PHILIPS INTERNATIONAL 56E D 7110826 0042620 580 PHIN

T-37-17

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in TO-39 metal envelopes designed primarily for high-speed switching and driver applications for industrial service.

QUICK REFERENCE DATA

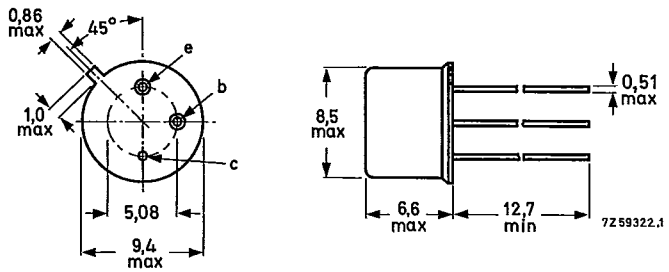
Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base)	2N2904	$-V_{CEO}$	max.	40	V
	2N2904A	$-V_{CEO}$	max.	60	V
Collector current (d.c.)		$-I_C$	max.	600	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	0,6	W
Junction temperature		T_j	max.	200	°C
D.C. current gain at T_j = 25 °C $-I_C$ = 150 mA; $-V_{CE}$ = 10 V		h_{FE}		40 to 120	
Transition frequency at f = 100 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 20 V; T_j = 25 °C		f_T	>	200	MHz
Storage time $-I_{Con}$ = 150 mA; $-I_{Bon} = I_{Boff}$ = 15 mA		t_s	<	80	ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39.

Collector connected to case.



Maximum lead diameter is guaranteed only for 12,7 mm.

Qualification approved to CECC 50 002-298

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RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)		$-V_{CBO}$	max.	60	V
Collector-emitter voltage (open base) $-I_C < 100$ mA	**2N2904**	$-V_{CEO}$	max.	40	V
	2N2904A	$-V_{CEO}$	max.	60	V
Emitter-base voltage (open collector)		$-V_{EBO}$	max.	5	V
Collector current (d.c.)		$-I_C$	max.	600	mA
Total power dissipation up to $T_{amb} = 25$ °C		P_{tot}	max.	0,6	W
up to $T_{case} = 25$ °C		P_{tot}	max.	3,0	W
Storage temperature range		T_{stg}		−65 to +150	°C
Junction temperature		T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	292 K/W
From junction to case	$R_{th\ j\text{-}c}$	=	58 K/W

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CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			2N2904	2N2904A	
Collector cut-off current					
I_E = 0; $-V_{CB}$ = 50 V	$-I_{CBO}$	<	20	10	nA
I_E = 0; $-V_{CB}$ = 50 V; T_{amb} = 150 °C	$-I_{CBO}$	<	20	10	μA
$+V_{BE}$ = 0,5 V; $-V_{CE}$ = 30 V	$-I_{CEX}$	<	50	50	nA
Base current					
$+V_{BE}$ = 0,5 V; $-V_{CE}$ = 30 V	I_{BEX}	<	50	50	nA
Collector-base breakdown voltage					
open emitter; $-I_C$ = 10 μA	$-V_{(BR)CBO}$	>	60	60	V
Collector-emitter breakdown voltage *					
open base; $-I_C$ = 10 mA	$-V_{(BR)CEO}$	>	40	60	V
Emitter-base breakdown voltage					
open collector; $-I_E$ = 10 μA	$-V_{(BR)EBO}$	>	5	5	V
Saturation voltages *					
$-I_C$ = 150 mA; $-I_B$ = 15 mA	$-V_{CEsat}$	<	0,4	0,4	V
	$-V_{BEsat}$	<	1,3	1,3	V
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CEsat}$	<	1,6	1,6	V
	$-V_{BEsat}$	<	2,6	2,6	V
D.C. current gain					
$-I_C$ = 0,1 mA; $-V_{CE}$ = 10 V	h_{FE}	>	20	40	
$-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	>	25	40	
$-I_C$ = 10 mA; $-V_{CE}$ = 10 V	h_{FE}	>	35	40	
$-I_C$ =150 mA; $-V_{CE}$ = 10 V *	h_{FE}	>	40	40	
		<	120	120	
$-I_C$ =500 mA; $-V_{CE}$ = 10 V *	h_{FE}	>	20	40	
Collector capacitance at f = 100 kHz					
$I_E = I_e$ = 0; $-V_{CB}$ = 10 V	C_c	<		8	pF
Emitter capacitance at f = 100 kHz					
$I_C = I_c$ = 0; $-V_{EB}$ = 2 V	C_e	<		30	pF
Transition frequency at f = 100 MHz					
$-I_C$ = 50 mA; $-V_{CE}$ = 20 V *	f_T	>		200	MHz

* Measured under pulse conditions to avoid excessive dissipation: $t_p \leqslant 300$ μs; $\delta \leqslant 0{,}02$.

