RPF88130B

MOS FET Power Amplifier Module with Antenna Switch for Dual-band(Tx) and Dual band(Rx) Mobile Phone

Rev.4.1
13 Dec. 2007

Application

- Dual band Tx Amplifier with Dual band Antenna Switch for
  Tx : GSM900 (880 to 915 MHz)
  DCS1800 (1710 to 1785 MHz)
  Rx : GSM900(925 to 960 MHz) , DCS1800 (1805 to 1880 MHz)

Features

- Small package : 5.5 × 5.5mm(typ) 1.2mm t max.
- Built-in closed loop APC circuit with power detector performs stable TRP(Total Radiated Power) under load mismatch conditions.
- Built-in Antenna Switch
- High gain 3stage amplifier: +3dBm input typ.
- Built-in ESD protection: outstanding 8KV ESD at Antenna.
- Lead free soldering process available
- GPRS Class 12 compatible
- High efficiency:
  41% Typ. for GSM900
  35% Typ. for DCS1800

Absolute Maximum Ratings (Ta = +25°C)

Item	Symbol	Rating	Unit	Remark
Supply voltage	Vbat	6.0	V	at no-operation
		5.0	V	at operation(50ohm load)
Supply current	Ibat	3.5	A	GSM900
		2	A	DCS1800
Control circuit supply voltage	Vbat_PC	5	V	
Txon voltage	Vtxb	3	V	
Band select voltage	Vband	3	V	
Tx ANT SW voltage	Vmode	3	V	
Power control voltage	Vramp	2.8	V	
Input power	Pin-LB/HB	+10	dBm	
Operating case temperature	Ta (op)	–30 to +85	°C	
Storage temperature	Tstg	–30 to +100	°C	
Output power	Pout	3.5 (35.5)	W (dBm)	GSM900
		2 (33.0)	W (dBm)	DCS1800

The maximum ratings shall be valid over the GSM900 (880-915MHz), DCS1800 (1710 to 1785MHz).

Pin Description

Pin name	Description
Pin-LB/HB	RF input for GSM900(LB),DCS1800(HB) (*Include DC cut capacitor)
Vapc/Verror	Vapc:HPA bias input Verror:APC error Amplifire output. (Should be connected each other on phone board)
Vbat,Vbat_PC	Vbat:HPA Power Supply , Vbat_PC:Power Supply for bias control IC.
RX-LB/HB	RX output. GSM900(LB) ,DCS1800 (HB) (*Not-include DC cut capacitor)
ANT	Antenna terminal
Vtxb	TX enable for HPA portion,
Vband	Band select voltage (HB/LB)
Vmode	Tx ANT SW control voltage
Vramp	Power control voltage (0.1 to 2.4V)

Electrical Characteristics for DC (Ta = +25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Drain cutoff current	Ileak	—	—	20	uA	Vbat,Vbat_PC = 4.6V, Control voltage off
Vtxb voltage range(Hi)	Vtxb(Hi)	1.4	—	2.8		Tx mode
Vtxb voltage range(Lo)	Vtxb(Lo)	0	—	0.2		Rx mode
Vtxb current	Itxb	—	—	50	uA	Vtxb =2.8V
Band select range(Hi)	Vband(Hi)	1.4	—	2.8		Hi:DCS1800
Band select range(Lo)	Vband(Lo)	0	—	0.2		Lo:GSM900
Band select current	Iband	—	—	50	uA	Vband=2.8V
Vmode voltage range(Hi)	Vmode(Hi)	1.4	—	2.8		ANT SW on
Vmode voltage range(Lo)	Vmode(Lo)	0	—	0.2		ANT SW off
Vmode current	Imode	—	—	50	uA	Vmode =2.8V

Electrical Characteristics for Rx mode (Ta = +25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Condition
ANT->RX-LB Insertion Loss	—	—	1.0	1.3	dB	
VSWR ANT & RX-LB	—	—	—	2.0		
ANT->RX-HB Insertion Loss	—	—	1.2	1.5	dB	
VSWR ANT & RX-HB	—	—	—	2.5		

Electrical Characteristics for GSM900 Tx mode (Ta = +25°C)

Test conditions unless otherwise noted:

f=880 - 915MHz , Vbat = Vbat_PC = 3.5V , Pin = 3dBm , Vramp = 2.4V ,

Vtxb = 2.7V , Vband = 0V , Rg = Rl = 50 ohm , Ta = +25°C , Vmode=2.7V

Pulse operation with pulse width 1154us and duty cycle 2:8 shall be used.

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Frequency	f	880	—	915	MHz	
Input power	Pin	0	+3	+6	dBm	
Control voltage range	Vramp	0.2	—	2.4	V	
Supply voltage	Vbat	3.1	3.5	4.6	V	
Total efficiency	Eff	-	41	—	%	Peak Efficiency
2nd harmonic distortion	2nd H.D.	—	-40	–36	dBm	Pout = 33.1dBm,
3rd harmonic distortion	3rd H.D.	—	-40	–36	dBm	Vramp = controlled
4th harmonic distortion	4th H.D.	—	-40	–36	dBm	
Input VSWR	VSWR (in)	—	—	3	—	
Output power (1)	Pout (1)	33.6	34.1	—	dBm	Vramp < Vramp,max,
Output power (2)	Pout (2)	32.1	32.5	—	dBm	Vbat = 3.1V, Vramp < Vramp,max, Ta = +85°C
Isolation (1)	—	—	—	-52	dBm	Vramp = 0.13V, Vtxb = 0V
Isolation (2)	—	—	-40	-10	dBm	Vramp = 0.13V, Vtxb = 2.7V
Stability	—	No parasitic oscillation			—	Pout ≤ 33dBm ,Vramp ≤ 2.4V Rg = 50ohm, Output VSWR = 15 : 1 All phases
Turn On/Off Time	tr,tf	—	—	5	us	Vramp = 0.2 to 2.4V(10us), Pout = 5 to 33.0dBm,
Power Slope	Slope	2	—	220	dB/V	Pout = 5 to 33.0dBm
Tx Leakage for RX-LB port		—	8	—	dBm	Pout = 33.0dBm

