Instruction Manual

Model 125E AC to DC

Automatic Ranging Converter

This manual is for instrument Serial No.________________

Non-Linear Systems, Inc.
Del Mar, California

125E;

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TABLE OF CONTENTS

SECTION		PAGE
1	Introduction	5
2	Specifications	7
3	Installation and Operation	9
4	Calibration	13
5	Theory of Operation	17
6	Maintenance and Troubleshooting	19
7	Recommended Spare Parts	25
8	Parts List	27
9	*Appendix*	33
	Warranty and Shipping Notice	
	Calibrating AC Digital Voltmeters	
	List of NLS Sales and Service Representatives	
	NLS Short Form Catalog	
	Main Schematic	inside back cover

LIST OF ILLUSTRATIONS

FIGURE NUMBER		
3-1	Cables Supplied with Converter	9
3-2	Cable Assemblies by Part Number	10
3-3	Converter, Rear View	10
3-4	Ground Circuits	11
4-1	Flow Diagram for Calibration Setup	13
4-2	Typical Plot of Error vs. Frequency after Calibration	15
4-3	Location of Calibration Controls made Accessible by Removal of Front Panel	16
5-1	Signal Flow Diagram	17
6-1	View of Converter with Top Cover Removed and Front Panel Dropped to Reveal Ranging Components	20

ADDENDUM

Model 125E (P/N 18053), 125B (P/N 18069), 125C (P/N 18072).

This addendum to the NLS 125E Manual updates the accuracy specification for the three instruments listed above. In the Specifications Section, page 7, each of three effects (range multiplier, linearity, and frequency) are listed as having an accuracy of 0.1% of full scale. This can lead to an overall accuracy of 0.3%.

The new accuracy specification is 0.1% of reading, plus one digit. The 125E, incidentally, while keeping to the specified average balance time, gets within ±0.01% of final reading in six seconds.

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	DIFFERENCE DATA SHEET	PREPARED BY: Joel A. Naive	DATE 6-23-61
	Model 125ER P/N 18079	CHECKED BY: JAN	DATE 6-23-61
	AC Reference Converter	RELEASE DATE Rev. 2 - 12-11-61	PAGE 1 OF 1

The Model 125ER AC Reference Converter can be used with any Non-Linear Systems Digital Ratiometer, a Model 125E AC-DC Converter and appropriate cables. In general, it is necessary that the associated Digital Ratiometer be modified for proper operation with the 125ER.

The Model 125ER P/N 18079 is identical to the Model 125C Converter P/N 18072 except that an operational amplifier wired for unity voltage gain has been added to the output. This amplifier provides sufficiently low output impedance to drive the reference input of any Non-Linear Systems Digital Ratiometer.

The additional circuitry includes a Philbreck Model P2 transistorized amplifier, a plus and minus 16 volt power supply for the amplifier, a 10 meg ohm amplifier input resistor, and three diodes in series with pins J, K, and H of J13. Connector J11 and J12 have been changed from 3 pin to 4 pin Connectors.

Even though the Model 125E and 125ER are each independently capable of automatic ranging, they must be manually ranged when making AC Ratio measurements to assure that they are both in the same range. The range should be selected according to the reference voltage. Up to 13 volts reference, the 10 volts range may be used. From 10 volts to 130 volts the 100 volt range should be used. From 100 volts to 1000 volts the 1000 volt range should be used.

Section 1

INTRODUCTION

The Model 125E AC to DC Converter permits NLS digital voltmeters to make AC voltage measurements precisely and automatically.

Precise measurements are assured by the high input impedance of the converter. The likelihood of error is further reduced because the voltage reading can be taken by untrained persons. The readings are clearly visible at distances to thirty feet. Another source of error has been eliminated by the inclusion of an automatic ranging unit; the operator has no controls to manipulate in order to shift scales. Thus, when coupled with an automatic ranging NLS digital voltmeter, a 125E Converter provides the user with a flexible, highly automated, and reliable instrument or system.

If an NLS printer or other recording device is used at the output of the digital voltmeter, automatic operation is extended to printed, taped, punched, or typewritten symbols. NLS systems are frequently integrated with other automated devices so as to enhance the data gathering and recording process as information flows reliably and rapidly through the system.

The NLS Engineering Department will be glad to help you with specific application problems. A call or letter to our representative in your area, as listed in the *Appendix*, or to the NLS home office will be promptly answered.

Section 2

SPECIFICATIONS

Input Voltage Ranges:

10/100/1000 volts AC. These ranges are selected:

1. Automatically,
2. Manually, by a switch on the digital voltmeter, or
3. Remotely, through contact closures.

Input Impedance:

10 megohms and 40 uuf shunt capacitance.

Output Voltage:

10 volts DC for 10, 100, or 1000 volts AC input (governed by the input voltage range in use) when connected to the 10-megohm input load of an NLS digital voltmeter.

Compatibility with NLS Digital Voltmeters:

The 125E Converter may be connected without wiring changes to the NLS Models V34A, V35A. The converter is also compatible with the Models V24 and M24 having serial number 10.700 or larger.
If the 125E is to be used with other instruments, or with earlier versions of the M24 and V24, consult an NLS representative or the factory for wiring changes.

Frequency Range:

30 cps to 10 kilocycles.

Accuracy of AC-to-DC Conversion (% of Full Scale on Each Range):

Scale multiplier accuracy ±0.1%; voltage linearity ±0.1%, frequency effect ±0.1%.

Calibration:

The 125E is calibrated in terms of the RMS value of a pure sine wave. The converter output voltage is proportional to the average value of the input voltage.

Balancing Time:

3 seconds, average.

Connections:

Signal input and signal output grounds are common, but are not connected directly to the converter's chassis within the converter. The converter's chassis and digital voltmeter chassis are common when the two instruments are connected. Type MS3102A connectors on the rear panel are used – one each for the input and output.

Power Source:

115 VAC, 60 cycles; power consumption is 70 watts. No power cord is used; the 125E converter draws its power through cabling to the digital voltmeter. The digital voltmeter power switch is wired ahead of the converter power take-off so that the converter works in unison with the digital voltmeter.

Dimensions:

The 125E mounts in a standard 19″ wide rack, is 3½″ high and 15¼″ deep.

Weight:

Net: 27 lbs., shipping: 45 lbs.

INSTALLATION AND OPERATION

3.1 Operating Environment

The 125E Converter may be mounted in a rack with associated equipment or it may be used as a bench instrument. Care should be taken to assure proper ventilation. Allow space for the blower exhaust at the rear as well as at the sides for air intake. Operation near strong electrical fields, as occur at radio transmitters and other radio-frequency equipment, should be avoided unless elaborate steps for electrical shielding have been taken. Stray high-frequency signals can be a source of spurious readings on the digital voltmeter. Since the converter uses mercury-wetted relays, it should not be tilted more than 30 degrees from the horizontal. Environmental conditions which are suitable for a digital voltmeter will suffice for the 125E Converter.

3.2 Connection Procedures

1. Connect the 34-pin connector (J-13) on the converter to the AC converter connector on the rear panel of the DC digital voltmeter by using the cable furnished with the converter. Figure 3-1 shows typical cables and Figure 3-2 identifies cabling connections.

2. Connect the converter's DC output (connector J-12) to the input terminal of the DC digital voltmeter by using the harness furnished with the converter. With Series 20 digital voltmeters, cable 15004-128 is used; with Series 30 instruments, the 15004-129 cable is used.

3. Connect the AC or DC input signal to J-11 at the rear of the converter. See Figure 3-3.

Pin A	Input high side
Pin B	Input low side
Pin C	Carries chassis ground of digital voltmeter and converter through converter to input.

NOTE

When measuring AC voltages, Pins B and C should normally be shorted together. If any AC voltage exists between Pins B and C, converter accuracy will suffer.

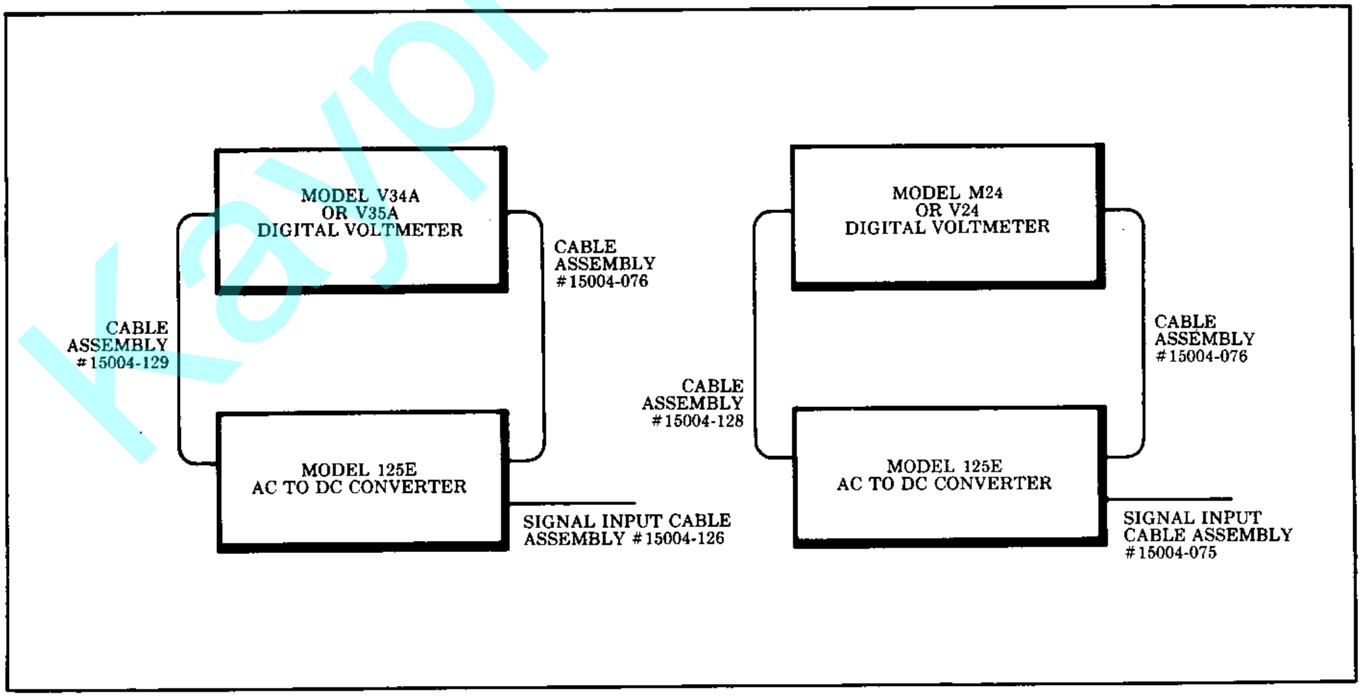
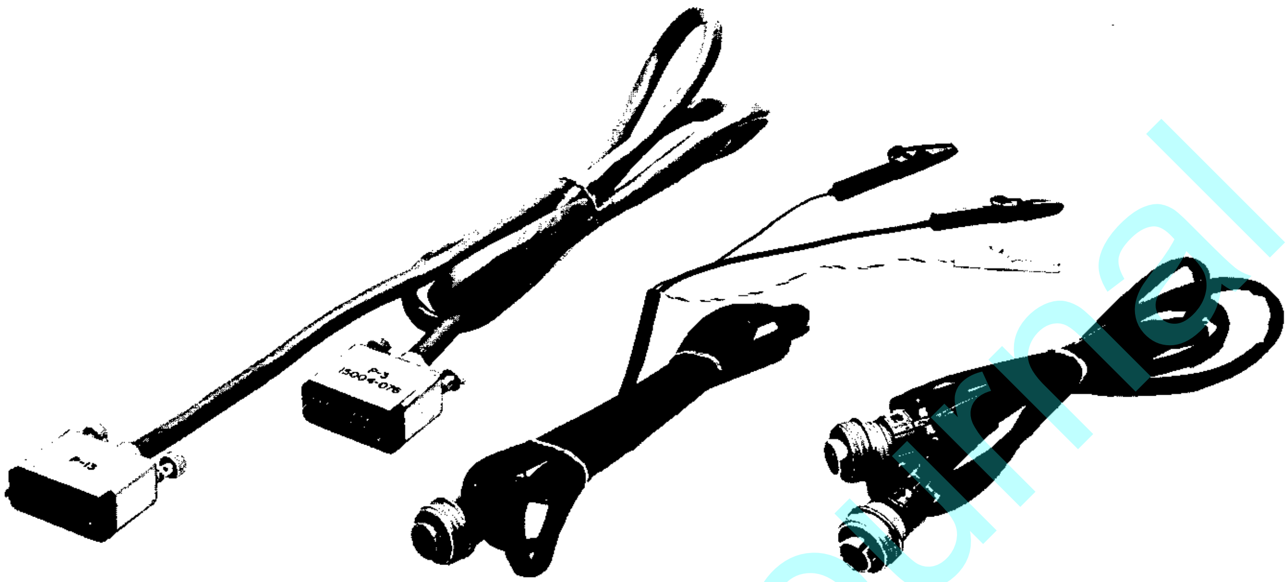


Figure 3-1. Cables Supplied with Converter.

