

# *MTL700 and 700P Series shunt-diode safety barriers*



**Instruction Manual**

**INM700**



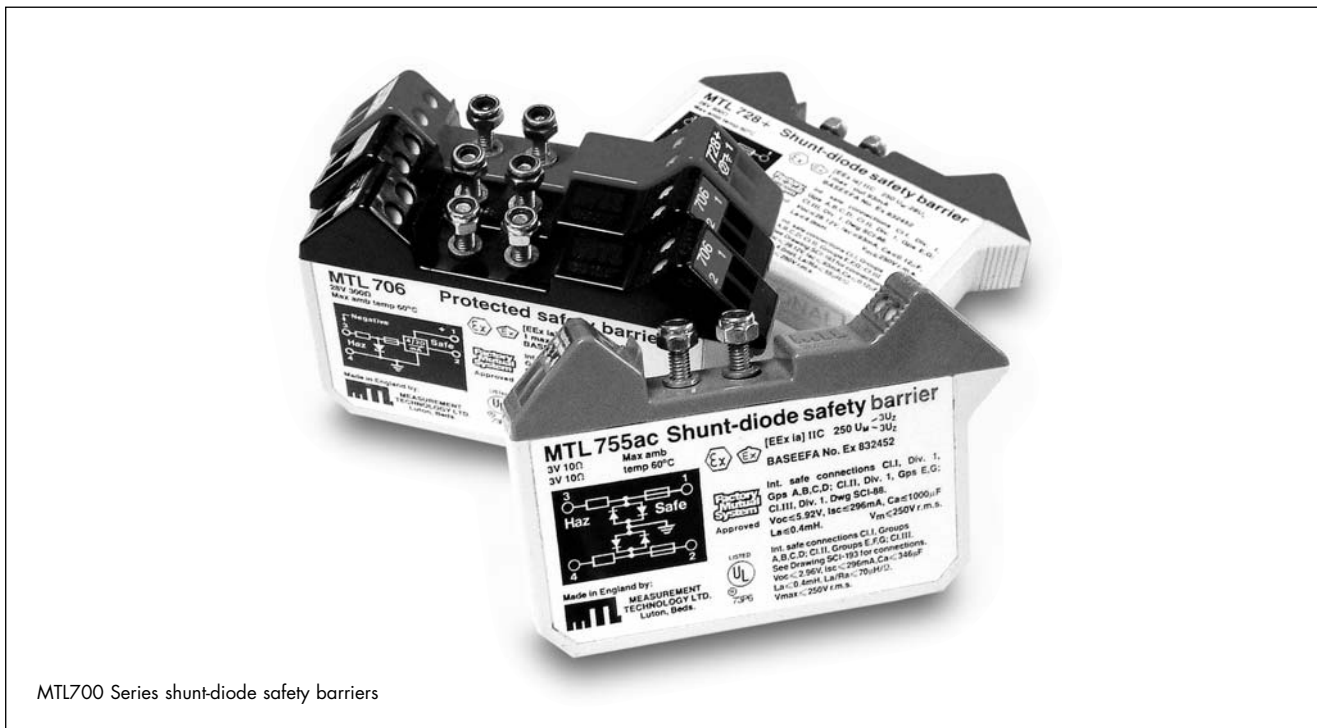
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MTL700 Series shunt-diode safety barriers

## 1 INTRODUCTION

This instruction manual contains the information necessary to install, maintain, fault-find and test MTL700 and MTL700P Series shunt-diode safety barriers. Section 4 of the manual contains a checklist which highlights all the important safety factors that should be considered when using MTL700 and 700P Series barriers to interface between non-hazardous (safe) and hazardous areas. All users should read this section, and particularly the checklist, before commencing work on the barrier installation.

For further applicational information concerning the theory and use of shunt-diode safety barriers, users are recommended to read the following MTL publications:

**Application Note AN9003**, A user's guide to intrinsic safety;  
**Application Note AN9007**, A user's guide to shunt-diode safety barriers (MTL700 Series);

MTL Intrinsic safety catalogue covering MTL700 and 700P Series barriers, and enclosures, parts & accessories;

CD700 customer drawings, for additional installation information.

These publications and a comprehensive selection of MTL technical papers (TPs) can be obtained from the company's Publicity department on request: TP1064, 1076, 1082, 1083 and 1106 are particularly relevant. Copies of the apparatus and system certificates issued by the various certifying authorities are also available.

## 2 DESCRIPTION

MTL700 and 700P Series shunt-diode safety barriers are 1-channel or 2-channel devices that employ intrinsically safe techniques to allow electrical signals to be passed between non-hazardous (safe) and hazardous areas. They achieve this by limiting the transfer of energy in one direction to a level that cannot cause ignition of explosive atmospheres.

Barriers that are connected in series with lines going to a hazardous area will protect wiring and equipment in that area from any faults occurring in the non-hazardous (safe) area, thus permitting a wide range of measurement and control operations to be undertaken safely.

Applications of MTL700 and 700P Series barriers include the protection of installations containing non-energy storing uncertified

devices such as switches, thermocouples, resistive sensors, photocells and LEDs, or separately certified 'energy storing' apparatus, for example ac sensors, transmitters and I/P converters. The barriers also enable maintenance work or calibration to be carried out without further precautions, and they permit non-hazardous (safe) area equipment to be worked on safely as and when necessary, with the minimum of restriction.

A range of five polycarbonate enclosures is available to provide environmental protection for barriers where required, and a Type N approved steel enclosure also is available to permit the barriers to be installed in Zone 2 areas. Enclosures and other accessories are fully described in this manual.

## 3 BARRIER SPECIFICATIONS

### 3.1 The MTL700 and 700P Series

The series consists of a carefully tailored range of application-orientated models, most polarised positively but some negatively and some non-polarised. There is also a 'dummy' barrier. Basic circuits, specifications and approvals for each model are given in sections 3.2 to 3.5.

In 1992/3 a range of MTL700P higher-power barriers was introduced and is listed under 3.2 General specifications. The MTL700P Series barriers complement similarly numbered MTL700 Series barriers but deliver more power into hazardous areas. The series covers two distinct types: one type is designed for IIC gas group areas while the other is for IIB gas groups. The additional power available with the IIC units is made possible by a change in the BSI's interpretation of the requirements of EN 50020 which brings it into line with other European authorities. It also corresponds with the requirements of North American standards.

The MTL700P barriers are mechanically identical to the MTL700 Series barriers and are therefore compatible with all MTL700 Series accessories.

Seven 'key' MTL700 Series models are highlighted in the sales literature as meeting most process control requirements. These models and their applications are listed in table 1. The literature also cross refers to MTL700P Series barriers where a higher-power barrier application may be required.

To minimise spares stocks and simplify maintenance procedures it is worth noting that the 'key' barriers can often be used in place of other models: the MTL706+ can replace the MTL702+ provided that the transmitter is certified for a  $U_{max}$  in of at least 28V and the transmitter and its lines require no more than 15V to operate. Both are nearly always the case. The MTL706+ consumes less current than the MTL702+ and allows 2-way communication with most 'smart' transmitters. Note that when undertaking the MTL702/706 substitution, terminals 3 and 4 of the MTL706 are reversed in polarity to those of the MTL702.

The MTL707+ can replace the MTL787+ provided only that the small extra voltage drop can be accepted. It accepts power supplies up to 35V without blowing its fuse. The MTL708+ can replace the MTL728+ with the same provisos and advantage, and also that the 1 mA leakage current through the 708's electronic protection network is acceptable.

The MTL787S can always replace the MTL787+ and drops 1.5V less at 20mA. Also, under most circumstances it can replace the MTL788+ for use with 2-wire, 4/20mA transmitters.

**Table 1:** 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)	Transmitters, 2-wire, 4/20mA	<b>787S+</b>	<b>706+</b>
Digital (on/off) input	Switches	<b>787S+</b>	<b>707+</b>
Digital (on/off) output	Solenoids, alarms, LEDs	<b>728+</b>	<b>708+</b>

**Table 2:** Patents issued to MTL700 and 700P Series barriers

BARRIER	UK PATENT	USA PATENT
MTL706+	2205699	4967302
MTL707+	2245439 and 2210521	-
MTL708+	2210521	-
MTL787S+	2210522	4860151
MTL707P+	2210521 and 2210522	4860151
MTL787SP+	2210522	4860151

## 3.2 General specifications

### 3.2.1 Terminology (Notes 1 to 7 in tables 3 and 4)

**1 Safety description.** The description of a barrier, eg, '28V 300Ω 93mA' 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 – not the working voltage or end-to-end resistance.

**2 Polarity.** Barriers are polarised 'positive' (+), 'negative' (-), or 'non-polarised' (ac). Polarised barriers accept and/or deliver non-hazardous (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.** This is the resistance between the two ends of a barrier channel at 20°C, ie, of the resistors and the fuse. If series diodes or transistors are present, their voltage drop (transistors ON) is quoted in addition.

**4 Working voltage (Vwkg).** This is the greatest steady voltage, of appropriate polarity, that can be applied between the non-hazardous (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).** This is the greatest voltage, of appropriate polarity, that can be applied continuously between the non-hazardous (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 may be 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.** This is 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.

**8 UM** (not shown on the tables). UM defines the maximum voltage that can be applied to the non-intrinsically safe connection facilities of associated apparatus without invalidating intrinsic safety. For all MTL700/700P barriers, UM is 250V rms or dc with respect to earth.

## 3.3 Additional specifications

### 3.3.1 MTL702 additional specification

#### Supply voltage

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

#### Voltage available for transmitter and lines (at 20mA)

$V_{supply}$  minus 8V, limited at 16V

#### Voltage available for load (at 20mA)

$V_{supply}$  minus 5V

#### Load resistance

850Ω maximum

#### Output impedance to load

>1MΩ

#### Calibrated accuracy (at 20°C with 250Ω load)

0.05% of maximum output, including non-linearity and hysteresis

#### Zero temperature drift

<0.005% of maximum output per °C

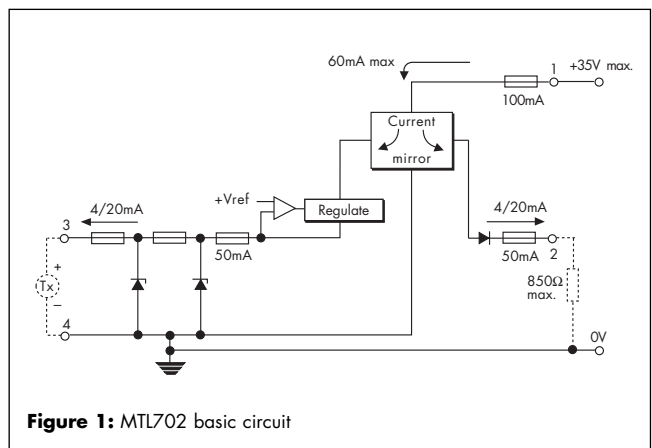
#### Span temperature drift

<0.005% of maximum output per °C

#### Supply current

8 to 40mA + 10mA maximum at 20V

8 to 40mA + 20mA maximum at 35V



**Figure 1:** MTL702 basic circuit

### 3.3.2 MTL706/705 additional specification

#### Supply voltage

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

#### Output current

**MTL706:** 4 to 20mA

**MTL705:** 0 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

**MTL706:**  $250\Omega \pm 5\%$

**MTL705:**  $300\Omega$

(can be greater if reduced transmitter voltage is acceptable)

### Accuracy

$\pm 2\mu\text{A}$  under all conditions

### Supply current

35mA typical at 20mA with 24V supply

40mA maximum at 20mA with 35V supply

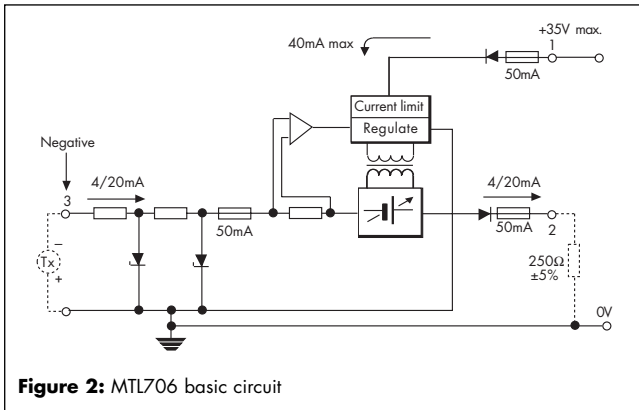


Figure 2: MTL706 basic circuit

### 3.3.3 MTL707/707P additional specification

#### Supply voltage (Vs)

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)

##### MTL707

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

$I_{out} \times 50\Omega + 2.1\text{V}$ , terminals 4 to 2

##### MTL707P

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

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

#### Supply current

##### MTL707

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

Limited at 50mA,  $V_s > 28\text{V}$  or low load resistance

##### MTL707P

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

Limited at 50mA,  $V_s > 28\text{V}$  or low load resistance

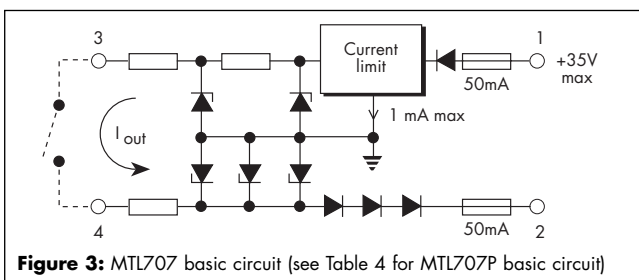


Figure 3: MTL707 basic circuit (see Table 4 for MTL707P basic circuit)

### 3.3.4 MTL708 additional specification

#### Supply Voltage (Vs)

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)

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

#### Supply current

$I_{out} + 1\text{mA maximum}$ ,  $V_s < 26\text{V}$

Limited at 50mA,  $V_s > 28\text{V}$  or low load resistance

## 3.4 Common specification

### Ambient temperature and humidity limits

-20°C to +60°C continuous working

-40°C to +80°C storage

5 to 95% RH

### Leakage current

For 'basic barriers' with a working voltage of 5V or more, the leakage current decreases by at least one decade/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 (barrier top)

Grey: Non-polarised

Red: Positive polarity (and MTL791)

Black: Negative polarity

Black (red label for safe area terminals): positive supply, negative to transmitter (MTL706)

White: Dummy barrier (MTL799)

### Weight

125g approximately

### Mounting and earthing

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

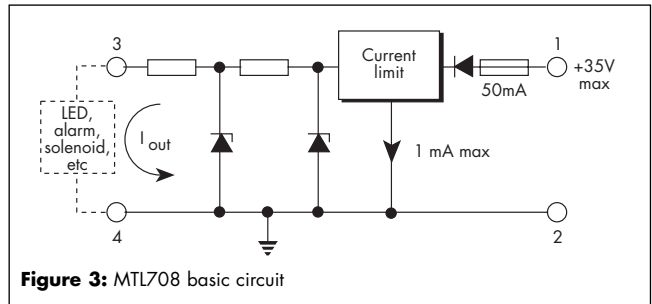


Figure 3: MTL708 basic circuit

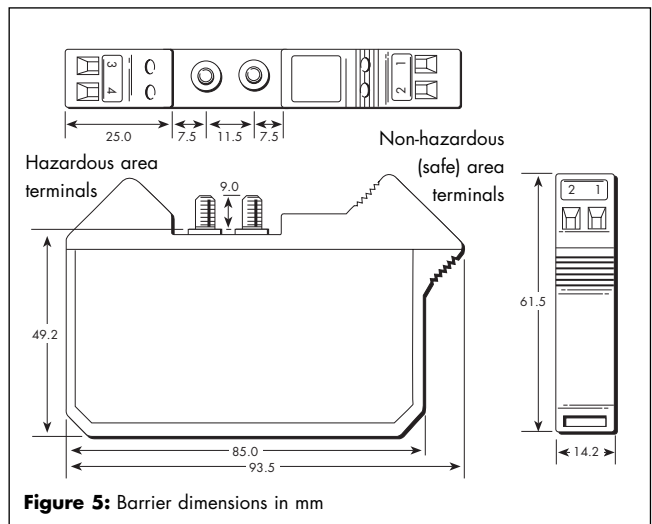


Figure 5: Barrier dimensions in mm

**Table 3: Basic circuits and specifications for MTL700 Series barriers**

(for notes 1 to 7 see 3.2.1 Terminology)

Model No.	Safety description			Polarities available		Application	Basic circuit		Max. end-to-end resistance $\Omega$	$V_{wkg}$ 10(1) $\mu$ A V	$V_{max}$ V	Fuse rating mA
	V	$\Omega$	mA	+	- ac		Hazardous	Safe				
<b>702</b>	25	200	125	✓		Transmitters		-	-	35	<b>See 3.3 Additional spec.</b> <b>50</b>	
<b>†705</b>	28	300	93	✓		Transmitters		-	-	35		
<b>706</b>	<b>28</b>	<b>300</b>	<b>93</b>	✓		<b>Transmitters</b>		-	-	<b>35</b>		
<b>707</b>	<b>28</b>	<b>300</b>	<b>93</b>	✓		<b>Switches</b>		-	-	<b>35</b>		
<b>708</b>	<b>28</b>	<b>diode</b>	-	✓		<b>Solenoids, alarms, LEDs</b>		-	-	-		
<b>710</b>	10	50	200	✓	✓	6V dc & 4V ac systems		85	6.0	6.9 <sup>c</sup>	50	
<b>715</b>	15	100	150	✓	✓	12V systems		155	12.0	13.0	100	
<b>722</b>	22	150	147	✓	✓	18V dc systems		185	19.0	20.2	50	
<b>728</b>	28	300	93	✓		<b>Controller outputs, solenoids</b>		<b>340</b>	<b>25.5</b>	<b>26.6</b>	<b>50</b>	
<b>728</b>	28	300	93		✓	Transmitters		340	25.5 <sup>b</sup>	26.6 <sup>d</sup>	50	
<b>751</b>	1	10	100		✓	Active dc & ac sensors (low impedance receivers)		20	0.3	2.0	250	
<b>755</b>	1	10	100		✓	<b>Resistance temperature detectors</b>		20	0.3	2.0	250	
<b>755</b>	<b>3</b>	<b>10</b>	<b>300</b>		✓	<b>Resistance temperature detectors</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		18	6.0	7.0	200	
<b>761</b>	7.5	10	750		✓			18	6.0	7.0	200	
<b>761</b>	9	90	100		✓			145	6.0	7.5	100	
<b>764</b>	9	90	100		✓			145	6.0	7.5	100	
<b>764</b>	12	1k	12	✓	✓	Strain-gauge bridges		1075	10.0	10.7 <sup>e</sup>	50	
<b>766</b>	12	1k	12		✓			1075	10.0	10.7 <sup>e</sup>	50	
<b>766</b>	12	150	80		✓			185	10.0	11.2	50	
<b>767</b>	12	150	80		✓			185	10.0	11.2	50	
<b>767</b>	15	100	150	✓	✓	12V dc systems		155	12.0	13.0	100	
<b>768</b>	15	100	150		✓			155	12.0	13.0	100	
<b>768</b>	22	150	147	✓	✓	18V dc systems		185	19.0	20.2	50	
<b>779</b>	22	150	147		✓			185	19.0	20.2	50	
<b>779</b>	28	300	93	✓	✓	Controller outputs	340	25.5	26.6	50		
<b>796</b>	28	300	93	✓	✓	Vibration probes (MTL796 negative)	340	25.5	26.6	50		
<b>796</b>	26	300	87	✓	✓		340	23.5	24.6	50		
<b>796</b>	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>85</b>	<b>6.0</b>	<b>7.4</b>	<b>50</b>	
<b>765</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	
<b>772</b>	15	100	150		✓	2-wire dc & ac systems		135	12.0	13.2	50	
<b>772</b>	22	300	73		✓			340	18.0	19.7	50	
<b>778</b>	22	300	73		✓			340	18.0	19.7	50	
<b>778</b>	28	600	47		✓			665	24.0	25.7	50	
<b>778</b>	28	600	47		✓		665	24.0	25.7	50		
<b>786</b>	28	diode	-	✓	✓	Signal returns		2.2V+30W	25.5	26.6	50	
<b>786</b>	28	diode	-		✓			2.2V+30W	25.5	26.6	50	
<b>787</b>	28	300	93	✓	✓	Controller outputs, switches		340	25.5	26.6	50	
<b>787S</b>	28	diode	-		✓	<b>Transmitters</b>		2.2V+30W	25.5	26.6	50	
<b>787S</b>	<b>28</b>	<b>300</b>	<b>93</b>		✓	<b>Controller outputs, switches</b>		<b>340</b>	<b>25.5</b>	<b>26.6</b>	<b>50</b>	
<b>787S</b>	<b>28</b>	<b>diode</b>	-		✓	<b>Controller outputs, switches</b>		<b>0.9V+20W</b>	<b>25.5</b>	<b>26.6</b>	<b>50</b>	
<b>788</b>	28	300	93	✓	✓	Transmitters		340	25.5	26.6	50	
<b>788R</b>	10	50	200		✓			85	6.0	6.9	50	
<b>788R</b>	28	300	93	✓	✓			340	25.5	26.6	50	
<b>791</b>	10	50	200		✓		85	6.0	6.9	50		
<b>791</b>	11	51	216	✓	✓	H1 (31.25kbit/s) Fieldbus installations		62.6	10V (at 50 $\mu$ A)	10.5	100	
<b>791</b>	11	51	216		✓			62.6	-10V (at 50 $\mu$ A)	-10.5	100	
<b>799</b>	Dummy barrier for securing cables for future installations											

a: Tolerance  $\pm 0.15W$  at 20°C, channels track within 0.15W 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.

