Solartron Metrology

DRC
DIN Rail Conditioner

user manual

AMETEK®
ULTRA PRECISION TECHNOLOGIES

Index

1.0 Safety Information

Terms in this Manual

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

Symbols in this manual

This symbol indicates where applicable cautionary or other information is to be found.

Warnings & Cautions

WARNING: **Do not operate in an explosive atmosphere.**

WARNING: **Safety critical environments**
This equipment is not intended for use in a safety critical environment.

CAUTION: Low voltage
This equipment operates at below the SELV and is therefore outside the scope of the *Low Voltage Directive*.

This equipment is designed to work from a low voltage DC supply. Do not operate this equipment outside of specification.

1.0 Safety Information (cont.)

Warnings & Cautions

1.1 CAUTION: Electrostatic Discharge
This equipment is susceptible to electrostatic discharge (ESD) when being installed or adjusted, or whenever the case cover is removed. To prevent ESD related damage, handle the conditioning electronics by its case and do not touch the connector pins.

During installation, please observe the following guidelines:

- Ensure all power supplies are turned off
- If possible, wear an ESD strap connected to ground. If this is not possible, discharge yourself by touching a metal part of the equipment into which the conditioning electronics is being installed
- Connect the transducer and power supplies with the power switched off
- Ensure any tools used are discharged by contacting them against a metal part of the equipment into which the conditioning electronics is being installed
- During setting up of the conditioning electronics, make link configuration changes with the power supply turned off. Avoid touching any other components
- Make the final gain and offset potentiometer adjustments, with power applied, using an appropriate potentiometer adjustment tool or a small insulated screwdriver

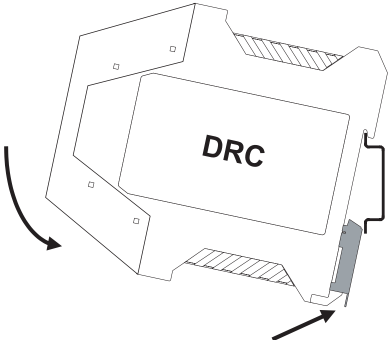
2.0 Installation

2.1 Mounting and Access

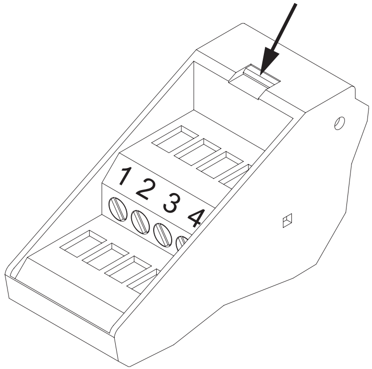
Before mounting the DRC, please refer to section 2.10.

Hook the DRC on the DIN rail with the release clip facing down and push onto the rail until a ‘click’ is heard.

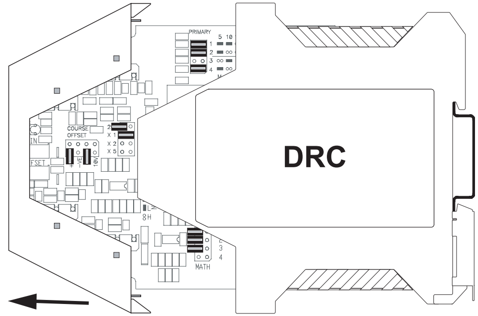
To remove, use a screwdriver to lever the release clip down. Pull the bottom of the housing away from the rail and unhook.



DIN Rail



Cover release latch

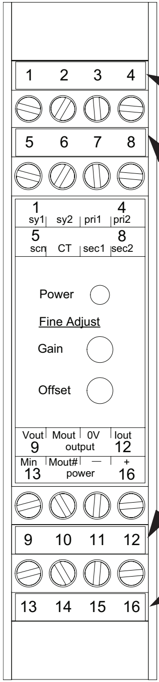


Withdraw PCB

To access internal links, the front cover and PCB must be withdrawn from the housing. Use a screwdriver or similar tool to depress the top latch. The cover will spring forward. Repeat with the bottom latch, then gently pull the PCB out.

2.0 Installation (cont.)

2.2 Connections and link identification



Transducer

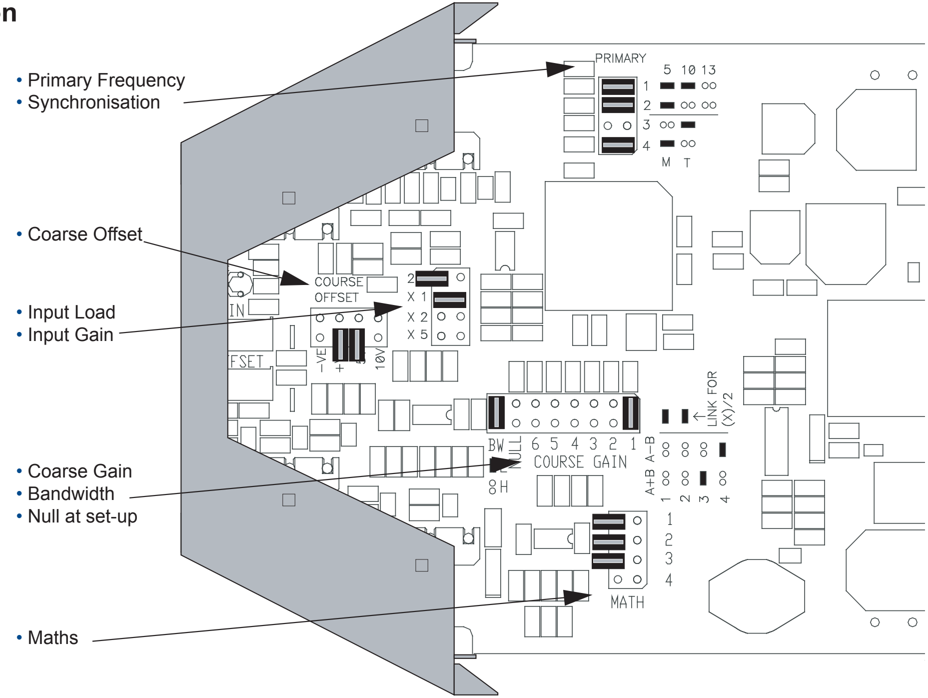
1 Synchronisation 1
2 Synchronisation 2
3 Primary (red)
4 Primary (blue)

5 Screen (0 V)
6 CT (yellow)
7 Secondary (green)
8 Secondary (white)

Power Supply & Outputs

9 Voltage Output
10 Math OUT
11 Signal 0 V
12 Current OUT

13 Math External IN
14 Inverted Math OUT
15 –VE power supply
16 +VE power supply



Terminals 5, 11, and 15 are internally connected but, for best performance, they should be treated as separate terminals.
Note: If the output polarity is incorrect, reverse the transducer secondary connections.

