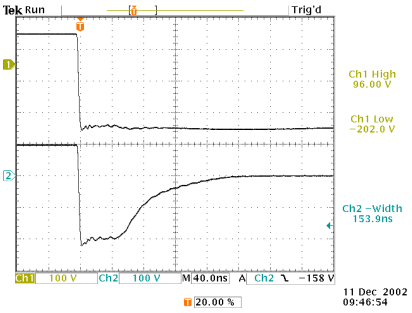
AVR-EB SERIES

t_{RR} & t_{FR} TEST GENERATORS FOR DIODE SWITCHING TIME TESTS INCLUDING METHODS 4031.1 & 4026.2



Top: AVR-EB4-B output. (100V/div, 40 ns/div)
Bottom: Reverse recovery of 1N4937 rectifier (+2A, -4A)

- Ideal for diode switching time tests (t_{RR}, t_{FR})
- Models for forward and reverse recovery testing
- MIL-STD-750E Method 4026.3
- MIL-STD-750E Method 4031.4 Conditions B1-B4
- Customized test jigs available
- IEEE-488.2 GPIB and RS-232 interfaces included

The AVR-EB series was designed for MIL-STD-750E diode switching time tests. The AVR-EB4-B is intended for reverse recovery testing of high-speed power rectifiers. The similar AVR-EB5-B is intended for more specialized reverse recovery testing of long-lifetime high-voltage PIN diodes, and the AVR-EB7-B is intended for low-current small-signal diodes. The AVR-EBF6-B is intended for forward recovery tests of most diode types.

For reverse-recovery tests of high-speeds rectifiers, the AVR-EB4-B generates a 2-20 us wide forward-bias pulse of up to +100V/+2A, which is then immediately followed by a 2-20 us wide reverse-bias pulse of up to -200V/-4A. The forward and reverse amplitudes and pulse widths are independently variable. The forward-to-reverse switching time is < 4.5 ns (10%-90%).

The current waveforms generated by this instrument are suitable for MIL-STD-750E Method 4031.4 Test Condition B tests. In the terminology of this standard, V3 = 0 to +200V, V4 = 0 to -200V, RF = 50 Ohms, R4 = 50 Ohms, and RR ≈ 0. These values differ from the values suggested in the standard, but the use of 50 Ohm resistances allows common coaxial cabling to be used for flexible connection arrangement, and greatly reduces the τ = L / R time constants that plague measurement systems based on the suggested values. As a result, the measurements are more accurate and more repeatable. (For additional information about the rationale behind the approach, please refer to Avtech Technical Brief 15, "A Comparison of Reverse Recovery Measurement Systems", available at http://www.avtechpulse.com/appnote.) The values of I_F, I_{RM}, and $i_{R(REC)}$ produced by this instrument are suitable for the MIL-STD-750E Method 4031.4 Test Conditions B1-B4. (B4 is not recommended by Avtech, however, because the high I_{RM} / $i_{R(REC)}$ ratio will make the results more sensitive to parasitic effects.) See the online manual for a selection of typical waveforms obtained with different diode types.

Standard AVR-EB4-B models include one AVX-TRR-MIX diode test jig. The instrument mainframe is connected to the test jig using one coaxial cable and one DB-9 control cable. This test jig contains a variety of pin sockets, which may be used to hold the diode device under test (DUT). The test jig has a hinged lid, which must be fully closed to protect the user from high voltages. The output will be automatically disabled if the lid is left open. The standard AVX-TRR-MIX test jig will accommodate TO-220AC (2 lead) packages, DO-style packages with (leads bent at 90°), and standard and reverse-polarity TO-3 packages. The AVR-EB4-B may also be provided with different or additional a customized test jigs, to meet particular customer package requirements. The standard tst jig may be replaced with one that accepts DO-41 and Type E axial packages without the need for lead-bending by specifying the -ANB option. (This jig can also be ordered separately as model AVX-TRR-ANB.)

