## MJE5740, MJE5742

## MJE5742 is a Preferred Device

## NPN Silicon Power <br> Darlington Transistors

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

## Features

- $\mathrm{Pb}-$ Free Packages are Available*


## Applications

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


## MAXIMUM RATINGS

| Rating |  |  | Symbol | Value | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Collector-Emitter Voltage |  | $\begin{aligned} & \text { MJE } \\ & \text { MJE } \end{aligned}$ | $\mathrm{V}_{\text {CEO(sus) }}$ | $\begin{aligned} & 300 \\ & 400 \end{aligned}$ | Vdc |
| Collector-Emitter Voltage |  | $\begin{aligned} & \text { MJE } \\ & \text { MJE } \end{aligned}$ | $\mathrm{V}_{\text {CEV }}$ | $\begin{aligned} & 600 \\ & 800 \end{aligned}$ | Vdc |
| Emitter-Base Voltage |  |  | $\mathrm{V}_{\mathrm{EB}}$ | 8 | Vdc |
| Collector Current | - Continuous <br> - Peak (Note 1) |  | $\begin{gathered} \hline \mathrm{I}_{\mathrm{C}} \\ \mathrm{I}_{\mathrm{CM}} \end{gathered}$ | $\begin{gathered} \hline 8 \\ 16 \end{gathered}$ | Adc |
| Base Current | - Continuous <br> - Peak (Note 1) |  | $\begin{gathered} \mathrm{I}_{\mathrm{B}} \\ \mathrm{I}_{\mathrm{BM}} \end{gathered}$ | $\begin{gathered} 2.5 \\ 5 \end{gathered}$ | Adc |
| Total Device Dissipation @ $\mathrm{T}_{\mathrm{C}}=25^{\circ} \mathrm{C}$ Derate above $25^{\circ} \mathrm{C}$ |  |  | $\mathrm{P}_{\mathrm{D}}$ | $\begin{gathered} 2 \\ 16 \end{gathered}$ | $\begin{gathered} \mathrm{W} \\ \mathrm{~W} /{ }^{\circ} \mathrm{C} \end{gathered}$ |
| Total Device Dissipation @ $\mathrm{T}_{\mathrm{C}}=25^{\circ} \mathrm{C}$ Derate above $25^{\circ} \mathrm{C}$ |  |  | $\mathrm{P}_{\mathrm{D}}$ | $\begin{gathered} 80 \\ 640 \end{gathered}$ | $\begin{gathered} \mathrm{W} \\ \mathrm{~W} /{ }^{\circ} \mathrm{C} \end{gathered}$ |
| Operating and Storage Junction Temperature Range |  |  | $\mathrm{T}_{\mathrm{J}}, \mathrm{T}_{\text {stg }}$ | -65 to +150 | ${ }^{\circ} \mathrm{C}$ |

## THERMAL CHARACTERISTICS

| Characteristics | Symbol | Max | Unit |
| :--- | :---: | :---: | :---: |
| Thermal Resistance, Junction-to-Case | $\mathrm{R}_{\text {ӨJC }}$ | 1.25 | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |
| Thermal Resistance, Junction-to-Ambient | $\mathrm{R}_{\theta \mathrm{JA}}$ | 62.5 | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |
| Maximum Lead Temperature for Soldering <br> Purposes 1/8" from Case for 5 Seconds | $\mathrm{T}_{\mathrm{L}}$ | 275 | ${ }^{\circ} \mathrm{C}$ |

Maximum ratings are those values beyond which device damage can occur Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. Pulse Test: Pulse Width $=5 \mathrm{~ms}$, Duty Cycle $\leq 10 \%$.
 download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## ON Semiconductor ${ }^{\circledR}$

http://onsemi.com

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



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

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

ELECTRICAL CHARACTERISTICS $\left(\mathrm{T}_{\mathrm{C}}=25^{\circ} \mathrm{C}\right.$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: |
| OFF CHARACTERISTICS (Note 2) |  |  |  |  |  |
| Collector-Emitter Sustaining Voltage MJE5740 <br> $\left(I_{\mathrm{C}}=50 \mathrm{~mA}, \mathrm{I}_{\mathrm{B}}=0\right)$ MJE5742 | $\mathrm{V}_{\text {CEO(sus) }}$ | $\begin{aligned} & 300 \\ & 400 \end{aligned}$ | - | - | Vdc |
| $\begin{aligned} & \text { Collector Cutoff Current }\left(\mathrm{V}_{\mathrm{CEV}}=\text { Rated Value, } \mathrm{V}_{\mathrm{BE} \text { (off) }}=1.5 \mathrm{Vdc}\right) \\ & \left(\mathrm{V}_{\mathrm{CEV}}=\text { Rated Value, } \mathrm{V}_{\mathrm{BE}(\text { (off })}=1.5 \mathrm{Vdc}, \mathrm{~T}_{\mathrm{C}}=100^{\circ} \mathrm{C}\right) \end{aligned}$ | $I_{\text {CEV }}$ | - | - | $\begin{aligned} & 1 \\ & 5 \end{aligned}$ | mAdc |
| Emitter Cutoff Current ( $\mathrm{V}_{\mathrm{EB}}=8 \mathrm{Vdc}, \mathrm{I}_{\mathrm{C}}=0$ ) | $\mathrm{I}_{\text {Ebo }}$ | - | - | 75 | mAdc |

