RTC5639 : 5 GHz Front End Module for 802.11a/n/ac

Description

The RTC5639 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. The antenna port are switched between transmit and receive. In the transmit path, the FEM performs a typical gain of 31 dB and delivers 20 dBm linear output power at 802.11ac MCS9 256QAM VHT80 dynamic EVM 1.8%. In the receive path, the FEM can deliver a typical gain of 14 dB and 2.8 dB noise figure. The RTC5639 is packaged in 16-lead surface mount package QFN 3.0mm x 3.0mm x 1.0mm(max) with lead-free RoHS compliant.

Feature

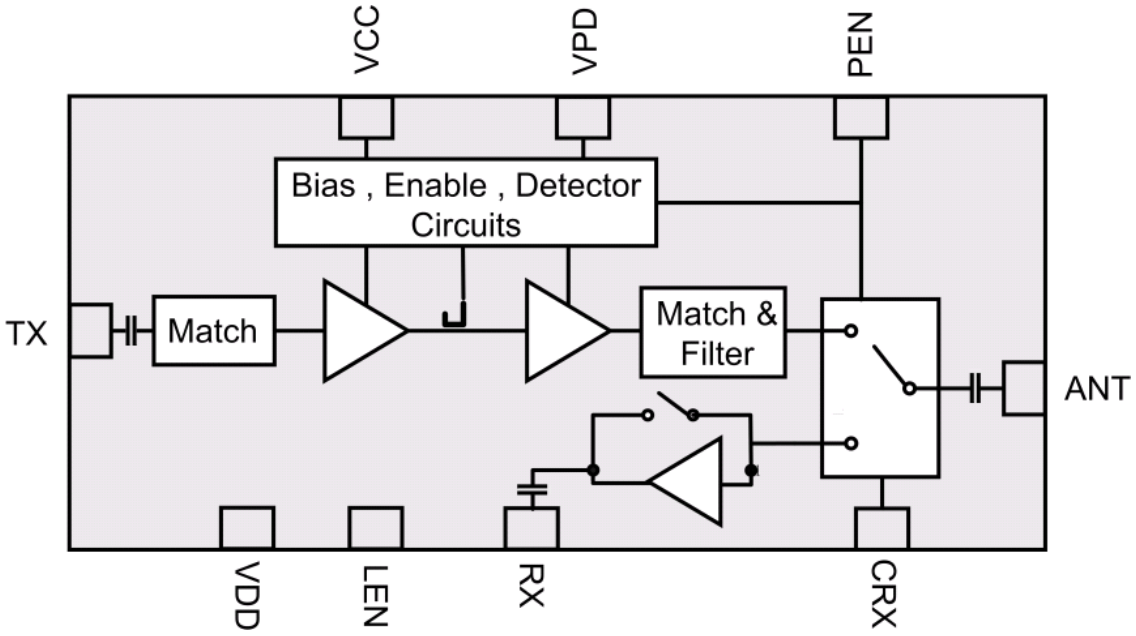
- Frequency Range: 5.15 – 5.85 GHz
- Integrated high performance PA, LNA with bypass function, harmonic filter and SPDT switch
- Input & output fully 50 ohm matching
- Output Power 20 dBm@1.8% DEVM, 802.11ac, VHT80, MCS9, 256QAM
- Output Power 21 dBm@3.0% DEVM, 802.11n, HT20/40, MCS7, 64QAM
- 14 dB gain and 2.8 dB noise figure for RX path
- Package in 16L QFN 3.0mm x 3.0mm x 1.0mm(max)
- RoHS, Pb-free, Halogen Free Compliant
- Moisture Sensitivity Level : MSL 3

