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 AVR-G1-C-PN-MITC1-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

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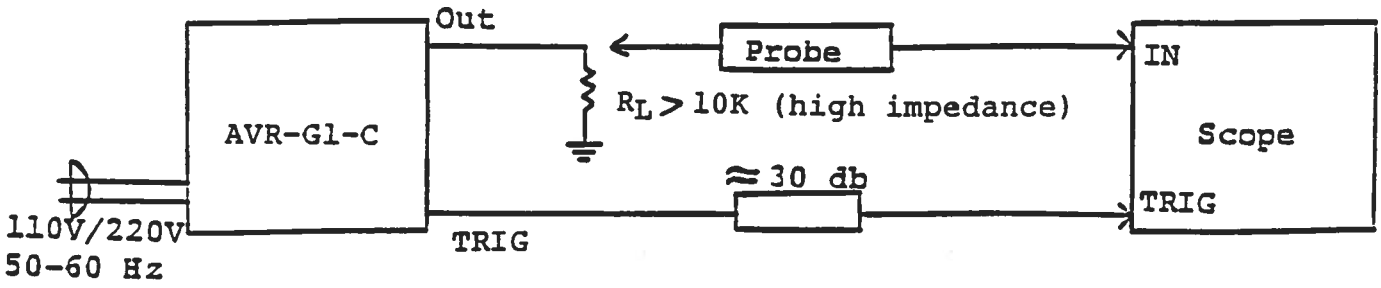
FIG. 1 PULSE GENERATOR TEST ARRANGEMENT



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-102-AVR-G1 section (at the end of the manual) for the instructions for this mode of operation. It is strongly recommended that the manual operation of the instrument be mastered before attempting the computer control 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. Note that this unit is designed to operate into a high impedance (> 10K) and may fail if operated into 50 Ohms.

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.

   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 100 us:

	MIN	MAX
Range 1	0.1 us	1.0 us
Range 2	1.0 us	10 us
Range 3	10 us	100 us

4) The output pulse width is controlled by means of the front panel one turn PW control and by the PW RANGE control (units with -PWT option have a ten turn PW control). Note that the MODE A-B switch must be in the A position. 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 20%:

	PW min	PW max
Range 1	0.1 us PRF max 1 kHz	1.0 us PRF max 1 kHz
Range 2	1.0 us PRF max 1 kHz	10 us PRF max 1 kHz
Range 3	10 us PRF max 1 kHz	100 us PRF max 1 kHz

5) To obtain a stable output display the PRF control on the front panel should be set mid range. The front panel INT-EXT toggle switch should be in the INT position and the MODE A-B switch should be in the A 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 and PRF FINE controls.

6) The output pulse amplitude is controlled by means of the two front panel ten turn AMP controls.

7) An external clock may be used to control the output PRF of the AVR unit by setting the front panel INT-EXT toggle switch in the EXT position and applying a 50 ns (or wider) TTL level pulse to the TRIG BNC connector input. With the MODE A-B switch in the A position, the output pulse width will be controlled by the front panel PW controls. If the switch is in the B position, the output pulse width equals the input trigger pulse width.

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

9) CAUTION: The output stage is protected against overload condition by a 0.25A 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 exceeding 20%. 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.

10) OVERLOAD INDICATOR. AVR-G-C 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)

11) 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.

12) For further assistance:

