

**COMPLEMENTARY PAIR SMALL SIGNAL TRANSISTOR IN SOT363**

**Features**

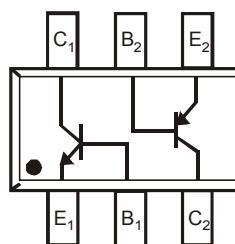
- Epitaxial Die Construction
- Two Internally Isolated NPN/PNP Transistors in One Package  
NPN = 4401  
PNP = 4403
- Ideal for Medium Power Amplification and Switching
- Ultra-Small Surface Mount Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**

**Mechanical Data**

- Case: SOT363
- 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 Finish. Solderable per MIL-STD-202, Method 208 **Ⓔ3**
- Weight: 0.006 grams (approximate)



Top View



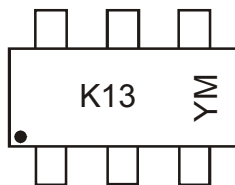
Device Schematic  
Top View

**Ordering Information** (Note 4)

Part Number	Marking	Reel Size (inches)	Tape Width (mm)	Quantity per Reel
MMDT4413-7-F	K13	7	8	3,000

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) 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 <http://www.diodes.com/products/packages.html>.

**Marking Information**



K13= Product Type Marking Code  
YM = Date Code Marking  
Y = Year (ex: A = 2013)  
M = Month (ex: 9 = September)

Date Code Key

Year	2010	2011	2012	2013	2014	2015	2016	2017
Code	X	Y	Z	A	B	C	D	E

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, 4401 Type (Q<sub>1</sub>)** (@T<sub>A</sub> = +25°C unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V <sub>CB0</sub>	60	V
Collector-Emitter Voltage	V <sub>CE0</sub>	40	V
Emitter-Base Voltage	V <sub>EB0</sub>	6	V
Collector Current	I <sub>C</sub>	600	mA

**Absolute Maximum Ratings: PNP, 4403 Type (Q<sub>2</sub>)** (@T<sub>A</sub> = +25°C unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V <sub>CB0</sub>	-40	V
Collector-Emitter Voltage	V <sub>CE0</sub>	-40	V
Emitter-Base Voltage	V <sub>EB0</sub>	-5	V
Collector Current	I <sub>C</sub>	-600	mA

**Thermal Characteristics – Total Device** (@T<sub>A</sub> = +25°C unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Power Dissipation (Note 5) Total Device	P <sub>D</sub>	200	mW
Thermal Resistance, Junction to Ambient (Note 5)	R <sub>θJA</sub>	625	°C/W
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-65 to +150	°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.

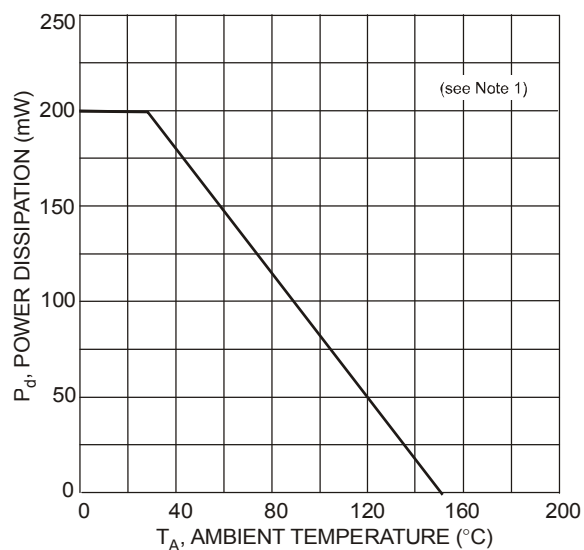
**Thermal Characteristics – Total Device**


Fig. 1, Power Derating Curve (Total Device)

