

RoHS Compliant Product  
A suffix of "-C" specifies halogen and lead free

**FEATURES**

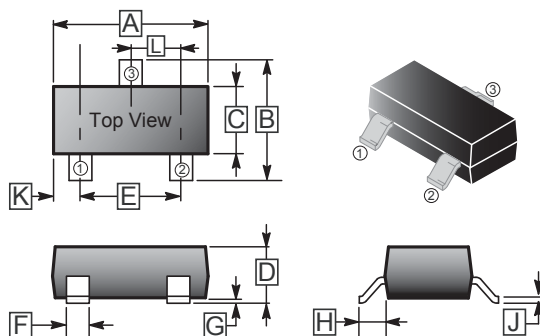
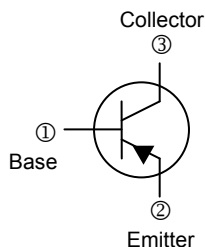
- ◆ Collector current capability  $I_C = -200\text{mA}$
- ◆ Collector-emitter voltage  $V_{CEO} = -40\text{V}$ .

**SOT-23**

**APPLICATION**

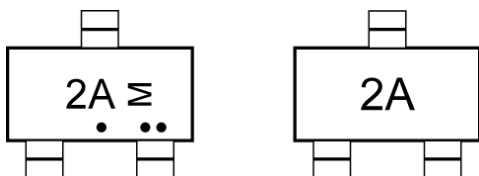
- ◆ General switching and amplification.

**PACKAGING DIMENSION**



REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	2.80	3.00	G	0.10 REF.	
B	2.25	2.55	H	0.55 REF.	
C	1.20	1.40	J	0.08	0.15
D	0.90	1.15	K	0.5 REF.	
E	1.80	2.00	L	0.95 TYP.	
F	0.30	0.50			

**MARKING**



**ABSOLUTE MAXIMUM RATINGS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

PARAMETER	SYMBOL	RATINGS	UNIT
Collector - Emitter Voltage	$V_{CEO}$	-40	Vdc
Collector - Base Voltage	$V_{CBO}$	-40	Vdc
Emitter - Base Voltage	$V_{EBO}$	-5.0	Vdc
Collector Current - Continuous	$I_C$	-200	mAdc
Total Device Dissipation FR-5 Board <sup>(1)</sup> , $T_A = 25^\circ\text{C}$	$P_D$	225	mW
Total Device Dissipation FR-5 Board, Derate above $25^\circ\text{C}$		1.8	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C} / \text{W}$
Total Device Dissipation Alumina Substrate <sup>(2)</sup> , $T_A = 25^\circ\text{C}$	$P_D$	300	mW
Total Device Dissipation Alumina Substrate, Derate above $25^\circ\text{C}$		2.4	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C} / \text{W}$
Junction, Storage Temperature	$T_J, T_{STG}$	-55 ~ +150	$^\circ\text{C}$