Turn-on time (see Fig. 2)
when switched to $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA

delay time	t_d	<	10 ns
rise time	t_r	<	40 ns
turn-on time	t_{on}	<	45 ns

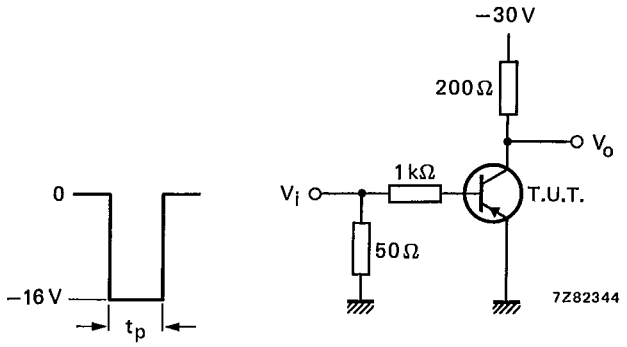

Fig. 2 Input waveform and test circuit for determining delay, rise and turn-on time.

Turn-off time (see Fig. 3)
when switched from $-I_{Con}$ = 150 mA; $-I_{Bon}$ = 15 mA
to cut-off with $+I_{Boff}$ = 15 mA

storage time	t_s	<	80 ns
turn-off time	t_{off}	<	100 ns

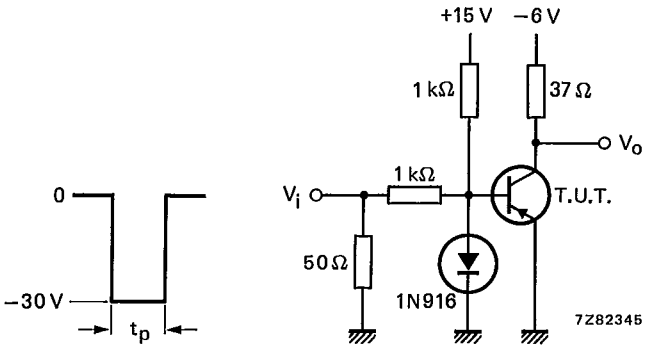

Fig. 3 Input waveform and test circuit for determining storage, fall and turn-off time.

Pulse generator (see Figs 2 and 3)

frequency	f	=	150 Hz
pulse duration	t_p	=	200 ns
rise time	t_r	≤	2 ns
output impedance	Z_o	=	50 Ω

Oscilloscope (see Figs 2 and 3)

rise time	t_r	≤	5 ns
input impedance	Z_i	=	10 MΩ

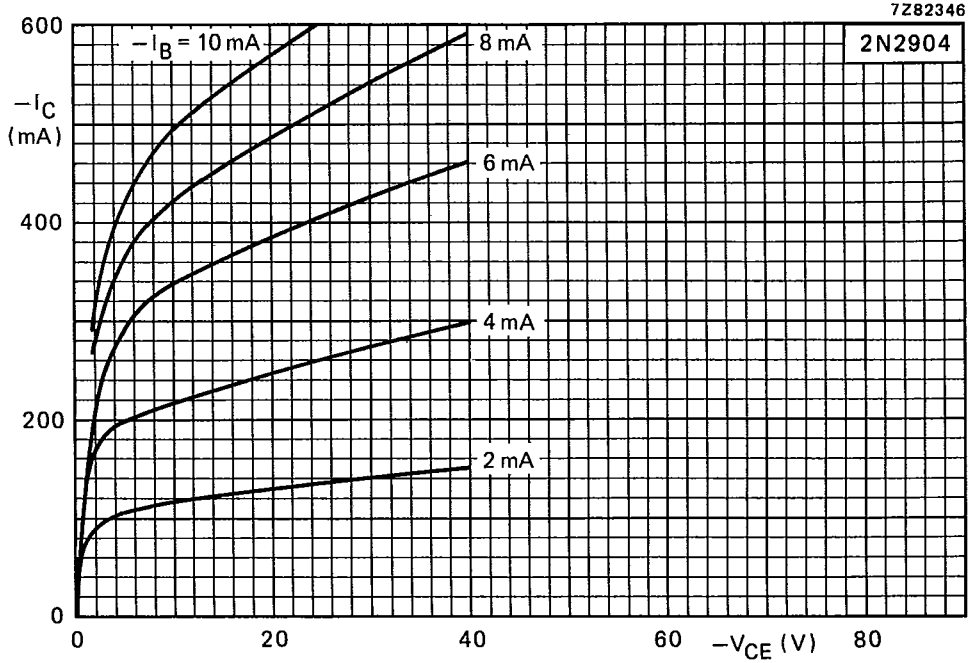

Fig. 4 Typical values; T_j = 25 °C.

