MJD18002D2

Bipolar NPN Transistor

High Speed, High Gain Bipolar NPN Power Transistor with Integrated Collector−Emitter Diode and Built−In Efficient Antisaturation Network

The MJD18002D2 is a state−of−the−art high speed, high gain bipolar transistor (H2BIP). Tight dynamic characteristics and lot to lot minimum spread (±150 ns on storage time) make it ideally suitable for light ballast applications. Therefore, there is no longer a need to guarantee an h_{FE} window.

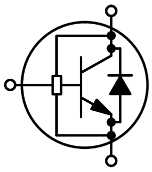
Features

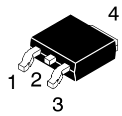
- Low Base Drive Requirement
- High Peak DC Current Gain (55 Typical) @ I_C = 100 mA
- **Extremely Low Storage Time Min/Max Guarantees Due to the H2BIP Structure which Minimizes the Spread**
- Integrated Collector−Emitter Free Wheeling Diode
- Fully Characterized and Guaranteed Dynamic V_{CEsat}
- Characteristics Make It Suitable for PFC Application
- Epoxy Meets UL 94 V−0 @ 0.125 in
- ESD Ratings: Human Body Model, 3B > 8000 V
  Machine Model, C > 400 V
- Six Sigma® Process Providing Tight and Reproducible Parameter Spreads
- Pb−Free Package is Available

ON Semiconductor®

http://onsemi.com

POWER TRANSISTOR
2 AMPERES
1000 VOLTS, 50 WATTS





DPAK
CASE 369C
STYLE 1

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector−Emitter Sustaining Voltage	V_{CEO}	450	Vdc
Collector−Base Breakdown Voltage	V_{CBO}	1000	Vdc
Collector−Emitter Breakdown Voltage	V_{CES}	1000	Vdc
Emitter−Base Voltage	V_{EBO}	11	Vdc
Collector Current − Continuous − Peak (Note 1)	I_C I_{CM}	2.0 5.0	Adc
Base Current − Continuous − Peak (Note 1)	I_B I_{BM}	1.0 2.0	Adc

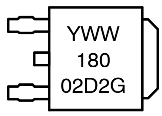
THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	50 0.4	W W/°C
Operating and Storage Temperature Range	T_J, T_{stg}	−65 to +150	°C
Thermal Resistance, Junction−to−Case	$R_{\theta JC}$	5.0	°C/W
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	71.4	°C/W
Maximum Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 seconds	T_L	260	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Pulse Test: Pulse Width = 5.0 ms, Duty Cycle = 10%.

MARKING DIAGRAM



Y = Year
WW = Work Week
18002D2 = Device Code
G = Pb−Free Package

ORDERING INFORMATION

Device	Package	Shipping†
MJD18002D2T4	DPAK	3000/Tape & Reel
MJD18002D2T4G	DPAK (Pb−Free)	3000/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Condition	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector–Emitter Sustaining Voltage (I_C = 100 mA, L = 25 mH)		$V_{CEO(sus)}$	450	570	–	Vdc
Collector–Base Breakdown Voltage (I_{CBO} = 1 mA)		V_{CBO}	1000	1100	–	Vdc
Emitter–Base Breakdown Voltage (I_{EBO} = 1 mA)		V_{EBO}	11	14	–	Vdc
Collector Cutoff Current (V_{CE} = Rated V_{CEO}, I_B = 0)		I_{CEO}	–	–	100	μAdc
Collector Cutoff Current (V_{CE} = Rated V_{CES}, V_{EB} = 0)	@ T_C = 25°C @ T_C = 125°C	I_{CES}	– –	– –	100 500	μAdc
(V_{CE} = 500 V, V_{EB} = 0)	@ T_C = 125°C		–	–	100	
Emitter–Cutoff Current (V_{EB} = 10 Vdc, I_C = 0)		I_{EBO}	–	–	500	μAdc
ON CHARACTERISTICS						
Base–Emitter Saturation Voltage (I_C = 0.4 Adc, I_B = 40 mAdc)	@ T_C = 25°C	$V_{BE(sat)}$	–	0.78	1.0	Vdc
(I_C = 1.0 Adc, I_B = 0.2 Adc)	@ T_C = 25°C		–	0.87	1.1	
Collector–Emitter Saturation Voltage (I_C = 0.4 Adc, I_B = 40 mAdc)	@ T_C = 25°C @ T_C = 125°C	$V_{CE(sat)}$	– –	0.36 0.50	0.6 1.0	Vdc
(I_C = 1.0 Adc, I_B = 0.2 Adc)	@ T_C = 25°C @ T_C = 125°C		– –	0.40 0.65	0.75 1.2	
DC Current Gain (I_C = 0.4 Adc, V_{CE} = 1.0 Vdc)	@ T_C = 25°C @ T_C = 125°C	h_{FE}	14 8.0	25 15	– –	–
(I_C = 1.0 Adc, V_{CE} = 1.0 Vdc)	@ T_C = 25°C @ T_C = 125°C		6.0 4.0	10 6.0	– –	
DYNAMIC CHARACTERISTICS						
Current Gain Bandwidth (I_C = 0.5 Adc, V_{CE} = 10 Vdc, f = 1 MHz)		f_t	–	13	–	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1 MHz)		C_{ob}	–	50	100	pF
Input Capacitance (V_{EB} = 8 Vdc)		C_{ib}	–	340	500	pF
DIODE CHARACTERISTICS						
Forward Diode Voltage (I_{EC} = 1.0 Adc)	@ T_C = 25°C	V_{EC}	–	1.2	1.5	Vdc
(I_{EC} = 0.4 Adc)	@ T_C = 25°C		–	1.0	1.3	
	@ T_C = 125°C		–	0.6	–	
Forward Recovery Time (I_F = 0.4 Adc, di/dt = 10 A/μs)	@ T_C = 25°C	t_{fr}	–	517	–	ns
(I_F = 1.0 Adc, di/dt = 10 A/μs)	@ T_C = 25°C		–	480	–	
DYNAMIC SATURATION VOLTAGE						
Dynamic Saturation Voltage Determinated 1 μs and 3 μs respectively after rising I_{B1} reaches 90% of final I_{B1}	I_C = 0.4 Adc, I_{B1} = 40 mA, V_{CC} = 300 Vdc, @ 1 μs, @ T_C = 25°C	$V_{CE(dsat)}$	–	7.4	–	V
	I_C = 0.4 Adc, I_{B1} = 40 mA, V_{CC} = 300 Vdc, @ 3 μs, @ T_C = 25°C		–	2.5	–	
	I_C = 1 Adc, I_{B1} = 0.2 A, V_{CC} = 300 Vdc, @ 1 μs, @ T_C = 25°C		–	11.7	–	
	I_C = 1 Adc, I_{B1} = 0.2 A, V_{CC} = 300 Vdc, @ 3 μs, @ T_C = 25°C		–	1.3	–	

