EVALUATION KIT AVAILABLE

19-3455; Rev 0; 10/04

MAX2828/MAX2829

单/双频、802.11a/b/g 全波段收发器IC

概述

MAX2828/MAX2829为单芯片射频收发器芯片，专为OFDM 802.11 WLAN应用设计。MAX2828为单频802.11a应用而设计，覆盖4.9GHz到5.875GHz全波段范围。MAX2829用于双频802.11a/g应用，覆盖2.4GHz至2.5GHz以及4.9GHz至5.875GHz全波段范围。这两款芯片都包括了实现RF收发功能所需要的全部电路，提供完全集成的接收通道、发送通道、VCO、频率合成器以及基带/控制接口。仅需PA、RF开关、RF带通滤波器(BPF)、RF非平衡变压器 (balun) 以及少量的无源器件便可构建完整的RF前端方案。

每款芯片在接收器/发送器内集成了滤波器,无需外部SAW滤波器。基带滤波器和Rx/Tx信号通道经过优化，可满足802.11a/g IEEE标准，覆盖全范围的数据速率要求 (OFDM的6Mbps、9Mbps、12Mbps、18Mbps、24Mbps、36Mbps、48Mbps和54Mbps；CCK/DSSS的1Mbps、2Mbps、5.5Mbps和11Mbps)，灵敏度比802.11a/g标准提高10dB。MAX2828/MAX2829收发器采用小尺寸、56引脚、具有裸露焊盘的薄型QFN封装。

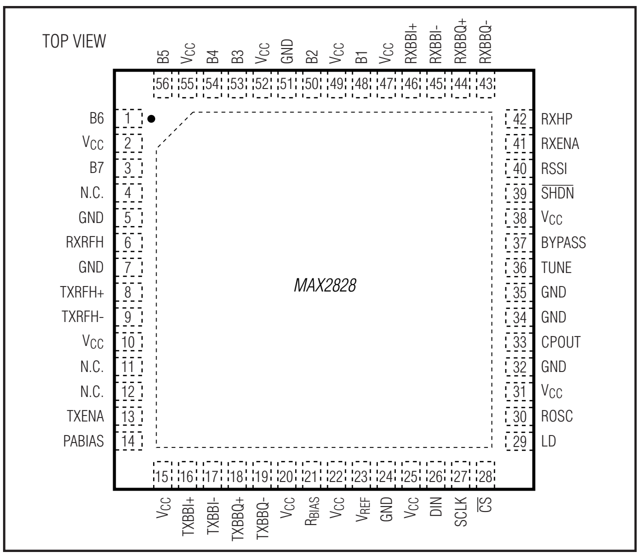
应用

802.11a/b/g单/双频无线应用

4.9GHz 公共安全无线应用

2.4GHz/5GHz MIMO和智能天线系统

引脚配置



特性

- 工作在全波段:
  MAX2828: 4.9GHz至5.875GHz (802.11a)
  MAX2829: 2.4GHz至2.5GHz和4.9GHz至5.875GHz (802.11a/b/g)
- 最好的收发器性能:
  在54Mbps (802.11g) 时Rx灵敏度为-75dBm
  -46dB (802.11g) /-51dB (802.11a) Tx边带抑制
  1.5% (802.11g) 和2% (802.11a) Tx EVM
  -100dBc/Hz (802.11g)/-95dBc/Hz (802.11a) 本振相位噪声
  可编程基带低通滤波器
  带3线串行接口的集成PLL
  接收器增益控制范围为93dB (802.11g)/97dB (802.11a)
  200ns Rx I/Q直流建立时间
  60dB Rx RSSI动态范围
  30dB Tx功率控制范围
  Tx/Rx I/Q误差检测
  用于Tx和Rx数字模式选择的I/Q模拟基带接口 (Tx、Rx、待机和电源关断)
  支持串行和并行增益控制
- 兼容于MIMO和智能天线，在多收发器中同步本振相位。
- 支持40MHz信道带宽 (turbo模式)。
- 单电源+2.7V至+3.6V供电。
- 1μA低功耗关断模式。
- 小尺寸、56引脚TQFN封装 (8mm x 8mm)。

定购信息

PART	TEMP RANGE	PIN-PACKAGE
MAX2828ETN	-40°C to +85°C	56 TQFN-EP* (T5688-2)
MAX2829ETN	-40°C to +85°C	56 TQFN-EP* (T5688-2)

*EP = 裸露焊盘。

引脚配置 (续) 见本数据资料的最后部分。

ABSOLUTE MAXIMUM RATINGS

V_{CC}, TXRFH_, TXRFL_ to GND..............................-0.3V to +4.2V
RXRFH, RXRFL, TXBBI_, TXBBQ_, ROSC, RXBBI_, RXBBQ_,
RSSI, PABIAS, V_{REF}, CPOUT, RXENA, TXENA, $\overline{SHDN}$, $\overline{CS}$,
SCLK, DIN, B_, RXHP, LD, R_{BIAS},
BYPASS to GND ....-0.3V to (V_{CC} + 0.3V)
RXBBI_, RXBBQ_, RSSI, PABIAS, V_{REF}, CPOUT,
LD Short-Circuit Duration..10s

CAUTION! ESD SENSITIVE DEVICE

RF Input Power ....+10dBm
Continuous Power Dissipation (T_A = +70°C)
56-Pin Thin QFN (derate 31.3mW/°C above +70°C)....2500mW
Operating Temperature Range ....-40°C to +85°C
Junction Temperature...+150°C
Storage Temperature Range ....-65°C to +160°C
Lead Temperature (soldering, 10s) ....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

(MAX2828/MAX2829 evaluation kits: V_{CC} = 2.7V to 3.6V, Rx/Tx set to maximum gain, R_{BIAS} = 11kΩ, no signal at RF inputs, all RF inputs and outputs terminated into 50Ω, receiver baseband outputs are open, no signal applied to Tx I/Q BB inputs in Tx mode, f_{REFOSC} = 40MHz, registers set to default settings and corresponding test mode, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +2.7V and T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETERS	CONDITIONS			MIN	TYP	MAX	UNITS
Supply Voltage				2.7		3.6	V
Supply Current	Shutdown mode, reference oscillator not applied, V_{IL} = 0				1	100	µA
	Standby mode	802.11g MAX2829	T_A = +25°C		37	47	mA
			T_A = -40°C to +85°C			51	
		802.11a MAX2828/MAX2829	T_A = +25°C		44	51	
			T_A = -40°C to +85°C			55	
	Rx mode	802.11g MAX2829	T_A = +25°C		118	151	
			T_A = -40°C to +85°C			158	
		802.11a MAX2828/MAX2829	T_A = +25°C		135	180	
			T_A = -40°C to +85°C			188	
	Tx mode	802.11g MAX2829	T_A = +25°C		124	164	
			T_A = -40°C to +85°C			175	
		802.11a MAX2828/MAX2829	T_A = +25°C		142	184	
			T_A = -40°C to +85°C			197	
	Standby mode (MIMO) (Note 2)	802.11g MAX2829	T_A = +25°C		65		
		802.11a MAX2828/MAX2829	T_A = +25°C		70		
	Rx mode (MIMO) (Note 2)	802.11g MAX2829	T_A = +25°C		136		
		802.11a MAX2828/MAX2829	T_A = +25°C		154		
	Tx mode (MIMO) (Note 2)	802.11g MAX2829	T_A = +25°C		139		
		802.11a MAX2828/MAX2829	T_A = +25°C		157		
	Tx calibration mode, T_A = +25°C	802.11g MAX2829			129		
		802.11a MAX2828/MAX2829			147		
	RX calibration mode, T_A = +25°C	802.11g MAX2829			188		
		802.11a MAX2828/MAX2829			210		
Rx I/Q Output Common-Mode Voltage	T_A = +25°C			0.80	0.9	1.05	V

DC ELECTRICAL CHARACTERISTICS (continued)

(MAX2828/MAX2829 evaluation kits: V_{CC} = 2.7V to 3.6V, Rx/Tx set to maximum gain, R_{BIAS} = 11kΩ, no signal at RF inputs, all RF inputs and outputs terminated into 50Ω, receiver baseband outputs are open, no signal applied to Tx I/Q BB inputs in Tx mode, f_{REFOSC} = 40MHz, registers set to default settings and corresponding test mode, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +2.7V and T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETERS	CONDITIONS	MIN	TYP	MAX	UNITS
Rx I/Q Output Common-Mode Voltage Variation	T_A = -40°C (relative to +25°C)		-25		mV
	T_A = +85°C (relative to +25°C)		20		
Tx Baseband Input Common-Mode Voltage Operating Range		0.9		1.3	V
Tx Baseband Input Bias Current				13	µA
Reference Voltage Output	-1mA < I_{OUT} < +1mA		1.2		V
Digital Input-Voltage High, V_{IH}		V_{CC} - 0.4			V
Digital Input-Voltage Low, V_{IL}				0.4	V
Digital Input-Current High, I_{IH}		-1		+1	µA
Digital Input-Current Low, I_{IL}		-1		+1	µA
LD Output-Voltage High, V_{OH}	Sourcing 100µA	V_{CC} - 0.4			V
LD Output-Voltage Low, V_{OL}	Sinking 100µA			0.4	V

AC ELECTRICAL CHARACTERISTICS—802.11g Rx Mode (MAX2829)

(MAX2829 evaluation kit: V_{CC} = +2.7V, f_{IN} = 2.437GHz; receiver baseband I/Q outputs at 112mV_{RMS} (-19dBV), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = RXENA = $\overline{CS}$ = high, RXHP = TXENA = SCLK = DIN = low, R_{BIAS} = 11kΩ, registers set to default settings and corresponding test mode, T_A = +25°C, unless otherwise noted. Unmodulated single-tone RF input signal is used, unless otherwise indicated.) (Tables 1, 2, 3)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RECEIVER SECTION: LNA RF INPUT TO BASEBAND I/Q OUTPUTS						
RF Input Frequency Range			2.412		2.500	GHz
RF Input Return Loss	With 50Ω external match	LNA high-gain mode (B7:B6 = 11)		-22		dB
		LNA medium-gain mode (B7:B6 = 10)		-24		
		LNA low-gain mode (B7:B6 = 0X)		-12		
Total Voltage Gain	Maximum gain, B7:B1 = 1111111	T_A = +25°C	87	94		dB
		T_A = -40°C to +85°C (Note 1)	85			
	Minimum gain, B7:B1 = 0000000	T_A = +25°C		1	5.5	
RF Gain Steps	From high-gain mode (B7:B6 = 11) to medium-gain mode (B7:B6 = 10) (Note 3)			-15.5		dB
	From high-gain mode (B7:B6 = 11) to low-gain mode (B7:B6 = 0X) (Note 3)			-30.5		
Gain Variation Over RF Band	f_{RF} = 2.412GHz to 2.5GHz				3	dB
Baseband Gain Range	From maximum baseband gain (B5:B1 = 11111) to minimum baseband gain (B5:B1 = 00000)			62		dB

AC ELECTRICAL CHARACTERISTICS—802.11g Rx Mode (MAX2829) (continued)

(MAX2829 evaluation kit: V_{CC} = +2.7V, f_{IN} = 2.437GHz; receiver baseband I/Q outputs at 112mV$_{RMS}$ (-19dBV), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = RXENA = $\overline{CS}$ = high, RXHP = TXENA = SCLK = DIN = low, R_{BIAS} = 11kΩ, registers set to default settings and corresponding test mode, T_A = +25°C, unless otherwise noted. Unmodulated single-tone RF input signal is used, unless otherwise indicated.) (Tables 1, 2, 3)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
DSB Noise Figure	Voltage gain ≥ 65dB, with B7:B6 = 11			3.5		dB
	Voltage gain = 50dB, with B7:B6 = 11			4		
	Voltage gain = 45dB, with B7:B6 = 10			16		
	Voltage gain = 15dB, with B7:B6 = 0X			36		
Output P-1$_{dB}$	Voltage gain = 90dB, with B7:B6 = 11			3.2		V_{P-P}
Out-of-Band Input IP3	-35dBm jammers at 40MHz and 78MHz offset; based on IM3 at 2MHz	Voltage gain = 60dB, with B7:B6 = 11		-10		dBm
		Voltage gain = 45dB, with B7:B6 = 10		-2		
		Voltage gain = 40dB, with B7:B6 = 0X		21		
In-Band Input P-1$_{dB}$	Voltage gain = 40dB, with B7:B6 = 11			-29		dBm
	Voltage gain = 25dB, with B7:B6 = 10			-14		
	Voltage gain = 5dB, with B7:B6 = 0X			2		
In-Band Input IP3	Tones at 7MHz and 8MHz, IM3 at 6MHz and 9MHz, P_{IN} = -40dBm per tone	Voltage gain = 40dB, with B7:B6 = 11		-17		dBm
		Voltage gain = 25dB, with B7:B6 = 10		-5		
		Voltage gain = 5dB, with B7:B6 = 0X		14		
I/Q Phase Error	B7:B1 = 1101110, 1σ variation			±0.5		degrees
I/Q Gain Imbalance	B7:B1 = 1101110, 1σ variation			±0.1		dB
Tx-to-Rx Conversion Gain for Rx I/Q Calibration	B7:B1 = 0010101 (Note 4)			-4		dB
I/Q Static DC Offset	RXHP = 1, B7:B1 = 1101110, 1σ variation			±2		mV
I/Q DC Droop	After switching RXHP to 0, D2 = 0 (see the *RX Control/RSSI Register Definition* section)			±1		mV/ms
RF Gain-Change Settling Time	Gain change from high gain to medium gain, high gain to low gain, or medium gain to low gain; gain settling to within ±2dB of steady state			0.4		µs
Baseband VGA Settling Time	Gain change from B5:B1 = 10111 to B5:B1 = 00111; gain settling to within ±2dB of steady state			0.1		µs
Rx I/Q Output Load Impedance	Minimum differential resistance			10		kΩ
	Maximum differential capacitance			8		pF
Spurious Signal Emissions at LNA Input	RF = 1GHz to 26.5GHz			-67		dBm

AC ELECTRICAL CHARACTERISTICS—802.11g Rx Mode (MAX2829) (continued)

(MAX2829 evaluation kit: V_{CC} = +2.7V, f_{IN} = 2.437GHz; receiver baseband I/Q outputs at 112mV$_{RMS}$ (-19dBV), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = RXENA = $\overline{CS}$ = high, RXHP = TXENA = SCLK = DIN = low, R_{BIAS} = 11kΩ, registers set to default settings and corresponding test mode, T_A = +25°C, unless otherwise noted. Unmodulated single-tone RF input signal is used, unless otherwise indicated.) (Tables 1, 2, 3)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RECEIVER BASEBAND FILTERS						
Baseband -3dB Corner Frequency	(See the *Lowpass Filter Register* section)	Narrowband mode		7.5		MHz
		Nominal mode		9.5		
		Turbo mode 1		14		
		Turbo mode 2		18		
Baseband Filter Rejection (Nominal Mode)	$f_{BASEBAND}$ = 15MHz			20		dB
	$f_{BASEBAND}$ = 20MHz			39		
	$f_{BASEBAND}$ > 40MHz			84		
RSSI						
RSSI Minimum Output Voltage	RXHP = 1, low range (D11 = 0, see the *Rx Control/RSSI Register Definition* section)			0.5		V
	RXHP = 1, high range (D11 = 1, see the *Rx Control/RSSI Register Definition* section)			0.52		
RSSI Maximum Output Voltage	RXHP = 1, low range (D11 = 0, see the *Rx Control/RSSI Register Definition* section)			2		V
	RXHP = 1, high range (D11 = 1, see the *Rx Control/RSSI Register Definition* section)			2.5		
RSSI Slope	RXHP = 1, low range (D11 = 0, see the *Rx Control/RSSI Register Definition* section)			22.5		mV/dB
	RXHP = 1, high range (D11 = 1, see the *Rx Control/RSSI Register Definition* section)			30		
RSSI Output Settling Time	To within 3dB of steady state	+40dB signal step		0.2		µs
		-40dB signal step		0.7		

AC ELECTRICAL CHARACTERISTICS—802.11a Rx Mode (MAX2828/MAX2829)

