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SPI-PULSE 25
TRANSMISSION LINE PULSER
OPERATING MANUAL

(14) TR-78-39

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(12) 26

SPIRE CORPORATION
Patriots Park
Bedford, Massachusetts 01730

393483

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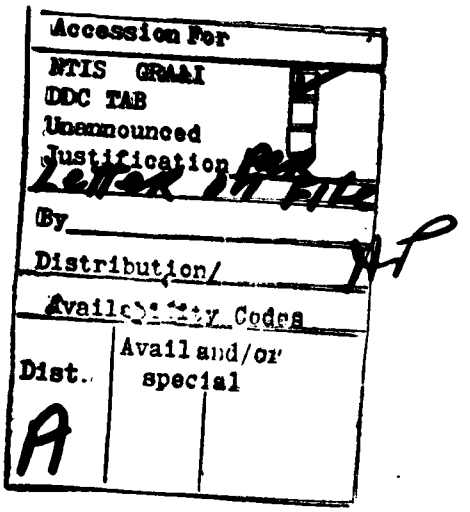
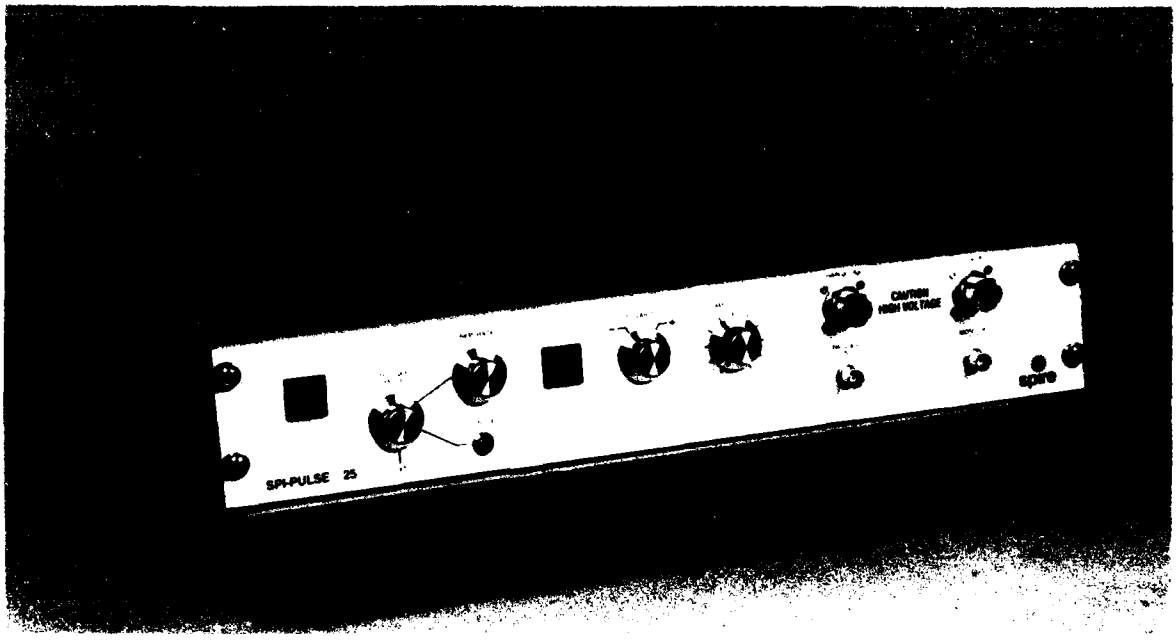




WARRANTY

Spire products are warranted to be free from defects in material and workmanship. If your SPI-PULSE 25 instrument is found to be defective within one year from date of delivery, repair or replacement will be made at no charge. This warranty is in lieu of all other warranties expressed or implied. Any defective instrument will be repaired or replaced at Spire's discretion during the warranty period.

This warranty does not apply if the instrument has been subject to accident, abuse, alteration, improper application, or any other form of misuse. The warranty also does not cover consequential loss or damage, including, but not limited to, loss of peripheral equipment and loss of time due to the malfunction of the instrument.

Specification and price change privileges reserved.

UNPACKING PROCEDURE

Carefully unpack your SPI-PULSE 25 when it arrives. Check for concealed damage. If any found, report it to the carrier immediately.

INTRODUCTION

The 50-ohm SPI-PULSE™ 25 transmission line pulser is designed to generate high-voltage, fast-risetime pulses over a range from 0 to 1,000 volts without internal adjustment. Pulse width, amplitude, and repetition rate are individually controlled by the operator. The instrument can be triggered internally or externally, either by single shot or repetitively up to 275 hertz.

The SPI-PULSE 25 uses a low-reactance, high-voltage switch packaged in a 50-ohm geometry to discharge a transmission line charge store. Discharging the line into a matched, 50-ohm load results in a step-function wave of one-half the stored voltage traveling down the transmission line in transit time, τ, reflecting off the open end of the transmission line, and returning at the same amplitude in a second period of transit time, τ. Thus a square pulse with an amplitude one-half that of the storage voltage and a width of 2τ is produced.

