Uvisor™ SF810*i*

Integrated SafeFlame Scanner

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This product meets the requirements specified in EMC Directive 89/366/EEC and in Low Voltage Directive 72/23/EEC.

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Use of Warning, Caution, Information and Tip Icons

This publication includes **Warning**, **Caution**, and **Information**, where appropriate, to point out safety related or other important information. It also includes **Tip** to point out useful hints to the reader. The corresponding symbols should be interpreted as follows:

Electrical warning indicates the presence of a hazard which could result in *electrical shock.*

.

Warning indicates the presence of a hazard which could result in *personal injury*.

Caution indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in *corruption of software or damage to equipment/property.*

Information alerts the reader to pertinent facts and conditions.

Tip indicates advice on, for example, how to design your project or how to use a certain function.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

SAFETY SUMMARY

Equipment environment

All components, whether in transportation, operation or storage must be in a non corrosive, static-electricity-safe environment.

Electrical shock hazard during maintenance

Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing. The SF810*i* is powered at a safe voltage (up to $29V_{DC}$) and has no dangerous internal voltages but the electrical connections of the relay terminal (J1) can be connected up to $240V_{AC}$ and, if exposed, present a shock hazard that can cause injury or death.

FIRST POWER-UP AND HAZARDOUS AREA

SF810*i*, when used with its communication line(s) in a bus architecture, needs a basic configuration to be done before installation. This basic configuration consists in the selection of the serial line communication protocol and the assignment of the station address.
These selections must be done manually with the rear cover open and while the unit is powered. Therefore, in case the unit is to be installed in an hazardous area, these initial settings cannot be performed on the final location; the unit protocol and address must be selected prior to the actual physical installation, operating on a lab bench in a non-hazardous area. The initial configuration requires connection to a $24V_{DC}$ power supply only. See page 38 for details about the operational modes.

QUICK RELEASE CONNECTOR AND HAZARDOUS AREA

SF810*i* (quick release connectorized versions), when installed in hazardous area, cannot be quickly disconnected under power.
To avoid disconnection under power, the plug is equipped with a locking Allen screw that must be unscrewed before releasing the connector.

ATEX CERTIFIED FIBER OPTIC VERSIONS

The ATEX certified fiber optic versions (SF810INT-FOC-xx-**T**-xx-xx and SF810INT-FOC-xx-**QC**-xx-xx) must be mandatory used together with the ABB ATEX certified fiber optic, otherwise the certification is invalidated. See Table 4.

SAFETY CONFIGURATION OF FUNCTION SETS WHEN USING DIGITAL INPUTS

SF810*i* has four internal sets of working parameters called Functions Sets (FS).
By default the unit uses Function Set A and switching to other FS is inhibited.
When the user enables the others FS, switching among FS can be driven by the digital inputs or by the serial interface. In case the switching is done by digital inputs, the four FS must be configured in such a way to lead the unit to a safe behavior in case of hardware failure of one digital input. Detailed instructions are given in Table 10 at page 47.

DO NOT DISASSEMBLE / REMOVE THE ELECTRONICS FROM THE ENCLOSURE

It is absolutely forbidden to un-tight / remove the two screws that hold the electronic boards in place.
In case the two screws are removed:
- warranty is void
- immediate, severe hardware failures might happens
- the electronics boards cannot be re-aligned in place by hand
- internal thermal binding between boards and enclosure is broken

There are no configurable / serviceable parts inside.

FLAME FAILURE RESPONSE VERIFICATION

For safety reasons, the user is requested to prove the flame failure response of the SF810*i* under any burner load / fuel conditions and under any selected file of parameters (Function Sets).

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About this book

Scope

This manual provides technical, maintenance and set-up information for the ABB Uvisor™ SF810*i* Integrated SafeFlame Scanner.
This manual does not cover the Uvisor™ SF810 SafeFlame scanner.

This manual describes the product SF810*i* Integrated SafeFlame Scanner itself, without considering that it is usually sold as part of a complete higher level assembly (including fiber optic extension and/or mounting and purge air / cooling accessories).

Intended User

This instruction manual can be used by anyone responsible for the installation and operation of the SF810*i*.

You should be familiar with the basic operating procedures of the boiler or furnace where the SF810*i* will be used.

Document Structure

This manual provides an overview of the major hardware components of the SF810*i*.
It describes in detail the procedures to install and operate the unit.

Later sections provide details about configuration and tuning activities.

Engineering drawings are included at the end of the manual in a reduced page size. These drawings can also be provided in full size upon request.

SF810i Firmware revisions

When this manual has been edited, the current firmware revision of the SF810*i* was B.0.

The firmware release A.6 is the version released before the current one, and is **CSA certified**. Release B.0 certification is in progress, but has not been obtained yet.

Version B.0 introduces changes, among which:

- Support for dual sensor scanners
- Wider scope of local display, both in programming and in visualization
- CI (Combustion Index) calculation

If your SF810*i* has already been installed and it is working properly, you may not need to update to version B.0. In this case, please continue to refer to the previous version of this manual (version C.1, released January 2008) to operate and configure your flame scanner.

Specific chapters related to local configuration and dual sensor are different in this manual and may confuse you if you are following them but you have A.6 modules.

For any doubt or question, please contact you local ABB dealer to get the right suggestion, or write to the tech support hot-line (see Technical support chapter of this manual).

Flame Explorer Software Tool revision

When this manual has been last updated, the current revision of the Flame Explorer software tool was the 1.0.3 (common launcher) and the current version for the SF810*i* application was 1.1.1.

Nomenclatures, Part Numbers and Related Documentation

Table 1 shows a preview of the main items related to the Uvisor™ SF810*i* product.
For a complete list of P/Ns and ordering codes (including cables, replacement parts etc… refer to SF810*i* data sheet (doc. No. 9AKK101130D4742).

All documentation is supplied in Adobe® Acrobat® reader (.PDF) format.

Nomenclature / Item	Description	P/No.	Related doc.
Uvisor™ SF810*i*	Integrated SafeFlame Scanner	SF810INT-xx-xx-xx-xx-xx (see table at page 19 for the meaning of all 5 suffixes)	SF810*i* User Manual Doc. No. 9AKK101130D9798 (this manual)
Flame Explorer	Software tool for configuration and monitoring	EC-PI-G018UTL218	Flame Explorer Manual Doc. No. 9AKK101130D9799-C
LOS mounting accessories	Line-Of-Sight mounting accessories	Not a single P/N Ref. to data sheet (doc. No. 9AKK101130D4742)	See APPENDIX 7 DRAWINGS
FOC mounting accessories	Fiber Optic extension and accessories	Not a single P/N Ref. to data sheet (doc. No. 9AKK101130D4742)	See APPENDIX 7 DRAWINGS

Table 1 - Nomenclatures and P/Ns for most important items

Compatibility with previous ABB flame detection products

Table 2 below shows the compatibility issues with previous products of Uvisor™, FAU800 and DFS/SafeFlame families. The table shows whether or not the SF810*i* unit can be installed as a replacement of the system made of previous flame scanners and Flame Analysis Units / Multi-flame detectors.

NOTE: here we consider a replacement of an existing scanner plus its FAU800 or MFD unit with the SF810i Integrated SafeFlame Scanner. Consider that it is not a one-to-one replacement (see following note). Changes in the wiring harness are required in this case.

NOTE: SF810i Integrated SafeFlame Scanner is a "single flame unit". If you are planning to replace one MFD and two flame scanners (or one FAU800 and two flame scanners) aimed at two different flames, then you need to use two SF810i units.

NOTE: for a one-to-one replacement of an existing scanner with a SF810 scanner ref. to SF810 User Manual.

Previous models	**Compatibility**	**SF810*i* P/No**
One UR600-IR + MFD (Line of Sight)	Yes	SF810INT -LOS-IR-x-y-z
One UR600-IR + MFD (Fiber Optic)	Yes (External guide pipe is compatible, inner fiber is not)	SF810INT -FOC-IR-x-y-z
One UR600-UV + MFD (Line of Sight)	Yes	SF810INT -LOS-UV-x-y-z
One UR600-UVEXT + MFD (Fiber Optic)	Yes (Extended guide pipe is compatible, inner fiber is not)	SF810INT -LOS-UV-x-y-z
One UR450 + MFD	Yes requires adapting flange	SF810INT -LOS-UV-x-y-z
One UR460 (Direct View) +MFD	In progress	
One UR460 (Fiber Optic) + MFD	In progress	
One SafeFlame Wall-mount UV scanner, cam lock + FAU800	Yes requires mech. adapter plus change of connector in the existing cable	SF810INT -LOS-UV-x-y-z
One SafeFlame IR (or VL or full spectrum) scanner (through the wind box, cam lock, FOC) + FAU800	Yes Existing guide pipe is compatible, requires flange adapter	SF810INT -FOC-IR-x-y-z
NOTE: see Table 3 at page 19 for the meaning of all suffixes of the P/N. NOTE: Owing to the change of architecture when replacing existing scanners and analysis units with a single "integrated" unit, it requires wiring changes. NOTE: Both connectorized versions need a wiring change too. The new connector is not compatible with the previous SafeFlame scanner connector to be replaced. Refer to Table 7 at page 33 .		

Table 2 - Compatibility with previous products

Technical Support

ABB provides full assistance in supporting the operation and repair of its products. Support requests should be addressed to the ABB reference office and person as indicated in the supply documentation.

Spare parts and ordering information

In case of need of spare parts ordering, the following information are requested:

1. System description, part and code number and quantity;
2. Model (or version) and serial number
3. Reference to the user manual, and page number, where the failing device is described (if applicable).

Formation and Training

ABB is running formation courses dedicated to ABB product related to operation, maintenance and installation skills. Such training courses can be organized also at the Client site on request.
Further information can be requested to ABB references at ABB offices.

Technical documentation

Additional copies of the present manual can be ordered to ABB sales offices.

Technical support

Technical support can be obtained via e-mail writing to:

CI.Supportcenter@it.abb.com

Please do use this address for questions, suggestions and also critics about all of our combustion optimization products.

INTRODUCTION

The Integrated SafeFlame Scanner

The Uvisor™ SF810*i* is an instrument designed to detect and analyze flames easily and reliably. It takes advantage of the latest technologies available to make flame detection and analysis as cost-efficient as possible, while retaining ABB's rock-solid reputation for reliability.

The main characteristic of the SF810*i* is its "Integrated" structure. All the electronics, from the sensor(s) to the wiring terminals (or quick release connector), including the processing unit, the relays, the communication ports are contained in the scanner enclosure. The enclosure dimensions are the same as the existing Uvisor™ UR600-XX family of "conventional" flame scanners; SF810*i* enclosure is approx. 1cm longer than previous UR600-XX enclosure.

Other important SF810*i* capability is its redundant Profibus communication lines running at up to 12Mbit/s. The communication protocol can be switched to the simpler "MODBUS" protocol for greater flexibility.

The SF810*i* is easy to install and configure, and flexible to operate.

The Purpose of a Flame Detection System

An ABB Flame Detection System is a crucial part of a boiler or furnace safety system.
Its primary function is to identify potentially dangerous "Flame-Out" conditions on ignition flame and on the main flame.
Because of the flame detection system importance, it must be extremely reliable and rugged.
ABB has provided reliable flame detection systems since 1966. This product is ABB's latest offering, representing 40 years of flame detection experience.

Conventional Vs Integrated architecture

Conventional

The so-called conventional architecture is shown in both Figure 1 and Figure 2.
The conventional flame detector system is made of three parts:

- the flame scanner head
- the processing electronics
- the cable connecting the two

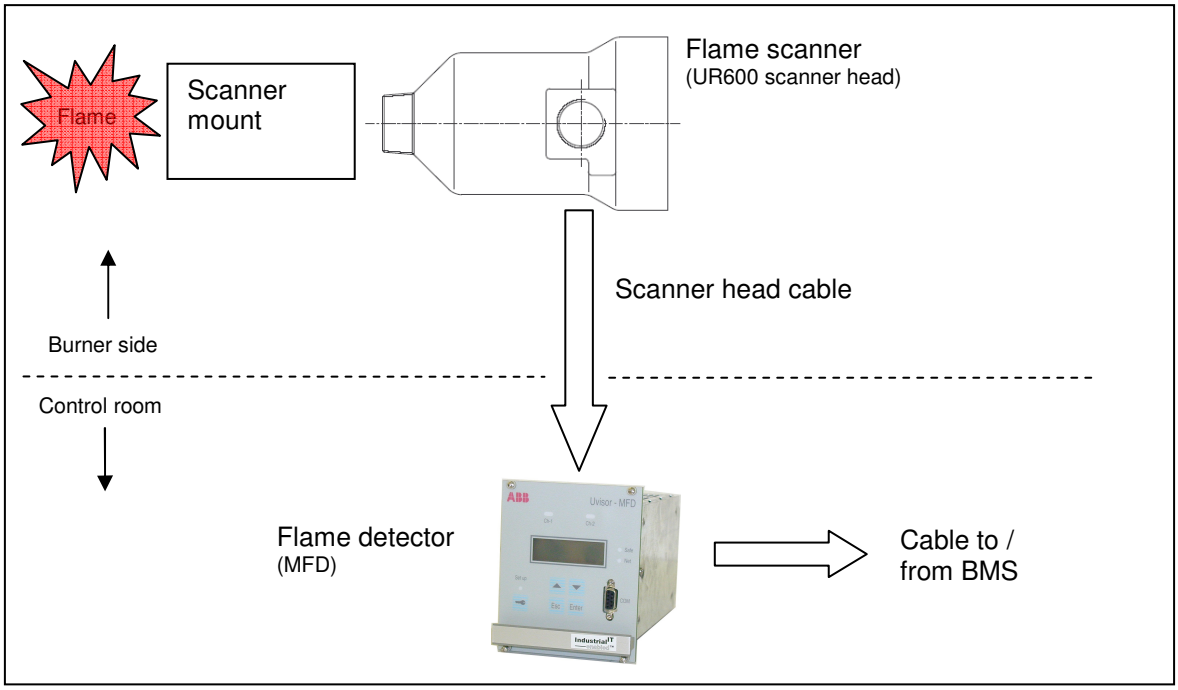


Figure 1 - Conventional architecture (showing ABB Uvisor™ UR600 and MFD products)

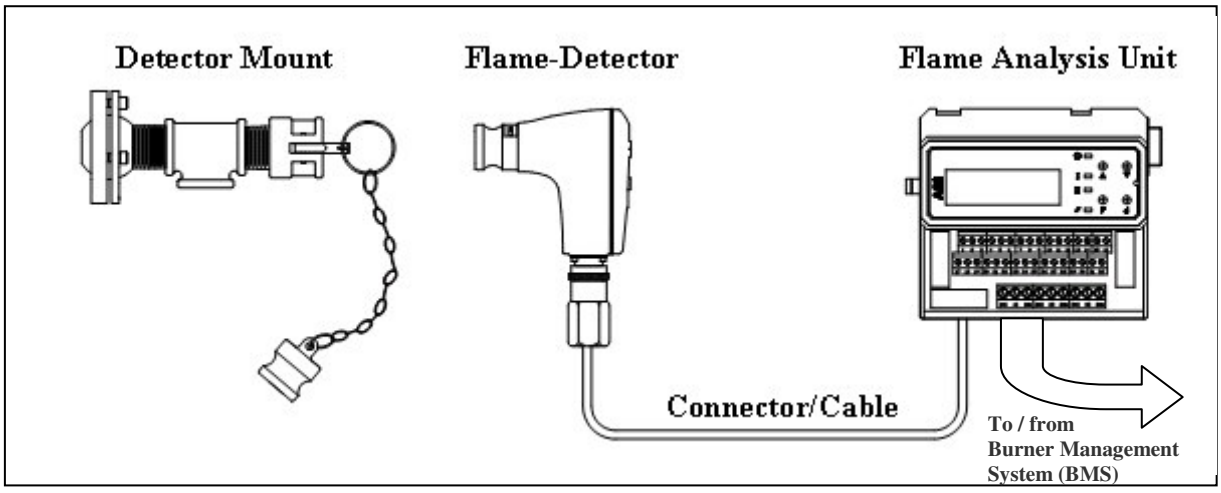


Figure 2 - Conventional architecture (showing ABB SafeFlame UV and FAU800 products)

Integrated

An Integrated architecture is shown in Figure 3. The flame detector consists of a single product, the SF810*i*.

The Integrated architecture has several advantages over the conventional one:

- Reduced part count
- Lower system cost
- Lower installation cost
- No dedicated cabinets required in control room
- Reduced cabling
- Reduced use of natural resources

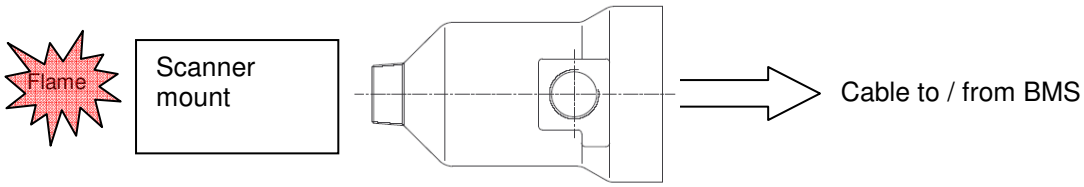


Figure 3 - Integrated architecture (showing ABB SF810i Integrated SafeFlame Scanner)

Scanner Mount

ABB supplies the flame scanner mounting hardware for the burner front. The mounting hardware is specifically constructed for your flame scanner and your operating environment.

Flame Scanner

A Flame Scanner is mounted on the hardware on the burner/wind box. The SF810*i* Integrated SafeFlame Scanner not only converts energy from fuel combustion to an electrical signal but also analyzes and measures the flame. Flame safety contacts, analog output, redundant serial communication interfaces, digital input for fuel or load switching can all be connected to the Burner Management System.
ABB offers several different Flame Scanners that are uniquely suited to specific operating environments.

Cable

A cable connects the Flame Scanner to a Burner Management System. As with the mounting hardware, ABB has the suitable cable for your flame scanner. Standard cable can also be used, see the relevant information on cables (APPENDIX 8 - CABLES).

Connector or terminals

ABB SF810*i* Integrated SafeFlame Scanner comes in a variety of versions. The standard version comes with removable terminals. The connector version is available, as well as a connector cable.
See Table 3 - Versions.

Versions

Uvisor™ SF810*i* is available in several variations of the characteristics show on Table 3.
WARNING: not all combinations are available. Contact ABB for details.

Ref. data sheet (doc. No. 9AKK101130D4742) for a complete listing of ordering codes

Feature	Available choices	SF810*i* PART NUMBER assignment
Light ingress	FOC (Fiber Optic Cable)	SF810INT - FOC - …… - … - … - …
	LOS (Line Of Sight)	SF810INT - LOS - …… - … - … - …
Spectral range	IR	SF810INT - …… - IR - … - … - …
	UV	SF810INT - …… - UV - … - … - …
	VL	SF810INT - …… - VL - … - … - …
	UV +IR (dual sensor)	SF810INT - …… - UVIR - … - … - …
Cabling method, protection index, ATEX	Removable screw terminals (IP66 and ATEX)	SF810INT - …… - …… - T - … - … See warning at the bottom of this page
	Removable screw terminals (IP66, non-ATEX)	SF810INT - …… - …… - TL - … - …
	Quick-release connector (IP66, non-ATEX)	SF810INT - …… - …… - Q - … - …
	Quick-release connector (IP66 and ATEX)	SF810INT - …… - …… - QC - … - … See warning at the bottom of this page
Conformal coating	Conformal coating of electronic boards (no choice, mandatory)	SF810INT - …… - …… - … - C - …
Rear Cover	Blind (solid aluminum)	SF810INT - …… - …… - … - … - B
	Transparent window	SF810INT - …… - …… - … - … - W

Table 3 - Versions

***WARNING**: The ATEX certified fiber optic versions (SF810INT-FOC-xx-**T**-xx-xx and SF810INT-FOC-xx-**QC**-xx-xx) must be mandatory used together with the ABB ATEX certified fiber optic, otherwise the certification is invalidated. See Table 4*

Fiber optics

Please refer to product data sheet (doc. No. 9AKK101130D4742) for a complete listing of Fiber Optic assemblies and related mounting hardware.

The following is part of the data sheet contents. Please refer to the data sheet to always access the most up-to-date information.

Feature	Available choices	PART NUMBER assignment
Fiber optic extension type	• Flexible extension • Rigid extension	**SF810INT - FOC - ..... - ... - ... - ... - FE - xxxx** For the assignment of the first 5 suffixes see next table XXXX = length (in mm) See Figure "A" FOC assembly includes: ▪ Detector Head ▪ Fiber optic cable ▪ Inner fiber optic cable guide pipe with lens assembly ▪ Flexible external guide pipe with coupling flange and guide ring **SF810INT - FOC - ..... - ... - ... - ... - RE - xxxx** For the assignment of the first 5 suffixes see next table XXXX = length (in mm) See Figure "A" FOC assembly includes: ▪ Detector Head ▪ Fiber optic cable ▪ Inner fiber optic cable guide pipe with lens assembly ▪ Rigid external guide pipe with coupling flange and guide ring

Table 4 - Fiber Optic extended higher level assemblies

Replacement parts

Please refer to product data sheet (doc. No. 9AKK101130D4742) for a complete listing of replacement parts.
The following is part of the data sheet contents. Please refer to the data sheet to always access the most up-to-date information.

Description	Ordering Code	Ordering information
Glass Fiber (for IR and VL FOC versions)	SF810-FO-G-XXXX-mm	State the length XXXX of the fiber optic cable
Quartz Fiber (for UV FOC version)	SF810-FO-O-XXXX-mm	State the length XXXX of the fiber optic cable
Inner guide pipe - flexible	SF810-IGP-XXXX-mm	State the length XXXX of the guide pipe
Outer guide pipe - rigid	SF810-OGP-R-XXXX-mm	State the length XXXX of the extended pipe
Outer Guide pipe - flexible	SF810-OGP-F-XXXX-mm	State the length XXXX of the extended pipe
Flame Explorer SW	EC-PI-G018UTL218	Monitoring and configuration PC tool

Table 5 - Replacement parts

HARDWARE

Overview

The SF810*i* consists of a relatively small round aluminum enclosure (explosion proof) (see Figure 4) containing, in its internal cavity, the electronic boards. The cable enter the enclosure through a side hole (see Figure 9). Connector versions have a connector in place of the cable entrance.
The rear cover allows access to the internal Terminal Board. A transparent window rear cover is available.

Under the rear cover, a 3-digits display and 4 push-buttons are available for aiming the unit to the target flame and for carrying out a basic configuration. (It is possible to operate the unit with the rear cover removed in non-hazardous area only).

The SF810*i* has no jumpers and no switches to be configured.
All internal configurations are microprocessor-based. Once selected the communication protocol and the station address (if needed), the configuration can be carried out either locally using the pushbuttons and display or remotely through the serial communication line(s).

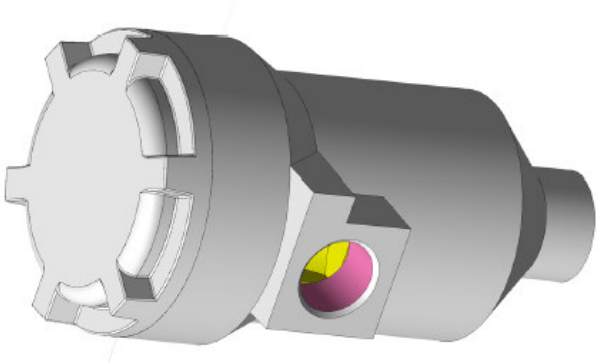


Figure 4 - Enclosure

Internal boards

The SF810*i* electronics is organized in three internal boards:

- SE, Sensor Electronics, usually single sensor (one photodiode sensible to either VL, IR or UV), but also available as dual sensor (two photodiodes, one sensible to UV light, and one sensible to IR light)
- SPE01, Signal Processing Electronics
- TB, SF810*i* Terminal Board (also referred to as 'ATB')

The internal power converter, to convert the $24V_{DC}$ to lower voltages suitable for the electronics, is a sub-module mounted on top of the SPE01 board.

There is no need to access the internal SE and SPE01 boards. All the accessible parts are located on the TB board and are easily reachable once the rear cover is unscrewed. Figure 5 shows the location of connectors, LEDs, display and push-buttons on the Terminal Board.

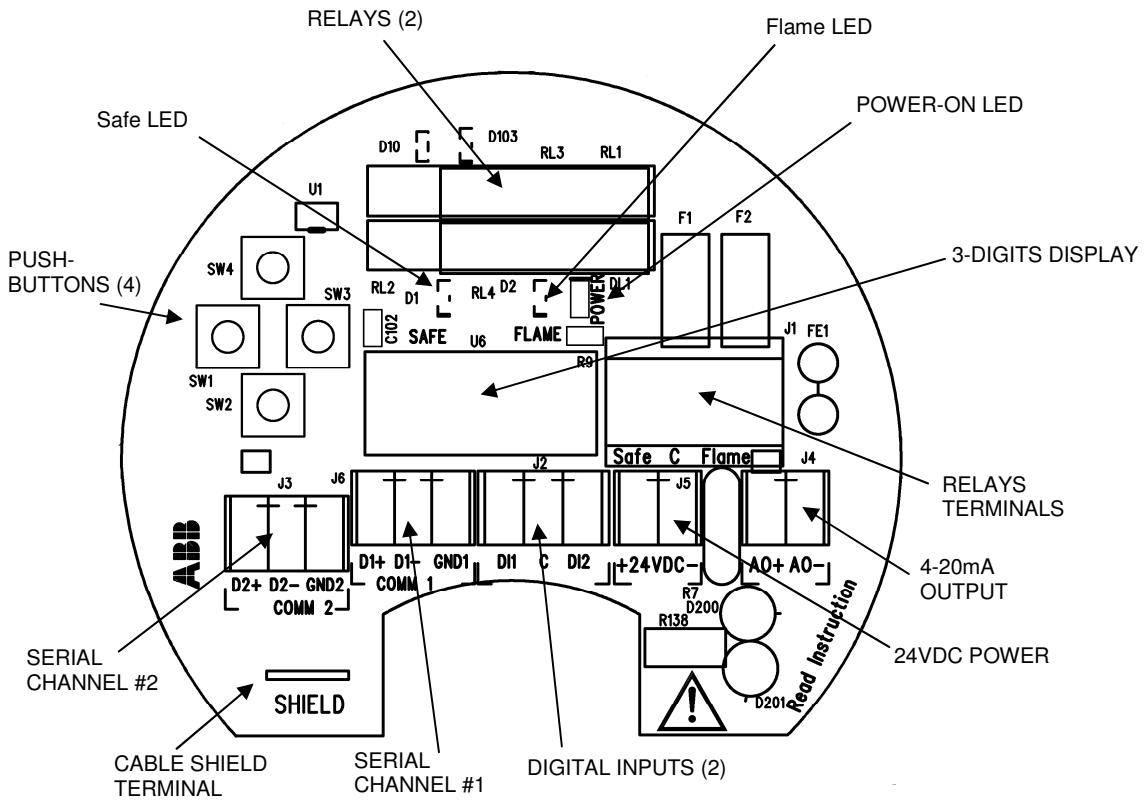


Figure 5 - Terminal board

Connections

The minimal set of connections that are required to use the SF810*i* is two: just $24V_{DC}$ power and relay contacts.
In more complete applications you can connect the 4-20mA analog output (and configure the SF810*i* to output an internal variable as, for instance, the flame quality), the redundant network (MODBUS or Profibus) and the digital inputs (for fuel-switching or load-switching).

