



Monolithic Transistor Array – SiS3046

Silicon General Purpose x5 NPN Transistor array in bare die form

Rev 1.1
20/10/17

Description

The SiS3046 consists of five general purpose silicon NPN transistors on a common monolithic substrate. Two of the transistors are internally connected to form a differentially-connected pair. The transistors are well suited to a wide variety of applications in low power systems in the DC through VHF range. They may be used as discrete transistors in conventional circuits however; in addition, they provide the very significant inherent integrated circuit advantages of close electrical and thermal matching. The SiS3046 is a direct electrical & mechanical replacement for the obsolete Intersil CA3046 & National (TI) LM3046.

Features:

- Two matched transistors:
 - V_{BE} Match $\pm 5\text{mA}$
 - I_{IO} Match $2\mu\text{A}$ (Max)
- Low Noise Figure 3.2dB (Typ) at 1kHz
- Operation From DC to 20MHz
- Wide Operating Current Range
- Full Military Temperature Range.

Ordering Information

The following part suffixes apply:

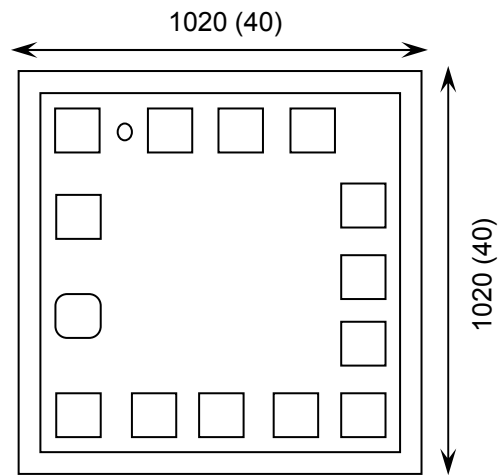
- No suffix - MIL-STD-883 /2010B Visual Inspection
- “H” - MIL-STD-883 /2010B Visual Inspection
+ MIL-PRF-38534 Class H LAT
- “K” - MIL-STD-883 /2010A Visual Inspection (Space)
+ MIL-PRF-38534 Class K LAT

LAT = Lot Acceptance Test.

For further information on LAT process flows see below.

www.siliconsupplies.com/quality/bare-die-lot-qualification

Die Dimensions in μm (mils)



Supply Formats:

- Default - Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – By specific request
- Unsawn Wafer – By specific request
- 14 Lead CERDIP / PDIP package – By specific request
- 14 Lead SOIC package – By specific request

Mechanical Specification

| | | |
|------------------------|--|-----------------------|
| Die Size (Unsawn) | 1020 x 1020 40 x 40 | μm mils |
| Minimum Bond Pad Size | 100 x 100 4 x 4 | μm mils |
| Die Thickness | 460 18.1 | μm mils |
| Top Metal Composition | TiW-AlSi 0.15 μm -3 μm | |
| Back Metal Composition | N/A – Bare Si | |

