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INSTRUCTIONS

MODEL AVOZ-A2-B-P-EA-S5-UPA

0 to +50 AMP, 0 to +50 V, 30 ns RISE TIME
LASER DIODE DRIVER
WITH IEEE 488.2 AND RS-232 CONTROL

SERIAL NUMBER: _____

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Manual Reference: /fileserver1/officefiles/instructword/avoz/AVOZ-A2-B,edition2,with -S5-UPA.sxw.
Last modified February 29, 2024.

INTRODUCTION

The Model AVOZ-A2-B-P-EA-S5-UPA pulse generator is designed for pulsing laser diode and other low impedance loads with rectangular pulses as high as +50V into 1Ω (i.e. +50 Amps) with 30 ns rise and fall times.

The pulse repetition frequency can vary from 1 Hz to 20 kHz, and pulse widths can vary from 40 ns to 1 us. The maximum duty cycle is 0.4%, and the maximum average output power is 10 Watts.

The Model AVOZ-A2-B-P-EA-S5-UPA pulse generator is a voltage pulser. The current amplitude is determined by Ohm's Law. That is, the current is the output voltage divided by the load resistance. The load resistance should be approximately 1Ω to attain a peak current of 50 A.

The loads can be connected to the pulse generator using the convenient 60 cm length of LZ1 flexible flat transmission line, which has a 1Ω characteristic impedance (Z_0), and is terminated with a small circuit board. The -S5-UPA option provides a 0.94Ω resistance and a socket for a user-supplied PFAS1S12 laser diode (described at http://www.lasercomponents.de/pdf/pe/pfaserie.pdf) on this board.

The AVOZ-A2-B-P-EA-S5-UPA 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 AVOZ-A2-B-P-EA-S5-UPA 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.

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

SPECIFICATIONS

Model:	AVOZ-A2-B-P-EA-S5-UPA
Amplitude:	0 to +50V into 1Ω (0 to +50A)
Pulse width:	40 ns to 1 us
Rise time (20% - 80%):	≤ 30 ns
Fall time (80% - 20%):	≤ 10 ns
PRF:	1 Hz to 20 kHz
Max. duty cycle:	0.4%
Output impedance:	≤ 0.1 Ohms
Propagation delay:	≤ 100 ns (Ext trig in to pulse out)
Jitter:	± 100 ps (Ext trig in to pulse out)
Trigger required:	external trigger mode: +5 Volt, 50 ns or wider (TTL)
Sync delay:	Sync out to pulse out: Variable 0 to ± 1 us
Sync output:	+ 3 Volts, 200 ns, will drive 50 Ohm loads
Connectors:	Out: solder terminals on the end of 60 cm flexible microstrip Trig, Sync, Gate: BNC
Power, AC:	100 - 240 Volts, 50 - 60 Hz
Temperature range:	+5° to +40° C

EC DECLARATION OF CONFORMITY

We

Avtech Electrosystems Ltd.
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Ottawa, Ontario
Canada K2C 3H4

declare that this pulse generator meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance pertains to the following specifications as listed in the official Journal of the European Communities:

EN 50081-1 Emission

EN 50082-1 Immunity

and that this pulse generator meets the intent of the Low Voltage Directive 72/23/EEC as amended by 93/68/EEC. Compliance pertains to the following specifications as listed in the official Journal of the European Communities:

EN 61010-1:2001 Safety requirements for electrical equipment for measurement, control, and laboratory use

CE

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:

