

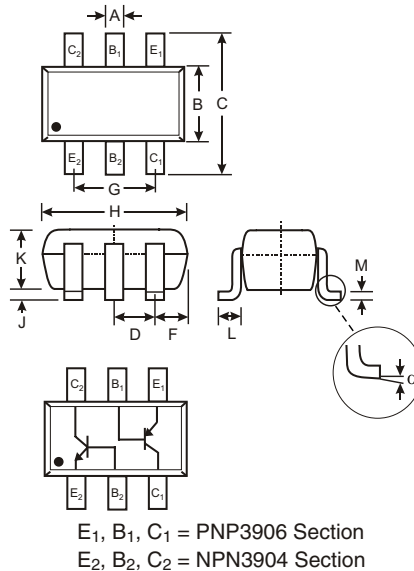
## COMPLEMENTARY NPN / PNP SMALL SIGNAL SURFACE MOUNT TRANSISTOR

### 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

### Mechanical Data

- Case: SOT-363, Molded Plastic
- Case material - UL Flammability Rating Classification 94V-0
- Moisture sensitivity: Level 1 per J-STD-020A
- Terminals: Solderable per MIL-STD-202, Method 208
- Terminal Connections: See Diagram
- Marking (See Page 2): K46
- Ordering & Date Code Information: See Page 2
- Weight: 0.006 grams (approx.)



SOT-363		
Dim	Min	Max
A	0.10	0.30
B	1.15	1.35
C	2.00	2.20
D	0.65 Nominal	
F	0.30	0.40
H	1.80	2.20
J	—	0.10
K	0.90	1.00
L	0.25	0.40
M	0.10	0.25
$\alpha$	0°	8°
All Dimensions in mm		

### Maximum Ratings, NPN 3904 Section @ $T_A = 25^\circ\text{C}$ unless otherwise specified

Characteristic	Symbol	NPN 3904 Section	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 (Note 1, 2)	$I_C$	200	mA
Power Dissipation (Note 1)	$P_d$	200	mW
Thermal Resistance, Junction to Ambient (Note 1)	$R_{\theta JA}$	625	$^\circ\text{C/W}$

### Maximum Ratings, PNP 3906 Section @ $T_A = 25^\circ\text{C}$ unless otherwise specified

Characteristic	Symbol	PNP 3906 Section	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 (Note 1)	$I_C$	-200	mA
Power Dissipation (Note 1, 2)	$P_d$	200	mW
Thermal Resistance, Junction to Ambient (Note 1)	$R_{\theta JA}$	625	$^\circ\text{C/W}$

- Notes:
1. 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>.
  2. Maximum combined dissipation.

