



AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS
SINCE 1975

P.O. BOX 265
OGDENSBURG, NY
U.S.A. 13669-0265
TEL: (315) 472-5270
FAX: (613) 226-2802

TEL: 1-800-265-6681
FAX: 1-800-561-1970

e-mail: info@avtechpulse.com
<http://www.avtechpulse.com>

P.O. BOX 5120 STN. F
OTTAWA, ONTARIO
CANADA K2C 3H4
TEL: (613) 226-5772
FAX: (613) 226-2802

INSTRUCTIONS

MODEL AVO-6D-C-PN-OP1 PULSE GENERATOR

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

Phone: 613-226-5772 or 1-800-265-6681

Fax: 613-226-2802 or 1-800-561-1970

E-mail: info@avtechpulse.com

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

EC Declaration of Conformity

We

Avtech Electrosystems Ltd.
P.O. Box 5120, Stn. F
Ottawa, Ontario
Canada K2C 3H4

declare that the AVO-6D-C-PN-0P1 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

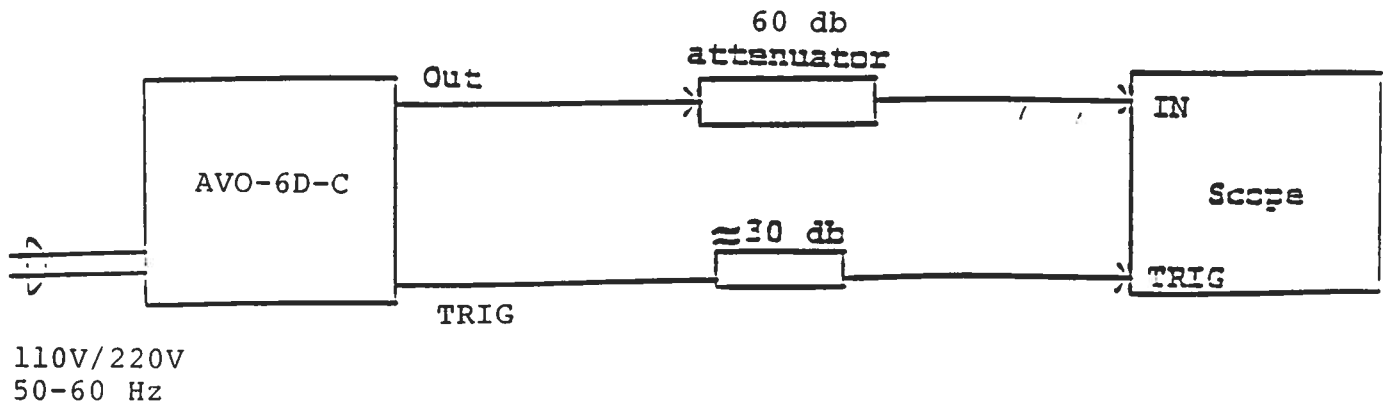


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Fig. 1

PULSE GENERATOR TEST ARRANGEMENT
(AVO-6D-T OUTPUT MODULE REMOVED)



Notes:

- 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-101-6D section (at the end of the manual) for the instructions for this mode of operation.
- 2) The bandwidth capability of components and instruments used to display the pulse generator output signal (attenuators, cables, connectors, etc.) should exceed 100 MHz.
- 3) The use of a 60 dB attenuator at the scope vertical input channel will insure a peak input signal to the scope of less than one Volt (necessary only if sampling scope used). If a high impedance real time scope is used, the pulse generator should be terminated using a shunt 50 Ohm resistor. Note that the unit provides a peak output as high as 250 Volts.
- 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 PW and PRF controls on the front panel should be set mid range. The front panel TRIG toggle switch should be in the INT position. The 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 controls.
- 6) The output pulse width is controlled by means of the front panel one turn PW control and the two-position range switch.
- 7) The output pulse polarity is controlled by the front panel two position polarity switch.
- 8) The output pulse amplitude is controlled by means of the front panel AMP control.
- 9) To voltage control the output pulse width, set the rear panel switch in the EXT position and apply 0 to +10V to connector A ($R_{IN} \geq 10K$). (option).

