

COMPLEMENTARY NPN/PNP SURFACE MOUNT TRANSISTOR
Features

- Epitaxial Planar Die Construction
- Ideally Suited for Automated Assembly Processes
- **Lead, Halogen and Antimony Free, RoHS Compliant (Note 1)**
- **"Green" Device (Note 2)**
- **Ultra Small Package**

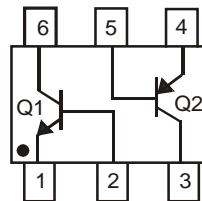
Mechanical Data

- Case: SOT-963
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish — Matte Tin annealed over Copper leadframe. Solderable per MIL-STD-202, Method 208
- Weight: 0.0027 grams (approximate)

SOT-963



Top View

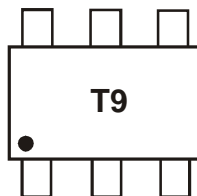


Device Schematic

Ordering Information (Note 5)

Device	Packaging	Shipping
DST3946DPJ-7	SOT-963	10,000/Tape & Reel

- Notes:
1. No purposefully added lead. Halogen and Antimony Free.
 2. Diodes Inc's "Green" Policy can be found on our website at <http://www.diodes.com>

Marking Information


T9 = Product Type Marking Code

Maximum Ratings - NPN (Q1) @ $T_A = 25^\circ\text{C}$ unless otherwise specified

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	6.0	V
Collector Current – Continuous	I_C	200	mA

Maximum Ratings - PNP (Q2) @ $T_A = 25^\circ\text{C}$ unless otherwise specified

Characteristic	Symbol	Value	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

Thermal Characteristics

Characteristic	Symbol	Value	Unit
Power Dissipation (Note 3)	P_D	300	mW
Thermal Resistance, Junction to Ambient (Note 3)	$R_{\theta JA}$	417	$^\circ\text{C}/\text{W}$
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to +150	$^\circ\text{C}$

Notes: 3. Device mounted on FR-4 PCB with minimum recommended pad layout.

