

# DATA SHEET



## NPN SILICON RF TRANSISTOR NE664M04 / 2SC5754 JEITA Part No.

### NPN SILICON RF TRANSISTOR FOR MEDIUM OUTPUT POWER AMPLIFICATION (0.4 W) FLAT-LEAD 4-PIN THIN-TYPE SUPER MINIMOLD (M04)

#### FEATURES

- Ideal for 460 MHz to 2.4 GHz medium output power amplification
- $P_{O(1\text{ dB})} = 26.0\text{ dBm TYP. @ } V_{CE} = 3.6\text{ V, } f = 1.8\text{ GHz, } P_{in} = 15\text{ dBm}$
- High collector efficiency:  $\eta_C = 60\%$
- UHS0-HV technology ( $f_T = 25\text{ GHz}$ ) adopted
- High reliability through use of gold electrodes
- Flat-lead 4-pin thin-type super minimold (M04) package

#### ORDERING INFORMATION

Part Number	Quantity	Supplying Form
NE664M04-A 2SC5754-A	50 pcs (Non reel)	• 8 mm wide embossed taping • Pin 1 (Emitter), Pin 2 (Collector) face the perforation side of the tape
NE664M04-T2-A 2SC5754-T2-A	3 kpcs/reel	

**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.

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

Parameter	Symbol	Ratings	Unit
Collector to Base Voltage	V <sub>CBO</sub>	13	V
Collector to Emitter Voltage	V <sub>CEO</sub>	5.0	V
Emitter to Base Voltage	V <sub>EBO</sub>	1.5	V
Collector Current	I <sub>c</sub>	500	mA
Total Power Dissipation	P <sub>tot</sub> <sup>Note</sup>	735	mW
Junction Temperature	T <sub>j</sub>	150	°C
Storage Temperature	T <sub>stg</sub>	-65 to +150	°C

**Note** Mounted on 38 × 38 mm, t = 0.4 mm polyimide PCB

**THERMAL RESISTANCE**

Parameter	Symbol	Test Conditions	Ratings	Unit
★ Junction to Ambient Resistance	R <sub>th j-a1</sub>	Mounted on 38 × 38 mm, t = 0.4 mm polyimide PCB	170	°C/W
	R <sub>th j-a2</sub>	Stand alone device in free air	570	°C/W

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

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
<b>DC Characteristics</b>						
Collector Cut-off Current	I <sub>CBO</sub>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0 mA	-	-	1 000	nA
Emitter Cut-off Current	I <sub>EBO</sub>	V <sub>BE</sub> = 1 V, I <sub>C</sub> = 0 mA	-	-	1 000	nA
DC Current Gain	h <sub>FE</sub> <sup>Note 1</sup>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 100 mA	40	60	100	-
<b>RF Characteristics</b>						
Gain Bandwidth Product	f <sub>T</sub>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 100 mA, f = 0.5 GHz	16	20	-	GHz
Insertion Power Gain	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 100 mA, f = 2 GHz	5.0	6.5	-	dB
Reverse Transfer Capacitance	C <sub>re</sub> <sup>Note 2</sup>	V <sub>CB</sub> = 3 V, I <sub>E</sub> = 0 mA, f = 1 MHz	-	1.0	1.5	pF
Maximum Available Power Gain	MAG <sup>Note 3</sup>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 100 mA, f = 2 GHz	-	12.0	-	dB
Linear Gain	G <sub>L</sub>	V <sub>CE</sub> = 3.6 V, I <sub>Cq</sub> = 20 mA, f = 1.8 GHz, P <sub>in</sub> = 0 dBm, 1/2 Duty	-	12.0	-	dB
Gain 1 dB Compression Output Power	P <sub>O(1 dB)</sub>	V <sub>CE</sub> = 3.6 V, I <sub>Cq</sub> = 4 mA, f = 1.8 GHz, P <sub>in</sub> = 15 dBm, 1/2 Duty	-	26.0	-	dBm
Collector Efficiency	η <sub>C</sub>	V <sub>CE</sub> = 3.6 V, I <sub>Cq</sub> = 4 mA, f = 1.8 GHz, P <sub>in</sub> = 15 dBm, 1/2 Duty	-	60	-	%

- Notes**
1. Pulse measurement: PW ≤ 350 μs, Duty Cycle ≤ 2%
  2. Collector to base capacitance when the emitter grounded

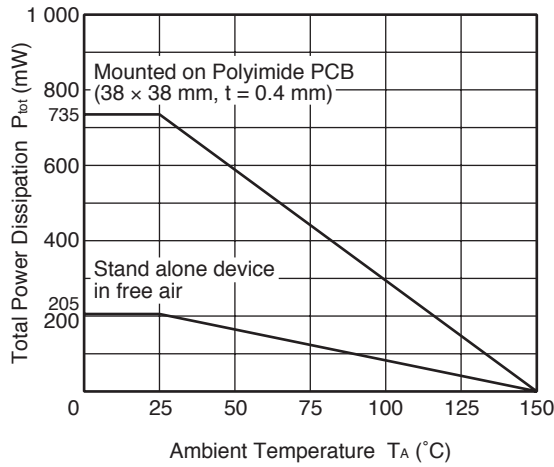
$$3. \text{MAG} = \left| \frac{S_{21}}{S_{12}} \right| (K - \sqrt{K^2 - 1})$$