INSTALLATION AND OPERATION



POWER & CONTROL | SIGNAL INPUT | SIGNAL OUTPUT

Figure 3-2. Cable Assemblies by Part Number.

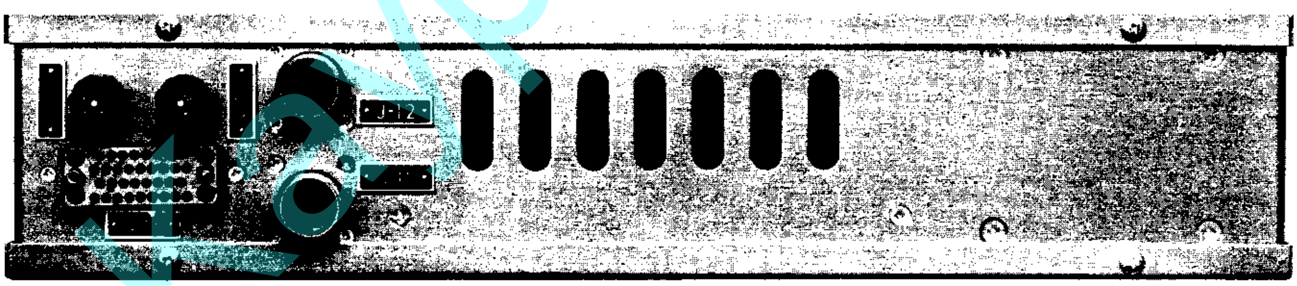


Figure 3-3. Converter, Rear View.

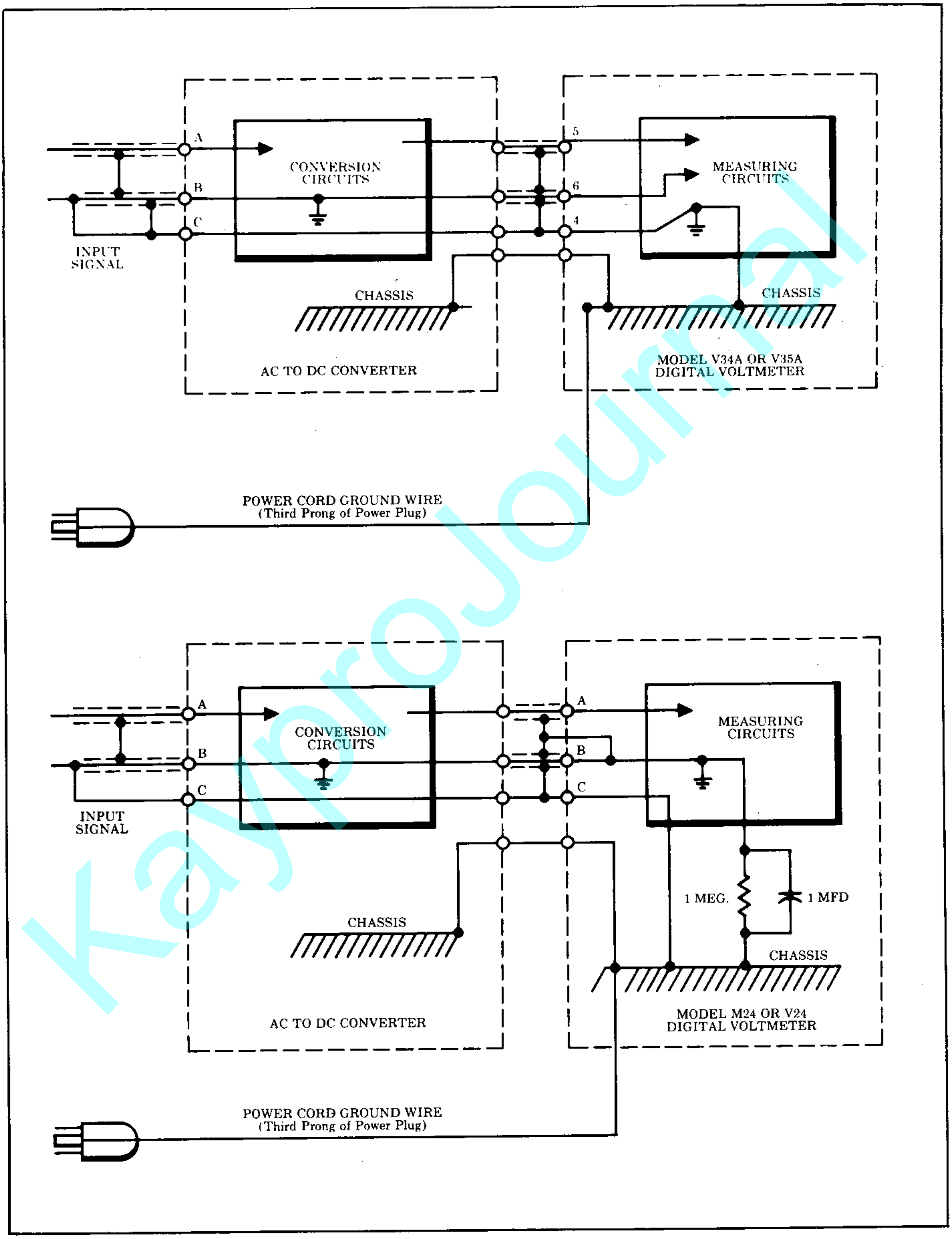


Figure 3-4. Ground Circuits.

On AC ranges, the digital voltmeter's selector switch connects the input signal to the AC-DC conversion circuits. On DC ranges, the selector switch connects the input signal directly to the converter's DC output (connector J-12). Remember that test lead capacitance can cause appreciable loading of signal circuits, especially at high frequencies. See Figure 3-4.

CAUTION

Chassis ground and signal ground are not connected together in the converter, but they are connected together through the digital voltmeter. Fuse F-2 protects the wiring against burnout if a "hot" lead is connected to the signal ground terminal.

Where completely ground isolated AC signal connections are required, use an external input transformer for the signal circuits. Important factors in transformer selection include frequency response characteristics, primary impedance, turns ratio accuracy, and adequate shielding to prevent noise pickup. Primary impedance is important only because of the effect that a low primary impedance might have upon the output voltage of the circuits being measured. Frequency response characteristics and turns ratio accuracy are important because of the effect they have on overall measurement accuracy.

4. Set the range selector switch on the digital voltmeter's front panel to AUTO VAC on the range of expected use for AC signals or to the DC position when measuring DC signals.

5. Turn on the 115-volt AC power.

6. The digital voltmeter readout decimal point location is controlled by the range selector switch or by the automatic range selection circuitry in the converter.

7. For remote selection of AC voltage range and AC or DC measurements, refer to the drawings provided with the digital voltmeter associated with the converter.

CAUTION

Do not connect more than 1000 volts to the converter input. Full accuracy is only obtained with inputs no higher than 10 volts on the 10 volt range, 100 volts on the 100 volt range, and 1000 volts on the 1000 volt range.

Section 4

CALIBRATION

4.1 General Procedure

To calibrate the converter, connect the equipment as shown in Figure 4-1; sweep the AC voltage source over the converter's frequency and voltage range or over the range required in your application, and compare the digital voltmeter's readings to readings on the standard AC voltage measuring instrument. The two sets of readings should agree after the composite error of several factors has been weighed. Consider the following possible errors:

1. Total error of the converter,
2. Error of the DC digital voltmeter,
3. Error of the standard AC voltage measuring instrument, and
4. Error due to harmonic distortion in the AC voltage source.

If, after considering the areas in which error may occur, the converter is not within tolerance, follow the balance of this section to readjust the instrument.

4.2 Precautions

Before calibrating, observe the following:

1. Load the converter's output only with a digital voltmeter having a 10-megohm input impedance. The converter has a high output impedance and small changes in load can affect its DC voltage output appreciably.

2. Calibration signal source must be very stable.

3. The calibration signal source wave form must be sinusoidal with low harmonic content to minimize inaccuracies caused by harmonic distortion. Remember, the converter is designed for measuring sinusoidal voltages; its reading is proportional to the average value of the input wave form and the instrument is calibrated at the factory to indicate the RMS value of a pure sine wave. If the signal wave form is not a pure sinusoid, do not expect the converter to agree with an AC instrument which measures the wave-form RMS value (thermal converters, dynamometer-type voltmeters, etc.). Differences between AC measurements made with the converter and the true RMS values of non-sinusoidal wave forms depend upon relative magnitudes and phase relationships between the fundamental and the harmonics which are present.

The following table shows the maximum differences that can exist between the measurements made with the average sensing converter and the true RMS value of the wave form being measured. Actual differences may be much less than the maximum shown in the table depending upon phase relationships between fundamental and existing harmonics.

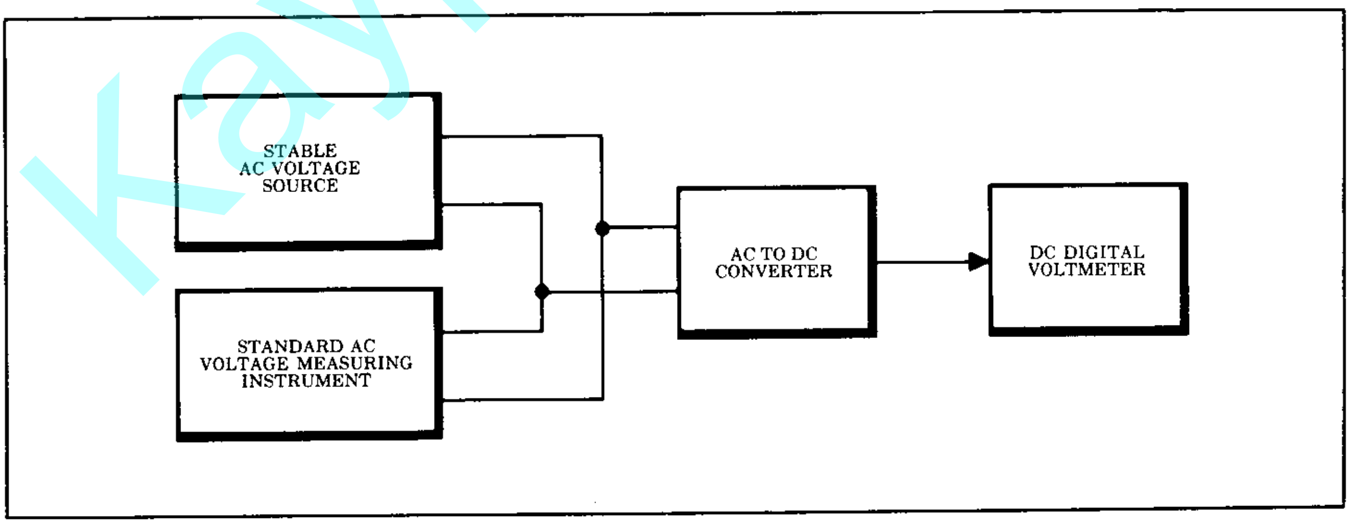


Figure 4-1. Flow Diagram for Calibration Setup.

