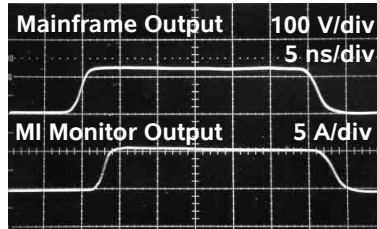


AVO-9A-B, 200 mA, 4 ns pulse



AVO-9P-B, 5A, 30 ns pulse

- ◆ IEEE-488.2 GPIB and RS-232 control (-B units)
- ◆ Peak currents from 100 mA to 10 Amps
- ◆ Pulse widths from 0.4 to 1 us, PRF to 250 MHz
- ◆ Rise times from 0.2 to 2.0 ns
- ◆ Simple socket mounting of laser diodes, which does not degrade rise times

The AVO-9 series offers a range of easy-to-use, ultra-high-speed pulsed laser diode drivers. Each model in the AVO-9 series consists of an instrument mainframe and an output module connected to the mainframe by a short (2 ft / 60 cm) coaxial cable. The mainframe generates a voltage pulse that is supplied to the output module. The output module has a special high-speed socket designed specifically for the user's particular laser diode, and a series resistance. This arrangement provides a user-friendly "plug-and-play" setup, without degrading performance. Different output modules can be ordered if the user needs to drive more than one type of diode.

All models include a variant of the AVX-S1 output module (see www.avtechpulse.com/laser-bias/avx-s1) that provides a socket into which the user's laser diode is inserted. Avtech can customize the sockets for many packages - for example, 14-pin butterfly, 5.6 mm can, 9 mm can, TO-3, and others. (The laser diodes are *not* supplied with the AVO-9 series). The output module connects to the instrument mainframe via a detachable 2-foot long 50Ω cable. (A longer user-supplied cable can be used, if required.) The output module contains the necessary elements to match the laser diode to the pulse generator mainframe. Output modules may be interchanged to accommodate different diode packages or different pin connections. A forward DC bias current of up to 100 mA may be applied to the laser diode by applying the desired DC current to a solder terminal on the output module. The output modules include "MV" and "MI" SMA outputs for sensing the voltage and current of the laser diode. An optional low-bandwidth SMA connection to a photo diode detector output is also available (-MD option). See the AVX-S1 datasheet at <http://www.avtechpulse.com/laser-bias/avx-s1> for more details.

At time of ordering, the customer must specify the basic model series and desired options (e.g. AVO-9A-C-P-MD), and the customer should email Avtech (info@avtechpulse.com) a copy of the diode datasheet so that we can confirm the electrical and mechanical design of the diode. Every output module is customized to accept a particular diode pinout. If the user wishes to test more than one diode, several output modules may be needed. Pricing depends on the mechanical complexity of the output module(s).

The polarity of the pulse supplied to the output module may be changed by adding a pulse transformer (typically the AVX-3, see <http://www.avtechpulse.com/transformer/avx-3>) between the mainframe and the output module. In addition, the output modules may be detached from the mainframe and used with other pulse or CW drivers. A more detailed description of the output module is given on the AVX-S1 datasheet (available at <http://www.avtechpulse.com/laser-bias/avx-s1>).

The mainframes for the AVO-9 series are slightly modified versions of standard Avtech pulse generators, as noted in the specification table. If desired, the mainframes may be used (without the output modules) to drive a resistive load directly.

When using the output module, the pulse current through the diode load is given by:

$$I_{\text{DIODE}} = (V_{\text{MAINFRAME}} / N - V_{\text{DIODE}}) \div (R_S + R_{\text{DIODE}})$$

where $V_{\text{MAINFRAME}}$ is the output voltage of the mainframe, V_{DIODE} is the diode voltage drop, R_{DIODE} is the parasitic resistance in

the diode, R_S is the fixed series resistance built into the output module, and N is the current-boosting ratio of the transformer in the module (if present).

$R_S + R_{\text{DIODE}}$ is selected to provide a proper transmission line termination for the coaxial cabling. For the low-current models (below 2 Amps), $N = 1$ and $R_S + R_{\text{DIODE}} \approx 50\Omega$. Models with currents in the range of 2 to 5 Amps have an internal transformer with $N = 2$, and $R_S + R_{\text{DIODE}} \approx 12.5\Omega$ (10Ω for model AVO-9M-B). The highest current model, the AVO-9W-B, also has $N = 2$, but $R_S + R_{\text{DIODE}} \approx 6\Omega$.

R_{DIODE} is determined by the user's diode. Many laser diodes have minimal parasitic resistance, and $R_{\text{DIODE}} \approx 0$. (Some laser diodes have a discrete resistance added internally - some common designs have $R_{\text{DIODE}} \approx 25\Omega$. These lasers can only be used with the drivers that require $R_S + R_{\text{DIODE}} \approx 50\Omega$.) R_{SERIES} is adjusted by Avtech for each instrument so that the correct $R_S + R_{\text{DIODE}}$ total is obtained.

