

INSTRUCTIONS

MODEL AVO-2W-B-DP-NGC

100 VOLT, 10 - 40 ns, DOUBLE-PULSE

HIGH PERFORMANCE PULSE GENERATOR

WITH IEEE 488.2 AND RS-232 CONTROL

SERIAL NUMBER: \_\_\_\_\_

### WARRANTY

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

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

E-mail: [info@avtechpulse.com](mailto:info@avtechpulse.com)

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## INTRODUCTION

The AVO-2W-B-DP-NGC is a high performance, GPIB and RS232-equipped instrument capable of generating up to +100V into 50 $\Omega$  loads at repetition rates up to 10 kHz. The output pulse width is variable from 10 to 40 ns. The output generates a double pulse burst in response to each trigger event, with the pulse separation variable from 60 to 2100 ns. (The separation is measured between the two rising edges.) The amplitude and the pulse width of the two pulses in each burst are independently adjustable.

The AVO-2W-B-DP-NGC is a highly flexible instrument. Aside from the internal trigger source, it can also be triggered or gated by external TTL-level signals. A front-panel pushbutton or a computer command can also be used to trigger the instrument.

The AVO-2W-B-DP-NGC features front panel keyboard and adjust knob control of the output pulse parameters along with a four line by 40-character backlit LCD display of the output amplitude, pulse width, pulse repetition frequency, and delay. The instrument includes memory to store up to four complete instrument setups. The operator may use the front panel or the computer interface to store a complete "snapshot" of all key instrument settings, and recall this setup at a later time.

This instrument is intended for use in research and development laboratories.

ORIGINAL QUOTATION / SPECIFICATIONS

April 8, 2003

To: Rich Caspers  
Northrop Grumman  
ph. 847-259-9600 x5887  
casperi@northropgrumman.com

Rich,

We spoke yesterday about your plans for the AVO-2W-B-DP-NGB that you currently have on order. You indicated that you planned to have several feet of cabling between the output module of the AVO-2W-B-DP-NGB and your devices under test. Unfortunately, this will lead to a severe transmission line mismatch, and you will not obtain a usable waveform.

Instead, I suggest that you send us a "corrected purchase order" for the instrument quoted below (which has a slightly different model number). This instrument will generate 2 Amps into a 50 Ohm load, which will allow you to use long lengths of coaxial cable to connect to your device, without introducing waveform distortions. Please note that the pulse width, minimum separation, and maximum PRF specifications have also be changed, to accommodate this new scheme.

The price is the same as before.

I am pleased to re-quote as follows for a special-purpose computer-controllable pulse generator:

Quote No: 11498

Model Designation: AVO-2W-B-DP-NGC

Output waveform: Double pulse, with the pulse separation variable from 60 to 2100 ns. (The separation is measured between the two rising edges.) The amplitude and the pulse width of the two pulses in each burst are independently adjustable.

Output Amplitude: variable from 0 to +100 Volts, into a 50 Ohm load (i.e., 2 Amps maximum). A 50 Ohm resistance must be placed in series with your laser diode. This resistor must be as close as possible to the laser diode, for proper transmission line termination. The length of the user-supplied output coaxial cable should not exceed 12 feet in length.

Output Pulse Width: variable from 10 to 40 ns

Rise Time: < 1.5 ns

Fall Time: < 2 ns

Sync delay: fixed (the delay between the rising edge of the SYNC output and the beginning of the double pulse is not adjustable.)

Maximum pulse repetition frequency: 10 kHz

Output connector: one SMA connector

Chassis Size: 3.9" x 14.8" x 17.8"

Computer control interfaces: IEEE-488.2 GPIB and RS-232 interfaces. See <http://www.avtechpulse.com/gpib/> for more details.

LabView driver: a LabView driver will be made available for downloading from the Avtech web site.

Other: As per the standard model AV0-2W-B, see <http://www.avtechpulse.com/laser/avo-2w/> for details.

Price: \$7998 US, FOB Destination

Delivery: 75 days, after receipt of order

Please advise us as soon as possible how you would like us to proceed with your order.

Please call or email me if I can be of further assistance.