The breakdown voltage of diodes tested by the AVR-EB4-B must exceed I_{RM} x 50Ω. For instance, for tests with I_{RM} = -1A, V_{BR} must exceed 50V.

Model AVR-EB8-B is similar, except that it offers higher currents (+4A, -8A) with slower switching times (10 ns).

The AVR-EB5-B is also similar, except that it is intended for use with diodes which have much longer recovery times (hundreds of microseconds), such as high-voltage PIN diodes. The switching times are slower than for the AVR-EB4-B, and the forward bias current is programmable in the range of +10 mA to +4A. In contrast to the AVR-EB4-B, the forward pulse is programmed in terms of the desired current (+10 mA to +4), rather than the applied voltage. The internal output impedance auto-ranges to achieve the desired current amplitude.

Model AVR-EB7-B is optimized for lower-current small-signal diodes (10 mA to 200 mA). The forward-to-reverse switching time is < 2.5 ns.

Model AVR-EBF6-B is intended for forward recovery tests, as per MIL-STD-750E Method 4026.3. This pulse generator provides a +5V to +50V output amplitude, with 50 Ohm output impedance (for backmatching) to drive 50 Ohm load impedances. Forward currents as high as +1A can be obtained. The mainframe output rise time is < 5 ns (10%-90%). An accessory coaxial rise time filter should be connected to the output to provide the rise time required for the test – typically 8, 10, or 12 ns (10%-90%). The 10 ns filter is included as a standard accessory, and the 8 and 12 ns filters are available as options. The pulse width is adjustable over the range of 200 ns to 10 us. Standard AVR-EBF6-B models include one AVX-TFR-MIX diode test jig. The instrument mainframe is connected to the test jig using one coaxial cable and one DB-9 control cable. The standard test jig contains a variety of pin sockets, which may be used to hold the diode device under test (DUT). The test jig has a hinged lid, which must be fully closed to protect the user from high voltages. The output will be disabled if the lid is left open. The standard AVX-TFR-MIX test jig will accommodate DO-41 packages, the Microsemi axial "E" package, DO-201AD, TO-220AC and similar packages. Lead bending is required for axial packages. The AVR-EBF6-B may also be provided with different or additional a customized test jigs, to meet particular requirements. Different rise times can also be provided, if required.

The test jigs supplied with all models are specially designed to minimize the effects of parasitic inductance as well as transmission line reflections. This helps improve the accuracy and repeatability of the tests.

All models are controlled by a front-panel keypad, adjust knob, and LCD display, or by programming commands sent via the included IEEE-488.2 GPIB and RS-232 ports.

Several relevant application notes are available on the Avtech web site, at http://www.avtechpulse.com/appnote. See application notes TB9, TB15, and TB16 in particular.

