

# 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

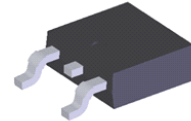
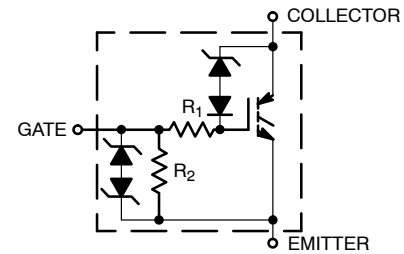
- Automotive Ignition Coil Driver Circuits
- High Current Ignition System
- Coil on Plug Application

### 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
$I_{C25}$	Collector Current Continuous at $V_{GE} = 4.0 \text{ V}$ , $T_C = 25^\circ\text{C}$	21	A
$I_{C110}$	Collector Current Continuous at $V_{GE} = 4.0 \text{ V}$ , $T_C = 110^\circ\text{C}$	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.

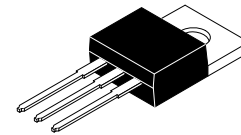
1. Self clamped inductive Switching Energy (ESCIS25) of 300 mJ is based on the test conditions that is starting  $T_J = 25^\circ\text{C}$ , L = 3 mHy, ISCIS = 14.2 A, VCC = 100 V during inductor charging and VCC = 0 V during time in clamp.
2. Self Clamped inductive Switching Energy (ESCIS150) of 170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

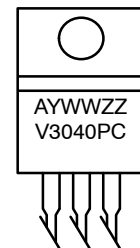


D2PAK-3  
CASE 418AJ



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
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### OFF CHARACTERISTICS

BV <sub>CER</sub>	Collector to Emitter Breakdown Voltage	I <sub>CE</sub> = 2 mA, V <sub>GE</sub> = 0 V, R <sub>GE</sub> = 1 kΩ, 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, R <sub>GE</sub> = 0, 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, 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 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 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	$V_{CE} = 14\text{ V}$ , $R_L = 1\text{ }\Omega$ , $V_{GE} = 5\text{ V}$ , $R_G = 470\text{ }\Omega$ , $T_J = 25^\circ\text{C}$	–	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	$V_{CE} = 300\text{ V}$ , $L = 1\text{ mH}$ , $V_{GE} = 5\text{ V}$ , $R_G = 470\text{ }\Omega$ , $I_{CE} = 6.5\text{ A}$ , $T_J = 25^\circ\text{C}$	–	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

