MOTOROLA
# SEMICONDUCTOR
TECHNICAL DATA

# 2N5179

## The RF Line

### NPN SILICON RF HIGH FREQUENCY TRANSISTOR

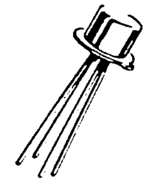
. . . designed primarily for use in high-gain, low-noise amplifier, oscillator, and mixer applications. Can also be used in UHF converter applications.

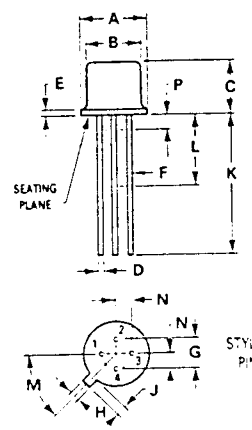
- High Current-Gain — Bandwidth Product — $f_T$ = 1.4 GHz (Typ) @ $I_C$ = 10 mAdc
- Low Collector-Base Time Constant — $r_b'C_c$ = 14 ps (Max) @ $I_E$ = 2.0 mAdc
- Characterized with Scattering Parameters
- Low Noise Figure — NF = 4.5 dB (Max) @ f = 200 MHz

4.5 dB @ 200 MHz

**HIGH FREQUENCY TRANSISTOR**

**NPN SILICON**






STYLE 10:
PIN 1. EMITTER
2. BASE
3. COLLECTOR
4. CASE

NOTE: ALL RULES AND NOTES ASSOCIATED WITH TO-72 OUTLINE SHALL APPLY

| DIM | MILLIMETERS MIN | MILLIMETERS MAX | INCHES MIN | INCHES MAX |
|---|---|---|---|---|
| A | 5.31 | 5.64 | 0.209 | 0.230 |
| B | 4.52 | 4.95 | 0.178 | 0.195 |
| C | 4.32 | 5.33 | 0.170 | 0.210 |
| D | 0.41 | 0.53 | 0.016 | 0.021 |
| E | — | 0.76 | — | 0.030 |
| F | 0.41 | 0.48 | 0.016 | 0.019 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 0.91 | 1.17 | 0.036 | 0.046 |
| J | 0.71 | 1.22 | 0.028 | 0.048 |
| K | 12.70 | — | 0.500 | — |
| L | 6.35 | — | 0.250 | — |
| M | 45° BSC | | 45° BSC | |
| N | 1.27 BSC | | 0.050 BSC | |
| P | — | 1.27 | — | 0.050 |

**CASE 20-03**
**TO-206AF**
**(TO-72)**

*MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Emitter Voltage<br>Applicable 1.0 to 20 mAdc | $V_{CEO}$ | 12 | Vdc |
| Collector-Base Voltage | $V_{CB}$ | 20 | Vdc |
| Emitter-Base Voltage | $V_{EB}$ | 2.5 | Vdc |
| Collector Current | $I_C$ | 50 | mAdc |
| Total Device Dissipation @ $T_A$ = 25°C<br>Derate above 25°C | $P_D$ | 200<br>1.14 | mW<br>mW/°C |
| Total Device Dissipation @ $T_C$ = 25°C<br>Derate above 25°C | $P_D$ | 300<br>1.71 | mW<br>mW/°C |
| Storage Temperature Range | $T_{stg}$ | -65 to +200 | °C |

*Indicates JEDEC Registered Data.

*ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | |
| Collector-Emitter Sustaining Voltage ($I_C$ = 3.0 mAdc, $I_B$ = 0) | $V_{CEO(sus)}$ | 12 | — | Vdc |
| Collector-Base Breakdown Voltage ($I_C$ = 0.001 mAdc, $I_E$ = 0) | $V_{(BR)CBO}$ | 20 | — | Vdc |
| Emitter-Base Breakdown Voltage ($I_E$ = 0.01 mAdc, $I_C$ = 0) | $V_{(BR)EBO}$ | 2.5 | — | Vdc |
| Collector Cutoff Current ($V_{CB}$ = 15 Vdc, $I_E$ = 0) ($V_{CB}$ = 15 Vdc, $I_E$ = 0, $T_A$ = 150°C) | $I_{CBO}$ | —<br>— | 0.02<br>1.0 | μAdc |
| **ON CHARACTERISTICS** | | | | |
| DC Current Gain ($I_C$ = 3.0 mAdc, $V_{CE}$ = 1.0 Vdc) | $h_{FE}$ | 25 | 250 | — |
| Collector-Emitter Saturation Voltage ($I_C$ = 10 mAdc, $I_B$ = 1.0 mAdc) | $V_{CE(sat)}$ | — | 0.4 | Vdc |
| Base-Emitter Saturation Voltage ($I_C$ = 10 mAdc, $I_B$ = 1.0 mAdc) | $V_{BE(sat)}$ | — | 1.0 | Vdc |
| **DYNAMIC CHARACTERISTICS** | | | | |
| Current-Gain — Bandwidth Product (1) ($I_C$ = 5.0 mAdc, $V_{CE}$ = 6.0 Vdc, f = 100 MHz) | $f_T$ | 900 | 2000 | MHz |
| Collector-Base Capacitance ($V_{CB}$ = 10 Vdc, $I_E$ = 0, f = 0.1 to 1.0 MHz) | $C_{cb}$ | — | 1.0 | pF |
| Small-Signal Current Gain ($I_C$ = 2.0 mAdc, $V_{CE}$ = 6.0 Vdc, f = 1.0 kHz) | $h_{fe}$ | 25 | 300 | — |
| Collector-Base Time Constant ($I_E$ = 2.0 mAdc, $V_{CB}$ = 6.0 Vdc, f = 31.9 MHz) | $r_b'C_c$ | 3.0 | 14 | ps |
| Noise Figure (See Figure 1) ($I_C$ = 1.5 mAdc, $V_{CE}$ = 6.0 Vdc, $R_S$ = 50 ohms, f = 200 MHz) | NF | — | 4.5 | dB |
| **FUNCTIONAL TEST** | | | | |
| Common-Emitter Amplifier Power Gain (See Figure 1) ($V_{CE}$ = 6.0 Vdc, $I_C$ = 5.0 mAdc, f = 200 MHz) | $G_{pe}$ | 15 | — | dB |
| Power Output (See Figure 2) ($V_{CB}$ = 10 Vdc, $I_E$ = 12 mAdc, f≥500 MHz) | $P_{out}$ | 20 | — | mW |

*Indicates JEDEC Registered Values.

(1) $f_T$ is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

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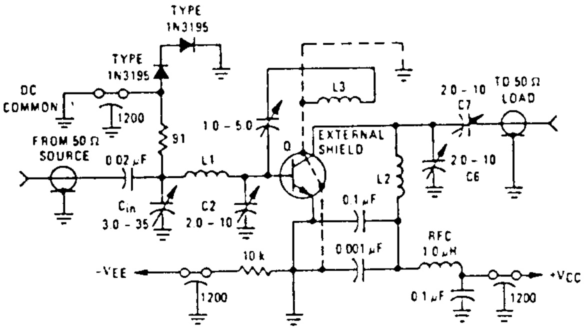
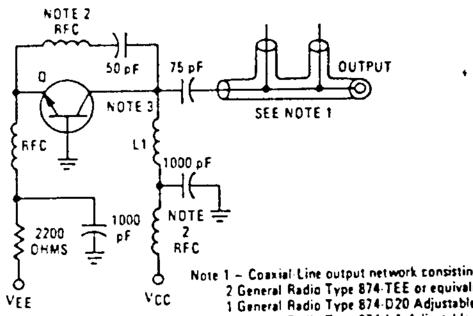
FIGURE 1 – 200 MHz AMPLIFIER POWER GAIN AND NOISE FIGURE CIRCUIT




L1 1-3/4 Turns, #18 AWG, 0.5" L, 0.5" Diameter
L2 2 Turns, #16 AWG, 0.5" L, 0.5" Diameter
L3 2 Turns, #13 AWG, 0.25" L, 0.5" Diameter (Position 1/4" from L2)