GPIB IEEE-488

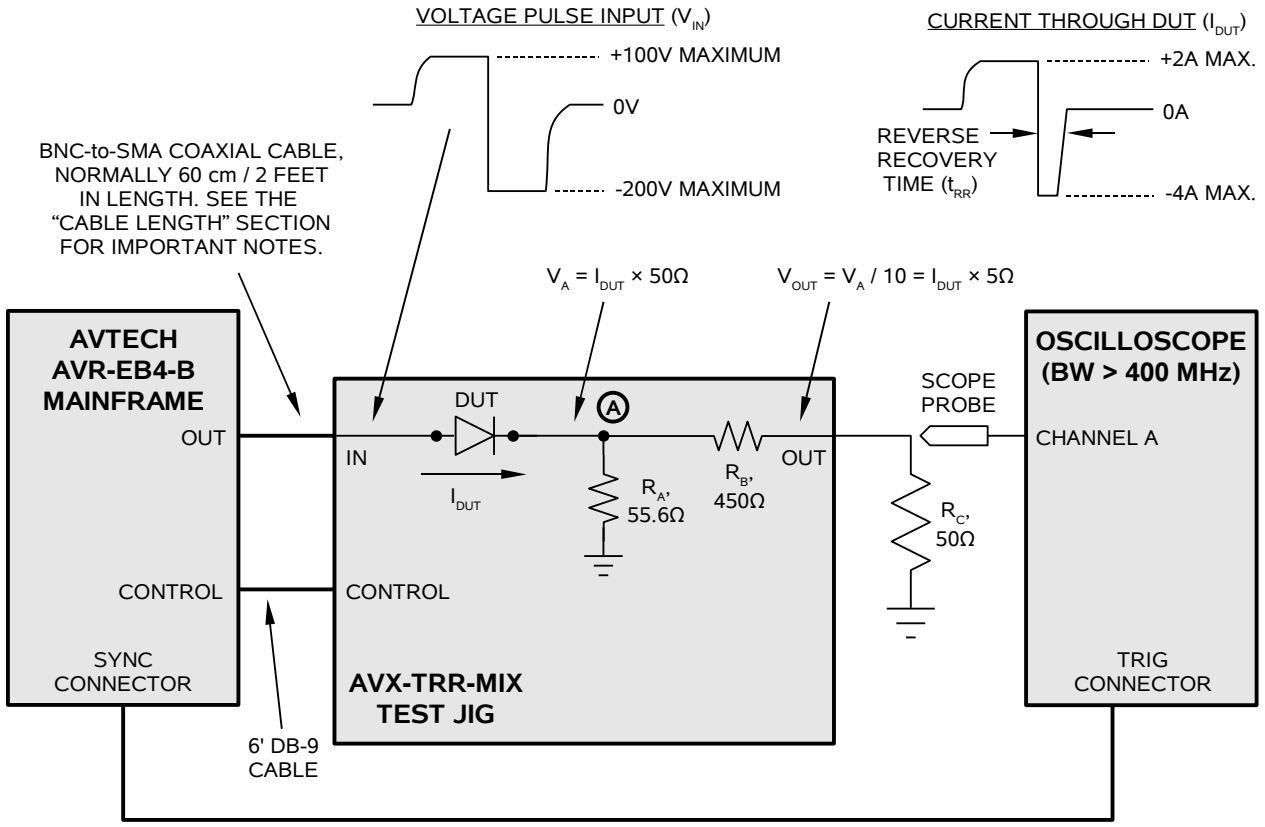
SPECIFICATIONS

AVR-EB SERIES

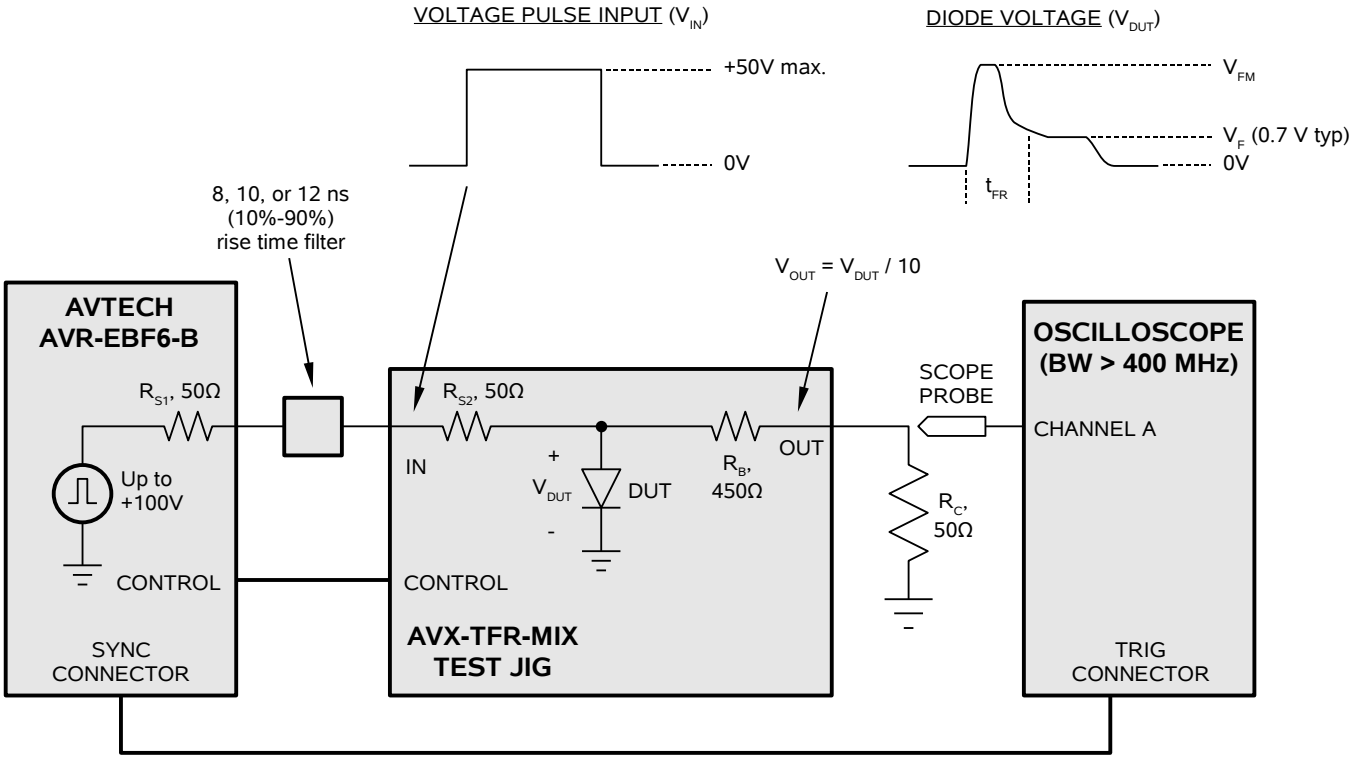
Model[1]:	AVR-EB4-B		AVR-EB8-B		AVR-EB5-B		AVR-EB7-B		AVR-EBF6-B
Recovery type:	Reverse recovery		Reverse recovery		Reverse recovery		Reverse recovery		Forward recovery
Intended application:	High-speed rectifiers		High-voltage high-speed rectifiers		Long-lifetime PIN diodes		High-speed small-signal diodes		Most diode types
Basic waveform:	A positive pulse followed immediately by a negative pulse		A positive pulse followed immediately by a negative pulse		A positive pulse followed immediately by a negative pulse		A positive pulse interrupted by a negative pulse		A positive pulse
Pulse polarity:	-	+	-	+	-	+	-	+	+
Voltage output[2,6,8]: (to R_L = 50Ω)	-2V to -200V	+5V to +100V	-4V to -400V	+10V to +200V	-2V to -200V	N/A	-0.2V to -20V	+0.1V to +10V	+5V to +50V
Corresponding diode current[2,6] (approx., depends on V_{DIODE}):	-40 mA to -4A	+100 mA to +2A	-80 mA to -8A	+200 mA to +4A	-40 mA to -4A	+10 mA to +4A	-10 mA to -200 mA	+10 mA to +200 mA	+100 mA to +1A
Pulse width (FWHM):	2 us - 20 us		2 us - 10 us		0.2 ms to 1 ms		100 ns	300 ns[10]	200 ns to 10 us[9]
Maximum duty cycle:	N/A		N/A		0.25% (250 us max. at 10 Hz, 1 ms max. at ≤ 2.5 Hz)		N/A		N/A
Rise time: (10%-90%)	< 4.5 ns	< 1 us	< 10 ns	< 1 us	< 50 ns	< 1 us	< 2 .5ns[11]	< 20 ns	No filter < 5 ns. Standard filter[5]: 10 ns Optional filter[5]: 8 ns Optional filter[5]: 12 ns
Output impedance during pulse (inside the mainframe):	≤ 2 Ohm	50 Ohms	≤ 2 Ohm	50 Ohms	≤ 2 Ohm	varies	50 Ohms	50 Ohms	50 Ohms
Maximum PRF:	100 Hz		50 Hz		10 Hz		5 kHz		100 Hz
Delay:	auto-aligned with positive falling edge	0 to ± 1.0 s variable	auto-aligned with positive falling edge	0 to ± 1.0 s variable	auto-aligned with positive falling edge	0 to ± 1.0 s variable	300 ns after start of the positive pulse[7]	0 to ± 1.0 s variable	0 to ± 1.0 s variable
Coaxial cable to test jig (supplied):	Normally 60 cm / 2 feet, RG-316 or RG-58C/U. A 5 meter cable is also supplied, in the case shorter cable arrangement generates transmission line reflections.				2 meter / 6 feet, RG-316 or RG-58C/U.		60 cm / 2 feet, RG-316 or RG-58C/U.		2 meter / 6 feet, RG-316 or RG-58C/U.
