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INSTRUCTIONS

MODEL AVO-7D-C-EA-AT-PN-OS-M2-OP1B-NWUA

0 to 100 AMP, 0 to +100 V, 1 μs RISE TIME
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 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.

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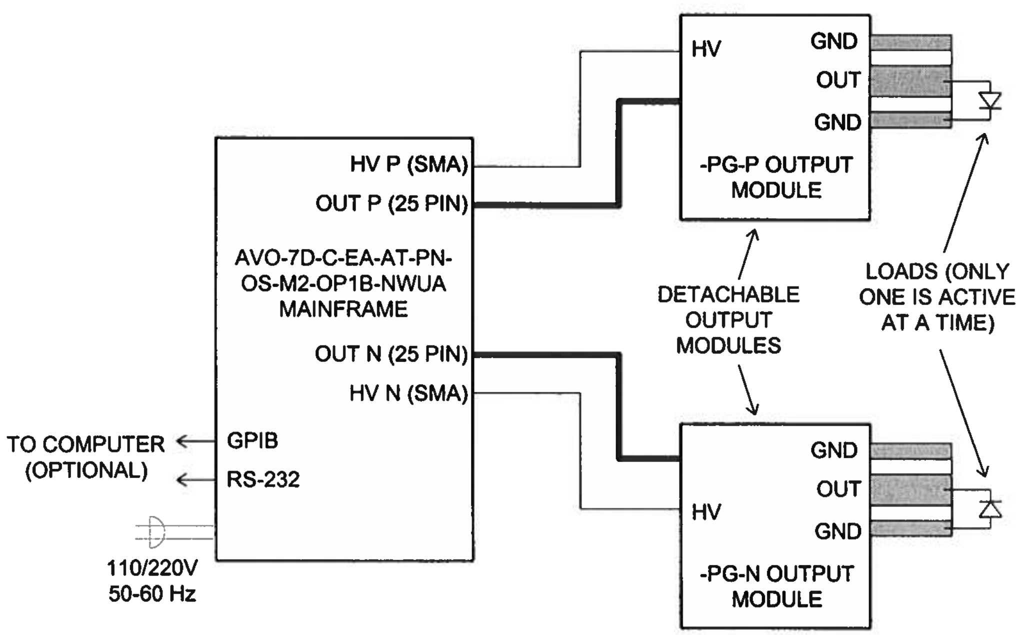
INTRODUCTION

The Model AVO-7D-C-EA-AT-PN-OS-M2-OP1B-NWUA pulse generator is designed for pulsing laser diode and other low impedance loads with rectangular pulses as high as 100 Amperes into load voltages up to100V, with 1 μs rise and fall times. The pulse repetition frequency can vary from 0.1 to 200 Hz, and pulse widths can vary from 2 us to 200 us. The maximum duty cycle is 0.1%.

The Model AVO-7D-C-EA-AT-PN-OS-M2-OP1B-NWUA pulse generator is a current pulser. The current amplitude is largely independent of the load voltage. The load voltage must not exceed 100V. 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.

The AVO-7D-C-EA-AT-PN-OS-M2-OP1B-NWUA system consists of an instrument mainframe, a positive output module (the AVO-7D-NWUA-P-PG), and a negative output module (the AVO-7D-NWUA-N-PG). Only one output module is used at a time, although both may be connected to the mainframe. Each output module connects to the mainframe using two cables: a 25-conductor cable, detachable at the mainframe end, carries the control signals, and a single-conductor shielded cable, detachable at both ends, carries the high voltage power supply.



The loads can be connected (soldered) to a microstrip transmission line that protrudes from the output module, or they can be connected via a SMA connector located directly below the output microstrip. The SMA connector is connected in parallel with the microstrip output.

The AVO-7D-C-EA-AT-PN-OS-M2-OP1B-NWUA has three amplitude ranges, of 0-1A, 0-10A, and 0-100A, allowing the instrument to be used at both moderate and very high current levels. (The instrument automatically selects the appropriate range based on the amplitude setting.) The current monitor has a full-scale output of approximately 1V within each range.