Power Control Stability

Pout,Vramp adjust to (at Pin=+3dBm, Ta=+25°C, f=897.4MHz,Vbat=3.5V)	5.0 to 11.0	13.0 to 31.0	33.0	dBm
Pout Variation (at f=880-915MHz,Pin=0 to+6dBm, Ta=25°C , Vbat=3.1 -4.6 V)	±3.5	±1.8	±1.5	dB
Pout,Vramp adjust to (at Pin=+3dBm, Ta=+25°C, f=897.4MHz,Vbat=3.5V)	5.0 to 11.0	13.0 to 31.0	33.0	dBm
Pout Variation (at f=880-915MHz,Pin=0 to+6Bm, Ta=-15 to +85°C , Vbat=3.1-4.6V)	±5.5	±3.5	±2.0	dB

Electrical Characteristics for DCS1800 Tx mode (Ta = +25°C)

Test conditions unless otherwise noted:

f=1710 - 1785MHz , Vbat = Vbat_PC = 3.5V , Pin = 3dBm , Vramp = 2.4V ,

Vtxb = 2.7V , Vband = 2.7V , Rg = Rl = 50 ohm , Ta = +25°C, Vmode=2.7V

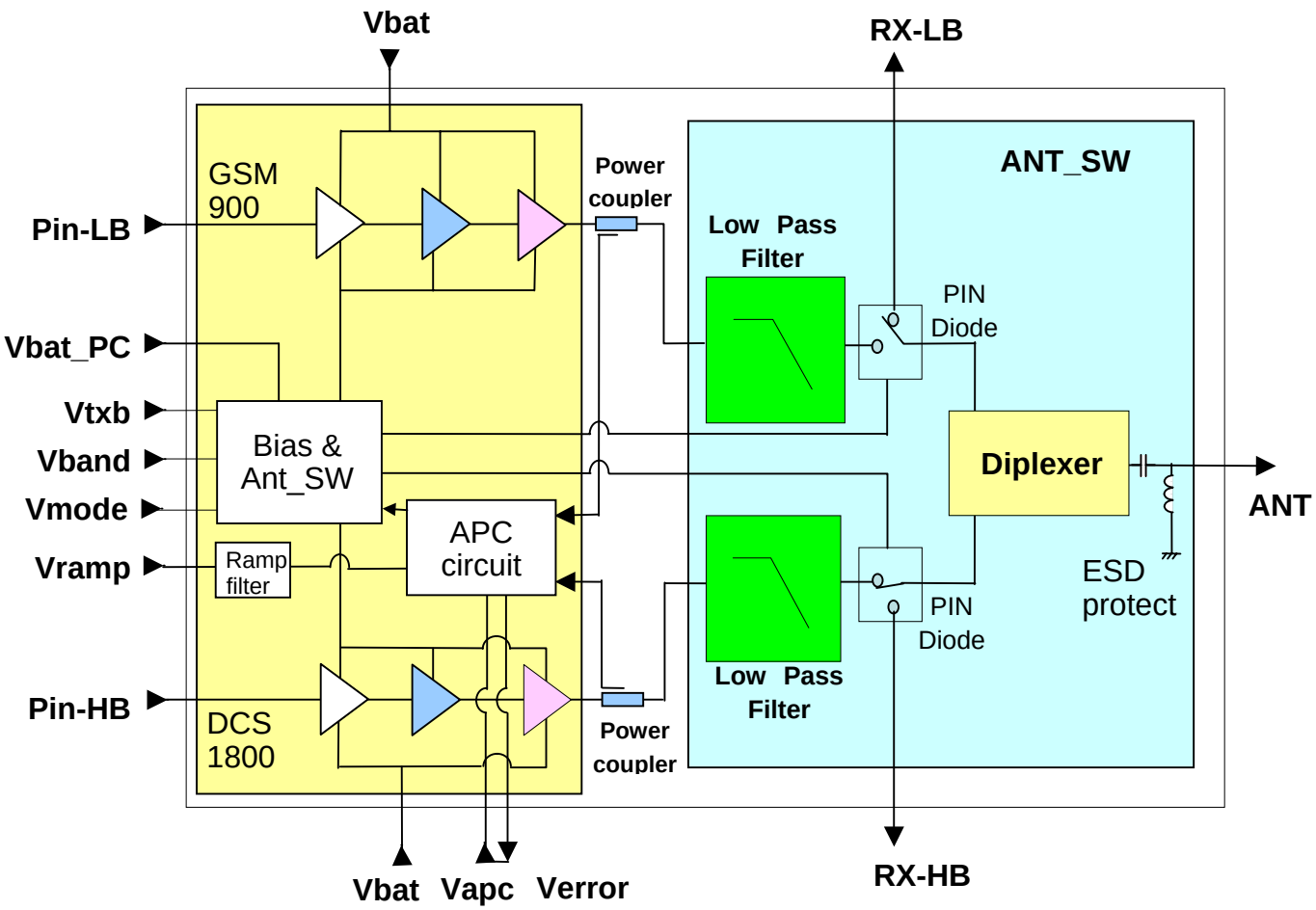
Pulse operation with pulse width 1154us and duty cycle 2:8 shall be used.

