FC62
Frequency-To-Voltage Converter
Module

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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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SECTION I
DESCRIPTION

1-1. INTRODUCTION.

This technical manual contains installation and operating instructions for Model FC62 Frequency-to-Voltage Converter Plug-in Module for a Multi-Channel Transducer Control System. The module is manufactured by Validyne Engineering Corporation, Northridge, California, 91324.

1-2. DESCRIPTION.

The Model FC62 is a Frequency-to-Voltage Converter Plug-in Module to Validyne Engineering Corporation's MC1 Multi-Channel Modular Transducer System. It is used to convert electrical frequency signals to a proportional DC voltage.

1-3. Any frequency between 50 Hz and 50 kHz may be adjusted to produce a 10 Vdc output from the FC62 by means of the 10-position FREQ RANGE switch and a range trim control (RANGE ADJ). This signal can be from a magnetic pickup, photocells, oscillators, or any other signal source that produces a polarity change of ±15 mV or more.

1-4. The speed of the response of the output signal is controlled by a 6-position LO-PASS FILTER selector switch. For high frequency input signals, an output frequency response of up to 200 Hz may be used to measure rapid changes in input frequency. For lower input frequencies, a low-pass filter may be selected as low as 0.1 Hz to smooth the output signal.

1-5. Any output voltage up to 10 volts may be suppressed to zero by means of a 10-turn SUPPRESSION control, to allow small changes around a fixed point to be observed. These small changes can then be expanded by a factor of 10 with a X10 OUTPUT GAIN switch. In this mode, a change in input frequency of ±10% of range will produce a ±10 Vdc output signal.

1-6. The high output current of the FC62 is compatible with most high-frequency galvanometers. The output may be monitored from the front panel test jack.

1-7. The FC62 may be calibrated by using the internal carrier frequency or by an external calibration signal applied to the front panel test jack. Zero crossing or logic level input detector thresholds are switch selected on the circuit board, as well as AC or DC operation.

1-8. OPERATING CONTROLS.

Table 1-1 lists the controls and adjustments for the FC62 Module, as shown in Figure 1-1.

1-9. TECHNICAL CHARACTERISTICS.

Table 1-2 gives the technical characteristics for the FC62 Module.

