

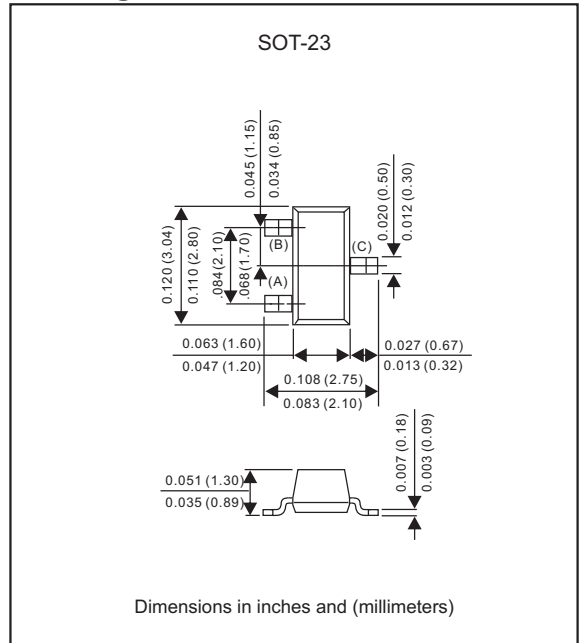
Features

- High collector-emitter breakdown voltage.
(V_{CE0} -40V Min.@ I_C = -1.0mA)
- Small load switch transistor with high gain and low saturation voltage, is designed for general purpose amplifier and switching applications at collector current.
- As complementary type, the NPN transistor FMBT3904 is recommended
- Capable of 225mW power dissipation.
- Lead-free parts for green partner, exceeds environmental standards of MIL-STD-19500 /228
- Compliant to Halogen-free
- Suffix "-Q1" for AEC-Q101

Mechanical data

- Epoxy: UL94-V0 rated flame retardant
- Case : Molded plastic, SOT-23
- Terminals : Solder plated, solderable per
MIL-STD-750, Method 2026
- Mounting Position : Any

Package outline



Maximum ratings (AT T_A = 25°C unless otherwise noted)

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Collector-base voltage		V_{CBO}			-40	V
Collector-emitter voltage		V_{CEO}			-40	V
Emitter-base voltage		V_{EBO}			-5.0	V
Collector current - continuous		I_C			-200	mA
Total device dissipation FR-5 board (Note 1)	$T_A = 25^\circ\text{C}$ Derate above 25°C	P_D			225 1.8	mW mW/°C
Thermal resistance(Note 1)	Junction to ambient	$R_{\theta JA}$			556	°C/W
Thermal resistance(Note 1)	Junction to case	$R_{\theta JC}$			300	°C/W
Total device dissipation alumina substrate(Note 2)	$T_A = 25^\circ\text{C}$ Derate above 25°C	P_D			300 2.4	mW mW/°C
Thermal resistance(Note 2)	Junction to ambient	$R_{\theta JA}$			417	°C/W
Thermal resistance(Note 2)	Junction to case	$R_{\theta JC}$			225	°C/W
Operating junction temperature range		T_J	-55		+150	°C
Storage temperature range		T_{STG}	-55		+150	°C

Notes 1: FR-5 = 1.0 X 0.75 X 0.062 in.

2: Alumina = 0.4 X 0.3 X 0.024 in. 99.5% alumina.

Electrical characteristics (AT $T_A=25^{\circ}\text{C}$ unless otherwise noted)

Off characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Collector-base breakdown voltage	$I_C = -10\mu\text{A}$, $I_E = 0$	$V_{(BR)CBO}$	-40			V
Collector-emitter breakdown voltage	$I_C = -1\text{mA}$, $I_B = 0$	$V_{(BR)CEO}$	-40			V
Emitter-base breakdown voltage	$I_E = -10\mu\text{A}$, $I_C = 0$	$V_{(BR)EBO}$	-5.0			V
Base cutoff current	$V_{CE} = -30\text{V}$, $V_{EB} = -3.0\text{V}$	I_{BL}			-50	nA
Collector cutoff current	$V_{CE} = -30\text{V}$, $V_{EB} = -3.0\text{V}$	I_{CEX}			-50	nA

On characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
DC current gain	$I_C = -0.1\text{mA}$, $V_{CE} = -1.0\text{V}$	h_{FE}	60			-
	$I_C = -1.0\text{mA}$, $V_{CE} = -1.0\text{V}$		80			
	$I_C = -10\text{mA}$, $V_{CE} = -1.0\text{V}$		100		300	
	$I_C = -50\text{mA}$, $V_{CE} = -1.0\text{V}$		60			
	$I_C = -100\text{mA}$, $V_{CE} = -1.0\text{V}$		30			
Collector-emitter saturation voltage(1)	$I_C = -10\text{mA}$, $I_B = -1.0\text{mA}$	$V_{CE(sat)}$			-0.25	V
	$I_C = -50\text{mA}$, $I_B = -5.0\text{mA}$				-0.40	
Base-emitter saturation voltage	$I_C = -10\text{mA}$, $I_B = -1.0\text{mA}$	$V_{BE(sat)}$	-0.65		-0.85	V
	$I_C = -50\text{mA}$, $I_B = -5.0\text{mA}$				-0.95	

1. Pulse test : pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2.0\%$.

Small-signal characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Current-gain-bandwidth product	$I_C = -10\text{mA}$, $V_{CE} = -20\text{V}$, $f = 100\text{MHz}$	f_T	250			MHz
Output capacitance	$V_{CB} = -5.0\text{V}$, $I_E = 0$, $f = 1.0\text{MHz}$	C_{obo}			4.5	pF
Input capacitance	$V_{EB} = -0.5\text{V}$, $I_C = 0$, $f = 1.0\text{MHz}$	C_{ibo}			10	pF
Input impedance	$V_{CE} = -10\text{V}$, $I_C = -1.0\text{mA}$, $f = 1.0\text{KHz}$	h_{ie}	2.0		12	kohms
Voltage feedback radio	$V_{CE} = -10\text{V}$, $I_C = -1.0\text{mA}$, $f = 1.0\text{KHz}$	h_{fe}	0.1		10.0	$\times 10^{-4}$
Small-signal current gain	$V_{CE} = -10\text{V}$, $I_C = -1.0\text{mA}$, $f = 1.0\text{KHz}$	h_{fe}	100		400	-
Output admittance	$V_{CE} = -10\text{V}$, $I_C = -1.0\text{mA}$, $f = 1.0\text{KHz}$	h_{oe}	3.0		60	μmhos
Noise figure	$V_{CE} = -5.0\text{V}$, $I_C = -100\mu\text{A}$, $R_s = 1.0\text{K ohms}$, $f = 1.0\text{KHz}$	NF			4.0	dB

Switching characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Delay time	$V_{CC} = -3.0\text{V}$, $V_{BE} = 0.5\text{V}$, $I_C = -10\text{mA}$, $I_{B1} = -1.0\text{mA}$	td			35	ns
Rise time		tr			35	
Storage time	$V_{CC} = -3.0\text{V}$, $I_C = -10\text{mA}$, $I_{B1} = I_{B2} = -1.0\text{mA}$	ts			225	
Fall time		tf			75	

Switching time equivalent test circuits

Figure 1. Delay and Rise Time Equivalent Test Circuit

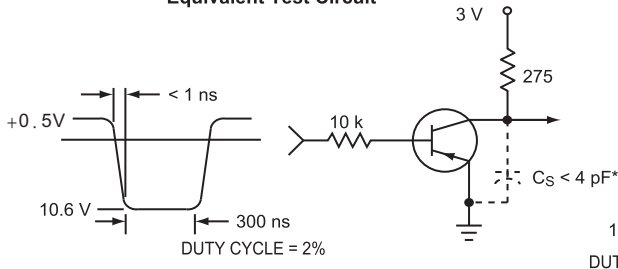
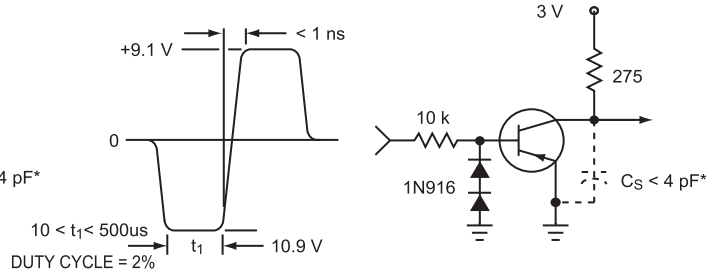


