

# Switching Transistor

## NPN Silicon

- This device is available in Pb-free package(s). Specifications herein apply to both standard and Pb-free devices. Please see our website at [www.onsemi.com](http://www.onsemi.com) for specific Pb-free orderable part numbers, or contact your local ON Semiconductor sales office or representative.

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CEO}$	15	Vdc
Collector–Emitter Voltage	$V_{CES}$	40	Vdc
Collector–Base Voltage	$V_{CBO}$	40	Vdc
Emitter–Base Voltage	$V_{EBO}$	5.0	Vdc
Collector Current — Continuous	$I_C$	300	mAdc
— 10 $\mu$ s Pulse		500	
Total Device Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	625	mW
Derate above $25^\circ\text{C}$		5.0	mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$	$P_D$	1.5	Watts
Derate above $25^\circ\text{C}$		12	mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	$^\circ\text{C}/\text{W}$

### ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage	( $I_C = 100 \mu\text{Adc}, V_{BE} = 0$ )	$V_{(BR)CES}$	40	—	Vdc
Collector–Emitter Sustaining Voltage <sup>(1)</sup>	( $I_C = 10 \text{ mAdc}, I_B = 0$ )	$V_{CEO(sus)}$	15	—	Vdc
Collector–Base Breakdown Voltage	( $I_C = 100 \mu\text{Adc}, I_E = 0$ )	$V_{(BR)CBO}$	40	—	Vdc
Emitter–Base Breakdown Voltage	( $I_E = 100 \mu\text{Adc}, I_C = 0$ )	$V_{(BR)EBO}$	5.0	—	Vdc
Collector Cutoff Current	( $V_{CE} = 20 \text{ Vdc}, V_{BE} = 0$ ) ( $V_{CE} = 20 \text{ Vdc}, V_{BE} = 0, T_A = 65^\circ\text{C}$ )	$I_{CES}$	—	0.5	$\mu\text{Adc}$
			—	3.0	

### ON CHARACTERISTICS<sup>(1)</sup>

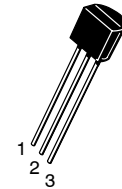
DC Current Gain	( $I_C = 30 \text{ mAdc}, V_{CE} = 0.4 \text{ Vdc}$ ) ( $I_C = 100 \text{ mAdc}, V_{CE} = 0.5 \text{ Vdc}$ ) ( $I_C = 300 \text{ mA}, V_{CE} = 1.0 \text{ Vdc}$ )	$h_{FE}$	30	120	—
			25	—	
			15	—	
Collector–Emitter Saturation Voltage	( $I_C = 30 \text{ mAdc}, I_B = 3.0 \text{ mAdc}$ ) ( $I_C = 100 \text{ mAdc}, I_B = 10 \text{ mAdc}$ ) ( $I_C = 300 \text{ mAdc}, I_B = 30 \text{ mAdc}$ ) ( $I_C = 30 \text{ mA}, I_B = 3.0 \text{ mA}, T_A = 65^\circ\text{C}$ )	$V_{CE(sat)}$	—	0.2	Vdc
			—	0.28	
			—	0.5	
			—	0.3	
Base–Emitter Saturation Voltage	( $I_C = 30 \text{ mAdc}, I_B = 3.0 \text{ mAdc}$ ) ( $I_C = 100 \text{ mAdc}, I_B = 10 \text{ mAdc}$ ) ( $I_C = 300 \text{ mAdc}, I_B = 30 \text{ mA}$ )	$V_{BE(sat)}$	0.73	0.95	Vdc
			—	1.2	
			—	1.7	

1. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .

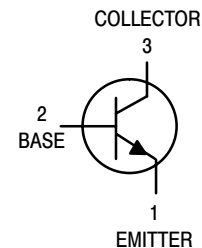
Preferred devices are ON Semiconductor recommended choices for future use and best overall value.

