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## Description

The RX3930 is a low power 315/433/868/915 MHz FM/FSK receiver IC which is suitable for use in the North American 315/915 MHz and the European 433/868 MHz ISM bands.

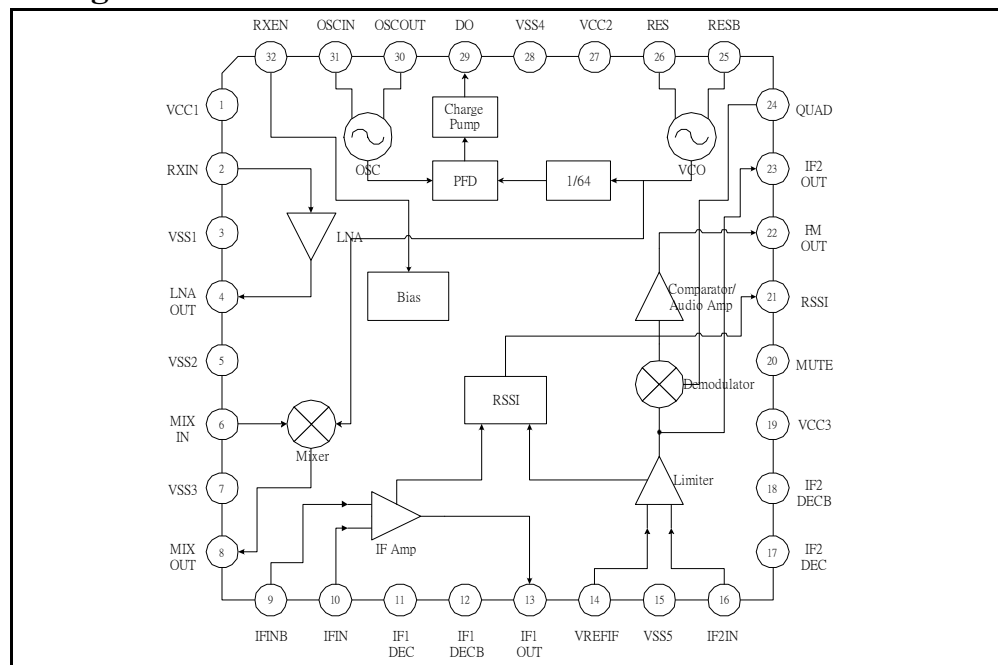
## Features

- ◆ Integrated VCO with fixed  $\div 64$  prescaler, phase/frequency detector, and reference oscillator forming complete phase-locked loop
- ◆ User selectable FM (sinusoidal) or FSK (CMOS compatible) output by the MUTE pin
- ◆ RSSI output with 70 dB of dynamic range
- ◆ Receiver enable pin for power saving (1  $\mu$ A current consumption in stand-by mode)
- ◆ TQFP 32L package (5 mm x 5 mm)

