

COMPLEMENTARY PAIR SMALL SIGNAL TRANSISTOR IN SOT363
Features

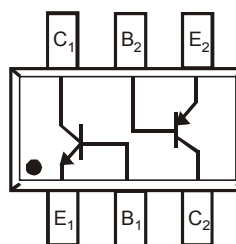
- Epitaxial Die Construction
- Two Internally Isolated NPN/PNP Transistors in One Package
NPN = 4401
PNP = 4403
- Ideal for Medium Power Amplification and Switching
- Ultra-Small Surface Mount Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" 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 **(e3)**
- Weight: 0.006 grams (approximate)



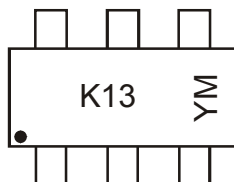
Top View


 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 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 (Q₁) (@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	600	mA

Absolute Maximum Ratings: PNP, 4403 Type (Q₂) (@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	-600	mA

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

Characteristic	Symbol	Value	Unit
Power Dissipation (Note 5) Total Device	P _D	200	mW
Thermal Resistance, Junction to Ambient (Note 5)	R _{θJA}	625	°C/W
Operating and Storage Temperature Range	T _J , T _{STG}	-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.

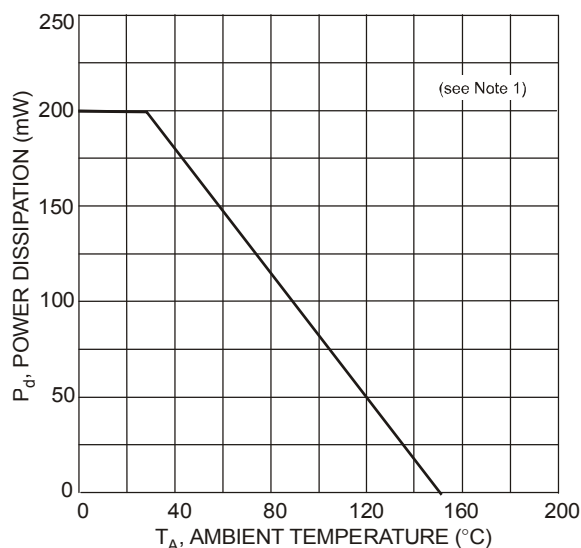
Thermal Characteristics – Total Device


Fig. 1, Power Derating Curve (Total Device)

Electrical Characteristics, NPN 4401 Section (@T_A = +25°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 = 100μA, I _E = 0
Collector-Emitter Breakdown Voltage	BV _{CEO}	40	—	V	I _C = 1.0mA, I _B = 0
Emitter-Base Breakdown Voltage	BV _{EBO}	6.0	—	V	I _E = 100 μA, I _C = 0
Collector Cutoff Current	I _{CEX}	—	100	nA	V _{CE} = 35V, V _{EB(OFF)} = 0.4V
Base Cutoff Current	I _{BL}	—	100	nA	V _{CE} = 35V, V _{EB(OFF)} = 0.4V
ON CHARACTERISTICS (Note 6)					
DC Current Gain	h _{FE}	20	—	—	I _C = 100μA, V _{CE} = 1.0V
		40	—		I _C = 1.0mA, V _{CE} = 1.0V
		80	—		I _C = 10mA, V _{CE} = 1.0V
		100	300		I _C = 150mA, V _{CE} = 1.0V
		40	—		I _C = 500mA, V _{CE} = 2.0V
Collector-Emitter Saturation Voltage	V _{CE(SAT)}	—	0.40 0.75	V	I _C = 150mA, I _B = 15mA I _C = 500mA, I _B = 50mA
Base-Emitter Saturation Voltage	V _{BE(SAT)}	0.75 —	0.95 1.2	V	I _C = 150mA, I _B = 15mA I _C = 500mA, I _B = 50mA
SMALL SIGNAL CHARACTERISTICS					
Output Capacitance	C _{cb}	—	6.5	pF	V _{CB} = 5.0V, f = 1.0MHz, I _E = 0
Input Capacitance	C _{eb}	—	30	pF	V _{EB} = 0.5V, f = 1.0MHz, I _C = 0
Input Impedance	h _{ie}	1.0	15	kΩ	V _{CE} = 10V, I _C = 1.0mA, f = 1.0kHz
Voltage Feedback Ratio	h _{re}	0.1	8.0	x 10 ⁻⁴	
Small Signal Current Gain	h _{fe}	40	500	—	
Output Admittance	h _{oe}	1.0	30	μS	
Current Gain-Bandwidth Product	f _T	250	—	MHz	V _{CE} = 10V, I _C = 20mA, f = 100MHz
SWITCHING CHARACTERISTICS					
Delay Time	t _d	—	15	ns	V _{CC} = 30V, I _C = 150mA, V _{BE(off)} = 2.0V, I _{B1} = 15mA
Rise Time	t _r	—	20	ns	
Storage Time	t _s	—	225	ns	V _{CC} = 30V, I _C = 150mA, I _{B1} = I _{B2} = 15mA
Fall Time	t _f	—	30	ns	