FIGURE 2 – 500 MHz OSCILLATOR CIRCUIT




Note 1 – Coaxial Line output network consisting of:
2 General Radio Type 874-TEE or equivalent
1 General Radio Type 874-D20 Adjustable Stub or equivalent
1 General Radio Type 874-LA Adjustable Line or equivalent
1 General Radio Type 874 WN3 Short-circuit termination or equivalent

Note 2 – RFC = 0.2 µH Ohmite #2-460 or equivalent

Note 3 – Lead Number 4 (case) floating

L1 – 2 turns # 16 AWG wire, 3/8 inch OD, 1-1/4 inch long

Q = 2N5179

FIGURE 3 – NOISE FIGURE versus FREQUENCY

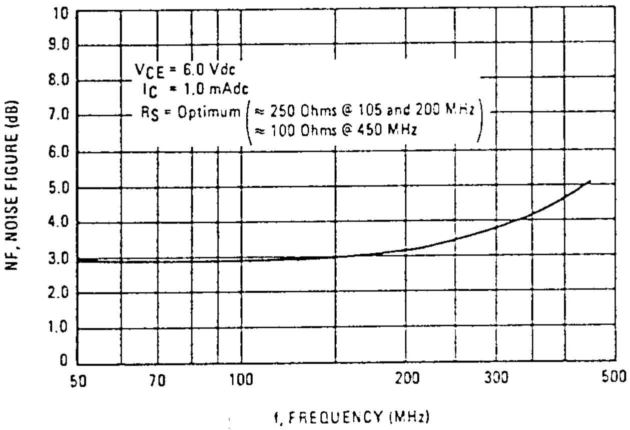



FIGURE 4 – NOISE FIGURE versus SOURCE RESISTANCE and COLLECTOR CURRENT

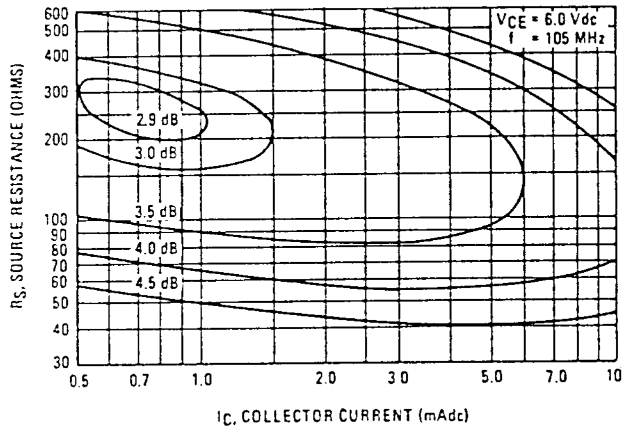



FIGURE 5 – NOISE FIGURE versus SOURCE RESISTANCE and COLLECTOR CURRENT

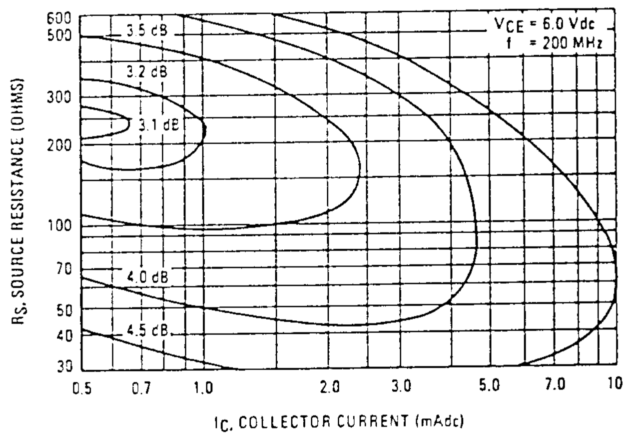


FIGURE 6 – CURRENT-GAIN-BANDWIDTH PRODUCT

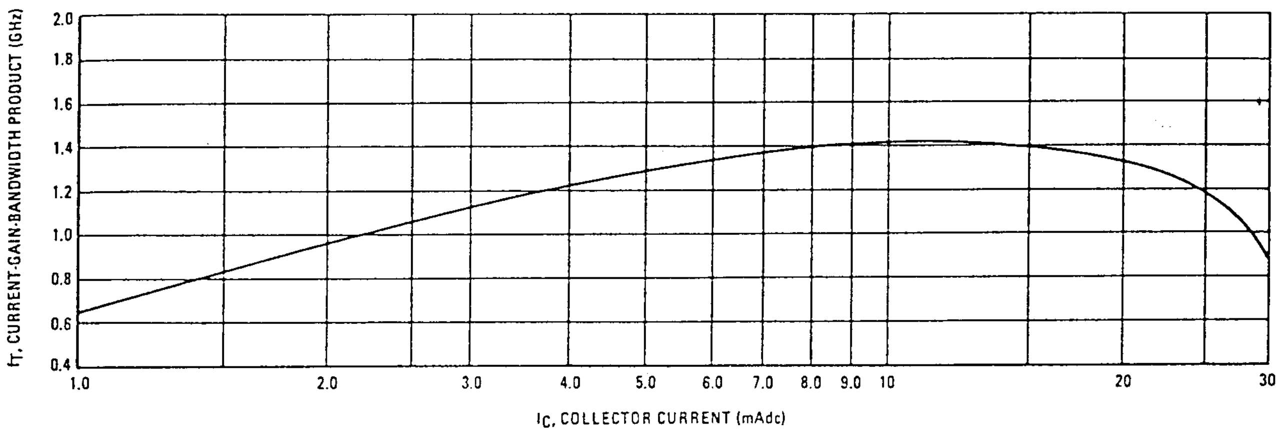



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FIGURE 7 – INPUT ADMITTANCE versus FREQUENCY

