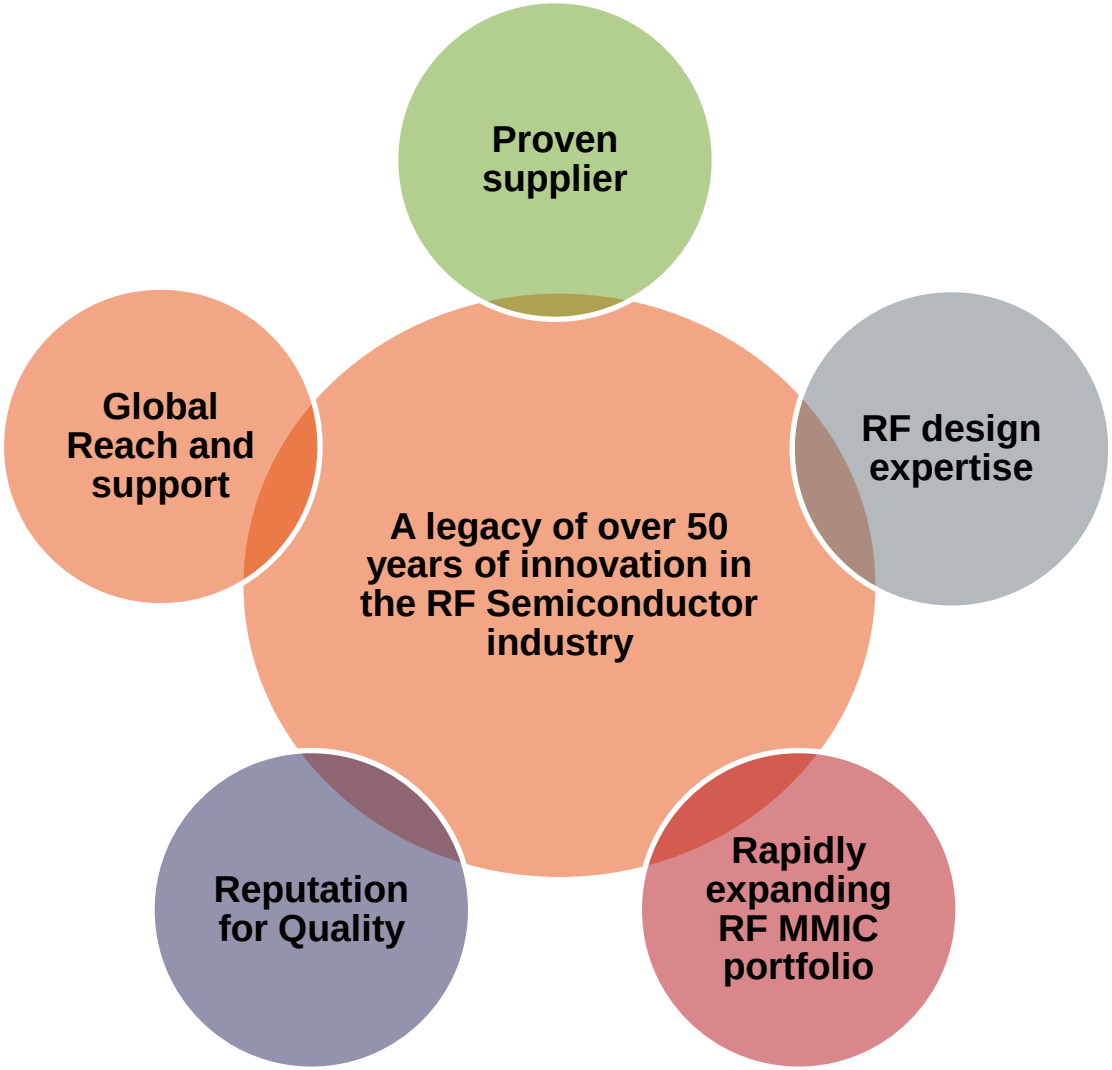
GaAs MMICs for Femtocell

May 2012

Outline

- Why Freescale?
- Linear and low noise amplifier markets and applications
- Linear and low noise amplifier selector guides
- Femtocell reference design
- Support resources

Why Freescale?



