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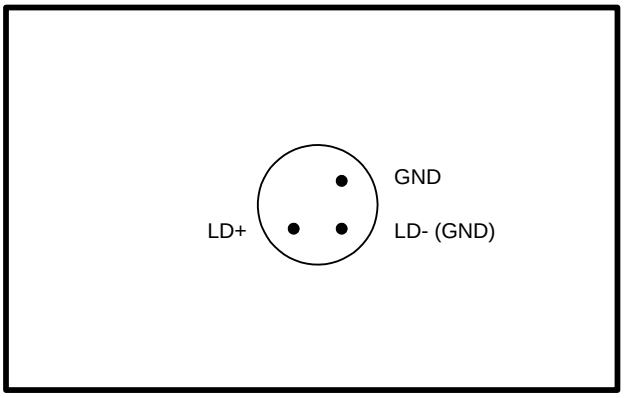
INSTRUCTIONS

MODEL AVO-9G-B

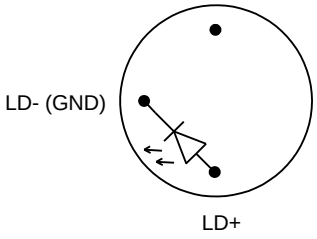
0 TO 1.0 A, 500 ps RISE TIME

HIGH PERFORMANCE LASER DIODE DRIVER WITH IEEE 488.2 AND RS-232 CONTROL

WITH PLUG-IN SOCKET OUTPUT MODULE



AVX-S1 OUTPUT MODULE, SOCKET VIEW



MATCHING USER-SUPPLIED DIODE PACKAGE (BOTTOM VIEW). 9mm TO-18 PACKAGE.

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.

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Manual Reference: /fileserver1/officefiles/instructword/avo-9/AVO-9G-B,SN10668,ed1.sxw.
Last modified February 29, 2024.

INTRODUCTION

The AVO-9G-B is a high performance, GPIB and RS232-equipped instrument capable of generating up to 1 A of current into diode loads, at repetition rates up to 50 kHz.

The AVO-9G-B consists of a mainframe unit and an AVX-S1 series output module, which provides a socket into which the user's laser diode may be inserted. The mainframe generates voltage pulses of between 0 and 50V. The output module connects to the instrument mainframe via a detachable 2-foot long coaxial cable. The output module contains the necessary elements to match the laser diode to the pulse generator mainframe. Output modules may be interchanged to accommodate different diode packages or different pin connections. A DC bias current of 0 to ±100 mA may be applied to the laser diode by applying the desired DC current to a solder terminal on the output module. The output modules include an SMA output connector that provides an attenuated coincident replica of the diode current. In addition, the output modules are available with an optional SMA output connector which provides an attenuated coincident replica of the diode voltage. Also, an optional SMA connection to a photo diode detector output is also available (-MD option).

The output polarity of the instrument depends on the model number:

"-P" units: 0 to +1 A
"-N" units: 0 to -1 A

The AVO-9G-B is a highly flexible instrument. Aside from the internal trigger source, it can also be triggered or gated by external TTL-level signals. A front-panel pushbutton or a computer command can also be used to trigger the instrument.

The AVO-9G-B features front panel keyboard and adjust knob control of the output pulse parameters along with a four line by 40-character backlit LCD display of the output amplitude, pulse width, pulse repetition frequency, and delay. The instrument includes memory to store up to four complete instrument setups. The operator may use the front panel or the computer interface to store a complete “snapshot” of all key instrument settings, and recall this setup at a later time.

SPECIFICATIONS

Model:	AVO-9G-B
Amplitude:	0 to 1 A
Allowed load voltage range:	0 to 3V
Pulse width:	20 to 200 ns
PRF:	0 to 50 kHz
Rise time:	$\leq$ 500 ps
Fall time:	$\leq$ 500 ps
Related 50 Ohm model:	AVR-E2-B
Polarity:	Positive or negative (specify)
GPIB and RS-232 control:	Standard on -B units.
LabView drivers:	-B units only: check http://www.avtechpulse.com/labview for availability and downloads
Propagation delay:	$\leq$ 70 ns (Ext trig in to pulse out)
Jitter: (Ext trig in to pulse out)	$\pm$ 35 ps $\pm$ 0.015% of sync delay
DC offset or bias insertion:	Apply required DC bias current in the range of $\pm$ 100 mA to solder terminal on output module.
Sync delay:	Variable 0 to $\pm$ 200 ns (sync out to pulse out)
Sync output:	+ 3 Volts, 200 ns (to 50 Ohms)
Gate input:	Synchronous or asynchronous, active high or low, switchable. Suppresses triggering when active.
Trigger required: (ext trig mode)	+ 5 V (TTL), $\geq$ 50 ns
Monitor output option: -MV	Provides a 20 dB (x10) attenuated coincident replica of diode voltage ($V_D = 10\ (V_{MV} - V_{MI})$ (Volts))
Monitor output option: -MD	Provides connection to output of photo diode detector.
Connectors: OUT TRIG, SYNC GATE (-B only) MONITOR	 specify TO-18 (2 or 3 leads), TO-5, OP-3, (others on request) BNC BNC SMA
Power requirements:	120/240 Volts (switchable) 50 - 60 Hz
Dimensions: Mainframe: (H x W x D) Output module:	100 mm x 430 mm x 375 mm (3.9" x 15" x 14.8") 41 mm x 66 mm x 76 mm (1.6" x 2.6" x 3.0")
Chassis material: Mainframe: Output module:	 anodized aluminum, with blue plastic trim cast aluminum, blue enamel

