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-6C-C-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 dissembled, 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

TABLE OF CONTENTS

WARRANTY 1

TABLE OF CONTENTS 2

OPERATING INSTRUCTIONS 4

TEST ARRANGEMENT 8

FRONT PANEL CONTROLS 11

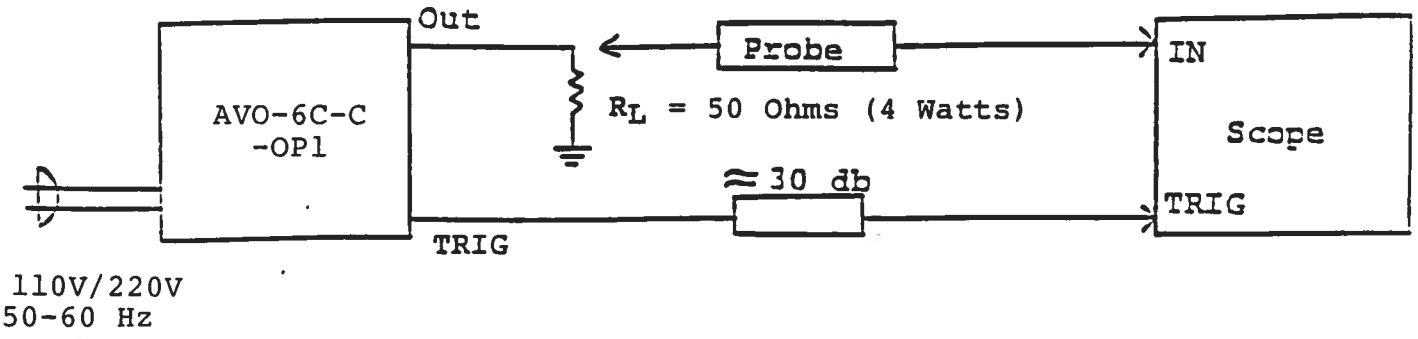
BACK PANEL CONTROLS 14

TOP COVER REMOVAL AND RACK MOUNTING 15

SYSTEM DESCRIPTION AND REPAIR PROCEDURE 16

FIG 1: PULSE GENERATOR TEST ARRANGEMENT

AVO-6C-T OUTPUT MODULE REMOVED
(MANUAL FRONT PANEL CONTROL)



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-101-6C 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 500 MHz. CAUTION: This unit requires a 50 Ohm load and it may be damaged if operated into a load other than 50 Ohms. Also note that the unit provides an output pulse as high as 250 Volts.

3) 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.

4) The output pulse width is controlled by means of the front panel one turn PW control and by the PW RANGE control. The minimum and maximum PW for each range and the corresponding maximum PRF are as follows. Note that the unit may fail if operated at duty cycles exceeding 1.0%.

	PW min	PW max
Range 1	50 ns PRF max 10 kHz	0.5 us PRF max 10 kHz
Range 2	0.5 us PRF max 10 kHz	5 us PRF max 2 kHz

To voltage control the output pulse width within each range, set the rear panel switch in the EXT position and apply 0 to +10 Volts between terminal A and ground ($R_{IN} \geq 10K$). (option).

5) To obtain a stable output display the PRF control on the front panel should be set mid range. The front panel TRIG 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 control.

6) The output pulse amplitude is controlled by means of the front panel one turn AMP control. To voltage control the output amplitude, set the rear panel switch in the EXT position and apply 0 to +10 Volts to the A BNC connector ($R_{IN} \geq 10K$). (option).

7) 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. For operation in this mode, the scope time base must also be triggered by the external clock rather than from the TRIG output.

8) The DELAY control controls the relative delay between the reference output pulse provided at the TRIG output and the main output. This delay is variable over the range of 5.0 ns to 5.0 us. 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.

