应用于 2.4GHz 蓝牙模块的射频前端芯片

特性

- **极低的工作电流：2.1 mA；**
- **极低的噪声系数（接收）：1.70 dB；**
- **高功率增益（接收）：12.0 dB；**
- **低插损（发射）：1.40 dB；**
- **高输入 1dB 压缩点（发射）：+13.5 dBm；**
- **简单的 PCB 应用，只需一个外置的匹配电感；**
- 输出内部匹配到 50 欧姆；
- 工作电压：1.6V~2.0V；
- 工作频率：2.4~2.5 GHz；
- 纤小的 1.1mmX0.7mmX 0.5mm DFN 6L 封装
- 2kV HBM 静电保护（包括 RFIN 和 RFOUT 引脚）

应用

- 手机、平板电脑、数码相机、笔记本
- 个人移动设备
- ISM 无线解决方案的射频前端模组
- BLUETOOTH 4.2/BLE 等 ISM 无线收发器

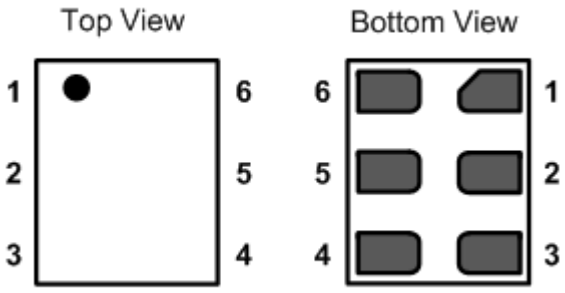
描述

SW5123 是一款集成低噪声放大器和发射开关的适用于 BLUETOOTH 4.2/BLUETOOTH LOW ENERGY 的射频前端芯片。其外围元器件简单，只需要一个外置输入匹配电感，节省占板面积，是一款经济高效的解决方案。

SW5123 具有极低噪声系数，高线性度，高增益，低插损等特性，可支持 1.6V 至 2.0V 的供电电压。所有这些特性使得 SW5123 成为蓝牙等 ISM 频段无线收发器射频前端的最佳选择，极低的噪声系数大大地改善了灵敏度，高线性度使得系统能更好地抵抗带外干扰，并且降低了前级的滤波要求，进而降低了 ISM 频段无线收发机的总成本。同时低插损也大大提高了发射效率。

SW5123 采用纤小的 1.1mm x 0.7 mm x 0.5 mm DFN-6L 封装，额定的工作温度范围为-40℃至 85℃。

引脚分布及标记图



Pin No.	Pin Name
1	VCC
2	GND
3	RFM
4	RFIN
5	EN
6	RFOUT

图 1. SW5123 引脚分布及标识图

2.4GHz front-end chip for BLUETOOTH module

FEATURES

- **Ultra-low power with current 2.1 mA;**
- **Ultra low noise figure(Rx)=1.70 dB;**
- **High power gain(Rx)=12.0 dB;**
- **Low insertion loss(Tx)=1.40 dB;**
- **High input 1dB-compression point (Tx) = +13.5 dBm;**
- **Requires only one input matching inductor;**
- RF output internally matched to 50 ohm;
- Supply voltage: 1.6V to 2.0V;
- Operating frequencies: 2.4~2.5GHz;
- Slim DFN-6L package:1.1mmX0.7mmX 0.5mm
- 2kV HBM ESD protection (including RFIN and RFOUT pin)

APPLICATIONS

- Smart phones, feature phones,
- Tablet PCs, Notebook
- Digital Still Cameras, Digital Video Cameras;
- RF Front End modules;
- Wireless solutions for ISM band
- BLUETOOTH wireless devices,;
- BLE wearable devices

