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Description

The RX3141 is a low power IF receiver IC which is fully compatible with the Toshiba TA31145 IC and is suitable for use as the second IF downconverter in double-conversion paging systems. The RX3141 is well-suited for POCSAG paging applications and incorporates a 2-level FSK demodulator consisting of a quadrature FM demodulator, on-chip bit-rate filter, and 1-bit comparator. An on-chip 1 V regulator is provided for convenient biasing of off-chip circuitry. In addition, an RSSI voltage output is included as a measure of the received signal strength.

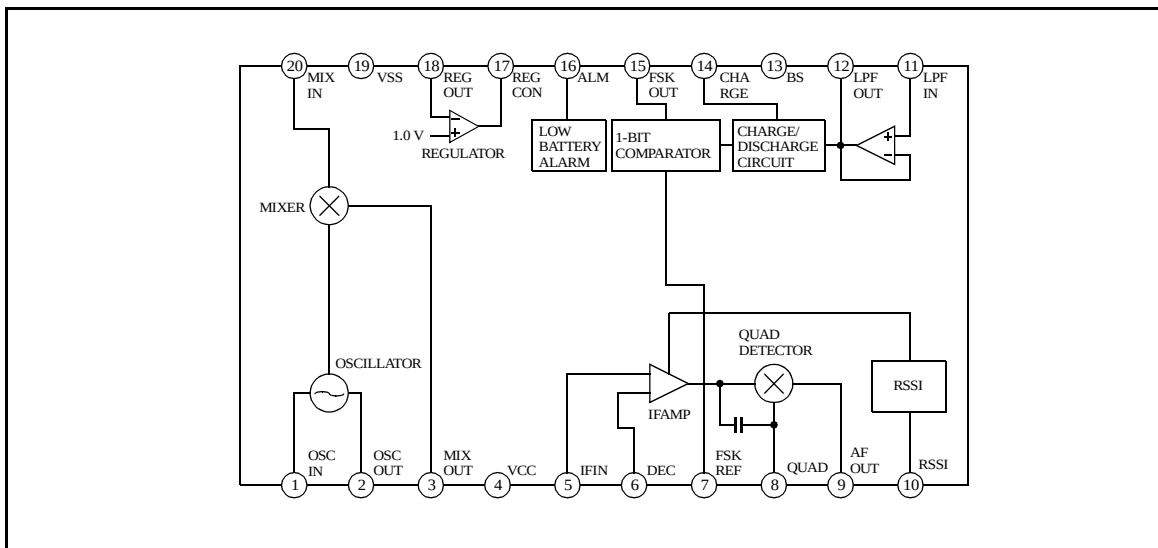
Features

- ◆ Extremely low power operation with power-down feature
- ◆ Built-in crystal oscillator for mixer local oscillator
- ◆ Mixer input frequency: 10 — 50 MHz
- ◆ RSSI function
- ◆ Quadrature detector
- ◆ On-chip bit-rate filter
- ◆ Audio output
- ◆ 1-bit comparator with open collector output
- ◆ 1 V regulator
- ◆ 1.1 V low battery alarm
- ◆ TSSOP-20 package (0.65 mm pitch)