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

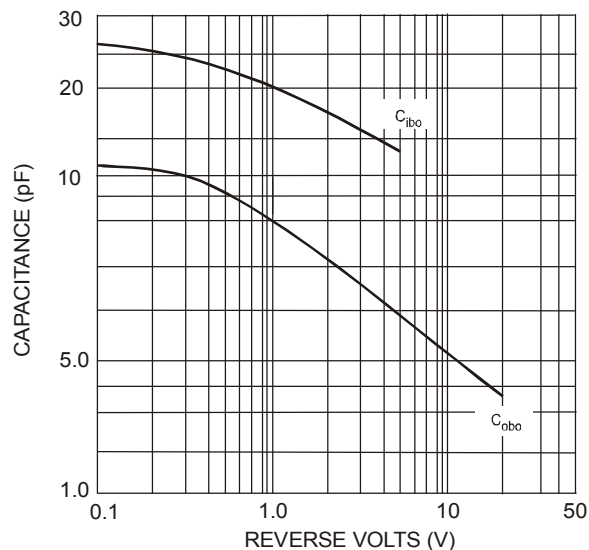


Fig. 1 Typical Capacitance (4401)

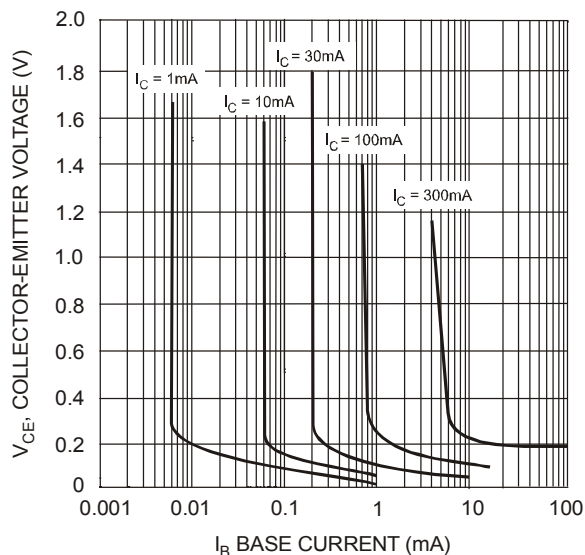


Fig. 2 Typical Collector Saturation Region (4401)

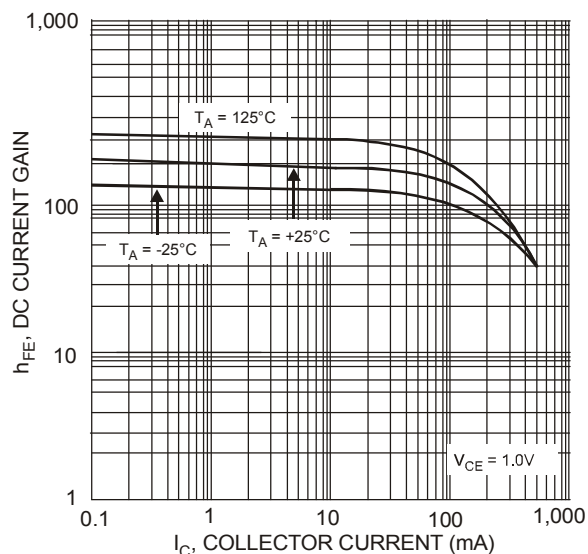


Fig. 3 Typical DC Current Gain vs. Collector Current (4401)

