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## INSTRUCTIONS

MODEL AVO-2-C-P-OP1-BEO3-R5-M PULSE GENERATOR

WITH

MODEL AVO-2T-BEO6 OUTPUT MODULE

S.N.:

### 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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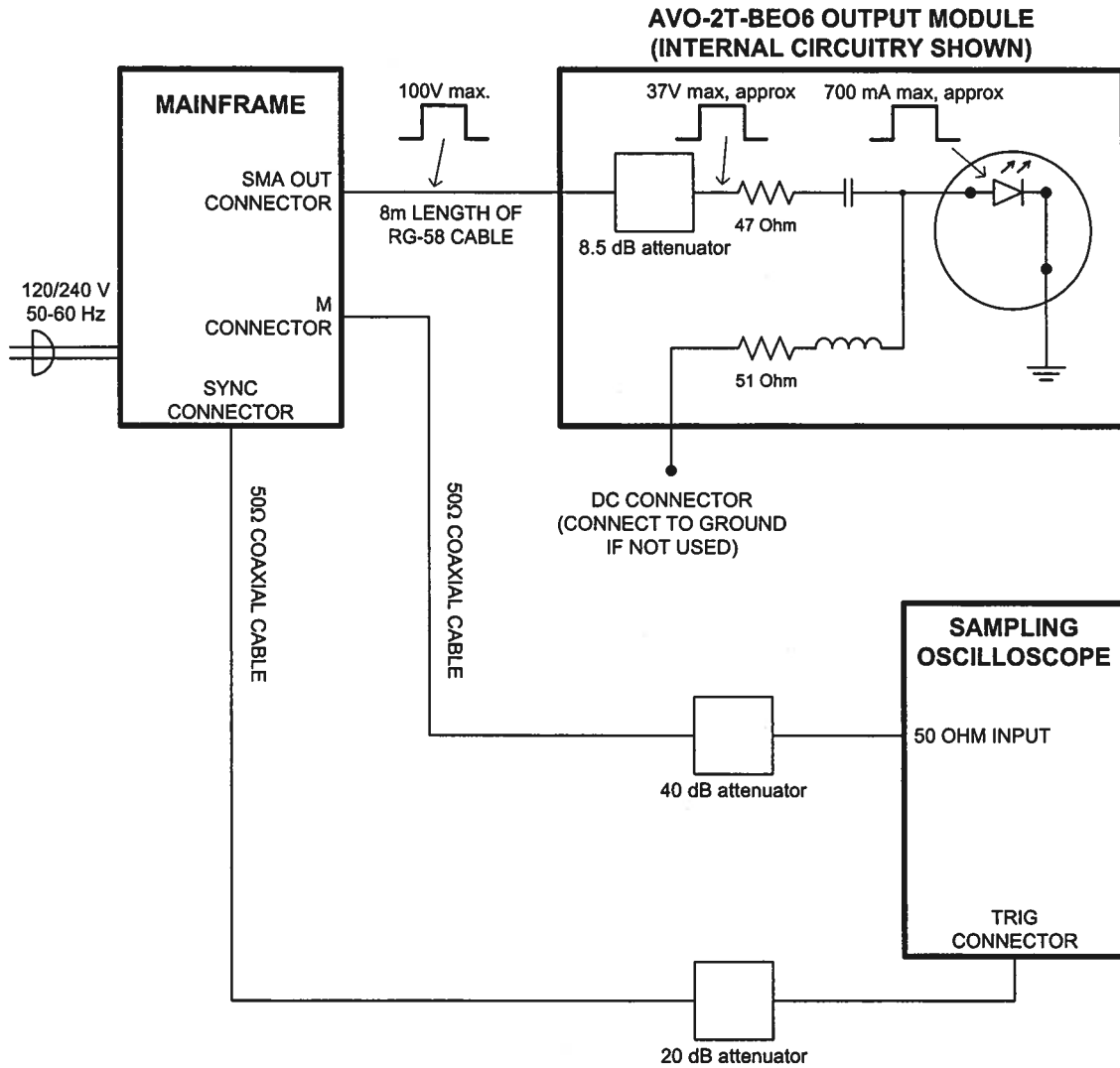
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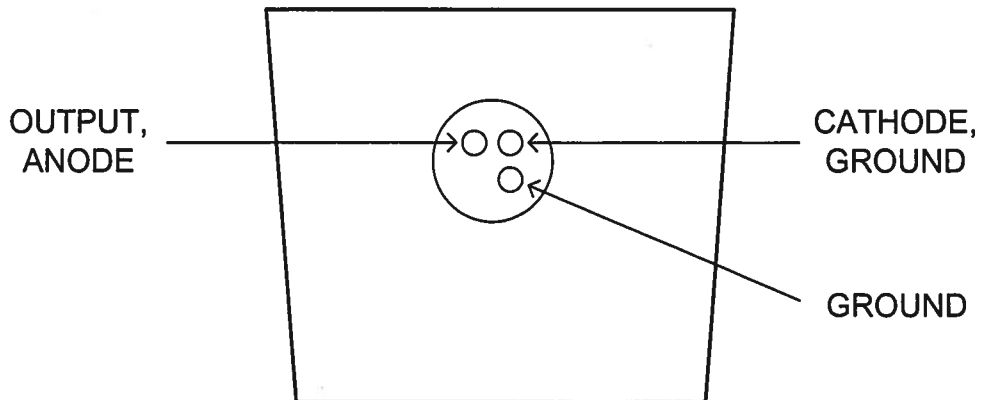
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**FIG. 1A: PULSE GENERATOR TEST ARRANGEMENT**



