Crown Pulse Series Service Documenation

The information furnished in this manual does not include all of the details of design, production, or variations of the equipment. Nor does it cover every possible situation which may arise during installation, operation or maintenance. If you need special assistance beyond the scope of this manual, please contact the Crown Technical Support Group.

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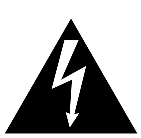
CAUTION	AVIS
TO PREVENT ELECTRIC SHOCK DO NOT REMOVE TOP OR BOTTOM COVERS. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL. DISCONNECT POWER CORD BEFORE REMOVING REAR INPUT MODULE TO ACCESS GAIN SWITCH.	**À PRÉVENIR LE CHOC ÉLECTRIQUE N'ENLEVEZ PAS LES COUVERTURES. RIEN DES PARTIES UTILES À L'INTÉRIEUR. DÉBRANCHER LA BORNE AVANT D'OUVRIR LA MODULE EN ARRIÈRE.**

WARNING

TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE!



The lightning bolt triangle is used to alert the user to the risk of electric shock.

The exclamation point triangle is used to alert the user to important operating or maintenance instructions.

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Cautions and Warnings

Exclamation Mark Symbol:
This symbol is used to alert the user to make special note of important operating or maintenance instructions.

Lightning Bolt Symbol:
This symbol is used to alert the user to the presence of dangerous voltages and the possible risk of electric shock.

DANGER: The outputs of the amplifier can produce LETHAL energy levels! Be very careful when making connections. Do not attempt to change output wiring until the amplifier has been off at least 10 seconds.

WARNING: This unit is capable of producing high sound pressure levels. Continued exposure to high sound pressure levels can cause permanent hearing impairment or loss. User caution is advised and ear protection is recommended when using at high levels.

WARNING: Do not expose this unit to rain or moisture.

WARNING: Only properly trained and qualified technicians should attempt to service this unit. There are no user serviceable parts inside.

WARNING: When performing service checks with the power off, discharge the main power supplies fully before taking any measurements or touching any electrical components. A 300-ohm 10-W resistor is recommended for this. Hold the resistor with pliers, as the resistor may become extremely hot.

CAUTION: Under load, with a sine wave signal at full power into both channels, the amplifier may draw in excess of 30 amperes from the AC service mains.

CAUTION: When performing tests, do not connect any load to the amplifier until instructed to do so. There is no danger to the amplifier in operating without any load (open outputs).

WARNING: Do not change the position of the mode switches when the amplifier is turned on. If the position of these switches is changed while the amplifier is powered, transients may damage your speakers.

WARNING: Heatsinks are not at ground potential. Simultaneously touching either heatsink and ground, or both heatsinks will cause electrical shock.

CAUTION: Eye protection should be worn at all times when protective covers are removed and the amplifier is plugged in.

CAUTION: When performing tests that require a load, the load must be resistive and must be capable of handling 1000 W (per channel).

CAUTION: Disconnect the power cord before installing or removing any cover or panel.

CAUTION: Electrostatic discharge will destroy certain components in the amplifier. Techicians must have approved ESD protection. Proper grounding straps and test equipment are required.

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Circuit Theory, Pulse Series

Introduction

This section is intended to assist maintenance and service of the Pulse family of amplifiers. Component references detailed are for channel 1. Operation of channel 2, 3, and 4 is identical except where explicitly noted.

Switch mode power supply

Mains power is brought in through a small, filtered IEC inlet; the purpose of this filter is to attenuate any high frequency noise produced by the SMPS, conducting back down the mains inlet.

The chassis fuse protects the system in the event of failure or severe abuse by the user.

A second, large, common mode inductor and two small Y capacitors, provide attenuation of relatively low frequency (100kHz – 1MHz) noise, conducting back down the mains.

An inrush limiting power resistor (R16), is used to prevent mains current inrush. The resistor is protected by a PTC thermistor (TH1) and once the SMPS is running, a relay (RLY1) closes over, shorting out the resistor and PTC and allowing normal operation. The bridge rectifier (BR2) is used with a bank of 6 1800uF/200V capacitors (C28, C29, C33, C34, C42 & C43), to produce 320V DC.

The SMPS control electronics is powered by the output of the SMPS; therefore in order to start the SMPS, a boot supply is used. The boot supply comprises of R30 and R102 (10K/2W), C76 (1000uF/63) and ZD5 (47V). C76 is charged up to 47V via R102 and R30 from the 320V rail, this then powers the control electronics until SMPS operation has started and can keep itself running. It takes approximately 4 seconds to charge C67 and the SMPS cannot be switched on until this capacitor has been fully charged. The purpose of the SMPS control electronics is to provide 85kHz switching waveforms to a pair of power IGBTS (TR24 and TR32) the micro-controller turns on the control electronics through an opto-coupler (OPT1).

When told to start by the microprocessor, all secondary supplies of the SMPS are off, and both soft start relays are open. Immediately after being told to start, the IGBT's are producing a power square wave, which is applied to the power transformer, initially through two 50R/5W resistors (R28, R142). The function of these resistors is to limit the start up current through the IGBT's. Approximately 50mS after start up, the secondary rails are present and the SMPS is powering its own control electronics, at this point the input soft start relay RLY1 will close. Approximately 100mS after RLY1 closes the relay (RLY2), across R28, and R142 will close and at this point the SMPS is fully up and running.

All secondary voltages are produced by rectification of the square wave from the IGBT's.

The power amplifier consists of a fairly conventional Class A driver stage driving a Class AB bipolar output stage. Each stage will be dealt with individually.

Input Stage

Class A Driver

The input signal returned from the level control is fed via DC blocking capacitor C143 and R221. DC bias current for the Class A input stage is supplied via R222, while 4n7 capacitor C116 prevents any extreme high frequency input signals from reaching the power amplifier and also provides a low source impedance at high frequencies to ensure frequency stability.

The first stage of the class A driver consists of TR76 and TR77 configured as a long tailed pair differential amplifier. Emitter resistors R238 and R239 de-sensitize the performance of the input stage to parametric variations of the two input transistors. The quiescent current for the input stage is delivered by current source TR65. Diodes D51 and D52 provide a reference voltage of approximately 1.2V, which is applied to the base of TR65. Approximately half of this (0.6V) will then appear across R187 (220R), which then sets the current, sourced from TR65 collector at approximately 2.7mA. In the quiescent state half of this current is driven through TR76 and TR77. Hence the voltage dropped across emitter resistors R238 and R239 will be approximately equal at 75mV.

Overall voltage feedback of the amplifier is derived through R243 and R241. R242 and C20 provide local feedback around the Class A section only to define the dominant pole of the amplifier. C126 connected in series with R241 gives 100% DC feedback to minimize any DC offset at the output. The resultant feedback signal is applied to the base of TR77.

The collector currents of TR76 and TR77 are fed via D76 and D75 to R260 and R272 respectively. Hence, in the quiescent state, R260 and R272 should each exhibit a voltage drop of 1.35V or so.

Under normal conditions the signals at the bases of TR76 and TR77 will be identical. However, under fault conditions, such as a DC offset at the output, the base voltages will become offset also. For example, in the event of a large DC offset of +50V at the output, a positive DC voltage will appear at the feedback point and hence at the base of TR77. Although this would, in theory, be the full +50V, owing to C126 being rated
at only 16V, the voltage will, in practice, be somewhat lower. However, the important issue is that the voltage is positive. In the event the voltage is negative this indicates that the feedback network is faulty (most likely R243 itself). The voltage at TR77 base being positive whilst the base of TR76 is close to 0V will then reverse bias TR77 base-emitter hence turning off the transistor. Hence, no voltage should appear across R239 and R272 while double the normal voltage will appear across R238 and R260 (150mV and 1.3V respectively). Should this not be the case, it indicates a fault in the input stage itself.

