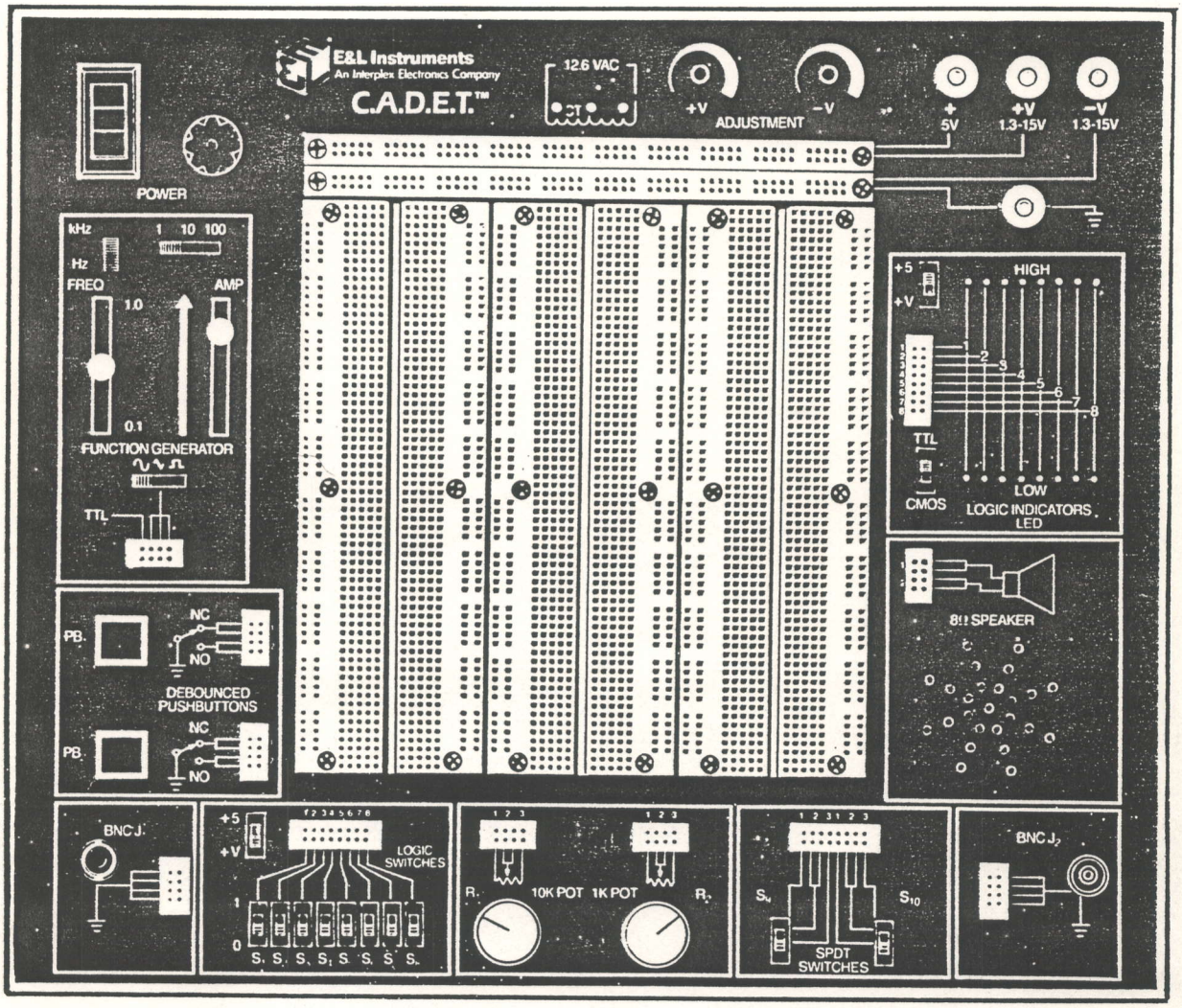
# C.A.D.E.T.

# COMPLETE ANALOG /DIGITAL ELECTRONICS TRAINER

## Instruction Manual

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## LIST OF ILLUSTRATIONS

## SPECIFICATIONS

### POWER

3-wire AC line input (117 V, 60 Hz typical) with power on indicator.
Fixed DC output: +5 V @ 1.0 A, ripple <5 mV.
+V Variable DC output: +1.3 V @150 mA to +15 V @ 500 mA, ripple <5 mV.
-V Variable DC output: -1.3 V @150 mA to -15 V @ 500 mA, ripple <5 mV.
Fixed AC output: 12.6 V AC center tapped @100 mA.

### FUNCTION GENERATOR

Frequency range: 0.1 Hz to 100 kHz in six ranges.
Output voltage: 0 to ± 10 V (20 Vp-p), short circuit protected.
Output impedance: 600 ohms (except TTL).
Output waveforms: sine, square, triangle, TTL.
Sine wave: distortion <3% (10 Hz to 100 kHz).
TTL pulse: rise and fall time <25 nS.
drive 10 TTL loads.
Square wave: rise and fall time <0.5 μS

### LOGIC INDICATORS

LED's: 16 LEDs; 8 red to indicate logic high, 8 green to indicate a logic low.

Logic High Threshold: 2.2 volts (nominal) in TTL/+5 V mode, 70% (nominal) of selected operating voltage in CMOS mode.

Logic Low Threshold: 0.8 volts (nominal) in TTL/+5 V mode, 30% (nominal) of selected operating voltage in CMOS mode.

Input Impedance: 100 K ohm.

### DEBOUNCED PUSHBUTTONS (PULSERS)

Two pushbutton-operated, open-collector output pulsers, each with one normally-open, one normally-closed output. Each output can sink up to 250 mA.

### POTENTIOMETERS

One 1 K ohm, one 10 K ohm, all leads available and uncommitted.

### BNC CONNECTORS

Two BNC connectors, shell connected to ground, pin connection available and uncommitted.

### SWITCHES

Eight logic switches select logic low or logic high. Low level is ground. High level is switchable between the fixed +5 volt supply and the 1.3 - 15 volt +V supply.
Two SPDT slide switches, all leads available and uncommitted.

**SPEAKER**

0.25 W, 8 ohms

**BREADBOARDING AREA**

Three SK-10 sockets with 840 tie-points each for a total of 2520 uncommitted tie-points.
Two QT-59B Bus strips internally connected to power and ground.
Fifty tie-points each for +5 V, +V, -V and ground.
Enclosure: High impact molded case.