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

PARAMETER	SYMBOL	MIN.	MAX.	UNIT	TEST CONDITIONS
<b>OFF CHARACTERISTICS</b>					
Collector-Emitter Breakdown Voltage <sup>(3)</sup>	$V_{(BR)CEO}$	-40	-	Vdc	$I_C = -1\text{mA}, I_B = 0$
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	-40	-	Vdc	$I_C = -10\mu\text{A}, I_E = 0$
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	-5.0	-	Vdc	$I_E = -10\mu\text{A}, I_C = 0$
Base Cut-Off Current	$I_{BL}$	-	-50	nA	$V_{CE} = -30\text{V}, V_{EB} = -3.0\text{V}$
Collector Cut-Off Current	$I_{CEX}$	-	-50	nA	$V_{CE} = -30\text{V}, V_{EB} = -3.0\text{V}$
<b>ON CHARACTERISTICS<sup>(3)</sup></b>					
DC Current Gain	$h_{FE(1)}$	60	-		$I_C = -0.1\text{mA}, V_{CE} = -1\text{V}$
	$h_{FE(2)}$	80	-		$I_C = -1.0\text{mA}, V_{CE} = -1\text{V}$
	$h_{FE(3)}$	100	300		$I_C = -10\text{mA}, V_{CE} = -1\text{V}$
	$h_{FE(4)}$	60	-		$I_C = -50\text{mA}, V_{CE} = -1\text{V}$
	$h_{FE(5)}$	30	-		$I_C = -100\text{mA}, V_{CE} = -1\text{V}$
Collector-Emitter Saturation Voltage <sup>(3)</sup>	$V_{CE(sat)}$	-	-0.25	Vdc	$I_C = -10\text{mA}, I_B = -1\text{mA}$
		-	-0.4		$I_C = -50\text{mA}, I_B = -5\text{mA}$
Base-Emitter Saturation Voltage <sup>(3)</sup>	$V_{BE(sat)}$	-0.65	-0.85	Vdc	$I_C = -10\text{mA}, I_B = -1\text{mA}$
		-	-0.95		$I_C = -50\text{mA}, I_B = -5\text{mA}$
<b>SMALL-SIGNAL CHARACTERISTICS</b>					
Current-Gain-Bandwidth Product	$f_T$	250	-	MHz	$I_C = -10\text{mA}, V_{CE} = -20\text{V}, f = 100\text{MHz}$
Output Capacitance	$C_{obo}$	-	4.5	pF	$V_{CB} = -5.0\text{V}, I_E = 0, f = 1.0\text{MHz}$
Input Capacitance	$C_{ibo}$	-	10	pF	$V_{EB} = -0.5\text{V}, I_C = 0, f = 1.0\text{MHz}$
Input Impedance	$h_{ie}$	2.0	12	k $\Omega$	$V_{CE} = -10\text{V}, I_C = -1.0\text{mA}, f = 1.0\text{kHz}$
Voltage Feedback Ratio	$h_{re}$	0.1	10	$\times 10^{-4}$	$V_{CE} = -10\text{V}, I_C = 1.0\text{mA}, f = 1.0\text{kHz}$
Small-Signal Current Gain	$h_{fe}$	100	400		$V_{CE} = -10\text{V}, I_C = 1.0\text{mA}, f = 1.0\text{kHz}$
Output Admittance	$H_{oe}$	3.0	60	$\mu\text{mhos}$	$V_{CE} = -10\text{V}, I_C = 1.0\text{mA}, f = 1.0\text{kHz}$
Noise Figure	NF	-	4.0	dB	$V_{CE} = -5.0\text{V}, I_C = -100\mu\text{A}, R_S = 1.0\text{k}\Omega, f = 1.0\text{kHz}$
<b>SWITCHING CHARACTERISTICS</b>					
Delay Time	$t_d$	-	35	nS	$V_{CC} = -3\text{V}, V_{BE} = 0.5\text{V}$
Rise Time	$t_r$	-	35		$I_C = -10\text{mA}, I_{B1} = -1\text{mA}$
Storage Time	$t_s$	-	225		$V_{CC} = -3\text{V}$
Fall Time	$t_f$	-	75		$I_C = -10\text{mA}, I_{B1} = I_{B2} = -1\text{mA}$

NOTE:

- FR-5=1.0 x 0.75 x 0.062 in.
- Alumina=0.4 x 0.3 x 0.024 in. 99.5% alumina.
- Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

