SafetyNet

CE

- *SIL2 certified 1oo1D (single Controller with diagnostics)*
- *Process Control & Safety Functions from a single platform*
- *Mix standard and SafetyNet Modules on the same node*
- *Single programming environment for Process, Logic and Safety Applications*
- *On-line changes supported*
- *Mounts in harsh and hazardous environments*

The MOST SafetyNet System is a new addition to the MTL Open Systems product family. Sharing the same fundamental platform as the Process Control products, a new SafetyNet Controller, a new Earth Line Fault Detect (ELFD) Controller Carrier and two new SafetyNet IO Modules have been developed and certified. The SafetyNet System uses the same field terminals, I/O Module Carriers and Power Supplies as the Process Control products. Configuration and application design is carried out using software tools specifically safety applications - but within a common programming environment.

Certified according to IEC 61508 as a "Programmable Electronic Safety System", MOST SafetyNet is suitable for use in safety-related applications up to Safety Integrity Level (SIL) 2. As part of the family of open system components designed by MTL for the process automation market, it can be closely integrated with the MOST Process Control System or used as a standalone safety system working alongside any Process Control solution. The system will also operate "openly" with your choice of HMI - whatever package you use.

Emergency Shutdown, Fire & Gas and Burner Management application requirements are all met, with certification to IEC 61511 for process industries and NFPA 85 for burner management systems.

Designed for SIL 2, the SafetyNet System has been specifically developed for safety applications, with features that ensure safety designed in to the product, with a simple and straightforward Safety Manual. The net result is a product that is easy to program, configure and use.

The modular approach provides cost effective solutions to safety applications with limited I/O counts per node. And since each SafetyNet node can accommodate up to 64 I/O modules, (each of 8 channels), the requirements of safety systems with high I/O counts are also met.

Using a 1 out of 1 with diagnostics structure (1oo1D), a single controller, input module and output module (together with the necessary field terminals, carriers and power supplies and a suitable sensor and final element) meet all the requirements of a SIL 2 safety function.

Redundant controllers can be used to improve availability for the SIL 2 safety function - with entirely bumpless transfer. Further availability enhancements can be made by the use of redundant, fault tolerant ethernet communications and redundant power supplies.

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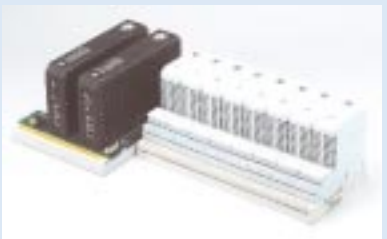
January 2007

SafetyNet System - Overview



General

The MOST SafetyNet System is a "Programmable Electronic Safety System", certified according to IEC 61508 as suitable for use in safety-related applications up to Safety Integrity Level 2.

The system is suitable for use in emergency shutdown, fire & gas and burner management applications.

New additions to the family

The MOST SafetyNet System uses the same basic structure as the MOST Process Control System, but in addition incorporates specifically developed components. These are:

- SafetyNet Controllers (8851-LC-MT)
- Dedicated Controller Carriers for Earth Leakage Fault Detection (8751-CA-NS)
- SafetyNet IO Modules -Analog Input with HART (8810-HI-TX) and Discrete IO (8811-IO-DC)
- Workbench software tools for use with the SafetyNet System (8841-LC-MT)

Open communications

MTL Open System Technologies products are just that - open. SafetyNet nodes communicate with one another, with standard MOST nodes, historian and asset management packages and with HMI packages over a fault tolerant Ethernet LAN, running at up to 100 Mbit/s.

Peer to peer communication

SafetyNet Controllers can communicate with one another via Ethernet using SafetyNet P2P - which has been certified as suitable for use in SIL 2 applications. Robust checks and controls on access and data corruption ensure the safety of communication and allow safety functions for which the inputs and outputs are widely separated to be easily implemented - both in terms of the software programming and in the hardware design.

Mixing safe and standard

Standard IO Modules can be mounted on SafetyNet Nodes - together with SafetyNet IO Modules - without affecting the node's functional safety performance. Only standard applications can read data from standard Modules, but both standard and SafetyNet applications are allowed to write to standard modules. This flexibility can simplify hardware design, where the physical constraints of the particular locality demand such an approach.

Serial interfaces

The Open approach extends to Modbus serial interface products - which can be connected to any node (SafetyNet or standard) by an RS485 connection.

As with data from standard IO Modules, this data can be read by standard Controllers, but not by SafetyNet Controllers. Both standard and SafetyNet Controllers can write to such devices.

Comprehensive programming tools

The SafetyNet System is programmed using the Workbench software package - in common with the MOST Process Control Products. In addition to providing the options of programming the required safety function in one of three IEC 61131-3 languages (Ladder Diagram, Function Block Diagram and Structured Text) the package also provides many useful tools to assist in testing and commissioning.

Restricted access

Access to modify safety-related parameters within the configuration and application program must be restricted to authorised personnel. The SafetyNet system provides a number of layers and methods of providing this protection. Only users with "Safety Responsibility" can access the safety-related aspects of the Workbench. Only computers that the SafetyNet Controller identifies as "trusted hosts" can download new parameters. A download can only take place when an "over-ride key-switch" is set to the required position. And, if required, each SafetyNet Controller can be protected by its own password - without which access to the safety parameters is denied.

Maintaining field instruments

Maintenance over-rides can be implemented from operator workstations in full compliance with the guidelines from TUV. Users define - as part of the safety application - the actions to be taken to maintain a particular instrument and the SafetyNet System then implements these pre-defined actions.

HART capability

The SafetyNet System allows full access to HART field devices for Emerson's AMS maintenance software. (The first release of SafetyNet will not have full HART capability, contact MTL for further information).

Earth leakage detection

Earth leakage fault detection may be implemented using the 8751-CA-NS Controller Carrier in conjunction with an input channel from an 8811-IO-DC Discrete I/O Module. If ELFD is not required, SafetyNet Controllers can be mounted on 8750-CA-NS Controller Carriers.

On-line changes

Where allowed by local practices - and following adequate testing and approval - new safety programs and configuration can be downloaded on-line and in real time. In some situations, this may be possible without interrupting the operation of the safety function.

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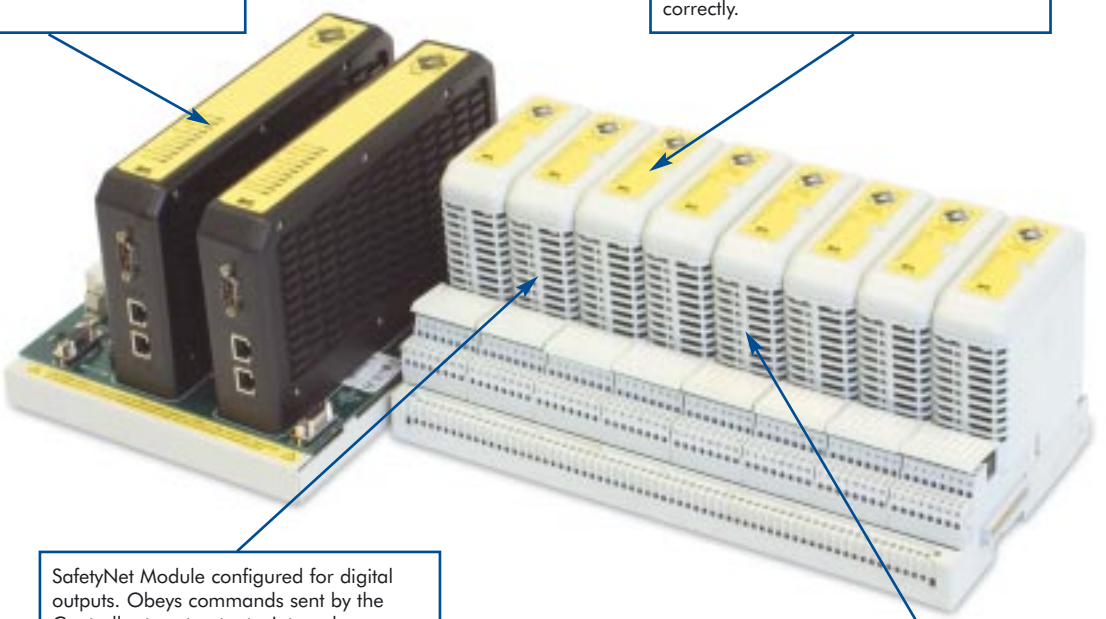

Harsh and hazardous environments

The SafetyNet System is as rugged as the other MOST Process Control Components: -40°C to +70°C operating ambient temperature; Zone 2 or Class 1 Division 2 hazardous area mounting; G3 corrosion resistance; and enhanced shock and vibration capability. The system will operate in the most extreme environments found in process industries, allowing remote mounting and a truly distributed architecture in even the most demanding situations.

Event Logging and Sequence of Events Recording

The SafetyNet System has the same Event Logging and Sequence of Events (SOE) recording capability as the MOST Process Control System. Data received from SafetyNet Modules is time-stamped by the SafetyNet Controller with a resolution of better than 200ms (this is dependent on the execution cycle - small nodes will deliver better resolution). Data from dedicated (non-SIL) SOE modules is time-stamped with a resolution of less than 0.25ms between different channels of the same SOE module and less than 1ms between channels from different SOE modules. The SafetyNet Controller can record up to 8000 events before its event data buffer begins to be over-written by new data.

Reduced cabling and termination costs

In common with the MOST Process Control Components, the SafetyNet System offers users the opportunity to significantly reduce their spending on wiring and termination costs. Moving control and safety hardware out of the control room and on to the plant gives significant savings. The Field Terminal design allows users to avoid unnecessary spend on marshalling cabinets, cross wiring and marshalling terminals. Integral tagging and fusing further simplifies cabinet design and installation.

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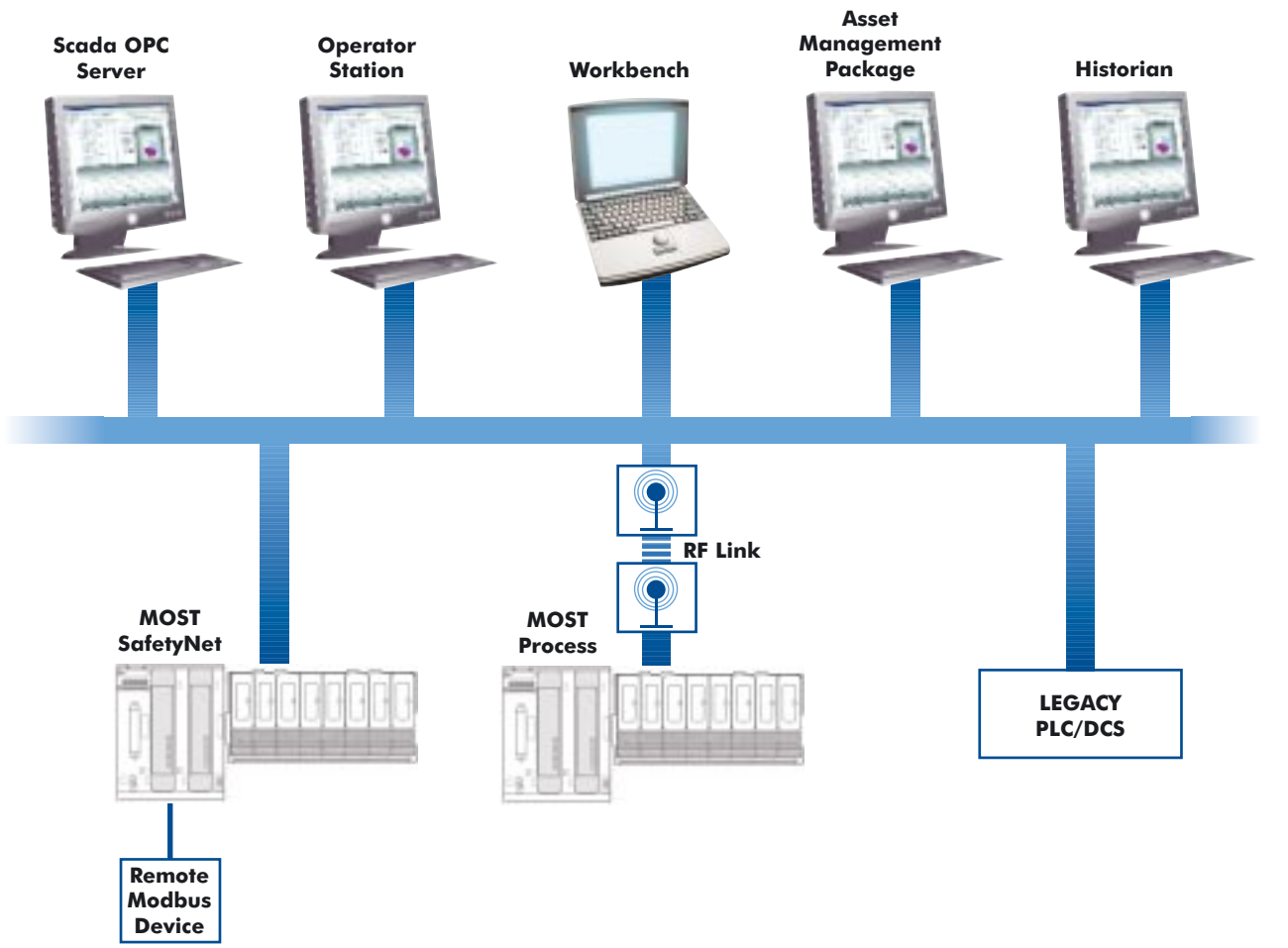

Figure 1 - typical MOST SafetyNet System layout

MOST SafetyNet on your plant

Figure 1 shows a typical layout of a MOST SafetyNet System, together with a MOST Process Control System, an OPC Server, an HMI and asset management and historian packages all connected together via an Ethernet LAN. Also shown is the MOST Workbench - the dedicated tool for programming and configuring MOST SafetyNet and Process Control Systems.

