RTC5633 : 5 GHz Frond End Module for 802.11a/n/ac

Description

The RTC5633 is a RF front-end module (FEM) with transmit/receive chain for 802.11a/n/ac WLAN applications. The device consists of a power amplifier (PA) with power detector, a low-pass filter (LPF) for harmonic rejection, a T/R switch and an RX low-noise amplifier (LNA) with bypass mode. A digital enable/disable function is also included in both PA and LNA, which allows power savings during off mode. The antenna ports are switched between transmit and receive. In the transmitting path, the FEM has a typical gain of 29 dB and delivers 16 dBm linear output power under 1.8% EVM 802.11ac 256QAM modulation. In the receiving path, the FEM can provide a typical gain of 10 dB and 2.5 dB noise figure. The RTC5633 is packaged in 16-lead surface mount package QFN 3mmx3mmx0.75mm with lead-free RoHS compliant.

Feature

- Frequency Range: 5.15 – 5.85 GHz
- Integrated high performance PA, LNA with bypass function, harmonic filter and SPDT switch
- Input & output fully 50 ohm matching
- Output Power 16 dBm@1.8% EVM, 802.11ac, HT80, MCS9
- Output Power 18 dBm@3% EVM, 802.11a, 64QAM
- Digital Enable/Disable control
- 10 dB gain and 2.5 dB NF for RX path
- Compact & low profile package in 16L QFN-3mmx3mmx0.75mm
- RoHS, Pb-free, Halogen Free Compliant
- Moisture Sensitivity Level : MSL 3

Application

- IEEE 802.11a/n/ac Wireless LAN System
- 5GHz ISM Band Application
- Cardbus, miniPCI, PCIe, AP Application

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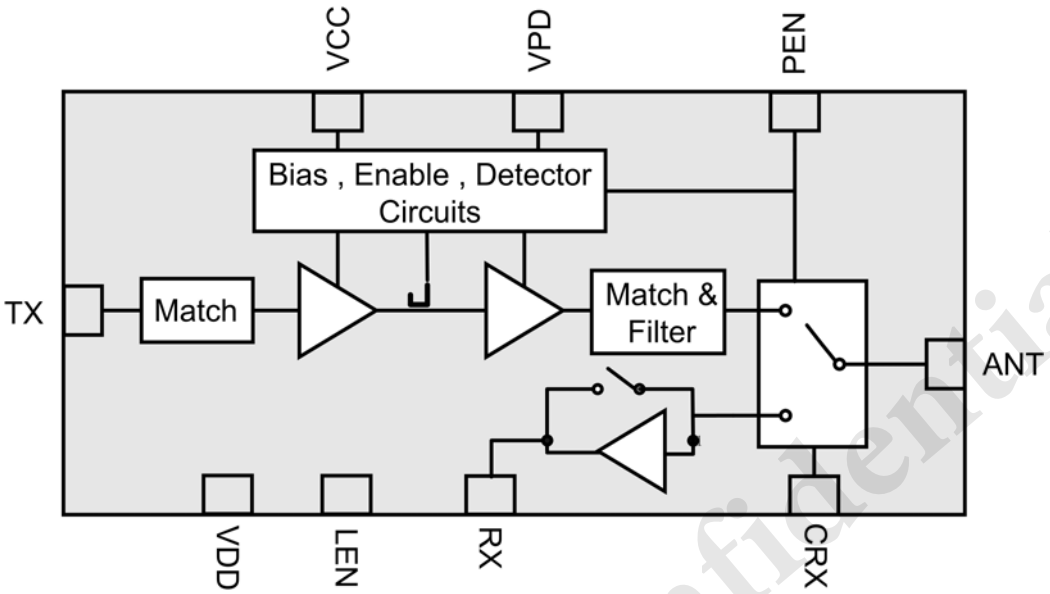
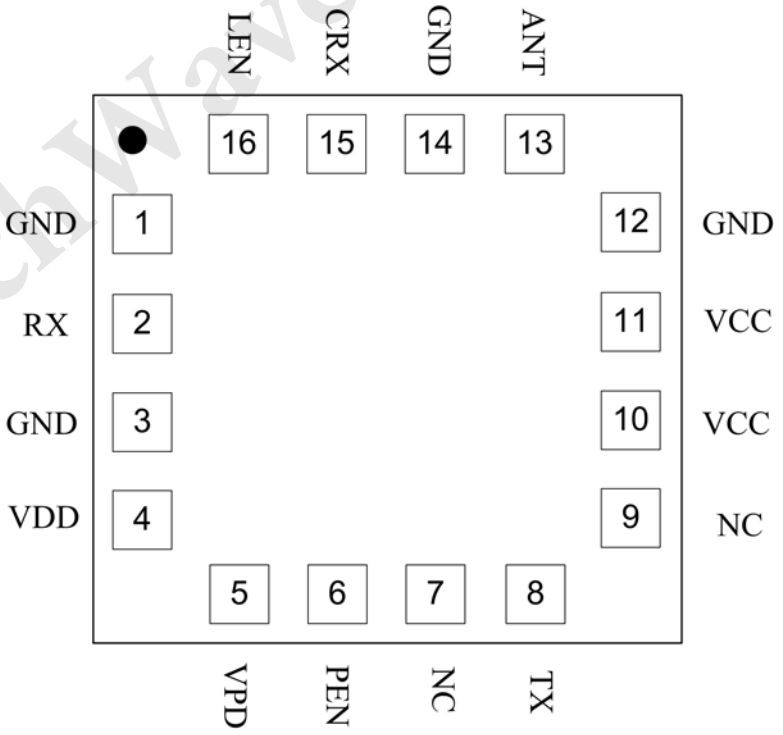
Functional Block Diagram



Pin Out (Top View through package)



