LVC - 2500

Low Voltage Conditioner

MACRO SENSORS™

Division Of Howard A. Schaevitz Technologies, Inc.

User Manual

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.

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

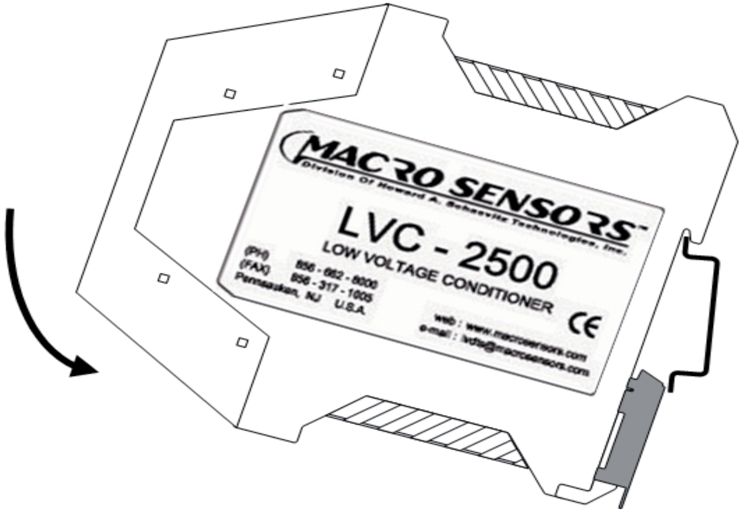
2.0 Installation

2.1 Mounting and Access

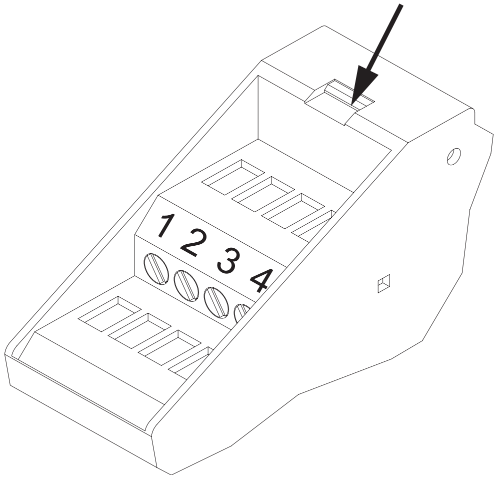
Before mounting the LVC, please refer to section 2.10.

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

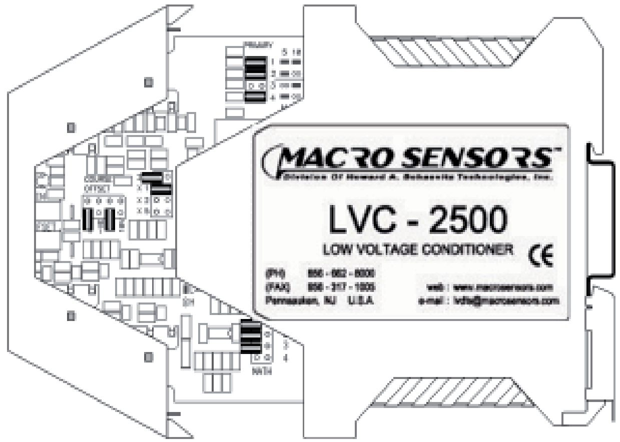
To remove, use a screwdriver to lever the release clip down. Pull the bottom of the housing away from the rail and unhook.



DIN Rail



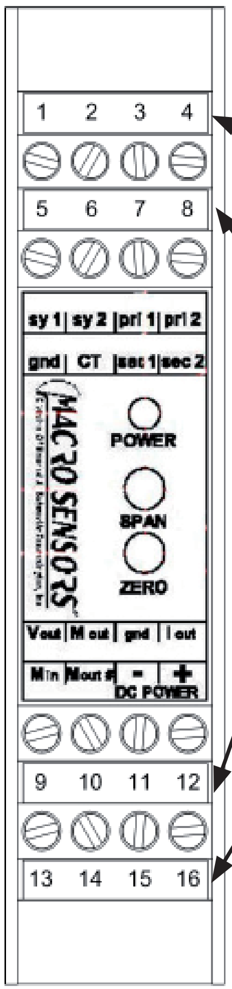
Cover Release Latch



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.

