



# MMDT4413

## COMPLEMENTARY NPN/PNP SMALL SIGNAL SURFACE MOUNT TRANSISTOR

**VOLTAGE** 40 Volt **POWER** 225 mWatt

### FEATURES

- Complementary Pair
- One 4401-Type NPN
- One 4403-Type PNP
- Epitaxial Planar Die Construction
- Ideal for Low Power Amplification and Switching
- Ultra-Small Surface Mount Package
- Also Available in Lead Free Version
- Lead free in compliance with EU RoHS 2011/65/EU directive
- Green molding compound as per IEC61249 Std. . (Halogen Free)

### MECHANICAL DATA

- Case: SOT-363, Plastic
- Terminals: Solderable per MIL-STD-750, Method 2026
- Approx. Weight: 0.0002 ounces, 0.006 grams.
- Marking: M6A

**SOT-363** Unit : inch(mm)

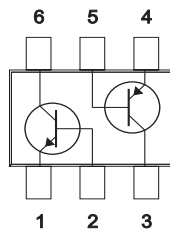
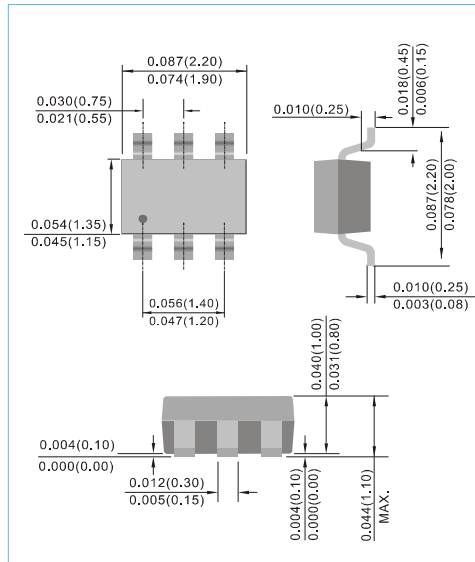


Fig.55

### MAXIMUM RATINGS, TOTAL DEVICE @ T<sub>A</sub>=25°C UNLESS OTHERWISE SPECIFIED

Characteristic	Symbol	Value	Unit
Power Dissipation	P <sub>d</sub>	225	mW
Thermal Resistance , Junction to Ambient	R <sub>θJA</sub>	625	K/W
Operating and Storage and Junction Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to 150	°C



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## MAXIMUM RATINGS,NPN 4401 SECTION@ $T_A=25^{\circ}\text{C}$ UNLESS OTHERWISE SPECIFIED

Characteristic	Symbol	NPN4401	Unit
Collector-Base Voltage	$V_{CB0}$	60	V
Collector-Emitter Voltage	$V_{CE0}$	40	V
Emitter-Base Voltage	$V_{EB0}$	6.0	V
Collector Current-Continuous	$I_c$	600	mA

## MAXIMUM RATINGS,NPN 4403 SECTION@ $T_A=25^{\circ}\text{C}$ UNLESS OTHERWISE SPECIFIED

Characteristic	Symbol	PNP4403	Unit
Collector-Base Voltage	$V_{CB0}$	-40	V
Collector-Emitter Voltage	$V_{CE0}$	-40	V
Emitter-Base Voltage	$V_{EB0}$	-5.0	V
Collector Current-Continuous	$I_c$	-600	mA



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## ELECTRICAL CHARACTERISTICS,NPN 4401 SECTION@TA=25°C UNLESS OTHERWISE SPECIFIED