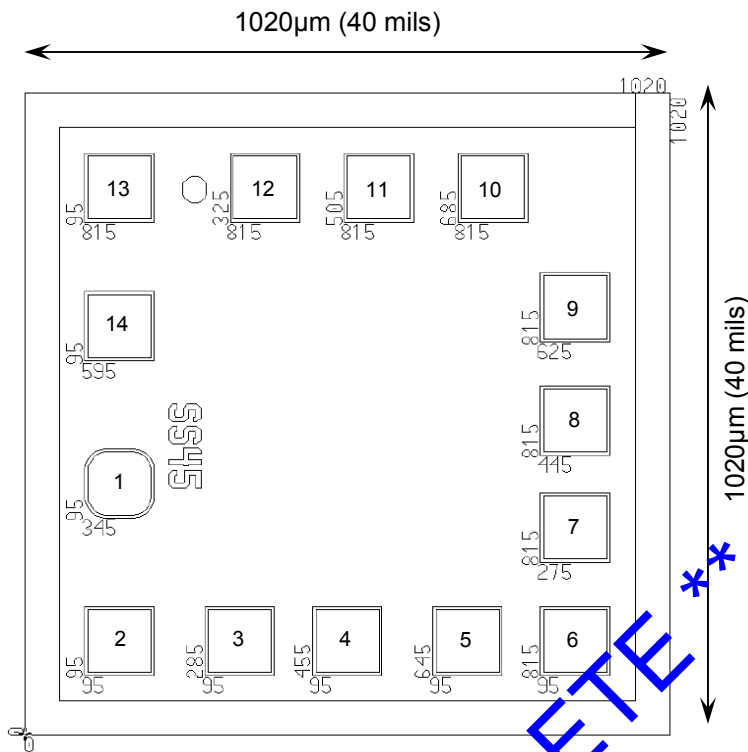




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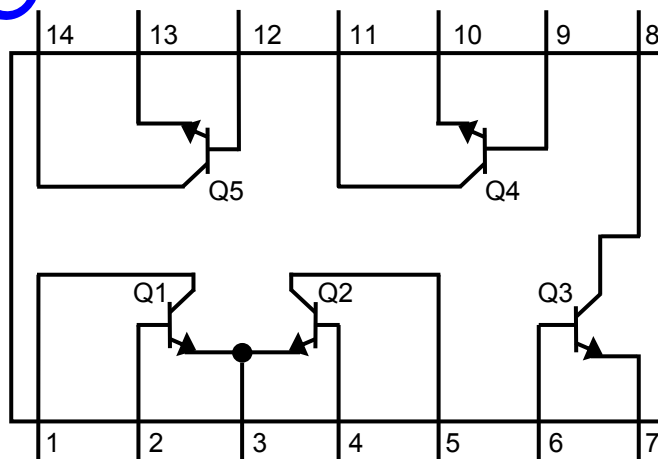
Pad Layout and Functions



| PAD | FUNCTION |
|-----|------------------------|
| 1 | COLLECTOR Q1 |
| 2 | BASE Q1 |
| 3 | EMITTERS Q1 & Q2 |
| 4 | BASE Q2 |
| 5 | COLLECTOR Q2 |
| 6 | BASE Q3 |
| 7 | EMITTER Q3 |
| 8 | COLLECTOR Q3 |
| 9 | BASE Q4 |
| 10 | EMITTER Q4 |
| 11 | COLLECTOR Q4 |
| 12 | BASE Q5 |
| 13 | EMITTER Q5 & SUBSTRATE |
| 14 | COLLECTOR Q5 |

Die backside must be connected to the most negative point in the external circuit to maintain isolation between transistors and to provide for normal transistor action.

Circuit Schematic





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Absolute Maximum Ratings

| PARAMETER | SYMBOL | VALUE | UNIT |
|--|-----------|------------|------|
| Collector-to-Emitter Voltage | V_{CEO} | 15 | V |
| Collector-to-Base Voltage | V_{CBO} | 20 | V |
| Collector-to-Substrate Voltage (Note 1) | V_{CIO} | 20 | V |
| Emitter-to-Base Voltage | V_{EBO} | 5 | V |
| Collector Current | I_C | 50 | mA |
| Maximum Power Dissipation (Any one transistor) | P_D | 300 | mW |
| Operating Temperature Range | - | -55 to 125 | °C |
| Maximum Junction Temperature | T_J | 75 | °C |

