

General Description

The TM2006 is a front-end MCM Module and uses an advanced Gallium Arsenide (GaAs) process. The front-end module consists of a Power Amplifier (PA), Low-Noise Amplifier (LNA) and a RF single pole double throw (SPDT) Switch. This device makes it ideal for IEEE 802.11.b/g, *Bluetooth*, 2.4Ghz Audio/Video, Wireless Data Terminal and portable battery powered equipment. The PA delivers +23dBm (maximum) output power with a high Power Added Efficiency (PAE) 41%. The noise figure of LNA is below 1.8dB. The RF SPDT Switch has very low insertion loss 0.4dB in the 2.4GHz to 2.5GHz range. The device is packaged in a QFN 3mm by 3mm 16L package.

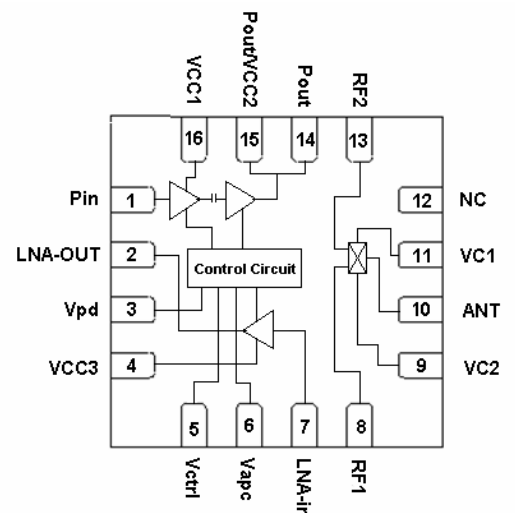
Features

- High Efficient Power Amplifier: 41% at Pout = 23dBm
- P-1dB: +21dBm Typical @ +3.3V
- Low-Noise Amplifier (NF typical 1.8dB)
- Low Insertion Loss: 0.4dB @ 2.45GHz
- IIP3: 55dBm @ Input Power up to 20dBm
- QFN 3x3 mm 16L with thermal ground ultra small plastic package
- Green, MSL 1

Applications

- Bluetooth™ PA (Class 1)
- Wireless Data Terminal
- Wireless Audio
- Portable Battery Powered Equipment

Functional Block Diagram



Absolute Maximum Ratings

Parameter	Maximum Rating	Unit
VCC1, VCC2 and VCC3 Supply Voltage	0 to 6	V
Vctrl, Vpd and Vpd Control Voltage	0 to 6	V
Switch Control VC1 , VC2	-6.0 to +6.0 ^{Note}	V
RF Switch input Power (>500MHz)	33	dBm
Storage Temperature	-55 to +150	°C
Power Supply Current	350	mA

Note | VC1-VC2 | ≤ 6.0V

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.**

Specification Summary
Power Amplifier

Parameter	Min.	Typical	Max.	Unit	Condition
Operating Frequency Range		2.4 to 2.5		GHz	
Maximum Output Power		+23		dBm	
PA Supply Current		100		mA	VCC1=VCC2=Vpd=3.3V, Vapc=2.8V, Pout=20dBm
Power Added Efficiency		30		%	Pout=20dBm,
Harmonics: 2Fo, 3Fo		-35,-32		dBc	Pout=20dBm
PA Small Signal Gain	23	25		dB	P _{IN} =-30dBm
Quiescent Current		47		mA	VCC1=VCC2=VCC3=3.3V Vpd=3.3V, Vapc=2.8V,
P ₋₁ dB		21		dBm	VCC1=VCC2=Vpd=3.3V, Vappc=2.8V

Low Noise Amplifier

Parameter	Min.	Typical	Max.	Unit	Condition
Operating Frequency Range		2.4 to 2.5		GHz	
Quiescent Current		7		mA	VCC3=Vctrl=3.3V, Pin=-30 dBm
Noise Figure		1.8		dB	
LNA Gain		13		dB	VCC3=Vctrl=3.3V, Pin=-30 dBm

