CD18
Carrier Demodulator
Module

SECTION II

SPECIFICATIONS

2.1 ELECTRICAL

Input Sensitivity:	15 mV/V to 75 mV/V for F.S. Output
Sensitivity Control:	0 to 50 mV/V
Bridge Excitation:	5 V rms 3 kHz from a precision center tapped transformer
Bridge Configuration:	2-arm variable-reluctance transducer
Input Impedance:	100 k ohms
Zero Control:	±5 mV/V front panel screwdriver adjustment
Span Control Range:	15 mV/V to 75 mV/V for 10 VDC output
Output A:	±10 volts DC @ 10 mA
Output B:	±5 mVDC @ 0.5 mA (short circuit)
Output Impedance:	Less than 10 ohms
Frequency Response:	DC to 200 Hz flat ±10%*
Linearity:	±0.05% F.S. maximum
Temperature Range:	0^{o}F (-18^{o}C) to 160^{o}F (-70^{o}C)
Thermal Zero Shift:	0.005%/^{o}F
Thermal Sensitivity Shift:	0.01%/^{o}F
Power Requirement:	5 V rms, 3 kHz and ±15 VDC from MC1 Module Case

*See Appendix for options

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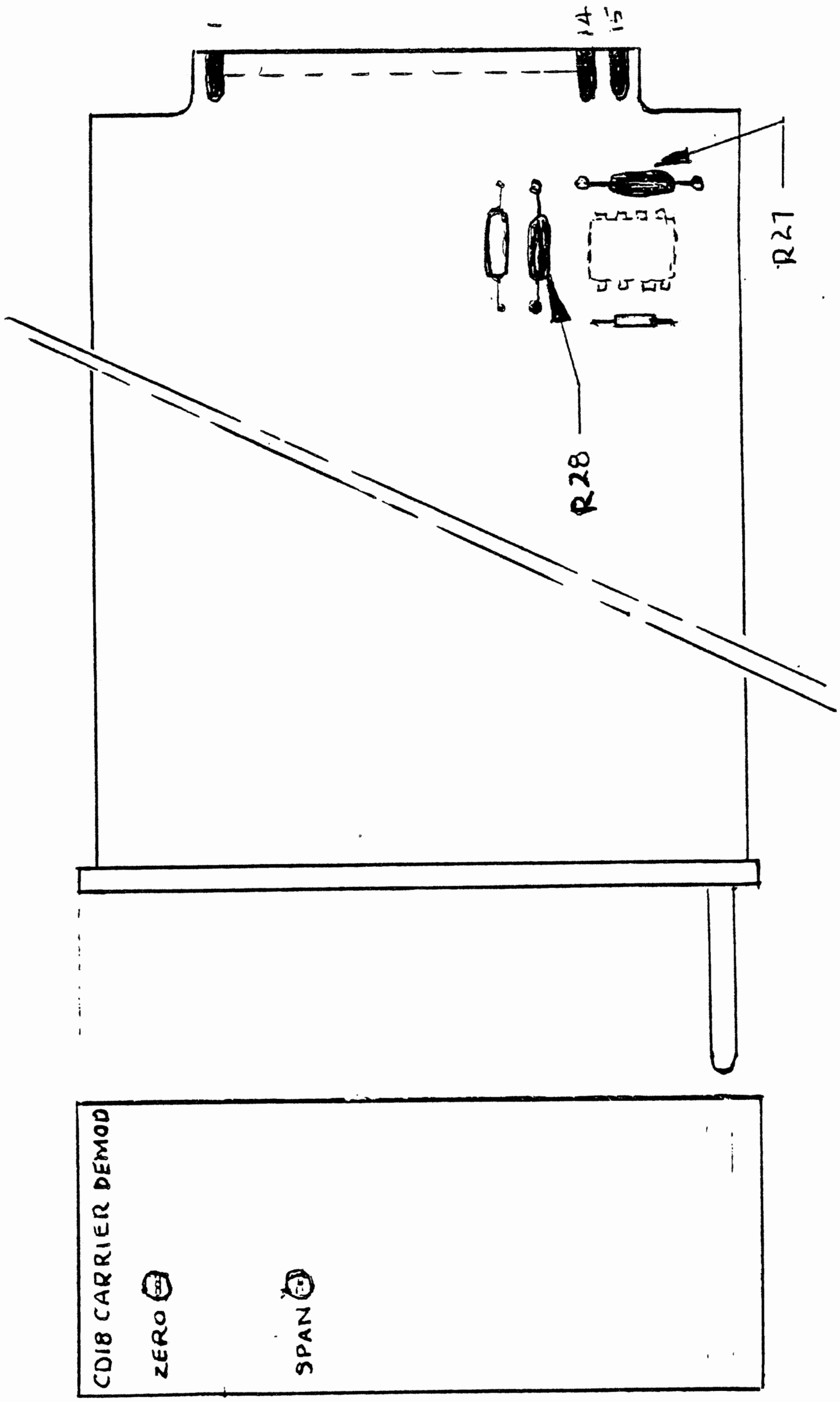