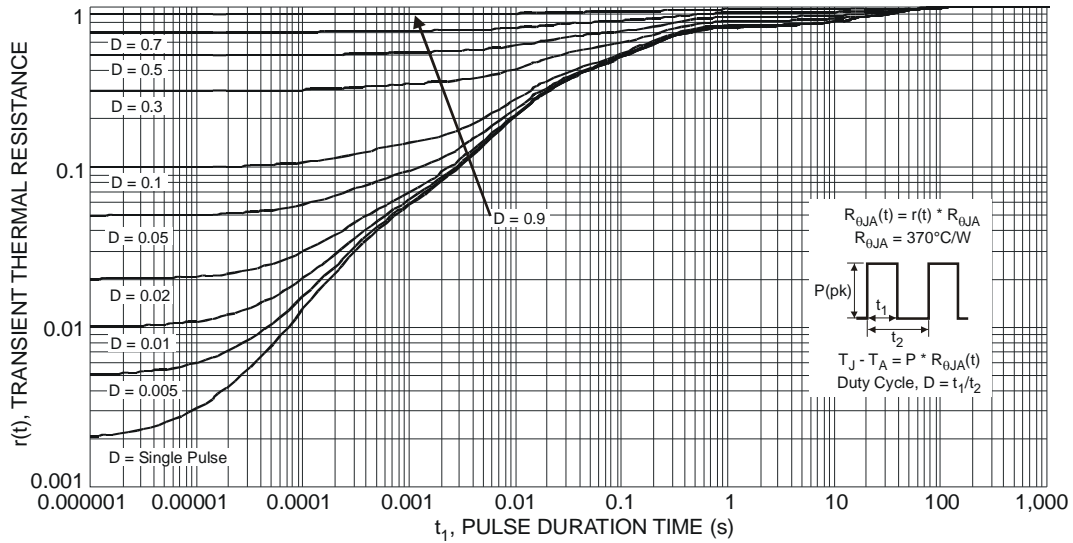


Fig. 1 Transient Thermal Response

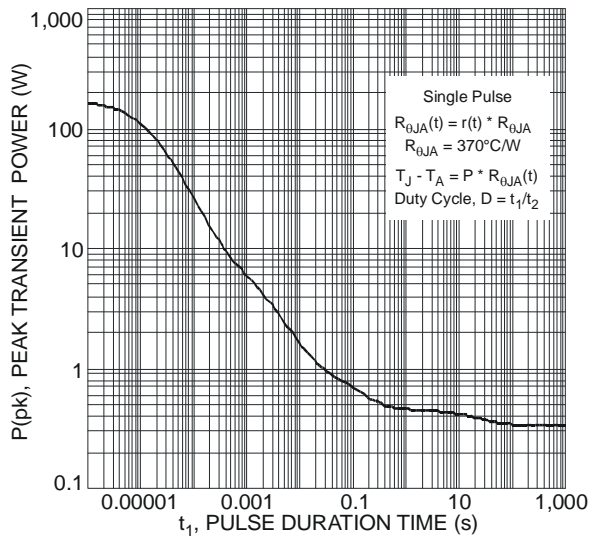


Fig. 2 Single Pulse Maximum Power Dissipation

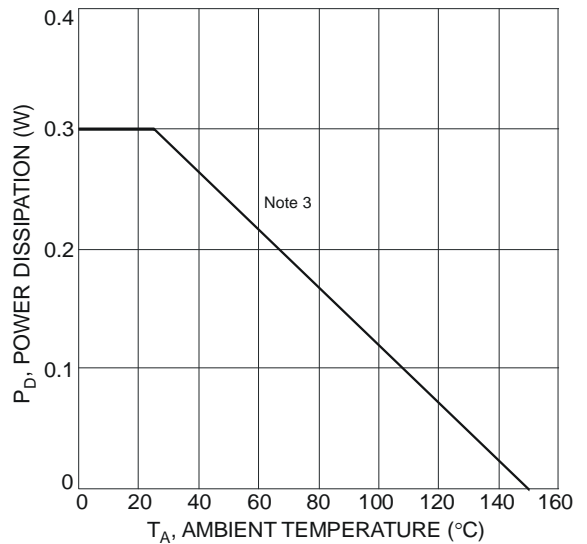


Fig. 3 Power Dissipation vs. Ambient Temperature

Electrical Characteristics - NPN (Q1) @ $T_A = 25^\circ\text{C}$ unless otherwise specified

Characteristic	Symbol	Min	Max	Unit	Test Condition	
OFF CHARACTERISTICS (Note 4)						
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	60	—	V	$I_C = 10\mu\text{A}, I_E = 0$	
Collector-Emitter Breakdown Voltage (Note 4)	$V_{(BR)CEO}$	40	—	V	$I_C = 1.0\text{mA}, I_B = 0$	
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	6.0	—	V	$I_E = 10\mu\text{A}, I_C = 0$	
Collector Cutoff Current	I_{CEX}	—	50	nA	$V_{CE} = 30\text{V}, V_{EB(OFF)} = 3.0\text{V}$	
Base Cutoff Current	I_{BL}	—	50	nA	$V_{CE} = 30\text{V}, V_{EB(OFF)} = 3.0\text{V}$	
ON CHARACTERISTICS (Note 4)						
DC Current Gain	h_{FE}	40	—	—	$I_C = 100\mu\text{A}, V_{CE} = 1.0\text{V}$	
		70	—			$I_C = 1.0\text{mA}, V_{CE} = 1.0\text{V}$
		100	300			$I_C = 10\text{mA}, V_{CE} = 1.0\text{V}$
		60	—			$I_C = 50\text{mA}, V_{CE} = 1.0\text{V}$
		30	—			$I_C = 100\text{mA}, V_{CE} = 1.0\text{V}$
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	—	0.20 0.30	V	$I_C = 10\text{mA}, I_B = 1.0\text{mA}$ $I_C = 50\text{mA}, I_B = 5.0\text{mA}$	
Base-Emitter Saturation Voltage	$V_{BE(SAT)}$	0.65 —	0.85 0.95	V	$I_C = 10\text{mA}, I_B = 1.0\text{mA}$ $I_C = 50\text{mA}, I_B = 5.0\text{mA}$	
SMALL SIGNAL CHARACTERISTICS						
Output Capacitance	C_{obo}	—	4.0	pF	$V_{CB} = 5.0\text{V}, f = 1.0\text{MHz}, I_E = 0$	
Input Capacitance	C_{ibo}	—	8.5	pF	$V_{EB} = 0.5\text{V}, f = 1.0\text{MHz}, I_C = 0$	
Input Impedance	h_{ie}	1.0	10	k Ω	$V_{CE} = 10\text{V}, I_C = 1.0\text{mA},$ $f = 1.0\text{kHz}$	
Voltage Feedback Ratio	h_{re}	0.5	8.0	$\times 10^{-4}$		
Small Signal Current Gain	h_{fe}	100	400	—		
Output Admittance	h_{oe}	1.0	40	μS		
Current Gain-Bandwidth Product	f_T	300	—	MHz		
SWITCHING CHARACTERISTICS						
Delay Time	t_d	—	35	ns	$V_{CC} = 3.0\text{V}, I_C = 10\text{mA},$ $V_{BE(off)} = -0.5\text{V}, I_{B1} = 1.0\text{mA}$	
Rise Time	t_r	—	35	ns		
Storage Time	t_s	—	200	ns	$V_{CC} = 3.0\text{V}, I_C = 10\text{mA},$ $I_{B1} = I_{B2} = 1.0\text{mA}$	
Fall Time	t_f	—	50	ns		