	MIN	MAX
Range 1	50 ns	0.5 us
Range 2	0.5 us	5 us

(9) AVO-C units with a serial number higher than 5600 are protected by an automatic average power overload protective circuit which controls the front panel overload light. If the unit is overloaded (by operating at an exceedingly high duty cycle), 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) Reducing the output amplitude

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

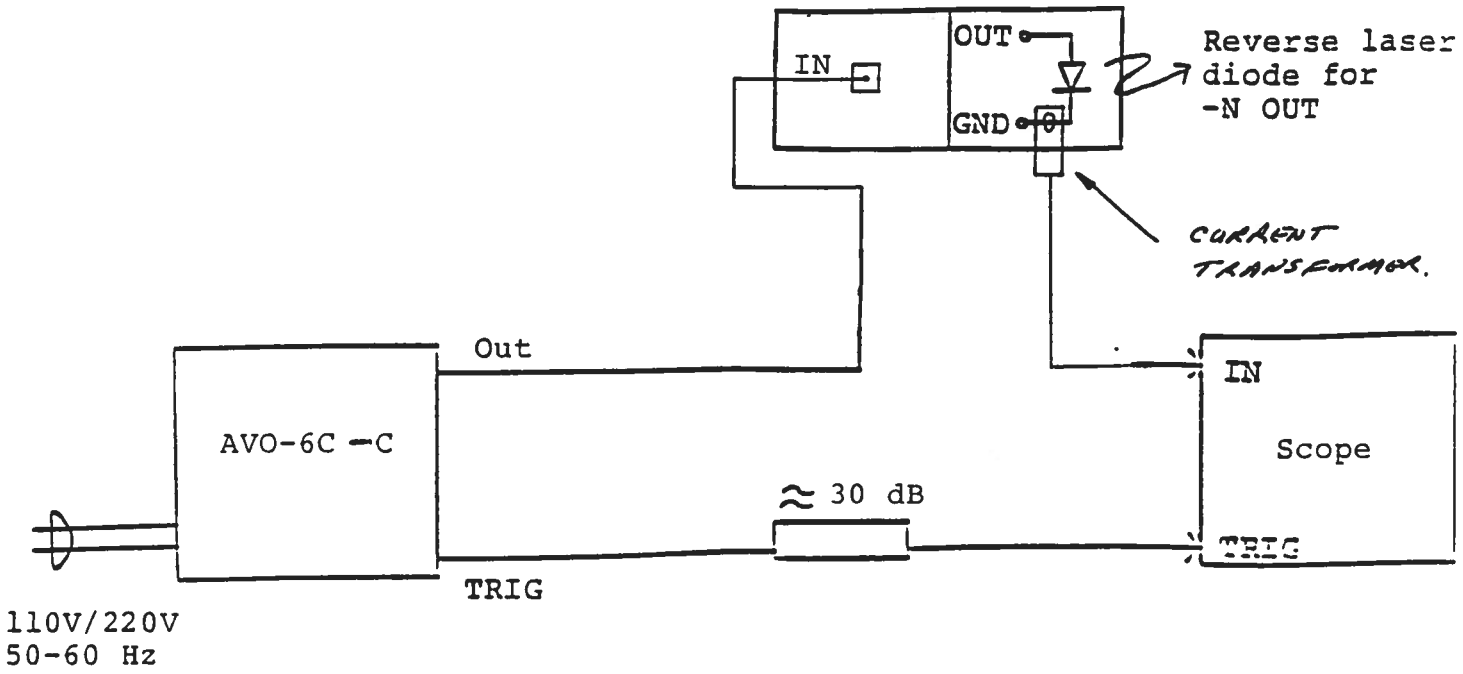
10) The unit can be converted from 120 to 240V 50-60 Hz operation by adjusting the voltage selector card in the rear panel fused voltage selector-cable connector assembly.

11) For additional assistance:

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

FIG 2. PULSE GENERATOR TEST ARRANGEMENT

(AVO-6C-T OUTPUT MODULE CONNECTED)



TEST ARRANGEMENT

1) A general description of the AVO-6C-T module is given in Fig. 3.

2) The AVO-6C-T module should be connected to the AVO-6C-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-6C-T module.

4) The mainframe provides a voltage pulse of up to 200 Volts to the 40 Ohms in series with the laser diode in the AVO-6C-T module (to provide a maximum current of 5 Amperes).

