

RTC5641EX

2.4 – 2.5 GHz Power Amplifier for 802.11b/g/n/ac

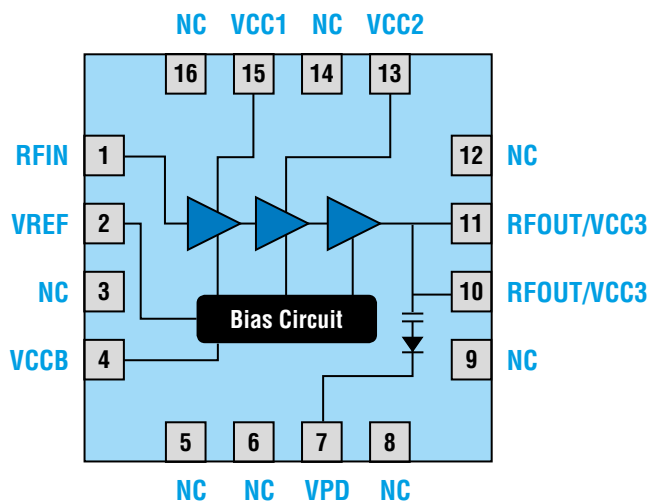


SEP 2018 - Ver. 1.7

Description

The RTC5641EX is a power amplifier (PA) designed for 2.4 – 2.5 GHz frequency range, compatible with 802.11b/g/n/ac wireless LAN systems. The device is manufactured based on advanced InGaP/GaAs HBT (Heterojunction Bipolar Transistor) process. The amplifier consists of 3 gain stages with inter-stage matching, built-in input matching network, and a power detector for close loop power control operation. The device is provided in an industrial standard 16-lead surface mount package QFN-3.0mm x 3.0mm x 1.0mm (max).

Functional Block Diagram



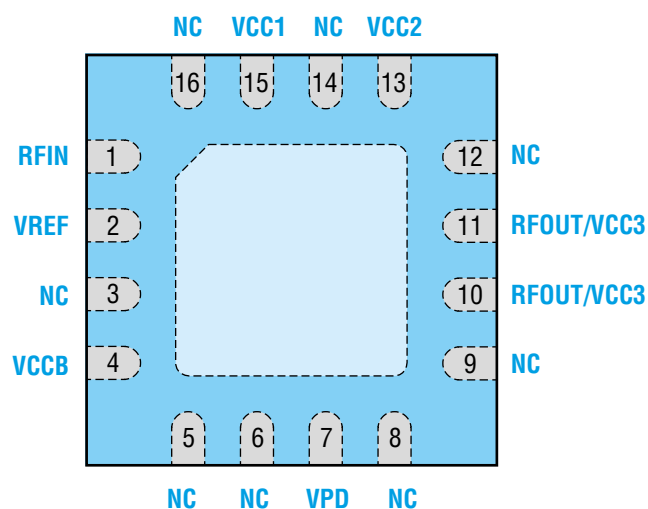
Features

- Frequency Range: 2.4 – 2.5 GHz
- Voltage Supply : 5 V and 3.3 V
- High Gain :
 - 31 dB @ 5 V
 - 30 dB @ 3.3 V
- Output Power :
 - +23 dBm for 802.11ac, HT40, MCS9, 1.8% EVM, 5 V
 - +21 dBm for 802.11ac, HT40, MCS9, 1.8% EVM, 3.3 V
 - +26 dBm for 802.11n, HT40, MCS7, 3% EVM, 5 V
 - +22 dBm for 802.11n, HT40, MCS7, 3% EVM, 3.3 V
- On-chip Input Matching
- 16L QFN-3.0mm x 3.0mm x 1.0mm (max) Package
- RoHS Compliant, Pb-free, Halogen Free
- Moisture Sensitivity Level : MSL 3

Applications

- High Power WLAN Applications
- IEEE 802.11b/g/n/ac Wireless LAN Systems
- IEEE 802.11ac 256QAM Wireless LAN
- 2.4 GHz ISM Band Applications
- 2.4 GHz Cordless Phones

Pin Assignments



Top View Through Package

Pin No.	Pin Name	Description
1	RFIN	RF input. Input matching network is built on chip
2	VREF	Bias control voltage for 1st, 2nd & 3rd stage
4	VCCB	Power supply for bias control circuit
7	VPD	Detector output voltage for output power index
10	RFOUT/VCC3	RF output & power supply for stage-3 (Vcc3)
11	RFOUT/VCC3	Same as pin 10
13	VCC2	Power supply for power stage-2
15	VCC1	Power supply for power stage-1
3, 5, 6, 8, 9, 12, 14, 16	NC	Not connected inside the package For the best performance please connect these pins to ground on PCB
Exposed Paddle		It must be connected to a ground through PCB via for best performance

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Supply Voltage	Vcc1, Vcc2, Vcc3, Vccb	6	V
Bias Voltage	Vref	3.5	V
RF Input Level, under 50Ω output terminated	RFin	+15	dBm
Operating Ambient Temperature	T _A	-40 to +85	°C
Storage Temperature	T _{STG}	-40 to +150	°C

NOTE: Stresses above those conditions listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only. Functional operation of the device above those conditions indicated in the Absolute Maximum Ratings is not implied. The functional operation of the device at the conditions in between Recommended Operating Ranges and Absolute Maximum Ratings for extended periods may affect device reliability.

