

# DATA SHEET



## NPN SILICON RF TRANSISTOR NE856M02 / 2SC5336 JEITA Part No.

### NPN SILICON RF TRANSISTOR FOR HIGH-FREQUENCY LOW DISTORTION AMPLIFIER 4-PIN POWER MINIMOLD

#### FEATURES

- High gain:  $|S_{21e}|^2 = 12$  dB TYP. @  $V_{CE} = 10$  V,  $I_c = 20$  mA,  $f = 1$  GHz
- 4-pin power minimold package with improved gain from the NE85634 / 2SC3357

#### ★ ORDERING INFORMATION

| Part Number                  | Quantity          | Supplying Form  |
|------------------------------|-------------------|---|
| NE856M02-AZ<br>2SC5336-AZ    | 25 pcs (Non reel) | • Magazine case   |
| NE856M02-AZ<br>2SC5336-T1-AZ | 1 kpcs/reel       | • 12 mm wide embossed taping<br>• Collector face the perforation side of the tape |

**Remark** To order evaluation samples, please contact your nearby sales office.  
Unit sample quantity is 25 pcs.

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = +25^\circ\text{C}$ )

| Parameter                    | Symbol           | Ratings     | Unit             |
|------------------------------|------------------|-------------|------------------|
| Collector to Base Voltage    | $V_{CBO}$        | 20          | V                |
| Collector to Emitter Voltage | $V_{CEO}$        | 12          | V                |
| Emitter to Base Voltage      | $V_{EBO}$        | 3.0         | V                |
| Collector Current            | $I_c$            | 100         | mA               |
| Total Power Dissipation      | $P_{tot}^{Note}$ | 1.2         | W                |
| Junction Temperature         | $T_j$            | 150         | $^\circ\text{C}$ |
| Storage Temperature          | $T_{stg}$        | -65 to +150 | $^\circ\text{C}$ |

**Note** Mounted on  $16\text{ cm}^2 \times 0.7\text{ mm}$  (t) ceramic substrate (Copper plating)

**Because this product uses high-frequency technology, avoid excessive static electricity, etc.**

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

| Parameter                    | Symbol                            | Test Conditions   | MIN. | TYP. | MAX. | Unit |
|------------------------------|-----------------------------------|---|------|------|------|------|
| DC Characteristics           |                                   |   |      |      |      |      |
| Collector Cut-off Current    | I <sub>CBO</sub>                  | V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0 mA             | –    | –    | 1.0  | μA   |
| Emitter Cut-off Current      | I <sub>EBO</sub>                  | V <sub>BE</sub> = 1 V, I <sub>C</sub> = 0 mA              | –    | –    | 1.0  | μA   |
| DC Current Gain              | h <sub>FE</sub> <sup>Note 1</sup> | V <sub>CE</sub> = 10 V, I <sub>C</sub> = 20 mA            | 50   | 120  | 250  | –    |
| RF Characteristics           |                                   |   |      |      |      |      |
| Gain Bandwidth Product       | f <sub>T</sub>                    | V <sub>CE</sub> = 10 V, I <sub>C</sub> = 20 mA            | –    | 6.5  | –    | GHz  |
| Insertion Power Gain         | S <sub>21e</sub>   <sup>2</sup>   | V <sub>CE</sub> = 10 V, I <sub>C</sub> = 20 mA, f = 1 GHz | –    | 12   | –    | dB   |
| Noise Figure (1)             | NF                                | V <sub>CE</sub> = 10 V, I <sub>C</sub> = 7 mA, f = 1 GHz  | –    | 1.1  | –    | dB   |
| Noise Figure (2)             | NF                                | V <sub>CE</sub> = 10 V, I <sub>C</sub> = 40 mA, f = 1 GHz | –    | 1.8  | 3.0  | dB   |
| Reverse Transfer Capacitance | C <sub>re</sub> <sup>Note 2</sup> | V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0 mA, f = 1 MHz  | –    | 0.5  | 0.8  | pF   |

