

40V COMPLEMENTARY NPN-PNP SMALL SIGNAL TRANSISTOR IN SOT363

Features

- $BV_{CEO} > 40V$
- $I_C = 200mA$ High Collector Current
- Ultra-Small Surface Mount Package
- Ideal for Low Power Amplification and Switching
- **Totally Lead-Free & Fully RoHS compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The MMDT3946Q is suitable for automotive applications requiring specific change control; this part is AEC-Q101 qualified, PPAP capable, and manufactured in IATF16949 certified facilities.**

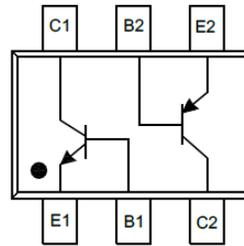
<https://www.diodes.com/quality/product-definitions/>

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 208③
- Weight: 0.006 grams (Approximate)



Top View



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

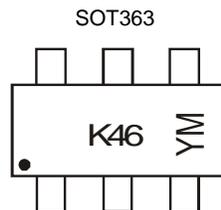
Device Schematic and Pinout Top View

Ordering Information (Note 4)

Product	Compliance	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
MMDT3946Q-7R	Automotive	K46	7	8	3,000

- 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 or \bar{Y} = Year (ex: I = 2021)
M or \bar{M} = Month (ex: 9 = September)

Date Code Key

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Code	I	J	K	L	M	N	O	P	R	S	T	U

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 (@ $T_A = +25^\circ\text{C}$ unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V_{CB0}	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 (@ $T_A = +25^\circ\text{C}$ unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V_{CB0}	-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 (@ $T_A = +25^\circ\text{C}$ 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 with 1oz copper that is on a single-sided 1.6mm FR4 PCB; the device is measured under still air conditions whilst operating in a steady-state.

