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
U.S.A. & CANADA

e-mail: info@avtechpulse.com

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

INSTRUCTIONS

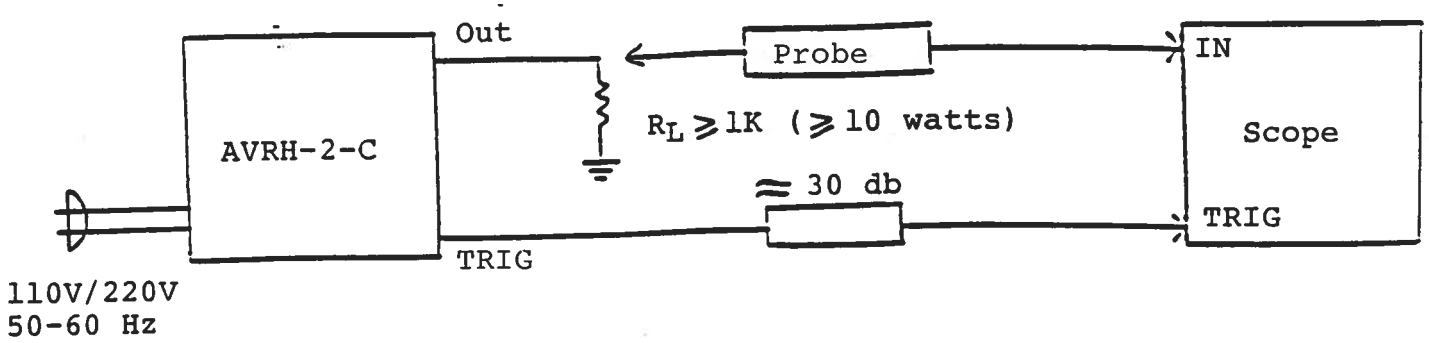
MODEL AVRH-2-C-PN-OP1 PULSE GENERATOR

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 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.

Fig. 1 PULSE GENERATOR TEST ARRANGEMENT



Notes:

1) CAUTION: EXTREME CAUTION SHOULD BE FOLLOWED WHEN USING THIS INSTRUMENT AS IT GENERATES OUTPUT PULSE AMPLITUDES AS HIGH AS 2,000 VOLTS.

2) 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-AVRH 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) The bandwidth capability of components and instruments used to display the pulse generator output signal (attenuators, cables, connectors, etc.) should exceed 50 MHz. The load impedance should not be less than 1,000 Ohms as this will result in possible damage to the output stages. Also, the coaxial cable between the SHV output connector and the load should not exceed about 0.5 meters (or the rise time will be degraded).

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.

   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 0.1 us to 2.5 us.

5) When the Mode AB switch is in the A position, the output pulse width is controlled by means of the front panel one turn PW control.

   When the Mode AB switch is in the B position and the INT-EXT-MAN switch is in the EXT position, the output pulse width is controlled by the pulse width of a TTL pulse applied to the TRIG BNC. CAUTION: The applied pulse width must not exceed 2.5 us.

6) To obtain a stable output display the PRF control 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.

7) The output pulse amplitude is controlled by means of the front panel ten turn AMP control.

* CAUTION: To avoid stressing the output stage it is recommended that the output amplitude control be set fully counter clockwise before applying prime power to the instrument.

8) The output pulse polarity is controlled by the front panel two-position polarity switch. CAUTION: Before changing polarity, the amplitude must be reduced to near zero (≤300 Volts). If the amplitude is not reduced to near zero, the pulse output will vanish.

9) An external clock may be used to control the output PRF of the AVR 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.

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

11) CAUTION: The output stage is protected against overload condition by a 2.0 A slow blow fuse on the main frame back panel. However, the output switching elements may fail if the unit is triggered at a PRF exceeding 1 kHz or at duty cycles resulting in an average output power in excess of 25 Watts. Heating and subsequent likely failure of the output stage is reduced if the following action is taken where possible:

    a) PRF is kept to a minimum, i.e. operate in a low PRF range when possible rather than in a high PRF range.
    b) Keep the output PW to a minimum.

