

# ECOSPARK® Ignition IGBT

300 mJ, 400 V, N-Channel Ignition IGBT

## ISL9V3040x3ST-F085C

### Features

- SCIS Energy = 300 mJ at  $T_J = 25^\circ\text{C}$
- Logic Level Gate Drive
- AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

### Applications

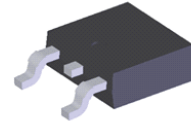
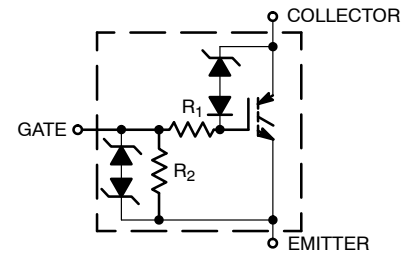
- Automotive Ignition Coil Driver Circuits
- High Current Ignition System
- Coil on Plug Application

### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Symbol                | Parameter                                                                                  | Value           | Unit                |
|-----------------------|--------------------------------------------------------------------------------------------|-----------------|---------------------|
| $BV_{\text{CER}}$     | Collector to Emitter Breakdown Voltage ( $I_C = 1\text{ mA}$ )                             | 400             | V                   |
| $BV_{\text{ECS}}$     | Emitter to Collector Voltage – Reverse Battery Condition ( $I_C = 10\text{ mA}$ )          | 24              | V                   |
| $ESCIS25$             | ISCIS = 14.2 A, L = 3.0 mHy, RGE = 1 K $\Omega$ , $T_C = 25^\circ\text{C}$ (Note 1)        | 300             | mJ                  |
| $ESCIS150$            | ISCIS = 10.6 A, L = 3.0 mHy, RGE = 1 K $\Omega$ , $T_C = 150^\circ\text{C}$ (Note 2)       | 170             | mJ                  |
| $IC25$                | Collector Current Continuous at $V_{\text{GE}} = 4.0\text{ V}$ , $T_C = 25^\circ\text{C}$  | 21              | A                   |
| $IC110$               | Collector Current Continuous at $V_{\text{GE}} = 4.0\text{ V}$ , $T_C = 110^\circ\text{C}$ | 17              | A                   |
| $V_{\text{GEM}}$      | Gate to Emitter Voltage Continuous                                                         | $\pm 10$        | V                   |
| PD                    | Power Dissipation Total, $T_C = 25^\circ\text{C}$                                          | 150             | W                   |
|                       | Power Dissipation Derating, $T_C > 25^\circ\text{C}$                                       | 1               | W/ $^\circ\text{C}$ |
| $T_J, T_{\text{STG}}$ | Operating Junction and Storage Temperature                                                 | $-55$ to $+175$ | $^\circ\text{C}$    |
| $T_L$                 | Lead Temperature for Soldering Purposes (1/8" from case for 10 s)                          | 300             | $^\circ\text{C}$    |
| $T_{\text{PKG}}$      | Reflow Soldering according to JESD020C                                                     | 260             | $^\circ\text{C}$    |
| ESD                   | HBM–Electrostatic Discharge Voltage at 100 pF, 1500 $\Omega$                               | 4               | kV                  |
|                       | CDM–Electrostatic Discharge Voltage at 1 $\Omega$                                          | 2               | kV                  |

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.

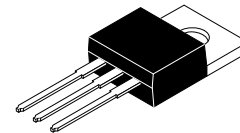
1. Self clamped inductive Switching Energy (ESCIS25) of 300 mJ is based on the test conditions that is starting  $T_J = 25^\circ\text{C}$ , L = 3 mHy, ISCIS = 14.2 A, VCC = 100 V during inductor charging and VCC = 0 V during time in clamp.
2. Self Clamped inductive Switching Energy (ESCIS150) of 170 mJ is based on the test conditions that is starting  $T_J = 150^\circ\text{C}$ , L = 3mHy, ISCIS = 10.6 A, VCC = 100 V during inductor charging and VCC = 0 V during time in clamp.



DPAK3  
CASE 369AS

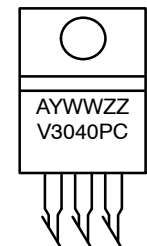


D2PAK-3  
CASE 418AJ



TO-220-3LD  
CASE 340AT

### MARKING DIAGRAMS



- A = Assembly Location  
 Y = Year  
 WW = Work Week  
 XXXX = Device Code  
 G = Pb-Free Package  
 ZZ = Assembly Lot Number  
 V3040PC = Device Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

# ISL9V3040x3ST-F085C

## THERMAL RESISTANCE RATINGS

| Characteristic                          | Symbol          | Max | Units |
|-----------------------------------------|-----------------|-----|-------|
| Junction-to-Case – Steady State (Drain) | $R_{\theta JC}$ | 1   | °C/W  |

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

| Symbol | Parameter | Test Conditions | Min | Typ. | Max. | Units |
|--------|-----------|-----------------|-----|------|------|-------|
|--------|-----------|-----------------|-----|------|------|-------|

