



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](mailto: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 AVX-DD-A3-PS

DIGITAL DELAY GENERATOR  
AND PULSE GENERATOR

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>

## TABLE OF CONTENTS

<b>WARRANTY.....</b>	<b>2</b>
<b>TECHNICAL SUPPORT.....</b>	<b>2</b>
<b>TABLE OF CONTENTS.....</b>	<b>3</b>
<b>INTRODUCTION.....</b>	<b>4</b>
<b>SPECIFICATIONS.....</b>	<b>4</b>
<b>INSTALLATION.....</b>	<b>6</b>
<b>VISUAL CHECK.....</b>	<b>6</b>
<b>POWER RATINGS.....</b>	<b>6</b>
<b>CONNECTION TO THE POWER SUPPLY.....</b>	<b>6</b>
<b>ENVIRONMENTAL CONDITIONS.....</b>	<b>6</b>
<b>LABVIEW DRIVERS.....</b>	<b>7</b>
<b>FUSES.....</b>	<b>8</b>
<b>AC FUSE REPLACEMENT.....</b>	<b>8</b>
<b>DC FUSE REPLACEMENT.....</b>	<b>9</b>
<b>FUSE RATINGS.....</b>	<b>9</b>
<b>FRONT PANEL CONTROLS.....</b>	<b>10</b>
<b>REAR PANEL CONTROLS.....</b>	<b>12</b>
<b>GENERAL INFORMATION.....</b>	<b>13</b>
<b>BASIC OPERATION - DELAY GENERATOR MODE.....</b>	<b>13</b>
<b>BASIC OPERATION - PULSE GENERATOR MODE.....</b>	<b>14</b>
<b>MECHANICAL INFORMATION.....</b>	<b>15</b>
<b>TOP COVER REMOVAL.....</b>	<b>15</b>
<b>RACK MOUNTING.....</b>	<b>15</b>
<b>ELECTROMAGNETIC INTERFERENCE.....</b>	<b>15</b>
<b>MAINTENANCE.....</b>	<b>16</b>
<b>REGULAR MAINTENANCE.....</b>	<b>16</b>
<b>CLEANING.....</b>	<b>16</b>
<b>PROGRAMMING YOUR INSTRUMENT.....</b>	<b>17</b>
<b>KEY PROGRAMMING COMMANDS.....</b>	<b>17</b>
<b>ALL PROGRAMMING COMMANDS.....</b>	<b>18</b>
<b>PERFORMANCE CHECK SHEET.....</b>	<b>20</b>

## INTRODUCTION

The AVX-DD-A3-PS is a highly flexible instrument that can be used as a digital delay generator or as a general-purpose pulse generator. The AVX-DD-A3-PS can be triggered by an internal trigger source, or 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 main output has variable amplitude (0 to  $\pm 10V$ ), offset (0 to  $\pm 10V$ ), delay (0 to 1 second), and pulse width (0 to 1 second). The main output has rise and fall times of 10 ns, and can drive 50 $\Omega$  loads. A "SYNC" output is also provided, for oscilloscope triggering purposes. This output has fixed pulse width and amplitude.

The AVX-DD-A3-PS 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, polarity, pulse width, pulse repetition frequency, source resistance 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.

This instrument is intended for use in research and development laboratories.

## SPECIFICATIONS

Model:	AVX-DD-A3-PS
Variable delay range:	0 to 1.0 s
Delay resolution:	Varies, < 0.3% of (delay + 20 ns)
Jitter <sup>3</sup> (trig in to pulse out):	$\pm 40$ ps $\pm 0.005\%$ of delay.
Accuracy (excluding insertion delay):	$\pm 2$ ns $\pm 2\%$ of delay.
Number of output channels:	One standard, Two optional <sup>1</sup>
Delay controls:	Front-panel keypad, GPIB, or RS-232
GPIB:	Yes. See <a href="http://www.avtechpulse.com/gpib">http://www.avtechpulse.com/gpib</a>
Insertion delay:	$\leq 110$ ns
Rise time, fall time:	$\leq 10$ ns
Update time:	$\leq 150$ ms (typical) <sup>2</sup>
Display:	4 line by 40 character back-lit LCD display
Output amplitude:	0 to $\pm 10$ V (variable), will drive 50 $\Omega$ loads
Trigger required:	+ 5 Volt, PW > 50 ns
OUT pulse width:	50 ns to 1.0 s (variable)
Max duty cycle:	80%
PRF:	0 to 10 MHz
Connectors:	BNC
Power requirement:	100 - 240 Volts 50 - 60 Hz
Dimensions:	100 x 430 x 375 mm (3.9" x 17" x 14.8")

- 1) To specify the two output channel option, add the suffix -TC to the model number.
- 2) Valid for single-channel model only.
- 3) Jitter = standard deviation of the measured delay during a one second interval.