Notes: 4. Short duration pulse test used to minimize self-heating effect.

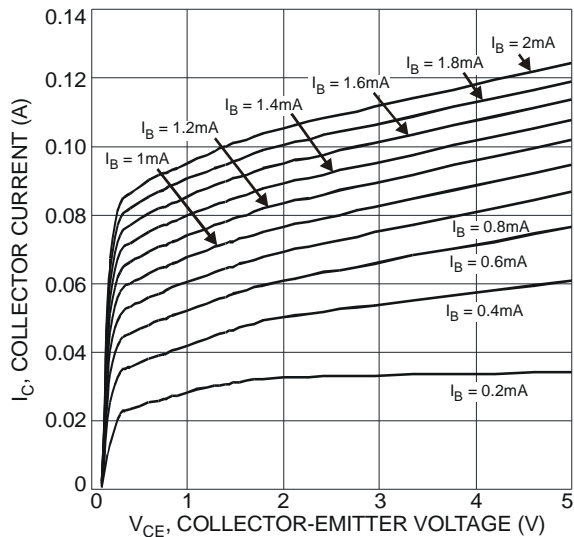


Fig. 4 Typical Collector Current vs. Collector-Emitter Voltage

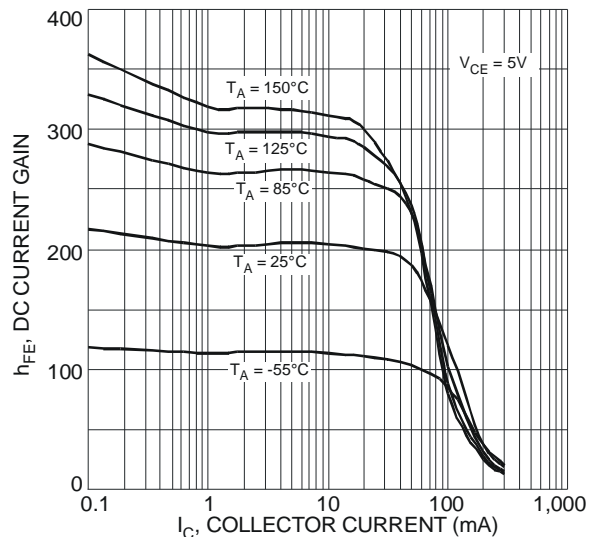


Fig. 5 Typical DC Current Gain vs. Collector Current

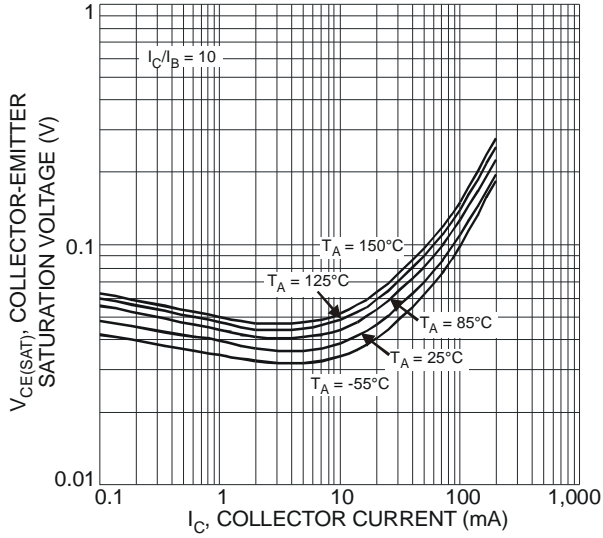


Fig. 6 Typical Collector-Emitter Saturation Voltage vs. Collector Current