Power supply

SF810*i* works at $24V_{DC}$. It has inrush current limiting circuits and a non-replaceable fuse on the power supply. The fuse is intended to protect against internal damage in case of excess current consumption and also to protect the $24V_{DC}$ distribution (in case the power is wired in parallel with other SF810*i*).
An internal DC/DC converter generates all the voltages needed by the electronics (+/- 15V, 5V, 3.3V and 2.5V).
The circuit is protected against polarity inversion.
The SF810*i* is designed to withstand hot insertion and hot removal; it can be connected to (and removed from) the $24V_{DC}$ distribution without causing problems to itself or to other units on the same power distribution. See APPENDIX 2 - SPECIFICATIONS for the inrush current value.
Individual protection against overload or short circuit realized on external power distribution panel shall be rated 0.5A with time lag.

Relays

There are two relays in the SF810*i* that you can use as Flame-relay or Safe-relay. The relay contacts are galvanic isolated; you can see also relay assignment summary on page 57 for information about relay assignment.

Flame-relay

Flame-relay is an ON/OFF switch that is energized (i.e. contact is closed - ON) when a flame is detected and de-energized (contact open - OFF) when a flame is not detected. See APPENDIX 5 - FLAME DETECTION THEORY, for more information about flame detection.
You can configure the SF810*i* to perform flame detection based on your requirements. Flame Failure Response Time (FFRT) is programmable from 0.2 to 4 s in 0.1s increments.

Safe-relay

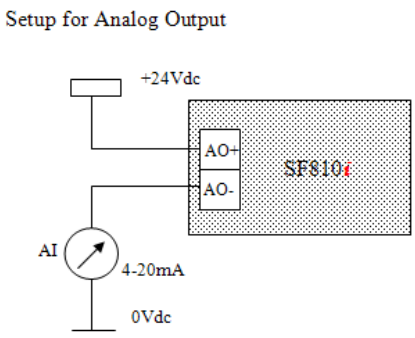
Safe-relay is an ON/OFF switch that is energized (i.e. contact is closed - ON) when no faults are present and de-energized (contact open - OFF) when a fault is detected. This relay can be used, in alternative to its default function, to be a “second flame relay” or a “flame quality relay”. See details in the next chapters of this document.

Both relays go to OFF (contact open, de-energized) state if any fault is detected (safe status).

4-20mA

The SF810*i* has a galvanic isolated 4-20mA analog output (external powered, see scheme aside) that can be assigned to be proportional to one of the following flame variables:

- Intensity
- Flicker frequency
- AC-amplitude
- Quality.



The output goes to the “low ” value of 3.5mA in case the SF810*i* detects a fault in any of its internal parts.

Figure 6 - Analog output external power

Communication lines

The SF810*i* has two identical, galvanic isolated, half-duplex communication lines used as a redundant pair. You can connect and use just one of them in case you do not need redundancy. Otherwise, you can have your master station interrogate the SF810*i* on one line or on the other indifferently; the rule is that the SF810*i* will answer on the line where the interrogation was placed.

The communication lines are based on the RS-485 serial communication physical level standard. The transmission is differential; high-speed and long distance can be used on a copper cable. See APPENDIX 2 - SPECIFICATIONS at page 86 for cable length.

Digital inputs

SF810*i* has two digital inputs (24V_{DC} external powered, see scheme aside) intended for changing the internal active Function Set. There are 4 (four) Function Sets. Ref. to section CONFIGURING at page 41 for information and warnings on how to configure and how to use the 4 different Function Sets. Different Function Sets are useful in order to dynamically switch the SF810*i* performance when there is a change of fuel or when there is a different load of the burner.

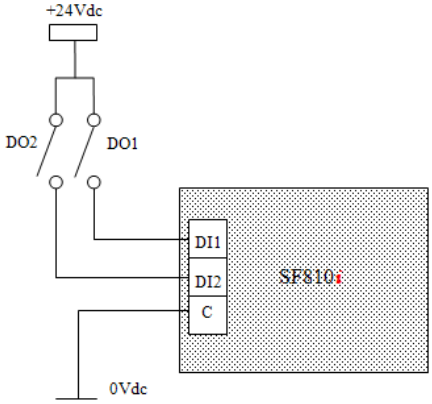


Figure 7 - Digital Inputs external power

Configuration memory

SF810*i* has a non-volatile internal memory that keeps configuration data indefinitely during power-down periods. The data retention circuit needs no batteries, it is based on FLASH semiconductor technology.
In case of SF810*i* replacement, the new unit must be configured as the old one.
Easy configuration, reconfiguration and tuning can be done with the Flame Explorer Software that, among the other features, allows the user to store any unit's configuration in a file that can be kept for reference or to reprogram a unit in case of replacement or failure.

Mounting and orientation

SF810*i* must be mounted horizontally or vertically. Care must be taken to face down the cable entry thus to prevent water drops to leak in.
In wall mount application it is advisable to install the flame scanner on a swivel flange, this will help optimizing the flame scanner aiming toward the burner flame.

Enclosure

The SF810*i* has an explosion-proof (ATEX certified in most versions) aluminum enclosure. Enclosure variations allow the product to be implemented in different versions. All the following values of the product P/No. suffixes depend on variations of the enclosure, not of the internal electronics boards:

- Light ingress: FOC / LOS
- Type of connectors and ATEX / IP66 rating: T / TL / Q / QC
- Rear cover (blind or windowed): B / W

Of course the suffixes related to the spectral range ((IR/VL/UV…) do depend on the internal electronic board variations, in particular to variations of the SE (Sensor Electronics) board.

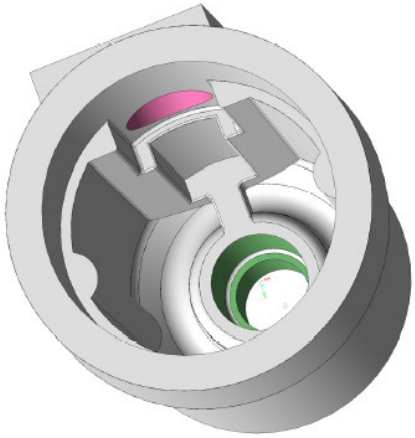


Figure 8 - Enclosure internal view

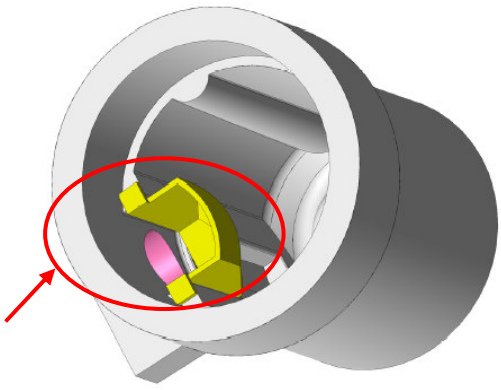


Figure 9 - Enclosure, cable inlet detail (circled)

On the external surface of the enclosure there are two labels. One is the label of the enclosure itself, showing all the information required by the ATEX certification. The other is the product label. Non-ATEX versions have only one label, the product label; they do not have an enclosure label.

INSTALLATION

This section consists of three main parts:

- Site verification
- Networking preparation
- Product Installation

The first two activities have to be done just once for each flame detection system. The second (networking preparation) is needed only when you are going to use the digital communication capabilities of the SF810*i*. The third must be repeated for each single unit to be installed.

Site verification

This activity consists in verifying that the local environment of the physical installation location complies with the product specifications.

Networking preparation

Under this activity we consider both the “design” and the implementation of the digital communication network that connects all units together (MODBUS or Profibus DP protocols).

First of all, decide whether or not to make use of the digital communication capabilities of the SF810*i*. In case you do not want this feature, just skip this activity and go to product installation.

If you choose to network together all the SF810*i* of your flame detection system, the next step is to make a choice between MODBUS or Profibus (DP) protocols. Details about this subject are out of the scope of this manual.
Anyway, both MODBUS and Profibus (DP) make use of the same physical level of communication (RS-485 industrial de-facto standard).

We just point out, on this subject, that the topology of a RS485 network is a “bus”. Therefore the network cable (or cables, when using redundant networks) must be routed starting from the master station (usually a PC or a DCS interface in a control room) and passing relatively close to each SF810*i*, ending in a junction box located close to the last (most remote) unit. Both ends of the network cable must be terminated with a resistor equal to the characteristic impedance of the network. Close to each SF810*i* the network must be provided with a junction box. From that junction box, a short piece (“stub”) of network cable will reach the SF810*i*. The max length of this “stub” is limited to a few meters and is strongly related to the maximum transmission speed that can be used on the network and to the total number of stubs. The shorter the stub, the higher the speed.

The above short considerations about bus network topology are enough to point out the next important concept: the topology of the network is not always (is rarely) equal to the topology of the remaining wiring needed to power-on and to interface the SF810*i* to the Burner Management System. The most obvious topology for all cabling except the network is a star configuration, not a bus. The center of the start is somewhere located in the control room or in the electronics cabinets room, while the points of the star are located in the junction box, above mentioned, close to each SF810*i*. From the junction box to the SF810*i*, ABB suggest to use a single special cable designed for the purpose. (See APPENDIX 8 - CABLES). You might also use a number of standard cables ready available on the market

Note: we intentionally avoided to discuss the simple case of a system made of a single SF810i. In this case, the bus topology is coincident with the start topology. Of course you can lay-out the network and the other wiring on the same cable path.

Note: with some restriction, and with the use of copper to fiber-optic converters, the RS-485 network can be implemented in a star topology, thus making possible to use the same cable routing paths as the rest of the wiring.

***Warning**: if you connect the relay contact(s) to a circuit whose voltage is higher that $24V_{DC}$ nominal, (for instance to $220V_{AC}$) then the routing of this part of wiring must be different from the network, from the other $24V_{DC}$ and from signal wires.*

Product installation

The installation of the SF810*i* begins with selection of protocol and station address, then the SF810*i* can be physically installed on the burner and then it can be wired as needed. Installation terminates with the correct procedure to close the cover of the enclosure in order to maintain the explosion proof capability and with the preliminary operations and adjustments.

In order to meet EMC specifications it is mandatory to follow the recommendations given in APPENDIX 8 - CABLES.

WARNING: *the SF810i comes from the factory already loaded with the factory-default configuration; this configuration could be not suitable to correctly discriminate the presence of the flame in your target burner. Therefore, for safety reasons, the SF810i will power up in a state (first-time power-up state) in which the flame relay will never energize, even if the Flame Algorithm vote for flame present.*
The SF810i exits from this first-time power-up state only after you change the configuration, thus replacing the default configuration with a user-prepared one.

Summary of installation procedure

The installation procedure refer to the actions required to install the SF810*i* up to the point when it can be powered and it can begin to roughly detect a flame. At this time you will be ready for the next phase (configuration and tuning for best performance).
Installation procedure:

- Preliminary steps (air flow, ESD precautions, special handling, unpacking and inspection)
- Protocol and station address selection
- Physical installation
- Wiring
- Closing the enclosure

The details of the above installation steps are discussed in the following

Preliminary steps

Air flow

SF810*i* is designed to be installed in a normal ambient environment. It is absolutely forbidden to cover its enclosure with thermal insulating or any other kind of material. See APPENDIX 2 - SPECIFICATIONS for specifications about environment of installation.

ESD precautions

Wear an anti-ESD wrist strap or equivalent system when operating with rear cover removed for installation, commissioning and servicing an SF810*i*.

Special handling

SF810*i* requires the care normally used to handle and electronic device (avoid mechanical stress and shocks). Observe the following steps needed to handle electronic circuitry:

- Before opening the SF810*i* enclosure, wear a wrist straps connected to ground (or equivalent anti-ESD system)
- Keep the wrist strap for all the time in which you operate with the SF810*i* enclosure opened
- Handle assemblies by the enclosure; avoid touching the semiconductors pins.

Unpacking and inspection

- Examine the hardware immediately for shipping damage
- Notify the nearest ABB sales office of any such damage
- File a claim for any damage with the transportation company that handled the shipment
- Use the original packing material and container to store the hardware
- Store the hardware in an environment of good air quality, free from temperature and moisture extremes

Protocol and station ADDRESS selection

Before using the SF810*i*, even before beginning to configure it, you must select the protocol of serial communication and the station address (see next paragraph for exceptions).

Available protocols

- Profibus DP V1
- MODBUS

NOTE about baud rate: for Profibus, the baud rate is automatic (imposed by the master station using AUTOBAUD feature) while for MODBUS it is 34800

baud, initially, and can be changed later by the master. Refer to Flame Explorer Manual doc. No. 9AKK101130D3799

Default initial setting

The SF810*i* comes from the factory already configured for MODBUS protocol, station No.1, 38400 baud.

Omitting or postponing protocol-station selection

You can **omit** the protocol and station selection procedure in the following cases:

- Installing the SF810*i* without using the serial communication channels
- Installing a point-to-point MODBUS serial channel (single or redundant) for each SF810*i*. In this case, every unit will be addressed as station 1 on its own network. This could reasonably be the case when the whole flame detection system consists of only one or two SF810*i*.

You can **postpone** the protocol and station selection procedure (you can select them after physical installation of the SF810*i* unit on the burner) in the following case:

- Installing the SF810*i* in a non-hazardous area

Protocol and station address selection procedure

To select the protocol and station address you must operate (turn-on) the SF810*i* with the cover removed, therefore this procedure cannot be performed in an hazardous area.

Before physical installation, select the protocol and station address operating on a bench in a non-hazardous area (for instance in an instrumentation lab).

For the actual procedure, ref. to LOCAL CONFIGURATION, Communication network parameters at page 42.

PHYSICAL INSTALLATION

The SF810*i* flame scanner comply with the safety rules for installation in explosive atmosphere(*).

Installation, removal, assembling and disassembling procedures shall be strictly made in accordance with the “INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS”, (Ref. Doc IM.C-170/06.02)

(*) except for non-ATEX versions

*Note: to prevent moisture to drop into the enclosure, we recommend to install the SF810*i* with cable inlet facing down.*

SF810*i* -LOS (Line Of Sight installation)

Flame Scanner SF810*i* -LOS is typically supplied as part of a complete higher level assembly, as shown in Drawing 3 (APPENDIX 7 DRAWINGS).

Supply generally includes all the indicated accessories, specially designed to easy the assembly / dismantling and the aiming of the flame scanner.

To provide a LOS (also called direct view) installation, drill a 55 mm hole in the burner plate according to the drilling template and fit the swivel flange basement (see item 1 of Drawing 3).
In case a single scanner shall detect both the igniter and main flame, aim the scanner to the primary zone of the main burner flame in a point where the pilot flame intersect the main flame. The effect of any turbulence set by the air register must also be taken into consideration in order to ensure that the pilot flame involves the targeted zone of the scanner.

Connect the air flexible hose in the ¾" provision on the "Y" union (item 3 in Drawing 3).

SF810*i* -FOC (Fiber Optic Cable installation)

The typical application of fiber optic extension are:

- Flexible-extended for corner fired tilting burners
- Rigid-extended for fixed burners large wind box

The extended flame scanner includes both internal and external carrier. The external extension pipe (outer carrier) may be considered a semi permanent component of the burner or relevant air box, as, once mounted, it needs no care or maintenance.
Only the inner carrier, housed in the outer one, incorporates components that may need maintenance and/or replacement (optic fiber lens).

Basic premises to determine the final location of the extended flame scanner are:

- Define where to weld the collar in the burner bucket
- Make sure levers or other mechanical parts do not crunch, bang or cut the outer carrier inside the burner vane.
- Test the corner tilt within the full range and make sure the flexible extension doesn't bend sharply.
- The end part of the outer carrier must be let free to slide inside the collar. The flexible part of the extended scanner shall work as a spring keep pressing the end part into the collar.

The extended flame scanner requires, in all models, low-pressure air (preferably supplied by booster fan). This air is for cooling and cleaning purposes. See specification for air requirement).

WIRING

How to connect the SF810*i* to the Burner Management System, to the communication network, to its power supply and to a Control System in general, depends on the type of SF810*i* you are using (whether it is equipped with terminals or connectorized), on the total number of SF810*i* that are needed and on the architecture of the interconnection network you choose.

The power supply should be distributed to the SF810*i* using one circuit breaker for each flame scanner; this will make possible to turn-off a single unit without affecting the rest of the flame detection system. As an example, a circuit breaker rated 0.5A nominal current and with characteristic curve "K" can be used.

In hazardous area, the cabling system must comply with the applicable safety regulations. How to make your cabling system compliant is outside of the purpose of this manual.

Earth

The SF810*i* must be connected to earth by means of a suitable cable connected to the ground protection terminal available on the enclosure body (it is identified by a yellow earth symbol).
The max allowed length of the earth cable is 3 meters. See APPENDIX 8 - CABLES for specifications of the earth cable.

Wiring: terminal equipped version

NOTE: Please ref. also to APPENDIX 8 - CABLES and to APPENDIX 2 - SPECIFICATIONS to properly select the external cable.

The terminal-equipped versions of SF810*i* (third suffix = T or TL) come with removable, screw-type, terminals.
The multi-conductors cable must be prepared as show in APPENDIX 7 DRAWINGS.

Once the SF810*i* is physically installed in its final location, remove the rear cover.
The cable, once inserted in the cable gland, must be inserted in the cable entry hole of the SF810*i* enclosure.
Then the cable gland can be screwed into place. Do not tight it yet on the cable.
Pull half a meter (approximately) of cable from the rear of the SF810*i*; this is facilitated by the presence of the cable guide that avoid hitting against the internal circuit board and facilitates the passage of the cable.
Next, connect each conductor to the corresponding removable terminal block and tight its screw. Terminate the cable shield, (after having isolated it with a piece of thermal shrinkable sleeve) with a FASTON and insert it in the corresponding male FASTON terminal named “SHIELD”. Now insert each removable terminal block into corresponding sockets and press the conductors gently in order to keep it separated from the threading of the cover and in order to maintain the visibility of the display and the accessibility of the 4 pushbuttons.

NOTE: make a double check of all connections, especially the connection to the relay contacts (J1 terminal block) and verify that all cables are correctly inserted in the screw terminals, that all the screws are tight and that no conductors are exposed.
This is of extreme importance for two reasons: first, if the wires of the relay contacts become short-circuited then you will loose the flame-off detection and this is a severe un-safe condition.
Second, when the relay contacts are connected to 240V_{AC} or other dangerous voltages, there is an obvious risk of electric shocks or short circuits between conductor and the enclosure.

Then you are ready to tight the cable gland and to complete the external wiring.
In order to correctly identify each terminal ref. to Figure 10 below and to Table 6.

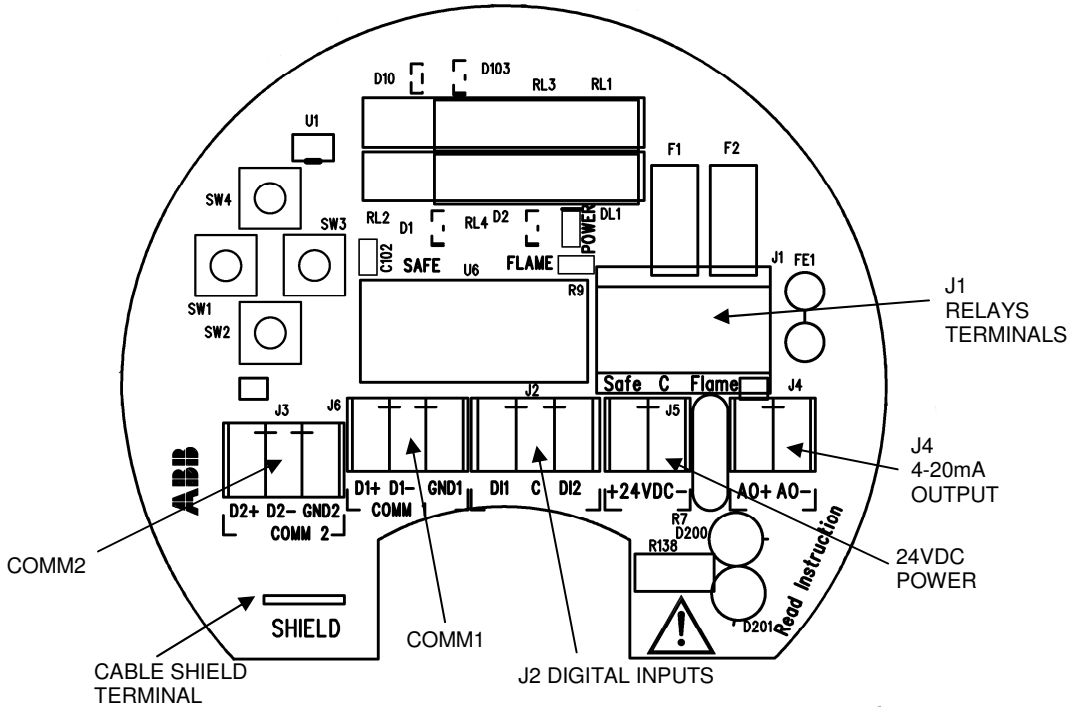


Figure 10 - Removable terminals location

Terminal block / Terminal	Signal name	Description
24VDC / +	$+24V_{DC}$	Power supply positive input
24VDC / -	GND	Return of power supply, ground ref. for all internal electronics
J4 / AO+	AO+	Analog output (4-20mA) positive (externally powered)
J4 / AO-	AO-	Analog output (4-20mA) negative (externally powered)
J2 / DI1	DI1	Digital input 1 (24V, externally powered)
J2 / DI2	DI2	Digital input 2 (24V, externally powered)
J2 / C	DI_common	Common return for DI1 and DI2
COMM1 / D1+	D1+	Serial communication port 1, data TX/RX, positive
COMM1 / D1-	D1-	Serial communication port 1, data TX/RX, negative
COMM1 / GND1	GND1	Ground ref. for serial comm. Port 1
COMM2 / D2+	D2+	Serial communication port 2, data TX/RX, positive
COMM2 / D2-	D2-	Serial communication port 2, data TX/RX, negative
COMM2 / GND2	GND2	Ground ref. for serial comm. Port 2
J1 / SAFE	SAFE	Safe-relay contact (NO)
J1 / FLAME	FLAME	Flame-relay contact (NO)
J1 / C	Common	Common for both Safe- and Flame-relay contacts
SHIELD	Shield	Earth connection point for the shields of the cable(s)

Table 6 - Terminal assignment

Wiring: quick-disconnect version

NOTE: Please ref. also to APPENDIX 8 - CABLES and to APPENDIX 2 - SPECIFICATIONS to properly select the external cable.

The connector versions of SF810*i* (third suffix = Q or QC) come with quick-release connector. You do not need to open the SF810*i* enclosure for making connections. Simply plug the connector cable (or pigtail) into the SF810*i* connector and you are ready for next step. Should you need to identify the pin-out in the socket available on the SF810*i* or in order to solder the external cable conductors in the connector plug, please ref. to Figure 11 and to Table 7 - Connector pin assignment. The pin-out in Figure 11 is as view from the outside of the SF810*i* , where the plug inserts into the socket.

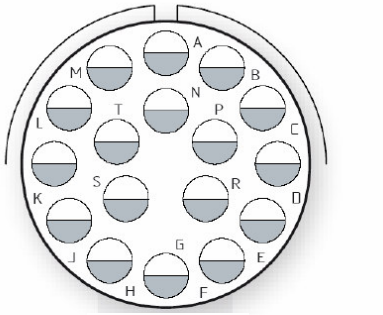


*Figure 11 - Connector pin-out (socket) in SF810*i* , external view*

Pin	Wire color SF810*i* internal wiring	Section mm^2	Section AWG	Signal name	Description
A	GREEN/ORANGE	0.22	24	D2+	Serial communication port 2, data TX/RX, positive
B	GREEN/PURPLE	0.22	24	D2-	Serial communication port 2, data TX/RX, negative
C	GREEN/BLU	0.22	24	GND2	Ground ref. for serial comm. Port 2
D	GREEN/BLACK	0.22	24	D1+	Serial communication port 1, data TX/RX, positive
E	GREEN/RED	0.22	24	D1-	Serial communication port 1, data TX/RX, negative
F	GREEN/LIGHTBLU	0.22	24	GND1	Ground ref. for serial comm. Port 1
G	YELLOW/RED	0.5	20	DI1	Digital input 1 (24V, extern powered)
H	YELLOW/BLUE	0.5	20	DI_common	Common return for DI1 and DI2
J	YELLOW/BROWN	0.5	20	DI2	Digital input 2 (24V, extern powered)
K	RED	1	17	$+24V_{DC}$	Power supply positive input
L	BLACK	1	17	GND	Return of power supply, ground ref. for all internal electronics
M	WHITE/RED	0.22	24	AO+	Analog output (4-20mA) positive
N	WHITE/BLACK	0.22	24	AO-	Analog output (4-20mA) negative
P	ORANGE	1.5	15	SAFE	Safe-relay contact (NO)
R	LIGHT BLUE	1.5	15	Common	Common for both Safe- and Flame-relay contacts
S	PINK	1.5	15	FLAME	Flame-relay contact (NO)
T	GRAY	1.5	15	Shield	Earth connection point for the shields of the cable(s)

Table 7 - Connector pin assignment

Architecture of interconnection network

There are several ways to build the interconnection network for the SF810*i*.

The simplest case is when you are using only one SF810*i* in your system. In that case, all connections are routed from the SF810*i* to the Control System in one single cable path. (Exceptions might apply). For your convenience you might add a junction box along the cable path.

Systems with multiple SF810*i* require more complex interconnection network whose details are not the purpose of this manual. We only point out that the communication network must be a bus structure with each station attached to the bus by means of a short stub. The cable must be terminated on its characteristic impedance at the first station of the bus (usually the master) and the last one.
The power supply can be distributed in a start topology or in a bus topology. Regarding to power, we recommend to insert a circuit breaker for each SF810*i* in order to easily operate on one unit for servicing purpose, leaving the rest of the system unaffected.

