



technical datasheet

## MTL700 Series

for safe measurement and control in hazardous areas

- 1 or 2 channels in same package
- Electronic protection prevents blown fuses
- Higher-power barriers for group IIC and IIB gases
- All models short-circuit proof
- Fixed tagging & cable-screen earthing accessories
- Certified to worldwide standards



**MTL700 Series shunt-diode safety barriers** are 1- or 2-channel devices which pass an electrical signal in either direction without shunting it, but limit the transfer of energy to a level that cannot ignite explosive atmospheres. Connected in series with the signal transmission lines on a process plant, they protect hazardous-area wiring and equipment against faults occurring in the safe area, and enable a wide range of measurement and control operations to be carried out simply and inexpensively by intrinsically safe techniques.

**Applications** include the protection of installations containing 'simple' uncertified devices such as thermocouples, switches, and resistive sensors, or separately certified 'energy storing' or 'voltage producing' apparatus, for example ac sensors, transmitters, and current-to-pneumatic (I/P) converters.

**Essential features** of the MTL700 Series are the self checking 'as-you-mount-it' earthing via two studs directly to nickel-plated brass or copper busbar. The earth connection is on top of the unit, allowing easy inspection, installation and removal.

The shape of the barrier has been designed for easy wiring, while the common (14.5 mm) space requirement of both 1- and 2-channel units simplifies planning or alteration of installations of all sizes. The busbar is insulated for separate earthing, to eliminate the danger of invasion by fault currents.

**MTL700P shunt-diode safety barriers** deliver more power into hazardous areas. Because of the higher power levels available, it is important when considering the use of MTL700P barriers to check the compatibility of the electrical safety parameters of the field equipment (such as transmitters and solenoid valves) with those of the barriers to make sure the combination is safe. In addition, with the barriers designed for IIB gas group applications, the overall gas classification of the system also needs checking

**References.** The following documents are available for further information on MTL700 Series barriers:

*AN9007 A user's guide to shunt-diode safety barriers*

*INM700 The MTL700 Series Instruction Manual*

EPS700 Rev3 010213

**COOPER** Crouse-Hinds

[www.mtl-inst.com](http://www.mtl-inst.com)

# SPECIFICATIONS 'Key' barriers shown in blue

Model No.	Safety description			Polarities available			Application	Basic circuit	Max. end-to-end resistance $\Omega$	$V_{wkg}$ at 10 (1) $\mu A$	$V_{max}$	Fuse rating		
	V	$\Omega$	mA	+	-	ac							Hazardous	Safe
<b>706</b>	<b>28</b>	<b>300</b>	<b>93</b>	✓			<b>Transmitters</b> <b>Switches</b> Transmitters, switches, controller outputs <b>Solenoids, alarms, LEDs, switches</b>	See "HOW THEY WORK" and "OVERVOLT-PROTECTED BARRIERS"	-	-	<b>35</b> <b>35</b> <b>50</b> 35 - - -	See 'How they work' 50 - -		
<b>707</b>	<b>28</b>	<b>300</b>	<b>93</b>	✓										
<b>707P†</b>	<b>28</b>	<b>diode</b>	-											
	28	164	170	✓										
	15	diode	-											
<b>708</b>	<b>28</b>	<b>300</b>	<b>93</b>	✓										
<b>710</b>	10	50	200	✓	✓	✓	6V dc & 4V ac systems 8V dc systems 12V systems 12V dc systems 18V dc systems 18V dc systems <b>Controller outputs, solenoids</b> Transmitters Controller outputs, solenoid valves Controller outputs, solenoid valves		85	6.0	6.9 <sup>c</sup>	50		
<b>710P</b>	10	33	300	✓	✓	✓			42	8.0	9.2	200		
<b>715</b>	15	100	150	✓	✓	✓			155	12.0	13.0	100		
<b>715P</b>	15	50	291	✓	✓	✓			60	12.5	13.8	200		
<b>722</b>	22	150	147	✓	✓	✓			185	19.0	20.2	50		
<b>722P</b>	22	101	213	✓	✓	✓			121	18.5	20.0	100		
<b>728</b>	<b>28</b>	<b>300</b>	<b>93</b>	✓					<b>340</b>	<b>25.5</b>	<b>26.6</b>	<b>50</b>		
	28	300	93	✓		✓			340	25.5 <sup>b</sup>	26.6 <sup>d</sup>	50		
<b>728P</b>	28	234	119	✓		✓			253	24.5	26.0	100		
<b>729P†</b>	28	164	170	✓		✓			184	24.5	26.0	100		
<b>751</b>	1	10	100			✓			Active dc & ac sensors (low impedance receivers) <b>Resistance temperature detectors</b>		20	0.3	2.0	250
	1	10	100			✓					20	0.3	2.0	250
<b>755</b>	<b>3</b>	<b>10</b>	<b>300</b>			✓					<b>18.0<sup>a</sup></b>	<b>(0.6)</b>	<b>3.6</b>	<b>250</b>
	<b>3</b>	<b>10</b>	<b>300</b>			✓			<b>18.0<sup>a</sup></b>	<b>(0.6)</b>	<b>3.6</b>	<b>250</b>		
<b>758</b>	7.5	10	750	✓	✓				Gas detectors Strain-gauge bridges Strain-gauge bridges Strain-gauge bridges Strain-gauge bridges Strain-gauge bridges 12V dc systems 18V dc systems Controller outputs Vibration probes (MTL796 negative)		18	6.0	7.0	200
	7.5	10	750	✓	✓		18	6.0			7.0	200		
<b>761</b>	9	90	100			✓	145	6.0			7.5	100		
	9	90	100			✓	145	6.0			7.5	100		
<b>761P</b>	9	350	25			✓	384	7.0			8.1	50		
	9	350	25			✓	384	7.0			8.1	50		
<b>764</b>	12	1k	12	✓	✓	✓	1075	10.0			10.7 <sup>e</sup>	50		
	12	1k	12	✓	✓	✓	1075	10.0			10.7 <sup>e</sup>	50		
<b>766</b>	12	150	80			✓	185	10.0			11.2	50		
	12	150	80			✓	185	10.0			11.2	50		
<b>766P</b>	12	75	157			✓	93	9.8			11.3	100		
	12	75	157			✓	93	9.8			11.3	100		
<b>767</b>	15	100	150	✓	✓		155	12.0			13.0	100		
	15	100	150	✓	✓		155	12.0			13.0	100		
<b>768</b>	22	150	147	✓	✓		185	19.0			20.2	50		
	22	150	147	✓	✓		185	19.0			20.2	50		
<b>779</b>	28	300	93	✓	✓		340	25.5			26.6	50		
	28	300	93	✓	✓		340	25.5			26.6	50		
<b>796</b>	26	300	87	✓	✓		340	23.5	24.6	50				
	20	390	51			✓	435	17.5	18.7	50				
<b>760</b>	<b>10</b>	<b>50</b>	<b>200</b>			✓	<b>Active dc &amp; ac sensors</b> <b>Thermocouples</b> 2-wire dc & ac systems		<b>85</b>	<b>6.0</b>	<b>7.4</b>	<b>50</b>		
	<b>10</b>	<b>50</b>	<b>200</b>			✓			<b>85</b>	<b>6.0</b>	<b>7.4</b>	<b>50</b>		
<b>765</b>	15	100	150			✓			135	12.0	13.2	50		
	15	100	150			✓			135	12.0	13.2	50		
<b>772</b>	22	300	73			✓			340	18.0	19.7	50		
	22	300	73			✓			340	18.0	19.7	50		
<b>778</b>	28	600	47			✓			665	24.0	25.7	50		
	28	600	47			✓	665	24.0	25.7	50				
<b>786</b>	28	diode	-	✓	✓		Signal returns		2.2V+30 $\Omega$	25.5	26.6	50		
	28	diode	-	✓	✓				2.2V+30 $\Omega$	25.5	26.6	50		
<b>787</b>	28	300	93	✓	✓		Controller outputs, switches <b>Transmitters</b> <b>Controller outputs, switches</b> Transmitters, controller outputs switches		340	25.5	26.6	50		
	28	diode	-	✓	✓				2.2V+30 $\Omega$	25.5	26.6	50		
<b>787S</b>	<b>28</b>	<b>300</b>	<b>93</b>	✓					<b>340</b>	<b>25.5</b>	<b>26.6</b>	<b>50</b>		
	<b>28</b>	<b>diode</b>	-			✓			<b>0.9V+20<math>\Omega</math></b>	<b>25.5</b>	<b>26.6</b>	<b>50</b>		
<b>787SP</b>	28	234	119	✓					258	24.5	26.5	80		
	28	diode	-			✓	0.9V+16 $\Omega$	24.5	26.5	80				
<b>788</b>	28	300	93	✓	✓		31.25kbit/s fieldbus installations		340	25.5	26.6	50		
	10	50	200	✓	✓				85	6.0	6.9	50		
<b>788R</b>	28	300	93	✓	✓				85	6.0	6.9	50		
	10	50	200	✓	✓									
<b>791</b>	11	51	216	✓	✓		31.25kbit/s fieldbus installations		62.6	10V (at 50 $\mu A$ )	10.5	100		
	11	51	216	✓	✓				62.6	-10V (at 50 $\mu A$ )	-10.5	100		
<b>799</b>	Dummy barrier for securing cables for future installations - takes hazardous-area circuits to earth.													