Typical applications for this high-performance pulser include laser diode pulsing in fiber optic communications research, timing signal generation, current injection testing to establish EMI burnout levels, and high-voltage instrument calibration.

SPECIFICATIONS

Performance Specifications

1. Peak output voltage . . . . . 1,000 volts (into 50-ohm load) (Amplitude adjustable by knob)
2. Peak output power . . . . . 20 kilowatts
3. Risetime . . . . . 0.5 nanosecond
4. Falltime . . . . . 0.5 nanosecond
5. Pulsewidth . . . . . 1-500 nanoseconds
   (Length of 50-ohm charge cable used determines pulsewidth: approximately 3 ns/ft)
6. Polarity . . . . . Selectable by switch (+ or -)
7. Droop . . . . . <3% of output voltage
8. Overshoot . . . . . <5% of output voltage
9. Output impedance . . . . . 50 ohms
10. Pulse repetition rate
    a) Manual (pushbutton) mode . . . . . Single shot
    b) Continuous mode . . . . . 30-275 hertz
       (Adjustable internal oscillator)
11. External trigger mode:
    a) Input voltage . . . . . 2.5-50 volts
    b) Input impedance . . . . . 1 megohm (nominal)
    c) Minimum pulsewidth . . . . . 100 nanoseconds
       (Minimum pulsewidth at 3 volts' amplitude)
    d) Pulse repetition rate . . . . . 0 to 275 hertz
    e) Jitter . . . . . 50 microseconds
12. Switching system . . . . . Special gas-pressurized reed switch
13. Switch operating life . . . . . 10^8 pulses (approximate — dependent on output voltage)
14. External power requirements
    a) Standard model . . . . . 115 VAC, 60 Hz
    b) Export model . . . . . 115/230 VAC, 50/60 Hz

Specifications - SPI-PULSE 25

Dimensions and Weights

		U.S.	Metric
1.	Width	19 1/2"	49.59 cm
2.	Height	4 7/8"	12.38 cm
3.	Depth	18 3/4"	47.63 cm
4.	Weight (net)	26 lb.	11.79 kg
5.	Weight (shipping)	36 lb.	16.33 kg

OPERATING INSTRUCTIONS

This section provides simplified operating instructions for the SPI-PULSE 25, as well as typical test configurations in which it can be used.

> WARNING: Potentially lethal voltages are present both at the front panel jacks and internally. The OUTPUT and CHARGE LINE jacks (see Figure 1) must be properly terminated when the instrument is in use.

1. Connect the instrument to the power source.

   Domestic version: 115 volts and 60 Hz

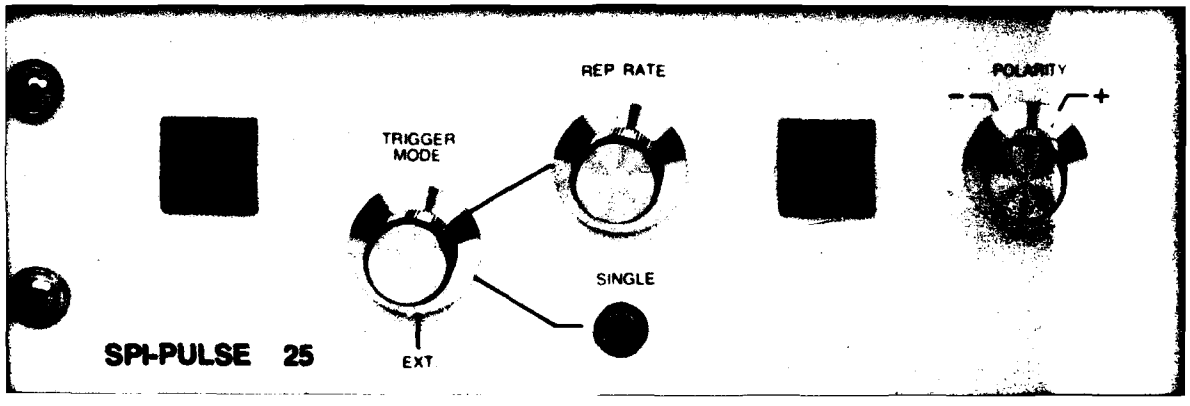
   Export version: Select either 115 volts or 230 volts (see section, "Instructions for Input Voltage Selection on Export Model (115/230 VAC, 50/60 Hz)")