†: For new designs, use MTL706

\*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

**Table 4: Basic circuits and specifications for the MTL700P Series higher-power barriers**

(for notes 1 to 6 see 3.2.1 Terminology)

Model No. (MTL)	Gas group	1 Safety description			2 Polarities available			Applications	Basic circuit		3 Max. end-to-end resistance (Ω)	4 Vwkg at 10(1)μA (V)	5 Vmax (V)	6 Fuse rating (mA)
		(V)	(Ω)	(mA)	(+)	(-)	(ac)		hazardous	safe				
707P	IIB	28	164	171	✓	-	-	Transmitters Controller outputs		See 3.3 additional specifications		35	50	
710P	IIC	10	33	300	✓	✓	-	8V dc systems		42	8.0	9.2	200	
715P	IIC	15	50	291	✓	-	-	12V dc systems		60	12.5	13.8	200	
722P	IIC	22	101	213	✓	-	-	18V dc systems		121	1.5	20.0	100	
728P	IIC	28	234	119	✓	-	-	Controller outputs, Solenoid valves		253	24.5	26.0	100	
729P	IIB	28	164	171	✓	-	-	Controller outputs, Solenoid valves		184	24.5	26.0	100	
761P	IIC	9	350	25	-	-	✓	Strain-gauge bridges		384	7.0	8.1	50	
766P	IIC	9	350	25	-	-	✓	Strain-gauge bridges		384	7.0	8.1	50	
787SP	IIC	28	234	119	✓	-	-	Transmitters, Controller outputs, Switches		258 0.9V+16Ω	24.5 24.5	26.5 26.5	80 80	

### 3.5 Approvals

**Changes may have occurred** since this document was printed. Check our web site for latest information – <http://www.mtl-inst.com>

**Table 5: Approvals for MTL700 Series barriers**

Country (Authority)	Standard	Certificate/file no.				Approved for
		MTL710 to 796	MTL702	MTL706	MTL707/708/7875	
Argentina	IAP CA 4.01 1989	INTICITEI 92A001	INTICITEI 92A001	INTICITEI 92A001	INTICITEI 92A001	[Ex ia] IIC
Australia (QMD)	CMA 1925-1981	QMD 85 6001 XSU*	QMD 85 6124 XU			Mining
Australia (NSW M)	CMRA 67/1982	MDA Ex. ia 1321	MDA Ex. ia 1411	MDA Ex. ia 1321	MDA Ex. ia 1321	Coal and shale mines
Australia (SA)	AS2380.7-1987	Ex 562	Ex 692	Ex 562X	Ex 562X	(BR-Ex ia) IIC
Brazil	NBR 8447/84	CE.Ex-221/92a		CE.Ex-220/92	CE.Ex-221/92	BR-Ex ia/ib IIC
Canada (CSA)	C 22.2, No 157	LR36637-14	LR36637-16	LR36637-26	LR366 37-20	Class I, II, III, Div. 1, A-G
China (NEPSI)	GB3836-1/7	GYJ93105	GYJ93105	GYJ93105	GYJ93105	(ia) IIC T6
Czechoslovakia (FTZU)	CSN 33 0380	J02033	J02033	J02033	J02033	[Ex ib] IIC
Denmark (DEMKO)	EN 50 020	R75916*				[EEx ia] IIC
Hungary (BKI)	MSZ 4814/7-77	87B2-018	87B2-018	87B2-018	87B2-018	[Ex ib] IIC
Japan (TIIS)	1979 Rec. Pract.	C10619 to C10636†	39286			Groups 2 and 3a, G5
Korea (KRS)		LND03065-EL001	LND03065-EL001	LND03065-EL001	LND03065-EL001	[EEx ia] IIC Tamb = 60°C
Poland (KDB)	PN-84/E-08107	KDB Nr.91.009W†	KDB Nr. 91.010W	KDB Nr 91.011W	KDB Nr.91.012W	[Ex ia] IIC
Romania (ISM)	STAS 6877/4-87	ISM Nr. 90.2820	ISM Nr. 90.2821	ISM Nr. 90.2822	ISM Nr. 90.2820	[Ex ia] IIC
Switzerland (SEV)	EN 50 020	ASEV 84.14332X	ASEV 84.14332X	ASEV 84.14332X	ASEV 84.14332X	[EEx ia] IIC
UK (BASEEFA)	EN 50 020	Ex832452b	Ex84B2307	Ex87B2428	Ex832452	[EEx ia] IIC
UK (BASEEFA) (Systems)	EN 50 039	Ex832469	Ex842308	Ex872513	Ex832469	[EEx ia] IIC
UK (BASEEFA)	BS 4683:Pt 3	Ex83453	Ex83453		Ex83453	Ex N II T6 in MT20N
UK (BASEEFA, Indian vn)	EN 50 020	Ex89C2346		Ex89C2347	Ex89C2346	[EEx ia] IIC
UK (HSE (M))	EN 50 020	HSE (M) 8570006			HSE (M) 8570006	[EEx ia] I - coal mining
UK (Lloyds Reg)	Type Approved	86/00102	86/00102	86/00102	86/00102	All vessels registered
USA (FM)	3610 Entity	J.I. 1H8A1.AX, J.I. 2POA4.AXc	J.I. 1K4A1.AX	J.I.0R6A1.AX	J.I. 2POA4.AX	Class I, II, III, Div. 1, A-G
USA (MSHA)	Classified	132011-17,20-31,40-44*	132010			Mining systems
USA (UL)	UL 913	E120058	E120058	E120058	E120058	Class I, II, III, Div. 1, A-G
CIS (VNIIVE)	GOST 22782.5-78 EN 50 020 & IEC 79-11	N 144	N 144	N 144	N 144	Ex ia/ib IIC

\*MTL758 certification in hand

†including MTL7875

Note: UK BASEEFA is to CENELEC standards

a: MTL758 CE.Ex222/92, approved for BR-Ex ib IIC

b: MTL791 Ex94C2172

c: MTL791 J.I.4X0A4.AX, approved additionally for non-incendive Class 1, Div 2, ABCD



**Table 6: Approvals for MTL700P Series high-power barriers** (see beginning of Section 3.5 for warning of approval changes)

Country (Authority)	Standard	Certificate/File No.		Approved for
		IIB barriers (Gps C-G)	IIC barriers (Gps A-G)	
Australia (SA) Canada (CSA)	AS2380.7-1987 C22.2, No.157	Ex2065 LR36637-58	Ex2065x LR36637-58 LR36637-66*	(Ex ia) IIC Class I, II, III, Div.1 Gps A-G
China (NEPSI)	GB3836-1/7	GYJ93106	GYJ93105	(ia) IIC T6 (ia) IIB T6
Hungary (BKI)	MSZEN 50 014 & 020		87B2-018	[EEx ia] IIC
UK (BASEEFA to CENELEC standards)	BS 5501:Pts 1&7 EN 50 014 & 020	Ex92C2375	Ex92C2373	[EEx ia] IIC
UK (BASEEFA to CENELEC standards)	BS 5501:Pt 9 EN 50 039	Ex92C2376	Ex92C2374	[EEx ia] IIB EEx ia IIC
UK (BASEEFA) (to CENELEC standards), held by MTL India	BS 5501:Pts 1&7 EN 50 014 & 020	Ex94C2377	Ex94C2378	EEx ia IIB [EEx ia] IIC
USA (FM)	3610 Entity	J.I.0W2A5.AX	J.I.0W2A5.AX J.I.5W0A3. AX (MTL787SP)	Class I, II, III, Div.1 Class 1, Div. 2 Gps A-D non-incendive

\*Certification/File No. for MTL787SP only

### 3.6 Enclosure specifications

**Table 7: Enclosure specifications**

| *Obsolete products* |

Specification	MT2	MT5	MT12	MT24	MT32	MT20N
<b>Max. barrier capacity</b>	2	5	12	24	32	20
<b>Construction</b>	Polycarbonate: glass-filled base, transparent lid					Sheet steel
<b>Finish</b>	Dark grey base		Light grey base			Mid grey painted
<b>Lid fixing</b>	4 captive screws				6 captive screws	Lift off floppy hinges, 4 captive screws, hasp for padlock
<b>Protection: dust-tight waterproof</b>	IEC529:IP65					IEC529:IP67
<b>Gland fixing</b>	4 x 20mm holes pre-drilled through top and bottom		Top and bottom gland plates detachable for drilling by user			
<b>Permitted location</b>	Non-hazardous (Safe) area	Non-hazardous (Safe) area	Non-hazardous (Safe) area	Non-hazardous (Safe) area	Non-hazardous (Safe) area	Zone 2 BASEEFA certificate No. Ex83453, Code: Ex N II T6, BS 4683: Pt 3, 1972
<b>Certification</b>	-	-	-	-	-	
<b>Mounting</b> (see figure 7)	Corner screws or plastic lugs screwed to base		Plastic lugs screwed to base plugged knockout holes, or rear-fixing screws			Fixed mounting lugs
<b>Mounting kit provided</b>	2 lugs + attaching screws		4 lugs + attaching screws, 4 plugs		As MT12 but 6 off	None
<b>Tagging facility provided</b>	None	Tagging strip(s) with label(s) and seal(s)				
<b>Cable trunking provided?</b>	No	No	No	No	Yes	Yes
<b>'Take care' IS label provided</b>	Adhesive front, inside lid					Adhesive back, on lid
<b>Earth terminals provided:</b>						
Large (<16mm <sup>2</sup> , 6AWG)	0	3	3	3	3	3
Small (<4mm <sup>2</sup> , 12AWG)	3	3	6	12	16	10
<b>Weight (ex barriers) kg:</b>	0.36	1.08	2.20	4.61	6.83	12.62

## 4 SAFETY CONDITIONS

### 4.1 General safety requirements

All users of shunt-diode barriers should be familiar with the installation instructions given in a nationally accepted code of practice,

e.g. BS EN 60079-14:2003 in the UK, or Recommended Practice, e.g. ANSI/ISA-RP12.6 for the USA.

### 4.2 Safety checks

Table 8 itemises all the important checks which should be carried out to ensure the safety of a barrier installation. Diligent use of the checklist will avoid the possibility of any important safety consideration being overlooked when installing, commissioning, modifying or servicing an installation that uses MTL700/700P Series barriers.

MTL recommends that on completion of any work on a barrier installation, each item on the checklist is again checked out, preferably by someone other than the person who actually carried out the work.

Each item on the checklist is cross-referred to the relevant section of the manual to which reference can be made for more detailed information.

## 5 MOUNTING THE BARRIERS (ENCLOSED SYSTEMS)

Although the construction of MTL700/700P Series barriers gives them IP20 protection, a higher IP rating and additional protection against mechanical damage and unauthorised modification can be provided by the 'MT' range of enclosures, which can mount up to 2, 5, 12, 24 or 32 MTL700/700P Series barriers in the non-hazardous (safe) area.

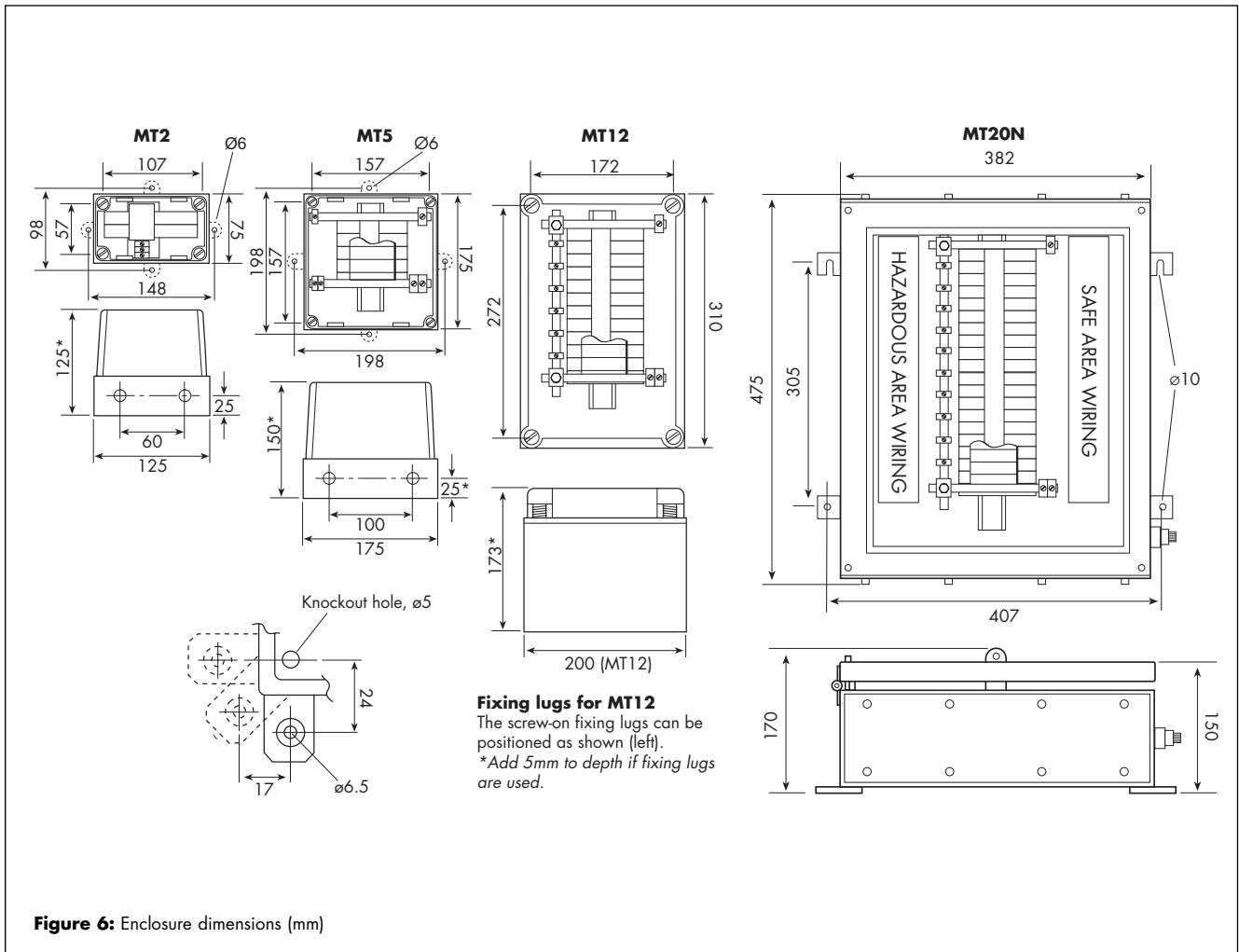


Figure 6: Enclosure dimensions (mm)

A type 'n' approved steel enclosure is available in the range for protecting up to 20 barriers in Zone 2 areas. The dimensions and specifications of the enclosures are given in table 7 and figure 6 respectively.

## 5.1 Fitting the barriers into the enclosure

Each enclosure is supplied ready-fitted with all the necessary accessories to allow immediate installation of barriers. To fit the barriers, remove the enclosure's lid by releasing the captive screws (the MT20N enclosure's lid is removed by also lifting it off its two hinges). Temporarily unclip the TGS7 tagging strip (not fitted on model MT2), then simply bolt each barrier via its two earth studs to the section of busbar provided, tightening all nuts to a torque of 2.3Nm using the 'TQS7' torque spanner or other suitable wrench. Note that these 'Nyloc' nuts will lose their anti-vibration feature after being tightened/released several times, so if possible avoid undoing them once they have been tightened.

Ensure that the barriers are mounted such that their hazardous-area terminals are adjacent to the row of terminals mounted alongside the busbar, or in the case of the MT5, the three small terminals mounted on the end brackets.

## 5.2 Mounting the enclosure

Depending on the model utilised, there are up to three different methods of mounting enclosures, and these are illustrated in figure 7 and described later. The enclosure specifications section 3.6 details mounting methods, dimensions and kit provided for each model.

Care should be taken when mounting enclosures to ensure the internal temperature does not exceed the maximum permitted ambient temperature for the barriers (i.e. 60°C). For this reason enclosures should not be mounted in areas where they will be subject to direct sunlight or other sources of heat.

### 5.2.1 Corner screws/plugged knockout holes (not MT20N)

With this method, enclosures are mounted from the front using screws or bolts (not provided). First, using a small screwdriver, pierce the corner knockouts from the rear of the enclosures (not applicable on MT2 and MT5; holes are already provided). Then, from the front of the enclosures, insert suitable screws or bolts through the 5mm diameter apertures made by the removal of the knockouts, and fix the enclosures into position. The mounting dimensions are shown in figure 6. Finally, on MT12, MT24 and MT32 only, insert the plastic sealing plugs (provided) into the holes above the screws, and push them firmly into place to seal the knockout apertures, so as to preserve the enclosure's IP65 integrity.