a: Tolerance  $\pm 0.15\Omega$  at 20°C, channels track within 0.15 $\Omega$  from -20 to +60°C.  
 b: ac version 24.5V.  
 c: ac version 7.4V.

d: ac version 26.1V.  
 e: ac version 11.2V.

† Gas group IIB (CENELEC), C (N America).

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

Patents for MTL787S: UK Patent No. 2210522, USA Patent No. 4860151; Patents for MTL707P: UK Patent Nos. 2210521, 2210522; USA Patent No. 4860151; Patents for MTL787SP: UK Patent No. 2210522; USA Patent No. 4860151



## HOW THEY WORK

All MTL700 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 MTL707P+ and MTL729P+, '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. An exception to this is the MTL791 Fieldbus barrier which has one positive and one negative channel.

### 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 overvoltage-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 (Um)

The maximum permissible safe-area voltage (Um) for MTL700 Series barriers is 250V ac/dc.

## GENERAL SPECIFICATION

### KEY BARRIER

#### 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 MTL755 it decreases by at least one decade for a 0.4V reduction in applied voltage.

#### Terminations

Terminals accommodate conductors up to 4mm<sup>2</sup> (12AWG)  
Hazardous-area terminals are identified by blue labels.

#### Colour coding of barrier top

- Grey: non-polarised
- Red: positive polarity
- Black: negative polarity
- Black (red label for safe-area terminals): positive supply, negative to transmitter (MTL706)
- White: dummy barrier, MTL799

#### Weight

125g approx

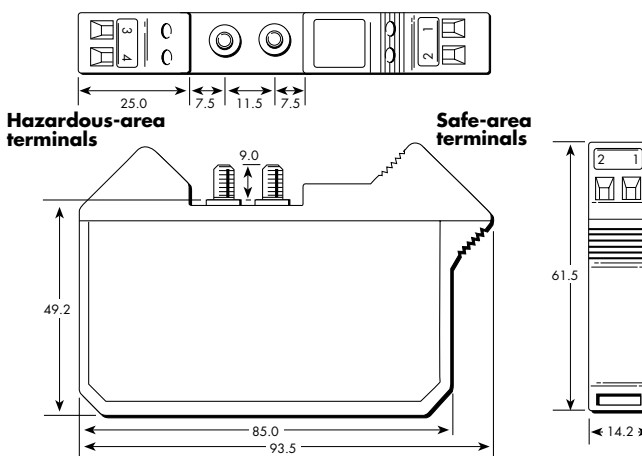
#### Mounting and earthing

By two integral M4 x 9 tin-lead plated steel fixing studs and stainless steel self-locking nuts (provided).

#### EMC compliance

EN 61326-1:2006  
(MTL707P+ is not CE marked. MTL706+ smart transmitter communications may be disrupted at high levels of radiated interference).

## DIMENSIONS (MM)



## MTL700 SERIES KEY BARRIERS SUMMARISED

TYPE	APPLICATION	KEY BARRIER	
Analogue input (low-level)	Resistance temperature detectors Thermocouples, ac sensors	<b>755ac</b> <b>760ac</b>	
Analogue output	Controller outputs, one line earthed Controller outputs, neither line earthed	<b>728+</b> <b>787S+</b>	
		dc power supply	
		26.0V	20-35V
Analogue input (high-level)		<b>787S+</b>	<b>706+</b>
Digital (on/off) input		<b>787S+</b>	<b>707+</b>
Digital (on/off) i output		<b>728+</b>	<b>708+</b>

#### Patents for MTL706+, 707+, 708+, 787S+

The given data is only intended as a product description and should not be regarded as a legal warranty of properties or guarantee. In the interest of further technical developments, we reserve the right to make design changes.



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EPS700 Rev3 010213

# OVERVOLT-PROTECTED BARRIERS

## OVERVOLT-PROTECTED BARRIERS

The 706+, 707+, 707P+ and 708+ have built-in overvoltage protection, allowing their use with unregulated power supplies. In many applications, e.g. 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, overvoltage protection allows the barriers to be used with unregulated supplies up to 35V dc and also gives protection against faulty wiring during commissioning.

### MTL706+ for 'smart' 2-wire 4/20mA transmitters

UK Patent No. 2205699

USA Patent No. 4967302

European Patent (Germany, France, Italy) No. EP 0 294 139 B1

The MTL706+ is a 1-channel shunt-diode safety barrier, with built-in electronic overvoltage 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 MTL706+ 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.