These models are intended for diode loads whose forward voltage drop is $\leq 3V$. The maximum obtainable current will decrease if the diode voltage is higher than this.

The AVO-9A, -9B, -9B1 and -9B2 families offer maximum currents of 100, 200, or 400 mA, with very fast switching times and moderate repetition rates. The AVO-9A provides up to 200 mA, narrow pulse widths of 0.4 to 4 ns, rise times of 200 ps, and pulse repetition frequencies (PRF) to 1 MHz. The AVO-9B series is similar, but with wider pulses of 5 to 100 ns. The AVO-9B1 offers a much wider pulse width range of 0.5 to 1000 ns, with slightly slower 250 ps rise times. The 400 mA AVO-9B2 family also offers a wide pulse width range (0.6 - 1000 ns), with 350 ps rise times and a maximum PRF of 100 kHz.

The AVO-9C, -9E, -9F1, -9F2 and -9F3 families are designed for operation at much higher frequencies. The AVO-9C family offers 100 mA amplitude, 0.5 to 10 ns pulse widths, 300 ps rise times, and frequencies of 10 kHz to 25 MHz. The AVO-9E family offers amplitudes to 400 or 800 mA, 10 to 200 ns pulse widths, 300 ps rise times, and a PRF up to 10 MHz.

For very high frequencies, the AVO-9F1 family operates at 5 to 75 MHz, with amplitudes to 100 or 200 mA, 1-5 ns pulse widths, and 200 ps rise times. The AVO-9F2 operates to 340 or 680 mA, 0.4 to 1 ns, and 25 to 100 MHz. The AVO-9F3-C operates at repetition rates as high as 250 MHz. The maximum output current is 240 mA and 250 MHz, and 540 mA at 100 MHz.

The AVO-9G, -9H, 9H1, -9L, -9M, -9P, and -9W families offer higher maximum currents (1-10A). Sub-nanosecond rise times are available for currents up to 4.5 Amps. Repetition rates up to 200 kHz are possible.

Instruments with the -B suffix include a complete computer control interface (see <http://www.avtechpulse.com/gpib> for details). This provides GPIB and RS-232 computer-control, as well as front panel keypad and adjust knob control of the output pulse parameters. A large backlit LCD displays the output amplitude, frequency, pulse width, and delay. To allow easy integration into automated test systems, the programming command set is based on the SCPI standard, and LabView drivers are available for download at the Avtech web site

(<http://www.avtechpulse.com/labview>).

The -C versions provide outputs similar to those of the -B models, but do not include the GPIB or RS-232 interfaces or LCD display. The output parameters are controlled by front-panel range switches and one-turn vernier controls.

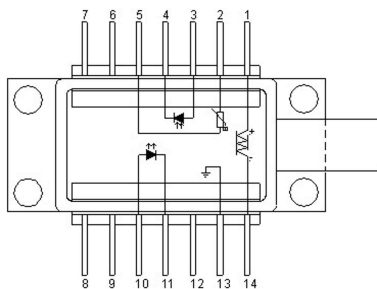
Except for the AVO-9F1-C, AVO-9F2-C and AVO-9F3-C, all models may be triggered externally using a TTL-level pulse, and include a delay control and sync output for oscilloscope triggering.

Most other Avtech high-speed pulse generators can be supplied with output modules for use with laser diodes, in a style similar to the AVO-9 series. Many aspects of the AVO-9 series can be adapted readily for particular applications. Call or email (info@avtechpulse.com) with your special requirement! A parametric search engine is available online at <http://www.avtechpulse.com/pick> to assist you in selecting the best instrument for your application.

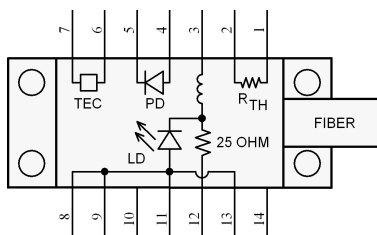
Visit <http://www.avtechpulse.com/appnote/vendors> for possible sources of laser diodes for use with the AVO-9 series.

COMMON PACKAGES THAT CAN BE ACCOMODATED

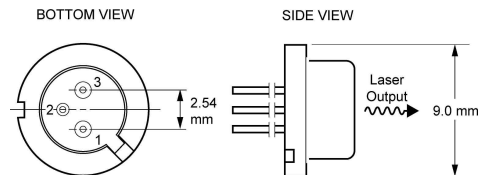
For butterfly devices, Avtech can provide output modules that either mate to just one side of the package (the side with the anode and cathode), or to both sides of the package (to permit access to the thermoelectric cooler and thermistor pins).