- 10) To voltage control the output amplitude, set the rear panel switch in the EXT position and apply 0 to +10V to connector A ($R_{IN} \geq 10K$). (option).
- 11) 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.
- 12) CAUTION: The output duty cycle must not exceed 1%. For example, for pulse width of less than 1 us, the PRF may be as high as 10 kHz. However, for pulse width of 5 us, the PRF must not exceed 2 kHz.
- 13) AVO-6D 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)

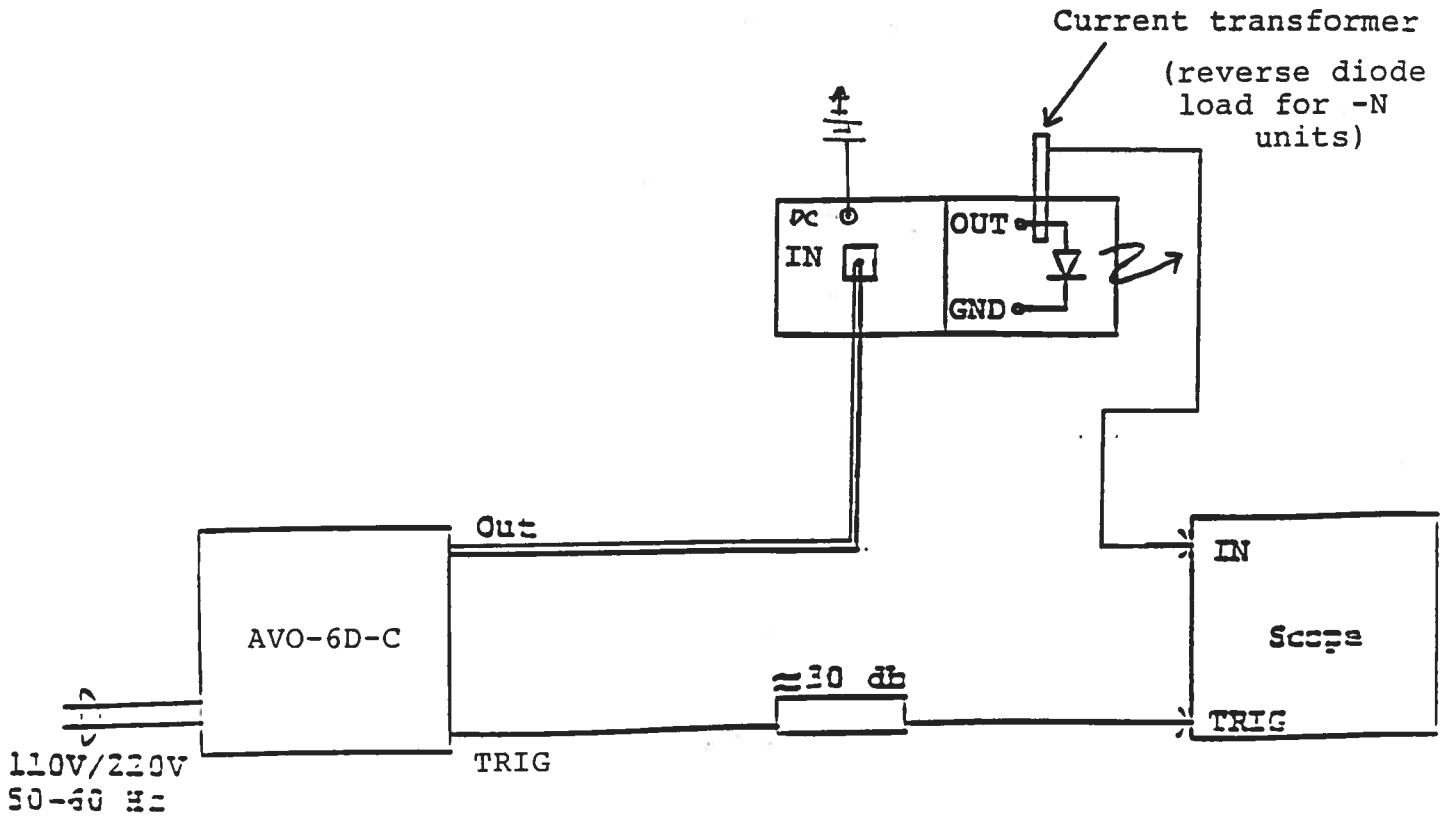
Note that the overload light may briefly illuminate when the prime power is first applied.

