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INSTRUCTIONS

MODEL AV-SVX-1-C PULSE GENERATOR

S.N.:

WARRANTY

Avtech Electrosystems Ltd. warrants products of its manufacture to be free from defects in material and workmanship under conditions of normal use. If, within one year after delivery to the original owner, and after prepaid return by the original owner, this Avtech product is found to be defective, Avtech shall at its option repair or replace said defective item. This warranty does not apply to units which have been dissembled, modified or subjected to conditions exceeding the applicable specifications or ratings. This warranty is the extent of the obligation or liability assumed by Avtech with respect to this product and no other warranty or guarantee is either expressed or implied.

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********** WARNING **********

SAFE OPERATING PROCEDURES AND PROPER USE OF THE EQUIPMENT ARE THE RESPONSIBILITY OF THE USER OF THIS SYSTEM.

AVTECH ELECTROSYSTEMS LTD. provides information on its products and associated hazards, but it assumes no responsibility for the after-sale operation and safety practices.

ALL PERSONNEL WHO WORK WITH OR ARE EXPOSED TO THIS EQUIPMENT MUST TAKE PRECAUTIONS TO PROTECT THEMSELVES AGAINST POSSIBLE SERIOUS AND/OR FATAL BODILY INJURY. DO NOT PERFORM INTERNAL REPAIR OR ADJUSTMENTS UNLESS ANOTHER PERSON CAPABLE OF RENDERING FIRST AID AND RESUSCITATION IS PRESENT.

1.0 GENERAL DESCRIPTION

The SVX is a high voltage solid state pulse generator designed to drive low inductance, resistive loads, typically into 50 ohms.

The pulser utilizes high-speed power MOSFETs as the high voltage switches, incorporated into a low impedance configuration featuring a multi-layer stripline-style output bus.

The power switch module receives support power from the 120VAC line, and high voltage power from the switch mode power supply This module also contains a low voltage power supply, providing support power to the switch mode supply, and an internal oscillator.

The internal oscillator provides a drive pulse to the power switch module to gate on and off the output pulse. The oscillator may be operated in either an internal or an external mode. In external mode, the trigger line provides the pulse recurrence frequency (PRF), while the SVX provides the pulse width through the "Pulse Width" potentiometer. A sync line is provided from the oscillator.

SPECIFICATIONS

Amplitude:	0 to 800 Volts[1] (to R = 50 Ohms)
Pulse width:	75 ns to 3.0 us[1]
Rise time (Fall time):	≤ 20 ns (≤ 30 ns)
PRF:	0.2 to 25 KHz[1]
Duty cycle (max):	0.2 %
Average power out (max):	25 Watts
Polarity:	Positive or negative (specify)[2]
Source impedance:	≤ 2.5 Ohms
Droop:	≤ 5% at 3.0 us
Propagation delay (Jitter): (EXT TRIG IN TO PULSE OUT)	≤ 130 ns (±100 ps)
Trigger required: (EXT TRIG mode)	+5 V (50 Ohms) 75 ns to 3 us
Sync delay: (sync to pulse out)	Coincident (not variable)
Sync output:	+1 Volt will drive 50 Ohms
Connectors:	BNC
Power requirement:	120/240 Volts (switchable) 50 - 60 Hz
Dimensions: (H x W x D)	92 mm x 92 mm x 230 mm (3.6" x 3.6" x 9.0")
Chassis material:	black anodized aluminum
Mounting:	Any
Temperature range:	+15° to +40° C
Warranty:	Full

1) Ten turn control.
2) Indicate desired polarity by suffixing model No. by -P or -N (i.e. positive or negative). AVX-ITXA transformer may be used to invert the polarity.

3.0 SAFETY

The high voltage nature of this device dictates the use of caution when operating or servicing this equipment. The following is a summary of general safety precautions that must be observed during all phases of operation and repair of the SVX.

3.1 Operating Safety Summary

The safety information contained in this summary is for both operating and servicing personnel. Specific warnings may be found throughout this manual, but may not appear in this summary.

3.1.1 Power Source

The pulser is designed to operate from a power source that will not apply more than 120 volts 50-60Hz between the supply conductors or between either supply conductor and ground. A protective grounding connection by way of the grounding conductor in the AC power cord is essential.

3.1.2 Grounding

The pulser is grounded through the grounding conductor of the AC power cord. **To avoid electrical shock, plug the pulser into a properly wired receptacle before making connection to any input or output connectors.** Use only a power cord that is in good condition.

