Revision History

Rev.	History	Issue Date	Remark
0.1	Initial version	2001107	Initial version
0.2	Update EVB into TM1001 EVB PCB1V1.0 on page 9.	20131011	Randall Lan
0.3	Add Product Markingon page 14	20141211	Jay Huang
0.4	Add Tape and Reel on page 15.	20150203	Rick Hsiao
1.0	Add Handling Precautions on page 16.	20150610	Randall Lan
2.3	Add revision history	20181130	Randall Lan
2.4	Add tape and Reel drawing	20210528	Randall Lan and Ethan

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TM1001 2.4GHz Power Amplifier MMIC

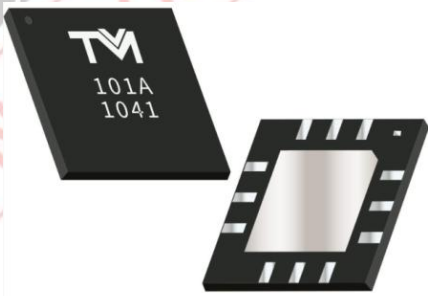
General Description

The TM1001 is manufactured on Gallium Arsenide Heterojunction Bipolar Transistor (GaAs HBT) process. The device is a low cost, high linearity,medium power, high efficiency amplifier IC designed for IEEE 802.11.b/g, *Bluetooth* Class 1, and other application in the 2.4GHz ISM band. The device also features analog power control to optimize transmit power while maximizing battery life in portable equipment. The device includes an integrated power detector circuit for closed loop control of output power. The TM1001 is packaged in a compact 3mm by 3mm QFN packagewith a backside ground.

Features

- Integrated Power Detector Circuit
- Analog Gain Control and Power control
- QFN-12L-3x3 mm with thermal ground
- RoHS compliant
- MSL-1

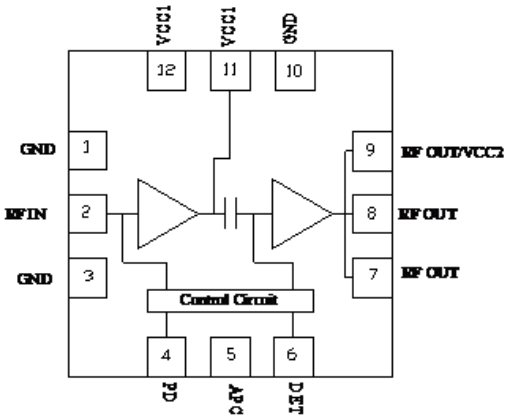
Product Photo



Applications

- Bluetooth™ PA (Class 1)
- WLAN 802.11.b/g
- Wireless Data Terminal
- Cordless Handset
- Portable Battery Powered Equipment

Functional Block Diagram



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Absolute Maximum Ratings

Parameter	Maximum Rating	Unit
VCC Supply Voltage	0 to 6	V
APC Control Voltage	0 to 6	V
RF Input Power	+ 5	dBm
Operating Temperature	-40 to +85	^{o}C
Storage Temperature	-55 to +150	^{o}C

Notes:

1. Operation of this device in excess of any maximum rating as specified above may cause permanent damage to the device.
2. **Caution! ESD Sensitive Device.**

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Specification Summary

1. WLAN 802.11. b/g Application:

(TM1001 Evaluation Board for 802.11b application, Vcc1=Vcc2=Vapc=Vpd=+5V, RFin=-1dBm TA=+25℃, unless otherwise noted)

Parameter	Min.	Typical	Max.	Unit	Conditions
Operating Frequency Range	2.4		2.5	GHz	
Linear Output Power (802.11.b 11Mbps CCK)		+24.5		dBm	meeting 802.11.b spectral mask Vcc1=Vcc2=Vapc=Vpd=+5V
Linear Output Power (802.11.b 11Mbps CCK)		+21		dBm	Vcc1=Vcc2=Vapc=Vpd=+3.3V
Linear Output Power (802.11.g 54Mbps OFDM)		+18		dBm	EVM<3%
Linear Efficiency		22		%	RFout=24.5dBm
802.11.b Adjacent Channel Power, 1st side lobe		35		dBc	RFout=+24.5dBm
802.11.b Adjacent Channel Power, 2nd side lobe		55		dBc	RFout=+24.5dBm
Harmonics: 2Fo, 3Fo		-45, -40		dBc	
Gain	23	26		dB	RFin=-30dBm
Gain Control Voltage	0		5	V	
Current Consumption		260		mA	RFout=+24.5dBm
		175		mA	RFout=+21dBm, Vcc1=Vcc2=Vapc=Vpd=+3.3V
		50		mA	Idle current, No RFin
		<10		uA	Shutdown Mode, Vapc=Vpd=0V