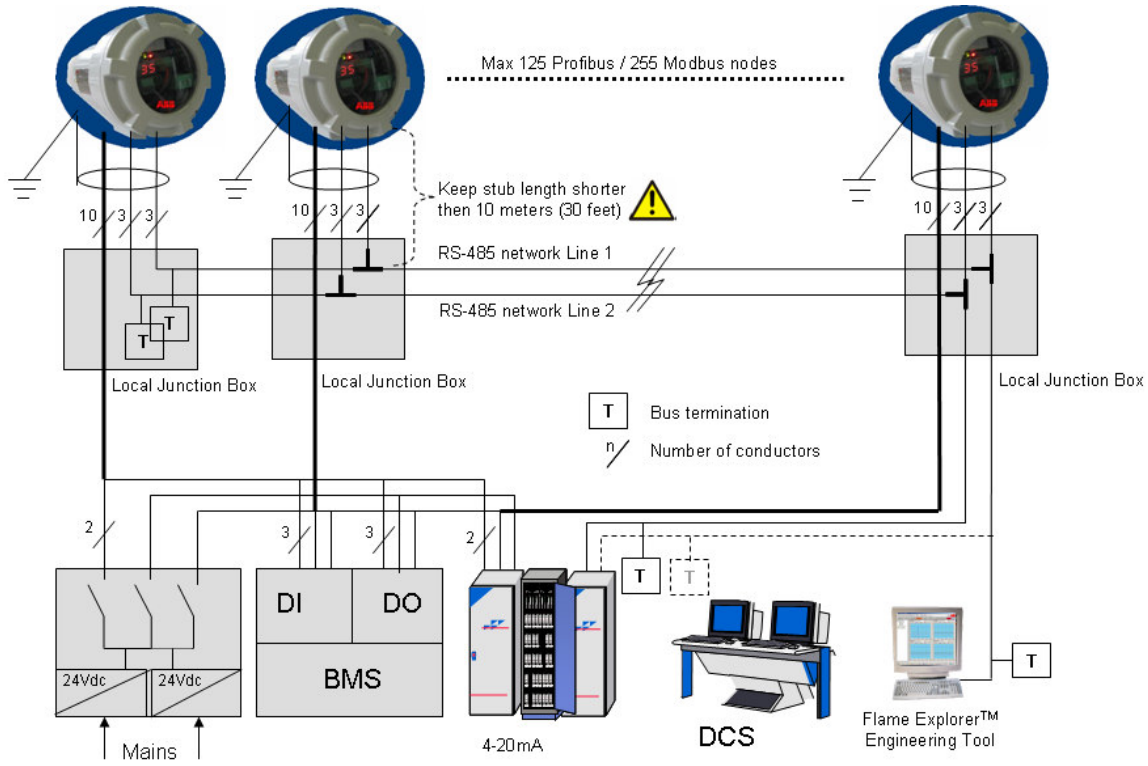


Figure 12 - Interconnection network

***NOTE**: the max number of nodes and the stub length indicated in the figure above are absolute maximum values. These parameters, together with the maximum total network length influence each other and have impact on the maximum attainable transmission speed. The number of stubs (nodes) and their length, for instance, limit the transmission speed. The design of the network layout is out of the purpose of this manual.*

Galvanic isolation

All the external interfaces (terminals) of the SF810*i* are galvanically isolated from the power supply and the internal electronics. The wiring should be done with the suitable care in order to keep the isolation specification. See also APPENDIX 2 - SPECIFICATIONS, Galvanic isolation specifications at page 88, for isolation specifications and Table 8 for a summary of the isolation zones.
Each table entry defines the test voltage between the zone itself and all other zones and chassis connected together.

Zone	Isolation (EN-61010-1)	Pulse voltage (1.2/50us EN-61010-1)	Description
1	510 V_{AC}	850 V_{peak}	Power supply and all internal electronics
2	510 V_{AC}	850 V_{peak}	Analog output 4-20mA
3	510 V_{AC}	850 V_{peak}	Digital inputs
4	510 V_{AC}	850 V_{peak}	Serial comm. port 1
5	510 V_{AC}	850 V_{peak}	Serial comm. port 2
6	2300 V_{AC}	4250 V_{peak}	Relays contacts
7	N/A	N/A	Chassis and Earth

Table 8 - Isolation zones

Cables

In order to meet SF810*i* specifications and relevant certifications, it is mandatory to use cable(s) that comply with the requirement in APPENDIX 8 - CABLES

Closing the enclosure

Now you are ready to screw the circular rear cover in place (remember to tighten the cover locking screw; you need a 2mm Allen wrench or a screwdriver with a 2mm Allen bit).

The threads of the cover must always be well lubricated with grease; otherwise you will not be able to open the cover in future. In case of installation in hazardous areas, then strictly follows the instructions in the document below, even for the relatively simple action of placing the cover in place.

> "INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS"
> Doc. No. IM.C-170/06.02

If the site of installation is not an hazardous area, you can power-on the unit while the cover is still open and begin a simple configuration using the pushbuttons, in order to have a preliminary feedback on its functionality.

Installation is complete.

Refer to the next sections of this manual for explanations on pushbuttons, LEDs, operational modes, display, configuration, local configuration and configuration parameters.

PUSHBUTTONS

The SF810*i* is equipped with 4 pushbuttons, miniature (UP, DOWN, LEFT, RIGHT).

Pushbuttons location

The miniature pushbuttons are located in the round terminal board and is accessible only when the enclosure cover is unscrewed. Ref. to Figure 13.

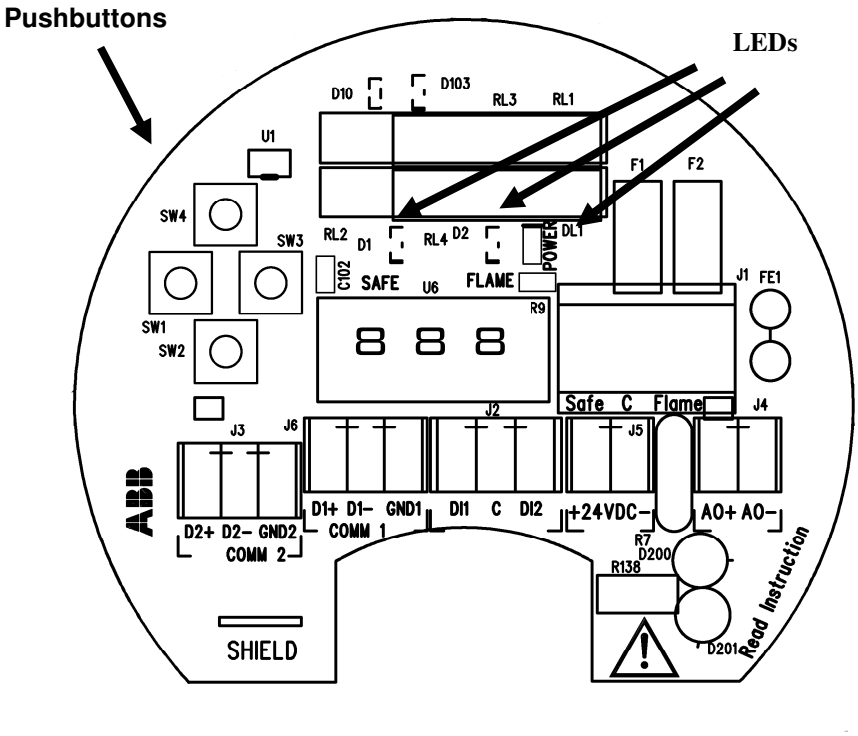


Figure 13 - Pushbuttons and LEDs location

Pushbuttons are intended to be used, together with the local 3-digits display, for local configuration.

If your SF810*i* is installed in an hazardous area you cannot operate on the pushbuttons (you cannot have the SF810*i* powered up while the cover is removed). In this case you have to provide every configuration through the serial communication channels.

See OPERATIONAL MODES at page 38 for information about the modes of operation.

LEDS

SF810*i* has three LEDs located on its terminal board. If your SF810*i* is equipped with the aluminum “blind” rear cover, then the LEDs are visible only when the enclosure cover is removed. If your unit is equipped with the transparent-window rear cover then you have continuous visibility of LEDs (and of the display). Ref to Figure 13 above for LEDs location. The LEDs are intended as visual feedback devices to help during configuration of the SF810*i* and (when using transparent-window rear cover) give immediate visual feedback of the status of Safe- and Flame-relay contacts.

Power LED

The rightmost LED is a power indicator that shows a green color when power is applied to the SF810*i*.

Safe LED

The leftmost LED is a bi-color indicator that illuminates:

- Red when the SF810*i* internal diagnostic and self-checking circuits determine a fault or an unsafe condition. When this LED illuminates in red, the corresponding relay (Safe-relay) will be de-energized. The Flame-relay will be de-energized too, for safety reasons.
- Green when the SF810*i* internal diagnostic and self-checking circuits detects no problems. In this case the corresponding relay is energized.
- When the Safe-relay is functioning as second Flame-relay or as Quality-relay, or as internal temperature relay, the status of this LED follows the status of its source. I.e.: green when the relay is energized and red when it is de-energized.

`

Flame LED

The centrally located LED is a bi-color indicator that illuminates:

- Green when the SF810*i* internal Flame Algorithm proves that the flame is present. In this condition the corresponding relay (Flame-relay) is energized.
- Red when there is no flame or (independently from the flame) if the internal diagnostic detects a problem (see Safe LED above).
- Blinking red (see note): the unit is functioning with the factory-default configuration (first-time power-up).
- Blinking fast red: the unit has detected a noise, that means the detected frequency signal is too steady to be coming from a real flame (please see Noise error paragraph in Diagnostics chapter for important information about this feature).
- Blinking green: the unit is functioning with the Flame-relay overridden; this means that, for a period of 60 minutes since the override command has been issued, the unit will maintain the flame relay energized no matter what the Flame Algorithm proves. The normal functionality of the relay can be restored immediately using the Flame Explorer software tool.

NOTE: the Flame LED blinks red even is the following conditions:

- *An AC-mains frequency noise is detected in the electronic boards (see troubleshooting) or*
- *You are aiming the SF810*i* to a AC-mains powered light source (usually a bulb or a fluorescent lamp).*

OPERATIONAL MODES

The SF810*i* uses three modes of operation. In each mode the SF810*i* operates to provide the optimal user interface.

The operational modes are:

- First-time power-up mode
- Normal mode
- Configuration mode

Except for the first-time power-up, the modes of operation are not mutually exclusive. For instance, when configuring, the SF810*i* maintaining its operability belonging to the normal mode (i.e. it continues to detect the flame if it was in Normal mode before entering the Configuring mode). In other words, the SF810*i* is “on-line configurable”.

First-time power-up mode

When the SF810*i* is factory new, or when you make a complete reset of the configuration to factory defaults, or when the configuration stored in non-volatile memory is not recognized as a valid one, it operates in a mode called “First-time power-up”.

The most important feature of this mode is to prevent Flame-relay from energizing until the user performs a configuration/tuning.

In this mode:

- Flame-relay is not energized (even if the Flame Algorithm votes for flame-ON)
- Flame LED is blinking red

A distinction must be done at protocol level:

- Factory default and manual reset of the configuration, both bring the unit in MODBUS mode, speed of 38.400 b/s and station address equal to one.
- Reset to default configuration driven by the detection of a configuration error maintains the protocol that was active BEFORE the configuration error was detected (i.e. if the unit was operating in Profibus, it remains in Profibus).

To exit from this mode, the user must configure (either using the Flame Explorer tool or locally with pushbuttons) the SF810*i*.

SF810*i*, when used with its communication line(s) in a bus architecture, needs a *basic configuration* to be done before installation. This basic configuration consists in the selection of the serial line communication protocol and the assignment of the station address.
These selections must be done manually with the rear cover open and while the unit is powered. Therefore, in case the unit is to be installed in an hazardous area, these initial settings cannot be performed on the final location; the unit protocol and address must be selected prior to the actual physical installation, operating on a lab bench in a non-hazardous area. The initial basic configuration requires connection to a $24V_{DC}$ power supply only.

Refer to page 42 for additional information.

Normal Mode

Normal monitoring of the flame.
While in this mode, the configuration cannot be changed (password protected).

Configuration Mode

Configuration of the SF810*i* unit and its relays.

The Configuration mode can be entered remotely, using the Flame Explorer SW Tool (running on a PC connected through the serial line) or locally using the 4 pushbuttons.

To be allowed to remotely enter configuration mode, you must supply a password. When you install the SW tool for the first time, the password is blank. Please make sure that you submit a password and disclose it only to the personnel who has the clearance and the knowledge to make changes into the configuration of the SF810*i*.

OPERATING DISPLAY

At power-on the unit displays briefly **"X.x"** (where 'X' is a letter and 'x' is a number, representing the software version installed into the unit, that is B.0 at the time of print of this manual), followed by **"1 – I"** and then by a number. This number is the detected value for flame intensity. So, when the unit is in "normal' mode and is operating properly, it shows on the display the detected value for flame intensity.

***NOTE**: modules with firmware version B.0 or higher will start showing by default the value that is also outputted on the 4-20 mA Analog Output.*

Using UP and DOWN buttons, it is possible to navigate through the current values as explained below.

Displays

Once positioned on the first value, pressing DOWN will show:

"1 – I"
Followed by the current Intensity value

"1 – F"
Followed by the current Frequency value

UP brings the visualization back to Intensity, DOWN will show:

"1- A"
Followed by the current AC Amplitude value if AC amplitude is Enabled (can be enabled from the Flame Explorer tool only, default is NOT enabled), otherwise will appear:

"1 – Q"
And then the current quality value.

For a single sensor unit, this is all that can be shown; further pressures on DOWN button will have no effect, while pushing UP button the visualization will scroll back to Quality, then AC amplitude (if configured), Frequency and, finally, intensity.

Displays for dual sensor

If the module is "dual sensor" (or single sensor with safe relay used as second flame relay), pressing DOWN button you can also read the current values for sensor 2:

"2 – I", then **"2 – F"**, then **"2 – A"** (if configured), and finally **"2- Q"** that is the last value shown.

From this point, pressing DOWN button again has no effect, while pushing UP button allows you to navigate back as in the previous example.

CONFIGURING

Local and remote configuration

There are several ways to configure the SF810*i*:

1. Locally, by means of the display and pushbuttons (operating with open enclosure, in non-hazardous area). Limited configuration capability.
2. Locally (MODBUS), by means of a PC (running Flame Explorer Software) connected with a short cable to one of the two serial channels of the SF810*i* (operating with open enclosure, in non-hazardous area). Full configuration capability.
3. Remotely (MODBUS), by means of a PC (running Flame Explorer Software) connected to the end of the communication network that, very likely, connects together all the SF810*i* of the system. Full configuration capability.
4. Remotely via the Profibus line. This allows full configuration capability.

NOTE: above points 2 and 3 are considered equivalent for the purpose of the following explanations. They can be referred to as MODBUS remote configuration.

LOCAL CONFIGURATION

SF810*i* Integrated SafeFlame Scanner is equipped with a local keyboard made by 4 pushbuttons (UP, DOWN, LEFT and RIGHT keys). By means of this keyboard it is possible to locally configure a limited set of functions necessary for SF810*i* to work properly, like the serial communication protocol type or basic parameters of the Flame Algorithm.

The local configurable parameters are explained below. They belong to two groups: communication parameters and Flame Algorithm parameters.

Communication network parameters

SF810*i* supports, as slave device, two serial communication protocols:

- MODBUS communication protocol
- Profibus DP-V1 communication protocol

The communication network parameters can be configured **ONLY** locally by pushbuttons.

Procedure

1) Open the SF810*i* cover and apply 24V_{DC} to turn it on.

2) Wait a few seconds until a number is shown on the display. The display sequence at power-on is:
   X.x (Firmware rev. - for instance A.6, or B.0)
   Y.Y (stands for the value that drives the analog output)
   XXX (number, actual value of the intensity)

3) Keeping LEFT pressed for al least 10 seconds, brings the unit into the communication programming mode.
   Then, a first display shows the communication protocol at present active:
   Mb . (when MODBUS protocol is active)
   Pb . (when Profibus protocol is active)

4) Pressing RIGHT you enter a menu where it is possible to change the active protocol. You can scroll the available options using UP and DOWN:
   MDB MODBUS protocol
   PFB Profibus protocol
   REC Permanent storage of the selected protocol

5) By pressing RIGHT again, a first sub-menu is entered, where by pressing UP and DOWN it is possible to move inside this menu level and then configure other parameters for the selected protocol.
   When MODBUS protocol is selected, the following items are displayed:
   AD1 Device address 1
   AD2 Device address 2
   BDR Communication baud rate

   When Profibus protocol is selected:
   AD1 Device address

5) By pressing RIGHT again, the current value of the selected item is displayed, which can be modified by pressing UP and DOWN in order to increase/decrease the displayed value.

In case of **device address** item is selected, the allowed value ranges from:

1 to **254** if MODBUS protocol is selected
1 to **126** if Profibus protocol is selected

In case of **baud rate** item is selected, the allowed value ranges from **0** to **3**, where:
0 selects **9600 bps**
1 " **19200 bps**
2 " **38400 bps**
3 " **115200 bps**

6) By pressing RIGHT again, the displayed value is stored in a temporary variable. The temporary storage operation is confirmed by the display showing "***tS***", for a few seconds. Instead, by pressing LEFT it folds back to higher menus (one level each pressure).

7) In order to permanently store the selections, it is first necessary to store in temporary storage the modified parameters and then, at the end of configuration phase, to go ***REC*** entry and pressing RIGHT (see diagram on next page). The storage operation is confirmed by the display showing "***Sto***", for a few seconds).This operation, besides storing all the last programming phase, resets the SF810*i* unit, if a protocol change has been selected (*Modbus* to *Profibus* or vice versa), showing the **F25** code on display; the SF810*i* unit will restart with the newly selected protocol after you manually power it OFF and power it ON again.

NOTE: If no permanent storage operation is done, all modified data will be lost when exiting from the configuration phase.

8) You can exit from the programming phase by pressing many times LEFT (until you get out of the configuration menu) or after 20 seconds of keyboard inactivity.

The above procedure is schematically represented in Figure 14 below.

WARNING: a duplicate station address will generate serious trouble on the communication with all SF810*i* connected on the same network.

Create and maintain a data base of all SF810*i* installed in your flame detection system and their station addresses. It will be useful in case of fault. The replacement SF810*i* must be configured with the correct address before being put in service.

NOTE*: when configuring MODBUS protocol, do not use address number 1, which is the default one, that is, the one the unit picks up when working with the factory-default configuration. This address is the one the unit would pick-up if errors were found in the configuration or if the user requested a reset to factory-default through the local display and pushbuttons. Remember that having more than one node in a multi-point line with the same address will likely cause problems and make the whole line unavailable.*
Likewise, Profibus default address for the SF810i is 7. Please change it to any other address (between 1 and 125) before installing the unit into a multi-point Profibus line.

NOTE*: after 20 seconds of inactivity (no button pressed) the SF810i exits from the configuration mode.*

Communication network parameters menu structure:

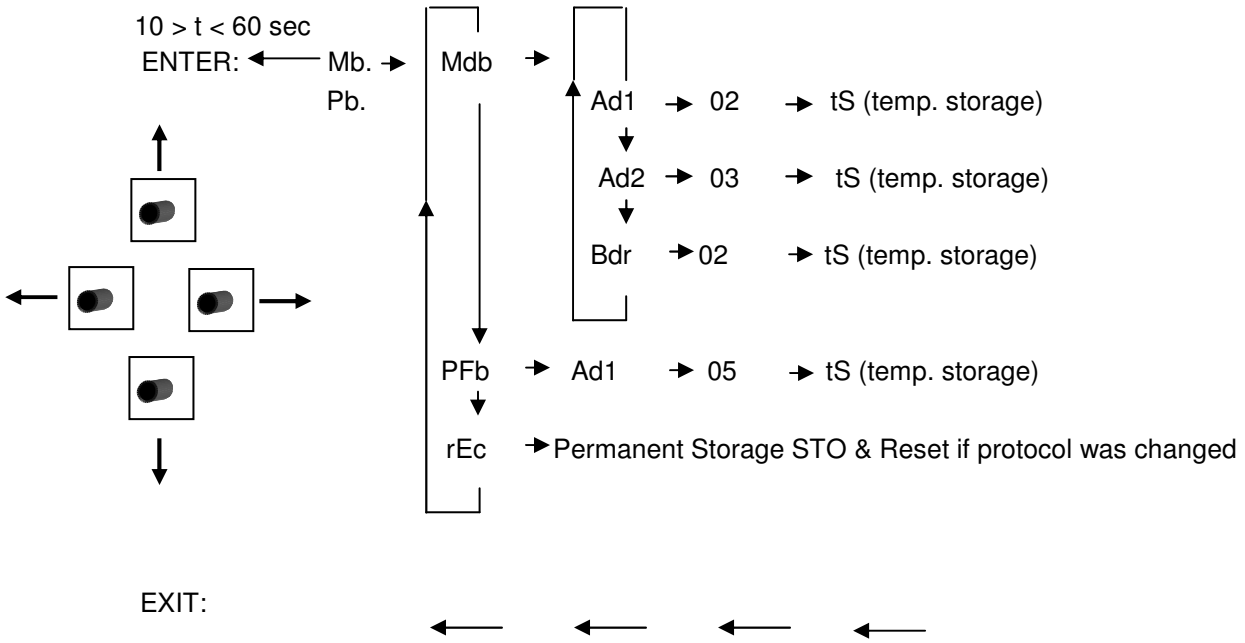


Figure 14 - Communication network parameters menu structure

Flame Algorithm parameters - local configuration

SF810*i* flame scanner can operate using up to 4 (four) different function sets (FSA, FSB, FSC, FSD). Each function set contains the necessary parameters to flame detection.
It is possible to program, by means of the local keyboard, a set of limited basic parameters belonging to each of the 4 function sets, made up by the following:

- Pull-In for Intensity, Frequency and AC Amplitude
- Drop-Out for Intensity, Frequency and AC Amplitude
- Frequency Sensitivity
- Delay Drop-out

Keeping pressed RIGHT for al least 10 seconds brings the module into the flame parameters programming mode.
Following this action a first display shows the function set currently active.

A.. : Indicates that the function set FS_A is active
B.. : Indicates that the function set FS_B is active
C.. :Indicates that the function set FS_C is active
D.. :Indicates that the function set FS_D is active

If SF810*i* is configured to operate as dual sensor, or the safe relay has been configured to be the second flame relay, the following will be shown:

AC. :Indicates that the function sets FS_A and FS_C are active (FS_A for the flame relay, FS_C for the safe relay).
AD. :Indicates that the function sets FS_A and FS_D are active (FS_A for the flame relay, FS_D for the safe relay).
BC. :Indicates that the function sets FS_B and FS_C are active (FS_B for the flame relay, FS_C for the safe relay).
BD. :Indicates that the function sets FS_B and FS_D are active (FS_B for the flame relay, FS_B for the safe relay).

Pressing RIGHT again it is possible to configure new flame parameters
You can scroll the available choices using UP, DOWN:

FSA: Function set A parameters programming
FSB: Function set B parameters programming
FSC: Function set C parameters programming
FSD: Function set D parameters programming
DEF: Restore default configuration
REC: Permanent storage of the carried out programming

Pressing RIGHT enters a first submenu, where it is possible to program the allowed flame parameters. You can scroll the available choices using UP, DOWN:

IPI: Intensity Pull-In
IDO: Intensity Drop-Out
INO: Intensity Normalization
FPI: Frequency Pull-In
FDO: Frequency Drop-Out
FNO: Frequency Normalization
API: AC Amplitude Pull-In (this item is present if AC Amplitude is enabled)
ADO: AC Amplitude Drop-Out (this item is present if AC Amplitude is enabled)
ANO: AC Amplitude Normalization (this item is present if AC Amplitude is enabled)
FSY: Frequency Sensitivity
DDI: Delay Pull-In
DDO: Delay Drop-Out (FFRT flame failure response time)

By pressing RIGHT, the current value of the selected item is displayed, which can be modified by pressing UP, DOWN in order to increase/decrease the displayed value. Pressing RIGHT again stores the displayed value in a temporary variable. The temporary storage operation is confirmed by the display showing "***tS***", for a few seconds.
Instead pressing, LEFT you go back to higher menus (one level each pressure).

To store the parameters it is necessary, first, storing in temporary storage the modified parameters and, then, at the end of programming phase, going to ***REC*** item and press RIGHT . The storage operation is confirmed by the display showing "***STO***", for a few seconds.

If no permanent storage operation is done, all modified data will be lost when exiting from the configuration phase.

The ***DEF*** *field* allows the current configuration to be overwritten with the factory default one. This operation is executed by pressing RIGHT, and it is confirmed by pressing both UP and DOWN at the same time, after which the display shows "***STO***", for a few seconds.

You can exit from the programming phase by pressing LEFT several times LEFT (until you arrive to highest menu); after 1 minute of keyboard inactivity, the programming mode is spontaneously aborted.

The programming procedure is schematically depicted in Figure 15.

Table 9 shows the minimum, maximum and default values for the parameters configurable locally.

PARAMETER	***MINIMUM VALUE***	***MAXIMUM VALUE***	***DEFAULT VALUE***
Intensity Pull-In	5	80	30
Intensity Drop-Out	5	80	30
Intensity Normalization	1	(***)	20
Frequency Pull-In	5	100	5
Frequency Drop-Out	5	100	5
Frequency Normalization	1	(***)	20
AC Amplitude Pull-In (**)	0	80	0
AC Amplitude Drop-Out(**)	0	80	0
AC Amplitude Normalization	1	(***)	20
Frequency Sensitivity	10	100	55
Delay Drop-Out (FFRT)	0.2 (sec)	4.0 (sec)	2.0 (sec)
Delay Pull-In	0.1 (sec)	10.0 (sec)	0.1 (sec)
Quality Threshold (*)	10	95	50

Table 9 - Range and default for Function Set parameters

(*) Not configurable locally with pushbuttons. Requires Flame Explorer SW Tools connected through serial port.
(**) Available if AC Amplitude is enabled. To enable AC Amplitude requires Flame Explorer
(***) Maximum depends on the configured Drop-Out value. The normalization is referred to the calculation of the flame quality value.

NOTE: locally, by pushbuttons, you can edit the parameters of all 4 functions sets but you cannot select the active function set. This can only be done by Digital Inputs or using the Flame Explorer SW tool.