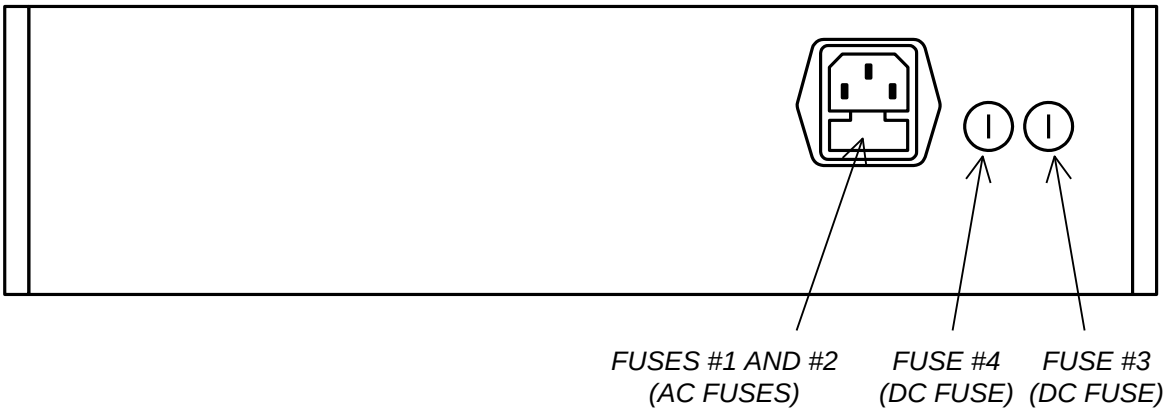
1. indoor use;
2. altitude up to 2 000 m;
3. temperature 5 °C to 40 °C;
4. maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C;
5. Mains supply voltage fluctuations up to ±10 % of the nominal voltage;
6. no pollution or only dry, non-conductive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

