TIME OF FLIGHT

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INSTRUCTION MANUAL

D-1040 PULSER and D-1003 POWER SUPPLY

PULSER P.S. PC BOARD REV-6
REMOTE PULSER PC BOARD REV-6
Updated Nov 15, 2010

WARNING

THIS EQUIPMENT USES VOLTAGES WHICH ARE DANGEROUS TO LIFE. IT SHOULD BE SERVICED ONLY BY QUALIFIED PERSONNEL, USING PROPER SAFETY PRECAUTIONS. DISCONNECT ALL CABLES AND POWER CORD BEFORE REMOVING TOP COVER.

TABLE OF CONTENTS

1.0 SPECIFICATIONS

1.1 PHYSICAL

Cabinet size	19.0" W. x 13.5" D. x 3.5" H.
Cabinet weight	9.5 Lbs.
Remote Pulser Size	5.5" W. x 4.3" D. x 1.1" H.
Remote Pulser Weight	1 lbs.

1.2 SERVICE REQUIREMENTS

Input Power	100/120/220/240 volts 1 PHASE, 50-60 Hz

2.0 GENERAL DESCRIPTION

The PULSER is used to deliver a voltage pulse which can be varied in magnitude, duration, and timing interval. These pulses, when applied to elements of a TOF instrument, can be used to extract bursts of ions and to gate or deflect ion and electron beams.

It provides voltage steps of 11 to 400V from an internal power supply with a rise and fall time of 10 nanoseconds. It can be biased up to 3500V. Maximum repetition rate is 200 kHz.

The Power Supply can be configured for either positive or negative going pulses. It will work with positive or negative bias voltage which is monitored on the front panel.

NOTE: Two wires must be changed to enable the meter to read upscale with a negative bias voltage. See Section 6.1.

3.0 CONNECTIONS

WARNING: Do not attempt to monitor the pulser output with an oscilloscope, volt meter, capacitor, etc. without first referring to Section 7 - PERFORMANCE TESTING.

Before connecting the mains, make certain the Voltage Selector Switch (100/120/220/240) is set properly. If the voltage wheel needs to be changed, a fuse with a value shown in the following table should be inserted into the fuse holder.

Mains voltage	Fuse value
100V 50/60 Hz	1-2/10A slow-blow
120V 50/60 Hz	1A slow-blow
220V 50/60 Hz	½A slow-blow
240V 50/60 Hz	½A slow-blow

Connect the Power Supply to the Remote Pulser with the cables supplied. Connect the "PULSE V" SHV connector on the power supply to the "PULSE V" SHV connector on the Remote Pulser. Connect the "BIAS V OUT" SHV connector on the power supply to the "BIAS" SHV connector on the Remote Pulser. Connect the "TRIGGER" BNC connector on the power supply to the "TRIGGER" BNC connector on the Remote Pulser. Connect the "+12V" BNC connector on the power supply to the "+12V" BNC connector on the Remote Pulser.

The Remote Pulser was not designed to drive a cable, so the output should be connected directly to an SHV vacuum feedthrough. Refer to section 10.2.3 for a description of what effect a cable will have on the output waveform.

An external bias power supply is connected to the "BIAS IN" SHV connector. If a negative bias voltage is used, the violet and black wires on the "PULSE V/BIAS V" switch must be reversed to make the meter read the correct polarity. Connect an external trigger to the "TRIGGER INPUT" BNC connector and select rising (+) or falling (-) edge triggering.

4.0 DESCRIPTION OF CONTROLS

4.1 TRIGGER INPUT BNC

A positive or negative input pulse with a magnitude of 1.3 to 10 volts is connected here to trigger the external trigger outputs on the rear panel.

4.2 ± TRIGGER SWITCH

Determines whether the Pulsers are triggered by the rising (+) or falling (-) edge of the trigger pulse.

4.3 DELAY FINE ADJUST KNOB

Adjusts the delay between the trigger pulse and the trigger outputs to the pulser by 2 to 30 μS.

4.4 DELAY COARSE SCREWDRIVER ADJUST

Adjusts the delay between the trigger pulse and the trigger outputs to the pulser up to 1.2 milliseconds.

4.5 DELAY MONITOR BNC

This BNC outputs a positive pulse to show the adjusted delay.

4.6 PULSE V SCREWDRIVER ADJUST

Adjusts the Pulsers output voltage amplitude (+400V max).

4.7 PULSE V/BIAS V SWITCH

Enables the meter to monitor the PULSE VOLTAGE or the amount of BIAS voltage to the pulser.

4.8 PULSE 1 DURATION FINE ADJUST KNOB

Adjusts the duration of the trigger pulse to Pulser 1 from 250 to 600 nanoseconds.

4.9 PULSER 1 DURATION COARSE SCREWDRIVER ADJUST

Adjusts the duration of the trigger pulse to Pulser 1 from 250 nanoseconds to 12 μS.

4.10 TRIGGER MONITOR PULSER 1 BNC

Shows the trigger pulse that goes to Pulser 1.

4.11 PULSER 2 DURATION FINE ADJUST KNOB

Adjusts the duration of the trigger pulse to Pulser 2 from 50 to 100 nanoseconds.

4.12 PULSER 2 DURATION COARSE SCREWDRIVER ADJUST

Adjusts the duration of the trigger pulse to Pulser 2 from 50 nanoseconds to 3.5 μS.

4.13 TRIGGER MONITOR PULSER 2 BNC CONNECTOR

Shows the trigger pulse that goes to Pulser 2.

5.0 DESCRIPTION OF REAR PANEL CONNECTIONS

5.1 BIAS IN SHV CONNECTOR

This is the input for the bias voltage from an external DC power supply (i.e. TOF Power Supply).

5.2 BIAS OUT SHV CONNECTOR

This connects to the "BIAS" SHV connector on the Remote Pulser which supplies the bias voltage for the Remote Pulser.

5.3 PULSE V SHV CONNECTOR

This connects to the "PULSE V" SHV connector on the Remote Pulser which supplies the pulse voltage for the Remote Pulser.

5.4 TRIGGER PULSER 1 BNC CONNECTOR

Connects to the "TRIGGER" BNC connector on the Remote Pulser and supplies the trigger pulse for the Remote Pulser.

5.5 TRIGGER PULSER 2 BNC CONNECTOR

Outputs a trigger pulse to remote Pulser 2 (if used).

5.6 +12V OUT BNC CONNECTORS

Supplies +12 volts DC to the Remote Pulser.

6.0 OPERATION

When used in conjunction with a pulse nozzle or other source of a pressure burst, the ion source elements can experience arc down due to a local pressure transient. This can be very hard to detect since it is synchronized with other events in the experiment. It is helpful to remember that Total Pressure Gages only tell you the average pressure. Local pressure can be momentarily much higher. If there is a possibility of this, it can be tested by changing the carrier gas to one which is more stable (less easily ionized) and taking note of any difference.

NOTE: It is best to operate the pulser with a Pulse voltage of only 200 volts and a Bias voltage of only 1500 volts when an experiment if first being run. This will reduce the possibility of an arc if a problem occurs. When things are consistently working correctly the Bias voltage and Pulse voltage can be increased.

There are four possible configurations for the Remote Pulser and Power Supply. See section 6.1 for a detailed description.

