



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-2A-C

0 TO 5 Amp, 1 ns RISE TIME,

2 to 50 ns PULSE WIDTH

20 kHz LASER DIODE DRIVER

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

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

TABLE OF CONTENTS

WARRANTY.....	2
TECHNICAL SUPPORT.....	2
TABLE OF CONTENTS.....	3
INTRODUCTION.....	5
SPECIFICATIONS.....	6
EUROPEAN REGULATORY NOTES.....	7
EC DECLARATION OF CONFORMITY.....	7
DIRECTIVE 2002/95/EC (RoHS).....	7
INSTALLATION.....	8
VISUAL CHECK.....	8
POWER RATINGS.....	8
CONNECTION TO THE POWER SUPPLY.....	8
ENVIRONMENTAL CONDITIONS.....	9
FUSES.....	10
AC FUSE REPLACEMENT.....	10
DC FUSE REPLACEMENT.....	11
FUSE RATINGS.....	11
FRONT PANEL CONTROLS.....	12
REAR PANEL CONTROLS.....	14
GENERAL INFORMATION.....	15
BASIC TEST ARRANGEMENT.....	15
OUTPUT MODULE.....	15
OFFSET (-OS OPTION).....	16
BASIC PULSE CONTROL.....	16
LENZ'S LAW AND INDUCTIVE VOLTAGE SPIKES.....	17
MECHANICAL INFORMATION.....	18
TOP COVER REMOVAL.....	18
ELECTROMAGNETIC INTERFERENCE.....	18
MAINTENANCE.....	19
REGULAR MAINTENANCE.....	19
CLEANING.....	19
PERFORMANCE CHECK SHEET.....	20

Manual Reference: T:\instructword\avo-2\AVO-2A-C,edition1.sxw.
Last modified January 18, 2005.
Copyright © 2005 Avtech ElectroSystems Ltd, All Rights Reserved.

INTRODUCTION

The AVO-2A-C is a high performance instrument capable of generating 0 to 5 A at repetition rates up to 20 kHz. The rise time is less than 1 ns. The AVO-2A-C includes an internal trigger source, but it can also be triggered by an external source. The AVO-2A-C consists of two parts, the mainframe and the output module. The mainframe is a voltage pulser, designed to operate into 50 Ohm loads. The output module contains a current-doubling transformer, which requires a load impedance of approximately 12.5 Ohms (e.g., a 10 Ohms resistor in series with a diode with 2.5 Ohms of parasitic resistance). The amplitude at the output of the output module (V_{OUT}) can vary from 0 to 62V, when operating into a 12.5 Ohm load, providing up to 5 A of current.

When driving a diode load in series with a resistor, the diode current is given by:

$$I_{DIODE} = (V_{OUT} - V_{DIODE}) / (R_{SERIES} + R_{DIODE})$$

where V_{DIODE} is the voltage drop across the diode, R_{DIODE} is the parasitic resistance of the diode, and R_{SERIES} is the resistance of the series resistor. $R_{SERIES} + R_{DIODE}$ should be equal to 12.5 Ohms.

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

SPECIFICATIONS

Model:	AVO-2A-C
Amplitude:	
"-P" units:	0 to +5 A (0 to +62 Volts into 12.5 Ohms)
"-N" units:	0 to -5 A (0 to -62 Volts into 12.5 Ohms)
"-PN" units:	0 to ± 5 A (0 to ± 62 Volts into 12.5 Ohms)
Pulse width:	2 to 50 ns
Rise time:	≤ 1 ns
Fall time:	≤ 2 ns
PRF:	1 Hz to 20 kHz
Output impedance:	$\approx 10\Omega$
Propagation delay:	≤ 200 ns (Ext trig in to pulse out)
Jitter:	± 100 ps $\pm 0.03\%$ of sync delay (Ext trig in to pulse out)
Trigger required:	External Mode: +5 Volt, 50 ns or wider (TTL)
Sync delay:	Sync out to pulse out: Variable 0 to 200 ns
Sync output:	+ 3 Volts, 200 ns, will drive 50 Ohm loads
Connectors:	Out: solder terminals, Trig: BNC, Sync: BNC, Gate: BNC
Power, AC:	100 - 240 Volts, 50 - 60 Hz
Dimensions:	Mainframe: 100 x 215 x 375 mm (3.9" x 8.5" x 14.8") Transformer Module: 23 x 28 x 38mm (0.9" x 1.1" x 1.5")
Chassis material:	anodized aluminum, with blue plastic trim
Mounting:	Any
Temperature range:	+5°C to +40°C

EUROPEAN REGULATORY NOTES

EC DECLARATION OF CONFORMITY

We

Avtech Electrosystems Ltd.
P.O. Box 5120, LCD Merivale
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



DIRECTIVE 2002/95/EC (RoHS)

This instrument is exempt from Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment. Specifically, Avtech instruments are considered "Monitoring and control instruments" (Category 9) as defined in Annex 1A of Directive 2002/96/EC. The Directive 2002/95/EC only applies to Directive 2002/96/EC categories 1-7 and 10, as stated in the "Article 2 - Scope" section of Directive 2002/95/EC.