RF SPDT Switch

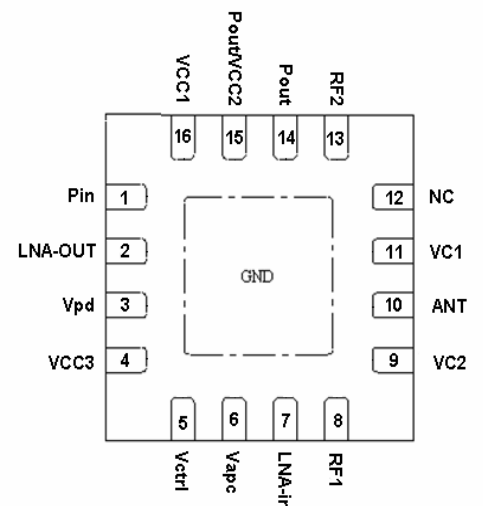
Parameter	Min.	Typ.	Max.	Unit	Test Conditions
Insertion Loss		0.3 0.4 0.4	0.4 0.5 0.6	dB dB dB	Input Power +25dBm DC-1.0GHz 1.0 -2.0GHz 2.0 -3.0GHz
Isolation	24 22 21	26 24 23		dB dB dB	Input Power +25dBm DC-1.0GHz 1.0 -2.0GHz 2.0 -3.0GHz
VSWR		1.2 1.2 1.5	1.4 1.4 1.6		DC-1.0GHz 1.0 -2.0GHz 2.0 -3.0GHz
Input Power for 1 dB compression		30		dBm	2.5GHz
Second Harmonics		-75		dBc	f=2.5GHz, Pin=25dBm
Third Harmonics		-80		dBc	f=2.5GHz, Pin=25dBm
Intermodulation Intercept Point (IIP3)		55		dBm	For two tones (f=2.5GHz, 2.501GHz) @ Input power +20dBm
Switch Time		50		ns	
Control Current		4	100	μA	Input Power +25dBm

Notes: All measurements made in 50Ω system, unless otherwise specified. DC=500MHz.

Functional Pin Description

Name	Pin #	Description
Pin	1	PA input. A matching network with DC block required.
LNA-out	2	LNA output
Vpd	3	Control the gain of PA
VCC3	4	Supply voltage for LNA
Vctrl	5	LNA ON/OFF control pin
Vapc	6	Control the output power of PA
LNA IN	7	LNA input
RF1	8	RF Switch, RF path 1
VC2	9	RF Switch, ANT-RF2 Control Voltage
ANT	10	RF Switch, RF I/O
VC1	11	RF switch , ANT-RF1 Control Voltage
NC	12	No connect
RF2	13	RF Switch, RF path2
Pout	14	PA power out put pin
Pout/Vcc2	15	PA 2 nd stage Vcc and Power output pin
Vcc1	16	PA 1 st stage Vcc
GND	center pad	This pin must be connected to ground

