



**THE DATASHEET OF
MMDT3946-7R-F**



40V COMPLEMENTARY SMALL SIGNAL TRANSISTOR IN SOT363
Features

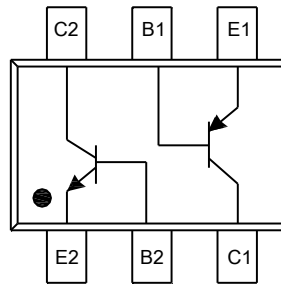
- Complementary Pair: One 3904-Type NPN
One 3906-Type PNP
- Ultra-Small Surface Mount Package
- Epitaxial Planar Die Construction
- Ideal for Low Power Amplification and Switching
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **An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



Top View

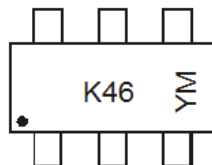

 E1, B1, C1 = PNP 3906
 E2, B2, C2 = NPN 3904

 Device Schematic and Pinout
 Top View

Ordering Information (Note 4)

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: F = 2018)
 M = Month (ex: 9 = September)

Date Code Key

Year	2023	2024	2025	2026	2027	2028	2029	2030				
Code	K	L	M	N	O	P	R	S				
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 (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V_{CB0}	60	V
Collector-Emitter Voltage	V_{CE0}	40	V
Emitter-Base Voltage	V_{EB0}	6	V
Collector Current	I_C	200	mA

Absolute Maximum Ratings, PNP 3906 (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V_{CB0}	-40	V
Collector-Emitter Voltage	V_{CE0}	-40	V
Emitter-Base Voltage	V_{EB0}	-5	V
Collector Current	I_C	-200	mA

Thermal Characteristics, Total Device (@ $T_A = +25^\circ\text{C}$, 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	$^\circ\text{C}/\text{W}$
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to +150	$^\circ\text{C}$

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.