DC Electrical Characteristics $T_A = 25^\circ\text{C}$ unless otherwise stated

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|--|-----|-------|-----|------------------------------|
| Collector to Base Breakdown Voltage | $V_{(BR)CBO}$ | $I_C = 10\mu\text{A}, I_E = 0$ | 20 | 60 | - | V |
| Collector to Emitter Breakdown Voltage | $V_{(BR)CEO}$ | $I_C = 1\text{mA}, I_B = 0$ | 15 | 24 | - | V |
| Collector-to-Substrate Breakdown Voltage | $V_{(BR)CIO}$ | $I_C = 10\mu\text{A}, I_{CI} = 0$ | 20 | 60 | - | V |
| Emitter to Base Breakdown Voltage | $V_{(BR)EBO}$ | $I_E = 10\mu\text{A}, I_C = 0$ | 5 | 7 | - | V |
| Collector Cutoff Current | I_{CBO} | $V_{CB} = 10\text{V}, I_E = 0$ | - | 0.002 | 40 | nA |
| Collector Cutoff Current (Figure 2) | I_{CEO} | $V_{CE} = 10\text{V}, I_B = 0$ | - | FIG 2 | 0.5 | μA |
| Forward Current Transfer Ratio (Static Beta) (Note 3) (Figure 3) | β_{FE} | $I_C = 10\text{mA}$ | - | 100 | - | - |
| | | $I_C = 1\text{mA}$ | 40 | 100 | - | - |
| | | $I_C = 10\mu\text{A}$ | - | 54 | - | - |
| Input Offset Current for Matched Pair Q1 and Q2. (Note 2) (Figure 4) | $ I_{O1} - I_{O2} $ | $V_{CE} = 3\text{V}, I_C = 1\text{mA}$ | - | 0.3 | 2 | μA |
| Base-to-Emitter Voltage (Note 3) (Figure 5) | V_{BE} | $I_E = 1\text{mA}$ | - | 0.715 | - | V |
| | | $I_E = 10\text{mA}$ | - | 0.800 | - | |
| Magnitude of Input Offset Voltage for Differential Pair (Note 2) (Figures 5, 7) | $ V_{BE1} - V_{BE2} $ | $V_{CE} = 3\text{V}, I_C = 1\text{mA}$ | - | 0.45 | 5 | mV |
| Magnitude of Input Offset Voltage for Isolated Transistors. (Note 2) (Figures 6, 7) | $ V_{BE3} - V_{BE4} $ $ V_{BE4} - V_{BE5} $ $ V_{BE5} - V_{BE3} $ | $V_{CE} = 3\text{V}, I_C = 1\text{mA}$ | - | 0.45 | 5 | mV |
| | | | - | - | - | - |
| | | | - | - | - | - |
| Temperature Coefficient of Base-to-Emitter Voltage (Figure 6) | $\frac{\Delta V_{BE}}{\Delta T}$ | $V_{CE} = 3\text{V}, I_C = 1\text{mA}$ | - | -1.9 | - | $\text{mV}/^\circ\text{C}$ |
| Collector-to-Emitter Saturation Voltage | V_{CES} | $I_B = 1\text{mA}, I_C = 10\text{mA}$ | - | 0.23 | - | V |
| Temperature Coefficient: Magnitude of Input Offset Voltage (Figure 7) | $\frac{ \Delta V_{IO} }{\Delta T}$ | $V_{CE} = 3\text{V}, I_C = 1\text{mA}$ | - | 1.1 | - | $\mu\text{V}/^\circ\text{C}$ |

Notes: **1.** The collector of each transistor is isolated from the substrate by an integral diode. The substrate (Terminal 13) must be connected to the most negative point in the external circuit to maintain isolation between transistors and to provide for normal transistor action. **2.** Actual forcing current is via the emitter for this test.





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Dynamic Electrical Characteristics $T_A = 25^\circ\text{C}$ unless otherwise stated