**h<sub>FE</sub> CLASSIFICATION**

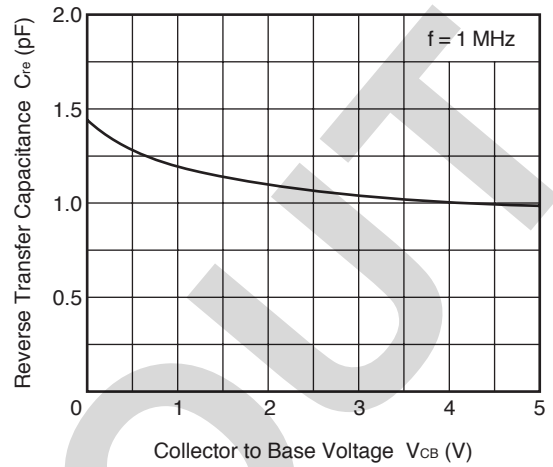
Rank	FB
Marking	R57
h <sub>FE</sub> Value	40 to 100

**TYPICAL CHARACTERISTICS (Unless otherwise specified,  $T_A = +25^\circ\text{C}$ )**

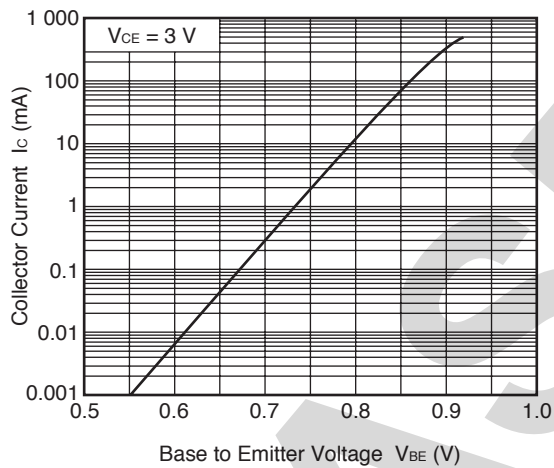
**TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE**



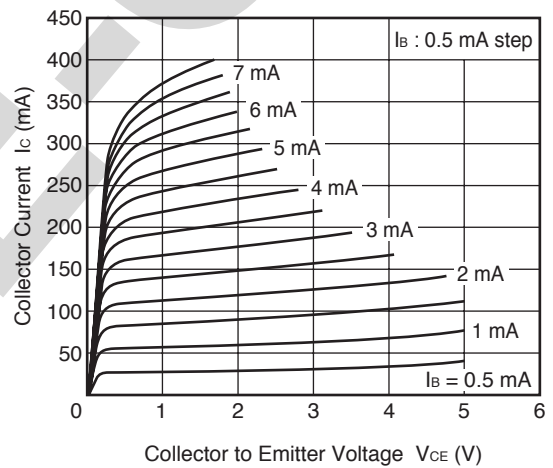
**REVERSE TRANSFER CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE**



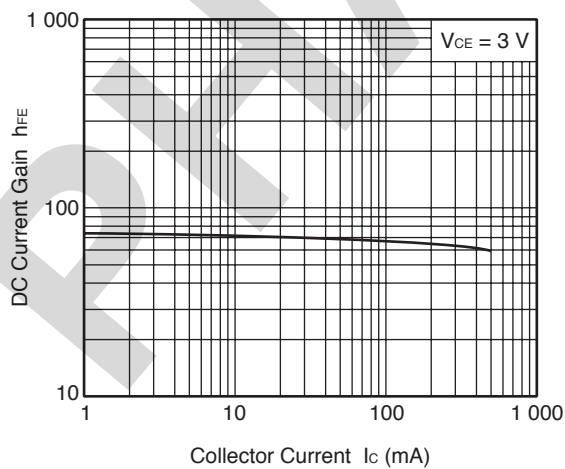
**COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE**



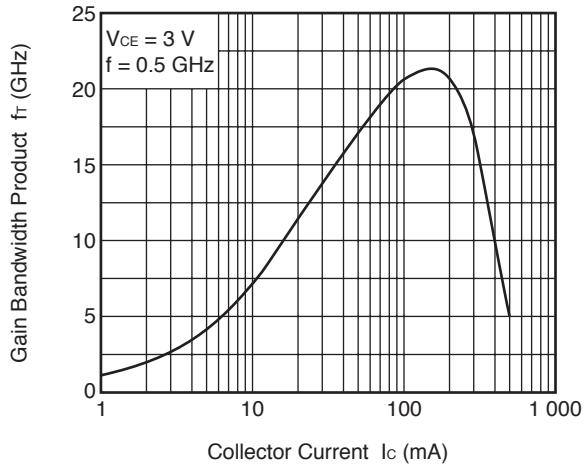
**COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE**



