

**PNP/NPN MULTI-CHIP TRANSISTOR**

**REVERSE VOLTAGE – 100 Volts**  
**FORWARD CURRENT – 0.15 Amperes**

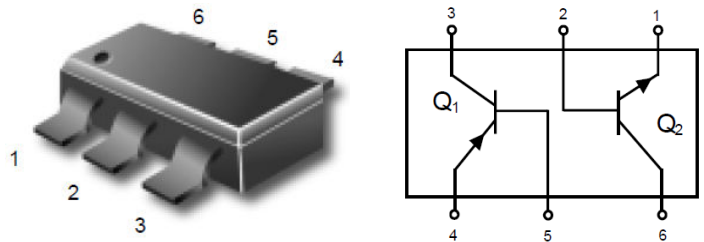
**FEATURES**

- Surface mount device
- $h_{FE}$ , 100 - 300
- Low  $V_{CE(SAT)}$ ,  $\leq 0.4$  V
- Simplifies Circuit design
- Reduces Board Space
- Reduces Component Count

**MECHANICAL DATA**

- Case: SOT-363 plastic

**SOT-363**



\*Q1 PNP  
 Q2 NPN

**MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS**

Ratings at 25°C ambient temperature unless otherwise specified.

**ABSOLUTE RATINGS**

PARAMETER		SYMBOL	VALUE	UNIT
Collector-emitter voltage	NPN	$V_{CEO}$	40	Vdc
	PNP		-40	
Collector-base voltage	NPN	$V_{CBO}$	60	Vdc
	PNP		-40	
Emitter-base voltage	NPN	$V_{EBO}$	6.0	Vdc
	PNP		-5.0	
Collector current-continuous	NPN	$I_C$	200	mAdc
	PNP		-200	

**THERMAL CHARACTERISTICS**

PARAMETER		SYMBOL	MAX.	UNIT
Total package dissipation (Note 1)	$T_J = 25^\circ\text{C}$	$P_D$	150	mW
Thermal resistance junction to ambient		$R_{thJA}$	833	$^\circ\text{C/W}$
Junction and storage temperature rang		$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$

**Note:**  
 1. Device mounted on FR4 glass epoxy printed circuit board using the minimum recommended footprint.

**REV-0, APR.-2015, KSTR10**

**ORDERING INFORMATION**

DEVICE	MARKING	SHIPPING
MMDT3946	46	3000/ Tape & Reel

**ELECTRICAL CHARACTERISTIC**  
**MMDT3946**



**OFF CHARACTERISTICS**

PARAMETER	TEST CONDITION		SYMBOL	MIN.	MAX	UNIT
Collector-emitter breakdown voltage (Note 2)	$I_C = 1.0 \text{ mAdc}, I_B = 0$	NPN	$V_{(BR)CEO}$	40	--	uA
	$I_C = -1.0 \text{ mAdc}, I_B = 0$	PNP		-40	--	
Collector-base breakdown voltage	$I_C = 10 \text{ uAdc}, I_E = 0$	NPN	$V_{(BR)CBO}$	60	--	
	$I_C = -10 \text{ uAdc}, I_E = 0$	PNP		-40	--	
Emitter-base breakdown voltage	$I_E = 10 \text{ uAdc}, I_C = 0$	NPN	$V_{(BR)EBO}$	6.0	--	V
	$I_E = -10 \text{ uAdc}, I_C = 0$	PNP		-5.0	--	
Base cutoff current	$V_{CE} = 30 \text{ Vdc}, V_{EB} = 3.0 \text{ Vdc}$	NPN	$I_{BL}$	--	50	nAdc
	$V_{CE} = -30 \text{ Vdc}, V_{EB} = -3.0 \text{ Vdc}$	PNP		--	-50	
Collector cutoff current	$V_{CE} = 30 \text{ Vdc}, V_{BE} = 3.0 \text{ Vdc}$	NPN	$I_{CEX}$	--	50	nAdc
	$V_{CE} = -30 \text{ Vdc}, V_{EB} = -3.0 \text{ Vdc}$	PNP		--	-50	

**ON CHARACTERISTICS** (Note 2)

PARAMETER	TEST CONDITION		SYMBOL	MIN.	MAX	UNIT
DC current gain	$I_C = 0.1 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$	NPN	$h_{FE}$	40	--	--
	$I_C = 1.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$			70	--	
	$I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$			100	300	
	$I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$			60	--	
	$I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$			30	--	
	$I_C = -0.1 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc}$	PNP		60	--	
	$I_C = -1.0 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc}$			80	--	
	$I_C = -10 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc}$			100	300	
	$I_C = -50 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc}$			60	--	
	$I_C = -100 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc}$			30	--	
Collector-emitter saturation voltage	$I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc}$	NPN	$V_{CE(SAT)}$	--	0.2	Vdc
	$I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc}$			--	0.3	
	$I_C = -10 \text{ mAdc}, I_B = -1.0 \text{ mAdc}$	PNP		--	-0.25	
	$I_C = -50 \text{ mAdc}, I_B = -5.0 \text{ mAdc}$			--	-0.4	
Base-emitter saturation voltage	$I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc}$	NPN	$V_{BE(SAT)}$	0.65	0.85	Vdc
	$I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc}$			--	0.95	
	$I_C = -10 \text{ mAdc}, I_B = -1.0 \text{ mAdc}$	PNP		-0.65	-0.85	
	$I_C = -50 \text{ mAdc}, I_B = -5.0 \text{ mAdc}$			--	-0.95	

