INSTRUCTIONS

MODEL AVO-8C-B

0 TO 40 V, 200 AMP
LASER DIODE DRIVER
WITH IEEE 488.2 AND RS-232 CONTROL

SERIAL NUMBER: _____

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 assumed by Avtech with respect to this product and no other warranty or guarantee is either expressed or implied.

TECHNICAL SUPPORT

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INTRODUCTION

The Model AVO-8C-B pulse generator is designed for pulsing laser diode and other low impedance loads with rectangular pulses as high as 200 Amperes (or 40 Volts), pulse widths from 2 us to DC, and average output power to 4000 Watts. The current and voltage polarities depend on the model number:

-P units: 0 to +40 V amplitude (0 to +200 Amps)
-N units: 0 to -40 V amplitude (0 to -200 Amps)
-PN units: 0 to 40 V amplitude (0 to ±200 Amps)

The maximum average output current amplitude is 100 Amps. (That is, the output duty cycle may be as high as 100% for peak amplitudes of up to 100 Amps. The duty cycle must be reduced at higher peak amplitudes. The maximum duty cycle is 50% for 200 Amp operation.)

The Model AVO-8C-B pulse generator is a voltage pulser. The current amplitude is determined by Ohm's Law. That is, the current is the output voltage divided by the load resistance.

$V_{OUT} \approx V_{DC} - 1V$

$I_{OUT} \approx (V_{OUT} - V_{DIODE}) / (R_{SERIES} + 0.01 \text{ Ohms})$

Duty Cycle = Pulse Width x Frequency

$I_{AVG} = I_{OUT}$ x Duty Cycle

$\Delta V_{OUT} = I_{OUT} \times \text{Pulse Width} / C$

C = 180000 uF + Power Supply Capacitance

The diode is shown oriented for positive (-P) operation. It must be reversed for negative (-N) units.
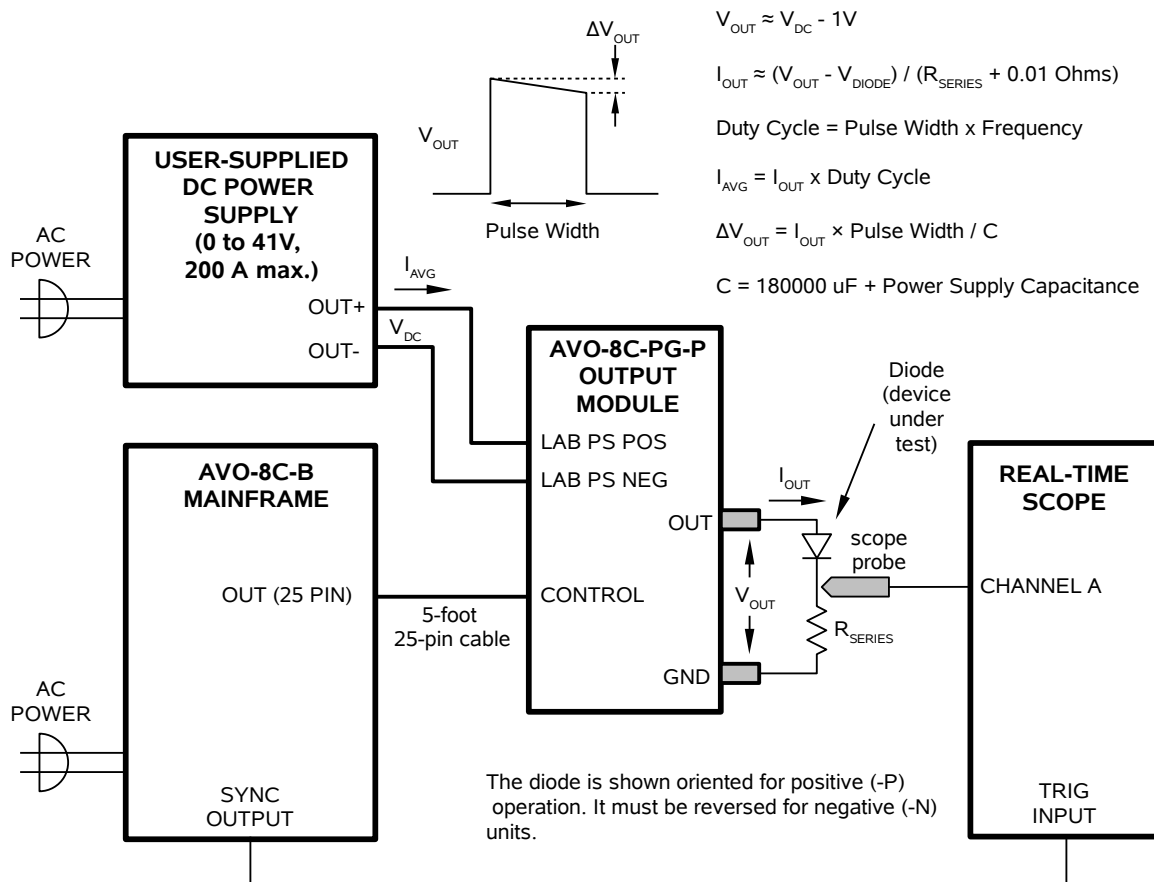
The AVO-8C-B system consists of an instrument mainframe, an output module which connects to the mainframe via a 5 foot long detachable D-subminiature cable, and a user-supplied high-current DC lab power supply. The load can be connected to either a pair of banana connector binding posts, or to a short length of protruding microstrip board. Output pulse amplitude control is achieved by means of the user-supplied high current DC lab power supply which provides the prime power to the output module (see diagram above). The output module acts as a high-efficiency, high-speed switch which connects the lab power supply to the load during the output pulse duration. The output pulse voltage amplitude is approximately equal to the lab power supply voltage less about one Volt. The lab power supply must be capable of supplying the average value (i.e. I_{DC}) of the peak current supplied to the load (I_{OUT}). I_{DC}, I_{OUT}, pulse width (PW) and pulse period (T) are related as shown in the diagram. It is essential that a low-inductance current-limiting resistor (R) be added in series with the diode being tested. See the "Basic Test Arrangement" section for details.

