



**AVTECH ELECTROSYSTEMS LTD.**

NANOSECOND WAVEFORM ELECTRONICS  
SINCE 1975

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INSTRUCTIONS

MODEL AVNN-1-PS-CUB

40 MHz TO 54 MHz

HIGH SPEED PULSE GENERATOR

WITH 100 ps 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

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>

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Manual Reference: T:\instructword\avnn\AVNN-1-PS-CUB,edition1.sxw.  
Last modified September 19, 2003.  
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## INTRODUCTION

The AVNN-1-PS-CUB is a high performance instrument capable of generating up to 5 Volts peak-to-peak into  $50\Omega$  loads at repetition rates of 40 to 54 MHz. The rise time and fall times are less than 100 ps. The pulse width is variable from 4 ns to 10 ns.

An external trigger is required to trigger the instrument. The trigger must be a 0.3 V RMS sine wave or 50% duty cycle square wave, 40 to 54 MHz.

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.

## SPECIFICATIONS

Model:	AVNN-1-PS-CUB
Amplitude: (50 Ohm load)	Variable to 5 Volts (peak to peak)
Pulse width:	Variable, 4 ns to 10 ns
PRF:	40 MHz to 54 MHz
Rise time (20%-80%):	$\leq 100$ ps
Fall time (80%-20%):	$\leq 100$ ps
Polarity <sup>1</sup> :	0 to $\pm 2.5$ Volts
Propagation delay:	$\leq 5$ ns (Ext trig in to pulse out)
Jitter:	$\pm 15$ ps (Ext trig in to pulse out)
DC offset or bias insertion:	Apply required DC offset to back panel solder terminals. $\pm 50$ Volts, 250 mA max
Trigger required:	0.3 V RMS sine wave or 50% duty cycle square wave
Connectors:	Out: SMA Trig: BNC
Dimensions (H x W x D):	100 x 215 x 375 mm (3.9 x 8.5 x 14.8")
Power requirement:	100-240 Volts, 50-60 Hz
Chassis material:	anodized aluminum, with blue plastic trim

- 1) The high duty cycle waveform is AC-coupled and so the output is bipolar. A unipolar output may be obtained by inserting a DC offset.

ORIGINAL QUOTATION

August 20, 2003  
 To: Dario Arena  
 Brookhaven National Labs  
 631-344-5135  
 darena@bnl.gov

Dario,

We can change the minimum frequency specification to 40 MHz. I have re-quoted with a new model number below. We can not deliver before September 30th.

I am pleased to quote as follows:

Quote number: 11713

Model number: AVNN-1-PS-CUB

Amplitude: 0 to 5V p-p, variable (one-turn control), to 50 Ohms.

Pulse width: 4 to 10 ns, variable (two one-turn controls)

Trigger required: 0.3 V RMS sine wave or 50% duty cycle square wave, 40 to 54 MHz. The external trigger is required; no internal trigger source is provided.

Rise and fall times (20%-80%): < 100 ps

Dimensions: 100 mm x 215 mm x 375 mm (3.9" x 8.5" x 14.8")

Power: 120/240 Volts (switchable) 50-60 Hz

Price: \$5261, FOB destination.

Delivery: 60-90 days.

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

Regards,  
 Dr. Michael J. Chudobiak  
 VP, New Product Development

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

PO Box 265	ph: 1-800-265-6681 or 613-226-5772	Box 5120 Stn. F
Ogdensburg, NY	fax: 1-800-561-1970 or 613-226-2802	Ottawa, Ontario
USA 13669-0265	email: info@avtechpulse.com	Canada K2C 3H4
	http://www.avtechpulse.com/	

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!

> -----Original Message-----  
 > From: Dario Alejandro Arena [mailto:darena@bnl.gov]  
 > Sent: Tuesday, August 19, 2003 1:04 PM  
 > To: Dr. Michael J. Chudobiak  
 > Subject: RE: Avtech pulse generator quote  
 >  
 >  
 > Hello Dr. Chudobiak,  
 >  
 > I have two questions regarding this quote.