The output of the input long-tailed-pair (i.e. the voltages at the anodes of D76 and D75) are fed to a second long-tailed-pair TR80 and TR81. The bias current for this stage, is set by resistor R261 thus; D76 drops approximately the same voltage as the base-emitter junction of TR80. The same can be said of D75, and the base-emitter junction of TR80. This sets a current of about 5.75mA, split between TR80 and TR81. C137 and C138 provide a little Miller Feedback around TR80 and TR81 respectively. These capacitors can be important to the stability of the amplifier but do not define the dominant pole. It should also be noted that either of these capacitors becoming "leaky" (difficult to measure in circuit) will result in a DC offset at the output. The collector of TR81 drives the output stage in conjunction with the collector of TR67 while the collector of TR80 drives current mirror TR66/TR67 via R212. In the quiescent state R212 will show a voltage drop of around 52V, and the current mirror emitter resistors R188 R189 and will show equal voltage drops of 145mV. Hence, for the same +50V DC offset, described earlier, one would expect no voltage drop across any of R212, R188 or R189, indicating that the feedback is attempting to correct the fault. Likewise, for a negative DC offset one would expect these voltages to be twice their usual value. If this is not the case then the second stage (TR80-TR67) is at fault. The collectors of TR81 and TR67 are joined to form the output of the class A driver by the Vbe multiplier - R128, R127 and TR71 (mounted on the heatsink) bypassed at AC by C124 - which sets the output stage bias. The bias voltage across the Vbe multiplier should range between 2.4V (heatsink warm) and 2.5V (heatsink cold). Bias voltages outside this range indicate a fault with the Vbe multiplier and/or a fault in the second long-tailed pair (TR80 - TR81, R261, R212, R188, R189). For example, too small a bias voltage could be caused by: R261 being high, R189 being high, R127 being low, TR71 being faulty etc. Too high a bias voltage is rare, and would, most likely, be caused by a faulty transistor or resistor in the Vbe multiplier circuit.

C132 is very important for ensuring HF Stability. A faulty capacitor in this position will usually cause excess distortion and in the case of anything less than 100pF can reveal a very spiky instability.

Output Stage

The output stage consists of a symmetrical Siklai follower - TR89-TR59, R189, R29A, R35A, R56A and C21A - generating the high current drive required for the parallel connected symmetrical follower output stage TR57, TR73, TR79, and TR93, R231, R244, R248, R257. V-I limiting is controlled by TR90, TR68B, R36A-R43A, C1A, C2A, R212, R25A-R27A, R30A, R33A, R55A, D7A-D9A, D11A, ZD76-ZD6A. As the output stage is symmetrical, the positive half only will be described (Q13A-Q16A, R44A-R47A, C2A, TR68A, R36A-R39A, R25A, R26A, R30A, R55A, D8A, D11A, ZD76, ZD5A).

Output stage protection is accomplished by a three-slope V-I limiting circuit which has limiting characteristics chosen to emulate the Safe operating area of the output stage transistors at their maximum operating temperature.

The V-I limiting works by controlling TR68A: when the base-emitter voltage of TR68A exceeds about 0.65V then TR68A turns on and steals current, via D8A, from the input of the output stage and thereby limiting the output. So, V-I limiting is controlled by controlling the base-emitter voltage of TR68A.

Each output device has its own current sharing resistor - R44A-R47A - the voltage across which is proportional to the current flowing in the output device. These voltages are sampled and summed by R36A-R39A. C2A ensures stability when V-I limiting is activated.

The voltage across the output devices is sampled by R25A and R26A (R30A and ZD5A limit the voltage range to reduce off-load distortion) and this, summed with the output current derived signals from R36A-R39A, controls TR68A for output voltages less than about 3Vpk. Thus the amplifier is protected for short circuits because the base-emitter voltage of TR68A increases when output current increases and when voltage across the output devices increases.

For output voltages exceeding about 3Vpk, ZD76 conducts connecting R55A to sense the output voltage. In this case, as output voltage increases, the base-emitter voltage of TR68A reduces, thus the current limit is increased as the output voltage increases, defining the third slope of the limiting characteristic.

“Peak” LED circuit

The “peak” LED (LED1A) is driven in series with the Limiter LED (LED2A) from the output of the amplifier via D13A with it’s threshold controlled by ZD7A and R58A. With no signal present, ZD7A and R58A generate a reference voltage at the anode of ZD7A, which is 18V below the +HT supply rail. All the current flowing through R58A comes from ZD7A. To turn the LED’s on, the amplifier is required to produce an output voltage approximately 5V above the reference, at which point ZD7A is no longer in breakdown and the current flowing through R58A comes from the output stage via D13A, LED1A and LED2A. Thus the “peak” LED threshold and the “Clip Limiter” threshold vary with the +HT voltage and thus the output loading conditions.

Protection System

The protection system is based around IC1, a TL074 quad op-amp. The temperature of the heatsink is monitored by TH1, an LM35DZ temperature sensor integrated circuit producing 10mV / o C. The temperature signal is then multiplied by 10 by one op-amp (pins 8,9,10) & R16,R17. The output (pin 8) is fed directly to pins 6 & 13 serving as a temperature dependent (0.1V / ºC) reference for two comparator circuits - one (pins 5, 6, 7) controls the relays and the other (pins 12, 13, 14) controls the fan speed.

The Fan can run at two speeds, the changeover happening at about 55 ºC. R9 and ZD2 produce a reference voltage of 9.1V at the cathode of ZD2. This is divided by R18 & R19 to give about 5.5V at pin 12, the non-inverting input, which is compared with the temperature signal at pin13, the inverting input.

1. Temperature signal is less than 5.5V: the output of the op-amp will be high (+24V), turning Q1 off and therefore Q2 off. The fan speed is controlled by R21 which forces approximately half speed.
2. Temperature signal is more than 5.5V: the output of the op-amp will be low (-5.6V), turning Q1 on and therefore Q2 on. R21 is now effectively shorted out by Q2 and the fan runs at full speed.

At turn-on C16 will charge through R9 and R10 towards the 9.1V reference (ZD2). The voltage is fed to the non-inverting input (pin 5) of op-amp at pins 5, 6, 7 configured as a comparator with hysterisis (D9 and R11). The reference for the comparator is set by the temperature reference which is about 2.5V at room temperature (25 ºC), When the voltage across C16 exceeds the temperature reference, the op-amp output will swing high (+24V) and turn Q3 on via current limiting resistor R13. When Q3 is on, it pulls current through the coils of RLY1 (soft-start) and RLY1A, RLY1B on the output board. This also means that the collector of Q3 will swing low (close to 0V) effectively shorting out R15 and LED2 to turn LED2 (Protect, Yellow) off.

Output Connections

The output of the amplifier is connected to Zobel Network R12A/C8A. This network presents a defined load impedance to the output stage at high frequencies to ensure stability. Either of R12A or C8A being faulty will result in the amplifier oscillating at high frequency, which may also be evidenced by mains "hum" and/or distortion at the output. This signal is fed via output choke L1A which isolates any load capacitance from the amplifier feedback to ensure stability. The output is then fed through output relay RLY1A and on to the rear panel output connectors.

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Pulse Checkout Procedures

Observe all Cautions and Warnings when servicing this amplifier.

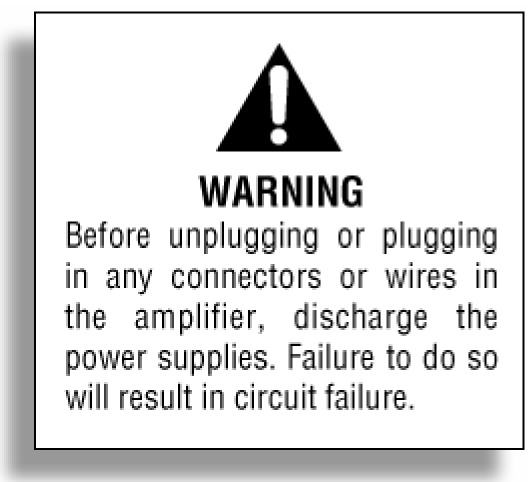
1 Dissassembly for Service

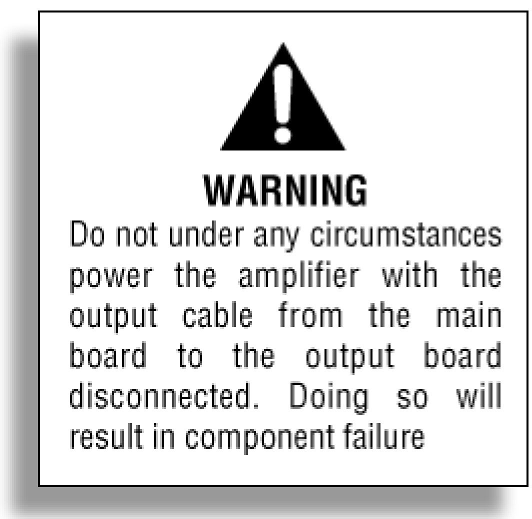
1.1 Main Module Removal

1. Remove the top cover by removing the two side, two back, and four top screws. Lift up slightly on the rear of the cover, and then pull it toward the back of the amplifier.
2. Remove the eight screws that hold the input connectors to the chassis.
3. Remove the four screws that hold the output jacks to the back panel.
4. Remove the four screws that hold the circuit board down to the chassis.
5. Remove nut from green and yellow striped ground wire connected to back panel.
6. Remove the two screws that hold the IEC filter to the back panel.

