MTL Instruments

Intrinsic Safety Solutions

COOPER Crouse-Hinds

Protecting Investments in Hazardous Areas Worldwide

1.

Why choose intrinsic safety ?

1.1 Introduction

Intrinsic safety (IS) is a low-energy signalling technique that prevents explosions from occurring by ensuring that the energy transferred to a hazardous area is well below the energy required to initiate an explosion.
The energy levels made available for signalling are small but useable and more than adequate for the majority of instrumentation systems.
The two mechanisms being considered that could initiate an explosion are:

- A spark
- A hot surface

1.2 The advantages of intrinsic safety

The major advantage of intrinsic safety is that it provides a solution to all the problems of hazardous areas (for equipment requiring limited power) and is the only technique which meets this criterion. The significant factors are as follows:

a) The IS technique is accepted throughout the world. There is an increasing acceptance of international certificates issued under the IEC Ex scheme but this has some way to go. Intrinsic safety is an acceptable technique in all local legislation such as the ATEX Directives and OSHA. The relevant standards and code of practice give detailed guidance on the design and use of intrinsically safe equipment to a level which is not achieved by any of the other methods of protection.

b) The same IS equipment usually satisfies the requirements for both dust and gas hazards.

c) Appropriate intrinsically safe apparatus can be used in all zones. In particular, it is the only solution that has a satisfactory history of safety for Zone 0 instrumentation. The use of levels of protection ('ia', 'ib' and 'ic') ensures that equipment suitable for each level of risk is available (normally 'ia' is used in Zone 0, 'ib' in Zone 1 and 'ic' in Zone 2).

d) Intrinsically safe apparatus and systems are usually allocated a group IIC gas classification which ensures that the equipment is compatible with all gas/air mixtures. Occasionally, IIB systems are used, as this permits a higher power level to be used. (However, IIB systems are not compatible with acetylene, hydrogen and carbon disulfide.)

e) A temperature classification of T4 (135°C) is normally achieved, which satisfies the requirement for all industrial gases except carbon disulfide (CS_2) which, fortunately, is rarely used.

f) Frequently, apparatus, and the system in which it is used, can be made 'ia IIC T4' at an acceptable cost. This removes concerns about area classification, gas grouping and temperature classification in almost all circumstances and becomes the universal safe solution.

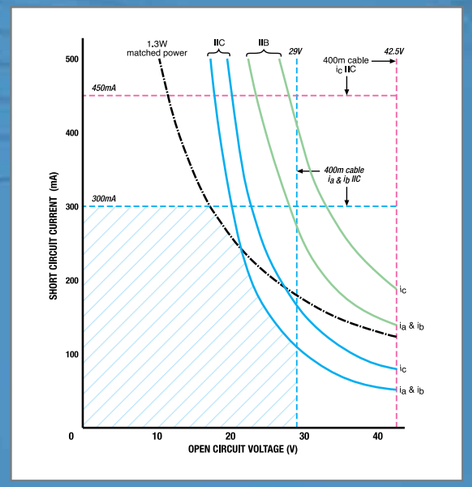
g) The 'simple apparatus' concept allows many simple pieces of apparatus, such as switches, thermocouples, RTD's and junction boxes to be used in intrinsically safe systems without the need for certification. This gives a significant amount of flexibility in the choice of these ancillaries.

h) The intrinsic safety technique is the only technique that permits live maintenance within the hazardous area without the need to obtain 'gas clearance' certificates. This is particularly important for instrumentation, since fault-finding on de-energised equipment is difficult.

i) The installation and maintenance requirements for intrinsically safe apparatus are well documented, and consistent regardless of level of protection. This reduces the amount of training required and decreases the possibility of dangerous mistakes.

j) Intrinsic safety permits the use of conventional instrumentation cables, thus reducing costs. Cable capacitance and inductance is often perceived as a problem but, in fact, it is only a problem on cables longer than 400 metres, in systems installed in Zones 0 and 1, where IIC gases (hydrogen) are the source of risk. This is comparatively rare and, in most circumstances, cable parameters are not a problem.

Figure 1.1 - Available power curves



1.3 Available power

Intrinsic safety is fundamentally a low energy technique and consequently the voltage, current and power available is restricted. Figure 1.1 is a simplified illustration of the available power in intrinsically safe circuits and attempts to demonstrate the type of electrical installation in which the intrinsically safe technique is applicable.

The blue and green curves are the accepted design curves used to avoid spark ignition by resistive limited circuits in Group IIC and IIB gases. The 'ic' curves are less sensitive because they do not require the application of a safety factor in the same way as for 'ia' and 'ib' equipment. In general the maximum voltage available is set by cable capacitance (400 metres corresponds to 80nF which has a permissible voltage of 29V in 'IIC ia' circuits) and the maximum current by cable inductance (400 metres corresponds to 400µH which has a permissible current of 300 mA in IIC ia circuits). A frequently used limitation on power is the 1.3W, which easily permits a T4 (135°C) temperature classification. These limits are all shown in Figure 1.1.

A simple approach is to say that if the apparatus can be operated from a source of power whose output parameters are within the (blue) hatched area then it can readily be made intrinsically safe to ' IIC ia T4' standards. If the parameters exceed these limits to a limited degree then it can probably be made intrinsically safe to IIB or 'ic' requirements.

The first choice, however, is always to choose 'IIC ia T4' equipment, if it provides adequate power and is an economic choice, as this equipment can be used in all circumstances (except if carbon disulfide (CS_2) is the hazardous gas, in which case there are other problems).

In practice almost all low voltage instrumentation can be made 'IIB ic T4' as the limits are set by the least sensitive of the ignition curves in Figure 1.1 (typically 24V 500 mA). The 'IIB ic' specification does restrict application to Zone 2 and where the hazardous gas is not hydrogen, acetylene or carbon disulfide but is still applicable to a large range of installations.

1.4 Conclusion

Intrinsic safety is the natural choice for all low voltage instrumentation problems. Adequate solutions exist which are compatible with all gases and area classifications. The technique prevents explosions rather than retains them which must be preferable, and the 'live maintenance' facility enables conventional instrument practice to be used.

MTL4500 Installation.

"Appropriate intrinsically safe apparatus can be used in all zones"

COOPER Crouse-Hinds

An Introduction to Intrinsic Safety 2.

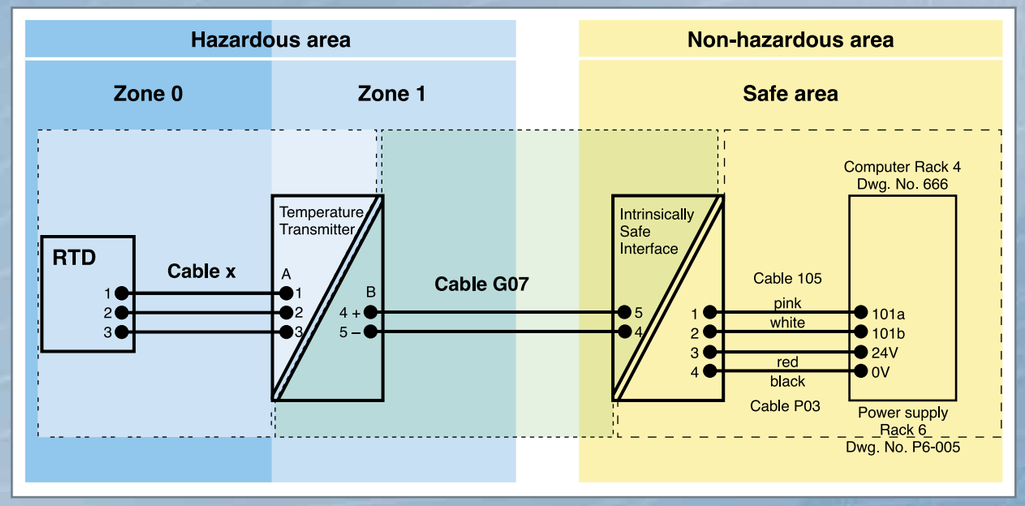


Figure 2.1 - Typical IS system

2.1 Definition of Intrinsic Safety

The definition of intrinsic safety used in the relevant IEC apparatus standard IEC 60079-11 is a 'type of protection based on the restriction of electrical energy within apparatus and of interconnecting wiring exposed to the potentially explosive atmosphere to a level below that which can cause ignition by either sparking or heating effects'. This is a concise statement of intent to introduce a multi-faceted subject.

2.2 Typical intrinsically safe system

Figure 2.1 illustrates a typical intrinsically safe (IS) system where the safe performance of each piece of apparatus is dependent on the integrity of all the equipment in the system. For example, the safety of the Temperature Transmitter (Tx) depends upon the amount of energy supplied by the IS Interface.
In most process control applications, each piece of apparatus in a system is individually certified. A document that confirms the safety of the whole system is then produced using the information from the individual apparatus certificates, in accordance with the system standard IEC 60079-25. This system document also includes details of cable types and simple apparatus used in the system.
It is important to recognise that where pieces of intrinsically safe apparatus are interconnected, it is the safety of the system that must be established. There are however some examples of apparatus which stand alone, such as mobile radios and portable gas detectors, where the system approach is not relevant.

2.3 Levels of protection

Intrinsic safety utilises three levels of protection, 'ia', 'ib' and 'ic' which attempt to balance the probability of an explosive atmosphere being present against the probability of an ignition capable situation occurring.

'ia'
This offers the highest level of protection and is generally considered as being adequately safe for use in the most hazardous locations (Zone 0) because the possibility of two 'faults' (see opposite) and a factor of safety of 1.5 is considered in the assessment of safety.

'ib'
'ib' apparatus, which is adequately safe with one fault and a factor of safety of 1.5 is considered safe for use in less frequently hazardous areas (Zone 1).

'ic'
'ic' apparatus which is assessed in 'normal operation' with a unity factor of safety is generally acceptable in infrequently hazardous areas (Zone 2). The 'ic' concept is relatively new (2005) and will replace the 'energy-limited' (nL) of the type 'n' standard IEC 60079-15 and possibly the 'non-incendive' concept of North American standards.

It is usual for a system to be allocated a level of protection as a whole, depending on the level of protection of the apparatus in the system. However it is possible for different parts of a system to have different levels of protection where suitable segregation exists. This must be made clear in the system documentation.

2.4 Faults

If a fault can adversely affect the safety of the equipment it is called a 'countable' fault. The situation is further complicated because the apparatus standard permits some specially designed components to be regarded as infallible and some inadequately designed features to be failed in normal operation. Consequently there are faults that are not considered to happen, faults, which are counted, and faults, which are imposed but not counted.
One of the major advantages of intrinsic safety is that 'live maintenance' on equipment is permitted without the necessity of obtaining 'gas clearance' certificates. A consequence of this is that during the safety analysis the possibility of open circuiting and short-circuiting any field wiring is regarded as normal operation.
Fortunately understanding the apparatus standard and faults is only necessary for apparatus designers and certifying authorities. The apparatus certificates remove the necessity to consider faults, except for field wiring faults, in system design.

2.5 Simple apparatus

In general, intrinsically safe apparatus is certified; usually by an independent body such as an Accredited Certification Body (ACB) under the IEC Ex scheme. Self-certification by the manufacturer of 'ic' equipment is also quite commonly accepted.
The exception to the rule is 'simple apparatus', which is considered not to appreciably affect the intrinsic safety of the system. This apparatus is exempted from the requirement for certification. The simple requirements are clearly specified in the apparatus standard. 'Simple apparatus' should always be readily demonstrable to be adequately safe. The usual examples are switches, thermocouples, RTD's and junction boxes.

2.6 Cables

Because cables have inductance and capacitance, and hence energy storage capabilities, they can affect system safety.
Consequently the system design imposes restrictions on the amount of each of these parameters. A great deal has been written on this subject but only rarely is there a serious limitation placed on the available cable.
As cable faults are taken into account during the system analysis, the type of cable in individual installations is not closely specified in the system standard. The choice is therefore determined by the need for reliable system operation.
Where intrinsically safe systems are combined in a multi-core, then there are special requirements. These determine which additional faults have to be considered.

2.7 Gas classification

The amount of energy required to ignite a particular gas/air mixture varies for each gas. Industrial gases capable of being ignited are divided, in the UK, into three classes, IIA, IIB and IIC.

Typical Gas	Gas Group	Ignition energy
Methane	IIA	160µJ
Ethylene	IIB	80µJ
Hydrogen	IIC	20µJ

Table 2.1: Typical gases, their classification & ignition energies

Table 2.1 shows a representative gas for each group and the minimum energy required to ignite it. IIC is clearly the most sensitive. Apparatus can be designed to be acceptably safe in any of these groups. Usually apparatus is designed to be safe in IIC, because it can then be used in any gas atmosphere. Sometimes a IIB classification is used as this permits slightly higher powers to be available. Only very rarely however is apparatus designed for the IIA classification because this restricts its use to this group alone.
Apparatus is usually assessed using the curves and tables included in the apparatus standard which lists acceptable levels of current and voltage. More complex circuits are checked with 'spark test' apparatus; normally the preserve of certifying authorities.

2.8 Temperature classification

The second method of causing an explosion is normally considered to be ignition by a hot surface. When a gas is heated above its ignition temperature it may spontaneously ignite. The ignition temperature varies with the gas and is not correlated to ignition energy. Consequently, when selecting apparatus, both properties of the explosive gas have to be considered.
Apparatus is classified into temperature ('T') classes depending on its maximum permitted surface temperature.

T1	T2	T3	T4	T5	T6
450°C	300°C	200°C	135°C	100°C	80°C

Table 2.2 The 'T' classes

The standard enables almost all apparatus, dissipating not more than 1.3W, to be allocated a temperature classification of T4 (135°C). Almost all intrinsically safe field mounted apparatus meets the requirements of T4 temperature classification, which permits its use in all industrial gas atmospheres except in those comprising carbon disulfide (CS_2) and air. These require a T6 classification, which is difficult to achieve at high ambient temperatures. There are also toxicity problems associated with carbon disulfide.
The other temperature that needs to be considered for each piece of apparatus is its ambient temperature rating, which does directly affect the safety of the apparatus in several ways.
Apparatus normally mounted in the safe area but which affects the safety of the intrinsically safe system (such as the intrinsically safe interface in Figure 2.1) is called 'associated apparatus'. Such apparatus does not need to be temperature classified but must be used within its specified ambient temperature range.

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2.9 Categories and equipment safety levels

When the European Directive (ATEX) for apparatus for use in hazardous areas (94/9/EC) was created, it introduced the concept of categories, which was intended to clarify the Zone(s) in which apparatus could safely be used. Unfortunately, and for nothing more than pedantic reasons, it was decided that a category 0 would not be used and the result was the confusing situation illustrated in Table 2.3, where the category and Zone numbers differ.

More recently (2004) the IEC took up the concept of identifying the level of protection offered by a piece of apparatus and also paid a little more attention to risk analysis as a method of determining the acceptable use of equipment. The result was the creation of equipment protection levels (EPLs), which are similar to ATEX categories but have numbers that align with their normal Zones of use.

In practice both categories and EPLs align with the levels of protection 'ia', 'ib' and 'ic' as indicated in Table 2.3 and, as far as intrinsic safety is concerned, they can largely be ignored, as the level of protection is already defined as 'ia', 'ib' or 'ic'. They do however appear on apparatus marking and certificates and consequently need to be explained.

2.10 Summary

Intrinsic safety offers an acceptable level of safety in all hazardous locations. Arguably it is safer and less prone to accidental errors than other methods of protection. This combined with its flexible use of available apparatus and the ability to do 'live working' means that it is the natural choice for instrumentation systems in hazardous areas. For example it is the only technique which is readily applicable to Zone 0 locations.

The introduction of the 'ic' concept completes the picture. The essential requirements of an intrinsically safe system are:

- The system must work.
- The apparatus in the system must be 'certified' or 'simple'.
- The compatibility of the apparatus must be established.
- The level of protection of the system established.
- The temperature classification and ambient temperature rating of each piece of apparatus established.
- The requirements of the cable established.

Level of Protection	Countable Faults	ATEX Category	IEC EPL	Normal Zone of Use
ia	2	1	0	0
ib	1	2	1	1
ic	0	3	2	2

Table 2.3 Relationships between different methods of assessing safety levels

MTL4500/5500 backplane and DIN-rail mounted safety isolators.

Installation & Inspection of IS apparatus
- An introduction

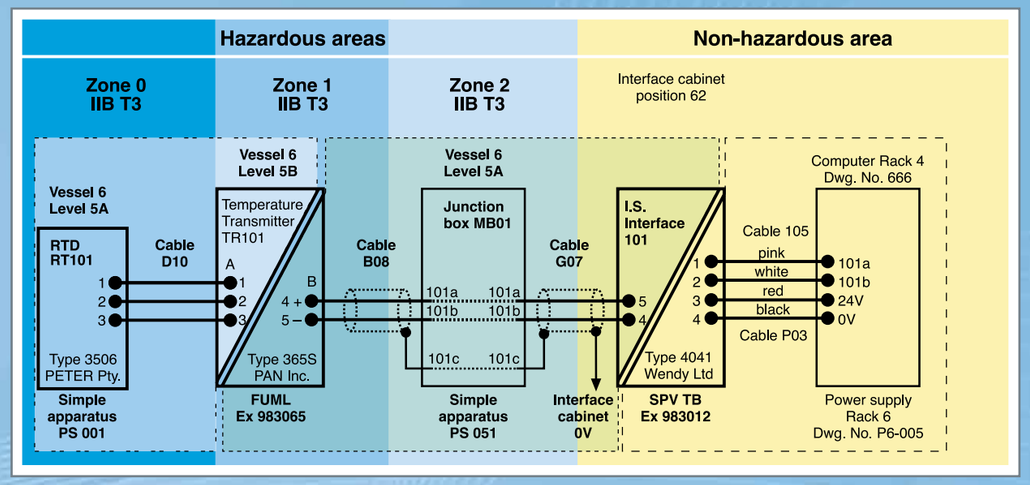


Figure 3.1 - Typical installation drawing for IS system

3.1 General

The long term continued safety of an intrinsically safe system depends on adequate inspection and maintenance. The relevant IEC standard is IEC 60079-17, which deals comprehensively with all methods of protection. Where installations are required to comply with the European 'user' Directive 1999/92/EC a documented inspection procedure becomes a part of the required risk analysis.

Any work on a hazardous plant needs to take into account overall plant safety. Consequently it is necessary to comply with the safety practices of the particular installation (for example work permits), even though the risk of ignition from the intrinsically safe circuits is minimal, and gas clearance certificates are not necessary. In some ways this is even more important in the pre-commissioning stage.

If there are significant changes in the plant operation, which for example modify the area classification then the safety analysis must be reviewed, the documentation modified, and possibly the inspection procedure changed and/or repeated.

The procedure places the onus for ensuring that the equipment used is suitable for its location on the creator of the installation drawing.

The nature of an inspection depends on how well the installation drawing, which changes the system design drawing into a drawing specific to a particular installation, has been carried out.

If the documentation is inadequate then any inspection can only be carried out by someone with detailed knowledge of the plant and exceptional expertise in hazardous area practice. Because such a person rarely exists, this analysis assumes that the documentation is adequate, and uses Figure 3.1 to illustrate the process.

If the person doing an inspection does not understand some aspect of the drawing, or believes it could be wrong, then they should be encouraged to question the document. IEC 60079-17 requires the identification of 'a technical person with executive function' to be responsible for inspection related matters in each installation. This person should be known to the technician doing the inspection, and should be available and able to answer questions.

The installation drawing should take into account what can be checked on the installation. For example, quoting permissible capacitance and inductance for a cable is not useful, because although it is possible to check these parameters, it is not easy to do so. Stating an acceptable type and length is much more useful.

The use of information available from 'intelligent' instruments can considerably reduce the routine inspection considered necessary on an intrinsically safe system. The use of this intelligence to reduce the inspection requirement is recognised in IEC60079-17 clause 5.3.1 but not discussed in detail.

The ability to identify a specific field instrument from the safe area, without having to go and read the label on the instrument, is a significant advantage. Almost all of the digital, "intelligent" instruments (HART, Foundation Fieldbus, etc) enable the serial number of an instrument to be read remotely. The computer record can then be used to confirm that it is the specified instrument, thus ensuring it satisfies all the requirements of the particular installation.

This type of check can be done at frequent intervals without interfering with operational requirements. The inspection of an instrument is then reduced to looking for mechanical damage or excessive corrosion which is comparatively easy and significantly less tedious.

3.1 General - continued

A remote check that the instrument is functioning correctly does not necessarily ensure that it is still safe but it does confirm that it has not been significantly damaged and is probably still safe.

This does imply that any malfunction should be quickly corrected or the defective equipment removed or at least made safe. A frequent check on functionality is a significant factor in further reducing the risk associated with any hazardous area apparatus.

How far this type of automatic inspection can simplify the inspection procedure is a decision for the end-user. But it is arguably a more reliable technique than manual inspection and simplifies the recording of the process. A relatively simple computer system can give ready access to the relevant installation and system drawings, which may be required if further investigation is thought to be necessary.

Some users may consider it desirable to do an occasional thorough spot check as reassurance that the system is functioning but this is a counsel of perfection. These techniques, combined with the availability of certificates and manuals on manufacturers' web sites, can lead to safer installations and a reduction in the bureaucratic load created by safety legislation.

3.2 Initial inspection

An initial inspection to ensure that the installation complies with the installation drawing is critical. Where an adequate drawing such as Figure 3.1 exists, the initial inspection should ensure that the actual installation conforms to the drawing.

Usually this involves checking each individual loop stage by stage, which involves a good deal of opening enclosures and clambering over structures. Where the technician involved is suitably qualified this inspection can be combined with the operational checks. However some organisations separate the two requirements, preferring 'independent' safety inspections.

This separation of functions is not conducive to shortening start up times. Frequently the initial inspection demonstrates the inadequacy of plant labelling, and the opportunity to improve this feature should not be missed.

3.3 Periodic inspections

The objective of periodic inspections is to ensure the system has not appreciably deteriorated and has not been modified in an unauthorised way. The required frequency of periodic inspections is influenced by many factors, such as the immediate environment, the presence of corrosive atmospheres and the susceptibility to mechanical damage. A usual starting point is to consider a three-year cycle, inspecting a third of the apparatus every year. If the inspection shows widespread deterioration then the inspection period should be shortened and remedial action taken.

Establishing that the intended apparatus is still in place is relatively easy providing that the apparatus has a unique identity.

Usually the manufacturers type number is adequate. Much has been written about checking the marking on the labels but except, as an intellectual exercise there is little point. Providing that the inspector is convinced that the apparatus is the intended apparatus then he has fulfilled his function. He should be encouraged to ask questions if he is unhappy about the apparatus or if the circumstances of use have changed but fundamentally it is not reasonable to expect a detailed analysis of every loop.

It is usually worth creating separate drawings of such things as interface cabinets and junction boxes so that they can be readily checked for any sign of unauthorised modification. Similarly preparing short lists of field equipment grouped in a particular area with their essential points of inspection can shorten the time required.

Most modern (smart) instruments can be identified from the safe area computer. It is relatively simple for the computer to check that the field instrument is unchanged and raise a flag if it is changed. This can be done frequently. The periodic inspection for that apparatus is then reduced to checking for deterioration.

There is a strong link between the need for periodic inspections for operational and safety reasons and it is usual to combine the requirements. For example, the short piece of field wiring used for the final connection to the instrument is often prone to mechanical damage and consequently is usually included in the inspection procedure even though its open or short-circuit failure would not create an incendive spark.

The check for mechanical deterioration is usually a quick check for corrosion, impact damage, efficiency of seals, security of mounting and adequacy of cable glands. Some judgement on the need for repair or replacement is required, and the need for operational reliability usually determines the necessary action. There is however no substitute for a well-trained technician with the right attitude.

3.4 Testing of apparatus

Sometimes it is suggested that apparatus should be removed for periodic testing. In practice, if an intrinsically safe loop is functional then it is very unlikely to have failed in a dangerous mode. Components critical to safety are derated, so the probability of external circumstances causing them to fail without causing a malfunction is small.

There is a bigger risk that a mistake could be made during the removal and replacement of the apparatus being tested. The argument for not interfering with a system, which has survived the initial inspection and is still functional, is very powerful.

A particular case sometimes cited is regarding shunt-diode safety barriers. Failure rate statistics can always be questioned, but the undetected failure rate to danger of a barrier (i.e. the shunt diodes not failing to an open circuit condition), can be readily demonstrated to be in better than 10^{-10}/annum. With this probability of failure they should remain untouched forever. If they are removed for any other reason a simple continuity check has some merit.

If a malfunction does occur, there is a risk that safety components could also have been damaged and power to the system should be removed as a precaution.

A repair should be carried out as quickly as possible. Apparatus or wiring which remains damaged or is not in use for a considerable time, should be removed from the hazardous area as it represents an unnecessary risk.

3.5 Testing of earth connections

It is always difficult to balance the traditional methods of testing earth connections with the need to ensure that an unacceptable risk to the plant is not introduced. Injecting significant voltages and currents into ill-defined circuits is not compatible with avoiding unnecessary risks.

In almost all intrinsically safe installations cable screens contribute to system safety and need to be earthed. In some apparatus such as shunt diode safety barriers and apparatus using a particular type of transformer, the earth connection is an important part of the method of protection.

Where surge protection against induced voltages (usually from lightning) is introduced then this introduces a further complication.

The design of the earthing system needs to be done with some care and provision made to enable the system to be tested safely. This is frequently done by providing duplicate leads. The subject is considered in detail in the section on earthing and it is not possible to adequately summarise the process.

If you believe in testing earths by injecting a significant current then think very hard about the possible paths that the current will use to come back to its point of origin. If you are confident that the path is well defined and safe - then there is no point in testing it!

3.6 Testing insulation

Insulation testing is usually carried out using a high voltage (500V or more), which is not compatible with the intrinsic safety concept. (The ignition capable capacitance corresponding to 500V rms in IIC is 160pF. This is the capacitance of approximately 1m of cable).

Where insulation testing is considered essential, it should be carried out using a suitably certified instrument. This instrument will apply a low voltage only (less than 6V) and have a low current capability (less than 10mA). However, bear in mind that it is difficult to ensure that there is no flammable gas at all points along an instrument circuit during the period of test.

If high voltages are applied, care should be taken to ensure that the connected equipment can not be damaged by the testing. For example, it may be necessary to disconnect any surge suppression devices that are connected in the circuit. It will also be necessary to take care to discharge any charge that may have accumulated in the equipment during testing.

Intrinsically safe circuits are usually fully floating or earthed at one point. The reason for this is that if a circuit is earthed at more than one point, the differential potential between the two points will cause an undefined current to flow through an unknown inductance.

On a well-bonded plant the voltages are low and the resultant current may not be incendive, but it is still unknown, could possibly be incendive and is therefore not desirable. Many intrinsically safe circuits that use shunt-diode safety barriers are designed to 'fail-safe' in the presence of an earth fault, and consequently there is no need to test the insulation.

Some circuits, but not many, are provided with earth leakage detection systems and these do not need testing. Fully isolated circuits would require two separate faults to earth points some distance apart before the circuit could possibly be dangerous.

The probability is that two such faults would also create an operational failure and consequently routine insulation testing of these circuits is not considered necessary.

There are a few remaining circuits that are not covered by the above, but the level of voltage and current necessary to cause an earth fault to be incendive (arguably greater than 9V and 100mA) would almost always causes an operational failure. Consequently, routine insulation testing of a functioning circuit on a well-bonded plant is not necessary or desirable.

The overall conclusion is that routine insulation testing of intrinsically safe circuits, which are functional, is not necessary.

The emphasis on 'functioning circuits' does however reinforce the argument for rapid repair of non-functional circuits discussed elsewhere.

Theoretically, just removing the power from a circuit with multiple earth connections does not make it safe if significant differences in plant potential exist. If insulation testing is thought to be desirable for other reasons it should be carried out with care using a suitably approved tester. Where apparatus has to be disconnected during the testing process then special care is required to ensure that the reconnection is correct, since this is an obvious risk. This usually involves at least a functional check.

3.7 Reference to apparatus certificates

Occasionally it will be thought desirable to refer to the certificate of a piece of apparatus. Sometimes a copy is available but the preferred technique is to check on the web for the latest version. Most manufacturers and some certification authorities make their certificates available by this means. For example, MTL certificates are available on the web-site **http://www.mtl-inst.com/support** and IEC Ex certificates are available on the web-site **http://www.iecex.com** The use of the web ensures that the most recent version of the certificate is available and that the certificate is complete.

MTL7700 Series DIN-rail mounted safety barriers.

Design of intrinsically safe systems 4.

4.1 General

Where intrinsically safe apparatus is interconnected by wiring, the safety of each piece of apparatus is affected by the performance of the other pieces of apparatus in the circuit. The safety technique relies on the system being correctly designed and intrinsic safety becomes a system concept. Other methods of protection are also dependent on the system concept to some extent, but it is a fundamental requirement of intrinsic safety.

For example flameproof equipment is only adequately safe when provided with the correct electrical protection and a means of isolation, but this is not generally regarded as being as significant as ensuring that the apparatus within an intrinsically safe system is compatible. There are some pieces of intrinsically safe apparatus, usually portable equipment, that are used in isolation, for example torches and radios. The following analysis of intrinsically safe systems does not apply to these types of apparatus.

In addition, some Fieldbus systems are constructed to the FISCO/FNICO standard IEC 60079-27, which introduces some simplification of the system rules. These requirements are discussed in MTL application note AN9026 but not in this document. This document concentrates on point-to-point wired systems, which are the predominant form of instrumentation.

The relevant IEC system standard is IEC 60079-25, which interacts with the IEC code of practice IEC 60079-14 to provide comprehensive coverage of the subject.

The system designer must accept responsibility for the adequacy of the design and the safety implications of the use of the system in association with hazardous areas. The designer must have an appropriate level of knowledge and training and the analysis should not be done without recognising the importance of getting it right. The analysis of simple systems is relatively easy and can be done by any competent professional engineer.

However some of the more complex systems such as those using a combination of non-linear and linear sources of power require a greater degree of experience and it may be desirable to approach an 'approved certification body' to provide an analysis for such a system.

4.2 Compliance with ATEX Directives and DSEAR

Unless they are considered to be 'simple apparatus' (see section 4.4), individual pieces of equipment are required to comply with the ATEX equipment directive (94/9/EC). However, the majority of intrinsically safe systems combine equipment from one or more suppliers and these systems become an 'installation' and do not need to be certified to the equipment directive. There might, however, be rare occasions when a manufacturer places a complete system on the market, in which case the system will have to comply with the equipment directive.

The installations directive (1999/92/EC), and the DSEAR regulations, require a risk analysis (within their jurisdiction) of any installation that contains one or more hazardous areas and the system documentation becomes an essential part of that analysis. In almost all other parts of the world similar requirements exist either for legal or insurance reasons. Where no such requirements exist there is still the fundamental requirement to operate safely and to be able to demonstrate that all reasonable precautions have been taken. For these reasons the preparation of adequate system documentation is an essential part of the design of an intrinsically safe installation.

The preparation of documentation for a new installation, to satisfy the installations directive and DSEAR, is usually relatively simple as all the equipment will comply with the apparatus directive or be simple apparatus and the necessary data will be readily available. A slightly more complex situation arises when it is thought desirable to incorporate existing equipment, which is not certified to the apparatus directive.

For example, such a situation arises if it becomes necessary to replace a central processor and its related interfaces but not to replace the field devices. In these circumstances, provided the field devices are considered to have an adequate level of safety and their documentation contains the necessary information to enable a system document to be prepared, an acceptable system document can be created.

To be considered as "adequately safe", older equipment must achieve a level of safety of the same order as equipment that has recently acquired documents of conformity to the ATEX apparatus directive. In the particular case of intrinsically safe equipment there has been no fundamental change in the standards, which has thrown into doubt the safety of equipment conforming to any of the CENELEC based standards. Arguably, even equipment conforming to the older SFA 3012 and SFA 3004 standards that were used in the UK is probably adequately safe.

NOTE: There is a problem regarding equipment spares that do not have documents of conformity to the ATEX apparatus directive, as they can no longer be supplied by the original manufacturer for use in association with hazardous areas. Only apparatus already in the possession of the end-user or 'in the supply chain' can be utilised. It seems prudent therefore to take this potential difficulty into account when considering the continued use of older equipment.

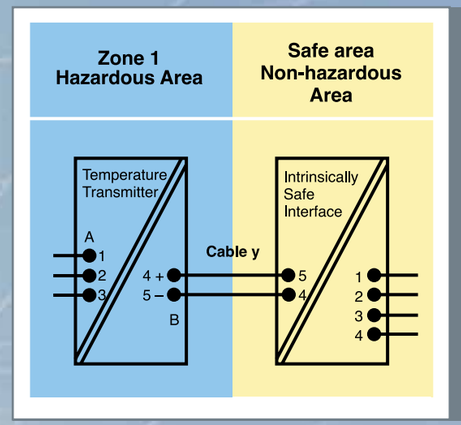
4.3 Simple systems

The majority of intrinsically safe systems are simple systems that contain a single source of power in associated apparatus connected to a single piece of intrinsically safe apparatus out in the field. Such a system is discussed in detail in an appendix of IEC 60079-11.

Here, we use the combination of a temperature transmitter and an intrinsically safe interface, shown in Figure 4.1, to illustrate the technique.

The first step is to obtain the safety data of the two pieces of apparatus in the circuit. This data is best derived from a copy of the certificate, which should be available to the system designer. In particular, any special conditions of use should be taken into account in the system design. The information placed on the system drawing should be the result of a clearly justifiable analysis making it relatively simple to create the installation drawing from this reference drawing.

NOTE:
Copies of MTL Certificates are available from web site:
http://www.mtl-inst.com/support
Copies of IEC Ex Certificates are available from web site:
http://www.iecex.com



- Classification ia IIC
- Cable parameters 80 nF, 3.0 mH, 55 µH/Ω isolated

Temperature Transmitter
Type: 365S (example)
Pan Inc., Boston, USA
Ex ia IIC T4 by FUML No. 983065
T_{amb} = –40°Cto +80°C

'B' Terminals
Ui: 30 V
Ii: 120 mA
Pi: 1 W
Ci: 3 nF
Li: 10 mH

Type MTL5541 - data
MTL Ltd, Luton, UK
[EEx ia] IIC by EECS
No. BASeefa07ATEX010123
T_{amb} = –20°C to +60°C

Safety Parameters	IIC Parameters
Um: 250 V	Co: 83nF
Uo: 28V	Lo: 4.2mH
Io: 93mA	Lo/Ro: 56µH/Ω
Po: 651mW	

Notes:
a) If cable 'y' becomes part of a multicore, then this multicore cable must be a Type 'A' or 'B', as specified in IEC 60079-14.
b) Cable 'y' has capacitive limitation 80 nF in IIC; 647 nF in IIB

Figure 4.1 - Simple system of interface and transmitter

The compatibility of two pieces of apparatus should be established by comparing the data of each apparatus. The sequence is usually as follows.

a) Compare the levels of protection. If they differ then the system takes the least sensitive level. For example if one device is 'ia' and the other 'ib' then the system becomes 'ib'.
A source of power that is certified 'ib' will have permitted output parameters for use in 'ic' circuits. If these higher values are used in the system design then the system becomes 'ic'.

b) Compare gas classifications. If they differ then the system takes the least sensitive classification. For example if one device is IIC and the other IIB then the system becomes IIB.
It is usual for a source of power certified as IIC to have permissible output parameters (Lo, Co and Lo/Ro) for IIB and IIA gas groups. If these larger values are used then the parameters used determine the system gas group.

c) Determine the temperature classification of the field mounted equipment. Apparatus may have different temperature classifications for different conditions of use (usually ambient temperature) and the relevant one should be selected and recorded. It should be noted that it is the apparatus that gets temperature classified not the system.

d) The permissible ambient temperature range of each piece of apparatus should be recorded.

e) The voltage (Uo), current (Io) and power (Po) output parameters of the source of power should be compared with the input parameters (Ui, Ii and Pi) of the field device and the output parameters should not exceed the relevant input parameters. Occasionally the safety of the field device is completely specified by only one of these parameters (usually Ui). In these circumstances the unspecified parameters are not relevant.

f) Determine the permitted cable parameters.
The permitted cable capacitance (Cc) is derived by subtracting the input capacitance of the field device (Ci) from the permitted output capacitance of the source of power (Co), that is Cc = Co – Ci. The permitted cable inductance (Lc) is derived by subtracting the input inductance of the field device (Li) from the permitted output inductance of the source of power (Lo), that is Lc = Lo – Li.
Determining the permitted L/R ratio of the cable (Lc/Rc) is very easy if the input inductance of the field device is negligible, i.e. if Li less than 1% of Lo. In this case, Lc/Rc is considered equal to Lo/Ro. However, if the inductance of the field device is more significant then the equation included in IEC 60072-26 can be used to calculate the permitted Lc /Rc. Fortunately this is not a frequently occurring requirement.
Recently there has been increasing concern about the interaction of system inductance and capacitance increasing the risk of ignition capable sparks.

"The safety technique relies on the system being correctly designed and intrinsic safety becomes a system concept"

COOPER Crouse-Hinds

Sequence step	Parameter	Interface	Temperature transmitter	System
a)	Level of protection	ia	ia	ia
b)	Gas group	IIC	IIC	IIC
c)	Temperature classification	T4		
d)	Ambient temperature	- 20°C to +60°C	- 40°C to +80°C	
e)	Parameter comparison			
	Voltage	Uo: 28V	Ui: 30V	
	Current	Io: 93mA	Ii: 120mA	
	Power	Po: 650mW	Pi: 1W	
f)	Cable parameters			
	Capacitance	Co: 83nF	Ci: 3nF	Cc: 80nF
	Inductance	Lo: 3.05mH	Li: 10µH	Lc: 3mH
	L/R ratio	Lo/Ro: 55µH/Ω	Lc/Rc: 55µH/Ω	
g)	Isolation	isolated	isolated	isolated

Table 4.1 Simple system analysis

4.3 Simple systems - continued

This concern is confined to fixed inductance and capacitance and not to the distributed parameters of a cable. Consequently on those rare occasions when BOTH the lumped inductance (the sum of Li of the source of power and the field device) and the lumped capacitance (the sum of Ci of the source of power and the field device) are greater than 1% of the respective output parameters of the source of power Lo and Co then the permissible output parameters are both to be divided by two.

It should be stressed that this reduction in output parameters is only applicable on very rare occasions since it is unusual for field devices to have BOTH inductive and capacitive input parameters which are significantly large.

Frequently the Li and Ci of a source of power are not quoted in the documentation and in these circumstances it can be assumed that they are negligible. There is no suggestion that it is considered necessary to go back and check the safety documentation on existing installations for this most recent requirement. However new analyses should take this remote possibility into account.

To summarise, check that either the lumped capacitance or inductance is less than 1% of the respective output parameters. If it is, then the original calculation is valid. If BOTH parameters are greater than 1% of the output parameters then Co and Lo of the system should be reduced by a factor of two. If this reduction seems to be necessary then go back and check the information used, as this is an unusual situation.

Where a source of power is certified 'ia' or 'ib', the permitted output parameters Lo, Co and Lo/Ro are derived using a factor of safety of 1,5. When such a source of power is used in an 'ic' circuit then the permitted output parameters may be derived using a unity safety factor. This results in a significant change, which usually removes the necessity to consider cable parameters in detail. Accurate values can be ascertained using the methods and tables in the apparatus standard. An acceptable conservative technique is to multiply the Lo and Lo/Ro by two and the Co by three, which normally removes any concern about cable parameters.

g) Check that the level of insulation from earth is acceptable, or that the system earthing requirements are satisfied.

If these criteria are all satisfied the compatibility of the two pieces of apparatus will have been established. A convenient way of recording the analysis is to create a table. Table 4.1 is an example that uses values from the typical system drawing (see Figure 4.1) and compares the intrinsically safe interface and the temperature transmitter.

4.4 The use of simple apparatus in systems

The apparatus standard (IEC 60079-11) distinguishes between complex apparatus, which normally requires some form of certification and 'simple apparatus' which is not required to be certified. This distinction is intended to permit the use of apparatus that does not significantly affect the intrinsic safety of a system, without the need for 'third party' certification.

There is an implication that it is possible to demonstrate that simple apparatus is obviously safe without recourse to the detail application of the remainder of the standard. For example, if any current or voltage limiting components are necessary then the apparatus is not considered to be simple. In practice it is relatively easy to decide which components are simple apparatus at the system design stage. If the decision is not easy then the apparatus is not simple.

NOTE: Although it is not considered essential that simple apparatus is certified by a third party, it is not unusual for simple apparatus that is used in significant quantities to be certified.

This is reassuring to the end user and is a significant marketing advantage. In these circumstances the apparatus is marked as required by the apparatus standard, but can be used in the same way as other simple apparatus.

The apparatus standard imposes limits of 1.5V, 100mA and 25mW on the values generated by simple apparatus, and it is accepted that simple apparatus can be added to an intrinsically safe system without the need to recalculate the safety of the system. It must be understood however, that any limitations on simple apparatus apply to the combination of all the pieces of simple apparatus in a system. For example, the use of one or two thermocouples in a system is permitted but a combination of a large number used in a single, average temperature circuit might not meet this criterion.

