19-2145; Rev 1; 8/03

MAXIM

200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

General Description

The MAX2900–MAX2904 complete single-chip 200mW transmitters are designed for use in the 868MHz/915MHz frequency bands. The MAX2900/MAX2901/MAX2902 are compliant with the FCC CFR47 part 15.247 902MHz to 928MHz ISM-band specifications. MAX2903/MAX2904 are compliant with the ETSI EN330-220 specification for the European 868MHz ISM band.

These transmitter ICs offer a high level of integration while minimizing the number of external components. This is achieved by full integration of the transmit modulator, power amplifier, RF VCO, 8-channel frequency synthesizer, and baseband PN sequence lowpass filter. By filtering the BPSK modulation, the spurious emissions are reduced, enabling up to eight independent transmit channels in the U.S. ISM band. Inputs are provided for spread-spectrum BPSK, ASK, and OOK. FM can be achieved by directly modulating the VCO. The devices are intended primarily for use with an external differential antenna.

Applications

Automatic Meter Reading
Wireless Security Systems/Alarms
Wireless Sensors
Wireless Data Networks
Wireless Building Control

Features

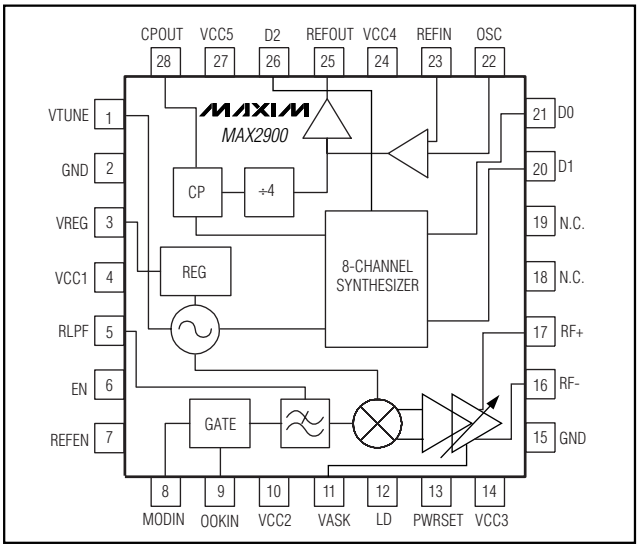
- **Versions for U.S. 902MHz to 928MHz Band and European 868MHz Band**
- **-7dBm to +23dBm Adjustable Differential RF Output Power**
- **+23dBm Output Power at 4.5V, +20dBm Output Power at 3.0V**
- **Support BPSK, OOK, ASK, and FM Modulations**
- **Modulation Filter for Direct Sequence BPSK up to 8Mchips/s**
- **Fully Integrated VCO with On-Chip Tank**
- **Extremely Low Frequency Pulling for OOK Modulation (typ 60kHz peak, 5kHz RMS)**
- **Integrated Frequency Synthesizer for up to 8 Channels (MAX2900)**
- **+2.7V to +4.5V Supply Operation**
- **Small 28-Pin QFN Package with Exposed Pad (5mm × 5mm)**

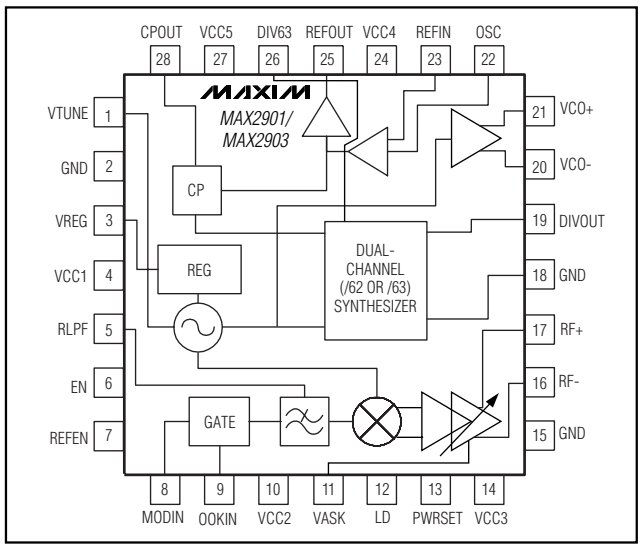
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX2900EGI	-40°C to +85°C	28 QFN-EP*
MAX2901EGI	-40°C to +85°C	28 QFN-EP*
MAX2902EGI	-40°C to +85°C	28 QFN-EP*
MAX2903EGI	-40°C to +85°C	28 QFN-EP*
MAX2904EGI	-40°C to +85°C	28 QFN-EP*

*Exposed pad

Functional Diagrams/Pin Configurations





Functional Diagrams/Pin Configurations are continued at end of data sheet.

200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND .....-0.3V to +5.0V
Analog/Digital Input Voltage to GND.....-0.3V to (V_{CC} + 0.3V)
Analog/Digital Input Current .....±10µA
Continuous Power Dissipation (T_A = +70°C)
28-Pin QFN-EP (derate 28.5mW/°C above +70°C).....2W
Operating Temperature Range .....-40°C to +85°C
Junction Temperature .....+150°C
Storage Temperature Range .....-65°C to +150°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.

CAUTION! ESD SENSITIVE DEVICE

Part Selection Information

Five different versions are available. The versions differ by their frequency band of operation, and by the synthesizer's mode of operation. The MAX2900 has an internal 8-channel synthesizer.

The MAX2901 and MAX2903 are dual-channel versions with a selectable internal synthesizer division ratio of 62 or 63. The MAX2901 operates in the 902MHz to 928MHz ISM band and the MAX2903 operates in the 867MHz to 870MHz European ISM band.

The MAX2902 and MAX2904 require an off-chip frequency synthesizer. The MAX2902 operates in the 902MHz– 928MHz ISM band and MAX2904 operates in the 867MHz–870MHz European ISM band.

The MAX2901–MAX2904 provide LO outputs to drive a receiver and/or an external synthesizer.

PART	FREQUENCY RANGE (MHz)	SYNTHESIZER	LO OUTPUTS
MAX2900EGI	902 to 928	Internal 8 selectable channels	No
MAX2901EGI	902 to 928	Internal 2 selectable channels	Yes
MAX2902EGI	902 to 928	Off-chip	Yes
MAX2903EGI	867 to 870	Internal 2 selectable channels	Yes
MAX2904EGI	867 to 870	Off-chip	Yes

DC ELECTRICAL CHARACTERISTICS

(V_{CC} = +2.7V to +4.5V, EN = OOKIN = REFEN = high, T_A = -40°C to +85°C. Typical values are at V_{CC} = +4.5V, T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	CONDITIONS		MIN	-3σ	TYP	+3σ	MAX	UNITS
Supply Voltage			2.7		4.5		4.5	V
Supply Current	Shutdown mode: EN = REFEN = low	V_{CC} = +4.0V			0.7		10	µA
		V_{CC} = +4.5V			60		200	
	Synth mode: OOKIN = low (MAX2900/MAX2901/MAX2903 only)				32		40	mA
	Transmit mode with output matching optimized for +23dBm at +4.5V: PWRSET loaded with 22kΩ resistor	T_A = -40°C to +85°C			150	200		
	Transmit mode with output matching optimized for +20dBm at +3.0V: PWRSET loaded with 22kΩ resistor	T_A = -40°C to +85°C			110	135		

