RCA
Solid State
Division

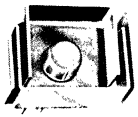
Power Transistors

2N4036 2N4037 2N4314 40391 40394

40394
H-1375

2N4036
2N4037
2N4314

JEDEC
TO-39



40391
H-1468

H-1381

Medium-Power Silicon P-N-P Planar Transistors

General-Purpose Types for
Industrial and Commercial Applications

Features:

- 2N4036, 2N4037 } are p-n-p complements of { 2N2102▲▲, 2N3053
- Gain-bandwidth product (f_T) = 60 MHz min
- High breakdown voltages
- Maximum-area-of-operation curves
- Planar construction provides low noise and low leakage
- Low saturation voltages
- High pulsed beta at high collector current
- Fast switching (2N4036)

These devices are available with either 1½-inch leads (TO-5 package) or ½-inch leads (TO-39 package). The longer-lead versions are specified by suffix "L" after the type number; the shorter-lead versions are specified by suffix "S" after the type number.

The 2N4036, 2N4037, 2N4314▲, 40391, and 40394 are double-diffused, epitaxial-planar, silicon p-n-p transistors; they differ in breakdown-voltage ratings, leakage-current, and saturation characteristics. The 40391 is a 2N4037 with a factory-attached heat radiator, intended for printed-circuit-board applications. Type 40394 is a 2N4037 with a factory-attached diamond-shaped mounting flange.

These transistors are intended for a wide variety of small-signal medium-power applications. With a minimum gain-bandwidth product (f_T) of 60 MHz, these devices provide useful gain at high frequencies. In addition, the 2N4036 is useful in high-speed saturated switching applications.

▲ Formerly Dev. Nos. TA2651, TA2670, and TA2670A, respectively.

▲▲ 2N2102 is a linear-beta type; the 2N3053 is a general-purpose type. For technical bulletins for these types, write to RCA Solid State Division, Box 3200, Somerville, N. J. 08876.

MAXIMUM RATINGS, *Absolute Maximum Values:*

		2N4036	2N4037 40391, 40394	2N4314	
* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	−90	−60	−90	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:					
With 1.5 volts (V_{BE}) of reverse bias	$V_{CEV}(sus)$	−85	−60	−85	V
With external base-to-emitter resistance (R_{BE}) ≤200 Ω	$V_{CER}(sus)$	−85	−60	−85	V
* With base open	$V_{CEO}(sus)$	−65	−40	−65	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	−7	−7	−7	V
* COLLECTOR CURRENT	I_C	−1.0	−1.0	−1.0	A
* BASE CURRENT	I_B	−0.5	−0.5	−0.5	A
* TRANSISTOR DISSIPATION:	P_T				
At case temperatures up to 25°C		7	7(2N4037)	7	W
		–	7(40394)	–	W
At free-air temperatures up to 25°C		1	3.5(40391)	1	W
		–	1(2N4037, 40394)	–	W
At temperatures above 25°C		←	See Figs. 6 and 7	→	
For pulsed operation		←	See Fig. 1	→	
* TEMPERATURE RANGE:					
Storage & Operating (Junction)		←	−65 to 200	→	°C
* LEAD TEMPERATURE (During soldering):					
At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		←	230	→	°C

* In accordance with JEDEC registration data format (JS-6 RDF-1 2N4036; JS-9 RDF-2 2N4037, 2N4314).

