Ultra-slim safety barriers that can be used like terminals

**MTL7000 Series**

*Shunt-diode safety barriers*

- Exceptionally high packing densities - only 7mm barrier width
- Quickly and easily installed - clamp securely onto DIN rail in one simple operation
- Commissioning and maintenance simplified - secondary replaceable fuse (MTL7100 barriers) and removable link (MTL7200 barriers) provide ‘disconnect’ features
- 24V dc supply connections simplified - optional power comb feeds many barriers
- Direct connection of cable screens and 0V lines - third terminal on both hazardous and safe sides
- Reduce need for separate field terminals - many features common to conventional terminals
- Patent US 5838547

**MTL7000 Series** award-winning, intrinsic safety shunt-diode safety barriers are innovative devices designed to provide exceptionally high packing densities, straightforward ‘single-operation’ installation and simplified connection, commissioning and maintenance facilities. Many of the MTL7000 Series features duplicate the functions of conventional field terminals and the barriers can, therefore, ‘double up’ as terminals for many applications, saving even more space.

A barrier width of only 7mm enables maximum packing densities due to the use of surface mount and thick-film hybrid circuit technologies (subjects of patent applications).

**Barriers clamp simply and securely** onto standard T-section DIN rail, simultaneously making a reliable IS earth connection. Earth terminals, insulating spacers and corrosion-resistant DIN rail are available to satisfy individual IS earthing requirements.

**Extra terminals on each side of the barrier** allow cable screens from field wiring and 0V returns to be terminated on the barrier. ‘Dummy’ barriers handle spare hazardous-area cable screens and signal lines. Additionally, and as an alternative, an earth rail accessory is available for terminating and securing cable screens, or earth returns and spare cores.

**Barrier identification** is provided by one or both of two methods. The first consists of tagging strips mounted on posts located at each end of a row of barriers while the other consists of separate identifiers attached to the tops of individual barriers. Of these, the first can be used to tag locations as well as barriers and is recommended for large installations while the second is better suited to installations of a few barriers only.

An optional power comb simplifies installations where multiple barriers are powered from a common 24V dc source (via a power feed module or a dummy barrier). The comb replaces individual power supply connections to each barrier, yet allows single barriers to be removed without affecting the others. The power feed module powers up to 40 barriers and incorporates a trip which switches off the supply to the barriers if a fault (such as an overvoltage) occurs in the power source circuit.

Secondary replaceable fuse versions of many barriers are available and form the MTL7100 sub-series. These are useful where there is a possibility of faults occurring during commissioning which would otherwise blow the barriers’ internal safety fuses. One secondary replaceable fuse for each barrier channel is provided and is lower in value than the related safety fuse. Fuses are packaged in small mouldings which can be latched in a ‘disconnect’ position to break the safe and hazardous areas during commissioning, maintenance or fault finding, thus avoiding the need for additional disconnect terminals.

**Where a fuse is less likely to be necessary,** the MTL7200 sub-series uses a latching-out link only, to provide the basic loop disconnection of the MTL7100 sub-series.
## MTL7000 SERIES - SPECIFICATIONS

### Key barriers shown in blue

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<th>MTL</th>
<th>Safety description</th>
<th>Application</th>
<th>Basic circuit</th>
<th>Max. end-to-end resistance (Ω)</th>
<th>$V_{\text{max}}$ at 10µA (V)</th>
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<th>Internal safety fuse/ fuse disconnect (FD) (mA)</th>
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### SPECIFICATIONS (continued)

<table>
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<tr>
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<th>Basic circuit</th>
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<th>Vwkg at 10Ω (A)</th>
<th>Vmax (V)</th>
<th>Internal safety fuse / fuse-disconnect (mA)</th>
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<td>Switches</td>
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<td>31 + 0.9V</td>
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<td>7208+</td>
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<td><strong>DUMMY BARRIERS</strong></td>
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</table>

†All barriers have internal, inaccessible, safety fuses. MTL7100 barriers have additional replaceable fuses, lower in value than the internal fuses. It is the value of the replaceable fuse that is quoted for MTL7100 barriers.