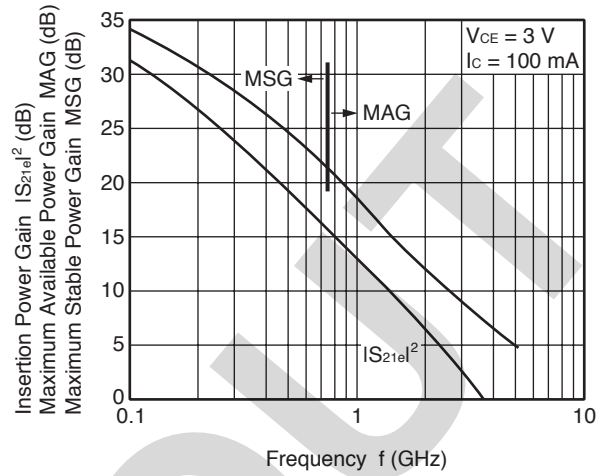
**DC CURRENT GAIN vs. COLLECTOR CURRENT**



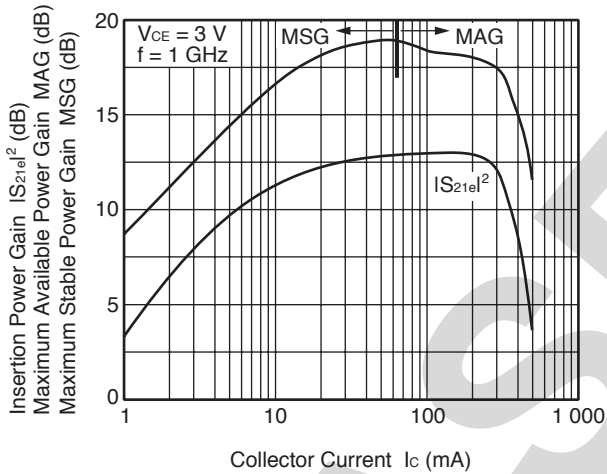
GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



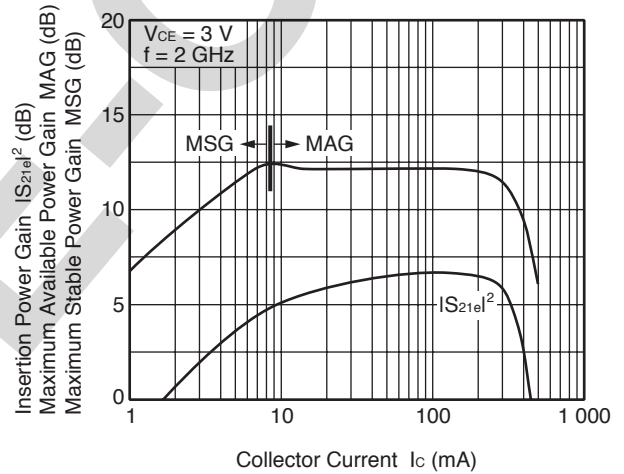
INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY



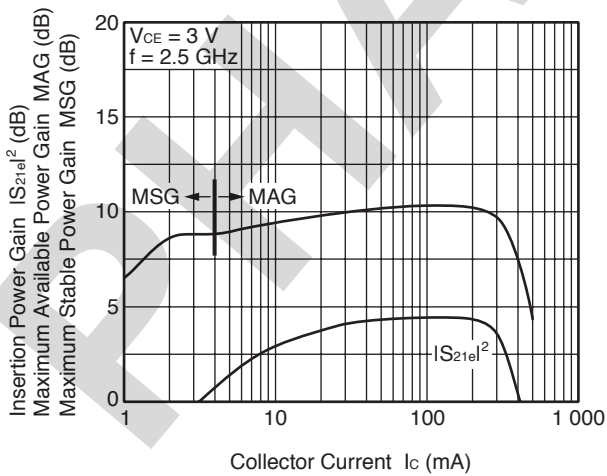
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



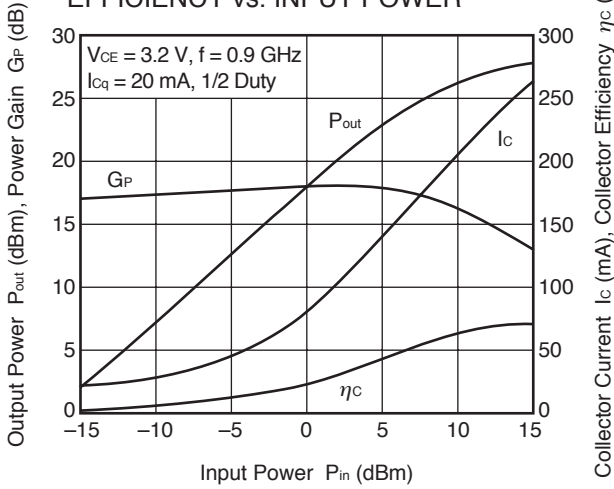
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



