

INSTRUCTIONS

MODEL AVR-3-B-PN-TELD  
DUAL-OUTPUT  
PULSE GENERATOR  
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 disassembled, 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](mailto:info@avtechpulse.com)

World Wide Web: <http://www.avtechpulse.com>

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## INTRODUCTION

The AVR-3-B-PN-TELD is a special-purpose dual-channel GPIB and RS232-equipped pulse generator.

Output #1 can generate 0 to +200V, and has 50 $\Omega$  output impedance. When driving a 50 Ohm single-ended load, the actual amplitude across the load will be reduced by a factor of two (0 to +100V), due to the 50 Ohm output impedance.

Output #2 can generate 0 to -200V, and has 50 $\Omega$  output impedance. When driving a 50 Ohm single-ended load, the actual amplitude across the load will be reduced by a factor of two (0 to -100V), due to the 50 Ohm output impedance.

The two outputs share common timing controls, but have independently variable amplitudes. Each output may drive a separate single-ended 50 $\Omega$  load, or the two outputs may drive either side of a single 100 $\Omega$  load.

The pulse width is variable from 100 ns to 100  $\mu$ s, and the duty cycle may be as high as 0.5%. Rise and fall times are fixed at  $\leq 10$  ns. The AVR-3-B-PN-TELD 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 output pulse width can be set to follow an input trigger pulse width.

The AVR-3-B-PN-TELD 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.

The instrument is protected against overload conditions (such as short circuits) 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.

## SPECIFICATIONS

Model:	AVR-3-B
GPIB and RS-232 control:	Standard
Amplitude <sup>1</sup> : Output #1: Output #2:	0 to +200V, adjustable. 0 to -200V, adjustable.  When driving a 50 Ohm single-ended load, the actual amplitudes across the loads will be reduced by a factor of two (0 to +/- 100V), due to the 50 Ohm output impedance.
Output Impedance:	50 $\Omega$ , approximately
Rise time:	$\leq 10$ ns
Fall time:	$\leq 10$ ns
Pulse width:	100 ns to 100 $\mu$ s
PRF:	0 to 10 kHz
Duty cycle (max):	0.5%
Propagation delay:	$\leq 100$ ns (Ext trig in to pulse out)
Jitter: (Ext trig in to pulse out)	$\pm 100$ ps $\pm 0.03\%$ of sync delay
Trigger required: (external trigger mode)	Ext Trig Mode A: +5 Volt, 50 ns or wider (TTL) Ext Trig Mode B: +5 Volt, $PW_{IN} = PW_{OUT}$ (TTL)
Sync delay:	Variable 0 to $\pm 100$ $\mu$ s (sync out to pulse out)
Sync output:	+3 Volts, 200 ns, will drive 50 Ohm loads
Gated operation:	sync or async, active high or low, switchable
Connectors:	Out, Trig, Sync, Gate: BNC
Power requirements:	120/240 Volts (switchable) 50 - 60 Hz
Dimensions:	100 mm x 430 mm x 375 mm (3.9" x 17" x 14.8")
Chassis material:	cast aluminum frame and handles, blue vinyl on aluminum cover plates
Mounting:	Any
Temperature range:	+15° to +40° C

- 1) For operation at amplitudes of less than 10% of full-scale, best results will be obtained by setting the amplitude near full-scale and using external attenuators on the output.

ORIGINAL QUOTATION

To: Jim Dixon  
 Telcordia Technologies  
 Morristown, NJ  
 ph. 973-829-4954  
 jdixon@telcordia.com

Jim,

following our telephone conversations, I am pleased to quote as follows:

Quote number: 11027

Model number: AVR-3-B-PN-TELD

Description: modified version of the AVR-3-B-PN, with two outputs, and 50 Ohm output impedance.

Outputs: Two, with independent amplitude controls, and common timing controls.

Output #1 amplitude: 0 to +200V, adjustable. When driving a 50 Ohm single-ended load, the actual amplitude across the load will be reduced by a factor of two (0 to +100V), due to the 50 Ohm output impedance.

Output #2 amplitude: 0 to -200V, adjustable. When driving a 50 Ohm single-ended load, the actual amplitude across the load will be reduced by a factor of two (0 to -100V), due to the 50 Ohm output impedance.

Output impedance: 50 Ohms.

Minimum load impedance, single-ended to ground: 50 Ohms

Minimum load impedance, when connected between the two outputs: 100 Ohms

Timing: Outputs #1 and #2 have common timing controls, and thus have equal pulse width and delay.

