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NANOSECOND WAVEFORM ELECTRONICS  
SINCE 1975

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## INSTRUCTIONS

MODEL AVO-9C-C-N-EA-TR-MJLB

HIGH PERFORMANCE

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

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E-mail: [info@avtechpulse.com](mailto:info@avtechpulse.com)

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

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Manual Reference: /files/server1/officefiles/instructword/avo-9/AVO-9C-C-N-EA-TR-MJLB,edition1.sxw.  
Last modified February 29, 2024.  
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## INTRODUCTION

The AVO-9C-C-N-EA-TR-MJLB is a high performance instrument capable of generating up to 100 mA into 50 $\Omega$  loads, or loads consisting of 50 $\Omega$  in series with a diode, at repetition rates up to 25 MHz. The maximum output voltage is -8V, and the maximum permitted diode voltage is -3V, yielding a maximum current of 100 mA.

The output pulse width is variable from 0.5 to 10 ns. The rise and fall times are less than 300 ps.

This instrument is intended to be used with the NTT Electronics NLK5C5E2KA laser diode. This diode is connected to the instrument mainframe using a supplied 24-inch length of RG-316 cabling with SMA connectors. (According the "Type K" connector datasheet at [http://www.anritsu.co.jp/Products/pdf\\_e/B04E\\_K.PDF](http://www.anritsu.co.jp/Products/pdf_e/B04E_K.PDF): "The K Connector interfaces electrically and mechanically with 3.5 mm connectors, including SMA and 3.5 mm without degradation in performance.")

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

## SPECIFICATIONS

Model:	AVO-9C-C-N-EA-TR-MJLB
Amplitude:	0 to -100 mA, to 50Ω, or 50Ω in series with a diode
Allowed diode forward voltage drop range:	0 to 3V
Pulse width:	0.5 to 10 ns
PRF:	0 to 25 MHz
Rise & fall time:	300 ps to 2 ns, adjustable using a five-position switch
Propagation delay:	≤ 30 ns (Ext trig in to pulse out)
Jitter:	± 15 ps (Ext trig in to pulse out)
Sync delay:	Variable 0 to 200 ns (sync out to pulse out)
Sync output:	+0.5 Volts, 20 ns (to 50 Ohms)
Trigger required:	+ 5 V (TTL), ≥ 50 ns (ext trig mode)
Connectors:           OUT:	SMA
TRIG / SYNC:	BNC
Power requirements:	100 - 240 Volts, 50 - 60 Hz
Dimensions (H x W x D):	100 mm x 430 mm x 375 mm   (3.9" x 7.5" x 14.8")
Chassis material:	anodized aluminum, with blue plastic trim
Temperature range:	+5°C to +40°C

ORIGINAL QUOTATION

Date: Tue, 24 Aug 2004 16:20:11 -0400

To: Jae-Pil Jeon  
Marketing Manager  
MJL Crystek Inc.  
jpjeon@mjlinc.com

Jae-Pil,

Following your recent inquiry, I am pleased to quote as follows:

Quote number: 12227

Model number: AVO-9C-C-N-EA-TR-MJLB

Description: Laser Diode Driver (Pulsed Voltage)

Polarity: negative

-MJLB option: The NTT Electronics NLK5C5E2KA laser diode will be connected to the instrument mainframe using a supplied 24-inch length of RG-316 cabling with SMA connectors. (According the "Type K" connector datasheet at [http://www.anritsu.co.jp/Products/pdf\\_e/B04E\\_K.PDF](http://www.anritsu.co.jp/Products/pdf_e/B04E_K.PDF): "The K Connector interfaces electrically and mechanically with 3.5 mm connectors, including SMA and 3.5 mm without degradation in performance.") All necessary drawings have been received.

Datasheet & pricing: <http://www.avtechpulse.com/laser/avo-9c>

Price: \$ \_\_\_\_ US each, Ex-works, Ottawa, Canada. Before discount.

Estimated delivery: 60-75 days after receipt of order (excluding export permit\* delays).

\*Export Permit: These instruments are very high performance pulse generators, which are considered to be "Nuclear-Related Dual-Use Goods" under government regulations. As such, an "End Use Statement" must be completed when ordering. The necessary form is attached (in Microsoft Word format). We will use the information in the completed form to apply for an export license from the Canadian government, which will take 1 to 6 weeks to obtain. We cannot ship your order without the license. Please return the completed form to us by fax.

