

1 June 2005

K-Line Negative Voltage Excursion

Description

One user has reported a problem when using either a model AVT-716 or a model AVT-718 interface unit to communicate with a specific Delphi ECM.

The communications mode used was K-line communications in KWP mode.

The user reports some symptoms of the problem were:

- Tach flare.
- MIL on/off.
- Not cranking or more than 10 seconds for cranking.
- Injector run.
- FPR run.
- Engine running response during EVAP Service Bay test.
- EST run.

Delphi has reported the cause of the problem to be a negative transient on the K-line, in excess of -1.0 volts (e.g. going lower than -1.0 volts). Delphi asserts that the AVT-716 and AVT-718 units are the cause of the negative transient on the K-line.

Summary

Testing shows that the AVT interface units do not drive the K-line negative, in and of themselves.

The negative transient on the K-line is most likely due to a combination of the following factors.

- Distributed capacitance and inductance of the wiring harness.
- The fast K-line switching of the AVT interface unit.
- The lack of or inadequate negative transient suppression devices in the AVT interface unit and the downstream module.

Remedy: Install a negative transient suppression or "clamping" diode to the AVT interface unit. Detailed modification instructions are provided later in this document.

Models Affected

AVT-716 board revisions "A" to "E".

AVT-718 board revisions "A" to "AA".

AVT-418 board revisions "A" to "C".

Users affected

The following users may be affected.

Users of the hardware listed above.

and

Using KWP communications mode.

and

Have difficulties with the module or vehicle to which the AVT interface is connected.

Applicable Specifications

ISO 9141

ISO 9141-2

ISO 14230-1

ISO 7637-1

AVT Analysis

The AVT-716, AVT-718, and the AVT-418 interface units all utilize the same K-line transmitter and receiver circuit designs.

AVT has reviewed the design of the K-line transmitter and receiver circuits on all three models. It was determined that it was not possible for the transmitter or receiver circuits to drive the external K-line network to a voltage level below ground (0V) – by themselves.

AVT Testing

AVT conducted testing of three different AVT interface units.

The following units were tested:

1. AVT-716 board revision “E”.
2. AVT-718 board revision “G”.
3. AVT-718 board revision “AA”.

Each unit was tested in three different configurations:

1. Original configuration; by itself; not connected to any external wiring.
2. Original configuration; connected to a lab network consisting of approximately 25 feet of 15-conductor #24 awg ribbon cable. (AVT makes no claim as to how well this ‘network’ does or does not simulate a vehicle wiring harness.)
3. Modified configuration; clamping diode installed on the K-line; connected to the lab network.

Note that an AVT-418 unit was not tested. The board design and layout is identical to that of the AVT-718 board revision “G” and “AA”. There is no reason to believe the AVT-418 performs significantly different from the AVT-718 “G” or “AA” boards.

Test Results

Testing of each unit, stand alone, not connected to any external network verifies the previous analysis that none of the three units are capable of driving the K-line below ground.

Connecting each unit to the lab network results in negative K-line excursions similar to that documented in the Delphi report.

Oscilloscope screen shots for each unit and each configuration are provided at the end of this document.

Cause

AVT theorizes that the cause of the negative excursions on the K-line are due to a combination of the following factors.

- Distributed capacitance and inductance of the wiring harness.
- The fast K-line switching of the AVT interface unit.
- The lack of an adequate negative transient suppression device in the AVT interface unit.

Solution

None of the controlling specifications provide any rise or fall time guidance for the transmitted waveform.

The all three AVT interface models support a wide range of K-line baud rates up to and including 115.2 kbaud. Therefore, AVT will not modify the K-line transmitter to incorporate transmitted slew rate control.

The most logical solution is to add an appropriate diode to the K-line to 'clamp' the negative excursion so that it does not exceed -1 volt (does not go more negative than -1 volt).

The L-line was not tested for this modification. Although the L-line transmitter is the same design as the K-line transmitter it does not participate in normal communications. Additionally, the L-line is not required or used in most applications.

Diode Selection

AVT has selected and tested two suitable diodes to clamp the negative K-line excursion. One is an axial lead (through hole) device and the other is an SMT device. The selection criteria included fast speed, low forward voltage drop (V_f), and high reverse breakdown.

- ON Semiconductor 1N5819 axial lead, case #59-04
- Vishay Lite-On B140-13 surface mount; case SMA

Testing shows that using one of these diodes to clamp the K-line limits the negative excursion of the K-line to about -0.6 volts (does not go more negative than -0.6 volts) and may perform slightly better.

Corrective Action – New Revision Hardware

The next board revision for the models AVT-718 and AVT-418 will include a change to add the clamping diode to the board.

Corrective Action – Existing Hardware

The corrective action for a specific model AVT interface unit depends on the model and board revision level. Refer to the list of modifications, by model and board revision.

Photos of the modifications are provided.

The L-line modification is only necessary if the L-line is used.
(Most applications do not use the L-line.)

If a user needs modification instructions for a unit not listed, please contact the factory for additional information.

AVT Board Revision Level

The modification instructions are based on board revision level; not hardware revision level.

The model number and board revision level of every AVT printed circuit board is in copper on the bottom of the board.

The board revision level may not be the same as what is marked in the little white “Rev” block found on the top of the board. (The little white “Rev” block is the hardware revision level.)

Board Modification

A customer may elect to modify an AVT interface unit themselves. All modification instructions are provided in this document. AVT can provide parts, on request. AVT can provide assistance via e-mail or telephone, on request

A customer can also submit an AVT interface to AVT for modification.

The customer should ship the unit to AVT, freight pre-paid, to the attention of Michael Riley at Advanced Vehicle Technologies. The shipping address and telephone number are provided on the bottom of the first page of this report. All contact information is also provided on our web site.

<http://www.AVT-HQ.com>

Please be sure to provide all necessary return information: Company name, address, contact name, and telephone number.

