2N1613, 2N2102

File Number **106**

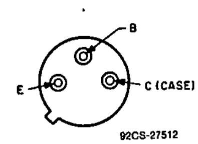
Medium-Power Silicon N-P-N Planar Transistors

For Small-Signal Applications
In Industrial and Commercial Equipment

2N2102 Features:

- *Gain bandwidth product (f_T) = 120 MHz (typ.); useful in applications from dc to 20 MHz*
- *High breakdown voltage: $V_{(BR)CBO}$ = 120 V min. at I_C = 0.1 mA*
- *Low saturation voltages: $V_{CE}(sat)$ = 0.5 V max. at I_C = 150 mA
  $V_{BE}(sat)$ = 1.1 V max. at I_C = 150 mA*
- *Beta (h_{FE}) controlled over 5 decades of I_C*

TERMINAL DESIGNATIONS



JEDEC TO-205AD

The RCA-2N1613 and 2N2102 are silicon n-p-n planar transistors intended for a wide variety of small-signal and medium-power applications in military and industrial equipment. They feature exceptionally low noise, low leakage, high switching speed, and high pulsed beta.

RCA-2N2102 is a direct replacement for the 2N1613. In addition, because of its junction design, the 2N2102 has higher breakdown-voltage ratings, higher dissipation ratings, lower saturation voltages, higher sustaining voltages, and lower output capacitance.

These transistors are supplied in the JEDEC TO-205AD hermetic package.

Features for Both Types:

- *For operation at junction temperature up to 200° C*
- *Planar construction for low noise and low leakage*
- *Low output capacitance*

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N2102	2N1613	
* V_{CBO}		120	75	V
* $V_{CER}(sus)$ R_{BE} = 10 Ω		80	50	V
* $V_{CEO}(sus)$		65	—	V
* V_{EBO}		7	7	V
I_C		1*	1	A
* P_T: At $T_C \leq 25°C$		5	3	W
At $T_A \leq 25°C$		1	0.8	W
At $T_C > 25°C$	Derate linearly	2.86	17.1	mW/°C
At $T_A > 25°C$	Derate linearly	5.7	4.57	mW/°C
* T_J, T_{stg}		-65 to +200		°C
* T_L (During soldering): At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		300		°C

* In accordance with JEDEC registration data format.

2N1613, 2N2102

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

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNITS
	Voltage V dc		Current mA dc		2N1613		2N2102		
	V_{CB}	V_{CE}	I_C	I_B	Min.	Max.	Min.	Max.	
* I_{CBO}	60				–	0.01	–	0.002	μA
At T_C=150°C	60				–	10	–	2	
* I_{EBO} V_{EB}=5 V			0		–	0.01	–	0.002	μA
* h_{FE}		10	0.01		–	–	10	–	
		10	0.1		20	–	20	–	
		10	10[a]		35	–	35	–	
		10	150[a]		40	120	40	120	
		10	500[a]		20	–	25	–	
At T_C=–55°C		10	10[a]		20	–	20	–	
* V_{RT} V_{EB}=1.5 V, I_E=0					–	–	120	–	V
* $V_{(BR)CBO}$ I_E=0			0.1		75	–	120	–	V
* $V_{(BR)EBO}$ I_E=0.1 mA			0		7	–	7	–	V
* V_{CEO}(sus)			100[a]	0	–	–	65	–	V
* V_{CER}(sus) R_{BE}=10 Ω			100[a]		50	–	80	–	V
* V_{BE}(sat)			150[a]	15	–	1.3	–	1.1	V
* V_{CE}(sat)			150[a]	15	–	1.5	–	0.5	V
* h_{fe} f=1 kHz		5	1		30	100	30	100	
		10	5		35	150	35	150	
$\|h_{fe}\|$ f=20 MHz		10	50		3	–	3	–	
* h_{ib} f=1 kHz	5		1		24	34	24	34	Ω
	10		5		4	8	4	8	
* h_{rb} f=1 kHz	5		1		–	$3x10^{-4}$	–	$3x10^{-4}$	
	10		1		–	$3x10^{-4}$	–	–	
	10		5		–	–	–	$3x10^{-4}$	
* h_{ob} f=1 kHz	5		1		0.05	0.5	0.01	0.5	μmho
	10		5		0.05	0.5	0.01	1	
* C_{ob} I_E=0	10				–	25	–	15	pF
* C_{ib} V_{EB} = 0.5 V			0		–	80	–	80	pF
* NF BW=1 Hz Ref.sig.freq.=1 kHz R_G=510 Ω (2N1613) Z_G=1000 Ω (2N2102)	10		0.3		–	12	–	6	dB
* $t_d + t_r + t_f$[b]					–	30	–	30	ns
$R_{\theta JC}$					–	58.3	–	35	°C/W
$R_{\theta JA}$					–	219	–	175	

* In accordance with JEDEC registration data format.

a Pulsed, pulse duration=300 μs, duty factor=1.8% (2N2102) ≤ 2% (2N1613). b See Fig. 14.