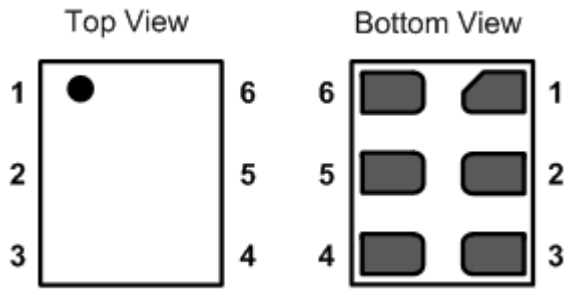
INTRODUCTION

The SW5123 is a single-chip RF front-end module with Low Noise Amplifier and transmitter switch designed for 2.4GHz ISM band (BLUETOOTH 4.2, BLE,etc.). The SW5123 requires only one external input matching inductor, reduces assembly complexity and the PCB area, enabling a cost-effective solution.

The SW5123 achieves ultra low noise figure, high linearity, high gain, low insertion loss over a wide range of supply voltages from 1.6V to 2.0V. All these features make SW5123 an excellent choice for wireless transceiver solutions with ISM band, as it improves sensitivity with low noise figure and high gain, provide better immunity against out-of-band jammer signals with high linearity, reduces filtering requirement of preceding stage and hence reduces the overall cost of the transceiver. Meanwhile, SW5123 achieves ultra-low insertion loss when transmitting, keeping the best efficiency.

The SW5123 is available in a small lead-free, RoHS-Compliant, 1.1mm x 0.7mm x 0.5mm 6-pin DFN package。

PIN CONFIGURATION AND MARKING



Pin No.	Pin Name
1	VCC
2	GND
3	RFM
4	RFIN
5	EN
6	RFOUT

Figure 1. SW5123 Pin Configuration and Marking

TYPICAL APPLICATION

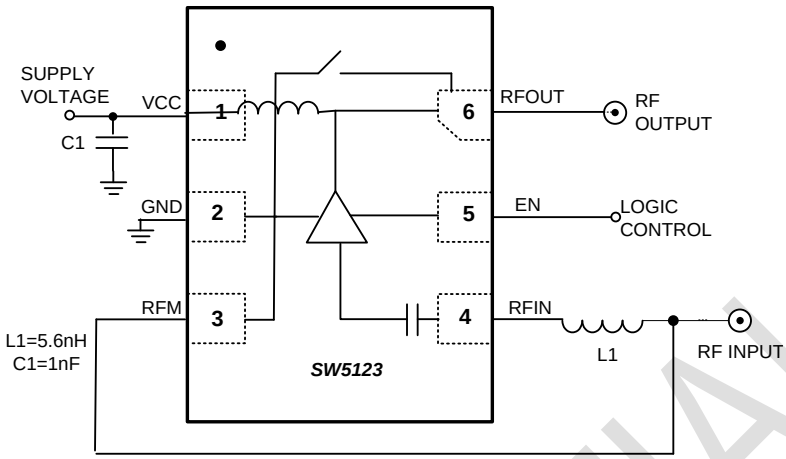


Figure 2. Application Schematic SW5123

For a list of components see *Table 5* and *Table 6*.

ORDER INFORMATION

Table 1. Order Information

Part Number	Temperature	Package	RoHS	Mark	SPQ
SW5123DNR	-40℃ ~ 85℃	1.1mm x 0.7 mm x 0.5mm DFN-6L	Yes	A	Tape and Reel 3000pcs/Reel

SW5123 □ □ □
R： Tape&Reel
DN: DFN

ABSOLUTE MAXIMUM RATINGS [1)]

Table 2 . Limiting Values

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Supply Voltage at pin VCC	V_{CC}	-0.3	-	3.0	V
Voltage at pin EN [2)]	V_{EN}	-0.3	-	3.0	V
Current into pin VCC	I_{CC}	-	-	10	mA
RF input power [3)]	P_{IN}	-	-	30	dBm
Package thermal resistance	θ_{JA}	-	148.2		℃/W
Junction temperature	T_J	-	-	150	℃
Storage temperature range	T_{STG}	-65	-	150	℃
Ambient temperature range	T_{amb}	-40	-	85	℃
Solder temperature(10s)		-	260	-	℃
ESD range					
HBM [4)]		±2000			V
Latch-up					
Standard：JEDEC STANDARD NO.78D NOVEMBER 2011		+IT: +400 -IT: -400			mA mA

