TM2006 2.4-2.5GHz RF Front-End Module

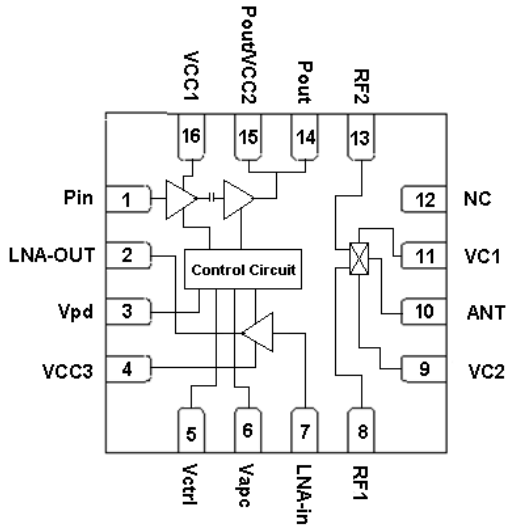
General Description

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 +22.5dBm (maximum) output power with a high Power Added Efficiency (PAE) 32%. 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: 32% at Pout = 22.5dBm
- P–1dB: +21dBm Typical @ +3.3V
- Low-Noise Amplifier (NF typical 1.8dB)
- Low Insertion Loss: 0.5dB @ 2.45GHz
- IIP3: 55dBm @ Input Power up to 20dBm??
- QFN 3x3 mm 16L with thermal ground ultra small plastic package
- MSL 1
- ROHS, PFOS, REACH compliant

Functional Block Diagram



Applications

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

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	^{o}C
Power Supply Current	350	mA

Note $|$**VC1-VC2**$| \leqq$ **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.**

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Specification Summary

Tx-Mode (Power Amplifier+Switch)

Parameter	Min.	Typical	Max.	Unit	Condition
Operating Frequency Range		2.4 to 2.5		GHz	
Maximum Output Power		+22.5		dBm	
PA Supply Current		125		mA	VCC1=VCC2=Vpd=3.3V, Vapc=3.3V, Pout=20dBm
Power Added Efficiency		25		%	Pout=20dBm,
Harmonics: 2Fo, 3Fo		-35,-32		dBc	Pout=20dBm
PA Small Signal Gain	24	25.5		dB	P_{IN}=-30dBm
Quiescent Current		80		mA	VCC1=VCC2=VCC3=3.3V Vpd=3.3V, Vapc=3.3V,
P_{-1}dB		21		dBm	VCC1=VCC2=Vpd=3.3V, Vapc=3.3V

Rx-mode (Low Noise Amplifier+Switch)

Parameter	Min.	Typical	Max.	Unit	Condition
Operating Frequency Range		2.4 to 2.5		GHz	
Current consumption		7		mA	VCC3=Vctrl=3.3V, Pin=-30 dBm
Noise Figure		2.5		dB	
Gain		11		dB	VCC3=Vctrl=3.3V, Pin=-30 dBm

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

Tx-mode:VCC1=VCC2=VCC3=Vpd=Vapc=VC2=3.3V, VC1=Vctrl=0V

Rx-mode:VCC1=VCC2=VCC3=VC1=Vctrl=3.3V, Vpd=Vapc=VC2=0V

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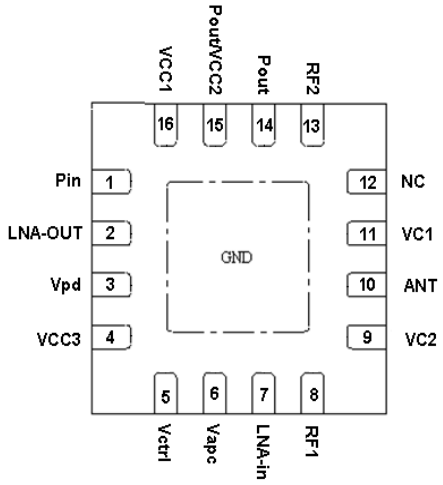
Functional Pin Description

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 2nd stage Vcc and Power output pin
Vcc1	16	PA 1st 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

