SOLAR ELECTRONICS COMPANY

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Innovative EMI Solutions Since 1960

INSTRUCTION BOOK
FOR
MODEL 8282-1
TRANSIENT PULSE GENERATOR

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Manual Revision History

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1.1	May 22, 1991	8282-1 Digital Meter Addendum created.
1.2	Apr. 13, 2021	Added page i, “Manual Revision History”. Moved to pages ii and iii, “TABLE OF CONTENTS”. Added number to page iv, and replaced image in “FIGURE 1 MODEL 8282-1”, also added “FIGURE 2 MODEL 8282-1” to page iv. Added page v, “Preface” text. Added page vi, “CAUTION and SAFETY!” text.

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TRANSIENT PULSE GENERATOR

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FIGURE 1 MODEL 8282-1

FIGURE 2 MODEL 8282-1

Preface

Notice to Users

The user must keep in mind that improper use of this equipment can result in serious injury and/or death. All setup configurations and test setups should be made prior to turning on equipment to prevent accidental shock and/or serious injury.

The user must also bear in mind that this instrument is designed to produce Waveforms with discharge energies in excess of 600 volts at very low source impedances will appear at module terminals. Connections to these terminals may be exposed during tests. Moreover, these energies may be delivered very efficiently to Equipment Under Test (EUT), making wiring harnesses, support components, and the equipment itself dangerous to touch.

The Solar Model 8282-1 Transient Pulse Generator has no user serviceable components inside and will not work if the top cover is removed. This interlock is part of the safety system designed to prevent electric shock.

Please exercise caution while connecting and using this instrument.

Precautions

Always observe high-voltage precautions while operating this instrument.

Do not touch or attempt to adjust the generator or EUT wiring while the generator is in operation.

Operator Use

It is important that ONLY qualified personnel to operate this equipment.

CAUTION and SAFETY!

The primary concern is the safety of the test engineer and observers. The voltages and currents developed in these tests are substantial. Because of this the operator should avoid touching the generator or EUT while calibrations and tests are being run.

Electric Shock Hazard

DO NOT TURN THIS EQUIPMENT ON WHEN THE PUSHBUTTON MARKED 0.15 µS IS DEPRESSED.

Do not depress the 0.15 µS pushbutton for at least thirty minutes after the equipment has been placed in a normal operating position with the front panel vertical.

Some of the mechanical parts in the 0.15 µS function must settle to normal attitude before power is applied. If power is applied prematurely, these delicate parts may be damaged.

INSTRUCTION BOOK
FOR
MODEL 8282-1
TRANSIENT PULSE GENERATOR

1.0 INTRODUCTION

The Model 8282-1 Transient Pulse Generator provides pulses with the wave-shape associated with “spikes” (transients) in electrical systems. It is espe- cially useful in performing spike susceptibility tests on incoming power lines as required by MIL-STD-461 B or C and other military and industry specifications.

As is characteristic of electrical transients, the waveform of the spike rises rapidly to a peak value and then decays exponentially to pass through zero and “ring” as determined by the inductance in the output circuit and the load to which it is connected. The amplitude of the peak transient voltage is adjustable with a panel control up to 600 volts, peak. The repetition rate of the spike is also adjustable with a panel control.

Three different spike durations are provided (0.15 µS, 5.0 µS, 10.0 µS) selected by means of panel-mounted push buttons. The time required for the spike to rise to peak and fall to zero is defined as the “duration” of the spike.

2.0 APPLICATIONS

The spike voltage output of the Model 8282-1 may be connected in parallel with a d.c. power line, or it can be connected in series with either an a.c. or d.c. power line. In test setups to be described later, this enables EMI test personnel to inject controllable spikes into electrical or electronic equipment to determine the threshold of susceptibility to power line transients. When the equipment under test (EUT) is powered by an a.c. line, the transient pulse can be adjusted in phase to fall on any point of the power frequency sine wave.

CAUTION!

DO NOT TURN THIS EQUIPMENT ON WHEN THE PUSHBUTTON MARKED 0.15 µS IS DEPRESSED.

Do not depress the 0.15 µS pushbutton for at least thirty minutes after the equipment has been placed in a normal operating position with the front panel vertical.

Some of the mechanical parts in the 0.15 µS function must settle to normal attitude before power is applied. If power is applied prematurely, these delicate parts may be damaged.

3.0 DESCRIPTION

The Model 8282-1 Transient Pulse Generator is a completely self-contained unit with more than sufficient output power to fully comply with the requirements of all sections of MIL-STD-461B, Method CS06. The dimensions of the unit are 12.25"W x 8.70"H x 13"Deep. The unit weighs approximately 30 pounds.

Front panel controls include a knob for the adjustment of spike amplitude, a knob to adjust the repetition rate, and a knob to shift the phase with respect to the desired position on the power frequency sine wave when the spike is injected on a.c. lines. The rest of the controls are pushbuttons which select functions and change the range of the repetition rate control. One pushbutton “enables” the single pulse feature and another (momentary) button can be used to inject single spikes at the discretion of the test engineer.

The pushbuttons are arranged in a single horizontal row as depicted in Fig. 2.

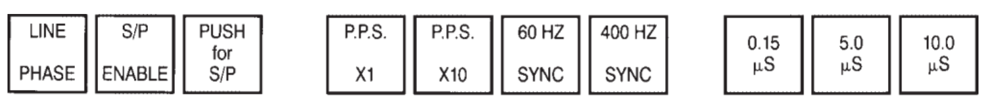


FIG. 2 LAYOUT OF FRONT PANEL PUSHBUTTONS

LINE PHASE – When injecting the spike on line frequency waveforms, the spike can be placed on the positive or negative half cycle of the a.c. sine wave as determined by this pushbutton switch. Since the phase relation is dependent upon the nature of the equipment under test, the spike will not begin at exactly zero crossover in all cases. However, with this switch in combination with the PULSE POSITION control, the spike can be positioned anywhere on the a.c. sine wave from 0˚ to 360˚.

S/P ENABLE – This switch selects the function which “enables” the test engineer to inject a single spike when needed. When this switch is depressed, the momentary pushbutton labeled PUSH FOR S/P may be used to manually inject a single spike.

PUSH-FOR-S/P – This is a momentary switch which can be used to manually inject single spikes into the EUT when “enabled” by the switch marked S/P ENABLE.

P.P.S., X1 and X10 – These push buttons select the range of the spike FREQUENCY control. The X1 switch is used when the repetition rate of the spike is to be adjusted from 0.5 to 5.0 pulses per second. The X10 switch multiplies the range of the frequency control by 10 so that the repetition rate can be adjusted from 5.0 to 50.0 pulses per second.

60 Hz SYNC – This switch selects internal circuitry to allow the spike to be placed on the 60 Hz power line serving the equipment being tested. The PULSE POSITION control will then allow the test engineer to position the spike to any point on the 60 Hz sine wave.

400 Hz SYNC – This switch performs the same function as the 60 Hz Sync switch when the equipment being tested is served by a 400 Hz power line.

0.15, 5.0, 10.0 µS – These switches select the duration of the spike as required by the test specification which governs the spike susceptibility test. The duration of the spike is defined as the time measured from the start of the pulse until it decays to zero crossover. This is illustrated in Fig. 3.

AMPLITUDE – This control adjusts the peak amplitude of the spike up to 600 volts. The level is not marked on the control knob. The amplitude level is displayed on the horizontal bar-graph meter which represents the level of the spike as it would appear across a five ohm resistive load. This feature makes it unnecessary to calibrate the spike amplitude into a resistor as described in test method CS06 of military specification MIL-STD-462. With 50 elements in the bar-graph meter, the accuracy is approximately 5% of full scale.

FREQUENCY, P.P.S. – As mentioned in the description of the push buttons, using this control the test engineer can set the repetition rate to any value from 0.5 to 50 p.p.s.

PULSE POSITION – When the push buttons select either 60 Hz Sync or 400 Hz Sync, this control allows the test engineer to move the spike through 360˚ of the power frequency sine wave.

REAR PANEL FEATURES – External connections for remote synchronization are provided on the rear panel. These include:

a) Terminals for connecting to a synchronizing power source other than the 50 Hz or 60 Hz which serves the Model 8282-1.

b) A three pin connector for cabling to remote controls.

c) A switch for selecting either INTERNAL or EXTERNAL power to the trigger circuits within the unit.

d) The main power connector and line fuses.

Detailed use of these features will be explained in Section 5.

4.0 SPECIFICATIONS

SPIKE DURATIONS – Pushbutton selectable durations of 0.15 µS, 5.0 µS and 10.0 µS (± 20%) into a 5.0 ohm resistive load.

ADJUSTABLE PEAK AMPLITUDES – Up to 600 volts for 0.15 µS, 5.0 µS and 10.0 µS durations into a five ohm non-inductive load.

PULSE REPETITION RATE – Manually adjustable up to 50 p.p.s. for all pulse durations. Remotely triggerable. See External Sync below.

PULSE SHAPE – Ringing characteristic similar to Fig. 19 of MIL-STD-462. The “undershoot” will be modified by EUT loads which are inductive (see Fig. 3). The waveshape in the 0.15 µS function is slightly irregular, with a purely resistive load. **Even a ten cm wire length between the output terminals and a non-inductive load will accentuate the irregularity of the pulse shape.**

With reference to the upper terminal of the output pair, the polarity of the 5.0 and 10.0 µS spikes is **positive-going**. However, the polarity of the 0.15 µS spike is **negative going**.

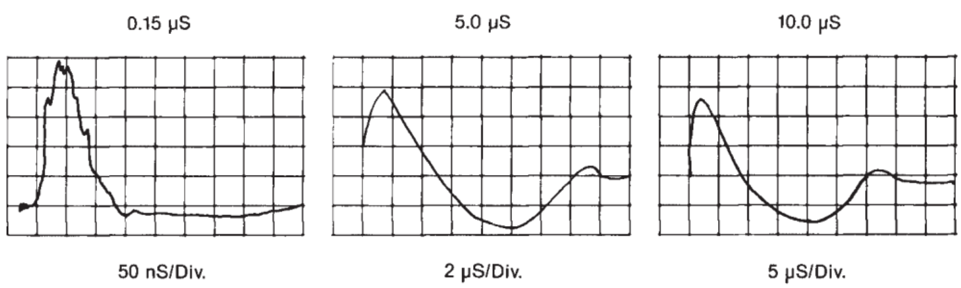


FIG. 3 TYPICAL WAVESHAPES

SOURCE IMPEDANCE – Less than 5 ohms for 0.15 µS, less than 2 ohms for 5.0 µS, less than one ohm for 10.0 µS.

PULSE POSITION – Adjustable from 0˚ to 360˚ on the sine wave of 50 Hz, 60 Hz or 400 Hz power lines.

EXTERNAL SYNC OPERATION – Remotely triggerable up to 50 p.p.s.for 0.15 µS, up to 1000 p.p.s. for 5.0 and 10.0 µS durations.

AMPLITUDE DISPLAY – The panel meter is an analog LED display of peak amplitude as established by the panel control and as it would be into a five ohm resistive load.

POWER CURRENT IN SERIES INJECTION MODE – Series output terminals can carry up to 50 amperes of current at power frequencies.

POWER REQUIREMENTS – 115/230 volts, 50-400 Hz; 3 amperes at 115 volts, 1.5 amperes at 230 volts.

5.0 OPERATION

5.1 GENERAL – The toggle switch on the rear of the unit must be in the INTERNAL position in all cases except when the power source to the EUT is not common to the 8282-1. This exception is described in Par. 5.4 and illustrated in Fig. 6.

