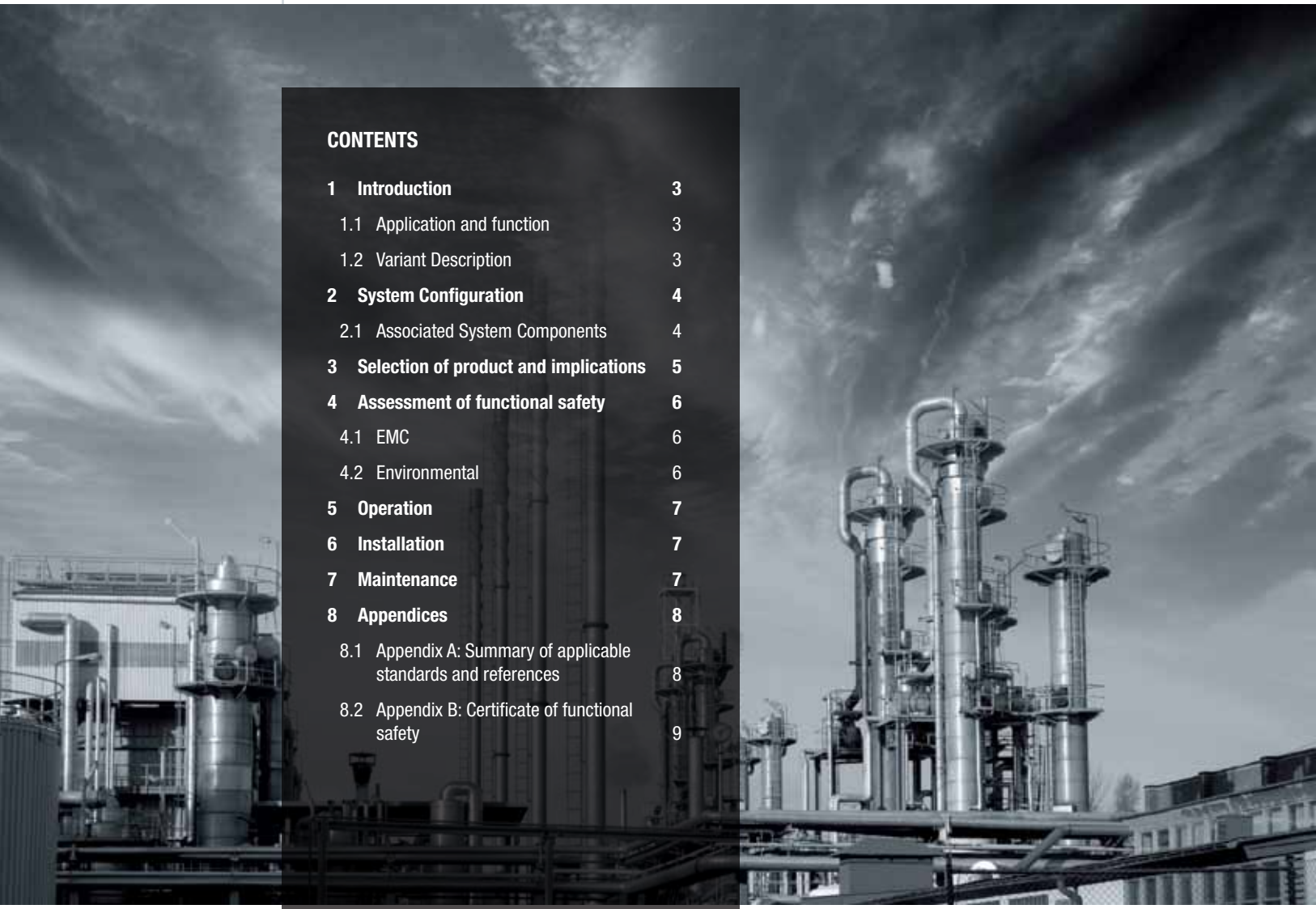
MTL4850 HART Multiplexer - **SAFETY MANUAL**

FUNCTIONAL SAFETY MANAGEMENT

These products do not form part of a safety system but can be connected to a Safety System conforming to the requirements of IEC 61508:2010 where the instrument loops are performing safety functions up to and including Safety Integrity Level SIL3.

