GUERRILLA RF

RICHARDSON RFPD – 5G INFRASTRUCTURE

SEPTEMBER 2019

INFRASTRUCTURE LNAS:

207X/208X Families:

- Industry leading NF, gain and linearity over 0.4 – 6.0 GHz.
- GRF208X adds digital shutdown functionality
- Flexible biasing with Vdd = 3 - 5 V and Iddq = 20 - 100 mA.
- Industry Standard Package/Pinout: 2.0 x 2.0 mm DFN-8
- Tunable Frequency Coverage:
  - GRF2070/80: 100 to 1500 MHz
  - GRF2071/81: 700 to 2700 MHz
  - GRF2072/82: 1500 to 3800 MHz
  - GRF2073/83: 2000 to 6000 MHz

INFRASTRUCTURE LNA: MEASURED RESULTS

Device	Function	Frequency Range (GHz)	Ref Freq (GHz)	Gain (dB)	EVB NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Bias V/mA	Package (mm)
GRF2051	Ultra-LNA	0.7 – 3.8	1.9	19.2	0.37	21.4	39.0	5.0/70	2.0 X 2.0 QFN-12
GRF2052	Ultra-LNA	1.5 – 4.5	2.5	19.2	0.49	19.7	38.0	5.0/70	2.0 X 2.0 QFN-12
GRF2070 GRF2080	Ultra-LNA	0.1 – 1.5	0.9	20.8	0.35	20.0	39.5	5.0/75	2.0 X 2.0 DFN-8
GRF2071 GRF2081	Ultra-LNA	0.7 – 2.7	1.9	19.0	0.37	21.4	38.0	5.0/55	2.0 X 2.0 DFN-8
GRF2072 GRF2082	Ultra-LNA	1.5 – 3.8	2.5	19.0	0.50	19.7	37.0	5.0/55	2.0 X 2.0 DFN-8
GRF2073 GRF2083	Ultra-LNA	2.0 – 6.0	3.6	18.9	0.69	18.5	36.5	5.0/70	2.0 X 2.0 DFN-8
GRF2093 **NEW!**	Ultra-LNA Sampling Now	1.0 – 6.0	2.5	21.0	0.38	19.0	36.0	5.0/70	1.5 X 1.5 DFN-6
GRF2171 **NEW!**	High Gain Ultra-LNA Sampling Now	1.0 – 6.0	3.6	29.5	0.75	19.0	41.0	5.0/75	1.5 X 1.5 DFN-6

NEW FOR 2019 BALANCED INFRASTRUCTURE LNAS:

GRF2078/2079:

- Industry leading NF, gain and linearity over 0.4 – 4.9 GHz.
- GRF2079 has higher gain than GRF2078
- Flexible biasing with Vdd = 3 - 5 V and Iddq = 40 - 200 mA.
- Industry Leading Compact Package/Pinout: 3.0 x3.0 mm QFN-16
- Performance snapshot:

Device	Function	Frequency Range (GHz)	Ref Freq (GHz)	Gain (dB)	EVB NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Bias V/mA	Package (mm)
GRF2078	Balanced Ultra-LNA	0.4 – 3.8	2.0	18.1	0.6	23.7	40.7	5.0/130	3.0 X 3.0 QFN-16
GRF2079	Balanced Ultra-LNA	1.5 – 4.9	2.7	19.0	0.8	22.5	39.5	5.0/130	3.0 X 3.0 QFN-16

NEW FOR 2019 INGAP HBT POWER AMPLIFIERS:

Saturated PAs for 900 and 450 MHz Applications:

- **GRF5504/GRF5509:** 36 dBm Pout with efficiency approaching 60%.
  - Optimized for 450 and 900 MHz applications respectively
  - Sampling now

Ultra-high Linearity PA/Driver:

- **GRF4205:** 50 dBm OIP3 at 2GHz
  - Tuning range: 400 to 3000 MHz
  - Sampling now

Cellular Booster/Repeater PA's:

- **GRF5507/5508/5517/5518/5519/5521:** 26dBm linear Pout meeting -19dBm IM3 FCC requirement
  - Internally matched 50Ω modules: 700 to 2170 MHz
  - Sampling early 2019

Ultra-rugged, high-power amplifiers:

- In development now using high-voltage HBT process
- Broadband gain blocks and >10 Watt PA devices
- Frequency range: near DC to 2700 MHz
- Sampling early 2019

SATURATED POWER AMPLIFIERS:

GRF5504:

- 2-stage InGaP HBT with on-die 2FO termination
- Flexible Vcc: 3.0 to 5.0 volts;
- Reference: 450 MHz, Vcc: 5.0V; Iccq: 120 mA
- Small-signal Gain: 40 dB
- Saturated Pout: CW 37.0 dBm at 60% efficiency
- 3.0 x 3.0 QFN-16

IN PRODUCTION NOW!
SAMPLES & EVBS AVAILABLE!

GRF5509:

- 2-stage InGaP HBT with on-die 2FO termination
- Flexible Vcc: 3.0 to 5.0 volts
- Reference: 915 MHz, Vcc: 5.0V; Iccq: 120 mA
- Small-signal Gain: 33 dB
- Saturated Pout: CW 37.0 dBm at 58% efficiency
- 3.0 x 3.0 QFN-16

LINEAR CELLULAR BOOSTER/REPEATER PAS:

GRF55XX Family:

- **Internally-matched 3.5 x 3.5 mm QFN modules with flexible Vcc and Iccq:**
- **GRF5507: 699 to 798 MHz**
- **GRF5508: 824 to 894 MHz**
- **GRF5510: 880 to 960 MHz**
- **GRF5517: 1710 to 1785 MHz**
- **GRF5518: 1805 to 1910 MHz**
- **GRF5519: 1920 to 1990 MHz**
- **GRF5521: 2110 to 2170 MHz**
- **GRF5526: 2500 to 2700 MHz (in development)**

NEW – GRF54XX FAMILY
EXTERNALLY MATCHED PA FAMILY
AVAILABLE IN 3MM X 3MM QFN
SAMPLING/PRODUCTION Q4 2019

SAMPLING NOW
PRODUCTION 1H 2020

- **Referencing GRF5508:**
  - Meets FCC -19 dBm IM3 requirement at 26.0 dBm composite Pout
  - Small-signal Gain: 31.3 dB at mid band
  - OP1dB: 31.6 dBm at mid band
- **Referencing GRF5518:**
  - Meets FCC -19 dBm IM3 requirement at 26.5 dBm composite Pout
  - Small-signal Gain: 27.0 dB at mid band
  - OP1dB: 32.3 dBm at mid band

Power-LNA™ Family: HIGH POWER LNA/DRIVER AMPLIFIERS

- Low Noise / Linear Drivers offered in both 3x3 mm QFN-16
- Industry leading performance:
  - EVB NF < 0.9 dB
  - OP1dB to 31.0 dBm (GRF5020 at Vdd: 10.0 volts)
  - OIP3 values up to 47.0 dBm
- Single external match covers wide bandwidth
  - GRF5010: 1700-3800 MHz
  - GRF5020: 1700-2700 MHz
- Tuning Range: 100-6000 MHz
- Flexible biasing with Vdd = 4.5 - 10 V

GRF5010

Freq: (MHz)	Gain (dB)	EVB NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Bias (V/mA)
2500	18.0	0.80	24.3	40.0	5.0/80
2500	18.3	0.82	28.0	45.0	8.0/130

GRF5020

Freq: (MHz)	Gain (dB)	EVB NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Bias (V/mA)
2500	17.0	0.77	24.7	44.0	5.0/110
2500	17.5	0.79	29.0	47.0	8.0/170

PA / PA DRIVERS:

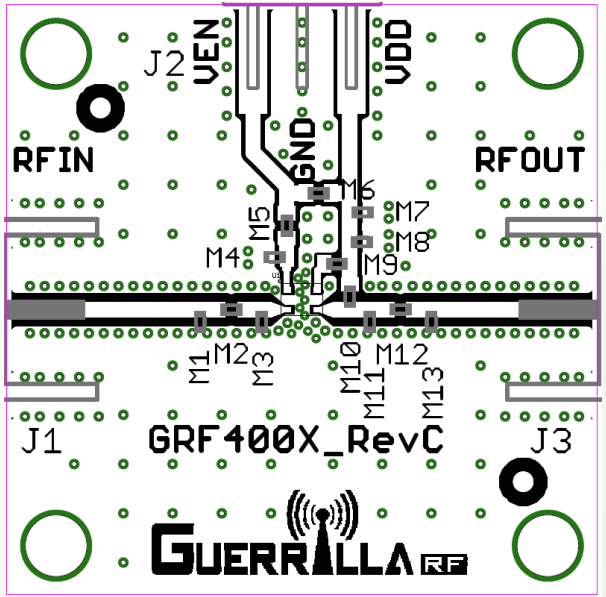
Device	Function	Frequency Range (GHz)	Ref Freq (GHz)	Gain (dB)	EVB NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Bias V/mA	Package (mm)
GRF5109	PA / Power-LNA™	0.4 – 1.5	0.9	17.9	1.2	28.3	45.0	5/170	3.0 X 3.0 QFN-16
GRF5110	PA / Power-LNA™	1.5 – 2.7	1.9	14.8	1.3	28.8	45.0	5/170	3.0 X 3.0 QFN-16
GRF5115	PA / Power-LNA™	0.1 – 2.7	1.9	14.4	1.3	32.5	45.7	5/300	3.0 X 3.0 QFN-16
GRF5511	PA / Power-LNA™	1.5 – 6.0	5.5	16.0 15.8	2.6 2.5	29.5 26.2	48.0 43.0	8/160 5.0/90	3.0 X 3.0 QFN-16

- All In Production Now!

GRF 1.5 MM DFN-6 PORTFOLIO

The following slides highlight this growing family of devices offering a wide range of NF, linearity and gain options, all with flexible biasing and using a common evaluation board/layout:

- GRF2003
- GRF2004
- GRF2012
- GRF2013
- GRF2014
- GRF2093
- GRF2100
- GRF2105
- GRF2103
- GRF2106
- GRF2133
- GRF2140
- GRF2373
- GRF2374
- GRF3042
- GRF3044
- GRF4001
- GRF4002
- GRF4003
- GRF4004
- GRF4005
- GRF4014
- GRF4100
- GRF4142



LOW NOISE, LINEAR AMPLIFIERS: MEASURED RESULTS

Device	Function	Frequency Range (GHz)	Ref Freq (GHz)	Gain (dB)	NF (dB)	OIP3 (dBm)	OP1dB (dBm)	Bias V/mA	Package (mm)
GRF2114 NEW!	Broadband, Ultra-linear, LNA	0.1 – 2.7	0.83	17.9	0.93	40.2	24.3	5.0/135	2.0 X 2.0 DFN-8
GRF2133	Broadband, Ultra-high gain, LNA	0.1 – 2.7	1.95	28.4	0.65	30.0	21.8	5.0/60	1.5 x 1.5 DFN-6
GRF4001	Broadband Driver/LNA	0.05 – 6.0	2.5	15.7	1.0	31.0	19.4	5.0/45	1.5 x 1.5 DFN-6
GRF4002	Broadband Driver/LNA	0.05 – 3.8	2.5	15.5	0.85	37.0	23.0	5.0/70	1.5 x 1.5 DFN-6
GRF4003	Broadband Driver/LNA	0.05 – 3.8	2.5	13.0	0.80	41.0	25.5	5.0/95	1.5 x 1.5 DFN-6
GRF4004	Broadband Driver/LNA	0.05 – 3.8	2.5	12.7	0.85	44.0	26.0	5.0/135	1.5 x 1.5 DFN-6
GRF4005	Broadband Driver/LNA	0.05 – 3.8	2.5	12.3	0.85	46.0	27.0	5.0/175	1.5 x 1.5 DFN-6
GRF4014	Broadband Driver/LNA	0.05 – 3.8	2.5	17.0	0.80	38.0	24.8	5.0/65	1.5 x 1.5 DFN-6