Figure 2. Storage and Fall Time Equivalent Test Circuit



* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

Figure 3. Capacitance

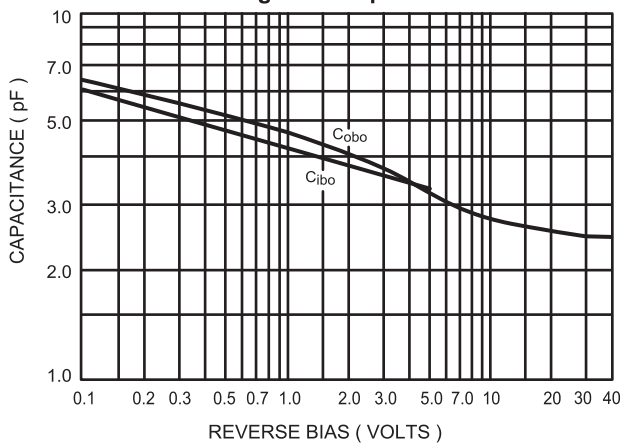


Figure 4. Charge Data

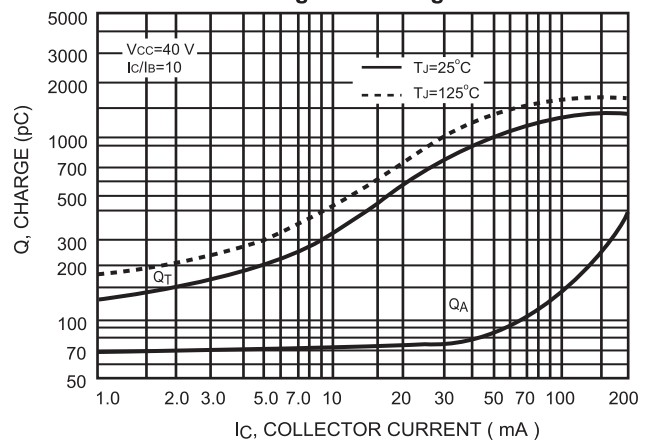


Figure 5. Turn-On Time

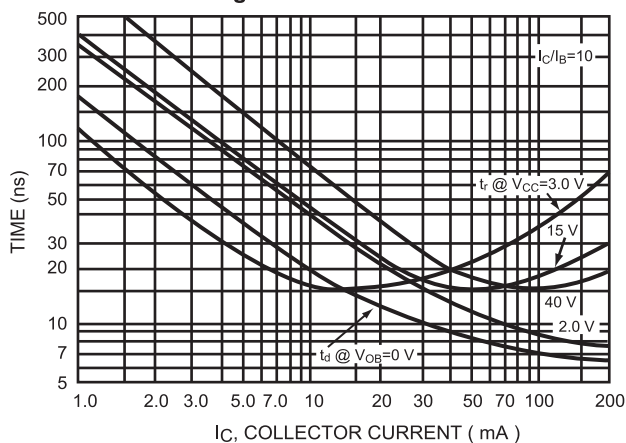
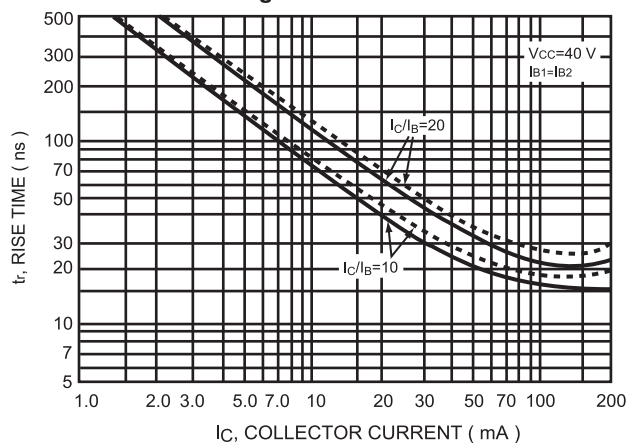


Figure 6. Fall Time



TYPICAL TRANSIENT CHARACTERISTICS

NOISE FIGURE VARIATIONS

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

Figure 7.