DC ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +2.7V to +4.5V, EN = OOKIN = REFEN = high, T_A = -40°C to +85°C. Typical values are at V_{CC} = +4.5V, T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	CONDITIONS		MIN	-3σ	TYP	+3σ	MAX	UNITS
Supply Current (continued)	Transmit mode with output matching optimized for +17dBm at +3.0V: PWRSET loaded with 36kΩ resistor	T_A = +25°C			75			mA
	Transmit mode with output matching optimized for +14dBm at +3.0V: PWRSET loaded with 51kΩ resistor	T_A = +25°C			57			
	Reference-only mode: EN = low				2		3	
	PA standby mode: OOKIN = low (MAX2902/MAX2904 only)				29		33	
VCO Input Tuning Pin Current	VTUNE = +4.5V, T_A = +25°C				0.02		2	µA
VREG VCO Regulator Voltage					2.0			V
DIGITAL INPUT/OUTPUTS (PINS EN, REFEN, D0, D1, D2, MODIN, OOKIN, LD)								
Input Level High			V_{CC} - 0.5V					V
Input Level Low							0.5	V
Input Bias Current			-10				10	µA
Output Level High			V_{CC} - 0.4					V
Output Level Low							0.4	V
Output Current			-100				100	µA
ANALOG CONTROL INPUTS (PINS PWRSET, RLPF, VASK)								
PWRSET Voltage					1.2			V
RLPF Voltage					1.2			V
VASK Input Impedance			100		220		400	kΩ

200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

AC ELECTRICAL CHARACTERISTICS

(MAX290_ EV kits. V_{CC} = +2.7V to +4.5V, R_{RLPF} = 68kΩ, R_{PWRSET} = 22kΩ, f_{RF} = 917.28MHz (MAX2900/MAX2901/MAX2902) or f_{RF} = 868MHz (MAX2903/MAX2904), VASK = VREG, f_{REF} = 14.56MHz (MAX2900/MAX2901/MAX2902) or f_{REF} = 13.62MHz (MAX2903/MAX2904), chip rate on MODIN = 1.22Mbps, P_{OUT} = +23dBm, T_A = -40°C to +85°C. Typical values are at V_{CC} = +4.5V, T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	CONDITIONS	MIN	-3σ	TYP	+3σ	MAX	UNITS
ANALOG INPUT PINS							
VTUNE Input Capacitance	VTUNE = +1.35V			15			pF
DIGITAL INPUT PINS							
Digital Input Pin Capacitance				3			pF
VCO AND SYNTHESIZERS SECTION							
RFOUT Frequency Range	(MAX2900/MAX2901/MAX2902)	902		917.28		928	MHz
	(MAX2903/MAX2904)	867		868		870	
REFIN Reference Frequency Range	(MAX2900/MAX2901/MAX2902)	14		14.56		15	MHz
	(MAX2903/MAX2904)	13		13.78		14.5	
REFDIV Fixed Reference Divider Ratio	(MAX2900)	4		4		4	
Main Divider Ratios	Table 4 (MAX2900)	249				256	
	(MAX2901/MAX2903)	62				63	
PLL Comparison Frequency	(MAX2900)	3.5		3.64		3.75	MHz
	(MAX2901/MAX2903)	13				15	
VCO Buffer Output Power	300Ω differential load (MAX2901–MAX2904)			-12			dBm
REFDIV Fixed Reference Divider Ratio	(MAX2901/MAX2903)	1		1		1	
VCO Phase Noise	At 100kHz offset, measured at RFOUT, PLL loop BW = 5kHz			-101			dBc/Hz
VCO Tuning Gain	VTUNE = +1.35V	44		65		86	MHz/V
VCO Frequency Pulling with OOK Modulation	OOKIN clocked at 19kHz, internal (crystal) or external reference frequency			5			kHz RMS
				60			kHz peak
PLL Phase Noise	Measured at RFOUT, 5kHz offset, PLL loop BW = 50kHz			-96			dBc/Hz
REFOUT Voltage Swing		100					mVp-p
CPOUT Charge Pump Current				500			µA
Reference Spurs				-62			dBc
Reference Input Voltage for Nominal Operation	Using an external frequency reference	200		300			mV
BPSK, OOK MODULATOR, AND PA							
MODIN Frequency Range				1.2		8	Mb/s
Modulation Filter Nominal 3dB Bandwidth				1			MHz
Modulation Filter Final Attenuation	Measured at 30MHz	28		41			dB
Carrier Suppression				28			dB
Noise Power Density	At 960MHz (measured at RFOUT at +23dBm output power)			-150			dBc/Hz

AC ELECTRICAL CHARACTERISTICS (continued)

(MAX290_ EV kits. V_{CC} = +2.7V to +4.5V, R_{RLPF} = 68kΩ, R_{PWRSET} = 22kΩ, f_{RF} = 917.28MHz (MAX2900/MAX2901/MAX2902) or f_{RF} = 868MHz (MAX2903/MAX2904), VASK = VREG, f_{REF} = 14.56MHz (MAX2900/MAX2901/MAX2902) or f_{REF} = 13.62MHz (MAX2903/MAX2904), chip rate on MODIN = 1.22Mbps, P_{OUT} = +23dBm, T_A = -40°C to +85°C. Typical values are at V_{CC} = +4.5V, T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	CONDITIONS		MIN	-3σ	TYP	+3σ	MAX	UNITS
RF Output Power	PWRSET = 22kΩ, V_{CC} = +4.5V, T_A = +25°C			21	23.5	25		dBm
	PWRSET = 22kΩ, V_{CC} = +4.5V, T_A = -40°C to +85°C			20.5		25		
	PWRSET = 22kΩ, V_{CC} = +3.0V, T_A = +25°C			18	20	21		
RF Output Power Flatness	f_{RF} = 900MHz to 930MHz (MAX2900/MAX2901/MAX2902)				0.3			dB
	f_{RF} = 867MHz to 870MHz				0.1			
Adjacent Channel Power Ratio	PN sequence at 1.22MHz				-17			dBc
Alternate Channel Power Ratio	PN sequence at 1.22MHz				-26			dBc
OOK Control Range			40		80			dB
ASK Output Power Adjustment Range	ASK output power back-off relative to max power	OOKIN = high, VASK = 0			41			dB
		OOKIN = high, VASK = 1V			16			
RFOUT Rise and Fall Time	Square-wave signal applied on OOK				1			µs
Spurious Emissions	At 2nd harmonic of RF output frequency with external matching network				-50			dBc
	At 3rd harmonic of RF output frequency with external matching network				-51			
	At 4th harmonic of RF output frequency with external matching network				-63			
	Out of 902MHz to 928MHz band other than harmonics with external matching network (MAX2900/MAX2901/MAX2902)				< -70			
	Out of 867MHz to 870MHz band other than harmonics with external matching network (MAX2903/MAX2904)				< -70			
Unlocked, Out-of-Band Spurious Output Level	Any condition when synthesizer unlocked (pin LD low)				< -50			dBm
Noise Level Out of Band	Modulation off, measured at 960MHz, any gain setting (MAX2900/MAX2901/MAX2902)				-126		-120	dBm/Hz
	Modulation off, measured at 900MHz, any gain setting (MAX2903/MAX2904)				-126		-120	
Output VSWR for Guaranteed Stability					2:1			
Maximum Allowable Output VSWR					2:1			

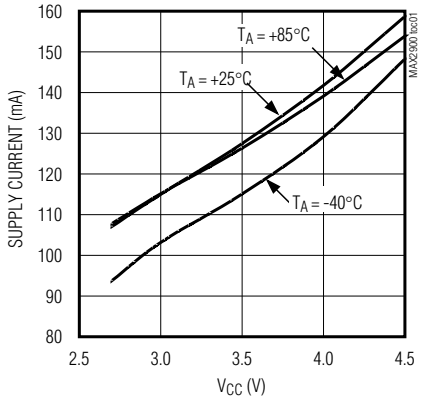
Note 1: Devices are production tested at T_A = +25°C and +85°C. Min/Max values are guaranteed by design and characterization over temperature and supply voltage.

