40V COMPLEMENTARY SMALL-SIGNAL TRANSISTOR IN SOT363

Features

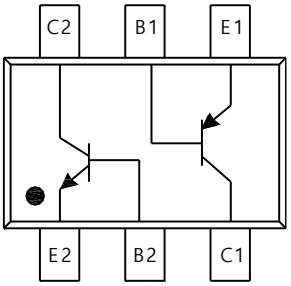
- Complementary Pair: One 3904-Type NPN
  One 3906-Type PNP
- Ultra-Small Surface-Mount Package
- Epitaxial Planar Die Construction
- Ideal for Low Power Amplification and Switching
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **An automotive-compliant part is available under separate datasheet (MMDT3946Q)**

Mechanical Data

- Package: SOT363
- Package Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish — Matte Tin Finish. Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.006 grams (Approximate)

SOT363

Top View



E1, B1, C1 = PNP 3906
E2, B2, C2 = NPN 3904

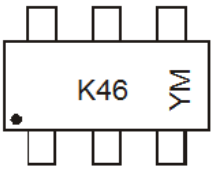
Device Schematic and Pinout
Top View

Ordering Information (Note 4)

Orderable Part Number	Package	Marking	Reel Size (inches)	Tape Width (mm)	Packing	
					Qty	Carrier
MMDT3946-7-F	SOT363	K46	7	8	3,000	Reel
MMDT3946-7R-F	SOT363	K46	7	8	3,000	Reel

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

Marking Information



K46 = Product Type Marking Code
YM = Date Code Marking
Y = Year (ex: M = 2025)
M = Month (ex: 9 = September)

Date Code Key

Year	2003	-	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Code	P	-	M	N	P	R	S	T	U	V	W	X

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	O	N	D

Absolute Maximum Ratings, NPN 3904 (@T_A = +25°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	V
Collector Current	I_C	200	mA

Absolute Maximum Ratings, PNP 3906 (@T_A = +25°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	V
Collector Current	I_C	-200	mA

Thermal Characteristics, Total Device (@T_A = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Power Dissipation (Note 5)	P_D	200	mW
Thermal Resistance, Junction to Ambient Air (Note 5)	$R_{\theta JA}$	625	°C/W
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to +150	°C

Note: 5. For a device mounted on minimum recommended pad layout that is on a single-sided 0.6mm FR-4 PCB; device is measured under still air conditions while operating in a steady state.

ESD Ratings (Note 6)

Characteristic	Symbol	Value	Unit	JEDEC Class
Electrostatic Discharge - Human Body Model	ESD HBM	4,000	V	3A
Electrostatic Discharge - Machine Model	ESD MM	400	V	C
Electrostatic Discharge - Charged Device Model	ESD CDM	1,000	V	C3

Note: 6. Refer to JEDEC specification JESD22-A114, JESD22-A115 and JESD22-C101.