3.1.3 Cover Removal

To avoid personal injury, do not remove the side covers. **Do not operate the pulser while the covers are removed.** The covers do not contain safety interlocks!

3.1.4 General Operating Precautions

Do not remove the input or output cables while the pulser is in operation. Never short-circuit the high voltage output of the pulser. Failure to observe these precautions can result in potential electric shock to personnel, arcing, and damage to the connectors and system.

Any pulsed power system is capable of random triggering via transients. Therefore when the pulser is turned on, or high voltage is present in the chassis, assume it is possible to get a pulse on the output connector.

3.2 Servicing Safety Summary

The pulser contains dangerous voltages and stored energy. AVTECH strongly recommends that all repairs and adjustments be performed by factory qualified personnel. DEI will not be responsible for personal injury or damage to the pulser that occurs during repair by any party other than the factory.

3.2.1 Servicing Procedure

Do not perform internal repair or adjustments unless another person capable of rendering first aid and resuscitation is present.

3.2.2 Internal Energy Storage

The pulser contains capacitors that are used as energy storage elements. When charged, these capacitors contain in excess of 0.8 joules of stored energy. This is sufficient energy to cause injury. **Assure that the AC power cord is disconnected from the pulser, and that the capacitor bank is fully discharged and a shorting strap installed before any repairs or adjustments are attempted.** Verify with a voltmeter that all circuits are de-energized before servicing. The voltmeter used to make these measurements must be certified for use at 1000VDC and 110VAC or greater. Dangerous voltages, floating ground planes and energy storage exist at several locations in the pulser. Touching connections and/or components could result in serious injury.

4.0 OPERATING CONSIDERATIONS

4.1 Output

The pulser is designed to operate into a predominantly resistive load with a small inductive term. An unterminated or improperly terminated output will cause excessive aberrations on the output waveform and could possibly damage the pulser. To ensure this does not occur, observe the following precautions:

- Use good quality cable and connectors;
- Make all external connections tight and as short as possible;
- Use terminators or impedance-matching devices to avoid reflections;
- Ensure that all external cables and hardware have adequate voltage and power ratings;
- Be extremely careful not to short the output of the pulser to ground, as this can cause damage to the pulser.

4.2 Pulse Risetime and Falltime

The physical and electrical characteristics of the cable transmitting the pulse determine the characteristic impedance, velocity of propagation and the amount of signal loss. Several feet of cable can attenuate high frequency information in a pulse with a fast rise time. It is therefore important to keep these cables as short as is practical.

4.3 Impedance Matching

If a pulse travels down a transmission line and encounters a mismatch, a reflection is generated and sent back along the line to the source. The amplitude and polarity of the reflection are determined by the impedance mismatch. If the reflected signal returns before the output pulse ends, it adds or subtracts from the amplitude of the pulse. This will distort the pulse shape and amplitude.

4.4 Trigger Input

When in external mode, an input trigger of +5V +/-1V into 50 ohms with a risetime of <20ns is required to gate on the pulser. Departure from these values can result in a loss of performance. These trigger requirements are met by any high quality low voltage pulse generator. The trigger should be set to +5V +/-1V into 50 ohms before the trigger cable is attached to the pulser trigger input. If the trigger input is greater than +5V into 50 ohms, pulse stretching can occur.

5.0 PREPARATION FOR USE

5.1 General

After unpacking, initial inspection and preliminary electrical check procedures should be performed to assure that the unit is in good working order. If it is determined that the unit is damaged, the carrier should be notified immediately. Repair problems should be directed AVTECH ELECTROSYSTEMS LTD.

5.2 Initial Inspection

1. Inspect unit for exterior mechanical damage.
2. Inspect power input cord and input power module for obvious signs of damage.

5.3 Input Power Cord

The input power cord terminates externally in a three-prong polarized plug. The unit chassis is wired to the plug through the line cord, and therefore, the insertion of the plug into a compatible receptacle, hooked up to a grounded input, will automatically ground the unit. **The unit should not be operated without a grounded AC input!**

6.0 OPERATING INSTRUCTIONS

6.1 Controls And Indicators

6.1.1 Power Switch and Indicator Lamp

The switch labeled "ON/OFF" controls all AC power in the chassis. The lamp above the switch illuminates when AC power is turned on.