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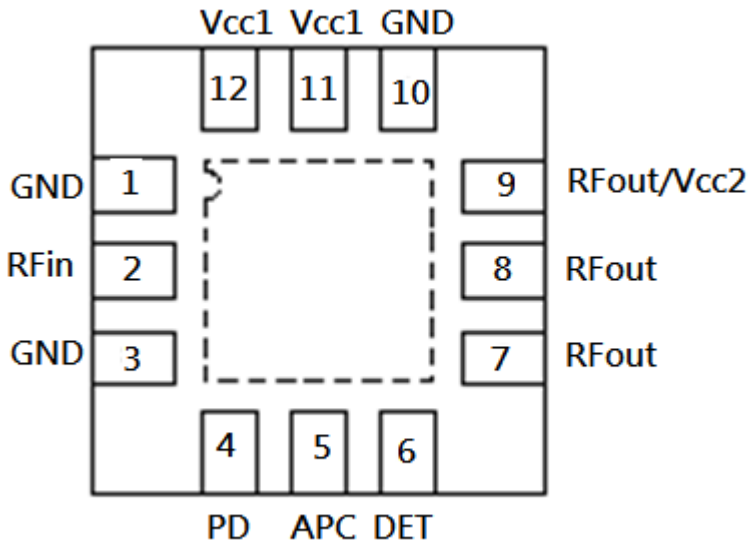
2. Bluetooth Class 1 Application:

(TM1001 Evaluation Board for Bluetooth Class 1 Application, Vcc1=Vcc2=Vapc=Vpd=+3V,RFin=-3dBm TA=+25℃, unless otherwise noted)

Parameter	Min.	Typical	Max.	Unit	Conditions
Operating Frequency Range	2.4		2.5	GHz	
Maximum Output Power		+24		dBm	
Power Added Efficiency		40		%	RFout=+22dBm
Harmonics: 2Fo, 3Fo		-35, -35		dBc	RFout=+22dBm
Gain	23	25		dB	
Gain Control Voltage	0		3	V	
Current Consumption		133		mA	RFout=+22dBm
		40		mA	Idle current, No RFin
		<10		uA	Shutdown Mode, Vapc=Vpd=0V

Pin Configuration

TM1001
(Top View)



Functional Pin Description

Name	Pin #	Description
RFin	2	RF input for the power amplifier. This pin requires a DC-blocking capacitor.
PD	4	Bias control about output power and gain.
APC	5	Bias control about output power.
DET	6	Detector output voltage for PA output power.
RFout	7,8,9	RF output for the power amplifier. This pin requires a DC-blocking capacitor.
Vcc2	9	DC supply voltage for second stage amplifier.
Vcc1	11,12	DC supply voltage for first stage
GND	1, 3, 10	Connect to ground
Die Pad	Bottom	This pad should be connected to the ground plane by vias directly under this pad.

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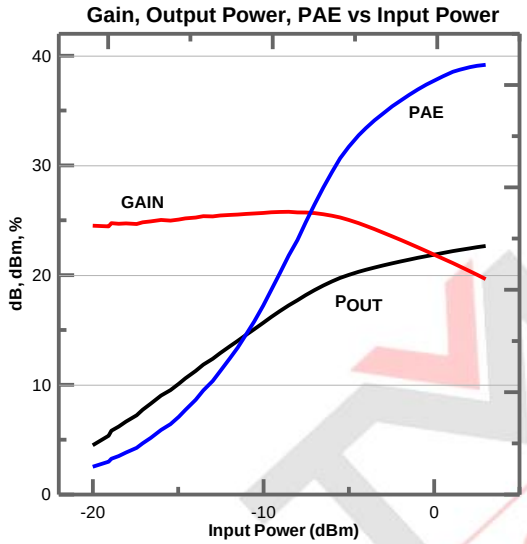
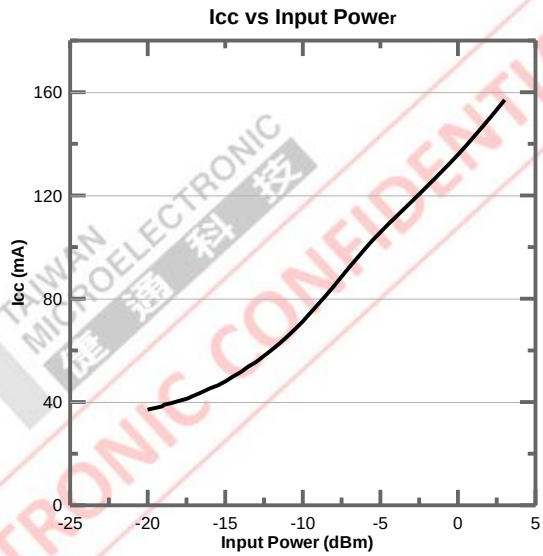
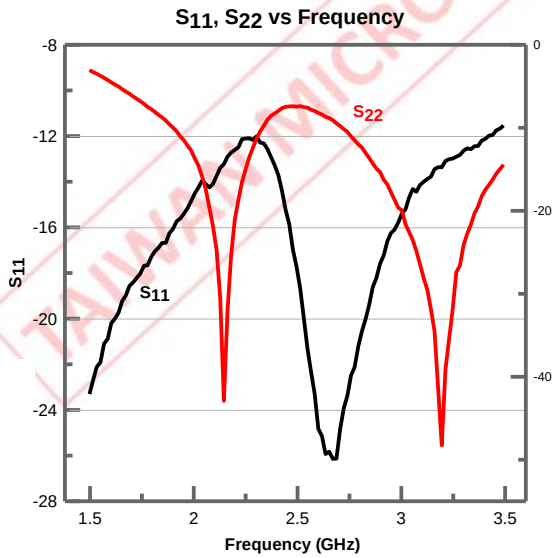
Performance Data

