

COMPLEMENTARY NPN / PNP SMALL SIGNAL SURFACE MOUNT TRANSISTOR
Features

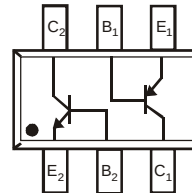
- Complementary Pair One 3904-Type NPN
One 3906-Type PNP
- Epitaxial Planar Die Construction
- Ideal for Low Power Amplification and Switching
- Ultra-Small Surface Mount Package
- Lead Free/RoHS Compliant (Note 3)**
- "Green" Device (Note 4 and 5)**



Top View

Mechanical Data

- Case: SOT-363
- Case Material: Molded Plastic, "Green" Molding Compound, Note 5. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020D
- Terminals: Matte Tin Finish annealed over Alloy 42 leadframe (Lead Free Plating) Solderable per MIL-STD-202, Method 208
- Terminal Connections: See Diagram
- Marking Information: See Page 5
- Ordering Information: See Page 5
- Weight: 0.006 grams (approximate)


 E1, B1, C1 = PNP3906 Section
 E2, B2, C2 = NPN3904 Section

Maximum Ratings, NPN 3904 Section @T_A = 25°C unless otherwise specified

Characteristic	Symbol	NPN 3904 Section	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 - Continuous (Note 1)	I _C	200	mA

Maximum Ratings, PNP 3906 Section @T_A = 25°C unless otherwise specified

Characteristic	Symbol	PNP 3906 Section	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 - Continuous (Note 1)	I _C	-200	mA

Thermal Characteristics, Total Device

Power Dissipation (Note 1, 2)	P _D	200	mW
Thermal Resistance, Junction to Ambient (Note 1)	R _{θJA}	625	°C/W
Operating and Storage Temperature Range	T _J , T _{STG}	-55 to +150	°C

- Notes:
- Device mounted on FR-4 PCB, 1 inch x 0.85 inch x 0.062 inch; pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.
 - Maximum combined dissipation.
 - No purposefully added lead.
 - Diodes Inc.'s "Green" policy can be found on our website at http://www.diodes.com/products/lead_free/index.php.
 - Product manufactured with Date Code UO (week 40, 2007) and newer are built with Green Molding Compound. Product manufactured prior to Date Code UO are built with Non-Green Molding Compound and may contain Halogens or Sb2O3 Fire Retardants.

Electrical Characteristics, NPN 3904 Section @T_A = 25°C unless otherwise specified

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 6)					
Collector-Base Breakdown Voltage	V _{(BR)CBO}	60	—	V	I _C = 10μA, I _E = 0
Collector-Emitter Breakdown Voltage	V _{(BR)CEO}	40	—	V	I _C = 1.0mA, I _B = 0
Emitter-Base Breakdown Voltage	V _{(BR)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)					
DC Current Gain	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	V _{CE} = 20V, I _C = 20mA, f = 100MHz
Current Gain-Bandwidth Product	f _T	300	—	MHz	
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, V _{BE(off)} = - 0.5V, I _{B1} = 1.0mA
Rise Time	t _r	—	35	ns	
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. Short duration pulse test used to minimize self-heating effect.

Electrical Characteristics, PNP 3906 Section @T_A = 25°C unless otherwise specified

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 6)					
Collector-Base Breakdown Voltage	V _{(BR)CBO}	-40	—	V	I _C = -10μA, I _E = 0
Collector-Emitter Breakdown Voltage	V _{(BR)CEO}	-40	—	V	I _C = -1.0mA, I _B = 0
Emitter-Base Breakdown Voltage	V _{(BR)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)					
DC Current Gain	h _{FE}	60	—	—	I _C = -100μA, V _{CE} = -1.0V
		80	—		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)}	—	-0.25 -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	V _{CE} = -20V, I _C = -10mA, f = 100MHz
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	