CALIBRATION

Second Harmonic

Percent Harmonic	Maximum Error Expected
10%	0.5%
20%	2 %
50%	12 %

Third Harmonic

0.3%	0.1 %
0.5%	0.17%
1 %	0.35%
5 %	1.7 %
10 %	4.5 %
20 %	8 %
50 %	22 %

4. Before calibrating the converter, the associated DC digital voltmeter must be within its specified accuracy tolerance.

5. Use shielded leads and a good ground to prevent noise pick-up problems.

6. One input terminal of the converter is connected to the digital voltmeter chassis, except in Series 20 instruments carrying part numbers below 10.700. Do not apply a potential between the "low" signal input terminal and chassis. A fuse has been provided to prevent damage to the wiring if this sort of connection is attempted.

7. For the best results, permit the converter to warm up for thirty minutes before adjusting its calibration controls.

8. Any voltage dividers used in the calibration procedure must be frequency compensated. At high frequencies, test wiring capacitances and converter input capacitance can cause appreciable loading; therefore, test leads should be as short as possible.

9. As with most measuring instruments, calibration is more accurate when performed near the top of each voltage range.

10. The adjustment procedure in Section 4.3 mentions frequencies of "30 to 100 cps" and "10 kc." Other frequencies between 30 cps and 10 kc can be used if these frequencies are not available. For example, 400 cps can be used for low frequency adjustments and 5 kc may be used for high frequency adjustments; the possibility of error below 400 cps and above 5 kc must be accepted. If your application requires use at a single frequency, maximum accuracy will be obtained if calibration is made at that one frequency.

11. The time required for calibration will be much shorter if the readings obtained after each step given in Section 4.3 are plotted on graph paper. Then, the effect of each control will be readily apparent. After reviewing the graph, the controls can be more satisfactorily adjusted to bring the converter into tolerance by, for example, causing an intentional error in one direction at a certain frequency so as to cause the curve of frequency versus error to come within tolerance at other frequencies. Another reason why the plotted readings are helpful is that frequency compensation controls have a much greater effect at higher frequencies than at lower frequencies. Figure 4-2 plots error versus frequency for a typical converter after calibration.

12. During the calibration procedure, the top and bottom covers of the converter should be in place. However, the front panel is removed to provide access to these controls. The front panel may be removed by detaching the handles. Adjustment controls are labeled on the inside panel as shown in Figure 4-3.

4.3 Adjustment Procedure

In the procedure steps which follow, the phrases "for agreement" or "to achieve agreement" mean *to bring the digital voltmeter reading within the accuracy tolerance required.*

1. Switch the digital voltmeter to bring the converter to the 10-volt range.

2. With an input voltage slightly less than 10 volts, at a frequency between 30 and 100 cps, adjust R-2 (labeled LOW FREQUENCY ADJUSTMENT, 10 V) for agreement.

CALIBRATION

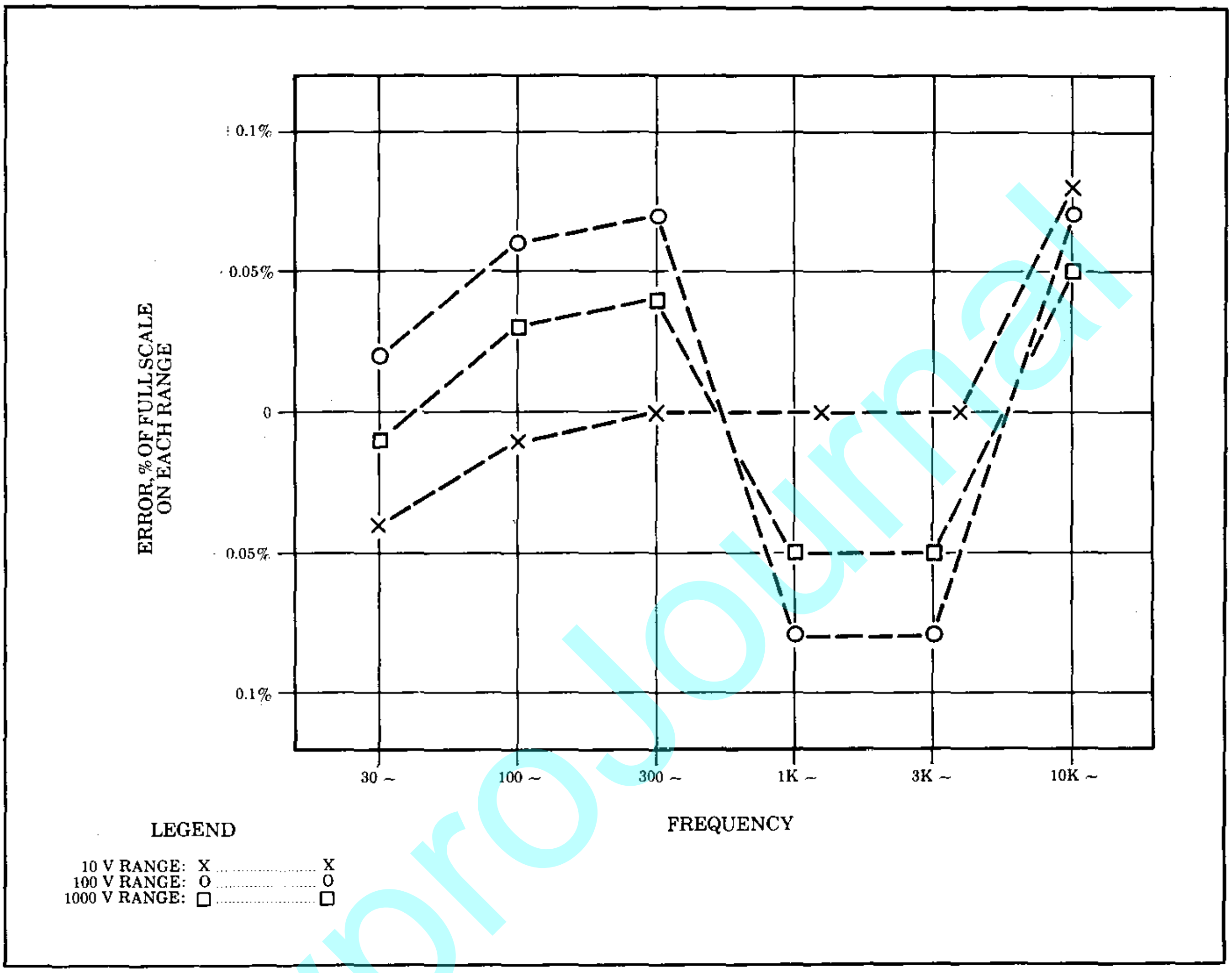


Figure 4-2. Typical Plot of Error vs Frequency after Calibration.

3. Switch the digital voltmeter to bring the converter to the 100-volt range.

4. With an input slightly less than 100 volts at a frequency between 30 and 100 cps, adjust R-3 (labeled LOW FREQUENCY ADJUSTMENT, 100 v) for agreement.

5. With an input voltage slightly less than 100 volts, and at a frequency of 10 kc, adjust C-1 (HIGH FREQUENCY ADJUSTMENT, 100 v) for agreement.

6. Repeat Step 4 and readjust R-3 (LOW FREQUENCY ADJUSTMENT, 100 v) if needed to achieve agreement. If R-3 has required readjustment, repeat Step 5. It may be necessary to repeat Steps 4 and 5 several times to achieve agreement at low and high frequencies. The adjustment of R-3 and C-1 can be readily achieved if it is realized that R-3 affects both the low and high frequency calibration, while C-1 affects mostly the high frequency calibration.

CALIBRATION

7. With an input voltage of at least several hundred volts and at a frequency of between 30 and 100 cps, adjust R-4 (LOW FREQUENCY ADJUSTMENT, 1000 v) for agreement.

8. With an input voltage of several hundred volts at 10 kc, adjust C-2 (HIGH FREQUENCY ADJUSTMENT, 1000 v) for agreement.

9. Repeat Step 7 and readjust R-4 (LOW FREQUENCY ADJUSTMENT, 100 v) if needed to achieve agreement. If R-4 requires readjustment, repeat Step 8. It may be necessary to repeat Steps 7 and 8 several times to achieve agreement at low and high frequencies. The adjustment of R-4 and C-2 can be achieved more readily if it is recognized that R-4 affects both the low and high frequency calibration while C-2 affects mostly the high frequency calibration.

10. C-1 and C-2 slightly interact if either one requires a large change during calibration. Repeat Steps 4 and 5 to check interaction. All ranges of the instrument are now in calibration. The remaining steps in the adjustment procedure apply to the automatic range changing circuitry only.

11. Rotate R-5 and R-6 counterclockwise and R-7 and R-8 clockwise until their stops are reached.

NOTE

The potentiometers require 43 turns to travel from stop to stop.

12. Apply 9.40 V of any frequency from 30 cps to 10,000 cps to the input of the converter.

13. Switch the digital voltmeter to bring the converter to the AUTO VAC mode. The digital voltmeter should read 09.40 V.

14. Rotate R-5 clockwise until the converter down ranges. The reading will then be 9.400 ±0.010.

15. With 94.0 volts going into the converter, the digital voltmeter should read 09.40 V.

16. Rotate R-6 clockwise until the converter down ranges. The reading will then be 94.00 ±00.10.

17. With 9.900 volts going into the converter, the digital voltmeter should read 9.900 V.

18. Rotate R-7 counterclockwise until the converter up ranges. The reading will then be 09.90 ±00.1 V.

19. With 99.00 volts going into the converter, the digital voltmeter should read 099.0 ±000.1 V. The converter has now been completely calibrated.

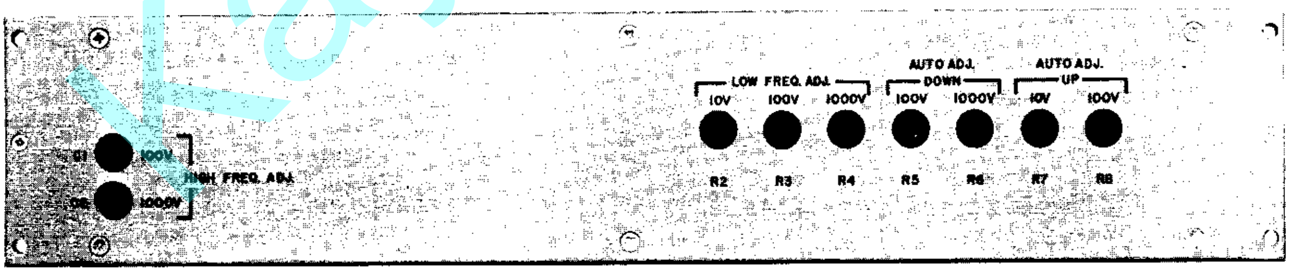


Figure 4-3. Location of Calibration Controls made Accessible by Removal of Front Panel.