6.1.2 Fault Indicator

The Fault lamp flashes when a fault condition is encountered. Fault conditions include an internal or external short, or an output power requirement in excess of the capabilities of the high voltage power supply. If the fault light illuminates, the unit should not be operated until the cause of the fault is rectified. In the event of excess power requirements, the power should be reduced by decreasing the PRF, decreasing the output pulse width, lowering the power, or some combination thereof, until the lamp extinguishes. If these actions fail to extinguish the lamp, a problem exists with either the load or with the pulser itself.

6.1.3 Voltage Adjustment

This potentiometer controls the output voltage pulse.

6.1.4 Pulse Width Adjustment

Pulse width is adjusted with the potentiometer labeled "Pulse Width". This adjustment functions when the pulser is either internally or externally triggered.

6.1.5 Frequency Adjustment

When internally triggered, the pulse recurrence frequency is controlled by the "Frequency" potentiometer. When externally triggered, this control is disabled.

6.1.6 SYNC Connector

The BNC connector labeled "SYNC" replicates the width and frequency of the output pulse, and is used to synchronize an oscilloscope to the output pulse. Output is +1V into 50 ohms.

6.1.7 Trigger Connector and Switch

The BNC connector labeled "TRIGGER" is the input to externally trigger the pulser. The trigger line provides the pulse recurrence frequency (PRF), while the pulse width is controlled through the "Pulse Width" potentiometer. An input trigger of +5V +/-1V into 50 ohms with a risetime of <20ns is required to gate on the pulser. When externally triggered, the "Trigger" switch should be set to EXT.

6.2 Operation

Before turning on the unit, ensure that all output adjustments are set to ZERO, and the output connector is connected to an appropriate load.

The output pulse should be monitored at the load with a high speed oscilloscope and appropriate probes and/or attenuators.

Turn ON the AC power, and slowly increase the Voltage, Pulse Width and Frequency adjustments while monitoring the oscilloscope until the desired output is generated. If the Fault lamp illuminates, reduce voltage, frequency or pulse width until the lamp extinguishes. If the lamp does not extinguish, if there is no output from the pulser, or the output is severely distorted, set the Voltage Adjust to zero. Leave the pulser connected to the AC input without high voltage and with all connectors in place for approximately one minute to bleed off the stored energy, then disconnect the AC power to the unit and refer to the Troubleshooting Section of this manual.

6.3 Power-Down Procedures

These procedures should be followed prior to handling the output cable, connectors or load:

1. Set the Voltage Adjust dial to zero.
2 Leave the pulser connected to the AC input without high voltage and with all connectors in place for approximately one minute to bleed off the stored energy.
3. Turn OFF the unit.
4. Disconnect the AC power to the unit.

7.0 TROUBLESHOOTING

WARNING

The pulser contains capacitors that are used as energy storage elements. When charged, these capacitors contain in excess of 0.8 joules of stored energy. This is sufficient energy to cause serious injury. **Assure that the AC power cord is disconnected from the pulser, and that the capacitor bank is fully discharged and a shorting strap installed before any repairs or adjustments are attempted.** Verify with a voltmeter that all circuits are de-energized before servicing. The voltmeter used to make these measurements must be certified for use at 1000VDC and 110VAC or greater. Dangerous voltages, floating ground planes and energy storage exist at several locations in the pulser. Touching connections or components could result in serious injury.

7.1 Troubleshooting Procedures

Before attempting to service or troubleshoot the pulser, review the servicing safety summary in Section 3.0.

The power MOSFETs utilized in the pulser are mounted underneath the printed circuit board, and utilize the mounting plate as a heat sink. In the unlikely event that a MOSFET need be replaced, it is highly recommended that the unit be returned to the factory for servicing.

The table below summarizes potential problems and their solutions. If these recommendations do not resolve the problem, DEI customer service can be contacted for further assistance.

SYMPTOM	SOLUTIONS
1. No AC ON Lamp.	-AC power not plugged in. -Fuse(s) are blown. See fuse replacement instructions in Section 7.1.1.
2. No output pulse.	-No input trigger. -Input trigger voltage too low. -Input trigger pulse width too short. Increase width. -Input trigger frequency too high. Reduce frequency. -Trigger switch incorrectly set. -High voltage supply set too low. Increase high voltage setting. -Output not connected correctly. Check all cables and connections. -Pulser is damaged. Contact DEI customer service.