**Electrical Characteristics, NPN 4401 Section** (@ $T_A = +25^\circ\text{C}$  unless otherwise specified.)

Characteristic	Symbol	Min	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS (Note 6)</b>					
Collector-Base Breakdown Voltage	$BV_{CBO}$	60	—	V	$I_C = 100\mu\text{A}, I_E = 0$
Collector-Emitter Breakdown Voltage	$BV_{CEO}$	40	—	V	$I_C = 1.0\text{mA}, I_B = 0$
Emitter-Base Breakdown Voltage	$BV_{EBO}$	6.0	—	V	$I_E = 100\mu\text{A}, I_C = 0$
Collector Cutoff Current	$I_{CEX}$	—	100	nA	$V_{CE} = 35\text{V}, V_{EB(OFF)} = 0.4\text{V}$
Base Cutoff Current	$I_{BL}$	—	100	nA	$V_{CE} = 35\text{V}, V_{EB(OFF)} = 0.4\text{V}$
<b>ON CHARACTERISTICS (Note 6)</b>					
DC Current Gain	$h_{FE}$	20	—	—	$I_C = 100\mu\text{A}, V_{CE} = 1.0\text{V}$ $I_C = 1.0\text{mA}, V_{CE} = 1.0\text{V}$ $I_C = 10\text{mA}, V_{CE} = 1.0\text{V}$ $I_C = 150\text{mA}, V_{CE} = 1.0\text{V}$ $I_C = 500\text{mA}, V_{CE} = 2.0\text{V}$
		40	—		
		80	—		
		100	300		
		40	—		
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	—	0.40 0.75	V	$I_C = 150\text{mA}, I_B = 15\text{mA}$ $I_C = 500\text{mA}, I_B = 50\text{mA}$
Base-Emitter Saturation Voltage	$V_{BE(SAT)}$	0.75 —	0.95 1.2	V	$I_C = 150\text{mA}, I_B = 15\text{mA}$ $I_C = 500\text{mA}, I_B = 50\text{mA}$
<b>SMALL SIGNAL CHARACTERISTICS</b>					
Output Capacitance	$C_{cb}$	—	6.5	pF	$V_{CB} = 5.0\text{V}, f = 1.0\text{MHz}, I_E = 0$
Input Capacitance	$C_{eb}$	—	30	pF	$V_{EB} = 0.5\text{V}, f = 1.0\text{MHz}, I_C = 0$
Input Impedance	$h_{ie}$	1.0	15	$k\Omega$	$V_{CE} = 10\text{V}, I_C = 1.0\text{mA}, f = 1.0\text{kHz}$
Voltage Feedback Ratio	$h_{re}$	0.1	8.0	$\times 10^{-4}$	
Small Signal Current Gain	$h_{fe}$	40	500	—	
Output Admittance	$h_{oe}$	1.0	30	$\mu\text{S}$	
Current Gain-Bandwidth Product	$f_T$	250	—	MHz	$V_{CE} = 10\text{V}, I_C = 20\text{mA}, f = 100\text{MHz}$
<b>SWITCHING CHARACTERISTICS</b>					
Delay Time	$t_d$	—	15	ns	$V_{CC} = 30\text{V}, I_C = 150\text{mA}, V_{BE(off)} = 2.0\text{V}, I_{B1} = 15\text{mA}$
Rise Time	$t_r$	—	20	ns	
Storage Time	$t_s$	—	225	ns	$V_{CC} = 30\text{V}, I_C = 150\text{mA}, I_{B1} = I_{B2} = 15\text{mA}$
Fall Time	$t_f$	—	30	ns	