Supplied test jig[4]:	Model AVX-TRR-MIX (for reverse testers) or AVX-TFR-MIX (for forward testers). Includes pin sockets for TO-220AC (2 lead) packages, DO-style packages[3] with leads bent at 90°, and standard and reverse-polarity TO-3 packages. Lead bending is required for axial packages.								
Alternate test jig for axial devices:	Add the suffix -ANB to the model number to replace the standard test jig with one that will accept DO-41 packages (0.205" x 0.107" body, max) and Microsemi Axial Type E packages (0.185" x 0.135" body, max). Unlike the standard jig, bending is NOT required to insert these packages. This jig will not accept any other type of package. This is also available separately as part number AVX-TRR-ANB (for reverse testers) or AVX-TFR-ANB (for forward recovery testers).								
Alternate test jigs for DIP and mil-style flat-pack diode arrays:	Add the suffix -DIPFP to the model number to replace the standard test jig with one that will accommodate DIP packages with up to 16 pins (width = 0.3", pitch = 0.1"). A flat-pack-to-DIP adapter will be provided to accept mil-style flat-packs with up to 16 pins (width < 0.27", pitch = 0.050"). The instrument can be programmed to switch the input and output signals to any pair of pins on the device under test, using a system of internal relays. This is not available as a separate part number. It must be ordered as an option for the AVR-EB-series instrument.								
Other test tigs:	Test jigs are available for MELF packages (AVX-TRR-MELF or AVX-TFR-MELF), DO-4 and DO-5 stud packages (AVX-TRR-STUD or AVX-TFR-STUD), SOT-23 3-pin packages (AVX-TRR-SOT23 or AVX-TFR-SOT23) and other packages. Contact Avtech for pricing and model numbers. These can be used in place of the standard supplied test jig, and can be ordered at a later time.								
Mainframe connectors:	BNC								
GPIB and RS-232 control:	Standard on -B units. See http://www.avtechpulse.com/gpib for details.								
Trigger required:	Ext trig mode: + 5 Volts, 10 ns or wider (TTL)								
Gate input	Active high or low, switchable. Suppresses triggering when active.								
Power requirements:	100 - 240 Volts, 50 - 60 Hz								
Dimensions:	H x W x D: 100 mm x 430 mm x 375 mm (3.9" x 17" x 14.8")								
Chassis material:	cast aluminum frame and handles, blue vinyl on aluminum cover plates								
Temperature range:	+5°C to +40°C								