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN	MAX	UNIT
OFF CHARACTERISTIC					
Collector - Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=100\mu A, I_E=0$	60	-	V
Collector - Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1.0mA, I_B=0$	40	-	V
Emitter - Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=100\mu A, I_C=0$	6.0	-	V
Collector Cutoff Current	$I_{cEX}$	$V_{CE}=35V, V_{EB(OFF)}=0.4V$	-	100	nA
Base Cutoff Current	$I_{BL}$	$V_{CE}=35V, V_{EB(OFF)}=0.4V$	-	100	nA
ON CHARACTERISTICS					
DC Current Gain (Note 2)	$h_{FE}$	$I_C=100\mu A, V_{CE}=1.0V$	20	-	-
		$I_C=1.0mA, V_{CE}=1.0V$	40	-	-
		$I_C=10mA, V_{CE}=1.0V$	80	-	-
		$I_C=150mA, V_{CE}=1.0V$	100	300	-
		$I_C=500mA, V_{CE}=2.0V$	40	-	-
Collector - Emitter Saturation Voltage	$V_{CE(SAT)}$	$I_C=150mA, I_B=15mA$ $I_C=500mA, I_B=50mA$	-	0.40 0.75	V
Base - Emitter Saturation Voltage	$V_{BE(SAT)}$	$I_C=150mA, I_B=15mA$ $I_C=500mA, I_B=50mA$	0.75 -	0.95 1.20	V
SMALL SIGNAL CHARACTERISTICS					
Output Capacitance	$C_{cb}$	$V_{CB}=5V, I_E=0, f=1.0MHz$	-	6.5	pF
Input Capacitance	$C_{eb}$	$V_{EB}=0.5V, I_C=0, f=1MHz$	-	30	pF
Input Impedance	$h_{ie}$	$V_{CE}=10V, I_C=1.0mA, f=1.0KHz$	1.0	15	k $\Omega$
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	$\mu S$
Current Gain - Bandwidth Product	$f_T$		$V_{CE}=10V, I_C=20mA, f=100MHz$	250	-
SWITCHING CHARACTERISTICS					
Delay Time	$t_d$	$V_{CC}=30V, V_{BE(OFF)}=2.0V,$ $I_C=150mA, I_{B1}=15mA$	-	15	ns
Rise Time	$t_r$		-	20	ns
Storage Time	$t_s$	$V_{CC}=30V, I_C=150mA$ $I_{B1}=I_{B2}=15mA$	-	225	ns
Fall Time	$t_f$		-	30	ns



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## ELECTRICAL CHARACTERISTICS, NPN 4403 SECTION @ TA=25°C UNLESS OTHERWISE SPECIFIED

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN	MAX	UNIT
<b>OFF CHARACTERISTIC</b>					
Collector - Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = -100\mu A, I_E = 0$	-40	-	V
Collector - Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = -1.0mA, I_B = 0$	-40	-	V
Emitter - Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = -100\mu A, I_C = 0$	-5.0	-	V
Collector Cutoff Current	$I_{CEX}$	$V_{CE} = -35V, V_{EB(OFF)} = -0.4V$	-	-100	nA
Base Cutoff Current	$I_{BL}$	$V_{CE} = -35V, V_{EB(OFF)} = -0.4V$	-	-100	nA
<b>ON CHARACTERISTICS</b>					
DC Current Gain (Note 2)	$h_{FE}$	$I_C = -100\mu A, V_{CE} = -1.0V$ $I_C = -1.0mA, V_{CE} = -1.0V$ $I_C = -10mA, V_{CE} = -1.0V$ $I_C = -150mA, V_{CE} = -2.0V$ $I_C = -500mA, V_{CE} = -2.0V$	30 60 100 100 20	- - - 300 -	-
Collector - Emitter Saturation Voltage	$V_{CE(SAT)}$	$I_C = -150mA, I_B = -15mA$ $I_C = -500mA, I_B = -50mA$	-	-0.40 -0.75	V
Base - Emitter Saturation Voltage	$V_{BE(SAT)}$	$I_C = -150mA, I_B = -15mA$ $I_C = -500mA, I_B = -50mA$	-0.75 -	-0.95 -1.30	V
<b>SMALL SIGNAL CHARACTERISTICS</b>					
Output Capacitance	$C_{cb}$	$V_{CB} = -10V, I_E = 0, f = 1.0MHz$	-	8.5	pF
Input Capacitance	$C_{eb}$	$V_{EB} = -0.5V, I_C = 0, f = 1MHz$	-	30	pF
Input Impedance	$h_{ie}$	$V_{CE} = -10V, I_C = -1.0mA, f = 1.0KHz$	1.5	15	k $\Omega$
Voltage Feedback Ratio	$h_{re}$		0.1	8.0	$\times 10^{-4}$
Small Signal Current Gain	$h_{fe}$		60	500	-
Output Admittance	$h_{oe}$		1.0	100	$\mu S$
Current Gain - Bandwidth Product	$f_T$		$V_{CE} = -10V, I_C = -20mA, f = 100MHz$	200	-
<b>SWITCHING CHARACTERISTICS</b>					
Delay Time	$t_d$	$V_{CC} = -30V, V_{BE(OFF)} = -2.0V,$ $I_C = -150mA, I_{B1} = -15mA$	-	15	ns
Rise Time	$t_r$		-	20	ns
Storage Time	$t_s$	$V_{CC} = -30V, I_C = -150mA$ $I_{B1} = I_{B2} = -15mA$	-	225	ns
Fall Time	$t_f$		-	30	ns



