

# MJE5740, MJE5742

## NPN Silicon Power Darlington Transistors

The MJE5740 and MJE5742 Darlington transistors are designed for high-voltage power switching in inductive circuits.

### Features

- These Devices are Pb-Free and are RoHS Compliant\*

### Applications

- Small Engine Ignition
- Switching Regulators
- Inverters
- Solenoid and Relay Drivers
- Motor Controls

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage MJE5740 MJE5742	$V_{CEO(sus)}$	300 400	Vdc
Collector-Emitter Voltage MJE5740 MJE5742	$V_{CEV}$	600 800	Vdc
Emitter-Base Voltage	$V_{EB}$	8	Vdc
Collector Current – Continuous – Peak (Note 1)	$I_C$ $I_{CM}$	8 16	Adc
Base Current – Continuous – Peak (Note 1)	$I_B$ $I_{BM}$	2.5 5	Adc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	2 0.016	W W/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	100 0.8	W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +150	$^\circ\text{C}$

### THERMAL CHARACTERISTICS

Characteristics	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.25	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes 1/8" from Case for 5 Seconds	$T_L$	275	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

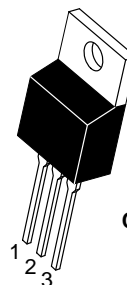
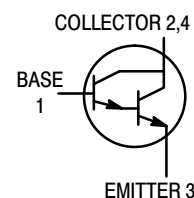
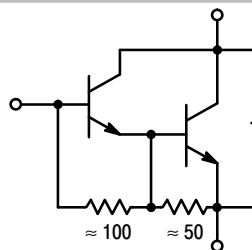
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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**POWER DARLINGTON  
TRANSISTORS  
8 AMPERES  
300-400 VOLTS  
80 WATTS**



TO-220AB  
CASE 221A-09  
STYLE 1

### MARKING DIAGRAM



MJE574x = Device Code  
x = 0 or 2  
G = Pb-Free Package  
A = Assembly Location  
Y = Year  
WW = Work Week

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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

Characteristic	Symbol	Min	Typ	Max	Unit	
<b>OFF CHARACTERISTICS</b> (Note 2)						
Collector–Emitter Sustaining Voltage (I <sub>C</sub> = 50 mA, I <sub>B</sub> = 0)	MJE5740 MJE5742	V <sub>CEO(sus)</sub>	300 400	– –	– –	Vdc
Collector Cutoff Current (V <sub>CEV</sub> = Rated Value, V <sub>BE(off)</sub> = 1.5 Vdc) (V <sub>CEV</sub> = Rated Value, V <sub>BE(off)</sub> = 1.5 Vdc, T <sub>C</sub> = 100°C)		I <sub>CEV</sub>	– –	– –	1 5	mAdc
Emitter Cutoff Current (V <sub>EB</sub> = 8 Vdc, I <sub>C</sub> = 0)		I <sub>EBO</sub>	–	–	75	mAdc

## SECOND BREAKDOWN

Second Breakdown Collector Current with Base Forward Biased	I <sub>S/b</sub>	See Figure 6
Clamped Inductive SOA with Base Reverse Biased	RBSOA	See Figure 7

## ON CHARACTERISTICS

 (Note 2)

DC Current Gain (I <sub>C</sub> = 0.5 Adc, V <sub>CE</sub> = 5 Vdc) (I <sub>C</sub> = 4 Adc, V <sub>CE</sub> = 5 Vdc)	h <sub>FE</sub>	50 200	100 400	– –	– –
Collector–Emitter Saturation Voltage (I <sub>C</sub> = 4 Adc, I <sub>B</sub> = 0.2 Adc) (I <sub>C</sub> = 8 Adc, I <sub>B</sub> = 0.4 Adc) (I <sub>C</sub> = 4 Adc, I <sub>B</sub> = 0.2 Adc, T <sub>C</sub> = 100°C)	V <sub>CE(sat)</sub>	– – –	– – –	2 3 2.2	Vdc
Base–Emitter Saturation Voltage (I <sub>C</sub> = 4 Adc, I <sub>B</sub> = 0.2 Adc) (I <sub>C</sub> = 8 Adc, I <sub>B</sub> = 0.4 Adc) (I <sub>C</sub> = 4 Adc, I <sub>B</sub> = 0.2 Adc, T <sub>C</sub> = 100°C)	V <sub>BE(sat)</sub>	– – –	– – –	2.5 3.5 2.4	Vdc
Diode Forward Voltage (Note 3) (I <sub>F</sub> = 5 Adc)	V <sub>f</sub>	–	–	2.5	Vdc