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Frequency range	f	1710	—	1785	MHz	
Input power	Pin	0	+3	+6	dBm	
Control voltage range	Vramp	0.2	—	2.4	V	
Supply voltage	Vbat	3.1	3.5	4.6	V	
Total efficiency	Eff	-	35	—	%	Peak Efficiency
2nd harmonic distortion	2nd H.D.	—	-40	–36	dBm	Pout = 31.4dBm,
3rd harmonic distortion	3rd H.D.	—	-40	–36	dBm	Vramp = controlled
4th harmonic distortion	4th H.D.	—	-40	–36	dBm	
Input VSWR	VSWR (in)	—	—	3	—	
Output power (1)	Pout (1)	31.5	32.0	—	dBm	Vramp < Vramp,max,
Output power (2)	Pout (2)	29.5	30.0	—	dBm	Vbat = 3.1V, Vramp< Vramp,max,Ta =+85°C
Isolation (1)	—	—	—	-52	dBm	Vramp = 0.13V, Vtxb = 0V
Isolation (2)	—	—	-30	-10	dBm	Vramp = 0.13V, Vtxb = 2.7V
Stability	—	No parasitic oscillation			—	Pout ≤ 30Bm ,Vramp ≤ 2.4 V Rg = 50ohm, Output VSWR = 15 : 1 All phases
Turn On/Off Time	tr,tf	—	—	5	us	Vramp =0.2 to 2.4V(10us), Pout = 0 to 30.0dBm,
Power Slope	Slope	2	—	270	dB/V	Pout = 0 to 30.0dBm
Tx Leakage for RX-HB port	—	—	3	—	dBm	Pout = 30.0dBm

Power Control Stability

Pout,Vramp adjust to (at Pin = 0dBm, Ta = +25°C, f = 1747.4MHz,Vbat = 3.5V)	0 to 2.0	4.0 to 12.0	14.0 to 28.0	30.0	dBm
Pout Variation (at f = 1710-1785MHz, Pin = 0 to+6dBm Ta = +25°C , Vbat = 3.1-4.6V)	±3.8	±2.8	±1.8	±1.5	dB
Pout,VPC adjust to (at Pin = 0dBm, Ta = +25°C, f = 1747.4MHz,Vbat = 3.5V)	0 to 2.0	4.0 to 12.0	14.0 to 28.0	30.0	dBm
Pout Variation (at f = 1710-1785MHz, Pin = 0 to+6dBm Ta = -15 to +85°C , Vbat = 3.1-4.6V)	±5.5	±4.5	±3.5	±2.0	dB

Circuit Diagram



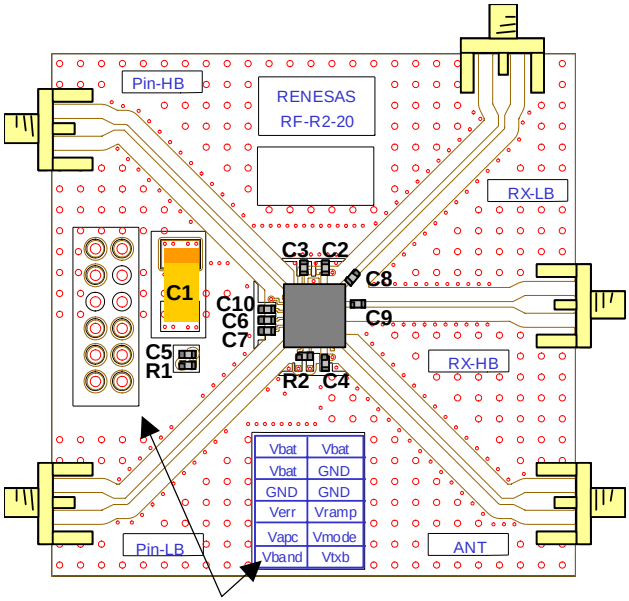
Logic Matrix for mode switch

Mode	Vtxb	Vband	Vmode
	PA OFF=0 PA ON=1	Tx LB=0 Tx HB=1	Rx=0 Tx=1
GSM Rx	0	X	0
DCS Rx	0	X	0
STANBY	1	X	0
GSM Tx	1	0	1
DCS Tx	1	1	1

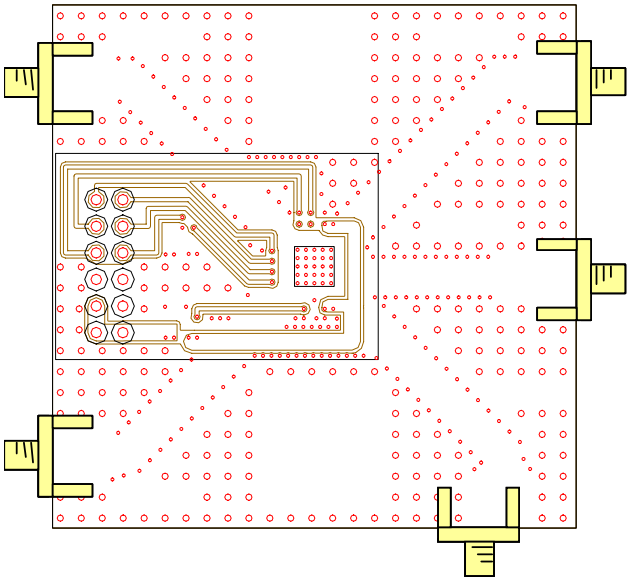
Evaluation Board

C1:150uF TANTALUM ELECTROLYTE
C2:10nF C6:1nF C10: 1nF
C3:100nF C7:1nF R1:15k Ohm
C4:10nF C8:100pF R2:0 Ohm
C5:100pF C9:100pF

Top view:

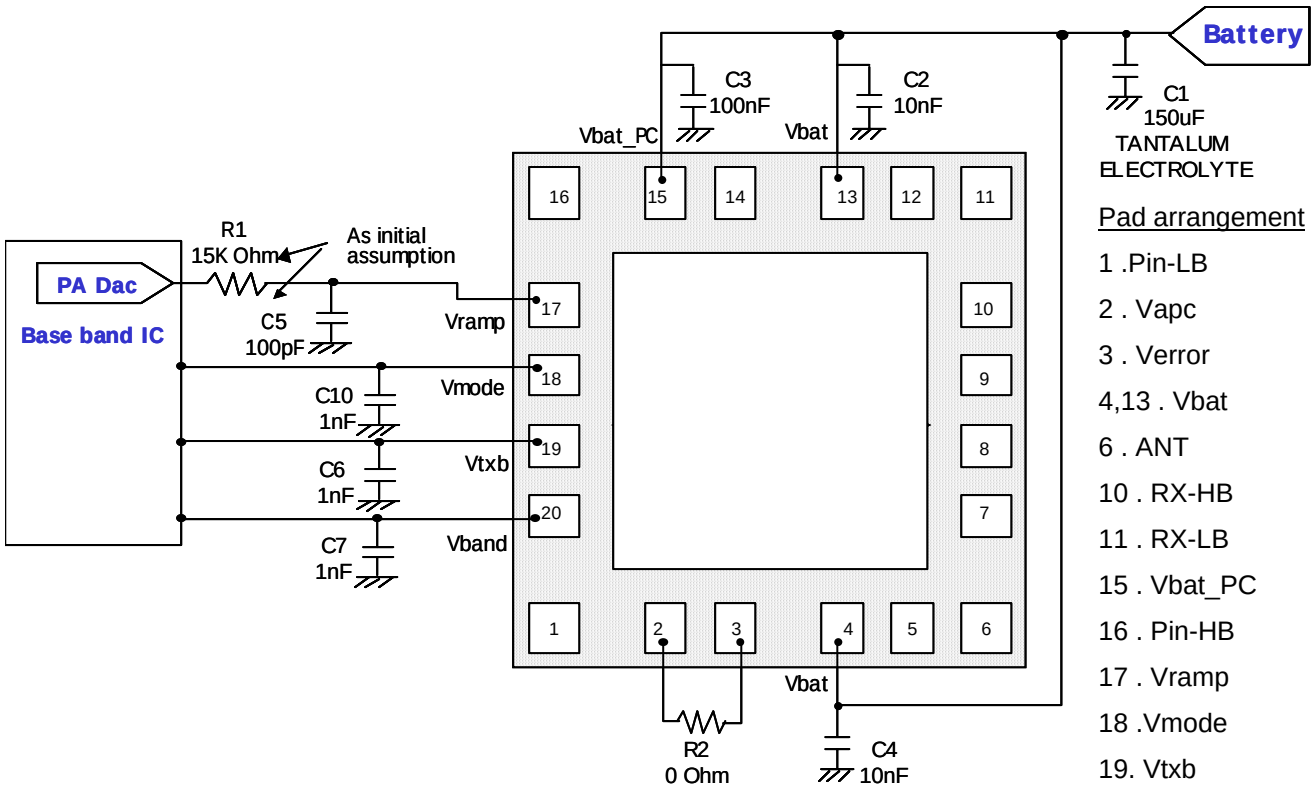


Bottom view:



Pin configurations for right connector

Evaluation Board Circuit Diagram



Top View

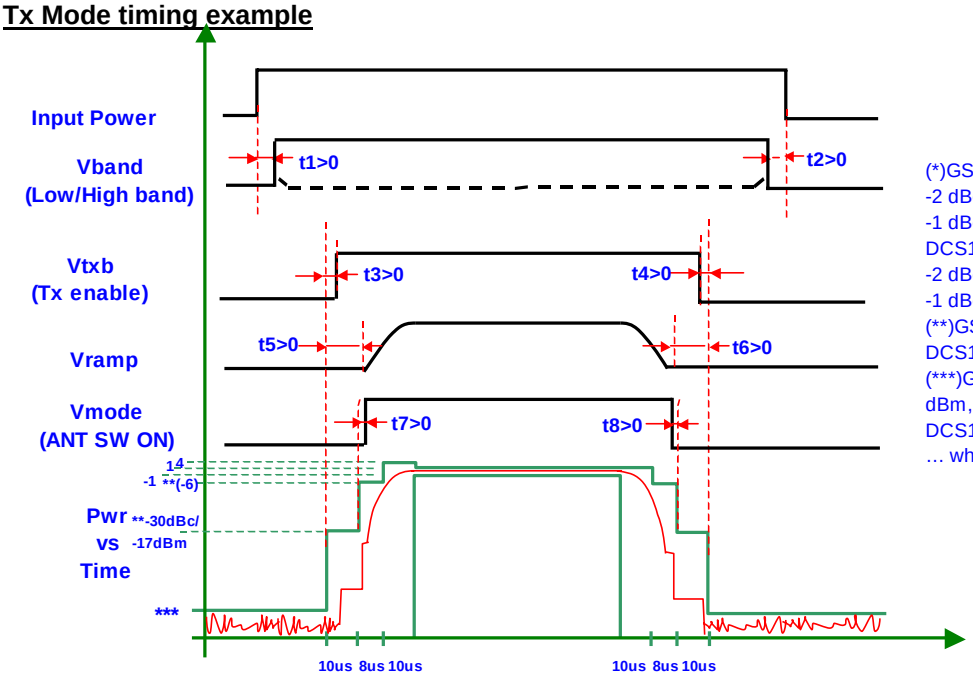
Pad arrangement

1 .Pin-LB
2 . Vapc
3 . Verror
4,13 . Vbat
6 . ANT
10 . RX-HB
11 . RX-LB
15 . Vbat_PC
16 . Pin-HB
17 . Vramp
18 .Vmode
19. Vtxb
20 . Vband

The others : GND

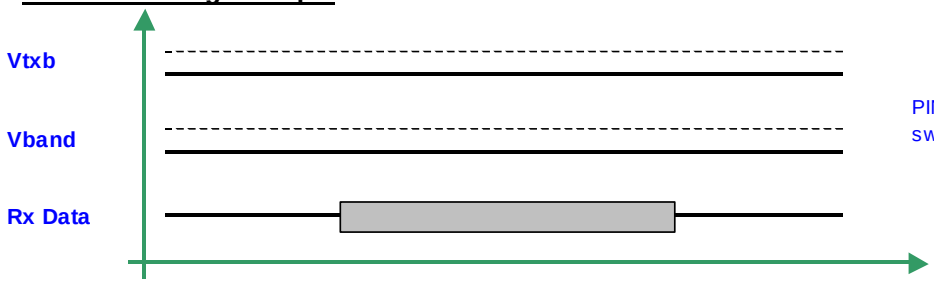
Timing Chart(recommended bias timing)

Tx Mode timing example



(*)GSM900:-4 dBc for PCL16,
-2 dBc for PCL17,
-1 dBc for PCL18, 19.
DCS1800:-4 dBc for PCL11,
-2 dBc for PCL12,
-1 dBc for PCL13~15.
(**)GSM900:-30 dBc or -17 dBm.
DCS1800:-30 dBc or -20 dBm.
(***)GSM900:-59 dBc or -36 dBm,
DCS1800:-48 dBc or -48 dBm.
... whichever is the higher.