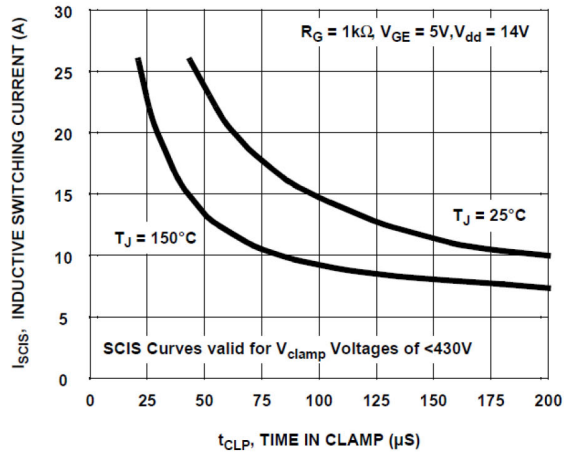


Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp

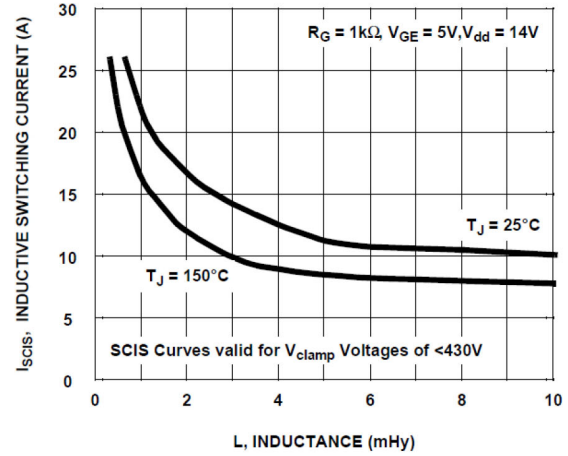


Figure 2. Self Clamped Inductive Switching Current vs. Inductance

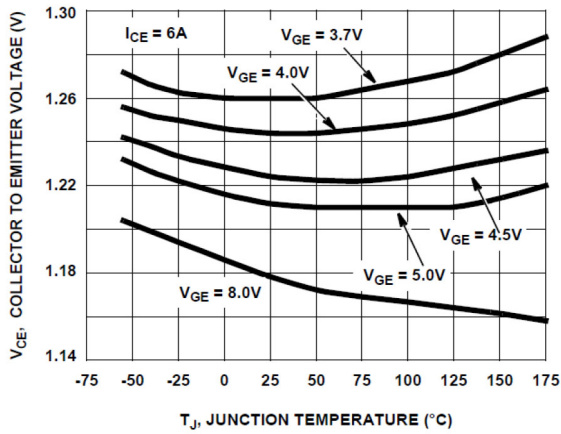


Figure 3. Collector to Emitter On-State Voltage vs. Junction Temperature

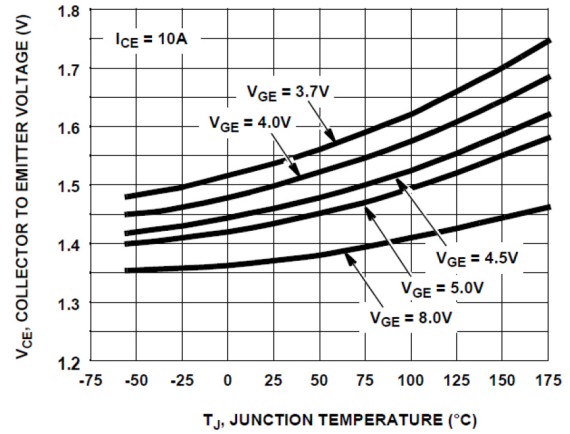


Figure 4. Collector to Emitter On-State Voltage vs. Junction Temperature

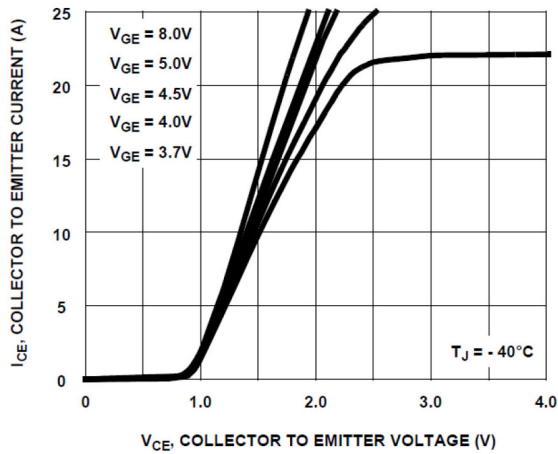


Figure 5. Collector to Emitter On-State Voltage vs. Collector Current

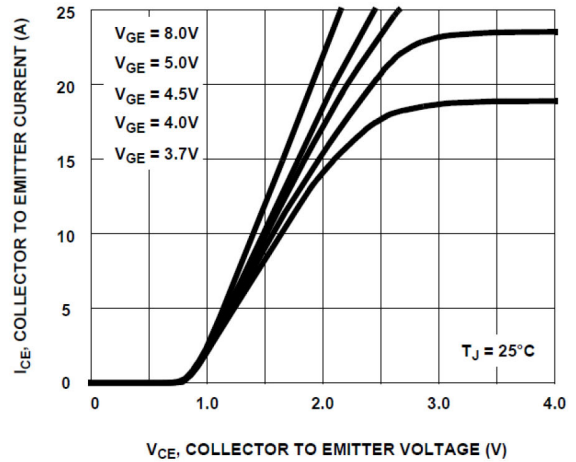


Figure 6. Collector to Emitter On-State Voltage vs. Collector Current

TYPICAL CHARACTERISTICS (continued)