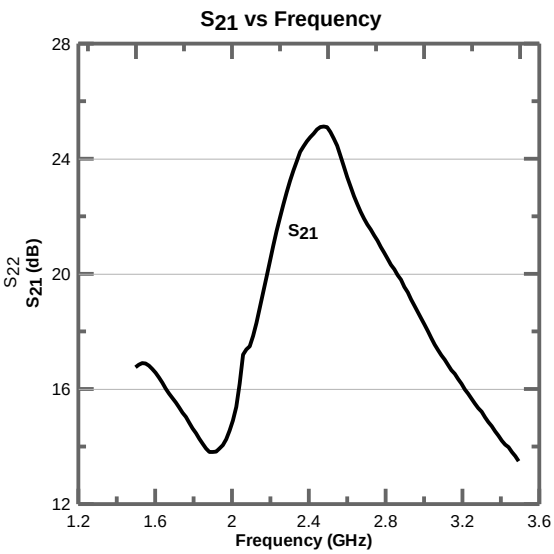
Bluetooth Performance Data

Test conditions:Vcc1=Vcc2=Vapc=Vpd=+3V, RFin=-30dBm, R3=560 ohm (refer to application circuit 1), Idle current=31mA









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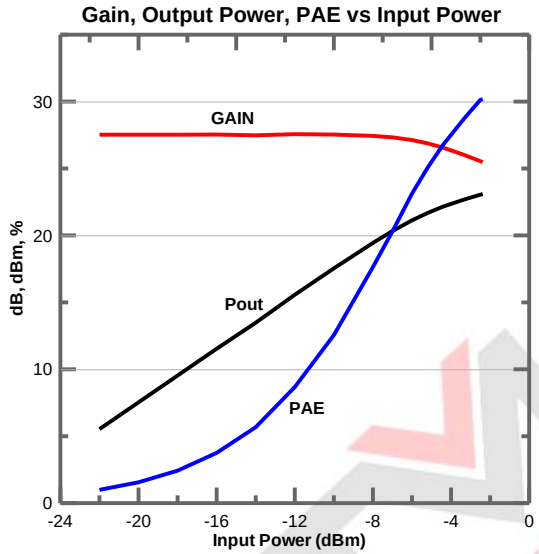
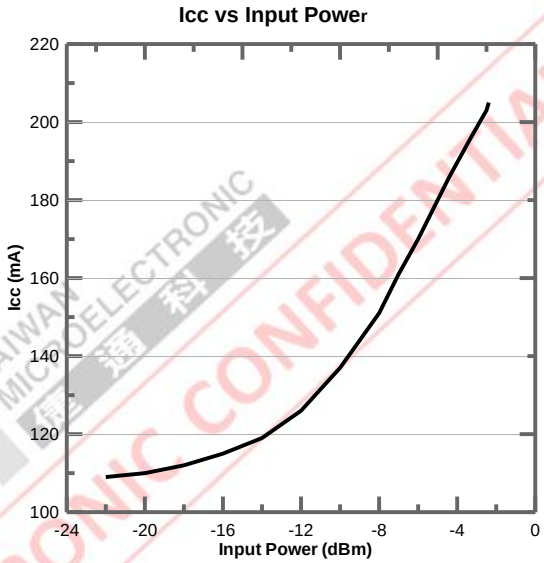
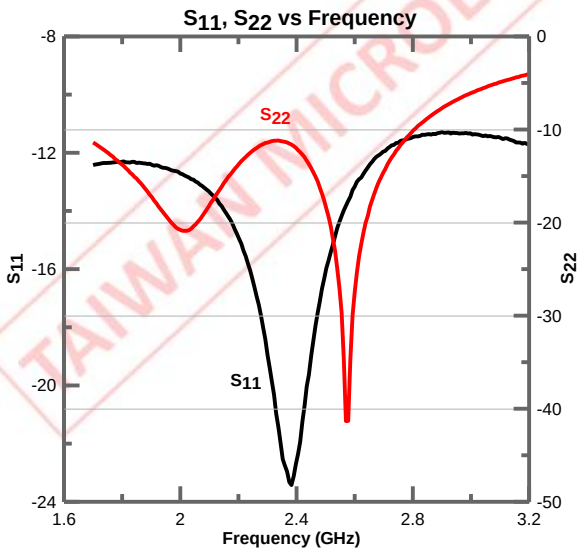
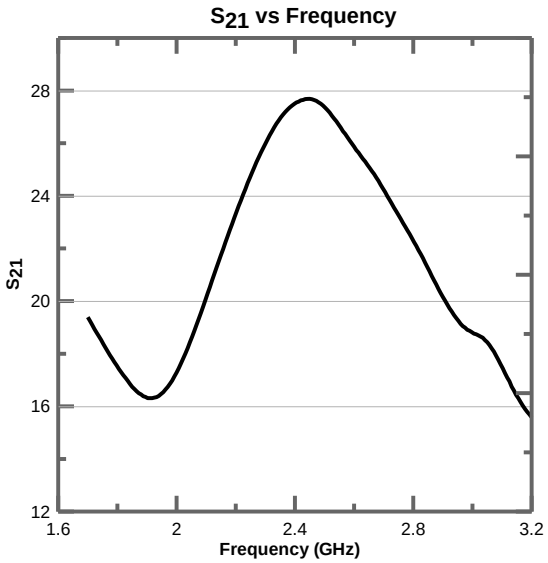
802.11.b Performance Data

