



# NPN SiGe RF ANALOG INTEGRATED CIRCUIT

# $\mu$ PA901TU

## NPN SiGe RF IC IN A 8-PIN LEAD-LESS MINIMOLD

### DESCRIPTION

The  $\mu$ PA901TU is a silicon germanium HBT IC designed for the power amplifier of 5.8 GHz cordless phone and other 5.8 GHz applications. This IC consists of two stage amplifiers and has excellent performance, high efficiency, high gain, low power consumption.

The device is packaged in surface mount 8-pin lead-less minimold plastic package.

The device is fabricated with our SiGe HBT process UHS2-HV technology.

### FEATURES

- Output Power :  $P_{out} = 19 \text{ dBm}$  @  $P_{in} = -3 \text{ dBm}$ ,  $V_{CE} = 3.6 \text{ V}$ ,  $f = 5.8 \text{ GHz}$
- Low Power :  $I_c = 90 \text{ mA}$  @  $P_{in} = -3 \text{ dBm}$ ,  $V_{CE} = 3.6 \text{ V}$ ,  $f = 5.8 \text{ GHz}$
- Single Power Supply Operation :  $V_{CE} = 3.6 \text{ V}$
- Built-in bias circuit
- 8-pin lead-less minimold ( $2.0 \times 2.2 \times 0.5 \text{ mm}$ )

### APPLICATIONS

- 5.8 GHz cordless phone
- 5.8 GHz band DSRC (Dedicated Short Range Communication) system
- 5.8 GHz video transmitter

### ORDERING INFORMATION

Part Number	Order Number	Quantity	Package	Marking	Supplying Form
$\mu$ PA901TU	$\mu$ PA901TU-A	50 pcs (Non reel)	8-pin lead-less	A901	• 8 mm wide embossed taping
$\mu$ PA901TU-T3	$\mu$ PA901TU-T3-A	5 kpcs/reel	minimold (Pb-Free)		• Pin 1, Pin 8 face the perforation side of the tape

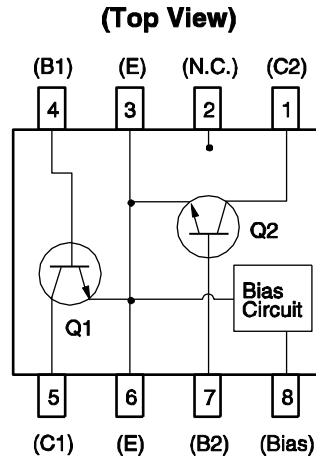
**Remark** To order evaluation samples, contact your nearby sales office.

The unit sample quantity is 50 pcs.

**Caution: Observe precautions when handling because these devices are sensitive to electrostatic discharge**

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

**PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM**



**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = +25°C)**

Parameter	Symbol	Ratings	Unit
Collector to Base Voltage	V <sub>CB0</sub>	15	V
Collector to Emitter Voltage	V <sub>CE0</sub>	4.5	V
Emitter to Base Voltage	V <sub>EB0</sub>	2	V
Collector Current of Q1	I <sub>C1</sub>	75	mA
Collector Current of Q2	I <sub>C2</sub>	250	mA
Bias Current	I <sub>BIAS</sub>	25	mA
Total Power Dissipation	P <sub>tot</sub> <sup>Note</sup>	410	mW
Junction Temperature	T <sub>j</sub>	150	°C
Storage Temperature	T <sub>stg</sub>	-65 to +150	°C
Operating Ambient Temperature	T <sub>A</sub>	-40 to +85	°C

**Note** Mounted on 20 × 20 × 0.8 mm (t) glass epoxy PCB (FR-4)

**THERMAL RESISTANCE (T<sub>A</sub> = +25°C)**

Parameter	Symbol	Test Conditions	Ratings	Unit
Channel to Ambient Resistance	R <sub>th(j-a1)</sub> <sup>Note</sup>		150	°C/W
	R <sub>th(j-a2)</sub>	Free Air	TBD	°C/W

**Note** Mounted on 20 × 20 × 0.8 mm (t) glass epoxy PCB (FR-4)

**RECOMMENDED OPERATING RANGE (All Parameter)**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Collector to Emitter Voltage	V <sub>CE</sub>	-	3.6	4.5	V
Total Current	I <sub>total</sub>	-	90	300	mA
Input Power	P <sub>in</sub>	-	-3	+5	dBm