12) OVERLOAD INDICATOR. AVRH 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)

13) Note that when the amplitude or PRF or PW are increased, the output stage of the unit will emit an audible hum. This noise is normal and is due to the step up transformer in the output stage.

14) CAUTION: DC potentials as high as 550 Volts and pulse potentials as high as 2,000 Volts exist in the interior of the instrument. For this reason it is recommended that the top cover of the unit should not be removed and that the unit should be returned to the factory for servicing (when necessary).

15) 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.

16) For further assistance:

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

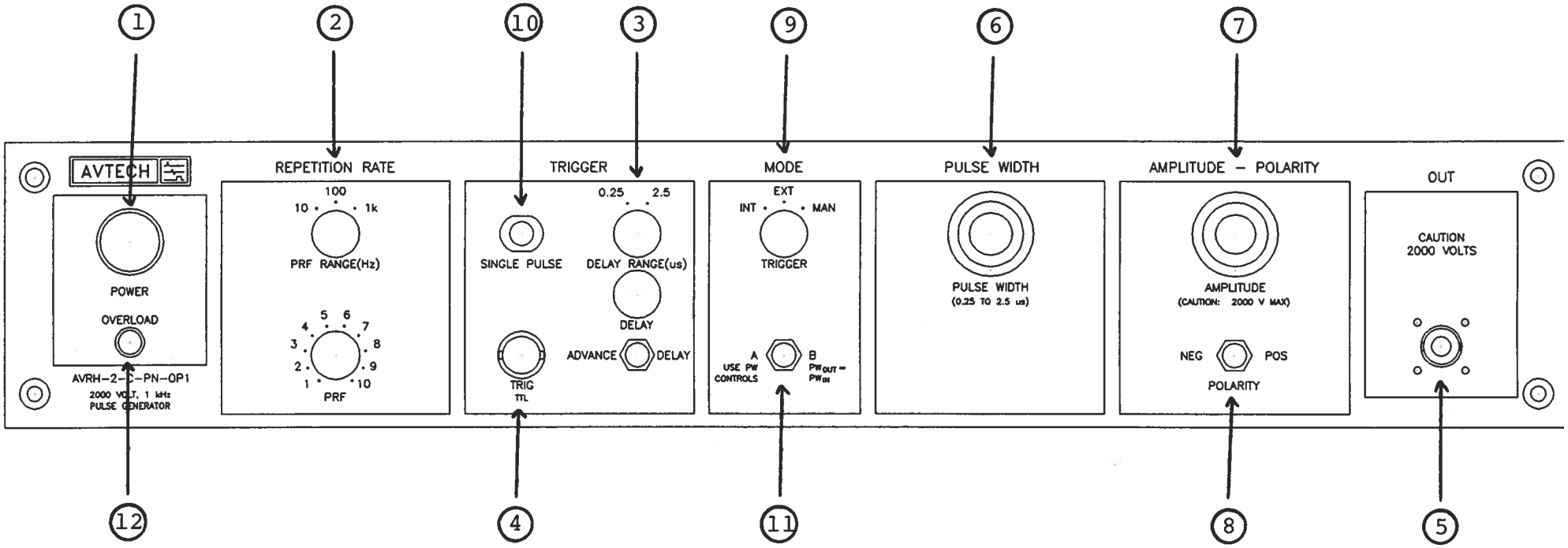


Fig. 2

FRONT PANEL CONTROLS

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

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

Range 1	1 Hz	10 Hz
Range 2	10 Hz	100 Hz
Range 3	100 Hz	1 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 0.1 to about 5 us. Delay LEADS or LAGS depending on the position of the ADVANCE-DELAY switch.

