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P02221B2P

Technical Note

500mW InGaP HBT Amplifier

♦Features

·1.8 to 2.5GHz Frequency Band
·+26.5dBm Output Power
·+43dBm Output IP3
·+5V Single Supply Voltage
·14dB Gain at 2.14GHz
·Highly Reliable InGaP HBT
·Pb-free SOT-89 SMT Package
·AuSn Die Attach for Low and Stable Thermal Resistance

♦Applications

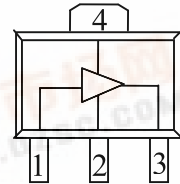
·Wireless communication system
·Cellular, PCS, PHS, W-CDMA, WLAN

♦Description

P02221B2P is a high performance InGaP/GaAs HBT amplifier housed in a low-cost SOT-89 package. The hetero-junction epitaxial structure has been designed to achieve low distortion, which leads to high IP3. The device needs only a +5V single power supply voltage in operation. Utilization of AuSn die attach has realized a low and stable thermal resistance.

♦Functional Diagram

Pin No.	Function
1	RF Input
2, 4	Ground
3	RF Output



♦Ordering Information

Part No	Description	Number of devices	Container
P02221B2P	HBT Amplifier	1000	7" Reel
KP035J	2.14GHz Application Circuit	1	Anti-static Bag

♦Absolute Maximum Ratings (@Tc=25°C)

Parameter	Symbol	Value	Units
Device Voltage	Vd	6	V
Device Current	Id	500	mA
RF Input Power (continuous)	Pin	15	dBm
Power Dissipation	Pt	2	W
Junction Temperature	Tj	+150	°C
Storage Temperature	Tstg	- 40 to +150	°C

Tc: Case Temperature. Operating the device beyond any of these values may cause permanent damage.

♦Electrical Specifications (@Tc=+25°C, Vs=+5V) Measured at 2140MHz using application circuit.

Parameter	Symbol	Test Conditions	Values Min.	Values Typ.	Values Max.	Units
Consumption Current	Is	RF=off	247	294	341	mA
Output IP3	IP3_12	Pout=12dBm S.C.L.	---	43	---	dBm
	IP3_15	Pout=15dBm S.C.L.	38.5	41	---	dBm
Output Power @ 1dB Gain Compression	P1dB	---	24.5	26.5	---	dBm
Small Signal Gain	Ga	Pin=-10dBm	12.5	14	---	dB
Input Return Loss	S11	Pin=-10dBm	---	-10	---	dB
Output Return Loss	S22	Pin=-10dBm	---	-8	---	dB
Thermal Resistance	Rth	Junction-Case	---	37	---	°C/W

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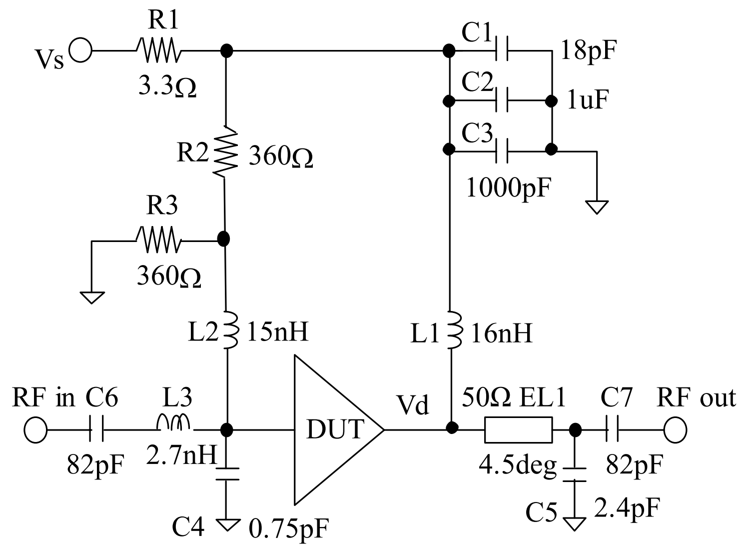
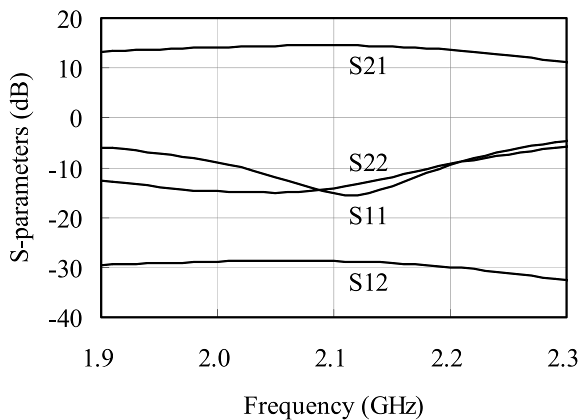
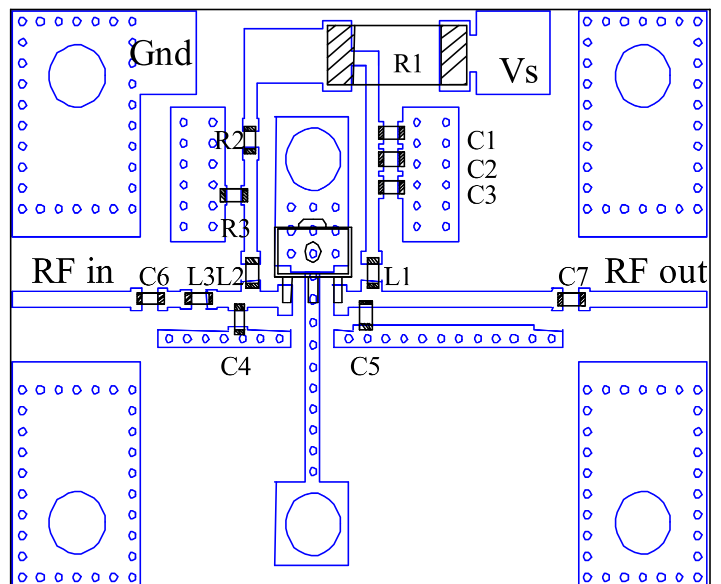
♦Application Circuit : 2140MHz