Thermal Characteristics and Derating Information

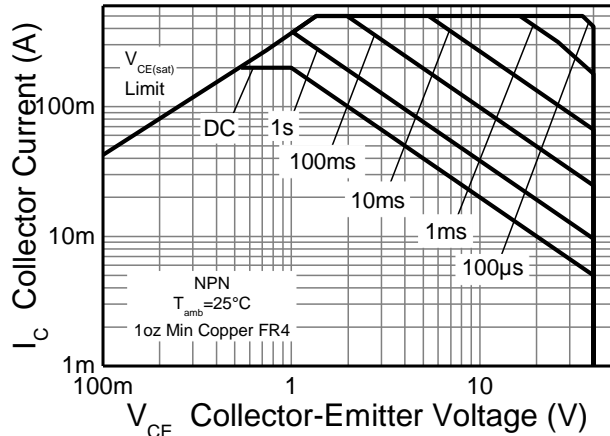


Fig. 1 NPN - Safe Operating Area

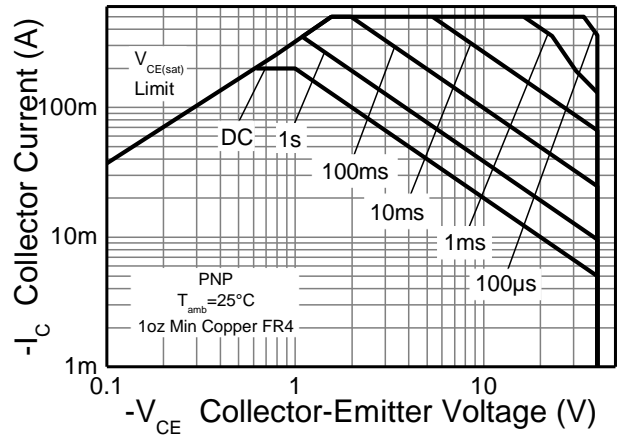


Fig. 2 PNP - Safe Operating Area

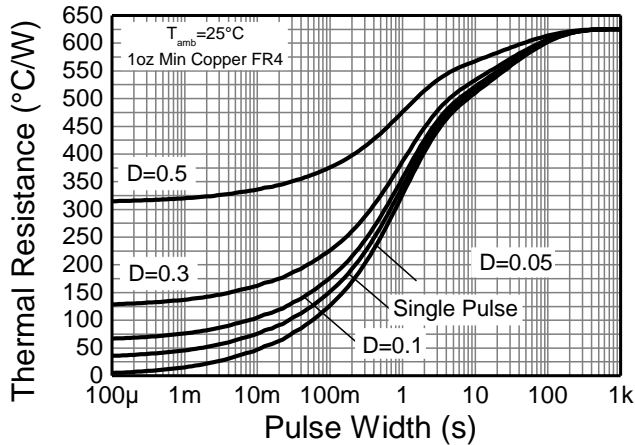


Fig. 3 Transient Thermal Impedance

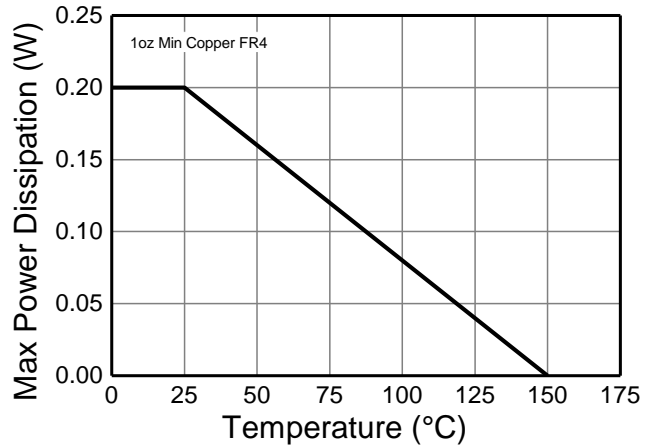


Fig. 4 Derating Curve

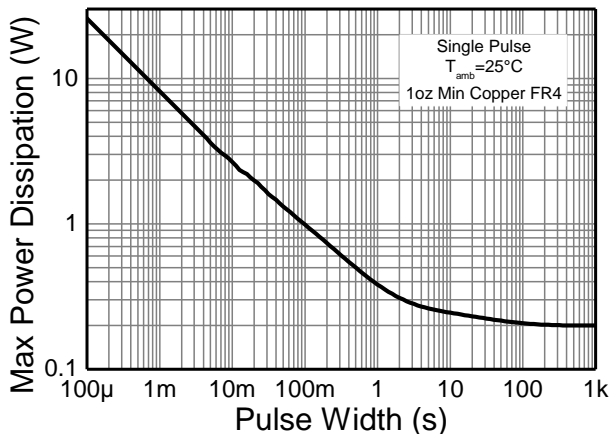


Fig. 5 Pulse Power Dissipation

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

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 6)					
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 6)					
Static Forward Current Transfer Ratio	h _{FE}	40	—	—	I _C = 100μA, V _{CE} = 1V
		70	—		
		100	300		
		60	—		
		30	—		
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,
Rise Time	t _r	—	35	ns	V _{BE(off)} = 0.5V, I _{B1} = 1mA
Storage Time	t _s	—	200	ns	V _{CC} = 3V, I _C = 10mA,
Fall Time	t _f	—	50	ns	I _{B1} = -I _{B2} = 1mA

Note: 6. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

Typical Electrical Characteristics, NPN 3904 (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

