



Title: **ISA Turn-on Hangup**  
Bulletin #: ISA0001 Issue Date: April 4, 2002  
Models Affected: ISA 750, 800T, 450, & 500T  
Bulletin Revision: A  
Production Range: 01/2000–04/2002 (serial # 0100xxxxx–0402xxxxx)

## Description

The circuitry that controls protective current cutback in ISA amplifiers may in some instances cause a channel—usually channel 1—to “hang up” at turn-on. This problem is most pronounced in the ISA 750 and ISA 800T models, but may also occur in some ISA 450 and ISA 500T amplifiers.

## Symptoms

When the amplifier is turned on, one or both channels remain inoperative, with their respective clip LEDs lit. In some cases, the problem will clear by itself after several seconds. This problem is merely a nuisance and presents no danger to the amplifier, the speakers, or the rest of the sound system.

Any one or more of these situations will tend to aggravate the problem:

- High-pass filters (low-frequency) filters engaged
- A DataPort accessory powered by the amp
- Low AC line voltage
- Cold ambient temperature

Passing an audio signal of a sufficient level through the affected channel will usually clear the problem; the level required generally depends on the severity of the hang-up.

## Background: the cause and the remedy

Each channel has an operational amplifier (op amp) driving its output stage. Its supply rails furnish just enough current for normal operation by themselves and use the output signal to help replenish them. When the output stage tries to put out too much current into a short circuit or abnormally low load impedance, it clips prematurely at a very low voltage; as a result, there is not enough output signal to replenish the op amp supply rails. The starved supply rails collapse, and with them, so does the op amp output. *This is a normal and vital part of the amplifier's protection against short circuits.*

A channel hangs when the op amp rails and the bias in the output transistor circuitry do not settle to their correct values quickly enough after turn-on. The op amp output swings to one rail, causing it to collapse and in turn causing the bias to not settle correctly. As a result, there is no negative feedback to force the op amp to resolve itself to zero volts.

To correct the situation, replace the 5.6-volt zener diodes (D107, D110, D207, and D210) with 4.7-volt diodes and recalibrate the current-limit trimpots (R139, R140, R239, and R240).

## Temporary work-arounds

Until the amplifier can be serviced, one of these actions will usually clear its hang-up and get it working properly:

- Quickly turning it off and on (CAUTION: this will cause an audible pop in any loudspeaker connected to the amp)
- Unplugging and re-connecting speaker load from the channel output

## Instructions

### Tools and materials required:

- Soldering iron with fine tip (recommended range 25 to 60 W)
- Rosin-core solder (60/40 or 63/37 eutectic type)
- Long-nose pliers
- #1 and #2 Philips screwdrivers
- Small diagonal cutters

### Tools and materials required (continued):

- Desoldering equipment or solder braid
- Four 4.7-volt ¼-watt zener diodes (Microsemi DZ840731ET/R; QSC part number QD-0004.7-ZT)

### Test equipment required:

- Oscilloscope
- 2-ohm resistive load (rated for at least 1200 watts)
- Wire or other means of shorting the amplifier output
- Variable AC transformer (e.g., Variac, Powerstat, etc.) rated for 25A (120V) or 12A (230V). Make sure your AC supply is appropriate for the amplifier.
- 1 kHz audio sine wave generator
- Digital multimeter
- AC current probe (e.g., BK Precision model CP-1)
- Trimpot adjustment tool (non-conductive)

**Note:** The circuit boards in the ISA 750 and ISA 800T are double-sided, while those in the ISA 450 and 500T are single-sided. Therefore, to minimize disassembly, this bulletin recommends two different procedures among these models:

- In the ISA 750 and ISA 800T, the zener diodes will be unsoldered and soldered from the component side. The instructions for this procedure begin below.
- In the ISA 450 and ISA 500T, the new zener diodes will be soldered “piggyback”-style to the old ones. The instructions for this procedure begin after those for the ISA 750 and ISA 800T.

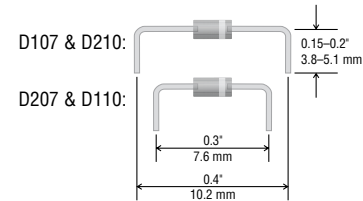


Figure 1. Prepare the leads of the new zener diodes.