Recommended Operating Ranges

Parameter	Symbol	Min	Typ	Max	Unit
Frequency Range	f	2.4		2.5	GHz
Supply Voltage	Vcc1, Vcc2, Vcc3, Vccb	3	3.3 or 5	5.5	V
Bias Voltage	Vref	2.75	2.8	2.9	V

NOTE: Recommended Operating Ranges indicate conditions for which the device is intended to be functional, but does not guarantee specific performance limits.

5 V Electrical Specifications

$T_A = +25^\circ\text{C}$, $V_{cc1} = V_{cc2} = V_{cc3} = V_{ccb} = 5\text{ V}$, $V_{ref} = 2.8\text{ V}$, unless otherwise noted

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Frequency Range	f		2.4		2.5	GHz
Small Signal Gain	G	Pin = -30 dBm	29	31		dB
1 dB Output Compression Point	P1dB	1 dB Power Compression	30	32		dBm
Linear Output Power	Pout	802.11ac, MCS9, HT40 1.8% EVM	21	23		dBm
		802.11ac, MCS9, HT40 1.25% EVM	18	20		dBm
		802.11n, MCS7, HT40 3% EVM	24	26		dBm
		802.11n, MCS7, HT20 3% EVM	25	27		dBm
		64 QAM/54 Mbps 3% EVM	25	27		dBm
		802.11g mask compliant power, OFDM 6Mbps	28	30		dBm
		802.11b mask compliant power, DSSS 1Mbps	27	29		dBm
Gain Flatness	ΔG	Gain Variation Over the Full Band			1	dB
Input return loss	S11	Pin = -30 dBm	8	11		dB
Output return loss	S22	Pin = -30 dBm	12	16		dB
2nd Harmonics	2fo	Pout = 26 dBm, CW No external harmonic filter ^(*Note)		-20	-15	dBm/ MHz
3rd Harmonics	3fo			-30	-25	dBm/ MHz
Delay and Rise/Fall Time	Tdr, Tdf	50 % of V_{EN} edge and 90/10 % of final output power level		150		ns
Supply Current	Icq	Quiescent, No RF		295		mA
	Icc	Pout = 23 dBm		450	550	mA
		Pout = 27 dBm		600	700	mA
Reference Current	Iref	Current at Vref, No RF		5	6.5	mA
Power Detector Output	Vpd	Pout = 19 dBm		0.6		V
		Pout = 26 dBm		1.1		V

NOTE : Apply external harmonic filter can further suppress harmonics less than -50dBm/MHz