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Pin Function Description

Pin	Function	Description
1	GND	Ground
2	RX	RF output port for LNA
3	GND	Ground
4	VDD	Supply Voltage for LNA
5	VPD	PA detector output
6	PEN	Control voltage for PA and TX switch
7	NC	Not connected
8	TX	RF input port for PA
9	NC	Not connected
10	VCC	PA Supply voltage
11	VCC	PA Supply voltage
12	GND	Ground
13	ANT	Antenna output
14	GND	Ground
15	CRX	Control voltage for RX switch
16	LEN	Control voltage for LNA
Paddle		Must be connected to GND for best performance

Truth Table

PEN	LEN	CRX	Mode
High	Low	Low	TX
Low	High	High	RX High Gain
Low	Low	High	RX Bypass

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Absolute Maximum Rating

Parameter	Rating	Units
Supply voltage (VCC, VDD)	4	V
PA Enable Voltage (PEN)	3.6	V
LNA Enable Voltage (LEN)	3.6	V
TX Input Power	+5	dBm
Operating Temperature	-30 to +85	℃
Storage Temperature	-40 to +150	℃

Note : Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only, functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation between operation range maximum and absolute maximum for extended periods may affect device reliability.

Recommended Operating Range

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	VCC, VDD	3.0	3.3	3.6	V
PA enable voltage (High)	PEN	2.8	3	3.3	V
PA enable voltage (Low)	PEN	0	0	0.3	V
LNA Enable Voltage (High)	LEN	2	3	3.3	V
LNA Enable Voltage (Low)	LEN	0	0	0.3	V
Switch control voltage (High)	CRX	2.8	3	3.3	V
Switch control voltage (Low)	CRX	0	0	0.3	V
Operating Temperature	T_A	-30	+25	+85	℃

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Electrical Specification

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Transmit Mode (TX – ANT) T_A = +25 °C, VCC = VDD = 3.3 V, PEN = 3 V, all unused RF ports terminated in a 50 Ω load, unless otherwise noted						
Operating Frequency	f		5.15		5.85	GHz
Output Power, High Linearity Mode, H/L=3.3V	Pout	802.11a, 64QAM/54Mbps, EVM = 3%		18		dBm
		802.11a mask compliant power, OFDM 6Mbps		19		dBm
		802.11ac, MCS9, EVM = 1.8%, HT80	15	16		dBm
Small Signal Gain	G	Pin = -30dBm	25	29		dB
Gain Flatness		Gain Variation from 5150 to 5850MHz	-1		1	dB
1 dB Output Compression Point	P1dB	1dB power Compression		25		dBm
Return Loss	|S11|	Input Return Loss	5	6		dB
	|S22|	Output Return Loss	5	7		dB
2f & 3f harmonics	2fo, 3fo	Pout = 18 dBm, 6Mbps, 802.11a		-36		dBm/MHz
All Spurious		Pout = 18 dBm, 6Mbps, 802.11a		-36		dBm/MHz
Isolation	ISO	From Ant to either TX or RX pin	35	47		dB
Power Detector Output	Vpd	Pout = 10dBm		0.4		V
		Pout = 20dBm		1.25		V
Supply Current	Icq	Quiescent (no RF)		175	210	mA
PA Enable Current	Ien	Quiescent (no RF)		1		μA
Supply Current, Transmit Mode	Icc	Pout = 18 dBm, 802.11a, 64QAM		240		mA

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		Pout = 16 dBm, 802.11ac, 256QAM		230		mA
Receive High Gain Mode T_A = +25 °C, VDD = 3.3 V, LEN = CRX = 3 V, all unused RF ports terminated in a 50 Ω load, unless otherwise noted						
Operating Frequency	f		5.15		5.85	GHz
RX Gain	G	High Gain Mode	8	10		dB
Return Loss	|S11|	Input Return Loss	3	4		dB
	|S22|	Output Return Loss	5	7		dB
Noise Figure	NF	High Gain Mode		2.5		dB
1 dB Input Compression Point	IP1dB	1dB Gain Compression		-8		dBm
Supply Current	Idd	RX ON		11	14	mA
Receive Bypass Mode T_A = +25 °C, VDD = 3.3 V, LEN = 0 V, CRX = 3 V, all unused RF ports terminated in a 50 Ω load, unless otherwise noted						
Operating Frequency	f		5.15		5.85	GHz
RX Gain	G	Bypass Mode		-10		dB
Return Loss	|S11|	Input Return Loss		3		dB
	|S22|	Output Return Loss		5		dB
Supply Current	Idd	RX ON		0.2		μA