(MAX2828/MAX2829 evaluation kits: V_{CC} = +2.7V, f_{IN} = 5.25GHz; receiver baseband I/Q outputs at 112mV$_{RMS}$ (-19dBV), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = RXENA = $\overline{CS}$ = high, RXHP = TXENA = SCLK = DIN = low, R_{BIAS} = 11kΩ, registers set to default settings and corresponding test mode, T_A = +25°C, unless otherwise noted. Unmodulated single-tone RF input signal is used, unless otherwise indicated.) (Tables 1, 2, 3)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RECEIVER SECTION: LNA RF INPUT TO BASEBAND I/Q OUTPUTS						
RF Input Frequency Range	802.11a low-band mode		4.900		5.350	GHz
	802.11a high-band mode		5.470		5.875	
RF Input Return Loss	With 50Ω external match	LNA high-gain mode (B7:B6 = 11)		-15		dB
		LNA medium-gain mode (B7:B6 = 10)		-11		
		LNA low-gain mode (B7:B6 = 0X)		-7		
Total Voltage Gain	Maximum gain, B7:B1 = 1111111	T_A = +25°C	91	97		dB
		T_A = -40°C to +85°C (Note 1)	88			
	Minimum gain, B7:B1 = 0000000	T_A = +25°C		0	3	
RF Gain Steps	From high-gain mode (B7:B6 = 11) to medium-gain mode (B7:B6 = 10) (Note 3)			-19		dB
	From high-gain mode (B7:B6 = 11) to low-gain mode (B7:B6 = 0X) (Note 3)			-34.5		
Gain Variation Relative to 5.25GHz	f_{RF} = 4.9GHz			-0.3		dB
	f_{RF} = 5.35GHz			0.4		
	f_{RF} = 5.875GHz			-4		
Baseband Gain Range	From maximum baseband gain (B5:B1 = 11111) to minimum baseband gain (B5:B1 = 00000)			62		dB
DSB Noise Figure	Voltage gain ≥ 65dB, with B7:B6 = 11			4.5		dB
	Voltage gain = 50dB, with B7:B6 = 11			4.8		
	Voltage gain = 45dB, with B7:B6 = 10			15		
	Voltage gain = 15dB, with B7:B6 = 0X			36		
Output P-1$_{dB}$	Voltage gain = 90dB, with B7:B6 = 11			3.2		V_{P-P}
Out-of-Band Input IP3	-35dBm jammers at 40MHz and 78MHz offset; based on IM3 at 2MHz	Voltage gain = 60dB, with B7:B6 = 11		-15		dBm
		Voltage gain = 45dB, with B7:B6 = 10		0.5		
		Voltage gain = 40dB, with B7:B6 = 0X		20		
In-Band Input P-1$_{dB}$	Voltage gain = 35dB, with B7:B6 = 11			-32		dBm
	Voltage gain = 20dB, with B7:B6 = 10			-12		
	Voltage gain = 5dB, with B7:B6 = 0X			3		

AC ELECTRICAL CHARACTERISTICS—802.11a Rx Mode (MAX2828/MAX2829) (continued)

(MAX2828/MAX2829 evaluation kits: V_{CC} = +2.7V, f_{IN} = 5.25GHz; receiver baseband I/Q outputs at 112mV_{RMS} (-19dBV), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = RXENA = $\overline{CS}$ = high, RXHP = TXENA = SCLK = DIN = low, R_{BIAS} = 11kΩ, registers set to default settings and corresponding test mode, T_A = +25°C, unless otherwise noted. Unmodulated single-tone RF input signal is used, unless otherwise indicated.) (Tables 1, 2, 3)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
In-Band Input IP3	Tones at 7MHz and 8MHz, IM3 at 6MHz and 9MHz, P_{IN} = -40dBm per tone	Voltage gain = 35dB, with B7:B6 = 11		-24		dBm
		Voltage gain = 20dB, with B7:B6 = 10		-5		
		Voltage gain = 5dB, with B7:B6 = 0X		13		
I/Q Phase Error	B7:B1 = 1101110, 1σ variation			±0.4		degrees
I/Q Gain Imbalance	B7:B1 = 1101110, 1σ variation			±0.1		dB
Tx-to-Rx Conversion Gain for Rx I/Q Calibration	B7:B1 = 0001111 (Note 4)			0		dB
I/Q Static DC Offset	RXHP = 1, B7:B1 = 1101110, 1σ variation			±2		mV
I/Q DC Droop	After switching RXHP to 0, D2 = 0 (see the *Rx Control/RSSI Register Definition* section)			±1		mV/ms
RF Gain-Change Settling Time	Gain change from high gain to medium gain, high gain to low gain, or medium gain to low gain; gain settling to within ±2dB of steady state			0.4		µs
Baseband VGA Settling Time	Gain change from B5:B1 = 10111 to B5:B1 = 00111; gain settling to within ±2dB of steady state			0.1		µs
Rx I/Q Output Load Impedance	Minimum differential resistance			10		kΩ
	Maximum differential capacitance			8		pF
Spurious Signal Emissions at LNA input	RF = 1GHz to 26.5GHz			-50		dBm
RECEIVER BASEBAND FILTERS						
Baseband -3dB Corner Frequency	(See the *Lowpass Filter Register Definition* section)	Narrow-band mode		7.5		MHz
		Nominal mode		9.5		
		Turbo mode 1		14		
		Turbo mode 2		18		
Baseband Filter Rejection (Nominal Mode)	$f_{BASEBAND}$ = 15MHz			20		dB
	$f_{BASEBAND}$ = 20MHz			39		
	$f_{BASEBAND}$ > 40MHz			80		

AC ELECTRICAL CHARACTERISTICS—802.11a Rx Mode (MAX2828/MAX2829) (continued)

(MAX2828/MAX2829 evaluation kits: V_{CC} = +2.7V, f_{IN} = 5.25GHz; receiver baseband I/Q outputs at 112mV$_{RMS}$ (-19dBV), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = RXENA = $\overline{CS}$ = high, RXHP = TXENA = SCLK = DIN = low, R_{BIAS} = 11kΩ, registers set to default settings and corresponding test mode, T_A = +25°C, unless otherwise noted. Unmodulated single-tone RF input signal is used, unless otherwise indicated.) (Tables 1, 2, 3)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RSSI						
RSSI Minimum Output Voltage	RXHP = 1, low range (D11 = 0, see the *Rx Control/RSSI Register Definition* section)			0.5		V
	RXHP = 1, high range (D11 = 1, see the *Rx Control/RSSI Register Definition* section)			0.52		
RSSI Maximum Output Voltage	RXHP = 1, low range (D11 = 0, see the *Rx Control/RSSI Register Definition* section)			2		V
	RXHP = 1, high range (D11 = 1, see the *Rx Control/RSSI Register Definition* section)			2.5		
RSSI Slope	RXHP = 1, low range (D11 = 0, see the *Rx Control/RSSI Register Definition* section)			22.5		mV/dB
	RXHP = 1, high range (D11 = 1, see the *Rx Control/RSSI Register Definition* section)			30		
RSSI Output Settling Time	To within 3dB of steady state	+40dB signal step		0.2		µs
		-40dB signal step		0.7		

AC ELECTRICAL CHARACTERISTICS—802.11g Tx Mode (MAX2829)

(MAX2829 evaluation kit: V_{CC} = +2.7V, f_{OUT} = 2.437GHz, f_{REFOSC} = 40MHz, $\overline{SHDN}$ = TXENA = $\overline{CS}$ = high, RXENA = SCLK = DIN = low, R_{BIAS} = 11kΩ, 100mV$_{RMS}$ sine and cosine signal (or 100mV$_{RMS}$, 54Mbps IEEE 802.11g I/Q signals wherever OFDM is mentioned) applied to baseband I/Q inputs of transmitter, registers set to default settings and corresponding test mode, T_A = +25°C, unless otherwise noted.) (Table 4)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
TRANSMIT SECTION: Tx BASEBAND I/Q INPUTS TO RF OUTPUTS						
RF Output Frequency Range, f_{RF}			2.412		2.500	GHz
Output Power	54Mbps 802.11g OFDM signal	1.5% EVM		-2.5		dBm
		B6:B1 = 111011		-4.5		
Output Power (CW)	V_{IN} = 100mV$_{RMS}$ at 1MHz I/Q CW signal, B6:B1 = 111111			-2		dBm
Output Power Range	B6:B1 = 111111 to B6:B1 = 000000			30		dB
Carrier Leakage	Without DC offset cancellation			-27		dBc
Unwanted Sideband Suppression	Uncalibrated			-46		dBc
Tx Output ACP	Measured with 1MHz resolution bandwidth at 22MHz offset from channel center (B6:B1 = 111011), OFDM signal			-69		dBm/MHz
RF Output Return Loss	With external 50Ω match			-14		dB

AC ELECTRICAL CHARACTERISTICS—802.11g Tx Mode (MAX2829) (continued)

(MAX2829 evaluation kit: V_{CC} = +2.7V, f_{OUT} = 2.437GHz, f_{REFOSC} = 40MHz, $\overline{SHDN}$ = TXENA = $\overline{CS}$ = high, RXENA = SCLK = DIN = low, R_{BIAS} = 11kΩ, 100mV$_{RMS}$ sine and cosine signal (or 100mV$_{RMS}$, 54Mbps IEEE 802.11g I/Q signals wherever OFDM is mentioned) applied to baseband I/Q inputs of transmitter, registers set to default settings and corresponding test mode, T_A = +25°C, unless otherwise noted.) (Table 4)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RF Spurious Signal Emissions	B6:B1 = 111011, OFDM signal	2/3 x f_{RF}		-64		dBm/MHz
		4/3 x f_{RF}		-61		
		5/3 x f_{RF}		-63		
		8/3 x f_{RF}		-52		
Baseband -3dB Corner Frequency	(See the *Lowpass Filter Register Definition* section)	Nominal mode		12		MHz
		Turbo mode 1		18		
		Turbo mode 2		24		
Baseband Filter Rejection	At 30MHz, in nominal mode (see the *Lowpass Filter Register Definition* section)			60		dB
Tx Baseband Input Impedance	Minimum differential resistance			60		kΩ
	Maximum differential capacitance			0.7		pF
TRANSMITTER LO LEAKAGE AND I/Q CALIBRATION USING LO LEAKAGE AND SIDEBAND DETECTOR (SEE THE Tx/Rx CALIBRATION MODE SECTION)						
Tx BASEBAND I/Q INPUTS TO RECEIVER OUTPUTS						
LO Leakage and Sideband-Detector Output	Calibration register, D12:D11 = 11, A3:A0 = 0110	Output at 1 x f_{TONE} (for LO leakage = -29dBc), f_{TONE} = 2MHz, 100mV$_{RMS}$		-3		dBV$_{RMS}$
		Output at 2 x f_{TONE} (for sideband suppression = -40dBc), f_{TONE} = 2MHz, 100mV$_{RMS}$		-13		
Amplifier Gain Range	D12:D11 = 00 to D12:D11 = 11, A3:A0 = 0110			26		dB
Lower -3dB Corner Frequency				1		MHz

AC ELECTRICAL CHARACTERISTICS—802.11a Tx Mode (MAX2828/MAX2829)

(MAX2828/MAX2829 evaluation kits: V_{CC} = +2.7V, f_{OUT} = 5.25GHz, f_{REFOSC} = 40MHz, $\overline{SHDN}$ = TXENA = $\overline{CS}$ = high, RXENA = SCLK = DIN = low, R_{BIAS} = 11kΩ, 100mV$_{RMS}$ sine and cosine signal (or 100mV$_{RMS}$, 54Mbps IEEE 802.11a I/Q signals wherever OFDM is mentioned) applied to baseband I/Q inputs of transmitter, registers set to default settings and corresponding test mode, T_A = +25°C, unless otherwise noted.) (Table 4)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
TRANSMIT SECTION: Tx BASEBAND I/Q INPUTS TO RF OUTPUTS						
RF Output Frequency Range, f_{RF}	802.11a low-band mode		4.900		5.350	GHz
	802.11a high-band mode		5.470		5.875	
Output Power	54Mbps 802.11a OFDM signal	2% EVM		-5		dBm
		B6:B1 = 111100		-6.5		
Output Power (CW)	V_{IN} = 100mV$_{RMS}$ at 1MHz I/Q CW signal, B6:B1 = 111111			-4.5		dBm
Output Power Variation Relative to 5.25GHz	f_{RF} = 4.9GHz			-6		dB
	f_{RF} = 5.35GHz			-0.5		
	f_{RF} = 5.875GHz			-1		
Output Power Range	B6:B1 = 111111 to B6:B1 = 000000			30		dB
Carrier Leakage	Without DC offset cancellation			-27		dBc
Unwanted Sideband Suppression	Uncalibrated			-51		dBc
Tx Output ACP	Measured with 1MHz resolution bandwidth at 30MHz offset from channel center (B6:B1 = 111100), OFDM signal			-80		dBm/MHz
RF Output Return Loss	With external 50Ω match			-16		dB
RF Spurious Signal Emissions	B6:B1 = 111100, OFDM signal	4/5 x f_{RF}		-55		dBm/MHz
		6/5 x f_{RF}		-64		
		7/5 x f_{RF}		-65		
		8/5 x f_{RF}		-49		
Baseband -3dB Corner Frequency	(see the *Lowpass Filter Register Definition* section)	Nominal mode		12		MHz
		Turbo mode 1		18		
		Turbo mode 2		24		
Baseband Filter Rejection	At 30MHz, in nominal mode (see the *Lowpass Filter Register Definition* section)			60		dB
Tx Baseband Input Impedance	Minimum differential resistance			60		kΩ
	Maximum differential capacitance			0.7		pF
TRANSMITTER LO LEAKAGE AND I/Q CALIBRATION USING LO LEAKAGE AND SIDEBAND DETECTOR (SEE THE Tx/Rx CALIBRATION MODE SECTION)						
Tx BASEBAND I/Q INPUTS TO RECEIVER OUTPUTS						
LO Leakage and Sideband-Detector Output	Calibration register, D12:D11 = 1, A3:A0 = 0110	Output at 1 x f_{TONE} (for LO leakage = -29dBc), f_{TONE} = 2MHz, 100mV$_{RMS}$		-4.5		dBV$_{RMS}$
		Output at 2 x f_{TONE} (for sideband suppression = -40dBc), f_{TONE} = 2MHz, 100mV$_{RMS}$		-14.5		
Amplifier Gain Range	D12:D11 = 00 to D12:D11 = 11, A3:A0 = 0110			26		dB
Lower -3dB Corner Frequency				1		MHz

AC ELECTRICAL CHARACTERISTICS—Frequency Synthesis

(MAX2828/MAX2829 evaluation kits: V_{CC} = +2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, SCLK = DIN = low, PLL loop bandwidth = 150kHz, R_{BIAS} = 11kΩ, T_A = +25°C, unless otherwise noted.)

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
FREQUENCY SYNTHESIZER							
RF Channel Center Frequency	802.11g mode			2412		2500	MHz
	802.11a low-band mode			4900		5350	
	802.11a high-band mode			5470		5875	
Charge-Pump Comparison Frequency					20		MHz
f_{REFOSC} Input Frequency				20		44	MHz
Reference-Divider Ratio				1		4	
f_{REFOSC} Input Levels	AC-coupled			800			mV_{P-P}
f_{REFOSC} Input Impedance					10		kΩ
Closed-Loop Phase Noise	802.11g		f_{OFFSET} = 1kHz		-87		dBc/Hz
			f_{OFFSET} = 10kHz		-103		
			f_{OFFSET} = 100kHz		-99		
			f_{OFFSET} = 1MHz		-112		
			f_{OFFSET} = 10MHz		-125		
	802.11a		f_{OFFSET} = 1kHz		-84		
			f_{OFFSET} = 10kHz		-95		
			f_{OFFSET} = 100kHz		-92		
			f_{OFFSET} = 1MHz		-108		
			f_{OFFSET} = 10MHz		-124		
Closed-Loop Integrated Phase Noise	RMS phase jitter, integrate from 10kHz to 10MHz offset		802.11g		0.6		degrees
			802.11a		1		
Charge-Pump Output Current					4		mA
Charge-Pump Output Voltage	>70% of I_{CP}			0.5		V_{CC} - 0.5V	V
Reference Spurs	20MHz offset		802.11g		-65		dBc
			802.11a		-58		
VOLTAGE-CONTROLLED OSCILLATOR							
VCO Tuning Voltage Range				0.4		2.3	V
LO Tuning Gain	802.11g		V_{TUNE} = 0.4V		135		MHz/V
			V_{TUNE} = 2.3V		62		
	802.11a	Low band	V_{TUNE} = 0.3V		324		
			V_{TUNE} = 2.2V		167		
		High band	V_{TUNE} = 0.3V		330		
			V_{TUNE} = 2.2V		175		

AC ELECTRICAL CHARACTERISTICS—Miscellaneous Blocks

(MAX2828/MAX2829 evaluation kits: V_{CC} = +2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, SCLK = DIN = low, R_{BIAS} = 11kΩ, T_A = +25°C, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
PA BIAS DAC						
Number of Programmable Bits				6		Bits
Minimum Output Sink Current	D5:D0 = 000000 (see the *PA Bias DAC Register Definition* section)			0		µA
Maximum Output Sink Current	D5:D0 = 111111 (see the *PA Bias DAC Register Definition* section), output voltage = 0.8V			313		µA
Turn-On Time	D9:D6 = 0000 (see the *PA Bias DAC Register Definition* section)			0.2		µs
DNL				1		LSB
ON-CHIP TEMPERATURE SENSOR						
Output Voltage	D11 = 1 (see the *Rx Control/RSSI Register Definition* section)	T_A = -40°C		0.5		V
		T_A = +25°C		1.05		
		T_A = +85°C		1.6		

AC ELECTRICAL CHARACTERISTICS—Timing

(MAX2828/MAX2829 evaluation kits: V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, SCLK = DIN = low, PLL loop bandwidth = 150kHz, R_{BIAS} = 11kΩ, T_A = +25°C, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
SYSTEM TIMING (See Figure 1)						
Turn-On Time	From $\overline{SHDN}$ rising edge (PLL locked)			50		µs
Shutdown Time				2		µs
Channel Switching Time	f_{RF} = 2.412GHz to 2.5GHz			25		µs
	f_{RF} = 5.15GHz to 5.35GHz			35		
	f_{RF} = 5.45GHz to 5.875GHz			130		
	f_{RF} = 4.9GHz to 5.875GHz			130		
Rx/Tx Turnaround Time	Measured from Tx or Rx enable rising edge; signal settling to within ±2dB of steady state	Rx to Tx		1		µs
		Tx to Rx, RXHP = 1		1.2		
Tx Turn-On Time (From Standby Mode)	From Tx enable rising edge; signal settling to within ±2dB of steady state			1		µs
Rx Turn-On Time (From Standby Mode)	From Rx enable rising edge; signal settling to within ±2dB of steady state			1.2		µs

AC ELECTRICAL CHARACTERISTICS—Timing (continued)

(MAX2828/MAX2829 evaluation kits: V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, SCLK = DIN = low, PLL loop bandwidth = 150kHz, R_{BIAS} = 11kΩ, T_A = +25°C, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
3-WIRE SERIAL INTERFACE TIMING (SEE FIGURE 2)					
SCLK-Rising-Edge to $\overline{CS}$-Falling-Edge Wait Time, t_{CSO}			6		ns
Falling Edge of $\overline{CS}$ to Rising Edge of First SCLK Time, t_{CSS}			6		ns
DIN-to-SCLK Setup Time, t_{DS}			6		ns
DIN-to-SCLK Hold Time, t_{DH}			6		ns
SCLK Pulse-Width High, t_{CH}			6		ns
SCLK Pulse-Width Low, t_{CL}			6		ns
Last Rising Edge of SCLK to Rising Edge of $\overline{CS}$ or Clock to Load Enable Setup Time, t_{CSH}			6		ns
$\overline{CS}$ High Pulse Width, t_{CSW}			20		ns
Time Between the Rising Edge of $\overline{CS}$ and the Next Rising Edge of SCLK, t_{CS1}			6		ns
Clock Frequency, f_{CLK}			40		MHz
Rise Time, t_R			2		ns
Fall Time, t_F			2		ns

Note 1: Devices are production tested at +85°C only. Min and max limits at temperatures other than +85°C are guaranteed by design and characterization.
Note 2: Register settings for MIMO mode. A3:A0 = 0101 and A3:A0 = 0010, D13 = 1.
Note 3: The expected part-to-part variation of the RF gain step is ±1dB.
Note 4: Tx I/Q inputs = 100mV$_{RMS}$. Set Tx VGA gain to max.