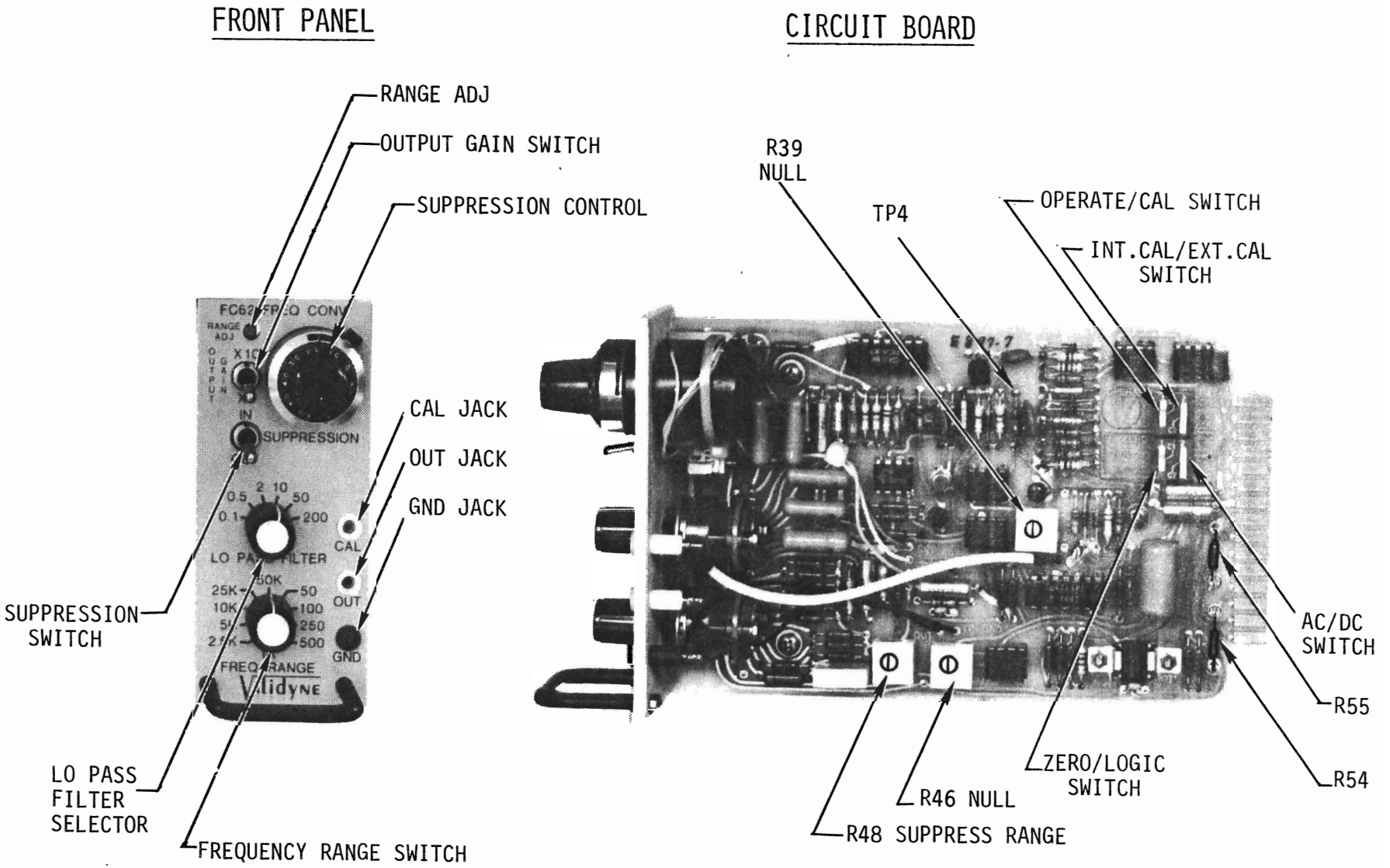

Figure 1-1. FC62 Frequency Converter, Front Panel and Circuit Board

Table 1-1. Operating Controls

CONTROL	FUNCTION
OUTPUT GAIN Switch	Expands output signal 10 times when in the X10 position. X1 position is normal.
RANGE ADJ.	Adjusts output to provide 10 Vdc output for any frequency from 100% of selected range to 40% of selected range.
SUPPRESSION Control	Ten-turn potentiometer and dial. Dial calibrated from 0-1000, representing 0-10 Vdc. Used to suppress the output voltage to zero.
SUPPRESSION Switch	Connects and disconnects the SUPPRESSION control from the circuit.
LO PASS FILTER Selector	Selects 0.1, 0.5, 2, 10, 50 or 200 Hz filter. For high frequency response of up to 200 Hz may be used to measure rapid changes in input frequency. For lower input frequencies, a low-pass filter as low as 0.1 Hz may be selected to smooth the output signal.
FREQUENCY RANGE Switch	10-position frequency range switch, selectable as follows: 0-50 Hz full scale 0-100 Hz full scale 0-250 Hz full scale 0-500 Hz full scale 0-1 kHz full scale 0-2.5 kHz full scale 0-5 kHz full scale 0-10 kHz full scale 0-25 kHz full scale 0-50 kHz full scale
GND Jack	System ground connector (black tip)
OUT Jack	Output A (ten-volt output) connector (white tip)
CAL Jack	For injecting a calibration signal into the input circuit.
OPERATE/CAL Switch (Located on Circuit Board)	Allows either CAL signal or normal input signal to be selected. When in the CAL position, the internal carrier frequency can be connected to the input of the FC62.
INT. CAL/EXT. CAL Switch (Located on Circuit Board)	Allows either the EXT CAL signal or the module case 3 kHz signal to be selected for calibration. Allows the module to be calibrated without disconnecting the input signal.

Table 1-1. Operating Controls (Continued)

CONTROL	FUNCTION
THRESHOLD SWITCHES	
ZERO/LOGIC Switch (Located on Circuit Board)	Selects zero crossing or logic level input detector thresholds.
AC/DC Switch (Located on Circuit Board)	Selects AC or DC operation.
NOTE: All controls are located on the front panel unless otherwise indicated. See Figure 1-1 for locations.	

