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INSTRUCTIONS

MODEL AV-108B-3-C-OP1 LASER DIODE DRIVER

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 or liability assumed by Avtech with respect to this product and no other warranty or guarantee is either expressed or implied.

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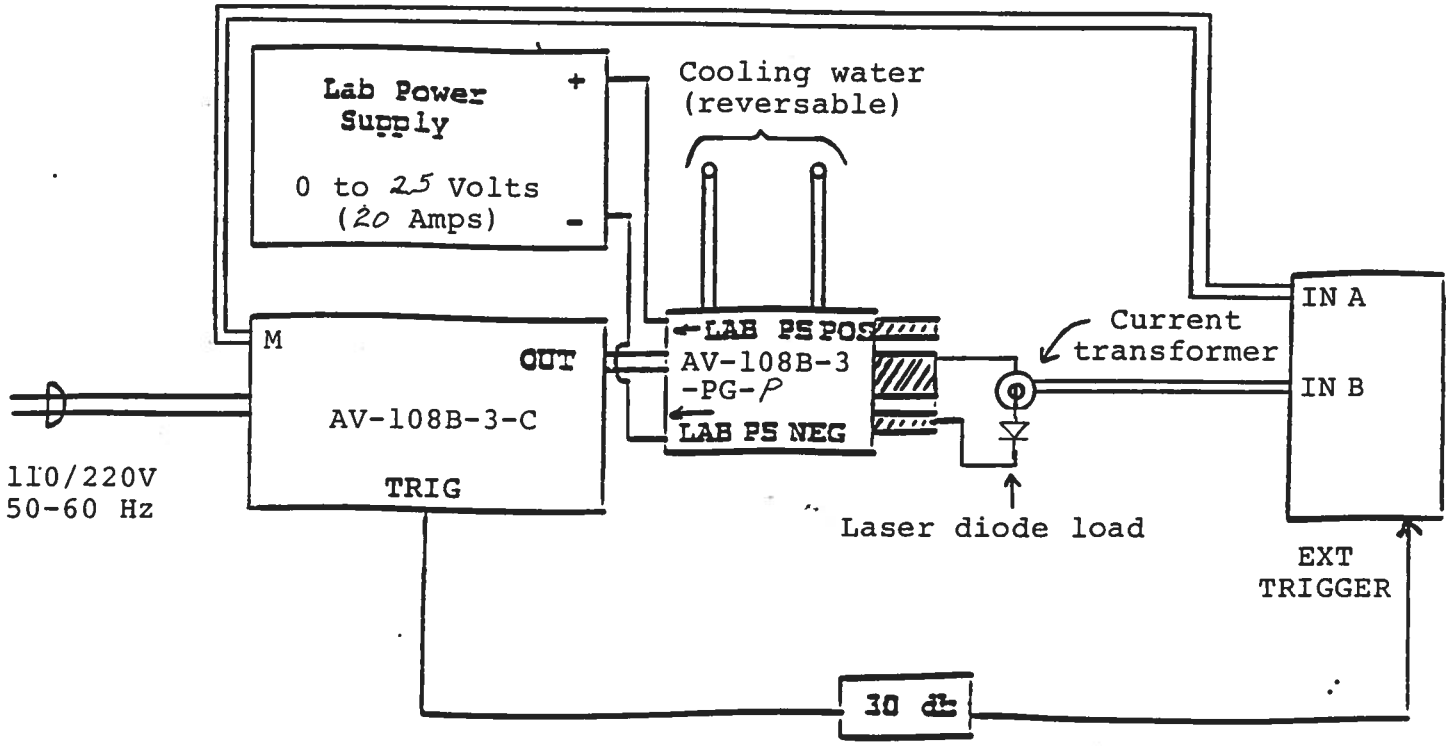
Fig. 1 PULSE GENERATOR TEST ARRANGEMENT



