Hazardous Area

Application Note – CSW and CPI.
Indicator IS Barrier Applications.

Ian Fellows LIMITED

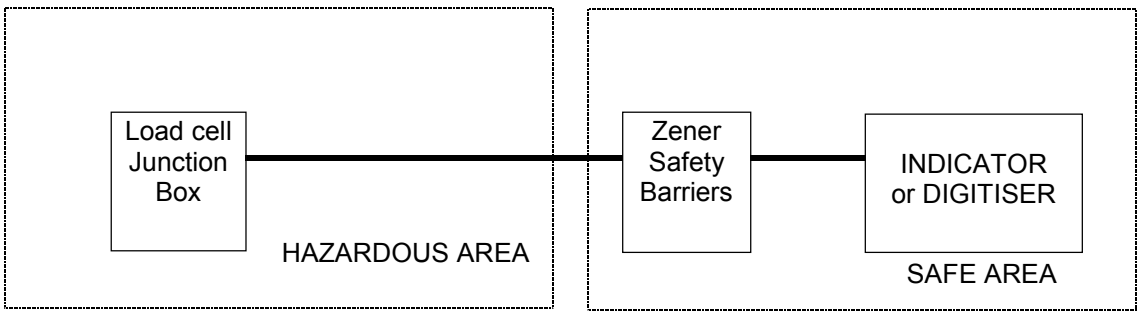
Introduction

When the weight indicator or digitiser is not Intrinsically Safe (all current Ian Fellows Ltd product), it may not be placed in a Hazardous Area. However, strain gauge load cells are inherently passive devices and 'safe'. (Although long cables may exceed capacitive and inductive limitations ~ a barrier to load cell cable length of 100m is usually no problem; other limitations not withstanding). So load cells may be placed in the Hazardous Area so long as the power delivered to them is strictly limited under any fault condition. Shunt Diode Safety Barriers are used to limit the power to safe levels, but their use must be according to approved safety practice.

General Considerations

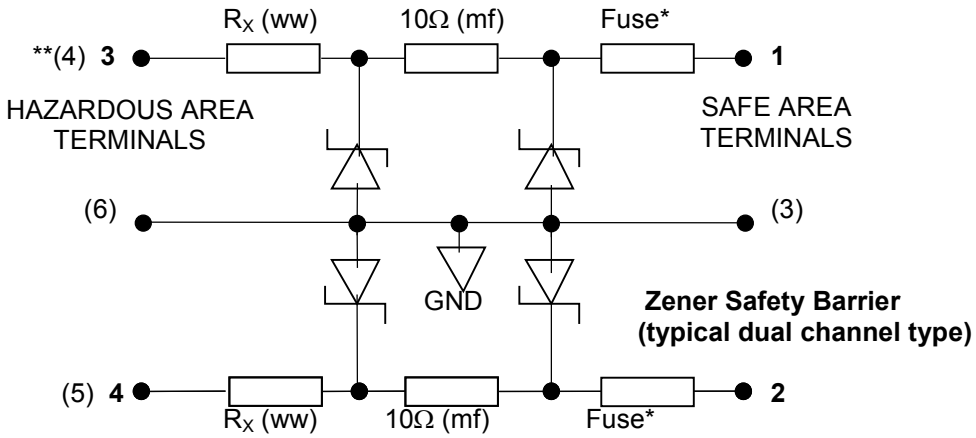
The Hazardous Area is where inflammable gases, vapours or dusts are (or may be) present. Intrinsically Safe electrical components and systems are designed and operated such that any failure will release insufficient spark or thermal energy to cause ignition. This is where the 'bottomworks' and the load cell(s) of the weighing system are located. There may also be remote switches to initiate printing, etc, and/or an intrinsically safe remote indicator for local weight display.

The Safe Area is where there is no danger of flammability. The weight indicator is placed in this area, together with the Zener Safety Barriers that are designed and certified to limit the voltage and current to the load cell(s) and any other connected device in the Hazardous area. The Safe Area could be an adjoining room or even a purged or explosion proof enclosure in the Hazardous Area.



Zener Safety Barriers consist of series resistors and shunt zener diodes (see below). The effective load cell excitation voltage is reduced because of the series resistance (~90/2 = 45ohm) of the pair of xx66P barriers in the +EXCITATION conductor. This should be taken into account when calculating 'microvolts per division'. See the table in Scheme E below for the actual excitation voltage for different combinations of cells and cell resistance.