AVT will modify, clean, and test a customer provided unit. AVT will return the unit to the customer via UPS ground. There will be no fee for this service. The usual turn around time is 1 day; but may be longer depending on work load and other factors. The customer should call before shipping a unit to AVT for modification.

Contact AVT if there are any questions.

AVT-716 Board Revision Level “E”

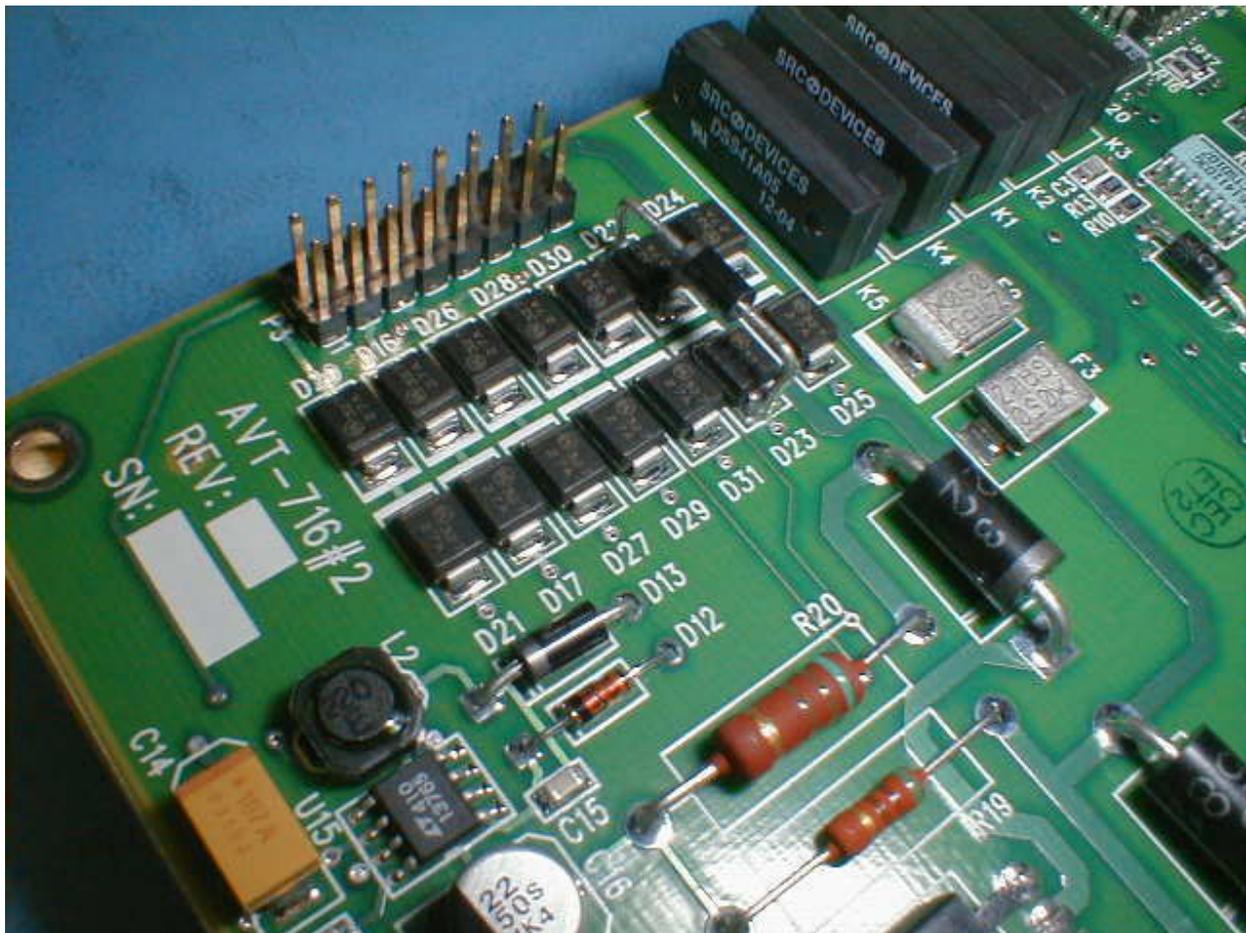
On AVT-716 board #2.

Install a 1N5819 diode across the anodes of TVS diodes D22 and D23. The cathode of the 1N5819 should be connected to the anode of D22. (This clamps the K-line.)

See the photo.

Note: The L-line modification is not required if the L-line is not used.

L-line modification: Install a 1N5819 diode across the anodes of TVS diodes D24 and D25. The cathode of the 1N5819 should be connected to the anode of D22.