Pin Configuration

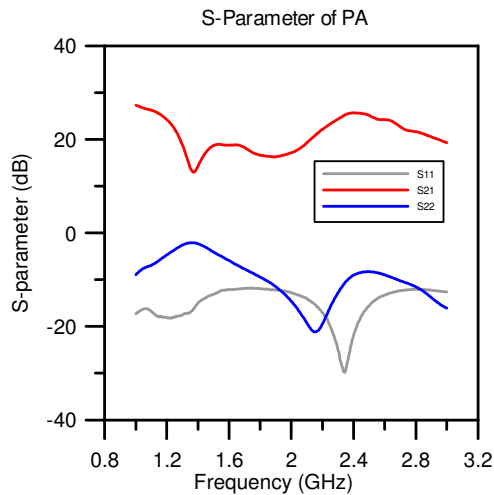


SW Truth Table

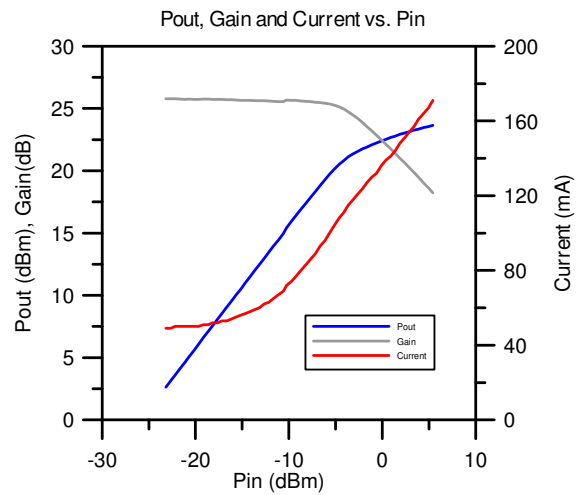
VC1	VC2	ANT-RF2	ANT-RF1
High	Low	Isolation	Insertion Loss
Low	High	Insertion Loss	Isolation

High: 3V to 5V, Low: -0.2V to 0.2V

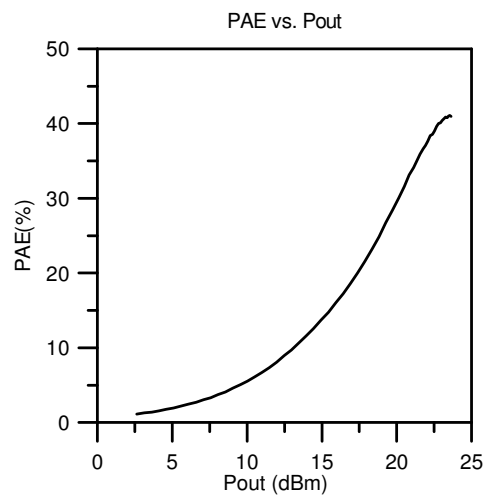
Typical Characteristics



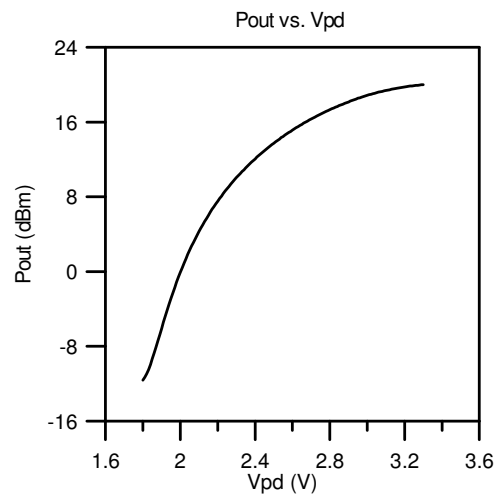
VCC1=VCC2=Vpd=3.3V, Vapc=2.8V and Pin=-30dBm



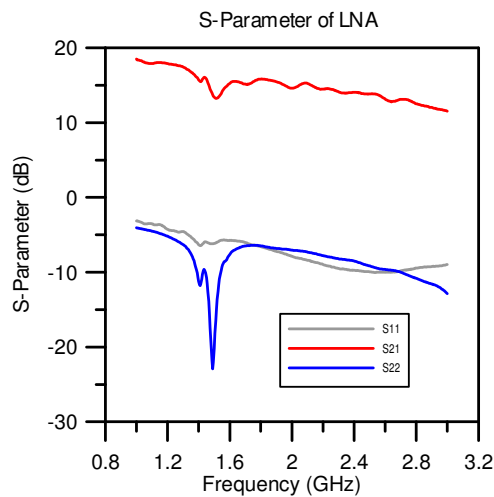
VCC1=VCC2=Vpd=3.3V
Vapc=2.8V and Freq=2.45GHz



