# AVO-8 SERIES

## 50, 100, 200, 500 AMPERE WIDE PULSE PULSED VOLTAGE LASER DIODE DRIVERS AVERAGE POWER TO 5 kW



AVO-8 Mainframe (Output connectors are on rear panel)

- IEEE-488.2 GPIB and RS-232 control (-B units)
- Peak outputs to 500 Amperes
- Pulse widths from 2 us to DC
- 1.0 us rise times
- 5000 Watts average output power
- Duty cycle to 100%

The AVO-8 series of pulse generators is designed for pulsing laser diodes and other low impedance loads with rectangular pulses as high as 500 Amperes (or 50 Volts), pulse widths from 2 us to DC, and average output powers to 5000 Watts.

Each AVO-8 model essentially acts as a high-current, high-speed switch for the output of a user-supplied DC power supply. The AVO-8 is installed between the DC power supply and the load. The signal timing is controlled by the AVO-8, and the amplitude (output voltage) is controlled by the DC power supply. Avtech can recommend suitable DC power supplies for particular applications, if you do not already have one.

Each model consists of a single "3U" high (5.25") rack-mountable (19" wide) instrument mainframe. The AVO-8A1-B, AVO-8B1-B, and AVO-8C1-B models offer two output connector arrangements: a high-average-power connector optimized for high average power, and a lower-average-power connector optimized for fast rise times. (The two output connectors are wired in parallel to the same point internally.)

The high-average-power output connectors will accept 6 mm safety sockets, or 4 mm "banana" plugs. (6 mm safety sockets will have considerably higher current capability). Accessory kits with 1 meter lengths of cable with 6 mm sockets on each end, and mating 6 mm plug  to M6 stud adapters are available for connecting to loads and power supplies. These cables introduce approximately 0.6 uH / meter of inductance, which will degrade the observed current rise times. (The rise time degradation introduced by an inductance L into a resistive load R is approximately 2.2 × L / R). These connectors are preferred when the fastest possible rise time is not required.

The lower-average-power connector is a DB-37 female  connector that will mate to Avtech AV-CLZ low impedance transmission lines (http://www.avtechpulse.com/transmission/av-clz1). This output is not rated for use above 75A of average current. However, the transmission line nature of the AV-CLZ cable and its low inductance ensure that the current rise time is not noticeably degraded by the cabling. The AV-CLZ cables must be ordered as an option (-AK6 option for a 60 cm cable), or they can be ordered as separate items. Longer cable lengths are available. See  http://www.avtechpulse.com/transmission/av-clz1 for model numbers.

The 500 Amp model (AVO-8D2-B) uses a different output connector arrangement. The output is provided on two 0.15 x 2.0 x 4.0 cm copper bus bars with provision for bolt connections.

On all models, the output pulse amplitude (voltage) is controlled by the user-supplied high-current DC lab power supply that is connected to the AVO-8 instrument (see the diagram on the following pages). The AVO-8 instrument acts as a high-efficiency, high-speed switch that connects the DC lab power supply to the load during the output pulse duration. The output is shorted to ground between pulses. The output pulse voltage amplitude is approximately equal to the lab power supply voltage minus 2V. The lab power supply must be capable of supplying at least the average value ($I_{AVG}$) of the peak current supplied to the load ($I_{OUT}$). $I_{AVG}$, $I_{OUT}$, pulse width (PW) and frequency are related as shown in the diagram on the following pages. Protective circuits monitor the lab power supply voltage level and the output circuit temperature and will automatically disable the triggering of the output stage if either the applied voltage or temperature exceed rated values.

The AVO-8 instruments are voltage pulsers. A non-inductive resistor must be connected in series with the diode under test to limit the current to the maximum rated current (or less). See the

diagram on the following pages for details. For some applications, the Avtech AV-HTL series of high-power, ultra-low-inductance resistors may be suitable (for instance, the Avtech AV-HTL-0R2, described at http://www.avtechpulse.com/accessories/av-htl-0r2, is suitable for most AVO-8C1-B applications).

Model AVO-8A1-B provides a peak output current of 50A to a load impedance as low as 1 Ohm and requires a 52V external DC power supply. The AVO-8A1-B can operate at duty cycles up to 100%.

Model AVO-8B1-B provides up to 100A to a load impedance as low as 0.2 Ohms and requires a 22V DC power supply. The AVO-8B1-B can operate at duty cycles up to 100%.