Freescale Global Presence

Freescale Tempe

Design, Packaging, Semiconductor Technology, Engineering, Reliability Marketing, Modeling Application, System

Tempe, Arizona

Freescale Oak Hill

8" Wafer Fab

Austin, Texas

Freescale Toulouse

Design, Engineering Marketing, Modeling Applications, System

Toulouse, France

Freescale Chengdu
Design Center

Freescale Kuala Lumpur Final Mfg

Kuala Lumpur, Malaysia

Freescale Tianjin
Final Mfg
Tianjin, China

Freescale Tokyo
Marketing, Application

Freescale Seoul
Marketing, Application

Freescale Shanghai
Marketing, Applications

Linear Amplifier Markets and Applications

- Enterprise WiFi AP and Backhaul
- Repeaters
- Wireless Applications
- Mesh Networking
- Femtocell and Picocell

Cellular BTS

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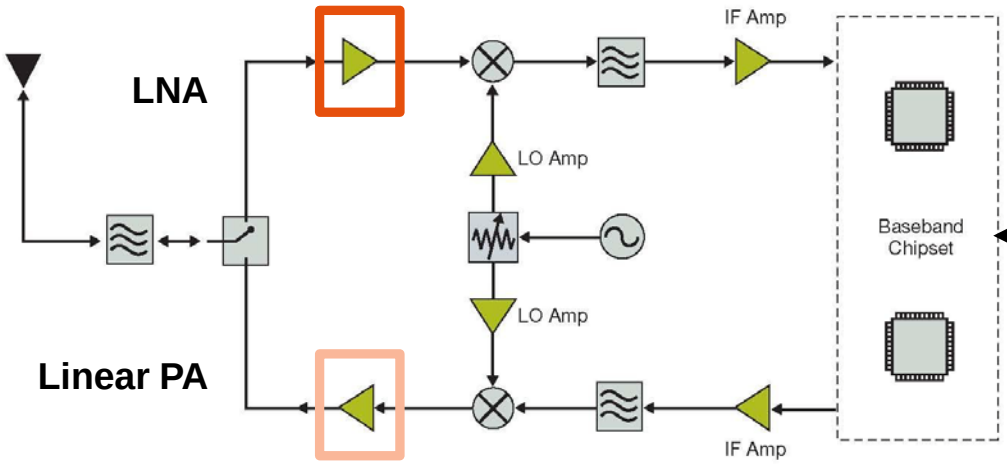
Where Do Linear PAs and LNAs Live?

Air Interface:

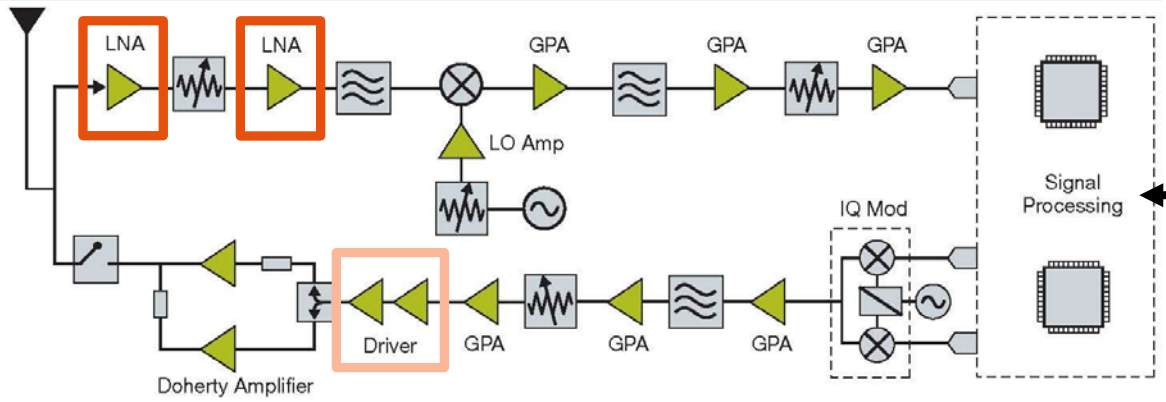
- LTE FDD/TDD
- WCDMA (HSPA+)
- CDMA2K
- TD-SCDMA
- WiMAX

