Silicon N-P-N and P-N-P Epitaxial-Base Complementary-Symmetry Transistors

General-Purpose Types for Switching and Linear-Amplifier Applications

Features:

- *Low saturation voltages*
- *Maximum safe-area-of-operation curves*
- *High gain at high current*
- *High breakdown voltages*

The 2N5781, 2N5782, and 2N5783 are epitaxial-base silicon p-n-p transistors -- complements of the silicon n-p-n types 2N5784, 2N5785, and 2N5786•, respectively.

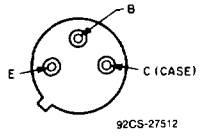
The three types in each family differ primarily in voltage ratings and saturation characteristics.

These transistors are intended for medium-power switching and complementary-symmetry audio amplifier applications.

All types are supplied in the JEDEC TO-205AD package.

• Formerly RCA Dev. Types TA7270, TA7271, TA7272, TA7289, TA7290, and TA7291 respectively.

TERMINAL DESIGNATIONS



JEDEC TO-205AD

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		P-N-P	2N5781♦	2N5782♦	2N5783♦	
		N-P-N	2N5784	2N5785	2N5786	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}		80	65	45	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
* With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$		80	65	45	V
With base open	$V_{CEO(sus)}$		65	50	40	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}		5	5	3.5	V
*CONTINUOUS COLLECTOR CURRENT	I_C		3.5	3.5	3.5	A
*CONTINUOUS BASE CURRENT	I_B		1	1	1	A
*TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C			10	10	10	W
At ambient temperatures up to 25°C			1	1	1	W
At case temperatures above 25°C ..... Derate linearly			0.057 W/°C, or see Fig. 7.			
At ambient temperatures above 25°C ..... Derate linearly			0.0057			W/°C
*TEMPERATURE RANGE:						
Storage and operating (Junction)			−65 to +200			°C
*LEAD TEMPERATURE (During soldering):						
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.			230			°C

*In accordance with JEDEC registration data format JS-6 RDF-2.

♦For p-n-p devices, voltage and current values are negative.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc		TEST CONDITIONS♦ CURRENT A dc		LIMITS 2N5781 p-n-p		LIMITS 2N5784 n-p-n		UNITS
			V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
	Collector Cutoff Current: With external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CER}	65				–	–10	–	10	μA
	At T_C = 150°C		65				–	–1	–	1	mA
*	With base-emitter junction reverse-biased and external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CEX}	–75 75	1.5 –1.5			– –	–10 –	– –	– 10	μA
*	At T_C = 150°C		–75 75	1.5 –1.5			– –	–1 –	– –	– 1	mA
*	With base open	I_{CEO}	50			0	–	–100	–	100	μA
*	Emitter Cutoff Current	I_{EBO}		–5	0		–	–10	–	10	μA
*	DC Forward-Current Transfer Ratio	h_{FE}	2 2		1[a] 3.2[a]		20 4	100 –	20 4	100 –	
*	Collector-to-Emitter Sustaining Voltage (see Figs, 2 and 3): With base open	$V_{CEO(sus)}$			0.1[a]	0	–65[b]	–	65[b]	–	V
	With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$			0.1[a]		–80[b]	–	80[b]	–	
*	Base-to-Emitter Voltage	V_{BE}	2		1[a]		–	–1.5	–	1.5	V
*	Collector-to-Emitter Saturation Voltage (measured 0.25 in (6.35 mm) from case)[c]	$V_{CE(sat)}$			1[a]	0.1	–	–0.5	–	0.5	V
*	Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio[d] f = 4 MHz	$\lvert h_{fe} \rvert$	–2		–0.1		2	15	–	–	
	f = 200 kHz		2		0.1				5	20	
*	Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	2		0.1		25	–	25	–	
	Saturated Switching Time (V_{CC} = 30 V, $I_{B1} = I_{B2}$): Turn-on ($t_d + t_r$)	t_{ON}			–1 1	–0.1 0.1	– –	0.5 –	– –	– 5	μs
	Turn-off ($t_s + t_f$)	t_{OFF}			–1 1	–0.1 0.1	– –	2.5 –	– –	– 15	
	Thermal Resistance: Junction-to-case	$R_{\theta JC}$					–	17.5	–	17.5	°C/W
	Junction-to-ambient	$R_{\theta JA}$					–	175	–	175	

* In accordance with JEDEC registration data format JS-6 RDF-2.

♦ For p-n-p devices, voltage and current values are negative.

[a] Pulsed, pulse duration = 300 μs, duty factor = 1.8%

[b] *CAUTION: Sustaining voltages $V_{CEO(sus)}$ and $V_{CER(sus)}$ MUST NOT be measured on a curve tracer.*

[c] Lead resistance is critical in this test.