**FIG. 1B: AVO-2T-BEO6 OUTPUT MODULE PIN SOCKET**



## GENERAL OPERATING INSTRUCTIONS

- 1) For front panel manual control of the output parameters, the rear panel LOCAL-REMOTE switch must be in the LOCAL position. For remote control using a personal computer, the switch should be in the REMOTE position. See the AN-101-AVO-2-C-BEO3 section (at the end of the manual) for the instructions for this mode of operation. Note that it is recommended that the front panel manual mode be mastered before attempting GPIB control of the instrument.
- 2) The bandwidth capability of components and instruments used to display the pulse generator output signal (attenuators, cables, connectors, etc.) should exceed two gigahertz.
- 3) The use of 30 dB attenuator at the sampling scope vertical input channel will insure a peak input signal to the sampling scope of less than one Volt.
- 4) The TRIG 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 TRIG output precedes the main output when the front panel ADVANCE-DELAY switch is in the ADVANCE position. The TRIG output lags the main output when the switch is in the DELAY position.
- 5) To obtain a stable output display the front panel TRIG toggle switch should be in the INT position. The front panel DELAY controls and the scope triggering controls are then adjusted to obtain a stable output. In the internal mode, the PRF is set at 20 kHz. An external clock may be used to control the output PRF of the AVO 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 (rear panel).
- 6) The output pulse width is fixed at 17 ns at the time of shipping. Note that the pulse width may be varied from about 10 ns to 23 ns by adjusting the one turn locking pot on the -PG module. This module is accessed by removing the top cover.
- 7) The output pulse amplitude is controlled by means of the front panel one-turn AMP control.
- 8) The AVO-2T-BEO6 output module connects to the mainframe via an 8 meter 50 Ohm cable and is designed to mate with the QPhotonics LD-50S-1060 diode. The mainframe provides a +100 Volt (maximum) pulse to this module. The internal attenuator and 47-Ohm resistor (and the diode resistance) limit the diode current to a maximum of 0.7 Amperes (see Fig. 1A).

- 9) Although this instrument was supplied with an AVO-2T-BEO6 output module, it may also be used with the AVO-2T-BEO2B3 output modules supplied with earlier units. The AVO-2T-BEO2B3 output module accommodates the EG&G C86119E diode. The AVO-2T-BEO2B3 output module has a 47 Ohm limiting resistor and no attenuator, so the maximum current will be limited to 2.0 Amps, approximately.
- 10) The DC terminal of the output module must either be shorted to ground (if a DC offset is not required) or a DC power supply must be applied. The laser diode will not function if the DC terminal is open circuited. Note that the DC current must not exceed +100 mA (applying a DC potential of 0 to +5 Volts is normally adequate).
- 11) A monitor port is located on the rear panel of the mainframe (BNC connector). This monitor provides an attenuated (x10) coincident replica of the voltage pulse on the line feeding the output module. When used with the AVO-2T-BEO6 output module, the diode current peak amplitude may be estimated from:

$$I_D = (3.7 V_{MON} - 2.0 \text{ Volts}) \div 47\Omega$$

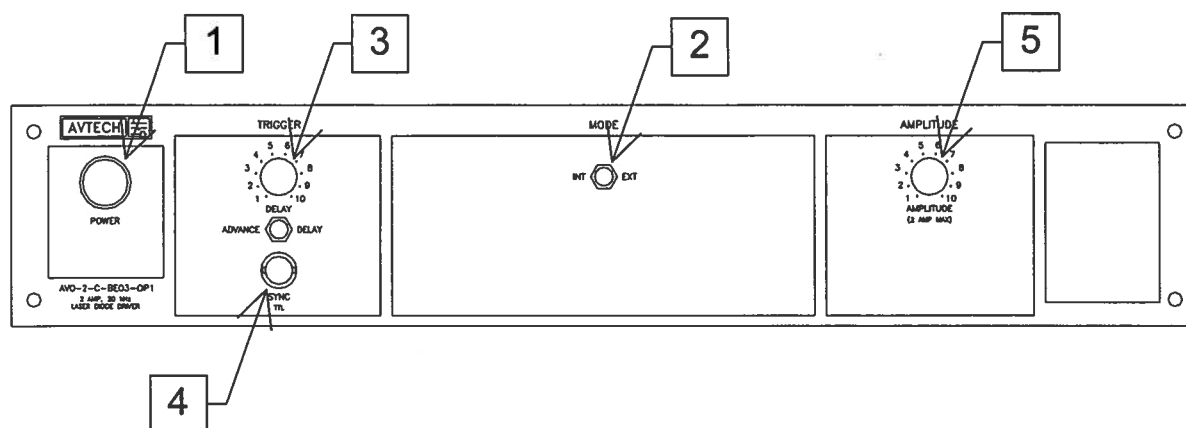
The above calculation assumes that the diode forward voltage drop is 2.0 Volts.

The monitor must be terminated in 50 Ohms.

For additional assistance:

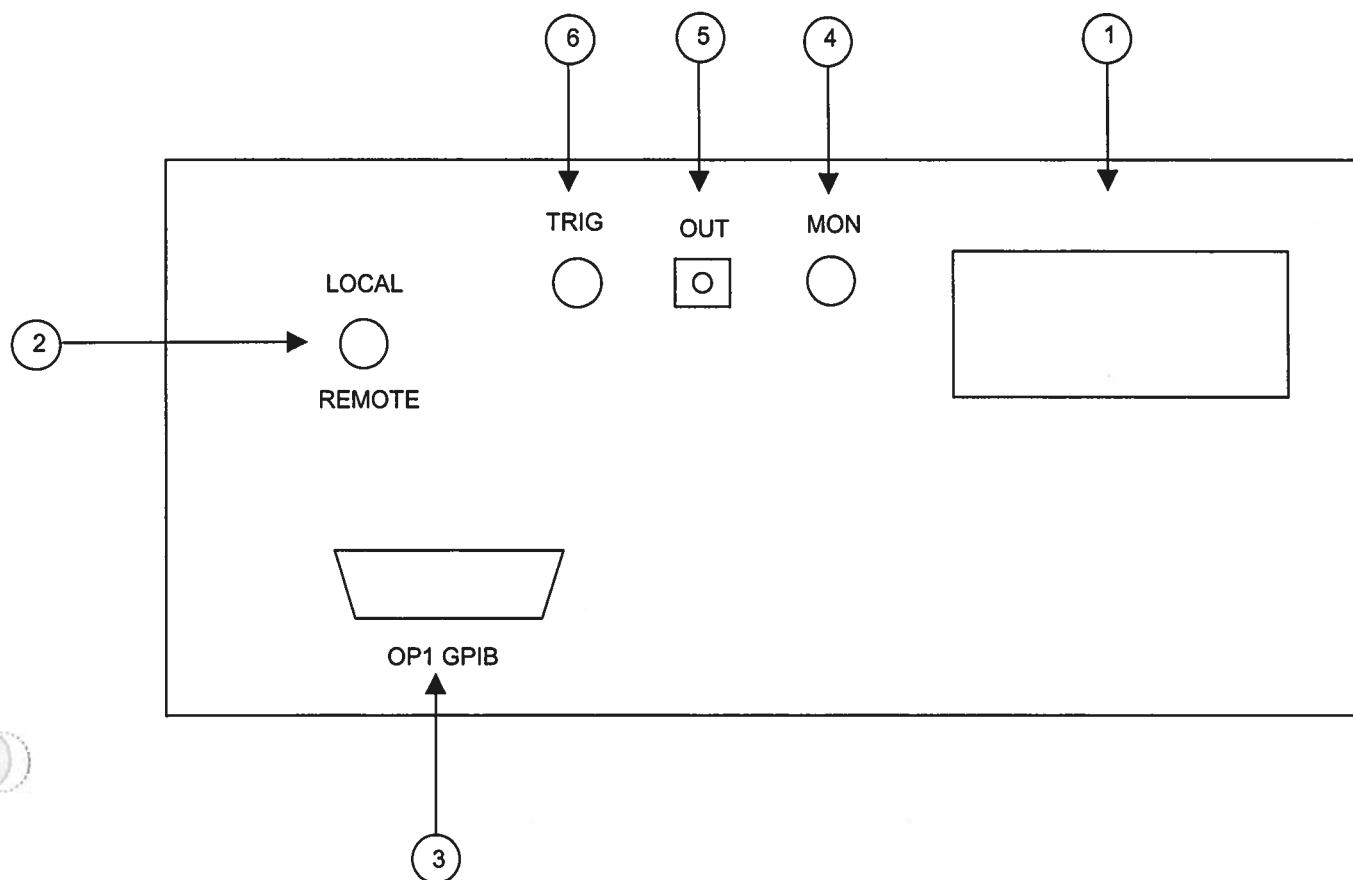
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## FRONT PANEL CONTROLS