Remove all eight screws from underneath the chassis. Grip the front silver handle and gently pull forwards about ½ inch (be careful; it is a tight fit), and then lift up and away from the chassis.

After removing the PCB from the chassis, discharge the power supply capacitors. For C75 use a 1k/5W resistor. For the bulk reservoir capacitors, use a 10k/5W resistor.





2 Troubleshooting

2.1 Non-Powered Checks

1. Perform a cursory check of all major items in the power supply i.e. IGBT's.

2. Locate the flyback diodes D114, D115, D214, and D215 on the main modules and check for indications of a short. If a short is indicated, this means that an output device or driver transistor in parallel with that diode is shorted, usually not the diode itself. If an output device is found to be defective, emitter resistors should also be checked. If no output device is found defective, perform a quick check of driver, pre-driver, and bias transistors.

3. Check driver and pre-driver transistors for shorts or opens. If a fault is found, do an in-circuit static check of all semiconductors on the main board. If no output device and nothing upstream is found defective, move to power-on checks.

Otherwise continue.

4. If a failure has occurred anywhere in the output stages, check the bias servo transistor. Any failure associated with bias transistors may result in repeat failure of the affected channel even if all other defective components have been found and replaced.

5. If a failure is found in any LVAs, checks should continue up to the voltage translator stage.

2.2 Powered Checks

WARNING: Use extreme caution when making internal adjustments when the unit is powered.

1. Apply AC mains. The PIC microprocessor will perfom a self-test, during which time the Fault LED and both Temp LEDs will flash. After the self-test, the AC-present LED will remain on.

2. Switch on the amplifier using the front panel switch. If the protect light is on and not flashing, this indicates a DC offset fault on one of the channels. Remove AC mains. Disconnect the output board from the main board at the header strip on the rear. Apply AC mains, switch the unit on, and measure for a DC offset at the output connector for each channel (WRT amplifier ground).

3. If the protect light is flashing, check the chassis fuse on the rear of the unit. If this is OK, you will make a few simple measurements with a DVM set to Ohms range:

4. Remove AC mains.

5. Discharge the power supply capacitors. For C75 use a 1k/5W resistor. For the bulk reservoir capacitors, use a 10k/5W resistor.

6. Check the soft-start resistors, located between the transformer and the left heat sink. These two ceramic resistors will be broken if the power supply is OK and there is a fault in one of the channels.

7. Measure the resistance between the following points. There should not be any short circuits or low-resistance readings.

- Case of the output devices to the heat sink.
- Case of the output devices to the output connector tag.
- Across the outer legs of the driver transistors (BF422, BF423) on each channel.

If you have a short or low resistance at any of these points, you have located the faulty channel. If these tests do not reveal the fault, then the fault is most likely in the power supply. The following procedure should help to locate it.

1. Be sure AC mains is removed.

2 . Separate the power supply unit and amplifier stages by breaking the links (shown in green on Diagram 1). These are down the front part of the PCB (underside) by the capacitors nearest the connections for the four black wires, shown in blue in Diagram 1.

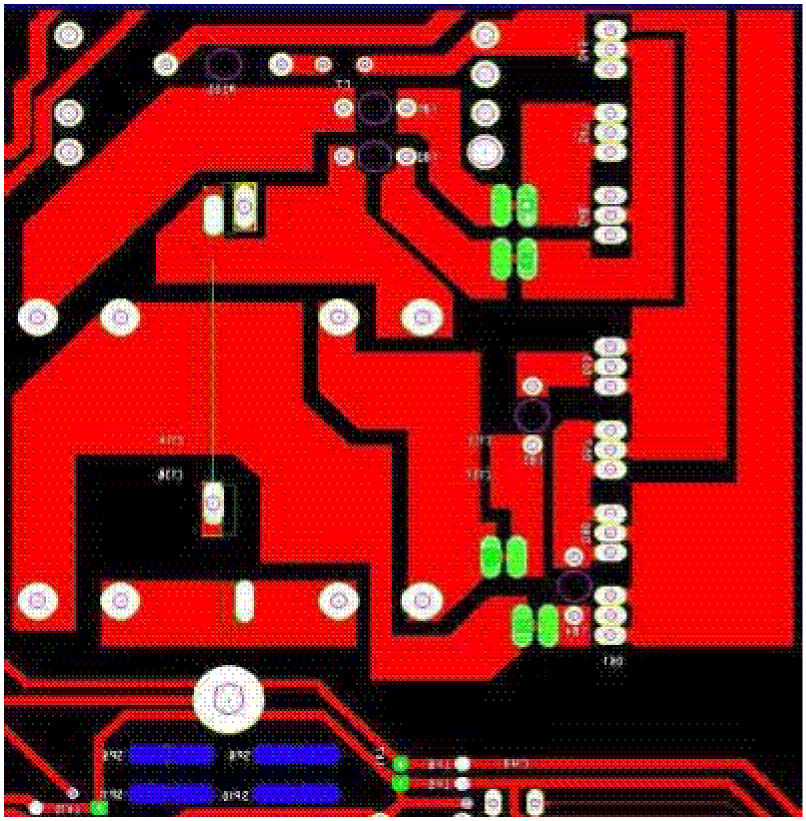
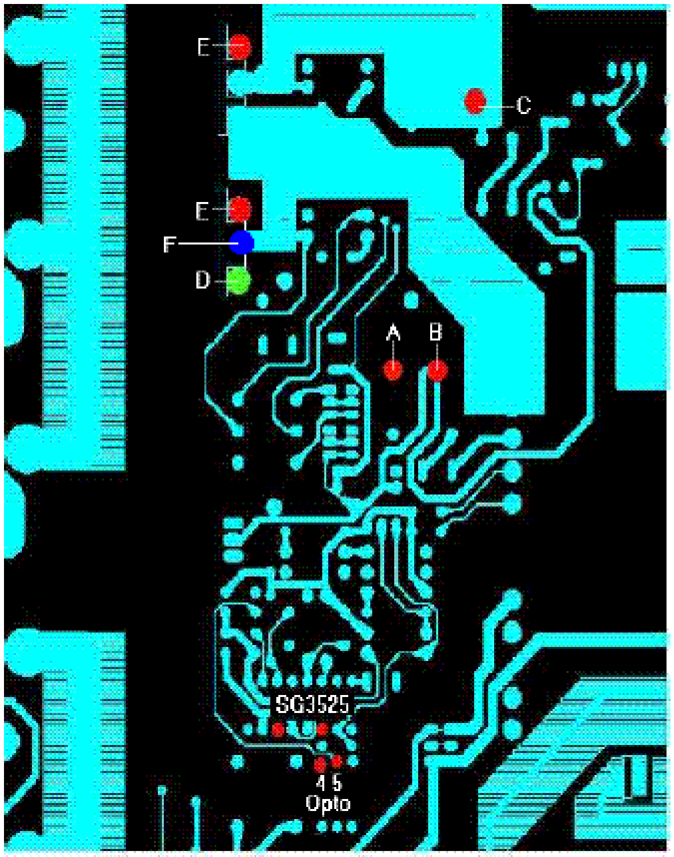


Diagram 1. View from solder side of PCB.