Table 1-2. Technical Characteristics

ITEM	CHARACTERISTIC
ELECTRICAL	
Frequency Range:	10 ranges, 50 Hz full scale to 50 kHz full scale. 0 - 50 Hz 0 - 100 Hz 0 - 250 Hz 0 - 500 Hz 0 - 1 kHz 0 - 2.5 kHz 0 - 5 kHz 0 - 10 kHz 0 - 25 kHz 0 - 50 kHz
Tracking or Switching Accuracy:	2%, top to bottom.
Input Sensitivity:	10 mV rms minimum to 20 V rms maximum, automatic Gain control (with 5 Hz or greater in AC mode).
Input Modes:	AC, DC or logic (selectable; logic level or zero crossing).
Output A:	0 to 10 V, 0 to ±100 mA less than 1Ω source impedance, short-circuit proof.
Output B:	0 to 1 Vdc, 90Ω source impedance. Provisions for attentuation resistors.
Range Adjust:	Adjusts output to provide 10 Vdc output for any frequency from 100% of selected range to 40% of selected range.
Output Suppression:	0 to 10 Vdc, any output up to 10 V may be suppressed to zero with the 10-turn calibrated suppression control.
Output Gain:	X10 Gain switch allows the output signal to be expanded 10 times. Frequency deviation from the suppressed value provides a linear output up to ±10 Vdc.
Output Frequency Response:	Six (6) ranges: 0 - 0.1 Hz 0 - 0.5 Hz 0 - 2 Hz 0 - 10 Hz 0 - 50 Hz 0 - 200 Hz

Table 1-2. Technical Characteristics (Continued)

ITEM	CHARACTERISTIC
ELECTRICAL (continued)	
Linearity:	±0.1% (typ. ±0.05%).
Operating Temperature:	0 to 160°F.
Temperature Sensitivity:	Span 0.005%/°F (typ.). Zero 0.001%/°F (typ.).
Power Requirements:	+15 Vdc at 50 mA, -15 Vdc at 28 mA, Supplied by module case.
MECHANICAL SPECIFICATIONS	
Width:	1.6 inches.
Heigth:	3.7 inches.
Weight:	Less than 7 ounces.
Plugs into Validyne's MC1 Module Case. Ten (10) plug-ins fit in a standard 19-inch rack width.	

SECTION II
INSTALLATION AND OPERATION

2-1. INSTALLATION.

The Model FC62 Frequency-to-Voltage Converter may be plugged into or out of any available channel of the MC1 Module Case while power is on without damage and without affecting adjacent channels.

2-2. INPUT/OUTPUT CONNECTIONS.

Inputs to the FC62 are by means of the WK4-32S connectors on the back of the MC1 Module Case. FC62 Output A and B come from separate XLR connectors on the back of the MC1 Module Case. Pin functions are the same for both A and B outputs. Figure 2-1 shows the input and output connections.

2-3. OPERATION (See Figure 1-1 for control locations).

The following are the operating procedures for the FC62 Module:

2-4. Circuit Board Switch Positions.

A. Place the CAL/OPERATE switch, located on the top-right corner of the circuit board, in the OPERATE position.

B. Set the Threshold Switch, located on the top-right corner of the circuit board (underneath the CAL/OPERATE switch), to the desired position. Set to ZERO (zero crossing position) for AC signals. The LOGIC position provides a +2 volt threshold for logic signals which go from either 0 to +5 volts or 10 volts.

C. Adjacent to the threshold switch is the AC/DC switch. The switch may be in the AC or DC position when selecting Zero Crossing operation. The switch should be in the DC mode when selecting Logic Level operation.

2-5. Front Panel Switch Selection.

A. Connect the frequency source to the input connector, and turn the FREQ RANGE selector switch to a range as high as the maximum frequency expected.

B. With the SUPPRESSION switch in the OUT position, set the OUTPUT GAIN switch to the X1 position, and the LO PASS FILTER switch to a range at least 100 times lower than the maximum input frequency.