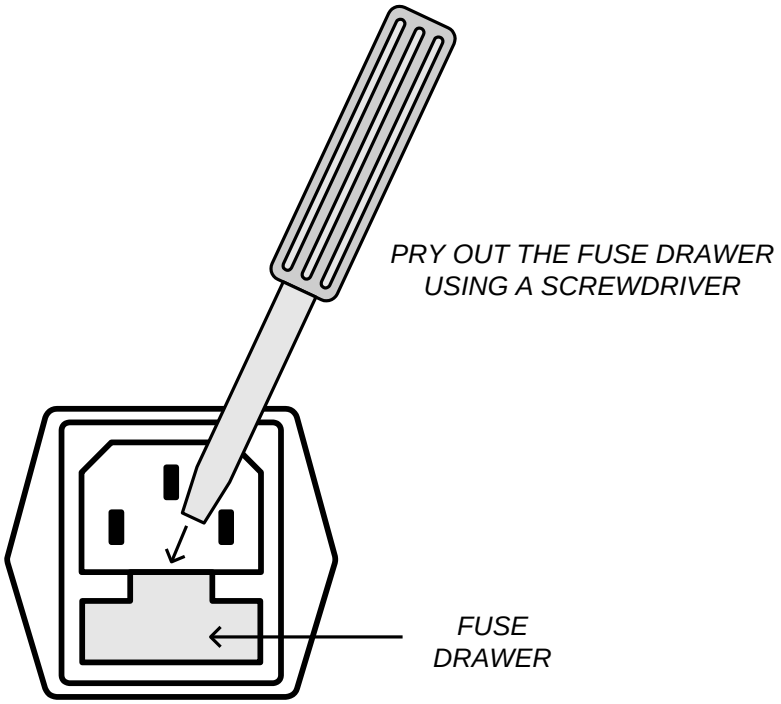
FUSES

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

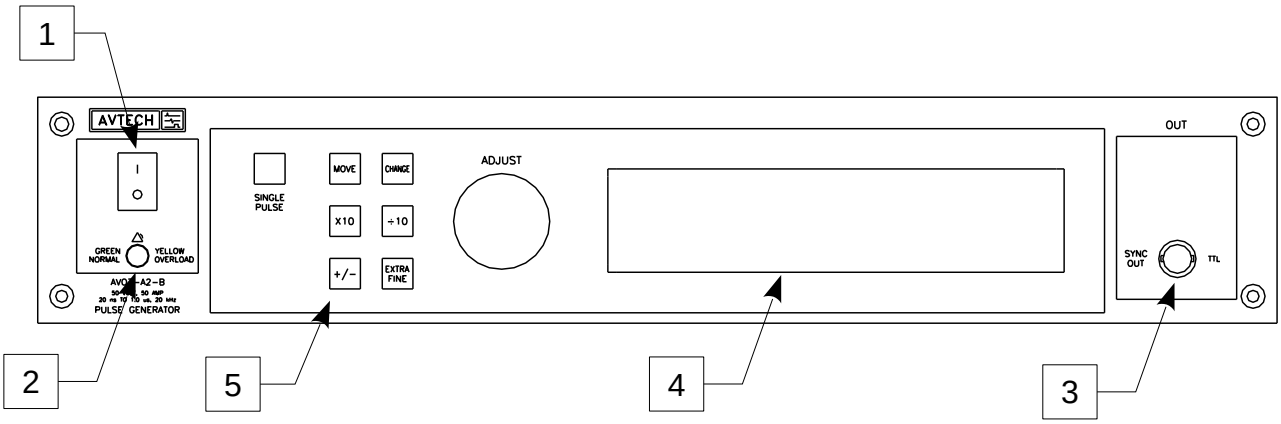
The following table lists the required fuses:

Fuses	Nominal Mains Voltage	Rating	Case Size	Manufacturer's Part Number (Wickmann)	Distributor's Part Number (Digi-Key)
#1, #2 (AC)	115 V	0.5A, 250V, Time-Delay	5 x 20 mm	1950500000	WK5041-ND
	230 V	0.5A, 250V, Time-Delay	5 x 20 mm	1950500000	WK5041-ND
#3 (DC)	N/A	1.6A, 250V, Time-Delay	5 x 20 mm	1951160000	WK5053-ND
#4 (DC)	N/A	1.0A, 250V, Time-Delay	5 x 20 mm	1951100000	WK5049-ND

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 is only likely to come on in two situations:

   - Briefly at startup. This is not a cause for concern.

   - When the load impedance is too low (< 1 Ω). In this case, turn off the instrument and connect the proper load.

3. 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.

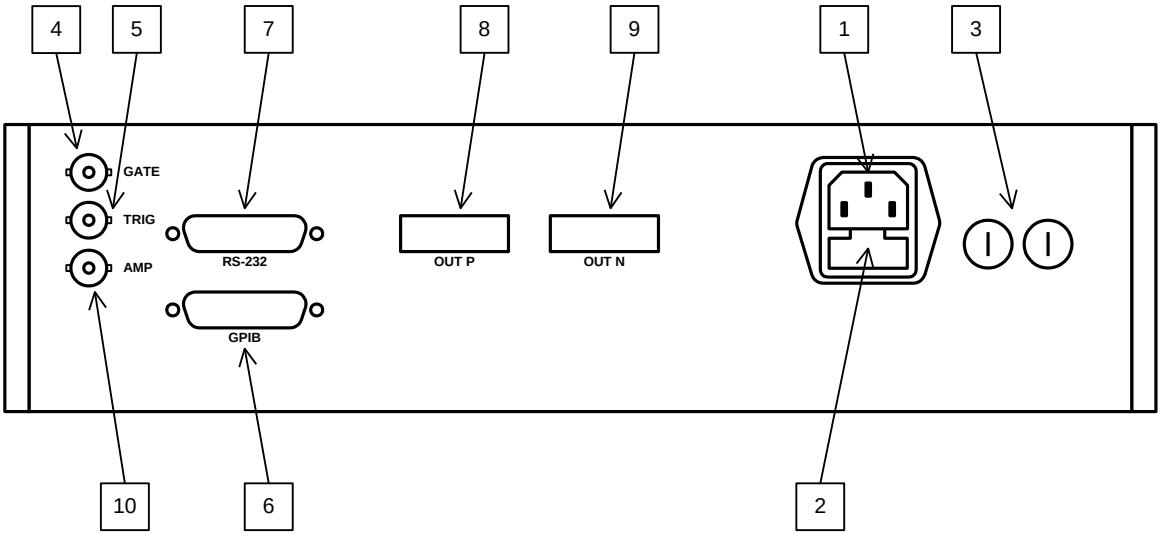
4. LIQUID CRYSTAL DISPLAY (LCD). This LCD is used in conjunction with the keypad to change the instrument settings. Normally, the main menu is displayed, which lists the key adjustable parameters and their current values. The “Programming Manual for -B Instruments” describes the menus and submenus in

detail.

