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INSTRUCTIONS

MODEL AVMP-3-C-PN-OS-SSTC PULSE GENERATOR

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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FIG. 1 PULSE GENERATOR TEST ARRANGEMENT

### GENERAL NOTES

- 1) The bandwidth capability of components and instruments used to display the pulse generator output signal (attenuators, cables, connectors, etc.) should exceed five gigahertz.
- 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 one Volt. CAUTION: The pulse generator requires a load impedance of 50 Ohms. The output pulse may be severely distorted if the load impedance is not 50 Ohms.
- 3) The SYNC output channel provides TTL level signals. To avoid overdriving the TRIG input channel of some scopes, a 30 dB attenuator should be placed at the input to the scope trigger channel. The SYNC output precedes the main output when the front panel ADVANCE-DELAY switch is in the DELAY position. The SYNC output lags the main output when the switch is in the ADVANCE position.
- 4) To obtain a stable output display the PRF control on the front panel should be set mid-range while the PRF range switch may be in either range. The front panel TRIG toggle switch should be in the INT position, while the ADVANCE-DELAY switch should not be set in the DELAY position. The front panel DELAY controls and the scope triggering controls are then adjusted to obtain a stable output. The scope may then be used to set the desired PRF by rotating the PRF control and by means of the PRF range switch.
- 5) The output pulse polarity is controlled by the front panel two-position POLARITY switch.
- 6) The output pulse width is controlled by means of the front panel 2 position range switch and one turn PW control. The control should initially be set maximum counter clockwise and the pulse width adjusted using an oscilloscope. CAUTION: Do not exceed the output duty cycle rating of 10%, for example:

PRF	PW MAX
10 kHz	10 us
100 kHz	1 us
1 MHz	100 ns

Note that as the duty cycle limit is approached the:

- a) Amplitude will decrease

- b) the fall time will increase
  - c) the overload light will come on (see 11)
- 7) The output pulse amplitude is controlled by means of the front panel one turn AMP control. The pulse width may change by several nanoseconds as the output amplitude is reduced from maximum to minimum. Therefore it is convenient to first set the desired amplitude and then set the desired pulse width.
- 8) Some properties of the output pulse may change as a function of the amplitude pot setting. For some demanding applications, it may be desirable to use a combination of external attenuators and the amplitude pot to achieve the desired output amplitude.
- 9) An external clock may be used to control the output PRF of the AVMP unit by setting the front panel TRIG toggle switch in the EXT position and applying a 50 ns (or wider) TTL level pulse to the TRIG BNC connector input. For operation in this mode, the scope time base must also be triggered by the external clock.
- 10) The "SINGLE PULSE" push button will trigger the instrument manually for one cycle of output, when the "INT/EXT" switch is in the "EXT" position. Otherwise, the push button has no effect.
- 11) AVMP units with a serial number higher than 5600 are protected by an automatic overload protective circuit which controls the front panel overload light. If the unit is overloaded (by operating at an exceedingly high duty cycle or by operating into a short circuit), the protective circuit will turn the output of the instrument OFF and turn the indicator light ON. The light will stay ON (i.e. output OFF) for about 5 seconds after which the instrument will attempt to turn ON (i.e. light OFF) for about 1 second. If the overload condition persists, the instrument will turn OFF again (i.e. light ON) for another 5 seconds. If the overload condition has been removed, the instrument will turn on and resume normal operation. Overload conditions may be removed by:
  - 1) Reducing PRF (i.e. switch to a lower range)
  - 2) Reducing pulse width (i.e. switch to a lower range)
  - 3) Removing output load short circuit (if any)
- 12) The AVMP-C unit can be converted from 110 to 220V 50-60 Hz operation by adjusting the voltage selector card in the rear panel fused voltage selector-cable connector assembly.
- 13) For additional assistance:

Tel: (613) 226-5772  
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FIG 2. FRONT PANEL CONTROLS

## FRONT PANEL CONTROLS DESCRIPTION

(1) POWER Switch. The POWER push button switch applies AC prime power to the primaries of the transformer, turning the instrument on. The push button lamp (#382 type) is connected to the +15V DC supply.

(2) INT/EXT Switch. In the "INT" position the instrument is internally triggered and the "SYNC OUT" connector provides a SYNC output which allows one to trigger other instruments, such as oscilloscopes. In the "EXT" position the instrument is triggered by a +5V 50 ns (or wider) input pulse on the "TRIG IN" connector, or by pressing the "SINGLE PULSE" push button.

(3) SINGLE PULSE Push Button. The "SINGLE PULSE" push button will trigger the instrument manually for one cycle of output, when the "INT/EXT" switch is in the "EXT" position. Otherwise, the push button has no effect.

(4) SYNC OUT. When the "INT/EXT" switch is in the "INT" position, 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  $R_L > 1K$  with a pulse width of about 50 ns.

