T-33-01

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*
- *Complementary n-p-n and p-n-p types*
- *Maximum safe-area-of-operation curves specified for dc operation*

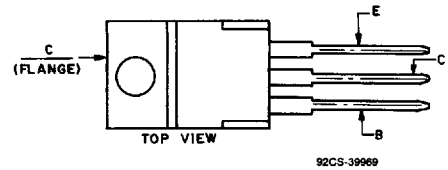
The 2N6106-2N6111, 2N6288-2N6293, and 2N6473-2N6476 are epitaxial-base silicon transistors supplied in a VERSAWATT package. The 2N6288-2N6293, 2N6473, and 2N6474* are n-p-n complements of p-n-p types 2N6106-2N6111, 2N6475, and 2N6476■, respectively. All these transistors are intended for a wide variety 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-213AA 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.

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

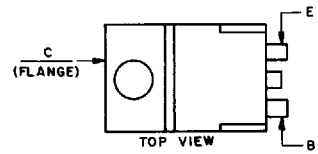
■Formerly RCA Dev. Nos. TA8210, TA7741, TA8211, TA7742, TA8212, TA7743, TA8445, and TA8722, respectively.

TERMINAL DESIGNATIONS



92CS-39969

JEDEC TO-220AB



92CS-40186

JEDEC TO-220AA

POWER TRANSISTORS

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	N-P-N	2N6288 2N6289	2N6290 2N6291	2N6292 2N6293	2N6473	2N6474	
	P-N-P	2N6110‡ 2N6111‡	2N6108‡ 2N6109‡	2N6106‡ 2N6107‡	2N6475‡	2N6476‡	
* V_{CBO}		40	60	80	110	130	V
* $V_{CEX(sus)}$ R_{BB} = 100 Ω, V_{BB} = 0 V		40	60	80	110	130	V
$V_{CEO(sus)}$		30	50	70	100	120	V
* V_{EBO}		5					V
* I_C ($T_C \leq 106°C$)		7			4		A
* I_B ($T_C \leq 130°C$)		3			2		A
P_T							
* $T_C \leq 25°C$		40					W
$T_C > 25°C \leq 100°C$		16					W
$T_C > 25°C$		Derate linearly 0.32					W/°C
$T_A \leq 25°C$		1.8					W
$T_A > 25°C$		Derate linearly 0.0144					W/°C
* T_{stg}, T_J		−65 to 150					°C
* T_L At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235					°C

*In accordance with JEDEC registration data.