Maximum duty cycle: 0.5%

Other: as per the standard AVR-3-B-PN.

Price: US \$10048, FOB destination.

Delivery: 60-75 days

Please call or email me if I can be of further assistance.

Regards,  
 Dr. Michael J. Chudobiak  
 VP, New Product Development

--- Avtech Electrosystems Ltd. ----- since 1975 ---  
 PO Box 265            ph: 1-800-265-6681 or 613-226-5772    PO Box 5120  
 Ogdensburg, NY      fax: 1-800-561-1970 or 613-226-2802    LCD Merivale  
 USA 13669-0265        email: info@avtechpulse.com            Ottawa, Ontario  
                           http://www.avtechpulse.com/            Canada K2C 3H4  
                           Nanosecond Waveform Generators  
                           for general purpose, R&D and OEM applications  
                           Pulse Generators - Laser Diode Drivers - Pulse Amplifiers  
                           Impulse Generators - Delay Generators - Comb Generators - Splitters  
                           Function Generators - Monocycle Generators - Frequency Dividers + more!  
 -----

## 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, and two instrumentation manuals (this manual and the "OP1B Interface Programming Manual") 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:

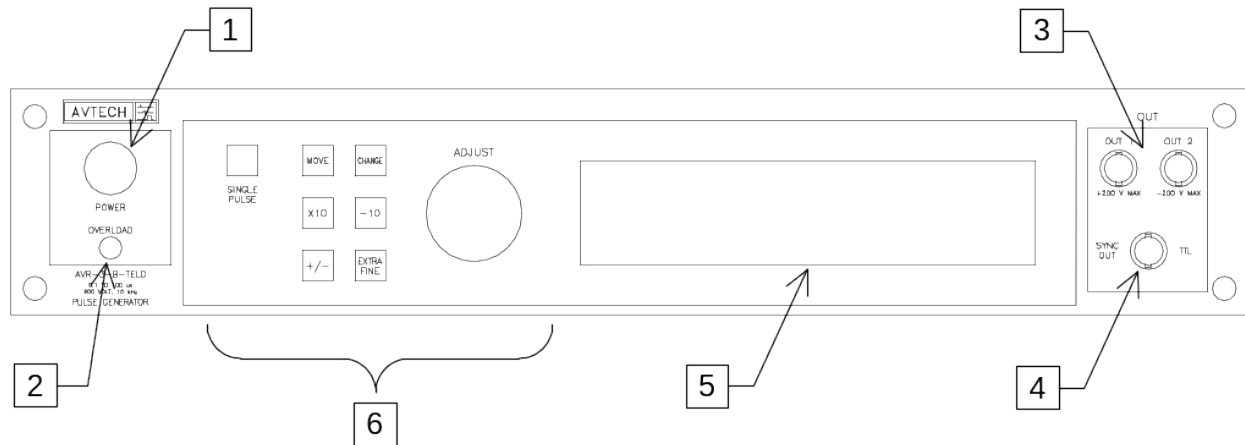
For AC line voltages of 220-240V, the power selector card should be installed so that the "240" marking is visible from the rear of the instrument, as shown below:

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.** The POWER push button switch applies AC prime power to the primaries of the transformer, turning the instrument on. The push button lamp (#382 type) is connected to the +15V DC supply.
2. **OVERLOAD.** The AVR-3-B-PN-TELD 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 is only likely to come on in two situations:

- Briefly at startup. This is not a cause for concern.
- When a low-impedance load ( $R_L < 50\Omega$ ), or a short-circuit, is connected to the output. In this case, turn off the instrument and connect the proper load.

Note that the output stage will safely withstand a short circuited load condition.

3. **OUT CONNECTORS.** Each output may drive a separate single-ended  $50\Omega$  (or higher) load, or the two outputs may drive either side of a single  $100\Omega$  load.
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  $R_L > 1K$  with a pulse width of approximately 200 ns.

5. 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.

6. 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.

## 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 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 k $\Omega$  resistor. When set to active low mode, this input is pulled-up to +5V by a 1 k $\Omega$  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 k $\Omega$ . (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](http://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.

