

## **SPRF2400A**

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# **2.4GHz RF Transceiver**

***Preliminary***

DEC. 22, 2008

Version 0.9

## 2.4GHZ RF TRANSCEIVER

### 1. FEATURES

- 2.4GHz GFSK RF transceiver
- Operates in unlicensed worldwide Industrial, Science and Medical (ISM) band (2.400GHz ~ 2.527GHz)
- Sensitivity up to  $-93$  dBm @250Kbps
- Output power up to 0 dBm
- Low-noise amplifier, power amplifier, modern and data slicer/recovery on chip
- Low operation voltage from 1.9V to 3.6V
- Low current consumption, 8.2mA@-20dBm at TX mode and 18mA at RX mode
- Programmable 250kbps/1Mbps transfer bit-rate
- Configurable preamble, scramble, source address, destination address and CRC generation
- Programmable data payload length from 1-byte to 32-byte
- 3-wire SPI interface for device configuration
- Complete RSSI function on chip
- Operation temperature range from  $-40$  °C to  $+85$  °C
- Compact 24-pin QFN 4x4 mm package

### 2. GENERAL DESCRIPTION

The SPRF2400A is a low-power, high-integrated single chip RF transceiver using 0.18 $\mu$ m mixed-mode CMOS process optimized for ISM 2.4GHz wireless systems.

The SPRF2400A contains receiver, transmitter, voltage-controlled oscillator (VCO) and phase-locked loop (PLL). The device is expressly designed for low power consumption. Specific expertise has been applied to save current consumption and thus to extend the battery life, which is of most importance to the portable wireless consumer applications. Power saving mode has also been implemented to further reduce the power consumption. The receiver contains a low-noise amplifier (LNA), a high-frequency mixer, a received signal strength indicator (RSSI), a channel select filter, a limiting amplifier, a demodulator and a data slicer with clock recovery. Current consumption of receive mode is 18mA and transmit mode is 10.5mA at  $-5$ dBm output.

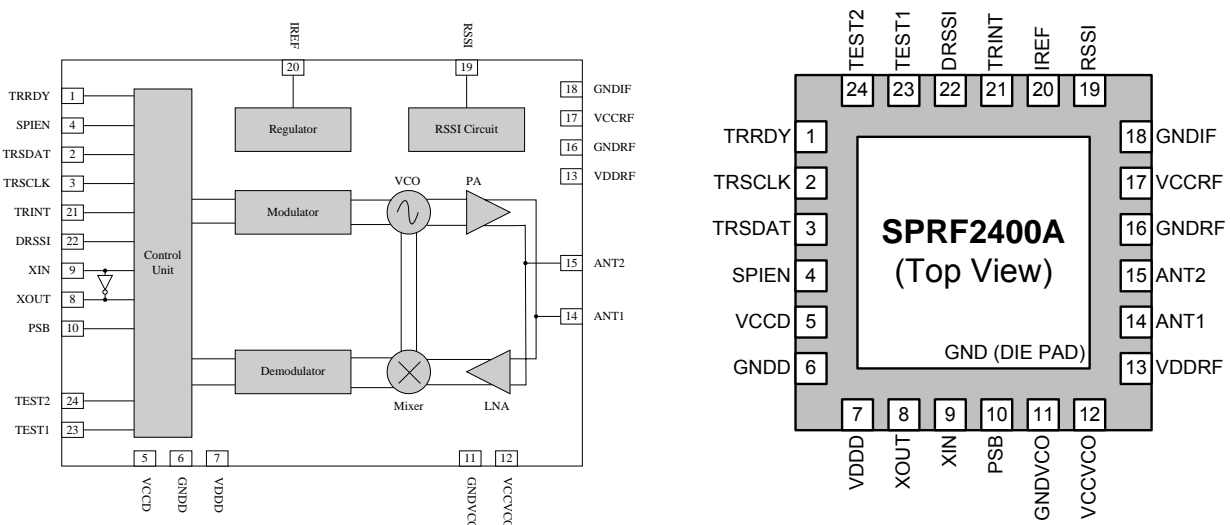
### 3. APPLICATION

- Wireless Mouse, Presenters, Keyboards and Gamepad
- Wireless VOIP and Headsets
- Remote Controls
- Toys
- Home Automation
- Consumer Electronics