- (1) ON-OFF Switch. Applies basic prime power to all stages.
- (2) MODE Control. With this toggle switch in the INT position, the PRF of the AVO unit is controlled via an internal clock, which is fixed at 20 kHz. With the toggle switch in the EXT position, the AVO unit requires a 50 ns (or wider) TTL level pulse applied at the rear panel 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.
- (3) DELAY Control. Controls the relative delay between the reference output pulse provided at the SYNC output (4) and the main rear panel output. This delay is variable over the range of 0 to about 200 ns. The TRIG output precedes the main output when the ADVANCE-DELAY switch is in the ADVANCE position and lags when the switch is in the DELAY position.
- (4) SYNC Output. When operating in the internal mode, this output is used to trigger the scope time base. The output is a TTL level 100 ns (approx) pulse capable of driving a fifty-Ohm load.
- (5) AMP Control. A one-turn control which varies the output pulse amplitude.

### BACK PANEL CONTROLS



- (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.

For AC line voltages of 110-120V, the power selector card should be installed so that the "120" marking is visible from the rear of the instrument.

For AC line voltages of 220-240V, the power selector card should be installed so that the "240" marking is visible from the rear of the instrument.

If it is not set for the proper voltage, remove the fuse and then grasp the card with a pair of pliers and remove it. Rotate horizontally through 180 degrees. Reinstall the card and the correct fuse.

In the 120V setting, a 0.5A slow blow fuse is required. In the 240V setting, a 0.25A slow blow fuse is required.



- 2) For front panel manual control of the output parameters, the LOCAL-REMOTE switch must be in the LOCAL position. For remote control using a personal computer, the switch should be in the REMOTE position. See the AN-101-AVO-2-C-BEO3 section (at the end of the manual) for the instructions for this mode of operation. Note that it is recommended that the front panel manual mode be mastered before attempting GPIB control of the instrument.
- 3) OP1 CONNECTOR. GPIB cable (supplied) connects between this connector and your personal computer.
- 4) MONITOR. The monitor output provides an attenuated (x10) coincident replica of the voltage pulse on the line feeding the output module. The diode current peak amplitude may be estimated from:

$$I_D = (3.7 V_{MON} - 2.0 \text{ Volts}) \div 47\Omega$$

The above calculation assumes that the diode forward voltage drop is 2.0 Volts.

Note that the monitor must be terminated in 50 Ohms.

- (5) OUT CONNECTOR. SMA connector provides output to the AVO-2T module via the supplied 8 meter cable.
- (6) TRIG CONNECTOR. With the front panel mode switch in the EXT position, the AVO unit requires a 50 ns (or wider) TTL level pulse applied at this BNC connector to trigger the output stages.