THEORY OF OPERATION

In the Model 125E Converter, semi-conductor diodes are used to convert the unknown AC input into pulsating DC. This DC is then filtered to obtain a very pure DC voltage proportional to the average value of the AC input wave form. A high-gain feedback system linearizes and stabilizes the rectification characteristics of the diodes. To best understand the operation of the Model 125E Converter, Figure 5-1, Signal Flow Diagram, and the main foldout schematic at the rear of the manual should be consulted.

The converter input attenuator (range unit) attenuates the unknown AC input by precisely 10:1 or 100:1, as required to restrict the conversion circuit input to 10 volts, maximum, for full scale inputs of 100 volts and 1000 volts, respectively. C-1 and C-2 provide frequency compensation adjustment in the attenuator on the 100-volt and 1000-volt ranges, respectively.

The attenuator output is fed into a high-input impedance-isolation amplifier, V-2A, and

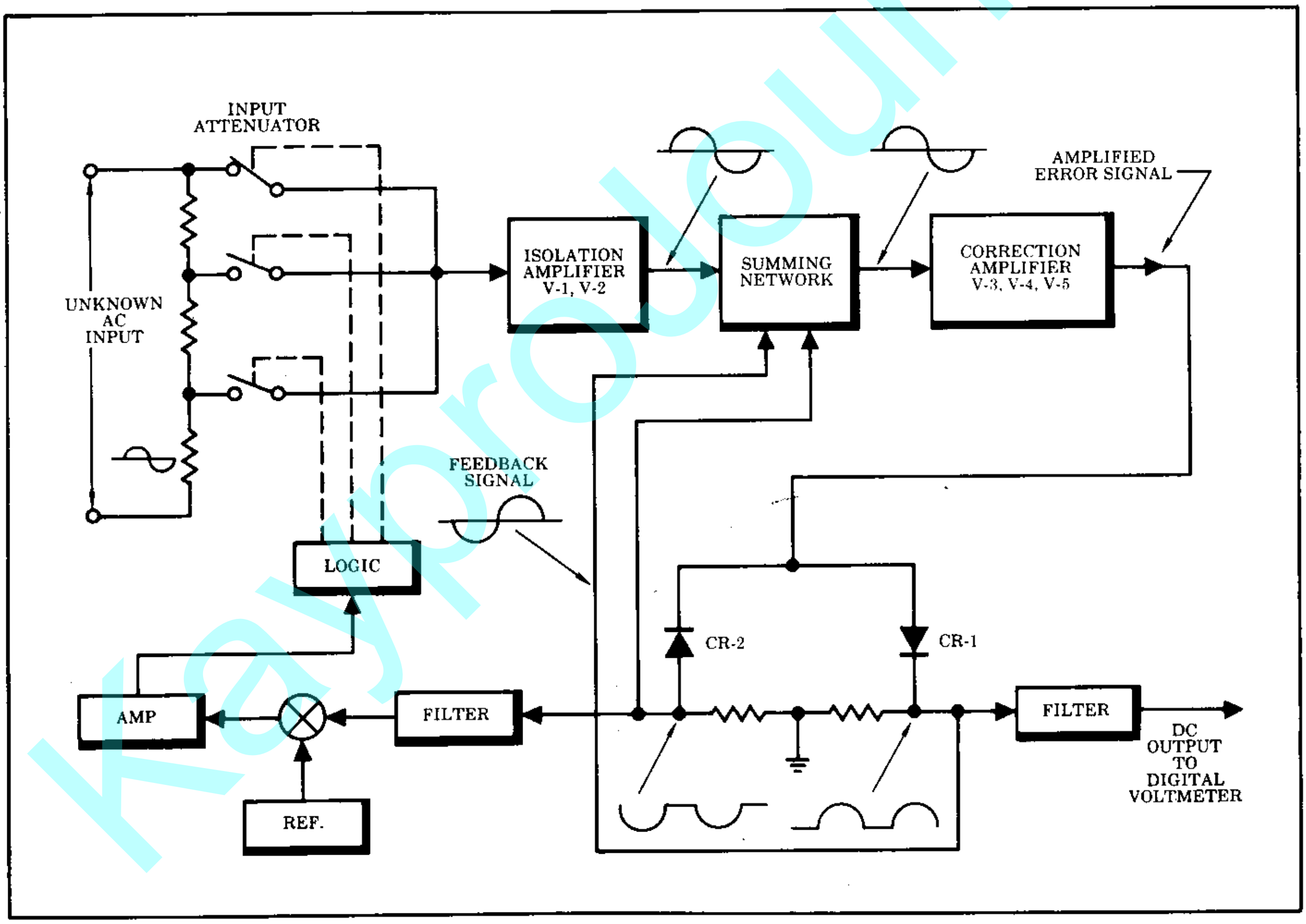


Figure 5-1. Signal Flow Diagram.

V-2B, which prevents the summing network R-18, R-19, R-20, R-21, and C-15 from loading the input attenuator.

The summing network sums the isolation amplifier output with a 180° out-of-phase feedback voltage derived from the converter output stage. The summing network output is amplified by the high gain amplifier V-6, V-7, and V-8, and rectified by diodes CR-13 and CR-14. The half-wave output of CR-13 is filtered and forms the DC output of the converter. The feedback signal is obtained by mixing the half-wave outputs of CR-13 and CR-14. R-2, R-3, and R-138 form adjustable output voltage dividers which permit adjusting the scale factor on each range. Relays K-1 and K-2 operate when selecting a mode of operation (AC measurements or DC measurements); K-3, K-4, K-5, and K-6 operate when selecting the AC voltage range. An internal 28-volt DC supply furnishes power for relays in the converter.

The output of the second filter operating from a half-wave output of CR-14 is compared with a DC reference by chopper K-7 and amplifier Q-3. The output of Q-3 controls the transistor logic circuits. The output of the logic circuit is allowed to control range relays K-3, K-4, K-5, and K-6 when the converter is operating in the automatic mode.

MAINTENANCE AND TROUBLESHOOTING

Trouble-shooting is much easier once the user has become completely familiar with the operation and theory of the instrument as described elsewhere in this manual.

The first general step in correcting any trouble which may develop in the converter is to isolate the malfunctioning section or sections of the circuit. The trouble-shooting tables and tube socket voltage charts at the end of this section will help to localize the area of breakdown. In addition, systematic signal tracing can locate troubles not mentioned in the charts. Additional maintenance help is available through the N.L.S. representative in your area, or directly from the home office of Non-Linear Systems, Inc.

6.1 Test Equipment

The only test equipment required for maintenance of the converter are an oscillator, a vacuum tube voltmeter, and an oscilloscope. Special equipment needed for calibrating the converter is discussed elsewhere in the manual.

6.2 Spare Parts

Most electronic parts used in the converter are standard, commercially available items. A parts list along with a separate spare parts list is included in this manual. If unlisted mechanical parts are needed, contact the home office of Non-Linear Systems, Inc., or a regional sales and service representative.

6.3 Signal Tracing

This section gives information to aid in tracing signals through the converter. Refer to Figure 5-1, Signal Flow Diagram, and the converter's schematic for additional information. Most voltage measurements are made with respect to signal ground.

1. Setup:

Connect a stable AC voltage to the converter's input terminals. Follow the instructions given in Section 3, Installation and Operation. The AC voltage should be slightly under 10 volts to avoid saturation, unless trouble is evidenced on the higher ranges.

2. Input attenuator:

The input attenuator output can be measured at Pin 2 of V-2. However, loading effects present so great a problem that measuring the attenuator's output voltage is generally of little help in trouble shooting.

CAUTION

Do not bend the wires which interconnect the range attenuator components. Attenuator wiring capacitances are very critical and the calibration will be affected by capacitance changes.

3. Isolation amplifier:

The output of the converter's isolation amplifier is measured at Pin 3 of V-2. As an accurate unity gain amplifier, its output voltage should be equal to its input voltage to within 0.2%. If it will help isolate trouble, disconnect the unity gain amplifier and drive the remainder of the converter from an AC signal source. This disconnection may be made by simply unsoldering the lead which connects C-15 to Pin 3 of V-2. Connect the AC input signal to the unsoldered end of C-15.

4. Correction Amplifier:

The correction amplifier is best tested by measuring the error signal at Pin 1 of V-7. The error voltage is normally 40 millivolts, maximum. A large error signal usually indicates absence of feedback voltage. Feedback voltage is developed by the correction amplifier output at Pin 7 of V-6, then through C-26, CR-13, CR-14,

Section 6

MAINTENANCE AND TROUBLESHOOTING

R-20, and R-21. The summing network, which consists of R-18 and R-19, sums the isolation amplifier output and CR-13 and CR-14 output to form an input (error signal) for the correction amplifier.

5. Conversion Diodes:

When a 10-volt RMS sine wave is applied to the converter's input terminals, the voltage from the junction of CR-13 and R-20 to ground and the voltage from the junction of CR-14 and R-21 to ground should be approximately 22 volts, peak. The wave form at each of these junctions should be a half-wave rectified sine wave. Use a low capacitance probe when measuring CR-13 and CR-14 output.

6. Output Filter:

The output filter (R-22, R-23, R-24, C-9, and C-15, and C-16) filters the half-wave output