The standard also allows capacitive and inductive components to be used in simple apparatus, provided that these components are included in the system evaluation. It is not usual to include inductors or capacitors of significant size, but the simple apparatus concept does permit the use of small radio-frequency (r.f.) decoupling components without undertaking a further analysis of the system. A useful rule-of-thumb is to ensure that the total capacitance and inductance added to the system is less than 1% of the respective output parameters of the source of power, in which case, their effect can be ignored. If BOTH the added capacitance and inductance, together with any other 'lumped' capacitance in the circuit are greater than 1% of the specified output parameters of the source of power then the permitted output parameters must be halved, as explained in Section 4.3. This is another very good reason for ensuring that the 'energy storing' components in simple apparatus are kept small.

It is also necessary to temperature classify simple apparatus when it is intended for hazardous area. The apparatus standard allows a T6 temperature classification for switches, plugs, sockets and terminals used within their normal rating at an ambient temperature of not greater than 40°C.

In practice, it is not easy to design a system that can be used with gases requiring a T6 (85°C) temperature classification and a T4 (135°C) classification is normally the level achieved. In reality, the only gas listed in the available documentation requiring a T6 temperature classification is carbon disulfide (CS_2). Fortunately, the use of this gas in industry is becoming rare because of its toxicity. A T4 temperature classification is therefore adequate normally and a claim of T6 is predominantly a marketing ploy rather than a requirement.

The temperature classification of other pieces of apparatus (with a surface area not less than 20mm^2) normally relies on the input power being no greater than 1,3W when the maximum ambient temperature required is 40°C. The corresponding powers for higher ambient temperatures are 1,2W at 60°C and 1W at 80°C. If this rule is not applicable then the possible maximum surface temperature has to be measured or assessed. If for any reason it is not obvious that the maximum surface temperature is considerably lower than 135°C (say 100°C) then the apparatus is probably not simple.

Simple apparatus is usually isolated from earth. However, the apparatus standard requires a 500V insulation test and if the simple apparatus cannot meet this then it introduces an earth on to the system and the system design must take this into account.

A typical example of simple apparatus is the resistance thermometer (RTD) shown as the sensor in the typical system drawing.

The RTD is a temperature sensitive resistor. It has negligible inductance (less than 4µH) because it is bifilar wound and negligible capacitance (less than 10pF). The matched power from the transmitter terminals is 2,5mW, which is considerably less than the 25mW considered negligible for simple apparatus.

This low level of power ensures that the temperature classification of the RTD is determined by the temperature being measured. (A T6 temperature sensor measuring 450°C is a common advertising phenomenon.) The RTD does not meet the required 500V insulation test and consequently this sub-cicuit is considered to be earthed at this point. The installation is satisfactory because of the isolation in the temperature transmitter.

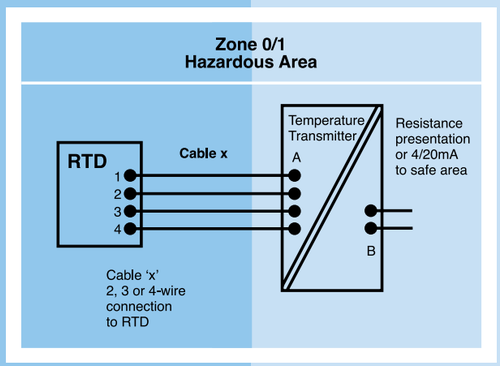
The ignition energy of a gas decreases at elevated temperatures and consequently the very low fault voltage and power available to the RTD is a beneficial factor in ensuring the safety of any measurement of high temperatures.

- Classification ia IIC
- Cable parameters 1000µF, 350mH
- Earthed at RTD

Note: 'T' class determined by maximum measured temperature.

RTD Type: 350L (example)
Peter Pty, Sydney, Australia
Simple Apparatus to IEC 60079-11
Passive component to subclause 5.4a)

Type: PS061
Maximum operating temperature 450°C
Temperature classification determined by maximum measured temperature.



Temperature Transmitter Type: 365S (example)
Pan Inc., Boston, USA
Ex ia IIC T4 by FUML No. 983065
Ambient temperature –40°C to +80°C

Terminals 'A'
Uo: 1.0 V
Io: 10 mA
Po: 2.5 mW
Co: 1000µF
Lo: 350 mH

Note: If cable 'x' becomes part of a multicore, then this multicore cable must be a Type 'A' or 'B', as specified in IEC 60079-14.

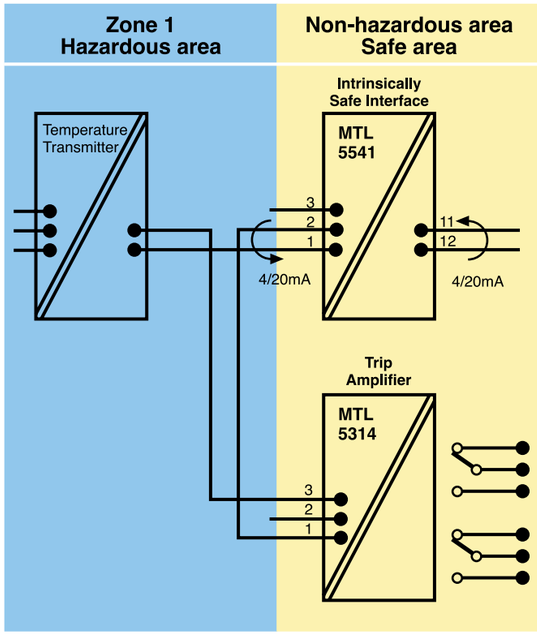
Figure 4.2 - RTD and transmitter sub-system

4.5 The use of apparatus with ‘simple apparatus’ input description

The other common use for the simple apparatus clause is to permit the use of certified apparatus with input parameters equivalent to simple apparatus, to be added to an existing intrinsically safe circuit with only a minor change in the documentation. The most frequent uses of this technique are for test equipment, indicators and trip amplifiers.

A typical example of this type of application is the MTL 5314 trip amplifier which is frequently used to monitor the 4-20 mA signals from a transmitter as illustrated in Figure 4.3. The input terminals satisfy the requirements of simple apparatus and hence the insertion of this apparatus does not require that the safety analysis of the existing system is modified. The presence of the trip amplifier and the fact that it is regarded as simple apparatus is all that needs to be recorded.

Where more than one piece of apparatus with simple apparatus output characteristics is included in a circuit then care should be taken to ensure that the permitted simple apparatus parameters are not exceeded. Advantage can sometimes be taken of the fact that the output voltage only appears under fault conditions and that it is permitted to apply the fault count to the system as a whole. For example if more than one piece of simple apparatus is connected in the circuit, then it can be argued that only one piece of apparatus is considered to fail at any one time, and hence only the most adverse set of output parameters needs to be considered. This type of argument is acceptable in ‘ib’ systems but needs to be carefully documented. For such an argument to be valid for ‘ia’ systems detailed knowledge of the derivation of the output parameters is required. This information is not usually readily available and hence the technique is not normally applicable to ‘ia’ systems. If it is known that the apparatus terminals are purely resistive in normal operation (as is frequently the case) then any number of these devices can be incorporated in an ‘ic’ system.



Simple Apparatus, Intrinsically Safe interface, Trip Amplifier MTL5314.

The Trip Amplifier connects in series with the 4/20 mA transmitter circuit, giving alarm signals to the safe area via changeover relays.

Using the Simple Apparatus (Non-energy Storing) rule the device may be connected in series with the hazardous side of the MTL5541.

Certification & Safety Parameters

Terminals 1 and 3 meet the Simple Apparatus rules having output parameters:

Uo: 1.0V, Io: 88mA, Po: 22mW
Certified [EEx ia] IIC by EECS
No. BAS 98 ATEX 7136
Tamb –20°C to +60°C
Um: 250 V

Figure 4.3 MTL5314 used as monitor

5. Maintenance and Repair of Intrinsically Safe equipment

5.1 General

The ability to do live maintenance on an intrinsically safe system is a major benefit of the technique. It is difficult to test an instrument system with the power removed, and difficult to obtain a meaningful ‘gas clearance certificate’ that covers the whole of the area affected by a system. Consequently live working is very desirable. There are however factors, other than gas ignition, that have to be considered whenever an instrument system is taken out of commission and consequently local safety practices such as ‘permits to work’ have still to be observed.

5.2 Permitted practices on the plant

The design of intrinsically safe apparatus and systems ensures that the short circuit and open circuit of field wiring cannot cause ignition of a gas atmosphere. The concept of live maintenance uses this feature but does not extend to carrying out detailed repairs; for example, repairing printed circuit boards within the hazardous areas. In practice, the permissible actions are restricted by the available tools hence deciding what is permissible is not difficult. IEC 60079-17 restricts live ‘working’ to:

i) disconnection of, and removal or replacement of electrical apparatus and cabling

ii) adjustment of any controls which is necessary for the calibration of the electrical apparatus or system

iii) removal and replacement of any plug in components or assemblies

iv) use of any test instruments specified in the relevant documentation. Where test instruments are not specified in the relevant documentation, only those instruments, which do not affect the intrinsic safety of the circuit, may be used

v) any other maintenance activity specifically permitted by the “relevant documentation”

These requirements are in line with the normal practice of maintenance on field mounted equipment and hence create no problem. Work on associated safe area apparatus, such as the intrinsically safe interface is restricted in the same way, except that there is greater freedom to operate on the safe area terminals.

Recently developed interfaces tend to operate from 24V supplies and there is no risk of electrocution. However it is not unusual for interfaces with relay outputs to be switching higher voltages, which may create a significant shock risk. Where this risk occurs, adequate warning labels are required and the relevant precautions should be taken during the maintenance process.

There is no risk of a significant electric shock being received by a technician working on an intrinsically safe circuit. There is a hypothetical possibility but in practice this is not a real problem actions are permitted, they are frequently embodied in the apparatus certificate and manufacturer’s instruction. This information should be made available to the relevant technician on the work sheet, as he is not likely to have ready access to the certificate and/or instructions. The apparatus marking would carry the ubiquitous ‘X’ marking but this is almost universally applied and consequently largely ignored.

5.3 Permitted practice in the workshop

The repair and testing of intrinsically safe and associated apparatus should only be carried out in favourable conditions and by adequately trained technicians. The IEC standard IEC 60079-19 provides some guidance on the approach to repair of intrinsically safe equipment.

There are always practical and economic limitations on what is practicable. For example, shunt diode safety barriers are invariably encapsulated and not repairable. Isolating interfaces are usually in boxes that are difficult to open, coated in varnish and impossible to test in detail without specialist test equipment and knowledge of the circuit. In general replacement by an identical unit is preferred for both economic and safety reasons.

Some repairs can be carried out without affecting the safety of equipment and, usually, it is obvious what limitations apply. For example, damage to enclosures does not usually directly affect the intrinsic safety of apparatus and consequently a repair which restores the enclosure to its original level of integrity (IP rating) is acceptable. The repair of printed circuit boards is sometimes considered but is usually impracticable. Removing components without damaging the board is difficult, repairing the coating on reassembly is messy and maintaining the original creepage and clearance distances may not be possible. A recent further complication is that if lead free solder has been used, the use of solder containing lead usually results in unsatisfactory joints.

A record of any repairs should be maintained. The use of before and after photographs (stored digitally) frequently simplifies the process.

5.4 Testing of IS apparatus using non-certified test apparatus

There are two circumstances under which non-certified test apparatus is used to test intrinsically safe and associated apparatus and systems. One is where apparatus is tested in the safe area, usually disconnected from the IS system, and, less frequently, when apparatus and the system is tested in the hazardous area using a gas clearance certificate.

It is sometimes questioned whether connecting non-certified apparatus during such procedures can result in the intrinsic safety of the apparatus or system being impaired by damage to the safety components. In the past, testing has not required any special precautions to be taken to avoid this possibility. The current standard on inspection and maintenance IEC 60079-17 does not address this question, consequently the following is only a considered opinion and should be regarded as such.

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5.4 Testing of IS apparatus using non-certified test apparatus - continued

A relevant point is that during the manufacturing of intrinsically safe products, the equipment used for both operational and safety testing relies on good engineering practice and regular inspection to achieve adequate safety. It is not subject to third party certification or any similar constraints. The apparatus design standards address some of the more obvious risks, such as the charging of batteries, but do not make any other recommendations to cover less frequently used facilities.

The factors, which justify the use of conventional test equipment when working on intrinsically safe apparatus, are:

a) Repair and maintenance should only be carried out by 'skilled personnel'. Such personnel should be adequately trained to recognise whether a mistake could have caused damage, which might lead to a dangerous situation, and be capable of taking any necessary corrective action.

b) Test equipment should be checked to ensure that it is operational before connecting it to the apparatus. Particular care should be taken to ensure that any variable controls, such as output voltage and current limits on power supplies, are set to the correct values before making the interconnection. The test equipment should be checked at the end of the test. Since the test equipment is only connected for a short time the probability of it failing in a way that can cause a potentially hazardous fault in that time is acceptably low.

c) The apparatus should be functioning correctly and be free of mechanical damage at the end of the test or re-calibration. It is possible that a safety component failure will not affect operational capability but usually an operational failure will also occur.

d) The more complex operations such as re-programming and downloading of apparatus memories are normally done using test rigs with specific plugs and sockets and hence the probability of incorrect connection is reduced.

e) Test equipment that satisfies the personnel safety requirements of IEC 61010, is not likely to produce currents or voltages, which will damage safety components. For example a functioning oscilloscope with high impedance probes is extremely unlikely to cause a problem.

There are some operations which do require special care, of which the most obvious is high voltage insulation testing. This should only be done when a special work instruction is available.

In practice such tests are best avoided and if an insulation test is thought to be necessary it should be done at a low voltage. It is generally accepted that the testing, calibration and programming of intrinsically safe apparatus in a safe area, or under gas clearance conditions by a competent person using conventional high quality test equipment does not invalidate its intrinsic safety certification.

5.5 Re-use of intrinsically safe field devices

The question is sometimes raised as to whether intrinsically safe apparatus which has been used in circuits which are not intrinsically safe, such as non-incendive or safe area circuits can subsequently be used in intrinsically safe circuits. The perceived problem is that use in the non-intrinsically safe circuits could cause damage, which is not self-revealing but would reduce the level of protection offered by the original certification. The relevant IEC standards do not give any guidance on this topic and hence the following text is only a considered opinion, which may not be universally accepted.

The question normally arises because it is common practice on most petrochemical installations to purchase a single type of instrument, for example a pressure transmitter, for use in all locations on a plant. An intrinsically safe transmitter can then be used on a temporary installation in a safe area in a conventional safe area loop, and after some time be returned to the store as a spare instrument. From the store it could be used to replace a defective instrument in an intrinsically safe loop.

It can be assumed that the replacing instrument is functional, and not mechanically damaged (the majority of instrument technicians would check this in the workshop before putting the instrument in the stores as a spare) and therefore the concern is that there is some fault which reduces the safety integrity but does not affect the operation of the instrument. Almost all faults from an external source would cause sufficient damage to the apparatus for it to malfunction, rather than cause the conservatively rated safety components to fail to danger without damaging any other components. This type of undetected failure is just possible but is sufficiently improbable to be ignored. In the particular case of a non-incendive installation then the selection of apparatus, and the installation code followed further reduce the probability of the IS apparatus being stressed.

There are a number of circumstances where a very similar risk occurs, and the risk is considered acceptable. A very clear example is that the IEC standard on inspection and maintenance (IEC 60079-17), permits the use of non-certified test equipment under 'gas clearance certificate' conditions. Similar risks are accepted during fault-finding procedures in instrument workshops. There are also significant risks of such faults occurring during the repair proedures permitted by the same standard on repairing this type of apparatus. The test equipment used in the final stages of manufacturing of IS equipment is not designed to be fault tolerant and could produce undetected faults. These risks illustrate the point that where a risk is small it can be, and is, accepted.

With the recent introduction of the 'ic' concept, this question becomes more relevant to intrinsically safe circuits; for example, the use of an 'ia' certified transmitter in an 'ia' system after it has been used in an 'ic' system may be questioned. The question of the transfer of apparatus from an 'ib' system to an 'ia' system has never been raised as far as is known.

The conclusion is therefore that the safety status of a field device is not changed provided that the device is both functioning correctly and not mechanically damaged after being used in any type of circuit. If these two requirements are met, the field device can be used in an intrinsically safe circuit without further consideration.

MTL4850 HART® Multiplexer.

6. Intrinsic Safety and Dust

6.1 General

A number of finely divided materials can be ignited to create an explosion when they form a cloud in air. Almost all organic and food product dusts together with metallic dust can readily be ignited. Dust explosions are generally more difficult to initiate than gas/air explosions but can be devastating. The initial explosion frequently disturbs and entrains layered dust to create one or more secondary explosions, thus creating a rolling explosion and extensive damage.

Dust explosions can be initiated by electrical sparks or by hot surfaces. There are numerous factors, which influence ignition energy and temperature of a particular material. For example the air to particle ratio, the particle size, humidity, and the melting temperature of the material.

Note: For those requiring a comprehensive reference 'Dust explosions in the process industries' by Rolf. K. Eckhoff published by Butterworth Heinemann. ISBN 0 7506 3270 4 is recommended.

The ignition energy of a dust/air mixture is high compared with that of a gas/air mixture. For example, some sensitive materials such as rubber, sulfur and fine wood dust require 1 to 10 mJ while less sensitive materials, such as coffee, require more than 500 mJ.

There is some concern that some very finely divided particles, for example those associated with nano-technology, may have even lower ignition energies. Consequently, the decision has been made to use the IIB gas as the test mixture (ignition energy 80µJ) for intrinsically safe apparatus for use in dust atmospheres. This is a very conservative decision but presents very little operational difficulty. The current state of knowledge on the spark ignition characteristics of dusts and the difficulty of creating a satisfactory test apparatus for dust atmospheres justifies a cautious prudent decision.

The major problem in dust atmospheres is the possibility of thermal ignition. There are two common mechanisms, one is the ignition of a dust cloud by a hot body and the other is the creation of smouldering in a layer of dust on a hot surface.

The minimum ignition temperature of the majority of dusts lies between 300°C and 600°C. Some dusts do ignite at lower temperatures, for example finely divided sulfur has a minimum ignition temperature of 240°C. It is quite difficult to generate these temperatures in a dust cloud with the power levels permitted by a IIB gas classification and hence the probability of ignition of a dust cloud by intrinsically safe apparatus is quite low and not the major problem.

The principal difficulty is the possibility of causing smouldering within a dust layer, which when disturbed bursts into flames and initiates an explosion. The mechanism of causing smouldering is complex but can be simplified into keeping the dust below its 'glow temperature'. The majority of materials have a glow temperature, ranging from 250°C to 500°C, that is lower than the minimum ignition temperature of the corresponding dust cloud.

There are also some flammable dust layers that have the fortunate characteristic of melting before attaining their theoretical glow temperature and consequently they do not create this ignition risk (for example polystyrene).

6.2 Intrinsically safe apparatus and dusts

Intrinsically safe apparatus certified for use in hazardous gas atmospheres has been used to ensure safety in dust atmospheres for many years. Currently a great deal of activity is taking place to formalise the requirements for apparatus specifically for use in dusts. An apparatus standard IEC 61241-11 is now published. The ultimate intention is to amalgamate the dust and gas requirements within the relevant IEC standards but this will take a number of years (five?). Eventually there will be three levels of protection 'iaD', 'ibD', and 'icD' corresponding to the equivalent gas levels of protection (see Table 6.1). The intention is that 'iaD' equipment will achieve the 'very high' level of protection required by equipment designated as 'EPL Da' (where EPL means 'Equipment Protection Level' as defined in IEC60079-0). 'ibD' with a 'high' level of protection will achieve an 'EPL Db' and 'icD' with an 'enhanced' level of protection will be 'EPL Dc'.

Level of protection	Countable faults	Level of risk	Equipment Protection Level - EPL	ATEX category	Normal zone of use
iaD	2	very high	Da	1	20
ibD	1	high	Db	2	21
icD	0	considerable	Dc	3	22

Table 6.1 - Comparison of different levels of risk

6.2 Intrinsically safe apparatus and dusts - continued

The risk of spark ignition is avoided by satisfying the requirements for apparatus intended for use in IIB gases To avoid the risk of thermal ignition the preferred technique for apparatus, which is intended to be located in the hazardous area, is to exclude the dust by using an IP 6X enclosure or by encapsulation. This involves determining a maximum temperature rise of the exposed surface, which in the case of most intrinsically safe apparatus will be very small.

The preference for a dust tight enclosure is because the 'dust fraternity' has implicit faith in this technique. It can be argued that the restriction of the available power is a more reliable technique as it is less prone to maintenance errors.

There is an exemption to the enclosure rule for apparatus that is difficult to operate inside an enclosure, such as some sensors. In these circumstances the power level is restricted to avoid the possibility of temperature ignition (750mW at 400°C), In practice all intrinsically safe associated apparatus such as barriers and isolated interfaces, which are IIC or IIB certified for gases are suitable for use in intrinsically safe systems. It is has been common practice for several years for interfaces to be certified for both gas and dust applications. For example, the current MTL range of barriers (MTL7700) and isolators (MTL4500/5500) are certified for both gas and dust applications in accordance with the requirements of the ATEX Directive and FM standards. The design of intrinsically safe apparatus for use in dusts is the subject matter of Part 11 of IEC 61241

6.3 Risk analysis

Analysing the risk associated with a flammable dust differs from the analysis of a gas risk largely because dust does not disperse in the same way as a gas, it has to be removed.

A decision was made some years ago to only area classify dust clouds and to treat the possibility of a smouldering dust layer as a source of ignition. (a decision largely influenced by the ATEX Directives).

The area classification of dust clouds follows the pattern of gas clouds. Zone 20 corresponds to Zone 0 (where the hazard is present continuously or for long periods) Zone 21 to Zone1 and Zone 22 to Zone 2 as the probability of the dust cloud being present reduces.

Area classification of dusts is the subject matter of Part 10 of IEC 61241. If the combination of area classification and sources of ignition is pursued too diligently this can create some tortuous thinking. Fortunately, the application of a little pragmatic common sense solves most instrumentation problems.

For example, if a temperature sensor is buried in a mound of grain for a considerable length of time, then it is reasonable to use a level of protection 'iaD' since deciding the area classification is difficult and if the grain is smouldering it will probably burst into flame when disturbed and could possibly explode. As it is not expensive to make the system 'iaD', this becomes the obvious solution. However if a temperature monitor is measuring temperature in a location where it is infrequently covered by dust and can be readily and frequently cleaned then a level of protection 'icD' is adequate. It might still be expedient to use 'iaD' equipment but it is not essential to do so.

6.4 Why use intrinsic safety?

The principal reason for using intrinsic safety is because it is essentially a low power technique. Consequently, the risk of ignition is minimised, and adequate safety can be achieved with a level of confidence that is not always achieved by other techniques.

It is difficult to assess the temperature rise, which can occur if equipment is immersed in a dust because of the many (frequently unpredictable) factors, which determine the temperature rise within the dust layer. The safest technique is therefore to restrict the available power to the lowest practical level. A major factor in favour of intrinsic safety is that the power level under fault conditions is controlled by the system design and does not rely on the less well-specified limitation of fault power.

Intrinsic safety also has the advantage that the possibility of ignition from immersed or damaged wiring is minimised. It is desirable to be able to do 'live maintenance' on an instrument system, and the use of the intrinsically safe technique permits this without the necessity of special 'dust free' certificates. There is a need to clear layers of dust carefully and to avoid contamination of the interior of apparatus during maintenance but this is apparent to any trained technician. (There is no significant possibility of a person, in a dust cloud that can be ignited, surviving without breathing apparatus).

To summarise, intrinsic safety is the preferred technique for instrumentation where dust is the hazard because:

- the inherent safety of intrinsic safety gives the greatest assurance of safety and removes concern over overheating of equipment and cables
- the installation rules are clearly specified and the system design ensures that all safety aspects are covered
- live maintenance is permitted
- equipment is available to solve the majority of problems

The principal reason for using intrinsic safety
is because it is essentially a low power technique,
consequently the risk of ignition is minimised.

COOPER Crouse-Hinds

Intrinsic Safety Interfacing

MTL provides two simple means of connecting instrument loops into hazardous areas of process plant using zener barriers or isolators.

- Zener Barriers - industry standards for more than 30 years.

Our range of shunt-diode safety barriers are the simplest type of IS interface for protecting electrical circuits in hazardous areas. The compact and inexpensive units are mounted and earthed in one operation, ensuring the safest possible installation with ultra-high reliability.

- Intrinsically safe isolating interfaces for every application

MTL isolating interfaces are alternatives to shunt-diode safety barriers for protecting electrical circuits in hazardous areas. They need no high-integrity earth and provide extra features such as signal amplification and relay functions. The isolation of hazardous- and safe-area circuits allows each to be earthed at any convenient point, simplifying installation and avoiding earth-loop problems.

MTL offers the best choice in DIN-rail and backplane mounting isolators to meet the requirements of modern control interfacing systems. The DIN-rail mounting isolator ranges provide a wide choice of functions with high accuracy and reliability, while the backplane mounting products are established as the leading IS system interface with solutions for all the major DCS companies.

The MTL4500 Series is the latest generation of backplane mounting products, building upon the heritage of MTL4000 and introducing many key application benefits. The MTL5500 Series launches a new industry standard for DIN rail mounting products, ideally suited to a wide variety of interface tasks for process instrumentation, complemented by the well proven MTL5000 Series.

Intrinsic safety	International	IECEx	IEC60079-0 IEC60079-11 IEC61241-11
	Europe	ATEX (Baseefa)	EN60079-0 EN60079-11 EN61241-11
	N.America	FM FM (Canada) CSA	FM3600, 3610, 3810 C22.2 No.157
Zone2, Div2 mount		ATEX Cat3 FM FM (Canada) CSA	EN60079-15 FM3611 CAN/CSA E60079-15 C22.2 No.213
Functional safety		Baseefa MTL	IEC61508

In most applications MTL4500 modules can directly replace MTL4000 models but check with MTL if you have any concerns. Similarly, MTL5500 supplants MTL5000 Series as the DIN rail interface family of choice. With this mounting arrangement, it is practical for models from both families to be used alongside each other during the transition phase from the old range to the new.

Visit the MTL web site, **www.mtl-inst.com**, where you will find the latest version of any of the material given here together with relevant certification details and application information.

Intrinsic safety (IS) isolators for hazardous area interfacing

MTL4500/MTL5500 SERIES

- **3-port isolation as standard**
- **Highest module/channel packing densities**
- **Low power dissipation**
- **Quick install and release mechanism**
- **Multi-channel I/O modules**
- **Broken line and earth-fault protection**
- **Compatible with preceding MTL isolator series for pluggable replacements**

MTL's latest generation of IS interfaces utilises an innovative "One-Core" technology to ensure the highest quality and availability while maintaining maximum flexibility at lowest cost. Incorporating advanced circuit design, a common set of components and innovative isolating transformer construction, they achieve a significant reduction in power consumption while increasing channel packing densities. The compact, 16mm wide design reduces weight and gives exceptionally high packing density. They build on the proven success of the MTL2000, 3000, 4000 and 5000 Series to bring the benefits of new developments in galvanic isolation without compromising the reliability of the designs from which they have evolved.

The backplane mounting MTL4500 Series is designed with system vendors in mind for "project-focussed" applications such as Distributed Control System (DCS), Emergency Shutdown Systems (ESD) and Fire and Gas monitoring (F&G).

The reduced power consumption and high efficiency enable high signal density to be achieved together with improved freedom in cabinet layout and design. Easy integration with the input/output assemblies of control or safety instrumentation systems not only simplifies project engineering but also reduces installation and maintenance costs.

A multiway connector to the backplane provides safe-area and power supply connections, while hazardous-area connections plug into the front of the module, simplifing installation and maintenance and reducing time, cost, and the risk of errors.

The DIN-rail mounting MTL5500 Series meets the needs of the IS interface market for "application focussed" projects, ranging from single instrument loops, through to fully equipped cabinets, across all industries where hazardous areas exist.

The MTL5500 clips quickly onto DIN rail, so it is compatible with the industry-standard mounting system. Wiring is simplified by plug-in safe- and hazardous-area connectors, and a power plug which accepts a power bus; it all leads to quicker insertion, fewer wiring errors and trouble-free, tidier installations.

Line fault detection (LFD) facilities are provided across the range of I/O functions; on the switch/proximity detectors, the MTL4523/5523 solenoid/alarm drivers and the isolating drivers. Analogue input units such as the MTL4541/5541 provide line fault detection by repeating o/c or s/c currents to the safe-area control system.

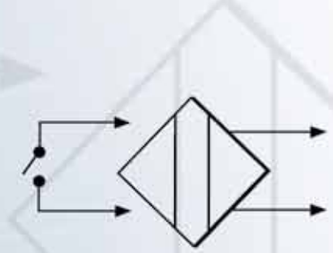
Status LEDs, configuration switches and ports are located on the top or side of individual modules, as appropriate, for easy access.

Both new series have been designed for compatiblity with earlier models. The MTL4500 series provides plug-replacements for earlier MTL4000 series units, while the MTL5500 models can easily replace MTL5000 series units. Each offer the latest in modern technology and efficiency without compromise.

COOPER Crouse-Hinds

ISOLATOR FUNCTION SELECTOR

Backplane MTL4500	*DIN-rail MTL5500*	*Channels*	*Function*
Digital Input			
MTL4501-SR	MTL5501-SR	1	fail-safe solid-state output + LFD alarm
MTL4504	–	1	switch/prox input, phase reversal + LFD
MTL4510	MTL5510	4	switch/prox input, solid-state output
MTL4510B	MTL5510B	4	multi-function switch/prox input, solid-state output
MTL4511	MTL5511	1	switch/prox input, c/o relay output
MTL4513	MTL5513	2	switch/prox input, solid-state output
MTL4514	MTL5514	1	switch/prox input, relay + LFD
MTL4516	–	2	switch/prox input, relay + LFD outputs
MTL4516C	MTL5516C	2	switch/prox input, c/o relay + LFD outputs
MTL4517	MTL5517	2	switch/prox input, relay + LFD outputs
Digital Output			
MTL4521	MTL5521	1	loop powered solenoid driver
MTL4521L	–	1	low power output, loop powered IIC gas groups
–	MTL5522	1	loop powered solenoid driver, IIB
MTL4523	MTL5523	1	solenoid driver with LFD
MTL4523L	–	1	loop powered solenoid driver with LFD
MTL4523R	–	1	solenoid driver with reverse LFD
MTL4524	MTL5524	1	switch operated solenoid driver
MTL4524S	–	1	switch operated solenoid driver, 24V override
MTL4525	MTL5525	1	switch operated solenoid driver, low power
MTL4526	MTL5526	2	switch operated relay
Pulse & Vibration			
MTL4531	MTL5531	1	vibration probe interface
MTL4532	MTL5532	1	pulse isolator, digital or analogue output
MTL4533	MTL5533	2	vibration probe interface
Analogue Input			
MTL4541	MTL5541	1	2/3 wire transmitter repeater
MTL4541A	MTL5541A	1	transmitter repeater, passive input
MTL4541AS	MTL5541AS	1	transmitter repeater, passive input, current sink
MTL4541S	MTL5541S	1	2/3 wire transmitter repeater, current sink
MTL4544	MTL5544	2	2/3 wire transmitter repeater
MTL4544A	MTL5544A	2	transmitter repeater, passive input
MTL4544AS	MTL5544AS	2	transmitter repeater, passive input, current sink
MTL4544S	MTL5544S	2	2/3 wire transmitter repeater, current sink
MTL4544D	MTL5544D	1	2/3 wire transmitter repeater, dual output
Analogue Output			
MTL4546	MTL5546	1	4-20mA smart isolating driver + LFD
MTL4546C	–	1	4-20mA smart isolating driver + oc LFD
MTL4546Y	MTL5546Y	1	4-20mA smart isolating driver + oc LFD
MTL4549	MTL5549	2	4-20mA smart isolating driver + LFD
MTL4549C	–	2	4-20mA smart isolating driver + oc LFD
MTL4549Y	MTL5549Y	2	4-20mA smart isolating driver + oc LFD
Fire & Smoke			
MTL4561	MTL5561	2	loop-powered, for fire and smoke detectors
Temperature Input			
MTL4575	MTL5575	1	temperature converter, THC or RTD
MTL4576-RTD	MTL5576-RTD	2	temperature converter, RTD
MTL4576-THC	MTL5576-THC	2	temperature converter, THC
General			
MTL4599	MTL5599	–	dummy module
MTL4599N	–	–	general purpose feed-through module



Isolator Applications:

DIGITAL INPUT - SWITCHES / PROXIMITY DETECTORS				
Backplane Device	DIN-rail Device	No. of channels	Output to safe area	Important features
MTL4501-SR	MTL5501-SR	1	24V logic	Safety related, SIL3
MTL4504		1	Relays 1 x SPDT 1 x SPDT	switch/prox input, phase reversal + LFD
MTL4510	MTL5510	4	4 x solid state	Can switch +ve or -ve polarity signals
MTL4510B	MTL5510B	4	4 x solid state	Multi-function selectable
MTL4511	MTL5511	1	Relay 1 x SPDT	Switch/proximity detector repeater
MTL4513	MTL5513	2	2 x solid state	dc to 1kHz frequency response
MTL4514	MTL5514	1	Relays 1 x SPDT 1 x SPDT	Switch/proximity detector repeater Independent LFD output
MTL4516		2	Relays 2 x SPST	Switch/proximity detector repeater
MTL4516C	MTL5516C	2	Relays 2 x SPDT	Switch/proximity detector repeater
MTL4517	MTL5517	2	Relays 2 x SPST 1 x SPST	Switch/proximity detector repeater Independent LFD output

COOPER Crouse-Hinds

MTL4501-SR – MTL5501-SR FAIL-SAFE SWITCH/PROXIMITY-DETECTOR INTERFACE
with LFD

With the MTLx501-SR, a fail-safe switch/proximity detector located in the hazardous area can control an isolated fail-safe electronic output. The MTLx501-SR also provides relay alarm contacts to signal line-fault conditions. The MTLx501-SR is for use with approved fail-safe sensors in loops that require operation up to SIL3 according to the functional safety standard IEC 61508.

SPECIFICATION

See also common specification

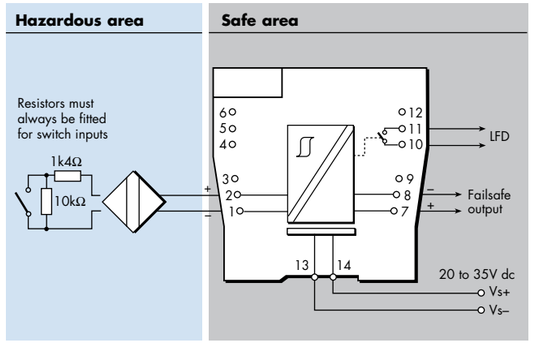
Number of channels
One
Location of switches
Zone 0, IIC, T6 hazardous area
Div. 1, Group A hazardous location
Location of proximity detector
Zone 0, IIC, T4–6, hazardous location
Div 1, Group A, hazardous location
Voltage applied to sensor
8.6V dc max from 1kΩ
Input/output characteristics

Input value in sensor circuits	Fail–safe output	Operation	LFD contacts
2.9mA < Is < 3.9mA	ON	Normal	CLOSED
Is < 1.9mA & Is > 5.1mA	OFF	Normal	CLOSED
Is < 50µA	OFF	Broken line	OPEN
Rs < 100Ω	OFF	Shorted line	OPEN

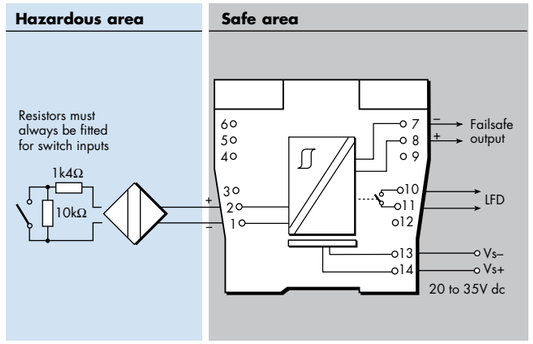
Note: Is = sensor current

Fail-safe electronic output
Output on: 24V nominal
Output off: 0V dc, max < 5V dc
Load: 750Ω to 10kΩ
Maximum on-state current: 25mA (at 750Ω)
Short-circuit current: 30mA
Line fault detection (LFD)
LFD relay output: contacts open when line fault detected
Switch characteristics: 0.3A 110V ac/dc; 1A 35V dc; 30W/33VA
Safety integrity level (SIL)
Highest level in single in-line subsystem SIL3
(in accordance with IEC61508-2)

MTL4501-SR



MTL5501-SR



LED indicators
Green: power indication
Yellow: channel status, on when fail-safe output energised
Red: LFD indication, flashing when line fault detected
Power requirements, Vs

@ Supply voltage	750Ω load	typ. load
20V dc	100mA	70mA
24V dc	90mA	60mA
35V dc	65mA	45mA

Power dissipation within unit

@ Supply voltage	750Ω load	typ. load
20V dc	1232mW	1160mW
24V dc	1392mW	1200mW
35V dc	1507mW	1335mW

Safety description
Uo = ±9.7V, Io = 30mA, Po = 0.07W, Ci = 0nF, Li = 0mH
Um = 253V

Note: switch-type sensors must be fitted with resistors as shown

MTL4504 SWITCH/ PROXIMITY DETECTOR INTERFACE
1-channel with LFD and phase reversal

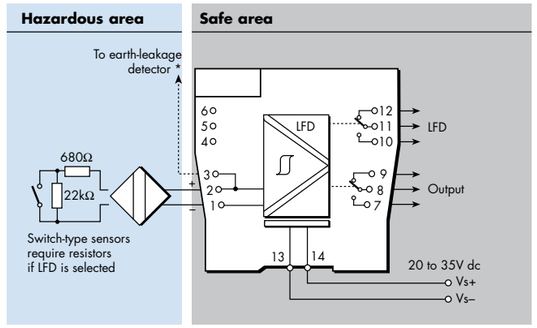
The MTL4504 enables a safe–area load to be controlled, through a relay, by a proximity detector or switch located in a hazardous area. Line faults are signalled through a separate relay and indicated on the top of the module. MTBF information for the LFD relay is available from MTL to allow the failure rate for the LFD relay to be calculated when used in the critical path with the output relay for safety critical applications. Switches are provided to select phase reversal and to enable the line fault detection.

SPECIFICATION

See also common specification

Number of channels
One
Location of switch
Zone 0, IIC, T6 hazardous area
Div.1, Group A, hazardous location
Location of proximity detector
Zone 0, IIC, T4–6 hazardous area, if suitably certified
Div.1, Group A, hazardous location
Hazardous–area inputs
Inputs conforming to BS EN60947–5–6:2001 standards for proximity detectors (NAMUR)
Voltage applied to sensor
7 to 9V dc from 1kΩ ±10%
Input/output characteristics
Normal phase
Outputs closed if input > 2.1mA (< 2kΩ in input circuit)
Outputs open if input < 1.2mA (> 10kΩ in input circuit)
Hysteresis: 200µA (650Ω) nominal
Line fault detection (LFD) (when selected)
User-selectable via switches on the side of the unit. Line faults are indicated by an LED. Line fault relay is de-energised and channel output relay de-energised if input line-fault detected
Open-circuit alarm on if I_{in} < 50µA
Open-circuit alarm off if I_{in} > 250µA
Short-circuit alarm on if R_{in} < 100Ω
Short-circuit alarm off if R_{in} > 360Ω
Note: Resistors must be fitted when using the LFD facility with a contact input
500Ω to 1kΩ in series with switch
20kΩ to 25kΩ in parallel with switch
Safe-area output
Channel: Single pole relay with changeover contacts
LFD: Single pole relay with changeover contacts
Note: reactive loads must be adequately suppressed
Relay characteristics
Response time: 10ms maximum
Contact rating: 10W, 0.5A, 35V dc

MTL4504



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: channel status, on when output energised
Red: LFD indication, on when line fault detected
Maximum current consumption
25mA at 24V dc
Power dissipation within unit
0.6W at 24V
Safety description
V_o=10.5V I_o=14mA P_o=37mW U_m = 253V rms or dc
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

MTL4510 – MTL5510 SWITCH/PROXIMITY DETECTOR INTERFACE

four-channel, digital input

The MTLx510 enables four solid-state outputs in the safe area to be controlled by up to four switches or proximity detectors located in a hazardous area. Each pair of output transistors shares a common terminal and can switch +ve or –ve polarity signals. A range of module configurations is available (see Table 1) through the use of selector switches. When proximity detector modes are selected, LFD is enabled and the output switches to OFF if a line fault is detected.

