INSTRUCTION MANUAL

CD218
Dual Channel Carrier Demodulator

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SECTION I

GENERAL

1.0 DESCRIPTION

The Model CD218 is a low-cost Dual Channel Carrier Demodulator plug-in module for use with the Validyne Engineering Corporation's MC170 Systems. It is used for the demodulation and signal-conditioning of output signals from variable-reluctance transducers and differential transformer devices.

The CD218 will produce a ±10 VDC full-scale output from transducers having outputs of 15 mV to 100 mV per volt, when excited with a 5 volt 3 kHz carrier supplied from the MC170 Module Case. Both outputs are of low impedance and short-circuit protected.

The CD218 is designed for a standard frequency response from DC to 200 Hz. (Other frequency ranges can be factory installed as customer cost option).

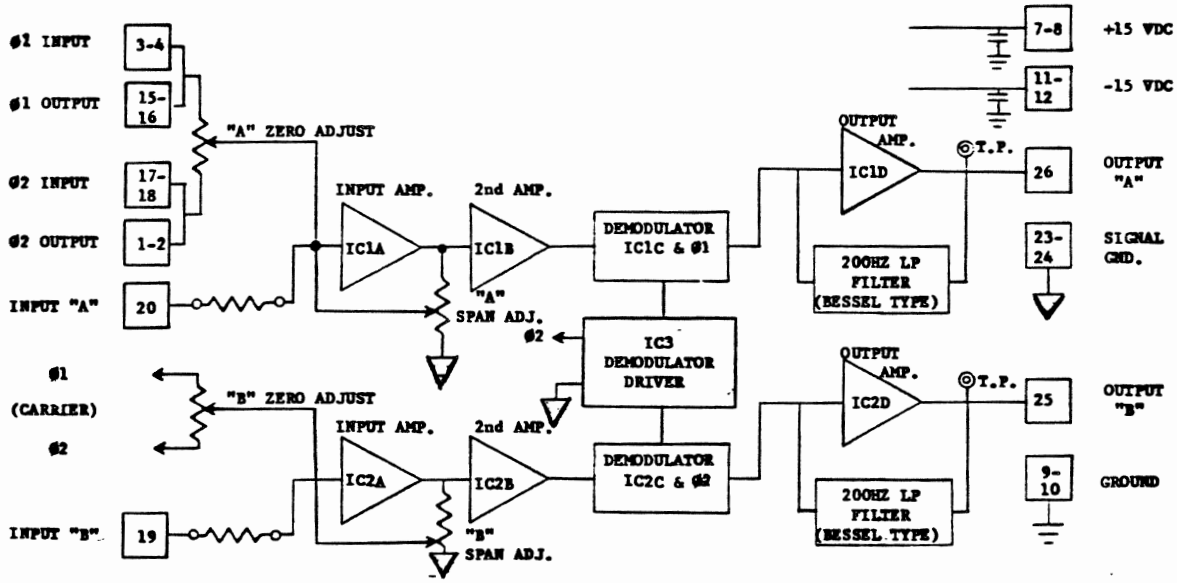


FIGURE 1

FUNCTIONAL BLOCK DIAGRAM

SECTION II

SPECIFICATIONS

2.0 ELECTRICAL

Input Sensitivity:	15 mV/V Minimum, 100 mV/V maximum
Sensitivity Control:	Continuously variable, 15 to 100 mV/V for 10 VDC output
Transducer Excitation:	5 V RMS, 3 kHz from a precision center tapped transformer
Input Impedance:	10 K OHMS
Controls accessible from panel.	
Zero Control:	10 mV/V front panel screwdriver adjustment
Span Control Range:	15 mV/V to 100 mV/V for 10 VDC output
Output A & B:	±10 volts DC @ 2 mA
Ripple & Noise:	10 mV RMS maximum
Output Impedance:	Less than 10 OHMS
Frequency Response:	DC to 200 Hz flat ±10%*
Linearity:	±0.05% F.S.maximum
Temperature Range:	0°F (-18°C) to 160°F (+70°C)
Thermal Zero Shift:	0.005%/°F
Thermal Sensitivity Shift:	0.01%/°F
Power Requirement:	5 V RMS, 3 kHz & ±15 VDC from MC170 (PS171 or PS176) Module Case

*Output Filter: The standard output filter on the Model CD218 provides a frequency response of 0-200 Hz. Other frequency responses are available.

2.1 MECHANICAL SPECIFICATIONS

Width:	0.45 in. Nominal (1.14 cm)
Height:	2.76 in. Nominal (7.0 cm)
Depth:	7.5 in. (19.05 cm)
Weight:	6 oz. (168 gms.) Nominal

Compatible with Validyne Engineering Corporation's MC170 Series System Module Cases.

CONTROLS:

Screwdriver adjustable Zero and Span controls and a DC output test point for each channel are located on the front panel. Use the system ground test point on the front panel of the power supply for the CD218 output ground.

