AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS
SINCE 1975

P.O. BOX 265
OGDENSBURG, NY
U.S.A. 13669-0265
TEL: (315) 472-5270
FAX: (613) 226-2802

TEL: 1-800-265-6681
FAX: 1-800-561-1970

e-mail: info@avtechpulse.com
http://www.avtechpulse.com/

BOX 5120, LCD MERIVALE
OTTAWA, ONTARIO
CANADA K2C 3H4
TEL: (613) 226-5772
FAX: (613) 226-2802

INSTRUCTIONS

MODEL AVO-5-B-S3

0 TO 28 Amp (0 to 84 Volts)
5 kHz LASER DIODE DRIVER
WITH
PLUG-IN DIODE SOCKET AND
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

Phone: 613-226-5772 or 1-800-265-6681
Fax: 613-226-2802 or 1-800-561-1970

E-mail: info@avtechpulse.com
World Wide Web: http://www.avtechpulse.com

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Manual Reference: /fileserver1/officefiles/instructword/avo-5/AVO-5-B-S3,edition1.sxw.
Last modified February 29, 2024.

INTRODUCTION

The AVO-5-B-S3 is a high performance, GPIB and RS232-equipped instrument capable of generating 0 to 28 A at repetition rates up to 5 kHz. The pulse width is variable from 6 to 100 ns. The rise time is less than 3 ns, and the fall time is less than 4 ns. The AVO-5-B-S3 includes an internal trigger source, but it can also be triggered or gated by an external source. A front-panel pushbutton can also be used to trigger the instrument.

The AVO-5-B-S3 features front panel keyboard and adjust knob control of the output pulse parameters along with a four line by 40 character back-lit 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.

The instrument is protected against overload conditions by an automatic control circuit. An internal power supply monitor removes the power to the output stage for five seconds if an average power overload exists. After that time, the unit operates normally for one second, and if the overload condition persists, the power is cut again. This cycle repeats until the overload is removed.

The AVO-5-B-S3 consists of two parts, the mainframe and the output module. The mainframe is a voltage pulser. The output module contains a 4:1 current-boosting transformer and a series resistance. The diode load plugs into a socket on the output module. The current through the diode is given by:

$$I_{DIODE} \approx (V_{SET} - V_{DIODE}) \div (R_{SERIES} + R_{DIODE})$$

where V_{SET} is the programmed output voltage (up to 84V), V_{DIODE} is the forward voltage drop across the diode (typically 2-3V for a laser diode), R_{DIODE} is the parasitic resistance of the diode (typically 0.3 Ω), and R_{SERIES} is the 2.7 Ω resistance inside the output module. Optimal performance is obtained when $R_{SERIES} + R_{DIODE} = 3\ \Omega$.

The voltage at the output of the mainframe is approximately 4 times the programmed voltage, to compensate for the 4:1 current boosting transformer in the output module.

-S3 OPTION

The output module of this instrument has a specially-designed socket that is intended to mate to a TO-3-packaged diode.

SPECIFICATIONS

Model:	AVO-5-B-S3
GPIB and RS-232 control[2]:	Standard on -B units.
Amplitude[3,4]:	0 to 28 A[6]
Required load impedance:	3 Ω[5,6]
Pulse width (FWHM):	6 to 100 ns
Maximum duty cycle:	N/A
Rise time (20%-80%):	3 ns
Fall time (80%-20%):	4 ns
PRF:	0 to 5 kHz
Output impedance:	≈ 3 Ohm
Polarity[8]:	Positive or negative or both (specify)
Propagation delay:	≤ 350 ns (Ext trig in to pulse out)
Jitter:	± 100 ps ± 0.03% of sync delay (Ext trig in to pulse out)
Trigger required:	External trig mode: +5 Volts, 50 to 500 ns (TTL)
Variable Sync delay:	0 to 200 ns (Sync out to pulse out)
Sync output:	+ 3 Volt, 200 ns, will drive 50 Ohm loads
Gate input:	Synchronous or asynchronous, active high or low, switchable. Suppresses triggering when active.
Monitor output option[9]:	Provides a 20 dB attenuated coincident replica of main output.
Connectors:	OUT:Solder terminals, or optional plug-in socket similar to AVX-S3 series[10] TRIG, SYNC, GATE (-B only):BNC MONITOR (optional[9]): BNC
Power requirements:	100 - 240 Volts, 50 - 60 Hz
Dimensions: Mainframe:	100 × 430 × 375 mm (3.9" × 17" × 14.8")
Transformer Module:	23 × 28 × 38 mm (0.9" × 1.1" × 1.5")
Chassis material:	Cast aluminum frame and handles, blue vinyl on aluminum cover plates
Mounting:	Any
Temperature range:	+ 5°C to + 40°C