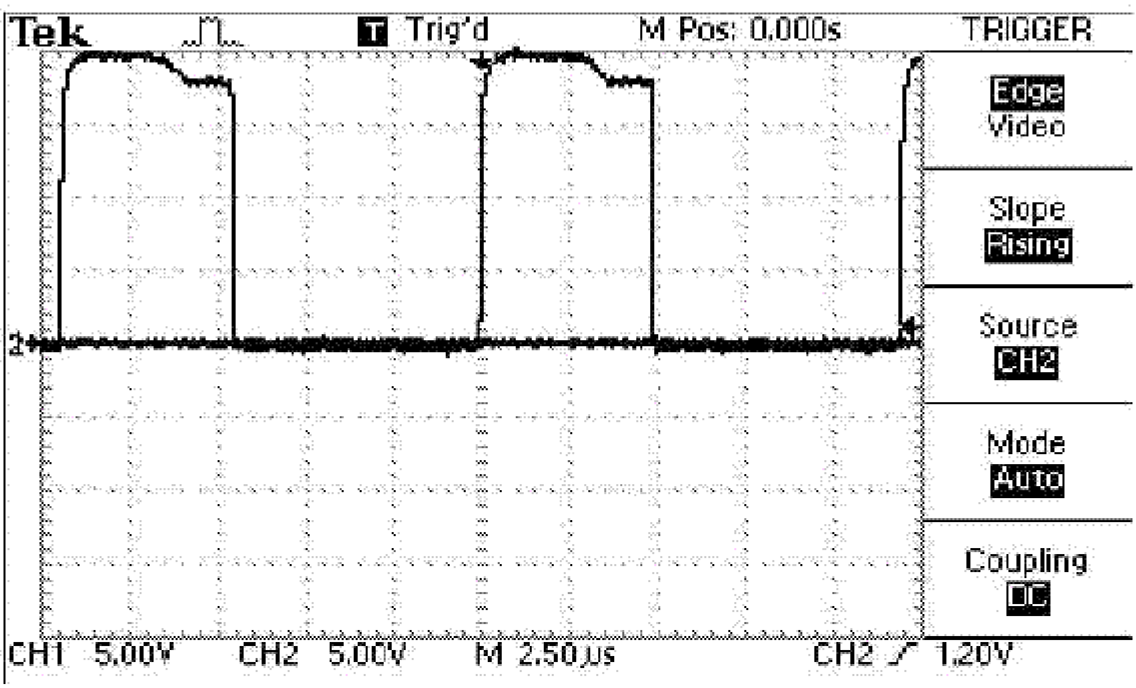
3. Use a 60V DC bench supply (current limited). Connect it across C75 with +60V to point B and Gnd to point A (see Diagram 2). Fit a switch (switched off) across pins 4 and 5 of OPTO1 (be very careful, as a spark here will kill it).



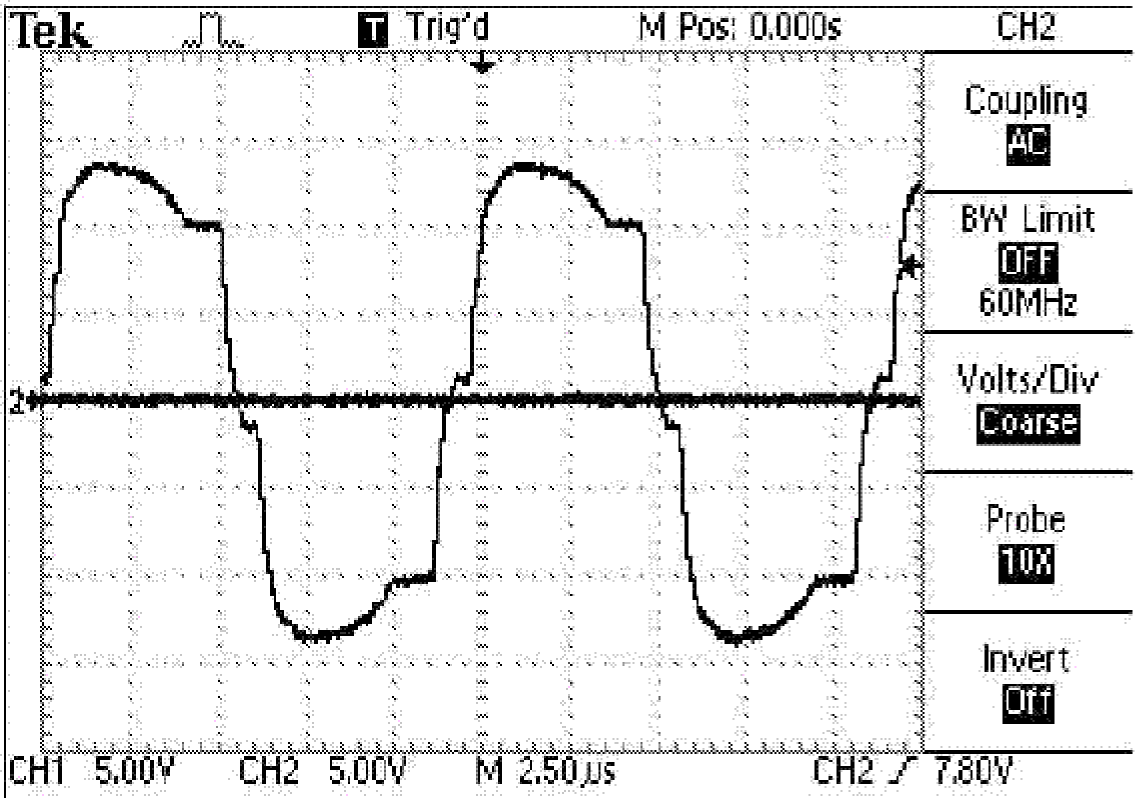
Diagram

4. With your scope Gnd referenced to point D or A, switch on the DC supply. Wait a second and then switch the opto. The current should go up to about 110 mA. If it goes rather high you have a fault.

5. Using the oscilloscope, check pins 11 and 14 of the SG3525. This should give a square wave output similar to that shown below:

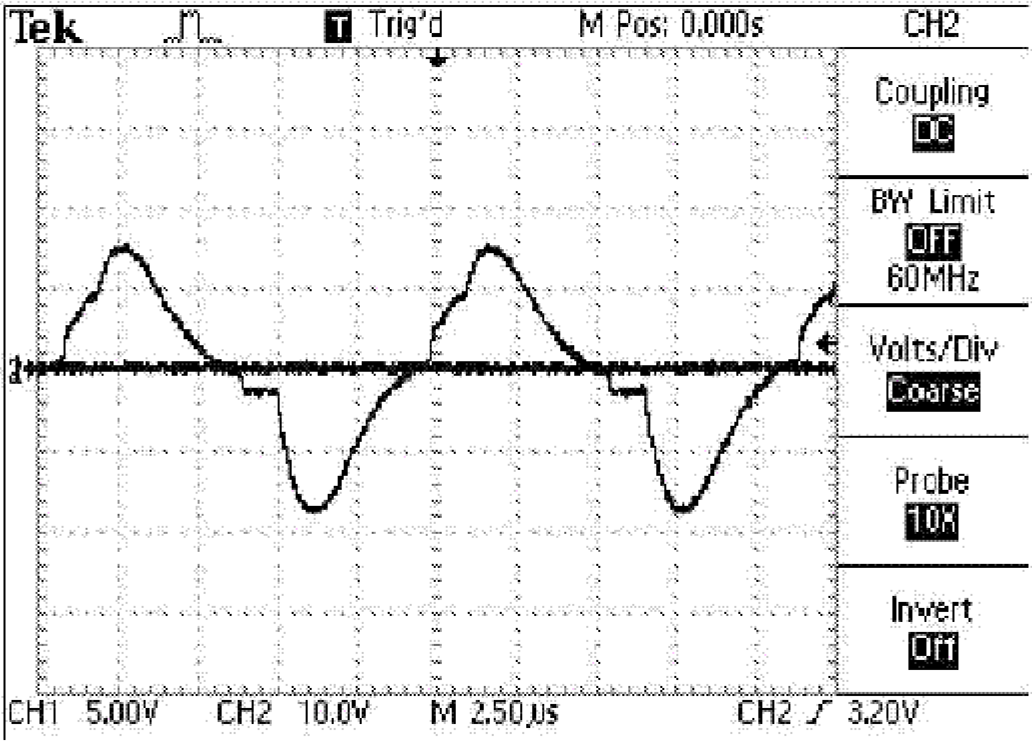


6. Move the probe to monitor the waveform at the IGBT's marked E on Diagram 2. You should see a switching waveform similar to that shown below.