2.2 Connections and link identification



Transducer

1 Synchronization 1
2 Synchronization 2
3 Primary
4 Primary

5 Shield (0 V)
6 CT
7 Secondary
8 Secondary

Power Supply & Outputs

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

13 Math External IN
14 Inverted Math OUT
15 -VE power supply (Gnd)
16 +VE power supply

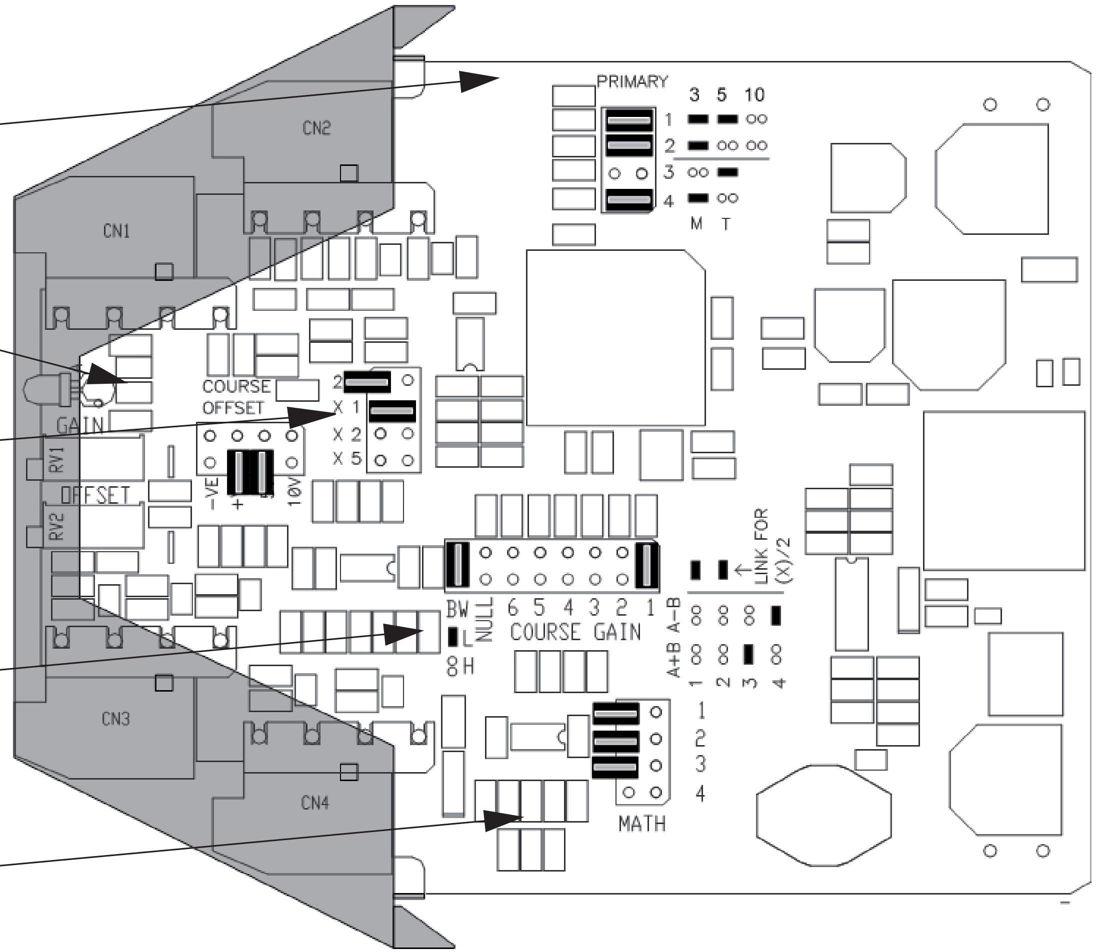
- Primary Frequency
- Synchronization

- Coarse Offset

- Input Load
- Input Gain

- Coarse Gain
- Bandwidth
- Null at set-up

- Math



Terminals 5, 11, and 15 are internally connected but, for best performance, they should be treated as separate terminals.

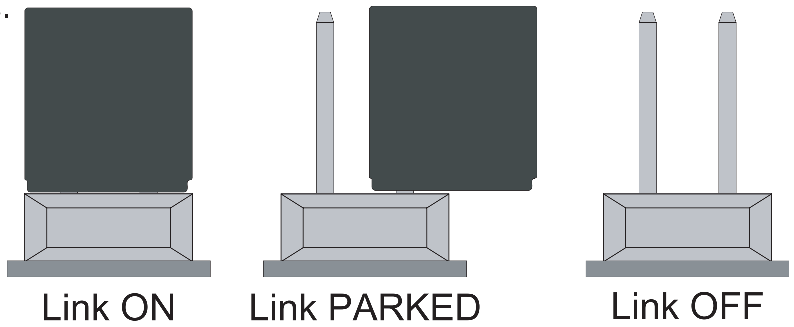
2.0 Installation (cont.)

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	3 kHz, 5 kHz, 10 kHz	Both links ON, 3 kHz
MT	Select synchronization 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 = 250 Hz, H = 500Hz	Link ON, 250 Hz
MATH	Enables math 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.

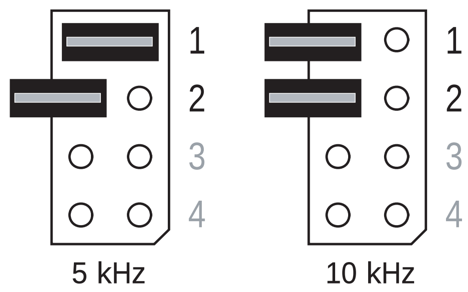


2.0 Installation (cont.)

2.4 Primary Frequency

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

Primary amplitude is not adjustable. The LVC 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 LVC 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 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 LVC has selectable bandwidth (BW). The bandwidth setting is independent of other LVC settings. Where possible, the lowest bandwidth setting should be used to minimize output noise.

250 Hz - Link ON
500 Hz - Link PARKED

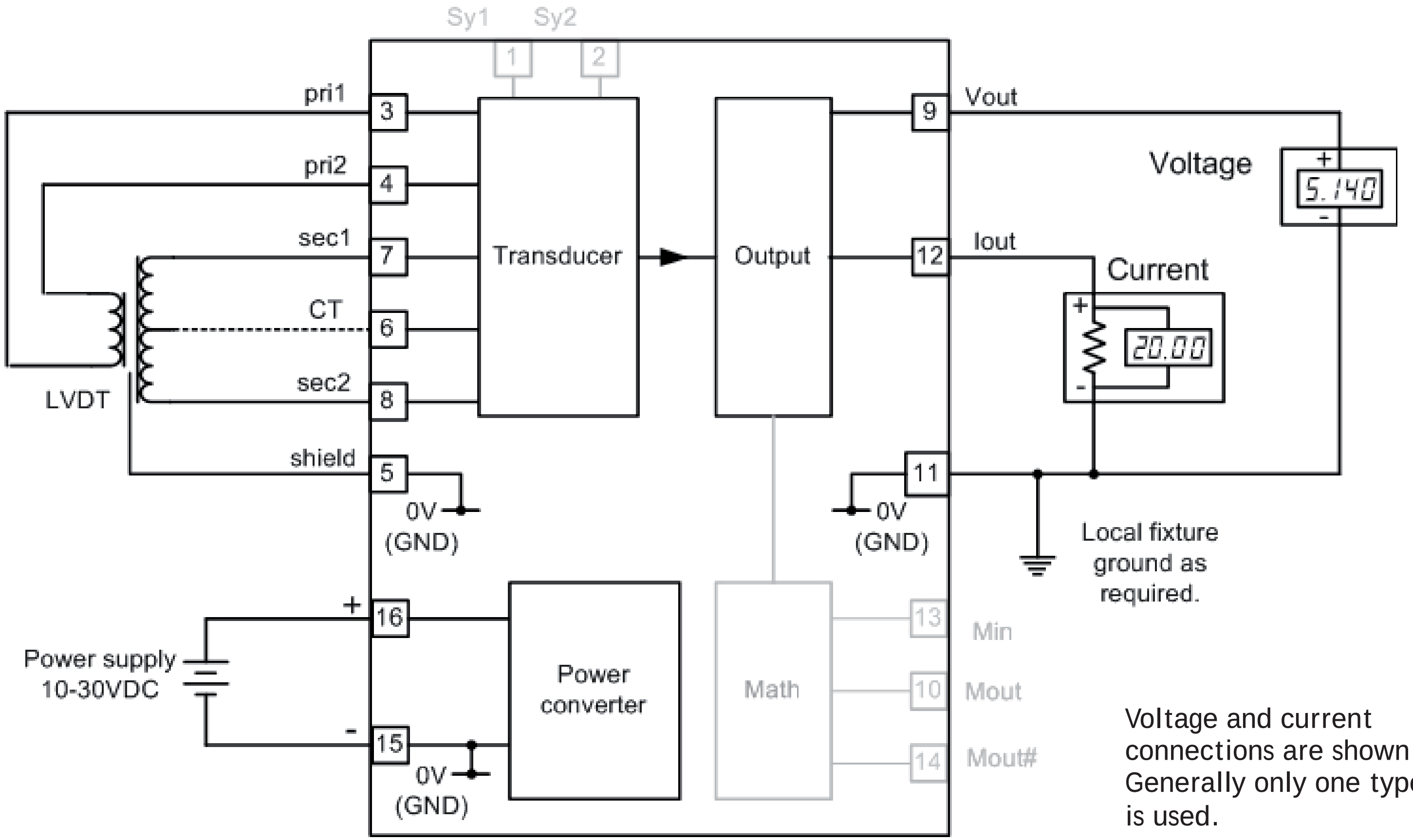
Note: Total system bandwidth is dependent on sensor type and application