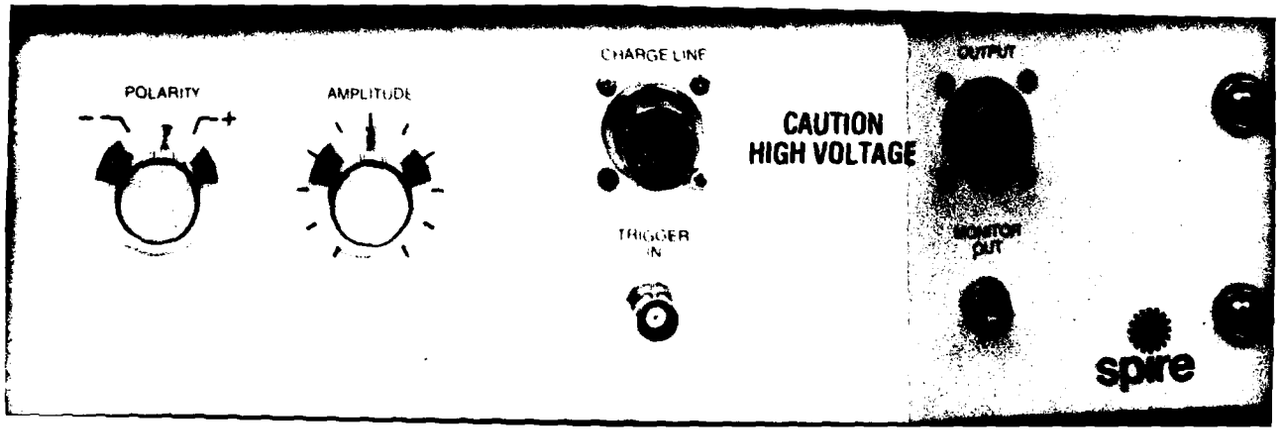
2. Make the following front panel connections (see Figure 1).

   a. OUTPUT connector (GR-874) - connect to the device to be pulsed.

   b. CHARGE LINE connector (GR-874) - connect to the desired length of charge line cable. Use RG-9 or similar cable; the RG-9 cable provides approximately 3 nanoseconds of pulsewidth per foot of cable.

> NOTE: The OUTPUT and CHARGE LINE connections must be made for the instrument to operate.


REP RATE
POLARITY
TRIGGER MODE
SINGLE
SPI-PULSE 25
EXT


POLARITY
AMPLITUDE
CHARGE LINE
TRIGGER IN
CAUTION
HIGH VOLTAGE
OUTPUT
MONITOR OUT
spire

c. MONITOR OUT connector (BNC) -if desired, connect a monitoring device, such as an oscilloscope.

NOTE 1: Typical monitoring devices are a high-speed oscilloscope for pulse-shape or amplitude monitoring, and a low-speed oscilloscope or frequency counter for repetition rate monitoring.

NOTE 2: The monitor output voltage equals OUTPUT voltage/100 if the MONITOR OUT is terminated in 50 ohms. The monitor output voltage equals OUTPUT voltage/50 if the MONITOR OUT is unterminated or terminated in high impedance.

d. TRIGGER IN connector (BNC) - if desired, connect an external signal to trigger the SPI-PULSE 25.

NOTE 1: The TRIGGER IN connection will function only when the TRIGGER MODE switch (see below) is in the EXT. (external) position.

NOTE 2: The trigger input pulse must meet the following specifications:

Minimum trigger voltage	2.5 volts
Maximum trigger voltage	50 volts
Input impedance	1 megohm (nominal)
Minimum pulsewidth	100 nanoseconds
Maximum pulse repetition rate	275 hertz

This input is CMOS and TTL compatible.

3. Select the TRIGGER MODE (see Figure 1) by setting the selector switch to one of the following three positions:

   a. REP. RATE - an internal oscillator controls the output repetition rate (30 to 275 Hz).

   > NOTE: The exact output frequency must be monitored externally via an oscilloscope plugged into the MONITOR OUT connector.

   b. SINGLE - the SPI-PULSE 25 provides one output pulse per each press of the SINGLE pushbutton (see Figure 1).

   c. EXT. - the TRIGGER IN connector is activated to provide one output pulse per input pulse at the connector.

4. Select the output POLARITY (see Figure 1).
   a. - = a negative-going pulse
   b. + = a positive-going pulse

5. Set the AMPLITUDE control knob to minimum, fully counterclockwise (see Figure 1).

6. Press the ON pushbutton to turn the instrument on; the pushbutton illuminates.

   > NOTE: If the instrument is in the REP. RATE mode, you will now hear the buzzing of the internal high-voltage switch. If you don't hear the buzzing, go to the "SPI-PULSE 25 Troubleshooting Chart".

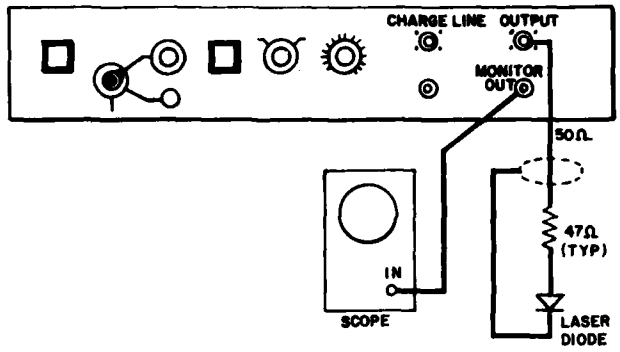
7. Press the H.V. (high-voltage) pushbutton to activate the OUTPUT connector; the pushbutton illuminates.