Application

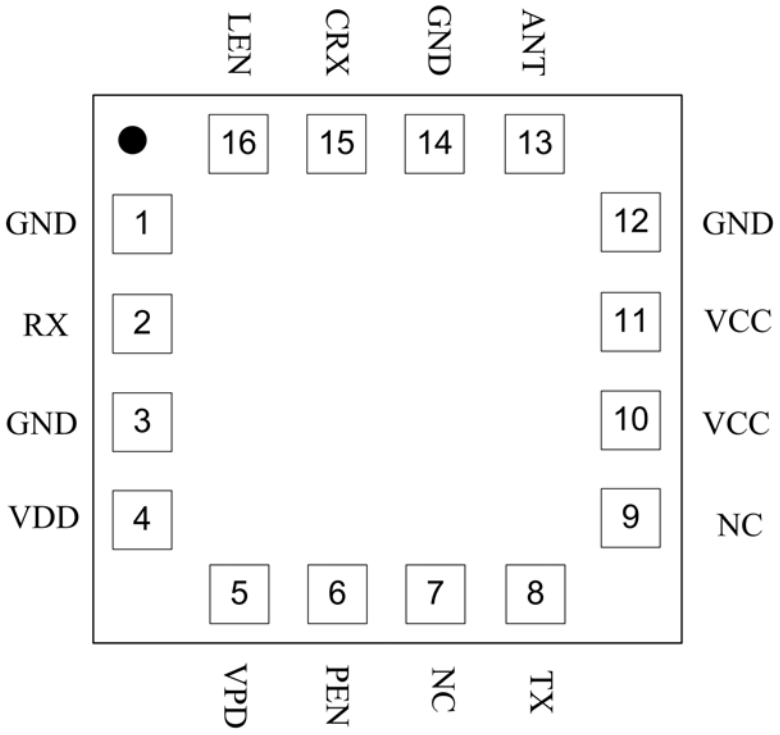
- IEEE 802.11a/n/ac Wireless LAN System
- 5GHz ISM Band Application
- Cardbus, miniPCI, PCIe, AP Application

Specifications subject to change without notice
RichWave Technology Corp. 3F, No. 1, Alley 20, Lane 407, Sec.2, Tiding Blvd., Taipei 114, Taiwan, R.O.C.
• Phone : +886-2-8751-1358 • Fax : +886-2-6600-6887 • Info@www.richwave.com.tw

Functional Block Diagram



Pin Out (Top View through package)



Specifications subject to change without notice
RichWave Technology Corp. 3F, No. 1, Alley 20, Lane 407, Sec.2, Tiding Blvd., Taipei 114, Taiwan, R.O.C.
• Phone : +886-2-8751-1358 • Fax : +886-2-6600-6887 • Info@www.richwave.com.tw

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
Backside Center Paddle		Must be connected to GND through PCB via for best performance

Truth Table

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

RichWave Technology Corp. 3F, No. 1, Alley 20, Lane 407, Sec.2, Tiding Blvd., Taipei 114, Taiwan, R.O.C.
• Phone : +886-2-8751-1358 • Fax : +886-2-6600-6887 • Info@www.richwave.com.tw

Absolute Maximum Rating

Parameter	Rating	Units
Supply Voltage (VCC, VDD)	6.0	V
PA Enable Voltage (PEN)	3.3	V
LNA Enable Voltage (LEN)	3.5	V
TX Input Power (Pin)	+10	dBm
Operating Temperature	-40 to +85	℃
Storage Temperature	-40 to +150	℃
Maximum Junction Temperature (T_J)	150	℃
Thermal Resistance - Junction to Ambient (θ_{JA})	43.6	℃/W

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	5	5.25	V
PA enable voltage (High)	PEN	2.7	2.8	3.0	V
PA enable voltage (Low)	PEN	-0.2	0	0.3	V
LNA Enable Voltage (High)	LEN	2.5	2.8	3.3	V
LNA Enable Voltage (Low)	LEN	-0.2	0	0.3	V
Switch control voltage (High)	CRX	2.5	2.8	3.3	V
Switch control voltage (Low)	CRX	-0.2	0	0.3	V