Turn on the Power Supply and adjust the desired Pulse voltage (+400V max). Adjust the "TRIGGER DELAY" by either monitoring the "TRIGGER MONITOR" BNC or the "DELAY MONITOR" BNC (see block diagram for timing).

NOTE: If the adjusted delay is longer than the period of the trigger waveform, the Power Supply will lock up.

The timing of the Pulser output can be monitored on the "TRIGGER MONITOR" BNC connectors (the actual pulse will be 250 to 300nS, constant, behind the trigger monitor waveform). This is sometimes referred to as the “throughput delay”.

6.1 CONFIGURATION

Determine which two voltages that you wish to switch between. The fixed output voltage will be the “Bias In” voltage. The variable output voltage will be the adjusted “Pulse Voltage”. Because of the polarity of the switching transistors in the Remote Pulser, the “Pulse V” connector always needs to be more positive in voltage than the “Bias” connector.

Power Supply Options

PC Board to Rear Panel options:

Connectors J9 (subtractive) and J10 (additive) are located on the rear left corner of the PC Board. In order for the voltage pulse to be less than the “Bias In” voltage, the power supply needs to be wired such that the Pulse Voltage subtracts from the “Bias In” voltage. For the voltage pulse to be greater than the “Bias In” voltage, the power supply needs to be wired such that the Pulse Voltage adds to the “Bias In” voltage. The PC Board connector used to connect between the rear panel and the PC Board determines these two configurations. Connecting the rear panel to the “SUB” connector (J9) will create a subtractive pulse voltage. Connecting the rear panel to the “ADD” connector (J10) will create an additive pulse voltage.

Front panel meter options:

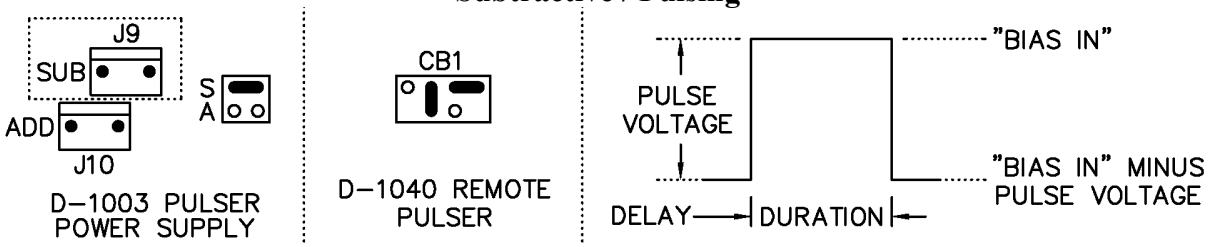
A four-pin jumper block is located to the left of the potentiometer R24 (Pulse Calib.) In order for the front panel meter to display the correct "Bias In" voltage, a jumper needs to be installed in the "S" (subtractive) or "A" (additive) position.

Remote Pulser Options

A six-pin jumper block is located next to the eight-pin integrated circuit A2. Two jumpers are used to configure the Remote Pulser.

The standard configuration for use with an E-Gun is:

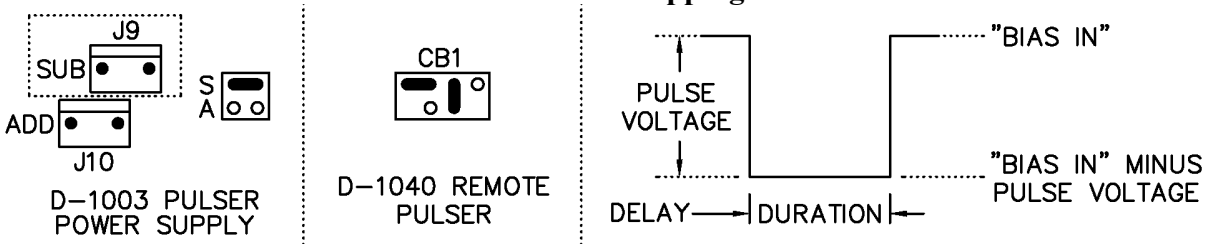
Subtractive / Pulsing



The non-triggered output voltage is the "Bias In" voltage minus the adjusted Pulse Voltage. After the Remote Pulser is triggered, the output voltage switches to the "Bias In" voltage for the adjusted Duration, and then it switches back to the "Bias In" voltage minus the adjusted Pulse Voltage.

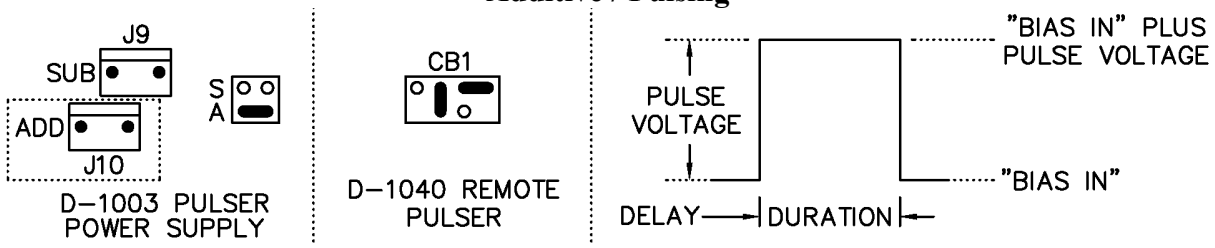
Other possible configurations are:

Subtractive / Dipping



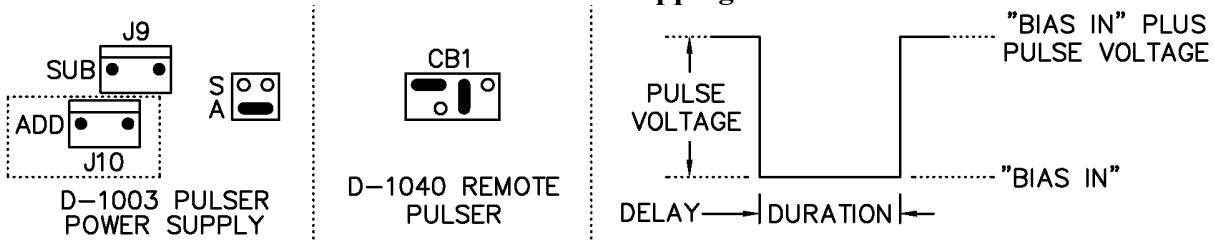
The non-triggered output voltage is the "Bias In" voltage. After the Remote Pulser is triggered, the output voltage switches to the "Bias In" voltage minus the adjusted Pulse Voltage for the adjusted Duration, and then it switches back to the "Bias In" voltage.

Additive / Pulsing



The non-triggered output voltage is the "Bias In" voltage. After the Remote Pulser is triggered, the output voltage switches to the "Bias In" voltage plus the adjusted Pulse Voltage for the adjusted Duration, and then it switches back to the "Bias In" voltage.

Additive / Dipping



The non-triggered output voltage is the "Bias In" voltage plus the adjusted Pulse Voltage. After the Remote Pulser is triggered, the output voltage switches to the "Bias In" voltage for the adjusted Duration, and then it switches back to the "Bias In" voltage plus the adjusted Pulse Voltage.