FIG 1
CD18 COMPONENT LAYOUT

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SECTION III

INSTALLATION AND OPERATION

3.1 INSTALLATION

The Model CD18 may be plugged into or out of any available channel of the MC1 Module Case while power is on without damage and without affecting the adjacent channels.

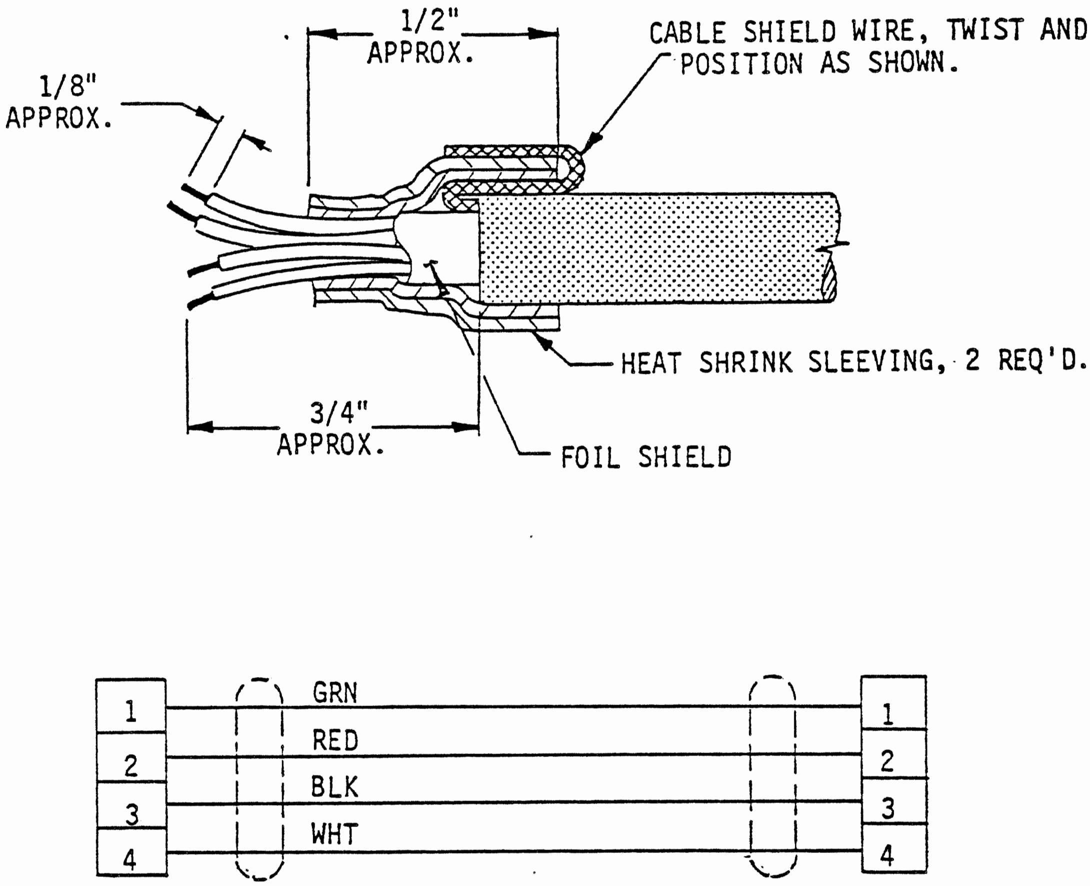
3.2 INPUT AND OUTPUT CONNECTIONS

Transducers are connected to the CD18 by means of the Wk-4-32S connector on the back of the MC1 Module Case. The CD18 outputs A and B come from separate XLR-3-32S connectors on the back of the MC1 Module Case. Table 3-1 describes the transducer pin connections. Figure 3-1 illustrates the suggested cabling method of connecting the transducer to the MC1 input connections. Figure 3-2 illustrates the cable types (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.