- 14) The 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.
- 15) For additional assistance:

Tel: (613) 226-5772
Fax: (613) 226-2802

Fig. 2

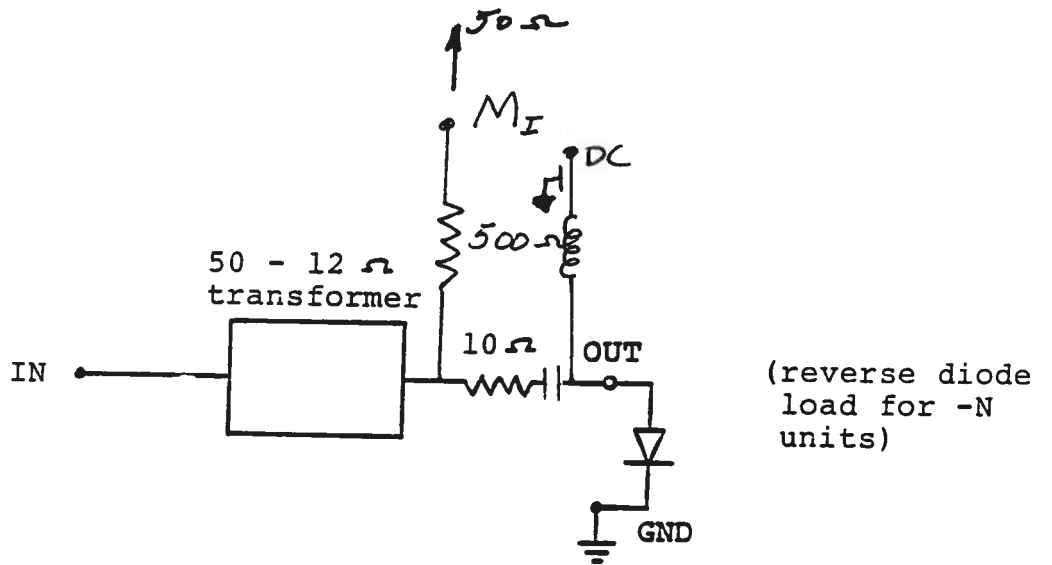
PULSE GENERATOR TEST ARRANGEMENT
(AVO-6D-T OUTPUT MODULE CONNECTED)



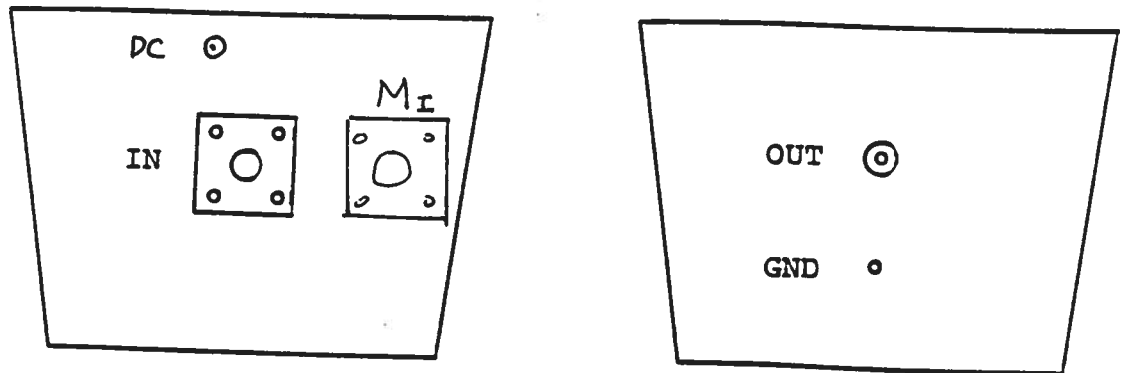
- 1) A general description of the AVO-6D-T module is given in Fig. 3.
- 2) The AVO-6D-T module should be connected to the AVO-6D-C mainframe via the supplied 24" RG174 cable.
- 3) The laser diode is solder-connected between the OUT and GND terminals on the side of the AVO-6D-T module.
- 4) The mainframe provides a voltage pulse of up to 250 Volts to the AVO-6D-T module. The module transforms the pulse to 125 Volts to 10 Ohms in series with the diode to yield a peak diode current of 10 Amps.
- 5) The MI out port should be connected to 50 Ohms to provide a voltage pulse (V_{MI}) which is 0.1 of the amplitude of the voltage pulse applied to the 10 Ohms in series with the diode load. The diode current (I_D) is then given by (option):