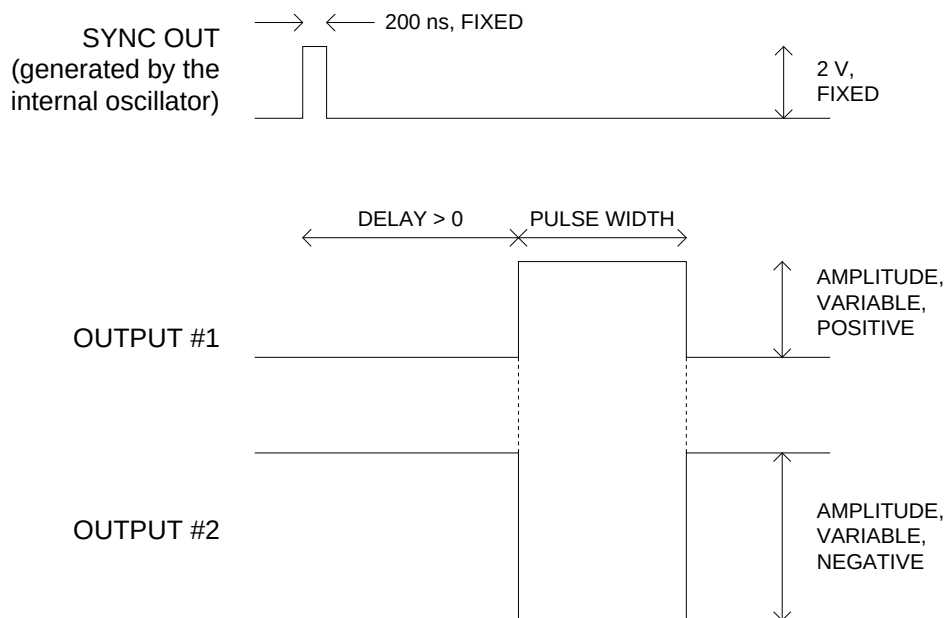
5. GPIB Connector. A standard GPIB cable can be attached to this connector to allow the instrument to be computer-controlled. See the “OP1B Interface Programming Manual” for more details on GPIB control.
6. RS-232 Connector. A standard serial cable with a 25-pin male connector can be attached to this connector to allow the instrument to be computer-controlled. See the “OP1B Interface Programming Manual” for more details on RS-232 control.

## GENERAL INFORMATION

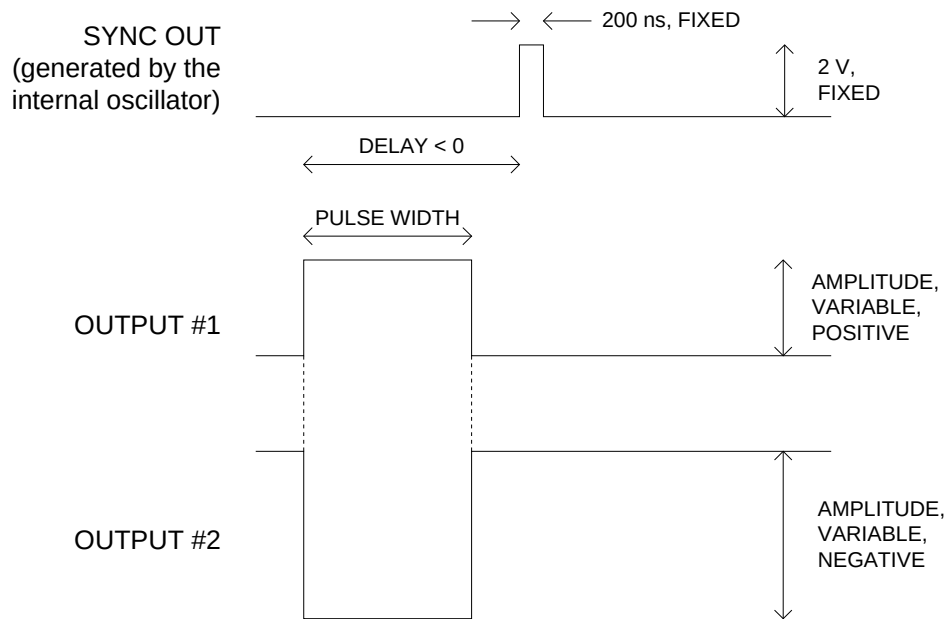
### BASIC PULSE CONTROL

This instrument can be triggered by its own internal clock or by an external TTL trigger signal. In either case, three output channels respond to the trigger: OUT 1, OUT 2 and SYNC. The OUT channels are the signals that are applied to the load(s). The two main output have separate amplitude controls, and common timing controls. 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 pulses. When the delay is set to a negative value the SYNC pulse follows the OUT pulses.