Protective circuits monitor the lab power supply voltage level and the output module temperature and will automatically disable the triggering of the output stage and sound an audible alarm if either the applied voltage or temperature exceed rated values.

SPECIFICATIONS

Model[1]:	AVO-8C-B
Amplitude: current:	0 to 200 Amperes
voltage:	0 to 40 Volts
Minimum load impedance: (required to limit output current)	0.2 Ω
Pulse width:	2 us to DC
Controls:	Keypad and adjust knob, and GPIB / RS-232 control
PRF:	0.1 Hz to 1 kHz
Rise and fall times:	≤ 1 us
Maximum duty cycle:	100%
Max. average output current:	100 Amperes
Output impedance:	≤ 0.01 Ohms
Polarity[2]:	Positive or negative or dual polarity (specify)
Remote control[1,3]:	GPIB and RS-232 ports are standard on -B units. Optional[3] telnet-based remote control is also available, for control over local area networks or the internet.
LabView drivers:	Check http://www.avtechpulse.com/labview for availability and downloads
Propagation delay:	± 100 ns (Ext trig in to pulse out)
Jitter:	± 500 ps ± 0.03% of sync delay (Ext trig in to pulse out)
Trigger required, for external trigger modes:	External trigger, internal PW control mode: +5 Volt, 50 ns or wider (TTL) External trigger, external PW control mode: +5 Volt, $PW_{IN} = PW_{OUT}$ (TTL)
Monitor output option[4]:	Provides an attenuated coincident replica of the main output current pulse
Sync delay, Sync output:	Sync out to pulse out: Variable 0 to ± 1 second. + 3 Volts, 200 ns, will drive 50 Ohm loads
Gate input:	Synchronous or asynchronous, active high or low, switchable. Suppresses triggering when active.
Connectors:	Out: Banana and Microstrip solder terminals
	Trig, Sync, Monitor, Gate: BNC DC Power: 100 Amp SUPERCON connectors (included)
Power requirements: DC[5]:	0 to 40 V, 200 Amp max
AC:	120/240 Volts (switchable), 50 - 60 Hz
Cooling:	Self contained fan.
Dimensions: Mainframe:	100 mm x 430 mm x 375 mm (3.9" x 17" x 14.8")
(H x W x D) Output Module:	152 mm x 152 mm x 229 mm (6" x 6" x 9")
Chassis material:	anodized aluminum, with blue plastic trim
Mounting, Temperature range:	Any, +5°C to +40°C

1) -B suffix indicates IEEE-488.2 GPIB and RS-232 control of pulse width, PRF and delay. (See http://www.avtechpulse.com/gpib for details).
2) Indicate desired polarity by suffixing the model number with -P or -N (i.e. positive or negative), or -PN for the dual polarity option.
3) To specify the telnet control option, add the suffix -TNT to the model number. See http://www.avtechpulse.com/options/tnt for details.
4) For monitor option add the suffix -M to the model number.
5) Requires a user-supplied DC power supply. Avtech suggests Xantrex as a source of DC power supplies (http://www.xantrex.com). Contact Avtech for recommendations about DC power supplies appropriate for your application.

<u>INSTALLATION</u>

<u>VISUAL CHECK</u>

After unpacking the instrument mainframe and the output module(s), examine to ensure that they have not been damaged in shipment. Visually inspect all connectors, knobs, liquid crystal displays (LCDs), and the handles. Confirm that a power cord, a GPIB cable, one 25-pin D-subminiature cable (two for -PN units), and two instrumentation manuals (this manual and the "Programming Manual for -B Instruments") are with the instrument. If the instrument has been damaged, file a claim immediately with the company that transported the instrument.

<u>PLUGGING IN THE INSTRUMENT</u>

Examine the rear of the instrument. There will be a male power receptacle, a fuse holder and the edge of the power selector card visible. Confirm that the power selector card is in the correct orientation.

For AC line voltages of 110-120V, the power selector card should be installed so that the "120" marking is visible from the rear of the instrument, as shown below:

For AC line voltages of 220-240V, the power selector card should be installed so that the "240" marking is visible from the rear of the instrument, as shown below:

If it is not set for the proper voltage, remove the fuse and then grasp the card with a pair of pliers and remove it. Rotate horizontally through 180 degrees. Reinstall the card and the correct fuse.

In the 120V setting, a 1.0A slow blow fuse is required. In the 240V setting, a 0.5A slow blow fuse is required.

FRONT PANEL CONTROLS
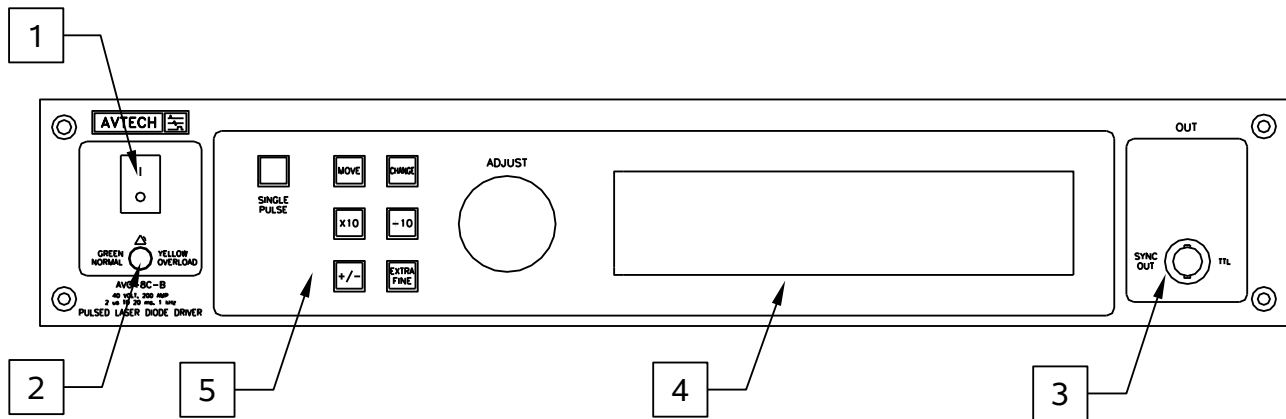
1. <u>POWER Switch</u>. This is the main power switch. When turning the instrument on, there may be a delay of several seconds before the instrument appears to respond.

