EVALUATION KIT AVAILABLE

* МΛXIΜ*

900MHz Image-Reject Transceivers

General Description

The MAX2420/MAX2421/MAX2422/MAX2460/MAX2463 are highly integrated front-end ICs that provide the lowest cost solution for cordless phones and ISM-band radios operating in the 900MHz band. All devices incorporate transmit and receive image-reject mixers to reduce filter cost. They operate with a +2.7V to +4.8V power supply, allowing direct connection to a 3-cell battery stack.

The receive path incorporates an adjustable-gain LNA and an image-reject downconverter with 35dB image suppression. These features yield excellent combined downconverter noise figure (4dB) and high linearity with an input third-order intercept point (IP3) of up to +2dBm.

The transmitter consists of a variable-gain IF amplifier with more than 35dB control range, an image-reject upconverter with 35dB image rejection, and a power-amplifier (PA) predriver that produces up to +2dBm (in some applications serving as the final power stage).

All devices include an on-chip local oscillator (LO), requiring only an external varactor-tuned LC tank for operation. The integrated divide-by-64/65 dual-modulus prescaler can also be set to a direct mode, in which it acts as an LO buffer amplifier. Four separate power-down inputs can be used for system power management, including a 0.5µA shutdown mode. These parts are compatible with commonly used modulation schemes such as FSK, BPSK, and QPSK, as well as frequency hopping and direct sequence spread-spectrum systems. All devices come in a 28-pin SSOP package.

For applications using direct VCO or BPSK transmit modulation as well as receive image rejection, consult the MAX2424/MAX2426 data sheet. For receive-only devices, refer to the MAX2440/MAX2441/MAX2442 data sheet.

Applications

Cordless Phones

Wireless Telemetry

Wireless Networks

Spread-Spectrum Communications

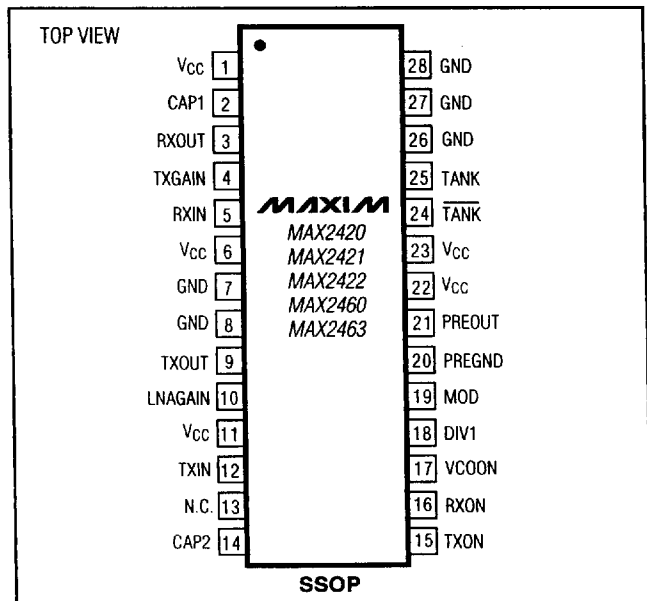Two-Way Paging

Features

♦ **Receive/Transmit Mixers with 35dB Image Rejection**

♦ **Adjustable-Gain LNA**

♦ **Up to +2dBm Combined Receiver Input IP3**

♦ **4dB Combined Receiver Noise Figure**

♦ **>35dB of Transmit Power Control Range**

♦ **PA Predriver Provides up to +2dBm**

♦ **Low Current Consumption: 23mA Receive**
  26mA Transmit
  9.5mA Oscillator

♦ **0.5µA Shutdown Mode**

♦ **Operates from Single +2.7V to +4.8V Supply**

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX2420EAI	-40°C to +85°C	28 SSOP
MAX2421EAI	-40°C to +85°C	28 SSOP
MAX2422EAI	-40°C to +85°C	28 SSOP
MAX2460EAI	-40°C to +85°C	28 SSOP
MAX2463EAI	-40°C to +85°C	28 SSOP

Functional Diagram appears on last page.

Pin Configuration

TOP VIEW

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          ┌────────────┐
  Vcc  [1]│ •          │[28] GND
  CAP1 [2]│            │[27] GND
 RXOUT [3]│            │[26] GND
TXGAIN [4]│            │[25] TANK
  RXIN [5]│  ΜΛXIΜ     │[24] TANK
   Vcc [6]│  MAX2420   │[23] Vcc
   GND [7]│  MAX2421   │[22] Vcc
   GND [8]│  MAX2422   │[21] PREOUT
 TXOUT [9]│  MAX2460   │[20] PREGND
LNAGAIN[10]│ MAX2463   │[19] MOD
   Vcc[11]│            │[18] DIV1
  TXIN[12]│            │[17] VCOON
  N.C.[13]│            │[16] RXON
  CAP2[14]│            │[15] TXON
          └────────────┘
              SSOP
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Selector Guide