	MIN	MAX
Range 1	0.1 us	0.25 us
Range 2	0.25 us	2.5 us

(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. This output precedes the output at (5) if the two position ADVANCE-DELAY switch is in the ADVANCE position. This output follows the output at (5) if the switch is in the DELAY position. The delay range is variable from 0.1 us to 5 us. The external trigger signal is applied at this input when the EXT-INT toggle switch is in the EXT position.

(5) OUT Connector. SHV connector provides output to a high impedance load (R_L > 1K Ohms). Panel connector will mate to King Model 1705-2 connector (for RG58A cable).

(6) PW Control. A one turn control which varies the positive output pulse width from 0.1 us to 2.5 us (when Mode AB switch is in the A position).

(7) AMP Control. A ten turn control which varies the output pulse amplitude from 0 to 2,000 Volts.

To avoid stressing the output stage, it is recommended that the AMP control be set fully counter clockwise before applying the prime power to the instrument.

(8) POLARITY. The output pulse polarity is controlled by this two-position switch. CAUTION: Before changing polarity, the amplitude should be reduced to zero (≤ 300 Volts). The output pulse will vanish if the amplitude is not reduced.

(9) EXT-INT-MAN Control. With this toggle switch in the INT position, the PRF of the AVRH 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 AVRH 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. With the MODE A-B switch in the A position the output pulse width is controlled by the PW controls. With the MODE A-B switch in the B position, the output pulse width equals the input trigger pulse width. For single pulse operation, set the INT-EXT-MAN switch in the MAN position.

(10) 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.

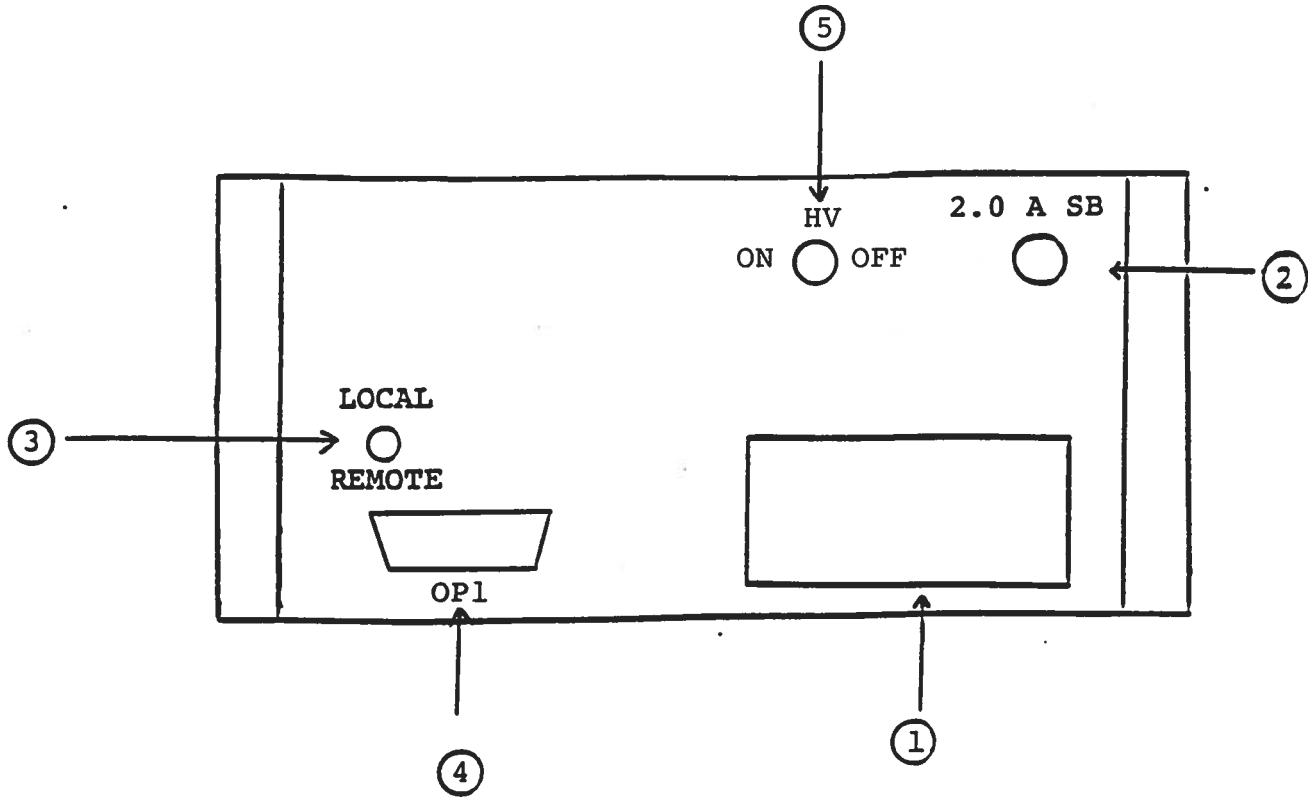
(11) MODE A-B. For output pulse width control via the PW controls, the MODE switch should be in the A position. When triggering via an externally applied TTL level trigger pulse, the output pulse width equals the input trigger pulse width if the MODE switch is in the B position.