**Note:**

2. Pulse Test: pulse width  $\leq 300 \text{ us}$ ; duty cycle  $\leq 2.0\%$ .



**ELECTRICAL CHARACTERISTIC**  
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**SMALL – SIGNAL CHARACTERISTICS**

PARAMETER	TEST CONDITION		SYMBOL	MIN.	MAX	UNIT
Current-gain-bandwidth product	$I_C = 10 \text{ mAdc}$ , $V_{CE} = 20 \text{ Vdc}$ , $f = 100 \text{ MHz}$	NPN	$f_T$	300	--	MHz
	$I_C = -10 \text{ mAdc}$ , $V_{CE} = -20 \text{ Vdc}$ , $f = 100 \text{ MHz}$	PNP		250	--	
Output capacitance	$V_{CB} = 5.0 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$	NPN	$C_{obo}$	--	4.0	pF
	$V_{CB} = -5.0 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$	PNP		--	4.5	
Input capacitance	$V_{CB} = 0.5 \text{ Vdc}$ , $I_C = 0$ , $f = 1.0 \text{ MHz}$	NPN	$C_{ibo}$	--	8.0	pF
	$V_{CB} = -0.5 \text{ Vdc}$ , $I_C = 0$ , $f = 1.0 \text{ MHz}$	PNP		--	10.0	
Input impedance	$V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$	NPN	$h_{ie}$	1.0	10	k $\Omega$
	$V_{CE} = -10 \text{ Vdc}$ , $I_C = -1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$	PNP		2.0	12	
Voltage feedback ratio	$V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$	NPN	$h_{re}$	0.5	8.0	$\times 10^{-4}$
	$V_{CE} = -10 \text{ Vdc}$ , $I_C = -1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$	PNP		0.1	10	
Small-signal current gain	$V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$	NPN	$h_{FE}$	100	400	--
	$V_{CE} = -10 \text{ Vdc}$ , $I_C = -1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$	PNP		100	400	
Output admittance	$V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$	NPN	$h_{oe}$	1.0	4.0	$\mu\text{mhos}$
	$V_{CE} = -10 \text{ Vdc}$ , $I_C = -1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$	PNP		3.0	60	
Noise figure	$V_{CE} = 5.0 \text{ Vdc}$ , $I_C = 100 \text{ uAdc}$ , $R_s = 1.0 \text{ k}\Omega$ , $f = 1.0 \text{ kHz}$	NPN	NF	--	5.0	dB
	$V_{CE} = -5.0 \text{ Vdc}$ , $I_C = -100 \text{ uAdc}$ , $R_s = 1.0 \text{ k}\Omega$ , $f = 1.0 \text{ kHz}$	PNP		--	4.0	

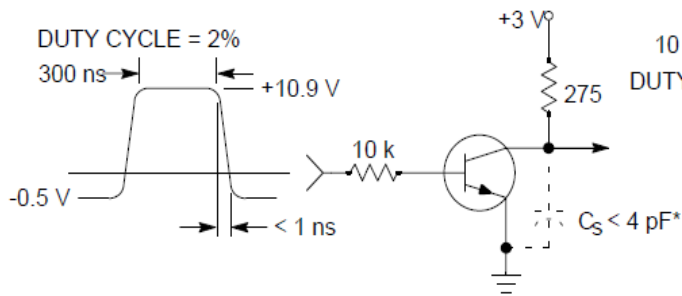
**SWITCHING CHARACTERISTICS**

PARAMETER	TEST CONDITION		SYMBOL	MIN.	MAX	UNIT
Delay time	$V_{CC} = 3.0 \text{ Vdc}$ , $V_{BE} = -0.5 \text{ Vdc}$	NPN	$t_d$	--	35	ns
	$V_{CC} = -3.0 \text{ Vdc}$ , $V_{BE} = -0.5 \text{ Vdc}$	PNP		--	35	
Rise time	$I_C = 10 \text{ mAdc}$ , $I_{B1} = 1.0 \text{ mAdc}$	NPN	$t_r$	--	35	
	$I_C = -10 \text{ mAdc}$ , $I_{B1} = -1.0 \text{ mAdc}$	PNP		--	35	
Storage time	$V_{CC} = 3.0 \text{ Vdc}$ , $V_{BE} = 10 \text{ mAdc}$	NPN	$t_s$	--	200	
	$V_{CC} = -3.0 \text{ Vdc}$ , $V_{BE} = -10 \text{ mAdc}$	PNP		--	225	
Fall time	$I_{B1} = I_{B2} = 1.0 \text{ mAdc}$	NPN	$t_f$	--	50	
	$I_{B1} = I_{B2} = -1.0 \text{ mAdc}$	PNP		--	75	

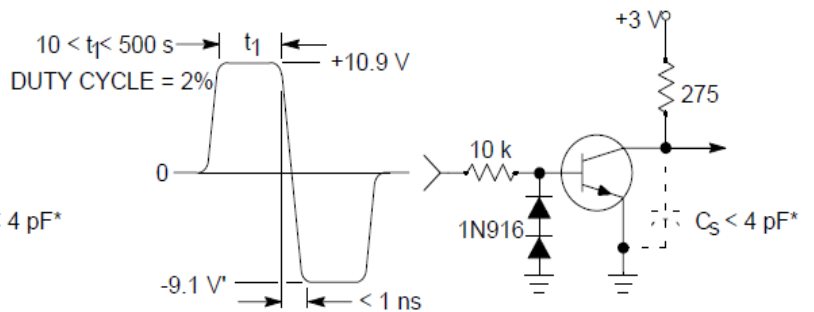
**ELECTRICAL CHARACTERISTIC CURVES**  
**MMDT3946**