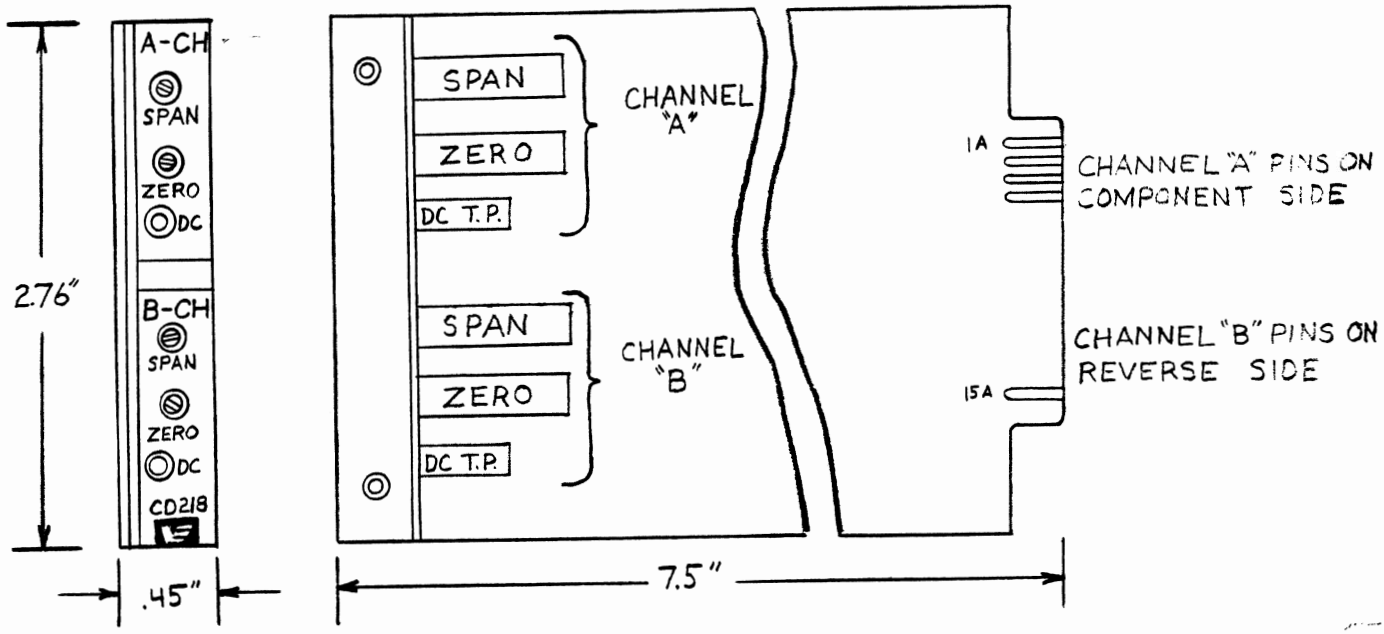


FIGURE 2

CONTROL PANEL LAYOUT

SECTION III

OPERATION

3.0 INSTALLATION & OPERATION

Model CD218 may be plugged into or out of the MC170 Module Case while the power is on. Transducers are connected to the Module Case as shown in the accompanying drawings. With zero stimulus on the transducer, the output may be adjusted to zero volts with the multi-turn screwdriver adjusted "Zero" control. With full-scale stimulus on the transducer, the output may be adjusted to 10 volts with the multi-turn screwdriver adjusted "Span" control.

The CD218 is designed for use with variable-reluctance transducers and differential transformer devices. The correct wiring procedure is as follows:

3.1 HALF-BRIDGE (TWO-ARM OPERATION) - VARIABLE-RELUCTANCE TRANSDUCERS.

Connect transducer as shown in Figure 3-1. With zero stimulus applied to the transducer, the output may be adjusted to zero volts with the 15-turn screwdriver adjust "ZERO" control. With full-scale stimulus applied to the transducer, the output may be adjusted to 10 volts with the 15-turn screwdriver adjust "SPAN" control. The resolution on both controls is at least 0.01% of full-scale.

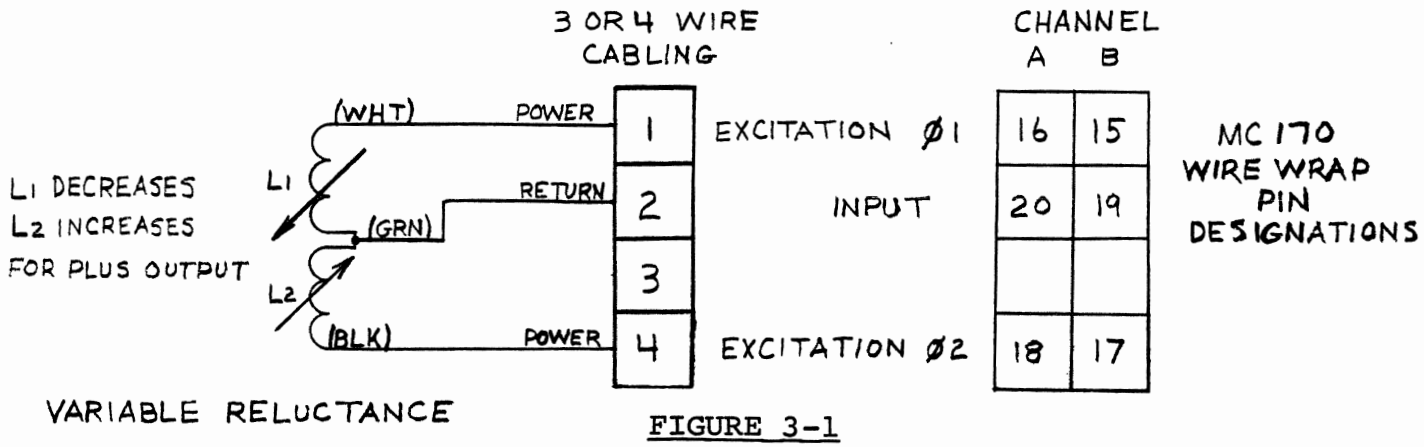


FIGURE 3-1

TRANSDUCER CONNECTIONS FOR HALF-BRIDGE, TWO-ARM OPERATION

3.2 LVDT/RVDT TRANSDUCERS - GENERAL

The LVDT/RVDT is an electromechanical transducer which produces an electrical output proportional to the displacement of a separate movable core. When the primary or center coil is energized with alternating current, voltages are induced in the two outer coils.