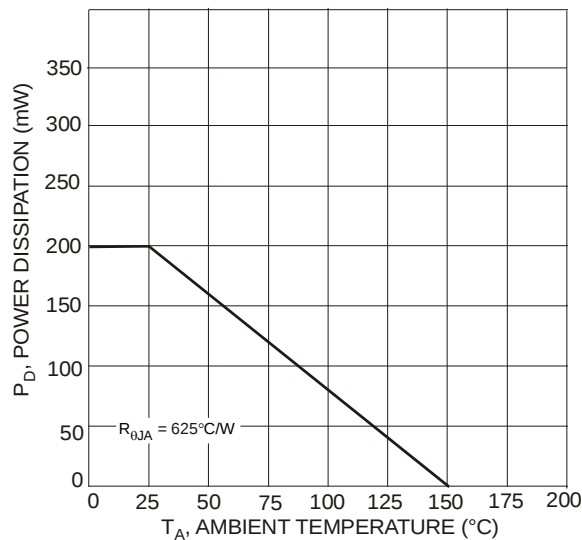


Fig. 1 Power Dissipation vs. Ambient Temperature (Total Device, Note 1)

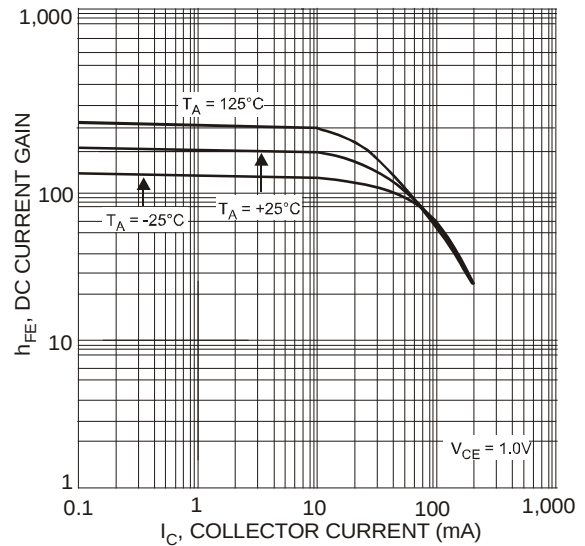


Fig. 2 Typical DC Current Gain vs. Collector Current (NPN-3904)

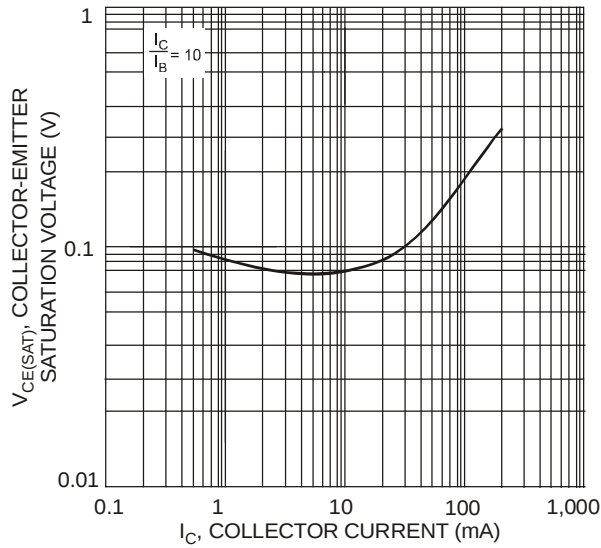


Fig. 3 Typical Collector-Emitter Saturation Voltage vs. Collector Current (NPN-3904)

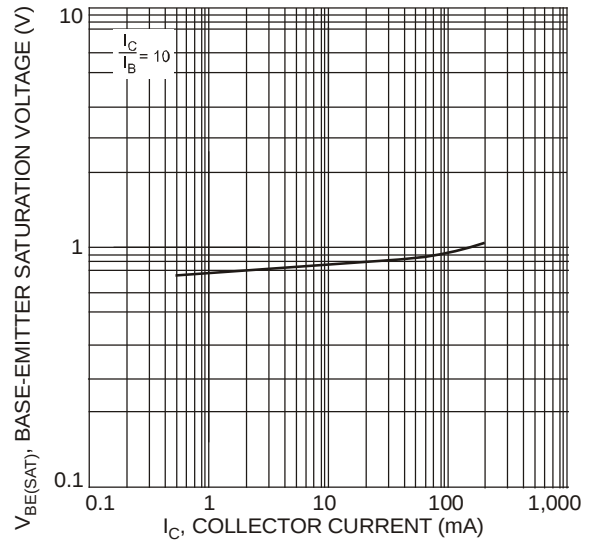


Fig. 4 Typical Base-Emitter Saturation Voltage vs. Collector Current (NPN-3904)