## 4. SIGNAL DESCRIPTIONS

### 4.1. PIN Descriptions

IC Name	PIN No.	I/O	Function Description
TRRDY	1	I	Digital input. Assert to set the SPRF2400A to Active Mode.
TESCLK	2	B	Digital input at Burst Mode and digital output at Direct Mode. Clock signal of the SPI/FIFO interface.
TRSDAT	3	B	Digital input/output. Data signal of the SPI/FIFO interface.
SPIEN	4	I	Digital input. Enable signal of the SPI interface.
VCCD	5	P	Digital power pin. +3.3V <sub>DC</sub> .
GNDD	6	P	Digital ground.
VDDD	7	P	Crystal output pin.
XOUT	8	O	Crystal input pin.
XIN	9	I	General Purpose I/O Port_A1
PSB	10	I	Digital input. Assert to force SPRF2400A to enter Power-Saving Mode or Power-Down Mode, depended on the state of TRRDY.
GNDVCO	11	P	VCO ground.
VCCVCO	12	P	VCO power pin. +3.3V <sub>DC</sub>
VDDRF	13	P	RF decoupling power pin
ANT1	14	B	RF signal pin. Antenna I/F
ANT2	15	B	RF signal pin. Antenna I/F
GNDRF	16	P	RF ground
VCCRF	17	P	RF power pin. +3.3V <sub>DC</sub>
GNDIF	18	P	Analog IF ground.
RSSI	19	O	Analog output. Analog RSSI output pin
IREF	20	I	Analog input. Reference current input pin
TRINT	21	O	Digital output. Asserted when transmitting or receiving is accomplished
DRSSI	22	O	Digital output. Digital RSSI output.
TEST1	23	-	Reserved for future testing
TEST2	24	-	Reserved for future testing.



## 5. ELECTRICAL SPECIFICATION

### 5.1. Absolute Maximum Rating

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Storage Temperature	T <sub>STR</sub>	-55	-	125	°C	
Voltage Rating on Input	V <sub>IN</sub>	-0.4	-	3.6	V	
Other terminal voltages	-	VSS-0.4	-	VCC+0.4	V	

**Note:** Stresses beyond those given in the Absolute Maximum Rating table may cause operational errors or damage to the device. For normal operational conditions see AC/DC Electrical Characteristics.

### 5.2. Recommended Operating Conditions

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Operating temperature range	VDD	1.9	-	3.6	V	
Operating Ambient Temperature	T <sub>OPR</sub>	-40	-	+85	°C	

### 5.3. AC Characteristics

Description	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Crystal Frequency	F <sub>sys</sub>	4/8/16/20 *1			MHz	30ppm C <sub>L</sub>
Frequency deviation	F <sub>dev</sub>	-160	-	+160	KHz	
<b>RF General Parameter</b>						
Data Rate	Burst Mode	-	>0	-	1000	Kbps
	Direct Mode	-	250	-	1000	Kbps
Channel Spacing	-	-	1	-	MHz	
<b>RF Transmitter Parameter</b>						
Transmit output power	-	0	-	4	dBm	
Transmit output power control range	-	16	20	-	dBm	
Transmit output power control step	-	-	5	-	dB	
20dB bandwidth for modulation carrier	-	-	1000	-	KHz	
2 <sup>nd</sup> Adjacent Tx power 2MHz	-	-	-20	-	dBm	
3 <sup>rd</sup> Adjacent Tx power 3MHz	-	-	-40	-	dBm	
<b>RF Receiver Parameter</b>						
Sensitivity	0.1%BER @250Kbps	-	-	-93	-	dBm
	0.1%BER @1Mbps	-	-	-85	-	dBm
C/I Co-Channel	250Kbps	-	-	9	-	dB
	1Mbps	-	-	5	-	dB
C/I 1MHz	250Kbps	-	-	-20	-	dB
	1Mbps	-	-	1	-	dB
C/I 2MHz	250Kbps	-	-	-36	-	dB
	1Mbps	-	-	-22	-	dB
C/I 3MHz	250Kbps	-	-	-45	-	dB
	1Mbps	-	-	-35	-	dB
C/I <sub>image</sub>	250Kbps	-	-	-30	-	dB
	1Mbps	-	-	-30	-	dB