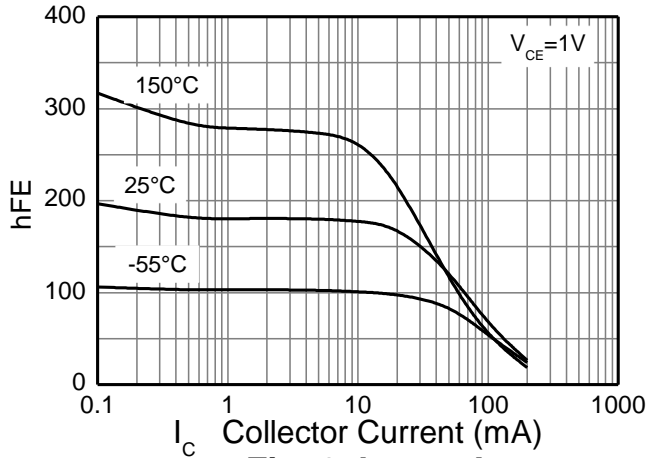


Fig. 6 $h_{FE} \ v \ I_C$

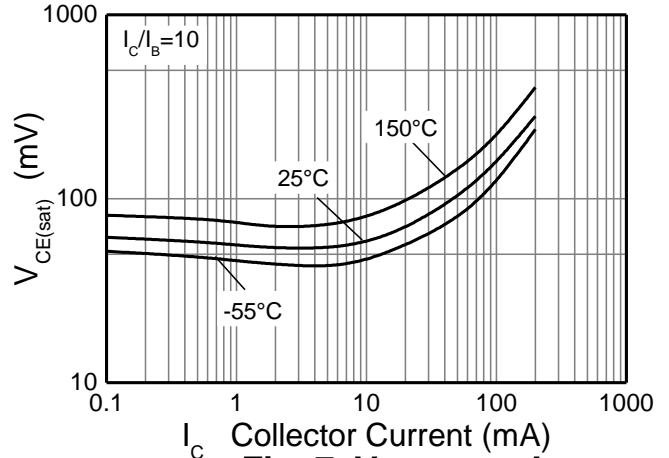


Fig. 7 $V_{CE(sat)} \ v \ I_C$

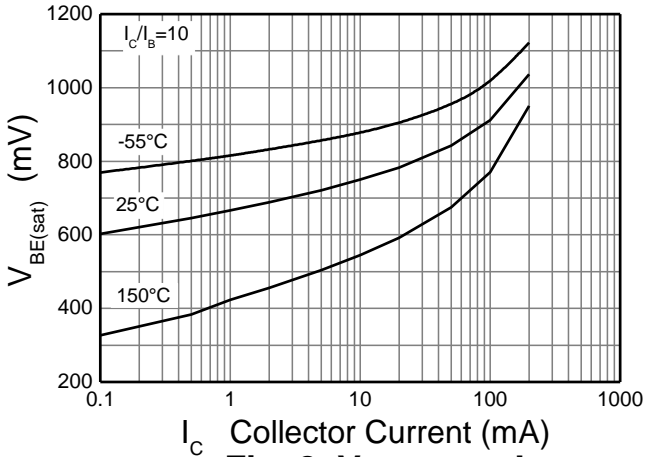


Fig. 8 $V_{BE(sat)} \ v \ I_C$

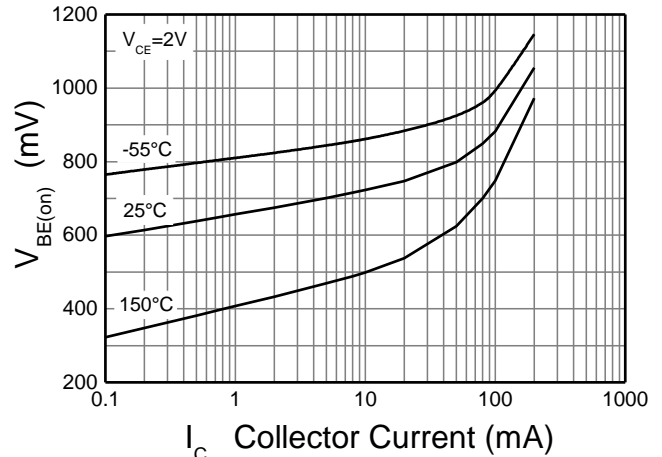


Fig. 9 $V_{BE(on)} \ v \ I_C$

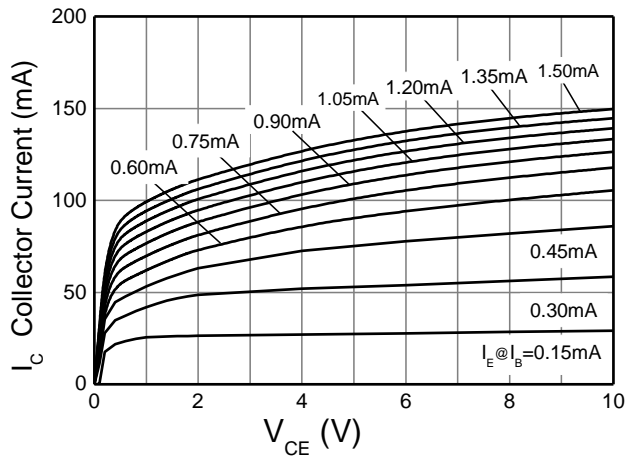


Fig. 10 $I_C \ v \ V_{CE}$

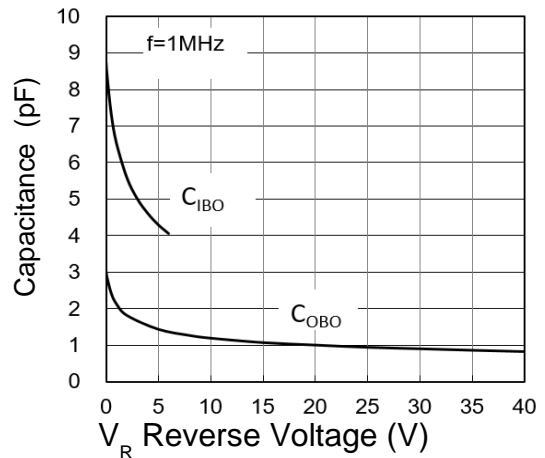


Fig. 11 Capacitance $v \ V_R$

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

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 6)					
Collector-Base Breakdown Voltage	BV _{CB0}	-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 6)					
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	V _{CC} = -3V, I _C = -10mA, I _{B1} = -I _{B2} = -1mA
Storage Time	t _s	—	225	ns	
Fall Time	t _f	—	75	ns	