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

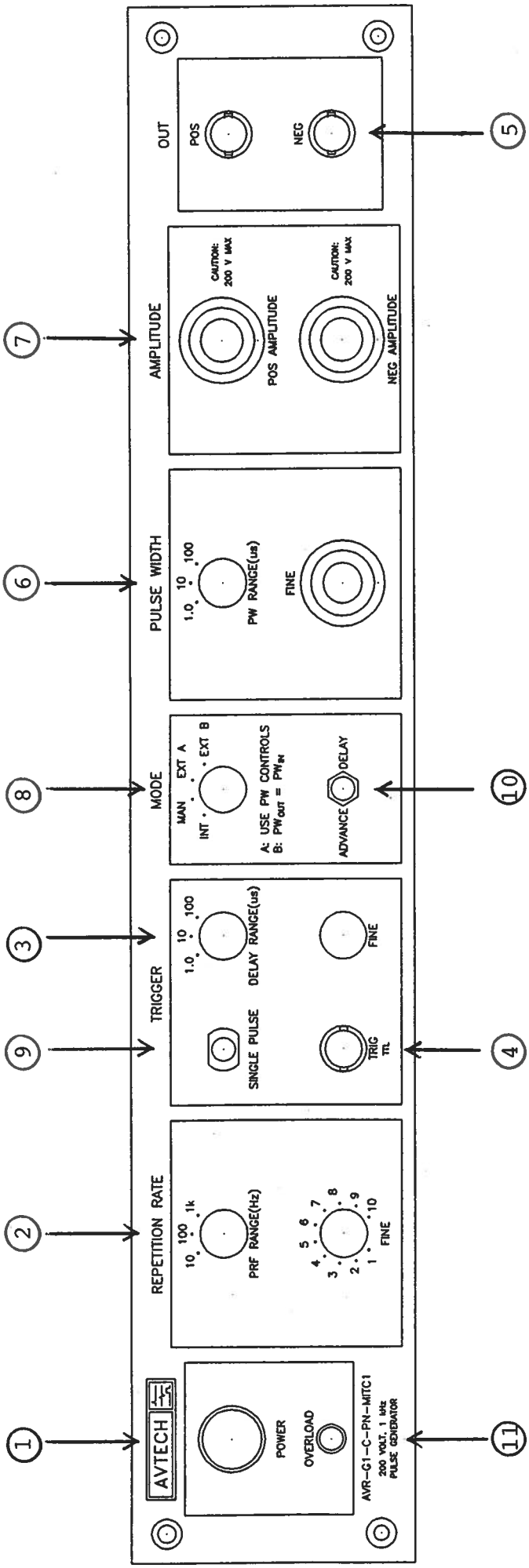


Fig. 2 FRONT PANEL CONTROLS

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

(2) PRF Control. Varies PRF from 1.0 Hz to 1.0 kHz as follows:

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

	MIN	MAX
Range 1	0.1 us	1.0 us
Range 2	1.0 us	10 us
Range 3	10 us	100 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 100 us. The external trigger signal is applied at this input when the EXT-INT toggle switch is in the EXT position.

(5) OUT Connectors. BNC connectors provide outputs to 10K (or higher) loads.

(6) PW Control. A one turn control (ten turn control for units with the -PWT option) and 4-position range switch which varies the positive output pulse width from 0.1 us to 1 ms (when the MODE A-B switch is in the A position). 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 the above.

	PW min	PW max
Range 1	0.1 us PRF max 1 kHz	1.0 us PRF max 1 kHz
Range 2	1.0 us PRF max 1 kHz	10 us PRF max 1 kHz
Range 3	10 us PRF max 1 kHz	100 us PRF max 1 kHz

(7) AMP Controls. Two ten turn controls which varies the output pulse amplitudes (POS and NEG).

(8) EXT-INT-MAN Control. With this toggle switch in the INT position, the PRF of the AVR 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 AVR 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.