### OFF CHARACTERISTICS

|                   |                                        |                                                                                                            |                        |     |     |     |    |
|-------------------|----------------------------------------|------------------------------------------------------------------------------------------------------------|------------------------|-----|-----|-----|----|
| BV <sub>CER</sub> | Collector to Emitter Breakdown Voltage | I <sub>CE</sub> = 2 mA, V <sub>GE</sub> = 0 V,<br>R <sub>GE</sub> = 1 kΩ,<br>T <sub>J</sub> = -40 to 150°C |                        | 370 | 400 | 430 | V  |
| BV <sub>CES</sub> | Collector to Emitter Breakdown Voltage | I <sub>CE</sub> = 10 mA, V <sub>GE</sub> = 0 V,<br>R <sub>GE</sub> = 0,<br>T <sub>J</sub> = -40 to 150°C   |                        | 390 | 420 | 450 | V  |
| BV <sub>ECS</sub> | Emitter to Collector Breakdown Voltage | I <sub>CE</sub> = -75 mA, V <sub>GE</sub> = 0 V,<br>T <sub>J</sub> = 25°C                                  |                        | 30  | -   | -   | V  |
| BV <sub>GES</sub> | Gate to Emitter Breakdown Voltage      | I <sub>GES</sub> = ±2 mA                                                                                   |                        | ±12 | ±14 | -   | V  |
| I <sub>CER</sub>  | Collector to Emitter Leakage Current   | V <sub>CE</sub> = 175 V<br>R <sub>GE</sub> = 1 kΩ                                                          | T <sub>J</sub> = 25°C  | -   | -   | 25  | μA |
|                   |                                        |                                                                                                            | T <sub>J</sub> = 150°C | -   | -   | 1   | mA |
| I <sub>ECS</sub>  | Emitter to Collector Leakage Current   | V <sub>EC</sub> = 24 V                                                                                     | T <sub>J</sub> = 25°C  | -   | -   | 1   | mA |
|                   |                                        |                                                                                                            | T <sub>J</sub> = 150°C | -   | -   | 40  |    |
| R <sub>1</sub>    | Series Gate Resistance                 |                                                                                                            |                        | -   | 70  | -   | Ω  |
| R <sub>2</sub>    | Gate to Emitter Resistance             |                                                                                                            |                        | 10K | -   | 26K | Ω  |

### ON CHARACTERISTICS

|               |                                         |                                                                              |   |      |      |   |
|---------------|-----------------------------------------|------------------------------------------------------------------------------|---|------|------|---|
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE} = 6\text{ A}$ , $V_{GE} = 4\text{ V}$ , $T_J = 25^\circ\text{C}$     | – | 1.25 | 1.65 | V |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE} = 10\text{ A}$ , $V_{GE} = 4.5\text{ V}$ , $T_J = 150^\circ\text{C}$ | – | 1.58 | 1.80 | V |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE} = 15\text{ A}$ , $V_{GE} = 4.5\text{ V}$ , $T_J = 150^\circ\text{C}$ | – | 1.90 | 2.20 | V |

### DYNAMIC CHARACTERISTICS

|                     |                                   |                                                                       |                        |      |     |     |    |
|---------------------|-----------------------------------|-----------------------------------------------------------------------|------------------------|------|-----|-----|----|
| Q <sub>G(ON)</sub>  | Gate Charge                       | I <sub>CE</sub> = 10 A, V <sub>CE</sub> = 12 V, V <sub>GE</sub> = 5 V |                        | –    | 17  | –   | nC |
| V <sub>GE(TH)</sub> | Gate to Emitter Threshold Voltage | I <sub>CE</sub> = 1 mA<br>V <sub>CE</sub> = V <sub>GE</sub>           | T <sub>J</sub> = 25°C  | 1.3  | –   | 2.2 | V  |
|                     |                                   |                                                                       | T <sub>J</sub> = 150°C | 0.75 | –   | 1.8 |    |
| V <sub>GEP</sub>    | Gate to Emitter Plateau Voltage   | V <sub>CE</sub> = 12 V, I <sub>CE</sub> = 10 A                        |                        | –    | 3.0 | –   | V  |

### SWITCHING CHARACTERISTICS

|               |                                       |                                                                                                                                                            |   |     |    |               |
|---------------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|----|---------------|
| $t_{d(ON)R}$  | Current Turn-On Delay Time–Resistive  | $V_{CE} = 14\text{ V}$ , $R_L = 1\text{ }\Omega$ ,<br>$V_{GE} = 5\text{ V}$ , $R_G = 470\text{ }\Omega$ ,<br>$T_J = 25^\circ\text{C}$                      | – | 0.7 | 4  | $\mu\text{s}$ |
| $t_{rR}$      | Current Rise Time–Resistive           |                                                                                                                                                            | – | 2.1 | 7  |               |
| $t_{d(OFF)L}$ | Current Turn-Off Delay Time–Inductive | $V_{CE} = 300\text{ V}$ , $L = 1\text{ mH}$ ,<br>$V_{GE} = 5\text{ V}$ , $R_G = 470\text{ }\Omega$ ,<br>$I_{CE} = 6.5\text{ A}$ , $T_J = 25^\circ\text{C}$ | – | 4.8 | 15 |               |
| $t_{fL}$      | Current Fall Time–Inductive           |                                                                                                                                                            | – | 2.8 | 15 |               |

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.

