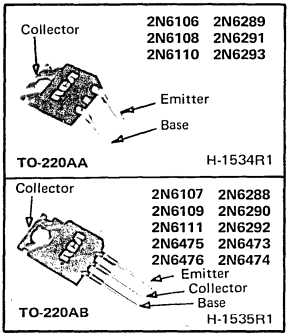
RCA Solid State Division

Power Transistors

2N6106-2N6111, 2N6288-2N6293, 2N6473-2N6476



Epitaxial-Base, Silicon N-P-N and P-N-P VERSAWATT Transistors

General-Purpose Medium-Power Types for Switching and Amplifier Applications

Features

- Low saturation voltages
- VERSAWATT package (molded silicone plastic)
- Complementary n-p-n and p-n-p types
- Thermal-cycling ratings
- Maximum safe-area-of-operation curves specified for dc operation

RCA-2N6106–2N6111, 2N6288–2N6293, and 2N6473–2N6476 are epitaxial-base silicon transistors supplied in a VERSAWATT package. The 2N6288–2N6293, 2N6473, and 2N6474[o] are n-p-n complements of p-n-p types 2N6106–2N6111, 2N6475, and 2N6476[□], respectively. All these transistors are intended for a wide variety of medium-power switching and amplifier applications, such as series and shunt regulators and driver and output stages of high-fidelity amplifiers.

The 2N6289, 2N6291, and 2N6293 n-p-n types and 2N6106, 2N6108, and 2N6110 p-n-p devices fit into TO-66 sockets. The remaining types are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package. All of these devices are also available on special order in a variety of lead-form configurations. Detailed information on these and other VERSAWATT outlines is contained in "RCA's Lineup of Power Transistors" (PSP-704).

[o] Formerly RCA Dev. Nos. TA7784, TA8323, TA7783, TA8232, TA7782, TA8231, TA8444, and TA8723, respectively.

[□] Formerly RCA Dev. Nos. TA8210, TA7741, TA8211, TA7742, TA8212, TA7743, TA8445, and TA8722, respectively.

		2N6288 2N6290 2N6292					
	N-P-N	2N6289	2N6291	2N6293	2N6473	2N6474	
MAXIMUM RATINGS, *Absolute-Maximum Values:*	P-N-P	2N6110♦ 2N6111♦	2N6108♦ 2N6109♦	2N6106♦ 2N6107♦	2N6475♦	2N6476♦	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	40	60	80	110	130	V
*COLLECTOR-TO-EMITTER VOLTAGE:							
With external base-supply resistance (R_{BB}) = 100Ω, and base supply voltage (V_{BB}) = 0	V_{CEX}	40	60	80	110	130	V
With base open	V_{CEO}	30	50	70	100	120	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	5	5	5	V
*COLLECTOR CURRENT (Continuous)							
At case temperature ⩽ 106°C	I_C	7	7	7	4	4	A
*BASE CURRENT (Continuous)							
At case temperature ⩽ 130°C	I_B	3	3	3	2	2	A
TRANSISTOR DISSIPATION:	P_T						
At case temperatures up to 25°C		40	40	40	40	40	W
* At case temperatures up to 100°C		16	16	16	16	16	W
At ambient temperatures up to 25°C		1.8	1.8	1.8	1.8	1.8	W
At case temperatures above 25°C		Derate linearly at 0.32 W/°C, or see Fig. 2.					
* At case temperatures above 100°C		Derate linearly at 0.32 W/°C					
At ambient temperatures above 25°C		Derate linearly at 0.0144 W/°C					
*TEMPERATURE RANGE:							
Storage and Operating (Junction)		← −65 to 150 →					°C
*LEAD TEMPERATURE (During Soldering):							
At distance ⩾ 1/8 in. (3.17 mm) from case for 10 s max.		← 235 →					°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		CURRENT A dc		LIMITS 2N6292 2N6293 2N6106♦ 2N6107♦		2N6290 2N6291 2N6108♦ 2N6109♦		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}	75				–	0.1	–	–	mA
			55				–	–	0.1		
	With (R_{BE}) = 100 Ω and T_C = 150°C		70				–	2	–	–	
			50				–	–	–	2	
*	With base-emitter junction reverse-biased	I_{CEX}	75	−1.5			–	0.1	–	–	mA
			56	−1.5			–	–	–	0.1	
*	With base-emitter junction reverse-biased and T_C = 150°C		70	−1.5			–	2	–	–	
			50	−1.5			–	–	–	2	
*	With base open	I_{CEO}	40			0	–	–	–	1	mA
			60			0	–	1	–	–	
*	Emitter-Cutoff Current	I_{EBO}		−5	0		–	1	–	1	mA
	Collector-to-Emitter Sustaining Voltage:										
*	With base open	$V_{CEO(sus)}$			0.1[a]	0	70	–	50	–	V
	With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$			0.1		80	–	60	–	V
			4		2[a]		30	150	–	–	
*	DC Forward-Current Transfer Ratio	h_{FE}	4		2.5[a]		–	–	30	150	
			4		7[a]		2.3	–	2.3	–	
*	Base-to-Emitter Voltage: 2N6292, 2N6293	V_{BE}	4		2[a]		–	1.5	–	–	V
	2N6290, 2N6291		4		2.5[a]		–	–	–	1.5	
	All Types		4		7[a]		–	3	–	3	
					2[a]	0.2	–	1	–	–	
*	Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$			2.5[a]	0.25	–	–	–	1	V
					7[a]	3[a]	–	3.5	–	3.5	
*	Common-Emitter, Small-Signal, Forward Current Transfer Ratio: f = 50 kHz	h_{fe}	4		0.5		20	–	20	–	
	Gain-Bandwidth Product:										
	2N6290-2N6293	f_T	4		0.5		4	–	4	–	MHz
	2N6106-2N6109		−4		−0.5		10	–	10	–	
*	Magnitude of Common-Emitter, Small-Signal, Forward-Current Transfer Ratio: f = 1 MHz	$\lvert h_{fe} \rvert$									
	2N6290-2N6293		4		0.5		4	–	4	–	
	2N6106-2N6109		−4		−0.5		10	–	10	–	
*	Collector-to-Base Capacitance: f = 1 MHz, V_{CB} = 10 V	C_{obo}			0		–	250	–	250	pF
	Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	3.125	–	3.125	°C/W
	Junction-to-Ambient	$R_{\theta JA}$					–	70	–	70	