Test conditions:Vcc1=Vcc2=Vapc=Vpd=+3.3V, RFin=-20dBm, R3=200ohm (refer to application circuit 2)









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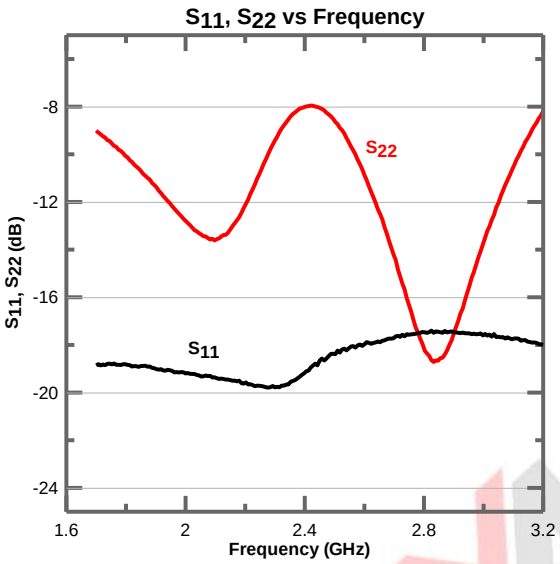
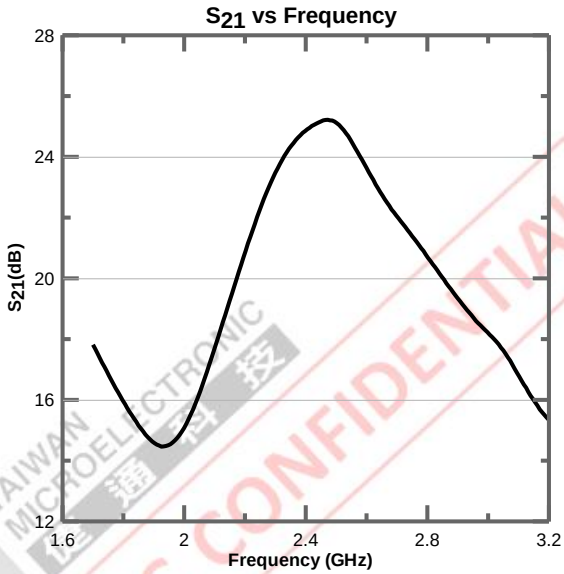
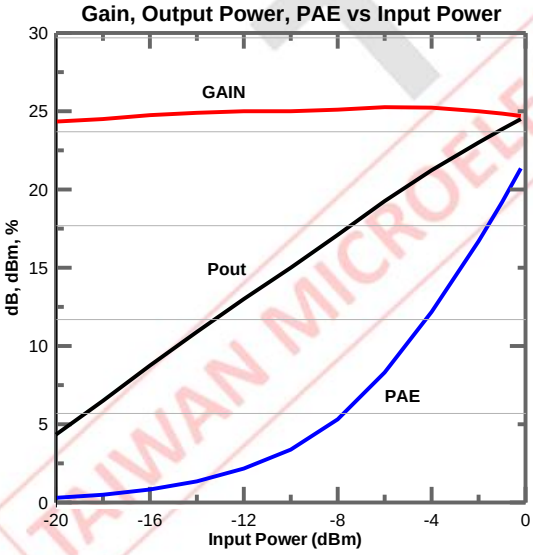
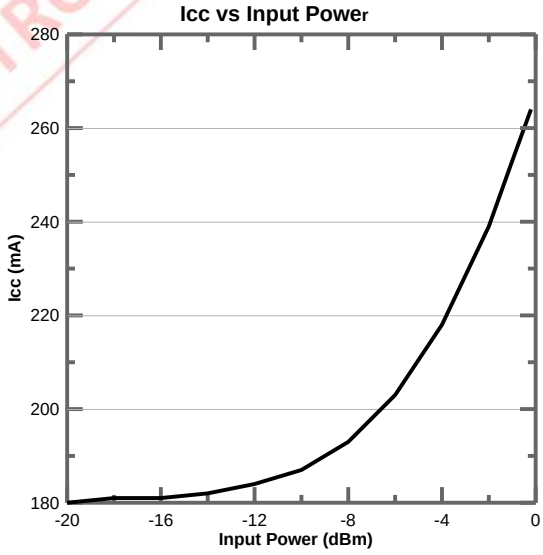
Test conditions:Vcc1=Vcc2=Vapc=Vpd=+5V, RFin=-30dBm, R3=560ohm (refer to application circuit 3)









