COMPACT REMOTE STATION

OPERATION AND MAINTENANCE MANUAL

Stock No. 990-59340-9800

consisting of:

Seismic Amplifier, Model 42.70
Voltage Controlled Oscillator, Model 46.32
VCO with FM Multiplexer, Model 46.32-1
Pulse Calibrator, Model PC-120
Input/Output Module, Model IO.40
I/O Module for Single Supply, Model IO.45
3-Channel Pre-amplifier/Filter, Model PF.70
16-Bit Remote Digitizer, Model 49.65

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COMPACT REMOTE STATION (CRS)
OPERATION AND MAINTENANCE MANUAL

1. INTRODUCTION

1.1 PURPOSE OF THE EQUIPMENT

The CRS is a modular system designed to accept signals from a seismometer such as Geotech's S-13, S-500 or BB-13, amplify and condition these signals to a useful level, and transmit the signals to a central location for recording and analysis. The system is housed in a Model 45.50 Enclosure, which is suitable for permanent installations and is small enough to be easily moved from site to site. A typical system is shown in figure 1-1.

1.2 THEORY OF OPERATION

Signals of earth motion are picked up by a seismometer and fed to the input of an amplifier. The signal must be amplified to a level where a small seismic disturbance can be discerned from the normal noise of the earth. Often some of the earth's noise must be filtered out of the signal and a passband of signal frequency selected for analysis. The conditioned signal then modulates a VCO or is digitized for digital telemetry. The VCO outputs an FM sine wave which is multiplexed and fed to a radio transmitter. The digitizer, or A/D converter, multiplexes up to three channels and formats the data before it is transmitted. The optional Model PC-120 Pulse Calibrator provides a programmable current pulse duration and period that can be connected to the seismometer calibration coil.

1.3 DESCRIPTION OF EQUIPMENT

The CRS consists of modules designed to provide an economical solution to a wide range of field installation requirements. The modules are packaged in a weatherproof metal case and are sealed from dust and moisture.

The system can include up to three amplifiers and VCO's, a pulse calibrator, an I/O module, with an optional DC/DC converter for single battery operation, and up to two radios. Connections for power, inputs, and outputs are through screw clamp terminal blocks mounted on the module PC boards. Transient protection is provided on the modules for seismometer connections and power connections. A multiplexer option is available. This option is installed on one of the VCO's to multiplex the three local signals and up to three external VCO signals.

Two options are available for digital telemetry, a 12-bit and a 16-bit digitizer. A 3-channel Pre-amplifier/Filter module, with lower gain is also available. The I/O module has jumper configuration to provide for the many options.

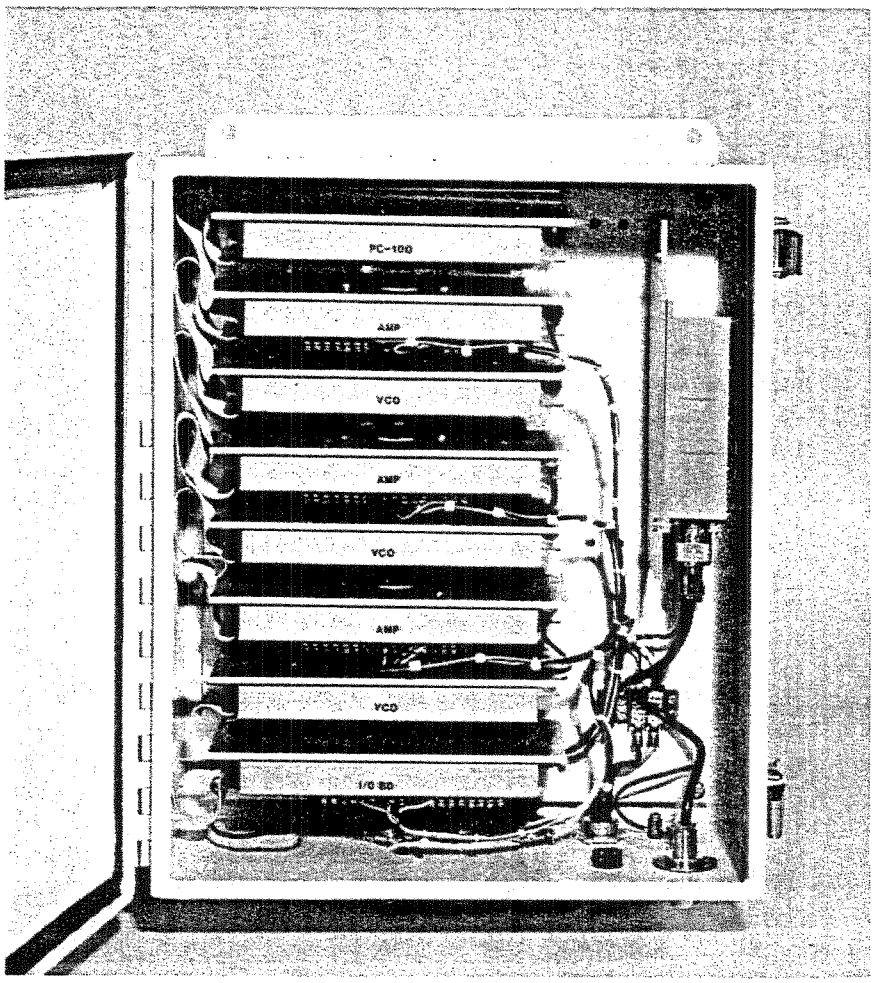

Figure 1-1. Typical Compact Remote Station

1.4 SCOPE

This manual provides the necessary information to operate and maintain all standard configurations of the Seismic Field System, except the option using the 49.60 Remote Digitizer. A separate manual is provided for the Model 49.60 module. Any given configuration may not include all the system components available.

Specifically, this manual contains information on the items listed below.

Seismic Amplifier, Model 42.70

Voltage Controlled Oscillator, Model 46.32

VCO with FM Multiplexer, Model 46.32-1

Pulse Calibrator, Model PC-120

Input/Output Module, Model IO.40

Input/Output Module, Model IO.45

3-Channel Pre-amplifier/Filter, Model PF.70

16-Bit Remote Digitizer, Model 49.65

If your system has a Model 49.60 or Model 49.65 Remote Digitizer, pay particular attention to the information in Chapter 6 concerning jumper configurations of the I/O module.

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2. INSTALLATION

2.1 UNPACKING

Upon receipt, the CRS System or module, if ordered separately, should be removed from its shipping container and inspected for visible signs of shipping damage and for shortages. Make note of any damage incurred during shipment for use in preparing a claim against the carrier. Any shortages should be reported to Teledyne Brown Engineering Geotech Instruments, 3401 Shiloh Road, Garland, Texas, 75041.

2.2 INSTALLATION

Locate a suitable place for installing the CRS after the seismometers have been emplaced and the radio antenna is erected. A suitable location for batteries and solar panels must be considered for many systems. The 45.50 Enclosure is weatherproof, but extended direct exposure to elevated temperatures and precipitation is not recommended for any permanent installation. A suitable earth ground is strongly recommended for most installations. Failure to provide adequate grounding increases the risk of damage from lightning.

2.3 CONNECTIONS

Seismometer output connections are made directly to the Seismic Amplifier module. When the 3-channel Pre-amplifier/Filter module is used, the calibration coil connections must be made to the I/O Module. Other inputs, power, and signal outputs are made on the I/O module. See figure 2.1 for typical system connections.

The 45.50 Enclosure is supplied with radio antenna bulkhead connectors. The remainder of the connections are through screw-clamp terminals that accommodate up to 12-gauge wire. Weatherproof cable clamps are supplied for seismometer and power cables.

2.4 SEISMOMETER DAMPING

The S-13 and many other seismometers require a external damping resistor. R7 on the Seismic Amplifier module is selected for the proper damping. Sockets are provided for a 1/4 watt 5% carbon composition or any other resistor of suitable physical size.

On the 3-channel Pre-amplifier/Filter module the three resistors locations R87, R88, and R89 are provided for external damping. These must be soldered in place. Resistance is calculated by the following formula in which DRX is the desired external damping resistance in Kilo ohms:

R7 = (20xDRX)/(20-DRX) Kohms

2.5 VCO OPTIONS

The CRS is designed for only one multiplexer version VCO per field station.

A VCO must be recalibrated if the center frequency tuning unit is exchanged.

2.6 JUMPER SELECTIONS

2.6.1 Channel Selection

Select the channel position on each Seismic Amplifier board and on each VCO board. Only jumper one selection per board.

On the amplifier board the selections are:

CH-1 W32
CH-2 W33
CH-3 W34

On the VCO board the selections are:

CH-1 W1
CH-2 W2
CH-3 W3

The 3-channel Pre-amplifier/Filter module does not require channel jumpers.

2.6.2 Calibration Coil Jumpers

2.6.2.1 With 42.70 Seismic Amplifier

Six jumper positions are provided on the Seismic Amplifier to allow for serial connection of up to three seismometer calibration coils. Two jumpers are selected for each coil. For coil 1, jumper +S1(W3) and -S1(W6). For coil 2, jumper +S2(W4) and -S2(W7). For coil 3, jumper +S3(W5) and -S3(W8).

For parallel connection, or a single senser, connect +S1 and -S3 jumpers.

For two units, coil 1 should be jumpered +S1 and -S1. Coil 2 then is jumpered +S2 and -S3.

The six jumpers W1 through W6 on the I/O module must be removed.

2.6.2.2 With Model PF.70 3-Channel Pre-amplifier/Filter

Six jumpers are provided on the Model IO.40 I/O module to allow serial or parallel connection for up to three calibration coils. For serial connection, jumper S1(W5) and S2(W6) and remove the four jumpers P1-P4 (W1-W4).

For parallel connections, jumpers P1-P4 are installed and S1 and S2 are removed.

Figure 2-1. Typical Seismic Field System Installation

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3. 42.70 SEISMIC AMPLIFIER

3.1 GENERAL

The 42.70 Seismic Amplifier provides a complete interface between a seismometer and a telemetry modulator, or the Model 49.60 12-bit digitizer. Transient protection for all seismometer connections are on the module. Seismometer damping, signal amplification and frequency response shaping for the system are provided. In addition, jumper selection for the seismometer calibration coil connections is provided. The module outline is shown in figure 3-1. Figures 3-3 and 3-4 are the module schematics.

3.2 JUMPER SELECTIONS

3.2.1 Gain Selections

The gain selections for the Model 42.70 Amplifier are shown in Table 3-1. Gains are selectable from 1 to 16384 in 6 dB increments.

3.2.2 High-pass Filter Selections

Three frequencies are selectable for the high-pass filter section. Two jumpers must be used for each selection.

0.01 Hertz	W16 and W18
0.20 Hertz	W17 and W19
0.50 Hertz	W20 and W21

NOTE: If all six jumpers were to be installed the high-pass cutoff frequency would be 0.71 Hertz.

The high-pass section can be bypassed by connecting a jumper across the DC selection (W15). This connection is for test, or for very low gain operation only.

3.2.3 Low-pass Selections

Four frequencies are selectable for the low-pass section. Two jumpers must be used for each selection.

1.0 Hertz	W27 and W31
5.0 Hertz	W41 and W28
12.5 Hertz	W25 and W29
25.0 Hertz	W26 and W30

NOTE: If all 8 jumpers were to be installed the low-pass frequency would be 43.5 Hertz.

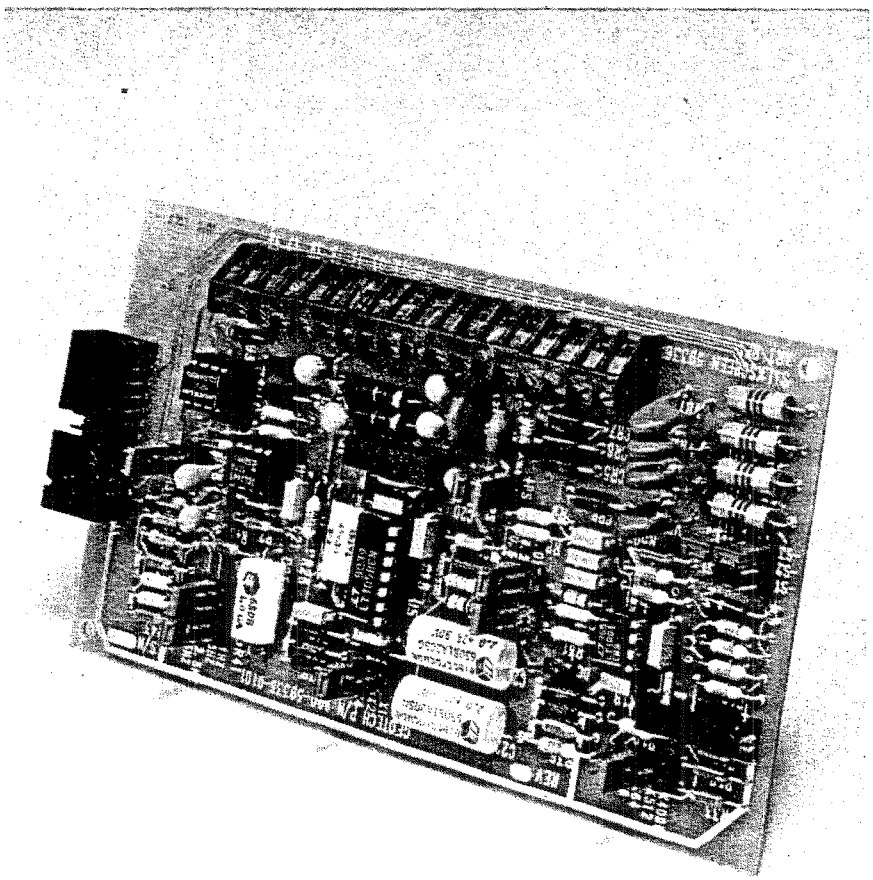

Figure 3-2. Seismic Amplifier Assembly

Table 3-1. Model 42.70 Amplifier Gain Selections

Total Gain	Input Gain Stage	Second Gain Stage
1	x1	x1
2	x1	x2
4	x1	x4
8	x8	x1
16	x8	x2
32	x8	x4
64	x64	x1
128	x64	x2
256	x64	x4
512	x512	x1
1024	x512	x2
2048	x512	x4
4096	x4096	x1
8192	x4096	x2
16384	x4096	x4

3.2.4 Power Control Jumpers (W1 and W2)

These jumpers are used in place of a power switch.

3.2.5 Channel Select

Each amplifier in a system must have a unique channel. Up to three channels are available in the ribbon cable.

3.2.6 Calibration Coil Serial Connect

See section 2.6.2.1 for how to jumper the seismometer calibration coil connection.

3.3 OPERATION

Make all connections in the system and select the proper jumpers before applying power. Normally the background noise of a site is monitored for some period before final amplifier settings are determined.

In most cases, the limiting factor is the local ground noise. For very quiet sites, the limiting factor may be the telemetry system, when VCO's are used. In digital telemetry, the limit may be the resolution of the digitizer. In almost all cases, depending on the seismometer, the gain can be increased to allow the earth's noise to be above the electronic noise.

Two amplifier adjustments are available for common mode (R20, 500 ohm) and for offset (R25, 20K). The common mode adjust normally does not have to be readjusted from factory setting. The offset may have to be adjusted seasonally if extreme temperatures are encountered.

3.4 SPECIFICATIONS

JUMPER SELECTABLE PROGRAMMING

Input Stage Gain	Single Jumper: x1, x8, x64, x512, x4096
Second Gain Stage	Single Jumper: x1, x2, x4
High-Pass Selection	Two Jumpers: 0.01 Hz, 0.2 Hz, 0.5 Hz Single Jumper: DC coupled (Recommended for test only or low gain)
Low-Pass Selection	Two Jumpers: 1.0 Hz, 5.0 Hz, 12.5 Hz, 25 Hz
Amplifier Channel Select	Single Jumper: Selects module for CH1, CH2, or CH3 to VCO or 49.60 Transmitter.
Seis Cal Coil Connections	Two jumpers provide simple calibration wiring for parallel or for up to three serial connections.
Power Connections	Two jumpers are provided to allow +12 and -12V power to be removed from the amplifier circuit.

TRANSIENT PROTECTION

Transient protection is provided at external seismometer connections.

OPERATING CHARACTERISTICS

Input

Type	Balanced or single ended
Impedance	20 Kohm for balanced input
Noise level	2.7 microvolts peak-peak max. Referred to input from 0.03 Hz to 25 Hz. Typical noise is 1.6 microvolts peak-peak.
Common Mode Rejection	Adjustable to 106 dB

3.4 (continued)

Output	
Type	Single ended
Level	10 volt p-p into 2 Kohm load
Output Resistance	100 ohm, 1% decoupling resistor
Linearity	0.05% of full scale deviation from best straight line.
Voltage Gain	1 to 16384, selectable in 6 dB steps
Gain Error	Less than ±1% at any selected gain
Dynamic Range	120 dB at x1, 47 dB at x16384 and full bandwidth
Output Stability	
0.01 Hz High-pass	35 microvolts per ^{o}C, typical, 400 microvolts per ^{o}C, worse case, adjustable to zero
0.2 and 0.5 Hz High-pass	26 microvolts per ^{o}C maximum
Filters	2 pole Butterworth, jumper selectable bandwidth. See figure 3-2
POWER REQUIREMENTS	
Voltage	±10.0 volts to ±15.0 volts
Current	±10.5 mA maximum
ENVIRONMENTAL CHARACTERISTICS	
Operating Temperature	-20 to +60 ^{o}C
Relative Humidity	5 to 95%, non-condensing

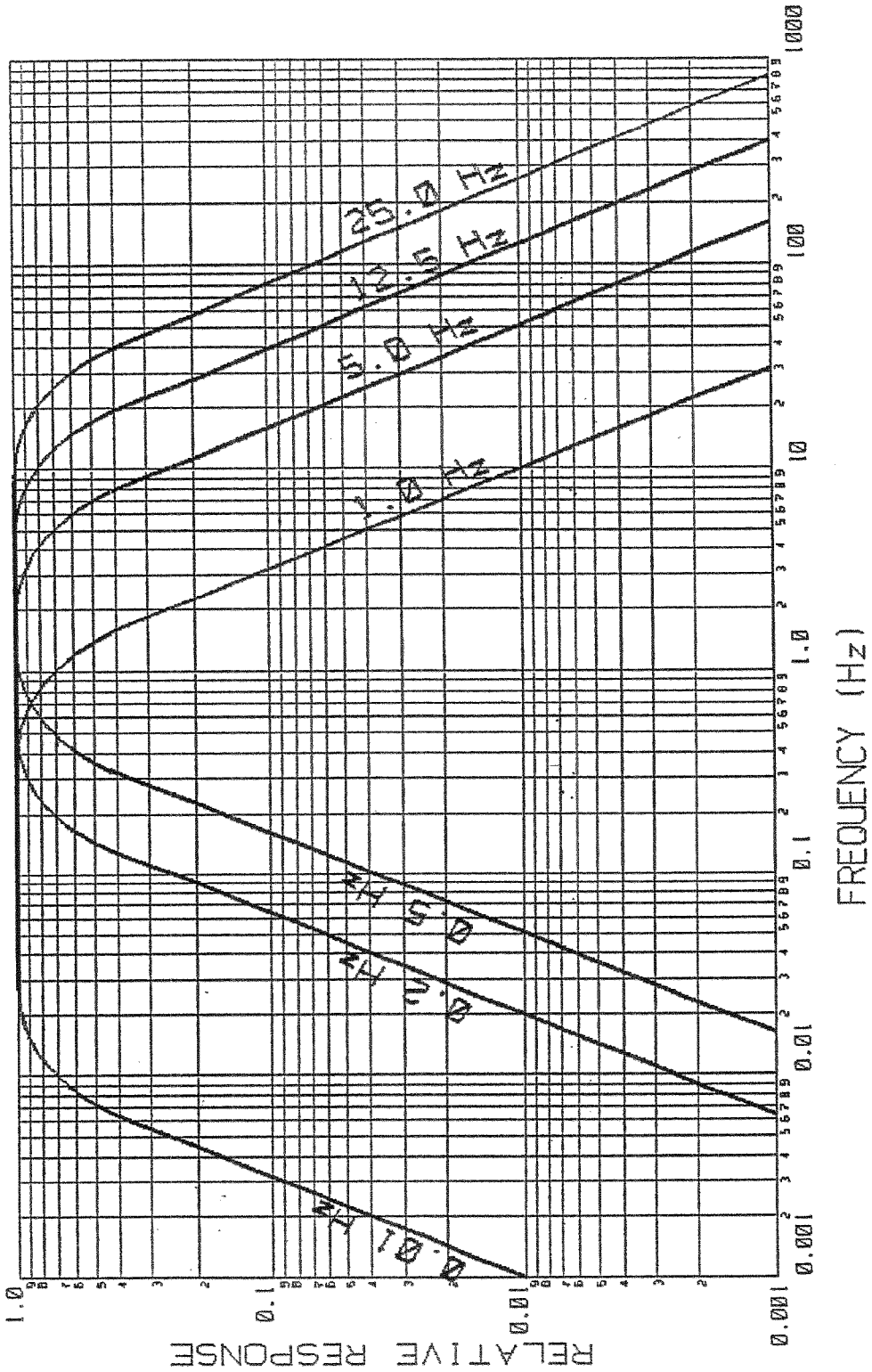

Figure 3-2. 42.70 AMPLIFIER FILTER RESPONSES

3.5 CIRCUIT DESCRIPTION

Figure 3-1 is an outline of the Seismic Amplifier showing the location of components. Figures 3-3 and 3-4 are the schematics of the module.

A listing of components is given in Table 3-2.

3.5.1 Transient Protection

The transient protection components are shown in figure 3-3. 18 volt MOV's (metal oxide varistors) are connected to six seismometer cable points and are in turn connected to the terminal reserved for earth ground (TB1-1). These are designated as VR1-VR6 and include the + 12 volt and - 12 volt outputs to seismometers requiring power.

The calibration coil connections and the amplifier input connections are further protected by 100 microhenry chokes and transorbs (CR5-CR8) which are connected back to the earth ground terminal. In addition, connections for cable shields are returned to ground.

The transient protection, when combined with proper external grounding, will insure years of trouble free performance in a permanent installation. When long seismometer cables are required, remote lightning protection circuits are available (see figure 6-2).

3.5.2 Voltage Regulators

The voltage regulator circuits are shown in figure 3-3. C1-C4, L1 and L2 provide filtering for the input power. CR1 and CR2 are transorbs to protect the regulator chips from transients.

U2 is a low power positive regulator set for +9 volts output by R2 and R3. R1 sets the current limit to 25 mA.

U3 is a low power negative regulator set for -9 volts output by R5 and R6. R4 sets the current limit to -25 mA.

C6 and C8 provide output filtering for the regulators. The regulators provide isolation and the regulated outputs should be between + / - 8.2 volts and + / - 9.8 volts.

3.5.3 Input-Gain Stage

U5A, R8-R13, R20 and R21 provide 60 dB attenuation for common mode signals without interfering with differential signals. R12 and R13 are also part of the gain section and determine the input impedance.

C15 provides filtering out of the passband. R20 provides a trim adjust for the output from U4.

U4 is a very low-noise precision operational amplifier that converts a differential signal to single ended output, with gain. R16, R17 and R50 provide with R12 and R13 a precision bridge circuit with a gain of one.

The network formed by R14, R15, R18, R19, and R33-R36 provide gain selection by W9-W13. Resistor values are selected so the resistance at the jumper points matches R50 (200 ohms). C13, C14 and C27 provide some filtering out of the passband.

3.5.4 High-Pass Section

The network around U5B provides a selectable 2-pole high-pass filter and offset adjustment. The section is a follower configuration with C22 and C23 acting with R27 and R29, or R28 and R30, or R31 and R32 to cut-off low frequencies below those selected. The filtered response is 3 dB down at the selected frequency.