In the transformer installation, the outer or secondary coils are connected in series opposition so that the two voltages in the secondary circuit are opposite in phase, the net output of the transformer being the difference of these voltages. For one central position of the core, this output voltage will be zero. This is called the balance point or null position.

In practice, the output voltage does not quite become zero at the null position of the core because of small residual voltage components which do not cancel.

Variable differential transformers, either linear or rotary-position types, are high output devices. The actual output voltage in mV/V of the LVDT/RVDT can be determined by multiplying the sensitivity by the displacement in thousands of an inch.

Output Voltage = Sensitivity X Displacement

(mV/V) (obtained from mfg. data sheet) (obtained from Mfg. data sheet)

To avoid saturation of the CD218 input amplifier, three different methods of connection will be described in the following sections. The first method is for LVDT/RVDT output voltages from 15 mV/V to 100 mV/V (See paragraph 3-2A, Figure 3-2A). The second method is for output voltages from 100 mV/V to 600 mV/V (see paragraph 3-2B, Figure 3-2B) and the third method is for output voltages from

150 mV/V to 1000 mV/V (paragraph 3-2C, Figure 3-2C).

3.2A LVDT/RVDT Transducer Operation (Outputs less than 100 mV/V

Connect the LVDT/RVDT as shown in Figure 3-2A.

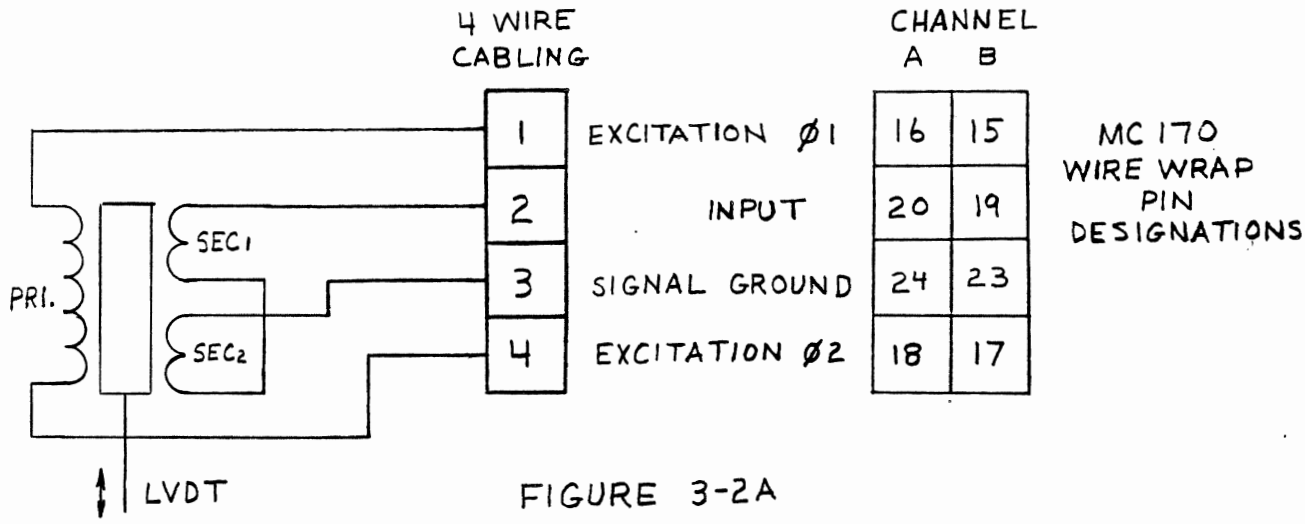


FIGURE 3-2A

To balance (null) the transducer, position the transducer actuating shaft or core in the zero, or null position. Connect an AC voltmeter (3 VAC range), or an oscilloscope (1 V/cm range) to the input terminal (wire 2 High - wire 3 Low). This is to monitor the LVDT/RVDT input to the CD 218.

NOTE: The residual signal at null may be up to 10% of the full-scale output signal, as observed at the input. If this condition exists, it may become necessary to mechanically move the actuating shaft or core slug very slightly to obtain the best mechanical null. If the actuating shaft or core is properly positioned, a minimum voltage level as measured at the input should occur with no additional balance resistors.

To set the Zero and full-scale outputs, use a DC Voltmeter (10 VDC

Scale) to monitor the A/B DC output test point on the front panel of the CD 218.

With the LVDT/RVDT in the null position, adjust the Zero control until the DC output voltage is 0.00 VDC.

To set the full-scale output, adjust the transducer actuator shaft or core to the desired full-scale position while observing the DC output level. If the DC output reaches 10 volts before full mechanical travel of the transducer is reached, reduce the SPAN control setting accordingly. With the actuating shaft or core in the desired full-scale position, the SPAN control is then adjusted to produce its precise output level.

3.2B LVDT/RVDT Transducer Operation 100 - 600 mV/V

Connect the LVDT/RVDT as shown in Figure 3-2B.