**WEIGHT**

5 lbs. 14 oz. (2.66 kg)

**OVERALL DIMENSIONS**

6 1/2 x 16 x 11 1/2 inches H x W x D
(16.5 x 41 x 29 cm)

# WARNING

## FEDERAL REGULATION (PART 15 OF FCC RULES) PROHIBITS THE USE OF COMPUTING EQUIPMENT WHICH CREATES RADIO OR TV INTERFERENCE

Interplex Electronics specifically warns the user of this instrument that it is intended for use in a classroom or laboratory environment for the purpose of learning and experimentation. When building experimental circuits, it may emit interference that will affect radio and television reception and the user may be required to stop operation until the interference problem is corrected. Home use of this equipment is discouraged since the likelihood of interference is increased by the close proximity of neighbors.

### CORRECTIVE MEASURES:

Interference can be reduced by the following practices.

1) Install a commercially built RFI power filter in the power line at the point where the cord enters the unit.

2) Avoid long wires. They act as antennas.

3) If long wires must be used, use shielded cables or twisted pairs which are properly grounded and terminated.

**CAUTION:**

**FOR CONTINUED PROTECTION AGAINST FIRE, REPLACE ONLY WITH FUSE OF SPECIFIED VOLTAGE AND CURRENT RATINGS.**

**115VAC— 1/2Amp., 250V Slow Blow Fuse**
**230VAC— 1/4Amp., 250V Slow Blow Fuse**

## INTRODUCTION

The CADET, Complete Analog/Digital Electronic Trainer*, is a versatile, time-saving tool for circuit designers, engineering technicians, students, and hobbyists. A large breadboard area and a wide choice of built-in circuit accessories allow rapid and accurate construction of virtually any type of analog or digital circuit.

Circuit power is provided by three power supplies, two variable and one fixed. The circuit breadboard area includes over 2500 contact points. A multiple-waveform function generator supplies sine, triangle, and square wave output for analog circuits. A built-in speaker may be used for analog output.

Outputs also include a TTL-level square wave generator, two debounced pushbutton switches, and a bank of eight logic switches. Eight logic indicators may be used to display high and low logic levels.

Two built-in potentiometers and two SPDT switches are provided for circuit control and adjustment. Connections to external test equipment or signal sources may be made using the two BNC connectors on the CADET.

The CADET eliminates the clutter and confusion that often results when constructing sophisticated circuits. Alligator clips and similar connectors are seldom needed. Sockets on the CADET allow insertion of components or wires of up to 20 gauge.

A detailed panel layout and description of the CADET is given in the section "Description of Individual Features".

## DESCRIPTION OF INDIVIDUAL FEATURES

In order to properly use the full capabilities of the CADET, it is highly recommended that the user become familiar with the panel layout and the features of the components. (See Figure 1)

### POWER SUPPLIES

By combining the three DC power supplies on the CADET, the user may work with virtually any type of integrated circuit or discrete component. The fixed 5 volt supply has become an industry standard for powering digital IC's. IC's which require +5 V, +12 V, and -5 V are easily accommodated by the CADET. The variable supply output voltages may be changed by using the screwdriver adjustment on the front panel. The positive and negative outputs are continuously variable from +1.3 to +15 volts and -1.3 to -15 volts respectively. Both variable supply outputs are referenced to circuit common. This creates a split supply which is often used with differential and operational amplifiers (op amps). The adjustments are recessed to prevent inadvertent voltage changes which could be destructive to a circuit.

In addition to the DC power supplies, the CADET also

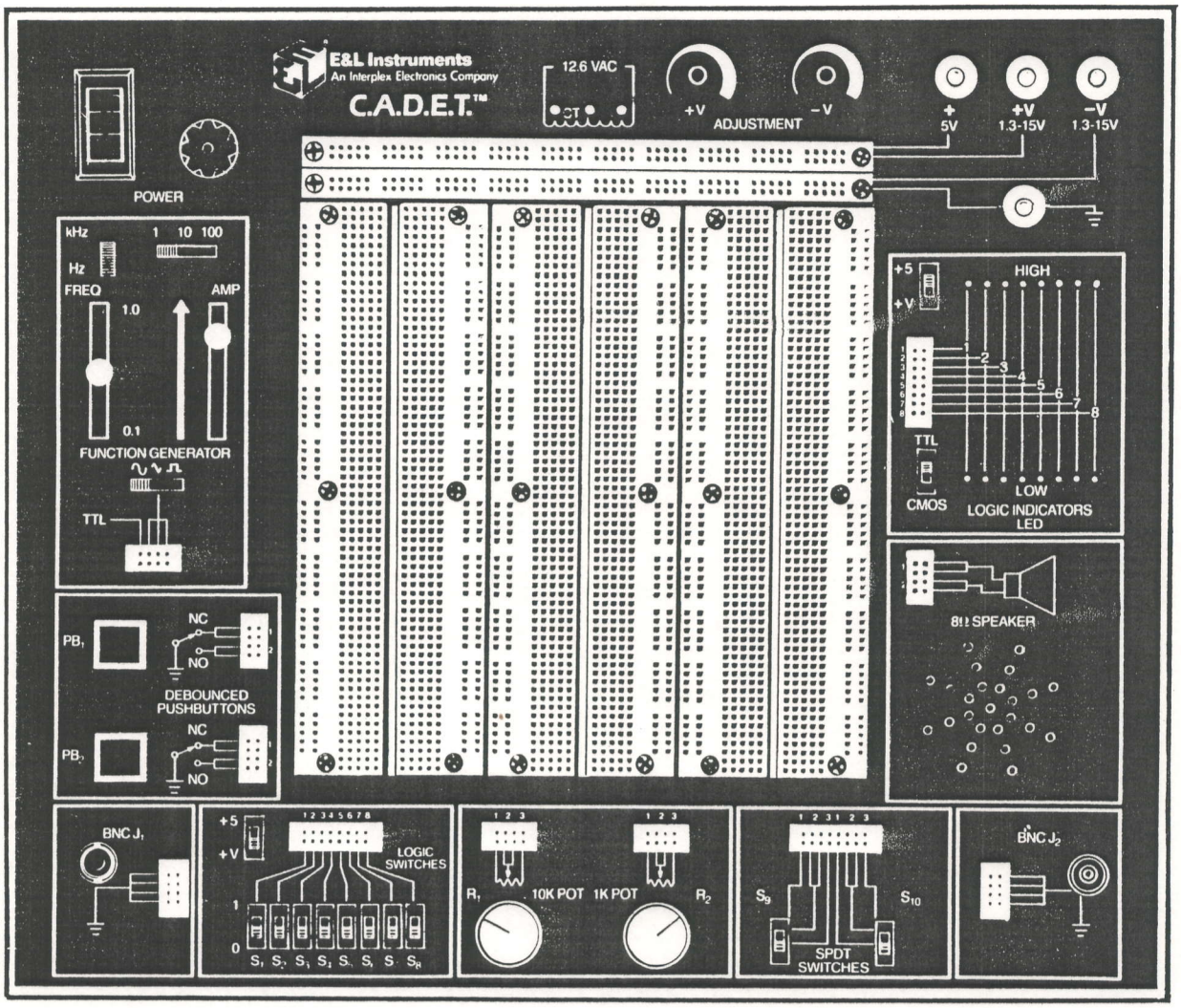



FIGURE 1. CADET panel layout.

provides a 12.6 volt center-tapped AC supply. This allows the user to construct any of a variety of half-wave and full-wave rectified power supplies on the breadboarding area and apply power by simply connecting jumper wires to the three AC supply output pins.