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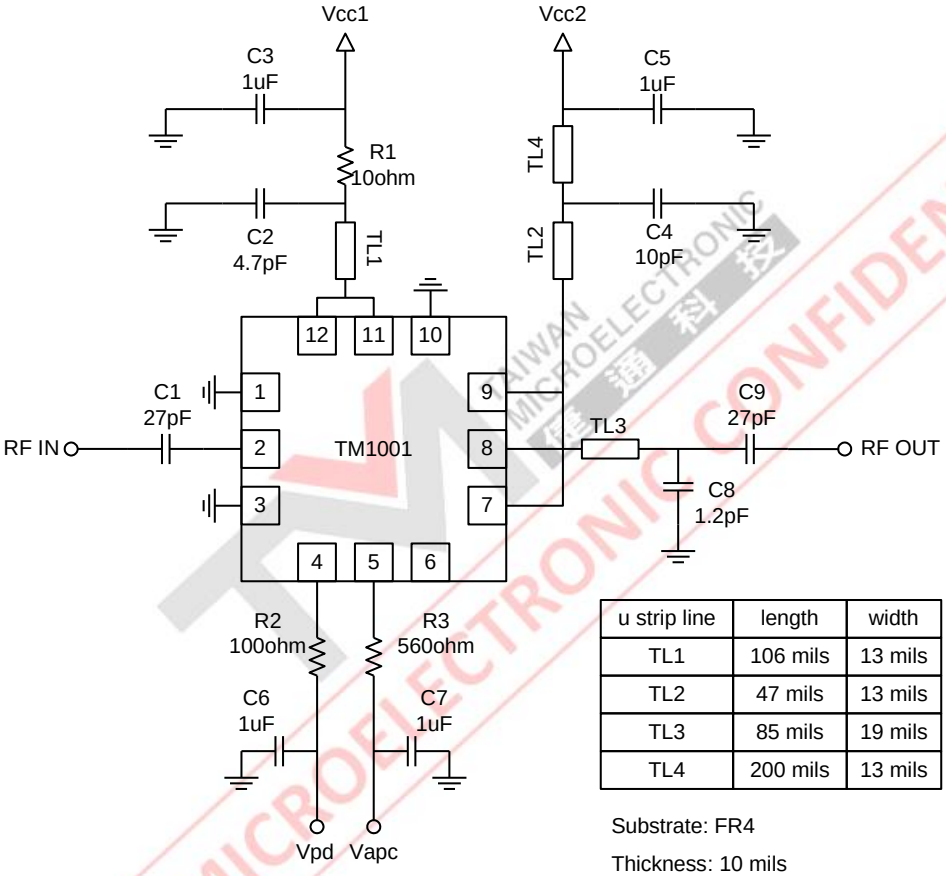
Application Circuits

1. Bluetooth Class 1application, VCC=3 V



u strip line	length	width
TL1	106 mils	13 mils
TL2	47 mils	13 mils
TL3	85 mils	19 mils
TL4	200 mils	13 mils

Substrate: FR4

Thickness: 10 mils

Note:

1). The location or value of C2 will affect the performance of Gain.
2). The location of C8 will affect the performance of harmonic.
3). The value of C8 will affect the performance of P1dB.
4). The location of C4 will affect the performance of harmonic.