## Applications

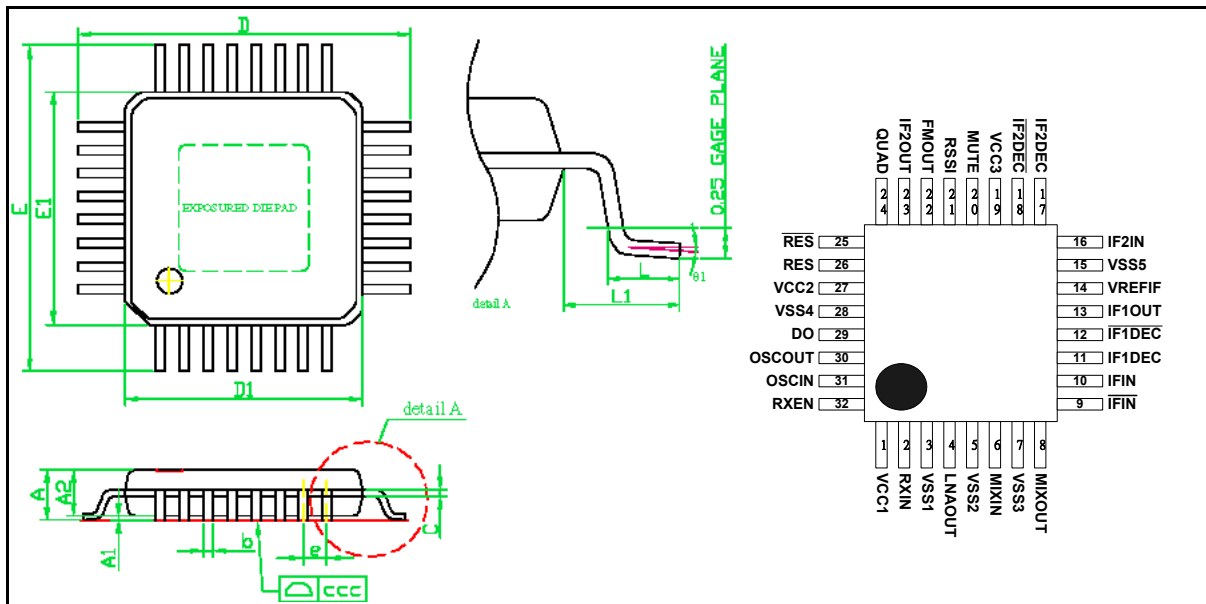
- ◆ Wireless mouse / joystick
- ◆ Wireless voice transmission
- ◆ Wireless car alarm system

## Block Diagram





## Package and Pin Assignment: 32L, TQFP



Symbols	Dimensions in mm			Dimensions in inches		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	—	—	1.20	—	—	0.047
A1	0.05	—	0.15	0.002	—	0.006
A2	0.95	1.00	1.05	0.037	0.039	0.041
b	0.17	0.22	0.27	0.007	0.009	0.011
C	0.09	—	0.20	0.003	—	0.008
D1	4.90	5.00	5.10	0.193	0.197	0.201
D	6.80	7.00	7.20	0.267	0.275	0.283
E1	4.90	5.00	5.10	0.193	0.197	0.201
E	6.80	7.00	7.20	0.267	0.275	0.283
e	—	0.50 (typ.)	—	—	0.02 (typ.)	—
L	0.45	0.60	0.75	0.018	0.024	0.029
L1	—	1.00 (ref.)	—	—	0.039 (ref.)	—
θ1	0°	3.5°	7°	0°	3.5°	7°
ccc	—	—	0.008	—	—	0.003

## Pin Descriptions

Pin	Name	I/O	Description	Interface Schematic
1	VCC1	POWER	DC voltage supply for the RF section. A bypass capacitor should be added between this pin and ground (47 pF is recommended for 915 MHz and 100 pF is recommended for 433 MHz).	
2	RXIN	I	RF amplifier input for the receiver. It requires a matching network from the antenna to the RXIN pin for optimum sensitivity.	
3	VSS1	GND	Ground for RF amplifier. It should immediately be connected to the ground plane for best performance.	
4	LNAOUT	O	LNA output. This pin is the open-collector structure and must be connected to the DC bias by an external inductor. A series capacitor may be used to match the LNA output and the mixer input.	
5	VSS2	GND	Ground for 40 dB IF limiting amplifier. It should immediately connect to the ground plane for the best performance.	
6	MIXIN	I	RF input to RF Mixer. An L-C matching network should be connected between the LNA output and the mixer input.	
7	VSS3	GND	Ground for RF Mixer.	
8	MIXOUT	O	IF output from RF Mixer. An external inductor is connected from this pin to the DC bias and a series capacitor is used to match the 330 ohm terminal impedance of the 10.7 MHz ceramic filter. In addition, a 15 pF capacitor is recommended to be put from this pin to the ground.	
9	$\overline{\text{IFIN}}$	I	Inverting IF input of the 40 dB limiting amplifier (requires 10 nF DC blocking capacitor).	
10	IFIN	I	Same as pin 9 except non-inverting amplifier input.	
11	IF1DEC	I/O	DC feedback for 40 dB limiting amplifier (requires 10 nF bypass capacitor).	see pin9 and pin10
12	$\overline{\text{IF1DEC}}$	I/O	See pin 11.	
13	IF1OUT	O	IF output from the 40 dB limiting amplifier. This output pin has a nominal 330 ohm output impedance and may be directly connected to the 10.7 MHz ceramic filter.	