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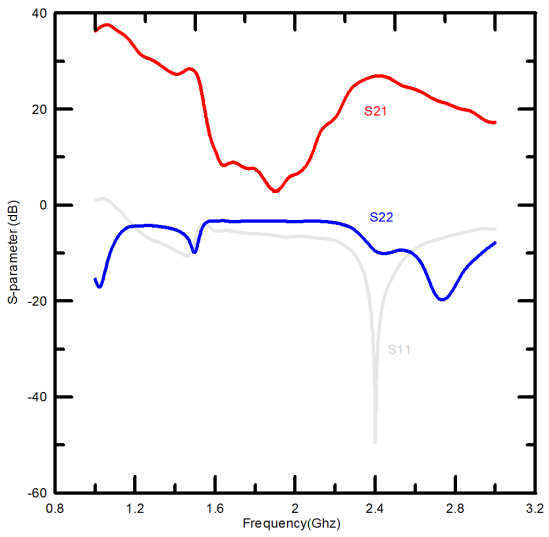
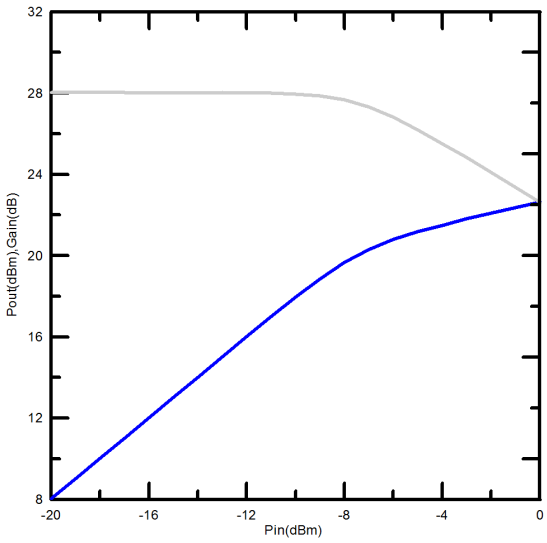
Typical Characteristics