FUNCTIONAL SAFETY MANAGEMENT



CONTENTS

This manual supports the application of the products in functional-safety related loops. It must be use in conjunction with other supporting documents to achieve correct installation, commissioning and operation. Specifically, the data sheet, instruction manual and applicable certificates for the particular product should be consulted, all of which are available on the MTL web site.

In the interest of further technical developments, we reserve the right to make design changes.

Functional Safety cass Approved Company

sira CERTIFICATION

FSM FUNCTIONAL SAFETY MANAGEMENT IEC 61508:2010

www.mtl-inst.com enquiry@mtl-inst.com

1 INTRODUCTION

1.1 Application and function

The MTL4850 HART multiplexer is used to create a two-way communications channel between numerous items of HART-enabled field equipment and a plant asset-monitoring/control system. Each multiplexer module can incorporate the HART data for up to 32 field channels into a single RS485 signal for onward linking to PC based instrument management software, thereby simplifying the wiring and reducing the cost-per-channel.

The MTL4850 combines the functions of a HART modem, a power supply conditioner and all the necessary signal-switching and addressing circuitry to multiplex the HART data. It provides a compact, convenient and cost-effective building block that can incorporated easily into both new and existing installations, especially as a partner for MTL's 4500 Series intrinsic safety interfaces. It is the modern version of MTL's popular MTL4840 Series equipment and further simplifies the system.

MTL4850 on 32-channel
HART Termination Panel

MTL4850s on 64-channel
HART Multiplexer Panel

The MTL4850 multiplexer enables the user to gain access to valuable HART data provided by modern field devices in addition to the conventional 4/20mA loop signal provided by them. Many early process installation projects around the world did not take advantage of the data from HART-capable devices at start-up, so the MTL4850 offers a simple upgrade path to that data for asset management as well as the obvious live status and configuration information of the field devices.

Most distributed control systems (DCS) now on the market incorporate the ability to pass HART communications information on the analogue input and output channels, but many safety systems (SIS and F&G) do not. Increasingly therefore, one of the main uses for the HART multiplexer is to provide HART communications for the field instruments connected to safety systems. In such implementations, it is crucial that the HART multiplexer does not interfere with the analogue loops of the safety system.

1.2 Variant Description

There are two versions of the product which are essentially the same but the modules differ in mounting in the following way:

- MTL4850 is the general purpose MTL product supplied in a blue enclosure

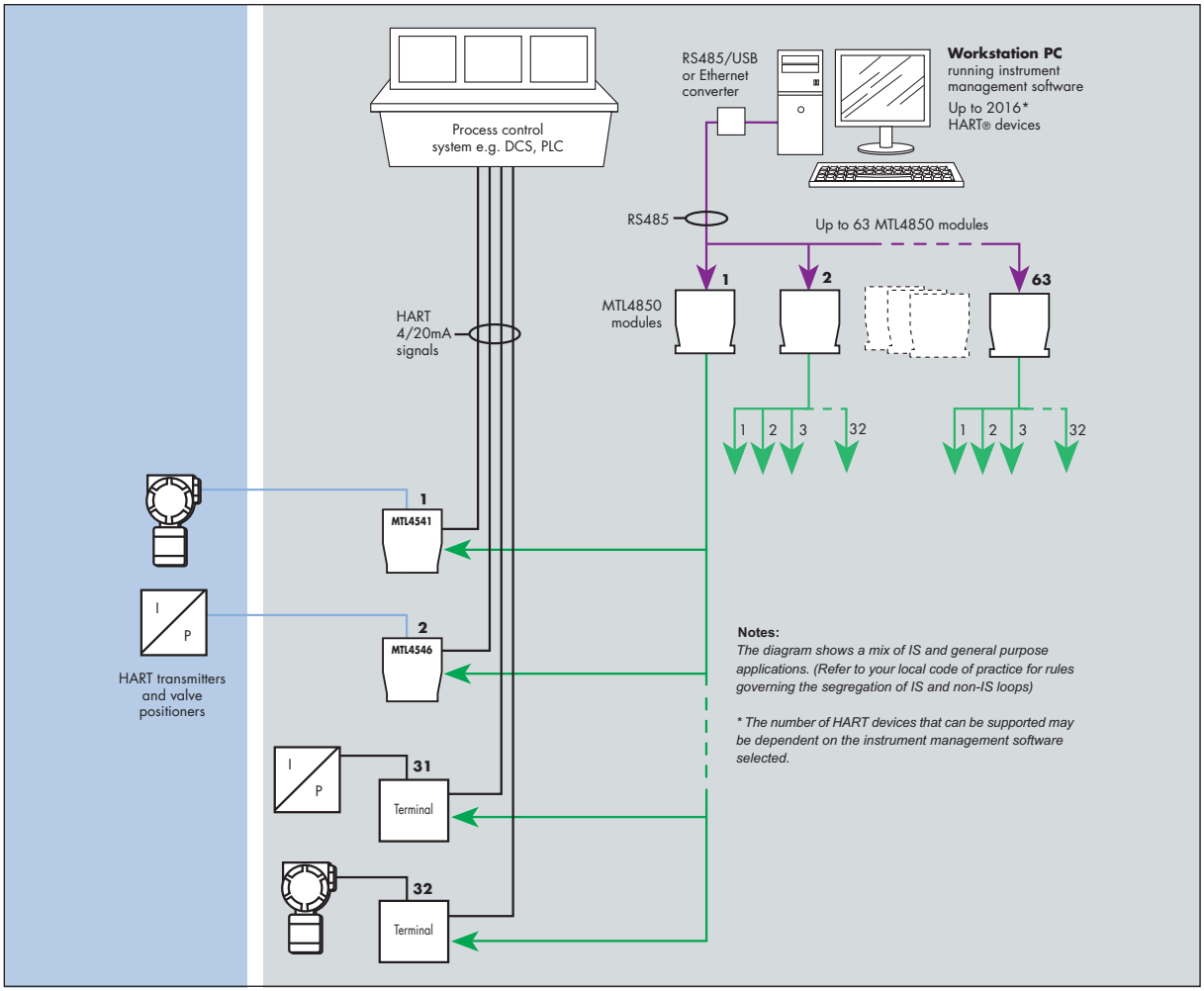
- MTL4850-TR is supplied solely to Invensys (Triconex) in a black enclosure.

Physically and electrically the products are the same but may contain different revision levels of the operating firmware. There is no difference between the products in regard to their application for functional safety.

The functional safety assessment applies to MTL4850 with revision status 03 onwards and firmware version 1.02 onwards, as denoted on the product side label.

2 SYSTEM CONFIGURATION

The MTL4850 multiplexer may be used as part of an asset management system connecting to instrument signal loops that form part of a Safety Instrumented System up to SIL3. In general, the structure of such a system is illustrated below.



The HART multiplexer system provides access to the HART data in the field devices alongside the conventional 4/20mA loops connecting them to the control or instrumentation system.

"Capacitive isolation" is used to pick off the HART data from each 'leg' of the field signals. This ensures that the integrity of each channel connection is unaffected by a component failure in another channel. As the multiplexer provides a common bridge for the thirty-two channels that are connected to it, the importance of this signal separation may be readily understood. This is particularly important when the multiplexer is associated with signal loops that are feeding a safety shutdown system. It is critical that the integrity of the analogue loops for the safety system is unaffected by any possible failures within the multiplexer.