SafetyNet node layout and powering

Figure 2 shows a typical layout of a SafetyNet node, with Controllers, IO Modules, Field Terminals, and Carriers. The power connections that need to be made are also shown.

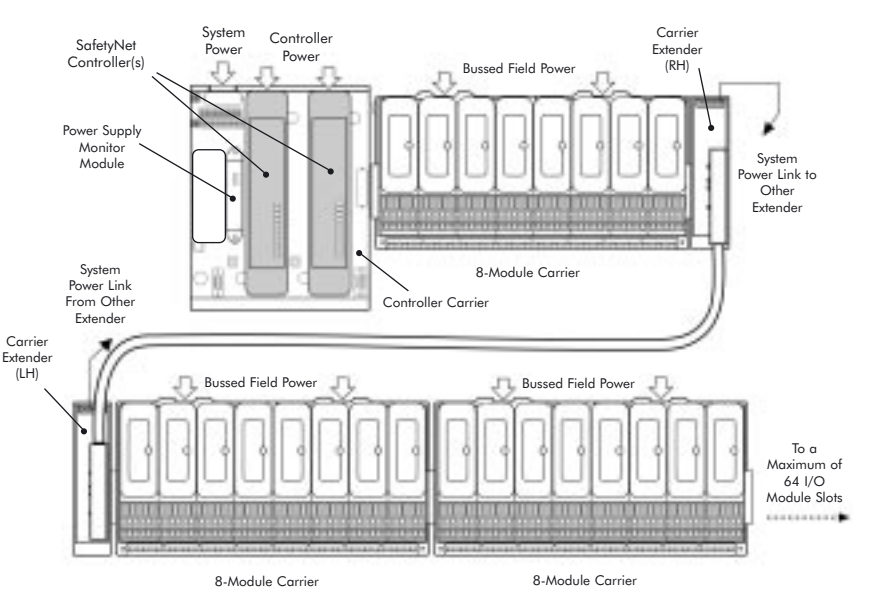

Figure 2 - typical MOST SafetyNet Node layout

SafetyNet System - Overview

Fault Tolerant Redundant LAN

The availability of Ethernet connections - between SafetyNet and standard Controllers, historian and asset management packages and HMI stations - has a significant impact on the effectiveness and availability of both safety and control functions.

To maximise availability of the Ethernet LAN, MOST SafetyNet Systems feature Fault Tolerant Ethernet ports that monitor the integrity of their local network and automatically switch to an alternate path if the existing path becomes unavailable. If suitable Ethernet switches are used - such as Moxa Industrial Ethernet Switches - they too will monitor their local network and switch to an alternative path when this is required.

Monitoring the local network paths - even when they are not being used - allows the system to report the loss of any failed paths so that appropriate maintenance can be carried out.

Moxa Industrial Ethernet Switches

The Moxa Ethernet Switch range is specifically designed for use in Industrial applications that require high availability in harsh environments, with a broad operating temperature range (-40°C to +75°C, except EDS-205: -10°C to +60°C) and hazardous area mounting capability (Class 1, Div 2 or Zone 2).

Two alternative topologies are shown in figures 1 and 2. Which topology is preferred will depend on the physical layout of the entities on the LAN and local preferences.

Figure 1 shows a redundant Ethernet LAN, with intra-LAN link whilst figure 2 shows a single "Turbo Ring" that provides an alternate means of ensuring Ethernet availability - implemented in the Moxa EDS405 5-port switch. If any part of the Turbo Ring fails, communication is re-routed automatically within 300ms. Further improvements to availability can be achieved by putting in place a second identical, "Turbo Ring" which should be connected to the first ring by a single intra-LAN link. This link would normally be mounted in the control room.

The Moxa switches are available with either all copper or a combination of copper and fibre ports. For media conversion between fibre and copper the MOXA IMC-101 can be used. All the Moxa products (except the EDS-205) have dual power supply inputs and a relay output for user configurable fault reporting.

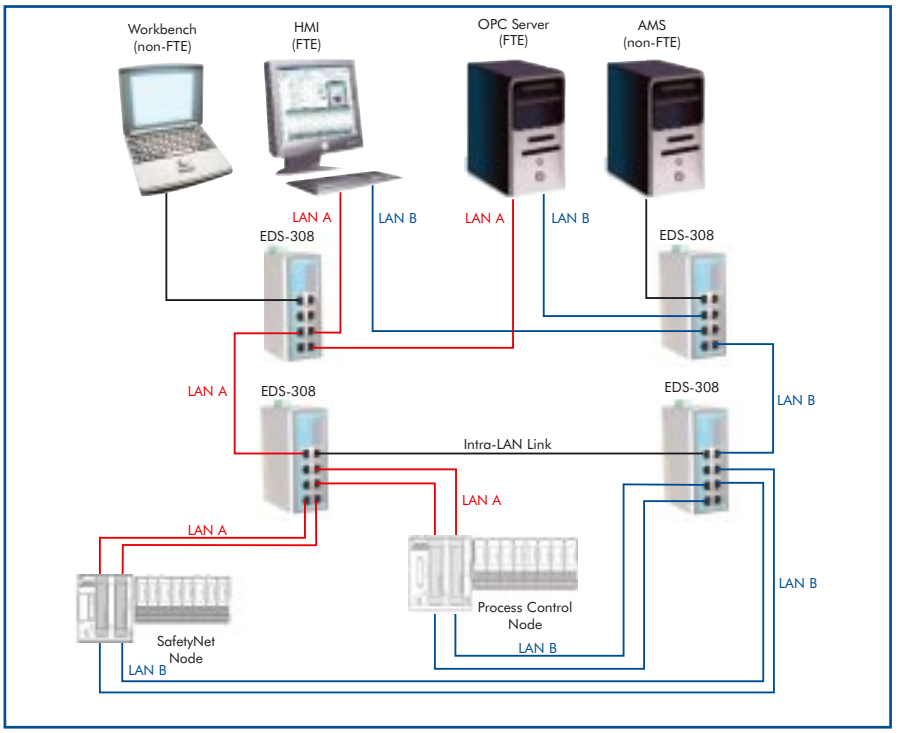

Figure 1 - redundant Ethernet LAN with intra-LAN link

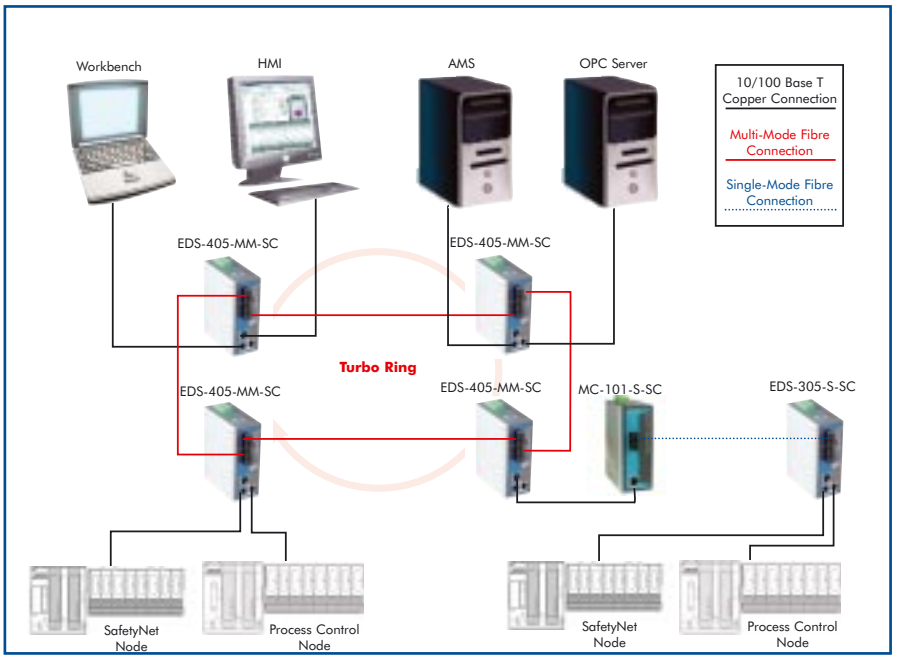

Figure 2 - "Turbo Ring" Ethernet LAN

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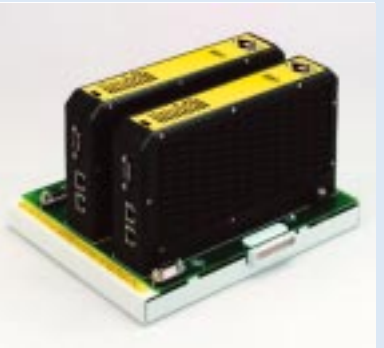
SafetyNet Controller - Overview



General

The 8851-LC-MT SafetyNet Controller stores and runs the SafetyNet application program which is downloaded from the Workbench.

It manages a number of communication paths: with the IO Modules mounted on the local node via the internal Railbus; with other entities on the Ethernet LAN (other MOST nodes, PCs running the Workbench programming tools, HMI, historian packages and asset management tools) and with remote mounted serial devices.

The SafetyNet Controller also manages the implementation of the redundancy strategy either as master or standby.

Certification

The SafetyNet Controller is certified for use in safety-related applications up to and including SIL 2. The SafetyNet Controller achieves this Safety Integrity Level with a 1oo1D architecture (i.e. it operates in "simplex" mode, with correct operation ensured by comprehensive internal diagnostics). In such applications the SafetyNet Controller is used in conjunction with the 8811-IO-DC SafetyNet Digital Input/Output Module and the 8810-HI-TX SafetyNet Analog Input Module with HART*. The SafetyNet Controller is mounted on its dedicated Carrier 8751-CA-NS.

*First release of SafetyNet will not have full HART capability.

Safe by design

The SafetyNet Controller has been designed specifically for safety-related applications and is certified on the basis of the excellence of its design. It does not depend for its certification on "proven in use" data.

Diagnostics

If the SafetyNet Controller's internal diagnostics detect a fault that would prevent the SafetyNet System from carrying out its safety function, then it will initiate a controlled shutdown. A controlled shutdown has two objectives - firstly, to ensure that the SafetyNet System enters its failsafe mode; and secondly, to record sufficient data to allow the reason for the shutdown to be determined.

If a SafetyNet Controller enters a controlled shutdown, then all communication with IO Modules is stopped and - when the programmed time delay for each IO module has elapsed - they will enter their safe states.

System size

The SafetyNet Controller can interface with up to 64 locally mounted, 8-channel IO Modules - giving a total capacity of over 500 channels per node. The Ethernet LAN is capable of supporting over 200 nodes, giving a maximum theoretical capacity of over 100 000 channels!

HART pass-through

SafetyNet Controllers can be configured to allow transparent access to the process variables and status information provided by HART field instruments. HART data cannot be used within the SafetyNet application (as - for example - it does not employ sufficiently rigorous data error detection algorithms), but communication with such devices can be achieved by using a "pass-through" command which does not involve, nor interfere with, the safety application. (The first release of SafetyNet will not have full HART capability, contact MTL for further information).

Live maintenance

Once the Ethernet LANs are isolated, SafetyNet Controllers can be removed and replaced - with the local power supplies still connected - even in Division 1, Class 2 or Zone 2 hazardous areas.

Redundant Controllers

SafetyNet Controllers can be used in a master - standby redundant configuration to improve the availability of the safety function, but this is not required for safety. Redundancy is implemented by simply inserting the new Controller in to the free slot on the Controller Carrier.

The SafetyNet system will automatically upload the required SafetyNet application to the new Controller and initiate the redundancy algorithms. Switching between redundant Controllers on detection of a fault is automatic and bumpless.

The standby Controller continually performs the same processing, on the same data and at the same time as the Master and the results are routinely cross-checked. This ensures that the Standby is always ready to take over control from the Master. The redundancy strategy employed is known as "rendezvous redundancy".

The "Change State" button on the Controller Carrier is used to switch a master to being the standby in a redundant pair, to switch a standby offline and to instruct an offline standby Controller to synchronise itself with the Controller and to enter standby.

If a SafetyNet Controller has entered the “Failsafe” state, it can be brought out of this state by use of the “Change State” button.

Serial communications

Each SafetyNet Controller provides two serial ports - one of which is physically connected via the Controller Carrier, the other directly on the Controller itself. The two ports can be configured to be entirely independent, or can be made to work redundantly, either as redundant connections to the same serial link or as redundant connections to redundant links.