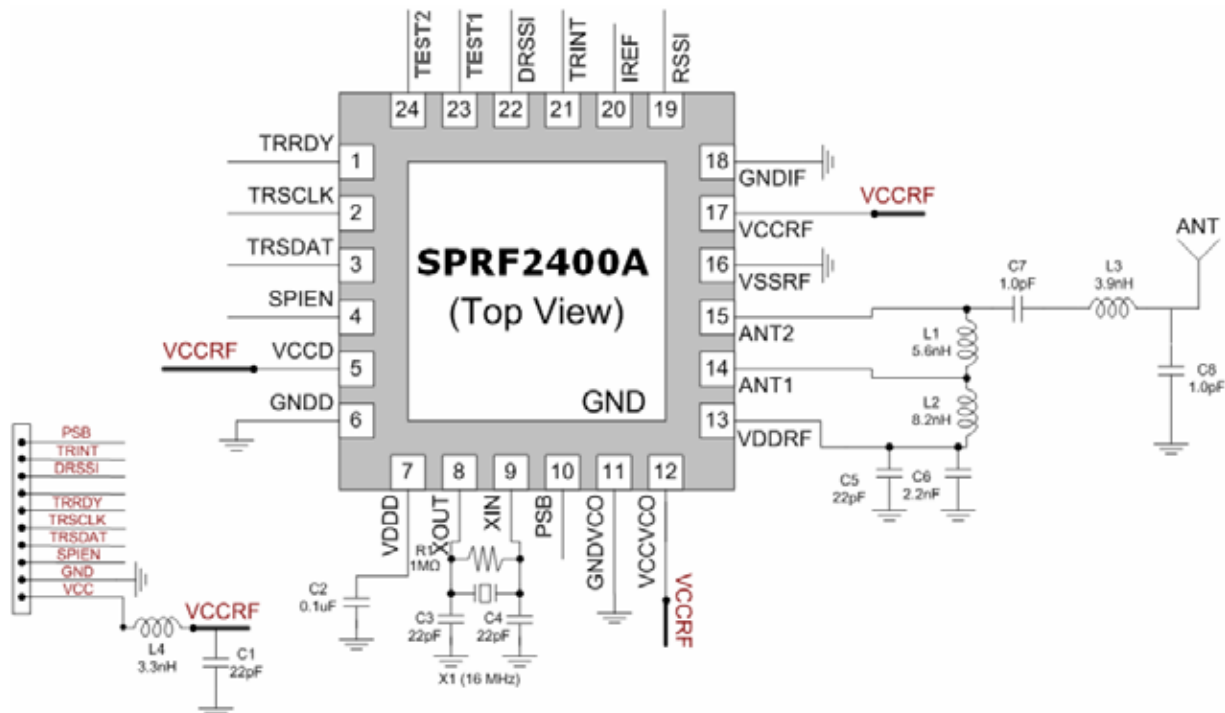
\*1: 16MHz crystal frequency is required if 1Mbps is employed.

## 5.4. DC Characteristics

Parameter	Min.	Typ.	Max.	Unit	Test Condition	
$V_{IL}$	-0.4	-	0.8	V	Vcc =3.3V	
$V_{IH}$	0.7Vcc	-	Vcc+0.4	V		
$V_{OL}$	-	3.6	0.4	V		
$V_{OH}$	Vcc-0.4	3.0	-	V		
Current Consumption	-	400	-	nA	Power Down Mode	
	-	1	-	uA	Power Saving Mode	
	-	12	-	uA	$f_{sys} = 4\text{MHz}$	Standby Mode
	-	22*	-	uA	$f_{sys} = 16\text{MHz}$	
	-	13	-	mA	0 dBm	Transmit Mode
	-	10.5	-	mA	-5 dBm	
	-	9	-	mA	-10 dBm	
	-	8.2	-	mA	-20 dBm	
	-	18	-	mA	250 Kbps	Receive Mode
-	19	-	mA	1 Mbps		