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 minimize ground loop noise problems. Please refer to section 6.1 for a typical arrangement.

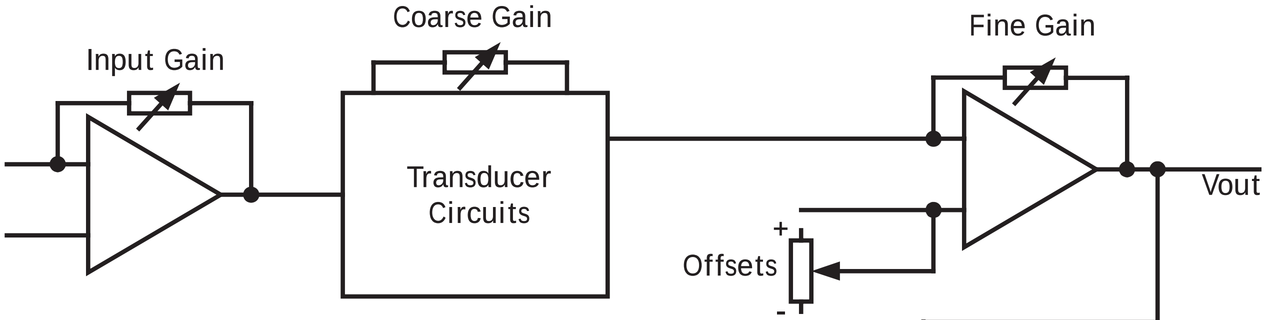


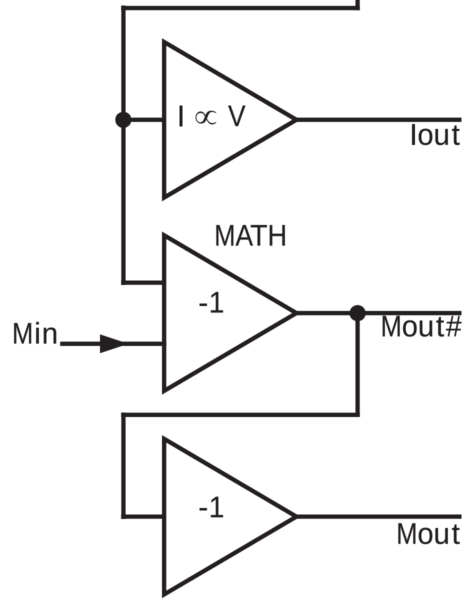
Voltage and current connections are shown. Generally only one type is used.

2.0 Installation (cont.)

2.8 Output Descriptions

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



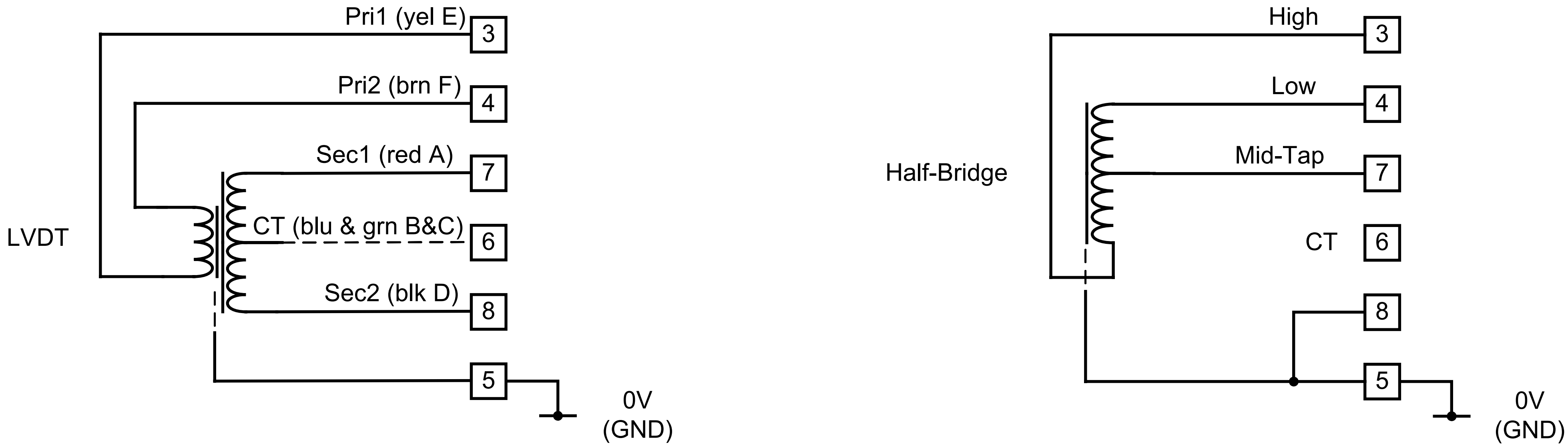


<table>
<tr><td>Vout</td><td>This is a voltage output. The gain and offset controls are used to set the required output range. All other outputs are affected by changes made to Vout.</td></tr>
<tr><td>Iout</td><td>This is a current output only, LVC is not loop powered. This can be set for up to ±20 mA. 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 scale factor or offset.