2. <u>OVERLOAD Indicator</u>. When the instrument is powered, this indicator is normally green, indicating normal operation. If this indicator is yellow, an internal automatic overload protection circuit has been tripped. If the unit is overloaded (by operating at an exceedingly high duty cycle or by operating into a very low impedance), the protective circuit will disable the output of the instrument and turn the indicator light yellow. The light will stay yellow (i.e. output disabled) for about 5 seconds after which the instrument will attempt to re-enable the output (i.e. light green) for about 1 second. If the overload condition persists, the output will be disabled again (i.e. light yellow) for another 5 seconds. If the overload condition has been removed, the instrument will resume normal operation.

   This overload indicator may flash yellow briefly at start-up. This is not a cause for concern.

3. <u>SYNC OUT</u>. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to R_L > 50Ω with a pulse width of approximately 200 ns.

4. <u>LIQUID CRYSTAL DISPLAY (LCD)</u>. This LCD is used in conjunction with the keypad to change the instrument settings. Normally, the main menu is displayed, which lists the key adjustable parameters and their current values. The "Programming Manual for -B Instruments" describes the menus and submenus in detail.

5. <u>KEYPAD</u>.

Control Name	Function
MOVE	This moves the arrow pointer on the display.
CHANGE	This is used to enter the submenu, or to select the operating mode, pointed to by the arrow pointer.
×10	If one of the adjustable numeric parameters is displayed, this increases the setting by a factor of ten.
÷10	If one of the adjustable numeric parameters is displayed, this decreases the setting by a factor of ten.
+/-	If one of the adjustable numeric parameters is displayed, and this parameter can be both positive or negative, this changes the sign of the parameter.
EXTRA FINE	This changes the step size of the ADJUST knob. In the extra-fine mode, the step size is twenty times finer than in the normal mode. This button switches between the two step sizes.
ADJUST	This large knob adjusts the value of any displayed numeric adjustable values, such as frequency, pulse width, etc. The adjust step size is set by the "EXTRA FINE" button. When the main menu is displayed, this knob can be used to move the arrow pointer.

REAR PANEL CONTROLS
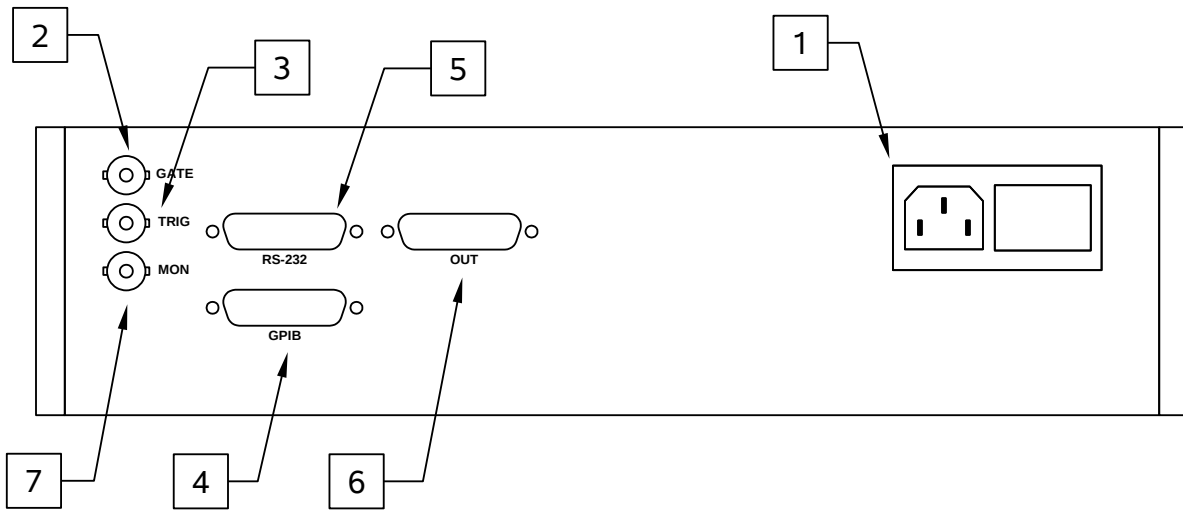
1. <u>AC POWER INPUT</u>. A three-pronged recessed male connector is provided on the back panel for AC power connection to the instrument. Also contained in this assembly is a slow blow fuse and a removable card that can be removed and repositioned to switch between 120V AC in and 240V AC in.

    For AC line voltages of 110-120V, the power selector card should be installed so that the "120" marking is visible from the rear of the instrument.

    For AC line voltages of 220-240V, the power selector card should be installed so that the "240" marking is visible from the rear of the instrument.

    If it is not set for the proper voltage, remove the fuse and then grasp the card with a pair of pliers and remove it. Rotate horizontally through 180 degrees. Reinstall the card and the correct fuse.

    In the 120V setting, a 1.0A slow blow fuse is required. In the 240V setting, a 0.5A slow blow fuse is required. See the "Installation" section for more details.

2. <u>GATE</u>. This TTL-level (0 and +5V) logic input can be used to gate the triggering of the instrument. This input can be either active high or active low, depending on the front panel settings or programming commands. (The instrument triggers normally when this input is unconnected). When set to active high mode, this input is pulled-down to ground by a 1 kΩ resistor. When set to active low mode, this input is pulled-up to +5V by a 1 kΩ resistor.