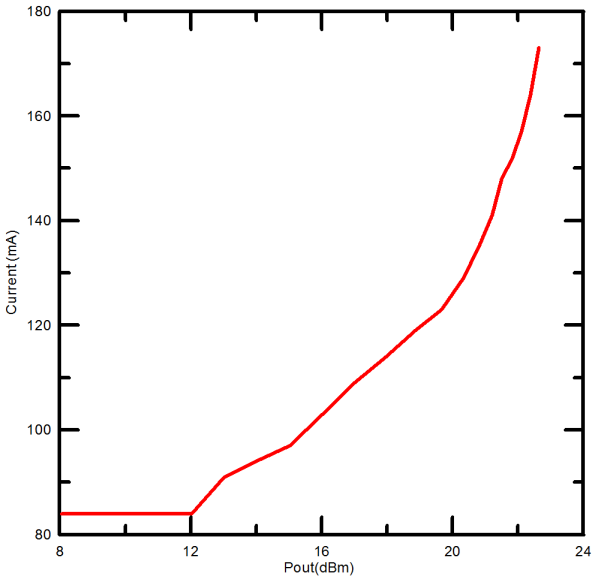
S-Parameter of Tx-mode



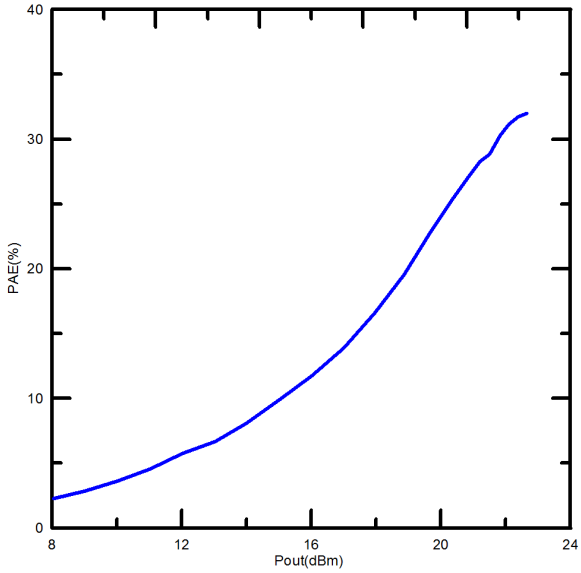
Pout,Gain vs. Pin of Tx-mode



Current vs. Pout of Tx-mode



PAE vs. Pout of Tx-mode



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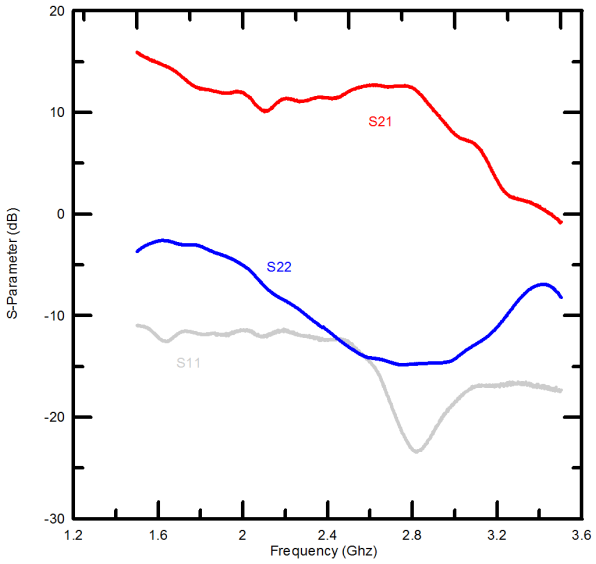
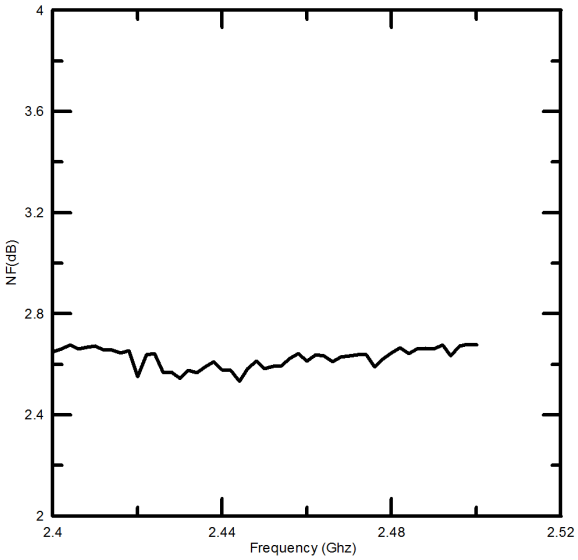
S-parameter of Rx-mode



Noise VS. Frequency



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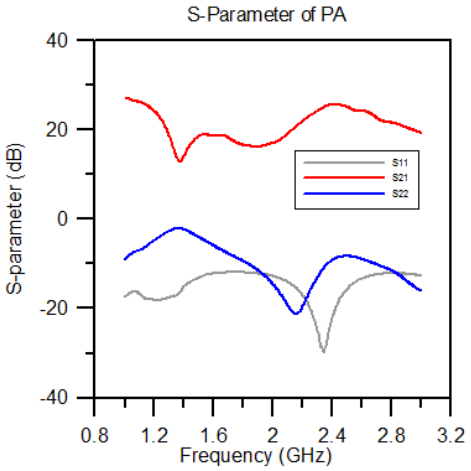
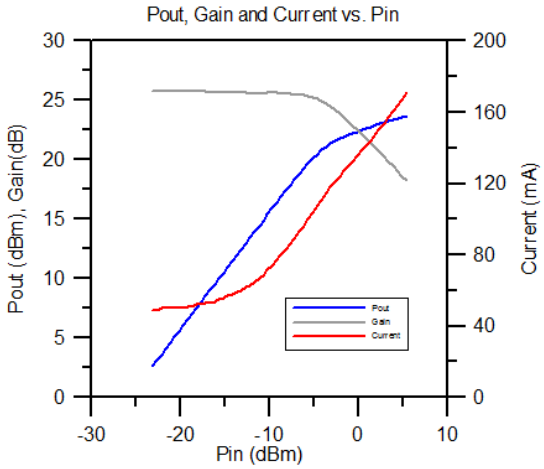
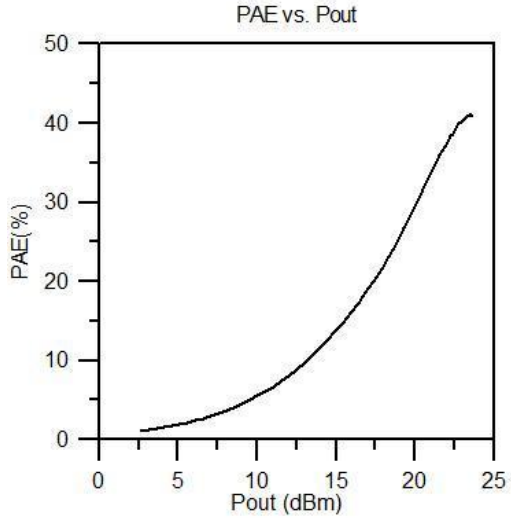
Typical Characteristics