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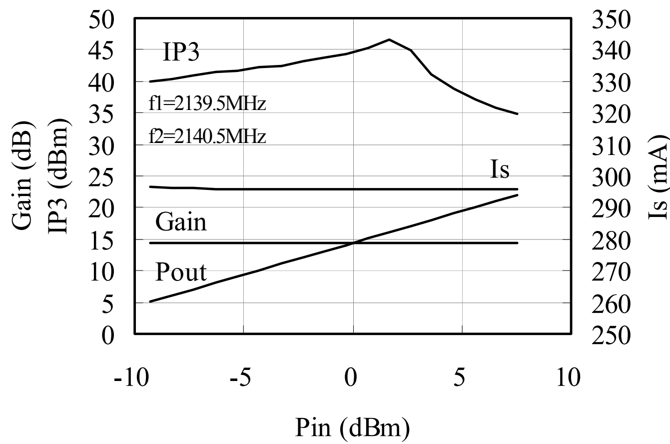
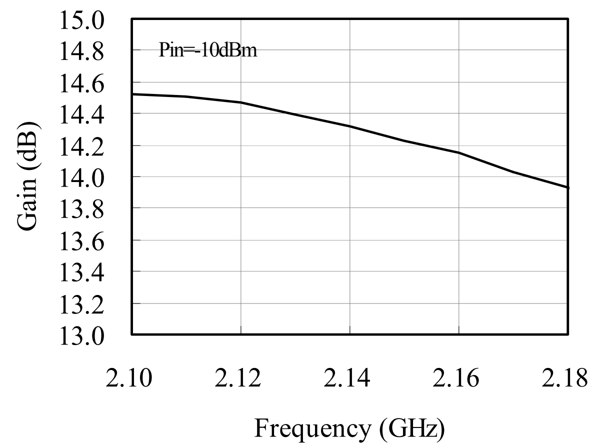
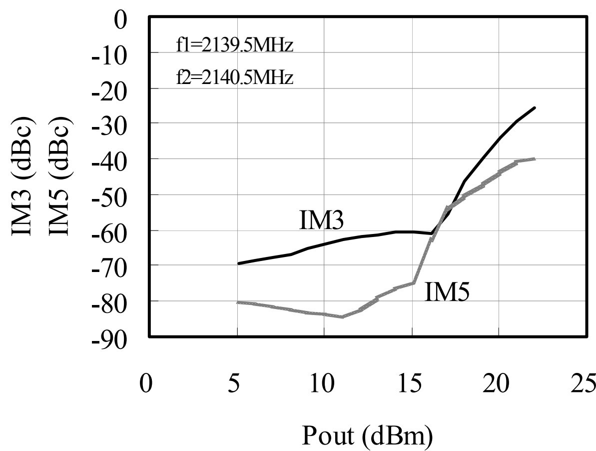
[Typical Performance]