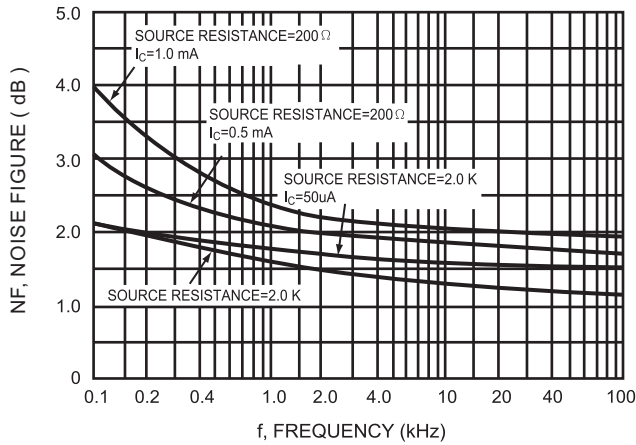
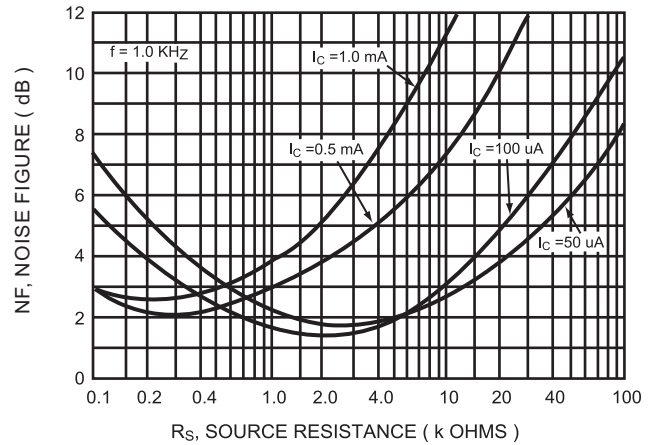


Figure 8.