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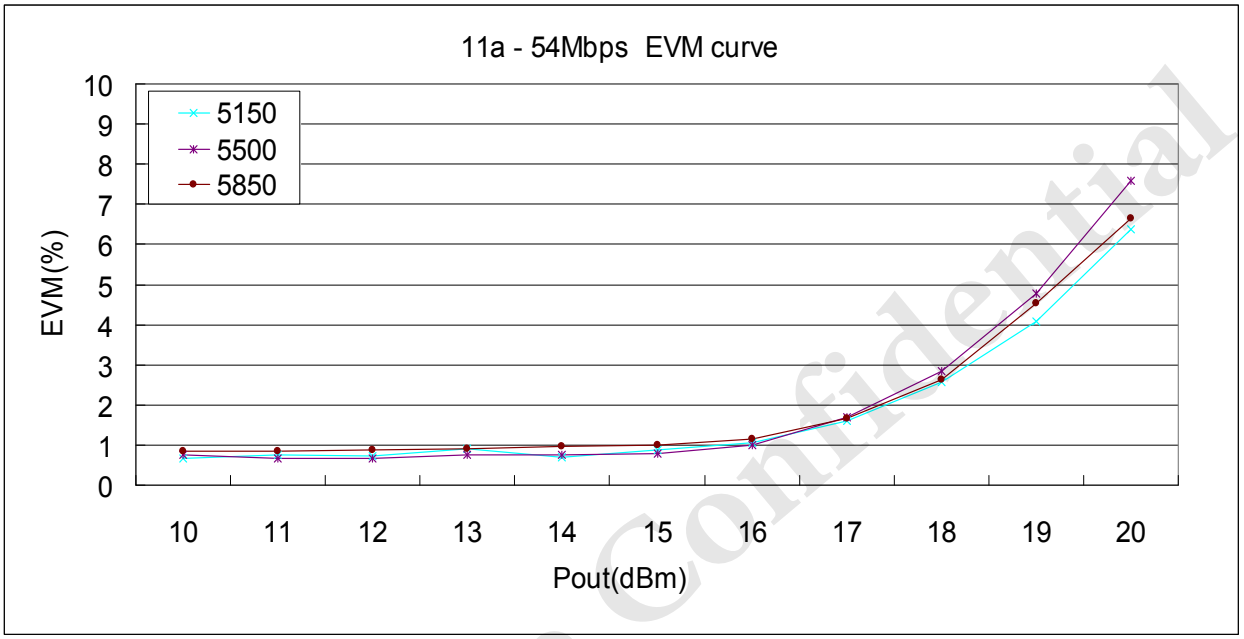
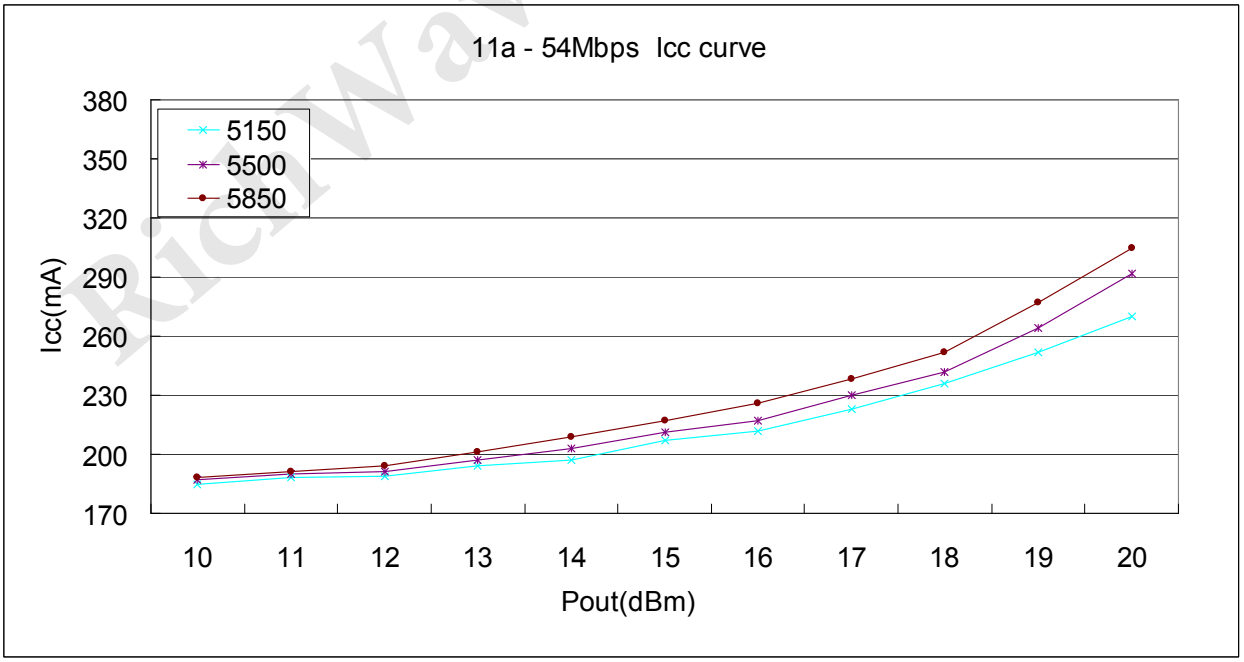
Typical Transmit Characteristics