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

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CB}	V_{CE}	V_{BE}	CURRENT mA dc I_C	LIMITS: 2N4036 Min.	2N4036 Max.	2N4037 40391 40394 Min.	2N4037 40391 40394 Max.	2N4314 Min.	2N4314 Max.	UNITS
Collector Cutoff Current:												
With emitter open	I_{CBO}	−90				–	−0.1●	–	–	–	–	mA
		−60				–	−0.02	–	−0.25●	–	−0.25●	μA
With base open	I_{CEO}		−30			–	−0.5●	–	−5●	–	−5●	μA
With base-emitter junction reversed biased	I_{CEX}		−85	1.5		–	−100●	–	–	–	–	mA
$T_C = 150°C$			−30	1.5		–	−0.1●	–	–	–	–	
Emitter Cutoff Current	I_{EBO}			7	0	–	−0.1●	–	–	–	–	mA
				5	0	–	−0.02	–	−1●	–	−1●	μA
Collector-to-Base Breakdown Voltage ($I_E = 0$)	$V_{(BR)CBO}$				−0.1	−90	–	−60●	–	−90●	–	V
Emitter-to-Base Breakdown Voltage ($I_E = -0.1mA$)	$V_{(BR)EBO}$				0	−7	–	−7	–	−7	–	V
Collector-to-Emitter Sustaining Voltage: *(See Figs. 2 and 3)* With base-emitter junction reversed biased	$V_{CEV(sus)}$			1.5	−100	−85[a]	–	−60[a]	–	−85[a]	–	V
With external base-to-emitter resistance ($R_{BE} \leq 200\ \Omega$)	$V_{CER(sus)}$				−100	−85[a]	–	−60[a]	–	−85[a]	–	V
● With base open	$V_{CEO(sus)}$				−100	−65[a]	–	−40[a]	–	−65[a]	–	V
● Collector-to-Emitter Voltage ($I_B = -15$ mA)	$V_{CE(sat)}$				−150	–	−0.65	–	−1.4	–	−1.4	V
Base-to-Emitter Voltage	V_{BE}		−10		−150	–	−1.1	–	−1.5●	–	−1.5●	V
● Base-to-Emitter Voltage ($I_B = -15$ mA)	$V_{BE(sat)}$				−150	–	−1.4	–	–	–	–	V
● DC Forward-Current Transfer Ratio	h_{FE}		−2		−150	20	200	–	–	–	–	
			−10		−0.1	20	–	–	–	–	–	
			−10		−1.0	–	–	15	–	15	–	
			−10		−150[b]	40	140	50	250	50	250	
			−10		−500[b]	20	–	–	–	–	–	
Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (at f = 20MHz)	h_{fe}		−10		−50	3.0	–	3.0	–	3.0	–	
● Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (at f = 20MHz)	$\lvert h_{fe} \rvert$		−10		−50	3.0	–	3.0	10	3.0	10	
Collector-Base Capacitance (at f = 1MHz, $I_E = 0$)	C_{cb}	−10				–	30	–	30●	–	30●	pF
Input Capacitance	C_{ib}			0.5	0	–	90	–	90	–	90	pF
● Sat. Switching Time: **c** *(See Figs. 10 and 11)*												
Rise time	t_r		−30		−150	–	70	–	–	–	–	
Storage time	t_s		−30		−150	–	600	–	–	–	–	
Fall time	t_f		−30		−150	–	100	–	–	–	–	ns
Turn-on time	t_{on}		−30		−150	–	110	–	–	–	–	
Turn-off time	t_{off}		−30		−150	–	700	–	–	–	–	
Thermal Resistance:												
Junction-to-Case	$R_{\theta JC}$					–	25●	25 (max.) 2N4037 & 40394		–	25	°C/W
						–	–			–	–	
Junction-to-Ambient	$R_{\theta JA}$					–	165	165 (max.) 2N4037 & 40394		–	165	°C/W
						–	–	50 (max.) 40391		–	–	°C/W

[a] CAUTION: The sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEV}(sus)$ MUST NOT be measured on a curve tracer. These sustaining voltages should be measured by means of the test circuit shown in Fig. 2.

[b] Pulsed; pulse duration 300 μs, duty factor < 2%.

● In accordance with JEDEC registration data format (JS-6 RDF-1 2N4036; JS-9 RDF-2 2N4037, 2N4314).