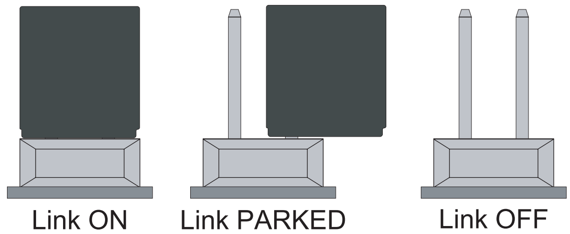
2.0 Installation (cont.)

2.3 Description of links

The table below and subsequent diagrams explain the link functions and detail the factory settings.

Link	Description	Options	Factory Setting
COARSE GAIN	Select coarse output gain	Range 1 to 6	Link ON, position 1
COARSE OFFSET	Select coarse output offset	+VE, -VE, 5 V, 10 V	No offset, links PARKED
NULL	Used during set-up to null output	Output in null state or enabled	Link PARKED, output enabled
PRIMARY	Select primary frequency	5 kHz, 10 kHz, 13 kHz	Both links ON, 5 kHz
MT	Select synchronisation mode	Master or track	Set as master
INPUT LOAD	Select transducer secondary load	100 kΩ or 2 kΩ	Link PARKED, 100 kΩ
INPUT GAIN	Input gain	X1, X2, X5, DIV2	Link ON, X1
BW	Sets output signal bandwidth	L = 500 Hz, H = 1 kHz	Link ON, 500 Hz
MATH	Enables maths option	A+B, A-B, (A+B)/2, (A-B)/2	Links PARKED, maths not set

Note: If the output polarity is incorrect, reverse the transducer secondary connections.

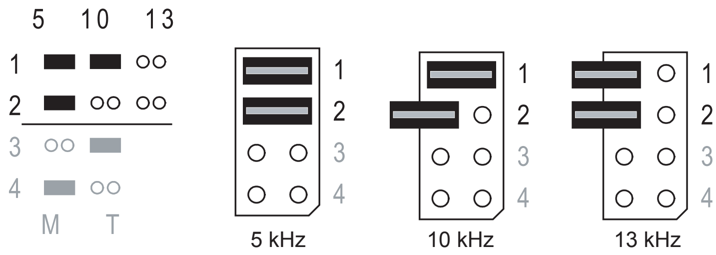


2.0 Installation (cont.)

2.4 Primary Frequency

The DRC primary frequency is set using links as shown below. Transducer specifications determine the optimum frequency.

Primary amplitude is not adjustable. The DRC uses ratiometric techniques and is insensitive to primary amplitude. Maximum secondary transducer amplitudes must be observed. Refer to section 5.1.



2.5 Transducer Input Load

The DRC has two input load ranges. 100 kΩ is often used for LVDT transducers while 2 kΩ is often used for Half Bridge transducers. If loads of less than 100 kΩ are required, an external resistor may be wired across the SEC1 and SEC2 terminals. Most Solartron transducers perform well into 100 kΩ. See specification section 7.2 for further details.

100 kΩ - link PARKED
2 kΩ - link ON

2.6 Bandwidth

The DRC has selectable bandwidth (BW). The bandwidth setting is independent of other DRC settings. Where possible, the lowest bandwidth setting should be used to minimise output noise.

500 Hz - Link ON
1 kHz - Link PARKED

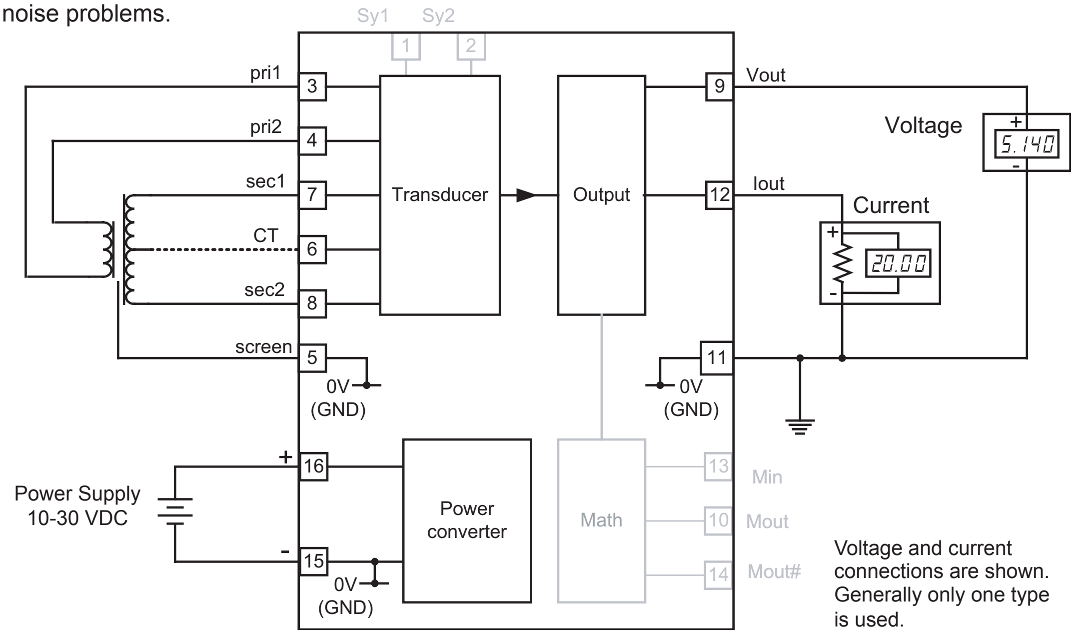
Note: Total system bandwidth is dependent on probe type and application

2.0 Installation (cont.)

2.7 Basic Configuration

Please refer to section 2.10 before installation.