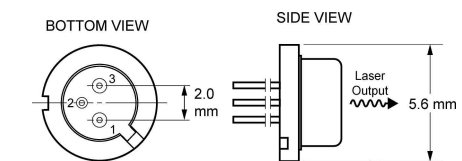
-P1B / -T1B Package Options, for butterfly packages with the anode on pin 10 and the cathode on pin 11. The -P1B option provides high-speed pin sockets for pins 8-14. To specify an additional low-bandwidth slide-on socket for pins 1-7, add the -T1B option.



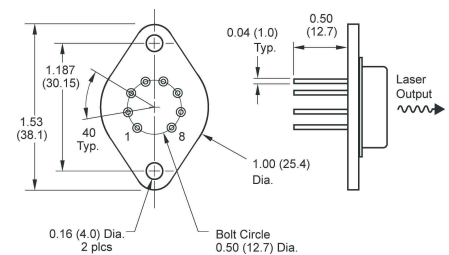
-P1C / -T1C Package Options, for butterfly packages with the anode on pin 11 and the cathode on pin 12, and an internal series resistance of ≈ 25 Ohms. The -P1C option provides high-speed pin sockets for pins 8-14. To specify an additional low-bandwidth slide-on socket for pins 1-7, add the -T1C option.



-P0 Option, generic* 9 mm Package



-P2 Option, generic* 5.6 mm Package



-TO3 Option, generic* TO-3 Package

* Additional details (pinout, diode resistance) must be supplied by the end-user if this option is specified.

**Other packages can be accommodated.
Contact Avtech with your special requirement!**

OUTPUT MODULE SPECIFICATIONS / PINOUTS

Each model is customized for a specific diode's pinout and I-V characteristics. If a generic pinout option (e.g., -P0, -P1, -P2, -P3, -TO3) is selected, then a drawing showing the diode package size and electrical pinout must be provided by the end-user, and the model number and price may change. If a specific pinout option has been selected (-P1B or -P1C, for instance - see the next page for details), no additional information is required.

If you have selected the basic pulser that you need (for instance, the AVO-9A-B), but are confused about the mechanical specifications, simply email the diode datasheet to Avtech (info@avtechpulse.com) and we will provide you with the most appropriate complete model number (customized, if required).



SPECIFICATIONS

AVO-9 SERIES

Models < 1 Amp, with PRF ≤ 10 MHz

Model:	AVO-9A-C ¹ AVO-9A-B ²	AVO-9B-C ¹ AVO-9B-B ²	AVO-9B1-B ²	AVO-9B2-B ²	AVO-9E-B ²
Amplitude ^{3,7} :	0 - 200 mA		0 - 200 mA	0 - 400 mA	0 - 400 mA
Max. output of mainframe into 50Ω (V _{MAINFRAME}):	13V		13V	23V	23V
R _S + R _{DIODE} :	50Ω				
Transformer ratio, N:	1				
Allowed load voltage range:	0 to 3V. (Contact Avtech if your diode has a higher forward voltage drop)				
Pulse width (FWHM) ⁸ :	0.4 - 4 ns	5 - 100 ns	0.5 - 1000 ns	0.6 - 1000 ns	10 - 200 ns
Duty cycle limits:	N/A		5%		10%
Minimum PRF: -C units: -B units:	100 Hz 1 Hz		1 Hz		1 Hz
Maximum PRF:	1 MHz		1 MHz	100 kHz	10 MHz
Rise / fall times (20%-80%):	≤ 200 ps		≤ 250 ps	≤ 350 ps	≤ 300 ps
Related 50Ω series:	AVP-AV-1	AVMP-2	AVPP-1A	AVPP-2A	AVMR-2
Included output module:	AVX-S1				
Polarity ⁴ :	Positive or negative (specify)				
GPIB and RS-232 control ² :	Standard on -B units. Not available on -C units.				
LabView drivers:	-B units only: check http://www.avtechpulse.com/labview for availability and downloads				
Telnet / Web control ⁵ :	Optional for -B units. See http://www.avtechpulse.com/options/tnt for details				
Propagation delay:	-C units: ≤ 100 ns -B units: ≤ 150 ns (Ext trig in to pulse out)				
Jitter:	-C units: ± 15 ps, B units: ± 35 ps ± 0.015% of sync delay (Ext trig in to pulse out)				
DC offset or bias insertion:	Apply required DC bias current in the range of ± 100 mA to solder terminal on output module.				
Sync delay:	Variable 0 to 200 ns (Sync out to pulse out)				
Sync output (to 50Ω):	+3V, 100 ns				
Gate input: (-B only)	Synchronous or asynchronous, active high or low, switchable. Suppresses triggering when active.				
Trigger required: (ext trig mode)	+ 5 V (TTL) ≥ 50 ns				
Monitor output option ⁶ :	Provides connection to output of photo diode detector.				
Connectors: Out: Other:	User-specified socket. Sockets can be provided for 5.6 mm, 9 mm, butterfly, and other packages. Trig, Sync, Gate (-B only): BNC, Monitor: SMA				
Recommended accessory kit:	Add the suffix "-AK1" to the model number to include the recommended accessory kit. Consists of three SMA, 18 GHz, 2 Watt attenuators (10, 20 & 30 dB) for use on the output, and two 50 Ohm, 1 GHz, 1 Watt feed-through terminators (one SMA, one BNC) for use on external trigger inputs.				
Power requirements:	100 - 240 Volts, 50 - 60 Hz				
Dimensions, Mainframe: (H×W×D)	100 x 430 x 375 mm (3.9" x 17" x 14.8"). Anodized aluminum, with blue plastic trim.				
Dimensions, Output Module:	41 x 66 x 76 mm (1.6" x 2.6" x 3.0"), cast aluminum, blue enamel				
Temperature range:	+5°C to +40°C				