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic			Symbol	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS: Resistive Load (D.C.S. 10%, Pulse Width = 40 μs)							
Turn–on Time	I_C = 0.4 Adc, I_{B1} = 40 mAdc I_{B2} = 200 mAdc V_{CC} = 300 Vdc	@ T_C = 25°C @ T_C = 125°C	t_{on}	– –	225 375	350 –	ns
Turn–off Time		@ T_C = 25°C @ T_C = 125°C	t_{off}	0.8 –	– 1.5	1.1 –	μs
Turn–on Time	I_C = 1.0 Adc, I_{B1} = 0.2 Adc I_{B2} = 0.5 Adc V_{CC} = 300 Vdc	@ T_C = 25°C @ T_C = 125°C	t_{on}	– –	100 94	150 –	ns
Turn–off Time		@ T_C = 25°C @ T_C = 125°C	t_{off}	0.95 –	– 1.5	1.25 –	μs
SWITCHING CHARACTERISTICS: Inductive Load (V_{clamp} = 300 V, V_{CC} = 15 V, L = 200 μH)							
Fall Time	I_C = 0.4 Adc I_{B1} = 40 mAdc I_{B2} = 0.2 Adc	@ T_C = 25°C @ T_C = 125°C	t_f	– –	130 120	175 –	ns
Storage Time		@ T_C = 25°C @ T_C = 125°C	t_s	0.4 –	– 0.7	0.7 –	μs
Cross–over Time		@ T_C = 25°C @ T_C = 125°C	t_c	– –	110 100	175 –	ns
Fall Time	I_C = 0.8 Adc I_{B1} = 160 mAdc I_{B2} = 160 mAdc	@ T_C = 25°C @ T_C = 125°C	t_f	– –	130 140	175 –	ns
Storage Time		@ T_C = 25°C @ T_C = 125°C	t_s	2.1 –	– 3.0	2.4 –	μs
Cross–over Time		@ T_C = 25°C @ T_C = 125°C	t_c	– –	275 350	350 –	ns
Fall Time	I_C = 1.0 Adc I_{B1} = 0.2 Adc I_{B2} = 0.5 Adc	@ T_C = 25°C @ T_C = 125°C	t_f	– –	100 100	150 –	ns
Storage Time		@ T_C = 25°C @ T_C = 125°C	t_s	– –	1.05 1.45	1.2 –	μs
Cross–over Time		@ T_C = 25°C @ T_C = 125°C	t_c	– –	100 115	150 –	ns