R22 - R26 provide adjustment through the potentiometer R25 for offsets of +/- 4.5 mV. This compensates for the offsets of U5B, U5C and U5D. C20 provides noise filtering as does C21.

3.5.5 Second Gain Stage

The network around U5C is a simple inverting amplifier with an input resistor R37 and jumper selected feedback resistors R38, R39 and R40.

3.5.6 Low-Pass Output Section

The low-pass filter circuit around U5D is a 2-pole filter in a follower configuration that is 3 dB down at the cut-off frequency. Four frequencies can be selected by jumpering two resistors for each frequency. C25 is the feedback capacitor and C26 the second pole capacitor.

R49 is a decoupling resistor between the op amp and the cable. W32-W34 select the appropriate channel in the interconnecting cable for the module output.

3.6 USE WITH Model 49.60 Remote Digitizer

3.6.1 General

When the VCO modules are replaced with the Model 49.60 Remote Digitizer the Seismic Amplifier low-pass Section is integrated into the anti-alias filter of the Remote Digitizer module. Otherwise, the functions of the Remote Digitizer are unchanged.

3.6.2 50 SPS Operation

When the Model 49.60 Remote Digitizer is operated at 50 samples per second its filter section is set to 12.5 Hertz cutoff. The low-pass section of the Seismic Amplifier should be jumpered for 12.5 Hertz also (W25, W29). See section 3.2.3.

3.6.3 100 SPS Operation

When the Model 49.60 Remote Digitizer is operated at 100 samples per second its filter section is set to 25.0 Hertz cutoff. The low-pass section of the Seismic Amplifier should be jumpered for 25.0 Hertz also (W26, W30). See section 3.2.3.

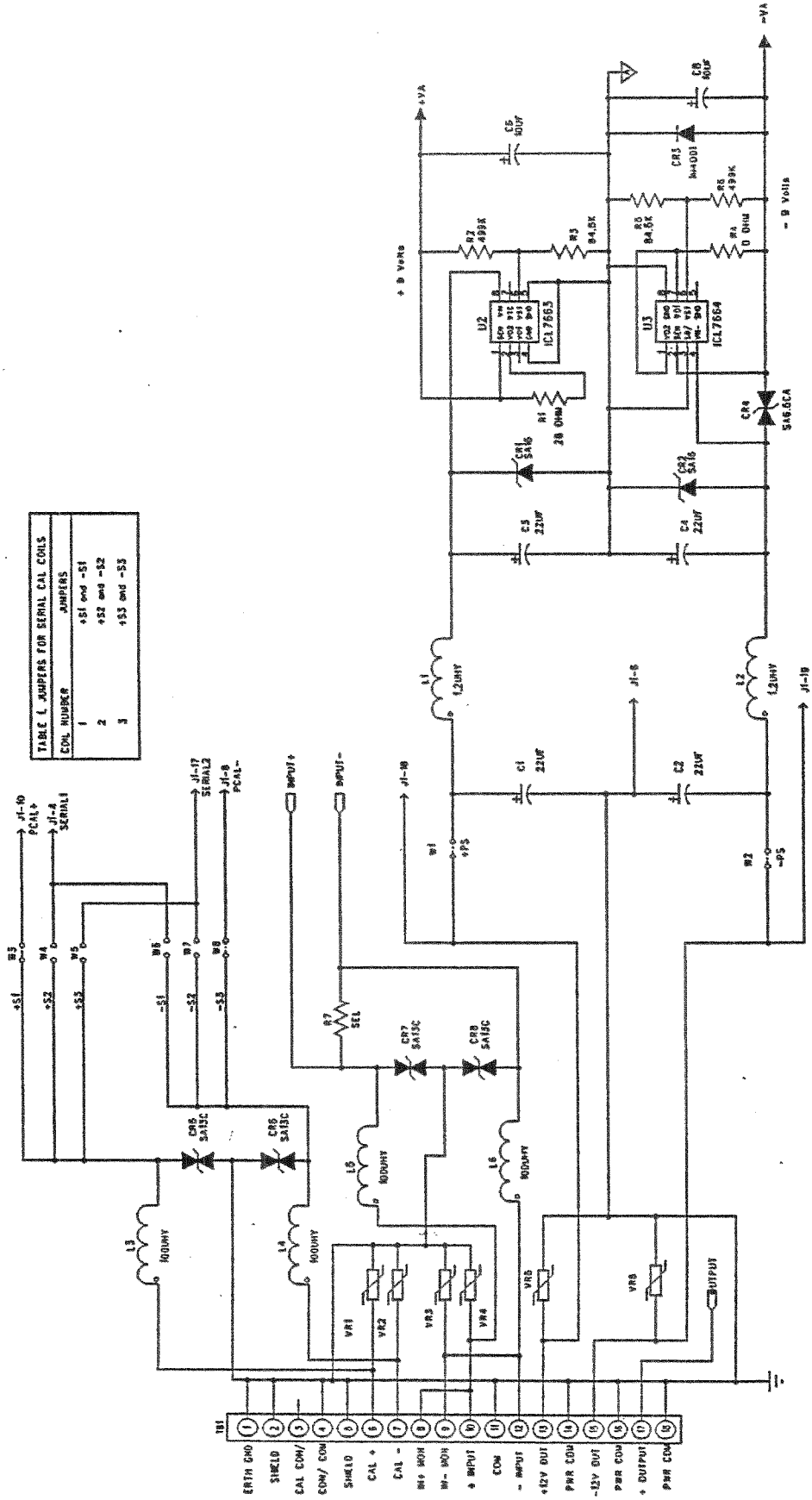

Figure 3-3. Seismic Amplifier Schematic, sheet 1

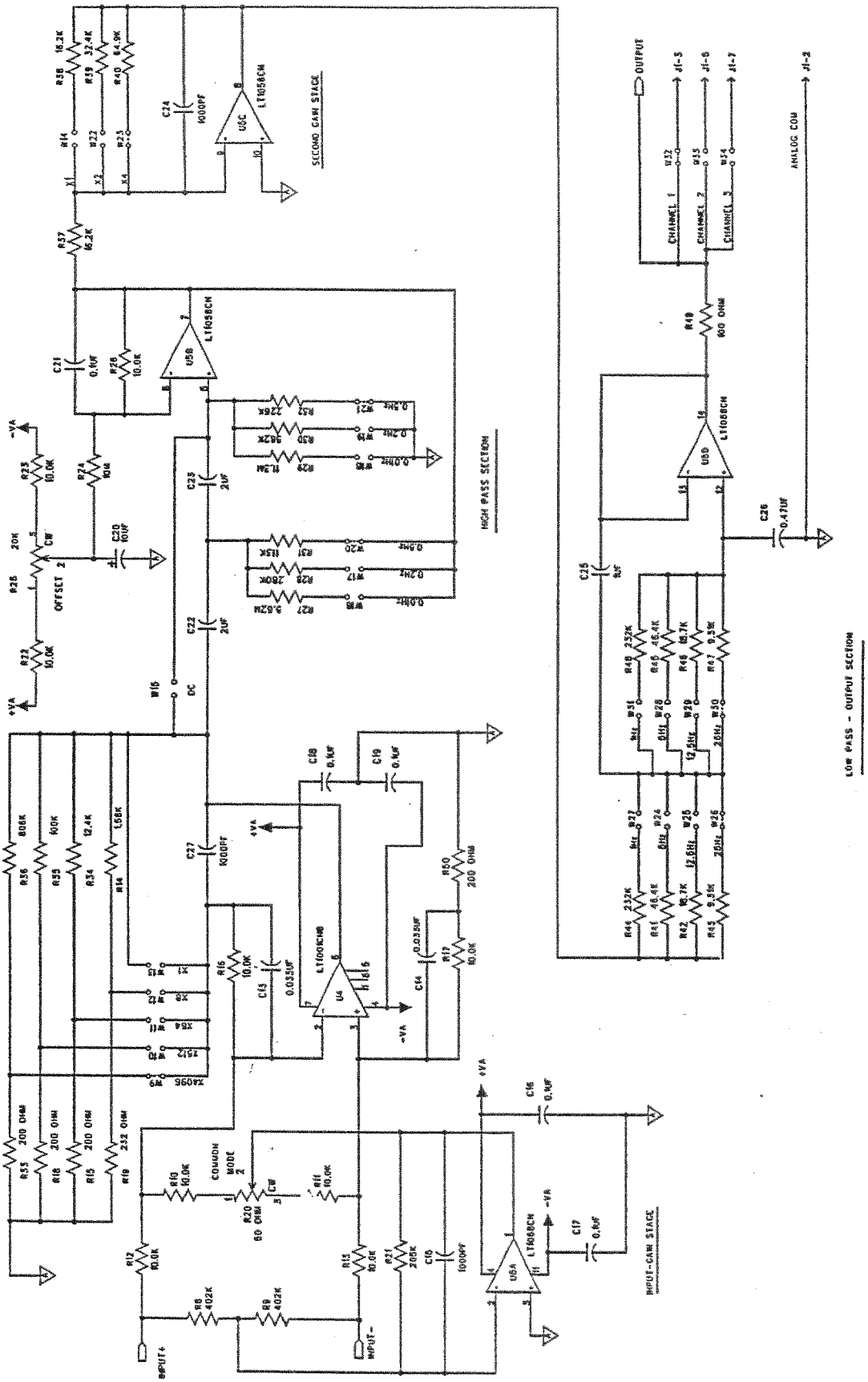

Figure 3-4. Seismic Amplifier Schematic, sheet 2

Table 3-2. Seismic Amplifier Parts List

TG3340 — T E L E D Y N E G E O T E C H
TRANS: MILPL — MILITARY SINGLE LEVEL PARTS LIST
RUN DATE 28-Sep-93 — RUN TIME 02:48 PM — SHEET 2

PARENT PART		DESCRIPTION/SPECIFICATION	ENG DRAWING REFERENCE	FSCM	REVISION	ECN
990593360101	1	ASSY-SEISMIC AMPLIFIER A/990-59336-1101/PARTS LIST D/990-59336-2101/SCHEMATIC A/990-59336-5101/SEISMIC AMPLIFER A/990-59336-6101/ACCEPTANCE TEST		099019	D5	E47325

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
001	990593360201	0	FAB-SEISMIC AMPLIFIER	990593360201	099019	-	EA	1.0000
005	002722258669	9	CAPACITOR,22 MF,25V,20% C1,2,3,4	199D226X0025DA1	056289	-	EA	4.0000
006	002710250712	7	CAPACITOR,10MF,25V,10% SPRAGUE C6,8,20	199D106X9025CA2	056289	-	EA	3.0000
007	002433505033	2	CAPACITOR,.033 MF,50V,5% C13,14	VENDOR ITEM	099019	-	EA	2.0000
008	002310500668	3	CAPACITOR,.001MF,50V,10% C15,24,27	VENDOR ITEM	099019	-	EA	3.0000
009	002510509033	0	CAPACITOR,0.1 MF,50V,+80, -20% C16,17,18,19,21	VENDOR ITEM	099019	-	EA	5.0000
010	302020000098	9	CAPACITOR,2 MF,50V,2% C22,23	302-02000-0098	099019	-	EA	2.0000
011	302020000094	3	CAPACITOR,1 MF,50V,2% C25	302-02000-0094	099019	-	EA	1.0000
012	302020000090	7	CAPACITOR,0.47 MF,50V,2% C26	302-02000-0090	099019	-	EA	1.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
016	012021911500	3	TRANSZORB,15V,GENERAL SEMICONDUCTOR,SA15 CR1,2	SA15	024444	-	EA	2.0000
017	012010400100	4	DIODE,1N4001 CR3	1N4001	ANY	-	EA	1.0000
018	012021911331	8	TRANSZORB,GENERAL SEMI CONDUCTOR,SA13CA CR5,6,7,8	SA13CA	024444	D	EA	4.0000
019	012021916531	5	TRANSZORB BIPOLAR GENERAL SEMICONDUCOR CR4	SA6.5CA	024444	C	EA	1.0000
021	307000022000	3	HEADER,RT ANGLE,20 PIN SOURCE CONTROL DRAWING J1	307-00002-2000	099019	A	EA	1.0000
022	007783312723	3	SOCKET,SPRING,COMPONENT J2,3	2-331272-3	004618	-	EA	2.0000
025	010752120156	7	INDUCTOR,FIXED,SHIELDED 1.2 UH L1,2	9250-122	076493	-	EA	2.0000
026	010754100156	7	INDUCTOR,FIXED,SHIELDED ,100 UF,SIZE 15 L3,4,5,6	VENDOR ITEM	099019	-	EA	4.0000
029	001074020907	1	RSTR,FXD,402K,1/10W,.1% R8,9	RN55C4023B	ANY	-	EA	2.0000
030	001032800901	3	RSTR,FXD,28 OHM,1/10W,1% R1	RN55C28R0F	ANY	C	EA	1.0000
031	001074990901	1	RSTR,FXD,499K,1/10 W,1%,R R2,6	RN55C4993F	ANY	-	EA	2.0000
032	001068450901	4	RSTR,FXD,84.5K,1/10 W,1%, R3,5	RN55C8452F	ANY	-	EA	2.0000
033	001000000901	8	RSTR,SELECTED,1/10W,1% R7	RN55C	ANY	-	EA	SEL

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
035	001061000907	8	RSTR,FXD,10K,1/10W,.1% R10,11,12,13,16,17	RN55C1002B	ANY	-	EA	6.0000
036	001051580907	1	RSTR,FXD,1.58K,1/10W,.1% R14	RN55C1581B	ANY	-	EA	1.0000
037	001042000907	2	RSTR,FXD,200 OHM,1/10W, .1% R15,18,33,50	RN55C2000B	ANY	-	EA	4.0000
038	001042320907	4	RSTR,232 OHM,1/10W,.1% R19	RN55C2320B	ANY	-	EA	1.0000
039	001135009407	6	RSTR,VAR,50 OHM,5%,VISHAY R20	1285G-50-5%	018612	C	EA	1.0000
040	001072050907	0	RSTR,205K,1/10W,0.1% R21.	RN55C2053B	ANY	-	EA	1.0000
041	001061000901	4	RSTR,FXD,10K,1/10 W,1%,RN 55C(CORNING NC4) R22,23,26	RN55C1002F	ANY	-	EA	3.0000
042	001091001035	5	RSTR,FXD,10M,1/4 W,5%,ALL EN BRADLEY CB R24	CB1065	001121	-	EA	1.0000
043	001162008408	3	RSTR,VAR,20K,10%,15PPM VISHAY R25	1280G-20K-10%	018612	-	EA	1.0000
044	001085621902	8	RSTR,FXD,5.62 MEG,1/4W,1% R27	5053YL5.62MF	019701	-	EA	1.0000
045	001072800901	4	RSTR,FXD,280K,1/10 W,1%,R R28	RN55C2803F	ANY	-	EA	1.0000
046	001091131902	0	RSTR,FXD,11.3MEG,1/4W,1% R29	5053YL11.3MF	019701	-	EA	1.0000
047	001075620901	3	RSTR,FXD,562K,1/10 W,1%, R30	RN55C5623F	ANY	-	EA	1.0000
048	001071130901	7	RSTR,FXD,113K,1/10W,1% R31	RN55C1133F	ANY	-	EA	1.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
049	001072260901	1	RSTR,FXD,226 K,1/10 W,1%, R32	RN55C2263F	ANY	-	EA	1.0000
050	001061240907	0	RSTR,FXD,12.4K,1/10W,.1% R34	RN55C1242B	ANY	-	EA	1.0000
051	001071000907	5	RSTR,FXD,100K,1/10W,.1% R35	RN55C1003B	ANY	-	EA	1.0000
052	001078060907	3	RSTR,FXD,806K,1/10W,.1% R36	RN55C8063B	ANY	-	EA	1.0000
053	001061620907	3	RSTR,FXD,16.2K,1/10W,.1% R37,38	RN55C1622B	ANY	-	EA	2.0000
054	001063240907	8	RSTR,FXD,32.4K,1/10W,.1% R39	RN55C3242B	ANY	-	EA	1.0000
055	001066490907	6	RSTR,FXD,64.9K,1/10W,.1% R40	RN55C6492B	ANY	-	EA	1.0000
056	001064640901	4	RSTR,FXD,46.4K,1/10 W,1%, R41,45	RN55C4642F	ANY	-	EA	2.0000
057	001061870901	0	RSTR,FXD,18.7K,1/10W,1% R42,46	RN55C1872F	ANY	-	EA	2.0000
058	001059310901	1	RSTR,FXD,9.31K,1/10W,1% R43,47	RN55C9311F	ANY	-	EA	2.0000
059	001072320901	3	RSTR,FXD,232K,1/10W,1% R44,48	RN55C2323F	ANY	-	EA	2.0000
060	001041000907	3	RSTR,FXD,100OHM,1/10W,.1% R49	RN55C1000B	ANY	-	EA	1.0000
061	064252210500	1	WIRE,JUMPER,INSULATED,TEF ,0.500 LG X 0.250 HIGH,22 AWG,SQUIRES ELECTRONICS J0.500X0.250T22 R4			C	EA	1.0000
066	012107663231	3	I.C.,VOLTAGE REG.,MAXIM U2	ICL7663BCPA	01ES66	-	EA	1.0000
067	012107664301	6	I.C.,VOLTAGE REG.,MAXIM U3	ICL7664CPA	01ES66	-	EA	1.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
068	012621001300	9	PRECISION OP-AMP LINEAR TECHNOLOGY INC U4	LT1001CN8	037964	-	EA	1.0000
069	012621058100	1	OP-AMP,QUAD LINEAR TECHNOLOGY INC. U5	LT1058ACN	037964	-	EA	1.0000
075	008711130018	8	TERMINAL BLOCK,18 POS, ALTECH CORP. TB1	AK300-18	00DU12	-	EA	1.0000
078	001522261001	4	VARISTOR,V22ZA1,G.E. VR1,2,3,4,5,6	V22ZA1	003508	-	EA	6.0000
080	007936510102	9	CONNECTOR,2 POS ,BERG XW1,2,15	65610-102	06V559	-	EA	3.0000
081	007936510106	5	CONNECTOR,6 POS, BERG XW3,4&5:XW6,7&8:XW14,22&23:XW16,17&20: XW18,19&21:XW32,33&34	65610-106	06V559	-	EA	6.0000
082	007936510108	3	CONNECTOR,8 POS,BERG XW26,25,24,27:WX30,29,28,31	65610-108	06V559	C	EA	2.0000
083	007936510110	9	CONNECTOR,10 POS,BERG XW9,10,11,12&13	65610-110	06V559	-	EA	1.0000
087	007936547404	6	JUMPER,BERG W1,2,3,8,9,20,21,23,26,30,32	65474-010	06V559	B	EA	11.0000

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4. VOLTAGE CONTROLLED OSCILLATOR

4.1 GENERAL

The Model 46.32 Voltage Controlled Oscillator is designed to convert signals from the Seismic Amplifier to narrow-band telemetry channels. With the Model 46.32-1, these outputs can be added together (multiplexed) to permit transmission over a single pair of wires. An outline of the module showing component location is shown in figure 4-1.

4.2 CONTROLS

Table 4-1 lists the internal circuit controls that are normally factory pre-set. Most are not available for adjustment when the module is installed in the 45.50 Enclosure. Readjustment should only be required after maintenance, after extended use, or reconfiguration and/or moving to a new sight. The procedures for properly setting the adjustments are found in section 4.6.

Table 4-1. PC Board Adjustments

Reference	Function
R8	Adjusts the sensitivity of the VCO
R11	Adjusts the center frequency of the VCO
R25	Adjusts the output amplitude of the VCO
R20	Adjusts the output amplitude of the multiplexer and line output option

4.3 OPERATING PROCEDURES

Make all power, input and output connections as described in section 2. Make all proper jumper connections. The VCO jumper descriptions are given in table 4-2.

The VCO channel must be selected with W1, W2 or W3. If the VCO has the multiplexer option, jumpers W4, W5 and W6 should be removed. If the VCO does not have the multiplexer option, then W5 must be installed. If the VCO is a stand alone unit then, W4, W5, and W6 should be installed.

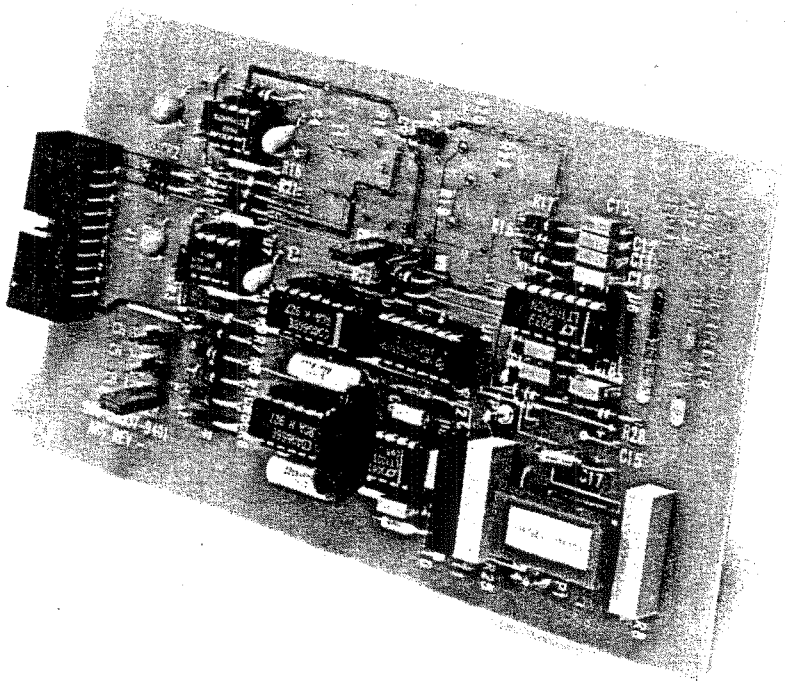

Figure 4-1. VCO/Multiplexer Assembly

Table 4-2. VCO Jumper Selections

Reference	Function
W1	Selects Channel 1 Seismic Amplifier for input
W2	Selects Channel 2 Seismic Amplifier for input
W3	Selects Channel 3 Seismic Amplifier for input
W4	Connects one side of line output to signal ground
W5	Provides U5D feedback path when VCO does not have the multiplexer option
W6	Provides direct connection of U5D output to line output signal
W7	Provides summing junction path for multiplexer

4.4 SPECIFICATIONS

OPERATING CHARACTERISTICS

Input impedance	20K ohm, single ended
Sensitivity	±5 volts for full scale deviation
Channels	Standard constant bandwidth: 340, 680, 1020, 1360, 1700, 2040, 2380, 2720 and 3060 Hertz with ±125 Hz Deviation. Special channels and deviations available on request.
Output	1.0 Volt RMS into 600 ohm load, adjustable ±6dB. Transformer coupled with multiplexer
Dynamic Range	60dB, over 25 Hertz bandwidth
Linearity	0.2% max of full scale, based on best straight line
Drift	0.02% of center frequency per ^{O}C

POWER REQUIREMENTS

Voltage	±10 to ±12 volts dc
Current	10 mA from each supply, typical

4.5 CIRCUIT DESCRIPTION

4.5.1 General

The Model 46.32 VCO is designed to allow selection of center frequency and deviation sensitivity by changing one resistor assembly. Features include low power, on module voltage regulation, single-ended input, and sinewave output. Figure 4-1 is an outline of the module showing component location, and figure 4-2 is a block diagram of the VCO. Figures 4-4 and 4-5 are schematics of the VCO.

Looking at figure 4-2, the positive and negative modulators are synchronized with the square wave output of a current-to-frequency converter. The modulators supply a current proportional to input voltage and opposite in polarity respectively. This current is summed with the reference current in the current to frequency converter. The result is a symmetrical increase in current for a positive input and a symmetrical decrease in current for a negative input.

