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SINCE 1975

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## INSTRUCTIONS

MODEL AVMR-2-C

0 TO 20 VOLTS, 10 MHz

HIGH SPEED PULSE GENERATOR

WITH 3 ns RISE & FALL TIMES

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

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Manual Reference: /fileserver1/officefiles/instructword/avmr/avmr-2-c,edition1.sxw.  
Last modified February 29, 2024.  
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## INTRODUCTION

The AVMR-2-C is a high performance instrument capable of generating up to 20V into 50 $\Omega$  loads at repetition rates up to 10 MHz. The output pulse width is variable from 20 to 200 ns, and the sync delay is variable up to 200 ns. The rise fall times are less than 3 ns. The maximum duty cycle is 20%.

Instruments with the "-P" model suffix can generate 0 to +20V, whereas instruments with the "-N" model suffix can generate 0 to -20V. Instruments with the "-PN" suffix can generate both polarities.

The output is designed to drive 50 $\Omega$  loads. (A 50 $\Omega$  load is required for proper operation.) The output is AC-coupled.

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

## AVAILABLE OPTIONS

This instrument is available with several options:

"-OT" Option: this option adds an internally-generated 0 to  $\pm 5$ V DC offset to the main output.

"-EO" Option: the DC offset can be controlled by an externally generated 0 to +10V analog control voltage.

"-EA" Option: the amplitude can be controlled by an externally generated 0 to +10V analog control voltage.

"-EW" Option: the pulse width can be controlled by an externally generated 0 to +10V analog control voltage.

"-M" Option: a monitor output is provided.

## SPECIFICATIONS

Model:	AVMR-2-C <sup>1</sup>
Amplitude <sup>3,4</sup> : (50 Ohm load)	Variable to 20 Volts
Pulse width <sup>3</sup> :	20 to 200 ns
PRF:	0 to 10 MHz
Duty cycle:	20%
Rise and fall times: (20%-80%)	3 ns fixed (standard), or 300ps/3ns switchable (-TRF option <sup>5</sup> )
Polarity <sup>6</sup> :	Positive or negative or both (specify)
Propagation delay:	< 150 ns. Ext trig in to pulse out.
Jitter:	± 15 ps
DC offset or bias insertion <sup>3,7</sup> :	Apply required DC offset to back panel solder terminals (± 50 V, 250 mA max)
Trigger required:	ext trig mode: + 5 Volts, 10 ns or wider (TTL)
Sync delay and output:	Sync out to pulse out delay: variable 0 to 200 ns. Sync output: +2V, 200 ns, will drive 50 Ohms.
Monitor output option <sup>8</sup> :	Provides a 20 dB attenuated coincident replica of main output
Connectors:	Out, Monitor: SMA. Trig: BNC
Power requirements:	100 - 240 Volts, 50-60 Hz
Dimensions: (H x W x D)	100 mm x 215 mm x 375 mm (3.9" x 8.5" x 14.8")
Chassis material:	cast aluminum frame & handles, blue vinyl on aluminum cover plates
Temperature range:	+5°C to +40°C

- 1) -C suffix indicates stand-alone lab instrument with internal clock and line powering. No suffix indicates miniature module requiring DC power and external trigger. (See page 112 for additional details of the basic instrument formats).
- 2) -B suffix indicates IEEE-488.2 GPIB and RS-232 control of amplitude, pulse width, PRF and delay (See page 8).
- 3) For electronic control (0 to +10V) of amplitude, pulse width, or DC offset, suffix model number with -EA or -EW or -EO. Electronic control units also include standard front-panel controls.
- 4) For operation at amplitudes of less than 10% of full-scale, best results will be obtained
- 5) by setting the amplitude near full-scale and using external attenuators on the output.
- 6) For switchable rise/fall time option suffix the model number with -TRF. Available only on -C units and modules.
- 7) Indicate desired polarity by suffixing model number with -P or -N (i.e. positive or negative) or -P-PN or -N-PN for dual polarity option where the suffix preceding -PN indicates the polarity at the mainframe output. (-PN available only for -B & -C units).
- 8) For internally generated DC offset option (0 to ± 5V, one-turn control) add the suffix -OT to model number. -OT and -EO options not available on modules.
- 9) For monitor option add suffix -M (not available on modules).

EC DECLARATION OF CONFORMITY

We

Avtech Electrosystems Ltd.  
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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



## 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 cable used to connect the instrument to the mains supply must provide an earth connection. (The supplied cable does this.)