Model AVO-8C1-B provides up to 200A to a load impedance as low as 0.2 Ohms and requires a 42V DC power supply. The AVO-8C1-B can operate at duty cycles up to 100% for currents of up to 100A. For higher peak currents, the duty cycle must be limited such that the average current is less than 100A.

Model AVO-8D2-B provides up to 500A to a load impedance as low as 0.1 Ohms and requires a 62V DC power supply. The AVO-8D2-B can operate at duty cycles to 20% at 200A, or 7% at 500A.

For high duty cycle (> 50%) or wide pulse width (> 1 ms) applications the current rating of the lab power supply should be near the desired peak output load current, particularly if low output pulse droop is required. However, for low duty cycle applications (e.g. 10%) the current rating of the lab power supply may be considerably less than the desired peak load current because the large capacitance present in the AVO-8 output circuits (170000 uF typically) provides the necessary high peak pulse current.

The pulse repetition frequency is variable for all models from 1 Hz to 1 kHz using the internal oscillator. A delay control and a sync output are provided for oscilloscope triggering purposes. A pushbutton is provided for one-shot operation. The units can also be triggered externally using a TTL-level pulse. All AVO-8 units include a monitor output option that provides an attenuated coincident replica of the main output current pulse.

The output pulse width may be set to track the input trigger pulse width over the range of 2.0 us to DC. The output duty cycle may be as high as 100% provided the average current does not exceed 100 Amperes (50 Amps for the AVO-8A1-B).

All models offer an optional current limit feature. This function will disable the output if the current exceeds a set level. The response time of the limit circuit is < 5 us. The trip level may be set from the front panel or by computer command. If the limit circuit is tripped the user must re-enable the output from the front panel or by computer command.

IEEE-488.2 GPIB and RS-232 control of pulse width, pulse repetition frequency, and delay is provided. These models include a front-panel keypad and adjust knob control of the output pulse parameters, along with a four line 40-character back-lit LCD display of the pulse width, pulse repetition frequency and delay. (Note that the DC power supply must be equipped with a GPIB feature, if you wish to remotely control the amplitude.) Optional telnet or web-based remote control is also available (http://www.avtechpulse.com/options/tnt), for control over local area networks or the internet.

Visit the application note area of the Avtech web site (http://www.avtechpulse.com/appnote)  for general applications assistance.