7.1.1 Fuses

To avoid fire hazard or damage to the pulser, use only 3A fast blow fuses (Littelfuse #312003 or equivalent). Fuse replacement should be performed by qualified personnel only. **Assure that the AC power cord is disconnected from the pulser, and that the capacitor bank is fully discharged and a shorting strap installed before fuse replacement is attempted.** Verify with a voltmeter that all circuits are de-energized before servicing. The voltmeter used to make these measurements must be certified for use at 1000VDC and 110VAC or greater.

The fuses are located in the corner of the printed circuit boards. To access the circuit boards, remove the retaining screws for the power entry module, and remove the rear panel. Then remove the corner and side screws from the

front panel. The front panel and PCB assemblies will then slide out from the case, providing access to the fuses.

7.2 Factory Service

If the procedures above fail to resolve an operational problem, please contact the factory for further assistance:

AVTECH ELECTROSYSTEMS LTD.

TEL: 1-800-265-6681
FAX: 613-226-2802

8.0 SYSTEM FAILURE MODES

The SVX is capable of generating large amplitude voltage pulses with fast rise and fall times. It is the user's responsibility to assure that the interconnect cables and load do not create transients, over-current or over-voltage conditions that could damage the pulse generator.

8.1 Over-Current Failure

When the output is shorted, the pulser can deliver near 40A of current (depending on cabling, HV power supply setting, etc.). A current pulse of this magnitude is in excess of the driver's maximum specification, and may cause damage to the pulser, load and/or associated cabling.

8.2 Over-Voltage Failure

One may incorrectly assume that the voltage across the MOSFET switching device could never exceed the 800V maximum setting of the high voltage control. It is possible to create voltages in excess of 800V by driving an improperly terminated cable or by generating L di/dt spikes caused by an inductive load.

L di/dt spikes are created when current flowing through an inductor is interrupted (i.e. current is turned off). The amplitude of the resultant voltage spike is defined by the formula:

$$V = L \, di/dt,$$

where L is the circuit inductance, di is the current value at turn off and dt is the time it takes for the current to get to zero (i.e. fall time). By monitoring the voltage output of the pulser, the user can measure L di/dt voltage spikes. With this measurement, the user can determine the actual voltage across the MOSFET switching device, with the formula:

$$V_{max} = [L\ di/dt] + V_{supply}$$

where

$L\ di/dt$ = peak of the negative-going spike;
V_{supply} = panel meter voltage;
V_{max} = 800 volts.

Any time the test setup (e.g. interconnect cables and/or load resistance) is changed, it will be necessary to again verify that V_{max} is no greater than 800 volts.