Pin	Name	I/O	Description	Interface Schematic
14	VREFIF	O	DC voltage reference for the IF limiting amplifier (requires 10 nF capacitor).	
15	VSS5	GND	Ground for 60 dB IF limiting amplifier. It should immediately be connected to the ground plane for best performance.	
16	IF2IN	I	Inverting input to the 60 dB limiting amplifier (requires 10 nF DC blocking capacitor).	
17	IF2DEC	I/O	DC feedback node for the 60 dB limiting amplifier (required 10 nF bypass capacitor).	
18	$\overline{\text{IF2DEC}}$	I/O	See pin 17	
19	VCC3	POWER	DC voltage supply to the 60 dB IF limiting amplifier. A bypass capacitor should be added between this pin and ground (10 nF is recommended for 10.7 MHz IF application).	
20	MUTE	I	Control pin for FMOUT output. MUTE = L is FSK mode; MUTE = H disables the FMOUT output; MUTE = floating is FM mode.	
21	RSSI	O	Received signal strength indicator output. Outputs a DC voltage (0.5 V – 2.5 V) proportional to the received signal strength.	
22	FMOUT	O	Demodulator output. The output level is CMOS-compatible in FSK mode and linear sinusoidal in FM mode.	
23	IF2OUT	O	IF output from the 60 dB limiting strip. A 2.7 pF capacitor is connected between this pin and the QUAD input (pin 24).	
24	QUAD	I	FM demodulator input (not AC coupled). A DC blocking capacitor is required to avoid a DC path to ground. An L-C tank resonator or a ceramic discriminator should be connected to this pin.	



Pin	Name	I/O	Description	Interface Schematic
25	$\overline{\text{RES}}$	I/O	DC voltage supply to VCO through an external resonator inductor. The VCO resonator tank is connected to $\overline{\text{RES}}$ and RES (pins 25 and 26).	
26	RES	I/O	See pin 25.	
27	VCC2	POWER	DC voltage supply to the frequency synthesizer. A bypass capacitor should be added between this pin and ground.	
28	VSS4	GND	Ground for the frequency synthesizer.	
29	DO	I/O	Output of the charge pump. An R-C low-pass filter is used from this pin to ground and determines the PLL bandwidth.	
30	OSCIN	I/O	Crystal oscillator input (transistor base). A 100 pF capacitor should be connected between this pin and OSCOUT (pin 31).	
31	OSCOUT	I/O	Crystal oscillator output (transistor emitter). A 100 pF capacitor should be connected between this pin and ground.	
32	RXEN	I	Receiver enable pin. RXEN = H enables the entire RX3930 receiver IC and RXEN = L puts the entire receiver IC into stand-by mode).	



## Absolute Maximum Ratings

$$V_{SS} = 0 \text{ V}$$

Parameter	Symbol	Rating	Unit
Supply voltage	$V_{CC1}$ $V_{CC2}$	$V_{SS} - 0.5$ to $V_{SS} + 5.5$	V
Operating temperature range	$T_{OPR}$	-40 to 85	°C
Storage temperature range	$T_{STG}$	-40 to 150	°C
Soldering temperature range	$T_{SLD}$	255	°C
Soldering time range	$t_{SLD}$	10	s