200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

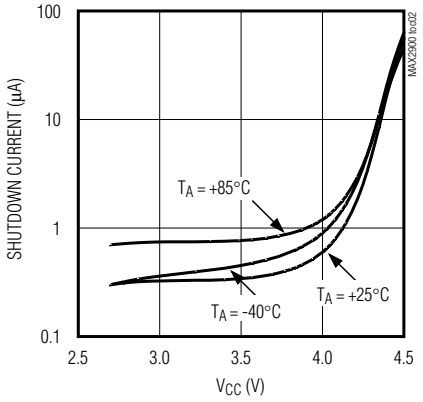
Typical Operating Characteristics

(MAX290_ EV kits. V_{CC} = +4.5V, f_{RF} = 917.28MHz (MAX2900/MAX2901/MAX2902) or f_{RF} = 868MHz (MAX2903/MAX2904), R_{RLPF} = 68kΩ, R_{PWRSET} = 22kΩ, VASK = VREG, f_{REF} = 14.56MHz (MAX2900/MAX2901/MAX2902) or f_{REF} = 13.78MHz (MAX2903/MAX2904), chip rate on MODIN = 1.22 Mbps, RF output matching network optimized for +23dBm, V_{CC} = 4.5V, T_A = +25°C, unless otherwise noted.)

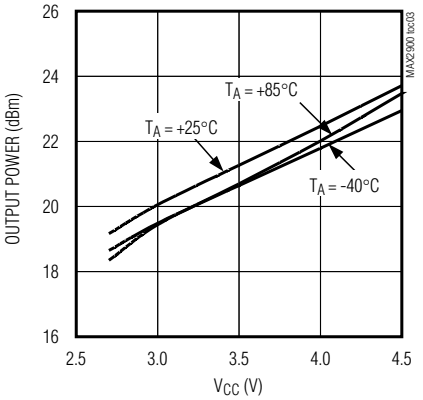
SUPPLY CURRENT vs. V_{CC}



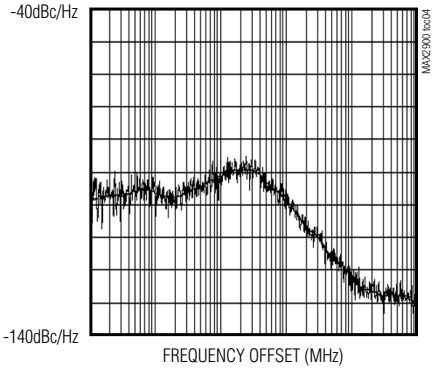
SHUTDOWN CURRENT vs. V_{CC}



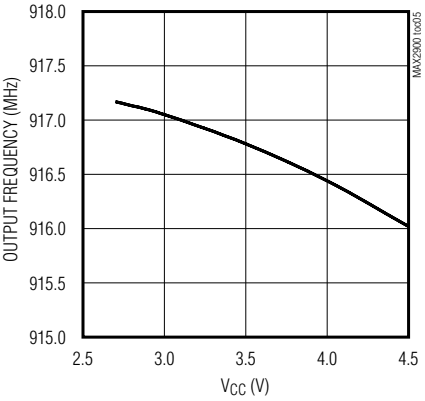
OUTPUT POWER vs. V_{CC}



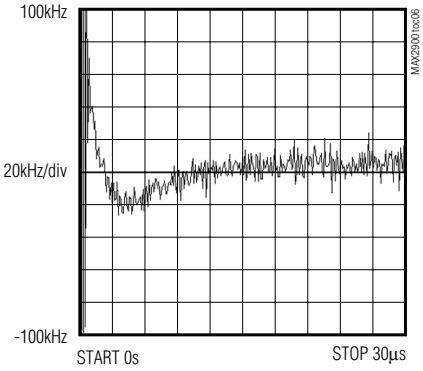
VCO PHASE NOISE AT 917.28MHz



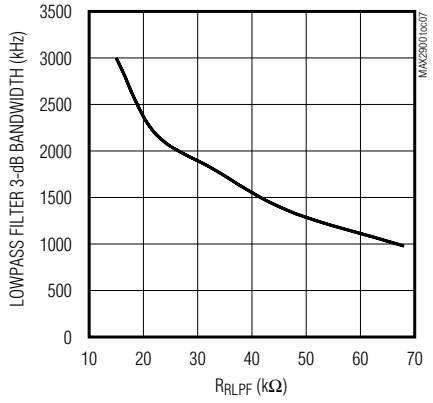
VCO SUPPLY PUSHING vs. V_{CC}



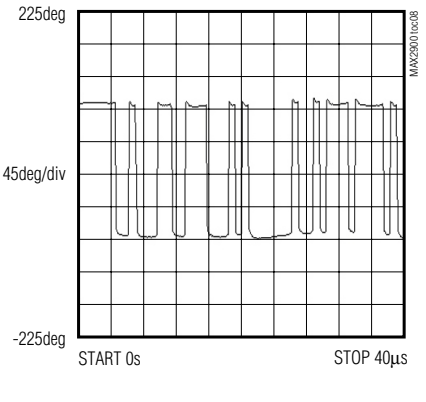
PLL LOCK TIME



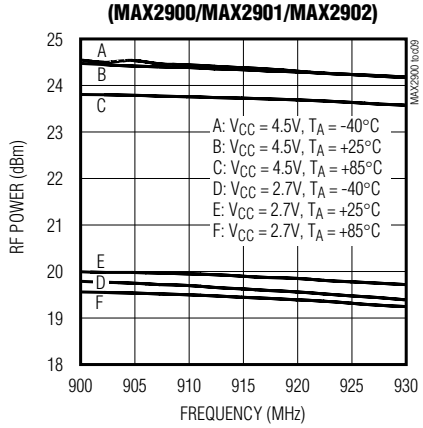
LOWPASS FILTER 3-dB RESPONSE vs. R_{RLPF}



BPSK MODULATION OUTPUT vs. TIME



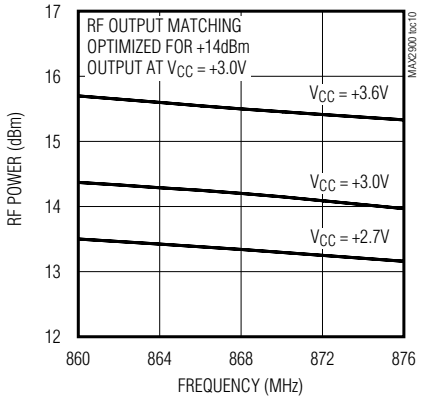
RF POWER vs. FREQUENCY (MAX2900/MAX2901/MAX2902)



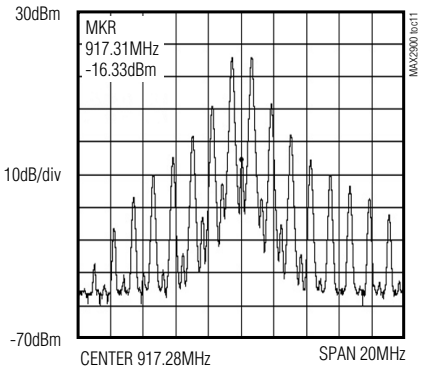
Typical Operating Characteristics (continued)

(MAX290_ EV kits. V_{CC} = +4.5V, f_{RF} = 917.28MHz (MAX2900/MAX2901/MAX2902) or f_{RF} = 868MHz (MAX2903/MAX2904), R_{RLPF} = 68kΩ, R_{PWRSET} = 22kΩ, VASK = VREG, f_{REF} = 14.56MHz (MAX2900/MAX2901/MAX2902) or f_{REF} = 13.78MHz (MAX2903/MAX2904), chip rate on MODIN = 1.22 Mbps, RF output matching network optimized for +23dBm, V_{CC} = 4.5V, T_A = +25°C, unless otherwise noted.)