**Electrical Characteristics, NPN 3904 Section**

 @ T<sub>A</sub> = 25°C unless otherwise specified

Characteristic	Symbol	Min	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS</b> (Note 3)					
Collector-Base Breakdown Voltage	V <sub>(BR)CBO</sub>	60	—	V	I <sub>C</sub> = 10μA, I <sub>E</sub> = 0
Collector-Emitter Breakdown Voltage	V <sub>(BR)CEO</sub>	40	—	V	I <sub>C</sub> = 1.0mA, I <sub>B</sub> = 0
Emitter-Base Breakdown Voltage	V <sub>(BR)EBO</sub>	5.0	6.0	V	I <sub>E</sub> = 10μA, I <sub>C</sub> = 0
Collector Cutoff Current	I <sub>CEX</sub>	—	50	nA	V <sub>CE</sub> = 30V, V <sub>EB(OFF)</sub> = 3.0V
Base Cutoff Current	I <sub>BL</sub>	—	50	nA	V <sub>CE</sub> = 30V, V <sub>EB(OFF)</sub> = 3.0V
<b>ON CHARACTERISTICS</b> (Note 3)					
DC Current Gain	h <sub>FE</sub>	40 70 100 60 30	— — 300 — —	—	I <sub>C</sub> = 100μA, V <sub>CE</sub> = 1.0V I <sub>C</sub> = 1.0mA, V <sub>CE</sub> = 1.0V I <sub>C</sub> = 10mA, V <sub>CE</sub> = 1.0V I <sub>C</sub> = 50mA, V <sub>CE</sub> = 1.0V I <sub>C</sub> = 100mA, V <sub>CE</sub> = 1.0V
Collector-Emitter Saturation Voltage	V <sub>CE(SAT)</sub>	—	0.20 0.30	V	I <sub>C</sub> = 10mA, I <sub>B</sub> = 1.0mA I <sub>C</sub> = 50mA, I <sub>B</sub> = 5.0mA
Base- Emitter Saturation Voltage	V <sub>BE(SAT)</sub>	0.65 —	0.85 0.95	V	I <sub>C</sub> = 10mA, I <sub>B</sub> = 1.0mA I <sub>C</sub> = 50mA, I <sub>B</sub> = 5.0mA
<b>SMALL SIGNAL CHARACTERISTICS</b>					
Output Capacitance	C <sub>obo</sub>	—	4.0	pF	V <sub>CB</sub> = 5.0V, f = 1.0MHz, I <sub>E</sub> = 0
Input Capacitance	C <sub>ibo</sub>	—	8.0	pF	V <sub>EB</sub> = 0.5V, f = 1.0MHz, I <sub>C</sub> = 0
Input Impedance	h <sub>ie</sub>	1.0	10	kΩ	V <sub>CE</sub> = 10V, I <sub>C</sub> = 1.0mA, f = 1.0kHz
Voltage Feedback Ratio	h <sub>re</sub>	0.5	8.0	x 10 <sup>-4</sup>	
Small Signal Current Gain	h <sub>fe</sub>	100	400	—	
Output Admittance	h <sub>oe</sub>	1.0	40	μS	
Current Gain-Bandwidth Product	f <sub>T</sub>	300	—	MHz	
Noise Figure	NF	—	5.0	dB	V <sub>CE</sub> = 5.0V, I <sub>C</sub> = 100μA, R <sub>S</sub> = 1.0kΩ, f = 1.0kHz
<b>SWITCHING CHARACTERISTICS</b>					
Delay Time	t <sub>d</sub>	—	35	ns	V <sub>CC</sub> = 3.0V, I <sub>C</sub> = 10mA, V <sub>BE(off)</sub> = - 0.5V, I <sub>B1</sub> = 1.0mA
Rise Time	t <sub>r</sub>	—	35	ns	
Storage Time	t <sub>s</sub>	—	200	ns	V <sub>CC</sub> = 3.0V, I <sub>C</sub> = 10mA, I <sub>B1</sub> = I <sub>B2</sub> = 1.0mA
Fall Time	t <sub>f</sub>	—	50	ns	

Note: 3. Short duration test pulse used to minimize self-heating effect.

## Electrical Characteristics, PNP 3906 Section

@ T<sub>A</sub> = 25°C unless otherwise specified

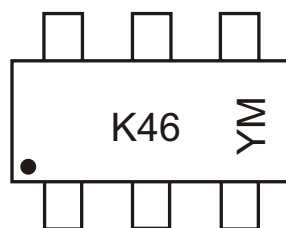
Characteristic	Symbol	Min	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS</b> (Note 3)					
Collector-Base Breakdown Voltage	V <sub>(BR)CBO</sub>	-40	—	V	I <sub>C</sub> = -10μA, I <sub>E</sub> = 0
Collector-Emitter Breakdown Voltage	V <sub>(BR)CEO</sub>	-40	—	V	I <sub>C</sub> = -1.0mA, I <sub>B</sub> = 0
Emitter-Base Breakdown Voltage	V <sub>(BR)EBO</sub>	-5.0	—	V	I <sub>E</sub> = -10μA, I <sub>C</sub> = 0
Collector Cutoff Current	I <sub>CEX</sub>	—	-50	nA	V <sub>CE</sub> = -30V, V <sub>EB(OFF)</sub> = -3.0V
Base Cutoff Current	I <sub>BL</sub>	—	-50	nA	V <sub>CE</sub> = -30V, V <sub>EB(OFF)</sub> = -3.0V
<b>ON CHARACTERISTICS</b> (Note 3)					
DC Current Gain	h <sub>FE</sub>	60 80 100 60 30	— — 300 — —	—	I <sub>C</sub> = -100μA, V <sub>CE</sub> = -1.0V I <sub>C</sub> = -1.0mA, V <sub>CE</sub> = -1.0V I <sub>C</sub> = -10mA, V <sub>CE</sub> = -1.0V I <sub>C</sub> = -50mA, V <sub>CE</sub> = -1.0V I <sub>C</sub> = -100mA, V <sub>CE</sub> = -1.0V
Collector-Emitter Saturation Voltage	V <sub>CE(SAT)</sub>	—	-0.25 -0.40	V	I <sub>C</sub> = -10mA, I <sub>B</sub> = -1.0mA I <sub>C</sub> = -50mA, I <sub>B</sub> = -5.0mA
Base- Emitter Saturation Voltage	V <sub>BE(SAT)</sub>	-0.65 —	-0.85 -0.95	V	I <sub>C</sub> = -10mA, I <sub>B</sub> = -1.0mA I <sub>C</sub> = -50mA, I <sub>B</sub> = -5.0mA
<b>SMALL SIGNAL CHARACTERISTICS</b>					
Output Capacitance	C <sub>obo</sub>	—	4.5	pF	V <sub>CB</sub> = -5.0V, f = 1.0MHz, I <sub>E</sub> = 0
Input Capacitance	C <sub>ibo</sub>	—	10	pF	V <sub>EB</sub> = -0.5V, f = 1.0MHz, I <sub>C</sub> = 0
Input Impedance	h <sub>ie</sub>	2.0	12	kΩ	V <sub>CE</sub> = 10V, I <sub>C</sub> = 1.0mA, f = 1.0kHz
Voltage Feedback Ratio	h <sub>re</sub>	0.1	10	x 10 <sup>-4</sup>	
Small Signal Current Gain	h <sub>fe</sub>	100	400	—	
Output Admittance	h <sub>oe</sub>	3.0	60	μS	
Current Gain-Bandwidth Product	f <sub>T</sub>	250	—	MHz	
Noise Figure	NF	—	4.0	dB	V <sub>CE</sub> = -5.0V, I <sub>C</sub> = -100μA, R <sub>S</sub> = 1.0kΩ, f = 1.0kHz
<b>SWITCHING CHARACTERISTICS</b>					
Delay Time	t <sub>d</sub>	—	35	ns	V <sub>CC</sub> = -3.0V, I <sub>C</sub> = -10mA, V <sub>BE(off)</sub> = 0.5V, I <sub>B1</sub> = -1.0mA
Rise Time	t <sub>r</sub>	—	35	ns	
Storage Time	t <sub>s</sub>	—	225	ns	V <sub>CC</sub> = -3.0V, I <sub>C</sub> = -10mA, I <sub>B1</sub> = I <sub>B2</sub> = -1.0mA
Fall Time	t <sub>f</sub>	—	75	ns	