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.

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

5. 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.)

6. 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.

7. 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.

8. OUT P. This is the main positive output, present on "-P" and "-PN" units. The 60 cm length of LZ1 transmission line plugs into this socket. The upper side of the socket ("UP") is the signal line. The lower side ("DOWN") is connected to ground.

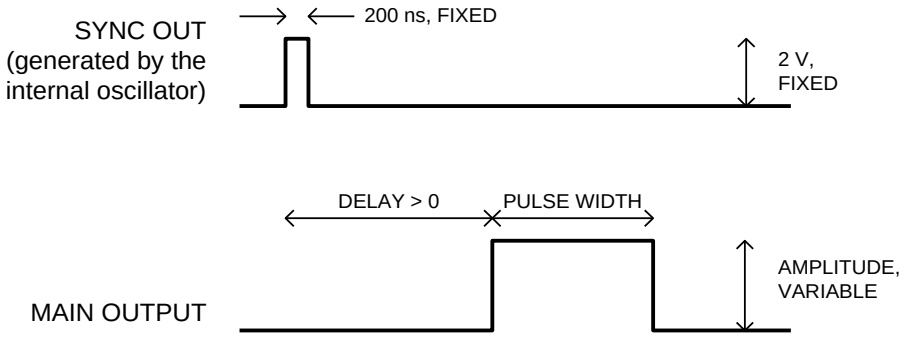
9. OUT N. This is the main negative output, present on "-N" and "-PN" units. The 60 cm length of LZ1 transmission line plugs into this socket. The upper side of the socket ("UP") is the signal line. The lower side ("DOWN") is connected to ground.

GENERAL INFORMATION - PULSE GENERATOR TIMING

BASIC PULSE CONTROL

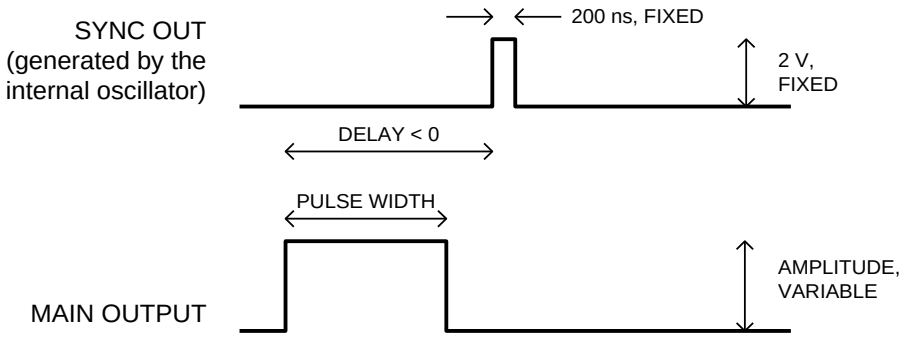
This instrument can be triggered by its own internal clock or by an external TTL trigger signal. In either case, two output channels respond to the trigger: OUT and SYNC. The OUT channel is the signal that is applied to the device under test. Its amplitude and pulse width are variable. The SYNC pulse 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.