- 1) -C suffix indicates stand-alone lab instrument with internal clock and line powering. (See <http://www.avtechpulse.com/formats/> for details of the instrument formats).
- 2) -B suffix indicates IEEE-488.2 GPIB and RS-232 control of amplitude and frequency. See <http://www.avtechpulse.com/gpib/> for details.
- 3) For operation at amplitudes of less than 20% of full-scale, best results will be obtained by setting the amplitude near full-scale and using external attenuators on the output, between the mainframe and the output module. Attenuators are available in the -AK1 accessory kit option.
- 4) Indicate desired polarity by suffixing model number with -P or -N.

- 5) Add the suffix -TNT to the model number to specify the Telnet / Web Ethernet control option.
- 6) For photo diode output monitor option add suffix -MD.
- 7) Standard AVO-9A-C, AVO-9B-C, and AVO-9E-C units have a one-turn amplitude dial. To specify a ten-turn amplitude dial, suffix the model number with -AT. Not applicable for -B units.
- 8) Standard AVO-9A-C, AVO-9B-C, and AVO-9E-C units have a one-turn pulse width dial. To specify a ten-turn pulse width dial, suffix the model number with -PWT. Not applicable for -B units.



SPECIFICATIONS

AVO-9 SERIES

Models < 1 Amp, with PRF > 10 MHz

Model:	AVO-9C-C ¹	AVO-9F1-C ¹	AVO-9F2-C ¹	AVO-9F3-C ¹
Maximum amplitude ² :	0 - 100 mA	0 - 100 mA	0 - 340 mA	540 mA at 25-100 MHz 340 mA at 100-200 MHz 240 mA at 200-250 MHz
Max. output of mainframe into 50Ω (V _{MAINFRAME}):	8V	8V	20V	30V at 25-100 MHz 20V at 100-200 MHz 15V at 200-250 MHz
R _S + R _{DIODE} :	50Ω			
Transformer ratio, N:	1			
Allowed load voltage range:	0 to 3V. (Contact Avtech if your diode has a higher forward voltage drop)			
Pulse width (FWHM):	0.5 - 10 ns	1 - 5 ns	0.4 - 1 ns	0.4 - 1 ns
Minimum PRF:	10 kHz	5 MHz	25 MHz	25 MHz
Maximum PRF:	25 MHz	75 MHz	100 MHz	250 MHz
Rise / fall times (20%-80%):	≤ 300 ps	≤ 200 ps	≤ 200 ps	≤ 250 ps
Related 50Ω series:	AVMM-2	AVN-W2	AVN-4	AVN-5A
Included output module:	AVX-S1			
Polarity ³ :	Positive or negative (specify)			
Propagation delay:	< 100 ns (Ext trig in to pulse out)			
Jitter:	± 15 ps (Ext trig in to pulse out)			
DC offset or bias insertion:	Apply required DC bias current in the range of ± 100 mA to solder terminal on output module.			
Sync delay:	Variable 0 to 200 ns (Sync out to pulse out)	N/A		
Sync output (to 50Ω):	+0.5V pulse, 20 ns width.	400 mV square wave, AC-coupled. Must be terminated with 50 Ohms to ground.		
Trigger required: (External trigger mode ⁵)	+ 5 V (TTL) ≥ 10 ns. 1 kΩ input impedance.	ECL-logic-level (LOW = -1.6V, HIGH = -0.8V) square wave with 50% duty cycle. The trigger input is terminated by 50 Ohms to -2V internally.		
Monitor output option ⁴ :	Provides a connection to output of the photodiode detector (if present in the device under test).			
Connectors: Out: Other:	User-specified socket. Sockets can be provided for 5.6 mm, 9 mm, butterfly, and other packages. Trig / Sync: BNC, Monitor: SMA			
Recommended accessory kit:	Add the suffix "-AK1" to the model number to include the recommended accessory kit. Consists of three SMA, 18 GHz, 2 Watt attenuators (10, 20 & 30 dB) for use on the output, and two 50 Ohm, 1 GHz, 1 Watt feed-through terminators (one SMA, one BNC) for use on external trigger inputs.			
Power requirements:	100 - 240 Volts, 50 - 60 Hz			
Dimensions, Mainframe (H×W×D):	100 x 215 x 375 mm (3.9" x 8.5" x 14.8")	100 x 430 x 375 mm (3.9" x 17" x 14.8")		
Dimensions, Output Module:	41 x 66 x 76 mm (1.6" x 2.6" x 3.0"), cast aluminum, blue enamel			
Temperature range:	+5°C to +40°C			