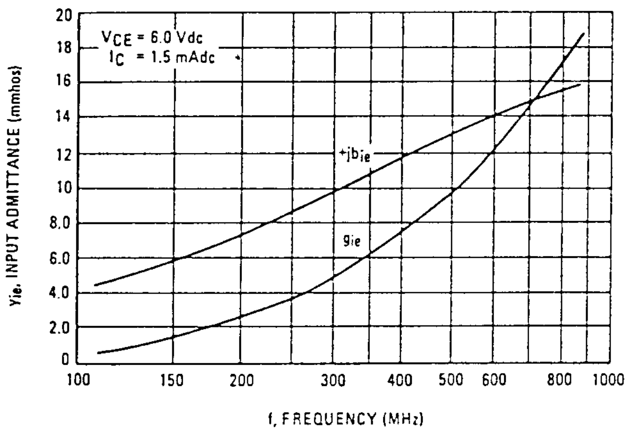


FIGURE 8 – OUTPUT ADMITTANCE versus FREQUENCY

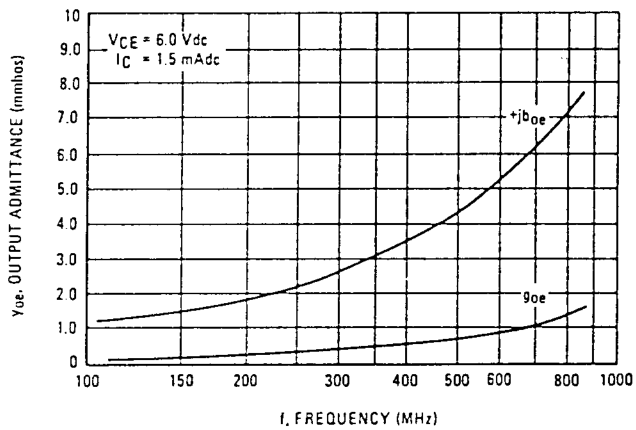


FIGURE 9 – FORWARD TRANSFER ADMITTANCE versus FREQUENCY

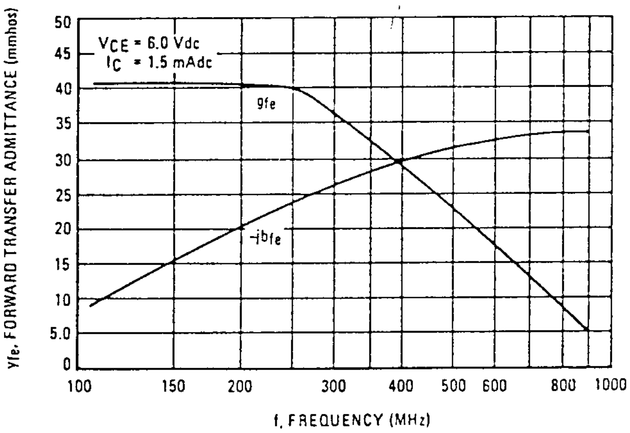


FIGURE 10 – REVERSE TRANSFER ADMITTANCE versus FREQUENCY