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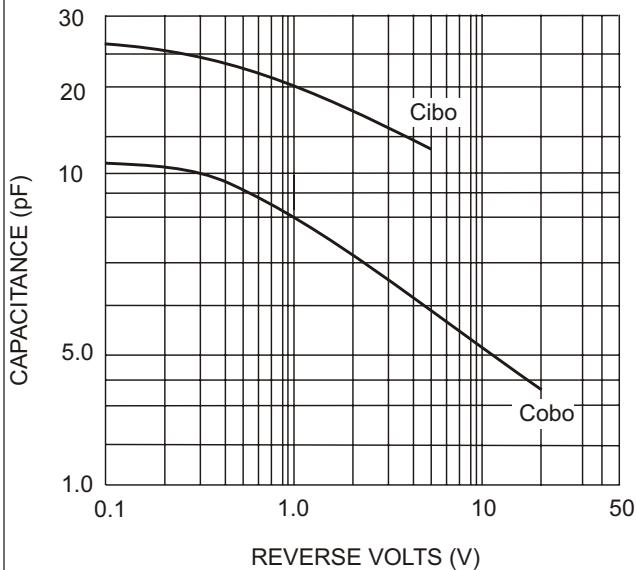


Fig. 1 Typical Capacitance (4401)

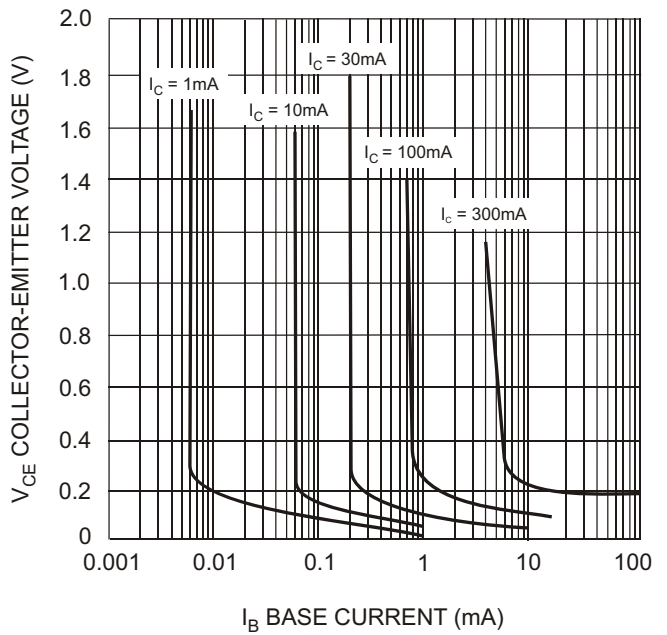


Fig. 2 Typical Collector Saturation Region (4401)