Rx Mode timing example

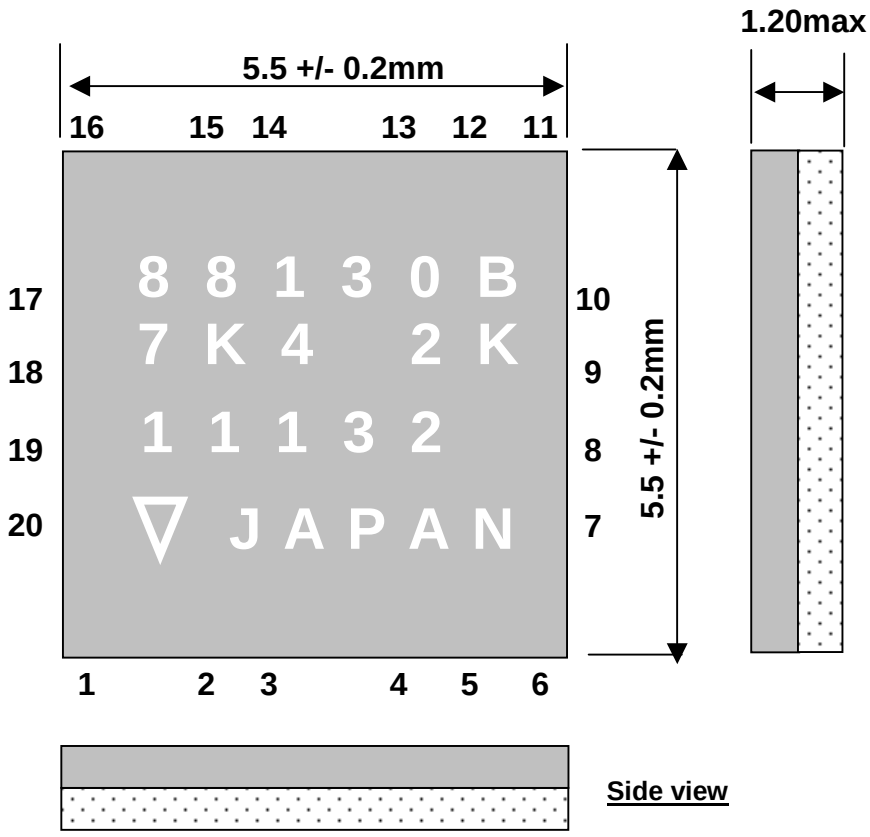


PIN diode + Diplexer type ANT switch is no need bais control

Package Dimensions

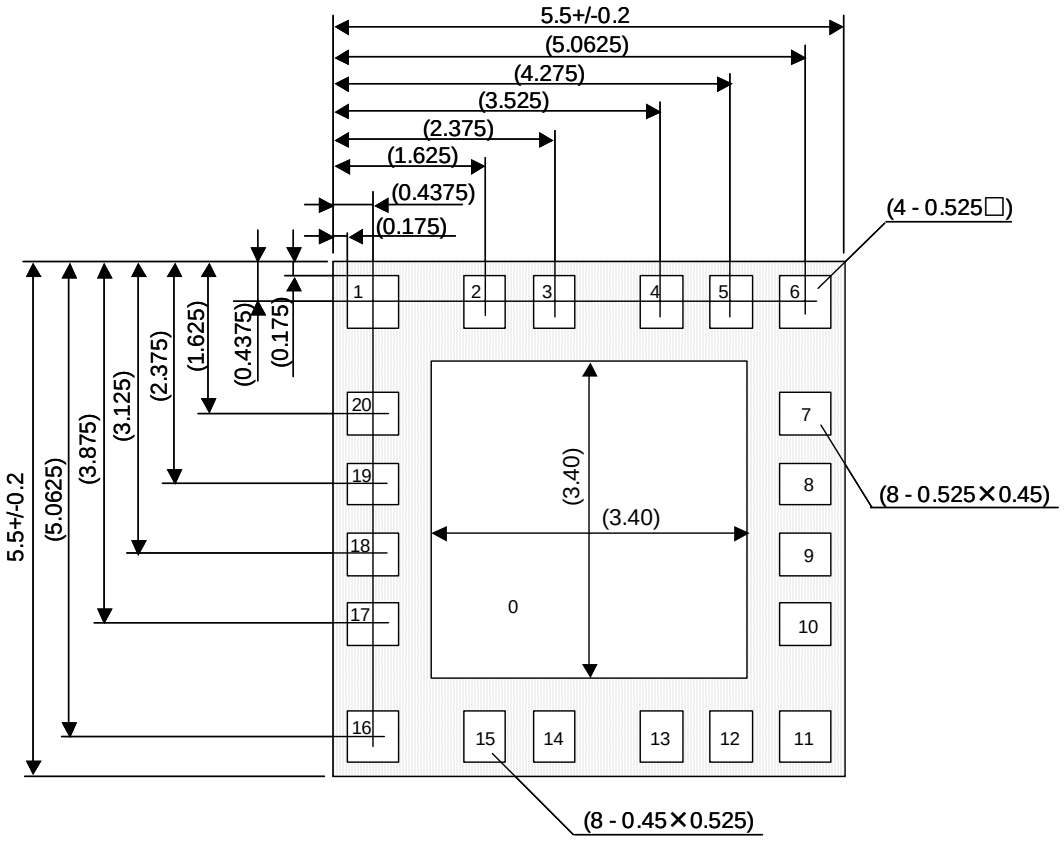
[unit : mm]