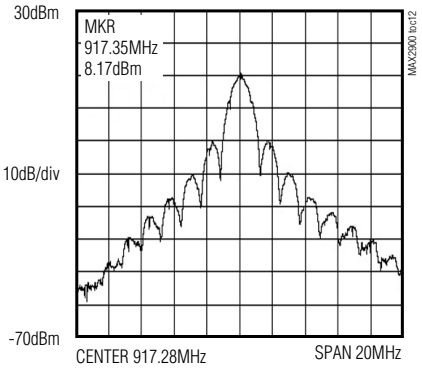
RF POWER vs. FREQUENCY (MAX2903/MAX2904)



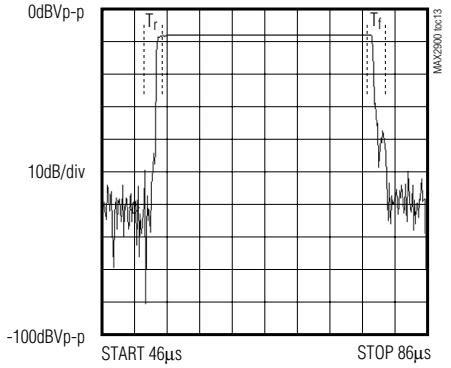
OUTPUT SPECTRUM WITH 600kHz SQUARE WAVE INPUT AT MODIN



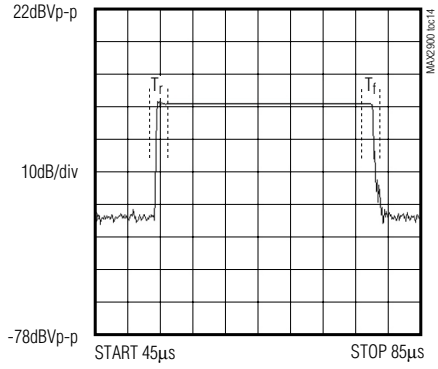
OUTPUT SPECTRUM WITH PN SEQUENCE AT 1.22MHz AT MODIN



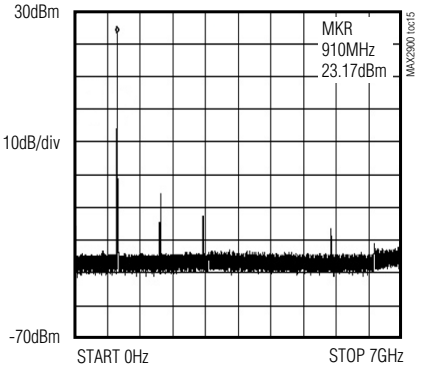
RF OUT RISE AND FALL TIME TRANSIENT WITH SQUARE OOK



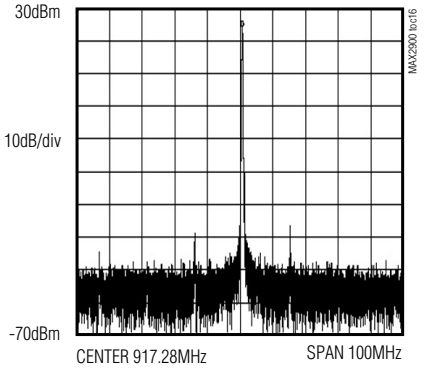
RF OUT RISE AND FALL TIME TRANSIENT WITH SQUARE ASK



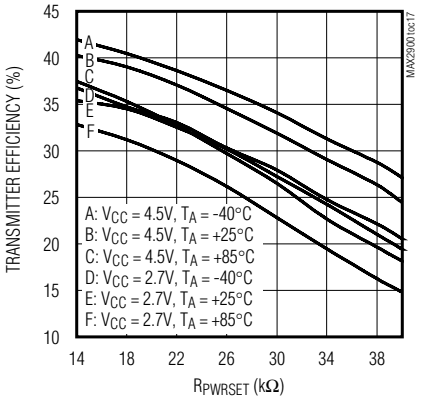
SPURIOUS LEVEL FROM DC TO 7TH HARMONIC



SPURIOUS LEVEL BETWEEN ±50MHz FROM CARRIER FREQUENCY



TRANSMITTER EFFICIENCY vs. R_{PWRSET}



200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

Pin Description

PIN			NAME	PIN TYPE	FUNCTION
MAX2900	MAX2901 MAX2903	MAX2902 MAX2904			
1	1	1	VTUNE	Analog Input	VCO tuning voltage input
2	2	2	GND	Supply Pin	Ground
3	3	3	VREG	Analog Input/Output	Regulated voltage output to supply the VCO. Bypass with a 0.01µF capacitor to GND as close to the part as possible.
4	4	4	VCC1	Supply Pin	Power supply pin for VCO circuits. Bypass with a 1000pF and a 10µF capacitor to GND as close to the part as possible.
5	5	5	RLPF	Analog Input Resistor to Ground	Resistor to ground on this pin sets the modulation filter bandwidth.
6	6	6	EN	Digital Input	Chip-enable digital input pin. Set EN low maintain the chip in power-down mode.
7	7	7	REFEN	Digital Input	Enable for crystal oscillator and frequency reference buffer.
8	8	8	MODIN	Digital Input	BPSK modulation input
9	9	9	OOKIN	Digital Input	On-off keying modulation. On state = high.
10	10	10	VCC2	Supply	Power supply pin for internal RF buffer circuits. Bypass with a 100pF and a 0.01µF capacitor to GND as close to the part as possible.
11	11	11	VASK	Analog Voltage Input	ASK voltage input pin
12	12	—	LD	Digital Output	Lock detector output digital pin. Level is high when PLL is inside lock range.
—	—	12	D.C.	Do NOT Connect	—
13	13	13	PWRSET	Analog Input Resistor to Ground	Current input set to adjust output power.
14	14	14	VCC3	Supply	Power supply pin for RF power amplifier circuits. Bypass with a 100pF capacitor to GND as close to the part as possible.

Pin Description (continued)

PIN			NAME	PIN TYPE	FUNCTION
MAX2900	MAX2901 MAX2903	MAX2902 MAX2904			
15	15	15	GND	Supply Pin	Ground
16, 17	16, 17	16, 17	RF-, RF+	RF Output	RF differential output, open-collector type
18	—	—	N.C.	Not Connected	—
—	18	—	GND	Supply Pin	Ground
—	—	18	D.C.	Do Not Connect	—
19	—	19	N.C.	Not Connected	—
—	19	—	DIVOUT	ECL Output	Divider output
—	20, 21	20, 21	VCO-, VCO+	Open Collector RF	VCO output (differential)
20	—	—	D1	Digital Input	Channel selection bit 1
21	—	—	D0	Digital Input	Channel selection bit 0
22	22	22	OSC	Analog Input	Crystal oscillator connection. See *Typical Operating Circuit*.
23	23	23	REFIN	Analog Voltage Input	Reference input pin analog (can be used as input or as crystal oscillator driver). See *Typical Operating Circuit*.
24	24	—	VCC4	Supply Pin	Power-supply pin for the synthesizer circuits. Bypass with a 1000pF capacitor to GND as close to the part as possible.
—	—	24	VCC4	Supply Pin	Power-supply pin for the digital circuits. Bypass with a 100pF capacitor to GND as close to the part as possible.
25	25	25	REFOUT	Analog Output	Buffered clock analog output pin
26	—	—	D2	Digital Input	Channel selection bit 2
—	26	—	DIV63	Digital Input	Division ratio selections (division ratio = 62 when DIV63 = high; division ratio = 63 when DIV63 = low).
—	—	26	N.C.	Not Connected	—
27	27	—	VCC5	Supply Pin	Power-supply pin for charge pump circuits. Bypass with a 100pF capacitor to GND as close to the part as possible.
—	—	27	VCC5	Supply Pin	Power-supply pin. Bypass with a 100pF capacitor to GND as close to the part as possible.
28	28	—	CPOUT	Analog Output	Charge pump output pin
—	—	28	D.C.	Do Not Connect	—
GROUND	GROUND	GROUND	GROUND	Electrical Ground	Back side of package is connected to ground.