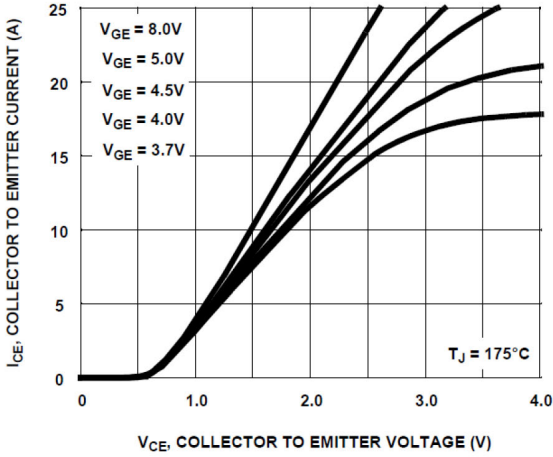


Figure 7. Collector to Emitter On-State Voltage vs. Collector Current

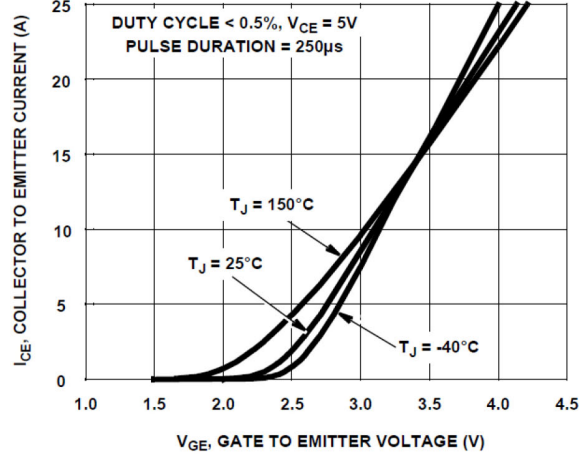


Figure 8. Transfer Characteristics

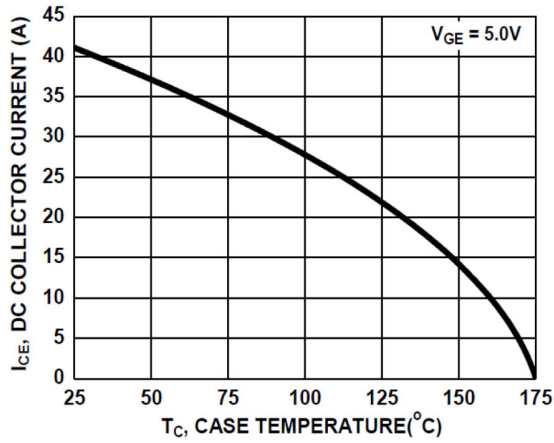


Figure 9. DC Collector Current vs. Case Temperature

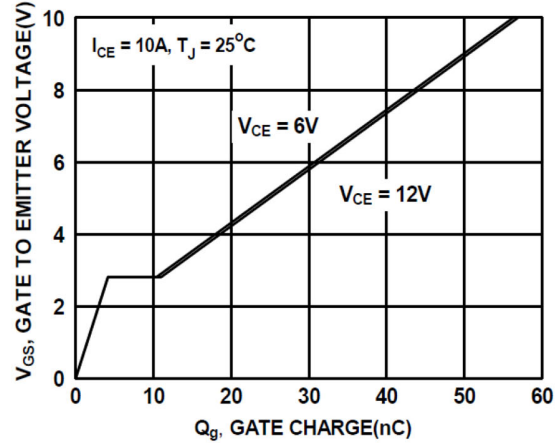


Figure 10. Gate Charge

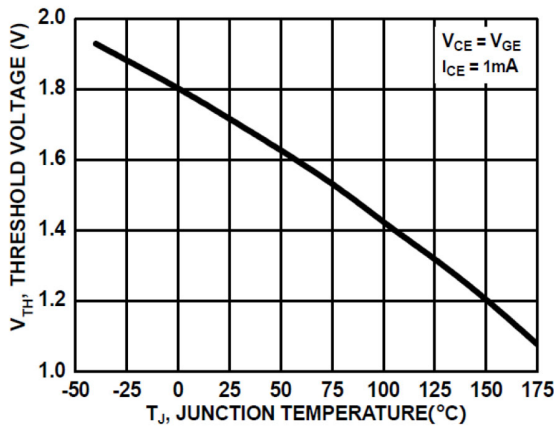