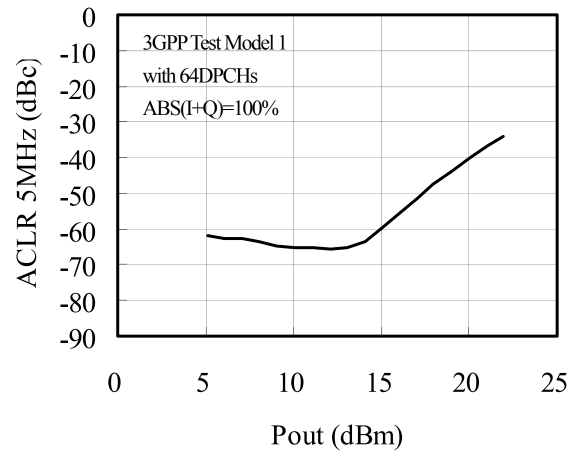
KP035J Application Circuit

(Vs=5V, Tc=25°C, f=2140MHz)









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♦Attention to Heat Radiation

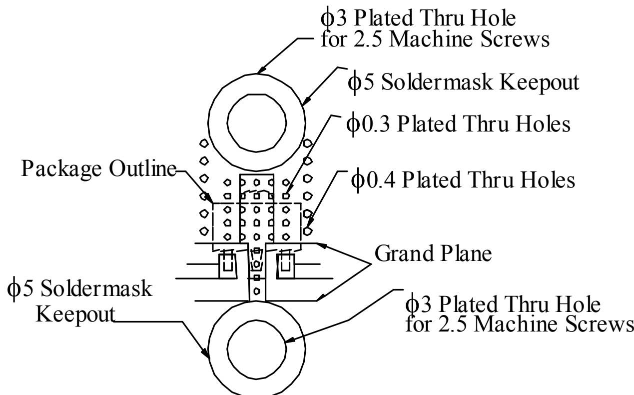
In the layout design of the printed circuit board (PCB) on which the InGaP HBT Amplifier are attached, the heat radiation to minimize the device junction temperature should be taken into account, since it significantly affects the MTTF and RF performance. In any environment, the junction temperature should be lower than the absolute maximum rating during the device operation and it is recommended that the thermal design has enough margin.
The junction temperature can be calculated by the following formula.

$$T_{jmax}=(Vd*Id-P_{out})(R_{th}+R_{board}+R_{hs})+T_a$$

Vd: Device voltage
Id: Device current
P_{out}: Output power
R_{th}: Thermal resistance between junction and case
R_{board}: Thermal resistance of PCB
R_{hs}: Thermal resistance of heat sink
T_a: Ambient temperature
T_{jmax}: Maximum junction temperature

Generally, there are two ways of heat radiation. One is the plated thru hole and the other is the heat sink. Key points will be illustrated in each case below. Note that no measure against oscillation is adopted in the figures. In the design of circuit and layout, you should take stabilizing into account if necessary.

[Using Thru Hole]



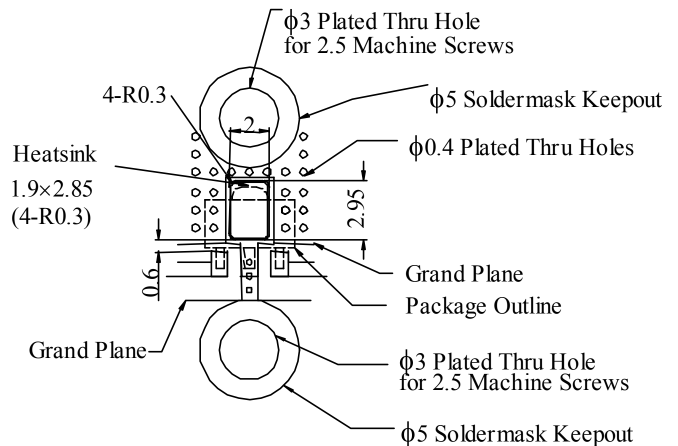
□Multiple plated thru holes are required directly below the device.

□Place more than 2 machine screws as close to the ground pin (pin 4) as possible. The PCB is screwed on the mounting plate or the heat sink to lower the thermal resistance of the PCB.

□Lay out a large ground pad area with multiple plated thru holes around pin 4 of the device.

□The required matching and feedback circuit described in the application circuit examples should be connected to the device, although it is not shown in the figure below.

[Using Heat Sink]



If you cannot get the junction temperature lower than the absolute maximum rating only with the plated thru holes, then you need to employ the heat sink. Attaching the heat sink directly under pin 4 of the device improves the thermal resistance between junction and ambient.

[Note]

□Ground/thermal vias are critical for the proper device performance. Drills of the recommended diameters should be used in the fabrication of vias.

□Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.

□Mounting screws can be added near the part to fasten the board to heat sink. Ensure that the ground/thermal via region contacts the heat sink.

□Do not put solder mask on the backside of the PCB in the region where the board contacts the heat sink.

□RF trace width depends upon the PCB material and construction.

□Use 1 oz. Copper minimum.