When redundant ports of a single Controller are configured as Modbus masters, redundancy issues are handled automatically by the SafetyNet Controller (deciding when to switch to the standby port, alarming failures in the standby).

When redundant ports of a single Controller are configured as Modbus slaves and multi-dropped on a single serial link, the SafetyNet Controller will again manage the redundancy (deciding which port respond to the Modbus master and alarming a fault in the standby port).

When redundant Controllers are used, this adds additional availability to the arrangements above. It is not possible to use the ports on the standby Controller as additional serial connections.

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SafetyNet Controller

8851-LC-MT

- *Certified for use in SIL 2 safety applications, according to IEC 61508*
- *Comprehensive internal diagnostics provide basis for safety architecture 1oo1D*
- *Optional redundancy with bumpless transfer for increased availability*
- *Dual redundant high speed fault tolerant Ethernet LAN*
- *Two connections to serial devices*
- *On-line configuration and re-configuration*
- *Communicates with up to 64 I/O modules*
- *Communicates on peer-to-peer basis with other SafetyNet and standard Controllers*
- *Can write to standard output modules without compromising safety function*
- *Live maintainable and hot-swappable - even in Class 1, Div 2 or Zone 2 hazardous areas*
- *HART pass-through of process and status variables*
- *Event logging up to 8000 events*
- *12Vdc Controller power required from 8913-PS-AC*

CONTROLLER SPECIFICATION

See also System Specification

LAN INTERFACE

Transmission medium.....100BaseTX or 10BaseT Ethernet™
Transmission protocol.....SafetyNet P2P*
Transmission rates .....10 - 100 Mbits/s
LAN connector type (x2) .....RJ 45 (8-pin)
LAN isolation (dielectric withstand).....1500 V
Action on software malfunction .....Halt CPU / Reset CPU

* SafetyNet P2P is a modified form of Modbus™ certified as suitable for use in SIL 2 safety related applications that require peer-to-peer communication.

SERIAL INTERFACES (COM 1 & COM 2)

Transmission rates.....1.2 – 115.2 kbits/s (async.)
Transmission standard.....RS485 half-duplex
COM 1 connector (on carrier).....9-pin D-type connector (F)
COM 2 connector (on controller) .....9-pin D-type connector (M)

HAZARDOUS AREA SPECIFICATION

Protection Technique.....EEx nL IIC T4
Location (FM and CSA) .....Class 1, Div.2, Grps A,B,C,D T4

POWER SUPPLIES

Controller Power Voltage.....12V dc (from 8913-PS-AC)
Controller Power Supply.....0.4A (typical), 0.5A (max.)
System Power Supply.....15mA (max.)

MECHANICAL

Module dimensions.....69 (w) x 232 (l) x 138 (h) mm
Weight (approx.).....1.35kg

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SafetyNet Controller - Specification

SIL 2 Certified Controller — 8851- LC-MT

LED's

The SafetyNet Controller has a number of LED's that indicate the status and mode of operation of the Controller. The table below explains what they refer to and describes their operation:

Note: the information here given here is simplified. Additional combinations of LED states are used to provide further indication of the status of the SafetyNet Controllers. Full details are found in the relevant instruction manuals.

LED name	Colour	On	Off	Flashing
Power	Green	12V power supply to the Controller is ON.	12V power supply to the Controller is OFF.	-
Master	Yellow	The Controller is the Master in a redundant pair or is in simplex mode.	The Controller is the Standby in a redundant pair.	-
Healthy	Yellow	(Master) Running the application program. (Standby) Capable of running the application program.	IO data is not current - cannot take control.	(Master) Reading IO data on start-up. (Standby) Copying configuration and control parameters from the Master.
Fault	Red	If FAILSAFE LED is also ON - has performed controlled shutdown. If HEALTH LED is also Flashing - has requested a "refresh" of parameters.	For all other Controller states.	The Controller is initialising after a power cycle.
Failsafe	Red	If HEALTH LED is also ON - is in Failsafe. If HEALTH LED is OFF - is offline.	The Controller is running the application program.	No IO Module scanning is taking place and the application program is not running.
LAN A	Yellow	LED is ON when a packet of data is being transmitted.		
LAN B	Yellow	LED is ON when a packet of data is being transmitted.		
COM 1	Yellow	LED is latched ON for 2 seconds after a valid packet of data is received.		
COM 2	Yellow	LED is latched ON for 2 seconds after a valid packet of data is received.		
Safe Mode	Yellow	In SAFE mode.	In CONFIGURATION mode.	-
I/O COM	Yellow	The internal communication link (Railbus) between Controller and IO Modules is working correctly.	The internal communication link (Railbus) between Controller and IO Modules is not in use.	The internal communication link (Railbus) between Controller and IO Modules is in fault.

Workbench for SafetyNet – Overview

MOST Workbench

The MOST Workbench is the engineering and documentation tool for the MOST Process Control and SafetyNet Systems.

The Workbench is used to perform the following tasks:

- *Configure IO Channel and Module parameters*
- *Configure Controller and network parameters*
- *Input and manage the IO tag database*
- *Engineer and document the control or safety application*
- *Generate wizards to simplify HMI design*
- *Simulate and test control and safety applications*
- *Generate reports to assist in Factory and Site Acceptance Testing*

SafetyNet Workbench

The SafetyNet Workbench (8841-LC-MT) has all the features of the standard Workbench, but additionally includes the special tools required for safety applications.

Safety programming languages

The Workbench provides three IEC61131 programming languages that can be used to write safety-related application programs:

- Ladder logic (LD)
- Function Block Diagram (FBD)
- Structured Text (ST)

Configuration Mode and Safety Responsibility

Changes to safety-related parameters are carried out with the SafetyNet Controller in "Configuration Mode". Access to this mode is restricted to personnel with "Safety Responsibility" and its use is constrained by a number of further layers of protection for downloading parameters to SafetyNet Controllers. The SafetyNet system defines 6 password protected levels of access authority – with only the 3 highest levels being granted "Safety Responsibility".

Trusted Hosts

To prevent access to SafetyNet Controllers by non-approved instances of the Workbench, remote Modbus devices, asset management packages and HMI, only those that the SafetyNet Controller identifies as "Trusted Hosts" can download new parameters.

Each Trusted Host is recognised by its IP and MAC addresses (remote Modbus devices are recognised by the serial port to which they are connected). For each Trusted Host a number of other restrictions can be defined:

- Modbus write not allowed
- Workbench write not allowed
- HART pass-through not allowed

Key Switch Protection

When a SafetyNet Controller is added to the Workbench the user is given the option of selecting a tag to act as a "Key Switch". This can be used by an Operator to lock the SafetyNet System so that Configuration Mode cannot be entered without their awareness or permission.

The Key Switch can be a physical switch, driven from an HMI screen or it can be an output from the SafetyNet application.

Controller Passwords

When a SafetyNet Controller is added to the Workbench the user is given the option to use a Controller Password. If this option is selected, it is subsequently impossible to enter Configuration Mode without the Controller Password.

On-line download

Users with safety responsibility can download new parameters to a SafetyNet Controller, from a Trusted Host, to a Controller whose Key Switch is set to permit new downloads and where the particular SafetyNet Controller's Password is known.

New parameter download is carried out as a background task over a number of cycles to ensure that the fault reaction and response times are not compromised. Once download is complete and the new parameters have passed the checking and security tests, the new parameters will be automatically adopted. Where redundant SafetyNet Controllers are used, the stand-by Controller will also be automatically updated.

Note: on-line download should only be used where there are adequate procedures for approving the changes that have been made and testing them prior to download.

Static Analysis Tool

Any safety-related application program must be developed by suitably qualified personnel and must be subject to careful scrutiny to ensure safety, but the Workbench provides an additional safety test. The Static Analysis Tool checks for illegal constructs within the safety program prior to download.

Differences Utility

Once a new SafetyNet application is successfully compiled, it can be downloaded to a SafetyNet Controller. On download, two text reports are generated: a Download Report and a Master Tag Xref. These can be used for comparison with other downloads using the Differences Utility.

Download backup

A time stamped backup of each safety application is automatically created following a successful download. Changes between versions can be viewed and backups can be used either as a start point for developing new safety applications or to restore an earlier version.

Change Control Log

The Workbench maintains a Change Control Log that records - for example - when:

- IO Modules are added, deleted or moved
- Tags are added to, removed from, or moved within an IO Module
- IO Configuration parameters are saved
- Controller IP addresses or node numbers are entered or modified
- External node numbers are entered or modified
- Serial communications parameters are entered or modified
- A successful download is made
- A Strategy is removed
- The Controller password is changed

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SafetyNet IO Modules – Overview

General

SafetyNet IO Modules interface to safety system field wiring via Field Terminals. The IO Modules and the Field Terminals mount on Carriers that provide mechanical support, but also connect the internal communication bus and power supply connections to the Modules.

The IO Modules are certified as suitable for use in SIL 2 safety-related applications.

Certification

The SafetyNet IO Modules are certified for use in safety-related applications up to and including SIL 2. The SafetyNet System achieves this certification with a 1oo1D architecture.

The SafetyNet IO Modules have been designed specifically for safety-related applications and are certified on the basis of the excellence of their design. The certification does not depend on "proven in use" data.

Diagnostics

The IO Modules perform comprehensive internal diagnostic tests as an essential part of ensuring that the IO can carry out the required safety function.

If the SafetyNet IO Module's internal diagnostics detect a fault that would prevent the SafetyNet System from carrying out its safety function, then it will initiate a controlled shutdown. A controlled shutdown has two objectives – firstly, to ensure that the IO Module enters its failsafe mode; and secondly, to record sufficient data to allow the reason for the shutdown to be determined.

If a SafetyNet Module enters a controlled shutdown, then all IO channels are de-activated: input channels are not scanned; and output channels are de-energised.

Bussed Field Power

The Bussed Field Power (BFP) connectors on the rear of IO Module Carriers provide the power connections for field instruments wired to the IO Modules.

For the SafetyNet System, BFP must be 24V dc and supplied by MTL's 8914-PS-AC units. These power supplies may be used in redundant pairs, if required.

Live maintenance

SafetyNet IO Modules can be removed and replaced in a Class 1, Division 2 or Zone 2 hazardous area - once the relevant Bussed Field Power (BFP) connection has been isolated using an appropriate hazardous area switch (such as the MTL951). Removing and replacing the Modules does not interrupt the operation of the other parts of the node.

If a Module is replaced by another Module of identically the same type, then no intervention is required for the System to begin operating normally once the Bussed Field Power is restored.

Line fault monitoring

In addition to the comprehensive internal diagnostics the SafetyNet IO Modules can monitor field wiring for line faults.

Event logging

Data from SafetyNet IO Modules can be time stamped and stored by the SafetyNet Controller before being downloaded to the MOST SOE Data Retrieval Client or a 3rd party historian package. SafetyNet IO Module data is time stamped with a resolution of better than 200ms.

Failsafe Mode

IO Modules will enter Failsafe Mode from the Running State either due to loss of communications with the Controller or because the module has received an instruction from the Controller to enter the Failsafe State. In this state:

- The Red Fault LED is lit
- The IO Module is flagged as unhealthy to the Controller
- All Railbus Write requests are rejected, except instructions to Reset or to exit the Failsafe State
- Inputs and HART data are read
- Outputs are de-energised
- Background diagnostics continue and if a failure is detected, the module will enter Controlled Shutdown

Controlled Shutdown

A Controlled Shutdown is carried out if a fault is detected in the Module. In this state it can communicate the reason for shutdown.

LED's

A number of LED's are provided on each IO Module to provide visual indication of the status of the Module, its channels and its power supply.

Module 'Fault' LED (red)

On - Failsafe

Off - Normal operation

Flashing (equal:mark space ratio) - Cold start in process, will flash until communication is established with SafetyNet Controller.

Blinking (On for a short period, then On for a longer period – morse code 'a') - Fault state after controlled shutdown

Module 'Power' LED (green)

On - Power OK

Off - BFP or Railbus Power Failure

Module 'Channel' LED's (yellow)

See Individual Module Specifications.

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SafetyNet Analog IO Module – Overview

General

The SafetyNet Analog Input Module with HART provides the interface to 8 channels of 4-20 mA input signals.

The SafetyNet Analogue Input Module is certified for use in safety-related applications up to SIL 2. In such applications the module is used with the 8851-LC-MT SafetyNet Controller and 8811-IO-DC SafetyNet Discrete Input/Output Module.

Diagnostics

The SafetyNet Analogue Input Module carries out a number of diagnostic checks to confirm the accuracy of the measurement reported and the correct operation of the module.

In addition to the primary measurement, a second diagnostic measurement is made using different internal circuitry. The two values are then compared. The primary measurement is reported as faulty if it differs from the diagnostic measurement value by more than 2%.

Further tests are carried out on internal supply and references voltages.

If a particular channel fails a test, then that channel is made inactive. If the failed test indicates that the Module is not working correctly, it will enter Controlled Shutdown.

Live maintenance

The field wiring connections to the SafetyNet Analogue Input Module are classified as non-incendive and can therefore be live worked in a Class 1, Division 2 or Zone 2 hazardous area.

(Note the Bussed Field Power connection must be isolated before the module is removed or replaced).

