


40V COMPLEMENTARY NPN-PNP SMALL SIGNAL TRANSISTOR IN SOT363

Features

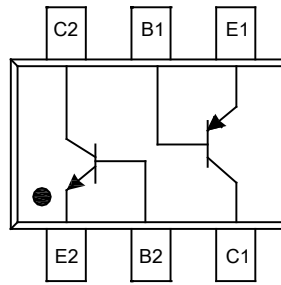
- Complementary Pair One 3904-Type NPN
One 3906-Type PNP
- Ultra-Small Surface Mount Package
- Epitaxial Planar Die Construction
- Ideal for Low Power Amplification and Switching
- **Totally Lead-Free & Fully RoHS compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified 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 
- Weight: 0.006 grams (approximate)



Top View



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

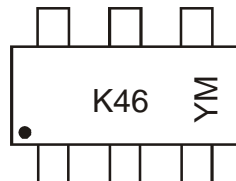
Device Schematic and Pinout
Top View

Ordering Information (Note 4)

Product	Compliance	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
MMDT3946-7-F	AEC-Q101	K46	7	8	3,000
MMDT3946-7R-F	AEC-Q101	K46	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



K46 = 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 3904 (@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}	6.0	V
Collector Current	I _C	200	mA

Absolute Maximum Ratings, PNP 3906 (@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}	-5.0	V
Collector Current	I _C	-200	mA

Thermal Characteristics, Total Device (@T_A = +25°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 _{θJA}	625	°C/W
Operating and Storage Temperature Range	T _J , T _{STG}	-55 to +150	°C

Notes: 5. For a device mounted on minimum recommended pad layout that is on a single-sided 0.6mm FR4 PCB; device is measured under still air conditions whilst operating in a steady-state.

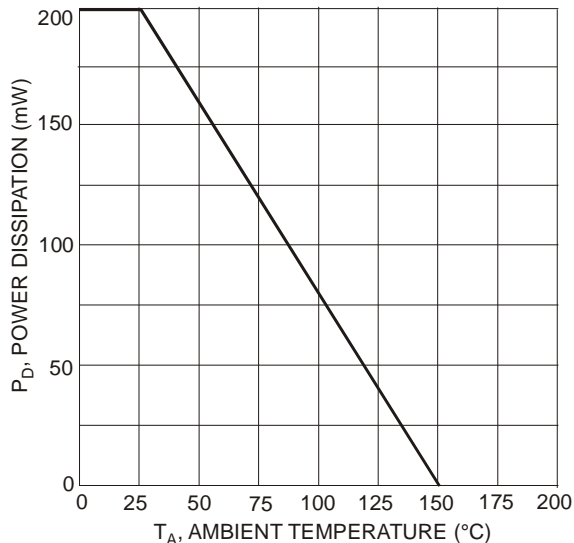


Fig. 1, Power Dissipation vs. Ambient Temperature (Total Device)

Electrical Characteristics, NPN 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 = 1.0mA, I _B = 0	
Emitter-Base Breakdown Voltage	BV _{EBO}	5.0	6.0	V	I _E = 10μA, I _C = 0	
Collector Cutoff Current	I _{CEX}	—	50	nA	V _{CE} = 30V, V _{EB(OFF)} = 3.0V	
Base Cutoff Current	I _{BL}	—	50	nA	V _{CE} = 30V, V _{EB(OFF)} = 3.0V	
ON CHARACTERISTICS (Note 6)						
Static Forward Current Transfer Ratio	h _{FE}	40	—	—	I _C = 100μA, V _{CE} = 1.0V	
		70	—			I _C = 1.0mA, V _{CE} = 1.0V
		100	300			I _C = 10mA, V _{CE} = 1.0V
		60	—			I _C = 50mA, V _{CE} = 1.0V
		30	—			I _C = 100mA, V _{CE} = 1.0V
Collector-Emitter Saturation Voltage	V _{CE(SAT)}	—	0.20 0.30	V	I _C = 10mA, I _B = 1.0mA I _C = 50mA, I _B = 5.0mA	
Base-Emitter Saturation Voltage	V _{BE(SAT)}	0.65 —	0.85 0.95	V	I _C = 10mA, I _B = 1.0mA I _C = 50mA, I _B = 5.0mA	
SMALL SIGNAL CHARACTERISTICS						
Output Capacitance	C _{obo}	—	4.0	pF	V _{CB} = 5.0V, f = 1.0MHz, I _E = 0	
Input Capacitance	C _{ibo}	—	8.0	pF	V _{EB} = 0.5V, f = 1.0MHz, I _C = 0	
Input Impedance	h _{ie}	1.0	10	kΩ	V _{CE} = 10V, I _C = 1.0mA, f = 1.0kHz	
Voltage Feedback Ratio	h _{re}	0.5	8.0	x 10 ⁻⁴		
Small Signal Current Gain	h _{fe}	100	400	—		
Output Admittance	h _{oe}	1.0	40	μS		
Current Gain-Bandwidth Product	f _T	300	—	MHz	V _{CE} = 20V, I _C = 20mA, f = 100MHz	
Noise Figure	NF	—	5.0	dB	V _{CE} = 5.0V, I _C = 100μA, R _S = 1.0kΩ, f = 1.0kHz	
SWITCHING CHARACTERISTICS						
Delay Time	t _d	—	35	ns	V _{CC} = 3.0V, I _C = 10mA,	
Rise Time	t _r	—	35	ns	V _{BE(off)} = -0.5V, I _{B1} = 1.0mA	
Storage Time	t _s	—	200	ns	V _{CC} = 3.0V, I _C = 10mA, I _{B1} = I _{B2} = 1.0mA	
Fall Time	t _f	—	50	ns		