## Procedure: Replacing zener diodes in an ISA 750 or ISA 800T amplifier

1. Disconnect the amplifier from AC and wait at least 10 minutes for internal voltages to bleed down. Remove the top cover.
2. Prepare the new zener diodes as shown in Figure 1.
3. Remove the four screws on the bottom of the amplifier that fasten the heat sink to the chassis.
4. Remove the three screws that attach the channel module assembly to the chassis standoffs.
5. Lift up the front of the channel module assembly. Rotate it so that channel 1's module (the lower one) is on top; set the assembly down in the chassis with the heat sink resting on the standoffs (Figure 2).
6. Disconnect the ribbon cable from the channel 1 module.
7. Locate zener diode D107. It is near where three wires are soldered to the circuit board and secured with hot glue. If the hot glue covers the diode, use the tip of your hot soldering iron and a small screwdriver to melt and clear the glue away (Figure 3).
8. Notice the orientation of D107. Unsolder and remove it; be careful not to damage the through-plating in the holes. Install and solder a new zener diode oriented in the same direction. Do the same with zener diode D110.
9. Reattach the ribbon cable and turn the channel module assembly back over so that the channel 2 module is on top.
10. Locate zener diode D207 and notice its orientation. Carefully



Figure 2. Prop the channel module assembly up on the chassis standoffs.

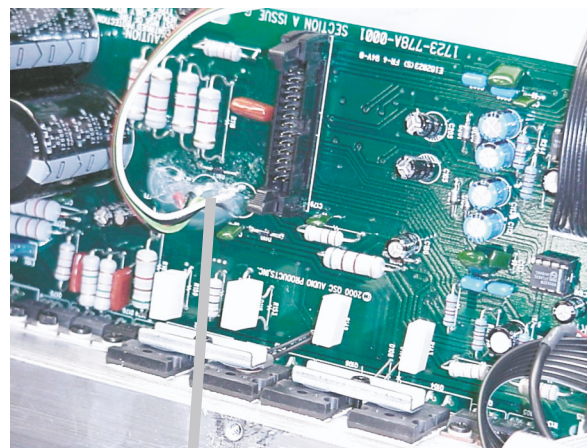


Figure 3. You might need to clear hot glue away from diode D107. Use your hot soldering iron tip.

unsolder and remove it. Install and solder a new zener diode oriented in the same direction. Do the same with diode D210.

11. Check your work. Don't reattach the channel module assembly and heat sink to the chassis yet. Instead, continue with the bias and current-limit calibration.

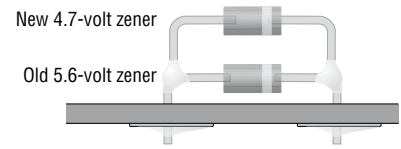


Figure 4. Solder a new zener diode "piggyback"-style onto each old one.

## Procedure: Installing new zener diodes in an ISA 450 or ISA 500T amplifier

1. Disconnect the amplifier from AC and wait at least 10 minutes for internal voltages to bleed down. Remove the top cover.
2. Remove the four screws on the bottom of the amplifier that fasten the heat sink to the chassis.
3. Remove the three screws that attach the channel module assembly to the chassis standoffs.
4. Locate zener diodes D107 and D110 on the channel 1 module (the upper circuit board). Bend and trim the leads of two new zener diodes and solder them piggyback-style to D107 and D110, oriented in the same direction (Figure 4).
5. Turn the channel module assembly over and repeat step 4 with zener diodes D207 and D210.
6. Check your work. Don't reattach the channel module assembly and heat sink to the chassis yet. Instead, continue with the bias and current-limit calibration.

## Procedure: Bias and current-limit calibration

Note: During the current-limiting part of this procedure, the amplifier will draw high amounts of AC: approximately 22 amperes at 120V, or 11 amperes at 230V. Be thorough, but work quickly to avoid tripping the amplifier's circuit breaker.

1. Start with the variable transformer turned all the way down to zero, the amplifier turned off, and its top cover still removed.
2. On the amplifier's circuit boards, locate resistors R147 and R247, and trim pots R131, R231, R139, R239, R140, and R240. To reach R147 on the ISA 750 and ISA 800T or R247 on the ISA 450 and ISA 500T, rotate the chassis module assembly and rest it on the heat sink so the bottom circuit board is accessible. Note that the trim pots for the bottom channel module are located on a small circuit board next to *Table 1*.