The current-to-frequency converter is a current controlled oscillator with a very linear current-to-frequency relationship. With zero volts input, the modulation circuits have no effect on the frequency output; thus, a minimum number of components affect the center frequency stability. The triangle wave output from the converter is filtered by a low-pass notch filter to give only the fundamental frequency at the output. The filter is designed to provide maximum rejection of third harmonics and greater for all passband frequencies around the center frequency.

The multiplexer stage provides a summing junction for two other VCO modules and for external inputs. The external inputs must be isolated by 510K resistors and terminated by proper line impedance external to the VCO.

4.5.2 Input Circuit

The VCO input circuit is essentially a resistor divider network consisting of R5, R6 and R7. The divider output voltage is 1/4 the input. R5 limits the current to the voltage limiting diodes CR5 and CR6. This limits the input voltage to + 5.5 volts and - 5.5 volts.

The capacitors C7 and C8 are part of the modulators but also provide filtering for the input circuit. The effective low-pass cutoff frequency is a little over 100 Hertz.

4.5.3 Positive and Negative Modulators

The positive and negative modulators work together to provide symmetrical modulation of the current to frequency converter by the input signal. The positive modulator is made up of the quad switch U3, normally open single throw, and the capacitor C8. The negative modulator is made up of the quad switch U2 and the capacitor C7.

A positive output level from the current-to-frequency converter (pins 1 and 5 of U4) turns "on" the four switches of in U3. The low output (pins 3 and 12 of U4) turns "off" the four switches in U2 at the same time. When U3 is "on" both terminals of C8 are connected across R7, and C8 is charged to the attenuated input voltage. At the same time C7 is switched to the current-to-frequency converter circuit through the potentiometer R8 and a selected resistor in U1 (terminals 1 and 16). C7 was charged to the attenuated input voltage when the output from the current-to-frequency converter was negative. The charge on C7 provides current through R8 that is proportional to the input voltage. If the input voltage is positive the reference current will be increased. If the input voltage is negative this current will be decreased.

When the output from the current-to-frequency converter reverses, the four switches in U2 close and C7 is charged while C8 is connected to the converter. C8 is connected in the opposite polarity from which it received its charge; thus, a positive input voltage will increase the negative half cycle current to the converter, and a negative input voltage will decrease this half cycle.

The currents from the modulator are added and subtracted to and from the reference current at pin 2 of U5. (see Figure 4-2.)

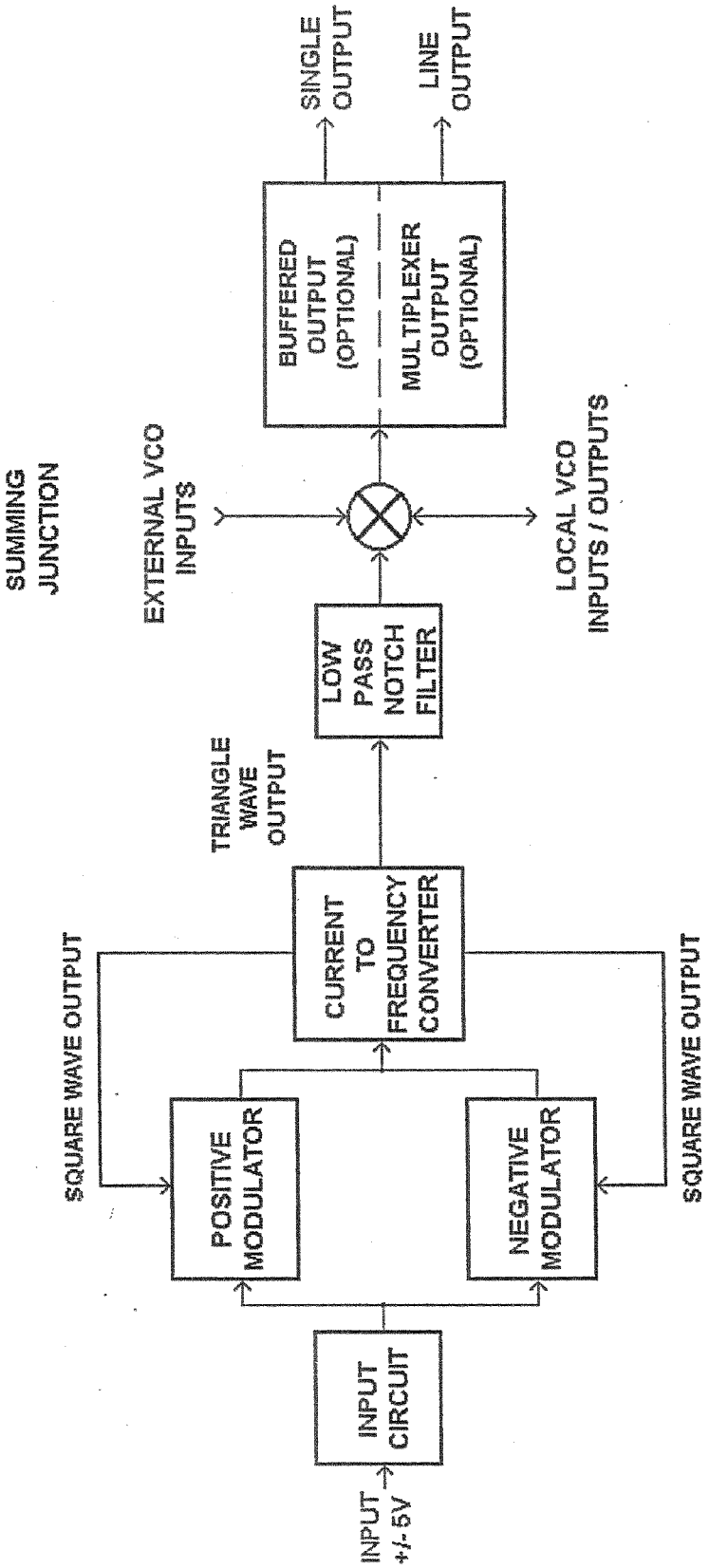

Figure 4-2. VCO Block Diagram

4.5.4 Current-to-Frequency Converter

The current-to-frequency converter consists of U4, U5, R10 through R12, C9, and the resistor in U1 between terminals 2 and 15.

U5 is a precision op amp, and U4 is three CMOS transistor stages with inverted outputs and predictable switching levels. The circuit uses only two of these stages, one as a crossover detection amplifier and the other as an output buffer.

U5, with feedback capacitor C9, forms what is essentially an ideal integrator. The inverting input is held at common by current through C9 from U5's output stage. The current is supplied through the resistor in U1 from the square wave output at pins 1 and 5 of U4. This current has a constant magnitude and is either positive or negative, depending on the level of the square wave. Thus, the output at pin 6 of U5 is a symmetrical triangle wave with its frequency directly proportional to the current through C9.

The output level of U5 is sensed at the CMOS transistor input (pin 10 of U4) through a resistor divider R10, R11, and R12 connected between the square wave output and the triangle wave output. R11 is a potentiometer used to adjust the level of the triangle wave; thus, setting the output frequency. The CMOS transistor will switch when its input level is at approximately zero volts from common. Note the switching will occur when the triangle is at a peak and the square wave is of opposite polarity. The output from this CMOS transistor stage is approximately a square wave and is used to turn "on" and "off" the four switches in U2. This output also drives a second CMOS inverter pair whose input is at pin 3 and its output at pins 1 and 5. This output is a perfect square wave switching between the reference voltage levels +5V and -5V. This output controls the switch in U3 and is the feedback voltage to the integrator.

4.5.5 Low-Pass Notch Filter

The low-pass notch filter has two sections, a three-pole notch section and a two-pole low-pass with maximum flat response. The filter characteristics are controlled by six resistors in the resistor assembly U1. These resistors are given the following designations by location for reference.

R3' - U1, terminals 3 and 14
R4' - U1, terminals 4 and 13
R5' - U1, terminals 5 and 12
R6' - U1, terminals 6 and 11
R7' - U1, terminals 7 and 10
R8' - U1, terminals 8 and 9

The notch filter is a two stage circuit consisting of a summing amplifier and a tuned high-pass. The summing amplifier consists of U6A, R3', R5', and C11. Feedback from the tuned high-pass is provided through R4'. The tuned high-pass consists of U6B, C12, C13, R14, R15, R17, and R6'.

The triangle output from the current-to-frequency converter is coupled through C10 to the summing amplifier. The output of the summing amplifier goes to the tuned high-pass which is tuned to the third harmonic of the VCO center frequency. The third harmonic is amplified, inverted, and fed back to the summing amplifier to cancel the harmonic input.

The two-pole low-pass provides additional third harmonic rejection plus it eliminates all harmonics greater than the third. The two-pole low-pass is made up of U6C, C16, C17, C18, R7', R25, R26, and R28. This section also amplifies the carrier frequency to a level suitable for multiplexing. R25 is a potentiometer used to adjust the carrier level to the multiplexer.

Table 4-3. Equations for Selecting Resistors in U1

Symbol	Equation	Units	Description
ω_o	$(2\pi f_c)\times 2.9$	radians per second	notch frequency
d	$125/f_c$	dimensionless	VCO deviation rate
k	$3/(1+d)$	dimensionless	ratio of notch frequency to corner frequency
Q	$4200/f_c$	dimensionless	notch sharpness factor
α	$1370/\sqrt{f_c^{\,2}+3.7\times 10^6}$	dimensionless	damping coefficient for corner frequency
ω_2	$(2\pi f_c)(1+\alpha^2)$	radians per second	second low pass cutoff frequency
R6'	$\left[(1.63\times 10^7)/\omega_o\right]^2$	ohms	1/4W. 5% resistor (notch select)
R5'	$\dfrac{(\alpha k-1/Q)}{(\omega_o\times 560\times 10^{-12})(1-1/k^2)}$	ohms	1/4W. 5% resistor (summing amplitude)
R3'	$R5'/\alpha$	ohms	1/4W. 5% resistor (summing amplifier gain)
R4'	$\left[(\omega_o\times 560\times 10^{-12})(\alpha/k-1/Q)+(k^2-1)/R5'\right]^{-1}$	ohms	1/4W. 5% resistor (notch feedback)
R7'	$6\times 10^8/\omega_2$	ohms	1/4W. 5% resistor (2 pole low pass)
R8'	$5.3\times 10^9/\omega_2$	ohms	1/4W. 5% resistor (2 pole low pass)
R2'	$(4\times 10^8)/f_c$	ohms	1%. 50 ppm resistor (center frequency)
R1'	$\dfrac{0.305R2'}{d}-5\times 10^5$	ohms	1/4W. 5% resistor (sensitivity)

4.5.6 Multiplexer

The multiplexer circuit consists of the following components:

CR7, CR8
R18-R20, R22, R29
T1
U6D
W7

U6D is an adjustable gain amplifier with a summing junction at its inverting input (pin 13) through the jumper W7. R20 is a potentiometer which with R19 and R22 provides a gain adjustment common to all multiplexed carriers. R18 is a matching impedance for the line output transformer T1. CR7 and CR8 provide transient protection for U6.

External VCO's are summed at pin 20 of J1. External line inputs must be properly terminated and isolated through 51K ohms to pin 20 of J1. This external input may be a single carrier or a multiplexed set of carriers.

4.5.7 VCO Tuning Unit (U1)

U1 is a plug in assembly of eight resistors. These resistors are selected for VCO sensitivity, for VCO center frequency, and for optimum low-pass notch characteristics. Table 4-2 lists the equations for calculating filter characteristics and resistor values for constant bandwidth VCO's (+/- 125 Hz) with center frequencies between 340 and 3060 Hertz. In table 4-2 fc is the VCO center frequency in Hertz. Note that for VCO's with constant percent deviation (+/-7.5%, +/-15%, etc.), the values for d and k will be constant regardless of the value of fc.

4.6 ADJUSTMENT PROCEDURES

4.6.1 Equipment Required

a) Voltage source, Dial-a-Source Model DAS 46L, or equal.
b) 2 each power supplies, 10 to 15 volts adjustable at 20mA.
c) Frequency counter, 200 to 10000 Hz ±0.05%.
d) Oscilloscope, Tektronix Model 503, or equal.

4.6.2 Frequency

Location of the various controls is shown in figure 4-1.

a) Make connections shown in figure 4-3. Set the voltage source to zero volts and adjust R25 for approximately 1 volt peak-to-peak at TP1.

b) Adjust R11 until the frequency counter reads the center frequency ±0.05%.

c) Set the voltage source to +5.000 (±0.001) volts.

d) Adjust R8 until the frequency counter reads 125 Hz above the center frequency (±0.05%).

e) Set the voltage source to -5.000 (±0.001) volts. The frequency counter should read 125 Hz below the center frequency (±0.2%).

f) Adjust R25 for a VCO output signal at TP1 to 1/3 V rms (0.94 volts peak-to-peak) ±2%. Seal the adjustments of R8 and R11.

4.6.3 Output Level

With the VCO's installed in the system and the line or radio transmitter connected across terminals 8 and 9 of TB1 on the I/O module, monitor the voltage across terminals 8 and 9 with the oscilloscope or an rms reading dvm. Adjust R20 on the VCO multiplexer for 1 volts rms. This is approximately 3 volts p-p as measured on the scope, for multiplexed signals.

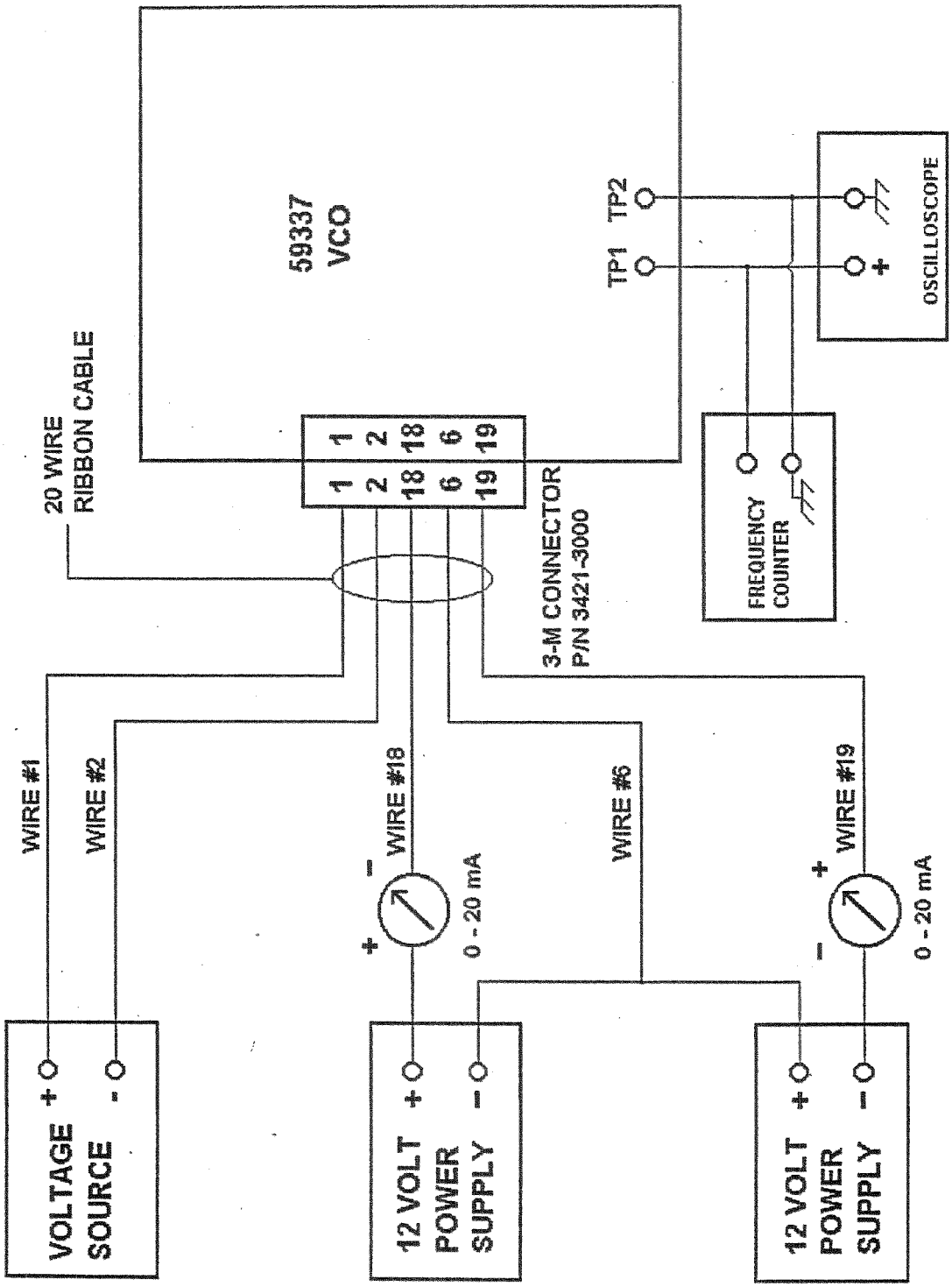

Figure 4-3. VCO Test Setup

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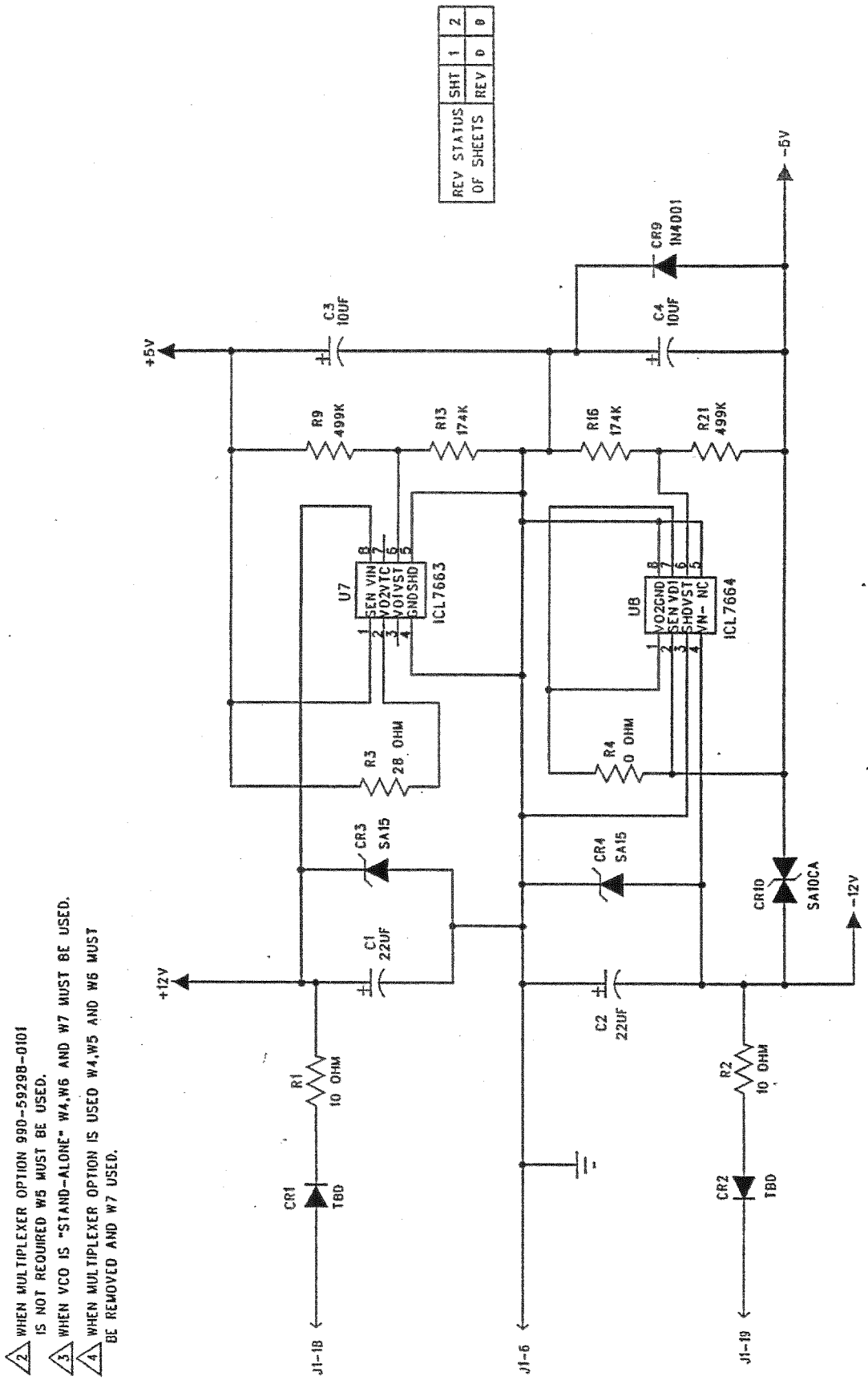

Figure 4-4. VCO/Multiplexer Schematic, sheet 1

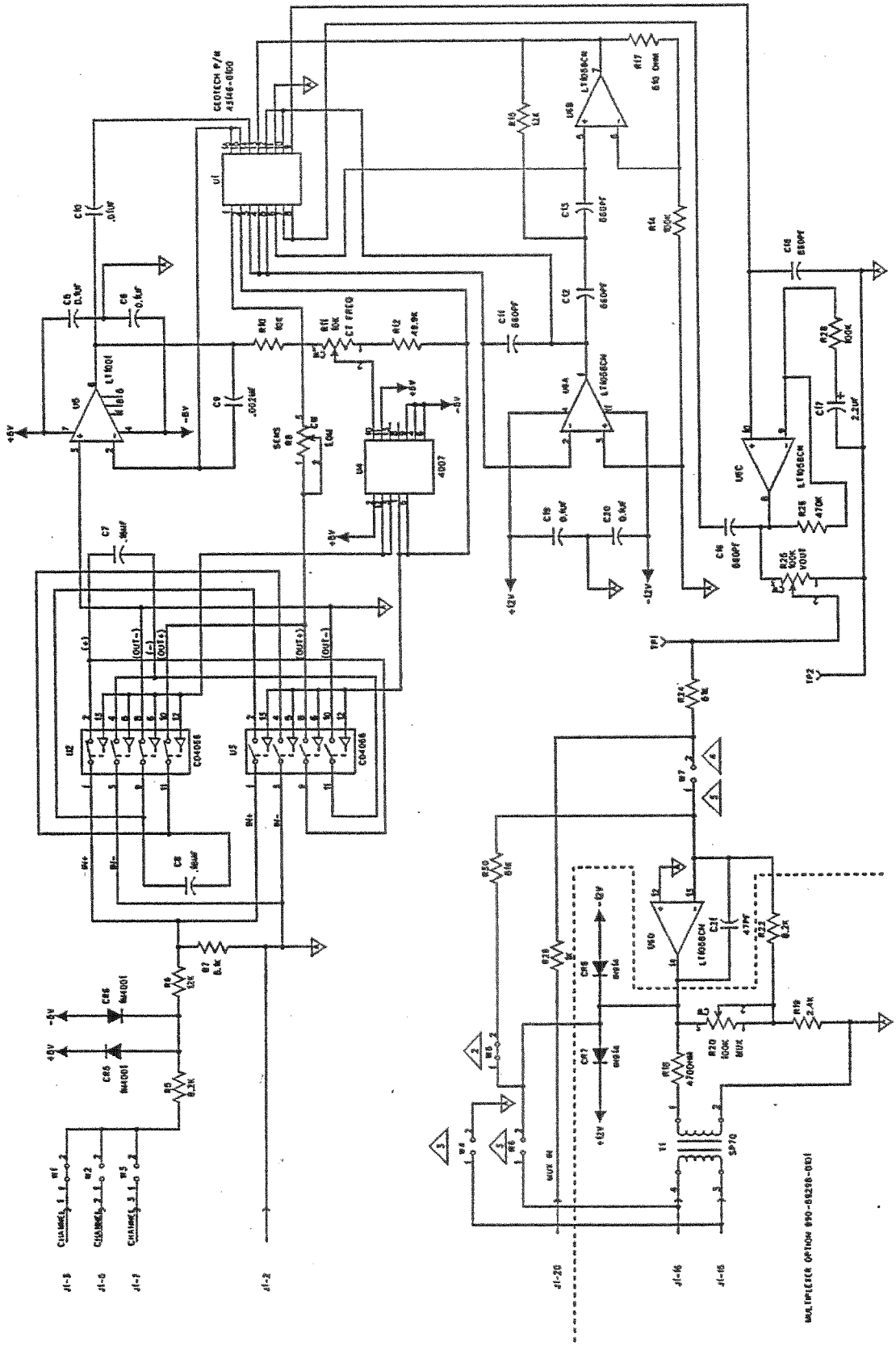

Figure 4-5. VCO/Multiplexer Schematic,

Table 4-4. VCO Parts List

TG3340 T E L E D Y N E G E O T E C H
TRANS: MILPL MILITARY SINGLE LEVEL PARTS LIST
RUN DATE 28-Sep-93 RUN TIME 02:49 PM SHEET 2