INSTALLATION

VISUAL CHECK

After unpacking the instrument, examine to ensure that it has 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, two instrumentation manuals (this manual and the “Programming Manual for -B Instruments”), and the output module 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:

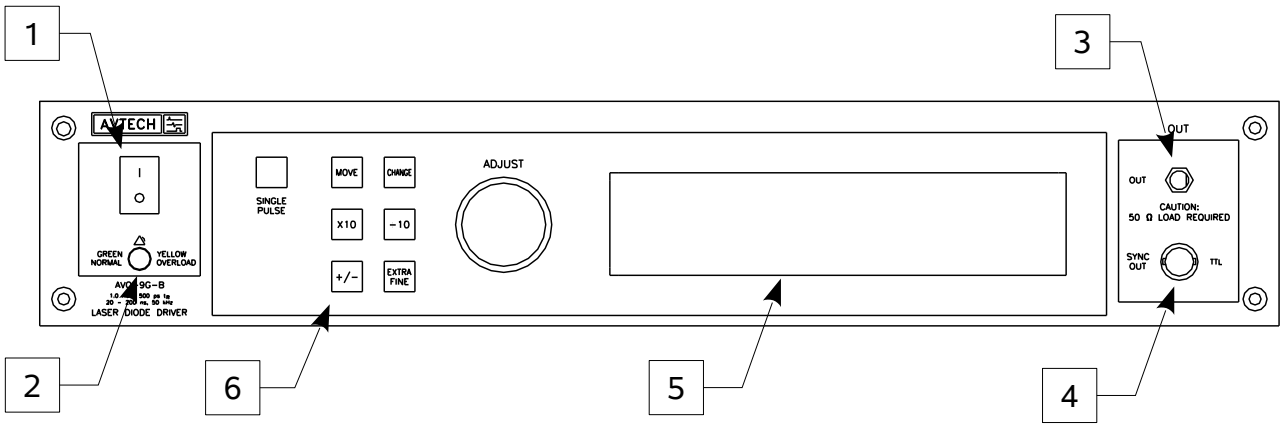
If it is not set for the proper voltage, remove the fuse and then grasp the card with a pair of pliers and remove it. Rotate horizontally through 180 degrees. Reinstall the card and the correct fuse.

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

LABVIEW DRIVERS

A LabVIEW driver for this instrument is available for download on the Avtech web site, at http://www.avtechpulse.com/labview. A copy is also available in National Instruments' Instrument Driver Library at http://www.natinst.com/.

FRONT PANEL CONTROLS



1. POWER Switch. 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. OVERLOAD Indicator. 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. OUT CONNECTOR. This SMA connector is connected to the output module, when the output module is used to drive a diode load. If the output module is not used, this output will generate up to 10V into a load impedances of 50Ω. (NOTE: when the output module is not used, this output *requires* a 50Ω load to function properly).

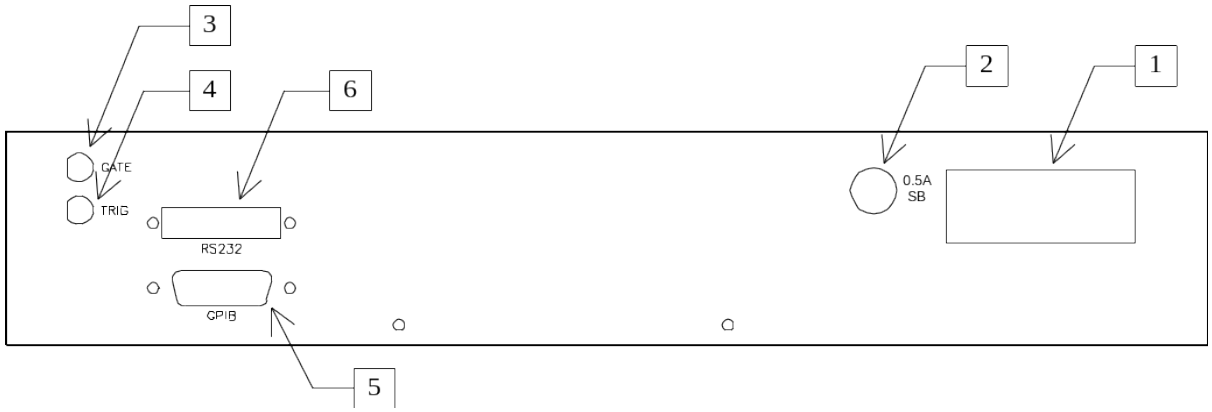
4. SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to R_L > 1kΩ with a pulse width of approximately 200 ns.