RichWave Technology Corp. 3F, No. 1, Alley 20, Lane 407, Sec.2, Tiding Blvd., Taipei 114, Taiwan, R.O.C.
• Phone : +886-2-8751-1358 • Fax : +886-2-6600-6887 • Info@www.richwave.com.tw

Electrical Specification

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Transmit Mode (TX – ANT) T_A = +25 °C, VCC = VDD = 5 V, PEN = 2.8 V, LEN = CRX = 0 V, All unused RF ports terminated in a 50 Ω load, unless otherwise noted						
Operating Frequency	f		5.15		5.85	GHz
Output Power	Pout	802.11ac, MCS9, VHT80 DEVM = 1.8% 256QAM rate 5/6	18	20		dBm
		802.11ac, MCS11, VHT80 DEVM = 1.2% 1024QAM rate 5/6	17	19		dBm
		802.11n, MCS7, HT20/40 DEVM = 3%	19	21		dBm
		802.11ac, 80MHz, MCS0 Spectral Mask	21	23		dBm
		802.11n, 20MHz, MCS0 Spectral Mask	22	24		dBm
Small Signal Gain	G	Pin = -30dBm	28	31		dB
Gain Flatness	ΔG	Gain Variation Over the full band		2		dB
1 dB Output Compression Point	P1dB	1dB power Compression		28		dBm
Return Loss	|S11|	Input Return Loss	7			dB
	|S22|	Output Return Loss	5			dB
2f harmonics	2fo	802.11a, 6 Mbps Pout = 24.5 dBm		-22		dBm/MHz
3f harmonics	3fo			-32		dBm/MHz
Isolation	ISO	ANT-RX		15		dB
Power Detector Output	Vpd	802.11ac, MCS9, VHT80 Pout = 10 dBm		0.22		V
		802.11ac, MCS9, VHT80 Pout = 20 dBm		0.57		V
Supply Current	Icq	Quiescent (no RF)		260	290	mA

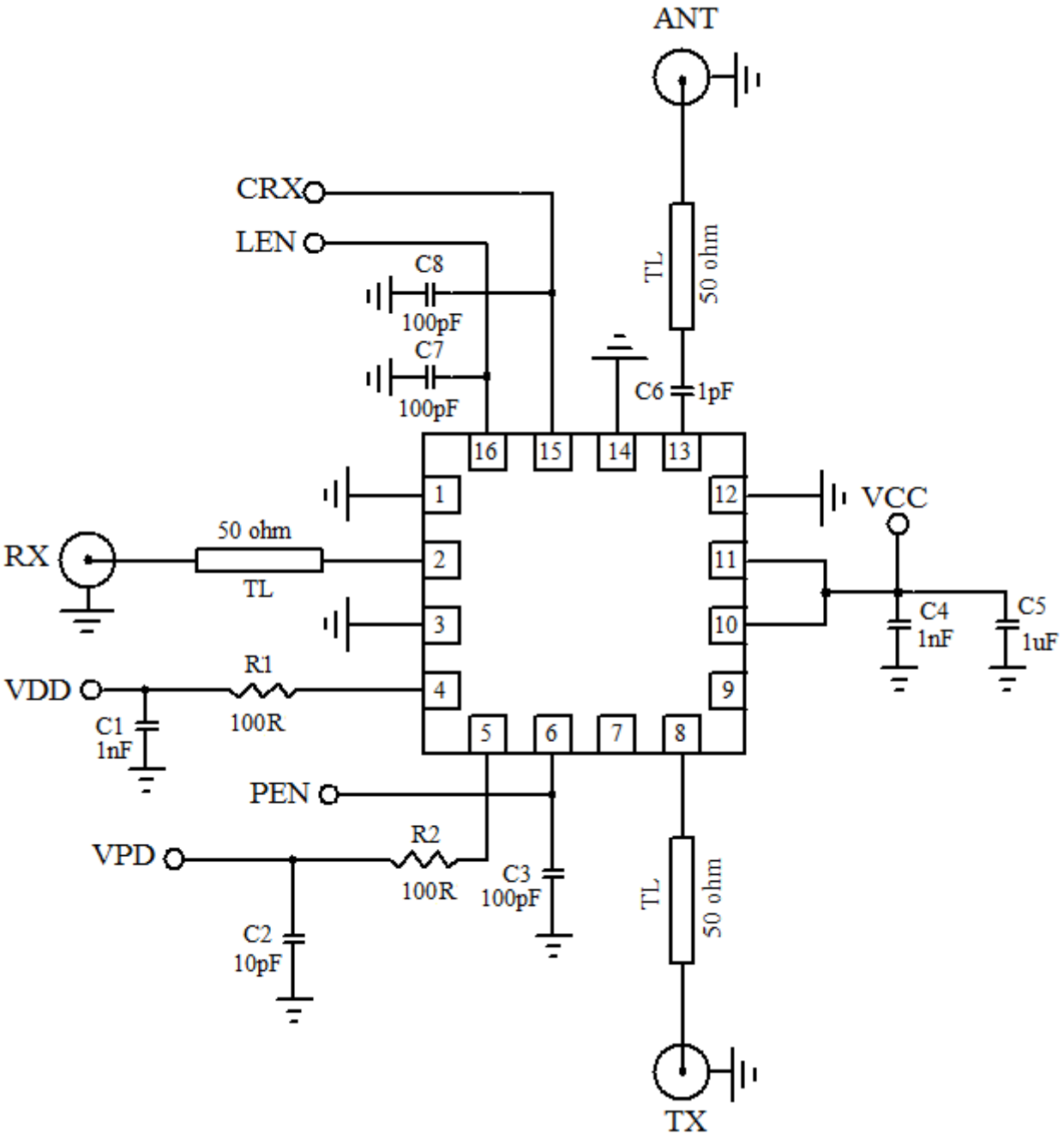
RichWave Technology Corp. 3F, No. 1, Alley 20, Lane 407, Sec.2, Tiding Blvd., Taipei 114, Taiwan, R.O.C.
• Phone : +886-2-8751-1358 • Fax : +886-2-6600-6887 • Info@www.richwave.com.tw