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

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

	CHARACTERISTIC	TEST CONDITIONS♦ VOLTAGE V dc		TEST CONDITIONS♦ CURRENT A dc		LIMITS 2N6292 2N6293 2N6106♦ 2N6107♦		LIMITS 2N6290 2N6291 2N6108♦ 2N6109♦		LIMITS 2N6288 2N6289 2N6110♦ 2N6111♦		UNITS
		V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
	I_{CER} (R_{BE} = 100 Ω)	75				–	0.1	–	–	–	–	
		55				–	–	–	0.1	–	–	
		35				–	–	–	–	–	0.1	
	(R_{BE} = 100Ω, T_C = 150°C)	70				–	2	–	–	–	–	
		50				–	–	–	2	–	–	
		30				–	–	–	–	–	2	
*	I_{CEX} (R_{BE} = 100 Ω)	75	–1.5			–	0.1	–	–	–	–	
		56	–1.5			–	–	–	0.1	–	–	
		37.5	–1.5			–	–	–	–	–	0.1	mA
	(R_{BE} = 100 Ω, T_C = 150°C)	70	–1.5			–	2	–	–	–	–	
		50	–1.5			–	–	–	2	–	–	
		30	–1.5			–	–	–	–	–	2	
*	I_{CEO}	60			0	–	1	–	–	–	–	
		40			0	–	–	–	1	–	–	
		20			0	–	–	–	–	–	1	
*	I_{EBO}		–5	0		–	1	–	1	–	1	
*	$V_{CEO(sus)}$[b]			0.1[a]	0	70	–	50	–	30	–	V
	$V_{CER(sus)}$[b] (R_{BE} = 100 Ω)			0.1[a]		80	–	60	–	40	–	
*	h_{FE}	4		2[a]		30	150	–	–	–	–	
		4		2.5[a]		–	–	30	150	–	–	
		4		3[a]		–	–	–	–	30	150	
		4		7[a]		2.3	–	2.3	–	2.3	–	
*	V_{BE}	4		2[a]		–	1.5	–	–	–	–	
		4		2.5[a]		–	–	–	1.5	–	–	
		4		3[a]		–	–	–	–	–	1.5	
		4		7[a]		–	3	–	3	–	3	V
*	$V_{CE(sat)}$			2[a]	0.2	–	1	–	–	–	–	
				2.5[a]	0.25	–	–	–	1	–	–	
				3[a]	0.3	–	–	–	–	–	1	
*				7[a]	3	–	3.5	–	3.5	–	3.5	
*	$\|h_{fe}\|$ (f = 1 MHz) 2N6288-93	4		0.5		4	–	4	–	4	–	
	2N6106-11	–4		–0.5		10	–	10	–	10	–	
*	h_{fe} (f = 50 kHz)	4		0.5		20	–	20	–	20	–	
	f_T 2N6288-93	4		0.5		10	–	10	–	10	–	MHz
	2N6106-11	–4		–0.5		10	–	10	–	10	–	
*	C_{obo} (f = 1 MHz)	10[c]		0		–	250	–	250	–	250	pF
	$R_{\theta JC}$					–	3.125	–	3.125	–	3.125	°C/W
	$R_{\theta JA}$					–	70	–	70	–	70	

* In accordance with JEDEC registration data.

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

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

[c] V_{CB} value.

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

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

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N6474 2N6476♦		2N6473 2N6475♦		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CER} (R_{BE} = 100 Ω)	120				–	0.1	–	–	mA
	100				–	–	–	0.1	
(R_{BE} = 100 Ω T_C = 100°C)	120				–	2	–	–	
	100				–	–	–	2	
* I_{CEX} (R_{BE} = 100 Ω)	120	–1.5			–	0.1	–	–	
	100	–1.5			–	–	–	0.1	
(R_{BE} = 100 Ω, T_C = 100°C)	120	–1.5			–	2	–	–	
	100	–1.5			–	–	–	2	
* I_{CEO}	60			0	–	1	–	–	
	50			0	–	–	–	1	
* I_{EBO}		–5		0	–	1	–	1	
* $V_{CEO(sus)}$[b]			0.1[a]	0	120	–	100	–	V
$V_{CER(sus)}$[b] (R_{BE} = 100 Ω)			0.1[a]		130	–	110	–	
* h_{FE}	4		1.5[a]		15	150	15	150	
	2.5		4[a]		2	–	2	–	
* V_{BE}	4		1.5[a]		–	2	–	2	V
	2.5		4[a]		–	3.5	–	3.5	
* $V_{CE(sat)}$			1.5[a]	0.15	–	1.2	–	1.2	
			4[a]	2	–	2.5	–	2.5	
* $\|h_{fe}\|$ (f = 1 MHz) 2N6473-74	4		0.5		4	–	4	–	
2N6475-76	–4		–0.5		5	–	5	–	
* h_{fe} (f = 50 kHz)	4		0.5		20	–	20	–	
f_T 2N6473-74	4		0.5		4	–	4	–	MHz
2N6475-76	–4		–0.5		5	–	4	–	
* C_{obo} (f = 1 MHz)	10[c]		0		–	250	–	250	pF
$R_{\theta JC}$					–	3.125	–	3.125	°C/W
$R_{\theta JA}$					–	70	–	70	

* In accordance with JEDEC registration data

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

[b] **CAUTION:** The sustaining voltage $V_{CEO(sus)}$ are $V_{CER(sus)}$ ***MUST NOT*** be measured on a curve tracer.

[c] V_{CB} value.