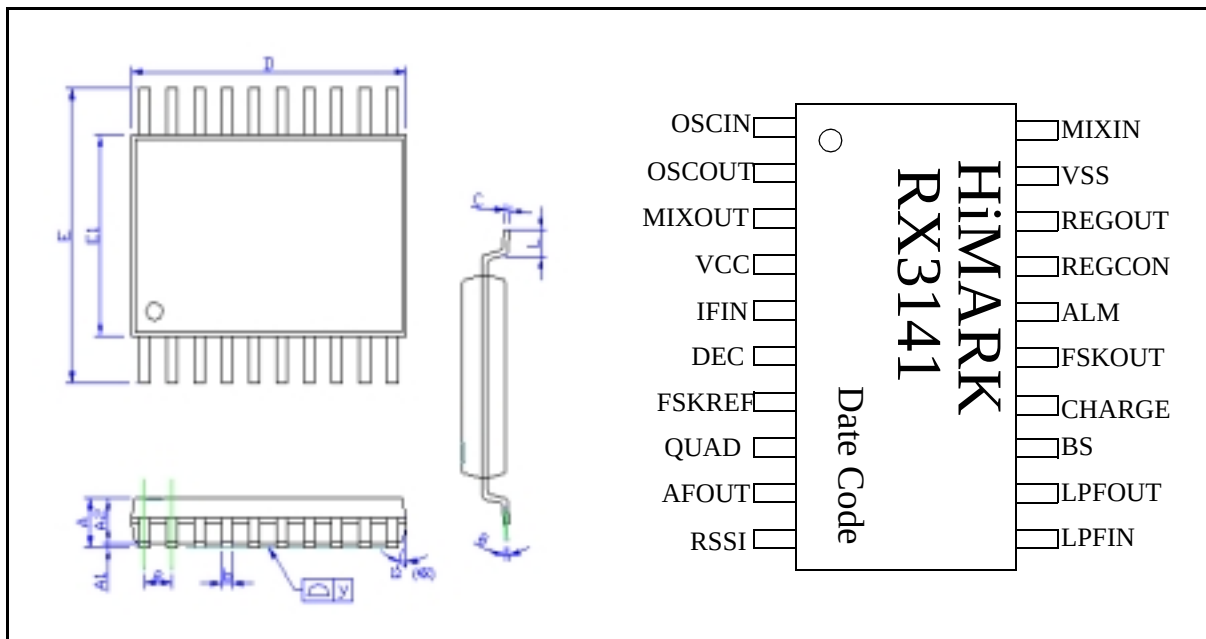
Applications

- ◆ Pager
- ◆ Wireless mouse
- ◆ Two-way car alarm system

Block Diagram and Pin Assignment



Package and Pin Assignment: 20L, TSSOP



Symbols	Dimensions in mm			Dimensions in inch		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	---	---	1.20	---	---	0.048
A1	0.05	---	0.15	0.002	---	0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19	---	0.30	0.007	---	0.012
C	0.09	---	0.20	0.004	---	0.008
D	6.40	6.50	6.60	0.252	0.256	0.260
E	---	6.40	---	---	0.252	---
E1	4.30	4.40	4.50	0.169	0.173	0.177
e	---	0.65	---	---	0.026	---
L	0.45	0.60	0.75	0.018	0.024	0.030
y	---	---	0.10	---	---	0.004
θ	0°	---	8°	0°	---	8°

Pin Descriptions

Number	Name	I/O	Description
1	OSCIN	I	Oscillator input (base)
2	OSCOUT	O	Oscillator output (emitter)
3	MIXOUT	O	Mixer output (2 K Ω output impedance)
4	VCC	POWER	Nominal 1.4 V supply
5	IFIN	I	IF amplifier input (2 K Ω input impedance)
6	DEC	I	IF amplifier de-coupling capacitor connection
7	FSKREF	I	1-bit comparator reference input (requires external capacitor)
8	QUAD	I	Quadrature FM demodulator input
9	AFOUT	O	Quadrature FM demodulator output
10	RSSI	O	RSSI voltage output
11	LPFIN	I	LPF operational amplifier input
12	LPFOUT	O	LPF operational amplifier output
13	BS	I	Two-state logic input to control receiver power up/down. (BS = high = normal operation; BS = low = stand-by mode)
14	CHARGE	I	Two-state logic input to control charge-discharge circuit. (CHARGE = high = fast charge; CHARGE = low = slow charge)
15	FSKOUT	O	Open collector NRZ comparator output (requires pull-up resistor)
16	ALM	O	Open collector low battery alarm output (requires pull-up resistor)
17	REGCON	O	1.0 V regulator control output for connection to external PNP base
18	REGOUT	I	1.0 V regulator input for connection to external PNP collector
19	VSS	GND	Ground
20	MIXIN	I	Mixer input (5 K Ω input impedance)

Absolute Maximum Ratings

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

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	$V_{SS} - 0.3$ to $V_{SS} + 3.5$	V
Operating temperature range	T_{OPR}	-30 to 85	°C
Storage temperature range	T_{STG}	-55 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}	1.1	1.35	1.6	V
MIXIN input frequency	f_{MIXIN}			50	MHz
Operating temperature	T_A	-10	25	60	°C