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

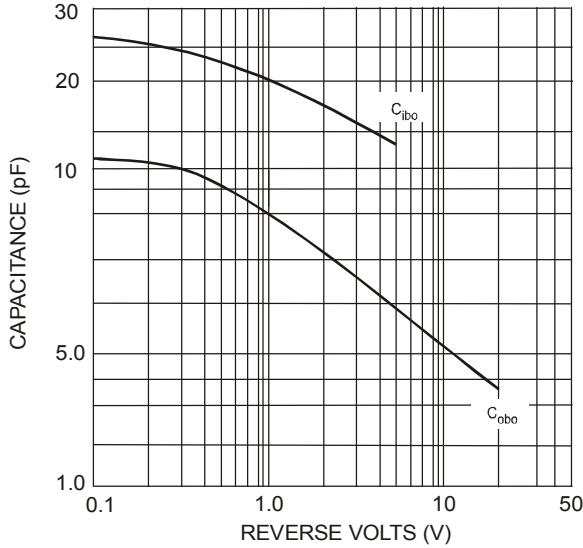


Fig. 1 Typical Capacitance (4401)

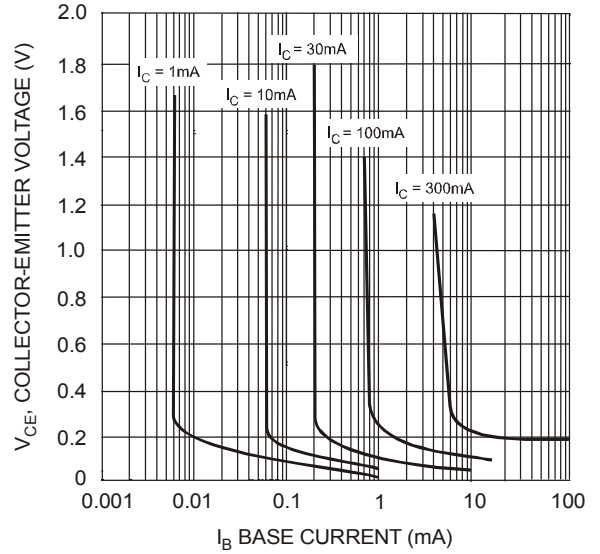


Fig. 2 Typical Collector Saturation Region (4401)

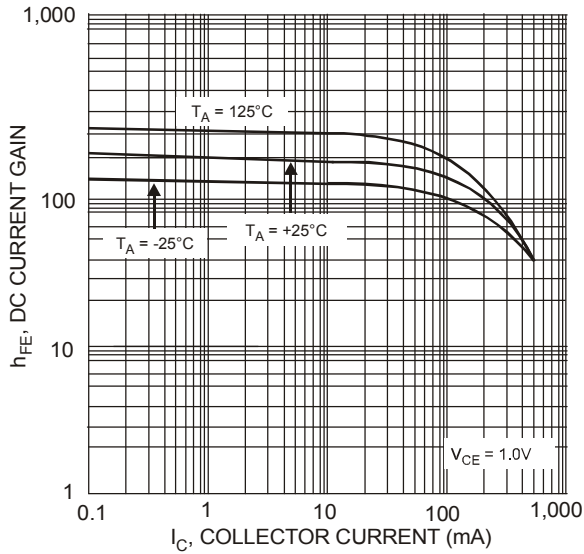


Fig. 3 Typical DC Current Gain vs. Collector Current (4401)

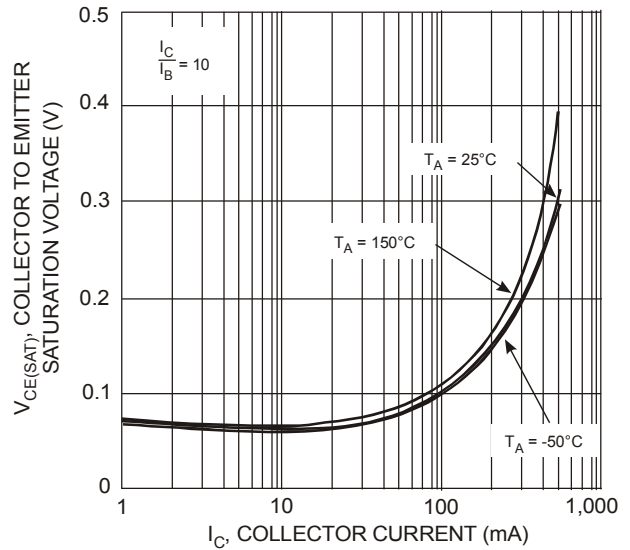


Fig. 4 Collector Emitter Saturation Voltage vs. Collector Current (4401)