5. 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 “Programming Manual for -B Instruments” describes the menus and submenus in detail.

6. 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.
×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. 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. 0.5A SB. This slow-blow fuse protects the output stage.

3. 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 kΩ resistor. When set to active low mode, this input is pulled-up to +5V by a 1 kΩ resistor.

4. 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 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.)

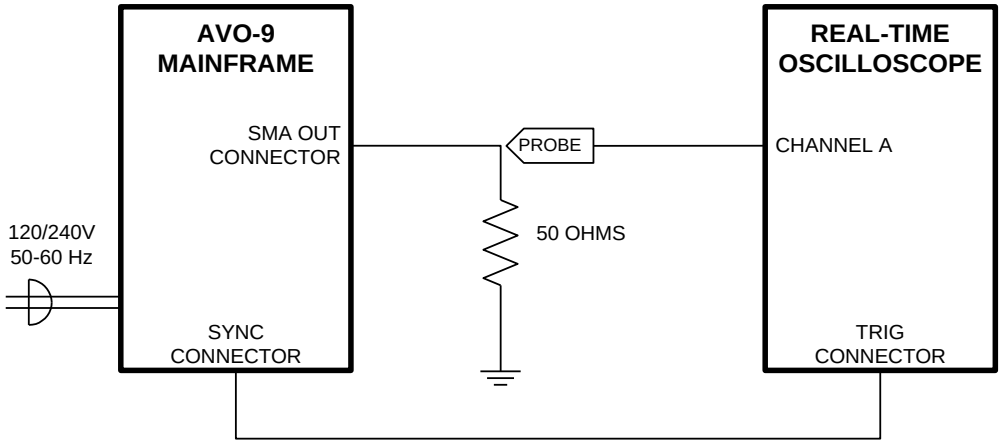
5. GPIB Connector. A standard GPIB cable can be attached to this connector to allow the instrument to be computer-controlled. See the “Programming Manual for -B Instruments” for more details on GPIB control.

6. 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.

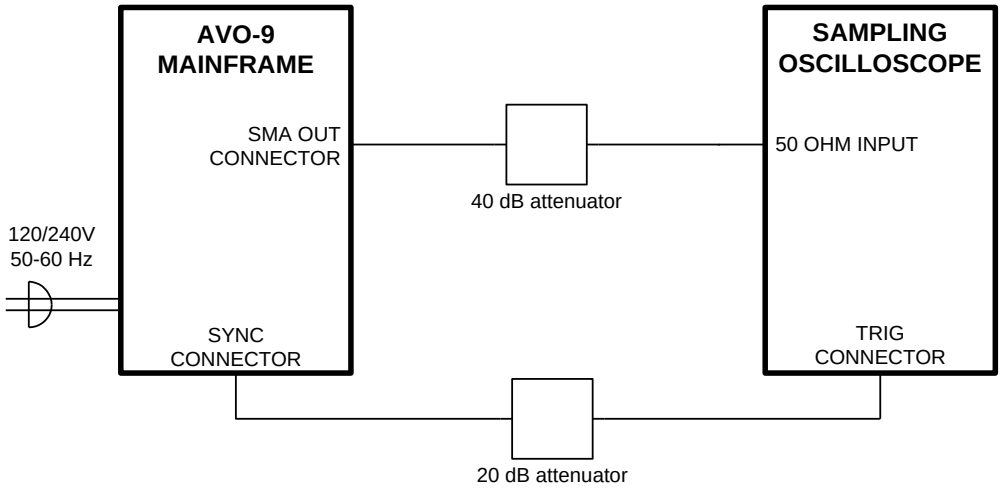
GENERAL INFORMATION

MINIMAL TEST ARRANGEMENT - WITHOUT OUTPUT MODULE

The AVO-9G-B can be tested initially without the supplied output module. If the output module is not used, the mainframe output generates 0 to +50 Volts (for -P units), or 0 to -50V (for -N units), into a 50 Ohm load, as illustrated below:



Since the AVO-9G-B can generate pulses with rise times as low as 500 ps, it may be necessary to use a sampling oscilloscope, rather than a real-time oscilloscope. In this case, the test arrangement should be altered as shown below:

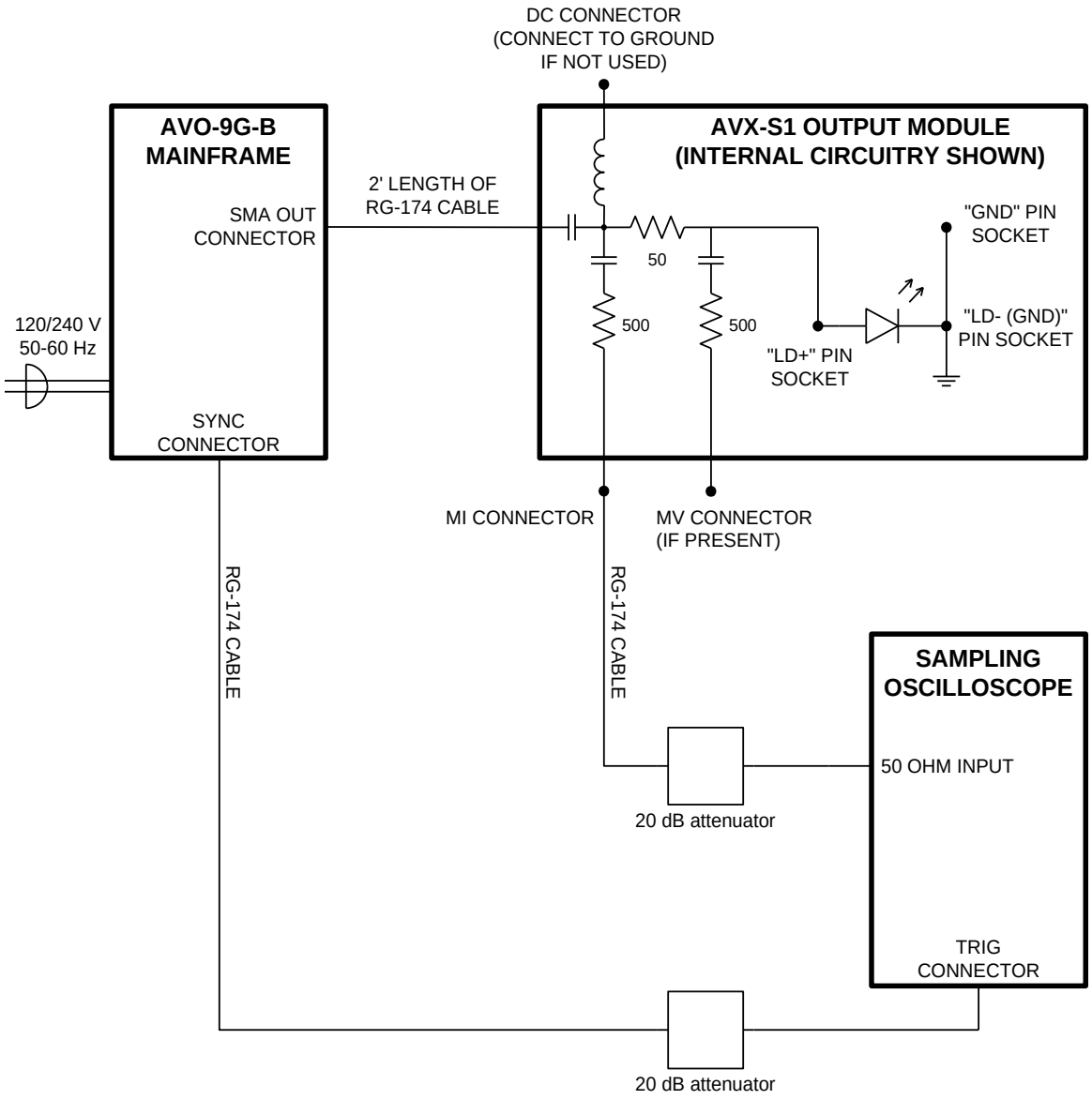


Since most sampling oscilloscopes have limited input amplitude ranges, attenuators are required. Select appropriate attenuators for your oscilloscope.

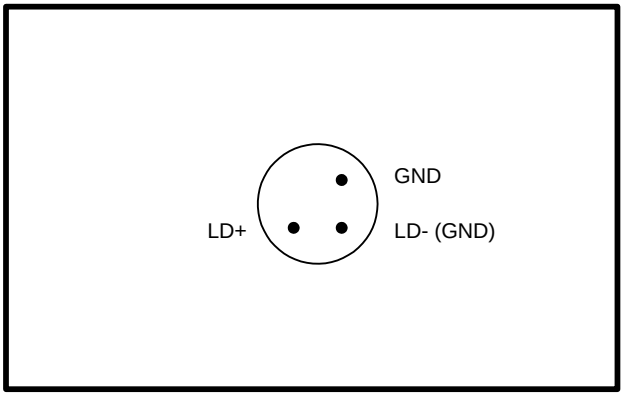
When the output module is not used, a 50 Ohm load impedance is *required* for proper test operation.