7.0 PULSER PERFORMANCE TESTING

The output of the pulser should only be monitored by the following procedure:

Disconnect the "BIAS IN" SHV connector on the power supply rear panel and connect a shorting SHV connector in its place. A good high speed oscilloscope (100 MHZ) with a high speed 10X probe (100 MHZ) can be connected to the output of the Remote Pulser through an SHV panel connector. Trigger the oscilloscope off of the "TRIGGER MONITOR PULSER 1" BNC connector. Turn the "PULSE V" adjust to zero volts (all the way counter-clockwise) before turning on the PULSER Power Supply. While watching the output of the Remote Pulser on the oscilloscope, slowly turn up the Pulse voltage to the desired amplitude. Turn off the PULSER Power Supply before disconnecting the oscilloscope from the Remote Pulser.

WARNING: Failure to follow the above test procedure will almost certainly result in the destruction of the Remote Pulser transistors.

8.0 CONTROL UNIT SERVICE PROCEDURES

8.1 SAFETY PRECAUTIONS

WARNING: Before removing the top cover or disconnecting any of the rear panel connections, turn off the "POWER" and disconnect the power supply from its power source. Also turn off any power supply connected to the "BIAS IN" connector and disconnect all of the cables from the rear panel. Even though the power is disconnected, the "BIAS IN" voltage will elevate half of the circuitry on the PC Board which can result in a dangerous electrical shock.

8.2 TROUBLESHOOTING

The majority of the problems with the PULSER and Power Supply are caused by arcing due to a high pressure burst near the element to which the Remote Pulser is connected. If the PULSER Power Supply periodically has problems, pressure or voltage parameters may have to be changed.

8.2.1 SUBSTITUTION TESTING

All integrated circuits in this equipment are mounted in sockets and can easily be changed. Do not reverse position of IC's or they will be destroyed. IC's have a notch on the end near Pin 1 and/or a dot over Pin 1. The IC sockets have a notch on the one end to show the position of Pin 1.

8.2.2 NO POWER OR METER LAMPS

Check power source and 1 Amp slow blow fuse on rear panel.

8.2.3 NO PULSER OPERATION

If there is no indicated Pulse Voltage, go on to the next step. If there is an indicated Pulse Voltage, check the "DELAY MONITOR" BNC connector on the front panel for the proper waveform. If there is no "DELAY MONITOR" the problem could be that the adjusted delay is too long for the repetition rate, or A10 could be bad. If the "DELAY MONITOR" waveform is correct then check the "TRIGGER" output connector on the rear panel. If there is no "TRIGGER" output, then the problem is more than likely A11 or A12.

If the above steps don't resolve the problem then it is more than likely with the Remote Pulser.

8.2.4 NO PULSE VOLTAGE

Turn off the "POWER" and also turn off the external bias power supply. Disconnect the "PULSE V", "BIAS IN", and "BIAS OUT" SHV connectors on the rear panel. Connect a shorting SHV connector to the "BIAS IN" SHV connector. Turn on the "POWER" and verify the Pulse Voltage on the front panel meter. If there is still no Pulse Voltage after the above steps are followed, the problem is more than likely a component on the PC Board is bad. Remove the top cover and check the voltage across CR6, A4, and A2 Pin 39. If these voltages are correct, check that the voltage from A2 Pin 17 to Pin 18 is the same voltage as the one measured on A2 Pin 39.

If the Pulse Voltage works when the cables are disconnected the problem is with the Remote Pulser or that the output of the Remote Pulser is being loaded down. Turn off the PULSER Power Supply and reconnect the "PULSE V" and "BIAS OUT" cables from the Remote Pulser and disconnect the Remote Pulser output connector from the system SHV vacuum feedthrough. Turn on the PULSER Power Supply and check the pulse voltage. If there is still no Pulse Voltage then the problem is a bad cable or a blown Remote Pulser Module. If the Pulse Voltage works when the Remote Pulser output is disconnected, the Remote Pulser is being loaded down by something in the system.

8.2.5 BAD REMOTE PULSER

First follow steps 8.2.3 and 8.2.4 to verify proper operation of the PULSER Power Supply.

It should be noted that 90% of the time a bad Remote Pulser can be fixed with just a new Pulser Repair Kit. The other 10% of the time, PS1 or PS2 will also need to be replaced in addition to the Pulser Repair Kit. It is very seldom that anything else goes bad.

To check the Remote Pulser, disconnect the output from the TOF system and disconnect the "PULSE V" and "BIAS" cables from the Remote Pulser. Connect a shorting SHV connector to the "BIAS" SHV connector on the Remote Pulser. Remove the Remote Pulser top cover and then turn on the PULSER Power Supply. The Remote Pulser output should have a pulse with an amplitude of approximately 11 volts. Check the +12V, input voltage, +12V across C2 (1uF, 35V), +5V across C13 (1uF, 35V) and -12V across C1 (1uF, 35V). If these voltages are correct, check that when the “TRIGGER” pulse goes high (+3 volts amplitude minimum), the voltage at the junction of R5 and A4 Pin 1 goes from +12 volts down to less than 10 volts. If it doesn't then R8, A4 or Q4 is bad. Check for an inverted trigger pulse on A2 Pin 2 or Pin 4 depending on which jumper option is selected. If there is no inverted trigger pulse then A3 is possibly bad but that is very seldom the case. Check for an inverted or non-inverted trigger pulse on A1 Pin 10 depending on which jumper option is selected. If the pulse on A1 Pin 10 is correct, the problem is more than likely a blown Q1 (VP0550N3), Q2 (VN0550N3), or A1 (IR2110). If Q1, Q2, or A1 is bad all three parts should be replaced as a set to insure good performance and reliability. It is recommended that A2 (ICL7667CPA) be replaced also.

8.2.6 DETAILED INSTRUCTIONS FOR FIXING THE REMOTE PULSER

The Remote Pulser has two high voltages connected to the two SHV connectors marked "PULSE V" and "BIAS". There are two transistors inside the Remote Pulser that connect the output SHV connector to either the "PULSE V" or the "BIAS" input voltages. As shown on the REMOTE PULSER SCHEMATIC C01040, when the Q1 (VP0550N3) transistor is turned on, it connects the OUTPUT to the "PULSE V" input voltage. When Q1 is turned off and Q2 (VN0550N3) is turned on, it connects the OUTPUT to the "BIAS" input voltage. When Q1 or Q2 is damaged, it usually acts like a short circuit. If Q1 is damaged, the OUTPUT is continually connected to the "PULSE V" input voltage. If Q2 is damaged, the OUTPUT is continually connected

to the "BIAS" input voltage. If Q1 and Q2 are both damaged, the "PULSE V", "BIAS", and OUTPUT are continually connected together. This causes the Pulse Voltage power supply to overload and stay at zero volts. When both the "PULSE V" and "BIAS" connectors are disconnected, the Pulse Voltage power supply should then operate normally. If the Pulse Voltage front panel meter is adjustable from 0 to 400 volts, this indicates that the Pulse Voltage power supply is operating correctly.

In most cases if a "Pulser Repair Kit" is installed in a Remote Pulser, it will then operate properly. A "Pulser Repair Kit" consists of:

1- Q1 (VP0550N3) Transistor
1- Q2 (VN0550N3) Transistor
1- A1 (IR2110) Integrated Circuit
1- A2 (ICL7667CPA) Integrated Circuit

If all four of these parts are installed in the Remote Pulser, it will usually cause the Remote Pulser to operate properly.