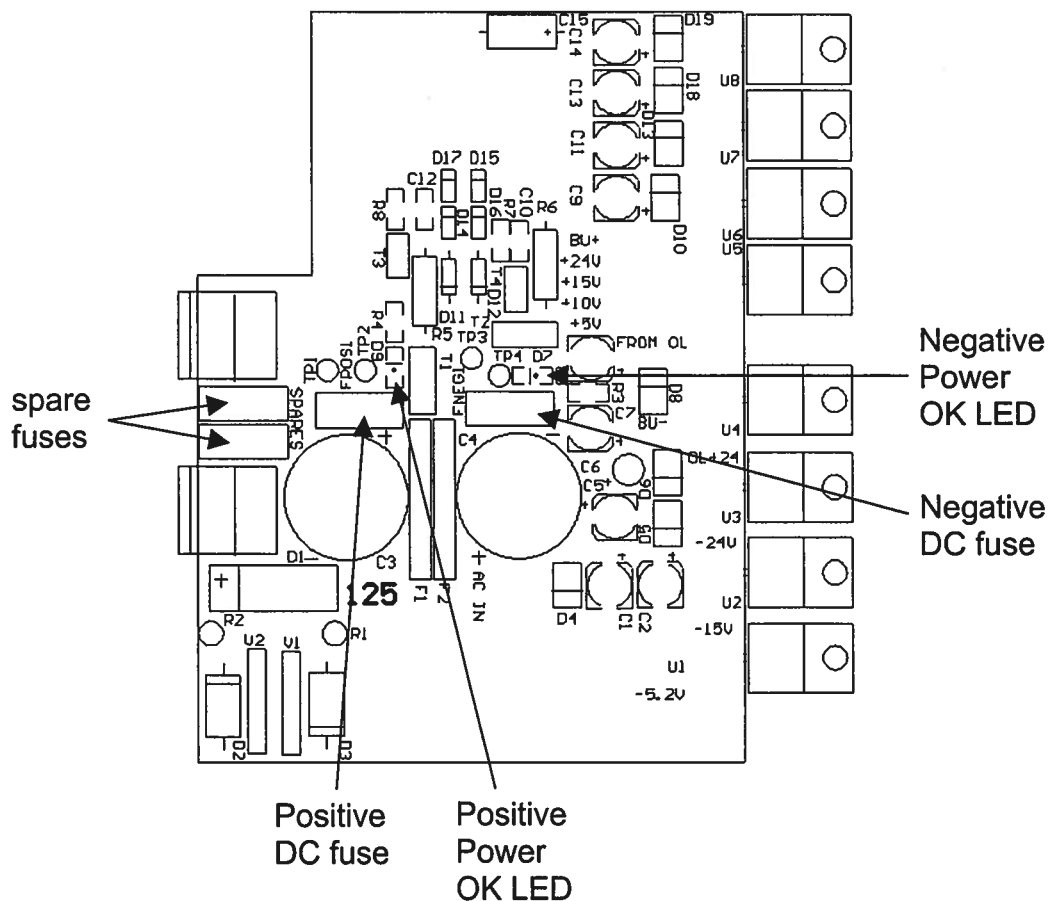
## TOP COVER REMOVAL AND RACK MOUNTING

- 1) 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).
- 2) The -R5 rack mount kit may be installed after first removing the one Phillips screw on the side panel adjacent to the front handle.

## POWER SUPPLY AND FUSE REPLACEMENT

This instrument has three main fuses, plus two spares. One, which protects the AC input, is located in the rear-panel power entry module, as described in the "Rear Panel Controls" section of this manual. If the power appears to have failed, check the AC fuse first.

The other two fuses (plus two spares) are located on the internal DC power supply, as shown below:



The positive fuse and one of the spare fuses on this circuit board are 1.5A slow-blow fuses, Littlefuse part number R45201.5. (This fuse can be ordered from Digikey, [www.digikey.com](http://www.digikey.com). The Digikey part number is F1344CT-ND). The negative fuse and the second spare fuse are 0.5A slow-blow fuses (Littlefuse R452.500, Digikey part number F1341CT-ND).

If you suspect that the DC fuses are blown, follow this procedure:

1. Remove the top cover, by removing the four Phillips screws on the top cover and then sliding the cover back and off.
2. Locate the two "Power OK" LEDs on the power supply circuit board, as illustrated above.
3. Turn on the instrument.
4. Observe the "Power OK" LEDs. If the fuses are not blown, the two LEDs will be lit (bright red). If one of the LEDs is not lit, the fuse next to it has blown.
5. Turn off the instrument.
6. If a fuse is blown, use needle-nose pliers to remove the blown fuse from its surface-mount holder.
7. Replace the fuse. (Spare 1.5 Amp and 0.5 Amp fuses are provided on the circuit board. They may be transferred to the active fuse locations using needle-nose pliers.)