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



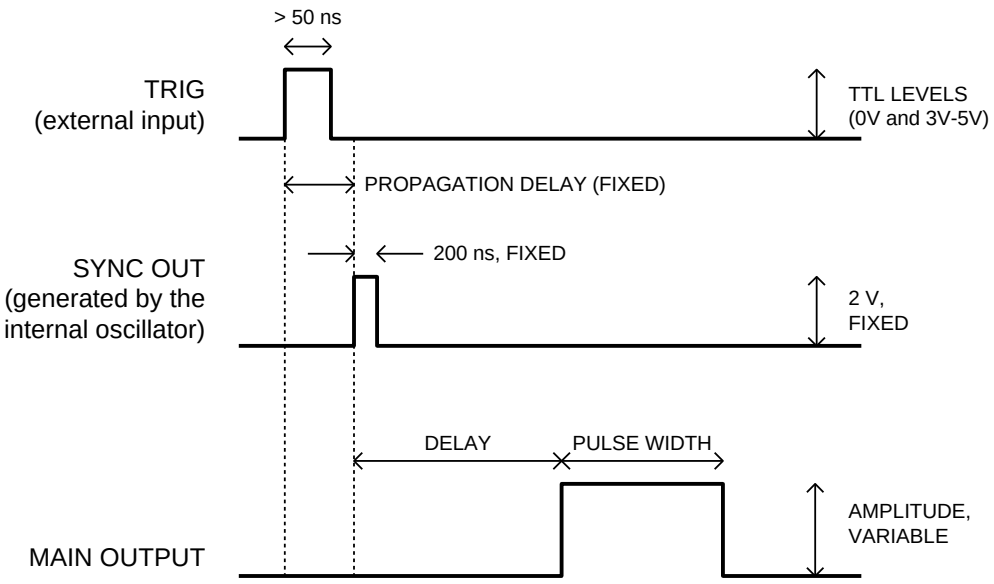
Basic Output Pulses for Delay > 0

The order of the output pulses is reversed for negative delays:



Basic Output Pulses for Delay < 0

When the triggering is set to external mode, a TTL-level pulse on the TRIG input will trigger the pulse generator, as shown below:



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

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.

GENERAL INFORMATION - OPERATING INTO A LOAD

AMPLITUDE CONTROL

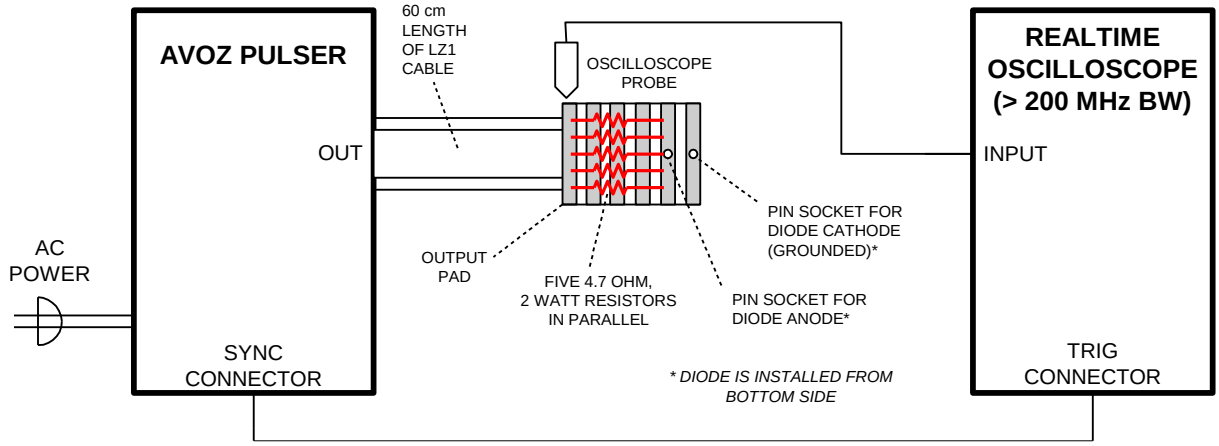
The Model AVOZ-A2-B-P-EA-S5-UPA pulse generator is a voltage pulser. The current amplitude is determined by Ohm's Law. That is, the current is the output voltage divided by the load resistance.

More specifically: $I_{DIODE} \approx (V_{PROGRAMMED} - V_{DIODE}) / R_{SERIES}$

where $V_{PROGRAMMED}$ is the set amplitude, V_{DIODE} is the diode voltage, and R is the series resistance (including any series resistance in the diode itself). R is normally approximately 1Ω; it should not be smaller than this.