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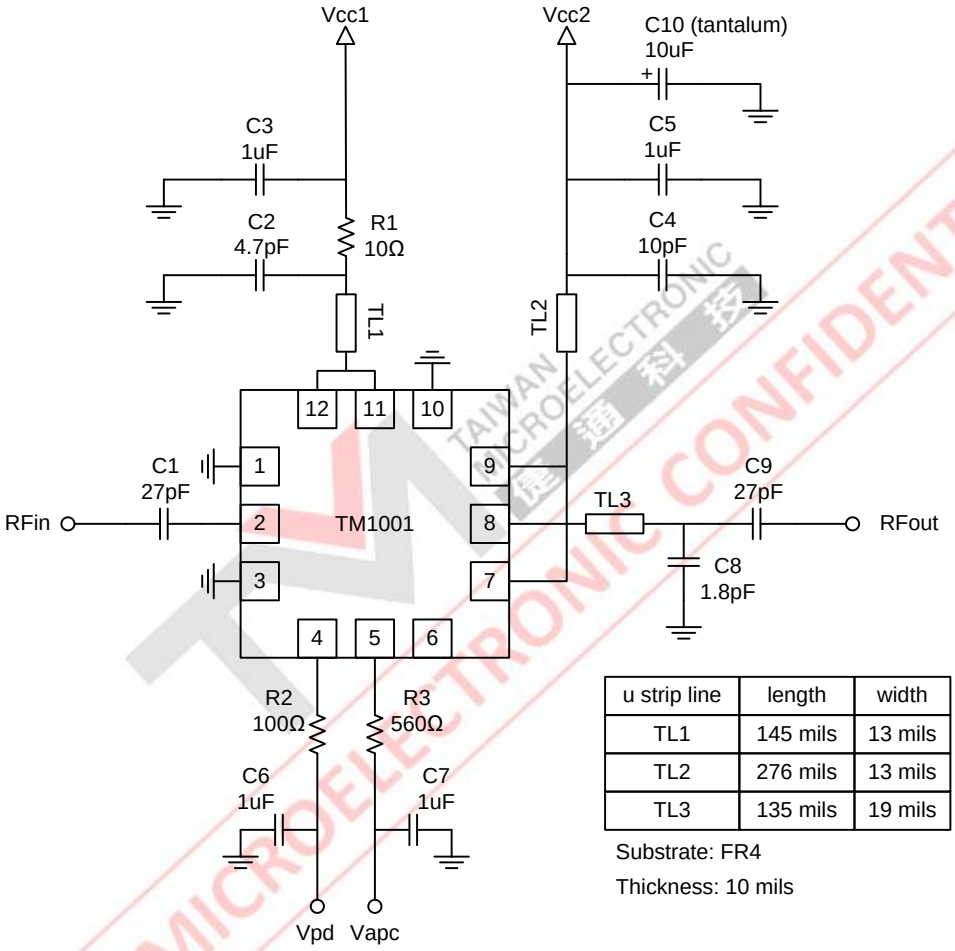
2. 802.11.b 3.3V application



u strip line	length	width
TL1	145 mils	13 mils
TL2	276 mils	13 mils
TL3	135 mils	19 mils

Substrate: FR4

Thickness: 10 mils

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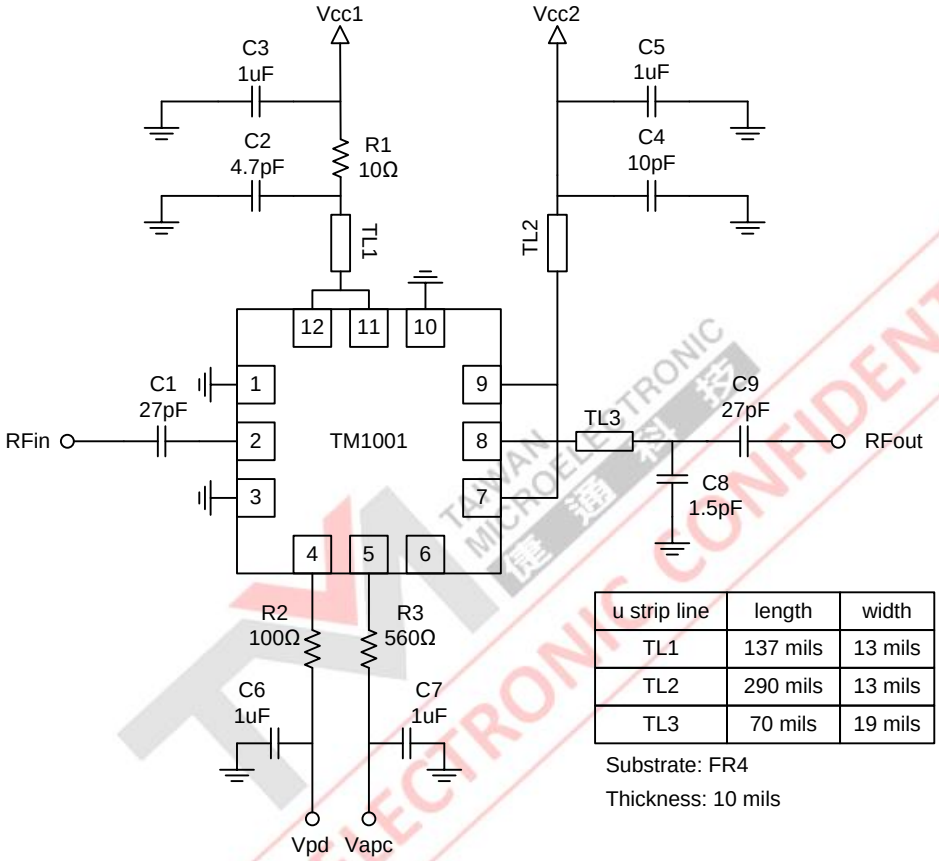
3. 802.11.b 5V application



u strip line	length	width
TL1	137 mils	13 mils
TL2	290 mils	13 mils
TL3	70 mils	19 mils