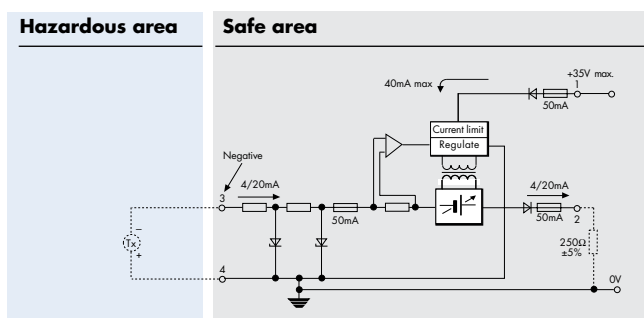
Since the MTL706+ has no return channel for energising the load, the entire output of the single '28V' channel is available to power the transmitter, providing high output capability. This channel is negatively polarised, and the safe-area signal is in fact the very current that returns through it from 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. This is achieved by monitoring the 4/20mA current, an arrangement which allows all-frequency communication in both directions. A separate circuit limits the current to protect the fuse in the event of a short circuit in the hazardous area.

With a 22V supply, the barrier will deliver 15V minimum at 20mA for the transmitter and lines and consumes less than 40mA in normal operation.

**Note: the MTL706+ supercedes the MTL705+, which was similar in basic performance but did not pass outgoing communication signals below about 1kHz.**

### BASIC CIRCUIT



### ADDITIONAL SPECIFICATION

#### Supply voltage

20 to 35V dc, positive w.r.t. earth

#### Output current

4 to 20mA

#### Voltage available for transmitter and lines

15V minimum at 20mA with 22V supply

15.5V typical at 20mA with 24V supply

Note: voltages are negative w.r.t. earth

#### Load resistance

250Ω ±5% (can be greater if reduced transmitter voltage is acceptable)

#### Accuracy

±2μA under all conditions

#### Supply current

35mA typical (at 20mA with 24V supply)

40mA maximum (at 20mA with 35V supply)

### MTL707+ for switch inputs

UK Patent Nos. 2245439, 2210521

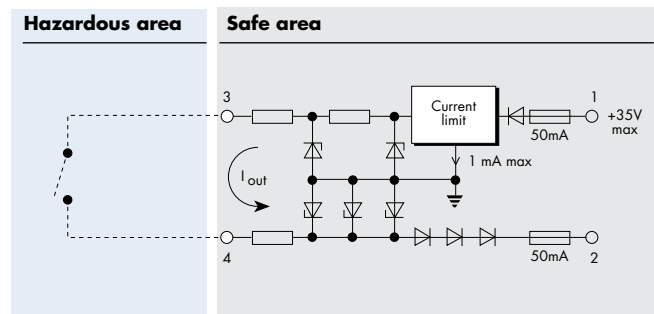
European Patent No. EP 0 310 280 B1

The MTL707+ is a 2-channel shunt-diode safety barrier similar to the MTL787+ but with built-in electronic overvoltage 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

#### Supply voltage (V<sub>s</sub>)

10 to 35V dc, positive w.r.t. earth

#### Output current (I<sub>out</sub>)

Up to 35mA available

#### Maximum voltage drop (at 20°C, current not limited)

I<sub>out</sub> × 370Ω + 1.5V, terminal 1 to 3

I<sub>out</sub> × 50Ω + 2.1V, terminal 4 to 2

#### Supply current

I<sub>out</sub> + 1mA max, V<sub>s</sub> < 26V

Limited at 50mA, V<sub>s</sub> > 28V or low load resistance

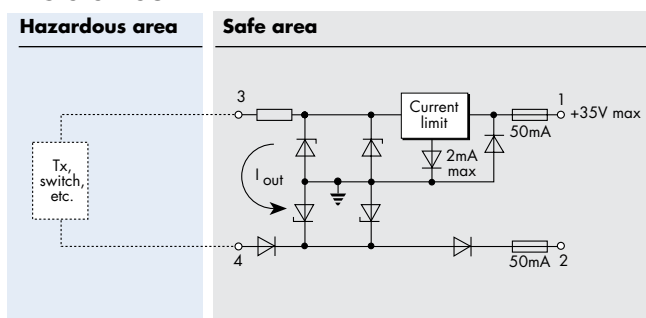


# OVERVOLT-PROTECTED BARRIERS

## MTL707P+ for switch inputs, IIB gases

The MTL707P+ is a two-channel shunt-diode safety barrier similar to the MTL787SP+, but is designed for use with group IIB gases and features built-in electronic overvoltage 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

#### Supply voltage – channel 1 (V<sub>s</sub>)

10 to 35V dc positive with respect to earth

#### Output current – channel 1 (I<sub>out</sub>)

Up to 35mA available

#### Maximum voltage drop (at 20°C, current not limited)

$I_{out} \times 200\Omega + 0.2V$ , terminals 1 to 3

$I_{out} \times 18\Omega + 1.3V$ , terminals 4 to 2

#### Supply current

$I_{out} + 2mA$  max,  $V_s < 25V$

Limited at 50mA,  $V_s > 28V$  or low load resistance

## MTL708+ for switched outputs

UK Patent No. 2210521

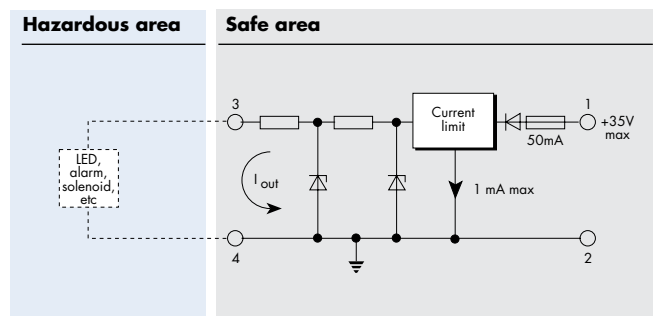
European Patent No. EP 0 310 280 B1

The MTL708+ is a 1-channel shunt-diode safety barrier similar to the MTL728+ but with built-in electronic overvoltage protection. It is intended primarily for safeguarding solenoids, alarms, light-emitting diodes or other hazardous-area loads controlled by a safe-area switch from an unregulated dc supply in the safe area.

The barrier accepts supply voltages up to +35V and is protected against reverse voltages.

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 hazardous-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

#### Supply voltage (V<sub>s</sub>)

10 to 35V dc, positive w.r.t. earth

#### Output current (I<sub>out</sub>)

Up to 35mA available

#### Maximum voltage drop (at 20°C, current not limited)

$I_{out} \times 370\Omega + 1.5V$ , terminal 1 to 3

#### Supply current

$I_{out} + 1mA$  max,  $V_s < 26V$

Limited at 50mA,  $V_s > 28V$  or low load resistance



# BARRIERS FOR SENSORS

## ANALOGUE INPUTS, LOW LEVEL

### Thermocouples

The preferred barrier for thermocouples is the MTL760ac, whose 2-channel non-polarised design retains the 'earth-free' nature of the signal. Provided that the receiver's input circuit floats, the combination rejects common-mode ac and dc interference up to at least 6V and is unaffected by earth faults on the primary element. Even if the receiver's circuit is tied to its '0V' rail, the use of a 2-channel barrier takes the worry out of earthing. To eliminate errors due to thermal emfs, the compensating cable should be continued from the barrier to the receiver. For moving coil or other low resistance receivers, use the MTL751 (40Ω) or the MTL755ac (36Ω) if the resistance of the MTL760 (170Ω) is unacceptable.