An externally supplied DC offset (0 to 100 mA) can be added to the output.

The AVO-7D-C-EA-AT-PN-OS-M2-OP1B-NWUA can be controlled from the front panel, or via a computer connected to the IEEE 488.2-compliant GPIB port, or the RS-232 serial port.

SPECIFICATIONS

Model:	AVO-7D-C-EA-AT-PN-OS-M2-OP1B-NWUA
Amplitude:	0 to ±100 Amperes, for load voltages of 0 to ±100 Volts
Pulse width:	2 us to 2 us
Rise time:	≤ 1 us
Fall time:	≤ 1 us
PRF:	0.1 Hz to 200 Hz
Max. duty cycle:	0.1%
Output impedance:	≥ 10 Ohms
Maximum offset:	100 mA, same polarity as pulse output
Propagation delay:	≤ 100 ns (Ext trig in to pulse out)
Jitter:	± 500 ps (Ext trig in to pulse out)
Trigger required: (external trigger mode)	Internal PW Mode: +5 Volt, 50 ns or wider (TTL) External PW Mode: +5 Volt, $PW_{IN} = PW_{OUT}$ (TTL)
Monitor output:	Provides an attenuated coincident replica of the main output current pulse.
Sync delay:	Sync out to pulse out: Variable 0 to ± 200 us
Sync output:	+ 3 Volts, 200 ns, will drive 50 Ohm loads
Connectors:	Out: microstrip solder terminals and SMA connector DC offset: SMA Trig, Sync, Gate, Monitor: BNC
Power, AC:	120/240 Volts (switchable) 50 - 60 Hz
Temperature range:	+ 10° to + 40° C

INSTALLATION

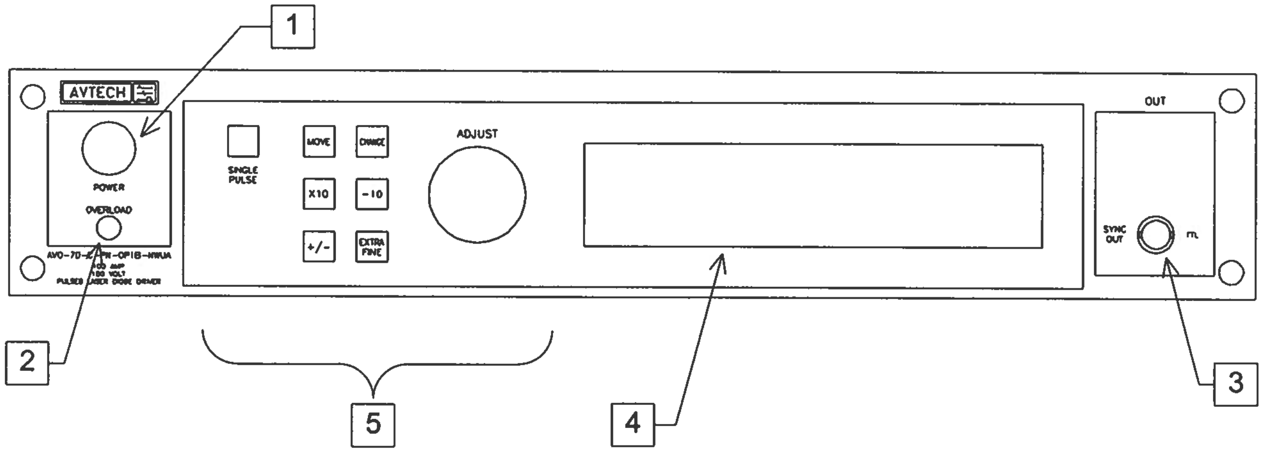
VISUAL CHECK

After unpacking the instrument mainframe and the two output modules, 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.

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 internal power supply is supplying an excessive amount of current to the output stages. 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.