[d] Measured at a frequency where $\lvert h_{fe} \rvert$ is decreasing at approximately 6 dB per octave.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc		CURRENT A dc		LIMITS 2N5782 p-n-p		2N5785 n-p-n		UNITS
			V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
	Collector Cutoff Current: With external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CER}	50				–	–10	–	10	μA
	At T_C = 150°C		50				–	–1	–	1	mA
*	With base-emitter junction reverse-biased and external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CEX}	–60 60	1.5 –1.5			– –	–10 –	– –	– 10	μA
*	At T_C = 150°C		–60 60	1.5 –1.5			– –	–1 –	– –	– 1	mA
*	With base open	I_{CEO}	35			0	–	–100	–	100	μA
*	Emitter Cutoff Current	I_{EBO}		–5	0		–	–10	–	10	μA
*	DC Forward-Current Transfer Ratio	h_{FE}	2 2		1.2[a] 3.2[a]		20 4	100 –	20 4	100 –	
*	Collector-to-Emitter Sustaining Voltage (see Figs. 2 and 3): With base open	$V_{CEO(sus)}$			0.1[a]	0	–50[b]	–	50[b]	–	V
	With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$			0.1[a]		–65[b]	–	65[b]	–	
*	Base-to-Emitter Voltage	V_{BE}	2		1.2[a]		–	–1.5	–	1.5	V
*	Collector-to-Emitter Saturation Voltage (measured 0.25 in (6.35 mm) from case)[c]	$V_{CE(sat)}$			1.2[a] 3.2[a]	0.12 0.8	– –	–0.75 –2	– –	0.75 2	V
*	Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio[d] f = 4 MHz	$\lvert h_{fe} \rvert$	–2		–0.1		2	15	–	–	
	f = 200 kHz		2		0.1		–	–	5	20	
*	Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	2		0.1		25	–	25	–	
	Saturated Switching Time (V_{CC} = 30 V, $I_{B1} = I_{B2}$): Turn-on ($t_d + t_r$)	t_{ON}			–1 1	–0.1 0.1	– –	0.5 –	– –	– 5	μs
	Turn-off ($t_s + t_f$)	t_{OFF}			–1 1	–0.1 0.1	– –	2.5 –	– –	– 15	
	Thermal Resistance: Junction-to-case	$R_{\theta JC}$						17.5	–	17.5	°C/W
	Junction-to-ambient	$R_{\theta JA}$					–	175	–	175	

* In accordance with JEDEC registration data format JS-6 RDF-2.

[a] Pulsed, pulse duration = 300 μs, duty factor = 1.8%.

[b] *CAUTION: Sustaining voltages $V_{CEO(sus)}$, and $V_{CER(sus)}$ MUST NOT be measured on a curve tracer.*

♦ For p-n-p devices, voltage and current values are negative.

[c] Lead resistance is critical in this test.

[d] Measured at a frequency where $\lvert h_{fe} \rvert$ is decreasing at approximately 6 dB per octave.

ELECTRICAL CHARACTERISTICS. *At Case Temperature (T_C) = 25°C unless otherwise specified*

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc		CURRENT A dc		LIMITS 2N5783 p-n-p		LIMITS 2N5786 n-p-n		UNITS
			V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
	Collector Cutoff Current: With external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CER}	40				–	–10	–	10	μA
	At T_C = 150°C		40				–	–1	–	1	mA
*	With base-emitter junction reverse-biased and external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CEX}	–45 45	1.5 –1.5			– –	–10 –	– –	– 10	μA
*	At T_C = 150°C		–45 45	1.5 –1.5			– –	–1 –	– –	– 1	mA
*	With base open	I_{CEO}	25			0	–	–100	–	100	μA
*	Emitter Cutoff Current	I_{EBO}		–3.5	0		–	–10	–	10	μA
*	DC Forward-Current Transfer Ratio	h_{FE}	2 2		1.6[a] 3.2[a]		20 4	100 –	20 4	100 –	
*	Collector-to-Emitter Sustaining Voltage (see Figs. 2 and 3): With base open	$V_{CEO(sus)}$			0.1[a]	0	–40[b]	–	40[b]	–	V
	With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$			0.1[a]		–45[b]	–	45[b]	–	
*	Base-to-Emitter Voltage	V_{BE}	2		1.6[a]		–	–1.5	–	1.5	V
*	Collector-to-Emitter Saturation Voltage (measured 0.25 in (6.35 mm) from case)[c]	$V_{CE(sat)}$			1.6[a] 3.2[a]	0.16 0.8	– –	–1 –2	– –	1 2	V
*	Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio[d] f = 4 MHz	$\lvert h_{fe} \rvert$	–2		–0.1		2	15	–	–	
	f = 200 kHz		2		0.1		–	–	5	20	
*	Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	2		0.1		25	–	25	–	
	Saturated Switching Time (V_{CC} = 30 V, $I_{B1} = I_{B2}$): Turn-on ($t_d + t_r$)	t_{ON}			–1 1	–0.1 0.1	– –	0.5 –	– –	– 5	μs
	Turn-off ($t_s + t_f$)	t_{OFF}			–1 1	–0.1 0.1	– –	2.5 –	– –	– 15	
	Thermal Resistance: Junction-to-case	$R_{\theta JC}$						17.5	–	17.5	°C/W
	Junction-to-ambient	$R_{\theta JA}$					–	175	–	175	

* In accordance with JEDEC registration data format JS-6 RDF-2.

♦ For p-n-p devices, voltage and current values are negative.

[a] Pulsed, pulse duration = 300 μs, duty factor = 1.8%.

[b] *CAUTION: Sustaining voltages $V_{CEO(sus)}$, and $V_{CER(sus)}$ MUST NOT be measured on a curve tracer.*

[c] Lead resistance is critical in this test.

[d] Measured at a frequency where $\lvert h_{fe} \rvert$ is decreasing at approximately 6 dB per octave.