USA regulations permit the thermocouple to be earthed on the assumption that the barrier will not conduct, but Europe and other 'IEC countries' assume that it may do so. In these countries either the thermocouple and its cables must be insulated to withstand 500V, Fig. 1; or the earth loop must be broken by an isolating transmitter, Fig. 2, or by one of the isolating interface devices in the MTL4500 or MTL5500 series.

### Photocells, ac sensors, flowmeters

Similar arguments apply, and the MTL760ac is recommended, Fig. 3. Any other 2-channel non-polarised barrier that will handle the voltage would be suitable. All MTL barriers of this type transmit signals up to a few kHz. At higher frequencies the self capacitance of the Zener diodes – around 1000pF – may attenuate the signal. No certification is required for sensors generating less than 1.2V, 0.1A, 20μJ and 25mW. In practice this includes all photocells, but some ac sensors may have significant inductance and require to be certified for use in hazardous areas.

### Resistance temperature detectors

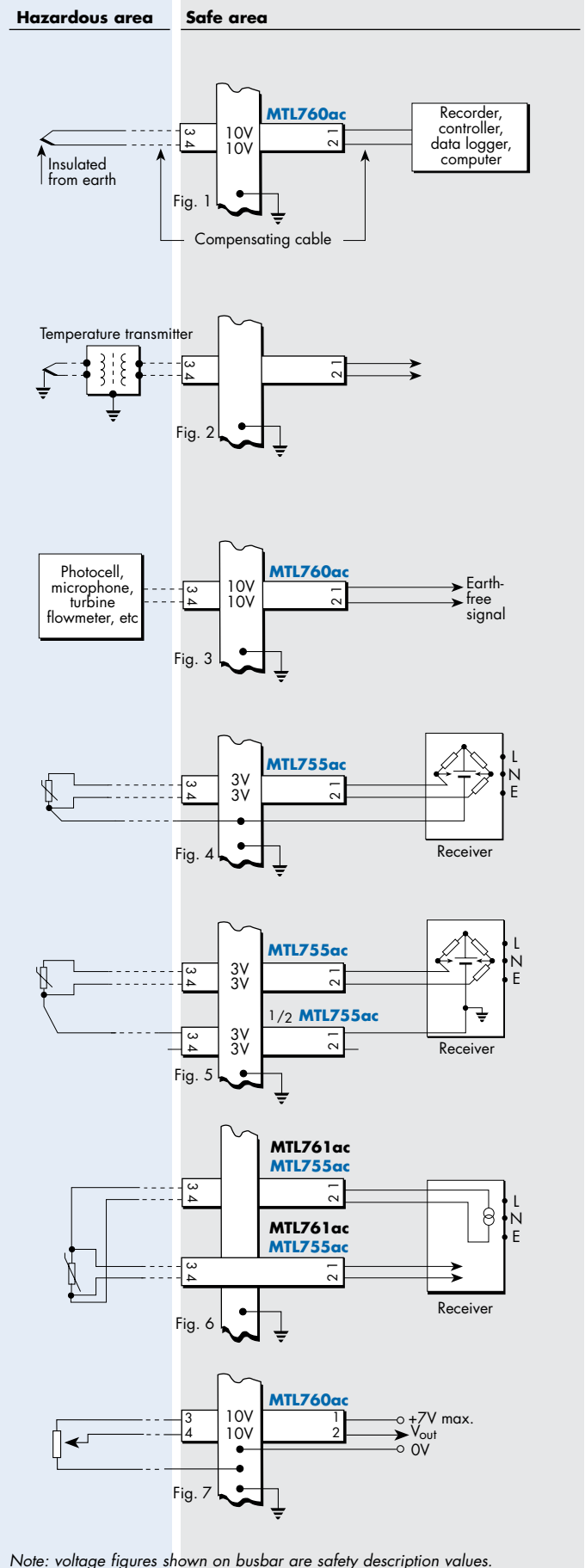
For 3-wire circuits with a floating bridge, the most economical solution is provided by the MTL755ac 2-channel barrier, Fig.4. The two leads from the bridge arms are protected by the barrier, while the third (supply) lead is earthed at the busbar. The MTL755ac has a low end-to-end resistance of only 18.0Ω per channel to minimise span changes, and its channels track within 0.15Ω (from -20 to +60°C) to minimise zero shift with temperature. Close tolerancing of each channel to ±0.15Ω at 20°C facilitates barrier substitution.

If the bridge circuit is already earthed, a third barrier channel is needed; in practice this can be one half of another MTL755ac, Fig. 5. For extreme accuracy use three channels and an earth-free bridge, since the small errors due to barrier leakage tend to cancel.

4-wire constant-current circuits do not require matched barrier resistances, and can be protected more economically by two MTL761ac 2-channel barriers, Fig.6. If the increase in loop resistance is too great, use two MTL755acs.

### Slidewire displacement transducers

There are many solutions. Perhaps the simplest is that shown in Fig. 7, where an MTL760ac supplies power and brings back a unipolar signal. Other barriers that could be used include the MTL761ac, 765ac, 772ac, 778ac. Where polarity reversal or very high accuracy are required, use the techniques designed for strain-gauge bridges, overleaf.



Note: voltage figures shown on busbar are safety description values.



# BARRIERS FOR SENSORS

(continued)

## ANALOGUE INPUTS, LOW LEVEL (continued)

### Strain-gauge bridges

Fig. 8 shows an arrangement using two or three barriers, which is safe in IIC gases (system certificate no. Ex842125). With the MTL761ac, the circuit is powered from a 12V, 290Ω source; if the bridge resistance is 290Ω, then the bridge voltage is 6V. If the MTL766ac is used, the source is 20V, 370Ω, and provides a bridge voltage of 10V when the bridge resistance is 370Ω.