2.9 Connections

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



The CT terminal is provided to terminate the center tap (CT) connection of a transducer if present. There is no electrical connection within the LVC.

2.10 Placement and EMC

The LVC 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 LVC.

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 pair wire which is a cost-effective option giving good performance in this environment. Standard equipment wire (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. The LVC should be mounted inside an industrial steel enclosure designed for EMI shielding. Many enclosures, though metal, are not designed for shielding and so careful installation is important. Place the LVC away from equipment within the enclosure that is likely to produce high levels of EMI.

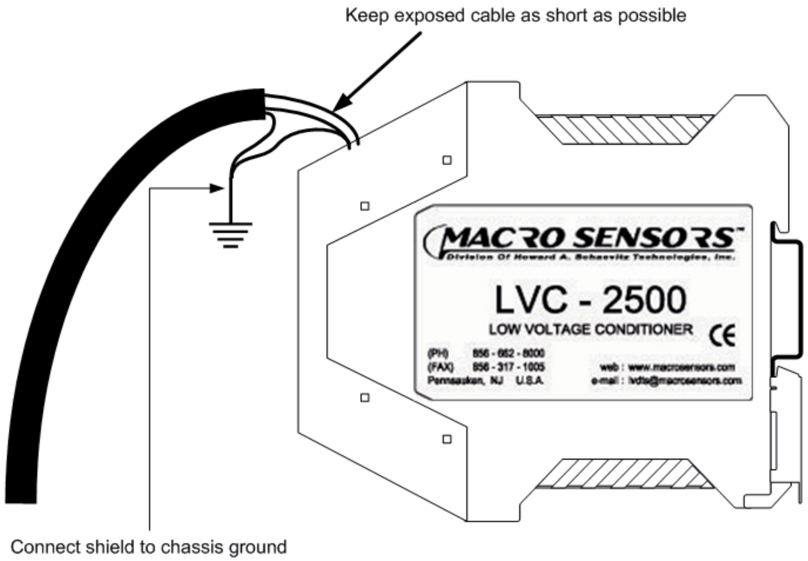
Connections should be made using a shielded cable (braided or foil schielded cables may be used). The cable shield should be connected to the housing at the cable entry point. An EMC cable gland is recommended. If this is not possible, then the unshielded section of cable should be kept as short as possible,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

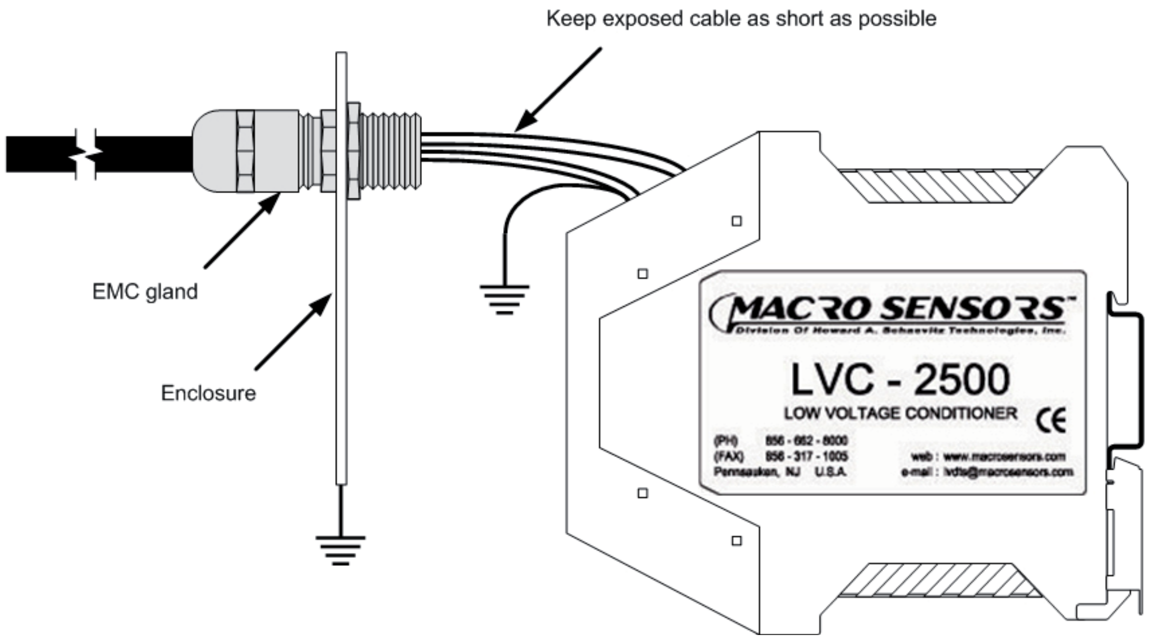
Where possible, the LVC should be the only ground connection point. If voltage, current or power supplies are ground referenced and connected at some distance from LVC, then noise may be introduced.

All Gnd terminals on LVC are connected internally. Only one local ground is needed for each LVC.