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

Regards,  
Dr. Michael J. Chudobiak  
Chief Engineer

--- Avtech Electrosystems Ltd. ----- since 1975 ---

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USA 13669-0265	<a href="http://www.avtechpulse.com/">http://www.avtechpulse.com/</a>	Canada K2C 3H4

Nanosecond Waveform Generators  
for general purpose, R&D and OEM applications

Pulse Generators - Laser Diode Drivers - Pulse Amplifiers  
Impulse Generators - Current Pulsers - Delay Generators - Splitters

Function Generators - Monocycle Generators - Frequency Dividers + more!

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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



## 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 ( <a href="http://www.volex.com">http://www.volex.com</a> ) Part Number	Newark ( <a href="http://www.newark.com">http://www.newark.com</a> ) 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

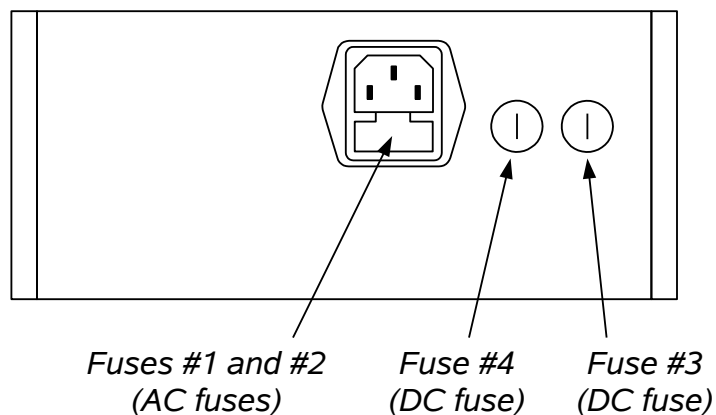
## ENVIRONMENTAL CONDITIONS

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  $\pm 10$  % of the nominal voltage;
6. no pollution or only dry, non-conductive pollution.

