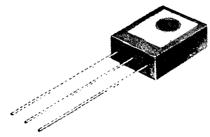
RCA
Solid State
Division

Power Transistors

2N6178 2N6180
2N6179 2N6181

Silicon N-P-N & P-N-P Power Transistors

"Plastic TO-5" General-Purpose Types for Large-Signal, Medium-Power Applications



"Plastic TO-5"

H-1642

Features:

- Maximum area-of-operation curves
- Planar construction for low-noise and low-leakage characteristics
- Low saturation voltage (2N6178, 2N6180)
- High beta (2N6179, 2N6181)
- Fast switching (2N6178, 2N6179)
- "Plastic TO-5" package with insulated mounting hole

RCA types 2N6178, 2N6179, 2N6180, and 2N6181• are silicon power transistors intended for large-signal, medium-power applications in industrial and commercial equipment.

The 2N6178 and 2N6179 are triple-diffused silicon n-p-n planar types. These types have features similar to the popular 2N2102 plus higher collector-current ratings and dissipation capability.

Types 2N6180 and 2N6181 (p-n-p complements of the 2N6178 and 2N6179, respectively) are double-diffused, epitaxial-planar devices. These types have features similar to the 2N4036 plus higher collector-current ratings and dissipation capability.

TERMINAL CONNECTIONS
Lead 1 – Emitter
Lead 2 – Base
Lead 3 – Collector
Rectangular Metal Slug-Collector

In addition, these types utilize the new RCA-developed "Plastic TO-5" package. This plastic package has an insulated mounting hole for ease of mounting and heat sinking for optimum thermal contact.

• Formerly RCA Dev. Nos. TA7554–TA7557, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N6179	2N6181	2N6178	2N6180	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	75	-75	100	-100	V
COLLECTOR-TO-EMITTER VOLTAGE:						
* With 1.5 volts (V_{BE}) of reverse bias	V_{CEX}	75	-75	100	-100	V
With external base-to-emitter resistance (R_{BE}) = 100Ω, sustaining	V_{CER}(sus)	65	-65	90	-90	V
With base open, sustaining	V_{CEO}(sus	50	-50	75	-75	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	-5	7	-7	V
*CONTINUOUS COLLECTOR CURRENT	I_C	2	-2	2	-2	A
*CONTINUOUS BASE CURRENT	I_B	1	-1	1	-1	A
*TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C		25	25	25	25	W
At case temperatures above 25°C			See Figs. 1, 2, & 3			
At case temperatures up to 100°C		10	10	10	10	W
At case temperatures above 100°C			See Figs. 3, 4, & 5			
*TEMPERATURE RANGE:						
Storage and operating (Junction)		←	-65 to 150		→	°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-1.