Substrate: FR4

Thickness: 10 mils

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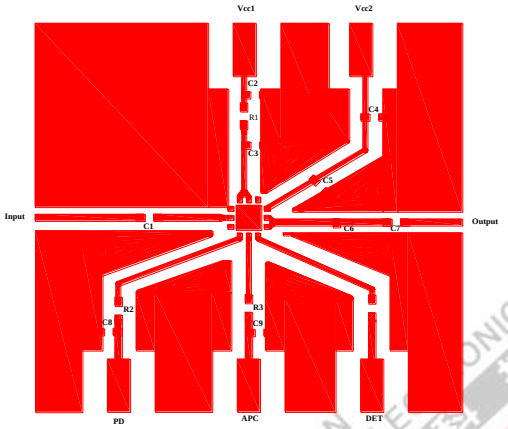
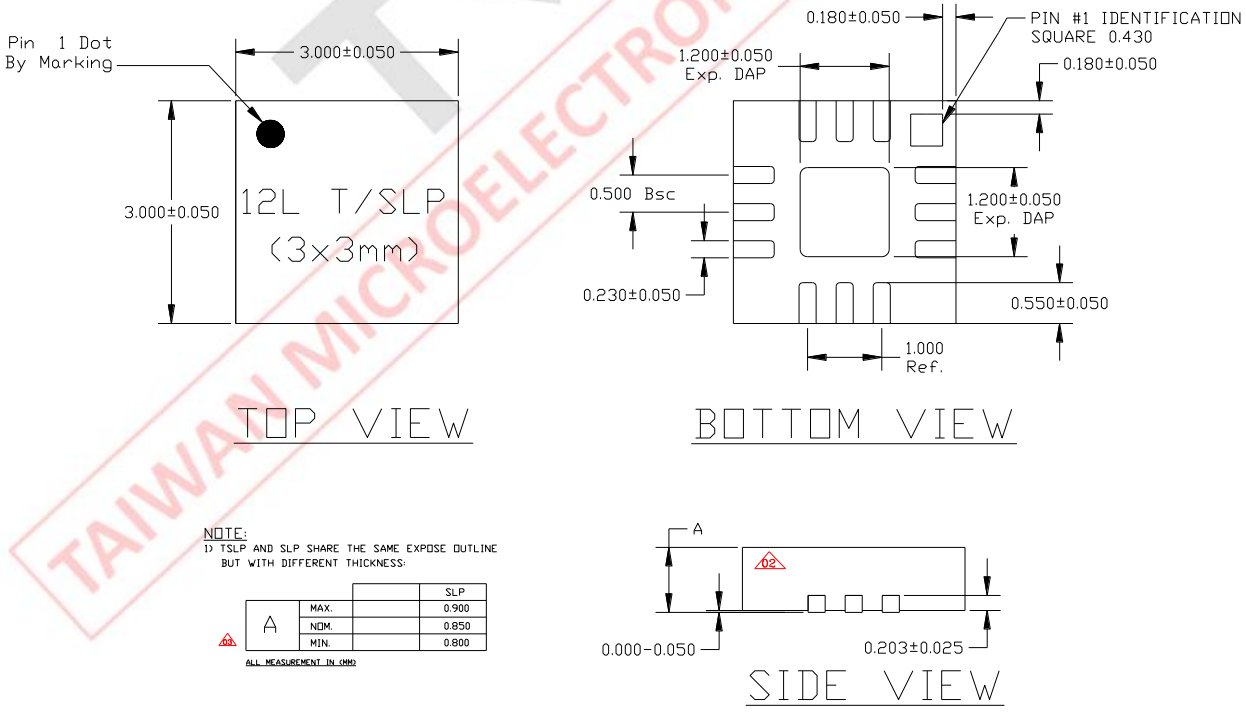
Evaluation Board Layout



Package Information



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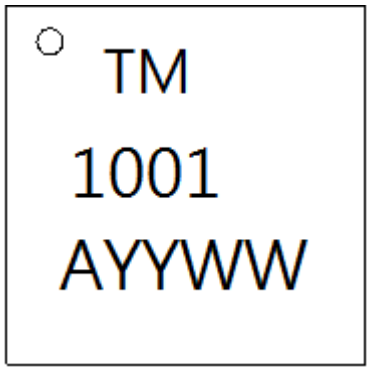
Product Marking