[a]Pulsed: Pulse duration = 300 μs, duty factor = 0.018. ♦For p-n-p devices, voltage and current values are negative.

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

CAUTION: The sustaining voltage $V_{CER(sus)}$ MUST NOT be measured on a curve tracer.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc V_{CE}	TEST CONDITIONS♦ VOLTAGE V dc V_{BE}	TEST CONDITIONS♦ CURRENT A dc I_C	TEST CONDITIONS♦ CURRENT A dc I_B	LIMITS 2N6288 2N6289 MIN.	LIMITS 2N6288 2N6289 MAX.	LIMITS 2N6110♦ 2N6111♦ MIN.	LIMITS 2N6110♦ 2N6111♦ MAX.	UNITS
	Collector-Cutoff Current: With external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CEX}	35				–	0.1	–	–0.1	mA
	With (R_{BE}) = 100 Ω and T_C = 150°C		30				–	2	–	–2	
*	With base-emitter junction reverse-biased	I_{CEX}	37.5	–1.5			–	0.1	–	–0.1	mA
*	With base-emitter junction reverse-biased and T_C = 150°C		30	–1.5			–	2	–	–2	
*	With base open	I_{CEO}	20			0	–	1	–	–1	mA
*	Emitter-Cutoff Current	I_{EBO}		5	0		–	1	–	–1	mA
	Collector-to-Emitter Sustaining Voltage:										
*	With base open	$V_{CEO(sus)}$			0.1[a]	0	30	–	–30	–	V
	With external base-to emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$			0.1		40	–	–40	–	V
*	DC Forward Current Transfer Ratio	h_{FE}	4 4		3[a] 7[a]		30 2.3	150 –	30 2.3	150 –	
*	Base-to-Emitter Voltage: 2N6288, 2N6289	V_{BE}	4		3[a]		–	1.5	–	–	V
	All Types		4		7[a]		–	3	–	3	
*	Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$			3[a] 7[a]	0.3 3	– –	1 3.5	– –	–1 –3.5	V
*	Common-Emitter, Small-Signal, Forward-Current Transfer Ratio: f = 50 kHz	h_{fe}	4		0.5		20	–	20	–	
	Gain-Bandwidth Product: 2N6288-2N6289	f_T	4		0.5		4	–	–	–	MHz
	2N6110-2N6111		–4		–0.5		–	–	10	–	
*	Magnitude of Common-Emitter, Small-Signal, Forward-Current Transfer Ratio: f = 1 MHz 2N6288-2N6289	$\lvert h_{fe} \rvert$	4		0.5		4	–	–	–	
	2N6110-2N6111		–4		–0.5		–	–	10	–	
*	Collector-to-Base Capacitance: f = 1 MHz, V_{CB} = 10 V	C_{obo}			0		–	250	–	250	pF
	Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	3.125	–	3.125	°C/W
	Junction-to-Ambient	$R_{\theta JA}$					–	70	–	70	

[a]Pulsed: Pulse duration = 300 μs, duty factor = 0.018.