表 1. 接收器前端增益控制设置

B7	B6	GAIN
1	1	High
1	0	Medium
0	X	Low

表 2. 接收器基带 VGA 增益设置

B5:B1	GAIN
11111	Max
11110	Max - 2dB
11101	Max - 4dB
:	:
00000	Min

表3. 接收器基带VGA增益步进设置

BIT	GAIN STEP (typ)
B1	2dB
B2	4dB
B3	8dB
B4	16dB
B5	32dB

表4. Tx VGA增益控制设置

NUMBER	B6:B1	OUTPUT SIGNAL POWER
63	111111	Max
62	111110	Max - 0.5dB
61	111101	Max - 1.0dB
:	:	:
49	110001	Max - 7dB
48	110000	Max - 7.5dB
47	101111	Max - 8dB
46	101110	Max - 8dB
45	101101	Max - 9dB
44	101100	Max - 9dB
:	:	:
5	000101	Max - 29dB
4	000100	Max - 29dB
3	000011	Max - 30dB
2	000010	Max - 30dB
1	000001	Max - 30dB
0	000000	Max - 30dB

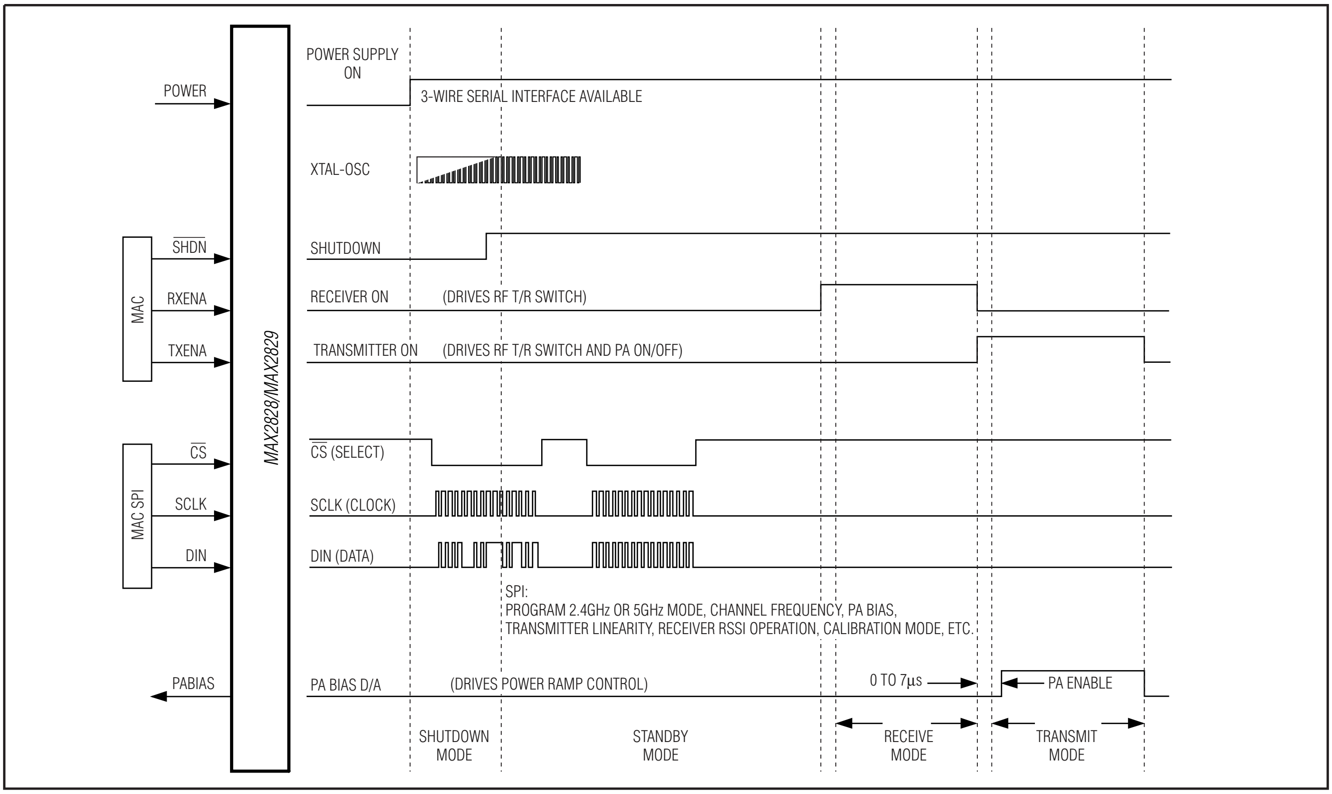


图1. 系统时序图

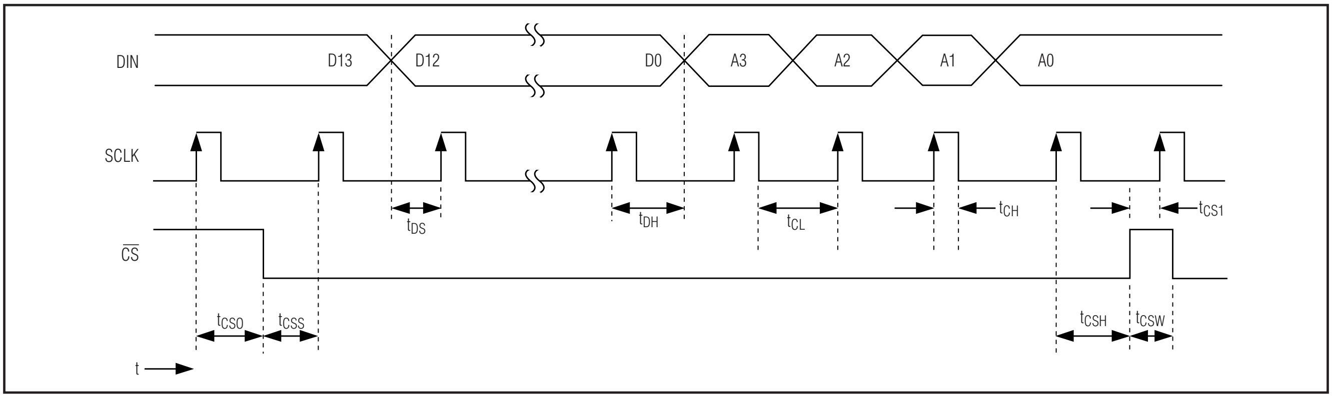


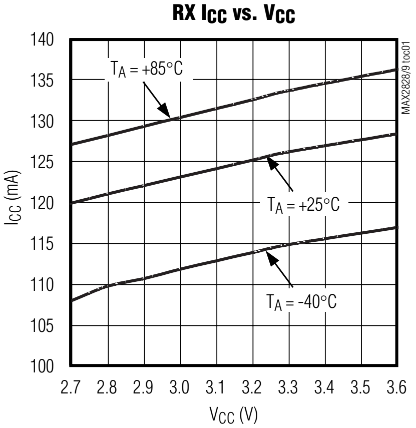
图2. 3线串行接口时序图

典型工作特性

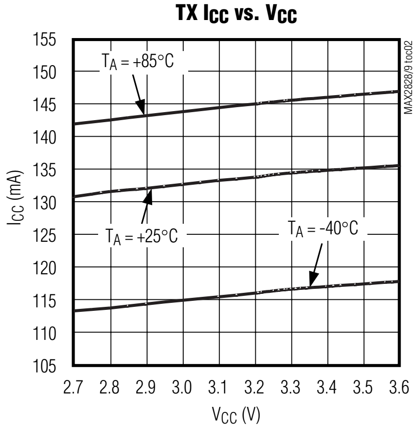
(V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, RXHP = SCLK = DIN = low, R_{BIAS} = 11kΩ, T_A = +25°C using the MAX2828/MAX2829 evaluation kits.)

802.11g

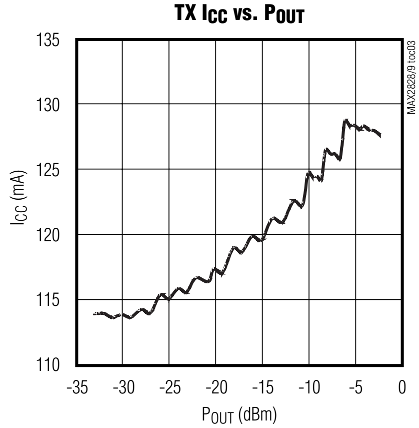
RX I_{CC} vs. V_{CC}



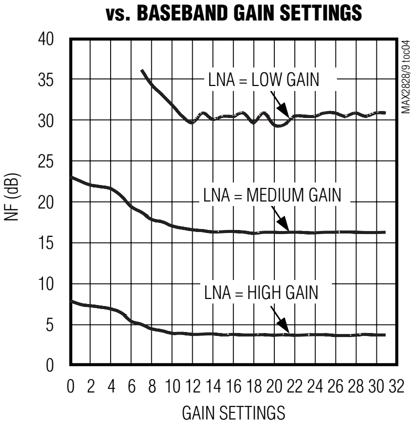
TX I_{CC} vs. V_{CC}



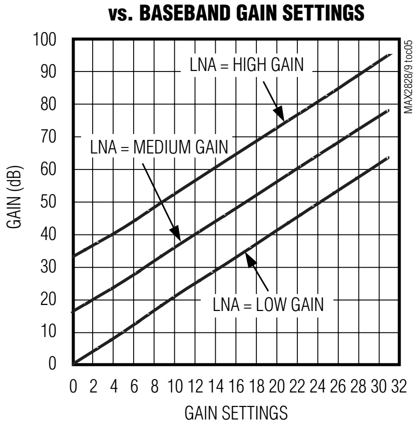
TX I_{CC} vs. P_{OUT}



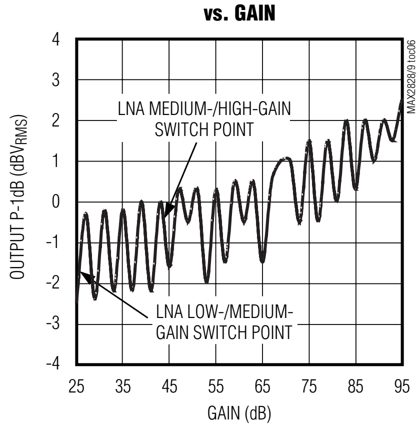
NOISE FIGURE vs. BASEBAND GAIN SETTINGS



RX VOLTAGE GAIN vs. BASEBAND GAIN SETTINGS



RX IN-BAND OUTPUT P-1dB vs. GAIN

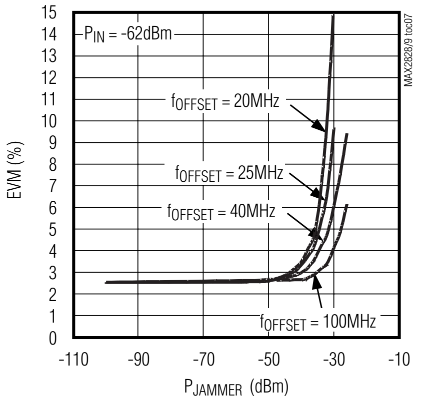


典型工作特性 (续)

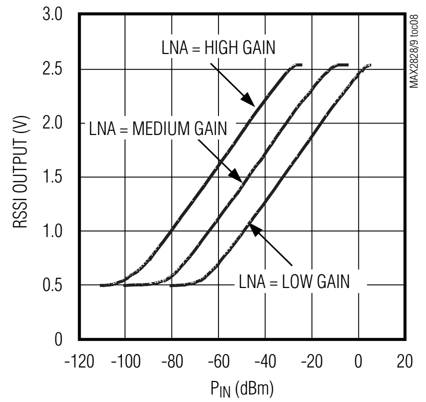
(V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, RXHP = SCLK = DIN = low, R_{BIAS} = 11kΩ, T_A = +25°C using the MAX2828/MAX2829 evaluation kits.)

802.11g

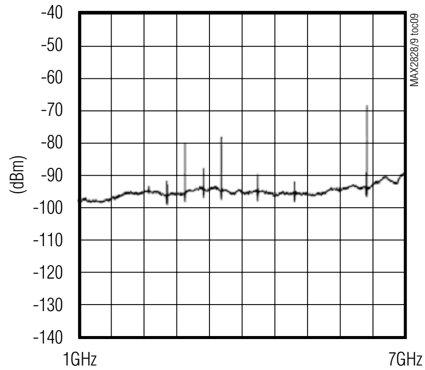
OFDM EVM WITH OFDM JAMMER vs. OFDM JAMMER LEVEL WITH JAMMER OFFSET FREQUENCY



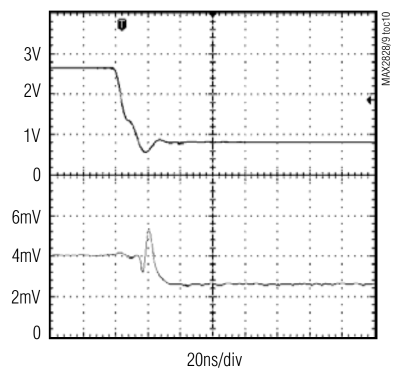
RX RSSI OUTPUT vs. INPUT POWER



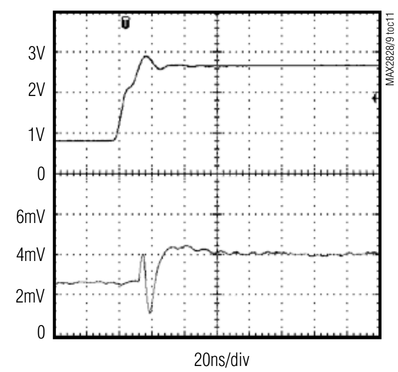
RX EMISSION SPECTRUM, LNA INPUT (TX OFF, LNA = LOW GAIN)



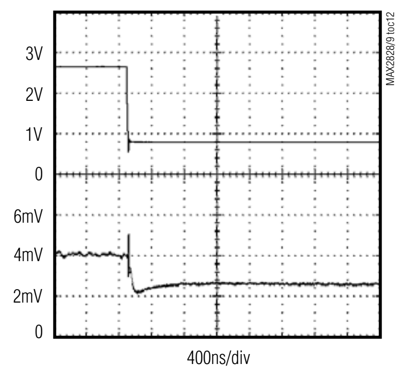
RX I/Q DC OFFSET SETTLING RESPONSE (-8dB BB VGA GAIN STEP)



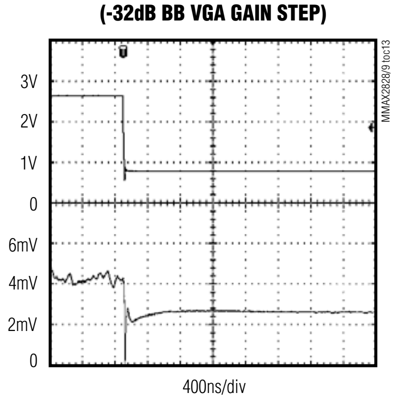
RX I/Q DC OFFSET SETTLING RESPONSE (+8dB BB VGA GAIN STEP)



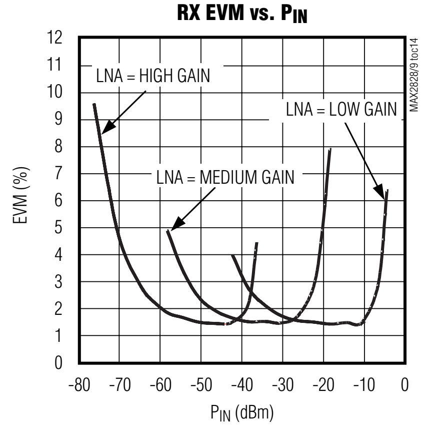
RX I/Q DC OFFSET SETTLING RESPONSE (-16dB BB VGA GAIN STEP)



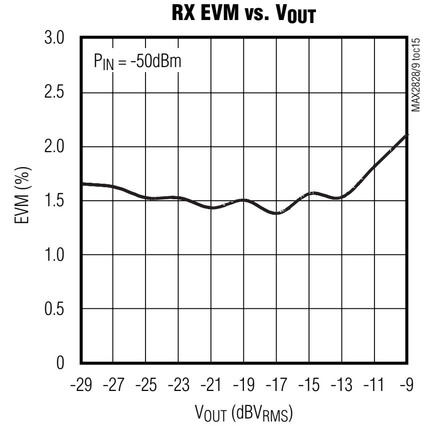
RX I/Q DC OFFSET SETTLING RESPONSE (-32dB BB VGA GAIN STEP)



RX EVM vs. P_{IN}



RX EVM vs. V_{OUT}



(V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, RXHP = SCLK = DIN = low, R_{BIAS} = 11kΩ, T_A = +25°C using the MAX2828/MAX2829 evaluation kits.)