TYPICAL STATIC CHARACTERISTICS

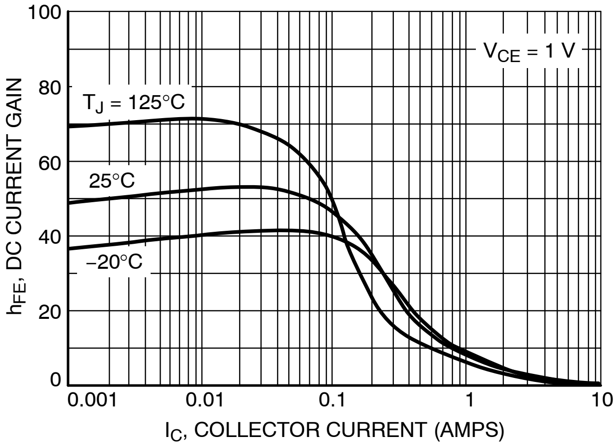


Figure 1. DC Current Gain @ 1 V

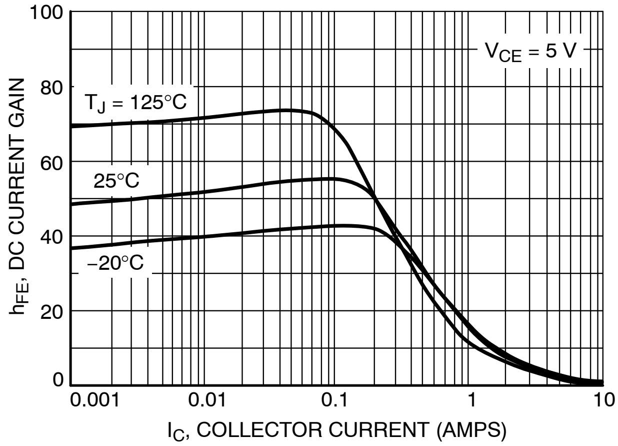


Figure 2. DC Current Gain @ 5 V

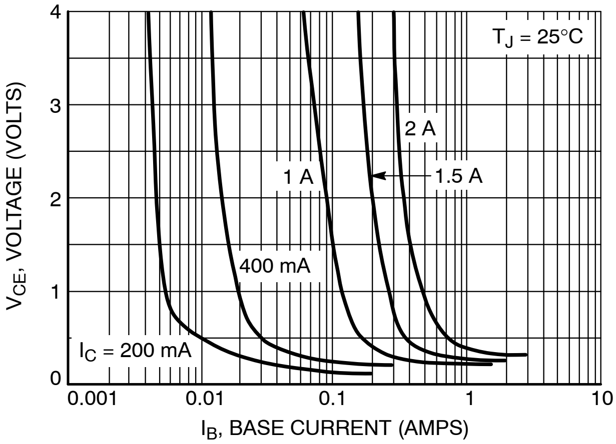


Figure 3. Collector Saturation Region

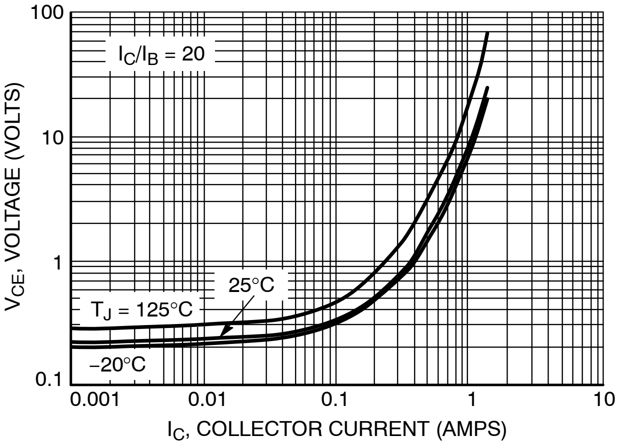


Figure 4. Collector−Emitter Saturation Voltage

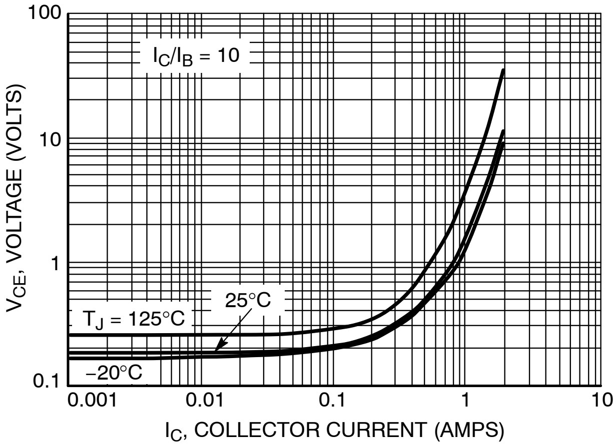


Figure 5. Collector−Emitter Saturation Voltage

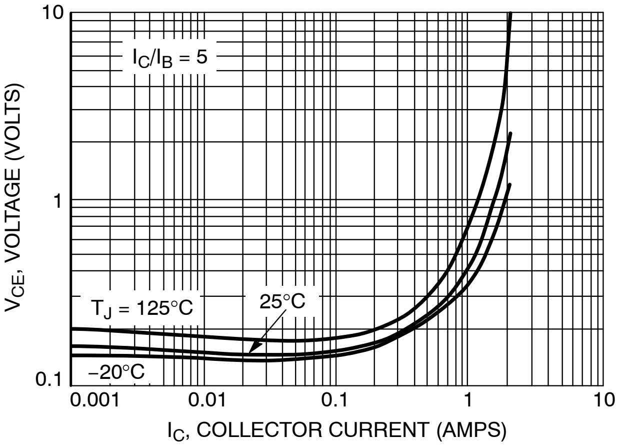


Figure 6. Collector−Emitter Saturation Voltage

MJD18002D2

TYPICAL STATIC CHARACTERISTICS