## 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 “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.

### POWER RATINGS

This instrument is intended to operate from 100 - 240 V, 50 - 60 Hz.

The maximum power consumption is 57 Watts. Please see the “FUSES” section for information about the appropriate AC and DC fuses.

This instrument is an “Installation Category II” instrument, intended for operation from a normal single-phase supply.

### CONNECTION TO THE POWER SUPPLY

An IEC-320 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket. The other end of the detachable power cord plugs into the local mains supply. Use only the cable supplied with the instrument. The mains supply must be earthed, and the cable used to connect the instrument to the mains supply must provide an earth connection. (The supplied cable does this.)

### ENVIRONMENTAL CONDITIONS

This instrument is intended for use under the following conditions:

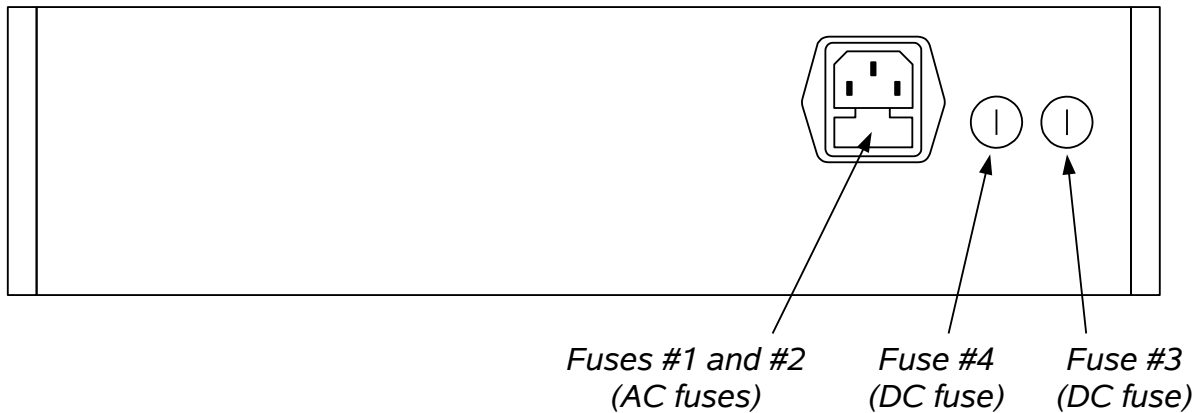
1. indoor use;
2. altitude up to 2 000 m;
3. temperature 5 °C to 40 °C;
4. maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C;
5. Mains supply voltage fluctuations up to  $\pm 10$  % of the nominal voltage;
6. no pollution or only dry, non-conductive pollution.

## 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/>.

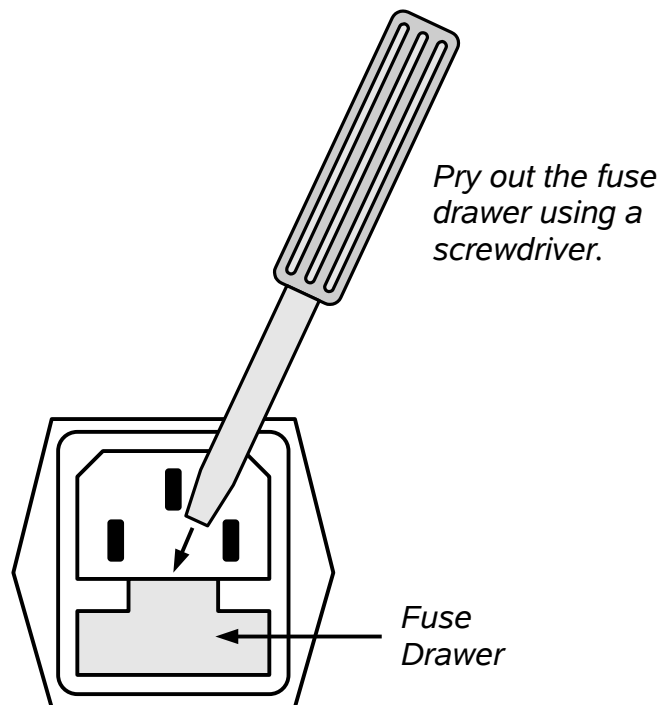
## FUSES

This instrument contains four fuses. All are accessible from the rear-panel. Two protect the AC prime power input, and two protect the internal DC power supplies. The locations of the fuses on the rear panel are shown in the figure below:



### AC FUSE REPLACEMENT

To physically access the AC fuses, the power cord must be detached from the rear panel of the instrument. The fuse drawer may then be extracted using a small flat-head screwdriver, as shown below:





## DC FUSE REPLACEMENT

The DC fuses may be replaced by inserting the tip of a flat-head screwdriver into the fuse holder slot, and rotating the slot counter-clockwise. The fuse and its carrier will then pop out.