Input sampling and filtering

Each input channel is sampled once every 25ms and is filtered by 1st order hardware and software filters. The software filter can be disabled or set to a number of different values according to the filtering requirements of each channel.

HART capability

The HART capabilities of the Analogue Input Module allow acquisition of secondary variables – which can be used by a standard (but not SafetyNet) application program. The Module also allows Emerson's AMS package to communicate with any HART field device transparently, using HART pass-through. (The first release of SafetyNet will not have full HART capability, contact MTL for further information).

LED's

For the operation of the Power and Fault LED's see IO Module Overview.

Module 'Channel' LED's (yellow)

On – Channel in range (4-20mA)
Off – Channel inactive

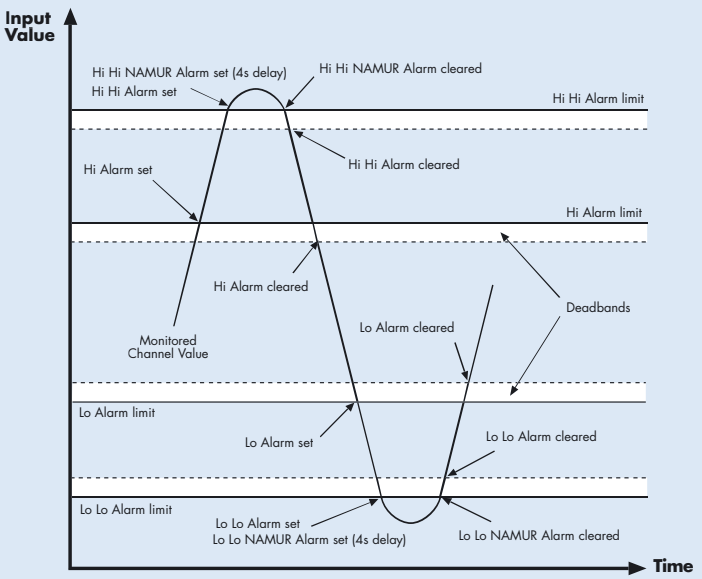
Flashing (equal:mark space ratio) – Any of the following, with an active channel: line fault (indicated by the input measurement being outside the 4-20mA range), loss of HART signal, Hi-Hi or Lo-Lo alarm.

Alarms, Deadband, Dead Zone

The Analogue Input Module has a number of configurable parameters for managing setting and clearing alarms and triggering the reporting of a new input value.

Hi, Hi-Hi, Lo and Lo-Lo alarms can be configured – together with a Deadband through which the input must move before the alarm is cleared. The relationship between these parameters is shown in the diagram below.

A Dead Zone can also be configured, which is the value by which an input measurement must change before it is reported as a new value.



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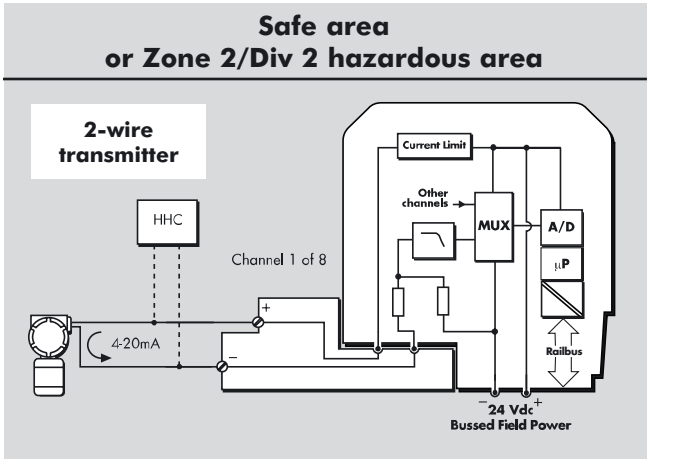
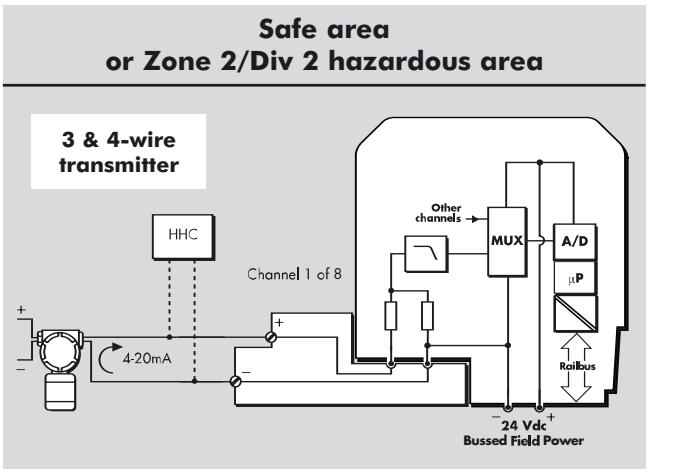
SafetyNet Analogue Input Module

4-20 mA with HART

8810-HI-TX

- *8 single ended 4-20mA input channels*
- *Certified for use in SIL 2 safety applications*
- *Non-incendive field circuits*
- *2-, 3- or 4-wire transmitters*
- *HART pass-through, acquisition and status reporting**
- *24V dc Bussed Field Power required from 8914-PS-AC*





MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels .....8, single-ended
Nominal signal range (span) .....4 to 20mA
Full signal range .....0.25 to 24mA
Line fault detection
Short circuit current .....> 23.5mA
Open circuit current .....< 0.5mA
Output voltage (@ 20mA).....10.2V (min.)
Output current .....28mA (max.)
Accuracy (at 25°C) .....± 0.1% of span
Temperature coefficient .....38 ppm/C
Resolution .....16 bits
Repeatability .....0.05% of span
Data format .....16-bit unsigned (0-25mA = 0-65,535)
HART data format .....IEEE754 floating point
Isolation
(any channel to Railbus) .....250V ac RMS
(between channels) .....none

CONFIGURABLE PARAMETERS

Alarms. .....high, high-high, low and low-low
Alarm deadband (hysteresis) .....user defined value
Input filter time constant .....user defined value
Input dead zone .....user defined value
Drive on fault state .....disabled /upscale /downscale
HART variable and status reporting ..... enable /disable

RESPONSE TIME

Signal change to availability on Railbus
4– 20 mA mode .....25ms (max.)
HART mode.....0.75s per channel

* The first release of SafetyNet will not have full HART capability, contact MTL for further information.

HAZARDOUS AREA SPECIFICATION

Protection Technique.....EEx nA [nL] IIC T4
Location (FM and CSA) .....Class 1, Div.2, Grps A,B,C,D T4
(CSA with non-incendive field terminal, subject to conditions in CSA certificate.)

FM non-incendive field wiring parameters (each channel)
.....Voc = 28.7V; Isc = 33mA
Gas groups A, B .....Ca = 0.17µF; La = 11mH
Gas group C .....Ca = 0.51µF; La = 33mH
Gas group D .....Ca = 1.36µF; La = 88mH

POWER SUPPLIES

System Power Supply.....50mA (typical), 70mA (max.)
Bussed Field Power Supply
.....350mA (2-wire TX max.), 110mA (4-wire TX max.)

MECHANICAL

Module Key Code A1
MODULE WIDTH 42mm
WEIGHT 200g

For recommended and compatible Field Terminals, see Field Terminal - Specification and Selection Guide.

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January 2007

SafetyNet Discrete Input/Output Module

8-channel combination

8811-IO-DC

General

The SafetyNet Discrete Input/Output Module provides the interface to 8 channels that may be configured in any combination of discrete inputs and outputs.

The SafetyNet Discrete Input/Output Module is certified for use in safety-related applications up to SIL 2. In such applications the module is used with the 8851-LC-MT SafetyNet Controller and 8810-HI-TX SafetyNet Analogue Input Module with HART.

Combined inputs and outputs

Each of the 8 channels of the SafetyNet Discrete Input/Output Module may be configured, on a channel-by-channel basis, as either an input or an output.

When configured as an input, the channel is suitable for use with dry contacts – with power supplied from the Module.

When configured as an output, the channel is capable of switching up to 2.0A (maximum of 6.0A continuous per module). Output channels are used with solenoids, valves and alarms

Diagnostics

Comprehensive diagnostic tests are performed on the module and each of its channels, including tests for stuck ON and stuck OFF output switches.

Live maintenance

The field wiring connections to the SafetyNet Discrete I/O Module are classified as non-sparking and can only be worked on in a Class 1, Division 2 or Zone 2 hazardous area once the Bussed Field Power connection has been isolated.

Note: the Bussed Field Power connection must also be isolated before removing or replacing the module.

Input configuration

Input channels are used to interface to volt free contacts. Line fault detection can be turned OFF or can detect open circuits or both open and short.

Input filtering

A change in the input state is recorded only if the states observed at the start and end of the filter time interval are the same. If they are different the previous state is maintained. (This reduces the chance of noise being incorrectly interpreted as a change of input value).

The filter time interval can be configured between 0 and 8s, in 1ms intervals.

Input transition counting

A counter can record the number of filtered transitions of a particular type. Depending on the polarity setting, the counter will either count transitions from 0 to 1, or from 1 to 0. The counter "wraps around" from 65 535 to zero without indication.

Transitions are counted even if the channel is configured to "latching".

Earth leakage detection

Where earth leakage fault detection is required, a single channel of an 8811-IO-DC module must be configured to monitor earth leakage and wired to the appropriate terminals of an 8751-CA-NS Controller Carrier.

Input latching

Inputs can be configured to "latch" a particular (filtered) input transition and maintain the output in the latched state until the latch is cleared. "Normal Polarity" will latch a transition from 0 to 1 as 1, "Inverse Polarity" will latch a transition 1 to 0 as 0. The operation is described in **figure 1**.

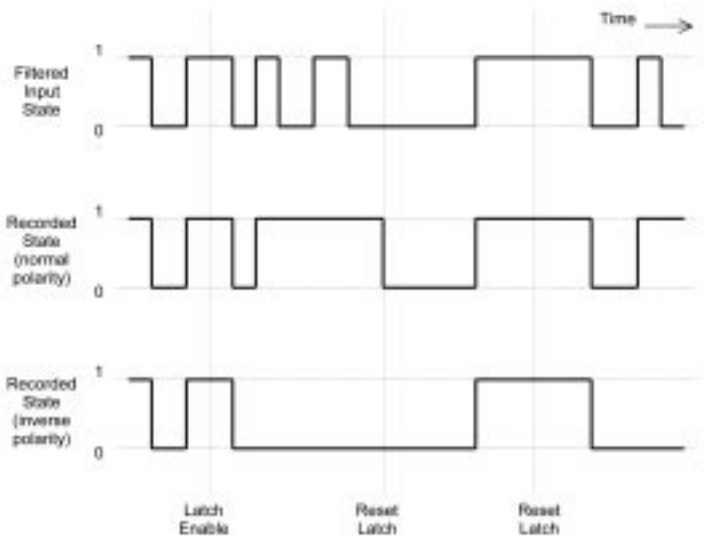

Figure 1 - recording of input states

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Normally energised and normally de-energised outputs

Individual output channels can be either normally energised or de-energised.

Each output channel comprises 2 switches that operate in series with the load – one on the supply line, the other on the return

For normally energised outputs, if a single switch fails short circuit, the other switch can still de-energise the load. If either fails open circuit, the load will be immediately de-energised by the fault.

For normally de-energised outputs, if a single switch fails short circuit, the other switch can energise the load. If either fails open circuit, the load cannot be energised.

Switches are tested by pulsing them ON or OFF for a maximum of 5 ms – the load must not respond to this length of pulse. This test can be disabled if required.

Short circuit protection

Channels that are configured as outputs and which are short-circuited are protected by over-temperature thermal detection. If an output channel is short-circuited it will briefly conduct an over specification current, but this will be identified by the thermal detection and the relevant channel made inactive.

Pulsed output

Output channels can be configured to give a pulsed output – of either single static, single dynamic, continuous or continuous dynamic form.

The single static pulse is ON for a pre-determined time. It then remains OFF until a new pulse instruction is received.

The single dynamic pulse is ON for a period that may be changed by the application, then remains OFF until a new instruction to write is received.

In continuous pulse mode a series of pulses of defined ON period are sent, with a defined OFF period between.

Continuous dynamic pulse mode allows the application to continually vary the ON and OFF times of the pulse train.

For all types of Pulsed Output, the ON time of the pulse may be between 0 and 60s in 1ms intervals.

For the continuous pulse mode, the OFF period can be set between 0 and 60s, in 1ms intervals.

Pre-configured output patterns

A number of different, pre-defined output patterns are available, which can be used to indicate the occurrence of different events, using the same alarm hardware. The patterns comply with the requirements of NFPA 72 and are shown in **figure 2**.