Two sets of output terminals are provided. The upper pair is used when injecting the spike in PARALLEL with a d.c. power line. The lower pair of terminals is used when the spike is injected in SERIES with the power connection to the EUT.

ALTHOUGH SERIES INJECTION CAN BE USED ON EITHER A.C. OR D.C. POWER LINES, PARALLEL INJECTION MUST NOT BE USED ON A.C. POWER LINES. THIS WOULD SEVERELY DAMAGE THE SPIKE GENERATOR.

5.2 INTERCONNECTION FOR PARALLEL INJECTION – When injecting spikes on d.c. power lines, the upper pair of terminals on the Model 8282-1 are connected to the power leads as shown in Fig. 4. The vertical input to a high quality oscilloscope may be connected to the terminals of the Model 8282-1 to provide a visual representation of the amplitude and shape of the spike being delivered to the EUT. Since the input to most oscilloscopes is not isolated from earth, it is desirable to take suitable precautions to prevent shorting the power source. Use a power line isolation transformer such as Solar Electronics Type 7032-1 at the power input to the oscilloscope to remove the power ground from the case of the oscilloscope.

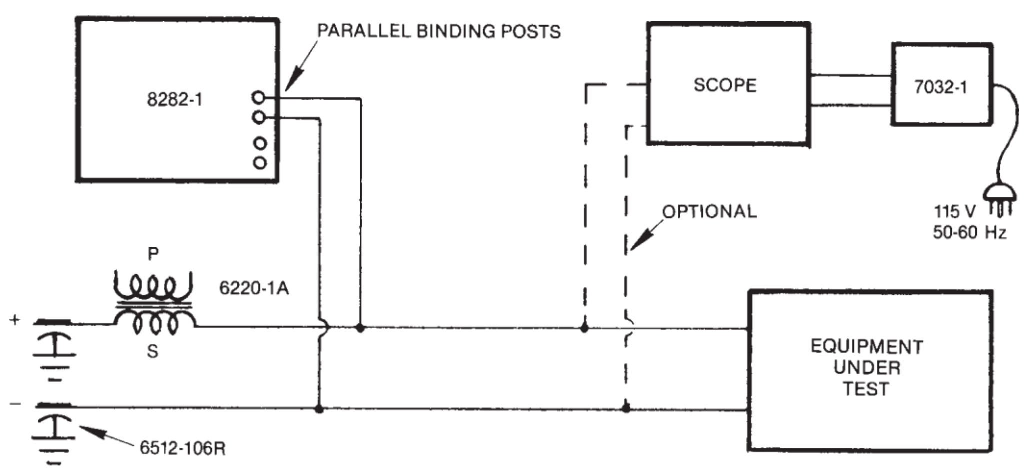


FIG. 4 TEST SETUP FOR PARALLEL INJECTION

If the d.c. line voltage is 50 volts or greater, caution is advised, since touching the case and earth ground simultaneously may result in an uncomfortable shock, which could be dangerous.

ALL TERMINALS ON THE 8282-1 ARE ISOLATED FROM THE CASE.

As shown in Fig. 4, for d.c. lines it is necessary to provide an inductor in series with the power connections. This assures that the spike will be injected to the EUT without being shunted by the impedance of the power source. The secondary of Solar Electronics Type 6220-1A transformer (normally used in CS01 testing) is well suited for this purpose and is capable of carrying up to 50 amperes of power current without saturation.

5.3 INTERCONNECTION FOR SERIES INJECTION – For series injection of the spike on d.c. or a.c. power lines, connect the lower pair of output terminals in series between the power source and the EUT as depicted in Fig. 5. It is recommended that the injection be in series with the ungrounded power lead.

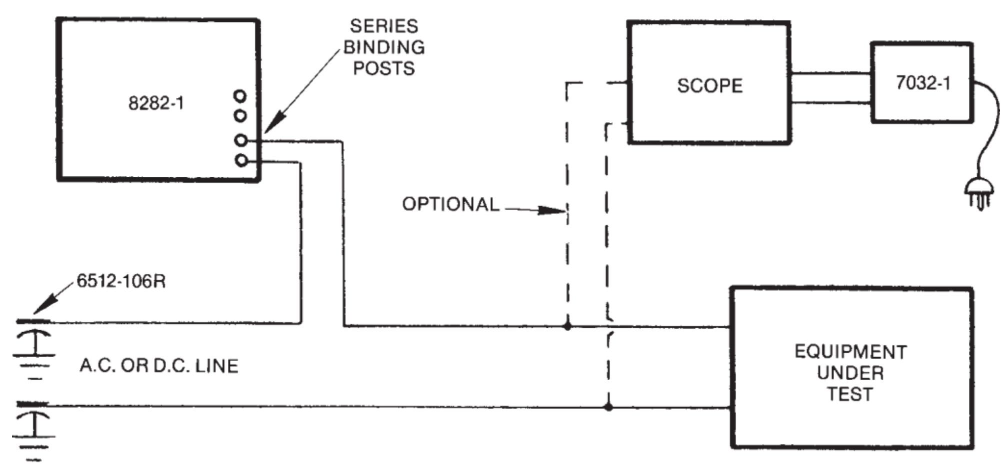


FIG. 5 TEST SETUP FOR SERIES INJECTION

The SERIES output terminals of the Model 8282-1 are capable of carrying up to 50 amperes power current, provided that large enough wires can be used with firm connections to the terminals. The wire hole in the terminals will accommodate a #12 A.W.G. wire, but for currents above 10 amperes, heavy lugs connected to larger wires can be inserted between the faces of the terminals.

The SERIES connection inserts approximately 14 microhenries in series with the power to the EUT. The power frequency voltage drop across this reactance at line currents up to 50 amperes is not great (even at 400 Hz) and is normally considered tolerable.

With a 100 MHz oscilloscope connected across the power input to the EUT, it is possible to adjust the controls of the oscilloscope to see the spike on the a.c. waveform. This may not be possible with the 0.15 uS spike, since the trigger circuits of the oscilloscope will respond to the power frequency, rather than the spike frequency.

However, most test plans allow the spike amplitude and duration to be seen and adjusted across a 5 ohm resistor prior to connecting to the EUT. With the analog LED panel meter on the Model 8282-1, this step is not necessary for repetition rates below 10 p.p.s. since the meter indicates the amplitude which would appear on a 5 ohm load. The spike voltage injected into the EUT is dependent upon the characteristics of the EUT and cannot be readily predicted. Most EMI specifications do not require measuring the spike amplitude across an unknown load, such as presented by the EUT.

5.4 PULSE POSITIONING – With the test setup shown for series injection in Fig. 5, push the button for 60 Hz or 400 Hz Sync as required. If the power frequency serving the EUT is 60 Hz, move the toggle switch on the rear of the Model 8282-1 to INTERNAL SYNC.

If the power frequency to the EUT is not 60 Hz, move the rear toggle switch to EXTERNAL SYNC and connect the terminals on the rear panel to the same power source that serves the EUT. If the line voltage to the EUT is greater than the voltage into the line cord of the Model 8282-1, add a step-down transformer at the points marked X in Fig. 6 to reduce the voltage applied to the rear terminals. If an oscilloscope is used, it must be externally triggered from the same power source as the EUT.

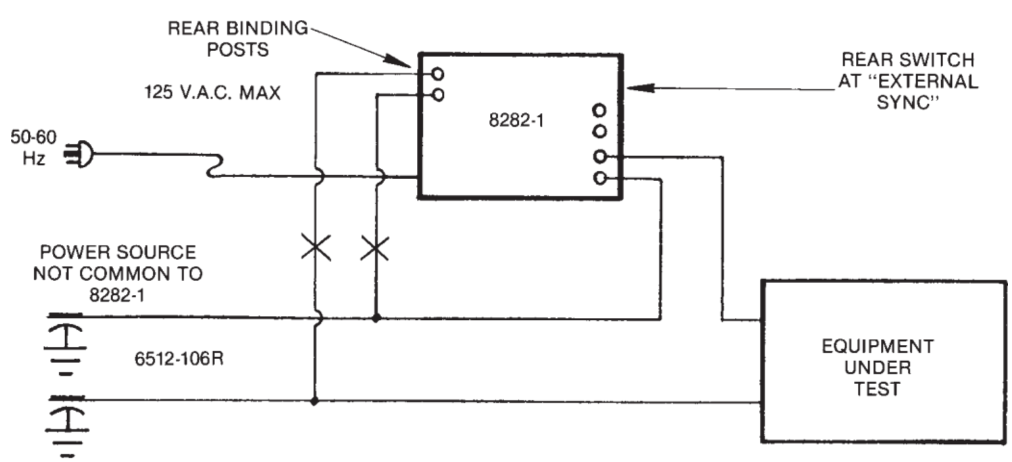


FIG. 6 PULSE POSITIONING ON OTHER A.C. POWER SOURCES

The PULSE POSITION control together with the LINE PHASE pushbutton for selecting phase polarity, enables phase shift of the injected spike through 360° of the power frequency sine wave as observed on the oscilloscope. With the LINE PHASE button depressed, the phase can be shifted through 180°, and with the button released, the phase can be shifted to complete the cycle through 360°. Due to phase differences existing in the test setup and depending upon the characteristics of the EUT, the knob position on the PHASE POSITION control corresponding to zero crossover of the sine wave will not be the same for all equipments under test.

When syncing on 50 or 60 Hz, the spike appears on every fourth sine wave of the power frequency. When syncing with 400 Hz, the spike appears on every sixteenth sine wave of the power frequency.

5.5 REPETITION RATE – The calibration of the panel knob is only approximate. When the exact rate must be determined, it may be measured with the time base of the associated oscilloscope. The rate is independent of load conditions.

5.6 SPIKE AMPLITUDE – The amplitude is adjusted with a front panel control and displayed on the analog LED panel meter. The displayed value is the value that would appear across a five ohm resistive load for all repetition rates below 10 p.p.s. **At rates higher than 10 p.p.s., the amplitude falls off and the LED panel meter no longer represents the actual output voltage.** When syncing with 400 Hz, the maximum amplitude is limited by the 400 p.p.s. rate. The amplitude under this condition is different for each pulse shape. The shorter the pulse duration, the higher the output level. The lowest amplitude is in the 10.0 µS function.

Although the source impedance of the spike is quite low, the actual amplitude of the spike as it is injected into the EUT depends upon the impedance of the EUT at the frequency represented by the rise time of the spike. The shape of the spike may also be altered by the reactive components in the power input circuit of the EUT.

5.7 SPIKE POLARITY – The upper terminals of the PARALLEL pair and the SERIES pair provide a **positive-going** spike on the 5.0 µS and the 10.0 µS modes. These terminals deliver a **negative-going** spike in the 0.15 µS mode. When the test plan requires both a positive and a negative spike, it is necessary to reverse the connections to the output terminals of the Model 8282-1 Spike Generator.

5.8 REMOTE TRIGGERING – In lieu of the panel button controls for repetition rate adjustment or phase shifting on a.c. waveforms, it is also possible to trigger the spike in step with an external pulse source or by system-generated switching of the single pulse feature.

As shown in Fig. 7, the connector on the rear panel can be wired for either of two triggering methods:

a) With an external square wave pulse generator connected to pins A and B, and with the S/P ENABLE button depressed, the spike can be triggered up to 1000 p.p.s. in the 5.0 I-IS and 10.0 I-IS modes and up to 50 p.p.s. in the 0.15 I-IS mode. The amplitude of the external pulse generator should be 10 volts peak-to-peak. At rates greater than 25 p.p.s., the LED meter will not indicate the actual output level.

b) With a remote switch supplying 24 volts d.c. to pins A and C, and with the S/P ENABLE button depressed, the spike can be triggered up to 50 p.p.s. in all three waveshapes.