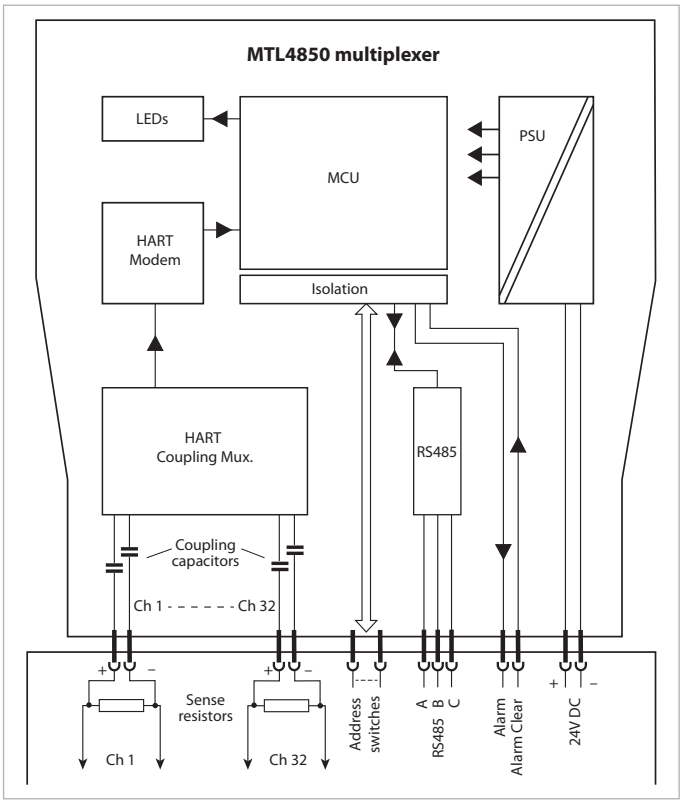
2.1 Associated System Components

The connections onto the 4/20mA current signals that carry the HART data must be made through suitable wiring and terminations that preserve the separation and segregation of the idividual instrument loops.

In process applications where the field signals use the intrinsic safety principle for explosion protection, the MTL4850 can be mounted together with the MTL4500 Series isolators on backplanes such as the CPH-SC16 or the CPH-SC32. Alternatively, the isolators could be mounted on a backplane that is customised to suit a specific instrument system, with the HART signals linked

to the multiplexer through multi-way cables. In this case, the MTL4850 would be mounted on an HMP-HM64 backplane which accepts HM64RIB20 multi-way ribbon cables from the backplanes.

Block diagram of MTL4850



For applications that do not involve intrinsic safety, termination boards such as the HCU16 or HCU16AO provide the connection for the field and instrument system signals with the HM64RIB20 cables again linking to an HMP-HM64. In other instances the HTP-SC32 backplane offers a convenient mounting for the MTL4850 with connections available for 32 field and system signals.

Refer to the instruction manual, INM4850, for details of all connection arrangements.

3 SELECTION OF PRODUCT AND IMPLICATIONS

The transmission of HART data is not considered as part of the safety function and is excluded from this analysis, i.e. the HART functions of the MTL4850 are not to be used as a primary part of a safety system. An asset management software package, running on a PC and connected to the HART multiplexer, may be monitoring the health and performance of the field devices, or being used in a diagnostic role for example, but is not an integral part of the safety system.

Protection against unintended changes to the configuration of the HART field devices must be employed either through the hardware of the devices using links or switches, or through firmware locks. Also the host management system running the communications to the HART multiplexers must include provision such as password protection to prevent re-configuration of the HART field devices by mistake.

As the analogue signals carrying the HART data are part of a safety instrumented system, on-line changes to configuration, calibration or maintenance activity with the asset management system should be avoided. See also the need to ensure the integrity of the field signal connections explained in Section 5.

Safety procedures must be put in place to ensure proper use of the configuration, calibration and maintenance facilities of the host software package with suitable verification of any changes made.

4 ASSESSMENT OF FUNCTIONAL SAFETY

The MTL4850 HART multiplexer does not itself implement a safety function but may be applied alongside measurement and control equipment that is providing a safety function.

The multiplexer is designed to ensure that there is no effect on the analogue loops to which it is connected; multiple concurrent faults in the components that couple the MTL4850 to the analogue loops would have to be present before the isolation would be compromised.

The design features, and the techniques/measures used to prevent systematic faults, make the MTL4850 suitable for use in applications where the 4/20mA instrument loops, to which it is connected, are implementing safety functions up to SIL3. Refer to the certificate for the method of assessment applied to avoid systematic failures.

The hardware assessment shows that MTL4850 HART Multiplexers:

- have a hardware fault tolerance of 0
- are classified as Type B devices
- have no relevant internal diagnostic elements.**

The random hardware failure rate of the MTL4850 at an ambient temperature of 60°C was determined as follow:-

Model	λ_s	λ_{dd}	λ_{du}
MTL4850	1.13E-05	0	1.0E-08

The safe failure fraction is >90% (99%).

It is assumed that the module is powered from a nominal 24V dc supply and at a maximum ambient temperature of 45°C under normal conditions.

There are no opportunities for external diagnostics to be applied to the MTL4850 HART multiplexer itself. Any monitoring of the analogue loops to which it is connected must be conducted within the safety system.

