

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

FEATURES

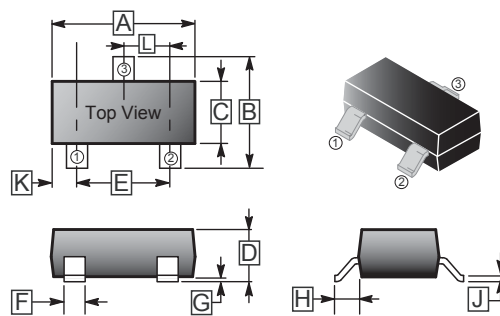
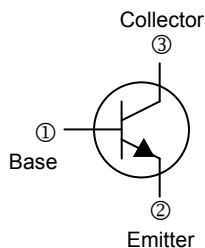
- ◆ Collector current capability $I_C=200\text{mA}$
- ◆ Collector-emitter voltage $V_{CEO}=40\text{V}$.

SOT-23

APPLICATION

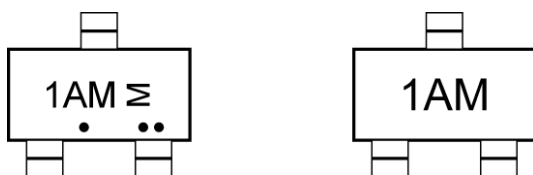
- ◆ General switching and amplification.

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)

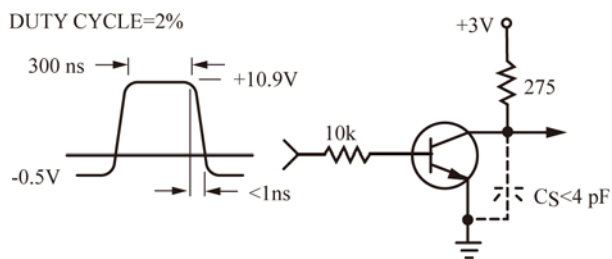
PARAMETER	SYMBOL	RATINGS	UNIT
Collector - Emitter Voltage	V_{CEO}	40	Vdc
Collector - Base Voltage	V_{CBO}	60	Vdc
Emitter - Base Voltage	V_{EBO}	6.0	Vdc
Collector Current - Continuous	I_C	200	mAdc
Total Device Dissipation FR-5 Board ⁽¹⁾ , $T_A=25^\circ\text{C}$	P_D	225	mW
Total Device Dissipation FR-5 Board, Derate above 25°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 ⁽²⁾ , $T_A=25^\circ\text{C}$	P_D	300	mW
Total Device Dissipation Alumina Substrate, Derate above 25°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)(Continued)