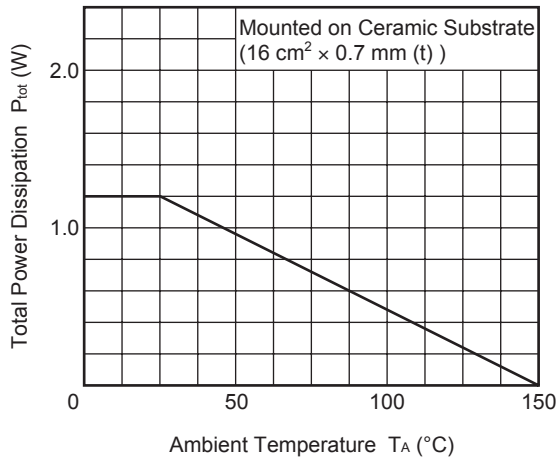
- Notes 1.** Pulse measurement: PW ≤ 350 μs, Duty Cycle ≤ 2%  
**2.** Collector to base capacitance when the emitter grounded

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

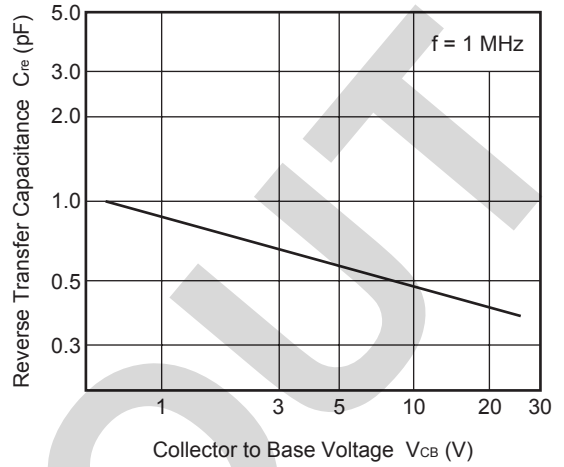
|                       |           |           |            |
|-----------------------|-----------|-----------|------------|
| Rank                  | RH        | RF        | RE         |
| Marking               | RH        | RF        | RE         |
| h <sub>FE</sub> Value | 50 to 100 | 80 to 160 | 125 to 250 |

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

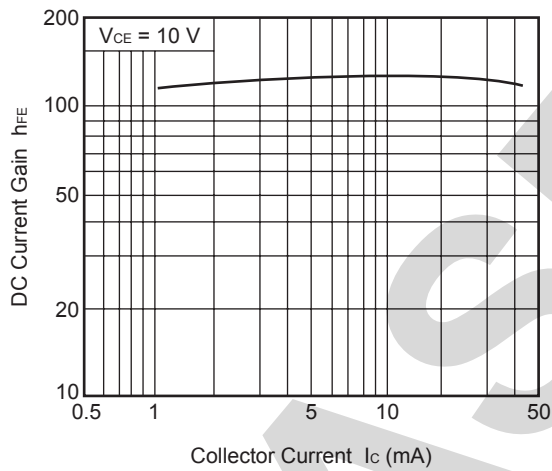
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



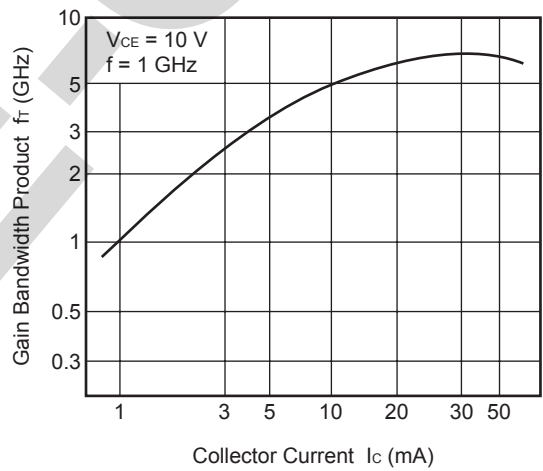
REVERSE TRANSFER CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