EVM and Icc at 802.11a 64QAM 54Mbps

T = 25℃, VCC = VDD = 3.3 V, PEN = 3 V





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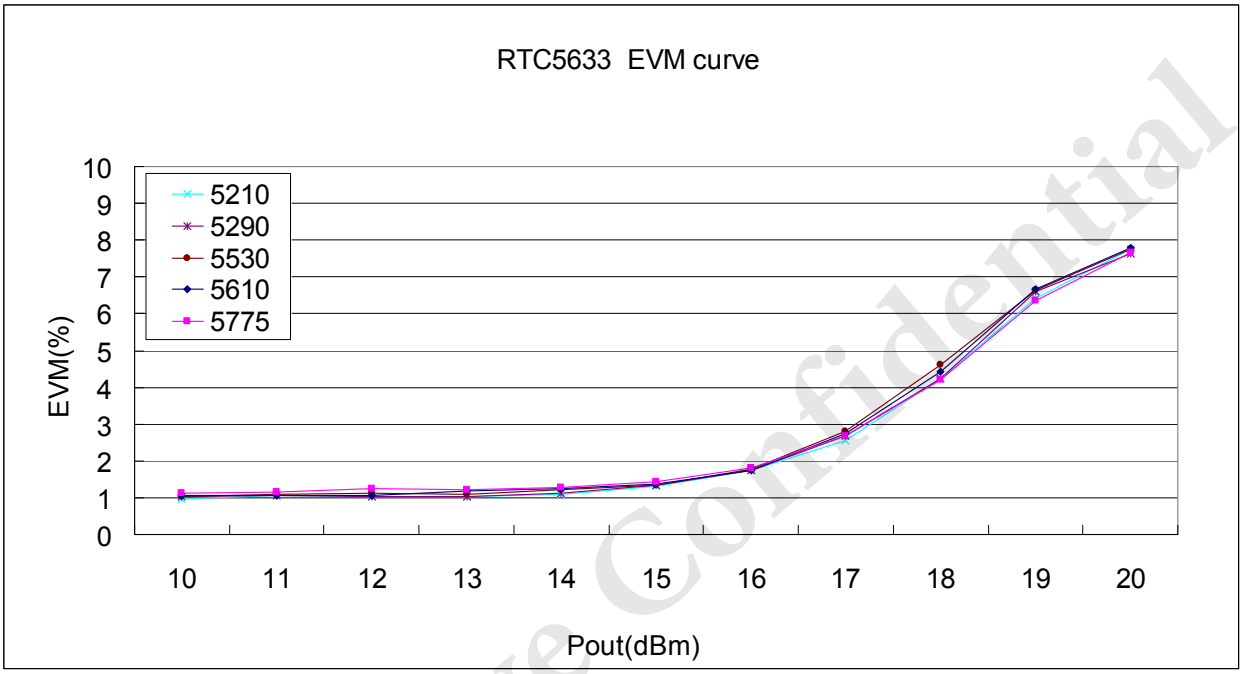
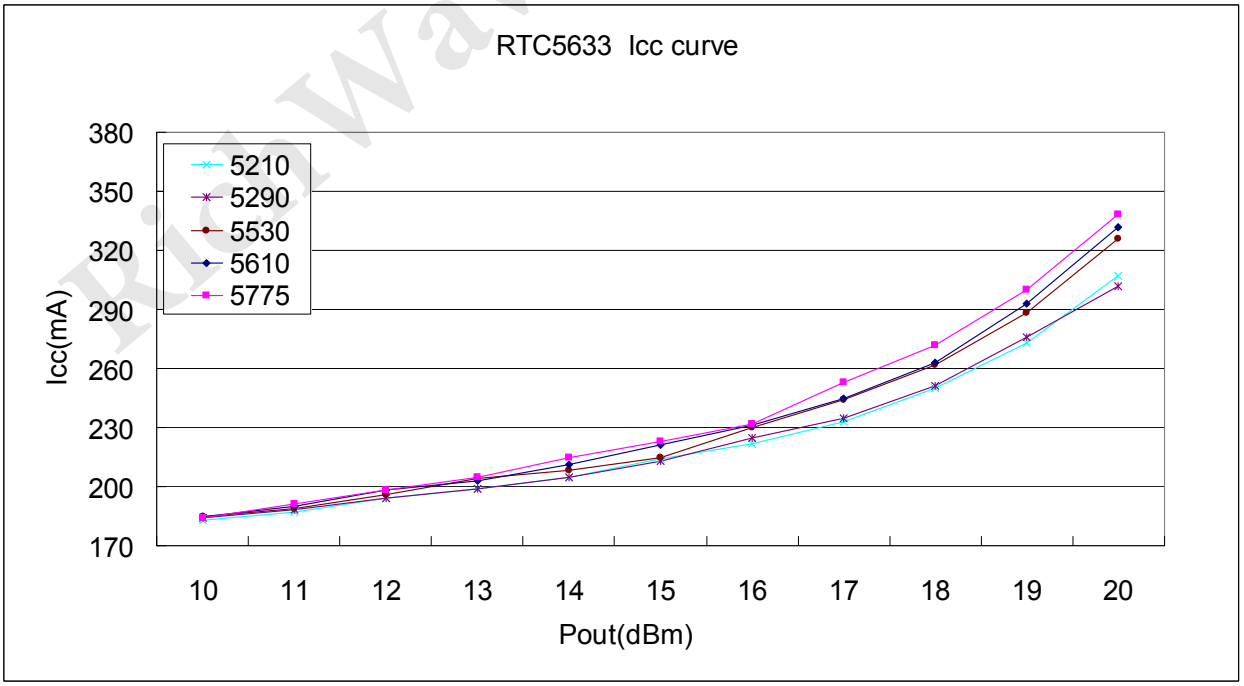
Typical Transmit Characteristics

EVM and Icc at 802.11ac 256QAM HT80

T = 25℃, VCC = VDD = 3.3 V, PEN = 3 V





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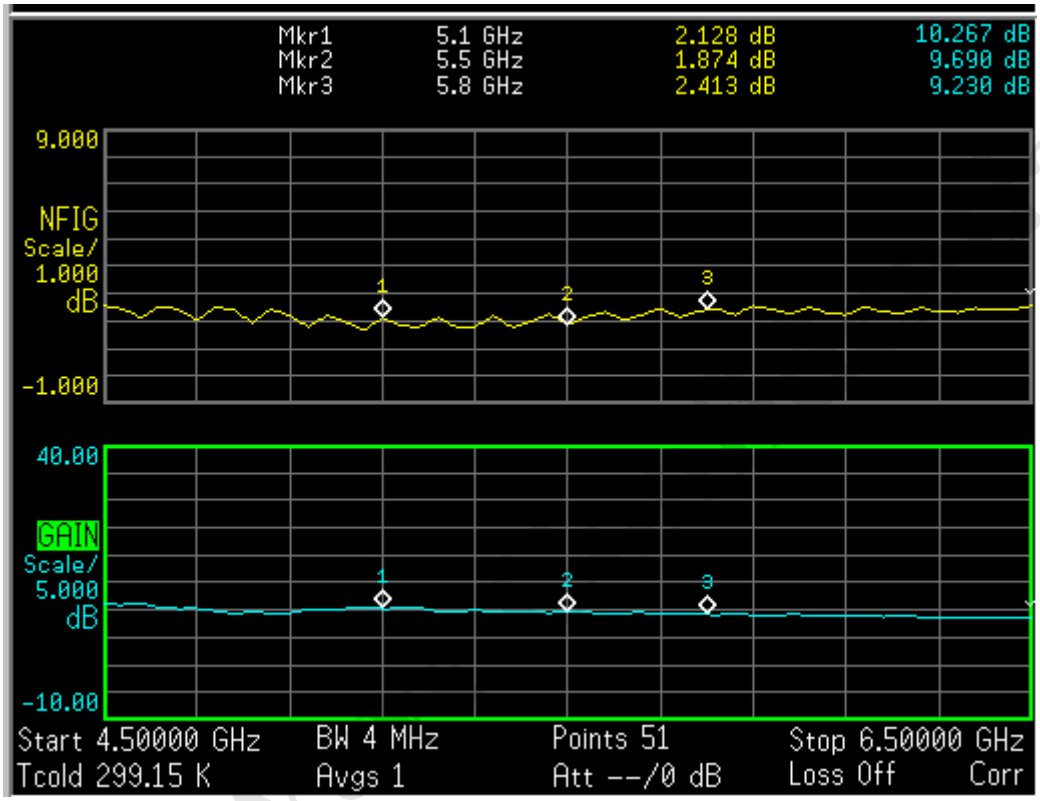
Typical Receive Characteristics (High Gain Mode)