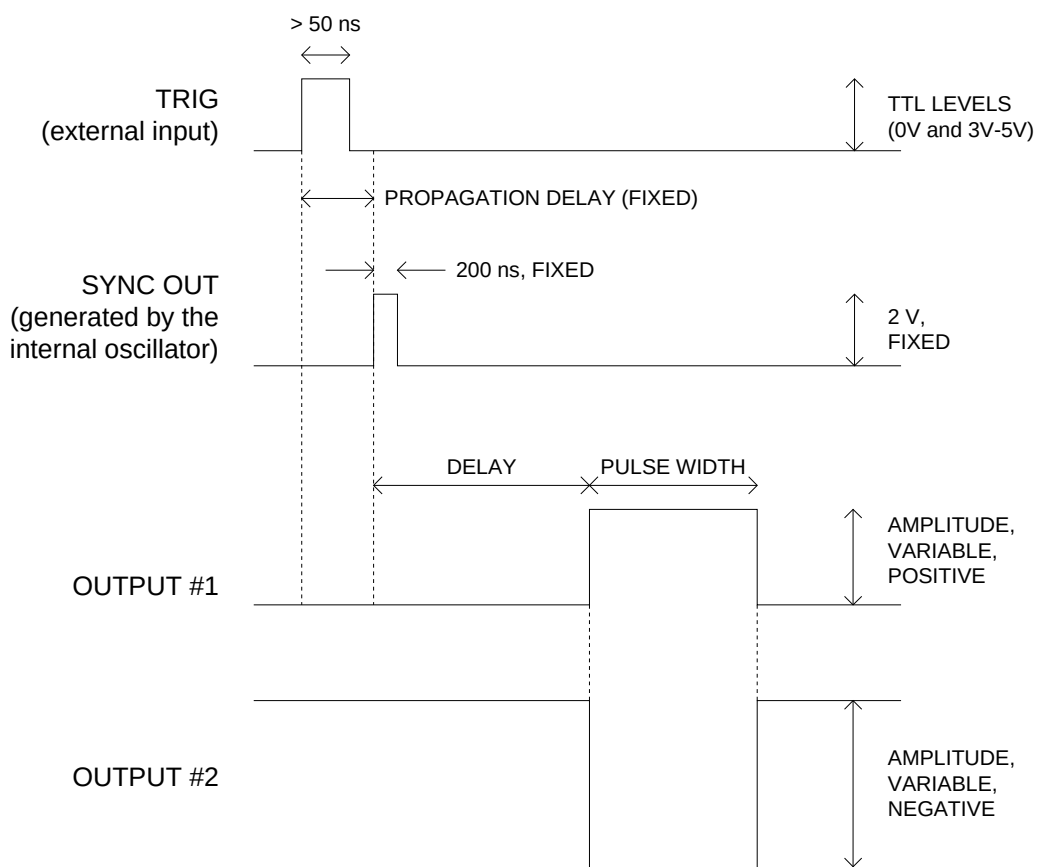
These pulses are illustrated below, assuming internal triggering and a positive delay:



