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## INSTRUCTIONS

**MODEL AV-108B-3-P-B-RWC**

**0 to 200 AMP, 0 to +20 V,  
PULSED CONSTANT CURRENT  
LASER DIODE DRIVER  
WITH IEEE 488.2 AND RS-232 CONTROL**

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

### 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 disassembled, 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.

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Manual Reference: Q:\office\instructword\AV-108\AV-108B-3-P-B-RWC.doc, created September 21, 1999

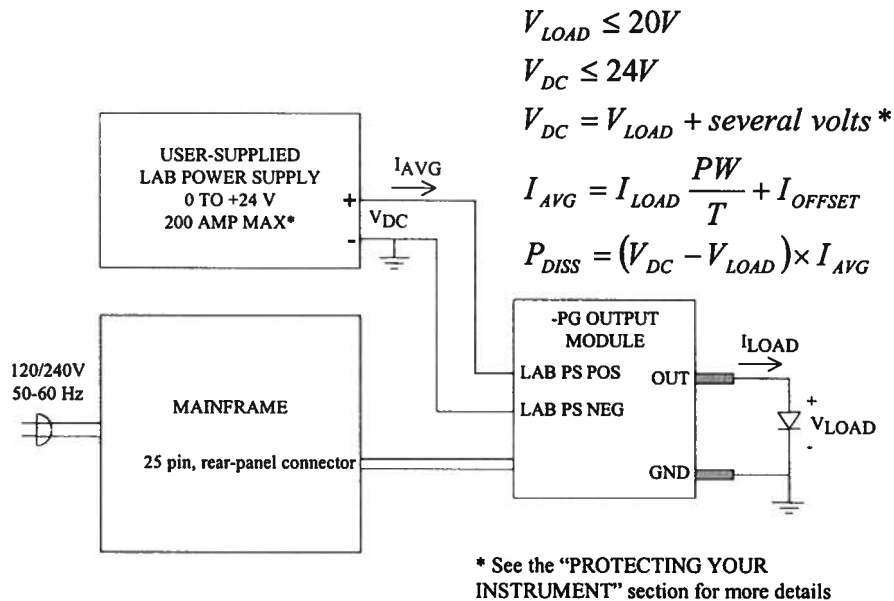
## INTRODUCTION

The Model AV-108B-3-P-B-RWC pulse generator is designed for pulsing laser diode and other low impedance loads with rectangular pulses as high as 200 Amperes into load voltages up to 20V, with 10  $\mu$ s rise and fall times. The pulse repetition frequency can vary up to 1 kHz, and pulse widths can vary from 10  $\mu$ s to 100 ms. The maximum duty cycle is 10%.

The Model AV-108B-3-P-B-RWC pulse generator is a current pulser. The current amplitude is largely independent of the load voltage. The load voltage must not exceed 20V.

The AV-108B-3-P-B-RWC system consists of an instrument mainframe, an output module (the AV-108B-3-P-RWC-PG) which connects to the mainframe via a 4 foot long detachable cable and a user-supplied high-current DC lab power supply. The load is connected to two banana connectors.

The output amplitude is controlled by the AV-108B-3-P-B-RWC, but the user-supplied high current DC lab power supply provides the prime power to the output module (see diagram below). This external power supply must be set just above the maximum load voltage, and it must be capable of supplying the average value (i.e.  $I_{DC}$ ) of the peak current supplied to the load ( $I_{LOAD}$ ).  $I_{DC}$ ,  $I_{LOAD}$ , pulse width (PW) and pulse period (T) are related as shown in the diagram. See the "Basic Test Arrangement" section for further details.



The AV-108B-3-P-B-RWC includes provision for water-cooling, which should be used when the power dissipated in the output module ( $P_{DISS}$ ) exceeds 30 Watts.

Protective circuits monitor the lab power supply voltage level and the output module temperature and will automatically disable the triggering of the output stage if either the applied voltage or temperature exceed rated values (+24V, +50°C).

A rear-panel BNC monitor output is available which provides an attenuated coincident replica of the main output current pulse. The front-panel display also shows the measured current amplitude.

This instrument has been built with provision for a negative output module, which may be purchased at a later date. The instrument must be returned to Avtech to activate the negative-output drive circuitry.

### SPECIFICATIONS

Model:	AV-108B-3-P-B-RWC
Amplitude:	0 to +200 Amperes, for load voltages of 0 to +20 Volts
Pulse width:	10 us to 100 ms
Rise time:	$\leq 10$ us
Fall time:	$\leq 10$ us
PRF:	1 Hz to 1 kHz
Max. duty cycle:	10%
Output current regulation: (change in current between minimum and maximum load voltage)	$\leq 5\%$
Max. average output power:	400 Watts
Trigger required: (external trigger mode)	Internal PW Mode: +5 Volt, 50 ns or wider (TTL)
Monitor output:	Provides an attenuated coincident replica of the main output current pulse. $V_{MON} = I_{LOAD} \times 0.05 \Omega$
Sync delay:	Sync out to pulse out: Variable 0 to $\pm 100$ ms
Sync output:	+ 5 Volts, 200 ns, will drive 50 Ohm loads
Connectors:	Out: Two banana connectors Trig, Sync, Monitor: BNC DC Power: SUPERCON connectors (included)
Power, DC:	0 to +24 V, 200 Amp max
Power, AC:	120/240 Volts (switchable) 50 - 60 Hz
Dimensions: (H x W x D)	Mainframe: 3.9" x 17" x 14.8" Output module: 6.5" x 9" x 8"
Chassis material:	anodized aluminum, with blue plastic trim
Mounting:	Any
Temperature range:	+ 10° to + 40° C
Pipe Thread:	1/4" NPT