>  
> First, can the frequency range of the pulse be extended down  
> to 40 MHz?  
>  
> Second, for budgetary reasons, it would be easiest for us to  
> accept delivery  
> before the end of the fiscal year (September 30th). Assuming  
> we place an  
> order in the near future, can you deliver the pulser by that date?  
>  
> Thank you,  
>  
> Dario Arena  
>  
> -----Original Message-----  
> From: Dr. Michael J. Chudobiak [mailto:mjc@avtechpulse.com]  
> Sent: Monday, August 18, 2003 4:14 PM  
> To: darena@bnl.gov  
> Cc: Avtech Sales  
> Subject: Avtech pulse generator quote  
>  
>  
> To: Dario Arena  
> Brookhaven National Labs  
> 631-344-5135  
> darena@bnl.gov  
>  
>  
> Dario,  
>  
> We spoke a few minutes ago about the AVNN-1-PS-CUA.  
> Unfortunately, we can  
> not improve the rise time specification, even at the expense  
> of the fall  
> time.  
>  
> I am pleased to quote as follows:  
>  
>  
> Quote number: 11705  
>  
> Model number: AVNN-1-PS-CUA  
>  
> Amplitude: 0 to 5V p-p, variable (one-turn control), to 50 Ohms.  
>  
> Pulse width: 4 to 10 ns, variable (two one-turn controls)  
>  
> Trigger required: 0.3 V RMS sine wave or 50% duty cycle  
> square wave, 50 to  
> 54 MHz. The external trigger is required; no internal trigger  
> source is  
> provided.  
>  
> Rise and fall times (20%-80%): < 100 ps  
>  
> Dimensions: 100 mm x 215 mm x 375 mm (3.9" x 8.5" x 14.8")  
>  
> Power: 120/240 Volts (switchable) 50-60 Hz  
>  
> Price: \$5261, FOB destination.  
>  
> Delivery: 60-90 days.  
>  
>  
> Please call or email me if I can be of further assistance.  
>  
>  
>  
> Regards,  
> Dr. Michael J. Chudobiak  
> VP, New Product Development



## 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

A large, bold, black CE mark logo consisting of the letters 'C' and 'E' joined together.

## 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 115 / 230 V  $\pm$  10%, 50-60 Hz. The instrument automatically switches between these two levels. Note, however, that different fuses are required for the two ranges, as described in the "FUSES" section.

The maximum power consumption is 57 Watts. 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.)

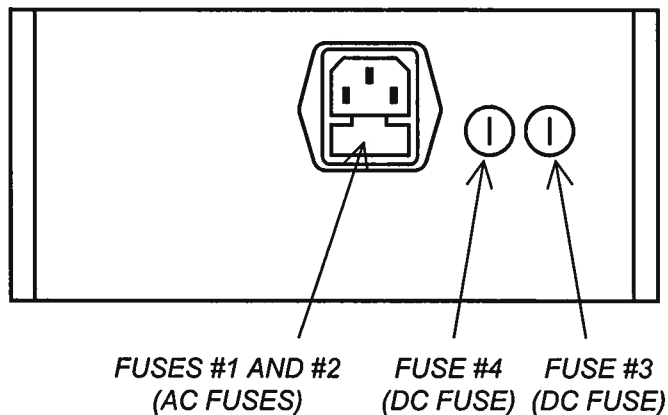
### ENVIRONMENTAL CONDITIONS

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.