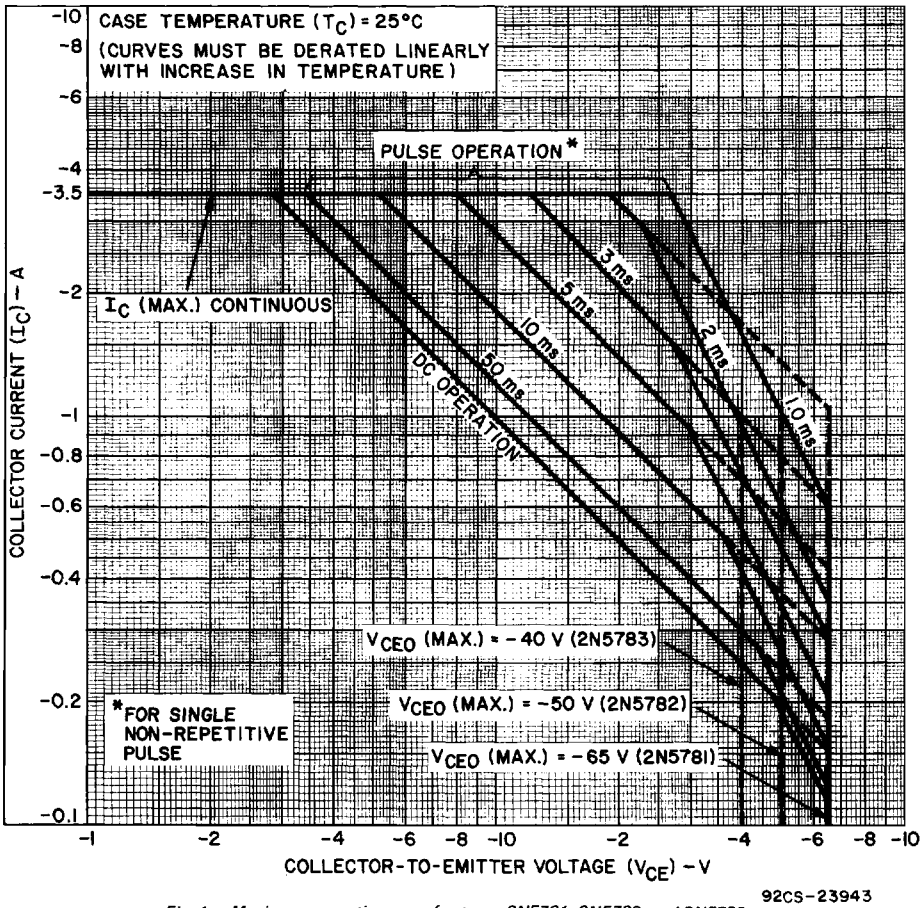


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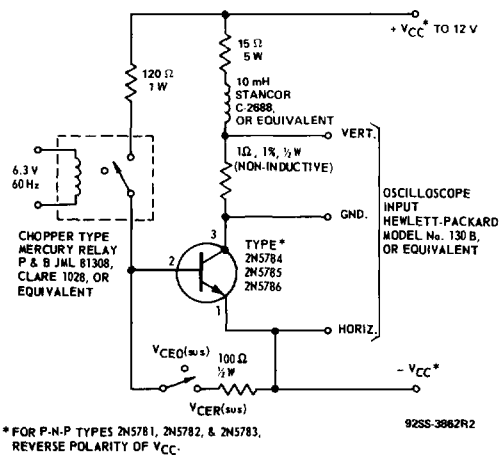
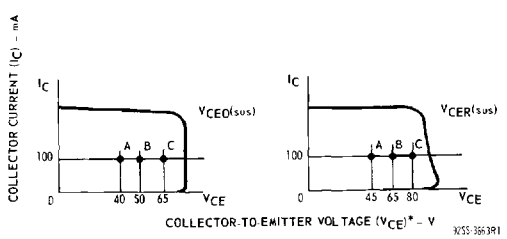
Fig. 1 – Maximum operating areas for types 2N5781, 2N5782, and 2N5783.



*FOR P-N-P TYPES 2N5781, 2N5782, & 2N5783, REVERSE POLARITY OF V_{CC}.

Fig. 2 – Circuit used to measure sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$.



*FOR TYPES 2N5781, 2N5782, AND 2N5783, THE VALUES FOR I_C AND V_{CE} ARE NEGATIVE.

The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ are acceptable when the trace falls to the right and above point "A" (2N5783 & 2N5786), "B" (2N5782 & 2N5785), or "C" (2N5781 & 2N5784).

Fig. 3 – Oscilloscope display for measurement of sustaining voltages. (Test circuit shown in Fig. 2).