NORMAL TEST ARRANGEMENT

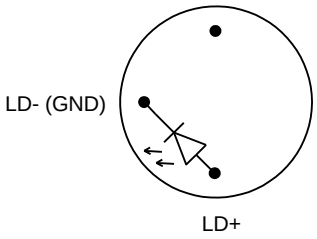
To fully test the instrument, and for normal operation, the output module must be connected as shown below:



The diode load is inserted into the socket on the output module. The physical layout of the socket is shown below:

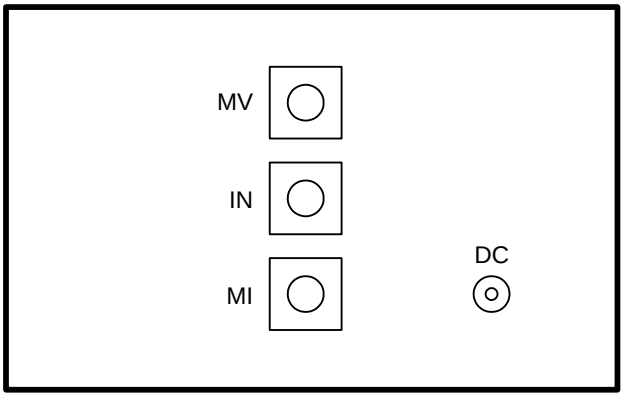


AVX-S1 OUTPUT MODULE, SOCKET VIEW



MATCHING USER-SUPPLIED DIODE PACKAGE (BOTTOM VIEW). 9mm TO-18 PACKAGE.

An oscilloscope may be used to monitor the MI, MV, and/or MD outputs. A forward DC bias may be applied to the laser diode by connecting a DC potential of 0 to +5 Volts to the DC solder terminal. The application of a small forward bias often yields a more ideal diode current waveform (as observed on the MI port). Note that the DC port must be shorted to ground if a bias is not applied.



AVX-S1 OUTPUT MODULE, CONNECTOR VIEW

AMPLITUDE CONTROL

When using the output module, the pulse current through the diode load is given by:

$$I_{DIODE} = (V_{SET} - V_{DIODE}) / 50\Omega$$

where V_{SET} is the amplitude setting on the mainframe (between 0 and 50V), and V_{DIODE} is the forward voltage drop across the diode (typically 2 or 3V).

BASIC PULSE CONTROL

This instrument can be triggered by its own internal clock or by an external TTL trigger signal. In either case, two mainframe output channels respond to the trigger: OUT and SYNC.

- OUT. This is the main output. The maximum output voltage is 50V.
- SYNC. 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 a positive delay:

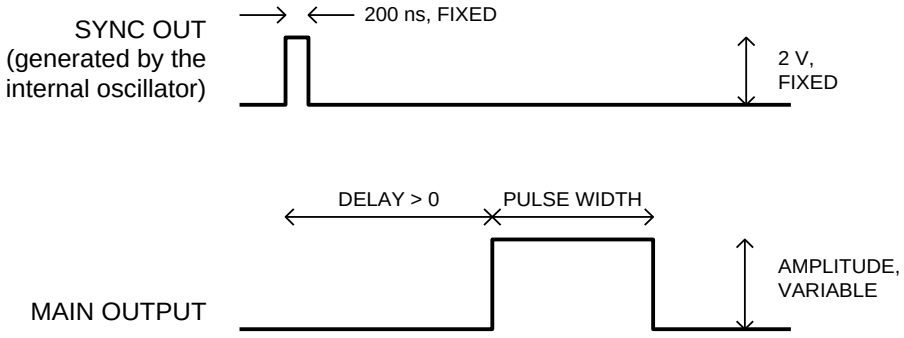


Figure A

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

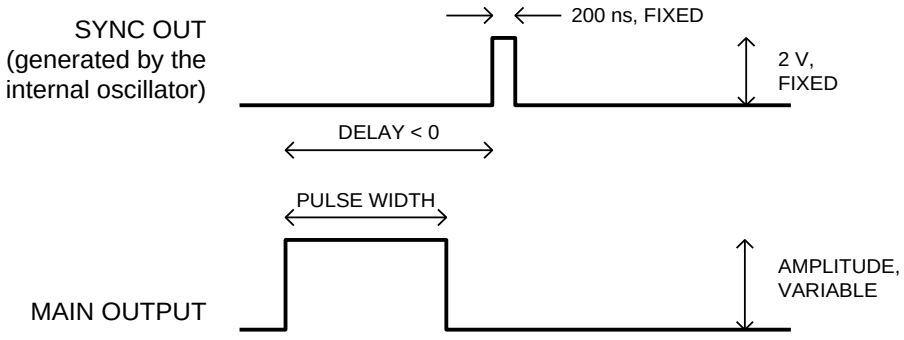


Figure B

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

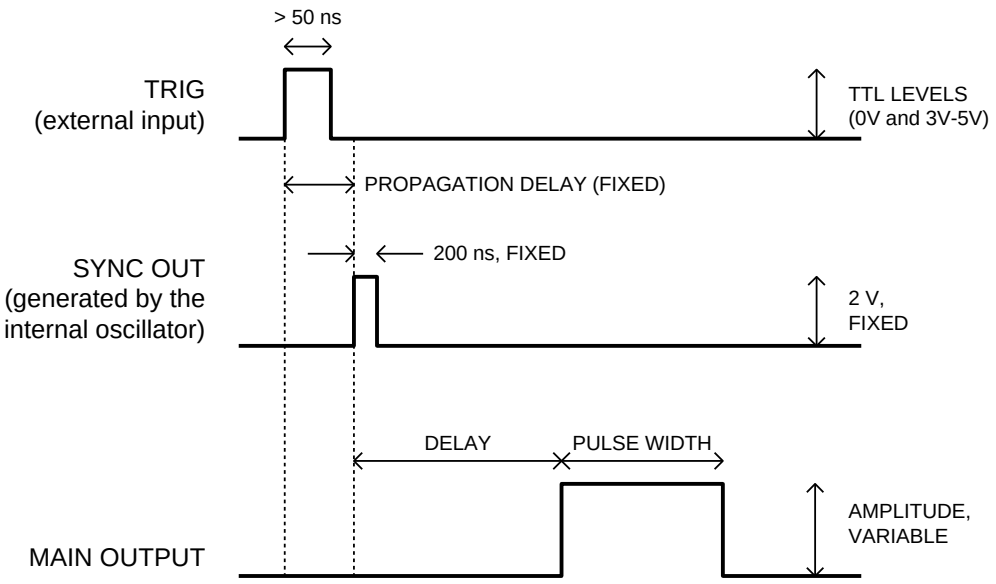


Figure C

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

In general, 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 “Programming Manual for -B Instruments” for more details.)

WARNING: The output stage may be damaged if triggered by an external signal at a pulse repetition frequency greater than 50 kHz.

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. When gated, the output will complete the full pulse width if the output is high, and then stop triggering. Pulses are not truncated.

PULSE WIDTH / AMPLITUDE INTERACTION

The pulse width and delay of the output pulse may vary slightly with the amplitude setting, particularly at lower amplitudes. For some demanding applications, it may be desirable to use external attenuators in conjunction with the AVO-9G-B, instead of generating a low-amplitude pulse directly.

PROTECTING YOUR INSTRUMENT

DO NOT EXCEED 50 kHz

The output stage may be damaged if triggered by an external signal at a pulse repetition frequency greater than 50 kHz.

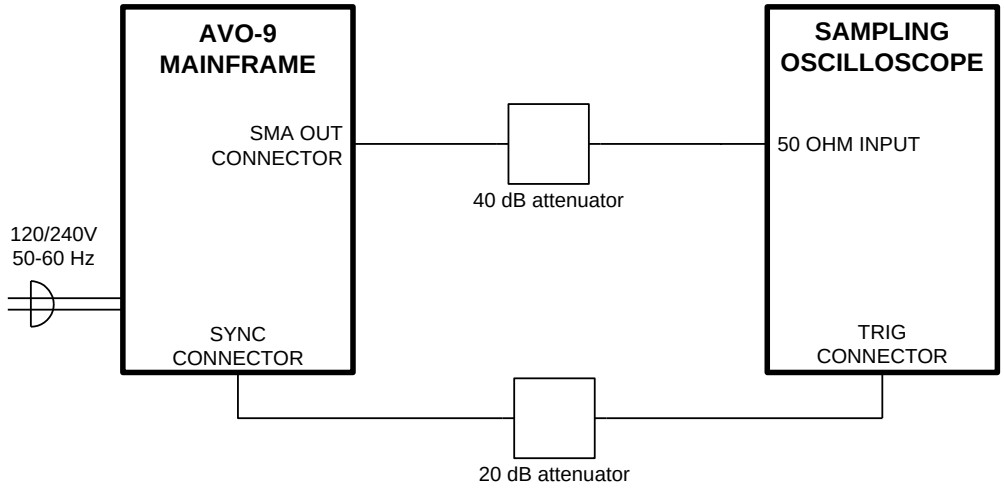
USE A 50Ω LOAD

The mainframe output stage may be damaged if the output is not terminated into the output module or a 50Ω dummy load.

OPERATIONAL CHECK

This section describes a sequence to confirm the basic operation of the instrument. It should be performed after receiving the instrument. It is a useful learning exercise as well.