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = +25°C)**

**–DC CHARACTERISTICS–**

**(1) Q1**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Collector Cut-off Current	I <sub>CB0</sub>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0 mA	–	–	60	nA
Emitter Cut-off Current	I <sub>EB0</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0 mA	–	–	120	nA
DC Current Gain	h <sub>FE</sub> <sup>Note</sup>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 6 mA	80	120	160	–
Current Ratio (I <sub>C (set) 1</sub> /I <sub>BIAS</sub> )	CR1	V <sub>CE</sub> = 3.6 V, V <sub>BE</sub> = V <sub>BIAS</sub> = 0.865 V	2	4.5	9	–

**(2) Q2**

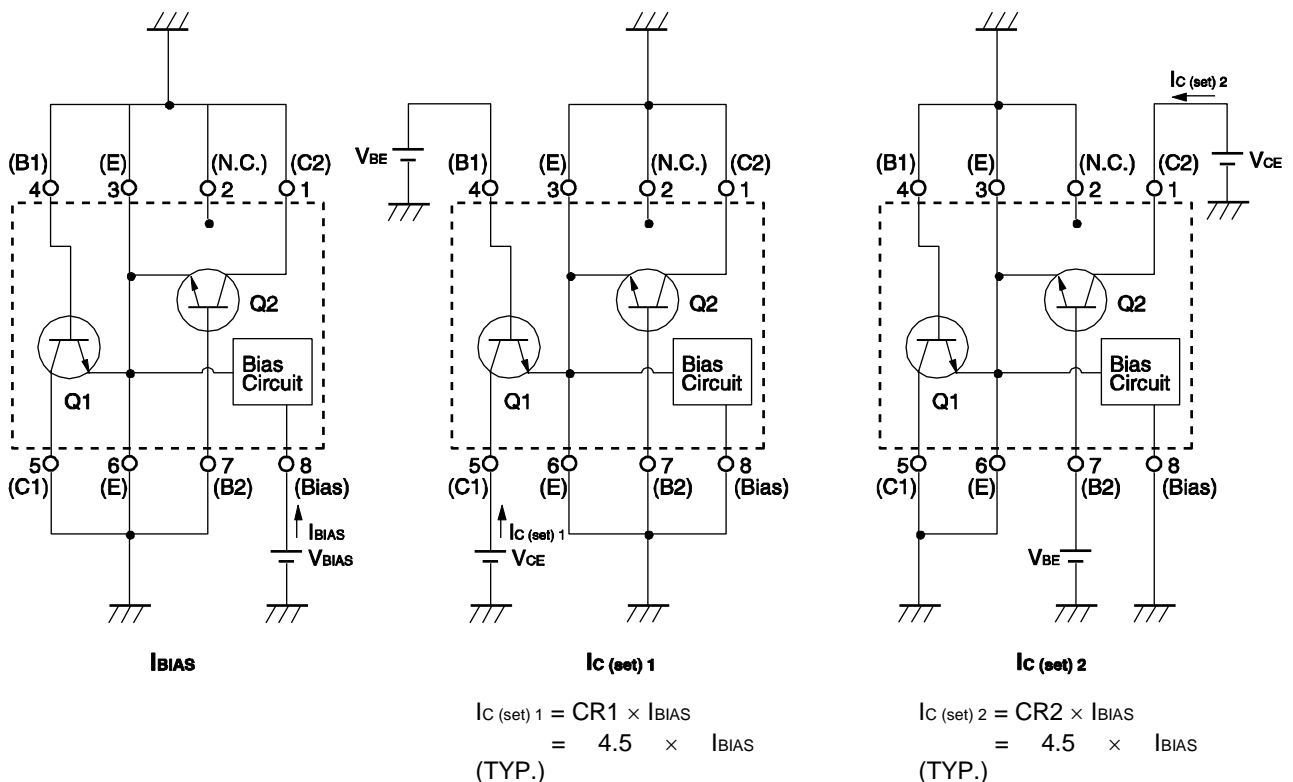
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Collector Cut-off Current	I <sub>CB0</sub>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0 mA	–	–	200	nA
Emitter Cut-off Current	I <sub>EB0</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0 mA	–	–	400	nA
DC Current Gain	h <sub>FE</sub> <sup>Note</sup>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 20 mA	80	120	160	–
Current Ratio (I <sub>C (set) 2</sub> /I <sub>BIAS</sub> )	CR2	V <sub>CE</sub> = 3.6 V, V <sub>BE</sub> = V <sub>BIAS</sub> = 0.865 V	8	10	13	–