## FUNCTION GENERATOR

The multi-waveform function generator provides continuously variable frequency signals from 0.1 Hz (for extra-low frequency work) to radio frequency signals of 100 KHz. The frequency is selected in six decade ranges, with a vernier to adjust frequency within each range. The sine wave output is factory adjusted for minimum distortion. The triangle waveform is adjusted for best linearity. The standard square wave and TTL level outputs are both set at a 50% duty cycle. The TTL output, capable of driving up to 10 TTL loads,is continuously available and in phase with

the square wave output. The low output impedance of the sine, square, and triangle waveforms (600 ohms) assures maximum coupling of the output signal to the device being driven. All outputs can withstand a continuous short circuit to ground.

## LOGIC INDICATORS

Sixteen LEDs, eight red and eight green, make up eight Logic Indicators that will display logic high and low conditions based on either TTL or CMOS thresholds, selectable by the user. Operating voltage can also be selected by the user to be either at +5 volts, or at the setting of the 1.3 - 15 volts +V supply. This selection should be the same as the operating circuitry that is to be monitored. The red LEDs will light when the voltages at the inputs are 2.2 volts or higher when in the TTL position, or 70% of the operating voltage or higher when in the CMOS position. The green LEDs will light when the voltages at the inputs are 0.8 volts or less when in the TTL position, or 30% of the operating voltage or less when in the CMOS position. An unconnected input, or an input not at a valid logic level, will cause both LEDs to be extinguished. Note that the thresholds determined by the TTL positions are only accurate when the +5 volt range is selected. The 100 K ohm input impedance ensures minimal loading effects of the circuit under test.

## DEBOUNCED PUSHBUTTONS (PULSERS)

The CADET uses clocked flip-flops to provide debounced pushbutton switch functions. The pushbutton circuitry has open-collector outputs which can sink up to 250 mA each. This type of debouncing gives the user a sharp, glitch-free trigger source which assures reliable operation in digital circuits. Each pushbutton has a normally-open and a normally-closed output. If necessary, a pull-up resistor can connect any pulser output to any of the positive voltage sources.

## POTENTIOMETERS

Two potentiometers are provided on the CADET. The resistance values chosen (1 K and 10 K ohms) may be used in common circuit applications such as volume controls, DC offset controls for op amps, and timing circuit controls. All leads for both potentiometers are available and uncommitted.

## BNC CONNECTORS

The CADET may be connected to other pieces of equipment via two BNC connectors. This allows the use of shielded cable to minimize noise and interference.

## SWITCHES

Two single pole, double throw (SPDT) switches are provided for general switching functions. All leads are available and

clearly marked on the CADET for easy connection. Eight switches are configured as Logic Switches to provide a convenient source of digital outputs. These switches will provide logic levels of zero volts (ground) for a logic low, and logic high levels of either +5 volts or the voltage setting of the 1.3 -15 volt +V supply. The high level is determined by the setting of the +5/+V switch. This arrangement makes connecting special digital circuitry such as an eight-bit input port quick and easy, and allows compatibility with virtually any logic family.

**CAUTION**

Integrated circuits can be destroyed if a voltage is applied to their inputs that is higher than the operating voltage of the ICs. Always insure that the setting of the +5/+V high-level switch is in the correct position before making connections to any device.

## CHECKING OUT THE CADET

The CADET may be checked out for proper operation by making a few simple measurements and connections. Begin by connecting the AC line cord to a suitable receptacle. The AC power indicator should light when the power switch is turned on.

Using a DC voltmeter, check for +5 volts between the ground terminal and the +5 volt terminal. Repeat the measurement for the positive (+) variable supply terminal and the negative (-) variable supply terminal. Check the variability of each supply by turning the appropriate adjusting screw. To test the logic indicators, switch the +5/+V operating voltage switch to the +5 position. The TTL/CMOS threshold switch can be in either position. With no input to the logic indicators, all LEDs should be turned off. Connect one end of a jumper wire to the + 5 volt terminal and the other end to logic indicator 1; the red LED of logic indicator 1 should light. Repeat this test for logic indicators 2 through 8. Disconnect the jumper from the +5 volt terminal and connect it to the ground terminal. Connect the other end to logic indicator 1; the green LED of logic indicator 1 should light. Repeat this test for logic indicators 2 through 8.

The function generator may be tested by connecting its output to one of the speaker inputs. Connect the other speaker input to the ground terminal (or one of the connectors on the ground bus strip). Switch the function generator range switch to "1" and the Hz/kHz switch to "kHz". Move the frequency control all the way to the top. Move the amplitude control upward until you hear a tone coming from the speaker. Switch the waveform selector to select sine, square, and triangle. A changing but clearly audible tone should be heard in each position. Changing the position of the frequency control should vary the pitch of

the tone.

If an oscilloscope is available, you may check the function generator for proper waveform and frequency using standard measurement techniques.

The debounced pushbuttons can be checked by connecting one side of a resistor (20 ohms, to 100 K) to +5 volts and the other side to PB1-1, the NC point. Then connect PB1-1 to LED-1 with the Logic Indicator +5/+V switch in the +5 position, the red LED should light when PB1 is pressed and the green LED should light when PB1 is released. Next, move the connections from PB1-1 to PB1-2, the NO point. Now the red LED should be lit when PB1 is not pressed, and the green LED should be lit when PB1 is pressed. Repeat these steps to test PB2.

The logic switches can be tested by connecting the output of logic switches 1 through 8 to the input of logic indicators 1 through 8. Switch the logic switch +5V/+V high level switch to +5, and switch the logic indicator +5/+V operating voltage switch to +5. Select the CMOS position on the logic indicator TTL/CMOS threshold select switch. Now the logic indicators should reflect the conditions of the logic switches, that is, red LEDs will indicate switches in the high (logic "1") position and green LEDs will indicate switches in the low (logic "0") position. Move each switch between its high and low position to verify proper functioning. Switch the logic switch +5/+V high level switch to +V and the logic indicator +5/+V operating voltage switch to +V; the relationship between the switch positions and the logic indicator display should remain the same, regardless of the setting of the 1.3 - 15 volts +V supply.