## Ordering Information (Note 4)

Device	Packaging	Shipping
MMDT3946-7	SOT-363	3000/Tape & Reel

- Notes: 3. Short duration test pulse used to minimize self-heating effect.  
4. For Packaging Details, go to our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

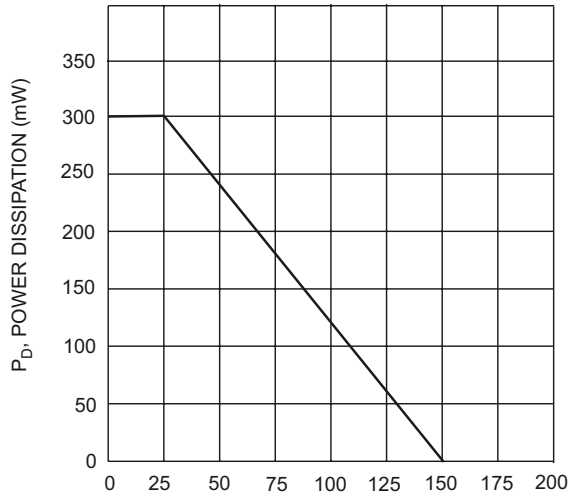
## Marking Information



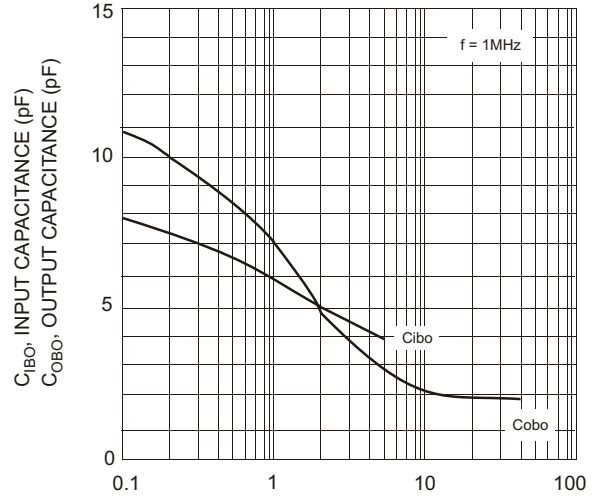
K46 = Product Type Marking Code  
YM = Date Code Marking  
Y = Year ex: N = 2002  
M = Month ex: 9 = September