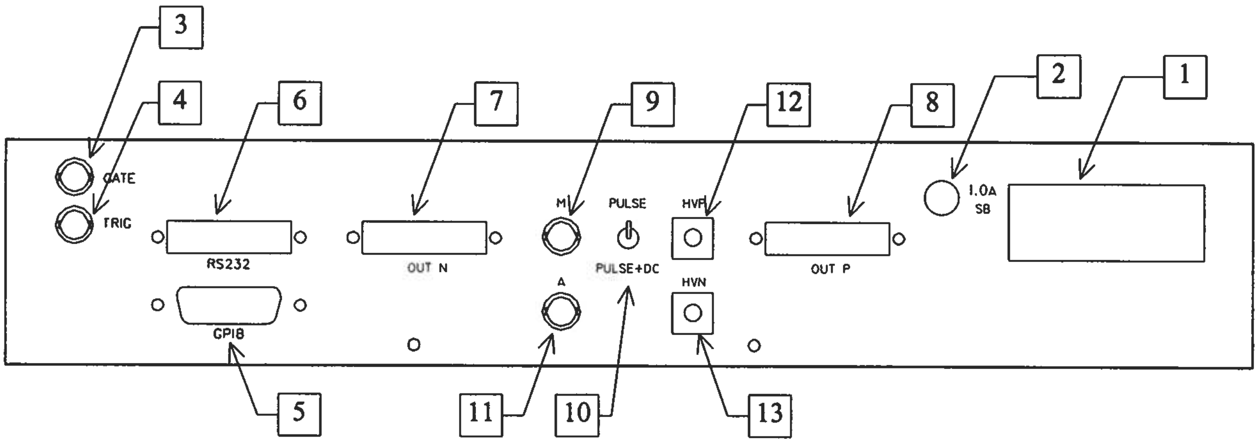
3. SYNC OUT. This connector supplies a SYNC output that can be used to trigger other equipment, particularly oscilloscopes. This signal leads, or lags, the main output by a duration set by the "DELAY" controls and has an approximate amplitude of +3 Volts to R_L > 1kΩ with a pulse width of approximately 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. DC FUSE. This 1.0A slow-blow fuse protects the internal 24V 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).

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.

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 N. The 25-pin cable from the negative output module is connected to this connector.

8. OUT P. The 25-pin cable from the positive output module is connected to this connector.

9. M. This is the current monitor output. This output provides a voltage waveform that is proportional to the current waveform on the main output. When the PULSE / PULSE+DC switch (item 10) is in the PULSE position, the monitor output voltage is given by: $V_{MON} = R_{SENSE} \times I_{PULSE}$, for a load of > 1 kΩ, where I_{PULSE} is amplitude of the current pulse. Any applied DC offset is not included. (The monitor output can also drive a 50Ω load, but the output voltage will be reduced by a factor of two.)

   The R_{SENSE} value depends on the amplitude range. Each output module operates in three amplitude ranges, of 0-1A, 0-10A, and 0-100A approximately. The R_{SENSE} values for these ranges are 1Ω, 0.1Ω, and 0.01Ω, respectively. (This yields a full-scale monitor output of 1V, approximately, in each range.)

   When the PULSE / PULSE+DC switch (item 10) is in the PULSE+DC position, the monitor output voltage is given by: $V_{MON} = R_{SENSE} \times I_{PULSE} + 10\,\Omega \times I_{OFFSET}$, for a load of > 1 kΩ, where I_{PULSE} is amplitude of the current pulse and I_{OFFSET} is the DC offset current, if present. (The monitor output can also drive a 50Ω load, but the output voltage will be reduced by a factor of two.)

   This output is short-circuit protected. The monitor output may exhibit "spikes" on the rising and falling edges of the waveform, of approximately 5 μs in width. These are artefacts of the measurement process, and are not present in the output. The rise and fall times of the monitor output are slightly slower than the main output.

10. PULSE / PULSE+DC Switch. This switch determines the function of the M output (item 9), as described above.

    Note that the measured current displayed on the front panel LCD is only accurate when this switch is in the PULSE position.

11. A Connector. The output current amplitude can set to track the voltage on this input, using the "Ext DC Control" option in the front-panel amplitude submenu, or the "source:current external" programming command. (0V in on this connector corresponds to 0A out, 10V in corresponds to 100A out, approximately.)