TYPICAL CHARACTERISTICS

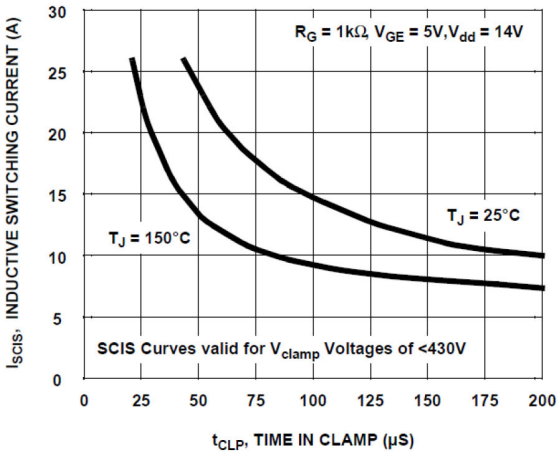


Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp

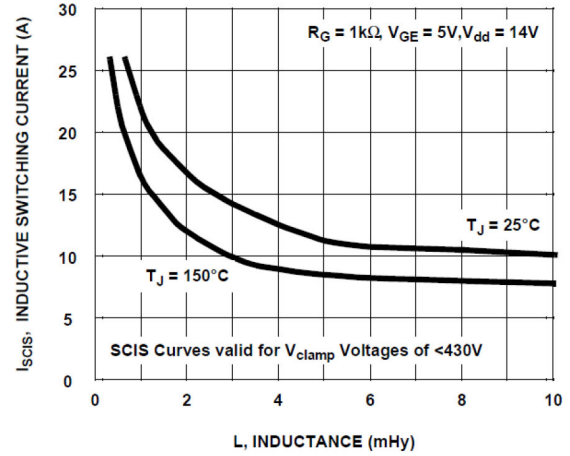


Figure 2. Self Clamped Inductive Switching Current vs. Inductance

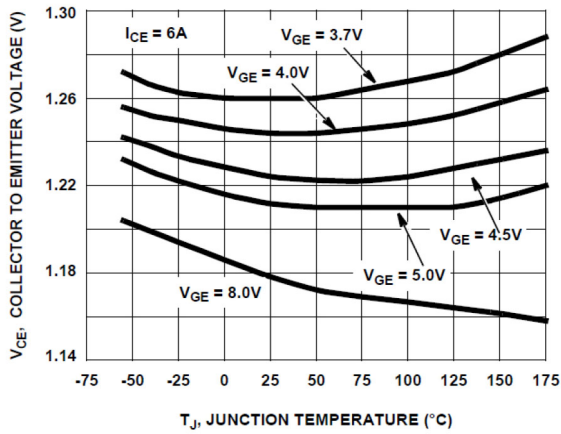


Figure 3. Collector to Emitter On-State Voltage vs. Junction Temperature

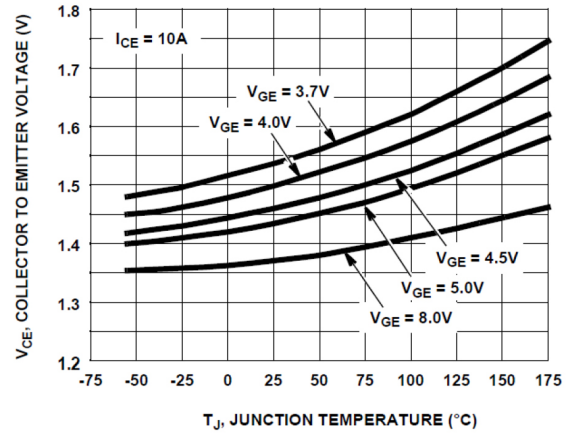


Figure 4. Collector to Emitter On-State Voltage vs. Junction Temperature

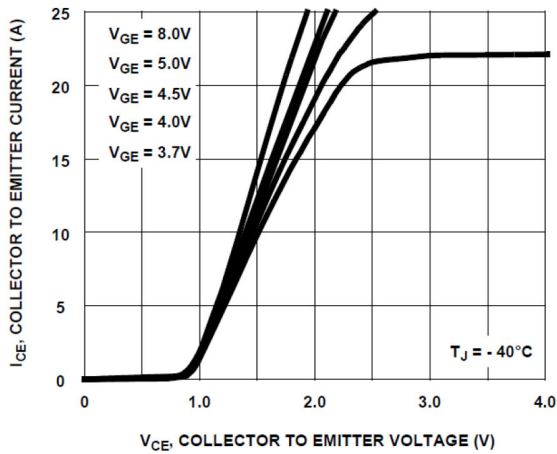


Figure 5. Collector to Emitter On-State Voltage vs. Collector Current

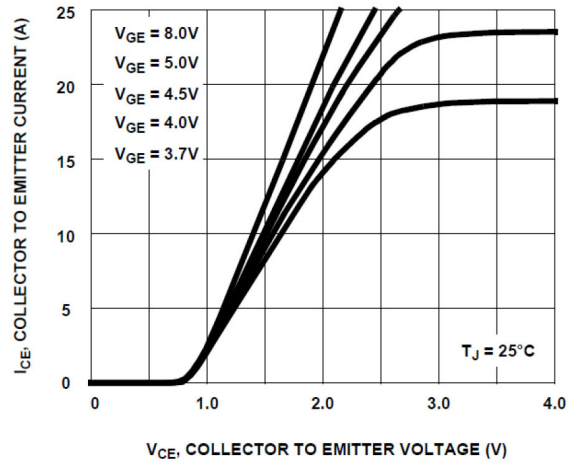


Figure 6. Collector to Emitter On-State Voltage vs. Collector Current

TYPICAL CHARACTERISTICS (continued)