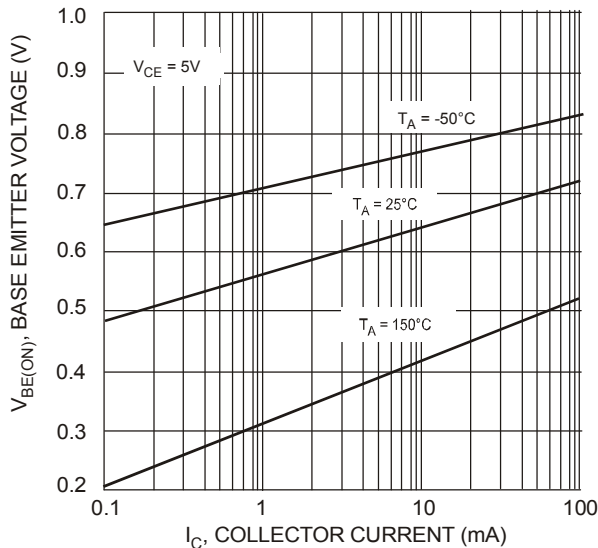


Fig. 5 Base Emitter Voltage vs. Collector Current (4401)

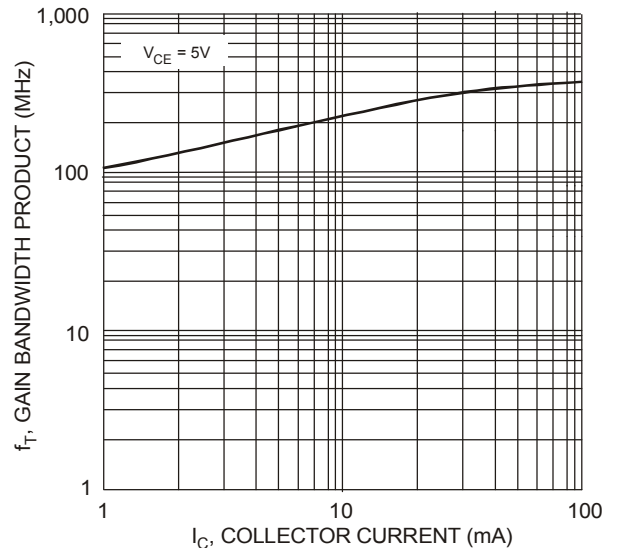


Fig. 6 Gain Bandwidth Product vs. Collector Current (4401)