Top view



Side view

Bottom view



[unit : mm]

Pad arrangement

1 .Pin-LB
2 . Vapc
3 . Verror
4,13 . Vbat
6 . ANT
10 . RX-HB
11 . RX-LB
15 . Vbat_PC
16 . Pin-HB
17 . Vramp
18 .Vmode
19. Vtxb
20 . Vband
The others : GND

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Remark:

1) Coplanarity of bottom side of terminals are less than 0.1mm. Measured condition is as follows (Fig.1): Put the product on the level surface, and measure the gap between the product and the level surface.

2) Coplanarity of topside is less than 0.15mm. Measured area is 4.5 x 4.5mm from center of the module surface (Fig.2).

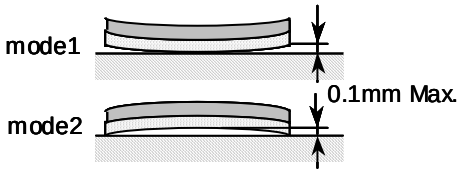


Fig.1 Coplanarity measurement

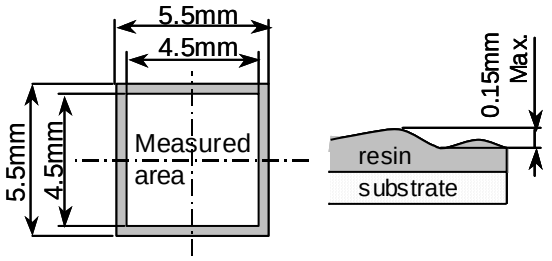


Fig.2 Measure area of surface coplanarity

Mounting

1) Unevenness and distortion at the surface of PCB should be as small as possible.

2) Recommended foot print pattern is shown in Fig3. To get good thermal diffusion and stability, all the GND terminals must be soldered to PCB.

3) Recommend solder stencil is shown in Fig.4. Recommended thickness is 0.1mm. If thickness is different from 0.1mm, the solder area should be adjusted to be equal volume of solder as recommended solder stencil for every terminals.

[unit : mm]

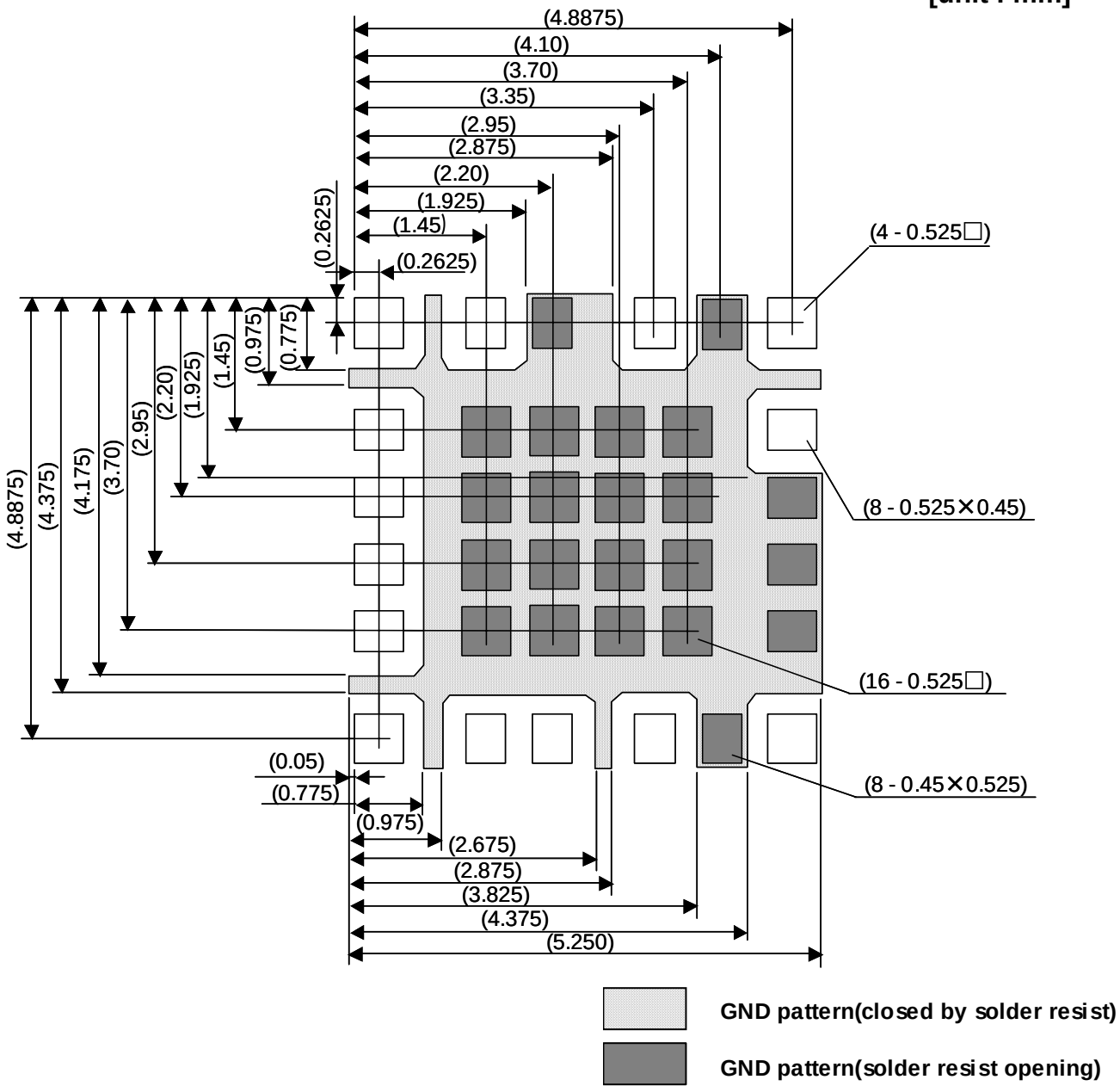


Fig.3 Recommended PCB foot print pattern

Top View

[unit : mm]