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|---|----------|--|-----|----------------------|-----|------------------|
| Low Frequency Noise Figure (Figure 9) | NF | $f = 1 \text{ kHz}$, $V_{CE} = 3\text{V}$ $I_C = 100\mu\text{A}$, Source Resistance = $1\text{k}\Omega$ | - | 3.25 | - | dB |
| Low Frequency, Small Signal Equivalent Circuit Characteristics | | | | | | |
| Forward Current Transfer Ratio (Figure 11) | h_{FE} | $f = 1 \text{ kHz}$ $V_{CE} = 3\text{V}$, $I_C = 1\text{mA}$ | - | 10 | - | - |
| Short Circuit Input Impedance (Figure 11) | h_{iE} | $f = 1 \text{ kHz}$ $V_{CE} = 3\text{V}$, $I_C = 1\text{mA}$ | - | 9.5 | - | $\text{k}\Omega$ |
| Open Circuit Output Impedance (Figure 11) | h_{oE} | $f = 1 \text{ kHz}$ $V_{CE} = 3\text{V}$, $I_C = 1\text{mA}$ | - | 15.6 | - | μmho |
| Open Circuit Reverse Voltage Transfer Ratio (Figure 11) | h_{rE} | $f = 1 \text{ kHz}$ $V_{CE} = 3\text{V}$, $I_C = 1\text{mA}$ | - | 1.8×10^{-4} | - | - |
| Admittance Characteristics | | | | | | |
| Forward Transfer Admittance (Figure 12) | Y_{FE} | $f = 1 \text{ kHz}$ $V_{CE} = 3\text{V}$, $I_C = 1\text{mA}$ | - | $31 - j1.5$ | - | - |
| Input Admittance (Figure 13) | Y_{iE} | $f = 1 \text{ kHz}$ $V_{CE} = 3\text{V}$, $I_C = 1\text{mA}$ | - | $0.3 + j0.04$ | - | - |
| Output Admittance (Figure 14) | Y_{oE} | $f = 1 \text{ kHz}$ $V_{CE} = 3\text{V}$, $I_C = 1\text{mA}$ | - | $0.001 + j0.03$ | - | - |
| Reverse Transfer Admittance (Figure 15) | Y_{rE} | $f = 1 \text{ kHz}$ $V_{CE} = 3\text{V}$, $I_C = 1\text{mA}$ | - | Fig 14 | - | - |
| Gain Bandwidth Product (Figure 16) | f_T | $V_{CE} = 3\text{V}$, $I_C = 1\text{mA}$ | 300 | 550 | - | MHz |
| Emitter-to-Base Capacitance | C_{EB} | $V_{EB} = 3\text{V}$, $I_E = 0$ | - | 0.6 | - | pF |
| Collector-to-Base Capacitance | C_{CB} | $V_{CB} = 3\text{V}$, $I_C = 0$ | - | 0.58 | - | pF |
| Collector-to-Substrate Capacitance | C_{CI} | $V_{CS} = 3\text{V}$, $I_C = 0$ | - | 2.8 | - | pF |

Typical Performance Characteristics

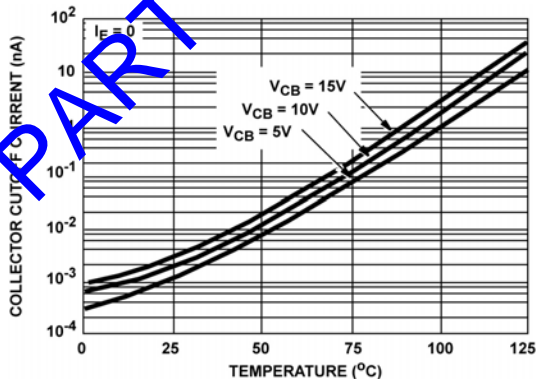


FIGURE 1. Typical Base-To-Collector Current vs Temperature (each transistor)

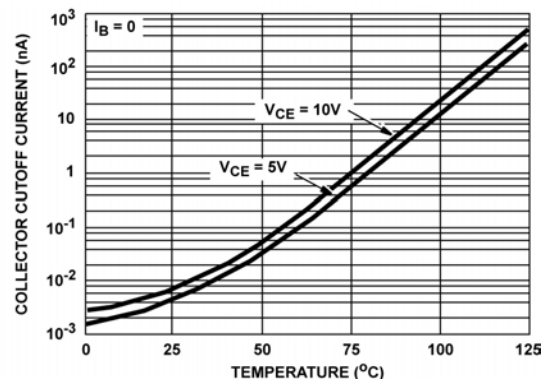


FIGURE 2. Typical Collector-To-Emitter Cutoff Current vs Temperature (each transistor)