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

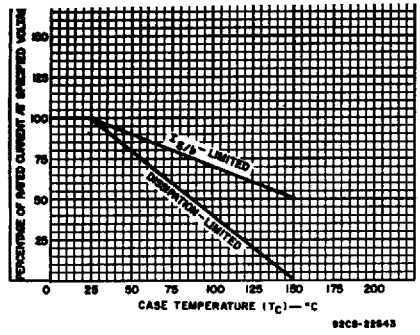


Fig. 1 – Current derating curves for all types.

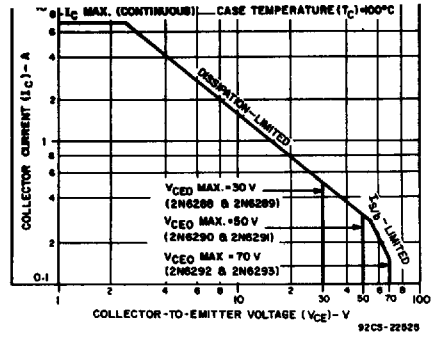


Fig. 2 - Maximum operating areas for 2N6288 – 2N6293 (T_C = 100°C).

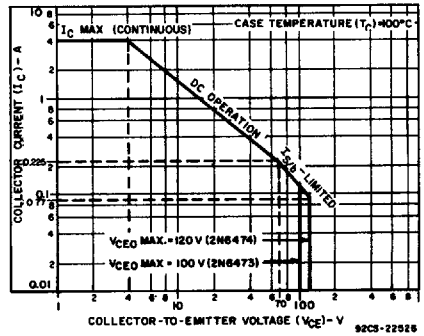


Fig. 3 - Maximum operating areas for 2N6473 – 2N6474 (T_C = 100°C).

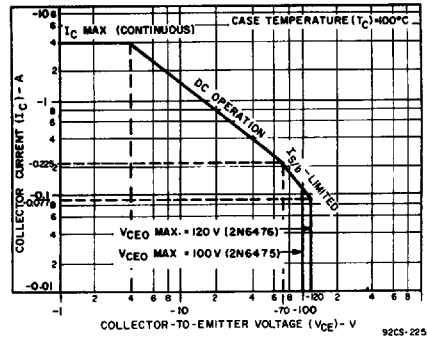


Fig. 4 - Maximum operating areas for 2N6475 and 2N6476 (T_C = 100°C).

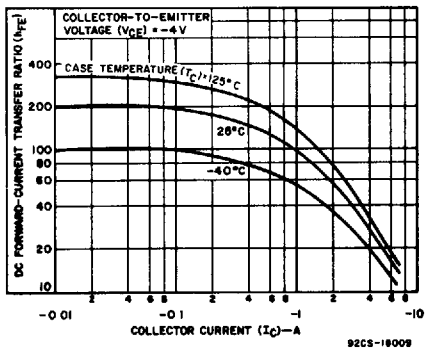


Fig. 5 - Typical dc beta characteristics for 2N6106 – 2N6111.

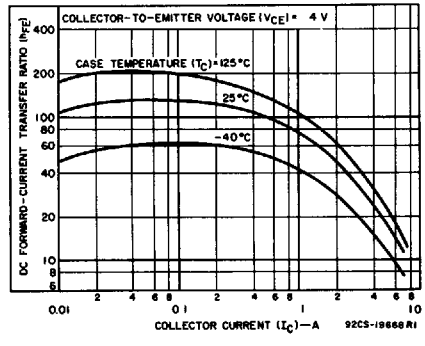


Fig. 6 - Typical dc beta characteristics for 2N6288 – 2N6293.

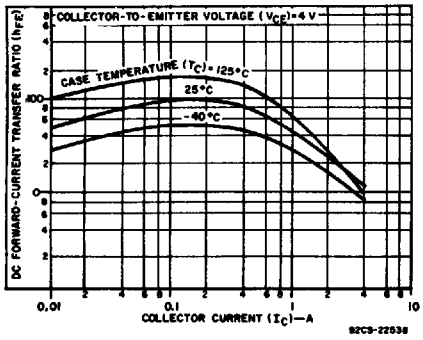


Fig. 7 – Typical dc beta characteristics for 2N6473 and 2N6474.