1) -B suffix indicates IEEE-488.2 GPIB and RS-232 control of amplitude, pulse width, PRF and delay (see http://www.avtechpulse.com/gpib).
2) For operation at amplitudes of less than 10% of full-scale, best results will be obtained by setting the amplitude near full-scale and using external attenuators on the output.
3) DO-15, DO-35, DO-41, DO-201AD, etc.
4) Customized jigs available upon request.
5) The 10 ns (10%-90%) rise time filter is included as a standard feature. To add an 8 ns filter, add the -f8ns option to the model number. To add a 12 ns filter, add the -f12ns option to the model number. The rise time filter accuracy is ± 1.2 ns.
6) The amplitude settings should not be relied upon for any degree of accuracy, because the dynamics of the device under test can affect the actual generated waveforms. Amplitude settings should always be verified by oscilloscope measurements.
7) Thus the diode must come to forward steady-state within 300 ns.
8) The diode must have a breakdown voltage exceeding these amplitude limits. Contact Avtech for special arrangements if $I_{MAX} \times 50\Omega > V_{BR}$.
9) Maximum pulse width is reduced to 500 ns for units with the -DIPFP option.
10) The full forward pulse width is 2 us, but the reverse pulse is super-imposed on the forward pulse 300 ns after the start of the forward pulse.
11) Increases to 4.5 ns for units with the -DIPFP option, due to the switching relay inductance.