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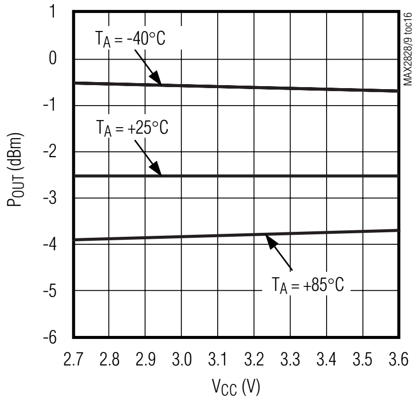
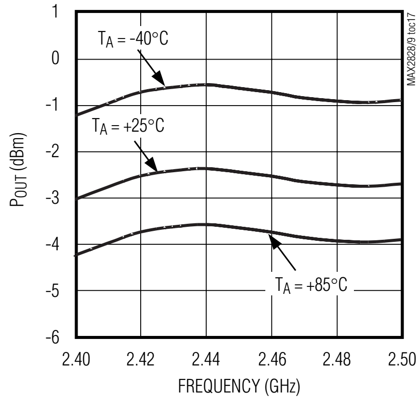
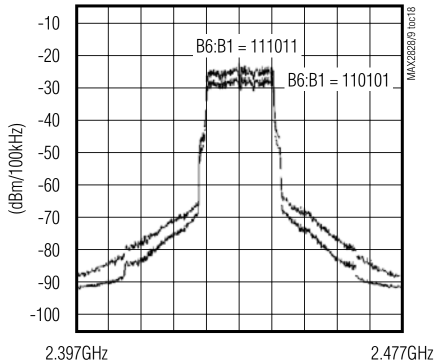
TX OUTPUT POWER vs. V_{CC} (B6:B1 = 111111)



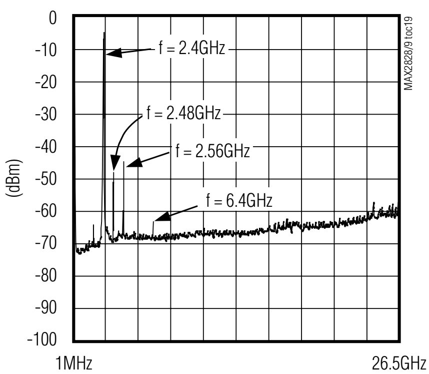
TX OUTPUT POWER vs. FREQUENCY (B6:B1 = 111111)



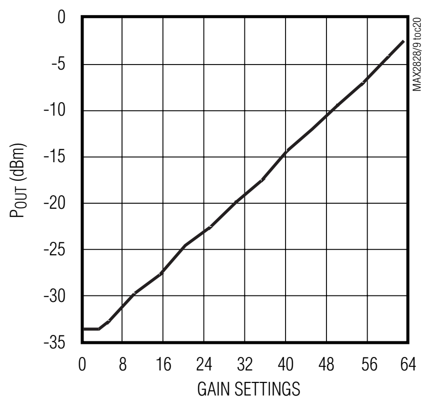
TX OUTPUT SPECTRUM (54Mbps OFDM SIGNAL)



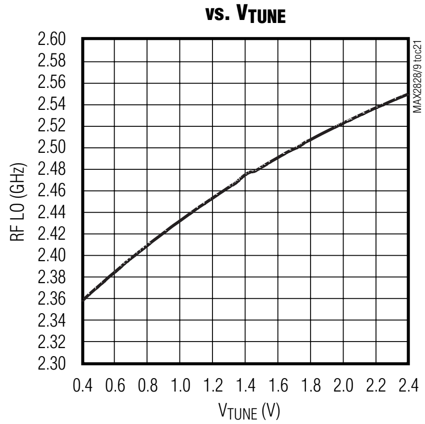
TX OUTPUT SPECTRUM



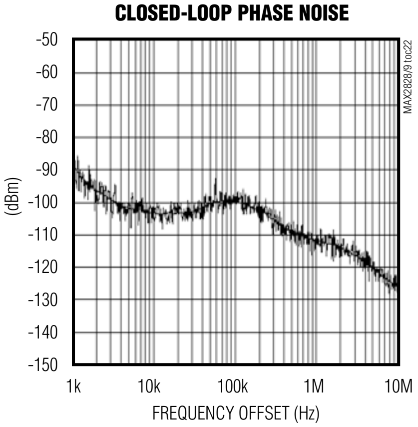
TX OUTPUT POWER vs. GAIN SETTINGS



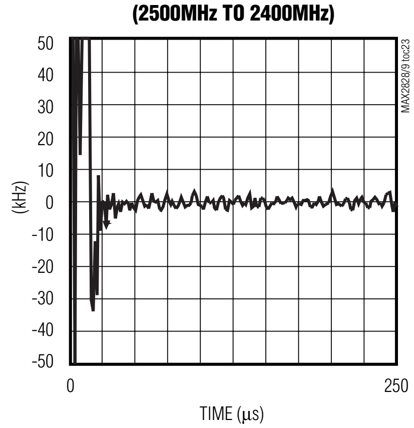
LO FREQUENCY vs. V_{TUNE}



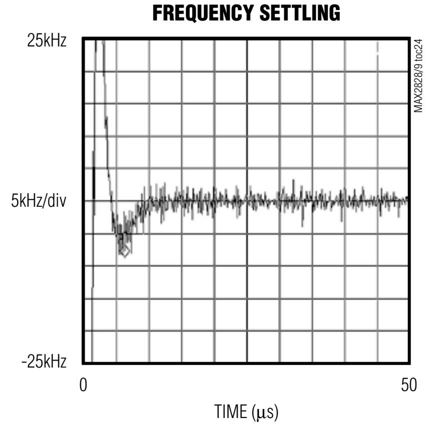
CLOSED-LOOP PHASE NOISE



CHANNEL-SWITCHING FREQUENCY SETTLING (2500MHz TO 2400MHz)



TX-RX TURNAROUND FREQUENCY SETTLING

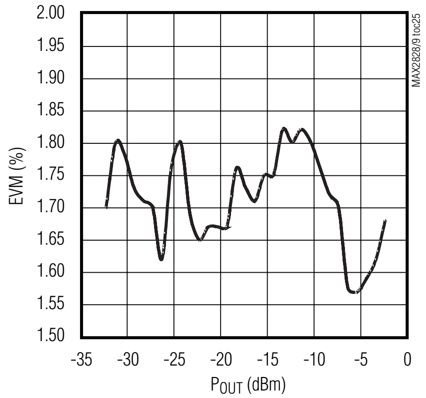


典型工作特性 (续)

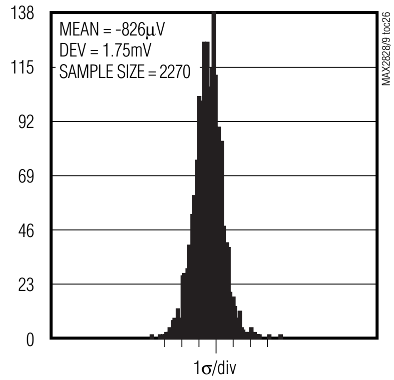
(V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, RXHP = SCLK = DIN = low, R_{BIAS} = 11kΩ, T_A = +25°C using the MAX2828/MAX2829 evaluation kits.)

802.11g

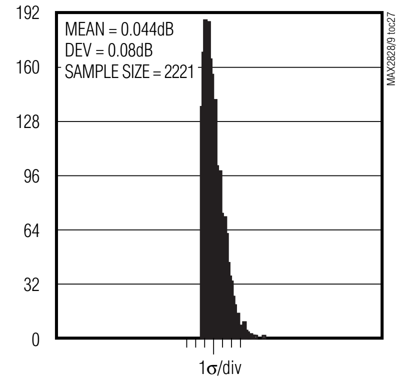
TX EVM vs. P_{OUT}



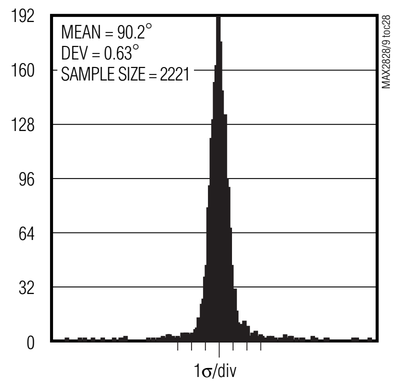
RX STATIC DC OFFSET



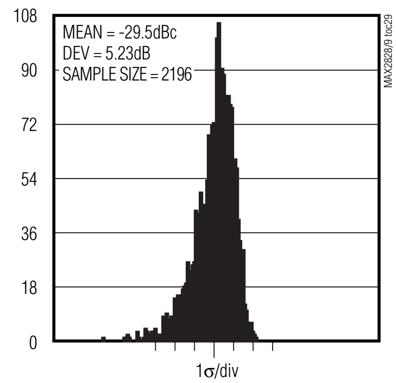
RX GAIN IMBALANCE



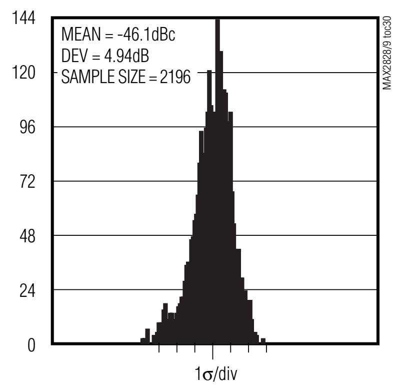
RX PHASE IMBALANCE



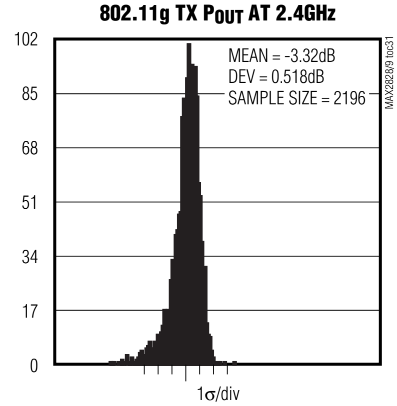
TX LO LEAKAGE



TX SIDEBAND SUPPRESSION



802.11g TX P_{OUT} AT 2.4GHz

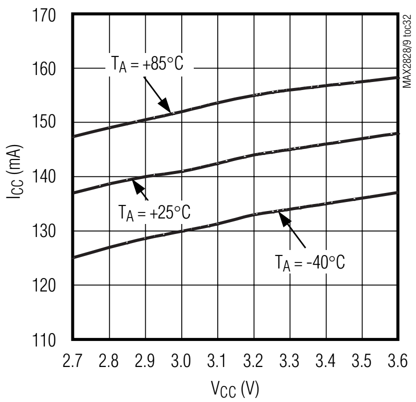


典型工作特性 (续)

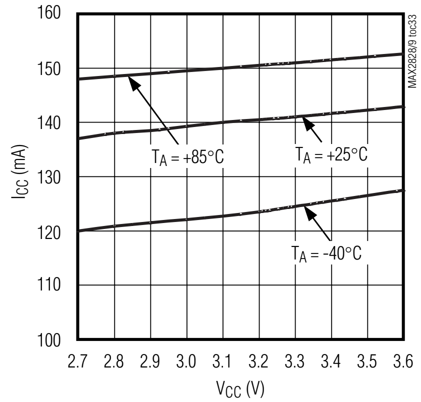
(V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, RXHP = SCLK = DIN = low, R_{BIAS} = 11kΩ, T_A = +25°C using the MAX2828/MAX2829 evaluation kits.)

802.11a

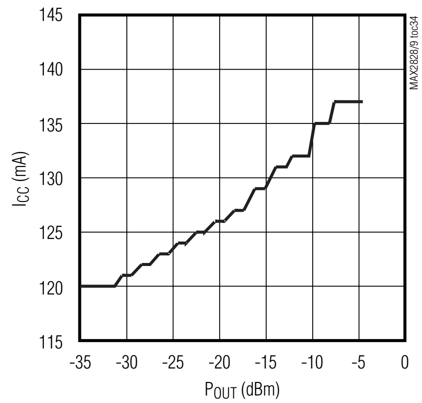
RX I_{CC} vs. V_{CC}



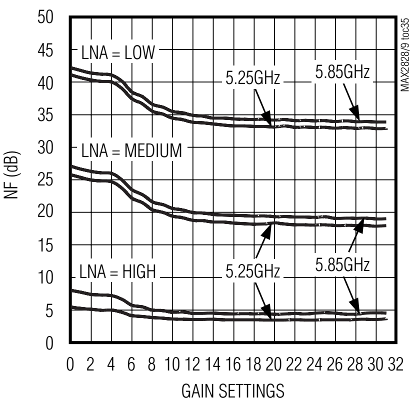
TX I_{CC} vs. V_{CC}



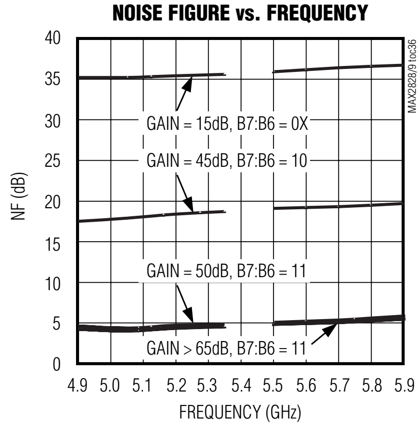
TX I_{CC} vs. P_{OUT}



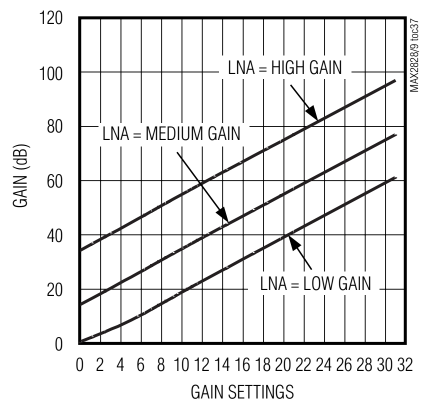
NOISE FIGURE vs. BASEBAND GAIN SETTINGS



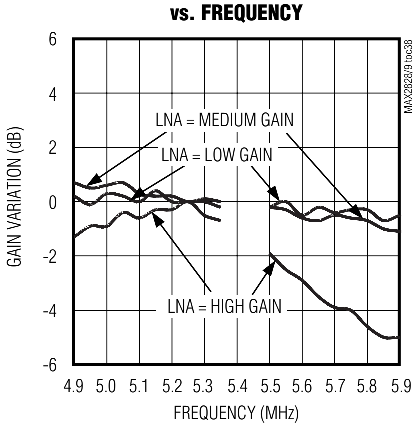
NOISE FIGURE vs. FREQUENCY



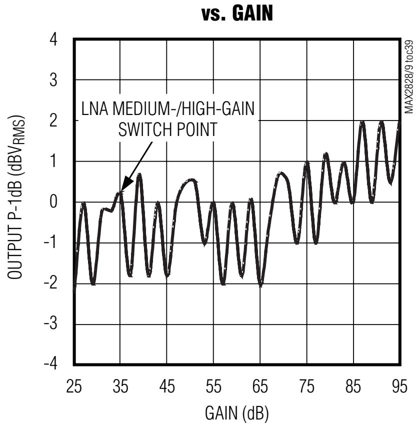
RX VOLTAGE GAIN vs. BASEBAND GAIN SETTING



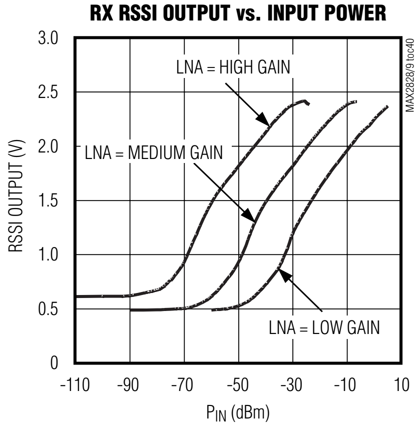
RX VOLTAGE GAIN VARIATION vs. FREQUENCY



RX IN-BAND OUTPUT P-1dB vs. GAIN



RX RSSI OUTPUT vs. INPUT POWER

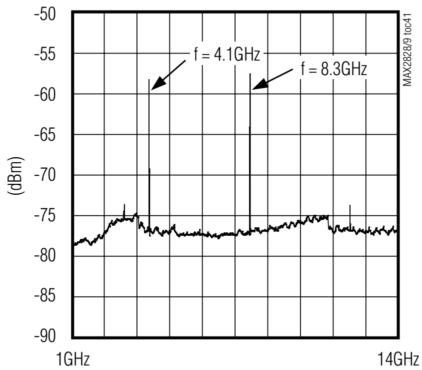


典型工作特性 (续)

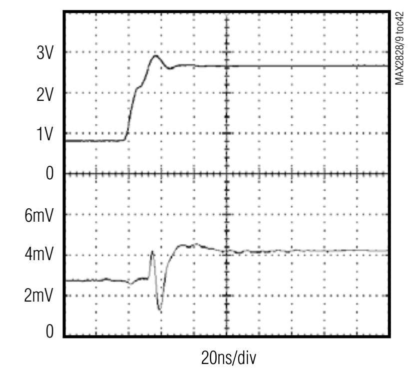
(V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, RXHP = SCLK = DIN = low, R_{BIAS} = 11kΩ, T_A = +25°C using the MAX2828/MAX2829 evaluation kits.)