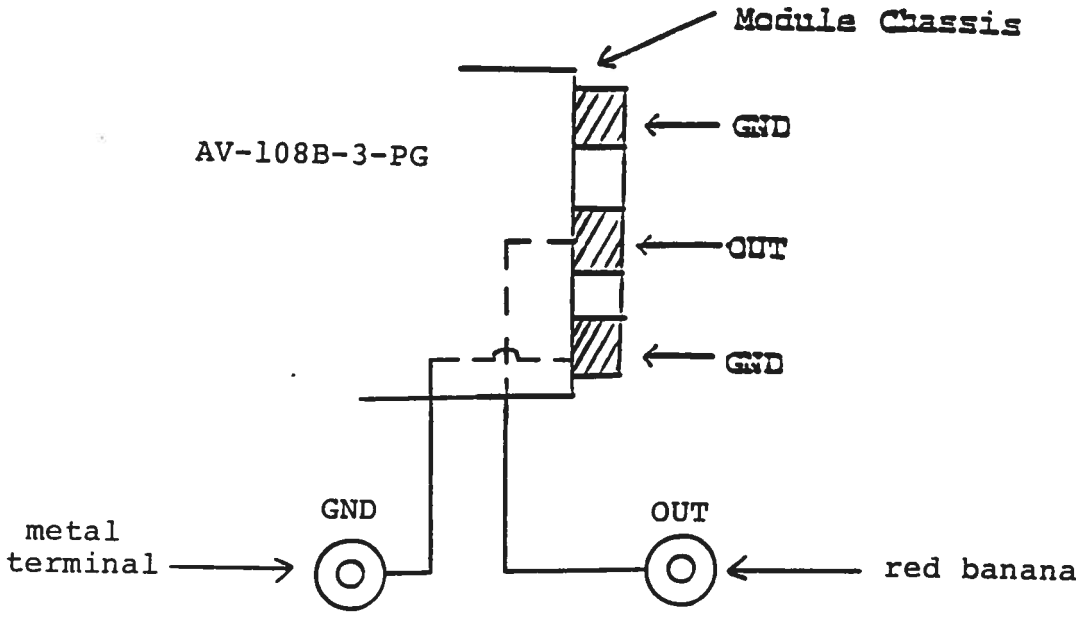
GENERAL OPERATING INSTRUCTIONS

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-AV-108B-C section (page 17) for the instructions for this mode of operation.

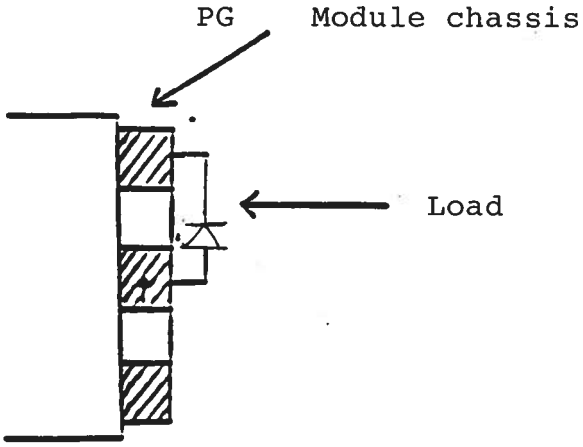
2) The equipment should be connected in the general fashion shown above. The user supplied lab power supply attaches to the -PG output module via the red and black SUPERCON connectors which are supplied. The positive terminal of the power supply is to be connected to the RED SUPERCON connector on the -PG module. The negative terminal on the lab power supply is to be connected to the BLACK SUPERCON connector on the -PG module. CAUTION: The -PG module may be damaged if polarities are reversed. Note that an alarm will sound if the power supply voltage exceeds 25 Volts. Normally, the power supply should be set at 20 Volts. The lab power supply should be set to current limit so that average current supplied to the -PG module cannot exceed 20 Amperes (the AV-108B-3-C has a maximum duty cycle rating of 10%). Note that the peak output current of 200 Amperes is supplied by the very large energy storage capacitors (200,000 ufd) in the -PG module.

3) It is critically important that a cooling water supply be connected to the -PG module, particularly if operated at high peak currents and near the maximum duty cycle. It is recommended that the -PG module be connected to a tap water outlet. Without the water cooling, the unit will operate for several minutes (at the maximum duty cycle) and then a loud audible alarm will sound and the unit will cease to trigger. The alarm can be turned off by turning off the 60 Hz prime power or by reducing the duty cycle and allowing the unit to cool down. The water pipes protruding from the side of the -PG module have a male 1/4" NPT thread.