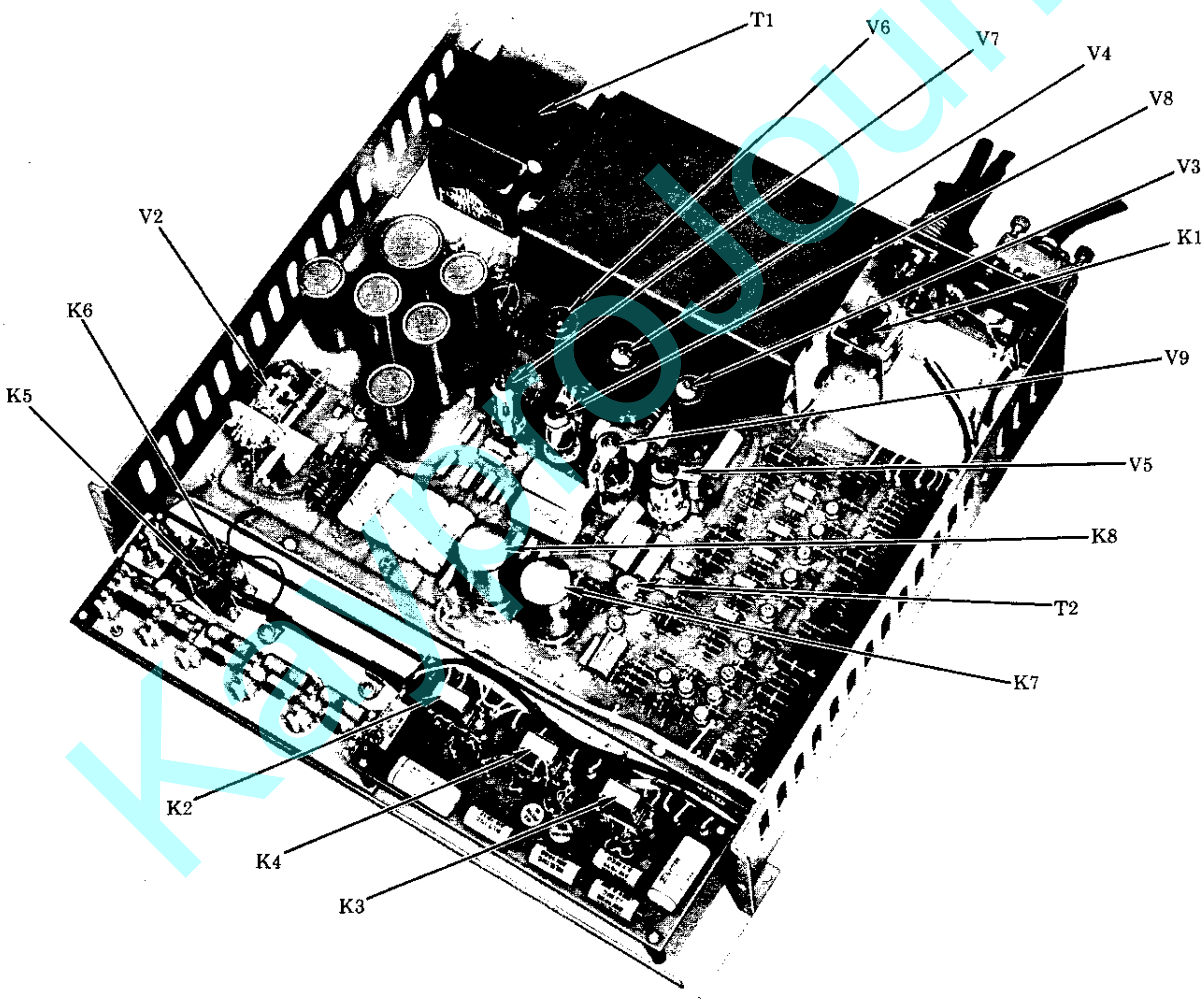


Figure 6-1. Top View of Converter with Front Panel Dropped to Reveal Ranging Components.

of CR-13 to form the pure positive DC output signal. The filter's time constant is relatively long since it must reduce the ripple in the converter output to less than 0.01% even with AC outputs as low as 30 cps, and CR-13 output contains a large AC component. Because of the high series resistance of the output filter, the converter's output voltage will be greatly affected by the load connected to the converter output terminals. The converter's output voltage is correct only when its load is an NLS digital voltmeter with 10 megohms impedance.

7. Auto Range Filter:

This circuit (R-36, R-37, R-38, C-19, C-27, and C-28) filters the output of CR-14 to form a pure negative DC output signal; the time constants are the same as described in the preceding paragraph.

8. Auto Range Reference:

The output of the auto range filter is continuously summed through R-64 and R-68 with reference voltages coming from the reference attenuator (R-5, R-6, R-7, R-8, R-60, and R-61). The attenuator is supplied voltage by the +280-volt regulated power supply.

9. Chopper and Amplifier:

A line synchronous chopper (K-7) driven by Q-2 converts the voltage at the junction of R-64 and R-68 into pulses. The amplitude and polarity of these pulses vary linearly with the difference between the auto range filter voltage and the auto range reference voltage. The pulse amplifier, Q-3 and T-2, amplifies these pulses sufficiently to trigger the UP and DOWN flip-flops.

10. UP and DOWN Flip-Flops:

The flip-flops are triggered by the amplifier and are reset by the chopper driver, Q-2. The state of these flip-flops determines the state of the UP and DOWN pulse lines which control the state of A and B flip-flops.

11. A and B Flip-Flops:

These flip-flops control the 10 V, 100 V, and 1000 V buffers in the automatic mode. Refer to the chart on the main schematic to see the relationships between the UP and DOWN flip-flops, and the A and B flip-flops.

12. Buffers:

The 10 V, 100 V, and 1000 V buffers (Q-4, Q-5, and Q-6) control the range relays (K-3, K-4, K-5, and K-6). They also control the range indicators in the digital voltmeter readout by way of Pins H, K, and J of J-13.

6.4 Tube Socket Voltages

Knowledge of these voltages will be useful for trouble-shooting purposes. Measurements are made with respect to signal ground rather than to chassis ground. Generally, considerable voltage variation can be tolerated. These measurements are made with a line voltage of 115 volts. "FIL" means Filament. In some cases, filaments are operating above ground. Refer to the main foldout schematic at the rear of the manual for filament wiring.

TUBE SOCKET VOLTAGES

Measured with 10 Megohm Input VTVM (HP 410B)

	SOCKET PIN								
TUBE	1	2	3	4	5	6	7	8	9
V-2	150	25	27	Fil	Fil	278	–	150	Fil
V-7	–	1.38	Fil	Fil	278	59	1.38	–	–
V-8	–	1.38	Fil	Fil	137	59	1.38	–	–
V-6	2.6	1	2.6	Fil	Fil	Fil	155	135	2.6
V-3	255	278	Fil	Fil	520	520	255	–	–
V-4	255	278	Fil	Fil	520	520	255	–	–
V-5	258	170	170	Fil	Fil	170	84	85	Fil
V-9	85	–	–	–	85	–	–	–	–

Measured with 20,000 Ohms/Volt Voltmeter

	SOCKET PIN								
TUBE	1	2	3	4	5	6	7	8	9
V-2	150	–	27	Fil	Fil	278	–	150	Fil
V-7	–	1.35	Fil	Fil	275	54	1.35	–	–
V-8	–	1.35	Fil	Fil	135	54	1.35	–	–
V-6	2.5	–	2.5	Fil	Fil	Fil	150	130	2.5
V-3	250	275	Fil	Fil	520	520	250	–	–
V-4	250	275	Fil	Fil	520	520	250	–	–
V-5	258	170	170	Fil	Fil	170	83	84	Fil
V-9	84	–	–	–	84	–	–	–	–

MAINTENANCE AND TROUBLESHOOTING

TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	REMEDY
Converter output voltage high (about 24 volts) for any value of input signal.	Feedback voltage is not reaching correction amplifier.	Correct the open circuit or faulty component between conversion diodes and correction amplifier input.
Converter output voltage very low on 100 or 1000 volt ranges.	Range selector switch is on wrong range.	Select proper range.
	Open circuit or faulty resistor in input attenuator.	Replace faulty component.
	Faulty range relay K-3, K-4, K-5, or K-6.	Replace faulty relay.
Converter output exceeds several millivolts with input leads grounded.	Excessive hum pick-up from heater to cathode leakage in some vacuum tube.	Replace faulty vacuum tube.
Converter output zero, or very low and continuously drifting.	Ground fuse, F-2, blown.	Replace fuse. Do not connect "hot" lead to signal "low" side terminal.
	Relays K-1 or K-2 faulty. Faulty vacuum tube.	Replace faulty relay. Replace tubes.
Converter output voltage zero on any one range.	Range calibration pots R-2, R-3, or R-4 open circuited. Range relays K-3 or K-4 faulty.	Replace faulty components.
Converter output much too high on all ranges at all frequencies.	R-138 open circuited.	Replace faulty component.
Converter output continuously drifts.	Low B+ voltage.	Repair power supply or remove excessive load from power supply.
Tube filaments do not light and blower does not operate.	Power fuse, F-1, blown.	Replace fuse. Examine circuits for excessive loads.
When measuring high frequency signals, converter can be almost, but not completely, brought into tolerance.	CR-13 and CR-14 faulty.	Replace.
	Low frequency calibration controls must be readjusted sufficiently to permit bringing calibration in at high frequencies.	Recalibrate entire converter. See calibration procedure.
Converter output very non-linear as a function of input frequency.	Conversion diodes CR-13 or CR-14 are bad.	Replace faulty diodes.
Converter cannot be brought into tolerance on 100 or 1000 volt ranges when measuring low and high frequency signals.	V-1 drawing excessive grid current.	Replace V-1.
Digital voltmeter connected to converter will not measure DC voltages.	K-1 or K-2 faulty.	Replace K-1 or K-2.
Entire AC input signal appears at converter output.	K-1 faulty.	Replace K-1.
Converter will not automatically change range.	Faulty chopper.	Replace K-7.
Readout shows an extra decimal.	Shorted Buffer (Q-4, Q-5, or Q-6).	Replace transistor.

RECOMMENDED SPARE PARTS LIST

This section lists the spare parts which we recommend be stocked for the maintenance of ten (10) Model 125E Converters for a period of one year. If you desire to know the name of the manufacturer, check this list against the parts list given in Section 8. For up-to-date price information, check with your service representative, as listed in the *Appendix*, or contact the NLS home office.

PART NUMBER	DESCRIPTION	REQ. PER UNIT	SPARES REQ.
E1-155E	Capacitor, 1.5 μf, 100 V, 10%	7	1
W20228	Capacitor, 0.1 μf, 600 V, 20%	1	1
CM-15-E-680-F	Capacitor, 68 $\mu\mu$f, 500 V, ±1%	3	3
CM-15-E-201-F	Capacitor, 200 $\mu\mu$f, 500 V, ±1%	1	1
CM-20E-182-F	Capacitor, 1800 $\mu\mu$f, 500 V, ±1%	1	1
CM-15C-050	Capacitor, 5 $\mu\mu$f, 500 V, ±0.5 $\mu\mu$f	1	1
VC5G	Capacitor, .8-18 $\mu\mu$f, 1000 V	2	2
D2-105	Capacitor, 1 μf, 200 V	1	1
PWE50020	Capacitor, 20 μf, 50 V	2	4
D2473E	Capacitor, .047 μf, 200 V	9	1
40B816	Capacitor, 40 μf, 450 V	1	2
30B306	Capacitor, 50 μf, 350 V	2	4
1B1248	Capacitor, 1000 μf, 10 V	1	2
1B1249	Capacitor, 250/250/250 μf, 50 V	1	2
D4-205D	Capacitor, 2 μf, 400 V	1	1
40B817	Capacitor, 10 μf, 450 V	1	2
MW64M4104	Capacitor, .1 μf, 400 V	2	1
XK2-682	Capacitor, .0068 μf, 200 V	1	1
1N429	Diode, Zener, 6 V	1	2
1N2071	Diode, Silicon, 600 V	24	50
1N916	Diode, Silicon, 75 V	2	4
LD-125	Diode, Germanium	19	50
STC-180	Diode, Silicon, 30 V	4	10
1N458	Diode, Silicon, 150 V	4	10
3/4 M14Z5	Diode, Zener, 14 V	1	2

RECOMMENDED SPARE PARTS LIST
(continued)

PART NUMBER	DESCRIPTION	REQ. PER UNIT	SPARES REQ.
313001	Fuse, 3AG, 1 Amp., Slo-Blo	1	10
312002	Fuse, 3AG, 2 Amp.	1	20
55ST-2-32	Lamp (Neon)	2	20
0369	Muffin Fan, Venturi	1	2
0250L-1	Potentiometer, 2KΩ	2	10
0250L-1	Potentiometer, 20KΩ	2	10
0250L-1	Potentiometer, 125KΩ	3	10
BR7Y1KC7	Relay, DPDT	3	10
RP7641-G8	Relay, DPDT, Type F	3	10
HGSS1001	Relay, Mercury	2	10
AW1635	Resistor, 2.2 Meg. ±0.1%, ⅔ W	4	4
PW1719	Resistor, 8 KΩ, ±0.1%, ½ W	1	1
PW1719	Resistor, 76KΩ, ±0.1%, ½ W	1	1
18035-109	Transformer, (Power)	1	2
9000-113	Transformer, (Pulse)	1	2
2N1310	Transistor, NPN	1	2
2N527	Transistor, PNP	4	10
2N651	Transistor, PNP	8	20
2N1305	Transistor, PNP	5	10
6201	Tube, Dual Triode	1	10
6AQ5A	Tube, Pentode	2	20
12AX7	Tube, Dual Triode	1	10
12BY7A	Tube, Pentode	1	10
6136	Tube, Pentode	2	20
5651	Tube, Regulator	1	20

PARTS LIST

This Section lists electrical parts used in the 125E. Hardware items such as brackets, grommets, nuts, and bolts have been deleted. If any unlisted item is required, contact the factory or your regional sales and service representative. Federal supply code numbers, as used in the last column of the listing, are drawn from the *Federal Supply Code for Manufacturers*, Cataloging Handbook H4-1. This publication may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C.

