

INSTRUCTIONS

MODEL AVO-8D-B

0 TO 50 V, 500 AMP
LASER DIODE DRIVER
WITH IEEE 488.2 AND RS-232 CONTROL

SERIAL NUMBER: _____

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Manual Reference: T:\instructword\avo-8\AVO-8D-B,edition1.sxw.
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INTRODUCTION

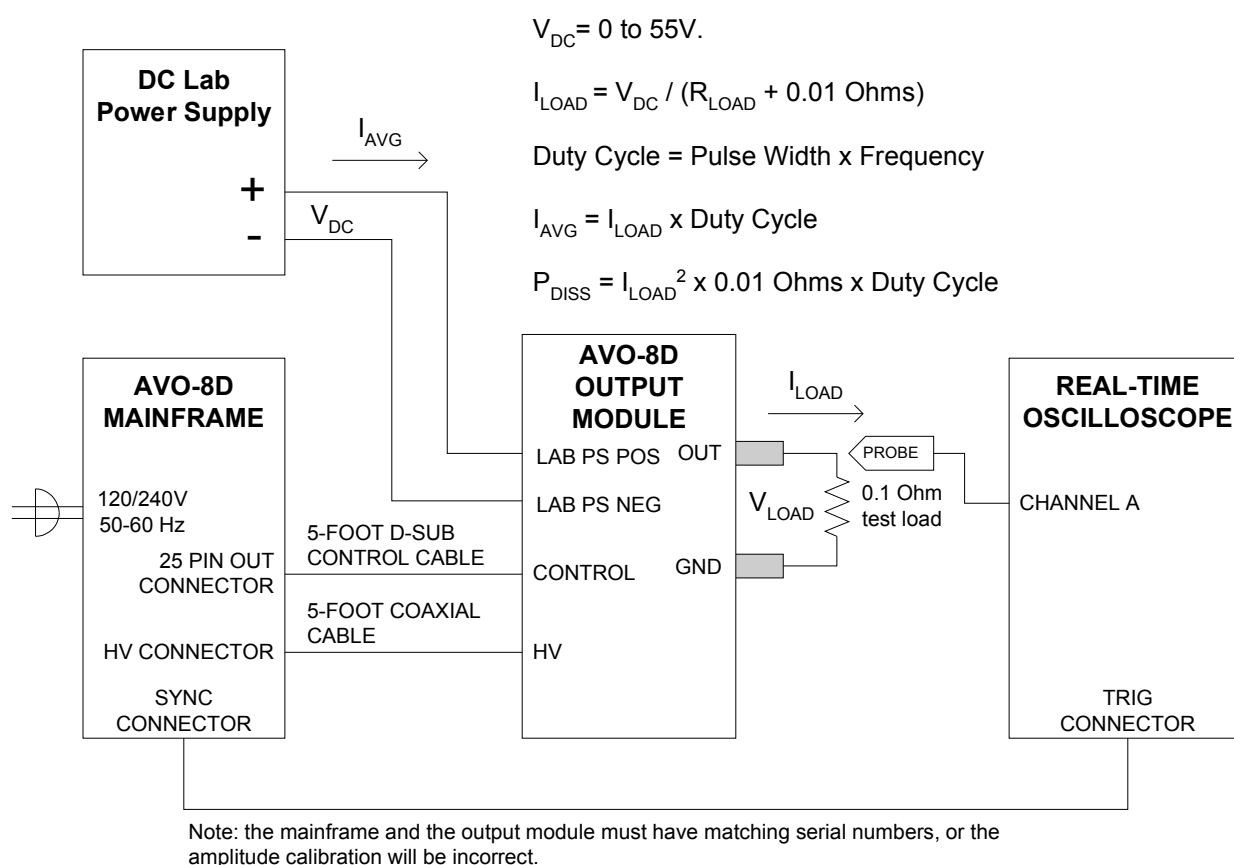
The Model AVO-8D-B pulse generator is designed for pulsing laser diode and other low impedance loads with rectangular pulses as high as 500 Amperes (or 50 Volts), pulse widths from 5 us to 10 ms, and average output powers to 5000 Watts. The maximum duty cycle is 20%. The current and voltage polarities depend on the model number:

"-P" units: 0 to +50 V amplitude (0 to +500 Amps)

"-N" units: 0 to -50 V amplitude (0 to -500 Amps)

"-PN" units: 0 to ± 50 V amplitude (0 to ± 500 Amps)

The Model AVO-8D-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.