802.11a

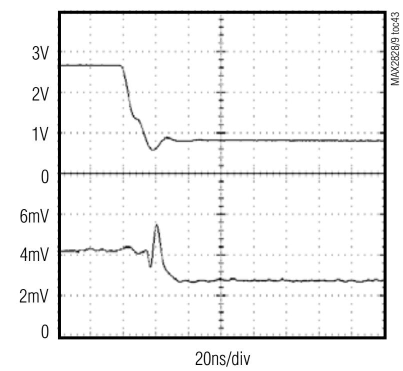
RX EMISSION SPECTRUM, LNA INPUT (TX OFF, LNA = LOW GAIN)



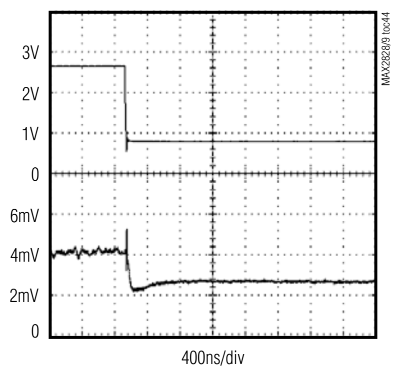
RX I/Q DC OFFSET SETTLING RESPONSE (+8dB BB VGA GAIN STEP)



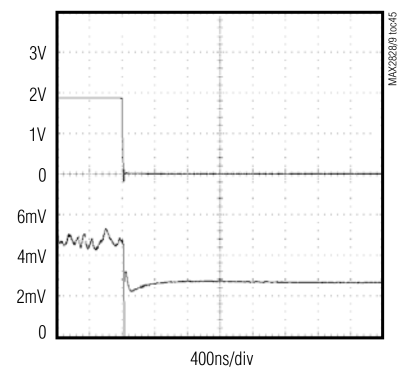
RX I/Q DC OFFSET SETTLING RESPONSE (-8dB BB VGA GAIN STEP)



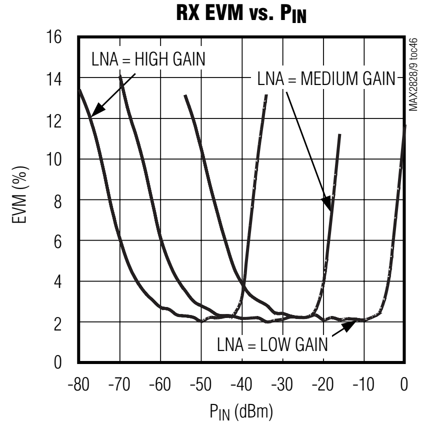
RX I/Q DC OFFSET SETTLING RESPONSE (-16dB BB VGA GAIN STEP)



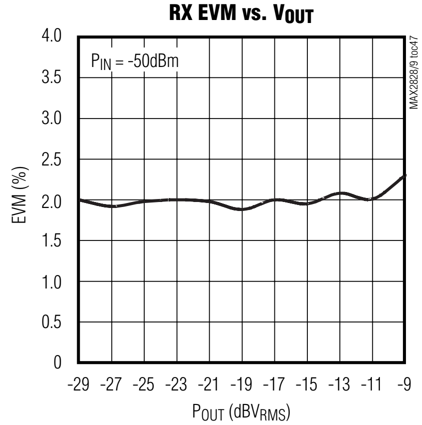
RX I/Q DC OFFSET SETTLING RESPONSE (-32dB BB VGA GAIN STEP)



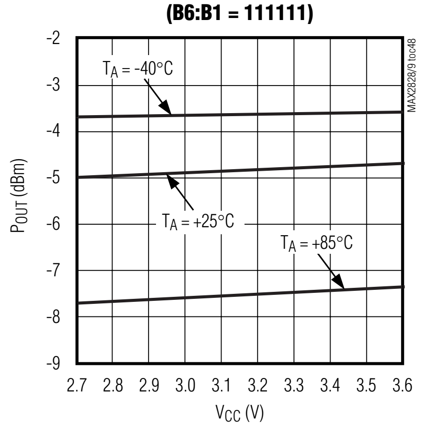
RX EVM vs. P_{IN}



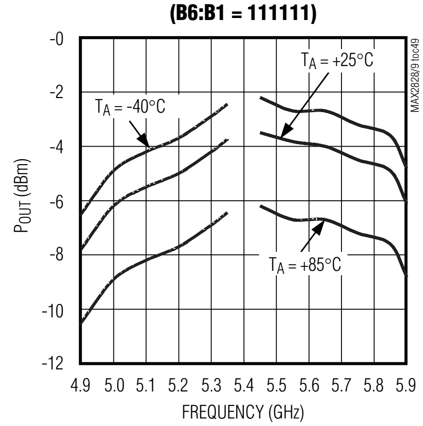
RX EVM vs. V_{OUT}



TX OUTPUT POWER vs. V_{CC} (B6:B1 = 111111)



TX OUTPUT POWER vs. FREQUENCY (B6:B1 = 111111)

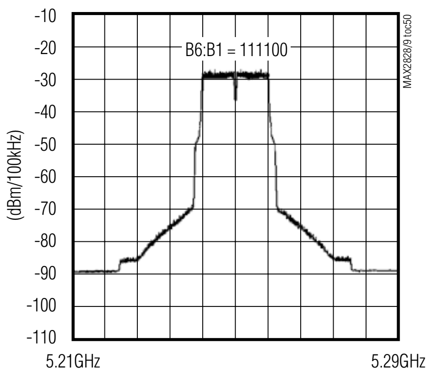


典型工作特性 (续)

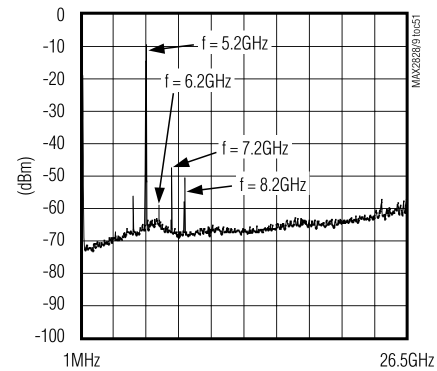
(V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, RXHP = SCLK = DIN = low, R_{BIAS} = 11kΩ, T_A = +25°C using the MAX2828/MAX2829 evaluation kits.)

802.11a

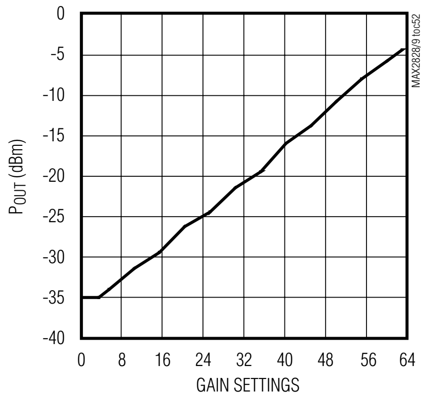
TX OUTPUT SPECTRUM (54Mbps OFDM SIGNAL)



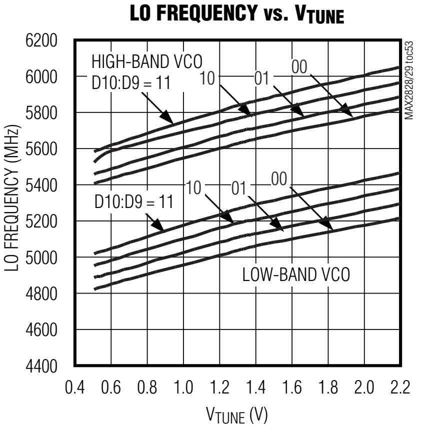
TX OUTPUT SPECTRUM



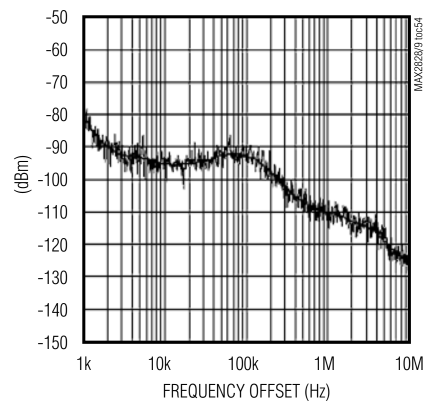
TX OUTPUT POWER vs. GAIN SETTINGS



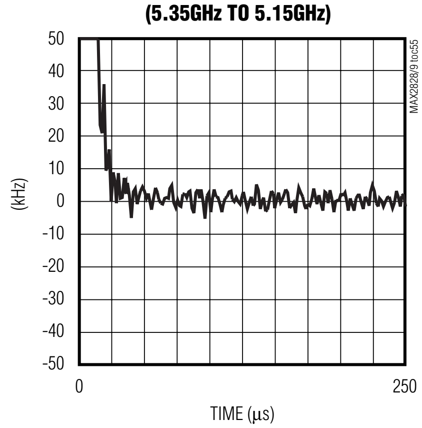
LO FREQUENCY vs. VTUNE



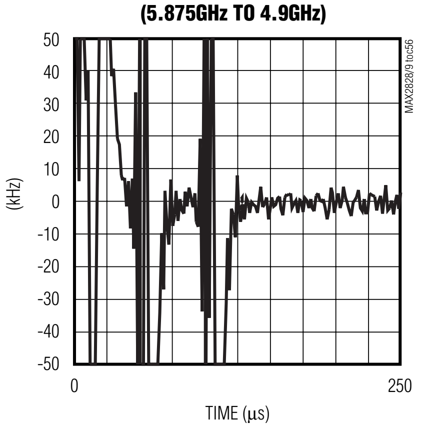
CLOSED-LOOP PHASE NOISE



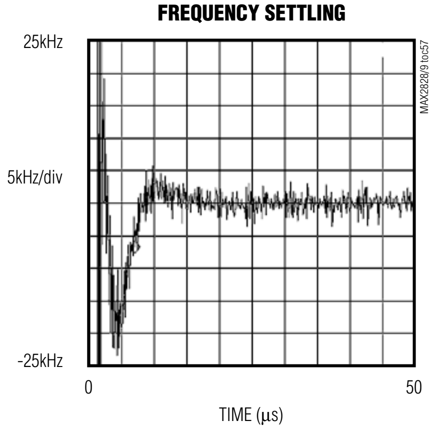
CHANNEL-SWITCHING FREQUENCY SETTLING (5.35GHz TO 5.15GHz)



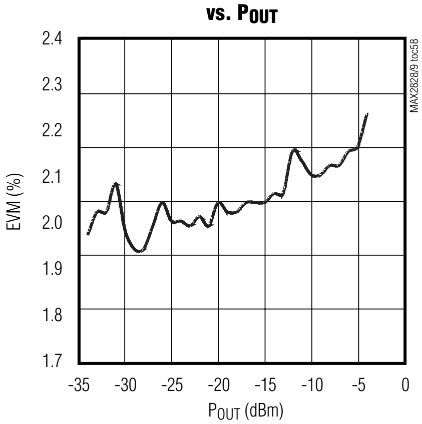
CHANNEL-SWITCHING FREQUENCY SETTLING (5.875GHz TO 4.9GHz)



TX-RX TURNAROUND FREQUENCY SETTLING



TX EVM vs. POUT



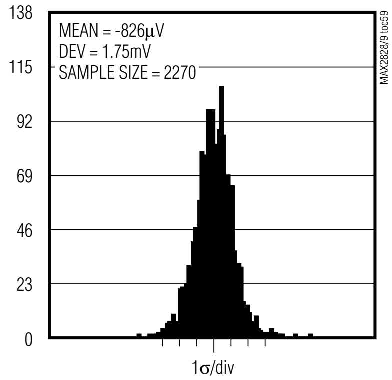
MAX2828/MAX2829
单/双频、802.11a/b/g 全波段收发器 IC

典型工作特性 (续)

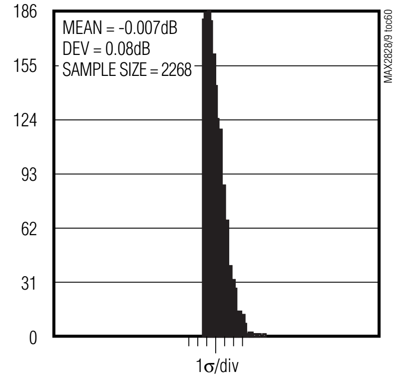
(V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, RXHP = SCLK = DIN = low, R_{BIAS} = 11kΩ, T_A = +25°C using the MAX2828/MAX2829 evaluation kits.)

802.11a

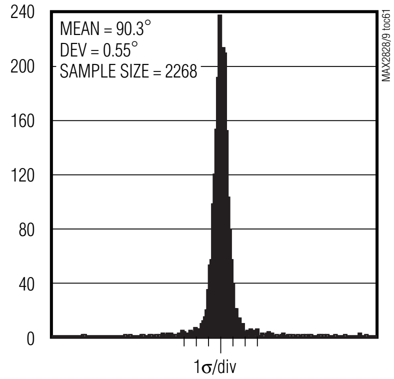
RX STATIC DC OFFSET



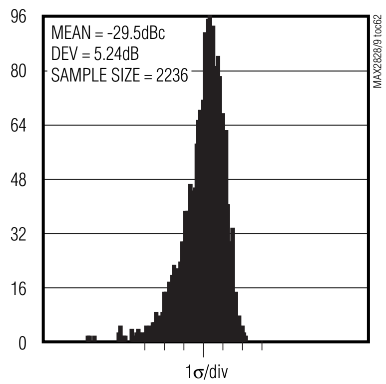
RX GAIN IMBALANCE



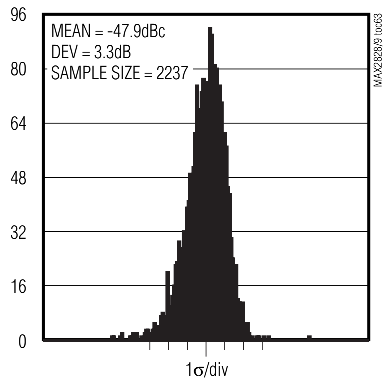
RX PHASE IMBALANCE



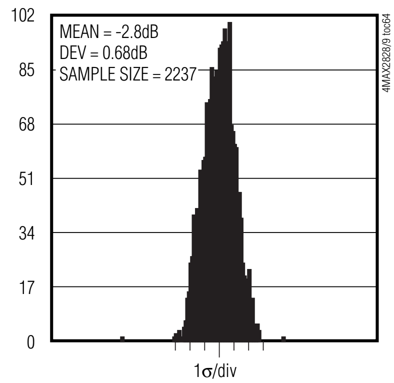
TX LO LEAKAGE



TX SIDEBAND SUPPRESSION

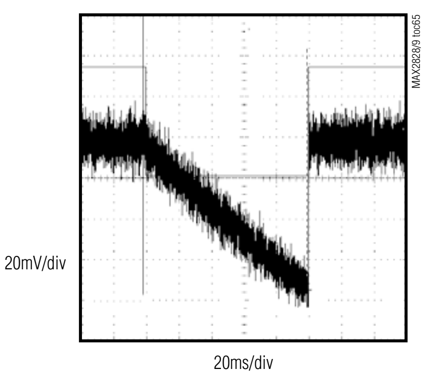


802.11a TX P_{OUT} AT 5.25GHz

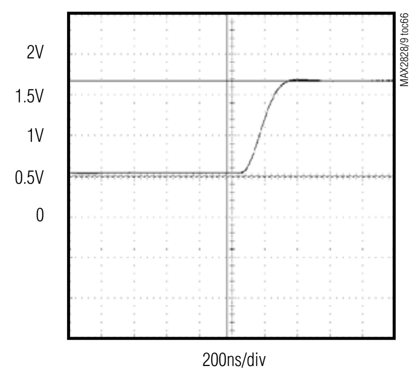


802.11g/802.11a

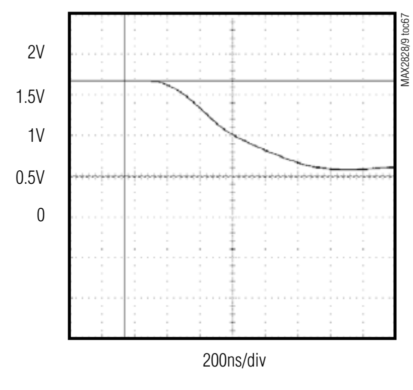
I/Q OUTPUT DC ERROR DROOP (RXHP = 1–0; A3:A1 = 1000, D2 = 0)



RX RSSI STEP RESPONSE (+40dB SIGNAL STEP)



RX RSSI STEP RESPONSE (-40dB SIGNAL STEP)

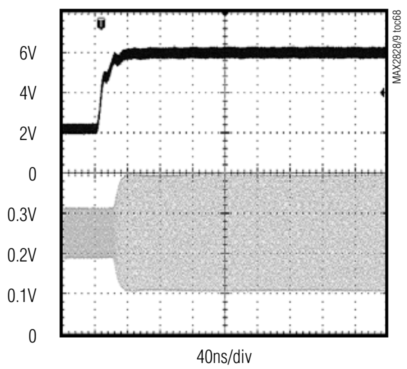


典型工作特性 (续)

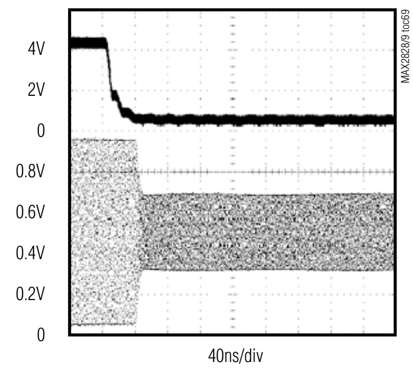
(V_{CC} = 2.7V, f_{RF} = 2.437GHz (802.11g) or f_{RF} = 5.25GHz (802.11a), f_{REFOSC} = 40MHz, $\overline{SHDN}$ = $\overline{CS}$ = high, RXHP = SCLK = DIN = low, R_{BIAS} = 11kΩ, T_A = +25°C using the MAX2828/MAX2829 evaluation kits.)