Regards,  
Dr. Michael J. Chudobiak  
VP, New Product Development

--- Avtech Electrosystems Ltd. ----- since 1975 ---

|                |   |                 |
|----------------|---|-----------------|
| PO Box 265     | ph: 1-800-265-6681 or 613-226-5772                                    | Box 5120 Stn. F |
| Ogdensburg, NY | fax: 1-800-561-1970 or 613-226-2802                                   | Ottawa, Ontario |
| USA 13669-0265 | email: <a href="mailto:info@avtechpulse.com">info@avtechpulse.com</a> | Canada K2C 3H4  |
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-----

## INSTALLATION

### VISUAL CHECK

After unpacking the instrument, examine to ensure that it has not been damaged in shipment. Visually inspect all connectors, knobs, liquid crystal displays (LCDs), and the handles. Confirm that a power cord, a GPIB cable, and two instrumentation manuals (this manual and the "Programming Manual for -B Instruments") are with the instrument. If the instrument has been damaged, file a claim immediately with the company that transported the instrument.

### PLUGGING IN THE INSTRUMENT

Examine the rear of the instrument. There will be a male power receptacle, a fuse holder and the edge of the power selector card visible. Confirm that the power selector card is in the correct orientation.

For AC line voltages of 110-120V, the power selector card should be installed so that the "120" marking is visible from the rear of the instrument, as shown below:



For AC line voltages of 220-240V, the power selector card should be installed so that the "240" marking is visible from the rear of the instrument, as shown below:

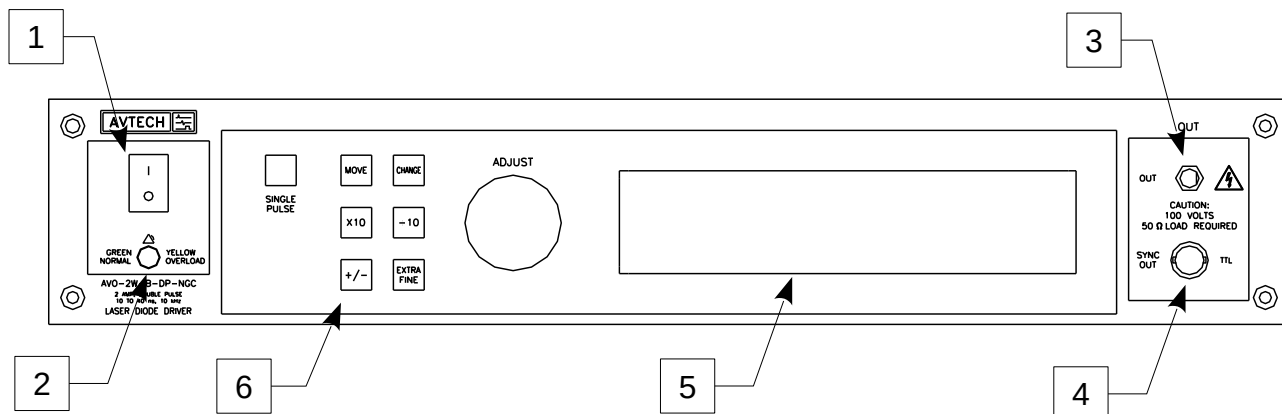


If it is not set for the proper voltage, remove the fuse and then grasp the card with a pair of pliers and remove it. Rotate horizontally through 180 degrees. Reinstall the card and the correct fuse.

In the 120V setting, a 1.0A slow blow fuse is required. In the 240V setting, a 0.5A slow blow fuse is required.



## FRONT PANEL CONTROLS




1. POWER Switch. This is the main power switch.
2. OVERLOAD Indicator. When the instrument is powered, this indicator is normally green, indicating normal operation. If this indicator is yellow, an internal automatic overload protection circuit has been tripped. If the unit is overloaded (by operating at an exceedingly high duty cycle or by operating into a very low impedance), the protective circuit will disable the output of the instrument and turn the indicator light yellow. The light will stay yellow (i.e. output disabled) for about 5 seconds after which the instrument will attempt to re-enable the output (i.e. light green) for about 1 second. If the overload condition persists, the output will be disabled again (i.e. light yellow) for another 5 seconds. If the overload condition has been removed, the instrument will resume normal operation.