Notes: 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.)

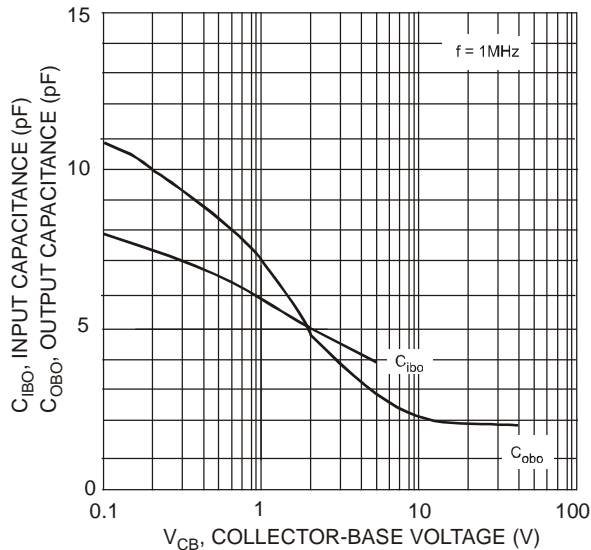


Fig. 2, Input and Output Capacitance vs. Collector-Base Voltage (NPN-3904)

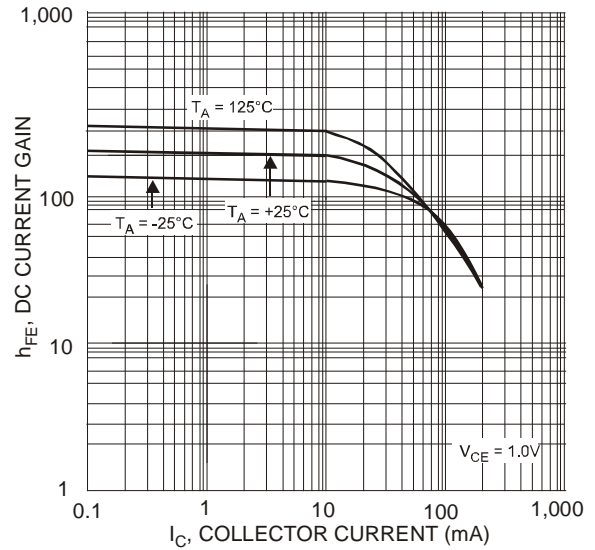


Fig. 3, Typical DC Current Gain vs. Collector Current (NPN-3904)

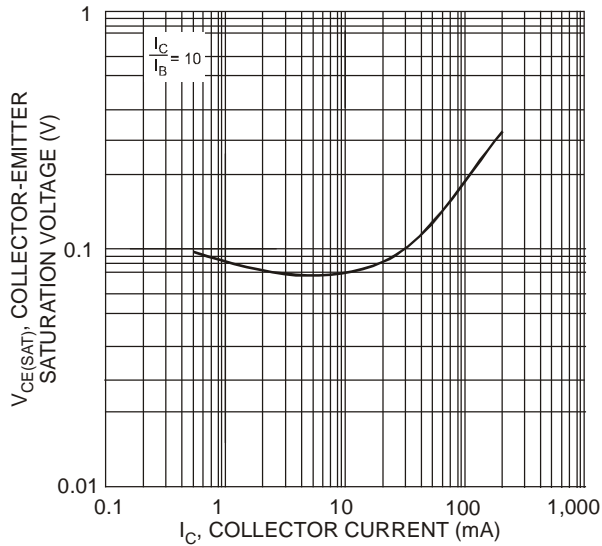


Fig. 4, Typical Collector-Emitter Saturation Voltage vs. Collector Current (NPN-3904)