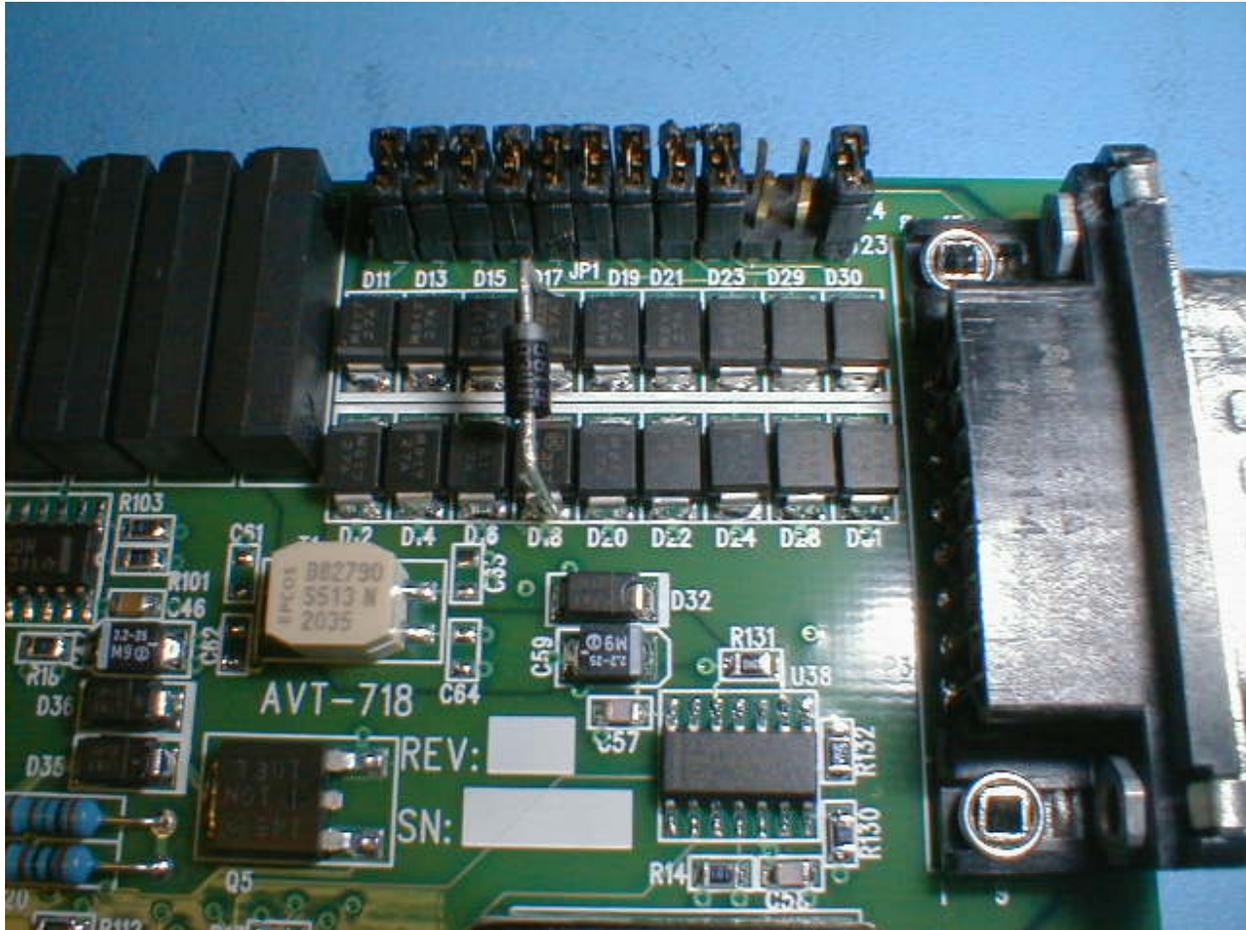
AVT-718 Board Revision Levels “A”, “C”, “F”, and “G”

Install a 1N5819 diode across the anodes of TVS diodes D17 and D18. The cathode of the 1N5819 should be connected to the anode of D17. (This clamps the K-line.)

See the photo.

Note: The L-line modification is not required if the L-line is not used.

L-line modification: Install a 1N5819 diode across the anodes of TVS diodes D19 and D20. The cathode of the 1N5819 should be connected to the anode of D19.



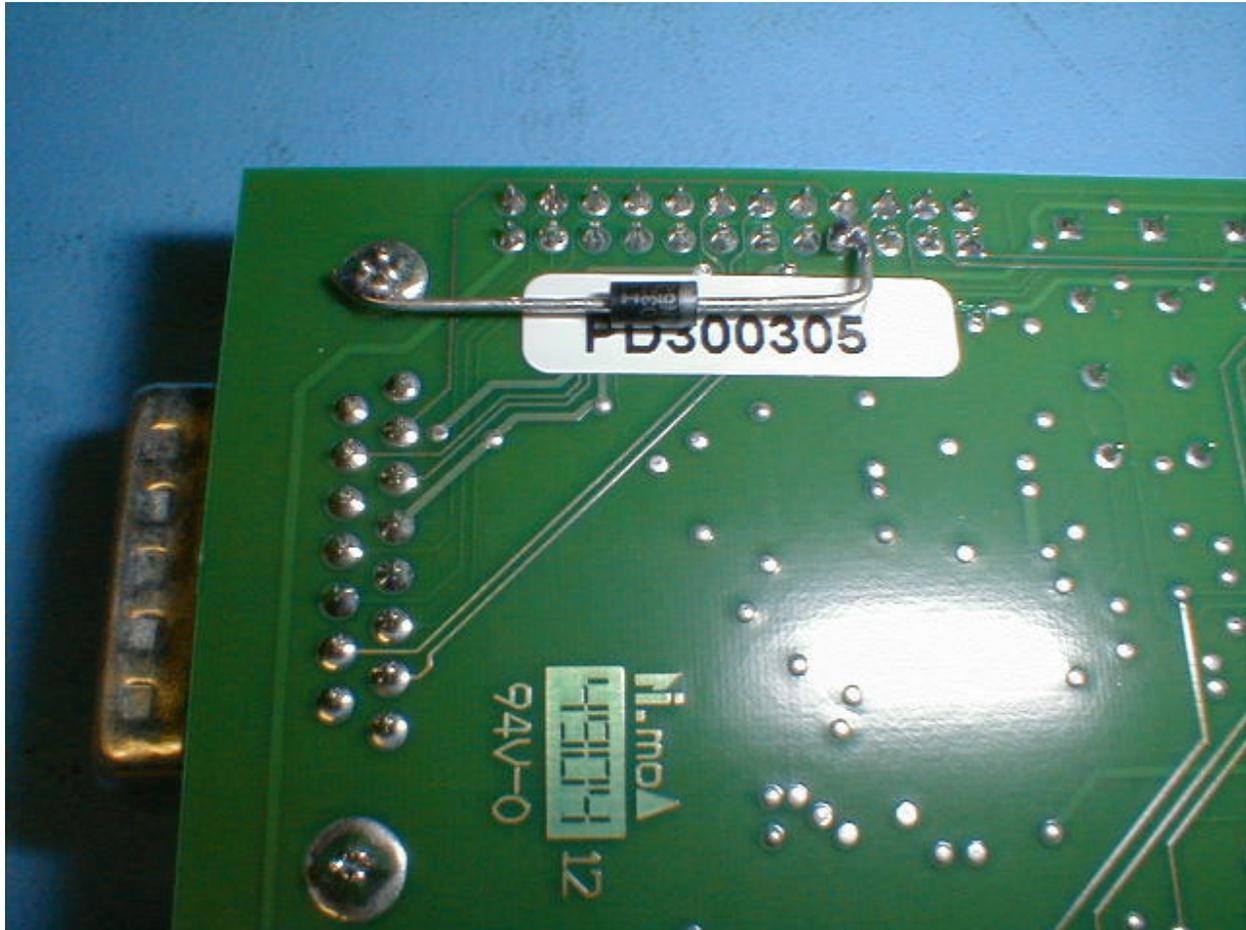
AVT-718 Board Revision Level “AA”

Install a 1N5819 diode as shown in the photo.