A severe arc will also damage the PS1 or PS2 power supply module. These modules are easy to test for proper operation.

To repair the Remote Pulser, the following procedure should be performed:

Disconnect the two SHV connectors marked "PULSE V" and "BIAS".
Disconnect the BNC connector marked "TRIGGER".
Remove the top cover of the Remote Pulser (four screws).
Remove the two output transistors Q1 (VP0550N3) and Q2 (VN0550N3). They are mounted on red sockets next to the output.
Remove A1 (IR2110) the 14 pin IC, and A2 (ICL7667CPA) the 8 pin IC.

NOTE: The amount of current drawn from the “+12V” BNC connector is limited by Poly Switch P1 (Raychem RXE030). Under normal conditions the Remote Pulser draws only 100mA of current from the “+12V” BNC connector. At this current, the Poly Switch has a resistance of about one ohm. At approximately 500mA of current draw, the Poly Switch heats up and its resistance increases until the current draw is about 60mA. When the excessive current draw is removed, the Poly Switch reverts to its one ohm resistance.

First measure the voltage on the “+12V” BNC connector. Check for +12V on the cathode of CR3 (Square Pad). If the difference between these two voltages is greater than 0.2 volts, there is too much current draw. The fault can be further isolated by alternately removing PS1 and PS2.

PS1 (C&D NMS1212) is located near the output connector. The -12 volts generated by PS1 can be measured across C1 (1uF, 35V). If no voltage is measured, check the +12V and -12V on the output pins of PS1. Please notice that the 0V output pin is connected to the “PULSE V.” SHV connector. If no voltage is measured across C1, but the proper voltages are measured on the output pins of PS1, then L3 (220uH, 250mA) could be open circuit. If there are no measured output voltages, check the input voltage pins for +12 volts. If there is no voltage on the input pins of PS1, then L1 (220uH, 250mA) could be open circuit.

PS2 (C&D NMS1212) is located near the output connector. The +12 volts generated by PS2 can be measured across C2 (1uF, 35V). If no voltage is measured, check the +12V and -12V on the output pins of PS2. Please notice that the 0V output pin is connected to the "BIAS" SHV connector. If no voltage is measured across C2, but the proper voltages are measured on the output pins of PS2, then L4 (220uH, 250mA) could be open circuit. If there are no measured output voltages, check the input voltage pins for +12 volts. If there is no voltage on the input pins of PS2, then L2 (220uH, 250mA) could be open circuit.

If one of the power supplies is bad, replace it with a new part, and check the output voltages. If it tests OK, install the new "Pulser Repair Kit". Please notice that Pin 1 of the two integrated circuits is pointing in opposite directions. Pin 1 of the integrated circuits is marked with a rounded indentation on one end. Pin 1 of the integrated circuit sockets is marked with a rounded notch on one end. **Please note that Q1(VP0550N3) is the transistor located closest to the Remote Pulser output connector**.

The Remote Pulser should now operate properly.

9.0 CONTROL UNIT CIRCUITRY DESCRIPTION

9.1 CONTROL UNIT

The control unit contains two sets of ± 12 volt power supplies, a +5 volt power supply, a floating 0 to +400 volt power supply, and a trigger shaping and delay circuit. There are several special grounding points that are very carefully marked on the PULSER schematic and an understanding of their purpose is needed before the following circuit descriptions will make any sense.

9.2 CONTROL UNIT WIRING OPTIONS

The control unit can be wired two different ways. The most common wiring is for a subtractive Pulse Voltage. For a subtractive Pulse Voltage, the connector to the rear panel is connected to J9 which is the "SUB" connector shown on the Pulser Power Supply PCB Assembly drawing D01001. A jumper also needs to be inserted into the position marked "S" of the four pin header next to R24. The other possibility is for an additive Pulse Voltage. For an additive Pulse Voltage, the connector to the rear panel is connected to J10 which is the "ADD" connector shown on the Pulser Power Supply PCB Assembly drawing D01001. A jumper also needs to be inserted into the position marked "A" of the four pin header next to R24. This jumper is what enables the "BIAS V" meter to read the correct voltage.

9.3 CIRCUIT DESCRIPTION

See Control Unit Schematic, drawing D01003.

9.3.1 POWER SUPPLY

Line power (100/120/220/240 volts, 50 or 60 Hz) is brought in through a fuse, line switch, interlock switch, and a voltage selector switch to the main power transformer

T301. The "POWER" indicator light and the meter lights are powered from one of the 120 volt primaries of T301.

T301 has three secondary windings which connect to the PC Board. One of those windings has an isolation voltage of 8,000 volts between the primary windings and the two other secondary windings.

There are two different ± 12 volt power supplies and a +5 volt power supply. The 30 volt 8KV isolated center tapped winding is full wave rectified and supplies +20 volts to C3 and -20 volts to C4. The +20 volts on C3 supplies voltage regulator Q1 for the floating +12 volt power supply. The output voltage of regulator Q1 is set by resistors R1 and R2. The -20 volts on C4 supplies voltage regulator Q3 for the floating -12 volt power supply. The output voltage of regulator Q3 is set by resistors R3 and R4.

The 30 volt center tapped winding is full wave rectified and supplies +20 volts to C18 and -20 volts to C43. The +20 volts on C18 supplies voltage regulator Q5 for the +12 volt power supply. The output voltage of regulator Q5 is set by resistors R20 and R21. The -20 volts on C43 supplies voltage regulator Q6 for the -12 volt power supply. The output voltage of regulator Q6 is set by resistors R51 and R52.

The 8.6 volt winding is full wave rectified and supplies +11 volts to C17. The +11 volts on C17 supplies voltage regulator Q4 for the +5 volt power supply. The output voltage of regulator Q4 is set by resistors R18 and R19.

9.3.2 PC BOARD

The circuitry on the PC Board is divided into two sections. The circuitry on the half of the PC Board closest to the front panel is referenced to ground (chassis). The circuitry on the half of the PC Board closest to the rear panel is referenced to the "BIAS IN" potential.

9.3.3 PULSE VOLTAGE POWER SUPPLY

The Pulse Voltage power supply is adjustable from 0 to +400 volts and floats on the "BIAS IN" voltage.

NOTE: The Pulse voltage power supply regulation circuitry built around amplifier A2 uses voltages which are referenced to the "BIAS IN" voltage. The front panel controls and metering circuit are referenced to ground (chassis).

The Zener regulator made by R35 and CR6 supplies 9 volts to the front panel "PULSE V" control R103. The voltage from the "PULSE V" control goes through the buffer amplifier A4 to the isolation amplifier A2. The isolation amplifier outputs a voltage equal to the input voltage that is referenced to the "BIAS IN" voltage. The output of the isolation amplifier A2 drives the Pulse Voltage regulation amplifier A1. As the voltage to the regulation amplifier is increased Q2 starts to conduct which turns on the SC-5 power supply. Feedback resistors R7, R8, R14 and R15 create a voltage divider such that when the Pulse voltage is 400 volts the voltage on A1 Pin 2 will be about 6 volts.