When using Digital Inputs for Function Set selection, in order to maintain a safe behavior the user must configure the four Function Sets in the following way:

Digital Input (1=asserted) DI_2	DI_1	Function set	Usage
0	0	FS_A	Safety setting (*)
0	1	FS_B	Operating setting x (**)
1	0	FS_C	Operating setting y (**)
1	1	FS_D	Safety setting (*)

Table 10 – Function Set selection through DI

(*) a setting that gives a "flame not proven" result, independently of the flame (Flame-relay de-energized)

(**) x, y are any settings that are adequate for two values of burner load / fuel switching

Flame parameters configuration menu structure (this is an example, not all programmable fields have been included for brevity):

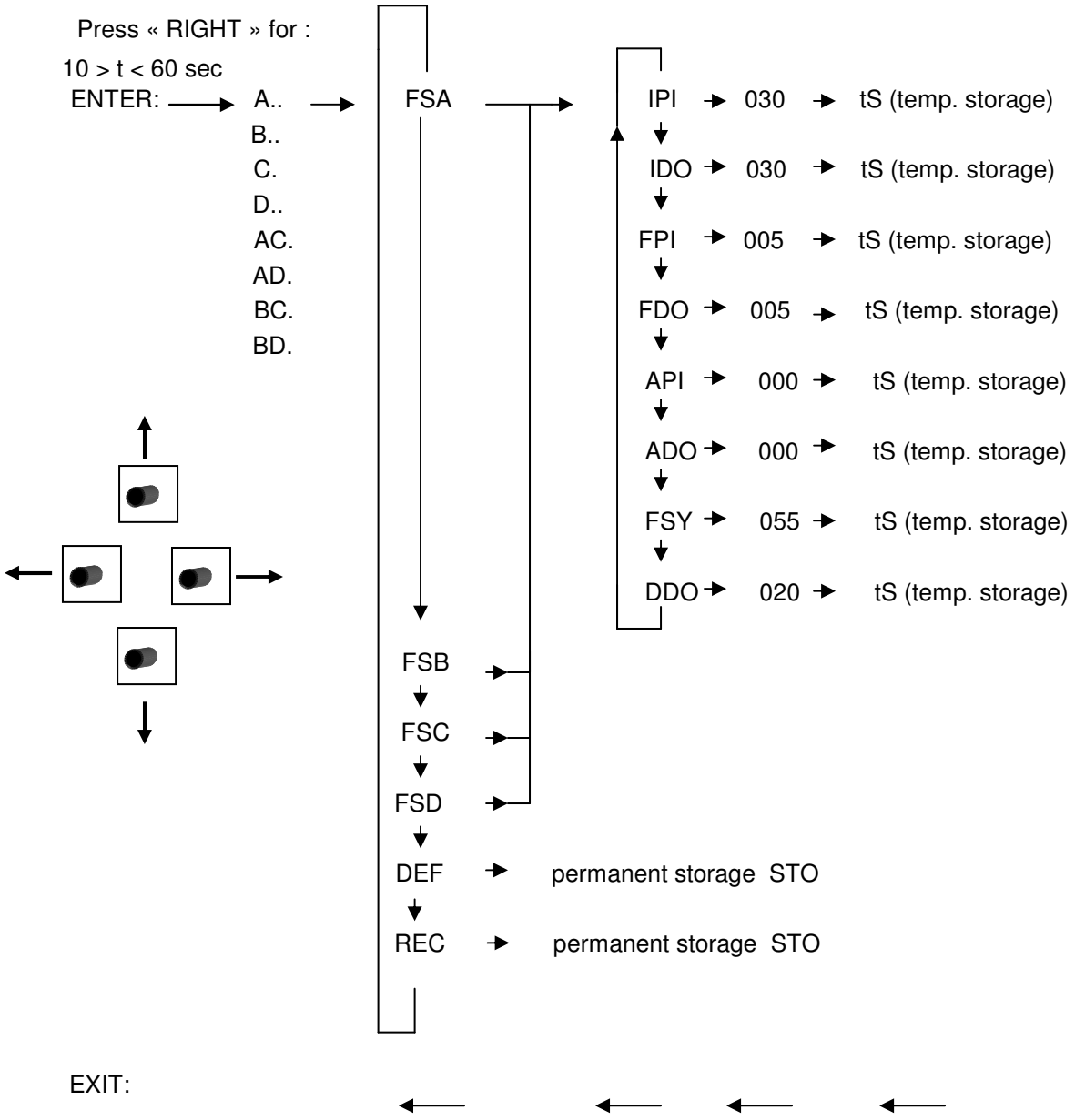


Figure 15 - Flame Algorithm parameters menu structure

CONFIGURATION PARAMETERS

There are many parameters that, combined together, form the configuration of a SF810*i*. In this section each of these parameters is described in detail.

Please be aware that most parameters are configurable only using the Flame Explorer tool or through the Profibus master.

A subset of parameters (main values for each Function Set and basic communication setting) can also be modified locally.

The main parameters page of the Flame Explorer tool for the SF810*i* is shown in the next picture. Note that on the left side are the parameters which normally don't change (or are very seldom changed), whilst on the right part are the parameters that can be changed more frequently (such as Pull-In and Drop-Out values).

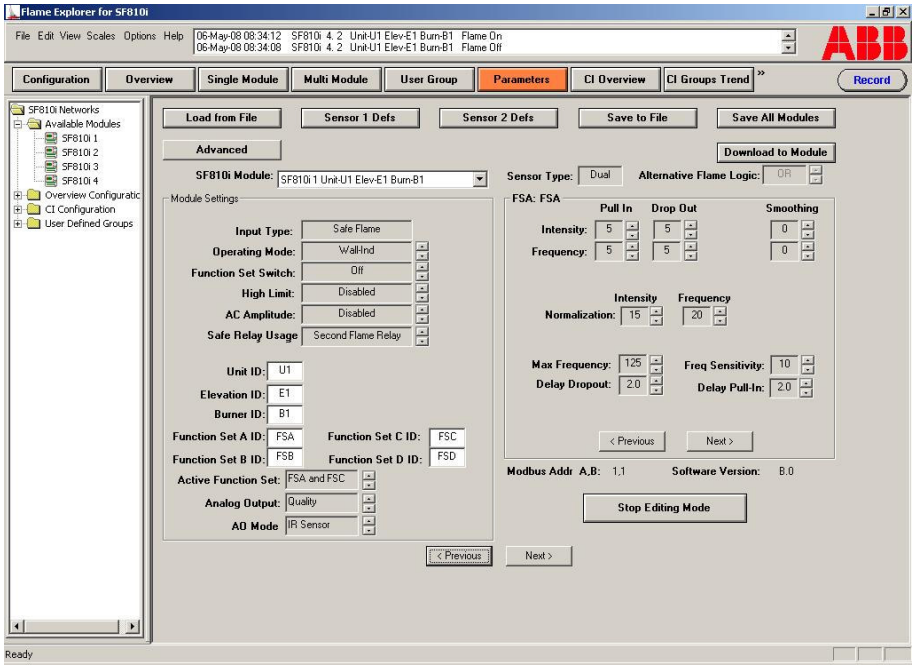


Figure 16 - Parameters page on Flame Explorer

Sensor Type

The sensor can be:

Single VL
Single IR
Single UV
Dual (UV+IR)

The configuration simply needs to know if the sensor is single or dual (this information is needed to the Flame Calculation Algorithm). No details on the sensor spectral sensitivity are needed at this point. The sensor type is automatically recognized by the firmware residing on the SF810*i*. The sensor type can be read from the tool accessing to the unit's advanced status page (see Show Sensor Type) in this chapter.

Alternative Flame Logic (for DUAL sensor modules only)

This field is editable only if the SF810*i* is working with a dual sensor. In this case, it is possible to configure the unit to vote flame conditions by calculating an OR or an AND of the flame condition detected independently by the two sources.

- Selecting OR, the unit will vote FLAME ON if at least one of the two sources detects flame presence .
- Selecting AND, the unit will vote FLAME ON if both sources detect flame presence

Operating mode

Can be:

Wall Industrial (default)
Lighter
Turbine
Corner

Function Set Switch

In some firing systems the characteristics of the Measured-Values may change with the fuel used (multi-fuel burners) or with the load. Under these circumstances the ideal Flame-Logic settings may be different depending on fuel or load.
With these conditions a user can implement the Function Set Switch feature to more precisely determine flame characteristics.
The Function Set Switch parameter determines how flame presence is voted into the SF810*i*. This is explained below. (Function Sets are referred to as FSA, FSB, FSC, FSD).

Off

Flame presence is always voted using:

Single Sensor, Safe-relay used as safe:

FSA for flame relay.

Single Sensor with Safe-relay as second Flame-relay:

FSA for flame relay, FSC for Safe-relay.

Dual Sensor, Safe-relay used as safe:

Use FSA for UV sensor, FSC for IR sensor, result on Flame-relay

Dual Sensor, Safe-relay used as second Flame-relay (related to IR sensor):

Use FSA for Flame-relay, FSC for Safe-relay

On through digital inputs

In this mode, the Function Set used to vote Flame is commanded by the status of the two digital inputs of the SF810*i* :

Single Sensor, Safe-relay used as safe:

DI 1 = 0	DI 2 = 0	Use FSA for Flame-relay
DI 1 = 1	DI 2 = 0	Use FSB for Flame-relay
DI 1 = 0	DI 2 = 1	Use FSC for Flame-relay
DI 1 = 1	DI 2 = 1	Use FSD for Flame-relay

Single Sensor with Safe Relay as second Flame-relay:

DI 1 = 0	DI 2 = 0	Use FSA for Flame-relay, FSC for Safe-relay
DI 1 = 1	DI 2 = 0	Use FSB for Flame-relay, FSC for Safe-relay
DI 1 = 0	DI 2 = 1	Use FSA for Flame-relay, FSD for Safe-relay
DI 1 = 1	DI 2 = 1	Use FSB for Flame-relay, FSD for Safe-relay

Dual Sensor, safe relay used as safe:

DI 1 = 0	DI 2 = 0	Use FSA for sensor 1, FSC for sensor 2, result on Flame-relay
D I1 = 1	DI 2 = 0	Use FSB for sensor 1, FSC for sensor 2, result on Flame-relay
D I1 = 0	DI 2 = 1	Use FSA for sensor 1, FSD for sensor 2, result on Flame-relay
DI 1 = 1	DI 2 = 1	Use FSB for sensor 1, FSD for sensor 2, result on Flame-relay

Dual Sensor, safe relay used as second flame relay (related to IR sensor):

DI 1 = 0	DI 2 = 0	Use FSA for Flame-relay, FSC for Safe-relay
DI 1 = 1	DI 2 = 0	Use FSB for Flame-relay, FSC for Safe-relay
DI 1 = 0	DI 2 = 1	Use FSA for Flame-relay, FSD for Safe-relay
DI 1 = 1	DI 2 = 1	Use FSB for Flame-relay, FSD for Safe-relay

On through serial line

In this mode, the Function Set used to vote Flame is commanded by the status of Active Function Set field (two bits), that can be written via serial line on both MODBUS and Profibus.

As per the relays usage, are applied the same rules as in the “On through Digital Inputs” section of this paragraph.

Use Hi Limit

This function activates the High-Limit trip function. If the High-Limit function is activated, the SF810*i* will vote a Flame-Off condition when the measured-Values exceed the programmed High-Limit values.
In most applications the High-Limit function is OFF.

Use AC Amplitude

This function activates the AC-Amplitude Measured-Value, that hence enters in the equation that determines the presence of flame. If AC-Amplitude is activated, the SF810*i* will vote a Flame-Off condition if the AC-Amplitude drops below the programmed Drop-Out value.
In most applications the AC-Amplitude function is OFF.

Unit IDs

Each unit can be uniquely identified using three category fields. Each field can have up to four alphanumeric characters.
• These IDs are NOT required for basic flame detection.

Channel Identifiers

• Unit ID.
• Elevation ID.
• Burner/Combustor/Corner/Lighter ID.

Function-Set Identifiers

You can assign names to the Function-Sets..

- Function-set A ID - Sets the identification of the first Tuning Function-Set.
- Function-set B ID - Sets the identification of the second Tuning Function-Set.
- Function-set C ID - Sets the identification of the third Tuning Function-Set.
- Function-set D ID - Sets the identification of the fourth Tuning Function-Set.

Active Function Set

Gives information about which Function Sets are active. If “Function Set Switch” is configured to be “On through Serial Line”, this field can be edited to decide which Function Set(s) must be used to vote flame condition.

Safe relay usage

Safe relay can be used in four different ways. Please see “Relay assignment” chapter for details.

Analog Output

Use the Analog Output function to specify the type of information that will be transmitted to the 4 to 20 analog output. This information can be related to:

Intensity
This option will output the Intensity value in a range of 4 to 20 mA = 0 - 100%.

Frequency
The Frequency option outputs the Flicker-Frequency value which is proportional to the maximum Flicker-Frequency for the application selected.
For Corner applications:
- 4 to 20 ma = 0 - 125 Hz.

For Wall/Industrial applications:
- 4 to 20 ma = 0 - 125 Hz.

For Lighter applications:
- 4 to 20 ma = 0 - 125 Hz.

For Gas Turbines:
- 4 to 20 ma = 0 -125 Hz or 0 - 250 Hz.

AC-Amplitude
This option will output the AC-Amplitude in a range of 4 to 20 mA = 0 to 100%.

Quality (default)
The Quality option will output the Quality value in a range of 4 to 20 mA = 0 to 100%.

CI (Combustion Index)
The CI option will output the CI value in a range of 4 to 20 mA (0 to 100).

Load Default Parameters

From the local pushbuttons / display it is possible to request to the unit to load back its factory default parameters.
In this way ALL the unit parameters will be brought back to the factory default with the following exception the active protocol will NOT change:

- if the unit is MODBUS it will remain MODBUS (but will bring back address and baud rate to 1 / 38.400).
- if the unit is Profibus it will remain Profibus (but will bring back address to the default value of 7).

NOTE: Profibus is AUTOBAUD, meaning that the Profibus chips are capable to understand the baud rate required by the Master Station. So, there is no need to configure the baud rate for Profibus.

Show Sensor Type (Diagnostic page)

To make sure that the sensor type matches with the sensor declared on the unit's label, from the tool access to the diagnostic page and read the sensor type field:

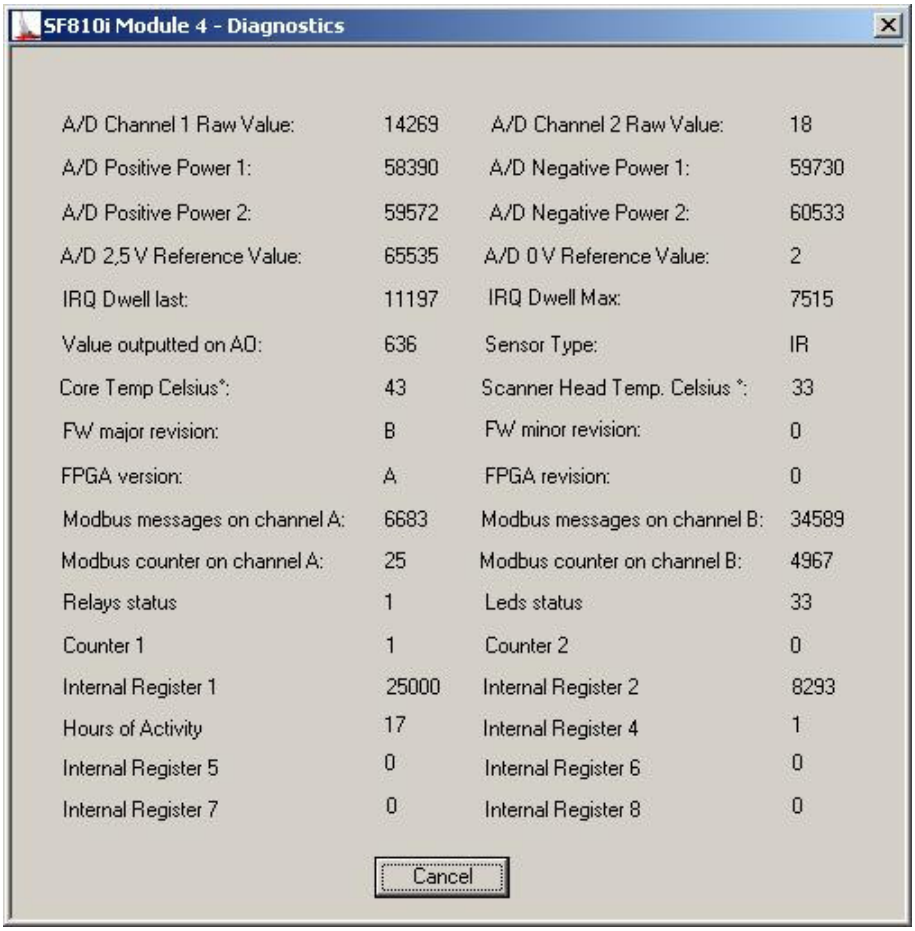


Figure 17 - Diagnostic page on Flame Explorer

Show Software Version

On the parameters page, bottom-right corner, the firmware version of the unit is shown (see Figure 16), for instance "A.6" or "B.0" may be shown.

Currently Selected Tuning Function-Set

As explained above in this chapter, it is possible to instruct the unit on the Function Set(s) to be used in Flame Calculation Algorithm. The currently active Function Set(s) is shown in the unit's "Status" page of the Flame Explorer tool.

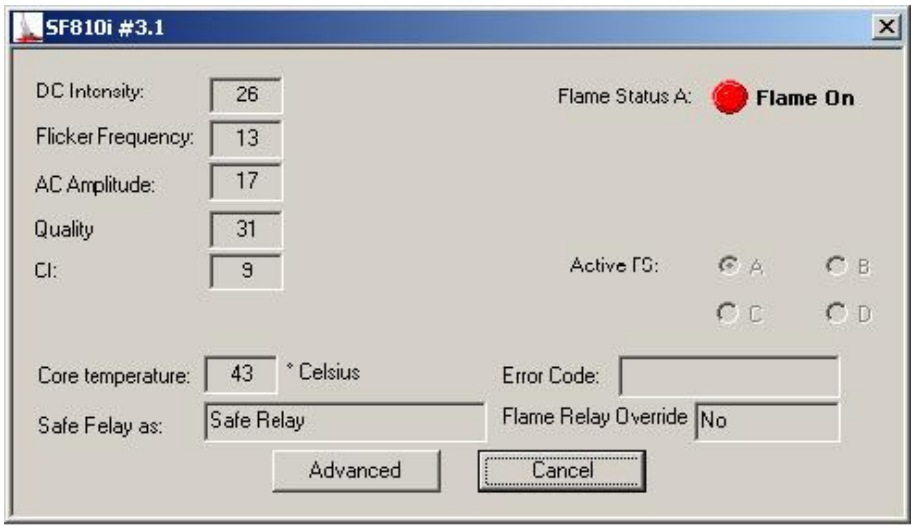


Figure 18 - Active Function Set from "Status" page on Flame Explorer

Recommended initial settings

The recommended initial settings for specific Applications can be found in Appendix D, Recommended Initial Settings. These setting allow the SF810*i* to operate effectively in most configurations.

The specific Program-Mode functions are described in the following sections in the order of appearance on the menu.

Function Set to Edit

Locally it is possible to configure only the main parameters of each function set. Using the tool (in MODBUS) or via Profibus it is possible to modify all the parameters of each function set.

Trip Points

Adjust the Pull-In, Drop-Out, and High-Limit values for Measured-Values with the following considerations:

• The AC Amplitude trip values for the Measured-Values will only be available for editing if you have enabled the Use AC Amplitude function.

• The High-Limit trip values for the Measured-Values will only be available for editing if you have enabled the High-Limit function.

• If the Pull-In value is changed, the Drop-Out value will automatically change to the same value as the Pull-In. To set a different Drop-Out value, make a manual change.

Quality Normalization

The Quality Normalization values allow you to increase or decrease the sensitivity of the Quality Calculation.

- A low Normalization value causes less sensitivity. This causes the Quality value to rapidly change from 100% to 0%.

! This rapid change may provide very little warning of a problem before the Flame-Proven condition is lost.

- A high normalization value causes increased sensitivity. This causes the Quality value to change by small increments.
  ! With this feature you can detect small changes in the flame signal. You are more likely to spot combustion problems before they lead to a Flame-Off condition.

Quality Normalization Parameters:

$$\text{Quality} = \left(\frac{\Delta F}{F_n}\right) \times \left(\frac{\Delta I}{I}\right) \times \left(\frac{\Delta AC}{AC_n}\right) \times 100\%$$

Where:

$\Delta F = F - F_d$

$\Delta I = I - I_d$

$\Delta AC = AC - AC_d$

And:

F, I, and AC are actual flame signal values

F_d, I_d, and AC_d are drop-out settings

F_n, I_n, and AC_n are normalized (weighted) values

Frequency Sensitivity

Frequency Sensitivity impacts the Flicker-Frequency measurement.
The higher the Frequency Sensitivity setting, the lower the measured Flicker-Frequency.
Frequency Sensitivity is adjustable in increments of 1, between a low of 10 and a maximum of 100. The highest Flicker-Frequency will be measured at a setting of 10 and the lowest Flicker-Frequency at a setting of 100.

Accounting for Background Light

In some Applications the change in Flicker-Frequency resulting from a change in Frequency Sensitivity may be different for light in the background when compared to the burner flame.
In these cases the Frequency Sensitivity function can be used to maximize the difference between burner ON and burner OFF (background) Flicker-Frequencies.
The SF810*i* is then able to discriminate between the burner flame and background light.

Detecting Flicker-Frequency Noise

The SF810*i* has a precision A/D converter that is capable of measuring very small Flicker-Frequency levels in the flame scanner input signal.
If electrical noise exists in the flame scanner wiring, the SF810*i* may detect the electrical noise if the Flicker-Frequency sensitivity is set too low.
During initial flame scanner tuning, the system should be checked to insure that no electrical noise is present.

Check for Electrical Noise

- Darken the flame scanner by making sure that it is not exposed to any flame or ambient light.
- Set the Flicker-Frequency sensitivity to the minimum value expected for the application.

- Select frequency as the value to be shown on the display/

  The Flicker-Frequency displayed should be 0 Hz. If it is not 0 Hz, the minimum Flicker-Frequency sensitivity must be raised, or the electrical wiring inspected for proper shielding and installation.

Smoothing

Smoothing filters are algorithms to smooth variations in the Measured-Value values. Smoothing provides more consistent signals for analysis. This allows for more sensitive Trip Points without causing unnecessary Flame-Off conditions.
There are 11 stages of smoothing available for Measured-Values.
The Smoothing function values can be set to NONE, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10.

- A value of NONE disables smoothing filters.
- Disabling smoothing will **maximize** the speed of flame detection.
- A value of 1 provides the minimum amount of smoothing.
- A value of 10 provides the maximum amount of smoothing.

Delay Drop-Out

The Delay Drop-Out function is a “Time-Delay on Drop-Out” feature for flame detection. If a Flame-Proven condition exists, and one or more of the Measured-Values are below or above the Trip Points, this function will provide a delay before:

- Voting a Flame-Off condition.
- De-energizing Flame-relay(s).

This feature allows the flame scanner to ride through transient events. You can set the amount of Time-Delay from 0.2 to 4.0 seconds. This parameter is also know as FFRT (Flame Failure Response Time).

Delay Pull-In

The Delay Pull-In function is a “Time-Delay on Pull-In” feature for flame detection. If a proven Flame-Off condition exists, and one or more of the active Measured-Values exceed the programmed Pull-In values, the SF810I will delay before:

- Providing a Flame-On signal.
- Energizing the Flame-relay(s).

You can set the amount of time for the delay:

- This only allows enough time to insure that the fuel-supply-valves clear the fully-opened limits before the SF810*i* proves flame.

This feature allows the flame scanner to ride through transient events. You can set the amount of Time-Delay from 0.1 to 10.0 seconds.

Quality Threshold

The Quality Threshold allows the user to specify a threshold on quality level. If the Safe-relay usage is configured as “Quality-relay”, the Safe-relay will be energized if the calculated quality is equal or above the configured threshold, and will be de-energized if the calculated quality is below the configured threshold.

If the Safe-relay is not used as Quality-relay, this parameter has no effect.

FLAME EXPLORER SOFTWARE

Flame Explorer is an optional configuration, data trending and historian software package that runs on a stand-alone computer. It can be used to assist in the initial setup of the SF810*i* and also with monitoring during routine operation.

Flame Explorer can be used on a single SF810*i* or on a multi-drop RS485 network where multiple SF810*i* can be connected. You can use the Flame Explorer to configure all SF810*i* units on a MODBUS network from one location.

With the Flame Explorer you can monitor and trend the Measured-Values in real-time. You can also track other information like the flame quality. See next picture for a glimpse of a trend page.

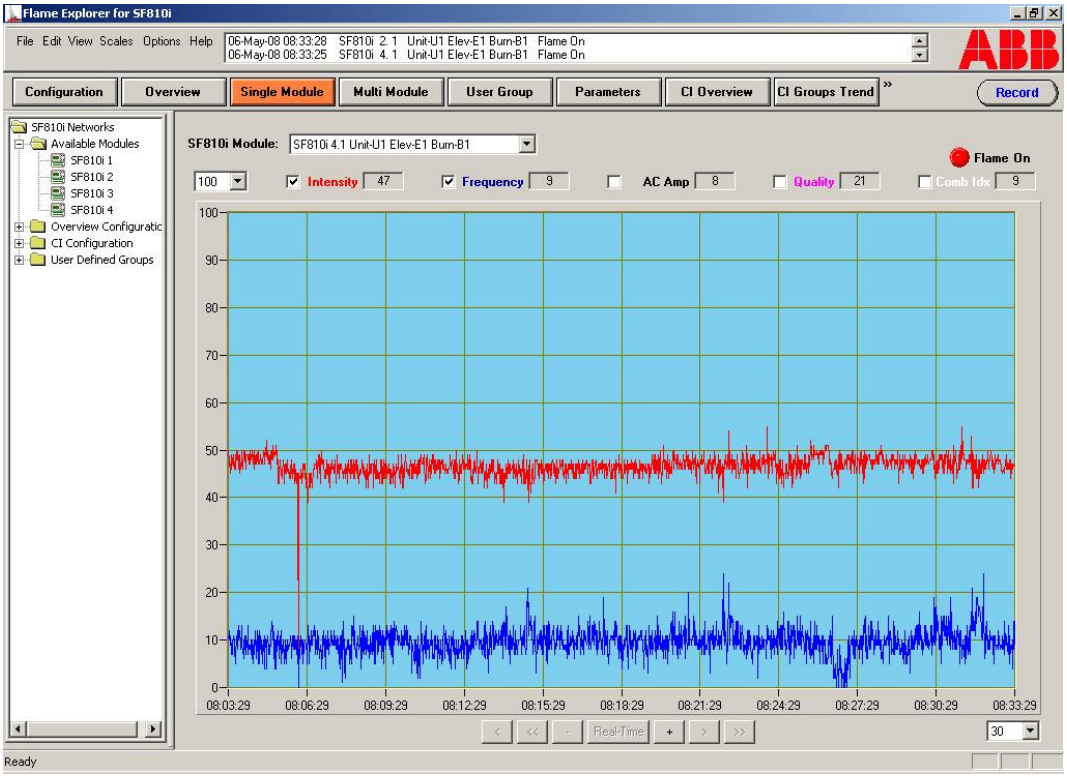


Figure 12 – Trend page on Flame Explorer

Up to four SF810*i* scanners can be displayed simultaneously on the Flame Explorer screen. Each display can be easily customized.