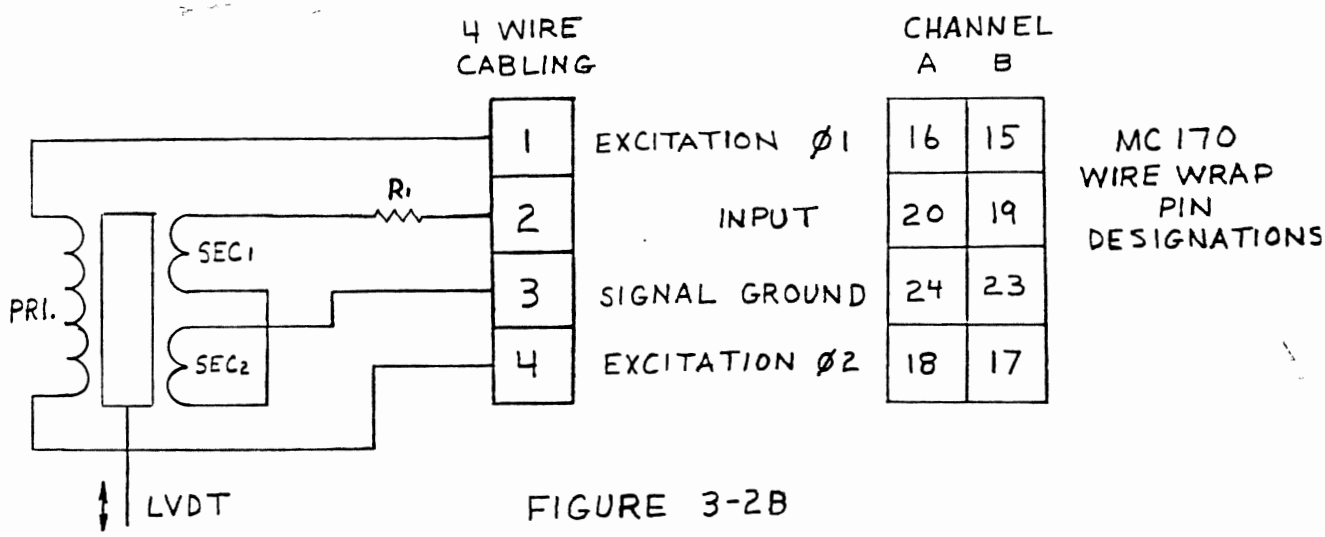


FIGURE 3-2B

Outputs greater than 100 mV/V may cause saturation of the CD 218 amplifier. The LVDT/RVDT may be used with a resistor attenuator network in the transducer cable to reduce the output to the usable input range of the CD 218.

Resistor R_1 may be calculated once the full-scale LVDT output is known. The input resistance of the CD 218 is 10 K OHMS, which forms an attenuator when R_1 is placed as shown in Figure 3-2B. The preferred location for R_1 is at the CD 218 end of the cable.

$$R_1 = \left(\frac{E_o}{E_{in}} - 1\right) 10 \text{ K}\Omega$$

Where E_o is LVDT full-scale output (mV/V), and E_{in} is CD 218 input (mV/V), where E_{in} must be between 15 and 100 mV/V. R_1 should be a metal film or wire wound resistor for good temperature stability.

3.2C LVDT/RVDT Transducer Operation (Outputs Greater Than 150 mV/V and Less than 1000 mV/V).

Outputs greater than 150 mV/V and less than 1000 mV/V may be connected as follows:

Connect a stepdown transformer between the excitation output and the transducer input as shown in Figure 3-2C. Further attenuation can be provided by resistor R_1 connected as shown. Full-scale output (the voltage between terminal 2 and the transformer center tap) should be scaled between a maximum of 100 mV/V and a minimum 15 mV/V.

TRANSDUCER CONNECTIONS FOR LVDT OPERATION. (LVDT'S OUTPUT IN EXCESS OF 150 mV/V WHEN DIRECT INPUT TO CD218 EXCEEDS 100 mV).

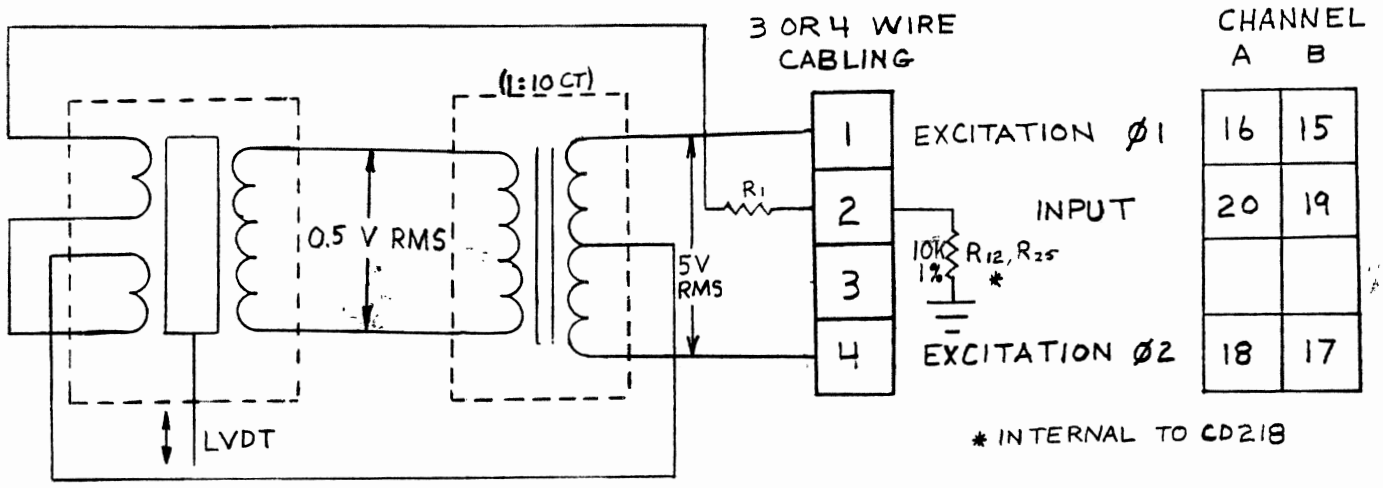


FIGURE 3-2C

TRANSFORMER
(EXAMPLE: TRIAD TY-33X
OR EQUIVALENT)

LVDT connection for use with CD 218 when output of LVDT is greater than 150 mV/V.

$$R_1 = \frac{(E_o - 100)\ \ 10\ K}{100}$$

Where E_o is LVDT output in mV/V. Use metal film or wire wound resistors.