ELECTRICAL CHARACTERISTICS, *at case temperature (T_C) = 25°C, unless otherwise specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Voltage (V) V_{CB}	V_{CE}	V_{BE}	DC Current (mA) I_C	I_B	LIMITS: Type 2N6178 Min.	Max.	Type 2N6179 Min.	Max.	Type 2N6180 Min.	Max.	Type 2N6181 Min.	Max.	UNITS
Collector-Cutoff Current With emitter open	I_{CBO}	80					–	0.5	–	–	–	–	–	–	µA
		60					–	–	–	0.5	–	–	–	–	
		–80					–	–	–	–	–	–0.5	–	–	
		–60					–	–	–	–	–	–	–	–0.5	
With base open	I_{CEO}		60			0	–	1	–	–	–	–	–	–	mA
			45			0	–	–	–	1	–	–	–	–	
			–60			0	–	–	–	–	–	–1	–	–	
			–45			0	–	–	–	–	–	–	–	–1	
• With base reverse-biased	I_{CEV}		100	–1.5			–	0.1	–	–	–	–	–	–	mA
			75	–1.5			–	–	–	0.1	–	–	–	–	
			–100	1.5			–	–	–	–	–	–0.1	–	–	
			–75	1.5			–	–	–	–	–	–	–	–0.1	
• With base reverse-biased and T_C = 100°C	I_{CEV}		70	–1.5			–	0.5	–	–	–	–	–	–	mA
			45	–1.5			–	–	–	0.5	–	–	–	–	
			–70	1.5			–	–	–	–	–	–0.5	–	–	
			–45	1.5			–	–	–	–	–	–	–	–0.5	
• Emitter-Cutoff Current	I_{EBO}			–7	0		–	0.1	–	–	–	–	–	–	mA
				–5	0		–	–	–	0.1	–	–	–	–	
				7	0		–	–	–	–	–	–0.1	–	–	
				5	0		–	–	–	–	–	–	–	–0.1	
Emitter-to-Base Breakdown Voltage (I_E = 0.1 mA)	$V_{(BR)EBO}$				0		7	–	5	–	–	–	–	–	V
					0		–	–	–	–	–7	–	–5	–	
• Collector-to-Emitter Breakdown Voltage: With base-emitter junction reverse-biased	$V_{(BR)CEV}$			–1.5	0.1		100	–	75	–	–	–	–	–	V
				1.5	–0.1		–	–	–	–	–100	–	–75	–	
• With base open	$V_{(BR)CEO}$				100	0	75	–	50	–	–	–	–	–	V
					–100	0	–	–	–	–	–75	–	–50	–	
Collector-to-Emitter Sustaining Voltage: With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$[a]				100		90	–	65	–	–	–	–	–	V
					–100		–	–	–	–	–90	–	–65	–	
With base open	$V_{CEO}(sus)$[a]				100	0	75	–	50	–	–	–	–	–	V
					–100	0	–	–	–	–	–75	–	–50	–	
• Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				500	50	–	0.5	–	0.8	–	–	–	–	V
					–500	–50	–	–	–	–	–	–0.7	–	–1.2	
• Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$				500	50	–	1.2	–	1.5	–	–	–	–	V
					–500	–50	–	–	–	–	–	–1.2	–	–1.5	
Output Capacitance (At 1 MHz)	C_{obo}	10					12	20	12	20	–	–	–	–	pF
		–10					–	–	–	–	25	40	25	40	
• DC Forward-Current Transfer Ratio	h_{FE}		4		50		–	–	30	–	–	–	–	–	
			–4		–50		–	–	–	–	–	–	30	–	
			2		500[b]		30	130	40	250	–	–	–	–	
			–2		–500[b]		–	–	–	–	30	130	40	250	
			2		1000[b]		10	–	–	–	–	–	–	–	
			–2		–1000[b]		–	–	–	–	10	–	–	–	
Second-Breakdown Collector Current [c, d] (With base forward-biased)	$I_{S/b}$		V_{CC}= 50				200	–	200	–	–	–	–	–	mA
			–50				–	–	–	–	–150	–	–150	–	
Gain-Bandwidth Product	f_T		4		50		50	–	50	–	–	–	–	–	MHz
			–4		–50		–	–	–	–	50	–	50	–	
• Magnitude of Common Emitter, Small-Signal, Short-Circuit Forward-Current Transfer Ratio (f = 10 MHz)	$\|h_{fe}\|$		4		50		5	–	5	–	–	–	–	–	
			–4		–50		–	–	–	–	5	–	5	–	

Chart continued on page 3.

CHARACTERISTIC	SYMBOL	TEST CONDITIONS					LIMITS								UNITS
		DC Voltage (V)			DC Current (mA)		Type 2N6178		Type 2N6179		Type 2N6180		Type 2N6181		
		V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Saturated Switching Time: (See Fig. 30 & 31) Turn-on Time	t_{on}		V_{CC}= 30 −30		500 −500	50 −50	– –	80 –	– –	80 –	– –	-- 100	– –	– 100	ns
Turn-off Time	t_{off}		V_{CC}= 30 −30		500 −500	50 −50	– –	800 –	– –	800 –	– –	– 1000	– –	– 1000	ns
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$						–	5	–	5	–	5	–	5	°C/W
Junction-to-Ambient	$R_{\theta JA}$						–	156	–	156	–	156	–	156	°C/W

* In accordance with JEDEC registration data format JS-6/RDF-1.

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

[b] Pulsed; pulse duration $\leq$300 μs, duty factor $\leq$0.02.

[c] Safe operating regions for forward-bias operation are shown on Figs. 1, 2, 4, and 5.

[d] Pulsed: 0.4s, non-repetitive pulse.