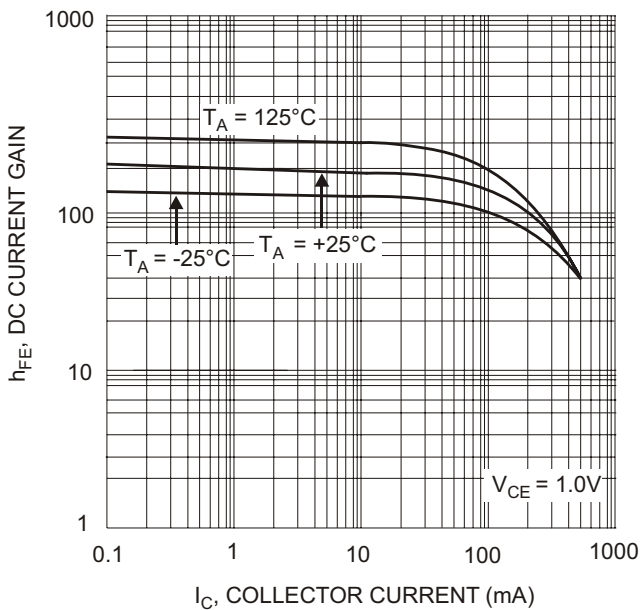


Fig. 3 Typical DC Current Gain vs. Collector Current (4401)

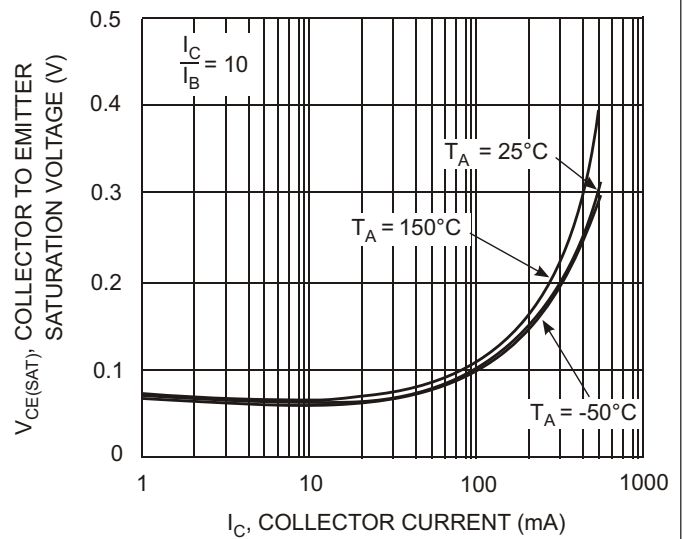


Fig. 4 Collector Emitter Saturation Voltage vs. Collector Current (4401)



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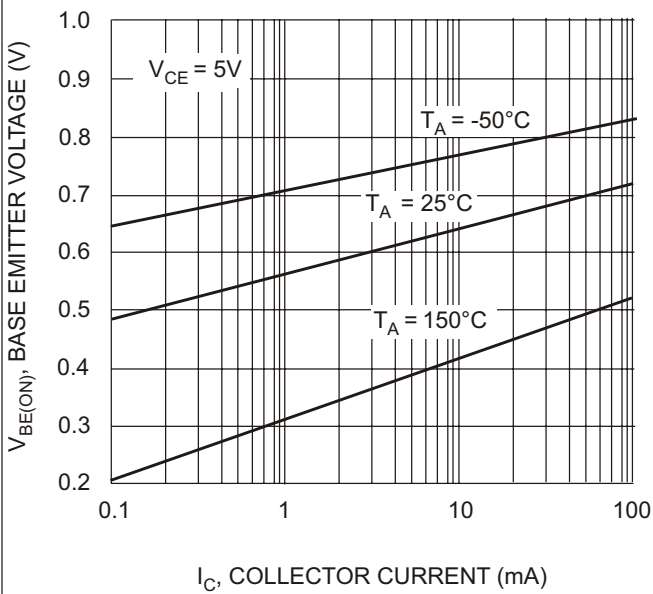