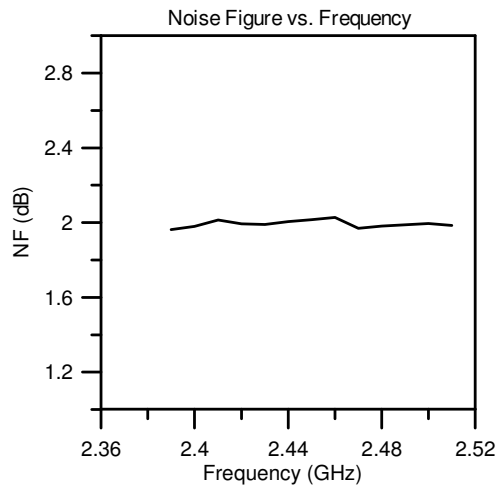
VCC1=VCC2=Vpd=3.3V,
Vapc=2.8V, Freq=2.45GHz



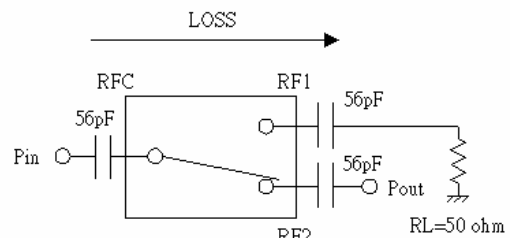
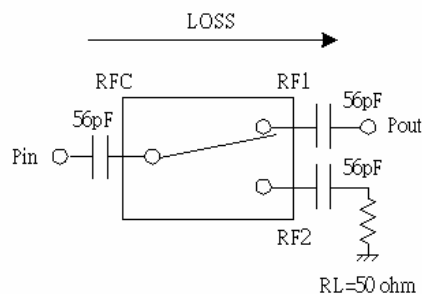
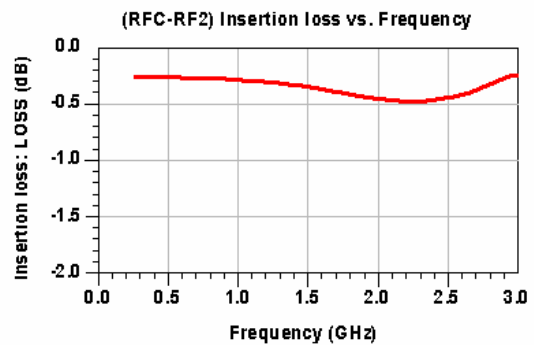
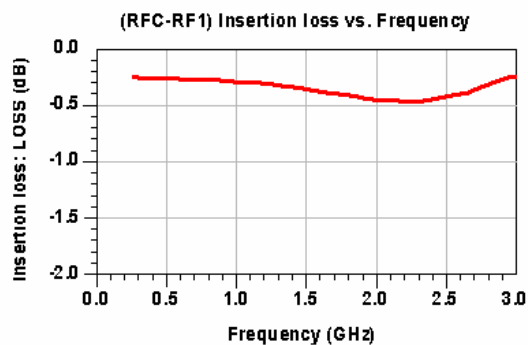
VCC1=VCC2=3.3, Vapc=2.8V
Pin=-5.25dBm, Freq=2.45GHz