# MPS3646

ON Semiconductor Preferred Device



CASE 29-11, STYLE 1  
TO-92 (TO-226AA)



# MPS3646

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Max	Unit
<b>SMALL-SIGNAL CHARACTERISTICS</b>				
Current-Gain — Bandwidth Product ( $I_C = 30\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 100\text{ MHz}$ )	$f_T$	350	—	MHz
Output Capacitance ( $V_{CB} = 5.0\text{ V}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	—	5.0	pF
Input Capacitance ( $V_{EB} = 0.5\text{ V}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	$C_{ibo}$	—	9.0	pF

## SWITCHING CHARACTERISTICS

Turn-On Time	$(V_{CC} = 10\text{ Vdc}$ , $I_C = 300\text{ mA}$ , $I_{B1} = 30\text{ mA}$ ) (Figure 1)	$t_{on}$	—	18	ns
Delay Time		$t_d$	—	10	ns
Rise Time		$t_r$	—	15	ns
Turn-Off Time	$(V_{CC} = 10\text{ Vdc}$ , $I_C = 300\text{ mA}$ , $I_{B1} = I_{B2} = 30\text{ mA}$ ) (Figure 1)	$t_{off}$	—	28	ns
Fall Time		$t_f$	—	15	ns
Storage Time ( $V_{CC} = 10\text{ Vdc}$ , $I_C = 10\text{ mA}$ , $I_{B1} = I_{B2} = 10\text{ mA}$ ) (Figure 2)		$t_s$	—	18	ns