# SPECIFICATIONS                    AVO-8 SERIES

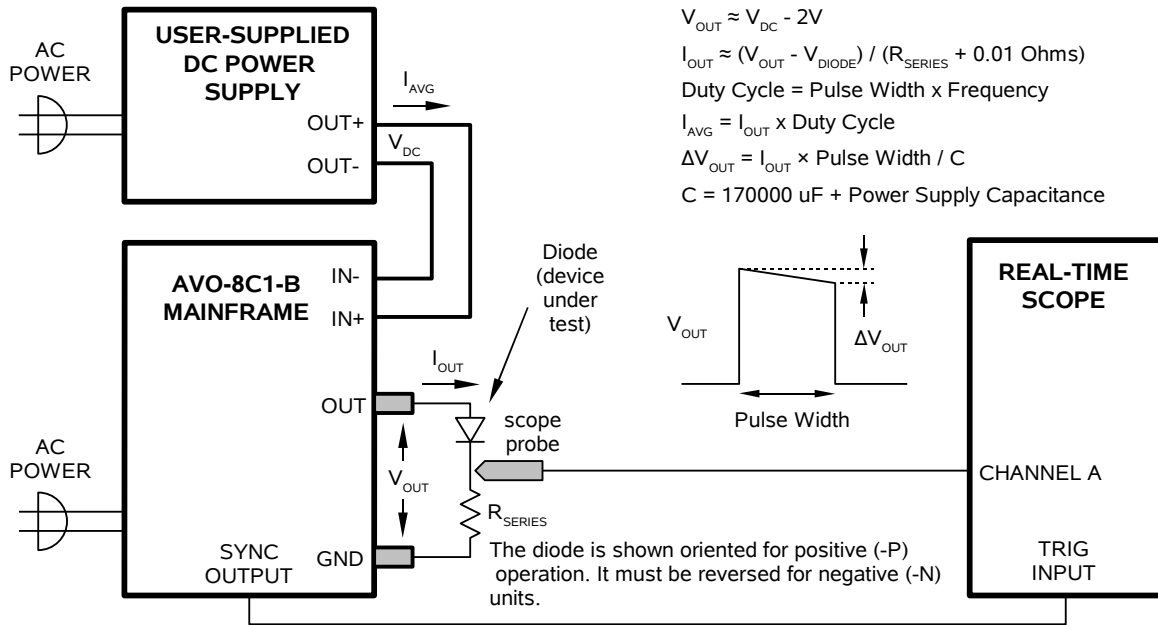| Model[1]: | AVO-8A1-B | AVO-8B1-B | AVO-8C1-B | AVO-8D2-B |
|---|---|---|---|---|
| Amplitude:                    current:<br>voltage: | 0 to 50 Amperes<br>0 to 50 Volts | 0 to 100 Amperes<br>0 to 20 Volts | 0 to 200 Amperes<br>0 to 40 Volts | 0 to 500 Amperes<br>0 to 50 Volts |
| Minimum load impedance:<br>(required to limit output current) | 1 Ω | 0.2 Ω | 0.2 Ω | 0.1 Ω |
| Pulse width (FWHM): | 2 us to 1 second, and DC[5]. | | | 5 us to 10 ms |
| Pulse repetition freq. (PRF): | 1 Hz to 1 kHz | | | |
| Rise and fall times (20%-80%)[9]: | ≤ 0.5 us | ≤ 1 us | | ≤ 2 us |
| Maximum duty cycle:<br>Normal PW mode:<br>$PW_{IN}$=$PW_{OUT}$ mode[5]:<br>DC mode: | 80%<br>100%<br>100% | 80%<br>100%<br>100% | < 100A: 80%, > 100A: 50%<br>< 100A: 100%, > 100A: 50%<br>Usable up to 100A | < 200A: 20%, > 200A: 7%<br>N/A<br>N/A |
| Max. average output current: | 50 Amperes | 100 Amperes | | N/A (see duty cycle limits) |
| Output impedance: | ≤ .025 Ohms | ≤ 0.01 Ohms | | |
| Polarity[2]: | Positive or negative (specify) | | | |
| Current limit function: | Optional[10]. Will disable the output if the current exceeds a set level.<br>The trip level may be set from the front panel, or by computer command.<br>Requires user intervention to re-enable the  output. Trip level accuracy: ±2% ± 2A. Response time: < 5 us. | | | |
| GPIB and RS-232 control[1]: | GPIB and RS-232 ports are standard on -B units. | | | |
| LabView drivers: | Check http://www.avtechpulse.com/labview for availability and downloads | | | |
| Internet control[3]: | Optional on -B units. See http://www.avtechpulse.com/options/tnt for details. | | | |
| Propagation delay: | ± 100 ns (Ext trig in to pulse out) | | | |
| Jitter: | ± 500 ps ± 0.03% of sync delay (Ext trig in to pulse out) | | | |
| Trigger required, for external trigger modes: | External trigger, internal PW control mode: +5 Volt, 50 ns or wider (TTL)<br>External trigger, external PW control mode: +5 Volt, $PW_{IN}$ = $PW_{OUT}$ (TTL) | | | |
| Monitor output: | Provides an attenuated coincident replica of the main output current pulse | | | |
| Sync delay, Sync output: | Sync out to pulse out: Variable 0 to ± 1 second.   + 3 Volts, 100 ns, will drive 50 Ohm loads | | | |
| Gate input: | Synchronous or asynchronous, active high or low, switchable.<br>Suppresses triggering when active. | | | |
| Connectors (high-average-power): | N/A | | | 1.5×20×40mm copper bus-bar (one each for OUT, GND) |
| Connectors (medium-average-power): | 6 mm plug / 4 mm sockets[6]  (OUT yellow, GND green).<br>Not for use for at peak currents > 200A if duty cycle > 5%. | | | |
| Connectors (low-average-power): | DB-37 female. Pins 1-19 = signal, pins 20-37 = ground. Suitable for mating to<br>AV-CLZ1 type cables (http://www.avtechpulse.com/transmission/av-clz1).<br>Not for use for average currents greater than 75 Amps, or at peak currents > 200A if duty cycle > 1%. | | | |
| Connectors (DC Power in): | 6 mm plug / 4 mm sockets[6] (+ red, - black) | | | |
| Optional recommended accessory kits[8]: | -AK4 option: Provides four 1 meter cables (one each of red, black, green, yellow)<br>with 6 mm safety sockets[7], and four 6 mm safety plug to M6 stud<br>adapters[6] (one each of red, black, green, yellow)<br><br>-AK6 option: Provides one AV-CLZ1-60 cable (60 cm length, $Z_0$ = 1 Ohm,<br>see http://www.avtechpulse.com/transmission/av-clz1) and one<br>AV-CTLX cable-to-PCB adapter (http://www.avtechpulse.com/accessories/av-ctlx) | | | |
| Suggested series resistor: | Avtech AV-HTL-1R0 | Avtech AV-HTL-0R2 | | Avtech AV-HTL-0R1 |
| Power requirements:                    DC[4]: | 0 to 52 V, > 50 Amp | 0 to 22 V, > 100 Amp | 0 to 42 V, > 200 Amp | 0 to 55 V, > 100 Amp |
| AC: | 100 - 240 Volts, 50 - 60 Hz | | | |
| Cooling: | Self-contained fan. | | | |
| Dimensions:                    Mainframe: | 138 mm x 430 mm x 425 mm<br>(5.5" x 17" x 16.8") | | | |
| Rack-mount kit: | Add the suffix -R6 to the model number to include 19" rack mount kit. | | | |
| Chassis material: | Anodized aluminum, with blue plastic trim | | | |
| Temperature range: | +5°C to +40°C | | | |