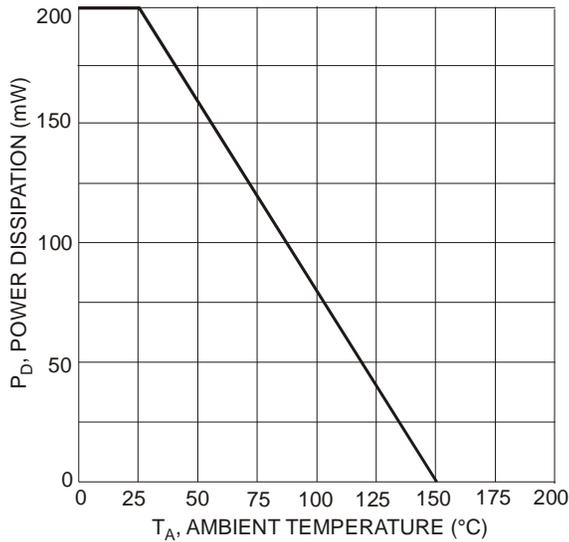


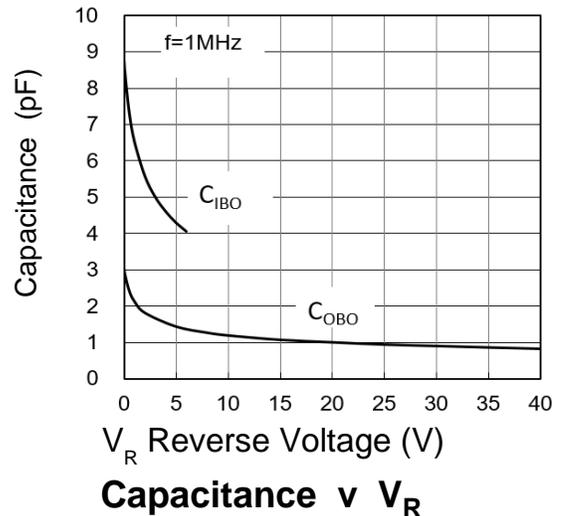
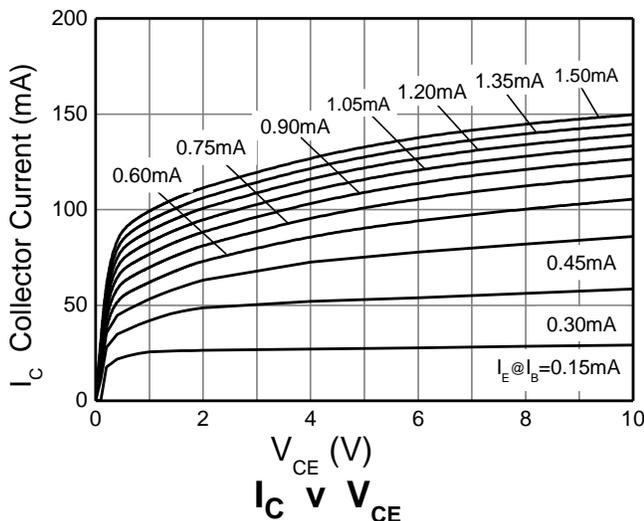
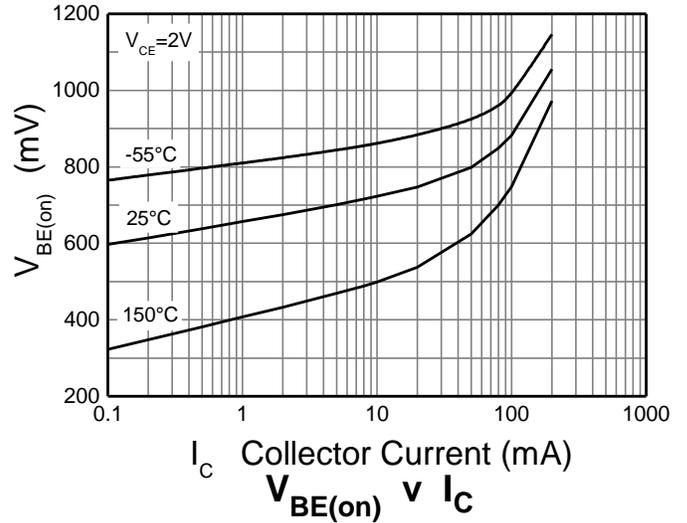