Noise Figure

T = 25℃, VCC = VDD = 3.3 V, LEN = CRX = 3 V



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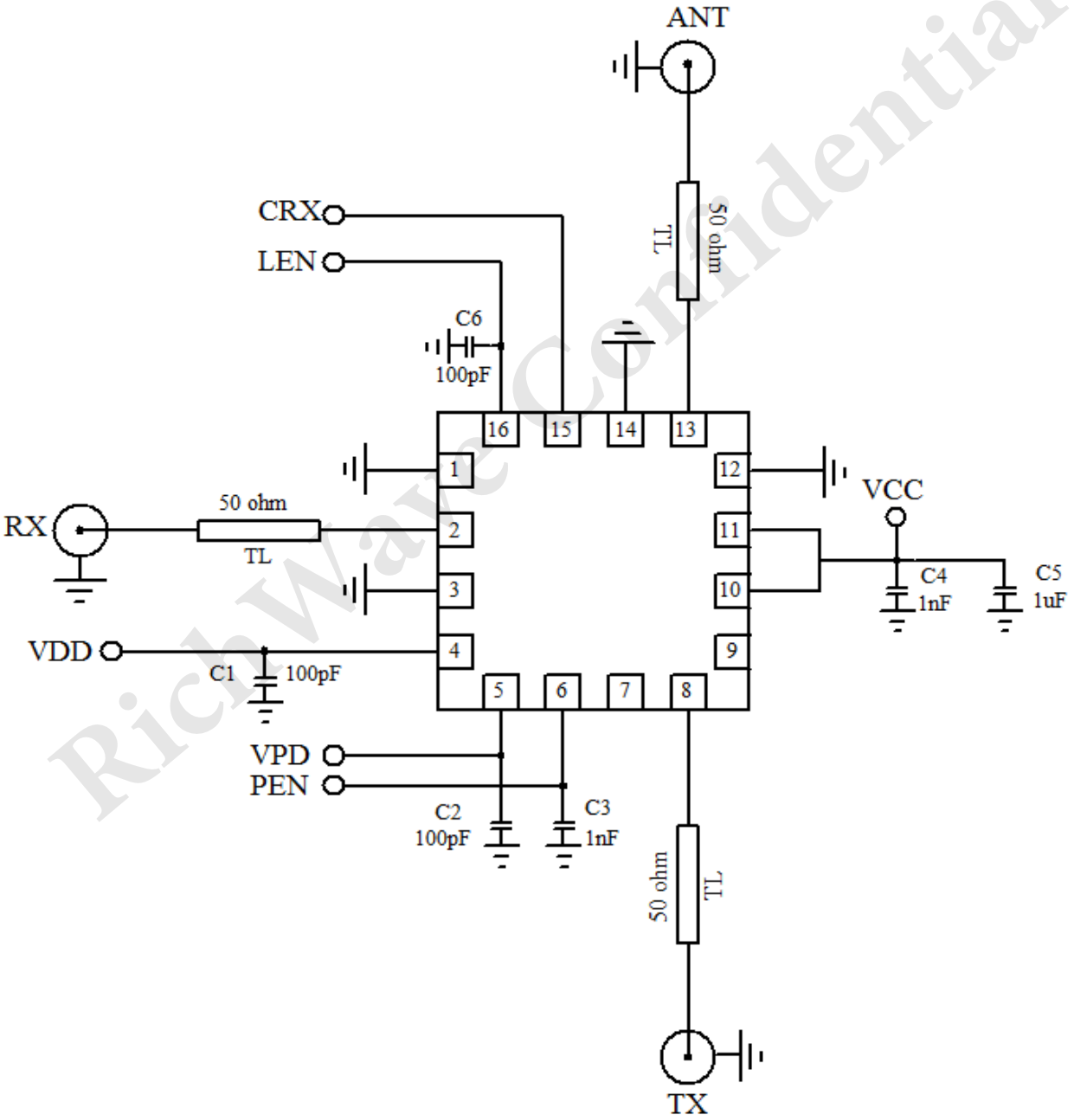
Application Circuit

The application circuit and below evaluation board are used for the performance test of RTC5633 (5GHz 11ac FEM). The RF characteristics of RTC5633 shown in the specification table are measured by the evaluation board. Evaluation board setup procedure: (1) connect GND to PCB backside (2) Apply 3.3V to Vcc pad (3) Select test path according to control truth table.