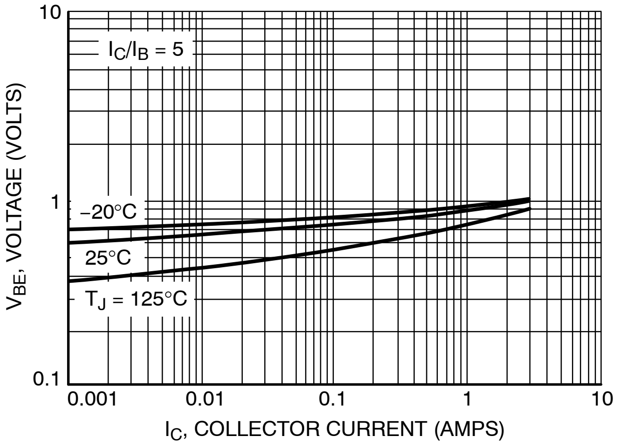


Figure 7. Base−Emitter Saturation Region
I_C/I_B = 5

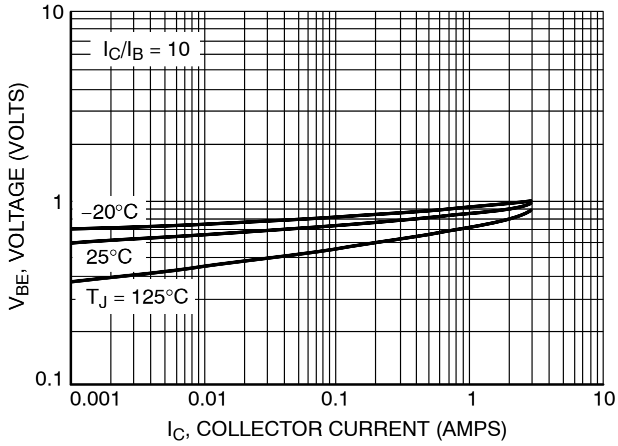


Figure 8. Base−Emitter Saturation Region
I_C/I_B = 10

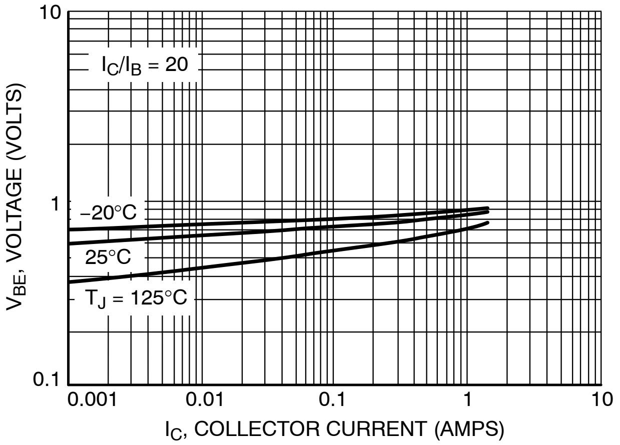


Figure 9. Base−Emitter Saturation Region
I_C/I_B = 20

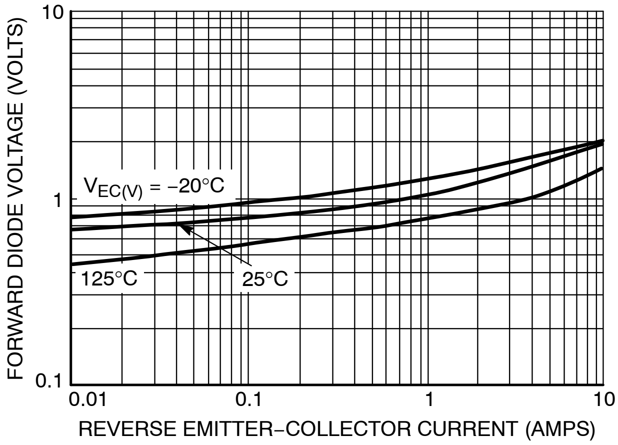


Figure 10. Forward Diode Voltage

TYPICAL SWITCHING CHARACTERISTICS

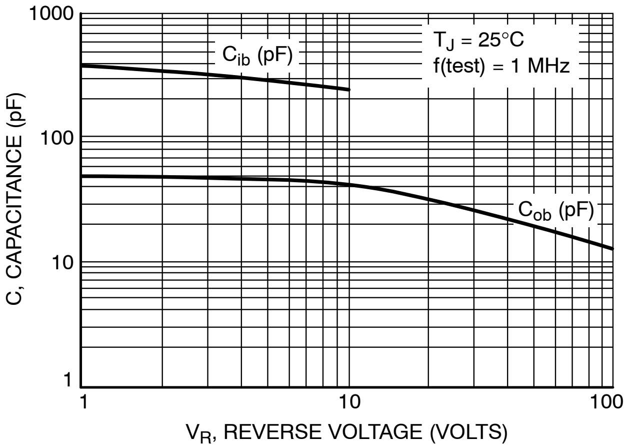


Figure 11. Capacitance

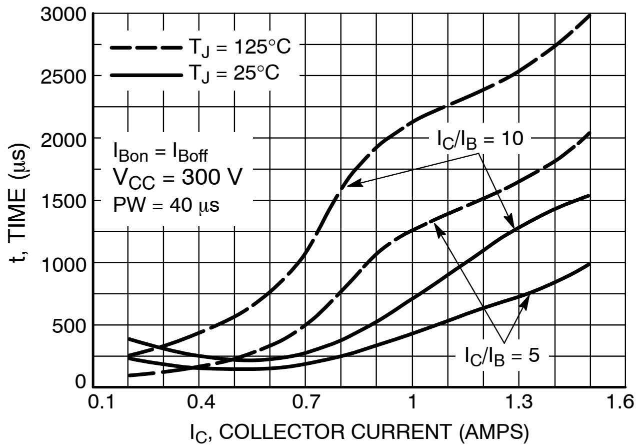


Figure 12. Resistive Switch Time, t_{on}