**FIG.1 - Delay and rise time equivalent test circuit**

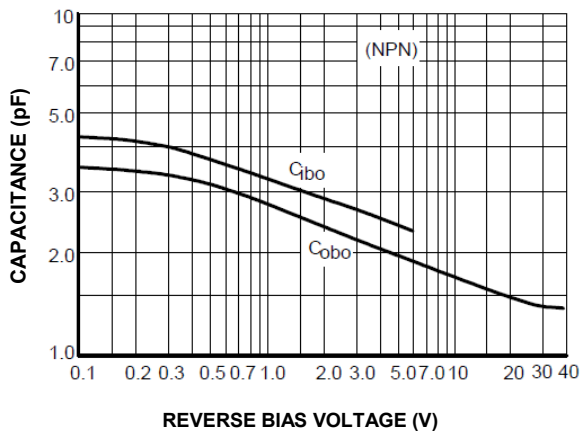


**FIG. 2 - Storage and fall time equivalent test circuit**

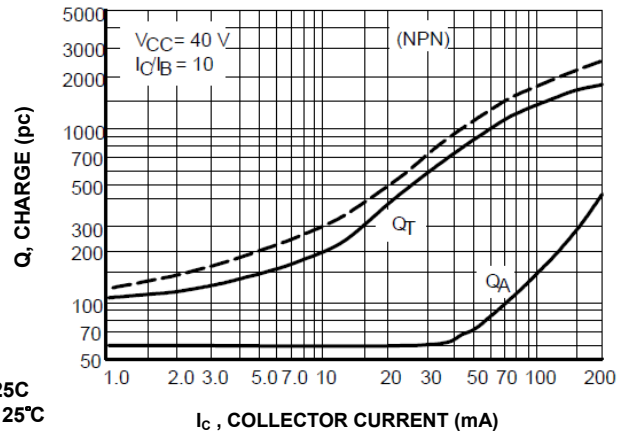


\* Total shunt capacitance of test jig and connectors

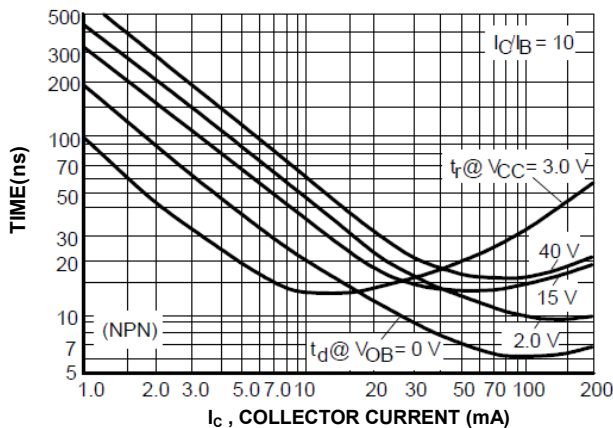
**FIG.3 - Capacitance**



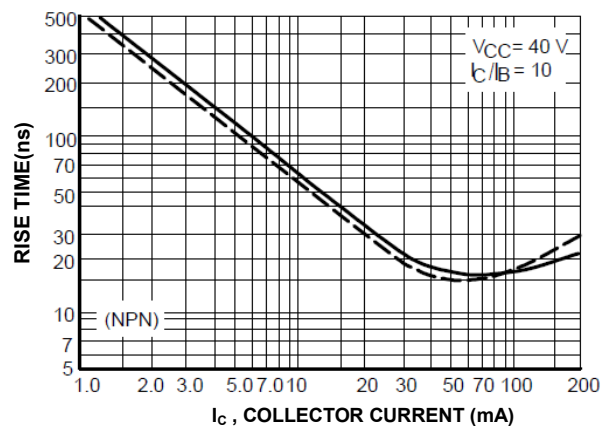
**FIG.4 - Charge data**



**FIG.5 - Turn ± on time**

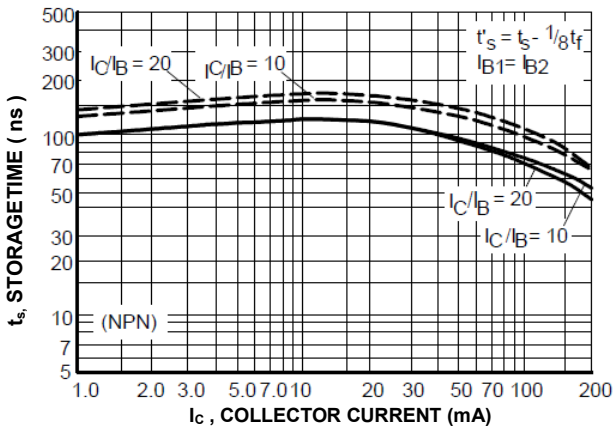


**FIG.6 - Rise time**

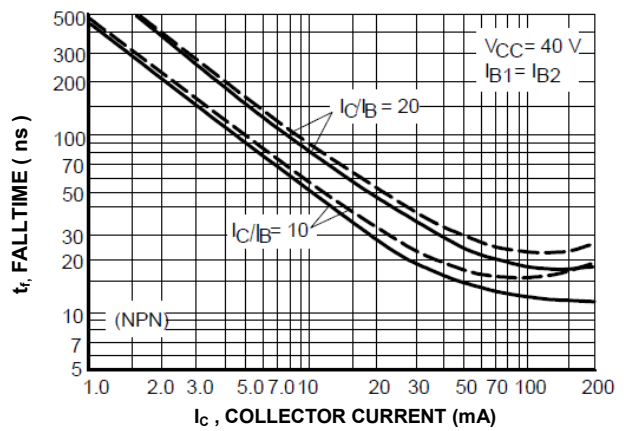


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**FIG.7 - Storage time**

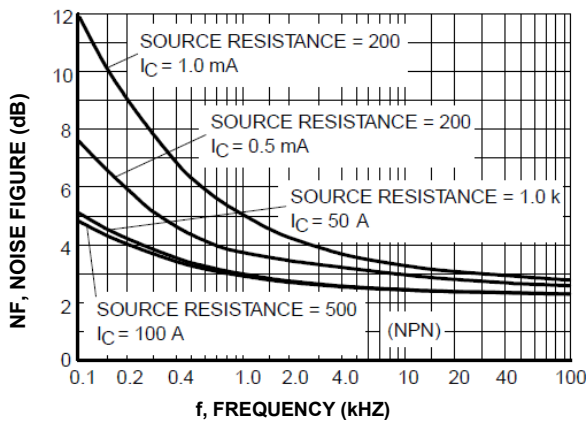


**FIG.8 - Fall time**

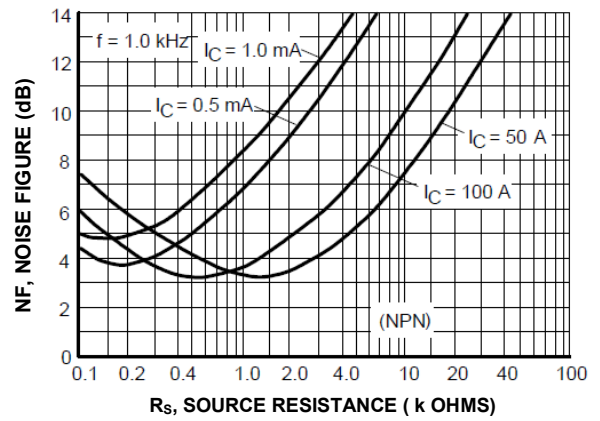


**TYPICAL AUDIO SMALL ± SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS**  
( $V_{CE} = 5.0 V_{dc}$ ,  $T_A = 25^\circ C$ , Bandwidth = 1.0 Hz)