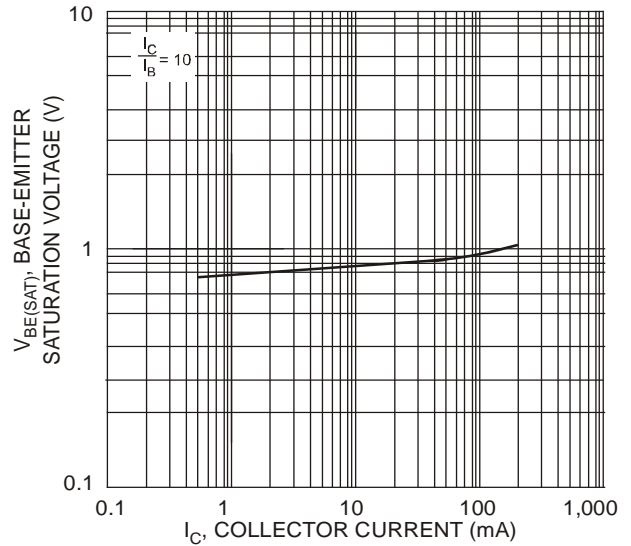


Fig. 5, Typical Base-Emitter Saturation Voltage vs. Collector Current (NPN-3904)

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 _{CBO}	-40	—	V	I _C = -10μA, 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 = -10μA, I _C = 0
Collector Cutoff Current	I _{CEX}	—	-50	nA	V _{CE} = -30V, V _{EB(OFF)} = -3.0V
Base Cutoff Current	I _{BL}	—	-50	nA	V _{CE} = -30V, V _{EB(OFF)} = -3.0V
ON CHARACTERISTICS (Note 6)					
Static Forward Current Transfer Ratio	h _{FE}	60	—	—	I _C = -100μA, V _{CE} = -1.0V
		80	—		
		100	300		
		60	—		
		30	—		
Collector-Emitter Saturation Voltage	V _{CE(SAT)}	—	-0.25 -0.40	V	I _C = -10mA, I _B = -1.0mA I _C = -50mA, I _B = -5.0mA
Base-Emitter Saturation Voltage	V _{BE(SAT)}	-0.65	-0.85 -0.95	V	I _C = -10mA, I _B = -1.0mA I _C = -50mA, I _B = -5.0mA
SMALL SIGNAL CHARACTERISTICS					
Output Capacitance	C _{obo}	—	4.5	pF	V _{CB} = -5.0V, f = 1.0MHz, I _E = 0
Input Capacitance	C _{ibo}	—	10	pF	V _{EB} = -0.5V, f = 1.0MHz, I _C = 0
Input Impedance	h _{ie}	2.0	12	kΩ	V _{CE} = 10V, I _C = 1.0mA, f = 1.0kHz
Voltage Feedback Ratio	h _{re}	0.1	10	x 10 ⁻⁴	
Small Signal Current Gain	h _{fe}	100	400	—	
Output Admittance	h _{oe}	3.0	60	μS	
Current Gain-Bandwidth Product	f _T	250	—	MHz	
Noise Figure	NF	—	4.0	dB	V _{CE} = -5.0V, I _C = -100μA, R _S = 1.0kΩ, f = 1.0kHz
SWITCHING CHARACTERISTICS					
Delay Time	t _d	—	35	ns	V _{CC} = -3.0V, I _C = -10mA, V _{BE(off)} = 0.5V, I _{B1} = -1.0mA
Rise Time	t _r	—	35	ns	
Storage Time	t _s	—	225	ns	V _{CC} = -3.0V, I _C = -10mA, I _{B1} = I _{B2} = -1.0mA
Fall Time	t _f	—	75	ns	

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

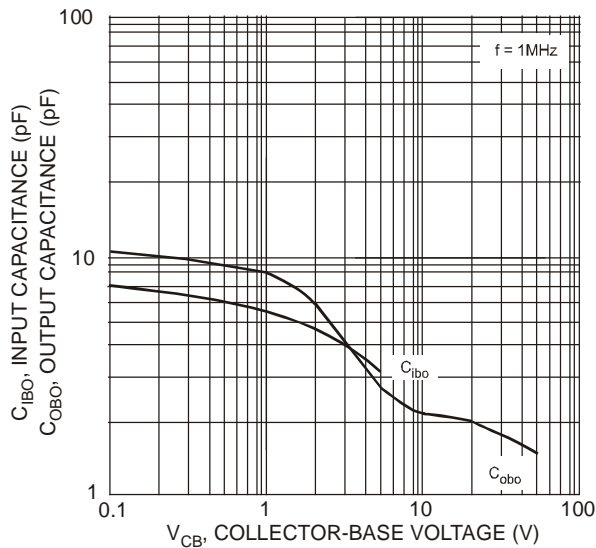


Fig. 6, Input and Output Capacitance vs. Collector-Base Voltage (PNP-3906)