This overload indicator may flash yellow briefly at start-up. This is not a cause for concern.

Note that the output stage will safely withstand a short-circuited load condition.

3. OUT CONNECTOR. This BNC connector provides the main output signal, into load impedances of  $50\Omega$ .

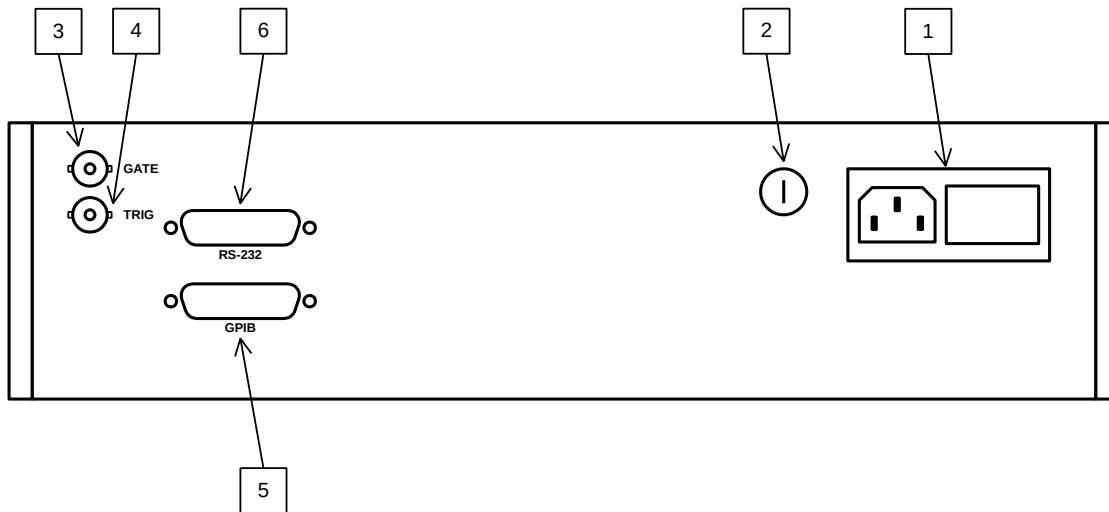
 Caution: Voltages as high as 100V may be present on the center conductor of this output connector. Avoid touching this conductor. Connect to this connector using standard coaxial cable, to ensure that the center conductor is not exposed.

4. SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads (or lags) the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to  $R_L > 1k\Omega$  with a pulse width of approximately 200 ns.

5. LIQUID CRYSTAL DISPLAY (LCD). This LCD is used in conjunction with the keypad to change the instrument settings. Normally, the main menu is displayed, which lists the key adjustable parameters and their current values. The "Programming Manual for -B Instruments" describes the menus and submenus in detail.
6. KEYPAD.

| Control Name | Function  |
|--------------|---|
| MOVE         | This moves the arrow pointer on the display.  |
| CHANGE       | This is used to enter the submenu, or to select the operating mode, pointed to by the arrow pointer.  |
| ×10          | If one of the adjustable numeric parameters is displayed, this increases the setting by a factor of ten.  |
| ÷10          | If one of the adjustable numeric parameters is displayed, this decreases the setting by a factor of ten.  |
| +/-          | If one of the adjustable numeric parameters is displayed, and this parameter can be both positive or negative, this changes the sign of the parameter.  |
| EXTRA FINE   | This changes the step size of the ADJUST knob. In the extra-fine mode, the step size is twenty times finer than in the normal mode. This button switches between the two step sizes.  |
| ADJUST       | This large knob adjusts the value of any displayed numeric adjustable values, such as frequency, pulse width, etc. The adjust step size is set by the "EXTRA FINE" button.<br><br>When the main menu is displayed, this knob can be used to move the arrow pointer. |