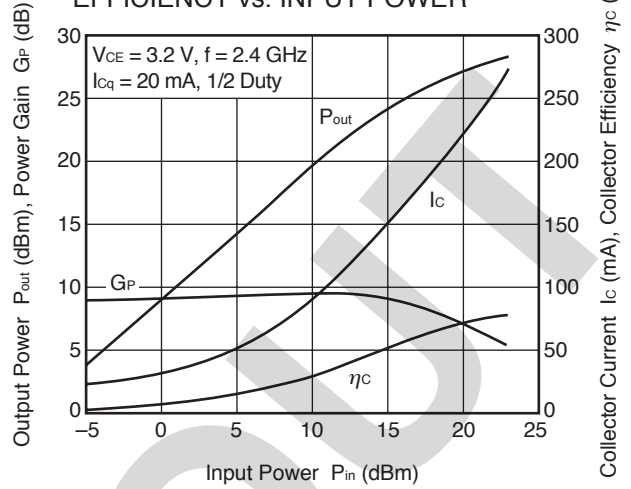
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



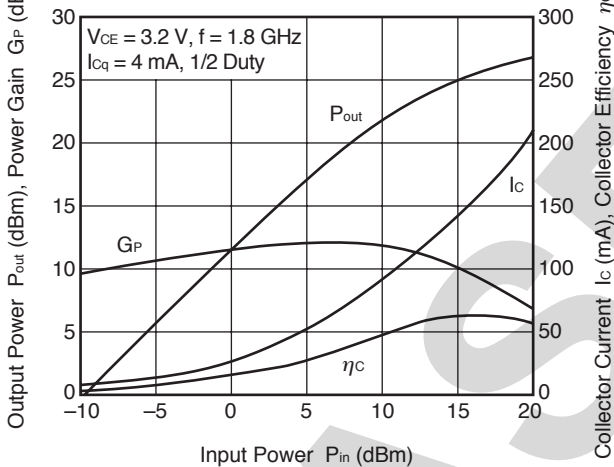
OUTPUT POWER, POWER GAIN, COLLECTOR CURRENT, COLLECTOR EFFICIENCY vs. INPUT POWER



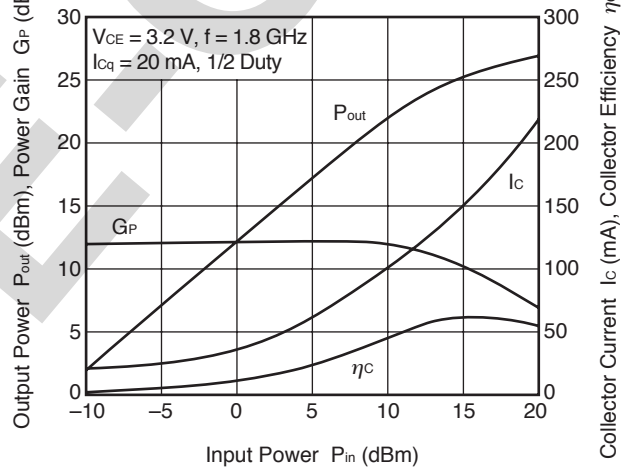
OUTPUT POWER, POWER GAIN, COLLECTOR CURRENT, COLLECTOR EFFICIENCY vs. INPUT POWER



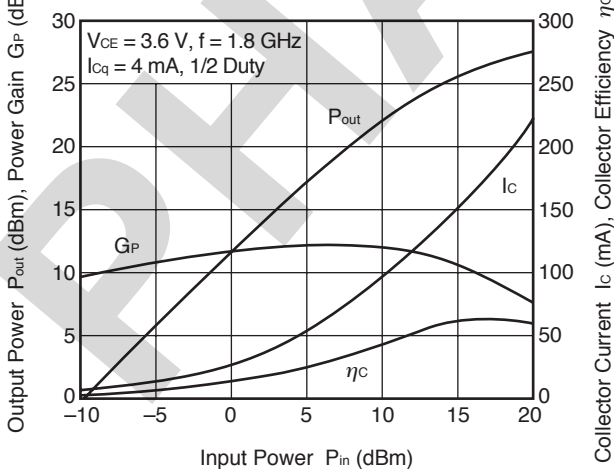
OUTPUT POWER, POWER GAIN, COLLECTOR CURRENT, COLLECTOR EFFICIENCY vs. INPUT POWER