The SENSE and SIGNAL inputs are very high impedance and are unaffected by the (~384ohm) series resistance of the xx61P barriers.



*Note there is a non-repairable fuse in series with terminals 1 and 2. If the applied voltage exceeds the barrier's rated voltage, the fuse may blow and the barrier is permanently damaged (non-repairable).
**Connector numbers in parenthesis are for corresponding MTL7000 series devices.

Application Notes

These notes give typical schematics of applications where the load cell is in a hazardous area and the indicator/digitiser is in the safe area. It examples the use of MTL 700P/7000P series barriers, but note that, as the Pepperl + Fuchs Z900/Z900.H series is almost identical; it can be assumed (but the installer needs to verify) that they are interchangeable. (The system certificates will be different, of course.) A table of the critical parameters is shown below.

Critical values of Barrier types:

xx	**..61**		**..66**	
	Resistance	Voltage	Resistance	Voltage
7xx	145	6	185	10
7xxP	384	7	93	9.8
72xx	115	7.2	n/a	n/a
70xxP	384	7.2	97	9.8
Z9xx	106	6.5	166	10
Z9xx.H	380	6.5	82	10

General Notes:

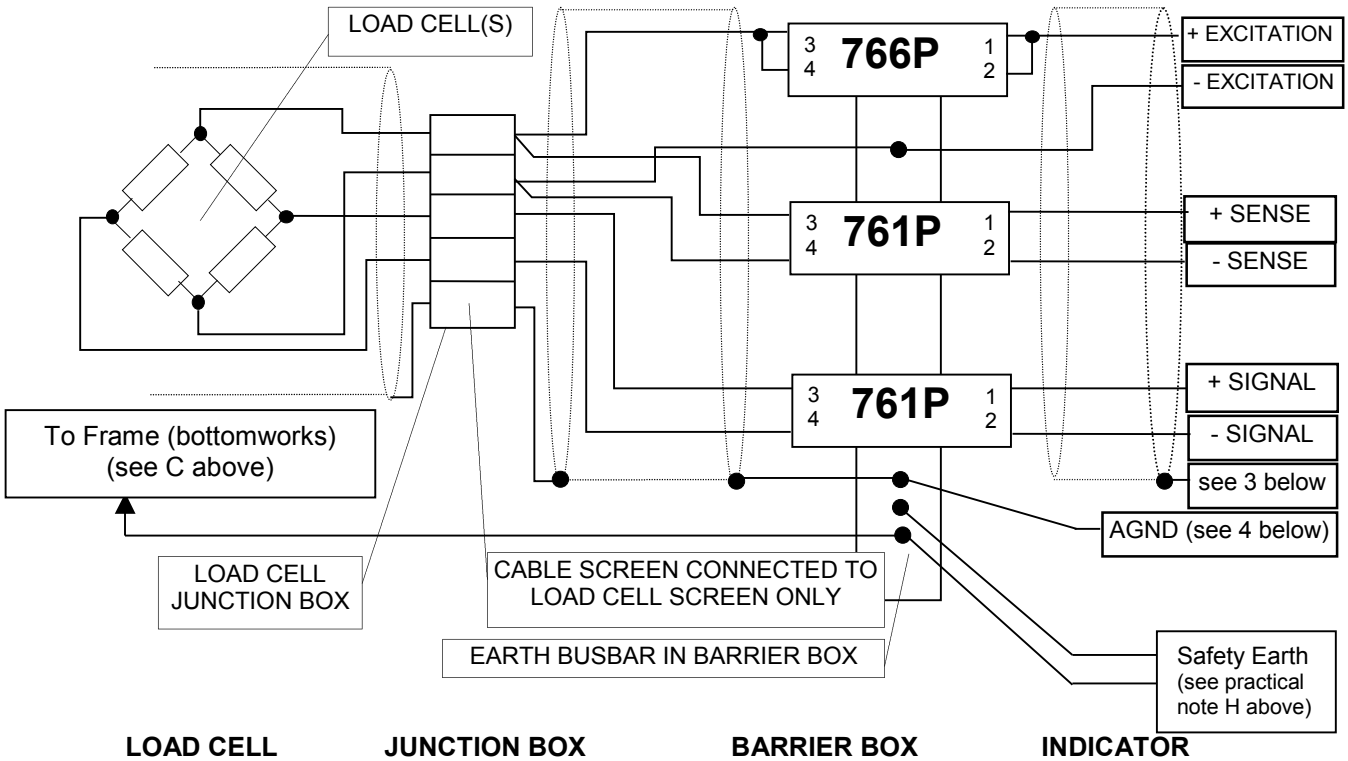
1. 700/7000 series are MTL, Z900 series is P+F.
2. Voltage is the maximum that may be applied before significant zener current begins to flow.
3. Generally 'ac' versions are specified in system certificates.
4. Existing 'system' certificates for IIc gases are:
   - Ex842128: 2 x 764ac + 4 x 766ac (i.e. no. of individual *channels,* not barriers)
   - Ex92C2424 2 x 766P + 4 x 761P
   - Ex98E2274 2 x 7066Pac + 4 x 7061Pac
5. No known P+F system certificates, but can assume equivalent parameters will give similar acceptable combinations.
6. All examples are for Class IIc environments. Class IIc is the most hazardous and is for hydrogen atmospheres.
7. Petroleum, dust and other typical industrial environments are usually Class IIb or IIa, where power levels significantly higher than in these examples may be used.
8. Load cells in the applications are assumed to be typical 350Ω types.