Fig. 5 Base Emitter Voltage vs. Collector Current (4401)

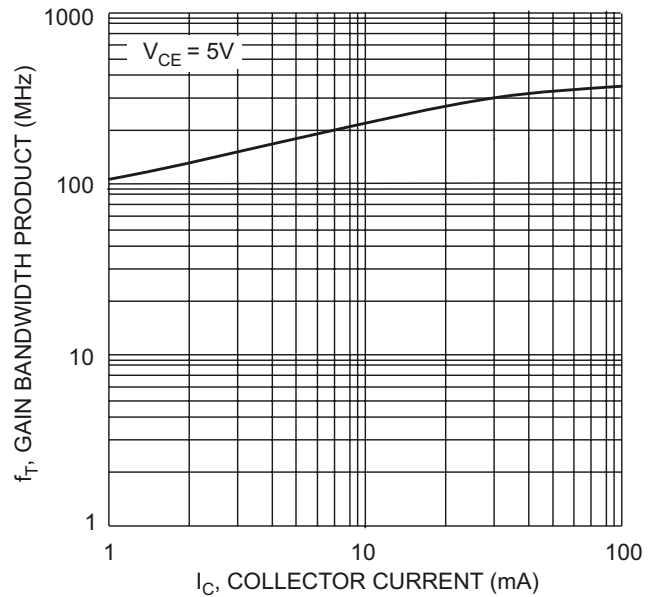


Fig. 6 Gain Bandwidth Product vs. Collector Current (4401)

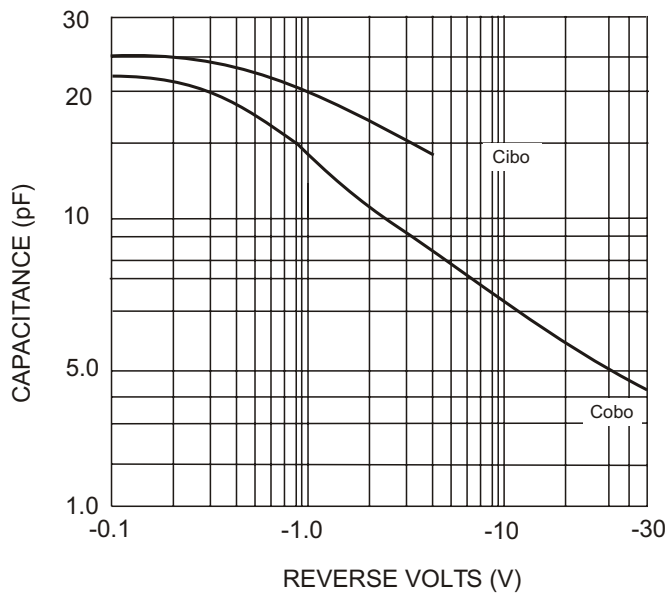


Fig. 7 Typical Capacitance (4403)