Connect the cathode to pin #7 of JP1.

Connect the anode to the ground tab of P3, the D15 connector.

Due to space constraints, the L-line modification is not recommended or shown.



AVT-418 Board Revision Levels “A” and “B”

Install a 1N5819 diode across the anodes of TVS diodes D17 and D18. The cathode of the 1N5819 should be connected to the anode of D17. (This clamps the K-line.)

See the AVT-718 revision “G” photo.

Note: The L-line modification is not required if the L-line is not used.

Install a 1N5819 diode across the anodes of TVS diodes D19 and D20. The cathode of the 1N5819 should be connected to the anode of D19.

AVT-418 Board Revision Level “C”

Install a 1N5819 diode as shown in the AVT-718 “AA” photo.

Connect the cathode to pin #7 of JP1.

Connect the anode to the ground tab of P3, the D15 connector.

Due to space constraints, the L-line modification is not recommended or shown.

Oscilloscope Screen Shots

Oscilloscope screen shots are on the following pages.

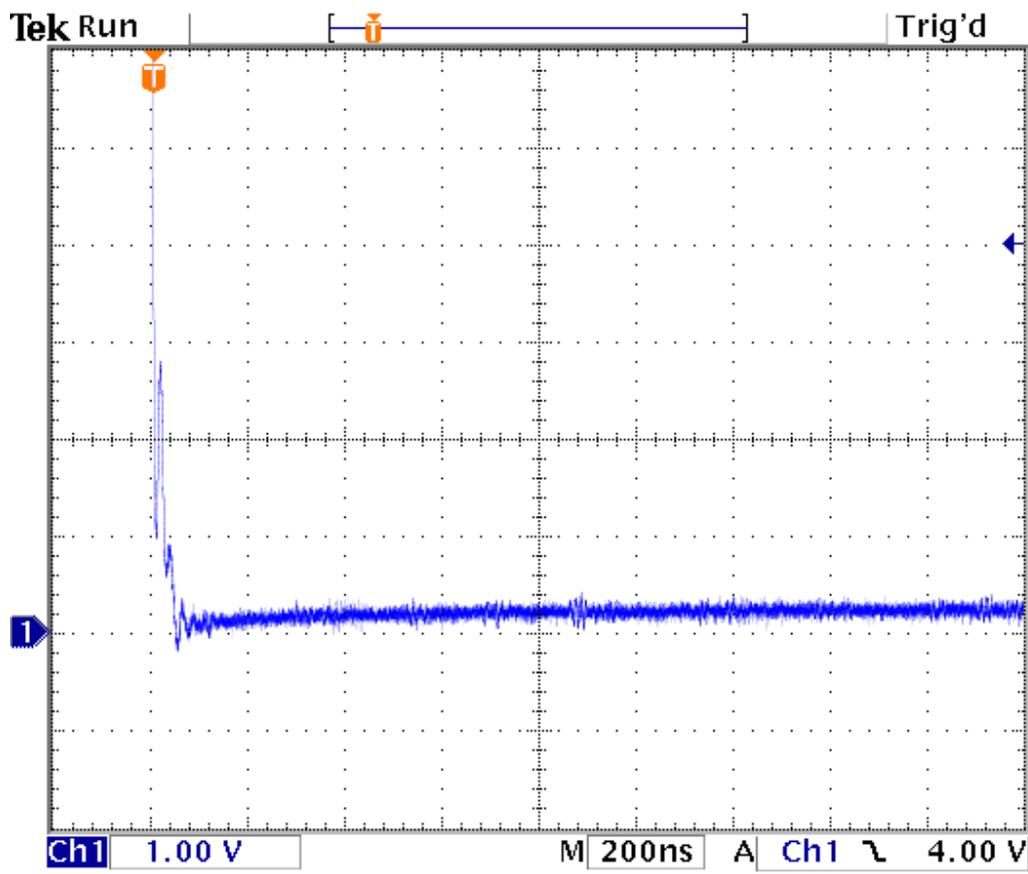
All measurements were taken at

- 1v per division vertical scale.
- 200 nsec per division horizontal scale.

Note that the 0v reference line was moved for some measurements.

The 0v reference line is noted by the small solid arrow to the left of the screen.