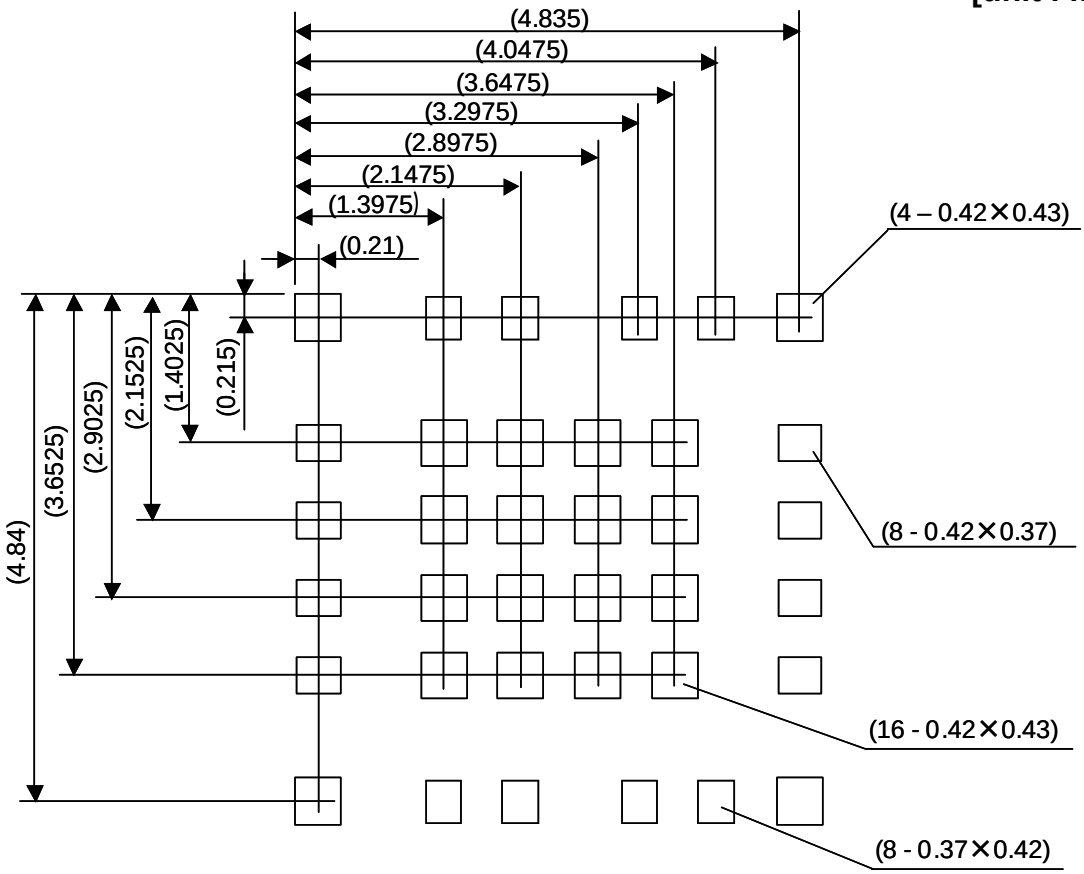


Fig.4 Recommended solder stencil pattern

Top View

Soldering

1) Soldering temperature and time for I.R. reflow and hot air reflow must be within the following reflow profile shown in Fig5. In the case of using solder including Pb is shown in profile(a) and Pb-free solder is shown in profile(b).

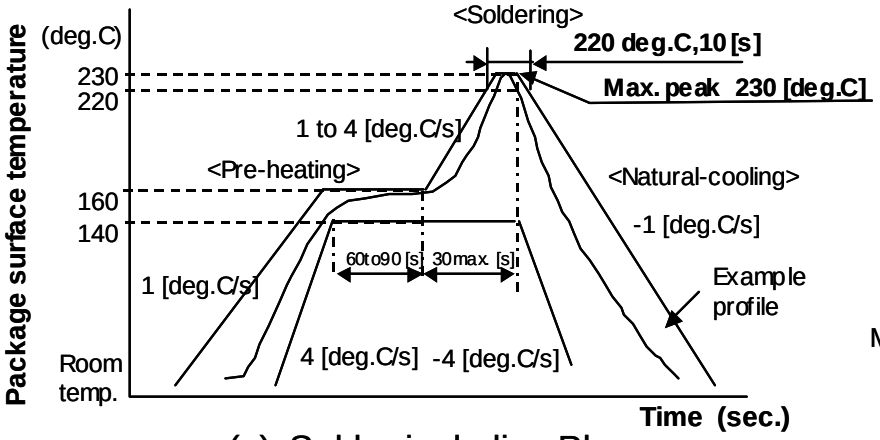
2) Don't apply dipping solder method to soldering.

3) The recommended component of solder paste including Pb is Sn/Pb/Ag(=62/36/2).

