



# Application Note

## Capitalizing on the Design Flexibility of Common Footprint DFN-6 Packages

### AN003

At Guerrilla RF, we are constantly adding to our portfolio of 1.5 mm DFN-6 devices. Currently, there are more than 20 amplifier devices in this family - offering a wide variety of gain, NF, linearity and bypass options.

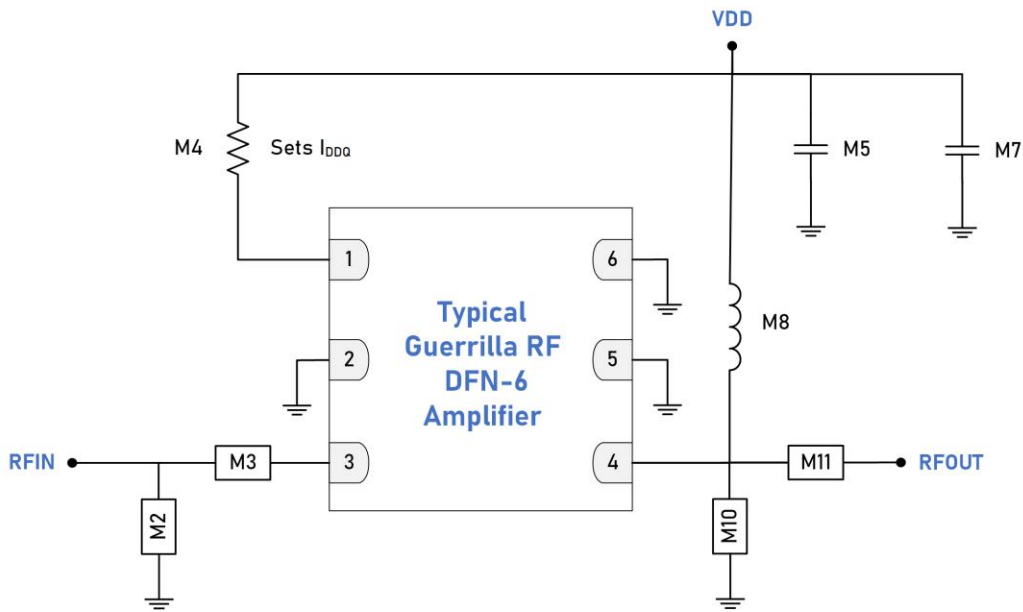
Why do we put so many of our amplifiers into the same package? Simple. **It provides our customers with maximum design flexibility.** Common packaging means common board layout and common application schematics. The DFN-6 is a leadframe based package known for high reliability, a factory-friendly MSL1 rating and RoHS compliance.

When your specs change - and you know they will - just select a new device from the library which more closely matches the new requirements without needing to re-layout your system board. Now that's flexibility!

Below is a list of our devices currently using this common package and pinout:

Device	Reference V/mA/GHz	Gain (dB)	NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Tuning Range (volts)	VDD Range (Volts)	IDDQ Range (mA)	Comments
GRF2003	5.0/55/5.5	12.0	3.5	15.0	29.0	0.1 to 10.0	2.7 to 5.0	40 to 80	
GRF2004	5.0/100/4.0	16.5	1.9	18.0	31.0	0.1 to 10.0	2.7 to 5.0	60 to 120	
GRF2012	5.0/90/0.9	14.8	2.7	23.0	40.0	0.05 to 3.8	2.7 to 5.0	15 to 100	
GRF2013	5.0/90/1.9	18.5	1.3	22.5	38.5	0.05 to 8.0	2.7 to 5.0	15 to 100	
GRF2014	5.0/150/0.9	15.9	3.4	24.0	43.5	0.05 to 3.8	2.7 to 5.0	50 to 180	
GRF2093	5.0/70/2.5	21.0	0.38	19.0	36.0	1.0 to 6.0	2.7 to 5.0	20 to 100	
GRF2100	3.3/15/2.5	16.5	0.8	10.0	19.0	0.1 to 3.8	1.8 to 5.0	8 to 30	
GRF2105	5.0/70/2.5	20.5	0.75	22.5	37.0	0.4 to 5.0	2.7 to 5.0	20 to 90	
GRF2106	3.3/15/2.5	16.5	0.8	12.0	26.0	0.1 to 4.2	1.8 to 5.0	10 to 40	
GRF2133	5.0/60/1.9	28.5	0.65	20.0	31.0	0.1 to 2.7	2.7 to 5.0	35 to 160	
GRF2140	3.3/15/1.9	18.0	1.1	9.3	20.0	0.1 to 3.8	1.8 to 5.0	8 to 30	Bypass Mode
GRF2373	3.3/15/1.9	18.5	1.3	13.5	25.0	0.1 to 3.8	2.7 to 5.0	10 to 25	
GRF2374	3.3/15/1.9	16.5	1.3	10.0	22.0	0.1 to 3.8	2.7 to 5.0	10 to 25	Bypass Mode
GRF2505	5.0/40/5.5	12.5	1.2	19.0	30.0	4.0 to 6.0	1.8 to 5.0	20 to 60	
GRF4001	3.3/45/2.5	15.5	0.9	16.5	30.5	0.1 to 6.0	1.8 to 3.6	15 to 50	
GRF4002	5.0/70/1.9	17.5	0.8	23.5	36.0	0.1 to 3.8	1.8 to 5.0	20 to 80	
GRF4003	5.0/95/1.9	15	0.8	24.5	41.0	0.1 to 3.8	1.8 to 5.0	20 to 120	
GRF4004	5.0/135/1.9	14.5	0.8	26.0	43.0	0.1 to 3.8	1.8 to 5.0	30 to 150	
GRF4005	5.0/170/1.9	15.0	0.8	26.5	42.0	0.1 to 3.8	1.8 to 5.0	50 to 200	
GRF4014	5.0/60/2.5	16.5	0.8	24.3	39.0	0.1 to 6.0	2.7 to 8.0	30 to 120	
GRF4142	3.3/50/1.9	15.3	0.9	19.3	33.0	0.1 to 3.8	1.8 to 5.0	15 to 80	Bypass Mode