4) The output terminals of the pulse generator module consists of a short length of microstrip transmission line protruding from the module chassis. The OUT terminal is the center conductor which is bounded on both sides by the ground plane (see below). Note that the "OUT" red banana terminal is in parallel with the microstrip center conductor and so may also be used as the output terminal.



The load should be connected between the OUT and GND terminals using very short leads (≤ 10.0 cm). If the load cannot be placed directly on the output terminals of the -PG module, the AV-LZ lines should be used between the -PG module and the load (see AV-LZ data sheet). Take care to insure that during soldering the OUT conductor is not shorted to the chassis. Also, use minimal heat when soldering.



CAUTION. It is critically important that the load inductance be kept low as the associated inductive voltage kick may damage the lased diode load and/or degrade the current rise time (see paragraph 14 of the Start-Up Check List).

5) The current waveform through the diode load may be monitored using a current transformer (available from PEARSON ELECTRONICS or ION PHYSICS INC.) or by using the rear panel monitor output (M). (See paragraph 16).

6) When the PW MODE switch is in the INT position, the output pulse width is controlled by the 3 position range switch and a ten turn fine control. CAUTION: When setting the pulse width it is critically important that the duty cycle be less than 10% (see 10). (See (11) for PW control when the PW MODE switch is in the EXT position).

7) The output amplitude is controlled by the front panel ten turn amplitude control (before applying power to the AV-108B-C unit this control should be set fully counterclockwise). To voltage control the amplitude, set the rear panel AMP switch in the EXT position and apply 0 to +5 VDC to the "A" BNC connector.

8) 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.

9) To obtain a stable output display the PW and PRF controls on the front panel should be set mid-range. The front panel INT-EXT-MAN-MOD 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. CAUTION: Take exceptional care to insure that the duty cycle does not exceed 10% (see 10 below).

10) CAUTION: The AV-108B-3-C may be damaged if operated at duty cycles exceeding 10%. For example, if the PRF is set at 1 kHz (i.e. a period of 1 ms), the pulse width must not exceed 100 us. Therefore, take extreme care when setting the pulse width and PRF controls to insure that the duty cycle is less than 10% since damage due to excess duty cycle operation is not covered by the warranty.

11) An external clock may be used to control the output PRF of the 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. When triggered externally, the output pulse width is controlled by the front panel PW controls provided the MODE A-B switch is in the A position. The MODE A-B switch is accessed by removing the top cover (by removing the four Phillips screws on the top panel and sliding the top cover back and off). When the MODE A-B switch is in the B position, the output pulse width equals the input trigger pulse width. The unit is shipped with the switch in the A position.

12) For single pulse manual operation, set the front panel INT-EXT-MAN switch in the MAN position and push the SINGLE PULSE button.

13) MOD MODE. The unit will operate as a voltage to current converter if the INT-EXT-MAN-MOD switch is placed in the MOD position and the rear panel EA switch is placed in the EXT position. A 0 to +5 Volt waveform applied to the rear panel "A" BNC terminal will be converted into an output current. CAUTION: Do not exceed the 10% duty cycle rating.

14) 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 1.0 us to 1 ms. 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	1.0 us	10 us
Range 2	10 us	100 us
Range 3	100 us	1.0 ms

15) The AV-108B-3-C is designed to supply up to 200 Amperes peak to a maximum load voltage of 20 Volts. Factory tests are conducted with 3 series silicon high current diodes capable of dissipating at least 400 Watts. Higher load resistance values may be used but the load voltage must be limited to 20 Volts or less. Note that the unit will cease to operate as a constant current source if the load voltage exceeds 20 Volts.

16) OVERLOAD ALARMS. Model AV-108B-3-C includes a high voltage protection circuit which sounds a loud audible alarm if the applied DC voltage exceeds 27 VDC. The output stages of the unit will not trigger while the alarm is sounding. The unit also includes a temperature limit circuit which activates the overload LED if the temperature of the output stage switching elements exceeds +50°C. To silence the alarm, do the following:

   1) If the applied voltage was too high, then reduce the power supply voltage

   2) If the output module has overheated (due to poor cooling or high duty cycle operation) then reduce the duty cycle to allow more rapid cooling

   3) To quiet the alarm immediately, simply turn off the 60 Hz prime power

17) The rear panel monitor output BNC (M) provides an output voltage (to 50 Ohms or higher) which is linearly proportional to the current flowing through the output terminals (5 Volts = 200 Amps). The pulse width (and general wave shape) at M is a replica of the load current.