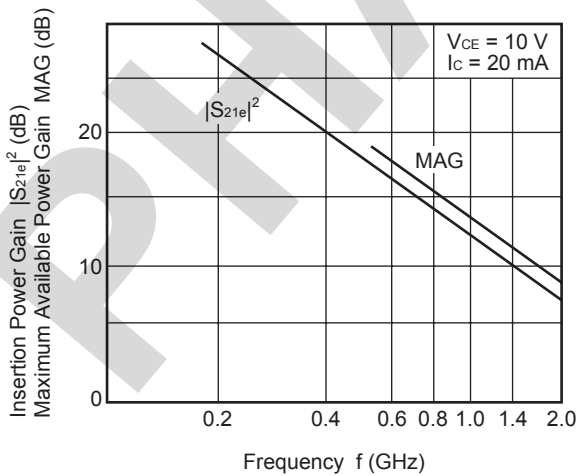
DC CURRENT GAIN vs. COLLECTOR CURRENT



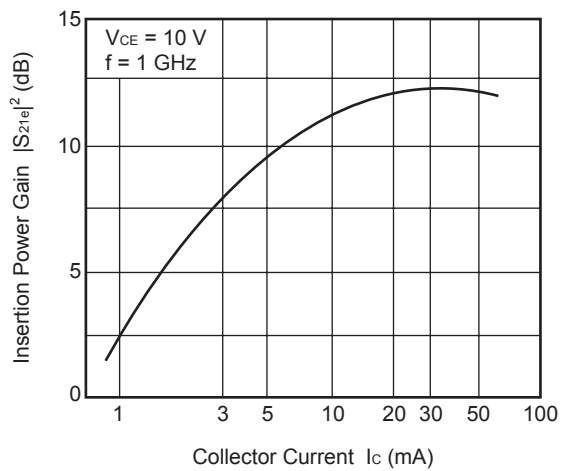
GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



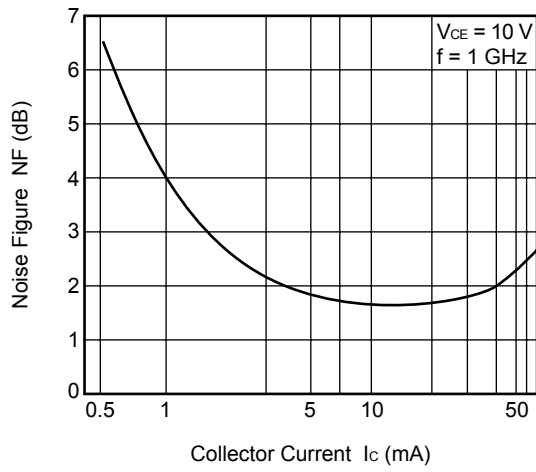
INSERTION POWER GAIN, MAG vs. FREQUENCY



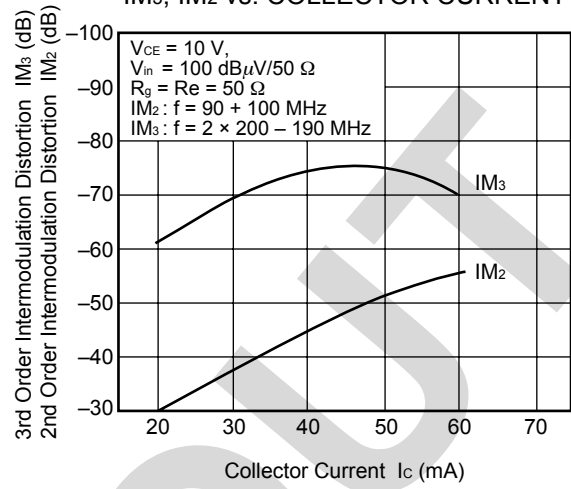
INSERTION POWER GAIN vs. COLLECTOR CURRENT