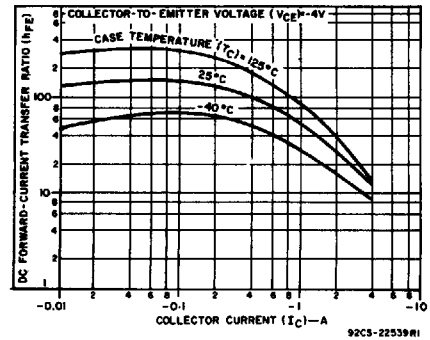


Fig. 8 – Typical dc beta characteristics for 2N6475 and 2N6476.

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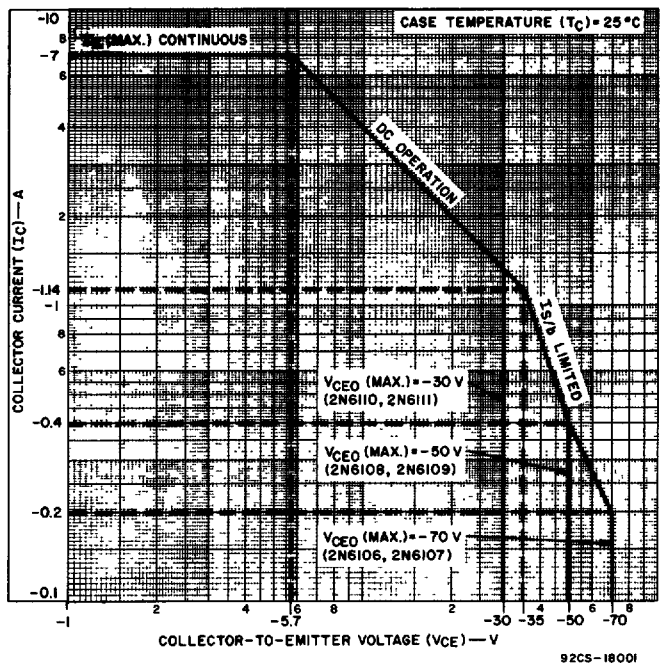

Fig. 9 – Maximum operating areas for 2N6106 – 2N6111 (T_C = 25°C).

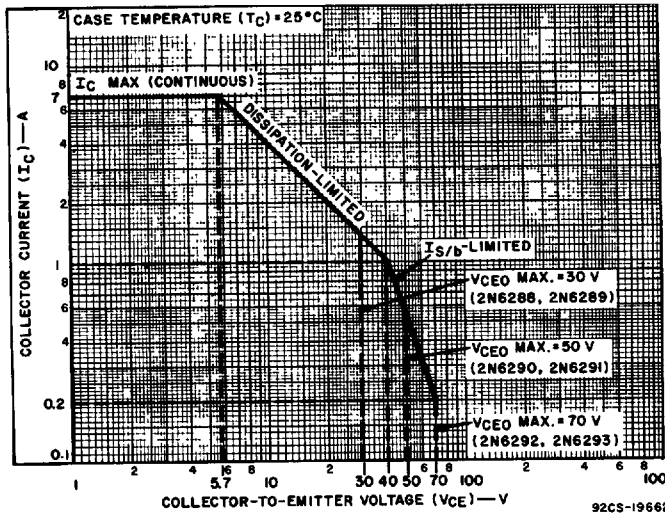

Fig. 10 - Maximum operating areas for 2N6288–2N6293 (T_C = 25°C).