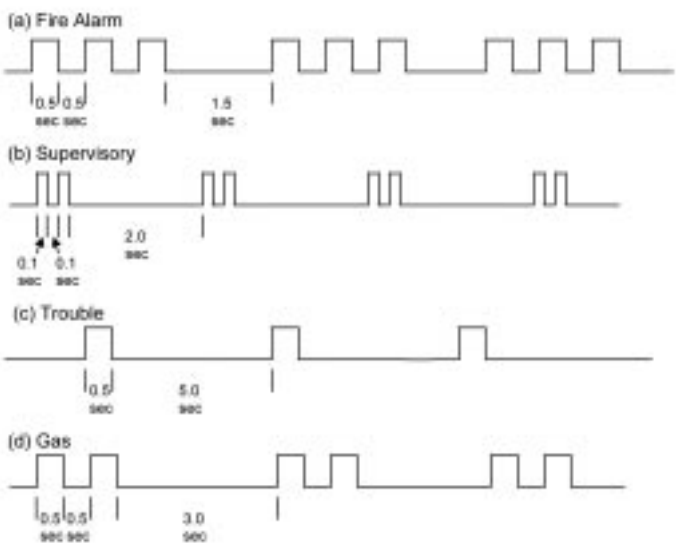


Figure 2 - pre-configured output patterns

Input channel line fault detection

Line fault detection (LFD) for open and short circuit line faults will normally be enabled for safety related input channels. Series resistors are required for short circuit detection and end of line resistors for open circuit detection, as shown in **figure 3**.

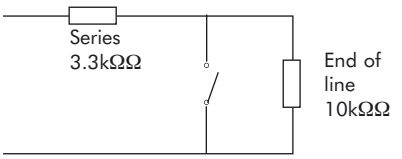


Figure 3 - LFD resistor values

The nominal resistance thresholds employed are shown in the table below.

Resistance	Value
Open circuit	>30kΩΩ
Open contact	>6.5kΩΩ
Closed contact	<6.5kΩΩ
Short circuit	<1.95kΩΩ

Output channel line fault detection

Line fault detection (LFD) for open and/or short circuit line faults can optionally be enabled for normally de-energised outputs. (Normally energised loads would be de-energised by either open or short circuit line faults, of these only short circuit faults will be detected and reported by the IO Module).

An open circuit fault will be reported for line resistances above 30kΩ.

Short circuit line fault detection can be enabled with forward or reverse biased test currents. With forward biased test currents, the threshold at which a short circuit fault is reported is configurable up to 1kΩ. With reverse biased test currents, the threshold is fixed at 1.95kΩ.

LED's

For the operation of the Power and Fault LED's see IO Module Overview.

Module 'Channel' LED's (yellow)

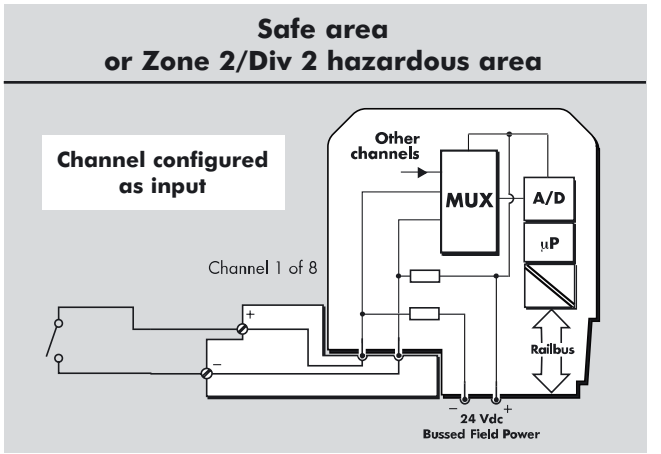
On – Input or output ON
Off – Input or output OFF

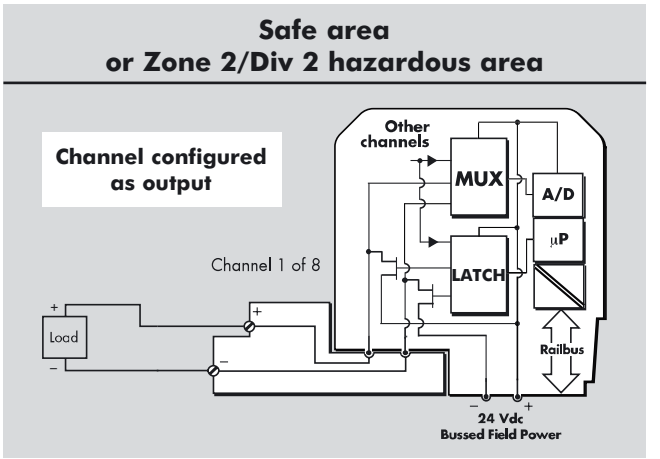
SafetyNet Discrete Input/Output Module

24Vdc, non-isolated, module powered inputs and outputs

8811-IO-DC

- *8 inputs - any combination of inputs and outputs*
- *Certified for use in SIL 2 safety applications*
- *Non-arcing inputs and outputs*
- *Output channels rated up to 2A continuous*
- *Inputs for dry contact switches*
- *24Vdc Bussed Field Power required from 8914-PS-AC*





MODULE SPECIFICATION

See also System Specification

Number of channels 8
(independently configured as inputs or outputs)

INPUTS

ON/OFF threshold current .....0.9mA (typ.)
O/C Voltage .....24V dc (typ.) - depends on BFP Supply
Wetting current .....1.2mA (typ.)
Minimum pulse width detected.....5ms
Max input frequency in pulse counting mode (no debounce) 30Hz
Isolation (any channel to Railbus).....250V ac

OUTPUTS

Maximum Output Current per Channel 2A
Maximum Output Current per Module
Continuous 6A
Non-continuous (<10 seconds) 8A

INPUT CONFIGURABLE PARAMETERS

Filter time interval .....0 to 8s (in 1ms steps)
Earth Leakage Detection Channel .....ON/OFF
Latch inputs .....enable /disable
Latch polarity .....latch on high/latch on low
Pulse counting .....up transition/down transition/disable
Line fault detection..... none/open circuit/open & short circuit

OUTPUT CONFIGURABLE PARAMETERS

Output type .....pulse/discrete/pattern
Pulse width.....1ms to 60s
Line fault detection*.....open line & short circuit detect /disable
* Normally de-energised channels only

RESISTANCE MEASUREMENT ACCURACY

For normally de-energised output open and short-circuit detection.
With forward biased test current
..... ±(3.4%+5.3Ω) for line resistance ≤ 220Ω
..greater of: ±7% or ±(3.1%+27Ω) for line resistance >220Ω, <1kΩ
With reverse biased test current
.....greater of: ±7% or ±(3.1%+430Ω)

RESPONSE TIME

Input Signal change to availability on Railbus .....5ms (max.)
Railbus command to output change .....1ms (max.)

HAZARDOUS AREA SPECIFICATION

Protection Technique.....EEx nA nL IIC T4
Location (FM and CSA) .....Class 1, Div.2, Grps A,B,C,D T4

POWER SUPPLIES

System Power Supply .....50mA (typ.), 70mA (max.)
Bussed Field Power Supply
All channels configured as inputs .....50mA (max)
Any channels configured as output.....50mA + output load currents

MECHANICAL

Module key code B6
Module width 42mm
Weight 210g

For recommended and compatible Field Terminals, see Field Terminal - Specification and Selection Guide.

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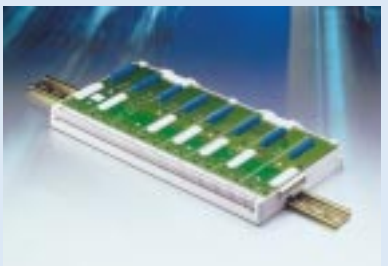
Carriers - overview



General

Carriers are the backplanes on to which the MOST SafetyNet and Process Control Systems are mounted. A Controller Carrier is required for each node, then IO Module Carriers, Carrier Extenders and Cables can be added as required – depending on the number of IO Modules needed and their physical distribution within the cabinet or junction box.

Power and communication

Carriers distribute "system" power to IO Modules and provide the communications route between Controllers and IO Modules. (Controller power is supplied by direct connections to the Controllers themselves).

IO Module Carriers provide connectors through which field power can be supplied (see "Bussed Field Power"). Note: field power to Intrinsically Safe IO is managed differently, see the relevant 2/1 data sheets.

Multi-pin connectors at the end of each carrier allow further Carriers to be added– and the "system" power supply and "Railbus" connections to be made.

Earthing screens and shields

All I/O Module Carriers have their own independent earthing/grounding strip to terminate the screens/shields of field wiring cables.

SafetyNet Controller Carrier

The SafetyNet Controller Carrier (8751-CA-NS) is the dedicated Carrier for the SafetyNet System. It can support simplex or redundant SafetyNet Controllers and the Power Supply Monitor (8410-NS-PS).

Serial communications

Two D-type connectors are provided on the SafetyNet Controller Carrier for connecting to serial devices. These link to Serial Port "1" of Controller A and Controller B.

A second pair of D-type connectors is found on the Controllers themselves, to provide connections to Serial Port "2" where redundant serial communication is required.

Further details of the serial port connections are given in the data sheet for the SafetyNet Controllers and Carriers.

Controller Carriers

Two Controller Carriers are available - the standard Controller Carrier and the ELFD Controller Carrier.

To comply with the earth leakage fault detection (ELFD) requirements of Fire & Gas application standards, the ELFD Controller Carrier (8751-CA-NS) can be used. A single channel of an 8811-IO-DC module must be allocated to earth leakage detection to implement this function.

SafetyNet applications that do not require ELFD can use the standard Controller Carrier (8750-CA-NS).

Change State buttons

Two change state buttons are mounted on the SafetyNet Controller Carrier – one for each Controller. The button is used to switch a master to being the standby in a redundant pair, to switch a standby offline and to instruct an offline standby Controller to synchronise itself with the Controller and to enter standby.

Terminations for power fail inputs

The 8913-PS-AC and 8914-PS-AC power supplies each have an output that indicates the health of the supply. These outputs can be connected to the termination block on the SafetyNet Controller Carrier and are used by the Power Supply Monitor Module to detect failures in any of up to 7 of these external power supplies.

Module Carrier

SafetyNet Systems use the 8-module Carrier with 64-slot addressing (8709-CA-08) for SafetyNet and standard modules.

Up to 8 of these may be used together to provide slots for up to 64 IO Modules.

The 4-module Carrier (8710-CA-04) can be used where the application requires four IO Modules or less. This will modify the addressing system and users should should contact MTL when considering this option.

Carrier Extenders and Cables

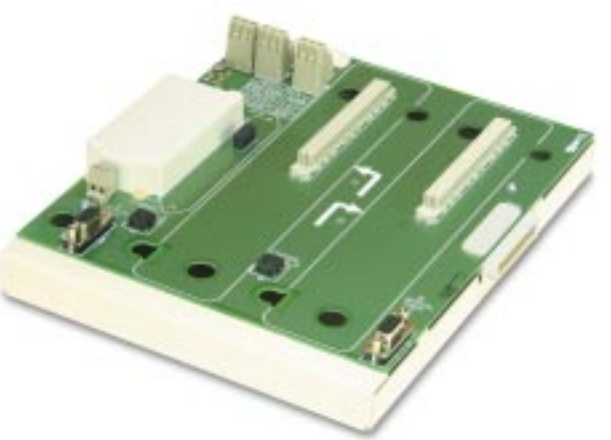
To allow for flexibility in cabinet layout, Carrier Extenders are provided which – together with the Extender Cables – are used to connect Carriers mounted on different sections of the cabinet backplane or DIN rail. Carrier Extenders are used in left- and right-hand pairs.

Controller Carrier

ELFD Controller Carrier

8751-CA-NS

- *terminals for earth leakage fault detection*
- *accommodates two SafetyNet Controllers*
- *accommodates Power Supply Monitor module*
- *two serial port connections*
- *manual " change state" buttons*



The ELFD Controller Carrier provides a mounting platform for up to two SafetyNet Controllers (8851-LC-MT). It can also accommodate a Power Supply Monitor module (8410-NS-PS) which can monitor the health of up to two 8913-PS-AC, four 8914-PS-AC power supplies and the 12V supply to Intrinsically Safe Modules (when these are used). For each Controller there is a serial port connector and a manually operated ""Change State" button. The Carrier also provides terminals that are used when earth leakage fault detection is required.