## INSTALLATION

### VISUAL CHECK

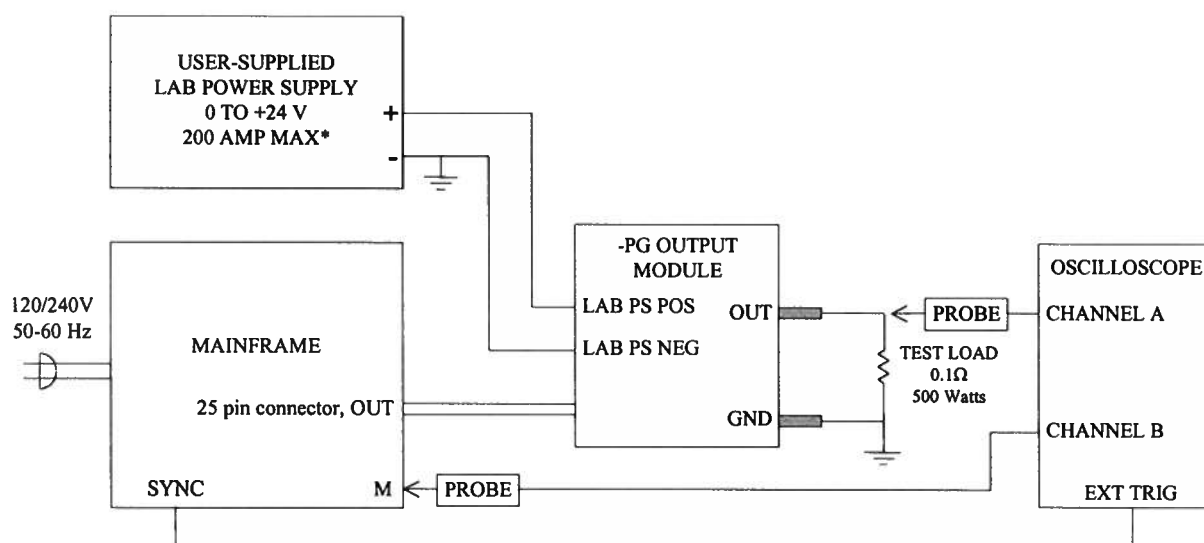
After unpacking the instrument mainframe and the output module, examine to ensure that they have not been damaged in shipment. Visually inspect all connectors, knobs, liquid crystal displays (LCDs), and the handles. Confirm that a power cord and two instrumentation manuals (this manual and the "OP1B Interface Programming Manual") 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 is in the correct orientation - it should be marked either 120 or 240, indicating whether it expects 120V AC or 240V AC. 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 1/2A slow blow fuse is required.

### CONNECTING THE OUTPUT MODULE TO THE MAINFRAME

The output module and the mainframe should be connected together as shown below:



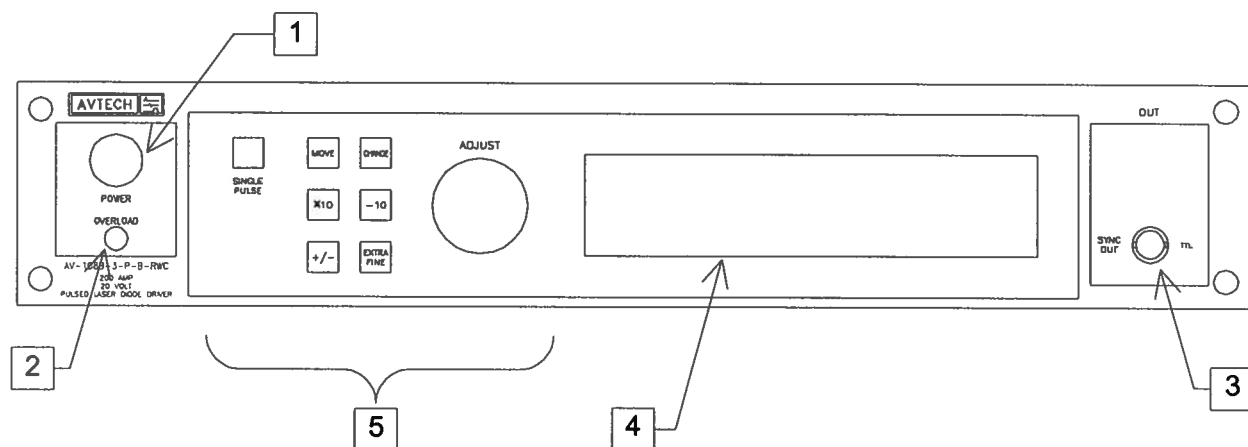
\* See the "PROTECTING YOUR INSTRUMENT" section for more details on choosing an appropriate power supply.



The gray cable mates to the multi-pin "OUT P" connector on the rear panel. The output module should always be connected to the mainframe BEFORE power is applied. The current monitor will not work properly otherwise.

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 ground and to the BLACK SUPERCON connector on the -PG module.

## MAINFRAME FRONT PANEL CONTROLS



1. **POWER Switch.** The POWER push button switch applies AC prime power to the primaries of the transformer, turning the instrument on. The push button lamp (#382 type) is connected to the +15V DC supply.
2. **OVERLOAD.** An protective circuit controls the front panel overload light. This indicator will light if:

The instrument becomes excessively hot ( $\geq 50^{\circ}\text{C}$ )

The applied DC voltage exceeds +24V

The applied DC voltage is negative

The power dissipation in the output switching transistor exceeds 200W for periods longer than 10ms.