Femtocell



QorIQ Qonverge PSC9131/9132

Macro BTS & Backhaul TXCVR



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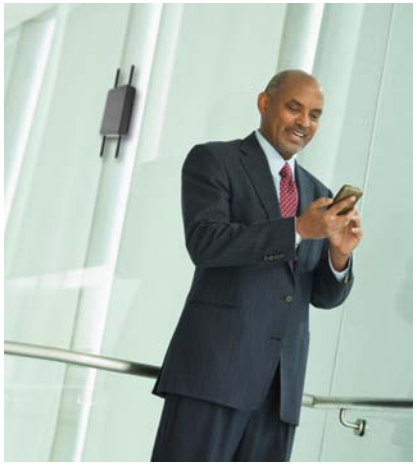
Linear Power Amplifier Challenges



Efficiency and linearity trade-off

- Linearity is mandated by the FCC and is characterized as Adjacent Channel Power Ratio (ACPR)
- Low quiescent current

Multiband & multiprotocol operation with the same device

- Bandwidths exceeding 100 MHz

Consistent performance over temperature

- Flat OIP3 over temperature

Robustness

- Ability to handle input overdrive
- Class 1B to 3A ESD - HBM
- 10:1 voltage standing wave ratio (MMZ25332B)

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Femtocell Linear Amplifier Portfolio

700 – 1000 MHz	1800 – 2200 MHz	2300 – 2700 MHz
Final PA	Final PA	Final PA
2-Stage GaAs HBT MMIC	2-Stage GaAs HBT MMIC	2-Stage GaAs HBT MMIC
MMZ09312B	MMA20312BV	MMZ25332B
V_{CC} = 3–5 V 	V_{CC} = 3–5 V 	V_{CC} = 3–5 V 
I_{CQ} = 74 mA	I_{CQ} = 70 mA	I_{CQ} = 390 mA
P1dB = 29.6 dBm	P1dB = 30.5 dBm	P1dB = 33 dBm
Pavg = 19 dBm	Pavg = 17 dBm	Pavg = 22 dBm (W-CDMA)
ACPR = -50 dBc	ACPR = -50 dBc	ACPR = -50 dBC
W-CDMA & LTE compliant	W-CDMA & LTE compliant	W-CDMA, LTE & WiFi compliant

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Freescale Linear Amplifiers: Features and Competitive Advantages

Features

- 400 MHz up to 2800 MHz bandwidths
- Single positive voltage supply 3–5 V
- Versatile across multiple applications and frequency bands
- Excellent gain flatness and dynamic range
- Good linearity versus efficiency trade-off
- Low external circuit component count
- Gains ranging from 26 to 31.7 dB

Competitive Advantages

- Superior Quality
- Ease of use
- Superior ESD & VSWR handling and overdrive capability
- Highly linear amplifiers based on InGaP HBT
- Low thermal resistance
- Stable performance over temperature
- P1dB ranging from 29.6 to 33 dBm
- High reliability
- Secure supply chain
- World-class global sales and applications support

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Linear Amplifier Product Selector Guide

Applications

- WLAN (IEEE® 802.11 b/g/n), WiMAX, LTE, GSM/EDGE, W-CDMA/HSPA, CDMA/EVDO, TD-SCDMA
- Smart Energy (IEEE® 802.15.4 ZigBee®)
- Small-cell transmitters (femtocell, picocell)