Thermal Characteristics and Derating Information

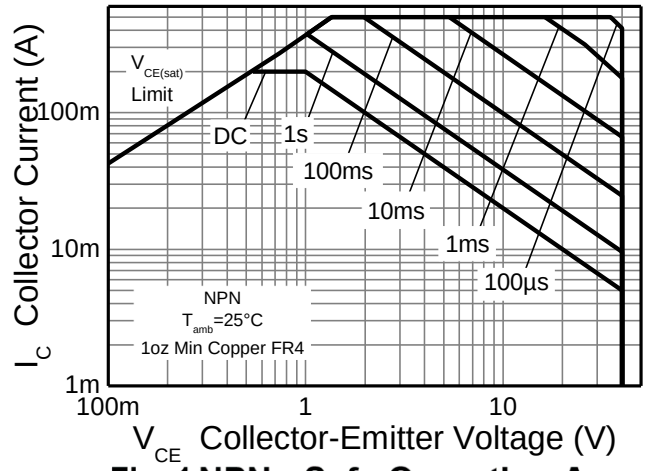


Fig. 1 NPN - Safe Operating Area

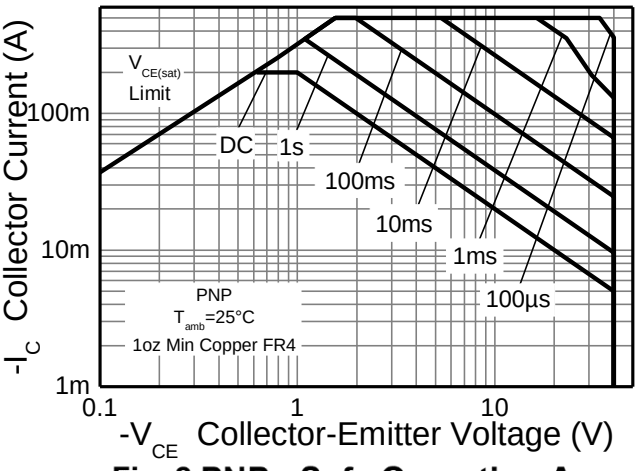


Fig. 2 PNP - Safe Operating Area

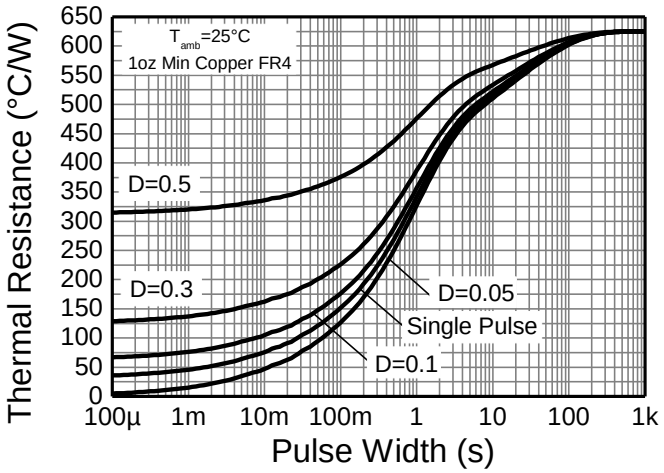


Fig. 3 Transient Thermal Impedance

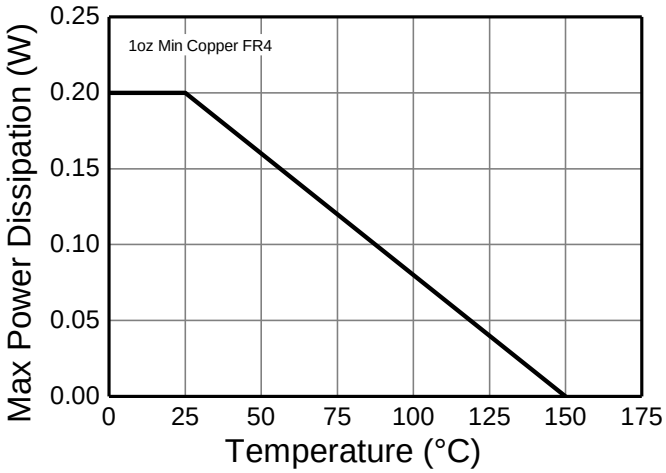


Fig. 4 Derating Curve

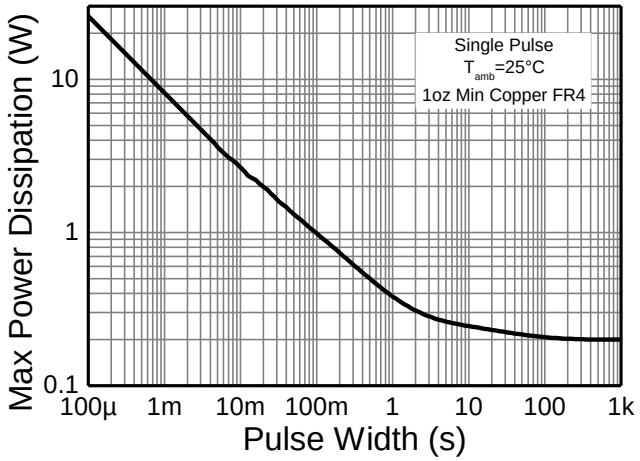


Fig. 5 Pulse Power Dissipation

Electrical Characteristics, NPN 3904 (@T_A = +25°C, unless otherwise specified.)