C. Adjust the RANGE ADJ control to product 10 volts output for any frequency between 40% and 100% of the selected range.

2-6. Suppressing Signal to Zero. The SUPPRESSION control has a 10-turn calibrated knob which reads in volts and hundredths of volts of output signal suppression. Any output signal up to 10 volts may be suppressed to zero with this control such that a decrease in input frequency will produce

a negative output, and an increase in frequency will produce a positive output. See Figure 2-2 for procedure for setting and reading the ten-turn potentiometer.

A. With the output signal suppressed to zero, or within 1 volt of zero, the OUTPUT GAIN switch may be placed in the 10X position. This will cause any output signal to be amplified by a factor of 10. A 10% of full-scale change in input frequency will produce a 10 volt change in output. Therefore, a plus or minus 10-volt output indicates a plus or minus 10% of the full-scale change in frequency around the frequency that had been suppressed to zero.

B. With an input frequency applied which produces between 1 and 10 volts at the A output, place the SUPPRESSION switch to the IN position.

C. Adjust the SUPPRESSION control to suppress the output to zero volts.

D. Turn the OUTPUT GAIN switch to the X10 position. Varying the incoming signal frequency should produce a ±10 volt signal as the frequency of the incoming signal is varied plus or minus 10% about the suppressed frequency.

2-7. Front Panel Test Points. The three front panel test points allow the FC62 to be monitored and calibrated from the front.

A. The black tip jack marked GND is system ground.

B. The white tip jack marked OUT is connected to the A output -- the 10-volt output.

C. The second white tip jack marked CAL is for applying an external calibration signal for independent calibration adjustment.

2-8. CALIBRATION.

If it should become necessary to recalibrate the FC62, proceed in the following manner:

A. Place the OPERATE/CAL switch in the CAL position.

B. Set the adjacent EXT CAL/INT CAL switch to the INT CAL position. With the CAL switch set in this position, the internal carrier frequency is connected to the input of the FC62.

C. Set the FREQUENCY RANGE switch to the 5K position.

D. Adjust the RANGE ADJ control for an output of 6.00 volts. This should be accomplished with the OUTPUT GAIN switch in the X1 position, and the SUPPRESSION switch in the OUT position. The LO PASS FILTER switch should be in the 10 Hz position or lower.