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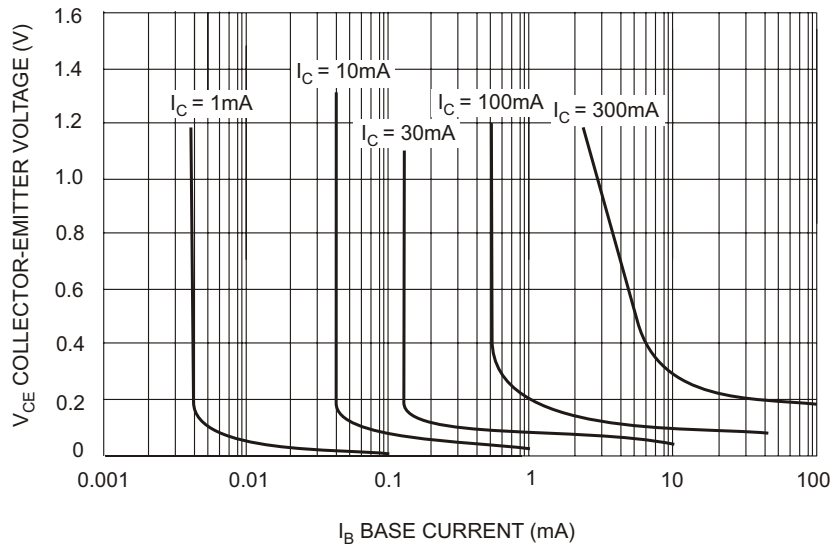


Fig. 8 Typical Collector Saturation Region (4403)

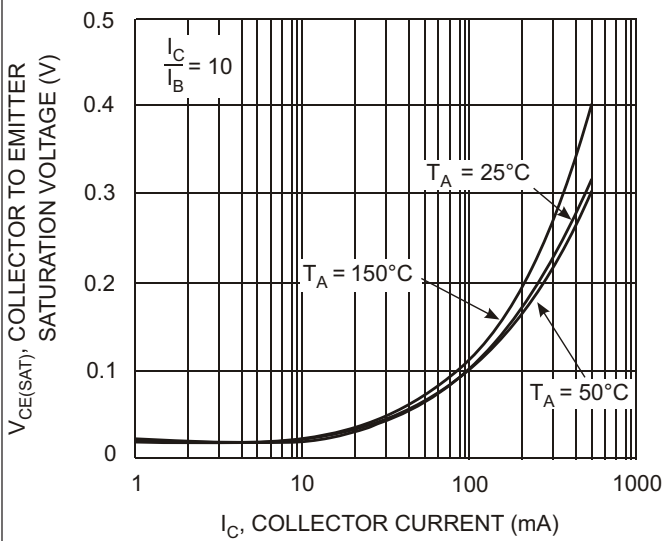


Fig. 9 Collector Emitter Saturation Voltage vs. Collector Current (4403)

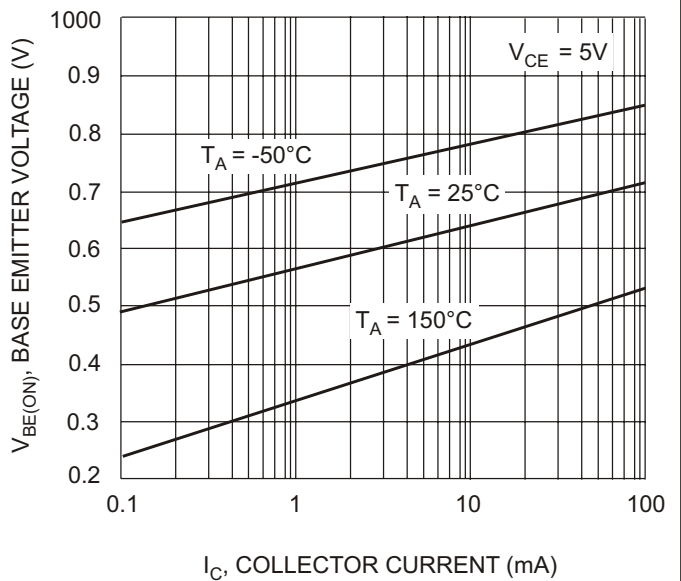


Fig. 10 Base-Emitter Voltage vs. Collector Current (4403)