PARENT PART		DESCRIPTION/SPECIFICATION	ENG DRAWING REFERENCE	FSCM	REVISION	ECN
990593370101	0	VCO / MULTIPLEXER */990-59337-0000/CONFIGURATION SHEET A/990-59337-1100/PARTS LIST D/990-59337-2100/SCHEMATIC A/990-59337-5100/DRAWING LIST A/990-59337-6100/ACCEPTANCE TEST */990-59337-9900/SPECIFICATION	990593370100	099019	D5	E47559

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
001	990593370301	8	FAB,VCO / MULTIPLEXER	990593370301	099019	-	EA	1.0000
002	001031001035	8	RSTR,FXD,10 OHM,1/4 W,5% ALLEN BRADLEY CB R1,R2	CB1005	001121	-	EA	2.0000
003	001032800901	3	RSTR,FXD,28 OHM,1/10W,1% R3	RN55C28R0F	ANY	B	EA	1.0000
004	001058201035	2	RSTR,FXD,8.2K,1/4 W,5%,AL LEN BRADLEY CB R5	CB8225	001121	-	EA	1.0000
005	001061201035	7	RSTR,FXD,12K,1/4 W,5%,ALL EN BRADLEY CB R6,R15	CB1235	001121	-	EA	2.0000
006	001055101035	7	RSTR,FXD,5.1K,1/4W,5%,A LLEN BRADLEY CB R7	CB5125	001121	-	EA	1.0000
007	001181009094	7	RSTR,VAR,1M,BECKMAN R8	89PR1M	073138	-	EA	1.0000
008	001074990901	1	RSTR,FXD,499K,1/10 W,1%,R R9,R21	RN55C4993F	ANY	-	EA	2.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
009	001061000901	4	RSTR,FXD,10K,1/10 W,1%,RN 55C(CORNING NC4) R10	RN55C1002F	ANY	-	EA	1.0000
010	001151018408	5	RSTR,VAR,10K,10%,VISHAY R11	1280G-10K-10%	018612	-	EA	1.0000
011	001064990901	3	RSTR,FXD,49.9K,1/10 W,1%, R12	RN55C4992F	ANY	-	EA	1.0000
012	001071740901	3	RSTR,FXD,174K,1/8 W,1% R13,R16	RN55C1743F	ANY	-	EA	2.0000
013	001071001035	9	RSTR,FXD,100K,1/4 W,5%,AL LEN BRADLEY CB R14,R28	CB1045	001121	-	EA	2.0000
014	001045101035	0	RSTR,FXD,510 OHM,1/4 W,5% ,ALLEN BRADLEY CB R17	CB5115	001121	-	EA	1.0000
015	307000022000	3	HEADER,RT ANGLE,20 PIN SOURCE CONTROL DRAWING J1	307-00002-2000	099019	A	EA	1.0000
017	001171009094	9	RSTR,VAR,100K,BECKMAN R100K R25	89PR100K	073138	-	EA	1.0000
019	001065101035	5	RSTR,FXD,51K,1/4 W,5%,ALL EN BRADLEY CB R24,R30	CB5135	001121	-	EA	2.0000
020	001074701035	1	RSTR,FXD,470K,1/4 W,5%,AL LEN BRADLEY CB R26	CB4745	001121	-	EA	1.0000
021	001051001035	3	RSTR,FXD,1K,1/4W,5%,ALLE N BRADLEY CB R29	CB1025	001121	-	EA	1.0000
023	012010400100	4	DIODE,1N4001 CR1,CR2,CR5,CR6,CR9	1N4001	ANY	-	EA	5.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
024	012021911500	3	TRANSZORB,15V,GENERAL SEMICONDUCTOR,SA15 CR3,CR4	SA15	024444	-	EA	2.0000
025	012021911031	1	TRANSZORB,GENERAL SEMI CR10	SA10CA	024444	C	EA	1.0000
026	002722250684	7	CAPACITOR,22 MF,25V,10% SPRAGUE C1,C2	199D226X9025DE2	056289	-	EA	2.0000
027	002710250669	0	CAP,10MF,25V,10%,SPRAGUE C3,C4	199D106X9025CA1	056289	-	EA	2.0000
028	002510508668	4	CAPACITOR,.1 MF,50V,20%, C5,C6,C19,C20	VENDOR ITEM	099019	-	EA	4.0000
029	302022000028	2	CAP,.18 MF,50V,1% SOURCE CONTROL DRAWING C7,C8	302-02200-0028	099019	-	EA	2.0000
030	002320855994	4	CAPACITOR,.002MF,500V,5%, CM06(DM19/D19/CD19) C9			-	EA	1.0000
031	002410508668	5	CAPACITOR,.01 MF,50 V,20% C10	VENDOR ITEM	099019	-	EA	1.0000
032	002256500668	9	CAPACITOR,560 PF,50V,10% C11,C12,C13,C16,C18	VENDOR ITEM	099019	-	EA	5.0000
033	002622200901	0	CAPACITOR,2.2MF,20V,10%, CS13BE225K(150D225X9020A2) (CSR13)(INSULATED) C17	150D225X9020A2	056289	-	EA	1.0000
034	008220252021	9	TERMINAL,USECO 2520B-1 TP1,TP2	2520B-1	088245	-	EA	2.0000
035	012107663231	3	I.C.,VOLTAGE REG.,MAXIM U7	ICL7663BCPA	01ES66	-	EA	1.0000
036	012107664301	6	I.C.,VOLTAGE REG.,MAXIM U8	ICL7664CPA	01ES66	-	EA	1.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
037	012104406625	4	I.C.DIGITAL,CMOS,SWITCH BILATERAL,QUAD,CD4066BE U2,U3	CD4066BE	002735	-	EA	2.0000
039	012100360000	2	TRANSISTOR ARRAY,RCA (OLD PART NO. CA3600E) U4	CD4007UBD	002735	-	EA	1.0000
040	012621001300	9	PRECISION OP-AMP LINEAR TECHNOLOGY INC U5	LT1001CN8	037964	-	EA	1.0000
041	012621058100	1	OP-AMP,QUAD LINEAR TECHNOLOGY INC. U6	LT1058ACN	037964	-	EA	1.0000
042	007936510106	5	CONNECTOR,6 POS, BERG XW1,XW2,XW3	65610-106	06V559	-	EA	1.0000
043	007936547404	6	JUMPER,BERG W1,W5	65474-010	06V559	-	EA	2.0000
044	007936510102	9	CONNECTOR,2 POS ,BERG XW4,XW5,XW6,XW7	65610-102	06V559	-	EA	4.0000
045	007370161100	6	SOCKET,I.C.,16 PIN,BURNDY DILB16P-11 XU1	DILB16P-11	009922	-	EA	1.0000
046	007370081100	6	SOCKET,I.C.,8 PIN,BURNDY XU8	DILB8P-11	009922	-	EA	1.0000
048	002147500668	2	CAPACITOR,47PF,50V,10% C21	VENDOR ITEM	099019	-	EA	1.0000
049	064252210500	1	WIRE,JUMPER,INSULATED,TEF ,0.500 LG X 0.250 HIGH,22 AWG,SQUIRES ELECTRONICS J0.500X0.250T22 R4			B	EA	1.0000
900	990592980101	7	MULTIPLEXER KIT ITEM 2,OPTION A1 ONE REQUIRED	990592980101	099019	-	EA	OPT
901	990000000000	2	OPTION NOT REQUIRED USED FOR DOCUMENTATION PURPOSES ITEM 2,OPTION A2 NONE REQUIRED	990000000000	099019	-	EA	OPT

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
902	990431460101	5	VCO TUNING UNIT,CENTER FREQ 340HZ,DEVIATION+/-125HZ ITEM 3, OPTION B1 ONE REQUIRED U1	990431460101	099019	-	EA	OPT
903	990431460102	4	VCO TUNING UNIT,CENTER FREQ 680HZ,DEVIATION+/-125HZ ITEM 3,OPTION B2 ONE REQUIRED U1	990431460102	099019	-	EA	OPT
904	990431460103	3	VCO TUNING UNIT,CENTER FREQ 1020HZ,DEVIATION+/-125HZ ITEM 3,OPTION B3 ONE REQUIRED U1	990431460103	099019	-	EA	OPT
905	990431460104	2	VCO TUNING UNIT,CENTER FREQ 1360HZ,DEVIATION+/-125HZ ITEM 3,OPTION B4 ONE REQUIRED U1	990431460104	099019	-	EA	OPT
906	990431460105	1	VCO TUNING UNIT,CENTER FREQ 1700HZ,DEVIATION+/-125HZ ITEM 3,OPTION B5 ONE REQUIRED U1	990431460105	099019	-	EA	OPT
907	990431460106	0	VCO TUNING UNIT,CENTER FREQ 2040HZ,DEVIATION+/-125HZ ITEM 3,OPTION B6 ONE REQUIRED U1	990431460106	099019	-	EA	OPT
908	990431460107	9	VCO TUNING UNIT,CENTER FREQ 2380HZ,DEVIATION+/-125HZ ITEM 3,OPTION B7 ONE REQUIRED U1	990431460107	099019	-	EA	OPT
909	990431460108	8	VCO TUNING UNIT,CENTER FREQ 2720HZ,DEVIATION+/-125HZ ITEM 3,OPTION B8 ONE REQUIRED U1	990431460108	099019	-	EA	OPT
910	990431460109	7	VCO TUNING UNIT,CENTER FREQ 3060HZ,DEVIATION+/-125HZ ITEM 3,OPTION B9 ONE REQUIRED U1	990431460109	099019	-	EA	OPT

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5. PULSE CALIBRATOR

5.1 GENERAL

The Model PC-120 Pulse Calibrator is designed to produce calibration pulses of a selectable fixed amplitude, a selectable fixed duration, and a fixed interval that is selectable. An outline of the module showing component locations is shown in figure 5-1.

5.2 CONTROLS

Table 5-1 lists the controls that are used for normal setup.

Table 5-1. Setup Controls and Adjustments

Control	Reference	Function
CURRENT ADJ	R1	Trims the calibration pulse current
MANUAL CAL	W31	Outputs a current pulse while jumper is installed
TIME RESET	W30	When jumper at W29 is moved to W30 the timing circuit is reset. The timing circuit restarts when W30 is removed.
RANGE	S3	Sets the calibration pulse current range
TIME ON	W16-W28	Jumpers to set calibration pulse duration
PERIOD	W3-W15	Jumpers to set calibration time interval

5.3 OPERATING PROCEDURES

Make all power, input, and output connections as described in section 2. The calibration current should be set as described in section 5.6. To make a manual calibration pulse, connect W31 and W32. If the current out is greater than 50 mA, do not make the pulse any longer than necessary to avoid possible overheating of the current generator circuit.

To restart the calibration interval, connect W30 and remove. The interval starts when W30 is removed. The jumper normally connected at W29 is for this purpose.

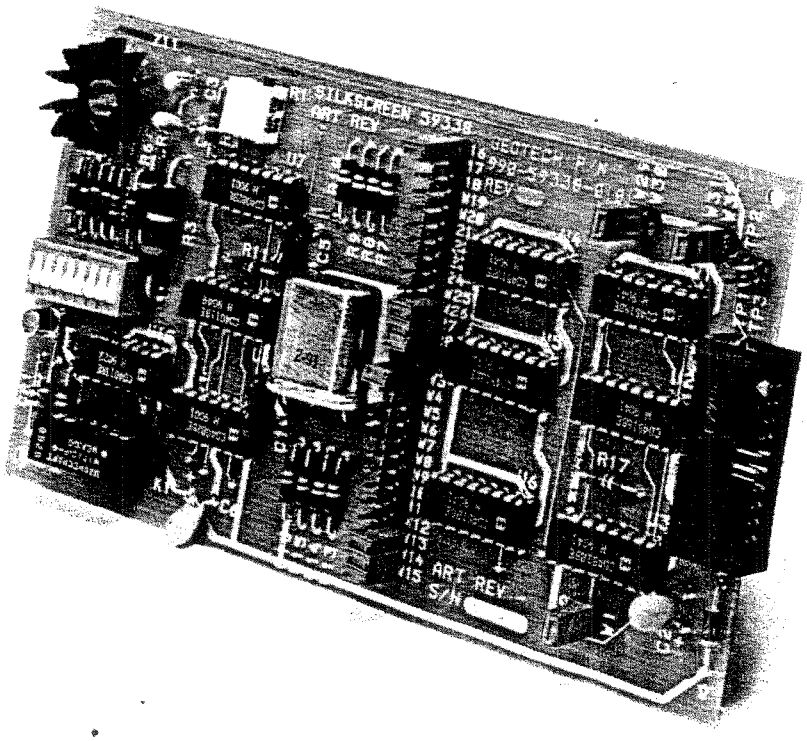

Figure 5-1. Pulse Calibrator Assembly

5.4 SPECIFICATIONS

OPERATING CHARACTERISTICS

Pulse duration	1-72 seconds, programmable
Pulse current	0.7 to 2.4 microamps or 2.6 to 100 milliamps, selectable and adjustable
Calibration interval	1-72 Hours programmable
Reference crystal frequency	1.0 MHz ±0.01%

POWER REQUIREMENTS

Voltage	10 to 15 volts dc
Current (quiescent)	2.3 mA at 12 Vdc, typical
Current (max.)	110 mA, selectable

ENVIRONMENTAL CHARACTERISTICS

Operating Temperature	-20 to +60 ^{o}C
Relative Humidity	5 to 95%, non-condensing

5.5 CIRCUIT DESCRIPTION

The circuit counts down a 1 MHz clock to hour intervals decoded in BCD: Jumpers select intervals for clocking the output circuitry to "on". Other jumpers select the duration pulse to reset the output circuitry to "off". The output circuit is isolated by a relay K1.

When K1 is closed, a reference voltage is supplied to the external load through a current limiting resistor.

The schematic is shown in figures 5-2 and 5-3. Gate U8A, and crystal Y1 with R11 and R12 and C1 and C5 produce a 1 MHz square wave oscillator that toggles U1 input. U1 through U6 are dual decade counters.

The frequency is divided down to 1 Hz at the output of U3 (pin 14). U4 is the seconds counter with selectable outputs to gate U7A providing a reset to deactivate the relay driving circuit.

The output of U4 is counted down by U5, with its outputs decoded by U7B, to provide hour intervals. Each time a count of 3600 seconds is reached by U5 gate, U7B outputs a positive clock transition to flip-flop U10A causing U10 pin 2 to be set low. This low going transition resets counter U5 to zero and advances counter U6. U6 is the hours counter.

U6 will continue to advance in hour increments until decoder gate U9A pin 1 goes high which sets flip-flop U10B pin 13 high, turning on Q1. Pin 12 of U10B resets the hours counter (U6) to zero. Q1 activates K1 and the circuit power supply. The potentiometer R1 is used to set the reference voltage to the value needed to produce the required calibration current.

5.6 ADJUSTMENT PROCEDURE

5.6.1 Output Current

The procedure to set the calibration output current should be performed in the following manner starting with power off.

a) Position current range switches S1-1 through S1-8 to open.

b) Set R1 to mid-range.

c) Connect a current meter in place of W32.

NOTE

If the current is less than 10 mA, the current meter may offer too high of an impedance. Therefore, it is recommended to measure the voltage drop across the load. If this method is used, replace W32.

d) Use the following table to select calibration current range. This table is calculated for a nominal load impedance of 20 ohms. Range switch positions 7 and 8 are used when the system contains a Model S-500 short-period seismometer.

Range Switch	Current Range (+/-5%)
S1-8	0.7 to 1.4 microamps
S1-7	1.1 to 2.3 microamps
S1-6	2.6 to 5.2 milliamps
S1-5	5.2 to 10.4 milliamps
S1-4	6 to 13 milliamps
S1-3	13 to 26 milliamps
S1-2	26 to 52 milliamps
S1-1	52 to 104 milliamps

e) Turn the power on (connect power source to the system) and connect jumper W31. Adjust R1 to the desired value.

**** CAUTION ****

When the current to calibration coil is 75 to 100mA, W31 should not be left in position for more than a minute or damage to the calibration coil in the seismometer may result.

f) Remove W31 and momentarily connect W30 to reset time.

5.6.2 Time Interval

To set the calibration time interval, install up to four jumpers at W3 through W15. The available hourly intervals and the jumpers required are given in table 5-2.

5.6.3 Pulse Duration

To set the calibration pulse duration, install up to four jumpers at W16 through W28. The available pulse lengths, in seconds, and the jumpers required are given in table 5-3.

Table 5-2. Calibration Time Interval

Jumpers (Wx)							
Hours	X1	X2	X4	X8	X10	X20	X40
1	3						
2		4					
3	3	4					
4			5				
5	3		5				
6		4	5				
7	3	4	5				
8				6			
9	3			6			
10					7		
11	3				7		
12		4			7		
13	3	4			7		
14			5		7		
15	3		5		7		
16		4	5		7		
17	3	4	5		7		
18				6	7		
19	3			6	7		
20						8	
21	3					8	
22		4				8	
23	3	4				8	
24			5			8	
25	3		5			8	
26		4	5			8	
27	3	4	5			8	
28				6		8	
29	3			6		8	
30					7	10	
31	3				7	10	
32		4			7	10	
33	3	4			7	10	
34			5		7	11	
36		4	5		7	12	
37	--- Not Available ---						

Table 5-2. (continued)

Jumpers (Wx)							
Hours	X1	X2	X4	X8	X10	X20	X40
38				6	7	11	
39	3			6	7	11	
40							9
41	3						9
42		4					9
43	3	4					9
44			5				9
45	3		5				9
46		4	5				9
47	3	4	5				9
48				6			9
49	3			6			9
50					7		13
51	3				7		13
52		4			7		13
53	3	4			7		13
54			5		7		14
55	3		5		7		14
56		4	5		7		15
57	--- Not Available ---						
58				6	7		14
59	3			6	7		14
60						10	9
61	3					10	9
62		4				10	9
63	3	4				10	9
64			5			11	9
65	3		5			11	9
66		4	5			12	9
67	--- Not Available ---						
68				6		11	9
69	3			6		11	9
70					7	10	14
71	3				7	10	14
72		4			7	10	15

Table 5-3. Calibration Pulse Duration

Jumpers (Wx)							
Seconds	X1	X2	X4	X8	X10	X20	X40
1	16						
2		17					
3	16	17					
4			18				
5	16		18				
6		17	18				
7	16	17	18				
8				19			
9	16			19			
10					20		
11	16				20		
12		17			20		
13	16	17			20		
14			18		20		
15	16		18		20		
16		17	18		20		
17	16	17	18		20		
18				19	20		
19	16			19	20		
20						21	
21	16					21	
22		17				21	
23	16	17				21	
24			18			21	
25	16		18			21	
26		17	18			21	
27	16	17	18			21	
28				19		21	
29	16			19		21	
30					20	23	
31	16				20	23	
32		17			20	23	
33	16	17			20	23	
34			18		20	24	
36		17	18		20	25	
37	--- Not Available ---						

Table 5-3. (continued)

Jumpers (Wx)							
Seconds	X1	X2	X4	X8	X10	X20	X40
38				19	20	24	
39	16			19	20	24	
40							22
41	16						22
42		17					22
43	16	17					22
44			18				22
45	16		18				22
46		17	18				22
47	16	17	18				22
48				19			22
49	16			19			22
50					20		26
51	16				20		26
52		17			20		26
53	16	17			20		26
54			18		20		27
55	16		18		20		27
56		17	18		20		28
57	--- Not Available ---						
58				19	20		27
59	16			19	20		27
60						23	22
61	16					23	22
62		17				23	22
63	16	17				23	22
64			18			24	22
65	16		18			24	22
66		17	18			25	22
67	--- Not Available ---						
68				19		24	22
69	16			19		24	22
70					20	23	27
71	16				20	23	27
72		17			20	23	28

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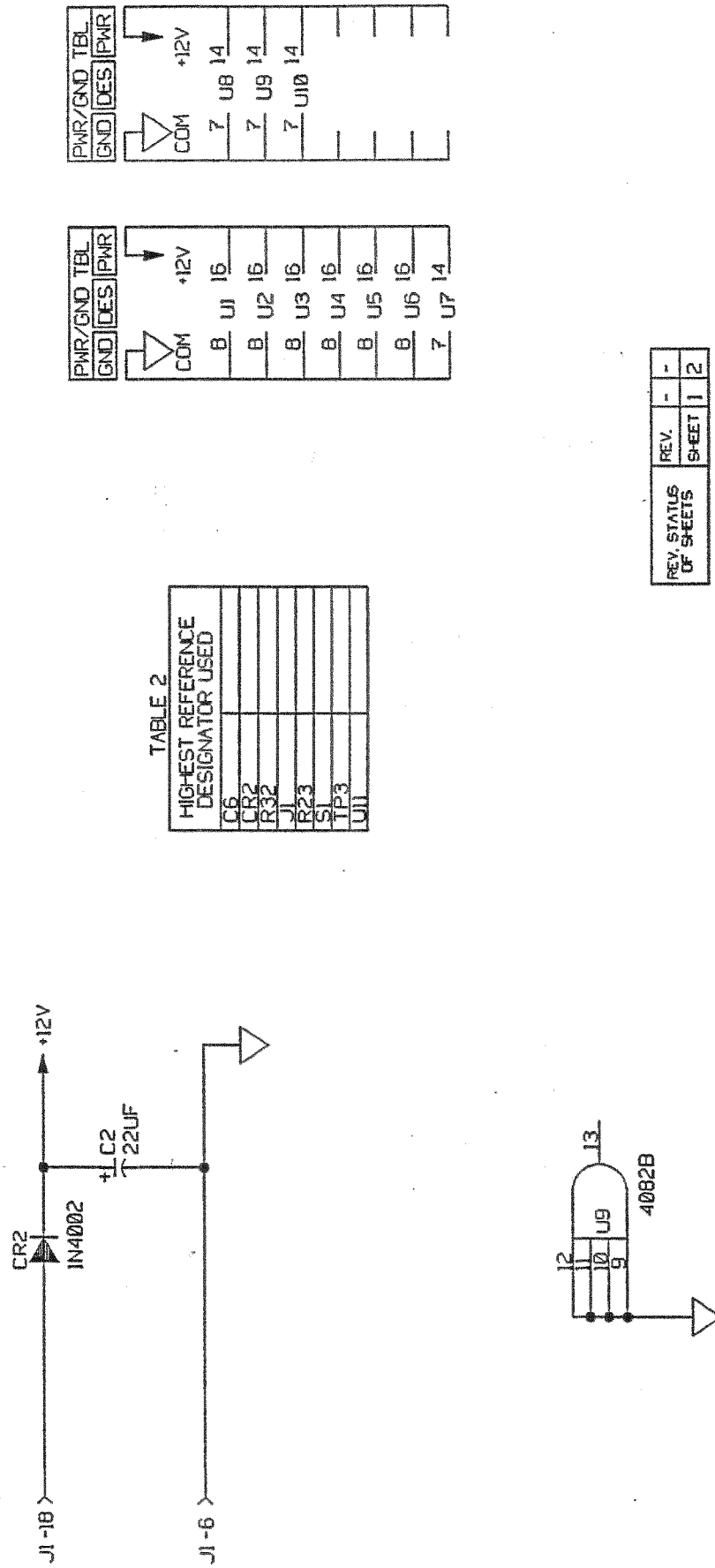