SPECIFICATION

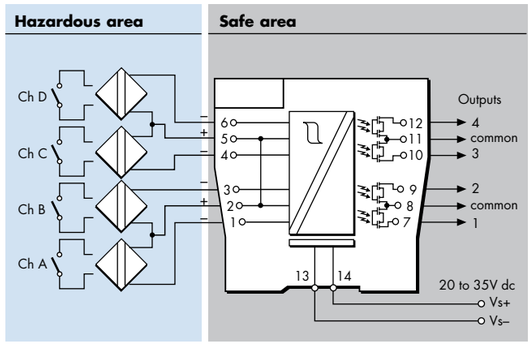
See also common specification

Number of channels
4, configured by switches
Location of switches
Zone 0, IIC, T6 hazardous area
Div 1, Group A hazardous location
Location of proximity detectors
Zone 0, IIC, T4-6 hazardous area if suitably certified
Div 1, Group A, hazardous location
Hazardous-area inputs
Inputs conforming to BS EN60947–5–6:2001 standards for proximity detectors (NAMUR)
Voltage applied to sensor
7 to 9V dc from 1kΩ ±10%
Input/output characteristics
Normal phase
Outputs closed if input > 2.1mA (< 2kΩ in input circuit)
Outputs open if input < 1.2mA (> 10kΩ in input circuit)
Hysteresis: 200µA (650Ω) nominal
Line fault detection (LFD) (when selected)
User-selectable via switches on the side of the unit.
Open-circuit alarm on if Iin < 50µA
Open-circuit alarm off if Iin > 250µA
Short-circuit alarm on if Rin < 100Ω
Short-circuit alarm off if Rin > 360Ω
Note: Resistors must be fitted when using the LFD facility with a contact input
500Ω to 1kΩ in series with switch
20kΩ to 25kΩ in parallel with switch
Safe-area outputs
Floating solid-state outputs compatible with logic circuits

Operating frequency:	dc to 500Hz
Max. off-state voltage:	± 35V
Max. off-state leakage current:	± 50µA
Max. on-state resistance:	25Ω
Max. on-state current:	± 50mA

LED indicators
Green: power indication
Yellow: four: on when output active
Red: LFD indication + faulty channel's yellow LED flashes
Maximum current consumption
40mA at 24V (with all output channels energised)
Power dissipation within unit
0.96W at 24V, with 10mA loads
Safety description (each channel)
V_o=10.5V I_o=14mA P_o=37mW U_m = 253V rms or dc

MTL4510



MTL5510

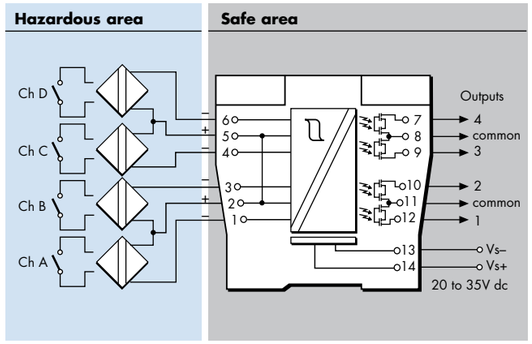


Table 1 - Mode options

MODE	o/p 1	o/p 2	o/p 3	o/p 4	i/p type
0	chA	chB	chC	chD	switch
1	chA rev.	chB	chC	chD	
2	chA	chB rev.	chC	chD	
3	chA	chB	chC rev.	chD	
4	chA	chB	chC	chD rev.	
5	chA rev.	chB	chC rev.	chD	
6	chA	chB rev.	chC	chD rev.	
7	chA rev.	chB rev.	chC rev.	chD rev.	
8	chA	chB	chC	chD	prox. detector + LFD
9	chA rev.	chB	chC	chD	
10	chA	chB rev.	chC	chD	
11	chA	chB	chC rev.	chD	
12	chA	chB	chC	chD rev.	
13	chA rev.	chB	chC rev.	chD	
14	chA	chB rev.	chC	chD rev.	
15	chA rev.	chB rev.	chC rev.	chD rev.	

See Instruction Manual INM4500 for further mode information.

MTL4510B – MTL5510B SWITCH/PROXIMITY DETECTOR INTERFACE

four-channel, multi-function, digital input

The MTL4510B enables four solid-state outputs in the safe area to be controlled by up to four switches or proximity detectors located in a hazardous area. Each pair of output transistors shares a common terminal and can switch +ve or –ve polarity signals. A range of module configurations is available (see Table 1) through the use of selector switches. These include start/stop operations and pulse output modes.

SPECIFICATION

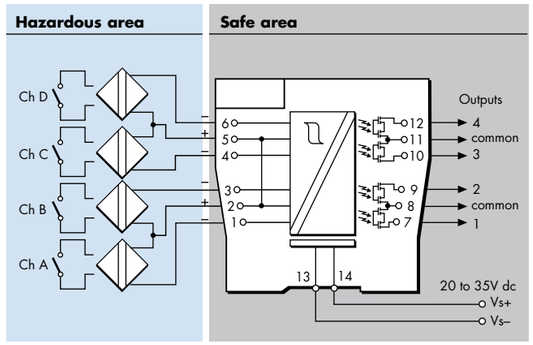
See also common specification

Number of channels
4, configured by switches
Location of switches
Zone 0, IIC, T6 hazardous area
Div 1, Group A hazardous location
Location of proximity detectors
Zone 0, IIC, T4-6 hazardous area if suitably certified
Div 1, Group A, hazardous location
Hazardous-area inputs
Inputs conforming to BS EN60947–5–6:2001 standards for proximity detectors (NAMUR)
Voltage applied to sensor
7 to 9V dc from 1kΩ ±10%
Input/output characteristics
Normal phase
Outputs closed if input > 2.1mA (< 2kΩ in input circuit)
Outputs open if input < 1.2mA (> 10kΩ in input circuit)
Hysteresis: 200µA (650Ω) nominal
Line fault detection (LFD) (when selected)
User-selectable via switches on the side of the unit.
Open-circuit alarm on if Iin < 50µA
Open-circuit alarm off if Iin > 250µA
Short-circuit alarm on if Rin < 100Ω
Short-circuit alarm off if Rin > 360Ω
Note: Resistors must be fitted when using the LFD facility with a contact input
500Ω to 1kΩ in series with switch
20kΩ to 25kΩ in parallel with switch
Safe-area outputs
Floating solid-state outputs compatible with logic circuits

Operating frequency:	dc to 500Hz
Max. off-state voltage:	± 35V
Max. off-state leakage current:	± 50µA
Max. on-state resistance:	25Ω
Max. on-state current:	± 50mA

LED indicators
Green: power indication
Yellow: four: on when output active
Red: LFD indication + faulty channel's yellow LED flashes
Maximum current consumption
40mA at 24V (with all output channels energised)
Power dissipation within unit
0.96W at 24V, with 10mA loads
Safety description (each channel)
V_o=10.5V I_o=14mA P_o=37mW U_m = 253V rms or dc

MTL4510B



MTL5510B

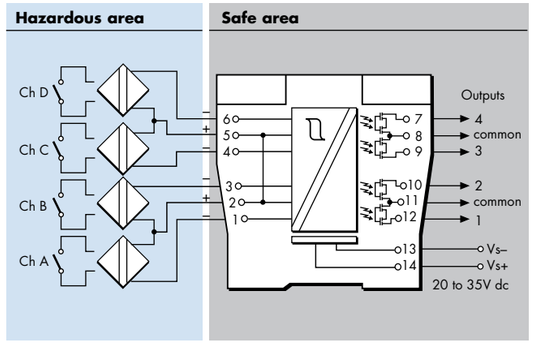


Table 1 - Mode options

MODE	Function	Equivalent*
0	4-ch switch input,	MTLx510
1	2-ch each channel one input, two outputs	MTL4016
2	Same as mode 1 with phase reversed	MTL4016
3	2-ch, 2-pole changeover output	
4	1-ch with line fault output	MTLx014
5	As mode 4 with changeover outputs	
6	1-ch with start-stop latch	MTL2210B
7	4-ch switch input,	MTLx510
8	4-ch switch input,	MTLx510
9	2-ch with line fault output	MTLx017
10	As mode 9 with LFD changeover	
11	As mode 10 with phase reversed	
12	3-ch with normally-open LFD output	
13	3-ch with normally-closed LFD output	
14	2-ch monostable, pulse stretcher	
15	4-ch switch input	MTLx510

* Note that terminal connections may not be the same on these models, and x can mean either '4' or '5'.
See Instruction Manual INM4500 for further mode information.

COOPER Crouse-Hinds

MTL4511 – MTL5511
SWITCH/ PROXIMITY DETECTOR INTERFACE
single channel, with line fault detection

The MTLx511 enables a safe-area load to be controlled by a switch or proximity detector located in a hazardous-area. When selected, open or short circuit conditions in the field wiring are detected by the line-fault-detect (LFD) facility and also indicated on the top of the module. Phase reversal for the channel is selected by a switch on the side of the module and output is provided by changeover relay contacts.

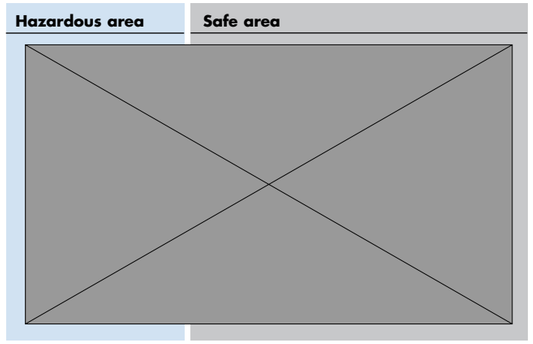
SPECIFICATION

See also common specification

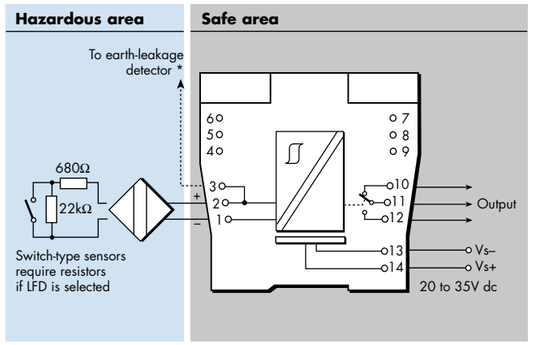
Number of channels
One
Location of switches
Zone 0, IIC, T6 hazardous area
Div. 1, Group A hazardous location
Location of proximity detector
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A hazardous location
Hazardous-area inputs
Inputs conforming to BS EN60947–5–6:2001 standards for proximity detectors (NAMUR)
Voltage applied to sensor
7 to 9V dc from 1kΩ ±10%
Input/output characteristics
Normal phase
Outputs closed if input > 2.1mA (< 2kΩ in input circuit)
Outputs open if input < 1.2mA (> 10kΩ in input circuit)
Hysteresis: 200µA (650Ω) nominal
Line fault detection (LFD) (when selected)
User-selectable via switches on the side of the unit. A line fault is indicated by an LED. The channel output relay is de-energised if an input line fault is detected.
Open-circuit alarm on if Iin < 50µA
Open-circuit alarm off if Iin > 250µA
Short-circuit alarm on if Rin < 100Ω
Short-circuit alarm off if Rin > 360Ω
Note: Resistors must be fitted when using the LFD facility with a contact input
500Ω to 1kΩ in series with switch
20kΩ to 25kΩ in parallel with switch
Safe-area output
Single pole relay with changeover contacts
Note: reactive loads must be adequately suppressed
Relay characteristics

	MTL4511	MTL5511
Response time:	10ms maximum	10ms maximum
Contact rating:	10W, 0.5A, 35V dc	250V ac, 2A, cosØ >0.7, 40V dc, 2A, resistive load

MTL4511



MTL5511



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: channel status, on when output energised
Red: LFD indication, on when line fault detected
Maximum current consumption
25mA at 24V
Power dissipation within unit
0.6W at 24V
Safety description (each channel)
V_o=10.5V I_o=14mA P_o=37mW U_m = 253V rms or dc
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

MTL4513 – MTL5513
SWITCH/ PROXIMITY-DETECTOR INTERFACE
two-channel, with line fault detection and phase reversal

The MTLx513 enables two solid-state outputs in the safe area to be controlled by two switches or proximity detectors located in the hazardous area. The Ch1/Ch2 output transistors share a common terminal and can switch +ve or -ve polarity signals. Independent output phase reversal and line fault detection are enabled via switches for each output. LFD indication is provided on the top of the module.

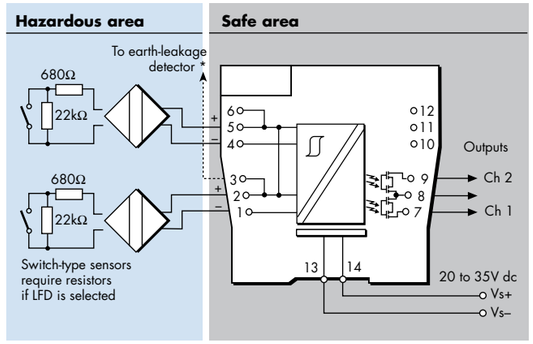
SPECIFICATION

See also common specification

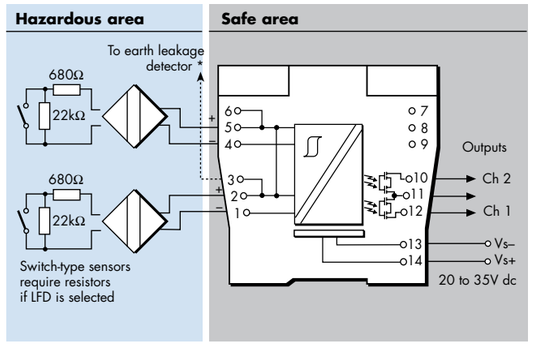
Number of channels
Two
Location of switches
Zone 0, IIC, T6 hazardous area
Div. 1, Group A hazardous location
Location of proximity detectors
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A hazardous location
Hazardous-area inputs
Inputs conforming to BS EN60947–5–6:2001 standards for proximity detectors (NAMUR)
Voltage applied to sensor
7 to 9V dc from 1kΩ ±10%
Input/output characteristics
Normal phase
Outputs closed if input > 2.1mA (< 2kΩ in input circuit)
Outputs open if input < 1.2mA (> 10kΩ in input circuit)
Hysteresis: 200µA (650Ω) nominal
Line fault detection (LFD) (when selected)
User-selectable for each channel via switches on the side of the unit. Line faults are indicated by an LED for each channel.
Open-circuit alarm on if Iin < 50µA
Open-circuit alarm off if Iin > 250µA
Short-circuit alarm on if Rin < 100Ω
Short-circuit alarm off if Rin > 360Ω
Note: Resistors must be fitted when using the LFD facility with a contact input
500Ω to 1kΩ in series with switch
20kΩ to 25kΩ in parallel with switch
Phase reversal
Independent for each channel, user-selectable
Safe-area outputs
Floating solid-state outputs compatible with logic circuits

Operating frequency:	dc to 500Hz
Max. off-state voltage:	± 35V
Max. off-state leakage current:	± 50µA
Max. on-state resistance:	25Ω
Max. on-state current:	± 50mA

MTL4513



MTL5513



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: two: channel status, on when output active
Red: two: LFD indication, on when line fault detected
Maximum current consumption
30mA at 24V
Power dissipation within unit
0.65W typical at 24V, with 10mA loads
0.78W max. with 50mA loads
Safety description (each channel)
V_o=10.5V I_o=14mA P_o=37mW U_m = 253V rms or dc

COOPER Crouse-Hinds

MTL4514 – MTL5514
SWITCH/PROXIMITY-DETECTOR INTERFACE
single channel with line fault detection and phase reversal

The MTLx514 enables a safe–area load to be controlled, through a relay, by a proximity detector or switch located in a hazardous area. Line faults are signalled through a separate relay and indicated on the top of the module. Switches are provided to select phase reversal and to enable the line fault detection.

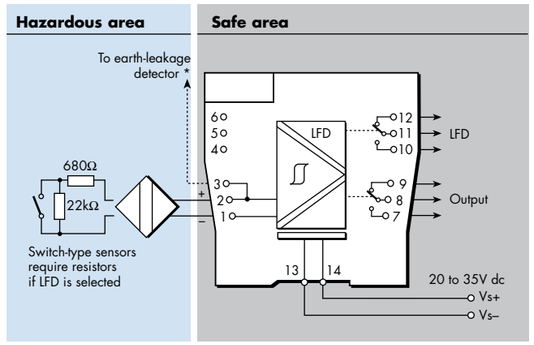
SPECIFICATION

See also common specification

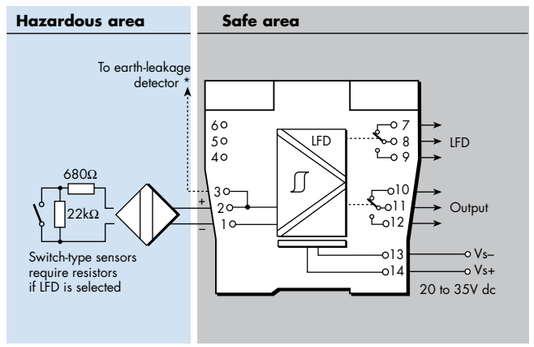
Number of channels
One
Location of switch
Zone 0, IIC, T6 hazardous area
Div.1, Group A, hazardous location
Location of proximity detector
Zone 0, IIC, T4–6 hazardous area, if suitably certified
Div.1, Group A, hazardous location
Hazardous–area inputs
Inputs conforming to BS EN60947–5–6:2001 standards for proximity detectors (NAMUR)
Voltage applied to sensor
7 to 9V dc from 1kΩ ±10%
Input/output characteristics
Normal phase
Outputs closed if input > 2.1mA (< 2kΩ in input circuit)
Outputs open if input < 1.2mA (> 10kΩ in input circuit)
Hysteresis: 200µA (650Ω) nominal
Line fault detection (LFD) (when selected)
User-selectable via switches on the side of the unit. Line faults are indicated by an LED. Line fault relay is energised and channel output relay de-energised if input line-fault detected
Open-circuit alarm on if I_{in} < 50µA
Open-circuit alarm off if I_{in} > 250µA
Short-circuit alarm on if R_{in} < 100Ω
Short-circuit alarm off if R_{in} > 360Ω
Note: Resistors must be fitted when using the LFD facility with a contact input
500Ω to 1kΩ in series with switch
20kΩ to 25kΩ in parallel with switch
Safe-area output
Channel: Single pole relay with changeover contacts
LFD: Single pole relay with changeover contacts
Note: reactive loads must be adequately suppressed
Relay characteristics

	MTL4514	MTL5514
Response time:	10ms maximum	10ms maximum
Contact rating:	10W, 0.5A, 35V dc	250V ac, 2A, cosØ >0.7, 40V dc, 2A, resistive load

MTL4514



MTL5514



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: channel status, on when output energised
Red: LFD indication, on when line fault detected
Maximum current consumption
25mA at 24V dc
Power dissipation within unit
0.6W at 24V
Safety description
V_o=10.5V I_o=14mA P_o=37mW U_m = 253V rms or dc
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

MTL4516/C – MTL5516C
SWITCH/PROXIMITY DETECTOR INTERFACE
two-channel, with line fault detection

The MTLx516/C enable two safe-area loads to be controlled by a switch or proximity detector located in a hazardous-area. When selected, open or short circuit conditions in the field wiring are detected by the line-fault-detect (LFD) facility and also indicated on the top of the module. Phase reversal for each channel is selected by a switch on the side of the module and output is provided by changeover relay contacts.

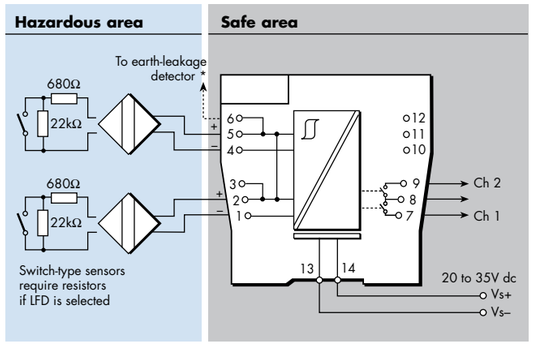
SPECIFICATION

See also common specification

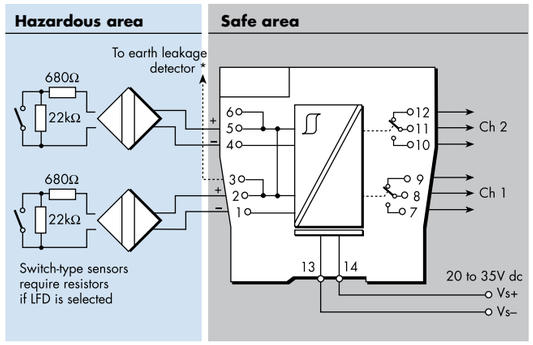
Number of channels
Two
Location of switches
Zone 0, IIC, T6 hazardous area
Div. 1, Group A hazardous location
Location of proximity detector
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A hazardous location
Hazardous-area inputs
Inputs conforming to BS EN60947–5–6:2001 standards for proximity detectors (NAMUR)
Voltage applied to sensor
7 to 9V dc from 1kΩ ±10%
Input/output characteristics
Normal phase
Outputs closed if input > 2.1mA (< 2kΩ in input circuit)
Outputs open if input < 1.2mA (> 10kΩ in input circuit)
Hysteresis: 200µA (650Ω) nominal
Line fault detection (LFD) (when selected)
User-selectable via switches on the side of the unit. Line faults are indicated by an LED for each channel. The channel output relay is de-energised if an input line fault is detected.
Open-circuit alarm on if I_{in} < 50µA
Open-circuit alarm off if I_{in} > 250µA
Short-circuit alarm on if R_{in} < 100Ω
Short-circuit alarm off if R_{in} > 360Ω
Note: Resistors must be fitted when using the LFD facility with a contact input
500Ω to 1kΩ in series with switch
20kΩ to 25kΩ in parallel with switch
Safe-area output
Two single-pole relays with changeover contacts
Note: reactive loads must be adequately suppressed
Relay characteristics

	MTL4516/C	MTL5516C
Response time:	10ms maximum	10ms maximum
Contact rating:	10W, 0.5A, 35V dc	250V ac, 2A, cosØ >0.7, 40V dc, 2A, resistive load

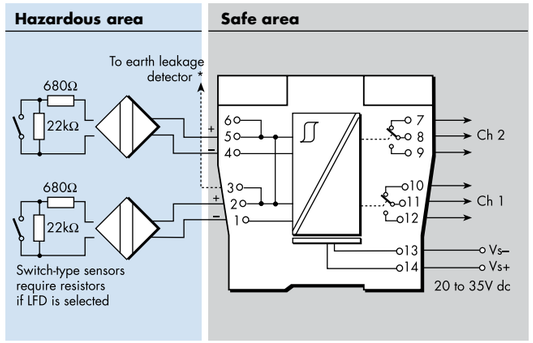
MTL4516



MTL4516C



MTL5516C



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: two: channel status, on when output energised
Red: two: LFD indication, on when line fault detected
Maximum current consumption
35mA at 24V
Power dissipation within unit
0.84W at 24V
Safety description (each channel)
V_o=10.5V I_o=14mA P_o=37mW U_m = 253V rms or dc
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

COOPER Crouse-Hinds

MTL4517 – MTL5517 SWITCH/PROXIMITY DETECTOR INTERFACE

two-channel with line fault detection and phase reversal

The MTLx517 enables two safe-area loads to be controlled, through a relay, by proximity detectors or switches located in a hazardous area. Line faults are signalled through a separate relay and indicated on the top of the module. Switches are provided to select phase reversal and to enable the line fault detection.

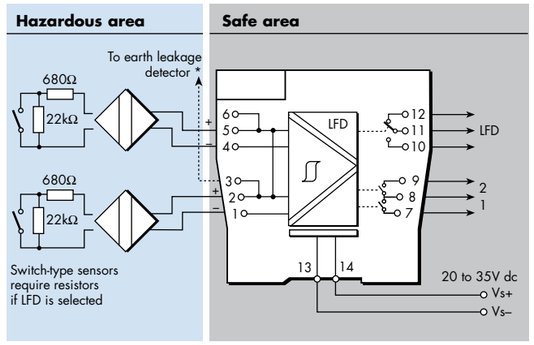
SPECIFICATION

See also common specification

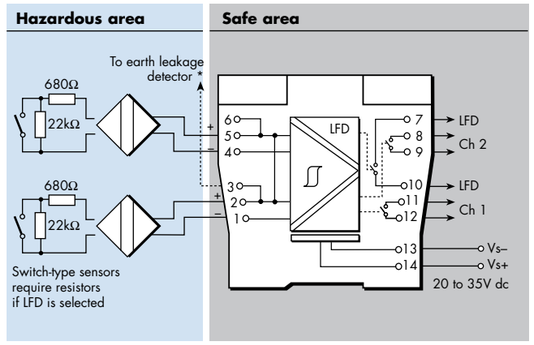
Number of channels
Two
Location of switch
Zone 0, IIC, T6 hazardous area
Div.1, Group A, hazardous location
Location of proximity detector
Zone 0, IIC, T4–6 hazardous area, if suitably certified
Div.1, Group A, hazardous location
Hazardous-area inputs
Inputs conforming to BS EN60947–5–6:2001 standards for proximity detectors (NAMUR)
Voltage applied to sensor
7 to 9V dc from 1kΩ ±10%
Input/output characteristics
Normal phase
Outputs closed if input > 2.1mA (< 2kΩ in input circuit)
Outputs open if input < 1.2mA (> 10kΩ in input circuit)
Hysteresis: 200µA (650Ω) nominal
Line fault detection (LFD) (when selected)
User selectable by switches on the side of the module. LIne faults are indicated by the LED for each channel.
Line fault relay is energised and channel output relay de-energised if input line-fault detected
Open-circuit alarm on if I_{in} < 50µA
Open-circuit alarm off if I_{in} > 250µA
Short-circuit alarm on if R_{in} < 100Ω
Short-circuit alarm off if R_{in} > 360Ω
Note: Resistors must be fitted when using the LFD facility with a contact input
500Ω to 1kΩ in series with switch
20kΩ to 25kΩ in parallel with switch
Safe-area output
Channel: Two single-pole relays with normally open contacts
LFD: Single pole relay with changeover contacts
Note: reactive loads must be adequately suppressed
Relay characteristics

	MTL4517	MTL5517
Response time:	10ms maximum	10ms maximum
Contact rating:	10W, 0.5A, 35V dc	250V ac, 2A, cosØ >0.7, 40V dc, 2A, resistive load

MTL4517

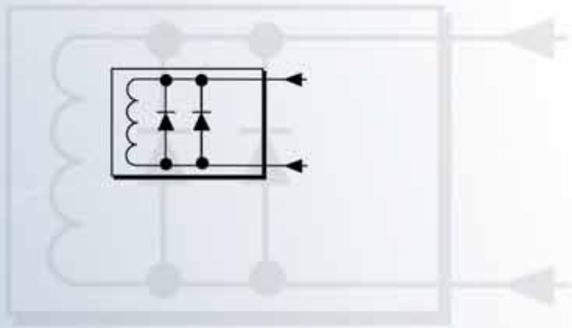


MTL5517



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: two: channel status, on when output energised
Red: two: LFD indication, on when line fault detected
Maximum current consumption
35mA at 24V
Power dissipation within unit
0.84W at 24V
Safety description (each channel)
V_o=10.5V I_o=14mA P_o=37mW U_m = 253V rms or dc
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.



Isolator Applications:

DIGITAL OUTPUT - ALARMS, LED's, SOLENOID VALVES ETC.				
Backplane Device	DIN-rail Device	No. of channels	Output to hazardous area	Important features
MTL4521	MTL5521	1	12.8V<Vo<24V Imax = 48mA	IIC gas groups, loop powered
MTL4521L		1	10.3V<Vo<24V Imax = 48mA	Low power output, loop powered IIC gas groups
	MTL5522	1	9.9V<Vo<24V Imax = 70mA	IIB gas groups, loop powered
MTL4523 MTL4523R	MTL5523	1	12.8V<Vo<24V Imax = 48mA	Independent LFD output
MTL4523L		1	12.8V<Vo<24V Imax = 48mA	Loop powered, independent LFD output
MTL4524	MTL5524	1	12.8V<Vo<24V Imax = 48mA	Safety override feature, separately powered
MTL4524S		1	12.8V<Vo<24V Imax = 48mA	Safety override feature, separately powered
MTL4525	MTL5525	1	7V<Vo<24V Imax = 48mA	override, low power output

DIGITAL OUTPUT - SWITCH OUTPUT TO HAZARDOUS AREA				
Backplane Device	DIN-rail Device	No. of channels	Output to hazardous area	Important features
MTL4526	MTL5526	1 2	RELAYS 1xDPDT 2xSPDT	Safe-area switch input, dual outputs Dual safe-area switch inputs

COOPER Crouse-Hinds

MTL4521/L – MTL5521
SOLENOID/ ALARM DRIVER
loop-powered, IIC

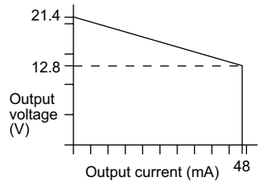
The MTLx521/L is a loop-powered module which enables a device located in the hazardous area to be controlled from the safe area. The MTLx521 can drive a certified intrinsically safe low-power load, as well as non-energy-storing simple apparatus such as an LED.

SPECIFICATION

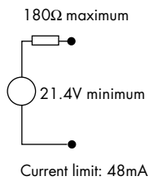
See also common specification

Number of channels
One
Location of load
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A hazardous location

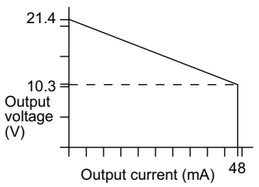
Minimum output voltage (MTLx521)



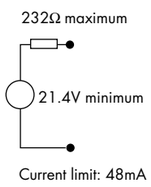
Equivalent output circuit



Minimum output voltage (MTL4521L)

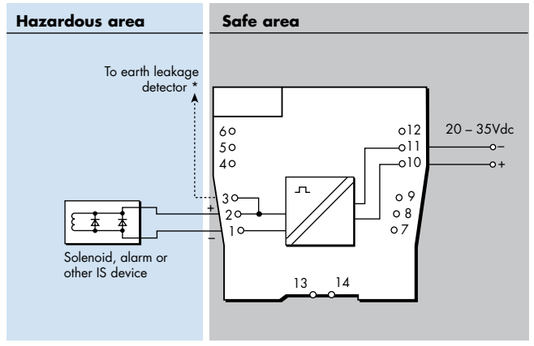


Equivalent output circuit

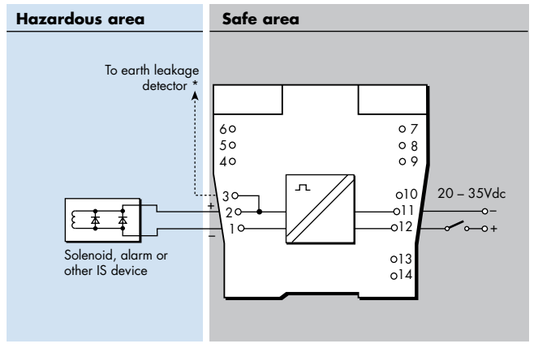


Input voltage
20 to 35V dc
Hazardous-area output (MTLx521)
Minimum output voltage: 12.8V at 48mA
Maximum output voltage: 24V from 180Ω
Current limit: 48mA
Hazardous-area output (MTL4521L)
Minimum output voltage: 10.3V at 48mA
Maximum output voltage: 24V from 232Ω
Current limit: 48mA
Output ripple
< 0.5% of maximum output, peak to peak
Response time
Output within 10% of final value within 100ms

MTL4521 / MTL4521L



MTL5521



*Signal plug HAZ1-3 is required for access to this function

LED indicator
Yellow: output status, on when output active
Maximum current consumption
90mA at 24V
Power dissipation within unit
1.4W at 24V
Safety description (MTLx521)
V_o=25V I_o=147mA P_o=0.92W U_m = 253V rms or dc
Safety description (MTL4521L)
V_o= 25V I_o= 108mA P_o= 0.68W U_m = 253V rms or dc
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

MTL5522
SOLENOID/ALARM DRIVER
loop-powered, IIB

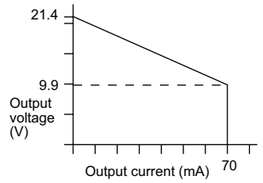
The MTL5522 is a loop-powered module which enables a device located in the hazardous area to be controlled from the safe area. The MTL5522 can drive a certified intrinsically safe low-power load, as well as non-energy-storing simple apparatus such as an LED. The unit's input/output isolation allows the control switch to be connected into either side of the 24V dc supply circuit.

SPECIFICATION

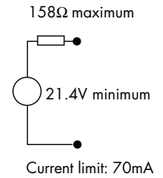
See also common specification

Number of channels
One
Location of load
Zone 0, IIB, T4–6 hazardous area if suitably certified
Div. 1, Group C hazardous location

Minimum output voltage

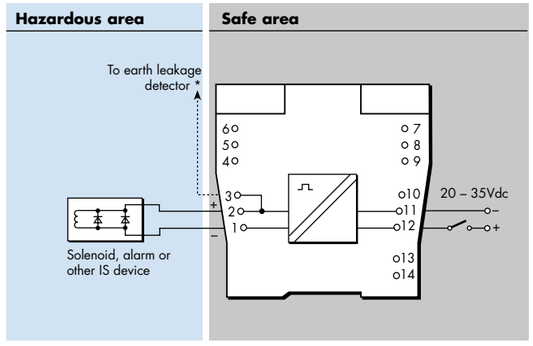


Equivalent output circuit



Input voltage
20 to 35V dc
Hazardous-area output
Minimum output voltage: 9.9V at 70mA
Maximum output voltage: 24V from 158Ω
Current limit: 70mA
Output ripple
< 0.5% of maximum output, peak to peak
Response time
Output within 10% of final value within 100ms

MTL5522



*Signal plug HAZ1-3 is required for access to this function

LED indicator
Yellow: output status, on when output active
Maximum current consumption
125mA (typ.) at 24V
Power dissipation within unit
1.4W at 24V
Safety description
V_o=25V I_o=166mA P_o=1.04W U_m = 253V rms or dc
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

COOPER Crouse-Hinds

MTL4523/R – MTL5523
SOLENOID/ALARM DRIVER
with line fault detection, IIC

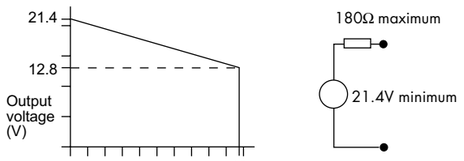
With the MTLx523 interface, an on/off device in a hazardous area can be controlled by a volt-free contact or logic signal in the safe area. It is suitable for driving loads such as solenoids. Line fault detection (LFD), which operates irrespective of the output state, is signalled by a safe-area solid-state switch which de-energises MTLx523, or energises MTL4523R, if a field line is open or short–circuited. Earth fault detection can be provided by connecting an MTL4220 earth leakage detector to terminal 3.

SPECIFICATION

See also common specification

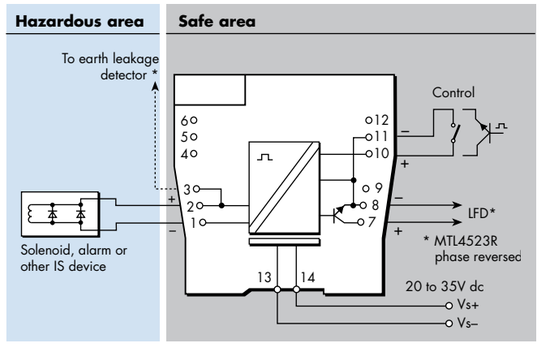
Number of channels
One
Location of load
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A, hazardous location

Minimum output voltage **Equivalent output circuit**

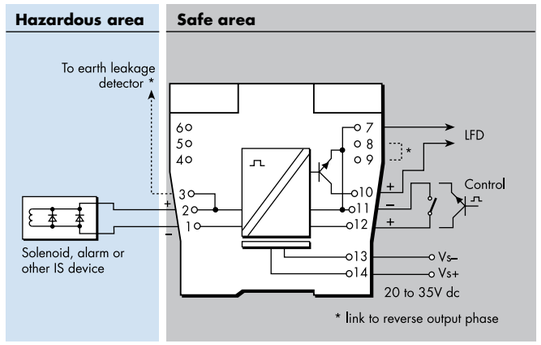


Hazardous-area output
Minimum output voltage: 12.8V at 48mA
Maximum output voltage: 24V from 180Ω
Current limit: 48mA
Output ripple
< 0.5% of maximum output, peak to peak
Control input
Suitable for switch contacts, an open collector transistor or logic drive (internal contact wetting voltage 12V @ 0.2mA contact closed. Not suitable for voltage control via series diode)
Output turns on if input switch closed, transistor on or < 1.4V applied across control input 11 & 12
Output turns off if input switch open, transistor off or > 4.5V applied across control input 11 & 12
Response time
Output within 10% of final value within 100ms
Line fault detection (LFD)
Open or short circuit in field cabling de-energises solid state line-fault signal.
LFD transistor is switched on, provided that the field circuit impedance is > 55Ω and < 6k5Ω.
Line fault signal characteristics
Maximum off-state voltage: 35V
Maximum off-state leakage current: 10µA
Maximum on-state voltage drop: 2V
Maximum on-state current: 50mA

MTL4523/MTL4523R



MTL5523



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: output status, on when output active
Red: LFD indication, on when line fault detected
Maximum current consumption
100mA at 24V dc
Power dissipation within unit
1.2W with typical solenoid valve, output on
2.0W worst case
Safety description
V_o=25V I_o=147mA P_o=919mW U_m = 253V rms or dc
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

MTL4523L
SOLENOID/ ALARM DRIVER
loop-powered with line fault detection, IIC

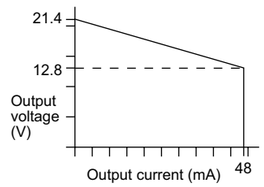
With the MTL4523L interface, an on/off device in a hazardous area can be controlled by a voltage signal in the safe area. It is suitable for driving loads such as solenoids. Line fault detection (LFD), which operates when the output is energised, is signalled by a safe-area solid-state switch which energises if a field line is open or short-circuited. Earth fault detection can be provided by connecting an MTL4220 earth leakage detector to terminal 3.

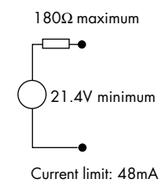
SPECIFICATION

See also common specification

Number of channels
One
Location of load
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A, hazardous location

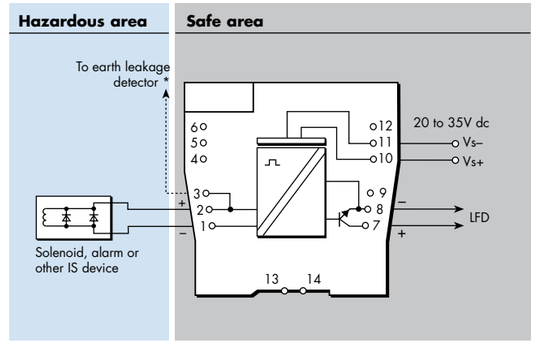
Minimum output voltage **Equivalent output circuit**





Input voltage
20 to 35V dc
Hazardous-area output
Minimum output voltage: 12.8V at 48mA
Maximum output voltage: 24V from 180Ω
Current limit: 48mA
Output ripple
< 0.5% of maximum output, peak to peak
Response time
Output within 10% of final value within 100ms
Line fault detection (LFD)
Open or short circuit in field cabling energises solid state line fault signal
LFD transistor is switched off, provided that the field circuit impedance is > 55Ω and < 6k5Ω.
Line fault signal characteristics
Maximum off-state voltage: 35V
Maximum off-state leakage current: 10µA
Maximum on-state voltage drop: 2V
Maximum on-state current: 50mA
Note: LFD signal is Zener-diode protected against inductive loads

MTL4523L



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Yellow: output status, on when output active
Red: LFD indication, on when line fault detected
Maximum current consumption
100mA at 24V dc
Power dissipation within unit
1.2W with typical solenoid valve, output on
Safety description
V_o=25V I_o=147mA P_o=919mW U_m = 253V rms or dc
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

COOPER Crouse-Hinds

MTL4524 – MTL5524
SOLENOID/ALARM DRIVER
switch operated with override, IIC

The MTLx524 enables an on/off device in a hazardous area to be controlled by a volt-free contact or logic signal in the safe area. It can drive loads such as solenoids, alarms, LEDs and other low power devices that are certified as intrinsically safe or are classified as non-energy storing simple apparatus.

The MTL4524 allows a second safe-area switch or logic signal to be connected that enables the output to be disabled to permit, for example, a safety system to override a control signal.

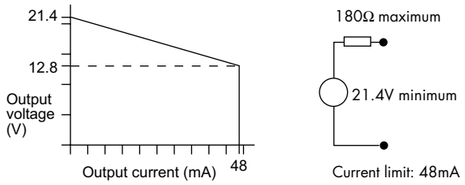
The MTL5524 may have its phase reversed by connecting a wire link between pins 8 and 9.