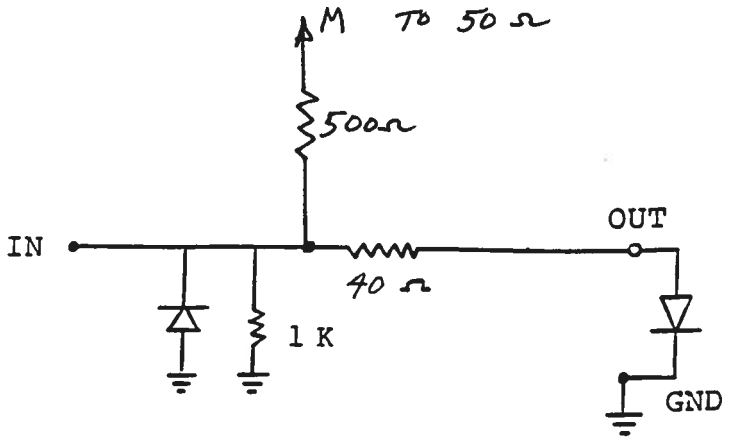
5) The M out port provides a voltage pulse (V_M) which is 0.1 of the amplitude of the voltage pulse applied to the input of the AVO-6C-T module. The voltage V_M (Volts) and diode current I_D (Amps) are related as follows:

$$I_D = \frac{10\,V_M - V_F}{40}$$

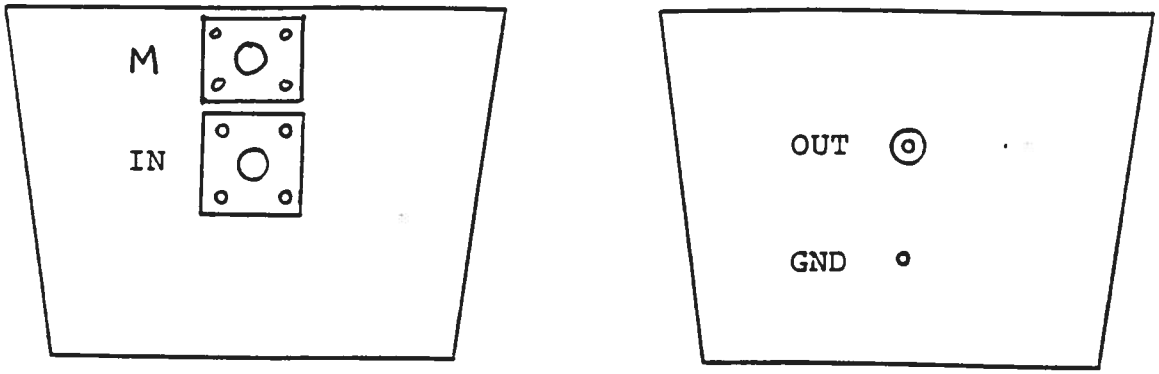
V_F = laser diode ON voltage, typically 2 Volts.

6) The diode current may 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).