### ENVIRONMENTAL CONDITIONS

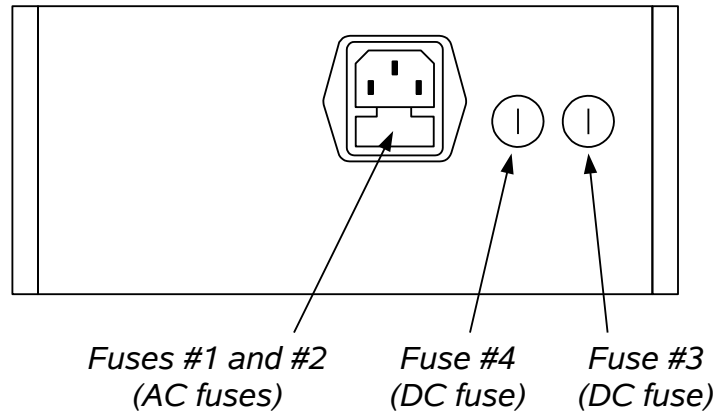
This instrument is intended for use under the following conditions:

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



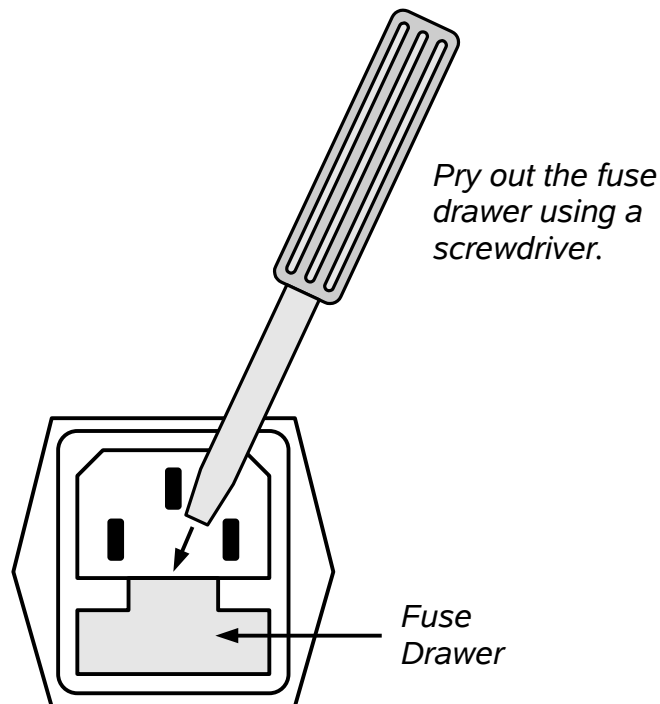
## FUSES

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

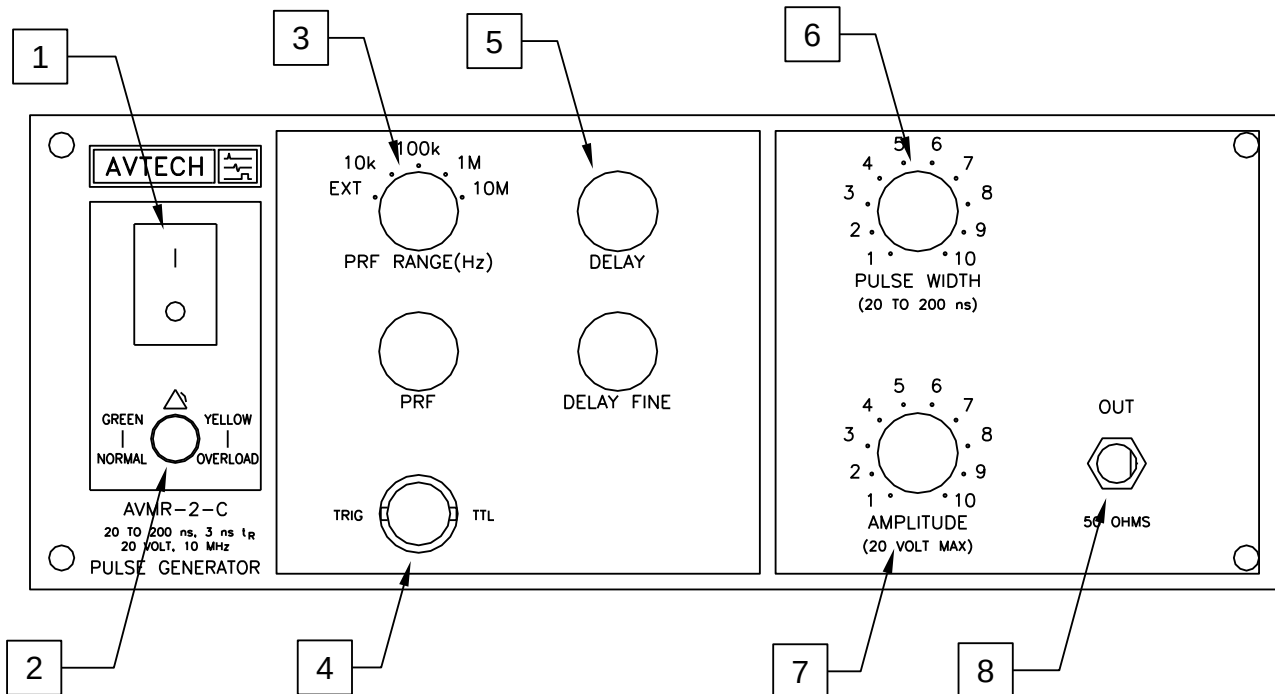
The following table lists the required fuses:

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.

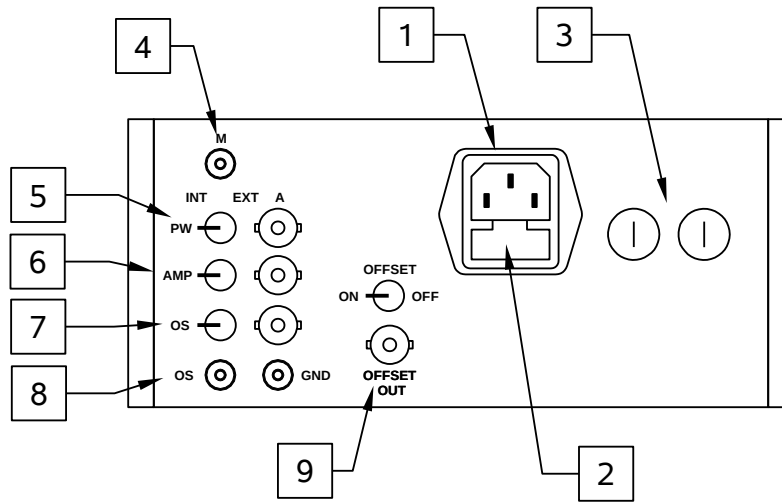
- 4) TRIG Connector. When the PRF Range Switch is set to one of the four internal oscillator ranges, this connector is an output, which supplies a 2V, 200 ns wide pulse for each trigger event. This output may be used to trigger oscilloscopes or other equipment.

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. 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. For systems using SMA connectors, the PE6026 SMA feed-thru 50 Ohm terminator is suggested.

- 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 500 ns, approximately, using the DELAY and DELAY FINE dials.
- 6) Pulse Width Control. This dial controls the pulse width.
- 7) Amplitude Control. This dial controls the pulse amplitude.
- 8) OUT Connector. This connector provides the main output signal, into load impedances of 50 $\Omega$ . (This output *requires* a 50 $\Omega$  load to function properly).