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

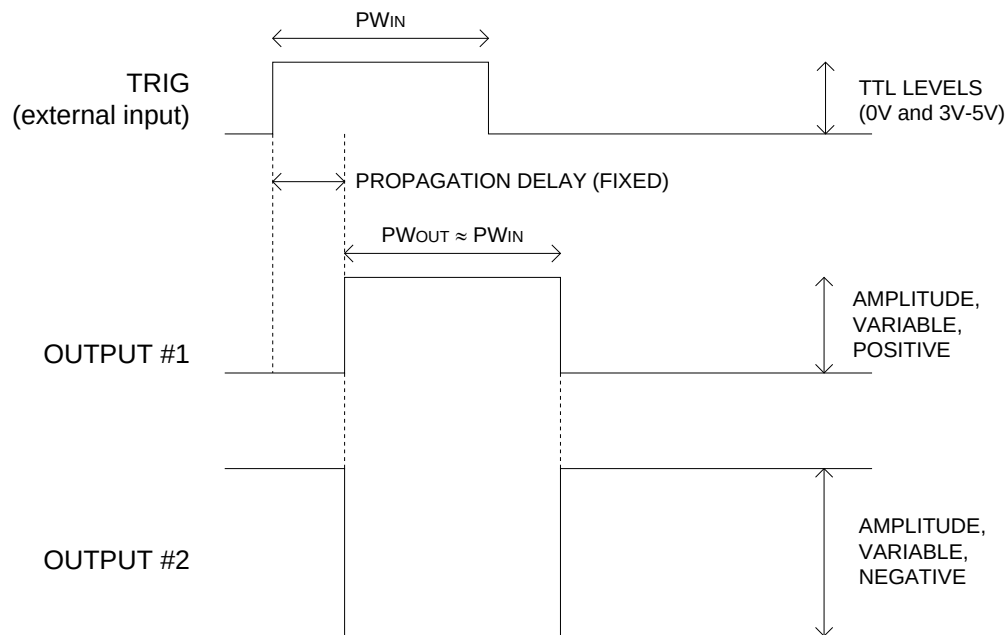


The next figure illustrates the relationship between the signals when an external TTL-level trigger is used:



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:



The delay, pulse width, and frequency (when in the internal mode), of the OUT pulses 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.)

### PULSE WIDTH MODES

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 “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.

### ELECTROMAGNETIC INTERFERENCE

To prevent electromagnetic interference with other equipment, all used outputs should be connected to shielded  $50\Omega$  loads using shielded  $50\Omega$  coaxial cables. Unused outputs should be terminated with shielded  $50\Omega$  BNC terminators or with shielded BNC dust caps, to prevent unintentional electromagnetic radiation. All cords and cables should be less than 3m in length.

### TOP COVER REMOVAL

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).

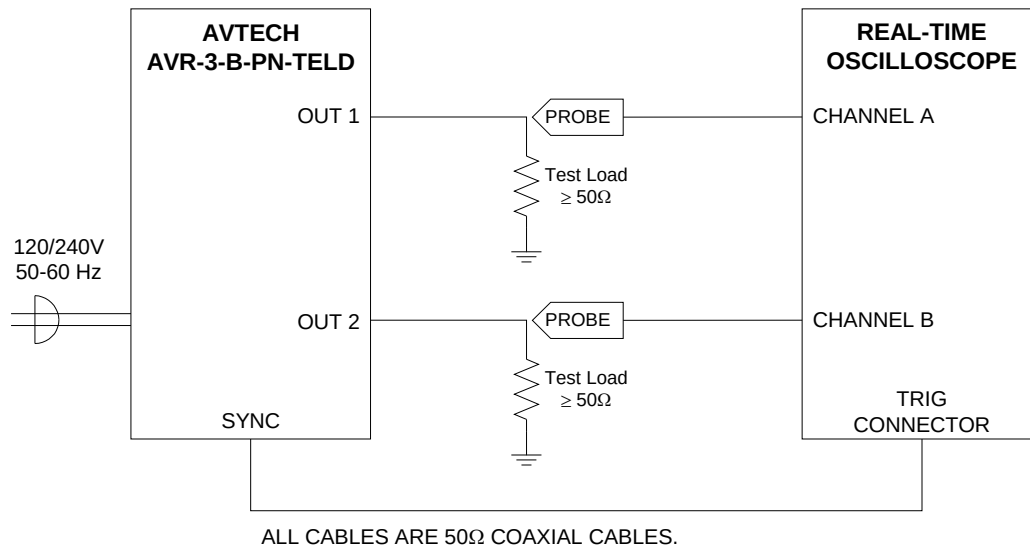


**CAUTION!** Extreme caution should be followed when using this instrument as it generates output pulse amplitudes as high as 200 Volts. DC potentials as high as 220 Volts are generated internally. It is therefore highly recommended that the unit be returned to Avtech for all repairs beyond the replacement of the AC line fuse or the DC rear-panel fuse.