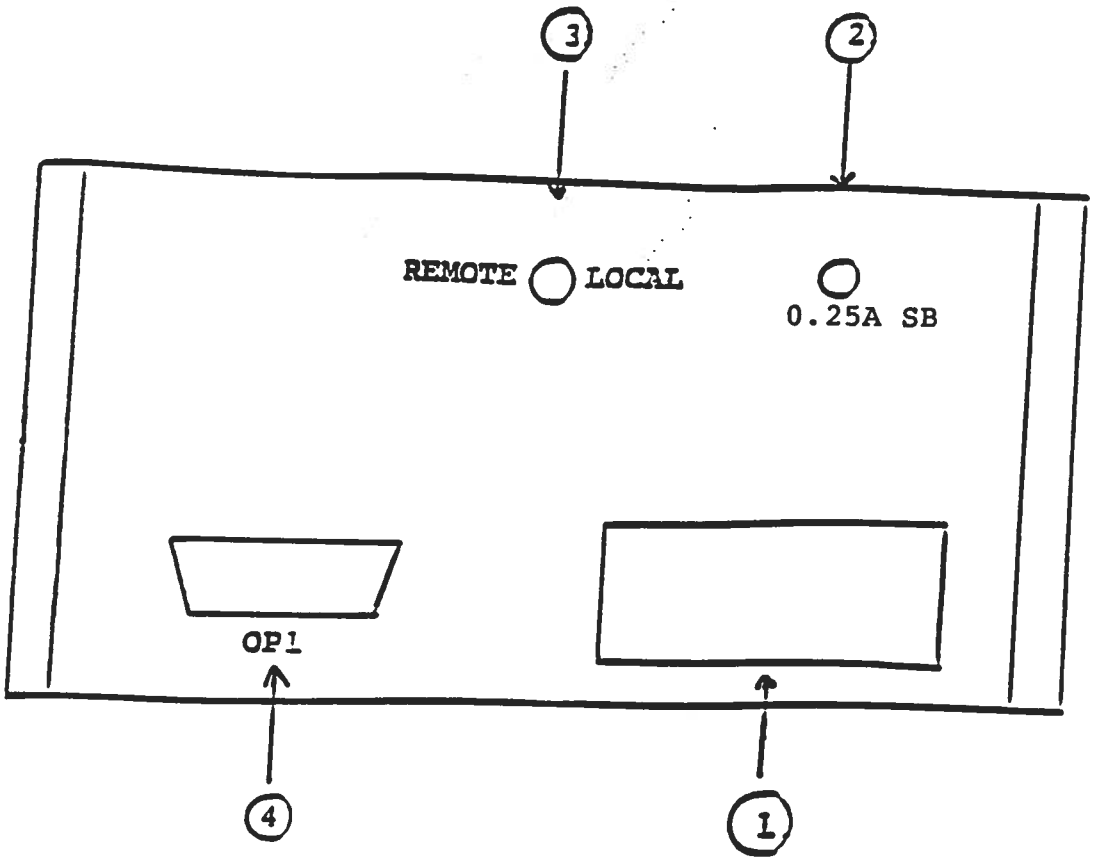
(9) SINGLE PULSE. For single pulse manual operation, set the front panel INT-EXT-MAN switch in the MAN position and push the SINGLE PULSE button.

(10) 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.

(11) OVERLOAD INDICATOR. AVR 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 output operating voltage. The unit also contains the main power fuse (0.5A SB)

(2) 0.25A 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 the 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.

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 -R 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 AVR-G1-C consists of the following basic modules:

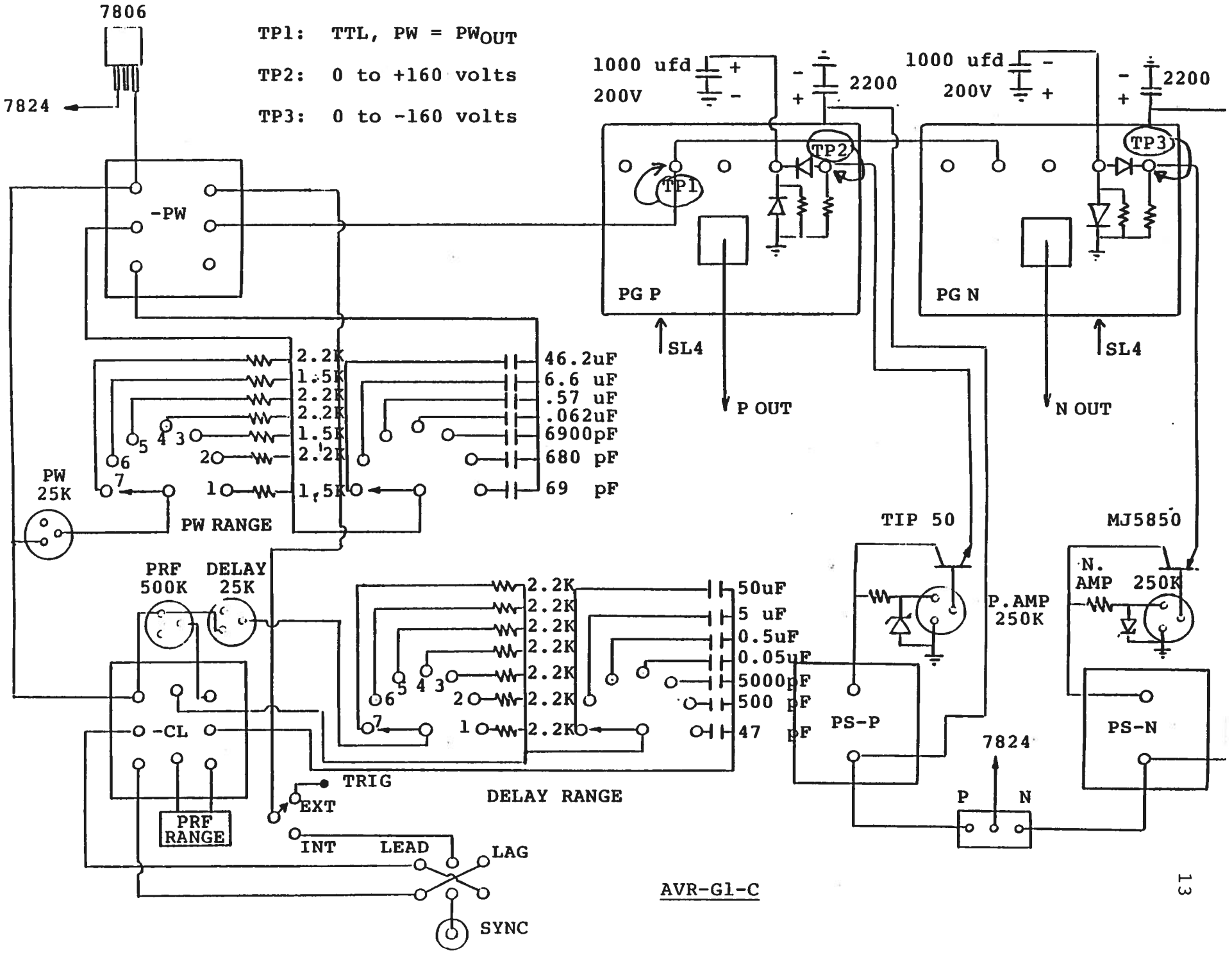
1) AVR-G1-PG pulse generator module
2) AVR-G1-CL clock module
3) +24V power supply board
4) AVR-G1-PS power supply module
5) AVR-G1-PW pulse width module
6) AVR-OL overload module

The modules are interconnected as shown in Fig. 4. 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. The PS module generates 0 to ±200 Volts to power the pulse generator module. The PW module controls the output pulse width. In the event of an instrument malfunction, it is most likely that the rear panel 0.25A 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. CAUTION: Briefly ground the SL4T tabs to discharge the 200 Volts power supply potential. The elements may be removed from their sockets by means of a needle nosed pliers. The SL4T is a selected MOSFET 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 back of 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 1 Hz to 1 kHz using the PRF controls.

c) The relative delay between the pin 2 and 3 outputs can be varied by at least 0.1 us to 1.0 us by the DELAY controls.