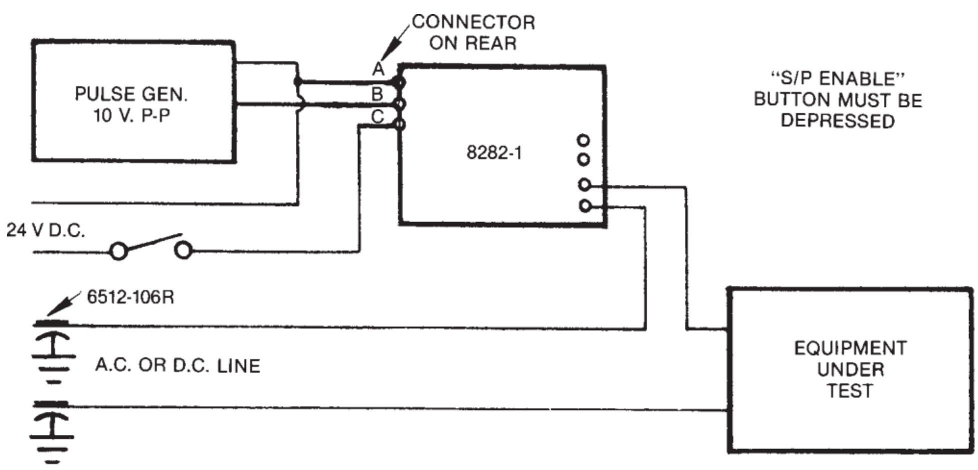


FIG. 7 TWO METHODS OF REMOTE TRIGGERING

6.0 APPLICATION INFORMATION

6.1 ACCESSORIES – In addition to the items indicated in the various test setup diagrams in previous paragraphs, accessories are available for special applications. For example:

a) High Current Loads – When injecting spikes into loads which demand more than 50 amperes of power current to the EUT, an auxiliary transformer is available. The Type 8282-150 Pulse Transformer is designed to plug directly into the SERIES output terminals of the Model 8282-1. The secondary of this transformer provides large terminal screws capable of carrying up to 150 amperes of power current when connected in series between the power source and the EUT.

However, this transformer will not transmit the spike without distortion. There will be some loss in amplitude and the duration of the spike will be stretched.

b) Injecting Into Cables – Another useful accessory is the Type 7512-1 Spike Injection Probe. This probe enables the injection of spikes into cables as required by Space Shuttle specifications and other specialized specifications. See Fig. 8. This probe will modify the duration and amplitude of the spike.

If a longer spike duration is desired, plug the Type 7519-1 Pulse Shaping Network into the SERIES output terminals and the Banana-to-BNC adapter into the output terminals of the Type 7519-1.

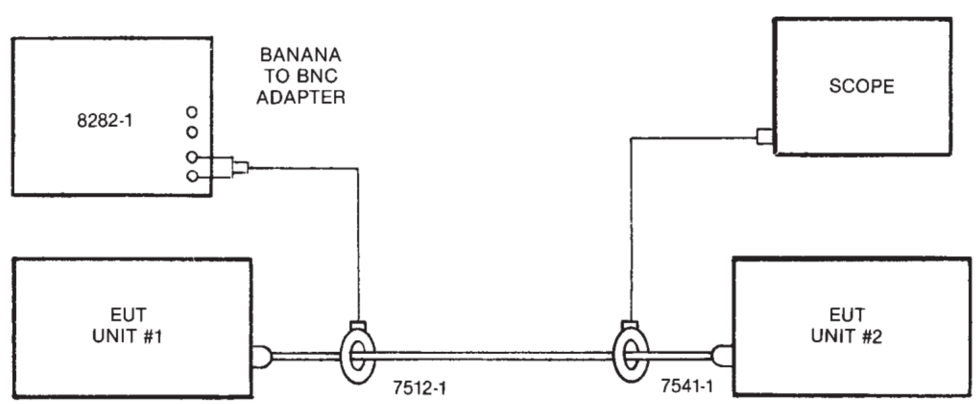


FIG. 8 TEST SETUP FOR INJECTION INTO CABLES

c) Spark Discharge Testing – When a high voltage spark discharge is required, it can be obtained by an external pulse transformer designed to plug directly into the SERIES terminals. The Type 7115-2 High Voltage Pulse Transformer can be used to step up the output voltage of the Model 8282-1 to as much as 15 kilovolts. The secondary of this transformer is fitted with ceramic insulated terminals. The space between the metal parts of the terminals will withstand up to 15 kilovolts before arcing occurs. For lower arc-over voltages, a spark gap such as the Type 7510-1 can be mounted on the terminals with electrodes which can be adjusted to shorter dimensions. Fig.9 illustrates one method of applying spark discharge voltages to the case of an equipment under test.

With a spark gap in dry air at sea level and 25°C, the approximate voltage required to break down the gap is:

Peak Voltage	7510-1 Needle Gap	7510-1 Spherical Gap
5 KV	.15" (3.8 mm)	.049" (1.24 mm)
10 KV	.33" (8.4 mm)	.10" (2.54mm)
15 KV	.60" (15.2 mm)	.17" (4.32 mm)

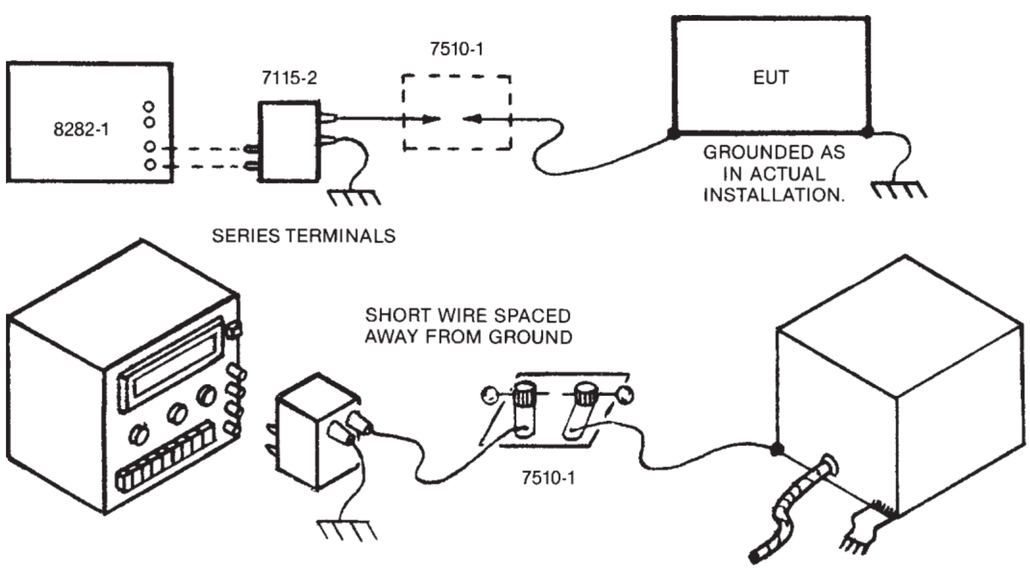


FIG. 9 TEST SETUP FOR STATIC DISCHARGE

d) Higher Output Voltages – The Type 8527-2 Transient Pulse Transformer is designed to plug into the SERIES output terminals to provide a step-up of the spike amplitude into higher impedance loads. The com- bination of the 8282-1 and the 8527-2 enables adjustment of the spike amplitude up to 2000 volts into a 50 ohm resistive load.

7.0 MAINTENANCE AND CALIBRATION

7.1 GENERAL – The following paragraphs explain the various adjustments which can bring the performance into the specified limits.

7.2 TEST EQUIPMENT REQUIRED

a) Variable Autotransformer, adjustable over the range needed for the line voltage input to the Model 8282-1. Either 105-125 volts or 210-250 volts as indicated below the power connector on the rear panel of the Model 8282-1. All of these tests must be performed with the line voltage adjusted to exactly 115 volts for domestic units and exactly 230 volts for exported units as required.

b) A.C. Voltmeter with scales suitable for establishing exactly 115 volts or 230 volts into the Model 8282-1 as required.

c) Digital D.C. Voltmeter with scales from 10 volts to 1000 volts.

d) High Frequency Oscilloscope with X100 Low Capacitance Probe. Must be capable of seeing 100 MHz waveforms. A scope with storage capability is also useful.

e) Two 10 ohm resistors, ± 5%, 2 watt composition, connected in parallel to provide a 5.0 ohm load on the output terminals, such as Solar Type 8525-1.

f) Power source, 400 Hz. Single phase, capable of supplying 115 or 230 volts at 3.0 amperes.

g) D.C. Power Supply, 24-28 volts, 0.1 amperes.

h) Step-down Transformer to supply approximately 6 to 10 volts, 50-400 Hz.

7.3 PRELIMINARY PROCEDURE

7.3.1 With no power connected, remove the black screws which fasten the top and bottom covers and put the covers aside. Place the unit upside down on the bench with the panel facing toward you.

DO NOT DEPRESS THE 0.15 μS BUTTON OR THE S/P BUTTON WHEN THE UNIT IS UPSIDE DOWN.

7.3.2 Connect the power cord to the rear of the unit and to the variable autotransformer. Also connect an A.C. voltmeter to the output of the autotransformer. Adjust the voltage out of the autotransformer to exactly 115 volts or 230 volts as required. The correct voltage is indicated below the power connector on the rear panel of the Model 8282-1. Be sure to maintain the exact line voltage throughout these tests.

7.3.3 Depress the P.P.S. X1, and the 10.0 µS buttons. Adjust the FREQUENCY, P.P.S. knob to 5 for approximately five pulses per second. Adjust the AMPLITUDE knob fully counterclockwise. Move the toggle switch on the rear panel to the INTERNAL SYNC position. Then depress the POWER pushbutton to apply power to the unit. The pushbuttons which have been depressed will light up. The LINE PHASE button will also be illuminated.

7.4 CHECK OF PLUG-IN LOW VOLTAGE POWER SUPPLY—(Located on the bottom side of the unit).

7.4.1 Connect negative probe of the digital D.C. Voltmeter to pin 6 on the plug at the base of the plug-in board. Pin #1 is nearest the front of the unit. See Fig. 10 and Fig. 11. Alternatively, the probe can be placed on the negative end (case) of the 500 µF (C8, Fig. 16) capacitor located on the p.c. board.

7.4.2 Place the positive voltmeter probe on pin 3 to measure + 20 volts. This voltage should be between 19 and 21 volts.

7.4.3 Place the positive voltmeter probe on pin 11 to measure + 10 volts. This voltage should be between 9.5 and 10.5 volts.

7.4.4 Place the positive voltmeter probe on pin 22 to measure approximately 8.0 volts. Record this exact voltage.

7.4.5 Connect the positive voltmeter probe to the junction of VR3 and R44. Refer to Fig. 11. This voltage should be between 4.5 and 5.2. Record the exact voltage for future reference.

7.5 ADJUSTMENT OF HIGH VOLTAGE POWER SUPPLY

7.5.1 Turn the unit over so that the top is accessible. See Fig. 12. Locate the two high wattage resistors, R1 and R7, on the right side toward the rear of the unit as viewed from the front. Also locate the two resistors, R5 and R6, on the left side as viewed from the front.

USE EXTREME CAUTION IN PERFORMING THE FOLLOWING STEP, SINCE THE VOLTAGES ENCOUNTERED CAN BE DANGEROUS!