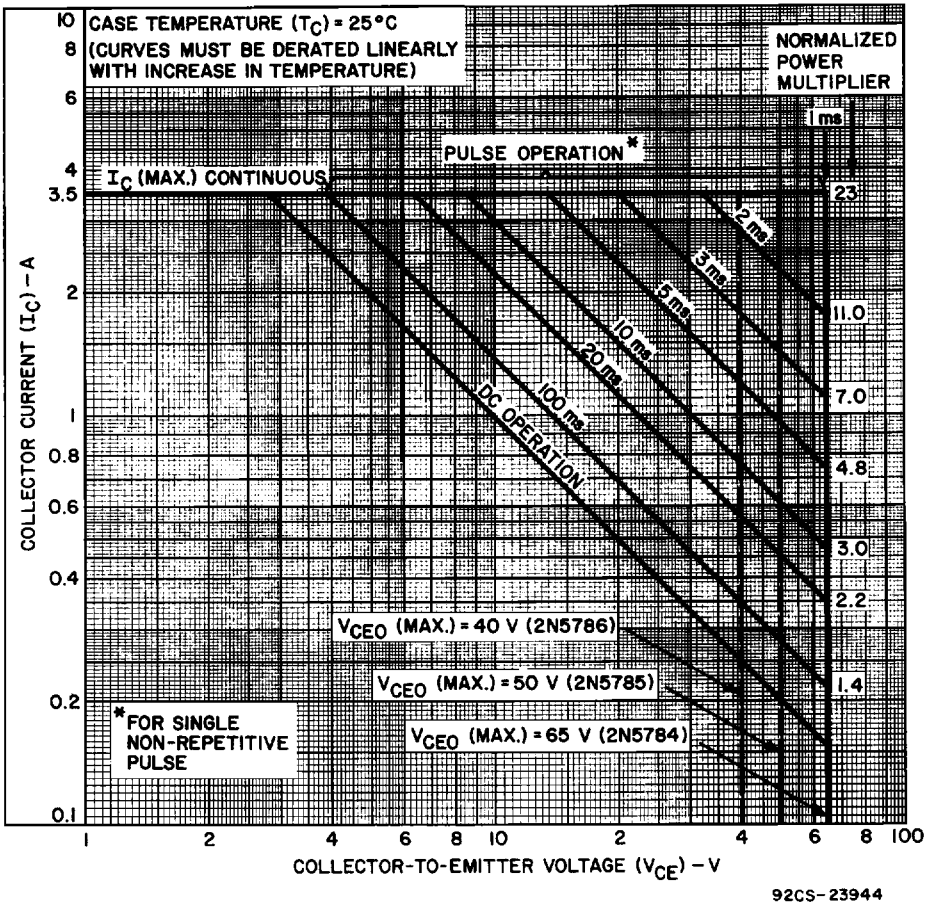


Fig. 4 – Maximum operating areas for types 2N5784, 2N5785, and 2N5786.

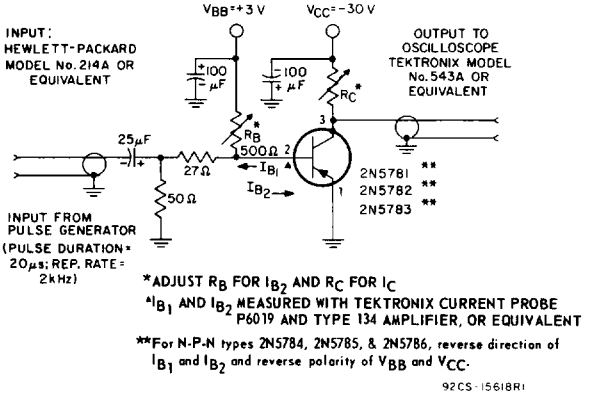


Fig. 5 – Circuit used to measure saturated switching times.

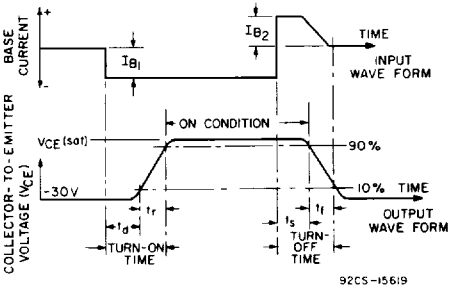


Fig. 6 – Oscilloscope display for measurement of switching times. (Test circuit shown in Fig. 5).

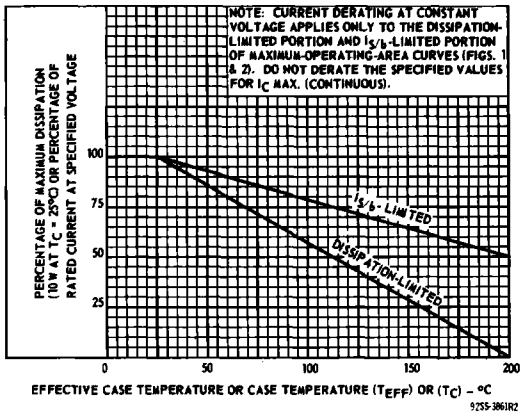


Fig. 7 – Dissipation derating curve for all types.

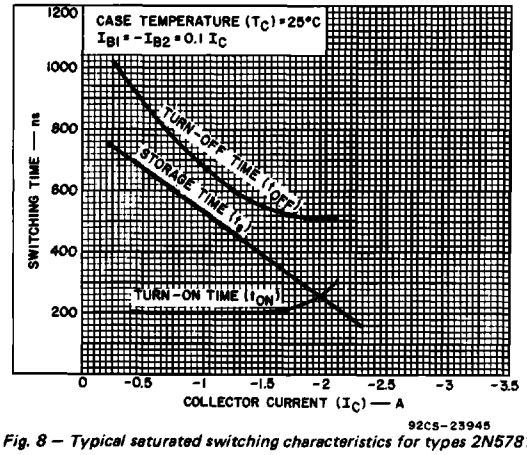


Fig. 8 – Typical saturated switching characteristics for types 2N5781, 2N5782, and 2N5783.

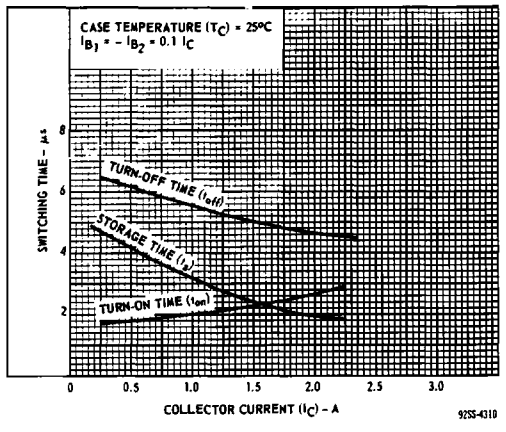


Fig. 9 – Typical saturated switching characteristics for types 2N5784, 2N5785, and 2N5786.