18) CURRENT LIMIT CONTROLS. The P1 and P4 ten turn trim pots (on the -PG module) may be used to limit the peak output current to less than 200 Amps. Rotating P1 CCW will cause the peak output current to be less than 200 Amps when the AMP control is set at max CW. The AMP control will still be active (basically linear) over its full range of rotation. Rotating P4 CCW will cause the output to abruptly limit at less than 200 Amps. The control will be initially linear and then at the limiting point will become inactive. At the time of shipping, both P1 and P4 were set to provide linear, 200 Ampere operation. CAUTION: The P2, P3 and P5 controls are for factory adjustment only. The warranty may become invalid if these 3 controls are adjusted.

19) 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.

20) If application assistance is required:

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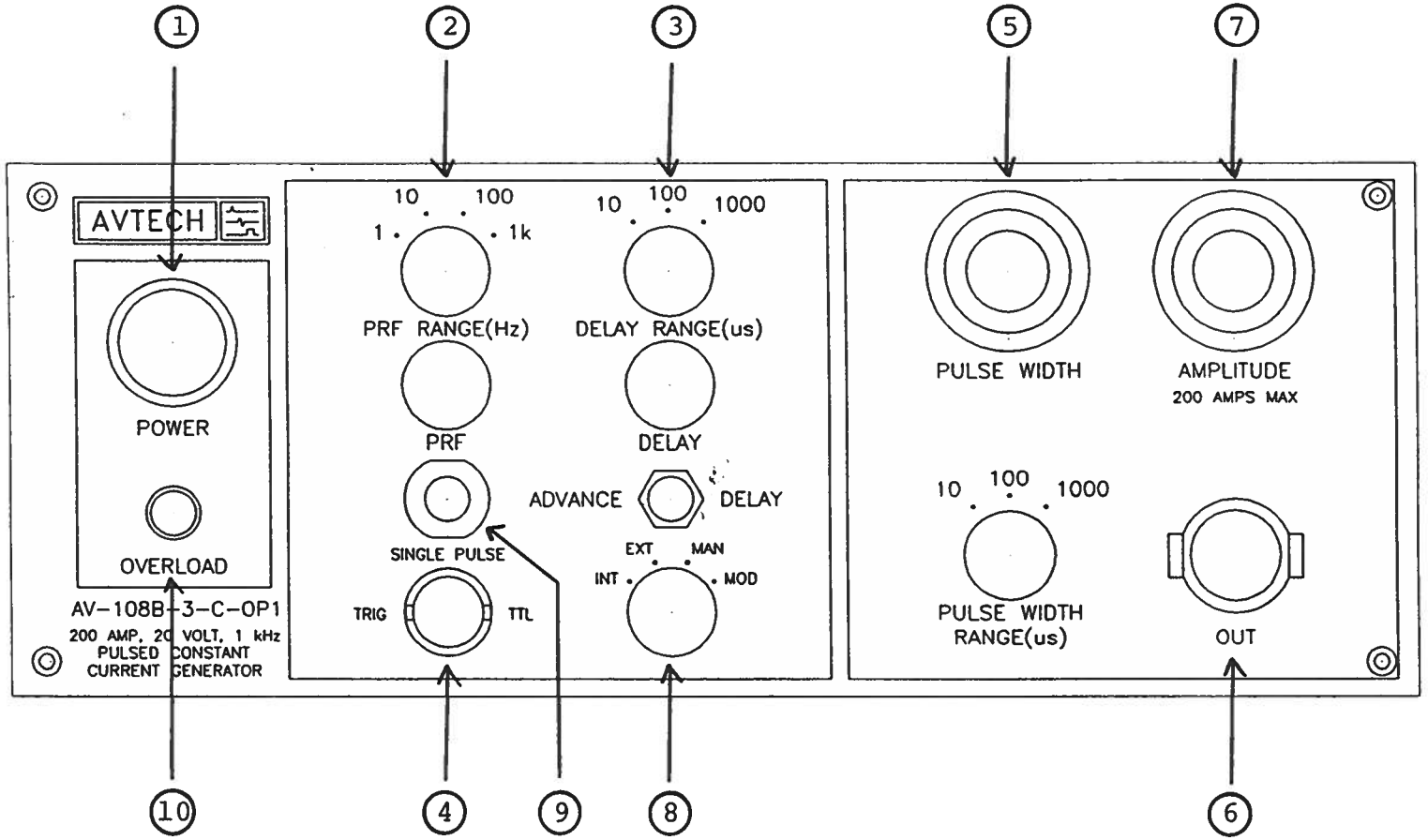