$$I_D = \frac{10 (V_{MI} - V_{DIODE})}{10} \approx V_{MI} - 2.5$$

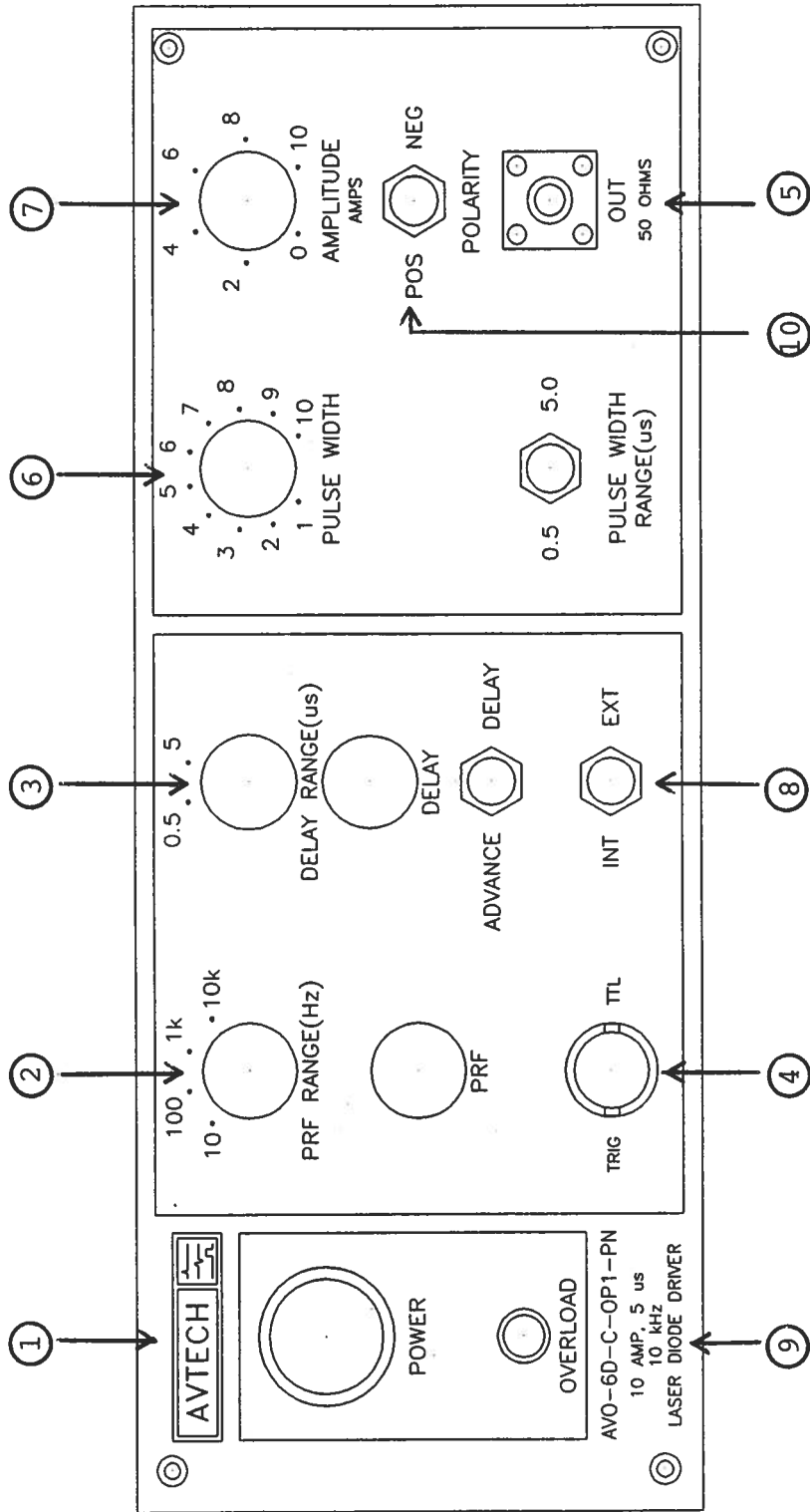
- 6) The diode current may also be monitored using a current probe (such as the TEKTRONIX CT-1, CT-2 series) or it may be monitored by placing a one Ohm resistor (to ground) in series with the laser diode. However, with this arrangement, the output waveform will exhibit pronounced overshoot and undershoot (but the amplitude and pulse width reading will be valid).
- 7) The DC bias current must not exceed 100 mA.
CAUTION: If the DC bias feature is not used, then the DC terminal must be shorted to ground.