## REAR PANEL CONTROLS



1. AC POWER INPUT. A three-pronged recessed male connector is provided on the back panel for AC power connection to the instrument. Also contained in this assembly is a slow blow fuse and a removable card that can be removed and repositioned to switch between 120V AC in and 240V AC in.
2. DC FUSE. This T 0.25A, 250V fuse protects the internal DC power supply.
3. GATE. This TTL-level (0 and +5V) logic input can be used to gate the triggering of the instrument. This input can be either active high or active low, depending on the front panel settings or programming commands. (The instrument triggers normally when this input is unconnected). When set to active high mode, this input is pulled-down to ground by a 1 k $\Omega$  resistor. When set to active low mode, this input is pulled-up to +5V by a 1 k $\Omega$  resistor.
4. TRIG. This TTL-level (0 and +5V) logic input can be used to trigger the instrument, if the instrument is set to triggering externally. The instrument triggers on the rising edge of this input. The input impedance of this input is 1 k $\Omega$ . (Depending on the length of cable attached to this input, and the source driving it, it may be desirable to add a coaxial 50 Ohm terminator to this input to provide a proper transmission line termination. The Pasternack ([www.pasternack.com](http://www.pasternack.com)) PE6008-50 BNC feed-thru 50 Ohm terminator is suggested for this purpose.)

When triggering externally, the instrument can be set such that the output pulse width tracks the pulse width on this input, or the output pulse width can be set independently.

5. GPIB Connector. A standard GPIB cable can be attached to this connector to allow the instrument to be computer-controlled. See the “Programming Manual for -B Instruments” for more details on GPIB control.
6. RS-232 Connector. A standard serial cable with a 25-pin male connector can be attached to this connector to allow the instrument to be computer-controlled. See the “Programming Manual for -B Instruments” for more details on RS-232 control.

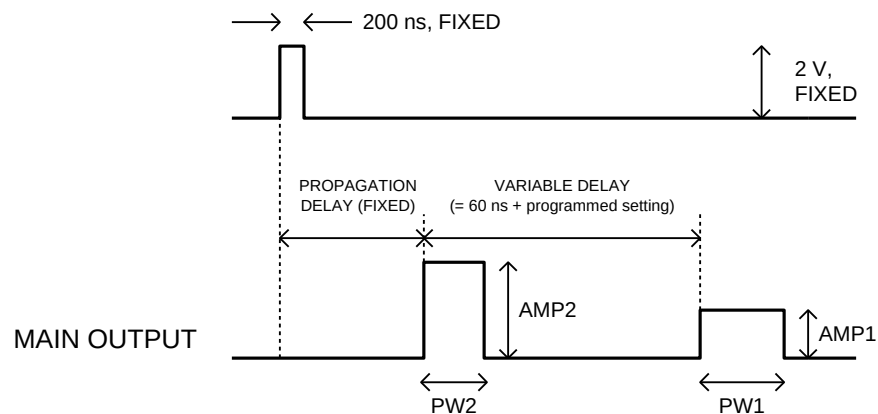
## GENERAL INFORMATION

### BASIC PULSE CONTROL

This instrument can be triggered by its own internal clock or by an external TTL trigger signal. In either case, two output signals are generating in response to the trigger: OUT and SYNC.

- OUT. This is the main output. A double pulse is generated on this output.
- SYNC. The SYNC pulse is a fixed-width TTL-level reference pulse used to trigger oscilloscopes or other measurement systems. When the delay is set to a positive value the SYNC pulse precedes the OUT pulse. When the delay is set to a negative value the SYNC pulse follows the OUT pulse.

These signals are illustrated below, assuming internal triggering. The OUT signal is composed of two separate pulses, which have independent amplitude and pulse width settings. The PW1 and AMP1 front-panel controls vary the settings for the delayed pulse. The PW2 and AMP2 front-panel controls vary the settings for the non-delayed pulse.



*Figure A*

When the delay is set to zero, the pulse separation within the burst is approximately 60 ns. Non-zero delay settings add to the 60 ns.

### TRIGGER MODES

This instrument has four trigger modes:

- Internal Trigger: the instrument controls the trigger frequency, and generates the clock internally.

- External Trigger: the instrument is triggered by an external TTL-level clock on the back-panel TRIG connector.
- Manual Trigger: the instrument is triggered by the front-panel “SINGLE PULSE” pushbutton.
- Hold Trigger: the instrument is set to not trigger at all.

These modes can be selected using the front panel trigger menu, or by using the appropriate programming commands. (See the “Programming Manual for -B Instruments” for more details.)