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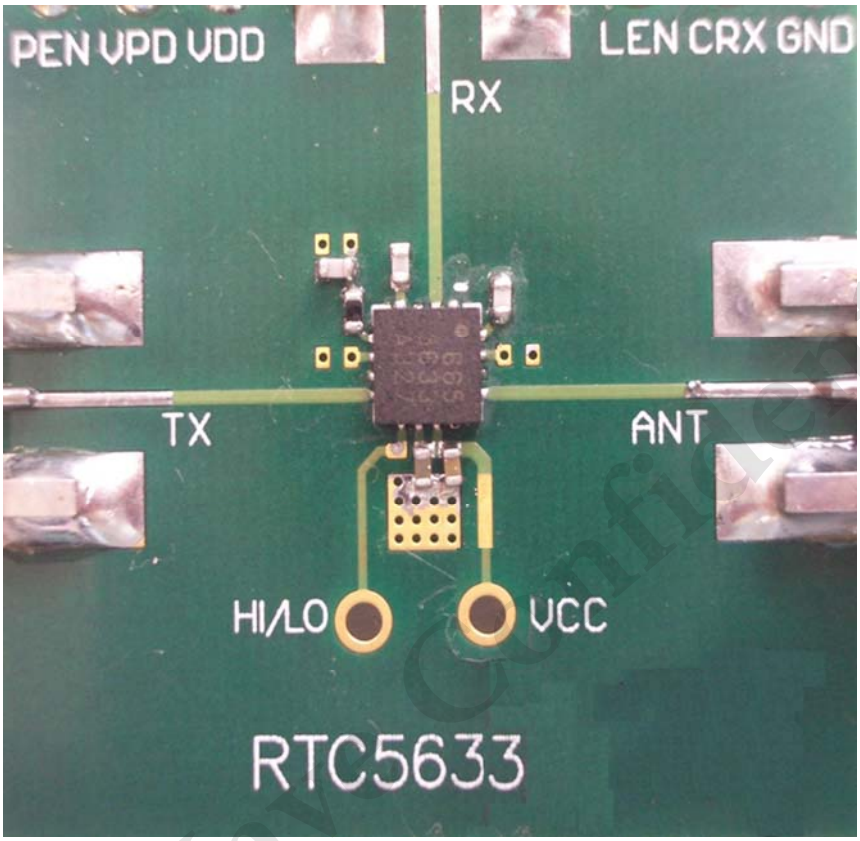
Evaluation Board Photograph



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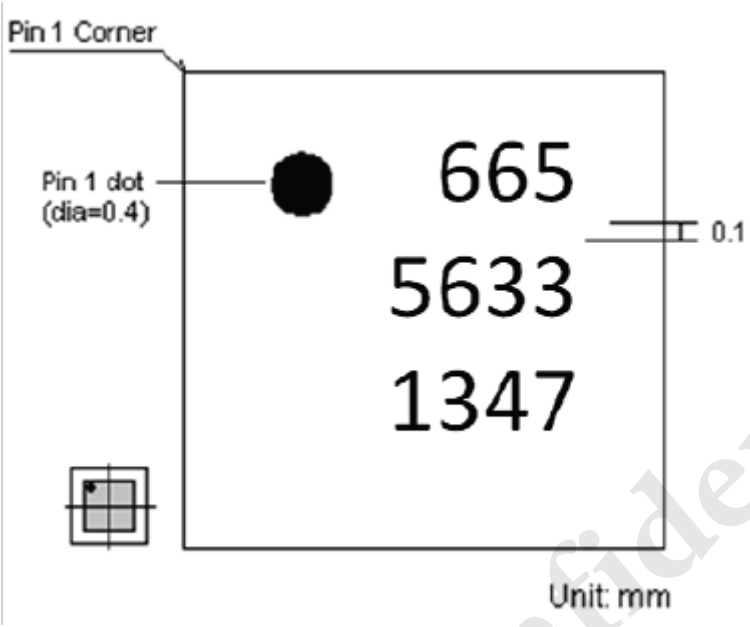
Marking Specifications



	Description	Position	Font Type	Height	Width	Space
Line1	665	Right	HELV.FNT	0.60mm	0.40mm	0.10mm
Line2	5633	Right	HELV.FNT	0.60mm	0.40mm	0.10mm
Line3	1347	Right	HELV.FNT	0.60mm	0.40mm	0.10mm

Lin1=665~Wafer Lot Number

Lin2=5633~Device name

Lin3=1~Wafer ID 3~Year Code: 2013; 47~week Code

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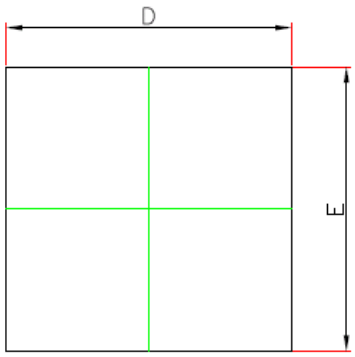
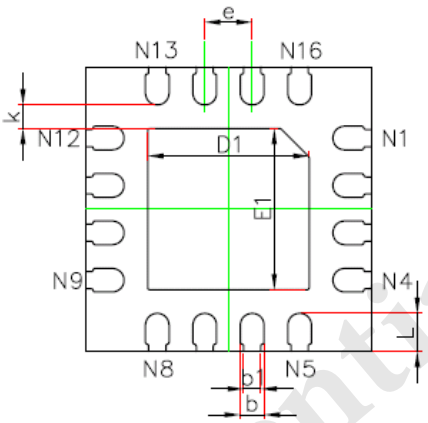
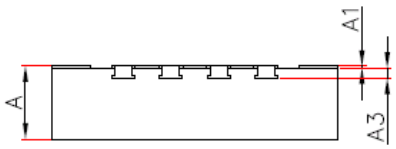
Package Outline Dimension