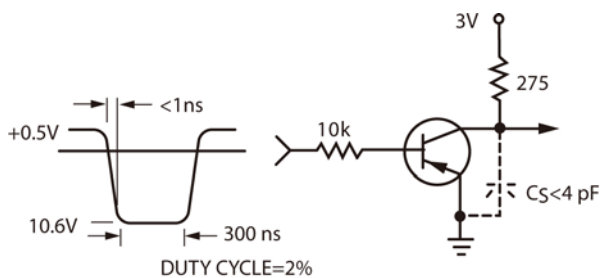


FIG.1 Delay and Rise Time  
Equivalent Test Circuit

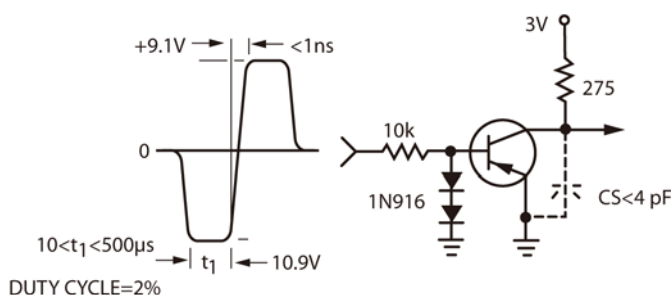


FIG.2 Storage and Fall Time  
Equivalent Test Circuit

\*Total shunt capacitance of test jig and connectors

**TYPICAL TRANSIENT CHARACTERISTICS**

—  $T_J = 25^\circ\text{C}$     - - - -  $T_J = 125^\circ\text{C}$

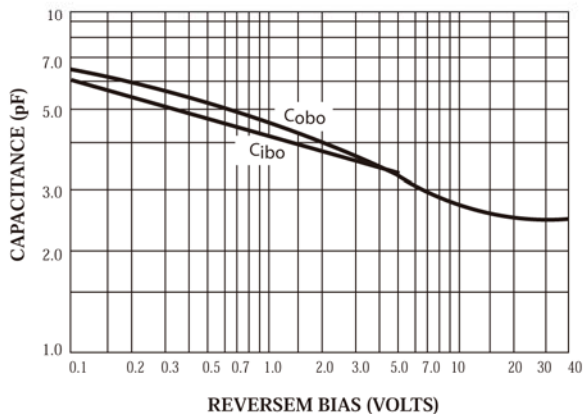


FIG.3 Capacitance

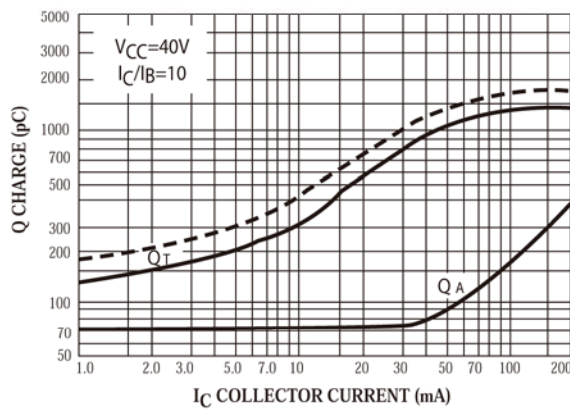


FIG.4 Charge Data

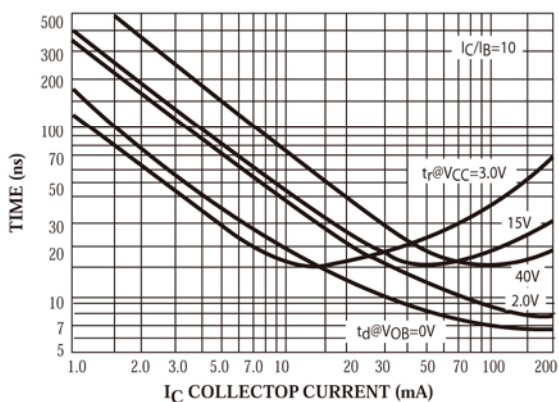


FIG.5 Turn-On Time

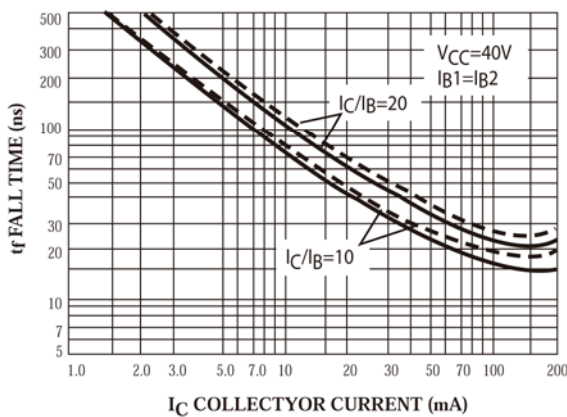


FIG.6 Fall Time

**TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS**

( $V_{CE} = -5.0$  Vdc,  $T_A = 25^\circ\text{C}$ , Bandwidth = 1.0Hz)