3.2 D LVDT/RVDT ALTERNATE METHOD OF SIGNAL REDUCTION

Another method of reducing the signal at the CD218 is by installing a large capacitor in parallel at the CD218 input. This will virtually eliminate the effects of cable capacitance upon the

signal from the LVDT. Since the LVDT is a high-inductance device, the effective transmitting impedance is typically on the order of 5 K to 10 K ohms.

When adequate shunt capacitance is installed, the phase shift of the input signal is 180°, thus reducing the effective input signal level at the CD218.

3.3 INPUT & OUTPUT CONNECTIONS:

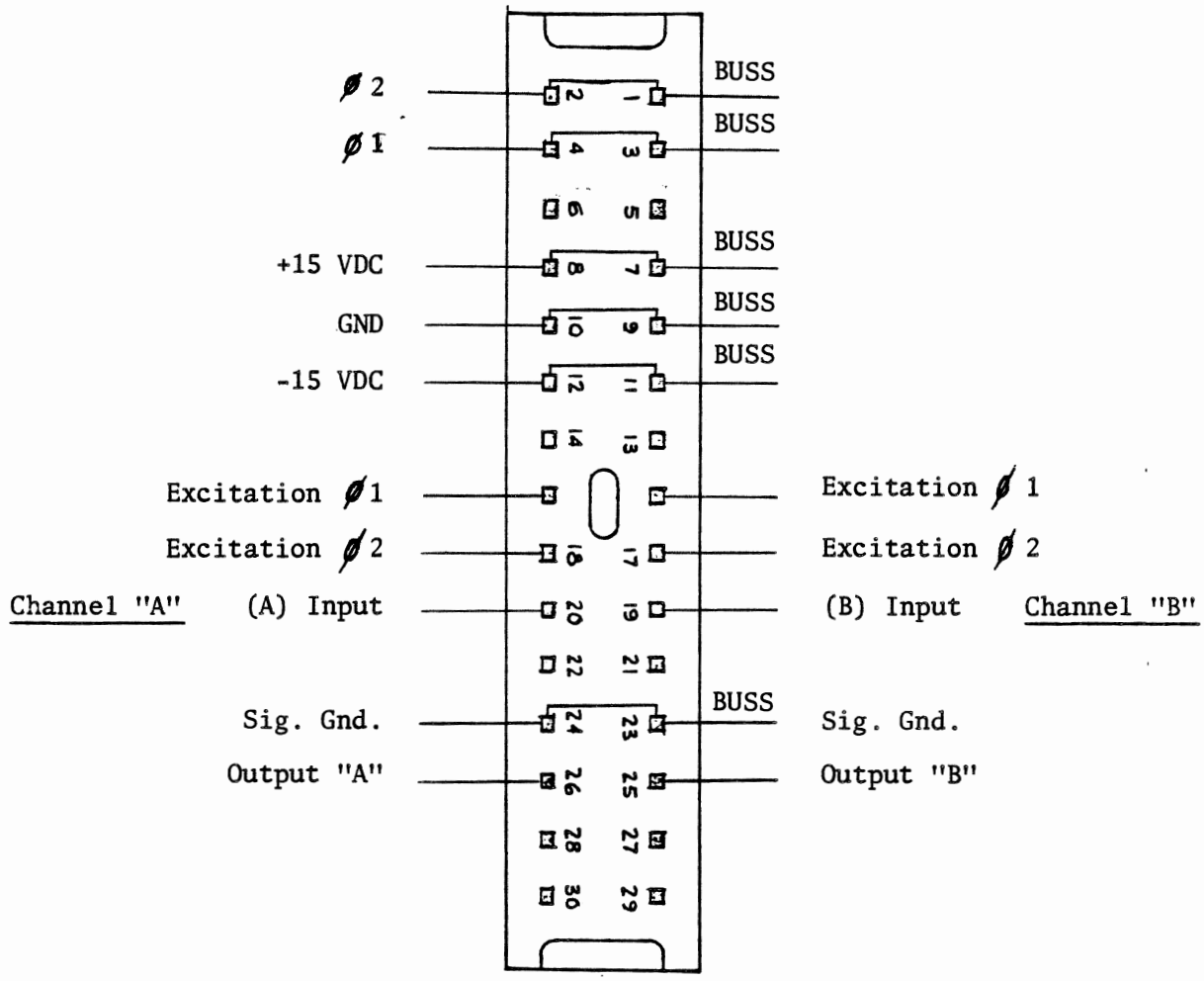
The transducers will be connected to the wire wrap terminals at the rear of the MC170 Module Case. There are several optional methods available for simplifying transducer input-output connections, such as MS connectors,screw terminal strips, bayonet connectors.

The transducers can then be wired directly/indirectly in accordance with the wire wrap terminal diagram as shown in Figure 3-4.

Figure 3-5 illustrates the suggested cabling method of connecting the transducer to the MC170 Module Case.

Figure 3-6 illustrates the cable arrangements (both acceptable and unacceptable). Cable shields should be connected to the shells of the mating connectors. In cases where the transducer body is grounded, the shield connection at the transducer end should be left open in order to eliminate noise from possible ground currents.