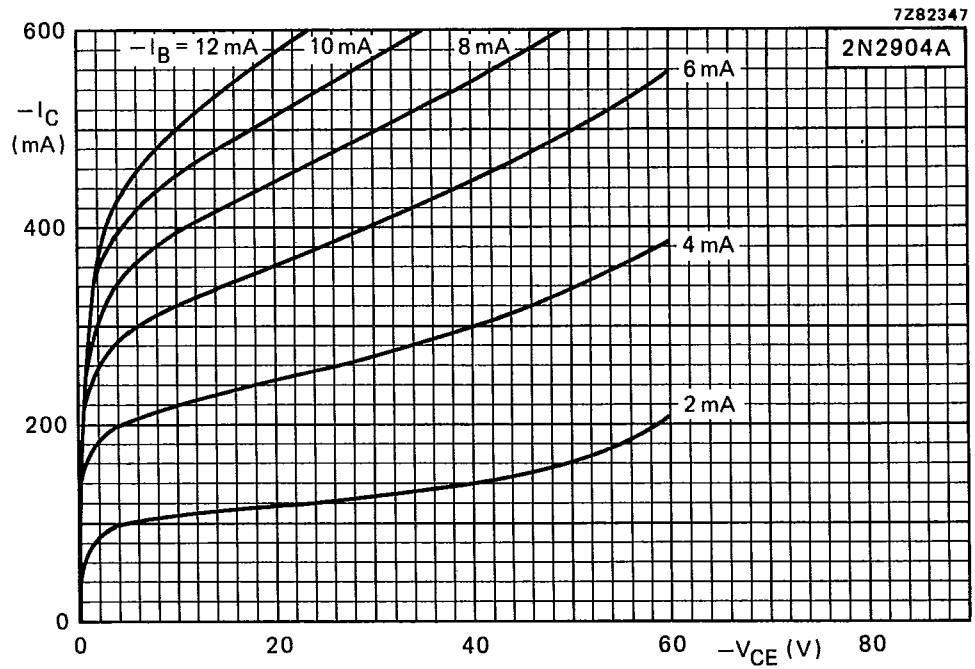

Fig. 5 Typical values; T_j = 25 °C.

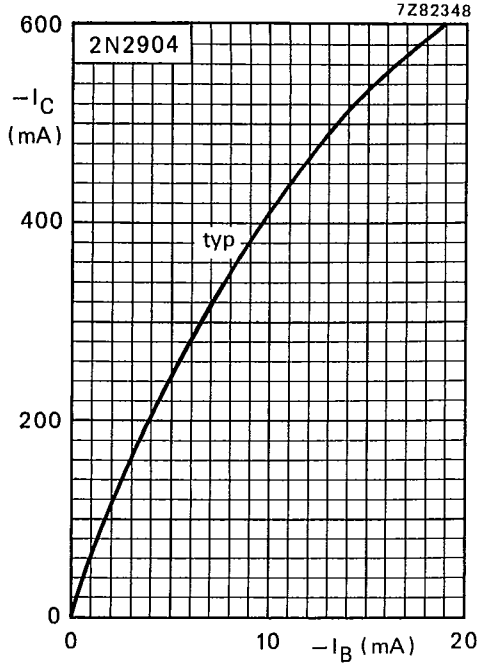

Fig. 6 $-V_{CE} = 5{,}0$ V; $T_J = 25$ °C.

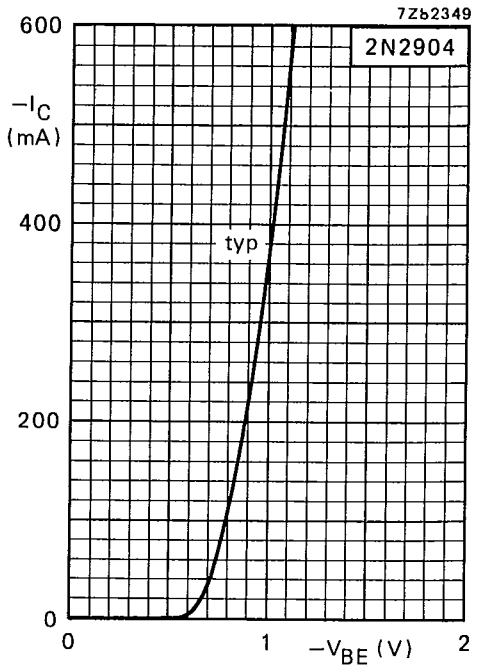

Fig. 7 $-V_{CE} = 5{,}0$ V; $T_j = 25$ °C.