Note 1: 24V dc power supply

Note 2: In star-connected barriers (eg, MTL7060/7160), the two channels are interlocked such that the voltage between them cannot exceed the working voltage, Vwkg.

Note 3: MTL7278ac: the working voltage between the two interlocked channels is 24.0V; Vmax is 25.3V.

### CERTIFICATION
MTL7000 Series barriers protect devices located in all normally occurring explosive atmospheres, including air/flammable gas mixtures, dusts and fibres. MTL7000 Series barriers are certified (EEEx ia) IIC (except MTL7129P+; certified II) BY BASEEFA to CENELEC standards, by FM in the USA, CSA in Canada and also by other authorities, providing worldwide certification. MTL7000 Series barriers are designed to the same safety descriptions as MTL700 Series equivalents (in some cases slightly stricter) and can therefore be used for the same applications.

### HOW THEY WORK
All MTL7000 Series barriers are based on the same simple principle. Each channel contains three stages of Zener or forward-connected diodes and an ‘infallible’ terminating resistor. In the event of an electrical fault in the safe area, the diodes limit the voltage that can reach the hazardous area and the resistor limits the current: active output-current limiting circuits are not used. An internal fuse protects the diodes, and the three stages of voltage limitation ensure continued safety if the first or second stage should fail. MTL7100 barriers have an additional replaceable fuse which protects the internal fuse.

The MTL7000 Series includes seven key barrier types which cover the majority of applications, simplifying barrier selection and the maintenance of spares stocks.

### SUB-SERIES
MTL7000 Series barrier circuits are based on the well-proven designs originally developed for the MTL7000 Series. To simplify identification for those familiar with the latter, part numbers are the same for equivalent barriers, but with a ‘0’, ‘1’ or ‘2’ inserted after the initial ‘7’ to identify the relevant sub-series.

### KEY BARRIERS SUMMARISED

#### TYPE
- Analogue input (low level)
- Analogue output
- Analogue input (high level)
- Digital input / output

#### APPLICATION
- Resistance temperature detectors
- Thermocouples, ac sensors
- Controller outputs, one line earthed
- Controller outputs, neither line earthed
- Transmitters, 2-wire, 4/20mA
- Switches
- Solenoids, alarms, LEDs

#### KEY BARRIER
- 7055ac
- 7060ac
- 7160ac
- 7028+ / 7128+
- 7087+ / 7187+
- 7206
- 7207+ / 7127+
- 7208+ / 7128+

Note: the circuit shown is as an example only. Standard, fuse- or link-disconnect options are shown shaded in the ‘basic circuits’ in the specifications tables.
ACTIVE BARRIERS

MTL7106/MTL7206, MTL7207+ and 7208+ active barriers

The MTL7106/MTL7206, MTL7207+ and 7208+ barriers have built-in overvolt protection, allowing their use with unregulated power supplies. In many applications, eg, sensor inputs or controller outputs, there is insufficient power available to blow the barrier fuse and this additional protection is not necessary. But, where the barrier is connected to a power supply, eg, for energising transmitters, switches, solenoids or local alarms, overvolt protection allows the barriers to be used with unregulated supplies up to 35V dc and also gives protection against faulty wiring during commissioning. The MTL7206, 7207+, 7208+ are equipped with a loop disconnect at power supply terminal 1 while the MTL7106 has a fuse-disconnect.

Nearest equivalent passive barriers

MTL7106 nearest equivalent MTL7128+/7187+
MTL7206 nearest equivalent MTL7028+/7087+
MTL7207+ nearest equivalent MTL7087+/7187+
MTL7208+ nearest equivalent MTL7028+/7128+

MTL7106/7206 for 2-wire 4/20mA and ‘smart’ transmitters

The MTL7106/MTL7206 is a single-channel barrier designed primarily for energising a conventional or ‘smart’ 2-wire 4/20mA hazardous-area transmitter. They can be thought of as an MTL7128– or an MTL7028– barrier with a built-in floating power supply and electronic overvolt protection. It provides a high voltage output (which is negative with respect to earth) to power the transmitter and delivers a 4/20mA signal into an earthed load in the safe-area. The novel design is noted for its extreme accuracy.