SECOND BREAKDOWN

| Second Breakdown Collector Current with Base Forward Biased | $\mathrm{I}_{\mathrm{S} / \mathrm{b}}$ | See Figure 6 |
| :--- | :---: | :---: |
| Clamped Inductive SOA with Base Reverse Biased | RBSOA | See Figure 7 |

ON CHARACTERISTICS (Note 2)

| $\begin{aligned} & \text { DC Current Gain }\left(\mathrm{I}_{\mathrm{C}}=0.5 \mathrm{Adc}, \mathrm{~V}_{\mathrm{CE}}=5 \mathrm{Vdc}\right) \\ & \left(\mathrm{I}_{\mathrm{C}}=4 \mathrm{Adc}, \mathrm{~V}_{\mathrm{CE}}=5 \mathrm{Vdc}\right) \end{aligned}$ | $\mathrm{h}_{\text {FE }}$ | $\begin{gathered} 50 \\ 200 \end{gathered}$ | $\begin{aligned} & 100 \\ & 400 \end{aligned}$ |  | - |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Collector-Emitter Saturation Voltage }\left(\mathrm{I}_{\mathrm{C}}=4 \mathrm{Adc}, \mathrm{I}_{\mathrm{B}}=0.2 \mathrm{Adc}\right) \\ &\left(\mathrm{I}_{\mathrm{C}}=8 \mathrm{Adc}, \mathrm{I}_{\mathrm{B}}=0.4 \mathrm{Adc}\right) \\ &\left(\mathrm{I}_{\mathrm{C}}=4 \mathrm{Adc}, \mathrm{I}_{\mathrm{B}}=0.2 \mathrm{Adc}, \mathrm{~T}_{\mathrm{C}}=100^{\circ} \mathrm{C}\right) \end{aligned}$ | $\mathrm{V}_{\text {CE(sat) }}$ | - | - | $\begin{gathered} 2 \\ 3 \\ 2.2 \end{gathered}$ | Vdc |
| $\begin{aligned} & \hline \text { Base-Emitter Saturation Voltage }\left(I_{C}=4 \mathrm{Adc}, \mathrm{I}_{\mathrm{B}}=0.2 \mathrm{Adc}\right) \\ &\left(\mathrm{I}_{\mathrm{C}}=8 \mathrm{Adc}, \mathrm{I}_{\mathrm{B}}=0.4 \mathrm{Adc}\right) \\ &\left(\mathrm{I}_{\mathrm{C}}=4 \mathrm{Adc}, I_{\mathrm{B}}=0.2 \mathrm{Adc}, \mathrm{~T}_{\mathrm{C}}=100^{\circ} \mathrm{C}\right) \end{aligned}$ | $\mathrm{V}_{\mathrm{BE} \text { (sat) }}$ | - | - | $\begin{aligned} & 2.5 \\ & 3.5 \\ & 2.4 \end{aligned}$ | Vdc |
| Diode Forward Voltage (Note 3) ( $\mathrm{I}_{\mathrm{F}}=5 \mathrm{Adc}$ ) | $\mathrm{V}_{\mathrm{f}}$ | - | - | 2.5 | Vdc |

## SWITCHING CHARACTERISTICS

| Typical Resistive Load (Table 1) |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Delay Time | $\begin{aligned} & \left(\mathrm{V}_{\mathrm{CC}}=250 \mathrm{Vdc}, \mathrm{I}_{(\mathrm{pk})}=6 \mathrm{~A}\right. \\ & \mathrm{I}_{\mathrm{B} 1}=\mathrm{I}_{\mathrm{B} 2}=0.25 \mathrm{~A}, \mathrm{t}_{\mathrm{p}}=25 \mu \mathrm{~s}, \\ & \text { Duty Cycle } \leq 1 \%) \end{aligned}$ | $\mathrm{t}_{\mathrm{d}}$ | - | 0.04 | - | $\mu \mathrm{S}$ |
| Rise Time |  | $\mathrm{tr}_{r}$ | - | 0.5 | - | $\mu \mathrm{S}$ |
| Storage Time |  | $\mathrm{t}_{\text {s }}$ | - | 8 | - | $\mu \mathrm{S}$ |
| Fall Time |  | $\mathrm{t}_{\mathrm{f}}$ | - | 2 | - | $\mu \mathrm{s}$ |
| Inductive Load, Clamped (Table 1) |  |  |  |  |  |  |
| Voltage Storage Time | $\begin{aligned} & \left(\mathrm{I}_{\mathrm{C}(\mathrm{pk})}=6 \mathrm{~A}, \mathrm{~V}_{\mathrm{CE}(\mathrm{pk})}=250 \mathrm{Vdc}\right. \\ & \left.\mathrm{I}_{\mathrm{B} 1}=0.06 \mathrm{~A}, \mathrm{~V}_{\mathrm{BE}(\mathrm{off})}=5 \mathrm{Vdc}\right) \end{aligned}$ | $\mathrm{t}_{\mathrm{sv}}$ | - | 4 | - | $\mu \mathrm{S}$ |
| Crossover Time |  | $\mathrm{t}_{\mathrm{c}}$ | - | 2 | - | $\mu \mathrm{S}$ |