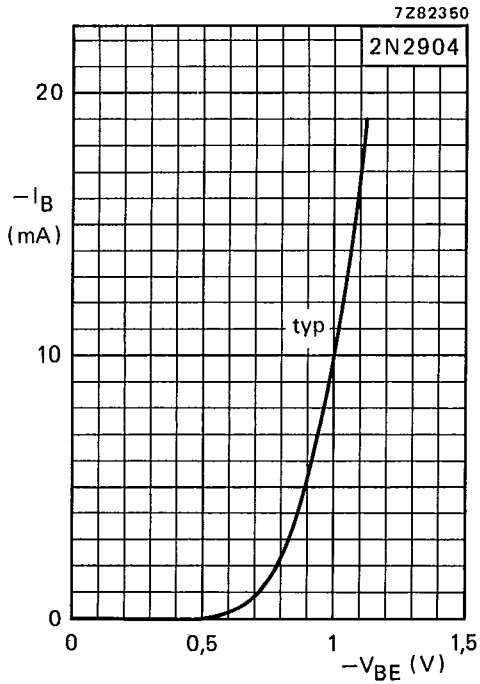

Fig. 8 $-V_{CE} = 5{,}0$ V; $T_j = 25$ °C.

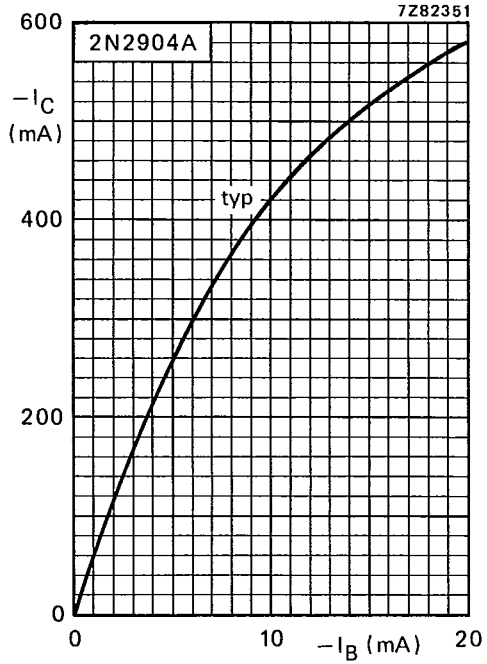

Fig. 9 $-V_{CE} = 5{,}0$ V; $T_j = 25$ °C.

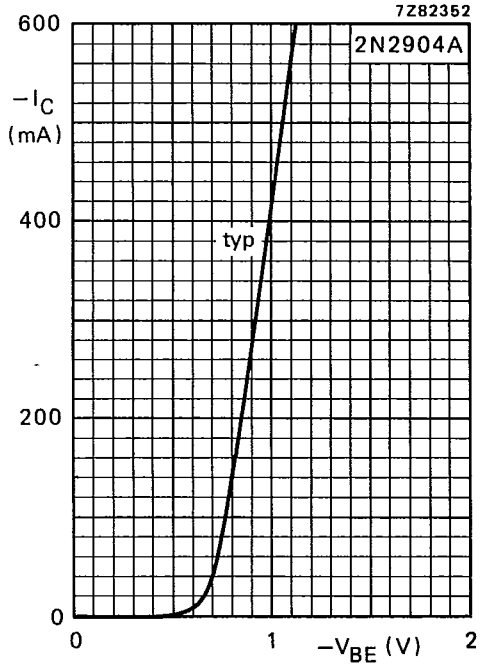

Fig. 10 $-V_{CE} = 5{,}0$ V; $T_j = 25$ °C.

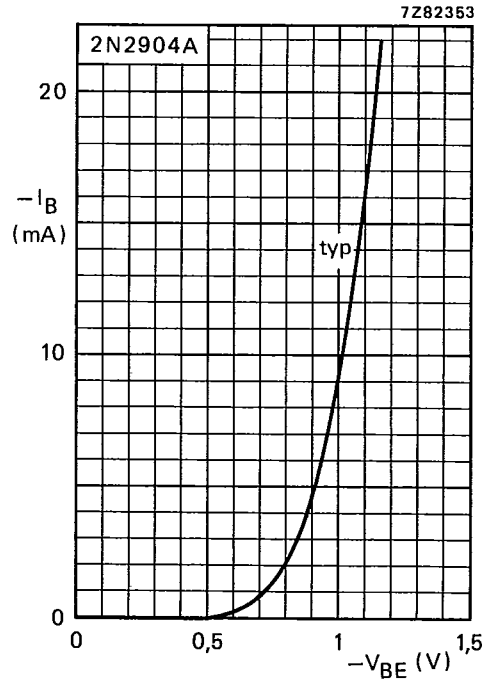

Fig. 11 $-V_{CE} = 5{,}0$ V; $T_j = 25$ °C.