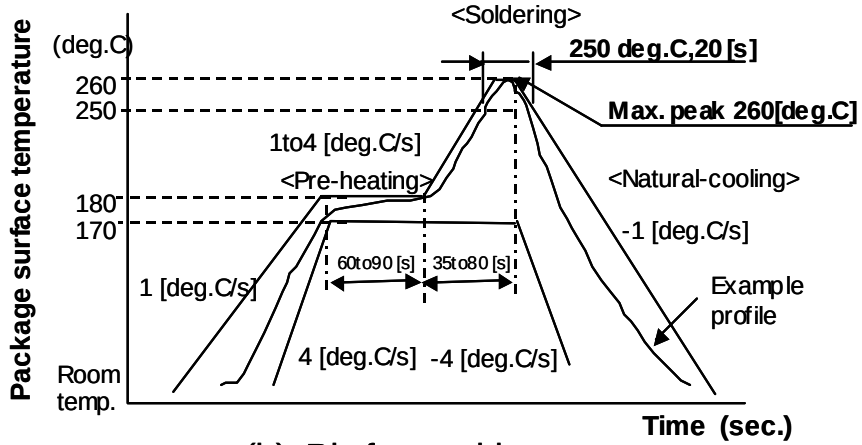
4) The recommended component of Pb-free solder paste is Sn/Ag/Cu(=96.5/3/0.5).

5) Re-soldering is permitted only once, in order to keep the reliability of terminal connection.

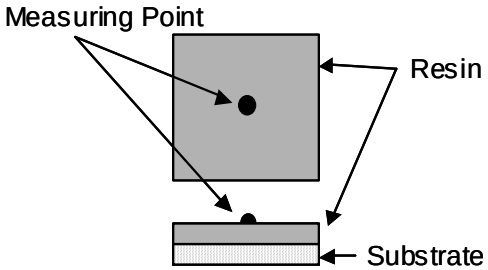
6) Don't use the soldering iron for re-work process, because the product has to be fully soldered its bottom side of terminals for stable operation.



(a) Solder including Pb



(b) Pb-free solder



(c) Measuring Point

Fig.5 Recommended reflow profile

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RPF88130B	×	○	○	○	○	○

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× ; Indicates that at least the relevant hazardous and toxic substances which contains in the relevant homogeneous materials exceed the required limit prescribed by SJ/T11363-2006. (In EU-ROHS, it is an exempted item.)

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Environment-Friendly Use Period = technical life / (average number of operating hours per day * 365).

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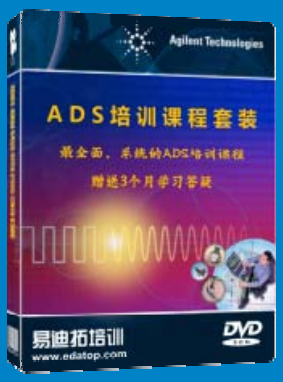
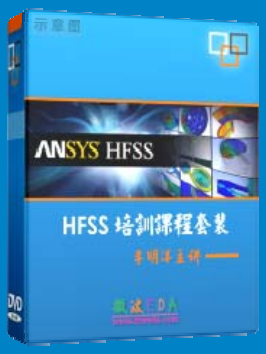
ADS 学习培训课程套装



该套装是迄今国内最全面、最权威的 ADS 培训教程，共包含 10 门 ADS 学习培训课程。课程是由具有多年 ADS 使用经验的微波射频与通信系统设计领域资深专家讲解，并多结合设计实例，由浅入深、详细而又全面地讲解了 ADS 在微波射频电路设计、通信系统设计和电磁仿真设计方面的内容。能让您在最短的时间内学会使用 ADS，迅速提升个人技术能力，把 ADS 真正应用到实际研发工作中去，成为 ADS 设计专家...

课程网址： http://www.edatop.com/peixun/ads/13.html



HFSS 学习培训课程套装

该套课程套装包含了本站全部 HFSS 培训课程，是迄今国内最全面、最专业的 HFSS 培训教程套装，可以帮助您从零开始，全面深入学习 HFSS 的各项功能和在多个方面的工程应用。购买套装，更可超值赠送 3 个月免费学习答疑，随时解答您学习过程中遇到的棘手问题，让您的 HFSS 学习更加轻松顺畅…

课程网址：http://www.edatop.com/peixun/hfss/11.html

CST 学习培训课程套装

该培训套装由易迪拓培训联合微波 EDA 网共同推出，是最全面、系统、专业的 CST 微波工作室培训课程套装，所有课程都由经验丰富的专家授课，视频教学，可以帮助您从零开始，全面系统地学习 CST 微波工作的各项功能及其在微波射频、天线设计等领域的设计应用。且购买该套装，还可超值赠送 3 个月免费学习答疑…

课程网址：http://www.edatop.com/peixun/cst/24.html

HFSS 天线设计培训课程套装

套装包含 6 门视频课程和 1 本图书，课程从基础讲起，内容由浅入深，理论介绍和实际操作讲解相结合，全面系统的讲解了 HFSS 天线设计的全过程。是国内最全面、最专业的 HFSS 天线设计课程，可以帮助您快速学习掌握如何使用 HFSS 设计天线，让天线设计不再难…

课程网址：http://www.edatop.com/peixun/hfss/122.html

13.56MHz NFC/RFID 线圈天线设计培训课程套装

套装包含 4 门视频培训课程，培训将 13.56MHz 线圈天线设计原理和仿真设计实践相结合，全面系统地讲解了 13.56MHz 线圈天线的工作原理、设计方法、设计考量以及使用 HFSS 和 CST 仿真分析线圈天线的具体操作，同时还介绍了 13.56MHz 线圈天线匹配电路的设计和调试。通过该套课程的学习，可以帮助您快速学习掌握 13.56MHz 线圈天线及其匹配电路的原理、设计和调试…

详情浏览：http://www.edatop.com/peixun/antenna/116.html

我们的课程优势：

※ 成立于 2004 年，10 多年丰富的行业经验，

※ 一直致力并专注于微波射频和天线设计工程师的培养，更了解该行业对人才的要求

※ 经验丰富的一线资深工程师讲授，结合实际工程案例，直观、实用、易学

联系我们：

※ 易迪拓培训官网：http://www.edatop.com

※ 微波 EDA 网：http://www.mweda.com

※ 官方淘宝店：http://shop36920890.taobao.com