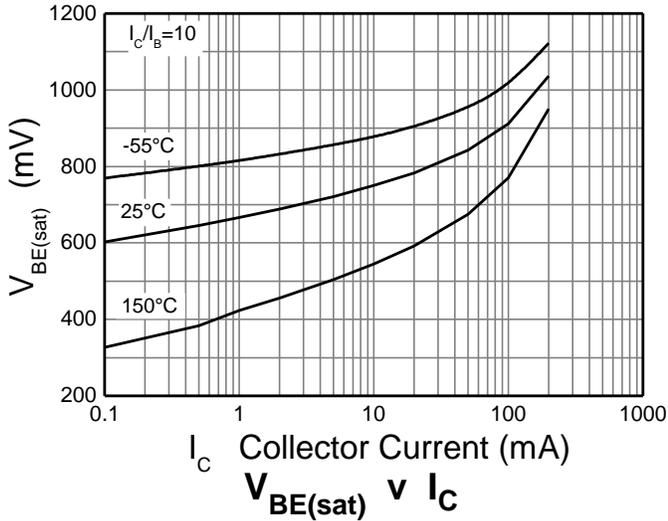
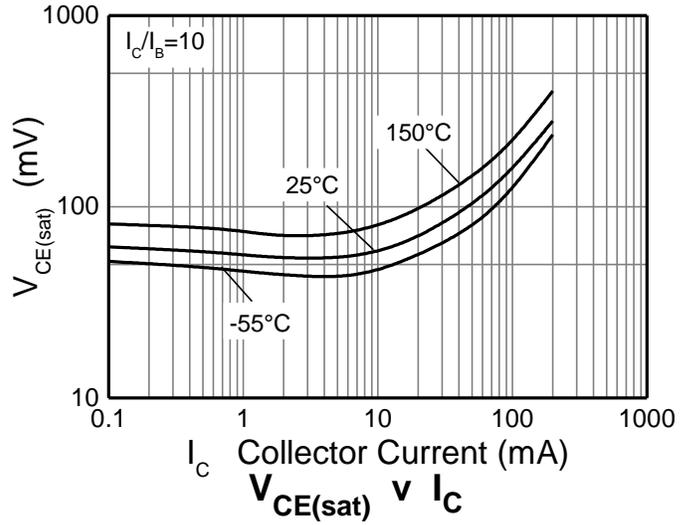
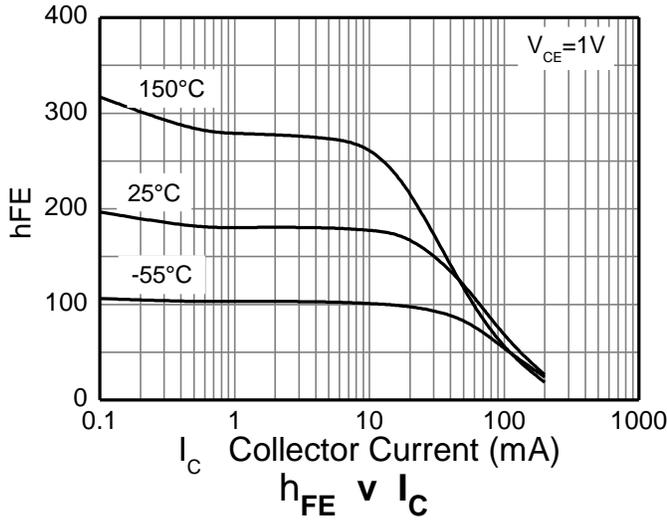
Fig. 1, Power Dissipation vs. Ambient Temperature (Total Device)