Figure 5-2. Pulse Calibrator Schematic, sheet 1

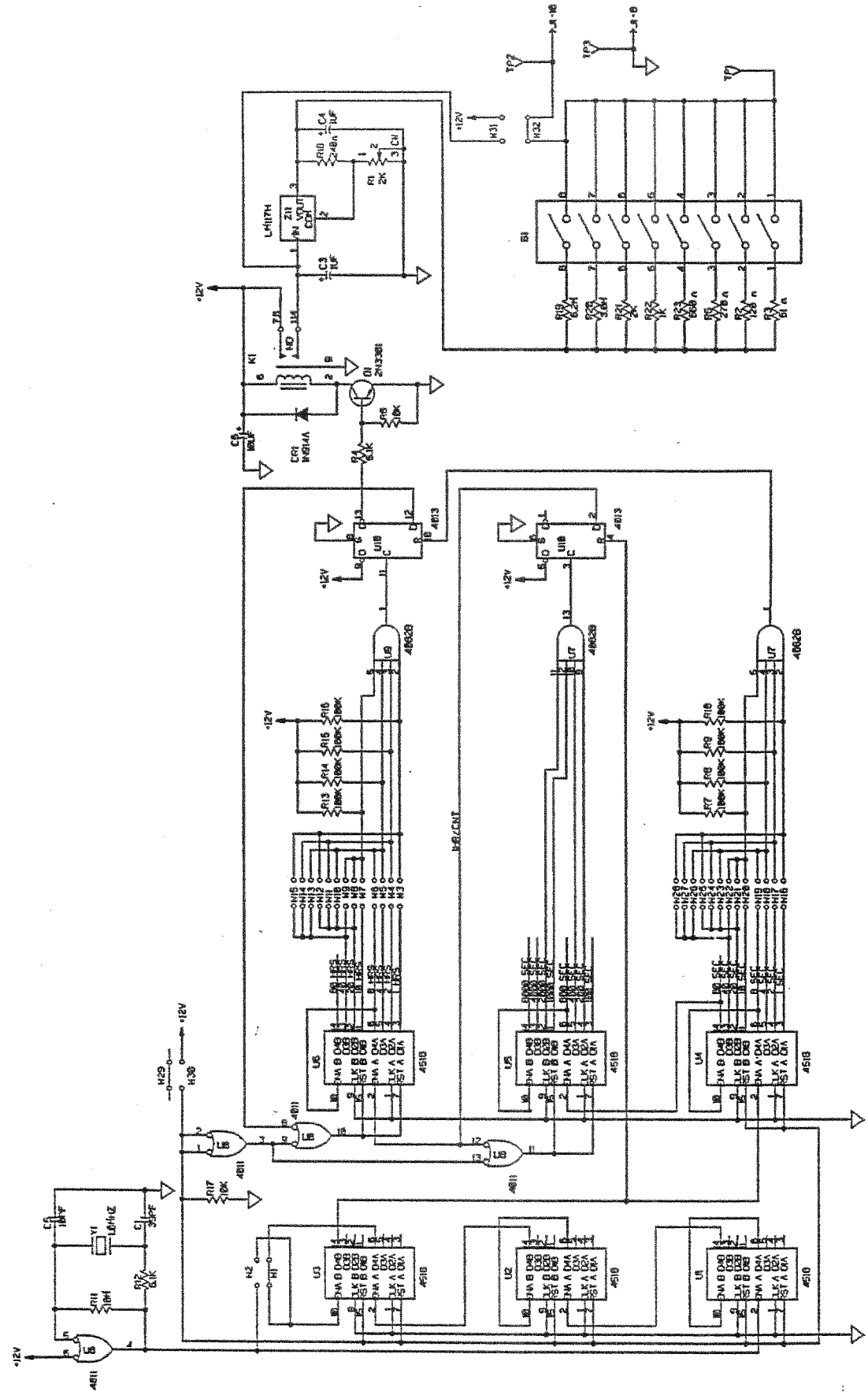

Figure 5-3. Pulse Calibrator Schematic, sheet 2

Table 5-4. Pulse Calibrator Parts List

T E L E D Y N E G E O T E C H
MILITARY SINGLE LEVEL PARTS LIST

TG3340
TRANS: MILPL RUN DATE 28-Sep-93 RUN TIME 02:49 PM SHEET 2

PARENT PART	DESCRIPTION/SPECIFICATION	ENG DRAWING REFERENCE	FSCM	REVISION	ECN
990593380101 9	ASSY-PULSE CALIBRATOR A/990-59338-1101/PARTS LIST D/990-59338-2101/SCHEMATIC A/990-59338-5101/PULSE CALIBRATOR		099019	A5	E46485

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
001	990593380201	8	FAB-PULSE CALIBRATOR	990593380201	099019	-	EA	1.0000
002	007370141100	8	SOCKET,I.C.,14 PIN,BURNDY DILB14P-11 XK1	DILB14P-11	009922	-	EA	1.0000
003	055284008000	4	TAPE,FOAM,ADHESIVE BOTH S IDES,1/8 THK X 3/4 WIDE,3M 4008	4008	004963		IN	USE
004	007936510104	7	CONNECTOR,4 POS,BERG XW1&2:XW29&30:XW31&32:TP1,2&3	65610-104	06V559	-	EA	4.0000
005	007936510126	1	CONNECTOR,26 POS,BERG XW3-15:XW16-28	65610-126	06V559	-	EA	2.0000
008	307000022000	3	HEADER,RT ANGLE,20 PIN SOURCE CONTROL DRAWING J1	307-00002-2000	099019	A	EA	1.0000
009	002722250684	7	CAPACITOR,22 MF,25V,10% SPRAGUE C2	199D226X9025DE2	056289	-	EA	1.0000
010	002110855993	9	CAPACITOR,10PF,500V,5%,CM 05(DM15/D15/CD15) C5			-	EA	1.0000
011	002610350712	6	CAPACITOR,1.0 MF,35V,10% SPRAGUE 20% ACCEPTABLE C3,4	199D105X9035AA2	056289	-	EA	2.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
012	002710250684	1	CAPACITOR,10 MF,25V,10% C6	199D106X9025CE2	056289	-	EA	1.0000
013	012010091410	6	DIODE,1N914A CR1	1N914A	ANY	-	EA	1.0000
015	012010400200	3	DIODE,1N4002 CR2	1N4002	ANY	-	EA	1.0000
016	009200171400	4	RELAY,MAGNECRAFT W171DIP -4 K1	W171DIP-4	094696	-	EA	1.0000
017	012060330100	2	TRANSISTOR,2N3301 Q1	2N3301	ANY	-	EA	1.0000
018	001152009358	3	RSTR,VAR,2 K,SPECTROL R1	64P202	002111	-	EA	1.0000
019	001041202032	3	RSTR,FXD,120 OHM,1/2 W,5% ,ALLEN BRADLEY EB R2	EB1215	001121	-	EA	1.0000
020	001035103918	0	RSTR,FXD,51 OHM,1 W,5% R3	RC32GF510J	ANY	-	EA	1.0000
021	001055101035	7	RSTR,FXD,5.1K,1/4W,5%,A LLEN BRADLEY CB R4,12	CB5125	001121	-	EA	2.0000
022	001061001035	1	RSTR,FXD,10K,1/4W,5%,AL LEN BRADLEY CB R5,17	CB1035	001121	-	EA	2.0000
023	001042701035	0	RSTR,FXD,270 OHM,1/4 W,5% ,ALLEN BRADLEY CB R6	CB2715	001121	-	EA	1.0000
024	001071001035	9	RSTR,FXD,100K,1/4 W,5%,AL LEN BRADLEY CB R7,8,9,10,13,14,15,16	CB1045	001121	-	EA	8.0000
025	001091001035	5	RSTR,FXD,10M,1/4 W,5%,ALL EN BRADLEY CB R11	CB1065	001121	-	EA	1.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
029	011020001900	2	CRYSTAL,1.0 MHZ,.005%, 10 PF,HC-33/U,SENTRY MFG INC SEE 901 FOR ALTERNATE Y1	1900	027073	-	EA	1.0000
030	012104451825	8	I.C.,DIGITAL,CMOS,COUNTER ,DECADE,DUAL SYNCHRONOUS,CD4518BE U1-U6	CD4518BE	002735	-	EA	6.0000
031	012104408225	4	I.C.,DIGITAL,CMOS,GATE,SF ,AND,DUAL 4-INPUT,CD4082BE U7,9	CD4082BE	002735	-	EA	2.0000
032	012104401125	0	I.C.,DIGIT.,CMOS,GATE,SF, NAND,QUAD 2-INPUT,CD4011BE U8	CD4011BE	002735	-	EA	1.0000
033	012104401325	8	I.C.,DIGITAL,CMOS,FLIP-FL OP,DUAL D,CD4013BE U10	CD4013BE	002735	-	EA	1.0000
034	002139852993	3	CAPACITOR,39PF,500V,2%, CM05(DM15/D15/CD15) C1			-	EA	1.0000
038	990548920101	8	DIP SWITCH,8 POSITION S1	990548920101	099019	-	EA	1.0000
039	012621171103	9	VOLTAGE REGULATOR,POSITIV E,3 TERMINAL,NATIONAL LM117H Z11	LM117H	012040	-	EA	1.0000
040	001042401035	7	RSTR,FXD,240 OHM,1/4 W,5% ALLEN BRADLEY CB R18	CB2415	001121	-	EA	1.0000
041	001086201035	8	RSTR,FXD,6.2M,1/4 W,5%,AL LEN BRADLEY CB R19	CB6255	001121	-	EA	1.0000
042	001083001035	5	RSTR,FXD,3M,1/4 W,5%,ALL EN BRADLEY CB R20	CB3055	001121	-	EA	1.0000
043	001052001035	2	RSTR,FXD,2K,1/4 W,5%,ALLE N BRADLEY CB R21	CB2025	001121	-	EA	1.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
044	001051001035	3	RSTR,FXD,1K,1/4W,5%,ALLEN BRADLEY CB R22	CB1025	001121	-	EA	1.0000
045	001045601035	9	RSTR,FXD,560 OHM,1/4 W,5%,ALLEN BRADLEY CB R23	CB5615	001121	-	EA	1.0000
052	020520207320	3	HEATSINK,WAKEFIELD 207CB	207CB	005820	-	EA	1.0000
058	012317717131	4	PAD,MOUNTING,TRANSISTOR,THERMALLOY 7717-131	7717-131	013103	-	EA	1.0000
059	007936547404	6	JUMPER,BERG W1,3,13,14,15,16,26,27,28,29,32	65474-010	06V559	-	EA	11.0000
901	011098171100	8	CRYSTAL,1 MHZ,.01%LD CAP,10 PF,CTS KNIGHT H17WHC33/U ALTERNATE FOR ITEM 29	H17WHC33/U	075378	-	EA	ALT

6. INPUT/OUTPUT MODULE

6.1 GENERAL

The Model IO.40 and IO.45 Input/Output modules provide screw clamp termination for interfacing to a CRS system. Power input and VCO output connections, as well as radio power and external calibration signal connections, are provided.

Many of the connections are dual purpose. When the Model PF.70 Three-Channel Pre-amplifier/Filter is used, external multiplexer connections are normally replaced with calibration coil connections from the seismometers. Also, the multiplexer output connections are replaced with RS-232 level signals when one of the Remote Digitizers is used.

An important option for the I/O Module is the DC/DC converter option that allows the field system to be powered by a single 12-volt battery (Model IO.40-1 and Model IO.45-1).

Figure 6-1 is a board outline showing component locations. The schematic diagram is shown on page 6-7.

Features of the I/O Module include fused transient protection for power and calibration coil connections, when required. Reverse polarity protection for power is provided, as are jumpers for analog power control, Remote Digitizer control, and VCO multiplexer interface resistors. Three external VCO signals can be multiplexed through this module to a multiplexer option (see chapter 4). Jumpers are provided for serial or parallel connection of seismometer calibration coils.

6.2 JUMPERS

6.2.1 Analog Power Control

W13 and W15 allow ±12 volt power to be provided to the 42.70 Seismic Amplifier. When these jumpers are installed, the regulator jumpers -W12 AND W14 ** **MUST BE REMOVED** **.

W12 AND W14 are installed when the PF.70 Three-Channel Pre-amplifier/Filter is used. When these jumpers are installed, W13 and W15 ** **MUST BE REMOVED** **.

** WARNING **

IF W12 AND W13 ARE BOTH INSTALLED, U2 MAY BE DAMAGED.
IF W14 AND W15 ARE BOTH INSTALLED, U4 MAY BE DAMAGED.

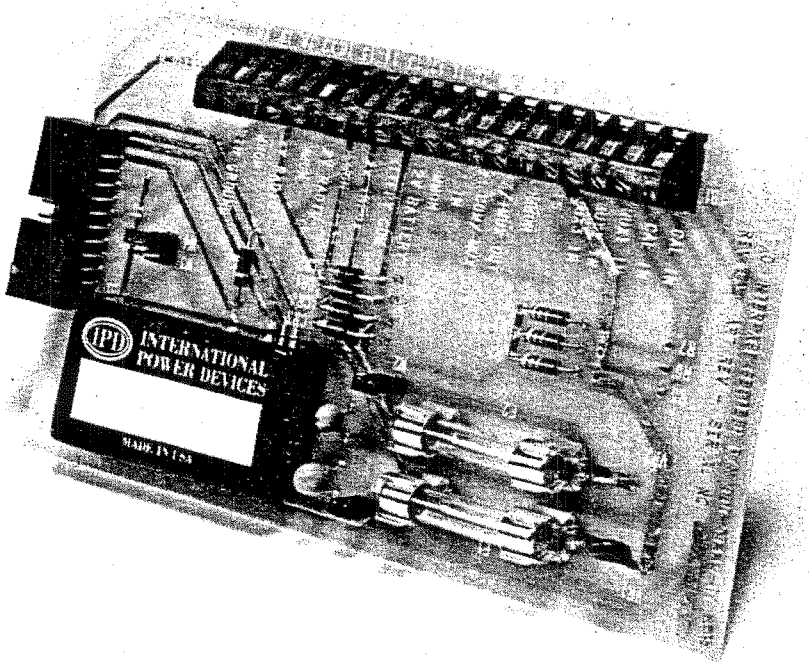

Figure 6-1. I/O Interface Assembly

6.2.2 CTS Control

Both Remote Digitizers require an external Clear to Send input control for operation. W8 provides a system pull-up jumper for operation with a radio transmitter. W7 is used when an external modem with CTS output is used.

6.2.3 External Multiplexer Jumpers

When external VCO signals are used (see section 6.3), jumpers W1 through W6 should be removed and jumpers W16, W17, and/or W18 installed.

W16 - W18 should be open when the 49.65 Remote Digitizer is used.

6.2.4 Calibration Coil Jumpers

When three seismometer calibration coils are connected, the calibration coils can be connected in series across the Pulse Calibrator output by jumpering W5 and W6, W1 - W4 should be removed.
Parallel calibration coil connections can be made by jumpering W1 through W4.

6.2.5 Auxiliary Input Jumper

Jumper W10 allows TB1-20 to be used for a fourth analog input signal when the 49.65 Remote Digitizer is used. The jumper W9 should not be installed when this option is used.

6.2.6 1PPS Jumper

Inserting jumper W11 will allow an external precision 1pps clock to interrupt the 49.65 16-bit Digitizer. This feature may be used to synchronize the digitizer to an external time standard.

6.3 EXTERNAL VCO CONNECTIONS

External VCO signals can be brought in to a local multiplexer from either a radio receiver or a telephone line. The resistors R7, R8, and R9 provide summing resistors for a local VCO multiplexer. R10, R11, and R12 can be selected to match the impedance of an external line. Each of the three inputs, XMUX1, XMUX2 and XMUX3, are referenced to the COMMON connection at TB1-8.

6.6 LOWER COST I/O INTERFACE

The 59339 I/O Interface is designed for use with the 42.70 Seismic Amplifier. The 42.70 has connections and transient protection for the seismometer calibration coil, so this circuitry is not provided on this I/O module. Because the 42.70 has regulators, there are no regulators on the 59339. Another difference is no connections are provided for 1 pps inputs or for an auxiliary input.

The specifications for Battery Protection and for the optional dc/dc converter do not change from what is given in section 6.5. The schematic is shown on page 6-11.

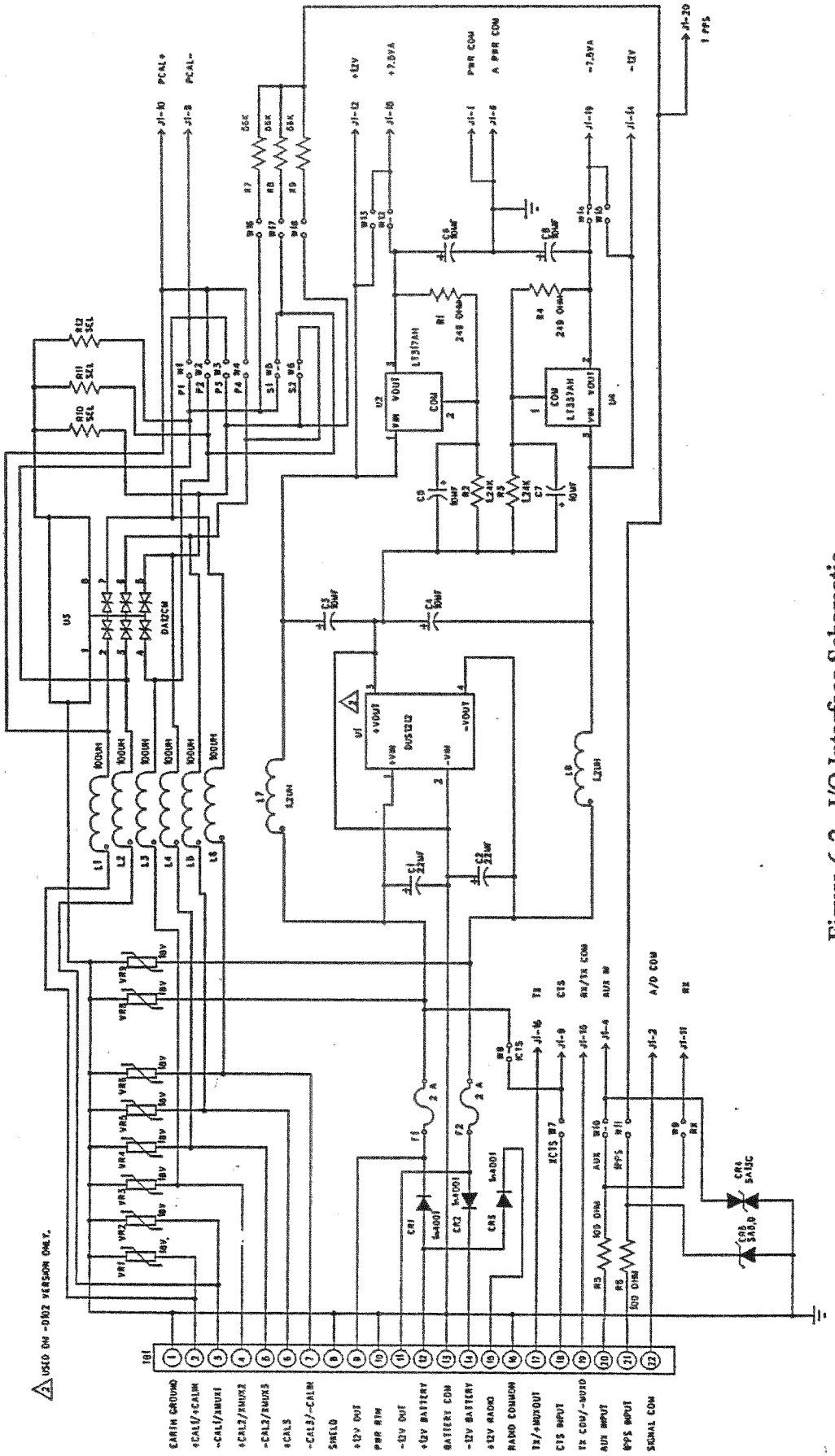

Figure 6-2. I/O Interface Schematic

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
035	001522261001	4	VARISTOR,V22ZA1,G.E. VR1-6,VR8,9	V22ZA1	003508	-	EA	8.0000
037	007936510108	3	CONNECTOR,8 POS,BERG W1-4	65610-108	06V559	-	EA	1.0000
038	007936510106	5	CONNECTOR,6 POS, BERG W16-18	65610-106	06V559	-	EA	1.0000
039	007936510104	7	CONNECTOR,4 POS,BERG (W5,6) (W14,15)	65610-104	06V559	-	EA	2.0000
040	007936510102	9	CONNECTOR,2 POS ,BERG W7,8,9,10,11,12,13	65610-102	06V559	-	EA	7.0000
041	012317717178	8	PAD,MOUNTING,TRANSISTOR,T HERMALLOY 7717-178N XU2,4	7717-178N	013103	-	EA	2.0000
042	990595430102	9	MARKER STRIP,TERMINAL BLOCK,22 PIN	990595430102	099019	-	EA	1.0000
043	007936547404	6	JUMPER,BERG W5,6,8,10,12,14	65474-010	06V559	-	EA	6.0000

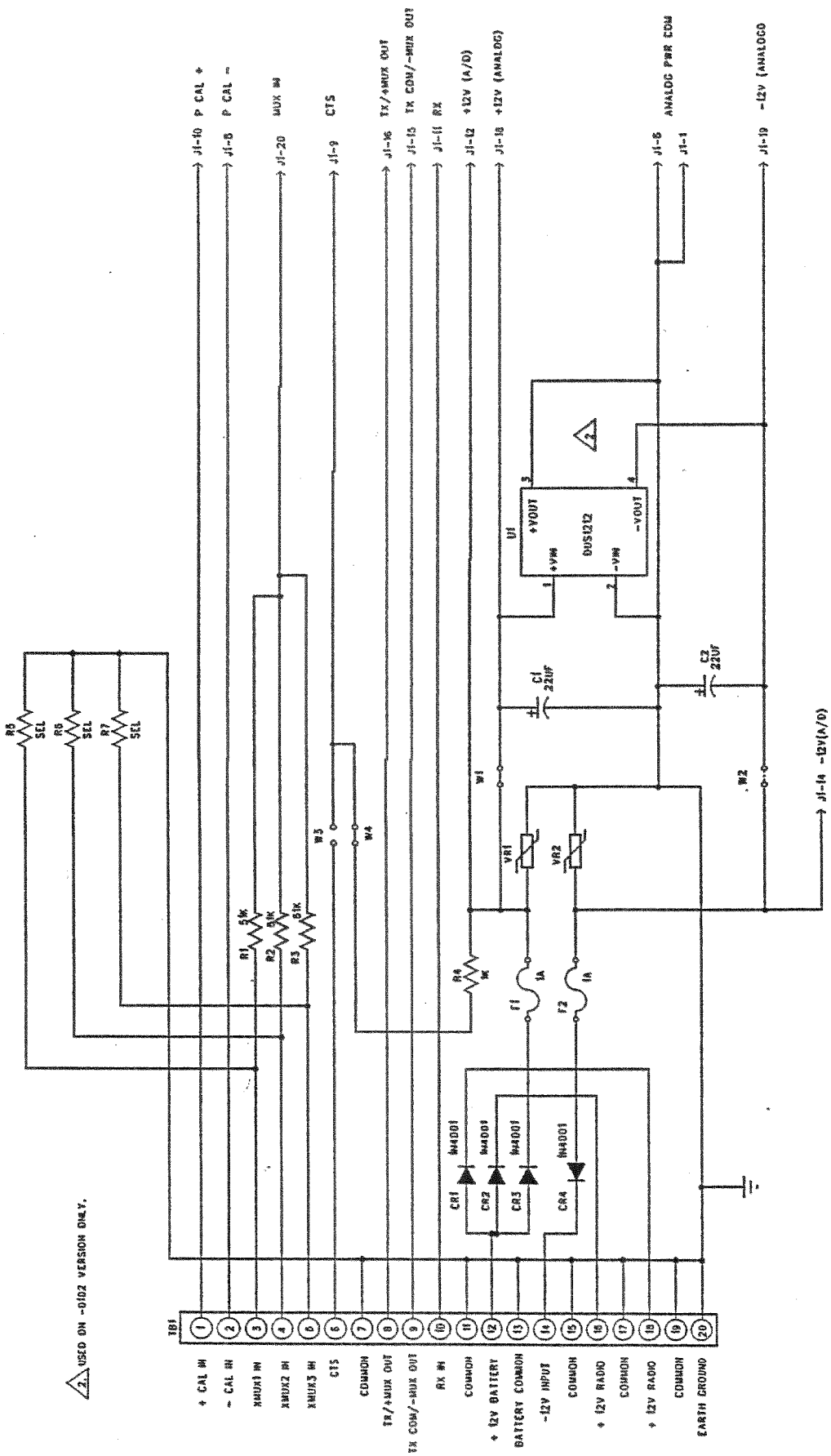

Figure 6-3. I/O Interface Schematic, Low-cost Version

Table 6-3. I/O Interface Parts List, Low-cost Version

TG3340 — TELEDYNE GEOTECH
TRANS: MILPL — MILITARY SINGLE LEVEL PARTS LIST
RUN DATE 28-Sep-93 — RUN TIME 02:50 PM — SHEET 4