FIG 3: AVO-6C-T



FUNCTIONAL EQUIVALENT CIRCUIT



PACKAGE

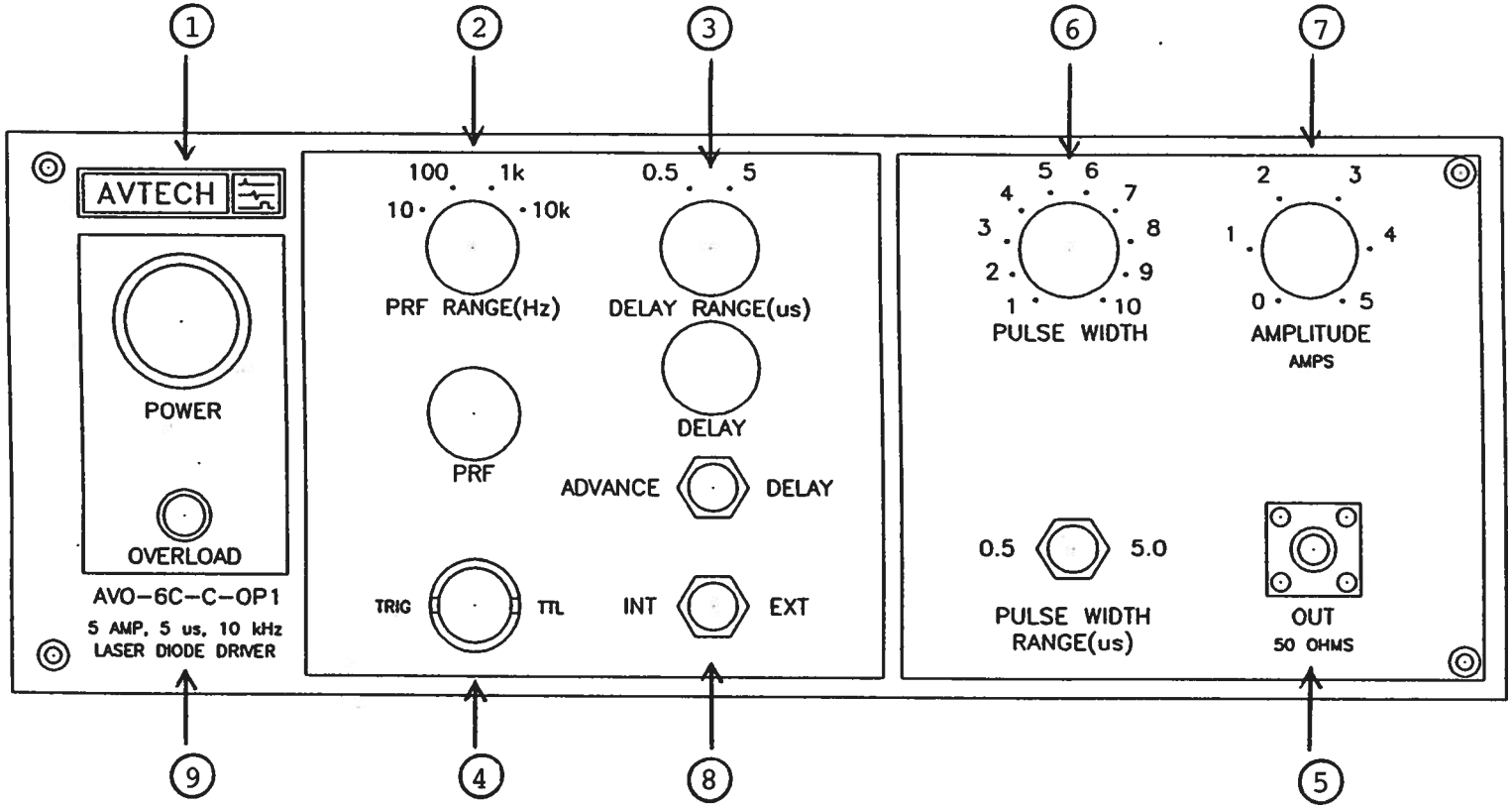


Fig. 4

FRONT PANEL CONTROLS

FRONT PANEL CONTROLS

(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 1 kHz
Range 4	1 kHz 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 1.0 us (Range 1) or 1.0 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-6C-T module (200 Volts to 40 Ohms).

(6) PW Control. A pot control and two position range switch which vary the output pulse width from 50 ns to 0.5 us and 0.5 us to 5.0 us. 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.

(7) AMP Control. A pot control which varies the output pulse amplitude from 0 to 200 V to a 40 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.