TYPICAL SWITCHING CHARACTERISTICS

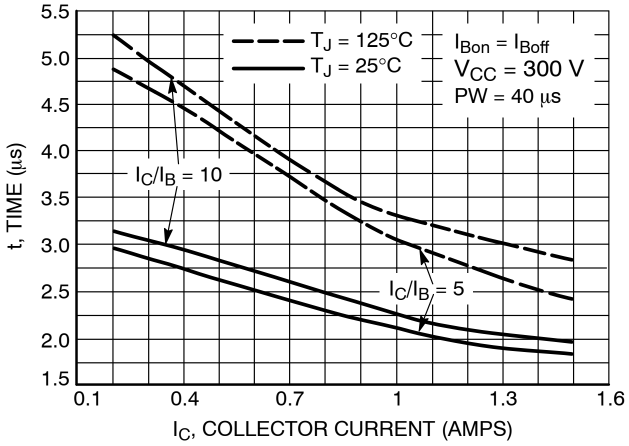


Figure 13. Resistive Switch Time, t_{off}

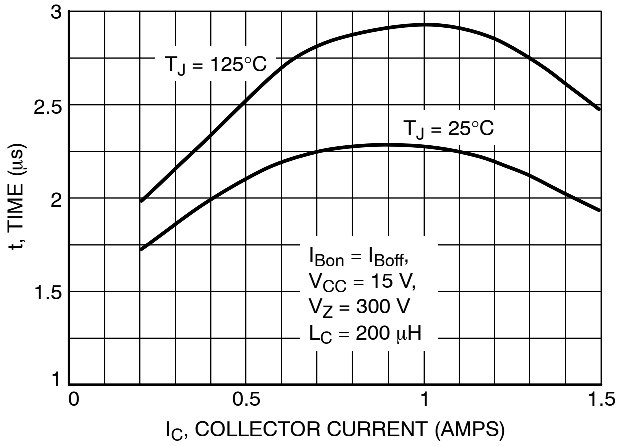


Figure 14. Inductive Storage Time, t_{si} @ $I_C/I_B = 5$

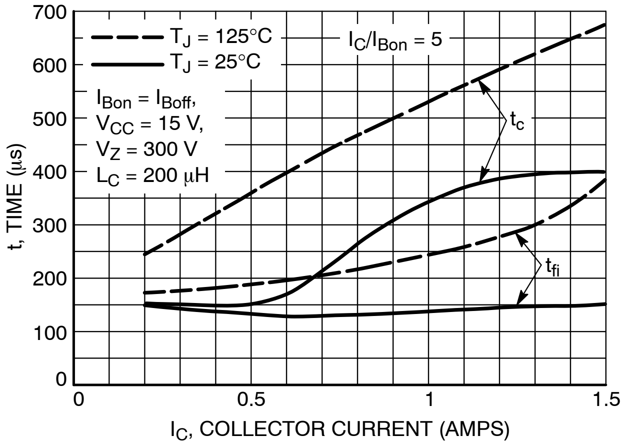


Figure 15. Inductive Switching, t_c & t_{fi} @ $I_C/I_B = 5$

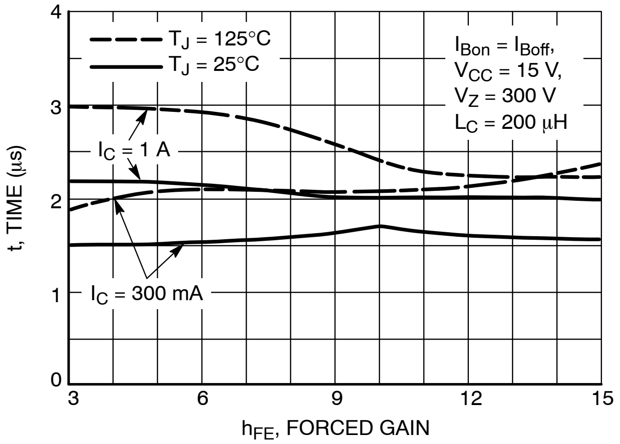


Figure 16. Inductive Storage Time

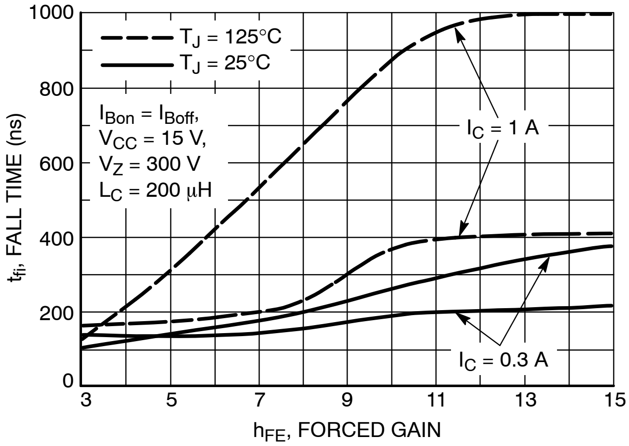


Figure 17. Inductive Fall Time

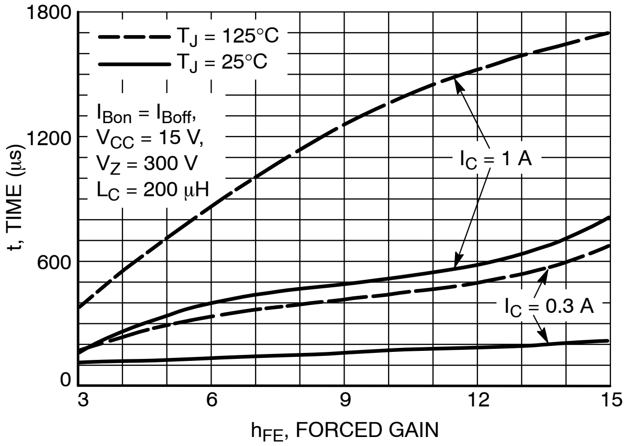


Figure 18. Inductive Cross−Over Time

TYPICAL SWITCHING CHARACTERISTICS