3. <u>TRIG</u>. This TTL-level (0 and +5V) logic input can be used to trigger the instrument, if the instrument is set to triggering externally. The instrument triggers on the rising edge of this input. The input impedance of this input is 1 kΩ. (Depending on the length of cable attached to this input, and the source driving it, it may be desirable to add a coaxial 50 Ohm terminator to this input to provide a proper transmission line
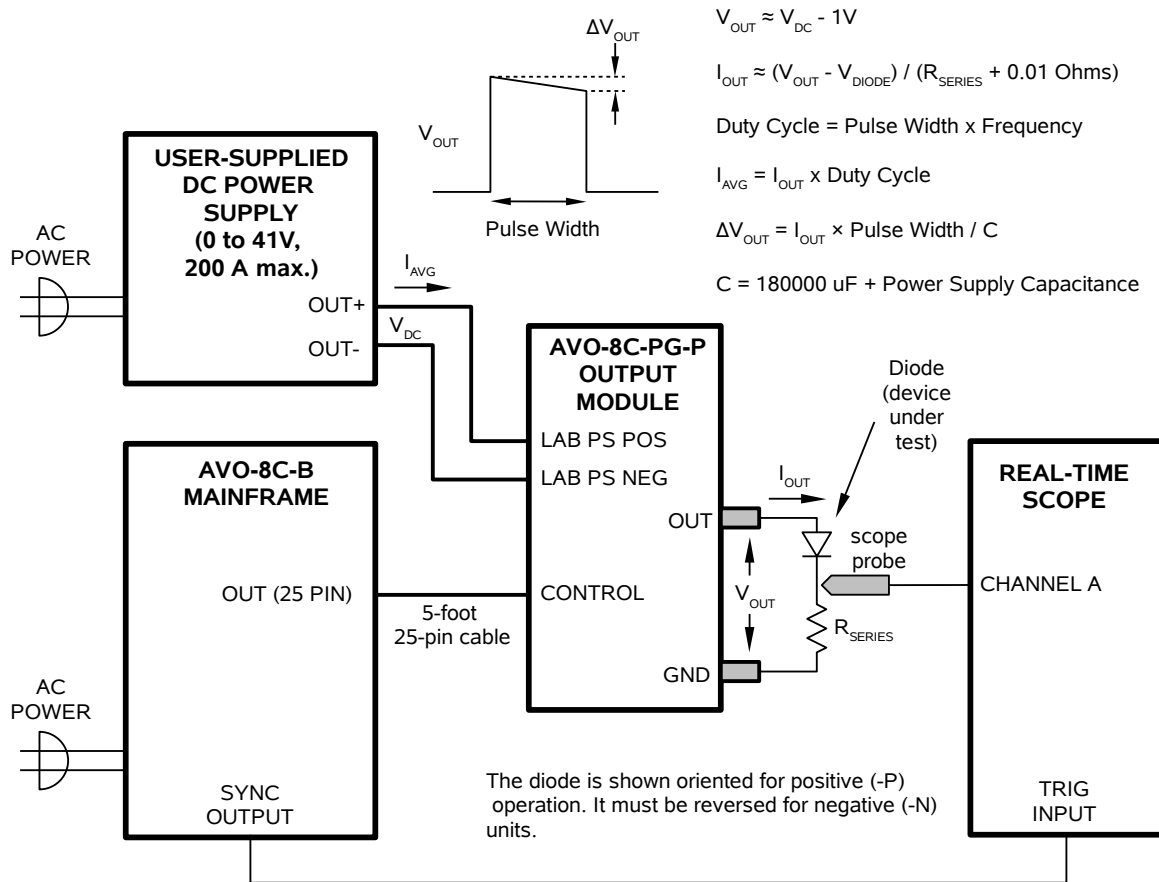
termination. The Pasternack (www.pasternack.com) PE6008-50 BNC feed-thru 50 Ohm terminator is suggested for this purpose.)

When triggering externally, the instrument can be set such that the output pulse width tracks the pulse width on this input, or the output pulse width can be set independently.

4. <u>GPIB Connector</u>. A standard GPIB cable can be attached to this connector to allow the instrument to be computer-controlled. See the "Programming Manual for -B Instruments" for more details on GPIB control.

5. <u>RS-232 Connector.</u> A standard serial cable with a 25-pin male connector can be attached to this connector to allow the instrument to be computer-controlled. See the "Programming Manual for -B Instruments" for more details on RS-232 control.

6. <u>OUT Connector</u>. A 5-foot-long, 25-pin D-subminiature cable is used to connect this output connector to the "Control" connector on the output module. This cable must be installed before power is applied.

7. <u>MON Connector</u>. (Optional feature. For models with -M suffix only.) This is a current monitor output. This output provides a voltage waveform that is proportional to the current waveform on the output. The monitor relationship is: $V_{MON} = I_{OUT} \times 0.01\Omega$, for a load of > 1 k$\Omega$. (The monitor output can also drive a 50Ω load, but the output voltage will be reduced by a factor of 2. This output is short-circuit protected.)

GENERAL INFORMATION

BASIC TEST ARRANGEMENT

$V_{OUT} \approx V_{DC} - 1V$

$I_{OUT} \approx (V_{OUT} - V_{DIODE}) / (R_{SERIES} + 0.01 \text{ Ohms})$

Duty Cycle = Pulse Width x Frequency

$I_{AVG} = I_{OUT} \times$ Duty Cycle

$\Delta V_{OUT} = I_{OUT} \times$ Pulse Width / C

C = 180000 uF + Power Supply Capacitance

The diode is shown oriented for positive (-P) operation. It must be reversed for negative (-N) units.

The equipment should be connected in the general fashion shown above. The output modules should always be connected to the mainframe BEFORE power is applied.

The user-supplied DC power supply should be capable of supplying 0 to 41V, and up to 200 Amps of current (if operation at high duty cycles is required). (See Appendix A for suggested power supplies.)

The output terminals of the pulse generator module consists of a short length of microstrip transmission line protruding from the module chassis. The OUT terminal is the center conductor which is bounded on both sides by the ground plane (see below). Note that the "OUT" red banana terminal is in parallel with the microstrip center conductor and so may also be used as the output terminal.

It is essential that a low-inductance current limiting resistor (see Appendix B for possible suppliers) be placed in series with the laser diode load, particularly if the diode has a low series resistance and "on" voltage (< 2.5V). This is necessary because the driver is

a pulsed voltage source and with a highly nonlinear load such as a laser diode it will be extremely difficult to control and limit the load current without a fixed series resistance.

The series load resistance must be 0.2Ω or higher. The power dissipated by the resistor may be as high as 4000W (depending on the voltage and duty cycle). It may be necessary to water-cool the resistor. The power dissipated in the resistor is given by

$$P = I^2 \times R \times PW / T,$$

where "I" is the current, "R" is the resistance, "PW" is the pulse width, and "T" is the pulse period (1/frequency).