## OP-1 OPERATING INSTRUCTIONS (AN-101-AVO-2-C-BEO3)

### 1.0 Introduction

This section describes how to use the OP-1 GPIB Bus Listener interface for remote computer control of the Avtech pulse generator, by means of the IEEE 488 General Purpose Interface Bus (GPIB).

The available commands and their structure, a typical command sequence and a sample program are included.

In addition, possible methods of incorporating remote duty cycle limit checking and instructions on how to change the GPIB address are provided.

### 2.0 Interface to the GPIB

The IEEE 488 compatible Bus functions available to the user for GPIB control are as follows: The listed functions define a Bus Listener capability:

-SHO, AH1, T0, TE0, L2, LE0, SR0, RL0, PP0, DC1, DT0, C0.

### 2.1 Available Commands

The OP-1 GPIB user interface is designed to be used to remotely program the Avtech pulse generator to control the pulse repetition rate, pulse amplitude and delayed (or advanced) trigger output.

The available command acronyms, outputs, units and range of acceptable values for the AVO-2C-BEO3-R5-P generator are defined in the table below:

Acronym	Output	Units	Range	Decades
I	I(current amplitude)	amps	0 to 2	
R	Repetition rate	Hertz	2 to 20000	4
D	Delay (trigger)	nano-sec	25 to 250	1
A	Advance (trigger)	nano-sec	25 to 250	1

### 2.2 Command Interpretation

The command may utilize the defined single letter acronym, or may be expanded to a longer word to make the control program easier to understand. This is because letters following the defined acronym letter are ignored. For example, a command of "I=0.2" will result in exactly the same result if the command is sent as "I (current) level of output pulse = 0.2". However, it is mandatory that the first letter of each command be one of the five defined acronyms.

Acronyms are case insensitive, for example, "R" or "r" are the same.

The number following the acronym letter may be any number in the range specified, however, the number of significant digits are limited to one part in 255 (for 8 bits of output resolution). For example, replate values of 12.82, 12.83 or 12.82145 will all result in the same output. (Note that output resolution and accuracy are not necessarily the same).

Leading or trailing zeros in numbers will be ignored.

Numbers expressed in "exponential" format will NOT be interpreted correctly. For example, 3e+2 will be interpreted as 3, not as 300.

The range of the specified values must be as specified for the equipment. Numbers outside the range will be ignored.

If desired, trailing text may be added to make the control program easier to understand, since it will be ignored. For example, a command of "delay=77" will result in the same output as the command "delay-77 microseconds".

The term "Delay" is used to specify the duration of the delay between the trigger output pulse and the occurrence of the actual output pulse. The term "Advance" similarly refers to the amount of time the trigger pulse will occur prior to the output pulse.

If an invalid command is sent, the unit will ignore the command and the previous value will remain unchanged. If an "out-of-range" value is sent, the unit will also ignore the command.

### 2.2.1 Typical Command Sequence Interpretation

Assume the following commands are sent using the computer, using the appropriate command structure as specified for the user's GPIB controller. Note that the default GPIB address is eight.

```
R=100  
I=1  
A=50
```

For example, for a GPIB controller from National Instruments, the following set of commands would be sent:

```
ibwrt "r=100"  
ibwrt "I=1"  
ibwrt "a=50"
```

This command sequence will cause the generator to produce an output pulse of width 17 nano-sec and an amplitude of 1 amp peak, repeated at a rate of 100 pulses per second. An oscilloscope attached to the generator output will confirm the result. If the generator output trigger port is used, it will be noted that each output pulse will occur 50 micro-sec after the trigger pulse occurs.

### 2.3 Sample Program

To illustrate the remote control process by means of the GPIB, a sample program written in BASIC is provided. While this example is prepared for use with the B&C MicroSystems PC488 circuit card, the general principles of control apply to any IEEE 488 GPIB Controller.

```
TEST of Pulser Controller
OPEN "PC488" FOR OUTPUT AS #1
PRINT #1, "ABORT"
PRINT #1, "CLEAR"
PRINT #1, "OUTPUT 8;I", 1
PRINT #1, "OUTPUT 8;R", 100
PRINT #1, "OUTPUT 8;A", 50
END
```

Note that the command; PRINT #1, "OUTPUT 8;S" will cause a single pulse to be generated in the single pulse mode.