PARENT PART		DESCRIPTION/SPECIFICATION	ENG DRAWING REFERENCE	FSCM	REVISION	ECN
990593390102	7	ASSY,I/O INTERFACE A/990-59339-1100/PARTS LIST D/990-59339-2100/SCHEMATIC A/990-59339-5100/I/O INTERFACE	990593390100	099019	-5	R59339

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
001	990593390201	7	FAB-I/O INTERFACE	990593390201	099019	-	EA	1.0000
003	002722258669	9	CAPACITOR,22 MF,25V,20% C1,2	199D226X0025DA1	056289	-	EA	2.0000
004	012010400100	4	DIODE,1N4001 CR1,2,3,4	1N4001	ANY	-	EA	4.0000
007	307000022000	3	HEADER,RT ANGLE,20 PIN SOURCE CONTROL DRAWING J1	307-00002-2000	099019	A	EA	1.0000
010	001065101035	5	RSTR,FXD,51K,1/4 W,5%,ALL EN BRADLEY CB R1,R2,R3	CB5135	001121	-	EA	3.0000
011	001051001035	3	RSTR,FXD,1K,1/4W,5%,ALLE N BRADLEY CB R4	CB1025	001121	-	EA	1.0000
012	001000001035	5	RSTR,SELECTED,1/4W,5% ALLEN BRADLEY R5,6,7	CB	001121	-	EA	SEL
015	008711130020	4	TERMINAL BLOCK, 20 POS, ALTECH CORP. TB1	AK300-20	00DU12	-	EA	1.0000
017	007936510102	9	CONNECTOR,2 POS ,BERG XW1,2	65610-102	06V559	-	EA	2.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
018	007936510104	7	CONNECTOR,4 POS,BERG XW3&4	65610-104	06V559	-	EA	1.0000
019	007936547404	6	JUMPER,BERG W1,2,4	65474-010	06V559	-	EA	3.0000
021	004101010005	4	FUSE,3 AG,1 AMP,250V (BUS SMAN AGC1 OR LITTELFUSE 312001) F1,2	AGC 1	071400	-	EA	2.0000
022	004200102069	2	CLIP,FUSE,3AG,LITTLEFUSE 102074 NICKEL PLATE (OLD NO. 102069) XF1,2	102074	075915	-	EA	4.0000
025	001522261001	4	VARISTOR,V22ZA1,G.E. VR1,2	V22ZA1	003508	-	EA	2.0000
027	065304191212	7	DC/DC CONVERTER INTERNATIONAL POWER DEVICES U1	DUS1212	047996	-	EA	1.0000

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7. THREE-CHANNEL PRE-AMPLIFIER/FILTER

7.1 GENERAL

The Model PF.70 Three-Channel Pre-amplifier/Filter provides an interface between three seismometers and a telemetry modulator, or a digitizer. The module is designed for the 49.65 Remote Digitizer and has less gain and fewer external connections than the 42.70 Seismic Amplifier.

Transient protection for three seismometer outputs is provided on the module. Seismometer damping, signal amplification, and frequency response shaping are provided by three identical channels. Figure 7-1 is an outline of the module showing component locations. Figure 7-2 shows the relative bandwidth response that can be selected for each channel. Figures 7-3 and 7-4 are the module schematics.

7.2 JUMPER SELECTIONS

7.2.1 Gain Selections

7.2.1.1 Channel 1

Input Stage Jumper	2nd Stage Jumper	Total Gain
W7	W1	1
W7	W2	2
W7	W3	4
W7	W4	8
W7	W5	16
W6	W1	32
W6	W2	64
W6	W3	128
W6	W4	256
W6	W5	512

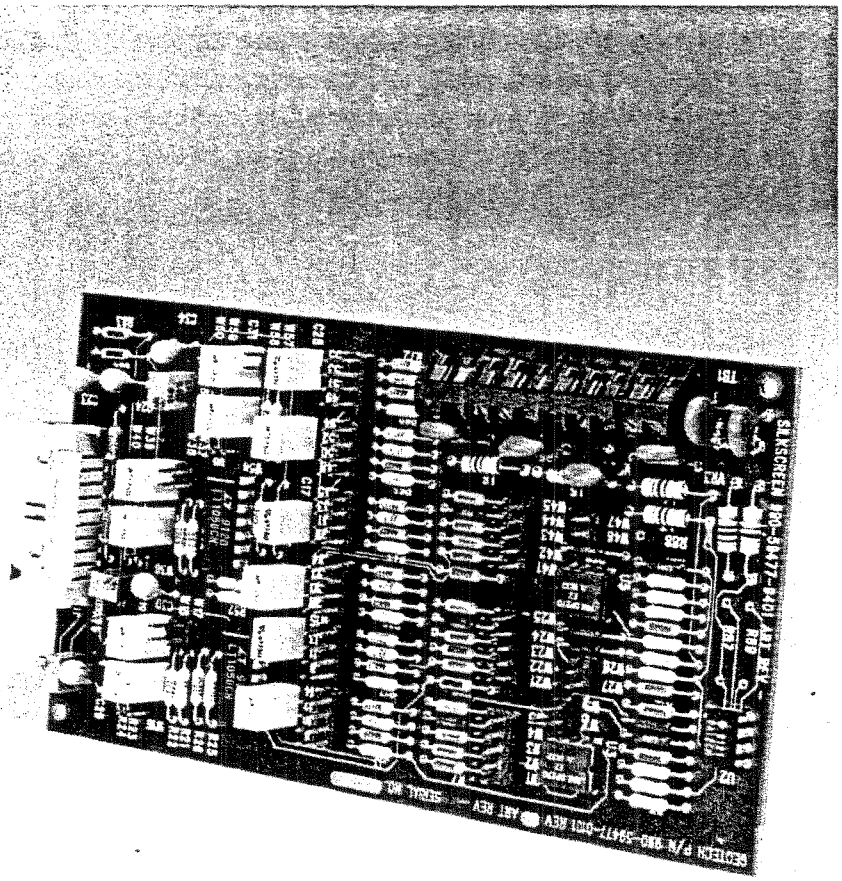

Figure 7-1 Three-Channel Seismic Amplifier Assembly

7.2.1.2 Channel 2

Input Stage Jumper	2nd Stage Jumper	Total Gain
W27	W21	1
W27	W22	2
W27	W23	4
W27	W24	8
W27	W25	16
W26	W21	32
W26	W22	64
W26	W23	128
W26	W24	256
W26	W25	512

7.2.1.3 Channel 3

Input Stage Jumper	2nd Stage Jumper	Total Gain
W47	W41	1
W47	W42	2
W47	W43	4
W47	W44	8
W47	W45	16
W46	W41	32
W46	W42	64
W46	W43	128
W46	W44	256
W46	W45	512

7.2.2 Low-pass Selections

Four two pole low-pass frequencies are selectable for each channel. Two jumpers are required for each selection.

7.2.2.1 Channel 1

1.0 Hz	W8 and W9
5.0 Hz	W10 and W11
12.5 Hz	W12 and W13
25.0 Hz	W14 and W15

7.2.2.2 Channel 2

1.0 Hz	W28 and W29
5.0 Hz	W30 and W31
12.5 Hz	W32 and W33
25.0 Hz	W34 and W35

7.2.2.3 Channel 3

1.0 Hz	W48 and W49
5.0 Hz	W50 and W51
12.5 Hz	W52 and W53
25.0 Hz	W54 and W55

7.2.3 High-pass Selections

Two pole high-pass frequencies can be selected for each channel. Two jumpers are required for each selection. In addition, response to dc can be selected for long period data with a single jumper.

7.2.3.1 Channel 1

0.2 Hz	W17 and W19
0.5 Hz	W18 and W20
DC	W16

7.2.3.2 Channel 2

0.2 Hz	W37 and W39
0.5 Hz	W38 and W40
DC	W36

7.2.3.3 Channel 3

0.2 Hz	W57 and W59
0.5 Hz	W58 and W60
DC	W56

7.3 ADJUSTMENTS

Each channel has an offset adjust for the output offset. The range of adjust is ±2 millivolts. R84 is for channel 1 offset. R85 is for channel 2 offset. R86 is for channel 3 offset.

7.4 SPECIFICATIONS

The PF.70 Pre-amplifier/Filter module has three identical pre-amplifiers. The following specifications apply to each amplifier circuit.

JUMPER SELECTABLE PROGRAMMING

Input Stage Gain	Single Jumper: x1 and x32
Second Gain Stage	Single Jumper: x1, x2, x4, x8 and x16
High-pass Selection	Two Jumpers: 0.2 Hz and 0.5 Hz Single Jumper: DC
Low-pass Selection	Two Jumpers: 1.0 Hz, 5.0 Hz, 12.5 Hz and 25.0 Hz.

CONNECTIONS

The module provides screw clamp connections for three seismometer coils and an earth ground wire.

Power and output connections are through a 20-wire ribbon cable connector.

TRANSIENT PROTECTION

Each amplifier input has transient protection for a differential input.

DAMPING RESISTOR

Each amplifier input provides a location for a selected damping resistor across the input.

OPERATING CHARACTERISTICS

Input Specifications

Type	Balanced or single ended
Impedance	20 Kohms
Noise Level	0.2 micro volts peak-peak max, 0.1-10 Hz, 0.08 micro volts peak-peak, typical
Common Mode Rejection	60 dB, typical

Output Specifications

Type	Single ended
Level	10 volts p-p into 2 Kohm load
Output Resistance	100 ohm, 1% de-coupling resistor
Linearity	Better than 0.05% of full scale
Voltage Gain	1 to 512, selectable in 6 dB steps
Gain Error	Less than ±1%
Dynamic Range	> 120 dB at gain of 1 > 100 dB at gain of 512
Output Offset	Adjustable to less than ±100 uV.
Filters	2-pole Butterworth for High-Pass and for Low-Pass (See figure 7-2)

POWER REQUIREMENTS

Voltage	±8.0 volts to ±15 volts
Current	±30 mA for three amplifiers

ENVIRONMENTAL CHARACTERISTICS

Operating Temperature	-20 to +60 °C
Relative Humidity	5 to 95%, non-condensing

PHYSICAL CHARACTERISTICS

Size	3.25 in. X 6.25 in. X 0.5 in.
Weight	1.1 lb.

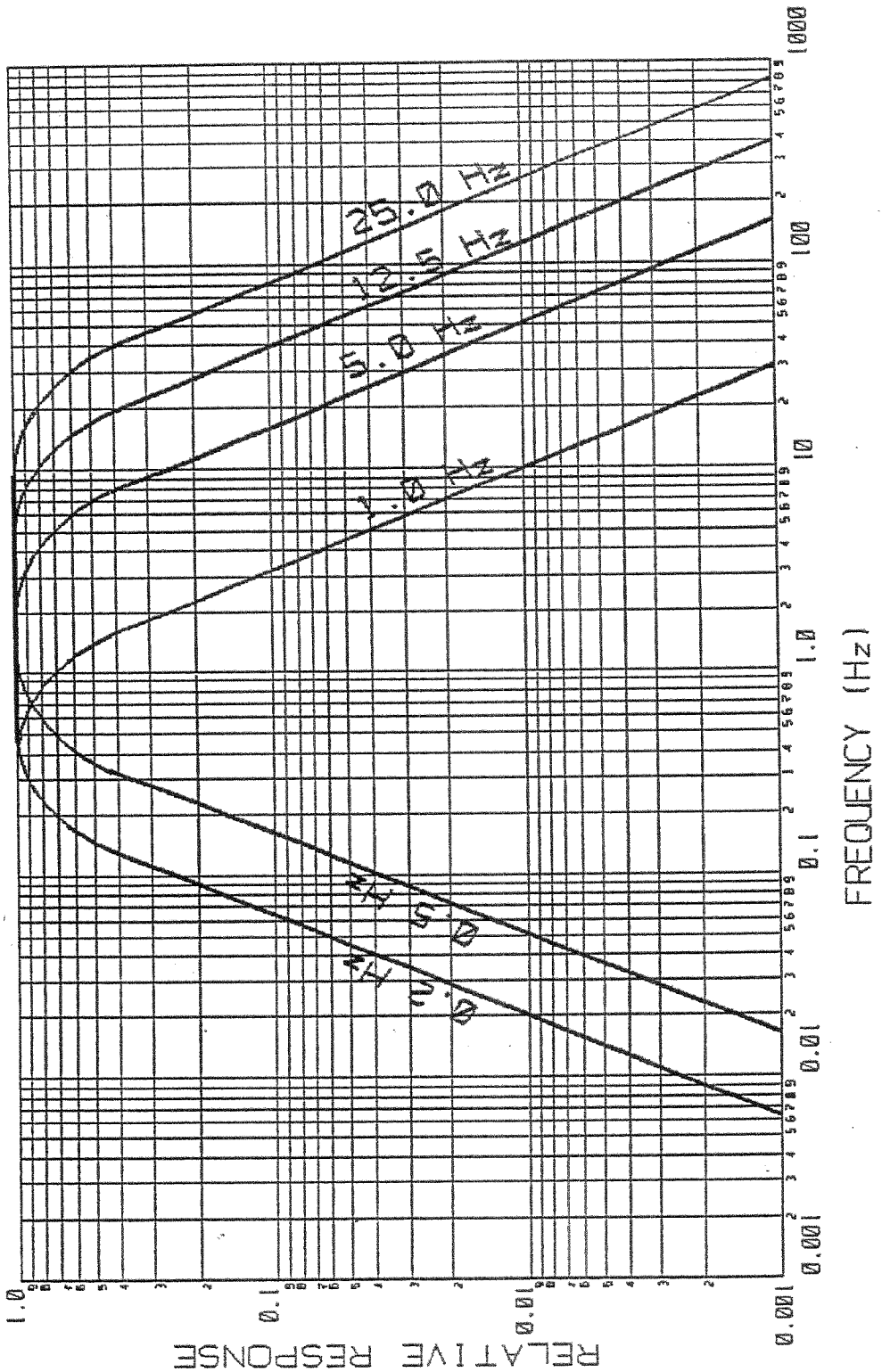

Figure 7-2. PF.70 Amplifier Filter Responses

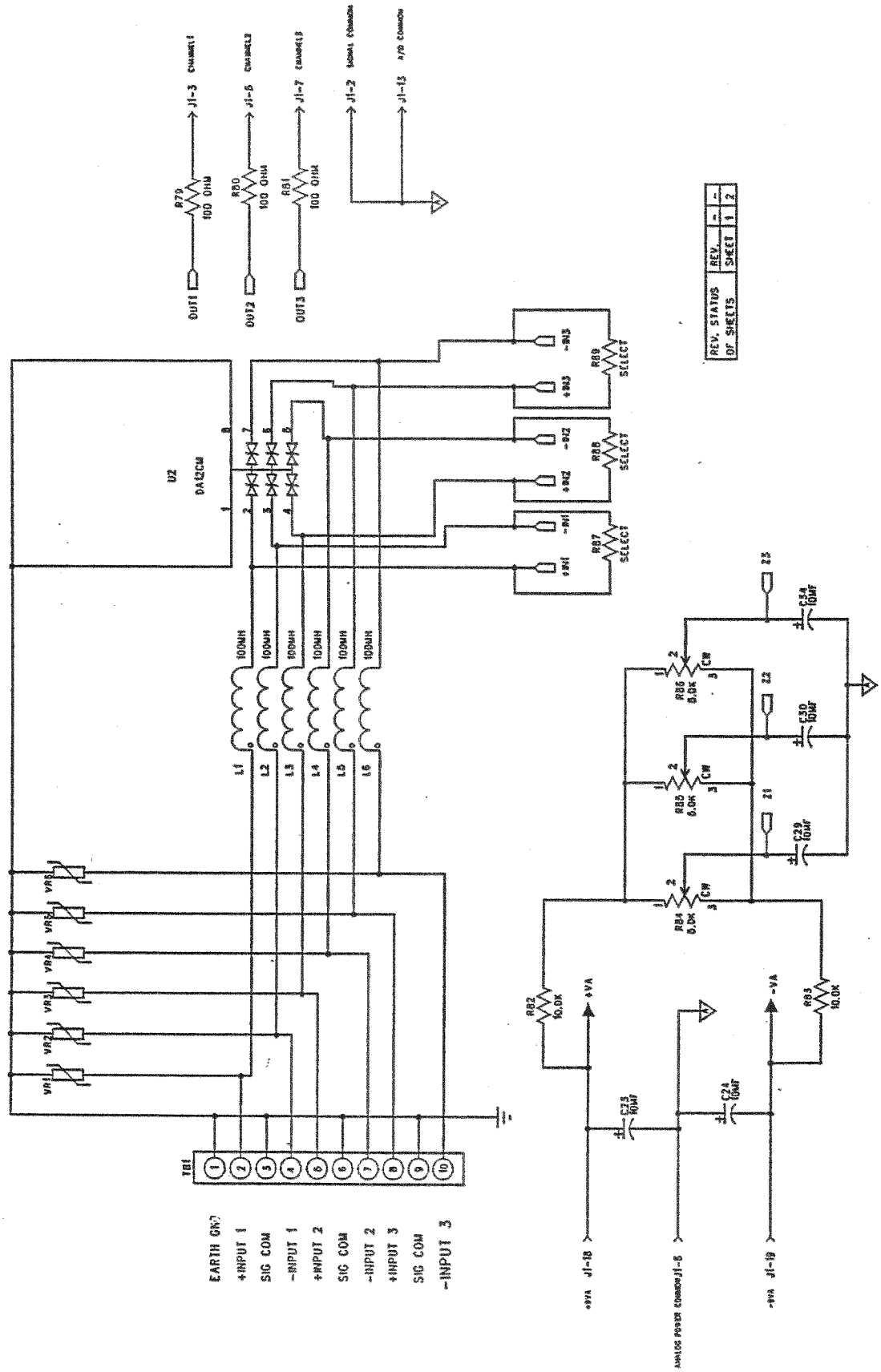

Figure 7-3. Three-Channel Pre-amplifier/Filter

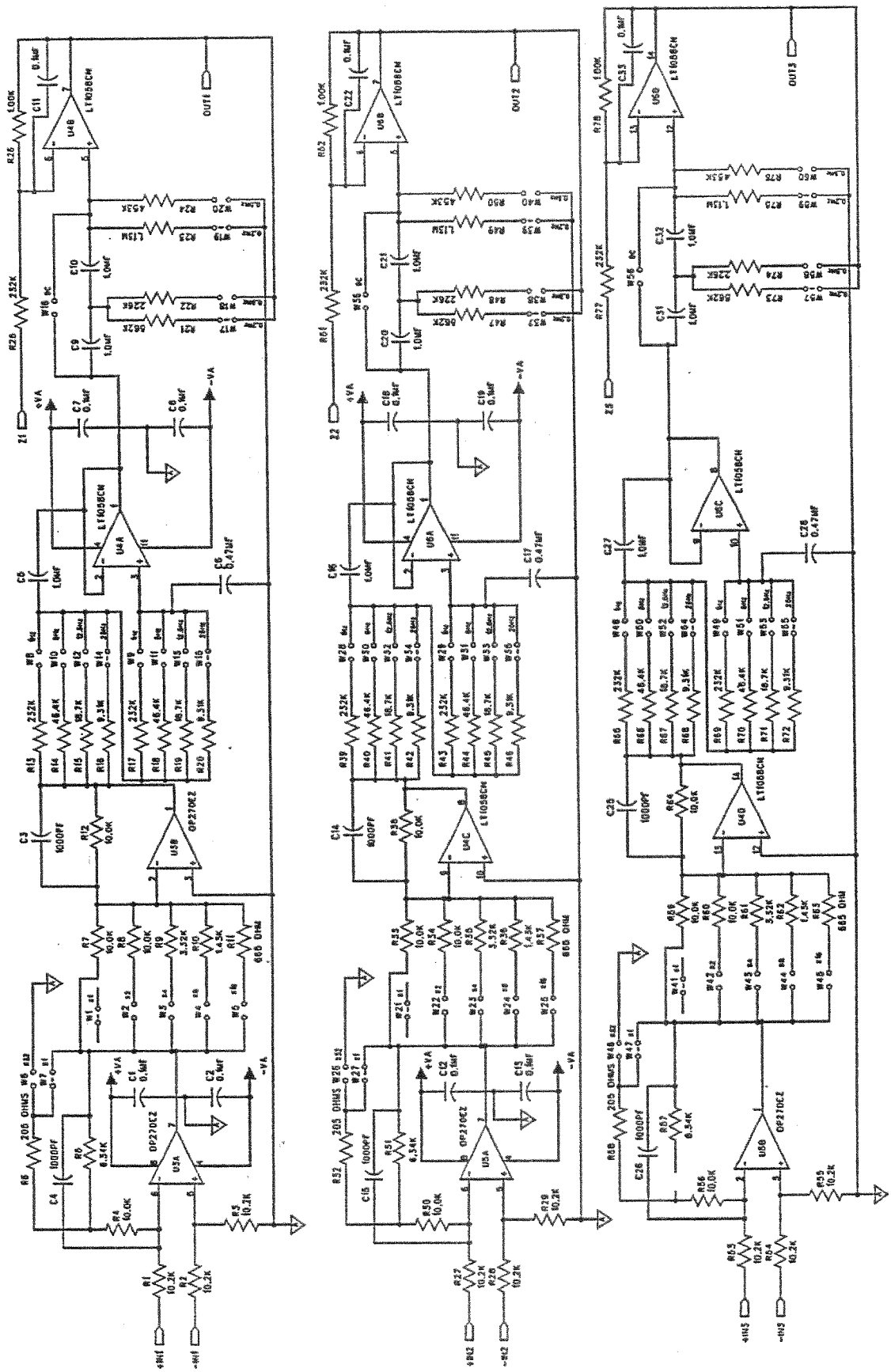

Figure 7-4. Three-Channel Pre-amplifier/Filter Schematic, sheet 2

Table 7-1. Three-Channel Pre-amplifier/Filter Parts List

TG3340 T E L E D Y N E G E O T E C H
TRANS: MILPL MILITARY SINGLE LEVEL PARTS LIST
RUN DATE 28-Sep-93 RUN TIME 02:51 PM SHEET 2