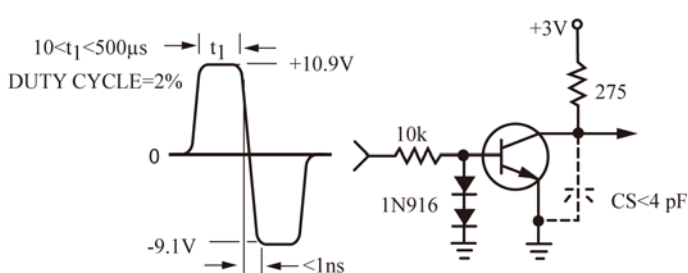
PARAMETER	SYMBOL	MIN.	MAX.	UNIT	TEST CONDITIONS
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage ⁽³⁾	$V_{(BR)CEO}$	40	-	Vdc	$I_C = 1\text{mA}, I_B = 0$
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	60	-	Vdc	$I_C = 10\mu\text{A}, I_E = 0$
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	6.0	-	Vdc	$I_E = 10\mu\text{A}, I_C = 0$
Base Cut-Off Current	I_{BL}	-	50	nA	$V_{CE} = 30\text{Vdc}, V_{EB} = 3.0\text{Vdc}$
Collector Cut-Off Current	I_{CEX}	-	50	nA	$V_{CE} = 30\text{Vdc}, V_{EB} = 3.0\text{Vdc}$
ON CHARACTERISTICS⁽³⁾					
DC Current Gain	$h_{FE(1)}$	40	-		$I_C = 0.1\text{mA}, V_{CE} = 1\text{Vdc}$
	$h_{FE(2)}$	70	-		$I_C = 1.0\text{mA}, V_{CE} = 1\text{Vdc}$
	$h_{FE(3)}$	100	300		$I_C = 10\text{mA}, V_{CE} = 1\text{Vdc}$
	$h_{FE(4)}$	60	-		$I_C = 50\text{mA}, V_{CE} = 1\text{Vdc}$
	$h_{FE(5)}$	30	-		$I_C = 100\text{mA}, V_{CE} = 1\text{Vdc}$
Collector-Emitter Saturation Voltage ⁽³⁾	$V_{CE(sat)}$	-	0.2	Vdc	$I_C = 10\text{mA}, I_B = 1\text{mA}$
		-	0.3		$I_C = 50\text{mA}, I_B = 5\text{mA}$
Base-Emitter Saturation Voltage ⁽³⁾	$V_{BE(sat)}$	0.65	0.85	Vdc	$I_C = 10\text{mA}, I_B = 1\text{mA}$
		-	0.95		$I_C = 50\text{mA}, I_B = 5\text{mA}$
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain-Bandwidth Product	f_T	300	-	MHz	$I_C = 10\text{mA}, V_{CE} = 20\text{Vdc}, f = 100\text{MHz}$
Output Capacitance	C_{obo}	-	4.0	pF	$V_{CB} = 5.0\text{Vdc}, I_E = 0, f = 1.0\text{MHz}$
Input Capacitance	C_{ibo}	-	8.0	pF	$V_{EB} = 0.5\text{Vdc}, I_C = 0, f = 1.0\text{MHz}$
Input Impedance	h_{ie}	1.0	10	k Ω	$V_{CE} = 10\text{Vdc}, I_C = 1.0\text{mA}, f = 1.0\text{kHz}$
Voltage Feedback Ratio	h_{re}	0.5	8.0	$\times 10^{-4}$	$V_{CE} = 10\text{Vdc}, I_C = 1.0\text{mA}, f = 1.0\text{kHz}$
Small-Signal Current Gain	h_{fe}	100	400		$V_{CE} = 10\text{Vdc}, I_C = 1.0\text{mA}, f = 1.0\text{kHz}$
Output Admittance	H_{oe}	1.0	40	μmhos	$V_{CE} = 10\text{Vdc}, I_C = 1.0\text{mA}, f = 1.0\text{kHz}$
Noise Figure	NF	-	5.0	dB	$V_{CE} = 5.0\text{Vdc}, I_C = 100\mu\text{A}, R_S = 1.0\text{k}\Omega, f = 1.0\text{kHz}$
SWITCHING CHARACTERISTICS					
Delay Time	t_d	-	35	nS	$V_{CC} = 3\text{Vdc}, V_{BE} = -0.5\text{Vdc}$
Rise Time	t_r	-	35		$I_C = 10\text{mA}, I_{B1} = 1\text{mA}$
Storage Time	t_s	-	200		$V_{CC} = 3\text{Vdc}$
Fall Time	t_f	-	50		$I_C = 10\text{mA}, I_{B1} = I_{B2} = 1\text{mA}$