CONNECTING THE LOAD

The output terminals of the pulse generator module consists of a short length of microstrip transmission line protruding from the module chassis. The OUT terminal is the center conductor which is bounded on both sides by the ground plane (see below). Note that the "OUT" red banana terminal is in parallel with the microstrip center conductor, and so may also be used as the output terminal.
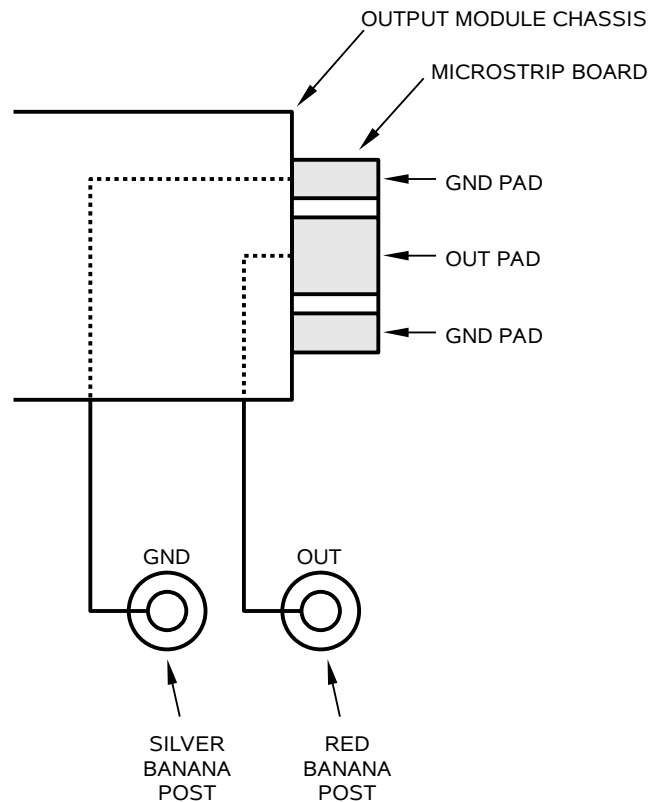
The load should be connected between the OUT and GND terminals using very short leads (≤ 2.0 cm). Take care to ensure that during soldering the OUT conductor is not shorted to the chassis. Also, use minimal heat when soldering to the microstrip board pads, to avoid delamination of the metallization.

BASIC PULSE CONTROL

This instrument can be triggered by its own internal clock or by an external TTL trigger signal. In either case, two output channels respond to the trigger: OUT and SYNC. The OUT channel is the signal that is applied to the load. Its amplitude and pulse width are variable. The SYNC pulse is a fixed-width TTL-level reference pulse used to trigger oscilloscopes or other measurement systems. When the delay is set to a positive value the SYNC pulse precedes the OUT pulse. When the delay is set to a negative value the SYNC pulse follows the OUT pulse.

These pulses are illustrated below, assuming internal triggering and positive delay:

SYNC OUT (generated by the internal oscillator) ← 200 ns, FIXED 3V, FIXED
DELAY > 0 PULSE WIDTH
MAIN OUTPUT AMPLITUDE, SET BY EXTERNAL POWER SUPPLY
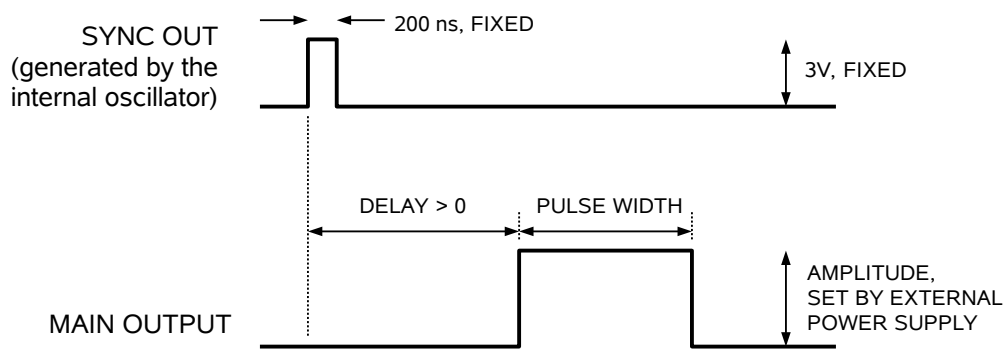
Figure A

If the delay is negative, the order of the SYNC and OUT pulses is reversed:

SYNC OUT (generated by the internal oscillator) 200 ns, FIXED 3V, FIXED
DELAY < 0
PULSE WIDTH
MAIN OUTPUT AMPLITUDE, SET BY EXTERNAL POWER SUPPLY
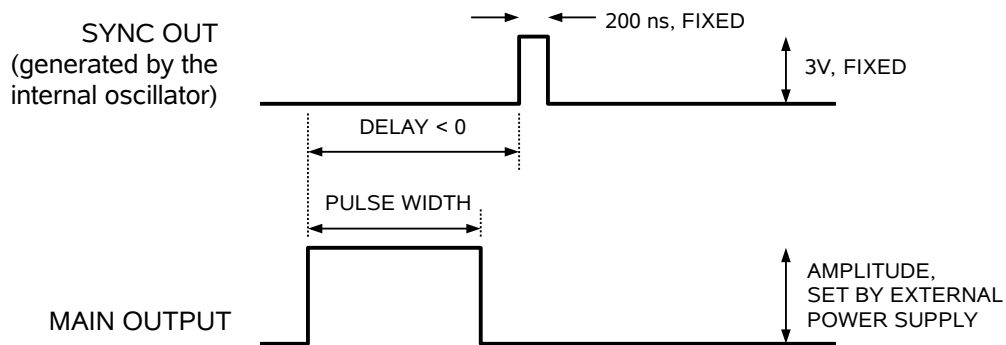
Figure B