## Recommended Operating Conditions

$$V_{SS} = 0 \text{ V}$$

Parameter	Symbol	Value			Unit
		min.	typ.	max.	
Supply voltage range	$V_{CC1}$	2.4	3.6	5.0	V
	$V_{CC2}$	2.4	3.6	5.0	V
	$V_{CC3}$	2.4	3.6	5.0	V
Operating temperature	$T_A$	-10	27	60	°C



## Receiver Characteristics

( $V_{CC1}, V_{CC2}, V_{CC3} = 2.4$  to  $5.0$  V,  $V_{SS} = 0$  V,  $RXEN = \text{high}$ ,  $T_A = -10$  to  $60$  °C unless otherwise noted)

Parameter	Symbol	Condition	Value			Unit
			min.	typ.	max.	
Input RF frequency range			300		1000	MHz
Sensitivity	$P_{SENS}$	$BW_{IF} = 180$ KHz $f_{RF} = 915$ MHz BER < 0.001		-97		dBm
Maximum RF input power	$P_{RF\_IN}$			-20		dBm
LO leakage	$\alpha_{LO}$			-55		dBm

## Electrical Characteristics

( $V_{CC1}, V_{CC2}, V_{CC3} = 2.4$  to  $5.0$  V,  $V_{SS} = 0$  V,  $RXEN = \text{high}$ ,  $T_A = -10$  to  $60$  °C,  $f_{RF} = 915$  MHz unless otherwise noted)