INSTALLATION

VISUAL CHECK

After unpacking the instrument mainframe and the transformer module, examine to ensure that they have not been damaged in shipment. Visually inspect all connectors, knobs, and handles. Confirm that a power cord and an instrumentation manual (this manual), 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 cord used to connect the instrument to the mains supply must provide an earth connection. (The supplied cord does this.) The table below describes the power cord that is supplied with this instrument, depending on the destination region:

Destination Region	Description	Volex (http://www.volex.com) Part Number	Newark (http://www.newark.com) Stock Number
Continental Europe	European CEE 7/7 "Schuko" 230V, 50Hz	17850-C3-326	44F1841
United Kingdom	BS 1363, 230V, 50Hz	17962-C3-10	84F1025
Switzerland	SEV 1011, 230V, 50Hz	2102H-C3-10	93F2452
Israel	SI 32, 220V, 50Hz	2115H-C3-10	04F1115
North America, and all other areas	NEMA 5-15, 120V, 60 Hz	17250-B1-10	36F1255

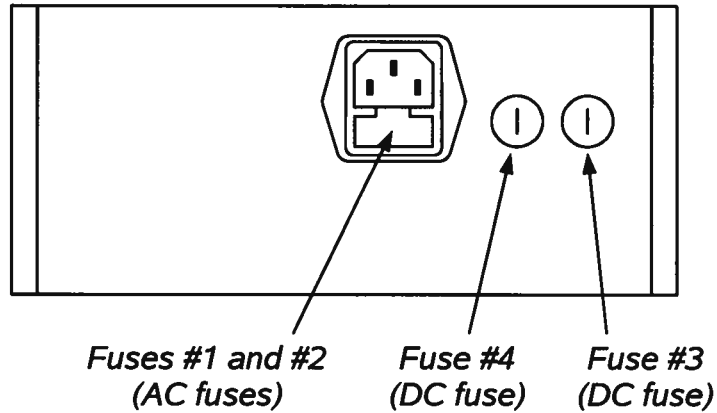
ENVIRONMENTAL CONDITIONS

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.