1) -B suffix indicates IEEE-488.2 GPIB and RS-232 control of pulse width, PRF and delay. (See http://www.avtechpulse.com/gpib for details).
2) Indicate desired polarity by suffixing the model number with -P or -N (i.e. positive or negative).
3) Add the suffix -TNT to the model number to specify the Internet control (Telnet and Web) option.
4) Requires a user-supplied DC power supply. Avtech suggests Xantrex as a source of DC power supplies (http://www.xantrex.com). Contact Avtech for recommendations about DC power supplies appropriate for your application. The cables for connecting the external DC power supply are not included with the standard model. 6 mm plug to 6 mm plug cables are available in the optional -AK3 and -AK4 accessory kits. These may or may not be suitable for your power supply, depending on the power supply's connectors. It is possible to cut and strip the ends of the optional accessory cables, and to attach other terminations. Multi-Contact (http://www.multi-contact.com or http://www.multi-contact-usa.com) can supply 6 mm plug to cable lug cables, and other configurations.
5) When externally triggered, the output pulse width can be controlled by the front panel controls (or computer command), or it can be set to follow the input pulse width (i.e., PWIN=PWOUT mode).

6) Multi-Contact (http://www.multi-contact.com or http://www.multi-contact-usa.com) ID/ S6AR-N-B4S series, or similar.
7) Multi-Contact (http://www.multi-contact.com or http://www.multi-contact-usa.com) SLK616-AR/BGG series, or similar.
8) Add the suffix(es) -AK3, -AK4, and/or -AK6 as appropriate, to the model number to include the accessory kit(s).
9) Valid for non-inductive loads installed directly on the output connectors (i.e., zero cable length) using low-inductance adapters, or for loads installed directly on the end of a AV-CLZ1-60 cable plugged into the DB-37 output connector. Inductive loads or cables will degrade the rise times. The 6 mm cables supplied with the optional accessory kits have an inductance of 0.6 uH / meter, approximately. The rise time degradation can be estimated as 2.2 × D × L / R, where D is the cable length, L = 0.6 uH/m, and R is the load resistance. With a 2m cable length and a 0.2Ω load, the rise time would degrade by 13.2 us. The AV-CLZ1-60 transmission lines do not display this inductive effect.
10) Add the suffix -TRIP to the model number to specify the current limit function. Units without this option will still have an over-current protection feature, but the trip level will be non-adjustable and set 20% above the maximum rated current, approximately.

*Rear panel of an AVO-8C1-B-N*

Basic Connection Arrangement for All Models



$V_{OUT} \approx V_{DC} - 2V$

$I_{OUT} \approx (V_{OUT} - V_{DIODE}) / (R_{SERIES} + 0.01 \text{ Ohms})$

Duty Cycle = Pulse Width x Frequency

$I_{AVG} = I_{OUT}$ x Duty Cycle

$\Delta V_{OUT} = I_{OUT} \times$ Pulse Width / C

C = 170000 uF + Power Supply Capacitance

The diode is shown oriented for positive (-P) operation. It must be reversed for negative (-N) units.

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at http://www.avtechpulse.com/pick
to find the best pulser for your application!

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Contact Avtech (info@avtechpulse.com) with your special requirement!

Avtech regularly adapts standard models for special
and "one-of-a-kind" applications.