(5) TRIG IN. When the "INT/EXT" switch is in the "EXT" position, the external trigger (+5 Volts, PW 50 ns) is applied to this connector. This input presents a high impedance (1 M Ohm).

(6) REPETITION RATE Controls. The rotary switch marked "RANGE" selects the pulse repetition rate for the internally triggered mode. The fine control provides continuously variable control of each range. There are six ranges and the instrument is set to the rate indicated on the front panel when the vernier is in the "MAX" position.

1 kHz - 10 Hz  
10 Hz - 100 Hz  
100 Hz - 1 kHz  
1 kHz - 10 kHz  
10 kHz - 100 kHz  
100 kHz - 1.0 MHz

**CAUTION:** Do not exceed the duty cycle rating of 10% (eg. At 1.0 MHz, the pulse width must not exceed 100 ns).



(7) DELAY Controls. The rotary switch selects one of six ranges and the vernier provides continuously variable control of each range. The instrument is set to the delay indicated on the front panel when the vernier is in the "MAX" position.

(8) ADVANCE, DELAY, DOUBLE PULSE. With this three position switch in the ADVANCE position, the leading edge of the output pulse precedes the leading edge of the SYNC output. When in the DELAY position, the leading edge of the SYNC output precedes the leading edge of the main output. When in the DOUBLE PULSE position, the main output provides two successive output pulses having a separation determined by the DELAY (8) controls.

(9) PULSE WIDTH Controls. The rotary switch selects one of two ranges and the vernier provides continuously variable control of each range. The instrument is set to the pulse width indicated on the front panel when the vernier is in the "MAX" position.

20 ns - 200 ns  
200 ns - 2 us

**CAUTION!!** Do not exceed the duty cycle rating of 10% (eg. At a pulse width of 2 us, the PRF must not exceed 50 kHz.)

(10) POLARITY Switch. If the polarity switch is in the "+" position, the main output pulse will pulse upwards (i.e. to a more positive level). If it is in the "-" position, the output will pulse downwards to a more negative level.

(11) AMPLITUDE. The ten turn amplitude vernier provides continuously variable control of the peak amplitude of the main output from 0 Volts to 20 Volts.

(12) OUT. SMA connector provides output to load impedance of 50 Ohms. Note that the pulser performance will be severely degraded if the load impedance is not 50 Ohms.

(13) OVERLOAD. An automatic overload protective circuit controls the front panel overload light. 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 turn the output of the instrument OFF and turn the indicator light ON. The light will stay ON (i.e. output OFF) for about 5 seconds after which the instrument will attempt to turn ON (i.e. light OFF) for about 1 second. If the overload condition persists, the instrument will turn OFF again (i.e. light ON) for another 5 seconds. If the overload condition has been removed, the instrument will turn on and resume normal operation. Overload conditions may be removed by:

- 1) Reducing PRF (i.e. switch to a lower range)
- 2) Reducing pulse width (i.e. switch to a lower range)
- 3) Removing output low load impedance (if any)
- 4) Reducing the output amplitude (i.e. switch to a lower range)

The overload light may illuminate when the prime power is first applied. The light will extinguish after a few seconds and the unit will then operate normally.

FIG. 3 BACK PANEL CONTROLS

## BACK PANEL CONTROLS DESCRIPTION

(1)FUSED CONNECTOR, VOLTAGE SELECTOR. The detachable power cord is connected at this point. In addition, the removable cord is adjusted to select the desired input operating voltage. The unit also contains the main power fuse (0.50 Amp).

(2)OS. To apply a DC offset to the output pulse, apply the required DC potential to the OS terminal. Note that the DC current must not exceed  $\pm 200$  mA (ie.  $\pm 10$  Volts to 50 Ohms) and the DC voltage must not exceed  $\pm 50$  Volts. The unit may be damaged if these ratings are exceeded. Also note that the installation of the OS module degrades the rise and fall time of the pulser by as much as 20% (eg a rise time of 250 ps rather than 200 ps) and also introduces the small spikes or perturbations on the pulse top approx 7 ns after the leading edge. If necessary, the OS module may be bypassed by removing the top cover and disconnecting the RG174 cables from the SMA input and output connectors on the OS module. The two RG174 cables may then be connected together using an SMA F/F sex adapter.

(3) 1.0 A SB. Fuse limits the current supplied to the output stage in cases of severe overloading.

## OPERATIONAL CHECK AND RECOMMENDED CALIBRATION PROCEDURE

### A) OPERATIONAL CHECK

This check is to confirm that the instrument is basically operational. Set the controls to the following values:

#### FRONT PANEL

- INT/EXT Switch: INT position
- REPETITION RATE RANGE Switch: 10 kHz
- REPETITION RATE Vernier: MAX
- DELAY RANGE Switch: 0.2 us
- DELAY Vernier: MID range
- ADVANCE, DELAY, DOUBLE PULSE: DELAY
- PULSE WIDTH RANGE Switch: 0.2 us
- PULSE WIDTH Vernier: MAX
- POLARITY Switch: POS
- AMPLITUDE Vernier: MAX

Connect the instrument to a wide bandwidth oscilloscope (BW > 5 GHz) as shown in Fig 1. The following sampling oscilloscope systems satisfy the bandwidth requirements:

Tektronix S4, 7S11, 7T11 (with a 7000 series mainframe)  
Tektronix 11801B with SD22 (or equivalent)  
Hewlett Packard 54120 series.