BROADBAND, LINEAR LNA WITH BYPASS:

GRF4042 – Low-loss bypass and shutdown
GRF4142 – Low-loss bypass with single control input

- Outstanding gain, NF and linearity w/ low loss bypass function from 0.7 – 2.7 GHz

- Excellent broadband performance
  - Internally pre-matched to 50Ω
  - Minimal external components
  - Bypass mode insertion loss typically 1.5 dB

  - **GRF4042:** Exceptional Shutdown-State isolation yields very low S(2,1) of -35 dB typical even with high RF input power of +15 dBm

- Flexible Biasing
  - Vdd = 1.8 - 5.0 V
  - Iddq = 20 - 100 mA: Iddq can be set independently from Vdd

- Package: **GRF4042:** 2.0 x 2.0 mm QFN-12; **GRF4142:** 1.5 x 1.5 mm DFN-6

GRF201X: HIGH LINEARITY GAIN BLOCKS

- Outstanding linearity and gain: 0.05 – 8.0 GHz
- Internally matched to 50Ω; Minimal external components.
- High Vdd capability supports high broadband P1dB and Psat.
- Internal, active bias with flexible Vdd and Iddq.
- Growing family of 1.5 mm DFN-6 devices with varying linearity and gain steps.

Device	Function	Frequency Range (GHz)	Reference Freq (GHz)	Gain (dB)	NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Bias V/mA	Vdd Range	Package (mm)
GRF2011 **NEW!**	High Linearity Gain Block	0.05 - 5.0	2.5	15.2	2.0	22.7	40.0	5.0/90	3.0 to 5.0	1.5 x 1.5 DFN-6
GRF2012	High Linearity Gain Block	0.05 - 5.0	2.5	15.2	2.5	22.7	40.0	5.0/90	3.0 to 5.0	1.5 x 1.5 DFN-6
GRF2013	High Linearity Gain Block	0.05 – 8.0	2.5	17.8	1.3	23.2	39.0	5.0/90	3.0 to 5.0	1.5 x 1.5 DFN-6
GRF2014	High Linearity Gain Block	0.05 – 3.8	0.9	15.9	3.3	24.2	43.5	5.0/165	3.0 to 5.0	1.5 x 1.5 DFN-6

NEW! ULTRA-LINEAR MIXER:

GRF7001

- Passive mixer with integrated LO Buffer (0dBm LO drive power)
- Excellent replacement for EOL CMY-210 mixer
- IF/RF Tuning range: 0.01 to 5 GHz; LO Range: 0.1 to 4GHz
- Reference: RF=808 MHz, LO=965MHz, IF=157MHz; Vdd=3V, Idd=10mA
  - Conversion Loss: 6 dB
  - OP1dB: >17 dBm
  - OIP3: 25 dBm
  - SSB NF: 7.1dB
- 1.5 x 1.5 mm DFN-6 package

IN PRODUCTION NOW!

FAILSAFE DEVICES:

GRF6011: SPDT Failsafe Switch

- Linear, low-loss performance under switched operation
- Failsafe (no input voltage):
  - Path 1: Low insertion loss
  - Path 2: High insertion loss
- Simple application schematics with low external part count
- Package: 1.5 x 1.5 mm DFN-6

NEW GRF2077: Linear LNA with Bypass and Failsafe Modes

- Broadband internally matched with high gain and sub 1.0 dB NF
- Low-loss, linear bypass and failsafe (no input voltage) modes
- Package: 1.5 x 1.5 mm DFN-6