PARENT PART		DESCRIPTION/SPECIFICATION	ENG DRAWING REFERENCE	FSCM	REVISION	ECN
990594770101	0	ASSY-3 CH SEISMIC AMP A/990-59477-1101/PARTS LIST D/990-59477-2101/SCHEMATIC A/990-59477-5101/3 CH SEISMIC AMP A/990-59477-6101/ACCEPTANCE TEST		099019	A5	E46499

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
001	990594770201	9	FAB-3 CH SEISMIC AMP	990594770201	099019	-	EA	1.0000
005	502510500856	2	CAPACITOR,0.1 MF,50V,10% JOHANSON DIELETRIC (SURFACE MOUNT)) PACKAGED ON TAPE REEL. VARIATIONS FROM THIS PACKAGING MUST BE APPROVED BY MFG BY DVA C1,2,7,8,11,12,13,18,19,22,33	500S41W104KP4E	029454	-	EA	11.0000
006	502310500856	4	CAPACITOR,1000PF,50V,10% JOHANSON DIELETRIC (SURFACE MOUNT) C3,4,14,15,25,26	500S41N102KP	029454	-	EA	6.0000
007	002610505557	3	CAPACITOR,1.0MF,50V,5% C5,9,10,16,20,21,27,31,32	168105J50G	090201	-	EA	9.0000
008	002547505557	1	CAPACITOR,0.47MF,50V,5% MALLORY C6,17,28	168474J50E	090201	-	EA	3.0000
009	002710258684	4	CAPACITOR,10MF,25V,20% SPRAGUE C23,24,29,30,34	199D106X0025CE2	056289	-	EA	5.0000
014	307000022000	3	HEADER,RT ANGLE,20 PIN SOURCE CONTROL DRAWING J1	307-00002-2000	099019	-	EA	1.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
017	010754100133	5	INDUCTOR,FIXED,SHIELDED, 100MH,NYTRONICS L1-6	WEE-WEE-100	072259	-	EA	6.0000
020	001061020930	7	RSTR,FXD,10.2K,1/10W,.1% R1-3,R27-29,R53-55	RN55C1022B	ANY	-	EA	9.0000
021	001061000907	8	RSTR,FXD,10K,1/10W,.1% R4,7,8,12,30,33,34,38,56,59,60,64	RN55C1002B	ANY	-	EA	12.0000
022	001056340907	5	RSTR,FXD,6.34K,1/10W,.1% R5,31,57	RN55C6341B	ANY	-	EA	3.0000
023	001053320907	0	RSTR,FXD,3.32K,1/10W,.1% R9,35,61	RN55C3321B	ANY	-	EA	3.0000
024	001042050907	7	RSTR,FXD,205OHM,1/10W,.1% R6,32,58	RN55C2050B	ANY	-	EA	3.0000
025	001051430907	9	RSTR,FXD,1.43K,1/10W,.1% R10,36,62	RN55C1431B	ANY	-	EA	3.0000
026	001046650907	0	RSTR,FXD,665OHM,1/10W,.1% R11,37,63	RN55C6650B	ANY	-	EA	3.0000
027	001072320901	3	RSTR,FXD,232K,1/10W,1% R13,17,25,39,43,51,65,69,77	RN55C2323F	ANY	-	EA	9.0000
028	001064640901	4	RSTR,FXD,46.4K,1/10 W,1%, R14,18,40,44,66,70	RN55C4642F	ANY	-	EA	6.0000
029	001061870901	0	RSTR,FXD,18.7K,1/10W,1% R15,19,41,45,67,71	RN55C1872F	ANY	-	EA	6.0000
030	001059310901	1	RSTR,FXD,9.31K,1/10W,1% R16,20,42,46,68,72	RN55C9311F	ANY	-	EA	6.0000
031	001075620901	3	RSTR,FXD,562K,1/10 W,1%, R21,47,73	RN55C5623F	ANY	-	EA	3.0000
032	001072260901	1	RSTR,FXD,226 K,1/10 W,1%, R22,48,74	RN55C2263F	ANY	-	EA	3.0000
033	001081130901	5	RSTR,FXD,1.13M,1/10W,1% R23,49,75	RN55C1134F	ANY	-	EA	3.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
034	001074530901	5	RSTR,FXD,453K,1/10W,1% R24,50,76	RN55C4533F	ANY	-	EA	3.0000
035	001051000901	6	RSTR,FXD,1K,1/10W,1%,RN55 R26,52,78	RN55C1001F	ANY	-	EA	3.0000
036	001041000901	9	RSTR,FXD,100 OHM,1/10W,1% R79,80,81	RN55C1000F	ANY	-	EA	3.0000
037	001061000901	4	RSTR,FXD,10K,1/10 W,1%,RN 55C(CORNING NC4) R82,83	RN55C1002F	ANY	-	EA	2.0000
038	001155009410	6	RSTR,VAR,5K,10% R84,85,86	1248W5000R10%	018612	-	EA	3.0000
039	001000000901	8	RSTR,SELECTED,1/10W,1% R87,88,89	RN55C	ANY	-	EA	3.0000
043	008711130010	6	TERMINAL BLOCK,10 POS ALTECH CORP TB1	AK300-10	00DU12	-	EA	1.0000
045	012104112313	5	TRANSZORB ARRY,GEN SEMI U2	DA12CM	024444	-	EA	1.0000
046	012622700526	3	OP-AMP,PMI U3,5	OP-270EZ	006665	-	EA	2.0000
047	012621058314	3	OP AMP,QUAD LINEAR TECHNOLOGY INC. U4,6	LT1058CN	037964	-	EA	2.0000
050	001522261001	4	VARISTOR,V22ZA1,G.E. VR1-6	V22ZA1	003508	-	EA	6.0000
052	007936510108	3	CONNECTOR,8 POS,BERG (W8,10,12,14) (W9,11,13,15) (W28,30,32,34) (W29,31,33,35) (W48,50,52,54) (W49,51,53,55)	65610-108	06V559	-	EA	6.0000
053	007936510102	9	CONNECTOR,2 POS ,BERG W16,36,56	65610-102	06V559	-	EA	3.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
054	007936510104	7	CONNECTOR,4 POS,BERG (W6,7) (W17,18) (W19,20) (W26,27) (W37,38) (W39,40) (W46,47) (W57,58) (W59,60)	65610-104	06V559	-	EA	9.0000
055	007936510110	9	CONNECTOR,10 POS,BERG W1-5,W21-25,W41-45	65610-110	06V559	-	EA	3.0000
056	007936547404	6	JUMPER,BERG W1,7,14,15,17,19,21,27,34,35,37, 39,41,47,54,55,57,59	65474-010	06V559	-	EA	18.0000
057	990595430101	0	MARKER STRIP,TERMINAL BLOCK,10 PIN	990595430101	099019	-	EA	1.0000

8. MODEL 49.65 REMOTE DIGITIZER

8.1 GENERAL

The 49.65 16-bit Remote Digitizer, shown in figure 8-1, provides continuous data transmission of 16-bit data for 1 to 3 inputs. Communications interface is RS-232 compatible. Data for three inputs sampled at 100 samples per second can be transmitted at 9600 baud or 7200 baud. At 4800 baud, data for a single input sampled at 100 samples per second or data for three inputs sampled at 50 samples per second can be transmitted. 2400 baud can be selected for single channels.

The 49.65 is designed to operate with the PF.70 Preamplifier/ Filter and the IO.45 Input/Output(I/O) Module. The 49.65 can be installed in a Compact Remote Station (CRS) with a PF.70 or up to three 42.70 Seismic Amplifiers.

The 49.65 provides three 7-pole low-pass filters and over samples the data at 200 samples per second to allow additional digital filtering. The 7-pole filters cut off at 12.5 Hz. and can be jumpered to cut off at 25 Hz. Aliasing is essentially eliminated without additional external filters.

8.2 JUMPER SELECTIONS

8.2.1 Setting Station Code

The eight position jumper block W1-W8 provides a means for setting the ID or station code. Table 8-1 shows how to set the jumpers for the correct decimal value. The 8-bit binary number is transmitted in the header with each block of data (see appendix A).

Table 8-1. Programming 49.65 Station Code

JUMPER NUMBER	DECIMAL VALUE
W1	1
W2	2
W3	4
W4	8
W5	16
W6	32
W7	64
W8	128

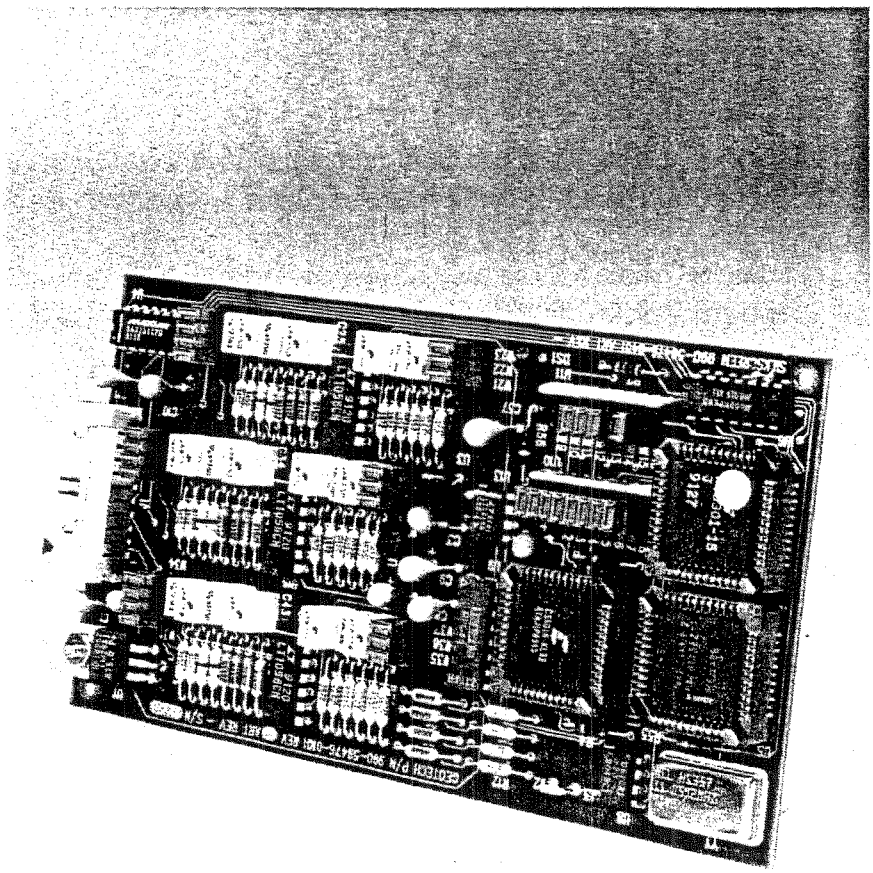

Figure 8-1. 16-bit Remote Digitizer Assembly

8.2.2 Setting 49.65 System Operation

Table 8-2 describes the jumper settings required to select the sample rate, communications baud rate, and the number of channels to transmit. Six jumpers, W9 through W14, are used to program the module. W15 is not used and W16 is reserved.

When jumper W13 is installed, the 49.65 will transmit data for the auxiliary input. Normally this is used for test only. Jumper W14 puts the module in the test mode and must be open for normal operation.

When jumper W11 is installed (50 sps), then the pass band select jumpers (W17 -W37) must be open (12.5 Hz bandwidth) to eliminate aliasing.

The example shown in table 8-2. is for 9600 baud, 3 channels of seismic data transmitted, auxiliary channel data, and normal operation.

Table 8-2. Programming the 49.65 System

W9	W10	Setting
OPEN	OPEN	9600 baud
JUMPER	OPEN	7200 baud
OPEN	JUMPER	4800 baud
JUMPER	JUMPER	2400 baud

W11	Setting
OPEN	100 sps
JUMPER	50 sps

W12	Setting
OPEN	3 Channel
JUMPER	1 Channel

W13	Setting
OPEN	No Auxiliary Data
JUMPER	Auxiliary Data

W14	Setting
OPEN	Normal Operation
JUMPER	Test Mode

W15	Setting
OPEN	Not Used

W16	Setting
Reserved	Reserved

8.2.3 Seven Pole Bandwidth Select

Seven jumpers are provided for each low-pass filter. These are W17- W23 for channel 1, W24-W30 for channel 2, and W31-W37 for channel 3. When the jumper posts are open, the low-pass cut-off frequency is 12.5 Hz. When all the jumpers are installed, the low-pass cut-off frequency is 25 Hz. When the 49.65 is operated at 50 samples per second, these jumpers must be open to eliminate aliasing. When 100 samples per second is selected, all 21 jumpers should be installed if a 25 Hz bandwidth is desired.

8.3 OPERATION

8.3.1 Power Considerations

The 49.65 Remote Digitizer module will operate from the same power source as the seismic amplifiers. The additional current required from a single 12-volt source is 155 milliamps. If power is from a +/- 12-volt supply the +12-volt requirement is 75 mA, and the -12-volt requirement is 40 mA.

8.3.2 Module Locations

The 49.65 should be installed with seismic amplifiers and the IO.45 I/O module. The location of the modules is not critical, but some shuffling may reduce noise in some installations.

8.3.3 Radio and Modem Connections

Connections are made through the I/O Module. The 49.65 requires CTS (Clear to Send). If the modem does not provide this signal, W8 (ICTS) on the I/O Module must be jumpered. W8 should always be jumpered when a radio transmitter is used.

8.4 SPECIFICATIONS

INPUTS

Number:	1 or 3 seismic data channels, jumper selectable. One Auxiliary channel, jumper selectable.
Voltage Range:	+/- 4.500 volts
Input Impedance:	Greater than 10 Meg. Ohms at DC.
Noise:	Less than 0.5 counts RMS from .03 Hz to 25 Hz
Bandwidth:	The bandwidth must be jumper selected. DC to 12.5 Hertz at 50 samples per sec. DC to 25.0 Hertz at 100 samples per sec.

OUTPUT

Type:	RS232 levels, asynchronous
Baud Rates:	2400, 4800, 7200 or 9600, jumper selected.
Transmission Rate:	One second of data is transmitted once per second.
Data Format:	See Appendix A and B

DIGITIZER CHARACTERISTICS

Resolution:	16 bit +/- 1/2 LSB
Multiplexer:	Eight channels. Three data channels plus five channels of test data.
Rate:	1600 samples per second. (The data channels are sampled 200 times per second).
Track Period:	555 microseconds
Hold Period:	70 microseconds
Non Linearity:	Less than 2 counts

HARDWARE FILTER

Type:	7 Pole Low Pass
Damping Factor:	0.70 (Q=1.4)
Gain:	1.0 +/- 0.1 %
Cutoff Frequency:	12.5 Hertz or 25.0 Hertz determined by jumpers.

SOFTWARE FILTER

The basic sample rate of 200 sps is reduced to 100 sps or 50 sps by simple averaging. For 100 sps data 4 samples are averaged for every 2 samples received. For 50 sps data 8 samples are averaged for every 4 samples received.

POWER REQUIREMENTS

Voltage:	+ 7.5 to + 14.0 volts and - 7.5 to - 14.0 volts
Current:	+ 95 mA. and - 40 mA.
Voltage Sensitivity:	At +/- 12 volts input a +/- 2 volt change will affect full scale calibration by less than +/- 1/2 LSB.

ENVIRONMENTAL CHARACTERISTICS

Operating Temperature:	- 20 deg C to + 60 deg C
Storage Temperature:	- 45 deg C to + 85 deg C
Relative Humidity:	5 to 95 % non condensing

PHYSICAL CHARACTERISTICS

Size:	6.2 in. x 0.5 in. x 3.25 in. The module takes one slot in a CRS Field Case.
Weight:	0.63 pounds

8.5 CHECK OUT OF 49.65 WITH A PC COMPUTER

8.5.1 PC Requirements

Any IBM PC XT or AT computer or its equivalent can be used. One RS-232 communications port is required. The PC should have DADiSP, Version 1.03 (or higher), installed.

8.5.2 Installing Test Software

A diskette with test software is provided with the 49.65. A directory labeled "TX16" should be created for test data and for the test software. This can be done using the DOS make directory command, example:

> type "MD TX16<cr>" where <cr> represents the return key.
> Enter the directory with the command "cd\tx16<cr>".

Insert the diskette in drive A and copy the test programs into the directory with the command "copy a:*.exe<cr>". The programs TEST16.EXE and DTS16.EXE will be copied into the directory.

Change to the DSP directory by typing "cd\dsp<cr>" and run the DADiSP2 program by typing "dsp<cr>". Use the cursor key to select CREATE from the LABBOOK menu. Create a labbook with the name "DTS16" and exit from the program using the ESC key or the quit command.

A sub-directory DTS16 has been created by DADiSP. Enter this directory by typing "cd dts16<cr>". Delete the file labeled "INDEX.PI" with the delete command "del index.pi<cr>". Now with the diskette provided in drive A, copy the DADiSP files with the command "copy a:*.pi<cr>". The files INDEX.PI, WS_0001.PI, WS_0002.PI and WS_0003.PI should be copied. These are the working windows for the DTS16 test data.

8.5.3 Using the TEST16 Program

TEST16 is designed for a fast check out and can be useful for field tests. The 49.65 must be in the TEST mode to operate with this program (W14 must be jumpered).

Figure 8-2 shows the screen displayed on the PC monitor when TEST16 is run. All the data provided by this program are displayed on this screen.

Figure 8-3 shows how to connect the PC for bench testing. For field testing, connections are made through the I/O Module. Simply replace the radio transmitter, or modem, with a connection to the P.C. RS232 connector.

When TEST16 is running and the 49.65 is powered on in the TEST mode, the data is updated every second. It will require 2 seconds to get a measurement on the screen.

Data from all three inputs are displayed in volts with the range from + 4.5000 volts to - 4.4999 volts. In addition, the zero reference, or offset, and the noise of the digitizer is displayed in volts.

The four power supply voltages are displayed as the value seen on the module. The +/- 7.5 V readings are from the regulators on the I/O Module. In some configurations, this may be +/- 12 volts. The +/- Va readings are from the 5-volt regulators for the digitizer.

The binary numbers for the jumpers are shown with the jumpered position represented by a 0 and the open position shown as a 1.

The EPROM check sum is shown in a four-digit, base-16, form. This is the simple addition of 8192 bytes with a two byte result. This number should be 9E95 (1 January 1992).

Calibration for the digitizer is automatic at power up. The digitizer may be checked by connecting a precision voltage source to the auxiliary channel input. Care must be taken to prevent ground loop errors.

49.65 TEST DATA MONITOR

DATA INPUT 1	DATA INPUT 2	DATA INPUT 3	DATA AUXILIARY
.0000 Volts	.0002 Volts	-0.0002 Volts	4.5000 Volts

AUX. OFFSET	AUX. NOISE P - P	EPROM CHECK SUM
.0000 Volts	.0003 Volts	9E95 HEX

+ 7.5 V	- 7.5 V	+ Va	- Va
7.525 Volts	-7.496 Volts	5.087 Volts	-5.106 Volts

W8	W7	W6	W5	W4	W3	W2	W1	
0	1	0	0	0	1	1	1	STATION CODE

W16	*	W14	W13	W12	W11	W10	W9	
1	0	0	1	0	0	0	0	PROGRAM & CTS

Use 'End' key to exit.

Figure 8-2. TEST16 Monitor Screen

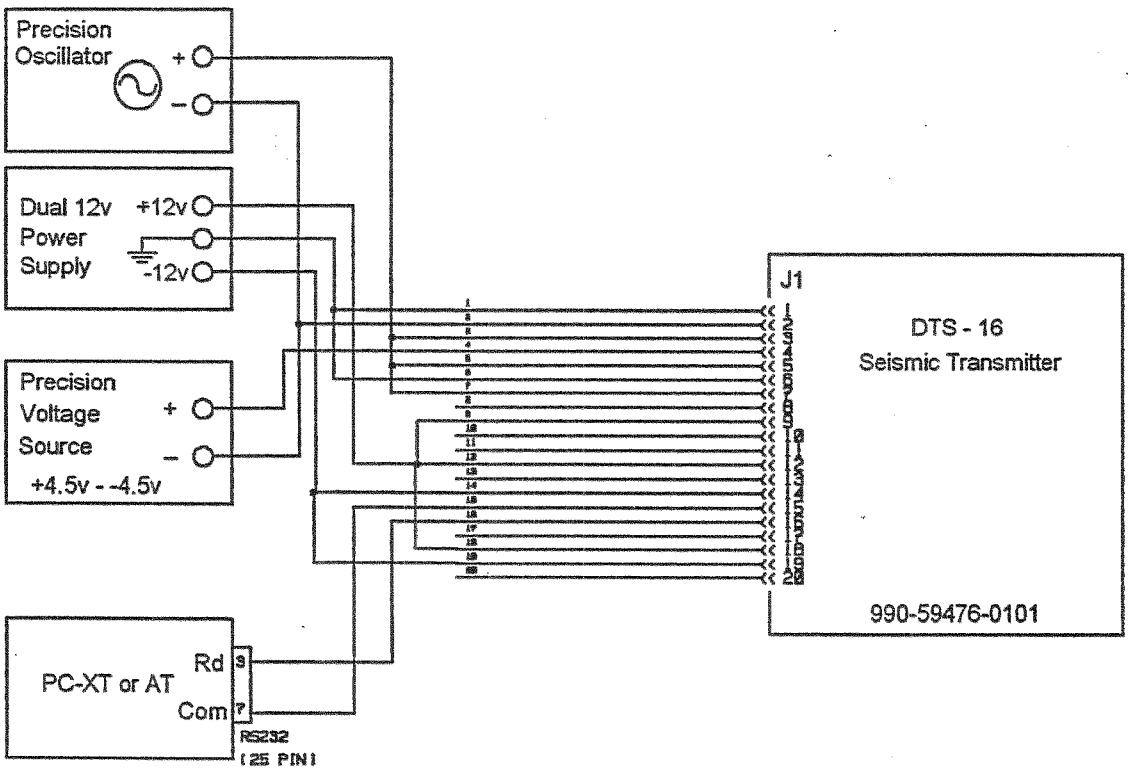

Figure 8-3. Connections for DTS-16 Bench Test

8.5.4 Using the DTS16 Program

The DTS16 program simply collects 30 of the one second blocks from the 49.65 in normal operation and creates a 30 second block of data for each channel in a format that can be read by DADiSP. The program will continue to run when the 'F1' key is depressed after data is recorded.

The files generated are in ASCII and the value of each data point is in counts. The files V.1, V.2 .. etc. are for channel 1 which is normally used for a vertical seismometer. The N.1, N.2 .. files are for channel 2 and E.1, E.2 .. are for channel 3. The A.1, A.2 ..files are for the auxiliary channel data.

DTS16 must be programmed to match the 49.65 configuration. When the program prompts to set the baud rate, simply type "4800<cr>" or "9600<cr>". To the prompt for number of channels, type "1<cr>", "3<cr>" or "4<cr>" and for sample rate, type "50<cr>" or "100<cr>".

8.5.5 Using DADiSP with 49.65 Data

When test data has been generated, go to the DSP directory and run DADiSP2. Select the labbook DTS16 that was created following the instructions in section 2.4.2 and open this labbook. Then, load the work sheet AMPLITUDE4 to look at the data of interest. The worksheet LINEARITY is a special test worksheet that requires special test equipment. When the work sheet has been loaded, depress the key "E" to enter the first window. Next press the function key "F3" and <cr>. The file V.1 generated in the directory TX16 will be loaded and displayed in window 1 (W1).

The vertical axis of window 1 will be in counts (32768 counts max.), and the horizontal scale will be in samples. To look at the data closer, refer to the DADiSP manual. Windows 2 through 4 are provided for north-south, east-west, and auxiliary channels.