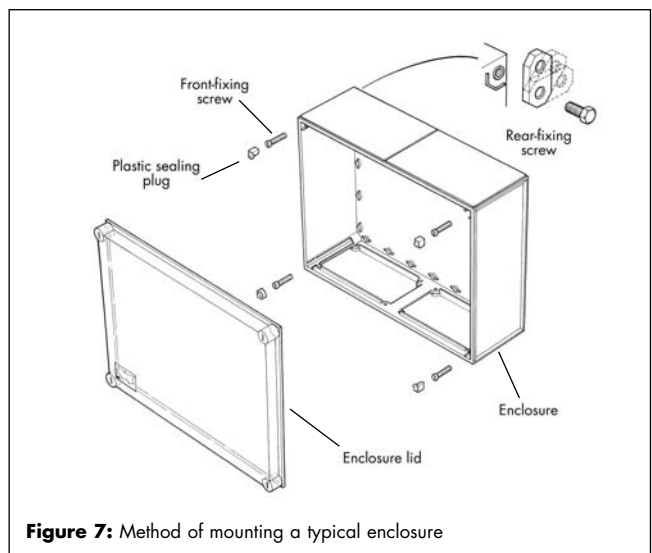


Figure 7: Method of mounting a typical enclosure

**Table 8:** Checklist

Item No	Check section:–	Refer to
1	Before commencing the installation ensure that the safety documentation confirms that the proposed system is fully certified (if applicable) and complies with the recommendations contained in the relevant sections of BS 5345 for the gas group, temperature classification and area classification required	4.1
2	Ensure that the barriers installed are of the correct type and polarity as specified in the safety documentation	8.1
3	Ensure that all barriers are mounted the right way around	5.1 and 6.2
4	Ensure that all barriers are securely mounted on the earth busbar by checking the tightness of both mounting nuts on each barrier with a torque spanner	5.1, 6.2 & 8.1
5	Ensure that all barriers are properly earthed in accordance with the safety documentation and in compliance with the recommendations contained in BS 5345: Part 4	7.2 & 8.1
6	Measure the resistance between the barrier earth busbar and the main power system earth and ensure that it does not exceed the maximum permitted resistance specified in the safety documentation	7.2 & 8.1
7	Carefully inspect all cables connected between the barriers and the hazardous-area equipment; ensure that the cables are the correct type specified in the safety documentation and that they are connected to the correct terminals	7.4 & 8.1
8	Ensure that all hazardous-area cables are well secured and are segregated from all other cables	7.4 & 8.1
9	Ensure that the permitted cable parameters for hazardous-area circuits are not exceeded	7.4
10	Ensure that all hazardous-area apparatus and cables are either earth-free or correctly bonded with an equipotential conductor	7.4
11	Ensure that all hazardous-area cables and cable screens are either terminated at a barrier or connected to the earth rail	7.4 & 8.1
12	Ensure that all unused hazardous-area cables are connected to a dummy barrier (MTL799) or otherwise safely secured to the earth rail (ERL7)	7.3
13	Ensure that all energy-storing devices installed in the hazardous area have been independently certified	7.4
14	Inspect all tagging labels and ensure that they display the correct barrier types, polarities and circuit loop numbers	5.1 & 6.2
15	Carefully inspect all cables connected to the non-hazardous (safe) area equipment and ensure that they are connected only to the non-hazardous (safe) area terminals of the barriers.	7.3
16	Ensure that no non-hazardous (safe) area equipment is supplied from, or contains, a source of potential with respect to earth that exceeds 250V rms or 250V dc under normal or fault conditions unless specifically permitted by the safety documentation. Note: one phase of a 3-phase supply of up to 440V is permitted as that value is the equivalent of 250V rms.	7.3
17	Ensure that all barriers are adequately protected from moisture, dust, dirt, vibration, mechanical damage, unauthorised modification and excessive temperature variations.	5.1 & 6.2
18	Ensure that all enclosures in which barriers are mounted are effectively sealed and that cable glands are correctly fitted.	5.2 & 7.1

### 5.2.2 Rear-fixing (not MT2, MT5 and MT20N)

Enclosures are mounted from the rear with this method, using the M6 screws provided. First drill holes through the surface onto which the enclosure is to be mounted, positioned so as to align with the tapped holes at the rear of the enclosure. These positions are the same as for corner screws in paragraph 5.2.1 and are shown in figure 6. Then, using the M6 x 12 screws provided, fix the enclosure into place from the rear. It will be necessary to use longer M6 screws than those provided if the thickness of the material on which the enclosure is mounted exceeds about 6mm.

### 5.2.3 Fixing lugs

All models can be mounted on a flat surface using the fixing lugs provided.

On models MT2 and MT5 the two plastic lugs can be positioned on either pair of opposite sides, as shown in figure 6. They are attached to the rear of the enclosure by the self-tapping screws provided.

On models MT12 and MT24, the plastic lugs are positioned one in each corner, and each can be attached in any one of three positions (see figures 6 and 7). The lugs are attached to the rear of the enclosure using the screws provided. Model MT32 is similar but uses six lugs: one in each corner, and two midway along the enclosure's length. This extra lug on each side should be fixed at right-angles to the enclosure's side, in either one of the two mounting holes.

Model MT20N has fixed mounting lugs, whose centres are shown in figure 6.

## 6 MOUNTING THE BARRIERS (UNENCLOSED SYSTEMS)

To simplify installation in circumstances where enclosures are not required, the parts needed are available either separately or as complete mounting kits for specified numbers of MTL700/700P barriers.

The range of accessories available for mounting MTL700/700P Series barriers as unenclosed systems is detailed in section 6.1. MTL certified customer drawings (CD701 Series) containing full specifications of each item are also available. Section 6.2 details the simple step-by-step procedure for constructing a comprehensive barrier mounting, earthing and tagging installation using the separate part accessories and section 6.4 gives the assembly instructions for the mounting kits.

### 6.1 The MTL700 and 700P Series accessories range

#### 6.1.1 Earth busbar EBB7

Used for mounting and earthing MTL700/700P Series barriers. Available in 1-metre lengths, in nickel-plated brass.

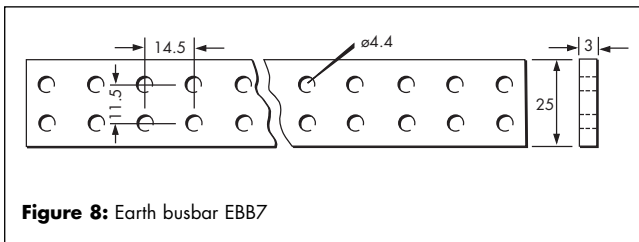


Figure 8: Earth busbar EBB7

#### 6.1.2 Insulating mounting block IMB7

Used for mounting EBB7 earth busbars and insulating them from panel/structural earth to prevent invasion by fault currents. IMB7s are sufficiently high to provide tagging and earthing facilities for MTL3000 and 2000 Series interface units if required. They can be mounted on a flat surface, top-hat rail (to EN50 022 – 35 x 7.5; BS 5584; 35 x 27 x 7.3 DIN46277), or G-profile rail (to EN50 035 – G32; BS 5825; 32 DIN46277).

#### 6.1.3 Insulating mounting block SMB7

An alternative to the IMB7, to reduce the overall height of the installation to 97mm. Mounts on a flat surface only.

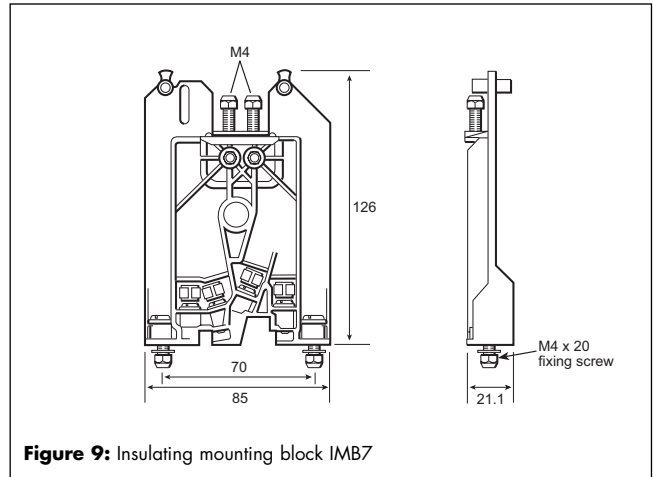


Figure 9: Insulating mounting block IMB7

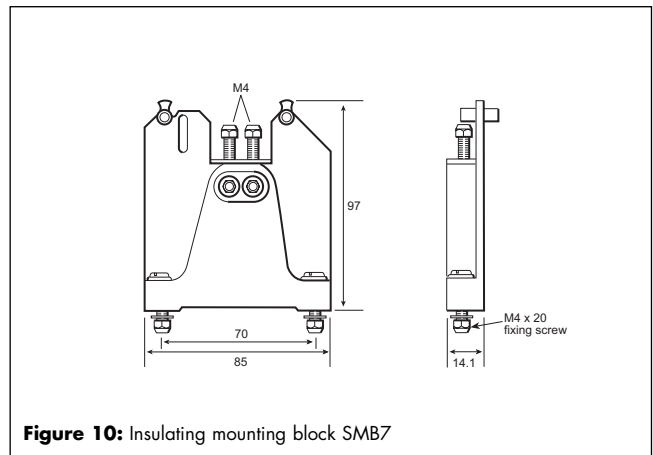


Figure 10: Insulating mounting block SMB7

#### 6.1.4 Earth rail mounting bracket ERB7

For supporting and electrically connecting the earth rail to the busbar, it mounts over either type of mounting block. Made of 3 x 10mm nickel-plated brass, the ERB7 is supplied with one bolt-down fitting for the rail – enabling easy removal for adding extra ETM7 terminals – and one 16mm<sup>2</sup> terminal for making an earth connection.

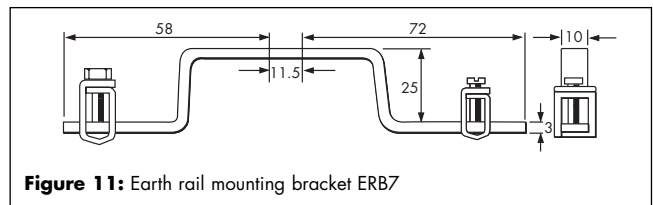


Figure 11: Earth rail mounting bracket ERB7

#### 6.1.5 Earth rail ERL7

This rail mounts the earth terminals that are used to earth incoming cables and screens and attaches to the mounting blocks via an ERB7 earth rail mounting bracket. It is available in 1-metre lengths and is made of 3 x 10mm nickel-plated brass.

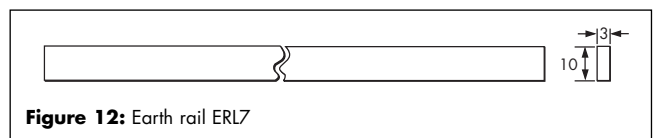


Figure 12: Earth rail ERL7

#### 6.1.6 Earth terminal ETM7

Suitable for mounting on ERL7 earth rail to earth incoming cables and screens, with up to 2.5 terminals per barrier width possible. Supplied

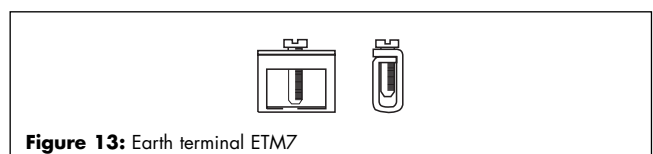


Figure 13: Earth terminal ETM7

in bags of 50.

### 6.1.7 Tagging strip TAG7

Provides tagging facilities for up to 64 barriers. Supplied in 1-metre

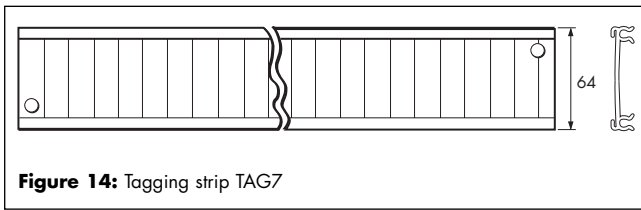


Figure 14: Tagging strip TAG7

lengths, and complete with TGL7 label and six 'clit' rivets for securing purposes.

### 6.1.8 Tagging strip label TGL7

Additional labels for TAG7 tagging strip, available separately. Supplied in 0.5 metre lengths, in packs of 10.

### 6.1.9 Tagging strip seal TGS7

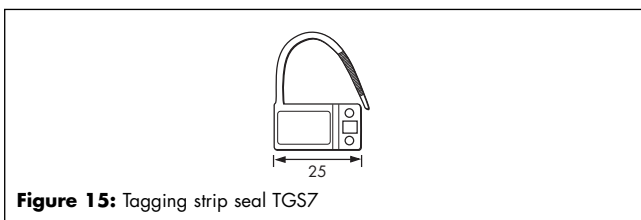


Figure 15: Tagging strip seal TGS7

Secures TAG7 tagging strip and label to the installation, to prevent unauthorised removal and maintain barrier identification. Supplied in bags of ten.

### 6.1.10 'Take Care' intrinsic safety labels

Warning labels bearing the words 'Intrinsically Safe System – TAKE

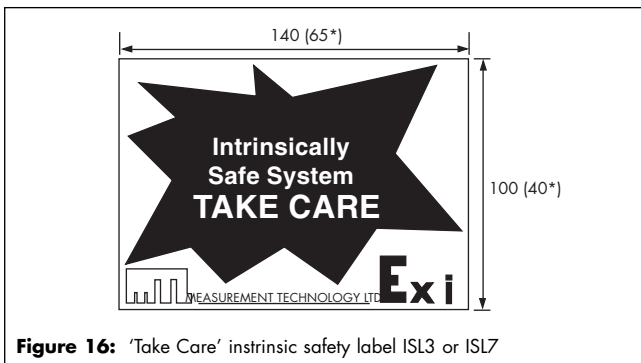


Figure 16: 'Take Care' intrinsic safety label ISL3 or ISL7

CARE' are available for attaching to enclosures or in areas where intrinsically safe systems and equipment are in use. Plastic labels with adhesive fronts (ISL7) for attaching to the insides of transparent enclosure lids, and metal labels with adhesive backs (ISL3) are

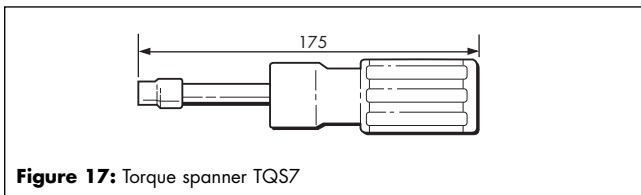


Figure 17: Torque spanner TQS7

available.

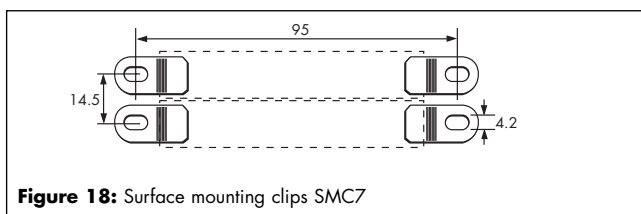


Figure 18: Surface mounting clips SMC7

### 6.1.11 Torque spanner TQS7

For tightening barrier mounting studs. The spanner is set to a torque of 2.3Nm (20lb in.) and fitted with a 7mm A/F socket.

### 6.1.12 Surface mounting clips SMC7

These clips are used for mounting small numbers of barriers on flat surfaces where it is not convenient or possible to use busbars. Supplied in bags of ten; two clips needed per barrier.



Figure 19: DIN-rail mounting kit DRK700

### 6.1.13 DIN-rail mounting kit DRK700

An MTL700/700P Series barrier fitted with the DRK700, can be attached to standard, 'T' section 35mm DIN rail, alongside MTL7000 and MTL7700 Series products. See Figure 19.

### 6.1.14 Dummy barrier MTL799

This accessory allows for expansion when designing a system and is a convenient means of reserving a position, or terminating spare leads and screens. It is packed as a standard MTL700/700P Series barrier, with hazardous-area terminals 3 & 4 internally connected to the fixing studs. Non-hazardous (safe) area terminals 1 & 2 are not connected. See figure 26 (page14).

### 6.1.15 Mounting kits

Four mounting kits are available, the MK2 (2 barriers), MK5 (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 earth screens and noting tagging information (except the MK2 kit). Assembly instructions are given in sections 6.4 and 6.5. See figures 22 and 23 (pages 12 and 13).

## 6.2 Constructing the installation

Installing MTL700/700P Series barriers is very simple. The barriers mount on standard earth busbar which is supported by insulating mounting blocks, themselves mounting on any flat surface or suitable DIN rail. In addition, an earth rail plus terminals is provided for terminating cable screens, and a tagging strip allows the barrier and its location to be identified.

Figure 20 shows how the accessories fit together to make up the installation, and should be referred to while carrying out the construction procedure.

**6.2.1** Determine the number of barriers to be mounted on the busbar. The maximum number is 25 between mountings, but a 1-metre length of busbar can accommodate up to 64 barriers. So for up to 25 barriers, cut a length of busbar with the required number of mounting positions, plus two extra for the mountings. For 26 to 50 barriers, three extra mounting positions are required. For 51 to 64 barriers, four extra positions are required.

**6.2.2** Position the busbar on the fixing studs of the IMB7 or SMB7 mounting blocks. The blocks should face the same way and be located not more than 25 spaces apart.

**6.2.3** Fit the ERB7 earth rail mounting brackets also onto each mounting block's studs, on top of the busbar, ensuring that the large terminals are on the hazardous-area side. Tighten the IMB7 or SMB7's fixing nuts using the TQS7 torque spanner.

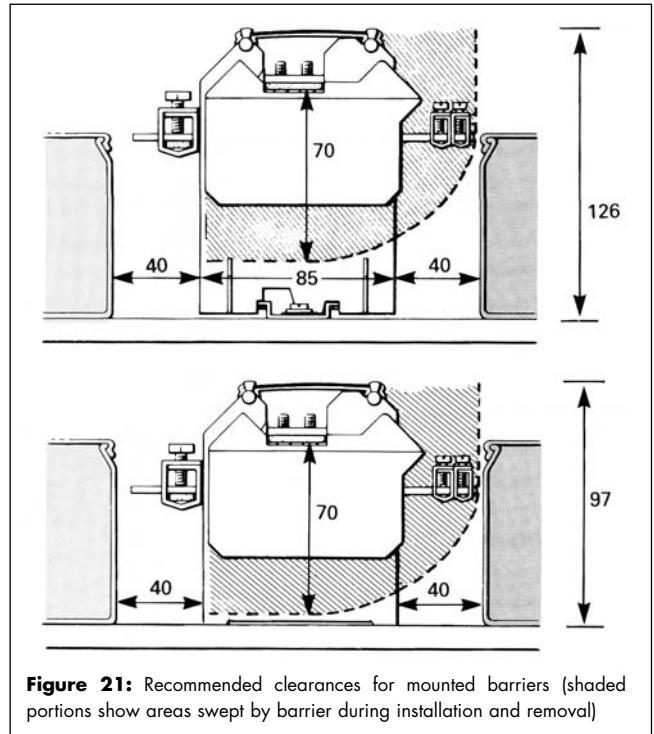
**6.2.4** If SMB7 mounting blocks have been used, fix the whole assembly to a flat surface using the two screws located in each block. Installations using IMB7s can be similarly mounted, or alternatively on top-hat or G-profile rail. For rail mounting, check that the swing nuts are turned out of the way, and locate the IMB7s on the rail. As the appropriate screws are tightened, the swing nuts pivot into position under the edges of the rail, thus securing the assembly. (The two angled screws are for G-profile rail, and the two vertical screws for top-hat rail). It may be necessary to remove the surface mounting screws from the IMB7s to achieve a flush fitting onto the rail.