**FIG.9 - Noise figure**



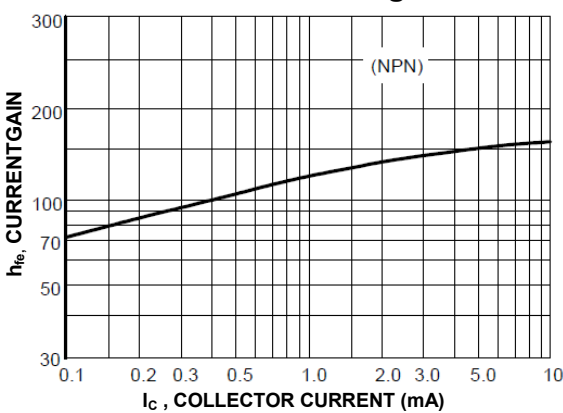
**FIG.10 - Noise figure**



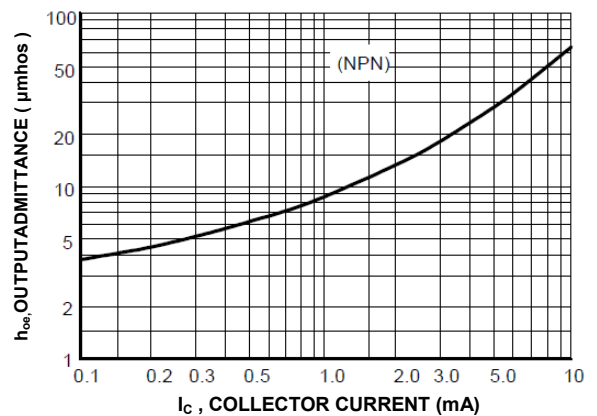
**h PARAMETERS**

( $V_{CE} = 10 V_{dc}$ ,  $f = 1.0 kHz$ ,  $T_A = 25^\circ C$ )

**FIG.11 - Current gain**



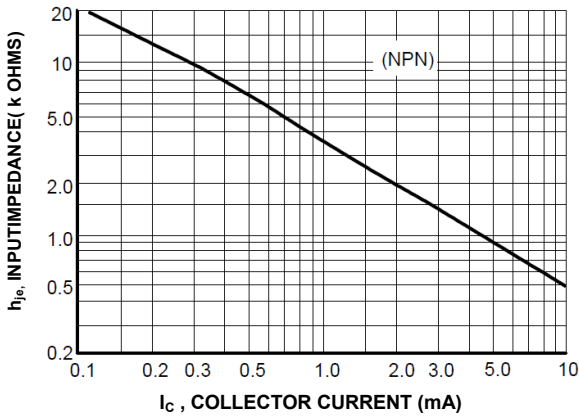
**FIG.12 - Out admittance**



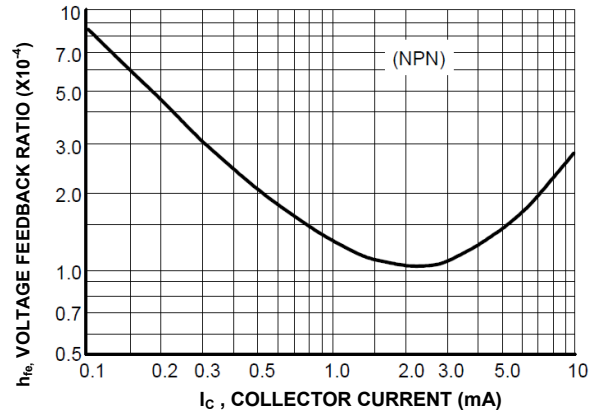
**ELECTRICAL CHARACTERISTIC CURVES**  
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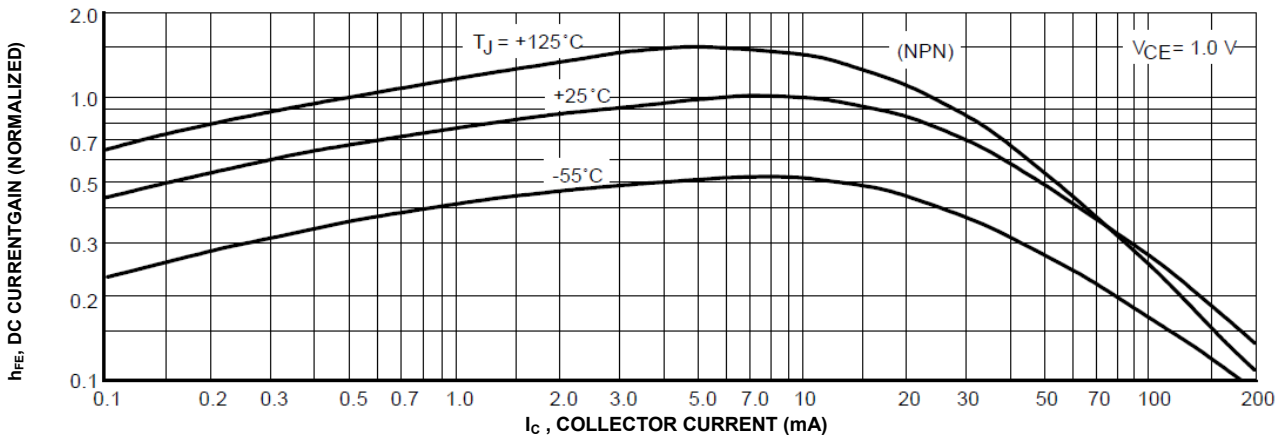
**FIG.13 - Input impedance**