## REAR PANEL CONTROLS



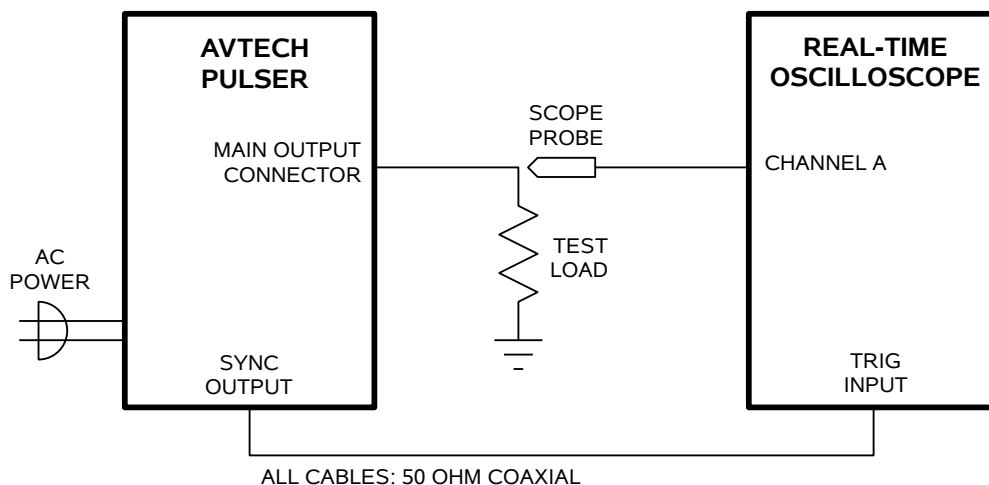
1. AC POWER INPUT. An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
2. AC FUSE DRAWER. The two fuses that protect the AC input are 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, -M units only). Provides an attenuated ( $\div 10$ ) coincident replica (to 50 Ohms) of the main output.
5. PW INT/EXT SWITCH AND CONNECTOR (Optional, -EW units only). To control the pulse width of the output with an external DC voltage, set the two-position switch to the EXT position and apply 0 to +10V to the BNC Connector ( $R_{IN} \geq 10 \text{ k}\Omega$ ). When this switch is in the “INT” position, the pulse width is controlled by the front-panel controls.
6. AMP INT/EXT SWITCH AND CONNECTOR (Optional, -EA units only). To control the amplitude of the output with an external DC voltage, set the two-position switch to the EXT position and apply 0 to +10V to the BNC Connector ( $R_{IN} \geq 10 \text{ k}\Omega$ ). When this switch is in the “INT” position, the amplitude is controlled by the front-panel controls.
7. OS INT/EXT SWITCH AND CONNECTOR (Optional, -EO units only). To control the offset of the output with an external DC voltage, set the two-position switch to the EXT position and apply 0 to +10V to the BNC Connector ( $R_{IN} \geq 10 \text{ k}\Omega$ ). When this switch is in the “INT” position, the offset is controlled by the front-panel controls.

8. OS INPUT (For units without -OT or -EO options). To add a DC offset the output pulse, connect a DC power supply set to the desired offset value to these terminals. The maximum allowable DC offset voltage is  $\pm 50$  Volts, and the maximum DC current is 250 mA. When not used, this input should be connected to the adjacent ground terminal.
9. OFFSET ON/OFF SWITCH & OUTPUT (Optional, -EO and -OT units only). This switch enables the offset feature when it is set to "ON". When it is set to "OFF", no offset is added to the output. The internally generated offset is available at the "OFFSET OUT" BNC connector, for monitoring purposes.

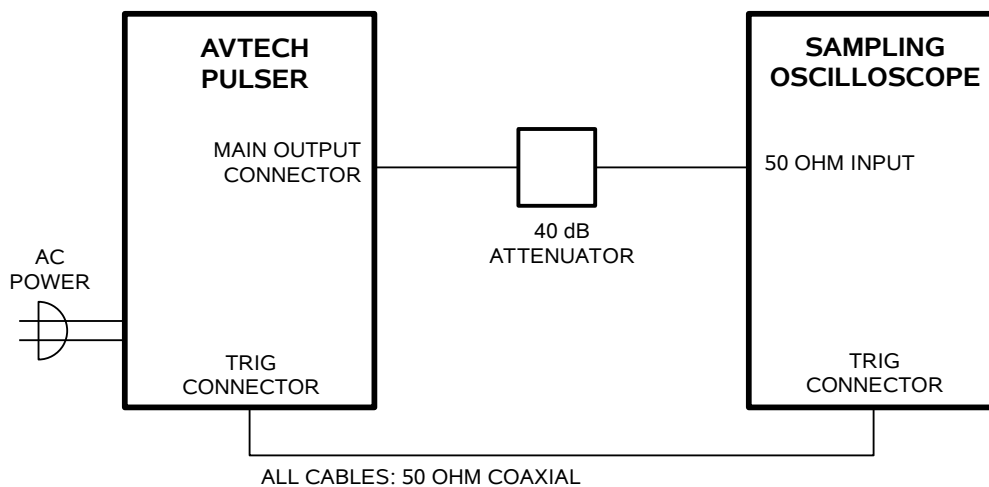
## GENERAL INFORMATION

### BASIC TEST ARRANGEMENT

The AVMR-2-C should be tested with an oscilloscope with a bandwidth of at least 300 MHz to properly observe the high-speed waveform. A typical test arrangement is shown below using a real-time oscilloscope:



A high-speed sampling oscilloscope can also be used:



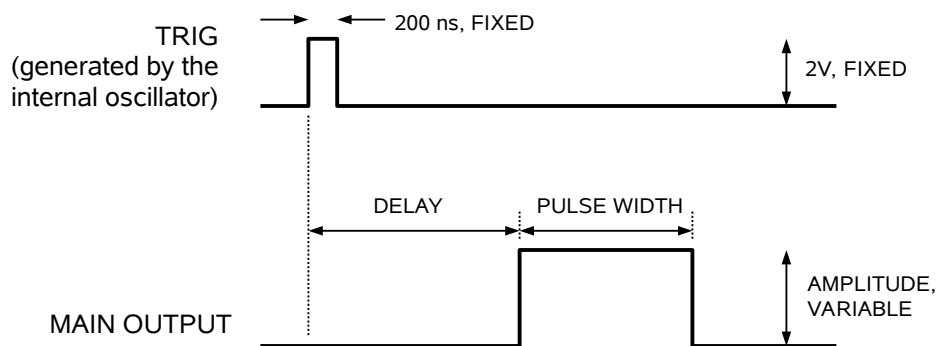
If a sampling oscilloscope is used, attenuators are required to prevent damage to the sampling oscilloscope. A 40 dB attenuator with sufficient voltage rating should be used on the main output. Factory tests are conducted using several Midwest Microwave 10 dB and 20 dB attenuators (models ATT-0444-10-SMA-02 and ATT-0444-20-SMA-02, respectively) connected in series.

## BASIC PULSE CONTROL

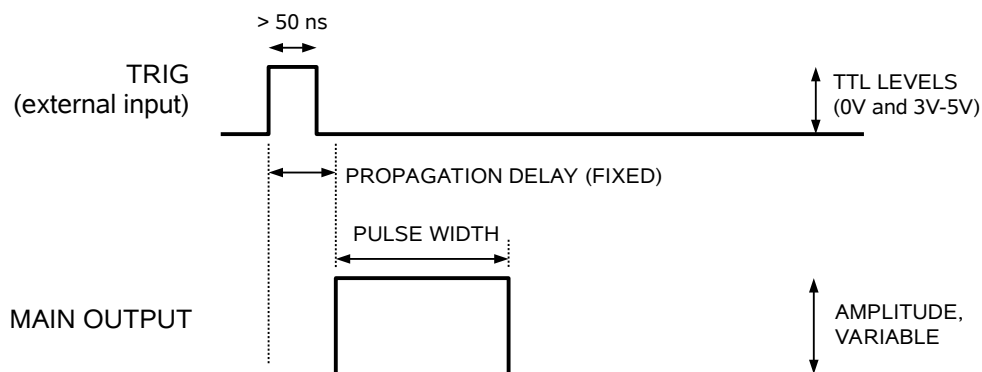
This instrument can be triggered by its own internal clock or by an external TTL trigger signal. When triggered internally, two mainframe output channels respond to the trigger: OUT and SYNC.

- OUT. This is the main output. The maximum output voltage is 20V.
- TRIG. The TRIG pulse is a fixed-width TTL-level reference pulse used to trigger oscilloscopes or other measurement systems.

The TRIG output precedes the main output. These pulses are illustrated below:



When triggered externally, the TRIG connector acts as an input. The delay controls do not function in this mode. This illustrated below:





## MINIMIZING WAVEFORM DISTORTIONS

### USE 50 OHM TRANSMISSION LINES AND LOADS

Connect the load to the pulse generator with 50 $\Omega$  transmission lines (e.g. RG-58 or RG-174 cable).

This instrument requires a 50 $\Omega$  load for proper operation. It will not properly drive a high-impedance load. The output stage will be damaged if it is operated into an open circuit (or any other high impedance). Failures due to improper output loading are not covered by the warranty.

### USE LOW-INDUCTANCE LOADS

Lenz's Law predicts that for an inductive voltage spike will be generated when the current through an inductance changes. Specifically,  $V_{\text{SPIKE}} = L \times dI_{\text{LOAD}}/dt$ , where L is the inductance,  $I_{\text{LOAD}}$  is the load current change, and t is time. For this reason, it is important to keep any parasitic in the load low. This means keeping wiring short, and using low inductance components. In particular, wire-wound resistors should be avoided.

## PREVENTING DAMAGE

The AVMR-2-C may fail if triggered at a PRF greater than 10 Mhz, or if the duty cycle exceeds 20%.

This unit is designed to operate into a load impedance of 50 Ohms and the output stage will be damaged if it is operated into an open circuit (or any other high impedance). Failures due to improper output loading are not covered by the warranty.

The lifetime of the switching elements in the pulse generator module is proportional to the running time of the instrument. For this reason the prime power to the instrument should be turned off when the instrument is not in use.

## 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 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.

PERFORMANCE CHECK SHEET