7.5.2 Connect the negative probe of the digital d.c. voltmeter to the black wire on R5.

7.5.3 Rotate the AMPLITUDE knob fully clockwise. With the digital D.C. voltmeter set for 1000 volt scale, measure the voltage on both ends of R1 or R7. The lower of the two voltages should be at least 725 volts. During this measurement and all other measurements the a.c. line voltage into the unit must be maintained at 115 volts or 230 volts as required.

FOR THE BALANCE OF THE TESTS, THE OSCILLOSCOPE AND THE 5 OHM LOAD MUST BE CONNECTED ACROSS THE SERIES OUTPUT TERMINALS.

7.6 ADJUSTMENT OF HIGH VOLTAGE TO 0.15 µS FUNCTION

7.6.1 Connect a 5 ohm **non-inductive** resistor mounted directly across the SERIES output terminals with zero lead length. Connect the 100 MHz oscilloscope across the resistor. Depress the X1 pushbutton and adjust the FREQUENCY knob to 5. Depress the 0.15 µS pushbutton and rotate the AMPLITUDE control fully clockwise.

It is normal for the shape of the 0.15 µS spike to have small irregularities. The ragged shape is similar to that encountered in systems which generate extremely short transients on power wiring.

7.6.2 With the equipment setup as in the previous step, locate the high wattage resistor R6 (Fig. 12). This is the adjustable resistor next to a fixed resistor mounted on the left side near the rear of the unit as viewed from the front.

CAUTION! HIGH VOLTAGES EXIST ON RESISTORS R6, R8 AND R10. BEFORE ADJUSTING A SLIDER ON A HIGH WATTAGE RESISTOR, TURN THE AMPLITUDE DOWN TO ZERO AND PUSH THE POWER SWITCH OFF. ADJUST THE SLIDER A SMALL AMOUNT, TURN ON THE POWER AND RESET THE AMPLITUDE. THIS PRECAUTION MAY REQUIRE REPEATING THE ADJUSTMENT SEVERAL TIMES BUT IT WILL AVOID AN ACCIDENTAL AND UNCOMFORTABLE ELECTRIC SHOCK.

7.6.3 Carefully adjust the oscilloscope to view the pulse (1 V/Div with X100 Low Capacitance probe, .05 µS/Div) and note the peak amplitude. If it is not 600 volts, peak, adjust the tap on R6, the adjustable resistor located in step 7.6.1, for exactly 600 volts.

7.7 ADJUSTMENT OF HIGH VOLTAGE TO 5.0 AND 10.0 µS FUNCTIONS

7.7.1 Turn the unit over so that it can be viewed from the bottom with the front panel toward you (Fig. 11). Locate the high wattage resistor, R8, with a green wire on the tap (in the cluster of resistors on the left side as viewed from the front).

7.7.2 With the 5 ohm load and the oscilloscope connected to the SERIES output terminals, depress the 5.0 µS pushbutton. Carefully adjust the controls on the oscilloscope to view the pulse (2 µS/Div) and note the peak amplitude. If it is not 600 volts, adjust the tap on R8, the resistor located in step 7.7.1, to exactly 600 volts, peak, on the oscilloscope.

7.7.3 Locate the high wattage resistor, R10 (Fig. 11), with a yellow wire connected to the tap (in the cluster of resistors on the left side as viewed from the front). Depress the 10.0 µS pushbutton and adjust the controls of the oscilloscope to view the pulse (5 µS/Div) and note the peak amplitude. If the amplitude is not 600 volts, adjust the tap on R10 to exactly 600 volts, peak, on the oscilloscope.

7.8 ADJUSTMENT OF THE BAR-GRAPH METER

7.8.1 Depress the 10.0 µS pushbutton. Turn the unit over so that the large printed board is accessible and is viewed from the front of the unit (Fig. 12). Rotate the AMPLITUDE knob for exactly 400 volts, peak, as viewed on the oscilloscope.

7.8.2 Locate the group of three trimpots to the right of the center of the large printed board. Adjust the rightmost trimpot, R24, until the bar-graph meter reads exactly 400 volts.

7.8.3 Depress the 5.0 µS pushbutton and adjust the trimpot, R23, in the center of the group until the bar-graph meter reads exactly 400 volts.

7.8.4 After a period of time to allow the 0.15 circuit to settle, at least ten minutes, depress the 0.15 µS pushbutton and adjust the leftmost trimpot, R22, of the group until the bar-graph meter reads exactly 400 volts.

7.9 ADJUSTMENT OF REPETITION RATE AND LINE SYNC CIRCUITS

7.9.1 Adjust oscilloscope controls for 20 mS/Div and 100 V/Div. Depress X10 and 10 µS push buttons. Set FREQUENCY control to 5 P.P.S. Locate the group of three trimpots to the left of the center of the large p.c. board.

7.9.2 A pulse should fall on every division of the oscilloscope. If not, adjust the rightmost trimpot, R33, until this condition is achieved (Fig. 12).

7.9.3 Adjust the oscilloscope controls for 1 mS/Div, 100 V/Div and LINE. Depress the pushbutton marked 60 Hz SYNC (European models are marked 50 Hz SYNC). The AMPLITUDE knob should be rotated for 100 volts indication on the bar-graph meter.

When syncing with a 60 Hz line, rotating the PULSE POSITION knob from one end to the other should move the spike across 8 1/2 divisions on the oscilloscope screen. When syncing with a 50 Hz power line, rotating the PULSE POSITION knob from one end to the other should move the spike across ten divisions on the oscilloscope screen. If these conditions are not found, adjust the middle trimpot, R30, (in the left group of trimpots) until this is possible (Fig. 12).

7.9.4 Adjust the oscilloscope controls for 0.2 mS/Div, 100 V/Div, External Sync. Apply 115 or 230 volts 400 Hz to the EXTERNAL SYNC terminals on the rear panel and move the toggle switch down. Connect a small 400 Hz voltage (6 to 10 volts) to the external sync input of the oscilloscope.

Depress the pushbutton marked 400 Hz SYNC. Under these conditions, the full range rotation of the PULSE POSITION knob should move the spike across 6 1/4 divisions on the oscilloscope screen. If not, adjust the leftmost trimpot, R31, in the left group until this condition is reached (Fig. 12).

7.9.5 After these adjustments are successfully carried out, return the rear toggle switch to its upper position (INTERNAL SYNC) and remove the external sync voltage from the scope. Adjust the oscilloscope to NORMAL Mode.

7.10 CHECK OF THE SINGLE PULSE FEATURE

7.10.1 With the oscilloscope and a 5 ohm load on the SERIES terminals, adjust the AMPLITUDE knob for 400 volts on the bar-graph meter. Depress buttons S/P ENABLE, X1 (or X10), and 10 µS.

7.10.2 With the oscilloscope set for internal automatic sync, observe the oscilloscope as the PUSH FOR S/P button is pressed. The amplitude of the observed waveform should match that of the bar-graph meter. If the waveform is not seen on the oscilloscope, depress the button again.

7.11 CHECK OF PULSE POSITIONING WITH
EXTERNAL POWER TO THE SYNC CIRCUIT

7.11.1 Connect the equipment as shown in Fig. 6. The toggle switch on the rear panel must be in the EXTERNAL SYNC position. In this position, the lamps in the pushbuttons on the spike generator will not illuminate until power is applied to the terminals on the rear panel of the unit.

7.11.2 Connect an oscilloscope across the power input to the EUT. **Use a power line isolation transformer in the power input to the oscilloscope to isolate the scope case from ground.**

7.11.3 Adjust the oscilloscope controls to view the a.c. waveform feeding the EUT. Depress the 60 Hz SYNC or the 400 Hz SYNC button as needed to match the power frequency feeding the EUT. Also press the 10.0 µS button.

7.11.4 Adjust the AMPLITUDE knob for 100 volts on the bar-graph meter. Rotate the PULSE POSITION knob and view the waveform on the oscilloscope. The 100 volt spike should be visible riding on the a.c. waveform. The full rotation of the knob should cause the spike to traverse at least one-half of the power frequency sine wave. When it disappears from view at some point in the rotation of the knob, push the LINE PHASE button to continue through the entire sine wave. If the spike does not travel the entire range, repeat the instruction of Paragraph 7.9.

Due to phase differences existing in the test setup, it is not possible to predict the exact knob position at which the spike will reach zero crossover on the a.c. sine wave.