SPECIFICATION

See also common specification

Number of channels
One
Location of load
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div.1, Group A, hazardous location

Minimum output voltage **Equivalent output circuit**

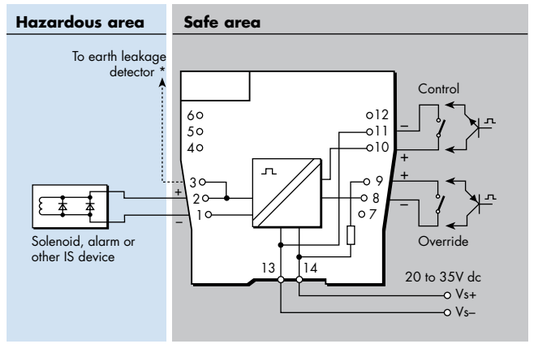


Hazardous-area output
Minimum output voltage: 12.8V at 48mA
Maximum output voltage: 24V from 180Ω
Current limit: 48mA
Output ripple
< 0.5% of maximum output, peak-to-peak
Control input
Suitable for switch contacts, an open collector transistor or logic drive
0 = input switch closed, transistor on or <1.4V applied
1 = input switch open, transistor off or >4.5V applied
Override input on MTL4524
An open collector transistor or a switch connected across the terminals can be used to turn the output off whatever the state of the control input
0 = transistor on or switch closed
1 = transistor off or switch open
Control and override inputs on MTL4524

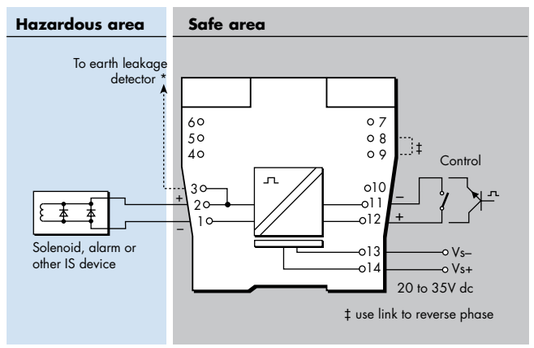
Control input	Override input	Output state
0	0	off
0	1	on
1	0	off
1	1	off

Response time
Output within 10% of final value within 100ms

MTL4524



MTL5524



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: output status, on when output active
Maximum current consumption
100mA at 24V dc
Power dissipation within unit
1.3W with typical solenoid valve, output on
1.9W worst case
Safety description
V_o=25V I_o=147mA P_o=919mW U_m = 253V rms or dc

MTL4524S
SOLENOID/ALARM DRIVER
switch operated with 24V override, IIC

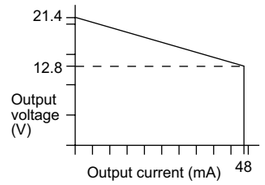
The MTL4524S enables an on/off device in a hazardous area to be controlled by a volt-free contact or a floating logic signal in the safe area. It can drive loads such as solenoids, alarms, LEDs and other low power devices that are certified as intrinsically safe or are classified as non-energy storing simple apparatus. By connecting a second safe-area voltage, the output can be disabled to permit, for example, a safety system to override a control signal.

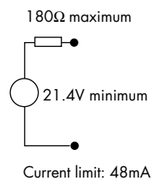
SPECIFICATION

See also common specification

Number of channels
One
Location of load
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div.1, Group A, hazardous location

Minimum output voltage **Equivalent output circuit**



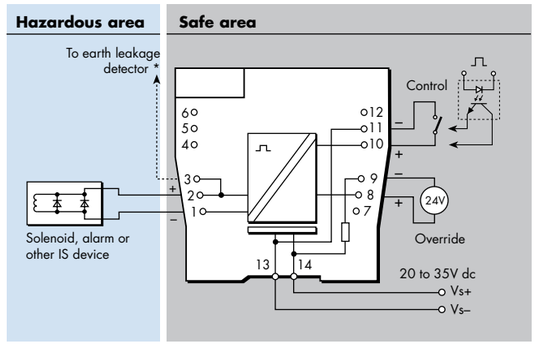


Hazardous-area output
Minimum output voltage: 12.8V at 48mA
Maximum output voltage: 24V from 180Ω
Current limit: 48mA
Output ripple
< 0.5% of maximum output, peak-to-peak
Control input (must be fully-floating)
Suitable for switch contacts or an opto-isolator
0 = input switch closed, transistor on or < 1.4V applied
1 = input switch open, transistor off or > 4.5V applied
Override input
A 24V logic signal applied across the terminals allows the solenoid/alarm to be operated by the control input. If it is disconnected, the solenoid/alarm is off.
0 = < 2.0V applied across terminals 8 & 9
1 = > 9.0V applied across terminals 8 & 9
(nominal switching point 4.5V)
Control and override inputs

Control input	Override input	Output state
0	0	off
0	1	on
1	0	off
1	1	off

Response time
Output within 10% of final value within 100ms

MTL4524S



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: output status, on when output active
Maximum current consumption
100mA at 24V dc
Power dissipation within unit
1.3W with typical solenoid valve, output on
1.9W worst case
Safety description
V_o=25V I_o=147mA P_o=919mW U_m = 253V rms or dc

COOPER Crouse-Hinds

MTL4525 – MTL5525
SOLENOID/ALARM DRIVER
switch operated with override, IIC, low power

The MTLx525 enables an on/off device in a hazardous area to be controlled by a volt-free contact or logic signal in the safe area. It can drive loads such as solenoids, alarms, LEDs and other low power devices that are certified as intrinsically safe or are classified as non-energy storing simple apparatus.

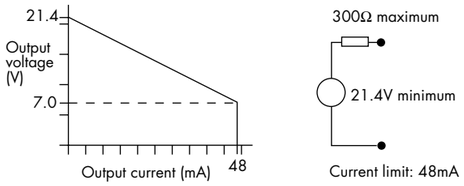
The MTL4525 allows a second safe-area switch or logic signal to be connected that enables the output to be disabled to permit, for example, a safety system to override a control signal.

SPECIFICATION

See also common specification

Number of channels
One
Location of load
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div.1, Group A, hazardous location

Minimum output voltage **Equivalent output circuit**

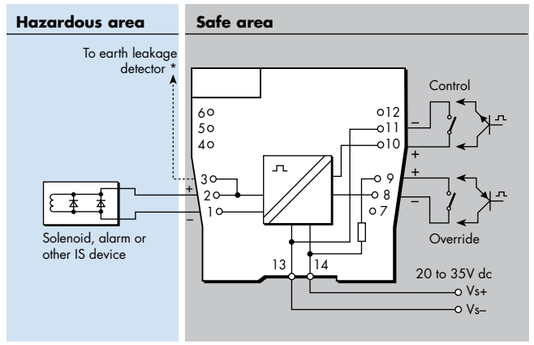


Hazardous-area output
Minimum output voltage: 7V at 48mA
Maximum output voltage: 24V from 300Ω
Current limit: 48mA
Output ripple
< 0.5% of maximum output, peak-to-peak
Control input on MTL4525
Suitable for switch contacts, an open collector transistor or logic drive
0 = input switch closed, transistor on or < 1.4V applied
1 = input switch open, transistor off or > 4.5V applied
Override input on MTL4525
An open collector transistor or a switch connected across the terminals can be used to turn the output off whatever the state of the control input
0 = transistor on or switch closed
1 = transistor off or switch open
Control and override inputs on MTL4525

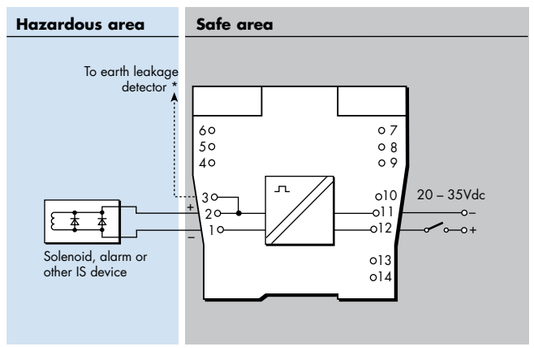
Control input	Override input	Output state
0	0	off
0	1	on
1	0	off
1	1	off

Response time
Output within 10% of final value within 100ms

MTL4525



MTL5525



*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: output status, on when output active
Maximum current consumption
100mA at 24V dc
Power dissipation within unit
1.3W with typical solenoid valve, output on
1.9W worst case
Safety description
V_o=25V I_o=83.3mA P_o=0.52W U_m = 253V rms or dc

MTL4526 – MTL5526
SWITCH-OPERATED RELAY
two–channel IS–output

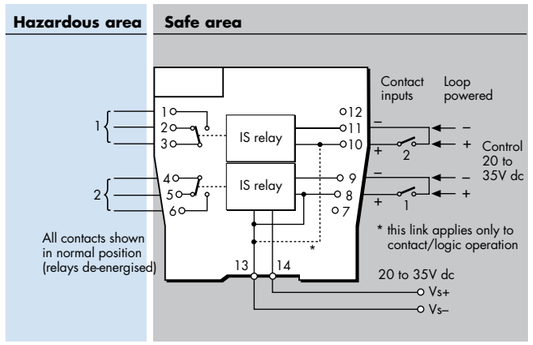
The MTLX526 enables two separate IS circuits in a hazardous area to be relay-contact controlled by two on-off switches or logic signals in a safe area. Applications include the calibration of strain–gauge bridges; changing the polarity (and thereby the tone) of an IS sounder; the testing of IS fire alarms; and the transfer of safe-area signals into an annunciator with IS input terminals not segregated from each other. The output–relay contacts are certified as non–energy–storing apparatus, and can be connected to any IS circuit without further certification, provided that separate IS circuits are such that they would remain safe if connected together.

SPECIFICATION

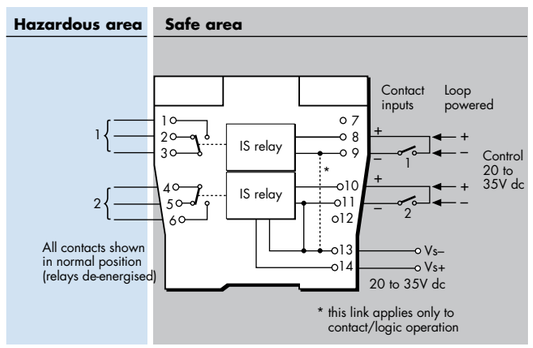
See also common specification

Number of channels
Two, fully floating
Location of control circuit
Safe area
Input/output characteristics
Contact/Logic mode
(Inputs suitable for switch contacts, an open–collector transistor or logic drive)
Relay energised if < 450Ω or < 1V applied
Relay de–energised if > 5kΩ or > 2V applied (35V max.)
Loop powered mode
Relay energised if >20V
Relay de-energised if <17V
Power supply failure protection
Relays de–energised if supply fails
Response time
25ms nominal
Contacts (suitable for connection to IS circuits)
1–pole changeover per channel
Contact rating
250V dc, limited to 30V dc for IS applications, 2A (reactive loads must be suppressed)
Contact life expectancy
2 x 10^7 operations at maximum IS load
Relay drive (see switch setting table)
Switch selection of loop powered or contact/logic control for both channels. Further switch selects "1in2out" mode

MTL4526



MTL5526

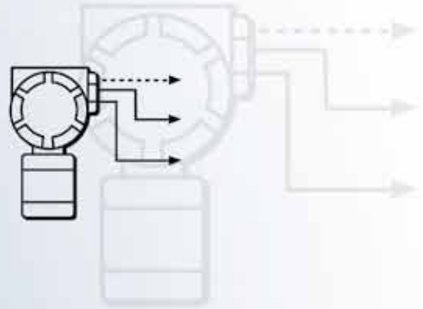


*Signal plug HAZ1-3 is required for access to this function

LED indicators
Green: power indication
Yellow: two: output status, on when relay energised
Power requirement, Vs
41mA at 20V dc
44mA at 24V dc
60mA at 35V dc
Power dissipation within unit
1.1W maximum at 24V
Safety description (each channel)
Non-energy–storing apparatus: relay contacts may be connected to any IS circuit without further consideration
User switch settings for operating mode

Mode	Function	SW1	SW2	SW3	SW4
Contact/Logic Input	2 ch	Off	On	On	On
	1in2out	On	On	On	On
Loop Powered	2 ch	Off	Off	Off	Off

COOPER Crouse-Hinds



Isolator Applications:

PULSE AND VIBRATION INPUT -				
Backplane Device	DIN-rail Device	No. of channels	Input from hazardous area	Important features
MTL4531	MTL5531	1	2-wire & 3-wire vibration probes	dc and ac voltage transfer
MTL4533	MTL5533	2	2-wire & 3-wire vibration probes	dc and ac voltage transfer
MTL4532	MTL5532	1	Switch, proximity detector, current pulse, voltage pulse	Repeats frequency and converts to analogue value, plus trip function

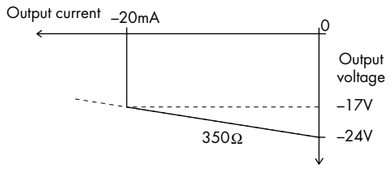
MTL4531 – MTL5531 VIBRATION TRANSDUCER INTERFACE

The MTLx531 repeats a signal from a vibration sensor in a hazardous area, providing an output for a monitoring system in the safe area. The interface is compatible with 3-wire eddy-current probes and accelerometers or 2-wire current sensors; the selection is made by a switch on the side of the module.

SPECIFICATION

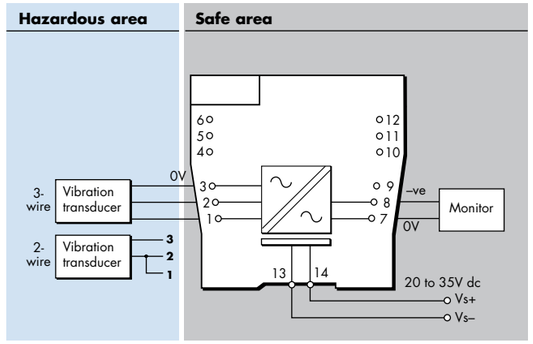
See also common specification

Number of channels
One
Location of signal source
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A hazardous location
Hazardous-area input
Input impedance
(terminals 2 & 3): 10kΩ
Transducer supply voltage, 3-wire (terminals 3 & 1)

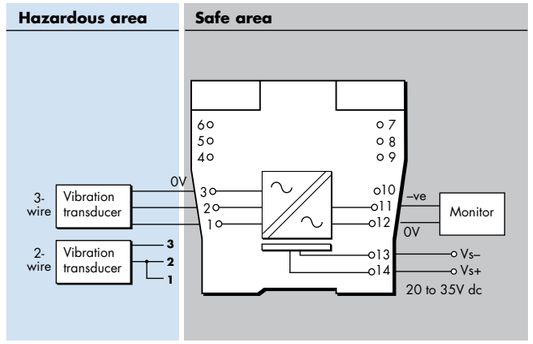


Transducer supply current, 2-wire
3.3mA (nom.) for 2-wire sensors, user selectable by switch
Signal range
Minimum –20V, maximum –0.5V
DC transfer accuracy at 20°C
<±50mV
AC transfer accuracy at 20°C
0Hz to 1kHz: ±1%
1kHz to 10kHz: –5% to +1%
10kHz to 20kHz: –10% to +1%
Temperature coefficient
±50ppm/°C (10 to 65°C)
±100ppm/°C (–20 to 10°C)
Voltage bandwidth
–3dB at 47kHz (typical)
Phase response
<14µs, equivalent to:
–1° at 200Hz
–3° at 600Hz
–5° at 1kHz
–50° at 10kHz
–100° at 20kHz
Safe-area output impedance
<20Ω

MTL4531



MTL5531



LED indicator
Green: power indication
Supply voltage
20 to 35V dc
Maximum current consumption (10mA transducer load)
96mA at 24V
Maximum power dissipation within unit
2W
Safety description
Terminals 3 to 1
V_o=26.6V I_o=94mA P_o=0.66W Um = 253V rms or dc
Terminals 3 to 2
Non-energy-storing apparatus ≤1.5V, ≤0.1A and ≤25mW

COOPER Crouse-Hinds

MTL4532 – MTL5532
PULSE ISOLATOR
pulse & 4/20mA current outputs

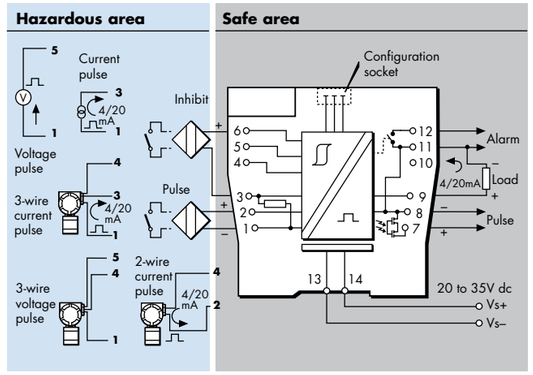
The MTLx532 isolates pulses from a switch, proximity detector, current pulse transmitter or voltage pulse transmitter located in a hazardous area. It is ideal for applications involving high pulse rates and fast response times, by repeating the pulses into the safe area. An analogue output proportional to frequency is also provided, together with a relay output, which may be configured to act as an alarm. Configuration is carried out with a personal computer.

SPECIFICATION

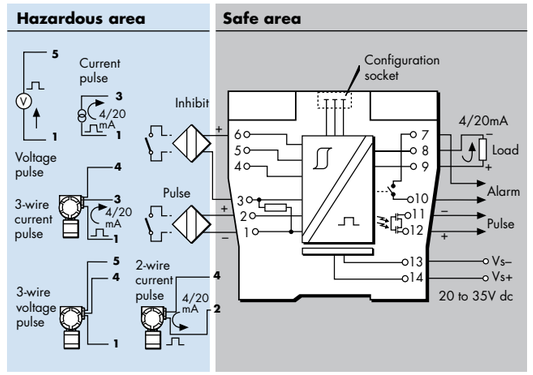
See also common specification

Number of channels
One, fully floating
Sensor type
Switch or proximity detector (NAMUR/BS EN 60947–5–6:2001)
2– or 3–wire voltage or pulse transmitter
Location of switch
Zone 0, IIC, T6 hazardous area
Div. 1, Group A, hazardous location
Location of proximity detector or transmitter
Zone 0, IIC, T4–T6 if suitably certified
Div.1, Group A, hazardous location
Input
Switch input:
Output ON if switch is closed
Proximity detector input:
Excitation: 7.0 to 9.0V dc from 1kΩ nominal
Output ON if input > 2.1mA* (< 2kΩ)
Output OFF if input < 1.2mA* (> 10kΩ)
Switching hysteresis: 0.2mA (650Ω) nominal
*NAMUR and BS EN 60947–5–6:2001standards
Current pulse input:
Transmitter supply: 16.5V dc at 20mA
Short circuit current: 24mA
Output: Iin > 9.0mA = ON, Iin < 7.0mA = OFF
Switching hysteresis: 0.5mA
Voltage pulse input
Input impedance: > 10kΩ
Switching point voltage (V_{sp}): 3, 6, or 12V nominal
(User selectable by switches on the side of the module)
Output: Vin > V_{sp} = ON, Vin < V_{sp} = OFF
Switching hysteresis: 100mV + (0.1 x V_{sp}) typical
Safe-area pulse output
Maximum off–state voltage: 35V
Maximum off–state leakage current: 10µA
Maximum on–state resistance: 25Ω
Maximum on–state current: 50mA
Output OFF if supply fails
Note: the output is zener diode protected against inductive loads
Safe-area current output
Signal range: 4 to 20mA
Under/over range: 0 to 22mA
Load resistance: 0 to 450Ω @20mA
Output resistance: >1MΩ
Ripple: < 50µA peak-to-peak
Accuracy: better than 20µA at 20°C
Temperature drift: < 1µA/°C
Response delay: TBA ms
Alarm output
Relay ON in alarm, 0.5A @ 35Vdc max.

MTL4532



MTL5532



Pulse width
High: 10µs min
Low: 10µs min
Frequency range
0 – 50kHz - pulse output mode
0 – 10KHz - for analogue output
LED indicators
Green: power indication
Yellow: on when output circuit is on
Red: flashing when line fault or error
Power requirement
65mA at 24V dc
70mA at 20V dc
55mA at 35V dc
Power dissipation within unit
1.35W maximum at 24V
1.75W maximum at 35V
Safety description (U_m = 253V rms or dc)
Terminals 2 to 1 and 6 to 1
V_o=10.5V I_o=14mA P_o=37mW
Terminals 4 to 3 and 1
V_o=28V I_o=93mA P_o=651mW
Terminals 3 to 1
Non-energy-storing apparatus ≤1.5V, ≤0.1A and ≤25mW; can be connected without further certification into any IS loop with an open-circuit voltage <28V
Terminals 5 to 4 and 1
V_{max} ≤ 28V, I_{max} ≤ 94mA, P_{max} ≤ 0.66W
Configurator
A personal computer running MTL PCS45 software with a PCL45USB serial interface.

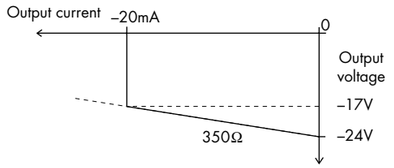
MTL4533 – MTL5533
VIBRATION TRANSDUCER INTERFACE
two channel

The MTLx533 repeats signals from vibration sensors in a hazardous area, providing outputs for a monitoring system in the safe area. The interface is compatible with 3-wire eddy-current probes and accelerometers or 2-wire current sensors, the selection is made by switches on the side of the module.

SPECIFICATION

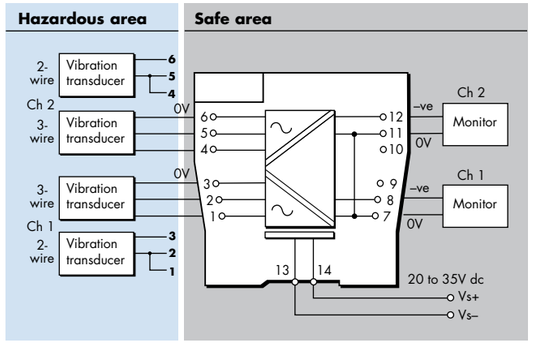
See also common specification

Number of channels
Two
Location of signal source
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A hazardous location
Hazardous-area input
Input impedance
(terminals 2 & 3, 5 & 6): 10kΩ
Transducer supply voltage, 3-wire (terminals 3 & 1 and 6 & 4)

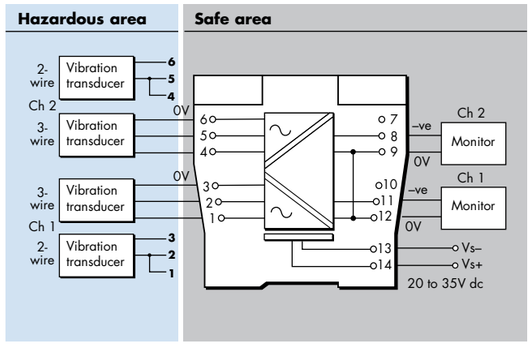


Transducer supply current, 2-wire
3.3mA (nom.) for 2-wire sensors, user selectable by switch
Signal range
Minimum –20V, maximum –0.5V
DC transfer accuracy at 20°C
<±50mV
AC transfer accuracy at 20°C
0Hz to 1kHz: ±1%
1kHz to 10kHz: –5% to +1%
10kHz to 20kHz: –10% to +1%
Temperature coefficient
±50ppm/°C (10 to 65°C)
±100ppm/°C (–20 to 10°C)
Voltage bandwidth
–3dB at 47kHz (typical)
Phase response
<14µs, equivalent to:
–1° at 200Hz
–3° at 600Hz
–5° at 1kHz
–50° at 10kHz
–100° at 20kHz
Safe-area output impedance
<20Ω

MTL4533



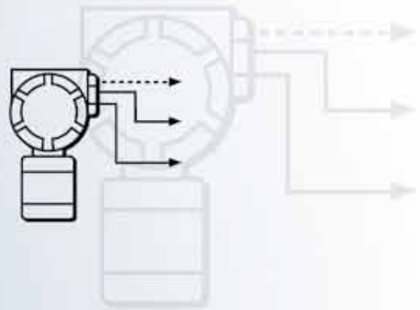
MTL5533



LED indicator
Green: power indication
Supply voltage
20 to 35V dc
Maximum current consumption (10mA transducer load/ch)
130mA at 24V
Maximum power dissipation within unit
2.7W
Safety description
Terminals 3 to 1and 6 to 4
V_o=26.6V I_o=94mA P_o=0.66W U_m = 253V rms or dc
Terminals 3 to 2 and 6 to 5
Non-energy-storing apparatus ≤1.5V, ≤0.1A and ≤25mW

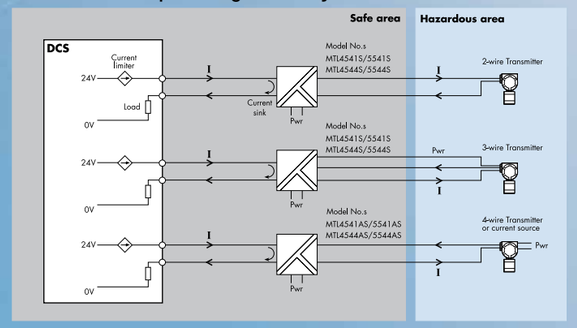
COOPER Crouse-Hinds

Isolator Applications:

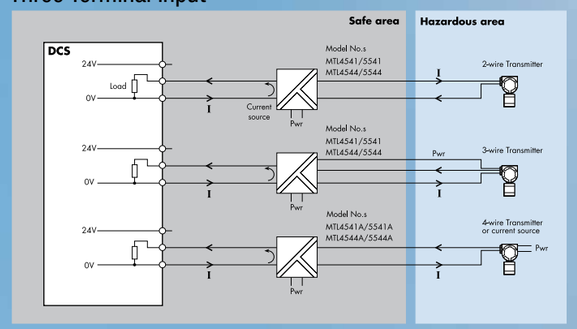


ANALOGUE INPUT - TRANSMITTERS, 4-20mA CONVENTIONAL AND 'SMART'				
Backplane Device	DIN-rail Device	No. of channels	Output to hazardous area	Important features
MTL4541 MTL4541S	MTL5541 MTL5541S	1	16.5V min @ 20mA	Compatible with most 2/3wire smart transmitters, source & sink variants
MTL4541A MTL4541AS	MTL5541A MTL5541AS	1	Passive current sink	For separately powered transmitters, source & sink variants
MTL4544 MTL4544S	MTL5544 MTL5544S	2	16.5V min @ 20mA	Compatible with most 2/3wire smart transmitters, source & sink variants
MTL4544A MTL4544AS	MTL5544A MTL5544AS	2	Passive current sink	For separately powered transmitters, source & sink variants
MTL4544D	MTL5544D	1	16.5V min @ 20mA	Compatible with most 2/3wire smart transmitters, dual outputs

Two Terminal Input - High Density



Three Terminal Input



MTL4541/S – MTL5541/S REPEATER POWER SUPPLY

4/20mA, HART®, for 2- or 3-wire transmitters

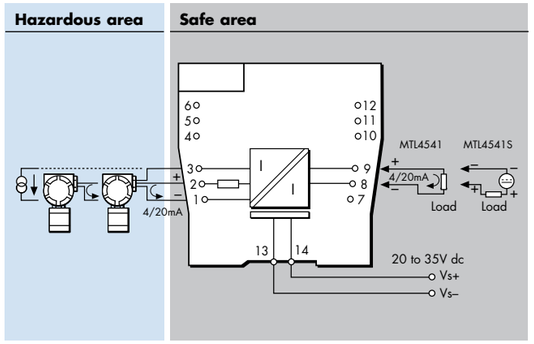
The MTLx541 provides a fully-floating dc supply for energising a conventional 2- or 3-wire 4/20mA transmitter, which is located in a hazardous area, and repeats the current in another floating circuit to drive a safe-area load. For HART 2-wire transmitters, the unit allows bi-directional communications signals superimposed on the 4/20mA loop current. Alternatively, the MTLx541S acts as a current sink for a safe-area connection rather than driving a current into the load.

SPECIFICATION

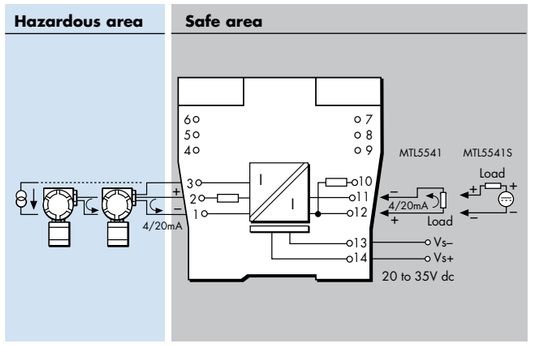
See also common specification

Number of channels
One
Location of transmitter
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A hazardous location
Safe-area output
Signal range: 4 to 20mA
Under/over-range: 0 to 24mA
Safe-area load resistance (MTLx541)
@ 24mA: 0 to 360Ω
@ 20mA: 0 to 450Ω
Safe-area load (MTLx541S)
Current sink: 600Ω max.
Maximum voltage source: 24V dc
Safe-area circuit output resistance: > 1MΩ
Safe-area circuit ripple
< 50µA peak-to-peak
Hazardous-area input
Signal range: 0 to 24mA (including over-range)
Transmitter voltage: 16.5V at 20mA
Transfer accuracy at 20°C
Better than 15µA
Temperature drift
< 0.8µA/°C
Response time
Settles to within 10% of final value within 50µs
Communications supported
HART (terminals 1 & 2 only)

MTL4541 / MTL4541S



MTL5541 / MTL5541S



LED indicator
Green: power indication
Maximum current consumption (with 20mA signal)
51mA at 24V
Power dissipation within unit (with 20mA signal)
MTLx541 0.7W @ 24V dc
MTLx541S 1.0W @ 24V dc
Safety description
Terminals 2 to 1 and 3:
V_o=28V I_o=93mA P_o=651mW U_m = 253V rms or dc
Terminals 1 to 3:
Simple apparatus ≤1.5V, ≤0.1A and ≤25mW; can be connected without further certification into any IS loop with an open-circuit voltage <28V
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

COOPER Crouse-Hinds

MTL4541A/AS – MTL5541A/AS CURRENT REPEATER

4/20mA passive input for HART® transmitters

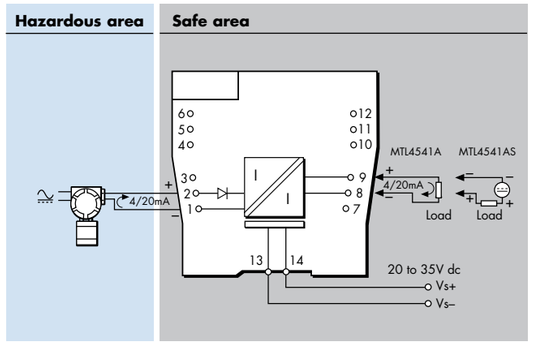
The MTLx541A provides an input for separately powered 4/20mA transmitters and also allows bi–directional transmission of HART communication signals superimposed on the 4/20mA loop current. Alternatively, the MTLx541AS acts as a current sink for a safe-area connection rather than driving a current into the load.

SPECIFICATION

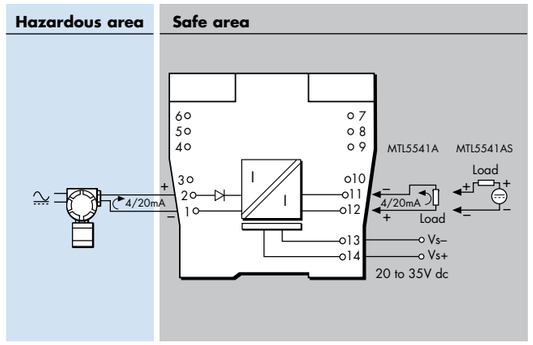
See also common specification

Number of channels
One
Location of transmitter
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div.1, Group A, hazardous location
Hazardous area input
Signal range: 4 to 20mA
Under/over-range: 1.0 to 21.5mA
Input impedance for HART signals
at terminals 1, 2: > 230Ω
Maximum input volt drop
at terminals 1, 2: < 6.6V
i.e. a transmitter load of 330Ω at 20mA
Safe-area output
Signal range: 4 to 20mA
Under/over-range: 1.0 to 21.5mA
Safe-area load resistance (MTLx541A)
Conventional transmitters: 0 to 360Ω
Smart transmitters: 250Ω ±10%
Safe-area load (MTLx541AS)
Current sink: 600Ω max.
Maximum voltage source: 24V DC
Safe-area circuit output resistance: > 1MΩ
Safe–area circuit ripple
< 50µA peak-to-peak up to 80kHz
Transfer accuracy at 20°C
Better than 20µA
Temperature drift
< 1µA/°C
Response time
Settles within 200µA of final value after 20ms
Communications supported
HART

MTL4541A / MTL4541AS



MTL5541A / MTL5541AS



LED indicator
Green: power indication
Power requirement (with 20mA signal)
50mA at 20V
45mA at 24V
35mA at 35V
Power dissipation within unit (with 20mA signals)
MTLx541A 0.8W @ 24V dc
MTLx541AS 1.1W @ 24V dc
Safety description
Terminals 1 to 2:
U_m = 253V rms or dc.
8.6V (diode). This voltage must be considered when calculating the load capacitance.
Non-energy-storing apparatus ≤1.5V, ≤0.1A and ≤25mW; can be connected without further certification into any IS loop with an open-circuit voltage <28V

MTL4544/S – MTL5544/S REPEATER POWER SUPPLY

two channel, 4/20mA, HART®, for 2- or 3- wire transmitters

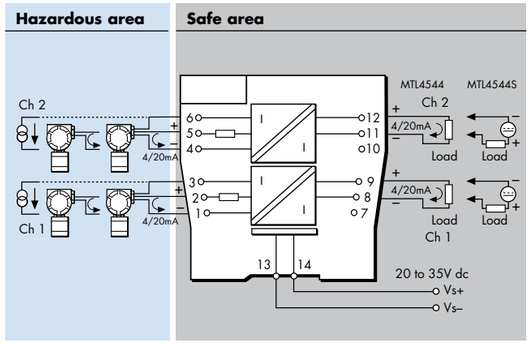
The MTLx544 provides fully-floating dc supplies for energising two conventional 2-wire or 3-wire 4/20mA or HART transmitters located in a hazardous area, and repeats the current in other circuits to drive two safe-area loads. For smart transmitters, the unit allows bi-directional transmission of digital communication signals superimposed on the 4/20mA loop current. Alternatively, the MTLx544S acts as a current sink for a safe-area connection rather than driving a current into the load.

SPECIFICATION

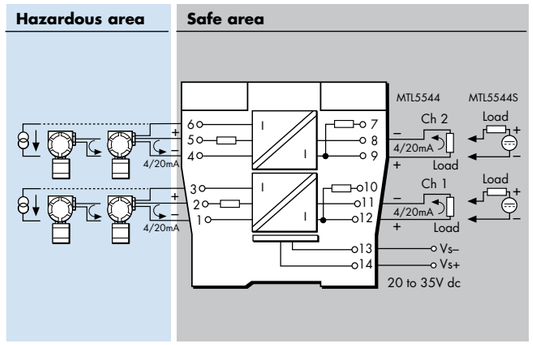
See also common specification

Number of channels
Two
Location of transmitter
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A hazardous location
Safe-area output
Signal range: 4 to 20mA
Under/over-range: 0 to 24mA
Safe-area load resistance (MTLx 544)
@ 24mA: 0 to 360Ω
@ 20mA: 0 to 450Ω
Safe-area load (MTLx544S)
Current sink: 600Ω max.
Maximum voltage source: 24V dc
Safe-area circuit output resistance: > 1MΩ
Safe-area circuit ripple
< 50µA peak-to-peak
Hazardous-area input
Signal range: 0 to 24mA (including over-range)
Transmitter voltage: 16.5V at 20mA
Transfer accuracy at 20°C
Better than 15µA
Temperature drift
< 0.8µA/°C
Response time
Settles to within 10% of final value within 50µs
Communications supported
HART (terminals 1 & 2 and 4 & 5 only)

MTL4544 / MTL4544S



MTL5544 / MTL5544S



LED indicator
Green: power indication
Maximum current consumption (with 20mA signals)
96mA at 24V dc
Power dissipation within unit (with 20mA signals)
MTLx544 1.4W @ 24V dc
MTLx544S 1.9W @ 24V dc
Safety description (each channel)
Terminals 2 to 1 and 3, and 5 to 4 and 6:
V_o=28V I_o=93mA P_o=651mW U_m = 253V rms or dc
Terminals 1 to 3 and 4 to 6:
Simple apparatus ≤1.5V, ≤0.1A and ≤25mW; can be connected without further certification into any IS loop with an open-circuit voltage <28V
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

COOPER Crouse-Hinds

MTL4544A/AS – MTL5544A/AS CURRENT REPEATER

4/20mA passive input for HART® transmitters

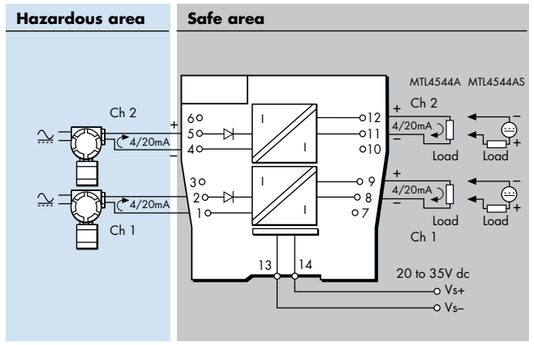
The MTLx544A provides an input for separately powered 4/20mA transmitters and also allows bi–directional transmission of HART communication signals superimposed on the 4/20mA loop current, so that the transmitter can be interrogated either from the operator station or by a hand-held communicator (HHC). Alternatively, the MTLx544AS acts as a current sink for a safe-area connection rather than driving a current into the load.

SPECIFICATION

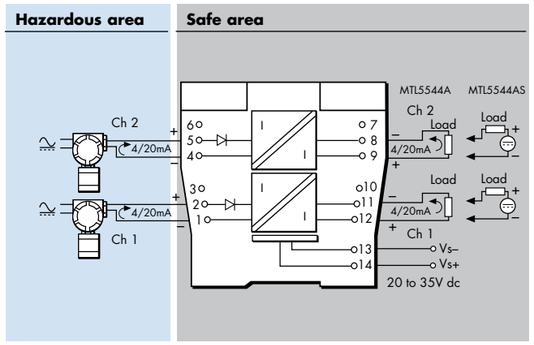
See also common specification

Number of channels
Two
Location of transmitter
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div.1, Group A, hazardous loc ation
Hazardous area input
Signal range: 4 to 20mA
Under/over-range: 1.0 to 21.5mA
Input impedance for HART signals
at terminals 1, 2 and 4, 5: > 230Ω
Maximum input volt drop
at terminals 1, 2 and 4, 5: < 6.6V
i.e. a transmitter load of 330Ω at 20mA
Safe-area output
Signal range: 4 to 20mA
Under/over-range: 1.0 to 21.5mA
Safe-area load resistance (MTL5544A)
Conventional transmitters: 0 to 360Ω
Smart transmitters: 250Ω ±10%
Safe-area load (MTL5544AS)
Current sink: 600Ω max.
Maximum voltage source: 24V DC
Safe-area circuit output resistance: > 1MΩ
Safe–area circuit ripple
< 50µA peak-to-peak up to 80kHz
Transfer accuracy at 20°C
Better than 20µA
Temperature drift
< 1µA/°C
Response time
Settles within 200µA of final value after 20ms
Communications supported
HART

MTL4544A/AS



MTL5544A/AS



LED indicator
Green: power indication
Power requirement (with 20mA signal)
70mA at 24V
85mA at 20V
50mA at 35V
Power dissipation within unit (with 20mA signals)
MTLx544A 1.5W @ 24V dc
MTLx544AS 2.0W @ 24V dc
Safety description
Terminals 1 to 2 and 4 to 5:
U_m = 253V rms or dc.
8.6V (diode). This voltage must be considered when calculating the load capacitance.
Non-energy-storing apparatus ≤1.5V, ≤0.1A and ≤25mW; can be connected without further certification into any IS loop with an open-circuit voltage < 28V

MTL4544D – MTL5544D REPEATER POWER SUPPLY

single channel, 4/20mA, HART® for 2- or 3-wire transmitters, two outputs

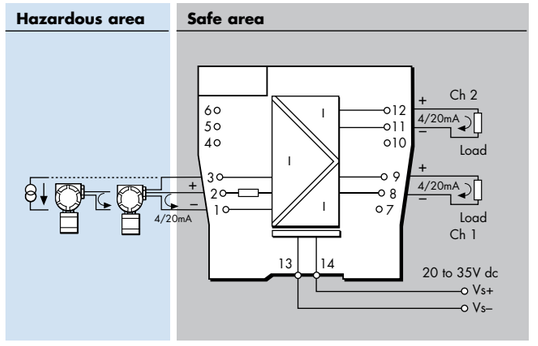
The MTLx544D provides a fully-floating dc supply for energising a conventional 2- or 3-wire 4/20mA transmitter located in a hazardous area, and repeats the current in other circuits to drive two safe-area loads. For HART 2-wire transmitters, the unit allows bi-directional transmission of digital communication signals superimposed on the 4/20mA loop current.