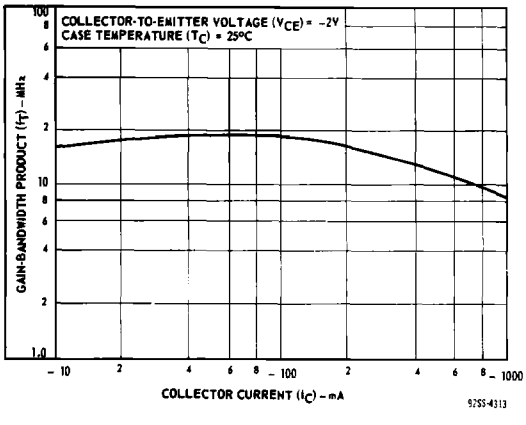


Fig. 10 – Typical gain-bandwidth product for types 2N5781, 2N5782, and 2N5783.

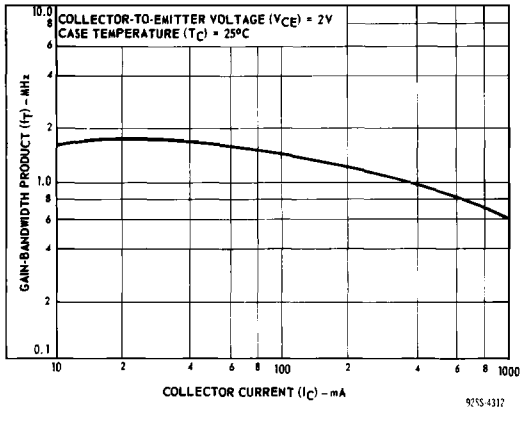


Fig. 11 – Typical gain-bandwidth product for types 2N5784, 2N5785, and 2N5786.

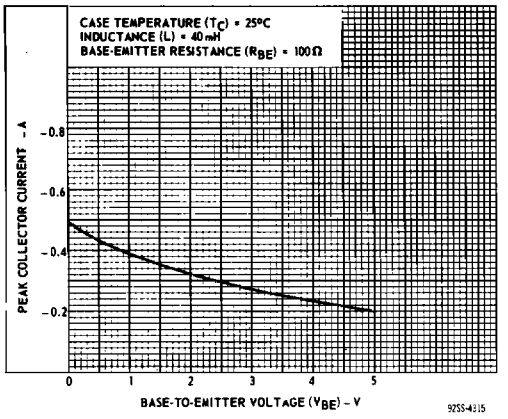


Fig. 12 – Reverse-bias second-breakdown characteristics for types 2N5781, 2N5782, and 2N5783.

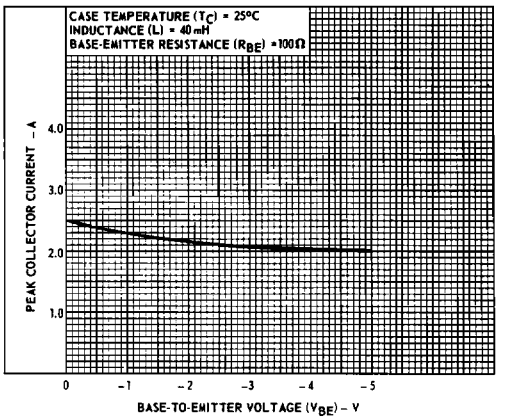


Fig. 13 – Reverse-bias second-breakdown characteristics for types 2N5784, 2N5785, and 2N5786.

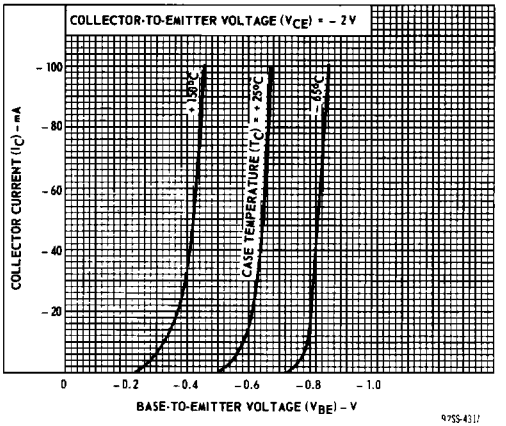


Fig. 14 – Typical transfer characteristics for types 2N5781, 2N5782, and 2N5783.

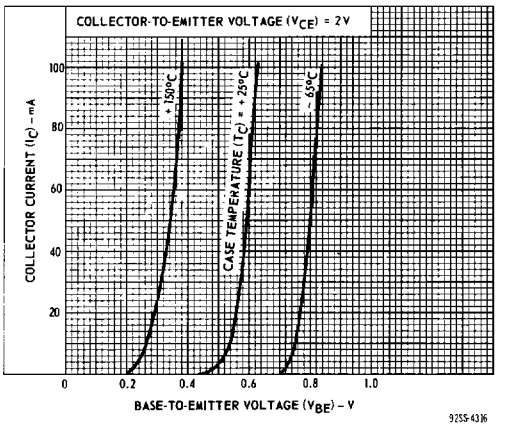


Fig. 15 – Typical transfer characteristics for types 2N5784, 2N5785, and 2N5786.