8.0 PARTS LOCATION

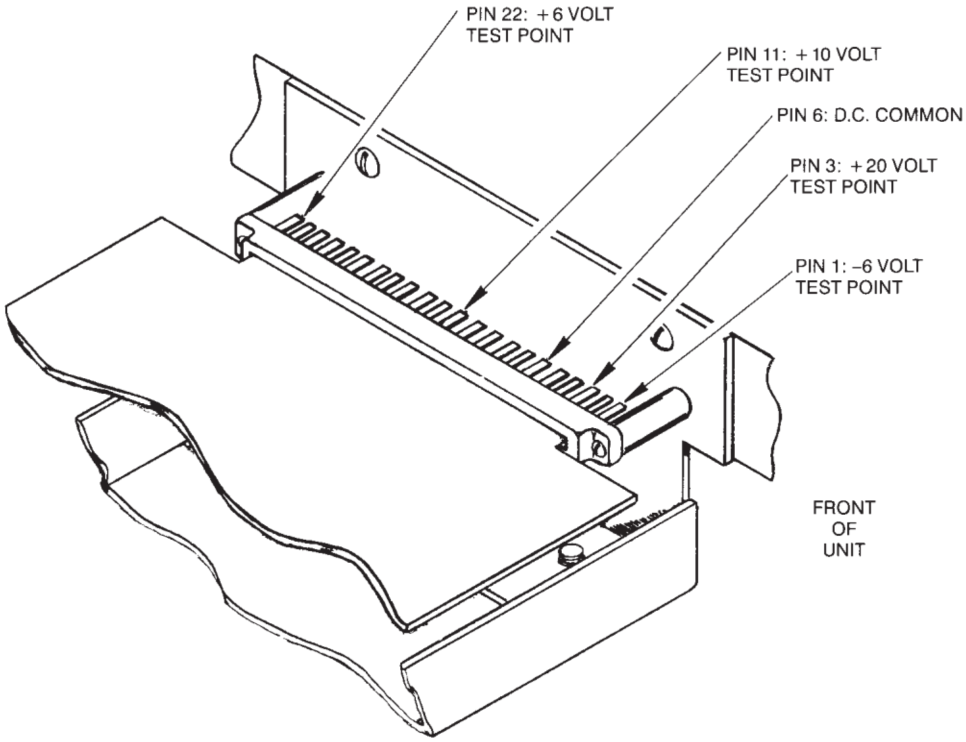


FIG. 10 LOW VOLTAGE POWER SUPPLY CONNECTOR TEST POINTS

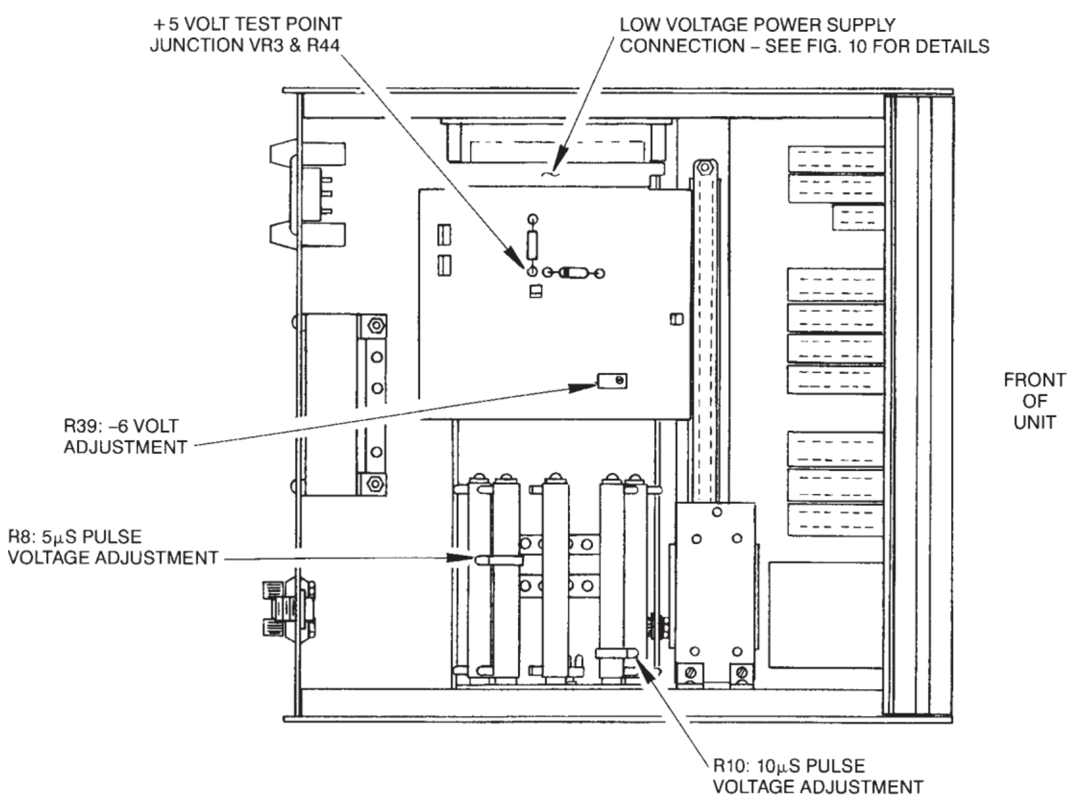


FIG. 11 BOTTOM VIEW VOLTAGE TEST AND ADJUSTMENT POINTS

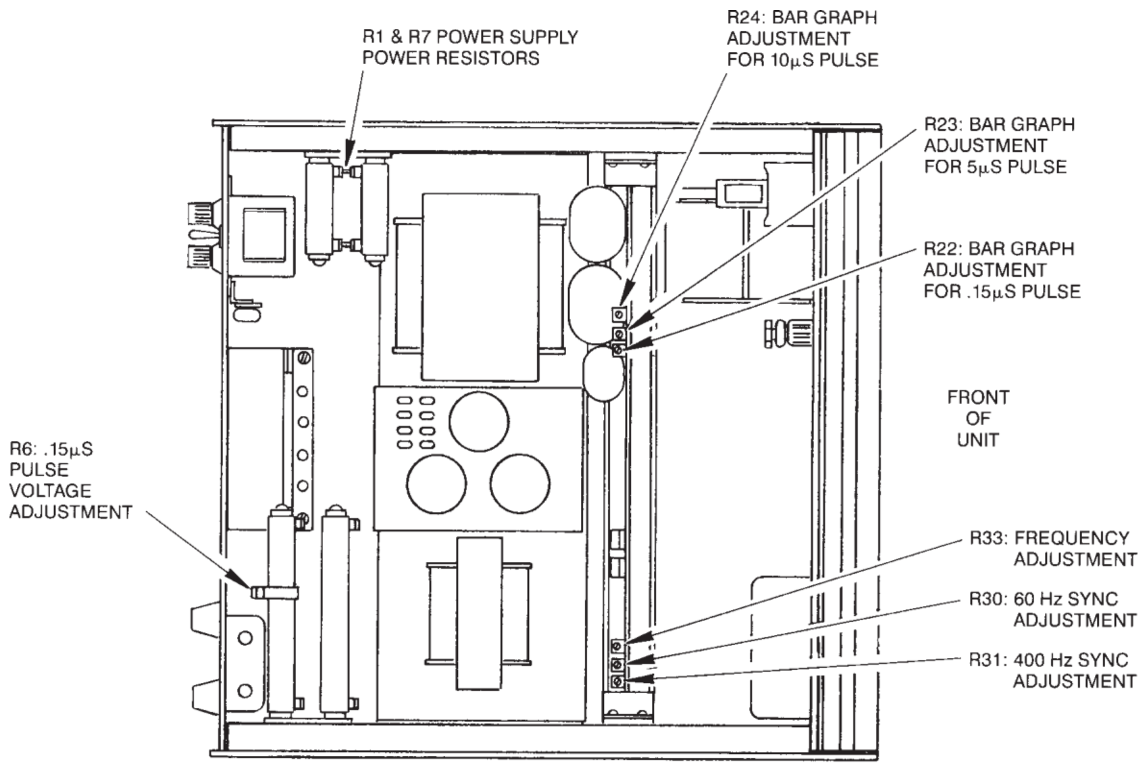


FIG. 12 TOP VIEW TEST AND ADJUSTMENT POINTS

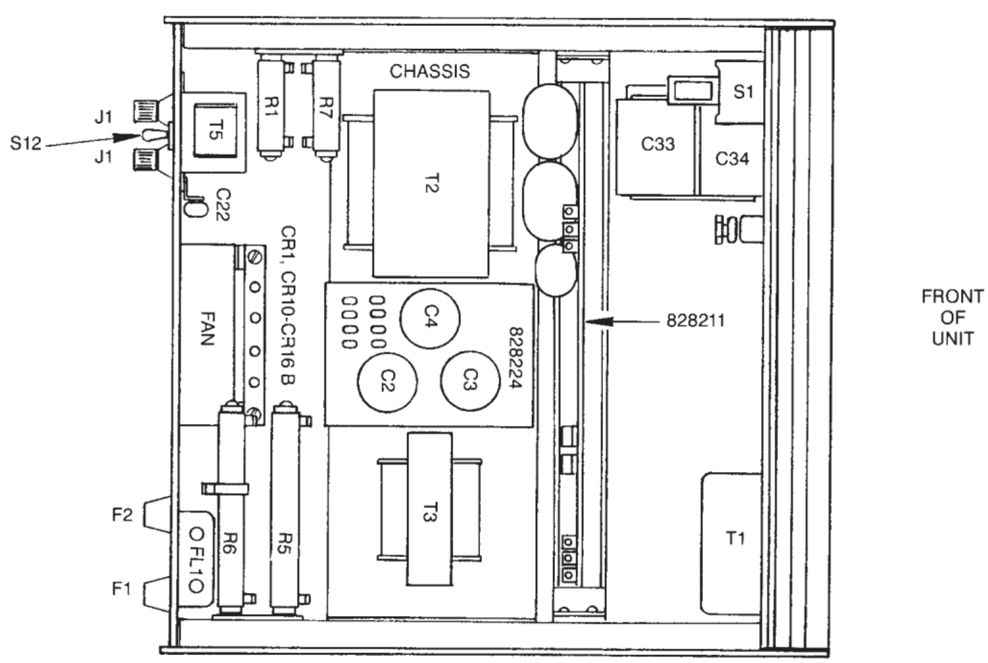


FIG. 13 TOP VIEW, PARTS LOCATION

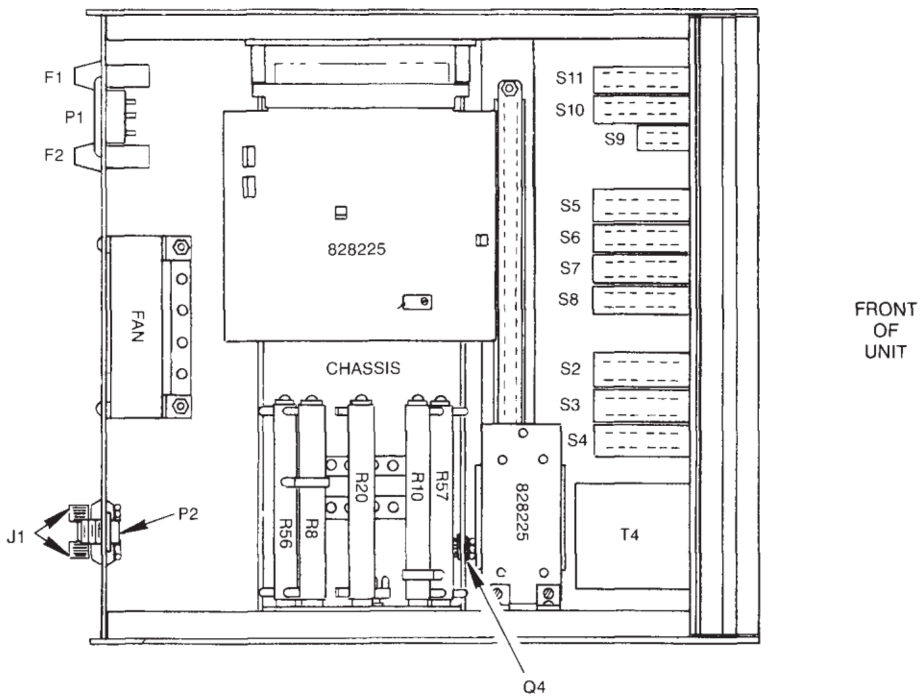


FIG. 14 BOTTOM VIEW, PARTS LOCATION