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

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

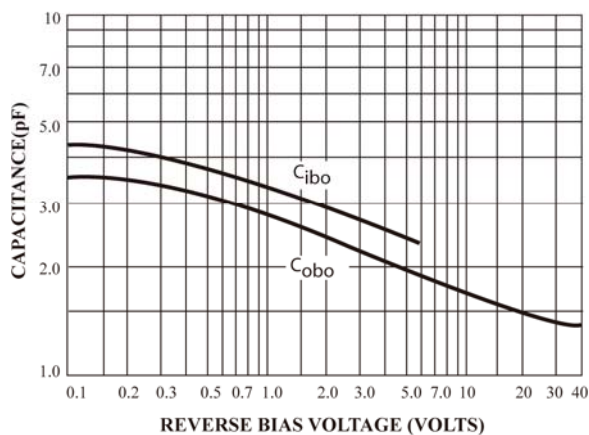


FIG.3 Capacitance

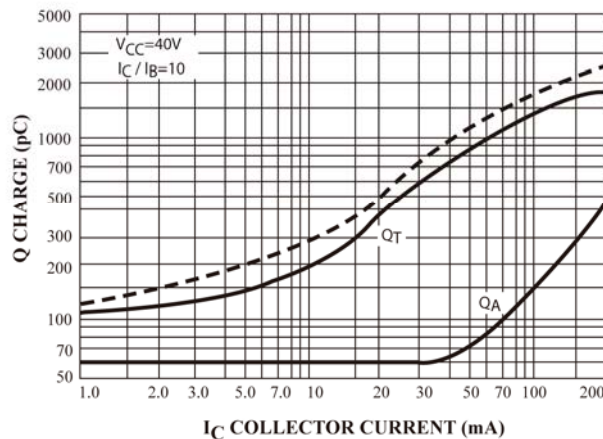


FIG.4 Charge Data

TYPICAL TRANSIENT CHARACTERISTIC CURVES

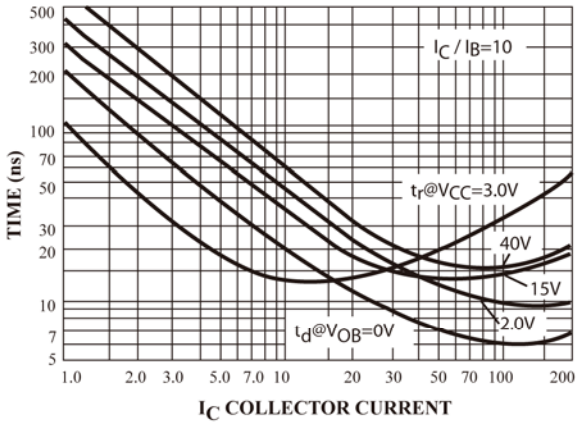


FIG.5 Turn-On Time