Electrical Characteristics

($V_{CC} = 1.4\text{ V}$, $V_{SS} = 0\text{ V}$, $T_A = 25\text{ }^{\circ}\text{C}$, BS = high unless otherwise noted)

Parameter	Symbol	Condition	Value			Unit
			min.	typ.	max.	
Quiescent current consumption	$I_{CC,total}$			1.2	1.7	mA
Standby current consumption	$I_{CC,standby}$	$V_{BS} = 0\text{ V}$			5	μA
Mixer conversion gain	G_C	measured after 455 KHz ceramic filter	9	12.5	16	dB
Mixer input intermodulation intercept point	IIP3			-10		dBm
Mixer input resistance	$R_{in,MIX}$			5		$\text{K}\Omega$
Mixer output resistance	$R_{out,MIX}$			2		$\text{K}\Omega$
IF amplifier input resistance	$R_{in,IF}$			2		$\text{K}\Omega$
S/N ratio 1	SN1	-53 dBm at MIXIN		63		dB
S/N ratio 2	SN2	-53 dBm at IFIN		63		dB
S/N ratio 3	SN3	-91 dBm at IFIN		25		dB
Demodulation output level	VOD	-53 dBm at IFIN		45		mVrms
AM rejection ratio	AMR	-53 dBm at IFIN, AM=30 %		50		dB
FSK output duty ratio	DR		40	50	60	%
Low battery alarm threshold voltage	V_{ALM}		1.05	1.1	1.15	V
Regulator output voltage	V_{REGOUT}	430 Ω load resistor	0.95	1.0	1.05	V
RSSI output voltage	V_{RSSI}	-53 dBm at IFIN	0.45	0.60	0.80	V
RSSI output resistance	R_{RSSI}			82		$\text{K}\Omega$
Charging/discharging current	I_{CH}	$V_{FSKREF} = 0\text{ V}$, $V_{LPFOUT} = 0.18\text{ V}$	35	70	110	μA
ALM logic HIGH output current	$I_{OH,ALM}$				2	μA
ALM logic LOW output voltage	$V_{OL,ALM}$				0.4	V
FSKOUT logic HIGH output current	$I_{OH,FSK-OUT}$				2	μA
FSKOUT logic LOW output voltage	$V_{OL,FSK-OUT}$				0.4	V

Functional Description

The RX3141 IF receiver IC incorporates a mixer, crystal-based local oscillator, IF amplifier, quadrature FM demodulator, bit-rate filter, and 1-bit comparator and is capable of demodulating 2-level FSK input signals. In addition, 1.0 V regulator and 1.1 V low battery alarm functions are provided.

Power-down Function

The entire receiver IC may be powered up and down through the control of the BS input (pin 13). During power down operation, the quiescent current consumption of the IC drops to approximately 0 μ A. The high input impedance of the BS pin allows for direct interfacing with the CMOS output of an off-chip microcontroller.

RSSI Function

A dc potential, which corresponds to the input signal level received at the IFIN input (pin 5), is developed across an internal 82 K Ω resistor. This potential is a measure of the received signal strength and is provided at the RSSI output (pin 10).

Charge/Discharge Circuitry

The function of the charge/discharge circuitry is for both fast and slow charging/discharging of the capacitor used for storing the voltage reference level of the FSKREF pin. The CHARGE input (pin 14) should be enabled (CHARGE = high = fast charge) immediately after transition of the receiver IC from power-down to normal operation in order to reduce the charging/discharging time for coarse adjustment of the FSKREF voltage to the appropriate dc level (*i.e.* dc level of the LPFOUT pin) and consequently to minimize the erroneous output of the 1-bit comparator. During actual data reception, the CHARGE pin should be set to low (CHARGE = low = slow charge) for fine adjustment of the FSKREF voltage.

1-bit Comparator

The integrated 1-bit comparator operates as a data slicer and “squares up” the bit-rate filtered output from the quadrature demodulator. The decision threshold voltage level for the 1-bit comparator is stored on an external capacitor connected to the FSKREF pin.