## SWITCHING CHARACTERISTICS

Typical Resistive Load (Table 1)						
Delay Time	(V <sub>CC</sub> = 250 Vdc, I <sub>C(pk)</sub> = 6 A I <sub>B1</sub> = I <sub>B2</sub> = 0.25 A, t <sub>p</sub> = 25 μs, Duty Cycle ≤ 1%)	t <sub>d</sub>	–	0.04	–	μs
Rise Time		t <sub>r</sub>	–	0.5	–	μs
Storage Time		t <sub>s</sub>	–	8	–	μs
Fall Time		t <sub>f</sub>	–	2	–	μs
Inductive Load, Clamped (Table 1)						
Voltage Storage Time	(I <sub>C(pk)</sub> = 6 A, V <sub>CE(pk)</sub> = 250 Vdc I <sub>B1</sub> = 0.06 A, V <sub>BE(off)</sub> = 5 Vdc)	t <sub>sv</sub>	–	4	–	μs
Crossover Time		t <sub>c</sub>	–	2	–	μs

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Pulse Test: Pulse Width 300 μs, Duty Cycle = 2%.

3. The internal Collector–to–Emitter diode can eliminate the need for an external diode to clamp inductive loads. Tests have shown that the Forward Recovery Voltage (V<sub>f</sub>) of this diode is comparable to that of typical fast recovery rectifiers.

## ORDERING INFORMATION

Device	Package	Shipping
MJE5740G	TO–220 (Pb–Free)	50 Units / Rail
MJE5742G	TO–220 (Pb–Free)	