By using an ohmmeter, you can check the potentiometers. To do so, select an appropriate range for measuring 10 K and connect the ohmmeter leads to R1-1 and R1-2. With R1 rotated fully counterclockwise a reading of zero ohms should be observed. As the potentiometer is rotated clockwise, the resistance reading will be seen to increase linearly up to 10 K ± 20%. Now move the ohmmeter lead from R1-1 to R1-3; with R1 fully clockwise the ohmmeter will read zero ohms, and the resistance will increase linearly to the full value noted previously as the potentiometer is rotated counterclockwise. Select an ohmmeter range appropriate for 1 K and repeat these steps on R2 to verify its function.

To test SPDT switch S9, put S9 in the up position and connect an ohmmeter to S9-1 and S9-2. The ohmmeter should read zero ohms. When the switch is brought to the down position, an open circuit should be indicated. Move the ohmmeter lead from S9-1 to S9-3 and observe a short circuit with S9 down, and an open with S9 up. These steps can be repeated on S10 to test its functions.

## BREADBOARDING TECHNIQUES

This section contains information which may prove useful when constructing circuits using the CADET. While there are no hard and fast rules for breadboarding, the following tips may

save time and trouble.

Unless a circuit is being prepared for a demonstration or display, avoid cutting component leads very short. While short wires and leads may look neat, the clipped components will only fit into a limited "span" of connector sockets, limiting the use of the component. It is perfectly permissible to use untrimmed components while exploring different circuit possibilities. The only time short leads may be necessary is when operating at higher frequencies and experiencing mysterious malfunctions. Sometimes the only way to correct high frequency circuit problems is to shorten all circuit connections.

Be cautious when using components which have been removed from a tape reel used in automatic insertion equipment. Suppliers of surplus components often sell components which are taped together in small batches. Removing the components from the tape does not always remove the adhesive from the leads of the components. Placing a formerly taped component into a socket connector may result in a poor electrical connection and, worse still, leave tape adhesive in the socket. Avoid this problem by either carefully cleaning taped component leads, clipping the taped portion of the lead off, or avoiding the use of taped components altogether.

Be especially careful when inserting integrated circuits into the breadboard sockets. Unless the IC pins are straight, it is very easy to crush the pin into a zig-zag shape or fold the pins underneath the body of the IC. Either way the result is a bad connection or no connection at all.

Always use solid wire for breadboard connections. When stripping the wire ends, be careful not to strip more than about three-eighths of an inch of insulation from the wire. Too much bare wire may result in unintentional connections near the wire end.

After you have built up a few circuits, you will have a good collection of prestripped jumper wires. Save them. By reusing these wires, you can save even more time and effort in assembling future circuits.

## ANALOG CIRCUIT EXAMPLES

The following section shows examples of analog circuits which may be easily constructed using the CADET. (See Figures 2, 3 and 4)

FIGURE 2. Variable-gain audio amplifier with output DC offset null control.

FIGURE 3. Full-wave rectified zener regulated power supply.

FIGURE 4. One-transistor audio amplifier.

## DIGITAL CIRCUIT EXAMPLES

The following section shows examples of digital circuits which may be easily constructed using the CADET. (See Figures 5, 6, and 7)

FIGURE 5. Basic set-reset flip-flop built with two NAND gates.

FIGURE 6. 8-Bit microcomputer input port.

FIGURE 7. 4-Bit resettable binary counter.

This concludes the circuit examples of the CADET, a Complete Analog/Digital Electronic Trainer.

FIGURE 8. Circuit schematic.

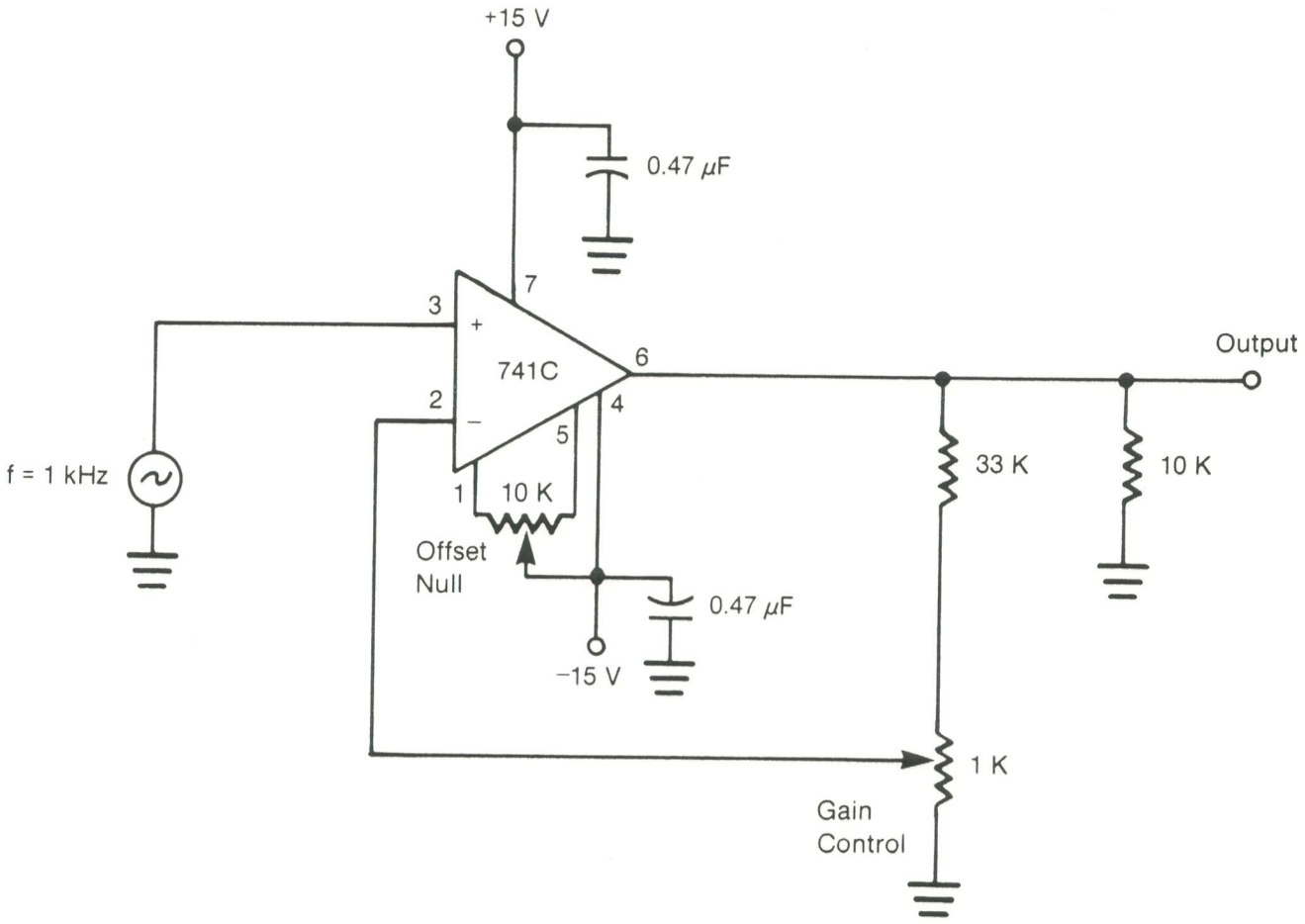



FIGURE 2. Variable gain audio amplifier with output DC offset null control.

