NEC

# SILICON TRANSISTOR
# 2SC3356

## MICROWAVE LOW NOISE AMPLIFIER
## NPN SILICON EPITAXIAL TRANSISTOR

### DESCRIPTION

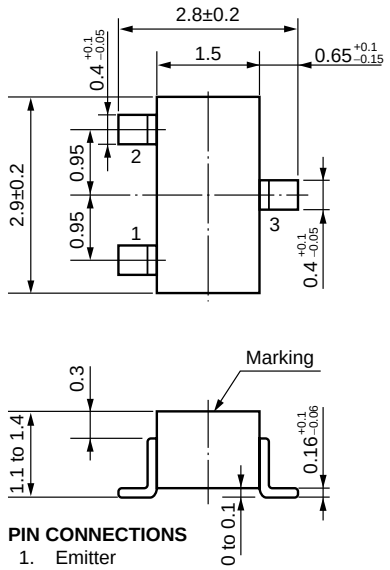
The 2SC3356 is an NPN silicon epitaxial transistor designed for low noise amplifier at VHF, UHF and CATV band.

It has dynamic range and good current characteristic.

### FEATURES

- Low Noise and High Gain
  NF = 1.1 dB TYP., $G_a$ = 11 dB TYP. @$V_{CE}$ = 10 V, $I_C$ = 7 mA, f = 1.0 GHz
- High Power Gain
  MAG = 13 dB TYP. @$V_{CE}$ = 10 V, $I_C$ = 20 mA, f = 1.0 GHz

**PACKAGE DIMENSIONS**
(Units: mm)




**PIN CONNECTIONS**
1. Emitter
2. Base
3. Collector

### ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °C)

| | | | |
|---|---|---|---|
| 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 | $P_T$ | 200 | mW |
| Junction Temperature | $T_j$ | 150 | °C |
| Storage Temperature | $T_{stg}$ | –65 to +150 | °C |

### ELECTRICAL CHARACTERISTICS ($T_A$ = 25 °C)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| Collector Cutoff Current | $I_{CBO}$ | | | 1.0 | μA | $V_{CB}$ = 10 V, $I_E$ = 0 |
| Emitter Cutoff Current | $I_{EBO}$ | | | 1.0 | μA | $V_{EB}$ = 1.0 V, $I_C$ = 0 |
| DC Current Gain | $h_{FE}$* | 50 | 120 | 300 | | $V_{CE}$ = 10 V, $I_C$ = 20 mA |
| Gain Bandwidth Product | $f_T$ | | 7 | | GHz | $V_{CE}$ = 10 V, $I_C$ = 20 mA |
| Feed-Back Capacitance | $C_{re}$** | | 0.55 | 1.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| Insertion Power Gain | $\|S_{21e}\|^2$ | | 11.5 | | dB | $V_{CE}$ = 10 V, $I_C$ = 20 mA, f = 1.0 GHz |
| Noise Figure | NF | | 1.1 | 2.0 | dB | $V_{CE}$ = 10 V, $I_C$ = 7 mA, f = 1.0 GHz |

* Pulse Measurement PW ≤ 350 μs, Duty Cycle ≤ 2 %

** The emitter terminal and the case shall be connected to the guard terminal of the three-terminal capacitance bridge.

**$h_{FE}$ Classification**

| Class | R23/Q * | R24/R * | R25/S * |
|---|---|---|---|
| Marking | R23 | R24 | R25 |
| $h_{FE}$ | 50 to 100 | 80 to 160 | 125 to 250 |

* Old Specification / New Specification

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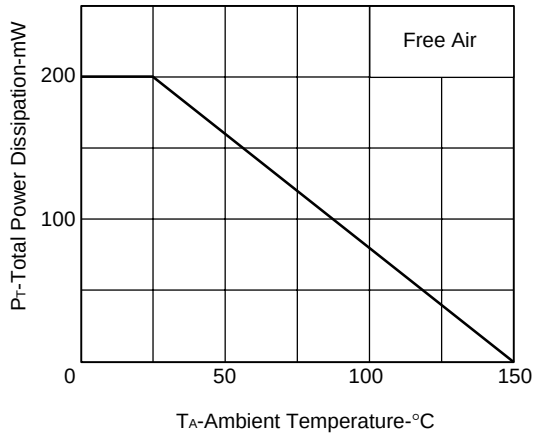
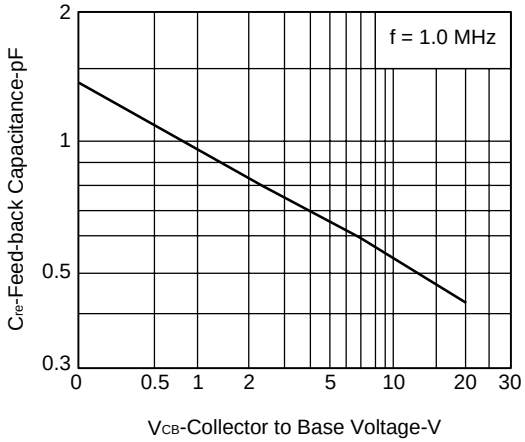
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C)

