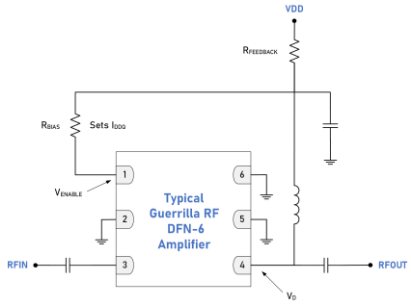
Application Note

Customizing an Amplifier's P_{SAT} Output Level

AN005

In an RF lineup with two amplifier stages (driver and final), there are times when you want to limit the saturated output power (P_{SAT}) of the driver stage. This might be to protect the input of the final amplifier from being damaged.



Often the problem is solved by selecting a device with the desired P_{SAT} characteristic. When such a device can't be found, there is a simple, but effective, way to limit P_{SAT} by using resistive feedback. The feedback resistor is placed in series with the driver amplifier power supply. Note that this effort to limit driver Psat assumes that linearity is not a concern.

Using a typical Guerrilla RF DFN-6 device schematic as a reference (see schematic above):

- The voltage input to pin 1 sets the device quiescent current (I_{DDQ}). This pin 1 voltage is generated by the chosen V_{ENABLE} voltage and an external bias resistor (R_{BIAS}).
- Inserting $R_{FEEDBACK}$ in series with V_{DD} is key to limiting the P_{SAT} of the device. A typical driver amplifier will tend to self-bias (I_{DDQ} increases) as the device approaches the 1-dB compression point (OP1dB) and P_{SAT}.
- The feedback works as follows: With increasing I_{DD} (caused by self-biasing), the voltage drop across $R_{FEEDBACK}$ increases. Since R_{BIAS} is tied to this node at the low end of $R_{FEEDBACK}$, the V_{ENABLE} voltage at pin 1 also drops as I_{DD} increases. As the voltage at pin 1 drops, device current lowers, thus counteracting the self–biasing effect. V_{DD} also drops, thus further limiting the device P_{SAT}.
- The net result of this resistive feedback is that the P_{SAT} of the driver can be controlled over a wide range depending on the value of the feedback resistor chosen.
- Additional benefits: This technique also tends to limit I_{DDQ} variation of the device over process and temperature. For pHEMT devices, I_{DDQ} variation can be quite large at around +/-20%, so resistive feedback is especially useful. Furthermore, gain and NF are largely unaffected by the inclusion of $R_{FEEDBACK}$.

Do you need help solving a problem in your RF lineup? Guerrilla RF is committed to providing the high performance RF solutions you need and we are pleased to provide the applications support necessary to successfully implement any of our devices. Just send us your RF specifications and we will do our best to provide a solution to address your requirements.

Contact us at applications@guerrilla-rf.com!

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Revision History

Revision	Date | Reason for Revision
Initial Release	September 1, 2020