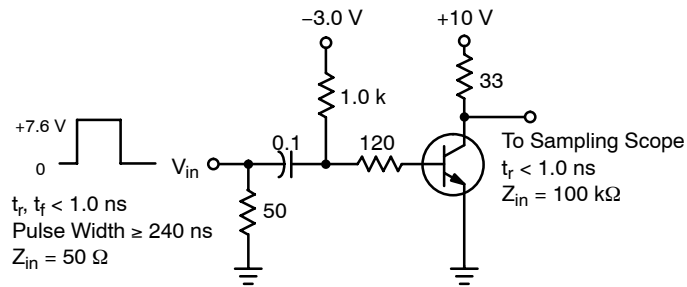


Figure 1. Switching Time Test Circuit

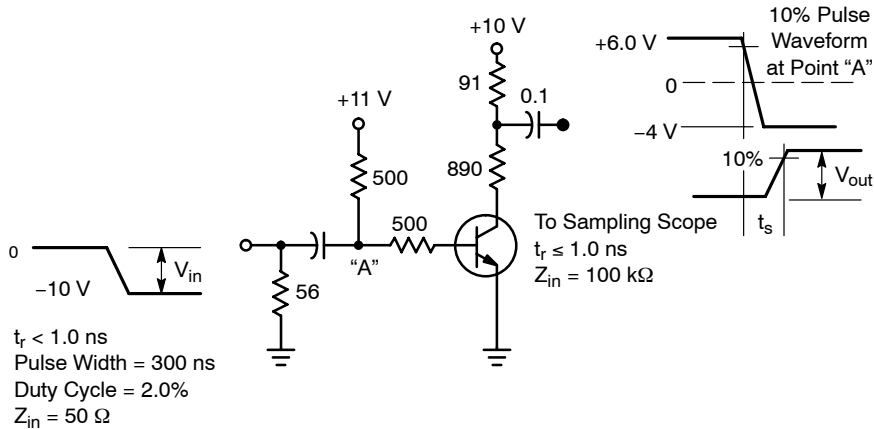


Figure 2. Charge Storage Time Test Circuit

# MPS3646

## CURRENT GAIN CHARACTERISTICS

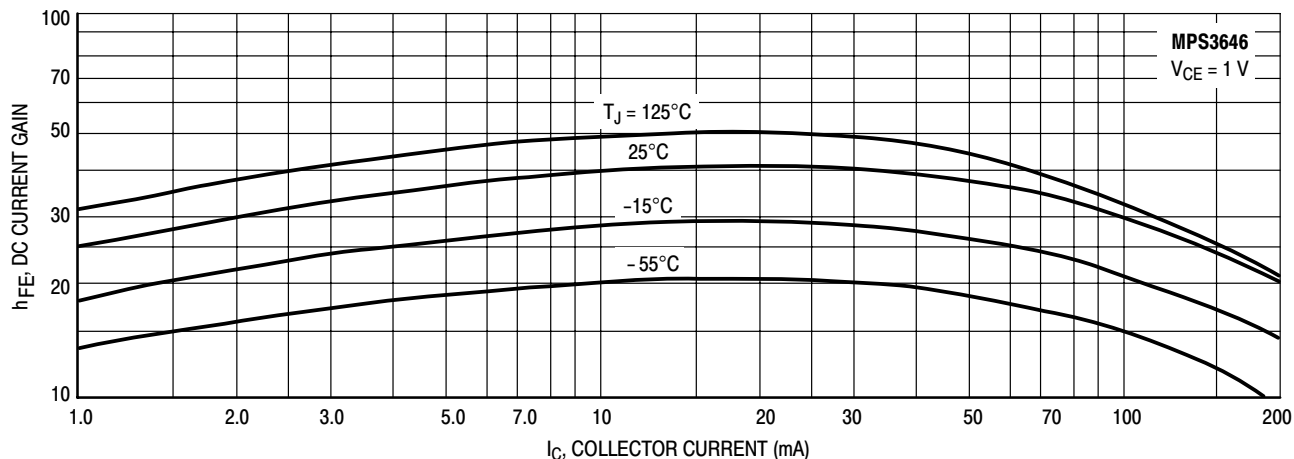


Figure 3. Minimum Current Gain

## “ON” CONDITION CHARACTERISTICS

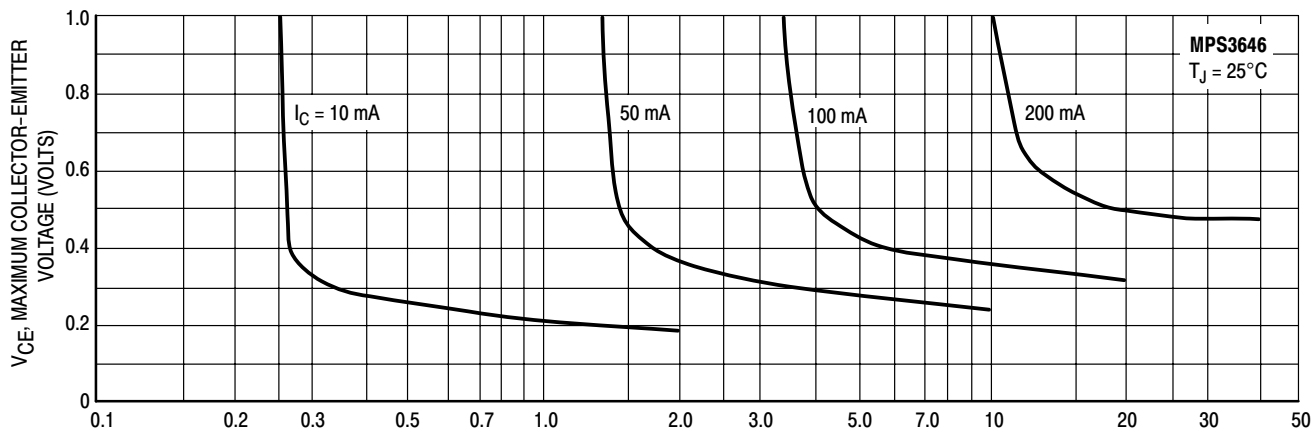


Figure 4. Collector Saturation Region

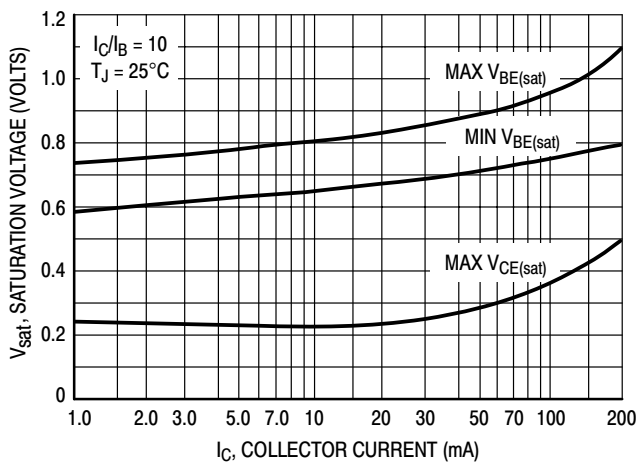


Figure 5. Saturation Voltage Limits

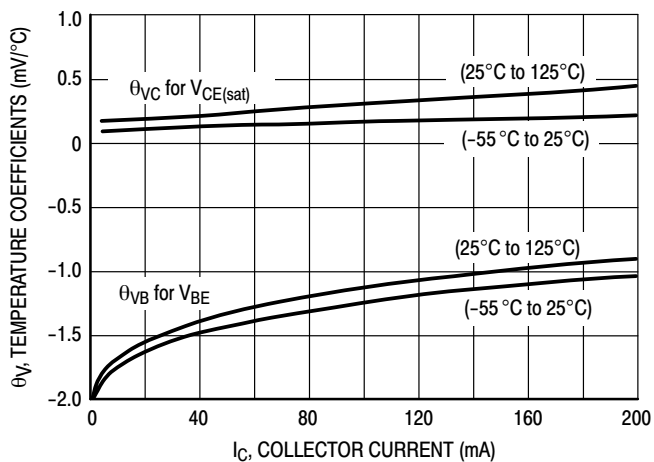


Figure 6. Temperature Coefficients