**WARNING:** The output stage may be damaged if triggered by an external signal at a pulse repetition frequency greater than 10 kHz.

### GATING MODES

Triggering can be suppressed by a TTL-level signal on the rear-panel GATE connector. The instrument can be set to stop triggering when this input high or low, using the front-panel gate menu or the appropriate programming commands. This input can also be set to act synchronously or asynchronously. When set to asynchronous mode, the GATE will disable the output immediately. Output pulses may be truncated. When set to synchronous mode, the output will complete the full pulse width if the output is high, and then stop triggering. No pulses are truncated in this mode.

## MECHANICAL INFORMATION

### TOP COVER REMOVAL

If necessary, 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).

Always disconnect the power cord before opening the instrument.

There are no user-adjustable internal circuits. For repairs other than fuse replacement, please contact Avtech (info@avtechpulse.com) to arrange for the instrument to be returned to the factory for repair.

⚠ Caution: High voltages are present inside the instrument during normal operation. Do not operate the instrument with the cover removed.

### RACK MOUNTING

A rack mounting kit is available. The -R5 rack mount kit may be installed after first removing the one Phillips screw on the side panel adjacent to the front handle.

### ELECTROMAGNETIC INTERFERENCE

To prevent electromagnetic interference with other equipment, all used outputs should be connected to shielded 50Ω loads using shielded 50Ω coaxial cables. Unused outputs should be terminated with shielded 50Ω BNC terminators or with shielded BNC dust caps, to prevent unintentional electromagnetic radiation. All cords and cables should be less than 3m in length.

## MAINTENANCE

### REGULAR MAINTENANCE

This instrument does not require any regular maintenance.

On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the “FUSES” section for details.

### CLEANING

If desired, the interior of the instrument may be cleaned using compressed air to dislodge any accumulated dust. (See the “TOP COVER REMOVAL” section for instructions on accessing the interior.) No other cleaning is recommended.



## PROTECTING YOUR INSTRUMENT

### TURN OFF INSTRUMENT WHEN NOT IN USE

The lifetime of the switching elements in the pulse generator module is proportional to the running time of the instrument. For this reason the prime power to the instrument should be turned off when the instrument is not in use. In the case of failure, the switching elements are easily replaced following the procedure described in a following section.

### DO NOT EXCEED 10 kHz

The output stage may be damaged if triggered by an external signal at a pulse repetition frequency greater than 10 kHz.

### USE A 50 OHM LOAD

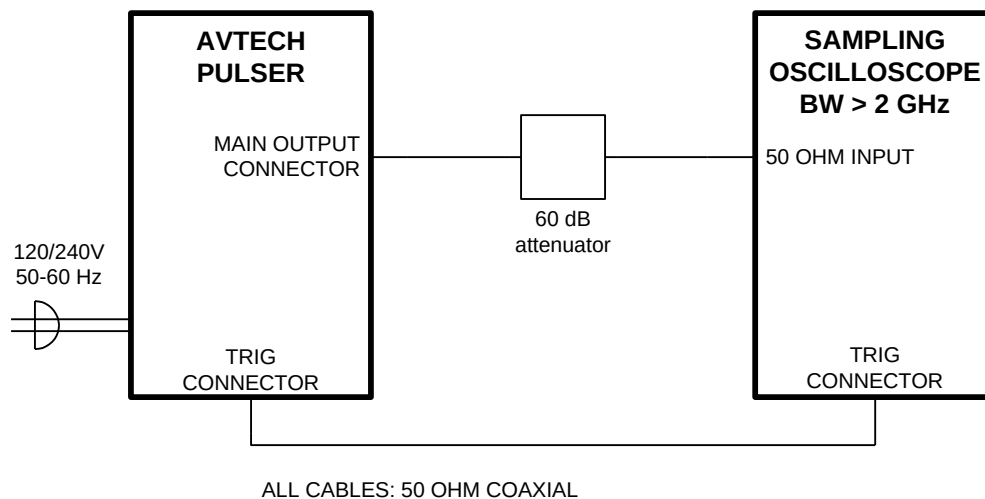
The output stage may be damaged if the output is not terminated into a 50 $\Omega$  load.