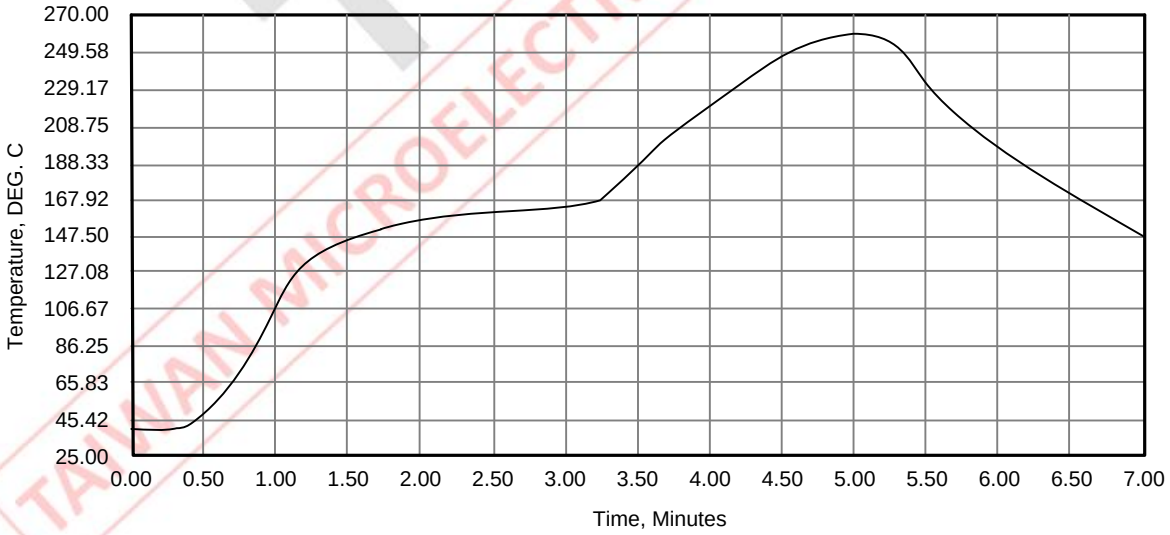


TM: company name

1001: product name

AYYWW : production control code

SMT Reflow Profile



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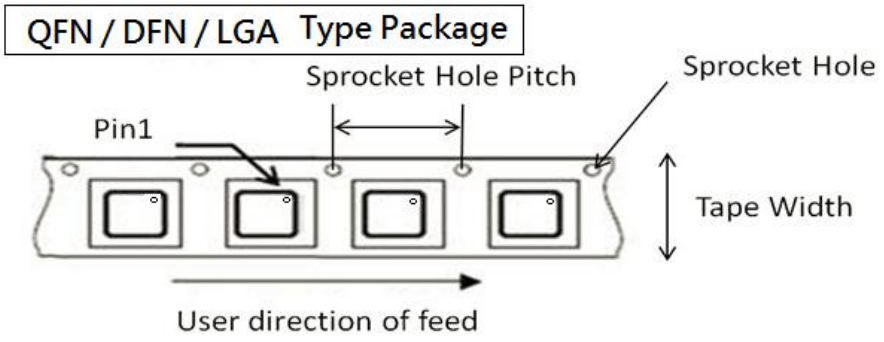
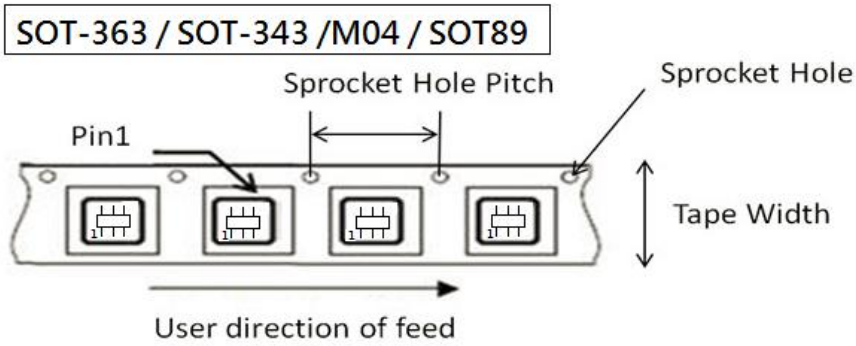
Tape and Reel





Package Type	Reel Size	Tape width (mm)	Sprocket Hole	Sprocket Hole Pitch (mm)	Leader Qty	Trailer Qty	Desiccant (g)
WLCSP 0.69x0.44mm	14"	12±0.03	Φ1.5 +0.1, -0	4.0±0.1	50	50	10
DFN 1.5x1.5mm	7"	12±0.03	Φ1.5 +0.1, -0	4.0±0.1	50	50	10
DFN 2x2mm	7"	12±0.03	Φ1.5 +0.1, -0	4.0±0.1	50	50	10
QFN 2x2mm	7"	12±0.03	Φ1.5 +0.1, -0	4.0±0.1	50	50	10
QFN 3x3mm	7"	12±0.03	Φ1.5 +0.1, -0	4.0±0.1	50	50	10
SOT 343 (M04)	7"	12±0.03	Φ1.5 +0.1, -0	4.0±0.1	50	50	10
SOT 363	7"	12±0.03	Φ1.5 +0.1, -0	4.0±0.1	50	50	10
SOT 89	7"	12±0.03	Φ1.5 +0.1, -0	4.0±0.1	50	50	10

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Handling Precaution

SAFETY INFORMATION ON THIS PRODUCT

Cautions on using this product	The product contains Gallium-Arsenide (GaAs). GsAs vapor and power are hazardous to human health if inhaled or ingested. ● Do not destroy or burn the product. ● Do not cut or cleave off any part of the product. ● Do not crush or chemically dissolve the product. Follow related laws and ordinances for disposal. The product should be excluded from general industrial waste or household garbage.

CAUTION: This device issensitive to Electro-Static Discharge(ESD).Observeprecautions for handling electro-staticsensitive devices.Such precautions are described in the*ANSI/ESD S20.20*,*IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

Mounting: This WLCSP is only used in an overmolded module using MUF.

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