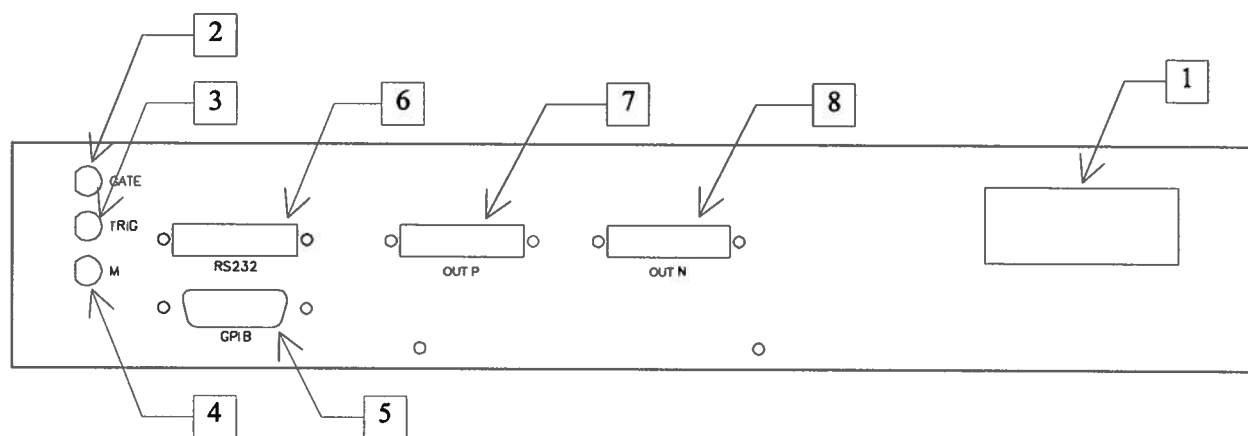
The overload light may illuminate briefly when the AC power is first applied. If this indicator lights at any other time, the instrument should be turned off until the cause of the overload has been identified and corrected.

3. **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  $R_L > 1\text{K}$  with a pulse width of approximately 200 ns.
4. **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 "OP1B Interface Programming Manual" describes the menus and submenus in detail.

5. 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.  When the main menu is displayed, this knob can be used to move the arrow pointer.

## MAINFRAME 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 1.0A slow blow fuse and a removable card that can be removed and repositioned to switch between 120V AC in and 240V AC in.
2. **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).
3. **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.
4. **M.** This is the current monitor output. This output provides a voltage waveform that is proportional to the current waveform on the main output. The monitor relationship is:  $V_{MON} = 0.05\Omega \times I_{OUT}$ , for a load of  $> 1 \text{ k}\Omega$ . (The monitor output can also drive a  $50\Omega$  load, but the output voltage will be reduced by a factor of two. This output is short-circuit protected.)
5. **GPIB Connector.** A standard GPIB cable can be attached to this connector to allow the instrument to be computer-controlled. See the "OP1B Interface Programming Manual" 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 "OP1B Interface Programming Manual" for more details on RS-232 control.
7. **OUT P CONNECTOR.** This is a 25-pin connector which attaches the 4-foot-long, 25-pin cable from the pulse generator module to the mainframe.

8. OUT N CONNECTOR. This 25-pin connector is provided for future addition of a negative output module.

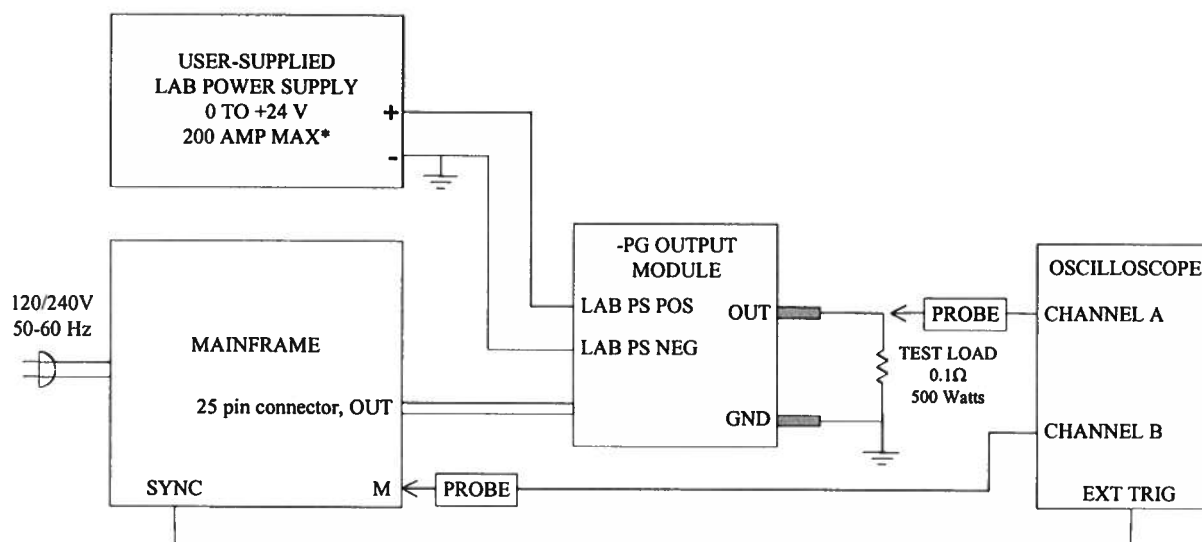
## OUTPUT MODULE CONTROLS

Several ten-turn trimpots are accessible on the -PG module.

1. P1, Amplitude Scale Control. Rotating this trimpot counter-clockwise will reduce the output current amplitudes proportionally, relative to the set amplitude. For instance, if the output current amplitudes are always 5% too high compared to the front-panel settings, this control can be used to bring the measured and set amplitudes into agreement.
2. P4, Amplitude Limit Control. This control sets the maximum allowed current amplitude. Rotating P4 counter-clockwise will cause the output amplitude to abruptly limit at less than 200A.
3. P2, Untriggered Quiescent Current Control. P2 is for factory-adjustment of the quiescent current level between trigger pulses (i.e. the current offset when not triggered.) This level is set to zero at the time of shipping and should not require further adjusting.
4. P5, Triggered Quiescent Current Control. P5 is for factory-adjustment of the base current level during output pulses (i.e. the current offset observed when triggered, and amplitude is set to zero). This level is set to zero at the time of shipping and should not require further adjusting.

**CAUTION:** The P2 and P5 controls are for factory adjustment only. The warranty may become invalid if these two controls are adjusted.

## BASIC TEST ARRANGEMENT



\* See the "PROTECTING YOUR INSTRUMENT" section for more details on choosing an appropriate power supply.

The equipment should be connected in the general fashion shown above.

The output module should always be connected to the mainframe BEFORE power is applied. The current monitor will not work properly otherwise.