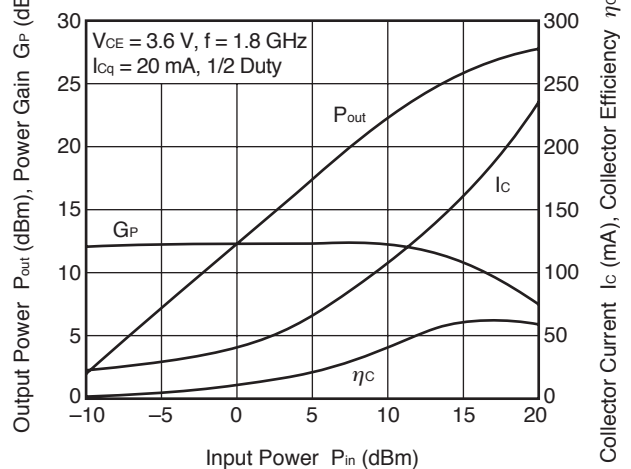
OUTPUT POWER, POWER GAIN, COLLECTOR CURRENT, COLLECTOR EFFICIENCY vs. INPUT POWER



OUTPUT POWER, POWER GAIN, COLLECTOR CURRENT, COLLECTOR EFFICIENCY vs. INPUT POWER



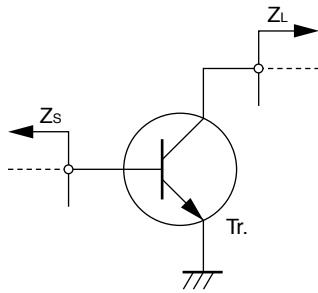
OUTPUT POWER, POWER GAIN, COLLECTOR CURRENT, COLLECTOR EFFICIENCY vs. INPUT POWER



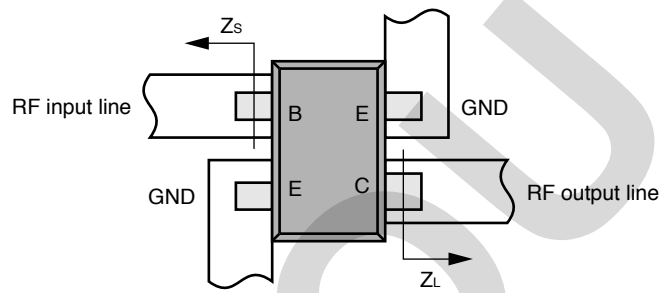
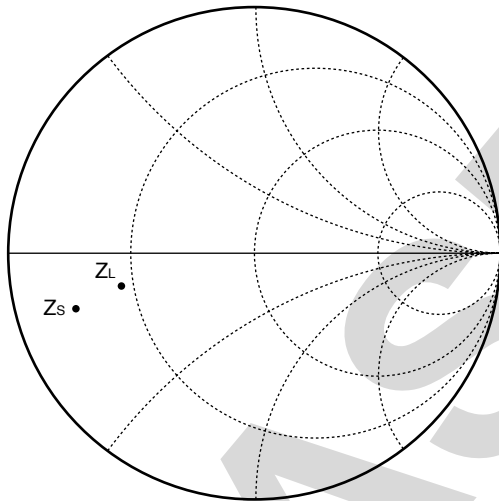
**Remark** The graphs indicate nominal characteristics.

**POWER SUPPLY IMPEDANCE, LOAD IMPEDANCE (Recommended value)**

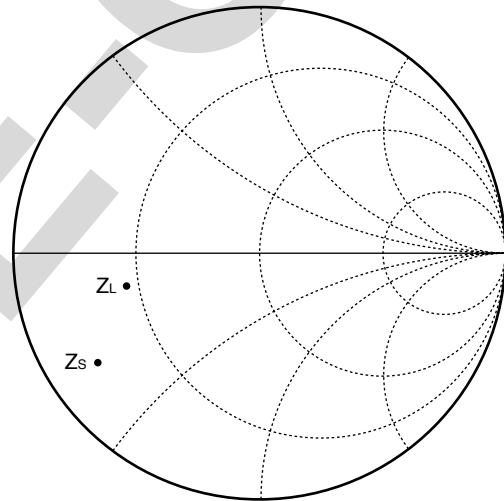
Frequency f (GHz)	Collector to Emitter Voltage V <sub>CE</sub> (V)	Supply Impedance Z <sub>s</sub> (Ω)	Load Impedance Z <sub>L</sub> (Ω)
0.9	2.8 to 3.6	8.4 - 5.2 j	15.1 - 4.3 j
1.8	2.8 to 3.6	6.3 - 16.4 j	15.8 - 6.9 j
2.4	2.8 to 3.6	5.9 - 22.1 j	15.2 - 17.9 j