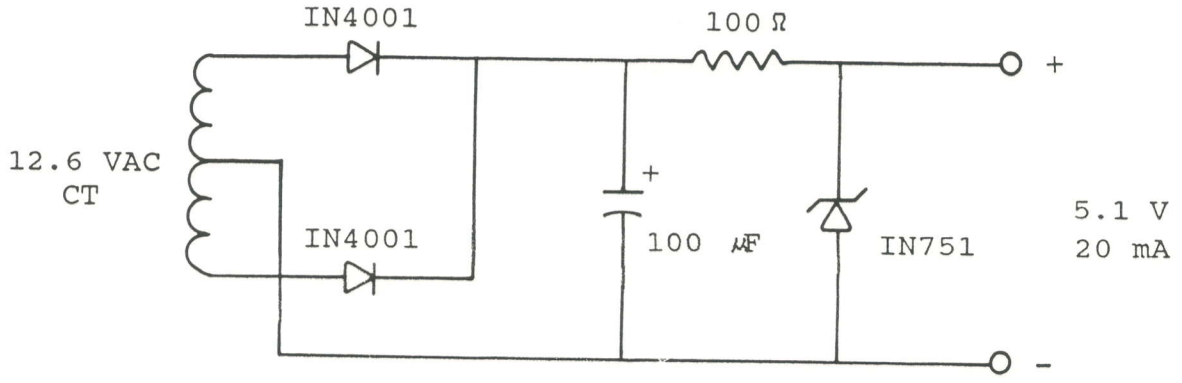



FIGURE 3. Full-wave rectified zener regulated power supply.

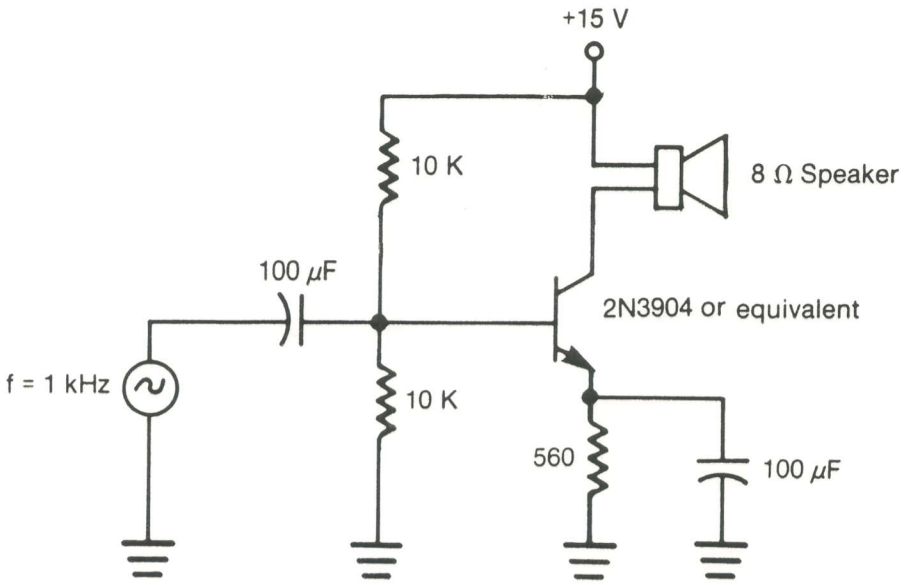



FIGURE 4. One-transistor audio amplifier.

