



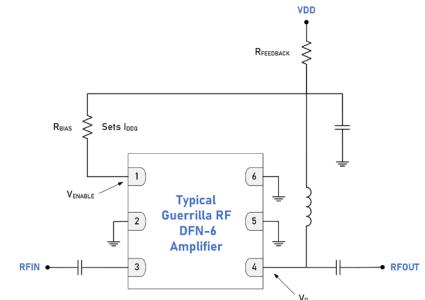
# Application Note

## 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  $P_{SAT}$  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  $\pm 20\%$ , 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](mailto:applications@guerrilla-rf.com)!

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APPLICATION NOTE

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## Revision History

Revision	Date   Reason for Revision
Initial Release	September 1, 2020