N-P-N

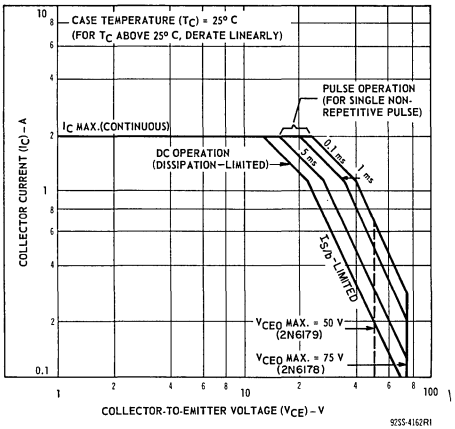


Fig.1—Maximum operating areas for 2N6178 and 2N6179 at T_C=25°C.

P-N-P

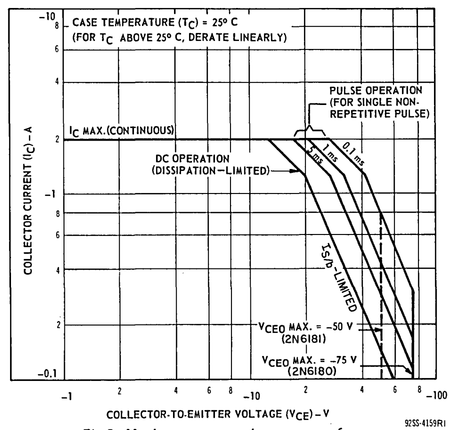


Fig.2—Maximum operating areas for 2N6180 and 2N6181 at T_C=25°C.

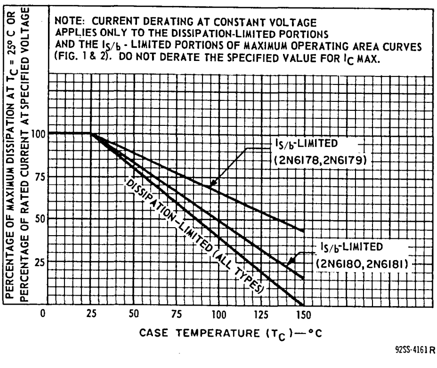


Fig.3—Derating curves for all types.

N-P-N

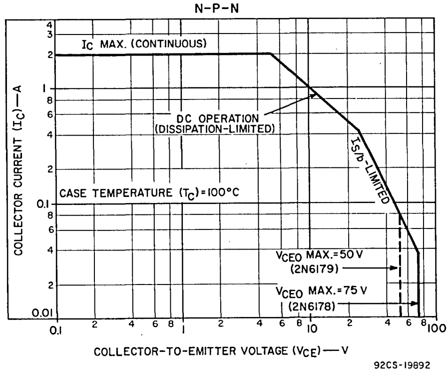


Fig.4—Maximum operating areas for 2N6178 and 2N6179 at T_C=100°C.

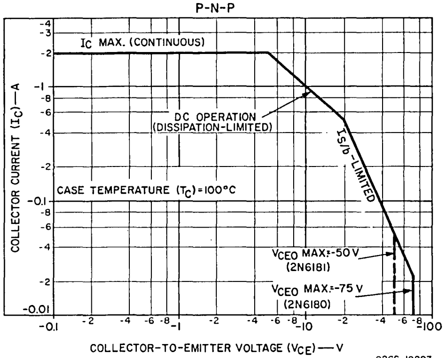


Fig.5—Maximum operating areas for 2N6180 and 2N6181 at T_C=100°C.

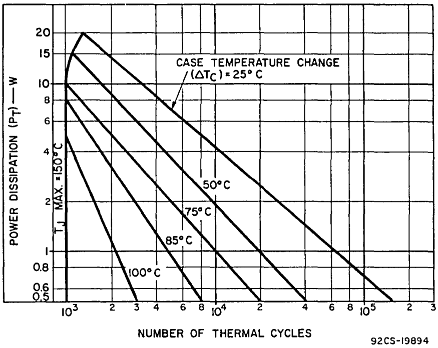


Fig.6—Thermal-cycling rating chart for all types.