8. Turn the AMPLITUDE control knob clockwise to the desired level.

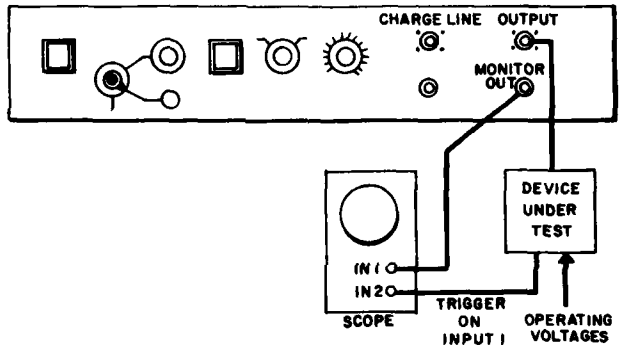
9. If the TRIGGER MODE selector switch is in the REP. RATE position, turn the REP. RATE control knob to the desired frequency. Clockwise rotation increases the frequency.

> NOTE: Because of the mechanical nature of the reed switch employed in this unit, resonant frequencies may be encountered that will produce irregular pulses. This condition is generally audible. A slight shift in the repetition rate will alleviate the condition if it occurs.

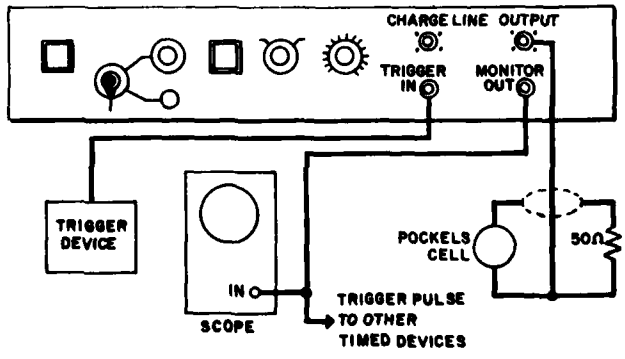
For your convenience, the schematics of several typical test setups are presented in Figure 2.



FREE-RUNNING LASER DIODE PUMPING



SINGLE-SHOT DESTRUCTIVE TESTING



EXTERNALLY TRIGGERED POCKELS CELL

FIGURE 2. TYPICAL TEST CONFIGURATIONS

CHARGE LINE

The SPI-PULSE 25 instrument operates by charging a known length of coaxial cable, then discharging the cable into a load. Thus the cable characteristics determine the output characteristics. Approximately 3 nanoseconds of output pulsewidth are provided per foot of cable; for critical applications, however, the cable length should be adjusted by output pulsewidth measurement or TDR techniques.

For optimum pulse shape a double-shielded, silverplated coaxial cable is recommended, with RG-9B/U or RG-214/U being suitable. One end must have a GR-874-type of connector affixed, while the other end is left open-circuited. Since twice the output voltage appears on the center conductor of this cable, the open end must be well insulated, not only to protect the user, but also to prevent shorting the cable and possibly damaging the instrument. Particular attention should be paid to trimming the braid, so that all the strands are cut off cleanly and evenly.

Complete charge line assemblies of any length (see Figure 3) are available from Spire Corporation. Please write or call for details: Pulser Sales, Spire Corporation, Patriots Park, Bedford, Massachusetts 01730 (617)/275-6000.

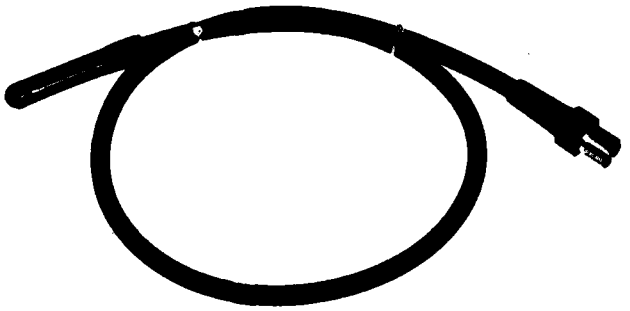


FIGURE 3. TYPICAL CHARGE LINE ASSEMBLY

INSTRUCTIONS FOR
INPUT VOLTAGE SELECTION
ON EXPORT MODEL (115/230 VAC, 50/60 Hz)

1. Remove the four Phillips screws holding the rear panel to the instrument's chassis.

2. Set the rear panel to one side, being careful not to pull the power cord attached to the rear panel.

3. Adjust with a small screwdriver the slide switch located on the lower left-hand side of the internal aluminum chassis (see Figure 4). Slide the switch so that the desired input voltage — "115" or "230" — appears in the window associated with the slide switch (see Figure 5).

> NOTE: The UP setting of the slide switch equals 115 volts, and the DOWN setting equals 230 volts, as shown by the number in the window.