4.1 EMC

The MTL4850 modules are designed for operation in normal industrial electromagnetic environment but, to support good practice, modules should be mounted without being subjected to undue conducted or radiated interference, see Appendix A for applicable standards and levels.

4.2 Environmental

The MTL4850 modules operate over the temperature range from -40°C to +70°C, and at up to 95% non-condensing relative humidity.

The modules are intended to be mounted in a normal industrial environment without excessive vibration, as specified for the MTL4850 and MTL45/5500 product ranges. See Appendix A for applicable standards and levels.

Continued reliable operation will be assured if the exposure to temperature and vibration are within the values given in the specification.

*** the multiplexer does in fact monitor the critical loop-connecting components, but it is not necessary for these diagnostics to operate to achieve the SIL3 rating.*

5 OPERATION

Refer to the product instruction manual (INM4850) where details of the LED indications, in both normal operation and under fault conditions, are given. A listing of the various messages recorded in the alarm/event logs, and their meanings, can also be found there.

The design life for the MTL4850 product family is ten years, so provision should be made for replacement of the products within this expected lifetime.

6 INSTALLATION

Reference must be made to the relevant sections within the product instruction manual (INM4850) for the MTL4850 before installing these products.

If the application involves intrinsic safety, then product instruction manuals INM4500 (MTL4500 Series) or INM5500 (MTL5500 Series) contain basic guides for the installation of the interface equipment to meet these requirements.

Provided that the installation requirements given in the manuals are followed then there are no additional factors to meet the needs of applying the products for functional safety use.

An important consideration for this equipment is that the analogue loops carrying the HART data form part of a safety system. All termination panels available from MTL have been designed and manufactured with the requisite separation and segregation between channels to ensure the integrity of the signals that are connected to the safety system.

The connection and cabling employed for the loop signals must be implemented in accordance with local codes of practice and with the care necessary to preserve the sensitive nature of the signals. The selection, installation, inspection and protection of the cabling must be carried out with due regard for the routing, mechanical protection against abrasion and any other damage that might cause interference with the safety signals.

To guard against the effects of dust and water the modules should be mounted in an enclosure providing at least IP54 protection degree, or the location of mounting should provide equivalent protection, such as inside an equipment cabinet.

7 MAINTENANCE

The MTL4850 does not form part of a safety system and accordingly there is no requirement to conduct proof testing of any safety function that it implements. For routine maintenance of the HART multiplexer system, refer to INM4850.

To follow the guidelines pertaining to operation and maintenance of intrinsically safe equipment in a hazardous area, yearly periodic audits of the installation are required by the various codes of practice.

In addition, proof-testing of the loop operation to conform with functional safety requirements should be carried out at the intervals determined by safety case assessment.

Proof testing must be carried out according to the application requirements, but it is recommended that this be carried out at least once every three years.

Note that there may also be specific requirements laid down in the E/E/PE operational maintenance procedure for the complete installation.

If an MTL4850 module is found to be faulty during commissioning or during the normal lifetime of the product then such failures should be reported to MTL. When appropriate, a Customer Incident Report (CIR) will be notified to enable the return of the unit to the factory for analysis. If the unit is within the warranty period then a replacement unit will be sent.

Consideration should be made of the normal lifetime for a device of this type which would be in the region of ten years.

8 APPENDICES

8.1 Appendix A: Summary of applicable standards and references

The annex lists together all standards referred to in the previous sections of this document:

IEC61508:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems. Parts 1 and 2, as relevant.
EN61131-2:2003	Programmable controllers – Part 2: Equipment requirement and tests (EMC requirements).
EN61326-1:2006	Electrical equipment for measurement, control and laboratory use – EMC requirements. (Criterion A).
EN 61326-3-1:2008	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - General industrial applications
NE21 : 2007	Electromagnetic Compatibility of Industrial Process and Laboratory Control Equipment. (Criterion A).

Reliability data for this analysis is taken from IEC TR 62380:2004 Reliability Data Handbook.

Failure mode distributions are taken principally from IEC 62061:2005 Safety of Machinery.