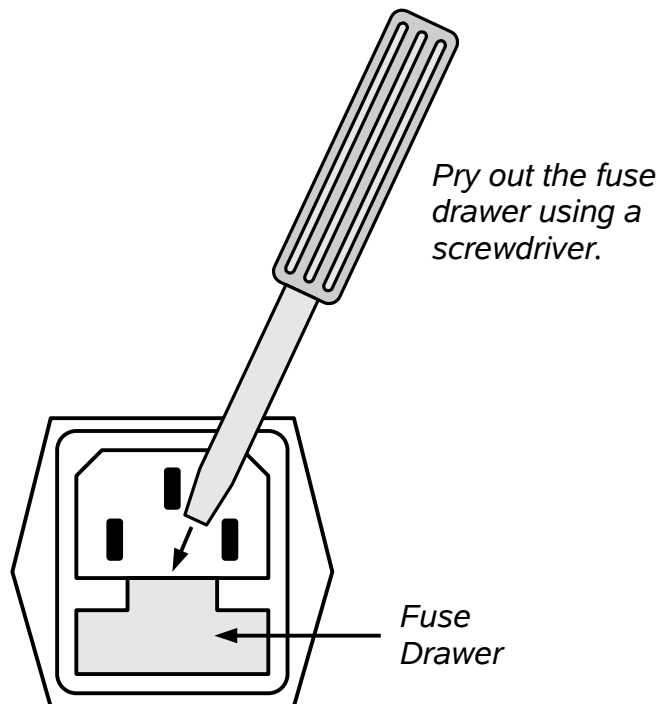
## FUSES

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

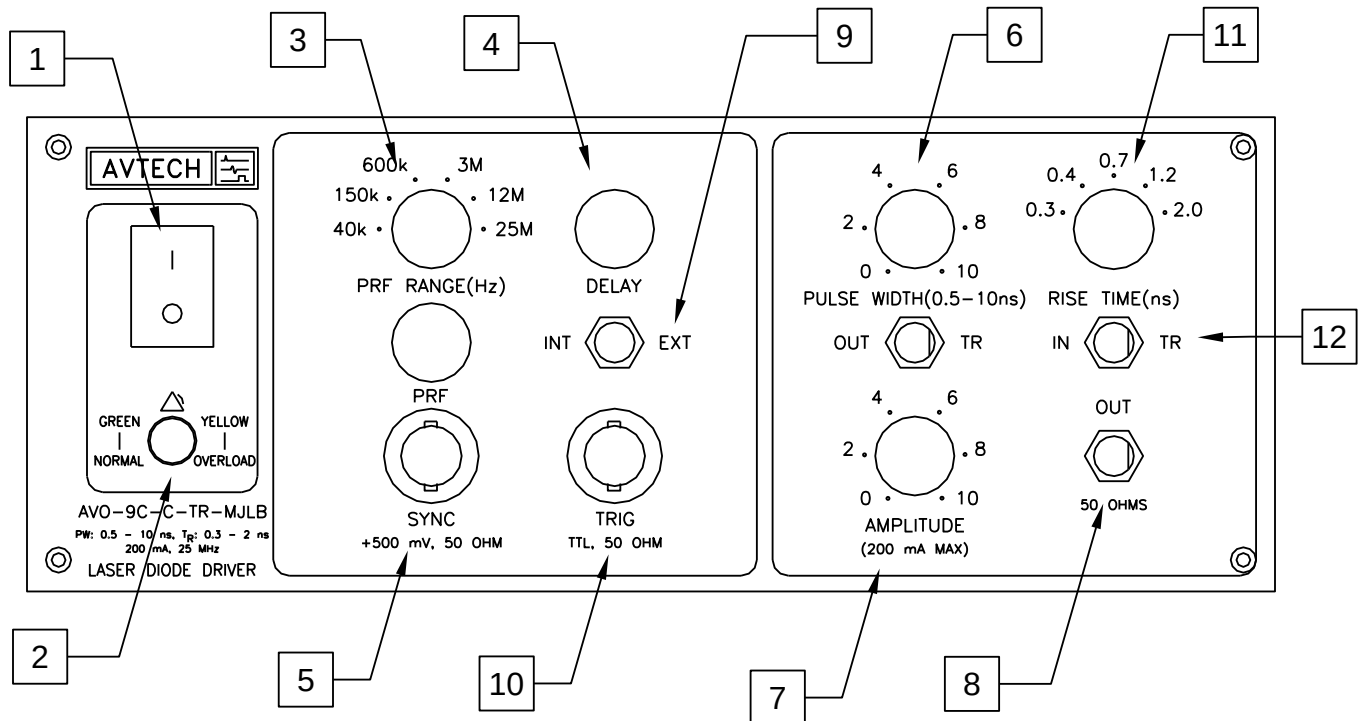
The following table lists the required fuses:

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	0.8A, 250V, Time-Delay	5×20 mm	1950800000	WK5046-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 and Vernier. This switch sets the pulse repetition frequency (PRF) range of the internal oscillator. The internal oscillator triggers the instrument when the INT/EXT switch is in the "INT" position. The marked value of each position is the upper limit range, approximately. The vernier dial directly below the switch varies the PRF within the set range.

4. DELAY Control. Controls the relative delay between the reference output pulse provided at the SYNC output (5) and the main output (8). This delay is variable over the range of 0 to 200 ns, approximately.
5. SYNC Output. This output precedes the main output (8) and is used to trigger the sampling scope time base. The output is a 500 mV, 20 ns (approx) pulse capable of driving a 50 Ohm load.
6. Pulse Width Control. This dial controls the pulse width.
7. Amplitude Control. This dial controls the pulse amplitude.
8. OUT Connector. This is the main output. (The total load impedance must be 50 Ohms for proper operation).