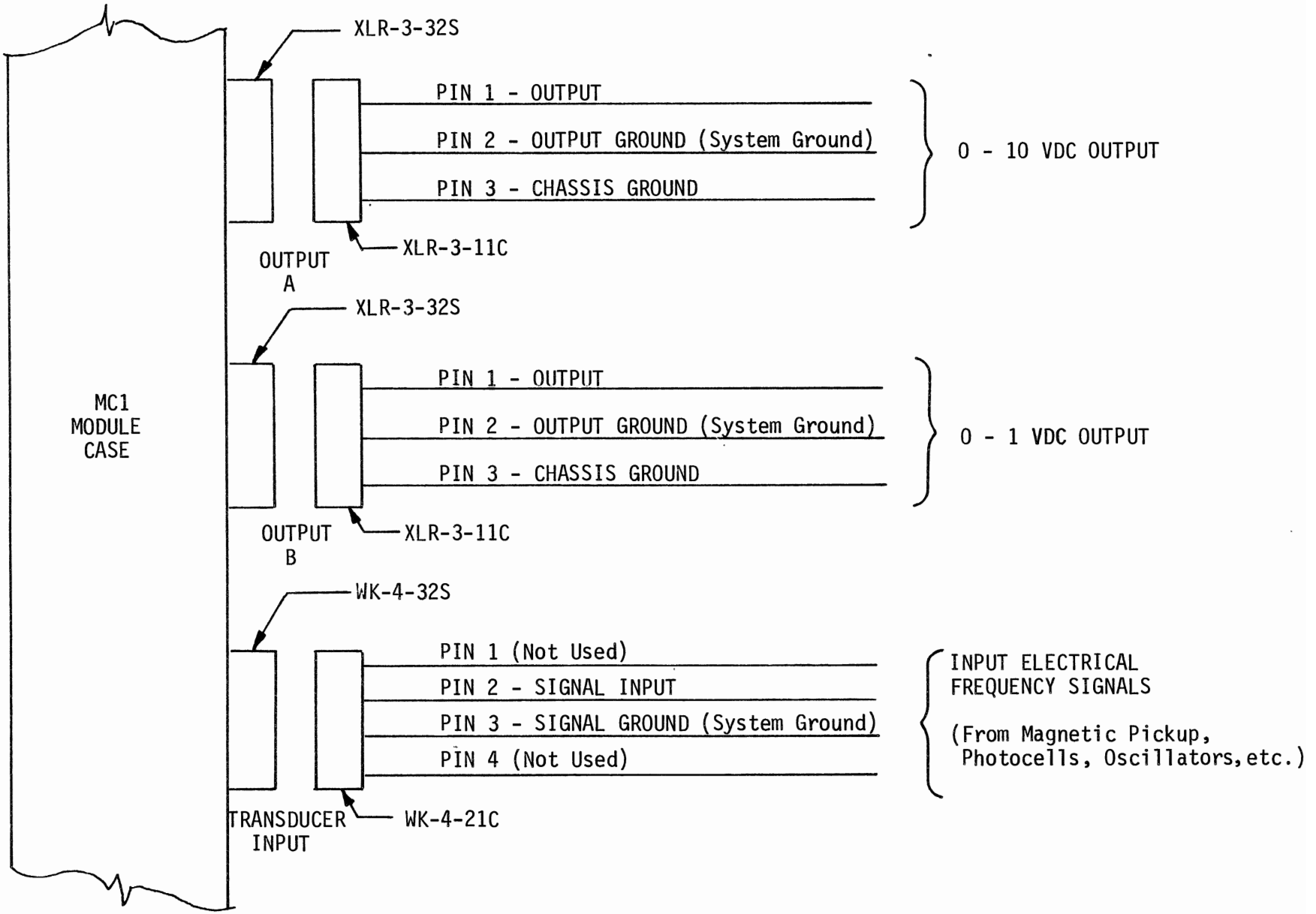

Figure 2-1. Typical Input/Output Connections

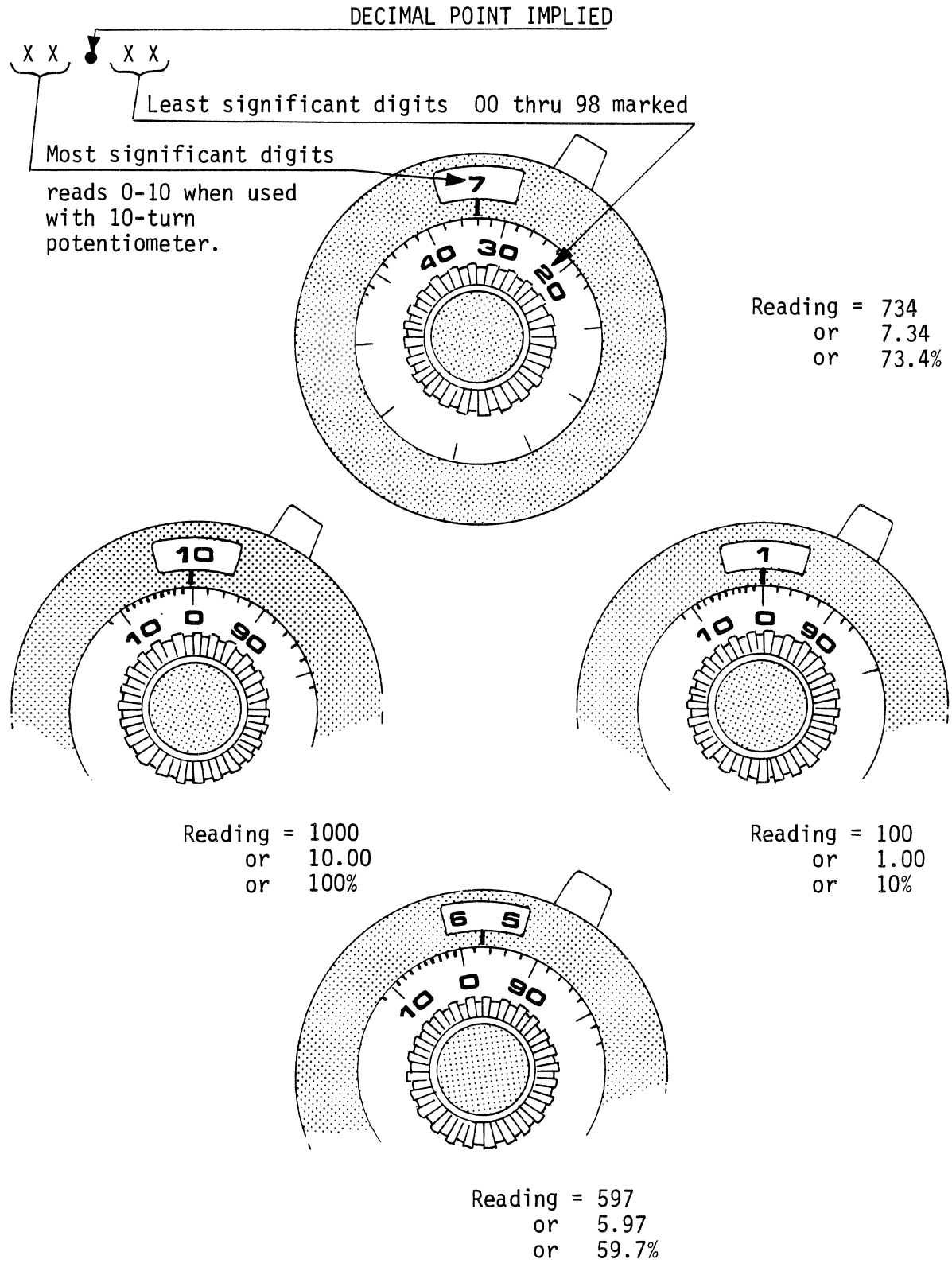

Figure 2-2. Procedure for Setting GAIN Control.

2-9. If it is desired to check calibration at a higher frequency or any frequency other than the carrier frequency, proceed as follows:

A. Place the OPERATE/CAL switch in CAL position.

B. Set the adjacent EXT CAL/INT CAL switch to the EXT CAL position.

C. Insert the calibration signal into the front panel jack marked CAL, and adjust as described in paragraph 2-8 (C through D).

2-10. Checking the Zero Output. From time-to-time it may be necessary to make other adjustments in the FC62. Should it be desirable to check that the zero output is available with no signal applied, proceed as follows: With the use of a module extender card, Part Number 7616-1, inserted in the FC62 position, plug the FC62 into the modular extender card.

A. Place OPERATE/CAL switch in the OPERATE position.

B. Place LOGIC/ZERO switch in the LOGIC position, and short the input signal.

C. While monitoring test point 4, adjust resistor R39 for a null indication, less than 0.1 mV dc.

D. Monitor the output TP3 and adjust R46 to obtain a null of less than 1 mV dc.

2-11. DUAL OUTPUTS A AND B.

Dual outputs are provided in a standard FC62; the Output A is 10 volts dc and Output B is 1 volt dc. These outputs are short-circuit protected so that if a short should occur at either of these outputs no damage will occur. When the short circuit is removed, the output will recover to normal operation after a few seconds.

2-12. Output B can be changed in the field from 1 volt dc to any desired value provided certain limitations and procedures are followed. These limitations are as follows: the output current available from both A and B Outputs should not exceed 100 mA dc. That is, the output current available from the output amplifier is limited to 100 mA dc. Choose the dissipation rating for R54 such that a short on the B Output doesn't damage R54 with ±13 volts across R54.