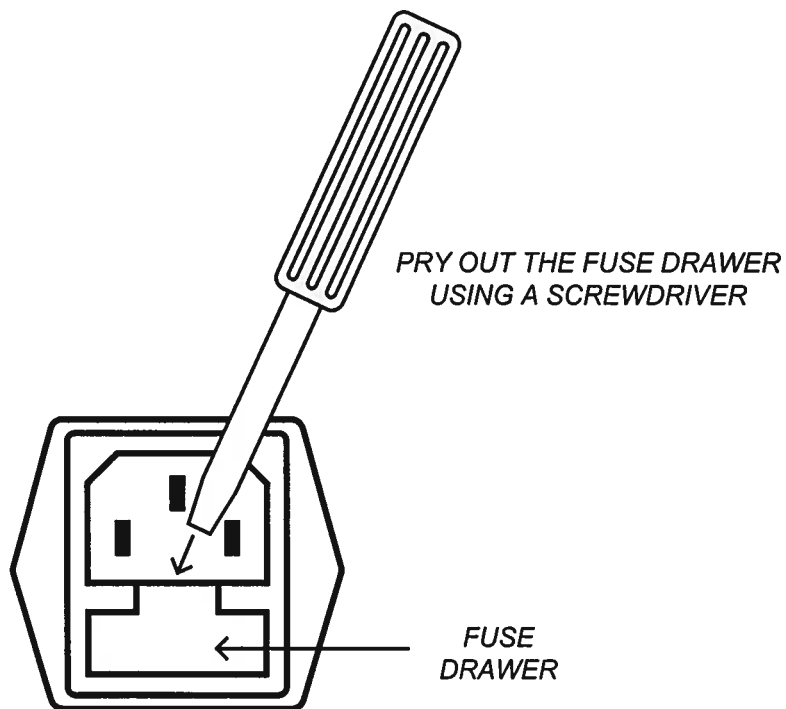
## FUSES

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

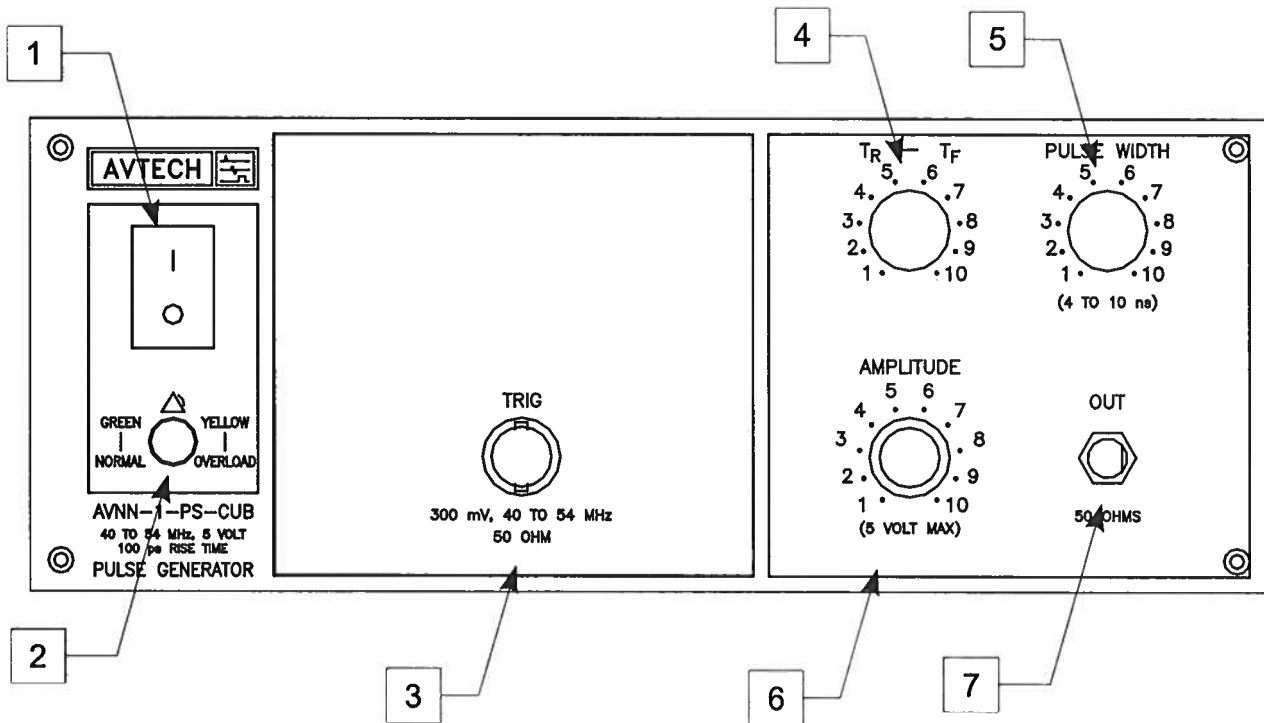
The following table lists the required fuses:

Fuses	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	0.25A, 250V, Time-Delay	5 x 20 mm	1950250000	WK5035-ND
#3 (DC)	115/230V	0.8A, 250V, Time-Delay	5 x 20 mm	1950800000	WK5046-ND
#4 (DC)	115/230V	0.8A, 250V, Time-Delay	5 x 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



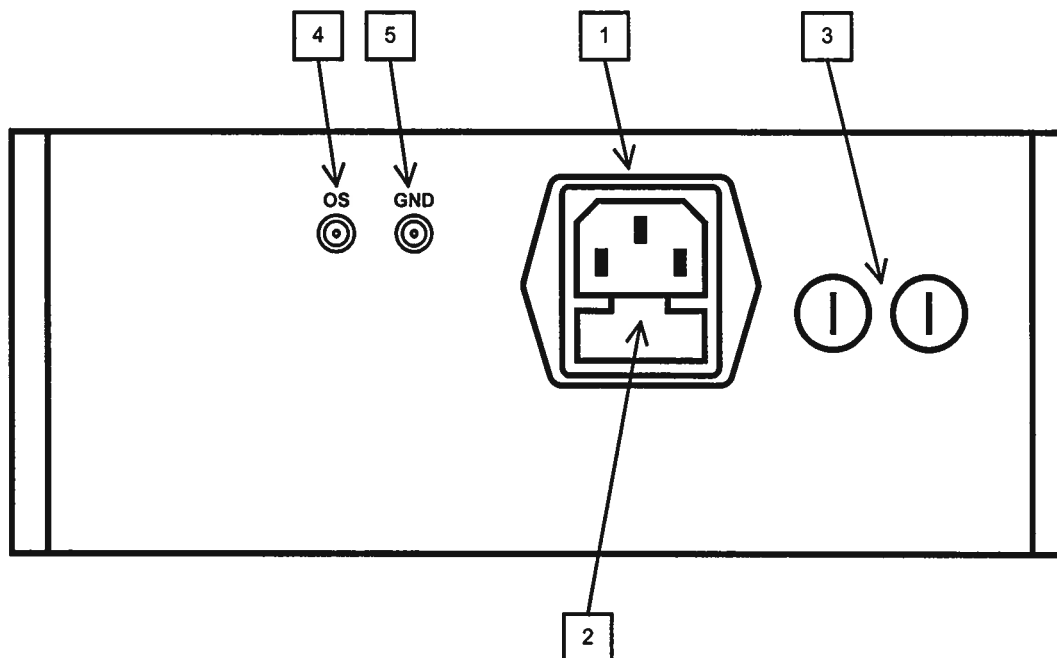
1. **POWER Switch.** This is the main power switch. When turning the instrument on, there may be a delay of several seconds before the instrument appears to respond.
2. **OVERLOAD Indicator.** When the instrument is powered, this indicator is normally green, indicating normal operation. If this indicator 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. **TRIG Input.** The external trigger signal is applied at this input. The trigger must be a 0.3 V RMS sine wave or 50% duty cycle square wave, 40 to 54 MHz.
4. **TR-TF Controls.** This dial controls flatness of pulse top and rise and fall time. Turn counter-clockwise to smooth top and to decrease rise, fall time.

5. PW Control. This dial varies the output pulse width / duty cycle. The duty cycle may be adjusted from approximately 4 ns to 10 ns.
6. AMP Control. This dial varies the output pulse amplitude from zero to maximum output.
7. OUT Connector. This SMA connector provides the main output to a 50 Ohm load.

