

OPERATING PRECAUTIONS FOR AMPLIFIERS (AN-60-008)

RF Amplifiers are designed to be reliable when operated under specified conditions. They find many applications because they provide maximum performance in characteristics such as frequency bandwidth, output power, and noise figure. To do this, amplifiers utilize high performance semiconductor components, which are sensitive and can be damaged if subjected to EOS (electrical overstress). This is particularly the case with multistage connectorized amplifiers, which are used as instrumentation or system components.

The risk of damage due to ESD (electrostatic discharge) is small in connectorized amplifiers, because a charged object would have to come into contact with the center conductor of the input or output connector. However, other sources of EOS can enter the amplifier by way of signal paths in the system. For example, the most frequent causes of user-induced failure in ZHL-series amplifiers are (a) excessive power applied to the input, and (b) improper sequencing of load connection - DC voltage - RF signal. The locations of the resulting damage — burned out first or last stage, respectively — have been observed with equal probability. Another possible cause of EOS failure is excessive steady state or momentary voltage applied to the DC terminal.

Several of the recently introduced high power amplifiers such as the LZY and ZVE series have some or all of the following self-protecting features:

- Protection from transients caused by shorting and unshorting the DC terminal to the case.
- Reversible shut-down of output stage at high RF input power.
- Over-temperature shut-down with automatic recovery.
- Immunity to reverse-polarity DC.
- Immunity to a limited-time short at the output, or immunity to load connection and disconnection, with DC and full RF input applied.

It must be emphasized, however, that excessive power applied to the input of an amplifier will damage the input stage even in models which have internal protection for the later stages. Most amplifiers having large-size cases are marked with a caution as a reminder to users:

Do not exceed (specified power in dBm) at input

ZHL-series amplifiers are additionally marked with directions:

To connect:

- 1. Connect output load**
- 2. Apply DC voltage**
- 3. Apply RF input**

To disconnect:

- 1. Remove RF input**
- 2. Remove DC voltage**
- 3. Remove load**

Precautions against EOS are particularly important when high voltage or high power devices are used, such as when loading a semiconductor-based amplifier with a TWT (traveling wave tube). Signals and DC transients might be conducted into the RF input and output ports or the DC terminal, and radiated RF signals can enter through housing seams.

Finally, a word about applying pulsed signals: Mini-Circuits RF amplifiers operate in Class A; their maximum power ratings are generally based upon instantaneous voltage or current limitations of internal components. Therefore, amplifier ratings must be applied to the peak power of pulsed signals rather than the average power.

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