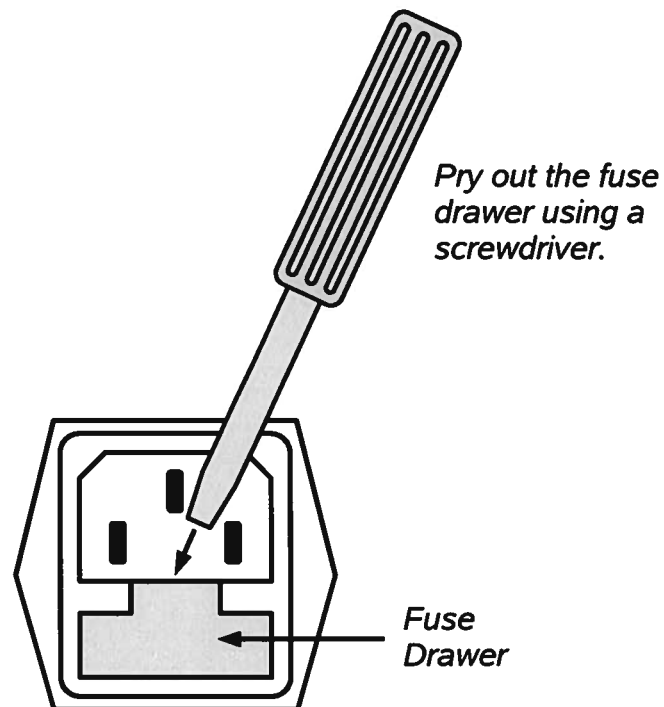
FUSES

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

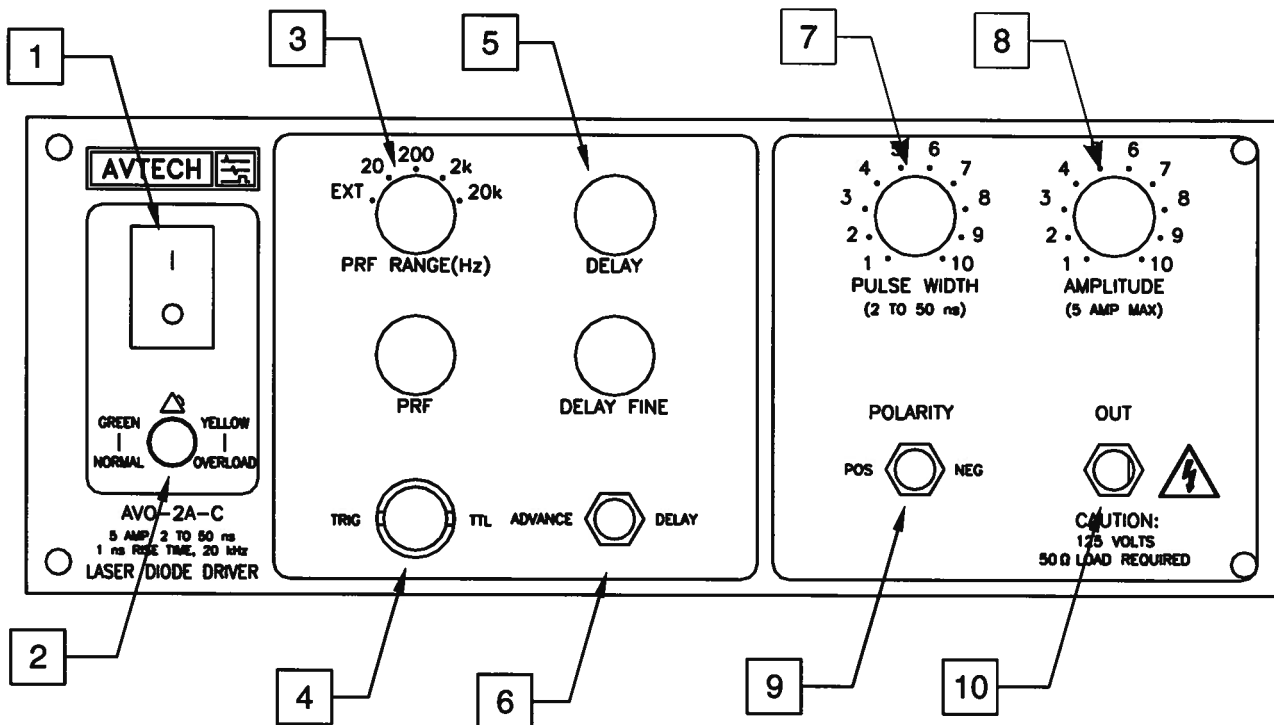
The following table lists the required fuses:

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	0.8A, 250V, Time-Delay	5×20 mm	1950800000	WK5046-ND
#4 (DC)	N/A	0.5A, 250V, Time-Delay	5×20 mm	1950500000	WK5041-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 may flash yellow briefly at start-up. This is not a cause for concern.

- 3) **PRF Range Switch.** This switch sets the pulse repetition frequency (PRF) range of the internal oscillator. The marked value of each position is the upper limit of the 10:1 range, approximately. The vernier dial directly below the switch varies the PRF within the set range.


If this switch is set to the "EXT" position, the instrument is triggered by a signal

applied to the TRIG connector, rather than by the internal oscillator.

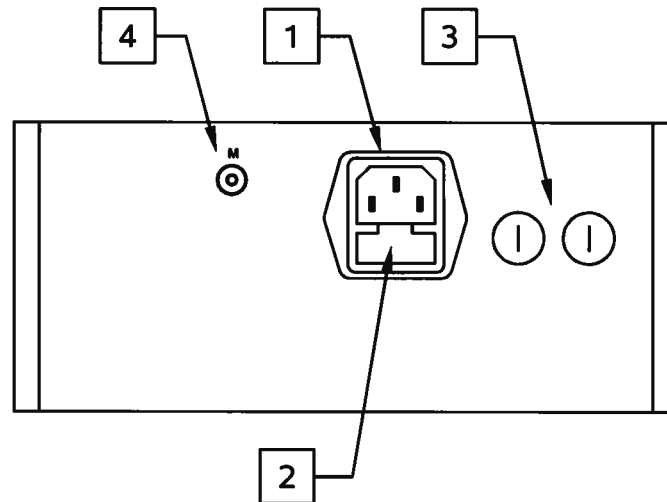
- 4) **TRIG Connector**. When the PRF Range Switch is set to "EXT", the instrument is triggered by a TTL pulse applied to this connector. The pulse must be at least 50 ns wide.