8.2 Appendix B: Certificate of functional safety

sira
CERTIFICATION

FUNCTIONAL SAFETY CERTIFICATE

This is to certify that the

MTL4850 HART Multiplexer

manufactured by

Measurement Technology Ltd.
Great Marlings
Butterfield
Luton
Bedfordshire
LU2 8DL
United Kingdom

has been assessed by Sira Certification Service with reference to the CASS methodologies and found to meet the requirements of

IEC 61508-2:2010

The Product and its associated failure data contained herein may be considered for connection to 4-20mA instrument loops performing safety functions up to and including

SIL 3*

when used in accordance with the scope and conditions of this certificate.

* The product that has been certified is not implicit of the achieved Safety Integrity Level (SIL) of the safety related system

Certification Manager: D Stubbings

Initial Certification: 30th April 2012
This certificate issued: 21st May 2012
Renewal date: 29th April 2017

This certificate may only be reproduced in its entirety, without any change.

cass

Certificate No.: Sira FSP 12008/02
Form 7016 issue 2
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UKAS PRODUCT CERTIFICATION

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Product description and scope of certification

The MTL4850 multiplexer is designed to monitor HART field devices connected to AI or AO field loops in safety-related measurement systems, communicating with an asset management system to provide data to HART configuration/maintenance software packages.

The MTL4850 itself does not perform a safety function, but it can be connected to a safety instrumented loop without interfering with the safety function performed by that loop.

Element Safety Function(s)[1]

The safety function of the product when it is connected to a safety instrumented system is defined for the purposes of the assessment as:

To not interfere with the analogue safety loop connected to the MTL4850 field terminals

This element safety function is being performed in Continuous Mode[1] of operation as indicated by the certified failure data overleaf.

[1] Refer to IEC 61508-4 for a definition of this term

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Certified Data in support of use in safety functions

The assessment has been carried out with reference to the *Conformity Assessment of Safety-related Systems* (CASS) methodology[2] using the Route 1_H[3] approach.

A Failure Mode and Effect Analysis (FMEDA) has established the failure modes and failure rates shown in Table 1 below. Failure rates have been taken from PD IEC TR 62380:2004 and a combination of FMD-91, PD IEC TR 62380:2004 and IEC 62061 used for failure mode distribution.

Table 1: Failure Data

Functional safety Parameter[3] required for connection to a safety-related system	**Symbol**	**Element Safety Function: To not interfere with the analogue safety loop connected to the MTL4850 field terminals**
Architectural constraints:	Type HFT SFF	B 0 99%
Random hardware failures:	λ	λ_{DU} < 1.0E-08 λ_{DD} = 0 λ_S = 1.13E-05
Probability of Failure on Demand:	PFD_{AVG}	Not applicable for continuous mode functions
Systematic Capability:	SC	SC 3
Demand Mode:		Continuous

Notes on the failure data:

a) Failure rates stated in Table 1 are in units of *failures per hour*.

b) Environment / stress criteria used in the FMEDA: 'Ground; stationary; non-weather protected' conditions.

c) All failure modes of the HART communications have not been assessed and are not included in the above data

[2] www.cass.uk.net
[3] Refer to IEC 61508-2, 7.4.4, for a definition of this term

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Table 2: Information supporting the failure rate data

1	Product identification:	MTL4850 revision 03 onwards and firmware 1.02 onwards, as denoted on the product label.
2	Functional specification:	Refer to the MTL Instruments datasheet EPS MTL4850-1, Oct-2009
3-5	Random hardware failure rates:	Refer to previous table
6	Environment limits:	Temperature range Operating: –40°C to +70°C Non-operating: –40°C to +85°C Relative humidity 5% to 95% - non-condensing
7	Lifetime/replacement limits:	10 years
8	Proof Test requirements:	Not applicable to this product
9	Maintenance requirements:	No specific functional safety related requirements. For maintenance information generally, refer to the Instruction Manual, INM4850-1, rev 2
10	Diagnostic coverage:	Diagnostics are performed for the dangerous failure modes but these are not relied upon for SIL 3 capability.
11	Diagnostic test interval:	1 minute on average but note comment in previous entry 10 above
12	Repair constraints:	No specific restraints. For servicing information generally, refer to the Instruction Manual, INM4850-1, rev 2
13	Safe Failure Fraction:	Refer to previous table
14	Hardware fault tolerance (HFT):	Refer to previous table
15	Highest SIL (architecture/type A/B):	SIL3
16	Systematic failure constraints:	Failure modes of the HART communications have not been assessed and are not included in the above data. The SPI system should be isolated on any adjoining backplane or interface.
17	Evidence of similar conditions in previous use:	Compliance Route 2_H (proven-in-use) not used
18	Evidence supporting the application under different conditions of use:	
19	Evidence of period of operational use:	
20	Statement of restrictions on functionality:	
21	Systematic capability:	SC 3
22	Systematic fault avoidance measures:	Based on techniques and measures used to avoid systematic failures introduced during the realisation lifecycle from 61508-2 Annex B.
23	Systematic fault tolerance measures:	The unit's fault status is alerted via the fault (solid state) relay contacts and LED on the top panel of the module.
24	Validation records:	As controlled under the certified FSM system and additional verification by Sira in report R56A26226A.