9.3.4 TRIGGER SHAPING AND DELAY CIRCUITRY

The trigger pulse received at the "TRIGGER IN" BNC is AC coupled to the shaping circuit through C101. The output of C101 is a positive pulse on the rising edge of the trigger input, and a negative pulse on the falling edge of the trigger input. The ± trigger switch determines whether these pulses go through the inverting or noninverting primary of T1. The positive pulse from the secondary of T1 is connected to A6 Pin 3 through R38 and CR7, with the negative pulse being clamped by CR8. A6 is a noninverting amplifier with a gain of 20 which amplifies the positive pulse from T1 to trigger the delay circuit A10. The delay is determined by the "COARSE" and "FINE" delay controls on the front panel as well as C37. The "FINE" delay control is adjustable from 2 to 30 µS and the "COARSE" delay control is adjustable up to 1.2 milliseconds. The delayed pulse from A10 Pin 10 goes to Pin 5 of A10, which makes a negative pulse 2 µS wide on A10 Pin 7 that is inverted by A5.

Timer A12 serves to limit the pulse rate by resetting A10 for a preset period after each pulse. The rate limit is set by R43 and C31 and is adjustable from 14 µS (70 kHz) to 720 nanoseconds (1.3 MHz). R42 and C32 make a power on reset circuit for A12.

9.3.5 PULSER 1 DELAY AND DURATION CIRCUIT

NOTE: DELAY 1 and DELAY 2 (as determined by the placement of jumpers on the PC board) are for controlling two events that have to be accurately synchronized with each other.

The delayed trigger pulse from A5 Pin 7 goes to the digital delay A11 which is adjustable from 0 to 100 nanoseconds in 10 nanosecond steps. The selected delay then goes to the duration timer A12 Pin 10. The duration is determined by the "COARSE" and "FINE" duration controls on the front panel as well as C30. The "FINE" duration control is adjustable from 250 to 600 nanoseconds. The "COARSE" duration control is adjustable up to 12 µS. The pulse from A12 Pin 12 goes to the inverter/driver A13 and then to the "TRIGGER PULSER 1" BNC connector on the rear panel.

9.3.6 PULSER 2 DELAY AND DURATION CIRCUIT

The delayed trigger pulse from A5 Pin 7 goes to the digital delay A7 which is adjustable from 0 to 100 nanoseconds in 10 nanosecond steps. The selected delay then goes to the duration timer A8 Pin 10. The duration is determined by the "COARSE" and "FINE" duration controls on the front panel as well as C45. The "FINE" duration control is adjustable from 50 to 100 nanoseconds. The "COARSE" duration control is adjustable up to 3.5 µS. The pulse from A8 Pin 12 goes to the inverter/driver A13 and then to the "TRIGGER PULSER 2" BNC connector on the rear panel.

9.3.7 METERING CIRCUITRY

The voltage divider R10, R22, and R24 creates a voltage that is 1/1000 of the "PULSE V" output voltage. This voltage drives the comparator amplifier A3-1 Pin 3

and is calibrated by the "PULSE CALIB" pot R24. The voltage divider R9, R28, and R25 creates a voltage that is 1/1000 of the "BIAS OUT" output voltage. This voltage drives the buffer amplifier A3-2 Pin 5 which in turn drives the comparator amplifier A3-1 Pin 2 and is calibrated by the "PULSE TRACK" pot R25. The comparator amplifier A3-1 measures the difference between the two voltage dividers and amplifies that difference by a factor of ten to drive the Pulse voltage meter when selected by the front panel switch S101.

The voltage divider R10, R22, and R24 also goes to A3-4 which drives the BIAS meter when selected by the front panel switch S101.

10.0 REMOTE PULSER CIRCUITRY DESCRIPTION

The Remote Pulser can more accurately be described as a remote high voltage switch. The output SHV connector is quickly connected to either the “PULSE V” or “BIAS” SHV connectors through the output transistors.

The Remote Pulser contains two isolation power supplies that create +12 volts that floats on the "BIAS" input voltage, and -12 volts that floats on the "PULSE V" input voltage. There is also a fiber optics transmitter and receiver to elevate the "TRIGGER" pulse to the "BIAS" input voltage potential to trigger A1 (IR2110).

10.1 REMOTE PULSER POLARITY OPTIONS

The Remote Pulser can be configured two different ways. The most common configuration is that the output waveform looks like the “TRIGGER” waveform. The jumper positions are shown on Drawing C01045-P. The other configuration is such that the output waveform is an inverted “TRIGGER” waveform. The jumper positions are shown on Drawing C01045-D.

10.2 CIRCUIT DESCRIPTION

See Remote Pulser Schematic, drawing C01040.

10.2.1 ISOLATED POWER SUPPLY CIRCUIT

The PULSER Power Supply delivers +12 volts to the isolation power supplies PS1 and PS2. PS1 and PS2 take the +12 volts and convert it into two independent, isolated and unregulated "12 volt power supplies. One of the power supplies (PS1) is wired as a -12 volt power supply that floats on the "PULSE V" and powers the pull up circuitry of the IR2110 (VB and VS). The other 12 volt power supply (PS2) is wired as a +12 volt power supply that powers the pull down circuitry of the IR2110 (VCC and COM). The +12 volt supply is reduced to +5 volts by Q3, and the voltage is set by R3 and R4. The +5 volt power supply powers the fiber optics receiver A3.

10.2.2 TRIGGER CIRCUITRY

A "TRIGGER" pulse (0V to +3V minimum, +20V maximum) is received from the PULSER Power Supply. This pulse turns on Q4 (2N7000) which lights an LED inside A4 through R8 (110 ohms). This pulse of light operates the inverting logic gate receiver A3. This timing pulse goes to a connector block (CB1) which determines

whether the output pulse of the Remote Pulser has the same waveform as the trigger input, or if the output pulse is the inverted waveform of the trigger input.

The input impedance of the "TRIGGER" BNC connector is 50 ohms.

10.2.3 PULSING CIRCUITRY

For best performance, the output of the Remote Pulser should be connected directly to a coaxial feedthrough. Because of the sub 10nS rise and fall time of the output, the load connected to the output of the Remote Pulser is very critical. A cable connected to the output has both inductance and capacitance which will reflect back any energy the cable is not able to absorb. This will result in the rise and fall of the output pulse to resemble a staircase with the steps being about 20nS wide. The capacitance of the cable will cause the output transistors to work harder at charging and discharging the output capacitance. This will result in the output transistors heating up as the repetition rate is increased.

The heart of the Remote Pulser is A1 (IR2110). This IC takes a trigger pulse from A2 (ICL7667CPA) and controls both the pull up transistor Q1 (VP0550N3) and the pull down transistor Q2 (VN0550N3). A1 has its own delay circuits that turn off one of the transistors 10nS before turning on the other transistor. This delay causes less heating of the transistors which results in a high repetition rate of 200 kHz.

Diode CR1 is used to limit the minimum output voltage of the Remote Pulser to approximately 11 volts. If the output of the Remote Pulser is allowed to go below 11 volts Pin 6 of A1 will go below zero volts and cause A1 to lock-up.

The Remote Pulser contains a dual inverter logic IC A2 (ICL7667CPA) which can be jumpered such that the Pulser output is either a pulsing or dipping (inverted) waveform. Drawings C01045-P and C01045-D show the jumper connections needed for the two options.