When the PRF Range Switch is set to one of the four internal oscillator ranges, this connector is an output, which supplies a 2V, 200 ns wide pulse for each trigger event. This output may be used to trigger oscilloscopes or other equipment.

- 5) **Delay Controls**. When the PRF Range Switch is set to one of the four internal oscillator ranges, the main output is advanced or delayed relative to the TRIG output pulse (item 3). The delay is variable up to 200 ns, approximately, using the DELAY and DELAY FINE dials.
- 6) **Advance/Delay Switch**. When the PRF Range Switch is set to one of the four internal oscillator ranges, this switch determines whether the TRIG output precedes the main output (ADVANCE mode), or whether the TRIG output occur after the main output (DELAY mode).
- 7) **Pulse Width Control**. This dial controls the pulse width.
- 8) **Amplitude Control**. This dial controls the pulse amplitude.
- 9) **Polarity Switch**. (Optional. Present on -PN units only.) This switch sets the output polarity.
- 10) **OUT Connector**. This SMA connector provides the output to the AVO-2A-T module.

 **Caution:** Voltages as high as $\pm 125\text{V}$ 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.

REAR PANEL CONTROLS

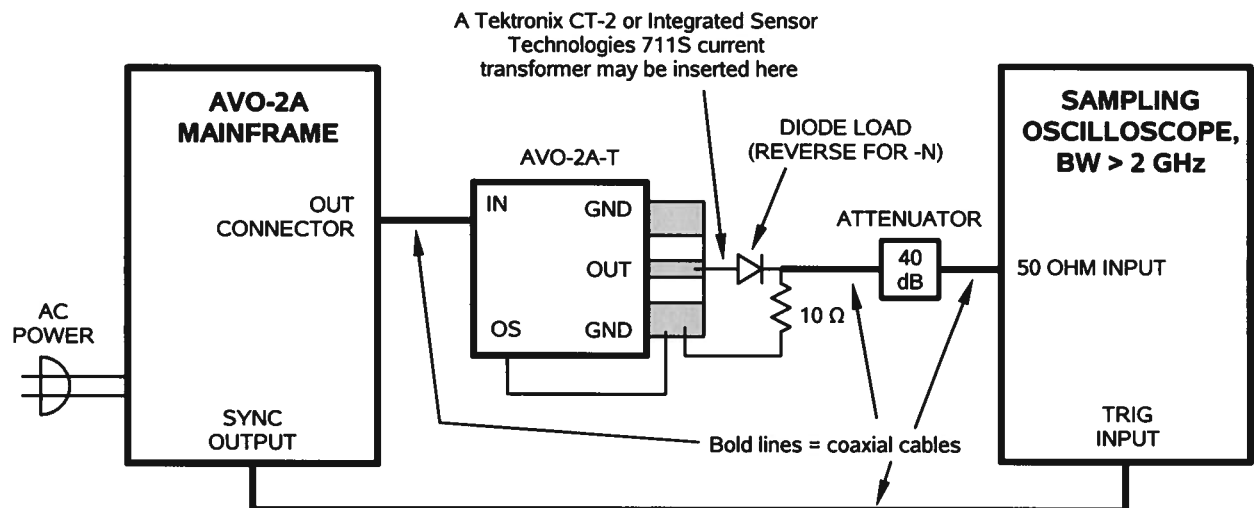


- 1) AC POWER INPUT. An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
- 2) AC FUSE DRAWER. The two fuses that protect the AC input 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) Monitor Output. (Optional. Present on -M units only.) The back panel monitor output port provides an output voltage to 50 Ohms which is approximately one-tenth of the output voltage of the mainframe OUT port, and thus one-fifth of the output voltage of the output module.

GENERAL INFORMATION

BASIC TEST ARRANGEMENT

The AVO-2A-C should be tested with a sampling oscilloscope with a bandwidth of at least 2 GHz to properly observe the high-speed waveform. A typical test arrangement is shown below:



OUTPUT MODULE

The AVO-2A-C consists of two parts, the mainframe and the output module. The mainframe is a voltage pulser, designed to operate into 50 Ohm loads. The output module contains a current-doubling transformer, which requires a load impedance of approximately 12.5 Ohms (e.g., a 10 Ohms resistor in series with a diode with 2.5 Ohms of parasitic resistance). The amplitude at the output of the output module (V_{OUT}) can vary from 0 to 62V, when operating into a 12.5 Ohm load, providing up to 5A of current.