## TEST ARRANGEMENT

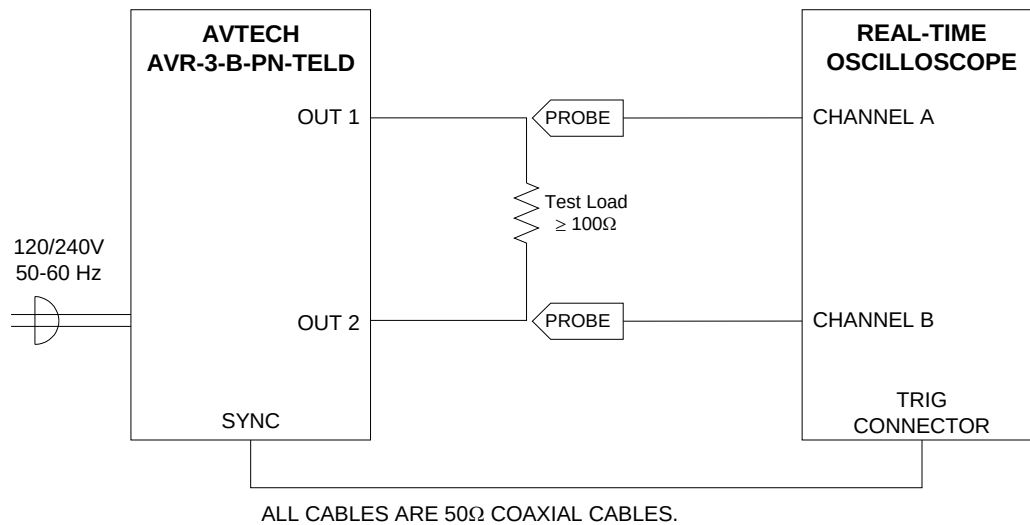
Each of the main output may drive a separate single-ended  $50\Omega$  load, or the two outputs may drive either side of a single  $100\Omega$  load.

The single-ended set-up is shown below:



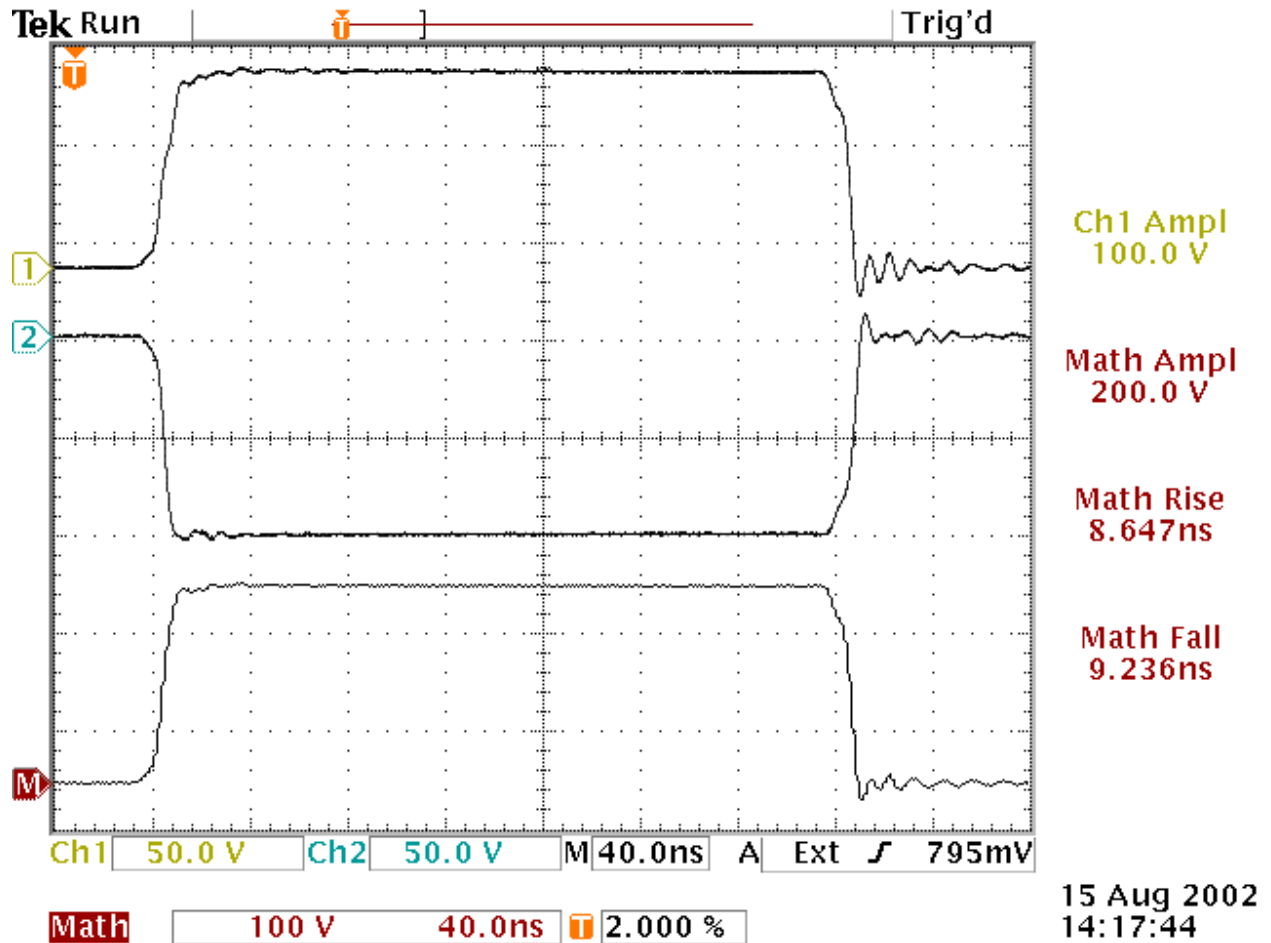
This set-up is most useful for testing the basic operation of the unit.