Input and Output Connections: (Accessible through Printed Circuit Board Connector at rear of MC170 Module Case.)

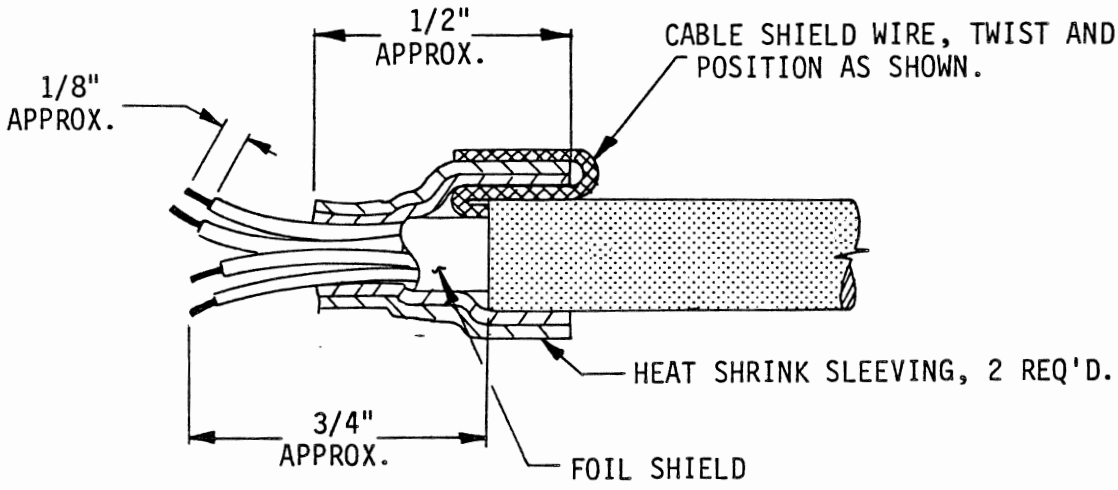


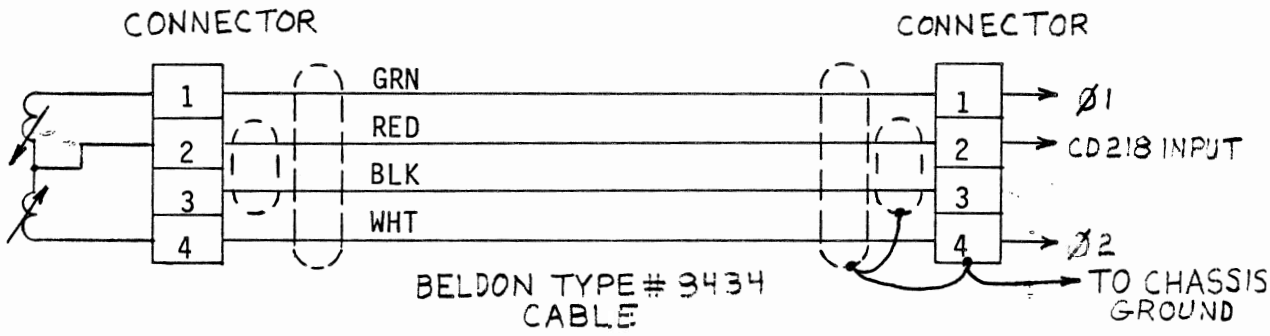
Printed Circuit Board Connector

As Viewed from Rear of
MC170 Module Case

(WIRE-WRAP TERMINAL DESIGNATION)

FIGURE 3-4





NOTES:

1. Cable shield should make contact with connector at cable clamps.

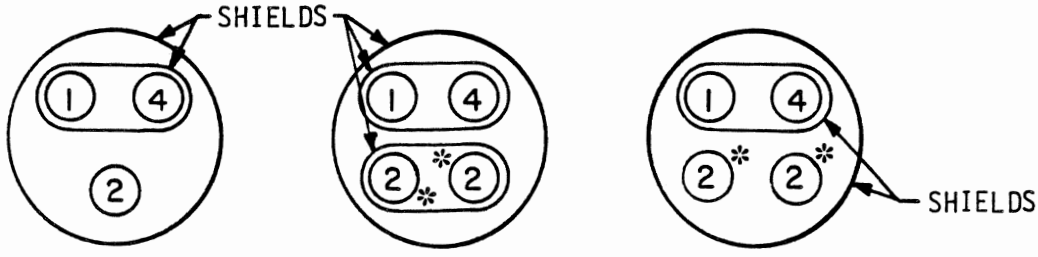
2. Leads for wires 1 and 4 should be in one shielded pair, signal wires 2 and 3 in the other shielded pair (provided two pairs are used).

FIGURE 3-5. FABRICATION OF TRANSDUCER CABLE

SUGGESTED CABLE ARRANGEMENTS FOR VARIABLE RELUCTANCE TRANSDUCERS

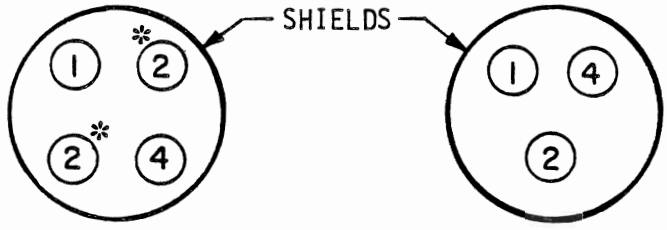
LEAD IDENTIFICATION: 1 - CARRIER EXCITATION
2 - OUTPUT SIGNAL
4 - CARRIER EXCITATION

*Signal lead can be either lead shown.