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 ground and to the BLACK SUPERCON connector on the -PG module.

The output terminals of the pulse generator module are standard banana connectors.

It is essential that the resistive test load be low-inductance. (Wirewound resistors are not acceptable.) The power dissipated in the resistor is given by

$$P = I^2 \times R \times \frac{PW}{T},$$

where "I" is the current, "R" is the resistance, "PW" is the pulse width, and "T" is the pulse period (1/frequency).

The AV-108B-3-P-B-RWC includes provision for water-cooling, which should be used when the power dissipated in the output module ( $P_{DISS}$ ) exceeds 30 Watts.  $P_{DISS}$  can be calculated using:  $P_{DISS} = (V_{DC} - V_{LOAD}) \times I_{DC}$ .

## OPERATING MODES

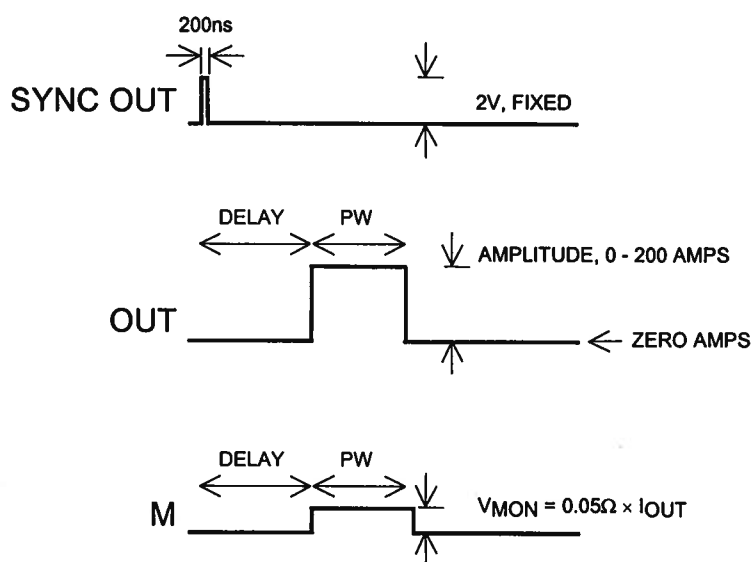
The AV-108B-3-P-B-RWC has three basic operating modes. Listed in order of ease-of-use, they are:

1. Pulse mode
2. Pulse plus offset mode
3. Voltage-to-Current amplifier mode

The pulse mode is relatively simple to use, and presents the least opportunity for damaging the instrument or damaging the load. The latter two modes require a higher degree of sophistication to operate. It is recommended that these modes only be used if the pulse mode will not accomplish the required task.

### PULSE MODE OPERATION

In the pulse mode, the instrument generates rectangular pulses of current, with no DC offset. The output is illustrated below:



Three output channels respond to a trigger: OUT, SYNC, and M. The OUT channel is the signal that is applied to the device under test. Its amplitude and pulse width are variable. 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. The M (Monitor) output is a voltage waveform that is proportional to the current waveform on OUT.  $V_{MON} = 0.05\Omega \times I_{OUT}$ , for a monitor load of  $> 1 \text{ k}\Omega$ .

This instrument can be triggered by its own internal clock or by an external TTL trigger signal.



When triggered by the internal clock, the instrument calculates the duty cycle and ensures that it is limited to a safe value. This is the most fool-proof mode of operation.

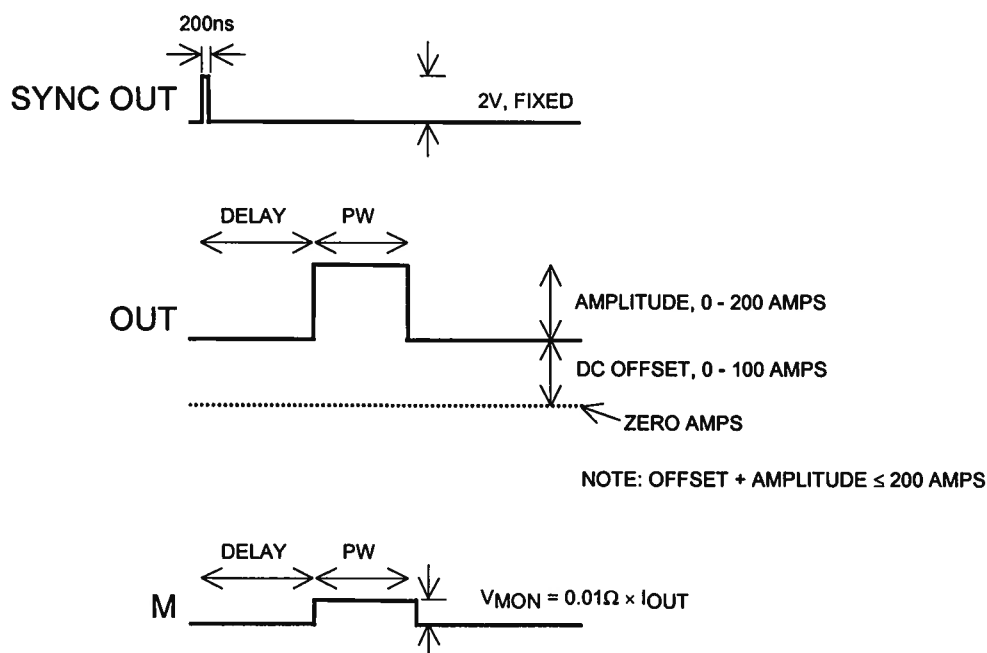
When triggered by an external TTL clock, the onus is on the user to ensure that the 10% duty cycle limit is observed. Exceeding this limit may damage the instrument. Damage caused to the unit by improper operating conditions is not covered by the warranty, so it is recommended that the internal trigger mode be used whenever possible.

The maximum allowed DC power supply voltage is 24V. However, wherever possible, the supply voltage should be reduced to the lowest level possible – at least 2 Volts above the maximum expected load voltage. This will reduce the power dissipation in the output switching transistor, prolonging the lifetime of the transistor. For instance, if the load is a diode, and the forward voltage drop is not expected to exceed 3V, then a power supply voltage of 10V or lower could be used. (The power supply must be at least 2V higher than the load voltage.)