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

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

CAUTION: The sustaining voltage V_{CER}(sus) MUST NOT be measured on a curve tracer.

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 2N6474 2N6476♦		LIMITS 2N6473 2N6475♦		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}	120 100				– –	0.1 –	– –	– 0.1	mA
	With (R_{BE}) = 100 Ω and T_C = 100°C		120 100				– –	2 –	– –	– 2	
*	With base-emitter junction reverse-biased	I_{CEX}	120 100	–1.5 –1.5			– –	0.1 –	– –	– 0.1	mA
*	With base-emitter junction reverse-biased and T_C = 100°C		120 100	–1.5 –1.5			– –	2 –	– –	– 2	
*	With base open	I_{CEO}	60 50			0 0	– –	1 –	– –	– 1	mA
*	Emitter-Cutoff Current	I_{EBO}		–5	0		–	1	–	1	mA
	Collector-to-Emitter Sustaining Voltage:	$V_{CEO(sus)}$									V
*	With base open				0.1[a]	0	120	–	100	–	
	With external base-to emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$			0.1		130	–	110	–	V
*	DC Forward-Current Transfer Ratio	h_{FE}	4 2.5		1.5[a] 4[a]		15 2	150 –	15 2	150 –	
*	Base-to-Emitter Voltage	V_{BE}	4 2.5		1.5[a] 4[a]		– –	2 3.5	– –	2 3.5	V
*	Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$			1.5[a] 4[a]	0.15 2	– –	1.2 2.5	– –	1.2 2.5	V
*	Common-Emitter, Small-Signal, Forward-Current Transfer Ratio: f = 50 kHz	h_{fe}	4		0.5		20	–	20	–	
	Gain-Bandwidth Product: 2N6473, 2N6474 2N6475, 2N6476	f_T	4 –4		0.5 –0.5		4 10	– –	4 10	–	MHz
*	Magnitude of Common-Emitter, Small-Signal, Forward-Current Transfer Ratio: f = 1 MHz 2N6473, 2N6474 2N6475, 2N6476	$\lvert h_{fe} \rvert$	4 –4		0.5 –0.5		4 10	– –	4 10	– –	
*	Collector-to-Base Capacitance: f = 1 MHz, V_{CB} = 10 V	C_{obo}			0		–	250	–	250	pF
	Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	3.125	–	3.125	°C/W
	Junction-to-Ambient	$R_{\theta JA}$					–	70	–	70	

[a]Pulsed: Pulse duration = 300 μs, duty factor = 0.018.

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

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CAUTION: The sustaining voltage V_{CER}(sus) MUST NOT be measured on a curve tracer.

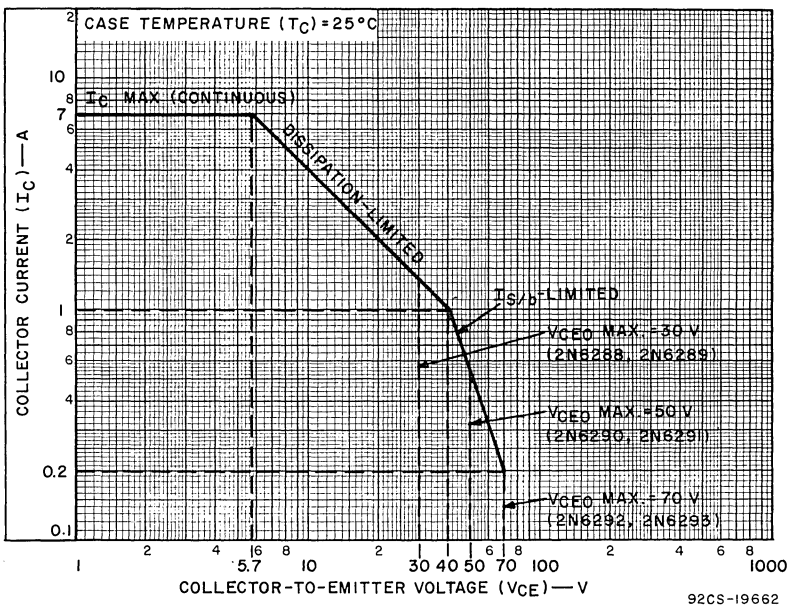


Fig. 1 — Maximum operating areas for 2N6288 — 2N6293.