SPECIFICATION

Supply voltage 20 to 35V dc
Supply current
- 40mA typical at 20mA with 28V dc supply
- 45mA typical at 20mA with 24V dc supply
- 60mA maximum at 20mA with 20V dc supply
Voltage for transmitter and lines
- 16.0V minimum at 20mA with 250Ω load
- 11.25V minimum at 20mA with 500Ω load
Note that the output voltage is negative with respect to earth.
Safe-area load resistance
- 0 to 500Ω
Output current
- 0 to 23.6mA
Accuracy
- ±2µA (4 to 20mA)
Out of range capability
- Overrange; >20mA to 23.6mA
- Underrange; <4mA to 0mA

‘Smart’ compatibility
- HART Communication Foundation HART®
- Honeywell DE
- Yokogawa BRAIN
- Foxboro ‘smart’
- Fuji ‘smart’
- Chessel 3500 Series

Patent Nos
- UK: 2205699
- European (Germany, France, Italy): EP 0 294 139 BI
- USA: 4967302

HART® is a registered trademark of HART Communication Foundation
**MTL7207+**

for digital (switch) inputs

**SPECIFICATION**

Supply voltage, terminal 1
+10 to +35V dc

Normal operation
In normal operation the protection circuit introduces only a small voltage drop and shunts less than 1.5mA to earth, so its overall effect is minimal

Supply voltage >27V
If the supply voltage exceeds about 27V, causing the Zener diodes to conduct, or if the safe-area load has a very low resistance, the supply current is limited automatically to <50mA. This protects the fuse and power supply and enables the loop to continue working.

Supply current
At Vs <26V; Iout + 1.5mA max
At Vs >28V or low load resistance; limited to <50mA

Internal fuse, terminal 1
50mA

Reverse voltage protection, terminal 1
Yes

**MTL7208+**

for digital (switched) outputs

**SPECIFICATION**

Supply voltage, terminal 1
+10 to +35V dc

Normal operation
In normal operation the protection circuit introduces only a small voltage drop and shunts less than 1.5mA to earth, so its overall effect is minimal

Supply voltage >27V
If the supply voltage exceeds about 27V, causing the Zener diodes to conduct, or if the safe-area load has a very low resistance, the supply current is limited automatically to <50mA. This protects the fuse and power supply and enables the loop to continue working.

Supply current
At Vs <26V; Iout + 1.5mA max
At Vs >28V or low load resistance; limited to <50mA

Internal fuse, terminal 1
50mA

Reverse voltage protection, terminal 1
Yes

Maximum voltage drop, terminals 1 to 4
\[(I_{out} \times 348\,\Omega) + 1.2\,V\] (current not limited)

Output current (lout), terminal 4
Up to 35mA

Leakage to earth
1.5mA max

Internal fuse, terminal 2
50mA

Maximum voltage drop, terminals 5 to 2
\[(I_{out} \times 33\,\Omega) + 0.9\,V\]
MTL7991
power feed module

The MTL7991 power feed module incorporates both voltage and current sense mechanisms to protect barrier circuits by activating a solid-state trip mechanism when fault or overload conditions occur in the power source circuit. Resetting the module after tripping is done by interrupting the supply to the unit. A red LED indicates a circuit trip condition and a green LED the availability of power at the outputs.

SPECIFICATION

Input voltage range (terminals 2 and 3)
20 to 26.8V

Maximum input voltage capability
35V

Power source requirement
Power source must be capable of delivering at least 1.8A

Trip mechanism
Minimum trip operating voltage: 26.8V (at 20°C ambient) at output terminal 1 wrt earth
Temperature coefficient: +18.4mV/°C

MTL7991
power feed module

GENERAL SPECIFICATION

Ambient temperature limits
-20 to +60°C (FM/CSA) continuous working
-20 to +40°C (BASEEFA) continuous working
-40 to +80°C storage

Humidity limits
5 to 95% RH

Case flammability
UL94: V-2

Terminations
Terminals accommodate conductors up to 2.5mm²
Hazardous-area terminals are identified as dark blue