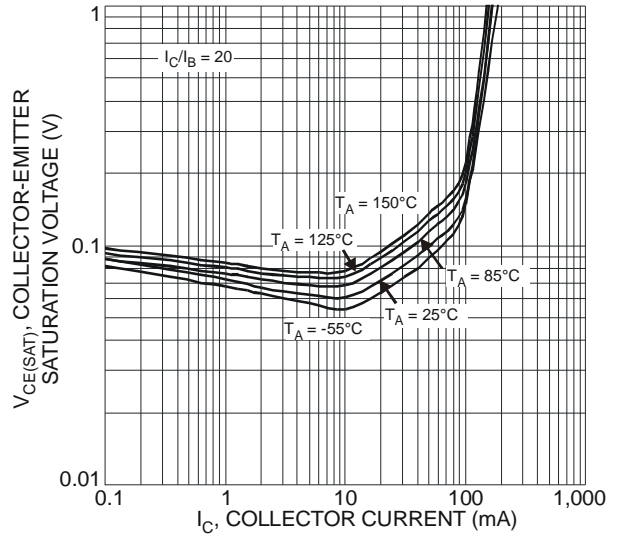


Fig. 7 Typical Collector-Emitter Saturation Voltage vs. Collector Current

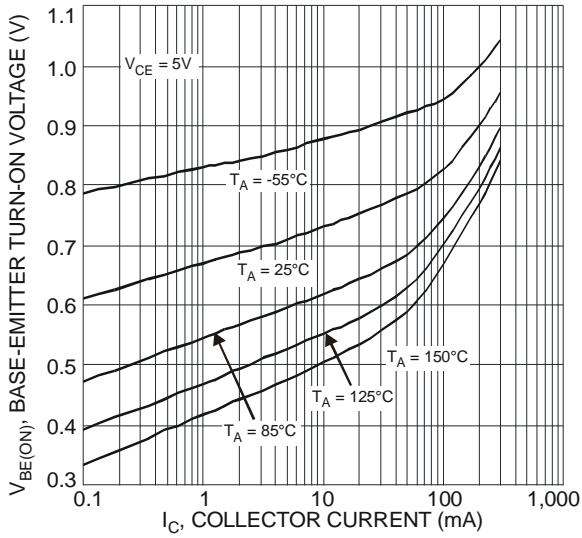


Fig. 8 Typical Base-Emitter Turn-On Voltage vs. Collector Current

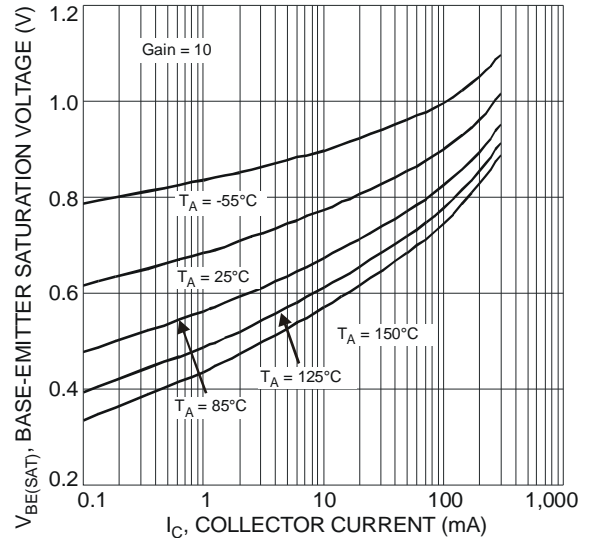


Fig. 9 Typical Base-Emitter Saturation Voltage vs. Collector Current

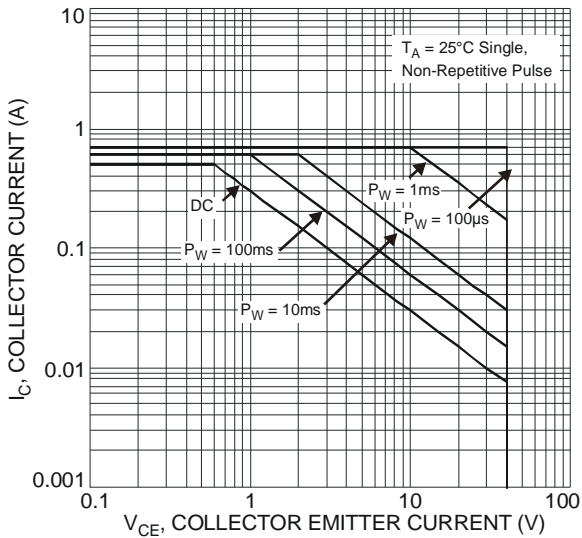


Fig. 10 Safe Operation Area (NPN)