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 7)					
Collector-Base Breakdown Voltage	BV_{CBO}	60	—	V	I_C = 10μA, I_E = 0
Collector-Emitter Breakdown Voltage	BV_{CEO}	40	—	V	I_C = 1mA, I_B = 0
Emitter-Base Breakdown Voltage	BV_{EBO}	6	—	V	I_E = 10μA, I_C = 0
Collector Cutoff Current	I_{CEX}	—	50	nA	V_{CE} = 30V, $V_{EB(OFF)}$ = 3V
Base Cutoff Current	I_{BL}	—	50	nA	V_{CE} = 30V, $V_{EB(OFF)}$ = 3V
ON CHARACTERISTICS (Note 7)					
Static Forward Current Transfer Ratio	h_{FE}	40 70 100 60 30	— — 300 — —	—	I_C = 100μA, V_{CE} = 1V I_C = 1mA, V_{CE} = 1V I_C = 10mA, V_{CE} = 1V I_C = 50mA, V_{CE} = 1V I_C = 100mA, V_{CE} = 1V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	—	0.20 0.30	V	I_C = 10mA, I_B = 1mA I_C = 50mA, I_B = 5mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	0.65 —	0.85 0.95	V	I_C = 10mA, I_B = 1mA I_C = 50mA, I_B = 5mA
SMALL-SIGNAL CHARACTERISTICS					
Output Capacitance	C_{obo}	—	4.0	pF	V_{CB} = 5V, f = 1MHz, I_E = 0
Input Capacitance	C_{ibo}	—	8.0	pF	V_{EB} = 0.5V, f = 1MHz, I_C = 0
Input Impedance	h_{ie}	1	10	kΩ	V_{CE} = 10V, I_C = 1mA, f = 1kHz
Voltage Feedback Ratio	h_{re}	0.5	8	x 10^{-4}	
Small-Signal Current Gain	h_{fe}	100	400	—	
Output Admittance	h_{oe}	1	40	μS	
Current Gain-Bandwidth Product	f_T	300	—	MHz	V_{CE} = 20V, I_C = 20mA, f = 100MHz
Noise Figure	NF	—	5	dB	V_{CE} = 5V, I_C = 100μA, R_S = 1kΩ, f = 1kHz
SWITCHING CHARACTERISTICS					
Delay Time	t_d	—	35	ns	V_{CC} = 3V, I_C = 10mA, $V_{BE(off)}$ = 0.5V, I_{B1} = 1mA
Rise Time	t_r	—	35	ns	
Storage Time	t_s	—	200	ns	V_{CC} = 3V, I_C = 10mA, I_{B1} = -I_{B2} = 1mA
Fall Time	t_f	—	50	ns	

Note: 7. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

Typical Electrical Characteristics, NPN 3904 (@T_A = +25°C, unless otherwise specified.)