2N1613, 2N2102

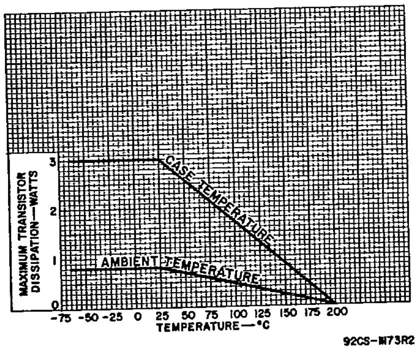


Fig. 1 – Rating chart for 2N1613.

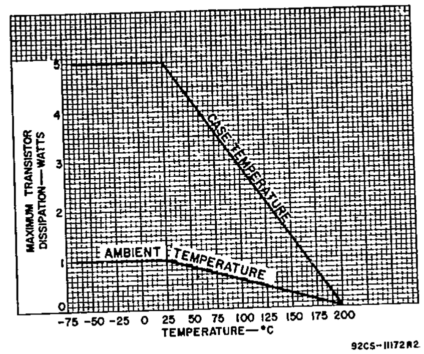


Fig. 2 – Rating chart for 2N2102.

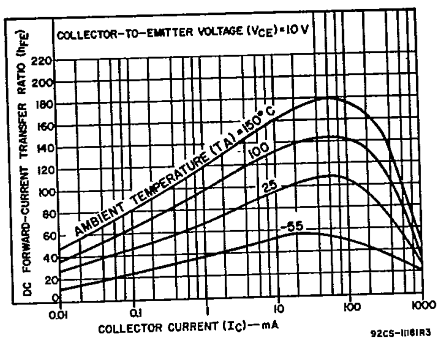


Fig. 3 – Typical dc beta characteristics for both types.

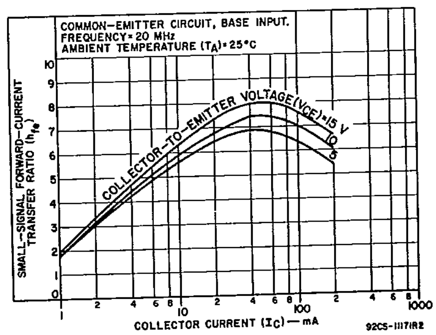


Fig. 4 – Typical small-signal beta characteristics for both types.

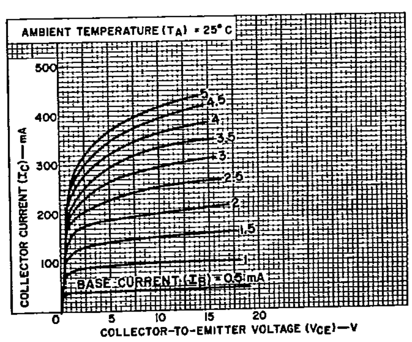


Fig. 5 – Typical output characteristics for both types.

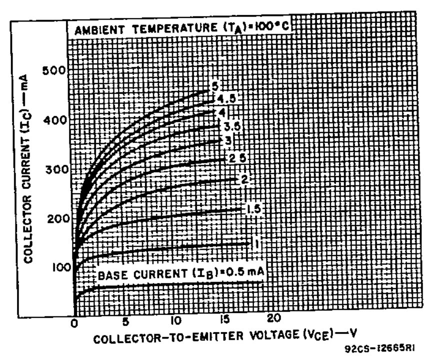


Fig. 6 – Typical output characteristics for both types at $T_A = 100^oC$.

2N1613, 2N2102

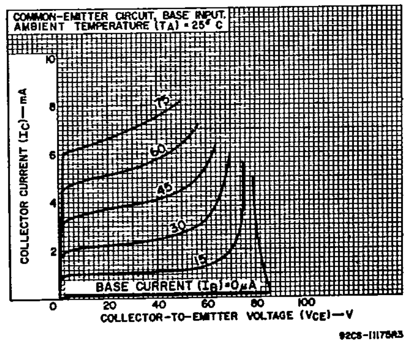


Fig. 7 — Typical high-current output characteristics for both types.