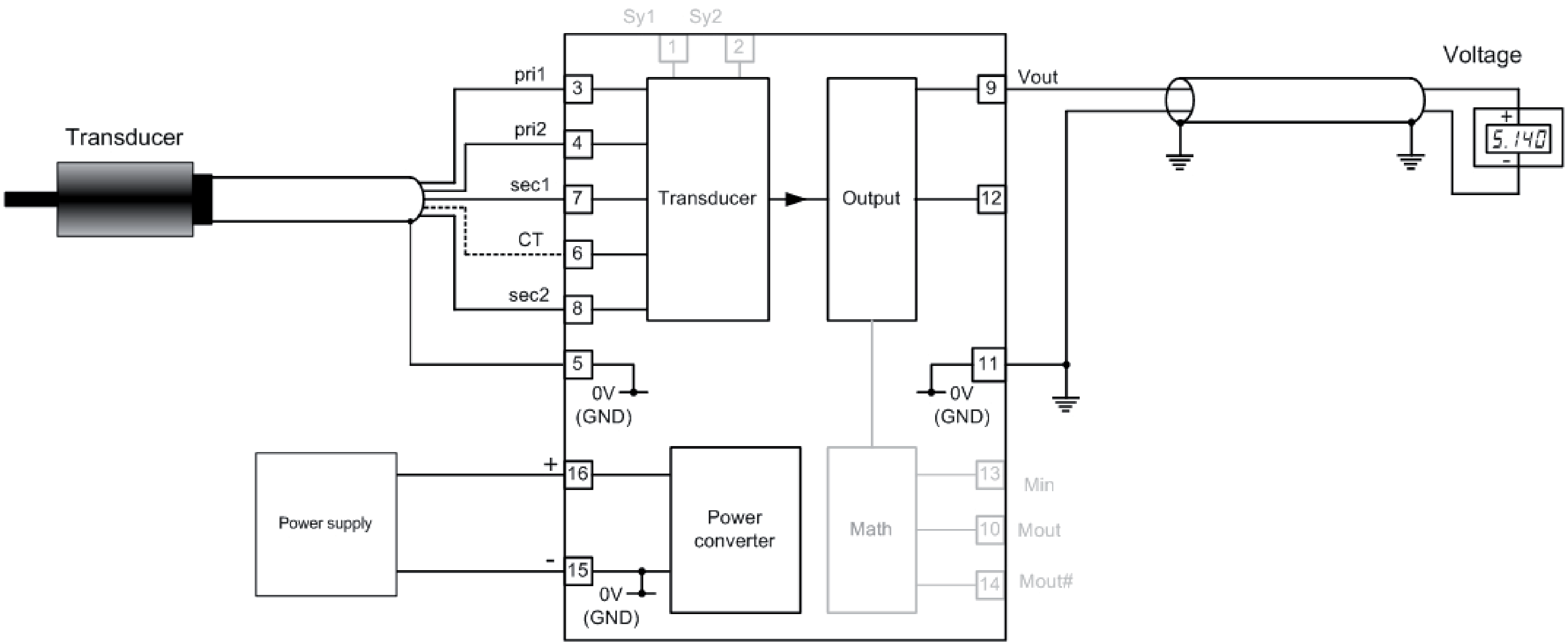
A local power supply is ideal but, if this is not possible, a shielded cable arrangement can be used to reduce noise picked up.

2.0 Installation (cont.)



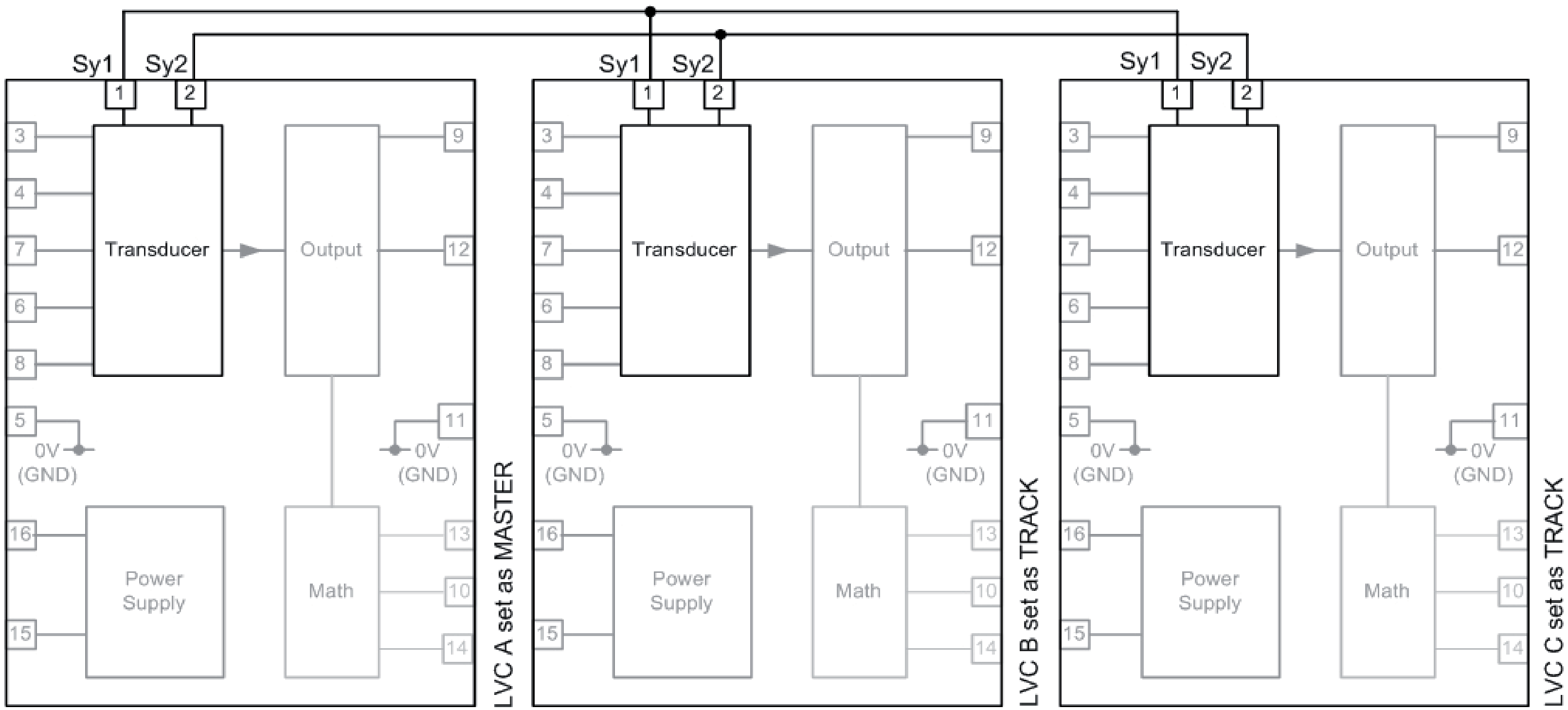


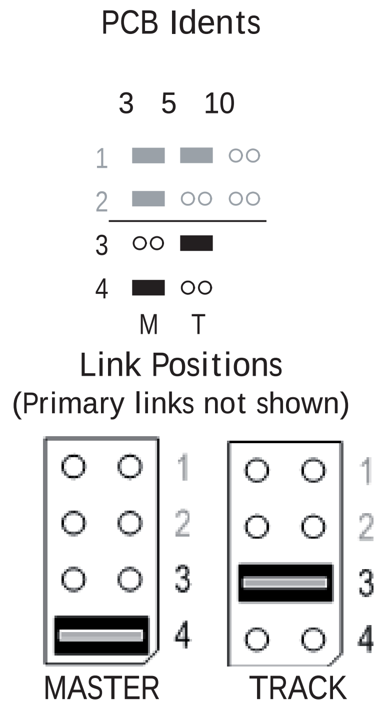
2.0 Installation (cont.)