TYPICAL CHARACTERISTICS

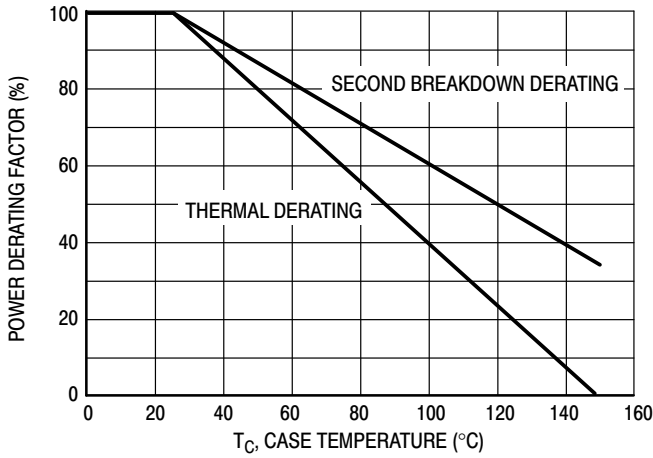


Figure 1. Power Derating

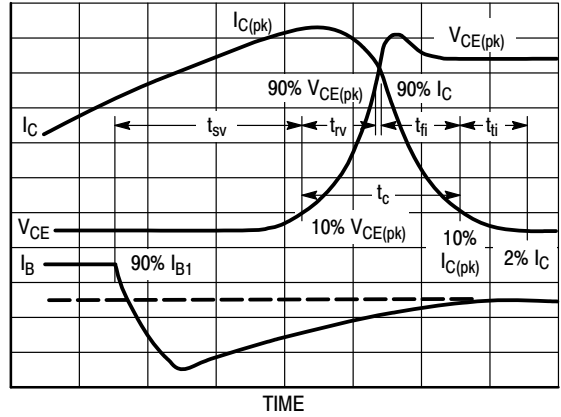


Figure 2. Inductive Switching Measurements

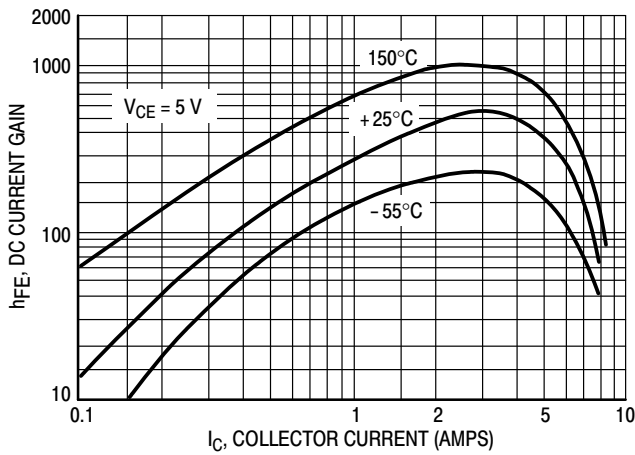


Figure 3. DC Current Gain

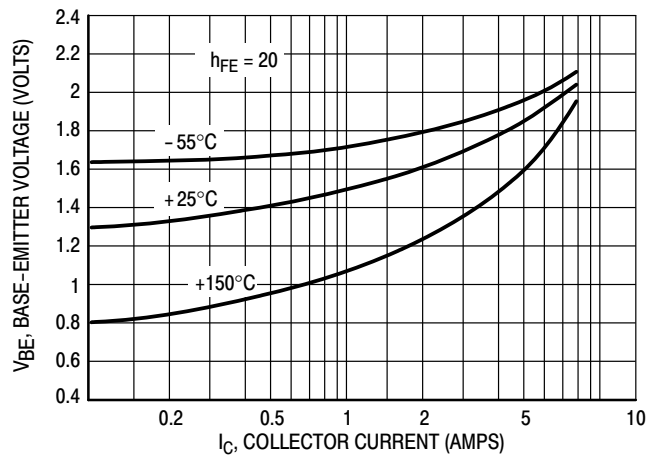


Figure 4. Base-Emitter Voltage

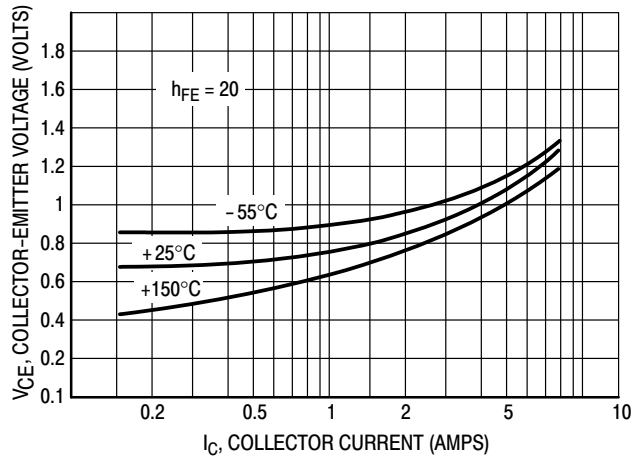


Figure 5. Collector-Emitter Saturation Voltage

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Table 1. Test Conditions for Dynamic Performance

REVERSE BIAS SAFE OPERATING AREA AND INDUCTIVE SWITCHING		RESISTIVE SWITCHING
TEST CIRCUITS	<p>DUTY CYCLE <math>\leq 10\%</math>  <math>t_r, t_f \leq 10 \text{ ns}</math></p> <p>NOTE:          PW and <math>V_{CC}</math> Adjusted for Desired <math>I_C</math>  <math>R_B</math> Adjusted for Desired <math>I_{B1}</math></p>	<p>*SELECTED FOR <math>\geq 1 \text{ kV}</math></p>
CIRCUIT VALUES	<p>COIL DATA:                  FERROXCUBE CORE #6656                  FULL BOBBIN (~16 TURNS) #16</p> <p>GAP FOR 200 <math>\mu\text{H}/20 \text{ A}</math>  <math>L_{\text{coil}} = 200 \mu\text{H}</math></p> <p><math>V_{CC} = 30 \text{ V}</math>  <math>V_{CE(\text{pk})} = 250 \text{ Vdc}</math>  <math>I_{C(\text{pk})} = 6 \text{ A}</math></p>	<p><math>V_{CC} = 250 \text{ V}</math>  <math>D1 = 1\text{N}5820 \text{ OR EQUIV.}</math></p>
TEST WAVEFORMS	<p>OUTPUT WAVEFORMS</p> <p><math>t_1</math> ADJUSTED TO OBTAIN <math>I_C</math></p> $t_1 \approx \frac{L_{\text{coil}} (I_{C(\text{pk})})}{V_{CC}}$ $t_2 \approx \frac{L_{\text{coil}} (I_{C(\text{pk})})}{V_{\text{clamp}}}$ <p>TEST EQUIPMENT          SCOPE-TEKTRONICS          475 OR EQUIVALENT</p>	<p><math>t_r, t_f &lt; 10 \text{ ns}</math>          DUTY CYCLE = 1%  <math>R_B</math> AND <math>R_C</math> ADJUSTED FOR DESIRED <math>I_B</math> AND <math>I_C</math></p>

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## SAFE OPERATING AREA INFORMATION

### FORWARD BIAS

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 6 is based on  $T_C = 25^\circ\text{C}$ ;  $T_{J(pk)}$  is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when  $T_C \geq 25^\circ\text{C}$ . Second breakdown limitations do not derate the same as thermal limitations. Allowable current at the voltages shown on Figure 6 may be found at any case temperature by using the appropriate curve on Figure 1.