The differential-load approach is shown below:



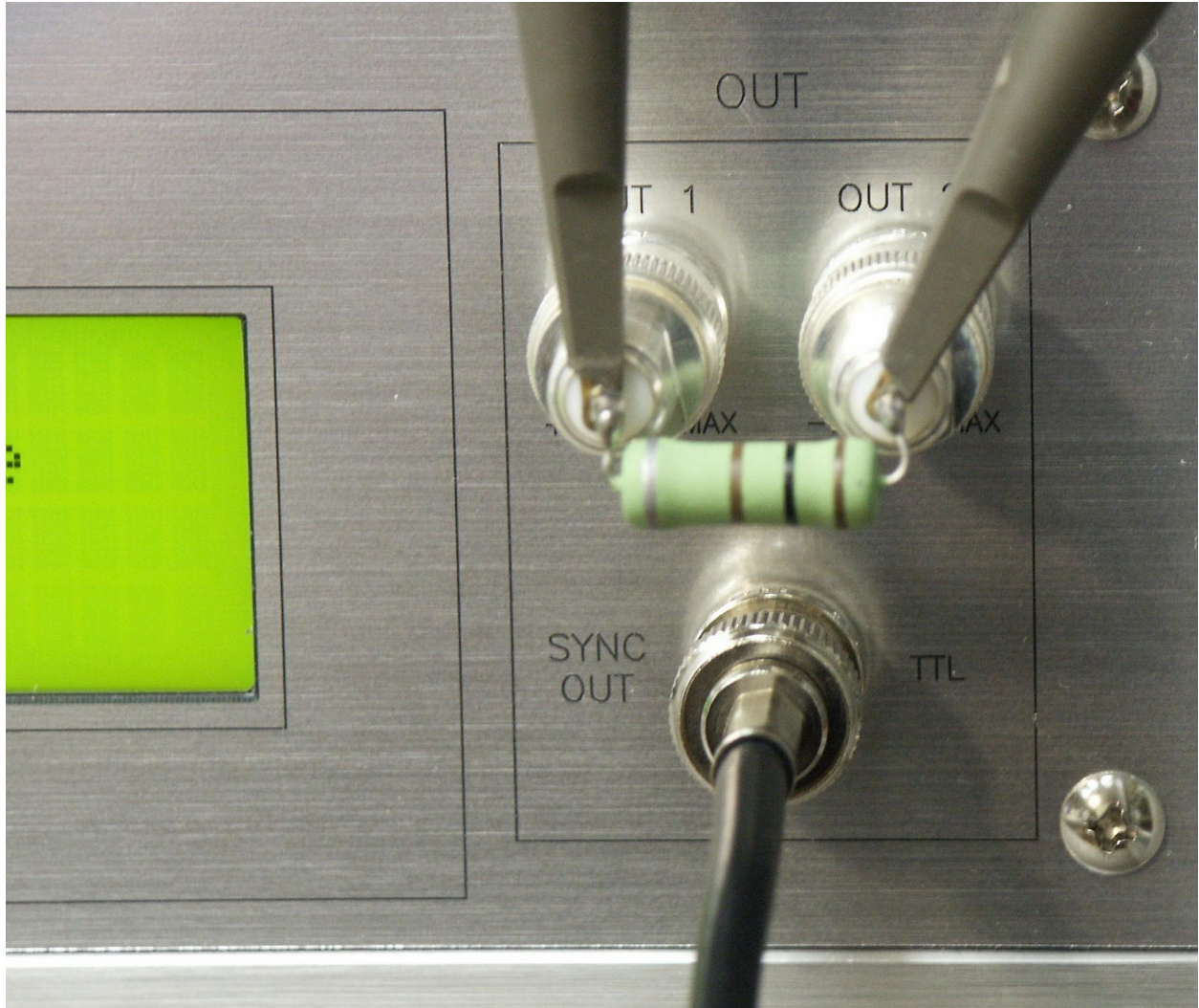
When connected as shown above, the voltage at the OUT 1 connector can be as high as +100V, and the voltage at the OUT 2 connector can be as high as -100V. The

voltage across the  $100\Omega$  load, which is the difference of the two voltage, can thus be as high as 200V. Some typical waveforms are shown below:



The top waveform is the OUT 1 signal (+100V), the middle waveform is the OUT 2 signal (-100V), and the bottom waveform is the calculated difference between them (i.e., the voltage across the  $100\Omega$  load). Note that the bottom waveform has a 200V amplitude, with rise and fall times less than 10 ns!

The following photo shows how these measurements were obtained, physically. Two BNC-to-solder-cup adapter were connected to the outputs, and a 2W  $100\Omega$  resistor was soldered between the signal lines.



## PROGRAMMING YOUR PULSE GENERATOR

### KEY PROGRAMMING COMMANDS

The “OP1B Interface Programming Manual” 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 1 us   (sets the pulse width to 1 us)
pulse:delay 2 us   (sets the delay to 2 us)
volt1 +200         (sets the OUT 1 amplitude to +200 V)
volt2 -200         (sets the OUT 2 amplitude to -200 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 1 us   (sets the pulse width to 1 us)
pulse:delay 2 us   (sets the delay to 2 us)
output on          (turns on the output)
volt1 +200         (sets the OUT 1 amplitude to +200 V)
volt2 -200         (sets the OUT 2 amplitude to -200 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 external triggering)
pulse:width 1 us   (sets the pulse width to 1 us)
pulse:delay 2 us   (sets the delay to 2 us)
volt1 +200         (sets the OUT 1 amplitude to +200 V)
volt2 -200         (sets the OUT 2 amplitude to -200 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 “OP1B Interface Programming Manual”. (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]:		
:PULSe		
:PERiod	<numeric value>	
:WIDTh	<numeric value>   EXTernal	
: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]

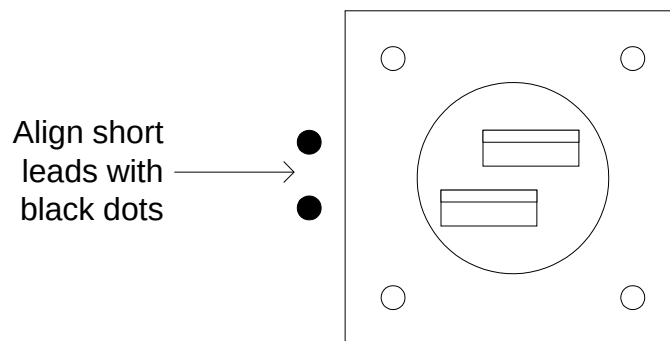
## SYSTEM DESCRIPTION AND REPAIR PROCEDURE

In the event of an instrument malfunction, it is most likely that the 0.5A slow blow fuse or the main power fuse on the rear panel has failed. Replace if necessary. If the unit still does not function, it is most likely that some of the output switching elements (SL4AT) may have failed due to an output short circuit condition or to a high duty cycle condition.

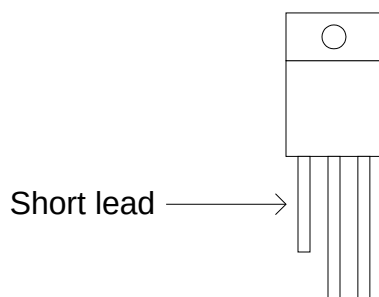
Two sets of switching elements (one for OUT 1, and one for OUT 2) may be accessed by removing the two cover plates on the bottom side instrument. The cover plates are removed by removing the four countersunk 6-32 Phillips screws.

NOTE: First turn off the prime power, and disconnect the power cord. Let the instrument sit for five minutes, to allow the internal capacitors to fully discharge.

*Bottom view of instrument,  
with cover plate removed*



*SL4AT transistor*



The elements may be removed from their sockets using needle-nosed pliers. The SL4AT is a selected MOSFET power transistor in a TO-220 package and may be checked on a curve tracer. If defective, replacement units should be ordered directly from Avtech. When replacing the SL4AT switching elements, take care to ensure that the short lead (of the three leads) is adjacent to the black alignment dots, as shown above.



PERFORMANCE CHECK SHEET