***Note1**: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.*

***Note2:** Warning: due to internal ESD diode protection, the applied DC voltage should not exceed 5.0V in order to avoid excess current.*

***Note3:** The RF input and RF output are AC coupled through internal DC blocking capacitor.*

***Note4**: HBM standard: MIL-STD-883H Method 3015.8.*

ELECTRICAL CHARACTERISTICS

Table 3 . Electrical Characteristics

（SW5123 EVB[1)]; V_{CC}=1.6 to 2.0V, T_A=-40~+85℃, f=2400MHz to 2500MHz; Typical values are at V_{CC}=1.8V and T_A=+25℃, f=2400MHz, unless otherwise noted.）

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
DC ELECTRICAL CHARACTERISTICS						
V_{CC}	Supply Voltage		1.6	1.8	2.0	V
I_{TX}	TX Current	EN=Low		0	0.1	uA
I_{RX}	RX Current	EN=High		2.1		mA
V_{EN}	Digital Input-Logic High		0.80			V
V_{EN}	Digital Input-Logic Low				0.45	V
AC ELECTRICAL CHARACTERISTICS						
Gp_{RX}	RX Power Gain			12.0		dB
$RL_{in,RX}$	RX Input Return Loss			6.5		dB
ISL_{RX}	RX Reverse Isolation			21.0		dB
$RL_{out,RX}$	RX Output Return Loss			16.5		dB
NF_{RX}	RX Noise Figure[2)]	Zs=50 ohm; No jammer		1.70		dB
Kf	Stability factor	f=20MHz...10GHz	1.0			
$NF_{j,RX}$	RX Noise Figure with jammer	Pjam=-20dBm; fjam=850MHz		TBD		dB
		Pjam=-20dBm; fjam= 1850MHz		TBD		dB
		Pjam=-30dBm; fjam=850MHz		TBD		dB
		Pjam=-30dBm; fjam= 1850MHz		TBD		dB
$IP_{1dB,RX}$	RX In-band input 1dB-compression point	f=2400MHz;		-6		dBm
$IIP3_{RX}$	In-band input 3rd-order intercept point	f1= 2400MHz; f2=2420MHz; Pin=-30dBm		+11.0		dBm
IL_{TX}	TX Insertion Loss	f= 2400MHz Pin=-30dBm		1.40		dB
ISO_{TX}	TX Isolation	f= 2400MHz Pin=-30dBm		25		dB
$IP_{1dB,TX}$	TX In-band input 1dB-compression point	f=2400MHz;		+13.5		dBm
$HARM_{TX}$	TX harmonics	f= 2400MHz Pin=+25dBm		TBD		dBm

Table 4 . Characteristics……*continued*

(SW5123 EVB[1)];VCC=1.6 to 2.0V, TA=-40~+85℃, f=2400MHz to 2500MHz;

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
AC ELECTRICAL CHARACTERISTICS						
$T_{power\ on}$	Power-on time[3)]	Supply from low to high		10		μs
t_{on}	Turn-on time[3)]	Tx to Rx		5		μs
t_{off}	Turn-off time[3)]	Rx to Tx		5		μs