APPENDIX

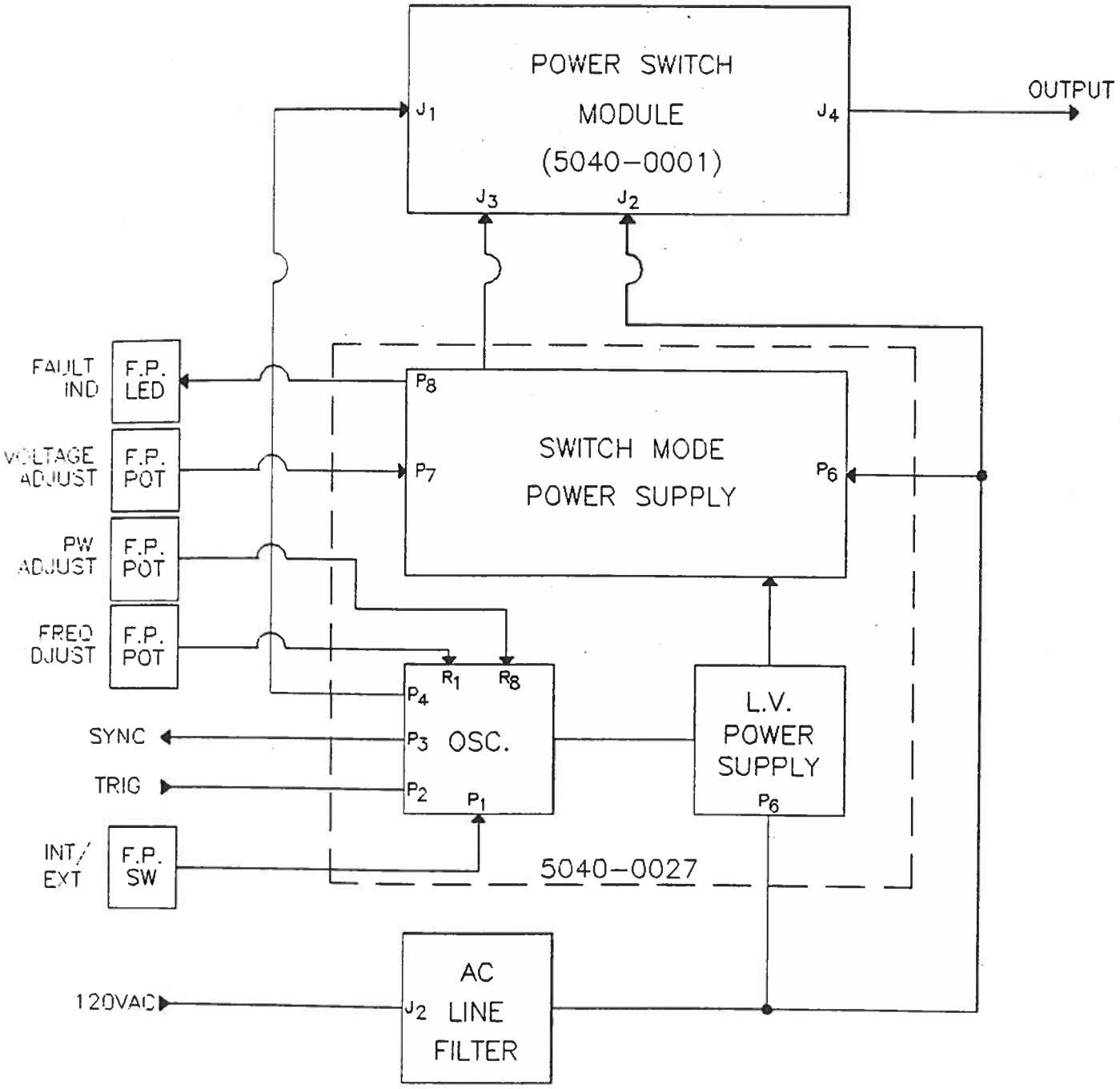