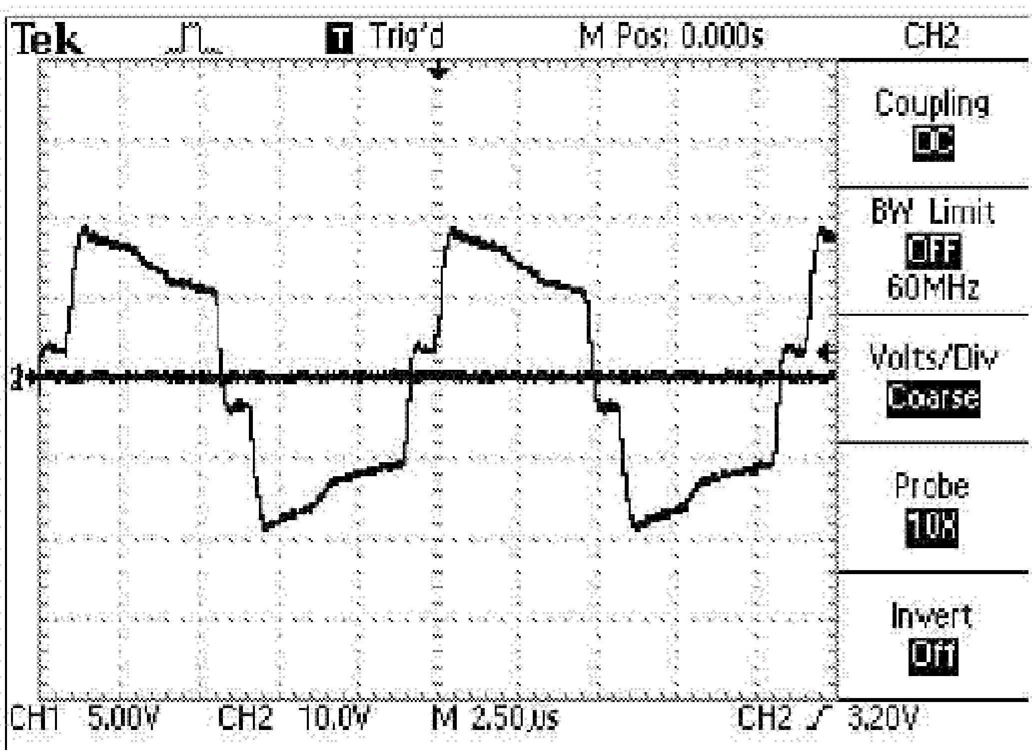


7. Some examples of incorrect waveforms are shown below, along with the likely area of failure.

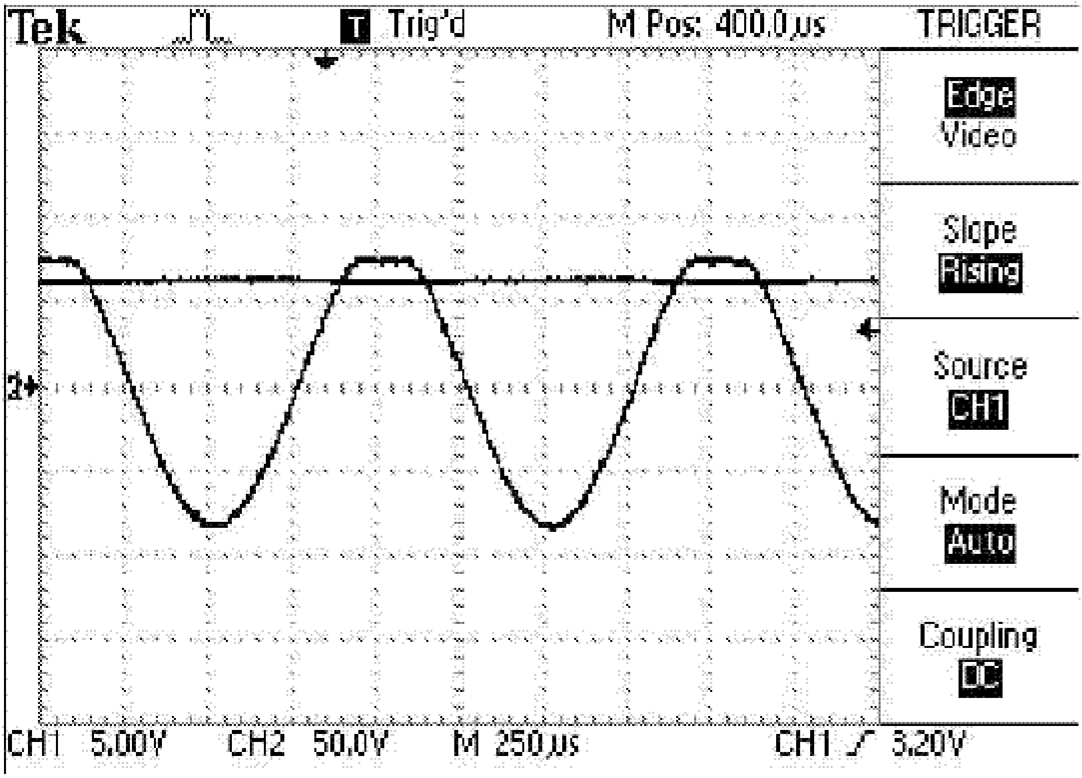
The waveform below is commonly caused by faulty ZTX650-ZTX750 transistors in the power supply.



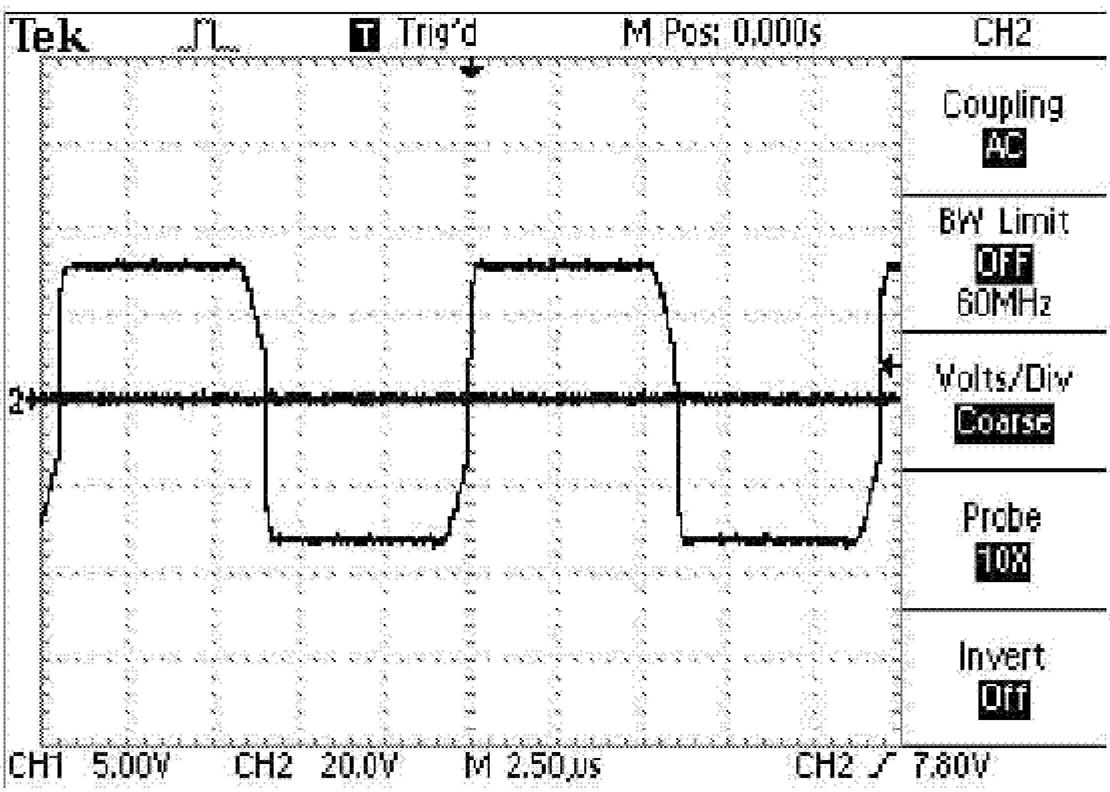
The waveform below is commonly caused by a faulty PWM transformer TX4.



The waveform below is typical of an overdrive fault (2x1100 version only). This may be caused by a faulty IRF540 or in the BC546-BC556-BF422 transistors in the FET drive section. Or it may be a result of breakdown in the BF422 transistors in the driver stage (refer to Tech Note #165.)



8. All being well, connect another jumper wire from the +60V rail to the PCB point marked C on Diagram 2. Check the waveform from the output of the IGBT. To do this, monitor the middle pin of the IGBT marked F on Diagram 2. You should have a waveform similar to that shown below.



9. Move the oscilloscope's Gnd reference to the normal ground point of the amplifier; i.e., the four black wires (shown blue in Diagram 1). When you turn on the DC power supply, the current should have risen to about 150 mA. You should see square-

wave outputs from the transformer at the points shown in green on Diagram 3.