PA Enable Current	Ien	Quiescent (no RF)		3	5	mA
Supply Current, Transmit Mode	Icc	Pout = 22 dBm, 802.11n, HT20, 100%		315	350	mA
		Pout = 20 dBm, 802.11ac, VHT80, 50%		295	330	mA
Receive High Gain Mode T_A = +25 °C, VDD = 5 V, PEN = 0 V, LEN = CRX = 2.8 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	12	14		dB
Return Loss	|S11|	Input Return Loss	9			dB
	|S22|	Output Return Loss	8			dB
Noise Figure	NF	High Gain Mode		2.8		dB
Isolation	ISO	ANT - TX		30		dB
1 dB Input Compression Point	IP1dB	1dB Gain Compression		-6		dBm
Supply Current	Idd	RX ON		12	15	mA
Receive Bypass Mode T_A = +25 °C, VDD = 5 V, PEN = 0 V, LEN = 0 V, CRX = 2.8 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		-8		dB
1 dB Input Compression Point	IP1dB	1dB Gain Compression		23		dBm
Isolation	ISO	ANT - TX	40	45		dB
Return Loss	|S11|	Input Return Loss	12			dB
	|S22|	Output Return Loss	10			dB

RichWave Technology Corp. 3F, No. 1, Alley 20, Lane 407, Sec.2, Tiding Blvd., Taipei 114, Taiwan, R.O.C.
• Phone : +886-2-8751-1358 • Fax : +886-2-6600-6887 • Info@www.richwave.com.tw