Practical Notes:

1. The cable length supplied attached to the load cells should normally not be modified and should be specified to reach the loadcell junction box. This cable need not be included in any cable length calculation as it is assumed to have its temperature co-efficient compensated for by the load cell manufacturer.
2. The Barriers are usually supplied in an enclosure similar to (but somewhat larger than) the Load cell Junction Box. The indicator may also be mounted in the same enclosure as the barriers. On trade certified systems it must have an approved method of sealing.
3. It should also be noted that many load cells might be damaged by the general IS 500v insulation test (strain gauge to substrate insulation may break down). In such cases it is generally necessary to run a >=4mm^2 bonding conductor between the load cell bottomworks and the barrier busbar. BASEEFA further suggest that where the barrier to load cell distance is short and the barrier is securely bonded to an 'equipotential earth', the bonding wire may not be necessary. (The reader is directed to MTL application note AN9003.)
4. To avoid a potential 'Earth Loop' the load cell cable between the barriers and the indicator/digitiser should have its screen connected at one end only. If they are in separate metallic enclosures, it should be connected to the entry (EMC-type) gland at the indicator box. If they share an enclosure, the screen should be earthed to the barrier busbar.
5. Ensure that the barrier assembly is clearly marked with replacement types.
6. Safe and hazardous cables must be segregated by >50mm (separate trunking).
7. Segregation between IS circuits must be >6mm, cables must have 500v/1minute insulation, and be clearly identified (blue) or blue tape every 1m.
8. Two cables >=4mm^2 area, Coded Green/Yellow, taped together with blue tape and taken to two separate earth screws at the Mains Neutral Star point and two separate earth screws at the Barrier Earth Bar. Using two conductors enables easy checking of the required <1Ω safety earth resistance by simply disconnecting one of the two at the barrier busbar and measuring the loop value.
9. **Ian Fellows Ltd has made every effort to ensure that this information is correct. However, it is provided as a guide only and, as always, it is the Installer's responsibility to ensure that the final system complies with all applicable standards and *has some sort of documentary evidence* (an MTL system certificate or their written approval, for example).**