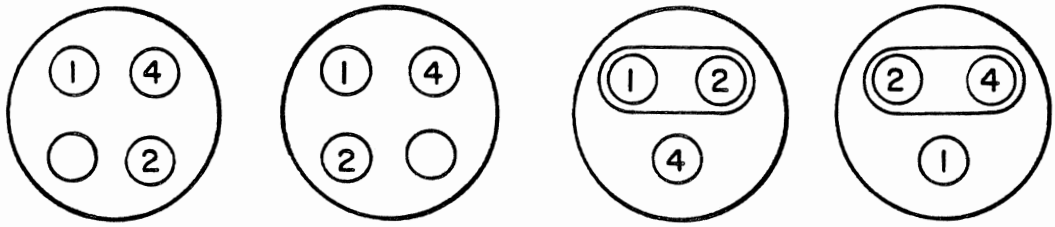
PREFERRED CABLE TYPES & ARRANGEMENTS

(Lengths to 1,000 ft. or more)



ACCEPTABLE CABLE TYPES & ARRANGEMENTS

(Lengths to approx. 100 ft.)



Unequal distance between signal lead and each carrier lead - capacitive unbalance

One carrier lead and signal lead in common shield - large capacitive unbalance

NOT RECOMMENDED

FIGURE 3-6

SECTION IV

PRINCIPLES OF OPERATION

4.0 PRINCIPLES OF OPERATION (See Figure 1)

The Model CD218 Dual Channel Carrier Demodulator amplifies, demodulates, and filters transducer signals. The transducer output (a carrier modulated signal) is fed into an AC Gain Amplifier (ICIA) where the signal is summed with the output from the zero potentiometer. Any residual output from the transducer may be nulled out by adjusting the Zero Control. The amplifier gain is adjusted by the span control potentiometer.

The second stage amplifier (IC1B) raises the signal level for input to the demodulator. The demodulator synchronously rectifies the carrier modulated signal producing a moderate ripple D.C. signal that is proportional to the transducer output. Square wave excitation to drive the demodulator switches (Q1 & Q2) is derived from the sinusoidal carrier signal by the zero crossing detector IC3.

The last stage of signal conditioning (IC1D), is the output amplifier and active 3-pole filter. The demodulated signal is fed to a 200Hz Bessel low pass filter network to remove remaining 6KHz ripple. The signal is current limited and capable of driving long cables without instability.

After amplifying, smoothing and filtering, the signal is ready for readout device presentation at ± 10Vdc.

Both channels function identically so that by substituting IC2 for IC1 in the discussion, channel B operation is described.

4.1 LONG-CABLE OPERATION

The Model CD218 will operate with over 1000 feet of cable between each transducer and the demodulator. Cables longer than 1,000 feet may be used with low-capacity cable.

For cables with all three conductors in the same shield, the critical factor is capacity balance between the output lead and each of the carrier leads. If a cable with a separate shield for the transducer output is used, the critical factor is total capacitance to ground.

The transducer source impedance is inductive; increasing the cable capacity causes the transducer output to increase up to the point where the capacity and the series inductance resonate. Increasing the capacity still further causes the output to decrease and produce an excessive phase shift.

NOTE: 1. See Figure 3-6 for preferred cable arrangements.

2. For optimum sensitivity, calibration should be accomplished with the actual cable to be used since length variations can affect calibration.

4.2 OUTPUT FILTER (Bessel type)

The standard 3-pole Bessel output filter on the Model CD218 provides a frequency response of 0-200 Hz. Other frequency responses are available.

SECTION V

REPAIR

5.0 REPAIR

The Model CD218 as a function of its basic design does not require periodic recalibration or maintenance, as such. If abnormalities in performance occur which cannot be corrected by calibration and adjustment procedures, the unit should be returned to the factory, transportation PREPAID, for evaluation and repair.

Turn around time will be improved when, along with a brief statement about the malfunctions or performance degradation, information regarding purchase order date and number are enclosed with the instrument.

An estimate of repair costs, if applicable, will be provided prior to commencement of work.