3. Plug the amplifier into the variable transformer.
4. Turn the gain controls all the way down.
5. Turn the amplifier on and gradually turn up the variable transformer to the amplifier's normal operating voltage while you monitor its AC current draw (it should not grossly exceed the idle current figures in Table 1). Make sure the amplifier is functioning correctly.

### Bias adjustment (perform only with unit at ambient temperature)

Note: This calibration must be done with the amplifier circuitry at ambient temperature. If the amp has begun to warm up, you must turn it off

Calibrations	Adjust	ISA 450 & ISA 500T	ISA 750 & ISA 800T
Channel 1 bias: DC voltage across R147	R131	0.12 V	0.07 V
Channel 2 bias: DC voltage across R247	R231	0.12 V	0.07 V
Output current into shorted load	Channel 1: R139 & R140 Channel 2: R239 & R240	4–5 A	8.5–9 A
AC current when driving shorted load*	Channel 1: R139 & R140 Channel 2: R239 & R240	4.5–5.5 A	5.5–6.5 A
Clipping voltage into 2 ohms (RMS)	Channel 1: Adjust R139 for symmetry Channel 2: Adjust R239 for symmetry	33.5–37.5 V	44–49 V
Clipping voltage into 2 ohms (peak)	Channel 1: Adjust R139 for symmetry Channel 2: Adjust R239 for symmetry	47.4–53 V	62.2–69.3 V
Idle AC demand* (at ambient temperature; higher when hot)		0.4 A, ±10%	0.6 A, ±10%

\*Figures shown are for 120V amplifiers; multiply current by 0.5 for 230V or by 1.2 for 100V.

and wait until it cools down to about room temperature.

6. Measure the DC voltage across R147. Adjust bias trimpot R131 to reach the correct voltage shown in Table 1.
7. Next, measure the DC voltage across R247. Adjust bias trimpot R231 to reach the correct voltage shown in Table 1.
8. Turn off the amplifier and reattach the channel module assembly and heat sink to the chassis.

### **Current limit adjustment**

Note: Read through these instructions before proceeding. To avoid tripping the amp's circuit breaker, work carefully but quickly, and don't run the amp too long at full power into 2 ohms. If you don't have the equipment to do this procedure properly, it is better to skip it and leave the current-limit trimpots as is than to risk misadjusting them.

9. Set the audio sine generator to 1 kHz at 1 volt RMS and connect it to channel 1's input. Connect channel 1's output to a 2-ohm load, and connect the oscilloscope probe across channel 1's output.
10. Turn the amplifier on. Turn up channel 1's gain control partway. On the oscilloscope you should see the amplitude of the sine wave increase accordingly.
11. Turn the gain control back down and apply a short circuit across the output terminals of channel 1. Clamp a current probe either onto one of the brown wires running to the AC switch or onto the gray output wire from channel 1's module.
12. Turn the gain control all the way up. Adjust trimpots R139 and R140 equally until the current measured falls within the range shown in Table 1.
13. Turn the gain control all the way down and remove the short circuit so the channel drives the 2-ohm load. Turn the gain control back up until the output clips. The voltage at which the signal starts to clip should fall within the range shown in Table 1. If the clipping is asymmetrical, that is, the signal clips on either the positive or negative side first, adjust R139 to make it symmetrical.
14. Turn the gain control down. If the amp has begun to warm up, shut it off and let it cool a few minutes before proceeding with channel 2.
15. Repeat steps 8 through 12 for channel 2. Use trimpots R239 and R240 to adjust the current limiting in steps 11 and 12.
16. Turn both channels' gain controls all the way down. Clamp the current probe onto one of the brown AC wires to check the amp's idle current. If the amplifier is still at about room temperature, the idle current should match the value shown in Table 1.

### **Finishing the repair**

17. Turn the amplifier off and disconnect all input and output cables.
18. Re-install the top cover. The amplifier can be returned to use.

## **Contact information**

If you need any further information regarding this service procedure, please contact QSC Technical Services at the addresses or numbers below.

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