(12) OVERLOAD INDICATOR. AVRH 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)

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) 2.0A SB. Fuse which protects the output stage if the output duty cycle rating is exceeded.

(3) 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-AVRH 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.

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

(5) HV ON-OFF. This switch must be in the "ON" position to obtain an output pulse. When prime power is applied to the unit, the output pulse may jump up momentarily to as much as several hundred Volts (even with the amplitude pot set fully CCW). This can be prevented by first setting the HV switch in the "OFF" position and then to the "ON" position after the prime power has been applied.

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.

SYSTEM DESCRIPTION AND REPAIR PROCEDURE

The AVRH-3-C generates a 2,000 Volt pulse by first generating a 500 Volt pulse (of the desired width). This 500 Volt pulse is then supplied to a x4 transformer which increases the output amplitude to 2,000 Volts (to R_L > 1.0K Ohms). DC potentials as high as 550 Volts are employed in the generation of the 500 Volt pulse so extreme caution must be employed when repairing this instrument. It is therefore highly recommended that the unit be returned to AVTECH for all repairs beyond the replacement of the 1.0 Amp line fuse or the 2.0 Amp SB rear panel fuse.

1.0 Introduction

This section describes how to use the OP-1 GPIB 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 listen-only 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 AVRH-2-C-PN-OP1 generator are defined in the table below:

Acronym	Output	Units	Range	Decades
V	Voltage amplitude	Volts	0 to 2000	
R	Repetition rate	Hertz	1 to 1000	3
W	Width of pulse	nano-sec	250 to 2500	1
D	Delay (trigger)	nano-sec	25 to 2500	3
A	Advance (trigger)	nano-sec	25 to 2500	3
P	Polarity		+ or -	

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 "V 70.2" will result in exactly the same result if the command is sent as "Voltage of output pulse = 70.2". However, it is mandatory that the first letter of each command be one of the six 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, amplitude 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+3 will be interpreted as 3, not as 3000.

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 "width =777" will result in the same output as the command " width = 777 nanoseconds".

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.

The polarity of the output pulse is controlled by sending the letter P followed by a + sign for positive or a - sign for negative.

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
W=400
V= 300
A=400
P=+

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

```
ibwrt "r=100"
ibwrt "w=400"
ibwrt "v=300"
ibwrt "a=400"
ibwrt "P=+"
```

This command sequence will cause the generator to produce a series of positve output pulses of width 400 nano-sec and an amplitude of 300 volts 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 be delayed 400 nano-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;V", 300
PRINT #1, "OUTPUT 8;W", 400
PRINT #1, "OUTPUT 8;R", 100
PRINT #1, "OUTPUT 8;A", 400
PRINT #1, "OUTPUT 8;P", +
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.

June 10/96

-R5

Disk: AVRH

Name: 2CPNOP1.INS