Colour coding of barrier type (label on top surface)
Red: Positive polarity (+)
Black: Negative polarity (-)
Black (with red text): MTL7097/7297 dummy barrier
Grey: Non-polarised (ac)
White: MTL7099/7299 dummy barrier
Orange: MTL7991 power feed module

Weight
100g approximately

Mounting and earthing
Clamping onto standard 35mm 'top-hat' DIN rail: 7.5mm (low profile) or 15mm (high profile)

Note: All specifications quoted at 20°C ambient unless otherwise stated.
Vibration probes
The 3-wire transmitters used with vibration monitoring equipment are invariably supplied by a –24V dc power supply – hence the recommended barrier choice is the negatively-polarised MTL7096–MTL7196. The ‘third terminal’ makes this choice ideal for these 3-wire applications.

2-wire transmitters, 4/20mA, conventional and smart
Recommended barriers for use with ‘conventional’ and ‘smart’ 4/20mA transmitters (fed by a regulated supply) are the MTL7087+ / 7187+ or MTL7087P+ / 7187P+. These provide up to 14.2V at Vwkg and 20mA for a transmitter and its lines as well as 5V for the typical 250Ω load. This application and these barriers are suitable for use with the optional power comb.

Vibration probes
The 3-wire transmitters used with vibration monitoring equipment are invariably supplied by a –24V dc power supply – hence the recommended barrier choice is the negatively-polarised MTL7096–MTL7196. The ‘third terminal’ makes this choice ideal for these 3-wire applications.

ANALOGUE INPUTS (HIGH-LEVEL)

MTL7000 Series barriers protect devices located in all normally occurring explosive atmospheres, including air/flammable gas mixtures, dusts and fibres. Applications covered include the protection of installations incorporating uncertified devices (‘simple apparatus’) such as thermocouples, switches and resistive sensors, or separately certified ‘energy storing’ (or ‘voltage producing’) apparatus including ac sensors, transmitters and current-to-pneumatic (I/P) converters. Recommended choices for specific applications are discussed briefly in the following pages.

These are examples, and many other configurations will suggest themselves. For advice on a particular application, please contact MTL.

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**RTDs**

For 3-wire RTDs, a single MTL7055ac barrier is the most economical choice. This is suitable for use with a floating bridge - the two leads from the bridge arms are protected by the barrier with the third (supply) lead being earthed through the barrier. The barrier has a low end-to-end resistance of only 24Ω/channel to minimise span changes and its channels track within 0.15Ω (between -20 to +60°C) to minimise zero shift with temperature.

If the bridge circuit is already earthed, the third barrier channel provided by an MTL7056ac is needed. For extreme accuracy, 3 channels and an earth-free bridge can be used, a configuration that cancels out the small errors due to barrier leakage.

Channels 2 and 3 (those between terminals 5 & 2, and 6 & 3 respectively) track to within 0.15Ω between -20 and 60°C.

4-wire constant-current circuits do not need matched barrier resistances and can be protected by two MTL7261ac barriers. If the increase in loop resistance is too great, use two MTL7055ac barriers instead.

**STRAIN-GAUGE BRIDGES**

**Single strain-gauge bridges**

This shows an arrangement using two or three barriers, which is safe in IIC gases. With the MTL7261ac, the circuit is powered from a 14V, 230Ω source; if the bridge resistance is 230Ω, then the bridge voltage is 7V. If the bridge resistance is 350Ω, then the bridge voltage is 8.4V.

An MTL7264ac can be used to sense the bridge supply voltage.

An MTL7261ac is used here for the mV output.

An MTL7166Pac provides 12.3V for a 350Ω bridge with a 20V supply. MTL7161Pac's can be used for the sense and pick-off circuits.
**ANALOGUE OUTPUTS**

**Controller outputs (I/P converters)**

The single-channel MTL7028+/7128+ with a voltage drop of 6.7V/6.9V is the recommended choice for most controller outputs. Higher-power versions are available: the MTL7128P+ (5.5V drop) is suitable for IIC applications; the MTL7129P+ (4.22V drop) for IIB applications.