SPECIFICATION

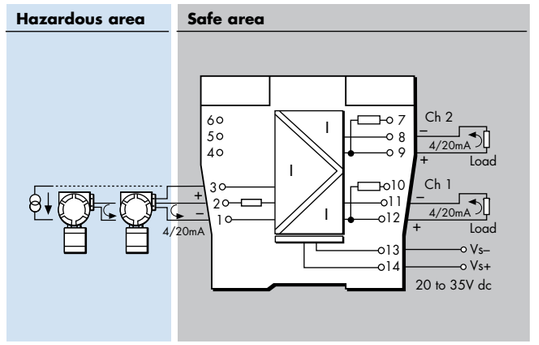
See also common specification

Number of channels
One
Location of transmitter
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A hazardous location
Safe-area output
Signal range: 4 to 20mA
Under/over-range: 0 to 24mA
Safe-area load resistance
@ 24mA: 0 to 360Ω
@ 20mA: 0 to 450Ω
Safe-area circuit output resistance: > 1MΩ
Safe-area circuit ripple
< 50µA peak-to-peak
Hazardous-area input
Signal range: 0 to 24mA (including over-range)
Transmitter voltage: 16.5V at 20mA
Transfer accuracy at 20°C
Better than 15µA
Temperature drift
< 0.8µA/°C
Response time
Settles to within 10% of final value within 50µs
Communications supported
HART (terminals 1 & 2, output Ch 1 only)

MTL4544D

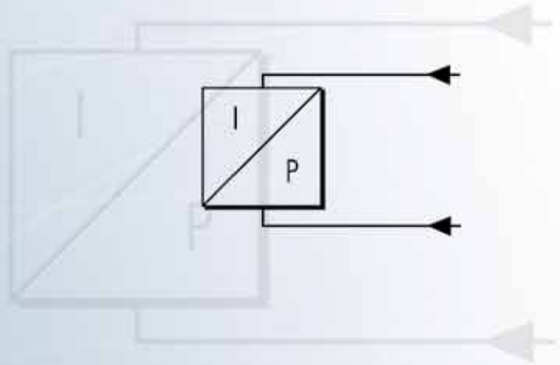


MTL5544D



LED indicator
Green: power indication
Maximum current consumption (with 20mA signals)
96mA at 24V dc
Power dissipation within unit (with 20mA signals)
1.4W @ 24V dc
Safety description
Terminals 2 to 1 and 3:
V_o=28V I_o=93mA P_o=651mW U_m = 253V rms or dc
Terminals 1 to 3:
Simple apparatus ≤1.5V, ≤0.1A and ≤25mW; can be connected without further certification into any IS loop with an open-circuit voltage <28V
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

COOPER Crouse-Hinds



Isolator Applications:

ANALOGUE OUTPUT - CONTROLLER OUTPUTS, I/P CONVERTERS				
Backplane Device	DIN-rail Device	No. of channels	Output to hazardous area	Important features
MTL4546	MTL5546	1	1mA <Io<24mA Vmax = 16V	Suitable for HART valve positioners, LFD
MTL4546C MTL4546Y	MTL5546C MTL5546Y	1	1mA <Io<24mA Vmax = 16V	Suitable for HART valve positioners, open cct LFD
MTL4549	MTL5549	2	1mA <Io<24mA Vmax = 16V	Suitable for HART valve positioners, LFD
MTL4549C MTL4549Y	MTL5549C MTL5549Y	2	1mA <Io<24mA Vmax = 16V	Suitable for HART valve positioners, open cct LFD

MTL4546/C/Y – MTL5546/Y ISOLATING DRIVER

for 4–20mA HART® valve positioners with line fault detection

The MTLx546 accepts a 4/20mA floating signal from a safe-area controller to drive a current/pressure converter (or any other load up to 800Ω) in a hazardous area. For HART valve positioners, the module also permits bi-directional transmission of digital communication signals. Process controllers with a readback facility can detect open or short circuits in the field wiring: if these occur, the current taken into the terminals drops to a preset level. The MTL4546C and the MTLx546Y are very similar to the MTLx546 except that they provide open circuit detection *only* (i.e. no short-circuit detection).

SPECIFICATION

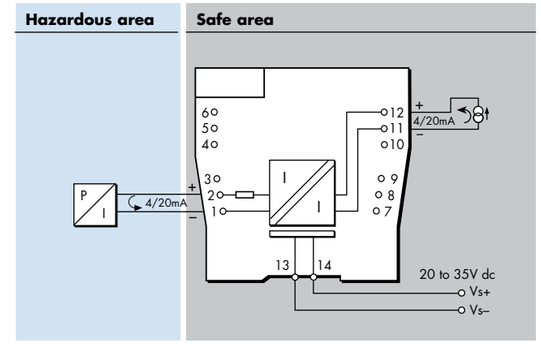
See also common specification

Number of channels
One
Location of I/P converter
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A, hazardous location
Working range
4 to 20mA
Digital signal bandwidth
500Hz to 10kHz
Maximum load resistance
800Ω (16V at 20mA)
Minimum load resistance
90Ω (short-circuit detection at < 50Ω)
Output resistance
> 1MΩ
Under/over range capability
Under range = 1mA
Over range = 24mA (load ≤ 520Ω)
Input and output circuit ripple
< 40µA peak-to-peak
Transfer accuracy at 20°C
Better than 20µA
Temperature drift
< 1.0µA/°C
Input characteristics

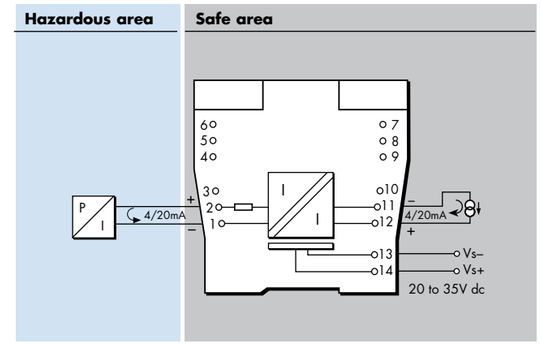
Field wiring state	MTLx546	MTL4546C	MTLx546Y
Normal	< 6.0V	< 6.0V	< 6.0V
Open-circuit	< 0.9mA	< 0.9mA	< 0.5mA
Short-circuit	< 0.9mA	N.A.	N.A.

Response time
Settles within 200µA of final value within 100ms
Communications supported
HART

MTL4546/C/Y



MTL5546/Y



LED indicator
Green: power indication
Maximum current consumption (with 20mA signals into 250Ω load)
35mA at 24V dc
Power dissipation within unit (with 20mA signals into 250Ω load)
0.8W at 24V
Safety description
V_o=28V I_o=93mA P_o=651mW U_m = 253V rms or dc
SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.

COOPER Crouse-Hinds

MTL4549/C/Y - MTL5549/Y ISOLATING DRIVER

two-channel, for 4–20mA, HART® valve positioners with line fault detection

The MTLx549 accepts 4/20mA floating signals from safe-area controllers to drive 2 current/pressure converters (or any other load up to 800Ω) in a hazardous area. For HART valve positioners, the module also permits bi-directional transmission of digital communication signals. Process controllers with a readback facility can detect open or short circuits in the field wiring: if these occur, the current taken into the terminals drops to a preset level. The MTL4549C and MTLx549Y are very similar to the MTLx549 except that they provide open circuit detection *only* (i.e. no short-circuit detection).

SPECIFICATION

See also common specification

Number of channels
Two

Location of I/P converter
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A, hazardous location

Working range
4 to 20mA

Digital signal bandwidth
500Hz to 10kHz

Maximum load resistance
800Ω (16V at 20mA)

Minimum load resistance
90Ω (short-circuit detection at < 50Ω)

Output resistance
> 1MΩ

Under/over range capability
Under range = 1mA
Over range = 24mA (load ≤ 520Ω)

Input and output circuit ripple
<40µA peak-to-peak

Communications supported
HART

Transfer accuracy at 20°C
Better than 20µA

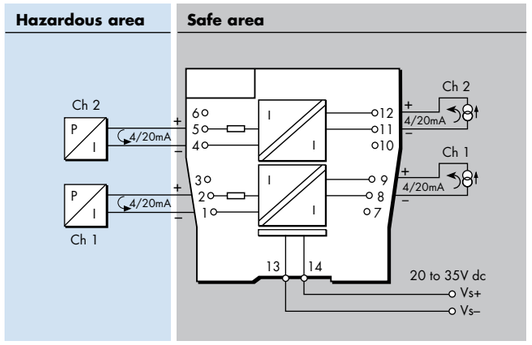
Temperature drift
< 1.0µA/°C

Input characteristics

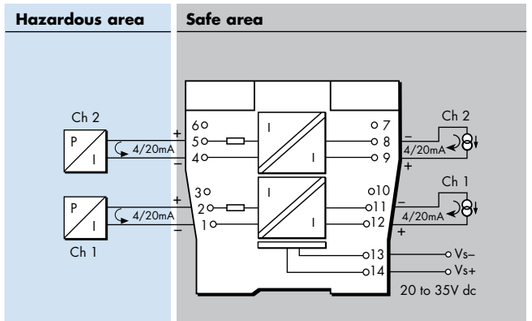
Field wiring state	MTL4549	MTL4549C	MTL4549Y
Normal	< 6.0V	< 6.0V	< 6.0V
Open-circuit	< 0.9mA	< 0.9mA	< 0.5mA
Short-circuit	< 0.9mA	N.A.	N.A.

Response time
Settles within 200µA of final value within 100ms

MTL4549/C/Y



MTL5549/Y



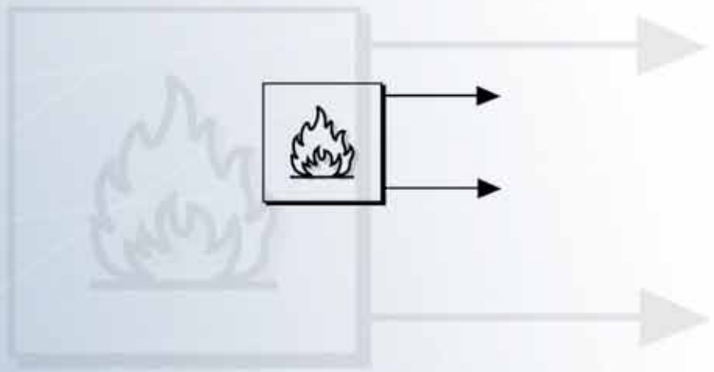
LED indicator
Green: power indication

Maximum current consumption (with 20mA signals into 250Ω load)
70mA at 24V dc

Power dissipation within unit (with 20mA signals into 250Ω load)
1.6W at 24V

Safety description (each channel)
V_o=28V I_o=93mA P_o=0.65W U_m = 253V rms or dc

SIL capable
These models have been assessed for use in IEC 61508 functional safety applications. See data on MTL web site.



Isolator Applications:

ANALOGUE INPUT - TRANSMITTERS, 4-20mA CONVENTIONAL AND 'SMART'

Backplane Device	DIN-rail Device	No. of channels	Output to hazardous area	Important features
MTL4561	MTL5561	2	Loop powered	0-40mA, fire and smoke detectors

COOPER Crouse-Hinds

MTL4561 – MTL5561 FIRE AND SMOKE DETECTOR INTERFACE

two-channel

The MTLx561 is a loop-powered 2–channel interface for use with conventional fire and smoke detectors located in hazardous areas. In operation, the triggering of a detector causes a corresponding change in the safe–area current. The unit features reverse input polarity protection, while 'no-fail' earth fault detection on either line can be provided by connecting an earth leakage detector to terminal 3 and/or 6.

SPECIFICATION

See also common specification

Number of channels
Two, fully floating, loop powered

Location of fire and smoke detectors
Zone 0, IIC, T4–6 hazardous area if suitably certified
Div. 1, Group A, hazardous area

Input voltage
6 to 30V dc

Current range
1 to 40mA, nominal

Quiescent safe–area current at 20°C
(hazardous–area terminals open circuit)
< 400µA at Vin = 24V per channel

Integral input polarity protection
Input circuit protected against reverse polarity

'No-fail' earth fault protection
Enabled by connecting terminals 3 and/or 6 to an earth leakage detector (see notes)
Fault on either line of each channel proclaimed: unit continues working

Notes:
1. To maintain isolation between the two channels, separate earth leakage detectors are needed.
2. The earth leakage detectors introduce a 100µA, 1Hz ripple to the field circuit.

Minimum output voltage Vout at 20°C
For Vin ≤ 25V: Vout = Vin – (0.38 x current in mA) – 2V
For Vin > 25V: Vout = 22.5V – (0.35 x current in mA)

Maximum output voltage
28V from 300Ω

Transfer accuracy at 20°C
Better than 400µA

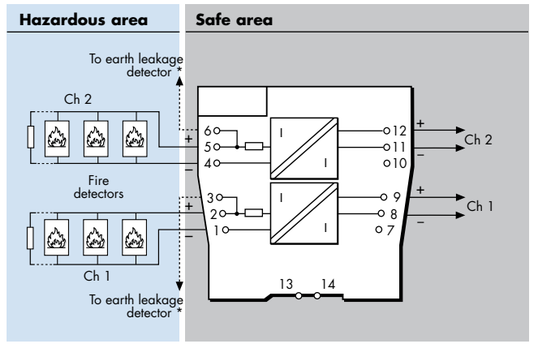
Temperature drift
< 4µA/°C (0°C to 60°C)
< 15µA/°C (–20°C to 0°C)

Response time to step input
Settles to within 5% of final value within 1.5ms

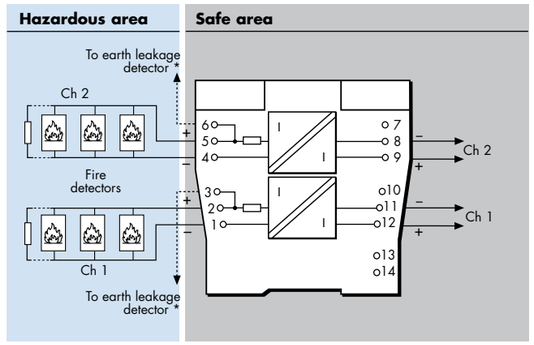
Power dissipation within unit
0.7W maximum at 24V with 40mA signal (each channel)
0.9W maximum at 30V with 40mA signal (each channel)

Safety description for each channel
V_o=28V I_o=93mA P_o=0.65W U_m = 253V rms or dc

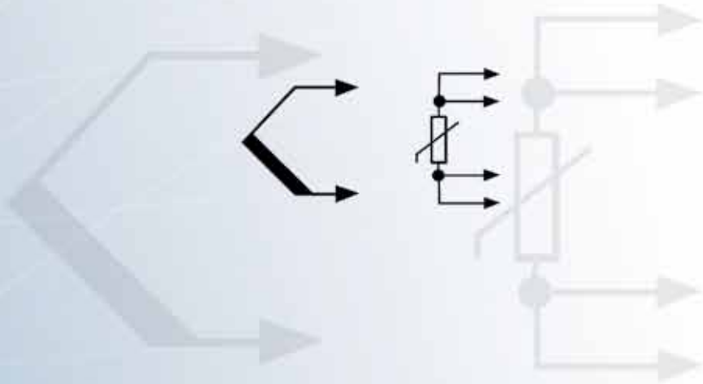
MTL4561



MTL5561



*Signal plug HAZ1-3 is required for access to this function



Isolator Applications:

TEMPERATURE INPUT - THERMOCOUPLE AND mV SOURCES, THC				
Backplane Device	DIN-rail Device	No. of channels	Input from hazardous area	Important features
MTL4575	MTL5575	1	Thermocouple or mV sources	Configurable linearised converter, trip alarm, early burn-out detect
MTL4576-THC	MTL5576-THC	2	Thermocouple or mV sources	Configurable linearised converter, early burn-out detect, custom options

TEMPERATURE INPUT - RESISTANCE SENSORS, RTD				
Backplane Device	DIN-rail Device	No. of channels	Input from hazardous area	Important features
MTL4575	MTL5575	1	Pt, Cu, Ni sensors 2/3/4 wire	Configurable linearised converter, trip alarm, early burn-out detect
MTL4576-RTD	MTL5576-RTD	2	Pt, Cu, Ni sensors 2/3 wire	Configurable linearised converter, early burn-out detect, custom options

COOPER Crouse-Hinds

MTL4575 – MTL5575 TEMPERATURE CONVERTER

THC or RTD input + Alarm

The MTLx575 converts a low-level dc signal from a temperature sensor mounted in a hazardous area into a 4/20mA current for driving a safe-area load. Software selectable features include linearisation, ranging, monitoring, testing and tagging for all thermocouple types and 2-, 3- or 4-wire RTDs. (For thermocouple applications the HAZ-CJC plug on terminals 1–3 includes an integral CJC sensor). Configuration is carried out using a personal computer. A single alarm output is provided and may be configured for high or low process alarm or to provide notice of early thermocouple failure.

SPECIFICATION

See also common specification

Number of channels
One
Signal source
THC types J, K, T, E, R, S, B or N to BS 60584 and XK
mV input
RTDs 2/3/4-wire platinum to BS 60751
Pt 100, Pt 500, Pt 1000
Cu-50 & Cu-53
Ni 100/500/1000 DIN 43760
Location of signal source
Zone 0, IIC, T4-6 hazardous area
Division 1, Group A, hazardous location
Input signal range
–75 to +75mV, or 0 to 400Ω (0 to 1000Ω Pt & Ni sensors)
Input signal span
3 to 150mV, or 10 to 400Ω (10 to 1000Ω Pt & Ni sensors)
RTD excitation current
200µA nominal
Cold junction compensation
Automatic or selectable
Cold junction compensation error
≤ 1.0°C
Common mode rejection
120dB for 240V at 50Hz or 60Hz (500ms response)
Series mode rejection
40dB for 50Hz or 60Hz
Calibration accuracy (at 20°C)
(includes hysteresis, non-linearity and repeatability)
Inputs: (500ms response)

mV/THC:	± 15µV or ± 0.05% of input value (whichever is greater)
RTD:	± 80mΩ
Output:	± 11µA

Temperature drift (typical)
Inputs:

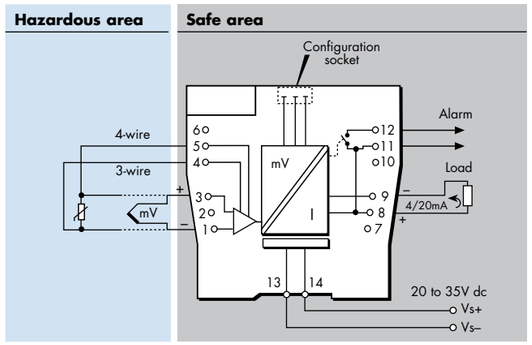
mV/THC:	± 0.003% of input value/°C
RTD:	± 7mΩ/°C
Output:	± 0.6µA/°C

Example of calibration accuracy and temperature drift (RTD input - 500ms response)

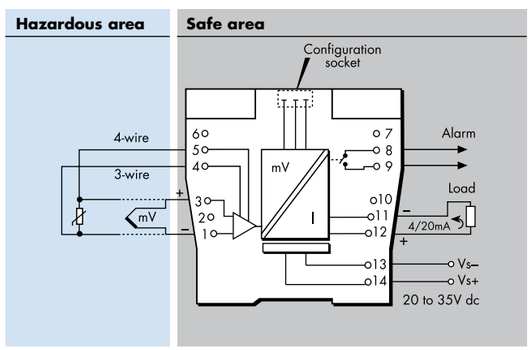
Span:	250Ω
Accuracy:	± (0.08/250 + 11/16000) x 100% = 0.1% of span
Temperature drift:	± (0.007/250 x 16000 + 0.6) µA/°C = ±1.0µA/°C

Safety drive on sensor failure
Upscale, downscale, or off
Early burnout
Early burnout detection for thermocouples (when selected)
Alarm trips when loop resistance increase is > 50Ω
Output range
4 to 20mA nominal into 600Ω max. (direct or reverse)
Alarm output (configurable)
Relay ON in alarm, 250mA @ 35V max
Maximum lead resistance (THC)
600Ω
Response time
Configurable - 500 ms default
(Accuracy at 100/200ms - contact MTL)
LED indicator
Green: power and status indication
Yellow: alarm indication, on when contacts are closed
Maximum current consumption (with 20mA signal)
50mA at 24V
Power dissipation within unit (with 20mA signal)
1.2W at 24V
Safety description
Refer to certificate for parameters. Um=253V rms or dc
Configurator
A personal computer running MTL PCS45 software with a PCL45USB serial interface.

MTL4575



MTL5575



MTL4576-RTD – MTL5576-RTD TEMPERATURE CONVERTER

RTD/potentiometer input, 2 ch

The MTLx576–RTD converts signals from resistance temperature detectors (RTDs) mounted in a hazardous area, into 4/20mA currents for driving safe-area loads. Software selectable features include input type and characterisation, ranging, monitoring, testing and tagging. Configuration is carried out using a personal computer. The MTLx576–RTD is compatible with 2– and 3–wire RTD inputs.

SPECIFICATION

See also common specification

Number of channels
Two
Signal source
2-/3-wire RTDs to BS 60751
Pt 100, Pt 500, Pt 1000
Cu-50 & Cu-53
Ni 100/500/1000 DIN 43760
Location of signal source
Zone 0, IIC, T4–6 hazardous area
Division 1, Group A, hazardous location
Input signal range
0 to 400Ω (0 to 4000Ω Pt & Ni sensors)
Input signal span
10 to 400Ω (10 to 1000Ω Pt & Ni sensors)
RTD excitation current
200µA nominal
Common mode rejection
120dB for 240V at 50Hz or 60Hz
Series mode rejection
40dB for 50Hz or 60Hz
Calibration accuracy (at 20°C)
(includes hysteresis, non-linearity and repeatability)

Input:	± 80mΩ
Output:	± 16µA

Temperature drift (typical)

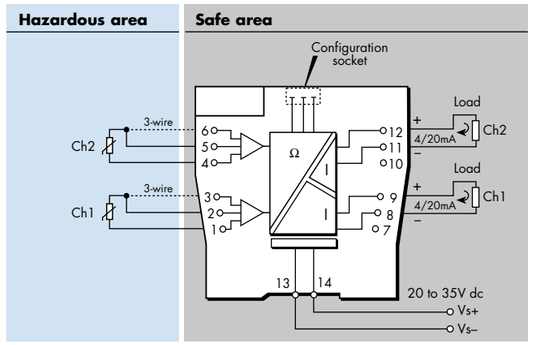
Input:	± 7mΩ/°C
Output:	± 0.6µA/°C

Example of calibration accuracy and temperature drift (RTD input)

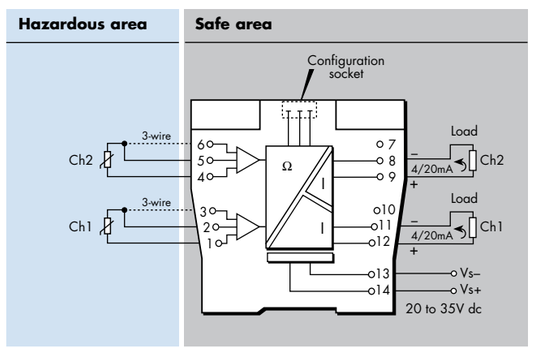
Span:	250Ω
Accuracy:	± (0.08/250 + 16/16000) x 100% = 0.13% of span
Temperature drift:	± (0.007/250 x 16000 + 0.6) µA/°C = ±1.0µA/°C

Safety drive on sensor failure
Upscale, downscale, or off
Output range
4 to 20mA nominal into 300Ω max. (direct or reverse)
Response time
Configurable - 500 ms default
(Accuracy at 100/200ms - contact MTL)
LED indicator
Green: power and status indication
Yellow: one provided for channel status
Red: alarm indication
Power requirement, Vs with 20mA signal
60mA at 24V
Power dissipation within unit with 20mA signal
1.4W at 24V
Isolation
Functional channel–channel isolation for safe and hazardous–area circuits
Safety description
Refer to certificate for parameters. Um=253V rms or dc
Configurator
A personal computer running MTL PCS45 software with a PCL45USB serial interface.

MTL4576-RTD



MTL5576-RTD



COOPER Crouse-Hinds

MTL4576-THC – MTL5576-THC TEMPERATURE CONVERTER

mV/THC input, 2 ch

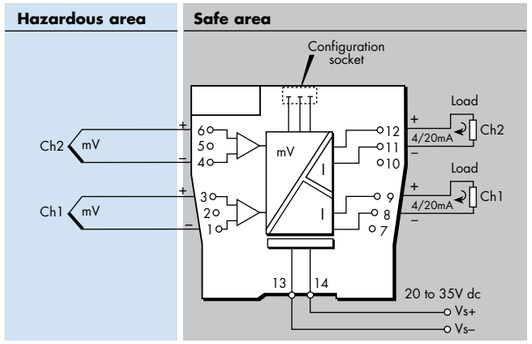
The MTLx576–THC converts low–level dc signals from temperature sensors mounted in a hazardous–area into 4/20mA currents for driving safe–area loads. Software selectable features include linearisation for standard thermocouple types, ranging, monitoring, testing and tagging. Configuration is carried out using a personal computer. The hazardous–area connections include cold–junction compensation and do not need to be ordered separately.

SPECIFICATION

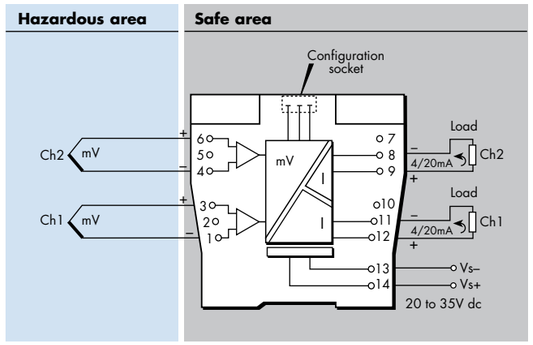
See also common specification

Number of channels
Two
Signal source
THC types J, K, T, E, R, S, B or N to BS 60584 and XK
mV input
Location of signal source
Zone 0, IIC, T4–6 hazardous area
Division 1, Group A, hazardous location
Input signal range
–75 to +75mV
Input signal span
3 to 150mV
Cold junction compensation
Automatic or selectable
Cold junction compensation error
≤ 1.0°C
Common mode rejection
120dB for 240V at 50Hz or 60Hz
Series mode rejection
40dB for 50Hz or 60Hz
Calibration accuracy (at 20°C)
(includes hysteresis, non-linearity and repeatability)
Input: ±15µV or ±0.05% of input value (whichever is greater)
Output: ±16µA
Temperature drift (typical)
Input: ±0.003% of input value/°C
Output: ±0.6µA/°C
Safety drive on sensor burnout
Upscale, downscale, or off
Output range
4 to 20mA nominal into 300Ω max. (direct or reverse)
Maximum lead resistance
300Ω
Response time
Configurable - 500 ms default
(Accuracy at 100/200ms - contact MTL)

MTL4576-THC



MTL5576-THC



LED indicator
Green: power and status indication
Yellow: one provided for channel status
Red: alarm indication
Power requirement, Vs with 20mA signal
60mA at 24V
Power dissipation within unit with 20mA signal
1.4W at 24V
Isolation
Functional isolation channel–channel for safe and hazardous–area circuits.
Safety description
Refer to certificate for parameters. Um=253V rms or dc
Configurator
A personal computer running MTL PCS45 software with a PCL45USB serial interface.

Isolator Applications:

GENERAL PURPOSE MODULES AND ACCESSORIES		
Backplane Device	DIN-rail Device	Important features
MTL4599	MTL5599	Dummy isolator modules for securing spare cable cores
MTL4599N		Feed-through for non-IS signals onto backplane
	MPA5500	Mains power supply for individual MTL5500 module
	MTL5991	Mains power supply, 24V, 2A capacity
	MTL5500 powerbus kit	Links power to 8, 16, 24, 32 MTL5500 modules
CPSxx		Standard backplanes for 4, 8, 16, 24 MTL4500 modules
PCL45USB / PCS45		Hardware adaptor for configuration of converter modules, together with pc software

Other mounting and connection accessories for both product ranges are identified within the following pages

COOPER Crouse-Hinds

MTL4599 - MTL5599 DUMMY ISOLATOR

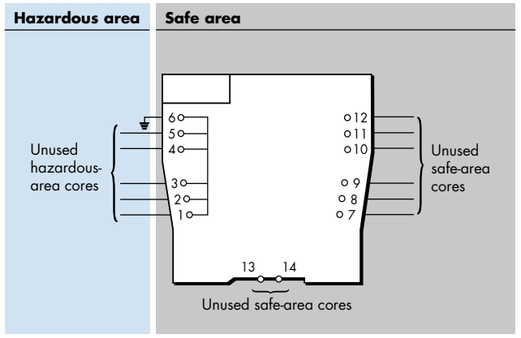
The primary function of the MTLx599, which can be used with all other MTLx500 Series units, is to provide termination and earthing facilities for unused cable cores from hazardous areas.

SPECIFICATION

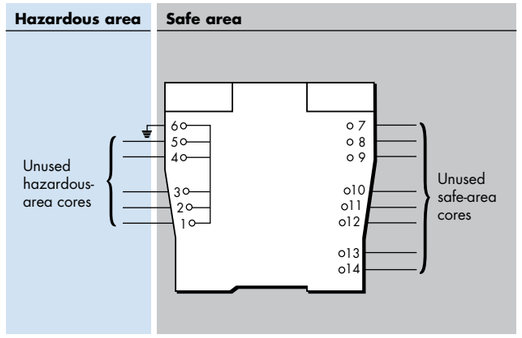
See also common specification

Weight
60g

MTL4599



MTL5599



MTL4599N GENERAL PURPOSE FEED-THROUGH MODULE

The feed–through termination module allows non–IS connections to the MTL4500 backplanes. The wires from the field are connected using screw terminals. Six terminals are provided for each contact of the multiway connector on the backplane. The terminals and cables conform to IS regulations so that non–IS and IS signals can be mixed on the same backplane.

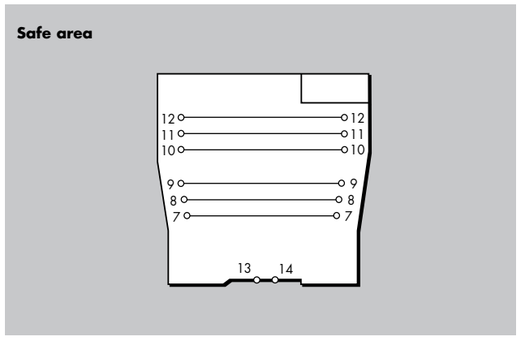
Note: Must not be used with signals >50V or >0.25A

SPECIFICATION

See also common specification

Weight
60g

MTL4599N



MTL4500 - MTL5500 SERIES COMMON SPECIFICATIONS

Please go to our website at www.mtl-inst.com for the latest information regarding safety approvals, certificates and entity parameters.

Connectors
Each unit is supplied with signal connectors, as applicable. When using crimp ferrules for the hazardous or non-hazardous (safe) signal connectors the metal tube length should be 12mm and the wire trim length 14mm.

Isolation
250V rms, tested at 1500V rms minimum, between safe- and hazardous-area terminals.
50V between safe-area circuits and power supply

Supply voltage
20 – 35V dc

Location of units
Safe area

Terminals
Accepts conductors of up to 2.5mm² stranded or single-core

Mounting
MTL4500
MTL4500 series backplanes
MTL5500
T-section 35mm DIN rail (7.5 or 15mm) to EN 50022

Ambient temperature limits
–20 to +60°C (–6 to +140°F) operating
–40 to +80°C (–40 to +176°F) storage

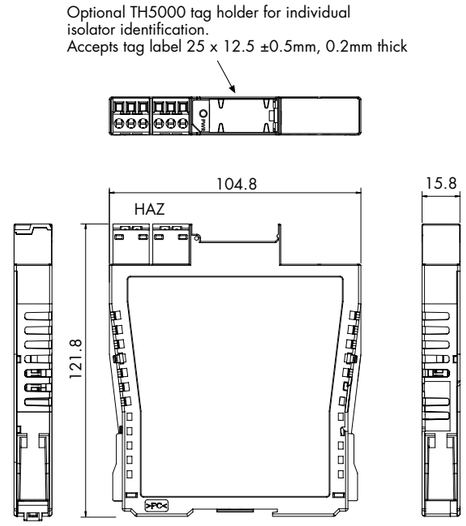
Humidity
5 to 95% relative humidity

Weight
MTL4500 140g
MTL5500 150g
Approximate (except where indicated)

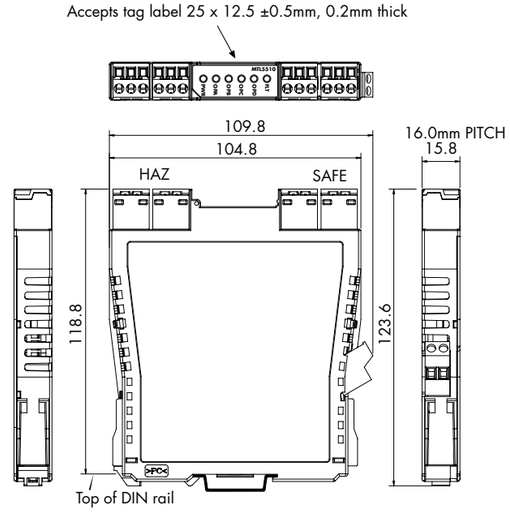
HART® *is a registered trademark of HART Communication Foundation*

DIMENSIONS (mm)

MTL4500



MTL5500

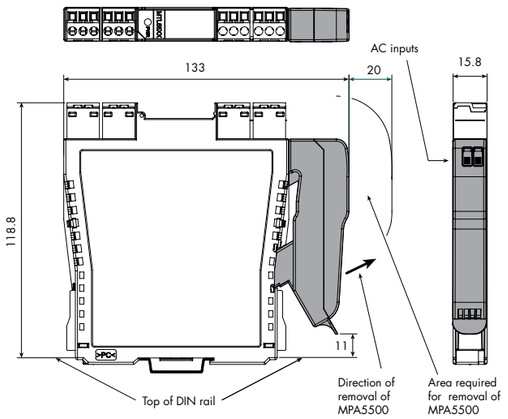


COOPER Crouse-Hinds

MPA5500
A.C. POWER ADAPTOR

The MPA5500 enables any MTL5500 Series module that is normally powered from a nominal 24V DC supply (i.e. those that are not loop-powered) to be powered from a high-voltage AC supply.

It plugs into the power socket (terminals 13 and 14) of an MTL5500 module and clips securely onto the module housing. The 25V DC power output from the adaptor is sufficient to supply a single module and can be connected to any normal AC power source.

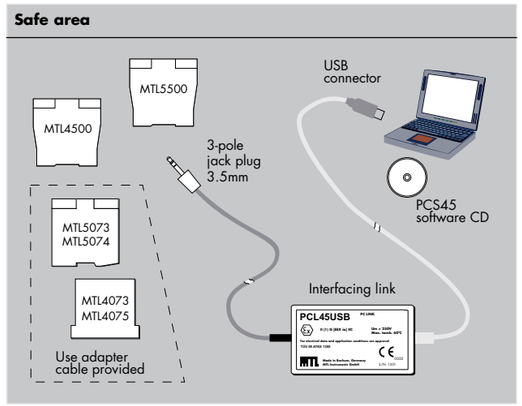


SPECIFICATION

Input voltage
85 – 265V AC, (45–65Hz)
Efficiency
71% typ. at 230V AC
Power dissipation
1.2W typ at 230V AC.
Input terminals
Cage-clamp terminals accommodating conductors up to 1.5mm² stranded or 16AWG single-core
Input protection
internal fuse, not user serviceable
Output voltage
25Vdc ± 10%
Output current
120mA at 25V
Ambient temperature
Operating: –20 to +60°C
Storage: –40 to +80°C
Mounting
Plugs into and clips onto MTL5500 Series I/O module
It is not for use with any equipment other than MTL5500.
Humidity
5 to 95% relative humidity
Mechanical
Ingress Protection: IP20
Material: polycarbonate
Weight: 28g approx.
Standards compliance
EN 61326, EN 61010

PCS45/PCL45USB
CONFIGURATOR
FOR MTL CONVERTERS

The PCS45/PCL45USB configurator allows MTL converters to be configured from a standard PC running a Microsoft® Windows® operating system. It comprises PC software, provided on a CD (PCS45), and an ATEX certified interfacing link (PCL45USB). Converters can be configured from the safe area, while on-line, and configurations can be saved to disk and printed out when required. It is suitable for use with MTL4000, MTL4500, MTL5000 and MTL5500 series products.

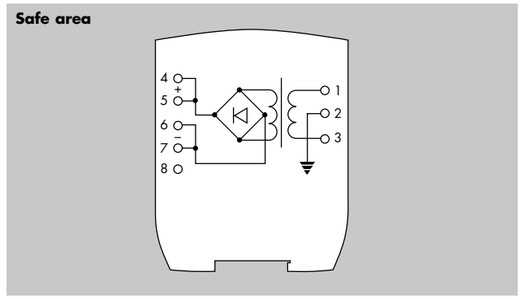


SPECIFICATION

PCL45USB hardware
Location
Safe area
Connections
PC side: USB B(F) socket
Converter side: cable with 3.5mm jackplug, 3-pole for MTL4500 and MTL5500 series converters. An adapter cable is provided for other earlier MTL converters.
Cable lengths
Converter side (fitted): 1.5m
USB cable A(M) to B(M) (supplied): 2m
Ambient temperature limits
–10°C to +60°C operating
–20°C to +70°C storage
Humidity
5 to 95% relative humidity (non-condensing)
Weight
200g
PCS45 Configuration software
Compatible with Windows 2000 or Windows XP.
Consult MTL for operation with any other operating system, e.g. Windows Vista™.
Software medium
PCS45 supplied on CD
Updates are available at www.mtl-inst.com
Recommended minimum PC configuration
Microsoft Windows 2000 or Windows XP
20MB of available hard disc space
CD ROM drive
Available USB port
Printer (local or network)

MTL5991
24V DC POWER SUPPLY

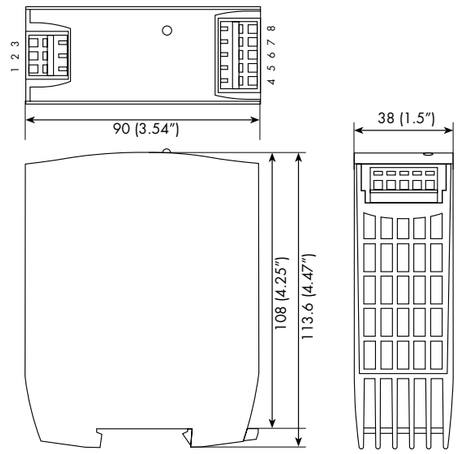
A DIN-rail mounted unit for locations where a dc supply is not readily available. The wide input power supply range makes this unit universally applicable and the 24V dc , 2A output will drive a useful number of MTL5000 and MTL5500 series modules.



SPECIFICATION

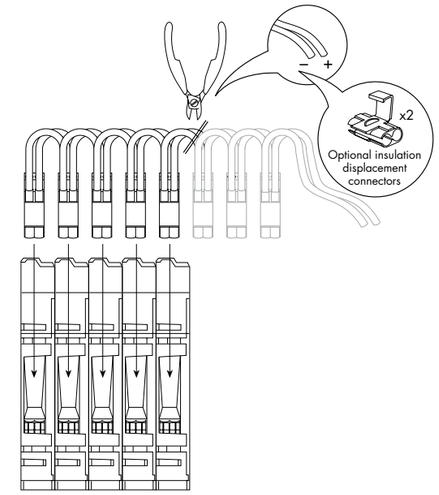
Power supply
85 to 264V ac 47 to 63Hz
Power dissipation within unit
7.2W @ 2A
Mounting
35mm DIN (top hat) rail
Output voltage
24V dc nom (23.64 min/24.36 max)
Output current
2A maximum (1.7A with <105V ac input)
LED indicators
Green: Power indication
Weight
310g
Ambient temperature
Operating temperature –10°C to +50°C
Storage temperature –40°C to +85°C
Terminals
Cage clamp type accommodating conductors up to 2.5mm², stranded or single-core

Note: Segregation between hazardous and safe area wiring must be maintained.



MTL5500 SERIES
POWERBUS KITS
PB - 8T,16T,24T,32T

A quick and easy way to distribute DC power to MTL5500 Series modules. Each powerbus kit includes 4 single ferrules, 4 twin ferrules and 2 insulation displacement connectors (Scotchlok).



SPECIFICATION

Available in 4 different lengths:
PB - 8T = 8 connectors and loops
PB - 16T = 16 connectors and loops
PB - 24T = 24 connectors and loops
PB - 32T = 32 connectors and loops
Insulation material :
PVC
Conductor :
24 strands of 0.2mm dia (0.75mm²) standard copper
Insulation thickness :
0.5 to 0.8 mm
Current rating :
12A max
Operating temperature range :
- 20°C to +60°C
Max voltage drop on 32 modules drawing 130mA max :
0.5V

CHOOSING A POWERBUS KIT

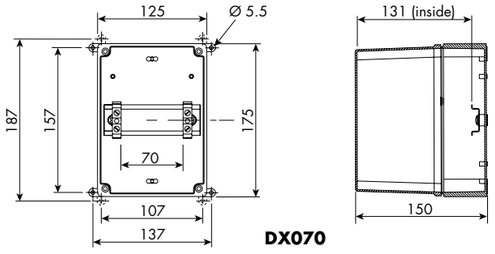
Choose a powerbus where the number of power plugs is greater than or equal to the number of isolators to be powered and if necessary cut the powerbus to the required number of terminations.

Note: To reduce the risk of excessive voltage drop or overcurrent do not connect powerbuses in series.

