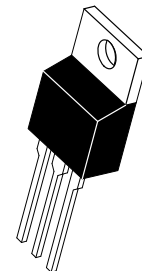
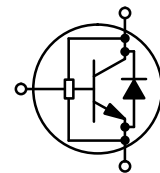


**MJE18604D2**

**POWER TRANSISTORS**  
**3 AMPERES**  
**1600 VOLTS**  
**100 WATTS**



**CASE 221A-06**  
**TO-220AB**

*Advance Information*

**High Speed, High Gain Bipolar NPN Power Transistor with Integrated Collector-Emitter Diode and Built-in Efficient Antisaturation Network for 1600 V Applications**

The MJE18604D2 is state-of-art High Speed High gain BIPolar transistor (H2BIP). Tight dynamic characteristics and lot to lot low spread ( $\pm 150$  ns on storage time) make it ideally suitable for light ballast applications. Therefore, there is no more a need to guarantee an  $h_{fe}$  window.

Main features:

- Low Base Drive Requirement
- High DC Current Gain (30 Typical) @  $I_C = 400$  mA
- Extremely Low Storage Time Min/Max Guarantees Due to the Internal Active Antisaturation (H2BIP) Structure which Minimizes the Spread
- Integrated Collector-Emitter Free Wheeling Diode Matched with the Power Transistor
- Fully Characterized and Guaranteed Dynamic  $V_{CE(sat)}$
- "6 Sigma" Process Providing Tight and Reproducible Parameter Spreads

**MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-Emitter Breakdown Voltage	$V_{CEO}$	800	Vdc
Collector-Emitter Sustaining Voltage @ $R = 200 \Omega$	$V_{CER}$	800	Vdc
Collector-Base Breakdown Voltage	$V_{CBO}$	1600	Vdc
Collector-Emitter Breakdown Voltage	$V_{CES}$	1600	Vdc
Emitter-Base Voltage	$V_{EBO}$	12	Vdc
Collector Current — Continuous	$I_C$	3	Adc
— Peak (1)	$I_{CM}$	8	
Base Current — Continuous	$I_B$	2	Adc
— Peak (1)	$I_{BM}$	4	
*Total Device Dissipation @ $T_C = 25^\circ C$	$P_D$	100	Watt
*Derate above $25^\circ C$		0.8	W/ $^\circ C$
Operating and Storage Temperature	$T_J, T_{stg}$	-65 to 150	$^\circ C$

**THERMAL CHARACTERISTICS**

Thermal Resistance — Junction to Case	$R_{\theta JC}$	1.25	$^\circ C/W$
— Junction to Ambient	$R_{\theta JA}$	62.5	
Maximum Lead Temperature for Soldering Purposes: 1/8" from case for 5 seconds	$T_L$	260	$^\circ C$

(1) Pulse Test: Pulse Width = 5 ms, Duty Cycle  $\leq 10\%$ .

This document contains information on a new product. Specifications and information herein are subject to change without notice.

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**MJE18604D2**

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector–Emitter Sustaining Voltage ( $I_C = 100\text{ mA}$ , $L = 25\text{ mH}$ , $R_{BE} = 200\ \Omega$ )	$V_{CER(sus)}$	800			Vdc
Collector–Base Breakdown Voltage ( $I_{CBO} = 1\text{ mA}$ )	$V_{CBO}$	1600			Vdc
Emitter–Base Breakdown Voltage ( $I_{EBO} = 1\text{ mA}$ )	$V_{EBO}$	12	14		Vdc
Collector Cutoff Current ( $V_{CBO} = \text{Rated } V_{CBO}$ , $I_B = 0$ )	$I_{CBO}$			100	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CE} = \text{Rated } V_{CES}$ , $V_{EB} = 0$ )  ( $V_{CE} = 1300\text{ V}$ , $V_{EB} = 0$ )	$I_{CES}$			100 1000 100	$\mu\text{Adc}$
Emitter–Cutoff Current ( $V_{EB} = 11\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$			500	$\mu\text{Adc}$