CARRIER SPECIFICATION

See also System Specification

CARRIER MOUNTING MODULES

SafetyNet Controller (x2) 8851-LC-MT
Power Supply Monitor Module 8410-NS-PS

ELECTRICAL CONNECTIONS

Railbus connector .....male out
Serial port connectors.....9-pin, D-type (female) (x2)
Power Fail connections.....screw terminals (x7 pairs)
Ground connection .....M4 screw terminal (x1)
BFP0V connection .....M4 screw terminal (x1)
Earth leakage fault detection connections
.....screw terminals (1 pair)
System Power connections.....6-Pin (male)
(Note: this does not provide power to the SafetyNet Controllers)

MECHANICAL

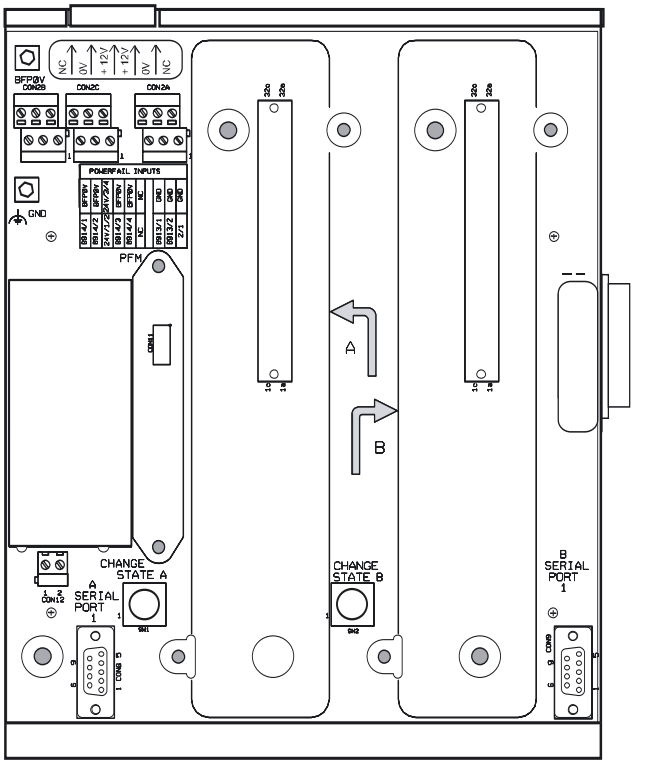
Dimensions .....200 (w) x 253 (d) mm (footprint)
Height .....28 mm (top of circuit board)
.....55 mm (overall)
Weight .....1.43 kg (approx.)
Mounting methods .....flat panel (4 fixings)

USER CONTROLS

Two " change state" buttons, one for each SafetyNet Controller, are provided on the carrier. The state change depends upon the controller state before the button is pressed. See table below for effects.

State	Effect
Master	Change to standby if current standby is healthy
Standby	Change to offline state
Backup	Re-synchronise and return to standby

CONTROLLER CARRIER LAYOUT



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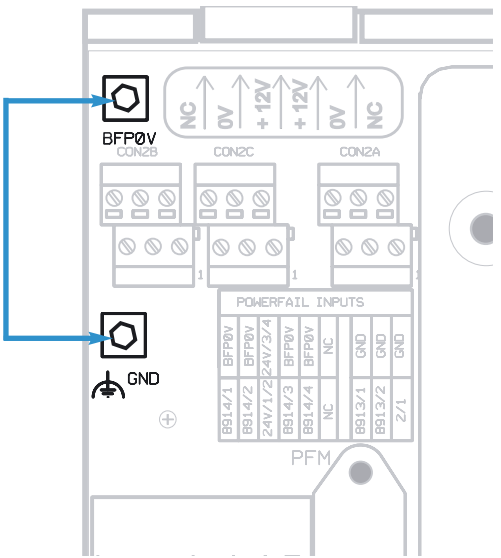
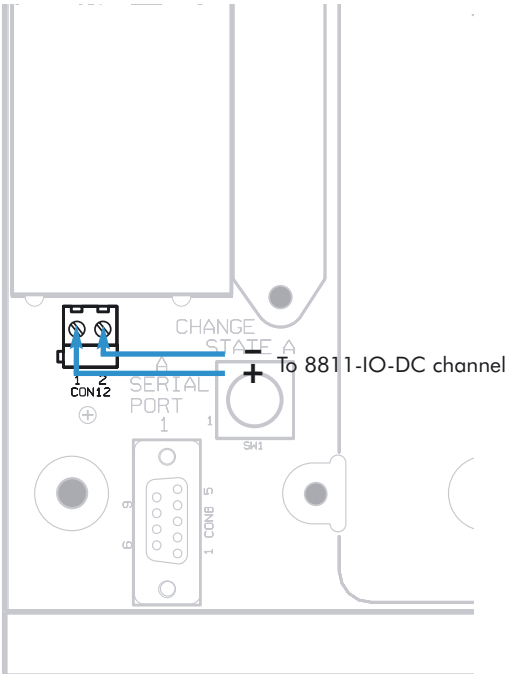
8751-CA-NS (continued)

EARTH LEAKAGE FAULT DETECTION

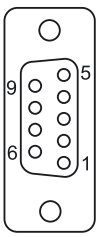
When earth leakage fault detection is NOT required, a link should be made - as shown below - between the BFP0V and GND connection studs. Note: the BFP0V connection stud must still be connected to Bussed Field Power 0V, marked "-" on the 8914-PS-AC power supply, and the GND connection must still be connected to ground.



When earth leakage fault detection IS required, then the terminals of connector CON12 must be wired to a channel of an 8810-IO-DC module - as shown below - that has been configured for earth leakage. Note: earth leakage fault detection can only operate when BFP0V and all field wiring and field instruments are isolated from ground (GND).

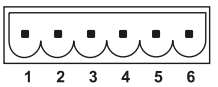


SERIAL PORT CONNECTORS (X2)



Pin #	Function
1	0V
2	NC
3	Tx/Rx (+)
4	Tx/Rx (+)
5	Tx/Rx (-)
6	Tx/Rx (-)
7	NC
8	NC
9	0V

SYSTEM POWER SUPPLY CONNECTIONS



Terminal	External Power
1	No connection
2	0V
3	+12V
4	+12V
5	0V
6	No connection

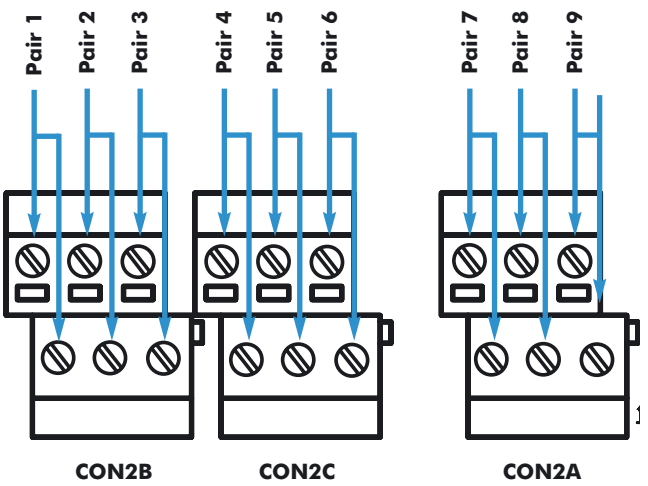
Two pairs of System Power supply connections (terminals 2/3 and terminals 4/5) are provided for wiring a redundant pair of 8913-PS-AC power supplies.
Note: The Controllers do not draw their power from these connections, they are supplied with Controller Power via connections on the Controllers themselves.

GND AND BFP0V CONNECTIONS

The GND terminal must always be connected to the main instrument earth or the 'star-point' bus-bar. (Note: the 0V of the 8913-PS-AC power supplies is GND).
The BFP0V terminal must always be connected to 0V of the 8914-PS-AC power supplies.

PSU POWER FAIL CONNECTIONS

An 8410-NS-PS Node Services Power Supply Monitor Module must be installed on the Controller Carrier to make use of this capability. If an 8410-NS-PS is not being used, then it is not necessary to make any connections to the PSU Power Fail terminals.



Terminal pairs 1, 2, 4 and 5

These terminal pairs are used to monitor the AUX (or power fail) output from up to four 8914-PS-AC power supplies.

The upper terminal of each pair is connected directly to the AUX terminal of the 8914-PS-AC that is to be monitored. It is not necessary to connect the lower terminal - as this is internally connected to the BFP0V terminal on the Carrier.

If any of the 8914-PS-AC supplies are acting as redundant pairs, then these should be connected to terminal pairs 1 and 2 and/ or terminal pairs 4 and 5.

If a pair is unused, a shorting link must be placed between the upper and lower terminals, otherwise the Power Supply Monitor Module will continuously report a fault.

Terminal pair 3

The upper terminal of this pair should be connected to the 24V dc supply of the 8914-PS-AC supply monitored by terminal pairs 1 and 2. The lower should be connected to the 24Vdc supply of the 8914-PS-AC monitored by terminal pairs 4 and 5.

If a single pair of 8914-PS-AC power supplies is being monitored, then it is only necessary to make single connection to appropriate terminal of pair 3.

Terminal pair 6

This terminal pair is unconnected and should not be used.

Terminal pairs 7 and 8

These terminal pairs are used to monitor the AUX (or power fail) output from up to two 8913-PS-AC power supplies.

The upper terminal of each pair is connected directly to the AUX terminal of the 8913-PS-AC that is to be monitored. It is not necessary to connect the lower terminal - as this is internally connected to the GND terminal on the Carrier.

If a pair is unused, a shorting link must be placed between the upper and lower terminals, otherwise the Power Supply Monitor Module will continuously report a fault.

Terminal pair 9

If a Railbus Isolator (8922-RB-IS) is not used in the node, this terminal pair must be fitted with a shorting link to prevent an alarm condition being signalled to the Controller.

If a Railbus Isolator is used, internal connections are made to monitor the failure of any power supplies used to provide power for the Intrinsically Safe IO Modules.

Module Carrier

8-module Carrier - extended addressing

8709-CA-08

- *64-slot address bus*
- *accepts up to eight SafetyNet and/or standard I/O modules*
- *DIN rail or panel mounting*
- *carries control signals and data on Railbus*
- *distributes System Power to modules*
- *distributes Bussed Field Power to modules*
- *isolated earthing bar for cable screens/shields*

CARRIER SPECIFICATION

See also System Specification

ELECTRICAL CONNECTIONS

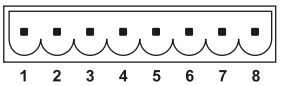
Railbus connectors .....female in, male out
Cable screens/shield connections...M4 screw terminals (x34)
Bussed field power supply connectors.....8-pin male (x2)
The two 8-pin connectors provided at the top rear of the carrier connect power supplies for 'field power'. These supplies are routed through I/O modules that require power for their field circuits.

MECHANICAL

Dimensions .....342 (w) x 170 (d) x 22 (h)mm
Weight 680g
Mounting methods.....Flat panel or DIN rail
DIN-rail types
.....'Top hat' 35 x 7.5mm rail or 35 x 15mm rail to EN 50022
.....G-section rail to EN 50035

Note: For applications with up to 4 IO Modules, it is possible to use the 4-module Carrier (8710-CA-04). For further information, contact MTL.

BUSSED FIELD POWER CONNECTOR



Terminal		Function
1	}	I/O modules 1 & 2
2	}	–ve (or Neutral)
3	}	I/O modules 1 & 2
4	}	+ve (or Live)
5	}	I/O modules 3 & 4
6	}	+ve (or Live)
7	}	I/O modules 3 & 4
8	}	–ve (or Neutral)

The table above gives the connection details for modules 1 to 4. The second connector provides identical connections for modules 5 to 8.

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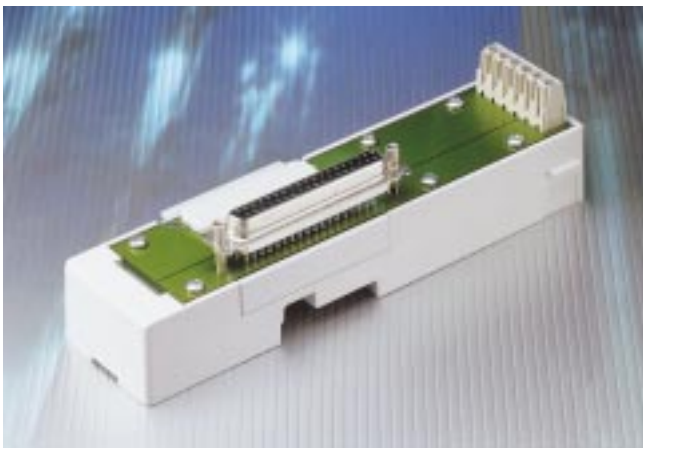
Carrier Extender

Left-hand/right-hand

802x-CE-xH



- *ensures Railbus and power supply continuity*
- *pairs (left & right hand) link separate carrier runs*
- *sub-D connectors linked via multi-way cable*
- *multi-pin connector to carrier*
- *maximum of 3 extender pairs per node*
- *32- and 64-slot address capable*

CARRIER SPECIFICATION

See also System Specification

ELECTRICAL CONNECTIONS

Railbus carrier connector

8020-CE-RH .....female in

8021-CE-LH.....male out

Extender cable connector .....Sub-D, 37-pin female

System Power cable connections* .....screw terminal (x6)

System Power cable conductor size.....2.5mm^2 (max.)

* The six terminals for the System Power connections must be made in addition to connecting the Extender cable. The Terminals on the left- and right- hand extenders indicate which connections need to be made for System Power (HVCC + and HVCC -) and an internal ground connection (SGND).

MECHANICAL

Dimensions (overall) .....42 (w) x 168 (d) x 37 (h)mm

Weight. 135g

Mounting method .....integral DIN-rail fixings

DIN rail types

.....'Top hat', 35 x 7.5mm or 35 x 15mm to EN 50022

.....G-section, to EN 50035

PART NUMBERS

Carrier Extender, Right-hand	8020-CE-RH
Carrier Extender, Left-hand	8021-CE-LH

Carrier Extender Cable

0.35m, 0.85m 1.2m

800x-CC-xx

- *Railbus data extender cables*
- *three lengths - 0.35, 0.85 and 1.2 m*
- *Sub-D cable connectors*

SPECIFICATION

See also System Specification

ELECTRICAL CONNECTIONS

Extender cable connectors.....Sub-D, 37-pin male (X2)

Carrier Extension Cable, 0.35m	8001-CC-35
Carrier Extension Cable, 0.85m	8002-CC-85
Carrier Extension Cable, 1.2m	8003-CC-12

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Field Terminals - overview

General

Field terminals are removable units for terminating wiring from field instruments.