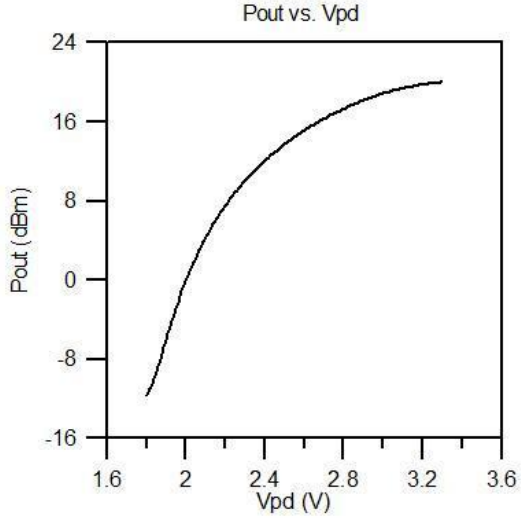
VCC1=VCC2=Vpd=3.3V, Vapc=3.3V and Pin=-30dBm



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



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



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

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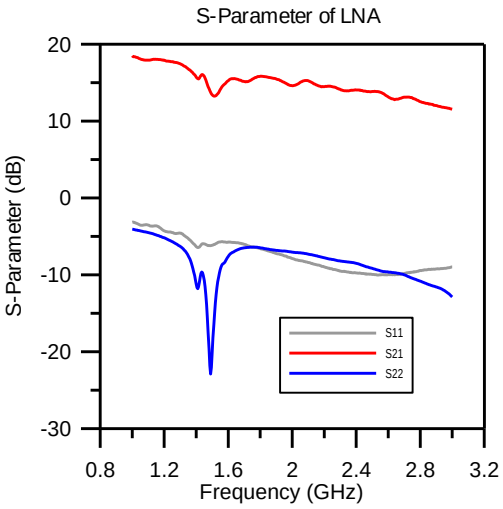
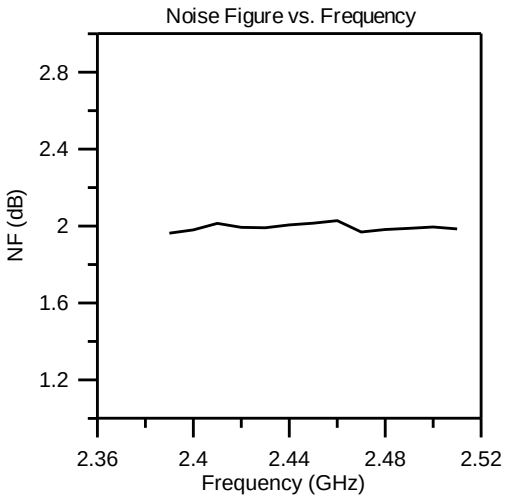
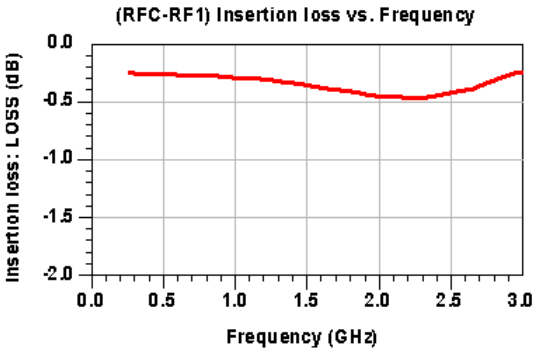
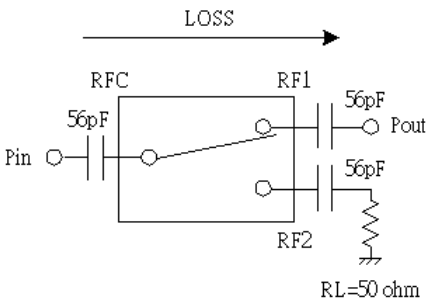