**(3) Bias Circuit**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Bias Circuit Current	I <sub>BIAS</sub>	V <sub>BIAS</sub> = 0.865 V	–	4	–	mA

**Note** Pulse measurement: PW ≤ 350 μs, Duty Cycle ≤ 2%

**I<sub>BIAS</sub>, I<sub>C (set) 1</sub>, I<sub>C (set) 2</sub> MEASUREMENT CIRCUIT**



The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = +25°C)**

**–RF CHARACTERISTICS–**

**(1) Q1**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Insertion Power Gain (Q1)	$ S_{21e} ^2$	V <sub>CE</sub> = 3.6 V, I <sub>C</sub> = 12 mA, f = 5.8 GHz	8.5	10.0	11.5	dB
Maximum Available Power Gain (Q1)	MAG1	V <sub>CE</sub> = 3.6 V, I <sub>C</sub> = 12 mA, f = 5.8 GHz	13.5	15.0	–	dB
Output Power (Q1)	P <sub>out1</sub>	V <sub>CE</sub> = 3.6 V, I <sub>C (set)</sub> = 12 mA, f = 5.8 GHz, P <sub>in</sub> = –3 dBm	10.2	11.2	–	dBm
Collector Current (Q1)	I <sub>cc1</sub>	V <sub>CE</sub> = 3.6 V, I <sub>C (set)</sub> = 12 mA, f = 5.8 GHz, P <sub>in</sub> = –3 dBm	–	20	–	mA