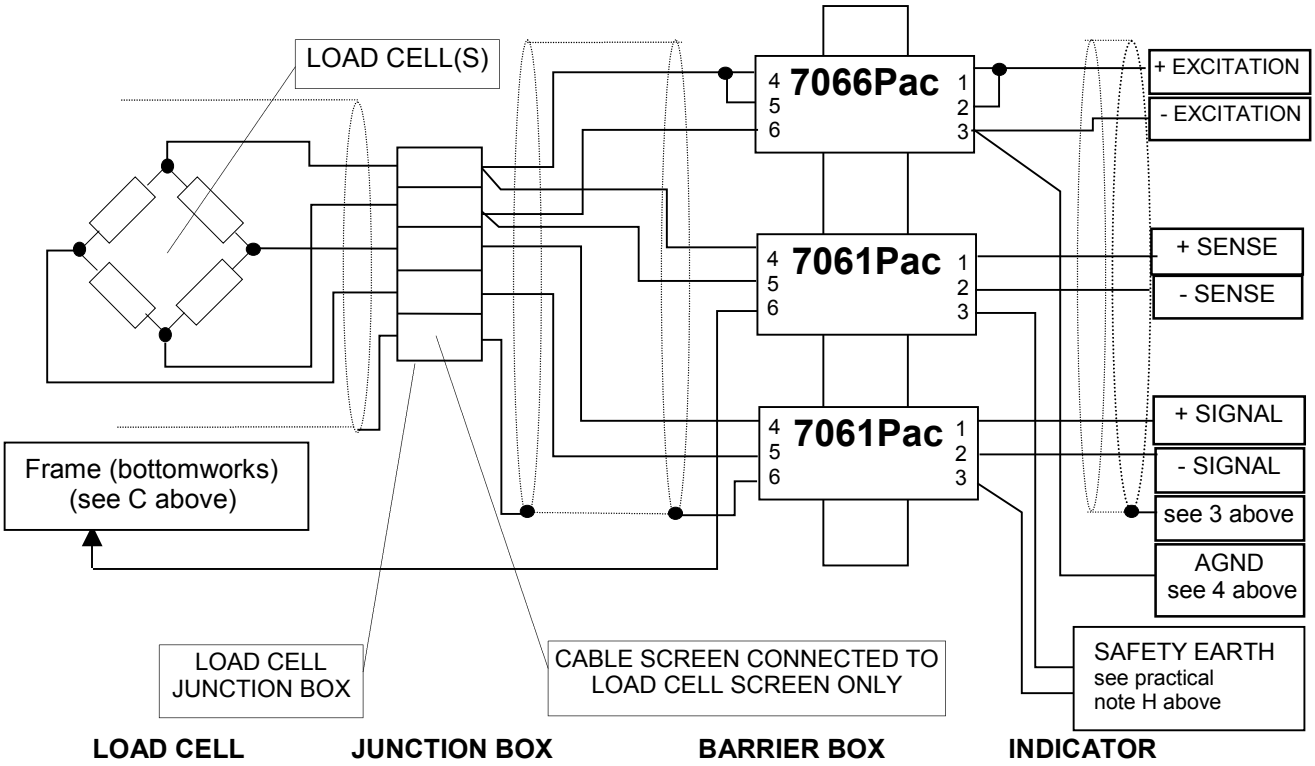
Schemes A, B, C and D relate to previous LUCID systems and are not reproduced here.

SCHEME E (5v excitation models only)



1. Maximum 'hazardous' cable length = 100m. (For typical L/C cables. There is no metrological reason why longer lengths may not be used, but a careful analysis of total inductance and capacitance must be carried out to ensure a safe installation.)
2. Cable screen must be continuous from barrier through to actual load cell screen(s) with NO OTHER CONNECTIONS.
3. The indicator to barrier section of load cell cable screen must be 'earthed' at one end only. It should be connected to the indicator's metallic enclosure at the (EMC-type) entry gland. If the indicator/digitiser shares the barrier enclosure, connect the load cell cable screen to the barrier busbar instead.
4. A separate >=1.5mm^2 min cable, Green/Yellow, *must be connected* to the Indicator 'Analogue Ground'. This is the 0.25" AMP spade terminal next to the 6-way load cell connector P1 on the CPI, or the CSW 'AGND' (P1.1) terminal. It is wired directly to the Barrier Earth Bar.
5. In the case of a CSW indicator not specifically supplied for an IS application, an internal link must be 'snipped'. It is near the mains input terminal block SK2, above the fuse, and links '0v' to an 'Earth' symbol.
6. Normally, a CPI indicator will be situated in the same enclosure as the barriers and its power supply. In this case, the power supply 0v and indicator 0v must be bonded to the barrier busbar. If the CPI is remote from the barrier box, its supply must be allowed to 'float' and it must have a separate >=1.5mm^2 min cable, Green/Yellow, between indicator 0v and the barrier busbar.
7. The SENSE and SIGNAL inputs have an effectively infinite input impedance so the 761P creates no temperature specification degradation.
   Actual cell excitation voltages are:
   - 1 x 350Ω cell: 4.4v
   - 2 x 350Ω cells: 3.9v
   - 3 x 350Ω cells: 3.55v
   - 4 x 350Ω cells: 3.26v
   - 6 x 350Ω cells: 2.77v
8. BASEEFA System Certificate No. Ex92C2424.
9. Trade approval has not yet been sought.