High-Performance Amplifiers

Part Number	Frequency Range (MHz)	Test Frequency (MHz)	Small Signal Gain (dB)	Gain Stages	P1dB (dBm)	OIP3 (dBm)	Supply Voltage (V)	Supply Current (mA)	Package
MMZ09312B(1)	400–1000	900	31.7	2	29.6	42	3–5	74	QFN 3×3
MMA25312B(1)*	2300–2700	2500	25.5	2	30	43	3–5	80	QFN 3×3
MMA20312BV	1800–2200	2140	27.2	2	30.5	44.5	3–5	70	QFN 3×3
MMA20312B	1800–2200	2140	27.2	2	30.5	44.5	5	70	QFN 3×3
MMZ25332B(1)	1800–2800	2500	26.5	2	33	48	3–5	390	QFN 3×3

(1) On chip power detector * Preliminary Data

UMTS Frequency Bands

Operating Band	Frequency Band (MHz)	UL (User Tx) Frequency Range (MHz)	DL (User Rx) Frequency Range (MHz)	Recommended Product
I	2100	1920–1980	2110–2170	MMA20312BV/MMZ25332B
II	1900	1850–1910	1930–1990	MMA20312BV/MMZ25332B
III	1800	1710–1785	1805–1880	MMA20312BV/MMZ25332B
IV	1700	1710–1755	2110–2155	MMA20312BV/MMZ25332B
V	850	824–849	869–894	MMZ09312B
VI	800	830–840	875–885	MMZ09312B
VII	2600	2500–2570	2620–2690	MMZ25312B/MMZ25332B
VIII	900	880–915	925–960	MMZ09312B
IX	1700	1749.9–1784.9	1844.9–1879.9	MMA20312BV/MMZ25332B
X	1700	1710–1770	2110–2170	MMA20312BV/MMZ25332B
XI	1500	1427.9–1447.9	1475.9–1495.9	–
XII	700	698–716	728–746	MMZ09312B
XIII	700	777–787	746–756	MMZ09312B
XIV	700	788–798	758–768	MMZ09312B

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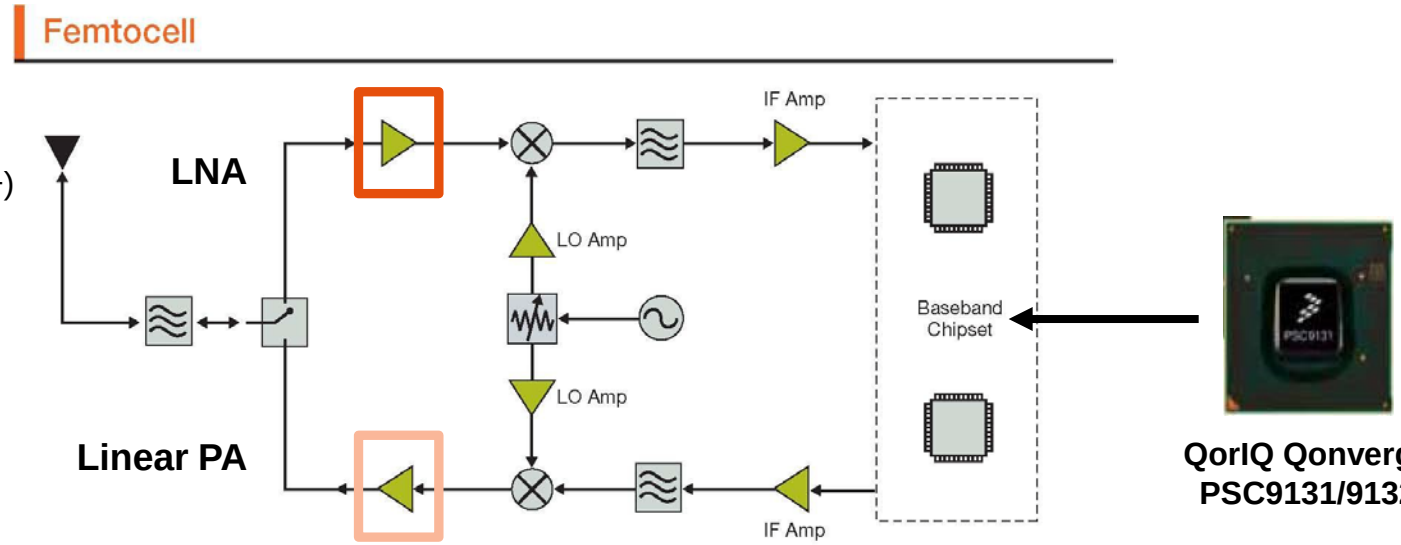
Femtocell Low Noise Amplifier Portfolio