### REAR PANEL CONTROLS

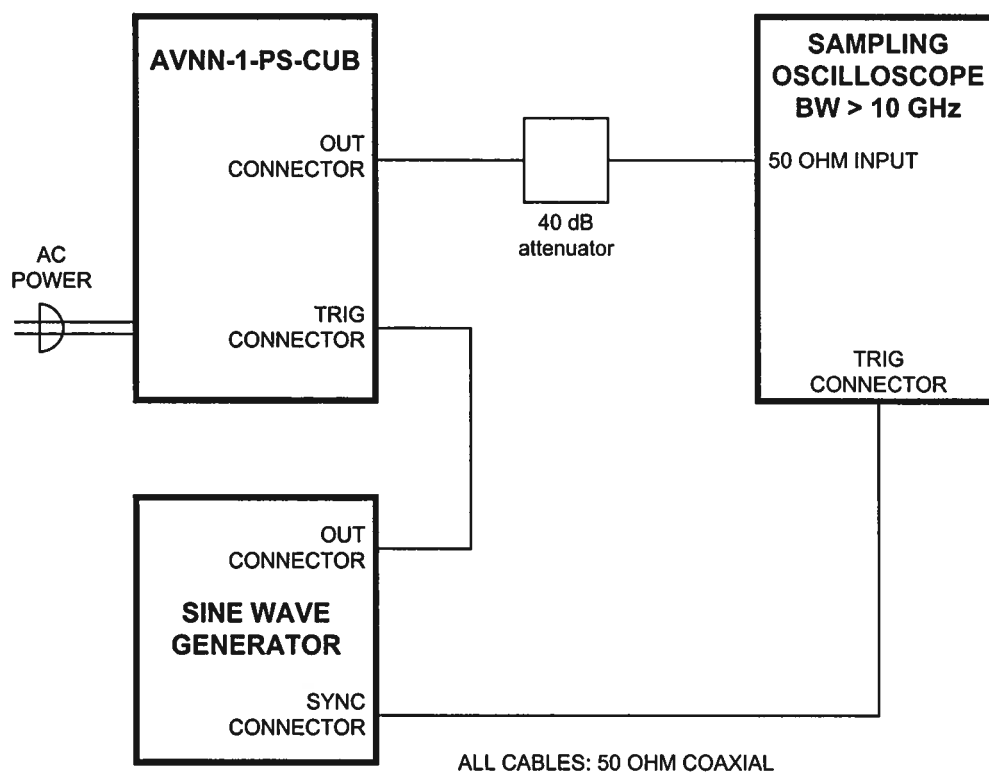


- 1) **AC POWER INPUT.** An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
- 2) **AC FUSE DRAWER.** The two fuses that protect the 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) **OS INPUT CONNECTOR.** A DC offset in the range of  $\pm 50\text{V}$  (250 mA max) 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 (using the adjacent GND connector). This is especially important when driving loads containing a diode.
- 5) **GND CONNECTOR.** This solder terminal is connected to ground. It may be used to ground the OS input connector.

## GENERAL INFORMATION

### BASIC TEST ARRANGEMENT

The AVNN should be tested with a sampling oscilloscope with a bandwidth of at least 10 GHz to properly observe the high-speed waveform. A typical 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.

### GENERAL OPERATING NOTES

- 1) The bandwidth capability of components and instruments used to display the pulse generator output signal (attenuators, cables, connectors, etc.) should exceed 10 GHz.
- 2) The use of 40 dB attenuator at the sampling scope vertical input channel will insure a peak input signal to the sampling scope of less than 1 Volt.



- 3) To trigger externally, set the INT-EXT switch to EXT and connect a sine wave generator to the TRIG connector. The output PRF will equal the sine wave PRF. The sine wave amplitude should be set at 0.3 VRMS.
- 4) Clockwise rotation of the PW control increases the output duty cycle. Adjust for desired output pulse width.
- 5) The desired output amplitude is controlled primarily by the AMP control and partially by the TR-TF control. The TR-TF control also serves to sharpen the rise and fall times and to flatten the pulse top. Several iterative adjustments of the AMP and TR-TF controls may be necessary to simultaneously obtain the desired output amplitude while maintaining excellent pulse rise-fall times and flatness. For initial set-up, set all controls at mid-range, and then adjust accordingly.
- 6) To add a DC offset to the output pulse, connect a DC power supply set to required DC offset value to the back panel terminals marked "OS". The maximum attainable DC offset voltage is  $\pm 50$  Volts.

## 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 instrument 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 AVNN may fail if triggered at a PRF greater than 54 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](mailto: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 $\Omega$  loads using shielded 50 $\Omega$  coaxial cables. Unused outputs should be terminated with shielded 50 $\Omega$  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.

Sept 19/03