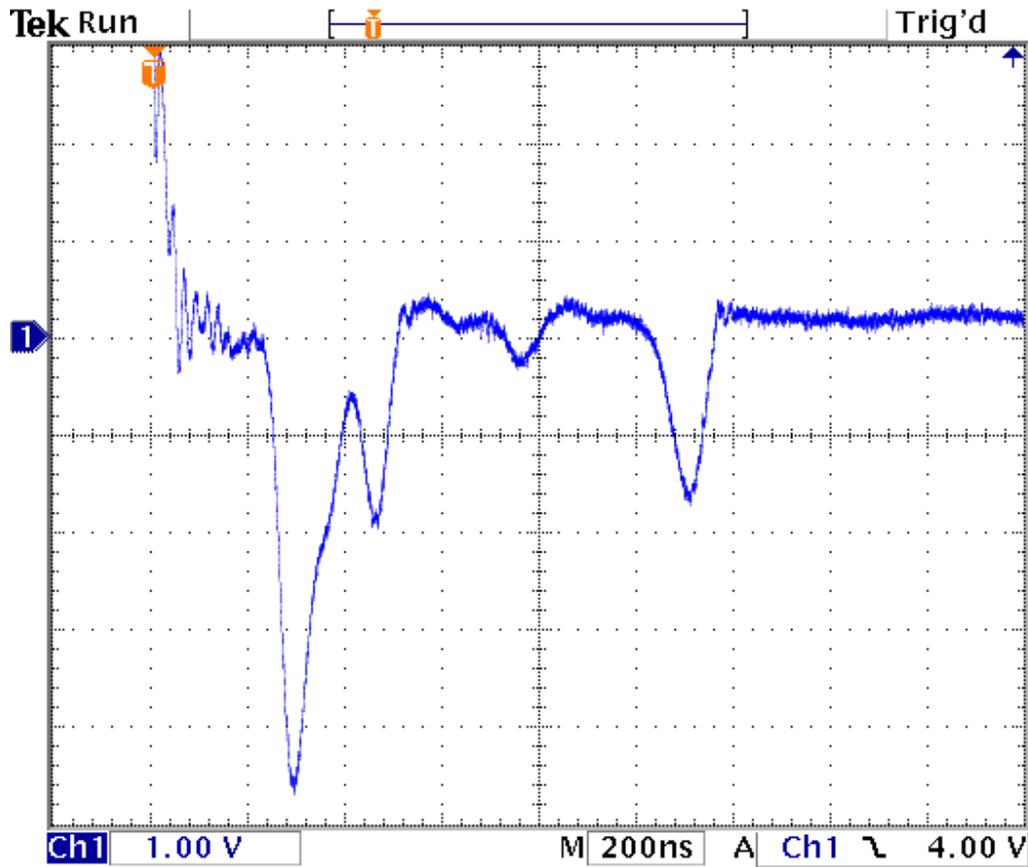
The caption notes the unit model number, board revision level, and test conditions.



10.40 %

30 May 2005
17:03:14

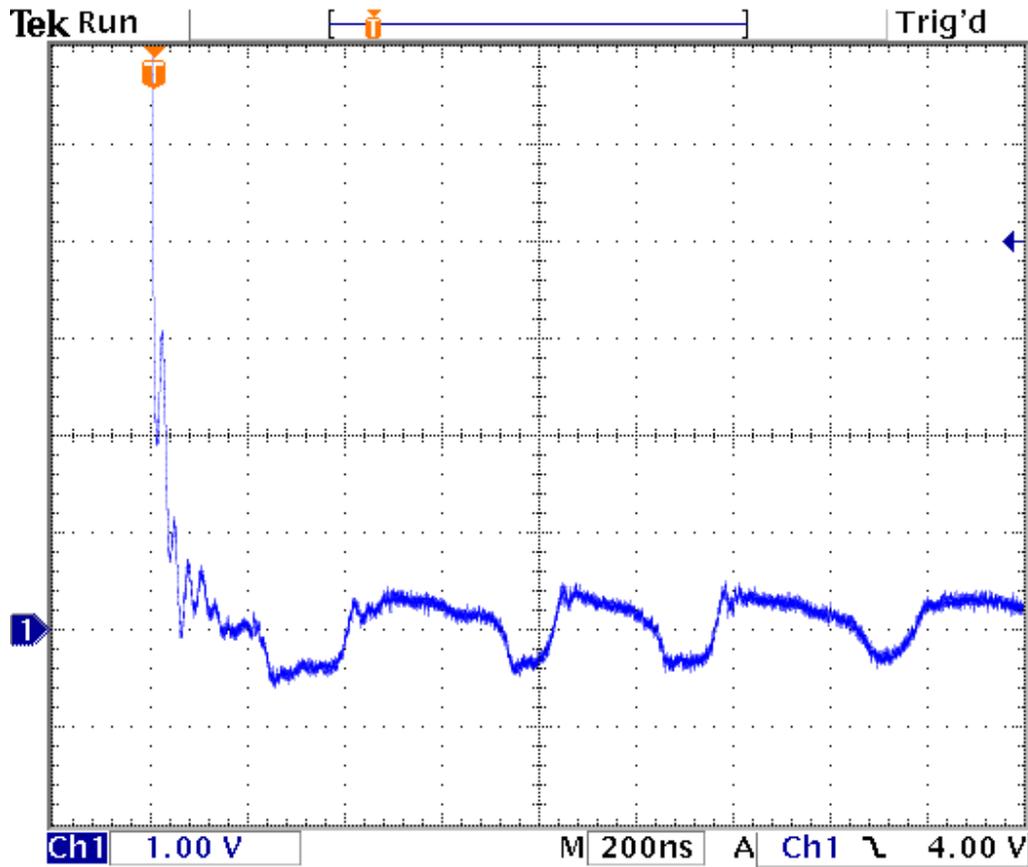
**AVT-716 Board Revision "E"
Original Configuration, Unit Alone**