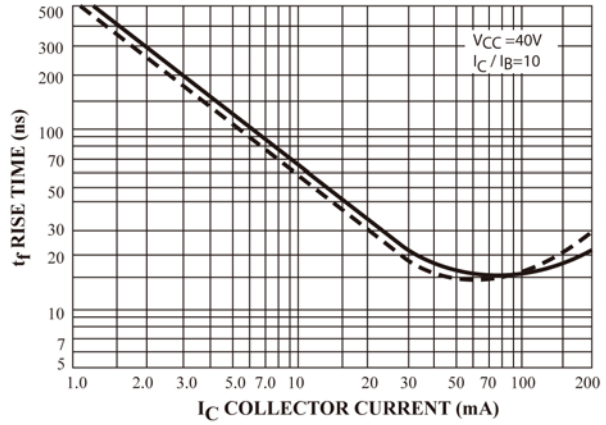


FIG.6 Rise Time

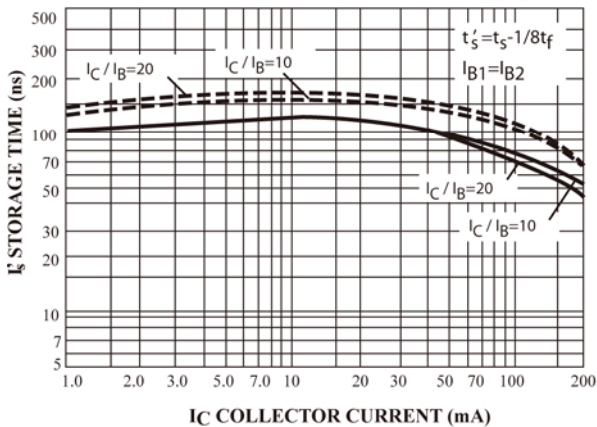


FIG.7 Storage Time

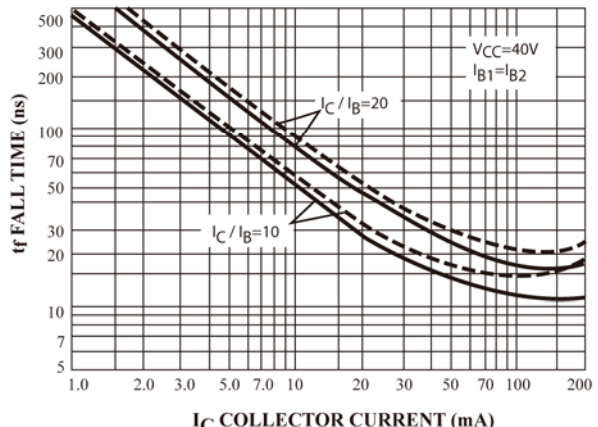


FIG.8 Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

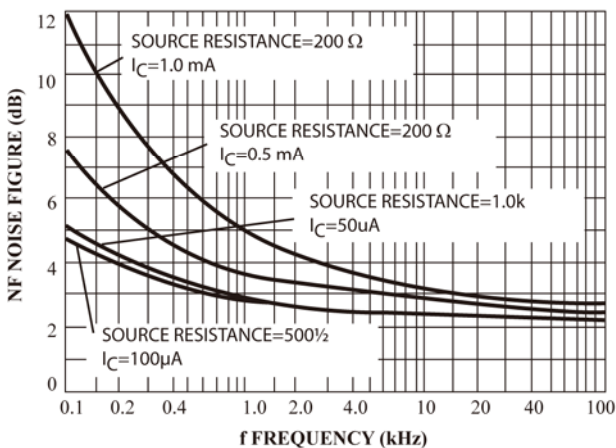


FIG.9

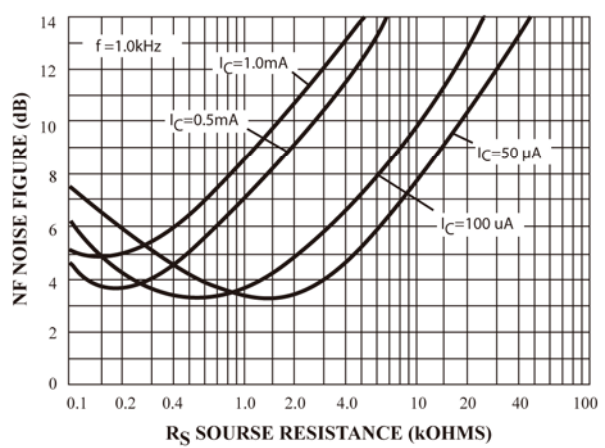


FIG.10

(NPN)