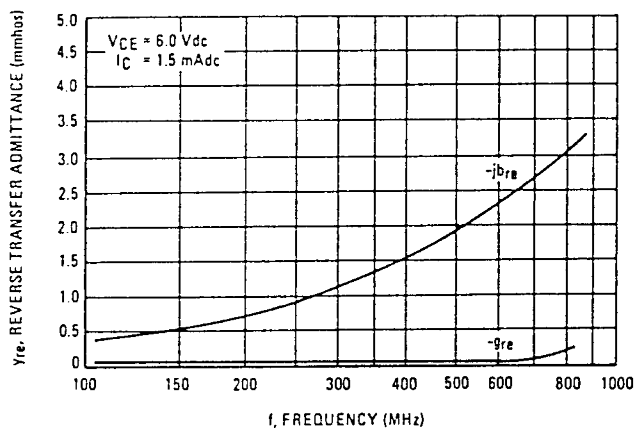

FIGURE 11 — $S_{11}$, INPUT REFLECTION COEFFICIENT

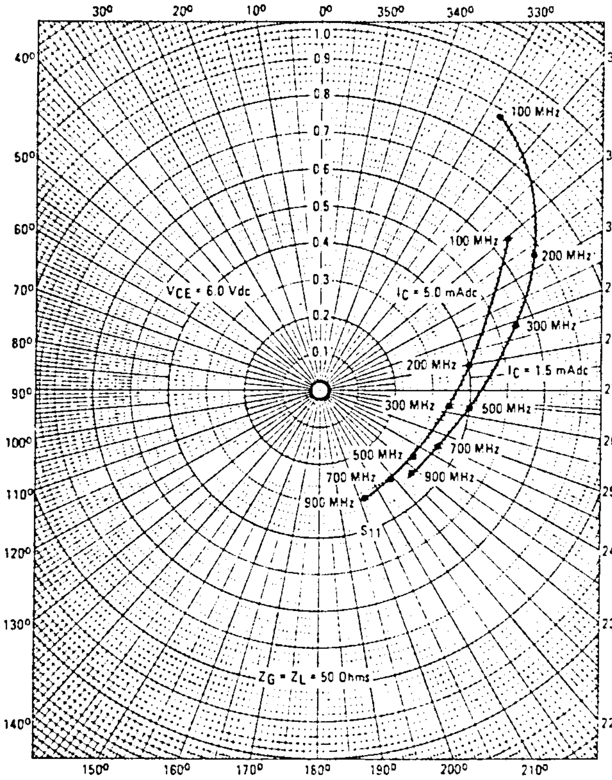


FIGURE 12 — $S_{22}$, OUTPUT REFLECTION COEFFICIENT

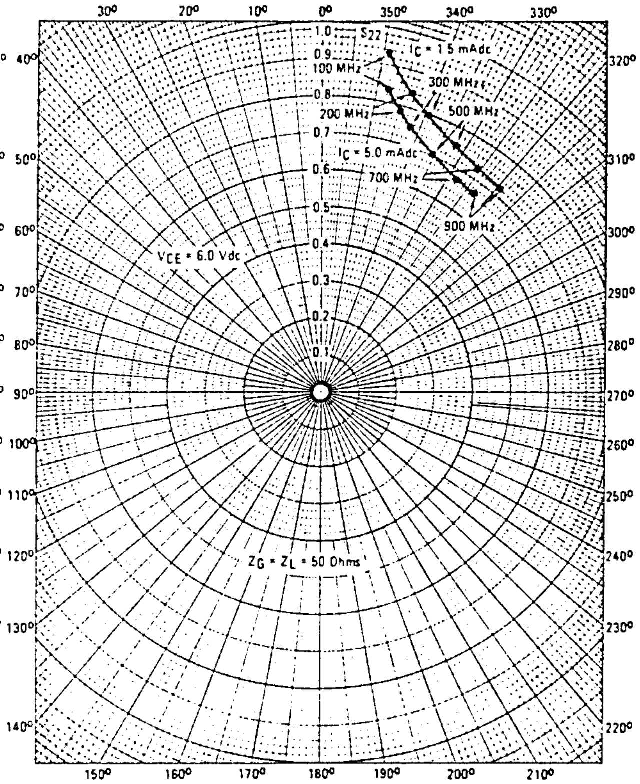