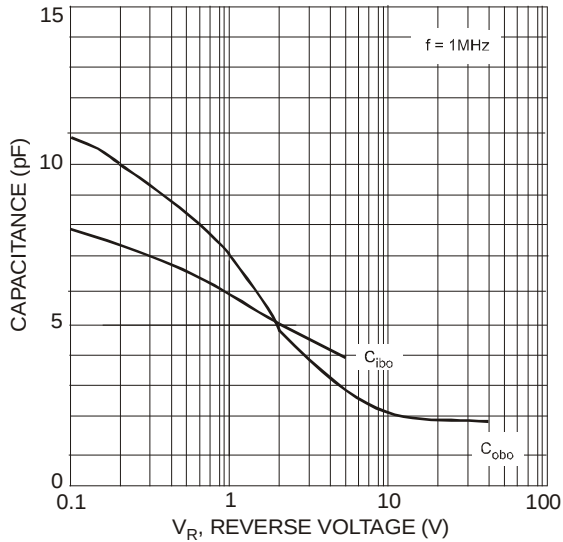


Fig. 5 Typical Capacitance Characteristics (NPN-3904)

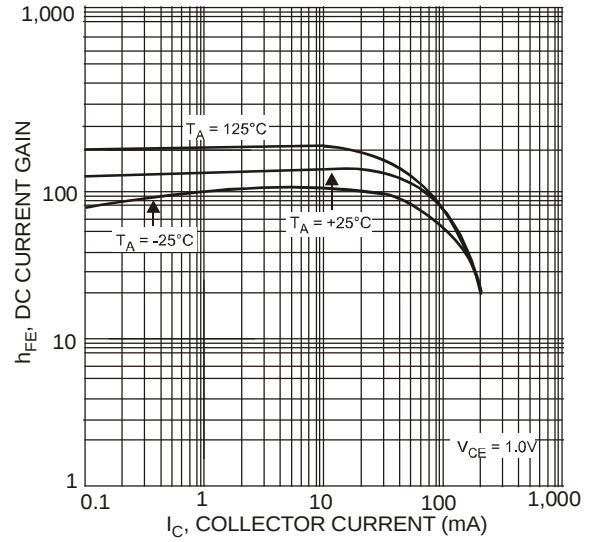


Fig. 6 Typical DC Current Gain vs. Collector Current (PNP-3906)

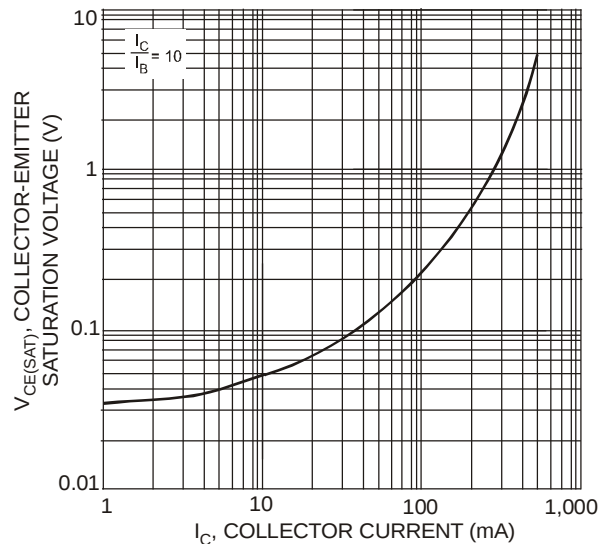


Fig. 7 Typical Collector-Emitter Saturation Voltage vs. Collector Current (PNP-3906)