**6.2.5** Mount the barriers on the busbar in the required positions, tightening all fixing studs using the TQS7 torque spanner, or a torque wrench set to 2.3Nm (20 lb.in.). Note that damage to the threads may occur if a higher torque than this is applied. Ensure all the barriers' hazardous-area terminals face the hazardous-area side. Where barriers are mounted in rows on parallel busbars, the barriers in alternate rows should be reversed to keep the hazardous and non-hazardous (safe) area terminals apart. Also ensure that there is sufficient clearance to allow their removal and replacement, as shown in figure 21.

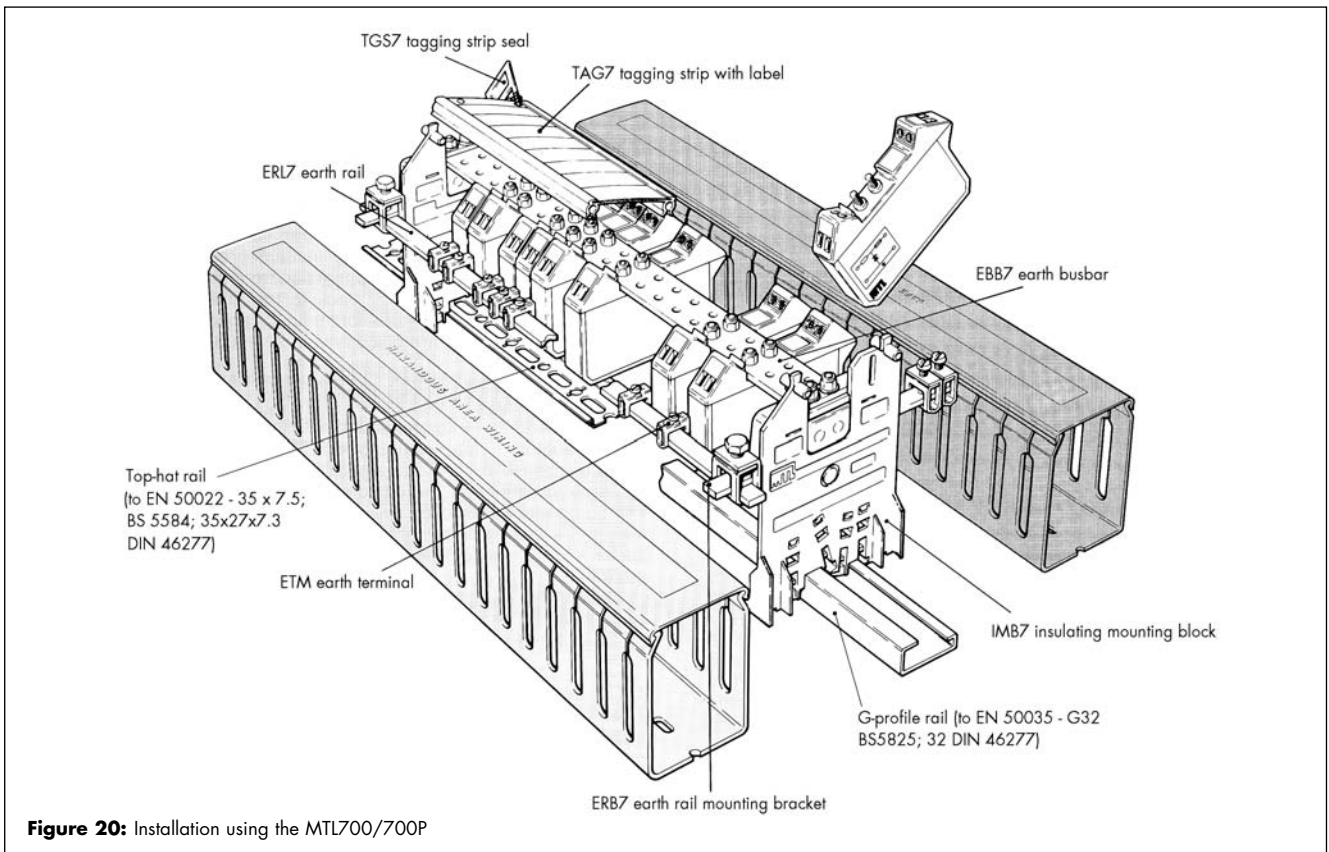
**6.2.6** Slide the required number of ETM7 earth terminals onto the ERL7 earth rail, and fit this assembly into the large terminals on the ERB7 brackets. Tighten these large terminals using a 10mm A/F spanner.

**6.2.7** Complete the installation by fitting the tagging facilities. First, take the 1-metre length of TAG7 tagging strip and remove the pack of four 'clik' rivets taped to the underside. Also, remove the clic rivets from both ends of the strip by pressing them out from the rear. The TGL7 tagging strip label can now be removed and, along with the TAG7 tagging strip, cut to length if necessary. After the TGL7 tagging strip label has been

marked with loop identification numbers etc., refit it into the TAG7 tagging strip and secure it by replacing one of the clic rivets. If the TAG7 has been cut to length, drill a 3.2mm diameter hole in the cut end, diagonally opposite the existing clic rivet (7.5mm along, 12.5mm in) to accommodate the tagging seal. Clip the TAG7 onto the installation, using the lugs located on the top of each mounting block. Finally, 'seal' the tagging information to the installation by fitting a TGS7 tagging strip seal through the hole drilled previously in the TAG7 tagging strip, and the vertical slot in the mounting block. The information on the TAG7 label and the barrier model numbers themselves can both be seen at the same time, thus making it easy



**Figure 21:** Recommended clearances for mounted barriers (shaded portions show areas swept by barrier during installation and removal)



**Figure 20:** Installation using the MTL700/700P

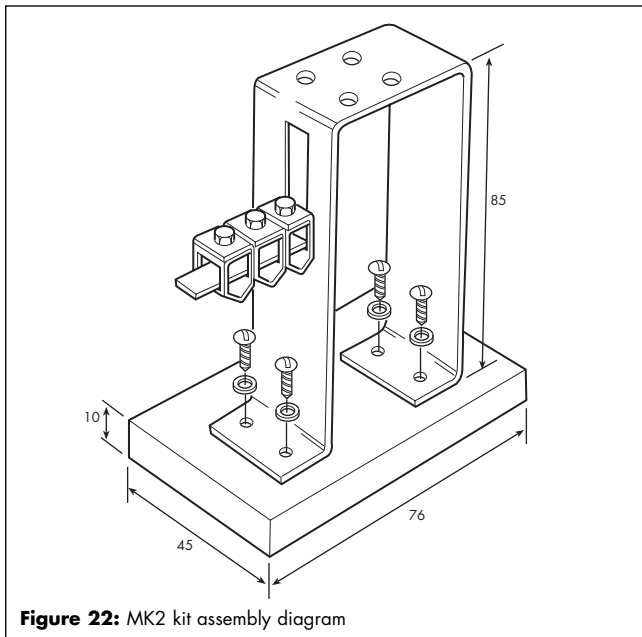


Figure 22: MK2 kit assembly diagram

### 6.3 Using SMC7 surface mounting clips

Insert one SMC7 clip into the slot in each end of the barrier, pushing well into place. The barrier can then be fixed to a flat surface using screws or bolts up to 4.2mm outside diameter (M4 or similar). See figure 26.

### 6.4 MK2 mounting kits

#### 6.4.1 MK2 parts list

Part number	Description	Quantity
1	Mounting bracket	1
2	Insulating block	1
3	3.9 x 9.5 self-tapping screws	4
4	M4 washers	4
5	Terminal clamp (4mm)	3

#### 6.4.2 MK2 kit assembly instructions

- Use the four self-tapping screws (3) and M4 washers (4) to attach the mounting bracket (1) to the insulating block (2) through the four M4 holes.
- The insulating block (2) is provided to keep the IS earth (terminated on the mounting bracket (1)) separate from a structural earth but, if the mounting surface is insulated, then the insulating block may not be necessary.
- Use the 4mm terminal clamps (5) to connect the IS earth and terminating cable screens to the mounting bracket.

### 6.5 MK5, MK12 and MK20 mounting kits

#### 6.5.1 MK5 parts list

Part number	Description	Quantity
1	DIN rail (156mm)	1
2	Earth busbar (99mm)	1
3	Earth rail mounting brackets	2
5	Insulating mounting block	2
6	Tag label assembly	1
7	Tagging strip seal	1
8	M4 Nyloc nuts	4
9	M4 washers	4
11	Terminal clamps (16mm)	3
12	Terminal clamps (4mm)	3

#### 6.5.2 MK12 parts list

Part number	Description	Quantity
1	DIN rail (246mm)	1
2	Earth busbar (200.5mm)	1
3	Earth rail mounting brackets	2
4	Earth rail (215mm)	1
5	Insulating mounting block	2
6	Tag label assembly	1
7	Tagging strip seal	1
8	M4 Nyloc nuts	4
9	M4 washers	4
10	Earth rail clamp	2
11	Terminal clamps (16mm)	3
12	Terminal clamps (4mm)	6

#### 6.5.3 MK20 parts list

Part number	Description	Quantity
1	DIN rail (388mm)	1
2	Earth busbar (316.5mm)	1
3	Earth rail mounting brackets	2
4	Earth rail (330mm)	1
5	Insulating mounting block	2
6	Tag label assembly	1
7	Tagging strip seal	1
8	M4 Nyloc nuts	4
9	M4 washers	4
10	Earth rail clamp	2
11	Terminal clamps (16mm)	3
12	Terminal clamps (4mm)	10

#### 6.5.4 MK5, MK12 and MK20 kits assembly instructions

Note: The MK5 kit is NOT provided with an earth rail and earth rail clamps, so take care to follow the special instructions given in d) rather than c) if using this kit.

- Locate the busbar (2) on the fixing studs of the insulating mounting blocks (5), making sure both blocks face the same way.
- Fit the earth rail mounting brackets (3) onto the studs of each mounting block on top of the busbar, and secure using M4 washers (9) and Nyloc nuts (8). The longer ends lie in the safe area.
- (MK12 and MK20 only). Fit the earth rail clamps (10) onto the shorter protruding lengths of the earth rail mounting brackets (3). This is the hazardous side of the assembly. Slide the smaller (4mm) terminal clamps (12) onto the earth rail (4) and mount the earth rail onto the earth rail mounting brackets (3) with the earth rail clamps (10). Fit the larger (16mm) terminal clamps (11) onto the longer protruding lengths of the earth rail mounting brackets (3), two being mounted on one bracket and one on the other. These terminals are used for connecting the IS earth.
- (MK5 only). Fit the smaller (4mm) terminal clamps (12) onto the shorter protruding lengths of the earth rail mounting brackets (3) and the larger (16mm) terminal clamps (11) onto the longer protruding lengths. In both cases, two are mounted on one bracket and one on the other. The smaller terminal clamps serve the same purpose as the earth rail and clamps for the MK12 and MK20 while the function of the larger terminal clamps is the same for all three kits.
- To mount the insulating mounting blocks (5), check that the swing nuts forming part of each unit are turned away and locate the units on the DIN rail (1). Tighten the screws accessing the swing nuts to pivot them underneath the edge of the DIN rail, so securing the blocks to the rail.
- Complete the installation by adding the tagging facilities. First, remove the label to add identification then replace and secure with the clic rivet. Second, clip the tag label assembly (6) onto the installation with the lugs on top of each insulating mounting block (5). Third, 'seal' the tagging information to the installation by fitting the tagging strip seal (7) through the hole in the tagging strip and the vertical slot in the mounting block. The tagging strip can be unclipped from one side only and hinged open to provide access to the mounting studs and terminals of the barriers when required.

## 7 WIRING INSTALLATION

Before undertaking the installation of MTL700/700P Series barriers, section 4 of this manual should be read before commencing the instructions contained in this section. All instructions in this section apply to barriers mounted in MTL enclosures or as unenclosed systems. Figure 24 should be referred to for usage of earthing terminals in enclosures. For enclosures, all cables will need to be connected via suitable glands (not supplied), as described below.

### 7.1 Glanding cables into enclosures

#### 7.1.1 MT2 and MT5

Two pre-drilled 20mm gland holes are provided in the base of each enclosure, fitted with push-in blanking plugs.

#### 7.1.2 MT12

The enclosure has detachable top and bottom gland plates, for drilling by the user. This can be done with the gland plates in situ, or removed if preferred. To remove the gland plates, firmly press the plate retaining lip on the inside of the enclosure to release the front edge of the plate. Then, gently lever the plate retaining lip at the back of the enclosure to release the rear edge of the plate. Note that the embossed arrow on the inside of the gland plate always points towards the front of the enclosure when fitted, and then drill the gland holes in the required positions. The gland plates snap back into position.

#### 7.1.3 MT20N

This enclosure has detachable top and bottom gland plates, for drilling by the user. This can be done with the gland plates in situ, or removed if preferred. To remove the gland plates, simply unbolt them from the enclosure.

### 7.2 Earthing the barriers

To ensure correct and safe operation of the barrier system, it is vitally important that the installation is earthed properly. All MTL700/700P Series barriers should be connected to a high-integrity earth via a copper conductor. The resistance of this conductor should not exceed 1Ω, although in order to increase safety and minimise interference, a resistance of 0.1Ω should be aimed for whenever possible. The cross-sectional area of the conductor must be greater than 4mm<sup>2</sup> (12AWG).

Where the barriers are mounted on a busbar, the conductor should be connected to the 16mm<sup>2</sup> terminal on the ERB7 earth rail mounting bracket. Alternatively, the connection can be made directly to the busbar using a vibration-proof ring tag. For greater integrity, a duplicate earth connection should be made to the terminal on a second ERB7 bracket.

On MT Series enclosures, the earth connections should be made to the ERB7 brackets as described above (or to the 4mm<sup>2</sup> terminals in the case of the MT2), and fed into the enclosure via the non-hazardous (safe) area cable gland.

Although terminals 2 and 4 on 1-channel barriers are internally connected to the barrier earth studs, (MTL702, 705 and 706: terminal 4 only), they SHOULD NOT be used as a means of connecting the system to the high-integrity earth circuit.

To avoid the difficulty posed by the need to test the earth circuit periodically in accordance with the requirements of BS 5345, it is advisable to use two earth conductors for earthing the system, as shown in figure 25. It is then possible to connect a multimeter into the loop to measure the loop resistance without disturbing the circuit. In this case the resistance should not exceed 2Ω. This arrangement will also allow

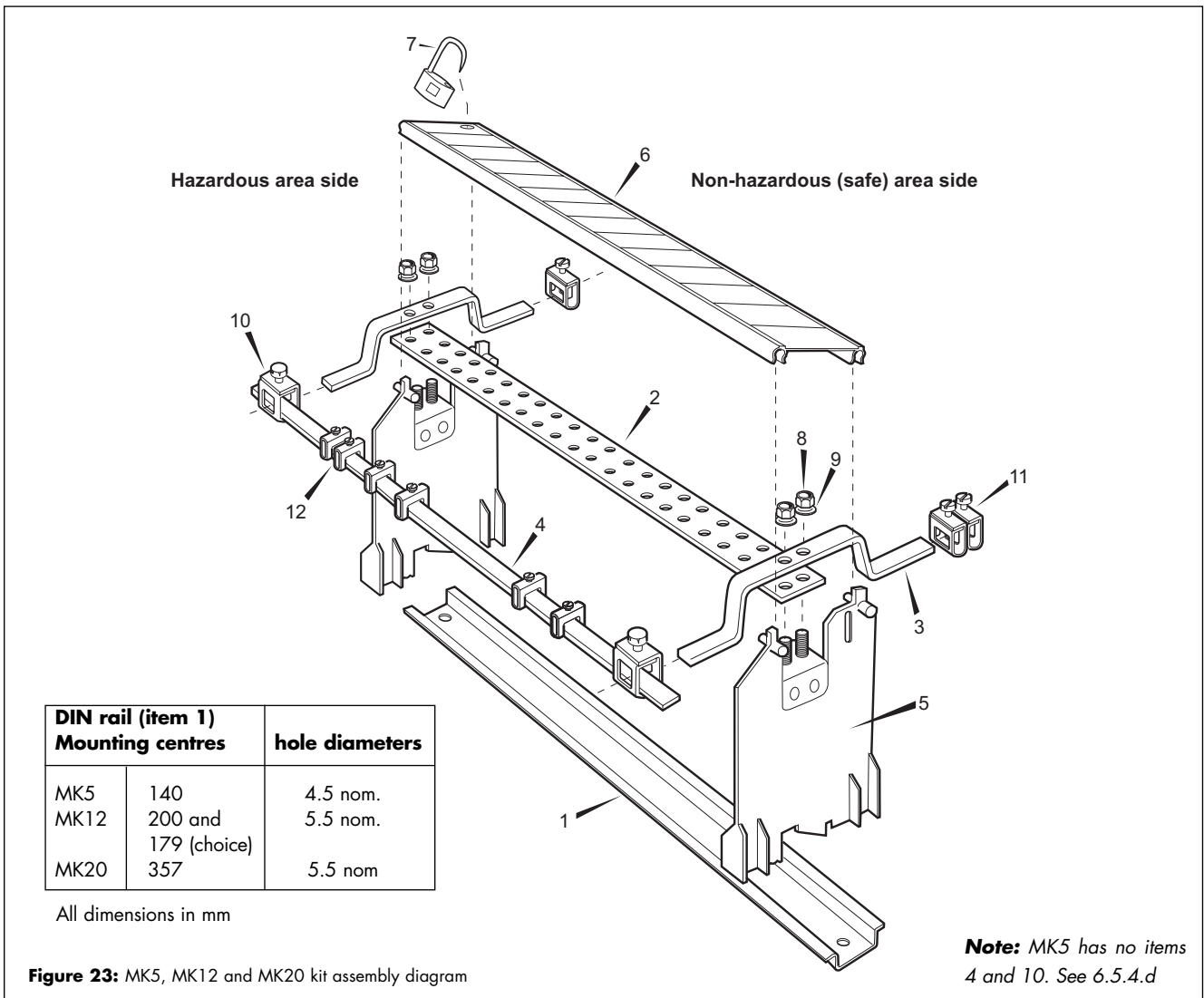


Figure 23: MK5, MK12 and MK20 kit assembly diagram



the circuit to be monitored continuously by a bonding integrity monitor such as the MTL2316, which gives warning if there is a significant increase in resistance, or if large currents are sensed. IS earth conductors should be identified by coloured insulating tape, preferably blue, wound around them at intervals along their length.

It is common practice (but not mandatory) to insulate IS earth busbars and associated conductors from the surrounding metalwork and plant earth cables. This minimises the possibility of the earth circuit being invaded by leakage or fault currents which, through common impedances, might interact adversely with this and other systems. It is far easier to design an insulated installation than to discover later that insulation is necessary, when disassembly and power removal will be unavoidable. MTL700/700P Series accessories IMB7 and SMB7 insulating mounting blocks are a convenient method of insulating busbars, as shown in figure 20. Further information about the earthing of IS systems is contained in BS 5345: Part 4: 1977, Section 3, Code 16.

If SCM7 surface mounting clips are used to mount a small number of barriers, the earth connections will have to be made directly to the barriers' earth studs. Figure 26 shows a recommended method where the two earths are connected to different barriers, with the remaining studs all linked together. The earth conductors must have a minimum cross-sectional area of 4mm<sup>2</sup>. Hazardous-area cable screens can be connected to the earth studs, or terminal 3 and 4 of an MTL799 dummy barrier.