Data from any or all of the SF810*i* units on a MODBUS network can be stored in an archive using a simple selection sheet.

Security is provided by passwords in the software, protecting the system from unauthorized use.

See the *Flame Explorer for* SF810*i* *Installation and Operation Guide* for detailed information (doc. No. 9AKK101130D3799).

NOTE: Flame Explorer Software requires a MODBUS connection to the SF810i unit(s). In case of Profibus network, see CONFIGURATION AND OPERATING USING PROFIBUS on page 68.

FIRMWARE DOWNLOADER TOOL

Firmware Downloader is an optional tool that allows to download new firmware versions into the SF810*i*.

When a new firmware version is received, simply start this tool and follow the simple instructions. At the end of the download, the SF810*i* starts immediately to execute the newly downloaded program image.

Should something go wrong during firmware download, to force the unit to go back in download mode, power off the module, and then power it on again keeping both UP and DOWN buttons pressed at the same time: after a few seconds, the module will bring itself in firmware download mode (on the display you will see “L00”).

Note that, during firmware download, Safe-relay is kept energized, whilst Flame-relay is kept de-energized.

New firmware versions usually do not provide configuration-related issues, meaning that new versions will always be backwards compatible. If you should have version A.4 installed on your module, and you receive A.5, you can safely download it without losing (or needing to change) the current configuration.

Should you receive versions with a different letter (e.g. “B.x” and you have “A.x”) please read carefully the release notes to verify whether you have a configuration issue and proceed accordingly. If in doubt, please contact ABB field service.

RELAY ASSIGNMENT

Relay Specifications

There are two relays mounted in the SF810*i*. Each relay has a single pole (NO - Common) contact arrangement.
Refer to APPENDIX 2 - SPECIFICATIONS at page 86 for detailed relay specifications.

Assigning Relay Use

You can specify the purpose of each relay based on your requirements. Change relay assignments using Configuration-Mode parameters.

Relay A

Relay A (usually referred to as 'flame relay') is always assigned as the Flame-relay. It energizes when a Flame-Proven condition occurs and no faults are detected by the diagnostic and self-checking.

Relay B

Relay B (usually referred to as 'safe relay') can be used for four different purposes depending on your needs. The options are outlined below:

Usage of relay B	Explanation
Safe-relay	This is the default usage. The majority of applications will use Safe-relay as "Safe relay". The Safe-relay is energized when no faults or other critical conditions are detected. When a fault or critical condition is detected, it de-energizes. This event will also ALWAYS de-energize relay A.
Second Flame-relay	Relay B can be also used as a second Flame-relay It energizes when flame is proven using the alternative Function Set (if single sensor). It energizes when the flame is proven for the second sensor and the second sensor is logically connected to this relay.
Quality-relay	Relay B can be used as a flame quality relay. In this case, it energizes when the calculated quality is equal or above the programmed quality threshold and de-energizes if the calculated quality is below the programmed quality.
Temperature-Relay	Relay B can be used as internal temperature relay. In this case, it energizes when the temperature inside the enclosure is normal, and it de-energized if the temperature becomes abnormally high (but the module is still safe to operate).

Table 11 - Possible use of relay B

SERIAL INTERFACES

This section is organized in two parts. The first is related to the MODBUS protocol and the second is related to the Profibus Protocol.

The SF810*i* has two identical serial communication channels used as a redundant pair.

SF810*i* is a “slave” station; this means that it never sends messages if not requested to do so by a Master station, so it only sends replies when receives requests addressed to it. The replies are sent on the same channel over which requests are received.

Physical level of communication

The serial communication channels are implemented, in hardware, using the RS-485 industry de-facto standard. It is a pair of copper wires that carry differential signals (D+ and D-) plus a shield and a GND reference. Usually the bus must be terminated with its characteristic impedance (120 Ohm).

MODBUS protocol

The master, in order to successfully communicate with an SF810i configured with the default parameters, must be configured:

Parameter	Value
Baud Rate	38400 bps
Parity	Even
Stop bits	1
Data bits	8
Addresses	1 to 254

Table 8 - RS-485 Serial Interface Default Settings for MODBUS protocol

Baud rate and address on the SF810*i* must be changed through the local display and push-buttons. Stop bits, parity and data bits are fixed and cannot be modified.

MODBUS registers

Coil Status Registers

The coil status registers provide access to the SF810*i* relay values. These values are read using MODBUS function code 1.

This information can be read by any MODBUS master conveniently configured.

Coil status	Register address
Flame Status (0 = no flame, 1 = flame)	3000
Flame Status for second sensor (if dual)	3001
FSA is used for Flame Calculation Algorithm on Flame-relay.	3002
FSB is used for Flame Calculation Algorithm on Flame-relay..	3003
FSC is used for Flame Calculation Algorithm (single sensor, dual sensor or Safe-relay as second Flame-relay).	3004
FSD is used for Flame Calculation Algorithm (single sensor, dual sensor or Safe-relay as second Flame-relay).	3005
Combined Unit Fault Status (0 = no fault, 1 = fault)	3006
Scanner Fault (0 = no Scanner-Fault, 1 = Scanner-Fault)	3007
Sensor 1 Fault (0 = no fault, 1 = fault)	3008
Sensor 2 Fault (0 = no fault, 1 = fault) If dual sensor only	3009
The scanner is using the factory default configuration (0= no, normal condition, 1 = yes, the module must be configured)	3010
The flame relay is currently overridden (1 = no, 1 = yes)	3011
The scanner is executing an Auto Tune procedure (0 = no, 1 = yes)	3012
Flame Status for second Function Set (if single and Safe-relay as second Flame-relay (0 = no flame, 1 = flame)	3013
The safe relay is closed (meaningful is safe relay used as quality or temperature relay).	3014
Spare	3015

Table 12 - Coil status registers (MODBUS)

Input Registers (Process Values)

The input registers provide the ability to read the scanner process values to a MODBUS master. These values are read using MODBUS function code 4. A MODBUS master cannot write to these values. The process values use the following MODBUS registers, including spare registers provided for future expansion.

These registers are 16-bits long. Since all the information contained in this table is no longer than 8 bits, information is packed into two values every 1 bits to make the data transfer faster.

This information can be read by any MODBUS master conveniently configured.

Scanner Process Values	Register address
Flame Status (0 = no flame, 1 = flame)	5100 / low byte
Flame Status for second sensor, if dual (0 = no flame, 1 = flame)	5100 / high byte
Flame Status for second flame relay, if single (0 = no flame, 1 = flame)	5101 / low byte
Spare	5101 / high byte
Active Function Set for Flame-relay	5102 / low byte
Active Function Set for dual sensor of for Safe-relay as second Flame-relay	5102 / high byte
Composed scanner fault	5103 / low byte
Combined scanner fault	5103 / high byte
Fault on sensor 1, (0 = no fault)	5104 / low byte
Fault on sensor 2, (0 = no fault)	5104 / high byte
Program change status (counter of the times configuration has been changed, between 0 and 100, then rolls to zero)	5105 / low byte
Spare	5105 / high byte
Intensity for sensor 1	5106 / low byte
Flicker Frequency for sensor 1	5106 / high byte
AC-Amplitude for sensor 1	5107 / low byte
Quality for sensor 1	5107 / high byte
Combustion index for sensor 1 (not for the current version)	5108 / low byte
Spare	5108 / high byte
Intensity for sensor 2	5109 / low byte
Flicker Frequency for sensor 2	5109 / high byte
AC-Amplitude for sensor 2	5110 / low byte
Quality for sensor 2	5110 / high byte
Combustion index for sensor 2 (not for the current version)	5111 / low byte
Internal temperature	5111 / high byte
Intensity for sensor 1 if safe as second flame relay	5112 / low byte
Flicker Frequency for sensor 1 if safe as second flame relay	5112/ high byte
AC-Amplitude for sensor 1 if safe as second flame relay	5113/ low byte
Quality for sensor 1 if safe as second flame relay	5113 / high byte
Spare (also spare 5114, 5115, 5116 and 5117)	5118 / low byte
Sensor type (VL, IR, UV, DUAL)	5118 / high byte

Table 13 - Process Value Registers (MODBUS)

Holding Registers (Programmable Parameter Registers)

The holding registers provide the ability to read / set the scanner parameter values to / from a MODBUS master.

NOTE: *change these values only using the Flame Explorer tool. There is an automatic procedure that performs safety operations in the Flame Explorer tool. This cannot be replicated (and MUST not be replicated) on a generic MODBUS master.*

Scanner Configuration Parameters	Register Addresses
Reserved for ABB	4000-4004
MODBUS address on serial #1	4005
MODBUS address on serial #2	4006
Sensor type (single or dual)	4007
Flame logic on dual sensor (OR / AND)	4008
Flame-relay Usage (Safe-relay, second Flame-relay, Quality-relay, temperature relay)	4009
Operating Mode	4010
Function Set Switch (Off, through Serial Line, through Digital Inputs)	4011
Enable High Limit (NO / YES)	4012
Enable AC Amplitude (NO / YES)	4013
Unit ID	4014-4017
Elevation ID	4018-4021
Burner ID	4022-4025
Function-set ID A	4026-2029
Function-set ID B	4030-4033
AO Output Mode	4034
AO Output Source (Intensity, Frequency, AC Amplitude, Quality. CI)	4035
Spares	4036-4056
Function-set ID C	4056-4059
Function-set ID D	4060-4063

Table12 - Channel Configuration Parameter Registers (MODBUS)

These values are read using MODBUS function code 3, and written to using MODBUS function codes 6 or 16.

The parameters require 64 MODBUS registers for the scanner Configuration (including spare registers provided for future expansion), and 40 registers for each of the four Function-sets (including spare registers). This is a total of 230 registers per scanner. This means that 2 MODBUS requests are required to access all the parameters for one SF810*i* scanner.

Users should update an entire Tuning Function-Set in one MODBUS request to ensure that all the parameters are consistent and that all are accepted or all or rejected.

Tuning Function-Set Parameters	Register Addresses
Function-set A	
Intensity Trip Point Pull-In (IP)	4070
Intensity Trip Point Drop-Out (ID)	4071
Intensity Trip Point High (IH)	4072
Intensity Normalization (IN)	4073
Intensity Normalization High (INH)	4074
Intensity Filter Select	4075
Frequency Trip Point Pull-In (FP)	4076
Frequency Trip Point Drop-Out (FD)	4077
Frequency Trip Point High (FH)	4078
Frequency Normalization (FN)	4079
Frequency Normalization High (FNH)	4080
Frequency Filter Select	4081
AC Ampl. Trip Point Pull-In (AP)	4082
AC Ampl. Trip Point Drop-Out (AD)	4083
AC-Amplitude Trip Point High (AH)	4084
AC-Amplitude Normalization (AN)	4085
AC-Amplitude Normalization High (ANH)	4086
AC-Amplitude Filter Select	4087
Max Frequency	4088
Flame-relay Trip Time	4089
Pull-In Delay Time	4090
Frequency Sensitivity	4091
Quality threshold	4092
Function-Set B	4110-4132
Function-Set C	4150-4172
Function-Set D	4190-4212

Table13 - Tuning Function-Set Parameter Registers (MODBUS)

Program Enable Register

The SF810*i* requires a degree of procedural security in order to allow scanner configuring and tuning. This is obtained through the exchange of a set of MODBUS commands between Flame Explorer and SF810*i* before configuration can be changed. This exchange is proprietary ABB and is not described here.

Profibus DP-V1 protocol

The SF810*i* requires a minimal degree of procedural security in order to allow scanner configuration and tuning.

The SF810*i* can communicate with AC800M (through CI854 board) using Profibus DP-V0. A future version capable of supporting DP-V1 will follow shortly (using DTM). However, it is already possible to connect SF810*i* to a third party Profibus DP-V1 Master.

To bring the SF810*i* in Profibus mode please refer to paragraph 1.2.

Once the SF810*i* is in Profibus mode it remains waiting for a master to connect to it on one of the two redundant Profibus lines.

An appropriate Control Builder Pro project must be created, starting from the GSD file and from the Hardware definition file provided together with the scanner.

NOTE: *Control Builder Pro is out of the scope of this manual. For any information on how to create a project, import GSD and HWD file and start Profibus communication please refer to Control Builder Pro documentation. The main page of a Control Builder Pro with a project that connects it to the SF810*i* is depicted in the following figure:*

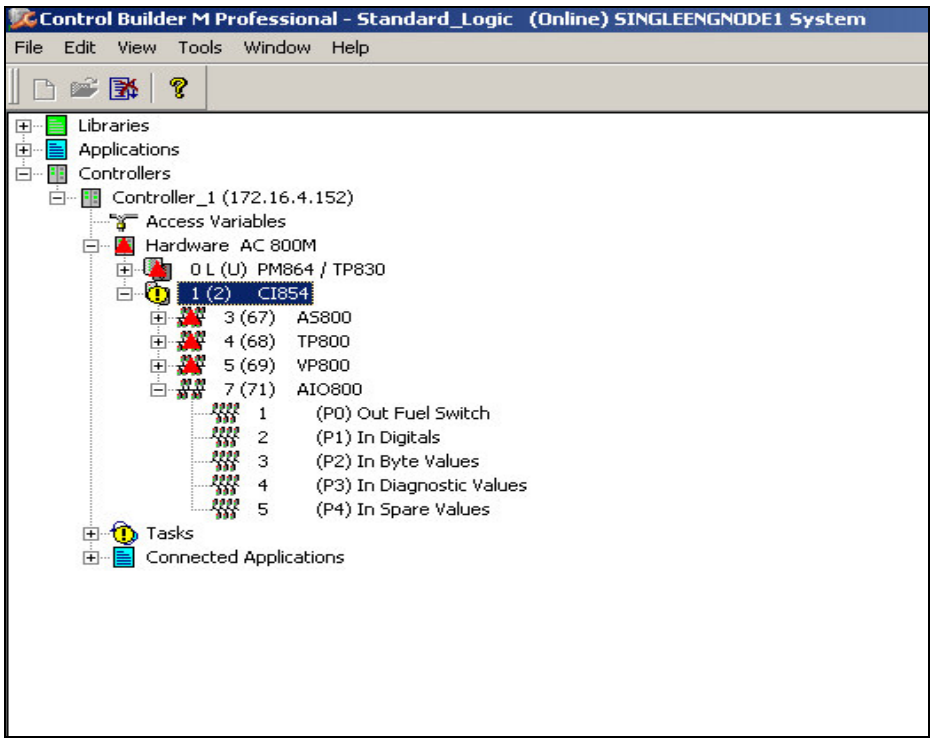


Figure 19 - Control Builder Pro

Profibus-wise, the SF810*i* is made of five Virtual Modules:

P0 (Out fuel switch), digital inputs for the SF810*i* that allow to:

- chose which Function Set is used for flame detection (FSA, FSB, FSC or FSD);
- request a reset of the diagnostic counters (reserved to ABB only).

See the next picture to see P0 virtual module on the Control Builder Pro.

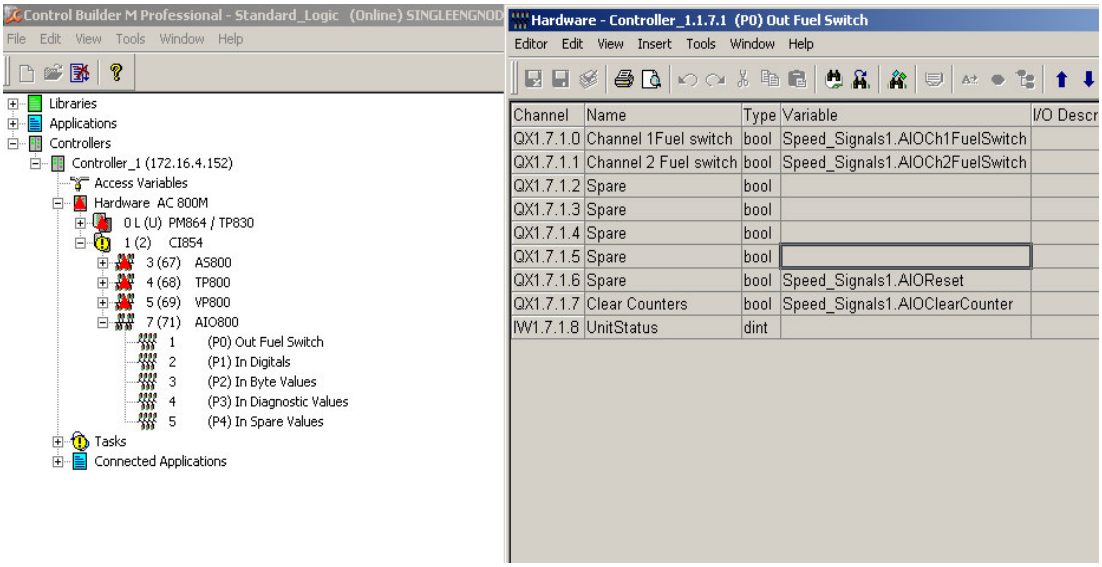


Figure 20 - Virtual module P0

P1 (In digitals), digital outputs for the SF810*i* that report the status of the digital values.

P2 (In byte value), byte outputs for the SF810*i* that report the status of the working parameters (intensity, frequency).

P3 (In diagnostic values) that are diagnostic values meaningful only for ABB personnel and not for the standard user.

P4 (In Spare values) that is intended to remain reserved for future use.

Profibus parameters

The scanner configuration that is, in MODBUS mode, downloaded with the Flame Explorer is in Profibus downloaded by means of Profibus Parameters.

Due to Profibus DP-V0 way of operation, Profibus Parameters (i.e. the SF810*i* configuration parameters) are downloaded from the Profibus Master to the SF810i every time a Profibus connection is established.

Using a Profibus DP-V1 master, it is possible to change parameters on-line (i.e. without the need to establish a new connection).

The Control Builder Pro uses by default the default values provided through the GSD and the HWD files; so it is up to the user, before commissioning an SF810*i* scanner, to verify and change the parameters in such a way that they reflect what the user wants.

Profibus Active Data Exchange

When communication between AC800M (through CI854) and SF810*i* has been established, the detectors exchange Active Data.
Active Data exchange consists in the Profibus Master sending Output Values to the SF810*i* (contained in P0 Virtual Module) to which the SF810*i* replies in the same Profibus cycle, sending its Input Data to the master (contained in P1, P2 and P3 virtual modules).
In practice, I/O values are exchanged between the SF810*i* and its master many times per second.

Profibus speed and cable length

The SF810*i* can communicate over a Profibus line at the following speeds:
19200b/s, 45.45kb/s, 93.75kb/s, 187.5kb/s, 500kb/s, 750kb/s, 1.5 Mb/s, 3 Mb/s, 6 Mb/s, 12 Mb/s.
At the maximum speed of 12 Mb/s the SF810*i* is guaranteed to work with a cable of length up to 200 meters and with stubs of negligible length.

NOTE: the transmission speed is derated by: number of stubs (nodes), stub length, total network length, impedance matching and cable terminations on the characteristic impedance.

*NOTE: The appropriate Profibus cables with the specified terminations must be used when connecting the SF810*i *to a Profibus line.*

*NOTE: The .GSE file (Scanner Description) and the .HWD (Hardware Definition File) are provided together with the scanner's documentation. In particular, the .GSE file is needed by ANY Profibus Master in order to know how to interact with the SF810*i*; the .HWD file is needed by Control Builder Pro (ABB product) to fully integrate the SF810*i* into its environment.*

CONFIGURATION AND OPERATING USING PROFIBUS

In addition to the continuous data exchange, a Profibus DP-V0 master station can also configure the SF810*i* with the limitation that every time a change in the SF810*i* configuration is needed, for such change to be sent, it is necessary to stop and restart the Profibus master.

A Profibus DP-V1 master, supporting acyclic communication, can do better by simply changing the needed configuration parameters without having to stop and restart communication.

The SF810*i* supports Profibus DP-V0 as well as DP-V1.

ABB suggests to use as Profibus master one of its products (e.g. AC800M with Profibus master CI854), anyway the SF810*i* can communicate with any vendor's Profibus master station.

Process values that are cyclically acquired via MODBUS are available likewise in Profibus using cyclic data exchange.

Configuration values can be sent at "link-up" by the master station, or can be "tuned" on-line if the master station has DP-V1 capabilities. In any case, before a new configuration / parameter is accepted, the SF810*i* accomplishes a number of checks in order to verify the correctness and the plausibility of the newly arrived configuration / parameters.

For more detail about the SF810*i* internal registers that are available through Profibus refer to section SERIAL INTERFACES.

For information on how to set-up and configure a Profibus master station in order to operate with the SF810*i*, refer to the master station's documentation.

AUTO TUNE

The goal in tuning the SF810*i* is to maximize the difference between the flame scanner signals that are detected when the flame is ON and when the flame is OFF. This enables the flame scanner to discriminate the burner flame from any background light.

- The burner ON environment represents the flame present in the burner.
- The burner OFF environment represents the light emitting from other sources when the burner is OFF. This is referred to as background light.

Tuning will vary somewhat with each flame scanner style and application. The user can, using the Flame Explorer tool, request to the SF810*i* to “auto tune” creating its own set of Pull-In and Drop-Out values following the procedure described below.

Auto Tuning is only available through Flame Explorer Software.

Auto Tune Tuning Procedure

Turn on the SF810*i* . The Safe LED should be green, the Flame LED status depends on the Flame condition (On, Off).

From the Parameters page, after having enabled the “Editing Mode”, go to “ADVANCED” page and do the following steps:

Auto Tune Values with the Burner On

Turn the burner ON.
Wait about 2 minutes for things to become steady.
Start Auto tune with Burner ON procedure by pressing the corresponding “Start” button.
The scanner analyzes the flame for 20 seconds and decides what are the best Pull-In values for Intensity, Frequency and AC Amplitude (note: AC amplitude is calculated here even if it should not be part of the Flame Calculation Algorithm, as the user may change idea later and want it in: in case, the values will be available without the need of running another auto tune session.

Auto Tune Values with the Burner OFF

Turn the burner OFF.
Wait about 2 minutes for things to become steady.
Start Auto tune with Burner OFF procedure by pressing the corresponding “Start” button.
The scanner analyzes the flame for 20 seconds and decides what are the best Drop-Out values for Intensity, Frequency and AC Amplitude (note: AC amplitude is calculated here even if it should not be part of the Flame Calculation Algorithm, as the user may change idea later and want it in: in case, the values will be available without the need of running another auto tune session.

Store Auto Tune Values

At this point the Pull-In and Drop-Out values are available and shown in the right side of the “Advanced” window. If these parameters seem to be Ok for the user, He can tell the SF810*i* to use them by pressing the “Store Auto Tune values for Sensor 1” button. In

this case, the newly calculated parameters will be automatically loaded into the currently active Function Set, and the scanner will begin immediately to execute the Flame Algorithm with them.

NOTE: the user must pay utter attention in using this function. Providing the SF810i with wrong or inconsistent parameters may result in wrong results in the Flame Algorithm.

TROUBLESHOOTING

This section addresses the troubleshooting of SF810*i* in two parts. The first applies to the Line-Of-Sight version (LOS) also called “Direct View” and the second applies to the Fiber Optic Cable (FOC) version.

Troubleshooting LOS

Problem	Possible causes	Corrective Actions
SF810*i* does not sense the flame	Scanner is not aimed on the target flame.	Loose the swivel flange and aim the scanner properly
	Combustion is bad	Ask for the authorized personnel to take actions
	Wrong wiring to the scanner	Check wiring
	Lens is dirty	Make sure the cooling/purging air matches the requirements, and follow the maintenance instruction for cleaning
	Electronics boards failure	Replace the unit
Flame is detected but the flame relay does not energize	Self-check task failed	See ‘Error code on display’ below
	Wrong wiring to the scanner	Check wiring
Flame LED blinks RED	AC-mains noise	Check the ground connections of cable shields and of the reference voltage of electronics (0V) Of the power supply used to power the SF810*i*
	Artificial ambient light	Ambient light from AC-mains powered light sources (bulbs or fluorescent) reach the light ingress of the SF810*i* Stop this spurious light from reaching the SF810*i* photodiode
Error code on display	Hardware failure (?)	Find out the error code in the DIAGNOSTICS section at page 73; Cycle SF810*i* power -OFF and then -ON. If the error recurs then decide if the unit needs to be replaced or if the cause can be external

Table 14 - Troubleshooting LOS

Troubleshooting FOC

Problem	Possible causes	Corrective Actions
SF810*i* does not sense the flame	Combustion is bad.	Ask for the authorized personnel to take actions.
	Lens at the hot side is dirty.	Make sure the cooling/purging air matches the requirements, and follow the maintenance instruction for cleaning
	Wrong wiring to the scanner	Check wiring
	Fiber optic bundle is damaged	Replace the fiber optic bundle and make sure no levers or mechanical bodies bangs or bends sharply the outer carrier
	Electronics board failure	Replace the unit
Flame is detected but the flame relay does not energize	Self-check task failed	See 'Error code on display' below
	Wrong wiring to the scanner	Check wiring
Flame LED blinks RED	AC-mains noise	Check the ground connections of cable shields and of the reference voltage of electronics (0V)
		Of the power supply used to power the SF810*i*
	Artificial ambient light	Ambient light from AC-mains powered light sources (bulbs or fluorescent) reach the light ingress of the SF810*i*
		Stop this spurious light from reaching the SF810*i* photodiode
Error code on display	Hardware failure (?)	Find out the error code in the DIAGNOSTICS section at page 73;
		Cycle SF810*i* power -OFF and then -ON. If the error recurs then decide if the unit needs to be replaced or if the cause can be external

Table 15 - Troubleshooting FOC

DIAGNOSTICS

SF810*i* runs internal self-checking diagnostic routines every 0.125 seconds. The list of error codes and related descriptions is shown in the tables of this section.

The error code is shown on the three-digit display; when non-fatal, it is reported through the serial communication channels (either MODBUS or Profibus protocols).

When using MODBUS, the errors can be seen in the relevant Flame Explorer Software screen (ref. to Flame Explorer Manual).

When using Profibus the errors are shown in the diagnostic page of the system connected to the Profibus master.

Due to safety reasons, only a small set of errors leaves the SF810*i* in operation; most errors bring the SF810*i* to a HALT mode in safe condition (no more program execution, all outputs into a safe state, both relays de-energized)

For the dual-sensor version, if a “Sensor-Fault” occurs then the associated Flame-relay is de-energized, and the associated LED becomes solid red.