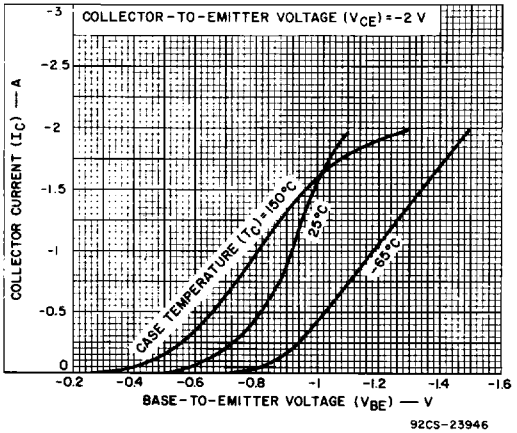


Fig. 16 – Typical transfer characteristics for types 2N5781, 2N5782, and 2N5783.

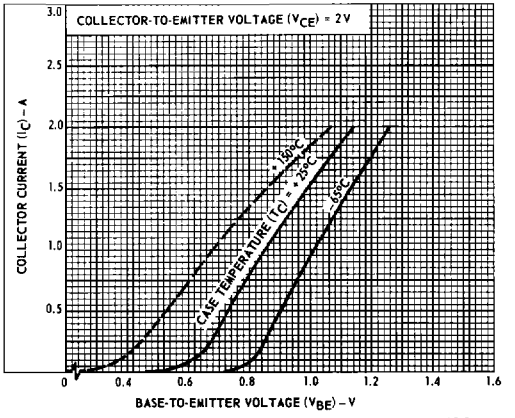


Fig. 17 – Typical transfer characteristics for types 2N5784, 2N5785, and 2N5786.

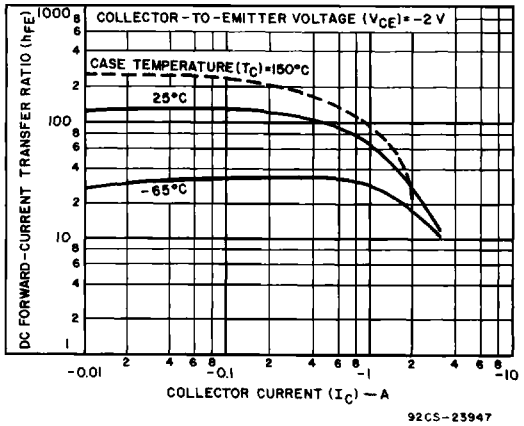


Fig. 18 — Typical dc beta characteristics for type 2N5781.

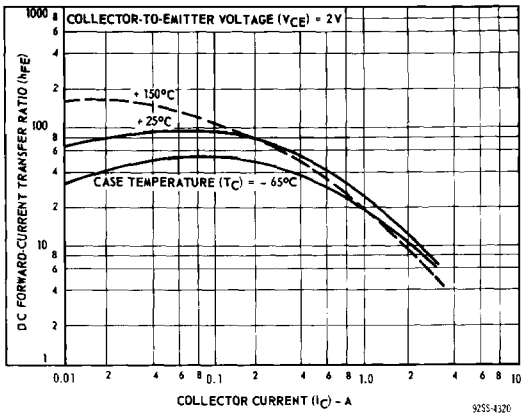


Fig. 19 — Typical dc beta characteristics for type 2N5784.

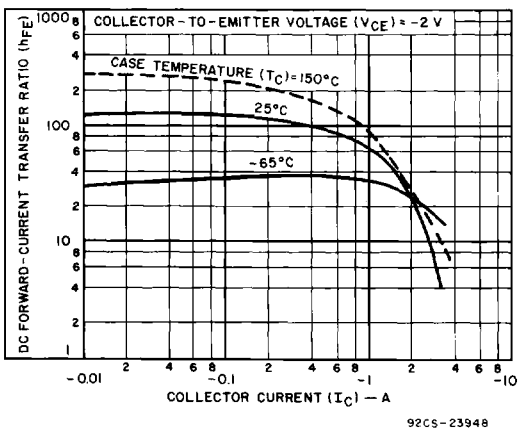


Fig. 20 — Typical dc beta characteristics for type 2N5782.

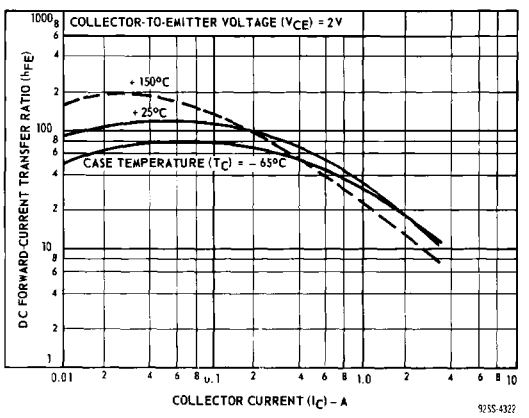


Fig. 21 — Typical dc beta characteristics for type 2N5785.

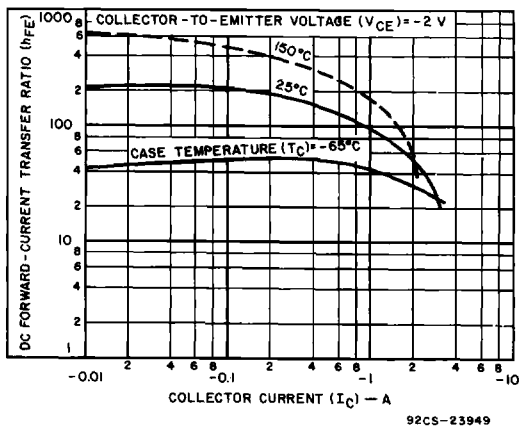


Fig. 22 — Typical dc beta characteristics for type 2N5783.