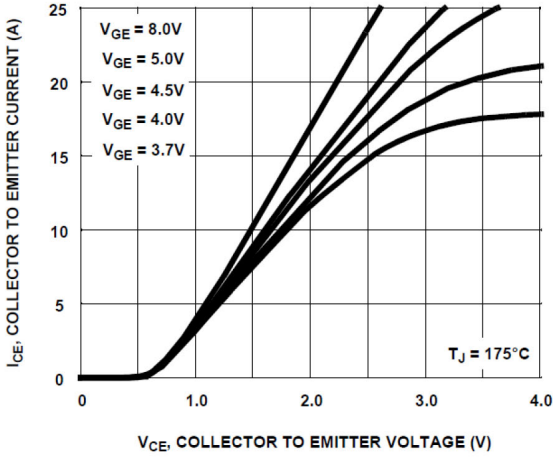


Figure 7. Collector to Emitter On-State Voltage vs. Collector Current

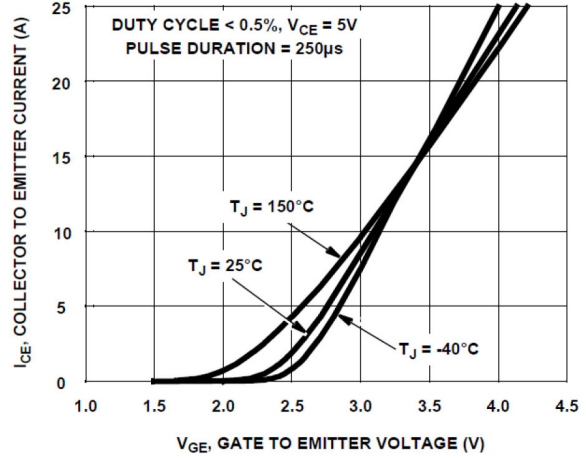


Figure 8. Transfer Characteristics

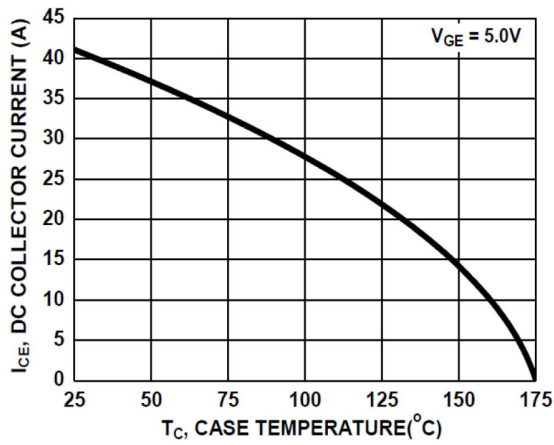


Figure 9. DC Collector Current vs. Case Temperature

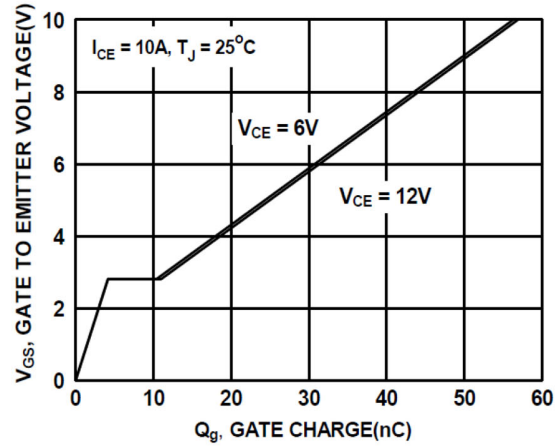


Figure 10. Gate Charge

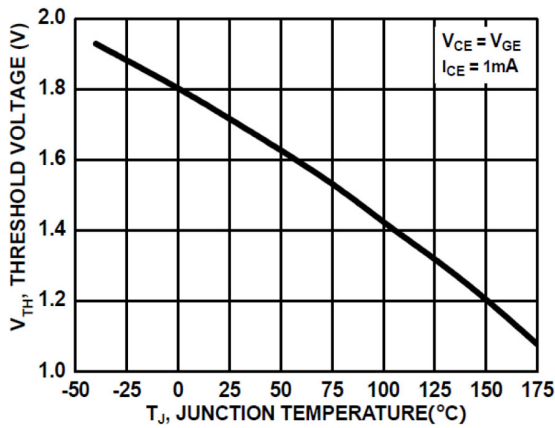


Figure 11. Threshold Voltage vs. Junction Temperature

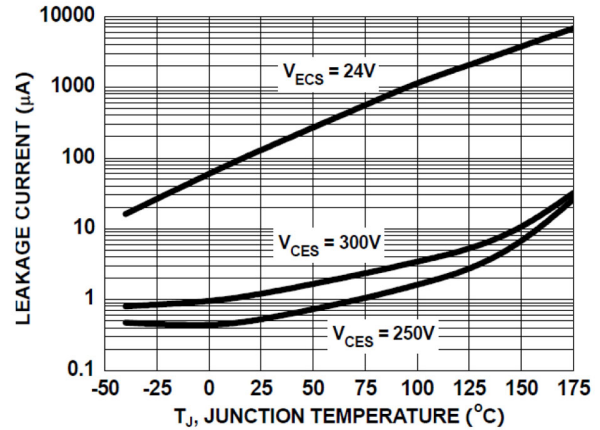


Figure 12. Leakage Current vs. Junction Temperature

# ISL9V3040x3ST-F085C

## TYPICAL CHARACTERISTICS (continued)

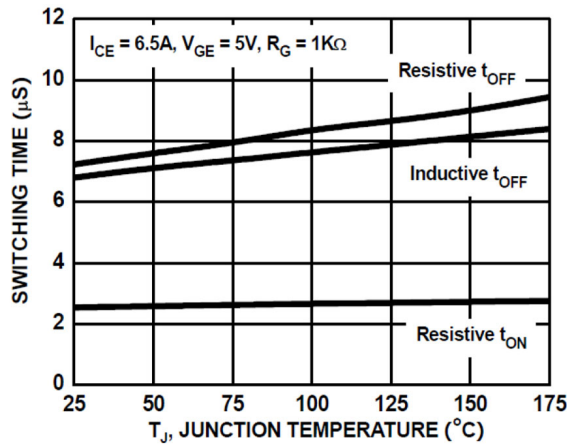


Figure 13. Switching Time vs. Junction Temperature

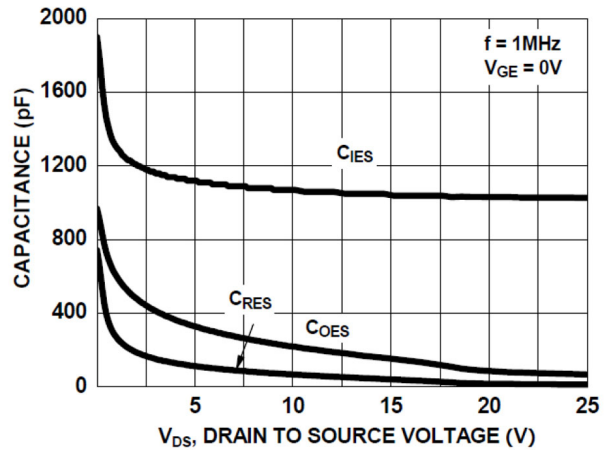


Figure 14. Capacitance vs. Collector to Emitter

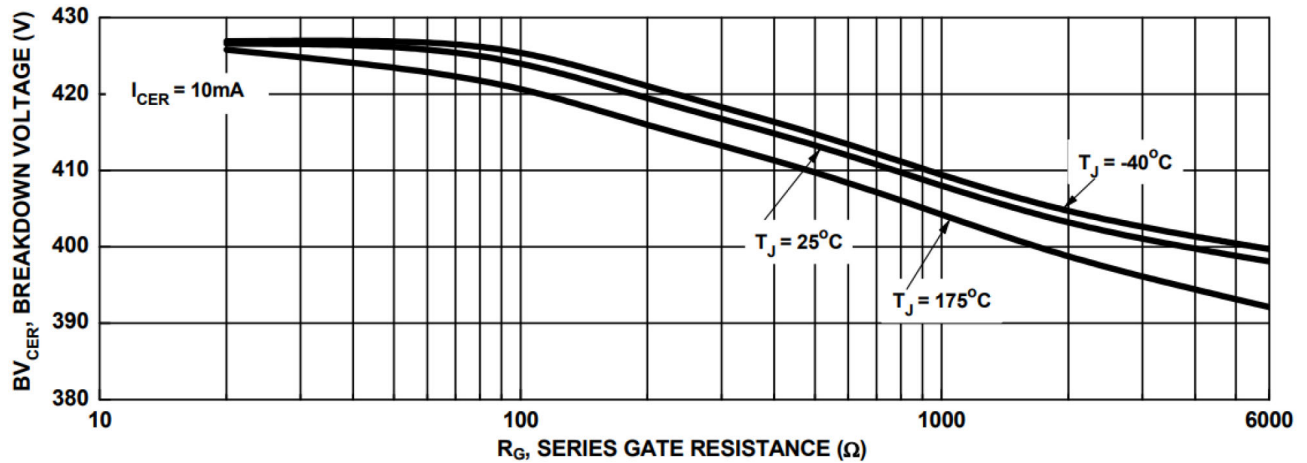


Figure 15. Break Down Voltage vs. Series Resistance

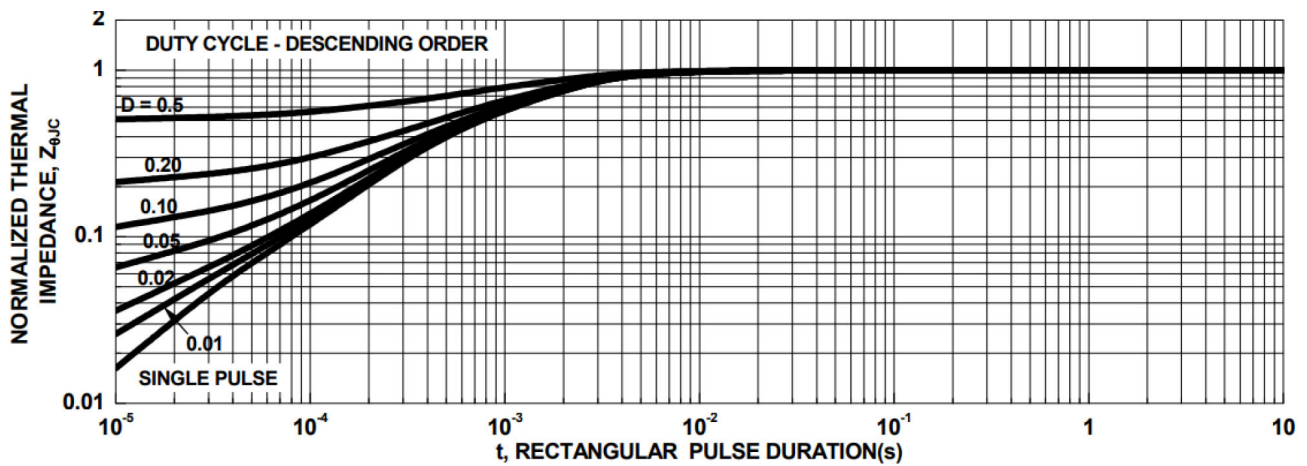


Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case