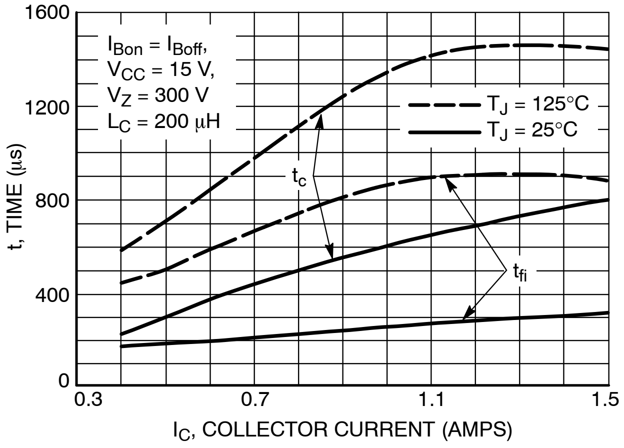


Figure 19. Inductive Switching Time, t_{fi} & T_C @ G = 10

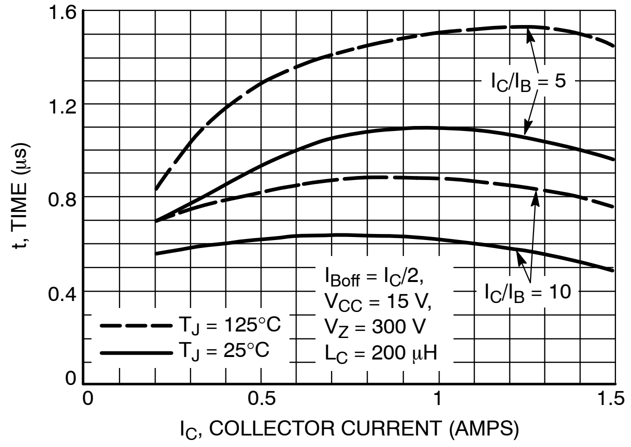


Figure 20. Inductive Switching Time, t_{si}

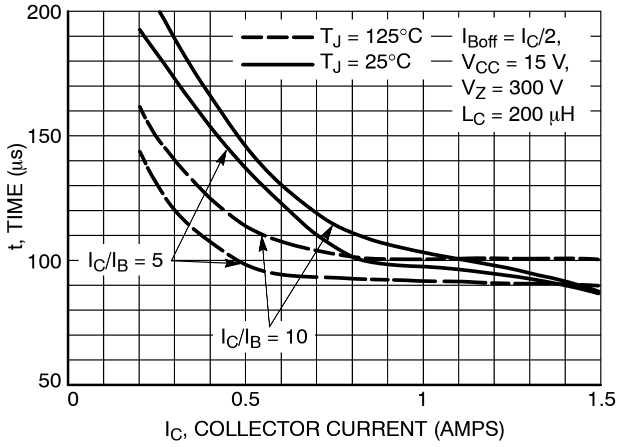


Figure 21. Inductive Storage Time, t_{fi}

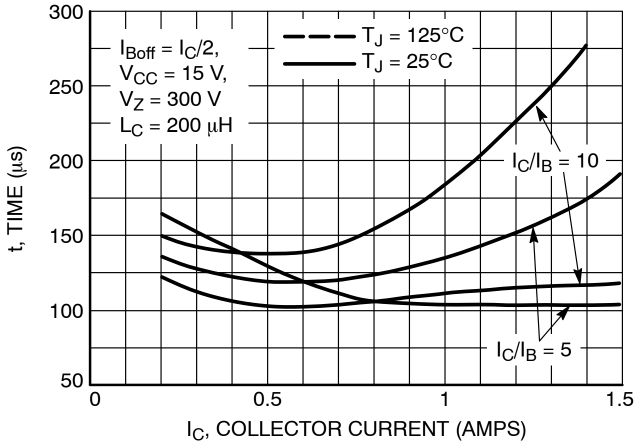


Figure 22. Inductive Storage Time, t_c

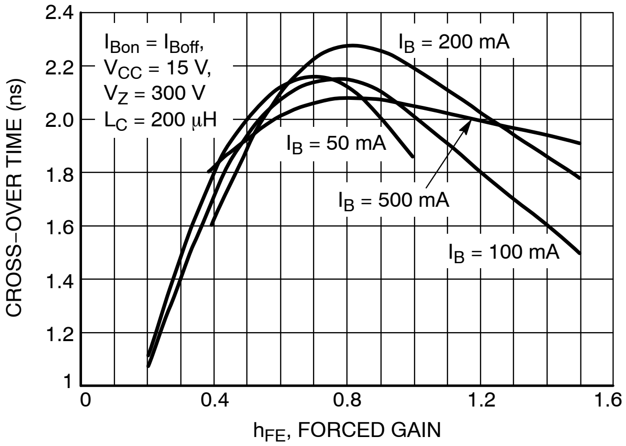


Figure 23. Inductive Storage Time, t_{si}

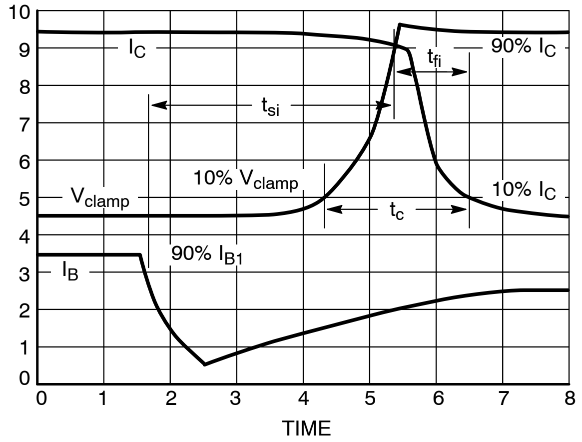
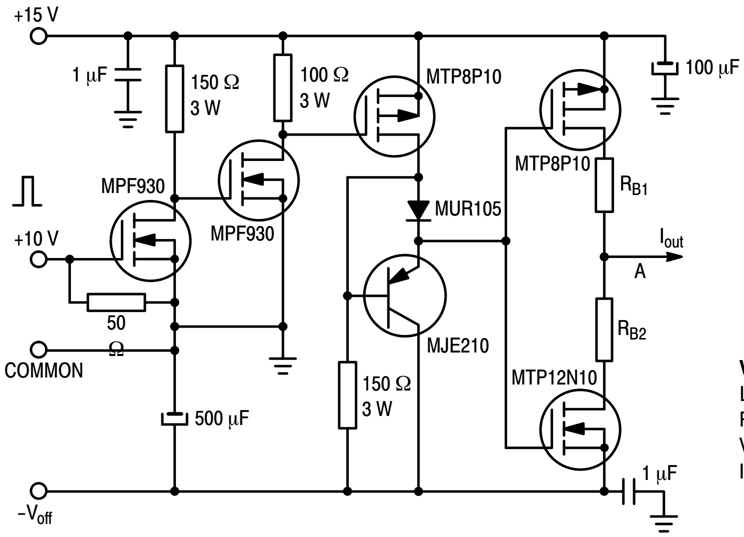
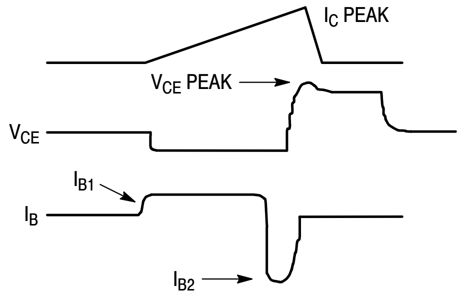