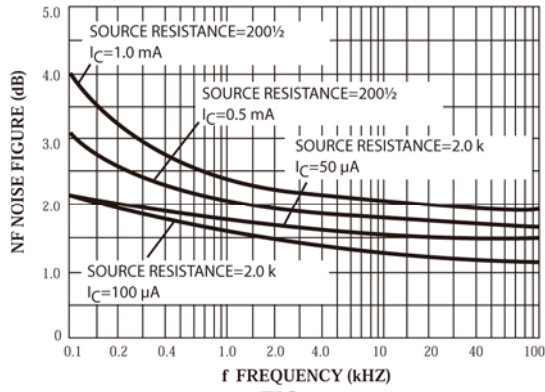


FIG.7

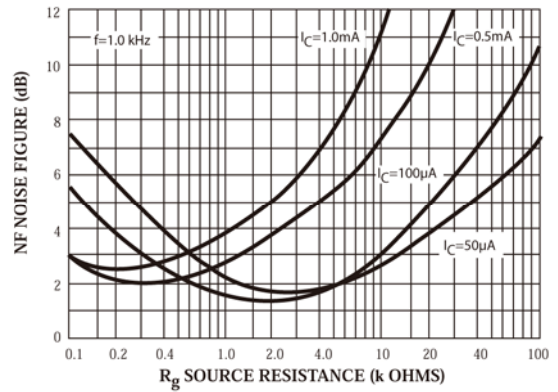


FIG.8

**h PARAMETERS** ( $V_{CE} = -10$  Vdc,  $f = 1.0$  kHz,  $T_A = 25^\circ\text{C}$ )

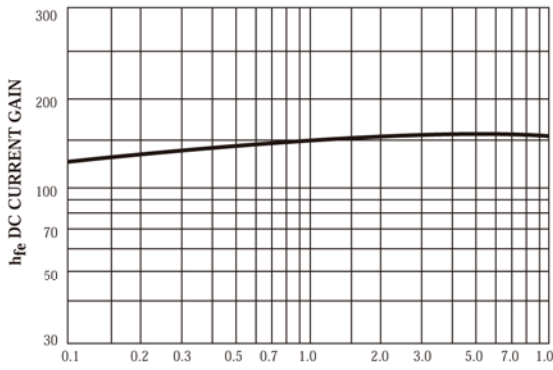


FIG.9 Current Gain

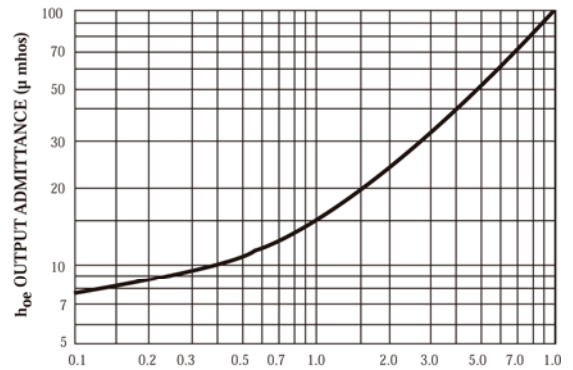


FIG.10 Input Impedance

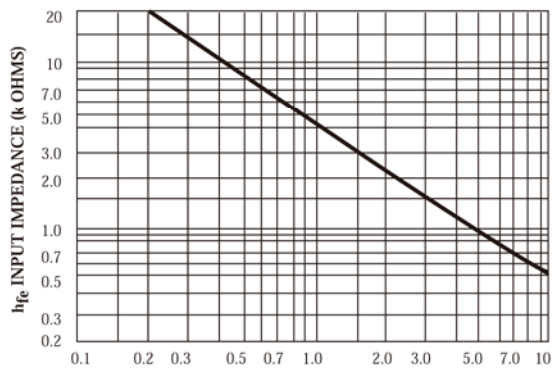


FIG.11 Input Impedance