The next figure illustrates the relationship between the signals when an external TTL-level trigger is used:
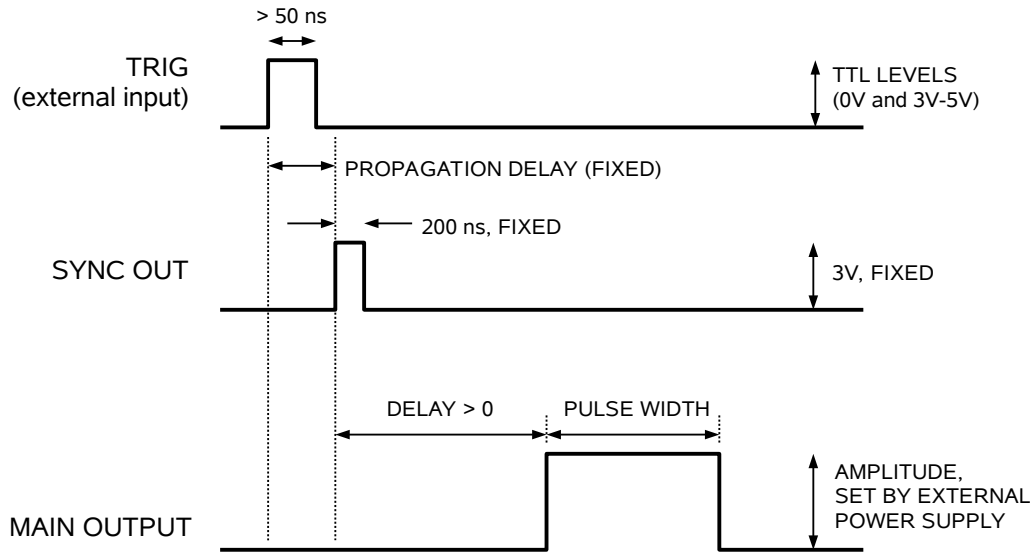
Figure C

As before, if the delay is negative, the order of the SYNC and OUT pulses is reversed.

The last figure illustrates the relationship between the signal when an external TTL-level trigger is used in the $PW_{IN}=PW_{OUT}$ mode. In this case, the output pulse width equals the external trigger's pulse width (approximately), and the delay circuit is bypassed:
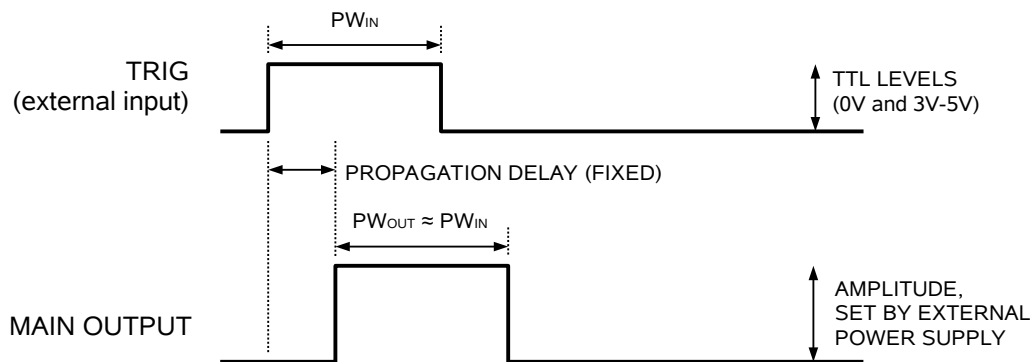
Figure D

The delay, pulse width, and frequency (when in the internal mode), of the OUT pulse can be varied with front panel controls or via the GPIB or RS-232 computer interfaces.

In all modes, the amplitude of the OUT pulse is controlled by the amplitude of the DC potential supplied to the SUPERCON connectors on the PG module. <u>CAUTION!!</u> DO NOT EXCEED 45V DC!

<u>CONTROLLING POLARITY (-PN UNITS ONLY)</u>

The output amplitude is controlled by the external power supplies, but the polarity is selected by the user using the front-panel amplitude menu. The amplitude displayed in this submenu is always either +0.00 or -0.00V. The numerical value is fixed at 0.00, and has no effect on the output amplitude, but pressing the +/- button control allows the output polarity to be controlled. The equivalent programming commands are "source:voltage -" and "source:voltage +".

The positive and negative modules can be connected to the mainframe at the same time, but only one will be triggered, depending on the polarity setting.

<u>TRIGGER MODES</u>

This instrument has four trigger modes:

- Internal Trigger: the instrument controls the trigger frequency, and generates the clock internally.

- External Trigger: the instrument is triggered by an external TTL-level clock on the back-panel TRIG connector.

- Manual Trigger: the instrument is triggered by the front-panel "SINGLE PULSE" pushbutton.

- Hold Trigger: the instrument is set to not trigger at all.

These modes can be selected using the front panel trigger menu, or by using the appropriate programming commands. (See the "Programming Manual for -B Instruments" for more details.)

<u>PULSE WIDTH MODES</u>

This instrument has two pulse width modes:

- Normal: the instrument controls the output pulse width.

- $PW_{IN} = PW_{OUT}$: the output pulse width equals the pulse width of the trigger signal on the "TRIG" connector. The instrument must be in the external trigger mode.

These modes can be selected using the front panel pulse width menu, or by using the appropriate programming commands. (See the "Programming Manual for -B Instruments" for more details.)

GATING MODES

Triggering can be suppressed by a TTL-level signal on the rear-panel GATE connector. The instrument can be set to stop triggering when this input high or low, using the front-panel gate menu or the appropriate programming commands. This input can also be set to act synchronously or asynchronously. When set to asynchronous mode, the GATE will disable the output immediately. Output pulses may be truncated. When set to synchronous mode, the output will complete the full pulse width if the output is high, and then stop triggering. No pulses are truncated in this mode.

ALARM CONDITIONS AND AUTOMATIC PROTECTION

To avoid damaging the instrument, observe these rules:

- Never let the lab power supply voltage exceed 45V
- Never let the peak output current exceed 200A

This pulse generator incorporates several features to protect against improper use. A protective circuit controls an internal buzzer. The buzzer will sound if:

- The instrument becomes excessively hot
- The applied DC voltage exceeds 45V
- The applied DC voltage is the incorrect polarity.

In these situations, triggering will be disabled.