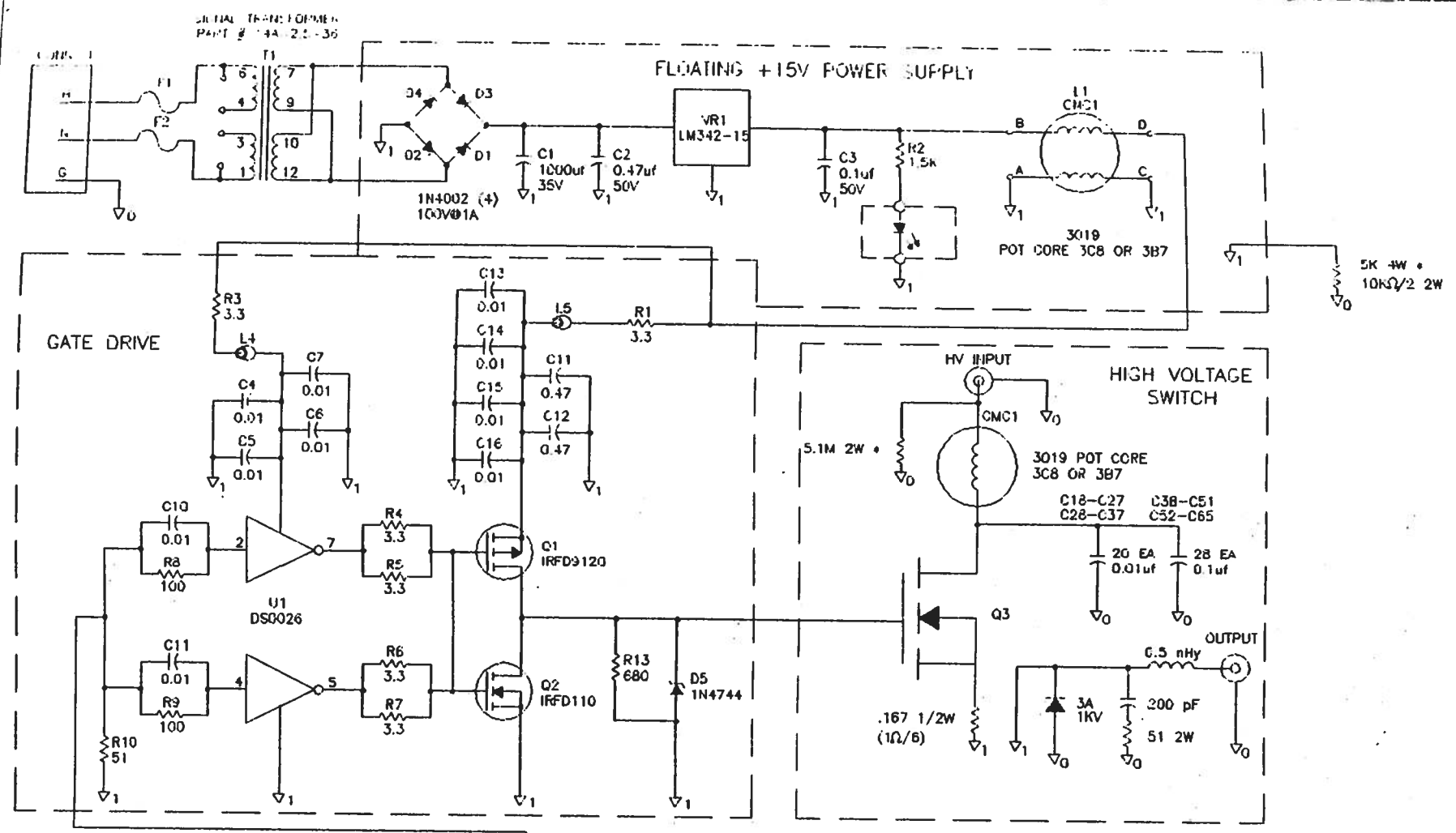