EXAMPLE:

A. To obtain a 10 Vdc output voltage at the B Output: R54 should be jumpered and R55 should be removed from the circuit.

B. Referring to Figure 2-3, R54 and R55 (damping resistor) terminals are arranged schematically as follows:

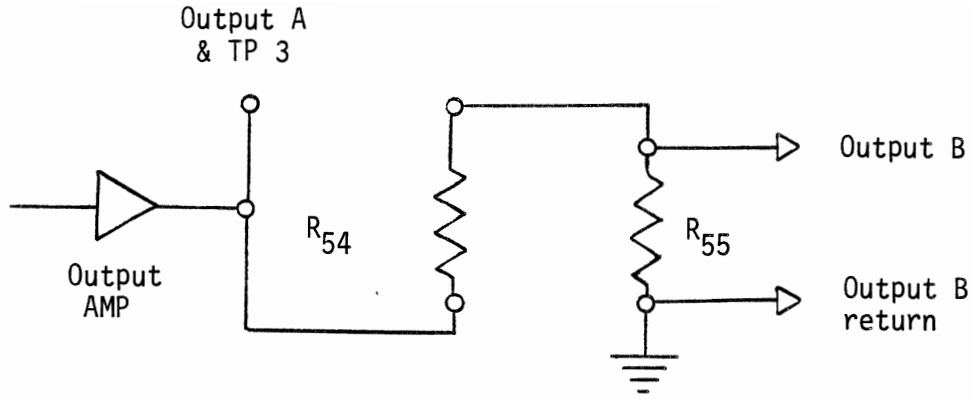

Figure 2-3. Resistors R54, R55 Schematic Arrangement.

2-13. As the output impedance of the amplifier is negligible for all practical purposes, a resistor in the R54 terminals will provide damping for most high frequency fluid damped-type galvanometer applications. That is, R54 = specified damping resistor from the galvanometer manufacturers' galvo-performance specifications.

2-14. It is recommended, in general, that the value of R54 never be lower than 50 ohms. If a damping resistance of less that 50 ohms is required, it is recommended that a value for R55 be calculated to obtain the correct damping:

$$R55 = \frac{50 \times R54}{50 - R54}$$

Where R55 = required galvo damping resistance

Then, R54 = 50 ohms and R55 = calculated value

2-15. For low frequency magnetically damped-type galvanometers, a high source impedance or R54 resistance will be required to obtain the proper galvo current and deflection control.

2-16. Using a value of R54 = 100 K ohms the value of R55 will, for all practical purposes, be equal to the required galvo damping resistance. Thus, R54 = 100 K ohms and R55 = specified galvo damping resistance.

SECTION III
THEORY OF OPERATION

3-1. THEORY OF OPERATION (See Figure 3-1 for Block Diagram and Figure 3-2 for Schematic Diagram).

3-2. The circuit board switches provide the following input signal modes:

A. AC or DC input coupling.

B. Logic (+2 v) or zero crossing threshold.

C. Operate or CAL Mode, INT or EXT CAL input.

3-3. The selected input mode couples the input signal to an automatic gain-controlled amplifier consisting of U1 and Q1, which serves to provide a normalized signal amplitude to the zero crossing comparator, U2. The output signal from U2 is differentiated by C6, R13 and buffered by Q2 to trigger a latch circuit, U3-1.

3.4 A one-shot precision amplitude pulse is generated by U3-2 in response to a timing signal on C11 generated via the Frequency Range Switch S4, and level detected by comparator U8. U9 provides the 12 volts reference signal.

3-5. The low-pass filter, U4, is set at 0.1 Hz to 200 Hz by switch S3, and provides a smoothed dc signal equal to the average value of the U3 one-shot output.

3-6. U5 mixes the Frequency Range Adjust output signal with the Suppression signal from U6, and the difference signal is applied to the output amplifier U7. An X1, X10 switch, S6, controls the Gain of the U7 output amplifier so that the expanded output discussed in Paragraph 2-3 can be obtained.

3-7. U7 contains internal current limiting and thermal-sensing protection so that short-circuit load conditions will not injure the amplifier, and normal operation will be resumed automatically after an output fault is cleared.