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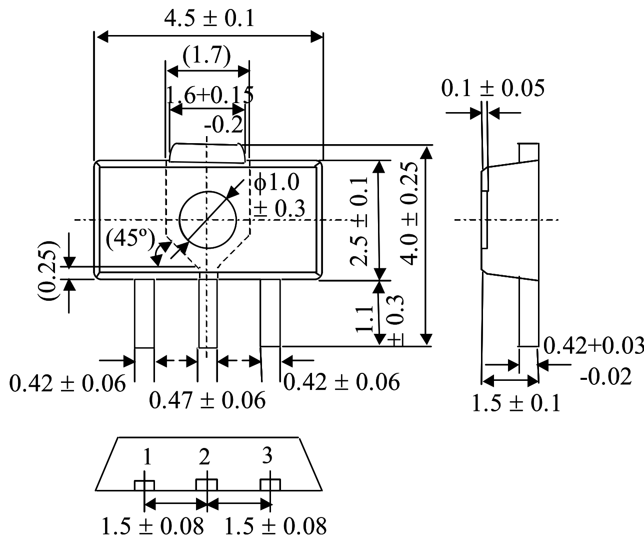
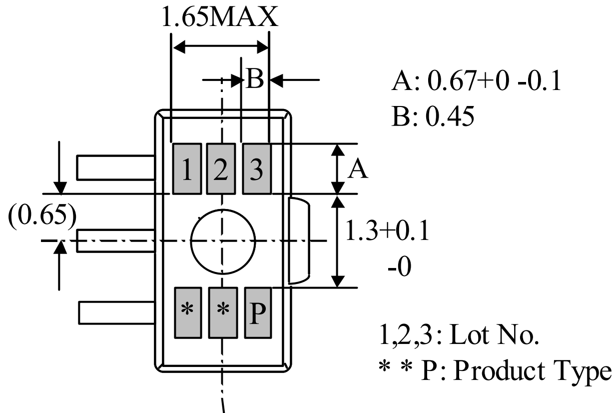
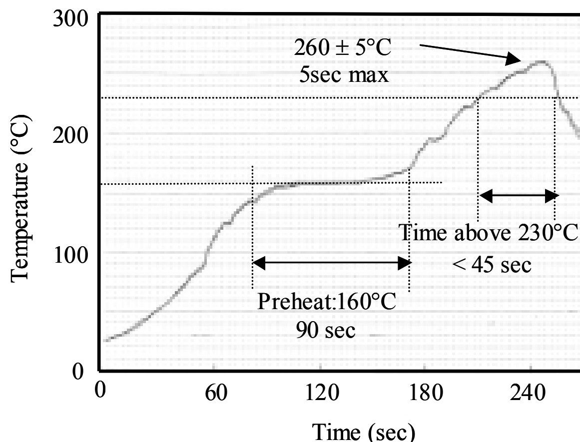
♦Package Drawing



♦Laser Marking



♦Convection Reflow Profile (Recommended)



[Note]

The reflow profile is different from the one for Sn-Pb plating

If you use a soldering iron to attach the devices, please beware of the followings.

(1) The tip of the iron should be grounded. Or you should use an iron that is electrostatic discharge proof.

(2) The temperature of the iron tip should be lower than 240°C and the soldering should be completed within 10 seconds.

♦Attention to ESD

Generally, GaAs devices are very sensitive to electrostatic discharge (ESD). To reduce the ESD damage, please pay attention to the followings. The devices should be stored with the electrodes short-circuited by conductive materials. The workstation and tools should be grounded for safe dissipation of the static charges in the environment. The workpeople are to wear anti-static clothing and wrist straps. For safety reasons, resistance of 10MΩ or so should exist between workpeople and ground.

♦Moisture Sensitivity Level

The moisture sensitivity level (MSL) of P02221B2P is 1, which means that the “floor life” is unlimited below 30°C with relative humidity (Rh) of 85%.

♦Reliability and Environmental Issues

Eudyna’s Yokohama Works, where the devices are manufactured, has been accredited ISO-14001 since 1999. We control the toxic materials in our products in accordance with PRTR regulation.

♦ Lead and Fluoride

To realize Pb-free products, Sn-Bi is used for the lead frame plating. Any fluoride that has been determined by the Montreal agreement is not used in the products.

♦ Compliance with RoHS

This product is in compliance with Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 for the restriction of use of certain hazardous substances in electrical and electronics equipment (RoHS Directives).

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♦Caution

InGaP/GaAs HBT chips are used in P02221B2P. For safety reasons, you should attend to the following matters:
(1) Do not put the products in your mouse.
(2) Do not make the products into gases or powders, by burning, breaking or chemical treatments.
(3) In case you abandon the products, you should obey the related laws and regulations.

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