4. Replace the rear panel.

> NOTE: The export versions of the SPI-PULSE 25 are shipped without a power plug. When attaching a plug, observe that the power cord wires are coded as follows:
>
> Green = ground (earth)
> Black = hot (live)
> White = neutral.

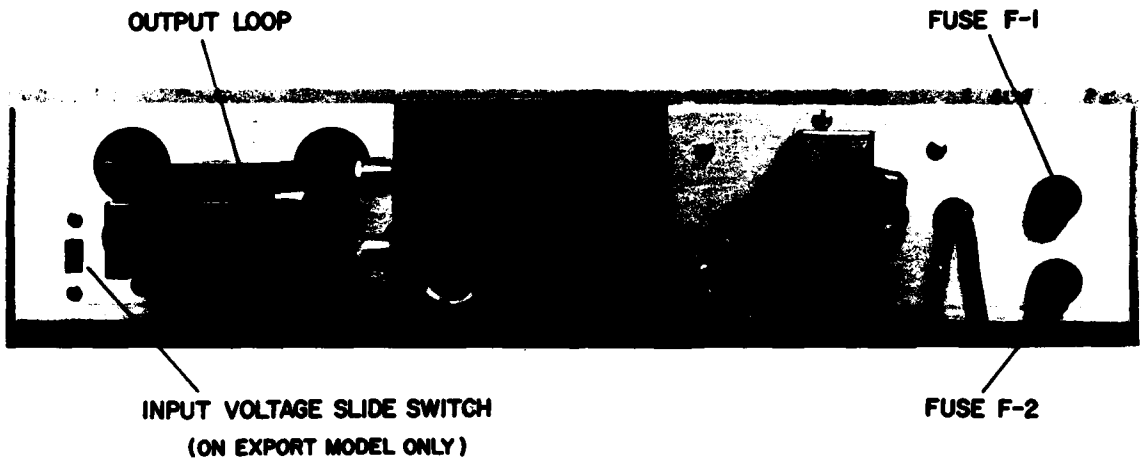


FIGURE 4. SPI-PULSE 25 WITH REAR PANEL REMOVED

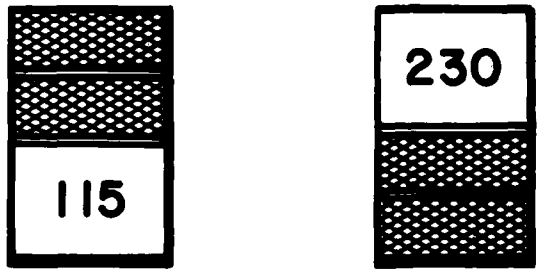


FIGURE 5. THE TWO SLIDE SWITCH SETTINGS

REPLACEMENT OF HIGH-VOLTAGE SWITCH ASSEMBLY

> WARNING: Potentially lethal voltages are present both at the front panel jacks and internally. Only personnel familiar with the techniques of working safety with high voltages should attempt replacing the high-voltage switch assembly.

Removal of Old Switch Assembly

1. Connect the charge line cable and a 50-ohm load to the SPI-PULSE 25.

2. Set the TRIGGER MODE selector switch to REP. RATE (see Figure 1).

3. Set the REP. RATE control knob at 12 o'clock.

4. Press the ON pushbutton.

> NOTE: Do not press the H.V. pushbutton.

5. Allow the instrument to run about 30 seconds, to discharge most of the charge on the high-voltage power supply.

6. Unplug the instrument, and remove the load and the charge line cable.

7. Remove the four Phillips screws holding the front panel to the instrument's case.

8. Slide the panel and attached chassis outward from the case.

> NOTE 1: The power cord is attached to both the rear panel and the chassis; however, you should find the cord to be long enough to allow the complete removal of the chassis from the case.

Replacement of High-Voltage Switch Assembly - SPI-PULSE 25

> NOTE 2: Be careful not to put pressure on the output loop extending through the rear of the chassis (see Figure 4).

9. Connect one end of an insulated jumper cable to a firm chassis ground.

10. Carefully connect the other end of the jumper cable to the high-voltage terminal. (Refer to Figure 6 for steps 10 through 19.)

> WARNING: Use extreme caution since the high-voltage terminal may still have high voltage present.

11. Cut the two coil wire splices in the middle of the heat shrink tubing.

12. Remove the tubing from the ends of the two coil drive wires, cutting off any exposed conductor and stripping the insulation back 1/4 inch.

13. Cut the high-voltage wire adjacent to the high-voltage resistor.

14. Remove any heat shrink tubing from the wire, cut off any exposed conductor, strip the insulation back 1/4 inch, and fold the wire back out of the way.

15. Cut the monitor-out cable adjacent to the monitor-out resistor.

16. Repeat step 14 for the monitor-out cable.

> NOTE: The ground nut must be removed to release the monitor-out ground.