For controllers with an output circuit separated from the 0V rail by the control transistor, the 2-channel MTL7087+/7187+ is the preferred choice as the return channel can handle up to 26.0V/26.0V allowing the control signal to be turned off completely. The voltage drop is 8.2V/8.6V at 20mA. A higher-power version of the latter, the MTL7087P+/7187P+, is also available. The return channel of these barriers handle up to 26.0V/26.0V and the maximum voltage drop is only 6.72V/7.24V.

The MTL7087+/7187+ and MTL7087P+/7187P+ are also suitable for controllers containing a resistor which enables the return current to be monitored for high-integrity operation.
DIGITAL (ON/ OFF) INPUTS

Switches
The normal choice is the MTL7087+/7187+ with a regulated supply. The MTL7207+ is recommended for applications where an unregulated supply of up to 35V is used.

For optimum power transfer, with relays the resistance of the load should be approximately equal to the combined resistance of the two channels and the relay coil should then be rated at about half the supply voltage.

DIGITAL (ON/ OFF) OUTPUTS

Alarms, LEDs, solenoids valves, etc
For these applications, the MTL7028+/7128+ is recommended. Higher-powered versions are available: the MTL7128P+ is suitable for IIC applications; the MTL7129P+ for IIB applications.

The MTL7208+ is recommended for applications where an unregulated supply of up to 35V is used.

If the control switch is to earth, then the 2-channel MTL7087+ /7187+ barrier should be used, or, alternatively, the MTL7087P+/7187P+ higher-power version. If the supply is poorly regulated use the MTL7207+.

+VE DC SYSTEMS

Low-level to 12V dc systems
The two channels of the MTL7162+, MTL7164+ and MTL7167+ can be combined safely in IIC.

The MTL7164+ can be used for low-level logic return signals. The MTL7162+ and MTL7167+ are used for 6V dc and 12V dc systems respectively.

18V dc systems
The single-channel M TL7122+ is recommended for 18V dc systems.

AC AND DC SYSTEMS

High-level ac and dc systems
The versatile star-connected MTL7265ac and MTL7278ac allow V_wkg to be developed from each channel to ground but only allow V_wkg to be developed between channels. This provides some common-mode voltage capability and can allow higher cable parameters to be used.

NEGATIVE AND FLOATING POWER SUPPLIES

Digital (on/ off) outputs
The MTL7028-/7128- is used with a negative power supply and positive earth. Typically used for digital inputs or outputs, as shown.

The MTL7028-/7128- can also be used with floating power supplies, for transmitters.
POWER COMB APPLICATIONS

The PWC7000 power comb is invaluable for saving installation time and wiring when connecting a 24V dc power source to a number of barriers.

Typical applications include hazardous-area switches, 4/20mA transmitters and solenoids. The diagram illustrates the configuration for 3 barriers but up to 40 barriers can be served by this method.

The MTL7991 power feed module would normally be used with standard barriers such as MTL7087+ and MTL7087P+ because the current/voltage trip protection mechanism of the MTL7991 removes the need for replaceable fuses in the barriers.

The MTL7099/7299 dummy barriers can be used instead of the MTL7991 for direct ‘feed-through’ connection of a 24V dc supply. In these circumstances, replaceable fuse barriers such as MTL7187+ and MTL7187P+ may be preferred.

The MTL7299 dummy barrier has a removable link between terminals 1 and 2 for easy disconnection of the supply.

Other units which can use the power comb: MTL7106
MTL7206
MTL7207+
MTL7208+

SPARE CABLE CORES AND SCREENS

The MTL7099/7299 dummy barriers are used primarily for securing and earthing unused cables and screen connections. Hazardous area terminals 4, 5 and 6 (and safe area terminal 3) are internally connected to the DIN-rail mounting/earth connection.

WIRED IN APPLICATIONS

MTL7299s can be ‘looped-in’ to provide link-disconnects for MTL70xx barriers, eg. as shown here with an MTL7055ac and an RTD.