The AVO-8D-B system consists of an instrument mainframe, one or two output modules (positive, negative, or both) which connect to the mainframe via a 5 foot long detachable D-subminiature cable and a 5 foot long coaxial cable. A user-supplied high-current DC lab power supply is required. The load is connected using bolts to two copper bars. 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). 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. 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.

The AVO-8D-B includes provision for water-cooling, which should be used when the power dissipated in the output module (P_{DISS}) exceeds 25 Watts. When operating at 500 Amps, this power is exceeded for duty cycles of 1% and higher.

SPECIFICATIONS

Model:	AVO-8D-B
Amplitude:	
"-P" units:	0 to +500 Amperes, 0 to +50 Volts
"-N" units:	0 to -500 Amperes, 0 to -50 Volts
"-PN" units:	0 to +500 Amperes, 0 to +50 Volts and 0 to -500 Amperes, 0 to -50 Volts
Pulse width:	5 us to 10 ms
Rise time:	≤ 2 us
Fall time:	≤ 2 us
PRF:	0.1 Hz to 1 kHz
Max. duty cycle:	20.00%
Output impedance:	≤ 0.01 Ohms
Max. average output current:	100 Amperes
Propagation delay:	≤ 100 ns (Ext trig in to pulse out)
Jitter:	± 500 ps $\pm 0.03\%$ of sync delay (Ext trig in to pulse out)
Trigger required:	Internal Mode: +5 Volt, 50 ns or wider (TTL) External Mode: +5 Volt, $PW_{IN} = PW_{OUT}$ (TTL)
Monitor output:	Optional Feature (requires "-M" suffix): Provides an attenuated coincident replica of the main output current pulse
Sync delay:	Sync out to pulse out: Variable 0 to ± 20 ms
Sync output:	+ 3 Volts, 200 ns, will drive 50 Ohm loads
Connectors:	Out: Two 0.15 x 2.0 x 4.0 cm copper strips (bolt connection) Trig, Sync, Monitor: BNC DC Power: 100 Amp SUPERCON connectors (included)
Power, DC:	0 to 55 V, 100 Amp max
Power, AC:	120/240 Volts (switchable) 50 - 60 Hz
Cooling:	Self-contained fan and tap water connection (5 litres/minute). Thread size is 1/4" NPT for water connections.
Dimensions: (H x W x D)	Mainframe: 100 mm x 430 mm x 375 mm (3.9" x 17" x 14.8") Output module: 152 mm x 229 mm x 305 mm (6" x 9" x 12")
Chassis material:	anodized aluminum, with blue plastic trim
Mounting:	Any
Temperature range:	+ 10° to + 40° C

INSTALLATION

VISUAL CHECK

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, one coaxial cable, 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.

PLUGGING IN THE INSTRUMENT

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:



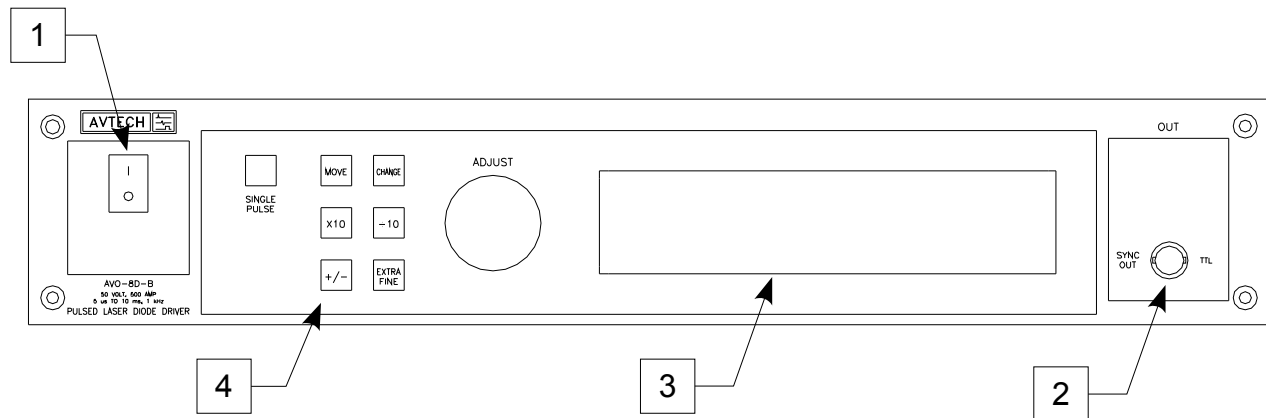
For AC line voltages of 220-240V, the power selector card should be installed so that the “240” marking is visible from the rear of the instrument, as shown below:



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. POWER Switch. This is the main power switch.
2. SYNC OUT. 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 $R_L > 1\text{ k}\Omega$ with a pulse width of approximately 200 ns.
3. LIQUID CRYSTAL DISPLAY (LCD). 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 "OP1B Interface Programming Manual" describes the menus and submenus in detail.
4. KEYPAD.

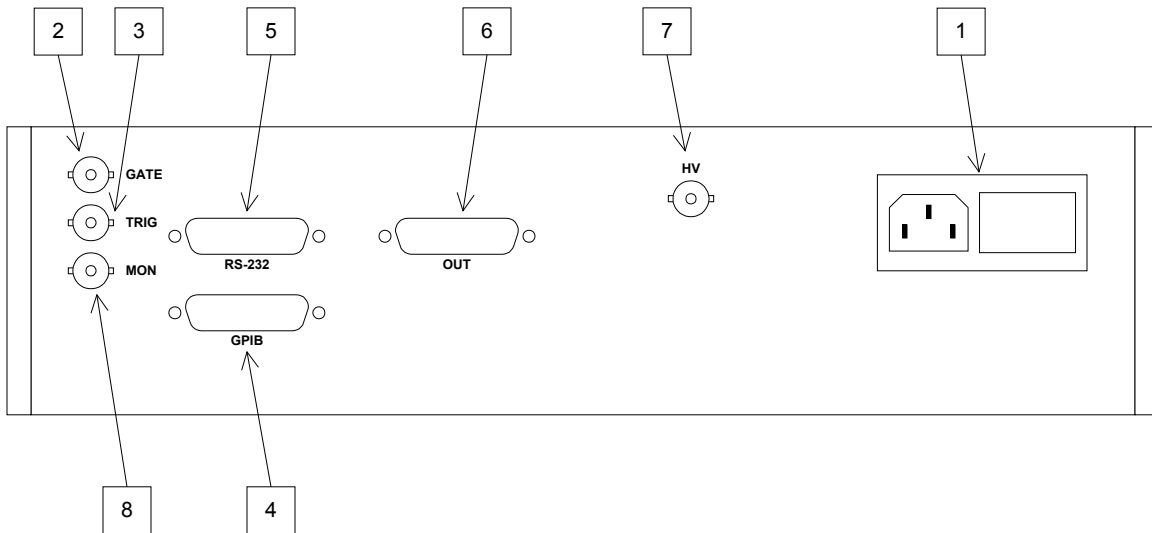
Control Name	Function
MOVE	This moves the arrow pointer on the display.
CHANGE	This is used to enter the submenu, or to select the operating mode, pointed to by the arrow pointer.
$\times 10$	If one of the adjustable numeric parameters is displayed, this increases the setting by a factor of ten.
$\div 10$	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. **AC POWER INPUT.** 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. **GATE.** 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 k Ω resistor. When set to active low mode, this input is pulled-up to +5V by a 1 k Ω resistor.
3. **TRIG.** 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 k Ω . (Depending on the