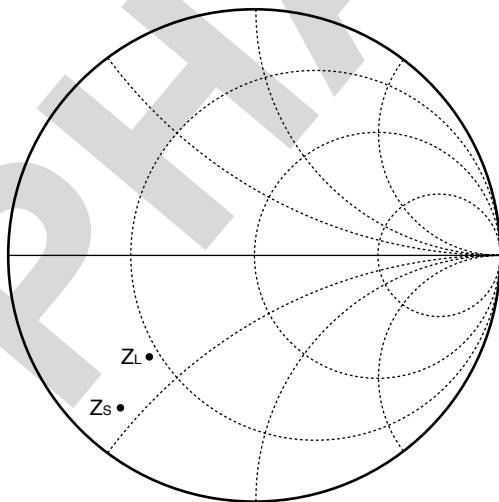
f = 0.9 GHz



f = 1.8 GHz

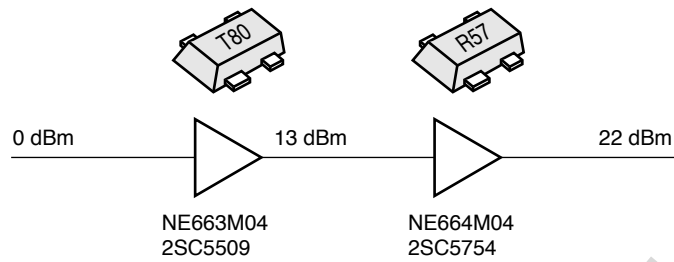


f = 2.4 GHz

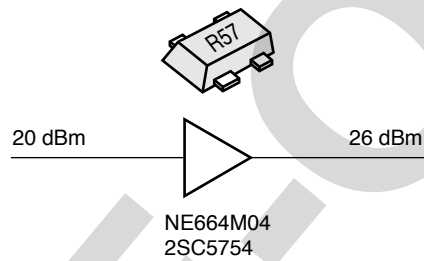


**APPLICATION EXAMPLE (Low-cost PA solution)**

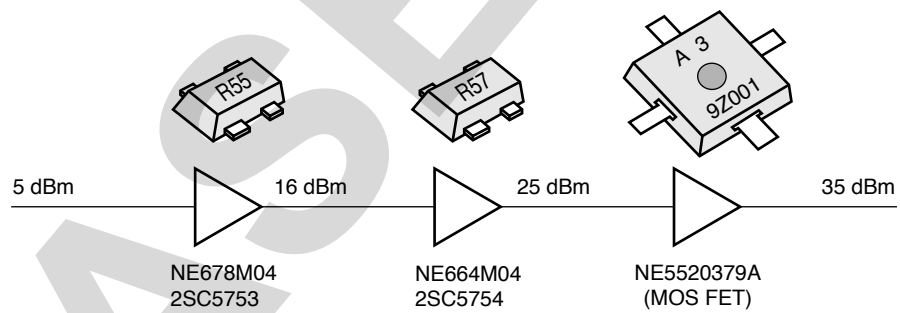
Bluetooth Power Class 1  
f = 2.4 GHz



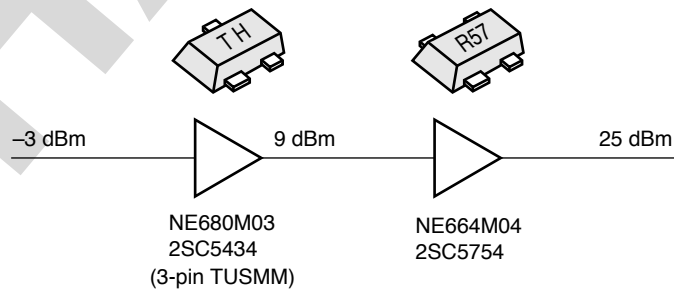
SS Cordless Phone  
f = 2.4 GHz



DCS1800 (GSM1800) Cellular Phone  
f = 1.8 GHz

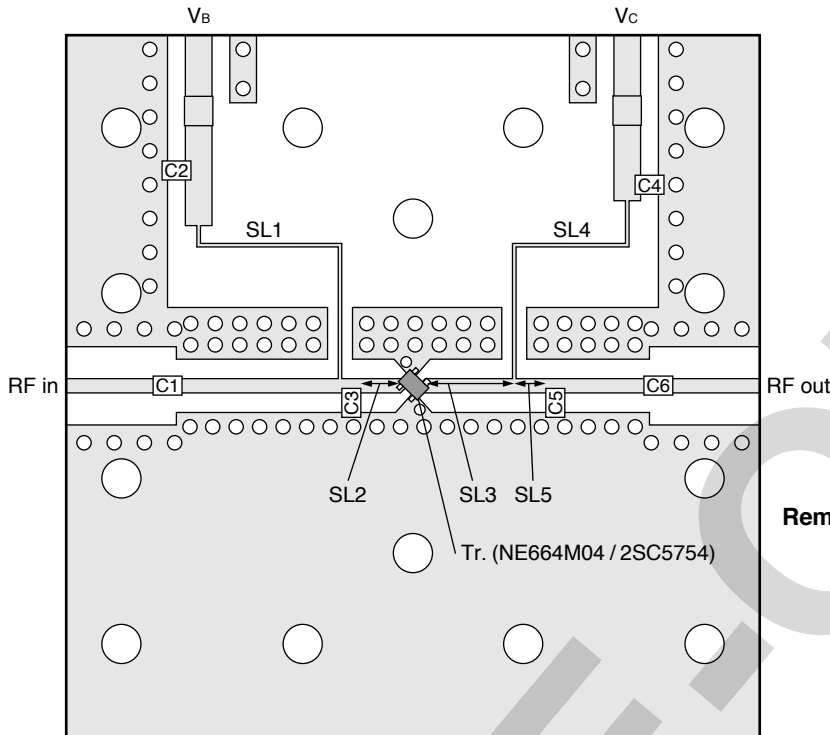


Cordless Phone  
f = 0.9 GHz