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

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 6)					
Collector-Base Breakdown Voltage	BV_{CBO}	60	—	V	$I_C = 10\mu\text{A}, I_E = 0$
Collector-Emitter Breakdown Voltage	BV_{CEO}	40	—	V	$I_C = 1\text{mA}, I_B = 0$
Emitter-Base Breakdown Voltage	BV_{EBO}	6	—	V	$I_E = 10\mu\text{A}, I_C = 0$
Collector Cutoff Current	I_{CEX}	—	50	nA	$V_{CE} = 30\text{V}, V_{EB(OFF)} = 3\text{V}$
Base Cutoff Current	I_{BL}	—	50	nA	$V_{CE} = 30\text{V}, V_{EB(OFF)} = 3\text{V}$
ON CHARACTERISTICS (Note 6)					
Static Forward Current Transfer Ratio	h_{FE}	40 70 100 60 30	— — 300 — —	—	$I_C = 100\mu\text{A}, V_{CE} = 1\text{V}$ $I_C = 1\text{mA}, V_{CE} = 1\text{V}$ $I_C = 10\text{mA}, V_{CE} = 1\text{V}$ $I_C = 50\text{mA}, V_{CE} = 1\text{V}$ $I_C = 100\text{mA}, V_{CE} = 1\text{V}$
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	—	0.20 0.30	V	$I_C = 10\text{mA}, I_B = 1\text{mA}$ $I_C = 50\text{mA}, I_B = 5\text{mA}$
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	0.65 —	0.85 0.95	V	$I_C = 10\text{mA}, I_B = 1\text{mA}$ $I_C = 50\text{mA}, I_B = 5\text{mA}$
SMALL SIGNAL CHARACTERISTICS					
Output Capacitance	C_{obo}	—	4	pF	$V_{CB} = 5\text{V}, f = 1\text{MHz}, I_E = 0$
Input Capacitance	C_{ibo}	—	8	pF	$V_{EB} = 0.5\text{V}, f = 1\text{MHz}, I_C = 0$
Input Impedance	h_{ie}	1	10	k Ω	$V_{CE} = 10\text{V}, I_C = 1\text{mA},$ $f = 1\text{kHz}$
Voltage Feedback Ratio	h_{re}	0.5	8	$\times 10^{-4}$	
Small Signal Current Gain	h_{fe}	100	400	—	
Output Admittance	h_{oe}	1	40	μS	
Current Gain-Bandwidth Product	f_T	300	—	MHz	$V_{CE} = 20\text{V}, I_C = 20\text{mA},$ $f = 100\text{MHz}$
Noise Figure	NF	—	5.0	dB	$V_{CE} = 5\text{V}, I_C = 100\mu\text{A},$ $R_S = 1\text{k}\Omega, f = 1\text{kHz}$
SWITCHING CHARACTERISTICS					
Delay Time	t_d	—	35	ns	$V_{CC} = 3\text{V}, I_C = 10\text{mA},$
Rise Time	t_r	—	35	ns	$V_{BE(off)} = 0.5\text{V}, I_{B1} = 1\text{mA}$
Storage Time	t_s	—	200	ns	$V_{CC} = 3\text{V}, I_C = 10\text{mA},$ $I_{B1} = -I_{B2} = 1\text{mA}$
Fall Time	t_f	—	50	ns	