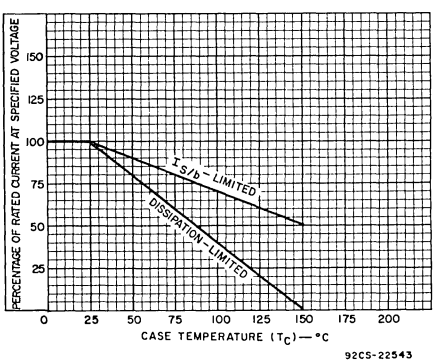


Fig. 2 — Current derating curves for all types.

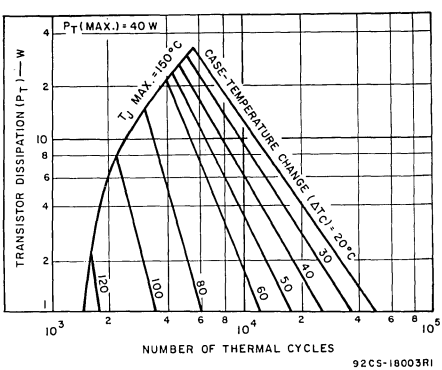


Fig. 3 — Thermal-cycling ratings for all types.

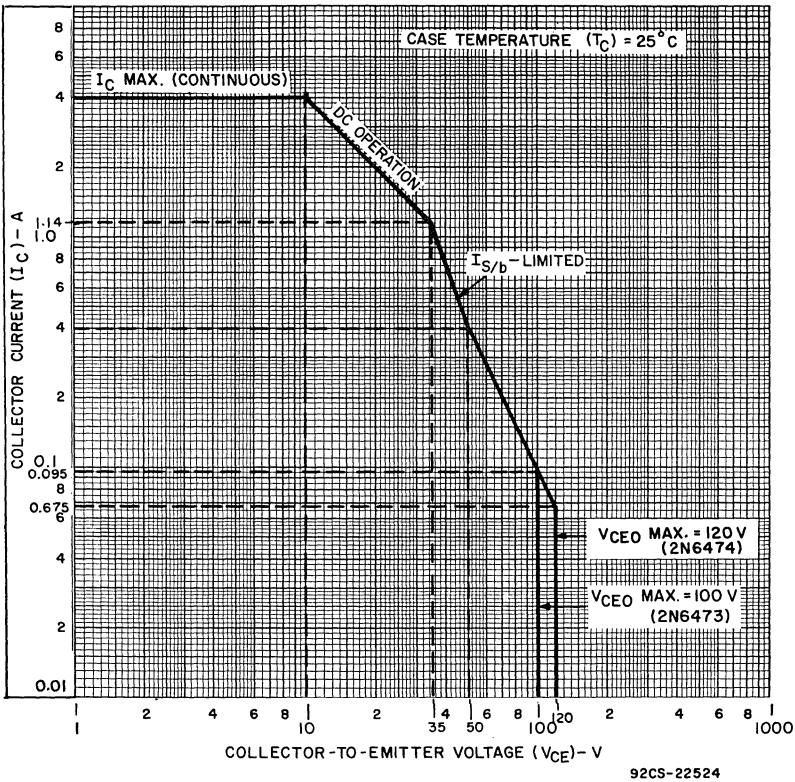


Fig. 4 — Maximum operating areas for 2N6473 and 2N6474.

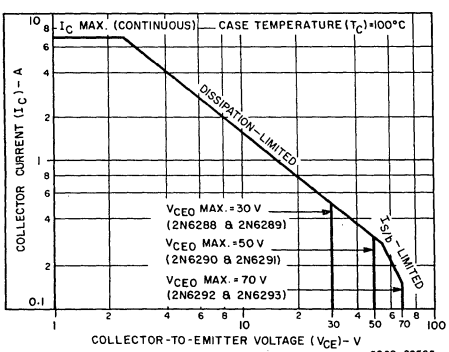


Fig. 5 — Maximum operating areas for 2N6288 — 2N6293.

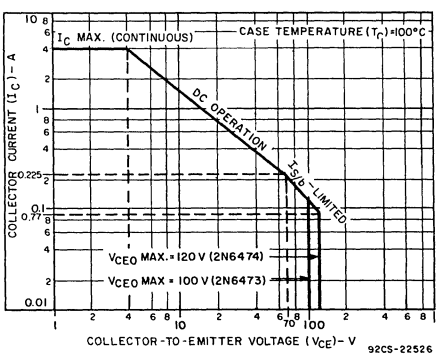


Fig. 6 — Maximum operating areas for 2N6473 — 2N6474.