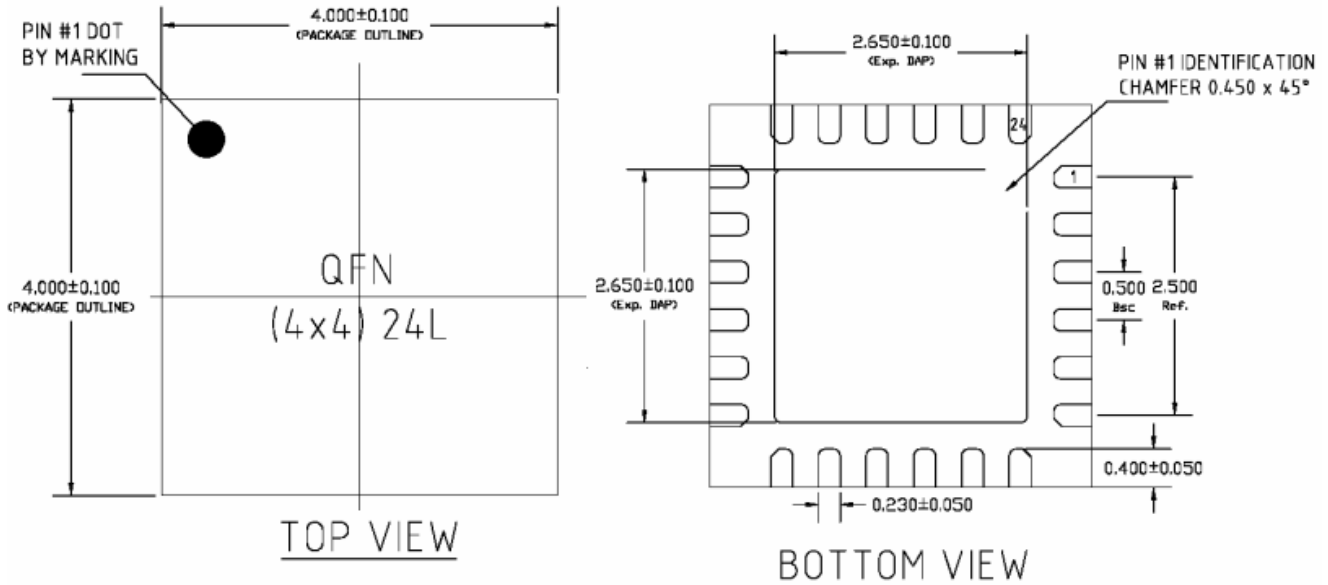
\*: The current consumption is depended on the CL of the external crystal; please refer to the section – “Global Clock” for detailed information.

## 6. APPLICATION REFERENCE CIRCUIT



Component	Description	Value	Tolerance	Units	Component	Description	Value	Tolerance	Units
C1	Ceramic capacitor, 50V, NPO	22	±5%	pF	C8	Ceramic capacitor, 50V, NPO	1	±0.25pF	pF
C2	Ceramic capacitor, 10V, X7R	0.1	±10%	μF	L1	Inductor, wore wound	5.6	±0.3nH	nH
C3	Ceramic capacitor, 50V, NPO	22	±5%	pF	L2	Inductor, wore wound	8.2	±0.3nH	nH
C4	Ceramic capacitor, 50V, X7R	22	±5%	pF	L3	Inductor, wore wound	3.9	±0.3nH	nH
C5	Ceramic capacitor, 50V, NPO	22	±5%	pF	L4	Inductor, wore wound	3.3	±0.3nH	nH
C6	Ceramic capacitor, 50V, NPO	2.2	±10%	nF	R1	Resistor	1	±5%	MΩ
C7	Ceramic capacitor, 50V, NPO	1	±0.25pF	pF	X1	Crystal, $C_L=12\text{pF}$ , $\text{ESR}<100\Omega$	16	±30ppm	MHz

## 7. PACKAGE DIMENSION



### NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. QFN AND TQFN SHARE THE EXPOSE OUTLINE BUT WITH DIFFERENT THICKNESS:

A	QFN	
	MAX.	1.000
	NOM.	0.850
	MIN.	0.800

## 8. ORDERING INFORMATION

Product Number	Package Type
SPRF2400A-HV111	Package form – QFN24

Notes: Above ordering information are for the green packages (default) only