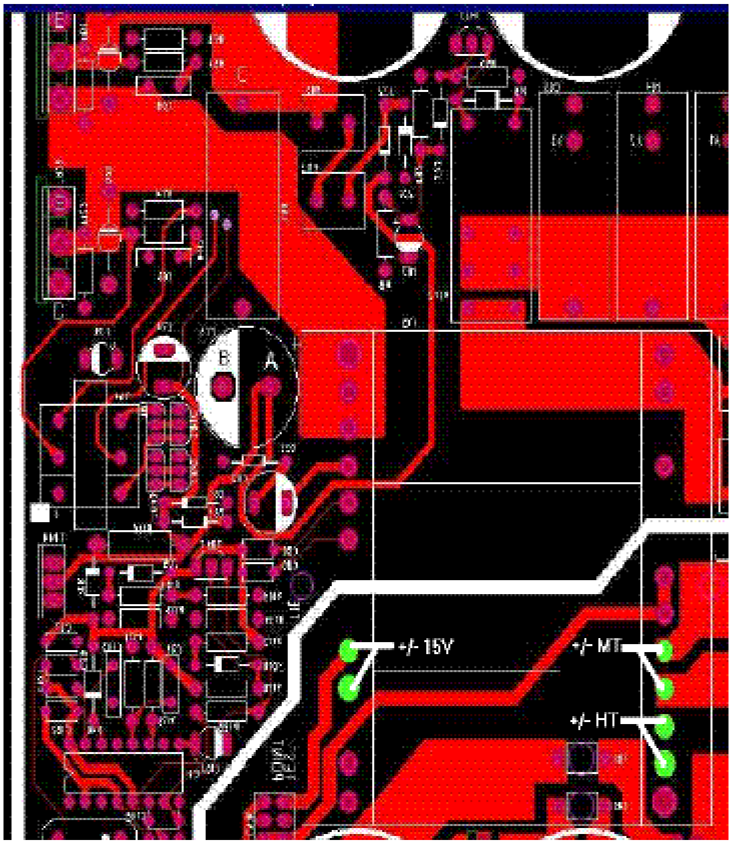
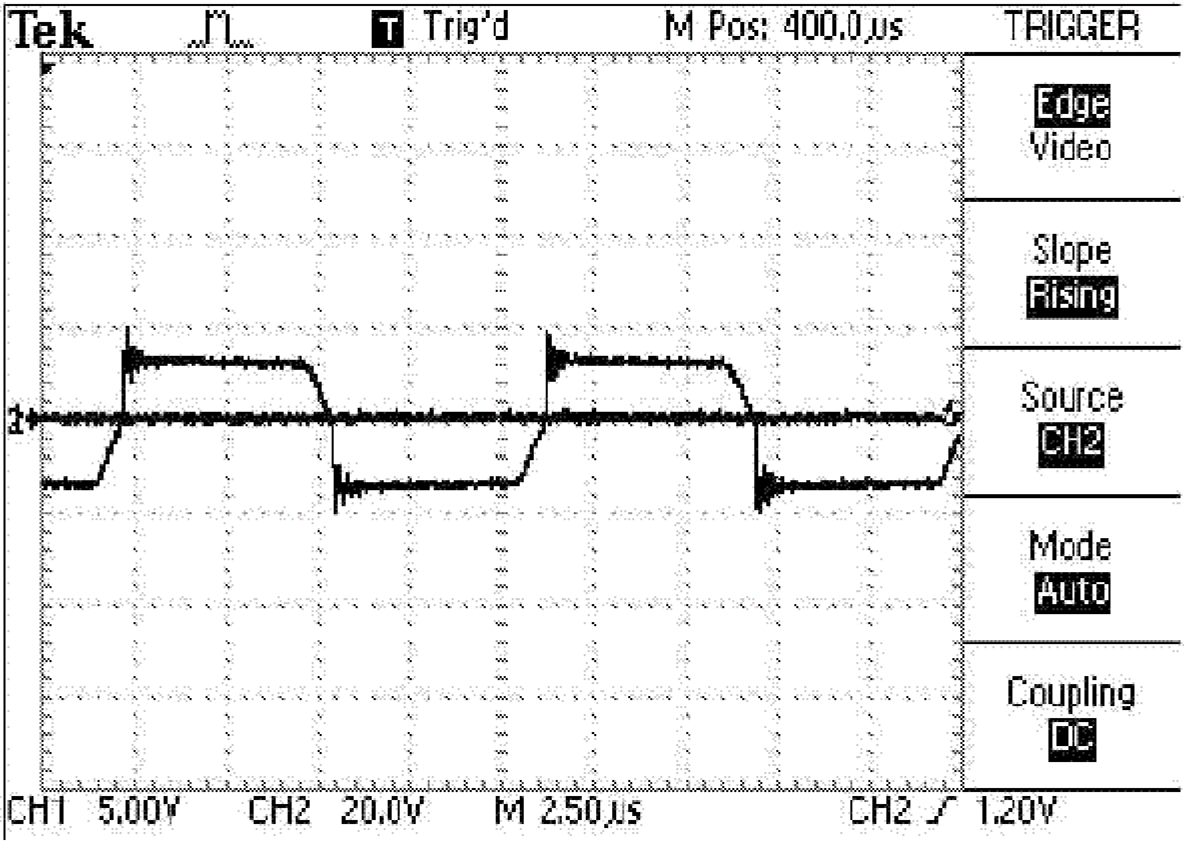
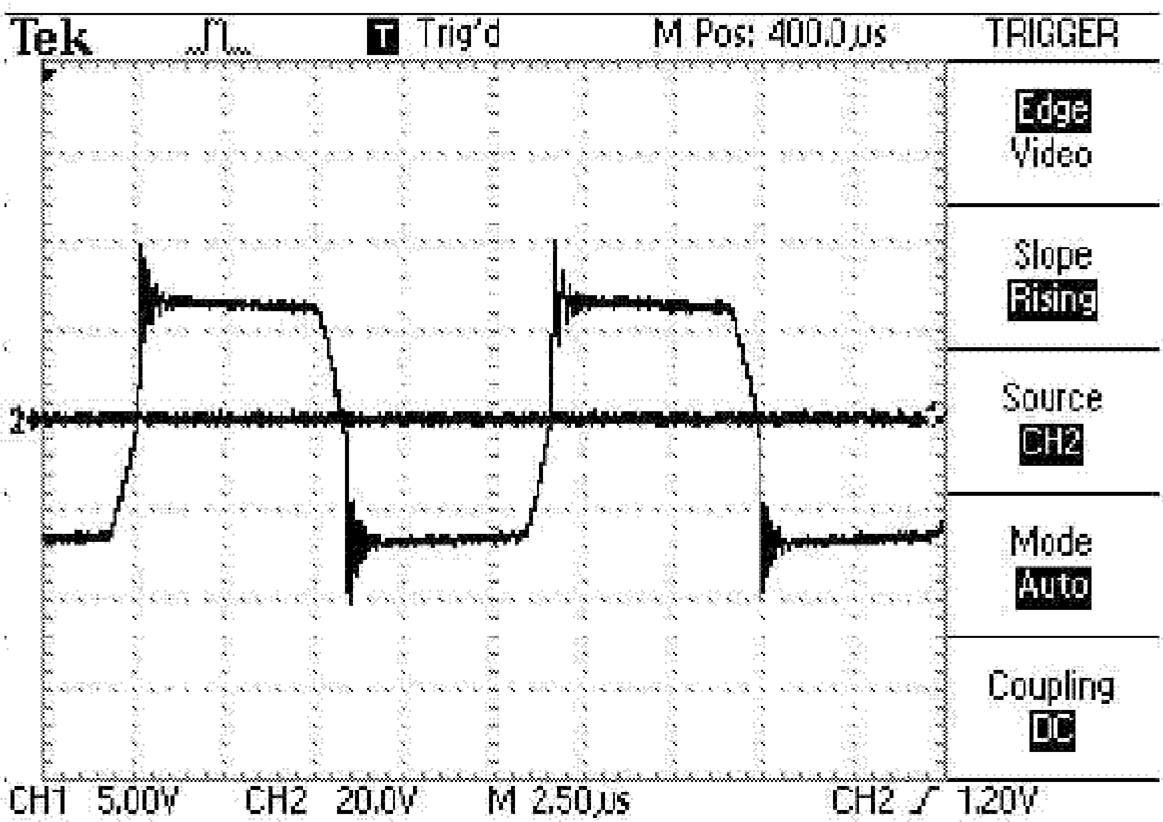


Diagram 3. View from solder side of PCB.