### 3.0 Duty Cycle Limits

Typically, Avtech pulse generators are limited to a maximum duty cycle because of thermal constraints, where duty cycle is the ration of Pulse Width to the reciprocal of the Repetition Rate (i.e.;  $R \times W$ ). Although the generator contains automatic protection against an excessive duty cycle, whenever this protection is activated, the output is inhibited. Therefore, it may be desirable to have the control computer calculate the duty ratio, then generate a warning message to the operator whenever the limits are exceeded (preferably prior to actually sending the command sequence).

This message could caution the user either to reduce the repetition rate or the pulse width, to avoid thermal overload.

While this calculation is not mandatory, it could avoid the annoyance of automatic inhibiting of the generator output.

### 4.0 Changing the Unit GPIB Address

Since the GPIB data bus address for the pulse generator has been preset to "8" in the factory, commands are required to be sent to this address. However, the

user may wish to change the address to any address in the allowed range of 0 to 30. This address may be easily changed by re-setting the GPIB address switch on the GPIB Interface board located inside the pulse generator chassis.

The address is set by means of a five-position "Dipswitch" located on the top of a small circuit card located inside the enclosure near the top rear. The switch may be observed to be set to the default address by noting that the Dipswitch position 4 is set in the OFF position, defining a binary address of 8.

The switch setting is calculated as the sum of the switch weights in the OFF position, calculated as follows: (a switch in the ON position it has a weight of zero):

Switch Number	OFF Weight
1	1
2	2
3	4
4	8
5	16

For example, a switch with positions 1, 4 and 5 set to OFF will result in an address setting of 25 (16 plus 8 plus 1 = 25).

## 5.0 Trouble-Shooting Aid

In the event that difficulties are encountered communicating via the GPIB interface, two auxiliary communications status indicators have been included on the GPIB interface circuit card. These status indicators are small LED lamps, one which flashes briefly whenever a properly addressed command is received. The second LED will light whenever an out-of-range value or invalid command is received, and will remain lit until a valid command with a valid in-range value is subsequently received.



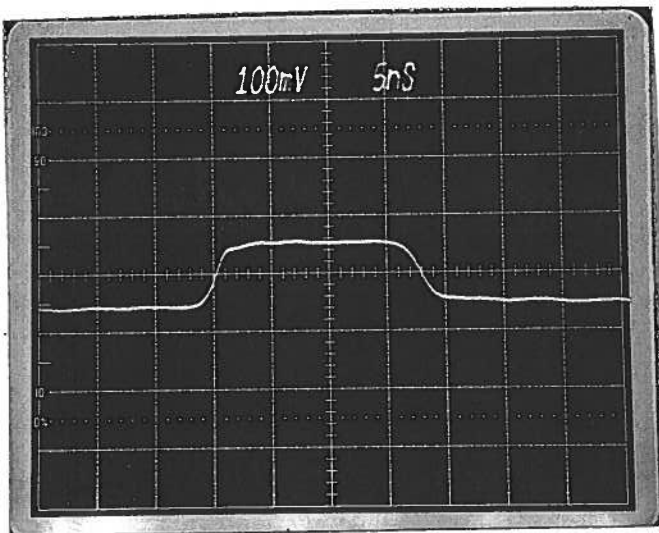
PULSE GENERATOR

ACCEPTANCE TEST REPORT/PERFORMANCE CHECK SHEET

Model: AVO-2-C-BE03-R5-P-0PI-M

S.N.: 10143

Date: JAN 18 2002



- a) Output signal amplitude: 0 TO +2 AMP ✓
- b) Pulse width: 17 NS ✓
- c) Rise time:  $\leq 2$  NS ✓
- d) Fall time:  $\leq 2$  NS ✓
- e) PRF: 0 TO 20 kHz ✓
- f) Jitter, stability: OK ✓
- g) Prime power: 120/240V, 50-60 Hz ✓

MONITOR OUT TO 40 dB  
100V/DIV, 2 AMP/DIV  
5 NS/DIV

AVO-2T-BE02B3 CONNECTED  
VIA A 8 METER CABLE  
IN459A IN SERIES WITH  
1  $\Omega$  USED AS TEST LOAD.  
PRF = 20 kHz