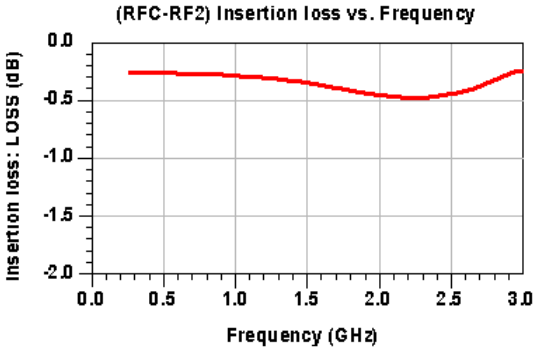
VCC3=Vctrl=3.3V, Pin=-30dBm

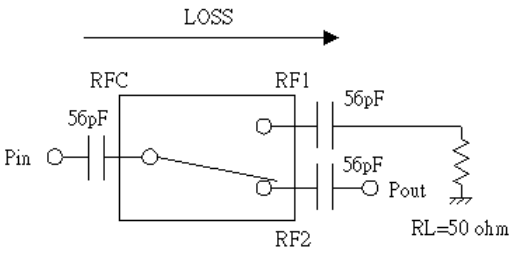


Switch Typical Characteristics (V_{cc}=0V/3.0V , P_{in}=0dBm) [following RFC is pin10 ANT]









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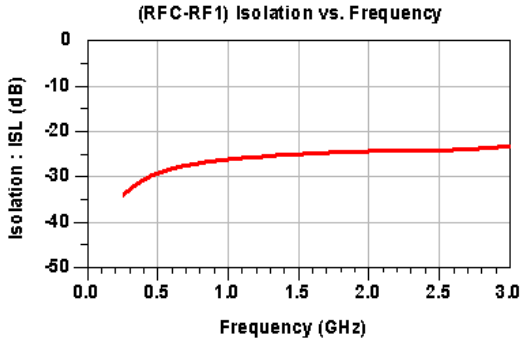