The useful operating range of the pulse amplitude is 2 to 100A. The instrument should not be used to generated amplitudes of less than 2A.

### PULSE PLUS OFFSET MODE OPERATION

In the “pulse plus offset” mode, the instrument generates rectangular pulses of current, with a constant DC offset. The output is illustrated below:



As in the pulse mode, the instrument can be triggered by its own internal clock or by an external TTL trigger signal.

Much larger amounts of heat are dissipated in the output switching transistor in this mode than in the pulse (with no offset) mode, due to the presence of the DC offset. As a result, the potential for instrument damage is higher.

To combat this, the instrument is equipped with a sensing circuit that ensures that the power dissipated in the switching transistor due to the offset is less than 200 W. This leads to operating restriction on the values of DC offset that can be achieved, as a function of the DC power supply voltage and the load voltage. (See the "PROTECTING YOUR INSTRUMENT" section for more details.)

As an example, when operating with a 20A offset, the difference between the DC power supply voltage and the load voltage must be less than 10V (since  $20\text{A} \times 10\text{V} = 200\text{W}$ ). This may limit the maximum pulse amplitude, since the voltage swing across the load will be limited to 10V.

To further the example, suppose that a  $0.2\Omega$  load requires a 20A DC offset. The offset will produce a load voltage of  $20\text{A} \times 0.2\Omega = 4\text{V}$ . As noted above, the DC power supply must be within 10V of the load voltage, so the DC supply will be limited to +14V. Now consider the pulse amplitude: the minimum load voltage will be 4V, due to the offset, and the maximum will be +14V, due to the DC power supply. The maximum possible pulse amplitude will thus be  $(14\text{V} - 4\text{V}) \div 0.2\Omega = 50\text{A}$ . The maximum possible peak current through the load will be  $14\text{V} \div 0.2\Omega = 70\text{A}$ .

If the sensing circuit detects excessive power dissipation in the switching transistor, the output will be disabled. To re-enable the output, it will be necessary to:

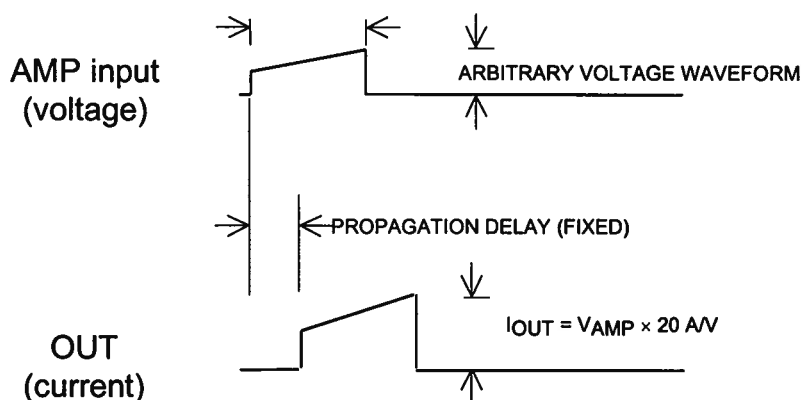
1. change the pulse parameters such that the overload condition does not re-occur, and
2. use the "OUTPUT ON" function from the front-panel, or send the "OUTPUT ON" command via computer to re-enable the output.

Although the sensing circuit is designed to automatically prevent operation at unsafe combination of current and voltage, calculations should nonetheless be performed beforehand to avoid unsafe operating conditions entirely.

The maximum allowed DC power supply voltage is 24V. However, wherever possible, the supply voltage should be reduced to the lowest level possible – at least 2 Volts above the maximum expected load voltage. This will reduce the power dissipation in the output switching transistor, prolonging the lifetime of the transistor. For instance, if the load is a diode, and the forward voltage drop is not expected to exceed 3V, then a power supply voltage of 10V or lower could be used. (The power supply must be at least 2V higher than the load voltage.)

## AMPLIFIER MODE (VOLTAGE-TO-CURRENT CONVERTER)

When the amplitude control is set to amplifier mode (i.e., the front-panel display reads "AMP:AMPLFY"), the instrument acts as a fixed-gain voltage-to-current amplifier, and the output current is:  $I_{OUT} \approx V_{AMP} \times 20 \text{ A/V}$ , where  $V_{AMP}$  is the voltage waveform on the AMP connector. This is illustrated below:



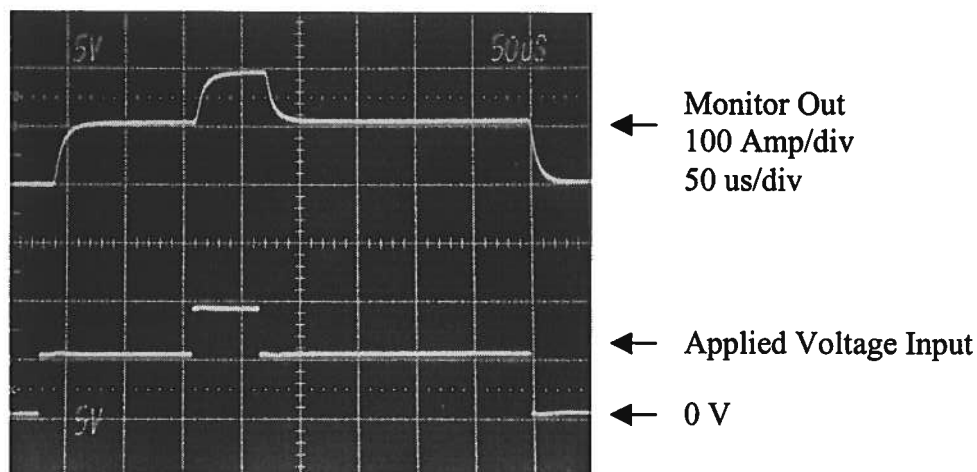
In this mode, the output pulse width and amplitude are determined by the signal on the AMP connector. The offset control is inactive, and the SYNC output is not useful in this mode. The trigger function may be set to any value or mode, since the trigger circuit is bypassed in this mode. However, it is recommended that you set the trigger to the "HOLD" mode, for consistency.