TEST ARRANGEMENT

The recommended test arrangement is shown below:



USING THE LZ1 OUTPUT LINE (WITH -S5-UPA OPTION)

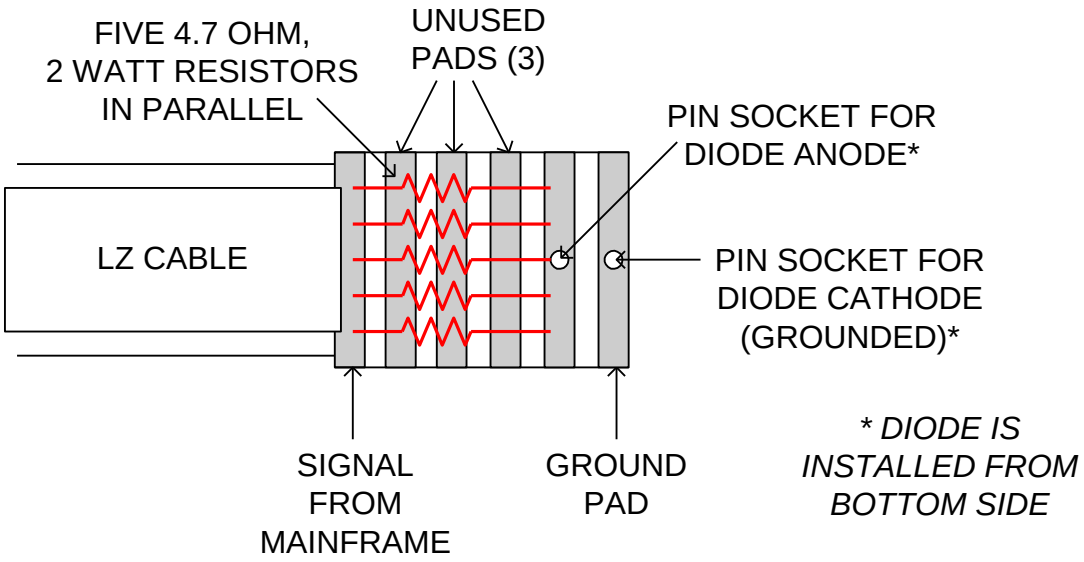
A 60 cm length of flexible, low-characteristic-impedance (1 Ohm) transmission line is supplied with this instrument. One end plugs into the front-panel OUT connector, and the other end is terminated with a 1.0 × 2.5 cm section of glass epoxy circuit board. The end that plugs into the front panel is marked with an "UP" side and a "DOWN" side. (The UP side is the signal output, and the DOWN side is ground.) It is critically important that the "UP" side of the line be visible.

The load may be inserted in the socket on the circuit board end. The -S5-UPA option provides a 0.94Ω resistance and a socket for a user-supplied PFAS1S12 laser diode (described at http://www.lasercomponents.de/pdf/pe/pfaserie.pdf) on this board. The

circuit board layout is illustrated below. The length of leads used to connect the load to the circuit board should be kept extremely short (< 0.5 cm), as discussed below.

The diode should be installed from the bottom (ground plane) side of the circuit board. The five parallel 4.7Ω resistors that comprise the 0.94Ω resistance are located on the top of the circuit board.

The general arrangement is illustrated below:



For initial testing purposes, a very short length of #24 AWG bus bar wire may be inserted into the diode socket. The waveform generated by the instrument may then be observed at the “SIGNAL FROM MAINFRAME” pad shown above.

LENZ’S LAW AND INDUCTIVE VOLTAGE SPIKES

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

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

For this reason, the length of leads used to connect the load to the circuit board should be kept extremely short (< 0.5 cm).

ATTACHING AND DETACHING LOADS

To avoid damaging the loads connected to main outputs, the loads should only be connected to or removed from the instrument when the instrument is off. Do not connect loads when the instrument is on and the output amplitude is not zero. This can cause sparking.