## OPERATIONAL CHECK

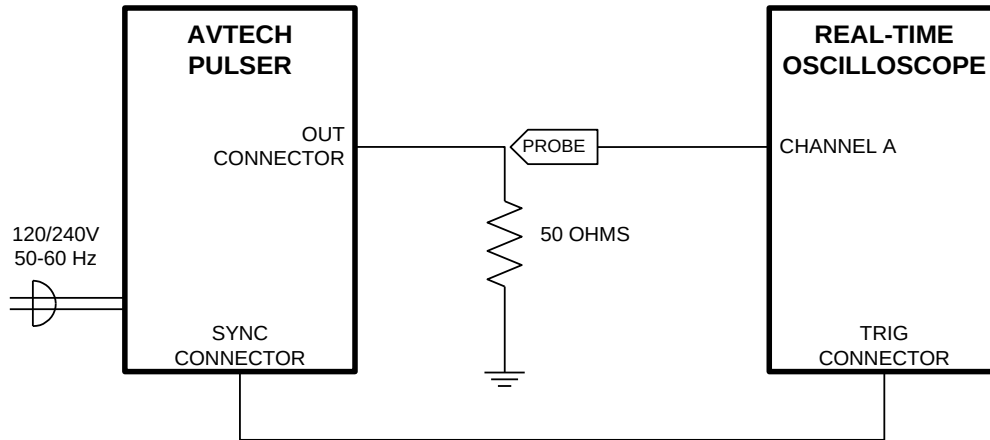
This section describes a sequence to confirm the basic operation of the instrument. It should be performed after receiving the instrument. It is a useful learning exercise as well.

Before proceeding with this procedure, finish reading this instruction manual thoroughly. Then read the “Local Control” section of the “Programming Manual for -B Instruments” thoroughly. The “Local Control” section describes the front panel controls used in this operational check - in particular, the MOVE, CHANGE, and ADJUST controls.

The AVO-2W-B-DP-NGC output may be observed using either a high-speed sampling oscilloscope, or a slower real-time oscilloscope. To accurately observe these rising and falling edges, a sampling oscilloscope with a bandwidth of 2 GHz is required. However, if the rising and falling edges do not need to be accurately observed, it may be more convenient to use a real-time oscilloscope. The two basic test arrangements are outlined in the figures below:



*BASIC TEST ARRANGEMENT, WITH A SAMPLING OSCILLOSCOPE*



*BASIC TEST ARRANGEMENT, WITH A REAL-TIME OSCILLOSCOPE*

1. Connect the pulse generator to an oscilloscope using one of the two methods shown above. Note that:
  - a) If using a sampling oscilloscope, the use of 60 dB attenuator at the sampling scope vertical input channel will insure a peak input signal to the sampling scope of less than 1 Volt. **WARNING:** This model may provide a peak output power in excess of 200 W. The peak power rating of the attenuator must exceed this limit. Factory tests are conducted using a Midwest Microwave model ATT-0527-20-SMA-07 attenuator.
  - b) The TRIG output channel provides TTL level signals (approximately 0 and +3V). (To avoid overdriving the TRIG input channel of some sampling oscilloscopes, a 20 dB attenuator may be required at the input to the scope trigger channel.)
  - c) The bandwidth capability of components and instruments used to display the pulse generator output signal (attenuators, cables, connectors, etc.) should exceed 2 GHz.
  - d) Set the oscilloscope to trigger externally with the vertical setting at 100 mV/div for sampling oscilloscopes, or 100 V/div for real-time scopes, and the horizontal setting at 50 ns/div.
2. Turn on the AVO-2W-B-DP-NGC. The main menu will appear on the LCD.
3. To set the AVO-2W-B-DP-NGC to trigger from the internal clock at a PRF of 10 kHz:
  - a) The arrow pointer should be pointing at the frequency menu item. If it is not, press the MOVE button until it is.