10.40 %

30 May 2005
17:04:24

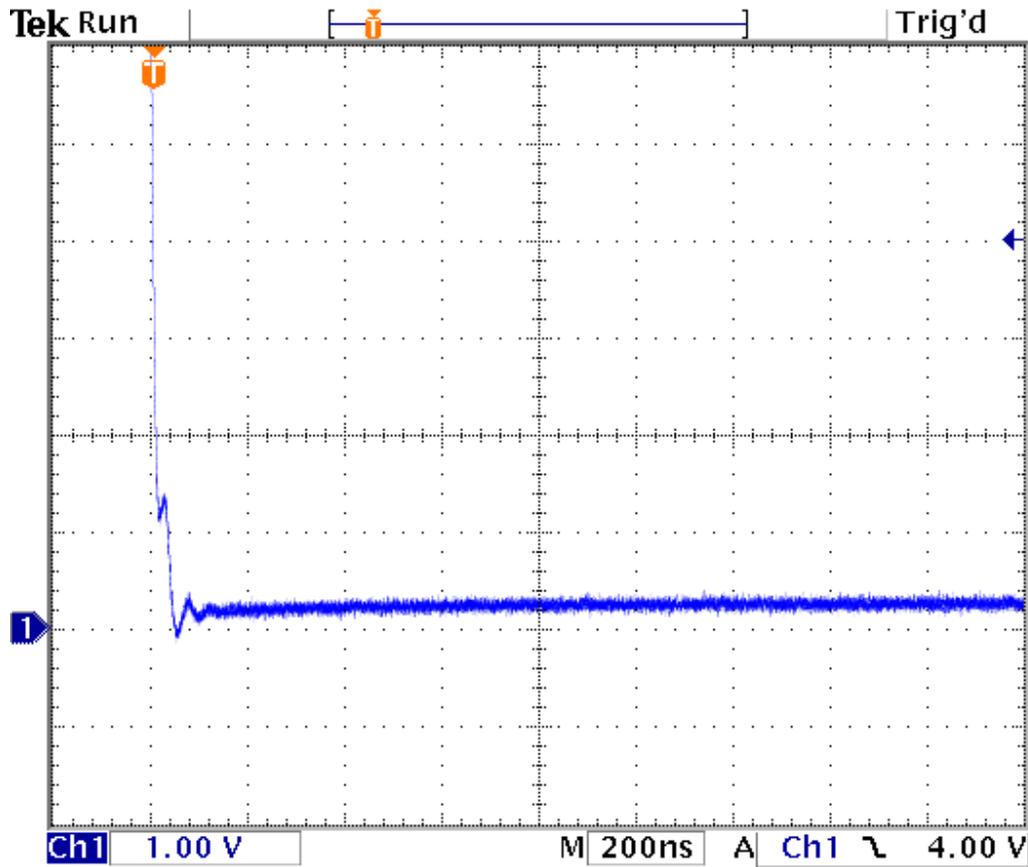
AVT-716 Board Revision "E"
Original Configuration, Connected to Lab Network



i 10.40 %

30 May 2005
17:39:14

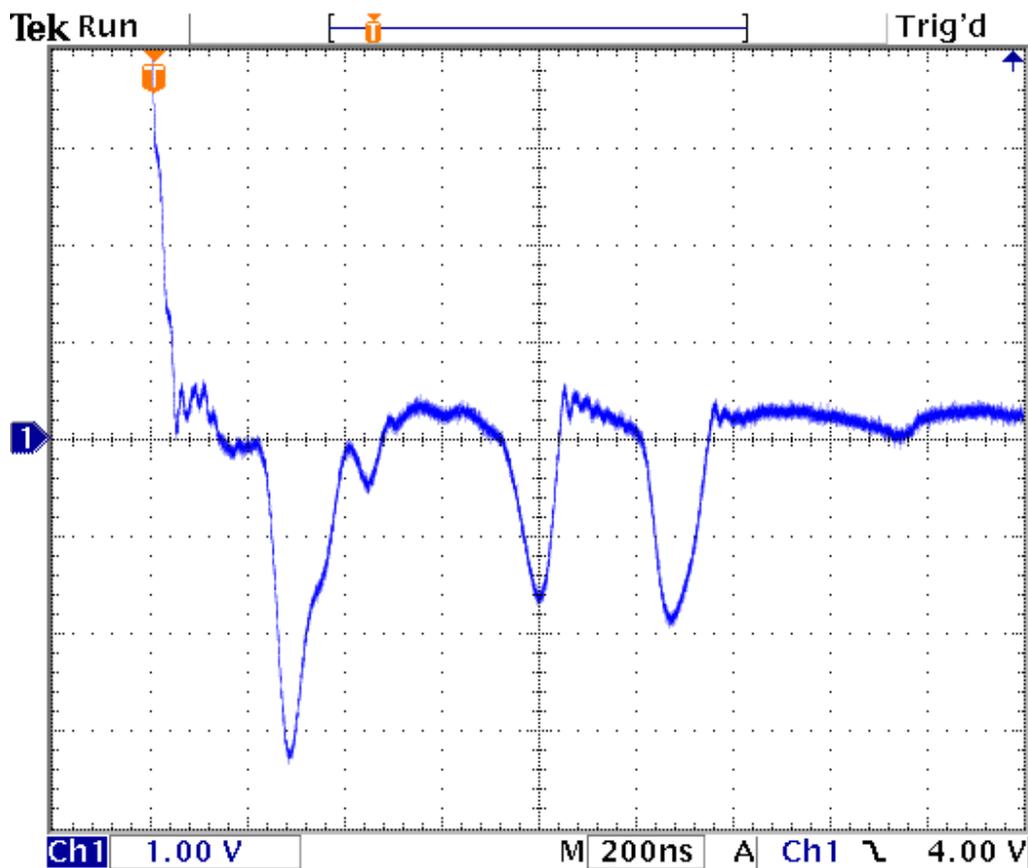
**AVT-716 Board Revision "E"
With 1N5819 Clamp Diode Installed, Connected to Lab Network**