CURRENT MEASUREMENT

Measuring current is more difficult than measuring voltage. There are several basic approaches to measuring pulsed current:

1. If the load is purely resistive, the current may be determined by observing the load voltage with an oscilloscope, and using Ohm's Law:

$$I_{LOAD} = V_{LOAD} \div R_{LOAD}$$

2. If the load is not purely resistive (for instance, a diode load), use a low-resistance, low-inductance, current-sensing resistor connected in series with the load. To minimize inductance, it is usually wise to connect several resistors in parallel. Beware that wirewound resistors usually have far too much inductance to be useful

as current-sensing resistors. The current through the load can be determined by measuring the voltage across the sensing resistor, using an oscilloscope.

3. Use a high-performance current transformer, such as the Pearson 101 (see the Pearson web site at www.pearsonelectronics.com). The voltage output of the current transformer (when terminated into a 50 Ohm load) is proportional to the load current.

4. Use the optional "-M" current monitor. This optional feature provides a BNC output connector, whose voltage waveform is proportional to the current waveform on the main output.

-M CURRENT MONITOR OPTION

As noted in the previous section, an optional current monitor output is available. The voltage waveform of the monitor output is proportional to the current waveform on the main output:

$$V_{MON} = I_{LOAD} \times 0.01 \text{ Volts/Amp}$$

The current monitor circuit also measures the amplitude of the most recent pulse, in amperes, and displays it on the front panel LCD. The value can also be read via the computer interface.

The rising and falling edges of the monitor waveform may show substantial voltages spikes caused by the inductance of the current sensing element. These spikes are artefacts of the measurement process and are not present in the actual current output waveform.

The output module should always be connected to the mainframe BEFORE power is applied. The current monitor will not work properly otherwise.

MECHANICAL INFORMATION

TOP COVER REMOVAL

If necessary, the interior of the instrument may be accessed by removing the four Phillips screws on the top panel. With the four screws removed, the top cover may be slid back (and off).

Always disconnect the power cord before opening the instrument.

There are no user-adjustable internal circuits. For repairs other than fuse replacement, please contact Avtech (info@avtechpulse.com) to arrange for the instrument to be returned to the factory for repair.

⚠ Caution: High voltages are present inside the instrument during normal operation. Do not operate the instrument with the cover removed.

RACK MOUNTING

A rack mounting kit is available. The -R5 rack mount kit may be installed after first removing the one Phillips screw on the side panel adjacent to the front handle.

ELECTROMAGNETIC INTERFERENCE

To prevent electromagnetic interference with other equipment, all used outputs should be connected to shielded loads using shielded coaxial cables. Unused outputs should be terminated with shielded coaxial terminators or with shielded coaxial dust caps, to prevent unintentional electromagnetic radiation. All cords and cables should be less than 3m in length.

<u>MAINTENANCE</u>

<u>REGULAR MAINTENANCE</u>

This instrument does not require any regular maintenance.

On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the "FUSES" section for details.

<u>CLEANING</u>

If desired, the interior of the instrument may be cleaned using compressed air to dislodge any accumulated dust. (See the "TOP COVER REMOVAL" section for instructions on accessing the interior.) No other cleaning is recommended.

START-UP CHECK-LIST FOR LOCAL CONTROL

1)   The instruction manual has been studied thoroughly.

2)   The "Local Control" section of the "Programming Manual for -B Instruments" has been studied thoroughly.

3)   The -PG module is connected to the mainframe as shown in the "Basic Test Arrangement" section. The 25-pin D-subminiature cable must be connected between the "OUT" connector on the rear-panel of the mainframe and the "Control" connector on the -PG module. (The output module should always be connected to the mainframe BEFORE power is applied.)

4)   The load is connected to the output module. Note that with a diode load, a low-inductance current limiting high power resistor <u>must</u> be placed in series with the diode to help limit the peak current. For initial testing, it is recommended that a resistive load be used. Factory tests are conducted using a 0.2 Ohm 2000 Watt resistive load.

5)   The user-supplied lab power supply is connected with the SUPERCON connectors. The power supply potential is set to zero.

6)   Turn on the prime power to the mainframe. The main menu will appear.

7)   The arrow pointer should be pointing at the frequency menu item. If it is not, press the MOVE button until it is.

8)   Press the CHANGE button. The frequency submenu will appear. Rotate the ADJUST knob until the frequency is set at the desired setting. The arrow pointer should be pointing at the "Internal" choice. If it is not, press MOVE until it is.

9)   Press CHANGE to return to the main menu.

10) Press the MOVE button to move the arrow pointer to the pulse width menu item. Press CHANGE to bring up the pulse width submenu, and rotate the ADJUST knob until the pulse width is set at the desired setting. The arrow pointer should be pointing at the "Normal" choice. If it is not, press MOVE until it is. Press CHANGE to return to the main menu.

11) Press the MOVE button to move the arrow pointer to the pulse width menu item. Press CHANGE to bring up the pulse width submenu, and rotate the ADJUST knob until the pulse width is set at the desired setting. The arrow pointer should be pointing at the "Normal" choice. If it is not, press MOVE until it is. Press CHANGE to return to the main menu.

12) Press the MOVE button to move the arrow pointer is pointing at the output item. Press CHANGE to bring up the output submenu. The arrow pointer should be

initially be pointing at the "Output Off" choice. Press MOVE so that the arrow pointer is pointing at the "Output On" choice. (The mainframe is now supplying a trigger to the output module.) Press CHANGE to return to the main menu.

13) Connect a scope probe across the resistive test load and apply prime power to the lab power supply (after first ensuring that the output amplitude is set to zero).

14) For "-PN" units only: If using the positive output module, make sure that the amplitude is set to +0.00V. If using the negative output module, make sure that the amplitude is set to -0.00V. To change the set polarity, press the MOVE button to move the arrow pointer is pointing at the amplitude item. Press CHANGE to bring up the output submenu. Press the +/- button to switch polarity.

15) Gradually increase the output amplitude on the lab power supply and observe the waveforms on the scope and the DC current level on the DC power supply. A rectangular pulse should appear on the scope (for both the load voltage and monitor channels) and the amplitude should increase as the amplitude control on the mainframe is rotated clockwise. At the same time, the average current supplied by the DC supply will increase.

16) Observe the pulse width and pulse period on the scope and confirm that the peak current does not exceed 200 Amps.

17) Observe the DC current supplied by the DC supply and ensure that the average current does not exceed 100 Amperes.

18) Adjust pulse width, pulse period (i.e. PRF) and amplitude to obtain the desired settings.