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Typical Performance Characteristics (Continued)

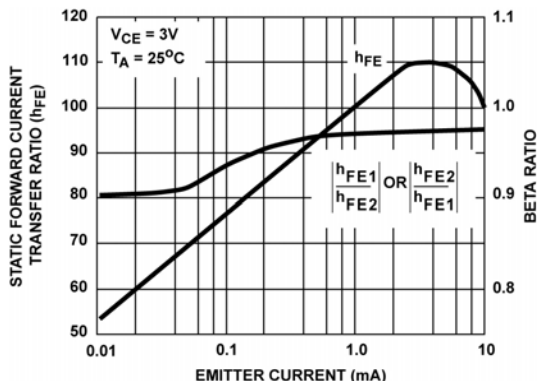


FIGURE 3. Typical Static Forward Current Transfer Ratio & Beta Ratio for Q₁ and Q₂ vs Emitter Current

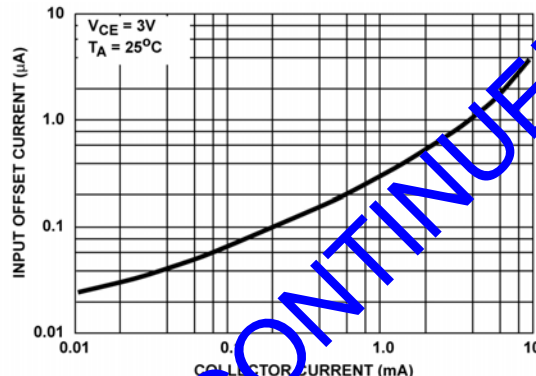


FIGURE 4. Typical Input Offset Current for matched transistor pair Q₁Q₂ vs Collector Current

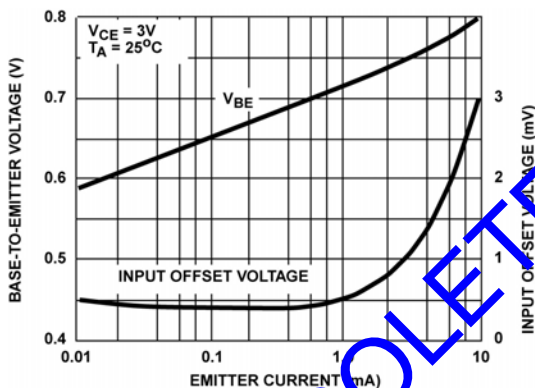


FIGURE 5. Typical static Base-to-Emitter Voltage characteristics and Input Offset Voltage for differential pair and paired isolated transistors vs Emitter Current

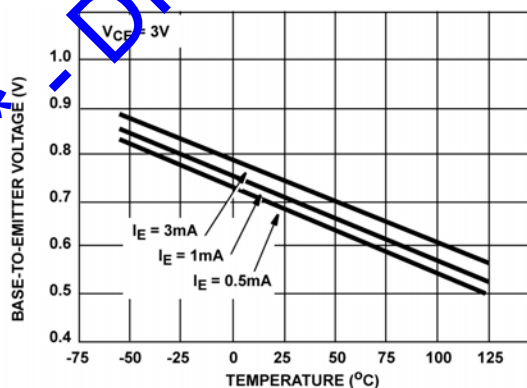


FIGURE 6. Typical Base-to-Emitter Voltage characteristic vs Temperature for each transistor.