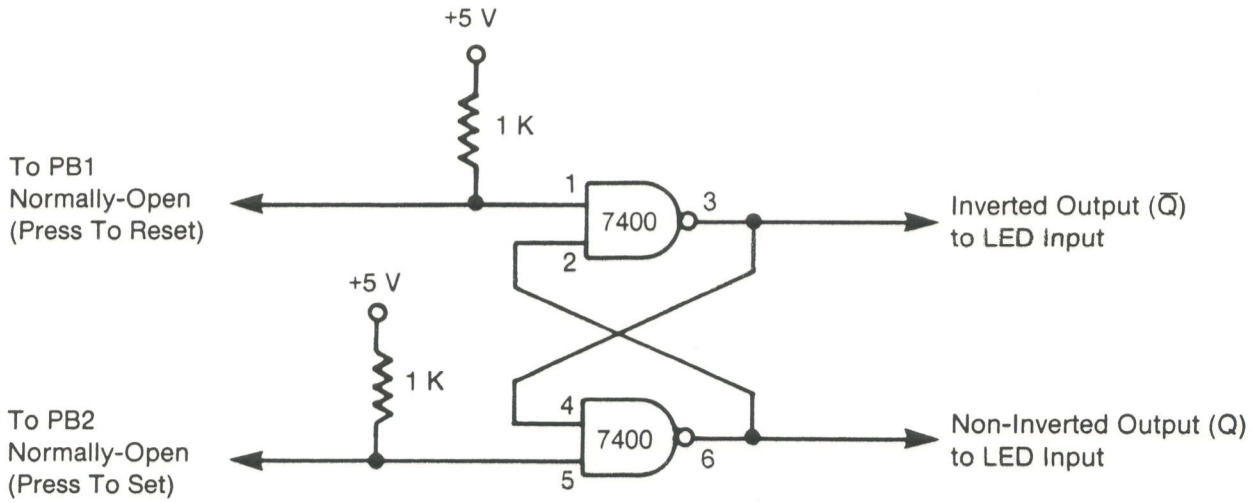
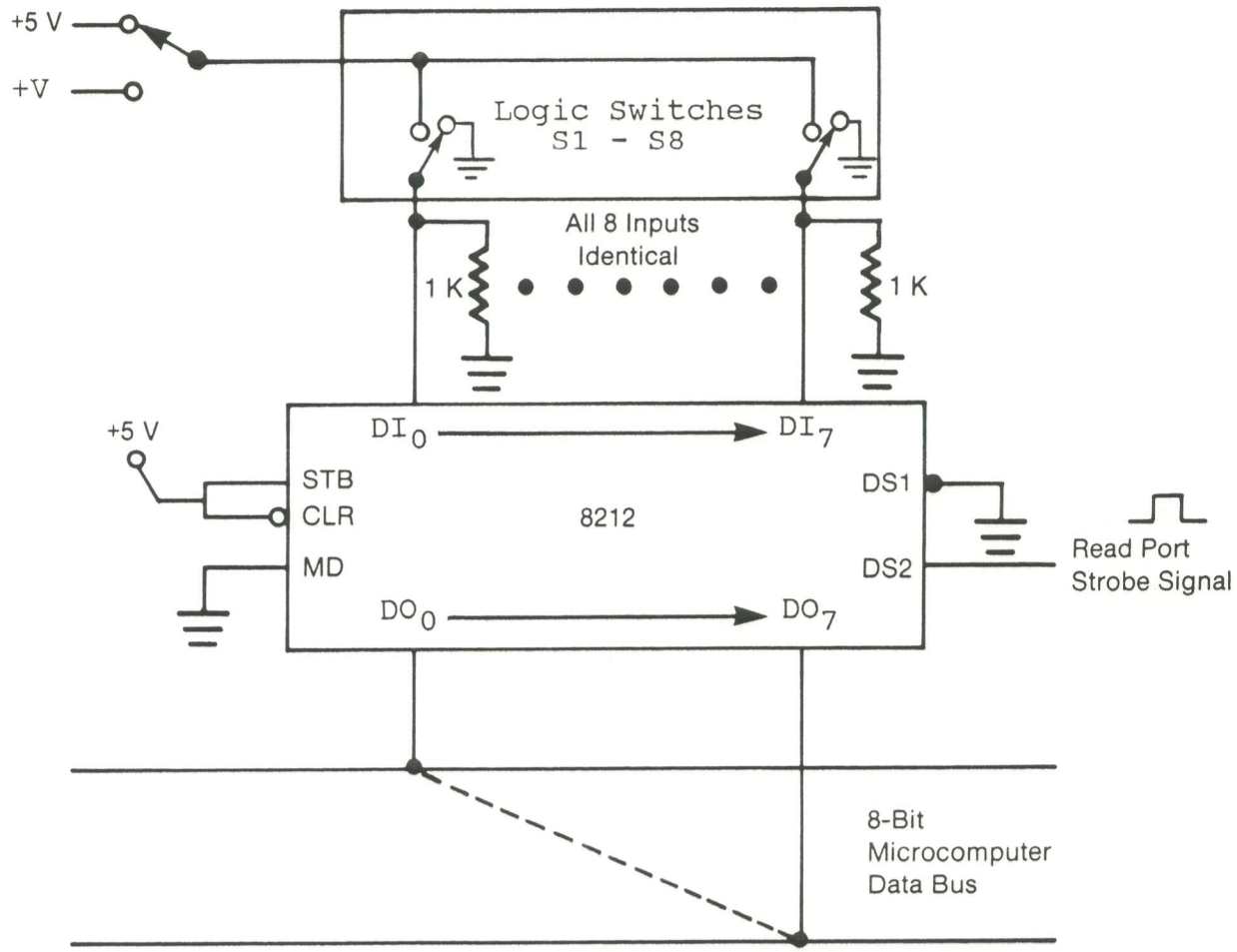
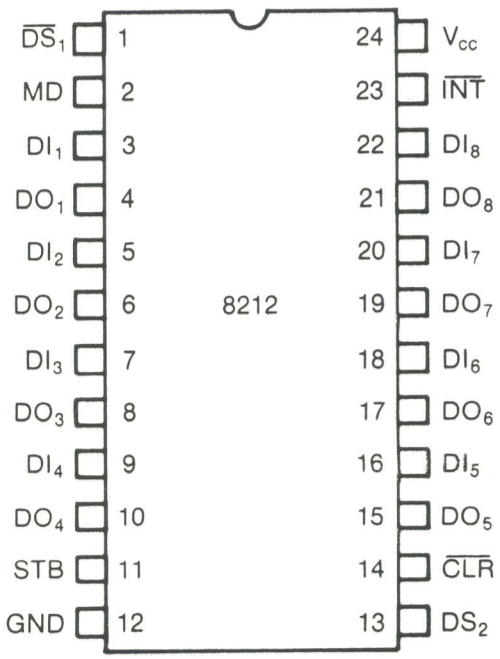



FIGURE 5. Basic set-reset flip-flop built with two NAND gates.




Pin Configuration




Pin Names

| | |
|---|---|
| $DI_1$ - $DI_8$ | Data In |
| $DO_1$ - $DO_8$ | Data Out |
| $\overline{DS}_1$, $DS_2$ | Device Select |
| MD | Mode |
| STB | Strobe |
| $\overline{INT}$ | Interrupt (Active Low) |
| $\overline{CLR}$ | Clear (Active Low) |

FIGURE 6. 8-Bit microcomputer input port.