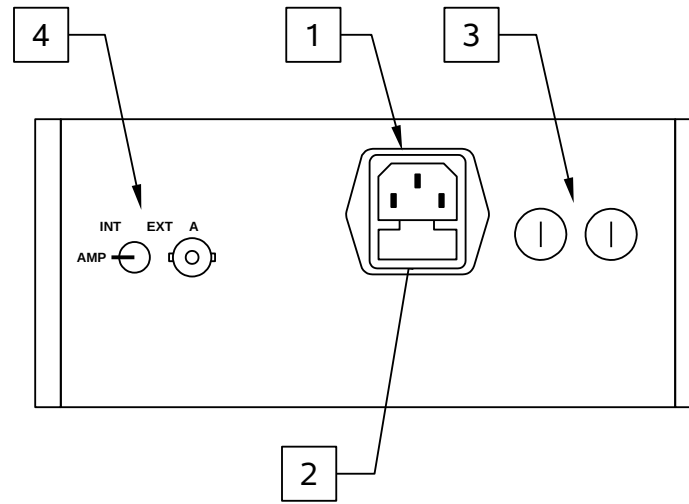
If the -TR variable rise time option is installed, and the user wishes to enable this feature, this output must be connected to the "IN TR" connector using the supplied 6" / 15 cm length of coaxial cable. The actual output signal will then be present on the "OUT TR" connector.

9. EXT-INT Control. With this toggle switch in the INT position, the PRF of the unit is controlled via an internal clock, which in turn is controlled by the PRF controls. With the toggle switch in the EXT position, the AVM unit requires a 15 ns (or wider) TTL level pulse applied at the TRIG input in order to trigger the output stages. In addition, in this mode, the scope time base must be triggered by the external trigger source.
10. TRIG Input. The external trigger signal is applied at this input when the EXT-INT toggle switch is in the EXT position.
11. TR Rise/Fall Time Control. (Optional feature. Present on units with the -TR option only.) This five-position switch controls the rise time of the signal on the "OUT TR" connector. (For this feature to be enabled, the "OUT" connector must be connected to the "IN TR" connector using the supplied 6" / 15 cm length of coaxial cable. The actual output signal will then be present on the "OUT TR" connector.)

The labelled values on the switch show the approximate rise times that will be obtained. The fall times will be slightly longer.

12. IN / OUT TR Connectors. (Optional feature. Present on units with the -TR option only.) If the -TR variable rise time option is installed, and the user wishes to enable this feature, the "OUT" connector must be connected to the "IN TR" connector using the supplied 6" / 15 cm length of coaxial cable. The actual output signal will then be present on the "OUT TR" connector.

## REAR PANEL CONTROLS



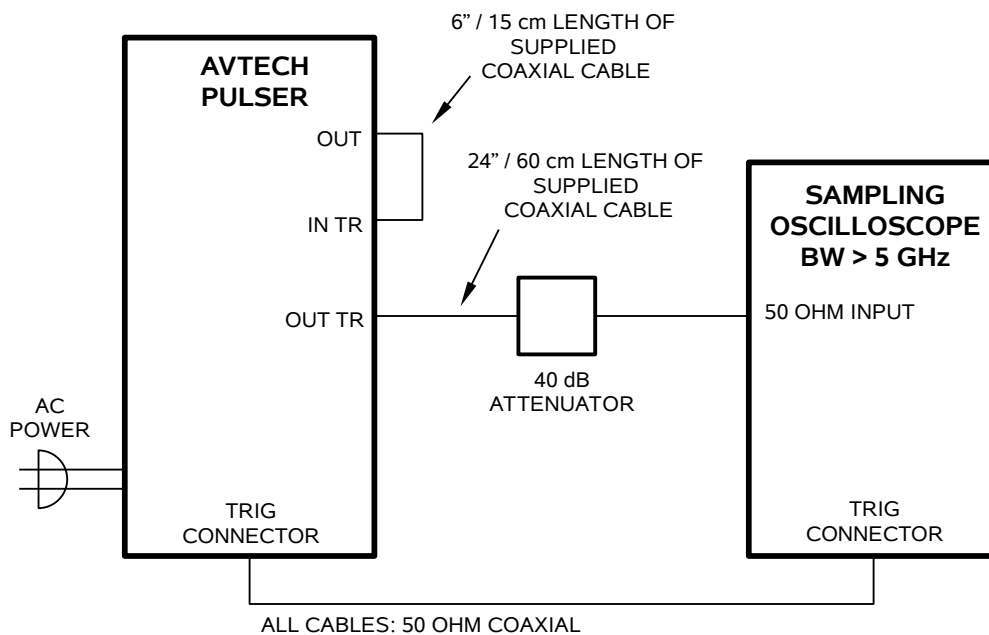
1. AC POWER INPUT. An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
2. AC FUSE DRAWER. The two fuses that protect the AC input are 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. 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.