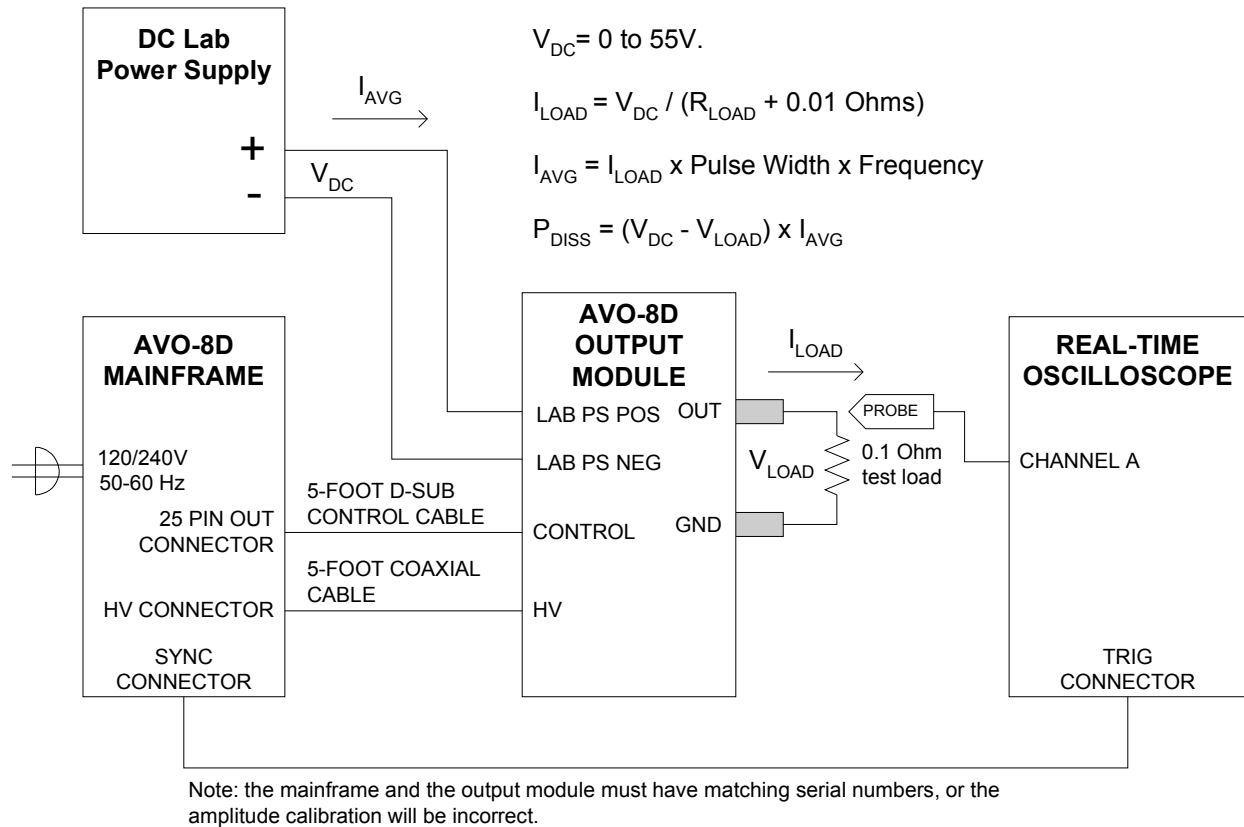
length of cable attached to this input, and the source driving it, it may be desirable to add a coaxial 50 Ohm terminator to this input to provide a proper transmission line termination. The Pasternack (www.pasternack.com) PE6008-50 BNC feed-thru 50 Ohm terminator is suggested for this purpose.)

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. GPIB Connector. 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. RS-232 Connector. 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. OUT Connector. A 5-foot-long, 25-pin D-subminiature cable is used to connect this output connector to the “Control” connector on the output module.
7. HV Connector. A 5-foot-long, coaxial cable is used to connect this connector to the corresponding “HV” connector on the output module.
8. MON Connector. (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 $> 1\text{ k}\Omega$. (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



The equipment should be connected in the general fashion shown above.

For “-PN” units, only one of the two output modules can be connected to the instrument at any given time.

The output modules should always be connected to the mainframe BEFORE power is applied.

The output terminals of the pulse generator module consist of short lengths of heavy copper sheet metal protruding from the module chassis.

If the device under test is a diode, it is essential that a low-inductance current limiting resistor (see the Appendix for possible suppliers) be placed in series with the laser diode load, particularly if the diode has a low series resistance. 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 resistor can be as large as 0.1Ω , but beware that the

power dissipated by the resistor may be as high as 5 kW (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).