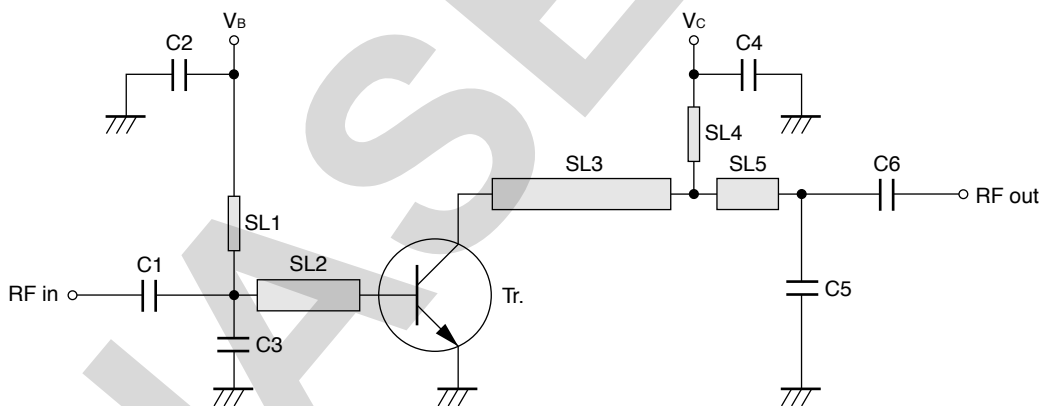
EVALUATION CIRCUIT EXAMPLE : 1.8 GHz PA EVALUATION BOARD

PCB Pattern and Element Layout



- Remarks**
1. 38 × 38 mm, t = 0.4 mm,  $\epsilon_r = 4.55$  double-sided copper-clad polyimide board
  2. Back side : GND pattern
  3. Solder plating on pattern
  4.  $\circ$  : Through holes

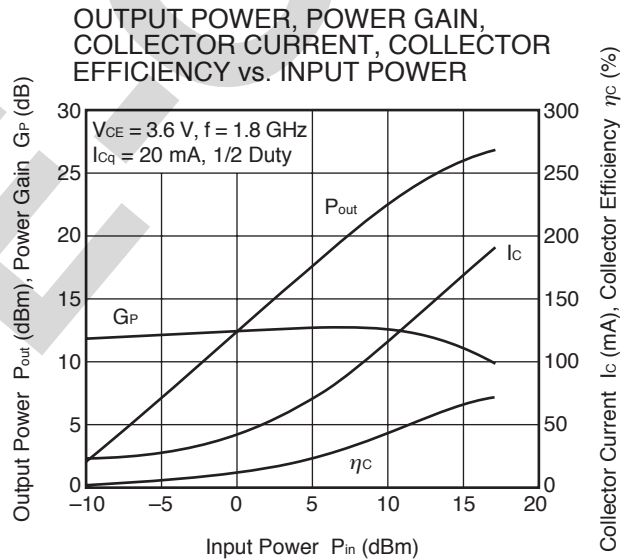
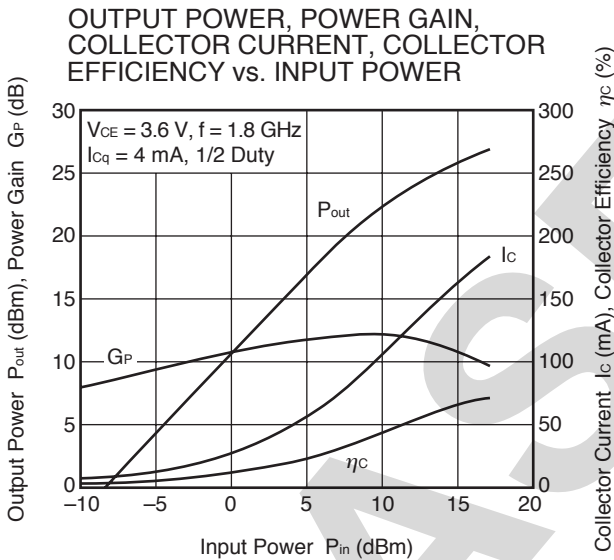
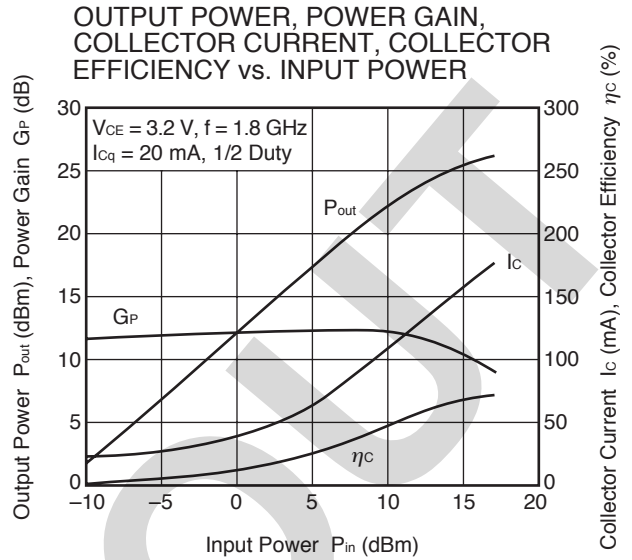
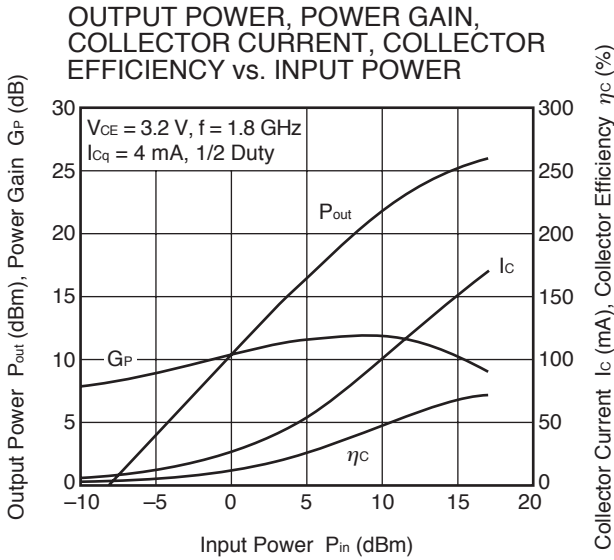
Equivalent Circuit