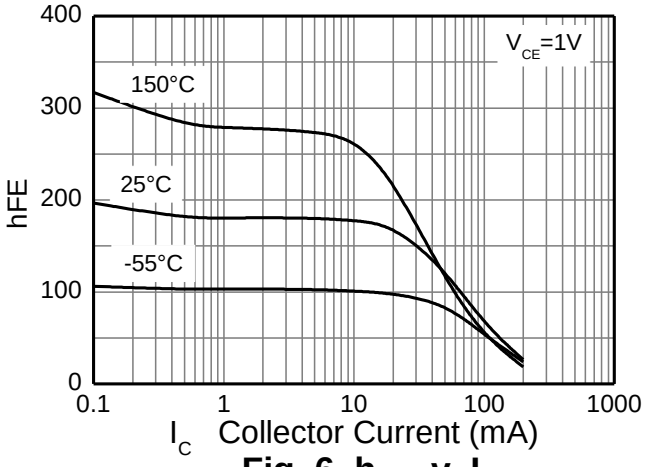


Fig. 6 h_{FE} v I_C

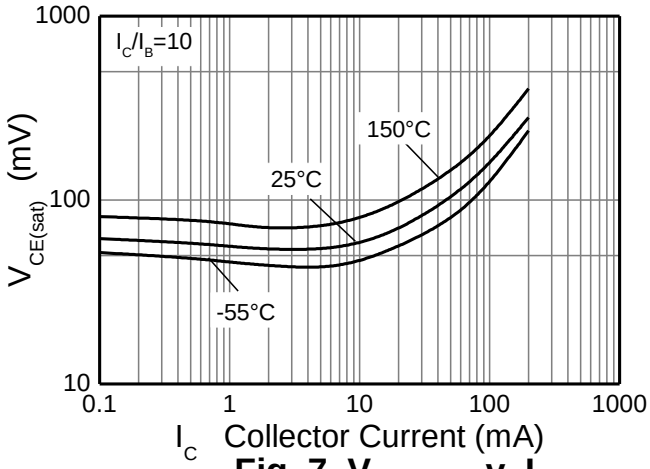


Fig. 7 $V_{CE(sat)}$ v I_C

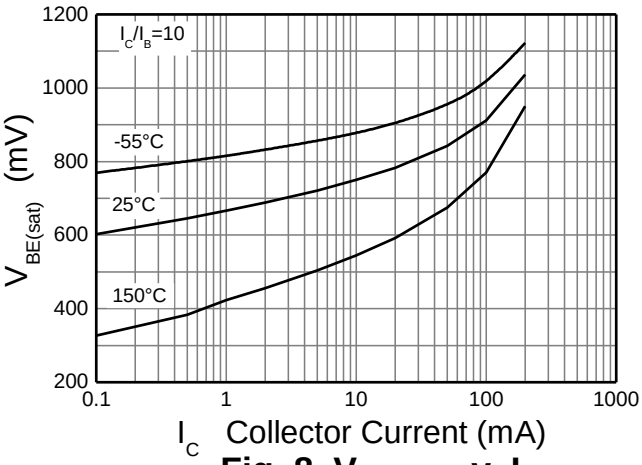


Fig. 8 $V_{BE(sat)}$ v I_C

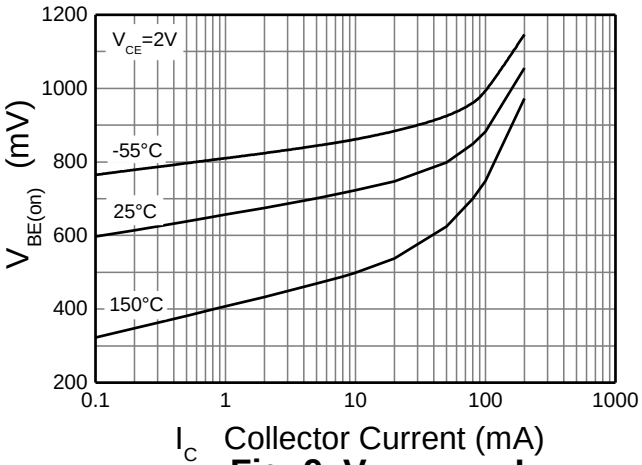


Fig. 9 $V_{BE(on)}$ v I_C

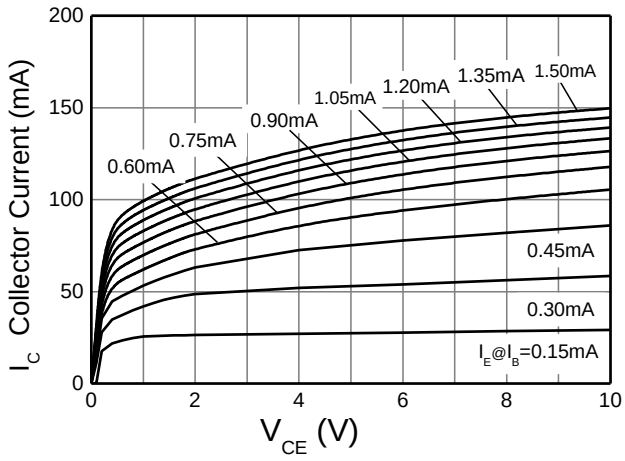


Fig. 10 I_C v V_{CE}

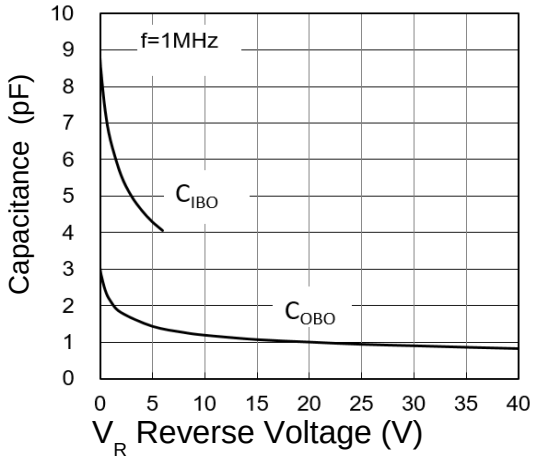


Fig. 11 Capacitance v V_R

Electrical Characteristics, PNP 3906 (@T_A = +25°C, unless otherwise specified.)

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 7)					
Collector-Base Breakdown Voltage	BV_{CBO}	-40	—	V	I_C = -10μA, I_E = 0
Collector-Emitter Breakdown Voltage	BV_{CEO}	-40	—	V	I_C = -1mA, I_B = 0
Emitter-Base Breakdown Voltage	BV_{EBO}	-5	—	V	I_E = -10μA, I_C = 0
Collector Cutoff Current	I_{CEX}	—	-50	nA	V_{CE} = -30V, $V_{EB(OFF)}$ = -3V
Base Cutoff Current	I_{BL}	—	-50	nA	V_{CE} = -30V, $V_{EB(OFF)}$ = -3V
ON CHARACTERISTICS (Note 7)					