Electrical Characteristics - PNP (Q2) @ $T_A = 25^\circ\text{C}$ unless otherwise specified

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS					
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	-40	—	V	$I_C = -10\mu\text{A}, I_E = 0$
Collector-Emitter Breakdown Voltage (Note 4)	$V_{(BR)CEO}$	-40	—	V	$I_C = -1.0\text{mA}, I_B = 0$
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	-5.0	—	V	$I_E = -10\mu\text{A}, I_C = 0$
Collector Cutoff Current	I_{CEX}	—	-50	nA	$V_{CE} = -30\text{V}, V_{EB(OFF)} = -3.0\text{V}$
	I_{CBO}	—	-50	nA	$V_{CE} = -30\text{V}, I_E = 0$
Base Cutoff Current	I_{BL}	—	-50	nA	$V_{CE} = -30\text{V}, V_{EB(OFF)} = -3.0\text{V}$
ON CHARACTERISTICS (Note 4)					
DC Current Gain	h_{FE}	60	—	—	$I_C = -100\mu\text{A}, V_{CE} = -1.0\text{V}$
		80	—		
		100	300		
		60	—		
		30	—		
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	—	-0.25 -0.40	V	$I_C = -10\text{mA}, I_B = -1.0\text{mA}$ $I_C = -50\text{mA}, I_B = -5.0\text{mA}$
Base-Emitter Saturation Voltage	$V_{BE(SAT)}$	-0.65	-0.85 -0.95	V	$I_C = -10\text{mA}, I_B = -1.0\text{mA}$ $I_C = -50\text{mA}, I_B = -5.0\text{mA}$
SMALL SIGNAL CHARACTERISTICS					
Output Capacitance	C_{obo}	—	4.5	pF	$V_{CB} = -5.0\text{V}, f = 1.0\text{MHz}, I_E = 0$
Input Capacitance	C_{ibo}	—	10	pF	$V_{EB} = -0.5\text{V}, f = 1.0\text{MHz}, I_C = 0$
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	$\times 10^{-4}$	
Small Signal Current Gain	h_{fe}	100	400	—	
Output Admittance	h_{oe}	3.0	60	μS	
Current Gain-Bandwidth Product	f_T	300	—	MHz	
SWITCHING CHARACTERISTICS					
Delay Time	t_d	—	35	ns	$V_{CC} = -3.0\text{V}, I_C = -10\text{mA}, V_{BE(off)} = 0.5\text{V}, I_{B1} = -1.0\text{mA}$
Rise Time	t_r	—	35	ns	
Storage Time	t_s	—	225	ns	$V_{CC} = -3.0\text{V}, I_C = -10\text{mA}, I_{B1} = I_{B2} = -1.0\text{mA}$
Fall Time	t_f	—	75	ns	

Notes: 4. Short duration pulse test used to minimize self-heating effect.