### Date Code Key

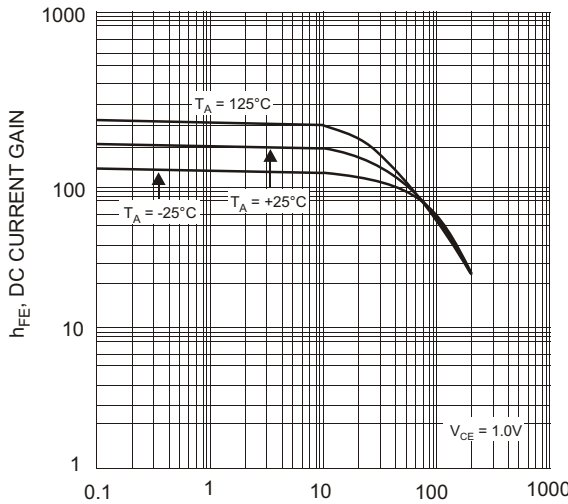
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Code	J	K	L	M	N	P	R	S	T	U	V	W
Month	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	O	N	D



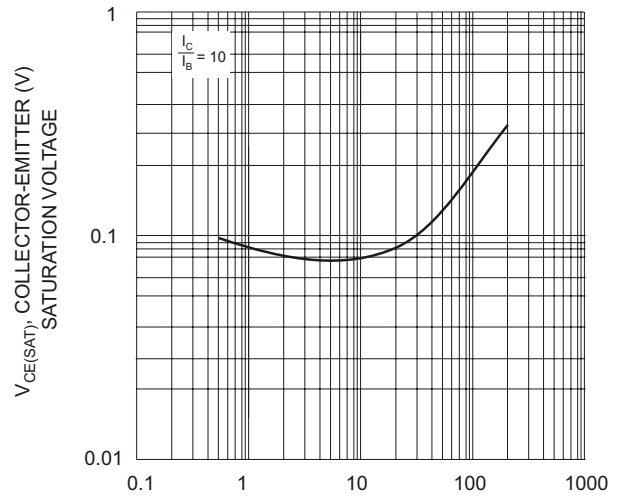
$T_A$ , AMBIENT TEMPERATURE (°C)  
Fig. 1, Max Power Dissipation vs Ambient Temperature (Total Device)



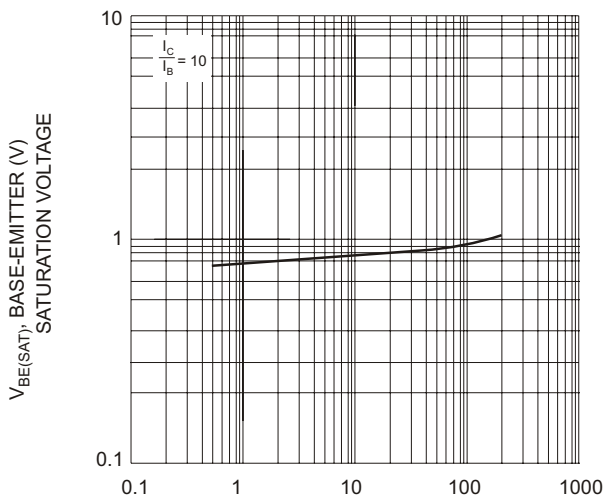
$V_{CB}$ , COLLECTOR-BASE VOLTAGE (V)  
Fig. 2, Input and Output Capacitance vs. Collector-Base Voltage (NPN-3904)



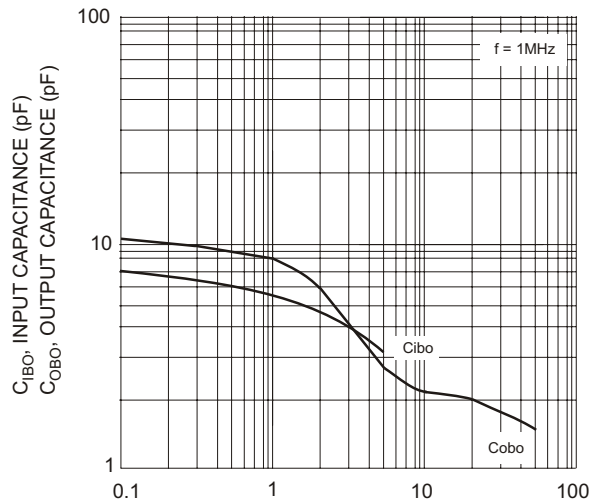
$I_C$ , COLLECTOR CURRENT (mA)  
Fig. 3, Typical DC Current Gain vs Collector Current (NPN-3904)