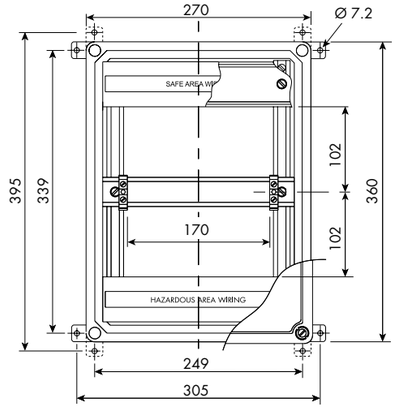
COOPER Crouse-Hinds

MTL5500 SERIES ENCLOSURES

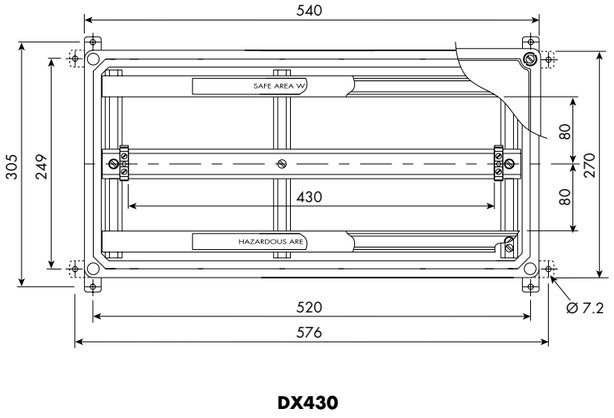
DIMENSIONS (mm) AND MOUNTING



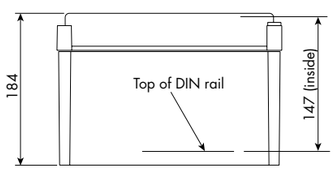
DX070

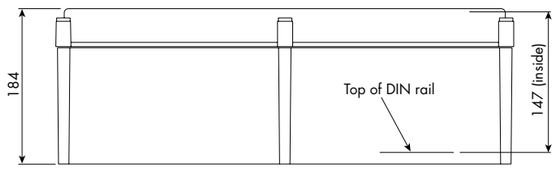


DX170



DX430





SPECIFICATION

Construction
Glass reinforced polycarbonate base - DX070
Glass reinforced polyester base - DX170, DX430
Transparent polycarbonate lid

Protection
Dust-tight and water-jet proof to IEC529:IP65

Lid fixing
Captive fixing screws

Weight (excluding barriers/isolators) kg

DX070	0.8
DX170	2.6
DX430	4.1

Items provided
DIN rail - fitted
ETL7000 Earth terminals (2 x) - fitted
"Take care IS" front adhesive label
Cable trunking (except DX070)
Note: Isolators are not included.

Mounting
Wall fixing lugs provided. For further details refer to INM5500.

Tagging and earth rail
Accommodates MTL5500 Series accessories.

Permitted location
- Safe (non-hazardous) area

Note: N. America/Canada - Enclosures are rated NEMA 4X so can be used in Class 1, Division 2 (gases) location, but check with local requirements and ensure all cable entries also conform. Additional warning label will be required on or near the enclosure, see installation details. Not suitable for Class II or III, Division 2 hazardous locations.

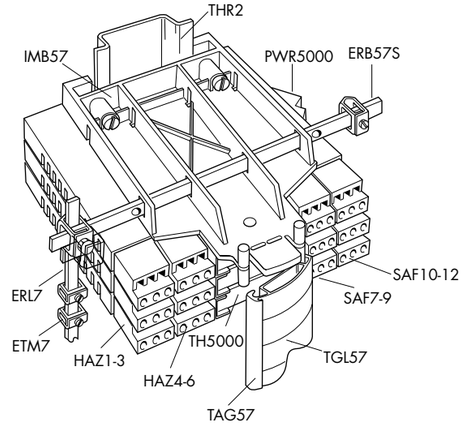
Approximate capacities (on DIN rail between earth terminals)
* Use these figures when IMB57 mounting blocks for tagging/earth are included.

	Number of MTL5500 isolators	
DX070	4	(2)*
DX170	10	(8)*
DX430	26	(24)*

Ambient temperature limits
Dependent on units fitted. See instruction manual INM5500.

MTL5500 SERIES ACCESSORIES

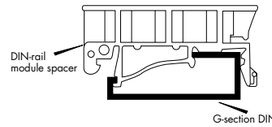
MTL5500 Series isolators mount quickly and easily onto standard DIN rail. A comprehensive range of accessories simplifies earthing and tagging arrangements.



MOUNTING

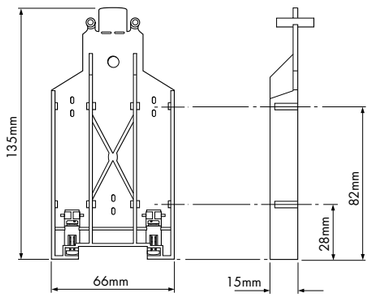
THR2 DIN rail,1m length
DIN rail to EN50022; BS5584; DIN46277

MS010 DIN rail module spacer, 10mm, pack of 5
Grey spacer, one required between each MTL5995 and any adjacent module on a DIN rail, to provide 10mm air-circulation space between modules

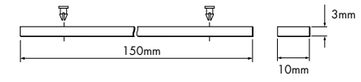


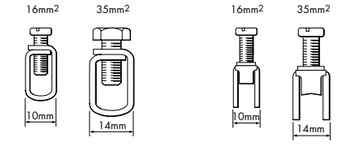
EARTH RAIL AND TAG STRIP

IMB57 Insulating mounting block
One required at each end of a tagging strip/earth rail. Suitable for low-profile (7.5mm) and high-profile (15mm) symmetrical DIN rail.

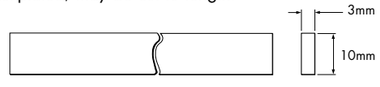


ERB57S Earth-rail bracket, straight
Nickel-plated; supplied with two push fasteners, one (14mm, 35mm²) earth-rail clamp and one (10mm, 16mm²) earth clamp.

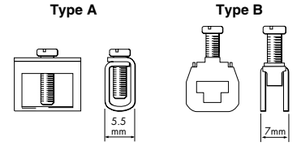




ERL7 Earth rail, 1m length
Nickel-plated; may be cut to length.



ETM7 Earth terminal, bag of 50
For terminating cable screens and 0V returns on the ERL7 earth rail. For cables ≤ 4mm². Exact dimension dependent on manufacturer.

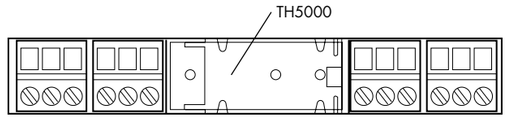


TAG57 Tagging strip, 1m length
Cut to size. Supplied with tagging strip label suitable for MTL5000 or MTL5500 modules.

TGL57 Tagging strip labels, set of 10 x 0.5m
Spares replacement, for use with TAG57 tagging strip. Suitable for MTL5000 or MTL5500 modules.

INDIVIDUAL ISOLATOR IDENTIFICATION

TH5000 tag holders
Each isolator may be fitted with a clear plastic tag holder, as shown below. Order TH5000, pack of 20.



CONNECTORS

Each MTL5500 unit is supplied with signal and power connectors, as applicable.

Spares replacement connectors are available separately; see ordering information.

See also
'MTL5500 Series powerbus kits'

COOPER Crouse-Hinds

CUSTOM, STANDARD AND UNIVERSAL BACKPLANES FOR EASY DCS INTEGRATION

- **Total flexibility**
- **Reduce wiring**
- **Simplify installation**
- **Special functions**
- **Signal conditioning**
- **HART® integration**

The MTL4500 Series backplanes, enclosures and other accessories provide comprehensive, flexible and remarkably compact mounting facilities for system vendors, original equipment manufacturers and end users alike.

Customised backplanes

MTL provides a complete design and manufacturing service for customised backplanes. Customised backplanes give the vendors and users of process control and safety systems the opportunity to integrate MTL4500/HART® modules directly into their system architecture. As there are no hazardous-area circuits on the backplanes, customised versions can be produced without the need for IS certification, so simplifying design and lowering costs.

Universal custom backplanes

The 'universal' backplane allows a fast and economic approach to providing a custom interface. Where tight time schedules exist, the backplane can be installed to allow the panel building and wiring to be completed. The customised adapter card can then be plugged in at any time up to integrated test.

Adapter cards

Adapter cards already exist for many of the DCS companies. In addition there is a range of general purpose cards that offer reduced wiring for use with specific MTL modules. These are also available in left- and right-hand versions to ease panel wiring.

Standard MTL backplanes

Standard MTL backplanes are available to accommodate 4, 8, 16, or 24 modules using screw-clamp connectors for the safe-area circuits. On an individual backplane, any module can be plugged into any position and module types can be mixed. For 8-, 16- and 24-way backplanes, screw-clamp connectors which plug into the backplanes provide primary and secondary 24V dc power supplies. Power to several 8- or 16-way backplanes can be interconnected to reduce and simplify wiring – see instruction manual **INM4500** for details.

Optional accessories

Optional accessories include colour coded tagging strip kits for all three sizes of backplane and earth rail kits for 8 and 16-way versions. Mounting accessories are available for surface (all backplanes), T-section and G-section DIN-rail (8- and 16-way versions), and a horizontal plate for mounting 24-way backplanes in 19-inch racks.

Weatherproof enclosures

Weatherproof enclosures are available for applications where separate safe–area enclosures are required for backplanes with modules. Available to accommodate one 4-way or one 8-way backplane, they are manufactured from GRP giving protection against dust and water to IEC529:IP65. The lids are made from transparent high-strength polycarbonate so that LEDs, switches, etc, on the tops of the modules are easy to see.

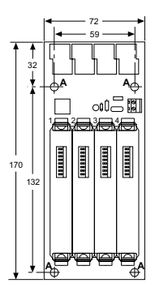
DCS vendors/systems supported:

ABB Automation
S100, INFI90
Rockwell Automation
Bently-Nevada
Foxboro
IA FBM & FBM2xx
Siemens-Moore
APACS, Quadlog
Honeywell
TDC, Plantscape
Honeywell-SMS
FSC
ICS
Triplex, Plantguard
Triconex
Tricon, Trident
Yokogawa
Centum XL, µXL, CS1000, CS3000, R3
Yokogawa Industrial Safety Systems
ProSafe & ProSafe RS

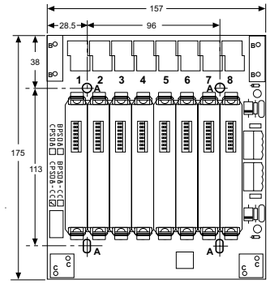
MTL CPS STANDARD BACKPLANES

Backplane model no.	Number of modules	Safe-area connections	MOUNTING KITS			ACCESSORIES		
			Surface	DIN–rail (T or G)	19–inch rack	Earth–rail kit	Tagging strip kit	Spare fuse pack
CPS04	4	Screw–clamp	SMS01	DMK01	–	–		FUS1.0ATE5
CPS08	8	Screw–clamp	SMS01	DMK01	–	ERK08	TSK08	FUS1.0ATE5
CPS16	16	Screw–clamp	SMS01	DMK01	–	ERK16	TSK16	FUS2.0ATE5
CPS24	24	Screw–clamp	SMS01	DMK01	HMP24	–	TSK24	FUS4.0ATE5

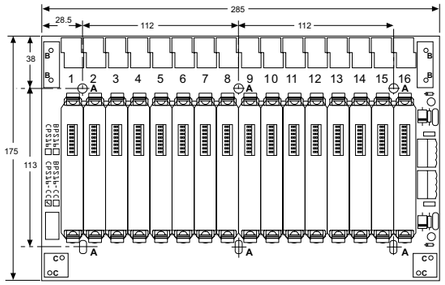
CPS BACKPLANE dimensions (mm)



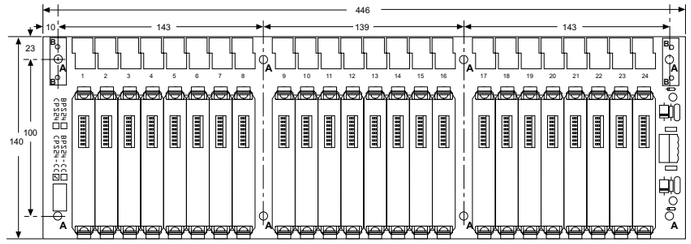
CPS04



CPS08



CPS16

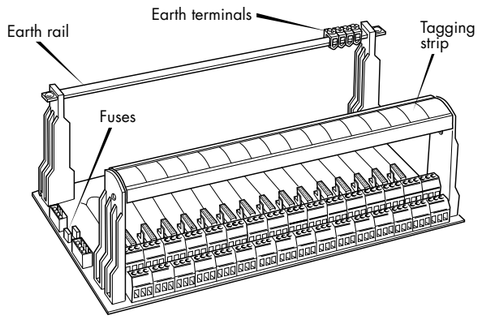


CPS24

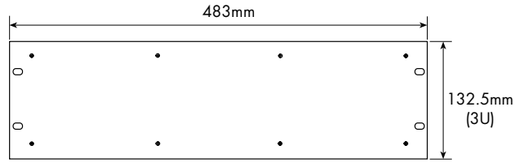
Power requirements, Vs
21V dc to 35V dc through plug-in connectors
Safe–area connections
CPS: 2.5mm² screw-clamp terminals – 6 positions per module
Power sense
Through separate plug-in crimp connector
Weight (without modules or accessories)

CPS04:	96g
CPS08:	225g
CPS16:	419g
CPS24:	592g

Backplane accessories



HMP24 mounting plate for 19 inch rack



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ORDERING INFORMATION

MTL4500/5500 Series isolators
Specify part number: eg, **MTL4511, MTL5575**

Individual isolator identification

TH5000	Tag holder (Pack of 20)

Connectors - MTL4500 & MTL5500

HAZ1-3	Hazardous-area plug, terminals 1, 2 and 3
HAZ4-6	Hazardous-area plug, terminals 4, 5 and 6
HAZ-CJC	Hazardous-area plug, terminals 1 and 3 with cold-junction sensor
HAZ-CJC2	Hazardous-area plug, terminals 4 and 6 with cold-junction sensor
SAF1-3	Safe-area plug, terminals 1, 2 and 3
SAF4-6	Safe-area plug, terminals 4, 5 and 6

Connectors - MTL5500 only

SAF7-9	Safe-area plug, terminals 7, 8 and 9
SAF10-12	Safe-area plug, terminals 10, 11 and 12
PWR5000	Power connector, terminals 13 and 14

PowerBus - MTL5500 only

PB-8T	Powerbus Kit for up to 8 isolators
PB-16T	Powerbus Kit for up to 16 isolators
PB-24T	Powerbus Kit for u p to 24 isolators
PB-32T	Powerbus Kit for up to 32 isolators

MTL5500 Mounting accessories

THR2	1m length of DIN rail to EN 50022; BS 5584; DIN 46277
MS010	DIN-rail module spacer, 10mm (pack of 5)

MTL5500 Earth-rail and tag strip accessories

IMB57	Insulating mounting block
ERB57S	Earth-rail bracket, straight
ERL7	Earth-rail, 1m length
ETM7	Earth terminal, bag of 50
TAG57	Tagging strip, 1m length
TGL57	Tagging strip labels, set of 10 x 0.5m

MTL5500 Enclosures

DX070	Enclosure for MTL5500 x 4
DX170	Enclosure for MTL5500 x 10
DX430	Enclosure for MTL5500 x 26

MTL4500 Standard Backplanes

CPS04	4-way backplane screw-clamp connector
CPS08	8-way backplane screw-clamp connector
CPS16	16-way backplane screw-clamp connector
CPS24	24-way backplane screw-clamp connector

MTL4500 Custom Backplanes
Contact MTL for options and advice

MTL4500 Backplane mounting accessories

DMK01	DIN-rail mounting kit, T- or G-section (pack of 40) 8-way backplanes require 4, 16-way backplanes require 6
SMS01	Surface mounting kit (pack of 40) 4- and 8-way backplanes require 4, 16-way backplanes require 6, 24-way backplanes require 8
HMP24	Horizontal mounting plate and screws for 19-inch rack mounting 24-way backplanes only
BMK08	Mounting kit for one 4- or 8-way backplane
BMK16	Mounting kit for one 16-way backplane

MTL4500 Backplane accessories

ERK08	Earth rail kit for CPS08 backplane
ERK16	Earth rail kit for CPS16 backplane
TSK08	Tagging strip kit for CPS08 backplane
TSK16	Tagging strip kit for CPS16 backplane
TSK24	Tagging strip kit for CPS24 backplane
FUS1.0ATE5	Fuse kit for 4- and 8-way backplanes, (10 per pack)
FUS2.0ATE5	Fuse kit for 16-way backplane, (10 per pack)
FUS4.0ATE5	Fuse kit for 24-way backplanes, (10 per pack)
MCK45	MTL4000 backplane conversion kit (16 clip pairs per pack)
MPL01	Module position label (blank) (50 per pack)

Literature

INM5500	MTL5500 Series instruction manual
INM4500	MTL4500 Series instruction manual

Configurator and software

PCL45USB	Configurator, PC interface and software
PCS45	PC software

Please go to our website at www.mtl-inst.com for the latest information regarding safety approvals, certificates and entity parameters.

HART® Multiplexers

MTL provides the connections between HART field instruments, control systems and process automation management software.

Whether for a new installation or the upgrade of an existing facility, MTL provides solutions for traditional I/O and process systems in both IS and general purpose applications.

The HART® protocol is a powerful communication technology used to realise the full potential of digital field devices whilst preserving the traditional 4-20mA analogue signal. HART® provides simultaneous analogue and digital operation so that the 4-20mA analogue signal can be connected to conventional I/O cards or modules for measurement and control, while the digital signal can be used for monitoring process variables, accessing device status and diagnostics, or implementing configuration changes.

MTL's HART® connections provide the means to make full use of these features. By connecting field instruments, control systems and instrument management software, MTL's HART® connections allow better use of maintenance resources, reduced commissioning and process down-time, and consequent lower costs for commissioning and loop maintenance.

There are two types of HART® multiplexer to suit new or existing installations:

- The new MTL4850 compact 32-channel module
- The well established MTL4840 Series with 16-channel modularity.

Both of these product lines offer a full range of connection support elements and will link with most instrument management software packages by use of the relevant driver or definition files.

HART® is a registered trademark of HART Communication Foundation

COOPER Crouse-Hinds

HART® Multiplexer

MTL4850

- **Designed to mount directly to a range of customised connection units**
- **Designed for use in SIL3 loops (non interfering)**
- **Connect over 2000 loops on one RS485 network**
- **Auto baud rate detection**
- **LED indication for fault diagnosis**
- **Isolated Power Supply**
- **Firmware upgradeable**
- **Onboard Diagnostics**
- **Alarm output**

The MTL4850 HART multiplexer provides a simple interface between smart devices in the field, control/safety systems and HART® instrument management software running on a PC.

The system is based on 32-channel modularity to provide a compact, easily configurable and expandable system. Using a standard RS485 serial link, up to 2016 individual HART devices can be connected to a single network.

For the optimum solution, the MTL4850 mounts directly to either a range of generic or customised connection units/backplanes.

Connectivity to HART Configuration and Instrument Management Software

The online access to the information contained within HART devices allows users to diagnose field device troubles before they lead to costly problems. Software can capture and use diagnostic data from HART field instruments via the MTL HART connection hardware. This allows users to realise the full potential of their field devices to optimise plant assets, which results in significant operations improvement and direct maintenance savings.

IMS products provide essential configuration, calibration, monitoring and maintenance history functions for conventional analogue (4-20 mA) and HART protocol compatible smart process instruments and field devices. They deliver powerful tools to meet the need for standardised instrument maintenance procedures and record keeping mandated by some quality standards and regulatory bodies.

The benefits of utilising these powerful software packages online include:

- Reduced commissioning time and costs
- Reduced maintenance costs
- Reduced documentation
- Reduced process downtime

The MTL4850 offers connectivity to a comprehensive range of FDT based software packages via the comms Device Type Manager (DTM). The DTM can be downloaded from www.mtl-inst.com. Other software packages work with the MTL4850 through custom software drivers or by the inclusion of the device description (DD) file for the MTL multiplexers

SPECIFICATION

Number of channels
32
Channel transmitter type
HART rev 5 – 7
Channel interface
2 connections to each channel field loop (64 total)
Host system interface
RS485 2-wire multidrop
(up to 63 MTL4850 modules can be connected to one host)
RS485 baud rate
38400, 19200, 9600, 1200 baud - (auto-detected)
Address selection
8-bit interface, up to 64 addresses
Alarm output (Open Collector - Referenced to 0V)
V_{max} = 35V, I_{max} = 5mA, P_{max} = 100mW

ISOLATION
Channel-to-channel isolation
50V dc
Field loop isolation
50V dc
Module is coupled to loops via capacitor in each connection leg (i.e. 2 capacitors per channel)
RS485 interface isolation (Between module and interface)
25V dc
Alarm output isolation (Between module and output)
50V dc
PSU isolation (Between module and PSU input)
50V dc

POWER
Supply voltage
19V to 35V dc
Currrent consumption
60mA at 24V ±10%
Power dissipation
<1.6W at 24V ±10%
PSU protection
Reversed polarity protected
Fused (375mA)

ENVIRONMENTAL
Temperature range
Operating: –40°C to +70°C
Non-operating: –40°C to +85°C
Relative humidity
5% to 95% - non-condensing

MECHANICAL
Dimensions
See drawing
Weight
125 g

Compatible FDT Frames include:-

FDT Frame	Manufacturer
FieldCare	Endress & Hauser/Metso Automation
PACTware	PACTware Consortium
FieldMate	Yokogawa
FDT Container	M&M Software

Approvals

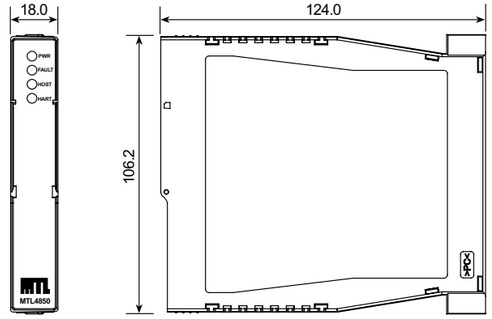
Zone 2 mounting	ATEX & IECEx
Div 2 mounting	CSA, FM & FMC

For full details of approvals and certification refer to the MTL website - see below.

LED INDICATORS

LED	Colour	State	Description
PWR	green	Off	Multiplexer is not receiving power
		On	Multiplexer is receiving power
FAULT	red	Off	Multiplexer is in the running state
		Steady flash	Multiplexer rebuild is in progress
		Short/long flash	No HART loops found
		On (steady)	A fault was detected and multiplexer operation was halted
HOST	yellow	Off	No communication on the channel
		Short flash (0.25 sec)	Correctly framed message received by the multiplexer
		Long flash (1 sec)	Response transmitted—this is re-triggerable so repeated transmissions will leave the indicator permanently on
HART	yellow	Off	No communication on the channel
		Short flash (0.25 sec)	Message transmitted
		Long flash (1 sec)	Response transmitted—this is re-triggerable so repeated transmissions will leave the indicator permanently on

DIMENSIONS (mm)

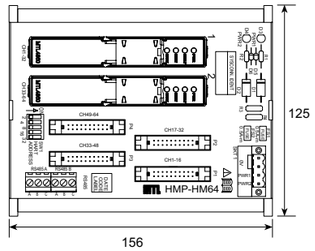


COOPER Crouse-Hinds

MTL4850 BACKPLANE SPECIFICATIONS GENERAL PURPOSE VERSIONS

HMP-HM64 BACKPLANE

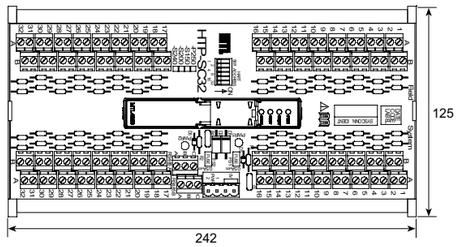
Capacity
2 x MTL4850 HART multiplexer modules
Maximum power requirements
2.9W when equipped with –
2 x MTL4850 HART multiplexers modules
HART interface connectors
4 x DIN41651 20-way HART signal cables
(16 HART signal connections + 4 common returns on each cable. Connections to HART signals via screw terminal interface or custom backplane. Contact MTL for details.)
Weight (excl. modules and accessories)
220g approx.



HMP-HM64

HTP-SC32 BACKPLANE *

Capacity
1 x MTL4850 HART multiplexer module
Maximum power requirements
1.4W
Weight (excl. modules and accessories)
330g approx.



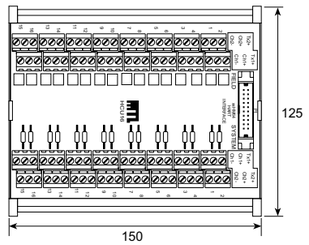
HTP-SC32

COMMON SPECIFICATION HMP-HM64 & HTP-SC32

Power requirements, Vs
21 to 35V dc through plug-in connectors
Mounting
Supplied fitted in DIN-rail (T- or G- section) carrier
RS485 port
2.5mm² screw terminals

HCU16 HART CONNECTION UNIT*

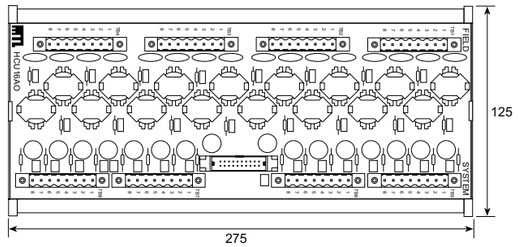
Accuracy (HCU16-P250 only)
250Ω ±0.05%
Connectors
2.5mm² screw clamp terminals
3 terminals per channel
20-way HART signal cable (to HMP-HM64)
Weight
383g approx.



HCU16

HCU16AO CONNECTION UNIT WITH FILTERS

Series impedance
dc < 2Ω
HART signal > 240Ω
Connectors
2.5mm² removable screw clamp terminals
2 terminals per channel in groups of 4 channels
20-way HART signal cable (to HMP-HM64)
Weight
768g approx.



HCU16AO

COMMON SPECIFICATION HCU16 & HCU16AO

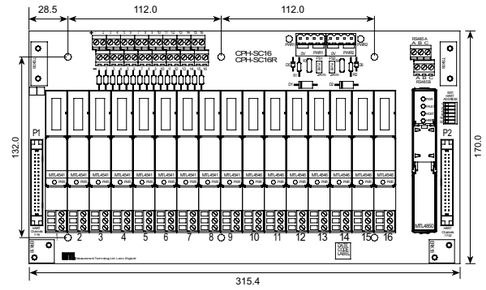
Capacity
16 channels
Isolation
Channel-to-channel 50V dc
Mounting
Supplied fitted in DIN-rail (T- or G- section) carrier

* for further details of the model options refer to the Instruction Manual INM4850 - available from the MTL website.

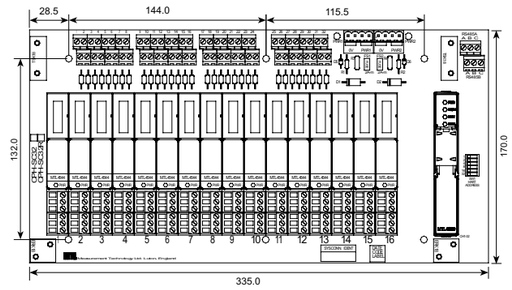
MTL4850 BACKPLANE SPECIFICATIONS INTRINSIC SAFETY VERSIONS

CPH-SC16/CPH-SC32 BACKPLANES

Capacity
16 x MTL4541/A, MTL4546/Y isolators
16 x MTL4544/A, MTL4549/Y (CPH-SC32 only)
1 x MTL4850 HART multiplexer
Power requirements, Vs
21 to 35V dc through plug-in connectors
Maximum power requirements
CPH-SC16 0.65A
CPH-SC32 1.2A
Safe-area connectors
2.5mm² screw terminals (2 terminals/module)
RS485 port
2.5mm² screw terminals
Accuracy
CPH-SCxxR: 250Ω ±0.05% conditioning resistor
Weight (excl. modules and accessories)
CPH-SC16 410g approx.
CPH-SC32 470g approx.



CPH-SC16(R)



CPH-SC32(R)

CUSTOMISED CONNECTION UNITS

MTL offers a range of general purpose and IS interfaces providing direct connection with control system I/O cables as well as HART® connectivity. For general purpose signals, a number of custom HART® interface termination units are available for most DCS and PLC I/O cards. These replace the existing DCS termination units, saving space and allowing easy upgrading. Please contact MTL for details.

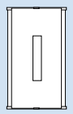
ORDERING INFORMATION

HART multiplexer

MTL4850	HART multiplexer module (connects with up to 32 loops)

General purpose connection units

HMP-HM64	64ch HART backplane (Link to connection units via signal cable)
HCU16 †	HART connection unit, 16ch i/p
HCU16-P250 †	HART connection unit, 16ch i/p
HCU16-S150 †	HART connection unit, 16ch i/p
HCU16-S200 †	HART connection unit, 16ch i/p
HCU16AO	HART connection unit, 16ch o/p (With HART filters)
HM64RIB20-xx	20-way HART signal cable xx = 0.5, 1.0, 1.5, 2.0, 3.0, 4.0, 4.5, 6.0 (metres)



Integrated connection units

HTP-SC32 †	Integrated HART connection unit, 32ch
HTP-SC32-P250 †	Integrated HART connection unit, 32ch
HTP-SC32-S150 †	Integrated HART connection unit, 32ch
HTP-SC32-S200 †	Integrated HART connection unit, 32ch
HTP-SC32-S240 †	Integrated HART connection unit, 32ch

† *See Notes*

MTL4500 Series backplanes

CPH-SC16	16ch backplane
CPH-SC16R	16ch backplane, (250Ω conditioning resistor)
CPH-SC32	32ch backplane
CPH-SC32R	32ch backplane, (250Ω conditioning resistor)

Literature

INM4850	MTL4850 Instruction manual
INA4850	ATEX safety instructions

Notes:

no suffix	No parallel resistor, 0Ω link in series - for use with current inputs with 250 ohm input impedance or HART compatible outputs
-P250	250Ω parallel resistor, 0Ω link in series - for use with 1-5V system inputs
-S150	150Ω series link, no parallel resistor - for use with current inputs with 100 ohm input conditioning
-S200	200Ω series link, no parallel resistor - for use with current inputs with 50 or 63.5 ohm input conditioning
-S240	240Ω series link, no parallel resistor - for use with isolators connected to field terminals.

COOPER Crouse-Hinds

MTL4840 Series

Communicate with, configure and monitor HART® smart devices in safe and hazardous areas

- **SIL3 rating**
- **Connect up to 7936 loops to a single PC**
- **LED indication of loop being scanned**
- **Easily scalable modular system**
- **Compact, ideal for new projects and upgrades**
- **Channel to channel isolation option**
- **HART signal conditioning**

The MTL4840 HART® connection system provides a simple interface between smart devices in the field and HART® instrument management software run on a PC.

The system is based on 16-channel modularity to provide a compact, easily configurable and expandable system. Using a standard RS485 serial link, up to 7936 individual HART® devices can be connected to a single workstation.

For the optimum solution, choose from a range of general purpose and IS termination boards. For maximum flexibility the BPHM64 HART® backplane locates an MTL4841 communications module and up to four MTL4842 interface modules. General purpose HART® connection units and IS backplanes are also available, each fitted with an interface cable for connection to the BPHM64 HART® backplane. MTL4841 and MTL4842 modules can also be located on HMU16 termination boards for general purpose applications or on BPMH16 / BPMH16U / BPSH16 / BPSH16-32 backplanes for IS isolator requirements.

The DIN-rail mounting HCU16 and HCU16AOHART® connect to 16 general purpose field instruments while maintaining channel to channel isolation. Resistor conditioning options are compatible with all I/O cards. It allows pass-through connections for transmitter power supply, input signal and common.

The HCU16AO unit includes HART® filters for I/O cards incompatible with HART® signals.

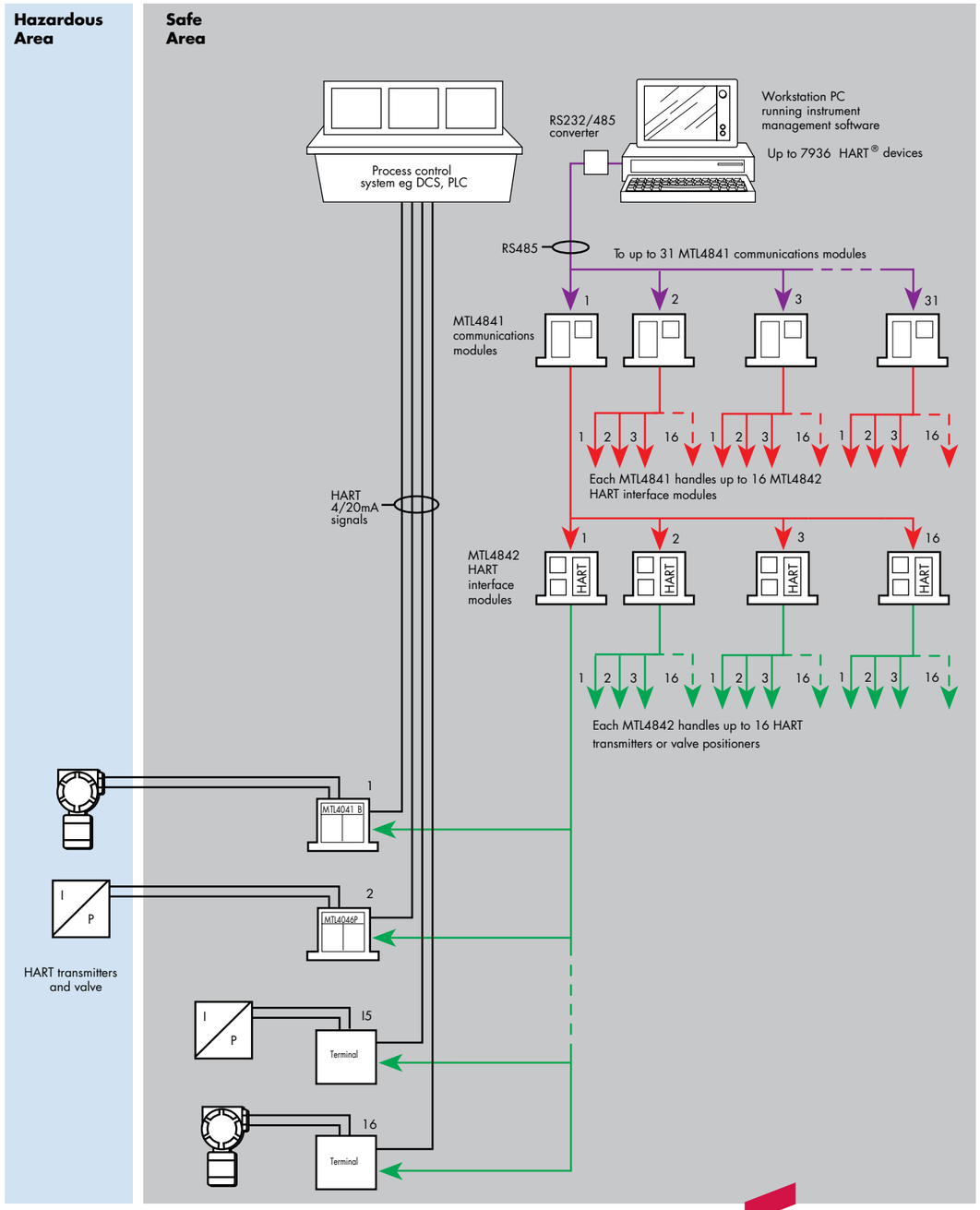
BPMH16/BPMH16U/BPSH16/BPSH16-32 backplanes with MTL4840 HART® modules fitted, connect either 16 or 32 IS field instruments. Adapter cards are available for the BPMH16U for easy integration to I/O cards and users have a choice of a DIN-rail mounting option.

Numerous features may be included in the connection units and backplanes, as required. Channel to channel isolation; resistors where required for HART® signal conditioning; and HART® filters for analogue systems where the output signal interferes with HART® data or becomes unstable with the presence of the HART® signal.

Customised backplanes and connection units are available to provide direct connection from DCS I/O cables, replacing the standard termination board.

MTL HART multiplexers are certified by BASEEFA as a safety related sub-system to IEC61508. See the SR Series Interfaces section of this catalogue.

MTL4840 SERIES SYSTEM DIAGRAM



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MTL4840 SERIES MODULE SPECIFICATIONS

MTL4841 COMMUNICATIONS MODULE

Host system interface
RS485 2-wire multidrop
Up to 31 MTL4841 modules can be connected to one host station
Unit address: switch-selectable on top of module
Isolation
RS485 output isolated from backplane power supply
Serial communication parameters
RS485 Baud rate: 1.2, 9.6, 19.2, 38.4kbaud, switch-selectable on top of module
RS485 highway length: up to 1km
MTL system interface
Links with up to 16 MTL4842 HART® interface modules via interface bus on backplane/ribbon cable
LED indicators
Green: one provided for power and status indication
Power requirements
Powered from backplane
Power consumption
<1.0W
Instrument management software supported
See 'Instrument management software'

MTL4842 HART® INTERFACE MODULE

MTL systems interface
Links up to 16 loops via backplanes
Receives multiplexer control signals via interface bus from MTL4841 and selects one channel for communication
Unit address
Switch selectable on top of module
Interface bus
Total length of interface bus between module 1 and module 16 must not exceed 4m
LED indicators
Green: one provided for power
Amber: one to indicate unit is selected by MTL4841
Red: four to identify loop address
Power requirements
Powered from backplane
Power consumption
<0.1W

MTL4000 SERIES MODULES

(See 'MTL4000 Series' for detailed specifications and circuit diagrams)

MTL4041A: Current repeater, 4/20mA, passive input for smart transmitters

MTL4041B: Repeater power supply, 4/20mA, for 2- or 3-wire transmitters

MTL4041P: High power repeater power supply, 4/20mA, for 2- or 3-wire transmitters

MTL4044: Repeater power supply, 4/20mA, two channel, for 2 wire transmitters

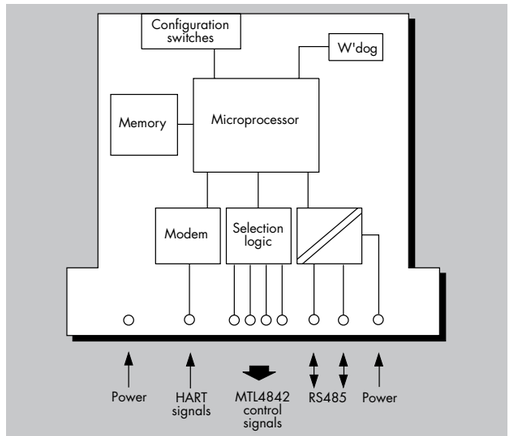
MTL4046/C: Isolating driver, for HART® valve positioners

MTL4046P: High power isolating driver for HART® valve positioners

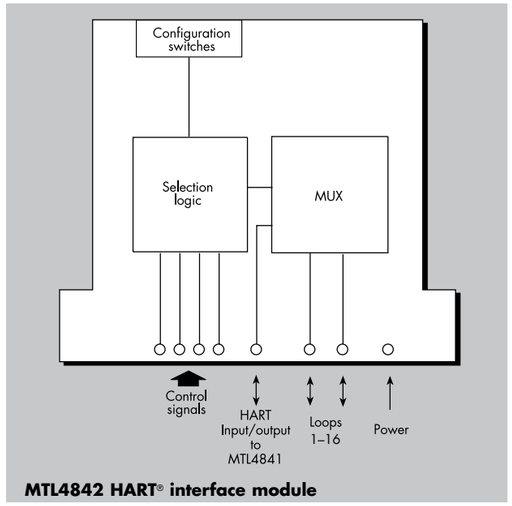
COMMON SPECIFICATION

(applies to all MTL4840 and 4000 Series modules)

Location of units
Safe area (MTL4840 can be located in Div2)
Long-term drift
No recalibration necessary
Ambient temperature limits
–20 to +60°C continuous working
–40 to +80°C storage
Humidity
5 to 95% RH (non-condensing)
Mounting
On surface or DIN-rail mounted MTL or custom backplanes.
Mounting pitch 16mm
Weight
100g approximately

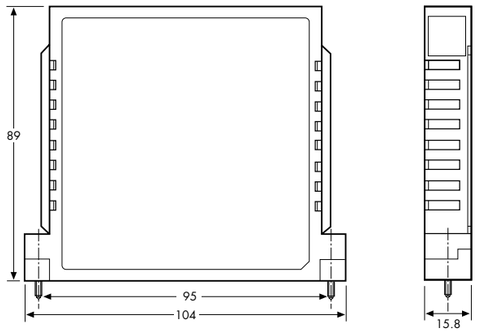


MTL4841 communications module



MTL4842 HART® interface module

DIMENSIONS (MM)



MTL4840 SERIES BACKPLANES SPECIFICATIONS GENERAL PURPOSE VERSIONS

BPHM64 BACKPLANE

Capacity
1 x MTL4841 communications module
4 x MTL4842 HART® interface modules
NB: An MTL4841 module is needed for only one in every sixteen MTL4842 modules
Maximum power requirements
1.35W when equipped with:–
1 x MTL4841 communications module
4 x MTL4842 HART® interface modules
HART interface connectors
4 x DIN41651 20-way ribbon cables
(16 HART® signal connections + 4 common returns on each cable. Connections to HART® signals via screw terminal interface or custom backplane. Contact MTL for details.)
Weight (excl. modules and accessories)
296g approx.