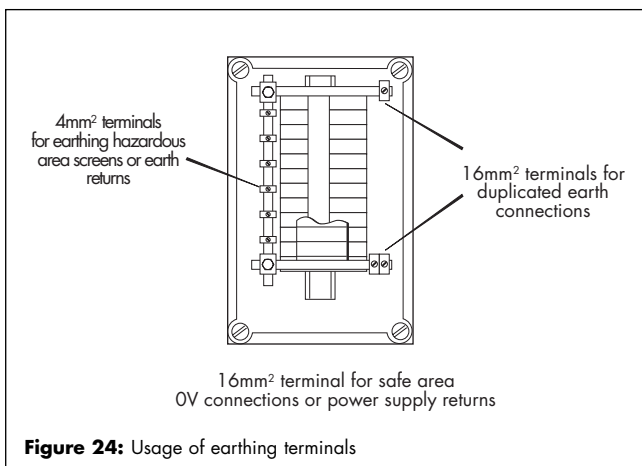


Figure 24: Usage of earthing terminals

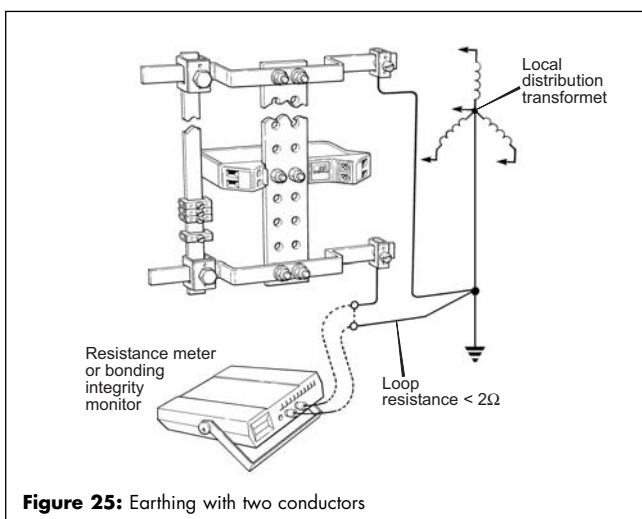


Figure 25: Earthing with two conductors

### 7.3 Connecting non-hazardous (safe) area cables to barriers

The non-hazardous (safe) area cables must be connected only to terminals 1 and 2 of MTL700/700P Series barriers. They should be segregated from hazardous-area cables and routed from the non-hazardous (safe) area equipment via the non-hazardous (safe) area loom, conduit or trunking. Care must be taken if standard barriers are to be connected to a non-hazardous (safe) area power supply. If the supply is connected the wrong way around, the barrier fuse will blow

and the unit will need replacing. (MTL702, 705, 706, 707, 707P and 708 overvoltage-protected barriers cannot be damaged in this manner). For standard barriers, ensure also that the supply voltage does not exceed the working voltage (V<sub>wkg</sub>) of the barriers as specified in section 3.2.

Do not connect barriers to non-hazardous (safe) area equipment that is supplied from, or contains, a source of potential with respect to earth that exceeds 250V rms or 250V dc under normal or fault conditions, unless specifically permitted to do so by the safety documentation. (Connection to non-hazardous (safe) area equipment fed from a three-phase 440V neutral earthed supply is permissible).

All unused non-hazardous (safe) area cables should be secured safely to terminals 1 and 2 of an MTL799 dummy barrier, or by some other suitable method.

### 7.4 Connecting hazardous-area cables to barriers

The hazardous-area cables must be connected only to terminals 3 and 4 of MTL700/700P Series barriers. They should be segregated from non-hazardous (safe) area cables and routed to the hazardous-area equipment via the hazardous-area loom, conduit or trunking.

Before making any connections, ensure that all energy-storing devices (i.e. devices that are not classified as 'simple apparatus') used in the hazardous area are certified compatible with the barrier combination being used. Then check that the cables used for connecting the barriers to the hazardous-area equipment conform with the type of cables

specified in the safety documentation. Make sure that the maximum permitted cable parameters stipulated for the particular types of barrier in tables 9 to 12 (BASEEFA) or tables 13 to 22 (FM) are not exceeded. In general, cable parameters are unlikely to present problems except where cables longer than 500m are used for Group IIC applications.

Hazardous-area equipment and its interconnections should be isolated from earth to the extent that it is capable of withstanding a 500V isolation test, but such tests can only be undertaken when the area is gas free. Fortunately however, most circuits may be tested at low voltages by first disconnecting at the barrier any cable connected directly to earth or returned via a barrier with a nominal voltage of less than 10V. The resistance to earth of the non-hazardous (safe) area terminals can then be checked with a multimeter and should be greater than 100kΩ.

**Note:** some hazardous-area instrumentation (e.g. pH and conductivity) is, by its nature, unable to withstand the 500V insulation test method mentioned above. Where this is the case, the system may alternatively comply with the installation requirements specified in IS sketch 121 (figure 27) and BS 5345, Part 4, 1977, Section 3, Code 16.

Hazardous-area earth returns and cable screens should be earthed via the ETM7 earth terminals mounted on the ERL7 earth rail (on the mounting bracket in the case of the MT2 enclosure). However, in the case of 1-channel barriers, earth returns and cable screens can be connected to terminal 4 of the barrier with which they are associated, because that terminal is internally connected to the earth studs.

All unused hazardous-area cables should be secured safely to terminals 3 and 4 of an MTL799 dummy barrier, or by some other suitable method.

Figure 26 shows the MTL799 used as a convenient technique for terminating screens and is another possible use.

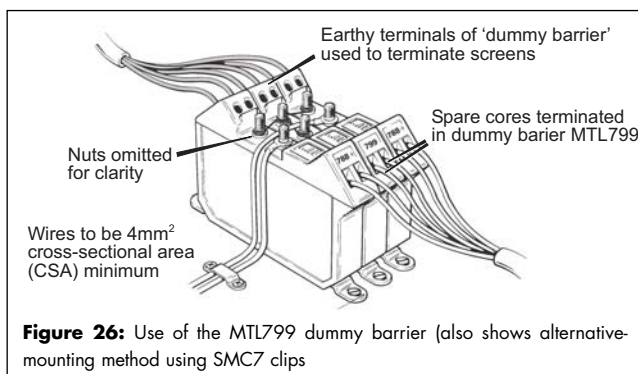


Figure 26: Use of the MTL799 dummy barrier (also shows alternative-mounting method using SMC7 clips)

Where the hazardous area equipment is connected to earth either directly or indirectly, and/or it will not withstand a 500V insulation test to ground, (e.g. strain-gauge bridges with low-voltage insulation, pH and conductivity measuring electrodes, bare and/or earthed thermocouples, some level detecting elements), the following apply:

## 1. Safety requirements

- 1.1 The pipe, vessel, or body of the hazardous-area apparatus and/or the adjacent metallic structure must be connected to the barrier busbar by a bonding conductor not less than 8mm<sup>2</sup> cross-sectional area (CSA). With this size conductor the bonding conductor must not exceed 200m in length. If the bonding conductor is less than 100m the conductor need only be 4mm<sup>2</sup> in cross-sectional area.
- 1.2 Where bonding conductors are used, care should be taken to avoid invasion of other intrinsically-safe systems, which do not utilise bonding conductors, by elevation caused by any currents which may flow in the common earthing systems due to the presence of the bonding conductor. Where this possibility cannot be avoided, then the busbar on which the barriers are fitted should contain only barriers associated with bonded systems, and it should be earthed separately from other barrier busbars.
- 1.3 The hazardous-area equipment and/or adjacent metallic structure bond connections must be secure against vibration and corrosion. A terminal of the type used on Type 'e' equipment is the required solution.
- 1.4 The barrier busbar connections must provide adequate termination facilities for the bonding conductor and usual 'earth return', by the provision of separate Type 'e' terminals.
- 1.5 Where the barriers are located in Zone 2, the enclosure and the wiring to the non-hazardous (safe) area connections of the barrier must comply with the requirements of Type 'N' protection.

## 2. Operational requirements

- 2.1 This sketch shows the '0V' rail of the non-hazardous (safe) area equipment returned to the barrier busbar by a separate insulated conductor, and the structural earths of the barrier enclosure and safe-area equipment returned separately to the neutral star point. This technique reduces interference problems, but is not essential for safety.
- 2.2 In general, the use of barriers in all measurement leads reduces the possibility of earth circulating currents creating measurement problems.

## 3. Neutral star point earth

- 3.1 Resistance to 'terrestrial earth' is determined by other regulations. It is NOT modified or determined by the intrinsic safety

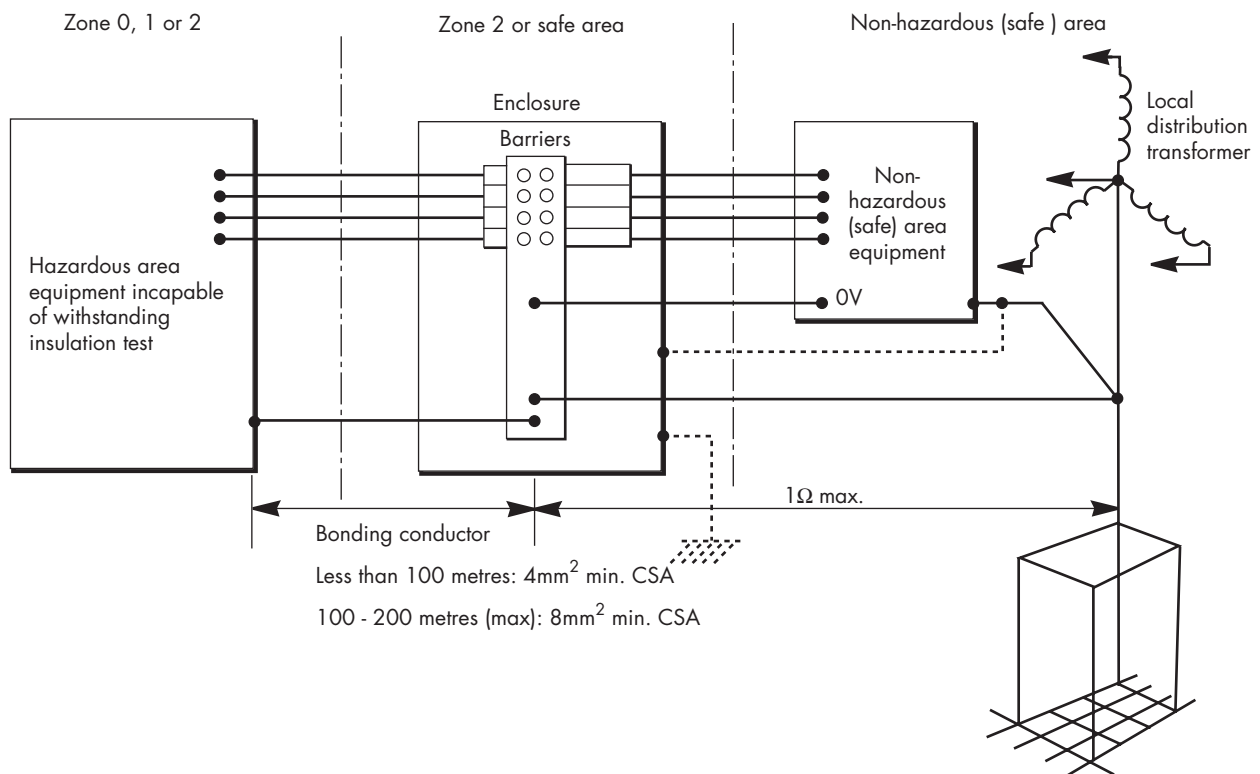


Figure 27: Bonding practice where hazardous area equipment cannot meet required standards of insulation from earth

requirements.

## 7.5 Cable parameters for MTL700 Series – BASEEFA(ATEX) & FM

**Table 9:** Maximum cable parameters (gas group IIC) (for notes 1, 2, and 3, see bottom of page)

Barrier model number MTL	Number of single channels interconnected within hazardous area	Earth 1 return used?	Maximum permissible cable parameters					Matched 2 power W (BASEEFA)
			BASEEFA (ATEX) (group IIC)			FM (groups A&B)		
			Capacitance $\mu$ F	Inductance mH	or L/R ratio $\mu$ H/ $\Omega$	Capacitance $\mu$ F	Inductance mH	
702+	1	Yes	0.110	2.39	47	0.17	2.2	0.782
706+	1	Yes	0.083	3.05	56	0.12	4.0	0.65
707+	Both	Yes	0.083	3.05	56	0.12	4.0	0.65
708+	1	Yes	0.083	3.05	56	0.12	4.0	0.65
710	1	Yes	3.0	0.91	74	3.0	1.0	0.50
710P	1	Yes	3.0	0.38	44	4.89	0.22	0.75
715	1	Yes	0.580	1.45	66	0.7	1.4	0.56
715P	1	Yes	0.580	0.33	28	1.04	0.23	1.09
722	1	Yes	0.165	1.45	45	0.2	1.4	0.81
722P	1	Yes	0.165	0.30	32	0.33	0.53	1.18
728	1	Yes	0.083	3.05	56	0.12	4.0	0.65
728P	1	Yes	0.083	1.82	44	0.16	2.86	0.83
751ac	1	Yes	100	3.72	1464	1000	4.5	0.025
	2	Yes	100	0.96	558	1000	1.2	0.05
		No	100	3.72	732	1000	4.5	0.05
755ac	1	Yes	100	0.46	145	1000	0.4	0.225
	2	Yes	100	0.13	69	150	0.1	0.45
		No	40	0.41	73	150	0.1	0.45
	3	No	40	0.125	48	-	-	0.68
	4	Yes	40	0.035	31.25	-	-	0.92
		No	40	0.06	42	-	-	0.92
758	1	Yes	11.1	0.070	26	6.0	0.05	1.40
	2	Yes	11.1	0.02	10	6.0	0.02	2.80
760ac	1	Yes	3.0	0.91	74	3.0	0.9	0.50
	2	Yes	3.0	0.20	27	3.0	0.2	1.00
761ac	1	Yes	4.9	3.72	163	3.1	3.5	0.225
	2	Yes	4.9	0.91	62	0.4	1.0	0.45
		No	0.31	3.72	81	0.4	1.0	0.45
	4	Yes	0.42	0.20	26.39	-	-	0.90
		No	0.42	0.37	37.78	-	-	0.90
	6	Yes	0.42	0.085	14.39	-	-	1.35
		No	0.42	0.13	18.67	-	-	1.35
761Pac	2	Yes	0.31	0.34	306	0.43	14.4	0.115
764±	1	Yes	1.41	240	1000	1.5	200	0.036
	2	Yes	1.41	61	360	1.0	60	0.072
764ac	1	Yes	1.41	240	1000	1.5	200	0.036
	2	Yes	1.41	61	360	0.18	60	0.072
		No	0.125	240	500	0.18	60	0.072
765ac	1	Yes	0.58	1.45	66	0.7	1.3	0.56
	2	Yes	0.58	0.32	22	0.7	1.4	1.125
766ac	1	Yes	1.41	5.8	151	1.5	5.6	0.24
	2	Yes	1.41	1.47	58	0.18	1.5	0.48
		No	0.125	5.8	75	0.18	1.5	0.48
766Pac	2	Yes	1.41	0.34	29	0.22	0.20	0.942
767	1	Yes	0.58	1.45	66	0.7	1.7	0.56
	2	Yes	0.58	0.32	22	0.5	0.4	1.125
768	1	Yes	0.165	1.45	45	0.2	1.7	0.81
772ac	1	Yes	0.165	6.77	89	0.2	6.0	0.404
	2	Yes	0.165	1.45	34	0.2	1.8	0.808
778ac	1	Yes	0.083	16	107	0.12	14	0.327
	2	Yes	0.083	3.05	42	0.12	4.2	0.654
779	1	Yes	0.083	3.05	56	0.12	4.0	0.65
786	1 or 2	Yes	0.083	-	-	0.11	500	-
787 & 787S	Both	Yes	0.083	3.05	56	0.11	4.0	0.65
787SP	2	Yes	0.083	1.82	44	0.13	2.70	0.835
788 & 788R	Both	Yes	0.083	0.33	25	0.11	0.5	0.92
791	Both	No	0.165	0.30	32	0.24	0.31*	1.18
796	Both	Yes	0.10	1.94	34	0.13	2.0	0.81
			<b>BASEEFA (group IIB)</b>			<b>FM (group C)</b>		
707P	2	Yes	0.65	5.65	127	0.45	6.21	1.19
729P	1	Yes	0.65	5.65	127	0.49	6.25	1.19

System combination	BASEEFA system Cert. No.	Earth 1 return used?	BASEEFA Maximum permissible cable parameters for group IIC (hydrogen)			Matched 2 power W (BASEEFA)
			Capacitance $\mu$ F	Inductance mH	or L/R ratio $\mu$ H/ $\Omega$	
1x715P 4x764ac	Ex92C2425	Yes	0.135	0.23	39.3	0.91
2 x 761ac channels 2 x 764ac channels 2 x 766ac channels	Ex842125	Yes	0.2	0.24	11.6	1.01
4 x 761ac channels 2 x 764ac channels	Ex842125	Yes	0.2	0.2	12.7	0.98
4x761Pac channels 2x766Pac channels	Ex92C2424	Yes	0.18	0.17	18.4	1.17
2 x 764ac channels 4 x 766ac channels	Ex842128	Yes	0.2	0.28	11	1.04
758 + 761ac	Ex872392	Yes	0.42	0.013	10.5	3.27
			<b>BASEEFA Maximum permissible cable parameters for group IIB (not safe for group IIC)</b>			
4 x 764ac channels 4 x 766ac channels	Ex842128	Yes	0.6	1.1	32.6	1.12
2 x 768 channels	Ex842114	Yes	0.78	1.8	70	1.62
2 x 768 channels Any number of 786 channels	Ex842114	Yes	0.39	1.8	46.6	1.62
2 x 779 channels	Ex842114	Yes	0.39	4.3	83	1.3
2 x 779 channels Any number of 786 channels	Ex842114	Yes	0.39	4.3	55.6	1.3

\* L/R = 31 $\mu$ H/ $\Omega$

The tables give the maximum permitted cable parameters (including cable and load) for hazardous-area circuits in group IIC and IIB gases. However, the tables are by no means exhaustive and for full details of other safe combinations, consult either BASEEFA system certificates Ex832469, Ex92C2374 or Ex92C2376 or MTL. The MTL702 is covered by BASEEFA system certificate Ex842308, and the MTL706 by Ex872513.

In practice cable parameters rarely present a problem, as all cables normally used for instrument interconnection have L/R ratios below 25 $\mu$ H/ $\Omega$  and capacitance below 200pF per metre.

**Note 1** If a 'No' value is not quoted for a barrier, use the 'Yes' value.

**Note 2** The maximum power that can be drawn from the barrier combination under fault conditions. Used for assessing the temperature classification of 'simple' hazardous-area apparatus.

**Note 3** Values for Groups IIA and IIB are given on certificates BASO1ATEX7202 and BASO1ATEX7203. For FM permitted combinations, refer to MTL document SCI-88 (via FM ref 1H8A1.AX).