1) -C suffix indicates stand-alone lab instrument with internal clock and line powering. (See http://www.avtechpulse.com/formats/ for additional details of the basic instrument formats).
2) -B suffix indicates IEEE-488.2 GPIB and RS-232 control of amplitude, pulse width, PRF and delay. (See http://www.avtechpulse.com/gpib).
3) For analog electronic control (0 to + 10 V) of amplitude, suffix model number with -EA. Electronic control units also include standard front-panel controls.
4) The minimum useful amplitude is approximately 20% of the maximum amplitude. The waveform may be distorted below this level.
5) The AVO-5 mainframe is essentially identical to Model AVL-2 and therefore may be used as a 336 Volt, 50 Ohm pulse generator (SMA output connectors). See http://www.avtechpulse.com/speed/avl-2.
6) The load impedance for the AVO-5 may be reduced to as low as zero Ohms. The maximum output amplitude increases for lower load impedances, to a maximum of 50 A at zero Ohms. However, the rise time, fall time, and waveform distortion (ringing) may increase at impedances lower than 3 Ohms, due to the impedance mismatch.
7) For variable rise, fall time option, add suffix -T1 to model number. Control is by a 10-position switch. Not available on -B units.
8) Indicate desired polarity by suffixing model number with -P or -N (i.e. positive or negative) or -PN for dual polarity option.
9) For monitor option add suffix -M.
10) To specify diode socket mounting option, suffix model number with -S3. When ordering, customer must also specify the diode package type (e.g. TO-18) and the required pin connections (e.g. anode, cathode, ground, etc.). See AVX-S Series for readily available package mounting. Contact Avtech for special or different packages.

INSTALLATION

VISUAL CHECK

After unpacking the mainframe and the output module, examine them 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, 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.

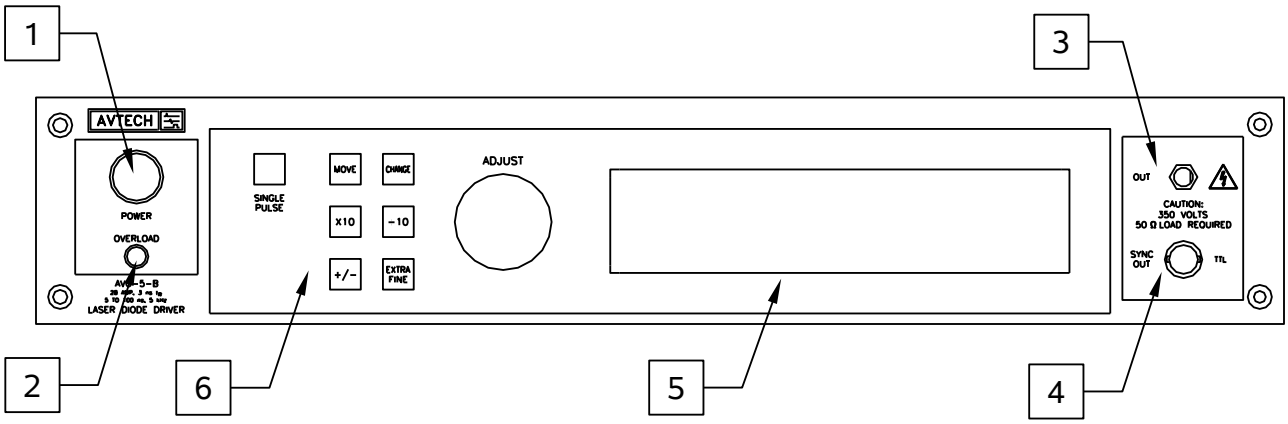
CONNECTING THE OUTPUT MODULE TO THE MAINFRAME

The AVO-5-T output module must be connected to the “OUT” SMA connectors on the rear panel of the mainframe (see the “General Information” section for details).

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. The AVO-5-B-S3 is protected in its internal software against conflicting or dangerous settings. As an additional protective measure, an automatic overload circuit exists, which controls the front panel overload light. 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 turn the output of the instrument OFF and turn the indicator light ON. The light will stay ON (i.e. output OFF) for about 5 seconds after which the instrument will attempt to turn ON (i.e. light OFF) for about 1 second. If the overload condition persists, the instrument will turn OFF again (i.e. light ON) for another 5 seconds. If the overload condition has been removed, the instrument will turn on and resume normal operation.

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

3. OUT Connector. This SMA connector is normally 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 336V into a load impedances of 50Ω. (NOTE: when the output module is not used, this output *requires* a 50Ω load to function properly).