HMU16/32

Capacity
1 x MTL4841 communications module
2 x MTL4842 interface modules
Power requirements, Vs
21 to 35V dc through plug in connectors
Maximum power requirements
1.2W when fully populated
Interface bus connectors
10-way ribbon socket
RS485 port
2.5mm² screw terminals
Mounting
Supplied fitted with DIN-rail (T-or G-section)
Weight (excl. modules and accessories)
330g

COMMON SPECIFICATION BPHM64 & HMU16

Power requirements, Vs
21 to 35V dc through plug-in connectors
Mounting
Supplied fitted with DIN-rail (T- or G- section) carrier
Interface bus connector
10-way ribbon socket
RS485 port
2.5mm² screw terminals

HCU16 HART® CONNECTION UNIT

Accuracy (HCU16-P250 only)
250Ω ±0.05%
Connectors
2.5mm² screw clamp terminals
3 terminals per channel
20-way flat cable (to BPHM64)
Weight
383g

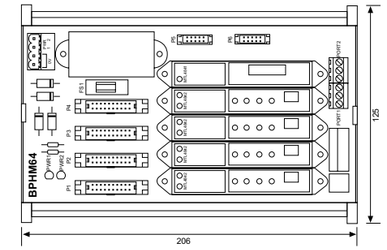
HCU16AO HART® CONNECTION UNIT WITH FILTERS

Series impedance
dc<2Ω
HART® signal >240Ω
Connectors
2.5mm² removable screw clamp terminals
2 terminals per channel in groups of 4 channels
20-way flat cable (to BPHM64)
Weight
768g

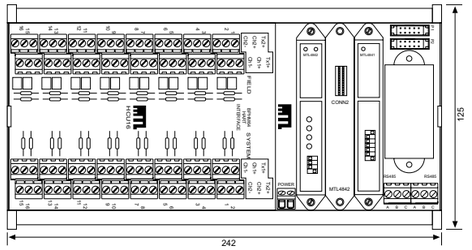
COMMON SPECIFICATION HCU16 & HCU16AO

Capacity
16 channels
Isolation
Channel to channel 50V dc
Mounting
Supplied fitted with DIN-rail (T- or G- section) carrier

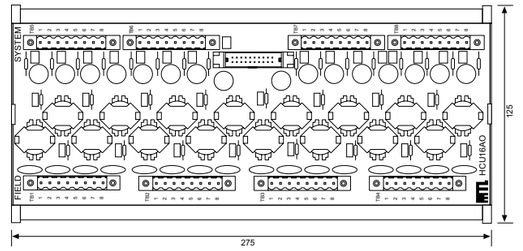
DIMENSIONS (MM)



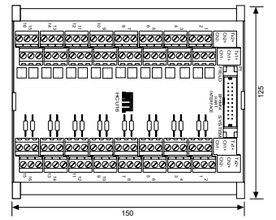
BPHM64



HMU16AI



HCU16AO



HCU16

COOPER Crouse-Hinds

MTL4840 SERIES BACKPLANES SPECIFICATIONS INTRINSIC SAFETY VERSIONS

BPMH16/BPMH16U/BPSH16/BPSH16-32 BACKPLANES

Capacity
16 x MTL4041A, MTL4041B, MTL4041P, MTL4046, MTL4046C, MTL4046P isolators (except BPSH16-32)
16 x MTL4044 (BPSH16-32 only)
1 x MTL4841 communications module
1 x MTL4842 HART® interface module (2 x MTL4842 on BPSH16-32)
NB: An MTL4841 module is needed for only one in every sixteen MTL4842 modules

Power requirements, Vs
21 to 35V dc through plug-in connectors

Maximum power requirements
1.35A (1.55A BPSH16-32)

Safe-area connectors
BPMH16: Elco 8016 38-pin male connector
BPMH16U: To customer's requirements
BPSH16: 2.5mm² screw terminals (2 terminals/module)
BPSH16-32: 2.5mm² screw terminals (4 terminals/module)

RS485 port
2.5mm² screw terminals

Accuracy
BPSH16-32R: 250Ω ±0.05% conditioning resistor

Weight (excl. modules and accessories)
350g approx.

ACCESSORIES

(for BPMH16/BPMH16U/BPSH16/BPSH16-32 backplanes)

ERK18 Earth rail kit
TSK18 Tagging strip kit
VMPH16 Vertical mounting plate
SMS01 Surface mounting kit for backplanes, pack of 40
DMK01 DIN-rail mounting kit (T- or G-section) for VMPH16 mounting plate, pack of 40
16-way backplanes require 6
ELC38 Elco 8016, 38-way cable plug kit
FUS02 Fuse kit, protects MTL4841/4842, pack of 10
FUS16 Fuse kit, protects module positions 1 to 16, pack of 10

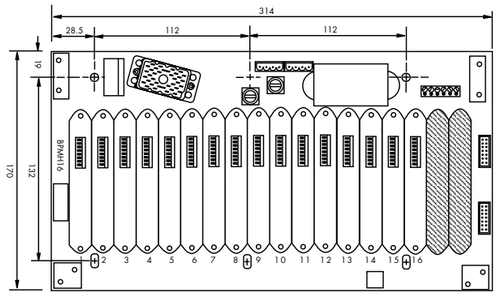
(for MTL4000)

CCH01 Hazardous-area crimp connector
SCC01 Hazardous-area screw-clamp connector
CRC01 Large crimps, pack of 100
CRC02 Small crimps, pack of 100
CRT01 Crimp tool for CRC01
CRT02 Crimp tool for CRC02
CRR01 Crimp removal tool for CRC01 and CRC02

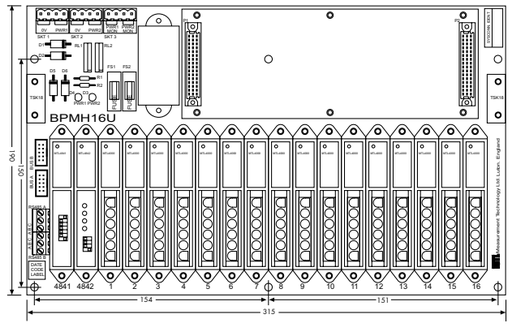
CUSTOMISED CONNECTION UNITS

MTL offers a range of general purpose and IS interfaces providing direct connection with control system I/O cables as well as HART® connectivity. For IS applications, MTL's universal backplanes, with a customised adapter card, give the user a compatible system connector complete with HART® interface. BPMH16U (see overleaf), BPM16U and BPM32 (see 'System Integration' section) backplanes may be used for IS signals. For general purpose signals, a range of custom HART® interface termination units are available for most DCS and PLC I/O cards. These replace the existing DCS termination units, saving space and allowing easy upgrading. Please contact MTL for details.

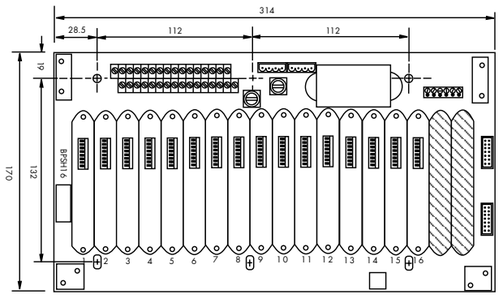
DIMENSIONS (MM)



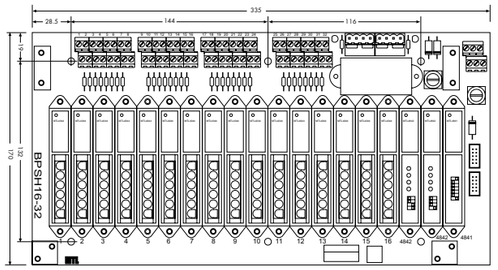
BPMH16 backplane



BPMH16U backplane



BPSH16 backplane

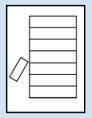


BPSH16-32 backplane

MTL4840 SERIES ORDERING INFORMATION

MTL4840 Series modules

MTL4841	HART communications module pre-configured for Cornerstone™ protocol
MTL4841-AMS	HART communications module pre-configured for AMS Intelligent Device Manager
MTL4841-PRM	HART communications module pre-configured for PRM
MTL4842	HART interface module (communicates with up to 16 loops)



General purpose connection units		
BPHM64	64 ch HART backplane	HART interface connector
HCU16	HART connection unit	No parallel resistor, 0Ω link fitted in series
HCU16-P250	HART connection unit	250Ω parallel resistor, 0Ω link fitted in series
HCU16-S200	HART connection unit	No parallel resistor, 200Ω resistor fitted in series
HCU16-S150	HART connection unit	No parallel resistor, 150Ω resistor fitted in series
HCU16AO	16 ch HART connection unit	With HART filters
HMU16	16 ch HART communication unit	
MTL4000 backplanes		
BPMH16	16 ch backplane	Safe-area multiway connector
BPSH16	16 ch backplane	Safe-area screw-clamp connector
BPSH16-32	32 ch HART backplane	
BPMH16U	16 ch HART backplane	Requires backplane adapter card (call MTL for options)
Backplane accessories		
ERK18	Earth rail kit	For BPMH16 and BPSH16 backplanes
TSK18	Tagging strip kit	For BPMH16 and BPSH16 backplanes
ELC38	38-way Elco connector	For BPMH16 safe-area connection
FUS02	Fuse kit, pack of 10	Protects MTL4841/4842
FUS16	Fuse kit, pack of 10	Protects backplane module positions 1 to 16
VMPH16	Backplane mounting plate	For DIN-rail and non-metallic surface mounting (BPMH16 and BPSH16 only)
DMK01	DIN-rail mounting kit	DIN-rail mounting kit, T- or G-section (pack of 40) 16-way backplanes require 6
SMS01	Surface mounting kit	Pack of 40 - 4 required for each backplane
HM64RIB10-xx	Ribbon Cable 10-way	-xx specifies the cable length - max 4m
HM64RIB20-xx	Ribbon Cable 20-way	-xx specifies the cable length - max 4.5m
Isolating interface modules and accessories		
MTL4041A	Current repeater	4/20mA, passive input, for smart transmitters
MTL4041B	Repeater power supply	4/20mA, for 2- or 3-wire transmitters
MTL4041P	High power repeater power supply	4/20mA, for 2- or 3-wire transmitters
MTL4044	Repeater power supply	2ch, 4/20mA, smart, for 2-wire transmitters
MTL4046	Isolating driver	For HART valve positioners
MTL4046C	Isolating driver	For HART valve positioners
MTL4046P	High power isolating driver	For HART valve positioners
CCH01	Crimp connector header	
CRC01	Large crimps	Pack of 100
CRC02	Small crimps	Pack of 100
SCC01	Screw-clamp connector	
MPL01	Module position label, blank	Pack of 50
Literature		
INM4840	MTL4840 instruction manual	

THE COMPLETE SYSTEM

The following components form a complete system:

MTL4840 HART® connection system – provides simple connection to field instruments, using general purpose and IS termination boards.

Personal computer – running instrument management software and linked to MTL4841 HART communications modules by:

Converter – connecting the computer's RS232 port to the MTL4840 Series' backplane RS485 connector.

Instrument management software

APPROVALS - *for the latest certification information visit www.mtl-inst.com/support/certificates*

Country	US
Authority	FM
Standard	Class 3600, 3611, 3810 Class 1, Div 2, Gps ABCD
Product No.	**Certificate No.**
MTL4841	3009149
MTL4842	3009149
HCU16	3009149
BPMH64	3009149

COOPER Crouse-Hinds

Zener Barriers

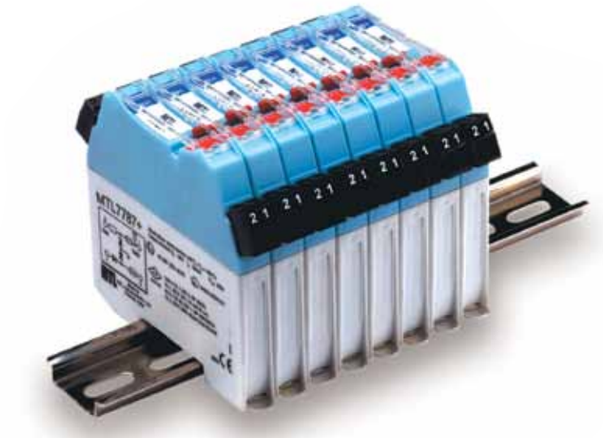
Our range of shunt-diode safety barriers are the simplest type of IS interface for protecting electrical circuits in hazardous areas. The compact and inexpensive units are mounted and earthed in one operation, ensuring the safest possible installation with ultra-high reliability.

The MTL7700 Series has an impressive pedigree and the user will benefit from the exceptional application knowledge that MTL has developed in this field.

Note that the well known MTL700 Series of busbar mounted safety barriers continues to be available. For details and specification sheets please visit our web site at http://www.mtl-inst.com

DIN rail mounting safety barriers

MTL7700 SERIES



- **Removable terminals**
- **Bussed power feed to other modules**
- **Relay and solid state switch modules**
- **Dual channel variants – 6.3mm per channel**
- **Proximity detector inputs**
- **Electronic fusing**
- **Direct replacement for MTL700 Series barriers**
- **Compatible terminal numbering and safety descriptions**

Since its introduction in 1984 the MTL700 Series barrier has established itself as the worldwide standard for safety barriers. Known for its quality and reliability, the MTL700 Series is widely used in applications all over the world.

The MTL7700 Series follows closely in the footsteps of the MTL700, but as a DIN rail mounting barrier, providing quick and easy installation without the need for special hardware.

Removable terminals are used for ease of installation, maintenance and for providing a loop disconnect by simply unplugging the terminals from the side of the module. Wire entry is also angled to assist wiring within limited space enclosures.

MTL7700 barriers clamp simply and securely onto standard T-section DIN rail, simultaneously making a reliable IS earth connection.

For applications where field power is required for switch inputs or 2-wire transmitters, the MTL7700 Series provides a bussed power feed facility. When used in conjunction with the MTL7798 power feed module the user has a fully protected, electronically fused supply to many barriers with no additional wiring required.

MTL7700 active modules are protected with an electronic fuse for the majority of applications. The MTL7798 active fused, power feed module can protect up to 40 other modules using the bussed power facility and provides a clear indication of a trip condition via a red LED.

The MTL774X range of barriers offer a NAMUR compatible input and a choice of relay or solid state output. The solid state outputs are floating so switching to ground or from a power rail into an input is also possible. The solid state interface also provides a high frequency transfer for use in flow or rotation applications.

Dual channel relay or solid state modules offer the highest packing density with only 6.3mm per channel and when used in conjunction with the power bus, offer users the minimum of wiring with the maximum packing density and the lowest cost per channel.

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SPECIFICATIONS

'Key' barriers shown in blue

For notes 1 to 7 see 'Terminology' (later in this section)

Model No.	Safety description [1]			Polarities [2] available			Application	Basic circuit	Max. end-[3] to-end resistance	Vwkg at [4] 10µA or (1µA)	[5] Vmax	[6] Fuse rating
MTL	V	Ω	mA	+	–	ac		Hazardous Safe	Ω	V	V	mA
7706+	**28**	**300**	**93**	✓			**Transmitters**	See 'HOW THEY WORK' and 'ACTIVE / ELECTRONICALLY PROTECTED BARRIERS'	See additional specification		**35**	**50**
7707+	**28**	**300**	**93**	✓			**Switches**				**35**	**50**
	28	**diode**									**35**	**50**
7707P+	28	164	171	✓			Transmitters, switches, controller outputs IIB				35	50
	28	diode	–								35	50
7710+	10	50	200	✓			6V dc & 4V ac systems		75	6.0	7.0	50
7715+	15	100	150	✓			12V systems		119	12.0	13.1	100
7715P+	15	50	291	✓			12V dc systems		64	12.6	13.7	100
7722+	22	150	147	✓			18V dc systems		174	19.6	20.2	50
7728+	**28**	**300**	**93**	✓			**Controller outputs, solenoids**		**333**	**25.9**	**26.5**	**50**
7728-	28	300	93		✓		Transmitters		333	25.9	26.5	50
7728ac	28	300	93			✓	Controller outputs, solenoid valves		333	25.0	25.9	50
7728P+	28	234	119	✓			Controller outputs, solenoid valves IIB		252	24.9	25.9	100
7729P+	28	164	170	✓					184	24.9	25.9	100
774X	**10**	**–**	**19**				**Prox sw input, solid state output and line fault detect**	See 'ACTIVE / ELECTRONICALLY PROTECTED BARRIERS'	**–**	**–**	**30/35**	**50**
7755ac	**3**	**10**	**300**			✓	**2 or 3- Wire RTDs (floating bridge)**		**19.0**	**(1)**	**3.4**	**250**
	3	**10**	**300**			✓			**19.0**	**(1)**	**3.4**	**250**
7756ac	**3**	**10**	**300**			✓	**3 - Wire RTDs (grounded bridge)✓**		**19.0**	**(0.7)**	**2.7**	**250**
	3	**10**	**300**			✓			**19.0**	**(0.7)**	**2.7**	**250**
	3	**10**	**300**			✓			**19.0**	**(0.7)**	**2.7**	**250**
7758+/-	7.5	10	750	✓	✓		Gas detectors		17	6.0	7.3	200
	7.5	10	750						17	6.0	7.3	200
7761ac	9	90	100			✓			107	6.0	7.0	100
	9	90	100						107	6.0	7.0	100
7761Pac	9	350	26			✓	Strain-gauge bridges		378	6.8	7.5	50
	9	350	26						378	6.8	7.5	50
7764+/ac	12	1k	12	✓		✓	Strain-gauge bridges		1050	10.0	10.9	50
	12	1k	12						1050	10.0	10.9	50
7766ac	12	150	80			✓			174	10.0	10.6	50
	12	150	80						174	10.0	10.6	50
7766Pac	12	75	157			✓	Strain-gauge bridges		92	9.6	10.5	100
	12	75	157				Strain-gauge bridges		92	9.6	10.5	100
7767+	15	100	150	✓			12V dc systems		119	12.0	13.1	100
	15	100	150				12V dc systems		119	12.0	13.1	100
7779+	28	300	93	✓			Controller outputs	requires channels separate in IIC	333	25.9	26.5	50
	28	300	93				Controller outputs		333	25.9	26.5	50
7796+	26	300	87	✓			Vibration probes		333	23.9	24.5	50
	20	390	51						428	18.3	18.9	50
7796-	26	300	87		✓		Vibration probes		333	23.9	24.5	50
	20	390	51						428	18.3	18.9	50
7760ac	**10**	**50**	**200**			✓	**Active dc & ac sensors Thermocouples**		**75**	**6.0**	**6.7**	**50**
	10	**50**	**200**						**75**	**6.0**	**6.7**	**50**
7765ac	15	100	150			✓			124	12.0	12.5	50
	15	100	150						124	12.0	12.5	50
7778ac	28	600	47			✓			651	24.0	25.4	50
	28	600	47						651	24.0	25.4	50
7789+	28	300	93[a]	✓			Switch inputs / Signal returns		651	26.6	27.2	50
									651	26.6	27.2	50
	28	diode	–						0.9V+26Ω	26.6	27.2	50
	28	diode	–						0.9V+26Ω	26.6	27.2	50
7787+/-	**28**	**300**	**93**	✓	✓		**Transmitters**		**333**	**26.6**	**27.2**	**50**
	28	**diode**	**–**				**Controller outputs, switches**		**0.9V+21Ω**	**26.6**	**27.2**	**50**
7787P+	28	234	119	✓					253	26.4	27.2	80
	28	diode	–						0.9V+21Ω	26.4	27.2	80
7788+	28	300	93	✓			Transmitters		333	25.9	26.5	50
	10	50	200	✓					75	6.0	7.0	50
7788R+	28	300	93	✓					333	25.9	26.5	50
	10	50	200	✓					75	6.0	7.0	50

[a] Terminals 3 & 7 connected together

* Diagrams show positive versions. All diodes reversed on negative versions. Additional diodes fitted on ac versions.

HOW THEY WORK

All MTL7700 Series barriers are based on the same simple principle. Each channel contains two stages of pulse-tested Zener or forward-connected diodes and an 'infallible' terminating resistor. In the event of an electrical fault in the safe area, the diodes limit the voltage that can reach the hazardous area and the resistor limits the current. A fuse protects the diodes, and the two stages of voltage limitation ensure continued safety if either stage should fail. No active output-current limiting circuits are employed. All models are certified 'ia' for all zones and 'IIC' for all explosive atmospheres (except MTL7707P+ and MTL7729P+, 'ia' 'IIB').

TERMINOLOGY

1. Safety description

The safety description of a barrier, eg '10V 50Ω 200mA', refers to the maximum voltage of the terminating Zener or forward diode while the fuse is blowing, the minimum value of the terminating resistor, and the corresponding maximum short-circuit current. It is an indication of the fault energy that can be developed in the hazardous area, and not of the working voltage or end-to-end resistance.

2. Polarity

Barriers may be polarised + or –, or non-polarised ('ac'). Polarised barriers accept and/or deliver safe-area voltages of the specified polarity only. Non-polarised barriers support voltages of either polarity applied at either end.

3. End-to-end resistance

The resistance between the two ends of a barrier channel at 20°C, ie of the resistors and the fuse. If diodes or transistors are present, their voltage drop (transistors ON) is quoted in addition.

4. Working voltage (Vwkg)

The greatest steady voltage, of appropriate polarity, that can be applied between the safe-area terminal of a 'basic' barrier channel and earth at 20°C for the specified leakage current, with the hazardous-area terminal open circuit.

5. Maximum voltage (Vmax)

The greatest steady voltage, of appropriate polarity, that can be applied continuously between the safe-area terminal of any barrier channel and earth at 20°C without blowing the fuse. For 'basic' barriers, it is specified with the hazardous-area terminal open circuit; if current is drawn in the hazardous area, the maximum voltage for these barriers is reduced. The 'ac' channels of 'basic' barriers and most channels of overvolt-protected barriers withstand voltages of the opposite polarity also – see circuit diagrams.

6. Fuse rating

The greatest current that can be passed continuously (for 1000 hours at 35°C) through the fuse.

7. Star connection

In star-connected barriers, the two channels are interlocked such that the voltage between them cannot exceed the working voltage, Vwkg: this allows for higher cable capacitance or inductance.

8. Maximum safe-area voltage (U_m)

The maximum permissible safe-area voltage (U_m) for MTL7700 Series barriers is 250V ac/dc.

GENERAL SPECIFICATION

Ambient temperature and humidity limits

–20 to +60°C continuous working
–40 to +80°C storage
5–95% RH

Leakage current

For 'basic' barriers with a working voltage of 5V or more, the leakage current decreases by at least one decade per volt reduction in applied voltage below the working voltage, over two decades. For the MTL7755ac/7756ac it decreases by at least one decade for a 0.4V reduction in applied voltage.

Terminations

Removable terminals accommodate conductors up to 2.5mm² (13AWG). Hazardous-area terminals are identified by blue labels. Removal force >15N

Colour coding of barrier label

Grey: non-polarised
Red: positive polarity (MTL7706 negative to transmitter)
Black: negative polarity
White: dummy barrier, MTL7799

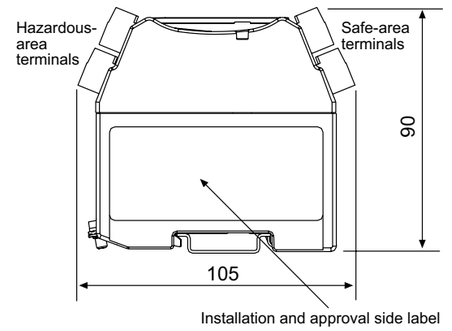
Weight

140g approx

Mounting and earthing

By 35mm Top Hat DIN rail

DIMENSIONS (MM)



MTL7700 SERIES KEY BARRIERS SUMMARISED

TYPE	APPLICATION	KEY BARRIER
Analogue input (low-level)	Resistance temperature detectors Thermocouples, ac sensors	**7756ac** **7760ac**
Analogue input (high-level)	Transmitters, 2-wire, 4/20mA	**7706+** **7787+**
Analogue output	Controller outputs, one line earthed Controller outputs, neither line earthed	**7728+** **7787+**
Digital (on/off) input	Switches	**7787+** **7741/3**
Digital (on/off) output	Solenoids, alarms, LEDs	**7728**

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ACTIVE / ELECTRONICALLY PROTECTED BARRIERS

ACTIVE / ELECTRONICALLY PROTECTED BARRIERS

The following barriers have built-in overvolt protection, allowing their use with unregulated power supplies. In many applications, eg, sensor inputs or controller outputs, there is insufficient power available to blow the barrier fuse and this additional protection is not necessary. However, where the barrier is connected to a power supply, eg, for energising transmitters, switches, solenoids or local alarms, overvolt protection allows the barriers to be used with unregulated supplies and also gives protection against faulty wiring during commissioning.

MTL7706+ for 'smart' 2-wire 4/20mA transmitters

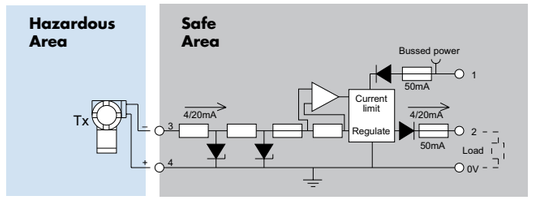
The MTL7706+ is a 1-channel shunt-diode safety barrier, with built-in electronic overvolt protection, for energising a 2-wire, 4/20mA transmitter in a hazardous area. It is powered from a positive supply of 20–35V dc and delivers a 4/20mA signal into an earthed load in the safe area. It is proof against short circuits in the field and in the safe area and is extremely accurate. The MTL7706+ will pass incoming communication signals up to 10kHz from a 'smart' transmitter, while in the outgoing direction it will pass signals of any frequency likely to be encountered.

Since the MTL7706+ has no return channel for energising the load, the entire output of the single '28V' channel is available to power the transmitter, providing high output capability. This channel is negatively polarised, and the safe-area signal is in fact the very current that returns through it from the hazardous area, the novel circuit being energised by a built-in floating dc supply derived from the external dc source of power.

To prevent any leakage through the zener diodes and maximise the output voltage available at 20mA, the floating supply is given a rising voltage/current characteristic. A separate circuit limits the current to protect the fuse in the event of a short circuit in the hazardous area.

With a 20V supply, the barrier will deliver 16.2V minimum at 20mA for the transmitter and lines and consumes typically 45mA at 24V operation.

BASIC CIRCUIT



ADDITIONAL SPECIFICATION

Safety description
28V 300Ω 93mA
Supply voltage
20 to 35V dc w.r.t earth
Output current
4 to 20 mA
Voltage available to transmitter and lines
16.2V @ 20mA with 250Ω load (negative w.r.t. earth)
11.0V @ 20mA with 500Ω load (negative w.r.t. earth)
Accuracy
±2µA under all conditions
Safe-area load resistance
0 to 500Ω
Supply current
45mA typical at 20mA and 24V supply
60mA maximum at 20mA and 20V supply

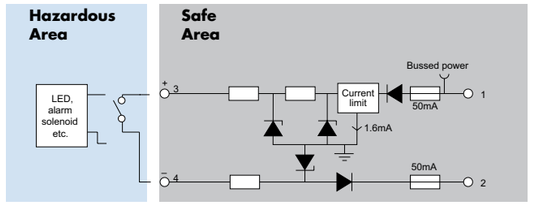
MTL7707+ FOR SWITCH INPUTS AND SWITCHED OUTPUTS

The MTL7707+ is a 2-channel shunt-diode safety barrier similar to the MTL7787+ but with built-in electronic overvolt protection. It is intended primarily for safeguarding a hazardous-area switch controlling a relay, opto-coupler or other safe-area load from an unregulated dc supply in the safe area.

The outgoing channel accepts supply voltages up to +35V and is protected against reverse voltages: the return channel is unaffected by voltages up to +250V.

In normal operation the protection circuit introduces only a small voltage drop and shunts less than 1mA to earth, so its overall effect is minimal. If the supply voltage exceeds about 27V, however, causing the Zener diodes to conduct – or if the safe-area load has a very low resistance – the supply current is limited automatically to 50mA, protecting the fuse and power supply and enabling the loop to continue working.

BASIC CIRCUIT



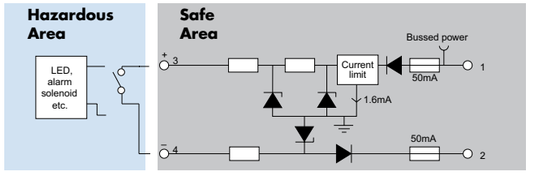
ADDITIONAL SPECIFICATION

Safety description
28V 300Ω 93mA, terminals 1 to 3
28V Diode, terminals 2 -4
Supply voltage
10 to 35V dc with respect to earth
Output current
Up to 35mA available
Maximum voltage drop
(at 20°C, current not limited)
Iout x 345Ω + 0.3V, terminals 1 to 3
Iout x 25Ω + 0.9V, terminals 4 to 2
Supply current
Iout + 1.6mA, supply <26V
Limited to 50mA, supply >28V or low load resistance

MTL7707P+ FOR SWITCH INPUTS AND SWITCHED OUTPUTS, 2W TRANSMITTERS (IIB GASES)

The MTL7707P+ is a two-channel shunt-diode safety barrier similar to the MTL7787P+, but is designed for use with group IIB gases and features built-in electronic overvolt protection allowing use with unregulated power supplies up to 35V dc. It is intended primarily as a low cost solution for driving IIB certified 2-wire 4/20mA transmitters, but can also be used with controller outputs with current monitoring, solenoid valves and switches. To protect the fuse and enable the loop to continue working, the supply current is limited automatically at 50mA should the output be short-circuited or excess voltage applied.

BASIC CIRCUIT



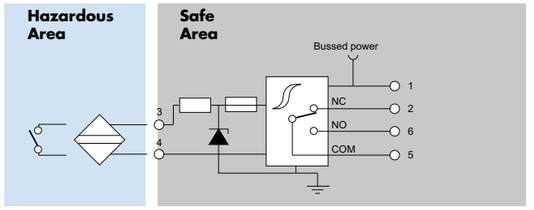
ADDITIONAL SPECIFICATION

Safety description
28V 164Ω 171mA, terminals 1 to 3
28V Diode, terminals 4 to 2
Supply voltage
10 to 35V dc with respect to earth
Output current
Up to 35mA available
Maximum voltage drop
(at 20°C, current not limited)
Iout x 218Ω + 0.3V, terminals 1 to 3
Iout x 20.1Ω + 0.9V, terminals 4 to 2
Supply current
Iout + 1.6mA, supply <26V
Limited to 50mA, supply >28V or low load resistance

MTL7741 PROXIMITY SENSOR OR SWITCH INPUT AND RELAY OUTPUT

The MTL7741 is a single channel switch/prox input barrier with changeover relay contacts acting as the safe area interface. Relay contacts provide a universal interface capable of switching a wide range of signals including ac, low level and high level voltages. Phase reversal is achieved by connecting the normally open or normally closed contacts as required. The power bus terminal may be used to connect the module to a power source.

BASIC CIRCUIT



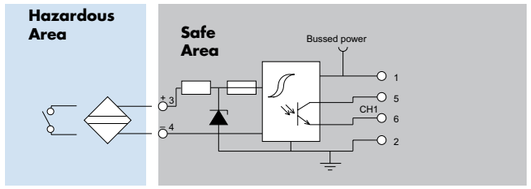
ADDITIONAL SPECIFICATION

Safety description
10V 19mA
Supply voltage
22.9 to 30V dc with respect to earth
Input characteristics
Relay energised if input >2.1mA(<2kΩ)
Relay de-energised if input <1.2mA(>10kΩ)
Relay Contacts
50V ac 0.5A. Resistive
30V dc, 1A. Resistive
Supply current
26mA maximum @ 24V
Response time
<10ms

MTL7742 PROXIMITY SENSOR OR SWITCH INPUT WITH SOLID STATE OUTPUT

The MTL7742 is a single channel switch/prox input barrier with an open collector solid state interface to the safe area equipment. The solid state switch is especially useful for high frequency switching apparatus including pulse and rotational sensors. The power bus terminal can be used to connect power to the module and the input power supply range makes the module suitable for use with unregulated supplies.

BASIC CIRCUIT



ADDITIONAL SPECIFICATION

Safety description
10V 19mA
Supply voltage
20 to 35V dc with respect to earth
Input characteristics
Output energised if input >2.1mA(<2kΩ)
Output de-energised if input <1.2mA(>10kΩ)
Output characteristics

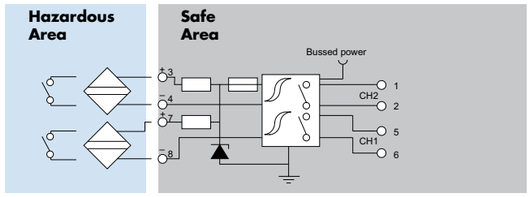
Operating frequency	dc to 2.5kHz
Max off-state voltage	35V
Max off-state leakage	10µA
Max on-state voltage drop	<1.41V @ 50mA <1.22V @ 2mA typically <1V
Max on-state current	50mA

Supply current
20mA maximum @ 24V

MTL7743 2 CHANNEL PROXIMITY SENSOR OR SWITCH INPUT AND RELAY OUTPUTS

The MTL7743 is a dual channel switch/prox sensor input barrier with a relay interface. This module is ideal for applications where high channel packing densities are required for digital inputs. Power is connected using the power bus terminal.

BASIC CIRCUIT



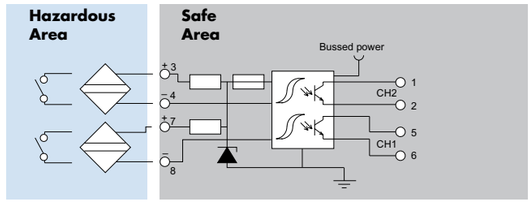
ADDITIONAL SPECIFICATION

Safety description
10V 19mA
Supply voltage
22.9 to 30V dc with respect to earth
Input characteristics
Relay energised if input >2.1mA(<2kΩ)
Relay de-energised if input <1.2mA(>10kΩ)
Relay Contacts
50V ac 0.5A. Resistive
30V dc, 1A. Resistive
Supply current
45mA maximum @ 24V
Response time
<10ms

MTL7744 2 CHANNEL PROXIMITY SENSOR OR SWITCH INPUTS WITH SOLID STATE OUTPUTS

A dual channel version of the MTL7742. This module provides two solid state interfaces for prox/switch inputs. Power is connected via the power bus.

BASIC CIRCUIT



ADDITIONAL SPECIFICATION

Safety description
10V 19mA
10V 19mA
Supply voltage
20 to 35V dc with respect to earth
Input characteristics
Output energised if input >2.1mA(<2kΩ)
Output de-energised if input <1.2mA(>10kΩ)
Output characteristics

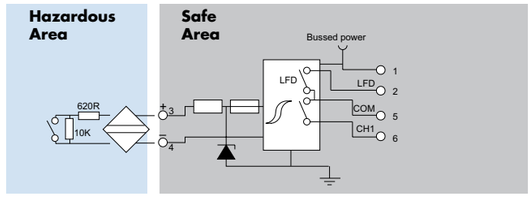
Operating frequency	dc to 2.5kHz
Max off-state voltage	35V
Max off-state leakage	10µA
Max on-state voltage drop	1.41V @ 50mA
	1.22V @ 2mA
	typically <1V
Max on-state current	50mA

Supply current
29mA maximum @ 24V

MTL7745 PROXIMITY SENSOR OR SWITCH INPUT WITH RELAY OUTPUT AND LINE FAULT DETECT

The MTL7745 is a single channel switch/prox input barrier providing line fault detection. Proximity detectors or switches fitted with end-of-line resistors may be connected. Short circuit or open ciruit conditions in the field wiring will generate an alarm condition. The LFD relay contacts close when a fault is detected allowing the contacts to be connected in parallel to provide a common alarm. The power bus terminal can be used to connect power to this module.

BASIC CIRCUIT



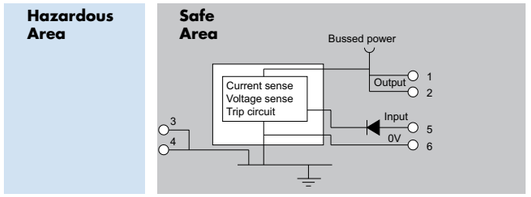
ADDITIONAL SPECIFICATION

Safety description
10V 19mA
Supply voltage
22.9 to 30V dc with respect to earth
Input characteristics
Output energised if input >2.1mA(<2kΩ)
Output de-energised if input <1.2mA(>10kΩ)
LFD relay + Red LED
Energised if input <50µA or <100Ω
Relay contacts
50V ac 0.5A. Resistive
30V dc, 1A. Resistive
Supply current
38mA maximum @ 24V
Response time
<10ms

MTL7798 POWER FEED AND PROTECTION MODULE

The MTL7798 power feed module incorporates both voltage and current sense mechanisms to protect barrier circuits by activating a solid state trip mechanism when fault or overload conditions occur in the power source circuit. Resetting the module after tripping is achieved by interupting the supply to the unit. A red LED indicates a circuit trip condition and a green LED the availability of power at the outputs. Bussed power for other modules is sourced from the top of the unit using the Bus Power Link BPL7700 or via terminals 1 and 2.

BASIC CIRCUIT



ADDITIONAL SPECIFICATION

Input voltage range (terminals 5&6)
20 to 26.8V
Maximum input voltage capability
45V
Power source requirements
>1.8A
Trip mechanism
Minimum trip 26.8V @ 20°C (+18mV/°C)
Output current range
0 to 800mA
Maximum voltage drop
20mV @ 0mA, 1.0V @ 800mA load

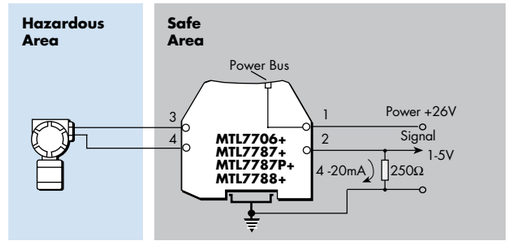
MTL7700 SERIES BARRIER APPLICATIONS

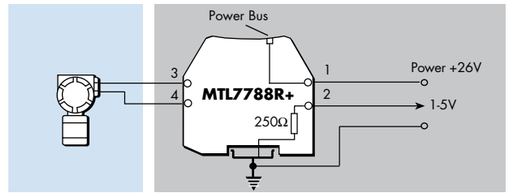
MTL7700 Series barriers protect devices located in all normally occurring explosive atmospheres, including air/flammable gas mixtures, dusts and fibres. Applications covered include the protection of installations incorporating uncertified devices ('simple apparatus') such as thermocouples, switches and resistive sensors, or separately certified 'energy storing' (or 'voltage producing') apparatus including ac sensors, transmitters and current-to-pneumatic (I/P) converters. Recommended choices for specific applications are discussed briefly in the following pages.

ANALOGUE INPUTS (HIGH LEVEL)

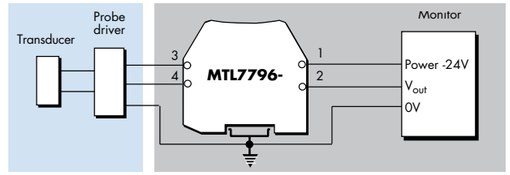
2-wire transmitters, 4/20mA, conventional and smart
The recommended barrier for use with 'conventional' and 'smart' 4/20mA transmitters (fed by a 26V regulated supply) is the MTL7787+. This provides up to 12.9V (14.6V for MTL7787P+) at Vwkg and 20mA for a transmitter and its lines as well as 5V for the typical 250Ω load. This application and this barrier is suitable for use with the optional power bus facility.

The MTL7706+ is recommended for applications where an unregulated supply of up to 35V is used. It provides 16.0V for conventional and Smart transmitters at 20mA, as well as 5V for a typical 250Ω load. With the MTL7706+ terminal 3 is negative with respect to earth, so the connections to terminals 3 and 4 should be reversed.



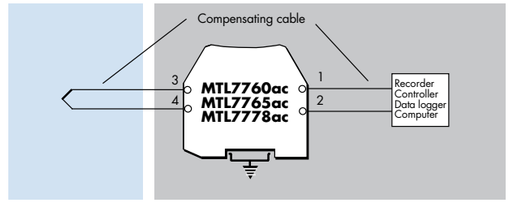


Vibration probes
The 3-wire transmitters used with vibration monitoring equipment are invariably supplied by a –24V dc power supply – hence the recommended barrier choice is the negatively-polarised MTL7796–.

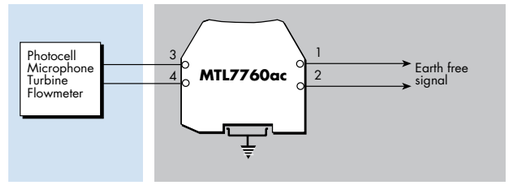


ANALOGUE INPUTS (LOW-LEVEL)

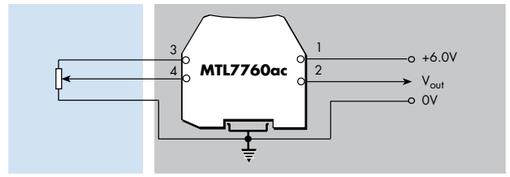
Thermocouples and mV sources
The recommended barrier for thermocouples and mV sources is the MTL7760ac. This 2-channel non-polarised barrier retains the 'earth-free' nature of the signal and, providing the receiver's input 'floats', rejects common-mode ac and dc interference up to at least 7V and is unaffected by earth faults on the primary element.



AC sensors, photocells, microphones and turbine flowmeters
The MTL7760ac is the recommended choice for these devices. While many of these are designated 'simple apparatus' and thus do not need certification, note that some ac sensors may be subject to a significant level of inductance and will therefore need to be designed and certified for hazardous-area locations.



Slidewire displacement transducers
The simplest choice is the MTL7760ac. This barrier supplies power and brings back a unipolar signal.