Application Circuit

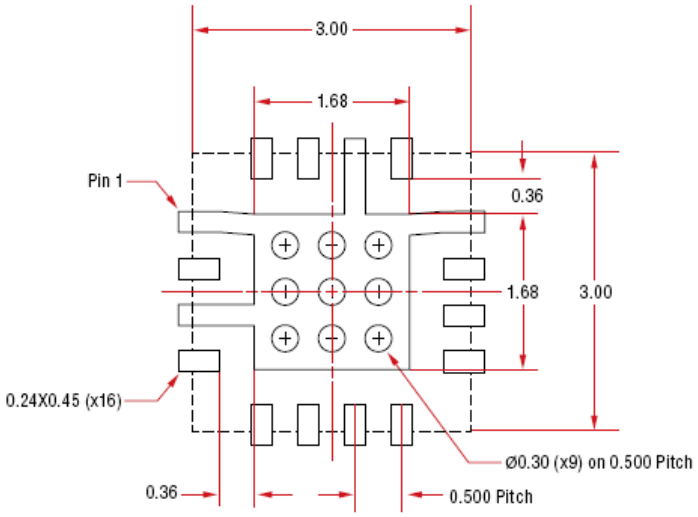
The application circuit and below evaluation board are used for the performance test of RTC5639 (5 GHz 11ac FEM). The RF characteristics of RTC5639 shown in the specification table are measured by the evaluation board. Evaluation board setup procedure: (1) Connect GND to PCB backside (2) Apply 5 V to VCC & VDD pins (3) Select test path according to control truth table.



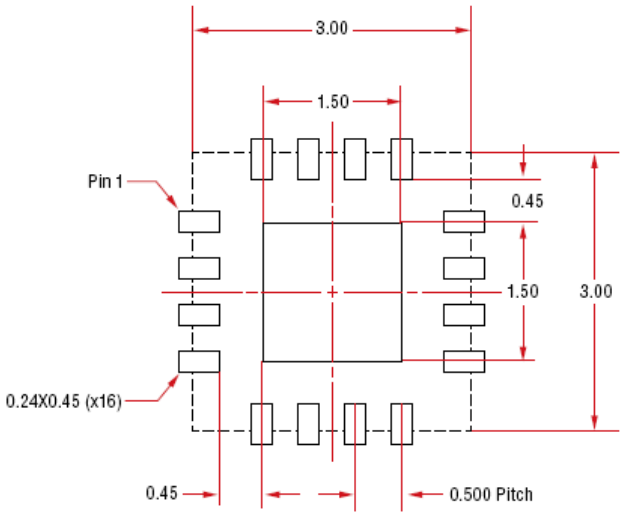
Evaluation Board

Specifications subject to change without notice
RichWave Technology Corp. 3F, No. 1, Alley 20, Lane 407, Sec.2, Tiding Blvd., Taipei 114, Taiwan, R.O.C.
• Phone : +886-2-8751-1358 • Fax : +886-2-6600-6887 • Info@www.richwave.com.tw