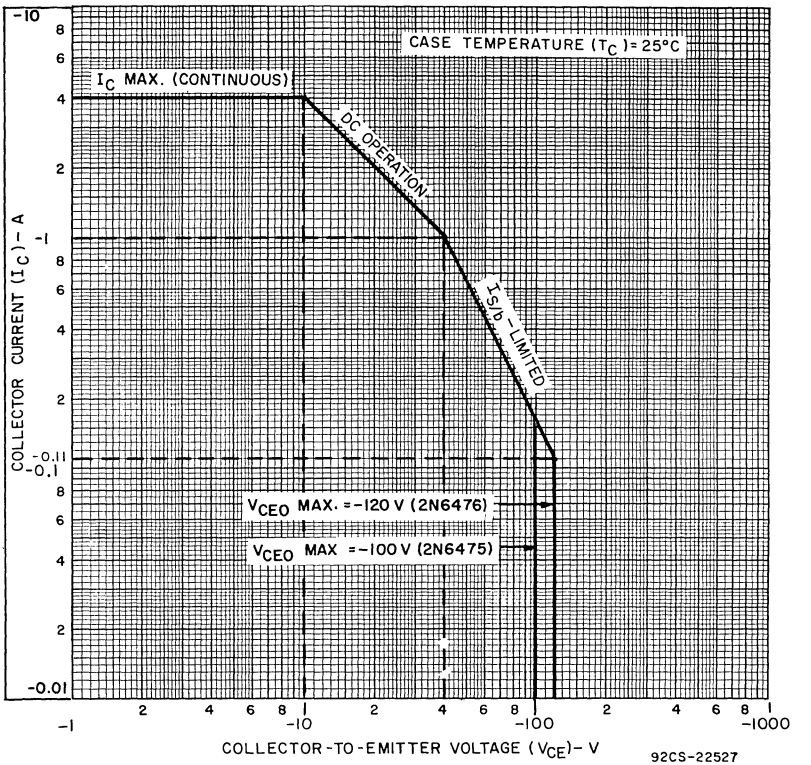


Fig. 7 — Maximum operating areas for 2N6475 — 2N6476.

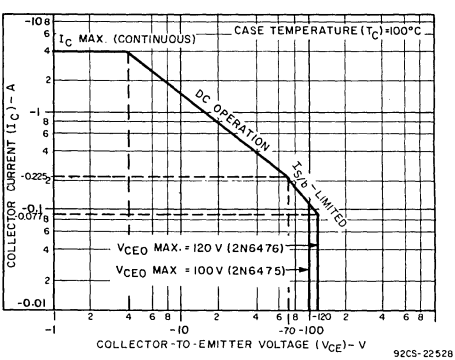


Fig. 8 — Maximum operating areas for 2N6475 and 2N6476.

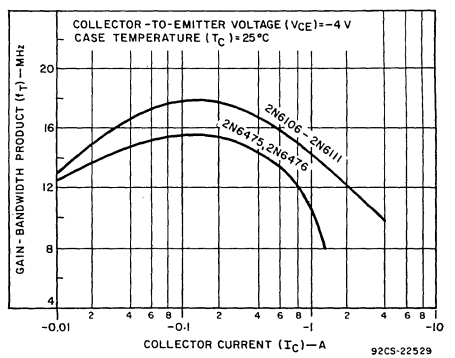


Fig. 9 — Typical gain-bandwidth product for 2N6106 — 2N6111, 2N6475, and 2N6476.