12. HVP SMA Connector. The shielded SMA cable from the positive output module is connected to this connector. This carries the high-voltage power supply to the output module.

13. HVN SMA Connector. The shielded SMA cable from the negative output module is connected to this connector. This carries the high-voltage power supply to the output module.

OUTPUT MODULE CONTROLS AND CONNECTORS

OUT Microstrip Line

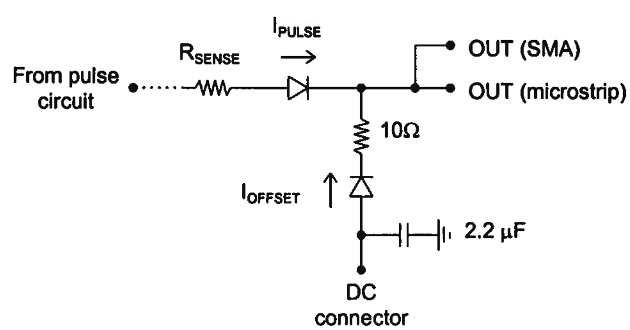
The main output is provided on the center conductor of the microstrip board protruding from the output module. The outer two conductors, as well as the reverse side of the microstrip board are connected to ground.

OUT SMA Connector

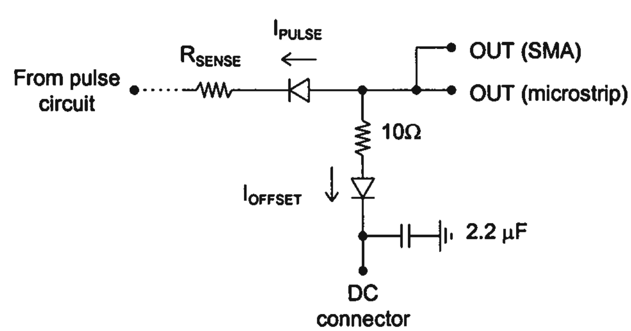
This SMA connector is connected in parallel with the OUT microstrip line. The same signal is present on both. However, the microstrip line is better suited for high-current pulses.

DC SMA Connector

A DC offset may be added to the output signal using this input. The equivalent circuit is shown below for the positive output module:



The negative output module is similar:



(Note that these drawings illustrate the R_{SENSE} resistor and the 10Ω resistor used to generate the monitor output.)

The DC offset can be added simply by applying a small DC voltage to the DC connector. The offset current will be approximately $V_{DC}/10\Omega$. Do not exceed 100 mA of offset current.

P1, P2 Controls. Two ten-turn potentiometer controls, located above the output terminals, are used to set the accuracy of the output amplitude setting. Both are set at the factory and should not be changed.

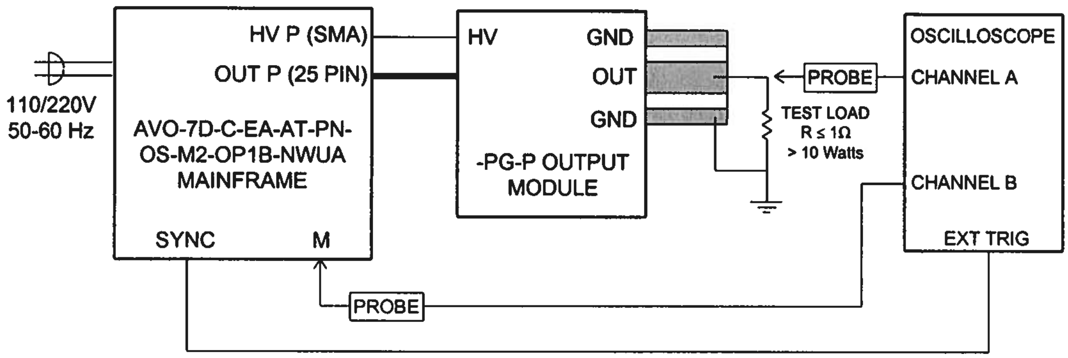
The P1 pot is a scale control, that adjusts the output amplitude proportionately. However, if a small discrepancy is noticed between the output setting and the measured current, the "diag:ampl:cal" command should be used before attempting to adjust this manual control.