11.0 DESCRIPTION AND CALIBRATION OF PC BOARD CONTROLS

WARNING: Before removing the top cover or disconnecting any of the rear panel connections, turn off the "POWER" and disconnect the power supply from its power source. Also, turn off any power supply connected to the "BIAS IN" connector and disconnect all of the cables from the rear panel. Even though the power is disconnected the "BIAS IN" voltage will elevate half of the circuitry on the PC Board, which can result in a dangerous electrical shock.

Adjustments 11.1 through 11.4 should be done with the cables disconnected from the Remote Pulser.

A shorting SHV connector should be connected to the "BIAS OUT" connector on the rear panel for power supplies wired as a subtractive pulsing output voltage which is described in section 6.1.

A shorting SHV connector should be connected to the "BIAS IN" connector on the rear panel for power supplies wired as an additive pulsing output voltage which is described in section 6.1.

11.1 RATE LIMIT SCREWDRIVER ADJUST POT

This adjustment limits the repetition rate of the pulser to 200 kHz. Adjust the "RATE LIMIT" pot completely counterclockwise. Connect a Pulse Generator to the "TRIGGER INPUT" BNC connector on the front panel. Connect a dual trace oscilloscope with one channel connected to the pulse generator and the other channel connected to the "DELAY MONITOR" BNC connector on the front panel. Adjust the pulse generator for a pulse spacing of 5 µS (200 kHz). Adjust the "RATE LIMIT" pot until the "DELAY MONITOR" shows a pulse for every other input pulse and then back the adjustment off a little so that there is one pulse on the "DELAY MONITOR" for every trigger pulse.

11.2 PULSE LIMIT SCREWDRIVER ADJUST POT

This adjustment limits the maximum Pulse Voltage that can be set from the front panel. Adjust the front panel "PULSE V" control completely clockwise. Connect a volt meter across C7. Turn on the power supply and adjust the "PULSE LIMIT" pot until the volt meter reads a maximum of 400 volts.

11.3 PULSE CALIB SCREWDRIVER ADJUST POT

Adjust the front panel "PULSE V" control until the voltage across C7 is 400 volts. Connect a Digital Volt Meter to chassis ground and A3 (LF347) Pin 8. Adjust the "PULSE CALIB" pot until the Digital Volt Meter reads 0.400 volts.

11.4 PULSE METER ADJ. SCREWDRIVER ADJUST POT

Turn the front panel "PULSE V" control to zero volts. Flip the meter switch up to monitor "PULSE V". Zero the front panel meter with the adjustment under the meter scale. Adjust the PULSE VOLTAGE for 400 volts across C7. Adjust the "PULSE METER ADJ." pot until the front panel meter reads 400 volts.

11.5 PULSE TRACK SCREWDRIVER ADJUST POT

This adjustment is to keep the indicated Pulse Voltage on the front panel meter from changing when the "BIAS IN" voltage is varied. Connect an external adjustable +5,000 volt power supply to the "BIAS IN" SHV connector. With the front panel meter still monitoring the Pulse voltage, adjust the "BIAS IN" power supply from zero to 3,000 volts. The "PULSE TRACK" pot is adjusted so that the indicated Pulse voltage on the front panel meter does not change when the "BIAS IN" voltage is changed.

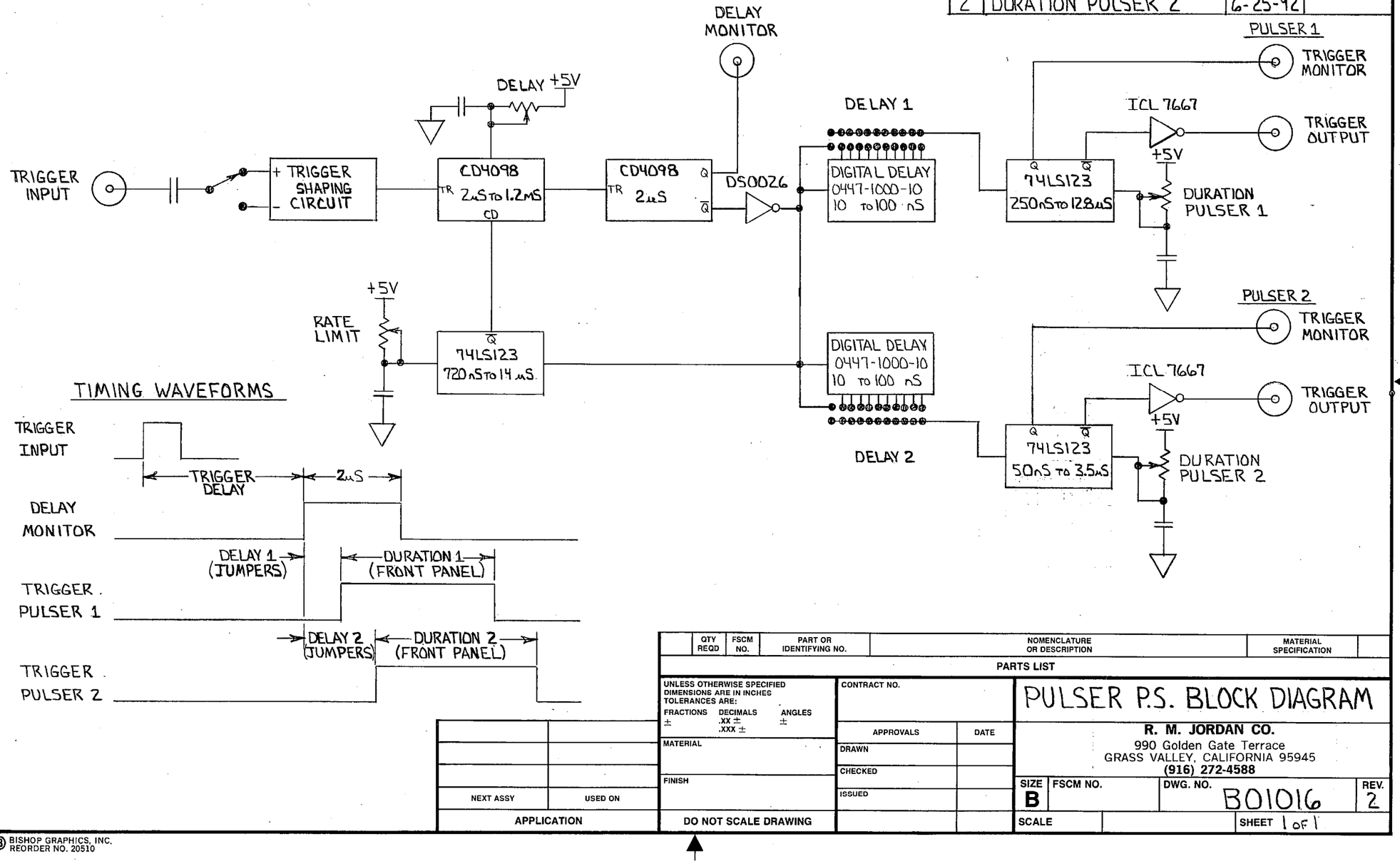
11.6 BIAS METER ADJ. SCREWDRIVER ADJUST POT

This adjustment is to calibrate the front panel meter when it is monitoring the "BIAS IN" voltage. Flip the front panel meter switch down to monitor the "BIAS V". Adjust the external "BIAS IN" power supply to +3,000 volts. Adjust the "BIAS METER ADJ." until the front panel meter reads 3,000 volts.