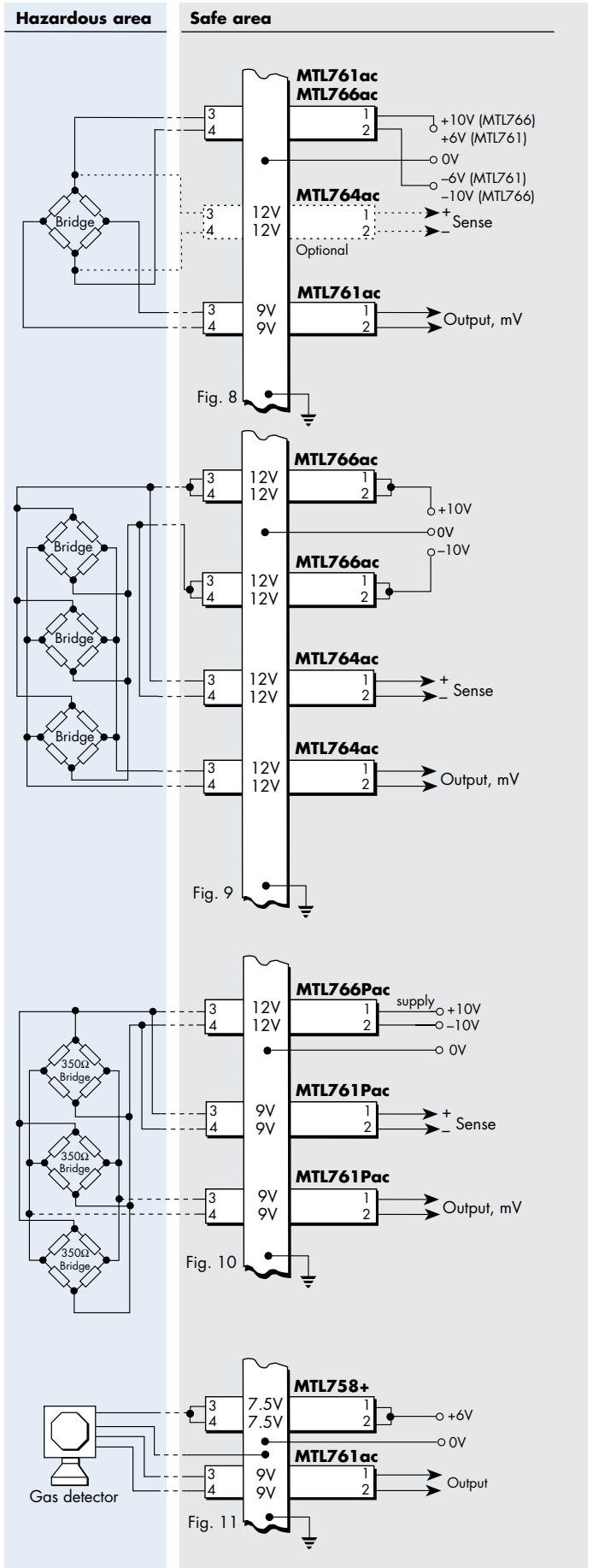
Quite frequently there is a demand to monitor three load cells, and a possible circuit is shown in Fig. 9 (system certificate no. Ex842128). The two channels of each MTL766ac barrier are connected in parallel to reduce the source resistance, and provide 8V across the three 350Ω bridges. However, the higher energy present means that the system is safe in IIA and IIB gases only.

Weighing by load-cell is an application where the lower voltage drop of the MTL766Pac, compared to the MTL766ac, is a great advantage. In such applications, the MTL766Pac supplies power to the bridge while an MTL761Pac interfaces with the sensing and pick-off circuits. Using the two barriers in combination (see Fig. 10), the minimum voltages available in 350Ω bridge systems with a ±10V supply are as follows:-

- 1 bridge: 13.0V
- 2 bridges: 9.7V
- 3 bridges: 7.7V
- 4 bridges: 6.4V

### Gas detectors, logic systems

Some devices require a high current at a low voltage, for example, 300mA at 2.3V for a typical gas detector. The low end-to-end resistance (18Ω) of the 2-channel MTL758+, and its working voltage of 6V, make this barrier ideal for energising gas detectors, 5V logic systems, certain displays and similar equipment. The two channels can be used separately or in parallel as required, and the system remains safe in IIC gases if an MTL761ac is added to bring back the measurement.



# BARRIERS FOR TRANSMITTERS AND SWITCHES

## ANALOGUE INPUTS, HIGH LEVEL

### 2-wire 4/20mA transmitters

If several transmitters are to be operated from a common dc supply, and this can be closely regulated (at 26V max), the MTL787S+ now beats the previously recommended MTL788+ by nearly half a volt, providing up to 12.9V at 20mA for a transmitter and its lines, as well as the usual 5V for the load, Fig. 12. Its return channel is more tolerant of errors during installation and fault finding, and it is safe with cables of much higher inductance. If the load requirement can be reduced, the voltage available for the transmitter will be greater.

If the supply can be closely regulated, and the transmitter is compatible with the higher power levels available from this barrier in IIC gas groups, the 2-channel MTL787SP+ is recommended. With a 26V supply it provides 14.6V at 20mA for a transmitter and lines as well as the usual 5V for the load, beating the MTL787S+ by 1.7V, Fig. 12.

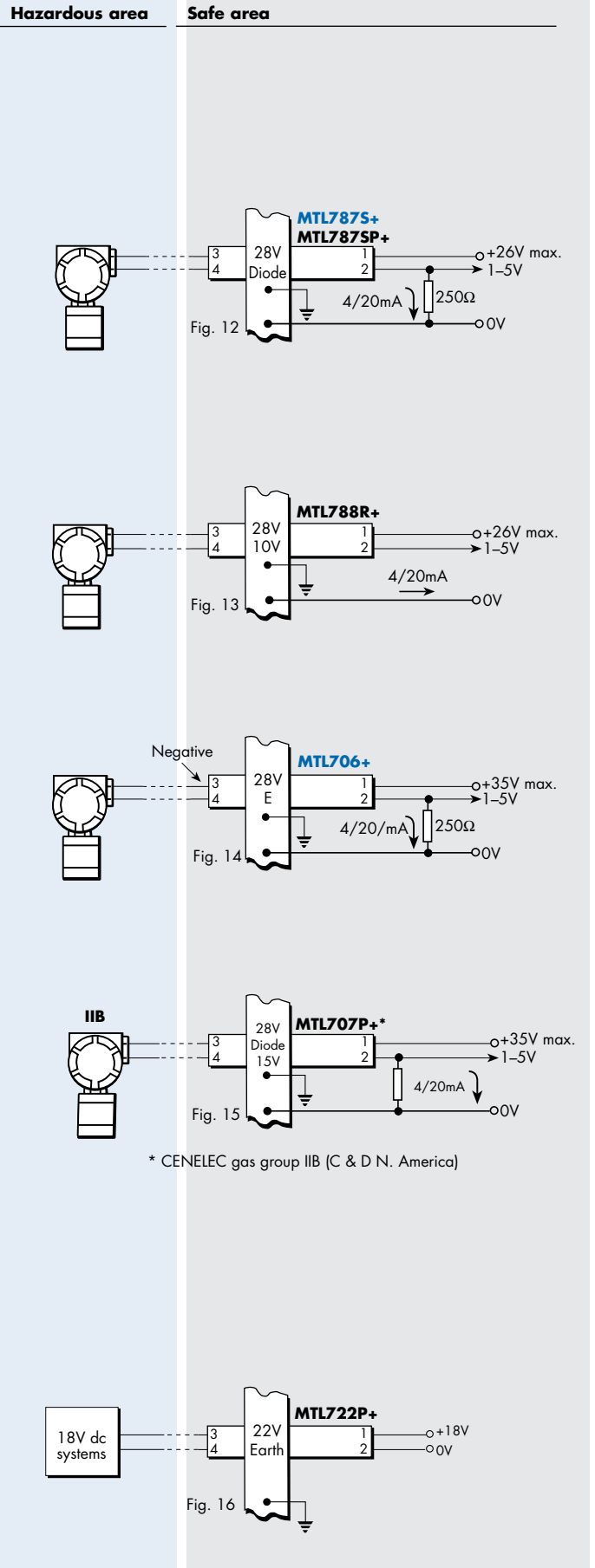
The voltage available for the transmitter and its lines can be increased by converting the return current into a 1–5V signal before it passes through an MTL788+ barrier. The MTL788R+ contains a 250Ω precision resistor for this purpose and makes 14.2V available, Fig. 13.