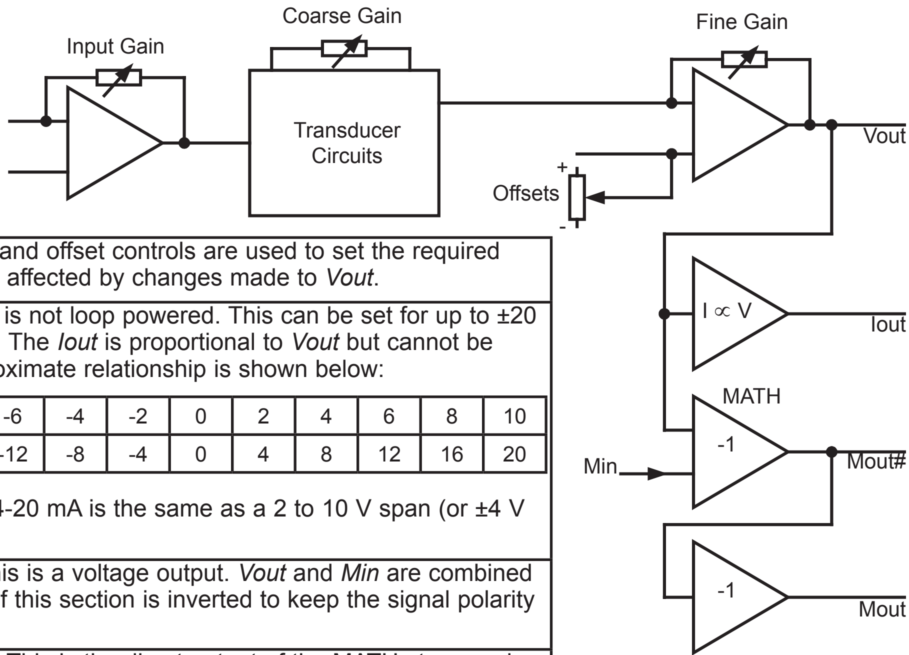
A floating output power supply is recommended as it will minimise ground loop noise problems. Please refer to section 6.1 for a typical arrangement.



Voltage and current connections are shown. Generally only one type is used.

2.8 Output Descriptions

This section describes how the various outputs of the DRC are related.

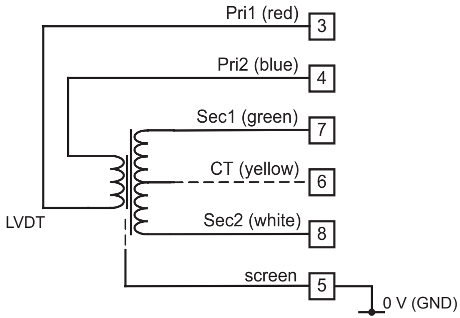


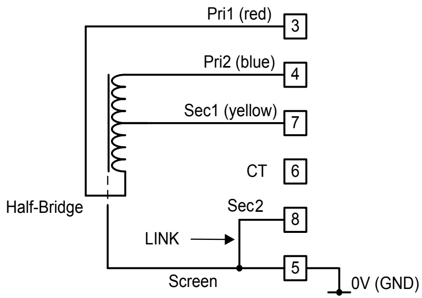
<table>
<tr><td>Vout</td><td>This is a voltage output. The gain and offset controls are used to set the required output range. All other outputs are affected by changes made to Vout.</td></tr>
<tr><td>Iout</td><td>This is a current output only, DRC is not loop powered. This can be set for up to ±20 mA. A common output is 4-20 mA. The Iout is proportional to Vout but cannot be independently adjusted. The approximate relationship is shown below:
<table>
<tr><td>Voltage (V)</td><td>-10</td><td>-8</td><td>-6</td><td>-4</td><td>-2</td><td>0</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td></tr>
<tr><td>Current (mA)</td><td>-20</td><td>-16</td><td>-12</td><td>-8</td><td>-4</td><td>0</td><td>4</td><td>8</td><td>12</td><td>16</td><td>20</td></tr>
</table>
When relating current to voltage, 4-20 mA is the same as a 2 to 10 V span (or ±4 V with a +6 V offset).</td></tr>
<tr><td>Mout</td><td>Mout is the main MATH output. This is a voltage output. Vout and Min are combined in the MATH section. The output of this section is inverted to keep the signal polarity the same as Vout.</td></tr>
<tr><td>Mout#</td><td>This is an auxiliary voltage output. This is the direct output of the MATH stage and is the inverse of Vout. If MATH options are not selected then Mout ∝ Mout# ∝ Vout. Refer to section 4.1.</td></tr>
</table>

All outputs may be used at the same time but cannot be independently adjusted for scalefactor or offset.

2.9 Connections

The diagram in section 2.7 shows a basic connection with LVDT. The following diagram gives further details of Solartron LVDT transducers and alternative connections for Half Bridge transducers.





LVDT Electrical Connections	
Red and blue	Primary (energising)
Green and white	Secondary (signal)
Yellow	Secondary centre tap
Black	Transducer body ground

Half Bridge Electrical Connections	
Red and blue	Energising
Yellow	Signal
Black	Transducer body ground

The CT terminal is provided to terminate the centre tap (CT) connection of a transducer if present. There is no electrical connection within the DRC. This is provided to allow for quadrature components to be fitted if required.

2.10 Placement and EMC

DRC has been designed to comply with EMC regulations. For best performance, the EMC compliance of surrounding equipment must be considered. High levels of EMI (electro magnetic interference) can affect the performance of DRC.

Residential, Commercial and Light Industrial Environments
Typically this will be an office, laboratory or industrial environment where there is no equipment likely to produce high levels of electrical interference such as welders or machine tools. Connections may be made using twisted unscreened wire which is a cost-effective option giving good performance in this environment. Standard equipment wire such as 7/0.2 (24AWG) can be twisted together as required. Standard data cable such as a generic CAT5 UTP will also give good performance.