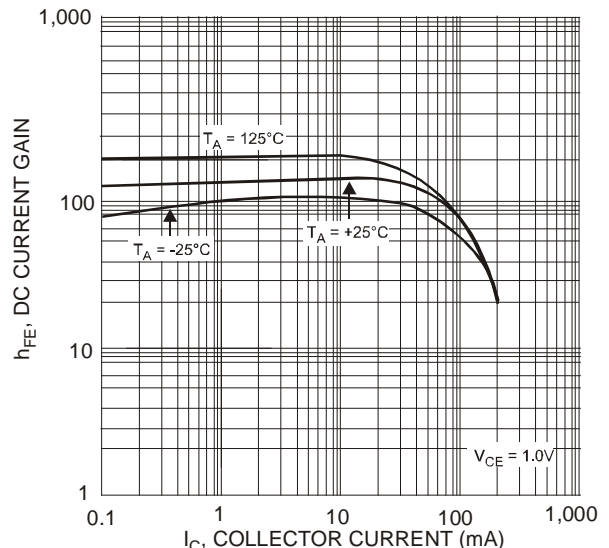


Fig. 7, Typical DC Current Gain vs. Collector Current (PNP-3906)

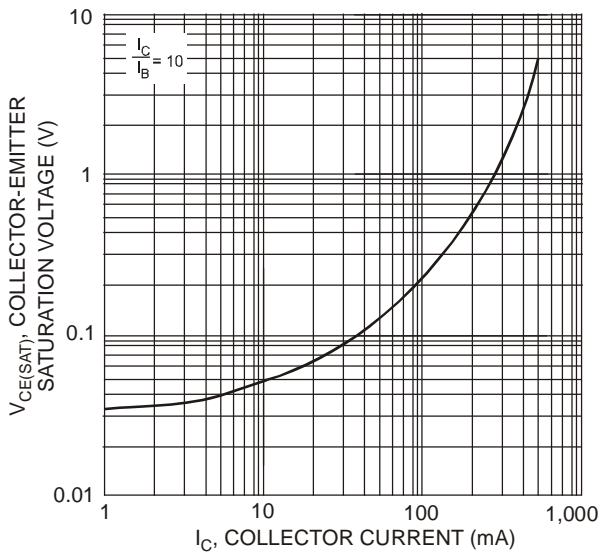


Fig. 8, Typical Collector-Emitter Saturation Voltage vs. Collector Current (PNP-3906)

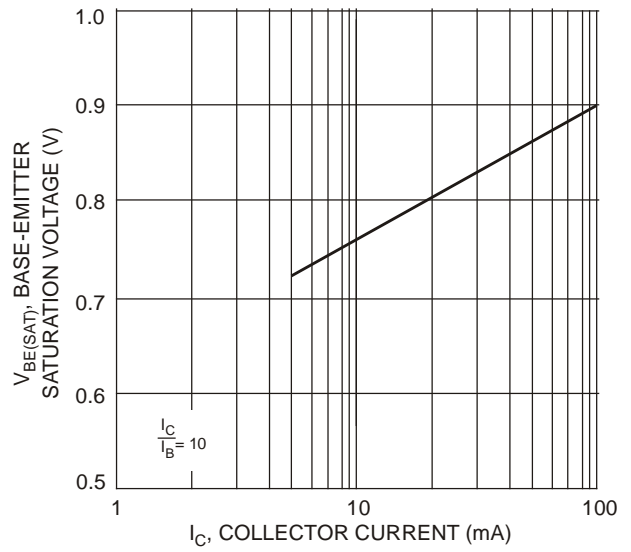
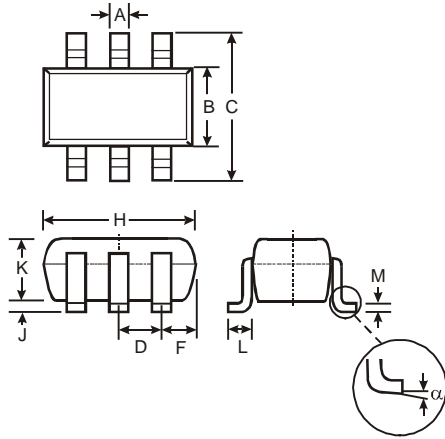


Fig. 9, Typical Base-Emitter Saturation Voltage vs. Collector Current (PNP-3906)

Package Outline Dimensions

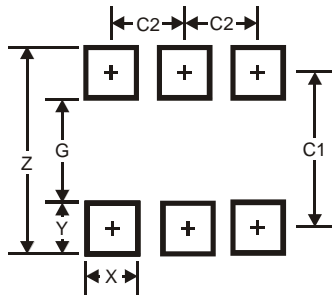
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.



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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