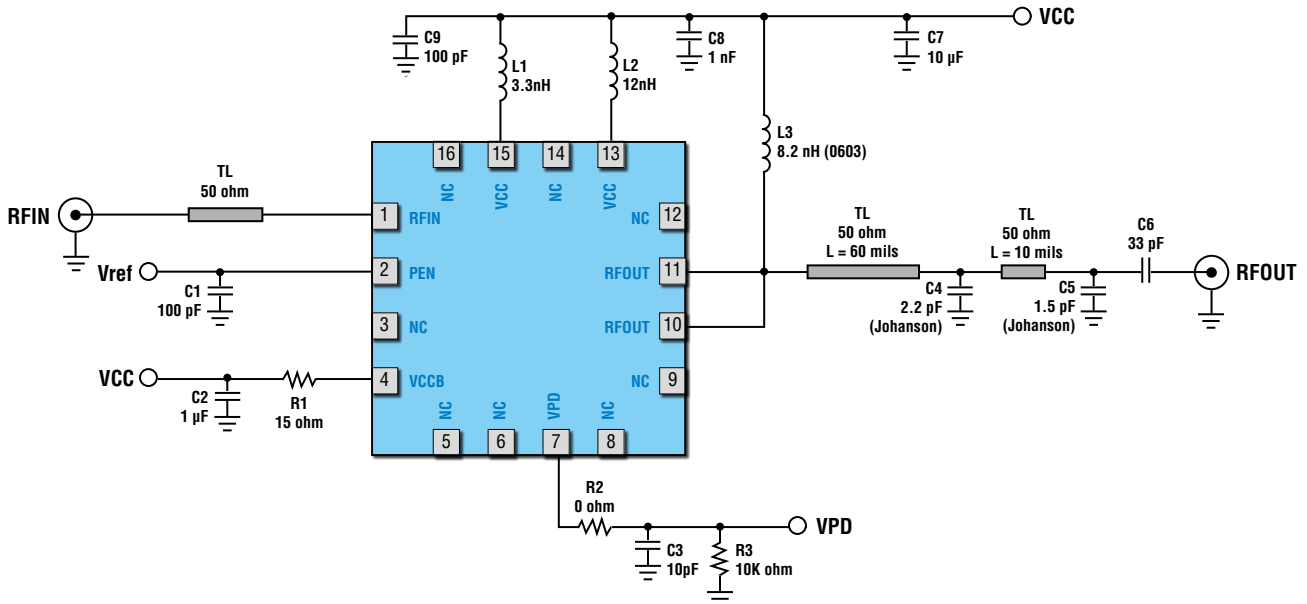
3.3 V Electrical Specifications

$T_A = +25^\circ\text{C}$, $V_{cc1} = V_{cc2} = V_{cc3} = V_{ccb} = 3.3\text{ V}$, $V_{ref} = 2.8\text{ V}$, unless otherwise noted

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Frequency Range	f		2.4		2.5	GHz
Small Signal Gain	G	Pin = -30 dBm		30		dB
1 dB Output Compression Point	P1dB	1 dB Power Compression		29		dBm
Linear Output Power	Pout	802.11ac, MCS9, HT40 1.8% EVM		21		dBm
		802.11ac, MCS9, HT40 1.25% EVM		20		dBm
		802.11n, MCS7, HT40 3% EVM		22		dBm
		802.11n, MCS7, HT20 3% EVM		22.5		dBm
		64 QAM/54 Mbps 3% EVM		22.5		dBm
		802.11g mask compliant power, OFDM 6Mbps		27		dBm
		802.11b mask compliant power, DSSS 1Mbps		26.5		dBm
Gain Flatness	ΔG	Gain Variation Over the Full Band			1	dB
Input return loss	S11	Pin = -30 dBm		15		dB
Output return loss	S22	Pin = -30 dBm		18		dB
2nd Harmonics	2fo	Pout = 26 dBm, CW No external harmonic filter ^(*Note)		-22		dBm/ MHz
3rd Harmonics	3fo			-30		dBm/ MHz
Supply Current	Icq	Quiescent, No RF		250		mA
	Icc	Pout = 21 dBm		385		mA
		Pout = 22 dBm		405		mA
Reference Current	Iref	Current at Vref, No RF		3		mA
Power Detector Output	Vpd	Pout = 19 dBm		0.54		V
		Pout = 22 dBm		0.74		V

NOTE : Apply external harmonic filter can further suppress harmonics less than -50dBm/MHz

Application Circuits

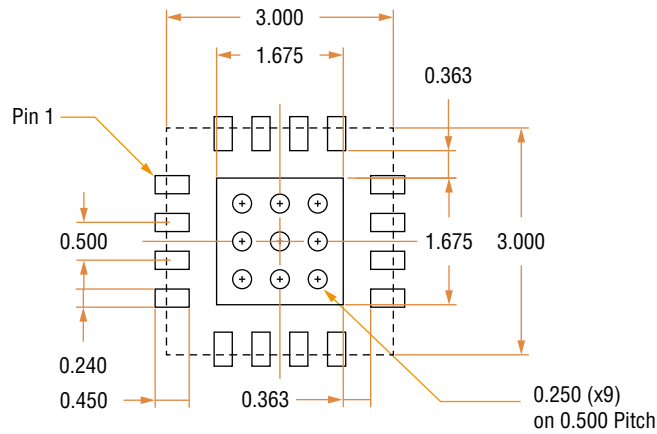


NOTE : Information in the above application is for reference only, and does not guarantee the mass production design of the device.