AMPLITUDE CONTROL

The AVO-8D-B is a voltage pulser. When used with a diode load, the diode is connected in series with a resistance (R_{SERIES}), so that the current through the diode is given by:

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

where V_{DIODE} is the voltage drop across the diode. The 0.01 Ohm resistance represents the parasitic resistance inside the output module. R_{SERIES} must be large enough (i.e. greater than 0.1Ω) such that the current never exceeds 500 Amps.

LENZ'S LAW AND INDUCTIVE VOLTAGE SPIKES

This instrument is designed to pulse resistive and diode loads and will exhibit a large output spike when used to drive a load with significant inductance (as predicted by LENZ'S LAW). For this reason the load should be connected to the output using low inductance leads (as short as possible and as heavy a gauge as possible).

The voltage developed across an inductance L (in Henries), when the current is changing at a rate given by di_{LOAD}/dt (in Amps/sec), is: $V_{\text{SPIKE}} = L \times di_{\text{LOAD}}/dt$.

If significant inductance is present in the load, noticeable degradation of the rise and fall times may also occur.

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, positive delay, and positive amplitude:

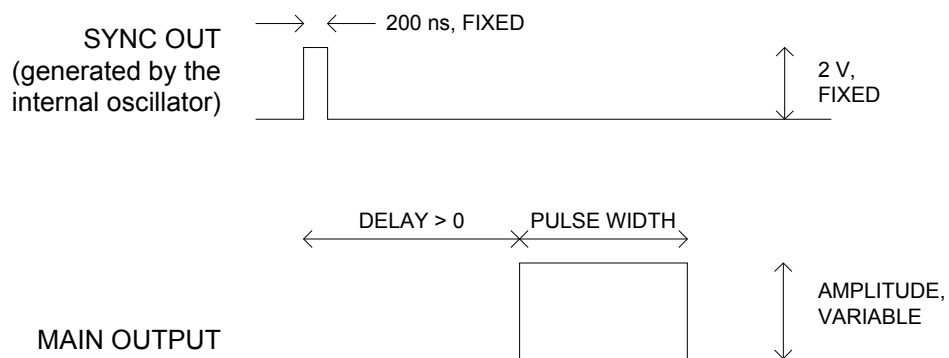


Figure A

The amplitude is controlled entirely by the DC power supply.