## 7.6 Entity concept parameters for MTL700 Series – FM

**Table 10:** Entity concept parameters for 1-channel MTL700 barriers (figure 28)

Barrier model no. (MTL)	Voc (V)	Isc (mA)	Ca (µF)	La (mH)
702	25.11	125	0.17	2.2
705	28.1	93	0.12	4.0
706	28.1	93	0.12	4.0
708	28.1	93	0.12	4.0
710	10.03	189	3.0	1.0
715	15.06	146	0.7	1.4
722	22.08	146	0.2	1.4
728*	28.12	93	0.12	4.0

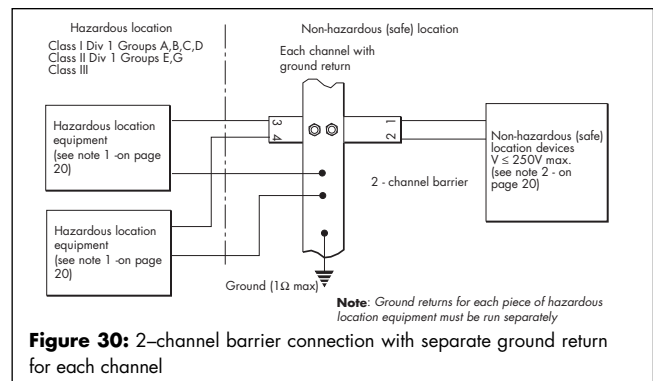
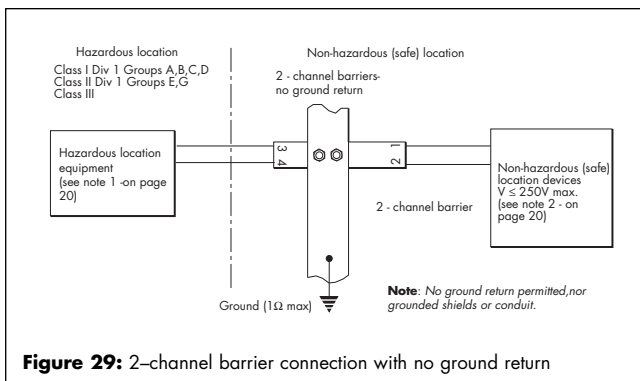
\* One channel of an MTL779 can be used in place of an MTL728

**Figure 28:** 1-channel barrier connections

**Table 11:** Entity concept parameters for 2-channel MTL700 barriers with no ground return (figure 29) and separate ground returns for each channel (figure 30)

Barrier model No. MTL	Figure 29				Figure 30			
	Voc (V)	Isc (mA)	Ca (µF)	La (mH)	Voc (V)	Isc (mA)	Ca (µF)	La (mH)
751	1.92	89	1000	4.5	0.96	89	1000	4.5
755	5.92	296	1000	0.4	2.96	296	1000	0.4
758	–	–	–	–	8.5	821	6.0	0.05
760	10.03	97	3	3.5	10.3	194	3.0	0.9
761	18.08	99	0.40	3.5	9.04	99	3.1	3.5
764±	13.25	6	1	800	12.05	12	1.5	200
764ac	24.10	12	0.18	200	12.05	12	1.5	200
765	15.08	75.4	0.70	6	15.08	147	0.7	1.3
766	24.10	80.4	0.18	5.6	12.05	80	1.5	5.6
767	16.35	75.8	0.50	6	15.15	147	0.7	1.7
768	23.33	73.5	0.20	6	22.13	147	0.2	1.7
772	22.13	36.9	0.20	22	22.13	73	0.2	6
778	28.23	23.6	0.12	58	28.23	46	0.12	14
779	29.37	46.5	0.11	14	28.17	93	0.12	4
786	29.20	0	0.11	500	28.00	0	0.12	500
787 (28V ch)	29.74*	94*	0.10*	4*	28.54	94	0.11	4
787 (diode ch)	–	–	–	–	28.00	0	0.12	500
788, 788R (28V ch)	28.75*	82*	0.11*	5.6*	28.15	93	0.12	4
788, 788R (10V ch)	–	–	–	–	10.04	189	3.0	1
796 (26V ch)	27.30*	40*	0.13*	22*	26.10	86	0.14	4.7
796 (20V ch)	–	–	–	–	20.05	51.4	0.3	13

\* Parameters when barrier channels are interconnected

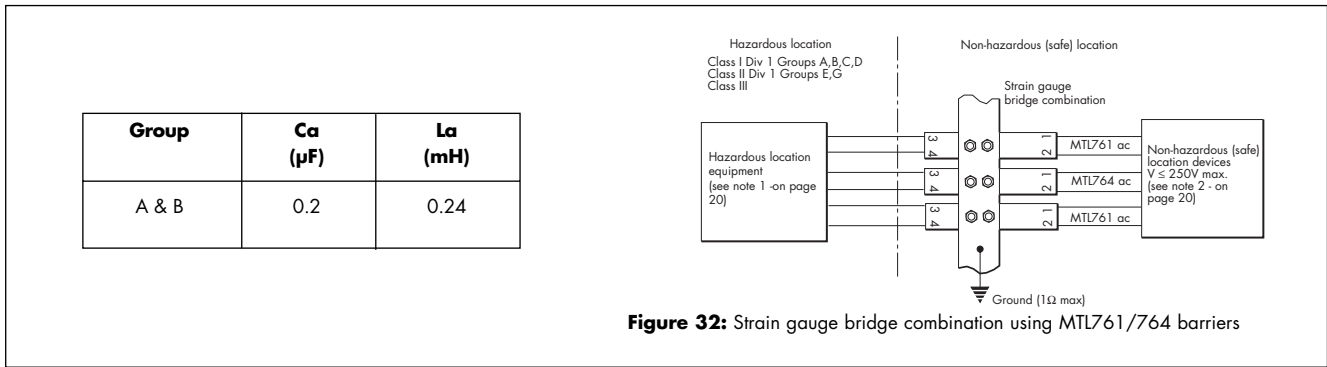


**Table 12:** Entity concept parameters for 2-channel MTL700 barriers with optional ground return (figure 31)

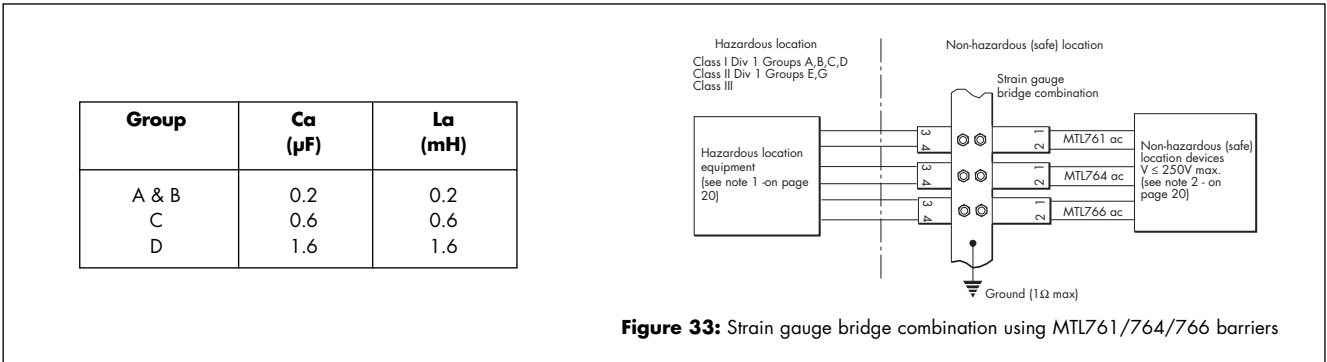
Barrier model no. (MTL)	Voc (V)	Isc (mA)	Ca (µF)	La (mH)
707	28.1	93	0.12	4.0
758	8.1	1482	6.0	0.02
787S	28.7	93	0.11	4.0

**Figure 31:** 2-channel barrier connection with optional ground return

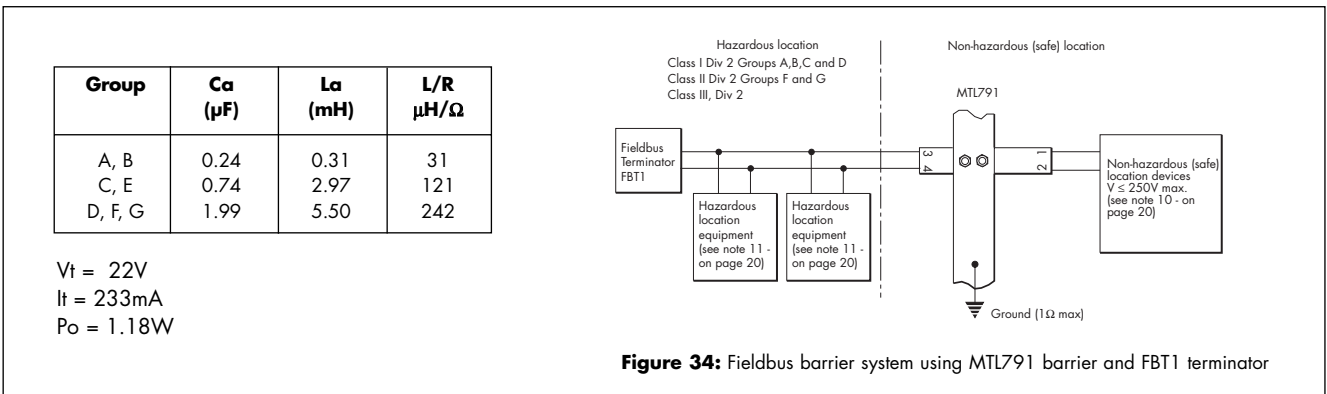
**Table 13:** Entity concept parameters for strain gauge bridge systems using MTL761/764 barriers (figure 32)



**Table 14:** Entity concept parameters for strain gauge bridge systems using MTL761/764/766 barriers (figure 33)



**Table 15:** Entity parameters for Fieldbus barrier MTL791 and terminator FTB1 (figure 34)



## 7.8 Entity concept parameters for MTL700P Series – FM

**Table 16:** Entity concept parameters for single channel MTL700P barriers with ground return (see figure 28 and notes 6 to 9)

Barrier model No. MTL	Groups	Voc (V)	Isc (mA)	Ca (µF)	La (mH)
710P+/-	A, B	9.0	267	4.89	0.22
710P+/-	C, E	9.0	267	14.6	2.23
710P+/-	D, F, G	9.0	267	39.1	4.22
715P+	A, B	13.7	264	1.04	0.23
715P+	C, E	13.7	264	3.13	2.27
715P+	D, F, G	13.7	264	8.37	4.30
722P+	A, B	20.1	194	0.33	0.53
722P+	C, E	20.1	194	0.99	4.33
722P+	D, F, G	20.1	194	2.65	7.96
728P+	A, B	26.3	112	0.16	2.86
728P+	C, E	26.3	112	0.49	12.0
728P+	D, F, G	26.3	112	1.32	23.8
729P+	C, E	26.3	160	0.49	6.25
729P+	D, F, G	26.3	160	1.32	11.6

**Table 17:** Entity concept parameters for 2-channel MTL787SP barriers with diode return (figures 29, 30 and 31 and notes 6 to 9)

Model No. (MTL)	Groups	Figure 29				Figure 30				Figure 31			
		Voc (V)	Isc (mA)	Ca (µF)	La (mH)	Voc (V)	Isc (mA)	Ca (µF)	La (mH)	Voc (V)	Isc (mA)	Ca (µF)	La (mH)
787SP (28V ch)	A, B	28.9	115	0.13	2.70	25.9	110	0.17	2.93	28.9	115	0.13	2.70
	C, E	28.9	115	0.39	11.52	25.9	110	0.51	12.3	28.9	115	0.39	11.52
	D, F, G	28.9	115	1.06	22.57	25.9	110	1.38	24.3	28.9	115	1.06	22.57
787SP (diode ch)	A, B	–	–	–	–	25.9	0	0.17	1000	–	–	–	–
	C, E	–	–	–	–	25.9	0	0.51	1000	–	–	–	–
	D, F, G	–	–	–	–	25.9	0	1.38	1000	–	–	–	–

**Table 18:** Entity concept parameters for two-channel MTL700P barriers with an optional ground return (figure 31 and notes 6 to 9)

Barrier model No. MTL	Groups	Voc (V)	Isc (mA)	Ca (µF)	La (mH)
707P+	C, E	27.4	160	0.45	6.21
707P+	D, F, G	27.4	160	1.20	11.5
761Pac	A, B	18.0	50	0.43	14.4
761Pac	C, E	18.0	50	1.29	53.0
761Pac	D, F, G	18.0	50	3.46	119.0
766Pac	A, B	23.0	297	0.22	0.20
766Pac	C, E	23.0	297	0.66	1.72
766Pac	D, F, G	23.0	297	1.77	3.39

**Table 19:** Entity concept parameters for two-channel MTL700P barriers with separate ground returns (figure 30 and notes 6 to 9)

Barrier model No. MTL	Groups	Voc (V)	Isc (mA)	Each channel Ca (µF)	Each channel La (mH)
707P+ (return)	C, E	14.1	0	2.85	1000
707P+ (return)	D, F, G	14.1	0	7.62	1000
707P+ (signal)	C, E	26.4	160	0.49	6.21
707P+ (signal)	D, F, G	26.4	160	1.31	11.5
761Pac	A, B	9.0	25	4.89	54.8
761Pac	C, E	9.0	25	14.6	194.0
761Pac	D, F, G	9.0	25	39.1	475.0
766Pac	A, B	11.5	149	1.87	1.25
766Pac	C, E	11.5	149	5.63	7.16
766Pac	D, F, G	11.5	149	15.0	13.4

**Note 1:** The hazardous-location-mounted equipment may be switches or thermocouples. Other apparatus such as RTDs, LEDs, non-inductive resistors, (and strain-gauge load cells for the systems shown in figures 32 and 33), may be used if the auto-ignition temperature of the hazardous location is greater than T4 (275°F, 135°C). For the systems shown in figures 28, 29 and 30, certified devices with the correct entity concept parameters can also be used.

**Note 2:** The non-hazardous location or control-room mounted equipment should not use nor generate more than 250V rms.

**Note 3:** For guidance on the installation see ANSI/SA RP 12.6.

**Note 4:** Five MTL700 Series barriers are approved for installation in Group F: MTL705, 707, 708, 787S and 758. All MTL700P Series barriers are approved for Group F.

**Note 5:** Full details of all approved combinations are available on MTL drawing No. SCI-88

**Notes 6 to 9 inclusive relate to tables 16 to 19 inclusive**

**Note 6:** The barriers are associated apparatus and, when mounted in an appropriate enclosure can be installed in the following areas:

- Non-hazardous locations
- Class 1, Division 2, Groups A, B, C, and D hazardous locations
- Class II, Division 2, Groups F and G hazardous locations
- Class III, Division 2 hazardous locations

**Note 7:** Barriers must be installed in enclosures meeting the requirements of ANSI/ISA-S82

**Note 8:** Use Factory Mutual Research Corporation approved dust-tight enclosures appropriate for environmental protection for the following locations:-

- Class II, Division 2, Groups F and G hazardous locations
- Class III, Division 2 hazardous locations

**Note 9:** For installation guidance see ANSI/ISA 12.6 and the National Electrical Code. See also Installation drawing SCI-326

**Notes 10 to 14 inclusive relate to table 15**

**Note 10:** The non-hazardous (safe) location equipment must not generate or use voltages in excess of 250V rms. or dc

**Note 11:** The hazardous location equipment. Any number of FMRC approved devices which meet the power and entity parameter requirements below may be connected to the Fieldbus:-

- All device's electronic circuitry which interface directly to the fieldbus must be powered from fieldbus power. Other power sources in the devices (if any) must be galvanically isolated from the fieldbus power.
- Vmax of all devices must be equal to or greater than 22V.
- I<sub>max</sub> of all devices must be equal to or greater than 233mA.
- P<sub>max</sub> of all devices must be equal to or greater than 1.18W.
- The sum of all devices unprotected input capacitance C<sub>i</sub>, plus the cable capacitance must be equal to or less than Ca for the applicable Gas Group in Table 15.
- The sum of all devices unprotected input inductance L<sub>i</sub>, plus the cable inductance must be equal to or less than La for the applicable Gas Group in Table 15.

**Note 12:** For guidance on installation see ANSI/ISA RP12.6 and the USA National Electric Code.

**Note 13:** The barrier must be installed in enclosures meeting the requirements of ANSI/ISA – S82 and the USA National Electric Code.

**Note 14:** Use FMRC – approved, or NRTL – listed, dust – ignition proof enclosures appropriate for environmental protection in Class II, Division 2, Groups F and G, and Class III Hazardous Locations.

## 7.9 Final check

After completing the installation, each item contained in the checklist (table 8) should again be checked out by a competent person, preferably someone who has not been involved in the work.

## 8 MAINTENANCE

Since the MTL700/700P Series barriers are encapsulated they cannot be repaired, but provided they are connected correctly to the circuits they are intended to protect, and provided those circuits are not themselves defective, barrier defects are unlikely to occur. For these reasons, servicing of barrier installations consists principally of the routine inspection and earth testing described in this section.

If replacements do have to be fitted however it is worth checking, in the case of barriers connected directly to power supplies, if one of the new overvolt-protected models can be substituted. These models can tolerate supply voltages up to 35V dc without blowing their fuses, and can therefore eliminate the problem of poorly regulated supplies. Further information about the maintenance of barrier installations is given in BS 5345: Part 4: 1977, Section 4.

### 8.1 Routine inspection

At intervals of not more than two years (more frequently for particular environments), visually check the barrier installation to check the following points.

When undertaking these checks, personnel should comply with all the regulations relating to the safety of the plant and personnel. Great care must be taken to prevent any direct interconnection between hazardous and non-hazardous (safe) area circuits. The instructions given in section 4 of this manual should be observed at all times.

- 8.1.1** Barriers should be of the types and polarities specified in the safety documentation.
- 8.1.2** The barriers should be attached securely to the earth busbar, thus making a good connection to the IS earth. Use a TQS7 torque spanner or other suitable wrench to check that each barrier's two 'Nyloc' nuts are tightened to a torque of 2.3Nm (20 lb.in.).
- 8.1.3** There should be no signs of damage or corrosion to the barriers or the IS earthing system.
- 8.1.4** All connections should be properly made, and the tightness of the hazardous and non-hazardous (safe) area terminals on the barriers checked.
- 8.1.5** Interconnecting cables should be of the type and rating specified in the safety documentation, and not frayed or otherwise damaged.
- 8.1.6** All earth returns and cable screens from the hazardous area should be connected to earth via an earth rail and terminals.
- 8.1.7** Visually examine the earth conductors and ensure that they are not damaged in any way, and that their terminations are secure and free from corrosion.
- 8.1.8** Using a low voltage, low-current test meter (i.e. a meter whose output does not exceed 3V and 50mA), measure the resistance between the earth busbar and the neutral star point of the supply and ensure that it does not exceed 1W. Record the reading. A consistent reading repeated over a long period of time is indicative that the earth return is sound and likely to remain so. If two earth conductors are used as described in section 7.2, the loop resistance should be measured as described in that section. The reading obtained should not exceed 2Ω.

**Important note:** do not attempt to perform a high-current earth resistance test unless it is confirmed by the authority in charge of the plant that the plant is gas free.

## 9 FAULT-FINDING

Most barrier-protected systems are relatively simple and can be checked easily for operation. However, fault-finding procedures can be undertaken only after notifying all personnel concerned with plant safety and ascertaining that it is safe to proceed.

While it is not possible to describe fault-finding procedures for every type of barrier-protected circuit, there are several guidelines that can help to speed up the process.

The fault-finding procedures described in this section assume the use of a modern digital multimeter as this is the meter most commonly used. However, other test meters can be used provided that their characteristics when measuring silicon diodes are known.

