

## **MMIC AMPLIFIER BIASING PROCEDURE**

- (1) To start, be sure to have the equipment you intend to use to bias the amplifier and that the amplifier is already in a fixture suitable for connection of DC voltages and RF, microwave, or millimeterwave cable connectors. Nothing should be connected yet. Be sure to use ESD procedures at all times as the devices are ESD sensitive. See the Hittite ESD Application Note page 8-2. For the device you intend to test you should have a complete current copy of the Hittite data sheet and be familiar with it.
- (2) This procedure assumes the amplifier under test is a part that requires a dual supply; a positive supply for the drain-source and a negative supply for the gate-source. If there are multiple gate controls it is assumed for this procedure that they are connected together. Use knob style voltage power supplies – not key pad entry types. The supplies should be used in a floating manner with no connection to the supply ground terminal.
- (3) Turn on power supplies and set both to zero volts – be sure to verify this by using a digital multi-meter. Measure the voltage between the plus and minus terminals of the power supplies since they are floating.
- (4) Connect the amplifier RF ports to the microwave test equipment. In some cases DC blocks may be required for the RF ports. Check the data sheet to verify if they are required.
- (5) Connect the minus terminal of the drain power supply to the amplifier ground and the positive terminal of the gate power supply to the amplifier ground.
- (6) Now connect the negative terminal of the gate power supply to the amplifier gate terminal. Connect the positive terminal of the drain power supply to the amplifier drain terminal. Note: at this point no current should be flowing since the voltage supplies are set to zero volts.
- (7) Increase the gate power supply voltage to a voltage sufficient to pinch off drain current. For a PHEMT this would typically be  $-1\text{V}$ . Note that “increasing the gate voltage” in this case causes a more negative voltage on the gate of the amplifier due to the way the gate power supply is connected to the amplifier. There is no “drain current” since the drain power supply is currently set to zero volts. Thus, you need to determine this voltage from the data sheet (typically  $+3$  to  $+4\text{V}$  for PHEMT). A small amount of gate current could be measured at this point due to gate leakage currents but they are only on the order of micro-amps.
- (8) Increase the drain power supply voltage to the desired drain operating voltage (per data sheet; typically  $+3$  to  $+4\text{V}$  for PHEMT). The drain current will still be in the micro-amp range since the gate power supply is pinching off the amplifier.
- (9) Finally, monitor the drain current while reducing the gate power supply voltage. Drain current will start to flow. Adjust the current to the level recommended on the data sheet.
- (10) If any oscillations are observed modify the test board to include 200 Ohm resistors in series with the gate line (or lines). These resistors should be placed as close as possible to the gate terminals of the amplifier.
- (11) A part that is damaged may have some of the following symptoms; high drain current that can't be changed by adjusting the gate voltage, no drain current, low or no gain, a voltage on either of the RF ports on a part that is DC blocked on the MMIC. If damage is suspected; review the data sheet, review the procedure to bias the amp, and review your assembly instructions vs. the assembly.