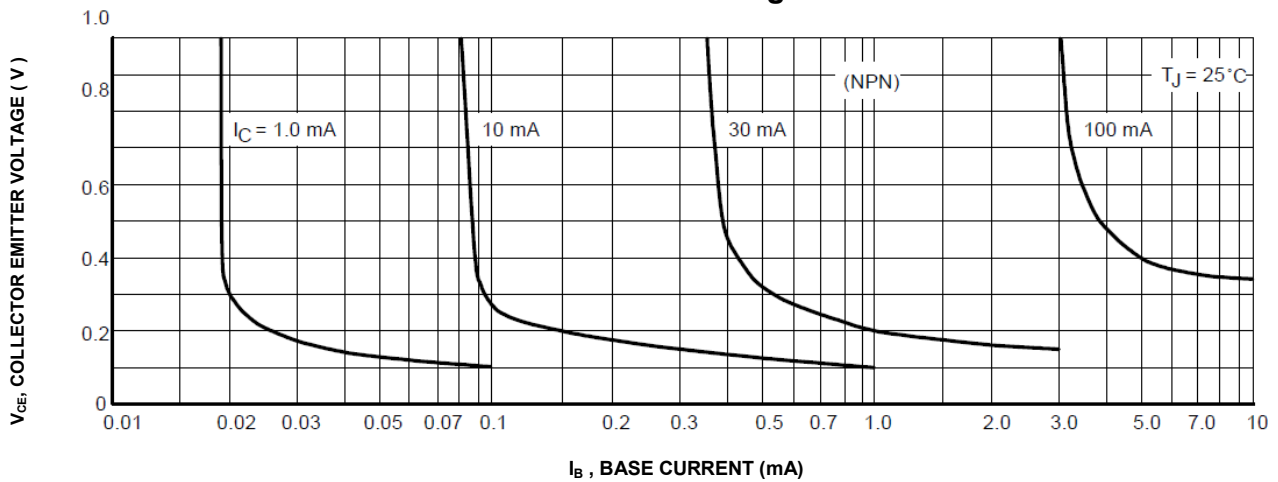
**FIG.14 - Voltage feedback ratio**



**FIG.15 - DC current gain**



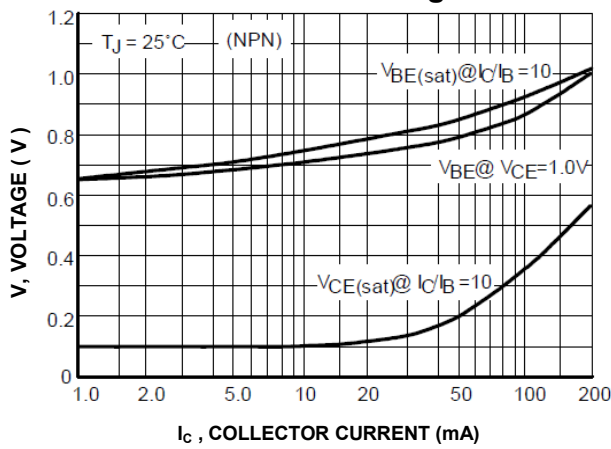
**FIG.16 - Current gain**



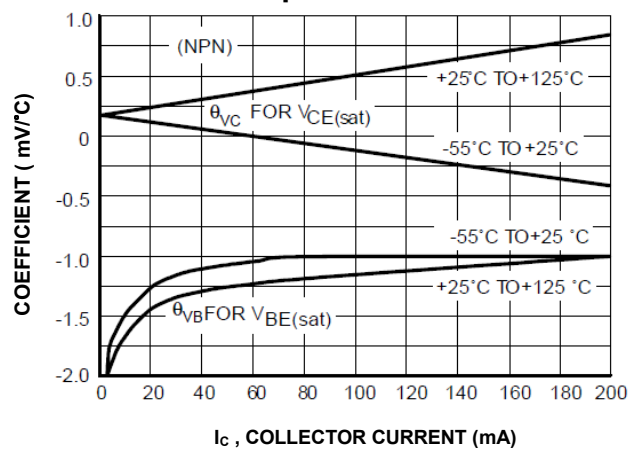
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**MMDT3946**