19) If additional assistance is required:

   Tel: (613) 226-5772, Fax: (613) 226-2802
   Email: info@avtechpulse.com

PROGRAMMING YOUR PULSE GENERATOR

KEY PROGRAMMING COMMANDS

The "Programming Manual for -B Instruments" describes in detail how to connect the pulse generator to your computer, and the programming commands themselves. A large number of commands are available; however, normally you will only need a few of these. Here is a basic sample sequence of commands that might be sent to the instrument after power-up:

```
*rst                        (resets the instrument)
trigger:source internal     (selects internal triggering)
source:function pulse       (enables pulse mode, rather than DC mode)
frequency 100 Hz            (sets the frequency to 100 Hz)
pulse:width 100 us          (sets the pulse width to 100 us)
pulse:delay 30 us           (sets the delay to 30 us)
output on                   (turns on the output)
```

These commands will satisfy 90% of your programming needs.

ALL PROGRAMMING COMMANDS

For more advanced programmers, a complete list of the available commands is given below. These commands are described in detail in the "Programming Manual for -B Instruments". (Note: this manual also includes some commands that are not implemented in this instrument. They can be ignored.)

Keyword	Parameter	Notes
LOCAL		
OUTPut:		
:[STATe]	<boolean value>	
:PROTection		
:TRIPped?		[query only]
REMOTE		
[SOURce]:		
:FREQuency		
[:CW | FIXed]	<numeric value>	
[SOURce]:		
:FUNCtion		
:[SHAPe]	DC | PULSe	
[SOURce]:		
:PULSe		
:PERiod	<numeric value>	
:WIDTh	<numeric value> | IN	
:DCYCle	<numeric value>	
:HOLD	WIDTh | DCYCle	
:DELay	<numeric value>	
:GATE		

```
            :TYPE               ASYNC | SYNC
            :LEVel              HIgh | LOw
STATUS:
    :OPERation
        :[EVENt]?                                   [query only, always returns "0"]
        :CONDition?                                 [query only, always returns "0"]
        :ENABle             <numeric value>         [implemented but not useful]
    :QUEStionable
        :[EVENt]?                                   [query only, always returns "0"]
        :CONDition?                                 [query only, always returns "0"]
        :ENABle             <numeric value>         [implemented but not useful]
SYSTem:
    :COMMunicate
        :GPIB
            :ADDRess        <numeric value>
        :SERial
            :CONTrol
                :RTS            ON | IBFull | RFR
            :[RECeive]
                :BAUD           1200 | 2400 | 4800 | 9600
                :BITS           7 | 8
                :ECHO           <boolean value>
                :PARity
                    :[TYPE]     EVEN | ODD | NONE
                :SBITS          1 | 2
    :ERRor
        :[NEXT]?                                    [query only]
        :COUNT?                                     [query only]
    :VERSion?                                       [query only]
TRIGger:
    :SOURce                 INTernal | EXTernal | MANual | HOLD | IMMediate
*CLS                                                [no query form]
*ESE                        <numeric value>
*ESR?                                               [query only]
*IDN?                                               [query only]
*OPC
*SAV                        0 | 1 | 2 | 3           [no query form]
*RCL                        0 | 1 | 2 | 3           [no query form]
*RST                                                [no query form]
*SRE                        <numeric value>
*STB?                                               [query only]
*TST?                                               [query only]
*WAI                                                [no query form]
```

APPENDIX A - DC POWER SUPPLIES

For your convenience, several DC supplies that may be appropriate for use with the AVO-8C-B are listed below. Please consult the manufacturer data sheets for the latest, most accurate information.

Manufacturer	Model	AC Power	Maximum Output	Maximum Duty Cycle at 200A	Remote Control
Xantrex, www.xantrex.com	XHR 40-25	1φ, 120/240V	40V, 25A	12.5%	Analog, GPIB optional
	XFR 40-70	3φ, 120/240V	40V, 70A	35%	Analog, GPIB optional
	XDC 40-300	3φ, 240V	40V, 300A	100%	Analog, GPIB optional
Sorensen, www.sorensen.com	DCR 40-40B2	1φ, 120V	40V, 40A	20%	Analog
	DCR 40-70B2	1φ, 240V	40V, 70A	35%	Analog
	DHP 40-250	3φ, 240V	40V, 250A	100%	Analog, GPIB optional
Kepco, www.kepco.com	JQE 55-20M	1φ, 120/240V	55V, 20A	10%	Analog
Agilent, www.agilent.com	6012B	1φ, 120/240V	40V, 30A*	15%	Analog
	6032A	1φ, 120/240V	40V, 30A*	15%	Analog, GPIB standard
	6684A	3φ, 220V	40V, 128A	64%	Analog, GPIB standard

* can generate higher voltages or higher currents, but not simultaneously.

APPENDIX B - LOW-VALUE, LOW-INDUCTANCE, HIGH-POWER RESISTORS

The best approach for obtaining a low-value, low-inductance resistor is to connect many higher-value resistors in parallel. Connecting resistors in parallel reduces the total effective resistance and inductance.

Avtech does not recommend the use of single, high-power resistors, even if they are low-inductance types. These resistors experience high failure rates in pulsed applications.

SUPPLIERS

- Ohmite Mfg. Co.
  3601 Howard Street
  Skokie, IL 60076
  Tel: (847) 675- 2600
  Fax: (847) 675- 1505
  www.ohmite.com

  The Ohmite OY series of 2 Watt ceramic composition resistors are extremely rugged and well suited to pulsed applications. Use many (i.e., >10) of these resistors in parallel to construct a high-current, high-power, low-inductance load.

  These resistors are readily available from Digi-Key (www.digikey.com).

- RCD COMPONENTS INC.
  520 East Industrial Park.,
  Manchester, NH USA 03109- 5316
  Tel: (603) 669-0054
  Fax: (603) 669-5455
  www.rcd-comp.com

  The RCD RSF2B series of 2 Watt ceramic composition resistors are rugged and well suited to pulsed applications (although not as well suited as the Ohmite OY series). Use many (i.e., >10) of these resistors in parallel to construct a high-current, high-power, low-inductance load.

PERFORMANCE CHECK SHEET