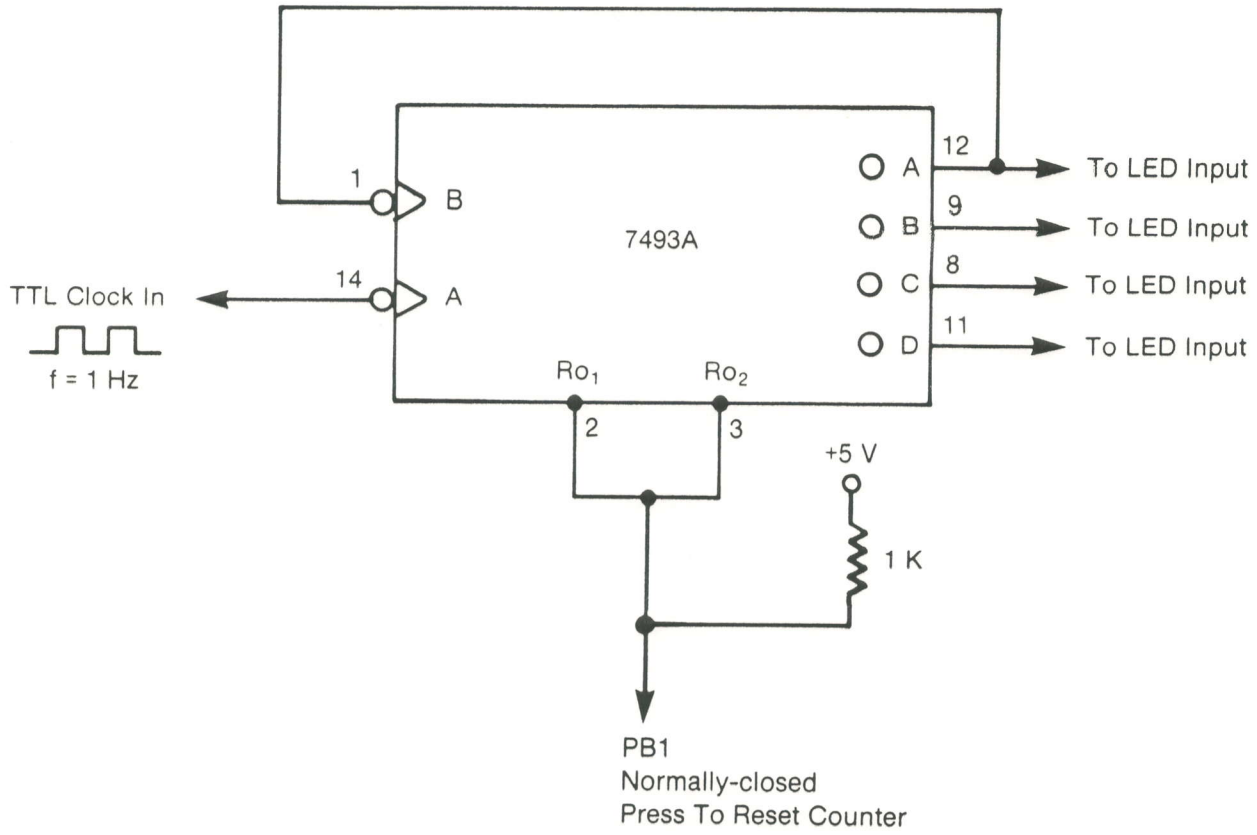



FIGURE 7. 4-Bit resettable binary counter.

# PARTS LIST

ITEM NUMBER 325-1400 C.A.D.E.T.

## TOP BOARD ASSEMBLY

| COMPONENT | DESCRIPTION | REQ QTY |
|---|---|---|
| 02-02-0004 | IF-2X-4 PROTOSTR | 8 |
| 02-02-0008 | IF-2X-8 PROTOSTR | 3 |
| 02-02-1159 | BT 59B W/ IF-PIN | 2 |
| 02-03-0001 | SK-10 | 3 |
| 20-01-0008 | BLU BND PST#30-2 | 1 |
| 20-01-0018 | YEL BND PST#30-2 | 1 |
| 20-03-0010 | BNC W/NUT/INT TO | 2 |
| 20-03-0140 | BP-25 BRDBDNG FI | 3 |
| 24-02-0007 | SPEAKER 8 OHM,2. | 1 |
| 24-02-0008 | SPKR BRKT #48SCO | 4 |
| 34-01-0008 | 10 CND FLEX JUMP | 2 |
| 38-02-0014 | POT.10K #34-1032 | 1 |
| 38-02-0015 | POT.1K #34-1022- | 1 |
| 40-02-0013 | PWR SW LTA 110-P | 1 |
| 40-03-0029 | SPST SLIDE SW#80 | 13 |
| 40-04-0028 | KEY SW CK#K511-R | 2 |
| 46-01-0005 | FUSE HOLDR PANEL | 1 |
| 47-01-0010 | 6FT LINE CORD W/ | 1 |
| 84-01-6516 | #6X5/16 TYPE "F" | 20 |
| 84-03-0004 | 4-40X3/8 SLT PNH | 4 |
| 84-03-0015 | 4-40X1/4 SCREW S | 5 |
| 84-04-0002 | 4-40 X 5/8 SCREW | 2 |
| 85-01-0008 | WSHR #6 FLAT FIB | 2 |
| 88-01-0018 | STRN RELIEF RGHT | 1 |
| 91-01-0034 | KNOB, ESCORT | 2 |
| 95-01-0260 | CADET TOP PCBD | 1 |

## BOTTOM BOARD ASSEMBLY

| COMPONENT | DESCRIPTION | REQ QTY |
|---|---|---|
| 08-02-0001 | TANTCAP 4.7UF 5% | 1 |
| 08-03-0025 | ELEC CAP 4700MFD | 1 |
| 08-03-0026 | ECAP 10 MFD 50V | 8 |
| 08-03-0027 | 47MF 35V 20% RAD | 1 |
| 08-03-0228 | ELEC CAP 2200M 3 | 2 |
| 08-04-0104 | CER CAP .1MFD 50 | 15 |
| 08-04-0390 | CAP CER 390PF 50 | 1 |
| 08-07-1472 | PFCAP.0047UF2%25 | 1 |
| 08-07-1473 | PFCAP .047UF 2% | 1 |
| 08-07-1474 | PFCAP .47uF 2% 2 | 1 |
| 08-09-0340 | TRCAP 3-40PF GYC | 1 |
| 10-01-4001 | 1N4001 DIODE | 13 |
| 10-01-4148 | IN4148 DIODE | 3 |
| 10-01-5391 | DIODE 1N5391 | 7 |
| 10-02-0011 | MINI GRN LED 508 | 8 |
| 10-02-0018 | MINI RED LED 100 | 8 |
| 20-02-0014 | 14 PIN DIP SKT S | 1 |
| 30-01-3906 | 2N3906 PNP XSTR | 1 |
| 30-01-4401 | SIL XSTR 2N4401 | 9 |
| 30-01-4403 | SIL XSTR 2N4403 | 3 |
| 34-92-2205 | GREEN .5 | 13 |
| 37-01-1005 | CCRES 1/4W 10 OH | 4 |
| 37-01-1015 | CCRES 1/4W 100 O | 2 |
| 37-01-1025 | CCRES 1/4W 1K OH | 10 |
| 37-01-1035 | CCRES 1/4W 10K O | 8 |
| 37-01-1045 | CCRES 1/4W 100K | 12 |
| 37-01-1065 | CCRES 1/4W 10M O | 1 |
| 37-01-1215 | CCRES 1/4W 120 O | 2 |
| 37-01-1525 | CCRES 1/4W 1.5K | 1 |
| 37-01-1535 | CCRES 1/4W 15K O | 1 |
| 37-01-2035 | CCRES 1/4W 20K O | 1 |
| 37-01-2225 | CCRES 1/4W 2.2K | 9 |
| 37-01-2725 | CCRES 1/4W 2.7K | 1 |
| 37-01-3015 | CCRES 1/4W 300 O | 10 |
| 37-01-3305 | CCRES 1/4W 33 OH | 3 |
| 37-01-3325 | CCRES 1/4W 3.3K | 3 |
| 37-01-3925 | CCRES 1/4W 3.9K | 2 |
| 37-01-3935 | CCRES 1/4W 39K O | 1 |
| 37-01-5125 | CCRES 1/4W 5.1K | 3 |
| 37-01-6815 | CCRES 1/4W 680 O | 1 |
| 37-01-8215 | CCRES 1/4W 820 O | 1 |
| 37-01-9125 | CCRES 1/4W 9.1K | 1 |
| 38-01-0004 | TRMPOT,2K IPT10M | 2 |
| 38-01-0005 | TRMPT 10K ESC341 | 1 |
| 38-01-0007 | PT10MV2K W/SHAFT | 2 |
| 38-01-1104 | POT PIHER 100K P | 3 |
| 38-05-0006 | 10K SL POT 34103 | 2 |
| 40-03-0012 | SLDE SW DW#128S0 | 2 |
| 40-03-0027 | 4PDT SLDE ALCD M | 1 |
| 41-01-0051 | XFMR,DUAL PRIMAR | 1 |
| 41-01-0071 | XFORMER 115V 12. | 1 |
| 44-01-0005 | INTERSIL ICL8038 | 1 |
| 44-01-0006 | IC LM 339 TI ONL | 4 |
| 44-01-0009 | IC 7805 VOLT REG | 1 |
| 44-01-0074 | SN74LS00 | 1 |
| 44-01-0099 | MC79L05--100MA+5 | 1 |
| 44-01-0104 | NE555VP | 1 |
| 44-01-0112 | 4013 DUAL D FLI | 1 |
| 44-01-0343 | LM358 DUAL OP AM | 1 |
| 44-01-0364 | IC LM 317 T | 1 |
| 44-01-0365 | LM337T TO-220 P | 1 |
| 81-01-0262 | HEAT SINK | 3 |
| 84-02-0003 | 8-32X3/8 PHILL P | 2 |
| 84-03-6380 | 6-32X3/8 SLT PNH | 2 |
| 85-02-0004 | #4 INT-TOOTH LOC | 10 |
| 85-02-0006 | #6 INT-TOOTH LOC | 2 |
| 85-02-1108 | L WASHER #8 | 2 |
| 86-02-0004 | 4-40 HEX NUT | 10 |
| 86-02-0006 | 6-32 HEX NUT STA | 2 |
| 86-02-0008 | 8-32 HEX NUT | 2 |
| 86-10-0032 | M/F HEX SPCR 4-4 | 7 |
| 86-10-0040 | SPACER ID.120 OD | 16 |
| 95-01-0261 | CADET BOT | 1 |