The P2 pot can be used to null out any current pulses observed with the amplitude set to zero. This should not normally require adjusting.

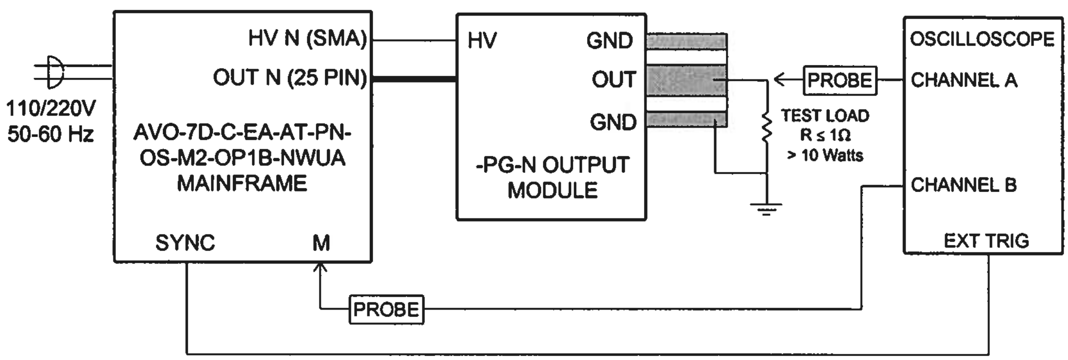
GENERAL INFORMATION

BASIC TEST ARRANGEMENT

Positive Test



Negative Test



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

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

Proper choice of test resistance is important. It is essential that the resistive test load be low-inductance. (Wirewound resistors are not acceptable, unless many are connected together in parallel.) The power dissipated in the resistor is given by

$$P_{AVERAGE} = I^2 \times R \times \frac{PW}{T}, \quad P_{PEAK} = I^2 \times R$$

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

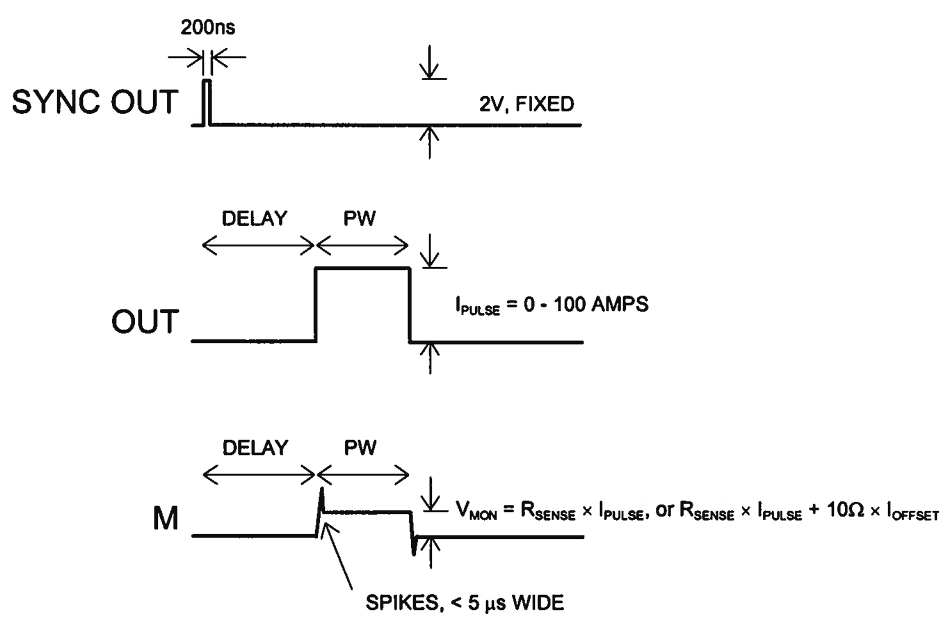
The power rating of the resistance should exceed this average power rating by a large margin. Beware that some low-value resistors exhibit a significant temperature-dependence, even when the average power dissipated is below the resistor's power rating. This is particularly true if the peak power exceeds the resistor's power rating.