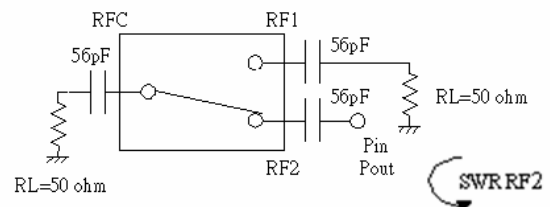
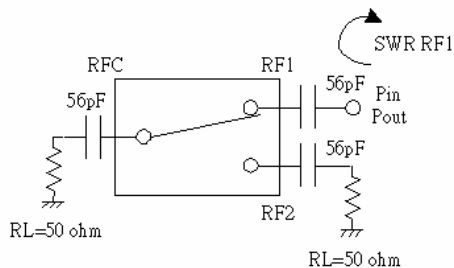
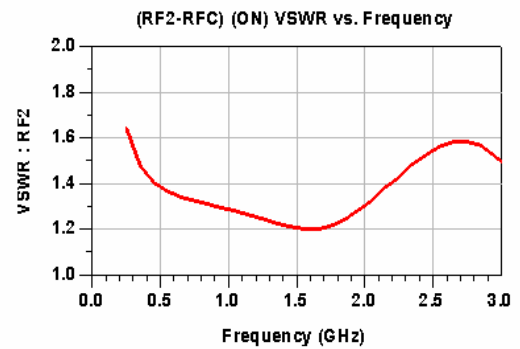
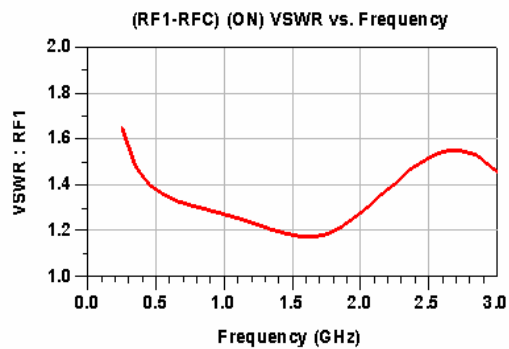
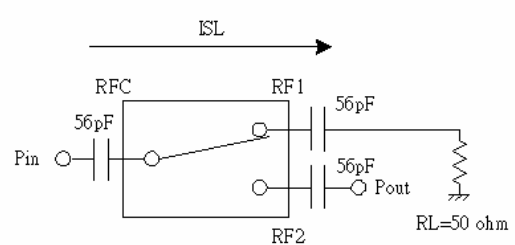
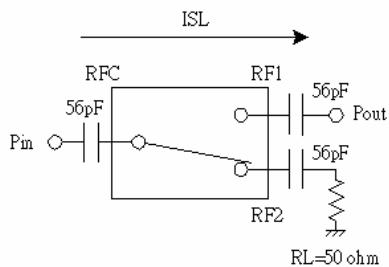
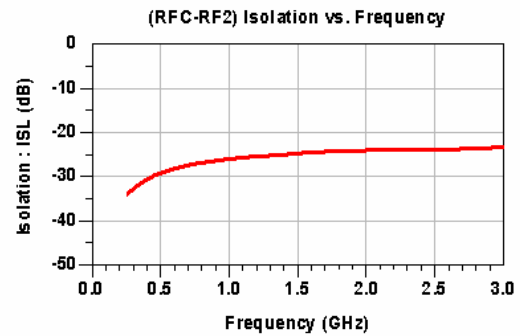
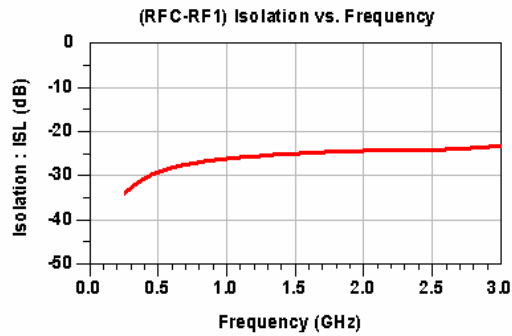
VCC3=Vctrl=3.3V, Pin=-30dBm

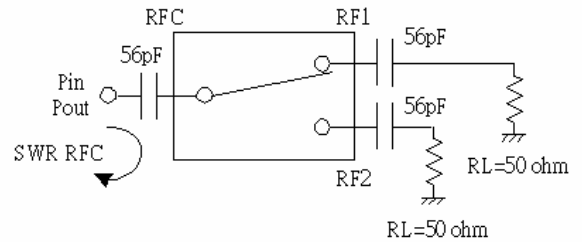
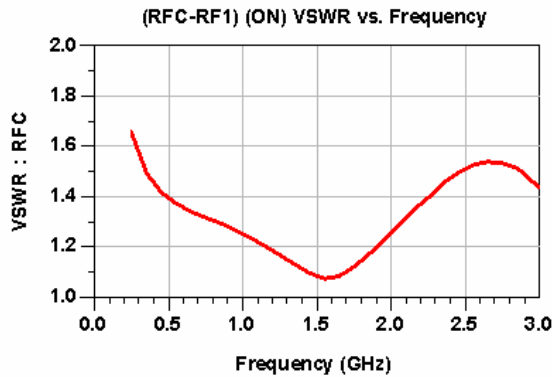