2. Pulse Test: Pulse Width $300 \mu \mathrm{~s}$, 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 $\left(\mathrm{V}_{\mathrm{f}}\right)$ of this diode is comparable to that of typical fast recovery rectifiers.

## ORDERING INFORMATION

| Device | Package | Shipping |
| :--- | :---: | :---: |
| MJE5740 | TO-220 |  |
| MJE5740G | TO-220 <br> (Pb-Free) | 50 Units / Rail |
| MJE5742 | TO-220 |  |
| MJE5742G | TO-220 <br> (Pb-Free) |  |

## MJE5740, MJE5742

TYPICAL CHARACTERISTICS


Figure 1. Power Derating


Figure 3. DC Current Gain


Figure 2. Inductive Switching Measurements


Figure 4. Base-Emitter Voltage

Table 1. Test Conditions for Dynamic Performance

| Reverse bias safe operating area and inductive switching |  | RESISTIVE SWITCHING |
| :---: | :---: | :---: |
|  |  |  |
|  | COIL DATA:  $V_{\text {CC }}=30 \mathrm{~V}$ <br> FERROXCUBE CORE \#6656 GAP FOR 200  <br> FUH/20 A $V_{\text {CE(pk) }}=250 \mathrm{Vdc}$  <br> FULL BOBBIN ( $\sim 16$ TURNS) \#16 $\mathrm{L}_{\text {coil }}=200 \mu \mathrm{H}$ $\mathrm{I}_{\text {( } \text { (pk })}=6 \mathrm{~A}$ | $\begin{aligned} & V_{\text {CC }}=250 \mathrm{~V} \\ & \mathrm{D} 1=1 \text { N } 5820 \text { OR EQUIV. } \end{aligned}$ |
|  | OUTPUT WAVEFORMS |  <br> $\mathrm{t}_{\mathrm{n}}, \mathrm{t}_{\mathrm{t}}<10 \mathrm{~ns}$ <br> DUTY CYCLE $=1 \%$ <br> $\mathrm{R}_{\mathrm{B}}$ AND RC ADJUSTED <br> FOR DESIRED $I_{B}$ AND $I_{C}$ |



Figure 5. Inductive Switching Measurements

MJE5740, MJE5742

## 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 $I_{C}-V_{C E}$ 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 $\mathrm{T}_{\mathrm{C}}=25^{\circ} \mathrm{C} ; \mathrm{T}_{\mathrm{J}(\mathrm{pk})}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to $10 \%$ but must be derated when $\mathrm{T}_{\mathrm{C}} \geq 25^{\circ} \mathrm{C}$. 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

## MJE5740, MJE5742

## PACKAGE DIMENSIONS

TO-220AB
CASE 221A-09
ISSUE AA


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.

|  | INCHES |  | MILLIMETERS |  |
| :---: | ---: | ---: | ---: | ---: |
| DIM | 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 | --- |
| $\mathbf{Z}$ | --- | 0.080 | --- | 2.04 |

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

[^0]
## PUBLICATION ORDERING INFORMATION

## LITERATURE FULFILLMENT

Literature Distribution Center for ON Semiconductor P.O. Box 61312, Phoenix, Arizona 85082-1312 USA

Phone: 480-829-7710 or 800-344-3860 Toll Free USA/Canada Fax: 480-829-7709 or 800-344-3867 Toll Free USA/Canada Email: orderlit@onsemi.com
N. American Technical Support: 800-282-9855 Toll Free USA/Canada

Japan: ON Semiconductor, Japan Customer Focus Center 2-9-1 Kamimeguro, Meguro-ku, Tokyo, Japan 153-0051 Phone: 81-3-5773-3850

ON Semiconductor Website: http://onsemi.com Order Literature: http://www.onsemi.com/litorder

For additional information, please contact your local Sales Representative.


[^0]:    ON Semiconductor and (IN) are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should
    Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