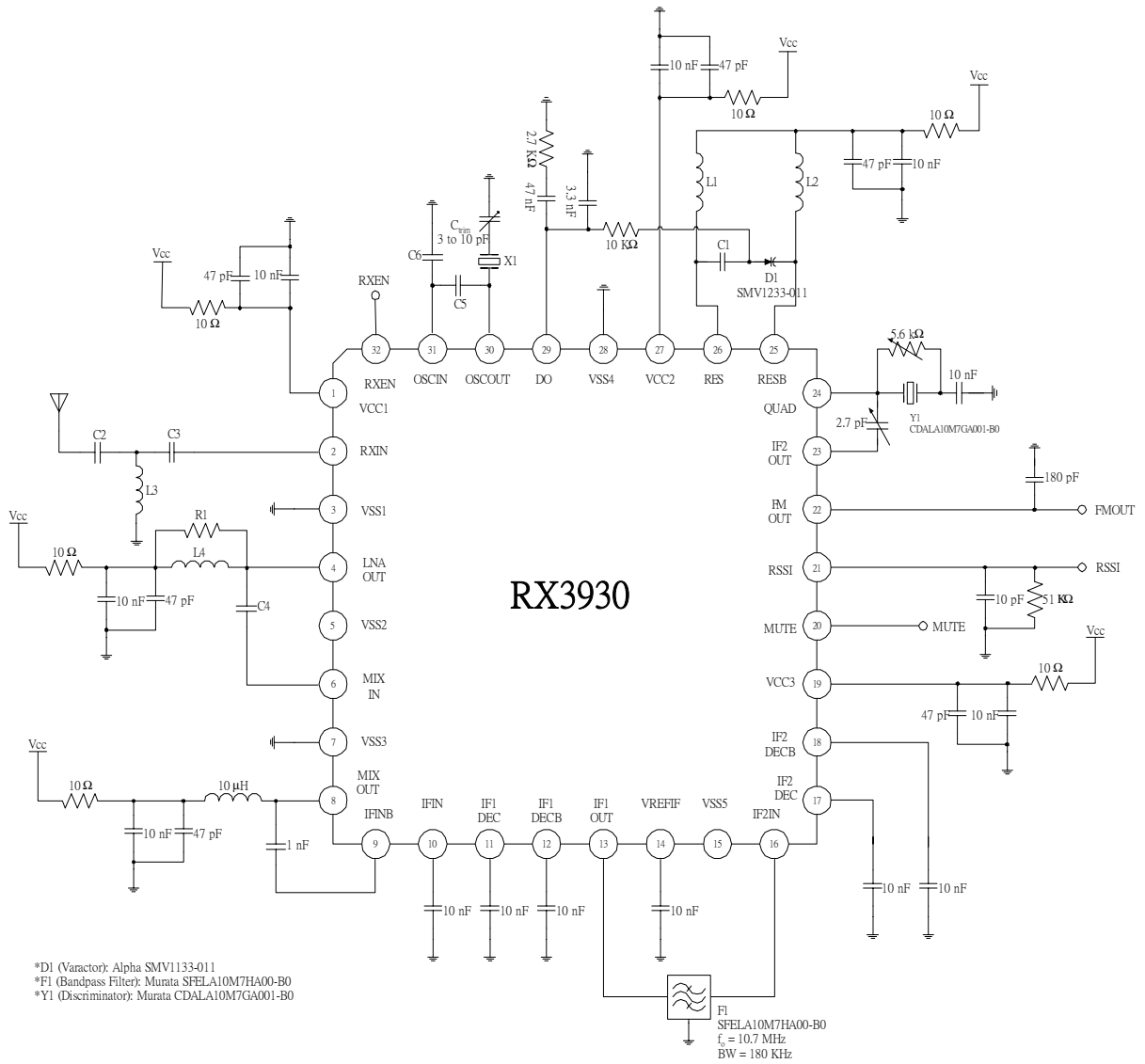
Parameter	Symbol	Condition	Value			Unit
			min.	typ.	max.	
<b>Power supply</b>						
VCC1 supply voltage	$V_{CC1}$		2.4	3.6	5.0	V
VCC2 supply voltage	$V_{CC2}$		2.4	3.6	5.0	V
VCC3 supply voltage	$V_{CC3}$		2.4	3.6	5.0	V
Total dc current (normal operation)	$I_{DC}$			7.5	9	mA
Total dc current (stand-by mode)	$I_{standby}$	$RXEN = \text{low}$			10	μA
<b>LNA</b>						
Power gain	$G_{LNA}$	Matched to $50 \Omega$		12		dB
Noise figure	$NF_{LNA}$	Depends on the matching network		3.5		dB
Input third-order intermodulation intercept point	$IIP3_{LNA}$			-14		dBm
<b>Mixer</b>						
Conversion power gain	$G_C$	Matched to $50 \Omega$		8		dB
Noise figure (SSB)	$NF_{MIX}$	Depends on the matching network		13		dB
Input third-order intermodulation intercept point	$IIP3_{MIX}$			-7.5		dBm



Parameter	Symbol	Condition	Value			Unit
			min.	typ.	max.	
<b>VCO</b>						
Frequency range		External varactor	300		1000	MHz
<b>PLL</b>						
N-divider ratio				64		
Reference frequency	$f_{REF}$				17	MHz
Charge pump current	$I_{CP}$		-40		40	$\mu A$
Phase Noise	$PN_{VCO}$	at 10 KHz offset		-74		dBc/Hz
		at 100 KHz offset		-95		dBc/Hz
Lock Time	$\tau_{lock}$	PLL's lock time is set by the bandwidth of the external loop filter		5		ms
<b>IF amplifier</b>						
Frequency range			0.1	10.7	30	MHz
Input impedance	$Z_{in,IF}$			330		$\Omega$
Output impedance	$Z_{out,IF}$			330		$\Omega$
<b>Limiter</b>						
Frequency range			0.1	10.7	25	MHz
Input impedance	$Z_{in,IF}$			330		$\Omega$
Output impedance	$Z_{out,IF}$			1K		$\Omega$
<b>RSSI</b>						
RSSI dynamic range				70		dB
RSSI dc output range		$R_{load} = 51 K\Omega$	0.5		2.5	V
<b>FM/FSK Demodulator</b>						
Demodulated output level (audio)	$V_{OD}$			70		mV <sub>rms</sub>
FSK output duty ratio			40	50	60	%