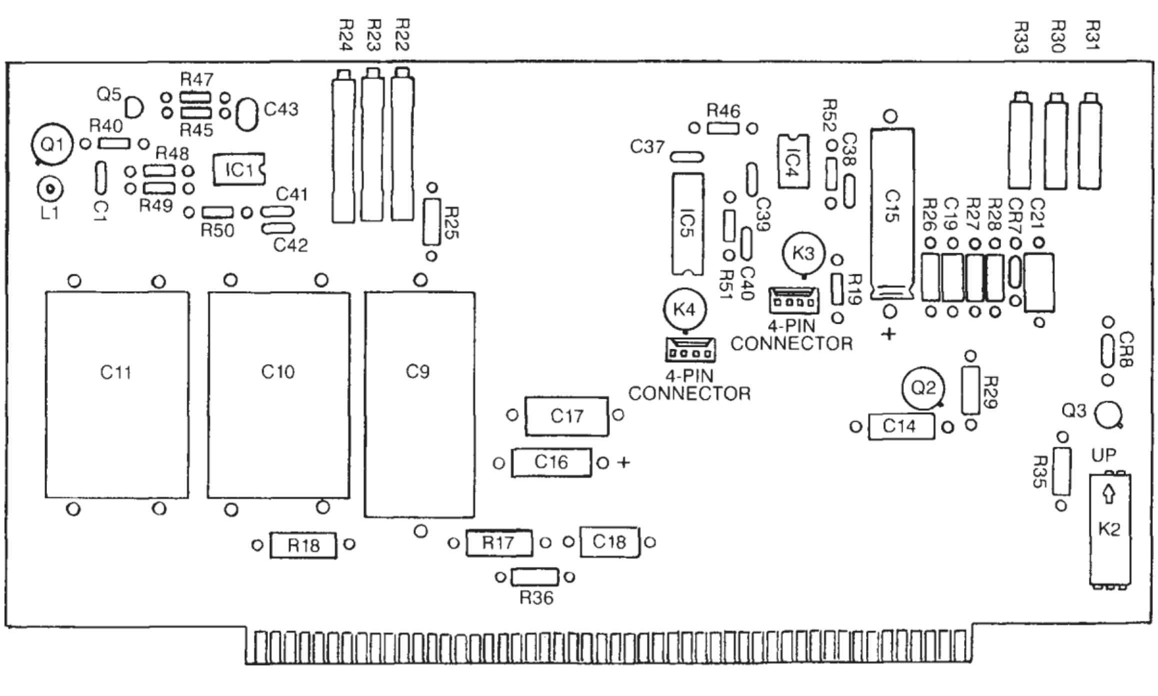


FIG. 15 PRINTED CIRCUIT BOARD 828211J VIEWED FROM THE REAR

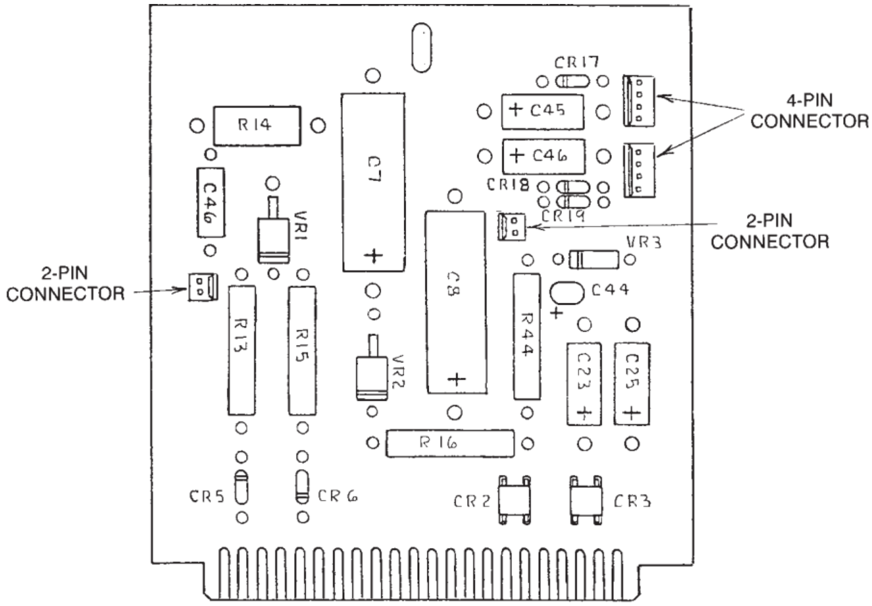


FIG. 16 LOW VOLTAGE POWER SUPPLY BOARD 828225F

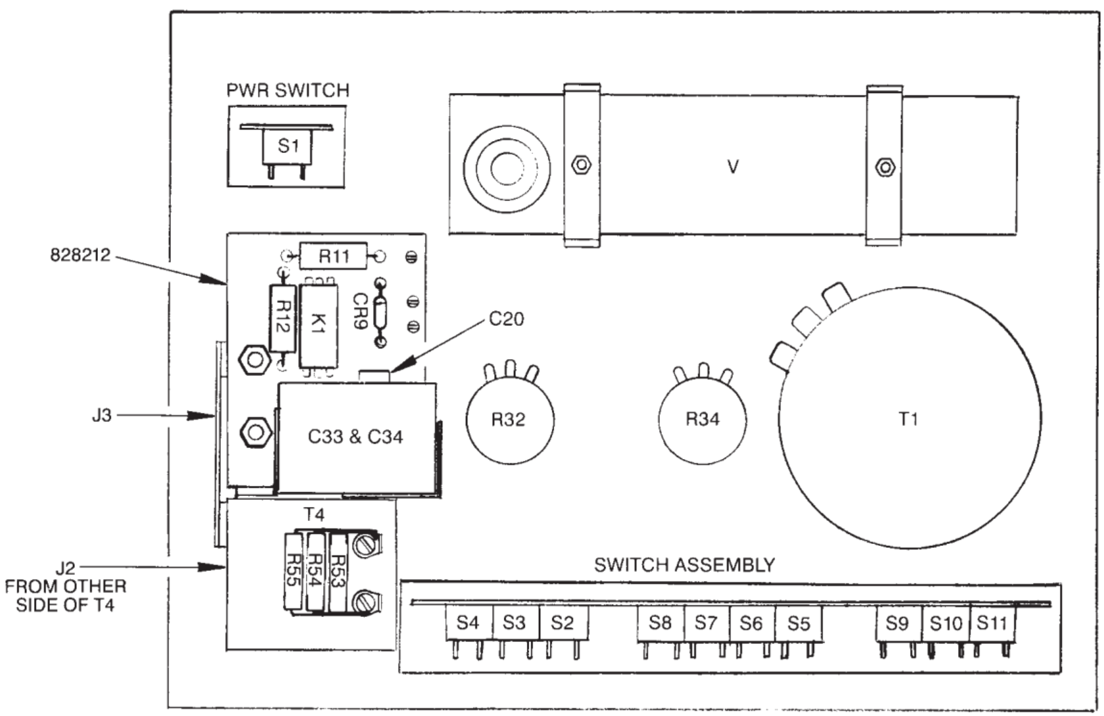
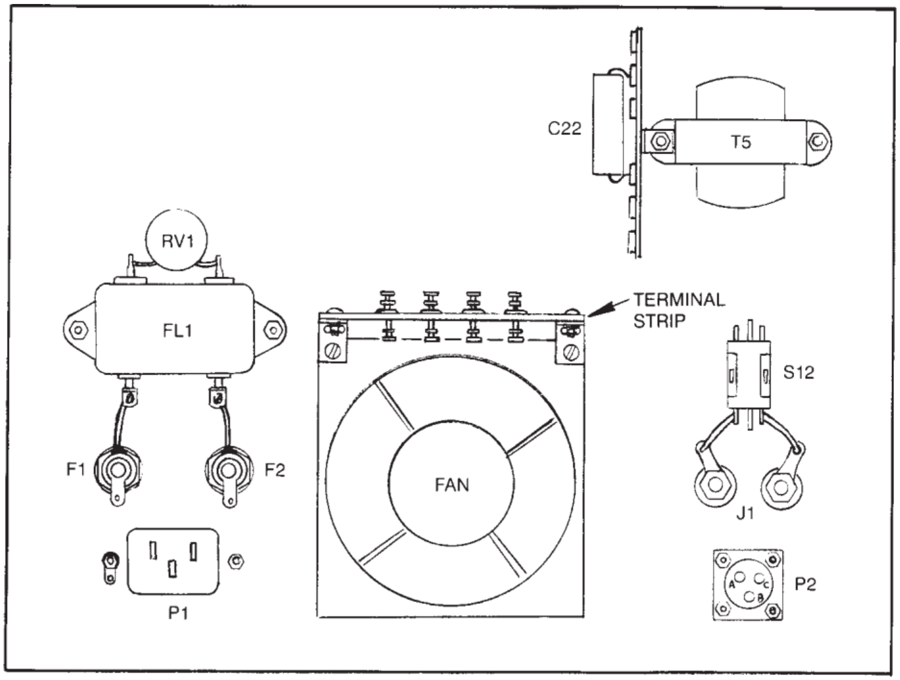


FIG. 17 FRONT PANEL PARTS LOCATIONS



VIEWED FROM INSIDE UNIT

FIG. 18 BACK PANEL PARTS LOCATION

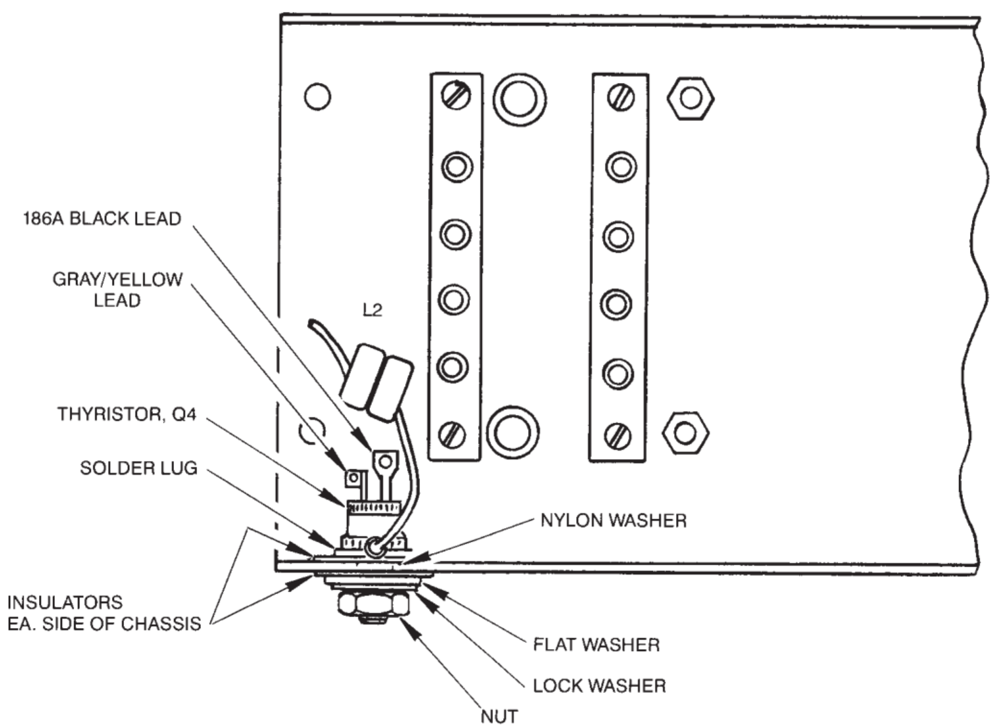
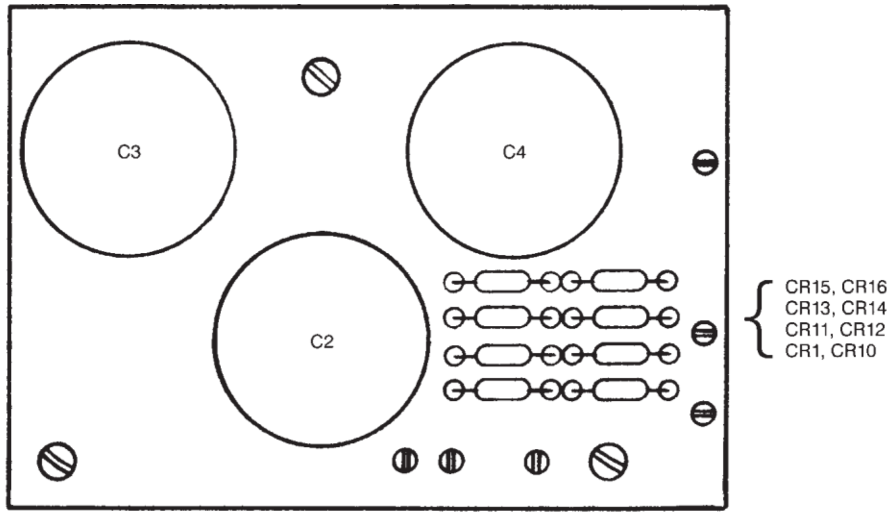
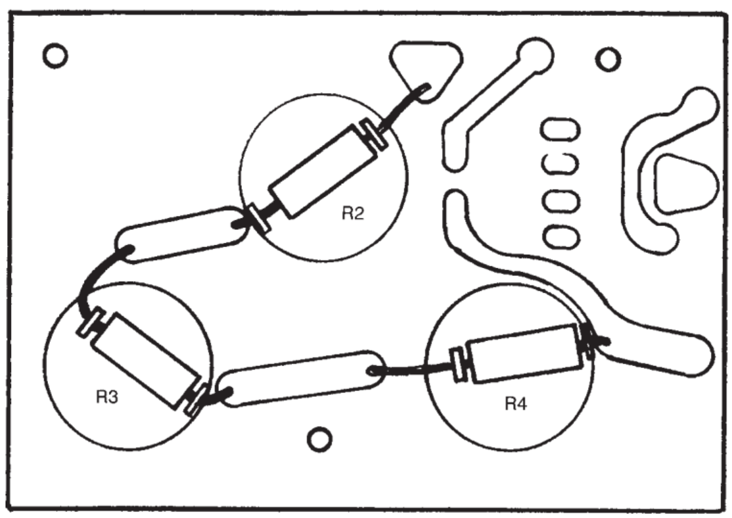