The bandwidth of the cables and attenuators must be considered as well since the overall display system rise time is given by the root of the sum of the squares as follows:

$$T_{RD} \text{ TOTAL} \approx \sqrt{T_R^2 \text{ ATTEN} + T_R^2 \text{ CABLES} + T_R^2 \text{ SCOPE}}$$

which should be less than one-third of the waveform rise time  $T_{RW}$ . For factory testing of 200 ps rise time units Avtech normally employs attenuators with 18 GHz bandwidth and SMA connectors (from suppliers such as Midwest Microwave and Hewlett Packard). Note the attenuators must have an average power rating of at least 2 Watts if the DC offset rating is to be tested at the  $\pm 200$  mA level.

For all oscilloscope systems, the displayed waveforms will be degraded by jitter unless exceptional care is taken to properly set the triggering controls on the oscilloscope and the pulse generators (as per the respective instruction manuals).

Set the oscilloscope to trigger externally with the vertical setting at 10 Volts/div and the horizontal setting at 20 ns/div. Note that the 40 db attenuator reduces the output voltage by a factor of 100. Then follow the instructions below and compare what is seen on the oscilloscope to what is described. Only approximate values are needed to confirm operation.

STEP	CONTROL	OPERATION	RESULTS
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1	POWER	Push in (ON)	+20V pulses at the main output, with period 100 us, pulse width 200 ns, <0.25 ns rise times and $\leq 0.3$ ns fall time.
2	REPETITION RATE VERNIER	Rotate to MIN, then to MAX	Period rises to about 1 ms then falls to about 100 us.
3	DELAY VERNIER	Rotate to MAX, then to MIN	Pulses shift to the right on the oscilloscope by 0.2 us then back.
4	PULSE WIDTH VERNIER	Rotate to MIN, then to MAX	Pulse width varies from $\leq 20$ ns to 200 ns.
5	PULSE WIDTH RANGE AND SCOPE HORIZONTAL SETTING	Switch the scope horizontal setting to 200 ns/div and switch the PW range from 0.2 us to 2.0 us and then back to 0.2 us.	The output pulse width switches from 200 ns to 2.0 us and then back to 200 ns.
6	POLARITY	Switch to NEG and then back to POS.	Output pulse switches from +20 Volts to -20 Volts and then back to +20 Volts.
7	OFFSET (OS)	Connect a 0 to $\pm 10$ Volt DC lab power supply to the rear panel OS terminals. Increase the rear panel supply output from 0 to +10 VDC and then back to zero. Then reverse the polarity and increase to -10 VDC and back to 0 Volts.	The DC current from the lab power supply will increase from 0 to +200 mA and then back to 0 mA and then to -200 mA and back to 0 mA. The baseline of the output voltage waveform displayed on the scope will rise from 0 to +10 VDC and then back down to 0 Volts and then to -10 VDC and then back to 0 VDC.

This completes the operational check.

**B) RISE TIME, FALL TIME CHECK**

This check should be performed after completing the basic operational check (see A). Set the output pulse width to 20 ns and the amplitude to 20 Volts and then the horizontal time base of the oscilloscope to 200 ps/div and carefully adjust the delay control vernier on the pulser (and the scope time base trigger controls) to obtain a stable display on the scope of the rising edge of the output pulse waveform. The rise time is to be measured between the 20 and 80% voltage points on the rising edge. Note that as discussed on page 9, the installation of the OS function may degrade the rise time by as much as 20 % (eg. 250 ps rather than 200 ps). The fall time may then be checked after adjusting the delay controls on the pulser and on the scope.



## JIG DESIGN CONSIDERATIONS

When designing and constructing the test jig, the following factors must be considered:

- 1) The load presented to the pulser must be close to 50 Ohms at all times.
- 2) The inductance in the load path must be extremely low (<5 nh) because of the extremely short rise and fall times. Lead lengths must not exceed  $\approx 0.2''$  and components used (resistors, capacitors, etc.) must be suitable for RF type applications.
- 3) The output of the pulser is AC-coupled and as a consequence, at high duty cycles, (eg. 10%) the output waveform will be bipolar in nature. For example, if set at maximum output amplitude with a duty cycle of 10%, the polar positive output will be about +18 Volts and the negative excursion will be about -2.0 Volts. If necessary, the negative excursion may be nulled by applying a positive DC offset.

PERFORMANCE CHECK SHEET

ORIGINAL QUOTATION