### REVERSE BIAS

For inductive loads, high voltage and high current must be sustained simultaneously during turn-off, in most cases, with the base to emitter junction reverse biased. Under these conditions the collector voltage must be held to a safe level at or below a specific value of collector current. This can be accomplished by several means such as active clamping, RC snubbing, load line shaping, etc. The safe level for these devices is specified as Reverse Bias Safe Operating Area and represents the voltage-current condition allowable during reverse biased turnoff. This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode. Figure 7 gives the complete RBSOA characteristics.

The Safe Operating Area figures shown in Figures 6 and 7 are specified ratings for these devices under the test conditions shown.

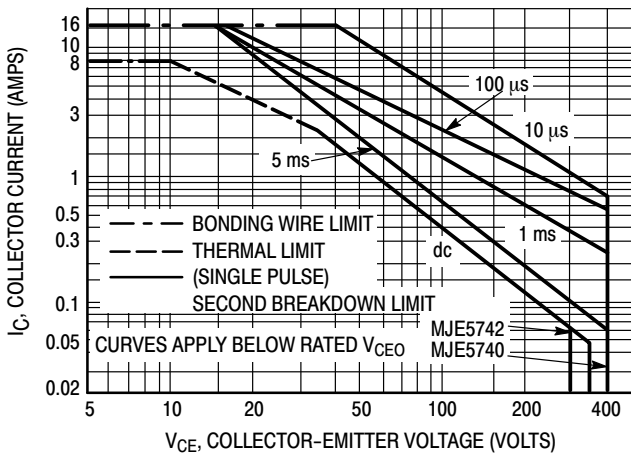


Figure 6. Forward Bias Safe Operating Area

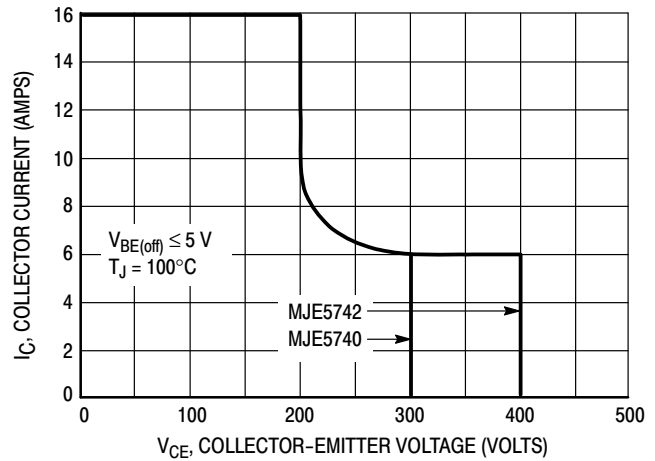


Figure 7. Reverse Bias Safe Operating Area

## RESISTIVE SWITCHING PERFORMANCE

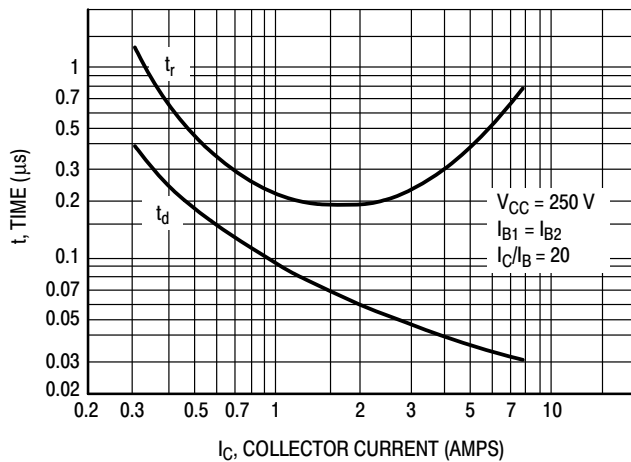


Figure 8. Turn-On Time

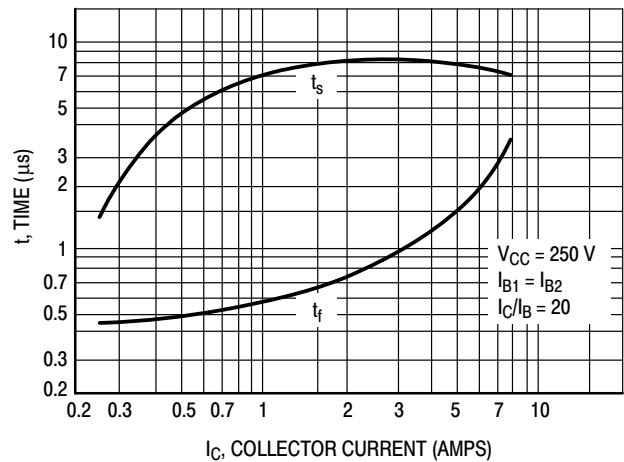


Figure 9. Turn-Off Time

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