200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

Detailed Description

Principles of Operation

When EN goes high, the reference and the VCO start while the PA stays in the off mode. For MAX2900/MAX2901/MAX2903, the PLL also starts when EN goes high. After the lock-detect pin LD goes high, the PA is set to stand-by mode. For the MAX2902/MAX2904, the VCO loop has to be closed by using an external synthesizer. After this, pulling OOKIN high turns on the PA. The internal modulation filter smoothes the power ramp-up of the PA.

The modulation filter BW is typically 0.8MHz, used for a 1.22Mbps chip rate, and can be adjusted by varying RLPF. A high value can be used for RLPF to get a slow PA ramping up when BPSK is not used.

The reference blocks can be turned on separately (and earlier) by pulling REFEN high, to allow the crystal frequency to settle.

The device supports various modulation modes:

- BPSK, filtered by the internal modulation filter, is obtained through the MODIN pin. This is the preferred mode of operation for MAX2900.
- OOK is obtained digitally with the OOKIN pin.
- ASK is obtained through the ASK pin.
- FM is imposed on the VCO or the reference.
- FM is the preferred mode of operation for the MAX2903/MAX2904 due to the narrowband operation common in Europe.

The maximum output power is set by the output matching network and the external biasing resistor on the PWRSET pin.

For the MAX2901–MAX2904, differential LO outputs are provided to drive a companion receiver and/or an external synthesizer.

Power-Up Modes

The circuit has four modes of operations, defined as follows:

1) Shutdown mode: Pin EN and REFEN are low, all functions are off, and the current consumption is leakage only.
2) Synth mode: Pin EN and REFEN are high, pin OOKIN is low. The reference circuits, VCO, and synthesizer are turned on. The power amplifier is in stand-by mode. Total current is less than 50mA. Note that as long as the LD pin is not going high, indicating that the PLL is unlocked, OOKIN high is ignored.
3) Transmit mode: Pin EN and REFEN are high. If output pin LD is high, the device is ready to transmit. When OOKIN is high, the power amplifier is turned on. The current consumption varies between 50mA and 120mA, depending on the output power requested by the combination of the OOK duty cycle, the PWRSET value, and output matching circuit.
4) Reference Only mode: This mode enables the use of the crystal reference from the IC to drive the external logic ICs. To obtain this mode, set the REFEN pin high and EN low. In this mode, only the reference circuit turns on, the crystal oscillator starts, and the clock is present at the REFOUT pin. The current consumption remains much lower than that in the SYNTH mode because the VCO, synthesizer, and PA standby circuits are off. When EN goes high, the IC goes into the SYNTH mode.

Synthesizer Programming

The three pins D0–D2 (MAX2900) and DIV63 (MAX2901/MAX2903) are used as digital entries to program the synthesizer division ratios. Tables 4 and 5 show the division ratios obtained for the various pin logic levels.

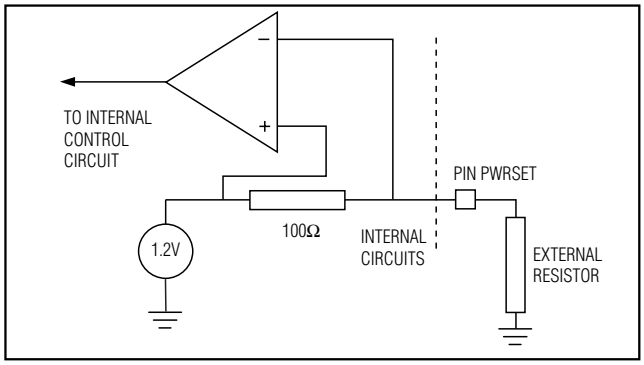


Figure 1. PIN PWRSET Equivalent Circuit

Analog Input Control Pins

The two pins PWRSET and VASK are analog inputs used to control the power of the transmitter. The equivalent input schematics are defined in Figures 1, 2, and 3. The PWRSET pin sets the biasing of the amplification chain. Because the last stage of the amplifier operates in saturation, the output power mostly depends on the load and supply voltage. The purpose of the PWRSET resistor is to achieve optimum biasing (and therefore efficiency) for various maximum output power configurations. For a given application with a known operating voltage and peak power, a fixed value of resistor is determined. The output power range of -7dBm to +23dBm at 4.5V is obtained by choosing a combination of output load line and the resistor on PWRSET; 22kΩ is

used on the EV kit board for +23dBm output power at 4.5V, and 22kΩ is also recommended for +20dBm output power at +3.0V. For +17dBm at 3.0V, 36kΩ is recommended. The current consumption, efficiency, and distortion in the amplification chain are affected by the choice of the resistor RPWRSET, offering a lot of design flexibility.

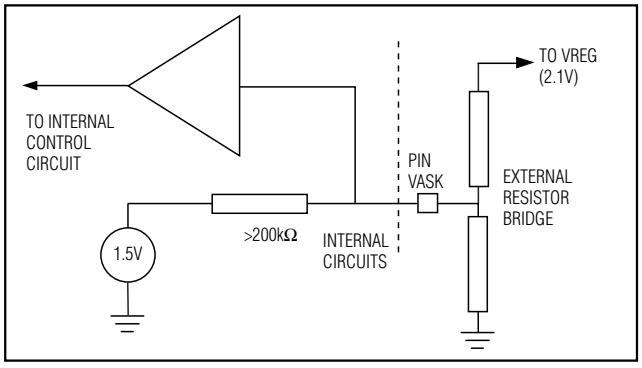


Figure 2. PIN VASK Equivalent Circuit

The VASK pin is an input to the internal gain control circuitry. The gain control is greater than 30dB over the full range of input voltages from 0 to VREG = 2.1V. This input is used for ASK modulation. At 1V, a typical 15dB attenuation is obtained from the peak power. When this input is not used, connect VASK to VREG.

The RLPF input controls the modulation filter center frequency.

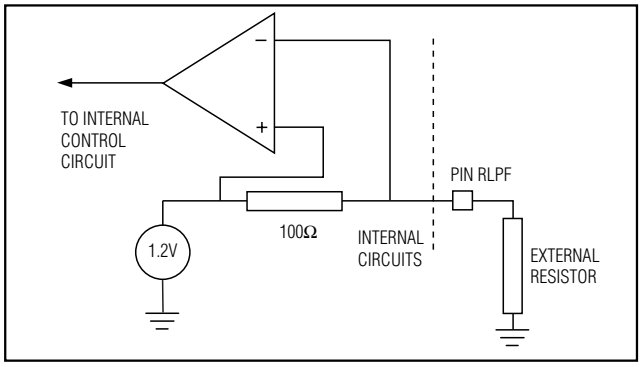


Figure 3. PIN RLPF Equivalent Circuit

The RLPF pin sets the bandwidth of the modulation filter. The default filter bandwidth, obtained with a 68kΩ resistor, is for 1.2Mchips/s. The bandwidth is increased to accommodate 5Mchips/s by decreasing the resistor value to about 26kΩ. The minimum value for the resistor is 12kΩ, which generates the maximum filter bandwidth. A higher value can be used in FM mode to set up a slow ramp-up time for the PA.