**Electrical Characteristics, PNP 4403 Section** (@T<sub>A</sub> = +25°C unless otherwise specified.)

Characteristic	Symbol	Min	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS (Note 6)</b>					
Collector-Base Breakdown Voltage	BV <sub>CB0</sub>	-40	—	V	I <sub>C</sub> = -100μA, I <sub>E</sub> = 0
Collector-Emitter Breakdown Voltage	BV <sub>CEO</sub>	-40	—	V	I <sub>C</sub> = -1.0mA, I <sub>B</sub> = 0
Emitter-Base Breakdown Voltage	BV <sub>EBO</sub>	-5.0	—	V	I <sub>E</sub> = -100μA, I <sub>C</sub> = 0
Collector Cutoff Current	I <sub>CEx</sub>	—	-100	nA	V <sub>CE</sub> = -35V, V <sub>EB(OFF)</sub> = -0.4V
Base Cutoff Current	I <sub>BL</sub>	—	-100	nA	V <sub>CE</sub> = -35V, V <sub>EB(OFF)</sub> = -0.4V
<b>ON CHARACTERISTICS (Note 6)</b>					
DC Current Gain	h <sub>FE</sub>	30	—	—	I <sub>C</sub> = -100μA, V <sub>CE</sub> = -1.0V
		60	—		I <sub>C</sub> = -1.0mA, V <sub>CE</sub> = -1.0V
		100	—		I <sub>C</sub> = -10mA, V <sub>CE</sub> = -1.0V
		100	300		I <sub>C</sub> = -150mA, V <sub>CE</sub> = -2.0V
		20	—		I <sub>C</sub> = -500mA, V <sub>CE</sub> = -2.0V
Collector-Emitter Saturation Voltage	V <sub>CE(SAT)</sub>	—	-0.40 -0.75	V	I <sub>C</sub> = -150mA, I <sub>B</sub> = -15mA I <sub>C</sub> = -500mA, I <sub>B</sub> = -50mA
Base-Emitter Saturation Voltage	V <sub>BE(SAT)</sub>	-0.75 —	-0.95 -1.30	V	I <sub>C</sub> = -150mA, I <sub>B</sub> = -15mA I <sub>C</sub> = -500mA, I <sub>B</sub> = -50mA
<b>SMALL SIGNAL CHARACTERISTICS</b>					
Output Capacitance	C <sub>cb</sub>	—	8.5	pF	V <sub>CB</sub> = -10V, f = 1.0MHz, I <sub>E</sub> = 0
Input Capacitance	C <sub>eb</sub>	—	30	pF	V <sub>EB</sub> = -0.5V, f = 1.0MHz, I <sub>C</sub> = 0
Input Impedance	h <sub>ie</sub>	1.5	15	kΩ	V <sub>CE</sub> = -10V, I <sub>C</sub> = -1.0mA, f = 1.0kHz
Voltage Feedback Ratio	h <sub>re</sub>	0.1	8.0	x 10 <sup>-4</sup>	
Small Signal Current Gain	h <sub>fe</sub>	60	500	—	
Output Admittance	h <sub>oe</sub>	1.0	100	μS	
Current Gain-Bandwidth Product	f <sub>T</sub>	200	—	MHz	V <sub>CE</sub> = -10V, I <sub>C</sub> = -20mA, f = 100MHz
<b>SWITCHING CHARACTERISTICS</b>					
Delay Time	t <sub>d</sub>	—	15	ns	V <sub>CC</sub> = -30V, I <sub>C</sub> = -150mA,
Rise Time	t <sub>r</sub>	—	20	ns	V <sub>BE(off)</sub> = -2.0V, I <sub>B1</sub> = -15mA
Storage Time	t <sub>s</sub>	—	225	ns	V <sub>CC</sub> = -30V, I <sub>C</sub> = -150mA,
Fall Time	t <sub>f</sub>	—	30	ns	I <sub>B1</sub> = I <sub>B2</sub> = -15mA

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

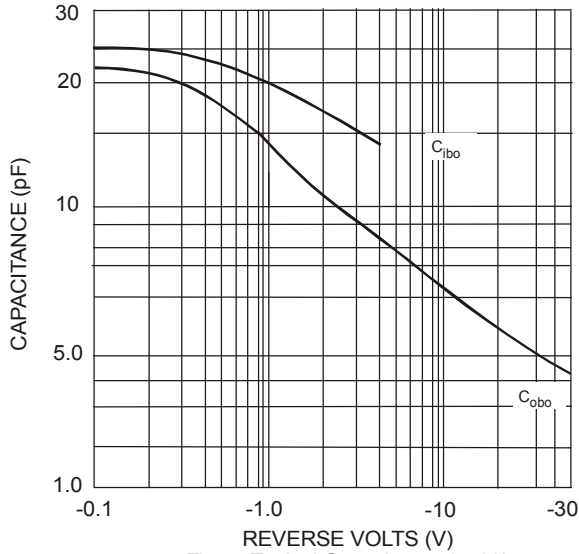


Fig. 7 Typical Capacitance (4403)