Where 2-way communication with ‘smart’ transmitters is required, there are two solutions. If the supply is closely regulated, choose the MTL787S+ (above). If it cannot be closely regulated, choose the MTL706+, Fig. 14. This overvoltage-protected barrier provides 15V at 20mA for the transmitter and lines from a 22–35V supply, plus 5V for the load. It is extremely accurate, has a standard safety description and consumes only 35mA. Note that the load resistor must be 250Ω ±5% and that terminal 3 is negative.

If the supply is poorly regulated, the 2-channel MTL707P+ provides a low cost solution for IIB applications, where its low end-to-end resistance makes 13V available for the transmitter and field cabling plus 5V for the load when powered from 24V dc, and its overvoltage protection allows supply variations up to 35V dc, Fig. 15.

### Fire and gas detection

Designed primarily for fire and gas detection systems, the lower maximum end-to-end resistance of the MTL722P+ (121Ω) compared to the MTL722+ (185Ω) can be an advantage (see Fig. 16). In addition, it may prove useful in other 18V dc systems.





## DIGITAL (ON/OFF) INPUTS

### Switches

For switch-status transfer, Fig. 17, the MTL707+ is preferred for two reasons. First, the circuit fails safe if there is an earth fault on either line – ie the safe-area load de-energises. Second, the MTL707+ accepts up to 35V from poorly regulated power supplies without blowing its fuse: if the supply is well regulated, the MTL787S+ can be used, see Fig. 18.

In both cases, optimum power transfer with relays is achieved if the resistance of the load is made about equal to the combined resistance of the two channels. The relay coil should then be rated at about half the supply voltage.

### Switches, data-loggers, logic systems

The MTL710P+ can be used for supplying power to low-voltage equipment in hazardous areas, such as data-loggers, switches and logic systems. Its low maximum end-to-end resistance of 42Ω, compared to 85Ω for the MTL710+, means it can typically supply more than 65mA current at 5V from an 8V supply (see Fig. 19). It also has the advantage of a higher working voltage (8V compared to 6V for the MTL710+).

The MTL715P+ functions similarly for 12V dc systems and can also be applied to multiple-switch and logic circuits where the additional power proves useful, Fig. 20.

## BARRIERS FOR CONTROL ELEMENTS

## ANALOGUE OUTPUTS

### Controller outputs – 4 to 20mA

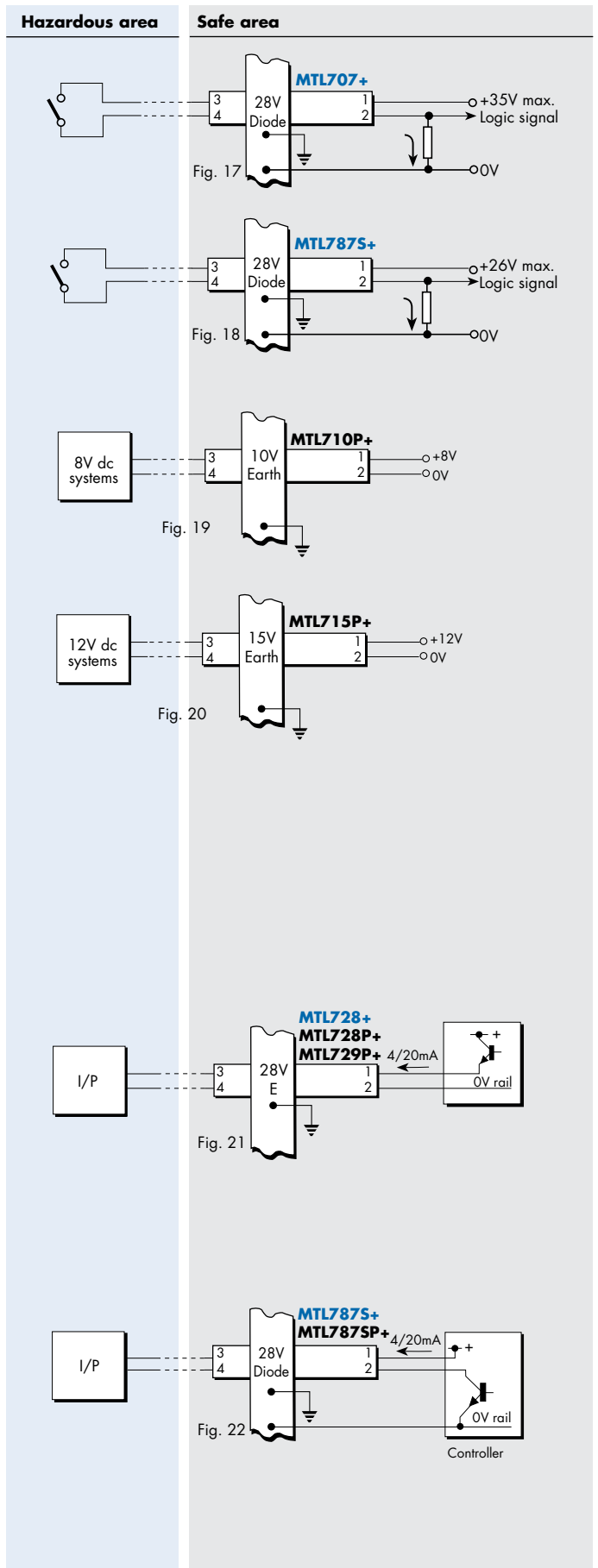
In most cases the output current of a controller flows directly to its '0V' rail and the rail can be earthed at the busbar - Fig. 21. Occasionally the output circuit may be fully floating. In either event the 1-channel MTL728+ or half an MTL779+ provides the solution. Overvolt protection is not required, since current limiting in the controller protects the fuse in the barrier. The voltage drop introduced by the barrier is 6.8V at 20mA.

The maximum voltage drop introduced by the MTL728P+ is only 5.1V at 20mA (compared to 6.8V for the MTL728+).

For IIB applications, the MTL728P+ can be replaced with the similarly designed 1-channel MTL729P+.

If the output circuit of the controller is separated from the '0V' rail by the control transistor - Fig. 22 - a 2-channel barrier is necessary. The MTL787S+ is recommended, since its return channel can handle up to 25.5V, allowing the control signal to be turned off completely. The voltage drop introduced by the barrier is 8.1V at 20mA.

The maximum voltage drop introduced by the MTL787SP+ is only 6.4V at 20mA (compared to 8.1V for the MTL787S+). The barrier return channel can handle up to 24.5V, allowing the control signal to be turned off completely.



The MTL787S+ and MTL787SP+ are also suitable for controllers containing a resistor which enables the return current to be monitored for high-integrity operation, Fig.23.

For IIB applications where a 2-channel barrier is needed (see above), the MTL707P+ can be used as, although the overvolt protection provided by this barrier is not necessary, the diode return channel and low voltage drop makes this an ideal replacement for the MTL787S+ or MTL787SP+ for IIB gas groups, Fig.24.