- b) Press the CHANGE button. The frequency submenu will appear. Rotate the ADJUST knob until the frequency is set at 10 kHz.
  - c) The arrow pointer should be pointing at the “Internal” choice. If it is not, press MOVE until it is.
  - d) Press CHANGE to return to the main menu.
4. To set the delay to 50 ns:
- a) Press the MOVE button until the arrow pointer is pointing at the delay menu item.
  - b) Press the CHANGE button. The delay submenu will appear. Rotate the ADJUST knob until the delay is set at 50 ns.
  - c) The arrow pointer should be pointing at the “Normal” choice. If it is not, press MOVE until it is.
  - d) Press CHANGE to return to the main menu.
5. To set the delayed-pulse pulse width to 30 ns:
- a) Press the MOVE button until the arrow pointer is pointing at the PW1 pulse width menu item.
  - b) Press the CHANGE button. The pulse width submenu will appear. Rotate the ADJUST knob until the pulse width is set at 30 ns.
  - c) The arrow pointer should be pointing at the “Normal” choice. If it is not, press MOVE until it is.
  - d) Press CHANGE to return to the main menu.
6. To set the non-delayed-pulse pulse width to 20 ns:
- a) Press the MOVE button until the arrow pointer is pointing at the PW2 pulse width menu item.
  - b) Press the CHANGE button. The pulse width submenu will appear. Rotate the ADJUST knob until the pulse width is set at 20 ns.
  - c) The arrow pointer should be pointing at the “Normal” choice. If it is not, press MOVE until it is.
7. Press CHANGE to return to the main menu.  
At this point, nothing should appear on the oscilloscope.

8. To enable the output:
  - a) Press the MOVE button until the arrow pointer is pointing at the output menu item.
  - b) Press the CHANGE button. The output submenu will appear.
  - c) Press MOVE until the arrow pointer is pointing at the "ON" choice.
  - d) Press CHANGE to return to the main menu.
9. To change the delayed-pulse output amplitude:
  - a) Press the MOVE button until the arrow pointer is pointing at the AMP1 amplitude menu item.
  - b) Press the CHANGE button. The amplitude submenu will appear. Rotate the ADJUST knob until the amplitude is set at +100V.
  - c) Observe the oscilloscope. You should see 30 ns wide, 100V pulses.
  - d) Press CHANGE to return to the main menu.
10. To change the non-delayed-pulse output amplitude:
  - a) Press the MOVE button until the arrow pointer is pointing at the AMP2 amplitude menu item.
  - b) Press the CHANGE button. The amplitude submenu will appear. Rotate the ADJUST knob until the amplitude is set at +60V.
  - c) Observe the oscilloscope. You should see a double-pulse burst.
11. Press CHANGE to return to the main menu.

This completes the operational check.

## PROGRAMMING YOUR PULSE GENERATOR

### KEY PROGRAMMING COMMANDS

The “Programming Manual for -B Instruments” describes in detail how to connect the pulse generator to your computer, and the programming commands themselves. A large number of commands are available; however, normally you will only need a few of these. Here is a basic sample sequence of commands that might be sent to the instrument after power-up:

```
*rst                (resets the instrument)
trigger:source internal (selects internal triggering)
frequency 1000 Hz    (sets the frequency to 1000 Hz)
pulse:width1 30 ns   (sets the delayed pulse width to 30 ns)
pulse:width2 20 ns   (sets the non-delayed pulse width to 20 ns)
pulse:delay 20 ns    (sets the delay to 20 ns)
volt:ampl1 50        (sets the delayed amplitude to +50 V)
volt:ampl2 100       (sets the non-delayed amplitude to +100 V)
output on           (turns on the output)
```

For triggering a single event, this sequence would be more appropriate:

```
*rst                (resets the instrument)
trigger:source hold  (turns off all triggering)
pulse:width1 30 ns   (sets the delayed pulse width to 30 ns)
pulse:width2 20 ns   (sets the non-delayed pulse width to 20 ns)
output on           (turns on the output)
volt:ampl1 50        (sets the delayed amplitude to +50 V)
volt:ampl2 100       (sets the non-delayed amplitude to +100 V)
trigger:source immediate (generates a single non-repetitive trigger event)
trigger:source hold  (turns off all triggering)
output off          (turns off the output)
```

To set the instrument to trigger from an external TTL signal applied to the rear-panel TRIG connector, use:

```
*rst                (resets the instrument)
trigger:source external (selects external triggering)
pulse:width1 30 ns   (sets the delayed pulse width to 30 ns)
pulse:width2 20 ns   (sets the non-delayed pulse width to 20 ns)
pulse:delay 1 us     (sets the delay to 1 us)
volt:ampl1 50        (sets the delayed amplitude to +50 V)
volt:ampl2 100       (sets the non-delayed amplitude to +100 V)
output on           (turns on the output)
```

These commands will satisfy 90% of your programming needs.