- 1) -C suffix indicates stand-alone lab instrument with internal clock and line powering. (See <http://www.avtechpulse.com/formats/> for details of the instrument formats).
- 2) For operation at amplitudes of less than 20% of full-scale, best results will be obtained by setting the amplitude near full-scale and using external attenuators on the output, between the mainframe and the output module.

- Attenuators are available in the -AK1 accessory kit option.
- 3) Indicate desired polarity by suffixing model number with -P or -N.
- 4) For photo diode output monitor option add suffix -MD.
- 5) These models are not suitable for non-repetitive or random triggering. Internal time constants and settling periods may cause unexpected results with aperiodic trigger signals.

Models ≥ 1 Amp – see previous pages for < 1 Amp

Model ¹ :	AVO-9G-B	AVO-9H-B	AVO-9H1-B	AVO-9L-B	AVO-9M-B	AVO-9P-B	AVO-9W-B
Amplitude, standard ² :	0 - 1 Amp,	0 - 2 Amp	0 - 2 Amp	0 - 2 Amp	0 - 4.5 Amp	0 - 5 Amp	0 - 10 Amp
Maximum voltage output of mainframe (V _{MAINFRAME}):	53V (to 50Ω)	103V (to 50Ω)	103V (to 50Ω)	50V (to 50Ω)	125V (to 50Ω)	125V (to 50Ω)	125V (to 25Ω)
R _S + R _{DIODE} :	50Ω	50Ω	50Ω	12.5Ω	10Ω	12.5Ω	6.2Ω
Transformer ratio, N:	1	1	1	2	2	2	2
Allowed load voltage range:	0 to 3V. (Contact Avtech if your diode has a higher forward voltage drop)						
Pulse width (FWHM):	20 - 200 ns		10 - 500 ns	1 - 20 ns	1 - 10 ns	4 - 50 ns	
Duty cycle limits:	N/A		2%	N/A			
Minimum PRF:	1 Hz						
Maximum PRF:	50 kHz		200 kHz	20 kHz	20 kHz	40 kHz	20 kHz
Rise time (20%-80%):	≤ 500 ps	≤ 700 ps	≤ 1.2 ns	≤ 500 ps	≤ 1 ns	≤ 2 ns	
Fall time (20%-80%):	≤ 500 ps	≤ 700 ps	≤ 2.0 ns ⁶	≤ 500 ps	≤ 1 ns	≤ 2 ns	
Related 50Ω series:	AVR-E2	AVR-E3	AVR-E3A	AVO-2L	AVO-2M	AVO-2A	AVO-2W
Included output module:	AVX-S2	AVX-S2	AVX-S2	AVX-S1-HC	AVX-S3A	AVX-S3A	AVX-S3C
Polarity ³ :	Positive or negative (specify)						
GPIB and RS-232 control ¹ :	Standard on -B units.						
LabView drivers:	Check http://www.avtechpulse.com/labview for availability and downloads						
Telnet / Ethernet control ⁴ :	Optional. See http://www.avtechpulse.com/options/tnt for details						
Propagation delay:	≤ 150 ns (Ext trig in to pulse out)						
Jitter:	± 35 ps ± 0.015% of sync delay (Ext trig in to pulse out)						
DC offset or bias insertion:	Apply required DC bias current in the range of ± 100 mA to solder terminal on output module.						
Sync delay:	Variable 0 to ± 1 second. (Sync out to pulse out)						
Sync output:	+ 3 Volts, 100 ns, will drive 50 Ohms						
Gate input:	Synchronous or asynchronous, active high or low, switchable. Suppresses triggering when active.						
Trigger required:	External trigger mode: TTL-level pulse (LO = 0V, HI = 3-5V), ≥ 10 ns						
Photodiode output option ⁵ :	Provides connection to output of photo diode detector. (Requires a photodiode in the device under test.)						
Connectors:	Out:	User-specified socket. Sockets can be provided for 5.6 mm, 9 mm, butterfly, and other packages.					
	Other:	Trig, Sync, Gate: BNC, Monitor: SMA					
Recommended accessory kit:	Add the suffix "-AK1" to the model number to include the recommended accessory kit. Consists of three SMA, 18 GHz, 2 Watt attenuators (10, 20 & 30 dB) for use on the output, and two 50 Ohm, 1 GHz, 1 Watt feed-through terminators (one SMA, one BNC) for use on external trigger inputs.						
Power requirements:	100 - 240 Volts, 50 - 60 Hz						
Dimensions:	Mainframe:	100 x 430 x 375 mm (3.9" x 17" x 14.8"), anodized aluminum, with blue plastic trim					
	Output module:	41 x 66 x 76 mm (1.6" x 2.6" x 3.0"), cast aluminum, blue enamel					
Temperature range:	+5°C to +40°C						