## DIGITAL (ON/OFF) OUTPUTS

### Solenoids, alarms, LEDs

If the supply is well regulated, an MTL728+ (or half an MTL779+) can be used.

For IIC applications, the lower end-to-end resistance of the MTL728P+ can make a big difference to the overall loop design when driving higher-power solenoid valves, provided the power supply is well regulated, Fig.25.

Should greater power be required for heavy-duty solenoids in IIB or IIA gases only ('IEC countries'; C & D in USA and Canada), use the two channels of the MTL779+ connected in parallel or consider the MTL5522.

Similarly the MTL729P+ is ideal for powering high-power heavy-duty solenoid valves, in IIB gas group applications, providing a maximum usable output power of 0.78W at 24V, Fig.25.

Most solenoid valves, alarms, light-emitting diodes (LEDs) and other on/off hazardous-area loads are best driven via an MTL708+ 1-channel barrier, with built-in overvolt protection, Fig.26. The circuit fails safe with an earth fault on the live line and is unaffected by an earth fault on the earth return, while the barrier will accept up to 35V without blowing its fuse.

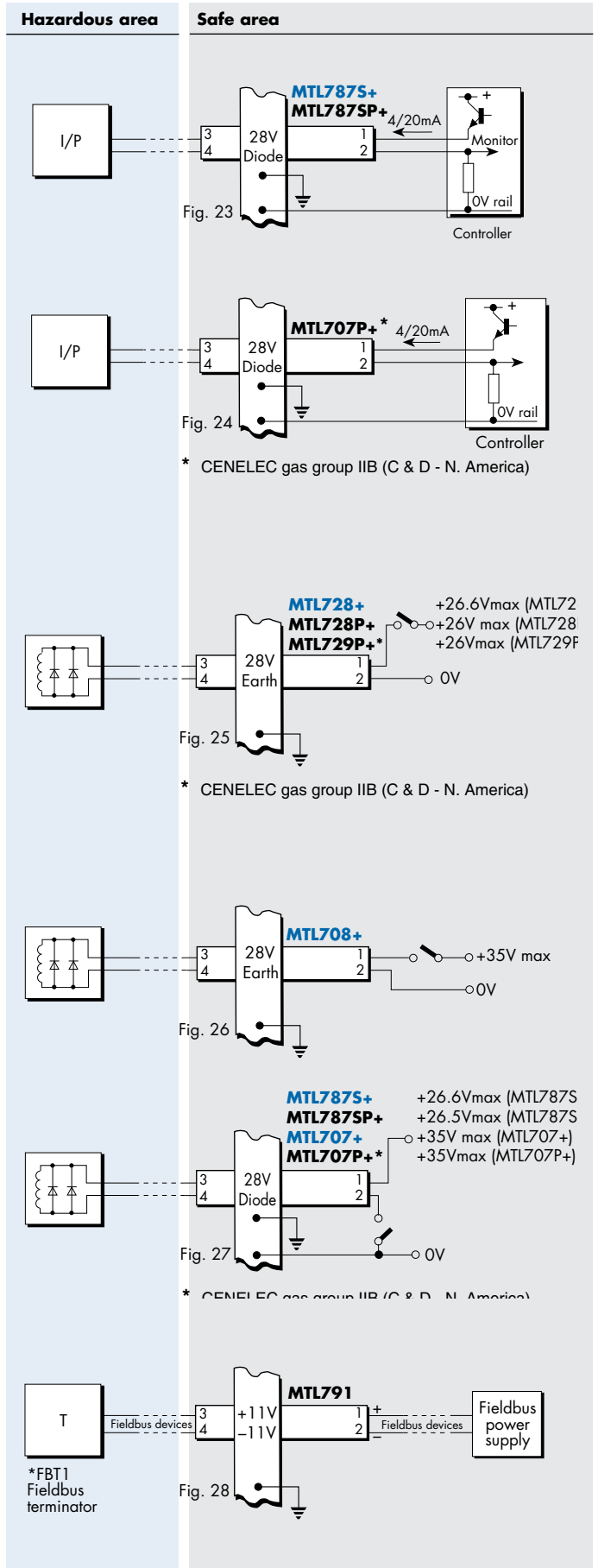
If the control switch is on earth, then a 2-channel barrier has to be used, Fig.27, but be aware that an earth fault on the return line will energise the solenoid, whereas one on the live line does the opposite. If the supply is poorly regulated use the MTL707+ (or MTL707P+ for IIB gases). If it is well regulated use the MTL787S+ (or MTL787SP+).

Alternatively, for operational safety, use an MTL4500 or MTL5500 series isolating interface unit.

### Fieldbus applications

The MTL791 (Fig. 28) is a 2-channel barrier designed specifically for 31.25kbit/s fieldbus applications. Used with a suitable floating fieldbus power supply of up to 20V (such as that provided by the MTL5995 unit) it extends the range of fieldbus applications into hazardous areas. It is provided with an internal integral safe-area terminator\*.

\* 'Terminators' are used to terminate a fieldbus.



# MTL700 SERIES ACCESSORIES

- Mounting kits for up to 20 barriers
- Busbar, earth terminals and insulating mounting blocks for separate connection to IS earth
- Earth terminal rail for cable screens and earth returns
- Integral tagging system to display barrier loop data

## DO-IT-YOURSELF MOUNTING ARRANGEMENT

Barriers are carried on lightweight plated busbar, which can be mounted on 'top hat' or G-profile rail or any flat surface with the busbar insulated for separate earthing. It is recommended that twin earth cables should be used for maximum security and easy testing. Each barrier is clamped to the busbar and thereby earthed in a single operation, making it virtually impossible to forget the earth connection, so easily left untightened or untested if there are scores of individual earth wires. Robust soft-plated double fixing studs on the top of each barrier ensure permanent 'gas-tight' joints, which are immune to vibration and corrosion yet allow barriers to be installed, inspected and removed easily.

The accessories system also provides a convenient row of terminals for terminating earth returns and cable screens, which remains in place to keep these safely earthed should any barrier be extracted: a dummy barrier is available as an alternative for the same purpose. With similar attention to users' needs, a unique lift-up tagging facility provides permanent identification of circuits and barrier types to guide installation, fault-finding and inspection, and to ensure correct replacement of any barrier for long-term safety.

## ACCESSORIES

**EBB7 earth busbar**, nickel-plated brass and ready drilled in one metre lengths.

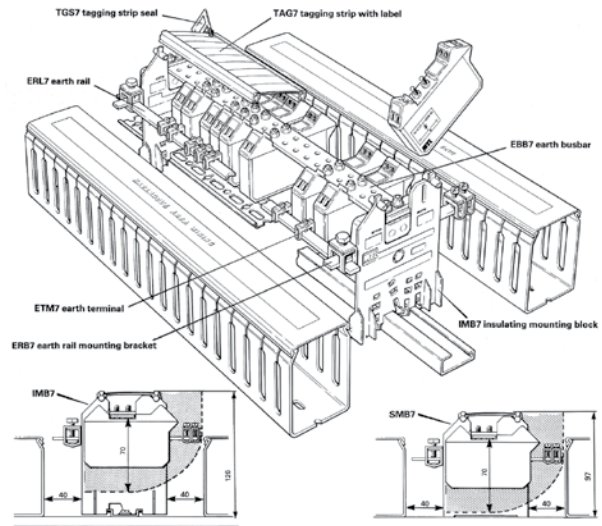
**IMB7 & SMB7 insulating mounting blocks** are a convenient method of supporting the busbar. They are supplied complete with fixing screws and are ready for mounting on any flat surface. IMB7 will also mount on top hat or G-profile DIN-rail. T-section DIN-rail **THR2** is available in 1 metre lengths.