TEST CIRCUIT AND WAVEFORMS

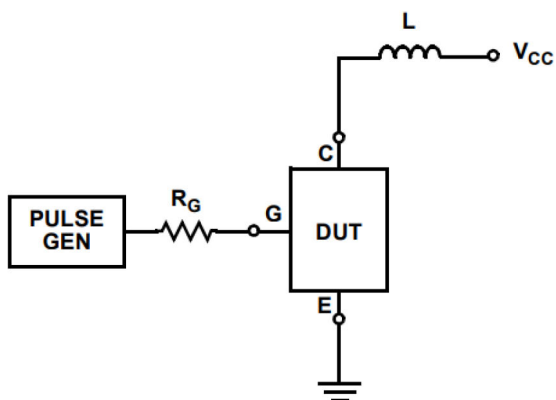


Figure 17. Inductive Switching Test Circuit

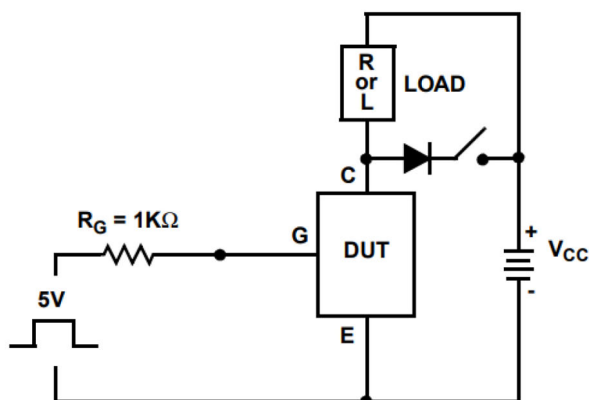


Figure 18.  $t_{ON}$  and  $t_{OFF}$  Switching Test Circuit

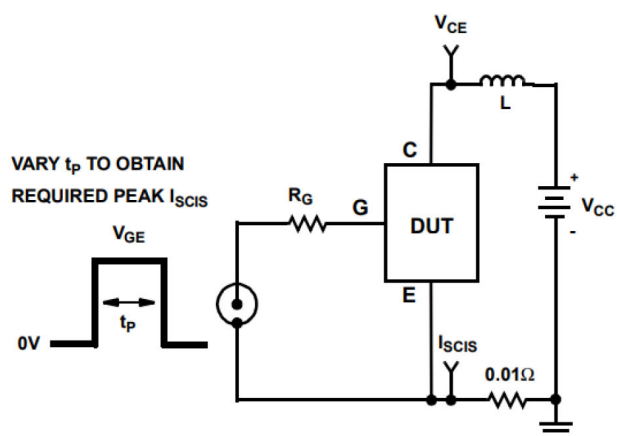


Figure 19. Energy Test Circuit

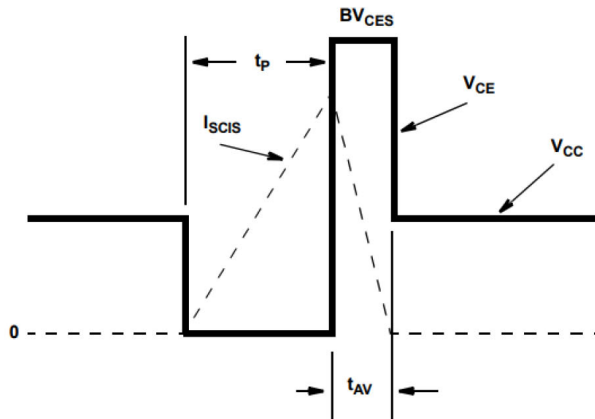


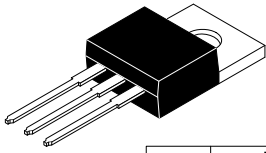
Figure 20. Energy Waveforms

## ISL9V3040x3ST-F085C

### PACKAGE MARKING AND ORDERING INFORMATION

| Device              | Package            | Shipping <sup>†</sup>  |
|---------------------|--------------------|------------------------|
| ISL9V3040D3ST-F085C | DPAK<br>(Pb-Free)  | 2500 Units/Tape & Reel |
| ISL9V3040S3ST-F085C | D2PAK<br>(Pb-Free) | 800 Units/Tape & Reel  |
| ISL9V3040P3-F085C   | TO220<br>(Pb-Free) | 50 Units/Tube          |

<sup>†</sup>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.



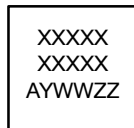
TO-220-3LD  
CASE 340AT  
ISSUE B

DATE 08 AUG 2022