Before proceeding with this procedure, finish reading this instruction manual thoroughly. Then read the “Local Control” section of the “Programming Manual for -B Instruments” thoroughly. The “Local Control” section describes the front panel controls used in this operational check - in particular, the MOVE, CHANGE, and ADJUST controls.



1. Connect the pulse generator to a sampling oscilloscope as shown above. Note that:

   a) The use of 40 dB attenuator at the sampling scope vertical input channel will ensure a peak input signal to the sampling scope of less than 1 Volt.

   b) The TRIG output channel provides TTL level signals (approximately 0 and +3V). To avoid overdriving the TRIG input channel of some scopes, a 20 dB attenuator should be placed at the input to the scope trigger channel.

   c) The bandwidth capability of components and instruments used to display the pulse generator output signal (attenuators, cables, connectors, etc.) should exceed 2 GHz.

   d) Set the oscilloscope to trigger externally with the vertical setting at 100 mV/div and the horizontal setting at 20 ns/div.

2. Turn on the AVO-9G-B. The main menu will appear on the LCD.

3. To set the AVO-9G-B to trigger from the internal clock at a PRF of 20 kHz:

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

    b) Press the CHANGE button. The frequency submenu will appear. Rotate the ADJUST knob until the frequency is set at 20 kHz.

    c) The arrow pointer should be pointing at the “Internal” choice. If it is not, press MOVE until it is.

    d) Press CHANGE to return to the main menu.

4. To set the delay to 100 ns:

    a) Press the MOVE button until the arrow pointer is pointing at the delay menu item.

    b) Press the CHANGE button. The delay submenu will appear. Rotate the ADJUST knob until the delay is set at 100 ns. (Note that it may be necessary to adjust the delay setting within a ±5ns range to obtain optimum jitter performance, as the jitter has a slight periodic delay dependency.)

    c) The arrow pointer should be pointing at the “Normal” choice. If it is not, press MOVE until it is.

    d) Press CHANGE to return to the main menu.

5. To set the pulse width to 50 ns:

    a) Press the MOVE button until the arrow pointer is pointing at the pulse width menu item.

    b) Press the CHANGE button. The pulse width submenu will appear. Rotate the ADJUST knob until the pulse width is set at 50 ns.

    c) The arrow pointer should be pointing at the “Normal” choice. If it is not, press MOVE until it is.

    d) Press CHANGE to return to the main menu.

6. At this point, nothing should appear on the oscilloscope.

7. To enable the output:

a) Press the MOVE button until the arrow pointer is pointing at the output menu item.

b) Press the CHANGE button. The output submenu will appear.

c) Press MOVE until the arrow pointer is pointing at the “ON” choice.

d) Press CHANGE to return to the main menu.

8. To change the output amplitude:

a) Press the MOVE button until the arrow pointer is pointing at the amplitude menu item.

b) Press the CHANGE button. The amplitude submenu will appear. Rotate the ADJUST knob until the amplitude is set at 50V.