Static Forward Current Transfer Ratio	h_{FE}	60 80 100 60 30	— — 300 — —	—	I_C = -100μA, V_{CE} = -1V I_C = -1.0mA, V_{CE} = -1V I_C = -10mA, V_{CE} = -1V I_C = -50mA, V_{CE} = -1V I_C = -100mA, V_{CE} = -1V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	—	-0.25 -0.40	V	I_C = -10mA, I_B = -1mA I_C = -50mA, I_B = -5mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	-0.65 —	-0.85 -0.95	V	I_C = -10mA, I_B = -1mA I_C = -50mA, I_B = -5mA
SMALL-SIGNAL CHARACTERISTICS					
Output Capacitance	C_{obo}	—	4.5	pF	V_{CB} = -5.0V, f = 1MHz, I_E = 0
Input Capacitance	C_{ibo}	—	10	pF	V_{EB} = -0.5V, f = 1MHz, I_C = 0
Input Impedance	h_{ie}	2.0	12	kΩ	V_{CE} = -10V, I_C = -1mA, f = 1kHz
Voltage Feedback Ratio	h_{re}	0.1	10	x 10^{-4}	
Small-Signal Current Gain	h_{fe}	100	400	—	
Output Admittance	h_{oe}	3	60	μS	
Current Gain-Bandwidth Product	f_T	250	—	MHz	V_{CE} = -20V, I_C = -10mA, f = 100MHz
Noise Figure	NF	—	4	dB	V_{CE} = -5V, I_C = -100μA, R_S = 1kΩ, f = 1kHz
SWITCHING CHARACTERISTICS					
Delay Time	t_d	—	35	ns	V_{CC} = -3V, I_C = -10mA, $V_{BE(off)}$ = -0.5V, I_{B1} = -1mA
Rise Time	t_r	—	35	ns	
Storage Time	t_s	—	225	ns	V_{CC} = -3V, I_C = -10mA, I_{B1} = -I_{B2} = -1mA
Fall Time	t_f	—	75	ns	