The worksheet LINEARITY has windows for the derivative of the raw data. The vertical axis shows Hertz but is actually in counts per sample. This shows the slope of the data at each data point. The horizontal axis is still in samples. This window is useful for running a linearity test if a precision signal at 1/30 Hertz is available. Note that any non-linearity in the source will be included in the data.

8.6 DATA HEADER

1 st Byte	AAh	Preamble
2 nd Byte	16h	Sync Character
3 rd Byte	xxh	Binary Station Code
4 th Byte	0xh	Number of Channels
5 th Byte	xx hex	Binary Sample Rate
6 th Byte	00 hex	Reserved

8.7 DATA FORMAT

8.7.1 Single Channel Data Format

First Sample	LSByte	CHANNEL 1
	MSByte	
Last Sample	LSByte	
	MSByte	
Check Sum	LSByte	
	MSByte	

8.7.2 Three Channel Data Format

First Sample	LSByte	CHANNEL 1
	MSByte	
Last Sample	LSByte	
	MSByte	
First Sample	LSByte	CHANNEL 2
	MSByte	
Last Sample	LSByte	
	MSByte	
First Sample	LSByte	CHANNEL 3
	MSByte	
Last Sample	LSByte	
	MSByte	
Check Sum	LSByte	
	MSByte	

8.8 TEST DATA FORMAT

1st Byte	16H - Sync Character
2nd Byte	Station Code
3rd Byte	System Code and CTS
4th Byte	LSByte of EPROM Check Sum
5th Byte	MSByte of EPROM Check Sum
6th Byte	LSByte of AUX Channel Offset
7th Byte	MSByte of AUX Channel Offset
8th Byte	LSByte of AUX Channel Noise
9th Byte	MSByte of AUX Channel Noise
10th Byte	LSByte of Channel 1 RAW DATA
11th Byte	MSByte of Channel 1 RAW DATA
12th Byte	LSByte of Channel 2 RAW DATA
13th Byte	MSByte of Channel 2 RAW DATA
14th Byte	LSByte of Channel 3 RAW DATA
15th Byte	MSByte of Channel 3 RAW DATA
16th Byte	LSByte of Auxiliary RAW DATA
17th Byte	MSByte of Auxiliary RAW DATA
18th Byte	LSByte of + 7.5v RAW DATA
19th Byte	MSByte of + 7.5v RAW DATA
20th Byte	LSByte of - 7.5v RAW DATA
21st Byte	MSByte of - 7.5v RAW DATA
22nd Byte	LSByte of + Va RAW DATA
23rd Byte	MSByte of + Va RAW DATA
24th Byte	LSByte of - Va RAW DATA
25th Byte	MSByte of - Va RAW DATA
26th Byte	LSByte of Check Sum
27th Byte	MSByte of Check Sum

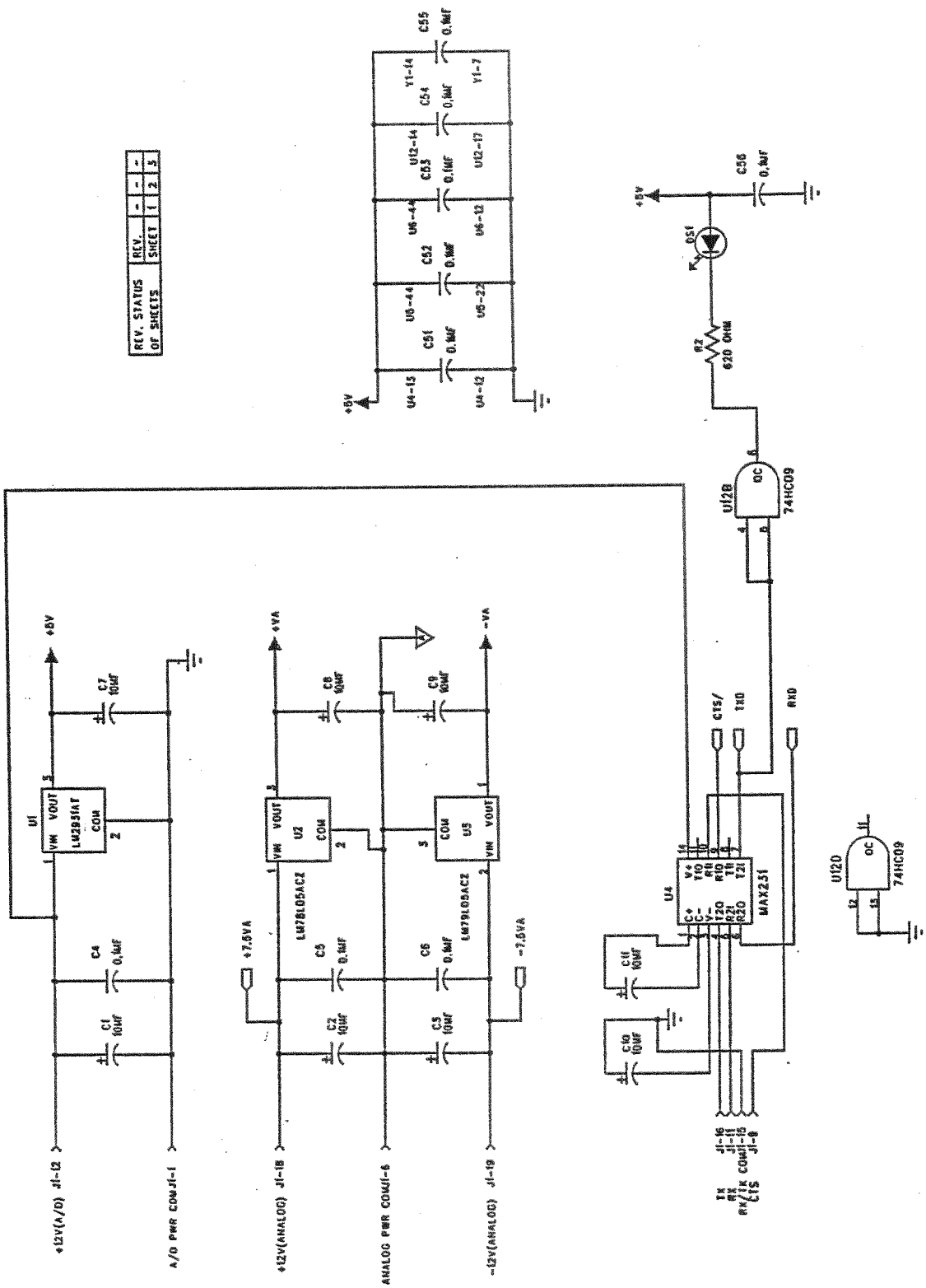

Figure 8-4 16-bit Remote Digitizer

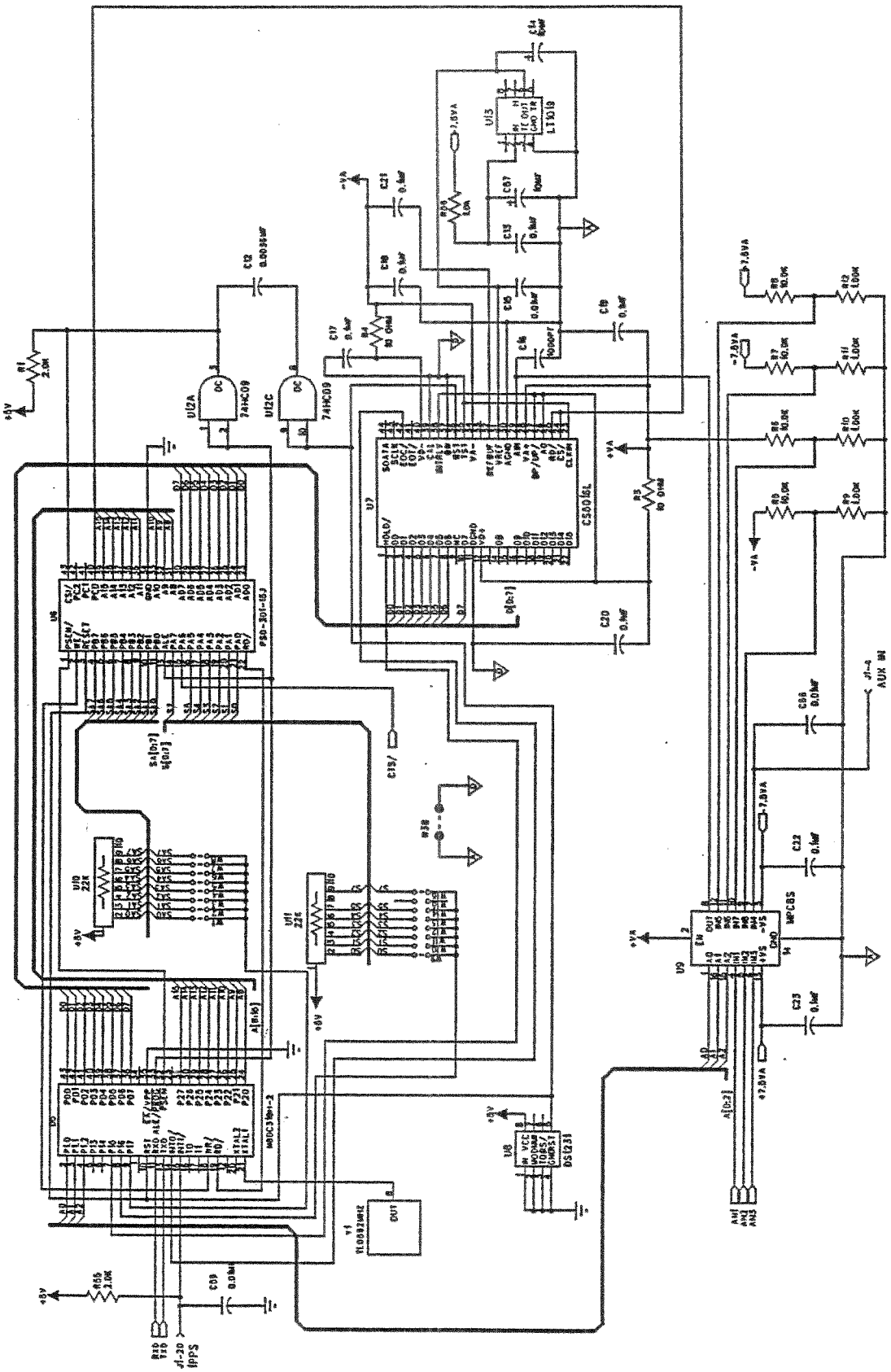

Figure 8-5. 16-bit Remote Digitizer Schematic,

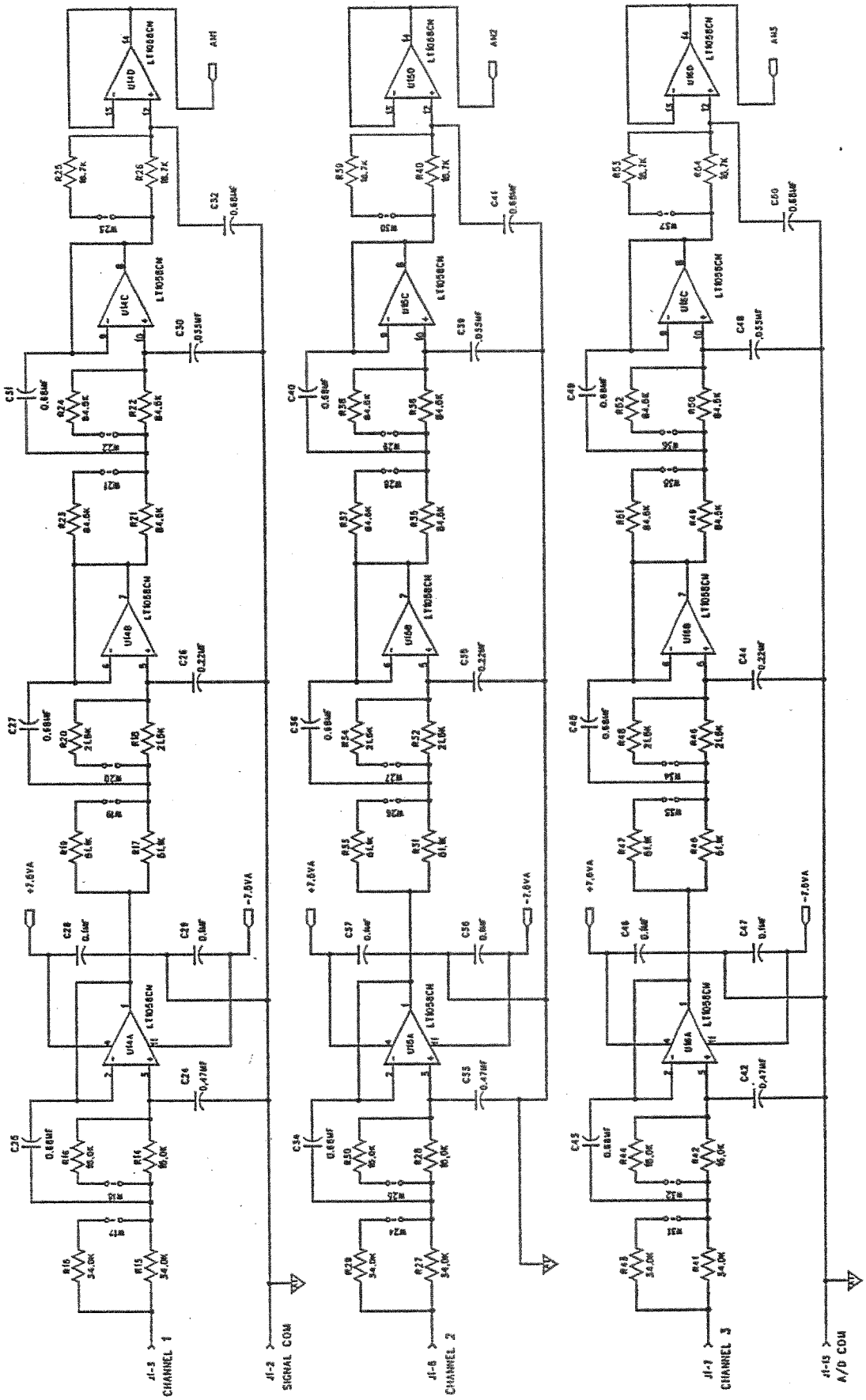

Figure 8-6. 16-bit Remote Digitizer Schematic,

Table 8-3. 16-bit Remote Digitizer Parts List

TG3340 — TELEDYNE GEOTECH
TRANS: MILPL — MILITARY SINGLE LEVEL PARTS LIST — RUN DATE 28-Sep-93 — RUN TIME 02:52 PM — SHEET 2

PARENT PART		DESCRIPTION/SPECIFICATION	ENG DRAWING REFERENCE	FSCM	REVISION	ECN
990594760101	1	ASSY-DTS-16 SEISMIC TX A/990-59476-1101/PARTS LIST D/990-59476-2101/SCHEMATIC A/990-59476-5101/DTS-16 SEISMIC TX A/990-59476-6101/ACCEPTANCE TEST		099019	A5	E46500

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
001	990594760201	0	FAB-DTS-16 SEISMIC TX	990594760201	099019	-	EA	1.0000
005	002710258684	4	CAPACITOR,10MF,25V,20% SPRAGUE C1-3,C7-11,14,57	199D106X0025CE2	056289	-	EA	10.0000
006	502510500856	2	CAPACITOR,0.1 MF,50V,10% JOHANSON DIELETRIC (SURFACE MOUNT)) PACKAGED ON TAPE REEL. VARIATIONS FROM THIS PACKAGING MUST BE APPROVED BY MFG BY DVA C4-6,13,C17-23,28,29,37,38,46,47,C51-56	500S41W104KP4E	029454	-	EA	23.0000
007	502410500855	4	CAPACITOR,0.01MF,50V,10% JOHANSON DIELETRIC (SURFACE MOUNT) C15,C58,C59	500R18W103KP	029454	A	EA	3.0000
008	502310500856	4	CAPACITOR,1000PF,50V,10% JOHANSON DIELETRIC (SURFACE MOUNT) C16	500S41N102KP	029454	-	EA	1.0000
009	002547505557	1	CAPACITOR,0.47MF,50V,5% MALLORY C24,33,42	168474J50E	090201	-	EA	3.0000
010	002568505557	5	CAPACITOR,0.68MF,50V,5% MALLORY C25,27,31,32,34,36,40,41,43,45,49,50	168684J50F	090201	-	EA	12.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
011	002522635557	5	CAPACITOR,.22MF,63V,5% MALLORY C26,35,44	168224J63C	090201	-	EA	3.0000
012	002433585557	0	CAPACITOR,.033MF,100V,5% MALLORY C30,39,48	168333J100A	090201	-	EA	3.0000
013	502333505856	6	CAPACITOR,0.0033MF,50V,5% JOHANSON DIELETRIC (SURFACE MOUNT) C12	500S41N332JP	029454	-	EA	1.0000
016	062100821700	1	LED,HEWLETT-PACKARD DS1	HLMP-1700	028480	B	EA	1.0000
020	307000022000	3	HEADER,RT ANGLE,20 PIN SOURCE CONTROL DRAWING J1	307-00002-2000	099019	-	EA	1.0000
021	007783312727	9	SOCKET,SPRING,COMPONENT L EAD(22 AWG),AMP 2-331272-7 J2,3	2-331272-7	004618	-	EA	2.0000
026	001051001035	3	RSTR,FXD,1K,1/4W,5%,ALLE N BRADLEY CB R56	CB1025	001121	-	EA	1.0000
027	001046201035	7	RSTR,FXD,620 OHM,1/4 W,5% ,ALLEN BRADLEY CB R2	CB6215	001121	-	EA	1.0000
028	001031001035	8	RSTR,FXD,10 OHM,1/4 W,5% ALLEN BRADLEY CB R3,4	CB1005	001121	-	EA	2.0000
029	001061000907	8	RSTR,FXD,10K,1/10W,.1% R5-8	RN55C1002B	ANY	-	EA	4.0000
030	001051000907	0	RSTR,FXD,1K,1/10W,.1% R9-12	RN55C1001B	ANY	-	EA	4.0000
031	001063400901	4	RSTR,FXD,34.0K,1/10W,1% R13,15,27,29,41,43	RN55C3402F	ANY	-	EA	6.0000
032	001065110901	7	RSTR,FXD,51.1K,1/10W,1%,R R17,19,31,33,45,47	RN55C5112F	ANY	-	EA	6.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
033	001068450901	4	RSTR,FXD,84.5K,1/10 W,1%, R21-24,R35-38,R49-52	RN55C8452F	ANY	-	EA	12.0000
034	001061870901	0	RSTR,FXD,18.7K,1/10W,1% R25,26,39,40,53,54	RN55C1872F	ANY	-	EA	6.0000
035	001052001035	2	RSTR,FXD,2K,1/4 W,5%,ALLE N BRADLEY CB R1,55	CB2025	001121	-	EA	2.0000
036	001061500901	3	RSTR,FXD,15K,1/10 W,1%,RN R14,16,28,30,42,44	RN55C1502F	ANY	-	EA	6.0000
037	001062150901	6	RSTR,FXD,21.5K,1/10W,1%,R R18,20,32,34,46,48	RN55C2152F	ANY	-	EA	6.0000
040	012622931505	9	VOLTAGE REGULATOR,5.0V NATIONAL SEMI OR MOTOROLA U1	LM2931AT-5.0	004713	-	EA	1.0000
041	012627805130	3	VOLTAGE REGULATOR,5V POS NATIONAL SEMICONDUCTOR U2	LM78L05ACZ	012040	-	EA	1.0000
042	012627905130	1	VOLTAGE REG,-5V,100MA NATIONAL SEMICONDUCTOR 79L05 U3	320L79L05A	012040	-	EA	1.0000
043	012102313164	1	DUAL RS232 TX/RX MAXIM INTERGRATED PRODUCTS U4	MAX231CPD	01ES66	-	EA	1.0000
044	012631803312	2	MICROCOMPUTER,8 BIT INTEL CORP U5	N80C31BH-2	034649	-	EA	1.0000
045	990595390101	6	PROGRAMMED SYSTEM DEVICE U6	990595390101	099019	-	EA	1.0000
046	012105016320	8	A/D CONVERTER CRYSTAL SEMICONDUCTOR CORP P. O. BOX 17847 AUSTIN, TX 78760 (512) 445-7222 U7	CS5016-KL32	101135	-	EA	1.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
047	012991231200	5	I.C.,POWER MONITOR DALLAS SEMICONDUCTOR CORP 34350 BELTWOOD PKWY SOUTH DALLAS, TX 75244 U8	DS1231-20	101132	-	EA	1.0000
048	012101316380	3	IC,8 CHANNEL MULTIPLEXER BURR-BROWN U9	MPC8S	013919	-	EA	1.0000
049	301712231009	3	RSTR,NETWORK,SIP,L-P,2%, 22 K,10 PIN,9 RSTR SOURCE CONTROL DRAWING U10,11	301-71223-1009	099019	-	EA	2.0000
050	012107483009	6	I.C.,QUADRUBLE 2-IN POS- AND GATES WITH OPEN-DRAIN OUTPUT TEXAS INSTRUMENTS U12	SN74HC09N	001295	-	EA	1.0000
051	012541019145	7	PRECISION REFERENCE LINEAR TECHNOLOGY INC. U13	LT1019ACN8-4.5	037964	-	EA	1.0000
052	012621058314	3	OP AMP,QUAD LINEAR TECHNOLOGY INC. U14,15,16	LT1058CN	037964	-	EA	3.0000
056	007936510116	3	CONNECTOR,16 POS,BERG W1-8,W9-16	65610-116	06V559	-	EA	2.0000
057	007936510106	5	CONNECTOR,6 POS, BERG W21-23,W28-30,W35-37	65610-106	06V559	-	EA	3.0000
058	007936510108	3	CONNECTOR,8 POS,BERG W17-20,W24-27,W31-34	65610-108	06V559	-	EA	3.0000
060	007002130444	2	SOCKET,PLCC TO PGA,44 PIN METHODE ELECTRONICS INC. XU5,6,7	213-044-401	026742	-	EA	3.0000
061	011128566291	2	CRYSTAL OSCILLATOR 11.0592MHZ,.0025%,HS357 N E L FREQUENCY CONTROLS INC. Y1	H56629-11	000815	-	EA	1.0000

LINE	COMPONENT PART		DESCRIPTION/SPECIFICATION	IDENTIFYING NO.	FSCM	REVISION	U/M	QTY/ASSY
062	007936547404	6	JUMPER,BERG W1-9,W16-37	65474-010	06V559	-	EA	31.0000
063	064252210200	4	WIRE,JUMPER,INSULATED,TEF ,.200 LG X .250 HIGH,22 AWG,SQUIRES ELECTRONICS J0.200X0.250T22 W38			-	EA	1.0000

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APPENDIX A. WIRE AND PIN DESCRIPTION

A.1 Wire and Pin Description for 20 Wire Ribbon Cable Assembly

Wire#	Pin#	Description
1	1	Power Common for Analog to Digital Converter Circuit
2	2	Signal Common for Amplifier
3	3	Channel 1 Output from Amplifier
4	4	Cal Coil Serial Interconnect for 42.70/ Aux Input for 49.70 Remote Digitizer
5	5	Channel 2 Output from Amplifier
6	6	Analog Power Common
7	7	Channel 3 Output from Amplifier
8	8	Pulse Calibrator Output Return (Common)
9	9	Clear to Send Input from Modem or Pull-up
10	10	Pulse Calibrator Output
11	11	not used (Reserved for RX)
12	12	+ 12 Volts for Digital Circuits and A/D
13	13	Digital Power Return
14	14	- 12 Volts for A/D Circuits
15	15	- VCO Multiplexer Output / TX/RX Common
16	16	+ VCO Multiplexer Output / TX , RS-232 Level Output
17	17	Cal Coil Serial Interconnect for 42.70
18	18	+ 12 Volts for Analog Circuits
19	19	- 12 Volts for Analog Circuits
20	20	Multiplexer Summing Junction / 1PPS Input

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