## MISCELLANEOUS

| | | |
|---|---|---|
| 84-01-0004 | 6X1/2 PHIL. PAN | 12 |
| 92-01-0001 | LG RUBBER FEET S | 4 |
| 94-02-0079 | SLDE POT SHAFT C | 2 |
| 94-03-0098 | CADET INSTR CASE | 1 |

# PRODUCT WARRANTY

## 1. WARRANTY INFORMATION

### A. ASSEMBLED INSTRUMENTS

E&L Instruments agrees to repair or replace, at no charge, any defects in assembled instruments for a period of two (2) years from the date of purchase by the customer. The warranty is void if the equipment has been subjected to abuse or improper operation. Any attempt by the customer or any other outside repair facility to repair an assembled instrument during the warranty period voids the warranty.

The recovery of damages incurred in shipping is the responsibility of the E&L Representative or the customer. Prompt claims should be filed with the appropriate carrier if damage in transit has occurred.

Warranty repairs will only be performed on merchandise returned in compliance with E&L's Return Policy. (See REPAIRS AND SHIPPING INFORMATION)

### B. KIT (Unassembled) INSTRUMENTS

Terms and conditions of the warranty on kit products are identical to those on assembled instruments except for the following changes. E&L warrants kit products for a period of ninety (90) days from the date of purchase by the customer. E&L cannot warrant the workmanship of the kit builder. Kits returned requiring repair of wiring errors or poor workmanship can only be repaired on a non-warranty basis. (See REPAIRS AND SHIPPING INFORMATION)

*****WARNING*****

Use of corrosive core solders or fluxes completely voids any warranty on kit products.

### C. SOCKETS

All E&L Instruments SK-series Breadboarding Sockets carry an:

******UNCONDITIONAL LIFETIME GUARANTEE******

If a socket ever fails to meet your requirements, return it to E&L, postpaid, for a free replacement. No questions asked.

## 2. REPAIRS AND SHIPPING INFORMATION

### A. REPAIRS

Non-warranty repairs are ordinarily performed on a fixed price, pre-paid basis in accordance with a standard fee schedule. For current prices contact the factory or any E&L Representative.

Rated companies desiring credit terms on repairs must accompany the returned merchandise with a purchase order covering all repair and shipping costs.

E&L reserves the right to replace all or any part of any unit returned for repair. All repairs are warranted for thirty (30) days following return of the repaired merchandise to the customer.

B. RETURN POLICIES

All merchandise returned to E&L for repair or any other reason must be of E&L's manufacture and must comply with the following procedures:

1. Sender must, prior to forwarding any returned merchandise to E&L, request from the E&L Sales Department a Return Material Authorization Number (RMA #). Sender should contact E&L by mail or telephone and request the RMA.

2. A separate RMA # must be procured for each item being returned.

3. A short description of any problems occurring with the material being returned for repair will shorten the repair time and is strongly suggested.

4. The RMA number issued to the sender must be prominently displayed on the outside of the shipping container and on any associated correspondence. Any material received at E&L without an RMA # will be subject to return to the sender freight collect.

C. SHIPPING INFORMATION

All material shipped to E&L must be shipped freight pre-paid. Please pack carefully. E&L cannot be responsible for merchandise damaged in transit. Forward all shipments to:

E&L INSTRUMENTS
P.O. Box 1942 70 Fulton Terrace
New Haven, Connecticut 06509
Attn: Repair Department

All merchandise received freight collect will be refused.
All warranty terms and conditions are subject to change without notice.
This warranty supersedes all previously written or implied warranties.

## APPLICATIONS NOTE DISCLAIMER

E&L has provided you with application information which may be of use to you. The intent of this information is to make you aware of problems and their potential solutions, or to inform you of new and interesting things which can be done with E&L equipment. E&L cannot assume responsibility for equipment damage or personal injury resulting from a misunderstanding of the content of this APP NOTE.

## KIT MANUAL DISCLAIMER

E&L has provided you with this kit building and operations manual so that you may construct and test your new piece of E&L equipment. E&L cannot assume responsibility for equipment damage or personal injury resulting from incorrect construction or testing in accordance with this manual.