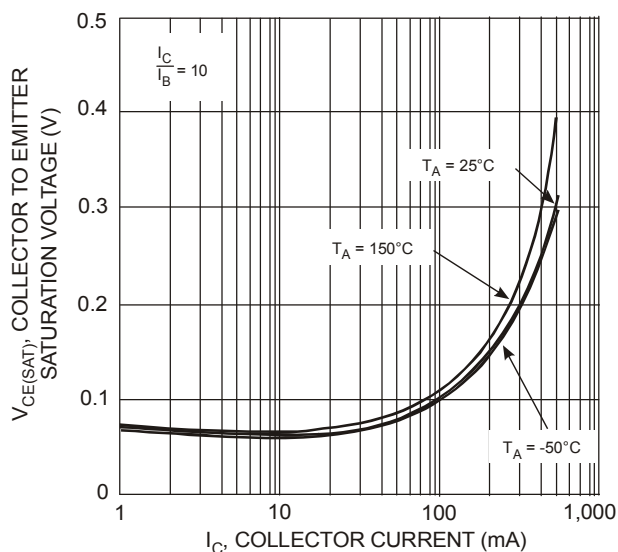


Fig. 4 Collector Emitter Saturation Voltage vs. Collector Current (4401)

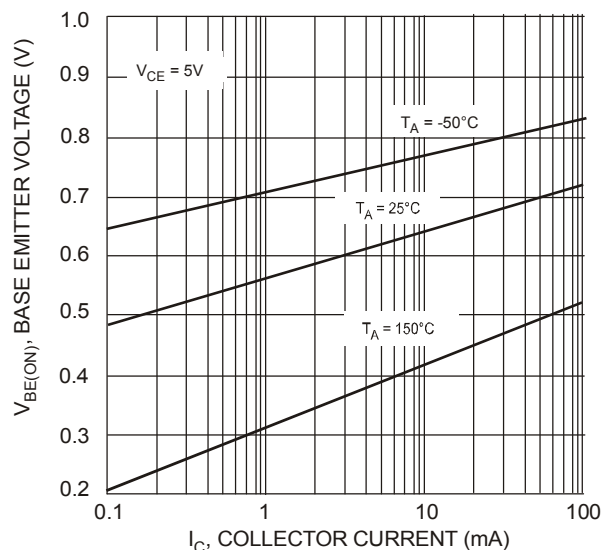


Fig. 5 Base Emitter Voltage vs. Collector Current (4401)

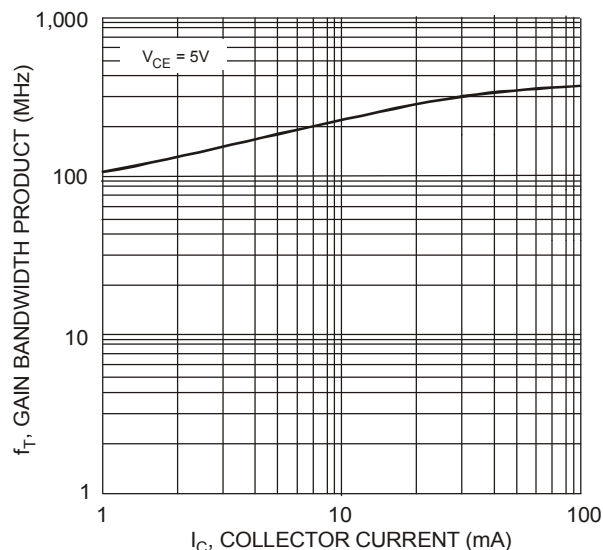


Fig. 6 Gain Bandwidth Product vs. Collector Current (4401)

Electrical Characteristics, PNP 4403 Section (@T_A = +25°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 = -100μA, I _E = 0
Collector-Emitter Breakdown Voltage	BV _{CEO}	-40	—	V	I _C = -1.0mA, I _B = 0
Emitter-Base Breakdown Voltage	BV _{EBO}	-5.0	—	V	I _E = -100μA, I _C = 0
Collector Cutoff Current	I _{CEX}	—	-100	nA	V _{CE} = -35V, V _{EB(OFF)} = -0.4V
Base Cutoff Current	I _{BL}	—	-100	nA	V _{CE} = -35V, V _{EB(OFF)} = -0.4V
ON CHARACTERISTICS (Note 6)					
DC Current Gain	h _{FE}	30 60 100 100 20	— — — 300 —	—	I _C = -100μA, V _{CE} = -1.0V I _C = -1.0mA, V _{CE} = -1.0V I _C = -10mA, V _{CE} = -1.0V I _C = -150mA, V _{CE} = -2.0V I _C = -500mA, V _{CE} = -2.0V
Collector-Emitter Saturation Voltage	V _{CE(SAT)}	—	-0.40 -0.75	V	I _C = -150mA, I _B = -15mA I _C = -500mA, I _B = -50mA
Base-Emitter Saturation Voltage	V _{BE(SAT)}	-0.75 —	-0.95 -1.30	V	I _C = -150mA, I _B = -15mA I _C = -500mA, I _B = -50mA
SMALL SIGNAL CHARACTERISTICS					
Output Capacitance	C _{cb}	—	8.5	pF	V _{CB} = -10V, f = 1.0MHz, I _E = 0
Input Capacitance	C _{eb}	—	30	pF	V _{EB} = -0.5V, f = 1.0MHz, I _C = 0
Input Impedance	h _{ie}	1.5	15	kΩ	V _{CE} = -10V, I _C = -1.0mA, f = 1.0kHz
Voltage Feedback Ratio	h _{re}	0.1	8.0	x 10 ⁻⁴	
Small Signal Current Gain	h _{fe}	60	500	—	
Output Admittance	h _{oe}	1.0	100	μS	
Current Gain-Bandwidth Product	f _T	200	—	MHz	V _{CE} = -10V, I _C = -20mA, f = 100MHz
SWITCHING CHARACTERISTICS					
Delay Time	t _d	—	15	ns	V _{CC} = -30V, I _C = -150mA, V _{BE(off)} = -2.0V, I _{B1} = -15mA
Rise Time	t _r	—	20	ns	
Storage Time	t _s	—	225	ns	V _{CC} = -30V, I _C = -150mA, I _{B1} = I _{B2} = -15mA
Fall Time	t _f	—	30	ns	