Figure 24. Inductive Switching Measurements

Figure 25. Inductive Load Switching Drive Circuit





$V_{(BR)CEO(sus)}$	Inductive Switching	RBSOA
L = 10 mH	L = 200 μH	L = 500 μH
$R_{B2} = \infty$	$R_{B2} = 0$	$R_{B2} = 0$
V_{CC} = 20 Volts	V_{CC} = 15 Volts	V_{CC} = 15 Volts
$I_{C(pk)}$ = 100 mA	R_{B1} selected for desired I_{B1}	R_{B1} selected for desired I_{B1}

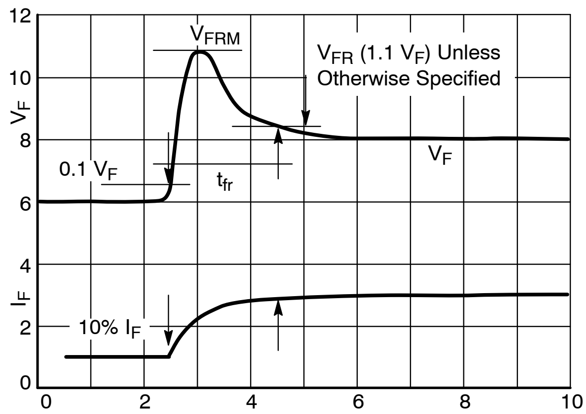


Figure 26. t_{fr} Measurement

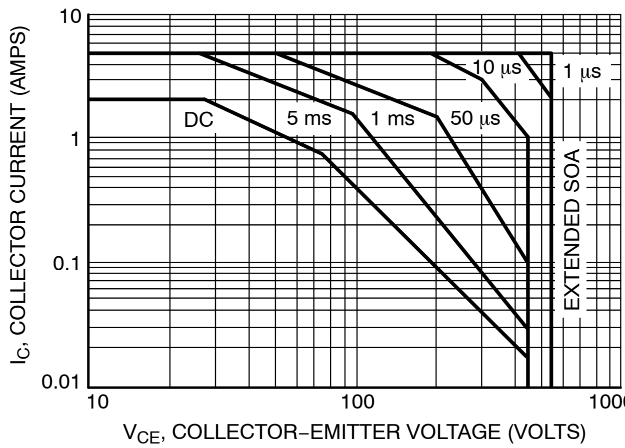


Figure 27. Forward Bias Safe Operating Area

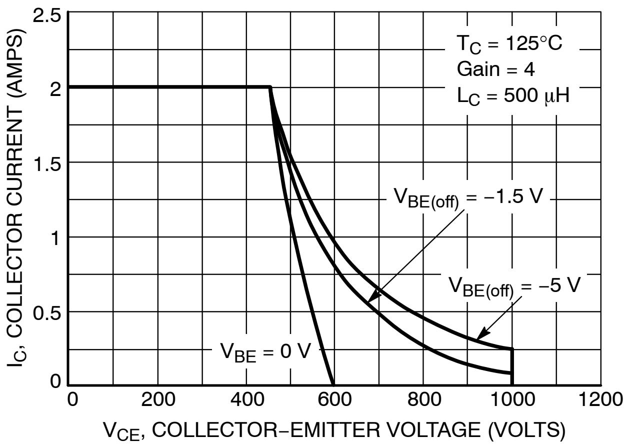


Figure 28. Reverse Bias Safe Operating Area

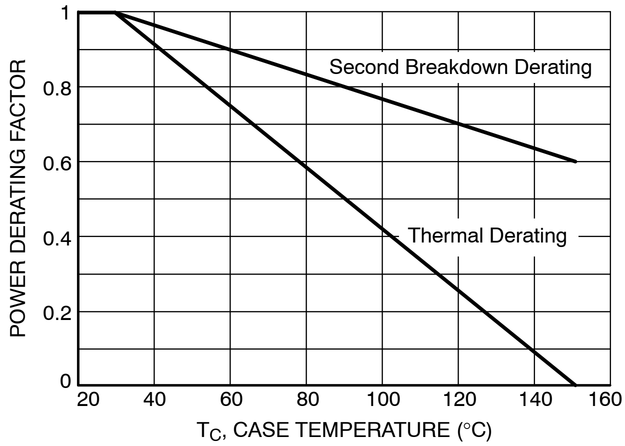


Figure 29. Forward Bias Power Derating

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C−V_{CE} limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate. The data of Figure 27 is based on T_C = 25°C; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when T_C > 25°C. Second Breakdown limitations do not derate the same as thermal limitations. Allowable current at the voltages shown on Figure 27 may be found at any case temperature by using the appropriate curve on Figure 29.

$T_{J(pk)}$ may be calculated from the data in Figure 30. At any case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown. For inductive loads, high voltage and current must be sustained simultaneously during turn−off with the base to emitter junction reverse biased. The safe level is specified as a reverse biased safe operating area (Figure 28). This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode.