	700 – 1000 MHz	1800 – 2200 MHz	2300 – 2700 MHz
LNA	Single Stage: MML09211H NF = 0.52 dB Gain = 21.3 dB P1dB = 22 dBm OIP3 = 32.6 dBm	Single Stage: MML20211H NF = 0.65 dB Gain = 18.6 dB P1dB = 21.3 dBm OIP3 = 33 dBm	Single Stage: MML20211H NF = 0.85 dB Gain = 18.1 dB P1dB = 19.6 dBm OIP3 = 33 dBm

Air Interface:

- LTE FDD/TDD
- WCDMA (HSPA+)
- CDMA2K
- TD-SCDMA
- WiMAX



QorIQ Qonverge PSC9131/9132

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Freescale Low Noise Amplifiers: Features and Competitive Advantages

Features

- Excellent Noise Figures (0.5 – 0.85 dB)
- Unconditionally stable over temperature
- Single +5 V supply; adjustable bias
- Performance insensitive to temperature
- Trade-offs between gain, NF, and IP3 performance are greatly eased
- Inputs tolerant of +20 dBm overdrive
- Very high reverse isolation

Competitive Advantages

- Long established reputation for quality
- Unconditional stability over temperature
- Superior ESD handling and overdrive capability
- Simplified solutions: minimal BOM
- High reliability: proven by intrinsic and extrinsic reliability test data for every product
- Most secure supply chain of any RF vendor
- Sophisticated and fully accessible technical support
- GaAs E-pHEMT: excellent linearity with the lowest NF
- Single and dual stage designs

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Low Noise Amplifier Product Selector Guide

Applications

- GSM, LTE, W-CDMA, TD-SCDMA, CDMA base station receivers
- Smart Energy (IEEE® 802.15.4 ZigBee®)
- Femtocell receivers

Freescale's new GaAs E-pHEMT low noise amplifiers are designed for today's demanding low noise, high linearity receiver applications in frequencies ranging from 400 to 2800 MHz. These amplifiers are available in cost-effective surface mount packages.

First Stage LNA

Part Number	Frequency Range (MHz)	Test Frequency (MHz)	Small Signal Gain (dB)	Noise Figure (dB)	P1dB (dBm)	OIP3 (dBm)	Supply Voltage (V)	Supply Current (mA)	Package
MML20211H	1400–2800	2140	18.6	0.65	21.3	33	5	60	DFN 2×2
MML09211H	400–1400	900	21.3	0.52	22	32.6	5	60	DFN 2×2
MML09212H*	400–1400	900	38.5	0.55	22.5	37	5	150	QFN 3×3
MML20242H*	1400–2800	2140	33	0.7	24	39.5	5	170	QFN 3×3

*Preliminary Data

Second Stage LNA

Part Number	Frequency Range (MHz)	Test Frequency (MHz)	Small Signal Gain (dB)	Noise Figure (dB)	P1dB (dBm)	OIP3 (dBm)	Supply Voltage (V)	Supply Current (mA)	Package
MMG15241H	500–2800	2600	14.4	1.3	24	40.6	5	85	SOT-89
MMG20271H	1500–2700	2140	16	1.7	27.5	42	5	180[1]	QFN 3×3
MMG20271H9	1500–2700	2140	16	1.7	27.5	43.1	5	215	SOT-89