Fig. 2 FRONT PANEL CONTROLS

(1) ON-OFF Switch. Applies basic prime power to all stages.

(2) PRF Control. Varies PRF from 0.1 Hz to 1 kHz as follows:

Range 1	0.1 Hz to 1.0 Hz
Range 2	1.0 Hz to 10 Hz
Range 3	10 Hz to 100 Hz
Range 4	100 Hz to 1.0 kHz

(3) DELAY Control. Controls the relative delay between the reference output pulse provided at the TRIG output (4) and the -PG output. This delay is variable as follows:

Range 1	1 us to 10 us
Range 2	10 us to 0.1 ms
Range 3	0.1 ms to 1 ms

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) PW Control. A one turn control and four position range switch which varies the output pulse width as follows (when the PW MODE switch is in the INT mode):

Range 1	1 us to 10 us
Range 2	10 us to 100 us
Range 3	100 us to 1.0 ms

(6) OUT Connector. A multi pin connector which attaches the 2 foot cable from the pulse generator module to the main frame.

(7) AMP Control. A one turn control (ten turn for -AT option) which varies the output pulse amplitude from 0 to 200 Amps (to 20 Volts max).

(8) INT-EXT-MAN Control. With this toggle switch in the INT position, the PRF of the unit is controlled via an internal clock which in turn is controlled by the PRF control. With the toggle switch in the EXT position, the 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. When triggered externally, the output pulse width is controlled by the front panel PW controls provided the MODE A-B switch is in the A position. The MODE A-B switch is accessed by removing the top cover (by removing the four Phillips screws on the back panel and sliding the top cover back and off). When the MODE A-B switch is in the B position, the output pulse width equals the input trigger pulse width. The unit is shipped with the switch in the A position. For single pulse manual operation, set the INT-EXT-MAN switch in the MAN position and push the SINGLE PULSE button. The unit will operate as a voltage to current converter if the INT-EXT-MAN-MOD switch is placed in the MOD position and the rear panel EA switch is placed in the EXT position. A 0 to +5 Volt waveform applied to the rear panel "A" BNC terminal will be converted into an output current. CAUTION: Do not exceed the 10% duty cycle rating.

(9) SINGLE PULSE. For single pulse manual operation, set the front panel INT-EXT-MAN switch in the MAN position and push the SINGLE PULSE button.