FIG. 19 THYRISTOR, Q4, ASSEMBLY



TOP VIEW



BOTTOM VIEW

FIG. 20 RECTIFIER PRINTED CIRCUIT BOARD 828224

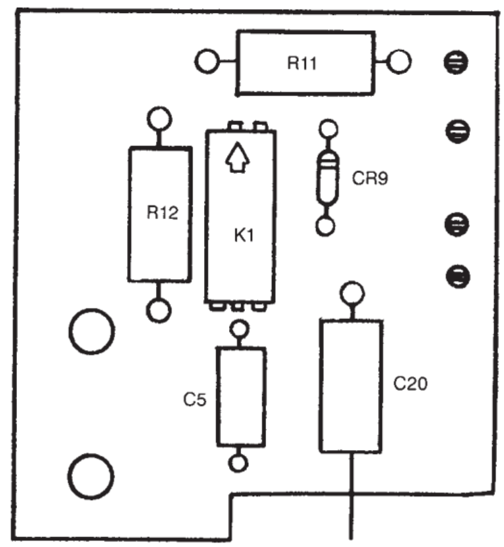


FIG. 21 RELAY PRINTED CIRCUIT BOARD 828212

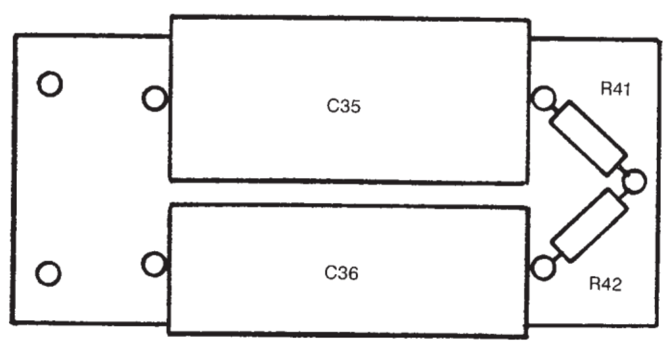


FIG. 22 SPARK SUPPRESSOR BOARD 828255

9.0 PARTS LIST

REFERENCE DESIGNATION	DESCRIPTION	MANUFACTURER & PIN
C1	Capacitor, 1.0 µF ± 10% 50V Ceramic	Kemet CKR06BX105KR
C2,C3,C4	Capacitor, 200-350 µF 350V Electrolytic	Mallory FP141
C5	Capacitor, .01 µF ± 20% 900V Met. Polyprop	Electrocube C-2829
C6	Deleted	
C7,C8,C15	Capacitor, 500 µF ± 10% 50V Electrolytic	Sprague TVA1315
C9	Capacitor, 1.2 µF ± 10% 270 VAC Polyprop-Foil	Electrocube 950B1 E125K
C10,C11	Capacitor, 1.8 µF ± 20% 270 VAC Polyprop-Foil	Electrocube C-2784
C12	Deleted	
C13	Deleted	
C14	Capacitor, .22 µF ± 20% 200V Met. Mylar	Electrocube 230B1 C224M
C16	Capacitor, 33 µF ± 10% 20V Tantalum	Sprague 150D-336X-9020R2
C17	Capacitor, 3.3 µF ± 5% 100V Met. Mylar	Electrocube 230B 1 B335J
C18	Capacitor, .15 µF ± 5% 100V Met. Mylar	Electrocube 230B1B154J
C19	Capacitor, .033 µF ± 5% 100V Met. Mylar	Electrocube 230B1 B333J
C20	Capacitor, .1 µF ± 20% 270 VAC Met. POlyprop	Electrocube 935B1 E104M
C21	Capacitor, .1 µF ± 20% 135 VAC Met. Polyprop	Electrocube 935B1 C104M
C22	Capacitor, .47 µF ± 20% 270 VAC Met. Polyprop	Electrocube 935B1 E474M
C23,C24	Capacitor, 820 µF ± 20% 15V Tantalum	Sprague 109D-827X-9015T2
C25,C26	Capacitor, 560 µF ± 20% 10V Tantalum	Kemet T140D567M010AS
C27 thru C32	Deleted	
C44	Capacitor, 220 µF ± 10% 10V Tantalum	Kemet T368D227K010AS
C33,C34	Capacitor, 5.0 µF ± 20% 270 VAC Met. Polyprop	Electrocube 910B1 E505M
C35	Capacitor, .47 µF ± 20% 270 VAC Polyprop-Foil	Electrocube 950B1 E474M
C36	Capacitor, 1.0 µF ± 10% 270 VAC Polyprop-Foil	Electrocube 950B1 E105K
C37,C38,C39	Capacitor, .1 µF ± 10% 100V Ceramic	Kemet CKR06BX104K
C40	Capacitor, .047 µF ± 10% 200V Ceramic	Kemet CKR06BX473K
C41	Capacitor,.47 µF ±10% 100V Ceramic	Kemet CKR06BX474K
C42	Capacitor, .01 µF ± 10% 200V Ceramic	Kemet CKR06BX103K
C43	Capacitor, .22 µF ± 5% 500V Mica	Sprague CM04ED220J03
C45,C47	Capacitor, 50 µF ± 20% 25V Electrolytic	Sprague TE1209
C46	Capacitor, .18 µF ± 10% 200V Met. Mylar	Electrocube 230B1 B184J
CR1,CR10,CR11, CR12,CR13,CR14, CR15,CR16	Diode	Motorola IN4007
CR2,CR3	Rectifier Bridge	Diodes Inc. DB-102
CR4	Deleted	
CR5,CR6,CR7, CR8,CR9,CR17, CR18,CR19	Diode	Diodes Inc. J2
DS1 thru DS11	Lamp	Sylvania No 327

REFERENCE DESIGNATION	DESCRIPTION	MANUFACTURER & PIN
F1, F2	Fuse 3 Amp Slow-Blow in 115V unit 1 1/2 amp Slow-Blow in 230V unit	Littlefuse 3AG3ASB Littlefuse 3AG1.5ASB
FAN	Blower 115/230 VAC 50/60 Hz	Toyo TF92345AW
FL	Line Filter	Solar 828254
IC1,IC4	Timer	11 NE555P
IC2	Deleted	
IC3	Deleted	
IC5	Sync Counter	T.I. SN74163N
J1	Binding Post, Red (2)	Superior BP31-1 OR
J2	Binding Post, Red (Mod.) (2)	Solar 828229
J3	Binding Posts, Red & Black (1 ea)	Superior BP31-1 OR Superior BP31-1 OB
K1	Relay, 5V Mercury Wetted	Magnecraft W134MIP-1
K2	Relay, 24V Reed	Magnecraft W1 04MIP-65
K3,K4	Relay, 26 VDC	Teledyne 712-26
L1	Coil	Solar 828251
L2	Coil	Solar 828252
P1	A.C. Receptacle	Switchcraft EAC-309
P2	Connector	Bendix MS3102A-10SL-3P
01	Transistor	Motorola 2N697
02	SCR	Motorola 2N2323
03	Transistor, Unijunction	Motorola 2N2647
04	SCR	Solid State 2N5206 or Int'l Rectifier 22RIA100
05	Transistor	Motorola 2N3904
R1,R7	Resistor, 25K ohm ± 5% 25W Wirewound	Ohmite L25J25R
R2,R3,R4	Resistor, 100K ohm ± 5% 2W Carbon	Allen-Bradley RCR42GF104J
R5,R56,R57	Resistor, 50K ohm ± 5% SOW Wirewound Adjustable	Ohmite L50J50K
R6,R8,R10	Resistor, 1 OK ohm ± 5% 50W Wirewound Adjustable	Ohmite D50K10K
R9	Deleted	
R20	Resistor, 3K ohm ± 5% 50W Wirewound	Ohmite L50J3KO
R11	Resistor, 180K ohm ± 5% 2W Carbon	Allen-Bradley RCR42GF184J
R12	Resistor, 10K ohm ± 5% 2W Carbon	Allen-Bradley RCR42GF103J
R13	Resistor, 4K ohm ± 5% 5W Wirewound	Ohmite 95J4KO
R14	Resistor, 1.2K ohm ± 5% 5W Wirewound	Ohmite 95J1 K2
R15	Resistor, 4.7K ohm ± 5% 2W Carbon	Allen-Bradley RCR42GF472J
R16,R44	Resistor, 470 ohm ± 5% 5W Wirewound	Ohmite 95J470
R17,R18	Resistor, 1.5 megohm ± 5% 1 W Carbon	Allen-Bradley RCR32GF155J

REFERENCE DESIGNATION	DESCRIPTION	MANUFACTURER & PIN
R19	Deleted	
R21	Deleted	
R22,R23,R24	Potentiometer, Trimmer 500K ohm	Bourns 3059Y-1-504
R25	Resistor, 825K ohm ± 1% 1/4W Film	Dale RN60D8253F
R26	Resistor, 22K ohm ± 5% 1/2W Carbon	Allen-Bradley RCR20GF223J
R27,R28	Resistor, 47 ohm ± 5% 1/2W Carbon	Allen-Bradley RCR20GF470J
R29,R36	Resistor, 100K ohm ± 5% 1/2W Carbon	Allen-Bradley RCR20GF104J
R30,R33	Potentiometer, Trimmer 5K ohm	Bourns 3006P-1-502
R31	Potentiometer, Trimmer 20K ohm	Bourns 3006P-1-203
R32,R34	Potentiometer, Molded Comp. 50K ohm ± 10% 2W	Ohmite CB-5031
R35	Resistor, 1 K ohm ± 5% 1/2W Carbon	Allen-Bradley RCR20GF102J
R37	Deleted	
R38	Deleted	
R39	Deleted	
R40	Resistor 1 K ohm ± 5% 1/4W Carbon	Allen-Bradley CR07GF102J
R41	Resistor, 24 ohm ± 5% 1/2W Carbon	Allen-Bradley RCR20GF240J
R42	Resistor, 22 ohm ± 5% 1/2W Carbon	Allen-Bradley RCR20GF220J
R43	Deleted	
R45,R46	Resistor, 2.2K ohm ± 5% 1/4W Carbon	Allen-Bradley RCR07GF222J
R47	Resistor, 470 ohm ± 5% 1/4W Carbon	Allen-Bradley RCR07GF471 J
R48	Resistor, 4.7K ohm ± 5% 1/4W Carbon	Allen-Bradley RCR07GF472J
R49	Resistor, 1.8K ohm ± 5% 1/4W Carbon	Allen-Bradley RCR07GF182J
R50	Resistor, 27K ohm ± 5% 1/4W Carbon	Allen-Bradley RCR07GF273J
R51	Resistor, 75 ohm ± 5% 1/4W Carbon	Allen-Bradley RCR07GF750J
R52	Resistor, 10K ohm ± 5% 1/4W Carbon	Allen-Bradley RCR07GF103J
R53,R54,R55	Resistor, 25 ohm ± 5% 25W Wirewound	Ohmite 95J25R
S1	Switch, Push-lock/Release 4 Pole	Switchcraft 67012-506
S2,S3,S4	Switch, 3 Station Interlock 4 Pole	Switchcraft 67031 K-512
S5,S6,S7,S8	Switch, 4 Station Interlock 4 Pole	Switchcraft 67041 K-512
S9,S10,S11	Switch, 3 Station (2 Push-Lock/Release 4 Pole One Non-Lock 2 Pole)	Switchcraft 67037-512
S12	Switch, Toggle DPDT	Arrowhart 81027CE
T1	Transformer, Variable for 115V unit for 230V unit	Superior 10C Superior 12
T2	Transformer	Solar 828235
T3	Transformer	Solar 828234
T4	Transformer, Pulse	Solar 828236
T5	Transformer	Solar 828271