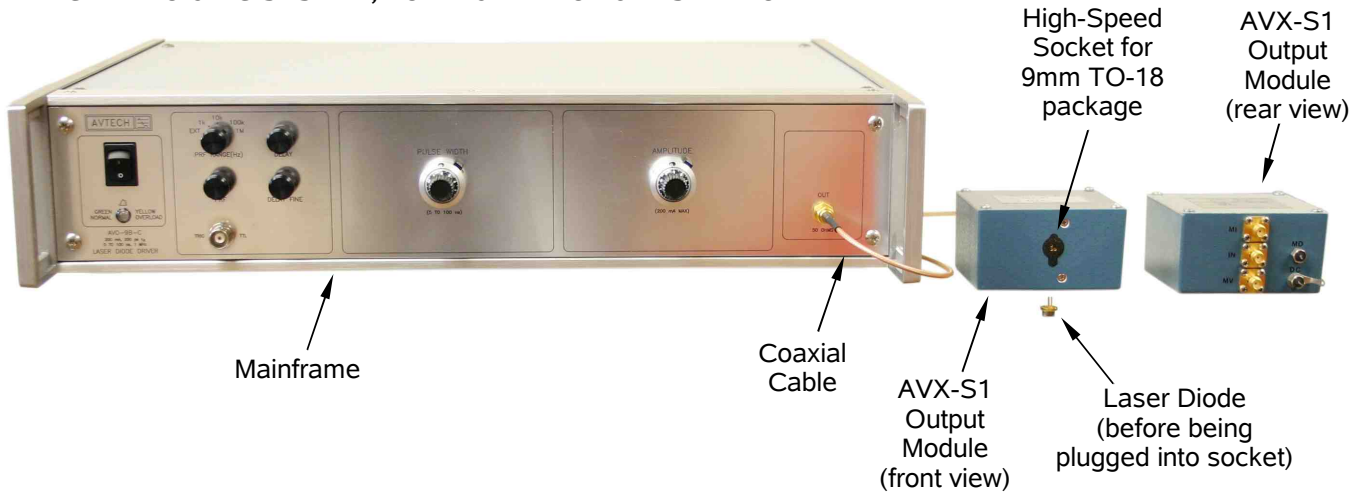
- B suffix indicates IEEE-488.2 GPIB and RS-232 control of amplitude and frequency. See <http://www.avtechpulse.com/gpib/> for details.
- For operation at amplitudes of less than 20% of full-scale, best results will be obtained by setting the amplitude near full-scale and using external attenuators on the output, between the mainframe and the output module. Attenuators are available in the -AK1 accessory kit option.
- Indicate desired polarity by suffixing model number with -P or -N (i.e. positive or negative).
- Add the suffix -TNT to the model number to specify the Telnet / Ethernet control option.
- For photo diode output monitor option add suffix -MD.
- Fall time increases to < 3 ns for pulse widths less than 15 ns.

AVO-9W-B MAINFRAME

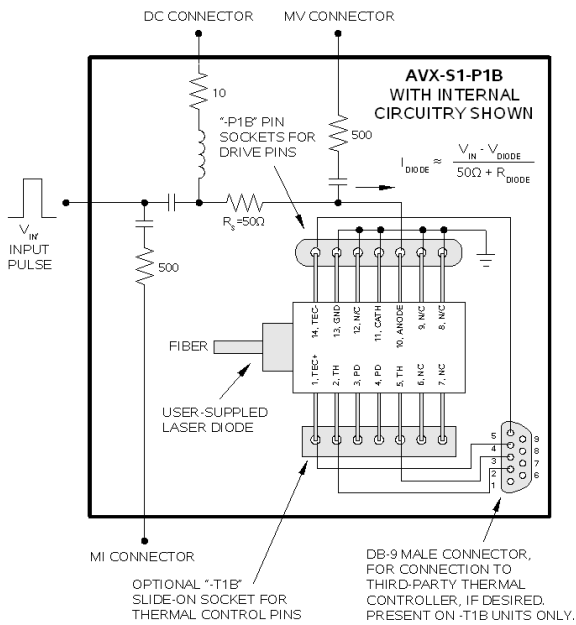


The cables lead to the output module, not shown.
(See below and next page for typical output modules.)