The output amplitude is subject to the same limitations as in the "pulse plus offset" mode, to ensure that the heat dissipated in the output switching transistor is kept within limits. (See the example above.) However, the situation is complicated by the fact that the input may be continuously changing, and it may enter unsafe operating regimes unexpectedly. Although the sensing circuit is designed to automatically prevent operation at unsafe combination of current and voltage, calculations should nonetheless be performed beforehand to avoid unsafe operating conditions entirely.

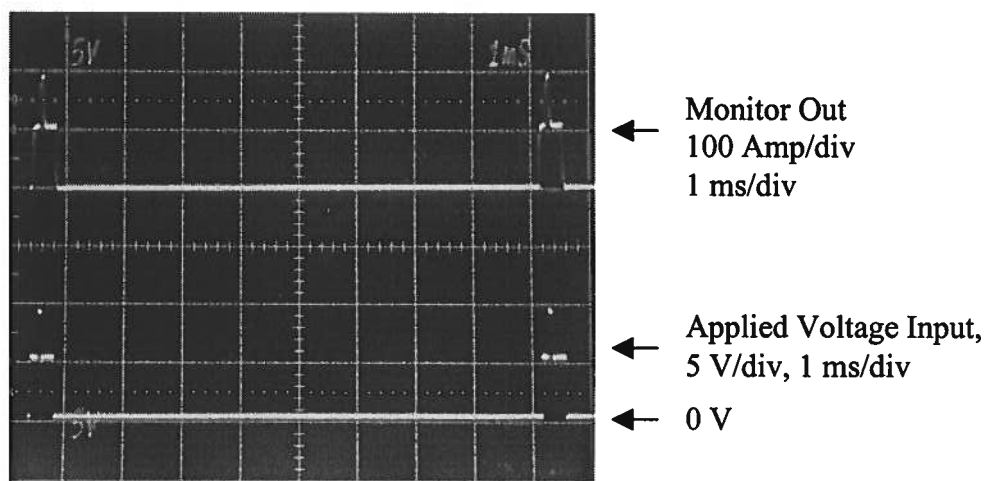
The stress on the output switching transistor may be minimized by following these procedures:

1. Keep the duty cycle below 10%.
2. The maximum allowed DC power supply voltage is 24V. However, wherever possible, the supply voltage should be reduced to the lowest level possible – at least 2 Volts above the maximum expected load voltage. This will reduce the power dissipation in the output switching transistor, prolonging the lifetime of the transistor. For instance, if the load is a diode, and the forward voltage drop is not expected to exceed 3V, then a power supply voltage of 10V or lower could be used. (The power supply must be at least 2V higher than the load voltage.)

3. Avoid the use of a DC offset. If an offset is required, use a "pulsed DC offset", as shown in the waveform photos below:



In this photo, an offset has been applied for a short duration before and after the main pulse. The photo below shows the same waveform on a longer time-scale:



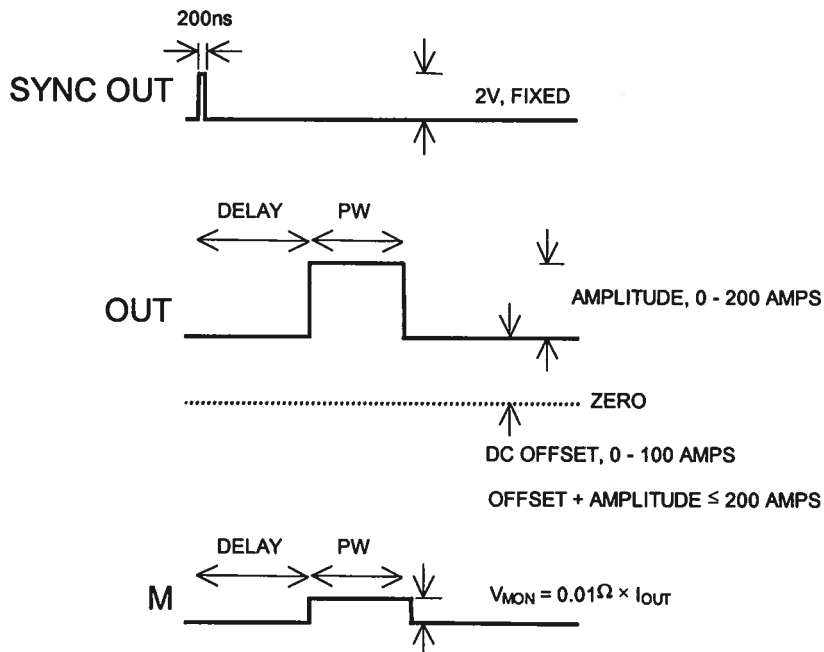
Note the low duty cycle.

### BASIC PULSE CONTROL

This instrument can be triggered by its own internal clock or by an external TTL trigger signal. In either case, three output channels respond to the trigger: OUT, SYNC, and M. The OUT channel is the signal that is applied to the device under test. Its amplitude and pulse width are variable. 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. The M (Monitor) output is a voltage waveform that is proportional to the current waveform on OUT.

$$V_{MON} = 0.05\Omega \times I_{OUT}, \text{ for a monitor load of } > 1 \text{ k}\Omega.$$

These pulses are illustrated below:



*Basic Output Pulses*

The delay, pulse width, and frequency (when in the internal mode), of the OUT pulse can be varied with front panel controls or via the GPIB or RS-232 computer interfaces.

### MONITOR CIRCUIT

As noted in the previous section, a current monitor output is available. The current monitor output also measures the amplitude of the most recent pulse, in amperes, and displays it on the front panel LCD. The value can also be read via the computer interface.

The output module should always be connected to the mainframe BEFORE power is applied. The current monitor will not work properly otherwise.