CIRCUIT REFERENCE	PART NUMBER	DESCRIPTION	QTY.	MFR.	FEDERAL SUPPLY CODE
	15004-076	Cable Assembly, AC-DC Converter to Series 20 or 30	1	NLS	03626
	15004-128	Cable Assembly, Output, Series 20	1	NLS	03626
	15004-129	Cable Assembly, Output, Series 30	1	NLS	03626
	18053-020	Basic Converter Assembly	1	NLS	03626
	0369	Muffin Fan, Venturi	1	Rotron	82877
	BR7Y1KC7	Relay, 1.8 to 18.0 V	1	Babcock	82050
	313001	Fuse, 3AG, 1 Amp. Slo-blo	1	Littelfuse	75915
	312002	Fuse, 3AG, 2 Amp.	1	Littelfuse	75915
	18053-109	Transformer, Power	1	NLS-Triad	81095
	18053-015	Range Board Assembly, Output	1	NLS	03626
C-9, C-28	EI-155E	Capacitor (Mylar Ext. Foil) 1.5 mfd, 100 V, 10%	2	Electron	99515
C-10	W20228	Capacitor (Mylar Ext. Foil) 0.1 mfd, 600 V. 20%	1	Westcap	96733
R-60, R-64, R-68, R-138	AW1635	Resistor, 2.2 Meg., ⅔ W, 0.1%	4	NLS	03626
R-63	PW1719	Resistor, 8KΩ, ½ W, 0.1%	1	NLS	03626
R-61	PW1719	Resistor, 76KΩ, ½ W, 0.1%	1	NLS	03626
K-2, K-3, K-4	RP7641-G8	Relay, DPDT, Type F, 675 ohms, 28 VDC, 3/16" Leads	3	C. P. Clare	71482
R-5, R-6	0250L-1	Potentiometer, 2KΩ	2	Con-Elco	06184
R-7, R-8	0250L-1	Potentiometer, 20KΩ	2	Con-Elco	06184
R-2, R-3, R-4	0250L-1	Potentiometer, 125KΩ	3	Con-Elco	06184
	18051-018	Range Board Assembly, Input	1	NLS	03626
C-3, C-4, C-5	CM-15-E-680-F	Capacitor, 68μμf, 500 V, 1% (Silver Mica)	3	Arco	84171
C-6	CM-15-E-201-F	Capacitor, 200 μμf, 500 V, 1% (Silver Mica)	1	Arco	84171
C-7	CM-20E-182-F	Capacitor, 1800 μμf, 500 V, 1% (Silver Mica)	1	Arco	84171

PARTS LIST
(continued)

CIRCUIT REFERENCE	PART NUMBER	DESCRIPTION	QTY.	MFR.	FEDERAL SUPPLY CODE
R-9, R-10, R-137	MEFT-5	Resistor, 3 Meg., 1 W, 1% (metalized film)	3	IRC	75042
R-45	MEBT-5	Resistor, 900 KΩ, ¼ W, 1% (metalized film)	1	IRC	75042
R-62	MEBT-5	Resistor, 100 KΩ, ¼ W, 1% (metalized film)	1	IRC	75042
K-5, K-6	BR7Y1KC7	Relay, 1.8 to 18.0 V	2	Babcock	82050
R-11	GB1041	Resistor, 100 KΩ, 1 W, 10% (Comp)	1	AB	04061
C-8	CM-15C-050	Capacitor, 5μμf, 500 V, ±.5% (Silver Mica)	1	Arco	84171
C-1, C-2	VC5G	Capacitor, .8 to 18 μμf, 1000 V, (Rotary Trimmed)	2	JFD	73899
V-2	6201	Vacuum Tube, Dual Triode, 9 Pin	1	RCA	49671
V-3, V-4	6AQ5A	Vacuum Tube, Pentode, 7 Pin	2	RCA	49671
V-5	12AX7	Vacuum Tube, Dual Triode, 9 Pin	1	RCA	49671
V-6	12BY7A	Vacuum Tube, Pentode, 9 Pin	1	CBS	97966
V-7, V-8	6136	Vacuum Tube, Pentode, 7 Pin	2	RCA	49671
V-9	5651	Vacuum Tube, Gas Regulator	1	RCA	49671
T-2	9000-113	Transformer, Pulse	1	NLS	03626
V-1, V-10	55ST-2-32	Lamp, Neon, 55 V	2	Signalite	74276
K-7, K-8	HGSS1001	Relay, Mercury	2	C. P. Clare	71482
R-53	GB1041	Resistor, 100 KΩ, 1 Watt, 10%	1	AB	04061
R-12, R-117	GB6831	Resistor, 68 KΩ, 1 Watt, 10%	2	AB	04061
R-13	EB1235	Resistor, 12 KΩ, ½ Watt, 5%	1	AB	04061
R-14	EB1051	Resistor, 10 Meg., ½ Watt, 5%	1	AB	04061
R-17	EB2025	Resistor, 2 KΩ, ½ Watt, 5%	1	AB	04061
R-18, R-19, R-22, R-23, R-37, R-38	MEBT-5	Resistor, 100 KΩ, ¼ Watt, 1%	6	IRC	75042
R-20, R-21	MEBT-5	Resistor, 500 KΩ, ¼ Watt, 1%	2	IRC	75042
R-24, R-36	KC60	Resistor, 120 KΩ, ¼ Watt, 1%	2	KEY	05921
R-25, R-39	KC60	Resistor, 10 KΩ, ¼ Watt, 1%	2	KEY	05921
R-26	Brown Devil	Resistor, 500 Ω, 10 Watt, 5%	1	Ohmite	44655
R-27, R-28	EB2741	Resistor, 270 KΩ, ½ Watt, 10%	2	AB	04061
R-29	EB1001	Resistor, 10 Ω, ½ Watt, 5%	1	AB	04061
R-30, R-31, R-32	Brown Devil	Resistor, 10 Ω, 5 Watts, 5%	3	Ohmite	44655

PARTS LIST
(continued)

CIRCUIT REFERENCE	PART NUMBER	DESCRIPTION	QTY.	MFR.	FEDERAL SUPPLY CODE
R-33	EB6245	Resistor, 620 KΩ, ½ Watt, 5%	1	AB	04061
R-34	EB2241	Resistor, 220 KΩ, ½ Watt, 10%	1	AB	04061
R-35	EB1221	Resistor, 1.2 KΩ, ½ Watt, 10%	1	AB	04061
R-40	EB1051	Resistor, 1 Meg., ½ Watt, 10%	1	AB	04061
R-41, R-49, R-15, R-112	EB1021	Resistor, 1 KΩ, ½ Watt, 10%	4	AB	04061
R-42	Brown Devil	Resistor, 6 KΩ, 10 Watts, 5%	1	Ohmite	44655
R-43	HB2735	Resistor, 27 KΩ, 2 Watts, 5%	1	AB	04061
R-44, R-46, R-48, R-57	EB1011	Resistor, 100 Ω, ½ Watt, 10%	4	AB	04061
R-47	EB2251	Resistor, 2.2 Meg., ½ Watt, 5%	1	AB	04061
R-50	KC75	Resistor, 56 KΩ, 1 Watt, 1%	1	KEY	05921
R-51, R-54	KC75	Resistor, 43 KΩ, 1 Watt, 1%	2	KEY	05921
R-52	EB4745	Resistor, 470 KΩ, ½ Watt, 5%	1	AB	04061
R-96, R-98, R-127, R-128	GB2721	Resistor, 2.7 KΩ, 1 Watt, 10%	4	AB	04061
R-58, R-70, R-89, R-92	HB1521	Resistor, 1.5 KΩ, 2 Watts, 10%	4	AB	04061
R-94, R-72, R-73, R-91	EB1821	Resistor, 1.8 KΩ, ½ Watt, 10%	4	AB	04061
R-16, R-65	EB2231	Resistor, 22 KΩ, ½ Watt, 10%	2	AB	04061
R-67, R-84, R-130, R-99, R-100, R-107, R-131	EB2721	Resistor, 2.7 KΩ, ½ Watt, 10%	7	AB	04061
R-69	EB2211	Resistor, 470 Ω, ½ Watt, 10%	1	AB	04061
R-71, R-90, R-93	EB8211	Resistor, 820 Ω, ½ Watt, 10%	3	AB	04061
R-75, R-76	EB4731	Resistor, 47 KΩ, ½ Watt, 10%	2	AB	04061
R-77, R-78, R-79, R-82, R-85, R-86, R-105, R-108, R-109, R-74	EB3921	Resistor, 3.9 KΩ, ½ Watt, 10%	10	AB	04061

PARTS LIST
(continued)

CIRCUIT REFERENCE	PART NUMBER	DESCRIPTION	QTY.	MFR.	FEDERAL SUPPLY CODE
R-80, R-81, R-83, R-88, R-95, R-97, R-103, R-104, R-66, R-106, R-110, R-111, R-113, R-114, R-115, R-116, R-118, R-119, R-120, R-121, R-123, R-124, R-126, R-129, R-133, R-134, R-136, R-125, R-87	EB4721	Resistor, 4.7 KΩ, ½ Watt, 10%	29	AB	04061
R-101, R-102, R-132, R-135	EB1041	Resistor, 100 KΩ, ½ Watt, 10%	4	AB	04061
R-139	Brown Devil	Resistor, 400 Ω, 5 Watts, 5%	1	Ohmite	44655
C-33	D2-105	Capacitor, 1 mfd, 200 V	1	Electron	99515
C-13, C-15, C-16, C-19, C-27	E1-155E	Capacitor, 1.5 mfd, 100 V, 10% (Mylar Ext. Foil)	5	Electron	99515
C-11, C-14	PWE50020	Capacitor, 20 mfd, 50 V (Ceramic Cased)	2	Aerovox	97262
C-12, C-34, C-35, C-36, C-37, C-38, C-39, C-22, C-23	D2-473E	Capacitor, .047 mfd, 200 V, 10% (Mylar Ext. Foil)	9	Electron	99515
C-31	40B816	Capacitor, 40 mfd, 450 V Royalitic, P.C.)	1	Ind.Cond.Corp.	74861
C-17, C-18	30B306	Capacitor, 50 mfd, 350 V (Royalitic, P.C.)	2	Ind.Cond.Corp.	74861
C-20	1B1248	Capacitor, 1000 mfd, 10 V (Royalitic, P.C.)	1	Ind.Cond.Corp.	74861
C-21	1B1249	Capacitor, 250/250/250 mfd, 50 V (Royalitic, P.C.)	1	Ind.Cond.Corp.	74861
C-24	D4-205D	Capacitor, 2 mfd, 400 V	1	Electron	99515
C-25	40B817	Capacitor, 10 mfd, 450 V (Royalitic, P.C.)	1	Ind.Cond.Corp.	74861
C-26	E4-224E	Capacitor, .22 mfd, 400 V, 10%	1	Electron	99515
C-29, C-30	MW64M4104	Capacitor, .1 mfd, 400 V	2	Westcap	96733
C-32	XK2-682	Capacitor, .0068 mfd, 200 V	1	Electron	99515
CR-1	1N429	Diode, Zener, Silicon 6 V	1	Hoffman	28959