TABLE 3-1. MC1 TRANSDUCER INPUT PIN CONNECTIONS

MC1 INPUT CONNECTIONS (WK4)	
Pin No.	Function
1	5 volt rms, 3 kHz carrier
2	+ Input signal from transducer
3	- Input signal from transducer
4	5 volt rms, 3 kHz carrier
MC1 OUTPUT CONNECTIONS (XLR)	
Pin No.	Function
1	Output
2	Circuit Ground
3	Chassis Ground

NOTE: Pin connections are the same for both Output A and B.



NOTES:

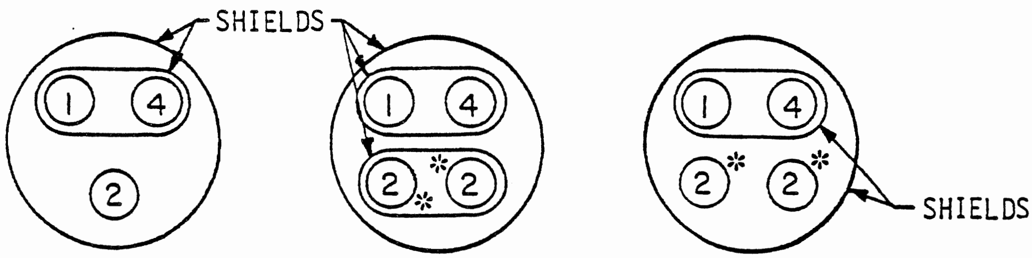
1. Cable shield should make contact with connector at cable clamps.

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

Figure 3-1. Fabrication of Transducer Cable.

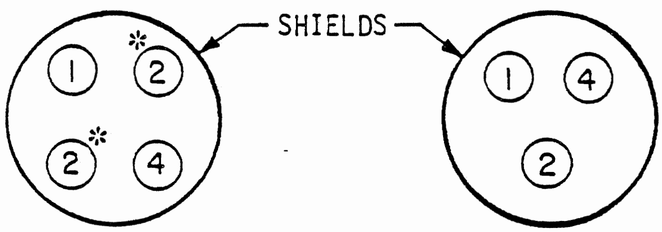
LEAD IDENTIFICATION: 1 - CARRIER EXCITATION
2 - OUTPUT SIGNAL
4 - CARRIER EXCITATION

*Signal lead can be either lead shown



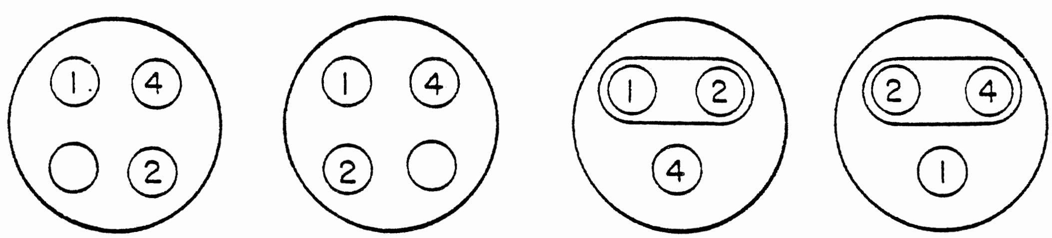
PREFERRED CABLE TYPES & ARRANGEMENTS

(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 3-2. TRANSDUCER CABLING

NOTE: Figures 3-3 through 3-5 describe the different methods of connecting the variable reluctance and LVDT/RVDT transducers to the MC1 input connector.