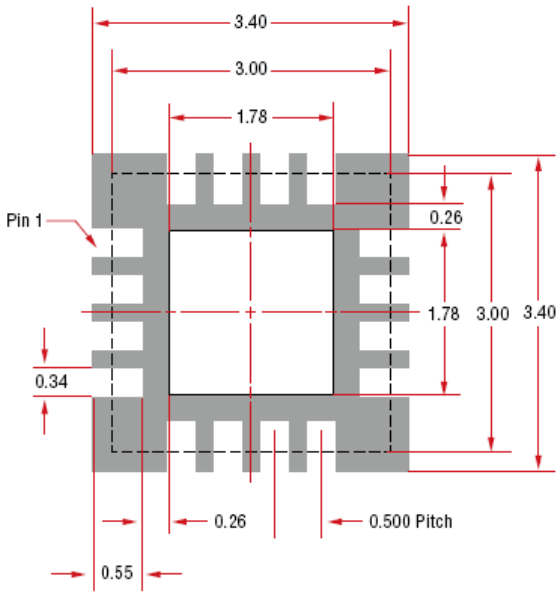
Recommended PCB Footprints



PCB Board Metal & Via Pattern
Top View



PCB Stencil Pattern
Top View
80% solder coverage on Pad

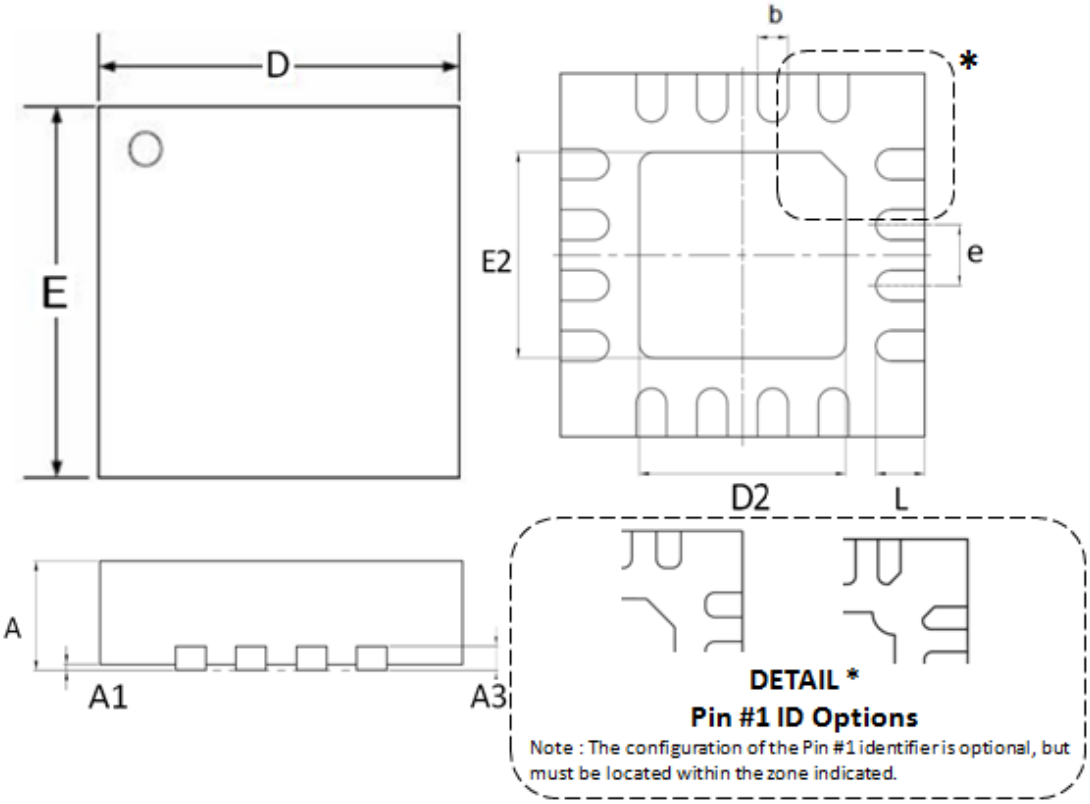


PCB Solder Mask Pattern
Top View

NOTE: All dimensions are measured in millimeters

RichWave Technology Corp. 3F, No. 1, Alley 20, Lane 407, Sec.2, Tiding Blvd., Taipei 114, Taiwan, R.O.C.
• Phone : +886-2-8751-1358 • Fax : +886-2-6600-6887 • Info@www.richwave.com.tw

Package Outline Dimension



16L QFN 3X3X1-A		
Symbol	Dimensions in Millimeters	
	MIN	MAX
A	0.800	1.000
A1	0.000	0.050
A3	0.200REF	
b	0.180	0.300
D	2.900	3.100
D2	1.550	1.800
e	0.500TYP	
E	2.900	3.100
E2	1.550	1.800
L	0.200	0.400

Specifications subject to change without notice
RichWave Technology Corp. 3F, No. 1, Alley 20, Lane 407, Sec.2, Tiding Blvd., Taipei 114, Taiwan, R.O.C.
• Phone : +886-2-8751-1358 • Fax : +886-2-6600-6887 • Info@www.richwave.com.tw