Note: 7. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

Typical Electrical Characteristics, PNP 3906 (@T_A = +25°C, unless otherwise specified.)

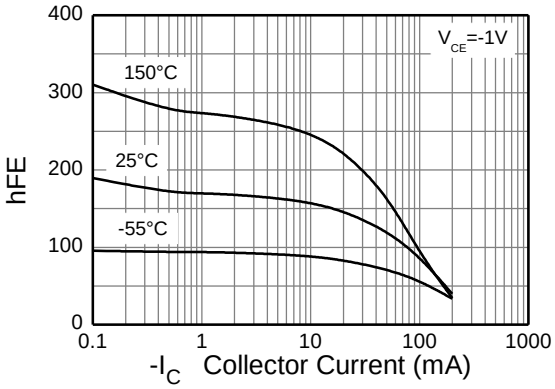


Fig. 12 h_{FE} v I_C

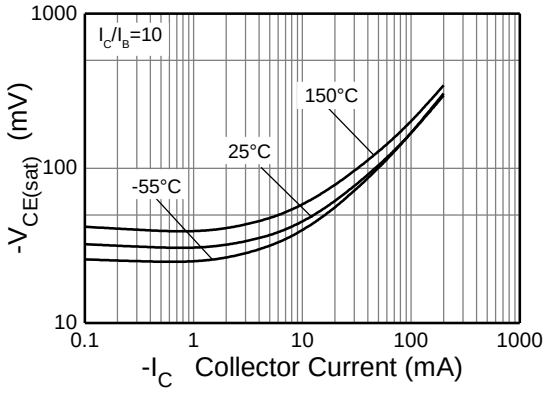


Fig. 13 $V_{CE(sat)}$ v I_C

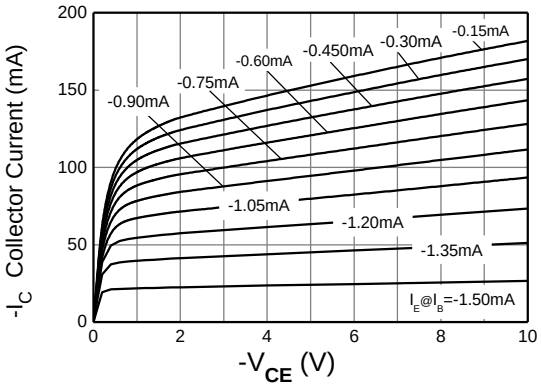


Fig. 14 I_C v V_{CE}

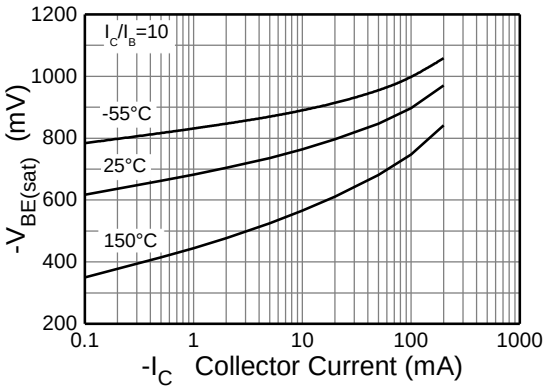


Fig. 15 $V_{BE(sat)}$ v I_C

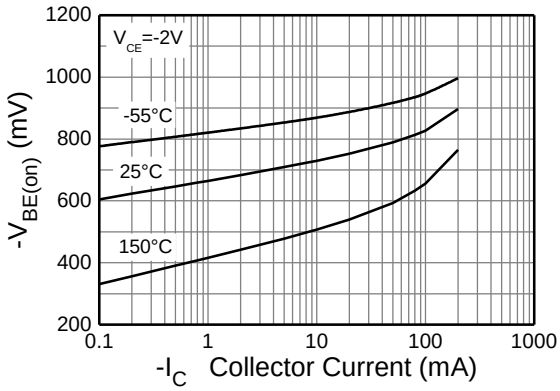


Fig. 16 $V_{BE(on)}$ v I_C

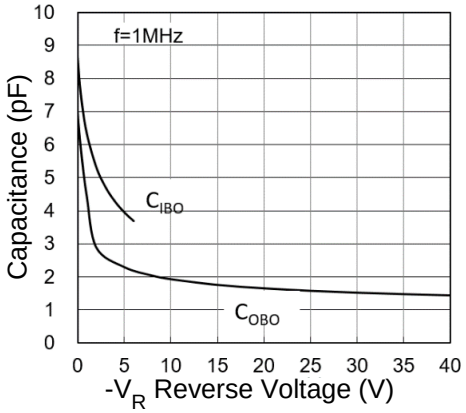
