NEC

NPN SILICON TRANSISTOR
2SC2785

DESCRIPTION   The 2SC2785 is designed for use in driver stage of AF amplifier and low speed switching.

FEATURES
- High Voltage V_{CEO} : 50 V MIN.
- Excellent h_{FE} Linearity : 0.92 TYP.
  h_{FE1} (0.1 mA)/h_{FE2} (1.0 mA)
- Complementary to the NEC 2SA1175 PNP Transistor.

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures

Storage Temperature .... −55 to +150 °C

Junction Temperature .... +150 °C Maximum

Maximum Power Dissipation (Ta = 25 °C)

Total Power Dissipation .... 250 mW

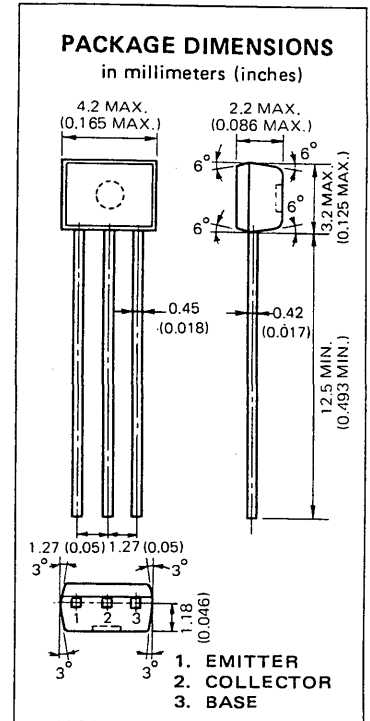Maximum Voltages and Currents (Ta = 25 °C)

V_{CBO} Collector to Base Voltage .... 60 V

V_{CEO} Collector to Emitter Voltage .... 50 V

V_{EBO} Emitter to Base Voltage .... 5.0 V

I_C Collector Current .... 100 mA

I_B Base Current .... 20 mA

PACKAGE DIMENSIONS
in millimeters (inches)

4.2 MAX. (0.165 MAX.)   2.2 MAX. (0.086 MAX.)   3.2 MAX. (0.125 MAX.)   12.5 MIN. (0.493 MIN.)

0.45 (0.018)   0.42 (0.017)

1.27 (0.05) 1.27 (0.05)   1.18 (0.046)

1 2 3

1. EMITTER
2. COLLECTOR
3. BASE

ELECTRICAL CHARACTERISTICS (Ta = 25 °C)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
h_{FE1}	DC Current Gain	50	185			V_{CE}=6.0 V, I_C=0.1 mA
h_{FE2}	DC Current Gain	110	200	600		V_{CE}=6.0 V, I_C=1.0 mA
NF	Noise Figure		0.8	15	dB	V_{CE}=6.0 V, I_C=0.1 mA, R_G=2.0 kΩ, f=1.0 kHz
f_T	Gain Bandwidth Product	150	250	450	MHz	V_{CE}=6.0 V, I_E=−10 mA
C_{ob}	Collector to Base Capacitance		3.0	4.0	pF	V_{CB}=6.0 V, I_E=0, f=1.0 MHz
I_{CBO}	Collector Cutoff Current			100	nA	V_{CB}=60 V, I_E=0
I_{EBO}	Emitter Cutoff Current			100	nA	V_{EB}=5.0 V, I_C=0
V_{BE}	Base to Emitter Voltage	0.55	0.62	0.65	V	V_{CE}=6.0 V, I_C=1.0 mA
$V_{CE(sat)}$	Collector Saturation Voltage		0.15	0.3	V	I_C=100 mA, I_B=10 mA
$V_{BE(sat)}$	Base Saturation Voltage		0.86	1.0	V	I_C=100 mA, I_B=10 mA

Classification of h_{FE2}

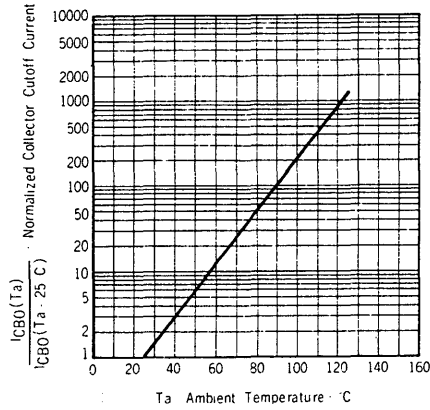| Rank	RF	JF	HF	FF	EF	KF
Range	110 − 180	135 − 220	170 − 270	200 − 320	250 − 400	300 − 600