Data Filter Characteristics

The data filter approximates a 3rd-order Butterworth filter. The 3dB cut-off frequency is adjusted through the resistor on pin RLPF, which controls the first two poles of the filter (the last high-frequency pole is fixed and set around 10MHz). The filter is adjustable in a range from approximately 700kHz to 7MHz.

With the nominal setting (3dB cut off at 0.8MHz), the filter attenuation is 10dB at 3.6MHz. If used with a BPSK at 1.22MHz, this provides about 30dB of modulation rolloff at 3.6MHz. Hence, a significant channelization effect is obtained.

In the wideband setting (3dB cut off at 5MHz), the attenuation at 30MHz is still 30dB, helping to pass the FCC spurious emissions at 960MHz.

200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

Table 1. MAX2900 Power-Up Modes

LOGIC LEVEL			INTERNAL BLOCK STATUS			
REFEN	EN	OOKIN	REFERENCE	VCO MOD FILTER	SYNTHESIZER	PA
0	0	X	Off	Off	Off	Off
1	0	X	On	Off	Off	Off
1	1	0	On	On	On	Off
1	1	1	On	On	On	On only after LD goes high

Table 2. MAX2901/MAX2903 Power-Up Modes

REFEN	EN	OOKIN	REFERENCE	VCO MOD FILTER	SYNTHESIZER	PA
0	0	X	Off	Off	Off	Off
1	0	X	On	Off	Off	Off
1	1	0	On	On	On	Off
1	1	1	On	On	On	On only after LD goes high

Table 3. MAX2902/MAX2904 Power-Up Modes

REFEN	EN	OOKIN	REFERENCE	VCO MOD FILTER	PA
0	0	X	Off	Off	Off
1	0	0	On	Off	Off
0	1	0	Off	On	Off
1	1	0	On	On	Off
0	1	1	Off	On	On
1	1	1	On	On	On

Table 4. MAX2900 Synthesizer Programming

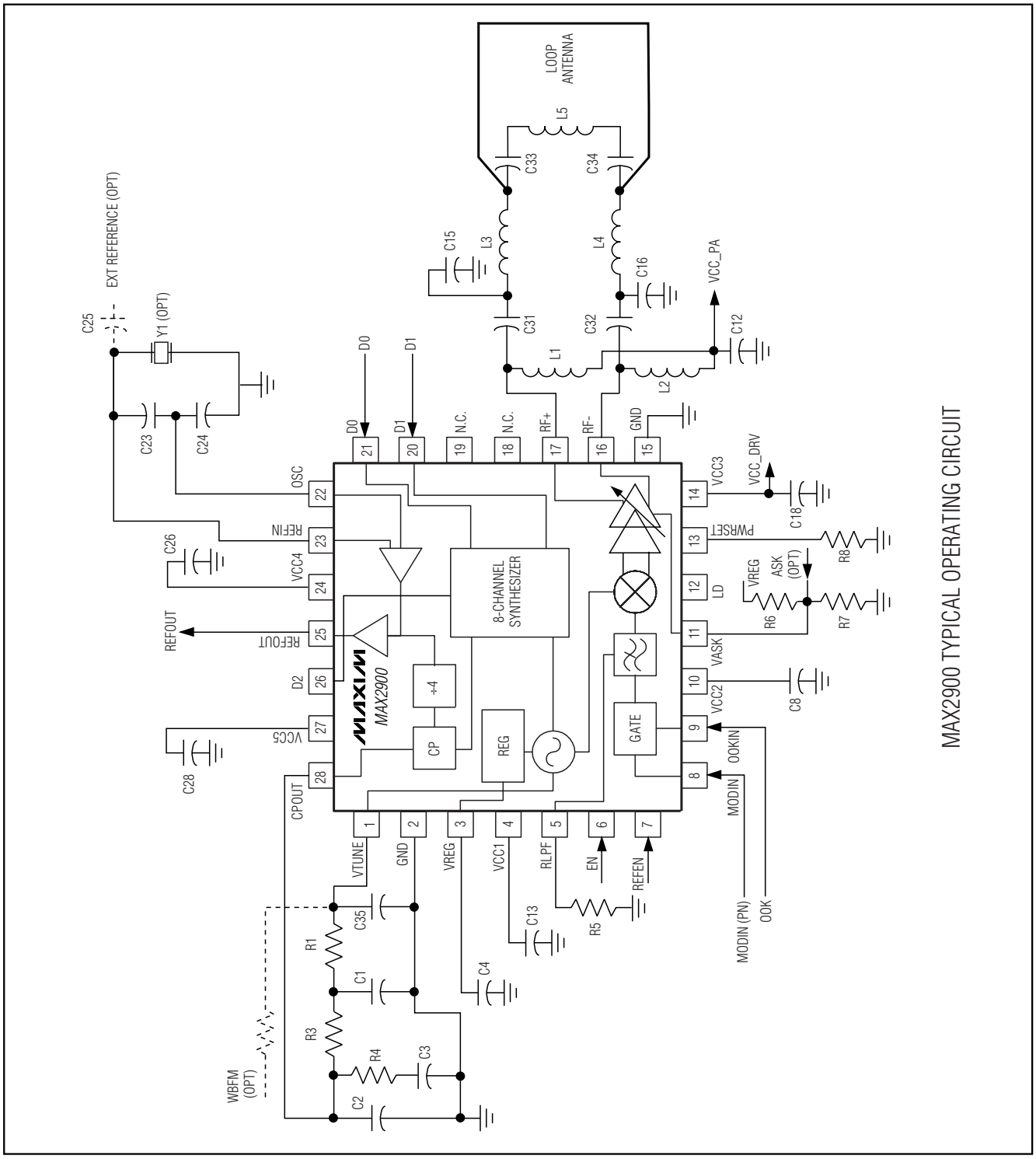
D0	D1	D2	DIVISION RATIO
0	1	1	249
0	1	0	250
0	0	1	251
0	0	0	252
1	1	1	253
1	1	0	254
1	0	1	255
1	0	0	256