PART	IF FREQ (MHz)	INJECTION TYPE	LO FREQ (MHz)
MAX2420	10.7	High side	f_{RF} + 10.7
MAX2421	46	High side	f_{RF} + 46
MAX2422	70	High side	f_{RF} + 70
MAX2460	10.7	Low side	f_{RF} - 10.7
MAX2463	110	Low side	f_{RF} - 110

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MAX2420/MAX2421/MAX2422/MAX2460/MAX2463

900MHz Image-Reject Transceivers

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND ....-0.3V to +5.5V
TXIN Input Power (330Ω system) ....-8dBm
Voltage on TXOUT.................................-0.3V to (V_{CC} + 1.0V)
Voltage on TXGAIN, LNAGAIN, TXON, RXON,
  VCOON, DIV1, MOD ....-0.3V to (V_{CC} + 0.3V)
RXIN Input Power 10dBm
TANK, $\overline{\text{TANK}}$ Input Power 2dBm
Continuous Power Dissipation (T_A = +70°C)

SSOP (derate 9.50mW/°C above +70°C) 762mW
Operating Temperature Range
  MAX242_EAI/MAX246_EAI ....-40°C to +85°C
Junction Temperature...+150°C
Storage Temperature Range ....-65°C to +165°C
Lead Temperature (soldering, 10sec) ....+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

(V_{CC} = +2.7V to +4.8V, no RF signals applied, LNAGAIN = TXGAIN = open, VCOON = 2.4V, RXON = TXON = MOD = DIV1 = 0.45V, PREGND = GND, T_A = T_{MIN} to T_{MAX}. Typical values are at T_A = +25°C, V_{CC} = +3.3V, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Supply-Voltage Range			2.7		4.8	V
Oscillator Supply Current	PREGND = floating			9.5	14	mA
Prescaler Supply Current (divide-by-64/65 mode) (Note 1)				4.2	6	mA
Prescaler Supply Current (buffer mode) (Note 2)	DIV1 = 2.4V			5.4	8.5	mA
Receive Supply Current (Note 3)	RXON = 2.4V, PREGND = floating			23	36	mA
Transmitter Supply Current (Note 4)	RXON = 0.45V, TXON = 2.4V, PREGND = floating			26	42	mA
Shutdown Supply Current	VCOON = RXON = TXON = MOD = DIV1 = GND	T_A = +25°C		0.5		μA
		T_A = T_{MIN} to T_{MAX}			10	
Digital Input Voltage High	RXON, TXON, DIV1, VCOON, MOD		2.4			V
Digital Input Voltage Low	RXON, TXON, DIV1, VCOON, MOD				0.45	V
Digital Input Current	Voltage on any one digital input = V_{CC} or GND			±1	±10	μA

Note 1: Calculated by measuring the combined oscillator and prescaler supply current and subtracting the oscillator supply current.
Note 2: Calculated by measuring the combined oscillator and LO buffer supply current and subtracting the oscillator supply current.
Note 3: Calculated by measuring the combined receive and oscillator supply current and subtracting the oscillator supply current.
    With LNAGAIN = GND, the supply current drops by 4.5mA.
Note 4: Calculated by measuring the combined transmit and oscillator supply current and subtracting the oscillator supply current.

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AC ELECTRICAL CHARACTERISTICS

(MAX242X/246X EV kit, V_{CC} = +3.3V; f_{LO} = 925.7MHz (MAX2420), f_{LO} = 961MHz (MAX2421), f_{LO} = 985MHz (MAX2422), f_{LO} = 904.3MHz (MAX2460); f_{LO} = 805MHz (MAX2463); f_{RXIN} = 915MHz; P_{RXIN} = -35dBm; P_{TXIN} = -15dBm (330Ω); LNAGAIN = 2V; TXGAIN = V_{CC}; VCOON = 2.4V; RXON = TXON = MOD = DIV1 = PREGND = GND; T_A = +25°C; unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RECEIVER (RXON = 2.4V)						
Input Frequency Range (Notes 5, 6)			800		1000	MHz
IF Frequency Range (Notes 5, 6)	MAX2420/MAX2460		8.5	10.7	12.5	MHz
	MAX2421		36	46	55	
	MAX2422		55	70	85	
	MAX2463		86	110	132	
Image Frequency Rejection			26	35		dB
Conversion Power Gain (Note 7)	LNAGAIN = V_{CC}, T_A = +25°C	MAX2420/MAX2421/MAX2460	20	22	24.5	dB
		MAX2422	19	21	23.5	
		MAX2463	18	20	22.5	
	LNAGAIN = V_{CC}, T_A = T_{MIN} to T_{MAX} (Note 5)	MAX2420/MAX2421/MAX2460	19.5		25	
		MAX2422	18		24	
		MAX2463	17		23	
	LNAGAIN = 1V			12		
	LNAGAIN = GND			-16		
Noise Figure (Notes 5, 7)	LNAGAIN = V_{CC}			4	5	dB
	LNAGAIN = 1V			12		
Input Third-Order Intercept (Notes 5, 8)	LNAGAIN = V_{CC}		-19	-17		dBm
	LNAGAIN = 1V			-8		
Input 1dB Compression	LNAGAIN = V_{CC}			-26		dBm
	LNAGAIN = 1V			-18		
LO to RXIN Leakage	Receiver on or off			-60		dBm
Receiver Turn-On Time	(Note 9)			500		ns
TRANSMITTER (TXON = 2.4V)						
Output Frequency Range (Notes 5, 6)			800		1000	MHz
IF Frequency Range	MAX2420/MAX2460		8.5	10.7	12.5	MHz
	MAX2421		36	46	55	
	MAX2422		55	70	85	
	MAX2463		86	110	132	
Image Frequency Rejection			26	35		dB
Conversion Gain	T_A = +25°C	MAX2420/2460	11	13.5	16	dB
		MAX2421	10	12.5	15	
		MAX2422	9	12	14.5	
		MAX2463	8	11	13.5	
	T_A = T_{MIN} to T_{MAX} (Note 5)	MAX2420/2460	10.5		16.5	
		MAX2421	10		15.5	
		MAX2422	9		15	
		MAX2463	8		14	