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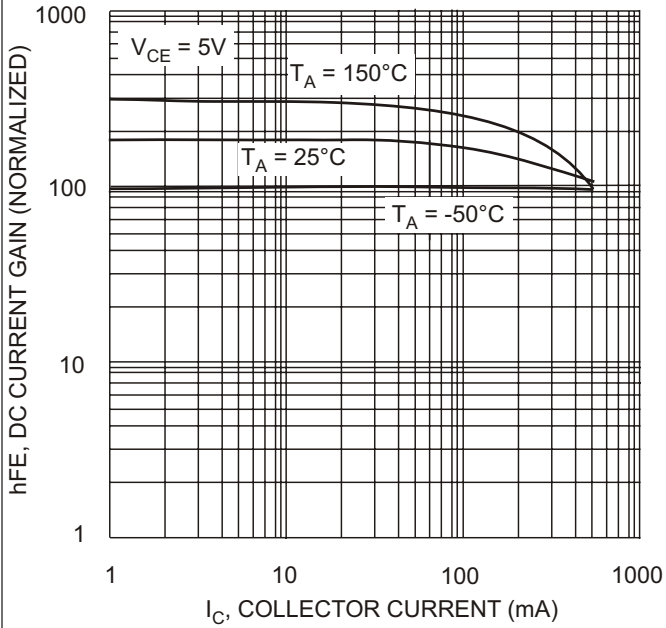


Fig. 11 DC Current Gain vs. Collector Current (4403)

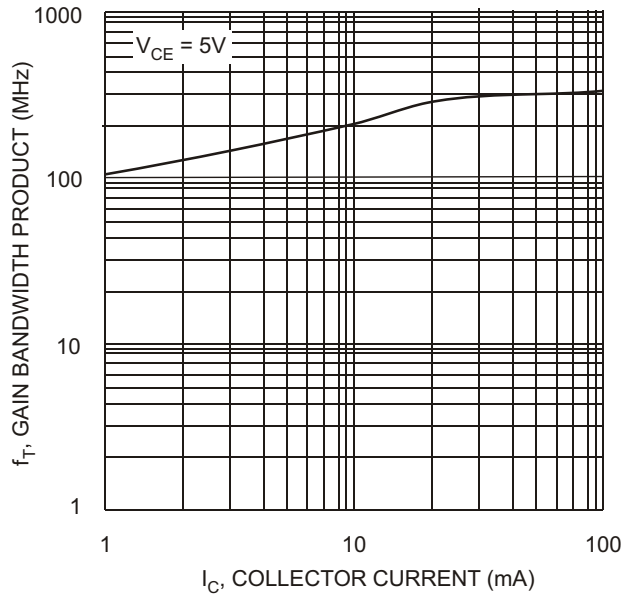


Fig. 12 Gain Bandwidth Product vs. Collector Current (4403)

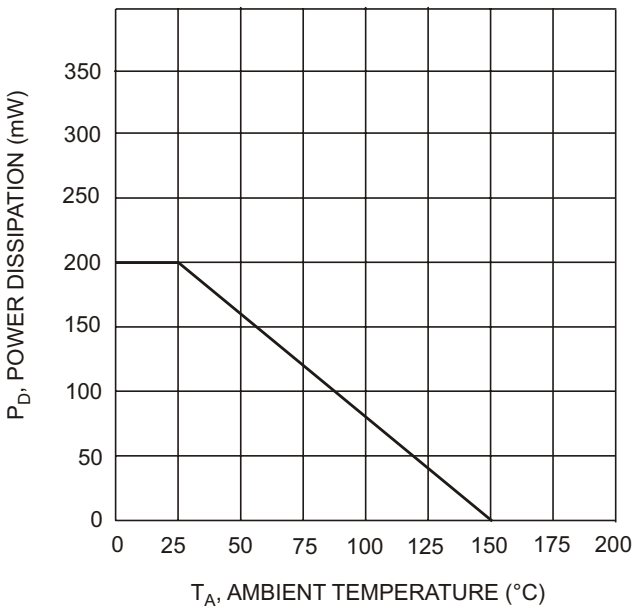


Fig. 13, Max Power Dissipation vs Ambient Temperature (4403)