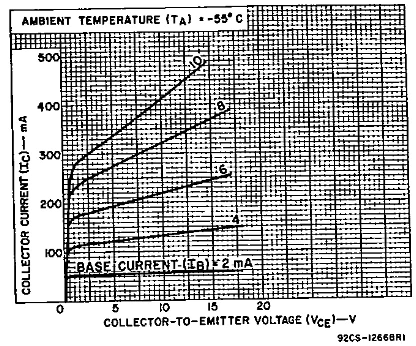


Fig. 8 — Typical output characteristics for both types at $T_A = -55°C$.

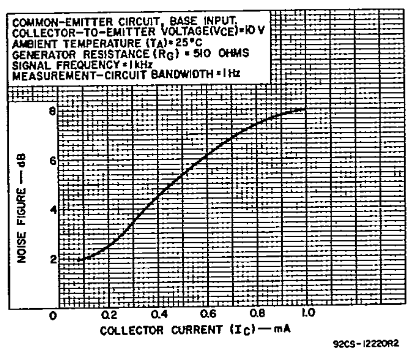


Fig. 9 — Typical noise figure characteristics for both types.

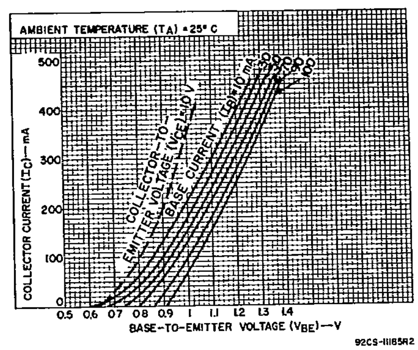


Fig. 10 — Typical transfer characteristics for both types.

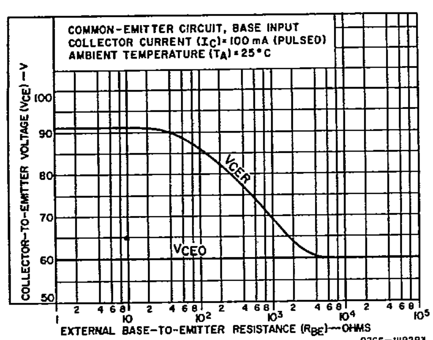


Fig. 11 — Typical sustaining voltage vs. base-to-emitter resistance for 2N1613.

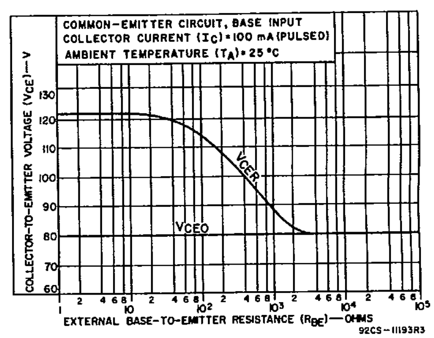


Fig. 12 — Typical sustaining voltage vs. base-to-emitter resistance for 2N2102.

2N1613, 2N2102

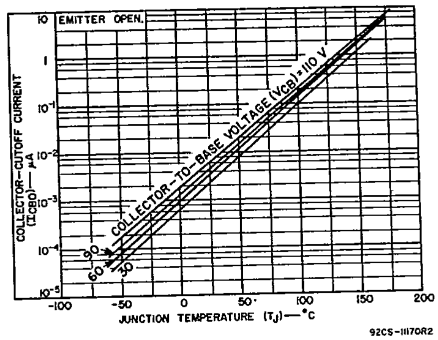


Fig. 13 – Typical leakage characteristics for both types.

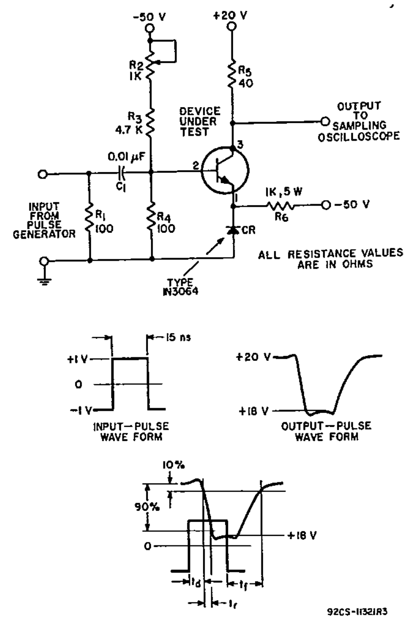


Fig. 14 – Circuit for measurement of switching time, and associated waveforms.