NOISE FIGURE vs. COLLECTOR CURRENT



IM<sub>3</sub>, IM<sub>2</sub> vs. COLLECTOR CURRENT



**Remark** The graphs indicate nominal characteristics.

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**S-PARAMETERS**

V<sub>CE</sub> = 10 V, I<sub>c</sub> = 20 mA

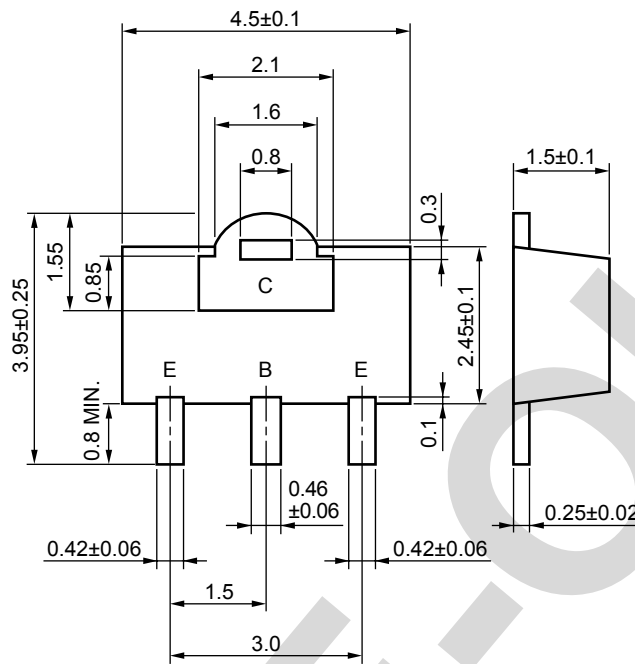
| Frequency<br>(GHz) | S <sub>11</sub> |                | S <sub>21</sub> |                | S <sub>12</sub> |                | S <sub>22</sub> |                |
|--------------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|
|                    | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) |
| 0.1                | 0.519           | -74.5          | 30.931          | 131.9          | 0.017           | 60.6           | 0.752           | -30.2          |
| 0.2                | 0.413           | -112.9         | 18.965          | 111.5          | 0.031           | 61.9           | 0.570           | -39.7          |
| 0.3                | 0.413           | -133.4         | 13.324          | 101.9          | 0.038           | 65.1           | 0.465           | -39.8          |
| 0.4                | 0.345           | -145.7         | 10.164          | 95.9           | 0.045           | 69.8           | 0.428           | -40.1          |
| 0.5                | 0.331           | -153.8         | 8.177           | 91.8           | 0.055           | 71.8           | 0.436           | -41.1          |
| 0.6                | 0.320           | -159.6         | 6.834           | 89.1           | 0.064           | 70.9           | 0.438           | -43.5          |
| 0.7                | 0.302           | -166.8         | 5.832           | 86.7           | 0.074           | 73.9           | 0.434           | -47.5          |
| 0.8                | 0.296           | -169.2         | 5.107           | 84.3           | 0.077           | 74.4           | 0.429           | -47.8          |
| 0.9                | 0.283           | -173.2         | 4.600           | 83.1           | 0.088           | 71.2           | 0.436           | -46.5          |
| 1.0                | 0.285           | -179.8         | 4.200           | 82.3           | 0.097           | 74.5           | 0.455           | -47.8          |
| 1.1                | 0.265           | 175.2          | 3.930           | 80.8           | 0.100           | 76.3           | 0.467           | -46.8          |
| 1.2                | 0.260           | 174.1          | 3.979           | 78.5           | 0.109           | 75.9           | 0.529           | -47.4          |
| 1.3                | 0.263           | 166.0          | 3.741           | 68.6           | 0.114           | 76.8           | 0.551           | -55.8          |
| 1.4                | 0.242           | 163.0          | 3.115           | 66.6           | 0.119           | 78.3           | 0.509           | -55.8          |
| 1.5                | 0.252           | 160.1          | 2.844           | 65.7           | 0.133           | 82.0           | 0.510           | -58.5          |
| 1.6                | 0.253           | 154.0          | 2.595           | 64.1           | 0.140           | 81.0           | 0.496           | -55.2          |
| 1.7                | 0.253           | 149.9          | 2.420           | 63.7           | 0.158           | 80.9           | 0.515           | -54.8          |
| 1.8                | 0.257           | 147.2          | 2.305           | 63.0           | 0.165           | 82.2           | 0.518           | -56.5          |
| 1.9                | 0.262           | 143.0          | 2.171           | 62.6           | 0.172           | 80.5           | 0.536           | -58.6          |
| 2.0                | 0.273           | 141.5          | 2.049           | 61.2           | 0.177           | 78.3           | 0.524           | -61.5          |