[c] $I_{B1} = I_{B2} = 15$ mA

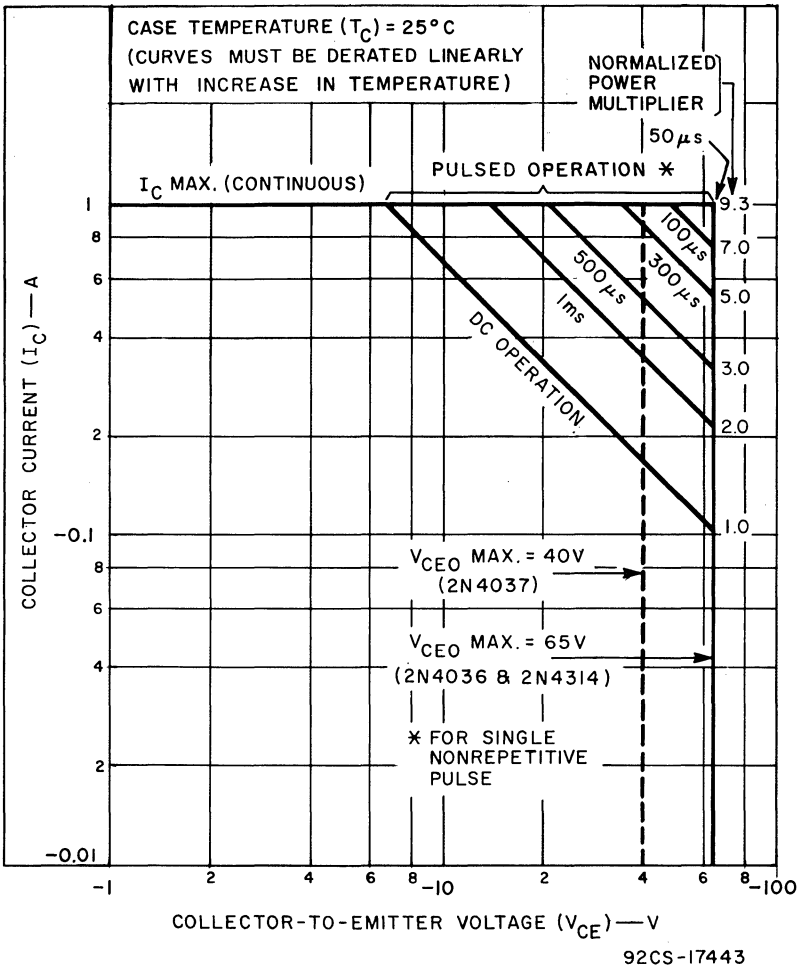


Fig.1 — Maximum operating areas for types 2N4036, 2N4037, and 2N4314.

TERMINAL CONNECTIONS FOR 40394

Lead 1 — Emitter
Lead 2 — Base
Flange, Lead 3 — Collector

TERMINAL CONNECTIONS FOR 2N4036, 2N4037, 2N4314

Lead 1 — Emitter
Lead 2 — Base
Case, Lead 3 — Collector

TERMINAL CONNECTIONS FOR 40391

Lead 1 — Emitter
Lead 2 — Base
Heat-Radiator, Lead 3 — Collector

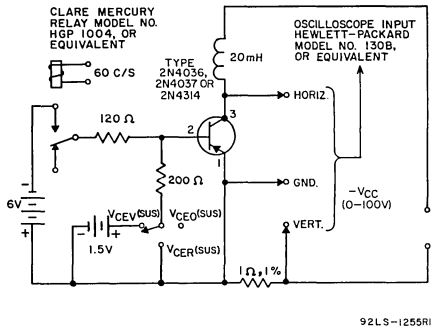
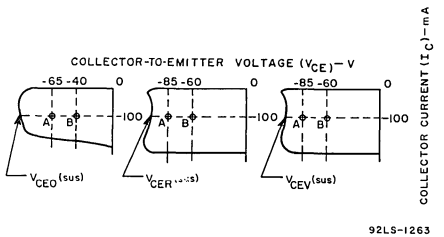


Fig.2 – Circuit used to measure sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEV}(sus)$ for all types.



NOTE: The sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEV}(sus)$ are acceptable when the traces fall to the left and below point "A" for type 2N4036 and 2N4314, and point "B" for type 2N4037.

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

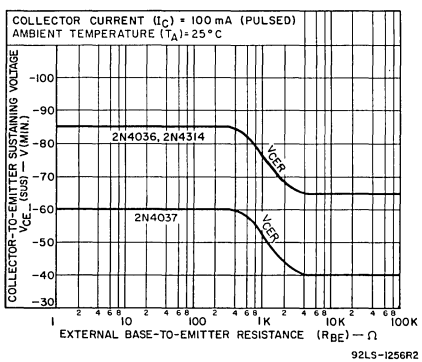


Fig.4 – Sustaining voltage vs. base-to-emitter resistance for all types.

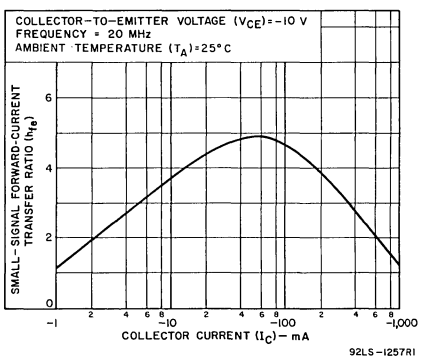


Fig.5 – Typical small-signal beta characteristic for all types.