FUNCTIONAL EQUIVALENT CIRCUIT



PACKAGE



FRONT PANEL CONTROLS

Fig. 4

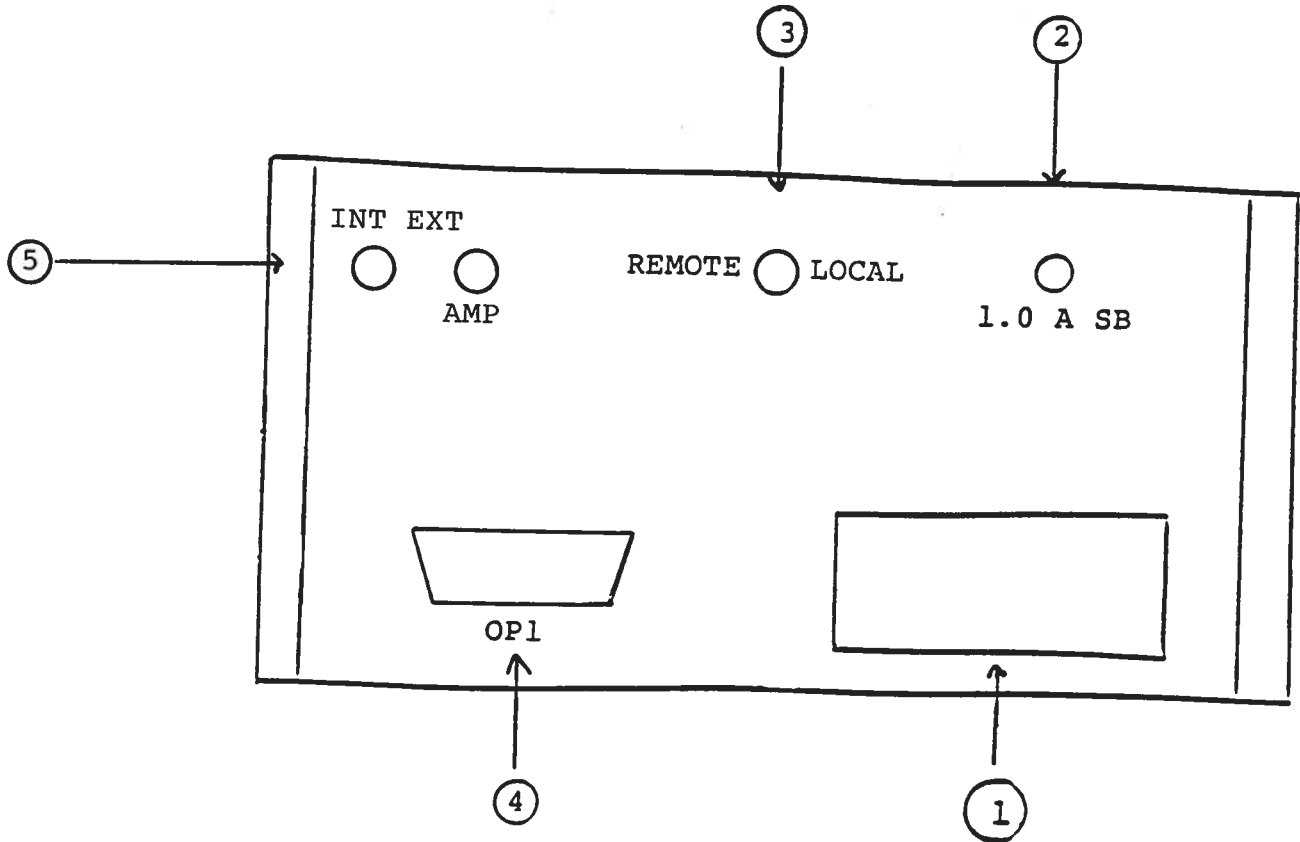
- (1) ON-OFF Switch. Applies basic prime power to all stages.
- (2) PRF Control. Varies PRF from 1 Hz to 10 kHz as follows:

Range 1	1 Hz to	10 Hz
Range 2	10 Hz to	100 Hz
Range 3	100 Hz to	1000 Hz
Range 4	1000 Hz to	10 kHz
- (3) DELAY Control. Controls the relative delay between the reference output pulse provided at the TRIG output (4) and the main output (5). This delay is variable over the range of 0 to about 0.5 us (Range 1) or 0.5 to 5.0 us (Range 2). 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) TRIG Output. 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) OUT Connector. SMA connector provides output to AVO-6D-T module (250 Volts to 50 Ohms).
- (6) PW Control. A pot control and two position range switch which vary the output pulse width from 50 to 500 ns and 0.5 us to 5.0 us.
- (7) AMP Control. A pot control which varies the output pulse amplitude from 0 to 250 V to a 50 Ohm load.
- (8) EXT-INT Control. With this toggle switch in the INT position, the PRF of the AVO 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 AVO unit requires a 50 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.