NOTE: Safety mode for outputs. When a fault is detected, the SF810i, before stopping execution, brings the values of outputs to the safety values listed below:

Output source	Safety value
Safe-relay	**OFF (de-energized)**
Flame-relay	**OFF (de-energized)**
Analog Output	**3.5 mA**
Safe LED	**Red**
Flame LED	**Red**
Power LED	**Green**
Display	**Error code (see tables)**
Comm lines NOTE	**Disabled**

Table 16 - Safety outputs

NOTE: In this way the transmitter is disabled, and communication between master and the other SF810i on a multi-drop line will not be affected.

Failures detected by on-board diagnostic routines

Fatal errors display a three digit error code. Display codes follow this general convention:

- **H x x** Hardware failure
- **F x x** Fatal error
- **D x x** Factory diagnostic error codes
- **L x x** Loader (FW update codes, not necessarily errors)
- **E x x** Other errors

where ‘**xx**’ is an hexadecimal number (00 – FF). See the tables below.

Program monitoring errors	Display code	Description
EXCEPTION HANDLER	F00	Reserved for ABB development only
ACCESS ERROR	F01	Reserved for ABB development only
ADDRESS ERROR	F02	Reserved for ABB development only
ILLEGAL INSTRUCTION	F03	Reserved for ABB development only
DIVIDE BY ZERO	F04	Reserved for ABB development only
UNIMPLEMENTED INSTRUCTION	F08/F09	Reserved for ABB development only
SPURIOUS INTERRUPT	F0C	Reserved for ABB development only
TASK MONITORING FAILURE	F1F	At least one major software task is not executing timely.
TIME SLOT MONITORING FAILURE	F20	slot monitoring of interrupt routines (no interrupts or interrupts too frequent).
DEAD MAN TIMER FAILURE	F21	Background diagnostic functions not executed.
MAIN EXECUTION	F23	Main program execution time frame failure.
CHANGE PROTOCOL	F25	The user changed protocol locally[1].

Table 17 - Program monitoring error codes

Instruction decoding	Display code	Description
CPU INSTRUCTION FAILURE	H10	CPU's instruction set failure.

Table 18 - Instruction execution error code

Memory errors	Display code	Description
FLASH CRC FAILURE	H0E	Program memory failure.
VARIABLE MARKER FAILURE	F22	RAM integrity failure.
OVERFLOW STACK FAILURE	F24	Stack(s) overflow and/or underflow.
PARAMETRS CRC FAILURE	H37	EEPROM (module's parameters) failure.
RAM FAILURE	H3B	RAM test

Table 19 - Memory error codes

[1] Power off and then on again the module, and it will restart with the new communication protocol.

Hardware circuitry	Display code	Description
POWER FAIL	F1E	The 24V power level reached a value below 18Volts.
PUSH BUTTON FAIL	H01	At least one local button is shorted.
OVERTEMPERATURE	H2A	Over temperature.
FPGA LOGIC FAILURE	H2B	FPGA logic is not executing timely
FLAME-RELAY FAILURE	H2C	Flame-relay failure.
SAFE-RELAY FAILURE	H2E	Safe-relay failure.
SENSOR ELECTRONICS SELFTEST FAILURE	H2F	Sensor self test failure.
RELAYS UNDULY POWERED	H30	Relays powered before they are actually controlled by the application
A/D MULTIPLEXING FAILURE	H31	Analog to digital input multiplexing failure.
A/D CONVERSION FAILURE	H32	Analog to digital input wrong conversion.
INPUT SIGNAL OF SENSOR TOO HIGH	H33	The input signal of the sensor is higher than 2.45 Volts.
EEPROM DEADLOCK	H34	The EEPROM is no longer responding to read / write requests.
INPUT SIGNAL TOO LOW	H35	The input signal to the A/D is too low (less than 40 mV), and hence unreliable
FPGA FAILURE	H3C	Generic FPGA failure
CH1 VOLTAGE FAILURE	H3D	Sensor 1 voltage fail.
CH2 VOLTAGE FAILURE	H3E	Sensor 2 voltage fail.
REFERENCE VOLTAGE FAILURE	H3F	2.5V Reference voltage failure.
ZERO VOLTAGE FAILURE	H40	0V Reference voltage failure.
CLOCK FAILURE	H41	Wrong frequency: there is a discrepancy between the CPU oscillator and the Profibus chips oscillator.

Table 20 - Hardware circuitry error codes

Firmware download	Display code	Description
FW download in progress	L10	Not an error, wait for the termination. When finished the SF810*i* will restart automatically, running the new FW
FW download in progress, erasing	L20	Not a failure, it lasts for a few seconds.
FW download in progress, programming	L30	Not a failure, it lasts for a few seconds.
FW download in progress, verifying	L40	Not a failure, it lasts for a few seconds.
FLASH CRC ERROR	L60	CRC error during the storage in FLASH of the downloaded FW.

Firmware download	Display code	Description
NO FLASH VALUE	L70	The RAM variables for firmware download seem correct, but in FLASH there is not the expected value.

Table 21 - Firmware Download display codes

Noise Error

The SF810*i* is capable to detect frequency values that are too stable to be generated by a flame, and associate them with an error that is called 'noise detected'. This error is reported if, for instance, you point your sensor towards a fixed light source such as the neon light in your room.
Since any flame can't have a 'constant' frequency, the detection of a constant frequency may also be related to an error in the Sensor Electronics.

When this condition is detected:

- The SF810*i* stops program execution and shows on the display the error code "**E01**".
- All outputs are brought in safe state (see table 16).

The only way to remove this error condition is power off the module and then to power it on again. Please be very careful in NOT pointing the module towards sources of constant light.

MAINTENANCE / CLEANING / INSPECTION

Maintenance

There is no periodic maintenance of the SF810*i* and of its related mounting accessories. Only a periodical cleaning is required, as explained in the next paragraph.

For FOC versions, the fiber optic assembly, instead, can be disassembled for replacement, cleaning, re-alignment of the focal distances.

WARNING: all repair/replacement operations must be executed by trained and authorized personnel only.

WARNING: dangerous voltage (up to 240V_{AC}) can be present on the relay terminals. Verify and disconnect any dangerous voltage before proceeding

WARNING: operating temperature of the enclosure is close to 80°C (176°F) when operating in 70°C ambient (158°F).

WARNING: The unit under maintenance can be covered by ash and carbon particles.

WARNING: Use protective clothing, gloves, and glasses.

WARNING: The SF810*i* (ATEX certified versions) complies with the safety rules for installation in explosive atmosphere. Assembling and disassembling procedures shall be made strictly in accordance with the “INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS”, (Ref. Doc IM.C-170/06.02).

Cleaning

Cleaning of the SF810*i* is limited to a periodic removal of ashes, carbon particles and other dusts and oils that might be deposited on the external surface of the enclosure.

Cleaning is needed in order to avoid excessive build up of ashes and carbon particles that might prevent an efficient thermal dissipation to ambient air.

Since it strongly depend on the general cleanness of the environment, no cleaning schedule is given here.

Version equipped with a lens (Line of Sight versions), might require a cleaning of the lens itself in the following cases:

- The purging air is not clean
- The purging air system have been non-working for a period of time

Proceed with the following steps

1. Read all warning at the beginning of this section
2. Read the document “INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS”, (Doc. No. IM.C-170/06.02)
3. Turn-off the power supply
4. Close the manual isolating valve (where provided)
5. Loose the thermal union and remove the unit
6. Clean the scanner lens. Use degreases liquid. Do not use abrasive tools. Let it dry.

7. Relocate the unit to the mounting (thermal union)
8. Open the manual isolating valve
9. Turn-on power supply

Fiber optic maintenance

Maintenance of the fiber optic assembly, when present, is given in the following procedure.

1. Read all warning at the beginning of this section
2. Read the document “INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS”, (Doc. No. IM.C-170/06.02)
3. Turn-off the power supply (optional)
4. Loose the locking ferrule and remove the unit
5. Withdraw the inner carrier
6. In case the fiber optic needs replacement or focal length adjustments, follow Fiber optic replacement at page 81
7. Clean the lens; use degreaser liquid; do not use abrasive tools/substances; let it dry
8. Check the color of the lens holder tip (hot terminal); it must be light-gray. Darker colors (like brown or violet) reveal the Fiber Optic has operated above the allowed maximum temperature. In this case, investigate the following: cooling air pressure (see requirements in Appendix B), cooling air hose (avoid sharp bend), burner throat or diffuser
9. Re-insert the inner carrier
10. Relocate the unit to the mounting (thermal union)
10. If power supply was turned-off, then turn it on

Inspection

Even if the SF810*i* has a powerful self-test capability, a small number of failures, not related to safety, are not automatically detected by the self-test. They are:

- failure of the display
- failure of LEDs
- failure of the 4-20mA analog output (can be detected by the system that is connected to it)
- failure of one communication line (can be automatically detected by the master of the network)

A periodic inspection of the above items can be scheduled at, for instance, 1 year period.

REPAIR AND REPLACEMENT

This section contains detailed procedures to replace the SF810*i* and (if it is a Fiber Optic Cable – FOC- version) to repair or replace the Fiber Optic assembly.

NOTE: in case you need to replace the whole SF810i , follow the procedure given in this section.

It is not possible to repair the internal parts of the SF810*i*.

WARNING: all repair/replacement operations must be executed by trained and authorized personnel only.

WARNING: dangerous voltage (up to 240V_{AC}) can be present on the relay terminals. Verify and disconnect any dangerous voltage before proceeding

WARNING: operating temperature of the enclosure is close to 80°C (176°F) when operating in 70°C ambient (158°F).

WARNING: The unit under maintenance can be covered by ash and carbon particles.

WARNING: Use protective clothing, gloves, and glasses.

WARNING: The SF810*i* complies with the safety rules for installation in explosive atmosphere. Assembling and disassembling procedures shall be made strictly in accordance with the “INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS”, (Ref. Doc IM.C-170/06.02).

Whole unit replacement

Versions with removable terminals

1. Read all the warnings at the beginning of this section
2. Initially power-on the replacement unit on a work-bench in a safe area and configure its protocol (Profibus or MODBUS) and its node address as the unit to be replaced. Ref. to Communication network parameters at page 42.
3. Read the document “INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS”, (Doc. No. IM.C-170/06.02)
4. Turn-off the power supply
5. Wear and anti-static wrist strap or equivalent system
6. Loose the locking screw on the cover (requires an allen wrench)
7. Unscrew the cover
8. Unplug all removable connectors and “shield” terminal from the round board after having take note of the assignment
9. Loose the cable gland and unscrew it from the enclosure
10. Carefully remove the cable harness from the enclosure
11. Unscrew the whole enclosure from the mechanical adapter that holds it at the light entrance port
12. If an optical fiber is present, clean its cold terminal before proceeding
13. Mount the new unit in place
14. Insert the cable harness in the cable entry bore
15. Re install the cable gland
16. Plug all connectors and “shield” terminal in respective sockets in the round board

17. Re-install the cover and thigh the locking screw. Follow the requirement in doc. No. IM.C-170/06.02)

Connector versions

1. Read all the warnings at the beginning of this section
2. If the unit to be replaced is connected to a data communication network, initially power-on the replacement unit on a work-bench in a safe area and configure its protocol (Profibus or MODBUS) and its node address as the unit to be replaced. Ref. to Communication network parameters at page 42.
3. Read the document “INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS”, (Doc. No. IM.C-170/06.02)
4. Turn-off the power supply
5. Disconnect the quick release connector
6. Disconnect the earthling cable; mind not to lose the screw and washer
7. Unscrew the whole enclosure from the mechanical adapter that holds it at the light entrance port
8. If an optical fiber is present, clean its cold terminal before proceeding
9. Mount the new unit in place
10. Re-connect the earthling cable with its screw and washer
11. Reconnect the quick release connector
12. Make a final check against the requirements of the doc. No. IM.C-170/06.02

Fiber optic replacement

WARNING: all repair/replacement operations must be executed by trained and authorized personnel only.

WARNING: dangerous voltage (up to 240V_{AC}) can be present on the relay terminals. Verify and disconnect any dangerous voltage before proceeding

WARNING: temperature of the hot terminal 350°C or higher (662°F).

WARNING: The unit under maintenance can be covered by ash and carbon particles.

WARNING: Use protective clothing, gloves, and glasses.

WARNING: The SF810*i* complies with the safety rules for installation in explosive atmosphere. Assembling and disassembling procedures shall be made strictly in accordance with the “INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS”, (Ref. Doc IM.C-170/06.02).

1. Remove the SF810 / SF810*i* inner assembly by loosing the ring nut (Figure 19.6).
2. Remove the SF810 / SF810*i* enclosure (Figure 19.9)
3. Free the fiber optic bundle loosing the screw on the lens barrel hot side end (Figure 20.6-7).
4. Free the fiber optic low temperature end side loosing the three Allen head screws on the coupling barrel (Figure 19.7-8)
5. Remove the lens barrel. (Figure 20.7)
6. Pull gently the fiber optic bundle out of the inner guide pipe. Recover the spring (Figure 19.1, Figure 20.2)
7. Replace the fiber optic bundle. (Figure 18)
8. Fasten the flexible guide pipe coupling barrel on to the fiber optic low temperature end (Figure 19.7-8, Figure 20.4)

9. Plug in the fiber optic hot end side into the lens barrel and secure it with the Allen head screw. (Figure 20.6)
10. Screw the lens barrel onto the flexible guide pipe terminal and secure it with flat screw. (Figure 20.6)
11. Couple the inner guide into the outer guide pipe and tight the ring nut (Figure 19.6-10)
12. Fit in place the SF810 / SF810*i* flame scanner

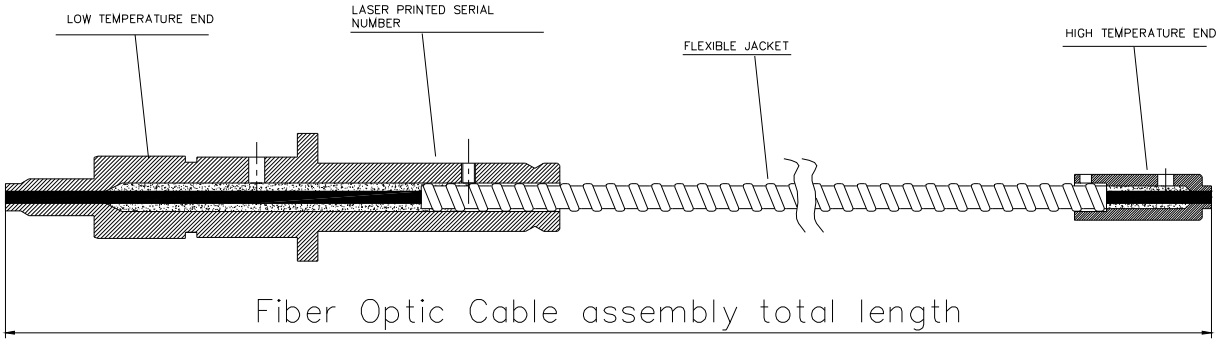
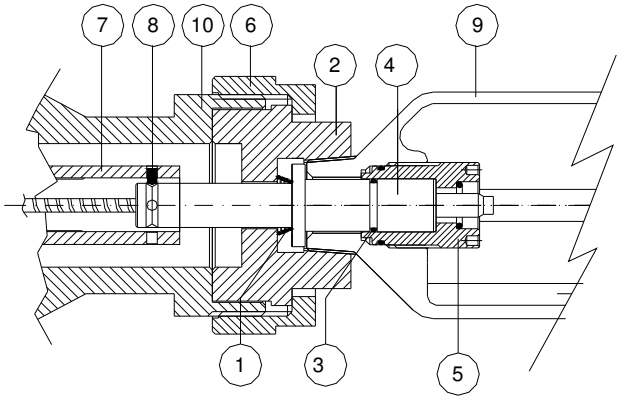


Figure 21 - Fiber optic bundle



Item	Description	Note
1	Spring	Mandatory in Atex certified environment
2	Thermal isolation union	
3	"O-Ring"	Apply a tiny film of silica grease before repositioning the fiber optic in place
4	FOC low temperature end	Make sure the fiber edge is clean before repositioning
5	Sleeve	
6	Ring nut	
7	Fiber optic to flex guide fastening barrel	
8	Allen head screws	3 nos. Use 2mm Allen key to loose or lock in seat the fiber optic cable.
9	SF810 SF810i housing	
10	External guide pipe	

Figure 22 – FOC assembly. Detector side (cold side)

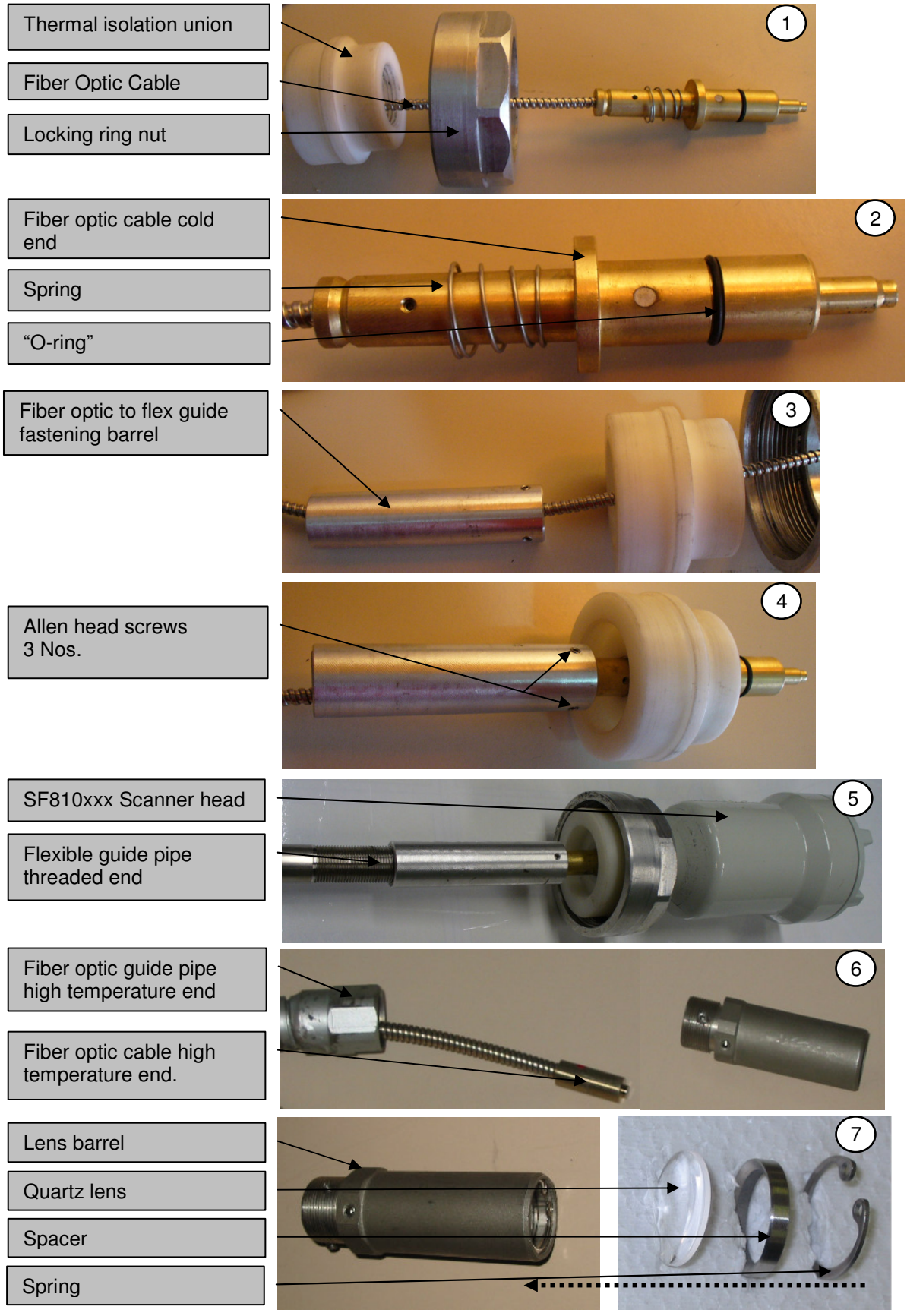


Figure 23 – Fiber Optic Cable Assembling and Disassembling

END OF PRODUCT-LIFE-CYCLE

SF810*i* is manufactured using materials that do not require special treatments. It does not contain radioactive materials.

SF810*i* does not contain batteries.

NOTE: local regulations might apply to the disposal of electronic assemblies.

APPENDIX 1 - CERTIFICATIONS

CE mark

CE mark declaration	This product complies with the following Directives/Standards for CE marking. **EMC Directive 89/336/EEC** EN 50081-2 EN 61000-6-4 EN 50082-2 EN 61000-6-2 **Low Voltage Directive 73/23/EEC** EN 61010-1

CSA

In progress

In accordance with the requirements of the following standard:

- CAN/CSA-C.22.2 N. 199 “Combustion safety controls and solid-state igniters for gas-and oil burning equipment”.
- CAN/CSA 60730-1 (Class “C”, Type 1 action).

FM

In progress

In accordance with the requirements of the following standard:

- FMRC (Factory Mutual Research Corp.) class N. 7610 - “Approval standard for combustion safeguards and flame sensing systems”

ATEX

ATEX certified (not all versions).

Refer to “INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS”, (Doc. No. IM.C-170/06.02) for details about the ATEX certification.

See also APPENDIX 9 - ATEX at page 112.

***WARNING**: The ATEX certified fiber optic versions (SF810INT-FOC-xx-**T**-xx-xx and SF810INT-FOC-xx-**QC**-xx-xx) must be mandatory used together with the ABB ATEX certified fiber optic, otherwise the certification is invalidated. See Table 4*

APPENDIX 2 - SPECIFICATIONS

Technical specifications

Property	Value
Optical spectrum	IR versions: 320 -1100 nm peak sensitivity @ 920 nm VL versions: 350 -720 nm peak sensitivity @ 560 nm UV versions: 210 - 360 nm peak sensitivity @ 280 nm
Optical sensor technology	IR versions: Si photodiode VL versions: Si photodiode UV versions: SiC photodiode
Power supply voltage	$24V_{DC}$ (-25%, +20% = 18 ÷ $29V_{DC}$)
Power supply current	150mA typical
Power consumption	3.6W typical, 4W max
Inrush current	6A peak, 2ms settling time
Hot insertion / removal	Allowed
Flame-relay Safe-relay	Contacts: 1 NO, for each relay 240 V_{AC} / 1.5A cycles ≥ 100,000 240 V_{DC} / 100 mA 30 V_{DC} / 300mA Minimum load 10mA, $5V_{DC}$
Flame-relay drop-out time	0.2s to 4.0s at 0.1s increments (configurable) 2s default
Flame-relay pull-in time	0.2s to 10s at 0.1s increments (configurable) 2s default
Analog output (4-20mA)	4÷20 mA (R load <= 500 Ω) Galvanically isolated Precision: +/-5% f.s. Externally powered (see Figure 6 at page 23)
Digital Inputs, 24 V_{DC}	Nr. 2 digital inputs (opto coupled), to allow selection of one out of four different sets of parameters; return signal common to both inputs. Nominal voltage $24V_{DC}$ (5 mA typical) Max Voltage 36 V_{DC} Off: < 5 V_{DC} On: > 18 Vdc Externally powered (see Figure 7 at page 24)
Communication ports	Two, redundant, RS-485 serial channels configurable in Profibus or MODBUS protocols. Profibus max speed 12 Mbit/s (auto negotiated by master station) MODBUS speed: selectable 9600, 19200, 38400 or 115200 baud Note: When the following two conditions occur simultaneously, the serial line(s) cable(s) must not be in the same tray as the relay contact wiring: - One or both the communication ports are used - The relay contact(s) is (are) wired to a circuit whose voltage is higher than 50V (AC or DC)
Local configuration interface	4 push buttons (UP, DOWN , LEFT, RIGHT) 3-digits LED display
Air source for lens cleaning	From clean ambient air

Air flow for lens cleaning	LOS (Line Of Sight) versions: 115 l/min (4 SCFM) Excessive contaminants might require a flow up to 400l/min (14 SCFM) FOC (Fiber Optic Cable) versions: 400 l/min (14 SCFM)
Minimum cleaning air pressure	LOS (Line Of Sight) versions: 20mm H_2O (1" W.C.) above the max wind box pressure measured at the "Y" connection inlet. FOC (Fiber Optic Cable) versions: 400mm H_2O (12" W.C.) above the max wind box pressure measured at the "Y" connection inlet.
Maximum fiber optic continuous operating temperature	Quartz fiber: 350° C (662° F) Glass fiber: 482° C (900 ° F)
Mounting thread	1" NPT male
Cable entry thread	¾ " NPT female (N/A for connectorized versions)
Electrical connections (terminal versions)	Removable terminals with screws Allowable cable sections: AWG24-AWG12, 0.2÷2.5mm^2 for Relay contacts (J1 terminal block) AWG28-AWG16, 0,08÷1.5mm^2 for all other terminal blocks
Earth connection	Standard yellow-green earth cable 2.5mm^2 min section 3m max length
Maximum length of electrical connections (by function)	Power supply Not specified COMM (MODBUS) Depends on transmission speed and network topology COMM (Profibus) Depends on transmission speed and network topology Digital Inputs Not specified Analog Output (4-20mA) Not specified Relay contacts Not specified
Mounting orientation	Any, provided that the cable entry (or quick-release connector) is facing down

Environmental specifications

Property	Characteristic / Value / standard / regulation
Safety Specifications	EN 61010-1 (IEC 61010-1)
Class of installation Over voltage category Pollution degree Protection (EN 60529)	I II 2 IP66
Environmental	
Ambient Operating temperature (EN/IEC 60068-2-1/2/14) Ambient Storage and transportation temperature (EN/IEC 60068-2-1/2/14) Relative humidity (EN/IEC 60068-2-78) Vibration sinusoidal operating (IEC 654-3 Severity Class VH4) (IEC 60068-2-6) Shock operating (IEC 60068-2-27)	-10° to 70°C ATEX Classified area -10° to 70°C non hazardous area -25°C / 85°C 40°C, RH 95% Frequency range: 5 ÷200 Hz, Acceleration: 20m/s^2 peak (2 G) Displacement: 0.15 mm peak Acceleration: 15G - Duration of pulses: 11 ms duration (half sine wave) - Three shocks in each direction (6 pulses in each axis)

Galvanic isolation specifications

EN 61010-1 (IEC 61010-1), **IEC 60060**	**Test severity levels**
Insulation resistance test (At 500 V_{DC}, t >5s) Zone to Zone and to Chassis	>100 Mohm
Dielectric test (Vac, 1 min.)	Zone 6: 2300 Vac To other zones and to chassis Other zones: 510 Vac To other zones (except zone 6) and to chassis
Impulse voltage (1.2/50µs, 3 pulses pos. and 3 neg.)	Zone 6: 4250 Vpeak To other zones and to chassis Other zones: 850 Vpeak To other zones (except zone 6) and to chassis

For isolation zone definitions, see Table 8 at page 35.