Switch Typical Characteristics ($V_{cc}=0V/3.0V$, $P_{in}=0dBm$) [following RFC is pin10 ANT]

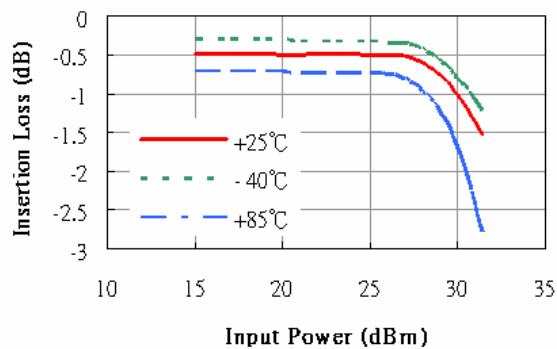


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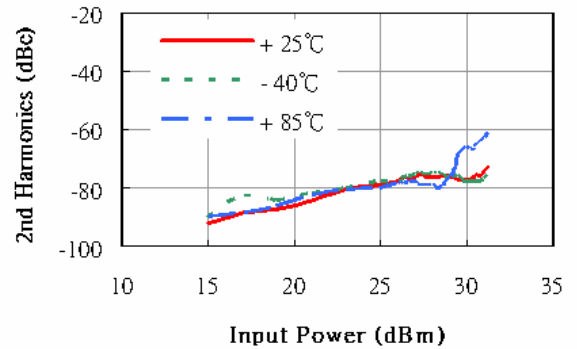




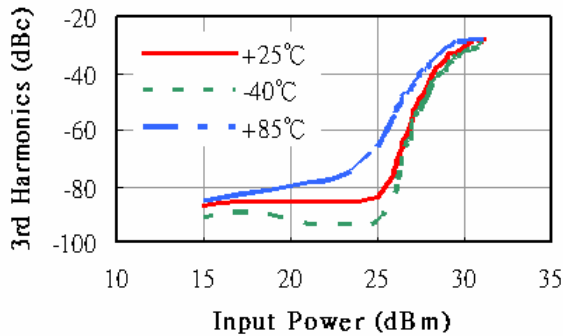
Insertion Loss vs. Input Power
(Vcc=0V/3.0V, 2.5GHz@-40°C,+25°C,+80°C)



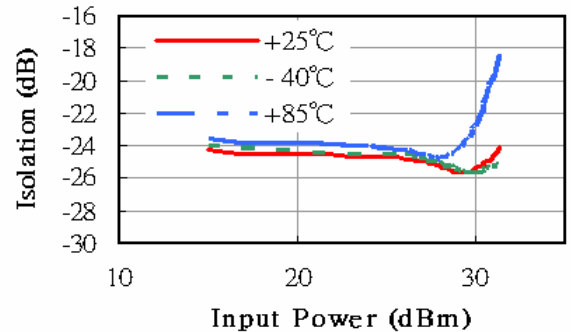
2nd Harmonics vs. Ambient Temperature
(Vcc=0V/3.0V, 2.5GHz@-40°C,+25°C,+80°C)



3rd Harmonics vs. Ambient Temperature
(Vcc=0V/3.0V, 2.5GHz@-40°C,+25°C,+80°C)