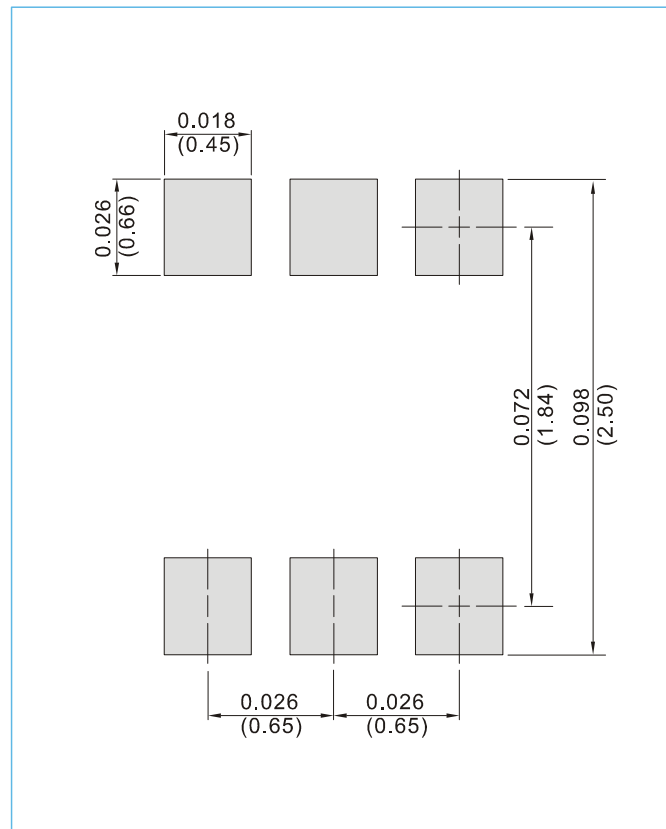


# MMDT4413

## MOUNTING PAD LAYOUT

SOT-363

Unit : inch(mm)



## ORDER INFORMATION

- Packing information
  - T/R - 10K per 13" plastic Reel
  - T/R - 3K per 7" plastic Reel



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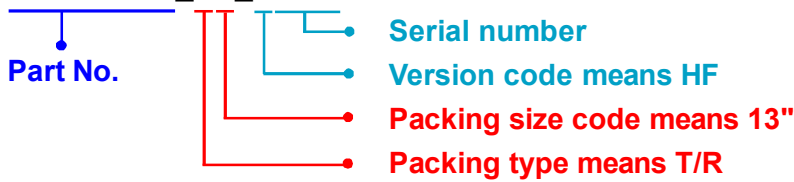
## Part No\_packing code\_Version

MMDT4413\_R1\_00001

MMDT4413\_R2\_00001

For example :

**RB500V-40\_R2\_00001**



Packing Code <b>XX</b>				Version Code <b>XXXXX</b>		
Packing type	1 <sup>st</sup> Code	Packing size code	2 <sup>nd</sup> Code	HF or RoHS	1 <sup>st</sup> Code	2 <sup>nd</sup> ~5 <sup>th</sup> Code
Tape and Ammunition Box (T/B)	<b>A</b>	N/A	<b>0</b>	<b>HF</b>	<b>0</b>	serial number
Tape and Reel (T/R)	<b>R</b>	7"	<b>1</b>	<b>RoHS</b>	<b>1</b>	serial number
Bulk Packing (B/P)	<b>B</b>	13"	<b>2</b>			
Tube Packing (T/P)	<b>T</b>	26mm	<b>X</b>			
Tape and Reel (Right Oriented) (TRR)	<b>S</b>	52mm	<b>Y</b>			
Tape and Reel (Left Oriented) (TRL)	<b>L</b>	PANASERT T/B CATHODE UP (PBCU)	<b>U</b>			
FORMING	<b>F</b>	PANASERT T/B CATHODE DOWN (PBCD)	<b>D</b>			



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