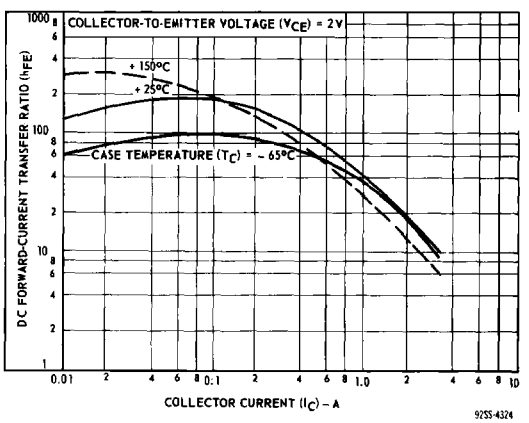


Fig. 23 — Typical dc beta characteristics for type 2N5786.

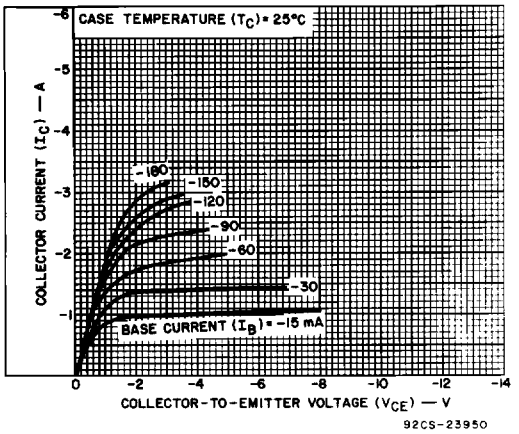


Fig. 24 — Typical output characteristics for type 2N5781.

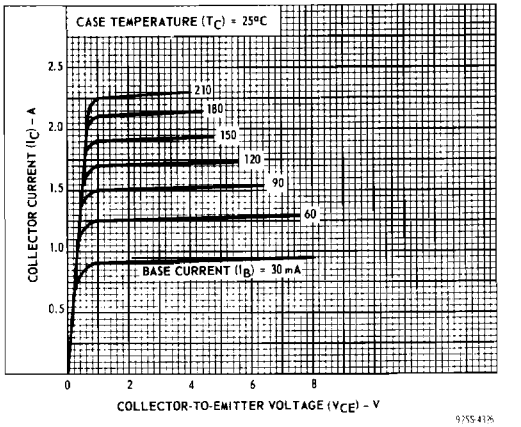


Fig. 25 — Typical output characteristics for type 2N5784.

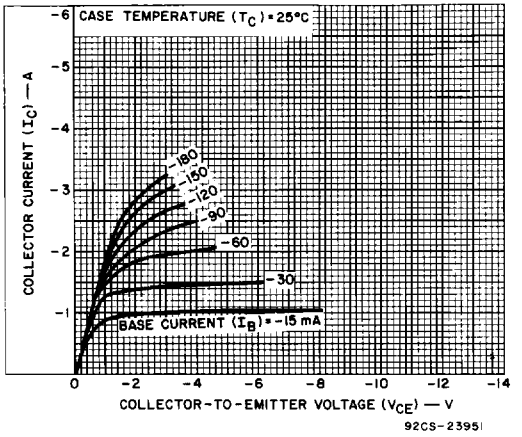


Fig. 26 — Typical output characteristics for type 2N5782.

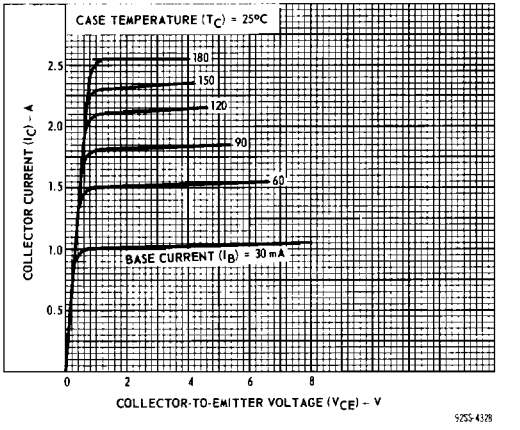


Fig. 27 — Typical output characteristics for type 2N5785.

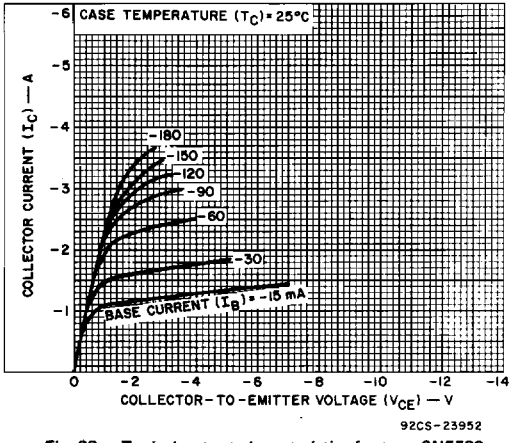


Fig. 28 — Typical output characteristics for type 2N5783.