3.3 OPERATION (See Figure 1-1 for component locations.)

3.4 HALF-BRIDGE (TWO-ARM OPERATION) -- VARIABLE RELUCTANCE TRANSDUCERS

A. Connect transducer as shown in Figure 3-3. 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.

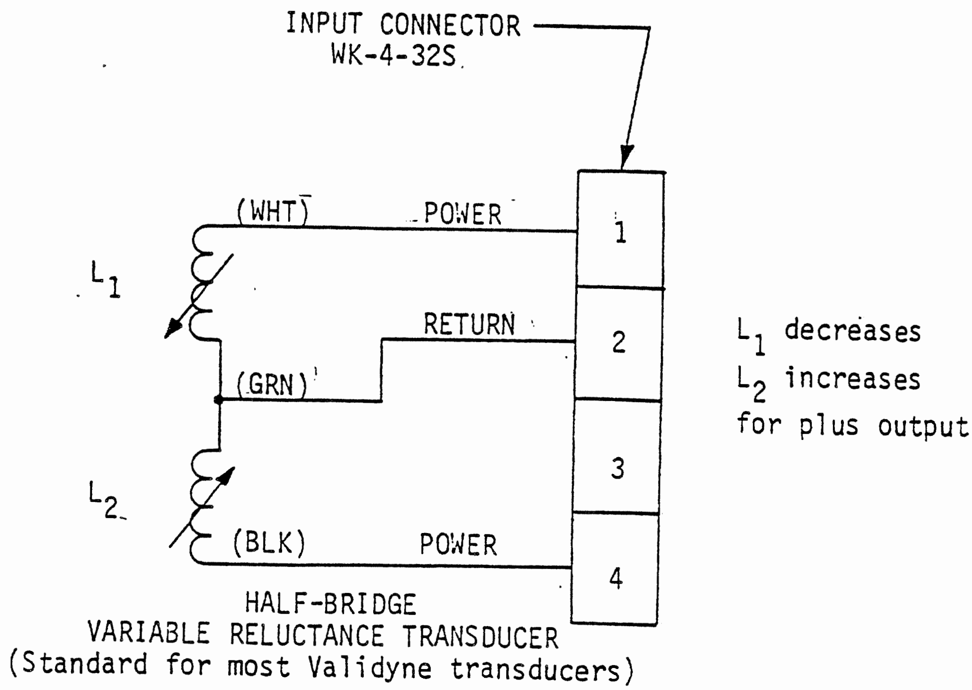


FIGURE 3-3

TRANSDUCER CONNECTIONS FOR HALF-BRIDGE, TWO-ARM OPERATION

3.5 EXTERNAL BALANCE

In the event the transducer output cannot be adjusted to zero, due to cable unbalance or residual stimulus on the transducer, additional balance capability may be obtained by connecting Pin 3 through an appropriate resistor value, to either Pin 1 or Pin 4 on the WK4 connector on the MC1 rear panel.

Connecting Pin 3 to Pin 1 will move the balance positive; connecting Pin 3 to Pin 4 will move the balance negative. The maximum shift occurs when these pins are directly connected. This shift is equivalent to approximately 29 mV per volt.

3.6 LVDT/RVDT TRANSDUCERS -- GENERAL

A. 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)

B. To avoid saturation of the CD18 input amplifier, two different methods of connection will be described in the following sections. The first method is for LVDT/RVDT output voltages less than 166 mV/V (paragraph 3-7, Figure 3-4), and the second method is for output voltages greater than 166 mV/V (paragraph 3-8, Figure 3-5).

C. 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.

D. LVDT/RVDT TRANSDUCER OPERATION (OUTPUTS LESS THAN 166 mV/V)

Connect the LVDT/RVDT as shown in Figure 3-4.