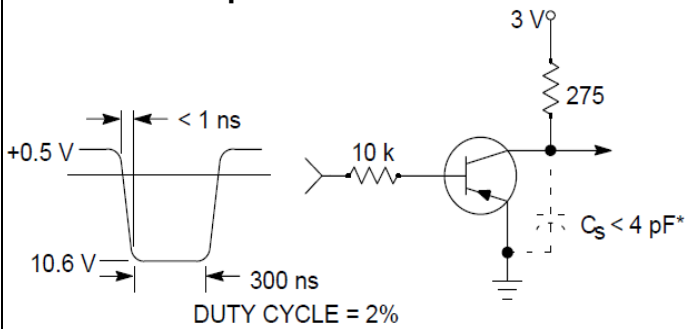
**FIG.17 - On voltages**



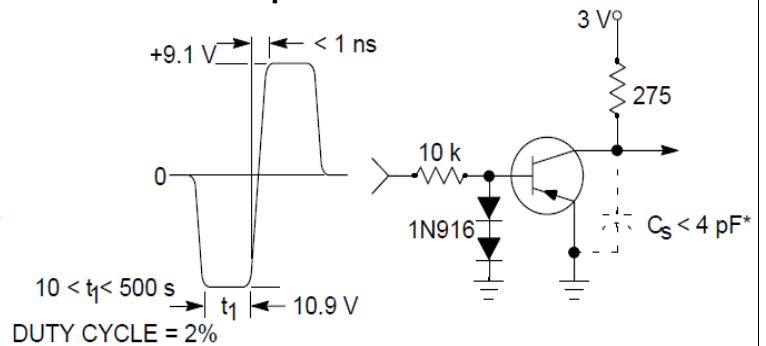
**FIG.18 - Temperature coefficients**



**FIG.19 - Delay and rise time equivalent test circuit**

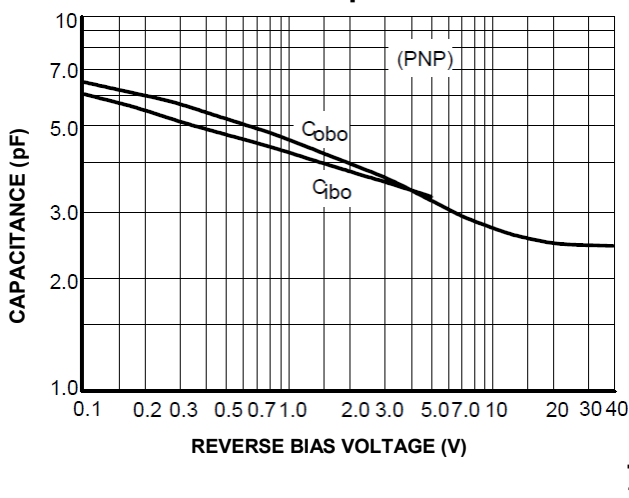


**FIG.20 - Storage and fall time equivalent test circuit**

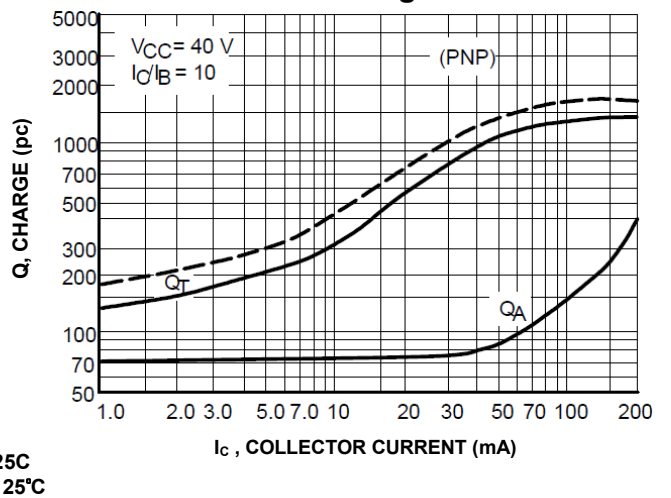


\* Total shunt capacitance of test jig and connectors

**FIG.21 - Capacitance**



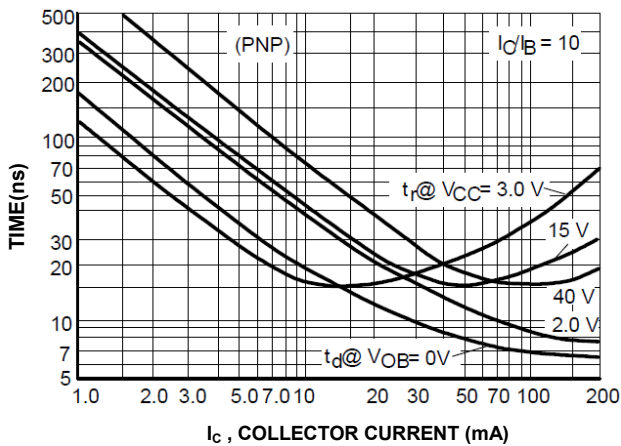
**FIG.22 - Charge data**



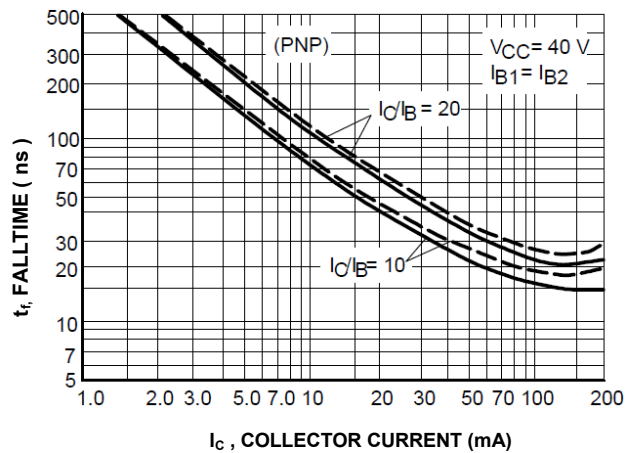
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**FIG. 23 - Turn - on time**

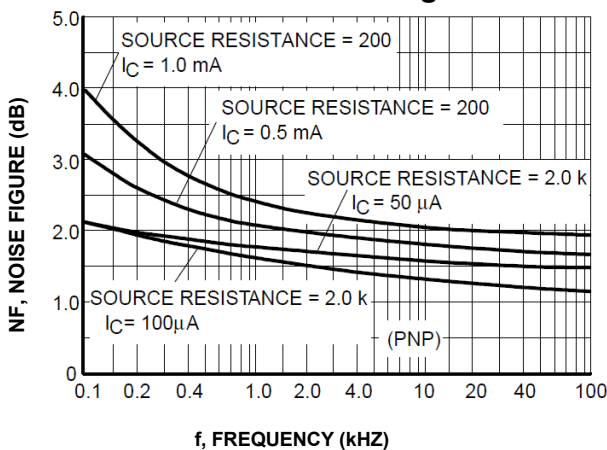


**FIG. 24 - Fall time**

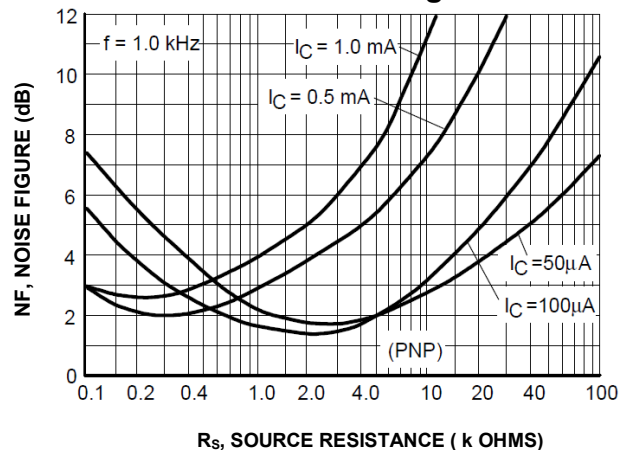


**TYPICAL AUDIO SMALL ± SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS**  
( $V_{CE} = \pm 5.0$  Vdc,  $T_A = 25^\circ\text{C}$ , Bandwidth = 1.0 Hz)