If a diode chain is involved when testing a barrier, it is useful to remember that many modern digital multimeters cater for such circuits by the provision of a diode test function. These meters usually pass 1mA through the diode and measure the voltage across it. When measuring more than two diode drops in series it is worth noting that the full scale range of some multimeters is only 2V on the diode test range. Therefore with three or more diode drops it is possible that the meter may indicate over-range and any voltage drop of more than 4V has been indicated in the test tables (this section and section 11) as infinity.

Zener diodes and ordinary silicon diodes have a typical forward voltage drop of approximately 0.6V per diode. Diode return paths with schottky diodes have a typical voltage drop of <0.3V for each diode in the chain, e.g. MTL787S and 787SP.

Figure 35 shows a typical switch-status transfer circuit protected by an MTL787S+ barrier, which can be used to illustrate some of the fault-finding techniques discussed in this section. To determine the serviceability of barriers, proceed as described in the remainder of this section, but whenever possible always check barriers by working on the non-hazardous (safe) area terminals and the circuits connected directly to them.

## 9.1 Power supply check

Check that the power supply is available to the barrier circuit and that the voltage across the supply and with respect to earth is correct. For example, referring to figure 35, the presence of 24V on terminal 1 and 12V on terminal 2 when the hazardous-area switch is closed confirms the serviceability of almost the complete circuit.

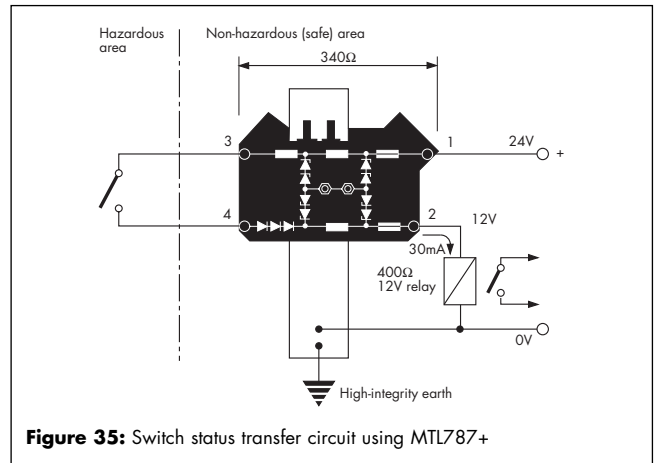


Figure 35: Switch status transfer circuit using MTL787+

## 9.2 Barrier resistance test (not MTL702, 705, 706, 707, 707P and 708)

If testing a barrier in situ, refer to figure 35 and proceed as follows:

- 9.2.1** Disconnect the hazardous-area cables from the barrier, terminals 3 and 4, and connect the cables to earth via the earth rail or some other means, or alternatively insulate them completely.
- 9.2.2** Disconnect the non-hazardous (safe) area cables, terminals 1 and 2, and insulate them completely to prevent them from shorting together, to other cables or earth. Be careful when handling non-hazardous (safe) area cables; the relay contacts in figure 35 for example could be carrying mains voltage.
- 9.2.3** Measure the end-to-end resistance of the barrier by connecting a digital multimeter (set to a suitable ohms range) between terminal 1 and 3. The reading should be slightly less than the maximum end-to-end resistance quoted in section 3.2, or approximately 10 to 20% higher than the figure specified in the safety description. For the MTL787S+ the reading should be in the range 317 to 340Ω.
- 9.2.4** Check the serviceability of the diode-return channel by selecting the diode test function on the test meter and connect between terminal 4 (+ve) and 2 (-ve). This will measure the forward voltage drop of the MTL787S's three Schottky diodes in the chain, and a reading of less than 0.9V should be expected. Then connect between terminal 2 (+ve) and 4 (-ve) for a reading of x for the reverse voltage drop.
- 9.2.5** Tests 9.2.3 and 9.2.4 confirm the continuity of both channels of the barrier. If either channel is open-circuit it is most likely that the fuse has blown, in which case the non-hazardous (safe) area circuit should be investigated. If this is not the case and the fault has not been found, then carry out the tests in sections 9.3 and 9.4, and if a fault is still not found, remove the barrier for bench testing as follows:
- 9.2.6** Remove the suspect barrier from the equipment and take it to a suitable area where it can be tested in accordance with section 11 Barrier tests. If the barrier is found to be defective, fit a new one of the appropriate model number.

**Caution:** After the removal of the barrier, ensure the safe-area and hazardous-area cables disconnected under 9.2.1 and 9.2.2 are either connected to an MTL799 dummy barrier or insulated completely.

## 9.3 Earth faults

Most intrinsically safe circuits are isolated from earth in the hazardous area. If it is suspected that a system earth fault exists, proceed as follows:

- 9.3.1** Disconnect the hazardous and non-hazardous (safe) area cables from the barrier terminals and either temporarily insulate them, or secure them safely to the appropriate terminals of an MTL799 dummy barrier.
- 9.3.2** For the barrier shown in figure 35 the readings shown in table 20 should be obtained when connecting a test meter with the diode test function selected.
- 9.3.3** In the case of the circuit shown in figure 35, with the hazardous-area cables connected to the terminals, and the test meter connected between terminals 1 (+ve) and 2 (-ve) a reading of  $\infty$  will be obtained if the switch is open and a reading of approximately 1.2V if the switch is closed, and no earth faults are present. To check if either of the hazardous-area cables is shorted to earth, connect the test meter as in table 21 which shows the readings that will indicate a fault to earth.

**Table 20:** Barrier earth fault tests with hazardous and non-hazardous (safe) area cables disconnected

Positive lead on terminal:	Negative lead on terminal:	Test meter reading:
1 Earth studs	Earth studs 1	$\infty$ 1.2V
2 Earth studs	Earth studs 2	$\infty$ 1.2V
1 2	2 1	$\infty$ $\infty$

**Table 21:** Barrier earth fault tests with hazardous and non-hazardous (safe) area cables connected

Positive lead on terminal:	Negative lead on terminal:	Test meter reading:	Cable fault from terminal:
1 Earth studs	Earth studs 2	0V 0.9V	3 to earth 4 to earth

## 9.4 Faults between barrier channels

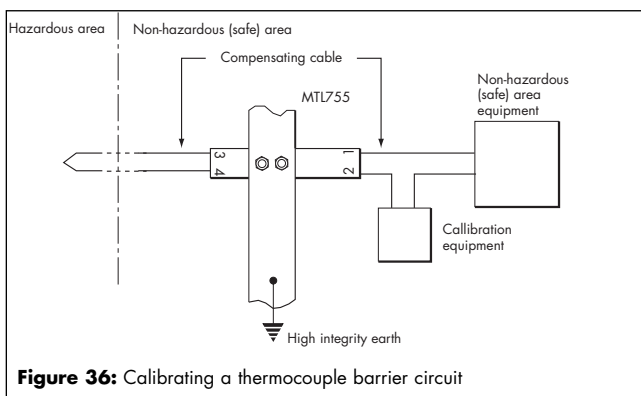
If it is suspected that faults exist between the channels of a 2-channel barrier, proceed as follows:

(Note that these tests are not applicable to MTL751 or 755 barriers).

- 9.4.1** Disconnect the hazardous and non-hazardous (safe) area cables from the barrier terminals and either temporarily insulate them, or secure them safely to the appropriate terminals of an MTL799 dummy barrier.
- 9.4.2** With a digital multimeter (set to diode test), check that there is an open circuit between the two channels of the barrier (terminal 1 to terminal 2), and in at least one direction between the earth studs and terminal 1, and the earth studs and terminal 2.

## 10 THERMOCOUPLE AND RTD TESTS

### 10.1 Thermocouple circuit testing

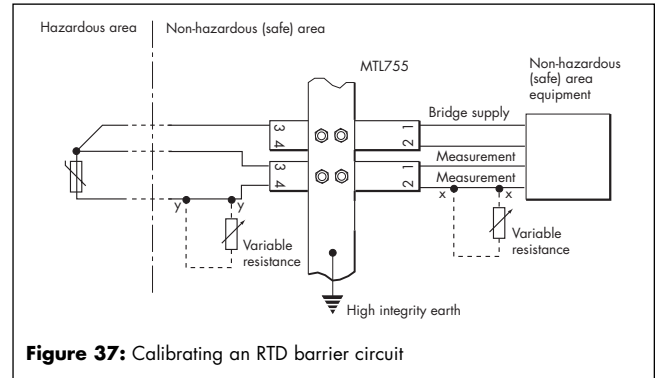


**Figure 36:** Calibrating a thermocouple barrier circuit

Thermocouple test and calibration equipment is not usually certified intrinsically safe and therefore requires special authorisation before it can be used for testing or calibrating thermocouple circuits in hazardous areas. To overcome this problem the thermocouple circuits can be protected by using an MTL760 barrier as shown in figure 36. The barrier allows the thermocouple output to be measured without the need to get special authorisation to use the thermocouple test equipment.

As it is seldom possible to accurately measure the temperatures of thermocouples located in hazardous areas, a safe means is required of adjusting the calibration tables to compensate for the plant temperature. This can be achieved by disconnecting the compensating cables from the thermocouple, shorting them together, and then measuring the temperature of the shorting point.

### 10.2 Resistance thermometer detector circuit testing



**Figure 37:** Calibrating an RTD barrier circuit

Resistance thermometer detector (RTD) circuits can be tested by disconnecting the measuring leads from the RTD head in the hazardous area and connecting them to a resistance box. Sometimes it is more convenient to connect the resistance box in the non-hazardous (safe) area, for instance at point xx as shown in figure 37. However, in this case the RTD must be shorted out, or allowance must be made for its temperature. The effect of a negative temperature change can be simulated by connecting the resistance box in the measurement lead at point yy. The advantage of connecting the resistance box at the RTD head is that any leakage can also be determined by connecting the resistance box at point yy.

## 11 BARRIER TESTS

**Note:** There is no requirement for barriers to be subjected to routine testing if they are in normal use.

The tests given in this section have been included to enable users to carry out additional tests to those given in section 8 if they suspect the performance of the barriers. Barriers which pass these tests satisfactorily are not likely to incur an unacceptable level of risk or cause a circuit malfunction.

From tables 26 to 33 it can be seen that there are two types of test: a simple test using a digital multimeter to test barriers without the need of having to remove them from the earth busbar, and a more comprehensive bench test using a constant current source to establish the breakdown characteristics of barriers.

BASEEFA certification requirements concentrate on high-current tests, but in many ways the leakage current tests given in this section are a more satisfactory method of testing suspect diodes. If a complete functional check of a barrier is required, then the multimeter tests and constant current tests described in section 10.1 and 10.2 should be undertaken. However, for most purposes the multimeter tests alone will suffice.

The MTL702, 705, 706, 707, 707P, and 708 cannot be tested in the same manner as ordinary 700 Series barriers; separate tests for these models are detailed in sections 11.3 to 11.6.



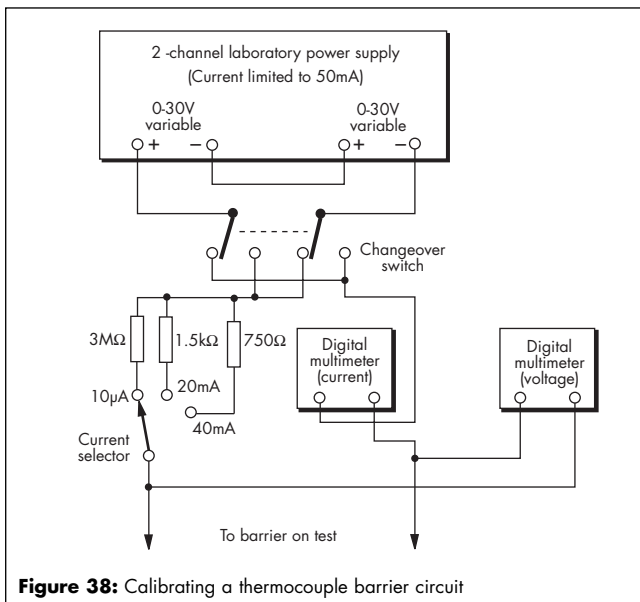
## 11.1 Multimeter tests

The use of a digital multimeter for testing barriers is described in section 9. The section 11 tables assume that the multimeter is selected to a suitable ohms range for the end-to-end resistance tests (except for diode return channels) and for the continuity tests, and that the multimeter diode test function is used for the diode tests, channel isolation tests and for the end-to-end resistance tests for diode return channels.

## 11.2 Constant-current tests

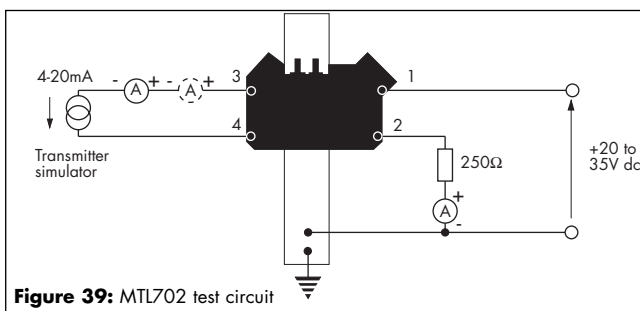
For these tests a constant-current generator is required. The generator must be capable of supplying 10µA, 20mA and 40mA currents from a 30V source. Ideally, a purpose-built current generator should be used, but a conventional laboratory power supply can be used as shown in figure 38. The current is measured on one multimeter and trimmed by adjusting the output voltage of the power supply indicated on a second multimeter. When using a constant-current generator for testing MTL700 Series barriers, the following points should be noted:

- 11.2.1** The current should be limited to 50mA to avoid damaging the barriers.
- 11.2.2** The accuracy of the current is not critical and can therefore vary by  $\pm 5\%$ .
- 11.2.3** The test leads must be connected securely to the barrier terminals.
- 11.2.4** The use of a high resistance in series with the barrier will give more stable results and make it easier to set the required current.



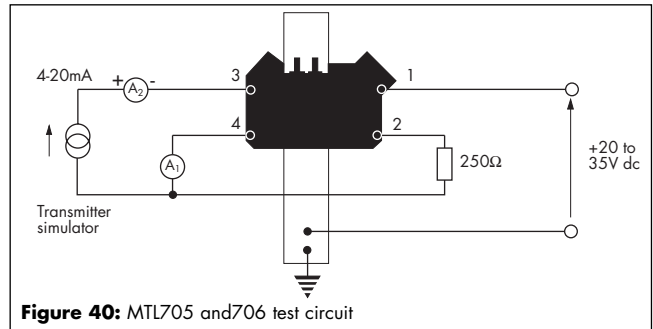
## 11.3 Tests for the MTL702

Comprehensive testing requires specialised equipment, however, an effective test which will confirm whether the unit is operating correctly is shown in figure 39. The two ammeters used should be able to measure a signal of between 4 and 20mA with fairly good accuracy. Connect them as shown initially in the lead to terminal 3, and note if any error is present between the two readings. Then, move one of the meters to the terminal 2 lead (ensuring correct polarity) and check that the readings on the two meters are approximately equal.



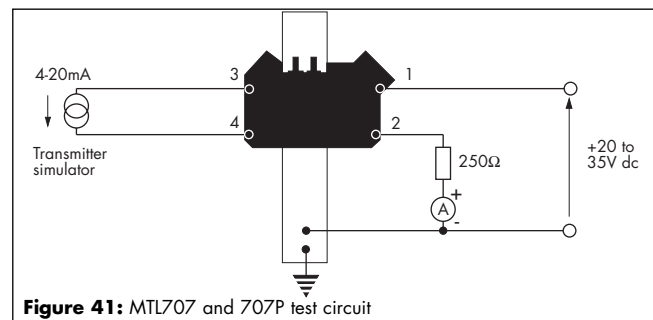
## 11.4 Tests for the MTL705 and 706

Owing to the nature of these units, comprehensive testing requires specialised equipment, beyond the scope of on-site checks. However, an effective test which will confirm whether the units are operating correctly is shown in figure 40. Connected in this manner, ammeter 1 measures the transmitter simulator current of between 4 and 20mA flowing from terminal 4 and the safe-area load current flowing to terminal 4 simultaneously. Since these two currents are equal and opposite, the resultant reading on the ammeter should be virtually zero. Ammeter 2 is used to verify the presence of the 4 to 20mA transmitter signal.



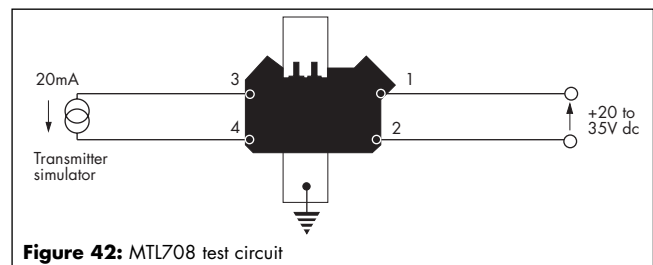
## 11.5 Tests for the MTL707 and 707P

Since these units incorporate a built-in protection circuit, they have to be tested in a different manner to an ordinary shunt-diode barrier. Referring to figure 41, set the transmitter simulator to various currents in the range 4 to 20mA and check that the ammeter reads approximately the same value. Then, set the simulator to 20mA, checking the voltage between terminals 1 and 2 (<9V for the MTL707 and <4.3V for the MTL707P), and between terminals 2 and 4 (<3.1V for the MTL707 and <1.9V for the MTL707P).



## 11.6 Tests for the MTL708

This unit, of similar design to the MTL707, is tested in the same manner. Referring to figure 41, set the transmitter simulator to 20mA and check that the voltage between terminals 1 and 3 is less than 8.9V.



## 11.7 Test tables

These tables describe the tests for models MTL710 to 796 inclusive. The figures adjacent to the diode symbols indicate the number of forward-biased diodes used in the barrier chain. Using a multimeter diode test function and referring to the diode voltage drop figures given in section 9 (approximately 0.6V for each Zener diode and 0.3V for each Schottky diode) the expected reading across the diode chain can be determined.

**Table 22: Tests for 1-channel positive and negative Zener diode barriers**

(For negative polarity barriers the same values apply, but the multimeter polarity and test leads must be reversed)

Barrier data			Multimeter tests				Constant current tests				
			End-to-end resistance test		Diode test		Continuity test	Voltages obtained when applying constant current to terminal 1 (+ve) and earth studs (-ve)			
MTL model no.	Safety description	Basic circuit	Connect between terminals 1 and 3		Connect +ve lead to terminal 1 & -ve lead to term'1 2	Connect -ve lead to terminal 1 & +ve lead to term'1 2	Check for continuity between term'ls 2 & 4 to earth studs	10µA		20mA	
			Min	Max				Min	Max	Min	Max
710	10V 50Ω		67Ω	85Ω	∞	▶ x 1	✓	6.0V	9.6V	6.6V	10.0V
710P	10V 33Ω		38Ω	42Ω	∞	▶ x 1	✓	8.0V	9.0V	8.2V	9.5V
715	15V 100Ω		113Ω	155Ω	∞	▶ x 1	✓	12.0V	14.2V	12.4V	14.9V
715P	15V 50Ω		56Ω	60Ω	∞	▶ x 1	✓	12.5V	13.4V	12.7V*	3.9V*
722	22V 150Ω		167Ω	185Ω	∞	▶ x 2	✓	19.0V	20.9V	19.8V	21.3V
722P	22V 101Ω		112Ω	121Ω	∞	▶ x 2	✓	18.5V	20.0V	18.6V	20.3V
728	28V 300Ω		317Ω	340Ω	∞	▶ x 2	✓	25.5V	26.5V	26.1V	26.9V
728P	28V 234Ω		240Ω	253Ω	∞	▶ x 3	✓	24.5V	25.7V	24.7V	26.0V
729P	28V 164Ω		173Ω	184Ω	∞	▶ x 3	✓	24.5V	25.7V	24.7V	26.0V

\* Voltages obtained when applying a 40mA constant current

**Table 23: Tests for 2-channel positive and negative Zener diode barriers**

These barriers have similar properties to the 1-channel barriers detailed in table 22. The table gives details for testing positive barriers. For negative polarity barriers the same values apply, but the multimeter and supply leads must be reversed.