10.40 %

30 May 2005
16:34:23

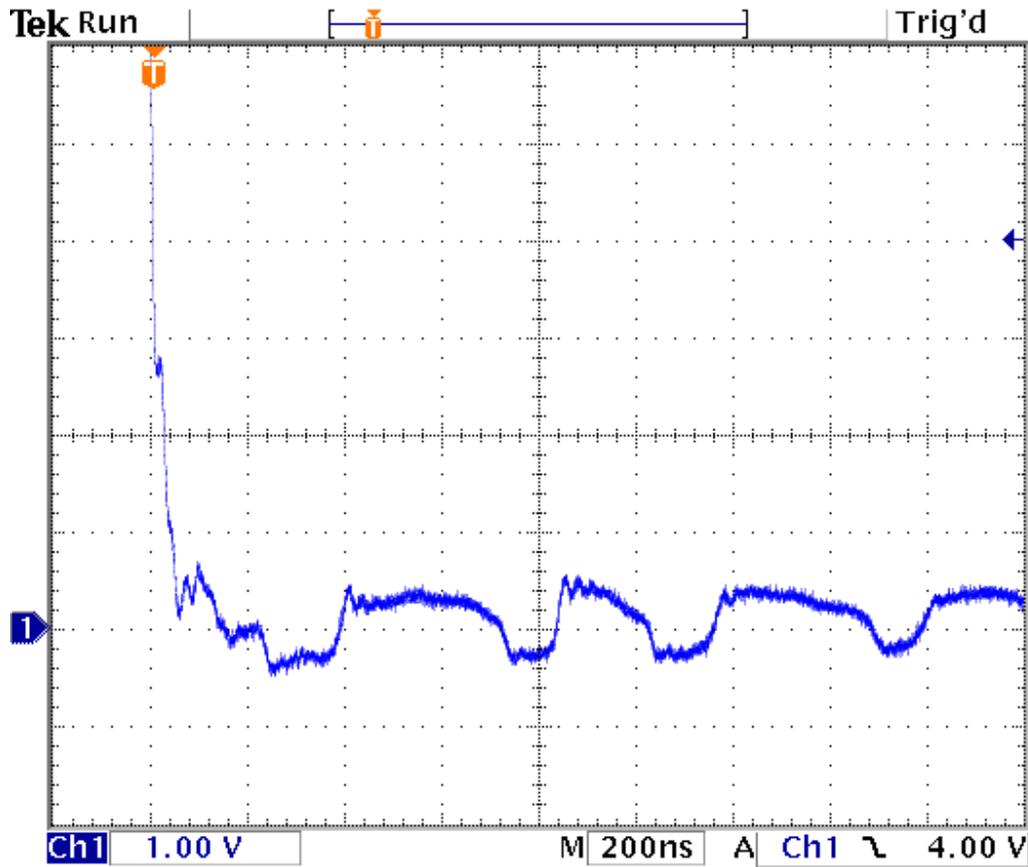
**AVT-718 Board Revision "G"
Original Configuration, Unit Alone**



10.40 %

1 Jun 2005
12:01:33

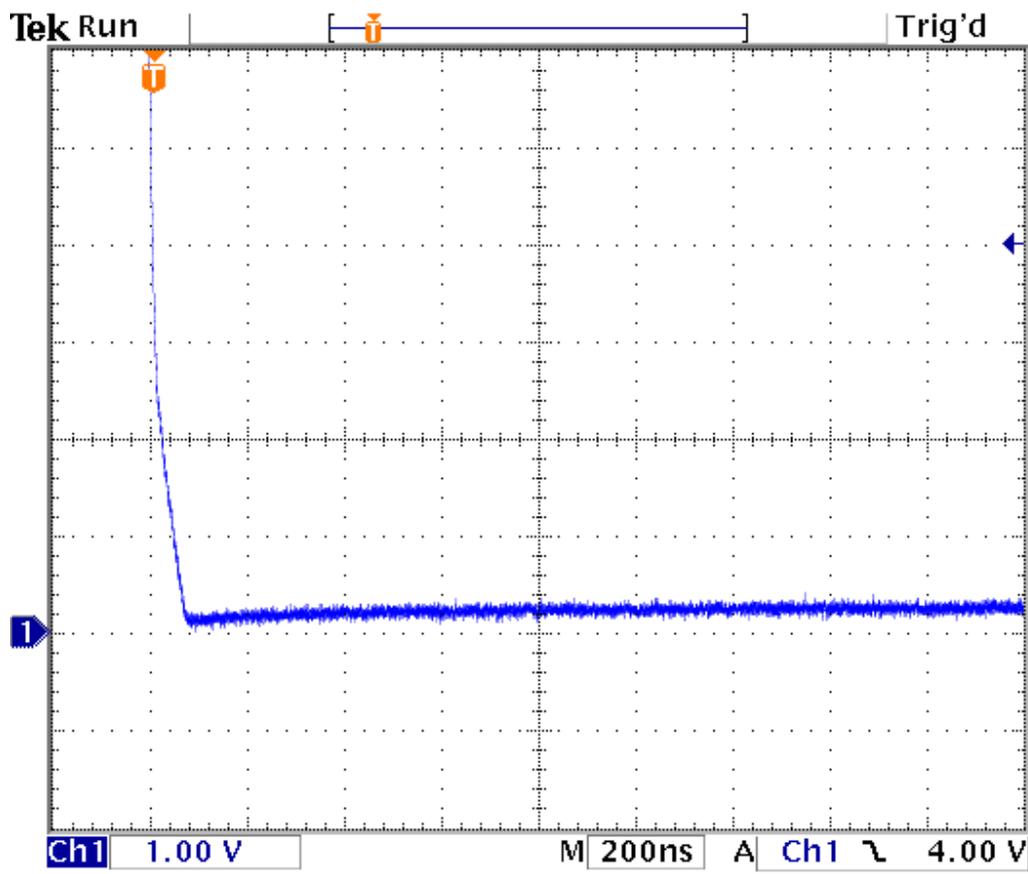
AVT-718 Board Revision "G"
Original Configuration, Connected to Lab Network