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MAX2420/MAX2421/MAX2422/MAX2460/MAX2463

AC ELECTRICAL CHARACTERISTICS (continued)

(MAX242X/246X EV kit, V_{CC} = +3.3V; f_{LO} = 925.7MHz (MAX2420), f_{LO} = 961MHz (MAX2421), f_{LO} = 985MHz (MAX2422), f_{LO} = 904.3MHz (MAX2460); f_{LO} = 805MHz (MAX2463); f_{RXIN} = 915MHz; P_{RXIN} = -35dBm; P_{TXIN} = -15dBm (330Ω); LNAGAIN = 2V; TXGAIN = V_{CC}; VCOON = 2.4V; RXON = TXON = MOD = DIV1 = PREGND = GND; T_A = +25°C; unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output 1dB Compression			2		dBm
Output Third-Order Intercept (Note 10)			11		dBm
LO to TXOUT Suppression (Note 11)			34		dBc
Noise Figure			23		dB
TXGAIN Control Slope (Note 12)	1V ≤ TXGAIN ≤ 2V		33		dB/V
Gain Control Range (Note 12)			36		dB
Transmitter Turn-On Time (Note 13)			400		ns
OSCILLATOR AND PRESCALER					
Oscillator Frequency Range (Notes 5, 14)		690		1100	MHz
Oscillator Phase Noise	10kHz offset (Note 15)		82		dBc/Hz
Oscillator Pulling	Standby to TX, or standby to RX		8		kHz
	RX to TX with P_{RXIN} = -45dBm (RX mode) to P_{RXIN} = 0dBm (TX mode) (Note 16)		70		
Prescaler Output Level	Z_L = 100kΩ || 10pF			500	mVp-p
Oscillator Buffer Output Level (Note 5)	DIV1 = 2.4V, Z_L = 50Ω, T_A = +25°C	-11	-8		dBm
	DIV1 = 2.4V, Z_L = 50Ω, T_A = T_{MIN} to T_{MAX}	-12			
Required Modulus Setup Time (Note 5)	Divide-by-64/65 mode (Note 17)	10			ns
Required Modulus Hold Time (Note 5)	Divide-by-64/65 mode (Note 17)	0			ns

Note 5: Guaranteed by design and characterization.
Note 6: Image rejection typically falls to 30dBc at the frequency extremes.
Note 7: Refer to the *Typical Operating Characteristics* for plots showing receiver gain versus LNAGAIN voltage, input IP3 versus LNAGAIN voltage, and noise figure versus LNAGAIN voltage.
Note 8: Two tones at P_{RXIN} = -45dBm each, f1 = 915.0MHz and f2 = 915.2MHz.
Note 9: Time delay from RXON = 0.45V to RXON = 2.4V transition to the time the output envelope reaches 90% of its final value.
Note 10: Two tones at P_{TXIN} = -21dBm each (330Ω), f1 = 10.6MHz, f2 = 10.8MHz (MAX2420/MAX2460), f1 = 45.9MHz, f2 = 46.1MHz (MAX2421), f1 = 69.9MHz, f2 = 70.1MHz (MAX2422).
Note 11: Refer to the *Typical Operating Characteristics* for statistical data.
Note 12: Refer to the *Typical Operating Characteristics* for a plot showing transmitter gain versus TXGAIN voltage.
Note 13: Time delay from TXON = 0.45V to TXON = 2.4V transition to the time the output envelope reaches 90% of its final value.
Note 14: Refers to useable operating range. Tuning range of any given tank circuit design is typically much narrower (refer to Figure 2).
Note 15: Using tank components shown in Figure 2.
Note 16: This approximates a typical application in which TXOUT is followed by an external PA and a T/R switch with finite isolation.
Note 17: Relative to the rising edge of PREOUT.

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