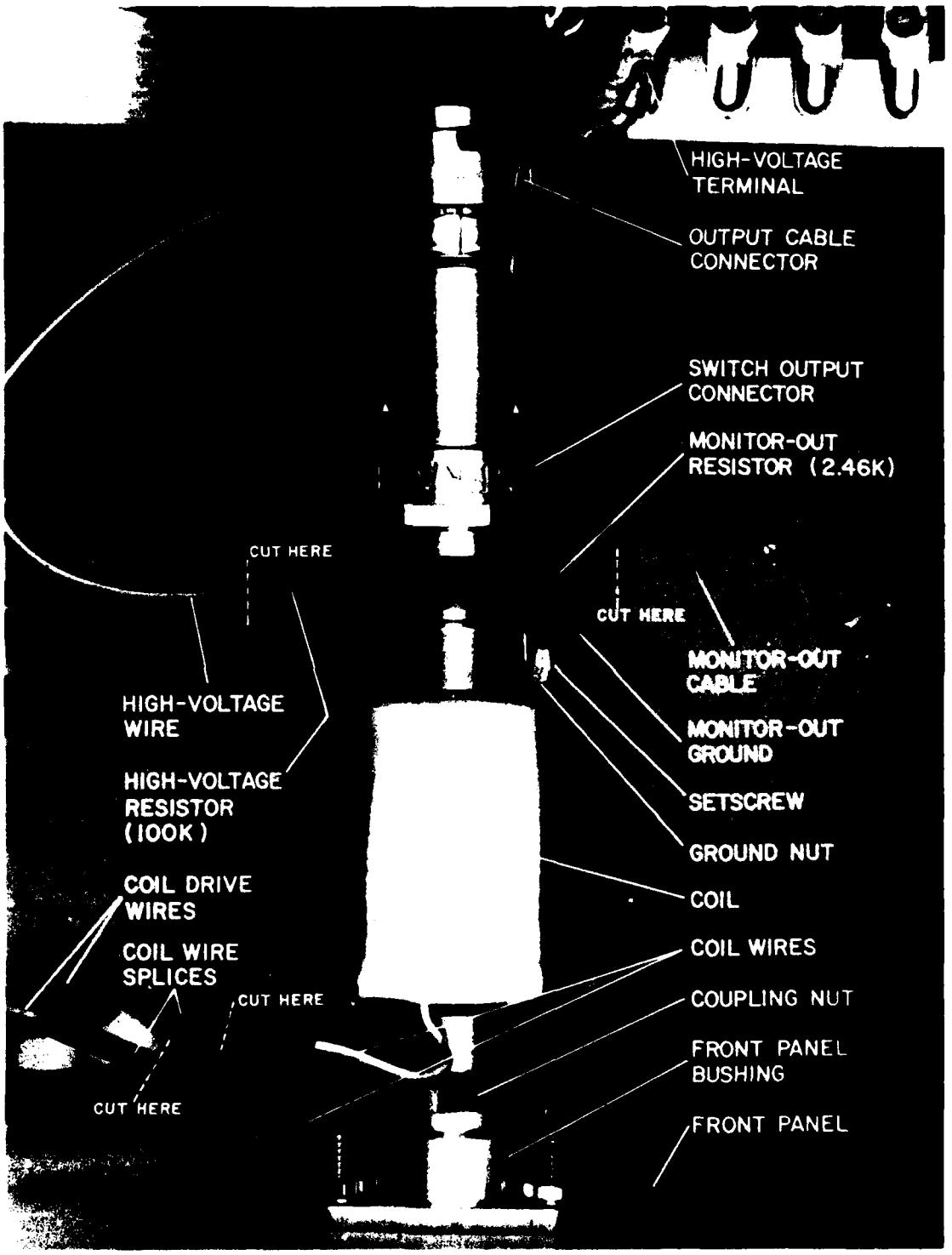


FIGURE 6. HIGH-VOLTAGE SWITCH ASSEMBLY (TOP VIEW)

Replacement of High-Voltage Switch Assembly - SPI-PULSE 25

17. Unplug the output cable connector from the switch output connector, taking care to avoid putting any lateral force on the switch assembly.

18. Unscrew the coupling nut.

19. Pushing the output cable connector downwards for clearance, work the switch assembly rearwards until it clears the front panel.

> NOTE: The old switch assembly may be returned for a core credit; contact Spire Corporation for details.

Installation of New Switch Assembly

> CAUTION: Twisting or bending the new assembly or excessively flexing the resistor leads can destroy the internal glass switch envelope.

1. Holding the output cable connector downwards for clearance, slide the end of the switch assembly without the resistors into the front panel bushing. (Refer to Figure 6 for steps 1 through 18.)

> CAUTION: The switch assembly will key into the front panel bushing in two locations 180^{o} apart. Make sure the assembly is keyed so that the 100K high-voltage resistor faces towards the center of the chassis.

2. Snug down the coupling nut.

3. Loosen but do not remove the setscrew.

4. Gently rotate the switch output connector so that it aligns with the output cable connector.

> CAUTION: The adjustment between the switch output connector and the output cable connector is critical. If done incorrectly, excessive torque will be applied to the switch assembly by the output cable connector.