- (9) AVO-6 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)
- 10) Polarity. Two position switch which controls the output pulse polarity (not controlled by -OP1 feature).

Fig. 5

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 (0.5 A SB).
- (2) 1.0A SB. Fuse which protects the output stage if the output duty cycle rating is exceeded.
- (3) LOCAL REMOTE SWITCH. This two-position switch must be in the LOCAL position to operate this instrument from the front panel controls. To control the instrument using your personal computer, the switch must be in the REMOTE position.
- (4) OP1 CONNECTOR. GPIB cable (supplied) connects between this connector and your personal computer.
- (5) EA. To voltage control the output amplitude, set the switch in the EXT position and apply 0 to +10 volts ($R_{IN} > 10K$) (option) to the Amp BNC connector.

SYSTEM DESCRIPTION AND REPAIR PROCEDURE

The AVO-6D-C consists of the following basic modules:

- 1) AVO-6D-PG pulse generator module
- 2) AVO-CL2 clock module
- 3) +24V power supply board
- 4) AVO-6D-PS-PW pulse width control-power supply module
- 5) AVO-6D-T output module

The modules are interconnected as shown in Fig. 5. The clock module controls the output PRF and the relative delay between the main output and the SYNC outputs. The PG pulse generator modules generate the output pulse. In the event of an instrument malfunction, it is most likely that the rear panel 1.0A SB fuse or some of the output switching elements (SL4T) may have failed due to an output short circuit condition or to a high duty cycle condition. The switching elements may be accessed by removing the cover plate on the bottom side of the instrument. NOTE: First turn off the prime power. The elements may be removed from their sockets by means of a needle nosed pliers. The SL4T is a selected VMOS power transistor in a TO 220 package and may be checked on a curve tracer. If defective, replacement units should be ordered directly from Avtech. When replacing the SL4T switching elements, take care to insure that the short lead (of the three leads) is adjacent to the black dot on the chassis. If the switching elements are not defective, then the four Phillips screws on the back panel should be removed. The top cover may then be slid off and operation of the clock and power supply modules should be checked. The clock module is functioning properly if:

- a) 0.1 us TTL level outputs are observed at pins 2 and 3.
- b) The PRF of the outputs can be varied over the range of 10 Hz to 100 kHz using the PRF controls.
- c) The relative delay between the pin 2 and 3 outputs can be varied by at least 5 us by the DELAY controls.

The sealed clock module must be returned to Avtech for repair or replacement if the above conditions are not observed. The power supply board generates +24V DC to power the other modules. If the voltage is less than +24V, turn off the prime power and unsolder the lead from the 7824 regulator chip on the power supply board. Solder a 100 Ohm 5 Watt resistor to the 7824 output to ground and turn on the prime power. A voltage of +24 Volts should be read. If the voltage is less then the power supply board is defective and should be repaired or replaced.

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:

- SH0, 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 width, pulse amplitude delayed (or advanced) trigger output and output pulse polarity.

The available command acronyms, outputs, units and range of acceptable values for the AVO-6D-C-OP1 generator are defined in the table below:

Acronym	Output	Units	Range	Decades
I	Peak amplitude	Amps	0 to 10	
R	Repetition rate	Hertz	1 to 10000	4
W	Width of pulse	micro-sec	0.05 to 5	2
D	Delay (trigger)	micro-sec	0.05 to 5	2
A	Advance (trigger)	micro-sec	0.05 to 5	2

OP-1 Operating Instructions

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=2" will cause exactly the same result if the command is sent as "I (peak current) level of output pulse =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, rep rate values of 128.2, 128.3 or 128.2145 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=0.2" will result in the same output as the command "delay = 0.2 micro-seconds".

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.

2.3 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=2

A=1

W=0.2

OP-1 Operating Instructions

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

```
ibwrt "r=100"  
ibwrt "i=2"  
ibwrt "a=1"  
ibwrt "w=0.2"
```

This command sequence will cause the generator to produce a positive output pulse of width 0.2 micro-sec and an amplitude of 2 amps 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 1 micro-sec after the trigger pulse occurs.

2.4 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", 2  
PRINT #1, "OUTPUT 8;R", 100  
PRINT #1, "OUTPUT 8;A", 1  
PRINT #1, "OUTPUT 8;W", 0.2  
END
```

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 ratio 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.

January 28 198

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