802.11g/802.11a

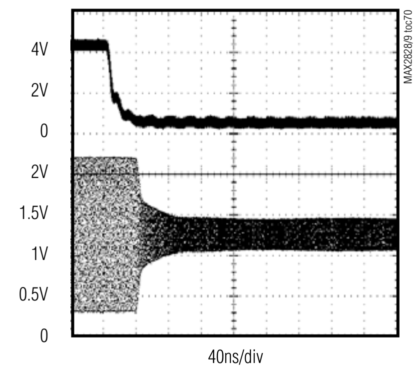
RX BB VGA SETTLING RESPONSE (+8dB GAIN STEP)



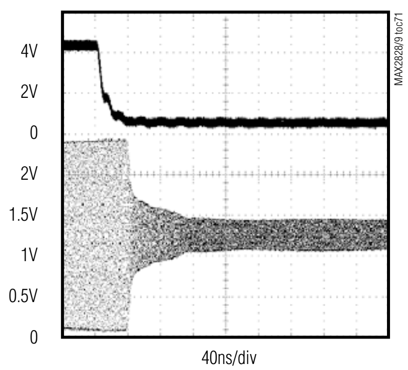
RX BB VGA SETTLING RESPONSE (-8dB GAIN STEP)



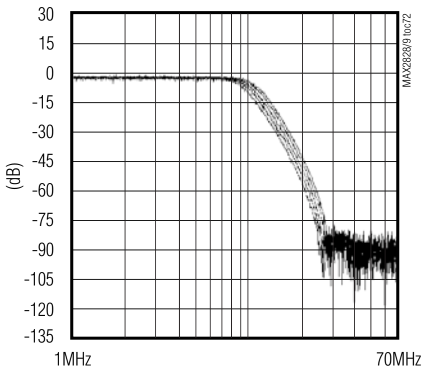
RX BB VGA SETTLING RESPONSE (-16dB GAIN STEP)



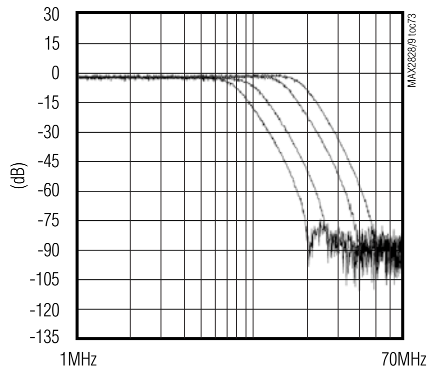
RX BB VGA SETTLING RESPONSE (-32dB GAIN STEP)



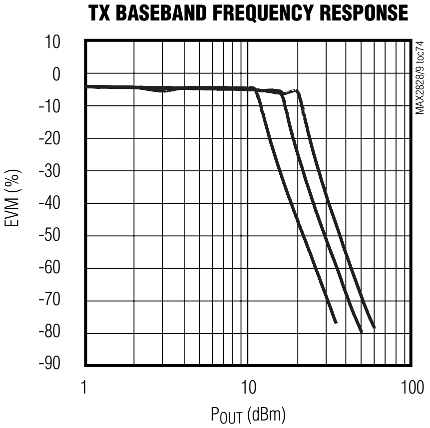
RX BB FREQUENCY RESPONSE vs. FINE SETTING (COARSE SETTING = 9.5MHz)



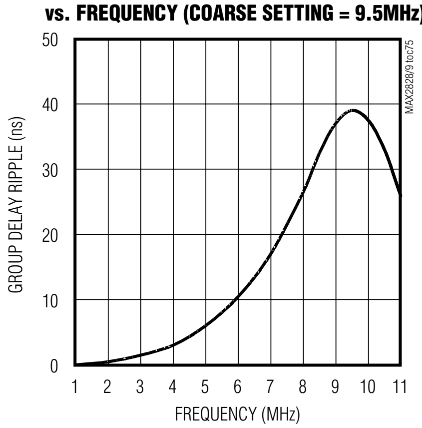
RX BB FREQUENCY RESPONSE vs. COARSE SETTING (FINE SETTING = 010)



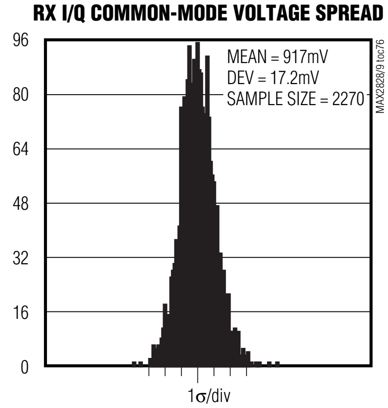
TX BASEBAND FREQUENCY RESPONSE



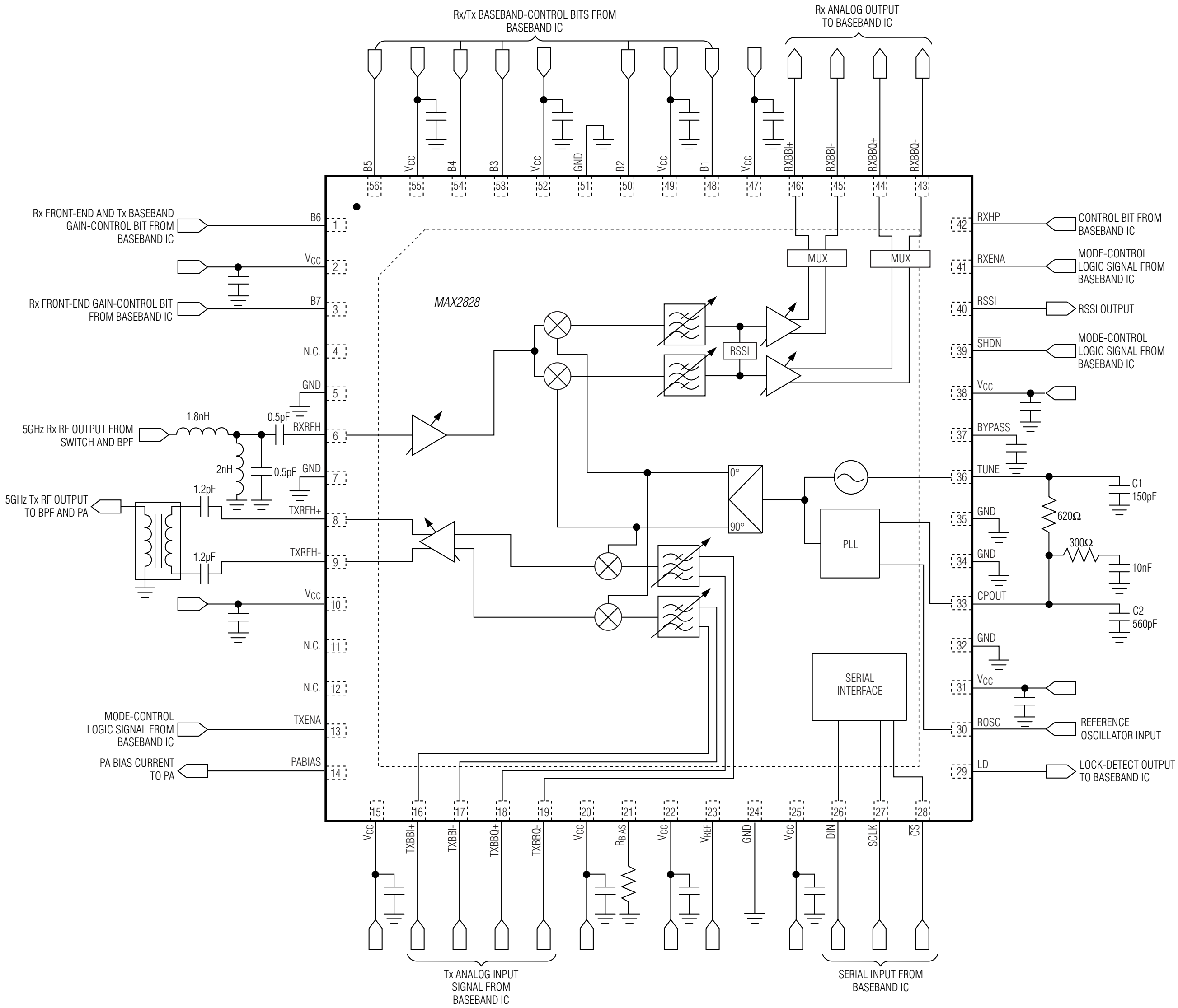
GROUP DELAY RIPPLE vs. FREQUENCY (COARSE SETTING = 9.5MHz)



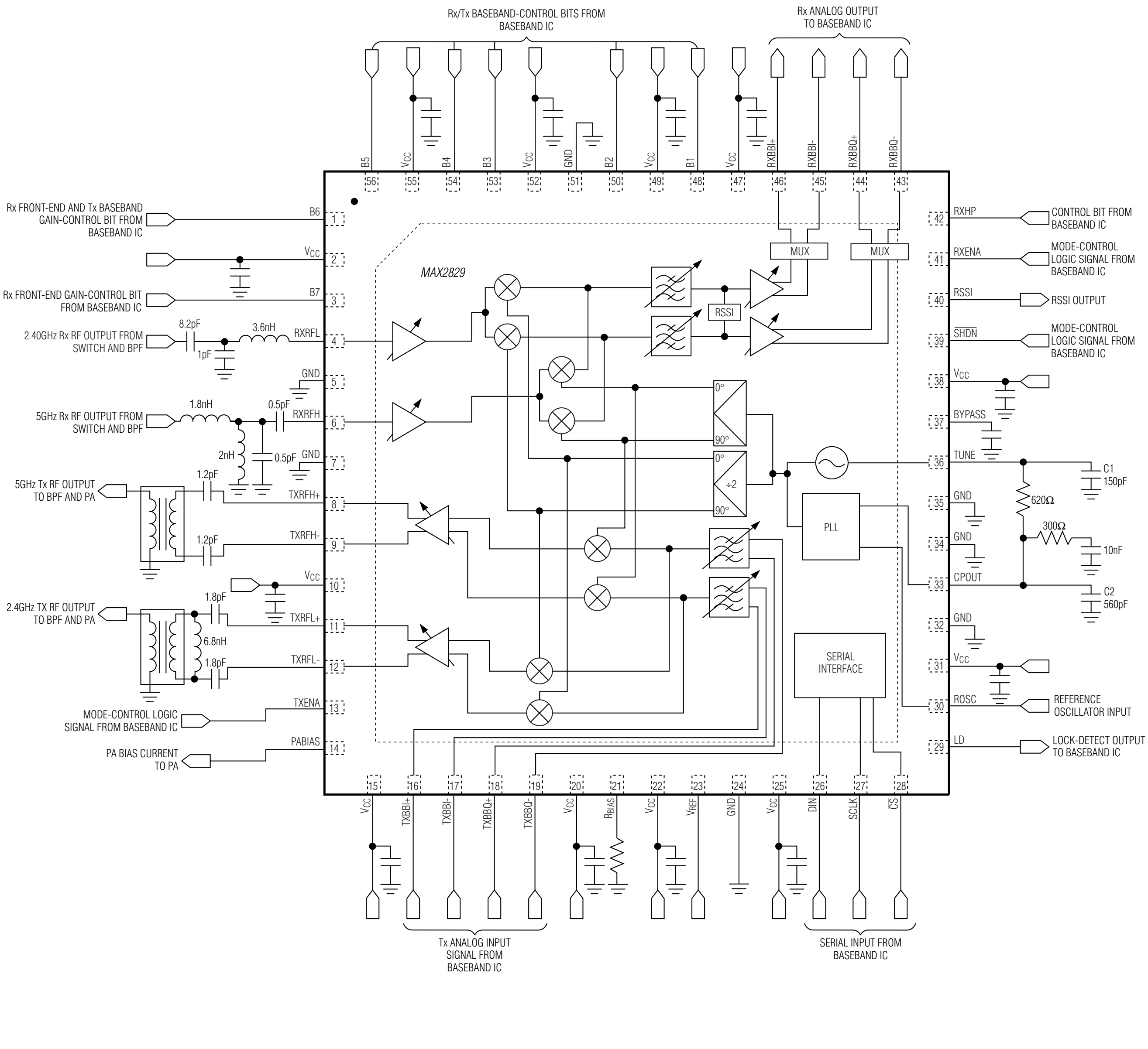
RX I/Q COMMON-MODE VOLTAGE SPREAD



原理框图/典型工作电路


Rx/Tx BASEBAND-CONTROL BITS FROM BASEBAND IC
Rx ANALOG OUTPUT TO BASEBAND IC
B5
VCC
B4
B3
VCC
GND
B2
VCC
B1
VCC
RXBBI+
RXBBI-
RXBBQ+
RXBBQ-
Rx FRONT-END AND Tx BASEBAND GAIN-CONTROL BIT FROM BASEBAND IC
B6
VCC
Rx FRONT-END GAIN-CONTROL BIT FROM BASEBAND IC
B7
N.C.
GND
5GHz Rx RF OUTPUT FROM SWITCH AND BPF
1.8nH
0.5pF
RXRFH
2nH
0.5pF
GND
5GHz Tx RF OUTPUT TO BPF AND PA
1.2pF
TXRFH+
1.2pF
TXRFH-
VCC
N.C.
N.C.
MODE-CONTROL LOGIC SIGNAL FROM BASEBAND IC
TXENA
PA BIAS CURRENT TO PA
PABIAS
MAX2828
MUX
MUX
RSSI
0°
90°
PLL
SERIAL INTERFACE
RXHP
CONTROL BIT FROM BASEBAND IC
RXENA
MODE-CONTROL LOGIC SIGNAL FROM BASEBAND IC
RSSI
RSSI OUTPUT
SHDN
MODE-CONTROL LOGIC SIGNAL FROM BASEBAND IC
VCC
BYPASS
TUNE
C1 150pF
GND
620Ω
GND
300Ω
10nF
CPOUT
C2 560pF
GND
VCC
ROSC
REFERENCE OSCILLATOR INPUT
LD
LOCK-DETECT OUTPUT TO BASEBAND IC
VCC
TXBBI+
TXBBI-
TXBBQ+
TXBBQ-
VCC
RBIAS
VCC
VREF
GND
VCC
DIN
SCLK
CS
Tx ANALOG INPUT SIGNAL FROM BASEBAND IC
SERIAL INPUT FROM BASEBAND IC

原理框图/典型工作电路 (续)



引脚说明

引脚		名称	功能
MAX2828	MAX2829		
1	1	B6	Rx前端和Tx增益控制数字输入第6位。
2	2	V_{CC}	2.4GHz/5GHz LNA电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。
3	3	B7	Rx前端增益控制数字输入第7位。
4, 11, 12	—	N.C.	无需连接，引脚悬空。
5	5	GND	LNA地。接地过孔的连线应尽可能短。地过孔不能与其他支路共用。
6	6	RXRFH	5GHz单端LNA输入。需要交流耦合和外部匹配网络。
7	7	GND	LNA地。接地过孔引线应尽可能短，而且，接地过孔不能与其他支路共用。
8	8	TXRFH+	5GHz Tx PA驱动器差分输出。与外部PA输入之间需要交流耦合和外部匹配网络(以及非平衡变压器)。
9	9	TXRFH-	
10	10	V_{CC}	Tx RF电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。
13	13	TXENA	Tx模式使能数字输入。设置为高电平使能Tx (见图1)。
14	14	PABIAS	DAC电流输出。直接连接到外部PA的偏置引脚。
15	15	V_{CC}	Tx基带滤波器电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。
16	16	TXBBI+	Tx基带I通道差分输入。
17	17	TXBBI-	
18	18	TXBBQ+	Tx基带Q通道差分输入。
19	19	TXBBQ-	
20	20	V_{CC}	Tx上变频器电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。
21	21	R_{BIAS}	该模拟输入内部偏置在带隙基准电压，外部接11kΩ精密电阻或在该引脚与地之间接电流源，设置器件的偏置电流。
22	22	V_{CC}	基准电路电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。
23	23	V_{REF}	基准电压输出。
24	24	GND	数字电路地。接地过孔的连线应尽可能短。地过孔不能与其他支路共用。
25	25	V_{CC}	数字电路电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。