5. After making sure the switch output connector is still fully engaged in the coil core, tighten the setscrew.

6. Avoiding any lateral force on the switch assembly, plug the output cable connector into the switch output connector.

7. Slide a 3/4-inch length of heat shrink tubing (provided) over each of the two coil wires.

8. Solder the coil wires to the coil drive wires.

> NOTE: Polarity does not matter.

9. Shrink the tubing over each splice.

10. If the high-voltage resistor or monitor-out resistor has been bent in shipment, align it so the lead is straight and the resistor body is normal to the switch assembly.

11. Center each inner lead in its hole.

12. Slide a 3/4-inch length of heat shrink tubing over the high-voltage wire.

Replacement of High-Voltage Switch Assembly - SPI-PULSE 25

13. Solder the high-voltage wire in a parallel splice to the high-voltage resistor.

14. Slide the heat shrink tubing over the resistor until the inner end of the tubing is even with the outer edge of the hole in the switch assembly body.

> NOTE: Do not allow the tubing to enter into the body of the switch assembly.

15. Shrink the tubing.

16. Repeat steps 12 through 15 with the monitor-out cable and the monitor-out resistor.

17. Attach the monitor-out ground to the setscrew with the ground nut.

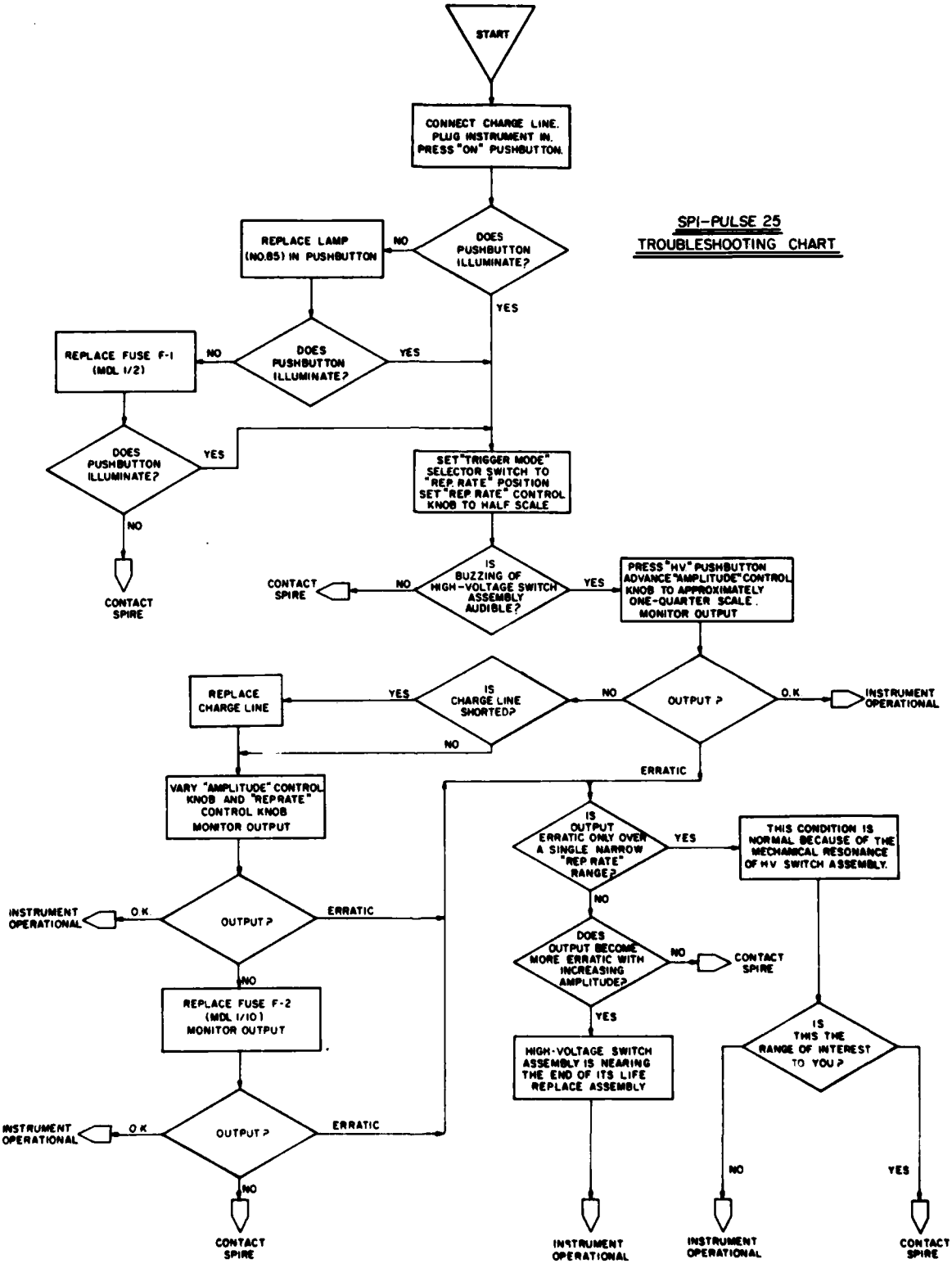
18. Dress all leads, as shown in Figure 6.