### 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 “OP1B Interface Programming Manual” for more details.)

### 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.

### WATER COOLING

The output module has provision for water cooling. (Thread size is 1/4” NPT.) This cooling is necessary when the power dissipated in the output module ( $P_{DISS}$ ) exceeds 30 Watts.  $P_{DISS}$  can be calculated using:  $P_{DISS} = (V_{DC} - V_{LOAD}) \times I_{DC}$ . The water requirement is approximately 5 litres/minute. If water cooling is not used, or if the water supply fails, the instrument will heat up until the automatic temperature-protection circuitry trips and disables the output until it has cooled.

### TOP COVER REMOVAL

The top cover of the instrument may be removed by removing the four Phillips screws on the top panel. With these four screws removed, the top panel may be slid off by pulling it towards the rear.

### 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.

## PROTECTING YOUR INSTRUMENT

### PROTECTION CIRCUITRY

This instrument is capable of generating extremely large pulses of current. As a result, the user must exercise caution when operating the instrument.

The output stage is protected by several aggressive protection circuits. These circuits will automatically disable the output under the following conditions:

- If the lab power supply voltage exceeds 24V
- If the lab power supply voltage is negative
- If the output switching transistor becomes excessively hot ( $\geq 50^{\circ}\text{C}$ )
- If the power dissipation in the output switching transistor exceeds 200W for periods longer than 10ms.

The last point must be kept in mind when operating with a significant DC offset, or when operating in the voltage-to-current amplifier mode. The power dissipated in the output transistor at any instant is given by:

$$P_{DISS} = (V_{DC} - V_{LOAD}) \times I_{LOAD}$$

The output will be disabled if  $P_{DISS} > 200\text{W}$  for 10 ms or longer. In other words, when operating with a 20A offset, the lab power supply voltage must be kept sufficiently low such that the difference between it and the load voltage will be less than 10V (since  $10\text{V} \times 20\text{A} = 200\text{W}$ ). When operating with a 50A offset, the allowed voltage differential falls to 4 V.

See the earlier “PULSE PLUS OFFSET MODE OPERATION” section for an example of how to calculate safe operating regimes, based on load impedance, load current, and the power supply voltage.

### KEEP THE DC POWER SUPPLY VOLTAGE AS LOW AS POSSIBLE

The maximum allowed DC power supply voltage is 24V. However, wherever possible, the supply voltage should be reduced to the lowest level possible – at least 2 Volts above the maximum expected load voltage. This will reduce the power dissipation in the output switching transistor, prolonging the lifetime of the transistor. For instance, if the load is a diode, and the forward voltage drop is not expected to exceed 3V, then a power supply voltage of 10V or lower could be used. (The power supply must be at least 2V higher than the load voltage.)

## SELECTING AN APPROPRIATE DC POWER SUPPLY

The DC power supply must be capable of supplying enough current to the pulser.

If operating at very wide pulses (e.g., 100 ms pulse width), the power supply must be capable of supplying the full *peak current* (amplitude + offset) of the output pulse. For example, if you intend to generate 100ms, 100A pulses with a 30A offset, the power supply must be rated at  $100A + 30A = 130A$ .

If operating at much narrower pulse widths (e.g. 1 ms), the internal capacitors store enough energy such that the power supply need only supply the *average current* of the output pulse (offset + amplitude  $\times$  duty cycle). For example, if you intend to generate 1ms, 100A pulses with 10 Hz pulse repetition frequency (i.e., duty cycle is 1%) with a 30A offset, the power supply must be rated at  $30A + (100A \times 0.01) = 31A$ .

It is recommended that you select the power supply such that it just meets your requirements. This will provide extra safety, by limiting the current that can flow through the pulser.

If the power supply has a current limit feature, it is recommended that you use it. Again, this provides extra safety.

The maximum allowed DC power supply voltage is 24V. However, wherever possible, the supply voltage should be reduced to the lowest level possible – at least 2 Volts above the maximum expected load voltage. This will reduce the power dissipation in the output switching transistor, prolonging the lifetime of the transistor. For instance, if the load is a diode, and the forward voltage drop is not expected to exceed 3V, then a power supply voltage of 10V or lower could be used. (The power supply must be at least 2V higher than the load voltage.)

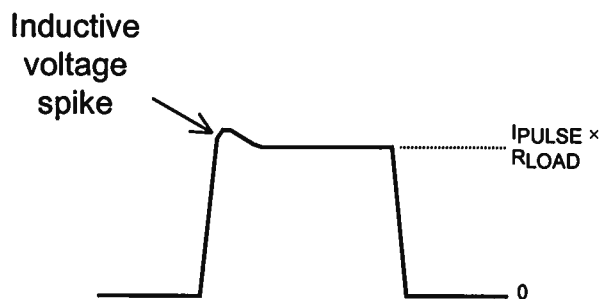


## LENZ'S LAW AND INDUCTIVE VOLTAGE SPIKES

This instrument is designed to pulse resistive and diode loads and will exhibit a large output spike when used to drive a load with significant inductance (as predicted by LENZ'S LAW). For this reason the load should be connected to the output using low inductance leads (as short as possible and as heavy a gauge as possible).

The voltage developed across an inductance  $L$  (in Henries), when the current is changing at a rate given by  $di_{LOAD}/dt$  (in Amps/sec), is:  $V_{SPIKE} = L \frac{di_{LOAD}}{dt}$ .