\* Coming Soon!



The above application schematic can accommodate virtually every device in this group over most frequency bands. New DFN-6 parts are being added to this family every month.

The Guerrilla RF applications engineering team is ready to assist you with custom matching, schematics, data collection and BOM recommendations. Contact us at [applications@guerrilla-rf.com](mailto:applications@guerrilla-rf.com) with any questions!

### Design Examples

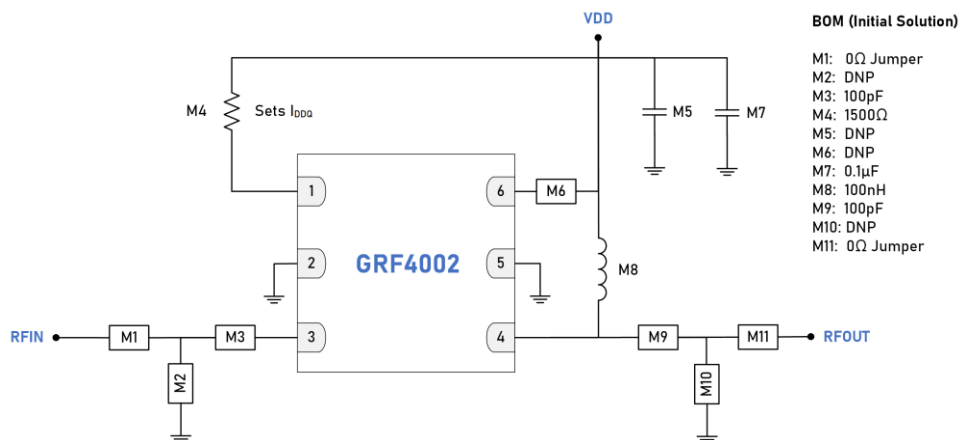
The following examples provide a practical demonstration of the design capability offered by this portfolio:

#### Initial Performance Requirement

- Frequency:** 2500 MHz
- Gain:**  $\geq 14.0$  dB
- Max. NF:**  $\leq 1.0$  dB
- OP1dB:**  $\geq 21.0$  dBm
- OIP3:**  $\geq 32.0$  dBm
- I<sub>ddq</sub>:**  $\leq 80$  mA
- V<sub>dd</sub>:** 5.0 V
- Bypass Capability:** No

#### Initial Solution:

- GRF4002**
- Gain:** 15.0 dB
- NF:** 0.85 dB
- OP1dB:** 23.5 dBm
- OIP3:** 34.0 dBm
- I<sub>ddq</sub>:** 70 mA
- Bypass:** No