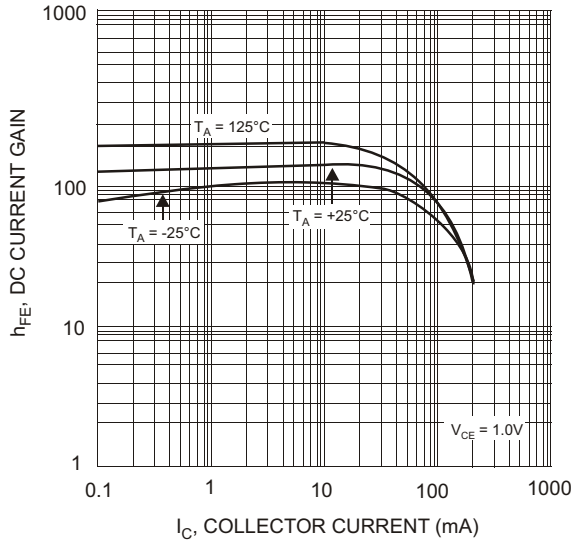
$V_{CE(SAT)}$ , COLLECTOR-EMITTER SATURATION VOLTAGE  
 $I_C$ , COLLECTOR CURRENT (mA)  
Fig. 4, Typical Collector-Emitter Saturation Voltage vs. Collector Current (NPN-3904)



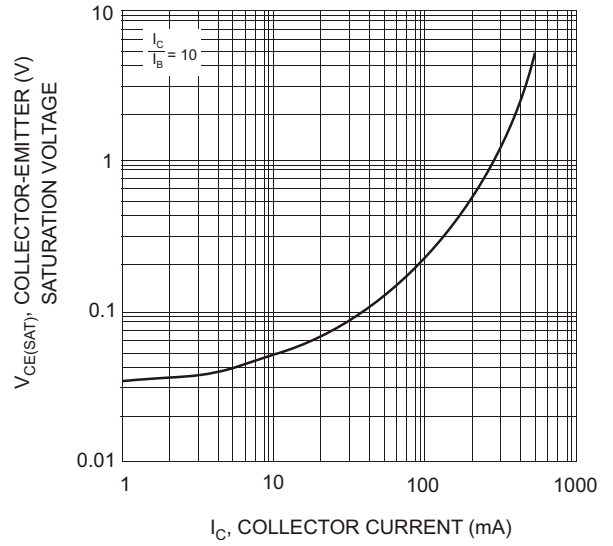
$V_{BE(SAT)}$ , BASE-EMITTER SATURATION VOLTAGE  
 $I_C$ , COLLECTOR CURRENT (mA)  
Fig. 5, Typical Base-Emitter Saturation Voltage vs. Collector Current (NPN-3904)



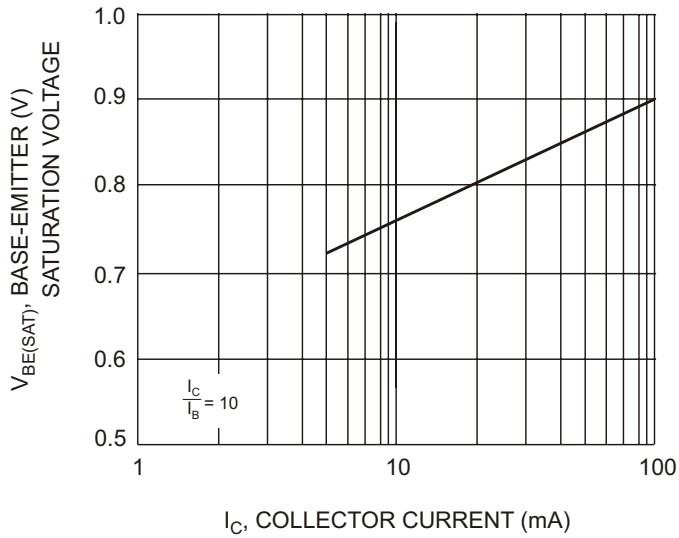
$V_{CB}$ , COLLECTOR-BASE VOLTAGE (V)  
Fig. 6, Input and Output Capacitance vs. Collector-Base Voltage (PNP-3906)



$I_C$ , COLLECTOR CURRENT (mA)  
Fig. 7, Typical DC Current Gain vs Collector Current (PNP-3906)



$I_C$ , COLLECTOR CURRENT (mA)  
Fig. 8, Typical Collector-Emitter Saturation Voltage vs. Collector Current (PNP-3906)



$I_C$ , COLLECTOR CURRENT (mA)  
Fig. 9, Typical Base-Emitter Saturation Voltage vs. Collector Current (PNP-3906)