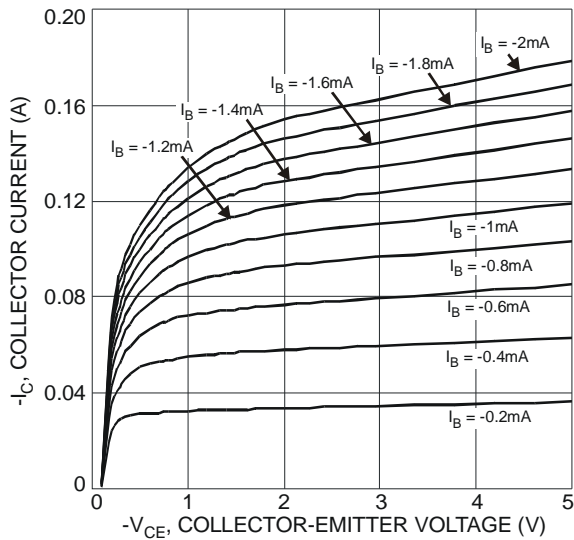


Fig. 11 Typical Collector Current vs. Collector-Emitter Voltage

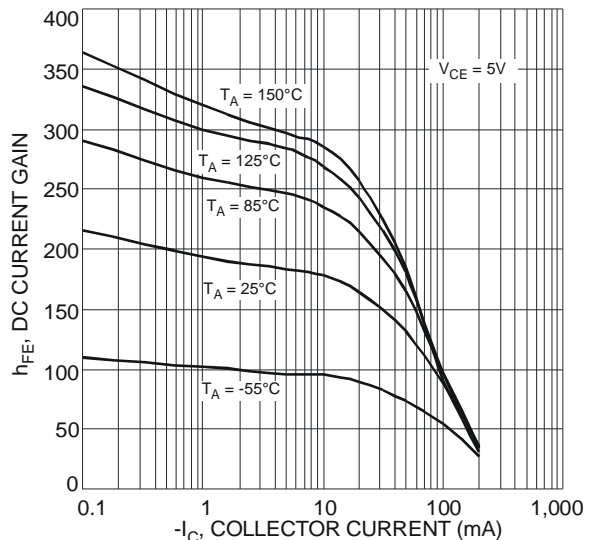


Fig. 12 Typical DC Current Gain vs. Collector Current

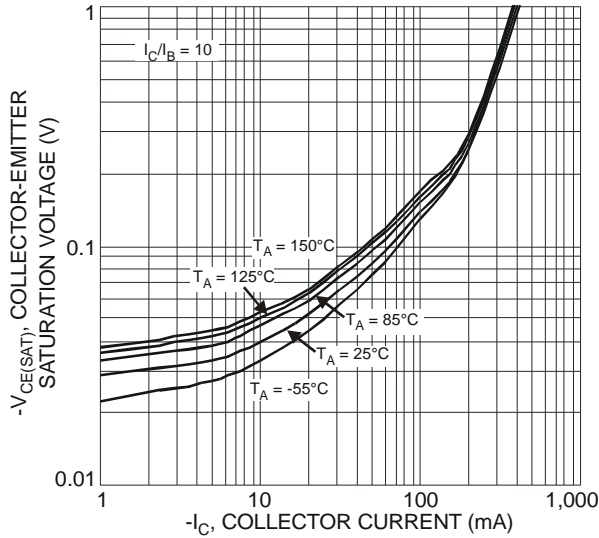


Fig. 13 Typical Collector-Emitter Saturation Voltage vs. Collector Current

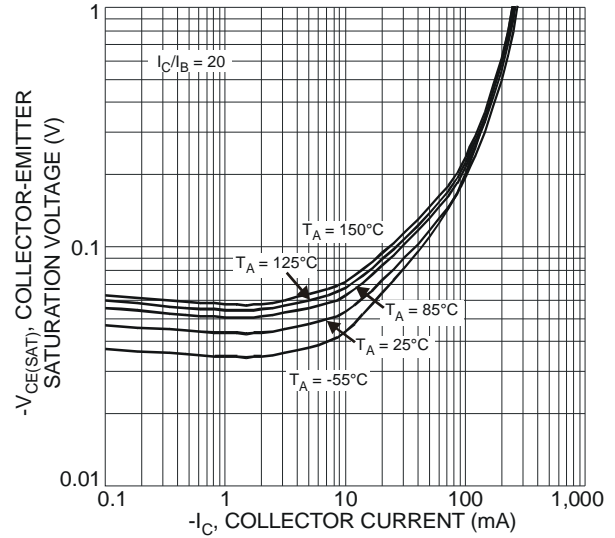


Fig. 14 Typical Collector-Emitter Saturation Voltage vs. Collector Current

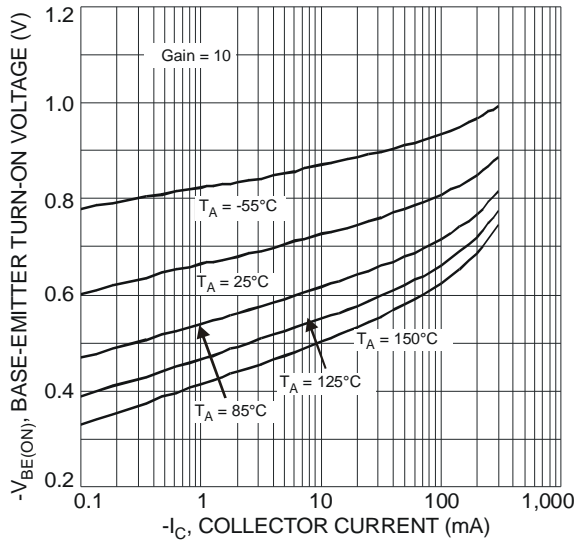


Fig. 15 Typical Base-Emitter Saturation Voltage vs. Collector Current

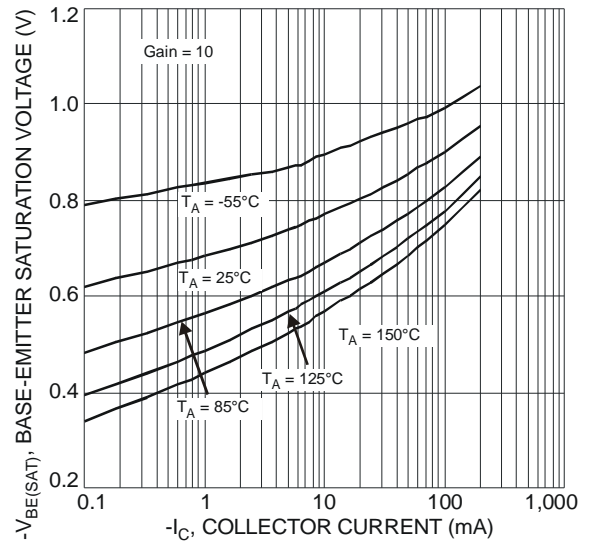