DWG. NO.	SH	REV.

REVISIONS

REV.	DESCRIPTION	DATE	APPROVED
1	DEVELOPED	7-18-88	
2	DURATION PULSER 2	6-25-92	



QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

NEXT ASSY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

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APPROVALS	DATE
DRAWN	
CHECKED	
ISSUED	

PULSER P.S. BLOCK DIAGRAM

R. M. JORDAN CO.
990 Golden Gate Terrace
GRASS VALLEY, CALIFORNIA 95945
(916) 272-4588

SIZE	FSCM NO.	DWG. NO.	REV.
B		B01016	2

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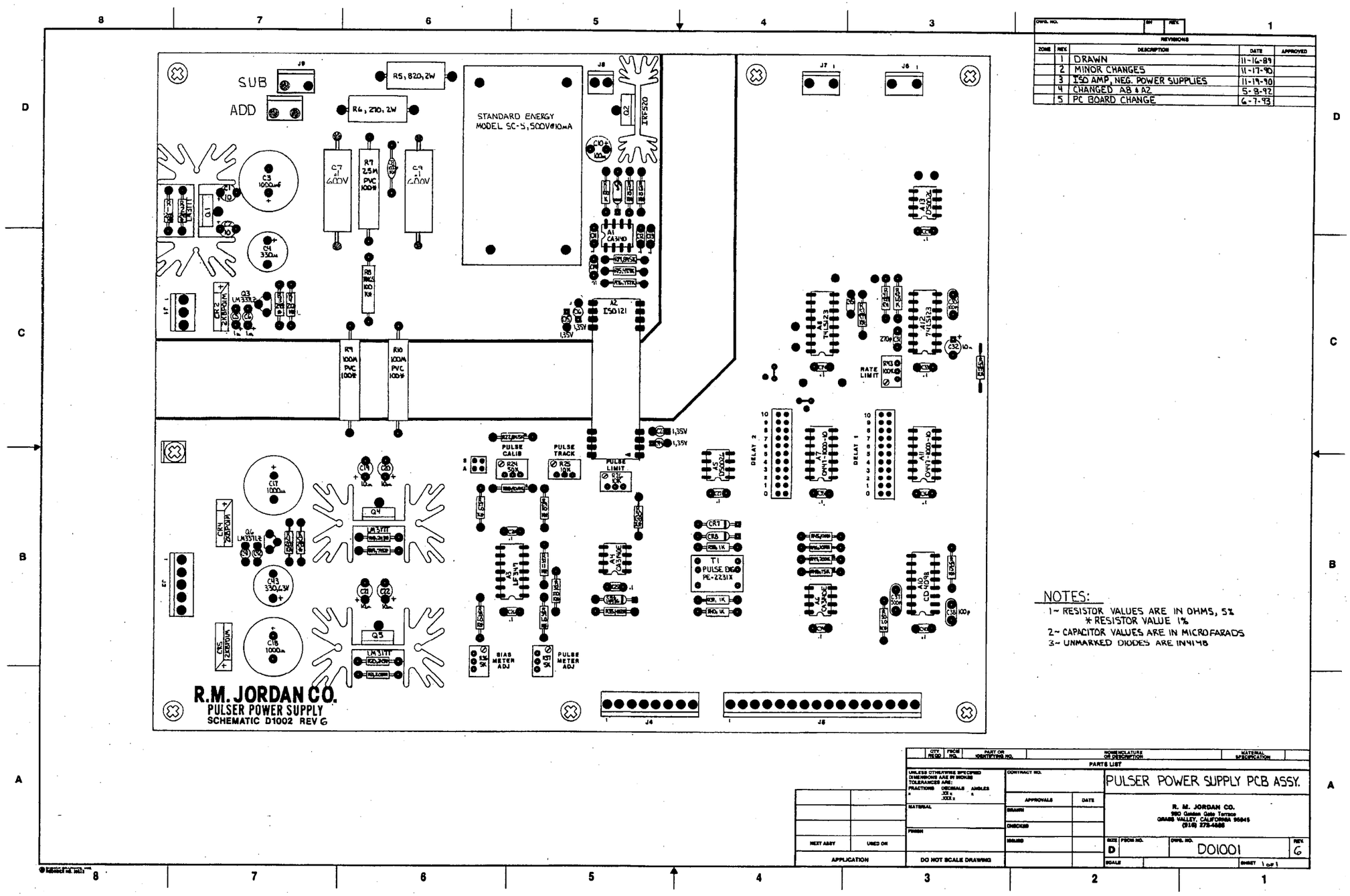
BISHOP GRAPHICS, INC.
REORDER NO. 20510



REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	1	DRAWN	11-16-89	
	2	MINOR CHANGES	11-17-90	
	3	ISO AMP, NEG. POWER SUPPLIES	11-19-90	
	4	CHANGED A8 & A2	5-8-92	
	5	PC BOARD CHANGE	6-7-93	

NOTES:
1- RESISTOR VALUES ARE IN OHMS, 5%
*RESISTOR VALUE 1%
2- CAPACITOR VALUES ARE IN MICROFARADS
3- UNMARKED DIODES ARE IN4148

PARTS LIST				
QTY PER SYS	ITEM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

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CONTRACT NO.

APPROVALS	DATE
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PULSER POWER SUPPLY PCB ASSY.

R. M. JORDAN CO.
5910 Golden Gate Terrace
GRASS VALLEY, CALIFORNIA 95945
(916) 272-4686

SIZE D | FSCM NO. | DWG. NO. D01001 | REV G
SCALE | SHEET 1 OF 1

REVISIONS				
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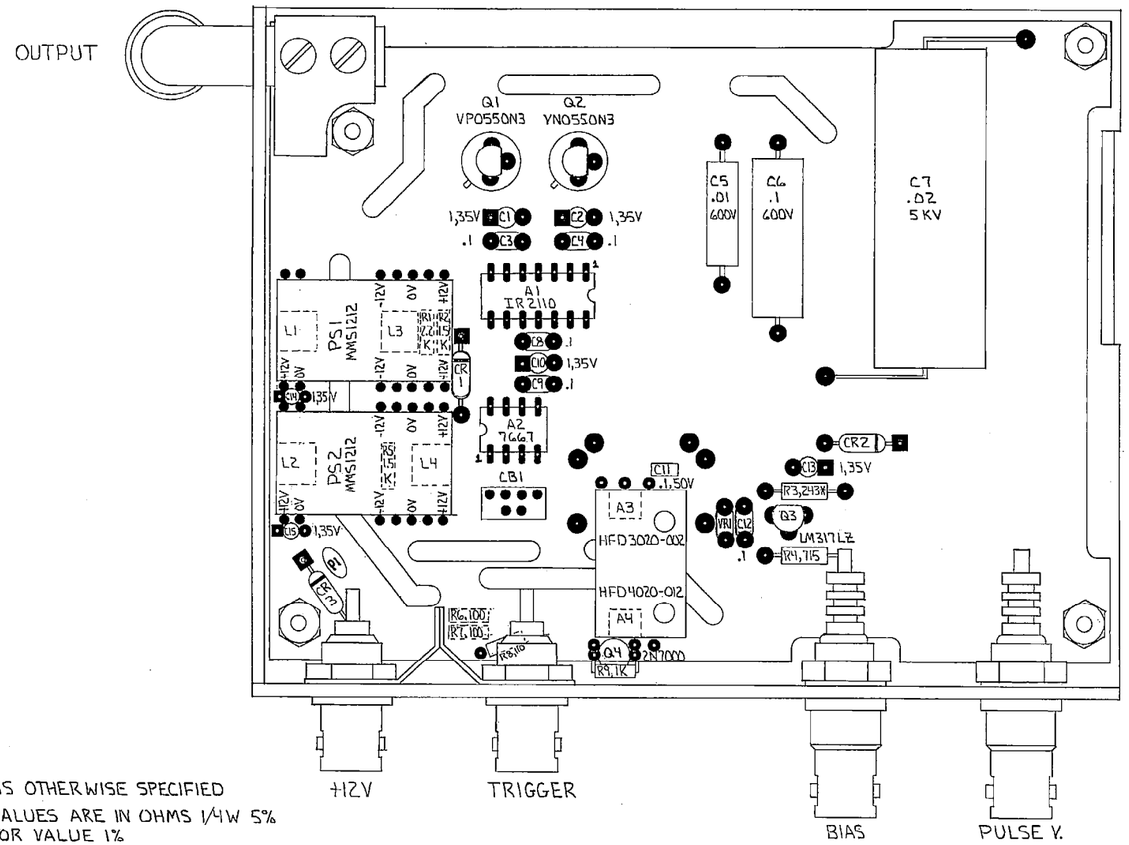
	5	REDEVELOPED	8-5-91	
	6	POWER SUPPLY CHANGE	11-4-05	