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

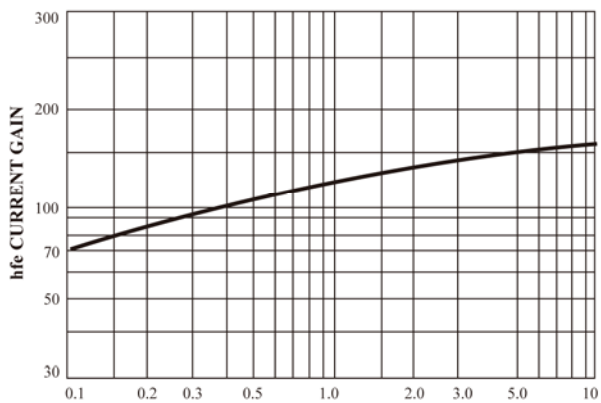


FIG.11 Current Gain

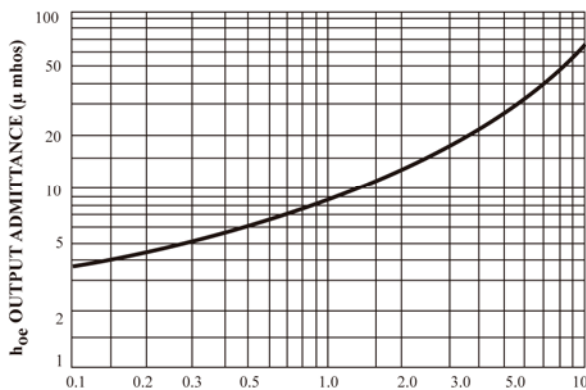


FIG.12 Output Admittance

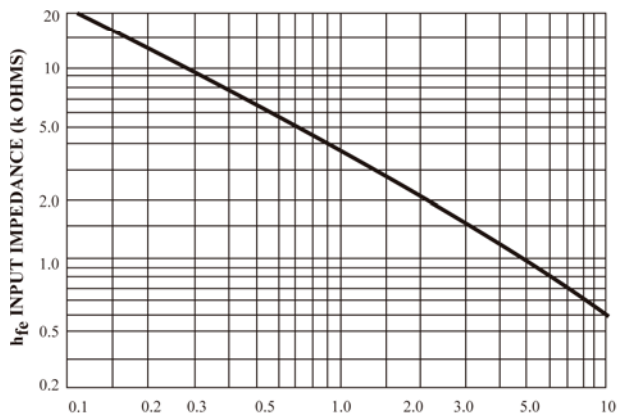


FIG.13 Input Impedance

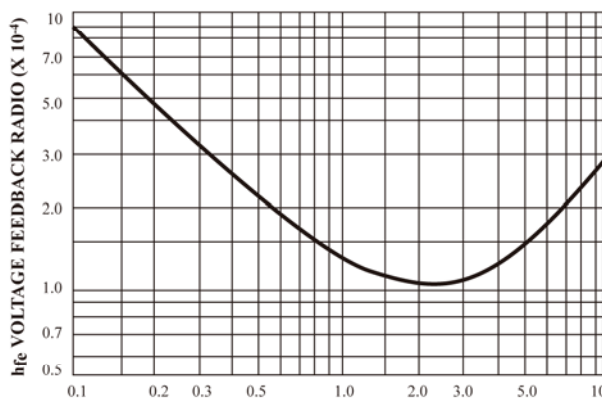