**(2) Q2**

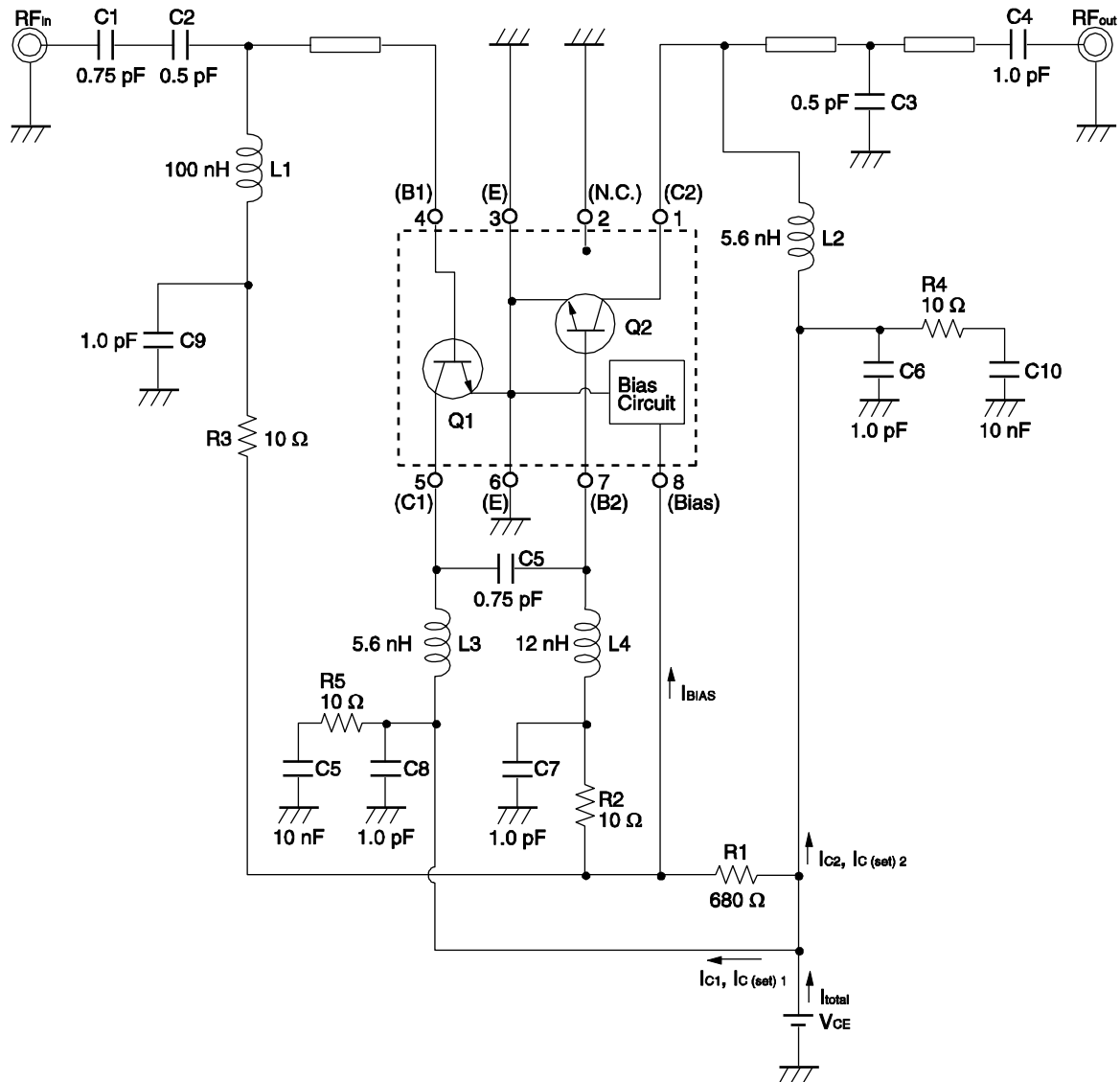
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Insertion Power Gain (Q2)	$ S_{21e} ^2$	V <sub>CE</sub> = 3.6 V, I <sub>C</sub> = 40 mA, f = 5.8 GHz	2	3.5	5	dB
Maximum Available Power Gain (Q2)	MAG2	V <sub>CE</sub> = 3.6 V, I <sub>C</sub> = 40 mA, f = 5.8 GHz	8.5	10.0	10.5	dB
Output Power (Q2)	P <sub>out2</sub>	V <sub>CE</sub> = 3.6 V, I <sub>C (set)</sub> = 40 mA, f = 5.8 GHz, P <sub>in</sub> = 11 dBm	17.5	19.0	–	dBm
Collector Current (Q2)	I <sub>cc2</sub>	V <sub>CE</sub> = 3.6 V, I <sub>C (set)</sub> = 40 mA, f = 5.8 GHz, P <sub>in</sub> = 11 dBm	–	70	–	mA

**(3) Q1 + Q2, 2 stage Amplifiers**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Output Power	P <sub>out</sub>	V <sub>CE</sub> = 3.6 V, R <sub>BIAS</sub> = 680 Ω, f = 5.8 GHz, P <sub>in</sub> = –3 dBm <b>Note</b>	17.5	19.0	–	mA
Total Current	I <sub>total</sub>	V <sub>CE</sub> = 3.6 V, R <sub>BIAS</sub> = 680 Ω, f = 5.8 GHz, P <sub>in</sub> = –3 dBm <b>Note</b>	–	90	–	mA