Figure 11. Threshold Voltage vs. Junction Temperature

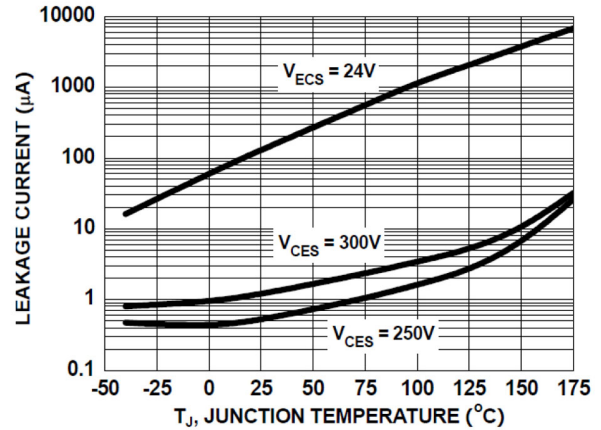


Figure 12. Leakage Current vs. Junction Temperature

# ISL9V3040x3ST-F085C

## TYPICAL CHARACTERISTICS (continued)

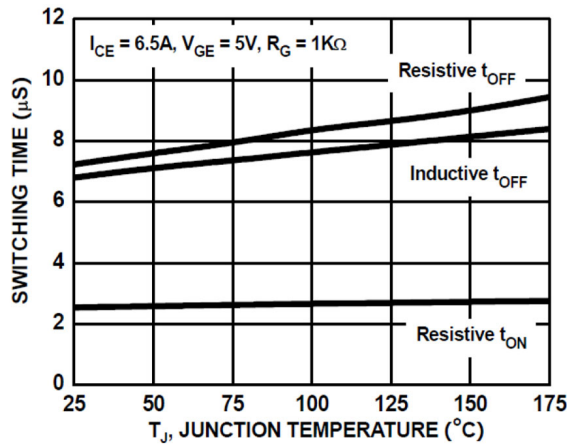


Figure 13. Switching Time vs. Junction Temperature

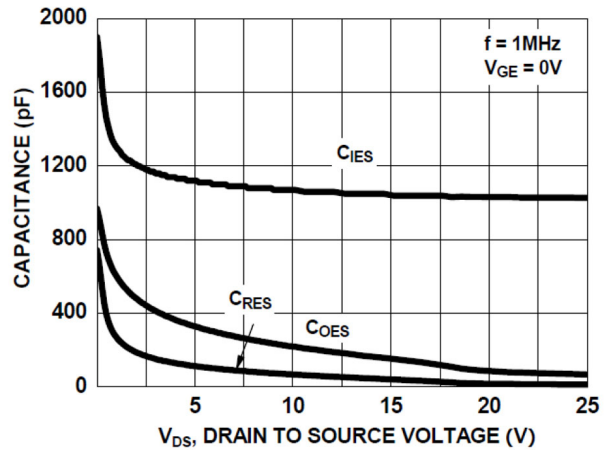


Figure 14. Capacitance vs. Collector to Emitter

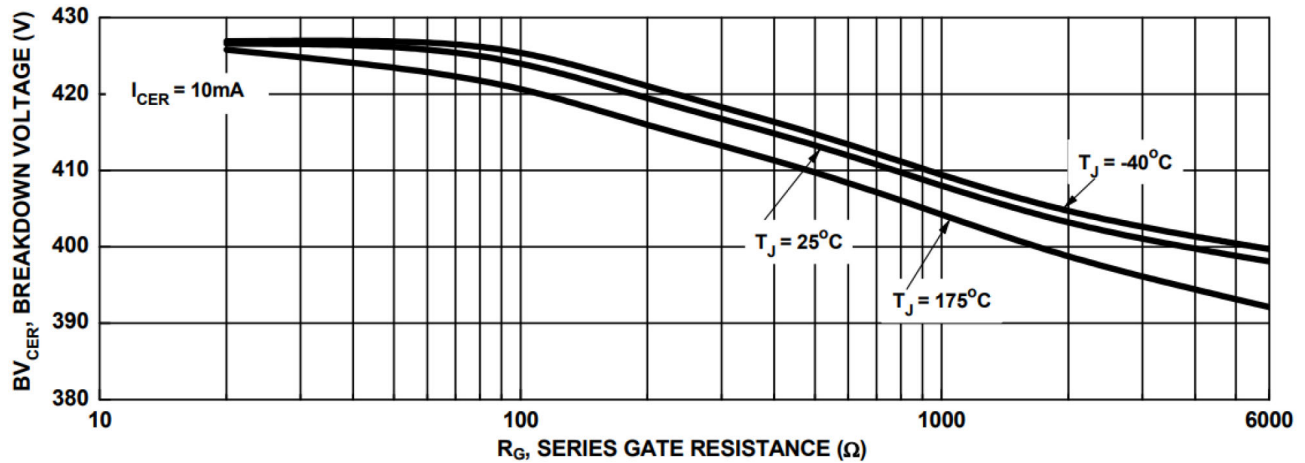