Parts List

Parts	Value	Size	Classification
C1, C6	18 pF		Multilayer ceramic chip capacitor
C2	3 300 pF		Multilayer ceramic chip capacitor
C3	3 pF		Multilayer ceramic chip capacitor
C4	15 pF		Multilayer ceramic chip capacitor
C5	1.5 pF		Multilayer ceramic chip capacitor
SL1, SL4		w = 0.20 mm	Strip line
SL2		w = 0.76 mm, l = 2.5 mm	Strip line
SL3		w = 0.76 mm, l = 5 mm	Strip line
SL5		w = 0.76 mm, l = 1.5 mm	Strip line

**EXAMPLE OF CHARACTERISTICS FOR 1.8 GHz PA EVALUATION BOARD**



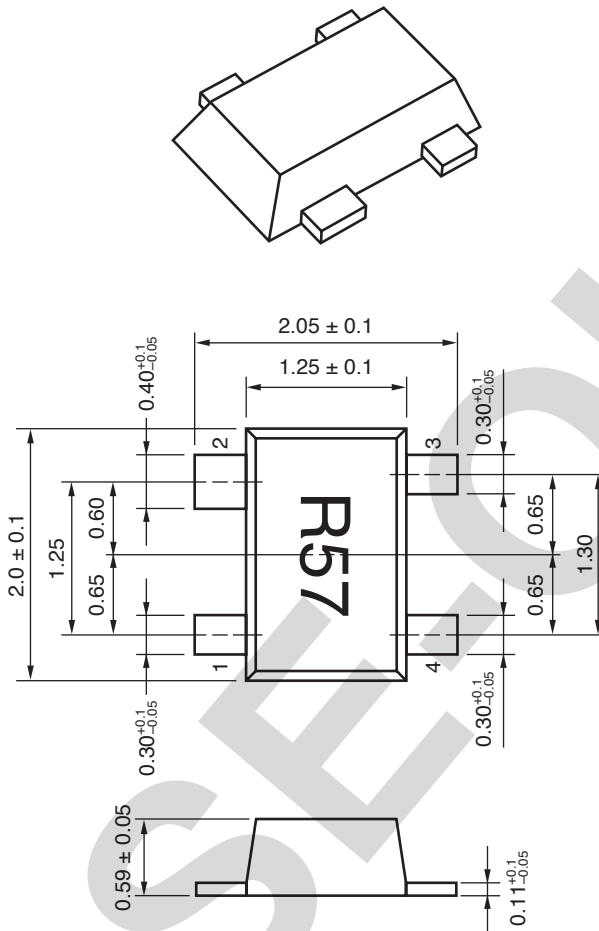
**Remark** The graphs indicate nominal characteristics.

**S-PARAMETERS**

- S-parameters and noise parameters are provided on our Web site in a format (S2P) that enables the direct import of the parameters to microwave circuit simulators without the need for keyboard inputs.
- Click here to download S-parameters.
- [RF and Microwave] ® [Device Parameters]
- URL <http://www.necel.com/microwave/en/>

**PACKAGE DIMENSIONS**

**FLAT-LEAD 4-PIN THIN-TYPE SUPER MINIMOLD (M04) (UNIT: mm)**



**PIN CONNECTIONS**

- 1. Emitter
- 2. Collector
- 3. Emitter
- 4. Base

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