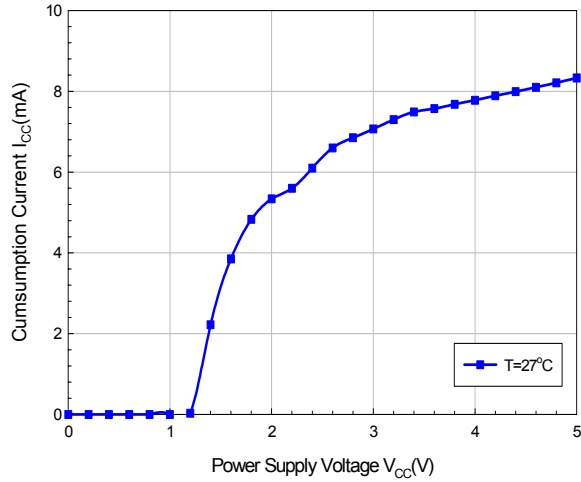
## Application Circuit



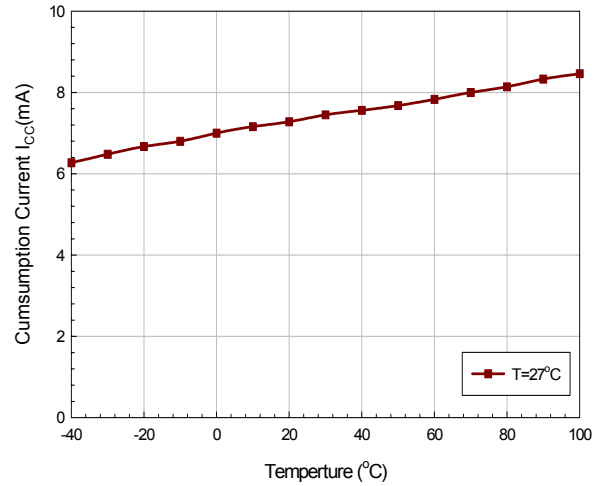
Frequency	L1,L2	C1	C2	C3	L3	L4	C4	R1	C5,C6	X1 (MHz)
905 MHz	3.9 nH	3.9 pF	3.3 pF	18 pF	6.8 nH	12 nH	4.7 pF	—	100 pF	14.31818
868 MHz	4.7 nH	2.2 pF	3.9 pF	22 pF	10 nH	12 nH	6.8 pF	—	100 pF	13.41050
434 MHz	18 nH	4.7 pF	2.2 pF	100 pF	27 nH	33 nH	10 pF	560	100 pF	6.612813
315 MHz	27 nH	10 pF	3.9 pF	100 pF	47 nH	47 nH	10 pF	560	100 pF	4.7546875

## Measurement Results

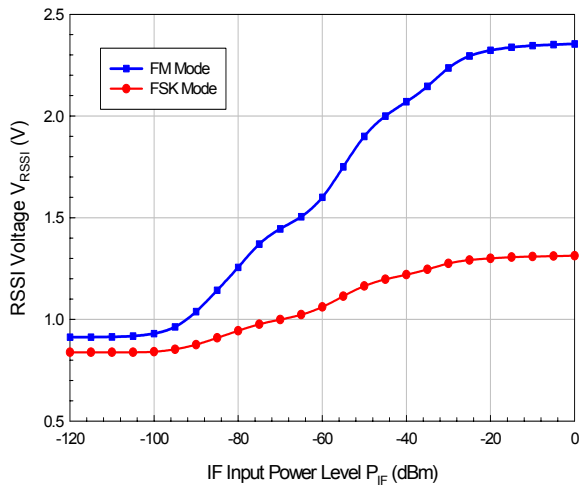
Consumption Current versus Supply Voltage



Consumption Current versus Temperature



RSSI Characteristic



LNA Input Impedance