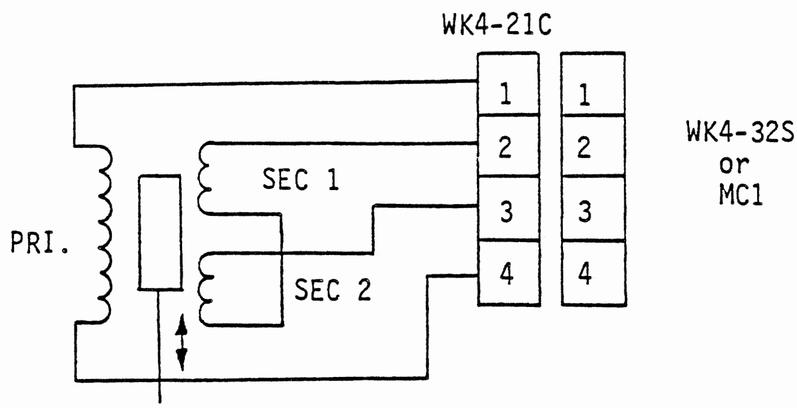


FIGURE 3-4

E. 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 (Pin 2 - High -- Pin 3 Low -- WK4 connector).

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. Proper phasing can be verified by following the procedure in paragraph 3.5. 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.

F. To set the full-scale output, monitor the output at the "A" output connector (Pin 1 - Output -- Pin 2 - Ground) using a DC voltmeter (10 VDC scale).

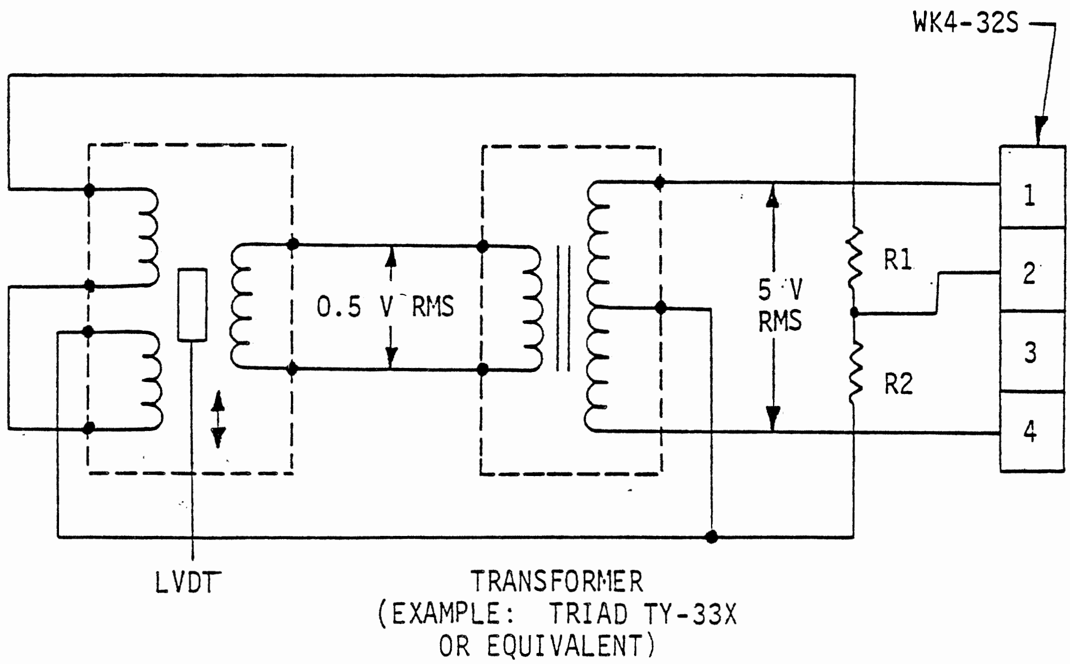
Adjust the transducer actuator shaft or core to the desired full-scale position while observing the DC output level. If the DC output reaches 10 volts before full mechanical travel of the transducer is reached, reduce the SPAN control setting accordingly. With the actuating shaft or core in the desired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

G. LVDT/RVDT TRANSDUCER OPERATION (OUTPUTS GREATER THAN 166 mV/V)

Outputs greater than 166 mV/V may cause saturation of the CD18 input amplifier. The following methods are for compensating for this condition:

1. Calculate the output voltage of the transducer as described in paragraph 3.6A. If the output voltage as calculated is greater than 166 mV/V, proceed as follows in paragraph H.