**FIG. 25 - Noise figure**



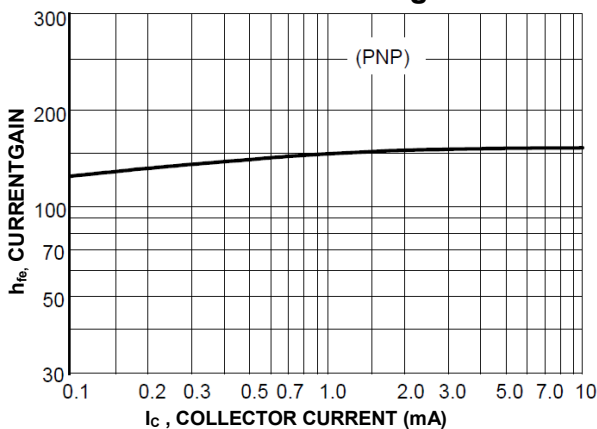
**FIG. 26 - Noise figure**



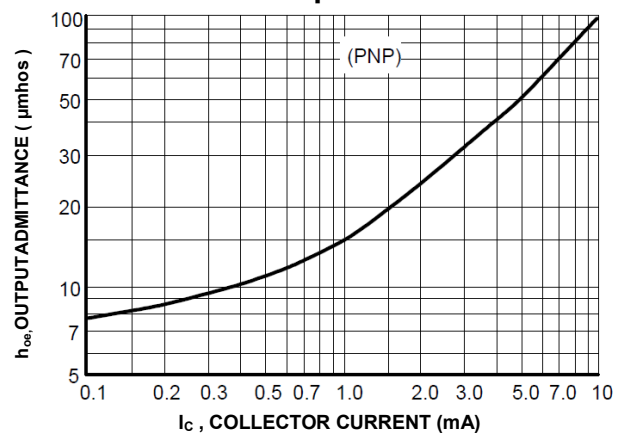
**h PARAMETERS**

( $V_{CE} = \pm 10$  Vdc,  $f = 1.0$  kHz,  $T_A = 25^\circ\text{C}$ )

**FIG. 27 - Current gain**



**FIG. 28 - Output Admittance**

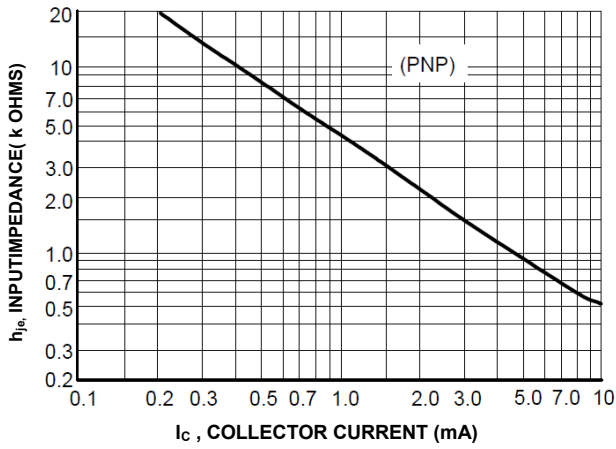




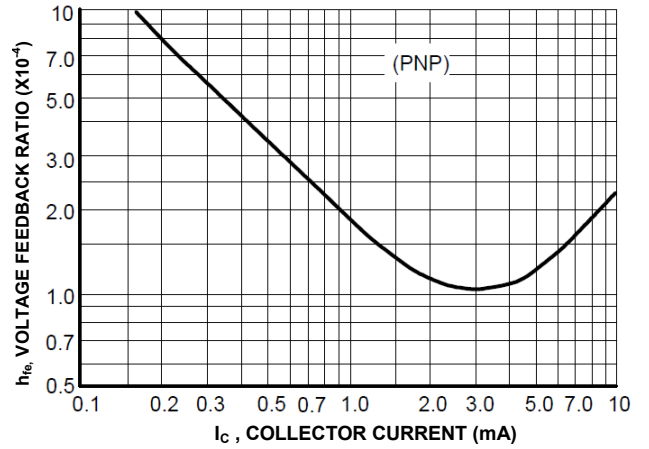
**ELECTRICAL CHARACTERISTIC CURVES**  
**MMDT3946**