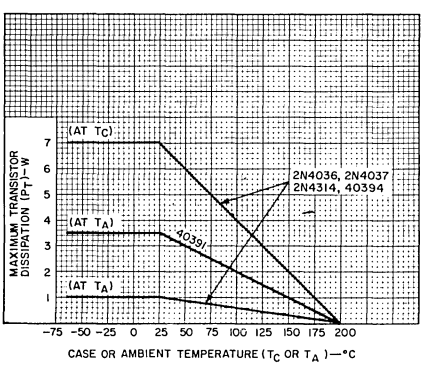


Fig.6 – Dissipation derating curve for all types.

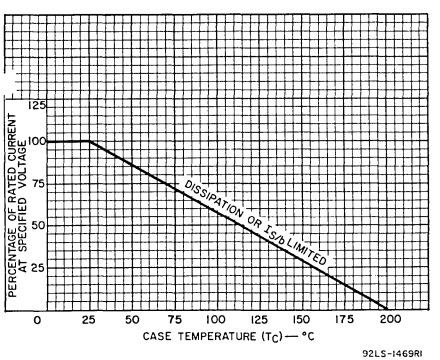


Fig.7 – Dissipation derating curve for types 2N4036, 2N4037, and 2N4314.

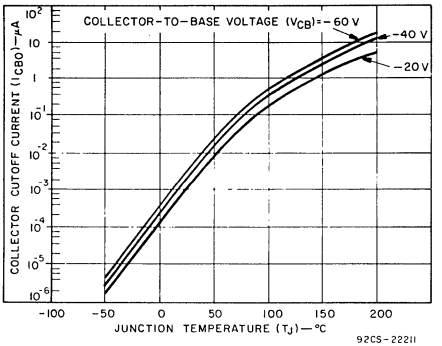


Fig.8 — Typical collector-cutoff current vs. junction temperature for type 2N4036.

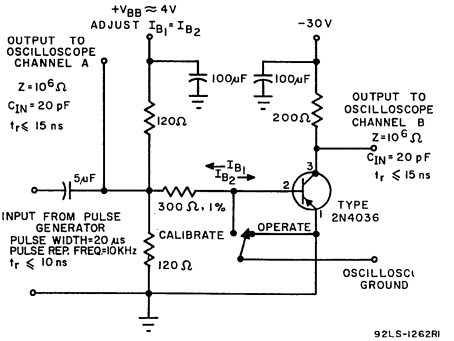


Fig.9 — Circuit used to measure switching times for type 2N4036.

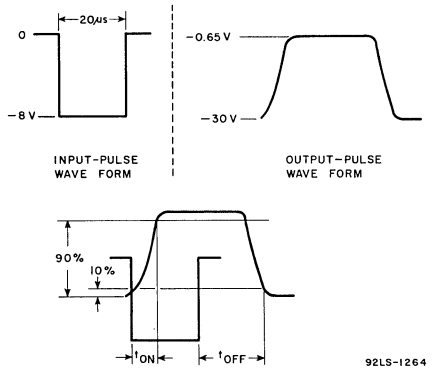


Fig.10 — Oscilloscope display for measurement of switching times test circuit shown in Fig.9).

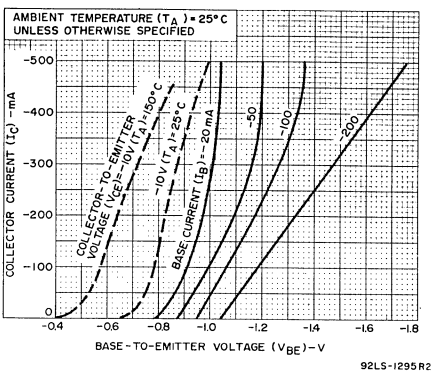


Fig.11 — Typical transfer characteristics for types 2N4037 and 2N4314.

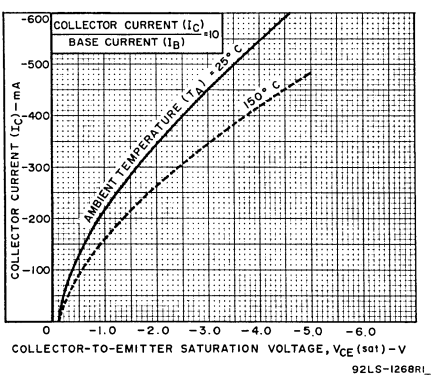


Fig.12 — Typical saturation-voltage characteristics for type 2N4036.