h_{FE2} Test Conditions : V_{CE}=6.0 V, I_C=1.0 mA

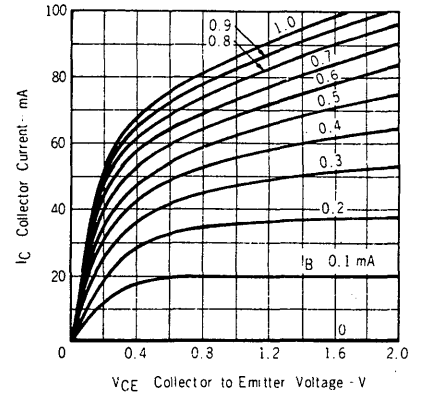## TYPICAL CHARACTERISTICS (Ta = 25 °C unless otherwise noted)
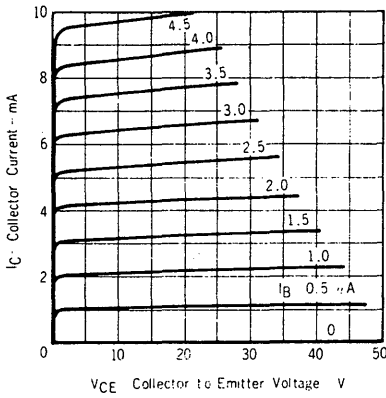
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE

Free Air

P_T – Total Power Dissipation – mW

Ta Ambient Temperature – °C
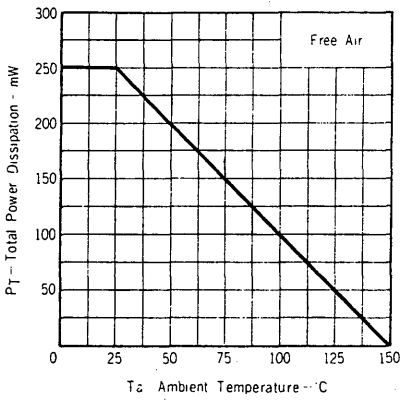
NORMALIZED COLLECTOR CUTOFF CURRENT vs. AMBIENT TEMPERATURE

$\frac{I_{CBO}(Ta)}{I_{CBO}(Ta = 25 C)}$ – Normalized Collector Cutoff Current

Ta Ambient Temperature – °C

COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE

I_C Collector Current – mA

0.9, 0.8, 1.0, 0.7, 0.6, 0.5, 0.4, 0.3, 0.2

I_B 0.1 mA

0

V_{CE} Collector to Emitter Voltage – V

COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE

I_C Collector Current – mA

4.5, 4.0, 3.5, 3.0, 2.5, 2.0, 1.5, 1.0

I_B 0.5 µA

0

V_{CE} Collector to Emitter Voltage – V

DC CURRENT GAIN vs. COLLECTOR CURRENT

Pulsed

h_{FE} – DC Current Gain

V_{CE} 6.0 V
3.0 V
2.0 V
1.0 V
0.5 V

I_C Collector Current – mA

DC CURRENT GAIN vs. COLLECTOR CURRENT

V_{CE} 6.0 V Pulsed

h_{FE} DC Current Gain

Ta 75 C
25 C
25 C
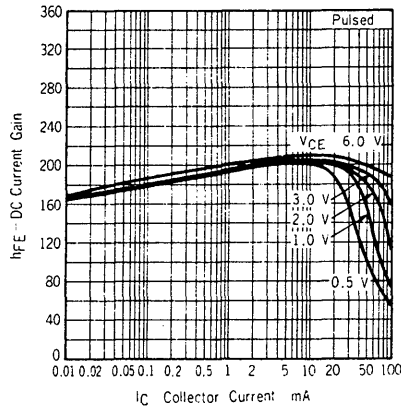
I_C Collector Current – mA
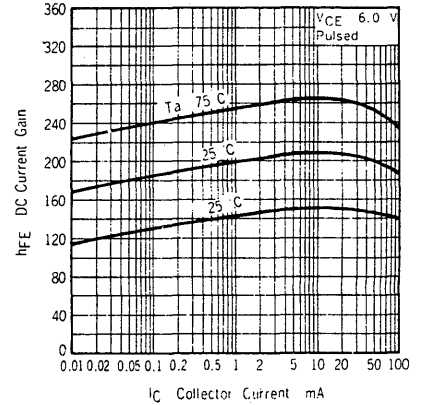
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE

V_{CE} 6.0 V Pulsed

I_C Collector Current – mA

Ta 75 C, 25 C, 25 C

V_{BE} Base to Emitter Voltage – V
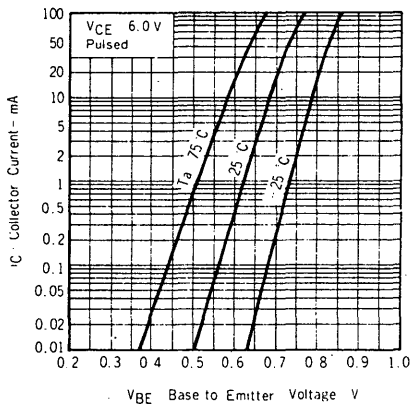
COLLECTOR AND BASE SATURATION VOLTAGE vs. COLLECTOR CURRENT

Pulsed

$V_{BE}(sat)$ Base Saturation Voltage – V
$V_{CE}(sat)$ Collector Saturation Voltage – V

I_C 10·I_B
$V_{BE}(sat)$
20, 50
$V_{CE}(sat)$
50, 20
I_C 10·I_B

I_C Collector Current – mA
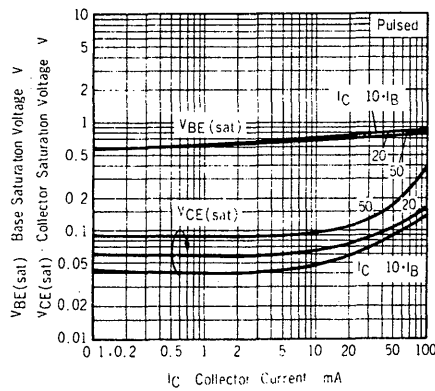
GAIN BANDWIDTH PRODUCT vs. EMITTER CURRENT

f_T Gain Bandwidth Product – MHz

V_{CE} = 10 V
6.0 V
2.0 V
1.0 V

I_E Emitter Current – mA
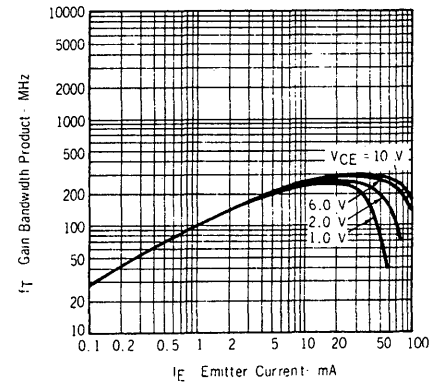
EMITTER TO BASE AND COLLECTOR TO
BASE CAPACITANCE vs. REVERSE VOLTAGE

f = 1.0 MHz

$C_{ib}(I_C = 0)$

$C_{ob}(I_E = 0)$

C_{ib} – Emitter to Base Capacitance – pF
C_{ob} – Collector to Base Capacitance – pF

V_{EB} – Emitter to Base Voltage – V
V_{CB} – Collector to Base Voltage – V
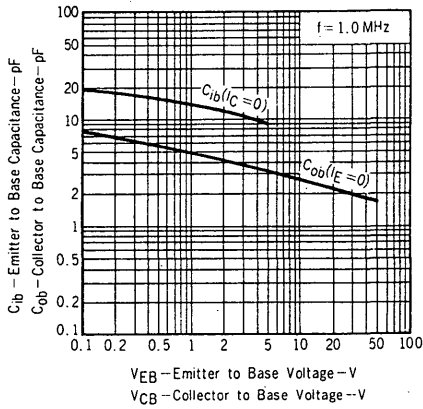
SMALL SIGNAL CURRENT GAIN
vs. DC CURRENT GAIN

$V_{CE} = 6.0$ V
$I_C = 1.0$ mA
$f = 1.0$ kHz

h_{fe} – Small Signal Current Gain
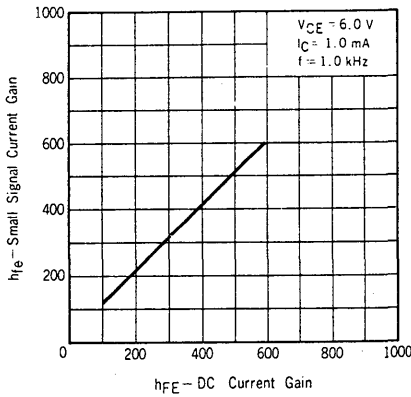
h_{FE} – DC Current Gain