Some load inductance is unavoidable. As a result, the output voltage waveform (measured across a resistance) will have some distortion on the leading edge, as shown:



### START-UP CHECK-LIST FOR LOCAL CONTROL

- 1) The instruction manual has been studied thoroughly.
- 2) The "Local Control" section of the "OP1B Interface Programming Manual" has been studied thoroughly.
- 3) The -PG module is connected to the mainframe as shown in the "Basic Test Arrangement" section. (The output module should always be connected to the mainframe BEFORE power is applied. The current monitor will not work properly otherwise.)
- 4) If the power dissipated in the output module,  $P_{DISS} = (V_{DC} - V_{LOAD}) \times I_{DC}$ , will exceed 30 W, the water-cooling provisions of the output module should be used. (Thread size is 1/4" NPT.) A flow rate of 5 litres/minutes should be sufficient to cool the module.
- 5) The load is connected to the output module. If the load is a diode, the anode of the load is connected to the OUT terminal. For initial testing, it is recommended that a resistive load be used. Factory tests are conducted using a low-inductance 0.1 Ohm, 500 Watt resistive load.
- 6) The user-supplied lab power supply is connected with the positive terminal connected to the red SUPERCON on the PG module and the negative terminal connected to the black SUPERCON. The negative terminal is grounded. The power supply potential is set to zero.
- 7) Turn on the prime power to the mainframe. The LCD will briefly display the message, "Nulling Current Monitor ....", and the main menu will appear.
- 8) The arrow pointer should be pointing at the frequency menu item. If it is not, press the MOVE button until it is.
- 9) Press the CHANGE button. The frequency submenu will appear. Rotate the ADJUST knob until the frequency is set at the desired setting. The arrow pointer should be pointing at the "Internal" choice. If it is not, press MOVE until it is.
- 10) Press CHANGE to return to the main menu.
- 11) Press the MOVE button to move the arrow pointer to the pulse width menu item. Press CHANGE to bring up the pulse width submenu, and rotate the ADJUST knob until the pulse width is set at the desired setting. The arrow pointer should be pointing at the "Normal" choice. If it is not, press MOVE until it is. Press CHANGE to return to the main menu.

- 12) Connect the rear panel M output to the scope (1 VOLT/DIV) and connect the TRIG out to the scope time base. The scope time base should be triggering.
- 13) Connect a scope probe across the resistive test load and apply prime power to the lab power supply (after first ensuring that the output amplitude is set to zero).
- 14) Increase the lab power supply voltage to the desired value ( $V_{LOAD} + 2V$ ).
- 15) Press the MOVE button to move the arrow pointer is pointing at the output item. Press CHANGE to bring up the output submenu. The arrow pointer should be initially be pointing at the "Output Off" choice. Press MOVE so that the arrow pointer is pointing at the "Output On" choice. (The mainframe is now supplying a trigger to the output module.) Press CHANGE to return to the main menu.
- 16) Press the MOVE button to move the arrow pointer to the amplitude menu item. Press CHANGE to bring up the amplitude submenu, and rotate the ADJUST knob until the amplitude is set at the desired setting. Observe the waveforms on the scope and the DC current level on the DC power supply. A rectangular pulse should appear on the scope (for both the load voltage and monitor channels) and the amplitude should increase as the ADJUST knob is rotated. At the same time, the average current supplied by the DC supply will increase.
- 17) Observe the pulse width and pulse period on the scope and confirm that the duty cycle does not exceed 5% and that the peak current does not exceed 200 Amps (i.e. 10 Volts out from the monitor output).
- 18) Observe the DC current supplied by the DC supply and ensure that the average current does not exceed 110 Amperes.
- 19) If additional assistance is required:

Tel: (613) 226-5772, Fax: (613) 226-2802  
Email: [info@avtechpulse.com](mailto:info@avtechpulse.com)

## PROGRAMMING YOUR PULSE GENERATOR

### KEY PROGRAMMING COMMANDS

The "OP1B Interface Programming Manual" 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:

### BASIC INTERNAL OPERATION

*rst	(resets the instrument)
trigger:source internal	(selects internal triggering)
frequency 10 Hz	(sets the frequency to 10 Hz)
pulse:width 200 us	(sets the pulse width to 200 us)
pulse:delay 30 us	(sets the delay to 30 us)
output on	(turns on the output)
source:current 50 A	(sets the current amplitude to 50 amperes)
source:current:low 10 A	(sets the DC offset to 10 amperes)
measure:amplitude?	(this returns the current amplitude, in amperes, as measured by the monitor circuit)

### TRIGGERING A SINGLE PULSE

*rst	(resets the instrument)
trigger:source hold	(turns off all triggering)
pulse:width 200 us	(sets the pulse width to 200 us)
output on	(turns on the output)
source:current 50 A	(sets the current amplitude to 50 amperes)
source:current:low 10 A	(sets the DC offset to 10 amperes)
trigger:source immediate	(generates a single non-repetitive trigger event)
trigger:source hold	(turns off all triggering)
measure:amplitude?	(this returns the current amplitude, in amperes)
output off	(turns off the output)

### TRIGGERING FROM AN EXTERNAL TTL PULSE

*rst	(resets the instrument)
trigger:source external	(selects internal triggering)
pulse:width 200 us	(sets the pulse width to 200 us)
pulse:delay 1 us	(sets the delay to 1 us)

source:current 50 A (sets the current amplitude to 50 amperes)  
 source:current:low 10 A (sets the DC offset to 10 amperes)  
 output on (turns on the output)

## VOLTAGE-TO-CURRENT AMPLIFIER MODE

\*rst (resets the instrument)  
 trigger:source hold (disables internal triggering)  
 source:current amplify (voltage-to-current mode, amplifies signal on the AMP input)  
 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 "OP1B Interface Programming Manual". (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		
MEASure:		
:AMPLitude?		[query only]
OUTPut:		
:[STATe]	<boolean value>	
:PROTection		
:TRIPped?		[query only]
REMOTE		
[SOURce]:		
:FREQuency		
[:CW   FIXed]	<numeric value>	
[SOURce]:		
:CURRent		
[:LEVel]		
[:IMMediate]		
[:AMPLitude]	<numeric value>   EXTernal	
:PROTection		
:TRIPped?		[query only]
[SOURce]:		
:PULSe		
:PERiod	<numeric value>	
:WIDTh	<numeric value>	
:DCYClE	<numeric value>	
:HOLD	WIDTh   DCYClE	
:DELay	<numeric value>	

:GATE		
:TYPE	ASync   SYNC	
:LEVel	High   Low	
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 CHECK SHEET