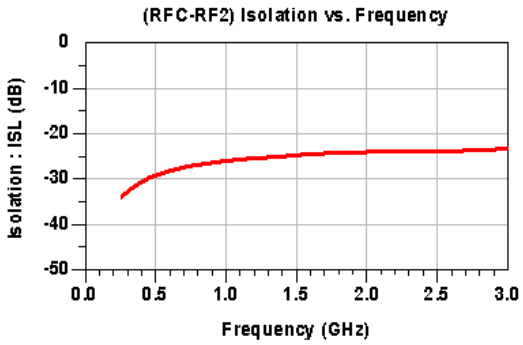

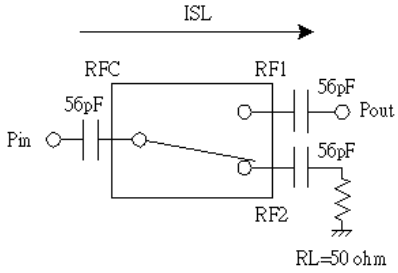

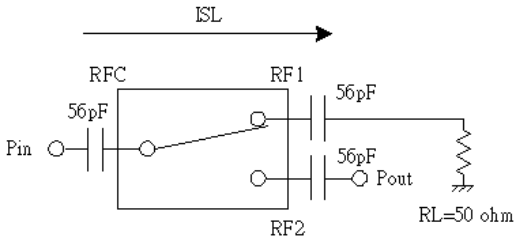

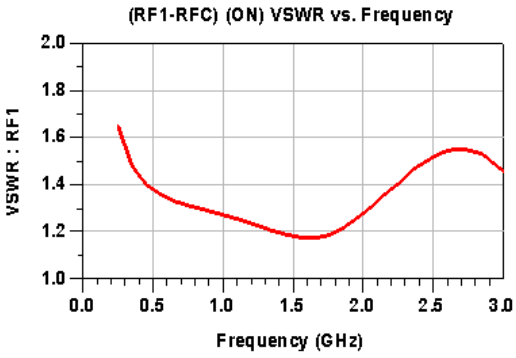

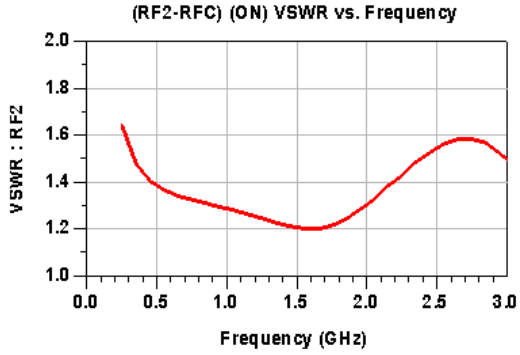

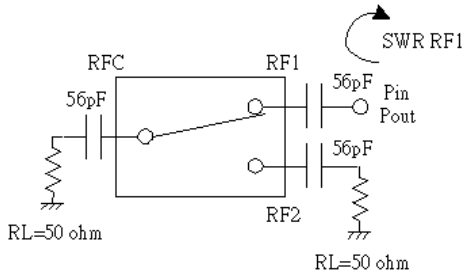

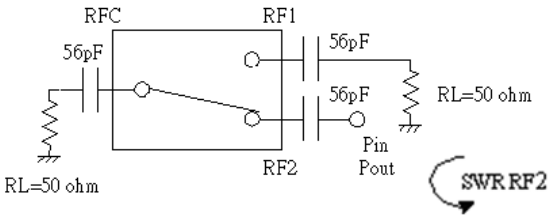

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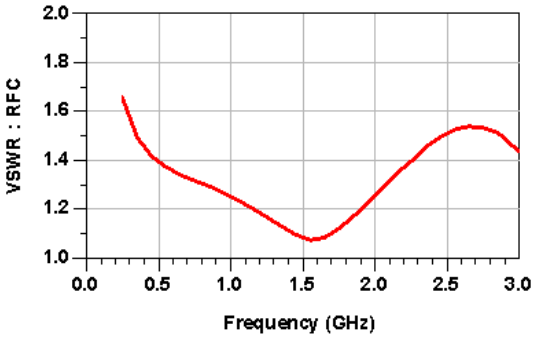
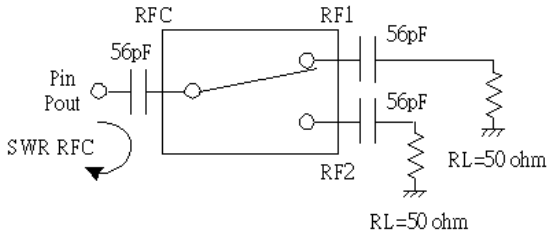
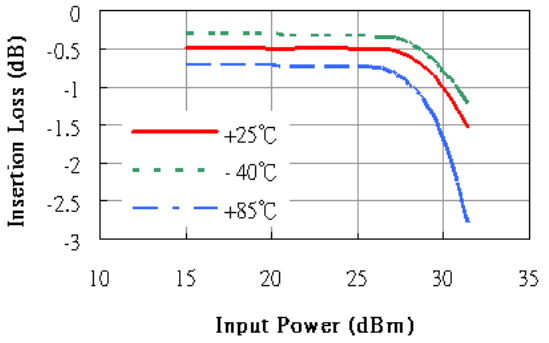
(RFC-RF1) (ON) VSWR vs. Frequency

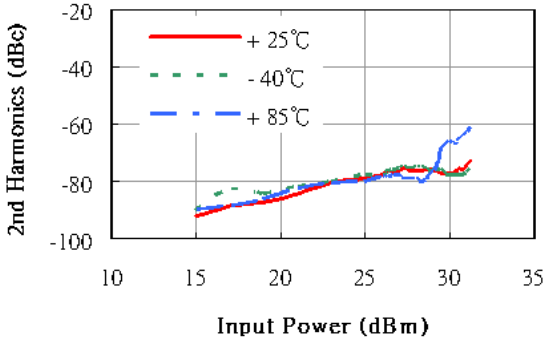




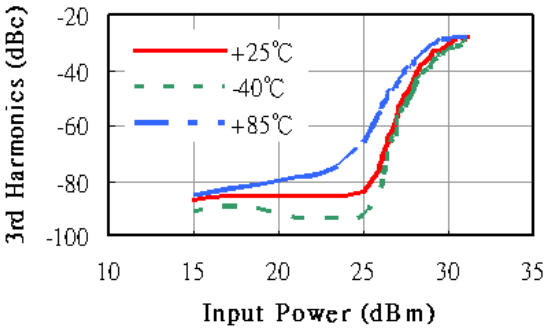
Insertion Loss vs. Input Power
(Vcc=0V/3.0V , 2.5GHz@-40℃,+25℃,+80℃)



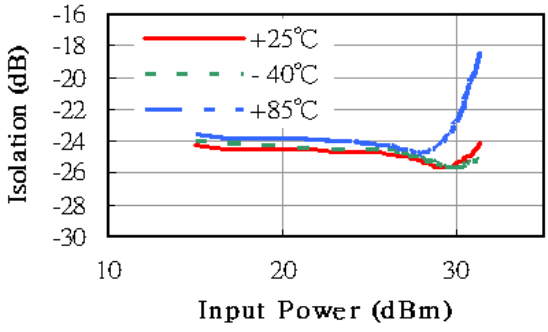
2nd Harmonics vs. Ambient Temperature
(Vcc=0V/3.0V , 2.5GHz@-40℃,+25℃,+80℃)