Scheme F (706x Barrier Version)



1. This is effectively identical to Scheme E; refer to the above notes.
2. Barrier connections 3 and 6 are linked together and to safety earth busbar.
3. BASEEFA System Certificate No. Ex98E2274.

Indicator Modifications for I.S. Working

For IS working, it is desirable that the load cell ground reference (effectively –EXCITATION) has no connection to mains safety earth within the indicator. This is to avoid ground loops, and possible 'noise' injection, caused by the fact that the indicator and the barrier busbar find their way back to 'earth' by different routes. The indicator will be connected to the mains safety earth, whilst the barrier box will have its own high integrity earth connection.

CSW Instruments

The CSW indicator usually has an internal connection between mains safety earth and the load cell input ground (AGND). On the baseboard PCB, there is normally a link positioned between fuse and transformer. For IS use it should be removed by cutting and separating the ends. Some CSW may use the small '13E789' CPI-style display. This PCB has mounting holes that connect to the fixing studs. These holes must be insulated from the mounting studs with insulating bushes (Farnell 936-949) to prevent grounding to the metal case.

CPI Indicators

On the CPI, there is no provision for mains input, so no obvious safety earth. However, the external DC supply output should be grounded to the barrier busbar rather than its own mains safety earth (by a separate >1.5mm^2 conductor and not via the 'Analogue Ground' wire, mentioned in note 4 above). As the enclosure is plastic, there is no need to insulate the display PCB mountings.

CBK Indicators

The CBK indicator is similar to CSW but uses the Lucid type display PCB 13E680.
The link on the 1155 baseboard PCB must be cut as described above for the CSW. The display must be modified as described below to isolate the internal circuit ground.

Remove the Display PCB 13E680 and modify by cutting the two foil tracks shown below (figure 1) on the 'front' (7-segment display) side; top left-hand corner.
Note that the Rev B version only requires 'cut A'; there is no foil where 'cut B' would be made.

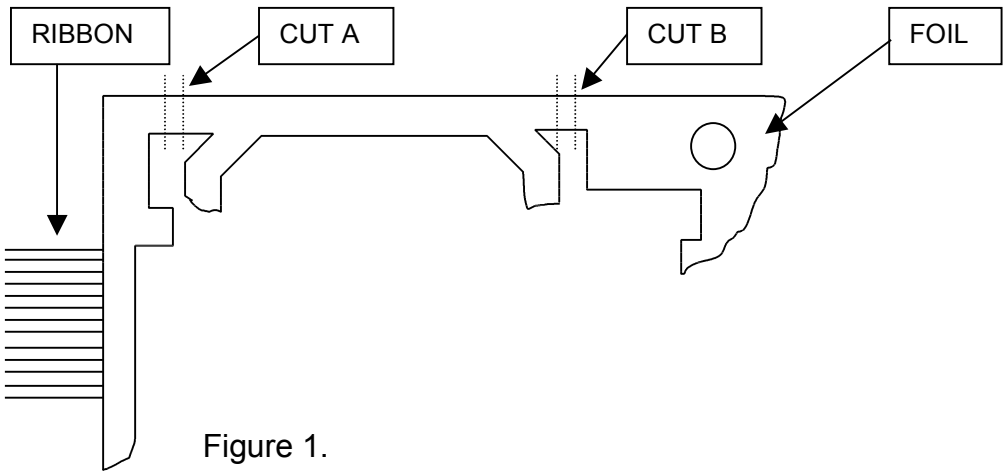
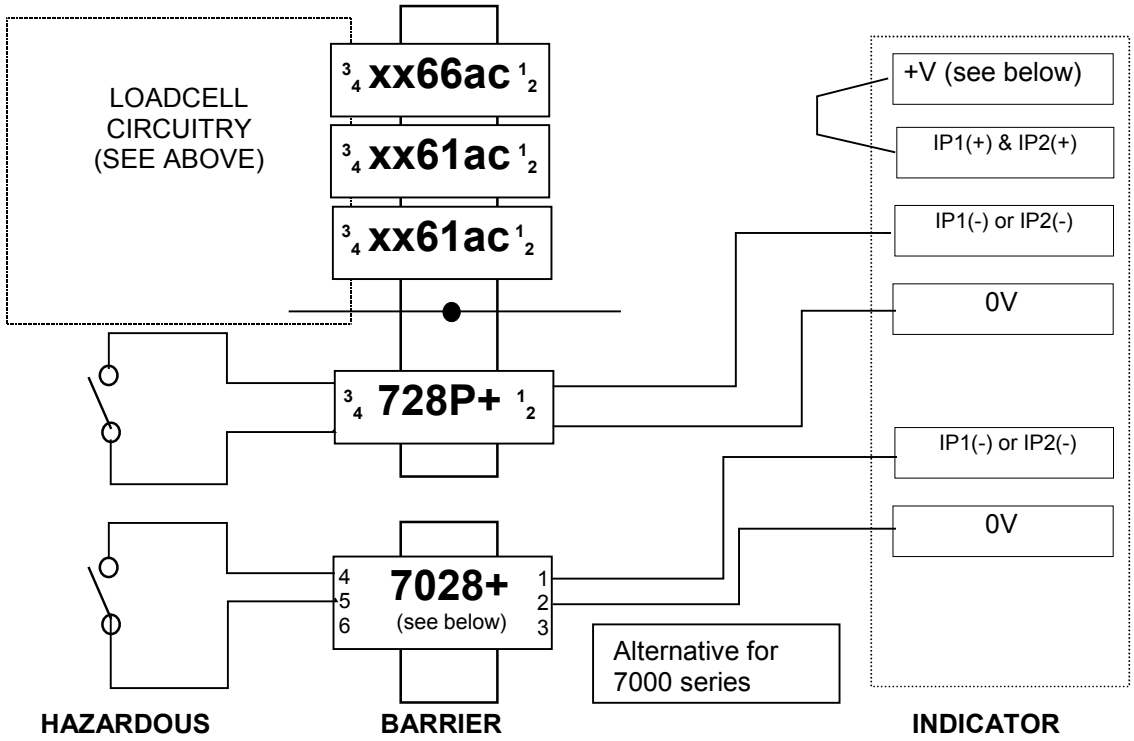


