fault, which is a Fire COPM Fault or Sun COPM Fault. The Fire COPM Fault indicates that the window is dirty and needs to be cleaned or there is a hardware problem with the Fire Channel detection circuitry or sensor. The Sun COPM Fault indicates that the window is dirty and needs to be cleaned or that there is a hardware problem with the Sun Channel detection circuitry.

Sun COPM Fault	=	02 (Lo Data Byte)
Fire COPM Fault	=	04 (Lo Data Byte)

High Data Byte Not Used.

7.7.8 Options

A read returns the status of the settings for the Detector Sensitivity, Relay Delay, Relay Latching/Non-Latching and Relay Energized/Non-Energized features from EEPROM. A write command changes the settings for the EEPROM.

Exception: If an EEPROM write error occurs, then the Exception Code 04 (Slave Device Failure) is returned.
These Functions operate on the Low Data Byte.

Function	Bit Position	Conditions	Access
Warn Energized	8 (MSB) 0 = Non-Energized	1 = Energized	Read/Write
Alarm Energized	7 0 = Non-Energized	1 = Energized	Read/Write
Warn Latched	6 0 = Non-Latched	1 = Latched	Read/Write
Alarm Latched	5 0 = Non-Latched	1 = Latched	Read/Write

(Time Delay in Seconds)		4	8	2	10	
Alarm Time Delay 2	4	0	0	1	1	Read/Write
Alarm Time Delay 1	3	0	1	0	1	Read/Write

(Sensitivity %)		100	75	50		
Sensitivity 2	2	0	0	1		Read/Write
Sensitivity 1	1 (LSB)	0	1	0		Read/Write

High Data Byte Not Used

7.7.9 Address

A read returns the address of the FL3112. A write changes the address to the requested address. The range of the address is 1 to 247 (01 to F7 Hex). After the address has been changed to the slave unit, the Modbus communications will cease because the address has changed; therefore the master will have to change its query address to the slave's new address in order to restart the communications.

Exception: If an EEPROM write error occurs, then the Exception Code 04 (Slave Device Failure) is returned.

7.7.10 Baud Rate

A read returns the baud rate of the FL3112. A write changes the baud rate to the requested baud rate. After the baud rate has been changed to the addressed unit, the Modbus communications will cease because the baud rate has changed; therefore the master will have to change its baud rate to the slave's new baud rate in order to restart the communications. These Functions operate on the Low Data Byte

Baud Rate	Low Data Byte	Access
19200	03	Read/Write
9600	02	Read/Write
4800	01	Read/Write
2400	00	Read/Write

High Data Byte Not Used
Exception: If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

Exception: If an EEPROM write error occurs, then the Exception Code 04 (Slave Device Failure) is returned.

7.7.11 Data Format

A read returns the data format of the FL3112. A write changes the data format to the requested data format. After the data format has been changed to the addressed unit, the Modbus communications may cease or start producing comm errors because the data format has changed; therefore the master will have to change its data format to the slave's new data format in order to restart or provide proper communications.
These Functions operate on the Low Data Byte.

Data	Parity	Stop	Format	Low	Data Byte	Access
8	None	1	8-N-1	00	Read/Write	
8	Even	1	8-E-1	01	Read/Write	
8	Odd	1	8-O-1	02	Read/Write	
8	None	2	8-N-2	03	Read/Write	

High Data Byte Not Used

Exception: If an EEPROM write error occurs, then the Exception Code 04 (Slave Device Failure) is returned.

7.7.12 Fire COPM Fault Total

A read indicates the Total Number of Fire Channel Window or Sensor COPM Faults that occurred in the slave device. This fault is usually caused by a dirty Window or faulty Fire Channel Sensor or Circuitry. The maximum count is 255 and then the counter will roll over to zero and begin counting again.

7.7.13 Sun COPM Fault Total

A read indicates the Total Number of Sun Channel Window or Sensor COPM Faults that occurred in the slave device. This fault is usually caused by a dirty Window or a faulty Fire Channel Sensor or Circuitry. The maximum count is 255 and then the counter will roll over to zero and begin counting again.

7.7.14 Remote Reset

Writing a 1 to the bit activates the Remote Reset function that resets the Alarm and Warn Conditions. The function is active momentarily and will reset automatically after being used.

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

7.7.15 Remote Alarm Test

Writing a 1 to the bit activates the Remote Alarm Test function that activates the Warn and Alarm relay turn-on along with the analogue current status. Once the Alarm Test is complete the function should be disabled by writing a zero to Remote Alarm Test and then resetting the Alarm and Warn relays by writing a one to the Remote Reset (referenced above).

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

7.7.16 Clear COPM Faults

A write to enable the bit activates the Clear COPM Faults function that resets all of the Fire Window COPM faults, the Fire Sensor COPM Faults, and the Sun COPM Faults. The bit and enable function is active momentarily and will reset to disable and zero after being used.

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

7.7.17 Total Receive Errors

A read indicates the total Modbus Comm Receive Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again. The total errors are an accumulation of the individual comm errors listed below.

7.7.18 Bus Activity Rate %

A read indicates the Bus Activity Rate in percent of this Slave's addressed node versus other addressed nodes. Range of this value is in hex (0-64) which translates to decimal (0-100%).

7.7.19 Function Code Errors

A read indicates the number of Function Code Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

7.7.20 Starting Address Errors

A read indicates the number of Starting Address Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

7.7.21 Number of Register Errors

A read indicates the Number of Register Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

7.7.22 RXD CRC Lo Errors

A read indicates the number of RXD CRC Lo Byte Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

7.7.23 RXD CRC Hi Errors

A read indicates the number of RXD CRC Hi Byte Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

7.7.24 Overrun Errors

A read indicates the number of Overrun Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

Note: An overrun error occurs when the next received byte of data tries to overwrite an existing received data byte which has not been processed. Therefore, the next received byte of data is lost. This can be controlled by implementing the proper DCS or PLC Error Handling Timing Settings (i.e. Reply Timeout Setting, Delay Time, and Number of Retries) and proper Baud Rate Settings.

7.7.25 Noise Flag Errors

A read indicates the number of Noise Flag Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

7.7.26 Framing Errors

A read indicates the number of Framing Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

7.7.27 SCI Errors

A read indicates the number of SCI (Serial Communications Interface) Errors that occurred in the slave device. The Maximum count is 255 and then the counter will rollover to zero and being counting again.

7.7.28 Clear Comm Errors

Writing a 1 to the bit activates the Clear Comm Errors function which resets all of the Modbus Comm Error counters to zero. The function is active momentarily and will reset automatically after being used.

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

Customer Satisfaction Questionnaire

Attention Field Operations:

We would appreciate your help in assessing and thus improving the quality of our Equipment and Service and would therefore be grateful if you would complete the Questionnaire below and return it to:

General Monitors Ireland Ltd,
Ballybrit Business Park,
Galway,
Republic of Ireland.

Thank you for your assistance

Client

Client Order No. _____

General Monitors Sales Order No. _____

(Please tick appropriate box)	Yes	No
1. Was the equipment the correct option?	☐	☐
2. Are sensors correct type and range?	☐	☐
3. Is mechanical assembly good? (everything proper fit and tight)	☐	☐
4. Did you receive the necessary accessories to commission the equipment?	☐	☐
5. Has the equipment been commissioned?	☐	☐
6. Any problems encountered during commissioning?	☐	☐
7. Is the equipment functioning correctly at present?	☐	☐

If you have answered **NO** to any of the above, please provide further details overleaf. **Thank you.**

Completed by: _____ Date: _____