H. Connect a stepdown transformer between the excitation output and the transducer input as shown in Figure 3-5. Further attenuation can be provided by resistors R1 and R2 connected as shown. Values for R1 and R2 should not exceed 50 K ohms, or be less than 10 K ohms for most applications. Full-scale output (the voltage between terminal 2 and the transformer center tap) should be adjusted to a maximum of 150 mV/V and a minimum 15 mV/V.



LVDT connection for use with CD18 when output of LVDT is greater than 166 mV/V.

$$R_1 = \frac{(Eo-166)\ R_2}{166}$$

Where Eo is LVDT output in mV/V, and R_2 is 10 K ohms. Use metal film or wire wound resistors.

FIGURE 3-5. TRANSDUCER CONNECTIONS FOR LVDT OPERATION. (LVDT'S OUTPUT IN EXCESS OF 166 mV/V WHEN DIRECT INPUT TO CD18 EXCEEDS 166 mV)

I. Another method of reducing the signal at the CD18 is by installing a large capacitor in parallel at the CD18 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 CD18.

J. Operate the same as described in paragraph 3.4.

3.7 OUTPUT FILTER

The standard CD18 output filter provides a frequency response of 0-200 Hz. Other frequency responses are available from the factory. (See Appendix)

3.8 LONG-CABLE OPERATION

The Model CD18 will operate with over 1000 feet of cable between each transducer and its 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 in inductive; increasing the 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 3-2 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.

3.9 DUAL OUTPUTS (A AND B)

Dual outputs are provided in the standard CD18; the "A" output is 10 VDC and the "B" output is 5 mVDC. These outputs are short-circuit protected so that if a short should occur at either of these outputs, the output amplifier will shut down. When the short-circuit is removed, the output amplifier will recover after a few seconds.

The "B" output can be changed in the field from 5 mVDC to any desired value provided certain limitations and procedures are followed:

3.9 DUAL OUTPUTS (A AND B) (Continued)

A. The output current available from both "A" and "B" outputs should not exceed 10 mADC. That is, the output current available from the output amplifier is limited to 10 mADC.

Example:

A. To obtain a 10 VDC output voltage at the "B" output:

R27 should be jumpered or shorted, and
R28 may be removed from the circuit.

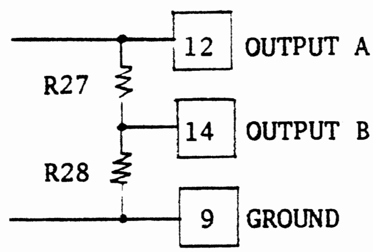
B. To obtain a 5 VDC output voltage at the "B" output, first ascertain the amount of current required. If the current desired from the "B" output is 1 mA, then proceed as follows:

$$R_t = \frac{E}{I}$$

Where R_t = total resistance of voltage divider network

E = 10 VDC

I = desired current



Therefore:

$$R_t = \frac{10}{1\ \text{mA}} = 10\ \text{K}$$

R27 = 5 K ohms

R28 = 5 K ohms

$$\text{VOLTAGE AT OUTPUT B} = \frac{R28}{R27 + R28} \cdot (10\ \text{VDC})$$

NOTE: 1. When replacing R27 and R28, use precision 1% resistors.