| DIM | MILLIMETERS  |      |       |
|-----|--------------|------|-------|
|     | MIN.         | NOM. | MAX.  |
| A   | 4.00         | --   | 4.70  |
| A1  | SEE NOTE "F" |      |       |
| A2  | 2.10         | --   | 2.85  |
| b   | 0.55         | --   | 1.00  |
| b2  | 1.10         | --   | 1.62  |
| b4  | 1.42         | --   | 1.62  |
| c   | 0.36         | --   | 0.60  |
| D   | 13.90        | --   | 16.30 |
| D1  | 8.13         | --   | 9.40  |
| D2  | 11.50        | --   | 14.30 |
| D3  | 15.42        | --   | 16.51 |
| E   | 9.65         | --   | 10.67 |
| E1  | 7.59         | --   | 8.65  |
| e   | 2.40         | --   | 2.67  |
| H1  | 6.06         | --   | 6.69  |
| L   | 12.70        | --   | 14.04 |
| L1  | 2.70         | --   | 4.10  |
| P   | 3.50         | --   | 4.00  |
| Q   | 2.50         | --   | 3.40  |
| z   | 2.13 REF     |      |       |
| z1  | 2.06 REF     |      |       |
| θ   | 3°           | --   | 5°    |

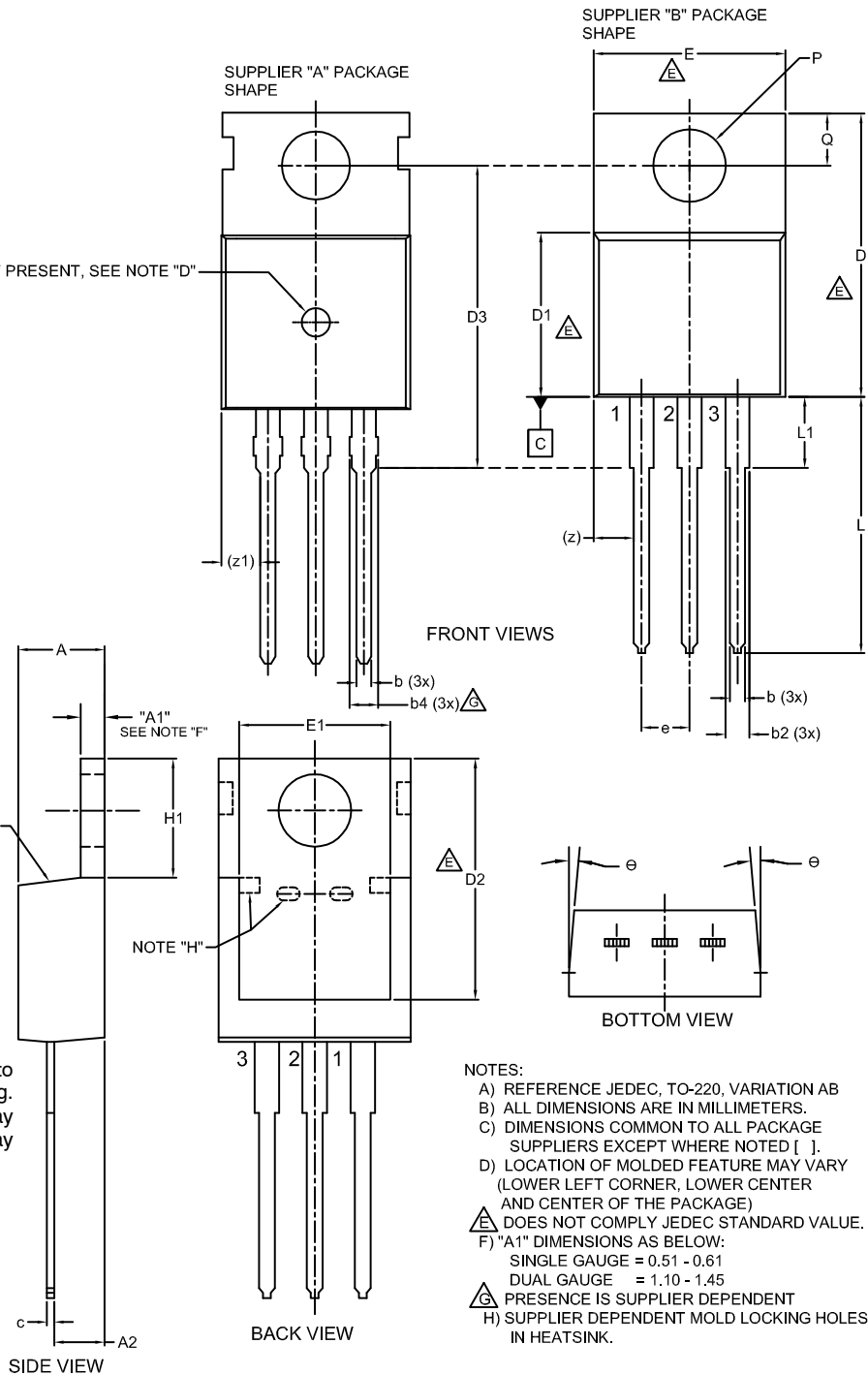
IF PRESENT, SEE NOTE "D"