Figure 15. Break Down Voltage vs. Series Resistance

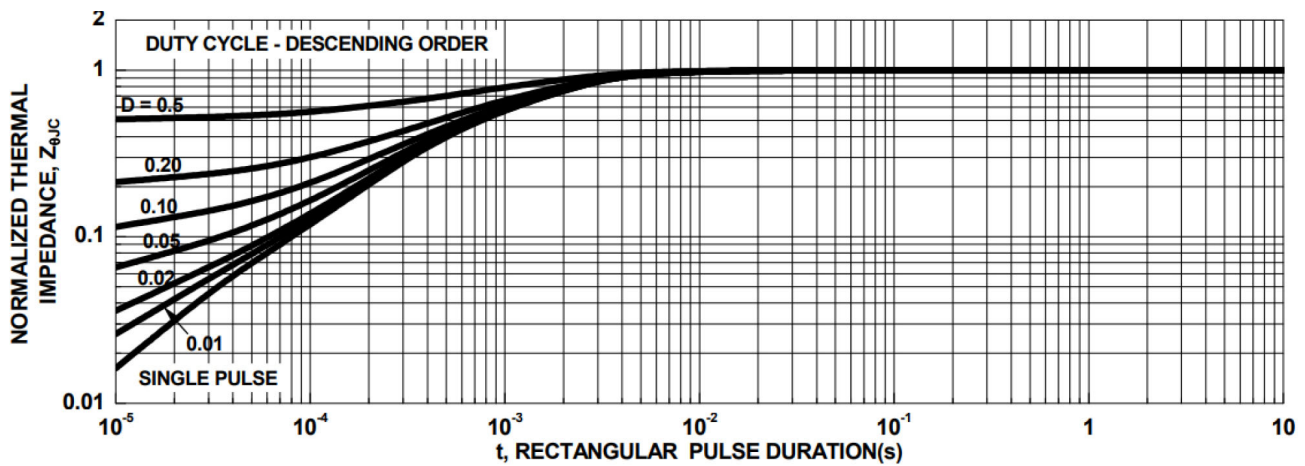


Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case

TEST CIRCUIT AND WAVEFORMS

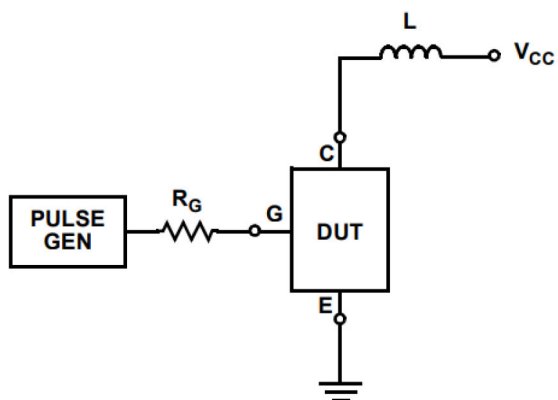


Figure 17. Inductive Switching Test Circuit

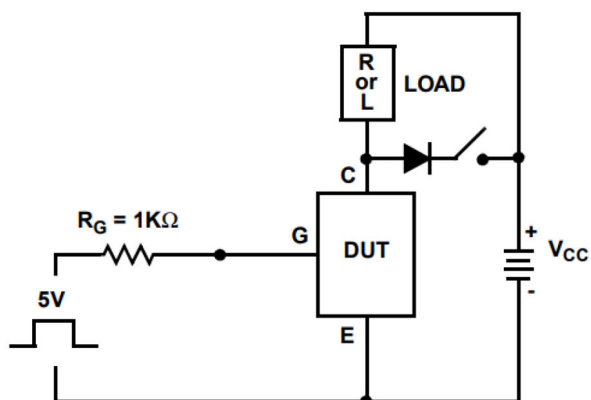


Figure 18.  $t_{ON}$  and  $t_{OFF}$  Switching Test Circuit

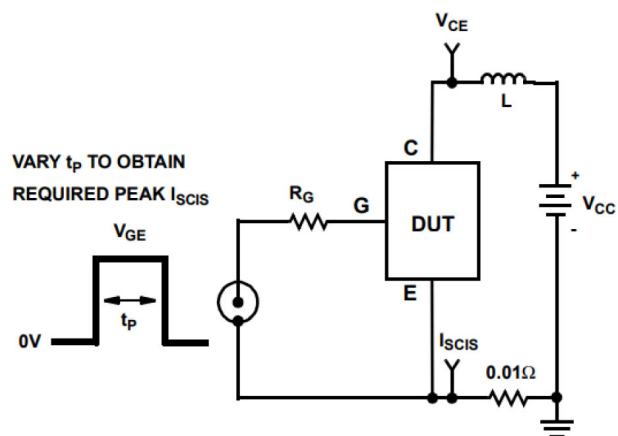


Figure 19. Energy Test Circuit