## FUSE RATINGS

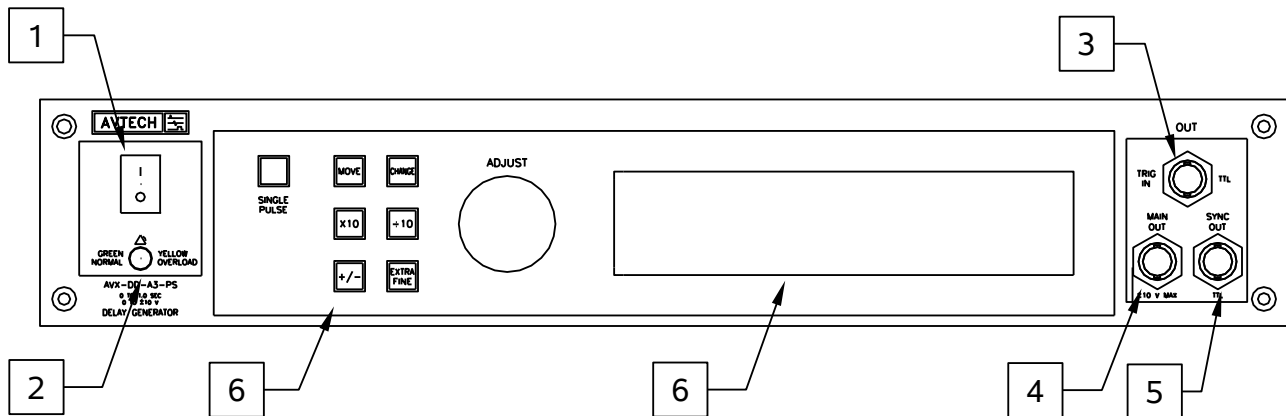
The following table lists the required fuses:

Fuses	Nominal Mains Voltage	Rating	Case Size	Manufacturer's Part Number (Wickmann)	Distributor's Part Number (Digi-Key)
#1, #2 (AC)	100-240V	0.5A, 250V, Time-Delay	5×20 mm	1950500000	WK5041-ND
#3 (DC)	N/A	1.0A, 250V, Time-Delay	5×20 mm	1951100000	WK5048-ND
#4 (DC)	N/A	Not used. A spare 1.0A fuse is installed here.			

The fuse manufacturer is Wickmann (<http://www.wickmann.com/>).

Replacement fuses may be easily obtained from Digi-Key (<http://www.digikey.com/>) and other distributors.

## 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.

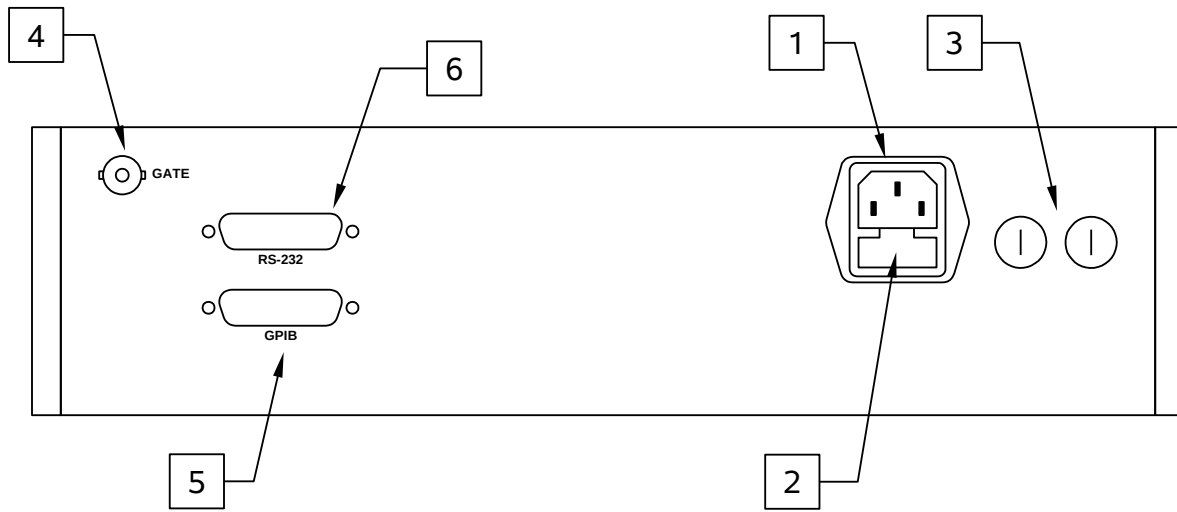
3. TRIG IN Connector. This TTL-level (0 and +5V) logic input can be used to trigger the instrument, if the instrument is set to triggering externally. The instrument triggers on the rising edge of this input. The input impedance of this input is 1 k $\Omega$ . (Depending on the length of cable attached 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.)
4. MAIN OUT Connector. This output is delayed relative to the trigger (which may be from the TRIG IN connector, in the external trigger mode, or the internal oscillator, in the internal trigger mode). The delay, pulse width, amplitude and offset settings of this output are variable, and may be changed using the front panel controls or the computer interfaces. This output will drive loads as low as 50  $\Omega$ .
5. SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal has an approximate