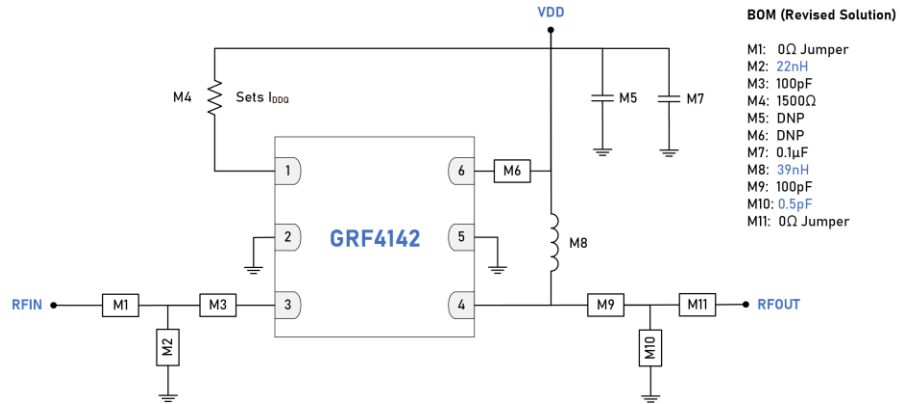
- BOM (Initial Solution)**
- M1: 0Ω Jumper
  - M2: DNP
  - M3: 100pF
  - M4: 1500Ω
  - M5: DNP
  - M6: DNP
  - M7: 0.1μF
  - M8: 100nH
  - M9: 100pF
  - M10: DNP
  - M11: 0Ω Jumper

For the given initial requirements, [GRF4002](#) has proven to be an excellent solution. But let's say the system dynamic range requirements change and it is determined that your LNA must offer a low-loss bypass capability which GRF4002 does not provide; the other RF requirements remain unchanged. Luckily, thanks to the breadth of the Guerrilla RF DFN-6 portfolio, a drop-in solution to the new requirement exists and it is called [GRF4142](#).

**Revised Solution with Bypass:**

**GRF4142**

- Gain:** 14.5 dB
- NF:** 0.95 dB
- OP1dB:** 22.5 dBm
- OIP3:** 33.0 dBm
- Iddq:** 70 mA Bypass: Yes



The example above showed how a completely new performance capability (bypass) could be accommodated by a single layout using the Guerrilla RF DFN-6 layout and general purpose schematic. The need to revise the layout for a new part/package was avoided.

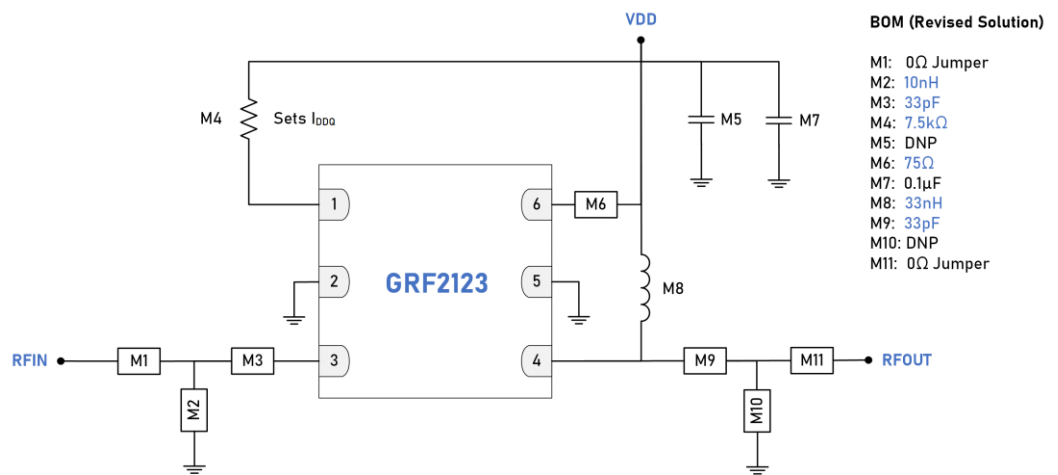
Following is an example of how this same layout can be used for a different frequency band, with significantly different RF performance targets. For this example, the goal is to find a single, ultra-high gain LNA to reduce a cascaded lineup of two amplifiers — down to a single device for cost and layout purposes.

**Performance Requirements:**

- Frequency:** 1900 MHz
- Gain:** >= 26.0 dB Max.
- NF:** <= 1.0 dB
- OP1dB:** >= 18.0 dBm
- OIP3:** >= 30.0 dBm
- Iddq:** <= 80 mA
- Vdd:** 5.0 V
- Bypass Capability:** No

**Solution: GRF2133**

- Gain:** 28.0 dB
- NF:** 0.6 dB
- OP1dB:** 20.0 dBm
- OIP3:** 31.0 dBm
- Iddq:** 60 mA



Regardless of your application requirements, the Guerrilla RF applications engineering team is happy to help recommend the optimal solution for you. Contact us at [applications@guerrilla-rf.com](mailto:applications@guerrilla-rf.com) with any questions!

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## Revision History

Revision	Date   Reason for Revision
Initial Release	September 1, 2020