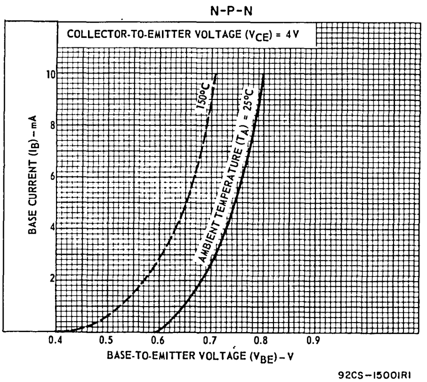


Fig.7—Typical input characteristics for 2N6178 and 2N6179.

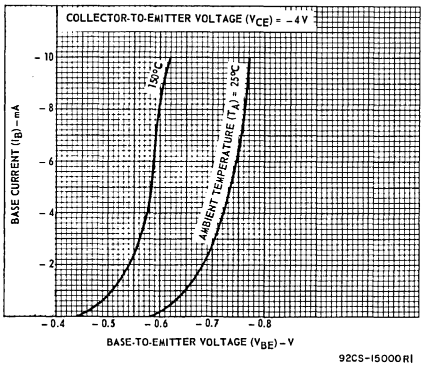


Fig.8—Typical input characteristics for 2N6180 and 2N6181.

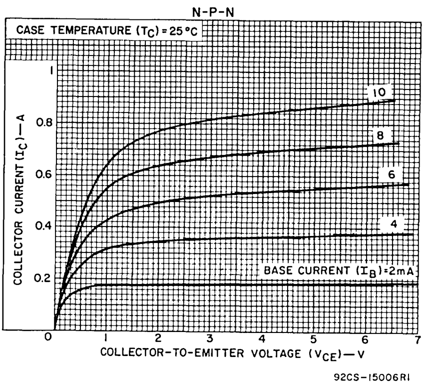


Fig.9—Typical output characteristics for 2N6178 and 2N6179.

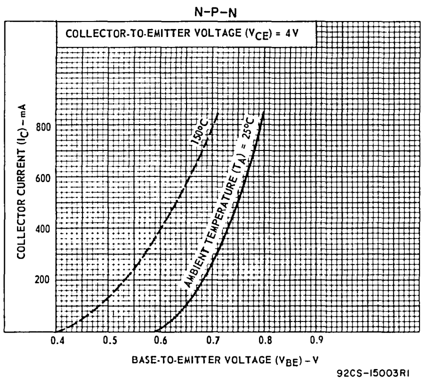


Fig.10—Typical transfer characteristics for 2N6178 and 2N6179.

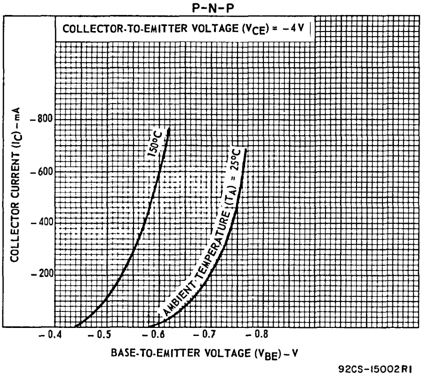


Fig.11—Typical transfer characteristics for 2N6180 and 2N6181.

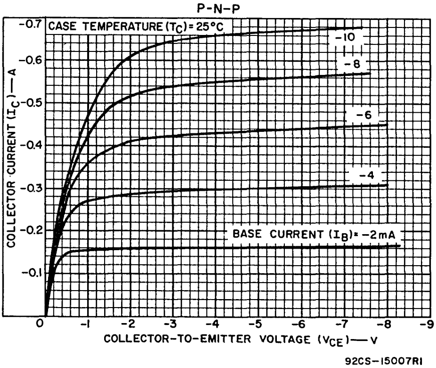


Fig.12—Typical output characteristics for 2N6180 and 2N6181.

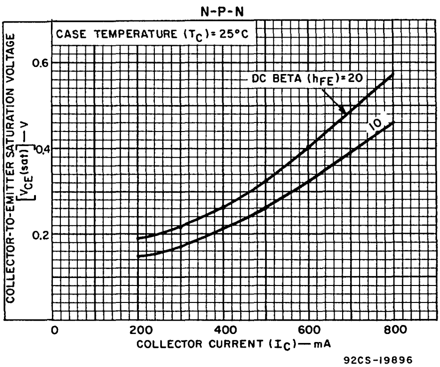


Fig.13—Typical saturation-voltage characteristics for 2N6178 and 2N6179.