FIG.14 Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

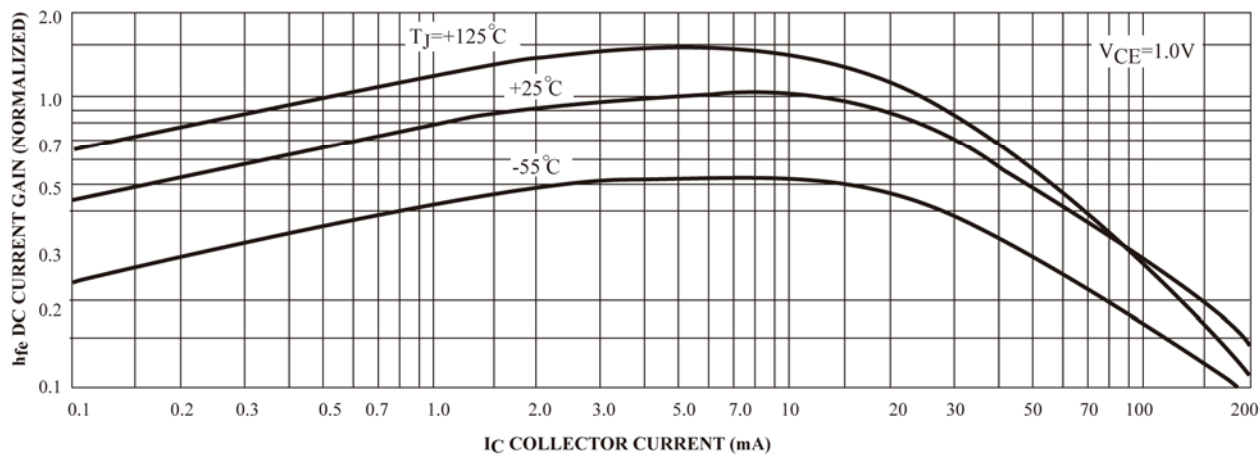


FIG.15 DC Current Gain

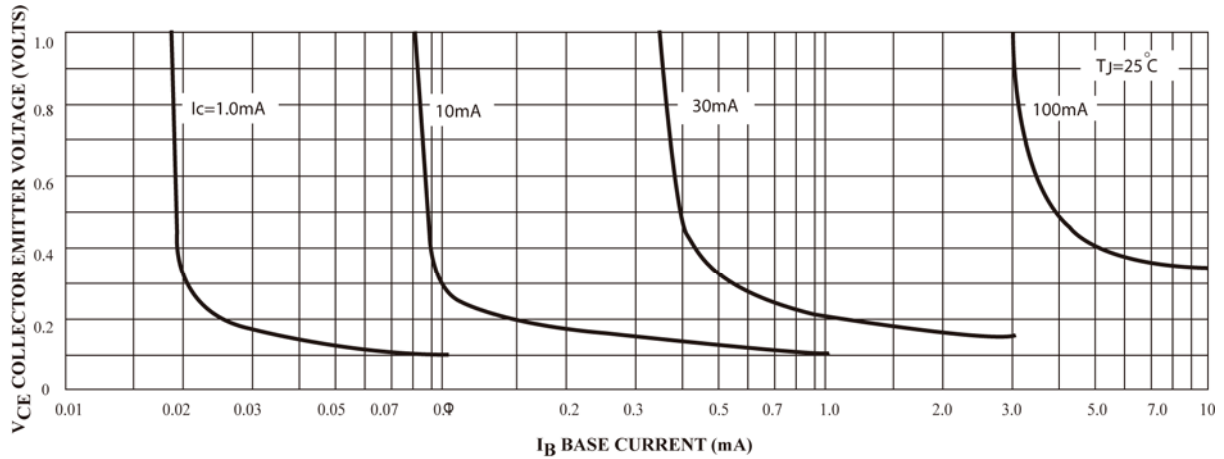


FIG.16 Collector Saturation Region

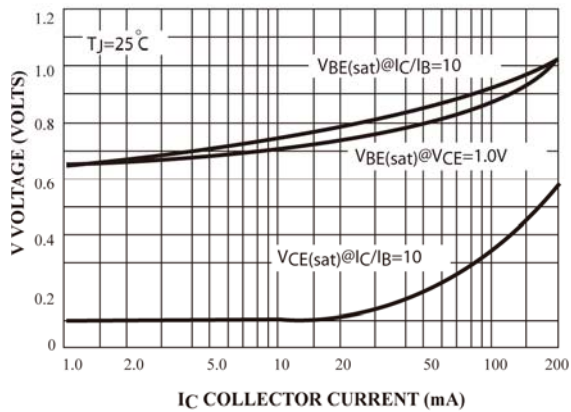


FIG.17 "ON" Voltage

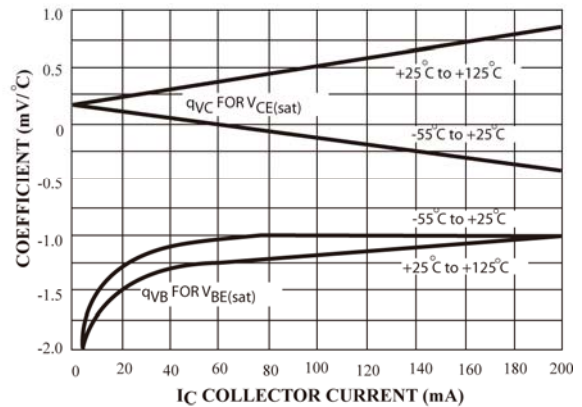


FIG.18 Temperature Coefficients