**ON CHARACTERISTICS**

Base–Emitter Saturation Voltage ( $I_C = 0.5\text{ Adc}$ , $I_B = 0.1\text{ Adc}$ )  ( $I_C = 1\text{ Adc}$ , $I_B = 0.1\text{ Adc}$ )  ( $I_C = 2\text{ Adc}$ , $I_B = 0.4\text{ Adc}$ )	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$V_{BE(sat)}$		0.8 0.6	1.1 1	Vdc
	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$			0.8 1	1 1	
	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$			0.9 0.8	1.2 1.1	
Collector–Emitter Saturation Voltage ( $I_C = 250\text{ mAdc}$ , $I_B = 25\text{ mAdc}$ )  ( $I_C = 0.5\text{ Adc}$ , $I_B = 50\text{ mAdc}$ )  ( $I_C = 0.8\text{ Adc}$ , $I_B = 80\text{ mAdc}$ )	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$V_{CE(sat)}$		1 1.7	1.25	Vdc
	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$			2.1 4	2.4	
	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$			3.7 5	5	
DC Current Gain ( $I_C = 0.4\text{ Adc}$ , $V_{CE} = 3\text{ Vdc}$ )  ( $I_C = 5\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$h_{FE}$	20 6	10	40	—
	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$		20 20	35 55		

**DYNAMIC SATURATION VOLTAGE**

Dynamic Saturation Voltage: Determined 1 $\mu\text{s}$ and 3 $\mu\text{s}$ respectively after rising $I_{B1}$ reaches 90% of final $I_{B1}$	$I_C = 0.3\text{ Adc}$ $I_{B1} = 50\text{ mA}$ $V_{CC} = 300\text{ V}$	@ 1 $\mu\text{s}$	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$V_{CE(dsat)}$		4.7 9.3	V
		@ 3 $\mu\text{s}$	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$			2.6 5.4	
	$I_C = 0.5\text{ Adc}$ $I_{B1} = 50\text{ mA}$ $V_{CC} = 300\text{ V}$	@ 1 $\mu\text{s}$	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$			9.7 18	
		@ 3 $\mu\text{s}$	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$			6.4 12.3	

**DIODE CHARACTERISTICS**

Forward Diode Voltage ( $I_{EC} = 0.4\text{ Adc}$ )  ( $I_{EC} = 1\text{ Adc}$ )	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$V_{EC}$		0.9 0.6	1.2	V
	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$			1.05 0.7	1.5	
Forward Recovery Time ( $I_F = 0.4\text{ Adc}$ , $di/dt = 10\text{ A}/\mu\text{s}$ )  ( $I_F = 1.0\text{ Adc}$ , $di/dt = 10\text{ A}/\mu\text{s}$ )	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_{fr}$		0.9 1.5		$\mu\text{s}$
	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$			1.15 1.6		

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>DYNAMIC CHARACTERISTICS</b>					
Current Gain Bandwidth ( $I_C = 0.5 \text{ Adc}$ , $V_{CE} = 10 \text{ Vdc}$ , $f = 1 \text{ MHz}$ )	$f_T$		13		MHz
Output Capacitance ( $V_{CB} = 10 \text{ Vdc}$ , $I_E = 0$ , $f = 1 \text{ MHz}$ )	$C_{ob}$		230	500	pF
Input Capacitance ( $V_{CE} = 8 \text{ Vdc}$ )	$C_{ib}$		480	1000	pF