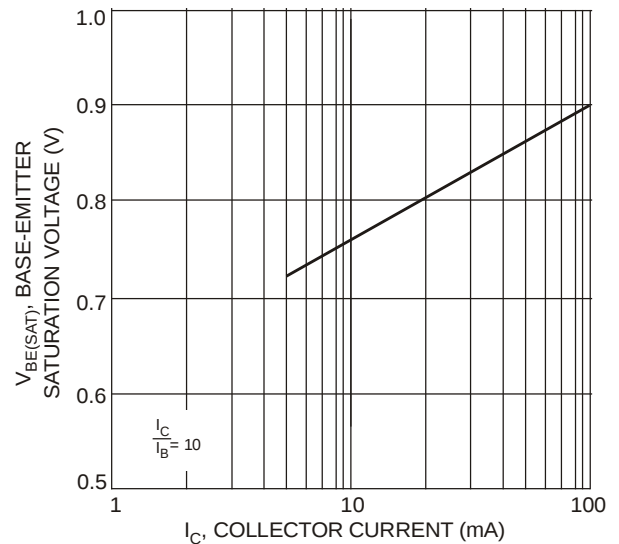


Fig. 8 Typical Base-Emitter Saturation Voltage vs. Collector Current (PNP-3906)

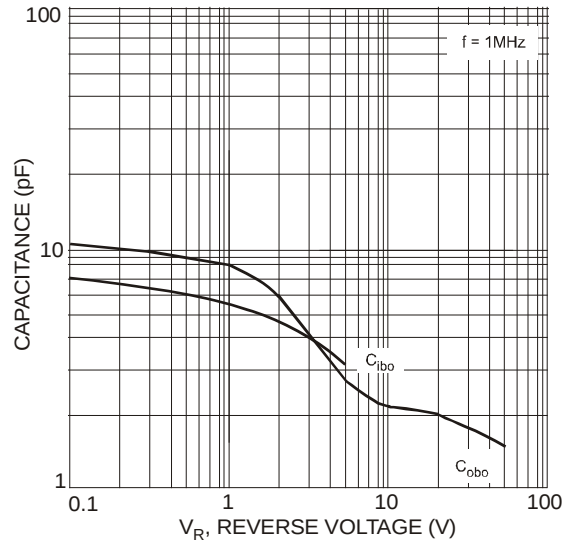


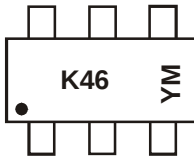
Fig. 9 Typical Capacitance Characteristics (PNP-3906)

Ordering Information (Note 7)

Part Number	Case	Packaging
MMDT3946-7-F	SOT-363	3000/Tape & Reel

 Notes: 7. For packaging details, go to our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

Marking Information



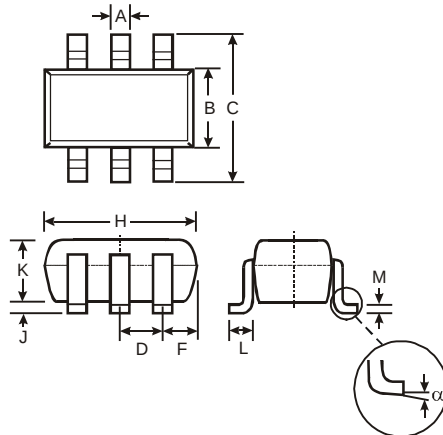
K46 = Product Type Marking Code
 YM = Date Code Marking
 Y = Year (ex: N = 2002)
 M = Month (ex: 9 = September)

Date Code Key

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Code	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	Z	A	B	C

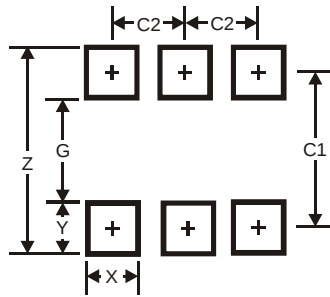
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	O	N	D

Package Outline Dimensions



SOT-363		
Dim	Min	Max
A	0.10	0.30
B	1.15	1.35
C	2.00	2.20
D	0.65 Typ	
F	0.40	0.45
H	1.80	2.20
J	0	0.10
K	0.90	1.00
L	0.25	0.40
M	0.10	0.22
α	0°	8°
All Dimensions in mm		

Suggested Pad Layout



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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