TOP VIEW



BOTTOM VIEW



SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700	0.800	0.028	0.031
A1	-0.004	0.046	0.000	0.002
A3	0.110REF.		0.004REF.	
D	2.924	3.076	0.115	0.121
E	2.924	3.076	0.115	0.121
D1	1.600	1.800	0.063	0.071
E1	1.600	1.800	0.063	0.071
k	0.200MIN.		0.008MIN.	
b	0.200	0.300	0.008	0.012
b1	0.130	0.230	0.005	0.009
e	0.500TYP.		0.020TYP.	
L	0.350	0.450	0.014	0.018

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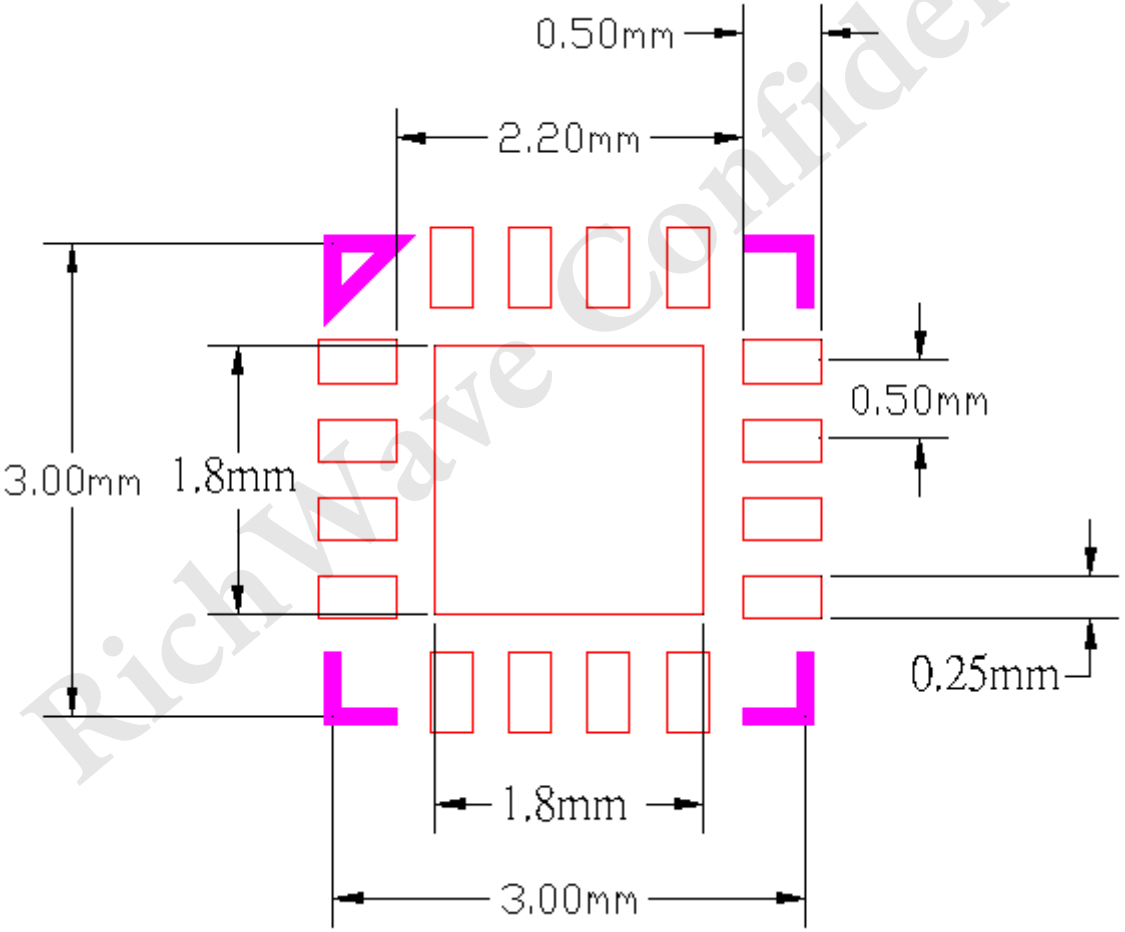
Package and Handling

The device is moisture sensitive and should be handled within proper MSL 3 guidelines to avoid damage from moisture absorption and exposure. Any unused devices after the MBB (Moisture Barrier Bag) has been opened for more than 48 hours or not stored at <10% RH should be baked before any subsequent reflow and board assembly. Re-baking should be done for a minimum of 8 hours at 125ºC. Unused devices can either be baked and dry-packed first before storage, or they can be baked just before the next board assembly.