FIGURE 1.
SVX PULSER
BLOCK DIAGRAM

REV	EC	DESCRIPTION	DATE	CHK'D	ENG
01	-	ORIGINAL ISSUE			



NOTICE

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CONTRACT NO.	
DRAWN: R.D. SHERWOOD	DATE: 7/24/91
CHECK: G. KRAUSSE	7/24/91
DESIGN	
DESIGN ACTIVITY	
CUSTOMER	

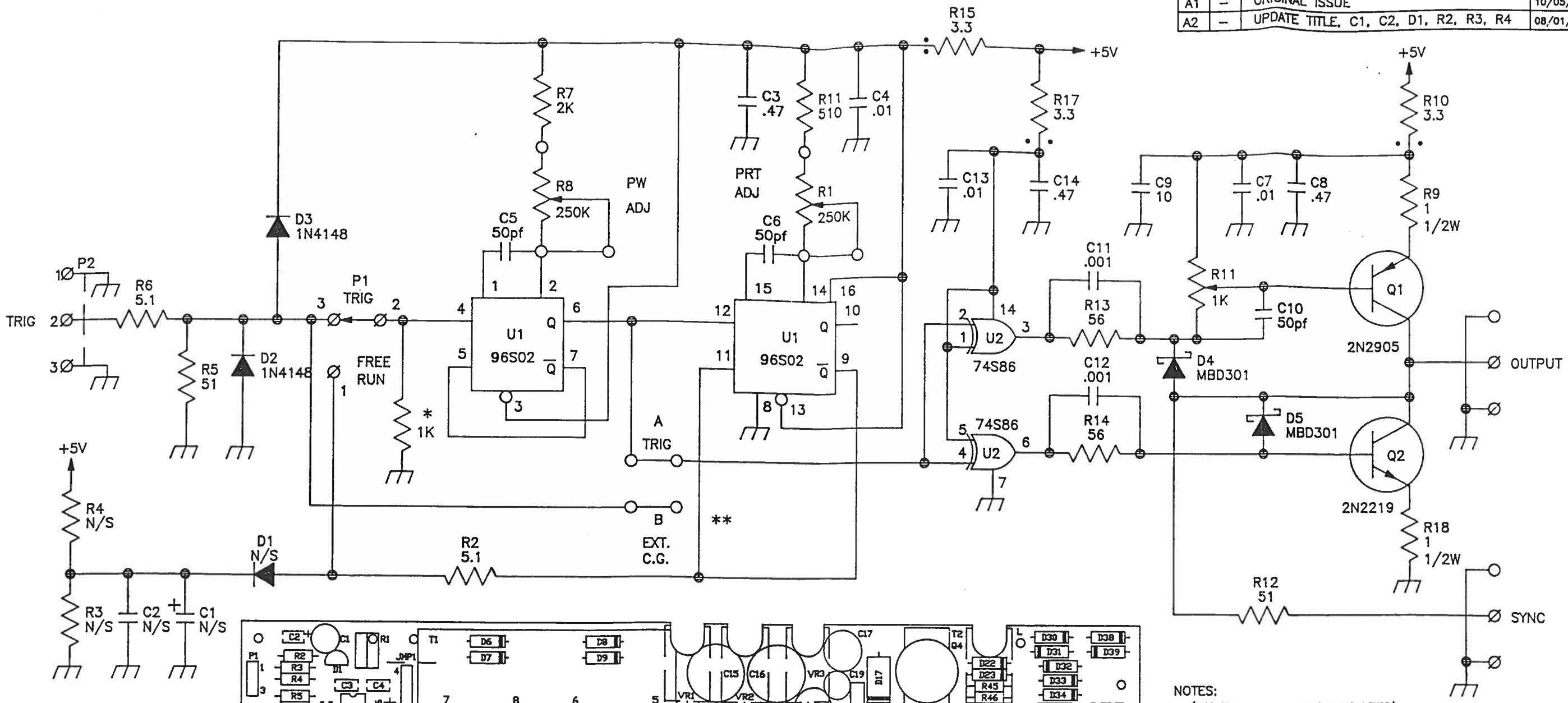
TITLE

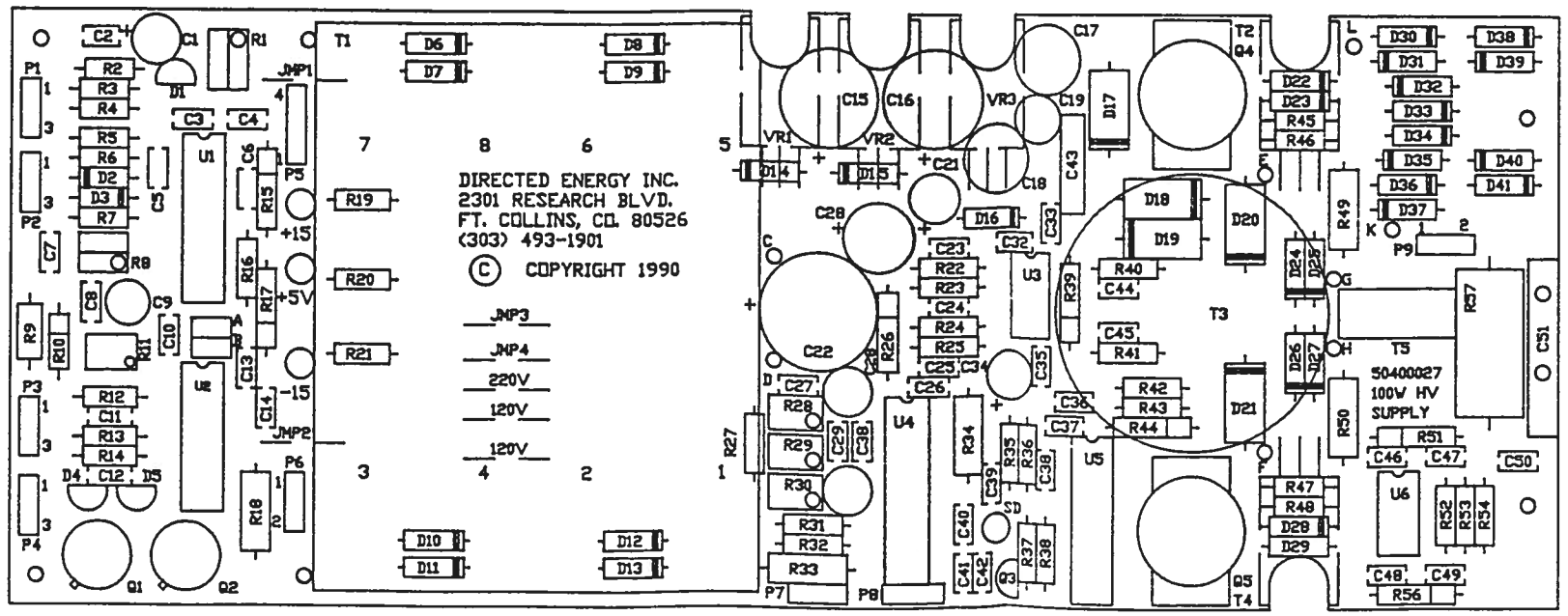
SVX PULSE MODULE SCHEMATIC

SIZE	FCSM NO.	DWG NO	REV
A		6040-3001	A

SCALE | RELEASE DATE | SHEET 1 OF 1

REV	EC	DESCRIPTION	DATE	BY	CHKD	ENG
A1	–	ORIGINAL ISSUE	10/05/90			
A2	–	UPDATE TITLE, C1, C2, D1, R2, R3, R4	08/01/91	RS	GK	GK