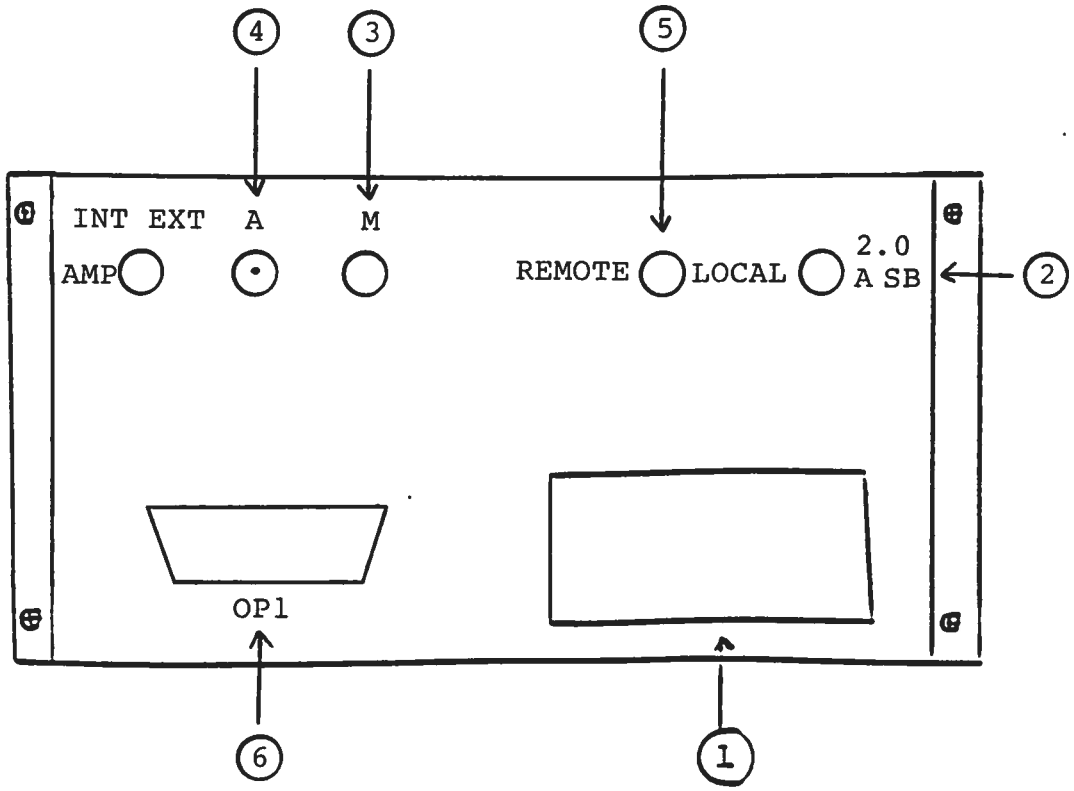
(10) OVERLOAD ALARMS. Model AV-108B-3-C includes a high voltage protection circuit which sounds a loud audible alarm if the applied DC voltage exceeds 27 VDC. The output stages of the unit will not trigger while the alarm is sounding. The unit also includes a temperature limit circuit which activates the overload LED if the temperature of the output stage switching elements exceeds +50°C. To silence the alarms, do the following:

1) If the applied voltage was too high, then reduce the power supply voltage

2) If the output module has overheated (due to poor cooling or high duty cycle operation) then reduce the duty cycle to allow more rapid cooling

3) To quiet the alarm immediately, simply turn off the 60 Hz prime power

Fig. 3 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 (1.0 A SB).

(2) 2.0 A SB. Fuse which limits the current supplied to the mainframe.

(3) M. This monitor output provides an output voltage (to 50 Ohms or higher) which is linearly proportional to the current flowing through the output terminals (5 Volts = 200 Amps). The pulse width (and general wave shape) at M is a replica of the load current.

(4) EA. To voltage control the output amplitude, set the switch in the EXT position and apply 0 to +5V to the "A" BNC connector ($R_{IN} \geq 10K$). (option).

(5) LOCAL REMOTE SWITCH. This two-position switch must be in the LOCAL position to operate the instrument from the front panel controls. To control the instrument using your personal computer, the switch must be in the REMOTE position.

(6) OP1 CONNECTOR. GPIB cable (supplied) connects between this connector and your personal computer.

TOP COVER REMOVAL

To remove the top cover, remove the four Phillips screws on the top cover and then slide the cover back and off.

START-UP CHECK LIST

1) The instruction manual has been studied thoroughly.

2) Connect the tap water supply to the -PG module and turn on the water.

3) The diode load is connected to the output module (the cathode is connected to the OUT terminal). For initial testing purposes, it is recommended that 2 or 3 high power silicon diodes connected in series be used as the test load. The laser diode load should be connected only after all the control functions have been understood and mastered.

4) The power supply positive terminal on the user-supplied lab power supply is connected to the red SUPERCON while the negative terminal is connected to the black SUPERCON and grounded. The power supply potential is set to zero.

5) Set the amplitude control on the mainframe fully CCW and set the pulse width and PRF controls at the approximate desired values (while insuring that the duty cycle is less than 10%).

6) Set the INT-EXT switch on INT.

7) Connect the rear panel M output to the scope (5 VOLT/DIV) and connect the TRIG out to the scope time base.

8) Turn on the prime power to the mainframe. The scope time base should be triggering.

9) Turn on the lab DC power supply and increase the DC voltage to 20 Volts. If an alarm sounds, immediately decrease the DC voltage and investigate the cause (voltage greater than 27 Volts?). At this point, the DC power supply should not supply any average current (but will supply the surge current to charge the 200,000 ufd when the DC voltage setting is being increased).