**TAG7 tagging strips** clip onto the mounting blocks to positively identify each location and provide space for the user to note details of barrier type, loop identification etc. Access to barrier mounting studs is not impaired; just unclip one edge and swing the strip 'open' or, if the optional plastic seal (**TGS7**) has not been fitted, unclip both edges and lift it right off. **TGL7** replacement labels for the tagging strips are also available.

**ERL7 earth rail** is a nickel-plated 3 x 10mm rail that attaches to the mounting blocks via an **ERB7** earth rail mounting bracket. It will accommodate up to 2.5 **ETM7** earth terminals per barrier location for terminating earth returns and cable screens from the hazardous area.

**ERB7 earth rail mounting bracket** mounts directly over either type of mounting block; for a rigid earth rail an **ERB7** on each mounting block is recommended. One end carries a bolt-down fitting for the rail – enabling easy removal for adding extra **ETM7** terminals – the other end carries a 16mm<sup>2</sup> terminal. When installed these 16mm<sup>2</sup> terminals provide connections for the high-integrity IS earth, for linking between sections of busbar, and for a common earth return from the safe area.

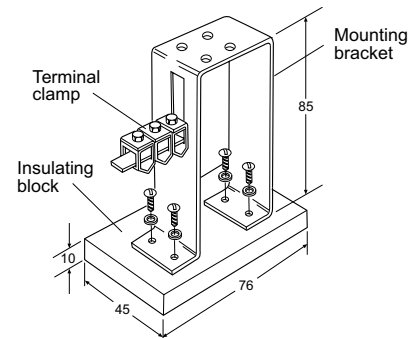
**Other accessories available** are the **TQS7** torque spanner for safe tightening of the vibration-proof self-locking nuts on the barrier earthing studs; **SMC7** surface mounting clips for mounting a single barrier on a flat surface; and **ISL3** or **ISL7** self adhesive 'Take Care' intrinsic safety warning labels.



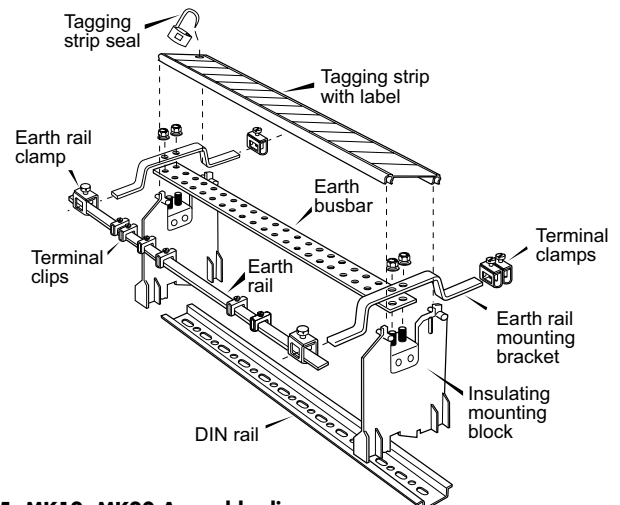
**End elevations with recommended spacing.** Shaded portions show areas swept by barrier during installation and removal.

## MOUNTING KITS

Mounting kits provide all the necessary parts for installing up to a specific number of MTL700 or MTL700P Series barriers. The kits available are the MK02 (2 barriers), MK05 (5 barriers), MK12 (12 barriers), and MK20 (20 barriers). Each kit provides facilities for mounting and earthing the barriers, connecting the IS earth cable, terminating cable screens and noting tagging information (except the MK02 kit which does not provide tagging facilities). Instruction Sheet INS701 includes full assembly instructions.



**MK02 Assembly diagram**



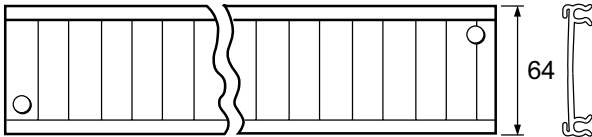
**MK05, MK12, MK20 Assembly diagram**

Note: MK05 has no earth rail, but does have terminal clamps on earth rail mounting brackets



## DIMENSIONS (mm)

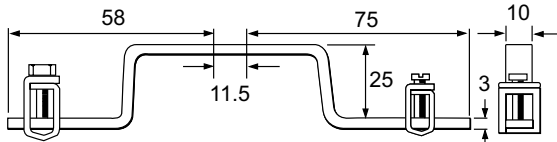
**TAG7 tagging strip** with label and 6 'click' rivets – 1 metre lengths



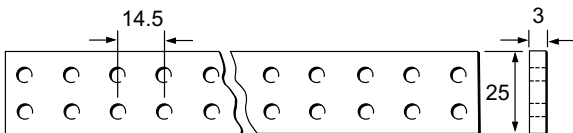
**TGL7 tagging strip label only** – packs of 10 x 0.5 metre lengths

**ERL7 earth rail** – 10 x 3mm - sold in 1 metre lengths. Unplated rail available as 'SSch 10 x 3mm brass busbar', from Klippon Electricals Ltd.

**ERB7 earth rail mounting bracket** – with earth rail bolt-down fitting and terminal for cable 16mm<sup>2</sup>



**EBB7 earth busbar** – 1 metre lengths. Mounts up to 64 barriers.



**IMB7 insulating mounting block** mounts on a flat surface or top hat rail (to EN 50 022 – 35 x 7.5; BS 5584; 35 x 27 x 7.3 DIN 46277) or G-profile rail (to EN 50 035 – G32; BS 5825; 32 DIN 46277). Recommended maximum number of barriers between blocks is 25.

**SMB7 insulating mounting block** mounts on a flat surface and provides minimum overall installation height. Recommended maximum number of barriers between blocks is 25.

**TGS7 tagging strip seal** –

sold in bags of 10

**ETM7 earth terminal** – sold in

25

Klippon Electricals Ltd.

**SMC7 surface mounting clip** – sold in bags of 10. Two clips needed per barrier

**TQS7 torque spanner** – set to 2.3Nm torque.

bags of 50. For cable 4mm<sup>2</sup>.

Also available as 'ZB4' from



95



14.5

4.2

Complete with 7mm A/F socket.

**ISL3 or ISL7 'Take Care' intrinsic safety label** –

ISL3 adhesive back, metal  
\*ISL7 adhesive front, plastic



MTL700 Series barriers to be



100 (40\*)



mounted directly on DIN-Rail.



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