BASIC TEST ARRANGEMENT – REVERSE RECOVERY TESTS



BASIC TEST ARRANGEMENT – FORWARD RECOVERY TESTS

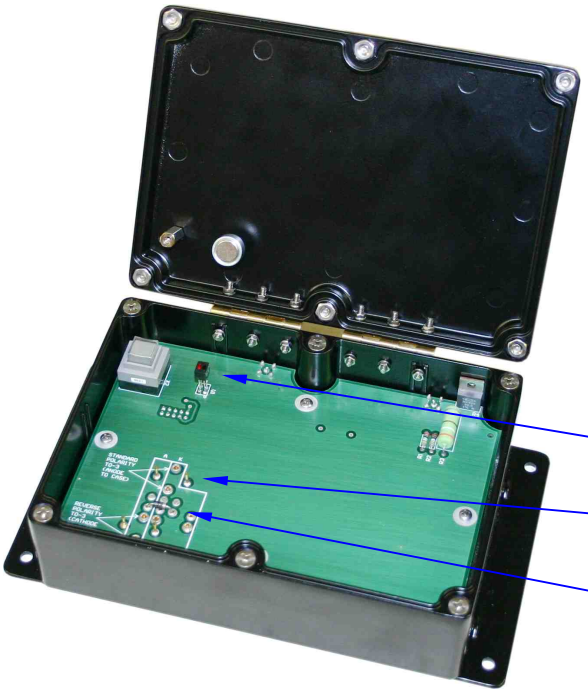


INSTRUMENT MAINFRAME

The OUT and CONTROL connectors that mate to the test jig cabling are located on the rear panel. The gate and external trigger BNC connectors, and the GPIB and RS-232 connectors are also on the rear panel.

TEST JIGS

The standard AVR-EB4-B, AVR-EB5-B, AVR-EB7-B, and AVR-EB8-B models include the AVX-TRR-MIX test jig, shown below:



The input, output, and control cables connect to the rear, shown below:

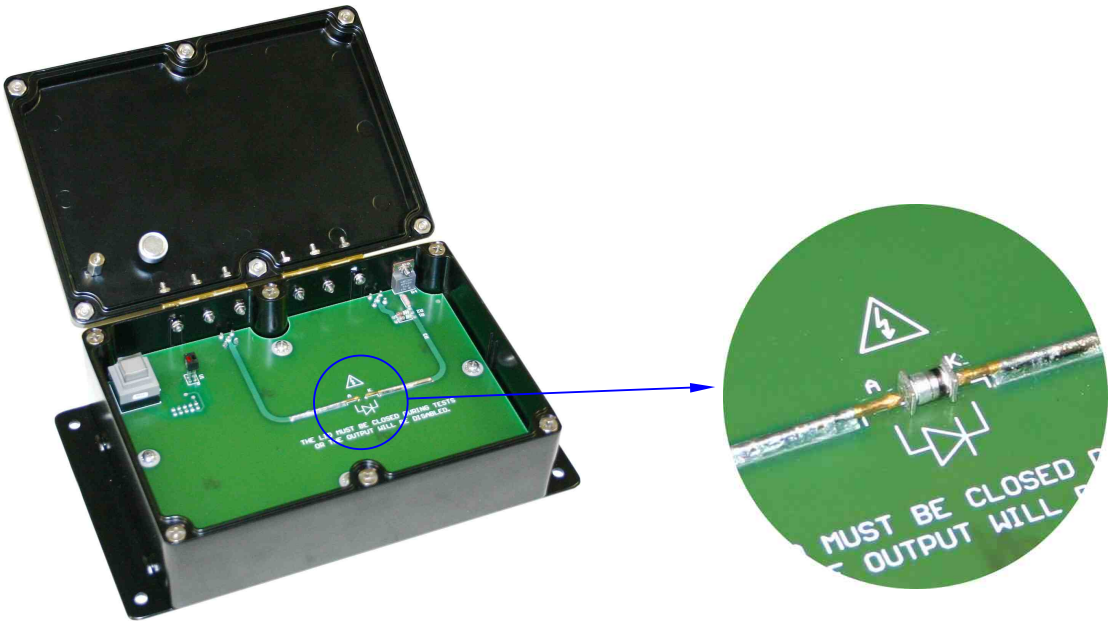
Safety interlocks

Pin sockets, to accommodate a range of leaded devices (DO-41, TO-220, TO-3, etc).

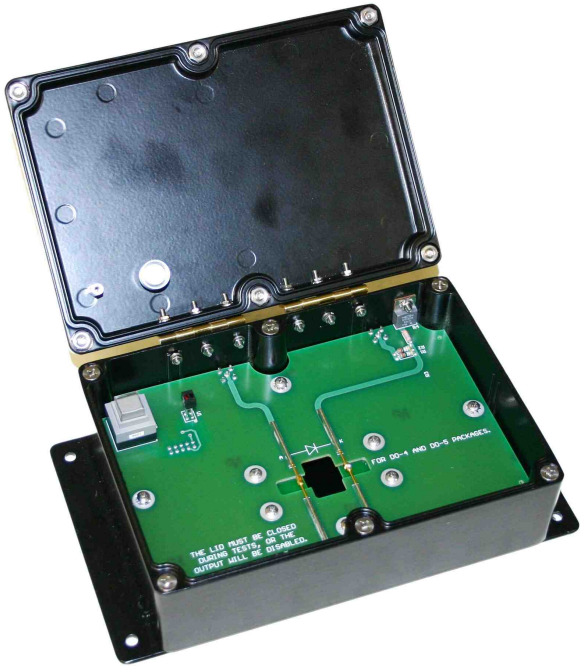
An installed device under test. DO-41 package.

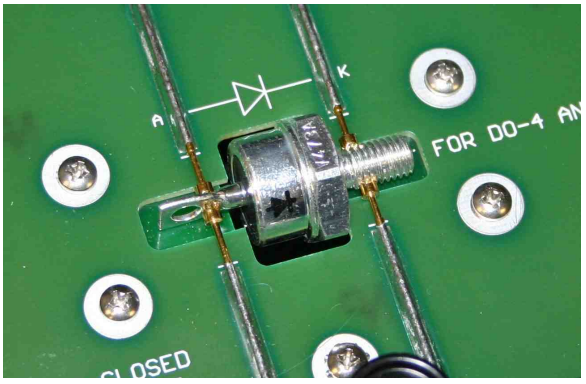
Each test jig is specially designed to minimize the parasitic inductance that can distort results, while maintaining ease of use.