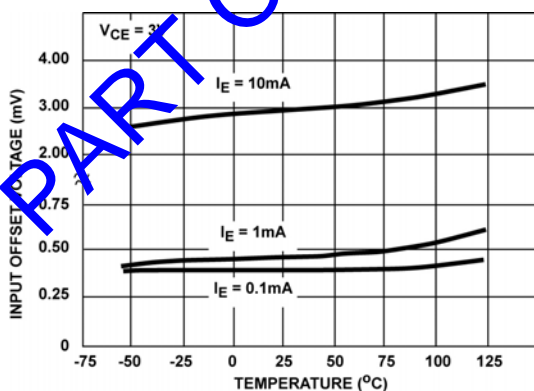


FIGURE 7. Typical Input Offset Voltage characteristics for differential pair and paired isolated transistors vs Temperature

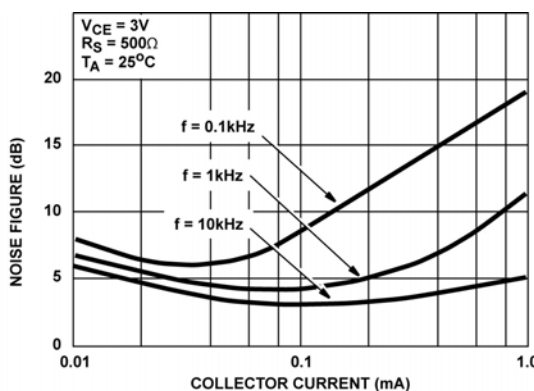


FIGURE 8. Typical Noise Figure vs Collector Current





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Typical Performance Characteristics (Continued)

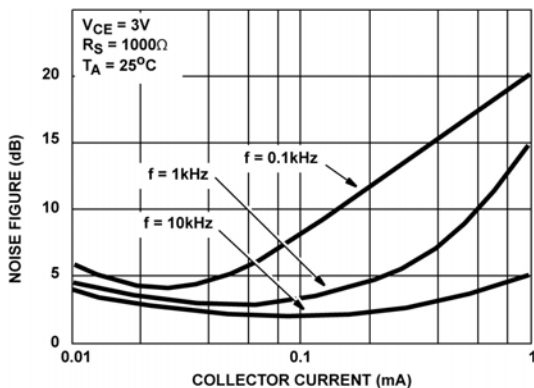


FIGURE 9. Typical Noise Figure vs Collector Current

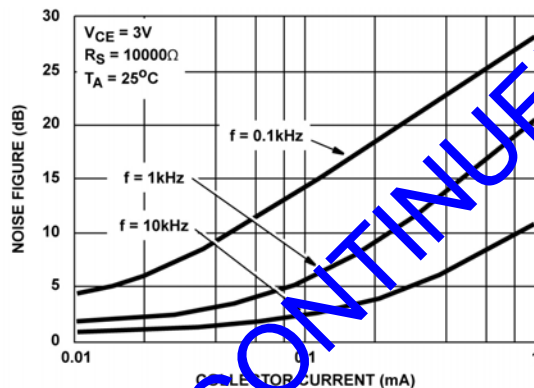


FIGURE 10. Typical Noise Figure vs Collector Current

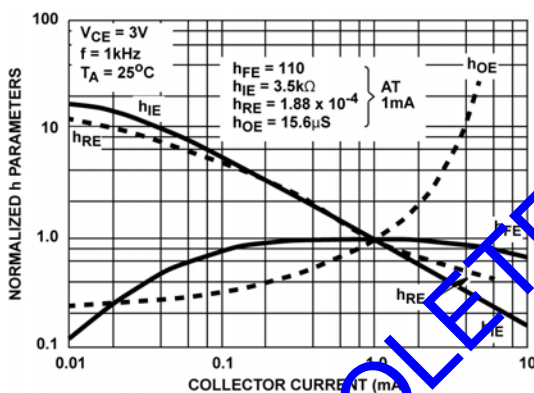


FIGURE 11. Typical Normalized Forward Current Transfer Ratio, Short Circuit Input Impedance, Open Circuit Output Impedance, And Open Circuit Reverse Voltage Transfer Ratio vs Collector Current