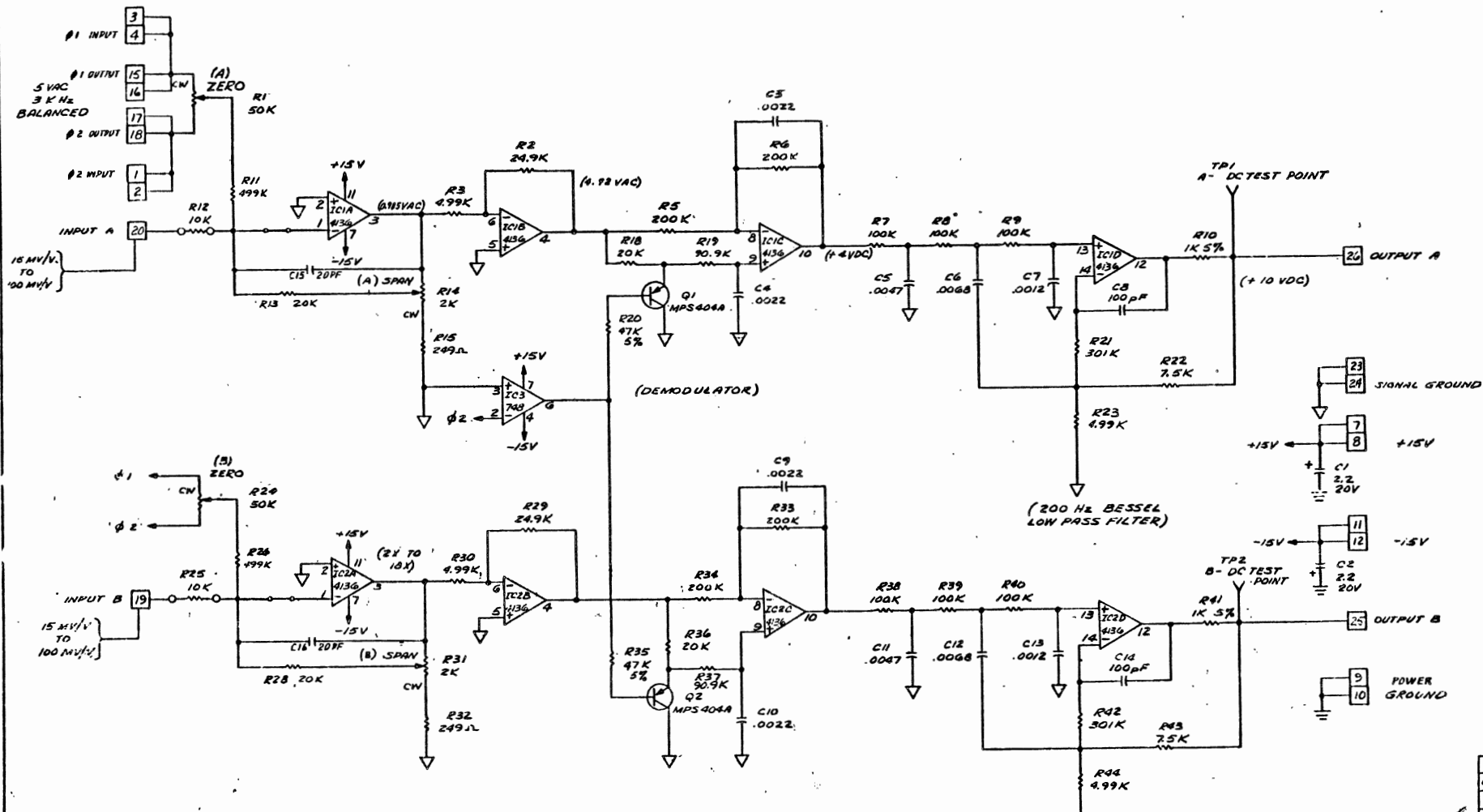
Warranty repairs will be handled as outlined in Validyne Engineering Corporation's Warranty Policy contained elsewhere in this manual.

Address all shipments and correspondence regarding returned units to:

VALIDYNE ENGINEERING CORPORATION
8626 Wilbur Avenue
Northridge, California 91324

Attention: Repair Department

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED
A	SEE DCN		
B	SEE DCN		
C	SEE DCN	3-21-79	JLF ED
D	SEE DCN	11-21-79	GWE ED



3. POWER GROUND (⏚) & SIGNAL GROUND (⏚) TIE TOGETHER AT POWER SUPPLY.
2. CAPACITOR VALUES ARE IN MICROFARADS.
1. RESISTOR VALUES ARE IN OHMS ± 1% 1/8 WATT.

NOTES: UNLESS OTHERWISE SPECIFIED.

HIGHEST REF DES USED						
C16	IC4	IC3	Q2	D4	T2	
REF DES NOT USED						
R45, R46, R47, R27						

CODE IDENT NO. 33107

Validyne ENGINEERING CORPORATION

SCHEMATIC

WARRANTY

VALIDYNE ENGINEERING CORPORATION warrants equipment of its own manufacture to be free from defects in material and workmanship under normal conditions of use and service.

VALIDYNE will rework or replace any item found to be defective on as return to VALIDYNE within the time specified below:

1. Pressure Transducers and Pressure Transmitters (including transducers supplied as part of Digital Manometer Systems) within three (3) years of its original purchase.

2. Electronics products (Transducer Indicators, Carrier Demodulators, plug-in SignalCondioners, Module Cases, etc.) within one (1) year of its original purchase.

3. OEM Transducers within one (1) year of its original purchase.

Buyer is requested to secure authorization of VALIDYNE, and to describe defect prior to return of equipment under warranty. Shipment to VALIDYNE shall be at Buyer's expense, with return at VALIDYNE's expense. NON-VERIFIED problems or malfunctions, whether warranty or not, are subject to a $100.00 evaluation charge.

The warranty carries no liability, either expressed or implied, beyond our obligation to rework or replace, at VALIDYNE's option, the unit which carries the warranty to the original purchaser. Prices, specifications, and designs are subject to change without notice. This warranty is void if the product is subjected to misuse, accident, neglect, or improper application or operation.

Out of Warranty Rework

Units returned to VALIDYNE for rework which are out of warranty will be subject to the following conditions:

1. A description of the problem or malfunction shall accompany the unit returned for rework, or be communicated to VALIDYNE prior to shipment. Otherwise there will be a minimum evaluation and/or calibration charge of $100.00.

2. Unit will be reworked automatically if the charge is less than 65% of current list price, unless other specific instructions are received. Above 65% VALIDYNE will request authorization by Buyer.

3. If a quotation is required before proceeding with rework, unit should be accompanied by a document so stating, or communicated to VALIDYNE prior to shipment. A $100.00 evaluation charge will be invoiced for this service.

4. Shipping charges in both directions are the responsibility of the Buyer for all out of warranty returns.

Warranty on Rework

Warranty coverage on rework is 90 days on work done, or to the end of the original warranty period, whichever is longest.

8626 Wilbur Avenue - Northridge, CA - 91324
818-886-2057 - Toll Free 800-423-5851 - Automatic Fax 818-886-6512