h PARAMETERS

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

Figure 9. Current Gain

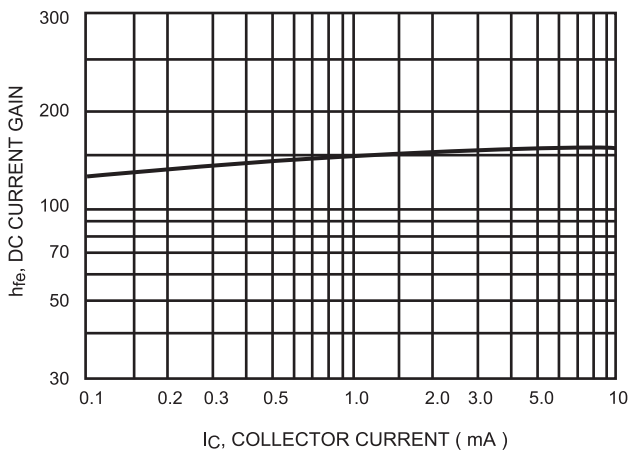


Figure 10. Output Admittance

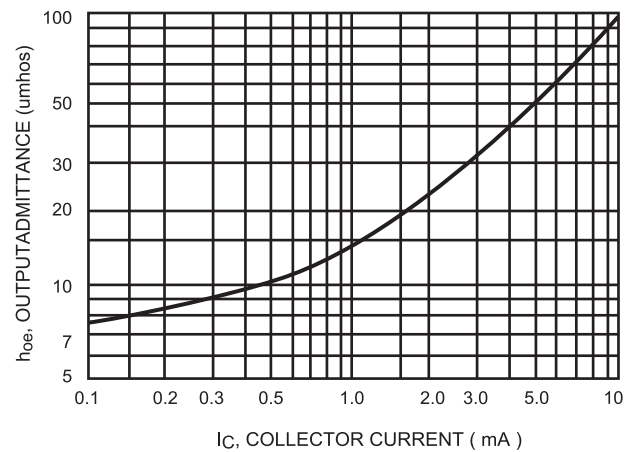


Figure 11. Input Impedance

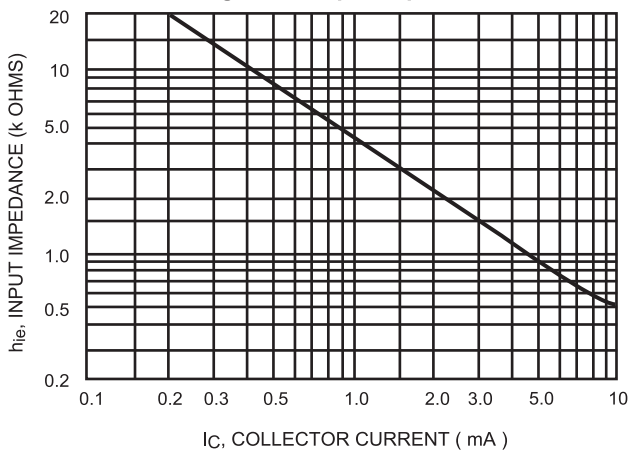
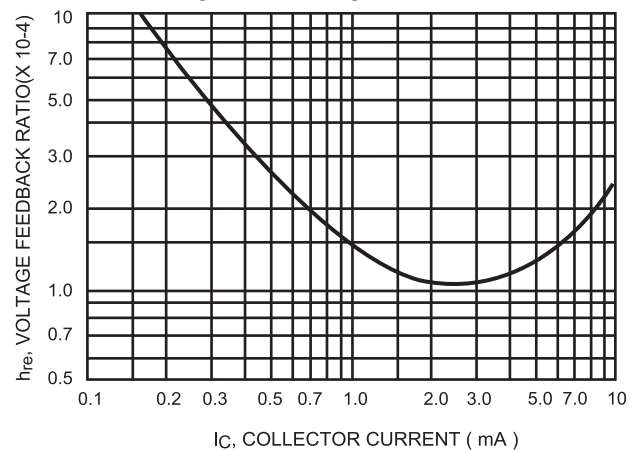