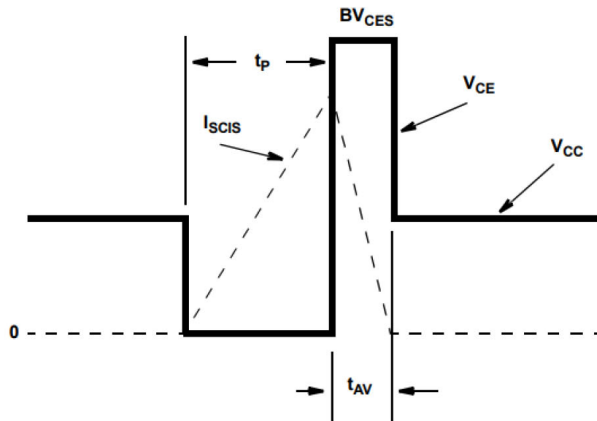


Figure 20. Energy Waveforms

## ISL9V3040x3ST–F085C

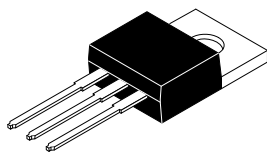
### PACKAGE MARKING AND ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
ISL9V3040D3ST–F085C	DPAK (Pb–Free)	2500 Units/Tape & Reel
ISL9V3040S3ST–F085C	D2PAK (Pb–Free)	800 Units/Tape & Reel
ISL9V3040P3–F085C	TO220 (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.