Industrial Environments
Typically this will be an industrial environment where there is equipment likely to produce high levels of electrical interference such as welders, large machine tools, cutting or stamping machines. DRC should be mounted inside an industrial steel enclosure designed for EMI screening. Many enclosures, though metal, are not designed for good screening and so careful installation is important. Place DRC away from equipment within the enclosure that is likely to produce high levels of EMI.

Connections should be made using a screened cable (braided or foil screened cables may be used). The cable screen should be connected to the housing at the cable entry point. An EMC cable gland is recommended. If this is not possible, then the unscreened section of cable should be kept as short as possible, and the screen should be connected to a local ground.

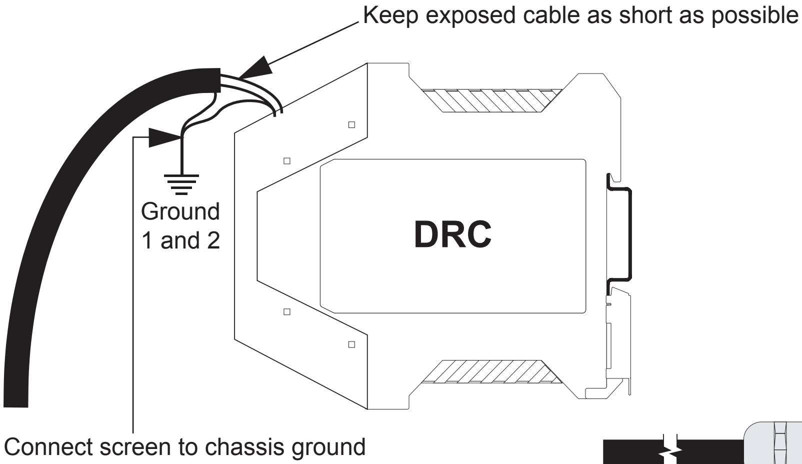
Where possible, the DRC should be the only ground connection point. If voltage, current or power supplies are ground referenced and connected at some distance from DRC, then noise may be introduced.

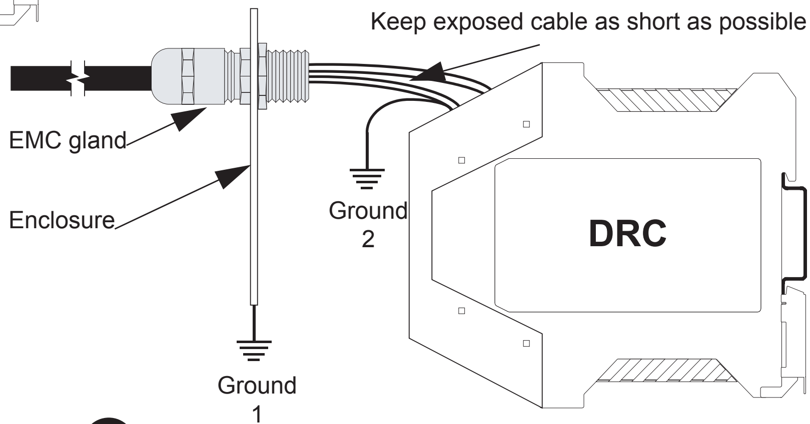
All 0 V terminals on DRC are connected internally. Ground 2 may be connected to any of the DRC 0 V terminals, however terminal 11 is preferred. Screen ground (ground 1) may be connected via terminal 11. Only one local ground is needed for each DRC.

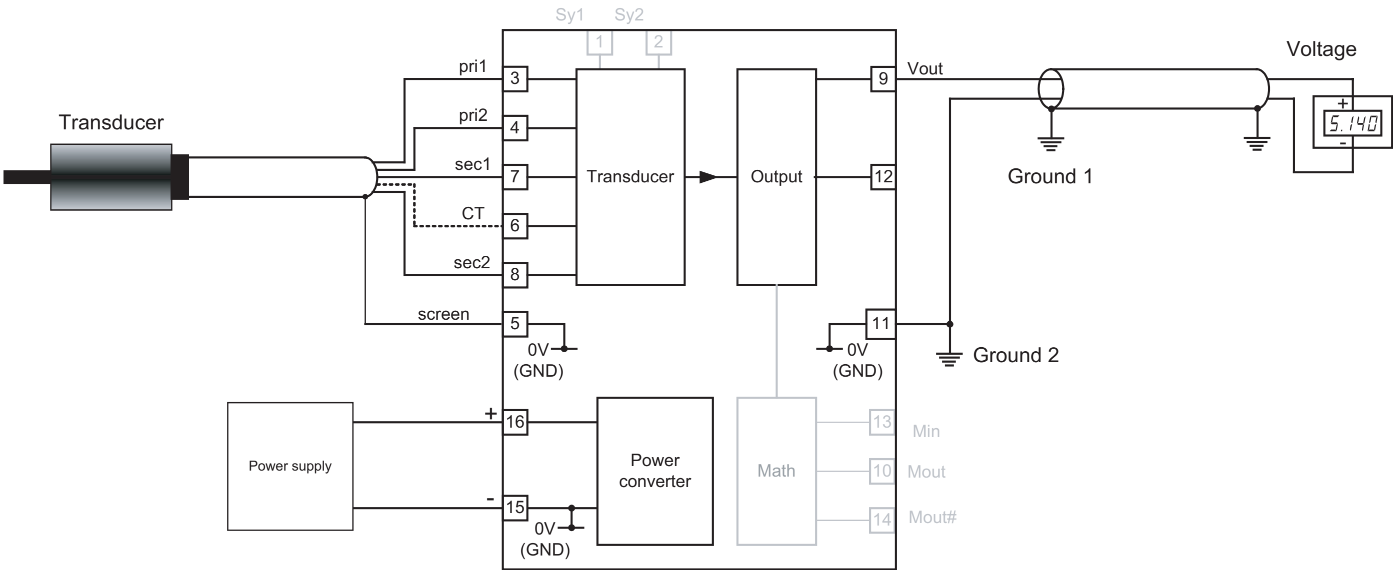
A local power supply is ideal but, if this is not possible, a screened cable arrangement can be used to reduce noise picked up.