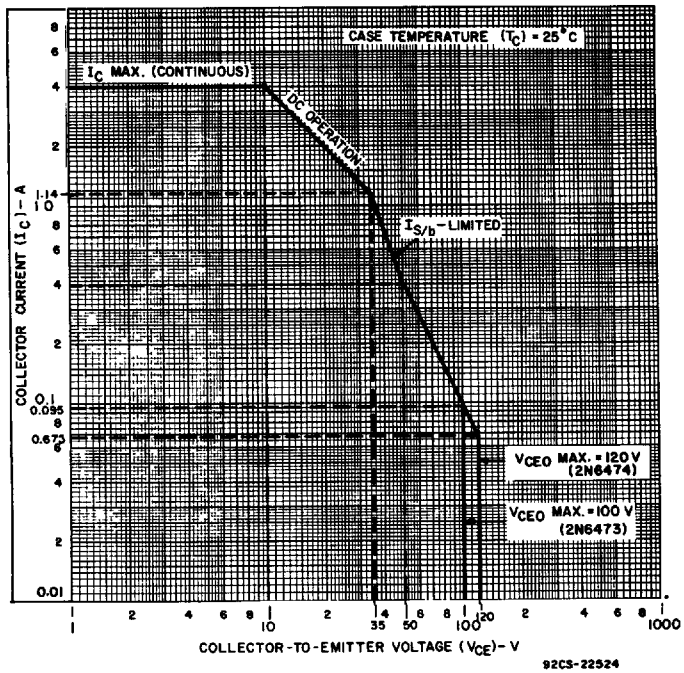

Fig. 11 - Maximum operating areas for 2N6473 and 2N6474 (T_C = 25°C).

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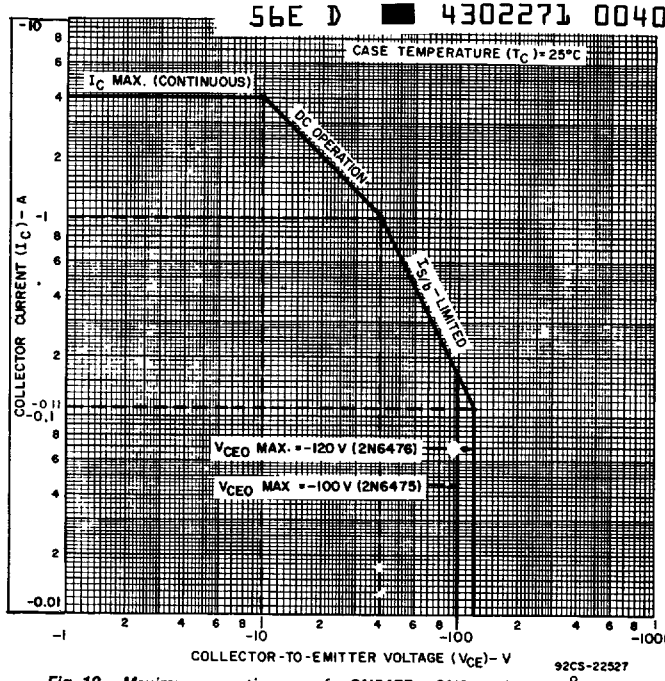

Fig. 12 - Maximum operating areas for 2N6475 – 2N6476 ($T_C = 25°C$).

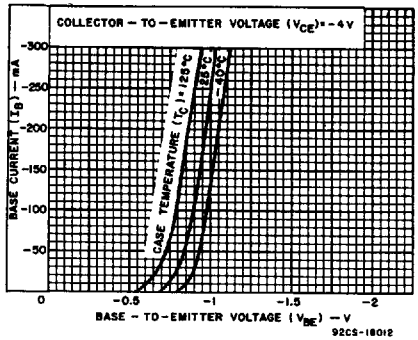

Fig. 13 - Typical input characteristics for 2N6106 – 2N6111, 2N6475, and 2N6476.

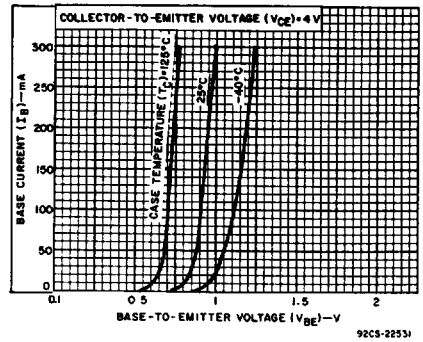

Fig. 14 - Typical input characteristics for 2N6288 – 2N6293.