For factory tests, Avtech uses one-hundred 50Ω, 5W resistors connected in parallel, effectively giving 0.5Ω, 500W.

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. $V_{MON} = R_{SENSE} \times I_{OUT}$, for a monitor load of > 1 kΩ, assuming that the PULSE / PULSE+DC switch is in the PULSE position. (The rise and fall times of the monitor output are slower than those of the main output. The monitor output has rise and fall times of approximately 2 μs.)

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.

ADDING A DC OFFSET

A "DC" SMA connector is present on each output module. This input is connected to the main output through a diode and a 10 Ohm resistance. By applying a small DC voltage to this input a 0 to +100 mA offset can be introduced to the positive output, or 0 to -100 mA for the negative output. (See the "Output Module Controls and Connectors" section for a more detailed description of this feature.)

MONITOR CIRCUIT

As noted in the previous section, a current monitor output is available. The current monitor output also measures 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. (Note that the LCD reading is only accurate when the PULSE / PULSE+DC switch is in the PULSE position.) The monitor output may exhibit "spikes" on the rising and falling edges of the waveform, of approximately 5 μs in width. These are artefacts of the measurement process, and are not present in the output.

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.)

PULSE WIDTH MODES

This instrument has two pulse width modes:

- Normal: the instrument controls the output pulse width.
- PW_{IN}=PW_{OUT}: the output pulse width equals the pulse width of the trigger signal on the "TRIG" connector. The instrument must be in the external trigger mode.

These modes can be selected using the front panel pulse width 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.

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.

LOAD PROTECTION

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: $V_{SPIKE} = L\frac{dI_{LOAD}}{dt}$.

ATTACHING AND DETACHING LOADS

To avoid damaging the loads connected to main outputs, the loads should only be connected to or removed from the instrument when the instrument is off. Do not connect loads when the instrument is on and the output amplitude is not zero. This can cause sparking.

CHANGING PARAMETERS WHEN A LOAD IS ATTACHED

If your load is easily damaged, the amplitude should be reduced to zero before changing the trigger source, frequency, pulse width, or other pulse parameters. This protects the loads from possible short transient effects.

OPEN AND SHORT CIRCUITS

The AVO-7D-C-EA-AT-PN-OS-M2-OP1B-NWUA will operate properly into a short circuit to ground.

Operation into an open circuit will not damage the instrument in any way, although the monitor circuit may not give the correct reading (which should be zero).

KEEP TRACK OF ALL CABLES

Do not reverse the positive and negative high voltage cables.
Do not reverse the positive and negative 25-pin control cables.
Do not plug the 25-pin control cables into the RS-232 connectors, and vice-versa.

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-P or -PG-N module (or both) 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.)

   Do not reverse the positive and negative high voltage cables.
   Do not reverse the positive and negative 25-pin control cables.
   Do not plug the 25-pin control cables into the RS-232 connectors, and vice-versa.

4) The load is connected to the output module microstrip output. The center conductor is the output line, and the two outer conductors are connected to ground. For initial testing, it is recommended that a resistive load be used. Factory tests are conducted using a 0.5 Ohm, 500 Watt resistive load.

5) Turn on the prime power to the mainframe. The LCD will briefly display the message, "Nulling Current Monitor ....", and the main menu will appear.

6) The arrow pointer should be pointing at the frequency menu item. If it is not, press the MOVE button until it is.

7) 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.

8) Press CHANGE to return to the main menu.

9) 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.

10) Connect the rear panel M output to the scope (0.5 VOLT/DIV) and connect the SYNC out to the scope time base. The scope time base should set to trigger from this signal.

11) Connect a scope probe across the resistive test load.

12) 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.

13) 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. If you are observing the output of the positive module, make sure that the amplitude setting is positive. If you are observing the output of the negative module, make sure that the amplitude setting is negative (use the +/- button if required). 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.