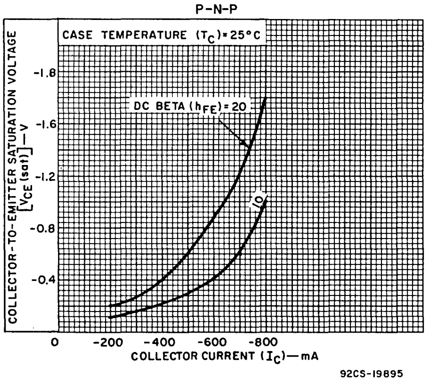


Fig.14—Typical saturation-voltage characteristics for 2N6180 and 2N6181.

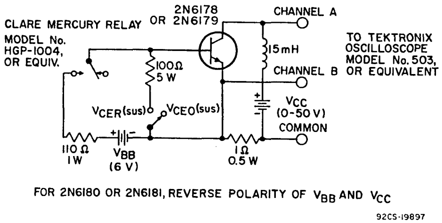


Fig.15—Circuit used to measure sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$.

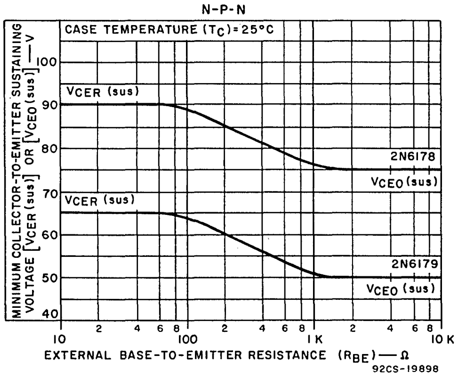


Fig.16—Collector-to-emitter sustaining voltage characteristics for 2N6178 and 2N6179.

P-N-P

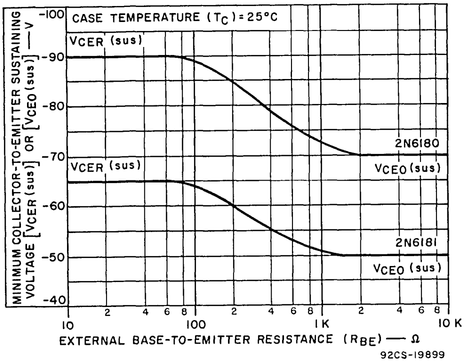
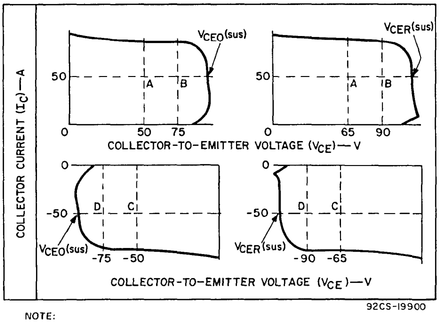


Fig.17—Collector-to-emitter sustaining voltage characteristics for 2N6180 and 2N6181.



NOTE:
SUSTAINING VOLTAGES V_{CEO}(sus) AND V_{CER}(sus) ARE ACCEPTABLE WHEN TRACES FALL TO THE RIGHT AND ABOVE POINTS "A" FOR TYPE 2N6179 POINTS "B" FOR TYPE 2N6178, TO THE LEFT AND BELOW POINTS "C" FOR TYPE 2N6181, AND POINTS "D" FOR TYPE 2N6180.

Fig.18—Oscilloscope display for measurement of sustaining voltages (test circuit shown in Fig.15).

N-P-N

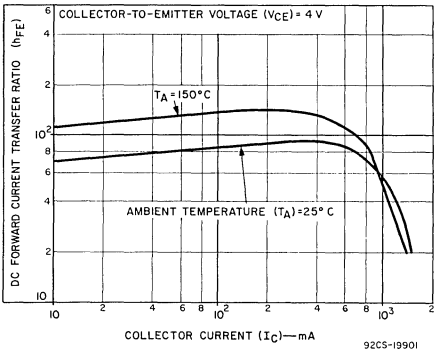


Fig.19—Typical dc beta characteristics for 2N6178 and 2N6179.