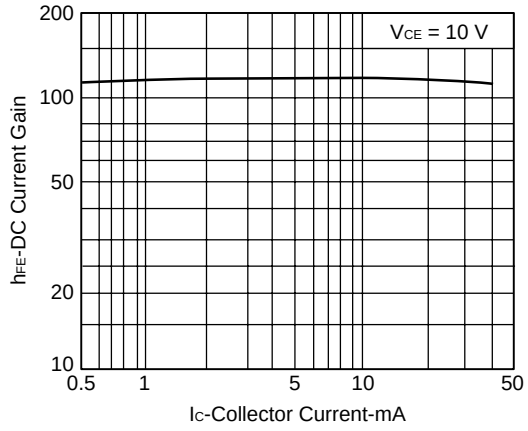
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



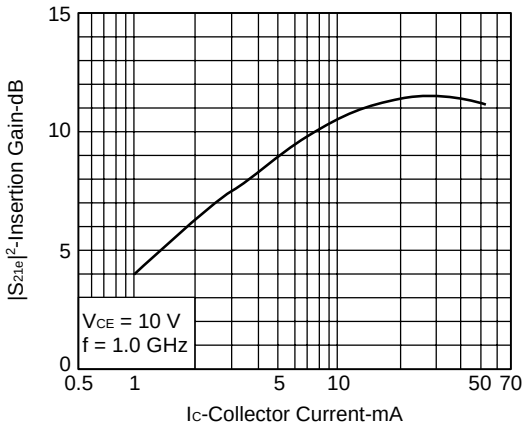

FEED-BACK CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



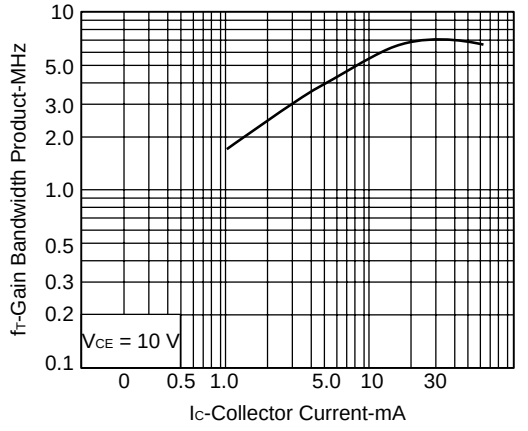

DC CURRENT GAIN vs. COLLECTOR CURRENT



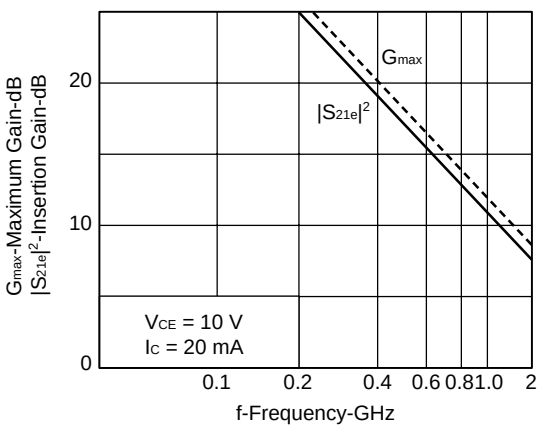

INSERTION GAIN vs. COLLECTOR CURRENT



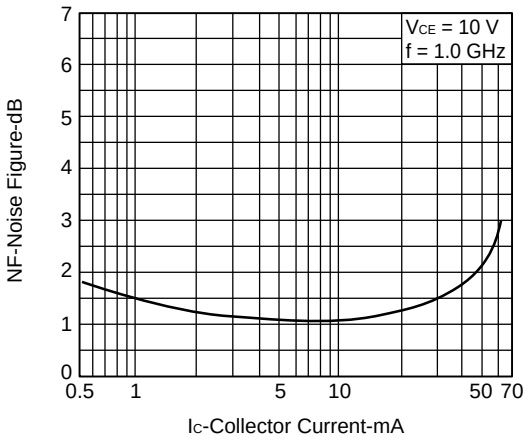

GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



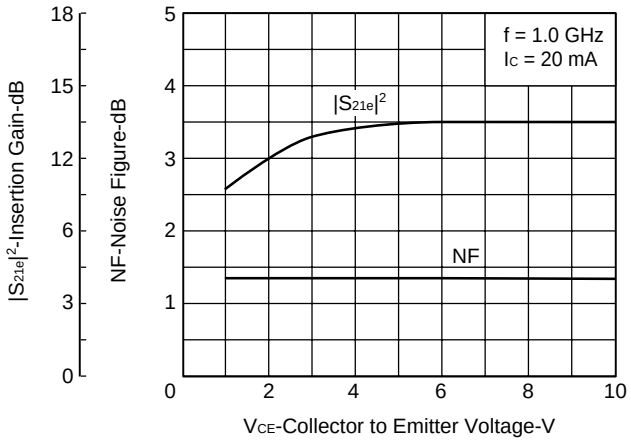

INSERTION GAIN, MAXIMUM GAIN vs. FREQUENCY



NOISE FIGURE vs.
COLLECTOR CURRENT




NOISE FIGURE, FORWARD INSERTION
GAIN vs. COLLECTOR TO EMITTER VOLTAGE




## S-PARAMETER

$V_{CE}$ = 10 V, $I_C$ = 5 mA, $Z_O$ = 50 Ω

| f (MHz) | $\lvert S_{11} \rvert$ | $\angle S_{11}$ | $\lvert S_{21} \rvert$ | $\angle S_{21}$ | $\lvert S_{12} \rvert$ | $\angle S_{12}$ | $\lvert S_{22} \rvert$ | $\angle S_{22}$ |