Note: 6. Measured under pulsed conditions. Pulse width $\leq 300\mu\text{s}$. Duty cycle $\leq 2\%$

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

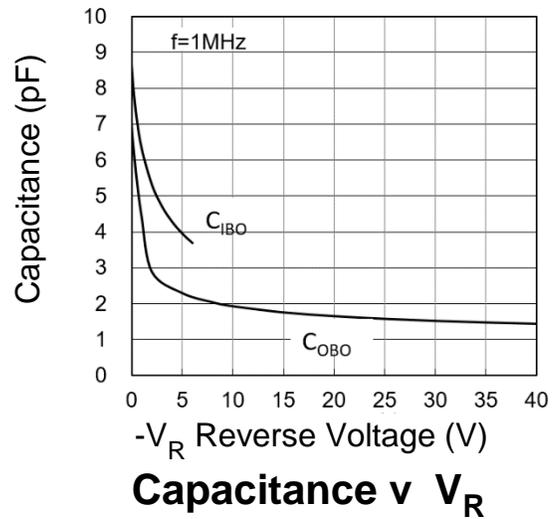
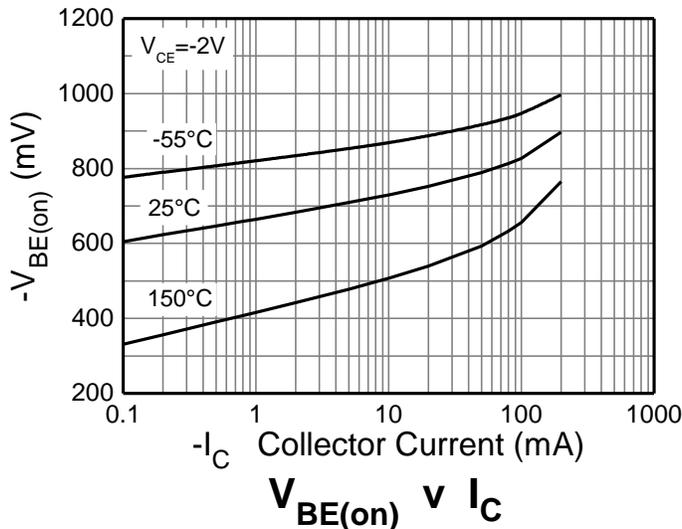
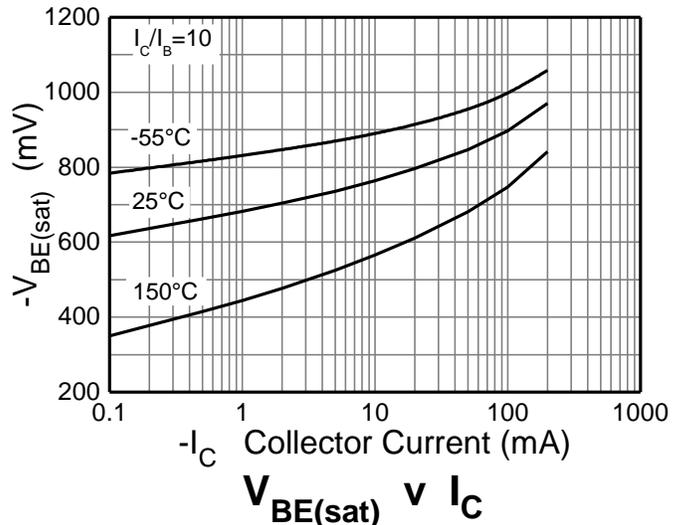
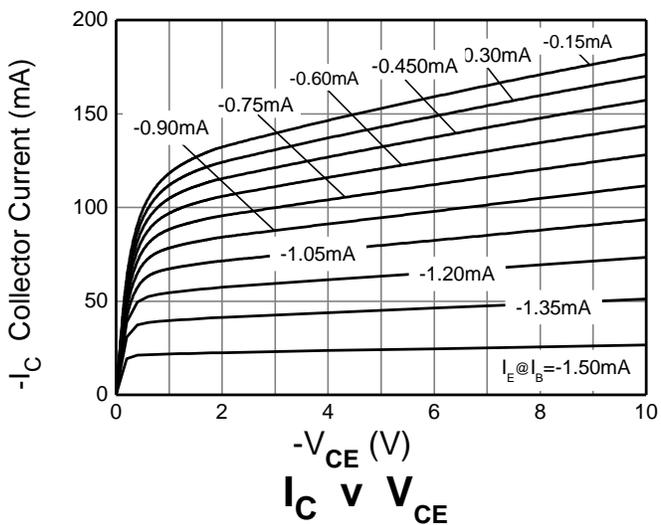
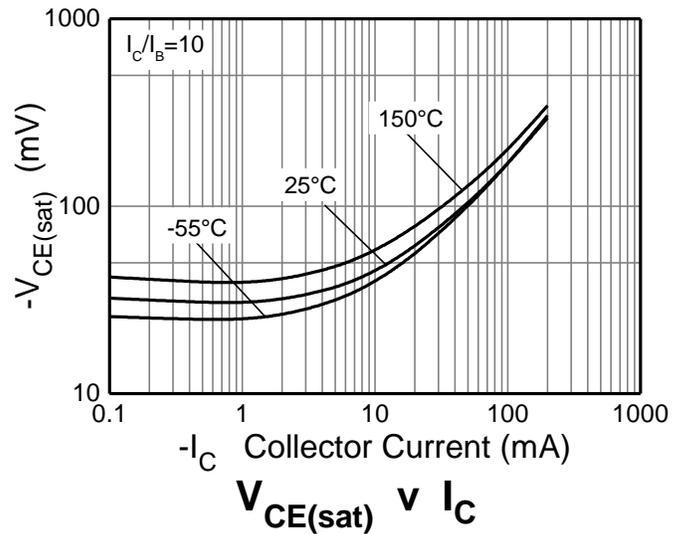
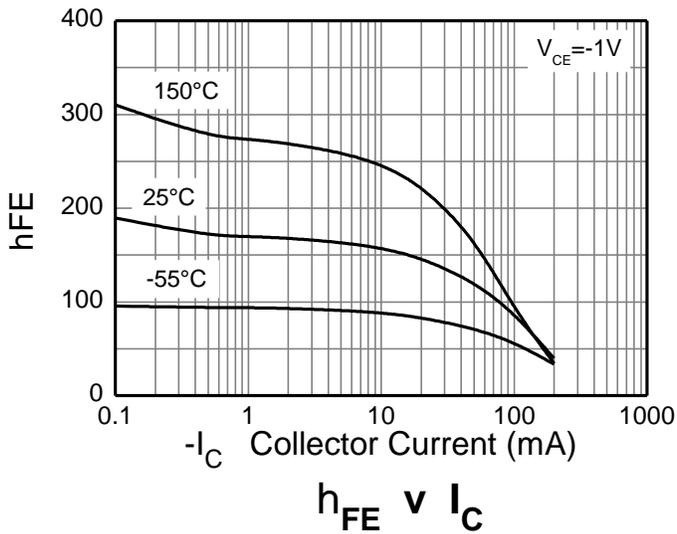