Specialized test jigs can be provided. For instance, the AVX-TRR-MELF test jig accommodates surface-mount MELF packages, using spring-loaded contact pins:

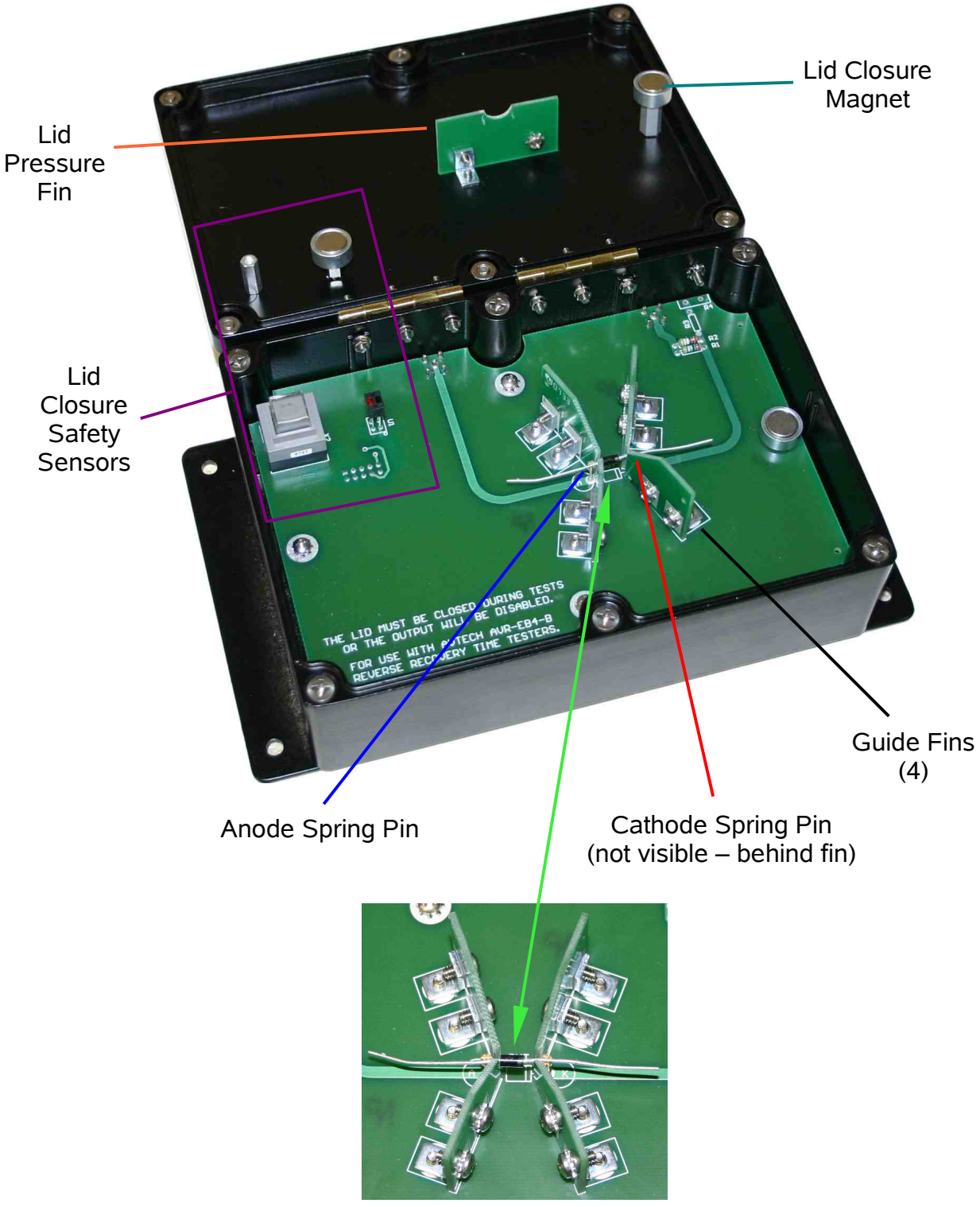


The AVX-TRR-STUD test jig accepts DO-4 and DO-5 stud packages:





The AVX-TRR-ANB is intended for applications where axial devices must be tested, but lead bending is undesirable:



Other test jigs can be provided upon request. Contact Avtech (info@avtechpulse.com) with your special test requirement!