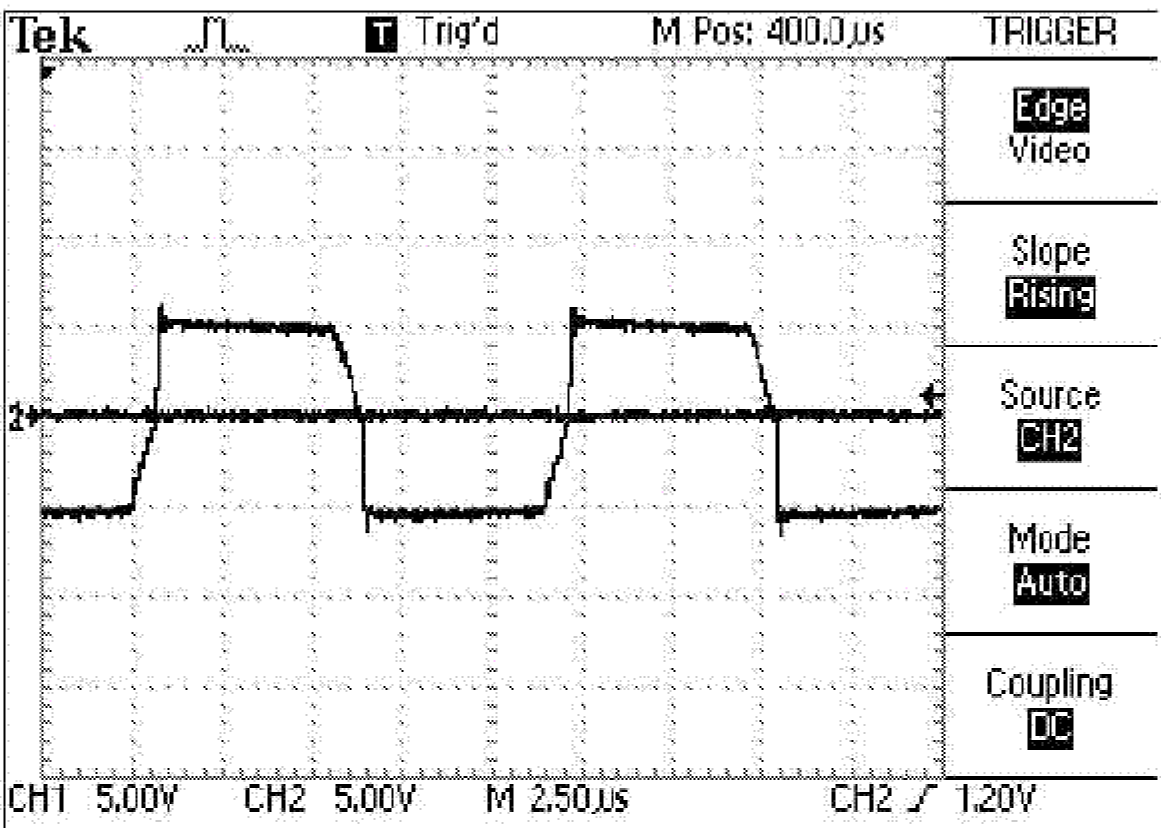
10. The waveforms should be similar to those shown below.
For ± MT:



For ± HT:



For ± 15V (Note: the gain on the V/Div has been increased to give a better view):



You have now determined that the power supply is running and that there are DC supplies being generated. You should now check the power supply using a mains supply input.

1. Remove all the connections used for the DC bench supply test. Be sure to remove the switch on the opto isolator -- if it's left in position and switched on, the power supply will not power up.

2. At this stage you WILL NEED a MAINS isolation transformer. Note: This is not the same as

3. Plug the mains isolation transformer into the mains AC supply.

4. From the output of this transformer, connect the AC power cord to the amplifier.

WARNING: Using a Variac or noise isolation transformer instead of a MAINS isolation transformer could lead to injury or death.

5. The unit should go through its normal start-up procedure. Once it has stopped flashing, move the Operate switch to the ON position. The amplifier's power supply should start up after approximately 2 seconds.

6. If the protection light flashes, disconnect the AC power cord and check the chassis fuse and replace if necessary.

7. Also check the soft-start resistors (the flat thick-film 20-ohm resistors alongside the main transformer). If the resistors are open circuit, use a temporary resistor during this phase, as changing the soft-start resistors is difficult and the resistors are fragile. See Diagram 4 for details of the temporary resistor.

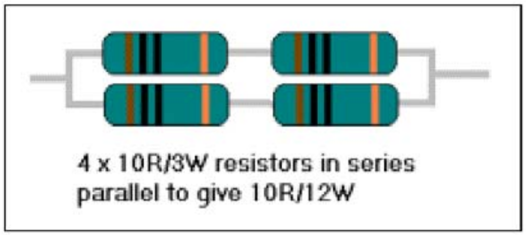


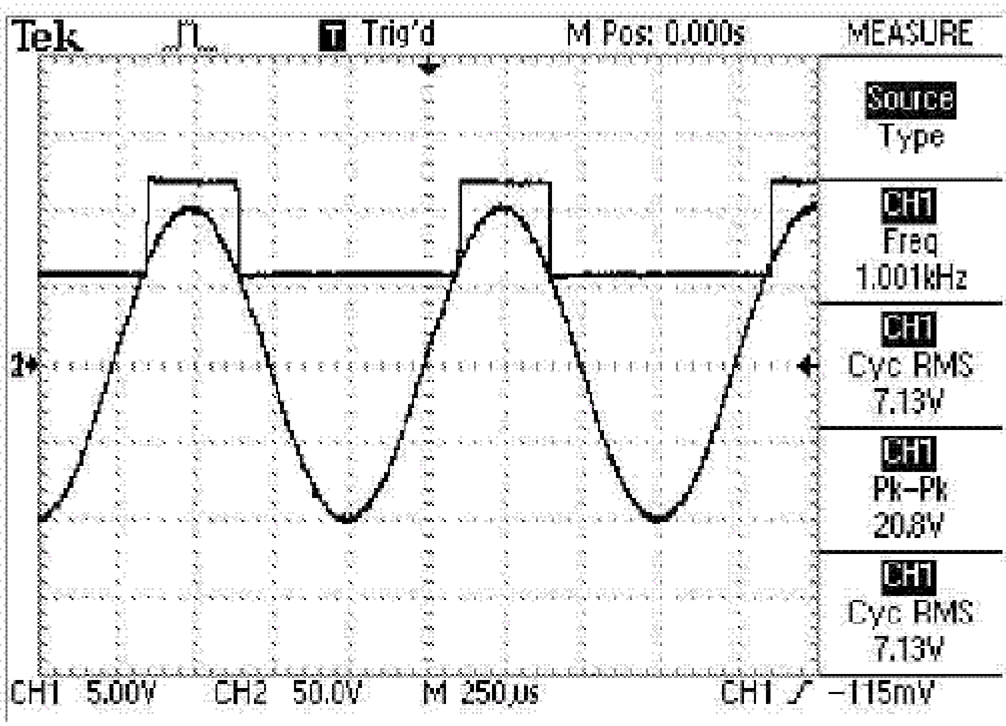
Diagram 4. Temporary resistor.

8. Replace the power cord and try the power supply again. It should start. You can measure the DC supply rails at the link points.

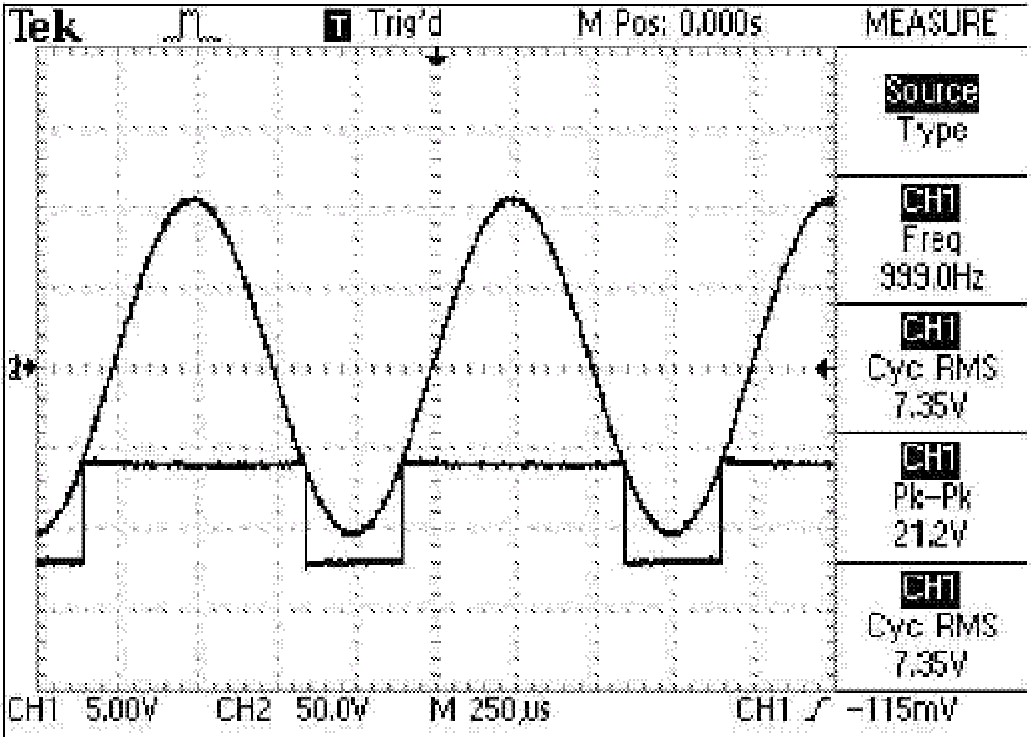
9. Switch off the unit and bridge the isolating links between the PSU and amplifier stages with solder. Switch on the unit.