   ⚠ Caution: Voltages as high as ±336V may be present on the center conductor of this output connector. Avoid touching this conductor. Connect to this connector using standard coaxial cable, to ensure that the center conductor is not exposed.

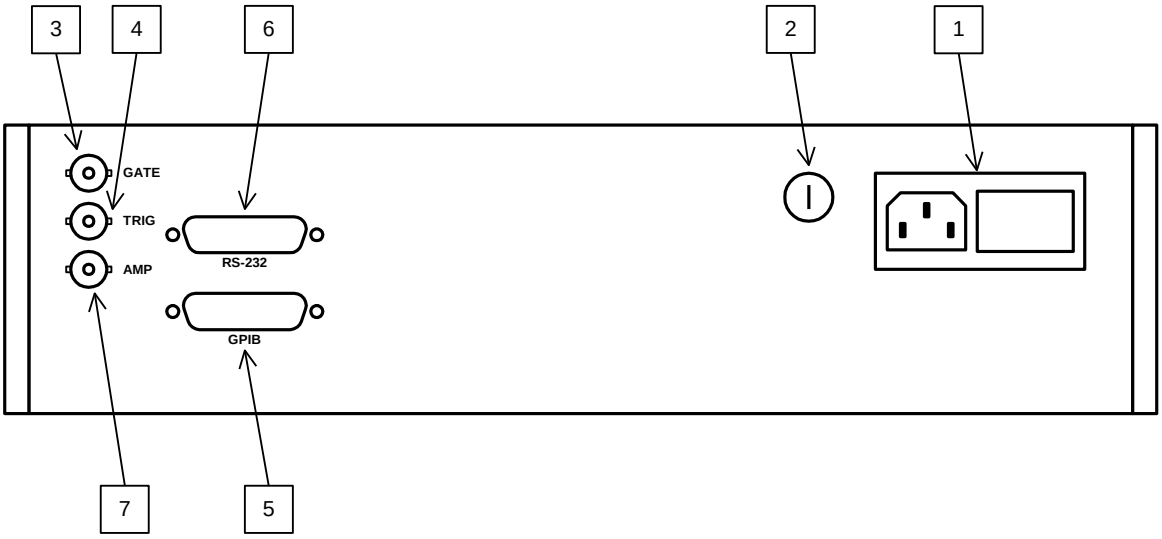
4. SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to R_L > 1 kΩ with a pulse width of approximately 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 1.0A slow blow fuse and a removable card that can be removed and repositioned to switch between 120V AC in and 240V AC in.

2. 1.0A SB. This 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.

7. AMP (Optional Feature). For instrument with the “-EA” option, the amplitude may be set to track the voltage on this input. 0 Volts in corresponds to zero output amplitude, and a +10V input corresponds to maximum amplitude out.

GENERAL INFORMATION

The AVO-5-B-S3 is a versatile instrument. Normally, the mainframe is used in conjunction with the output module, to test diode loads at currents up to 28A. The mainframe may also be used without the output module, to drive 50Ω loads. In this mode, the mainframe can generate up to 336V. Both modes of operation are discussed below.

AMPLITUDE CONTROL – WITH OUTPUT MODULE

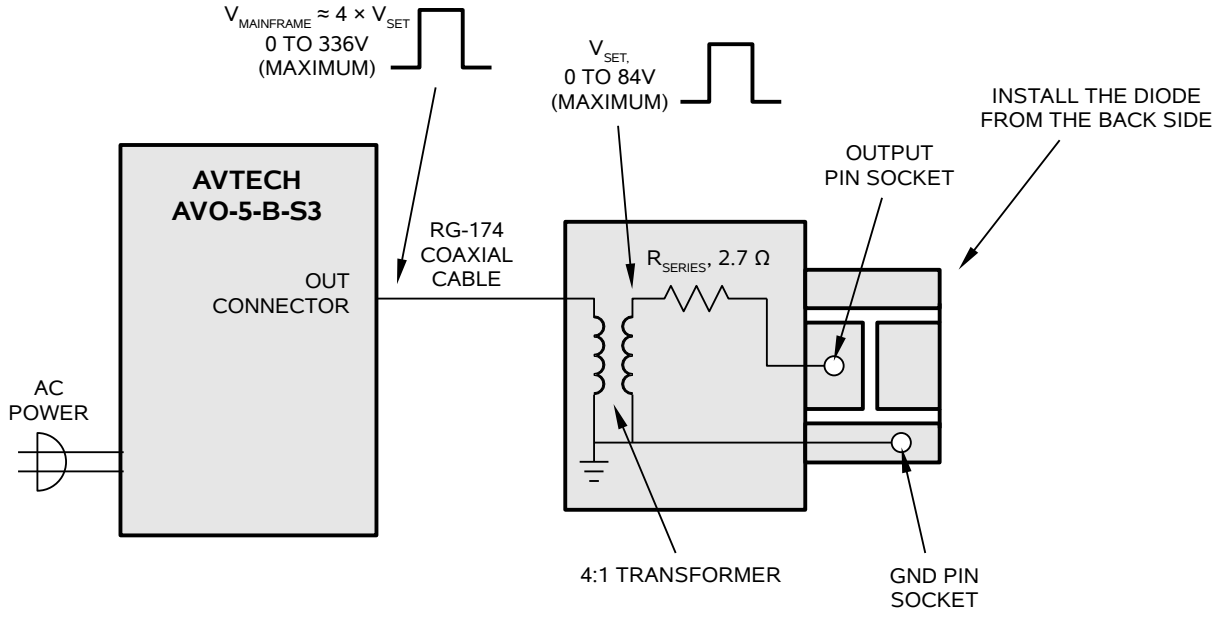
The AVO-5-B-S3 consists of two parts, the mainframe and the output module. The mainframe is a voltage pulser. The output module contains a 4:1 current-boosting transformer and a series resistance. The diode load plugs into a socket on the output module. The current through the diode is given by:

$$I_{DIODE} \approx (V_{SET} - V_{DIODE}) \div (R_{SERIES} + R_{DIODE})$$

where V_{SET} is the programmed output voltage (up to 84V), V_{DIODE} is the forward voltage drop across the diode (typically 2-3V for a laser diode), R_{DIODE} is the parasitic resistance of the diode (typically 0.3 Ω), and R_{SERIES} is the 2.7 Ω resistance inside the output module. Optimal performance is obtained when $R_{SERIES} + R_{DIODE} = 3\ \Omega$.

The voltage at the output of the mainframe is approximately 4 times the programmed voltage, to compensate for the 4:1 current boosting transformer in the output module.

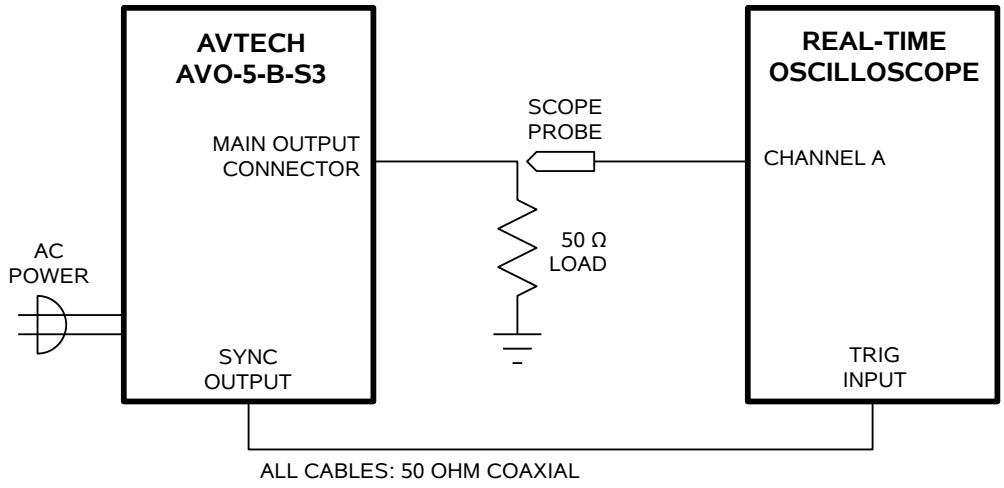
The basic scheme for connecting the mainframe and the output module to the laser diode load is shown below:



The device under test (DUT) IS installed in the two pin sockets on the output module, as shown above. The diode should be installed from the back side of the output module (the drawing above shows the front side). For positive (-P) units, the “OUTPUT PIN SOCKET” should be connected to the DUT anode, and the “GND PIN SOCKET” should be connected to the DUT cathode.