**Note** by MEASUREMENT CIRCUIT 1

MEASUREMENT CIRCUIT 1



$$I_{C (set) 1} = CR1 \times I_{BIAS}$$

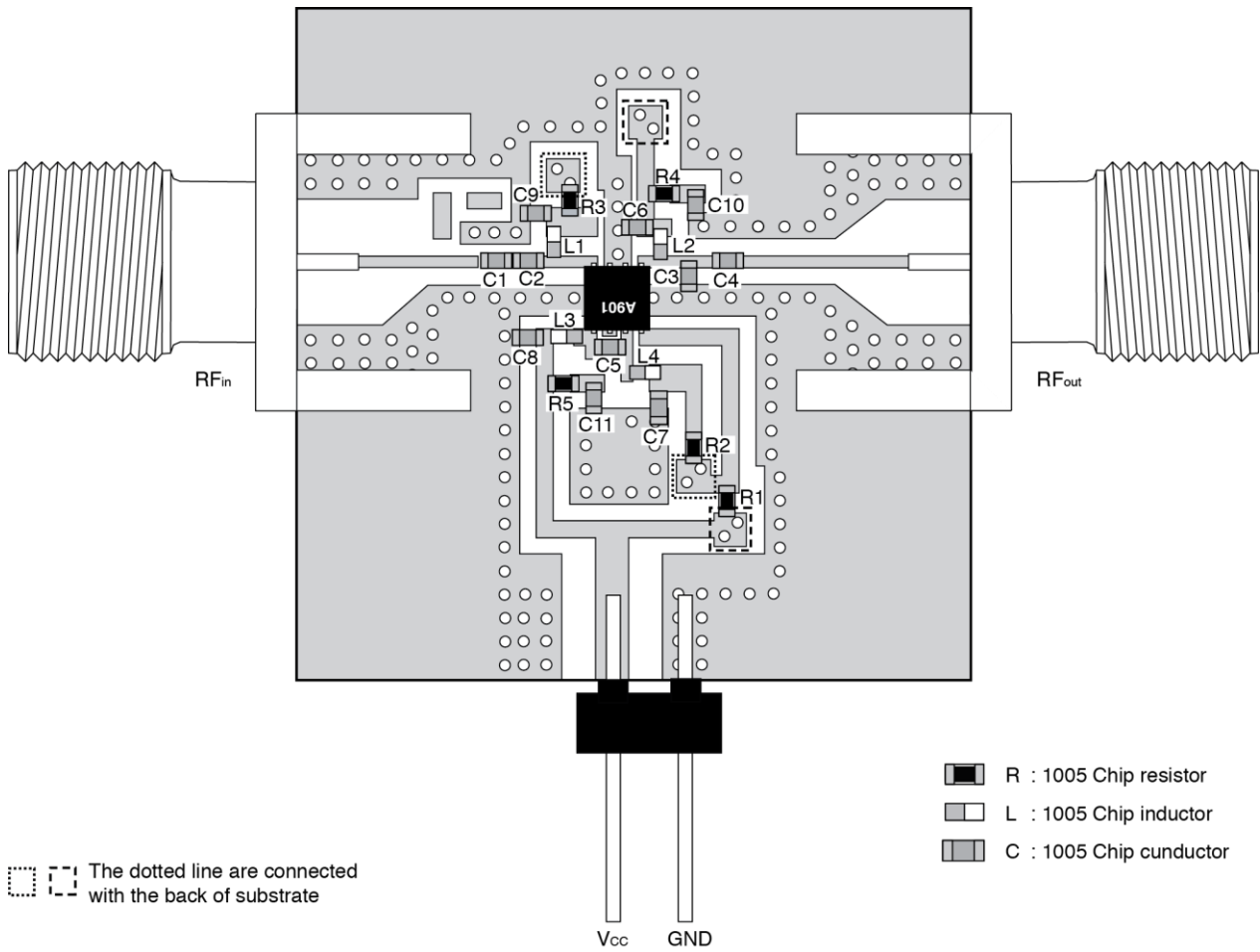
$$= 4.5 \times I_{BIAS} \text{ (TYP.)}$$

$$I_{C (set) 2} = CR2 \times I_{BIAS}$$

$$= 4.5 \times I_{BIAS} \text{ (TYP.)}$$

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ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



Remarks

1. Substrate : 20 × 20 × 0.8 (t) mm FR-4 (4 Layer, each thickness 0.2 mm), copper thickness 18 μm, gold flash plating
2. Back side : GND pattern
3. ○ : Through hole