10. If the unit goes into protect mode, there is another fault in one or more channels. If the unit powers up correctly, inject a 1 kHz 1.5 dBu signal into Channel 1. Monitor the output (off load) for a clean sine wave.

11. Then use the second channel of the oscilloscope to monitor the case of the MJ15024 device. As you increase the output from the amplifier, you should see a waveform similar to that shown below.



12. Move the second channel monitor to the case of the MJ15025 devices. Check that the waveform is similar to that shown below.



Now put the amplifier boards back into the chassis. Fit the minimum of screws to ensure good earthing. If there are any further problems, it is very frustrating to have to undo all the fixing screws again.

The screw fixings we suggest are

- The two chassis earth points.
- One of each heat sink to chassis screw.
- One silver PCB to chassis screw.
- Two output panel screws.

This will allow you to run the amplifier and perform the quick test. You will use a large input signal and overdrive each channel for a while, then short the output and again overdrive each channel for a while.

1. Load the output to 4 ohms.

2. Turn the level control to maximum.

3. Inject a +5 dBu, 100Hz sine wave signal into each channel's input and check for heavily clipped output. Run for 30 seconds.

4. After 30 seconds, short circuit the output for a further 30 seconds.

5. Remove the short circuit and reduce the signal to +1.5 dBu (+1 dBu for the 4x300). You should see a clean, unclipped output at the correct level shown below.

- **4x300** 300W
- **2x650** 650W
- **2x1100** 1100W

3 Checkout/Adjustment Procedures

The following instructions outline an orderly checkout and troubleshooting procedure. The purpose and arrangement of this procedure is to ensure proper operation after a repair has been completed. Before beginning these power-on tests, perform the checks listed in Section 2. These checks will minimize the possibility of receiving a nasty surprise when turning on the amplifier.

3.1 Initial Conditions

The start of each step assumes all switches are pre-set to the following positions:

- Mode Switch: Normal position.
- Level Controls: Both up (clockwise) fully.

3.2 Test Procedure

CAUTION: If you are attempting to check or measure VI limiting, output power, or any other test which would require the amplifier to produce large amounts of heat, the main module should be securely mounted inside the chassis. If the module must be removed from the chassis, the test should be of very short duration.

WARNING: Do not connect any load to the Pulse power amplifier during these tests until specifically instructed to do so.

3.2.1 Turn-on Delay No Signal

No Load
Apply mains and check for the following:
Mains LED is on and red. Protect LED (red) and both temp. LEDS (yellow) flash together 5 times and then go off.

Switch on and observe the following:
After 2 seconds the operate LED is on and yellow. Fans are on at full speed. After another 2 seconds clip LEDS flash and fans slow to idle.

3.2.2 DC Output Offset No Signal

No Load
With the input level controls turned fully clockwise, the DC offset for both channels should be less than ±100 millivolts. A large DC offset usually indicates a failure in the output stage, though such an offset should have shut down the amplifier on a DC/LFI signal.

3.2.3 Quiescent Power No Signal

No Load
While there is no published specification on quiescent power, it should be checked. A power draw with the fan operating slowly will normally be less than 120 W (<800mA). If quiescent power greatly exceeds expectation, then turn the amplifier off immediately and search for power supply or output failure. If quiescent draw exceeds expectation by a “small” amount, check bias immediately.

3.2.4 Sensitivity (Gain) 1-kHz Sine Wave

No Load
Check that both level controls are full clockwise. Insert a 0.1V 1-kHz sine wave and measure 14.9V – 16.5V at the output of each channel for the 2x1100, 11.7V – 13V at the output of each channel for the 2x650, 8V – 8.8V at the output of each channel for the 4x300 .

3.2.5 Bridge Mono 1-kHz Sine Wave

No Load
Note: Always turn power to the amplifier off prior to changing the position of the Mode Switch. With the dual/mono switch in the bridge mono position, insert a 0.45Vrms 1-kHz signal into channel one input. There should be signal present on both channel outputs, equal in amplitude, with channel two 180 degrees out of polarity from channel one (see Fig. 2.3). Channel one input level control should control the output level for both channels. Return the amplifier to stereo operation.

Figure 2.3 Bridge-Mono Waveform

3.2.6 10-kHz Square Wave 10-kHz Sq. Wave
Slew Rate Test 8-ohm Load
With an 8-ohm load on each channel, insert a 10-kHz square wave and adjust amplitude to produce an output 10V below clipping. Observe a 50V/µS (or higher) slew rate. The output waveform should be stable with no ringing or over-shoot.

WARNING: Many of the following checks are done by connecting a resistive load to the output of the amplifier. Use caution and follow check-out procedures carefully to ensure correct results. These tests require a resistive load capable of over 2000 W continuous into as low as 2 ohms.

WARNING: The Pulse-Series is capable of drawing 10 Amperes of current from 230VAC mains when loaded to 2 ohms per channel and with both channels driven by a 1 kHz sine wave.

Note: For the remaining tests, the main module should be placed back into the chassis if at all possible. Otherwise, the heatsinks will become very warm, causing the amplifier to thermally protect itself. It is also possible under high-power bench testing to blow the fuse.

3.2.7 1-kHz Power + THD 1-kHz Sine Wave
Various Loads
Note: Operation with a sine wave into a low-impedance load will cause the fuse to blow after 5 to 10 seconds.

AC Mains of 230 VAC, 50-Hz

- **8-Ohm Load:** Minimum voltage is 56.6 Vrms (400W) with <0.1% THD for the 2x650, 74.8 Vrms (700W) with <0.1% THD for the 2x1100, and 36.9 Vrms (170W) with <0.1% THD for the 4x300.
- **4-Ohm Load:** Minimum voltage is 51.0 Vrms (650W) with <0.1% THD for the 2x650, 66.3 Vrms (1100W) with <0.1% THD for the 2x1100, and 34.6 Vrms (300W) with <0.1% THD for the 4x300.
- **2-Ohm Load:** Minimum voltage is 41.2 Vrms (850W) with <1.0% THD for the 2x650, 54.8 Vrms (1500W) with <1.0% THD for the 2x1100, and 25.7 Vrms (330W) with <1.0% THD for the 4x300.

3.2.8 Noise No Signal
No Load
Make sure the level controls are fully clockwise. Terminate the input with a 600-ohm load. Using a 20 to 20,000- Hz bandpass filter, measure the noise on the output of the channel under test. Noise is measured relative to power output at 8 ohms: 56.6 Vrms (400W) for the 2x650, 74.8 Vrms (700W) for the 2x1100, and 36.9 Vrms (170W) for the 4x300 and should be at least 100-dB down from these numbers.

3.3 Post Testing Procedure

At the completion of testing, set all switches per customer request. If none are specified by the customer, the following are standard factory settings for original shipment:

- Mode Switch: Normal position.
- Level Controls: Both down (counter-clockwise) fully.
- Front panel switch: OFF position.

4 P.A.T. Check

There is also a requirement to perform a P.A.T (Portable Appliance Test) check on the product prior to return to customer. This must be carried out by a P.A.T. certified engineer.

The following are the settings required:

- Earth Bond 25A @ 6VRMS Pass <= 0.1Ω Typical 0.08Ω
- Insulation 500V DC Pass > 9.9MΩ
- Flash Test N/A (Unit will fail this test due to filtered IEC which will indicate a breakdown)
- Load Test Unit will power up for 8 seconds

- Operation Test Pass < 3KVA
- Leakage Test Pass < 3 mA

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