Table 5. MAX2901/MAX2903 Synthesizer Programming

DIV 63	DIVISION RATIO
0	62
1	63

200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

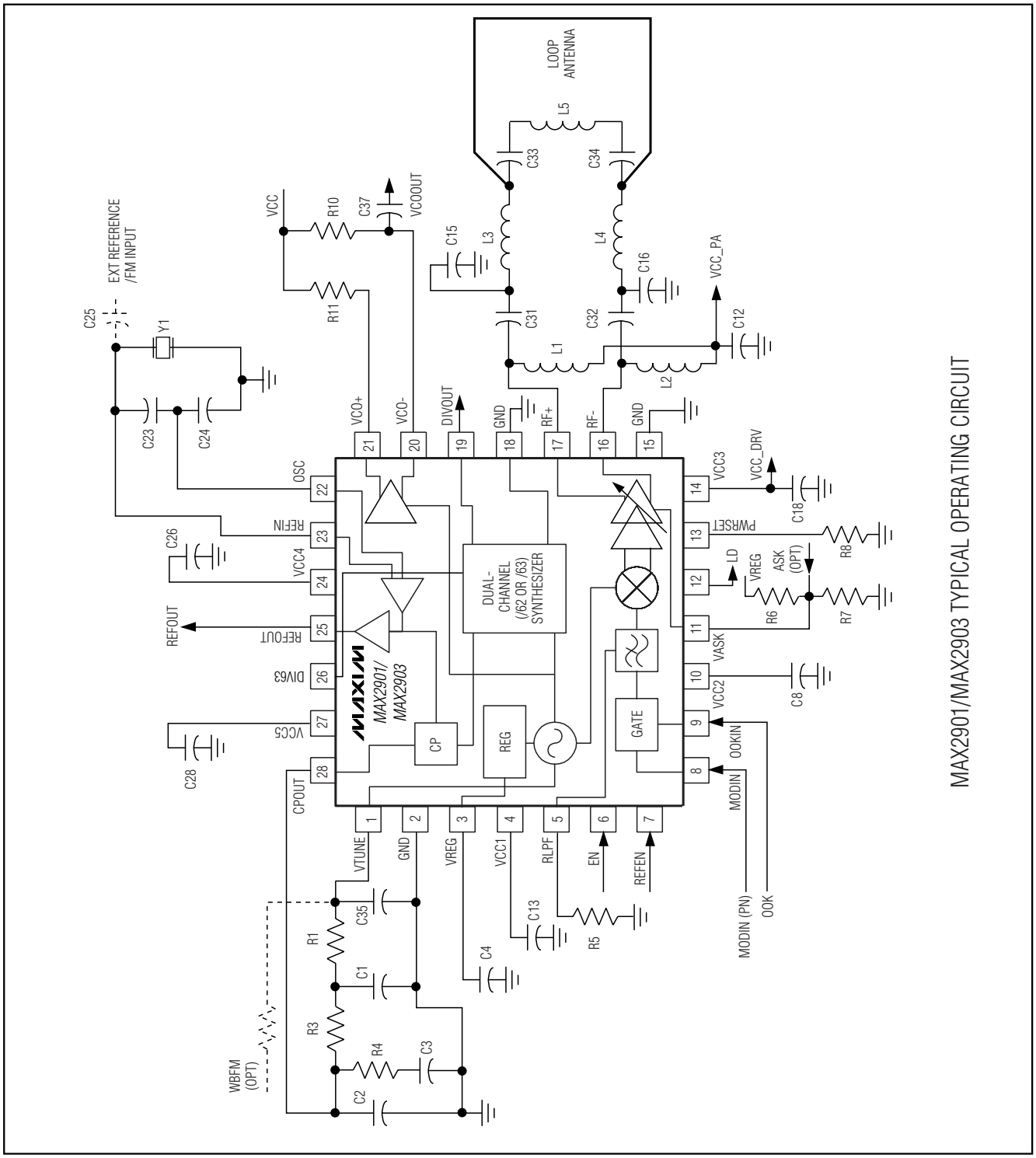
Typical Operating Circuits



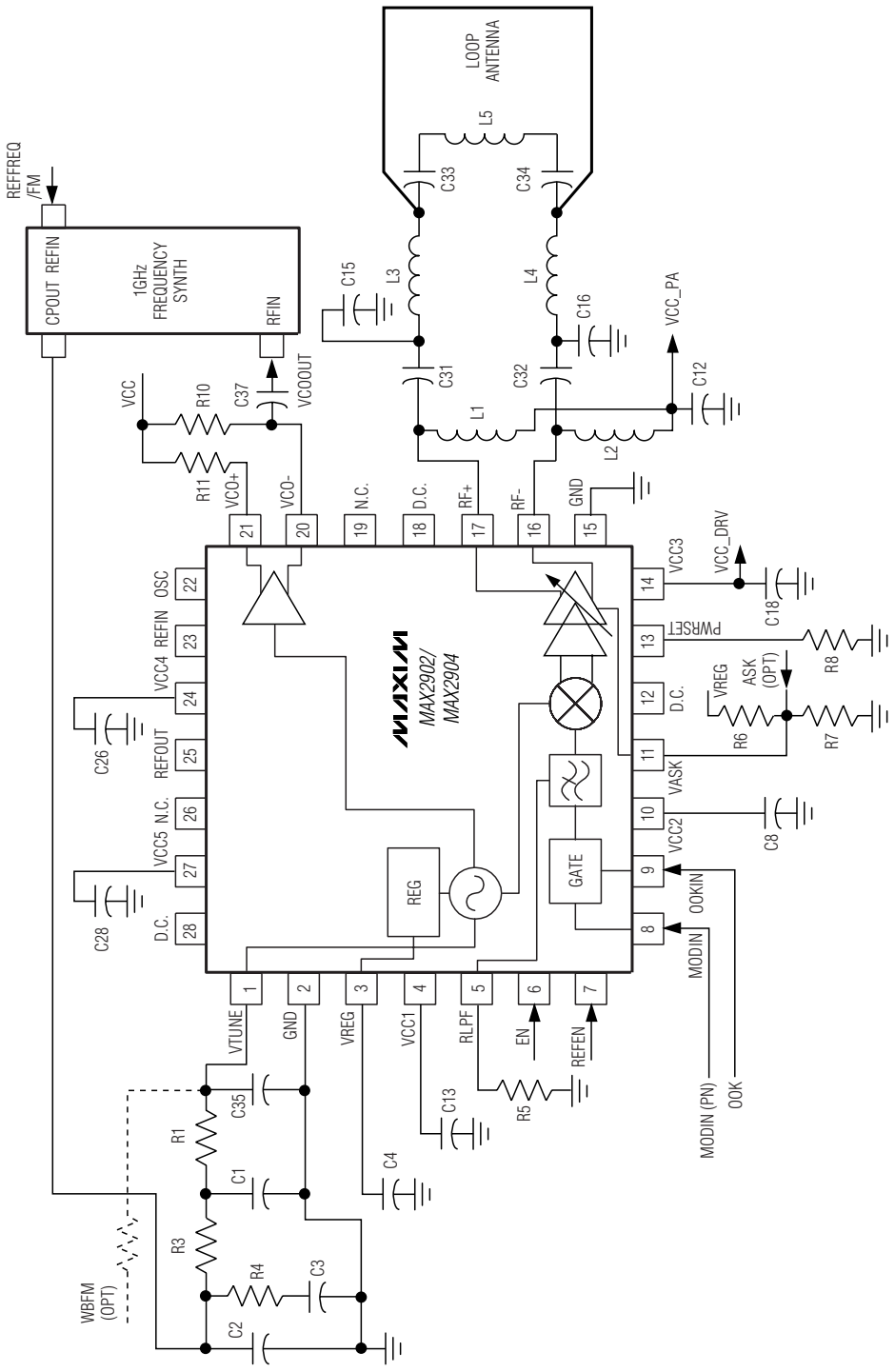
MAX2900 TYPICAL OPERATING CIRCUIT

200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

Typical Operating Circuits (continued)



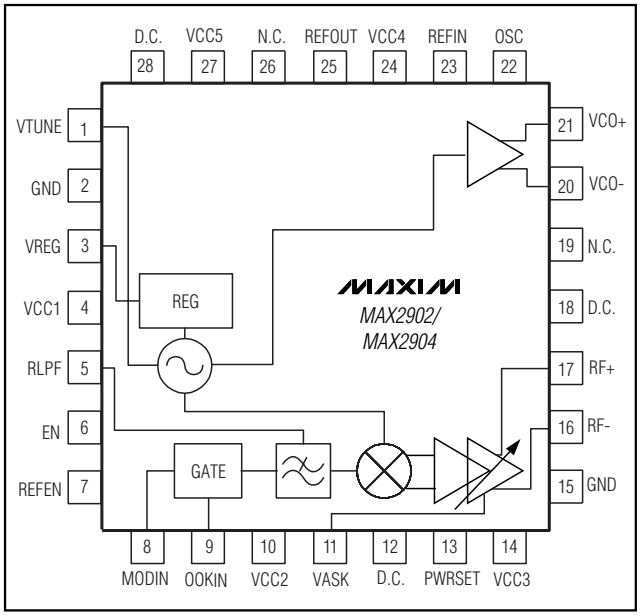
Typical Operating Circuits (continued)