2.11 LVC Synchronization

When a system comprises several LVC modules, it is possible to synchronize primary oscillator signals. Synchronization 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 sensors. This may be seen as a change in output from one module when the sensor connected to an adjacent module is moved. Even when sensors are installed close to each other, synchronization may not be required as cable shielding is generally effective. If interactions are seen, the cause is often poor ground or shield connection or mechanical effects between sensors when mounted together.

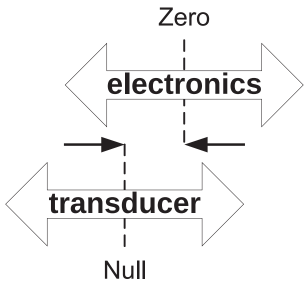
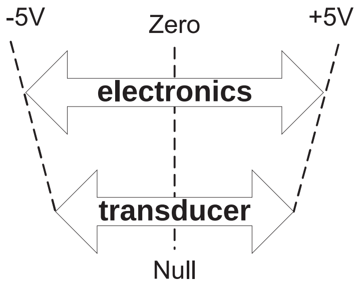
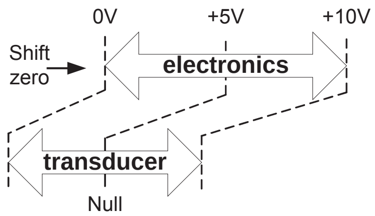




3.0 Setting Up

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* Primary frequency Transducer load Initial gain Bandwidth No offset* No MATH*	• Set LVC output to zero • Mechanically align transducer null 	• Move transducer to full scale position • Set LVC coarse and fine gain 	• Add offset if required • Set LVC coarse and fine offset 	• Final checks • Repeat steps 2 - 4 to check setting 

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

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 LVC links

If the transducer characteristics are known, set the frequency and input resistance links as required. If the transducer characteristics are not known, the factory default link settings should be used.

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

Step 2 - Mechanically align LVC and transducer null

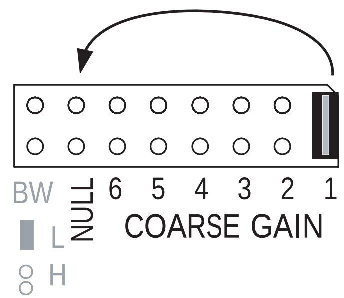
Any electrical offset in the LVC is removed. The transducer core position is adjusted so that transducer and LVC nulls are aligned.

Null the LVC

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 from null to the original position
4 Adjust the position of the transducer core to give as near zero output as practical. This is the center 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 LVC being set-up, although several iterations may be required when adjusting gain and offset.

3.0 Setting Up (cont.)

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

1 Move the transducer core to the position where maximum LVC output is required
2 If the output polarity is wrong, reverse the transducer primary connections (terminals 3 & 4). Move the transducer core back and re-check the zero position
3 Move the coarse gain link along from position 1 towards position 6 until the LVC 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 core 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 core to the null position. LVC 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 core to give ±5 V over the full range and then, with the transducer core at null, add +5 V offset. Adjust the fine offset to give 5 V. When the transducer core 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 core 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 core through 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.