Note: 6. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

Typical Electrical Characteristics, PNP 3906 (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

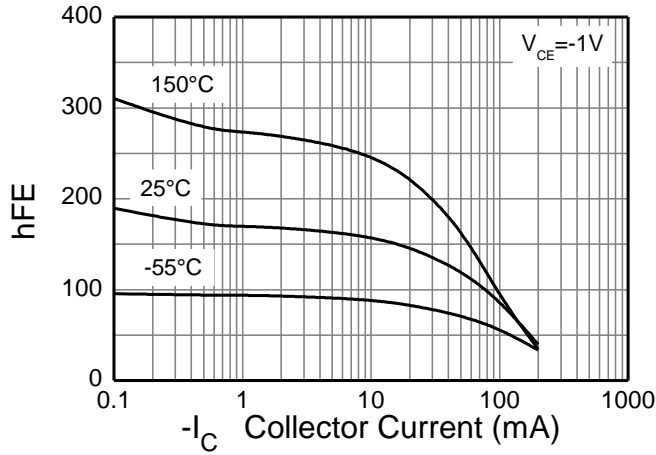


Fig. 12 $h_{FE} \ v \ I_C$

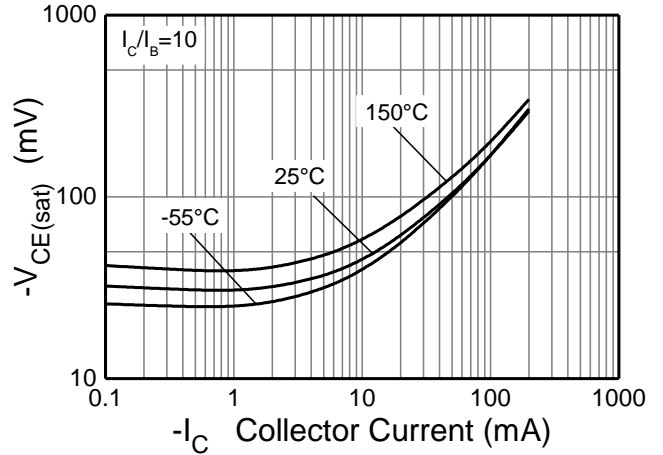


Fig. 13 $V_{CE(sat)} \ v \ I_C$

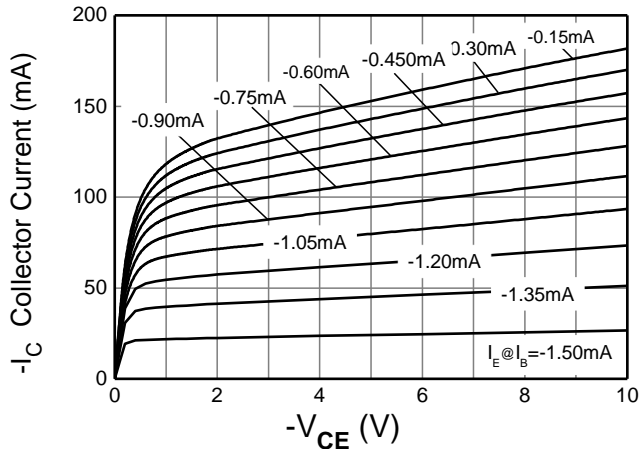


Fig. 14 $I_C \ v \ V_{CE}$

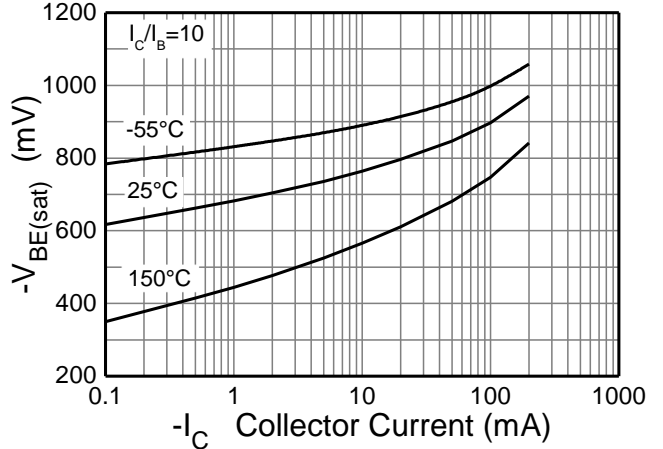


Fig. 15 $V_{BE(sat)} \ v \ I_C$

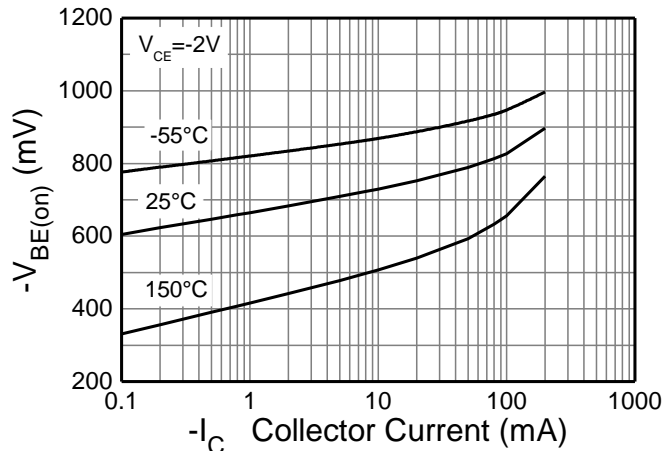


Fig. 16 $V_{BE(on)} \ v \ I_C$

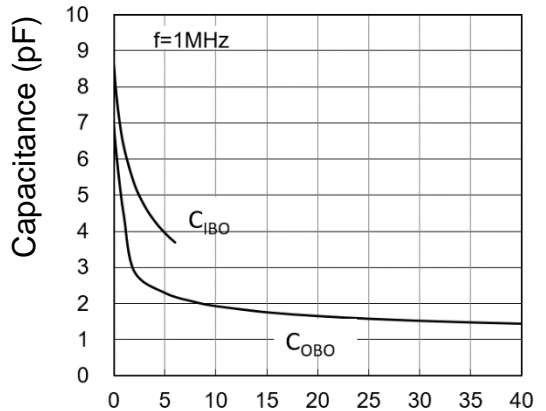