An application note outlining good practice for cable installation and routing is available from www.solartronmetrology.com

2.0 Installation (cont.)



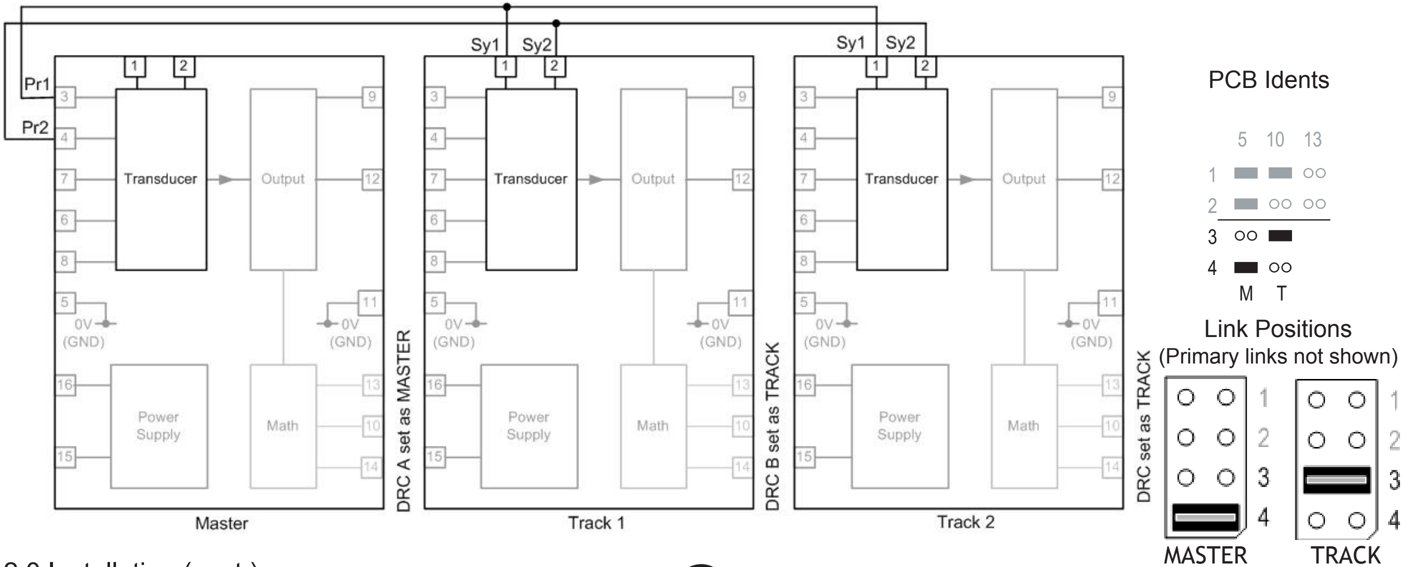



Transducer
Sy1
Sy2
1
2
pri1
3
pri2
4
sec1
7
CT
6
sec2
8
screen
5
0V
(GND)
Transducer
Output
9
12
11
0V
(GND)
Vout
Voltage
5.140
Ground 1
Ground 2
Power supply
+
16
-
15
0V
(GND)
Power converter
Math
13
Min
10
Mout
14
Mout#

2.0 Installation (cont.)

2.11 DRC Synchronisation

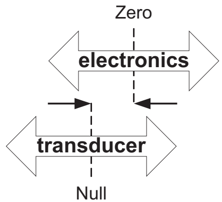
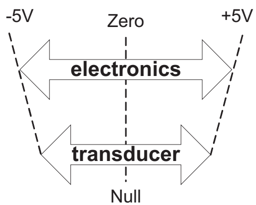
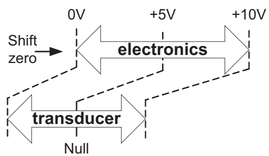
When a system comprises several DRC modules, it is possible to synchronise primary oscillator phases. Synchronisation will not be required for most installations. It is only required when transducers and their cables are installed in close proximity to each other and there may be electrical interaction or cross-talk between probes. This may be seen as a change in output from one module when the probe connected to an adjacent module is moved. Even when probes are installed close to each other, synchronisation may not be required as cable shielding is generally effective. If interactions are seen, the cause is often poor 0 V or screen connection or mechanical effects between probes when mounted together.



3.0 Setting Up

3.1 Set-up Summary

This is a set-up summary. A more detailed procedure is included in following sections but these simple steps describe a typical setting procedure and apply to most applications. Other procedures may be used as appropriate.

Step 1	Step 2	Step 3	Step 4	Step 5
Set links as required*	• Set DRC output to zero	• Move transducer to full scale position	• Add offset if required	• Final checks
	• Align transducer null	• Set DRC coarse and fine gain	• Set DRC coarse and fine offset	• Repeat steps 2 - 4 to check setting
Primary frequency Transducer load Initial gain Bandwidth No offset* No MATH*				✓

*If in doubt about initial link position, use the factory setting. Performing initial set-up without offset and MATH options makes set-up easier.

Note: If the output polarity is incorrect, reverse the transducer secondary connections.

For a bi-polar output i.e. ±10 VDC or ±20 mA, follow steps 1 to 3.

For a uni-polar output i.e. 0-10 VDC, 0-20 mA or 4-20 mA, follow steps 1 to 4.

In either case, step 5 (final checks) should be followed to complete the set-up.

3.0 Setting Up (cont.)

3.2 Set-up Procedure

Step 1 - Set-up DRC links

If the transducer characteristics are known, set the frequency and input resistance links as required. A list of standard settings for all Solartron transducers is available from www.solartronmetrology.com. If the transducer characteristics are not known, the factory link settings should be used.

If the transducer is known to be outside the standard sensitivity range, the X1, X2, X5 or DIV2 links will have to be used. Please refer to section 5.1

Step 2 - Align DRC and transducer null

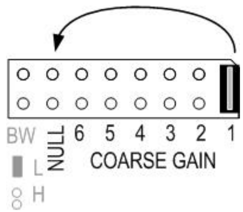
Any electrical offset in the DRC is removed. The transducer position is adjusted so that transducer and DRC nulls are aligned.