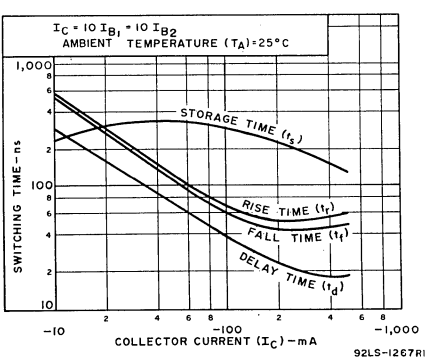


Fig.13 — Typical saturated switching times for type 2N4036.

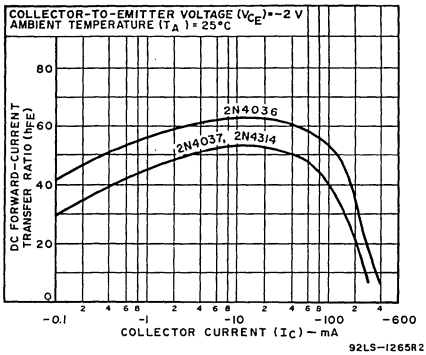


Fig.14 — Typical dc beta characteristics for all types.

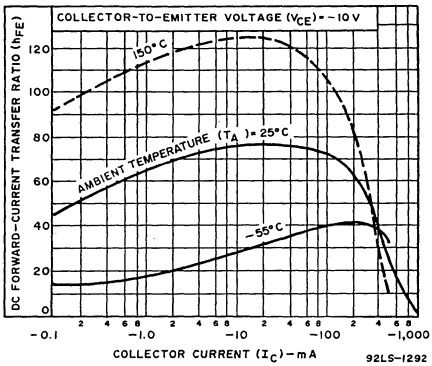


Fig.15 — Typical dc beta characteristics for types 2N4037 and 2N4314.

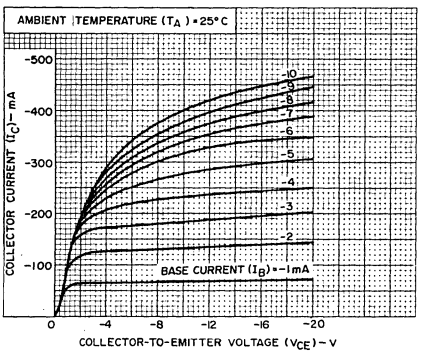


Fig.16 — Typical output characteristics for types 2N4037 and 2N4314.

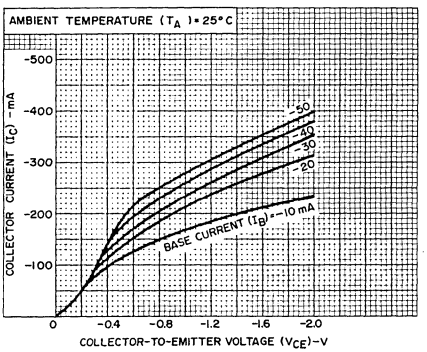


Fig.17 — Typical output characteristics for types 2N4037 and 2N4314.

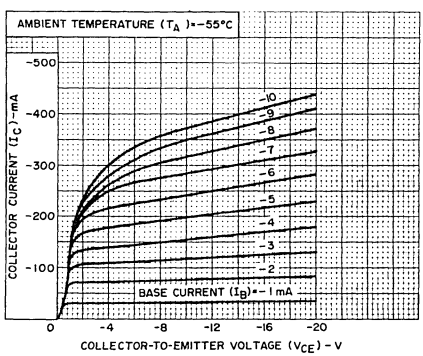


Fig.18 — Typical output characteristics for types 2N4037 and 2N4314.

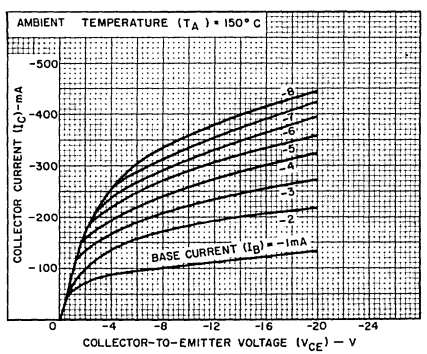


Fig.19 — Typical output characteristics for types 2N4037 and 2N4314.