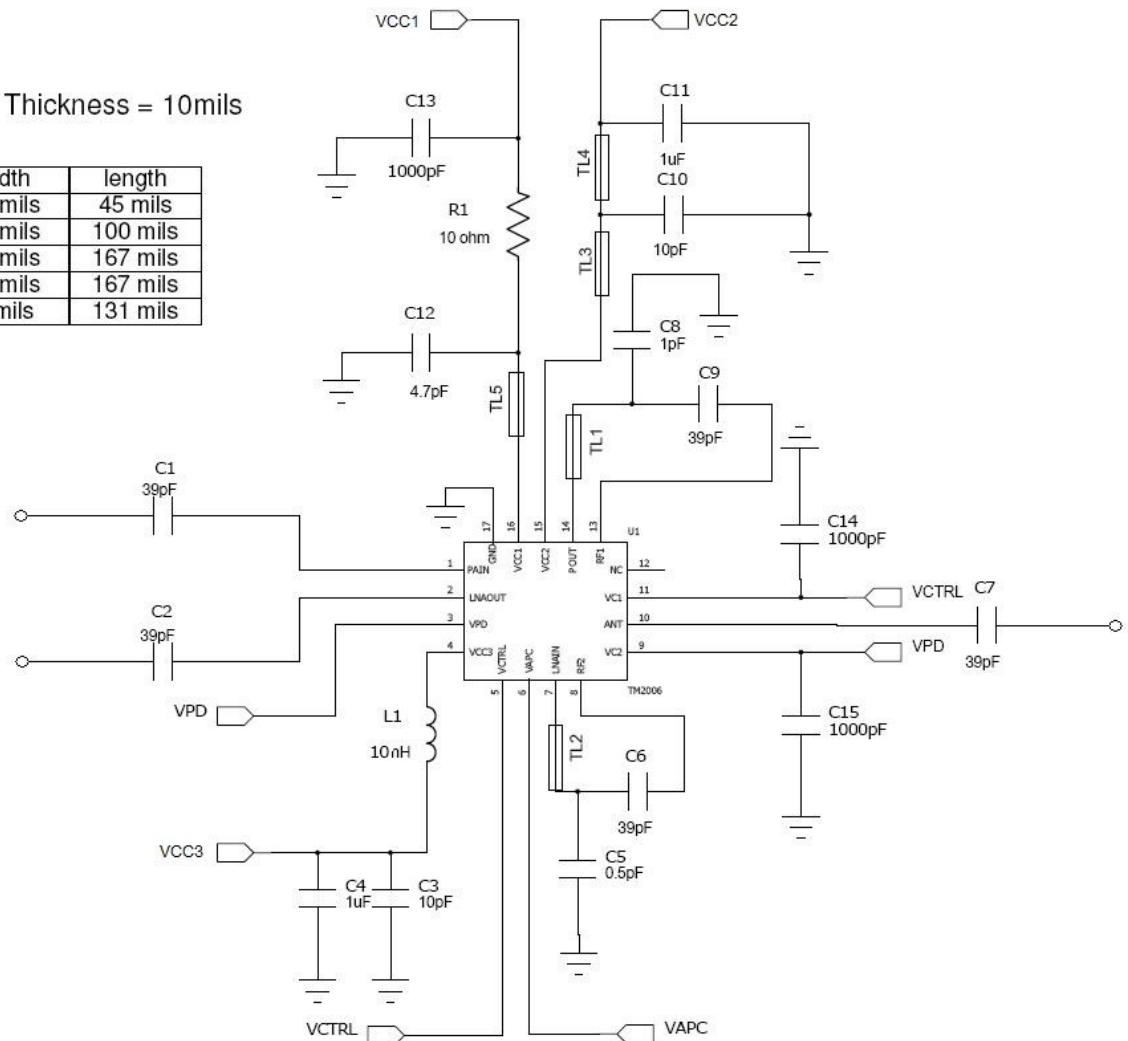
Isolation vs. Input Power
(Vcc=0V/3.0V, 2.5GHz@-40°C,+25°C,+80°C)