GENERIC  
MARKING DIAGRAM\*



XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Assembly Lot Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

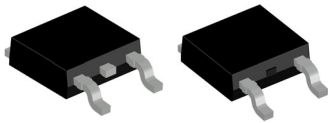


NOTES:

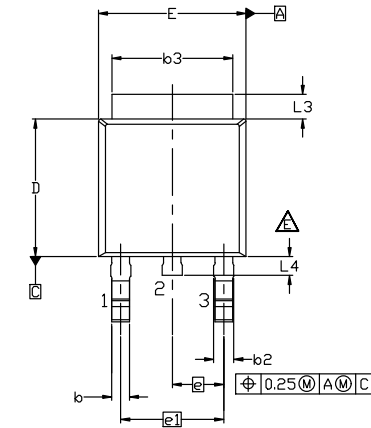
- A) REFERENCE JEDEC, TO-220, VARIATION AB
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
- D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
- △ DOES NOT COMPLY JEDEC STANDARD VALUE.
- F) "A1" DIMENSIONS AS BELOW:  
SINGLE GAUGE = 0.51 - 0.61  
DUAL GAUGE = 1.10 - 1.45
- △ PRESENCE IS SUPPLIER DEPENDENT
- H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

|                  |             |                                                                                                                                                                                     |
|------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| DESCRIPTION:     | TO-220-3LD  | PAGE 1 OF 1                                                                                                                                                                         |

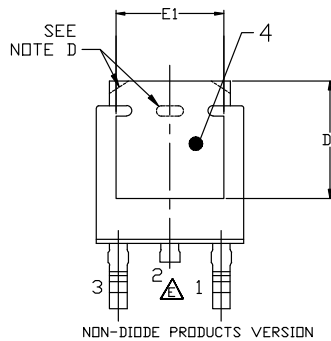
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**DPAK3 6.10x6.54x2.29, 4.57P**  
**CASE 369AS**  
**ISSUE B**

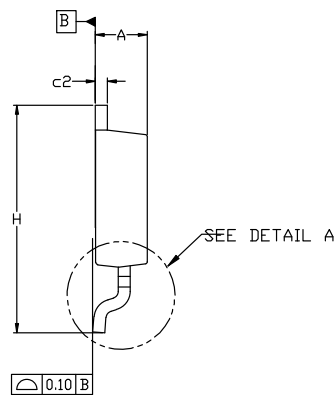
DATE 20 DEC 2023



NON-DIODE PRODUCTS VERSION



NON-DIODE PRODUCTS VERSION



NOTES: UNLESS OTHERWISE SPECIFIED

A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE F, VARIATION AA.

B) ALL DIMENSIONS ARE IN MILLIMETERS.

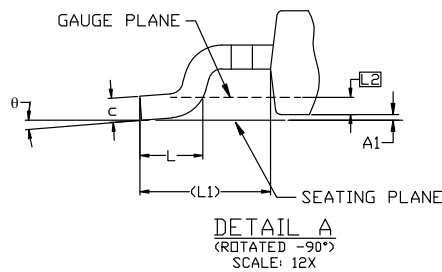
C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2018.

D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.

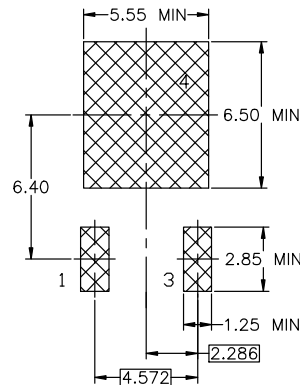
E) FOR DIODE PRODUCTS, L4 IS 0.25 MM MAX PLASTIC BODY STUB WITHOUT CENTER LEAD.

F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.