7806
7824
TP1: TTL, PW = PWOUT
TP2: 0 to +160 volts
TP3: 0 to -160 volts
1000 ufd
200V
2200
1000 ufd
200V
2200
TP1
TP2
TP3
-PW
PG P
PG N
SL4
SL4
P OUT
N OUT
2.2K
1.5K
2.2K
2.2K
1.5K
2.2K
1.5K
46.2uF
6.6 uF
.57 uF
.062uF
6900pF
680 pF
69 pF
PW
25K
PW RANGE
TIP 50
MJ5850
PRF
500K
DELAY
25K
2.2K
2.2K
2.2K
2.2K
2.2K
2.2K
2.2K
50uF
5 uF
0.5uF
0.05uF
5000pF
500 pF
47 pF
P.AMP
250K
N.
AMP
250K
-CL
PS-P
PS-N
7824
P
N
TRIG
EXT
DELAY RANGE
PRF
RANGE
INT
LEAD
LAG
SYNC
AVR-G1-C

PERFORMANCE CHECK SHEET

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

September 24, 1997.

Leonard Dvorson
M.I.T.
Room 39-651
60 Vassar Street
Cambridge, MA 02139

Tel: 617-253-0720
Fax: 617-253-0062

Dear Leonard:

Following our telephone conversation of September 24th, I am pleased to offer the following revised price and delivery quotation:

Model designation:	AVR-G1-C-PN-MITC1.
Basic description:	One positive and one negative output. The two output pulses are in sync (i.e. not staggered).
PRF:	0 to 1 kHz. Controlled by a 3-position range switch and one turn fine control.
Pulse amplitude:	0 to ±200 Volts, controlled by two separate ten turn amplitude controls.
Pulse width:	100 ns to 100 us, controlled by one common 3-position range switch and a ten turn fine control.
Output impedance:	50 Ohms.
Connectors:	BNC.
Chassis size:	3.9 x 17 x 14.8 inches. Includes a 19 inch rack mount kit.

.../2

Prime power:	120/240 Volts, 50-60 Hz.
Price:	$5,204.00 US each, FOB destination. This price includes our standard 5% academic discount.
Delivery:	60-90 days ARO.
Option available:	-OP1 GPIB control of PRF, pulse width, amplitude (positive and negative separately controlled) and delay (see page 8 of Cat. No. 9). To specify this option, add the suffix -OP1 to the model number and add $1,940.00 US to the price.

This special model is a modified version of our standard AVR-G1-C series (see Cat. No. 9, pages 42 and 43).

Thank you for you continuing interest in our products. Please call me again (1-880-265-6681) if you require any additional information or modifications to the above quotation.

Yours truly,

Dr. Walter Chudobiak
Chief Engineer

WC:my

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.

The available command acronyms, outputs, units and range of acceptable values for the AVR-G1-C-PN-MITC1-OP1 generator are defined in the table below:

Acronym	Output	Units	Range	Decades
PV	Positive voltage O/P	Volts	0 to 200	
NV	Negative voltage O/P	Volts	0 to 200	
R	Repetition rate	Hertz	1 to 1000	3
W	Width of pulse	microsec	0.1 to 100	3
D	Delay (trigger)	microsec	0.1 to 100	3
A	Advance (trigger)	microsec	0.1 to 100	3

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 "PV=20" will cause exactly the same result if the command is sent as "Positive voltage level of output pulse =20". 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, 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=22" will result in the same output as the command "delay = 22 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
PV=40
NV=30
A=5
W=5

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

```
ibwrt "r=100"
ibwrt "pv=40"
ibwrt "nv=30"
ibwrt "a=5"
ibwrt "w=5"
```

This command sequence will cause the generator to produce pulses with a 5 micro-second width, a positive voltage amplitude of 40 volts peak and a negative voltage amplitude of 30 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 occur 5 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;PV",40
PRINT #1, "OUTPUT 8;NV",30
PRINT #1, "OUTPUT 8;R", 100
PRINT #1, "OUTPUT 8;A",5
PRINT #1, "OUTPUT 8;W",5
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.

December 17/97

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