AMPLITUDE CONTROL – WITHOUT OUTPUT MODULE

The AVO-5-B-S3 may also be used without the output module. If the output module is not used, this output will generate up to 336V into a load impedances of 50Ω. (NOTE: when the output module is not used, this output *requires* a 50Ω load to function properly). The actual output amplitude will be approximately four times the programmed amplitude. The basic test arrangement is shown below:



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:

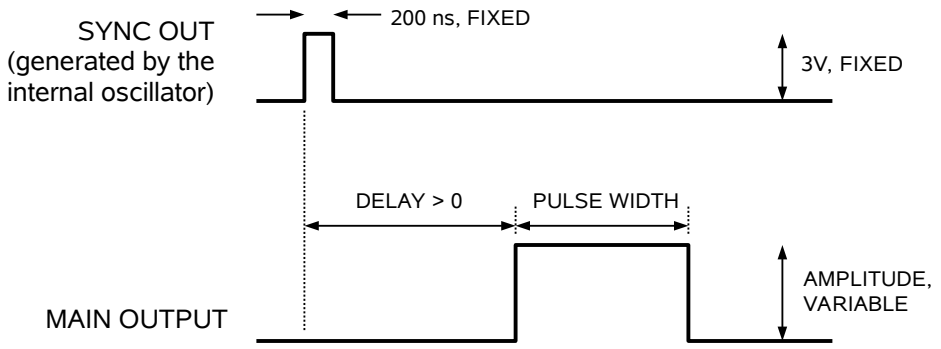


Figure A

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

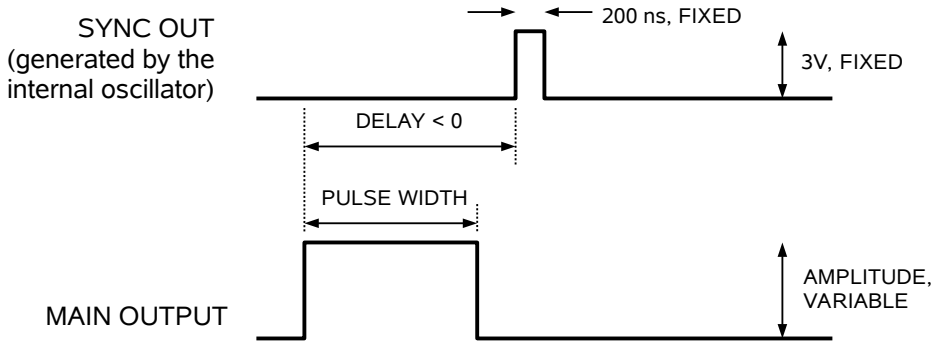


Figure B

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

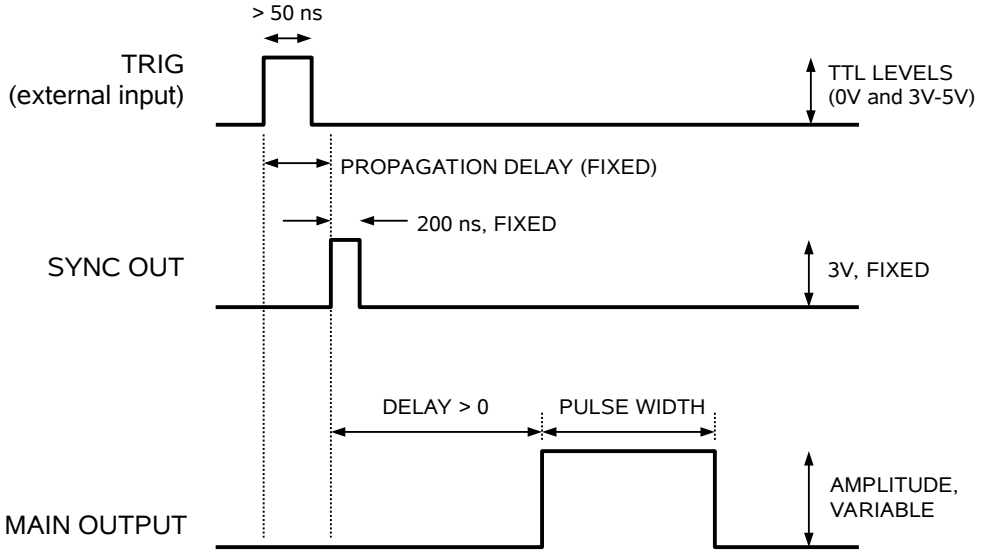


Figure C

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

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.)

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.

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.

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 100 ns      (sets the pulse width to 100 ns)
pulse:delay 200 ns      (sets the delay to 200 ns)
volt 84                 (sets the amplitude to 84 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 100 ns      (sets the pulse width to 100 ns)
output on               (turns on the output)
volt 84                 (sets the amplitude to 84 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 input:

```
*rst                    (resets the instrument)
trigger:source external (selects external triggering)
pulse:width 100 ns      (sets the pulse width to 100 ns)
pulse:delay 200 ns      (sets the delay to 200 ns)
volt 84                 (sets the amplitude to 84 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> | EXTernal	
: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]

PERFORMANCE CHECK SHEET