FIGURE 13 — $S_{12}$, REVERSE TRANSMISSION COEFFICIENT

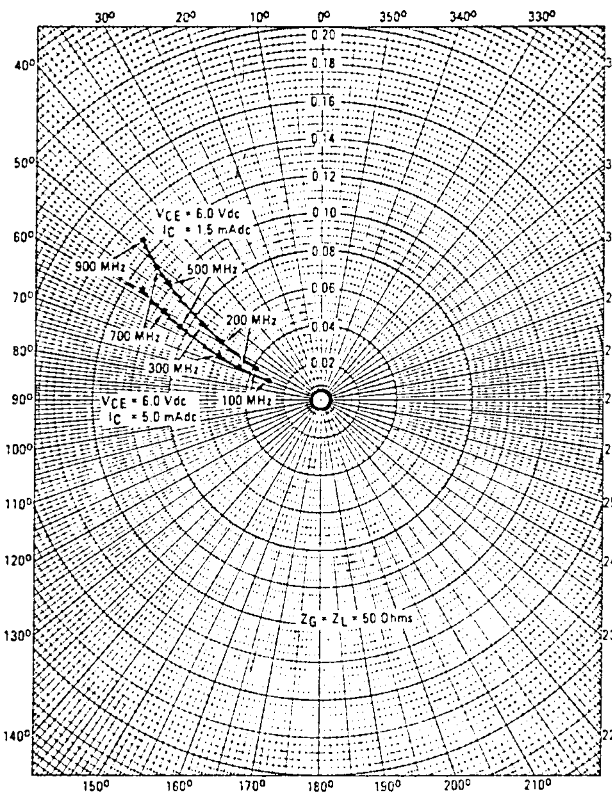


FIGURE 14 — $S_{21}$, FORWARD TRANSMISSION COEFFICIENT

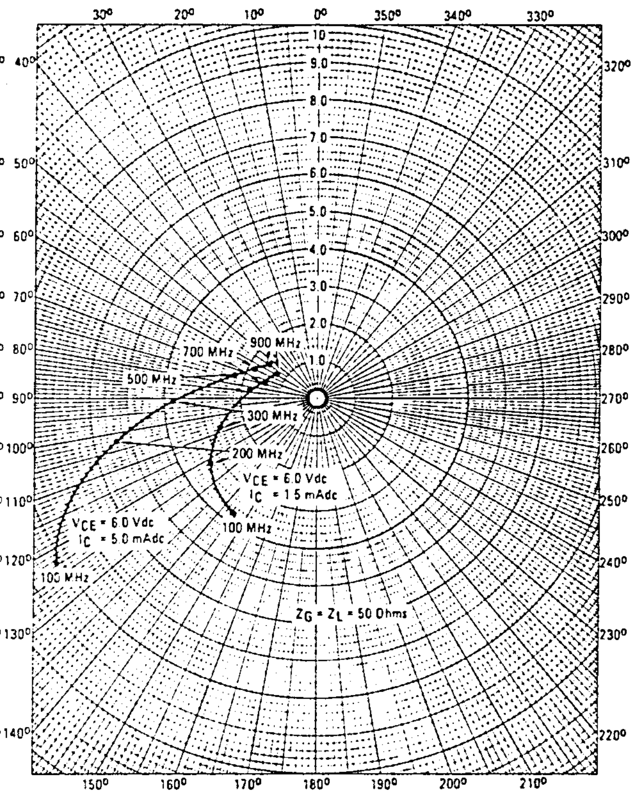

FIGURE 15 — $S_{11}$, INPUT REFLECTION COEFFICIENT AND $S_{22}$, OUTPUT REFLECTION COEFFICIENT