Note1: *input matched to 50 ohm using a high quality-factor 5.6nH inductor.*

Note2*: 0.1dB PCB losses are subtracted.*

Note3: *Within 20% of the final magnitude*

TIMING DIAGRAM

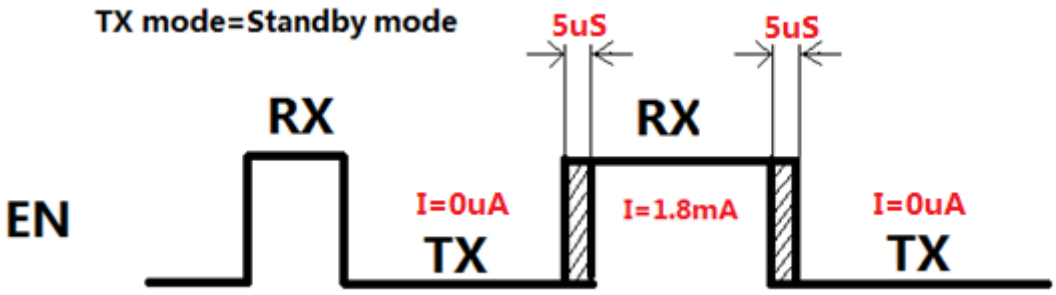


Figure 7. Timing diagram

APPLICATION INFORMATIONS

1.1 EN control

The SW5123 includes an internal switch to turn off the entire chip: apply logic high to EN to turn on, and a logic low to shut down.

1.2 List of components

1. The SW5123 requires only one external inductor for input matching. If the device/phone manufacturers implement very good power supply filtering on their boards, the bypass capacitor mentioned in this application circuit may be optional. With the capacitor we can get better performance like a little higher gain etc. The value is optimized for the best gain, noise figure, return loss performance. Typical value of inductor is 5.6nH, capacitor is 1nF. For schematics see *Figure2.*
2. The output of SW5123 is internally matched to 50 ohm and a DC blocking capacitor is integrated on-chip, thus no external component is required at the output.
3. The SW5123 should be placed close to the ISM antenna with the input-matching inductor. Use 50- ohm microstrip lines to connect RF INPUT and RF OUTPUT. Bypass capacitor should be located close to the device. For long Vcc lines, it may be necessary to add more decoupling capacitors. Proper grounding of the GND pins is very important.

Table 5 lists the recommended inductor types and values; Table 6 lists the recommended capacitor types and values.

Table 5: list of inductor

Part Number	Inductance	Q(min)	Q Test Frequency	Supplier	Size
Units	**nH**		**MHz**		
LQW15A	5.6	25	250	Murata	0402
LQP03T	5.6	11	500	Murata	0201
SDWL1005C	5.6	24	250	Sunlord	0402
HQ1005C	5.6	22	250	Sunlord	0402
SDCL0603Q	5.6	13	500	Sunlord	0201

Table 6: list of capacitor

Part Number	Capacitance	Rated Voltage	Supplier	Size
Units	**pF**	**V**		
GRM155	1000	50	Murata	0402
GRM033	1000	50	Murata	0201