10) Gradually clockwise rotate the amplitude control on the mainframe and observe the waveform on the scope and the DC current level on the DC power supply. A rectangular pulse should appear on the scope and the amplitude should increase as the amplitude control on the mainframe is rotated clockwise. At the same time, the average current supplied by the DC supply will increase.

11) Observe the pulse width and pulse period on the scope and confirm that the duty cycle does not exceed 10%.

12) Observe the DC current supplied by the DC supply and insure that the average current does not exceed 20 Amperes.

13) Adjust pulse width, pulse period (i.e. PRF) and amplitude to obtain the desired settings.

14) Note that the lab power supply voltage may be reduced to a lower value (as low as 10 Volts) but this will cause the rise time to increase (to as much as 20 us). This is due to the fact that the load voltage normally exhibits an inductive kick (due to LENZ'S LAW)

$$V = L \frac{di}{dt}$$

and so may exceed 20 Volts during the transition time (see the performance check sheet). To minimize this effect, the load inductance must be kept to a minimum. Also note that the diode load may be damaged by the inductive kick associated with the current fall time and so it may be necessary to place a protective shunt diode across the laser diode.

15) If additional assistance is required:

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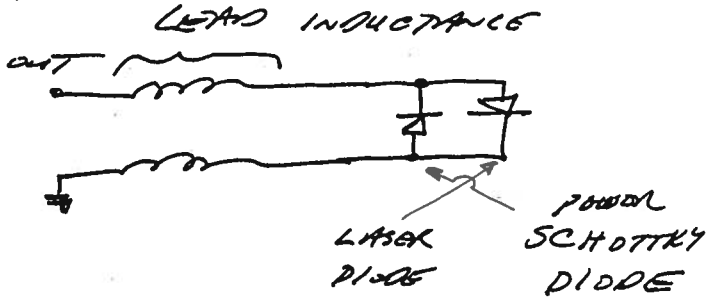
MODEL AV-108B-3-C-OP1

LASER DIODE TEST PRECAUTIONS

When attempting to drive a laser diode, the following precautions must be taken. Failure to do so may result in failure of the laser diode.

1) Extremely low inductance-high current leads must be used to connect the diode to the output terminals, to avoid the inductance kick due to LENZ'S LAW (see page 16 and the performance check sheet). Reverse spikes of 5 or 10 Volts are shown in the performance check sheet where the load was connected using 40 cm long copper strips (about 1 cm wide). Reducing the lead lengths by an order of magnitude would dramatically reduce the reverse spike amplitude.

2) The laser diode should be shunted by a power Schottky diode as shown below to clip any reverse spikes (due to LENZ'S LAW.



3) Initially, the duty cycle should be set extremely low (eg. ≤ 1%) and the peak current low increased in moderate increments.

4) If it is necessary to change PW or PRF ranges, the amplitude setting should first be reduced to zero.

5) Do not connect or disconnect a laser diode unless the prime power to the driver is turned off.

6) The current through the laser diode should initially be monitored using both the rear panel current monitor output and a current probe.

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-108B-3-C generator are defined in the table below:

Acronym	Output	Units	Range	Decades
I	I (current amplitude)	amps	0 to 200	
R	Repetition rate	Hertz	0.1 to 1000	4
D	Delay (trigger)	milli-sec	0.01 to 1	3
A	Advance (trigger)	milli-sec	0.01 to 1	3
W	Width of pulse	milli-sec	0.01 to 1	3

Although the instrument front panel has provision for delays and pulse widths in the range of 1 to 10 us, these values cannot be used when the instrument is in the remote mode.

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 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=2" will result in the same output as the command "delay = 2 milliseconds".

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= 10
A=5
W=2

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

```
ibwrt "r=100"
ibwrt "i=10"
ibwrt "a=5"
ibwrt "w=2"
```

This command sequence will cause the generator to produce an output pulse of width 2 milli-sec and an amplitude of 10 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 5 milli-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", 10
PRINT #1, "OUTPUT 8;R", 100
PRINT #1, "OUTPUT 8;A", 5
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.

March 27/97

Disk: AV-108

Name: 8B3COP1.INS

-M

-EA