引脚说明 (续)

引脚		名称	功能
MAX2828	MAX2829		
26	26	DIN	3线串行接口数字输入 (见图2)。
27	27	SCLK	3线串行接口时钟输入 (见图2)。
28	28	$\overline{CS}$	3线串行接口使能输入,低电平有效 (见图2)。
29	29	LD	频率合成器的锁定检测数字输出。输出高电平表示频率合成器锁定。
30	30	ROSC	参考振荡器输入，将外部参考振荡器连接到该模拟输入引脚。
31	31	V_{CC}	PLL电荷泵电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。
32	32	GND	电荷泵电路地。接地过孔的连线应尽可能短。地过孔不能与其他支路共用。
33	33	CPOUT	电荷泵输出。在CPOUT和TUNE之间接频率合成器的环路滤波器。该引脚与调谐输入的连线要尽可能短，以避免拾取杂散信号。C2尽可能靠近CPOUT连接。电容的接地过孔不要与其他支路共用 (见*典型工作电路*)。
34	34	GND	地。接地过孔的连线应尽可能短。地过孔不能与其他支路共用。
35	35	GND	VCO地。接地过孔的连线应尽可能短。地过孔不能与其他支路共用。
36	36	TUNE	VCO调谐输入。C1尽可能靠近TUNE连接，C1的接地端连接到VCO地。电容的接地过孔不要与其他支路共用 (见*典型工作电路*)。
37	37	BYPASS	用0.1μF电容旁路到地。这个电容供内部VCO稳压器使用。
38	38	V_{CC}	VCO电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。
39	39	$\overline{SHDN}$	低电平有效的关断输入。设置为高电平时器件使能。
40	40	RSSI	RSSI或温度传感器复用输出。
41	41	RXENA	Rx模式使能输入。设置为高电平时Rx使能。
42	42	RXHP	Rx基带交流耦合高通滤波器转角频率控制输入选择位。
43	43	RXBBQ-	Rx基带Q信道差分输出。在Tx校准模式中，这两个引脚为本振泄漏和边带检测输出。
44	44	RXBBQ+	
45	45	RXBBI-	Rx基带I信道差分输出。在Tx校准模式中，这两个引脚为本振泄漏和边带检测输出。
46	46	RXBBI+	
47	47	V_{CC}	Rx基带缓冲器电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。
48	48	B1	Rx/Tx增益控制数字输入第1位。
49	49	V_{CC}	Rx基带滤波器电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。

引脚说明(续)

引脚		名称	功能
MAX2828	MAX2829		
50	50	B2	Rx/Tx增益控制数字输入第2位。
51	51	GND	Rx IF地。接地过孔的连线应尽可能短。地过孔不能与其他支路共用。
52	52	V_{CC}	Rx IF电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。
53	53	B3	Rx/Tx增益控制数字输入第3位。
54	54	B4	Rx/Tx增益控制数字输入第4位。
55	55	V_{CC}	Rx下变频电源电压。用尽可能靠近该引脚的电容旁路到地，旁路电容的接地过孔不能与其他支路共用。
56	56	B5	Rx/Tx增益控制数字输入第5位。
—	4	RXRFL	2.4GHz单端LNA输入。需要交流耦合和外部匹配网络。
—	11	TXRFL+	2.4GHz Tx PA驱动器差分输出。与外部PA输入之间需要交流耦合和外部匹配网络(以及非平衡变压器)。
—	12	TXRFL-	
EP	EP	裸露焊盘	裸露焊盘。焊盘为保证正常工作和散热，用多个过孔连接到地平面。

表5. 模式表

MODE	LOGIC PINS			REGISTER SETTINGS
	$\overline{SHDN}$	TXENA	RXENA	
SPI™ Reset	0	1	1	X
Shutdown	0	0	0	X
Standby	1	0	0	X
Rx	1	0	1	X
Tx	1	1	0	X
Tx Calibration	1	1	0	Calibration register D1 = 1
Rx Calibration	1	0	1	Calibration register D0 = 1

X = 无关或无效。

详细说明

MAX2828/MAX2829为单芯片射频收发器芯片，专门设计用于WLAN应用。MAX2828设计用于5GHz 802.11a (OFDM) 应用，而MAX2829用于双频2.4GHz 802.11b/g和5GHz 802.11a应用。这两款芯片都包括了实现RF收发功能的所有电路，提供完全集成的接收通道、发射通道、VCO、频率合成器以及基带/控制接口。

工作模式

MAX2828/ MAX2829具有七个主要工作模式：关断、SPI复位、待机、发送、接收、发送校准和接收校准(见表5)。

SPI是Motorola, Inc.的商标。

关断模式

将 $\overline{SHDN}$ 拉低进入关断模式。关断模式下，除了串行接口以外其它所有电路模块均关断。在器件处于关断模式时，只要保持 V_{CC} (引脚 25) 电压，串行接口寄存器的数值将保持有效并可以修改。

SPI复位

将RXENA和TXENA驱动为高电平，同时 $\overline{SHDN}$ 置为低电平，所有电路将被关断，与关断模式相同。但是，SPI复位模式下所有寄存器将返回到缺省状态。建议在上电启动后复位SPI和所有寄存器，以保证寄存器设置正确(见表9)。

待机模式

$\overline{SHDN}$ 置为高电平，RXENA和TXENA为低电平，器件进入待机模式。该模式主要用于使能频率合成器模块，同时关断器件的其余电路。在此模式下，系统中的各个模块可根据待机寄存器表 (表 10) 选择开启或关断。

接收 (Rx) 模式

将RXENA置为高电平，器件进入接收模式。该模式下所有接收电路使能。

发送 (Tx) 模式

将TXENA置为高电平，器件进入发送模式。该模式下所有发送电路使能。

Tx/Rx校准模式

MAX2828/MAX2829具有Tx/Rx校准模式，可检测I/Q不平衡和发送LO泄漏。在Tx校准模式中，仅对信道中心频率的LO泄漏信号 (例如OFDM或QPSK频谱中心) 进行LO泄漏校准。LO泄漏校准包括在I/Q调制器的基带通道中所有直流失调的影响，还包括LO在I/Q调制器输出的直接泄漏。

校准期间，可以在接收器I或Q信道输出获得LO泄漏和边带检测输出。

在Tx LO泄漏和I/Q不平衡校准过程中，正弦信号和余弦信号 ($f = f_{TONE}$) 从基带IC输入到基带 I/Q Tx引脚。在LO泄漏和边带检测输出中，LO泄漏对应于频率 f_{TONE} 处的信号，而边带抑制则对应于频率 $2 \times f_{TONE}$ 处的信号。LO泄漏和所不希望的边带电平变化1dB，这些信号的输出功率将随之变化2dB。为了校准Tx通道，首先将功率检测器增益设置为8dB (表14)。调整基带输入的直流偏移以减小频率 f_{TONE} 处的信号 (LO泄漏)。然后，调整与基带输入相关的幅度和相位偏移，从而减小频率 $2 \times f_{TONE}$ 处的信号。如果需要，可以在更高的LO泄漏和边带检测器增益设置进行校准，以降低LO泄漏,增强镜频抑制。

校准发送器后，可对接收器进行校准。Rx校准模式中，经过校准的 Tx RF信号内部连接到接收器下变频输入。在这个闭环校准模式下，因为Tx和Rx同时工作，稳压器必须能够提供350mA的电流。

5GHz模式下RF频率合成器的设置

在5GHz模式下，RF频率合成器覆盖了4.9GHz至5.9GHz频率范围。为获得如此大的调谐范围，同时保持优异的噪声性能，1GHz频段在VCO调谐范围内划分成了子频段。VCO子频段的选择由有限状态机制 (FSM) 自动完成。对于1GHz的信道频率变化，PLL的建立时间大约为300µs。可通过VCO子频段手动设置、取消FSM，获得更快的PLL建立时间。

自动VCO子频段选择

使能子频段选择模式，只需对1位数据进行编程，以启动频率捕获功能。选定正确的VCO子频段、PLL锁定后，FSM自动停止。

表6. B1:B0 VCO子频段分配
(通过锁存检测引脚回读)

B1	B0	VCO FREQUENCY BAND
0	0	Band 0 (lowest frequency band)
0	1	Band 1
1	0	Band 2
1	1	Band 3 (highest frequency band)

需遵循以下步骤:

1) 设置D8 = 0 (A3:A0 = 0101)使能VCO子频段自动选择FSM。
2) 如果需要，使能PLL和VCO。必要时，对信道频率对应的分频比进行编程。
3) 设置D7 = 1 (A3:A0 = 0101)启动FSM。FSM仅在PLL和VCO使能后或在信道频率改变后启动。
4) VCO子频段选择和PLL的建立时间小于300µs。在频段切换完成以及PLL锁定到正确的信道频率之后，FSM自动停止。

每当编程信道频率或者PLL+VCO使能时，需要复位FSM，以便下一次使用。复位操作不会影响PLL和VCO。设置D7 = 0 (A3:A0 = 0101)复位FSM。

每个信道频率映射到某个VCO子频段。每个VCO子频段具有数字代码，2个最低位(B1:B0)可读。B1:B0码可通过引脚LD读取，设置D3:D0 = 0111 (A3:A0 = 0000)读取B1，设置D3:D0 = 0110 (A3:A0 = 0000)读取B0 (见表6)。

VCO子频段手动选择

为快速建立，可通过SPI对VCO子频段(B1:B0)直接编程。首先，必须确定每个信道频率的B1:B0码。一旦确定后，对于给定的信道频率，B1:B0码可与PLL分频比一起编程。在这种情况下，PLL建立时间约为50µs。

温度变化较大时(>+50°C)可能会导致信道频率进入邻界的子频段。为确定正确的子频段，两个片内比较器监视VCO的控制电压(V_{TUNE})。这些比较器的逻辑输出可通过LD引脚读取，以决定子频段是否正确或是否需要重新编程。

表7. D10:D9 VCO子频段分配
(通过SPI编成)

D10	D9	PROGRAMMED VCO FREQUENCY BAND
0	0	Band 0
0	1	Band 1
1	0	Band 2
1	1	Band 3

表8. 比较器输出定义

A3:A1 = 0000; D3:D0 = 0101	A3:A1 = 0000; D3:D0 = 0100	RESPONSE
0	0	Program to a lower sub-band if VCO is not in Band 0.
0	1	No change.
1	0	Program to a higher sub-band if VCO is not in Band 3.
1	1	Invalid state, does not occur.

按照以下步骤完成手动PLL频率捕捉和VCO子频段选择:

1) 设置D8 = 1 (A3:A0 = 0101)使能VCO子频段手动选择。
2) 如果需要，使能PLL和VCO。如果需要，编程信道频率对应的分频比。
3) 设置D10:D9 (A3:A0 = 0101)，按照表7对VCO频率子频段进行编程。D10:D9与B1:B0频段分配相同。在D10:D9编程后，PLL需要50µs的建立时间。
4) 经过50µs的PLL建立时间后，可通过LD引脚读取比较器输出(见表8)。
5) 根据比较器输出，VCO频率子频段可按照表8再次编程，直到捕捉到需要的频率。

较大的温度变化

如果PLL和VCO连续有效(即没有重新编程)，而且管芯温度变化了50°C (由片内温度传感器指示)，这种情况

表 9. 寄存器缺省值/SPI 复位设置

REGISTER	DEFAULT														ADDRESS	TABLE
	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	(A3:A0)	
Register 0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0000	—
Register 1	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0001	—
Standby	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0010	10
Integer-Divider Ratio	1	1	0	0	0	0	1	0	1	0	0	0	1	0	0011	11
Fractional-Divider Ratio	0	1	1	1	0	1	1	1	0	1	1	1	0	1	0100	12
Band Select and PLL	0	1	1	0	0	0	0	0	1	0	0	1	0	0	0101	13
Calibration	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0110	14
Lowpass Filter	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0111	15
Rx Control/RSSI	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1000	16
Tx Linearity/Baseband Gain	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1001	17
PA Bias DAC	0	0	0	0	1	1	1	1	0	0	0	0	0	0	1010	18
Rx Gain	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1011	19
Tx VGA Gain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1100	20

表 10. 待机寄存器 (A3:A0 = 0010)

DATA BIT	DEFAULT	DESCRIPTION
D13	0	MIMO Select. Set to 0 for normal operation. Set to 1 for MIMO applications.
D12	1	Set to 1
D11	0	Voltage Reference (Pin 23)
D10	0	PA Bias DAC, in Tx Mode
D9	0	Set to 0
D8	0	
D7	0	
D6	0	
D5	0	
D4	0	
D3	0	
D2	1	Set to 1
D1	1	
D0	1	

下，由于 VCO 漂移到了临界子频段，PLL 有可能失锁。此时，建议对 PLL 进行手动设置或自动子频段选择。

可编程寄存器

MAX2828/MAX2829 包括 13 个可编程、18 位寄存器：0、1、待机、整数分频比、分数分频比、频段选择和 PLL、校准、低通滤波器、Rx 控制/RSSI、Tx 线性特性/基带增益、PA 偏置 DAC、Rx 增益以及 Tx VGA 增益。14 位高有效位 (MSB) 用作寄存器数据，每个寄存器的 4 位低有效位 (LSB) 包含寄存器地址。数据高位在前传输，发送到器件的 18 位数据由 $\overline{CS}$ 控制。当 $\overline{CS}$ 为低电平时，时钟有效，在时钟上升沿数据串行移入器件。当 $\overline{CS}$ 变为高电平时，移位寄存器的数值锁存到由地址位选择的寄存器中，移位寄存器仅保留最后移入器件的 18 位数据，数据移入过程中不检验时钟脉冲。编程数据字低于 14 位时，仅需移入所需要的数据位和地址位，这样，可以得

表11. 整数分频比寄存器 (A3:A0 = 0011)

DATA BIT	DEFAULT	DESCRIPTION
D13	1	2 LSBs of the Fractional-Divider Ratio
D12	1	
D11	0	Set to 0
D10	0	
D9	0	
D8	0	
D7	1	Integer-Divider Ratio Word Programming Bits. Valid values are from 128 (D7:D0 = 10000000) to 255 (D7:D0 = 11111111).
D6	0	
D5	1	
D4	0	
D3	0	
D2	0	
D1	1	
D0	0	

到更快的Rx/Tx增益控制，其中仅LSB需要编程。可通过兼容于3线SPI/MICROWIRE™的串行接口进行编程。

启动时，建议把器件设置为SPI复位模式 (表5)，将所有寄存器复位。

待机寄存器定义 (A3:A0 = 0010)

利用待机寄存器 (在待机模式，见表10) 可以开启或关断内部各部分电路。设置位为1开启电路，设置位为0则关断电路。

整数分频比寄存器定义 (A3:A0 = 0011)

该寄存器包含频率合成器分频比的整数部分，与分数分频比寄存器配合使用能够精确选择频率。主频率合成器分频比整数部分为8位 (见表11)。该寄存器的有效数值为128至255 (D7−D0)，缺省值为210。D13和D12保留用作分数分频比的2个LSB。

分数分频比寄存器定义 (A3:A0 = 0100)

该寄存器 (连同整数分频比寄存器中的D13和D12) 以16位精度控制分数分频比。寄存器中的D13至D0与整数分频比寄存器中的D13和D12构成整个分数分频比 (见表12a和12b)。

MICROWIRE是National Semiconductor Corp.的商标。

表12a. IEEE 802.11g频率规划和分频比编程字

f_{RF} (MHz)	(f_{RF} x 4/3) / 20MHz (DIVIDER RATIO)	INTEGER-DIVIDER RATIO	FRACTIONAL-DIVIDER RATIO	
		A3:A0 = 0011, D7:D0	A3:A0 = 0100, D13:D0 (hex)	A3:A0 = 0011, D13:D12 (hex)
2412	160.8000	1010 0000	3333	00
2417	161.1333	1010 0001	0888	10
2422	161.4667	1010 0001	1DDD	11
2427	161.8000	1010 0001	3333	00
2432	162.1333	1010 0010	0888	10
2437 (default)	162.4667	1010 0010	1DDD	11
2442	162.8000	1010 0010	3333	00
2447	163.1333	1010 0011	0888	10
2452	163.4667	1010 0011	1DDD	11
2457	163.8000	1010 0011	3333	00
2462	164.1333	1010 0100	0888	10
2467	164.4667	1010 0100	1DDD	11
2472	164.8000	1010 0100	3333	00
2484	165.6000	1010 0101	2666	01

表 12b. IEEE 802.11a 频率规划和分频比编程字

f_{RF} (MHz)	(f_{RF} X 4/5) / 20MHz (DIVIDER RATIO)	INTEGER-DIVIDER RATIO	FRACTIONAL-DIVIDER RATIO	
		A3:A0 = 0011, D7:D0	A3:A0 = 0100, D13:D0 (hex)	A3:A0 = 0011, D13:D12 (hex)
5180	207.2	1100 1111	0CCC	11
5200	208.0	1101 0000	0000	00
5220	208.8	1101 0000	3333	00
5240	209.6	1101 0001	2666	01
5260	210.4	1101 0010	1999	10
5280	211.2	1101 0011	0CCC	11
5300	212.0	1101 0100	0000	00
5320	212.8	1101 0100	3333	00
5500	220.0	1101 1100	0000	00
5520	220.8	1101 1100	3333	00
5540	221.6	1101 1101	2666	01
5560	222.4	1101 1110	1999	10
5580	223.2	1101 1111	0CCC	11
5600	224.0	1110 0000	0000	00
5620	224.8	1110 0000	3333	00
5640	225.6	1110 0001	2666	01
5660	226.4	1110 0010	1999	10
5680	227.2	1110 0011	0CCC	11
5700	228.0	1110 0100	0000	00
5745	229.8	1110 0101	3333	00
5765	230.6	1110 0110	2666	01
5785	231.4	1110 0111	1999	10
5805	232.2	1110 1000	0CCC	11

表 13. 频段选择和PLL 寄存器 (A3:A0 = 0101)

DATA BIT	DEFAULT	DESCRIPTION
D13	0	Set to 0 for Normal Operation. Set to 1 for MIMO applications.
D12	1	Set D12:D11 = 11
D11	1	
D10	0	These Bits Set the VCO Sub-Band when Programmed Using the SPI (D8 = 1). D10:D9 = 00: lowest frequency band; 11: highest frequency band.
D9	0	
D8	0	VCO SPI Bandswitch Enable. 0: disable SPI control, bandswitch is done by FSM; 1: bandswitch is done by SPI programming.
D7	0	VCO Bandswitch Enable. 0: disable; 1: start automatic bandswitch.
D6	0	RF Frequency Band Select in 802.11a Mode (D0 = 1). 0: 4.9GHz to 5.35GHz Band; 1: 5.47GHz to 5.875GHz Band.
D5	1	PLL Charge-Pump-Current Select. 0: 2mA; 1: 4mA.
D4	0	Set to 0
D3	0	These Bits Set the Reference-Divider Ratio. D3:D1 = 001 corresponds to R = 1 and 111 corresponds to R = 7.
D2	1	
D1	0	
D0	0	RF Frequency Band Select. 0: 2.4GHz Band; 1: 5GHz band.