INPUT IMPEDANCE, VOLTAGE FEEDBACK
RATIO AND OUTPUT ADMITTANCE
vs. SMALL SIGNAL CURRENT GAIN

$V_{CE} = 6.0$ V
$I_C = 1.0$ mA
$f = 1.0$ kHz

h_{oe}
h_{re}
h_{ie}

h_{oe} – Output Admittance – μS
h_{re} – Voltage Feedback Ratio – $\times 10^{-1}$
h_{ie} – Input Impedance – kΩ

h_{fe} – Small Signal Current Gain

NORMALIZED h-PARAMETERS
vs. COLLECTOR CURRENT

h_{ie}
h_{re}
h_{fe}
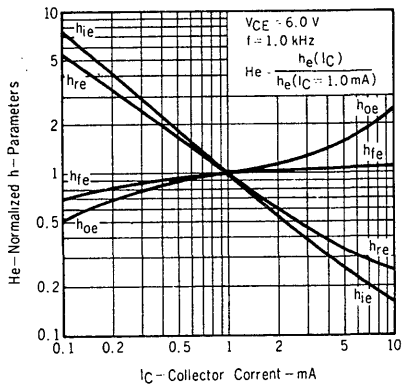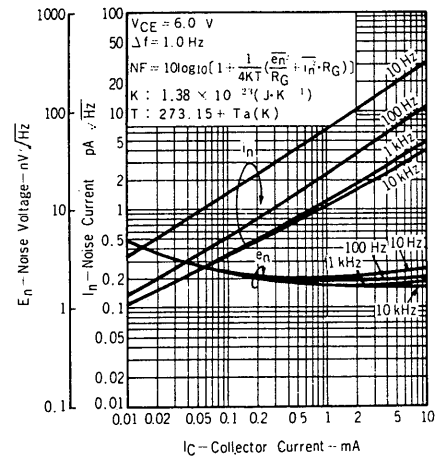h_{oe}
h_{oe}
h_{fe}
h_{re}
h_{ie}

$V_{CE} = 6.0$ V
$f = 1.0$ kHz
$H_e = \dfrac{h_e(I_C)}{h_e(I_C = 1.0 \text{ mA})}$

H_e – Normalized h–Parameters

I_C – Collector Current – mA

NORMALIZED h-PARAMETERS
vs. COLLECTOR TO EMITTER VOLTAGE

$I_C = 1.0$ mA
$f = 1.0$ kHz
$H_e = \dfrac{h_e(V_{CE})}{h_e(V_{CE} = 6.0 \text{ V})}$

h_{oe}
h_{re}
h_{fe}, h_{ie}
h_{fe}, h_{ie}
h_{re}
h_{oe}

H_e – Normalized h–Parameters

V_{CE} – Collector to Emitter Voltage – V

E_n AND I_n vs. COLLECTOR CURRENT

$V_{CE} = 6.0$ V
$\Delta f = 1.0$ Hz
$NF = 10 \log_{10}\left[1 + \dfrac{1}{4KT}\left(\dfrac{\overline{e_n^2}}{R_G} + \overline{i_n^2} \cdot R_G\right)\right]$
$K : 1.38 \times 10^{-23}$ (J·K^{-1})
$T : 273.15 + Ta$ (K)

I_n
e_n

10 Hz
100 Hz
1 kHz
10 kHz
100 Hz
10 Hz
1 kHz
10 kHz

E_n – Noise Voltage – nV/$\sqrt{Hz}$
I_n – Noise Current – pA/$\sqrt{Hz}$

I_C – Collector Current – mA

NOISE FIGURE MAP 1

$V_{CE} = 6.0$ V
$f = 10$ Hz
$\Delta f = 1.0$ Hz

20
15
12
8.0
5.0
3.0
2.0
1.5
NF = 1.0 dB
8.0
10

R_G – Source Resistance – Ω

I_C – Collector Current – mA

NOISE FIGURE MAP 2

$V_{CE} = 6.0$ V
$f = 100$ Hz
$\Delta f = 1.0$ Hz

15
12
8.0
5.0
3.0
NF = 0.5 dB
1.0
2.0
1.5
8.0

R_G – Source Resistance – Ω

I_C – Collector Current – mA

NOISE FIGURE MAP 3

$V_{CE} = 6.0$ V
$f = 1.0$ kHz
$\Delta f = 1.0$ Hz

12
8.0
5.0
3.0
1.0
NF = 0.5 dB
1.5
5.0
8.0

R_G – Source Resistance – Ω

I_C – Collector Current – mA