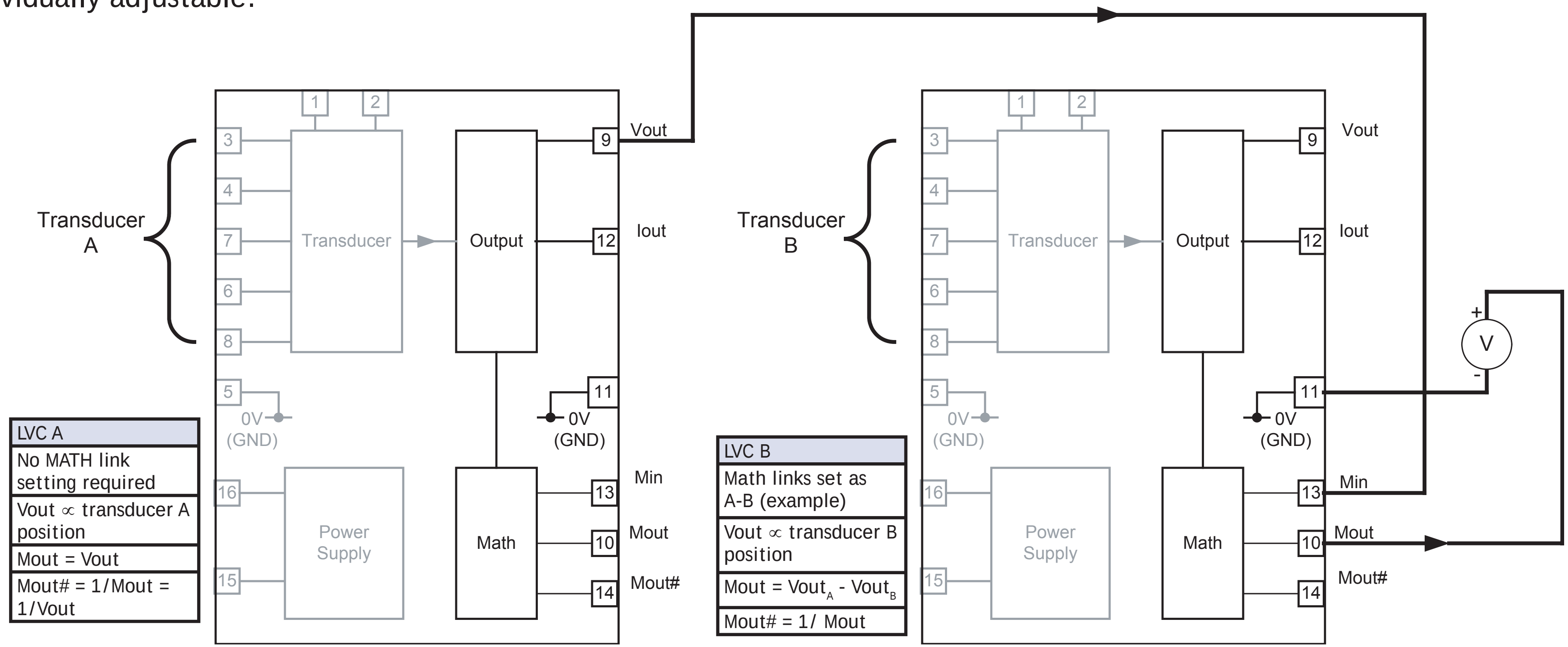
4.0 MATH Functions

4.1 MATH Introduction

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

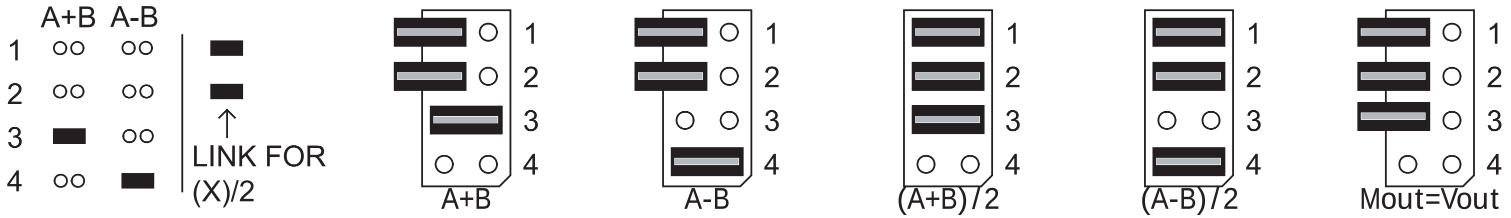
The output of LVC A, $Vout_A$, is connected to the Min terminal of LVC B. The output of LVC B is routed internally to the arithmetic circuits and the result is available at the Mout terminal.

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 LVC for MATH can become confusing as the output of each LVC 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 LVC to be determined. Vout of each LVC is used.

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

Step 2 - Initial set-up

Set up each LVC 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 LVC 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 LVC set for MATH.

5.0 Transducer Sensitivity

5.1 X2, X5 and DIV2 link

The LVC 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 LVC/transducer combination. For these transducers the X2, X5 or DIV2 input gain link must be used.

Calculating transducer Full Scale Output
In general, transducer sensitivity is quoted as V/V/inch where:

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

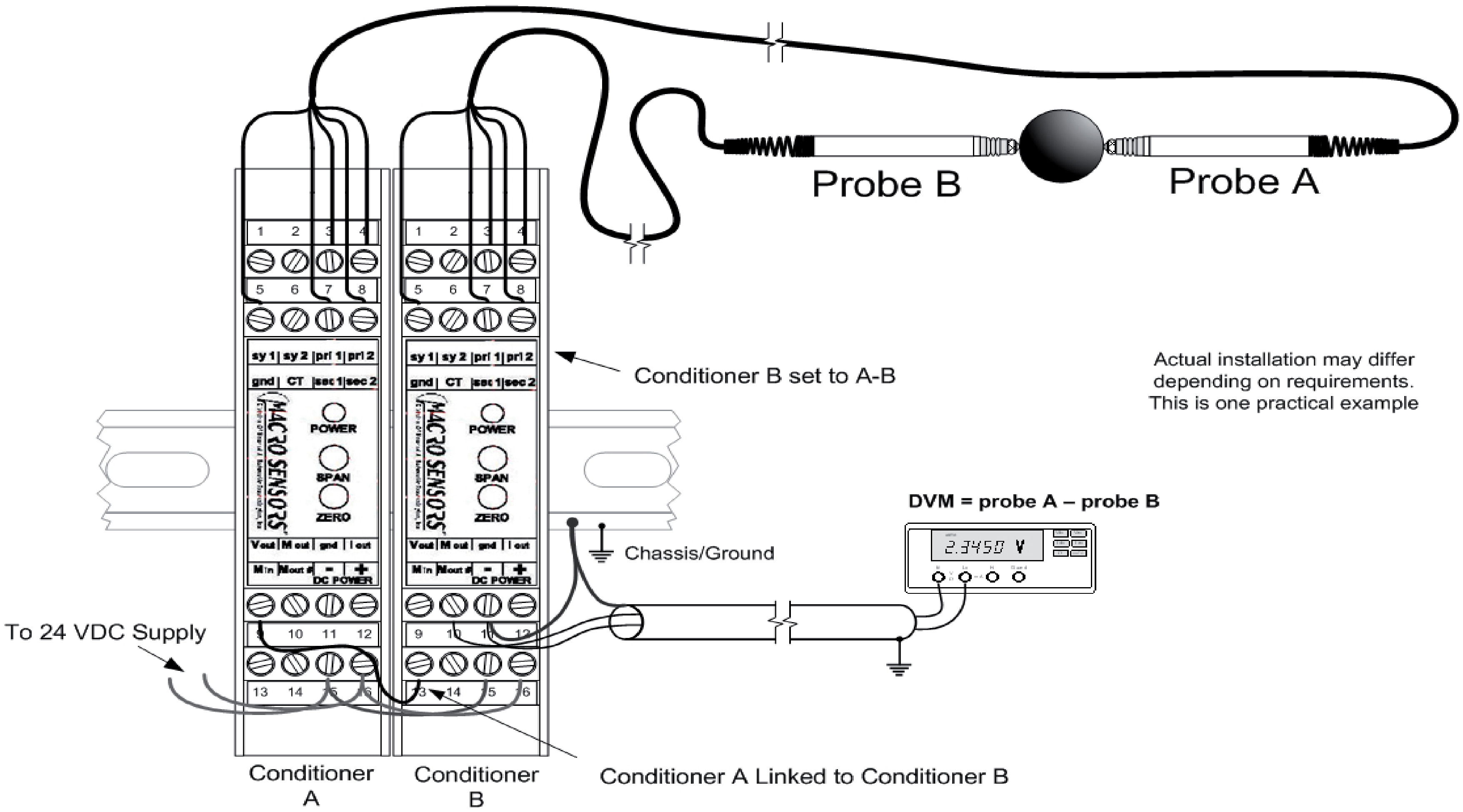
To calculate the transducer full scale output, simply multiply all three together.