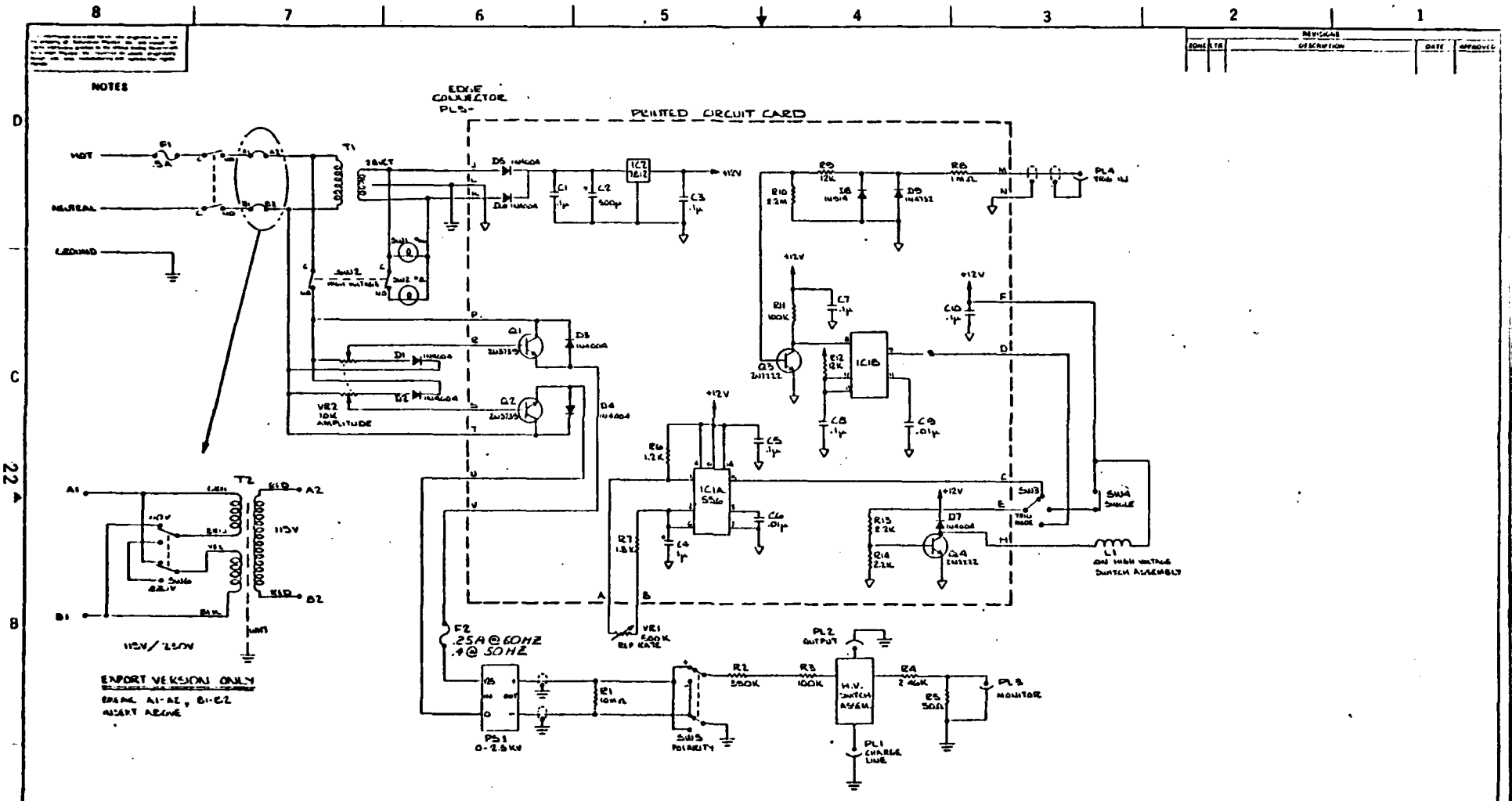
19. Remove the jumper cable.

20. Slide the chassis into the case, being careful not to pinch the power cord.

21. Secure the front panel with the four Phillips screws.

SPI-PULSE 25
TROUBLESHOOTING CHART





REVISIONS			
ZONE	LTR	DESCRIPTION	DATE	APPROVED

ITEM	QTY	DASH NO.	PART NO OR IDENTIFYING NO.	DESCRIPTION	MATERIAL	SPEC

PARTS LIST

NEXT ASSY	USED ON
APPLICATION	

spire SPIRE CORPORATION BEDFORD, MASS 01730

SCHEMATIC SPI-PULSE 25 MOD II

SIZE	DWG NO	REV
D	4D656	2005-0126

SCALE — SHEET 1 OF 1