## GENERAL INFORMATION

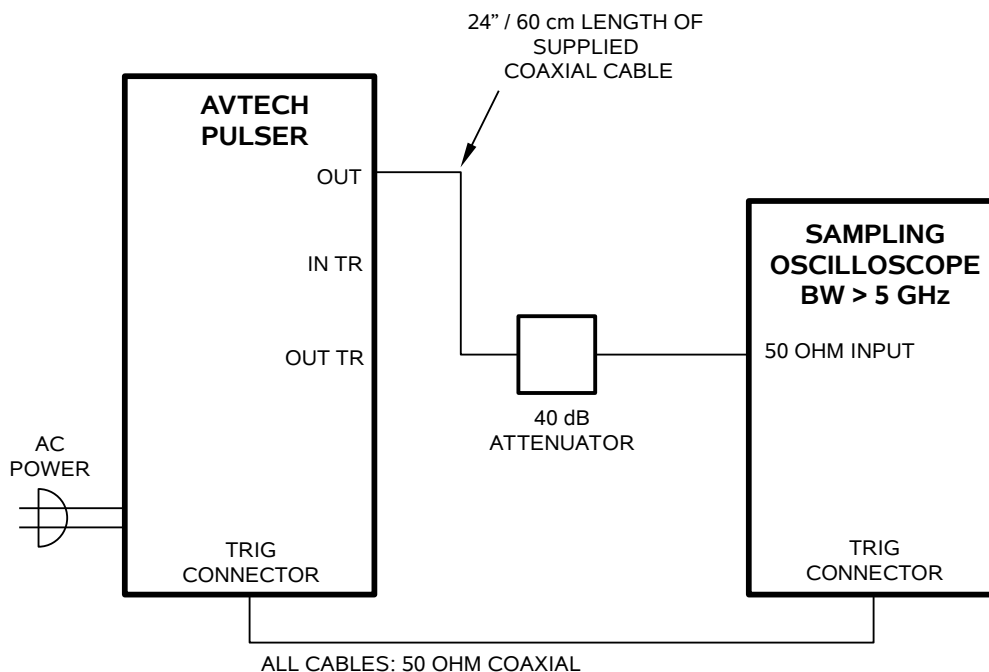
### BASIC TEST ARRANGEMENT - 50Ω OHM LOAD

The AVO-9C-C-N-EA-TR-MJLB should be tested with a sampling oscilloscope with a bandwidth of at least 5 GHz to properly observe the high-speed waveform. A basic test arrangement is shown below:



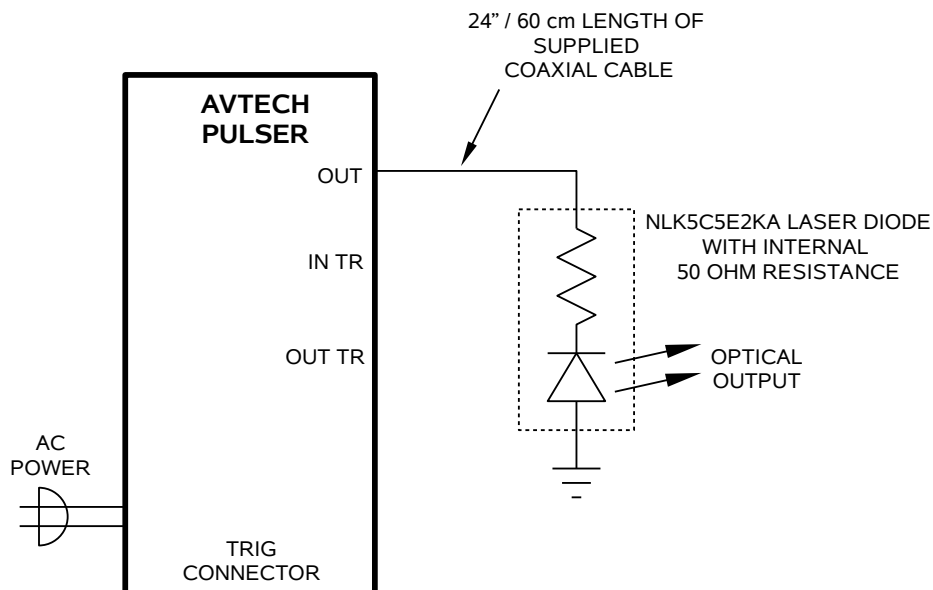
The attenuators are required to prevent damage to the sampling oscilloscope. A 40 dB attenuator with sufficient voltage rating should be used on the main output.