amplitude of +3 Volts to  $R_L > 1 \text{ k}\Omega$  with a pulse width of approximately 40 ns.

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 "Programming Manual for -B Instruments" describes the menus and submenus in detail.
7. 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

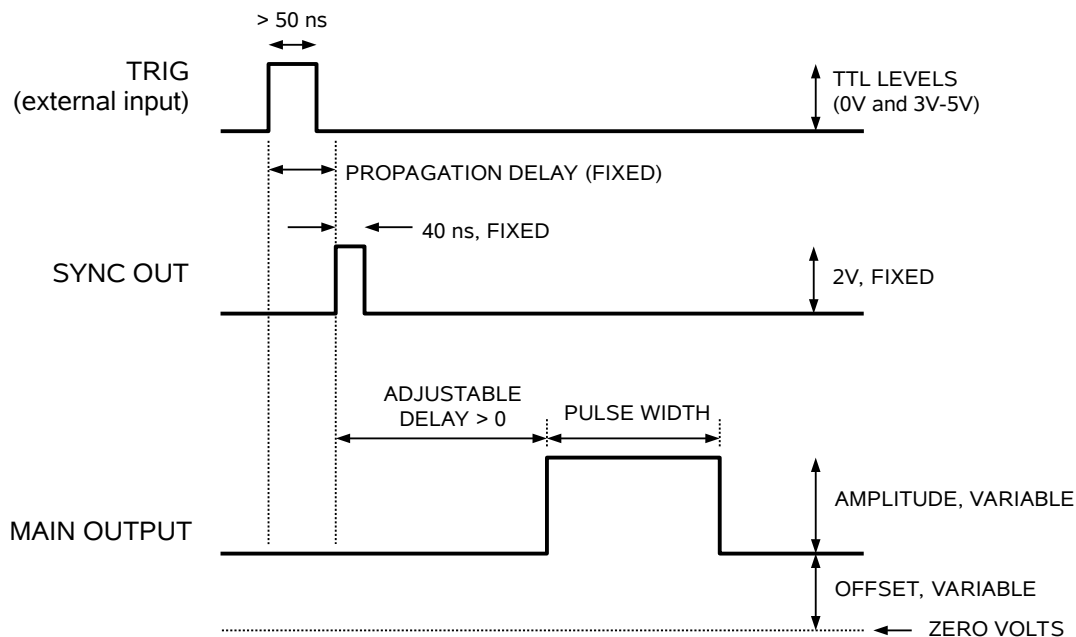


1. AC POWER INPUT. An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
2. AC FUSE DRAWER. The two fuses that protect the AC input are located in this drawer. Please see the “FUSES” section of this manual for more information.
3. DC FUSES. These two fuses protect the internal DC power supplies. Please see the “FUSES” sections of this manual for more information.
4. 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.
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.