PACKAGE INFORMATION

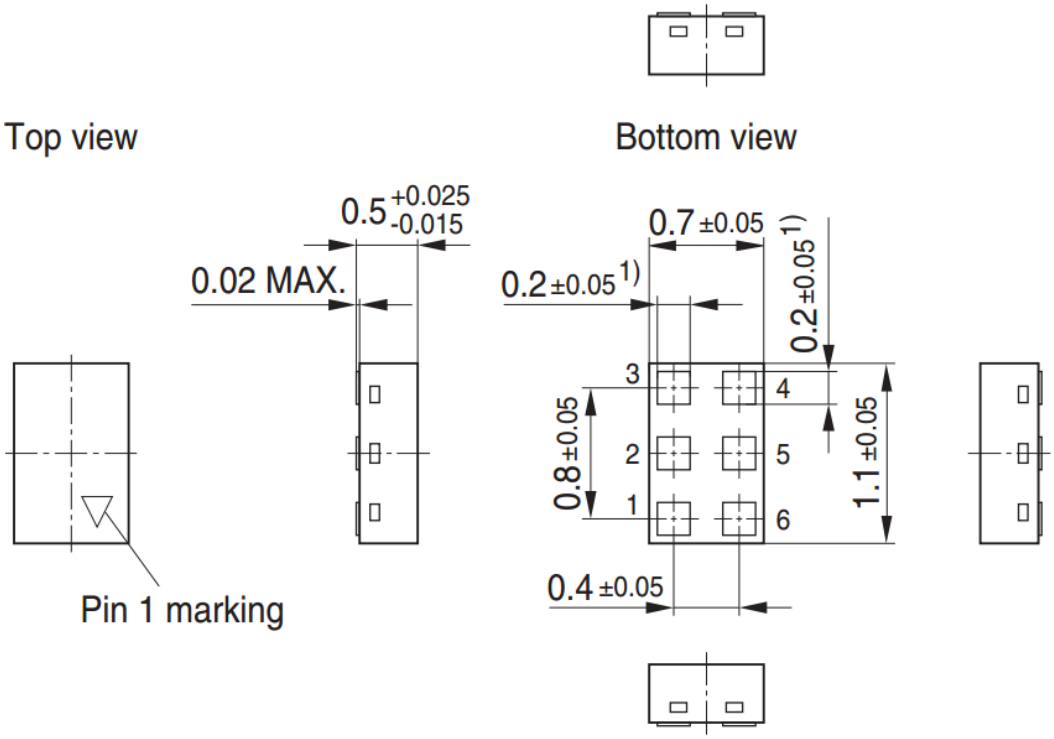


Figure 8. Package Outline

RECOMMENDED SOLDER TEMPERATURE

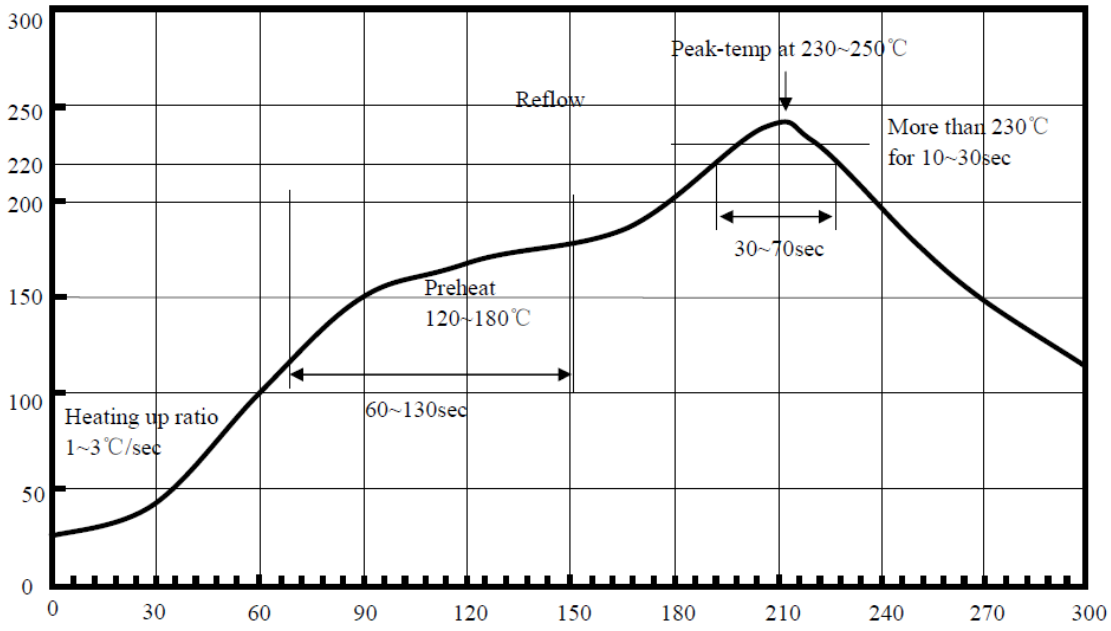


Figure 8. Recommended Solder Temperature

ROHS COMPLIANT

The product does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls(PBB) or polybrominated diphenyl ethers(PBDE), and are therefore considered RoHS compliant.