[1] Nominal supply current is fully adjustable

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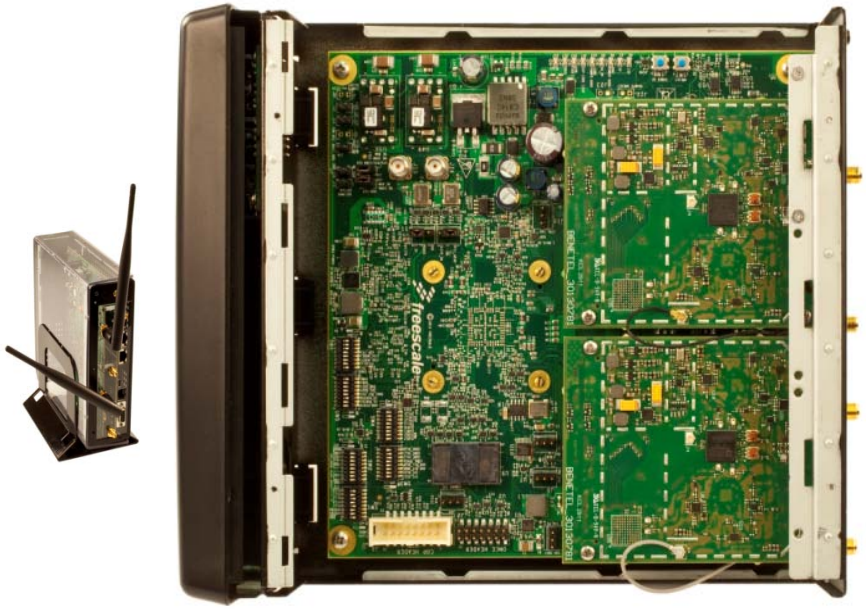
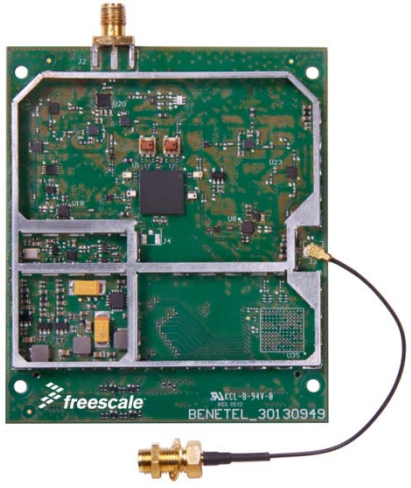
Freescale Femtocell Reference Design

- FDD LTE & WCDMA
- Band 1 & 13
- 20 mW average power at antenna

PSC9131 RDB



Baseband to Antenna Reference Design



Dual Band Radio Board(s)

GaAs MMIC Designer Kit and Solutions Binder

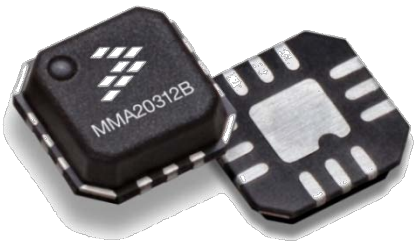
5-10 loose samples of each device in anti-static canisters

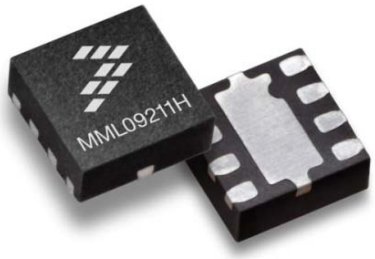
Designer Kit and GaAs Solutions Binder are available online at freescale.com/RFMMIC

Support Resources

- Data Sheets and Application Notes: freescale.com/RFMMIC
- S-Parameters: freescale.com/RFMMIC > Design Support
- Solutions Brochure: freescale.com/files/rf_if/doc/brochure/BR1609.pdf
- Cross Reference: freescale.com/files/rf_if/doc/quick_ref_guide/MMICGPAQRG.pdf
- Samples and Kits: freescale.com/RFMMIC

For more information on our GaAs portfolio, visit freescale.com/RFMMIC





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