Figure 12. Voltage Feedback Ratio



TYPICAL STATIC CHARACTERISTICS

Figure 13. DC Current Gain

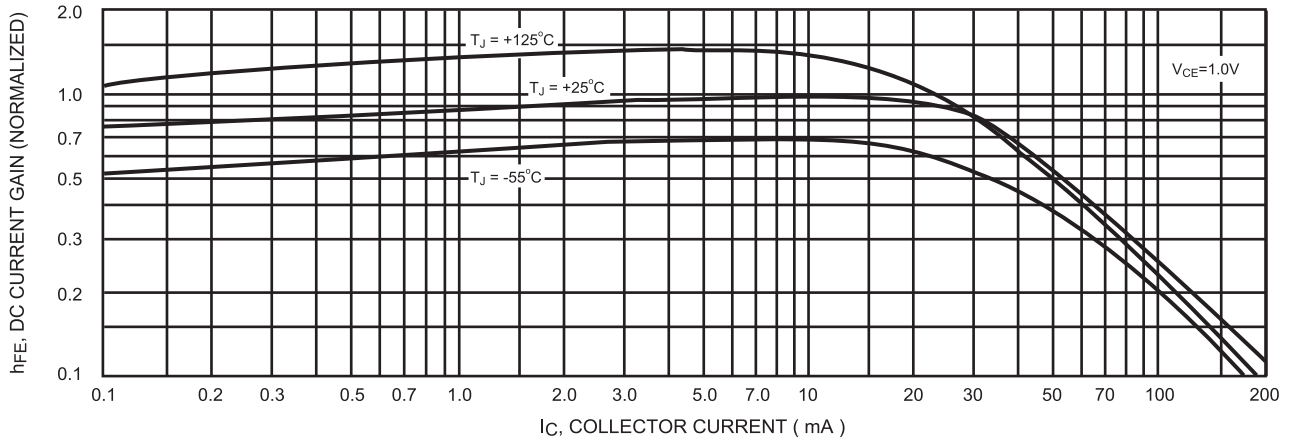


Figure 14. Collector Saturation Region

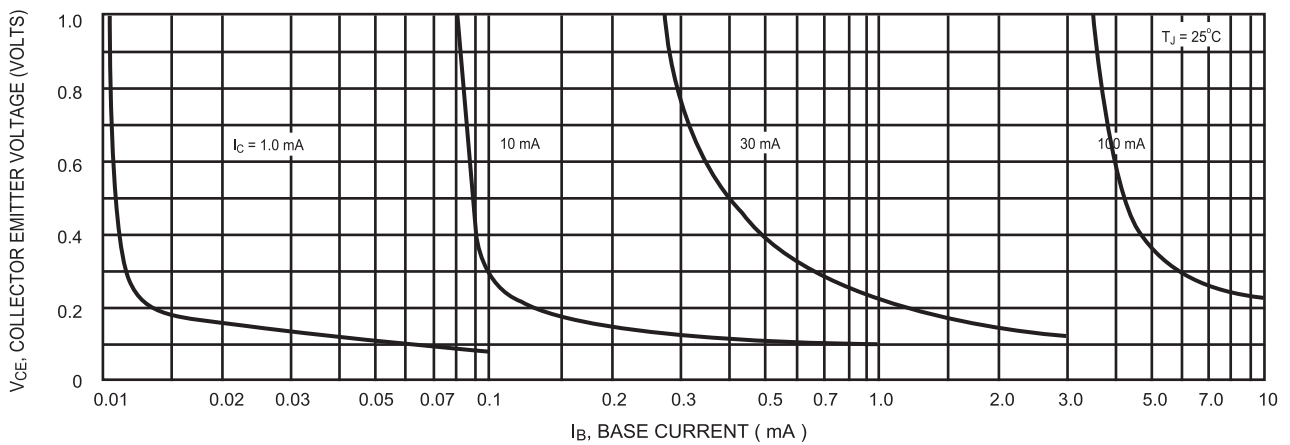


Figure 17. " ON " Voltage

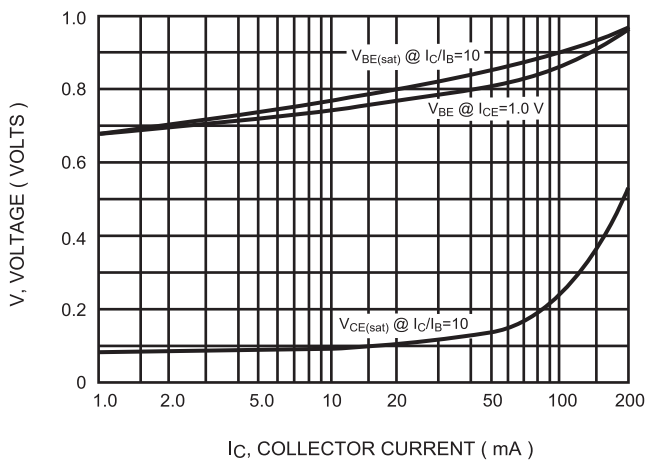
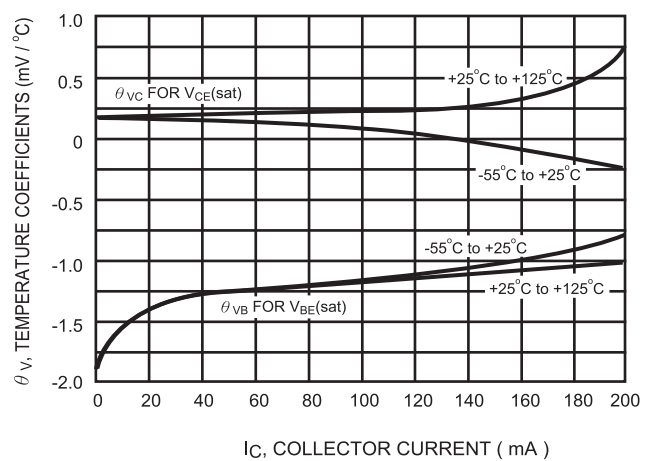
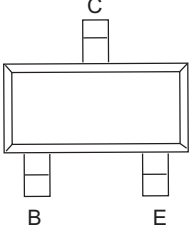
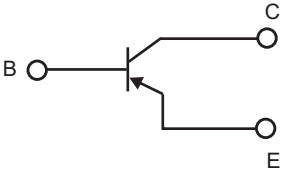


Figure 16. Temperature Coefficients



Pinning information

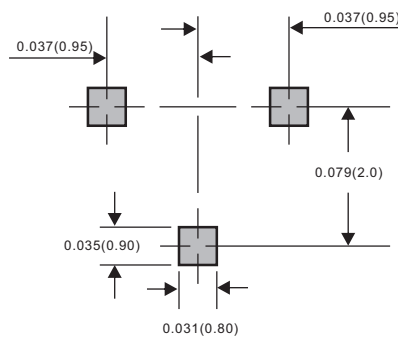
Pin	Simplified outline	Symbol
PinB Base PinC Collector PinE Emitter		

Marking

Type number	Marking code
MMBT3906-Q1	2A

Suggested solder pad layout

SOT-23



Dimensions in inches and (millimeters)