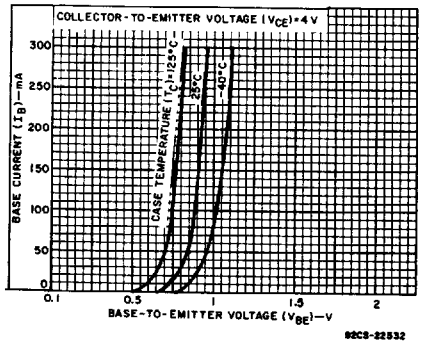

Fig. 15 - Typical input characteristics for 2N6473 2N6474.

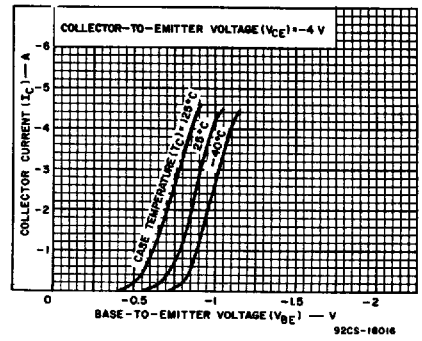

Fig. 16 - Typical transfer characteristics for 2N6106 – 2N6111.

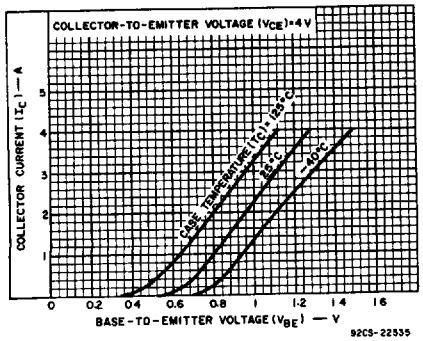

Fig. 17 - Typical transfer characteristics for 2N6288 – 2N6293.

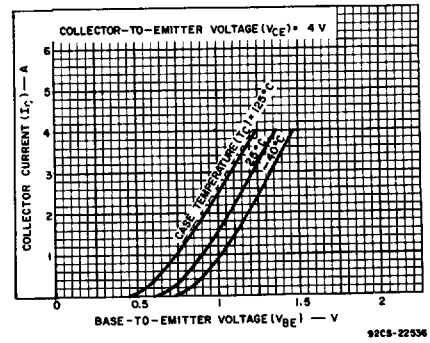

Fig. 18 - Typical transfer characteristics for 2N6473 and 2N6474.

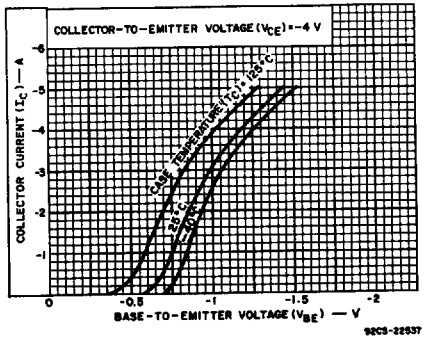

Fig. 19 - Typical transfer characteristics for 2N6475 and 2N6476.

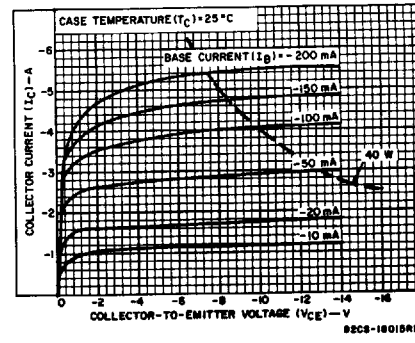

Fig. 20 – Typical output characteristics for 2N6106 – 2N6111.

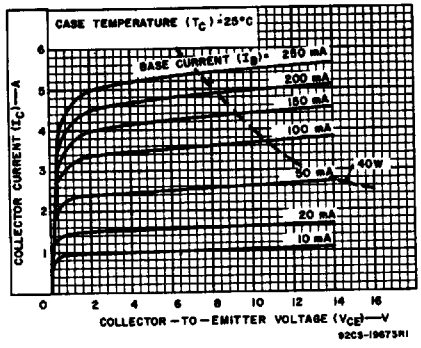

Fig. 21 – Typical output characteristics for 2N6288 – 2N6293.