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



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



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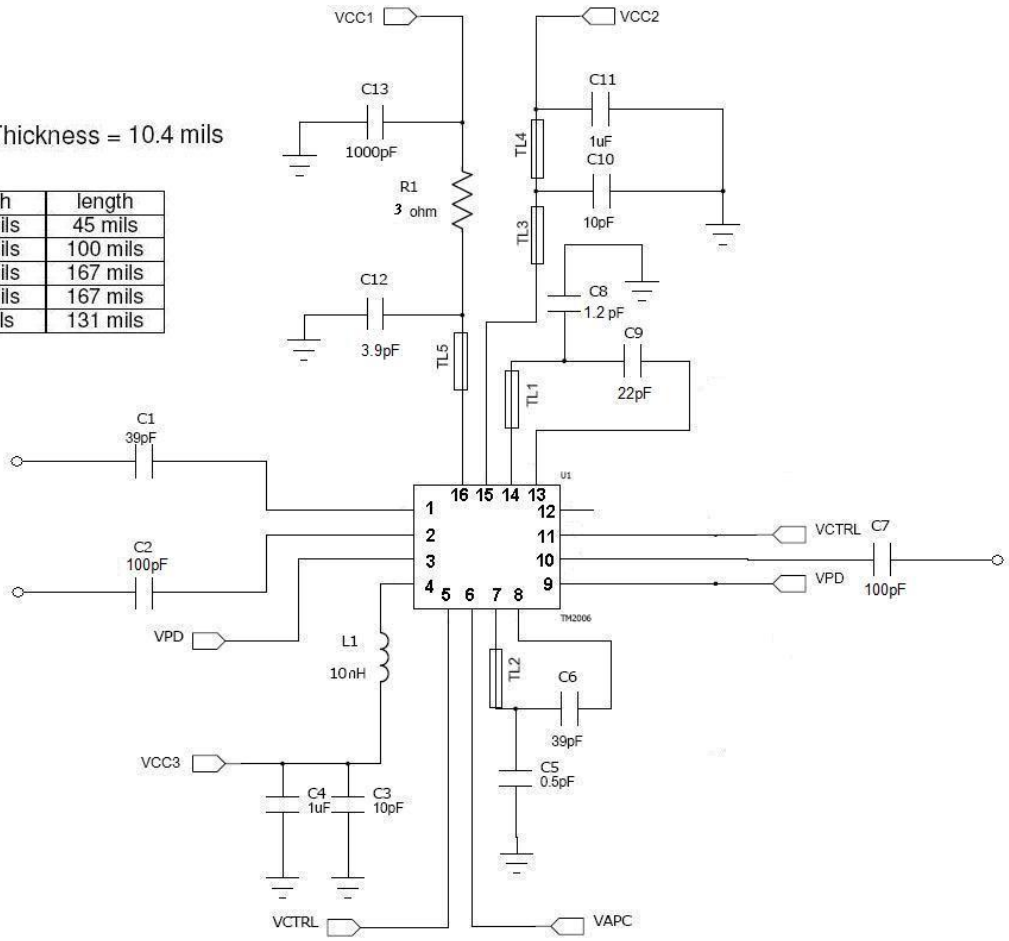
Application circuit

PCB: FR4 and Thickness = 10.4 mils

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



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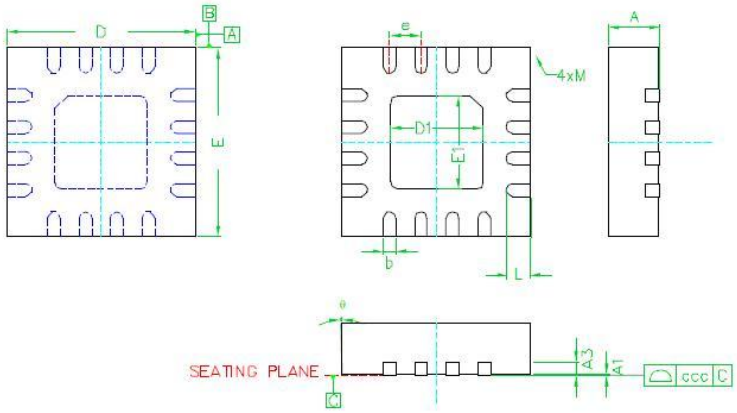
Package Dimension