14) Observe the pulse width and pulse period on the scope and confirm that the duty cycle does not exceed 0.1% and that the peak current does not exceed 100 Amps.

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

16) If additional assistance is required:

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Email: info@avtechpulse.com

CALIBRATION ADJUSTMENTS - SOFTWARE PROCEDURES

ADJUSTING AMPLITUDE ACCURACY

The AVO-7D-C-EA-AT-PN-OS-M2-OP1B-NWUA has six amplitude ranges: 0 to +1A, +1 to +10A, +10 to +100A, 0 to -1A, -1 to -10A, and -10 to -100A, approximately. The calibration of each range can be adjusted by a few percent if necessary.

If it is found that the output amplitude settings (as set by the front-panel controls or programming commands) do not agree exactly with measured values of amplitude (i.e., by examining the output on an oscilloscope) in one of these ranges, the amplitude calibration can be updated using software commands.

The following procedure is suggested:

1) Connect a precision, high-power resistive load to the output. (As an example, suppose 0.5 Ω is used.)

2) Connect the pulse generator to a computer using the GPIB or RS232 ports.

3) Turn on the pulse generator, and set the time controls (frequency, delay, pulse width) to typical values.

4) Turn on the outputs.

5) Set the output amplitude to 70% of the maximum current for that range. For instance, if the -10A to -100A range requires calibration, set the amplitude to -70A.

6) Observe the voltage across the load. (Using the 0.5Ω example, suppose that -40V is observed.) From this, calculate the measured current (-80A in this example).

7) Send the measured value to the instrument using the following command:

   diag:ampl:cal -80A

   The internal software compares the supplied measured value to the programmed value, and adjusts the internal calibration data to null out any differences.

8) Observe the voltage across the load again. The amplitude setting should now agree with the measured value.

ADJUSTING MONITOR ACCURACY

The AVO-7D-C-EA-AT-PN-OS-M2-OP1B-NWUA has six amplitude ranges: 0 to +1A, +1 to +10A, +10 to +100A, 0 to -1A, -1 to -10A, and -10 to -100A, approximately. The calibration of each range can be adjusted by a few percent if necessary.

If it is found that the output monitor readings (as observed on the front-panel LCD or using the "measure:amplitude?" program command) do not agree exactly with measured values of amplitude (i.e., by examining the output on an oscilloscope) in one of these ranges, the monitor calibration can be updated using software commands.

The following procedure is suggested:

1) Connect a precision, high-power resistive load to the output. (As an example, suppose 0.5 Ω is used.)

2) Connect the pulse generator to a computer using the GPIB or RS232 ports.

3) Turn on the pulse generator, and set the time controls (frequency, delay, pulse width) to typical values.

4) Turn on the outputs.

5) Set the output amplitude to 70% of the maximum current for that range. For instance, if the -10A to -100A range requires calibration, set the amplitude to -70A.

6) Observe the voltage across the load. (Using the 0.5Ω example, suppose that -40V is observed.) From this, calculate the measured current (-80A in this example).

7) Send the measured value to the instrument using the following command:

   diag:mon:cal -80A

   The internal software compares the supplied measured value to the programmed value, and adjusts the internal calibration data to null out any differences.

Observe the monitor reading on the LCD. The measured current should now agree with the reported monitor value.

Note that this procedure affects the current monitor readings shown on the front-panel display (or read using the "measure:amplitude?" commands) only. It does not change the waveforms present on the rear-panel monitor connectors.

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:

*rst	(resets the instrument)
trigger:source internal	(selects internal triggering)
frequency 10 Hz	(sets the frequency to 10 Hz)
pulse:width 100 us	(sets the pulse width to 100 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)
measure:amplitude?	(this returns the current amplitude, in amperes, as measured by the monitor circuit)

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.)

Keyword	Parameter	Notes
DIAGnostic:		
:AMPLitude		
:CALibration:	<numeric value>	[no query form]
:MONitor		
:CALibration:	<numeric value>	[no query form]
:STEP	<numeric value>	
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

May 22/98 Michael did this set in Word