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

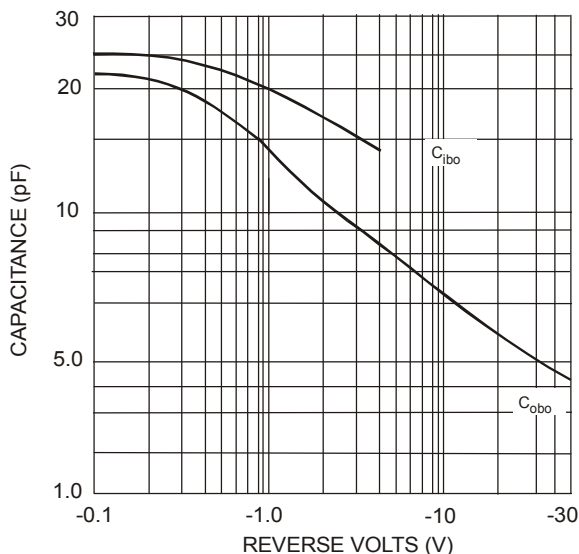


Fig. 7 Typical Capacitance (4403)

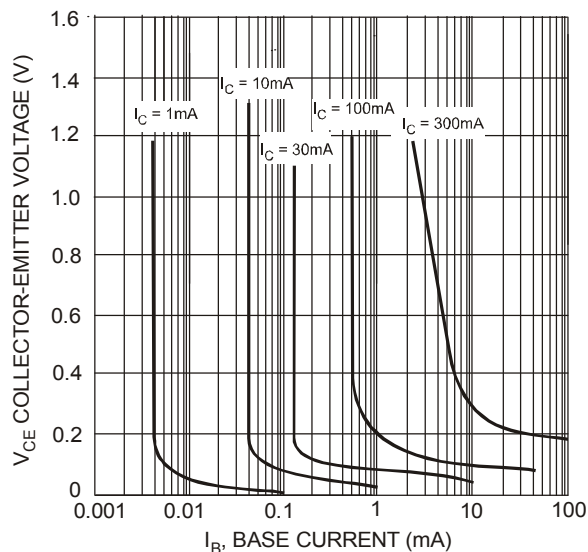


Fig. 8 Typical Collector Saturation Region (4403)

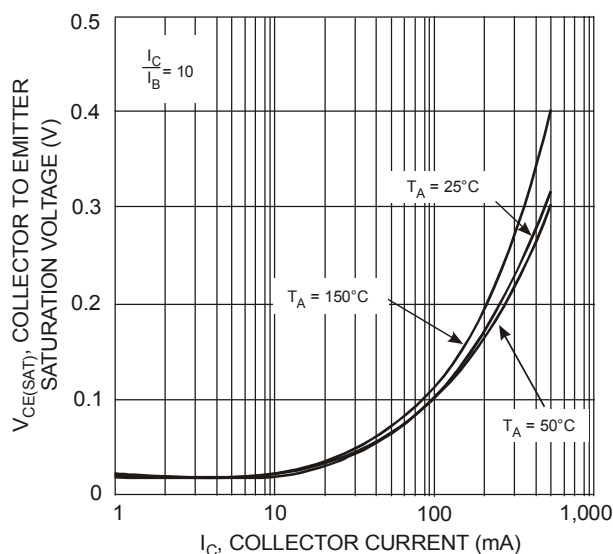


Fig. 9 Collector Emitter Saturation Voltage vs. Collector Current (4403)