Figure 1.

ALL:

A final check for spurious ground connection is to check there is no continuity between the mains safety earth connection and –EXCITATION using a low resistance range of a DVM (NOT a Megger').

CONTROL INPUT CONNECTION

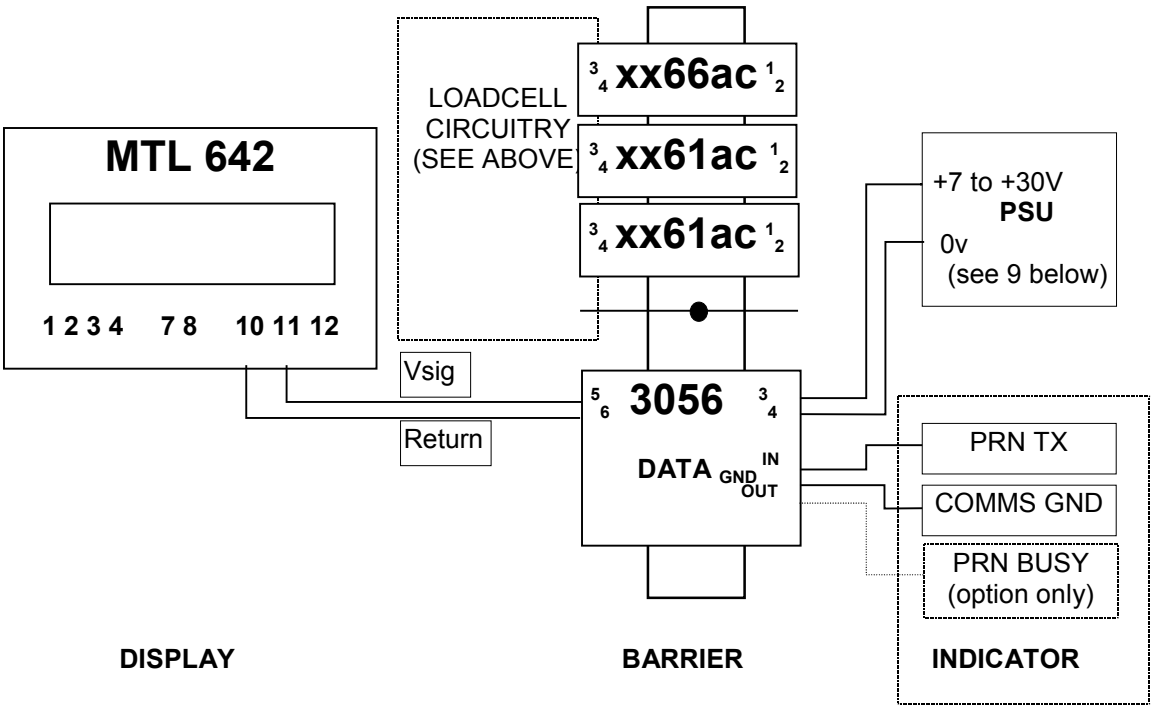


NOTES:

1. Alternative arrangements shown for 700 and 7000 series barriers.
2. + V supply must be an ABSOLUTE MAXIMUM of 26v.

   For CSW & CBK with baseboard REV E or later - the VOUT connection can be used (12-22V)
   For CSW & CBK with baseboard REV C - do NOT use VOUT which can rise above 30V. All Rev C boards have an integrated analogue o/p option fitted as standard, it is possible to use this as a supply. Connect to P3:1 (DA COM) and P3:3 (+18V) instead of the 0V and +V connections shown above. (Note inputs on rev C require correct +/- polarity). This supply is nominally 18volts but can only source about 50mA.
   For CPI the 0V & VIN connections are the supply voltage to the indicator. If a '24v' supply is used, it must be critically specified not to exceed 26v under all conditions. A 12v supply may be better, but must not be allowed to drop below 12V at al times.
   Alternatively an independent supply might be used to provide the 0V and +V required. The supply negative must be bonded to the barrier busbar. Observe the 26v absolute maximum.
3. Maximum 'hazardous' cable length (barrier to switch) = 100m for typical cable. If longer distances are required, the cable specification, particularly its inherent capacitance and inductance, must be examined to ensure I.S. limitations for stored energy are not breached.
4. Conductors to each switch MUST run as a close coupled pair (pref. multicore).
5. It is recommended that screened cable be used (connect screen to safety barrier earth only).
6. More than one switch circuit may be used, but each circuit must be independent in the hazardous area (i.e. a separate pair for every switch – no common connections between barrier and switch contacts).
7. There must be no interconnection between switch and *any other* circuitry in the hazardous area.
8. Conductors must have minimum 0.25mm insulation and withstand a test voltage of 500v (EN 50 039).

USE OF MTL 642 REMOTE INDICATOR



NOTES:

1. MTL 642 is 2 x 16 full alphanumeric character display module.
2. The MTL 3056 isolating interface is mounted in the Barrier Box.
3. The display is limited to ambient temperatures from 0 to 50°C (storage -20 to 70°C).
4. Zone 0, IIC, T4 Hazardous Area environment.
5. One indicator per system only.
6. No provision has been made to use the MTL 642 external switch inputs or the Alarm facility.
7. Similar limitations on maximum length of 'hazardous' cables apply; typically 100m.
8. It is recommended that screened cable be used.
9. The MTL 624 & 3056 will operate from 7V to 30V and require only 8mA. The CPI supply, or the CSW '0v' and '+Vout' (P4 – I/O HEADER) may be used, but not on 1155 baseboard Rev C. On rev C. it is possible to use the integrated analogue o/p as a source – Connect to P3:1 (DA COM) and P3:3 (+18V). The supply is nominally 18volts but can only source about 50mA. The MTL 624 & 3056 will operate from 7V to 30V and requires only 8mA leaving sufficient current to supply a 4-20mA analogue output current loop. Only one 3056 barrier may be connected in this way to a DAC module.
10. A Beka BA488 is an alternative to the MTL 624/3056. Note: The required supply voltage is 20-35v, so if CPI is using 24v this would be suitable. CSW VOUT will not be suitable, the DAC solution or a separate power supply would be required.

- Select MTL Address 50, 9.6kB, 1 Stop bit, No parity, 8 Data bits.
- SW setting 1-10 ~ OFF ON ON ON ON ON OFF OFF OFF ON (0 1)
- Set LUCI **'Pr_For_' 'CtrL' HP** to **2021b4c** (2 02 1B 4C = STX STX ESC L ~ inhibits any reply).
- Ensure that a carriage return and line feed are sent after both lines.
- Send a 'blank' (a couple of spaces) after a weight string to 'kill' any previous 'x10' digits.
- Transmission of an alarm message may be initiated automatically by selecting Product **'CodE' TR** to **99** and put a suitable 'alarm' text string into **'St2A/St2b' SC/SD**.