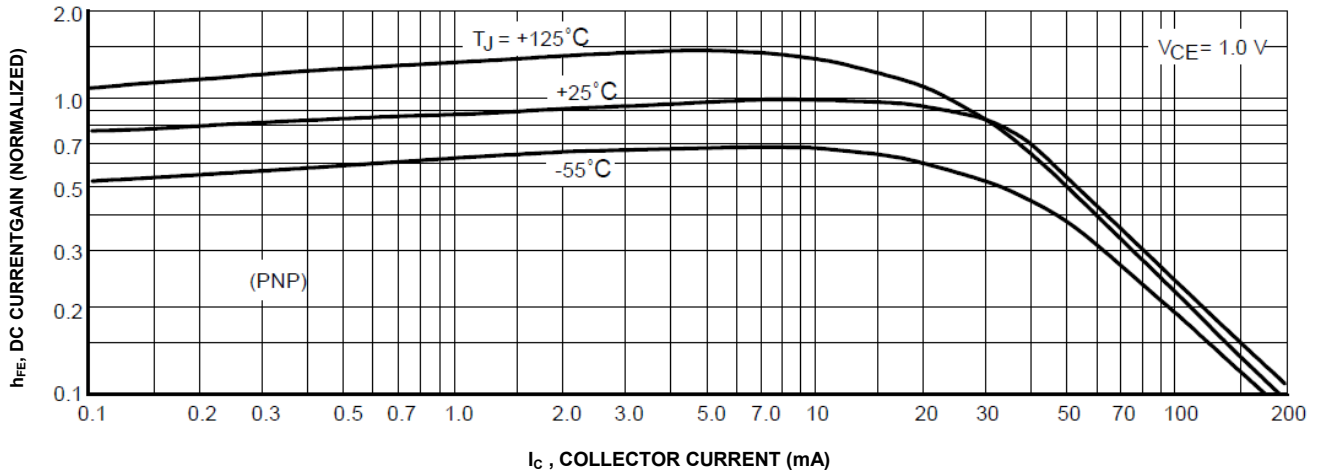
**FIG.29 - Input impedance**



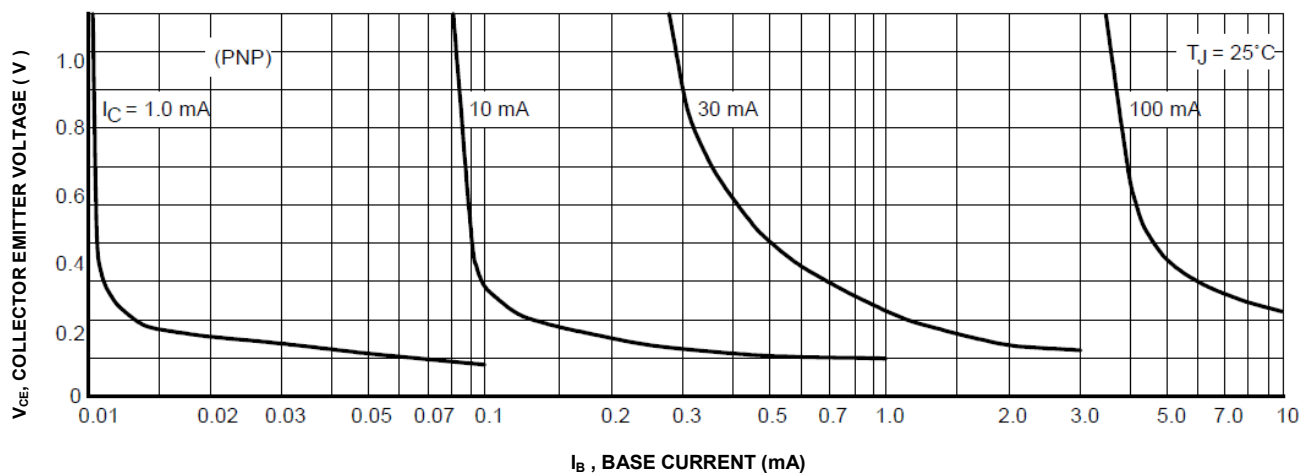
**FIG.30 - Voltage feedback ratio**



**FIG.31 - DC current gain**



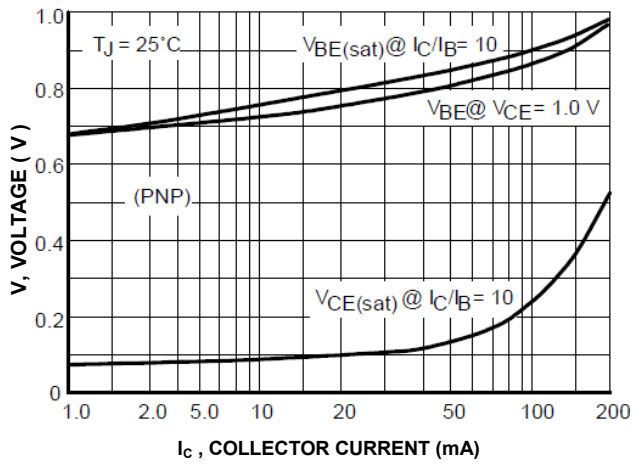
**FIG.32 - Collector saturation region**



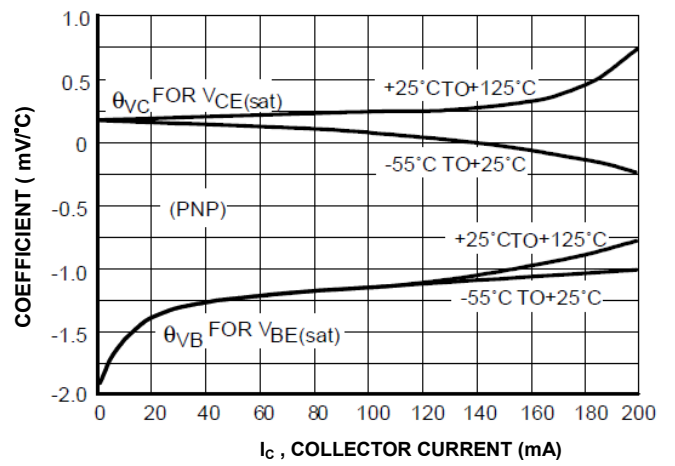
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**MMDT3946**



**FIG.33 - On voltages**



**FIG.34 - Temperature coefficients**

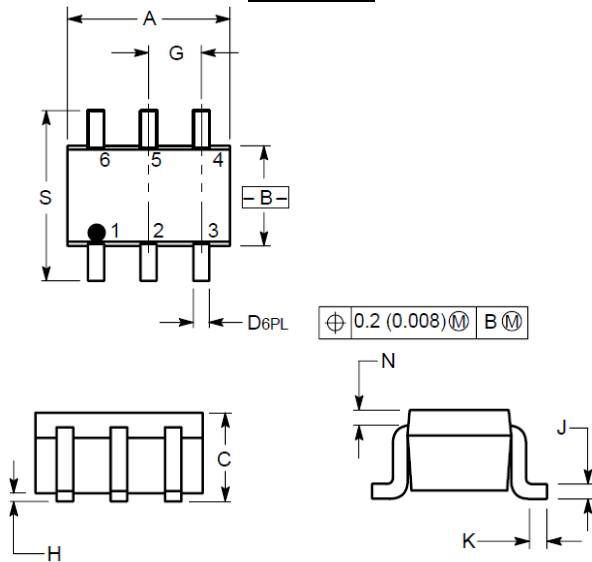


**MECHANICAL INFORMATION**  
**MMDT3946**



**Package Dimensions :**

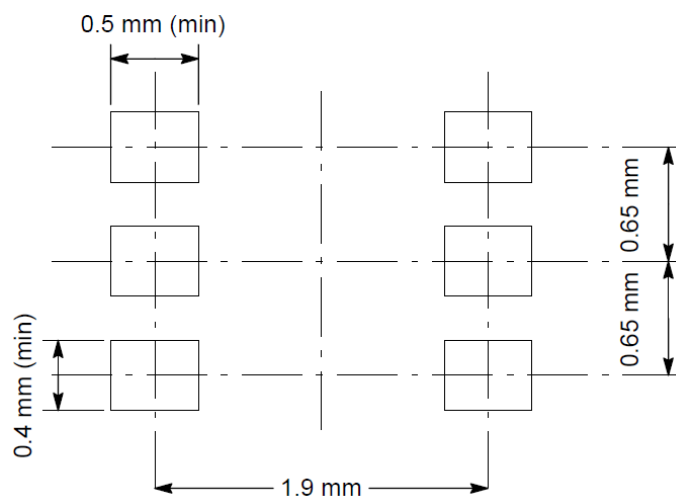
**SOT-363**



Dim.	INCHES		MILLIMETERS	
	Min.	Max.	Min.	Max.
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.031	0.043	0.80	1.10
D	0.004	0.012	0.10	0.30
G	0.026 BSC		0.65 BSC	
H	--	0.004	--	0.10
J	0.004	0.010	0.10	0.25
K	0.004	0.012	0.10	0.30
N	0.008 REF		0.20 REF	
S	0.079	0.087	2.00	2.20

- PIN 1 : EMITTER 2**
- 2 : BASE 2**
- 3 : COLLECTOR 1**
- 4 : EMITTER 1**
- 5 : BASE 1**
- 6 : COLLECTOR 2**

**Recommended Footprint :**



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