Fig. 16 Typical Base-Emitter Saturation Voltage vs. Collector Current

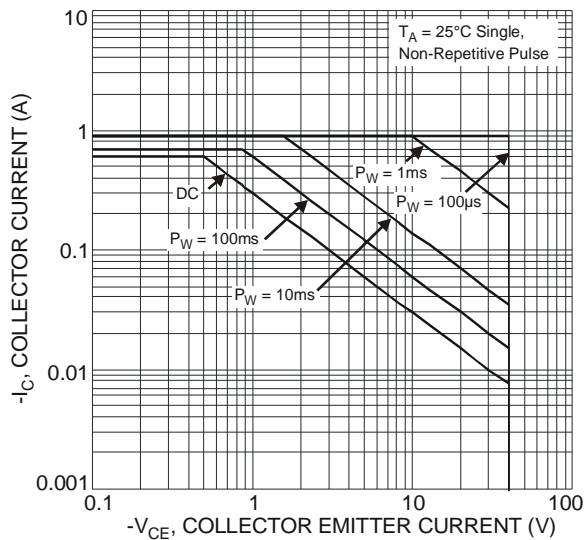
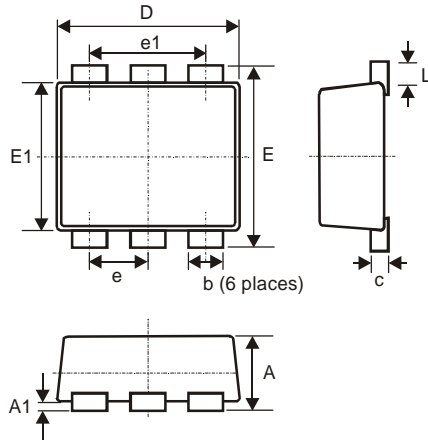


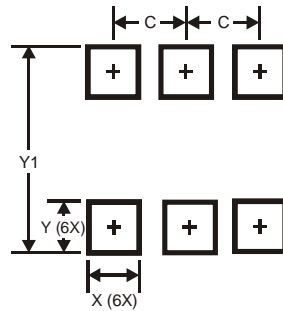
Fig. 17 Safe Operation Area (PNP)

Package Outline Dimensions



SOT-963			
Dim	Min	Max	Typ
A	0.40	0.50	0.45
A1	0	0.05	-
C	0.120	0.180	0.150
D	0.95	1.05	1.00
E	0.95	1.05	1.00
E1	0.75	0.85	0.80
L	0.05	0.15	0.10
b	0.10	0.20	0.15
e	0.35 Typ		
e1	0.70 Typ		
All Dimensions in mm			

Suggested Pad Layout



Dimensions	Value (in mm)
C	0.350
X	0.200
Y	0.200
Y1	1.100

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