(1) AC-DC COUPLED
(2) LOGIC - ZERO CROSSING THRESHOLD
(3) OPERATE-CAL MODE, INT-EXT CAL

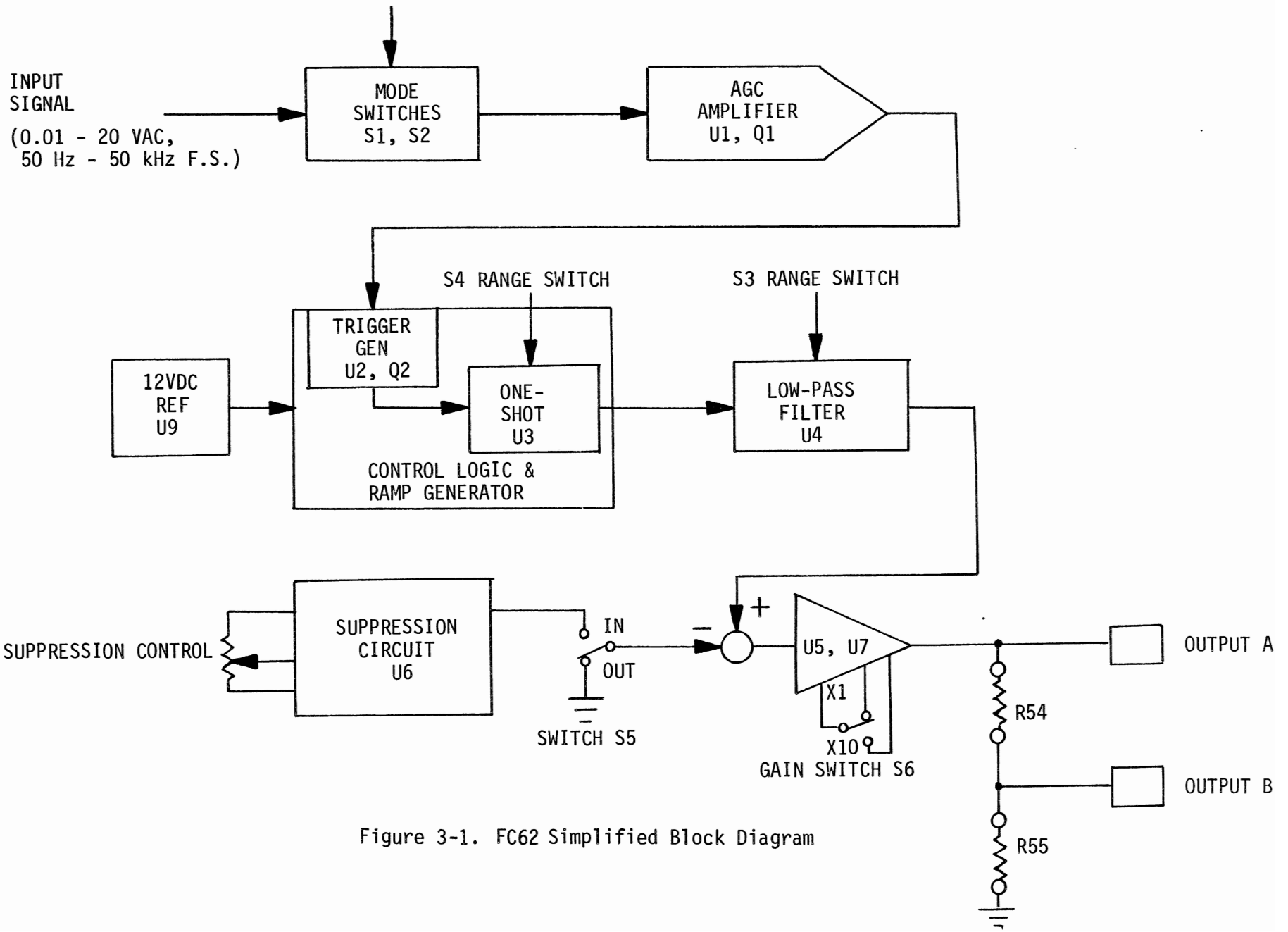

Figure 3-1. FC62 Simplified Block Diagram

SECTION IV
MAINTENANCE AND REPAIR

Validyne Products, as a function of their basic design, do not require periodic re-calibration or maintenance, as such. If abnormalities in performance occur which cannot be corrected by 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 malfunction or performance degradation, information regarding purchase order date and number are enclosed with the instrument.

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

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

Address all shipments and correspondence regarding returned units to:

Validyne Engineering Corp
8626 Wilbur Avenue
Northridge, California 91324

Attn: Customer Returns Group