V<sub>CE</sub> = 10 V, I<sub>c</sub> = 40 mA

| Frequency<br>(GHz) | S <sub>11</sub> |                | S <sub>21</sub> |                | S <sub>12</sub> |                | S <sub>22</sub> |                |
|--------------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|
|                    | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) |
| 0.1                | 0.378           | -97.1          | 32.908          | 123.3          | 0.017           | 71.1           | 0.665           | -34.7          |
| 0.2                | 0.317           | -131.8         | 18.819          | 106.0          | 0.027           | 71.2           | 0.487           | -38.7          |
| 0.3                | 0.308           | -150.1         | 12.955          | 97.5           | 0.035           | 71.8           | 0.398           | -38.5          |
| 0.4                | 0.299           | -158.7         | 9.775           | 93.1           | 0.042           | 78.1           | 0.393           | -36.9          |
| 0.5                | 0.297           | -165.5         | 7.899           | 89.8           | 0.052           | 78.5           | 0.399           | -37.6          |
| 0.6                | 0.288           | -169.2         | 6.586           | 87.6           | 0.061           | 79.1           | 0.407           | -39.9          |
| 0.7                | 0.274           | -173.7         | 5.607           | 85.2           | 0.071           | 77.4           | 0.400           | -44.6          |
| 0.8                | 0.261           | -177.3         | 4.879           | 83.5           | 0.081           | 76.4           | 0.415           | -47.4          |
| 0.9                | 0.255           | 178.9          | 4.435           | 82.2           | 0.092           | 76.5           | 0.399           | -46.2          |
| 1.0                | 0.260           | 173.0          | 4.024           | 81.4           | 0.095           | 77.6           | 0.440           | -44.3          |
| 1.1                | 0.243           | 169.4          | 3.801           | 80.6           | 0.098           | 77.1           | 0.441           | -45.2          |
| 1.2                | 0.239           | 169.3          | 3.827           | 78.2           | 0.109           | 78.3           | 0.494           | -46.2          |
| 1.3                | 0.245           | 160.3          | 3.587           | 68.4           | 0.117           | 78.0           | 0.517           | -55.4          |
| 1.4                | 0.216           | 157.8          | 2.980           | 66.0           | 0.125           | 80.3           | 0.486           | -54.5          |
| 1.5                | 0.235           | 155.3          | 2.726           | 66.1           | 0.137           | 86.5           | 0.500           | -59.0          |
| 1.6                | 0.243           | 148.8          | 2.537           | 64.0           | 0.143           | 80.6           | 0.474           | -53.7          |
| 1.7                | 0.233           | 146.0          | 2.348           | 64.2           | 0.159           | 81.2           | 0.496           | -56.8          |
| 1.8                | 0.242           | 144.6          | 2.200           | 63.5           | 0.163           | 80.4           | 0.491           | -53.6          |
| 1.9                | 0.249           | 141.9          | 2.073           | 63.3           | 0.171           | 81.7           | 0.534           | -58.0          |
| 2.0                | 0.260           | 140.4          | 1.986           | 61.7           | 0.184           | 77.5           | 0.535           | -61.3          |

★ PACKAGE DIMENSIONS

4-PIN POWER MINIMOLD (UNIT: mm)



**PIN CONNECTIONS**

- E: Emitter
- C: Collector
- B: Base

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