**SWITCHING CHARACTERISTICS: Resistive Load** (D.C.  $\leq 10\%$ , Pulse Width =  $40 \mu\text{s}$ )

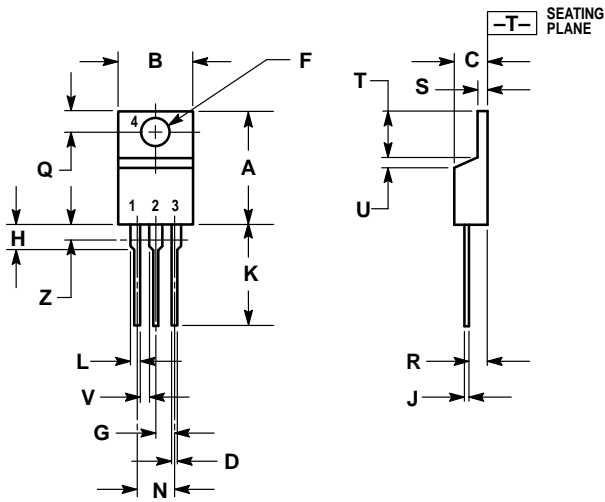
Delay Time	$I_C = 0.5 \text{ Adc}$ $I_{B1} = 66 \text{ mAdc}$ $I_{B2} = 390 \text{ mAdc}$ $V_{CC} = 125 \text{ V}$	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_d$		95 110	150	ns	
Rise Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_r$		475 900	750	ns	
Storage Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_s$	400		910	700	ns
Fall Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_f$			675 775	850	ns
Turn-on Time	$I_C = 0.3 \text{ Adc}$ $I_{B1} = 50 \text{ mAdc}$ $I_{B2} = 50 \text{ mAdc}$ $V_{CC} = 125 \text{ V}$	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_{on}$		440 570		ns	
Storage Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_s$		4 5.9		$\mu\text{s}$	
Fall Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_f$			375 675		ns
Turn-off Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_{off}$			4.5 6.6		$\mu\text{s}$
Turn-on Time	$I_C = 0.3 \text{ Adc}$ $I_{B1} = 50 \text{ mAdc}$ $I_{B2} = 150 \text{ mAdc}$ $V_{CC} = 125 \text{ V}$	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_{on}$		465 550	600	ns	
Storage Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_s$	500		1800	800	ns
Fall Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_f$			800 550	1000	ns
Turn-off Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_{off}$			1.5 2.4	1.75	$\mu\text{s}$
Turn-on Time	$I_C = 0.5 \text{ Adc}$ $I_{B1} = 50 \text{ mAdc}$ $I_{B2} = 50 \text{ mAdc}$ $V_{CC} = 125 \text{ V}$	@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_{on}$		550 1300		ns	
Storage Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_s$			4.35 5		$\mu\text{s}$
Fall Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_f$			500 2000		ns
Turn-off Time		@ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$	$t_{off}$			4.8 7		$\mu\text{s}$
Delay Time	$I_C = 0.5 \text{ Adc}$ $I_{B1} = 50 \text{ mAdc}$ $I_{B2} = 250 \text{ mAdc}$ $V_{CC} = 125 \text{ V}$	@ $T_C = 25^\circ\text{C}$	$t_d$		100	300	ns	
Rise Time		@ $T_C = 25^\circ\text{C}$	$t_r$		300	800	ns	
Storage Time		@ $T_C = 25^\circ\text{C}$	$t_s$		1	1.2	$\mu\text{s}$	
Fall Time		@ $T_C = 25^\circ\text{C}$	$t_f$		200	350	ns	

# MJE18604D2

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
<b>SWITCHING CHARACTERISTICS: Inductive Load (V<sub>CC</sub> = 15 V)</b>						
Fall Time	I <sub>C</sub> = 300 mA I <sub>B1</sub> = 50 mA I <sub>B2</sub> = 50 mA V <sub>Z</sub> = 300 V L <sub>C</sub> = 200 μH	@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>f</sub>	170 210		ns
Storage Time		@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>s</sub>	1.7 2.7		μs
Crossover Time		@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>c</sub>	150 400		ns
Fall Time	I <sub>C</sub> = 300 mA I <sub>B1</sub> = 50 mA I <sub>B2</sub> = 150 mA V <sub>Z</sub> = 300 V L <sub>C</sub> = 200 μH	@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>f</sub>	160 150	250	ns
Storage Time		@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>s</sub>	0.7 1.1	1	μs
Crossover Time		@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>c</sub>	160 160	250	ns
Fall Time	I <sub>C</sub> = 500 mA I <sub>B1</sub> = 50 mA I <sub>B2</sub> = 50 mA V <sub>Z</sub> = 300 V L <sub>C</sub> = 200 μH	@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>f</sub>	165 700		ns
Storage Time		@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>s</sub>	3 4.1		μs
Crossover Time		@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>c</sub>	200 800		ns
Fall Time	I <sub>C</sub> = 500 mA I <sub>B1</sub> = 50 mA I <sub>B2</sub> = 250 mA V <sub>Z</sub> = 300 V L <sub>C</sub> = 200 μH	@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>f</sub>	110 130	175	ns
Storage Time		@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>s</sub>	0.7 1.8	1	μs
Crossover Time		@ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 125°C	t <sub>c</sub>	130 250	200	ns

PACKAGE DIMENSIONS




- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	—	1.15	—
Z	—	0.080	—	2.04

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

CASE 221A-06  
 TO-220AB  
 ISSUE Y

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