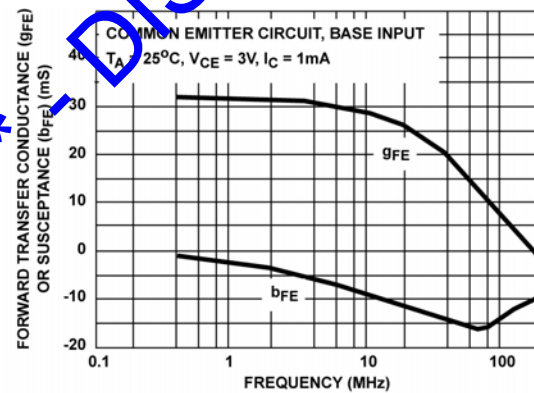


FIGURE 12. Typical Forward Transfer Admittance vs Frequency

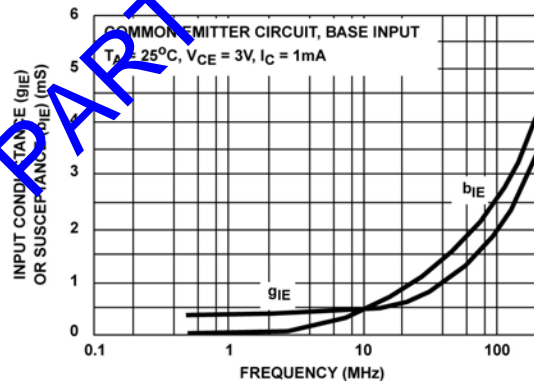


FIGURE 13. Typical Input Admittance vs Frequency

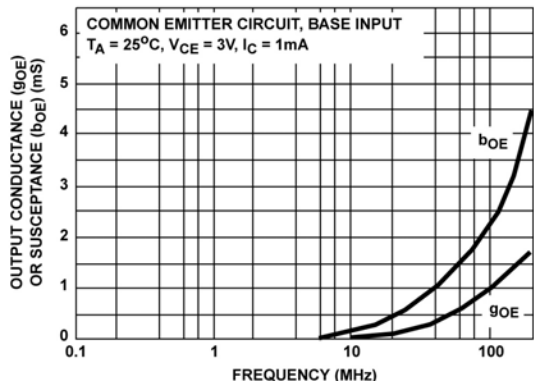


FIGURE 14. Typical Output Admittance vs Frequency





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Typical Performance Characteristics (Continued)

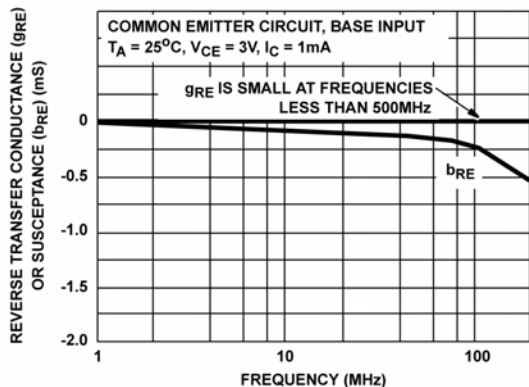


FIGURE 15. Typical Reverse Transfer Admittance vs Frequency

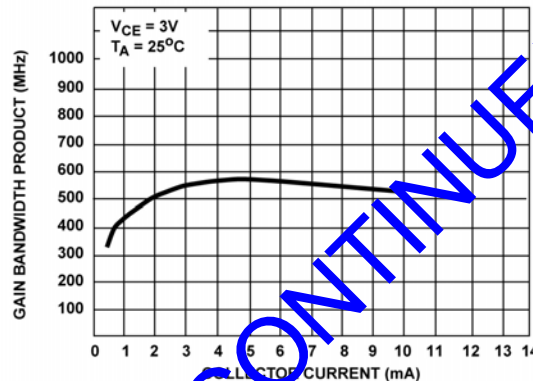


FIGURE 16. Typical Gain Bandwidth Product vs Collector Current

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