2. Other options are available from the factory. Consult the Appendix.

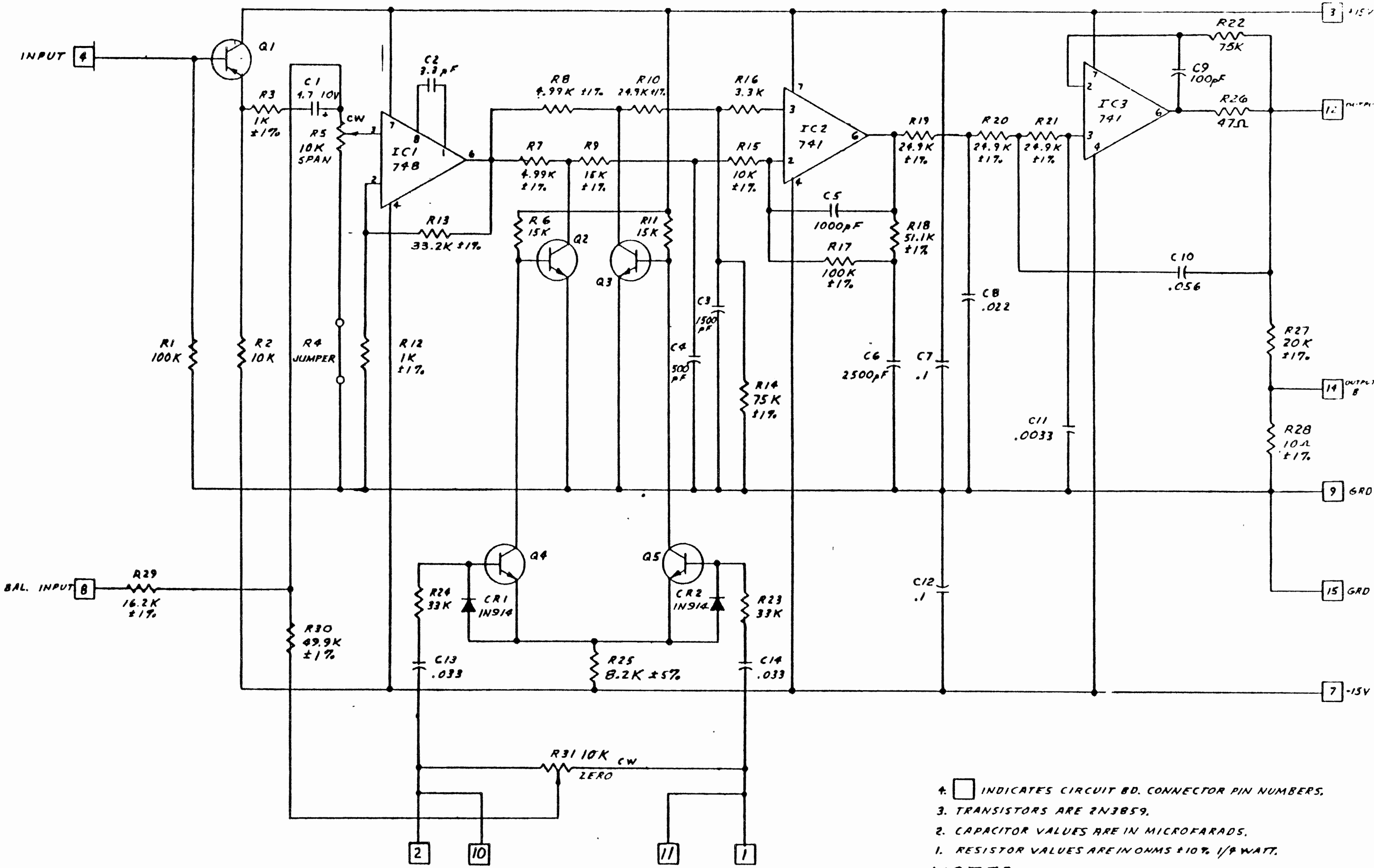
SECTION IV

PRINCIPLES OF OPERATION

4.1 PRINCIPLES OF OPERATION

The Model CD18 Carrier Demodulator balances, amplifies, demodulates and filters transducer's signals. The output from a transducer is fed into a unity gain buffer amplifier (Q1) where it is summed with the output from the zero potentiometer (R30). Any residual output from the transducer may be nulled out by adjusting the zero control. The transducer's signal then goes through the span potentiometer (R5) into the feedback amplifier (IC1). The AC output of IC1 goes to the demodulator, which routes the transducer signal, on one-half of the carrier cyle, to the inverting input of a differential amplifier (IC2), and to the non-inverting input on the other half of the carrier cycle. This differential amplifier is connected as a low-pass active filter to reduce the ripple on the demodulated transducer signal. This demodulated signal is fed into a second amplifier (IC3) which is connected as a unity gain low-pass active filter to remove more of the carrier ripple and to determine the output frequency response. R28 and R32 form a resistive voltage divider across the volt high-level output which provides a 5 mV low-level output.

B	ADDED C20, R33, [10] AND [11]: CHG R4, R13		ED
C	BROUGHT TO DATE		ED



NOTES: UNLESS OTHERWISE SPECIFIED.