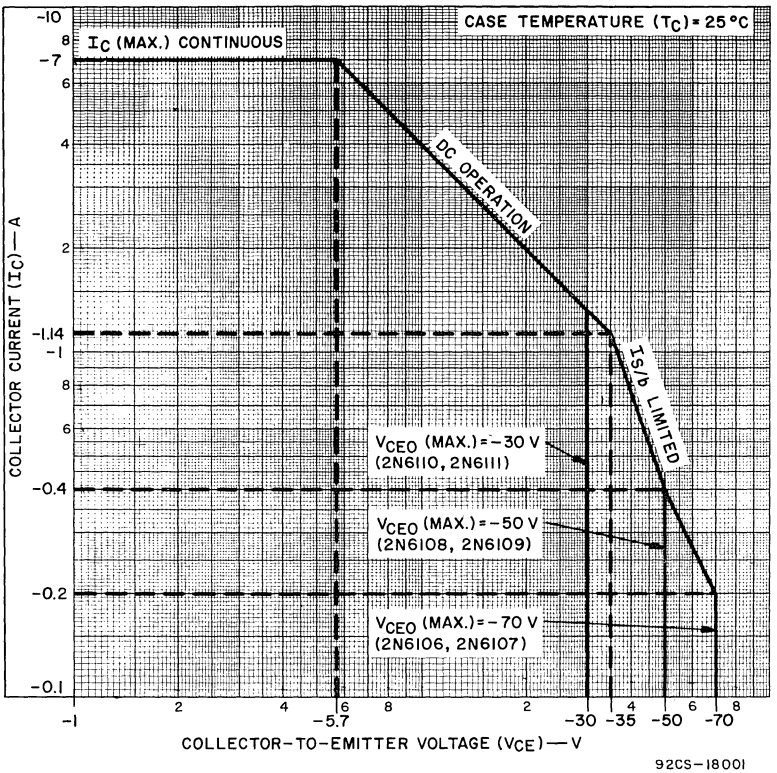


Fig. 10 – Maximum operating areas for 2N6106 – 2N6111.

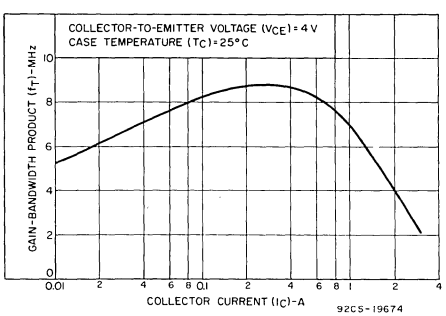


Fig. 11 – Typical gain-bandwidth product for 2N6288 – 2N6293.

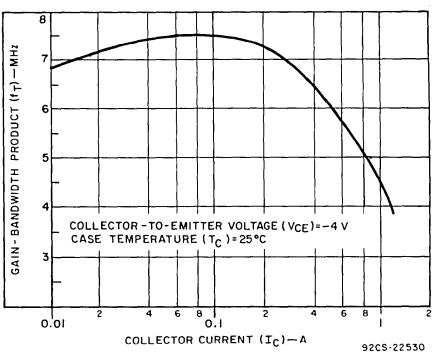


Fig. 12 – Typical gain-bandwidth product for 2N6473 and 2N6474.

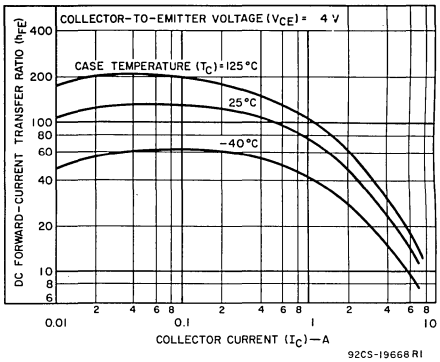


Fig. 13 – Typical dc beta characteristics for 2N6288 – 2N6293.

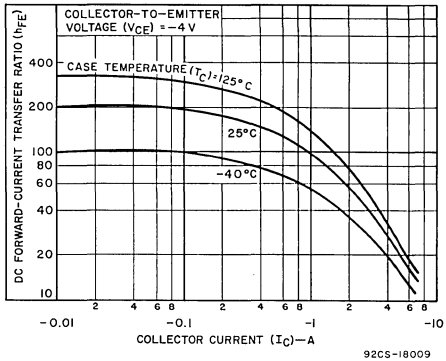


Fig. 14 – Typical dc beta characteristics for 2N6106 – 2N6111.

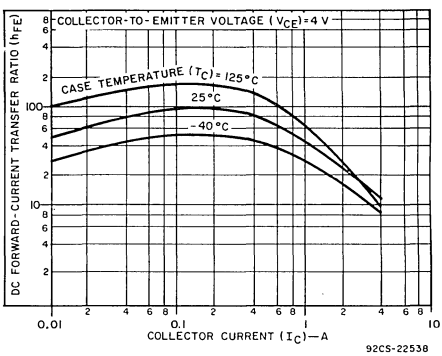


Fig. 15 – Typical dc beta characteristics for 2N6473 and 2N6474.