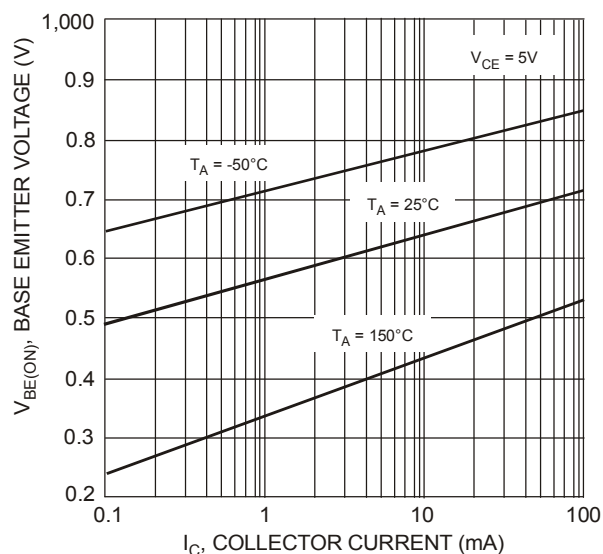


Fig. 10 Base-Emitter Voltage vs. Collector Current (4403)

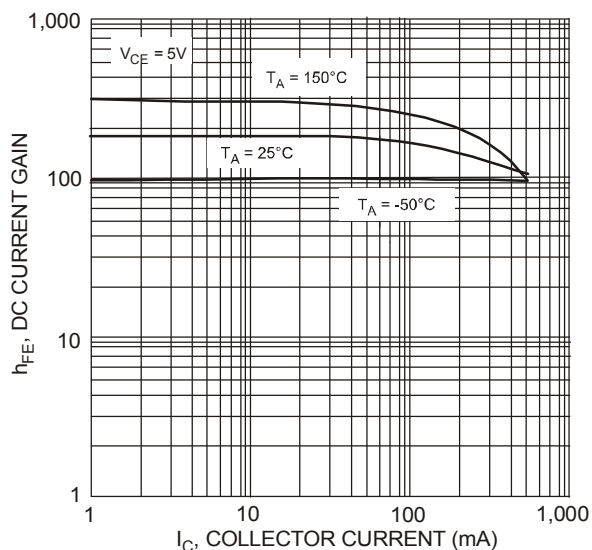


Fig. 11 DC Current Gain vs. Collector Current (4403)

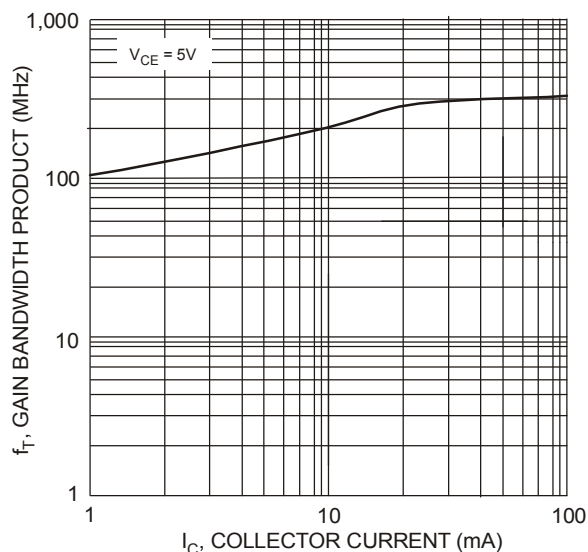
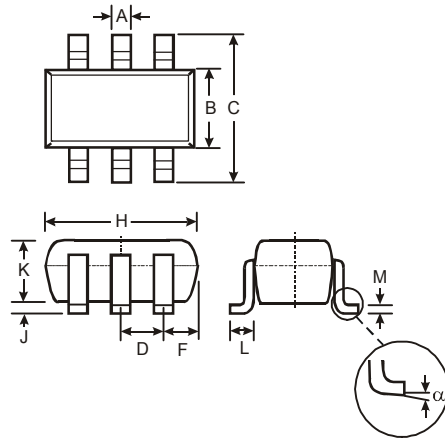


Fig. 12 Gain Bandwidth Product vs. Collector Current (4403)

Package Outline Dimensions

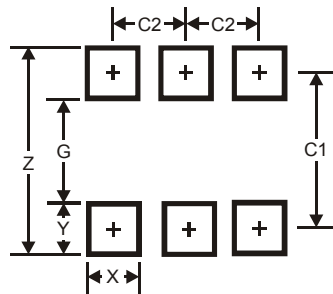
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.



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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