Null the DRC

1 Put the gain link onto the null position. This puts a temporary short across the transducer input and allows any electronics offset to be removed
2 Adjust the fine offset control to give as near zero output as practical

Null the transducer

3 Replace the gain link to the original position
4 Adjust the position of the transducer to give as near zero output as practical. This is the centre of the mechanical range



If the transducer cannot be centered for practical reasons, an offset will remain within the system. There may be noticeable interaction between gain and offset adjustment. This does not prevent the DRC being set-up, although several iterations may be required when adjusting gain and offset. Please consult your supplier for guidance if required.

3.0 Setting Up (cont.)

Step 3 - Setting bi-polar (±) full scale output

1. Move the transducer to the position where maximum DRC output is required
2. If the output polarity is wrong, reverse the transducer secondary connections (terminals 7 & 8). Move the transducer back and re-check the zero position
3. Move the coarse gain link along from position 1 towards position 6 until the DRC output is near the required value
4. Adjust the fine gain control to give the required output
5. The bi-polar output is now set. Proceed to step 5

If a uni-polar output is required proceed to step 4.

Example: ±10 V is required from a ±1 mm transducer. Set the transducer at the +1 mm position and set the output to +10 V.

Step 4 - Setting uni-polar full scale output (adding an offset)

1. Move the transducer to the null position. DRC output will be 0 V or 0 mA
2. Apply offset using the +VE, -VE, 5 V and 10 V links and adjust the fine offset control to set precisely. Both links may be used to give greater offset shift. Proceed to step 5

Example: 0-10 V is required for a ±1 mm transducer. Set the transducer to give ±5 V over the full range and then, with the transducer at null, add +5 V offset. Adjust the fine offset to give 5 V. When the transducer is moved to the +1 mm position, the output will be +10 V.

Example: 4-20 mA is required for a ±1 mm transducer. Set the transducer to give ±8 mA over range and then, with the transducer at null, add +5 V (≈10 mA) offset. Adjust the fine offset to give +12 mA. When the transducer is moved to the +1 mm position, the output will be +20 mA.

Step 5 - Final checks

Ensure that calibration is correct by moving the transducer across the required mechanical range (including the mid position) and checking the calibration points. Fine adjustments can be made if required.

It may only be possible to set the output accurately at the two calibration points. This is due to non-linearity within the transducer.

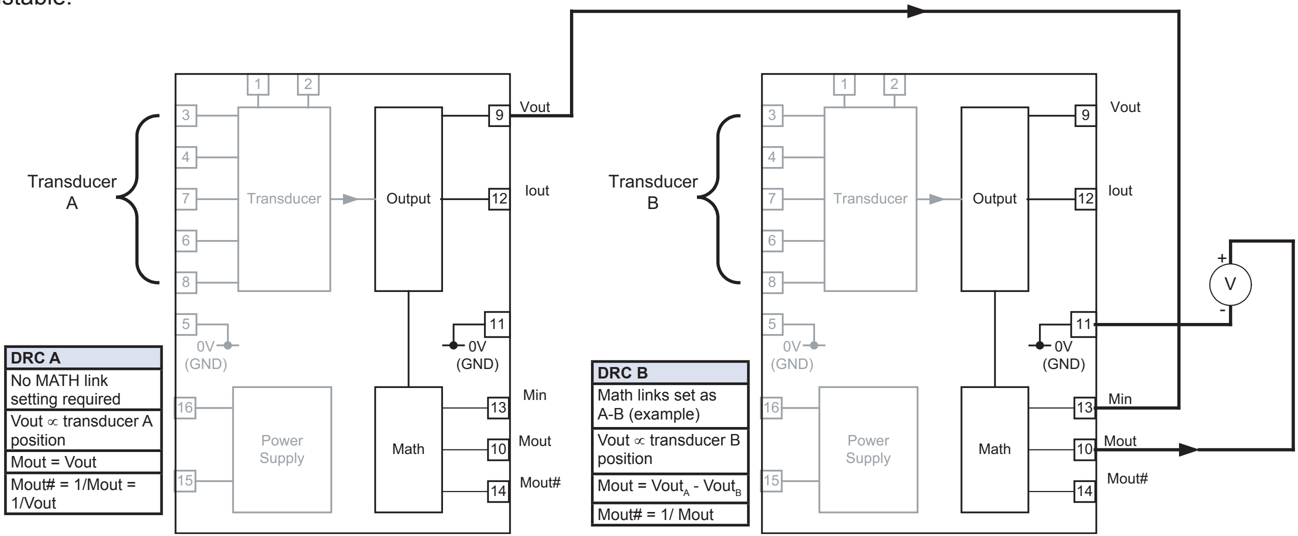
4.0 MATH Functions

4.1 MATH Introduction

By linking two DRC modules, the following analogue arithmetic may be performed: A+B, A-B, (A+B)/2 and (A-B)/2.

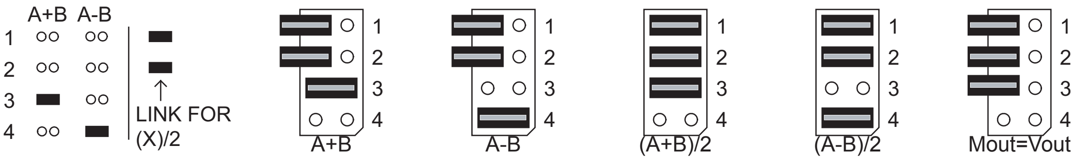
The output of DRC A, *Vout*$_A$, is connected to the Min terminal of DRC B. The output of DRC B is routed internally to the arithmetic circuits and the result is available at the *Mout* terminal.

The inverse of *Mout* is available as *Mout#*. *Vout*, *Mout* and *Mout#* may be used at the same time, however they are not individually adjustable.



4.0 MATH Functions (cont.)

4.2 MATH Set-up Procedure



Setting up two DRC for MATH can become confusing as the output of each DRC will affect the final output. The steps below are guidelines to help the set-up process.

Step 1 - Requirements

Write down the arithmetic required and the range of outputs likely to be seen. This will allow the requirement for each individual DRC to be determined. *Vout* of each DRC is used.

Example: ±10 V required for A-B.
If each DRC is set to ±10 V, then A-B would calculate to be ±20 V. However, as this is not possible, each DRC must be set to ±5 V or use ±10 V (A-B)/2.
Example: 0-10 V required for A+B.
Set each DRC for 0-5 V or set each DRC to 0-10 V and use (A+B)/2.