Each IO Module combines with a Field Terminal to which the wiring from field instrumentation is connected.

Recommended and compatible Field Terminal types are given in the Field Terminal Specification and Selection Guide. They can be selected to optionally include loop disconnection and fusing – eliminating the need for additional terminals and wiring between the Field Terminal and the instrumentation.

By wiring directly to the Field Terminal, there is no need for additional terminals or wiring.

8-channel Field Terminals

SafetyNet IO Modules use standard MOST 8-channel Field Terminals. Depending on the application, the Field Terminals may be for general purpose, non-arcing or non-incendive field wiring, may incorporate fused disconnects and may be for 2-, 3- or 4-wire transmitters.

Fused disconnect

The fused disconnect Field Terminals incorporate a 2A fuse that can be partially withdrawn from the Field Terminal to act as a loop disconnect.

Tag strip

Each Field Terminal is supplied with an integral tag strip, which is hinged to provide access to the wiring terminals and the fuse disconnects.

Field Terminal clicks on to Carrier

The Field Terminal is easily removed from the Carrier – it is held in place by a sprung latch that can be released without the need for tools. This simplifies connection of the field wiring. The Field Terminal is secured in place by the insertion of the IO Module.

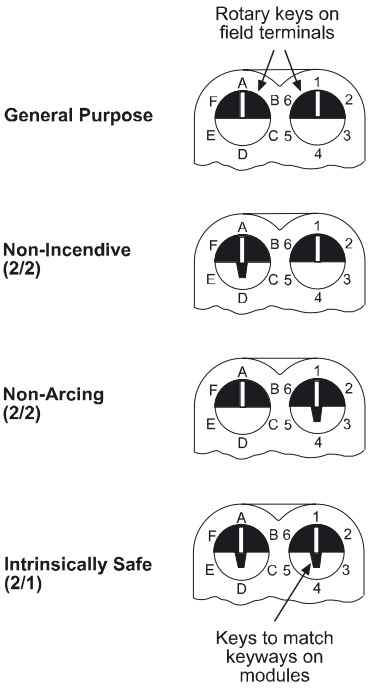
Wiring to Field Terminals

SafetyNet IO Modules all use 8-channel Field Terminals, to which wiring with a cross section of up to 2.5mm2 can be connected. Each termination point is clearly numbered to simplify recognition of each terminal. The two rows of terminals are offset to allow access to the lower row when wiring is in place.

Keying

Rotary keys in the Field Terminal are adjustable to allow insertion of certain modules. Modules that would cause field wiring to be unsafe (in respect of hazardous areas) cannot be inserted.

The four types of Field Terminal can be identified from the diagram below:



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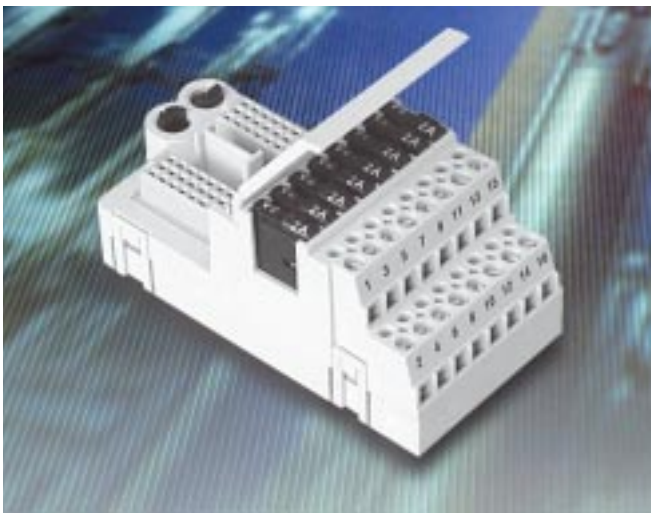
Field Terminal - Specification and Selection Guide

Field Terminals

86xx-FT-xx

- *a range of Field Terminals*
- *standard, fused and loop-disconnect*
- *tag strip fitted to all Field Terminals*



FIELD TERMINAL SPECIFICATION

See also System Specification

ELECTRICAL

Rated voltage .....250V ac

Maximum current per I/O channel 3A

Fuse rating (where fitted) 2A

Conductor size .....0.14–2.5mm^2

MECHANICAL

Dimensions - approx (including tagging strip)

.....42 (w) x 88 (d) x 39.5 (h)mm

Weights (typical - including tagging strip)

Unfused type 78g

Fused type 86g

PART NUMBERS

GENERAL PURPOSE FIELD WIRING

Field terminal description	Part number
Standard	8602-FT-ST
Standard fused	8604-FT-FU
4-wire transmitter	8615-FT-4W

ZONE 2/DIV2 FIELD WIRING APPLICATIONS

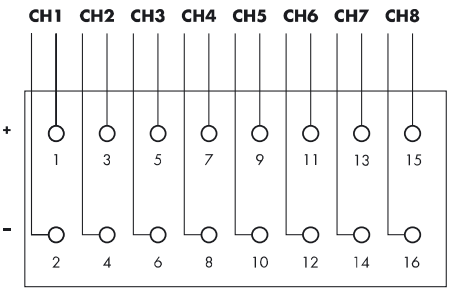
Field terminal description	Part number
Non-incendive	8601-FT-NI
Non-incendive fused	8603-FT-FU
Non-arcing standard	8610-FT-NA
Non-arcing fused	8611-FT-FU
4-wire transmitter	8615-FT-4W

ADDITIONAL COMPONENTS

Description	No. in Pack	Part Number
2A Fuse pack	10	8401-FU-2A
Loop-disconnect links pack	10	8405-LK-ZE

CONNECTION DIAGRAM

The connection diagram below applies to all Field Terminals used with SafetyNet IO Modules.



FIELD TERMINAL SELECTION

Field terminal	8810-HI-TX	8811-IO-DC
8601-FT-NI	R (2-wire TX)	
8602-FT-ST	C	
8603-FT-FU	C	
8604-FT-FU	C	C
8610-FT-NA		R
8611-FT-FU		C
8615-FT-4W	R (3 & 4-wire TX)	

R = Recommended, C = Compatible

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Power Supplies - overview

General

In order to meet the relevant safety requirements, the MTL power supplies specifically designed for use with the MOST SafetyNet and Process Control products must be used to power the SafetyNet Controller and IO Modules.

The 8913-PS-AC power supply must be used to supply the 12V dc for the SafetyNet Controller and System Power, and the 8914-PS-AC power supply must be used for the 24V dc Bussed Field Power supply to the SafetyNet IO Modules.

Redundancy

Redundancy is implemented by "pairing" each power supply with a second power supply. If the optional Nodes Services Power Supply Monitor (8410-NS-PS) is used, then this can detect if there has been a failure in any one of up to six 8913-PS-AC/ 8914-PS-AC power supplies and the 2/1 power supplies for nodes including Intrinsically Safe IO – and will then report that such a failure has occurred.

Wide range of input voltages

The 8913-PS-AC and 8914-PS-AC power supplies accept AC input voltages in the range 85 - 264V ac.

Hazardous area mounting

Each power supply can be mounted in Class 1, Division 2 or Zone 2 hazardous areas.

Operating ambient temperature

When mounted with the optimum orientation for cooling, the power supplies will provide their full rated output in operating ambient temperatures of +70C (provided the input range is in excess of 125V ac).

Power Supply

System Power

8913-PS-AC

- *12V dc @ 5A System and Controller power*
- *24V dc @ 5A for powering local instrumentation*
- *85 – 264V ac input voltage*
- *Zone 2/Div 2 hazardous area mounting*
- *12V output supports load sharing for redundancy†*

POWER SUPPLY SPECIFICATION

See also System Specification

ELECTRICAL CONNECTIONS

AC Input connections.....screw terminals (x3)
DC Output connections .....screw terminals (x8)
Power fail signal connection .....screw terminal (x1)

INPUT SPECIFICATION

Input voltage.....85–264V ac
Input frequency 47–65Hz
Power efficiency .....Up to 87 %
Input protection .....internal (6.3A) slow-blow fuse and VDR*

OUTPUT SPECIFICATION

DC24V output voltage .....24.7V dc ± 10%
DC12V output voltage .....11.95V dc ± 5%
DC24V output current.....5A (nominal - see Figure1)
DC12V output current .....5A (nominal - see Figure 1)
Input-output isolation .....2800V dc
Hold-up time (at full rated load) .....15ms (typ.)
Thermal protection. .....reduced output power
Supply health indicator. .....LED

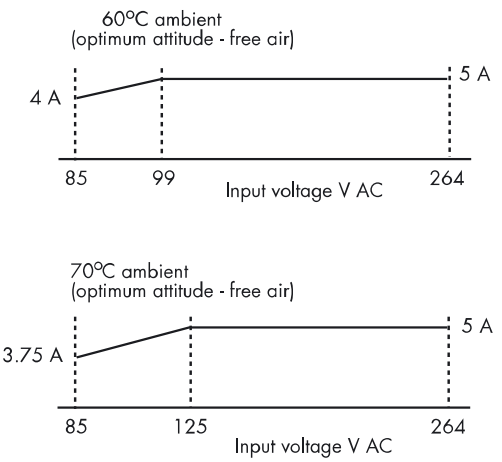

Figure 1 - DC24V and DC12V output current de-rating

† The 24Vdc output does not support load sharing and should only be used for supplying local 24Vdc instrumentation. It should not be used to supply 24Vdc Bussed Field Power.
** voltage dependent resistor*

POWER-FAIL SIGNALLING - DC12V output only

Threshold to trigger "power-fail" signal .....11.33V (max.)
.....10.30V (min.)

Power-fail signal output (open collector)

Power supply "OK".....Low impedance to –ve of DC12V output
Power supply "failure" .....High impedance to –ve of DC12V output

HAZARDOUS AREA SPECIFICATION

Protection Technique.....EEx nA II T4
Location (FM) .....Class 1, Div.2, Grps A,B,C,D T4
Location (CSA) .....Class 1, Div.2, Grps A,B,C,D T3C

MECHANICAL

Dimensions .....103 (w) x 138 (h) x 113.6 (d)mm (see Figure 4)
Mounting methods .....35 mm x 7.5 mm T-section DIN rail (see also Accessories overleaf)
Weight 750g

APPROVALS

- EN 61204: 1995 Low-voltage power supply devices, d.c. output - Performance characteristics and safety requirements
- EN 60950-1: 2002 Safety of information technology equipment
- EN 61326: 1997 + A1: 1998 + A2: 2001 Electrical equipment for measurement, control and laboratory use - EMC requirements (Class A equipment)
- EN50021: 1999 Electrical apparatus for potentially explosive atmospheres - Type of protection "n"

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System Power

TERMINAL ASSIGNMENTS
Input connector screw terminals

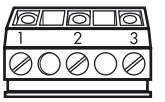

Figure 2 - AC input connector

Terminal	Des.	Description
1	⏚	Protective earth
2	N ~	Input neutral
3	L ~	Input live

Output connector screw terminals

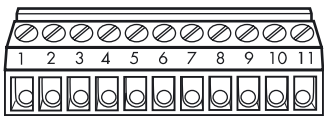

Figure 3 - DC output connector

Terminal	Des.	Description	
1	⏚	Not connected	
2	+	Output 1 + ve	DC24V
3	+	Output 1 + ve	
4	–	Output 1 – ve	
5	–	Output 1 – ve	
6	+	Output 2 + ve	DC12V
7	+	Output 2 + ve	
8	–	Output 2 – ve	
9	–	Output 2 – ve	
10	Aux.	Power fail signal	
11	⏚	Not connected	

ACCESSORIES
Heavy duty DIN rail mounting kit* 8413-FK-DN
Surface panel mounting kit.....8414-FK-SU
* For high vibration environments

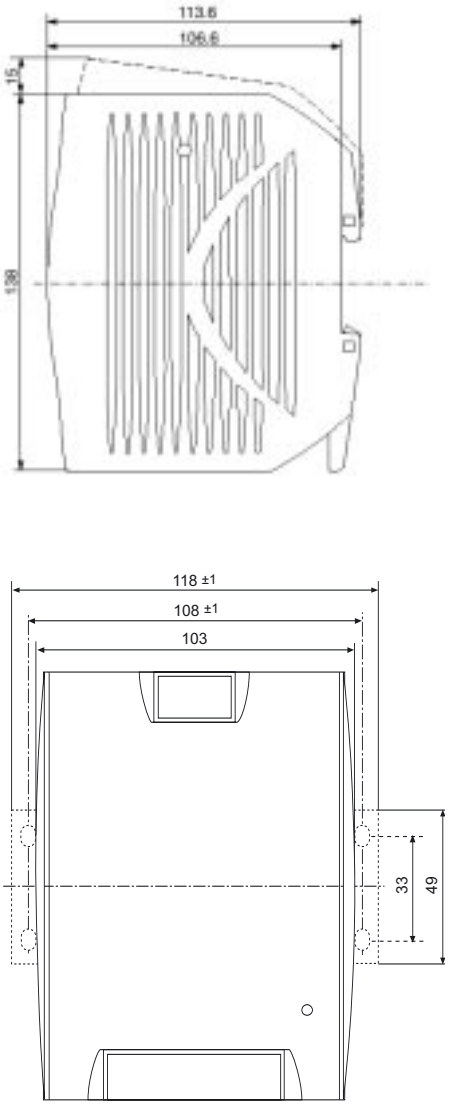

Figure 4 - outline and fixing dimensions

Power Supply

Bussed Field Power

8914-PS-AC

- *24V dc @ 10A for Bussed Field Power*
- *85 – 264V ac input voltage*
- *Zone 2/Div 2 mounting*
- *supports load sharing for redundancy*