P-N-P

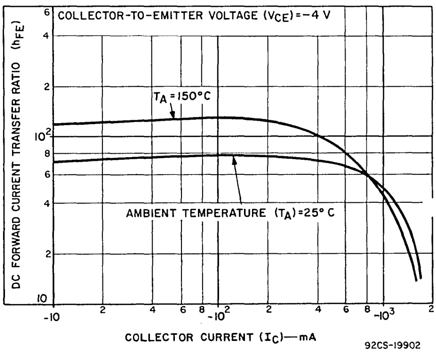


Fig.20—Typical dc beta characteristics for 2N6180 and 2N6181.

N-P-N

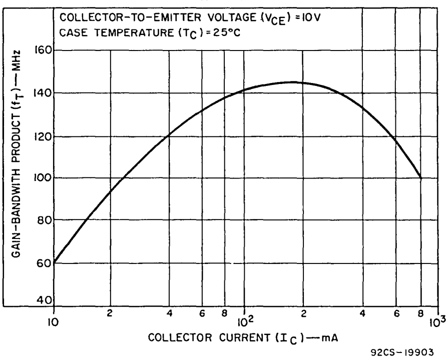


Fig.21—Typical gain-bandwidth product for 2N6178 and 2N6179.

N-P-N

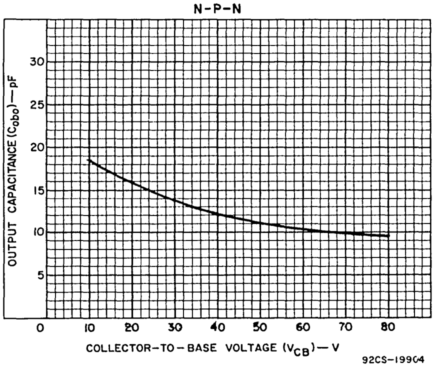


Fig.22—Typical output capacitance vs. collector-to-base voltage for 2N6178 and 2N6179.

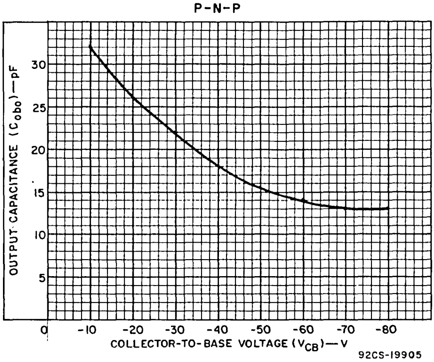


Fig.23—Typical output capacitance vs. collector-to-base voltage for 2N6180 and 2N6181.

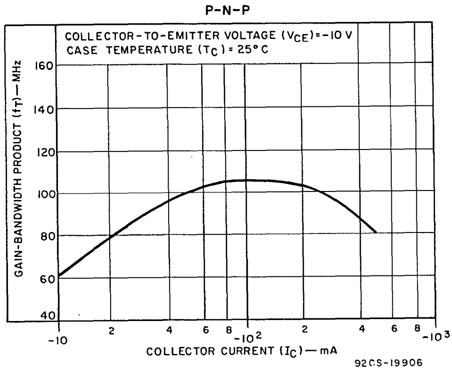


Fig.24—Typical gain-bandwidth product for 2N6180 and 2N6181.

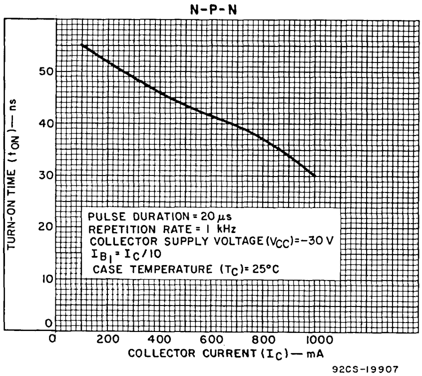


Fig.25—Typical turn-on time for 2N6178 and 2N6179.