Step 2 - Initial set-up

Set up each DRC as an individual module first.
Working around transducer null and having a ±V output will make set-up easier.

Step 3 - Final checks and further comments

Initially each DRC *Vout* may have been set to an accurate zero but an offset may still be seen at *Mout*. This is because of offsets inherent within the MATH circuits. To remove this offset, adjust one of the *Vout* offsets. *Mout* offset adjustment is best performed on the DRC set for MATH.

5.0 Transducer Sensitivity

5.1 X1, X2, X5 and DIV2 link

The DRC compensates for changes in primary signal amplitude by producing an internal error signal that is the ratio between the primary and secondary signals. If the transducer output signal is too high or too, low errors may occur that can degrade the performance of the DRC/transducer combination. For these transducers the X1, X2, X5 or DIV2 input gain link must be used. For Solartron transducers, consult the list of standard settings available from www.solartronmetrology.com

Calculating transducer Full Range Output (FRO)
In general, transducer sensitivity is quoted as mV/V/mm where:

mV = output of the transducer **V** = primary voltage **mm** = mechanical position of the transducer from null (usually mid mechanical range).

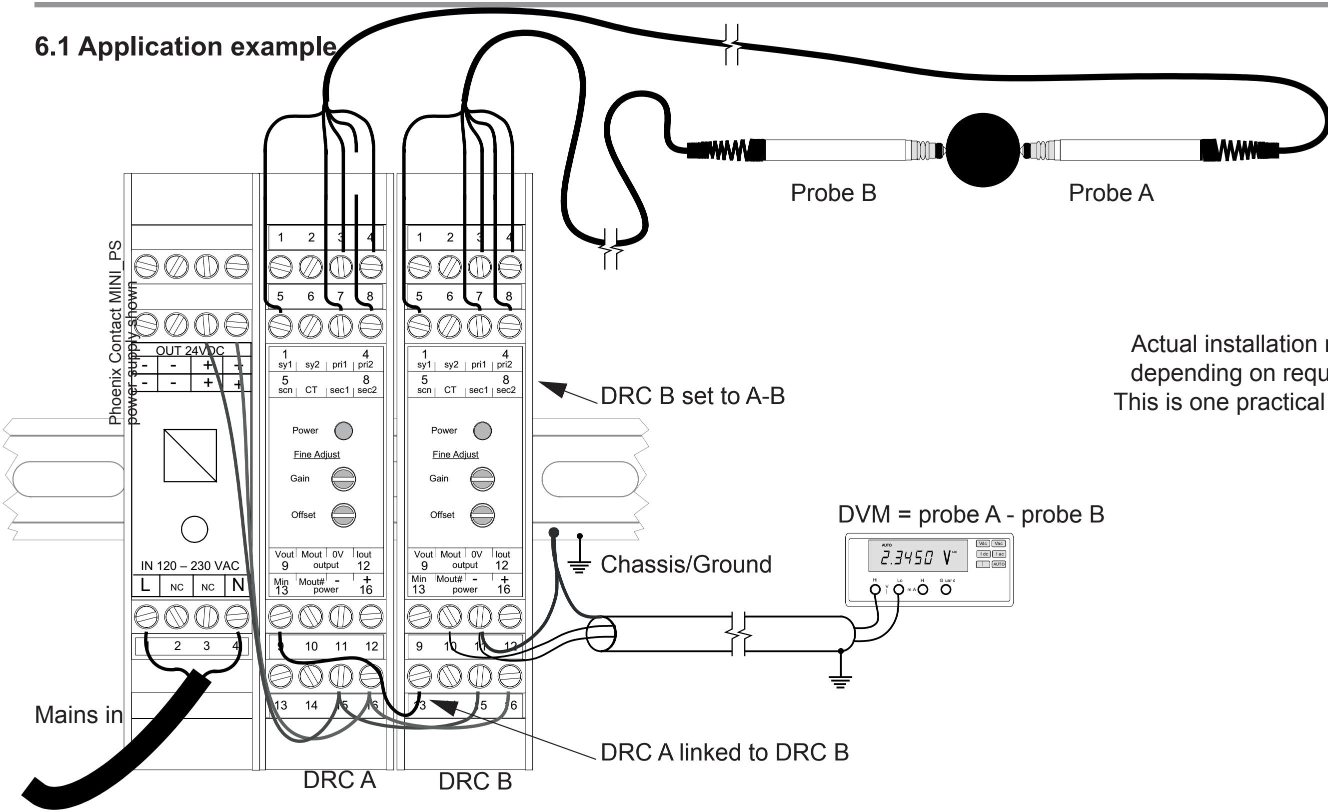
To calculate the transducer full range output, simply multiply all three together.
Example: AX/1.0 sensitivity is 210 mV/V/mm
DRC primary voltage is 3 V
AX/1.0 range is ±1 mm
Transducer full range output is 210 x 3 x 1 = 630 mV (0.63 V). It falls within the standard range.

Set the X1, X2, X5, DIV2 link as shown in the table below:

Transducer Full Range Output	Comment	Input Gain Link setting
400 mV FRO to 2500 mV FRO	Standard range	Link ON X1
150 mV FRO to 400 mV FRO	Low output transducer	Link ON X2
150 mV FRO to 400 mV FRO	Very low output transducer	Link ON X5
2500 mV FRO to 5000 mV FRO	High output transducer	DIV2 - Links X1, X2, X5 parked (ie. all OFF)