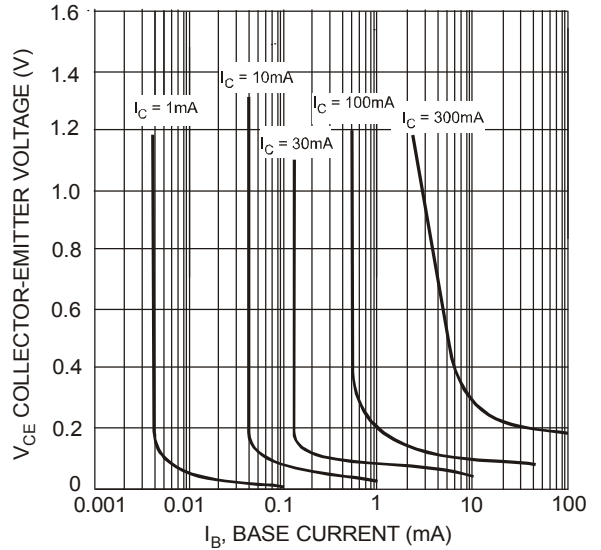


Fig. 8 Typical Collector Saturation Region (4403)

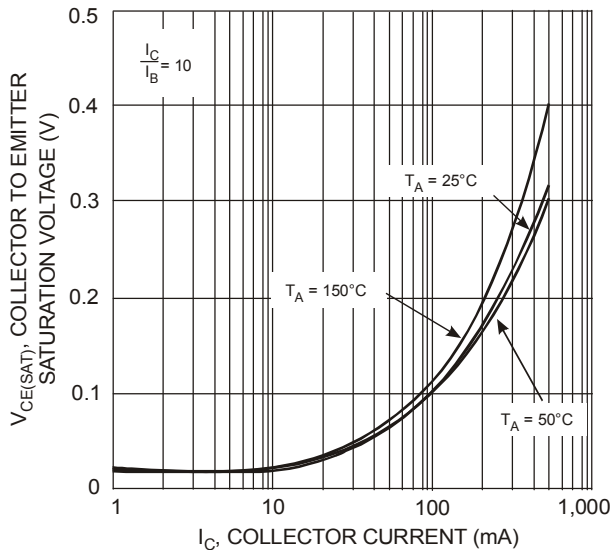


Fig. 9 Collector Emitter Saturation Voltage vs. Collector Current (4403)

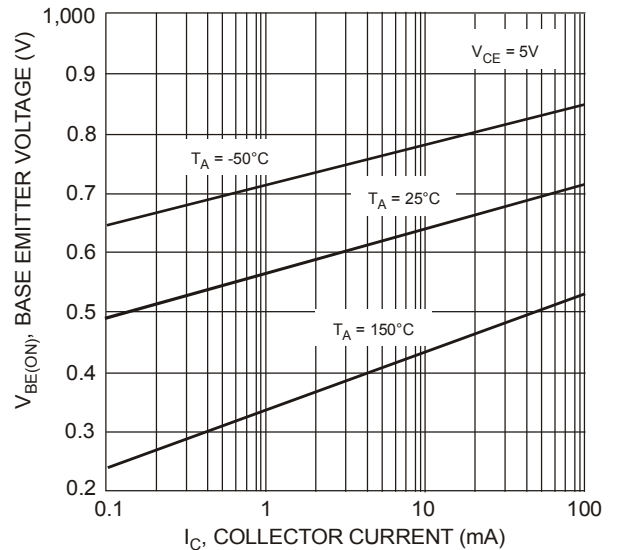


Fig. 10 Base-Emitter Voltage vs. Collector Current (4403)