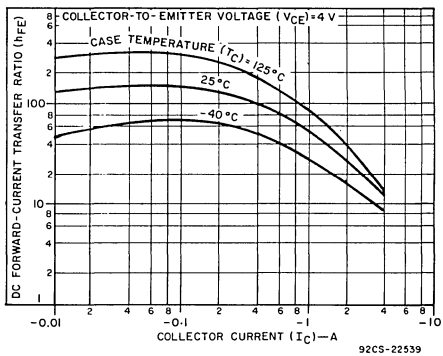


Fig. 16 – Typical dc beta characteristics for 2N6475 and 2N6476.

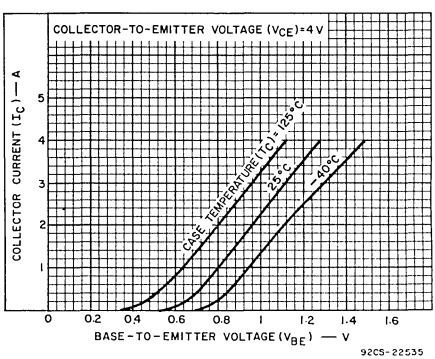


Fig. 17 – Typical transfer characteristics for 2N6288 – 2N6293.

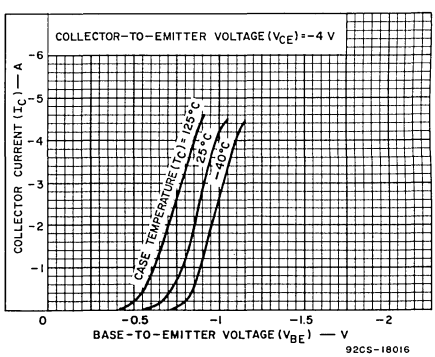


Fig. 18 – Typical transfer characteristics for 2N6106 – 2N6111.

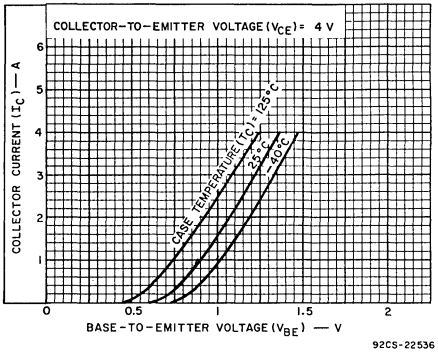


Fig. 19 — Typical transfer characteristics for 2N6473 and 2N6474.

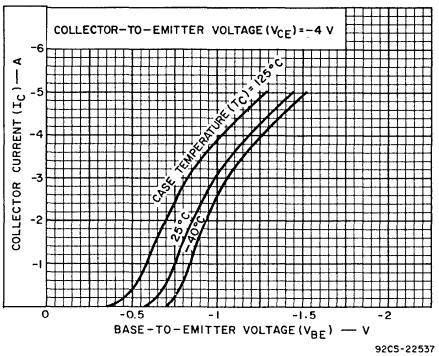


Fig. 20 — Typical transfer characteristics for 2N6475 and 2N6476.

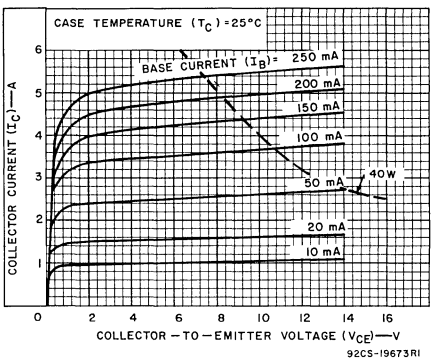


Fig. 21 — Typical output characteristics for 2N6288 — 2N6293.

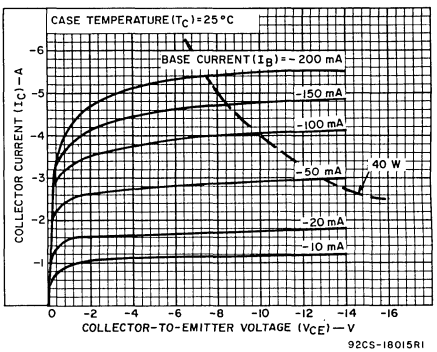


Fig. 22 — Typical output characteristics for 2N6106 — 2N6111.

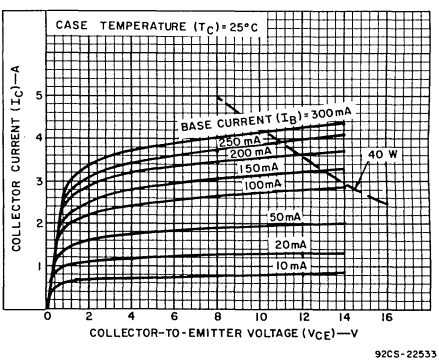


Fig. 23 — Typical output characteristics for 2N6473 and 2N6474.