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Management of functional safety

This product is controlled under the manufacturer's certified functional safety management system that meets the relevant requirements of IEC 61508-1:2010 clause 6. Refer to Sira certificate CASS 00015.

Identification of certified equipment

The certified equipment and it's safe use is defined in the manufacturer's documentation listed in Table 1 below.

Table 3: Certified drawings

Document no.	Rev	Date	Document description
AD4850-3	1	07/2008	MTL4850 assembly drawing
AD4850-1	4	11/2010	MTL4850 final assembly
TC4850-1	2	11/2008	4850 final assembly
PLE4850-3	1	10/7/2008	MTL4850 PCB ASSEMBLY
TP4850-1	1	06/11/2008	4850 ASSEMBLY
SM4850-1	1		MTL4850 Safety Manual

Conditions of Certification

The validity of the certified base data is conditional on the manufacturer complying with the following conditions:

1. The manufacturer shall analyse failure data from returned products on an on-going basis. Sira Certification Service shall be informed in the event of any indication that the actual failure rates are worse than the certified failure rates. (A process to rate the validity of field data should be used. To this end, the manufacturer should co-operate with users to operate a formal field-experience feedback program).
2. Sira shall be notified in advance (with an impact analysis report) before any modifications to the certified equipment or the functional safety information in the user documentation is carried out. Sira may need to perform a re-assessment if modifications are judged to affect the product's functional safety certified herein.
3. On-going lifecycle activities associated with this product (e.g., modifications, corrective actions, field failure analysis) shall be subject to surveillance by Sira in accordance with 'Regulations Applicable to the Holders of Sira Certificates'.
4. This product shall be controlled under the manufacturer's certified FSM system (Sira certificate CASS 00015).
5. The manufacturer shall ensure that the SPI terminals on the mounting boards are unconnected (open circuit) in order to maintain the electrical isolation of the product.

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Conditions of Safe Use

The validity of the certified base data in any specific user application is conditional on the user complying with the following conditions:

1. The product shall only be mounted on either the HMP-HM64, HTP-SC32 or CPH-SCx mounting boards, with the signal connections of analogue signals through HCU16x or HTP-SC32x, supplied for this product by the manufacturer
2. Refer to the safety manual regarding advice about avoiding the possibility of HART messages corrupting operation of the safety instrumented system to which this product is connected to.
3. The user shall comply with the requirements given in the manufacturer's user documentation (referred to in Table 2 above) in regard to all relevant functional safety aspects such as application of use, installation, operation, maintenance, proof tests, maximum ratings, environmental conditions, repair, etc;
4. Selection of this equipment for connection to safety functions and the installation, configuration, overall validation, maintenance and repair shall only be carried out by competent personnel, observing all the manufacturer's conditions and recommendations in the user documentation.
5. All information associated with any field failures of this product should be collected under a dependability management process (e.g., IEC 60300-3-2) and reported to the manufacturer.

General Conditions and Notes

1. This certificate is based upon a functional safety assessment of the product described in Sira Test & Certification Assessment Report R56A26226A and any further reports referenced in that report (under previous Sira projects).
2. If certified product or system is found not to comply, Sira Certification Service should be notified immediately at the address shown on this certificate.
3. The use of this Certificate and the Sira Certification Mark that can be applied to the product or used in publicity material are subject to the 'Regulations Applicable to the Holders of Sira Certificates' and 'Supplementary Regulations Specific to Functional Safety Certification'.
4. This document remains the property of Sira and shall be returned when requested by the issuer.

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