The arrangement shown above allows the switchable rise/fall time feature to be used. If this feature is not needed, or the fastest possible output is desired, the instrument may be connected in a simpler fashion:



### BASIC TEST ARRANGEMENT - WITH A DIODE

The diagram below shows how a diode load might be connected.



When connecting to the diode, care must be taken to maintain a proper high-bandwidth 50 Ohm transmission line system, using high-speed construction techniques.

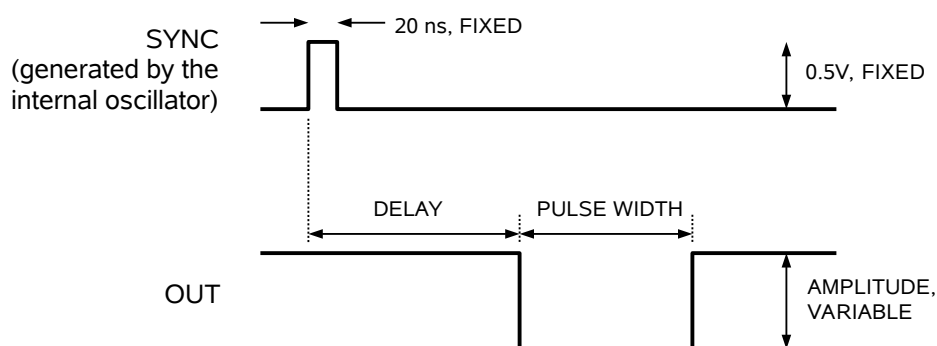
Since no electrical monitoring output is provided on the Avtech pulser or the NLK5C5E2KA laser diode package, the laser output should be observed optically.

## BASIC PULSE CONTROL

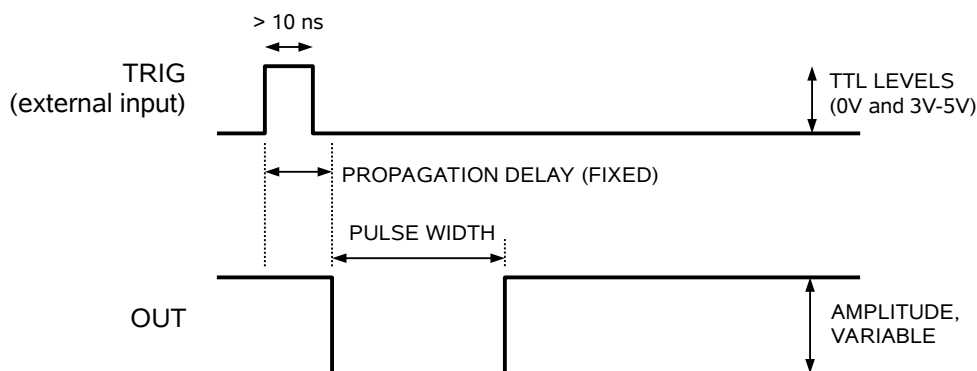
This instrument can be triggered by its own internal clock or by an external TTL trigger signal. When triggered internally, two mainframe output channels respond to the trigger: OUT and SYNC.

- OUT. This is the main output.
- SYNC. The SYNC pulse is a 500 mV, 20 ns reference pulse used to trigger oscilloscopes or other measurement systems.

These pulses are illustrated below:



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



*Figure B*

## AMPLITUDE INTERACTION

Some properties of the output pulse may change as a function of the amplitude setting. For some demanding applications, it may be desirable to use a combination of external attenuators and the amplitude dial to achieve the desired output amplitude.

## MINIMIZING WAVEFORM DISTORTIONS

### USE 50Ω TRANSMISSION LINES AND LOADS

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

This mainframe requires a 50Ω 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 AVO-9C-C-N-EA-TR-MJLB may fail if triggered at a PRF greater than 25 MHz.

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