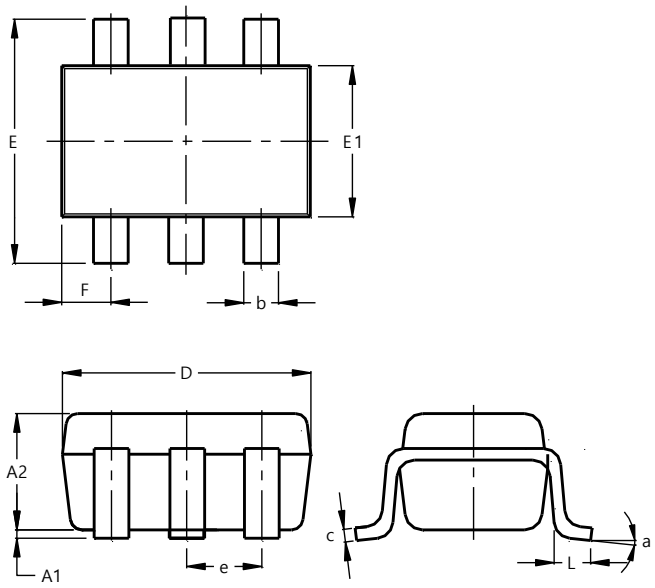


Fig. 17 Capacitance v V_R

Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT363

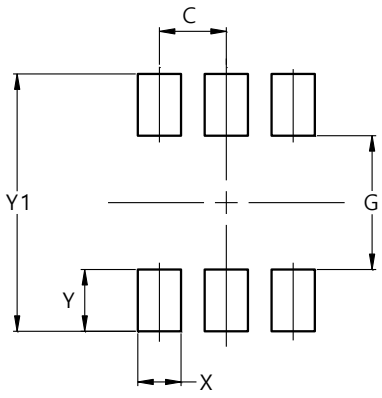


SOT363			
Dim	**Min**	**Max**	**Typ**
A1	0.00	0.10	0.05
A2	0.90	1.00	0.95
b	0.10	0.30	0.25
c	0.10	0.22	0.11
D	1.80	2.20	2.15
E	2.00	2.20	2.10
E1	1.15	1.35	1.30
e	0.650 BSC		
F	0.40	0.45	0.425
L	0.25	0.40	0.30
a	0°	8°	--
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT363



Dimensions	Value (in mm)
C	0.650
G	1.300
X	0.420
Y	0.600
Y1	2.500

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