10.40 %

1 Jun 2005
12:12:27

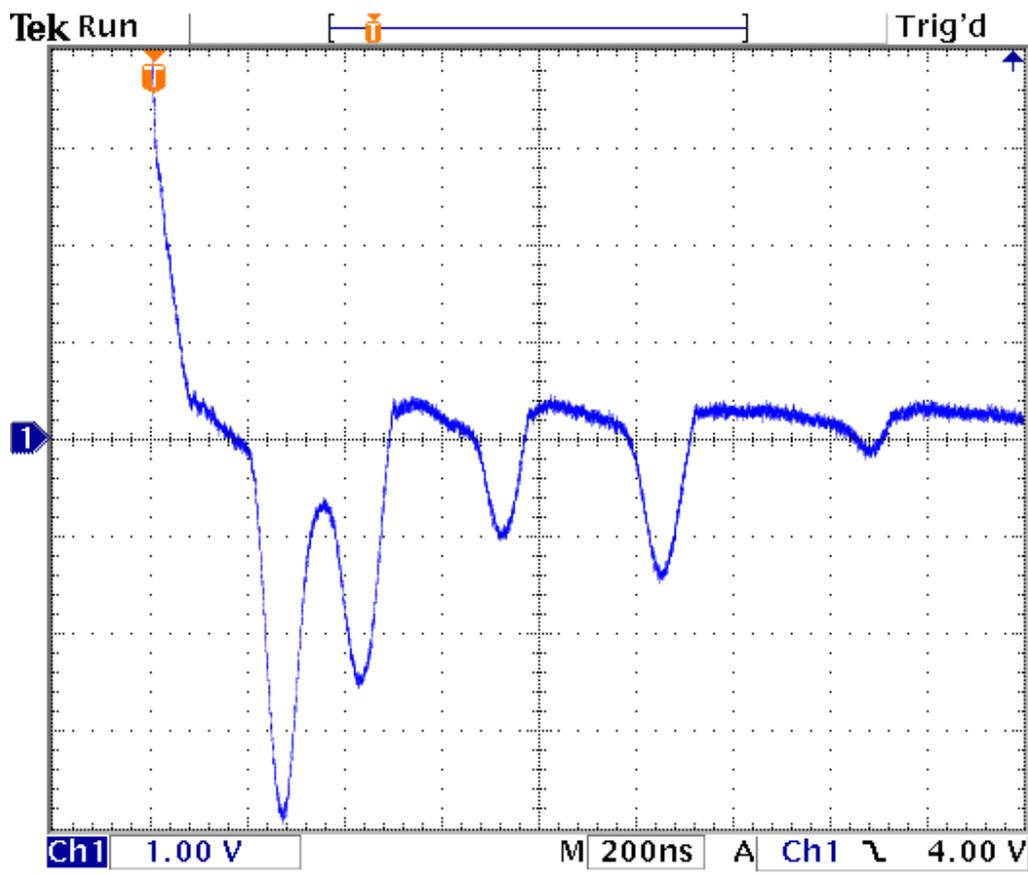
AVT-718 Board Revision "G"
With 1N5819 Clamp Diode Installed, Connected to Lab Network



10.40 %

30 May 2005
17:24:39

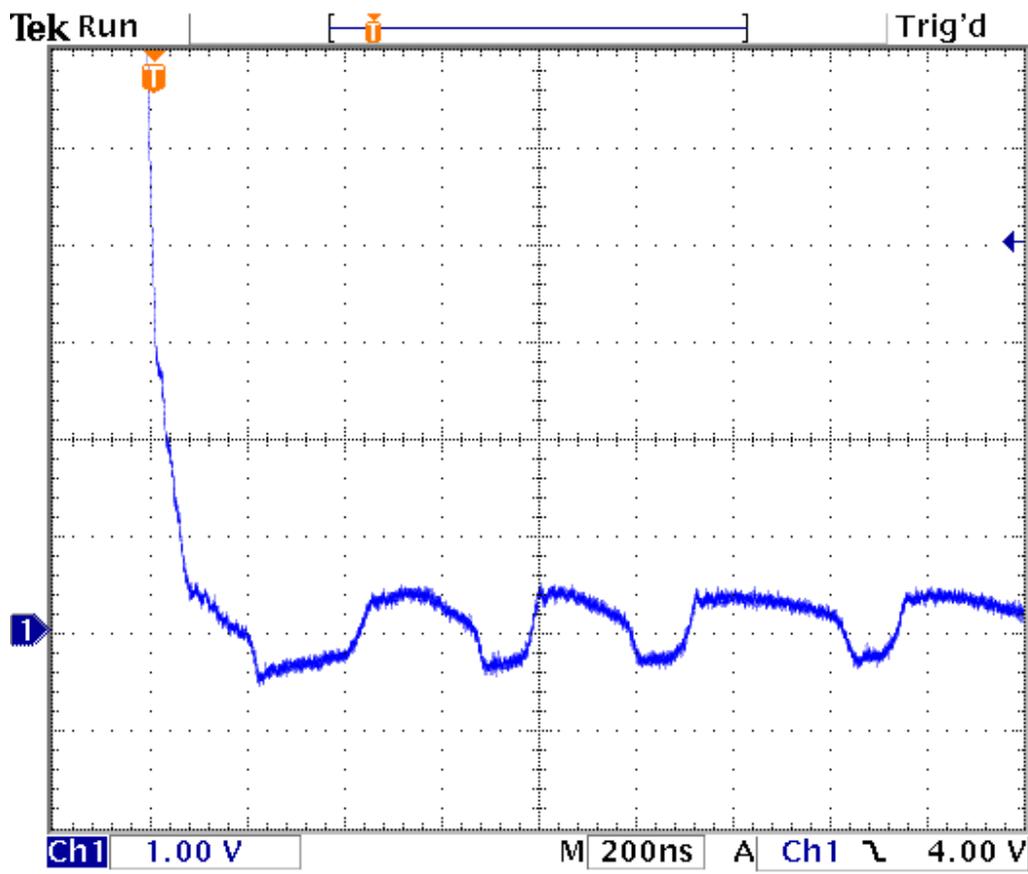
AVT-718 Board Revision "AA"
Original Configuration, Unit Alone



10.40 %

30 May 2005
17:26:07

AVT-718 Board Revision "AA"
Original Configuration, Connected to Lab Network



10.40 %

30 May 2005
17:31:54

AVT-718 Board Revision "AA"
With 1N5819 Clamp Diode Installed, Connected to Lab Network

Questions ??

Contact the factory.
 All contact information on the bottom of page 1.