DYNAMIC CHARACTERISTICS

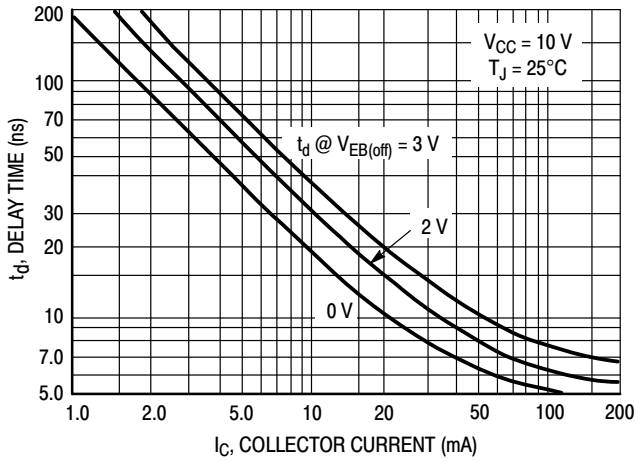


Figure 7. Delay Time

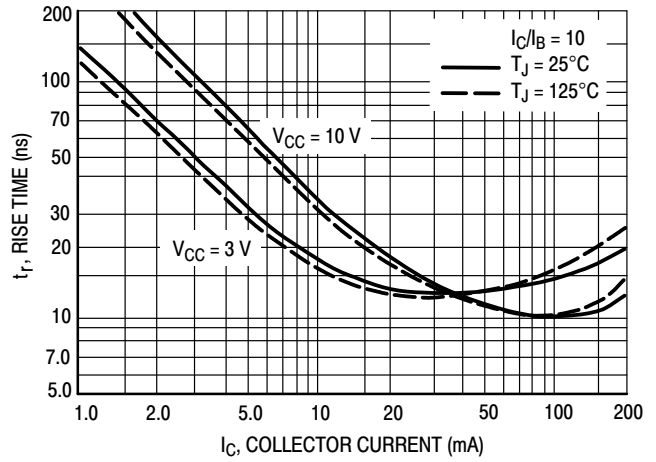


Figure 8. Rise Time

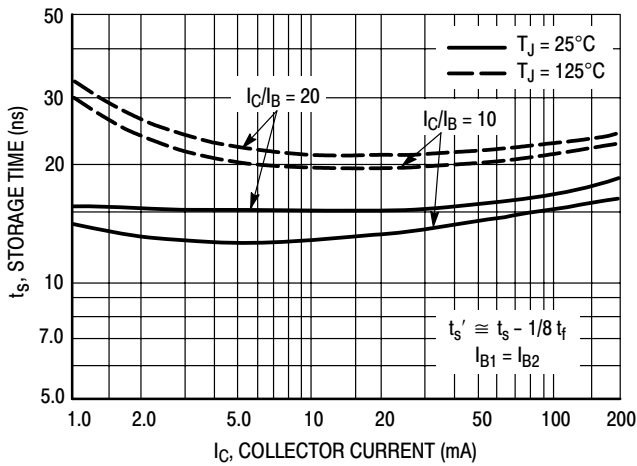


Figure 9. Storage Time

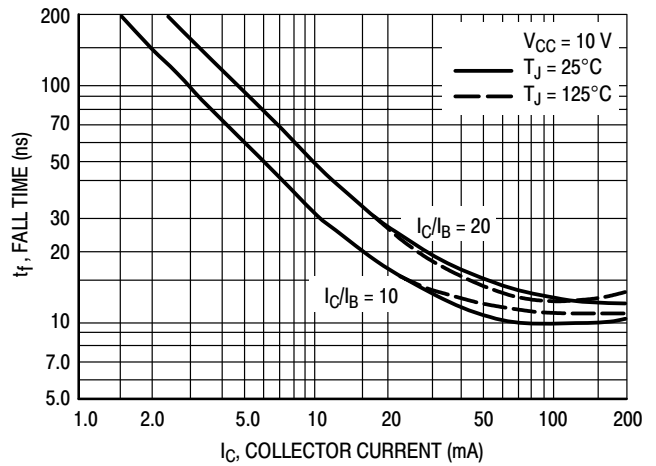


Figure 10. Fall Time

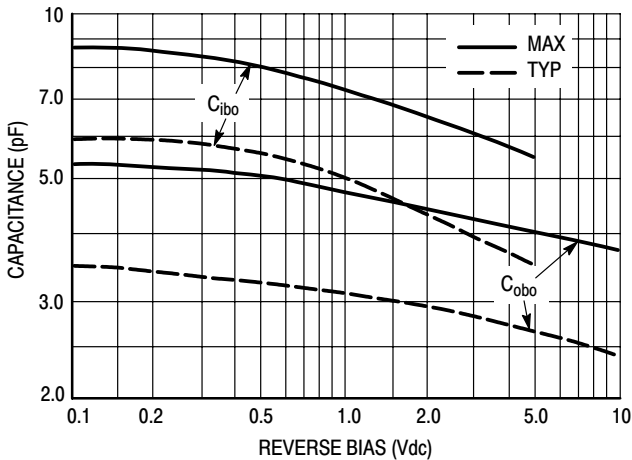


Figure 11. Junction Capacitance

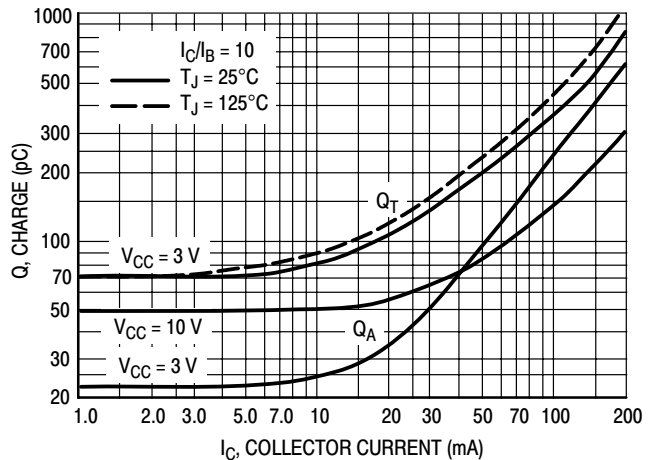
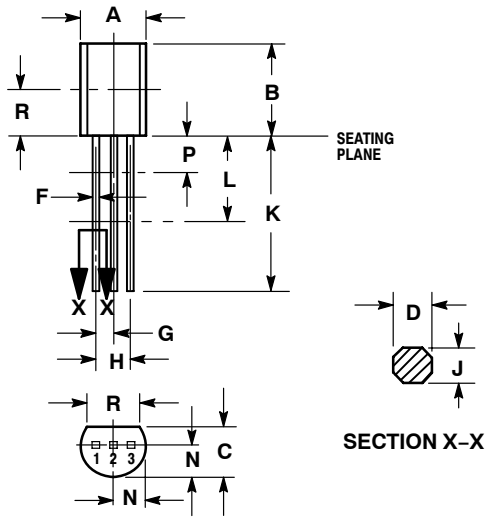


Figure 12. Maximum Charge Data

# MPS3646

## PACKAGE DIMENSIONS

### CASE 029-11 (TO-226AA) ISSUE AD



STYLE 1:  
PIN 1. EMITTER  
2. BASE  
3. COLLECTOR

#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSIONS D AND J APPLY BETWEEN L AND K MINIMUM. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.175	0.205	4.44	5.21
B	0.290	0.310	7.37	7.87
C	0.125	0.165	3.18	4.19
D	0.018	0.021	0.457	0.533
F	0.016	0.019	0.407	0.482
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.018	0.024	0.46	0.61
K	0.500	---	12.70	---
L	0.250	---	6.35	---
N	0.080	0.105	2.04	2.66
P	---	0.100	---	2.54
R	0.135	---	3.43	---

**Notes**

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