MAX2902/MAX2904 TYPICAL OPERATING CIRCUIT

200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

Functional Diagrams/ Pin Configurations (continued)



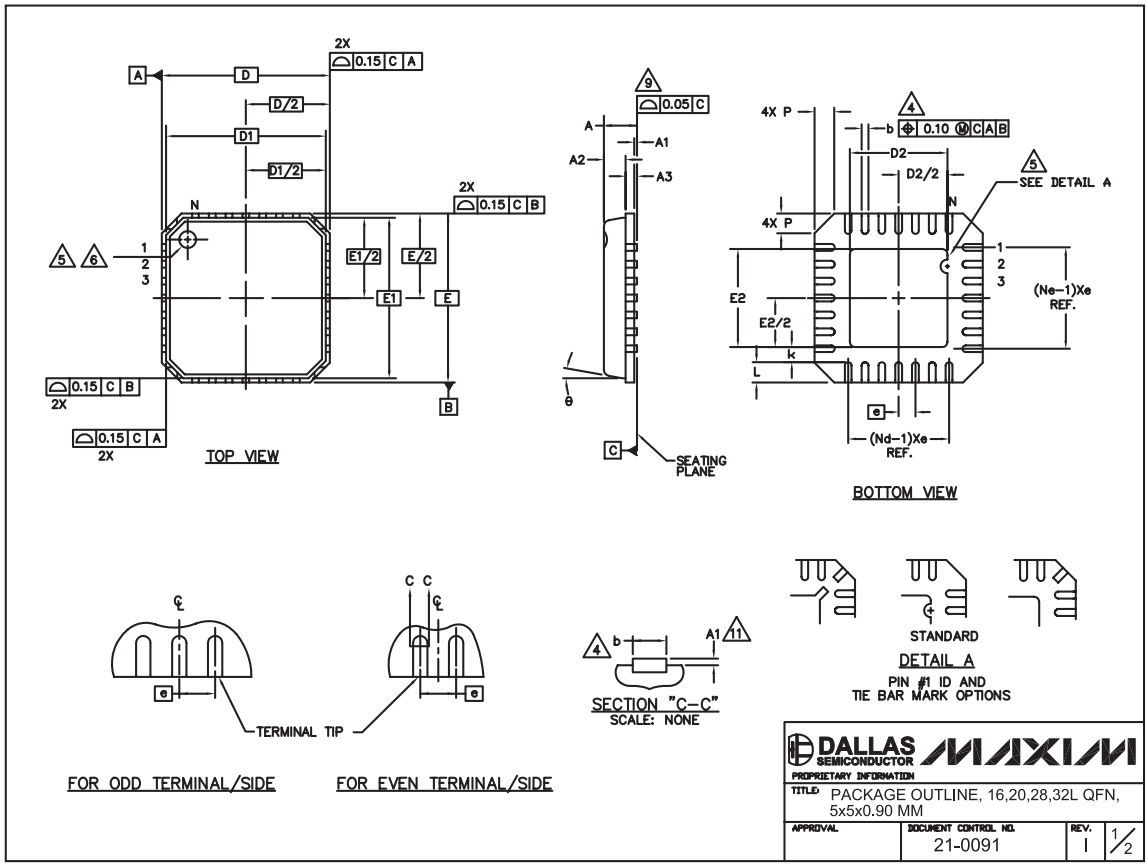
Chip Information

TRANSISTOR COUNT: 898

Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)

32L QFN.EPS



200mW Single-Chip Transmitter ICs for 868MHz/915MHz ISM Bands

Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)

COMMON DIMENSIONS												
PKG	16L 5x5			20L 5x5			28L 5x5			32L 5x5		
SYMBOL	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.80	0.90	1.00	0.80	0.90	1.00	0.80	0.90	1.00
A1	0.00	0.01	0.05	0.00	0.01	0.05	0.00	0.01	0.05	0.00	0.01	0.05
A2	0.00	0.65	1.00	0.00	0.65	1.00	0.00	0.65	1.00	0.00	0.65	1.00
A3	0.20 REF			0.20 REF			0.20 REF			0.20 REF		
b	0.28	0.33	0.40	0.23	0.28	0.35	0.18	0.23	0.30	0.18	0.23	0.30
D	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
D1	4.75 BSC			4.75 BSC			4.75 BSC			4.75 BSC		
E	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
E1	4.75 BSC			4.75 BSC			4.75 BSC			4.75 BSC		
e	0.80 BSC			0.65 BSC			0.50 BSC			0.50 BSC		
k	0.25	–	–	0.25	–	–	0.25	–	–	0.25	–	–
L	0.35	0.55	0.75	0.35	0.55	0.75	0.35	0.55	0.75	0.30	0.40	0.50
N	16			20			28			32		
ND	4			5			7			8		
NE	4			5			7			8		
P	0.00	0.42	0.60	0.00	0.42	0.60	0.00	0.42	0.60	0.00	0.42	0.60
θ	0°		12°	0°		12°	0°		12°	0°		12°

EXPOSED PAD VARIATIONS						
PKG. CODES	D2			E2		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
G1655-3	2.95	3.10	3.25	2.95	3.10	3.25
G2055-1	2.55	2.70	2.85	2.55	2.70	2.85
G2055-2	2.95	3.10	3.25	2.95	3.10	3.25
G2855-1	2.55	2.70	2.85	2.55	2.70	2.85
G2855-2	2.95	3.10	3.25	2.95	3.10	3.25
G3255-1	2.95	3.10	3.25	2.95	3.10	3.25

NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 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 EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/LASER MARKED. DETAILS OF PIN #1 IDENTIFIER IS OPTIONAL, BUT MUST BE LOCATED WITHIN ZONE INDICATED.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PACKAGE WARPAGE MAX 0.05mm.
9. APPLIED FOR EXPOSED PAD AND TERMINALS.
   EXCLUDE EMBEDDED PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220; EXCEPT DIMENSION "b".
11. APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
12. THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES).

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, 16,20,28,32L QFN, 5x5x0.90 MM			
APPROVAL	DOCUMENT CONTROL NO. 21-0091	REV. I	2/2

MAX2900

Part Number Table

Notes:

1. See the MAX2900 QuickView Data Sheet for further information on this product family or download the MAX2900 full data sheet (PDF, 832kB).
2. Other options and links for purchasing parts are listed at: http://www.maxim-ic.com/sales.
3. Didn't Find What You Need? Ask our applications engineers. Expert assistance in finding parts, usually within one business day.
4. Part number suffixes: T or T&R = tape and reel; + = RoHS/lead-free; # = RoHS/lead-exempt. More: See full data sheet or Part Naming Conventions.
5. * Some packages have variations, listed on the drawing. "PkgCode/Variation" tells which variation the product uses.

Part Number	Free Sample	Buy Direct	Package: TYPE PINS SIZE DRAWING CODE/VAR *	Temp	RoHS/Lead-Free? Materials Analysis
MAX2900EGI			QFN;28 pin;5x5x0.9mm Dwg: 21-0091I (PDF) Use pkgcode/variation: G2855-1*	-40C to +85C	RoHS/Lead-Free: No Materials Analysis
MAX2900EGI-T			QFN;28 pin;5x5x0.9mm Dwg: 21-0091I (PDF) Use pkgcode/variation: G2855-1*	-40C to +85C	RoHS/Lead-Free: No Materials Analysis
MAX2900ETI+			THIN QFN;28 pin;5x5x0.8mm Dwg: 21-0140K (PDF) Use pkgcode/variation: T2855+4*	-40C to +85C	RoHS/Lead-Free: Yes Materials Analysis
MAX2900ETI+T				-40C to +85C	RoHS/Lead-Free: Yes

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