PARTS LIST
(continued)

REFERENCE CIRCUIT	PART NUMBER	DESCRIPTION	QTY.	MFR.	FEDERAL SUPPLY CODE
CR-2, CR-3, CR-4, CR-5, CR-6, CR-7, CR-8, CR-9, CR-10, CR-11, CR-12, CR-23, CR-24, CR-25, CR-32, CR-33, CR-34, CR-38, CR-39, CR-40, CR-46, CR-47, CR-15, CR-16	1N2071	Diode, Silicon, 600 PIV.	24	Texas Instruments	01295
CR-13, CR-14	1N916	Diode, Silicon, 75 V	2	Texas Instruments	01295
CR-21, CR-22, CR-26, CR-27, CR-28, CR-29, CR-30, CR-31, CR-35, CR-36, CR-37, CR-41, CR-43, CR-44, CR-45, CR-48, CR-49, CR-53, CR-54	LD-125	Diode, Gemanium	19	CBS	97966
CR-42, CR-52, CR-50, CR-51	STC-180	Diode, Silicon, 30 V	4	Silicon Tr. Corp.	07256
CR-17, CR-18, CR-19, CR-20	1N458 (HD6007)	Diode, Silicon, 150 V, PIV.	4	Hughes	73293
CR-55	¾ M14Z5	Diode, Zener, Silicon, 14 V	1	Motorola	04713
Q-1	2N1310	Transistor, Germanium, NPN	1	GT	04662
Q-2, Q-4, Q-5, Q-6	2N527	Transistor, Germanium, PNP	4	GE	03508
Q-7, Q-8, Q-9, Q-10, Q-11, Q-12, Q-13, Q-19	2N651	Transistor, Germanium, PNP	8	Motorola	04713
Q-15, Q-16, Q-17, Q-18, Q-3	2N1305	Transistor, Germanium, PNP	5	Texas Instruments	01295

APPENDIX

WARRANTY

Non-Linear Systems, Inc. warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this warranty is limited to servicing or adjusting any instrument returned, prepaid, to the factory for that purpose.

This warranty does not cover tubes, transistors, choppers, fuses, or batteries. However, non-oil-bathed stepping switches are guaranteed for 90 days provided they have been lubricated in accordance with manufacturer's instructions.

Instruments returned to the factory are accepted only when prior authorization has been given by an authorized representative of Non-Linear Systems, Inc.

Non-Linear Systems, Inc. reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This warranty is expressly in lieu of all other obligations or liabilities on the part of Non-Linear Systems, Inc. and Non-Linear Systems, Inc. neither assumes nor authorizes any other person to assume for them any other liability in connection with the sales of Non-Linear Systems, Inc. instruments.

SHIPPING INSTRUCTIONS

Depending upon location, the choice of carrier will vary. Never ship an instrument to us without having received shipping instructions. If requested, an estimate of charges can be made before work begins.

Be certain to pack the instrument carefully; while an outer and inner box, separated by two or three inches of excelsior is desirable, the instrument can be placed into a single container provided it is so packed that it will not shift about. As with the double box method, use two or three inches of shock-absorbent packing materials. The instrument itself should be first wrapped in heavy paper so as to keep excelsior or other particles from entering the instrument's louvres.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it does not operate or is damaged, a claim should be made with the carrier. The claim agent should receive a full report of damage, and this report sent to Non-Linear Systems, Inc. After receiving such a report we will advise you of the disposition of the instrument and arrange for its repair or replacement. Be certain to include model and serial number when corresponding.

NON-LINEAR SYSTEMS, INC.
Del Mar, California

TECHNICAL INFORMATION BULLETIN

CALIBRATING AC DIGITAL VOLTMETERS

INTRODUCTION

The method that is generally accepted for calibrating the most precise AC voltmeters is a technique developed by F. L. Hermach at the National Bureau of Standards (see Reference). It is called the transfer thermocouple method, because the reading of accurate DC voltage measuring devices standardized against cadmium-mercury standard cells, is transferred to AC measurements. In this method of measuring AC voltage, the unknown AC is supplied to the heater of an instrument thermocouple, and the generated thermoelectric potential is measured by a millivoltmeter. The thermocouple heater is then connected to a DC power supply, and the voltage varied until the millivoltmeter reads the same thermoelectric potential as it did when the unknown AC was applied to the heater element. Absolute accuracy of the millivoltmeter is not important, but very fine resolution and repeatability are. The DC power supply voltage is then accurately measured and its value is, by definition, the true rms value of the AC voltage.

NLS PROCEDURE

All NLS AC-DC converters are calibrated against a Hermach-Engelhard Transfer Volt Ammeter. The NLS Hermach-Engelhard instrument has been certified by the National Bureau of Standards to plus or minus 0.05%. A variable turns ratio transformer accurate to plus or minus .001% is used to cover different ranges. Step by step instructions for calibration for specific models manufactured by NLS are included in each instrument's handbook.

EQUIPMENT USED

The calibration setup used at NLS is shown in Figure 1. The Hermach-Engelhard Transfer Volt Ammeter, which has ranges from 15 to 300 volts, is certified by NBS from 20 to 20,000 cps. The AC voltage source used for calibration must be stable enough to permit transferring the DC reading to AC without significant voltage output change. Also, harmonic distortion must be low, for the AC digital voltmeter reads in proportion to the waveform average value, but is normally calibrated in terms of the rms value of a pure sine wave. The power supply must cover the voltage and frequency range required with enough power to drive the thermocouple. NLS uses a special oscillator with a 0.05% maximum harmonic distortion, 0.01% short term drift, 6 watts maximum power output. 0.05% harmonic distortion produces much less than 0.1% error. An accurate attenuator is connected at AA in Figure 1 to extend the range. The Gertsch variable turns ratio transformer is used for this. purpose and for checking that the AC digital voltmeter's 10, 100 and 1,000 volt scale multipliers are adjusted correctly.

SUBSTITUTED EQUIPMENT

If the customer desires to calibrate AC digital voltmeters but does not have Hermach-Englehard equipment, a Weston type V-I (insulated bead) instrument thermocouple and a millivoltmeter with high resolution and repeatability can be used. In the absence of thermocouple equipment, a precision laboratory AC voltmeter of the dynamometer type can be used for less accurate tests and over a restricted frequency range.

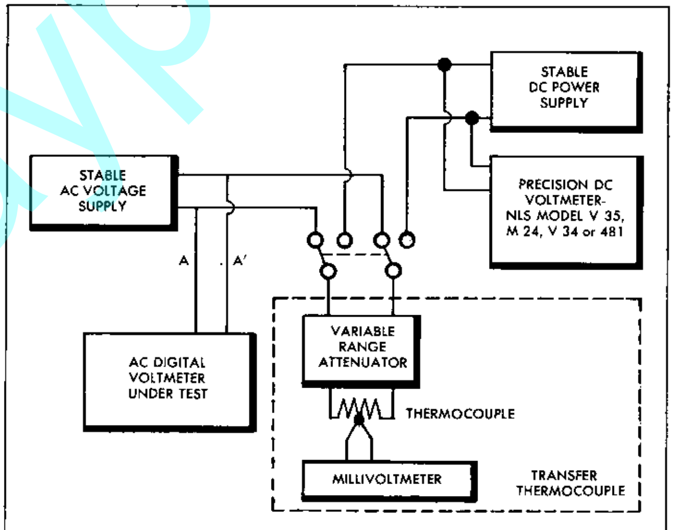
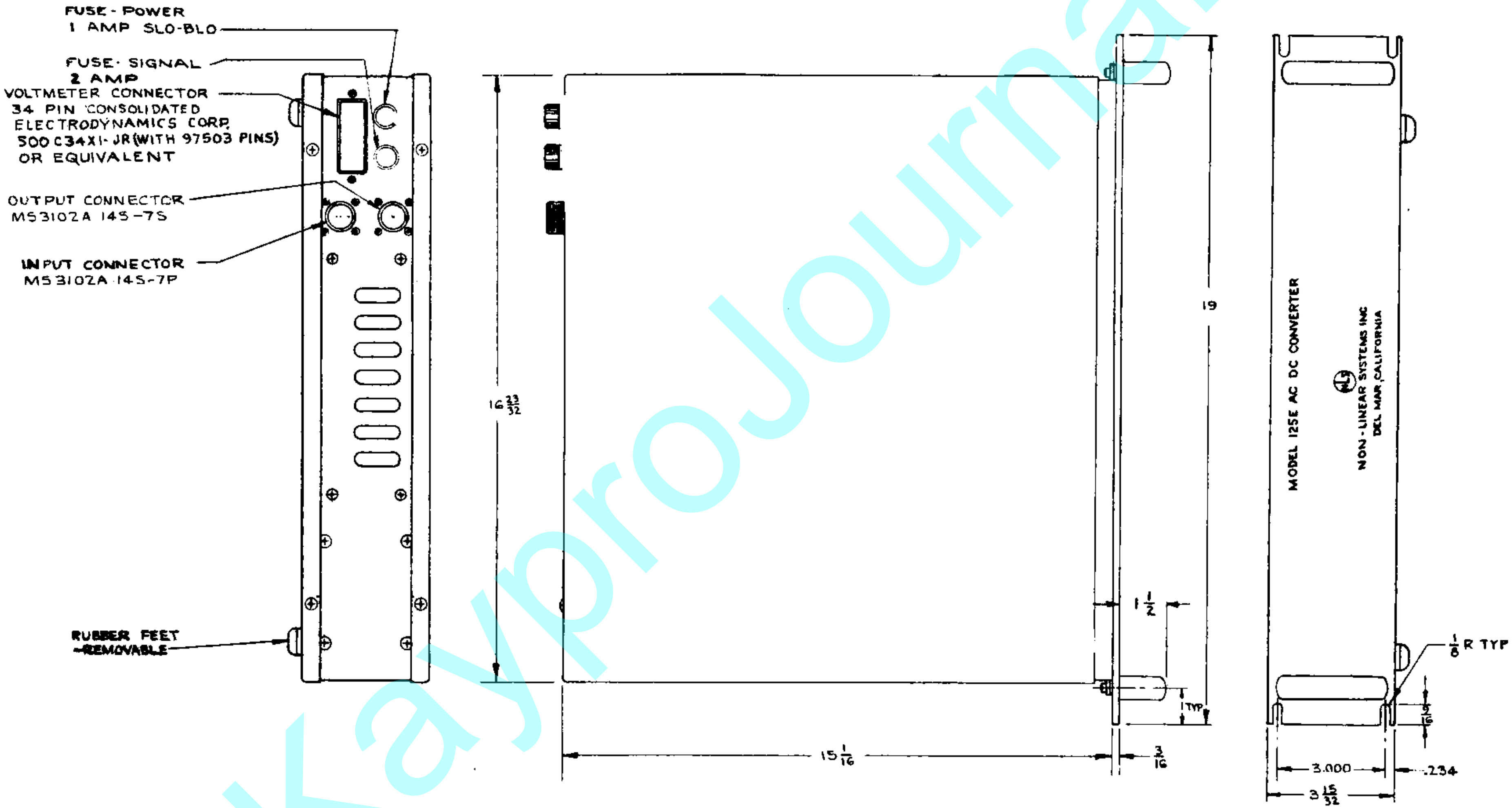