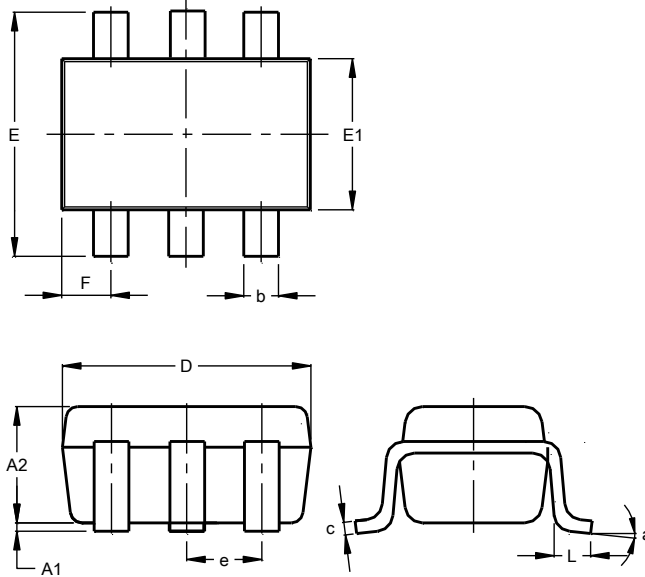


Fig. 17 Capacitance $v \ V_R$

Package Outline Dimensions

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

SOT363

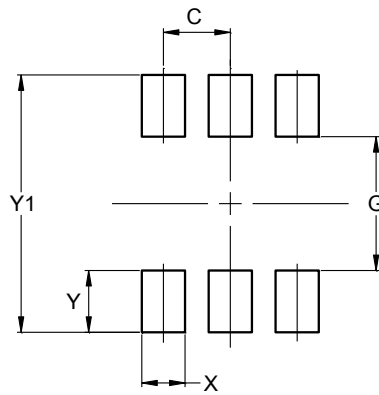


SOT363			
Dim	Min	Max	Typ
A1	0.00	0.10	0.05
A2	0.90	1.00	0.95
b	0.10	0.30	0.25
c	0.10	0.22	0.11
D	1.80	2.20	2.15
E	2.00	2.20	2.10
E1	1.15	1.35	1.30
e	0.650 BSC		
F	0.40	0.45	0.425
L	0.25	0.40	0.30
a	0°	8°	--
All Dimensions in mm			

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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