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

Transducer Full Scale Output	Comment	Input Gain Link setting
400 mV FSO to 2500 mV FSO	Standard range	Link ON X1
150 mV FSO to 400 mV FSO	Low output transducer	Link ON X2
55 mV FSO to 150 mV FSO	Very low output transducer	Link ON X5
2500 mV FSO to 5000 mV FSO	High output transducer	Link ON DIV2

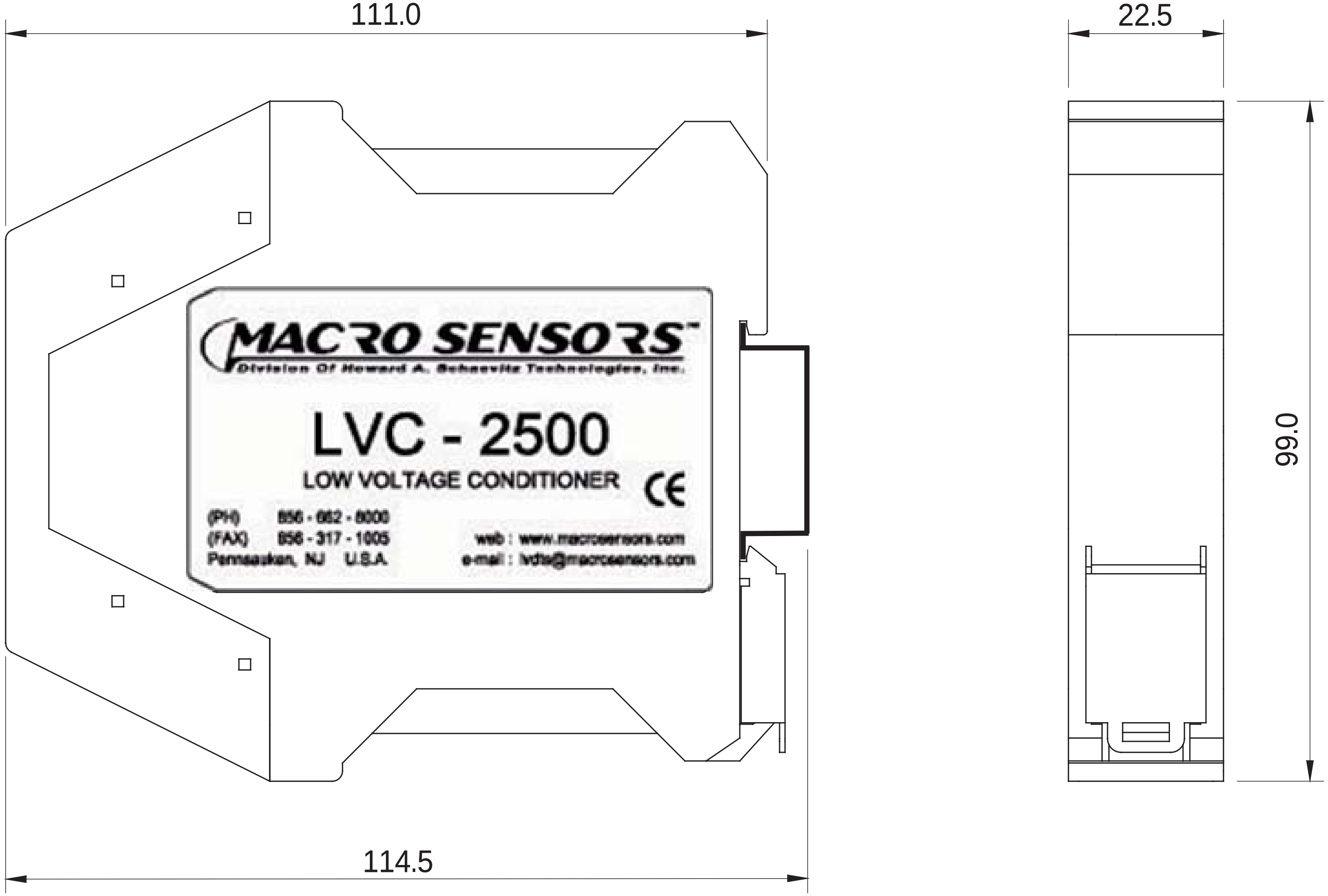
6.0 Application

6.1 Application 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	3 kHz, 5 kHz or 10 kHz
Primary Current		30 mA max.

Signal Input (Transducer Sensitivity Range)

Gain Range Link Select	Standard X1	400 to 2500 mV FSO (in 6 gain ranges)
	Special input gain X2	150 to 400 mV FSO
	Special input gain X5	55 to 150 mV FSO
	Special input gain DIV2	2500 to 5000 mV FSO
Input Load Resistance		100 kΩ, 2 kΩ[1]
Options		See note[2]

Signal Output

Voltage Output	Up to ±10 VDC[3, 4]		
Current Output	4 to 20 mA into a 550 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	250 Hz, 500 Hz
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)

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] Where load resistance is critical, an external resistor may be installed. If a 10 kΩ load is required an additional 11 kΩ resistor 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

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

[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 LVC. 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 LVC 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 the LVC means it can be installed in a variety of ways according to user requirements. Simple installations with short cables will meet the lesser light-industrial immunity regulations. Heavy industrial installations, especially with longer cables, will need more careful installation with shielded cable

Return of Product

Devices returned for service/repair/calibration should be shipped prepaid, Macro Sensors, USRT130N Bldg 22 Pennsauken, NJ 08110-1541 USA

The shipping container should be marked:
'**Attention Repairs**'

The following information should accompany the device(s):

1. Contact details of company/person returning device, including return shipping instructions.

2. Get an RMA number from Macro Sensors Customer Service Representative Call : 856-662-8000 or email sales@ macrosensor.com

3. Description of the device fault and the circumstances of the failure, including application environment and length of time in service.

4. Original purchase order number and date of purchase, if known.

Please note:

A standard assessment charge is applicable on all non-warranty devices returned for repair. Customer damage and any device found, upon inspection, to have no fault will be considered non-warranty.
Please contact Macro Sensors for warranty terms, service options and standard charges.
Adherence to these procedures will expedite handling of the returned device and will prevent unnecessary additional charges for inspection and testing to determine the condition.
Macro Sensors reserves the right to repair or replace goods returned under warranty.

Macro Sensors reserves the right to make changes without further notice to any products herein to improve reliability, function or design. Macro Sensors does not assume any liability arising out of the application or use of any product or circuit described herein, neither does it convey any license under patent rights nor the rights of others.

MACRO SENSORS™

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Innovators in Position Sensing

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