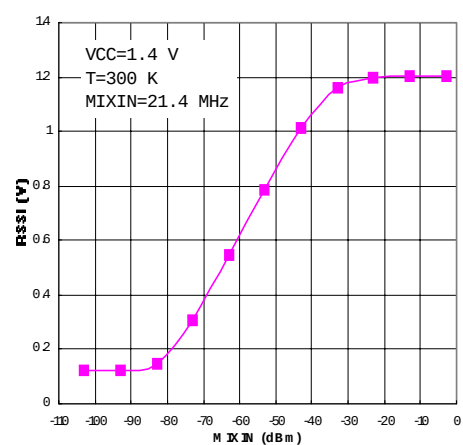
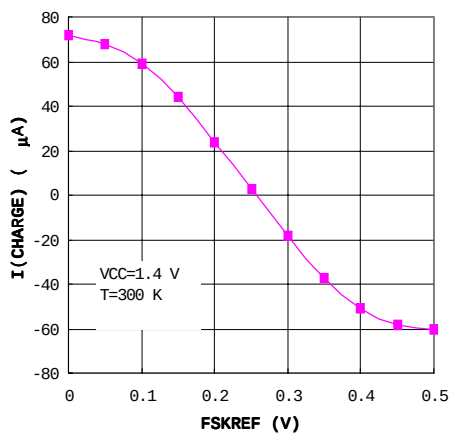
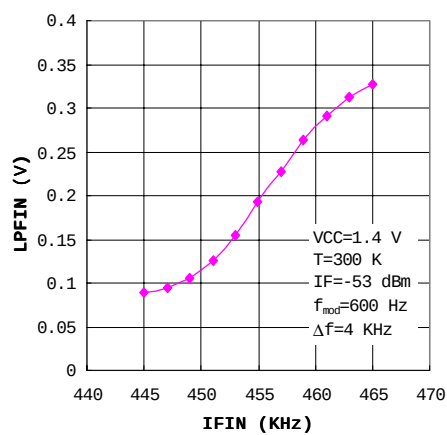
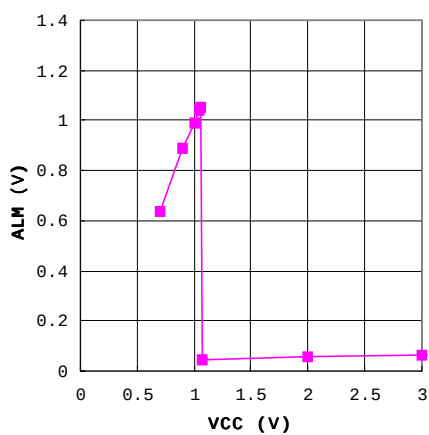
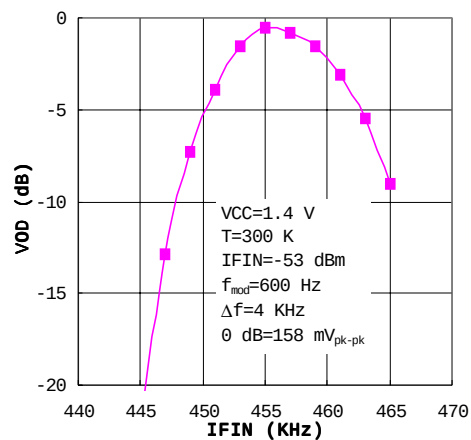
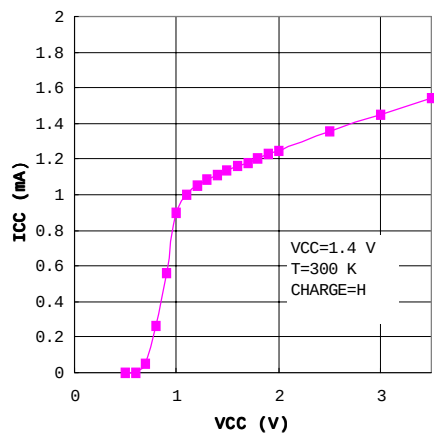
Regulator

The on-chip 1.0 V regulator requires a suitable off-chip PNP transistor to achieve regulation. The external PNP transistor should have an $h_{FE} > 200$ for $V_{CE} \geq 0.1$ V.