POWER SUPPLY SPECIFICATION

See also System Specification

ELECTRICAL CONNECTIONS

AC Input connections.....screw terminals (x3)
DC Output connections .....screw terminals (x8)
Power fail signal connection .....screw terminal (x1)

INPUT SPECIFICATIONS

Input voltage .....85–264V ac
Input frequency.....47–65Hz
Power efficiency .....up to 87 %
Input protection .....internal (6.3A) slow-blow fuse and VDR*

OUTPUT SPECIFICATIONS

Output .....24V dc ± 10%
Output current.....10A (nominal - see Figure 1)
Input-output isolation .....2800V DC
Hold-up time (at full rated load) .....15ms (typ.)
Thermal protection .....reduced output power
Supply health indicator .....LED

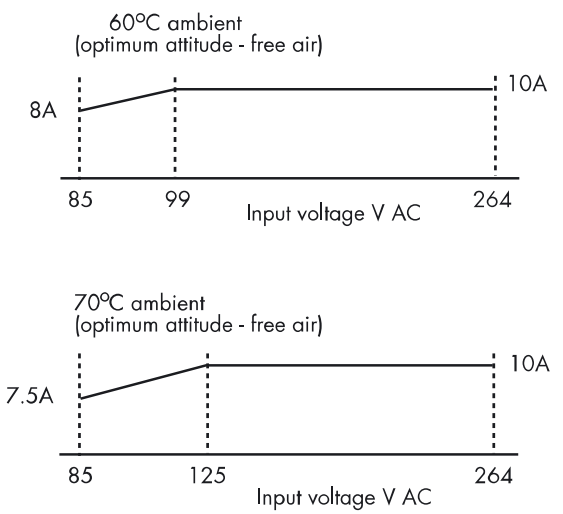

Figure 1 - output current de-rating

POWER-FAIL SIGNALING

Threshold to trigger "power-fail" signal.....23.3V (max.)
.....22.0V (min.)
Power-fail signal output (open collector)
Power supply "OK" .....low impedance to ground
Power supply "failure" .....high impedance to ground

HAZARDOUS AREA SPECIFICATION

Protection Technique.....EEx nA II T4
Location (FM) .....Class 1, Div.2, Grps A,B,C,D T4
Location (CSA) .....Class 1, Div.2, Grps A,B,C,D T3C

MECHANICAL

Dimensions .....103 (w) x 138 (h) x 113.6 (d)mm (see Figure 4)
Mounting methods .....35 mm x 7.5 mm T-section DIN rail
(see also Accessories overleaf)
Weight 750g

APPROVALS

- EN 61204: 1995 Low-voltage power supply devices, d.c. output - Performance characteristics and safety requirements
- EN 60950-1: 2002 Safety of information technology equipment
- EN 61326: 1997 + A1: 1998 + A2: 2001 Electrical equipment for measurement, control and laboratory use - EMC requirements (Class A equipment)
- EN50021: 1999 Electrical apparatus for potentially explosive atmospheres - Type of protection "n"

** voltage dependent resistor*

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Field Power

TERMINAL ASSIGNMENTS
Input connector screw terminals

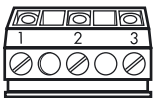


Figure 2 - AC input connector

Terminal	Des.	Description
1	⏚	Protective earth
2	N ~	Input neutral
3	L ~	Input live

Output connector screw terminals

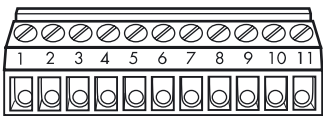


Figure 3 - DC output connector

Terminal	Des.	Description
1	⏚	Not connected
2	+	Output + ve
3	+	Output + ve
4	–	Output – ve
5	–	Output – ve
6	+	Output + ve
7	+	Output + ve
8	–	Output – ve
9	–	Output – ve
10	Aux.	Power fail signal
11	⏚	Not connected

ACCESSORIES
Heavy duty DIN rail mounting kit* 8413-FK-DN
Surface panel mounting kit.....8414-FK-SU
* For high vibration environments

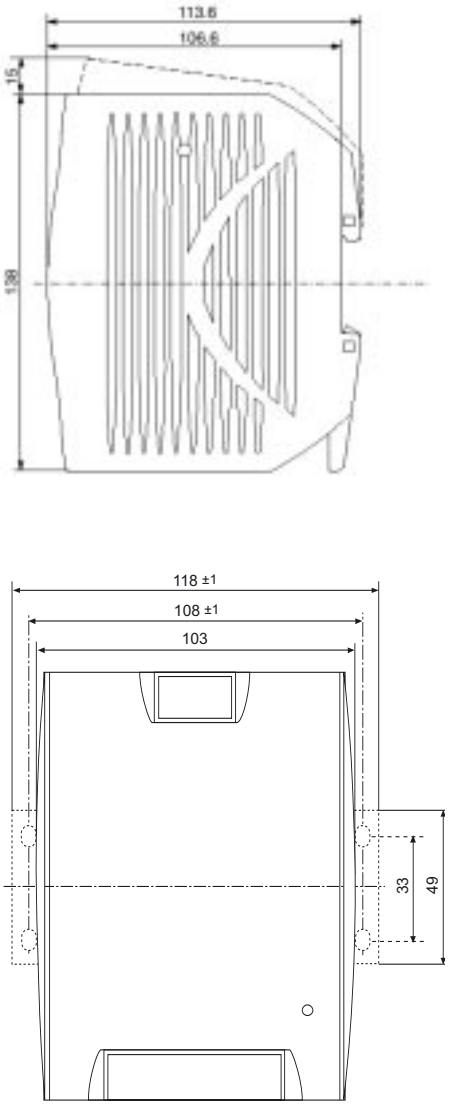


Figure 4 - outline and fixing dimensions

Node Services Power Supply Monitor

8410-NS-PS

- *power supply status monitoring for 8913-PS-AC and 8914-PS-AC power supplies*
- *indicates supply failures to SafetyNet Controller*
- *monitors up to two 8913-PS-AC, four 8914-PS-AC power supplies and the 2/1 supply for nodes including IS IO modules*
- *Zone 2/Div 2 hazardous area mounting*
- *mounts on 8571-CA-NS Carrier*

The Power Supply Monitor can monitor the health of supplies powering a SafetyNet node and signal the Controller in the event of any one of them failing. The module can receive power supply status signals from up to two 8913-PS-AC and four 8914-PS-AC power supplies. It can also monitor the status of 8920-PS-DC supplies powering intrinsically safe I/O modules. Where power supply redundancy is employed, the module enables failed power supplies to be identified and replaced without interference to the process. The module itself may be removed and replaced in a Zone 2/ Div 2 hazardous area without gas clearance.

MODULE SPECIFICATION

See also System Specification

LED INDICATOR

PWR (i.e. System power supply present)

HAZARDOUS AREA SPECIFICATION

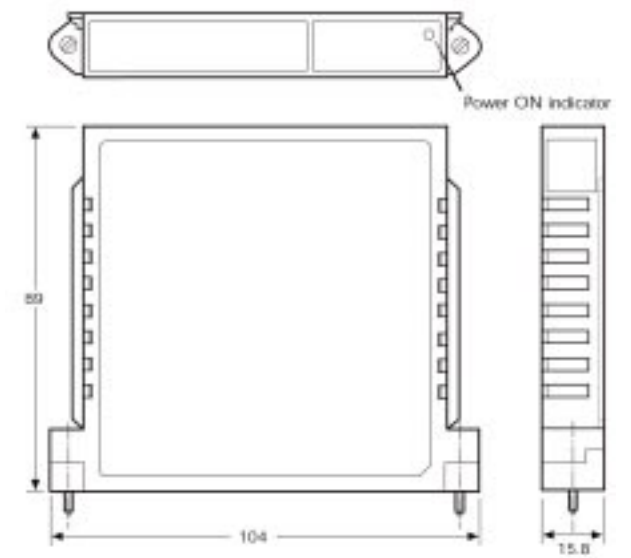
Protection Technique.....EEx nL IIC T4
Location (FM and CSA).....Class 1, Div.2, Grps A,B,C,D T4

POWER SUPPLIES

System Power Supply.....5mA (typ.), 10mA (max.)

MECHANICAL

Mounting method .....(captive x2) screw fixing
Weight (approx.).....75g



DIMENSIONS

Dimensions in mm

MTL MOST
EUROPE (EMEA) Tel: +44 (0)1582 723633 Fax: +44 (0)1582 422283
AMERICAS Tel: +1 603 926 0090 Fax: +1 603 926 1899
ASIA PACIFIC Tel: +65 487 7887 Fax: +65 487 7997
E-mail: info@mtlmost.com Web site: www.mtlmost.com

System Specification

ENVIRONMENTAL

Operating Ambient Temperature

Optimum orientation* .....-40ºC to +70ºC

Non-optimum orientation.....-40ºC to +50ºC

Storage .....-40ºC to +85ºC

Relative Humidity.....5 to 95% (non-condensing)

Ingress protection .....IP20 to BS EN60529: 1992

Corrosion resistance.....Designed to meet ten year service in Class G3 corrosive environment, as per ISA S-71.04: 1985 "Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants".

* With field terminals vertically above or below the IO Modules.

Operating vibration resistance

DIN rail mounted* .....

.....1g (sinusoidal vibration 10 – 500Hz to EN 60068-2-6)

.....1g (random vibration 20 – 500Hz to BS2011: Part 2.1)

Surface mounted .....

.....5g (sinusoidal vibration 10 – 500Hz to EN 60068-2-6)

.....5g (random vibration 20 – 500Hz to BS2011: Part 2.1)

* The ELFD Controller Carrier 8751-CA-NS can only be surface mounted.

Operating, Storage and Transportation vibration resistance

.....30g peak acceleration, with 11ms pulse width (EN 60068-2-27)

Storage and Transportation shock resistance

.....1m drop onto flat concrete (EN 60068-2-32)

MECHANICAL

DIN-rail types

.....'Top hat', 35 x 7.5mm to EN 50022

.....'Top hat', 35 x 15 mm to EN 50022

.....G-section, to EN 50035

ISOLATION

Between SafetyNet channels .....none

Channel (any) to railbus .....250V ac rms

NODE SIZE LIMITATIONS

Maximum physical length of railbus* 6.8m

Maximum number of extender cables 3

Maximum number of IO Modules.....64

Maximum number of SafetyNet nodes 249

* overall including backplanes and extender cables

HAZARDOUS AREA APPROVAL

SafetyNet node location

.....Safe area or

.....Zone 2, IIC, T4 hazardous area

.....Class 1, Div 2, Groups A-D T4* hazardous location

* 8913-PS-AC and 8914-PS-AC power supplies T3C

Field equipment and wiring location

.....Safe area or

.....Zone 2, IIC hazardous area

.....Class 1, Div 2, Groups A-D hazardous location

(Temperature classification will be determined by the field apparatus)

Applicable hazardous area standards:

- Factory Mutual Research Co., 3611: 2004. "Non-incendive Electrical Equipment for use in Class I and II, Division 2, and Class III Divisions 1 and 2, Hazardous (Classified) Locations".
- CSA C22.2 No 213-M1987, Reaffirmed 2004. "Non-incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations".
- EN 60079-0:2004 "Electrical apparatus for explosive gas atmospheres. Part 0: General Requirements".
- EN 60079-15: 2005 "Electrical apparatus for explosive gas atmospheres. Part 15: Construction, test and marking of type of protection 'n' electrical apparatus".

ELECTRICAL STANDARDS AND APPROVALS

Applicable EMC standards

- EN 61326-1: 2005. "Electrical equipment for measurement, control and laboratory use – EMC requirements. Part 1: General requirements".

Applicable Electrical Safety standards

- IEC 61131-2: 2003. "Programmable controllers - Part 2: Equipment requirements and tests".

SAFETY APPROVALS

Applicable Functional safety standards

- IEC 61508:2000. "Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems"
- IEC 61511:2004. "Functional Safety - Safety Instrumented Systems for the Process Sector".

CABLE PARAMETERS FOR NON-INCENDIVE FIELD WIRING

Module (each channel)	FM		
	Gas Group	C_a (µF)	L_a (mH)
8811-HI-TX	A+B	0.17	11
	C	0.51	33
	D	1.36	88