频段选择和PLL 寄存器定义 (A3:A0 = 0101)

该寄存器用于配置合成器的可编程参考频率分频比，并用于设置电荷泵的直流电流。可编程参考频率分频比通过对晶体振荡器分频为鉴相器提供参考频率 (见表 13)。

校准寄存器定义 (A3:A0 = 0110)

该寄存器用于配置 Rx/Tx 校准模式 (见表 14)。

表 14. 校准寄存器 (A3:A0 = 0110)

DATA BIT	DEFAULT	DESCRIPTION
D13	0	Set to 0
D12	1	Transmitter I/Q Calibration LO Leakage and Sideband-Detector Gain-Control Bits. D12:D11 = 00: 8dB; 01: 18dB; 10: 24dB; 11: 34dB
D11	1	
D10	1	Set to 1
D9	0	Set to 0
D8	0	
D7	0	
D6	0	
D5	0	
D4	0	
D3	0	
D2	0	
D1	0	0: Tx Calibration Mode Disabled; 1: Tx Calibration Mode Enabled (Rx outputs provide the LO leakage and sideband-detector signal)
D0	0	0: RX Calibration Mode Disabled; 1: Rx Calibration Mode Enabled

表15. 低通滤波器寄存器(A3:A0 = 0111)

DATA BIT	DEFAULT	DESCRIPTION
D13	0	Set to 0
D12	0	
D11	0	RSSI High Bandwidth Enable. 0: 2MHz; 1: 6MHz
D10	0	Set to 0
D9	0	
D8	0	
D7	0	
D6	0	Tx LPF Corner Frequency Coarse Adjustment. D6:D5 = 00: undefined; 01: 12MHz (nominal mode); 10: 18MHz (turbo mode 1); 11: 24MHz (turbo mode 2).
D5	1	
D4	0	Rx LPF Corner Frequency Coarse Adjustment. D4:D3 = 00: 7.5MHz; 01: 9.5MHz (nominal mode); 10: 14MHz (turbo mode 1); 11: 18MHz (turbo mode 2).
D3	1	
D2	0	Rx LPF Corner Frequency Fine Adjustment (Relative to the Course Setting). D2:D0 = 000: 90%; 001: 95%; 010: 100%; 011: 105%; 100: 110%.
D1	1	
D0	0	

低通滤波器寄存器定义(A3:A0 = 0111)

该寄存器可以用来调节Rx和Tx的低通滤波器转角频率(见表15)。

Rx控制/RSSI寄存器定义(A3:A0 = 1000)

该寄存器可以用来调节Rx部分和RSSI输出(见表16a和16b)。

表16a. Rx控制/RSSI寄存器(A3:A0 = 1000)

DATA BIT	DEFAULT	DESCRIPTION
D13	0	Set to 0
D12	0	Enable Rx VGA Gain Programming Serially. 0: Rx VGA gain programmed with external digital inputs (B7:B1); 1: Rx VGA gain programmed with serial data bits in the Rx gain register (D6:D0).
D11	0	RSSI Output Range. 0: low range (0.5V to 2V); 1: high range (0.5V to 2.5V).
D10	0	RSSI Operating Mode. 0: RSSI disabled if RXHP = 0, and enabled if RXHP = 1; 1: RSSI enabled independent of RXHP (see Table 16c).
D9	0	Set to 0
D8	0	RSSI Pin Function. 0: outputs RSSI signal in Rx mode; 1: outputs temperature sensor voltage in Rx, Tx, and standby modes (see Table 16c).
D7	0	Set to 0
D6	0	
D5	1	Set to 1
D4	0	Set to 0
D3	0	
D2	1	Rx Highpass -3dB Corner Frequency when RXHP = 0. 0: 100Hz; 1: 30kHz
D1	0	Set D1:D0 = 01
D0	1	

表 16b. Rx HP -3dB 转角频率调节

RXHP	A3:A0 = 1000, D2	Rx HP -3dB CORNER FREQUENCY
1	X	600kHz
0	1	30kHz
0	0	100Hz

表 16c. RSSI 引脚真值表

INPUT CONDITIONS				RSSI OUTPUT
A3:A0 = 1000, D8	A3:A0 = 1000, D10	RXENA	RXHP	
0	0	0	X	No Signal
0	0	1	0	No Signal
0	0	1	1	RSSI
0	1	0	X	No Signal
0	1	1	X	RSSI
1	X	X	X	Temperature Sensor

Tx 线性特性/基带增益寄存器定义 (A3:A0 = 1001)

该寄存器用于调节 Tx 增益和线性特性 (见表 17)。

表 17. Tx 线性特性/基带增益寄存器 (A3:A0 = 1001)

DATA BIT	DEFAULT	DESCRIPTION
D13	0	Set to 0
D12	0	
D11	0	
D10	0	Enable Tx VGA Gain Programming Serially. 0: Tx VGA gain programmed with external digital inputs (B6:B1); 1: Tx VGA gain programmed with data bits in the Tx gain register (D5:D0).
D9	1	PA Driver Linearity. D9:D8 = 00: 50% current (minimum linearity); 01: 63% current; 10: 78% current; 11: 100% current (maximum linearity).
D8	0	
D7	0	Tx VGA Linearity. D7:D6 = 00: 50% current (minimum linearity); 01: 63% current; 10: 78% current; 11: 100% current (maximum linearity).
D6	0	
D5	0	Set to 0
D4	0	
D3	0	Tx Upconverter Linearity. D3:D2 = 00: 50% current (minimum linearity); 01: 63% current; 10: 78% current; 11: 100% current (maximum linearity).
D2	0	
D1	0	Tx Baseband Gain. D1:D0 = 00: max baseband gain - 5dB; 01: max baseband gain - 3dB; 10: max baseband gain - 1.5dB; 11: max baseband gain.
D0	0	

表 18. PA 偏置 DAC 寄存器 (A3:A0 = 1010)

DATA BIT	DEFAULT	DESCRIPTION
D13	0	Set to 0
D12	0	
D11	0	
D10	0	
D9	1	Sets PA bias DAC turn-on delay after TXENA is set high and A3:A0 = 0010, D10 = 1, in steps of 0.5µs. D9:D6 = 0001 corresponds to 0µs and 1111 corresponds to 7µs.
D8	1	
D7	1	
D6	1	
D5	0	Sets PA bias DAC output current in steps of 5µA. D5:D0 = 000000 corresponds to 0µA and 111111 corresponds to 315µA.
D4	0	
D3	0	
D2	0	
D1	0	
D0	0	

表 19. Rx 增益寄存器 (A3:A0 = 1011)

DATA BIT	DEFAULT	DESCRIPTION	
D13	0	Not Used. For faster Rx gain setting, only D6:D0 need to be programmed.	
D12	0		
D11	0		
D10	0		
D9	0		
D8	0		
D7	0		
D6	1	Rx LNA Gain Control	Rx baseband and RF gain-control bits. D6 maps to digital input pin B7 and D0 maps to digital input pin B1. D6:D0 = 0000000 corresponds to minimum gain.
D5	1		
D4	1	Rx VGA Gain Control	
D3	1		
D2	1		
D1	1		
D0	1		

表 20. Tx VGA 增益寄存器 (A3:A0 = 1100)

DATA BIT	DEFAULT	DESCRIPTION
D13	0	Not Used. For faster Tx VGA gain setting, only D5:D0 need to be programmed.
D12	0	
D11	0	
D10	0	
D9	0	
D8	0	
D7	0	
D6	0	
D5	0	Tx VGA Gain Control. D5 maps to digital input pin B6 and D0 maps to digital input pin B1. D5:D0 = 000000 corresponds to minimum gain.
D4	0	
D3	0	
D2	0	
D1	0	
D0	0	

PA 偏置 DAC 寄存器定义 (A3:A0 = 1010)

该寄存器用于控制 DAC 输出电流，为外部 PA 提供偏置 (见表 18)。

Rx 增益寄存器定义 (A3:A0 = 1011)

当 A3:A0 = 1000、D12 = 1 时，该寄存器设置 Rx 基带和 RF 增益 (见表 19)。

Tx VGA 增益寄存器定义 (A3:A0 = 1100)

当 A3:A0 = 1001、D10 = 1 时，该寄存器设置 Tx VGA 增益 (见表 20)。

应用信息

MIMO 应用

MAX2828/MAX2829 支持多入多出 (MIMO) 应用，有多个收发器并行使用。这种应用有一个特殊要求，即所有接收器必须保持恒定的相对于本振的相位，并且，在经过收-发-收模式切换后仍需保持恒定。发送器也有同样的要求 — 所有发送器应当保持恒定的相对相位，在经过发-收-发模式切换后亦如此。在 MAX2828/MAX2829 中，通过设置 A3:A0 = 0010、D13 = 1 和 A3:A0 = 0101、D13 = 1，可以获得这一特性。在发送、接收和待机模式下，只要使用同一外部参考频率源 (晶体振荡器)，多个收发器即可保持恒定的相对相位。

Rx 增益控制

接收器增益可由数字输入引脚 B1 至 B7，或内部 Rx 增益寄存器设置。*典型工作特性*中给出了增益控制特性。

RSSI

RSSI 输出可配置为两种输出电压范围：0.5V 至 2V 或 0.5V 至 2.5V (见表 16a)。RSSI 输出不受 Rx VGA 增益设置的影响，它们可驱动高达 10kΩ ‖ 5pF 的负载。

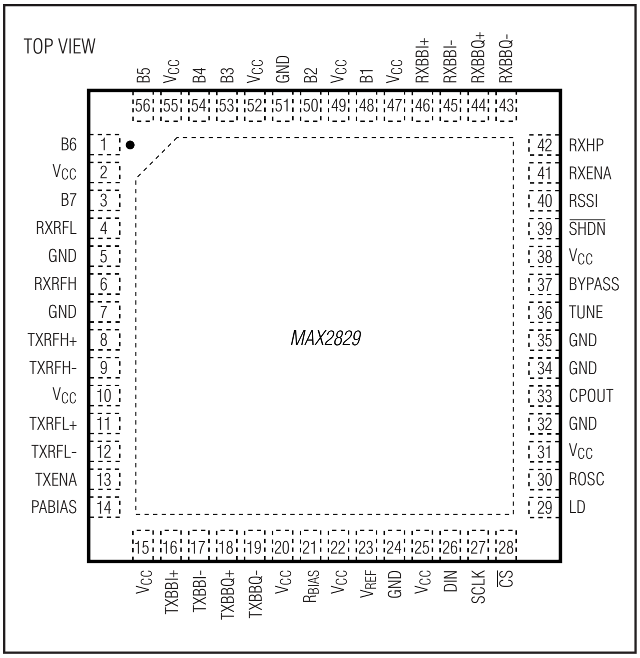
Tx VGA 增益控制

Tx 增益可由数字输入引脚 B1 至 B6，或内部 Tx VGA 增益寄存器设置。Tx 电路的线性特性可调 (表 17)。*典型工作特性*中给出了 Tx VGA 增益控制特性。

环路滤波器

环路滤波器拓扑和元件参数值可在 MAX2828/MAX2829 评估板数据资料中查找到。建议使用 150kHz 的环路带宽，以保证在 Tx/Rx 切换时能够快速建立环路。

引脚配置 (续)

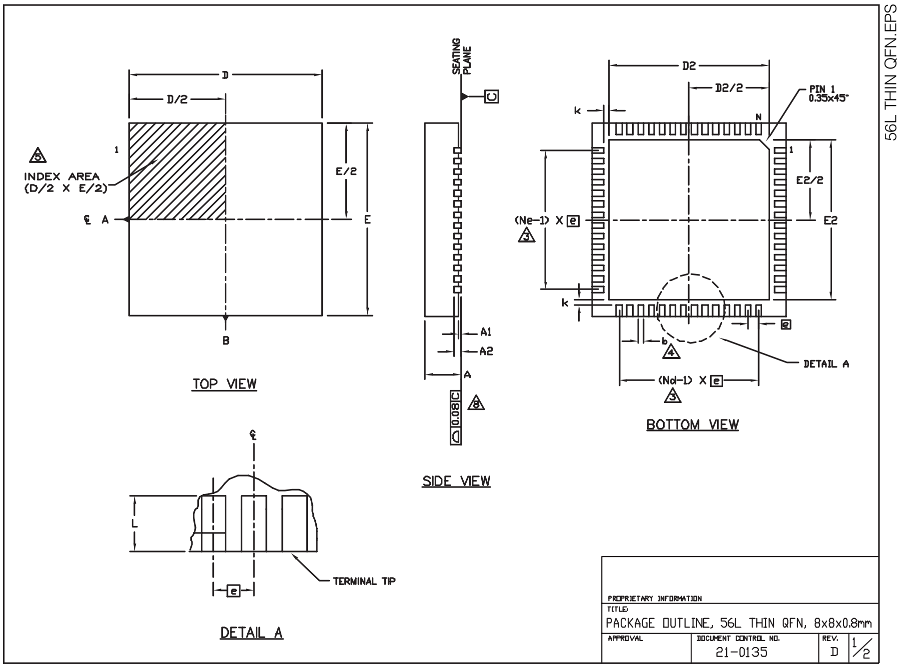


芯片信息

TRANSISTOR COUNT: 42,998

PROCESS: BiCMOS

(本数据资料提供的封装图可能不是最近的规格，如需最近的封装外型信息，请查询 www.maxim-ic.com.cn/packages。)



NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.225mm MAXIMUM (0.009 INCHES MAXIMUM).
2. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. - 1994.
3. N IS THE NUMBER OF TERMINALS. Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION & Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
5. THE PIN #1 IDENTIFIER MUST BE LOCATED ON THE TOP SURFACE OF THE PACKAGE WITHIN HATCHED AREA AS SHOWN. EITHER AN INDENTATION MARK OR INK/LASER MARK IS ACCEPTABLE.
6. ALL DIMENSIONS ARE IN MILLIMETERS.
7. PACKAGE WARPAGE MAX 0.01mm.
8. APPLIES TO EXPOSED PAD AND TERMINALS. EXCLUDES INTERNAL DIMENSION OF EXPOSED PAD.
9. MEETS JEDEC MO220.

SYMBOL	56L 8x8			NOTE
	MIN.	NOM.	MAX.	
A	0.70	0.75	0.80	
b	0.20	0.25	0.30	4
D	7.90	8.00	8.10	
E	7.90	8.00	8.10	
e	0.50 BSC			
N	56			3
Nd	14			3
Ne	14			3
L	0.30	0.40	0.50	
A1	0.00	0.02	0.05	
A2	0.20 REF			
k	0.25	--	--	

EXPOSED PAD VARIATION

PKG. CODE	D2			E2			JEDEC	DOWN BONDS ALLOWED
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.		
T5688-1	6.50	6.65	6.70	6.50	6.65	6.70	WLLD-5	NO
T5688-2	6.50	6.65	6.70	6.50	6.65	6.70	WLLD-5	YES
T5688-3	6.50	6.65	6.70	6.50	6.65	6.70	WLLD-5	NO

PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, 56L THIN QFN, 8x8x0.8mm
APPROVAL | DOCUMENT CONTROL NO. 21-0135 | REV. D | 2/2

MAX2828/MAX2829

单/双频、802.11a/b/g 全波段收发器IC

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