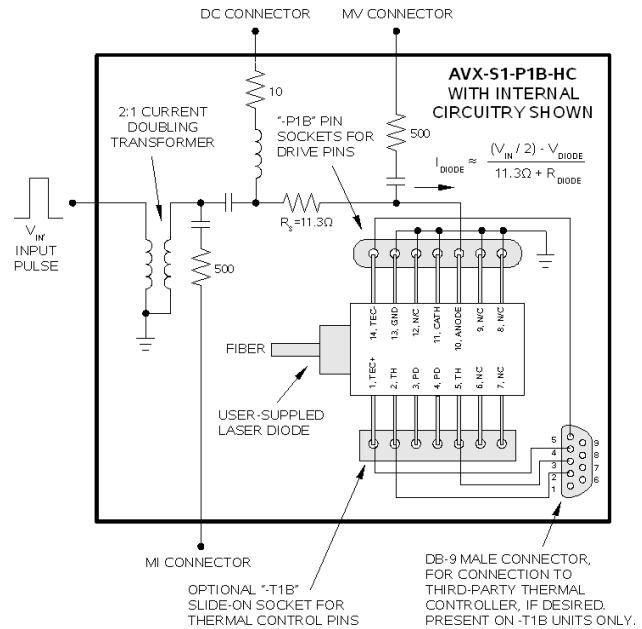
TYPICAL AVO-9B-C SYSTEM, FOR A 9 mm TO-18 LASER DIODE



AVX-S1-P1B Functional Equivalent Circuit

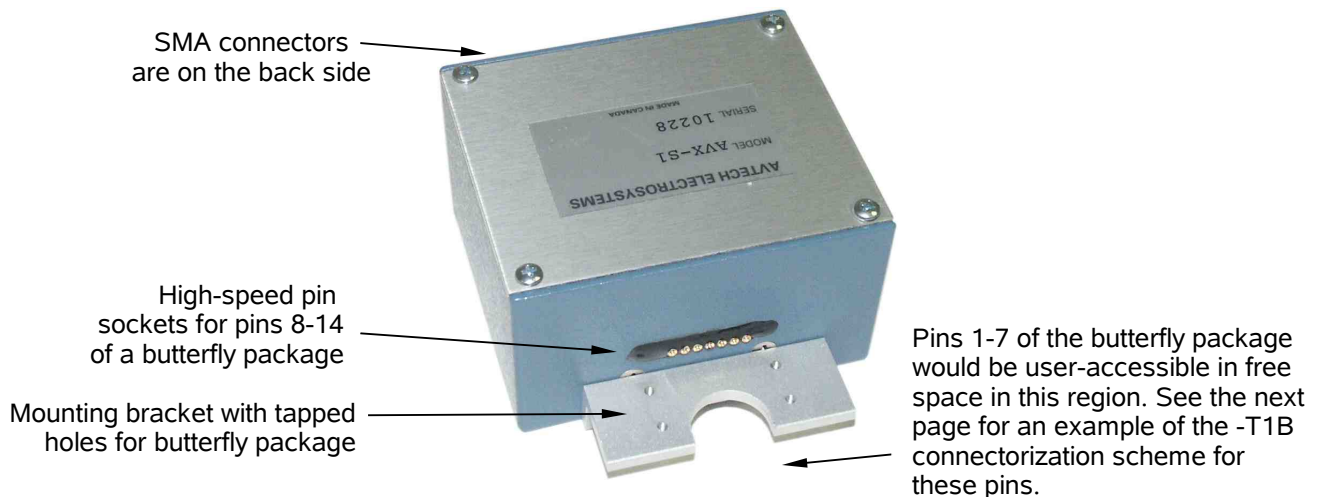


AVX-S1-HC-P1B Functional Equivalent Circuit



The exact pin configuration of the diode package must be specified at the time of ordering, so that a suitable socket can be provided. The above circuits illustrate one common configuration, which requires a positive pulser. See the AVX-S1 and AVX-S1-HC datasheets (<http://www.avtechpulse.com/laser-bias/avx-s1>) for more information and for examples of packages that can be accommodated.