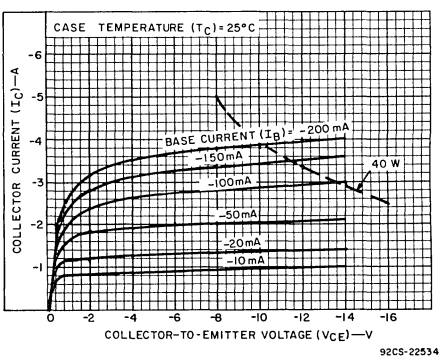


Fig. 24 — Typical output characteristics for 2N6475 and 2N6476.

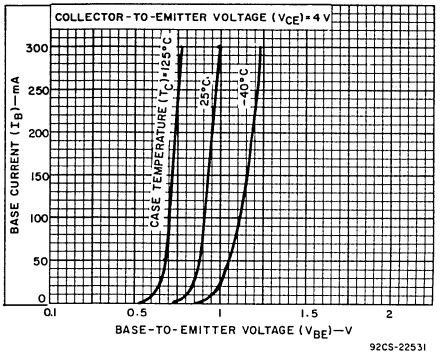


Fig. 25 – Typical input characteristics for 2N6288 – 2N6293.

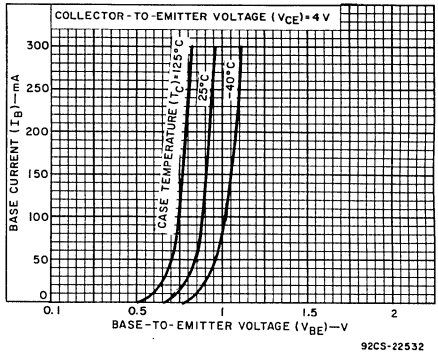


Fig. 26 – Typical input characteristics for 2N6473 and 2N6474.

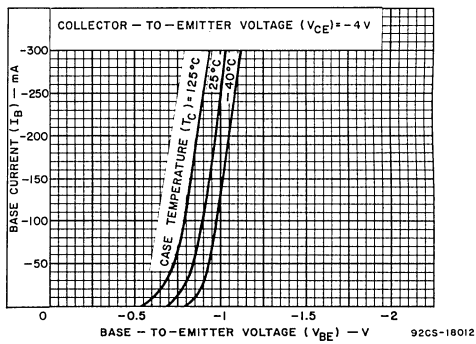


Fig. 27 – Typical input characteristics for 2N6106 – 2N6111, 2N6475, and 2N6476.

TERMINAL CONNECTIONS
JEDEC TO-220AA

Lead No.1 – Base
Stub – Do not use stub as tie point.
Lead No.3 – Emitter
Mounting Flange – Collector

TERMINAL CONNECTIONS
JEDEC TO-220AB

Lead No.1 – Base
Lead No.2 – Collector
Lead No.3 – Emitter
Mounting Flange – Collector

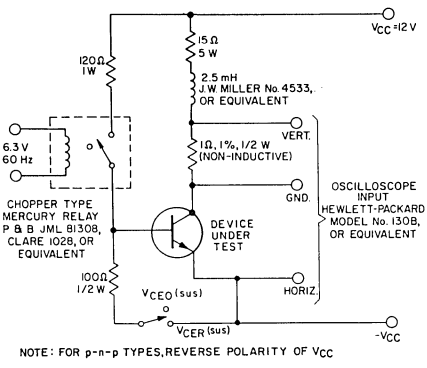
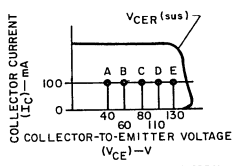


Fig. 28 – Circuit used to measure sustaining voltage V_{CER}(sus) for all types.



Note: Curve will be inverted and polarity reversed for p-n-p types. The sustaining voltage, V_{CER}(sus), is acceptable when the traces fall to the right and above the designated points:
Point A: 2N6110, 2N6111, 2N6288, 2N6289
Point B: 2N6108, 2N6109, 2N6290, 2N6291
Point C: 2N6106, 2N6107, 2N6292, 2N6293
Point D: 2N6475, 2N6473
Point E: 2N6476, 2N6474

Fig. 29 – Oscilloscope display for measurement of sustaining voltage (test circuit shown in Fig. 28).