Evaluation Board Bill of Material

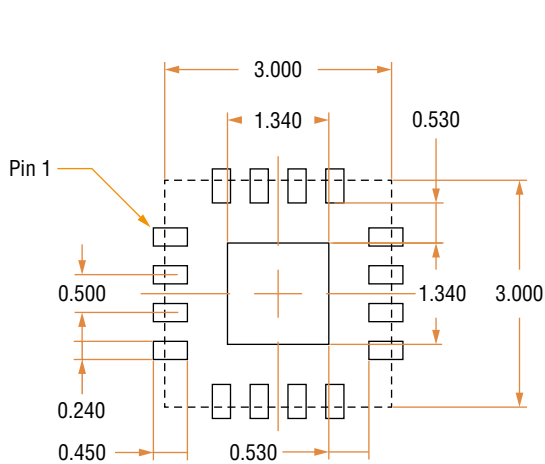
Component	Value	Description	Supplier	Part Number
IC		RTC5641EX	RichWave	
C1, C9	100 pF	De-coupling capacitor	Walsin	0402N101J500LT
C2	1 μF	De-coupling capacitor	Walsin	0402X105K6R3CT
C3	10 pF	De-coupling capacitor	Walsin	0402N100J500LT
C4	2.2 pF	Matching capacitor	Johanson	500R07S2R2CV4S
C5	1.5 pF	Matching capacitor	Johanson	500R07S1R5CV4S
C6	33 pF	DC blocking capacitor	Walsin	0402N330J500LT
C7	10 μF	De-coupling capacitor	Walsin	0603X106K6R3CT
C8	1 nF	De-coupling capacitor	Walsin	0402B102K500CT
R1	15 ohm		Walsin	WR04X15R0FTL
R2	0 ohm		Walsin	WR04X00R0PTL
R3	10K ohm		Walsin	WR04X1002FTL
L1	3.3 nH	RF choke inductor	ACX	HI1005-1C3N3SMT
L2	12 nH	RF choke inductor	ACX	HI1005-1C12NJMT
L3	8.2 nH	RF choke inductor	ACX	HI1608-1C8N2JMT

Recommended Footprint Patterns



PCB Board Metal & Via Pattern

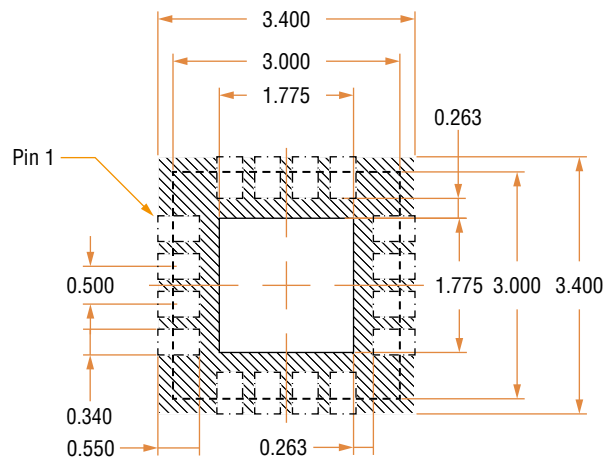
Top View



PCB Stencil Pattern

Top View

64% Solder Coverage on Pad



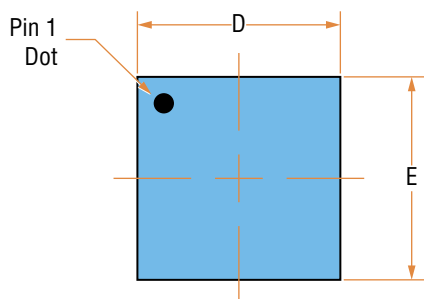
PCB Solder Mask Pattern

Top View

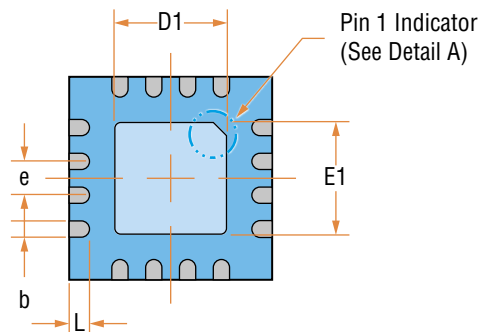
NOTE :

1. All dimensions are measured in millimeters.
2. Drawing is not to scale.

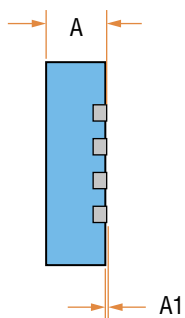
Package Dimensions



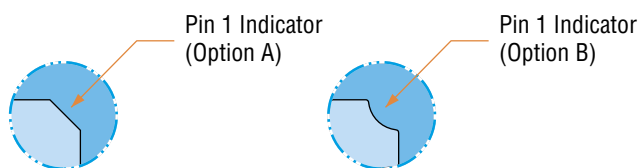
Top View



Bottom View



Side View



Detail A

16L QFN 3 X 3 X 1 - A		
SYMBOL	MIN	MAX
A	0.800	1.000
A1	0.000	0.050
b	0.180	0.300
D	2.900	3.100
D1	1.550	1.800
e	0.500BSC	
E	2.900	3.100
E1	1.550	1.800
L	0.200	0.400

NOTE :

1. All dimensions are measured in millimeters.
2. Drawing is not to scale.
3. The shape of the Pin 1 Indicator can be either Option A or Option B, but it must be located within the zone indicated.

Customer Service

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