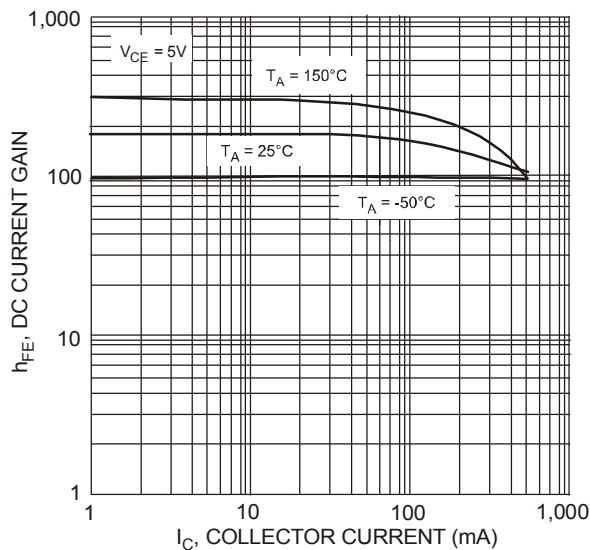


Fig. 11 DC Current Gain vs. Collector Current (4403)

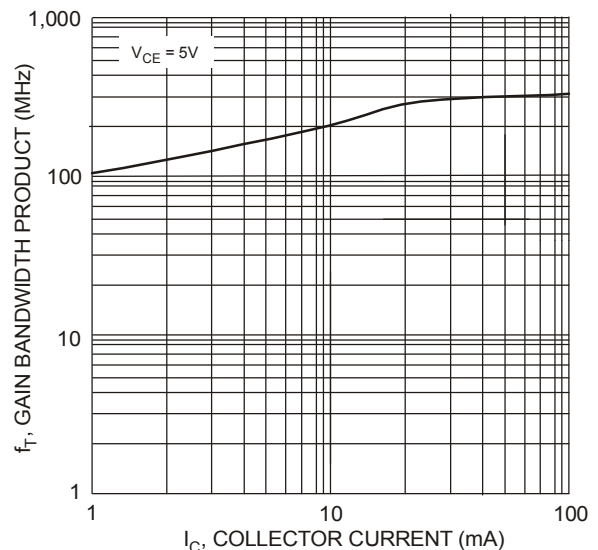
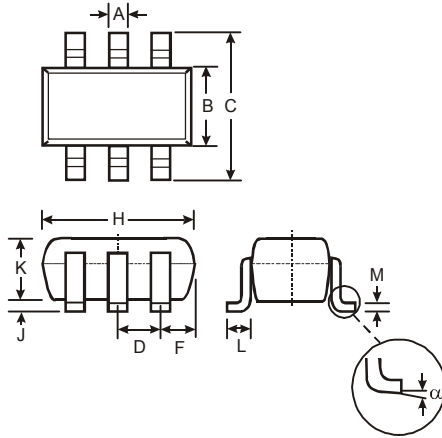


Fig. 12 Gain Bandwidth Product vs. Collector Current (4403)

## Package Outline Dimensions

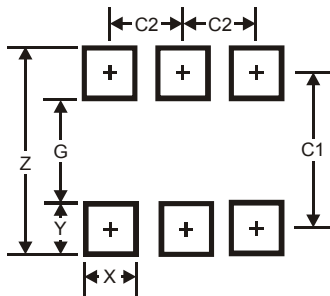
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.



SOT363			
Dim	Min	Max	Typ
A	0.10	0.30	0.25
B	1.15	1.35	1.30
C	2.00	2.20	2.10
D	0.65 Typ		
F	0.40	0.45	0.425
H	1.80	2.20	2.15
J	0	0.10	0.05
K	0.90	1.00	1.00
L	0.25	0.40	0.30
M	0.10	0.22	0.11
α	0°	8°	-
All Dimensions in mm			

## Suggested Pad Layout

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.



Dimensions	Value (in mm)
Z	2.5
G	1.3
X	0.42
Y	0.6
C1	1.9
C2	0.65

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