1. RESISTOR VALUES ARE IN OHMS ±10% 1/4 WATT.
2. CAPACITOR VALUES ARE IN MICROFARADS.
3. TRANSISTORS ARE 2N3859.
4. ☐ INDICATES CIRCUIT BD. CONNECTOR PIN NUMBERS.

HIGHEST REF DES USED						
C14	CR2	IC3	Q5	R31		

REF DES NOT USED

TOL. UNLESS NOTED
DEC. .XXX
FRAC & DEC. .XX
ANGLES ±½°
DIAMETERS WITH SAME ¢ SHALL BE CONCENTRIC WITHIN .005 TIR.
SURFACES MUST BE FLAT WITHIN .002 PER IN.
MAX FILLET .015 UNLESS NOTED.
DEBURR EDGES .005 MAX UNLESS NOTED.
SURFACE FINISH ∇ UNLESS NOTED.
DRILLED HOLE TOL. PER AND10387

VALIDYNE ENGINEERING CORPORATION
NORTHRIDGE, CALIFORNIA 91324

MODEL CD18

TITLE SCHEMATIC - CARRIER DEMODULATOR PLUG-IN

C 7277

SECTION V

REPAIR

5.0 REPAIR

The Model CD18 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 Ave.
Northridge, California 91324

Attention: Repair Department

Table A-1. System Applications

MEASURAND	TYPE OF TRANSDUCER	MC1 PLUG-IN MODULES	
		SIGNAL CONDITION	ACCESSORY
Pressure	Variable Reluctance Strain Gage, AC Exc.(1) Strain Gage, DC Exc.(2) Potentiometer	CD18, CD19 CD19, CD90 SG71 BA112	Modules listed can be connected to output of signal-condition module to provide the functions noted: AL64: Adjustable HI-LOW alarm. LPF162: Low-pass filter. PM118-2: Single-channel vertical-scale panel meter. PM204: 17-position vertical-scale meter for MC1-10 and -20. PM212-1: 17-position 3½-digit readout for MC1-10 and -20. PM212-2: 17-position 4½-digit readout for MC1-10 and -20. AD136: Peak hold or auto-zero functions. FV156: Respiratory flow integrator. NI157: Null indicator for use in nulling CD19, CD90 modules.
Temperature	Resistance Thermocouple	PT60 CM107(3), CD19, CD90	
Force/Load	Strain Gage, AC Exc.(1) Strain Gage, DC Exc.(2)	CD19, CD90 SG71	
Flow	Differential Pressure Turbine Flowmeter	See Pressure FC62	
Position, Linear & Angular	Variable Transformer Potentiometer	CD148 BA112	
Accelera-tion, Steady	Variable Reluctance Strain Gage	CD18, CD19 See Force	
Vibration	Piezo-Electric Strain Gage	PA89 SG71	
Velocity & Displace-ment Vibra-tional	Piezo-Electric Strain Gage Electro-magnetic	PA89 SG71, AM49, AM49	
RPM	Electro-magnetic Photocell	FC62 FC62	
Torque	Strain Gage Rotary Transformer	SG71 CD19, CD90	

(1) AC carrier excitation features low noise and good zero stability, but frequency response limited to 25% of carrier frequency.
(2) DC excitation features frequency response to limit of transducer.
(3) CM107 is an external accessory mounted near the thermocouple to convert the DC signal to a modulated carrier voltage.

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 repair or replace any component found to be defective on its 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. Electronic products (Transducer indicator, carrier demodulators, plug-in signal conditioners, module cases, etc.) 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 $80.00 evaluation charge.

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

REPAIR POLICY

Units returned to VALIDYNE for repair which are not under warranty will be subject to the following conditions.

1. A description of the problem or malfunction shall accompany the unit returned for repair, or be communicated to VALIDYNE prior to shipment. Otherwise there will be a minimum evaluation and/or calibration charge of $80.00.
2. Unit will be repaired automatically if 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 quotation is required before proceeding with repairs, unit should be accompanied by paper so stating, or information communicated to VALIDYNE prior to shipment.
4. Buyer is to secure authorization and shipping method from VALIDYNE prior to return of equipment or shipment will be rejected. (Applies to Canada only)

REPAIR WARRANTY

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

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