EMC specifications

Immunity tests	**EN 61000-6-2** **EN 51082-2** **IEC 60730-1** **CAN/CSA E60730-1:02** **EN 298 (in progress)**
Power frequency magnetic field test (IEC 61000-4-8)	30 A/m cont., 300 A/m for 1s
Radio frequency electromagnetic field test (Amplitude modulated) (IEC 61000-4-3, ENV 50140)	10V/m, 80÷1000 MHz 80% Amplitude Modulated (1 KHz, sin.)
Radio frequency electromagnetic field test (Pulse modulated) (IEC 61000-4-3, ENV 50204)	10V/m, 900 MHz, 1800 MHz 50% duty cycle, 200 Hz rep. freq.
Electrostatic discharge test (IEC 61000-4-2)	6 kV contact 8 kV air
Surge test (IEC 61000-4-5)	2 kV line to earth, 1 kV line to line
Fast transient test (IEC 61000-4-4)	2 kV 1 kV earth port
Common mode radio frequency electromagnetic field test (IEC 61000-4-6)	10 Vrms 0,15 ÷ 80MHz / 80% AM (1KHz)
Slow voltage variations test (IEC 61000-4-11)	V nom. + 20 % - Criterion A V nom. - 25 % - Criterion A

Emission test	**EN 61000-6-4** **EN 51081-2** **IEC 60730-1** **CAN/CSA E60730-1:02** **FCC part 15 sub-part B class B**
Radiated emission test (CEI EN 55011, 55022)	EN 55011/EN 55022 Class B Frequency range: 30 MHz – 230 MHz; 230 MHz – 1 000 MHz Limits: 30 dB(µV/m) Quasi-peak at 10 m; 37 dB(µV/m) Quasi-peak at 10 m FCC TITLE 47 Part 15 Subpart B Class B §15.109 Radiated emission limits. (a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values: Frequency of emission (MHz) / Field strength (microvolts/meter) 30–88 ..... 100 88–216 ..... 150 216–960 ..... 200 Above 960 500

Mechanical specifications

Property	Value
Dimensions	Diameter 95 mm max Overall length: 180mm approx
Weight	1.3 Kg approx.
Degree of protection	IP66 (CEI EN 60529)

APPENDIX 3 – LOCAL CONFIGURATION FUNCTIONS

These are the parameters in each Function Set that can be modified locally. In order to change the other parameters, a connection with the Flame Explorer tool is needed.

PROGRAM FUNCTIONS	LEVELS		DEFAULT VALUE	VALUES AVAILABLE
Function-set to edit	(Function Set to Edit)		FSA	FSA FSB FSC FSD
Trip Points	Intensity	Pull-In	30	5 to 80
		Drop-Out	30	Pull-In – 6 max
	Frequency	Pull-In	5	5 to 100 or 5 to 225 for turbine
		Drop-Out	5	Pull-In – 6 max
	AC-Amplitude	Pull-In	0	0 to 80
		Drop-Out	0	Pull-In – 6 max
FREQUENCY SENSITIVITY	N/A		55	10 to 100
DELAY DROP-OUT	N/A		2.0 seconds	0.2 to 4 seconds
RESTORE DEFAULT CONFIGURATION	N/A		Restores the scanner's default configuration	

APPENDIX 4 - PROPOSED INITIAL SETTING

Notes on the Proposed Initial Settings

Important values for flame detection that should be set before initial start-up are shown in bold.

Other values that can be changed, but are not critical for flame detection are shown in plain text.

NOTE: Using Flame Explorer tool, a user can load from a file the predefined, default values for a wide range of standard applications. Please refer to the Flame Explorer manual for details and for a list of the pre-defined configurations that are available.

NOTE: The examples below are based on two Function Sets named "A" and "B". Since for a single sensor SF810i there are up to 4 Function Sets that the user can select, a user can theoretically build up to four different sets and switch among them.

Corner applications

APPLICATION DESCRIPTION	Tangential - Coal w/oil Warm-up Discriminate		Tangential - Coal		Tangential - Gas only		Tangential - Oil only		Tangential - Gas and Oil	
FLAME SENSOR TYPE	Visible Light Fiber Optic Scanner		Visible Light Fiber Optic Scanner		UV Fiber Optic Scanner		Visible Light Fiber Optic Scanner		VL or UV Fiber Optic Scanner	
Fuel/Load switching	*On*		Off		Off		*On*		*On*	
Application Select	Corner		Corner		Corner		Corner		Corner	
Hi Limits	Off		Off		Off		Off		Off	
AC Amplitude	Off		Off		Off		Off		Off	
FUNCTION SET	A	B	A	B	A	B	A	B	A	B
Function Identifier	Coal	Oil	Coal		Gas		Low	Hi	Gas	Oil
Intensity Pickup	30	*20*	30		10		*55*	*65*	30	*20*
Intensity Dropout	30	*20*	30		10		*55*	*65*	30	*20*
Intensity Hi										
Frequency Pickup	5	*30*	5		20		*20*	*15*	10	*30*
Frequency Dropout	5	*30*	5		20		*20*	*15*	10	*30*
Frequency Hi										
AC Pickup										
AC Dropout										
AC Hi										
Quality Norm Int	20	20	20		20		20	20	20	20
Quality Norm Int Hi										
Quality Norm Freq	15	15	15		15		15	15	15	15
Quality Norm Freq Hi										
Quality Norm AC										
Quality Norm Freq AC										
Freq Sensitivity	55	*60*	55		30		58	58	30	60
Int Smoothing	*5*	*5*	*5*		*5*		*5*	*5*	*5*	*5*
Freq Smoothing	*8*	*8*	*8*		*5*		*8*	*8*	*5*	*8*
AC Smoothing										
Delay on Dropout	2	2	2		1		2	2	1	2
Delay on Pickup										
Max Frequency	125	125	125		125		125	125	125	125

Table 22 – Proposed Initial Settings for Corner Applications

Wall Fired applications

APPLICATION DESCRIPTION	Opposed Wall Coal with or without oil lighters		Gas Lighters on Opposed Wall Coal		Opposed Wall Gas with or without Oil		Front (or Rear) Wall Gas with or without Oil	
FLAME SENSOR TYPE	Visible Light or IR with or w/o Fiber Optic Scanner		UV Wall Mount Scanner		UV Wall Mount Scanner		UV Wall Mount Scanner	
Fuel/Load switching	*On*		Off		*On*		On	
Application Select	Wall/Industrial		Wall/Industrial		Wall/Industrial		Wall/Industrial	
Hi Limits	Off		Off		Off		Off	
AC Amplitude	Off		Off		Off		Off	
FUNCTION SET	A	B	A	B	A	B	A	B
Function Identifier	Low	Hi	Gas		Low	Hi	Gas	Oil
Intensity Pickup	30	30	*5*		*0*	*10*	*10*	*20*
Intensity Dropout	30	*30*	*5*		*0*	*10*	*10*	*20*
Intensity Hi								
Frequency Pickup	*10*	5	*15*		*15*	*25*	*15*	*15*
Frequency Dropout	*10*	5	*15*		*15*	*25*	*15*	*15*
Frequency Hi								
AC Pickup								
AC Dropout								
AC Hi								
Quality Norm Int	20	20	15		15	15	15	15
Quality Norm Int Hi								
Quality Norm Freq	15	15	15		15	15	15	15
Quality Norm Freq Hi								
Quality Norm AC								
Quality Norm Freq AC								
Freq Sensitivity	58	58	75		*75*	75	*55*	*75*
Int Smoothing	*5*	*5*	*5*		5	5	5	5
Freq Smoothing	*8*	*8*	*5*		5	5	5	5
AC Smoothing								
Delay on Dropout	2	2	*1*		*1*	*1*	*1*	*2*
Delay on Pickup								
Max Frequency	125	125	125		125	125	125	125

Table 23 – Proposed Initial Settings for Wall Fired Applications

Cyclone applications

APPLICATION DESCRIPTION	Cyclone coal and/or oil lighter		Cyclone gas lighter only	
FLAME SENSOR TYPE	Visible Light Scanner		UV Scanner	
Fuel/Load switching	Off		Off	
Application Select	Wall/Industrial		Lighter	
Hi Limits	Off		Off	
AC Amplitude	Off		Off	
FUNCTION SET	A	B	A	B
Function Identifier	Coal		Gas	
Intensity Pickup	30		***10***	
Intensity Dropout	30		***10***	
Intensity Hi				
Frequency Pickup	***15***		***25***	
Frequency Dropout	***15***		***20***	
Frequency Hi				
AC Pickup				
AC Dropout				
AC Hi				
Quality Norm Int	20		20	
Quality Norm Int Hi				
Quality Norm Freq	20		20	
Quality Norm Freq Hi				
Quality Norm AC				
Quality Norm Freq AC				
Freq Sensitivity	60		***60***	
Int Smoothing	5		5	
Freq Smoothing	8		5	
AC Smoothing				
Delay on Dropout	2		2	
Delay on Pickup				
Max Frequency	125		125	

Table 24 – Proposed Initial Settings for Cyclone Applications

GT and Side Igniter applications

APPLICATION DESCRIPTION	Gas Turbine		Side Ignitor	
FLAME SENSOR TYPE	IR or UV Remote Fiber Optic Scanner		Visible Light Scanner	
Fuel/Load switching	Off		Off	
Application Select	Turbine		Lighter	
Hi Limits	Off		Off	
AC Amplitude	Off		Off	
FUNCTION SET	A	B	A	B
Function Identifier	GT		IGN	
Intensity Pickup	5		10	
Intensity Dropout	5		10	
Intensity Hi				
Frequency Pickup	5		15	
Frequency Dropout	5		15	
Frequency Hi				
AC Pickup				
AC Dropout				
AC Hi				
Quality Norm Int	20		15	
Quality Norm Int Hi				
Quality Norm Freq	20		15	
Quality Norm Freq Hi				
Quality Norm AC				
Quality Norm Freq AC				
Freq Sensitivity	55		55	
Int Smoothing	0		5	
Freq Smoothing	0		8	
AC Smoothing				
Delay on Dropout	0		2	
Delay on Pickup				
Max Frequency	125		125	

Table 25 – Proposed Initial Settings for GT and Side Igniter Application

APPENDIX 5 - FLAME DETECTION THEORY

Basic Flame Detection

A flame scanner located on the igniter or main burner measures the instantaneous energy produced from the combustion of the fuel.
The SF810*i* digitizes the flame signal 2,000 times per second, then measures flame characteristics using proprietary analysis algorithms as shown below.

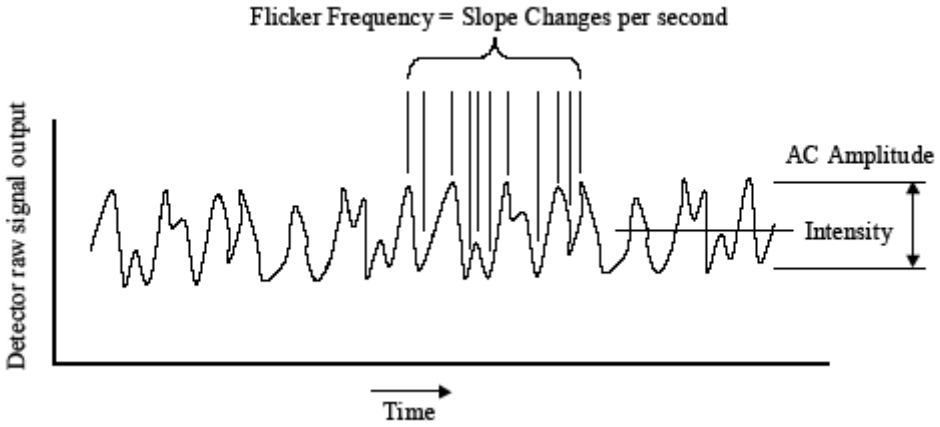


Figure 24 - Intensity, flicker frequency and AC-amplitude

Measured-Values

Measured-Values are the energy characteristics that can be measured with the SF810*i* .
They include:

- Intensity
- Flicker-Frequency
- AC-Amplitude
- Flame Quality

These values are compared to Pull-In and Drop-Out limits that you set during the tuning process.
If Measured-Values exceed the programmed Pull-In limits, the SF810*i* will:

- Vote a Flame-On condition in the program Flame-Logic
- Energize the Flame-relay
- Provide a Flame-Proven signal on the redundant serial ports

If Measured-Values fall below the programmed Drop-Out limits the SF810*i* will:

- Vote a Flame-Off condition in the Flame-Logic
- De-energize the Flame-relay
- Provide a Flame-Off signal on the redundant serial ports

The Figure 25 shows an example of the Pull-In and Drop-Out settings for Flicker-Frequency.

Measured-Values are Application Dependent

Depending on the application (flame, burner, fuel) and/or the spectral range (IR, UV, VL, IR+UV…), certain Measured-Values may be low in strength or may vary greatly with the operation of the burner.
Under that conditions these Measured-Values are not reliable for flame detection and may be removed from the Flame-Logic.

Flame Detection Using High-Limits

In rare instances more robust operation can be achieved by also applying a High-Limit to Measured-Values.

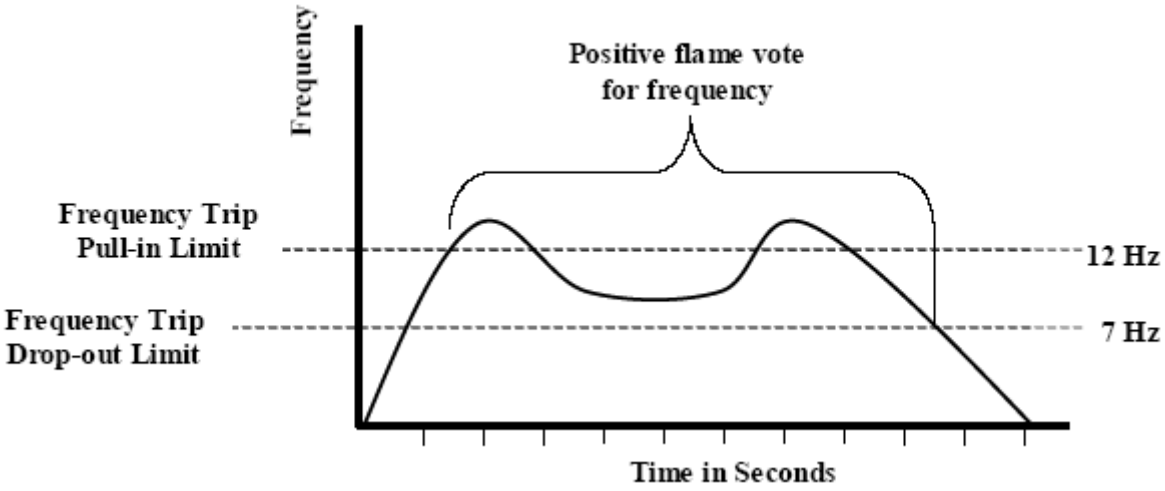


Figure 25 - Flicker frequency trip points

When the High-Limit feature is enabled, the SF810*i* will vote a Flame-Off condition whenever one or more of the active parameters are above the programmed High-Limit values.
The default condition for the High-Limit feature is OFF, so you must enable this Flame-Logic.

Smoothing and Time-Delays

Since rapid changes can occur in any combustion system, special features are included to minimize the chance of false readings due to transient conditions. Smoothing filters (rolling averages) can be applied to the Measured-Values to reduce the impact of sudden changes.

Fuel/Load Switching

In some combustion firing systems flame characteristics may change with fuel or load changes. Under these circumstances the ideal trip, sensitivity, and Time-Delay settings may be different for the different fuels or load.

Use the Fuel/Load Switching feature to more precisely determine flame characteristics under these conditions.

Flame Quality

Quality is a measure of how close the SF810*i* is to voting a Flame-Off condition.
The Quality value can range from zero to 100%.
Any drop in the Quality value from the top 100% level indicates that one or more of the Measured-Values values are approaching a Trip Point. You can use this information to take preventative actions before a trip occurs.

The Quality Calculation does not pinpoint the source of a burner problem; it only informs you of the general state of flame detection:

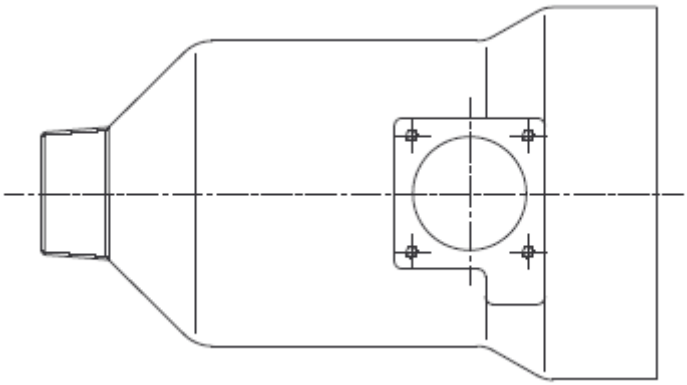
- The Quality Calculation does not affect the Flame-Logic algorithm

APPENDIX 6 - GLOSSARY

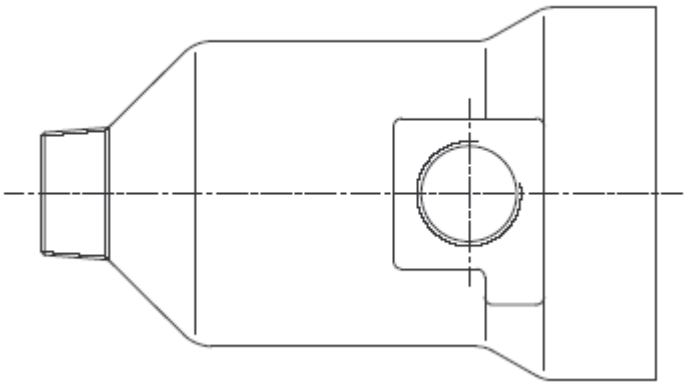
Term	Description
AC-Amplitude	The AC-Amplitude is defined as a measurement of the intensity of the flicker or pulsation of the flame. It is one of the Measured-Values
SF810i	Uvisor™ Integrated SafeFlame Scanner
ATB	Terminal Board for the SF810*i*
ATEX	Atmosphere Explosive
BMS	Burner Management System
Channel	A Channel is a connection to a flame scanner. The SF810*i* includes two Channels. Each Channel can be independently connected and operated by the SF810*i* .
Configuration-Mode	The SF810*i* is in Configuration-Mode when it has been enabled to modify Configuration functions
Control System	Used as synonymous of BMS
Conventional	Flame detector made of three parts, a scanner head, a separate electronic unit and a cable connecting the two
Drop-Out	A Drop-Out occurs when a Measured-Value goes below the Drop-Out value.
DW	Direct View, see LOS
ESD	Electro Static Discharge
Safe-relay	Safe-relay is an ON/OFF switch that is energized when no Faults are present, and de-energized when Faults are detected.
First-Time Power up	First-Time Power up is a mode of operation that the SF810*i* automatically enters when it is factory new or when a Complete Reset of the configuration performed.
Flame Explorer	Software tool for configuration and monitoring
Flame scanner	The flame scanner is a unit that detects changes in a light source.
Flame-Logic	Flame-Logic is the program code that determines when a flame is considered ON (Flame-On) or OFF (Flame-Off). This Flame-Logic can be customized using SF810*i* menus.
Flame-Off	The absence of a flame as calculated by the Flame-Logic.
Flame-On	The presence of a flame as calculated by the Flame-Logic.
Flame-Proven	A Flame-Proven condition occurs when the Flame-Logic determines that all requirements are met. A Flame-Proven condition will continue to exist until the Flame-Logic votes a Flame-Off condition.
Flame-relay	Flame-relay is an ON/OFF switch that is energized when a flame is detected, and de-energized when a flame is not present.
FOC	Fiber Optic - Fiber Optic Cable
Function Set Switch	Function Set switch allows the user to change, at a given moment of his burner's life cycle, the active Function Set used by the SF810*i* algorithm to vote flame conditions.
High-Limit	A Measured-Value must remain at or below the High-Limit value, or else the Flame-Logic will vote a Flame-Off condition.
Intensity	For SafeFlame Applications the Intensity is defined as the brightness of light energy. It is one of the Measured-Values.
IR	Infra Red, electromagnetic wave whose wavelength is from 750 to 2000nm and longer (approx).
LOS	Line of Sight

Term	Description
Measured-Values	The Measured-Values are the energy characteristics that can be measured with the SF810*i* .
MODBUS	Widely used and well-known serial communication protocol used in SF810*i* application to exchange working parameters and configuration data.
Normalization	A method of setting the sensitivity of the Quality Calculation. The normalization values can be modified to account for the Boiler environment.
Normal-Mode	The SF810*i* is in Normal-Mode when it is not in Configuration-Mode or Parameter-Mode. In this mode the SF810*i* will display flame monitoring information.
PCB	Printed Circuit Board
Profibus DP-V0	Standard fast speed protocol used in industrial equipment communication, based on the principle of cyclic communication between a Profibus master and its slaves.
Profibus DP-V1	An add-on to DP-V0 version that allows acyclic communication between master and slaves.
Program-Mode	The SF810*i* is in Program-Mode when it has been enabled to modify Program functions.
Pull-In	A Pull-In occurs when a Measured-Value goes from zero to a value that matches or exceeds the Pull-in Limit value.
Quality	Quality is a measure of how close the SF810*i* is to voting a Flame-Off condition. The Quality value serves as an indicator of the general state of flame detection.
RS-485	A de-facto industrial standard that specify the signal type, level and other basic parameters of a differential communication line on copper cable.
SafeFlame™	SafeFlame™ is an ABB trademarked name for a series for Flame Scanners that operate by measuring flame energy with photo-diode Sensors. These Sensors convert light energy into electronic signals
SE	Sensor Electronic - The SF810*i* sensor board
Single-Relay	A mode that enables a single Relay for use on a Channel.
SPE	Signal Processing Electronics - The SF810*i* processing board
TB	See ATB
Tuning Function-Sets	Stored records of function values organized by Channel. Multiple Tuning Function-Sets can be used for Fuel/Load Switching.
UV	Ultra Violet, electromagnetic wave whose wavelength is from 100 to 400nm (approx).
Uvisor™	ABB family of flame scanners and analysis products
VL	Visible Light, electromagnetic wave whose wavelength is from 400 to 750nm (approx).