FIG. 1 - CALIBRATING AC DIGITAL VOLTMETERS BY THE TRANSFER THERMOCOUPLE METHOD

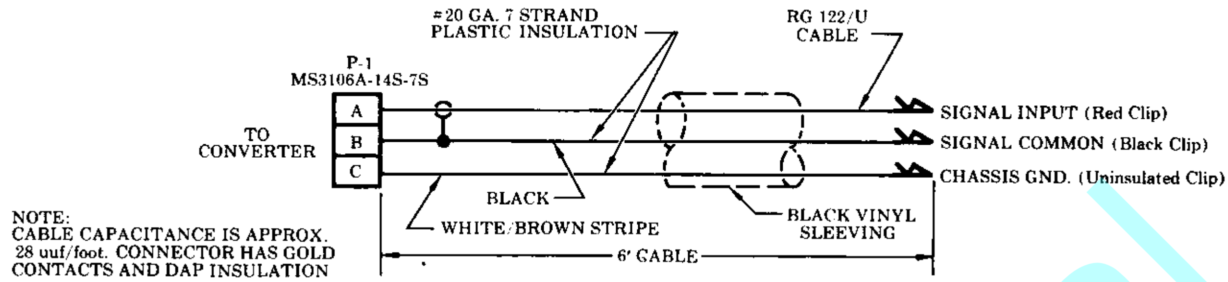
FIGURE 1

Calibrating AC Digital Voltmeters By The Transfer Thermocouple Method

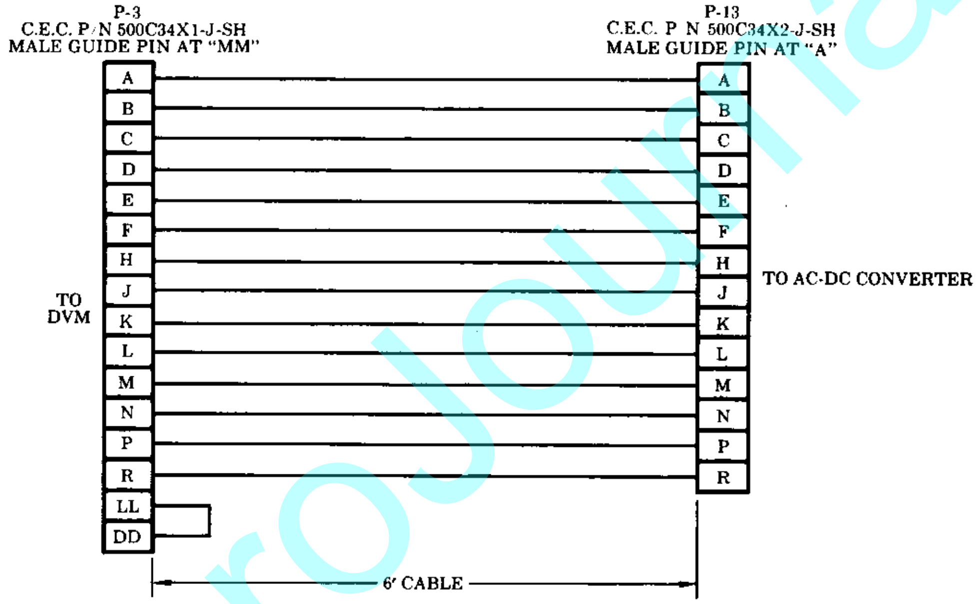
References: Hermach & Williams - Multirange, A.F. Thermocouple Insts. Research Paper 2494 - U.S. Gov't Printing Office (bound in Vol. 52, Journal of Research, N.B.S.) - Hermach - Thermal Converters as Transfer Standards, Research Paper 2296 - U.S. Gov't Printing Office (bound in Vol. 48, Journal of Research, N.B.S.)



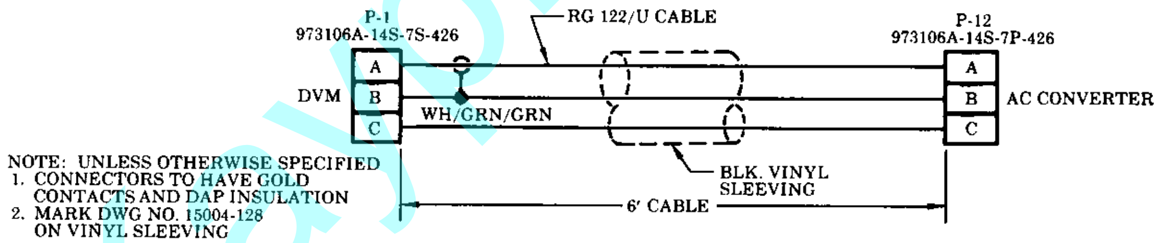
FUSE - POWER
1 AMP SLO-BLO
FUSE - SIGNAL
2 AMP
VOLTMETER CONNECTOR
34 PIN CONSOLIDATED
ELECTRODYNAMICS CORP.
500 C34X1-JR (WITH 97503 PINS)
OR EQUIVALENT
OUTPUT CONNECTOR
MS3102A 14S-7S
INPUT CONNECTOR
MS3102A 14S-7P
RUBBER FEET
-REMOVABLE
16 23/32
19
1 1/2
1 TYP
15 1/16
3/16
MODEL 125E AC DC CONVERTER
NON-LINEAR SYSTEMS INC
DEL MAR, CALIFORNIA
1/8 R TYP
5/16
3.000
.234
3 15/32



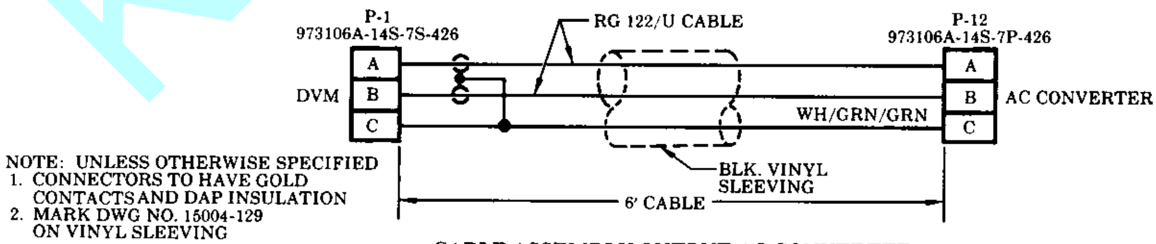
CABLE ASSEMBLY #15004-075



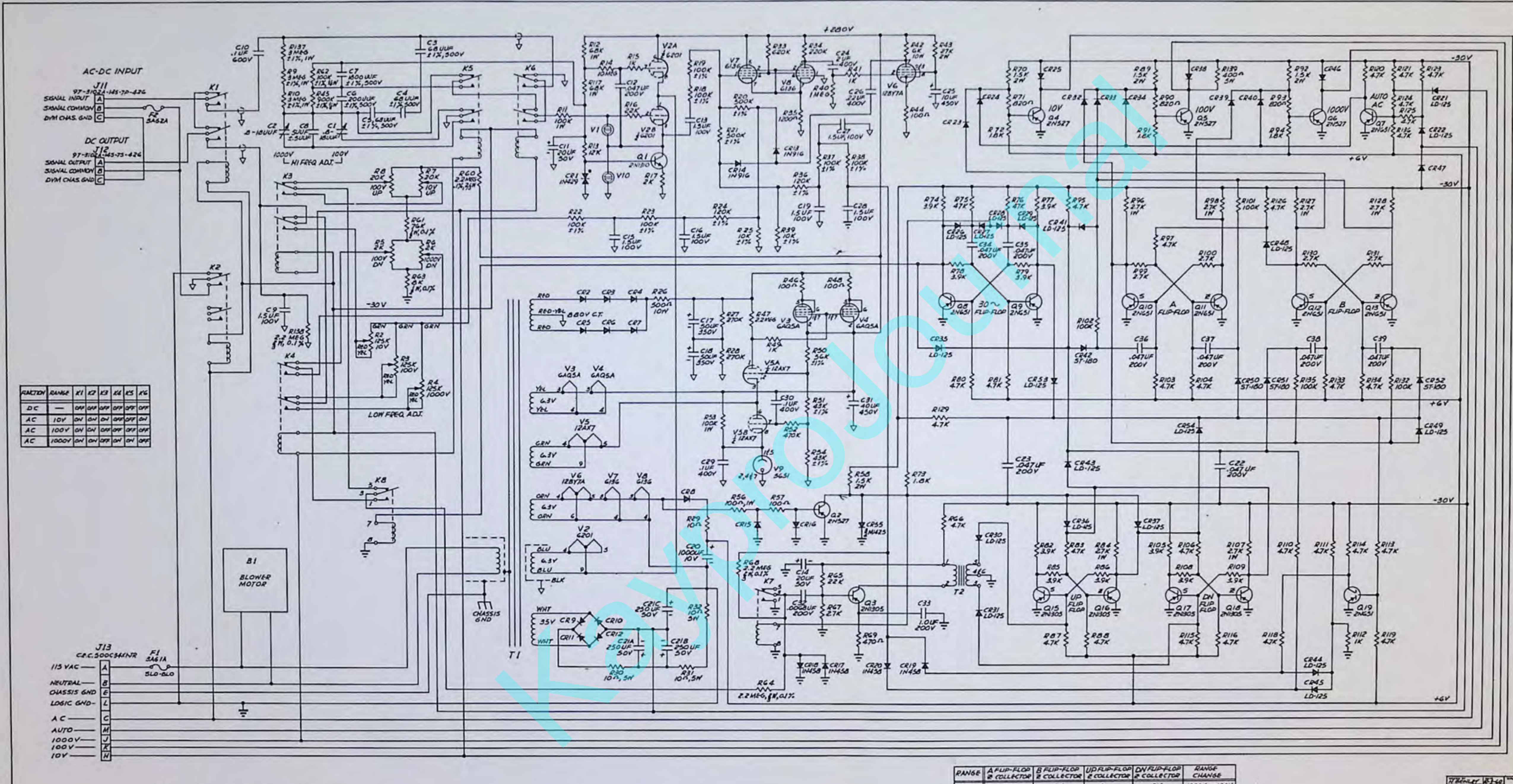
BELDEN #8748



CABLE ASSEMBLY OUTPUT, AC CONVERTER
MODEL 125E TO SERIES 20 OR 40



CABLE ASSEMBLY OUTPUT AC CONVERTER
MODEL 125E TO SERIES 30



FUNCTION	RANGE	K1	K2	K3	K4	K5	K6
DC	—	OFF	OFF	OFF	OFF	OFF	OFF
AC	10V	ON	ON	ON	OFF	OFF	ON
AC	100V	ON	ON	OFF	OFF	OFF	OFF
AC	1000V	ON	ON	OFF	ON	ON	OFF

RANGE	A FLIP-FLOP 2 COLLECTOR	B FLIP-FLOP 2 COLLECTOR	UP FLIP-FLOP 2 COLLECTOR	DN FLIP-FLOP 2 COLLECTOR	RANGE CHANGE
1000V	-15V	-15V	0	-15V	1000V → 100V
100V	0	-15V	-15V	0	100V → 1000V
100V	0	-15V	0	-15V	100V → 10V
10V	0	0	-15V	0	10V → 100V

3. ALL RELAYS ARE IN NORMALLY CLOSED (DE-ENERGIZED) POSITION.
2. ALL RESISTORS ARE ½ WATT.
1. ALL DIODES ARE TYPE 1N2071.
NOTES: UNLESS OTHERWISE SPECIFIED

SCHEMATIC
AC-DC CONVERTER
MODEL 125 E STD

NON-LINEAR SYSTEMS INC.

18053