Recommended PCB Land Pattern



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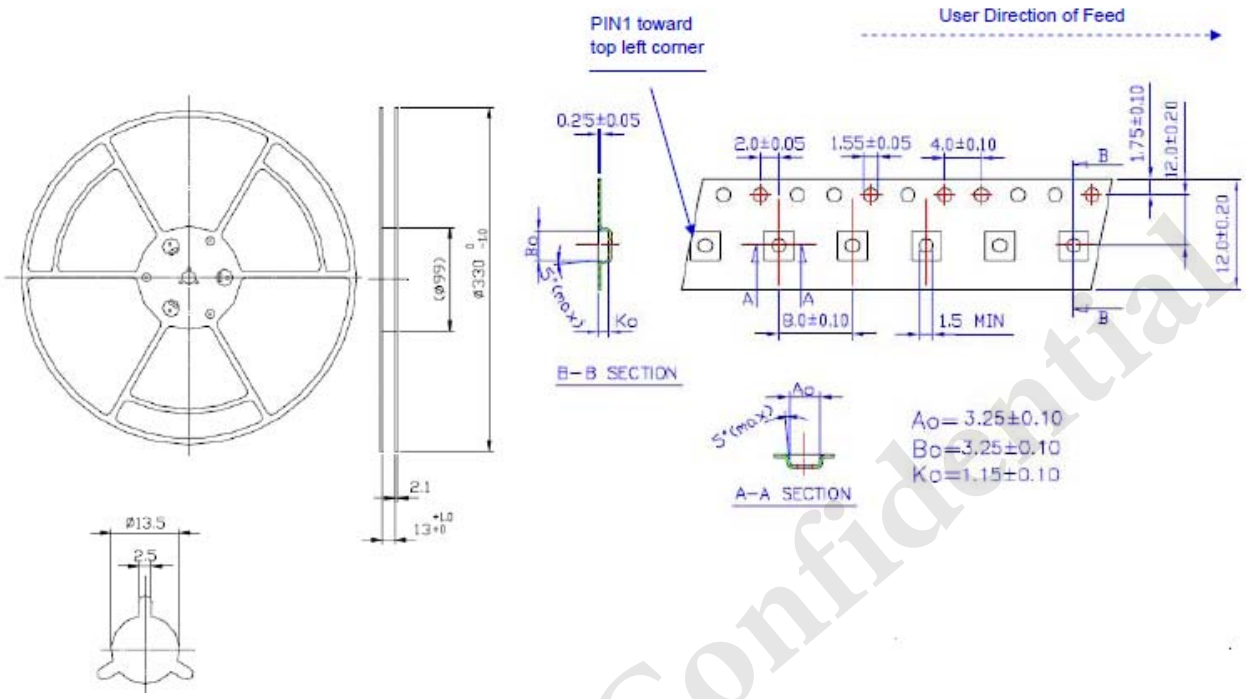
Tape and Real Dimension



Unit : mm

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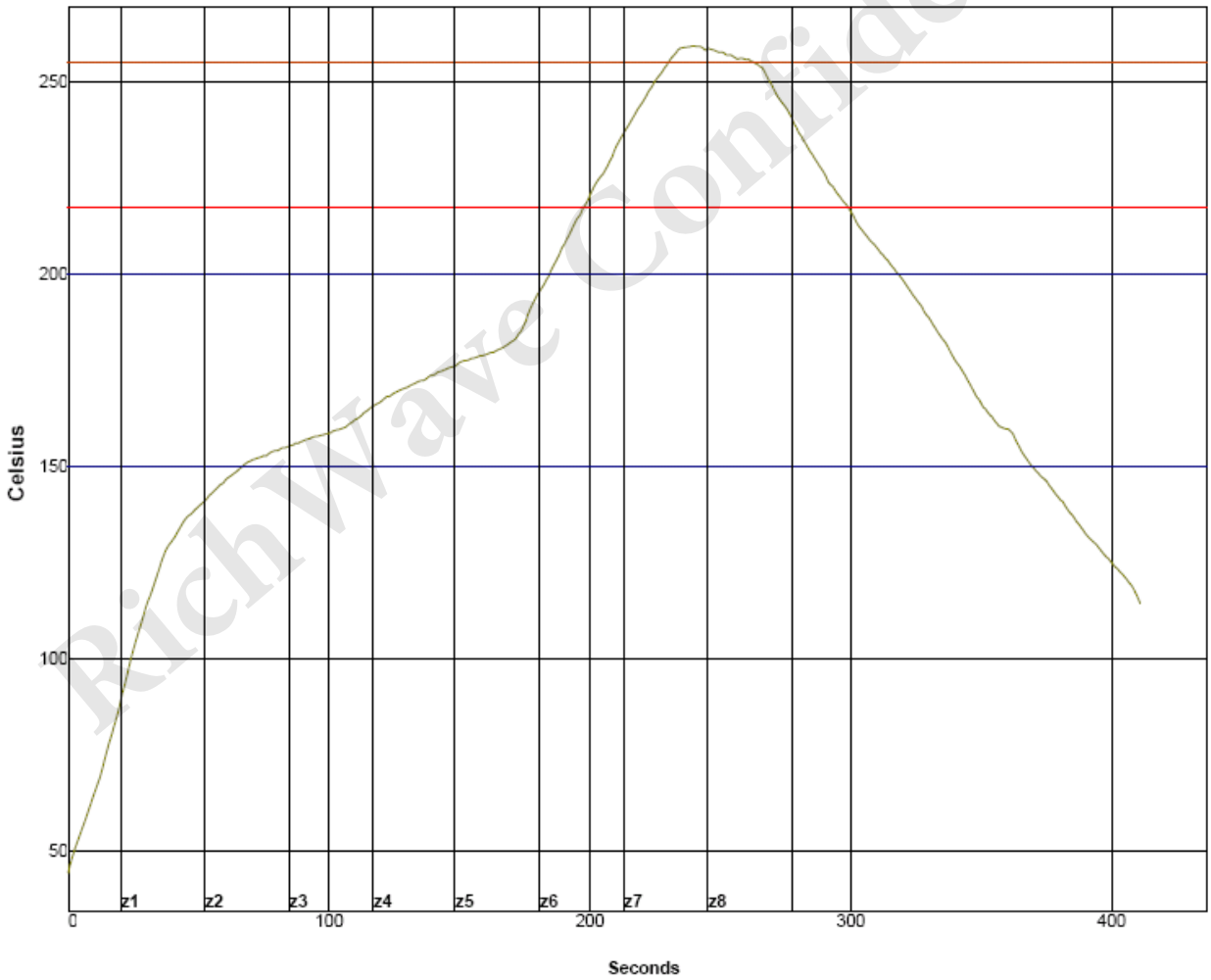
Recommended Solder Reflow Profiles

Average ramp-up rate (200˚C to peak)	3˚C/second max.
Preheat temperature 175 (+/-25) ˚C	60~120secs
Temperature maintained above 217˚C	60~150secs
Time within 5˚C of actual peak temperature	30 seconds min.
Peak temperature range	(260 +2/-2)˚C
Ramp down rate	6˚C/second max.
Time 25˚C to peak temperature	8 minutes max.

* Follow JEDEC spec J-STD-020D



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