For high accuracy or sensitive low level applications check that the additional connections do not degrade the signals.
MOUNTING DETAILS

MTL7000 Series barriers pack closely together on DIN rails, permitting up to 132 barriers per metre of rail, depending on the accessories used. When calculating how many barriers will fit onto a given length of rail, consider the following:

- Barrier packing pitch: 7.4mm
- ETL7000 earth terminal: 10mm (min of 2)
- IMB57 insulating mounting block: 15mm (min of 2)
- ISP7000 insulating spacer: 14.7mm (min of 2)

Notes:
1) barriers and accessories cannot be mounted directly above an ISP7000 spacer when using 7.5mm rail. If the space above the spacer is needed, use a) high-profile (15mm) rail or b) low-profile screws, M6 x 16 with 1mm heads.
2) to maintain rigidity of DIN-rail when using ISP7000 spacers, the distance between spacers should not exceed 500mm for 15mm high-profile rail and 250mm for 7.5mm low-profile rail.

EARTH RAIL

There is provision to terminate a cable screen or earth return on the third terminal (6 or 3) of MTL7000 Series barriers. Spare cores may be terminated on the MTL7099/7299 dummy barrier. An earth rail provides an alternative method for terminating cable screens and 0V earth returns, and securing spare cable cores. It is mounted on ERB57S/O brackets.

The earth rail (ERL7) must be electrically bonded to the IS earthing DIN rail (eg. THR2 or THR7000) on which the barriers are mounted and earthed. Copper cable, no less than 4mm² in crosssection and 80mm long when finished, should be connected between an earth terminal (ETM 7) on the earth rail and an earth terminal (ETL7000) on the IS earthing DIN-rail. A minimum of two such connections, one at each end, is recommended for each discrete length of earth rail.

Note:
For lengths of earth rail greater than 500mm, provide additional support by installing a third IMB57 mounting block and earth rail bracket, mid-way between the end mounting blocks.

Snap out the perforated extension between the lugs on this mounting block if a continuous tagging strip is to be fitted.

There is room for a maximum of one ETM 7 earth terminal per barrier on the earth rail.

Clearances (mm) for fitting and removing barriers

90 min
70 min
115
123
Blade dimensions
4 wide max
6 high min
Shaft length
60 min
70 min
90 min
14mm Earth-rail clamp
Push fastener
10mm Earth clamp
IMB57 in lower position
ETL7000
ISP7000
ERB57S
TAG57
ERB57O
ETM7
IMB57
BIL7000/BIL7000L
THR2/THR7000
BR7000
BIL7000/BIL7000L
RFA7050/RFA7100/RLA7000
TGL57
TAG57
ERL7
Snap off extension when using IMB57 as central support
MTL7000 AND MTL7000 SERIES EQUIVALENTS

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*Key* barriers shown in bold.

HOW TO ORDER

MTL700/7100/7200 barriers
Select by barrier number and polarity, e.g. MTL7028+

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

Standard earthing/earth-rail accessories
- **ETL7000**: Earth terminal, DIN-rail mounted
- **IMB57**: Insulating mounting block
- **ERB57S**: Earth-rail bracket, straight
- **ERB57O**: Earth-rail bracket, offset
- **ERL7**: Earth rail, 1m length
- **ETM7**: Earth terminal, pack of 50

Standard tagging accessories
- **TAG57**: Tagging strip, 1m length
- **TGL57**: Tagging strip labels, set of 10 x 0.5m
- **BRI7000**: Barrier identifier
- **BIL7000**: Barrier identification labels, sheet of 120
- **BIL7000L**: Barrier identification labels, A4 sheet of 126

Replaceable fuses/removable links
- **RFA7050**: Replaceable fuse assemblies, 50mA, pack of 5
- **RFA7100**: Replaceable fuse assemblies, 100mA, pack of 5
- **RLA7000**: Removable link, pack of 5

Enclosures
- **DX070**: Enclosure, for MTL7000 x 9
- **DX170**: Enclosure, for MTL7000 x 22
- **DX430**: Enclosure, for MTL7000 x 58

Literature
- **INM7000**: Instruction manual, MTL7000 Series
- **INM57ENC**: Instruction manual, MTL5000/7000 Series
- **CD700...**: Customer drawings