Electrical Characteristics, PNP (@ $T_A = +25^\circ\text{C}$ unless otherwise specified.)

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 6)					
Collector-Base Breakdown Voltage	BV_{CBO}	-40	—	V	$I_C = -10\mu\text{A}, I_E = 0$
Collector-Emitter Breakdown Voltage	BV_{CEO}	-40	—	V	$I_C = -1\text{mA}, I_B = 0$
Emitter-Base Breakdown Voltage	BV_{EBO}	-5	—	V	$I_E = -10\mu\text{A}, I_C = 0$
Collector Cutoff Current	I_{CEX}	—	-50	nA	$V_{CE} = -30\text{V}, V_{EB(OFF)} = -3\text{V}$
Base Cutoff Current	I_{BL}	—	-50	nA	$V_{CE} = -30\text{V}, V_{EB(OFF)} = -3\text{V}$
ON CHARACTERISTICS (Note 6)					
Static Forward Current Transfer Ratio	h_{FE}	60 80 100 60 30	— — 300 — —	—	$I_C = -100\mu\text{A}, V_{CE} = -1\text{V}$ $I_C = -1\text{mA}, V_{CE} = -1\text{V}$ $I_C = -10\text{mA}, V_{CE} = -1\text{V}$ $I_C = -50\text{mA}, V_{CE} = -1\text{V}$ $I_C = -100\text{mA}, V_{CE} = -1\text{V}$
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	—	-0.25 -0.40	V	$I_C = -10\text{mA}, I_B = -1\text{mA}$ $I_C = -50\text{mA}, I_B = -5\text{mA}$
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	-0.65 —	-0.85 -0.95	V	$I_C = -10\text{mA}, I_B = -1\text{mA}$ $I_C = -50\text{mA}, I_B = -5\text{mA}$
SMALL SIGNAL CHARACTERISTICS					
Output Capacitance	C_{obo}	—	4.5	pF	$V_{CB} = -5\text{V}, f = 1\text{MHz}, I_E = 0$
Input Capacitance	C_{ibo}	—	10	pF	$V_{EB} = -0.5\text{V}, f = 1\text{MHz}, I_C = 0$
Input Impedance	h_{ie}	2	12	k Ω	$V_{CE} = -10\text{V}, I_C = -1\text{mA},$ $f = 1\text{kHz}$
Voltage Feedback Ratio	h_{re}	0.1	10	$\times 10^{-4}$	
Small Signal Current Gain	h_{fe}	100	400	—	
Output Admittance	h_{oe}	3	60	μS	
Current Gain-Bandwidth Product	f_T	250	—	MHz	
Noise Figure	NF	—	4	dB	$V_{CE} = -5\text{V}, I_C = -100\mu\text{A},$ $R_S = 1\text{k}\Omega, f = 1\text{kHz}$
SWITCHING CHARACTERISTICS					
Delay Time	t_d	—	35	ns	$V_{CC} = -3\text{V}, I_C = -10\text{mA},$
Rise Time	t_r	—	35	ns	$V_{BE(off)} = -0.5\text{V}, I_{B1} = -1\text{mA}$
Storage Time	t_s	—	225	ns	$V_{CC} = -3\text{V}, I_C = -10\text{mA},$ $I_{B1} = -I_{B2} = -1\text{mA}$
Fall Time	t_f	—	75	ns	

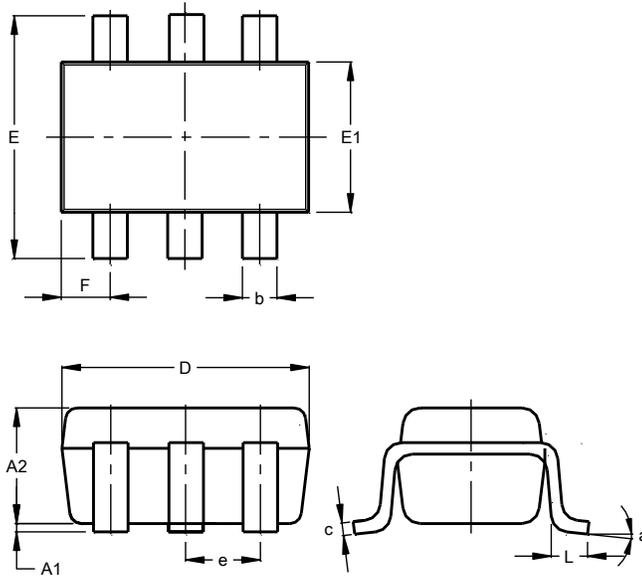
Note: 6. Measured under pulsed conditions. Pulse width $\leq 300\mu\text{s}$. Duty cycle $\leq 2\%$

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



Package Outline Dimensions

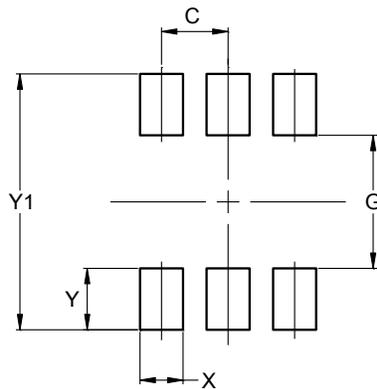
Please see <http://www.diodes.com/package-outlines.html> for the latest version.



SOT363			
Dim	Min	Max	Typ
A1	0.00	0.10	0.05
A2	0.90	1.00	1.00
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.



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

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