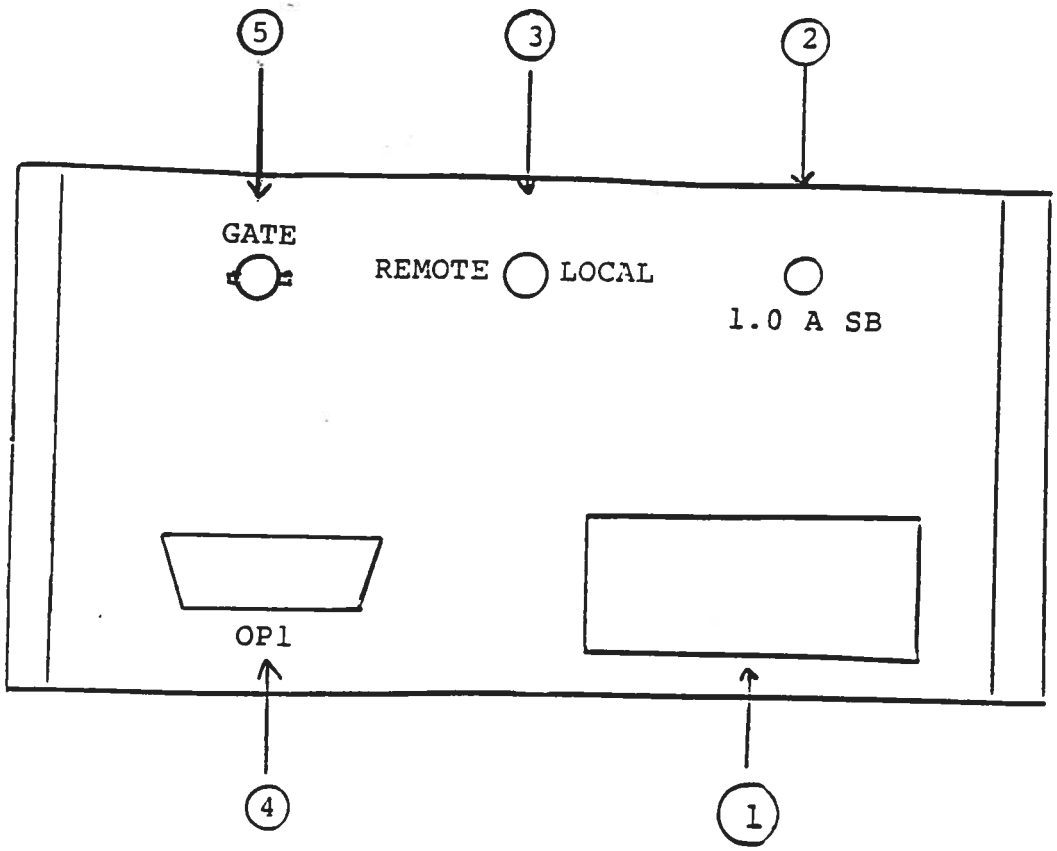
(9) OVERLOAD INDICATOR. AVO units with a serial number higher than 5600 are protected by an automatic overload protective circuit which controls the front panel overload light. If the unit is overloaded (by operating at an exceedingly high duty cycle or by operating into a short circuit), the protective 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 the overload light may indicate when the prime power is applied. The light will extinguish after a few seconds and the unit will then operate normally.

FIG 5: BACK PANEL CONTROLS



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) GATE. The application of a +5 VDC level to this BNC connector inhibits the output pulse (option).

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).

SYSTEM DESCRIPTION AND REPAIR PROCEDURE

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

1) AVO-6C-PG pulse generator module
2) +24V power supply board
3) -PS power supply module
4) AVO-OL overload module
5) OP1 Interface controller PCB

The modules are interconnected as shown in Fig. 5. The OP1 PCB module controls the output PRF and the relative delay between the main output and the TRIG outputs. The PG pulse generator module generates 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 (SL9T, SL23T) 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 SL9T and SL23T are selected VMOS power transistors in TO 220 packages and may be checked on a curve tracer. If defective, replacement units should be ordered directly from Avtech. When replacing the SL9T and SL23T switching elements, take care to insure that the short lead (of the three leads) is adjacent to the black dot on the chassis. CAUTION: The SL9T element must be placed adjacent to the single black dot while the SL23T element must be placed adjacent to the double black dot. 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 1 Hz to 10 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 and delayed (or advanced) trigger output.

The available command acronyms, outputs, units and range of acceptable values for the AV-6C-C-F1 generator are defined in the table below:

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

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 cause 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, rep rate values of 1.282, 1.283 or 1.282145 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=2" will result in the same output as the command "delay = 2 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.

2.3 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= 1
A=1
W=2

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=1"
ibwrt "w=2"
```

This command sequence will cause the generator to produce an output pulse of width 2 micro-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 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", 1
PRINT #1, "OUTPUT 8;R", 100
PRINT #1, "OUTPUT 8;A", 1
PRINT #1, "OUTPUT 8;W",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 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.

NOV 4/4/

In Word

File: C:\INSTRUCT\AV06\6CCOP1.DOC