START-UP CHECK-LIST FOR LOCAL CONTROL

1) Insert a very short section of #24 AWG bus bar wire between the anode and cathode pin sockets on the LZ1 circuit board.

2) Connect a cable from the SYNC OUT connector to the TRIG input of an oscilloscope. Set the oscilloscope to trigger externally.

3) Connect an oscilloscope probe to the signal side of the test load. On the oscilloscope, set the channel A vertical scale to 20 V/div, and the horizontal scale to 100 ns/div.

4) Turn on the instrument. The main menu will appear on the LCD.

5) To set the instrument to trigger from the internal clock at a PRF of 100 Hz:

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

- Press the CHANGE button. The frequency submenu will appear. Rotate the ADJUST knob until the frequency is set at 100 Hz.

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

- Press CHANGE to return to the main menu.

6) To set the delay to 100 ns:

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

- Press the CHANGE button. The delay submenu will appear. Rotate the ADJUST knob until the delay is set at 100 ns.

- Press CHANGE to return to the main menu.

7) To set the OUT pulse width to 400 ns:

- Press the MOVE button until the arrow pointer is pointing at the “PW” menu item.

- Press the CHANGE button. The pulse width submenu will appear. Rotate the ADJUST knob until the pulse width is set at 400 ns.

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

- Press CHANGE to return to the main menu.

8) At this point, nothing should appear on the oscilloscope.

9) To enable the output:

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

- Press the CHANGE button. The output submenu will appear.

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

- Press CHANGE to return to the main menu.

10) To change the OUT output amplitude:

- Press the MOVE button until the arrow pointer is pointing at the AMP menu item.

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

- Observe the oscilloscope. You should see 400 ns wide, 50V pulses on the probe connected to the main output.

- Press CHANGE to return to the main menu.

11) Try varying the pulse width, by repeating step (7). As you rotate the ADJUST knob, the pulse width on the oscilloscope will change. It should agree with the displayed value.

12) Compare the obtained results to those provided in the “PERFORMANCE CHECKSHEET” section of this manual.

13) This completes the operational check.

If additional assistance is required:

Tel: (613) 226-5772,
Fax: (613) 226-2802
Email: info@avtechpulse.com

MECHANICAL INFORMATION

TOP COVER REMOVAL

The top cover of the instrument may be removed by removing the four Phillips screws on the top panel. With these four screws removed, the top panel may be slid off by pulling it towards the rear.

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.

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 10 Hz         (sets the frequency to 10 Hz)
pulse:width 100 ns      (sets the pulse width to 100 ns)
pulse:delay 1 us        (sets the delay to 1 us)
output on               (turns on the output)
source:volt 50V         (sets the voltage amplitude to 50 Volts)
```

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)
source:volt 50V         (sets the voltage amplitude to 50 Volts)
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 100 ns      (sets the pulse width to 100 ns)
pulse:delay 1 us        (sets the delay to 1 us)
source:volt 50V         (sets the voltage amplitude to 50 Volts)
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
DIAGnostic:		
:AMPLitude		
:CALibration:	<numeric value>	[no query form]
LOCAL		
MEASure:		
:AMPLitude?		[query only]
OUTPut:		
:[STATe]	<boolean value>	
:PROTection		
:TRIPped?		[query only]
REMOTE		
[SOURce]:		
:FREQuency		
[:CW | FIXed]	<numeric value>	
[SOURce]:		
:VOLTage		
[:LEVel]		
[:IMMediate]		
[:AMPLitude]	<numeric value>	
:PROTection		
:TRIPped?		[query only]
[SOURce]:		
:PULSe		
:PERiod	<numeric value>	
:WIDTh	<numeric value>	
:DCYCle	<numeric value>	
:HOLD	WIDTh | DCYCle	
:DELay	<numeric value>	
:GATE		
:TYPE	ASYNC | SYNC	
:LEVel	HIgh | LOw	
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