About the SA-12/100/20 and 220 Mosfets

With the exception of the SA-8, which used Japanese vertical-channel MOSFETs, all Counterpoint SA power amps use lateral-channel types. These types have low internal resistance (Rds[on]), which is useful for high-current applications, but they also have a positive thermal temperature coefficient (tempco) at low current level and are quite difficult to match for proper operation when paralleled.

Harris Semiconductor and International Rectifier RFM10N12, RFM10P12 (SA-100), RFM10N15 and RFM10P15 (SA-20/220) are examples of these kinds of parts. Data sheets for these parts can be found on the web with a Google search. There existed in the 1980's other equivalent parts we found to be suitable. 10 amp was my minimum acceptable current rating, and I used 120v parts for the lower powered amps (SA-12, SA-100) and 150-180v ratings for the higher power amps (SA-20, SA-220).

In order to successfully use these parts in parallel, "current hogging" must be avoided to assure that all the parts do equal work or overheat. So matching is absolutely essential. Here is the procedure used at Counterpoint to match these parts:

1. Heat each MOSFET to 70C and apply 70 volts from drain-to-source and measure how much gate voltage is needed to turn the fet on sufficient to pass 300mA.
2. Write this initial rough-match Vgs number on the part.
3. Mount pairs (for the smaller amps) or quads (for the larger amps) of devices with similar Vgs values to a single heatsink (important -- they must all be the same temperature).
4. The MOSFETs are connected in parallel with no source resistor, to simulate operation in an amplifier. Gate resistors of 1,000 ohm are used to prevent parasitic oscillations in the RF frequency range. 0.1 ohm resistors are in each MOSFET source connection to measure current, then to ground (power supply return) through a common 10-ohm source resistor.
5. Connect drains to a 70VDC power supply.
6. Apply 70 volts drain-source voltage to all the MOSFETs in the group.
7. Apply sufficient Vgs to turn the entire group on to 500mA. A simple DC feedback servo circuit is used to set the overall current by monitoring the voltage across the single 10 ohm shared source resistor. Five volts across the resistor indicates that 500mA is passing through the entire group.

8. Industrial resistive-element heaters and temperature-controls are used to heat the heatsink to 70 degrees C.
9. As the group of devices heats up monitor individual MOSFET source currents by measuring the voltage across their 0.1 ohm resistors. Some devices will be found that will want to pass most of the current ("current hog"), while others will shut down.
10. Replace the current hogs with new MOSFETs until a stable set is found where each device handles its share of the current (within 10%) for several hours.

This is a very difficult procedure and it generally requires a few thousand devices to come up with a few dozen sets.

Japanese-type MOSFETs have a negative tempco and can be used without careful matching but the amplifier's maximum output current capability will decrease because those types of MOSFETs have higher internal resistance. I am not aware of any Japanese parts in the appropriate TO-3 (TO-247) metal can package to fit the drilling on the amplifier heatsinks.

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