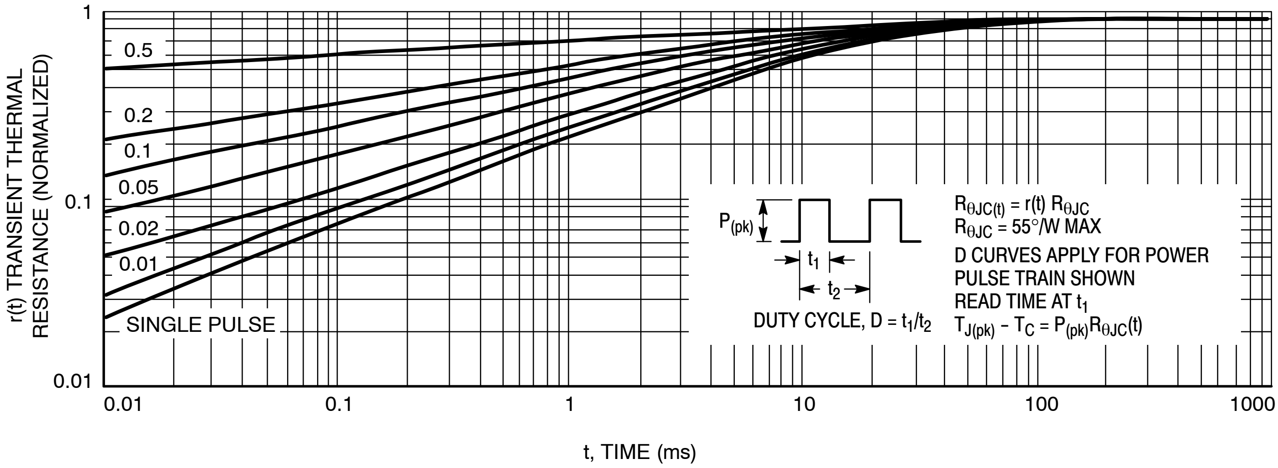


Figure 30. Typical Thermal Response ($Z_{\theta JC}(t)$) for MJD18002D2

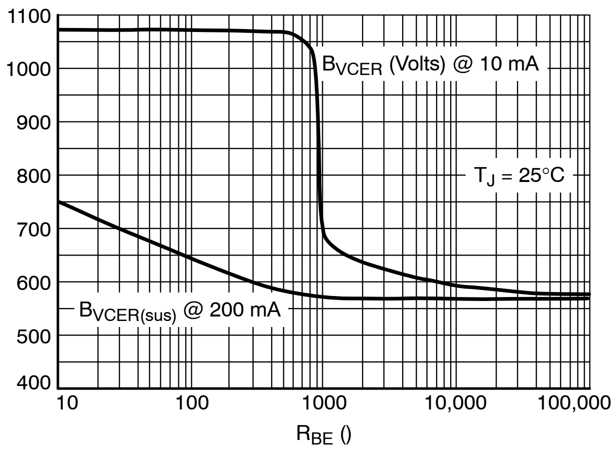


Figure 31. B_{VCER}

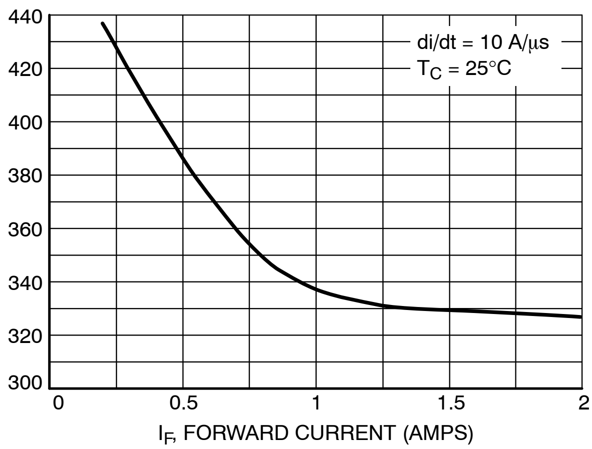
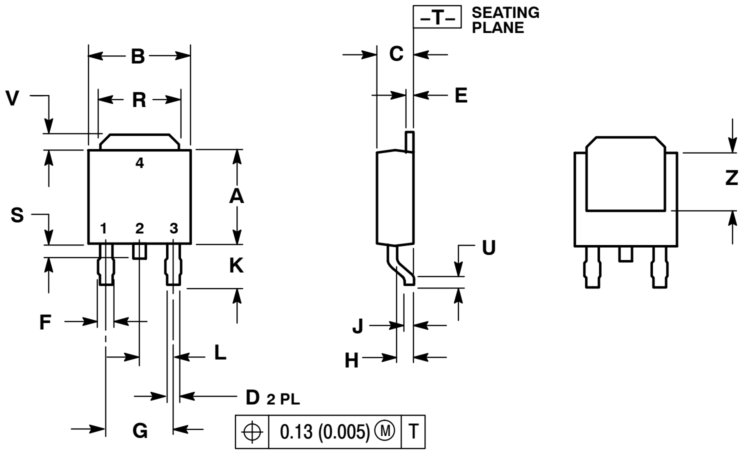


Figure 32. Forward Recovery Time, t_{fr}

MJD18002D2

PACKAGE DIMENSIONS

DPAK
CASE 369C−01
ISSUE B

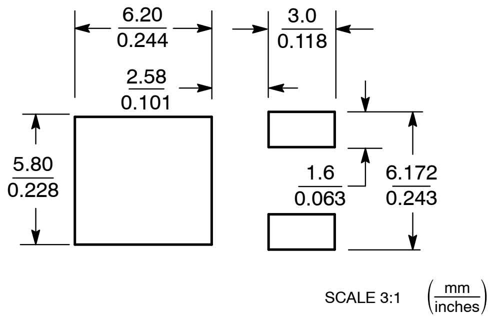


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.22
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
G	0.180 BSC		4.58 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.102	0.114	2.60	2.89
L	0.090 BSC		2.29 BSC	
R	0.180	0.215	4.57	5.45
S	0.025	0.040	0.63	1.01
U	0.020	−−−	0.51	−−−
V	0.035	0.050	0.89	1.27
Z	0.155	−−−	3.93	−−−

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

SOLDERING FOOTPRINT*



*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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