REFERENCE DESIGNATION	DESCRIPTION	MANUFACTURER & PIN
V	Meter (LED Display)	Solar 828280
VR1	Zener Diode, 20V	Motorola IN3027B
VR2	Zener Diode, 10V	Motorola IN3020B
VR3	Zener Diode, 5.1 V	Motorola IN5338B

MISCELLANEOUS:

Screened Lens	Solar 828266
Card Connector for 828225	Cinch 50-22A-20
Card Connector for 828211	Vector R-681-3
Transient Circuit Board	Solar 828211
Power Supply Printed Board	Solar 828225
Relay Printed Board	Solar 828212
Rectifier Printed Board	Solar 828224
Knob, Frequency	Buckeye SSN-97
Knob, Amplitude & Pulse Position	Buckeye SSN-95
Terminal Strip	H.H. Smith 901
Terminal Strip	H.H. Smith 862
Terminal Strip (3)	Solar 828223
Fuseholder (2)	Schurter FEU031.1653
Connector, Meter	Ampheno1126-222
Connector, External Cable	Bendix MS3106A-10SL-3S
Suppressor Board	Solar 828255
PC Board Hold-Down Bracket (2)	Solar 828256
Fuse Carrier	Schurter FEK031.1666
4 Terminal Header(2)	Molex 22-23-2041
2 Terminal Header(3)	Molex 22-23-2021
4 Socket Receptacle(2)	Molex 22-01-2047
2 Socket Receptacle(3)	Molex 22-01-2027.
Harness I	Solar 828245
Harness II	Solar 828246
Harness III	Solar 828247
Harness IV	Solar 828269
Instruction Manual	Solar 828270

OPTIONAL ACCESSORIES:

Type 7115-2 Transient Pulse Transformer
Steps up voltage to 15 KV. (Use with 7510-1 Spark Gap)

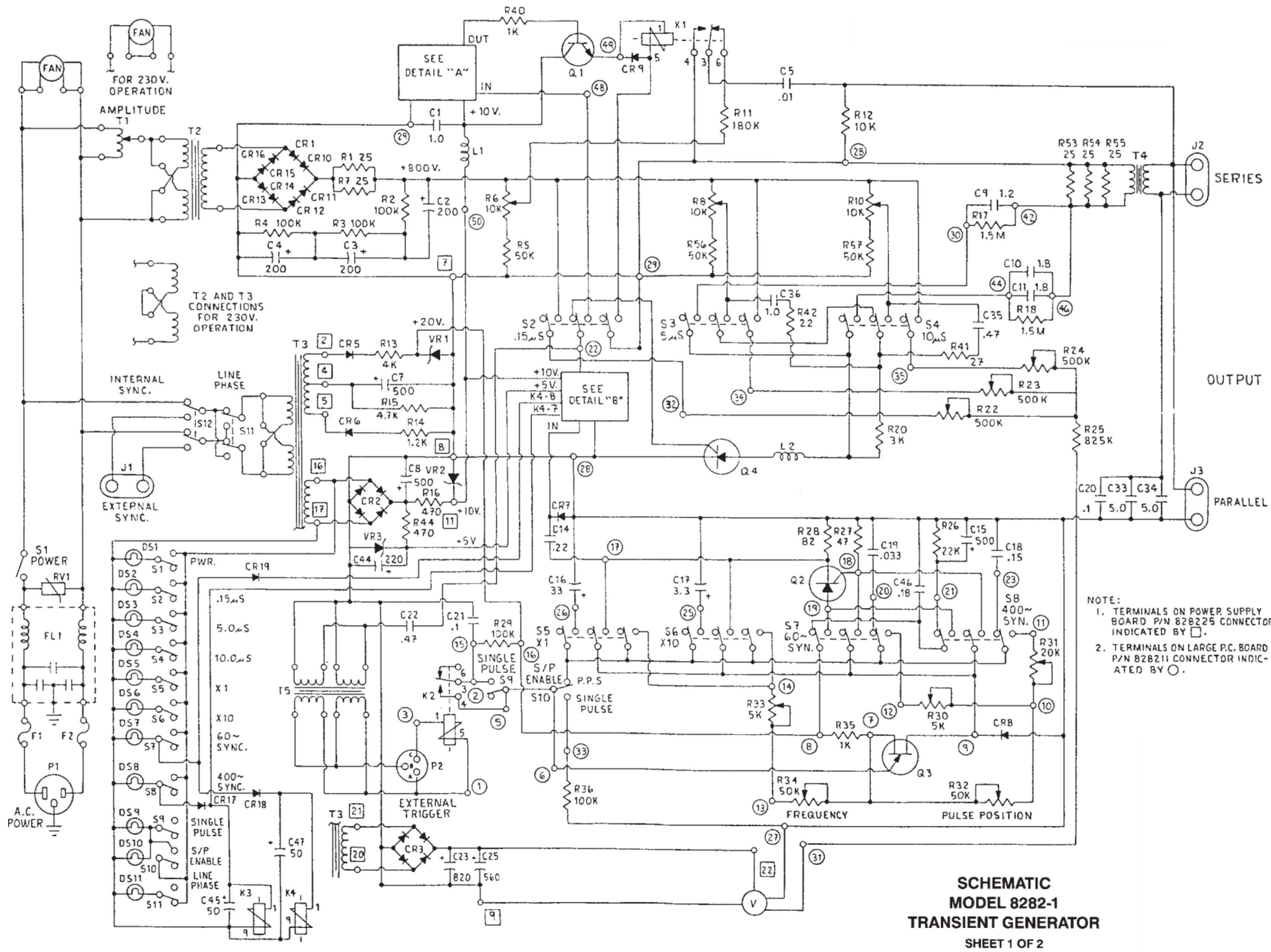
Type 8282-1 Transient Pulse Transformer
For 150 ampere loads

Type 8525-1 Resistive Load
5 ohms, 5%, 2 watt

Type 8527-2 Pulse Transformer
Steps up voltage to 2000 V into 50 ohms

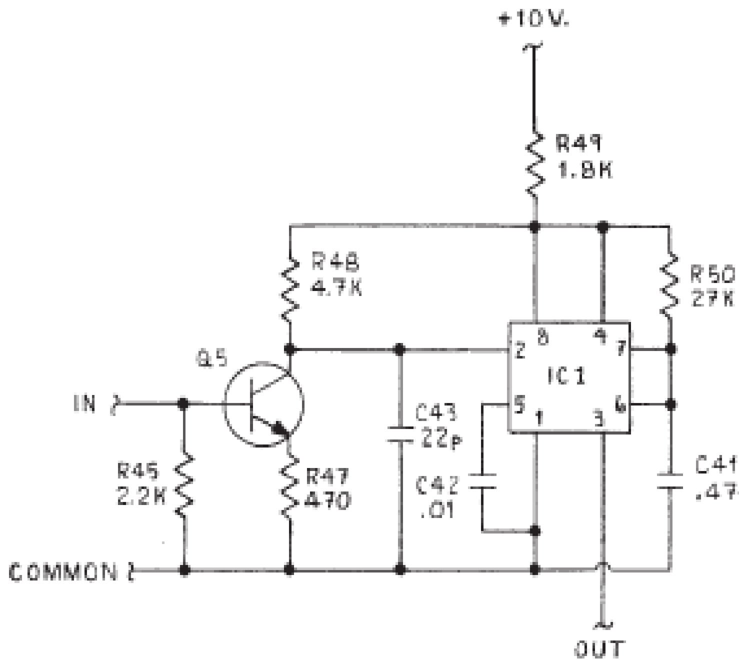
Type 8908-1 Pulse Transformer
Provides up to 600 V. from a 50 ohm source

10.0 SCHEMATIC

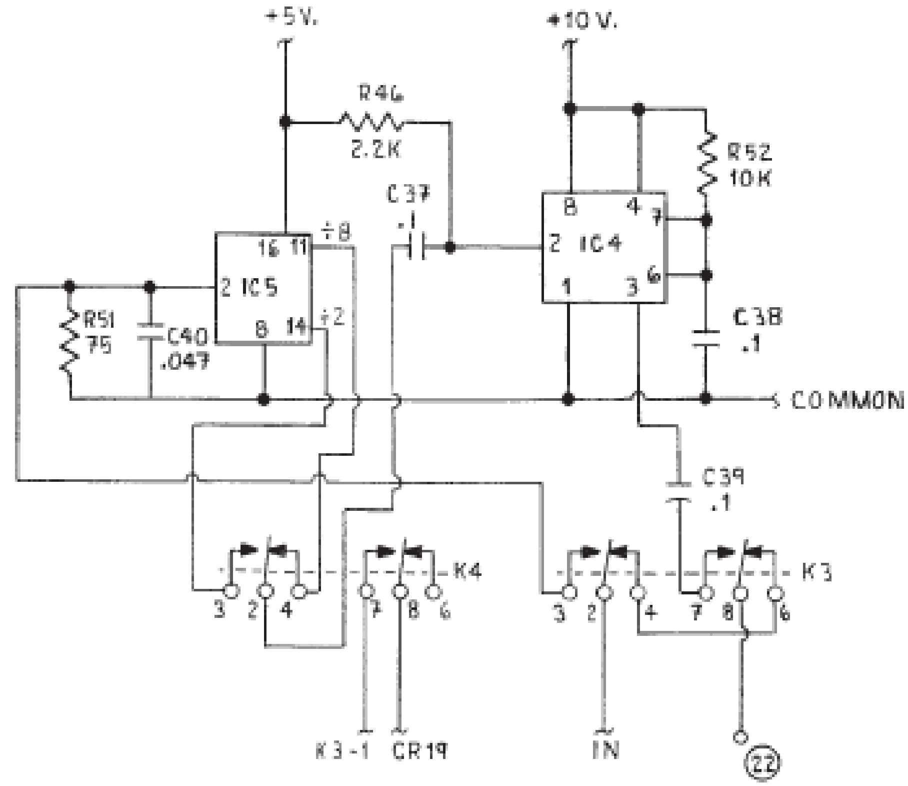


NOTE:
1. TERMINALS ON POWER SUPPLY BOARD P/N 828225 CONNECTOR INDICATED BY □.
2. TERMINALS ON LARGE P.C. BOARD P/N 828211 CONNECTOR INDICATED BY ○.

SCHEMATIC
MODEL 8282-1
TRANSIENT GENERATOR
SHEET 1 OF 2
REV. 5-22-91



DETAIL "A"



DETAIL "B"

SCHEMATIC
MODEL 8282-1
TRANSIENT GENERATOR

SHEET 2 of 2

REV. 9-10-87

Model 8282-1 Addendum

Digital Display

This Model 8282-1 features a Digital Display in place of horizontal bar graph meter. It still represents the level of the spike as it would appear across a five ohm load. The accuracy of the Digital Display is approximately 10%. The display is for reference only. The pulse should be monitored using a calibrated oscilloscope with calibrated X10 or X100 probe.