6.0 Application

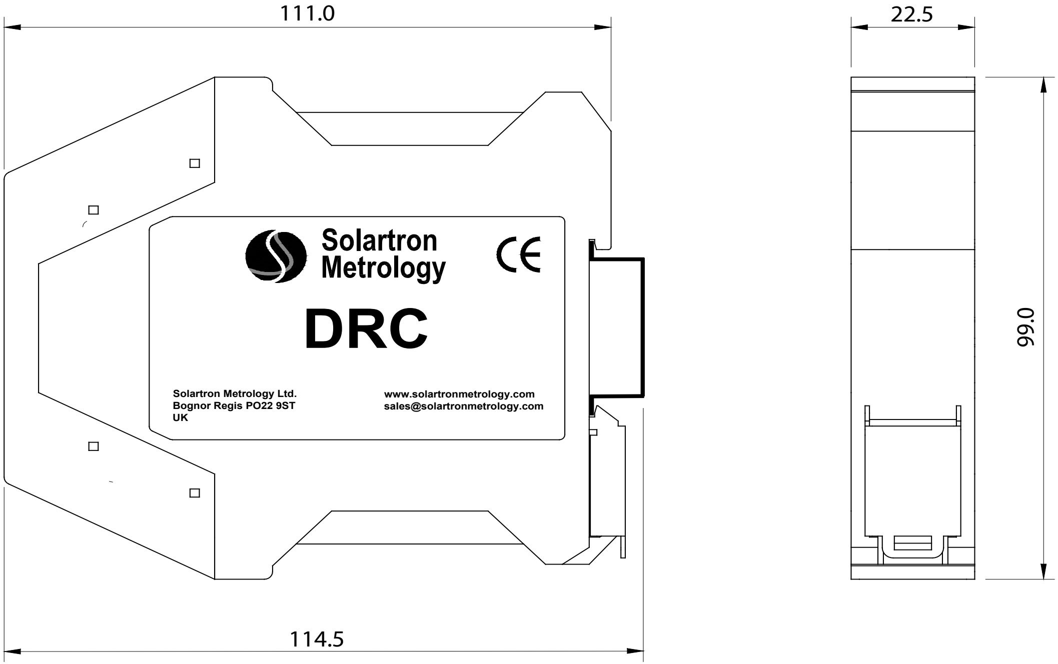
6.1 Application example



Actual installation may differ depending on requirements. This is one practical example.

7.0 Specification

7.1 Mechanical Outline (mm)



7.0 Specification (cont.)

7.2 Technical Specification

Power Requirement			
Voltage Range		10 to 30 VDC	
Current Range		160 mA at 10 V to 70 mA at 30 V	
Transducer Excitation			
Primary Voltage		3 V rms nominal	
Primary Frequency	Link Selectable	5 kHz, 10 kHz or 13 kHz	
Primary Current		30 mA max.	
Signal Input (Transducer Sensitivity Range)			
Gain Range Link Select	Standard X1	400 to 2500 mV FRO (in 6 gain ranges)	
	Special input gain X2	150 to 400 mV FRO	
	Special input gain X5	55 to 150 mV FRO	
	Special input gain DIV2	2500 to 5000 mV FRO	
Input Load Resistance		100 kΩ, 2 kΩ[1]	
Options		See note[2]	
Signal Output			
Voltage Output		Up to ±10 VDC[3, 4]	
Current Output		Up to ±20 mA into 500 Ω load[4]	
Output Ripple		<1 mV rms	
Output Offset	Up to 100% (coarse & fine adjustment)	Coarse (link selectable)	±10 VDC (≈20 mA), ±5 VDC (≈10 mA)
		Fine (front panel adjust)	±2.5 VDC (≈5.6 mA)

7.0 Specification (cont.)

Signal Output (cont.)

Temp. Co. Gain		<0.01% FRO/ºC
Temp. Co. Offset		<0.01% FRO/ºC
Warm-up		15 minutes recommended
Linearity		<0.1% FRO
Bandwidth (-3 dB)	Link Selectable	500 Hz, 1 kHz
Maths	Link Selectable	A + B, A - B, (A +B)/2, (A - B)/2[5]
Maths Accuracy		0.1% FRO

Environmental

Operational Temperature Range	0 to 60ºC (32 to 140ºF)
Storage Temperature Range	-20 to 85ºC (-4 to 185ºF)

Certification

Immunity	BS EN61000-6-2:2001 Immunity for Industrial Environments[6]
Emissions	BS EN61000-6-3:2001 Emission for Residential, Commercial and Light-Industrial Environments[6]

Mechanical and Connections

Transducer	Screw terminals
Power Supply	Screw terminals
Output Signal	Screw terminals
Enclosure (size)	114.5 x 99 x 22.5 mm
Weight	120 g
Material	Green polyamide

7.0 Specification (cont.)

Notes

[1] Solartron Transducers are calibrated using the following loads:

	Standardised (plugged)	Non-standardised (unplugged)	Displacement
LVDT	10 kΩ	100 kΩ	100 kΩ
Half Bridge	2 kΩ	1 kΩ	n/a

When a standard LVDT transducer is connected to DRC set for 100 kΩ, transducer characteristics will be similar to the non-standardised (unplugged) version of that transducer. When a non-standardised (unplugged) Half Bridge transducer is connected to DRC set for 2 kΩ, transducer characteristics will be similar to the standardised (plugged) version of that transducer. Any difference in transducer sensitivity is removed during DRC set-up.

Where load resistance is critical, an external resistor may be fitted. If a 10 kΩ load is required an additional 11 kΩ resistor may be may be used in conjunction with the 100 kΩ internal load. This may be connected across the SEC1 (7) and SEC2 (8) terminals. If a 1 kΩ load is required, an additional 1 kΩ resistor may be used.

[2] No input options are offered. As connection of transducer is by screw terminal, additional internal configuration methods are not required. By changing connections and use of external components, the user can perform:

• Change input polarity • Half Bridge connection • Grounding one side of the input • Phase correction • Quad resistors.

[3] DRC can drive into a 1 kΩ load but this offers no advantage. 10-100 kΩ is recommended.

7.0 Specification (cont.)

[4] Output range can be adjusted as required anywhere within this range by using a combination of gain and offset, for example: ±10 VDC, ±5 VDC, 0-5 VDC, 0-10 VDC, 4-20 mA.

[5] Maths requires the use of a second DRC. An additional output offset may be seen at any of the MATH outputs. This is not specified as it is trimmed out during set-up.

[6] The DRC is able to comply with the toughest electrical emissions and immunity regulations. Compliance requires proper installation according to the user manual. Compliance does not guarantee performance as the installation environment may be outside of test specification limits. The flexibility of DRC means it can be installed in a variety of ways according to user requirements. Simple installations with short non-screened cables will meet the lesser light-industrial immunity regulations. Heavy industrial installations, especially with longer cables, will need more careful installation with screened cables.