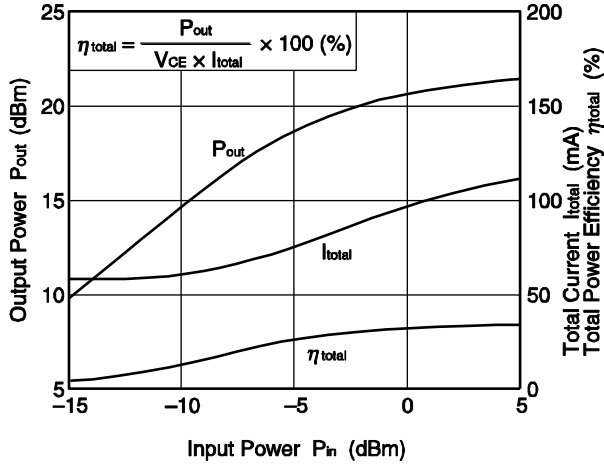
USING THE EVALUATION BOARD

Symbol	Values	Symbol	Values
R1	680 Ω	C2	0.5 pF
R2	10 Ω	C3	0.5 pF
R3	10 Ω	C4	1.0 pF
R4	10 Ω	C5	0.75 pF
R5	10 Ω	C6	1.0 pF
L1	100 nH	C7	1.0 pF
L2	5.6 nH	C8	1.0 pF
L3	5.6 nH	C9	1.0 pF
L4	12 nH	C10	10 nF
C1	0.75 pF	C11	10 nF

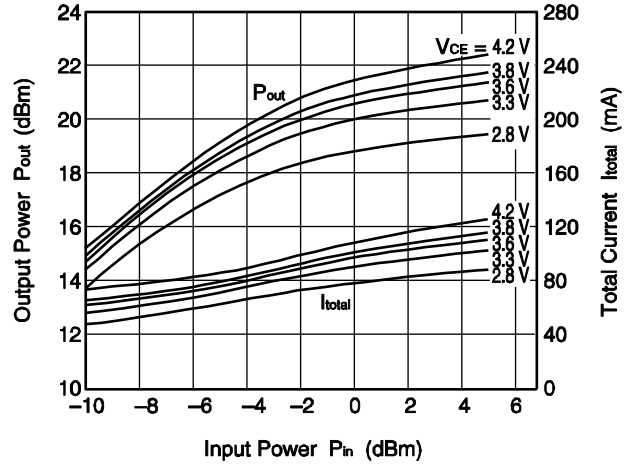
**TYPICAL CHARACTERISTICS**

( $T_A = +25^\circ\text{C}$ ,  $V_{CE} = 3.6\text{ V}$ ,  $R_{BIAS} = 680\ \Omega$ ,  $f = 5.8\text{ GHz}$ , unless otherwise specified)

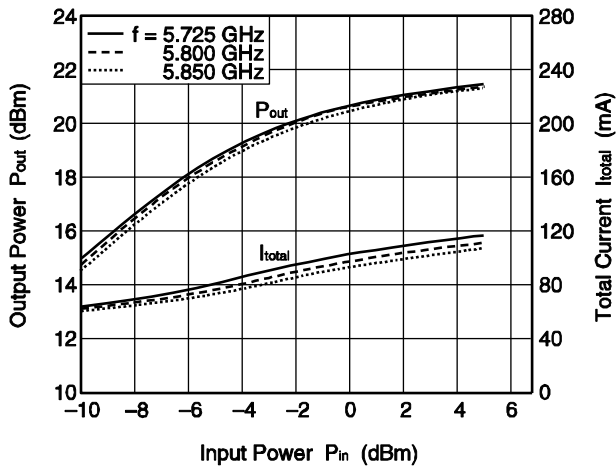
**OUTPUT POWER, TOTAL CURRENT, TOTAL POWER EFFICIENCY vs. INPUT POWER**



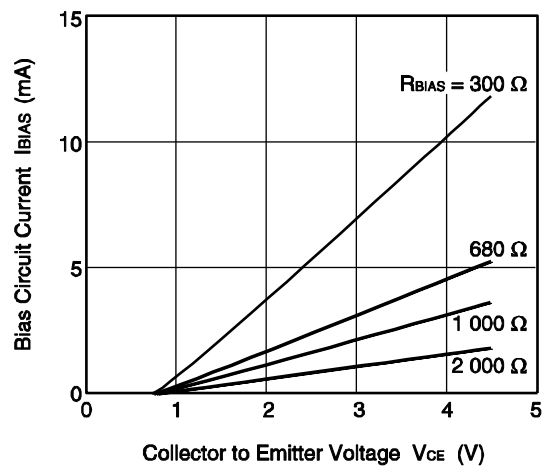
**OUTPUT POWER, TOTAL CURRENT, vs. INPUT POWER**



**OUTPUT POWER, TOTAL CURRENT, vs. INPUT POWER**



**BIAS CIRCUIT CURRENT vs. COLLECTOR TO EMITTER VOLTAGE**



**Remark** The graphs indicate nominal characteristics.





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