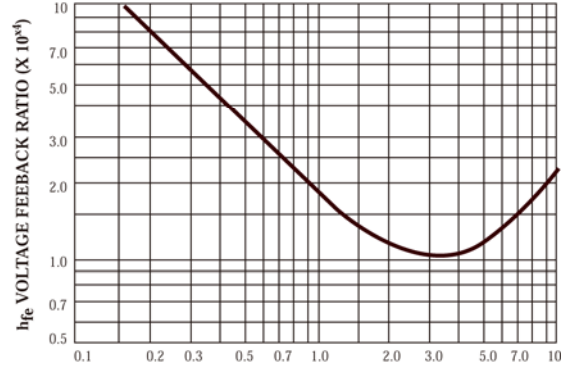


FIG.12 Votage Feedback Ratio

**TYPICAL STATIC CHARACTERISTICS**

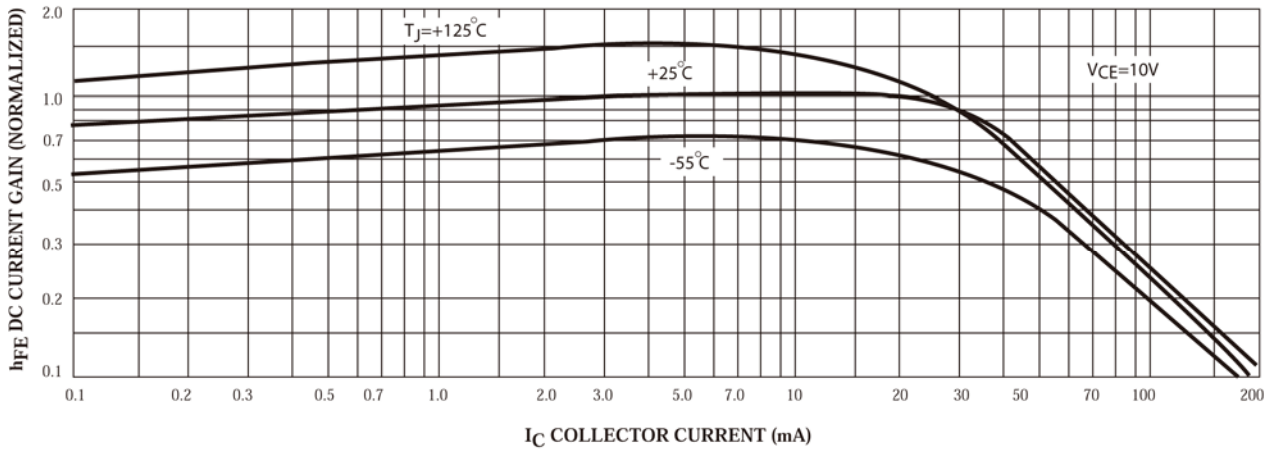


FIG.13 DC Current Gain

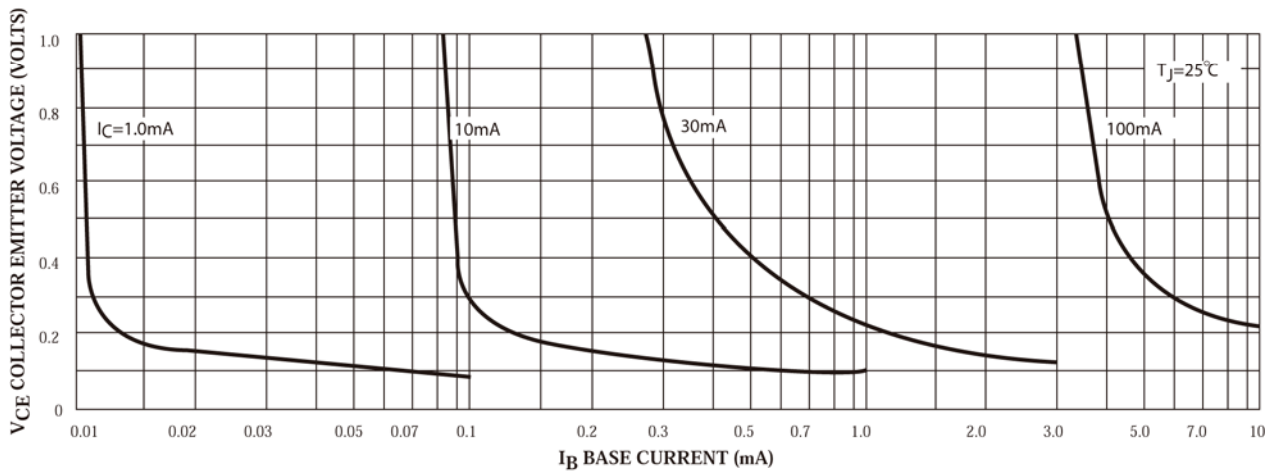


FIG.14 Collector Saturation Region

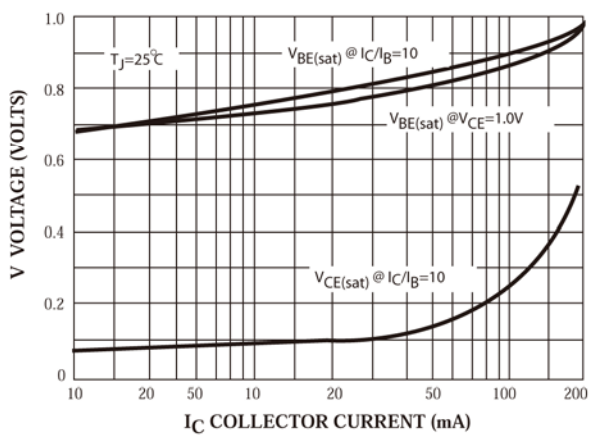


FIG.15 "ON" Voltages

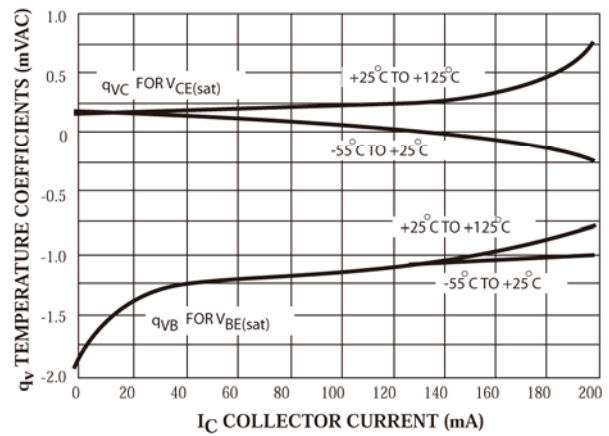


FIG.16 Temperature Coefficients