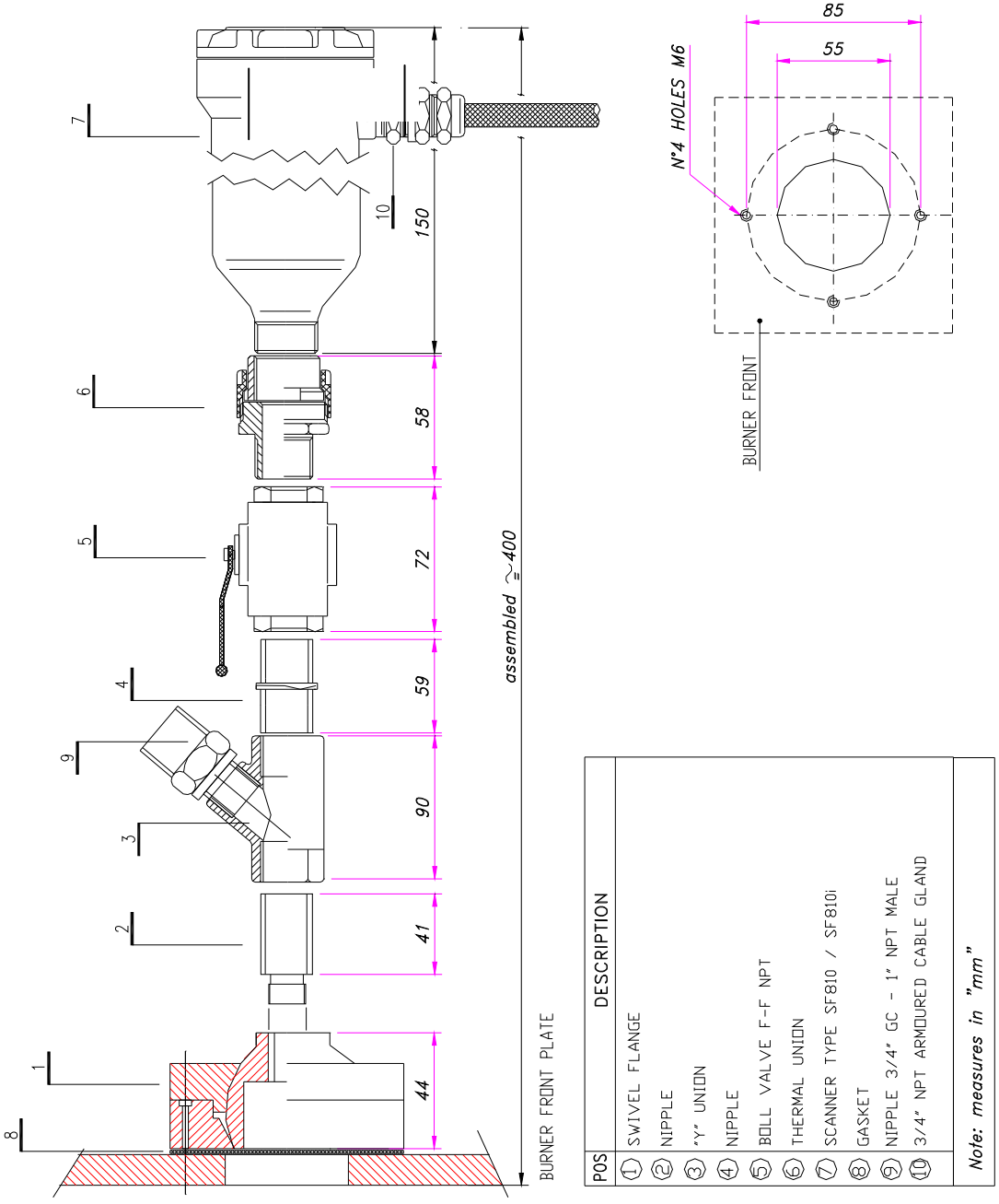
APPENDIX 7 DRAWINGS



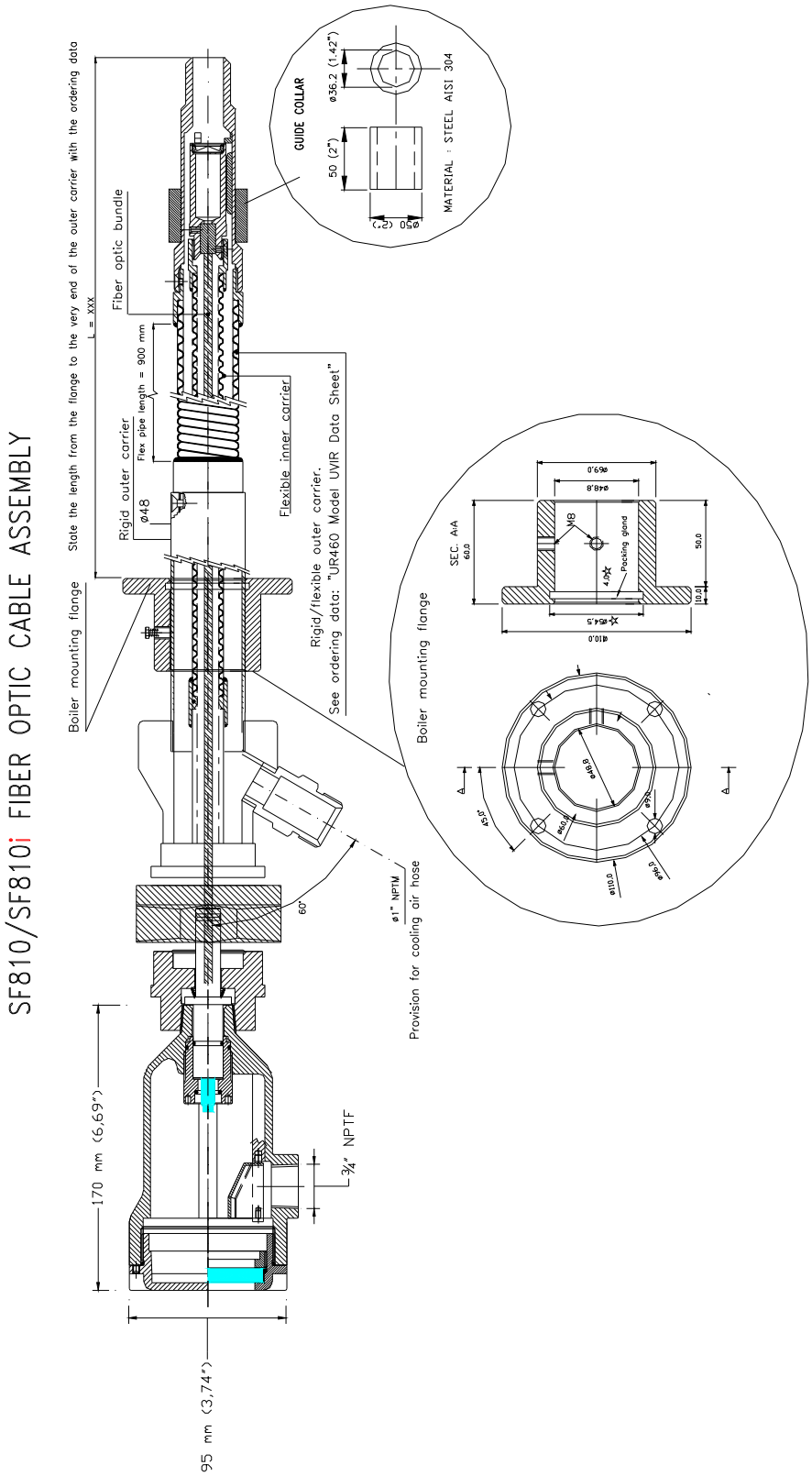
Drawing 1 - Enclosure connector version



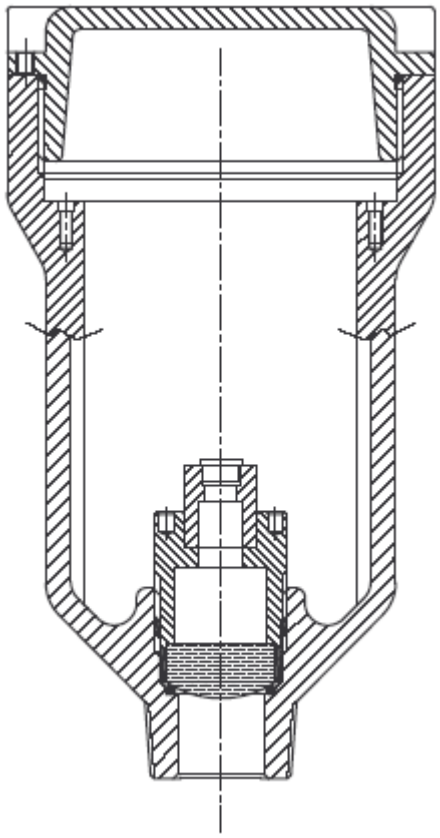
Drawing 2 - Enclosure, ¾" NPT version



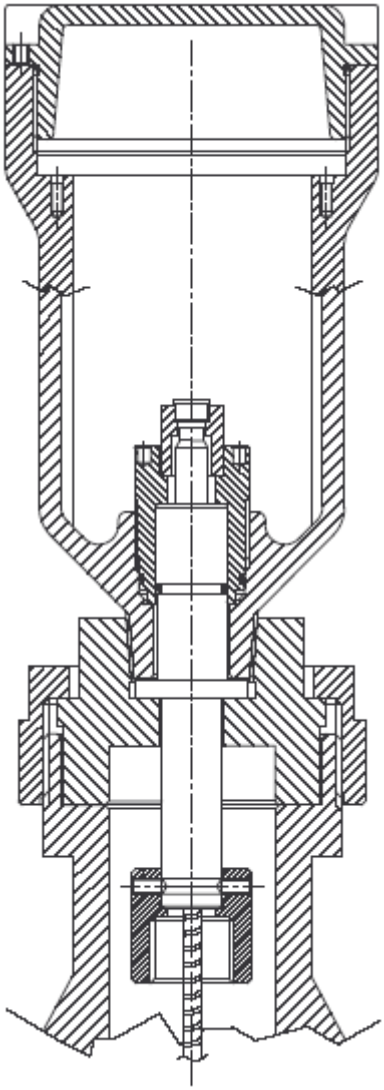
Drawing 3 - LOS installation



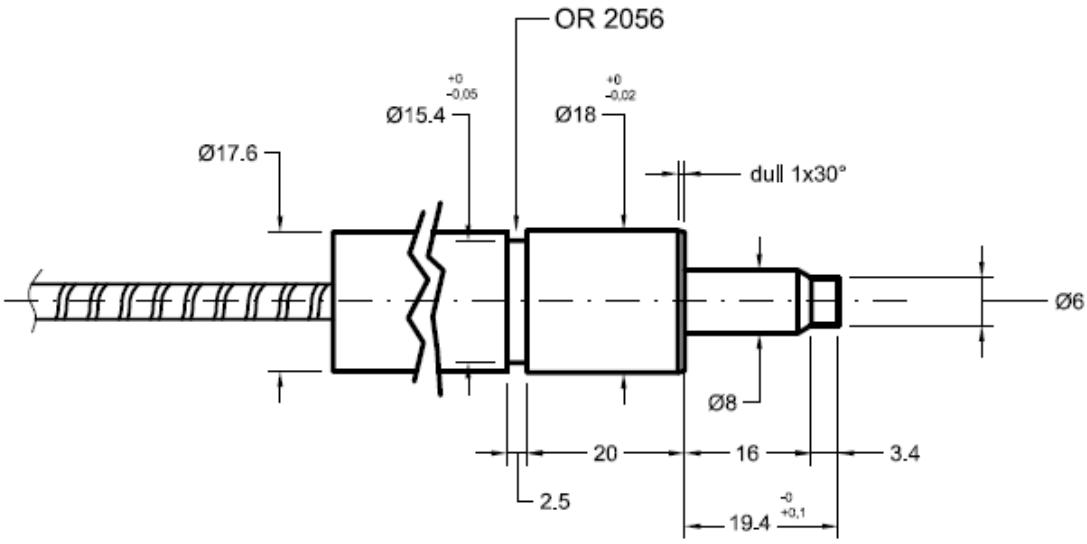
Drawing 4 - FOC installation



Drawing 5 - Enclosure longitudinal section (LOS)



Drawing 6 - Enclosure longitudinal section (FOC), incl. mount



Drawing 7 - Fiber optic cold terminal

APPENDIX 8 - CABLES

Earth connection cable

Standard yellow-green cable of 2.5mm^2 cross section, max 3 m length.

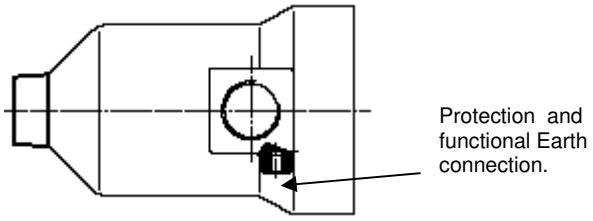


Figure 26 - Earth connection

Cable pinout for -Q and -QC versions

Pin	Color (*)	Section mm^2	Section AWG	Signal name	Structure	Description
A	Pale-Red	0.22	24	D2+	Profibus Pair #2	Profibus / RS485 port #2, data TX/RX+, positive data, "RS485 conductor B" (mind to the assignment: conductor B is on pin A)
B	Pale-Green	0.22	24	D2-		Profibus / RS485 port #2, data TX/RX-, negative data, "RS485 conductor A" (mind to the assignment: A conductor is on pin B)
C	TBD	0.22	24	Zero_2		Drain wire Ground ref. for serial comm. Port #2
D	Pale-Red	0.22	24	D1+	Profibus Pair #1	Profibus / RS485 port #1, data TX/RX+, positive data, "RS485 conductor B" (mind to the assignment: conductor B is on pin D)
E	Pale-Green	0.22	24	D1-		Profibus / RS485 port #1, data TX/RX-, negative data, "RS485 conductor A" (mind to the assignment: conductor A is on pin E)
F	TBD	0.22	24	Zero_1		Drain wire Ground ref. for serial comm. Port #1
G	TBD	0.5	20	DI1		Digital input #1 (24V, extern powered)
H	TBD	0.5	20	DI_common		Common return for DI1 and DI2
J	TBD	0.5	20	DI2		Digital input #2 (24V, extern powered)
K	RED	1	17	+24V$_{DC}$		Power supply positive input +24V$_{DC}$
L	BLACK	1	17	GND		Return of power supply, ground ref. for internal electronics
M	TBD	0.22	24	AO+	4-20mA twisted pair	Analog output (4-20mA) positive
N	TBD	0.22	24	AO-		Analog output (4-20mA) negative
P	TBD	1.5	15	SAFE		Safe-relay contact (NO)
R	TBD	1.5	15	Common		Common for both Safe and Flame relay contacts
S	TBD	1.5	15	FLAME		Flame-relay contact (NO)
T	GRAY	1.5	15	Shield	Shield	Earth connection point for the shields of the cable(s), functional earth

(*) Suggested color for external cable conductors.

Standard cables

SF810*i* can be connected to the system using standard cables available on the market. The following tables specifies the requirement for the cables.

Please note that in this case ABB does not specify mechanical properties, global cross sections, fire resistance properties and so on. The following are mainly electrical requirements.

24 V_{DC} power supply

Type	Pair
Conductor(s) section	1.2mm^2 each (AWG16)
Conductor(s) material	Copper
Colors	Conductor 1: red Conductor 2: black
Shield	Not required
Conductor resistance	<= 20 Ohm/Km (at 20 º C)
Isolation resistance	>= 1000 MOhm x Km (at 20 º C)
Working voltage	< 50V_{DC}

Relays contacts

Type	3 conductors
Conductor(s) section	1.2mm^2 each (AWG16)
Conductor(s) material	Copper
Colors	Conductor 1: Orange Conductor 2: Light-blue Conductor 3: Pink
Shield	Not required
Conductor resistance	<= 20 Ohm/Km (at 20 º C)
Isolation resistance	>= 1000 MOhm x Km (at 20 º C)
Working voltage	Up to 240 V_{AC}

Communication line(s)

Type	Shielded Twisted pair	Shielded Twisted pair
Conductor(s) section	0.22mm^2 AWG 24 / 7	0.34mm^2 22 AWG
Conductor(s) material	Copper	Copper
Colors	Conductor 1: red Conductor 2: green	Conductor 1: red Conductor 2: green
Shield	Aluminum ribbon/polyester; aluminum is in continuous contact with a 24/7AWG drain wire plus a copper shield	Aluminum ribbon/polyester; aluminum is in continuous contact with a 24/7AWG drain wire plus a copper shield
Conductor resistance	<= 88.6 Ohm/Km (at 20 º C)	Loop resistance <110 Ohm/km
Isolation resistance	>= 1000 MOhm x Km (at 20 º C)	>= 1000 MOhm x Km (at 20 º C)
Capacitance (1KHz)	42.0pF/m (conductor-conductor) 75.5 pF/m (conductor-shield)	<30pF/m
Impedance	120 Ohm	135-165 Ohm
Working voltage	< 50V_{DC}	< 50V_{DC}
Special requirement	Must be fully compliant with Profibus specification	Must be fully compliant with Profibus specification

Digital Inputs

Type	3 conductors
Conductor(s) section	0.5mm^2 each
Conductor(s) material	Copper
Colors	Conductor 1: yellow/red Conductor 2: yellow/blue Conductor 3: yellow/brown
Shield	Not required
Conductor resistance	<= 40 Ohm/Km (at 20 º C)
Isolation resistance	>= 1000 MOhm x Km (at 20 º C)
Working voltage	< 50V_{DC}

Analog Output

Type	Shielded twisted pair
Conductor(s) section	0.22mm^2 each (AWG24 / 7)
Conductor(s) material	Copper
Colors	Conductor 1: white/red Conductor 2: white/black
Shield	Yes
Conductor resistance	<= 88.6 Ohm/Km (at 20 º C)
Isolation resistance	>= 1000 MOhm x Km (at 20 º C)
Working voltage	< 50V_{DC}

ABB special cables

SF810*i* can be connected to its junction box using special cables developed for the purpose. Available cables are shown in the following table.

All these cables are multi-conductor, with a global shield, external sheath blue colored and are marked as “Flame scanner cable”.

Cable	**P/No** **(yyyy = lenght in meters)**	**Applications**
ABB cable for SF810*i* Cable only, no connectors, suitable for both ATEX and non-ATEX versions	SF810INT-CBL-yyyy	SF810INT-XXX-XX-**T**-X-X SF810INT-XXX-XX-**TL**-X-X
ABB connector cable for SF810*i* Non-ATEX Cable with pre-assembled quick-release plug at one side only (non-ATEX version)	SF810INT-CBL-Q-yyyy	SF810INT-XXX-XX-**Q**-X-X
ABB connector cable for SF810*i* ATEX Cable with pre-assembled quick-release plug at one side only (ATEX version)	SF810INT-CBL-QC-yyyy	SF810INT-XXX-XX-**QC**-X-X

Table 26 - ABB cables for SF810i

Global characteristics of the above ABB special cables:

Characteristic	**Value / usage**
Structure	Composite Cable with 6 internal elements for different purposes, kept all together in a global shield and global jacket.
Element 1	24 V_{DC} power supply
Element 2	Relays contacts (up to 240V_{AC})
Element 3	First communication line
Element 4	Second communication line
Element 5	Digital inputs
Element 6	Analog Output
Global shield	Yes
External sheath	Fire-retardant, oil and abrasion resistant AFUMEX 70ºC
External color	Blue
Marking on external sheath	“Integrated Flame Scanner Cable”
External diameter	<= 16.1mm
Length	From 1m to 2000m (cut to length, see P/No. suffix ‘yyyy’) Length tolerance (+/- 3%)

Table 27 - Global characteristics of ABB cables

APPENDIX 9 - ATEX

ATEX certification details

ATEX (Atmosphere Explosive) certifications available with the different SF810*i* versions are given in Table 28.

ATEX certification	Available with SF810*i* version:	Notes	IP66
None (IP66 only)	SF810INT-XXX-XX-**TL**-X-X SF810INT-XXX -XX-**Q**-X-X	**TL** = **T**erminals, **L**ow cost **Q** = **Q**uick release conn.	Yes
ATEX II 2D EEx d ("ATEX dust" for dust only)	No SF810*i* versions available with this ATEX certification		
ATEX II 2GD EEx d IIB (ATEX for gases and dust, not including hydrogen)	No SF810*i* versions available with this ATEX certification		
ATEX II 2GD EEx d IIC for dust and for every type of gases including hydrogen ("ATEX full")	SF810INT-XXX-XX-**T**-X-X SF810INT-XXX-XX-**QC**-X-X	**T** = **T**erminals **QC** = **Q**uick release connector ATEX **C**ertified	Yes

Table 28 - ATEX certifications available

***WARNING**: The ATEX certified fiber optic versions (SF810INT-FOC-xx-**T**-xx-xx and SF810INT-FOC-xx-**QC**-xx-xx) must be mandatory used together with the ABB ATEX certified fiber optic, otherwise the certification is invalidated. See Table 4*

NOTE: all ATEX-certified models must be installed strictly following the instructions given in the booklet that is shipped together with each unit. Otherwise the ATEX certification is invalid. Ref. to the "INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS", (Doc. No. IM.C-170/06.02).

*NOTE: in order to maintain the IP66 rating of the SF810*i* versions that have no ATEX certifications (i.e. SF810INT-XXX-XX-**TL**-X-X and SF810INT-XXX -XX-**Q**-X-X) you can use:*
- for LOS versions: any mounting methods/components (thermal union, flange…) that maintain the IP66 rating
- for FOC versions: either an ABB ATEX certified fiber or a custom-made fiber; in this latter case the cold terminal of the fiber itself must comply with the dimension and geometry requirements that are depicted in Drawing 7 - Fiber optic cold terminal (see APPENDIX 7 DRAWINGS) including the presence of the o-ring gasket.
In both cases the mounting accessories surrounding the fiber cold terminal must provide a way to keep the fiber fully inserted in the enclosure (for instance by spring-loading).

The following is an excerpt from “INSTALLATION, USE AND MAINTENANCE INSTRUCTIONS”, (Doc. No. IM.C-170/06.02).

Safety instructions

These instructions refer to the fitting, use and maintenance of Detection Units of the series **UR600…** and series **SF810…** for use on surface areas in an explosive atmosphere caused by dust (D) or gas or vapours (G) or dust and gas or vapours (GD).
The appliance included in the present instructions are protected against explosion risks as follow:

Type of protection	Category	Zone	Ambient Temperature
Ex tD A21 IP66 T80°C	II 2D	21 and 22	-20°C ÷ +70°C
Ex d IIC T6	II 2G	1 and 2	
Ex d IIC T6 Ex tD A21 IP66 T80°C	II 2GD	1 and 2 ; 21 and 22	

Installation and electrical connection

2.1 Compatibility between appliances and hazardous areas

According to the technical and legislative regulations the unit can be installed in explosive areas.
The unit must be fitted in a compatible area under the user’s responsibility.
The essential safety requirements against explosion risk inside classified areas are determined by European Directives 94/9/EC dated March 23rd 1994 (about appliances) and 1999/92/EC dated December 16th 1999 (about plants).
Areas with explosion risk are determined by technical criteria according to EN 60079-10 standards for gas presence and EN 50281-3 or EN 61241-10 standards for dust presence.
Electrical plants technical requirements inside classified areas are determined by EN 60079-14 standards for gas presence and EN 50281-1-2 or EN 61241-14 standards for dust presence.
Notify body (in charge for certification and production surveillance) references are indicated on the nameplate together with functional data.
WARNING: the appliance can not be installed in “ZONE 0” and in “ZONE 20”.
It is user’s responsibility to install the appliance in zones compatibly with its type of protection (see table).

2.2 Nameplate safety data marking

Appliance safety characteristics data and applicable norms are indicated in the following table.

II 2D	Appliance for surface plants with dust presence suitable for zone 21 and zone 22.
II 2G	Appliance for surface plants with gas presence suitable for zone 1 and zone 2.
II 2GD	Appliance for surface plants with category II 2D and II 2C combination.
IIC	Appliance suitable for IIC group gases presence.
T6	Appliance temperature class (superficial max temperature).
IP66	Protection degree according to EN60529.
T80°C	Superficial max temperature with dust presence.
CE nnnn	Conformity to relevant EC standards and number of Notified Body responsible for production surveillance.
Ex	Conformity to 94/9/EC Directive and related technical standards
ICEPI xxATEXyyyy	Notified Body issuing EC Type Certificate; **xx** = year of certificate; **yyyy** = number of certificate.

Notes:

a) The appliances of IIC group are also suitable for IIA, IIB areas;
b) The appliances with temperature class T6 are also suitable for all the substances with higher temperature class (T5÷T1).

APPENDIX 10 - TOOLS

Conventional maintenance tools is generally all that is necessary to perform installation, basic measurements for diagnostic purposes. A suitable “allen” wrench is needed to remove the cover looking screw.
Anti-ESD wrist strap is needed when operating with the rear cover removed.

NOTE: this section is intended to describe the tools needed to install and service the SF810i product itself, not considering the mechanical tools, welding station and accessories that are needed to physically mount the fiber optic external guide pipe, flanges and generically speaking all mounting accessories (among them: purge air pipe, swivel flange, valves and so on…).

Tools

- Allen wrench (2mm) for the cover locking screw.
- Allen wrench (3mm) for unlocking the quick-release connector (only for SF810INT-XX-XX-**QC**-X-X)
- One small flat-blade screwdriver, (2÷2.5mm) for the removable terminal screws
- One medium/large flat-blade screwdriver, (5mm) for the Earth connection screw
- Cutter
- Anti-ESD wrist strap or other equivalent system
- DMM (not strictly mandatory; could be useful to check the wiring of power supply, digital inputs and analog output 4÷20mA).
- Silicone grease (to add to the rear cover thread before reinstalling it). A copper-based lubricating past can be used, for instance Product code 8160 from AREXONS, MISAL AREXONS SpA, Via Antica di Cassano, 23, Cernusco S/N (MI) Italy, phone: (+39) 02 924361.
- RS-485 / USB converter for interfacing the SF810*i* with the PC running the local configuration Flame Explorer SW tool. In order to keep the PC isolated from the cables that reach the boiler area from the control room, it is better if it features galvanic isolation. Easy available on the market.
- Serial cable for RS-485
- Flashlight

Personal safety

ABB suggests to use the following items pertaining to personal safety:

- Safety glasses
- Protective gloves
- Protective clothing / working suit
- Respiratory mask with filter for ash, smoke and carbon particles

NOTE: local plant regulations might apply when working in the area surrounding the burner/boiler.

APPENDIX 11 - ENCLOSURES

Enclosure P/No assignment

Part number assignment of the enclosure:

SF810 Y1 / Y2 Y3 Y4 (note: this is not the P/No. of the whole unit)

Where:

Y1 = Q (quartz lens, for UV and UVIR spectral ranges)
G (glass lens, for all other spectral ranges)
F (Fiber, version with fiber optical port, for all spectral ranges)
D (Dual sensor, fiber version)
B (Dual sensor, line-of-sight version)

Y2 = B (blind rear cover - solid aluminum)
W (windowed rear cover)

Y3 = G (II 2GD Ex d IIC T6 tD A21 IP66 T80 C - ATEX "Full" certification, gas and dust)
D (II 2D Ex tD A21 IP66 T80 C - ATEX dust only)
A (II 2G Ex d IIC T6 - gas only)
S (non-ATEX, IP66 only)

Y4 = T (threaded cable entry)
C (with quick release connector)

Non-ATEX, (IP66 only) enclosures	**Part number of enclosure**
All enclosures with Y3 = 'S'	SF810_/_S_

ATEX certified enclosures **Listed for reference only. Because of the certification, they cannot be ordered as spare parts.**	**Part number of enclosure**
All enclosures with Y3 = 'G'	SF810_/_G_

Cross-reference between SF810*i* and enclosure

The SF810*i* P/No. has 5 suffixes: SF810INT-____-____-____-____-____

NOTE: the fourth suffix of the SF810*i* P/No. is related to the conformal coating of the internal electronics and has no impact on the assignment of the enclosure P/No.

SF810*i* Part Number	Enclosure Part Number
Line-of-Sight versions (LOS) with glass lens (IR and VL)	NOTE: the non-specified letter in the Enclosure P/No ("_") is always equal to the last suffix of the SF810*i* P/No. (Example: SF810INT-LOS-IR-T-___-**B** → SF810 G/**B**GT)
SF810INT-LOS-IR-T-___-___ SF810INT-LOS-VL-T-___-___	SF810 G/__GT
SF810INT-LOS-IR-TL-___-___ SF810INT-LOS-VL-TL-___-___	SF810 G/__ST
SF810INT-LOS-IR-Q-___-___ SF810INT-LOS-VL-Q-___-___	SF810 G/__SC
SF810INT-LOS-IR-QC-___-___ SF810INT-LOS-VL-QC-___-___	SF810 G/__GC
Line-of-Sight versions (LOS) with Quartz lens (UV)	
SF810INT-LOS-UV-T-___-___	SF810 Q/__GT
SF810INT-LOS-UV-TL-___-___	SF810 Q/__ST
SF810INT-LOS-UV-Q-___-___	SF810 Q/__SC
SF810INT-LOS-UV-QC-___-___	SF810 Q/__GC
FOC versions NOTE: the fiber optic versions (first suffix = FOC) have no lens therefore there is no need to differentiate the spectral range (second suffix) when specifying the enclosure.	
SF810INT-FOC-___-T-___-___	SF810 F/__GT
SF810INT-FOC-___-TL-___-___	SF810 F/__ST
SF810INT-FOC-___-Q-___-___	SF810 F/__SC
SF810INT-FOC-___QC-___-___	SF810 F/__GC

Table 29 - Cross reference between enclosure and whole unit

NOTE: as of January 2008, the above table does not contain the cross reference for the enclosure with Y3 = A and Y3 = D ("dust-only" and "gas-only")

NOTE: as of January 2008, the above table does not contain the cross reference for the dual-sensor versions).

APPENDIX 12 - CONFIGURATION FORM

In case the SF810*i* is installed without making use of the serial communication lines, photocopies of the following form can be helpful to write down and file the configuration data.

Property	Configured value	Notes
Burner / pilot flame Identification		
SF810*i* Serial Number		
Light ingress (LOS or FOC)		
Spectral sensitivity (IR, VL, UV)		
Function set A Intensity pull-in Intensity drop-out Frequency pull-in Frequency drop-out AC-amplitude pull-in AC-amplitude drop-out Frequency sensitivity Delay drop-out		
Function set B Intensity pull-in Intensity drop-out Frequency pull-in Frequency drop-out AC-amplitude pull-in AC-amplitude drop-out Frequency sensitivity Delay drop-out		
Function set C Intensity pull-in Intensity drop-out Frequency pull-in Frequency drop-out AC-amplitude pull-in AC-amplitude drop-out Frequency sensitivity Delay drop-out		
Function set D Intensity pull-in Intensity drop-out Frequency pull-in Frequency drop-out AC-amplitude pull-in AC-amplitude drop-out Frequency sensitivity Delay drop-out		

Table 30 - Configuration form

NOTE: AC-amplitude pull-in and drop-out can be locally configured using pushbuttons only if they have been enabled. Currently, the only way to enable them is using the Flame Explorer Software connected through the serial port.

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