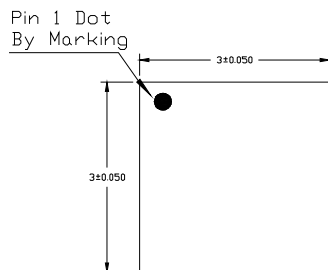
Application circuit

PCB: FR4 and Thickness = 10mils

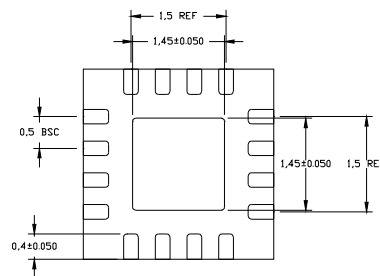
u-strip line	width	length
TL1	18 mils	45 mils
TL2	18 mils	100 mils
TL3	10 mils	167 mils
TL4	10 mils	167 mils
TL5	8 mils	131 mils



Package Dimension

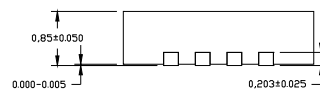


Top View



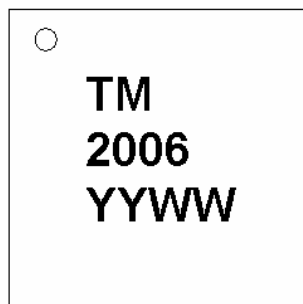
Bottom View

Dimension in mm



Side View

Product Marking



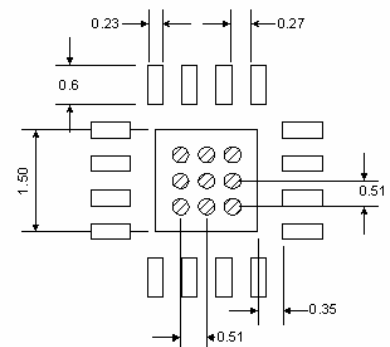
YYWW means date code
YY: year
WW: week

PCB Land Pattern

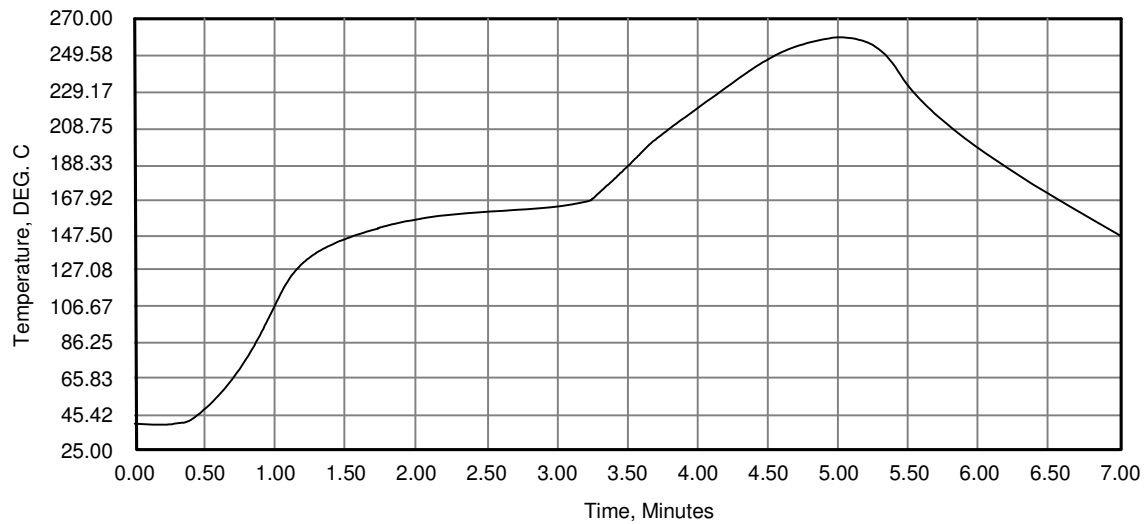
Dimension in mm

□ — PCB PAD

⊗ — Through hole diameter: 0.23mm



SMT Reflow Profile



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