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

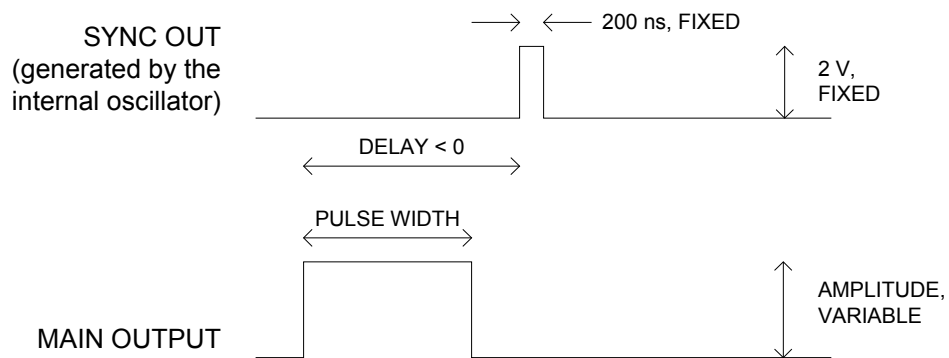


Figure B

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

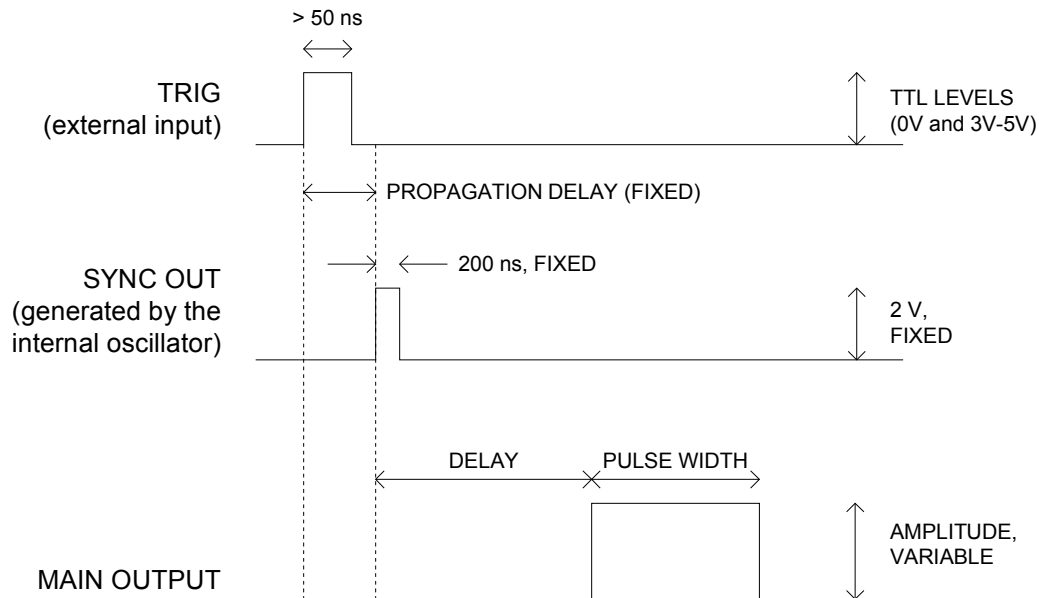


Figure C

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

The 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.

TRIGGER MODES

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 "OP1B Interface Programming Manual" 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 55V
- Never let the peak output current exceed 500A
- Never let the average output current exceed 100A

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 55V
- The applied DC voltage is the incorrect polarity.

In these situations, triggering will be disabled.

WATER COOLING

The output module has provision for water-cooling. (Thread size is 1/4" NPT.) This cooling is necessary when the power dissipated in the output module (P_{DISS}) exceeds 25 Watts. When operating at 500 Amps, this power is exceeded for duty cycles of 1% and higher.

P_{DISS} can be calculated using $P_{DISS} = I_{LOAD}^2 \times 0.01 \text{ Ohms} \times \text{Duty Cycle}$. (The 0.01 Ohm resistance represents the parasitic resistance inside the output module.) For instance, when operating at 500 Amps amplitude and 2% duty cycle, the power dissipation is $(500A)^2 \times (0.01 \text{ Ohms}) \times (0.02) = 50 \text{ Watts}$.

The water requirement is approximately 5 litres/minute. If water-cooling is not used, or if the water supply fails, the instrument will heat up until the automatic temperature-protection circuitry trips and disables the output until it has cooled.

Note: When connecting the water intake and discharge hoses, it is strongly recommended that teflon plumber's tape be applied to the threaded joints. Due to the

self-adhesion properties of some metals, the joint maybe become virtually impossible to disconnect if the plumber's tape is not used!

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:

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

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:

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

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 voltage 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.

MAINTENANCE

REGULAR MAINTENANCE

This instrument does not require any regular maintenance.

On occasion, one or more of the rear-panel fuses may require replacement. All fuses can be accessed from the rear panel.

CLEANING

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 coaxial cable must be connected between the “HV” connector on the rear-panel of the mainframe and the “HV” 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 must 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 0.1 Ohm 5000 Watt resistive load.
- 5) The user-supplied lab power supply is connected with the SUPERCON connectors (see page 11). 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) 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.
- 15) Observe the pulse width and pulse period on the scope and confirm that the peak current does not exceed 500 Amps.
- 16) Observe the DC current supplied by the DC supply and ensure that the average current does not exceed 100 Amperes. **Note that water-cooling is required if the duty cycle exceeds 1%.**
- 17) Adjust pulse width, pulse period (i.e. PRF) and amplitude to obtain the desired settings.
- 18) 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.)

<u>Keyword</u>	<u>Parameter</u>	<u>Notes</u>
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	
[SOURce]:			
	:VOLTagE		
	[:LEVel]		
	[:IMMediate]		
	[:AMPLitude]	+ -	
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 - 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