When driving a diode load in series with a resistor, the diode current is given by:

$$I_{DIODE} = (V_{OUT} - V_{DIODE}) / (R_{SERIES} + R_{DIODE})$$

where V_{DIODE} is the voltage drop across the diode, R_{DIODE} is the parasitic resistance of the diode, and R_{SERIES} is the resistance of the series resistor. $R_{SERIES} + R_{DIODE}$ should be equal to 12.5 Ohms.

Aside from providing the required termination, the added series resistance may also be used to monitor the output current waveform. However, better results (i.e., with less distortion) are normally obtained if a current transformer, such as a Tektronix (<http://www.tek.com>) CT-2 or an Integrated Sensor Technologies (<http://www.isensortech.com>) model 711S, is used to measure the current.

The AVO-2A-T module connects to the AVO-2A mainframe via a 2-foot long miniature coaxial cable. 1/4 watt carbon film or carbon composition resistors may be used for R_{SERIES} but all leads must be as short as possible (< 0.1 inch). Solder leads directly to the GND and OUT terminals.

CAUTION: Use moderate heat when soldering to the OUT terminal.

OFFSET (-OS OPTION)

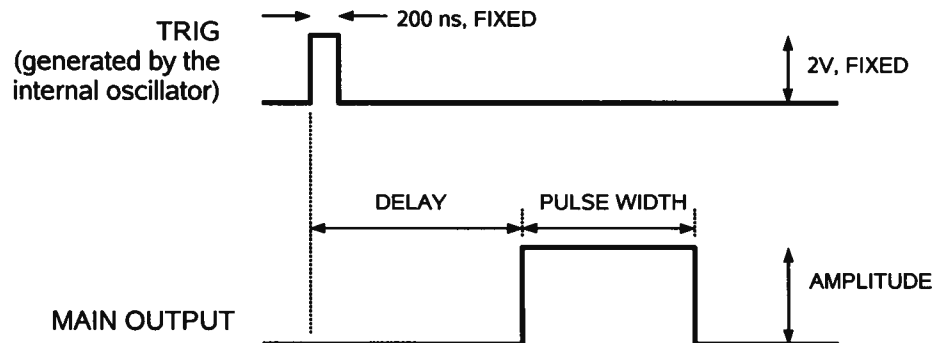
Units with -OS option have an "OS" terminal on the output module. A DC offset may be applied to this solder terminal. The DC offset will appear on the output. When this feature is not used, the OS input should be connected to ground. This is especially important when driving loads containing a diode. The current through the offset input must not exceed 250 mA.

BASIC PULSE CONTROL

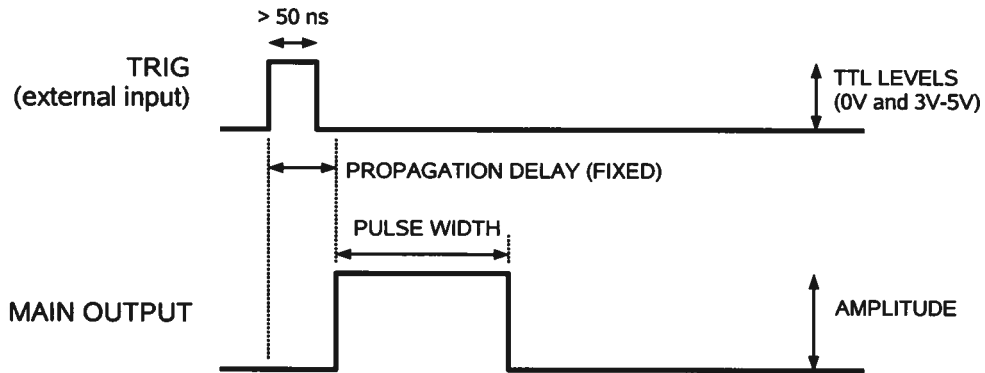
This instrument can be triggered by its own internal clock or by an external TTL trigger signal. When triggered internally, two mainframe output channels respond to the trigger: OUT and SYNC.

- OUT. This is the main output.
- TRIG. The TRIG pulse is a fixed-width TTL-level reference pulse used to trigger oscilloscopes or other measurement systems.

These pulses are illustrated below:



When triggered externally, the TRIG connector acts as an input. The delay controls do not function in this mode. Figure B illustrates this mode:



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).

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: $V_{SPIKE} = L di_{LOAD} / dt$.

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.

ELECTROMAGNETIC INTERFERENCE

To prevent electromagnetic interference with other equipment, all used outputs should be connected to shielded 50 Ω loads using shielded 50 Ω coaxial cables. Unused outputs should be terminated with shielded 50 Ω BNC terminators or with shielded BNC 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.

Jan 18/05