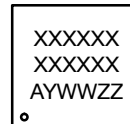
G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TD228P991X239-3N.



| DIM | MILLIMETERS |      |       |
|-----|-------------|------|-------|
|     | MIN.        | NDM. | MAX.  |
| A   | 2.18        | 2.29 | 2.39  |
| A1  | 0.00        | —    | 0.127 |
| b   | 0.64        | 0.77 | 0.89  |
| b2  | 0.76        | 0.95 | 1.14  |
| b3  | 5.21        | 5.34 | 5.46  |
| c   | 0.45        | 0.53 | 0.61  |
| c2  | 0.45        | 0.52 | 0.58  |
| D   | 5.97        | 6.10 | 6.22  |
| D1  | 5.21        | ---  | ---   |
| E   | 6.35        | 6.54 | 6.73  |
| E1  | 4.32        | ---  | ---   |
| e   | 2.286 BSC   |      |       |
| e1  | 4.572 BSC   |      |       |
| H   | 9.40        | 9.91 | 10.41 |
| L   | 1.40        | 1.59 | 1.78  |
| L1  | 2.90 REF    |      |       |
| L2  | 0.51 BSC    |      |       |
| L3  | 0.89        | 1.08 | 1.27  |
| L4  | ---         | ---  | 1.02  |
| θ   | 0°          | ---  | 10°   |


**LAND PATTERN RECOMMENDATION**

\*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

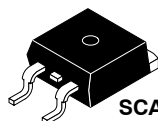
**GENERIC MARKING DIAGRAM\***


\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Assembly Lot Code

|                         |                                    |                                                                                                                                                                                  |
|-------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>DPAK3 6.10x6.54x2.29, 4.57P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

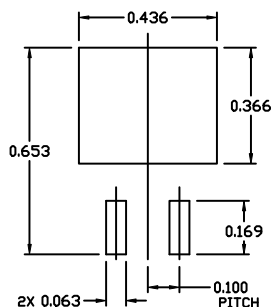
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SCALE 1:1

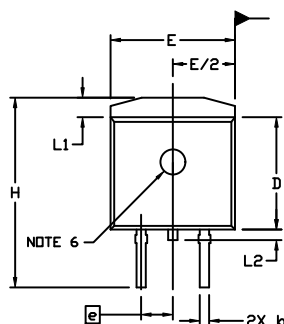
D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)  
CASE 418AJ  
ISSUE F

DATE 11 MAR 2021



RECOMMENDED  
MOUNTING 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.

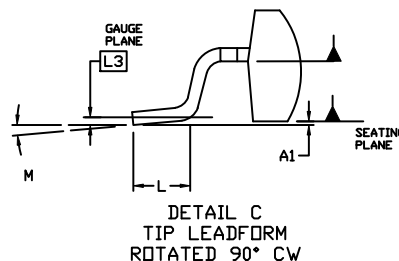
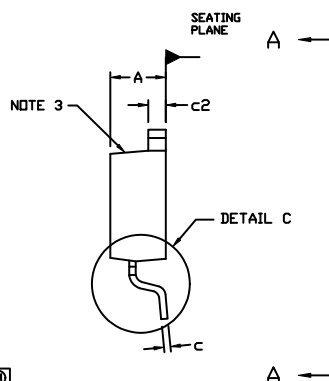


0.100 BSC 0.100 BSC

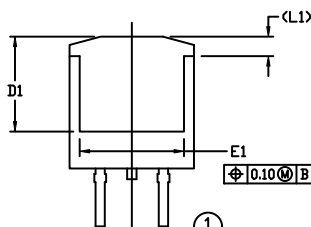
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. CHAMFER OPTIONAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
5. THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
6. OPTIONAL MOLD FEATURE.
7. ①, ② ... OPTIONAL CONSTRUCTION FEATURE CALL OUTS.

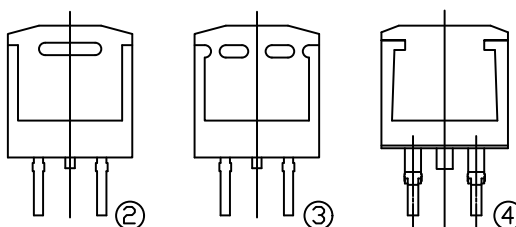
| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN.      | MAX.  | MIN.        | MAX.  |
| A   | 0.160     | 0.190 | 4.06        | 4.83  |
| A1  | 0.000     | 0.010 | 0.00        | 0.25  |
| b   | 0.020     | 0.039 | 0.51        | 0.99  |
| c   | 0.012     | 0.029 | 0.30        | 0.74  |
| c2  | 0.045     | 0.065 | 1.14        | 1.65  |
| D   | 0.330     | 0.380 | 8.38        | 9.65  |
| D1  | 0.260     | ---   | 6.60        | ---   |
| E   | 0.380     | 0.420 | 9.65        | 10.67 |
| E1  | 0.245     | ---   | 6.22        | ---   |
| e   | 0.100 BSC | ---   | 2.54 BSC    | ---   |
| H   | 0.575     | 0.625 | 14.60       | 15.88 |
| L   | 0.070     | 0.110 | 1.78        | 2.79  |
| L1  | ---       | 0.066 | ---         | 1.68  |
| L2  | ---       | 0.070 | ---         | 1.78  |
| L3  | 0.010 BSC | ---   | 0.25 BSC    | ---   |
| M   | 0°        | 8°    | 0°          | 8°    |



DETAIL C  
TIP LEADFORM  
ROTATED 90° CW

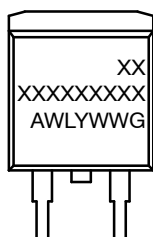


VIEW A-A

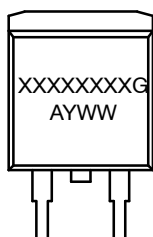


VIEW A-A  
OPTIONAL CONSTRUCTIONS

GENERIC MARKING DIAGRAMS\*



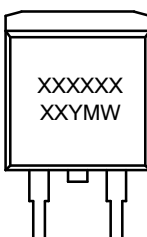
IC



Standard



Rectifier



SSG

XXXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week  
W = Week Code (SSG)  
M = Month Code (SSG)  
G = Pb-Free Package  
AKA = Polarity Indicator

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

|                  |                                       |                                                                                                                                                                                  |
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| DESCRIPTION:     | D <sup>2</sup> PAK-3 (TO-263, 3-LEAD) | PAGE 1 OF 1                                                                                                                                                                      |

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