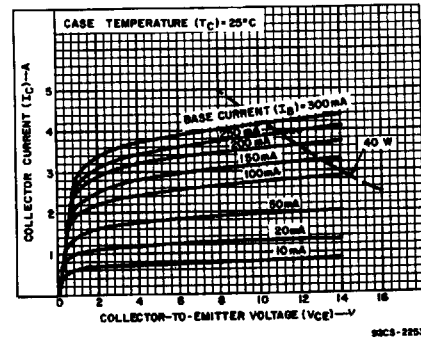

Fig. 22 – Typical output characteristics for 2N6473 and 2N6474.

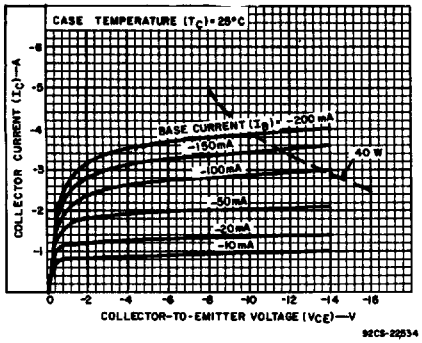

Fig. 23 - Typical output characteristics for 2N6475 and 2N6476.

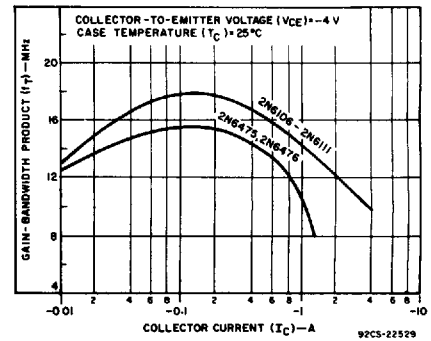

Fig. 24 - Typical gain-bandwidth product 2N6106 – 2N6111, 2N6475, and 2N6476.

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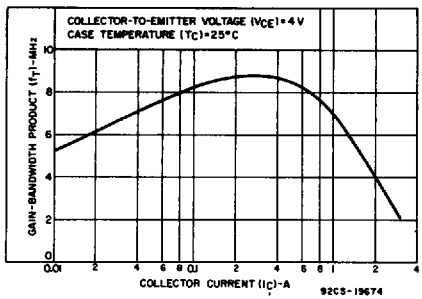


Fig. 25 - Typical gain-bandwidth product for 2N6288 – 2N6293.

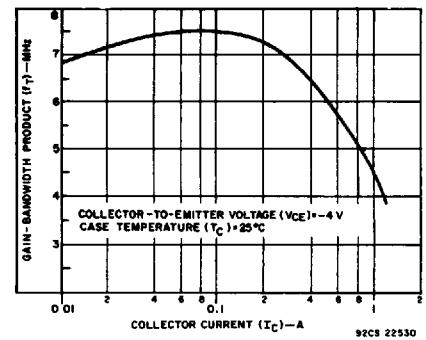


Fig. 26 - Typical gain-bandwidth product for 2N6473 and 2N6474.

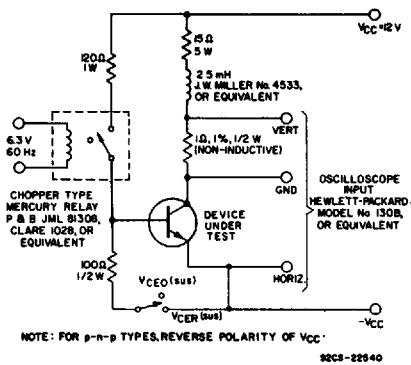
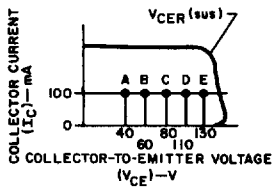


Fig. 27 - Circuit used to measure sustaining voltage $V_{CER}(sus)$ for all types.



Note: Curve will be inverted and polarity reversed for p-n-p types. The sustaining voltage, $V_{CER}(sus)$, is accepatble 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. 28 – Oscilloscope delay for measurement of sustaining voltage (test circuit shown in Fig. 27).