|---|---|---|---|---|---|---|---|---|
| 200 | 0.651 | −69.3 | 10.616 | 129.3 | 0.051 | 59.2 | 0.735 | −28.1 |
| 400 | 0.467 | −113.3 | 6.856 | 104.4 | 0.071 | 54.4 | 0.550 | −34.1 |
| 600 | 0.391 | −139.3 | 4.852 | 90.9 | 0.086 | 56.0 | 0.468 | −33.9 |
| 800 | 0.360 | −159.2 | 3.802 | 81.2 | 0.101 | 59.1 | 0.426 | −33.6 |
| 1000 | 0.360 | −176.9 | 3.098 | 72.9 | 0.118 | 61.0 | 0.397 | −35.7 |
| 1200 | 0.361 | 172.7 | 2.646 | 67.3 | 0.137 | 63.5 | 0.373 | −38.3 |
| 1400 | 0.381 | 160.3 | 2.298 | 59.3 | 0.157 | 63.3 | 0.360 | −43.0 |
| 1600 | 0.398 | 152.2 | 2.071 | 55.2 | 0.180 | 64.1 | 0.337 | −45.9 |
| 1800 | 0.423 | 143.3 | 1.836 | 49.0 | 0.203 | 63.7 | 0.320 | −52.3 |
| 2000 | 0.445 | 137.6 | 1.689 | 46.2 | 0.220 | 64.7 | 0.302 | −52.2 |

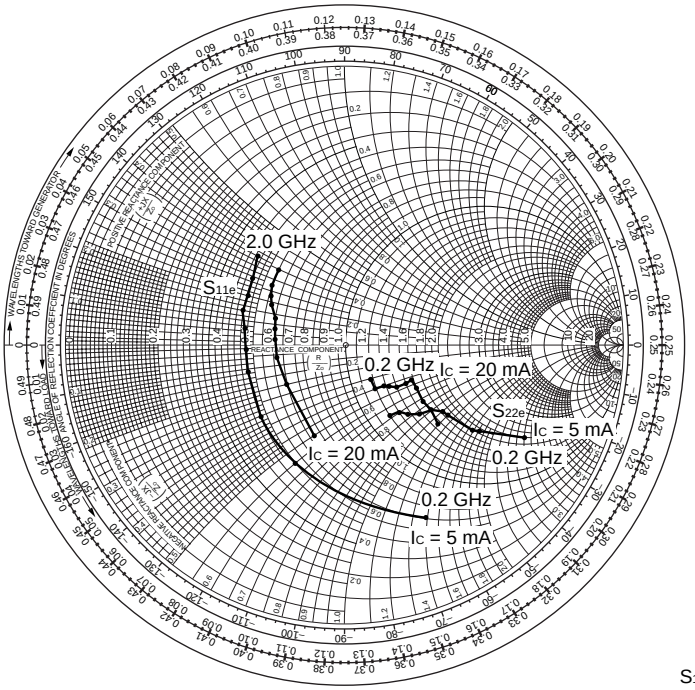
$V_{CE}$ = 10 V, $I_C$ = 5 mA, $Z_O$ = 50 Ω