SILK SCREEN

NOTES:
(UNLESS OTHERWISE SPECIFIED)
1. ALL RESISTOR VALUES ARE IN OHMS.
2. ALL RESISTORS ARE 1/4 W.
3. ALL CAPACITOR VALUES ARE IN MICROFARADS.
4. * ON BACK SIDE OF CARD.
5. ** ADD.
6. O ON-CARD / OFF-CARD.
7. Ø OFF CARD.
8. N/S = NOT STUFFED

CONTRACT NO.		
DESIGN T HOLZSCHUH	DATE 6/20/90	TITLE 25W HV SWITCHMODE PULSE GENERATOR
DRAWN PC/DESIGNS	10/05/90	
CHECK G KRAUSSE	10/09/90	
PROJECT ENGINEER		SIZE B / FCSM NO. 5040–0027 / A2
CUSTOMER		SCALE NONE / RELEASE DATE / SHEET 2 OF 2

REV	EC	DESCRIPTION	DATE	BY	CHKD	ENG
A1	—	ORIGINAL ISSUE	10/05/90			
A2	—	UPDATE TITLE, R27 VALUE AND R35 VALUE	08/01/91	RS	GK	GK

V ADJ
SHUT DOWN
R27 20K (1KV) 33K (500V)
R29 1K
MAX ADJ
R28 10K
V OUT
C27 .47
C28 10
R26 3.3
R19 1K
+15
O.K.
+15V
R39 3.3
C25 .47
C26 .1
R34 33 1/2 W
C32 .1
C33 .47
C23 .001
R22 510
R23 510
U3 0026
C30 .01
C31 10
R31 100K
I SET
R30 100K
C29 .47
U4 56 3526
R32 2K
C24 .001
R24 510
R25 510
U3 0026
C40 .0022
C41 .0022
C42 .0022
R33 1 1/2W
D14 4007
VR1 7815
C20 1000
C15 1000
C16 1000
D9 4007
D8 4007
D7 4007
D6 4007
T1
LP-30-800
JMP6
JMP4
JMP3
JMP5
JMP7
220
120
P6
120/220 AC 60
D15 4007
VR2 7805
C19 100 50V
C21 100 50V
R20 330
+5V
GRN
D10 4007
D11 4007
D12 4007
D13 4007
-15V
P5
+5V
+15V
C22 47
* 510K
R40 3.3
C44 .47
1408 T2
25T
25T
R45 3.3
MTP1N100 Q4
D16 4007
R46 1.5K
D23 15V
D22 15V
D19 160V
D20 4100
D18 160V
D17 160V
D21 4100
C43 .01 1KV
R49 1 1/2W
T3
#26 21T C
130T #30 L
21T #26 F
3622
VR3 7915
C17 10
C18 10
15V
GRN
R21 1K
-15V
R48 3.3
MTP1N100 Q5
HV OUT
R41 3.3
C45 .47
T4
25T
1408
25T
R47 1.5K
D18 15V
D19 15V
R50 1 1/2W
G
T5
H
25:1
D39 1100
D38 1100
D30 1100
D31 1100
D32 1100
D33 1100
D41 1100
D36 1100
D37 1100
D35 1100
D40 1100
D34 1100
C51 .1 1KV
C51 .1 1KV
GND
Q3 3904
SD
SHUT DOWN RED
R35 750
+15V
R43 27
R51 3.3
C46 .47
C47 .1
C35 .42
C34 10
R42 27
D26 4148
D27 4148
D24 4148
D25 4148
R52 10K
R53 10K
R57 1MEG 2W
R36 100K
U5 96S02
C38 .1
R37 510
TL082
U6
R56 3.3
C59 100 pf
3.3K R54
C48 .1
C49 .47
R38 510
-15V
C36 .1
C37 .47
C39 .01
R44 3.3
+5V

CONTRACT NO.	T HOLZSCHUH	6/20/90
DESIGN	PC/DESIGNS	DATE 10/05/90
DRAWN	G KRAUSSE	10/09/90
CHECK		
PROJECT ENGINEER		
CUSTOMER		

TITLE
25W HV SWITCHMODE POWER SUPPLY

SIZE	FCSM NO.	
B		5040-0027 A2

SCALE NONE RELEASE DATE SHEET 1 OF 2

01.25.93