## ALL PROGRAMMING COMMANDS

For more advanced programmers, a complete list of the available commands is given below. These commands are described in detail in the “Programming Manual for -B Instruments”. (Note: this manual also includes some commands that are not implemented in this instrument. They can be ignored.)

| <u>Keyword</u> | <u>Parameter</u>           | <u>Notes</u>                     |
|----------------|----------------------------|----------------------------------|
| LOCAL          |                            |                                  |
| OUTPut:        |                            |                                  |
| :[STATE]       | <boolean value>            |                                  |
| :PROTection    |                            |                                  |
| :TRIPped?      |                            | [query only]                     |
| REMOTE         |                            |                                  |
| [SOURce]:      |                            |                                  |
| :FREQuency     |                            |                                  |
| [:CW   FIXed]  | <numeric value>            |                                  |
| [SOURce]:      |                            |                                  |
| :PULSe         |                            |                                  |
| :PERiod        | <numeric value>            |                                  |
| :WIDTh         | <numeric value>            |                                  |
| :DCYClE        | <numeric value>            |                                  |
| :HOLD          | WIDTh   DCYClE             |                                  |
| :DELay         | <numeric value>            |                                  |
| :GATE          |                            |                                  |
| :TYPE          | ASYNc   SYNc               |                                  |
| :LEVel         | HIgh   LOw                 |                                  |
| [SOURce]:      |                            |                                  |
| :VOLTagE       |                            |                                  |
| [:LEVel]       |                            |                                  |
| [:IMMediate]   |                            |                                  |
| [:AMPLitude]   | <numeric value>   EXTeRnal |                                  |
| :PROTection    |                            |                                  |
| :TRIPped?      |                            | [query only]                     |
| STATUS:        |                            |                                  |
| :OPERation     |                            |                                  |
| :[EVENT]?      |                            | [query only, always returns "0"] |
| :CONDition?    |                            | [query only, always returns "0"] |
| :ENABle        | <numeric value>            | [implemented but not useful]     |
| :QUEStionable  |                            |                                  |
| :[EVENT]?      |                            | [query only, always returns "0"] |
| :CONDition?    |                            | [query only, always returns "0"] |
| :ENABle        | <numeric value>            | [implemented but not useful]     |
| SYSTEM:        |                            |                                  |
| :COMMunicate   |                            |                                  |
| :GPIB          |                            |                                  |
| :ADDRess       | <numeric value>            |                                  |
| :SERial        |                            |                                  |
| :CONTRol       |                            |                                  |
| :RTS           | ON   IBFull   RFR          |                                  |

|             |   |                 |
|-------------|---|-----------------|
| : [RECeive] |   |                 |
| :BAUD       | 1200   2400   4800   9600                       |                 |
| :BITS       | 7   8   |                 |
| :ECHO       | <boolean value>                                 |                 |
| :PARity     |   |                 |
| : [TYPE]    | EVEN   ODD   NONE                               |                 |
| :SBITS      | 1   2   |                 |
| :ERRor      |   |                 |
| : [NEXT]?   |   | [query only]    |
| :COUNT?     |   | [query only]    |
| :VERSion?   |   | [query only]    |
| TRIGger:    |   |                 |
| :SOURce     | INTernal   EXTernal   MANual   HOLD   IMMEDIATE |                 |
| *CLS        |   | [no query form] |
| *ESE        | <numeric value>                                 |                 |
| *ESR?       |   | [query only]    |
| *IDN?       |   | [query only]    |
| *OPC        |   |                 |
| *SAV        | 0   1   2   3                                   | [no query form] |
| *RCL        | 0   1   2   3                                   | [no query form] |
| *RST        |   | [no query form] |
| *SRE        | <numeric value>                                 |                 |
| *STB?       |   | [query only]    |
| *TST?       |   | [query only]    |
| *WAI        |   | [no query form] |



PERFORMANCE CHECKSHEET