| f (MHz) | $\lvert S_{11} \rvert$ | $\angle S_{11}$ | $\lvert S_{21} \rvert$ | $\angle S_{21}$ | $\lvert S_{12} \rvert$ | $\angle S_{12}$ | $\lvert S_{22} \rvert$ | $\angle S_{22}$ |
|---|---|---|---|---|---|---|---|---|
| 200 | 0.339 | −107.0 | 16.516 | 108.7 | 0.035 | 66.1 | 0.459 | −36.6 |
| 400 | 0.258 | −147.3 | 8.928 | 92.1 | 0.060 | 71.0 | 0.343 | −32.9 |
| 600 | 0.243 | −167.7 | 6.022 | 83.0 | 0.085 | 71.9 | 0.305 | −29.9 |
| 800 | 0.242 | 177.0 | 4.633 | 76.2 | 0.109 | 72.2 | 0.284 | −29.4 |
| 1000 | 0.260 | 164.5 | 3.744 | 69.9 | 0.136 | 70.4 | 0.266 | −31.7 |
| 1200 | 0.269 | 157.6 | 3.193 | 65.7 | 0.160 | 69.9 | 0.246 | −35.0 |
| 1400 | 0.294 | 148.7 | 2.750 | 58.8 | 0.187 | 66.7 | 0.233 | −40.4 |
| 1600 | 0.314 | 143.1 | 2.479 | 55.5 | 0.212 | 65.2 | 0.208 | −43.6 |
| 1800 | 0.343 | 136.5 | 2.185 | 50.1 | 0.238 | 62.4 | 0.190 | −50.5 |
| 2000 | 0.367 | 131.4 | 2.016 | 47.8 | 0.254 | 61.6 | 0.173 | −48.3 |

## S-PARAMETER

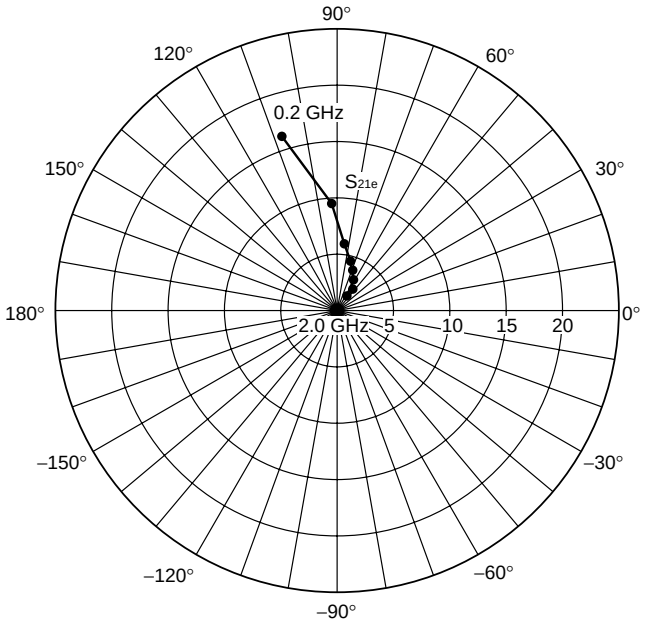
$S_{11e}$, $S_{22e}$-FREQUENCY

CONDITION $V_{CE}$ = 10 V
200 MHz Step



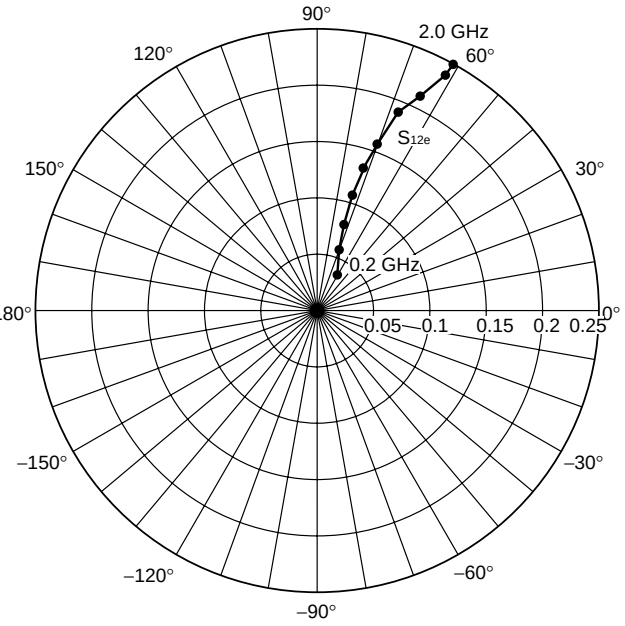

$S_{21e}$-FREQUENCY

CONDITION $V_{CE}$ = 10 V
$I_C$ = 20 mA




$S_{12e}$-FREQUENCY

CONDITION $V_{CE}$ = 10 V
$I_C$ = 20 mA



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