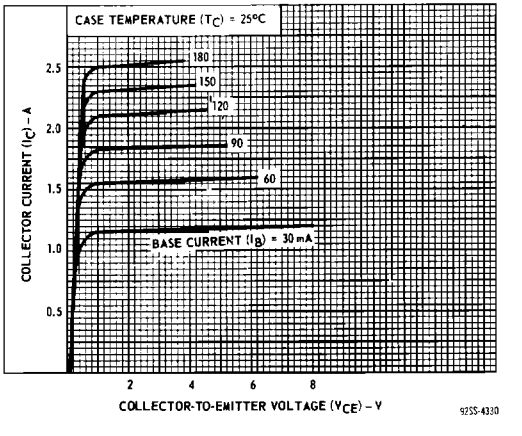


Fig. 29 — Typical output characteristics for type 2N5786.

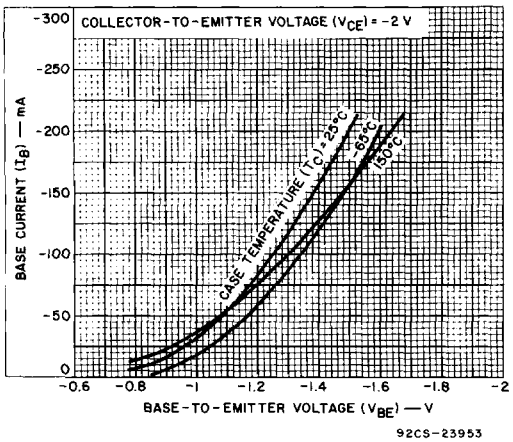


Fig. 30 – Typical input characteristics for type 2N5781.

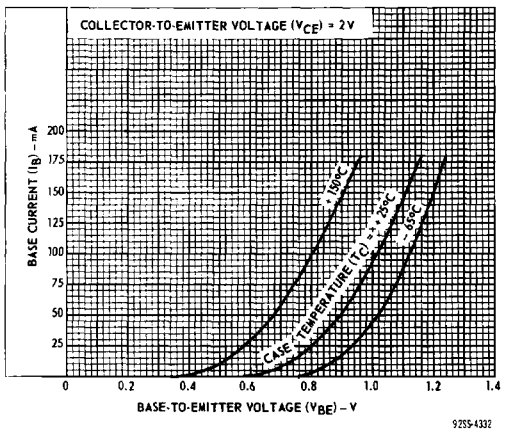


Fig. 31 – Typical input characteristics for type 2N5784.

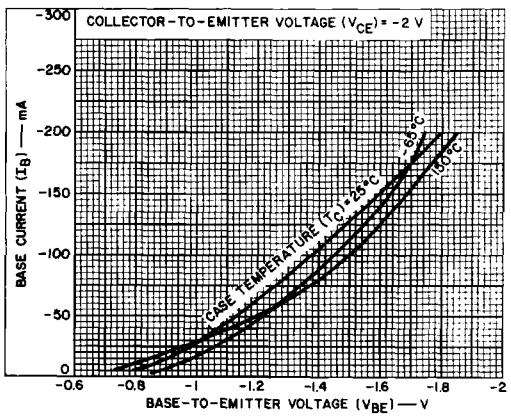


Fig. 32 – Typical input characteristics for type 2N5782.

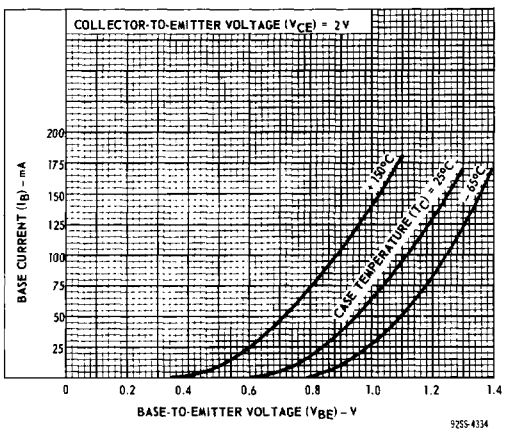


Fig. 33 – Typical input characteristics for type 2N5785.

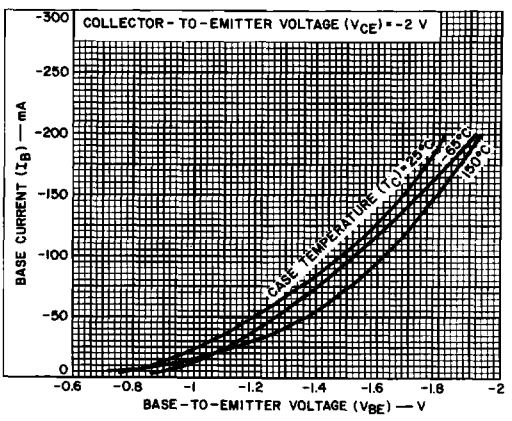


Fig. 34 – Typical input characteristics for type 2N5783.

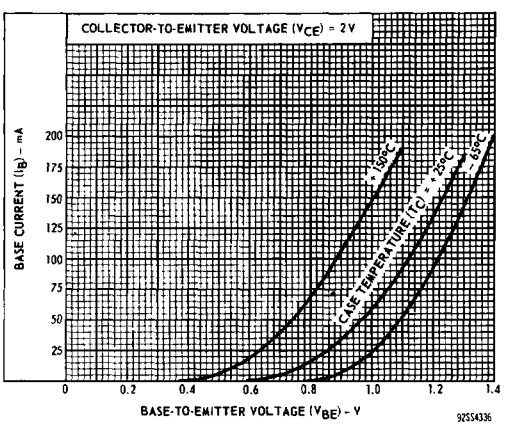


Fig. 35 – Typical input characteristics for type 2N5786.