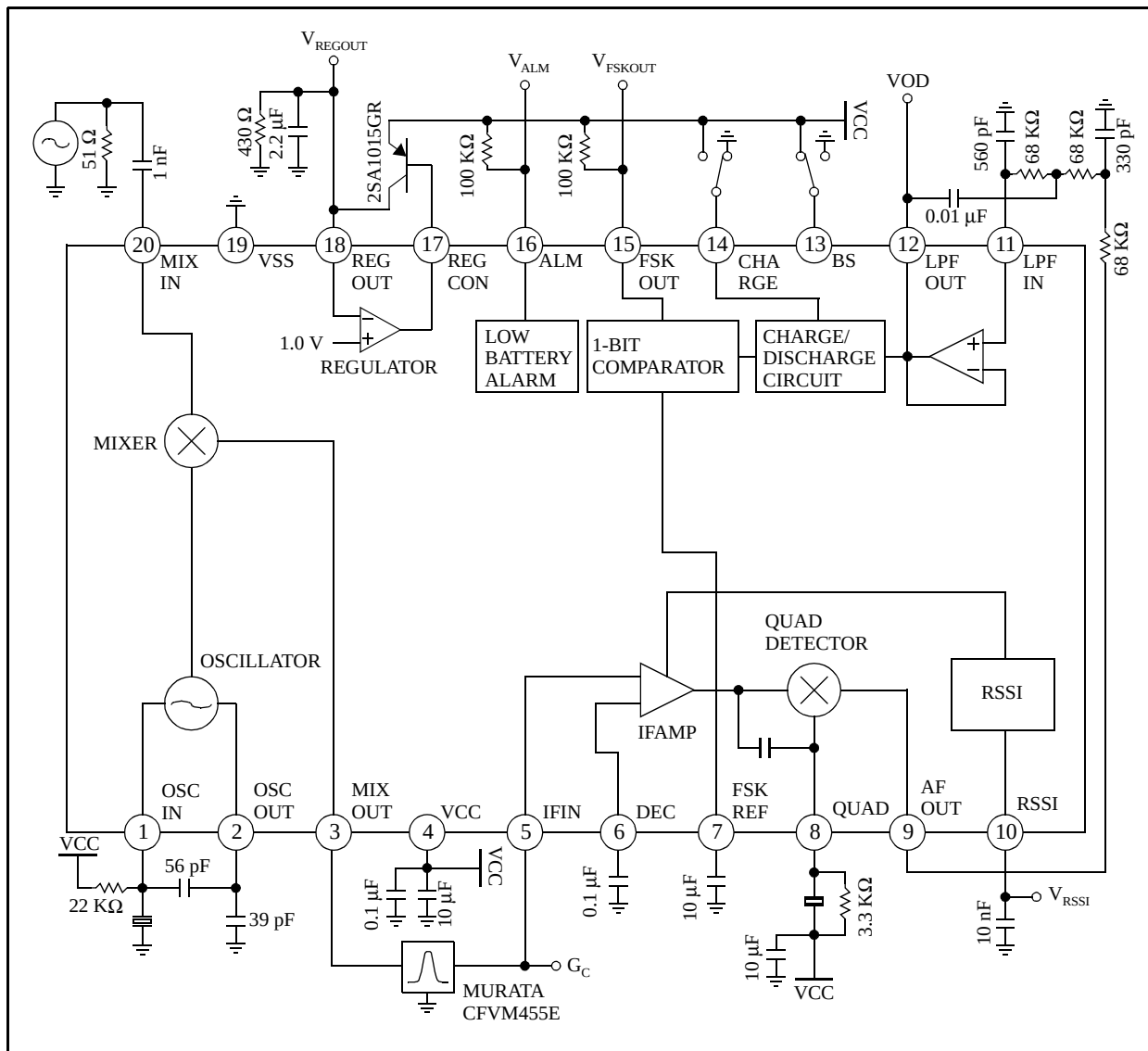
Low Battery Alarm

The low battery alarm output, ALM, is normally low, but rises to 1.1 V ($\approx V_{CC}$) when the VCC voltage falls below approximately 1.1 V.

Typical Performance Characteristics



Test Circuit



Application Circuit