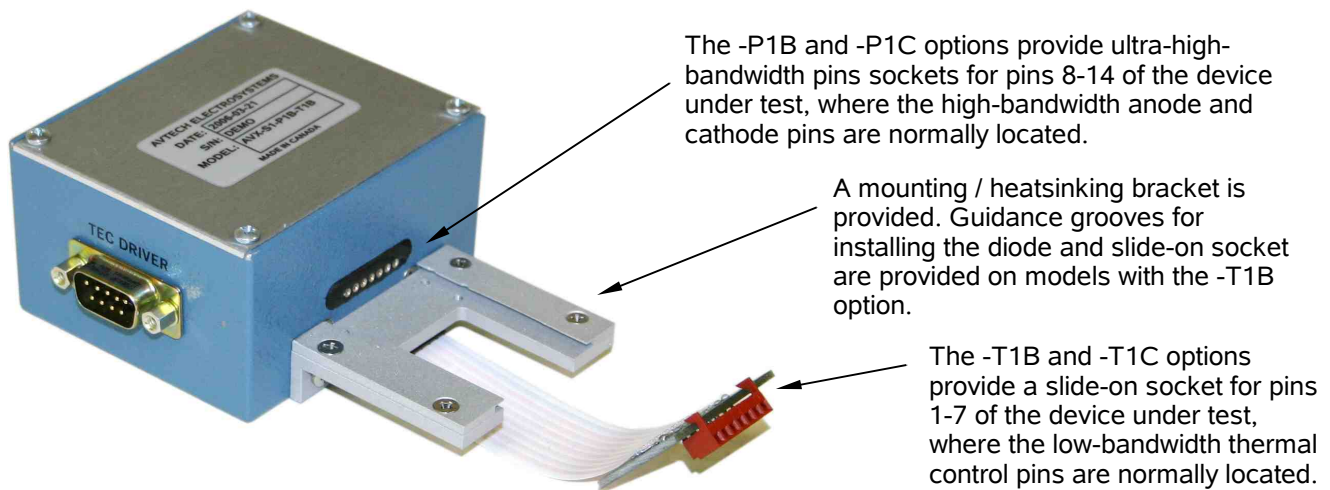
OUTPUT MODULE FOR A BUTTERFLY-PACKAGED DIODE, WITHOUT THE -T1B OR -T1C OPTIONS



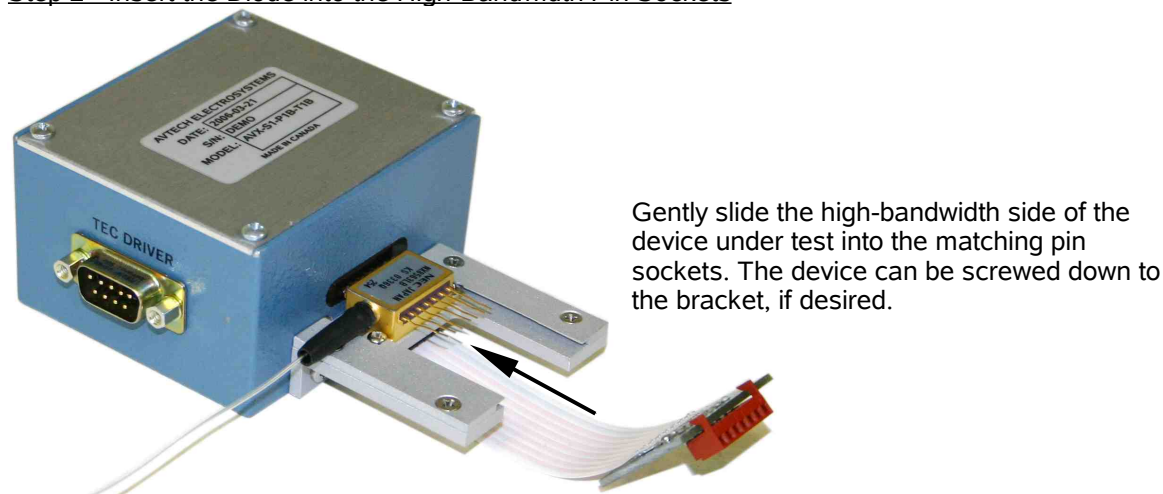
SAMPLE OUTPUT MODULE FOR A BUTTERFLY-PACKAGED DIODE, WITH THE -T1B OR -T1C OPTIONS

The photos below show the procedure from inserting a typical pigtailed device into an output module with the -P1B and -T1B options (or the -P1C and -T1C options). This is just an example; your diode may differ. (For instance, the fiber may exit the diode on the opposite side.)

Step 1 - Understand the Mechanical Aspects



Step 2 - Insert the Diode into the High-Bandwidth Pin Sockets



Step 3 - Install the Slide-On Socket on the Low-Bandwidth Pins