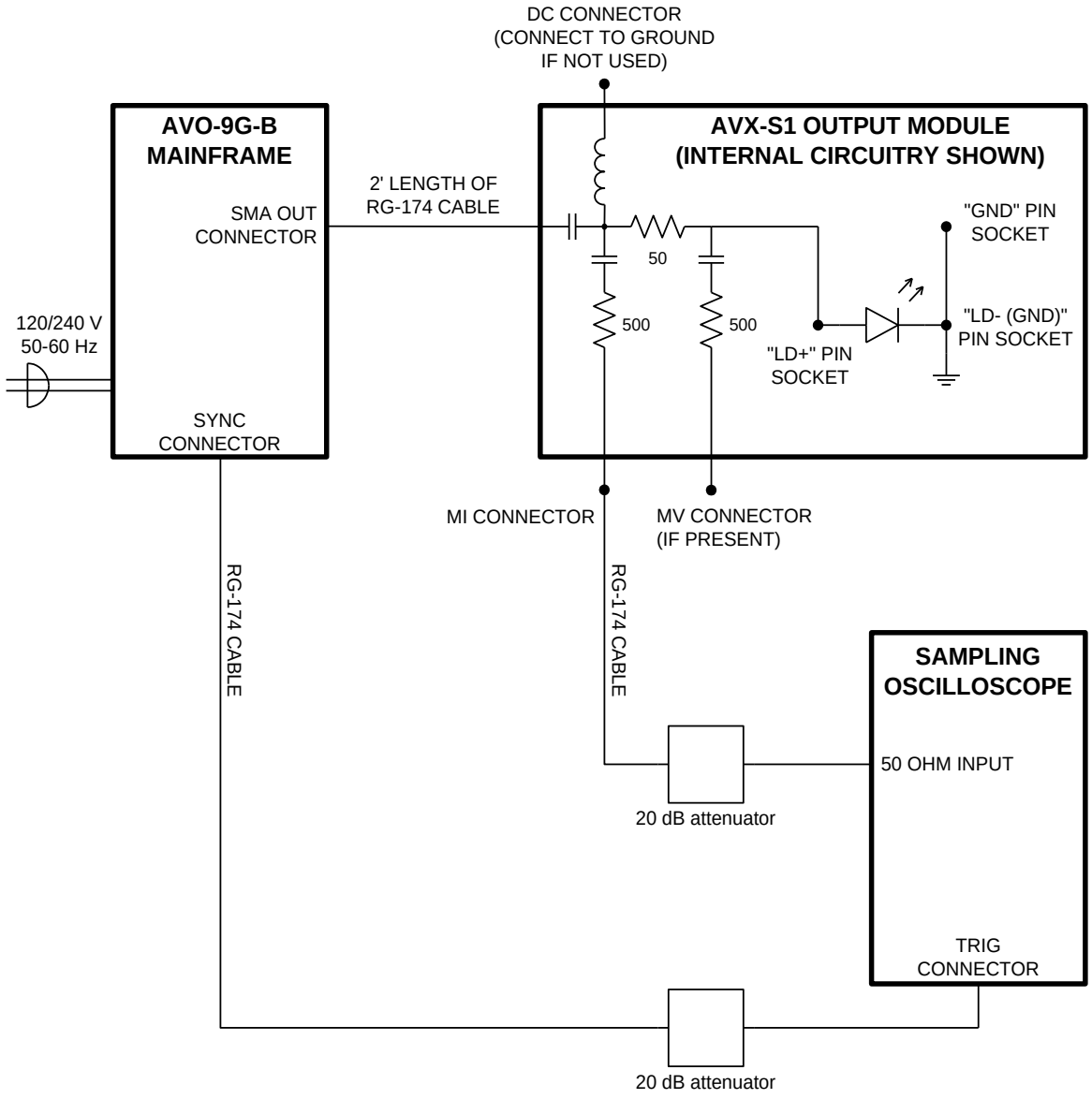
c) Observe the oscilloscope. You should see 50 ns wide, 50V pulses. If you do not, you may need to adjust the delay setting to a value more compatible with your sampling oscilloscope. Repeat step 4 if required. You may also need to adjust the sampling scope controls.

d) Rotate the ADJUST knob. The amplitude as seen on the oscilloscope should vary. Return it to 50V.

e) Press CHANGE to return to the main menu.

9. Try varying the pulse width, by repeating step (5). As you rotate the ADJUST knob, the pulse width on the oscilloscope will change. It should agree with the displayed value.

10. Turn off the instrument, and connect the output module as shown in the following diagram. Insert an appropriate diode load into the output module socket. Repeat steps 2 to 9, and view the “MI” output on the sampling oscilloscope.



This completes the operational check.

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)
frequency 1000 Hz       (sets the frequency to 1000 Hz)
pulse:width 50 ns       (sets the pulse width to 50 ns)
pulse:delay 20 ns       (sets the delay to 20 ns)
volt:ampl 50            (sets the amplitude to 50 V)
output on               (turns on the output)
```

For triggering a single event, this sequence would be more appropriate:

```
*rst                    (resets the instrument)
trigger:source hold     (turns off all triggering)
pulse:width 50 ns       (sets the pulse width to 50 ns)
output on               (turns on the output)
volt:ampl 50            (sets the amplitude to 50 V)
trigger:source immediate (generates a single non-repetitive trigger event)
trigger:source hold     (turns off all triggering)
output off              (turns off the output)
```

To set the instrument to trigger from an external TTL signal applied to the rear-panel TRIG connector, use:

```
*rst                    (resets the instrument)
trigger:source external (selects internal triggering)
pulse:width 50 ns       (sets the pulse width to 50 ns)
pulse:delay 100 ns      (sets the delay to 100 ns)
volt:ampl 50            (sets the amplitude to 50 V)
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]:		
:PULSe		
:PERiod	<numeric value>	
:WIDTh	<numeric value>	
:DCYCle	<numeric value>	
:HOLD	WIDTh | DCYCle	
:DELay	<numeric value>	
:GATE		
:TYPE	ASYNC | SYNC	
:LEVel	HIgh | LOw	
[SOURce]:		
:VOLTage		
[:LEVel]		
[:IMMediate]		
[:AMPLitude]	<numeric value>	
:PROTection		
:TRIPped?		[query only]
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]
```

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 50Ω loads using shielded 50Ω coaxial cables. Unused outputs should be terminated with shielded 50Ω coaxial terminators or with shielded coaxial dust caps, to prevent unintentional electromagnetic radiation. All cords and cables should be less than 3m in length.

MAINTENANCE

REGULAR MAINTENANCE

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.

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.

PERFORMANCE CHECKSHEET