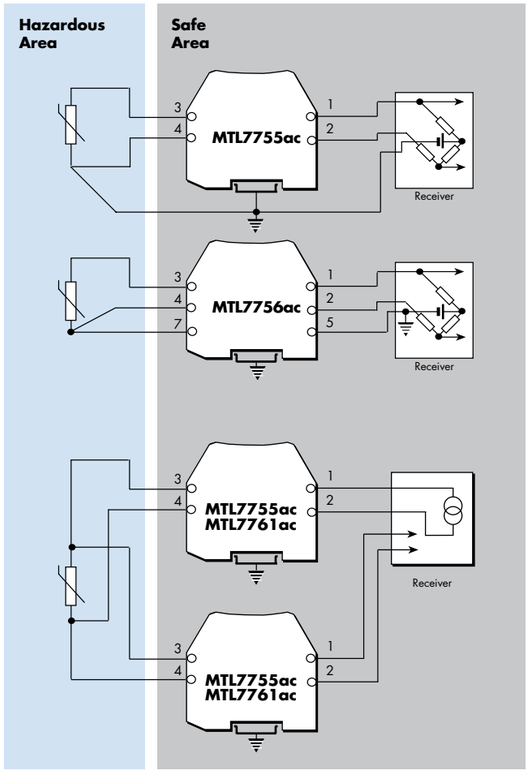
COOPER Crouse-Hinds

RTDs
For 3-wire RTDs, a single MTL7755ac barrier is the most economical choice. This is suitable for use with a floating bridge – the two leads from the bridge arms are protected by the barrier with the third (supply) lead being earthed through the barrier. The barrier has a low end-to-end resistance of only 19Ω/channel to minimise span changes and its channels track within 0.15Ω (between –20°C and +60°C) to minimise zero shift with temperature.

If the bridge circuit is already earthed, the third barrier channel provided by an MTL7756ac is needed. For extreme accuracy, 3 channels and an earth-free bridge can be used, a configuration that cancels out the small errors due to barrier leakage.

Channels 1 and 2 (those between terminals 1 & 2 and 3 & 4 respectively) track to within 0.15Ω (between –20°C and 60°C).

4-wire constant-current circuits do not need matched barrier resistances and can be protected by two MTL7761ac barriers. If the increase in loop resistance is too great, use two MTL7755ac barriers instead.



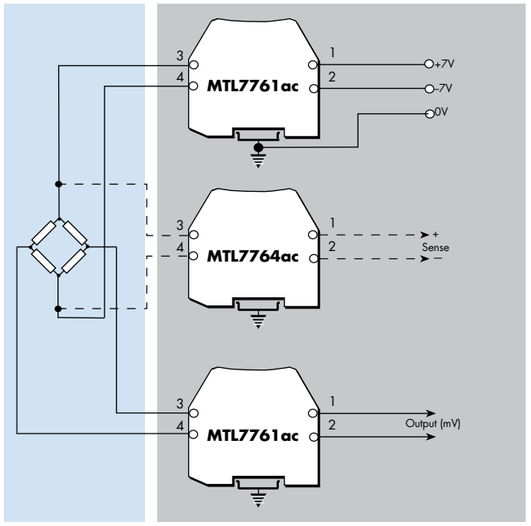
STRAIN-GAUGE BRIDGES

Single strain-gauge bridges
This shows an arrangement using two or three barriers, which is safe in IIC gases. With the MTL7761ac, the circuit is powered from a 14V, 230Ω source; if the bridge resistance is 230Ω, then the bridge voltage is 7V. If the bridge resistance is 350Ω, then the bridge voltage is 8.4V.

An MTL7764ac can be used to sense the bridge supply voltage.

An MTL7761ac is used here for the mV output.

An MTL7766Pac provides 12.3V for a 350Ω bridge with a 20V supply. MTL7761Pac's can be used for the sense and pick-off circuits.



STRAIN-GAUGE BRIDGES (CONT)

Double strain-gauge bridges
Quite frequently there is a demand to monitor two load cells, and a possible circuit, safe in IIC, is shown.

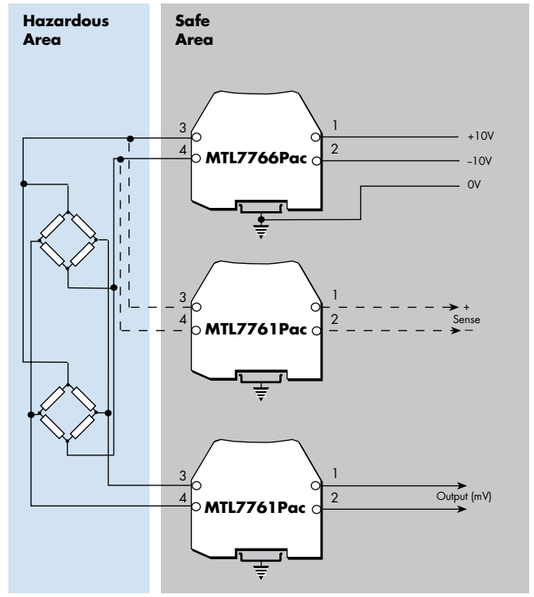
Here, the lower voltage drop of the MTL7766Pac is an advantage.

The MTL7766Pac supplies power to the bridge(s) while two MTL7761Pac barriers interface with the sense and pick-off circuits.

Using 350Ω bridge systems, the following voltages are available from an MTL7766Pac with a ±10V supply:

1 bridge: 13.11V

2 bridges: 9.75V

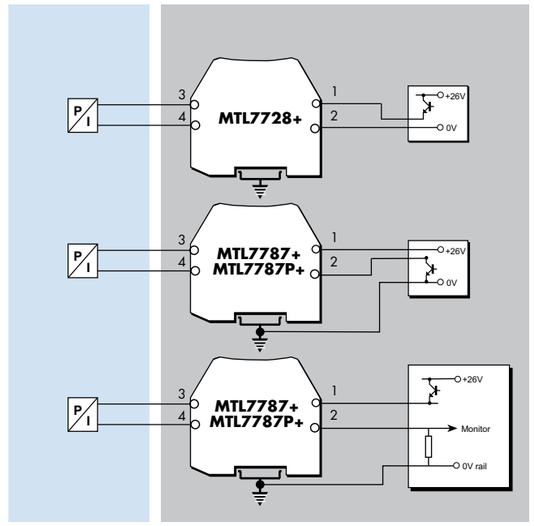


ANALOGUE OUTPUTS

Controller outputs (I/P converters)
The single-channel MTL7728+ with a voltage drop of 6.66V at 20mA is the recommended choice for most controller outputs. Higher-power versions are available: the MTL7728P+ (5.1V drop) is suitable for IIC applications; the MTL7729P+ (3.68V drop) for IIB applications.

For controllers with an output circuit separated from the 0V rail by the control transistor, the 2-channel MTL7787+ is the preferred choice as the return channel can handle up to 26.6V allowing the control signal to be turned off completely. The voltage drop is 8.1V at 20mA. A higher-power version of the latter, the MTL7787P+, is also available. The return channel of these barriers handle up to 26.4V and the maximum voltage drop is only 6.38V.

The MTL7787+ and MTL7787P+ are also suitable for controllers containing a resistor which enables the return current to be monitored for high-integrity operation.



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DIGITAL (ON/OFF) INPUTS

Switches
The normal choice is the MTL7787+/7787P+ with a regulated supply. The MTL774X modules are recommended for applications where an unregulated supply of up to 30V for relay output modules, or 35V for solid state output modules, is used.

The MTL7789+ offers a dual channel passive barrier for switch inputs where the input current for each channel is <10mA.

Switches / Proximity detectors
MTL's range of new switch/prox input barriers provide the user with a choice of relay and solid state outputs in single and dual channel versions.

The MTL7741 is single channel with a changeover relay output.

The MTL7742 has a single channel solid state switch that can be configured to switch from a power rail or down to ground. This is also ideal for high switching frequency applications.

The MTL7743 and MTL7744 are dual channel versions affording very high packing densities. Power must be provided to these modules using the power bus facility.

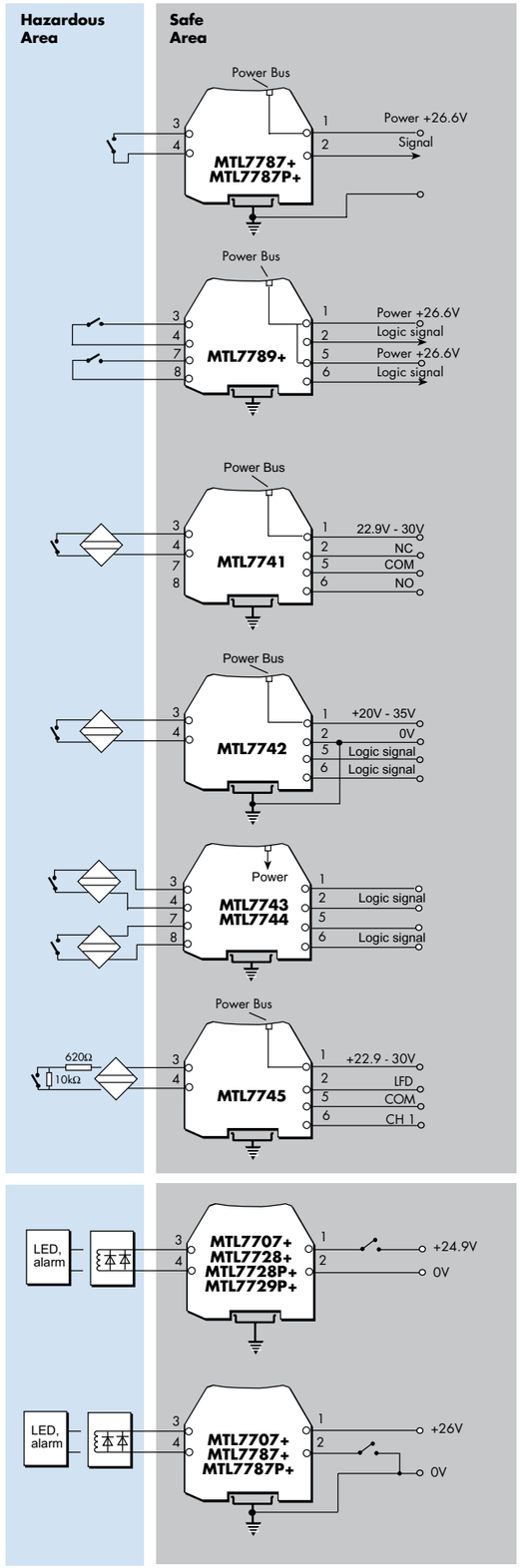
The MTL7745 is a single channel proximity input (or switch input if 'end of lines' resistors are fitted) with relay contacts providing switch and line fault status. The LFD relay contacts close when a fault is detected.

DIGITAL (ON/OFF) OUTPUTS

Alarms, LEDs, solenoids valves, etc
For these applications, the MTL7728+ is recommended. Higher-powered versions are available: the MTL7728P+ is suitable for IIC applications; the MTL7729P+ for IIB applications.

If the control switch is to earth, then the 2-channel MTL7787+ barrier should be used, or, alternatively, the MTL7787P+ higher-power version. If the supply is poorly regulated use the MTL7707+.

The MTL7707+ is recommended for applications where an unregulated supply of up to 35V is used.

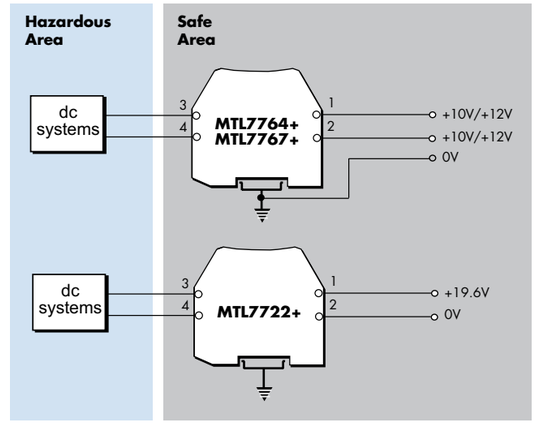


POSITIVE DC SYSTEMS

Low-level to 12V dc systems
The two channels of the MTL7764+ and MTL7767+ can be combined safely in IIC.

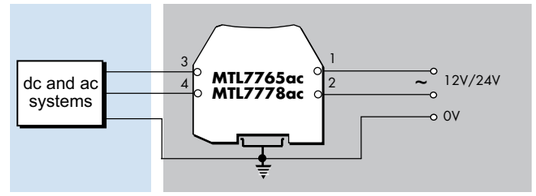
The MTL7764+ can be used for low-level logic return signals whilst the MTL7767+ is used for 6V dc and 12V dc systems.

18V dc systems
The single-channel MTL7722+ is recommended for 18V dc systems.



AC AND DC SYSTEMS

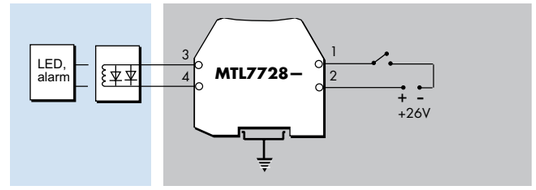
High-level ac and dc systems
The versatile star-connected MTL7765ac and MTL7778ac allow Vwkg to be developed from each channel to ground but only allow Vwkg to be developed between channels. This provides some common-mode voltage capability and can allow higher cable parameters to be used.



NEGATIVE AND FLOATING POWER SUPPLIES

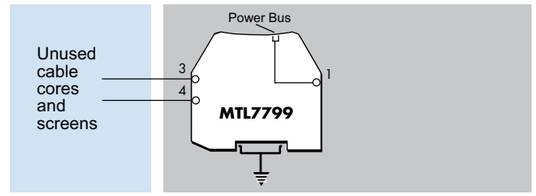
Digital (on/off) outputs
The MTL7728– is used with a negative power supply and positive earth. Typically used for digital inputs or outputs, as shown.

The MTL7728– can also be used with floating power supplies, for transmitters.



SPARE CABLE CORES AND SCREENS

The MTL7799 dummy barrier is used primarily for securing and earthing unused cables and screen connections. Hazardous area terminals 3 and 4 are internally connected to the DIN-rail mounting/earth connection. It also provides a power bus connection for direct connection of power for modules such as the MTL7743 and MTL7744 where no power supply screw terminal is provided.



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POWER BUS APPLICATIONS

The PB7700 power bus is invaluable for saving installation time and wiring when connecting a 24V dc power source to a number of barriers.

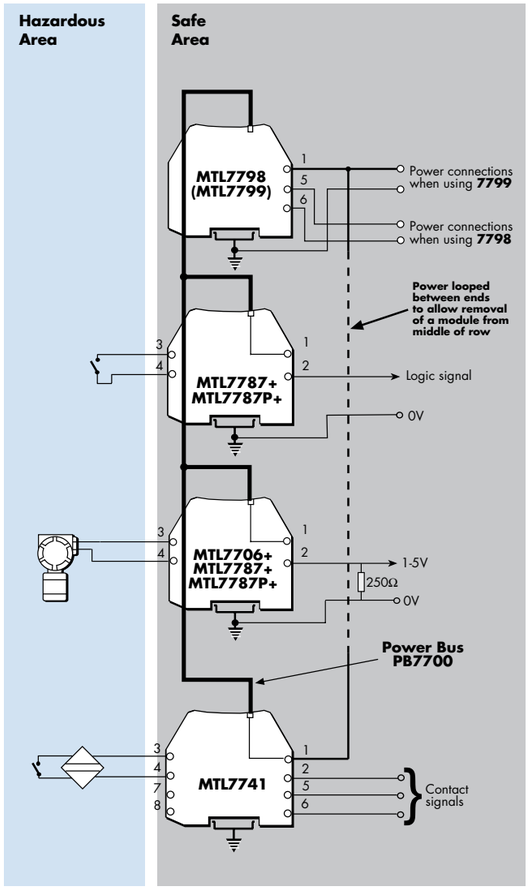
Typical applications include hazardous-area switches, 4/20mA transmitters and proximity detectors. The diagram illustrates the configuration for 4 barriers but up to 40 barriers can be served by this method.

The MTL7798 power feed module would normally be used with standard barriers such as MTL7787+ and MTL7787P+ because the current/voltage trip protection mechanism of the MTL7798 protects the fuses in the barriers.

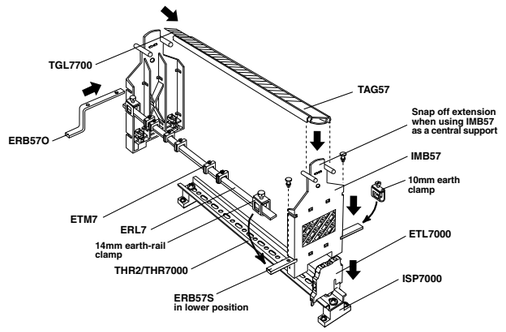
The MTL7799 dummy barrier can be used instead of the MTL7798 for direct 'feed-through' connection of a 24V dc supply onto the power bus. Looping the power feed to each end of the bussed power allows the removal of individual barriers without loss of power to others in the chain.

Other units that can use the power bus facility:

MTL7706
MTL7707+
MTL7707P+
MTL7741
MTL7742
MTL7743
MTL7744
MTL7745
MTL7787+
MTL7787P+
MTL7788+
MTL7788R+
MTL7789+



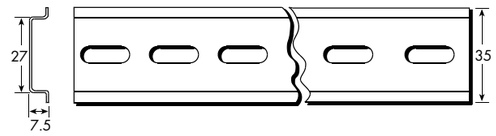
MTL7700 SERIES ACCESSORIES



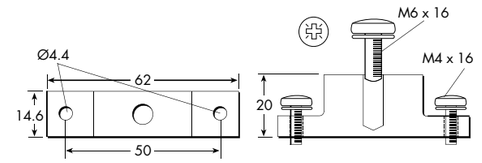
MOUNTING/EARTHING ACCESSORIES

MTL7700 Series barriers mount easily and quickly onto standard DIN rail which also acts as the intrinsically safe earth.

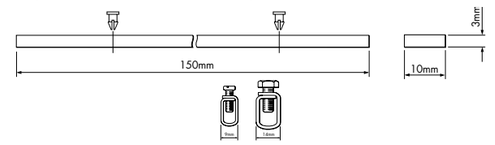
THR2 standard DIN rail
THR7000 plated rail
Specially nickel-plated T-section (35mm x 7.5mm) DIN rail for use in potentially corrosive atmospheres. Supplied in 1meter lengths.



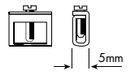
ISP7000 insulating spacers
Attached to the base of a DIN rail at either end or at intervals (depending upon DIN rail length) to isolate the IS earth from a structural earth.



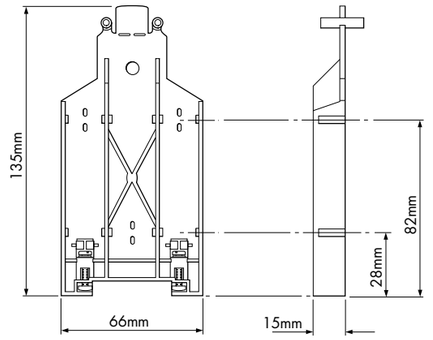
ERB57S Earth-rail bracket, straight
Nickel-plated; supplied with two push fasteners, one 14mm earth-rail clamp and one 10mm earth clamp for cables ≤16mm².



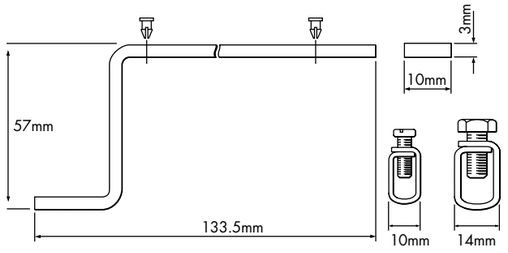
ETM7 earth terminal
For terminating cable screens and 0V earth returns and securing spare cores to the earth rail. A maximum of two ETM7s per barrier can be accommodated.



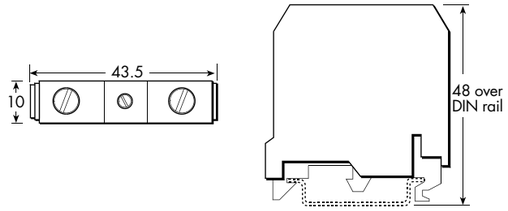
IMB57 Insulating mounting block
One required at each end of a tagging strip/earth rail. Suitable for low-profile (7.5mm) and high-profile (15mm) symmetrical DIN rail.



ERB57O Earth-rail bracket, offset
Nickel-plated; supplied with two push fasteners, one 14mm earth-rail clamp and one 10mm earth clamp for cables ≤16mm².



ETL7000 earth terminal
Provides connection for routing the IS earth from the DIN rail to an appropriate plant earth. Maximum cable cross-section is 10mm². Two recommended per discrete length of DIN rail. See instruction manual INM7700 for more details.



BPL7700 Power Bus link
When a number of barriers use a common power supply, the optional power link (BPL7700) can be used. Typical applications include hazardous area switches, solenoids and 4–20mA transmitters. The barriers it can be used with are the MTL7706, MTL7707+, MTL7787+, MTL7787P+, MTL7789P+ and MTL774X. See next page for further details.

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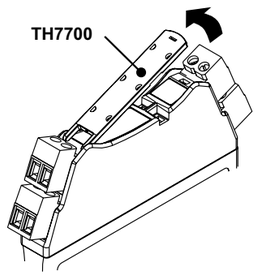
TAGGING ACCESSORIES

Two methods of tagging are available which can be used separately or together:

1) Individual barrier identification
TH7700 barrier identifiers
TH7700 barrier identifiers are supplied clipped on to the tops of individual barriers to provide transparent holders for identification labels.



2) Tagging strip method

TAG57 Tagging strip, 1m length
Cut to size. Supplied with reversible tagging strip label suitable for either MTL5000 or MTL7000 Series module spacing.

TGL7700 Tagging strip labels, set of 10 x 0.5m
For use with TAG57 tagging strip. Tags are reversible - one side for MTL7700, the other for MTL700.

HOW TO ORDER

MTL7700 barriers
Select by barrier number and polarity,
e.g. MTL7728+

Mounting accessories

THR2	Standard DIN-rail, 35 x 7.5mm
THR7000	T-section DIN-rail, specially-plated, 35 x 7.5mm, 1m length
ISP7000	Insulating spacer

Standard earthing/earth-rail accessories

ETL7000	Earth terminal, DIN-rail mounted
IMB57	Insulating mounting block
ERB57S	Earth-rail bracket, straight
ERB57O	Earth-rail bracket, offset
ERL7	Earth rail, 1m length
ETM7	Earth terminal, pack of 50

Standard tagging accessories

TAG57	Tagging strip, 1m length
TGL7700	Tagging strip labels, set of 10 x 0.5m

Bussed power links

BPL7700	Pack of 100

Enclosures

DX070	Enclosure, for MTL7700 x 5
DX170	Enclosure, for MTL7700 x 13
DX430	Enclosure, for MTL7700 x 33

Spares (all in packs of 10)

SAF7712	Safe-area terminals 1 & 2
HAZ7734	Hazardous area terminals 3 & 4

SAF7756	Safe-area terminals 5 & 6
HAZ7778	Hazardous area terminals 7 & 8
TH7700	Tag holder

Literature

INM7700	Instruction manual, MTL7700 Series
INA7700	ATEX information, MTL7700 Series
INM57ENC	Instruction manual, MTL5000/7000 Series Enclosures
CD7700...	Customer drawings

APPROVALS
(for the latest certificate information see www.mtl-inst.com/support/certificates)

Region (Authority)	UK (BASEEFA)	UK (BASEEFA) Systems	USA (FM)	Canada/USA (CSA)	Japan (TIIS)
Standard	EN 50014 EN 50020	EN 50039	3600, 3610 entity 3611, 3810	CAN/CSA E60079 UL698, UL913, UL1604 IEC60079, C22.2	See Certificates
Approved for	[EEx ia] IIC [EEx ia] IIB ‡	EEx ia IIC EEx ia IIB ‡	AIS/I,II,III/1/Entity ABCDEFG- SCI-942; NI/I/2/ABCD/T4 [I/0] AEx[ia]IIC – SCI-942 Entity; NI/1/2/IIC/T4 Ta=60°C except † where Ta=65°C	Class 1, Div 2, Gps A,B, C,D; Ex nA [iA] IIC T4 Class 1, Zone 2, AEx nA IIC T4	Ex (ia) IIC Ex (ia) IIB ‡
Model No.	**Certificate No.**				
MTL7706+	BAS01ATEX7217	Ex01E2219	3010737	1345550	
MTL7707+	BAS01ATEX7217	Ex01E2219	3010737	1345550	
MTL7707P+	BAS01ATEX7218‡	Ex01E2220‡	3010737‡	1345550	
MTL7710+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16433
MTL7715+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16434
MTL7715P+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16611
MTL7722+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16435
MTL7728+/–/ac	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16397
MTL7728P+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16436
MTL7729P+	BAS01ATEX7218‡	Ex01E2220‡	3010737‡	1345550	C16612‡
MTL7741	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16613
MTL7742	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16614
MTL7743	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16615
MTL7744	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16616
MTL7745	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16617
MTL7755ac	BAS01ATEX7217	Ex01E2219	3010737†	1345550	C16450
MTL7756ac	BAS01ATEX7217	Ex01E2219	3010737†	1345550	C16437
MTL7758+/–	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16618
MTL7760ac	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16619
MTL7761ac	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16438
MTL7761Pac	BAS01ATEX7217	Ex01E2219	3010737	1345550	
MTL7764+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16440
MTL7764ac	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16441
MTL7765ac	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16620
MTL7766ac	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16442
MTL7766Pac	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16443
MTL7767+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16444
MTL7778ac	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16621
MTL7779+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16445
MTL7787+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16447
MTL7787P+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16448
MTL7788+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16449
MTL7788R+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16449
MTL7789+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16622
MTL7796+	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16446
MTL7796–	BAS01ATEX7217	Ex01E2219	3010737	1345550	C16446
MTL7798			NI only		

Note : *For FM compliance, the MTL7700 Series barriers shall be installed in compliance with the enclosure, mounting, spacing and segregation requirements of the ultimate application.*

‡ *Certified to CENELEC IIB/FM Grps C-G only.*

MAXIMUM CABLE PARAMETERS
(for the latest information see www.mtl-inst.com/support/certificates)

Model No.	ac[1]/dc	Note [3] ref.	BASEEFA Group IIC			Matched Power (W)	FM (Grps A&B)			Matched Power (W)
			C (μF)	L [2] (mH)	L/R (μH/Ω)		C (μF)	L [2] (mH)	L/R (μH/Ω)	
MTL7706	+	a	0.083	3.05 (4.2)	56	0.65	0.083	4.2	56	0.65
MTL7707	+	a1/a2/b	0.083	3.05 (4.2)	56	0.65	0.083	4.2	56	0.65
MTL7710	+	a	3	0.91	74	0.50	3	0.91	74	0.50
MTL7715	+	a	0.58	1.45	66	0.56	0.58	1.45	66	0.56
MTL7715P	+	a	0.580	0.33	28	1.09	0.580	0.33	28	1.09
MTL7722	+	a	0.165	1.45	45	0.81	0.165	1.45	45	0.81
MTL7728	+/-/ac	a	0.083	3.05 (4.2)	56	0.65	0.083	3.05 (4.2)	56	0.65
MTL7728P	+	a	0.083	1.82 (2.51)	44	0.83	0.083	1.82 (2.51)	44	0.83
MTL774X		b3	2.86	96	742	—	2.86	96	742	0.039
MTL7755	ac	a1/a2	100	0.46	145	0.225	100	0.46	145	0.225
		b	100	0.13	69	0.45	40	0.13	69	0.45
		c	40	0.41	73	0.45	40	0.13	69	0.45
MTL7756	ac	a1/a2/a3	100	0.46	145	0.225	100	0.46	145	0.225
		b1	100	0.13	69	0.45	40	0.13	69	0.45
		b2	100	0.06	44	0.675	40	0.13	69	0.45
		c1	40	0.41	73	0.45	40	0.13	69	0.45
		c2	40	0.23	61	0.60	40	0.06	44	0.675
MTL7758	+/-	a1/a2	11.1	0.07	26	1.40	11.1	0.07	26	1.4
		b	11.1	0.02	10	2.8	8.8	0.02	10	2.8
MTL7760	ac	a1/a2	3	0.91	74	0.5	3	0.91	74	0.5
		b	3	0.20	27	1.00	3	0.20	35.6	1.00
MTL7761	ac	a1/a2	4.9	3.72	163	0.225	4.9	3.72	163	0.225
		b	4.9	0.91	62	0.45	0.31	0.91	62	0.45
		c	0.31	3.72	81	0.45	0.31	0.91	62	0.45
MTL7761P	ac	a1/a2	4.9	56	613	0.058	4.9	56	613	0.058
		b	4.9	14	236	0.115	0.31	14.0	236	0.115
		c	0.31	56	306	0.115	0.31	14.0	236	0.115
MTL7764	+	a1/a2	1.41	240	1000	0.036	1.41	240	1000	0.036
		b	1.41	61	360	0.072	1.0	61	360	0.072
MTL7764	ac	a1/a2	1.41	240	1000	0.036	1.41	240	1000	0.036
		b	1.41	61	360	0.072	0.125	61	360	0.072
		c	0.125	240	500	0.072	0.125	61	360	0.072
MTL7765	ac	a1/a2	0.580	1.45	66	0.56	0.580	1.45	66	0.56
		b	0.580	0.32	22	1.125	0.58	0.32	31.6	1.12
MTL7766	ac	a1/a2	1.41	5.8	151	0.24	1.41	5.8	151	0.24
		b	1.41	1.47	58	0.48	0.125	1.47	58	0.48
		c	0.125	5.8	75	0.48	0.125	1.47	58	0.48
MTL7766P	ac	a1	1.41	1.47	78	0.471	1.41	1.47	78	0.471
		b	1.41	0.34	29	0.942	0.125	0.34	29	0.942
		c	0.125	1.15	39	0.942	0.125	0.34	29	0.942
MTL7767	+	a1/a2	0.58	1.45	66	0.56	0.58	1.45	66	0.56
		b	0.58	0.32	22	1.125	0.58	0.32	22	1.125
MTL7778	ac	a1/a2	0.083	16	107	0.33	0.083	16	107	0.33
		b	0.083	3.05 (4.2)	42	0.33	0.083	4.0	107	0.654
MTL7779	+	a1/a2	0.083	3.05 (4.2)	56	0.65	0.083	3.05 (4.2)	56	0.65
		b	**NOT PERMITTED**							
MTL7787	+/-	a1	0.083	3.05 (4.2)	56	0.65	0.083	3.05 (4.2)	56	0.65
		a2	0.083	—	—	—	0.083	—	—	—
		b	0.083	3.05 (4.2)	56	0.65	0.011	4.2	56	0.65
MTL7787P	+	a1	0.083	1.82 (2.51)	44	0.835	0.083	1.82 (2.51)	44	0.83
		a2	0.083	—	—	—	0.083	—	—	—
		b	0.083	1.82 (2.51)	44	0.835	0.78	2.51	44	0.835
MTL7788	+	a1	0.083	3.05 (4.2)	56	0.65	0.083	3.05 (4.2)	56	0.65
		a2	3.0	0.91	74	0.5	3.0	0.91	74	0.5
		b	0.083	0.33	25	0.92	0.083	0.33	25	0.92
MTL7788R	+	a1	0.083	3.05 (4.2)	56	0.65	0.083	3.05 (4.2)	56	0.65
		a2	3.0	0.91	74	0.5	3.0	0.91	74	0.5
		b	0.083	0.33	25	0.92	0.083	0.33	25	0.92
MTL7789	+	C	0.083	16	106	0.33	0.083	16	106	0.33
MTL7796	+/-	a1	0.1	4.91	64	0.56	0.1	4.91	64	0.56
		a2	0.22	13	136	0.26	0.22	13	136	0.26
		b	0.1	1.94	34	0.81	0.096	1.94	34	0.81

Model No.	ac[1]/dc	Note [3] ref.	BASEEFA Group IIB			Matched Power (W)	FM (Grps C-G)			Matched Power (W)
			C (μF)	L [2] (mH)	L/R (μH/Ω)		C (μF)	L [2] (mH)	L/R (μH/Ω)	
MTL7707P	+	a1	0.65	5.34	125	1.20	0.65	5.34	125	1.20
		b	0.65	5.34	125	1.20	0.587	5.34	125	1.20
MTL7729P	+	a1	0.65	5.65	127	1.19	0.65	5.65	127	1.19

***Notes**: 1 'ac' indicates a non-polarised, star-connected barrier configuration.*
2 When the external circuit contains no lumped inductance greater than 10μH, the cable inductance may be increased to the values within parentheses.
3 See next page.

For further barrier channel configuration data, please refer to the relevant certificate.

***Note 3 :** The circuit configuration for the output parameters given in the table 'Maximum Cable Parameters' are as follows:-*

a Single channel barrier.
a1 First channel of a dual/triple channel barrier.
a2 Second channel of a dual/triple channel barrier.
a3 Third channel of a dual/triple channel barrier.
b Both channels of a dual channel barrier connected in parallel, with respect to earth.
b1 Two channels of a triple channel barrier connected in parallel, with respect to earth.
b2 Three channels of a triple channel barrier connected in parallel, with respect to earth.
b3 Both channels of each switch input connected together
c Both channels of a dual channel barrier interconnected, with no earth return.
c1 Two channels of a triple channel barrier interconnected, with no earth return.
c2 Three channels of a triple channel barrier interconnected, with no earth return. This assumes two of the channels are in parallel.

CORRELATION BETWEEN MTL7700 — MTL7000 — MTL700 BARRIERS (IIC)

Module No.	Bussed Power	MTL7000 Equivalent	MTL7000 Original Certificate Number(s)	MTL7000 ATEX Certificate Number(s)	MTL700 equivalent	MTL700 Original Certificate Number(s)	MTL700 ATEX Certificate Number(s)	Typical Application
MTL7710+	No	Half of MTL7162+	Ex95C2261	BAS99ATEX7285	MTL710+	Ex832452	BAS01ATEX7202	4/6V Systems
MTL7715+	No	N/A	N/A	N/A	MTL715+	Ex832452	BAS01ATEX7202	12V Systems
MTL7715P+	No	N/A	N/A	N/A	MTL715P+	Ex92C2373	BAS01ATEX7202	12V Systems
MTL7722+	No	MTL7122+	Ex95C2261	BAS99ATEX7285	MTL722+	Ex832452	BAS01ATEX7202	General Purpose
MTL7728+/-	No	MTL7028+/- MTL7128+/-	Ex95C2261	BAS99ATEX7285	MTL728+/-	Ex832452	BAS01ATEX7202	Analogue / Digital
MTL7728ac	No	N/A	N/A	N/A	MTL728ac	Ex832452	BAS01ATEX7202	General Purpose
MTL7728P+	No	MTL7128P+	Ex95C2261	BAS99ATEX7285	MTL728P+	Ex92C2373	BAS01ATEX7202	Analogue / Digital
MTL7755ac	No	MTL7055ac	Ex95C2261	BAS99ATEX7285	MTL755ac	Ex832452	BAS01ATEX7202	RTD, Grounded
MTL7756ac	No	MTL7056ac	Ex95C2261	BAS99ATEX7285	N/A	N/A	N/A	RTD, Grounded
MTL7758+/-	No	N/A	N/A	N/A	MTL758	Ex83453	BAS01ATEX7217	Active sensors,
MTL7760ac	No	N/A	N/A	N/A	MTL760ac	Ex832452	BAS01ATEX7202	Active sensors, Thermocouples
MTL7761ac	No	MTL7261ac	Ex95C2261	BAS99ATEX7285	MTL761ac	Ex832452	BAS01ATEX7202	Strain Gauges
MTL7761Pac	No	MTL7061Pac MTL7161Pac	Ex95C2261	BAS99ATEX7285	MTL761Pac	Ex92C2373	BAS01ATEX7202	Load cell
MTL7764+	No	MTL7164+	Ex95C2261	BAS99ATEX7285	MTL764+	Ex832452	BAS01ATEX7202	High resistance
MTL7764ac	No	MTL7264ac	Ex95C2261	BAS99ATEX7285	MTL764ac	Ex832452	BAS01ATEX7202	Strain / Level Gauges
MTL7765ac	No	N/A	N/A	N/A	MTL765ac	Ex832452	BAS01ATEX7202	General Purpose
MTL7766ac	No	N/A	N/A	N/A	MTL766ac	Ex832452	BAS01ATEX7202	Strain Gauges
MTL7766Pac	No	MTL7066Pac MTL7166Pac	Ex95C2261	BAS99ATEX7285	MTL766Pac	Ex92C2373	BAS01ATEX7202	Strain Gauges
MTL7767+	No	MTL7167+	Ex95C2261	BAS99ATEX7285	MTL767+	Ex832452	BAS01ATEX7202	Dual MTL715
MTL7779+	No	N/A	N/A	N/A	MTL779+	Ex832452	BAS01ATEX7202	Dual MTL728
MTL7787+/-	Yes	MTL7087+ MTL7187+	Ex95C2261	BAS99ATEX7285	MTL787S+	Ex832452	BAS01ATEX7202	Analogue / Digital
MTL7787P+	Yes	MTL7087P+ MTL7187P+	Ex95C2261	BAS99ATEX7285	MTL787SP+	Ex92C2373	BAS01ATEX7202	Analogue / Digital
MTL7788+	Yes	N/A	N/A	N/A	MTL788+	Ex832452	BAS01ATEX7202	Transmitters
MTL7788R+	Yes	N/A	N/A	N/A	MTL788R+	Ex832452	BAS01ATEX7202	1—5V systems
MTL7796+/-	No	MTL7096- MTL7196-	Ex95C2261	BAS99ATEX7285	MTL796+/-	Ex832452	BAS01ATEX7202	Vibration sensors

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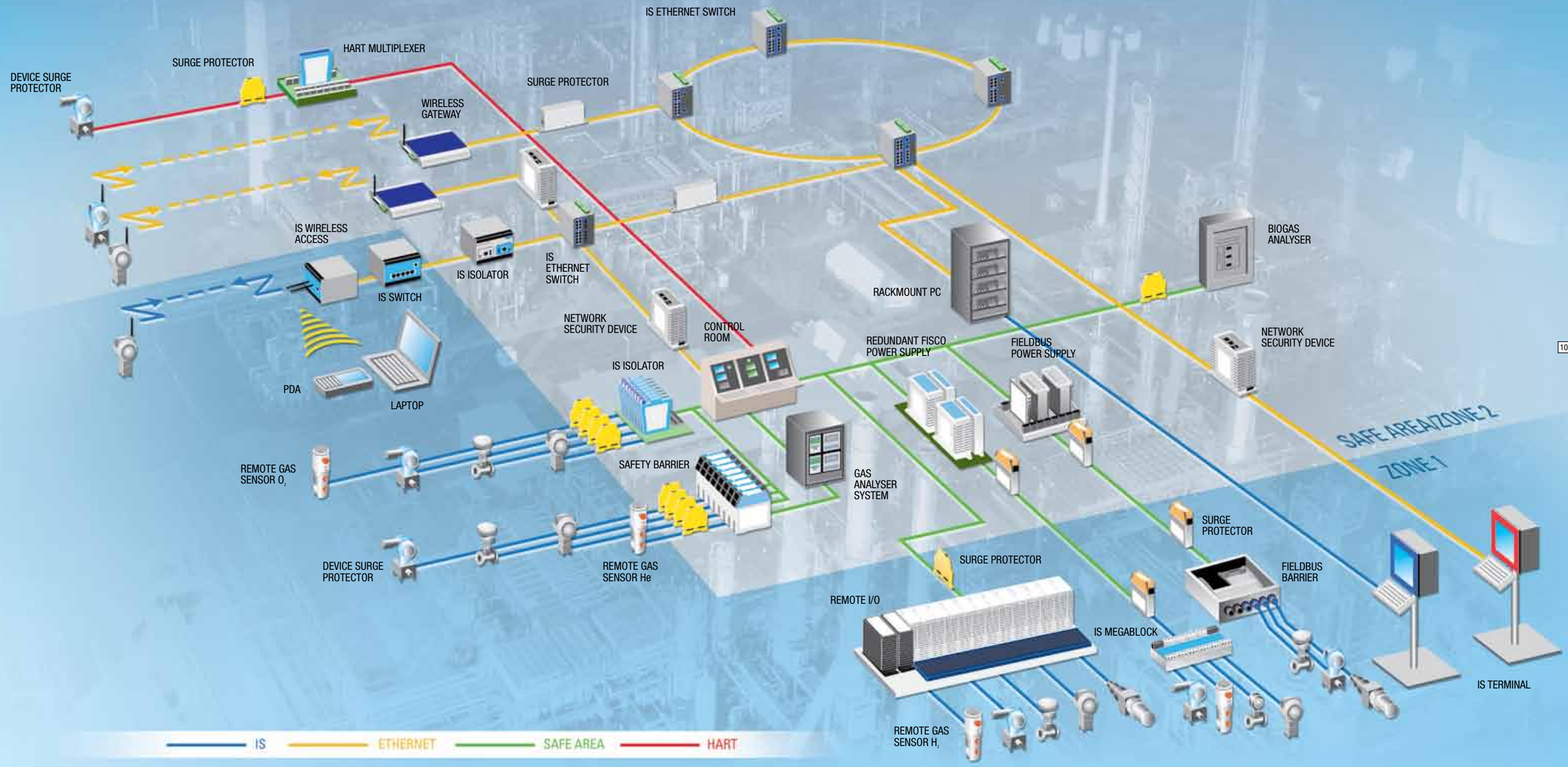

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