NOTES: UNLESS OTHERWISE SPECIFIED

1~ RESISTOR VALUES ARE IN OHMS 1/4W 5%
* RESISTOR VALUE 1%

2~ CAPACITOR VALUES ARE IN MICROFARADS

3~ ALL DIODES ARE IN4007

4~ INDUCTORS ARE 220 MICROHENRIES, .25 AMPS, 7mm FOOT PRINT

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

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REMOTE PULSER ASSEMBLY

TOF ELECTRONICS
10227 Missouri Bar Road
NEVADA CITY, CALIFORNIA 95959
(530) 478-5955 randall@gv.net

SIZE C | FSCM NO. | DWG. NO. C01040 | REV. 6

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DWG. NO. | SH | REV.

BISHOP GRAPHICS, INC. REORDER NO. 20511

REVISIONS				
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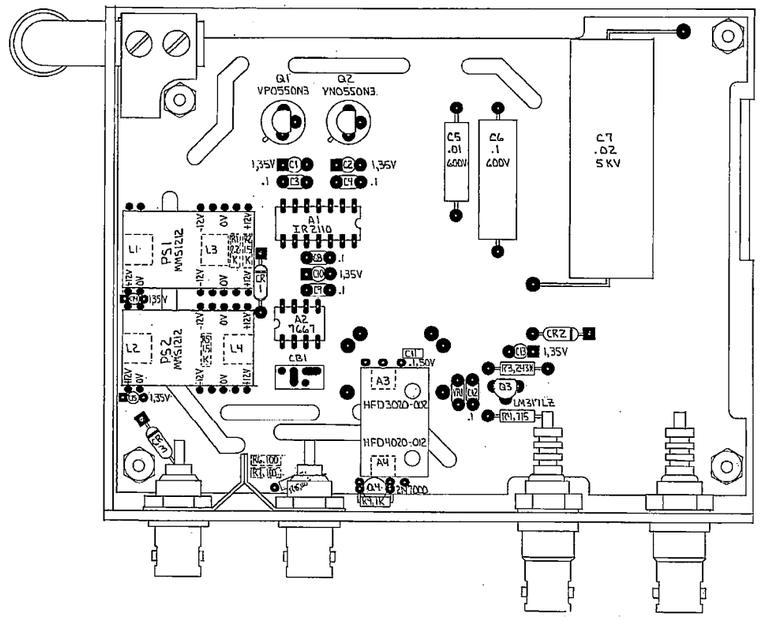
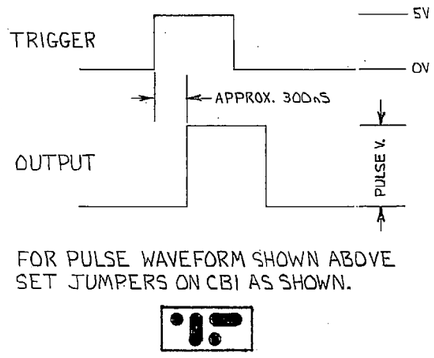
	6	CHANGED	11-4-05	





FOR PULSE WAVEFORM SHOWN ABOVE
SET JUMPERS ON CB1 AS SHOWN.

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PULSER POLARITY OPTION

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(530) 478-5955 randall@gv.net

SIZE C | FSCM NO. | DWG. NO. C01045-P | REV. 6

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REVISIONS				
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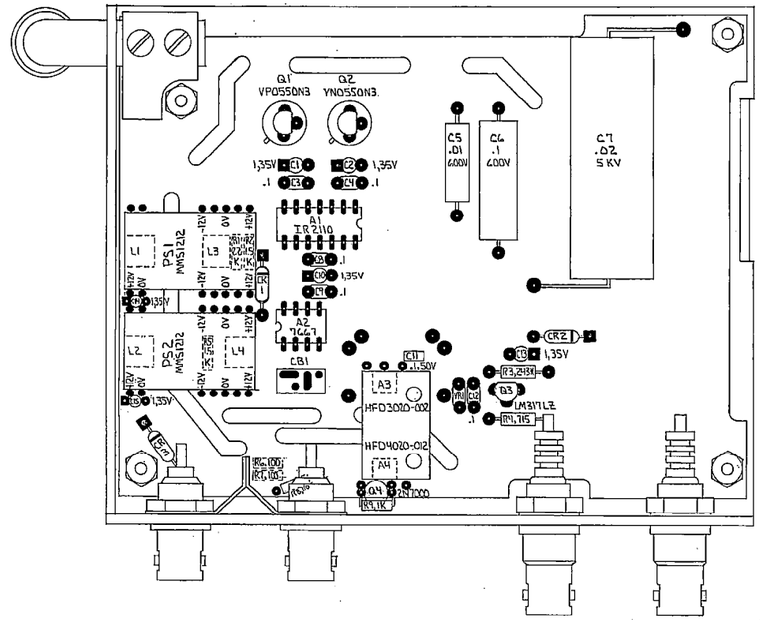
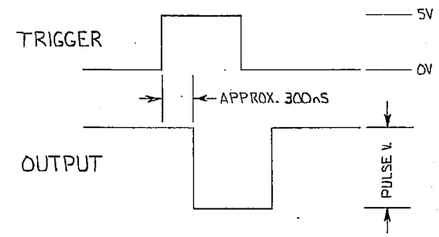
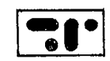
	6	CHANGED	11-4-05	





FOR DIPPED WAVEFORM SHOWN ABOVE
SET JUMPERS ON CB1 AS SHOWN



DWG. NO.

SH

REV.

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TOLERANCES ARE:
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PULSER POLARITY OPTION

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NEVADA CITY, CALIFORNIA 95959
(530) 478-5955 randall@gv.net

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C		C01045-D	6

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