Barrier data			Multimeter tests				Constant current tests				
			End-to-end resistance test		Diode test		Channel isolation test	Voltage obtained when applying constant current to terminal 1 (+ve) and then terminal 2 (+ve) & earth studs (-ve)			
MTL model no.	Safety description	Basic circuit	Connect between terminals 1 and 3 and then between 2 and 4		Connect -ve lead to earth studs & +ve lead to terminal 1 & then 2	Connect +ve lead to earth studs & -ve lead to terminal 1 & then 2	Connect between term'ls 1 & 2 (both polarities)	10µA		20mA	
			Min	Max				Min	Max	Min	Max
758	7.5V 10Ω		15Ω	18Ω	∞	▶ x 1	∞	6.0V	6.9V	6.5V	7.3V
764	12V 1kΩ		1.0kΩ	1.1kΩ	∞	▶ x 1	∞	10.0V	11.4V	10.4V	11.8V
767	15V 100Ω		113Ω	155Ω	∞	▶ x 1	∞	12.0V	13.9V	12.4V	14.5V
768	22V 150Ω		167Ω	185Ω	∞	▶ x 2	∞	19.0V	20.7V	19.8V	21.1V
779	28V 300Ω		317Ω	340Ω	∞	▶ x 2	∞	25.5V	26.3V	26.1V	26.7V
796	26V 300Ω		317Ω	340Ω	∞	▶ x 2	∞	23.5V	24.4V	24.1V	24.8V
	20V 390Ω		407Ω	435Ω	∞	▶ x 2	∞	17.5V	18.8V	18.3V	19.2V
788	28V 300Ω		317Ω	340Ω	∞	▶ x 2	∞	25.5V	26.4V	26.1V	26.8V
	10V 50Ω		67Ω	85Ω	∞	▶ x 2	∞	6.0V	9.5V	6.6V	9.9V
788R	28V 300Ω		317Ω	340Ω	∞	▶ x 2	∞	25.5V	26.4V	26.1V	26.8V
	10V 50Ω		67Ω	85Ω	0.33V	0.33V	▶ x 2 +0.33V	0V	0V	6.2V	6.8V

**Table 24: Tests for 1-channel ac Zener diode barriers**

Owing to the symmetry of these barriers, measurements should be made with the current flowing in both directions.

Barrier data			Multimeter tests			Constant current tests				
			End-to-end resistance test		Diode test		Voltages obtained when applying constant current to terminal 1 and earth studs (both polarities)			
MTL model no.	Safety description	Basic circuit	Connect between terminals 1 and 3		Connect between terminals 1 & 2 (both polarities)	Check for continuity between term'ls 2 & 4 to earth studs	10µA		20mA	
			Min	Max			Min	Max	Min	Max
710	10V 50Ω		67Ω	85Ω	∞	✓	6.0V	9.5V	6.9V	10.2V
728	28V 300Ω		317Ω	340Ω	∞	✓	24.5V	26.5V	25.7V	27.5V

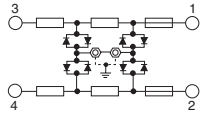
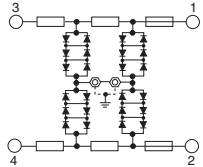
**Table 25: Tests for 2-channel ac Zener diode barriers**

Owing to the symmetry of these barriers, measurements should be made with the current flowing in both directions.

Barrier data			Multimeter tests			Constant current tests				
			End-to-end resistance test		Diode test	Channel isolation test	Voltages obtained when applying constant current to terminal 1 and earth studs (both polarities)			
MTL model no.	Safety description	Basic circuit	Connect between terminals 1 and 3 and then between 2 and 4		Connect between earth studs & terminal 1, and then terminal 2 (both polarities)	Connect between terminals 1 & 2 (both polarities)	10µA		20mA	
			Min	Max			Min	Max	Min	Max
761	9V 90Ω		102Ω	145Ω	∞	∞	6.0V	8.5V	6.9V	9.5V
761P	9V 350Ω		367Ω	384Ω	∞	∞	7.0V	8.7V	7.1V	9.0V
764	12V 1.0kΩ		1.0kΩ	1.1kΩ	∞	∞	10.0V	11.4V	10.7V	12.1V
766	12V 150Ω		165Ω	185Ω	∞	∞	10.0V	11.4V	10.7V	12.1V
766P	12V 75Ω		85Ω	93Ω	∞	∞	9.8V	11.1V	9.9V	11.4V

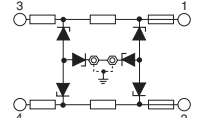
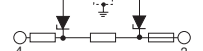
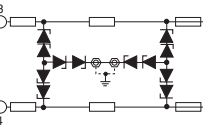
**Table 26: Tests for forward-diode barriers**

These barriers use forward-connected diodes as voltage limiters. They are used for ac signals.

Barrier data			Multimeter tests			Constant current tests			
			End-to-end resistance test	Diode test	Channel isolation test	Voltages obtained when applying constant current between earth studs and terminal 1, and earth studs and terminal 2 (both polarities)			
MTL model no.	Safety description	Basic circuit	Connect between terminals 1 and 3 and then between 2 and 4	Connect between earth studs & terminal 1, and then terminal 2 (both polarities)	Connect between terminals 1 & 2 (both polarities)	10µA		20mA	
			Min Max			Min	Max	Min	Max
751	1V 10Ω		14Ω 20Ω	▶ x 1	▶ x 2	0.3V	0.6V	0.6V	1.0V
755	3V 10Ω		17Ω 19Ω	▶ x 3	▶ x 6	0.9V	1.8V	1.8V	2.8V

**Table 27: Tests for star-connected ac Zener diode barriers**

Like positive and negative barriers, these barriers are symmetrical and should therefore be tested with the current flowing in both directions.

Barrier data			Multimeter tests			Constant current tests			
			End-to-end resistance test	Diode test	Channel isolation test	Voltages obtained when applying constant current between earth studs and terminal 1, and earth studs and terminal 2 (both polarities)			
MTL model no.	Safety description	Basic circuit	Connect between terminals 1 and 3 and then between 2 and 4	Connect between earth studs & terminal 1, and then terminal 2 (both polarities)	Connect between terminals 1 & 2 (both polarities)	10µA		20mA	
			Min Max			Min	Max	Min	Max
760	10V 50Ω		67Ω 85Ω	∞	∞	6.0V	9.4V	6.9V	10.1V
765	15V 100Ω		117Ω 135Ω	∞	∞	12.0V	14.0V	12.7V	14.7V
772	22V 300Ω		317Ω 340Ω	∞	∞	18.0V	20.2V	19.4V	21.2V

**Table 28: Tests for diode-return barriers**

The table gives details for testing positive polarity barriers. For negative polarity barriers the same values apply, but the multimeter and supply leads must be reversed.

Barrier data			Multimeter tests					Constant current tests			
			End-to-end resistance test		Diode test		Channel isolation test	Voltages obtained when applying constant current between earth studs and terminal 1, and earth studs and terminal 2 (both polarities)			
MTL model no.	Safety description	Basic circuit	Connect		Connect	Connect	Connect between terminals 1 & 2 (both polarities)	10µA		20mA	
			+ve to 1 -ve to 2 then +ve to 3 -ve to 4	-ve to 1 +ve to 2 then -ve to 3 +ve to 4	-ve lead to earth studs & +ve lead to term'l 1 & then 2	+ve lead to earth studs & -ve lead to term'l 1 & then 2		Min	Max	Min	Max
786	28V(diode)		∞	▶ x 3	∞	▶ x 2	∞	25.5V	28.0V	26.1V	28.4V
787	28V 300W		317Ω to 340Ω	317Ω to 340Ω	∞	▶ x 2	∞	25.5V	26.3V	26.1V	26.7V
	28V(diode)		∞	▶ x 3	∞	▶ x 2	∞	25.5V	28.0V	26.1V	28.4V
787S	28V 300Ω		317Ω to 340Ω	317Ω to 340Ω	∞	▶ x 2	∞	25.5V	26.3V	26.1V	26.7V
	28V(diode)		∞	▶ x 3 Schottky	∞	▶ x 2	∞	24.5V	25.7V	24.7V	26.1V
787SP	28V 234Ω		240Ω to 257Ω	240Ω to 257Ω	∞	▶ x 2	∞	24.5V	25.7V	24.7V	26.1V
	28V(diode)		∞	▶ x 3 Schottky	∞	▶ x 2	∞	24.5V	25.7V	24.7V	26.1V

**Table 29: Tests for fieldbus barriers**

This barrier has to provide balanced operation of the fieldbus with respect to earth. It therefore has identical positive and negative polarity channels. A fieldbus terminator is also included in the barrier.

Barrier data			Multimeter tests					Constant current tests				
			End-to-end resistance test		Diode test		Channel isolation test	Voltages obtained when applying constant current to terminals 1(+ve), and then terminals 2 (-ve) and earth studs				
MTL model no.	Safety description	Basic circuit	Connect between term'ls 1 & 3 and then between 2 and 4		Connect	Connect	Connect	Connect	10µA		20mA	
			Min	Max	-ve lead to earth studs & +ve lead to 1 & then 2	+ve lead to earth studs & -ve lead to 1 & then 2	+ve lead to term'l 1 & -ve lead to term'l 2	-ve lead to term'l 1 & +ve lead to term'l 2	Min	Max	Min	Max
791	11V 51Ω -11V 51Ω		59Ω	63Ω	∞	▶ x 1	∞	▶ x 2	10.0V	10.9V	10.1V	11.1V
			59Ω	63Ω	▶ x 1	∞	∞	▶ x 2	10.0V	10.9V	10.1V	11.1V

## APPENDIX A: ATEX certification information

The Essential Health and Safety Requirements (Annex II) of the EU Directive 94/9/EC [the ATEX Directive - safety of apparatus] requires that the installation manual of all equipment used in hazardous areas shall contain certain information. This annex is included to ensure that this requirement is met. It compliments the information presented in this document and does not conflict with that information. It is only relevant to those locations where the ATEX directives are applicable.

### General

- In common with all other electrical apparatus installed in hazardous areas, this apparatus must only be installed, operated and maintained by competent personnel. Such personnel shall have undergone training, which included instruction on the various types of protection and installation practices, the relevant rules and regulations, and on the general principles of area classification. Appropriate refresher training shall be given on a regular basis. [See clause 4.2 of EN 60079-17].
- This apparatus has been designed to meet the requirements of associated electrical apparatus in accordance with EN 50020 and EN50014.
- This apparatus has been designed and manufactured so as to provide protection against all the relevant additional hazards referred to in Annex II of the directive, such as those in clause 1.2.7.

### Installation

- The installation should comply with the appropriate European, national and local regulations, which may include reference to the IEC code of practice IEC 60079-14. In addition particular industries or end users may have specific requirements relating to the safety of their installations and these requirements should also be met. For the majority of installations the Directive 1999/92/EC [the ATEX Directive - safety of installations] is also applicable.
- This apparatus is an associated electrical apparatus and is normally mounted in a non-hazardous [safe] area. When mounted in a Zone1 location the apparatus must be provided with an enclosure, which offers an additional degree of protection appropriate to the area classification.
- This apparatus must not be subjected to mechanical and thermal stresses in excess of those permitted in the certification documentation, this manual and the product specification. If necessary the product must be protected by an enclosure to prevent mechanical damage.
- The apparatus must not be installed in a position where it may be attacked by aggressive substances and must be protected from excessive dust, moisture and other contaminants by an enclosure.

### Inspection and maintenance

- Inspection and maintenance should be carried out in accordance with European, national and local regulations which may refer to the IEC standard IEC 60079-17. In addition specific industries or end users may have specific requirements which should also be met.
- Access to the internal circuitry must not be made during operation.
- If the outer enclosure of the apparatus needs to be cleaned, this should be done with a cloth lightly moistened by a dilute mixture of detergent in water.

### Repair

- These barriers must not be repaired. A barrier must be replaced by an equivalent certified product.

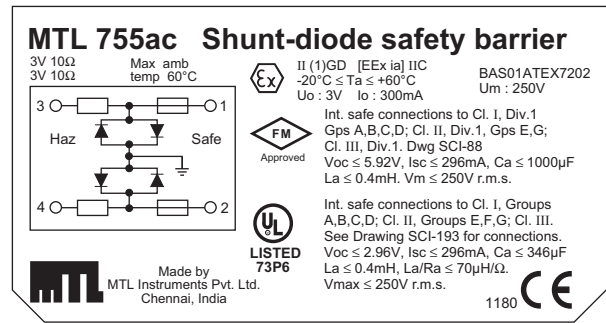
### Marking

MTL700 Series barriers carry a certificate number as detailed in Table 12. Each device is also CE marked with the Notified Body Identification Number of 1180, and carries the following information:

- Company logo
- Company Name and Address
- Product Number and Name
- Certificate Number(s)
- Ex Classification (where applicable)
- Schematic diagram
- Safety description parameters
- Ambient temperature range

This manual applies to products date marked 2002 or later.

Figure A1: Typical MTL700 Series barrier label



Model No.	V	Ω	mA
MTL702	25	200	125
MTL706	28	300	93
MTL707	28	300	93
	28	▶	-
MTL707P	28	164	170
	15	▶	-
MTL708	28	300	93
MTL710	10	50	200
MTL710P	10	33	300
MTL715	15	100	150
MTL715P	15	50	291
MTL722	22	150	147
MTL722P	22	101	213
MTL728	28	300	93
MTL728P	28	234	119
MTL729P	28	164	170
MTL751	1	10	100
	1	10	100
MTL755	3	10	300
	3	10	300
MTL758	7.5	10	750
	7.5	10	750
MTL761	9	90	100
	9	90	100
MTL761P	9	350	25
	9	350	25
MTL764	12	1k	12
	12	1k	12
MTL766	12	150	80
	12	150	80
MTL766P	12	75	157
	12	75	157
MTL767	15	100	150
	15	100	150
MTL768	22	150	147
	22	150	147
MTL779	28	300	93
	28	300	93
MTL796	26	300	87
	20	390	51
MTL760	10	50	200
	10	50	200
MTL765	15	100	150
	15	100	150
MTL772	22	300	73
	22	300	73
MTL778	28	600	47
	28	600	47
MTL786	28	▶	-
	28	▶	-
MTL787	28	300	93
	28	▶	-
MTL787S	28	300	93
	28	▶	-
MTL787SP	28	234	119
	28	▶	-
MTL788	28	300	93
	10	50	200
MTL788R	28	300	93
	10	50	200
MTL791	11	51	216
	11	51	216
MTL799	-	-	-

Table 11:  
MTL700 Series  
Safety parameters

Model No.	(V)	(Ω)	(mA)
MTL7122+	22	150	147
MTL7028+	28	300	93
MTL7128+	28	300	93
MTL7128P+	28	234	120
MTL7129P+	28	164	171
MTL7028-	28	300	93
MTL7128-	28	300	93
MTL7162+	10	50	200
	10	50	200
MTL7164+	12	1k	12
	12	1k	12
MTL7167+	15	100	150
	15	100	150
MTL7096-	26	300	87
	20	390	52
MTL7196-	26	300	87
	20	390	52
MTL7087+	28	300	93
	28	→	-
MTL7187+	28	300	93
	28	→	-
MTL7087P+	28	234	120
	28	→	-
MTL7187P+	28	234	120
	28	→	-
MTL7055ac	3	10	300
	3	10	300
MTL7056ac	3	10	300
	3	10	300
	3	10	300
MTL7261ac	9	90	100
	9	90	100
MTL7061Pac	9	350	26
	9	350	26
MTL7161Pac	9	350	26
	9	350	26
MTL7264ac	12	1k	12
	12	1k	12
MTL7066Pac	12	75	160
	12	75	160
MTL7166Pac	12	75	160
	12	75	160
MT7060ac	9	75	120
	9	75	120
MT7160ac	9	75	120
	9	75	120
MT7265ac	15	100	150
	15	100	150
MT7278ac <sup>3</sup>	28	600	47
	28	600	47
MT7106 <sup>4</sup>	28	300	93
MT7206 <sup>4</sup>	28	300	93
MT7207+	28	300	93
	28	→	-
MT7208+	28	300	93
MT7099	-	-	-
MT7299	-	-	-

Model no.	Number of single channels interconnected within the hazardous area	Earth <sup>1</sup> return used?	Maximum permissible <sup>2</sup> cable parameters			Matched power (W)
			BASEEFA (group IIC (hydrogen)) Capacitance (μF)	Inductance (mH)	L/R ratio (μH/Ω)	
MTL7106/7206	1	Yes	0.083	4.1	54	0.65
MTL7207+	2	Yes	0.083	4.1	54	0.65
MTL7208+	1	Yes	0.083	4.1	54	0.65
MTL7122+	1	Yes	0.165	1.66	44	0.81
MTL7028+/7128+	1	Yes	0.083	4.1	54	0.65
MTL7128P+	1	Yes	0.042	1.26	42	0.83
MTL7028-/7128-	1	Yes	0.083	4.1	54	0.65
MTL7129P+	1	Yes	-	-	-	1.19
MTL7055ac	1	Yes	1000	0.4	158	0.23
	2	Yes	1000	0.1	79	0.45
	2	No	40	0.4	79	0.45
	3	No	40	0.22	59	0.68
	4	Yes	40	0.035	31.25	0.92
MTL7056ac	1	Yes	1000	0.4	158	0.23
	3	No	40	0.22	59	0.68
MTL7060ac/7160ac	1	Yes	4.9	2.47	131	0.27
	2	Yes	4.9	0.61	65	0.54
MTL7061Pac/7161Pac	2	No	0.309	54.2	307	0.12
MTL7261ac	1	Yes	4.9	3.55	158	0.23
	2	Yes	4.9	0.88	79	0.45
MTL7162+	1	Yes	3.0	0.89	71	0.50
	2	Yes	3.0	0.22	35	1.0
	2	No	1.97	2.93	117	-
MTL7164+	1	Yes	1.41	246	987	0.04
	2	Yes	1.41	61.7	493	0.08
MTL7264ac	1	Yes	1.41	246	987	0.04
	2	Yes	1.41	61.7	493	0.08
		No	0.125	246	493	0.08
MTL7265ac	1	Yes	0.58	1.58	63	0.56
	2	Yes	0.58	0.4	31	1.13
MTL7066Pac/7166Pac	2	Yes	1.41	0.36	37	0.96
MTL7167+	1	Yes	0.58	1.58	63	0.56
	2	Yes	0.58	0.4	31	1.13
MTL7278ac	1	Yes	0.083	16.1	108	0.33
	2	Yes	0.083	4.02	54	0.66
MTL7087+/7187+	2	Yes	0.083	4.1	54	0.65
MTL7087P+/7187P+	2	Yes	0.042	1.26	42	0.84
MTL7096-/7196-	2	Yes	0.134	1.86	44	0.83

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