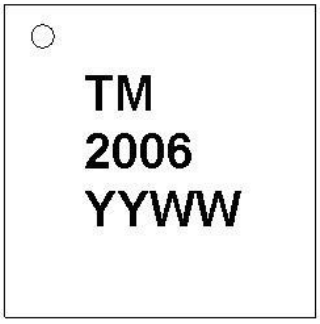


SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.80	0.85	0.90
A1	0	0.010	0.030
A3	---	0.20REF.	---
b	0.18	0.23	0.28
D	2.95	3.00	3.03
D1	---	1.60BSC	---
E	2.95	3.00	3.03
E1	---	1.60BSC	---
e	---	0.50BSC	---
L	0.35	0.40	0.45
θ	-12	---	0
ccc	---	0.08	---
M	---	---	0.05
Burr	0	0.030	0.060

Dimension in mm

For informational purpose only and is subject to change without notice

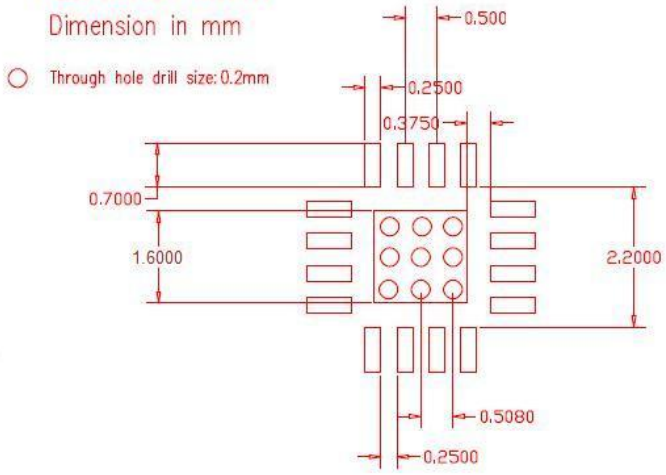
Product Marking



YYWW means date code
YY: year
WW: week

PCB Land Pattern

Dimension in mm



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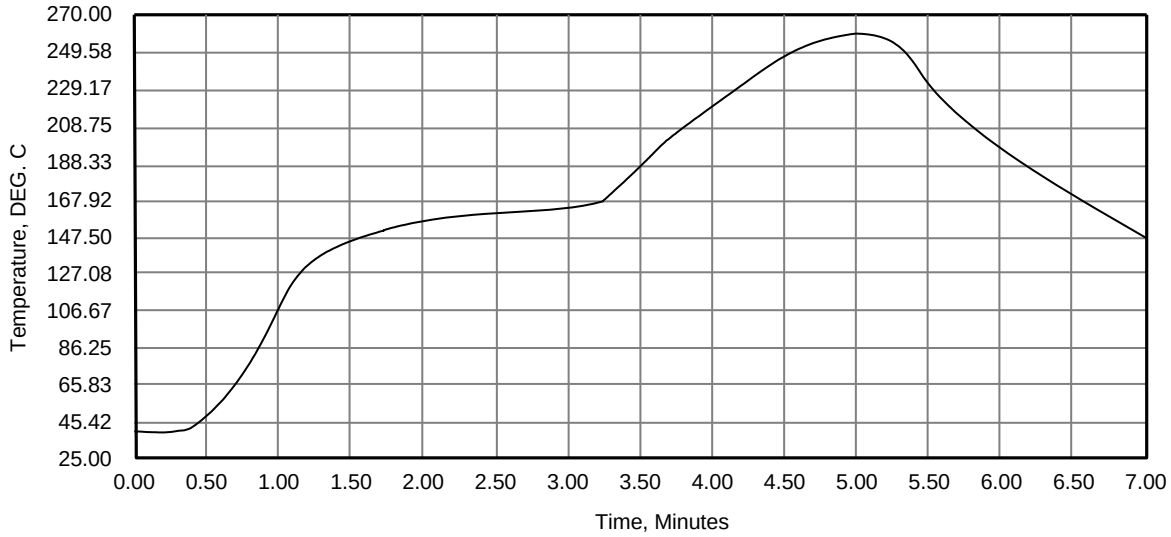
SMT Reflow Profile



Revision History

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