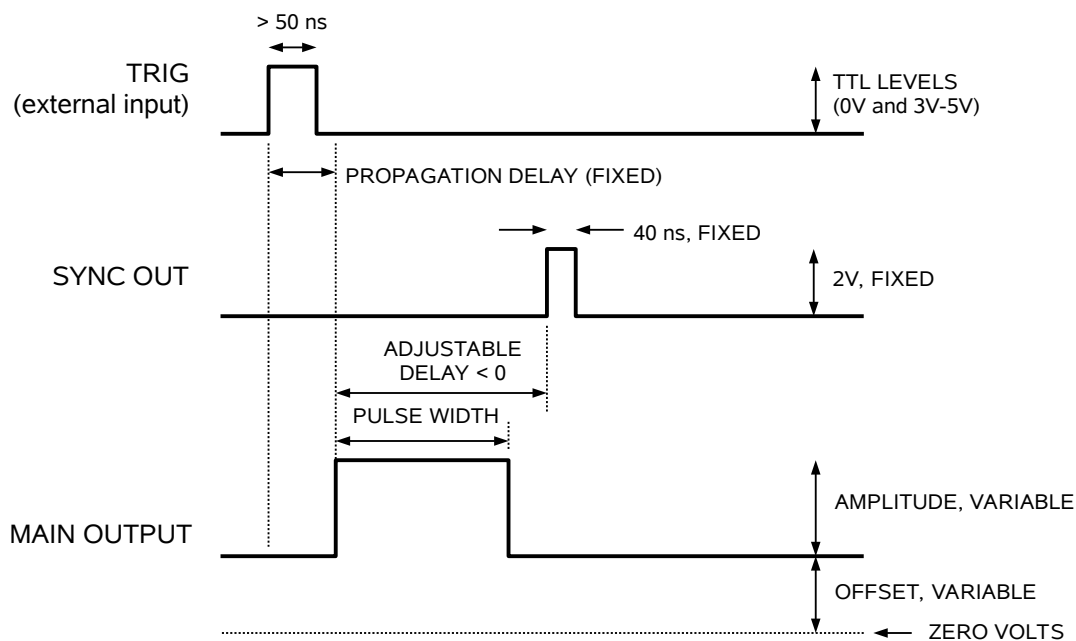
## GENERAL INFORMATION

### BASIC OPERATION - DELAY GENERATOR MODE

If the trigger source is set to the external mode (by using the front-panel trigger menu or the “trig:sour ext” command), the instrument acts as a delay generator. If the set delay is positive, the main output channel is delayed relative to the single input channel, as shown below. The delay is the sum of the insertion delay (approximately 100 ns) and the programmed delay. The SYNC output is provided to trigger oscilloscopes or other equipment. (In this mode, the TRIG-to-SYNC delay is fixed at < 110 ns.)



If the set delay is negative, the delay of the main output is set to minimum, and the SYNC output is delayed. This is illustrated below:



The outputs will drive load impedances as low as  $50\Omega$ .

### BASIC OPERATION - PULSE GENERATOR MODE

If the trigger source is set to the internal mode (by using the front-panel trigger menu or the "trig:sour int" command), the instrument acts as a pulse generator.

In this mode, no external trigger is applied to the instrument. The internal oscillator is used as the trigger instead. The frequency of this oscillator can be varied from 1 Hz to 10 MHz. In all other respects, the operation of the instrument is similar to that described in the previous section.

## 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 INSTRUMENT

### 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. Several sample sequences of commands that might be sent to the instrument after power-up are given below.

To use the instrument as a delay generator (i.e. to trigger from an external TTL signal applied to the TRIG IN connector), use:

*rst	(resets the instrument)
trigger:source external	(selects internal triggering)
pulse:width 10 us	(sets the pulse width to 10 us)
pulse:delay 1 us	(sets the delay to 1 us)
output:impedance 2	(sets the output impedance to 2Ω. The only other allowed setting is output:impedance 50.)
volt:ampl 5	(sets the amplitude to 5 V)
volt:low 0	(sets the DC offset to 0 V)
output on	(turns on the output)

To use the instrument as a pulse generator (i.e. to trigger from the internal oscillator), use:

*rst	(resets the instrument)
trigger:source internal	(selects internal triggering, i.e., pulse generator mode)
frequency 1000 Hz	(sets the frequency to 1000 Hz)
pulse:width 10 us	(sets the pulse width to 10 us)
pulse:delay 1 us	(sets the delay to 1 us)
output:impedance 2	(sets the output impedance to 2Ω. The only other allowed setting is output:impedance 50.)
volt:ampl 5	(sets the amplitude to 5 V)
volt:low 0	(sets the DC offset to 0 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 10 us	(sets the pulse width to 10 us)
pulse:delay 1 us	(sets the delay to 1 us)
output:impedance 2	(sets the output impedance to 2Ω. The only other allowed setting is output:impedance 50.)

output on	(turns on the output)
volt:ampl 5	(sets the amplitude to 5 V)
volt:low 0	(sets the DC offset to 0 V)
trigger:source immediate	(generates a single non-repetitive trigger event)
trigger:source hold	(turns off all triggering)
output off	(turns off 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>	
:IMPedance	<numeric 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		
:LEVel	High   LOw	
[SOURce]:		
:VOLTagE		
[:LEVel]		
[:IMMediate]		
[:AMPLitude]	<numeric value>	
:LOW	<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		
:ADDRes	<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