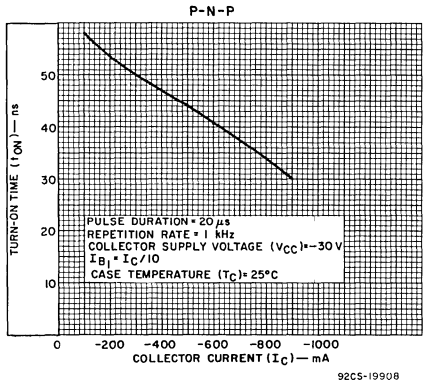


Fig.26—Typical turn-on time for 2N6180 and 2N6181.

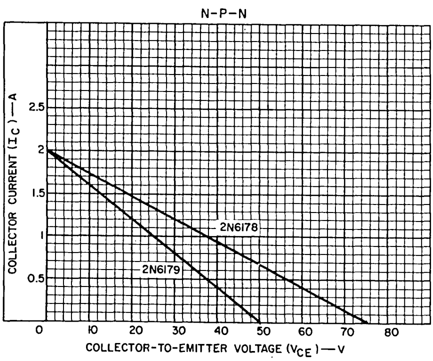


Fig.27—Maximum operating conditions, resistive-load switching between saturation and cutoff for 2N6178 and 2N6179.

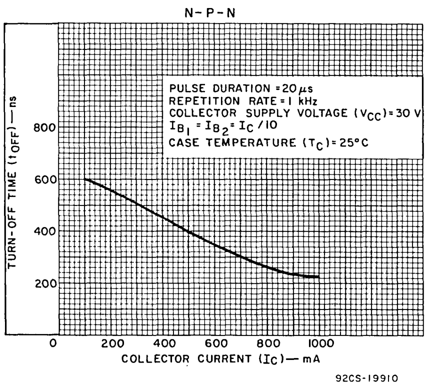


Fig.28—Typical turn-off time for 2N6178 and 2N6179.

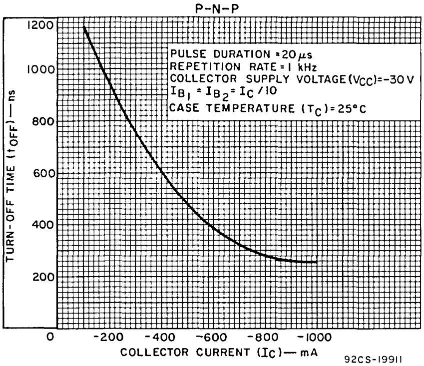


Fig.29–Typical turn-off time for 2N6180 and 2N6181.

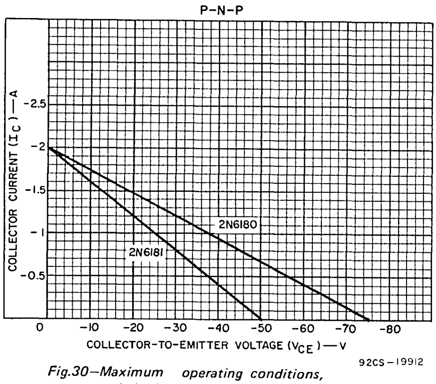


Fig.30–Maximum operating conditions, resistive-load switching between saturation and cutoff for 2N6180 and 2N6181.

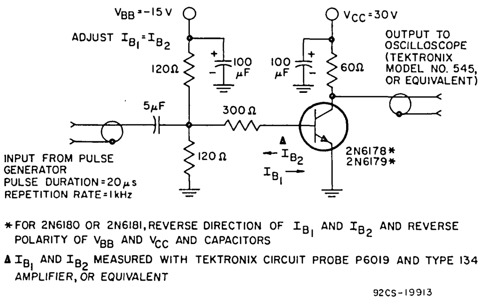


Fig.31–Circuit used to measure switching times for all types.

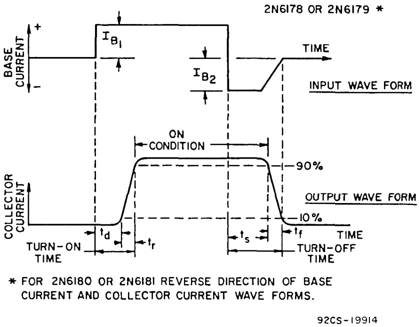


Fig.32–Phase relationship between input current and output voltage showing reference points for specification of switching times (test circuit shown in Fig.31).