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

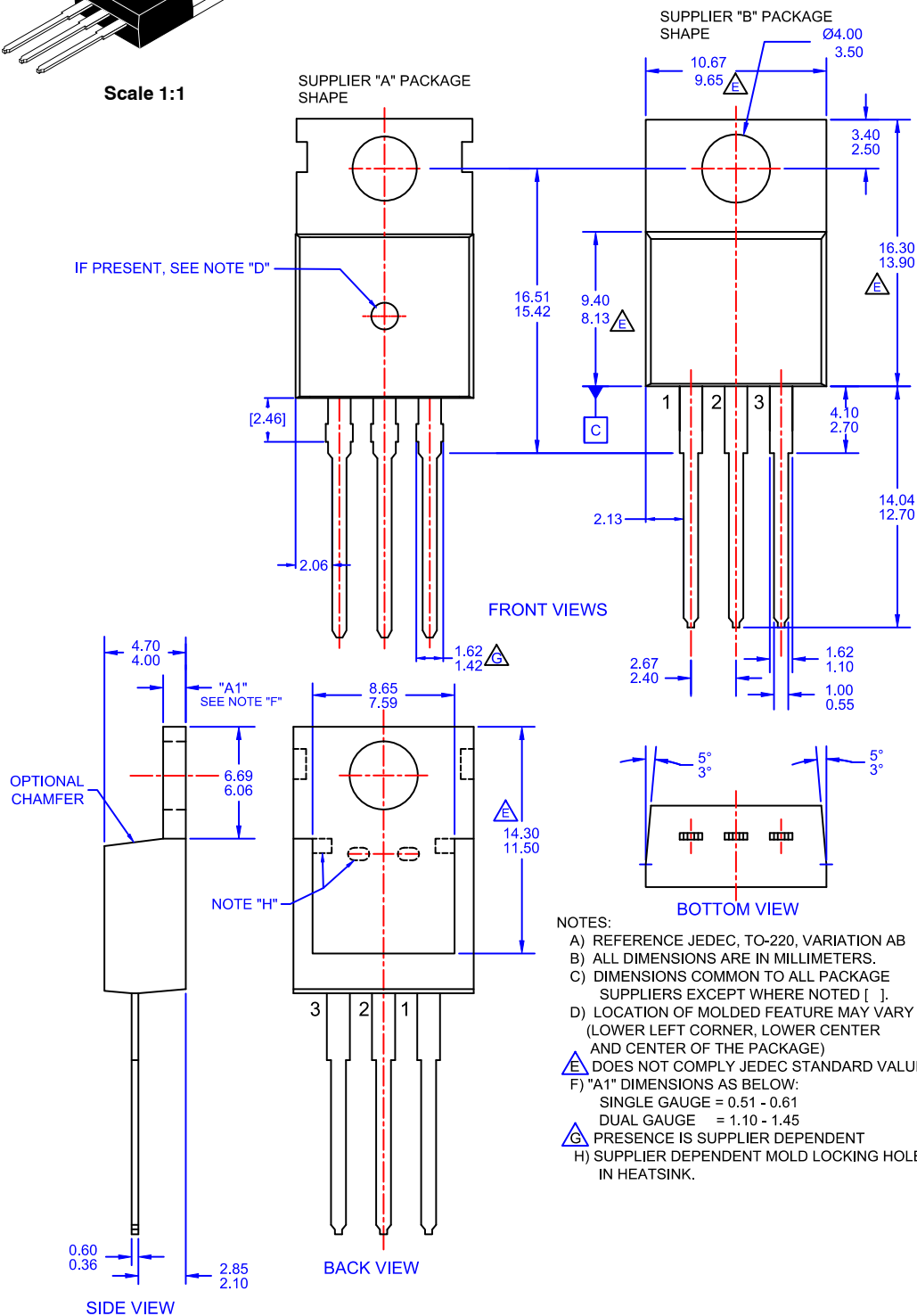
ON Semiconductor®



Scale 1:1

## TO-220-3LD CASE 340AT ISSUE A

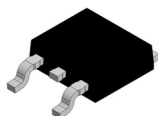
DATE 03 OCT 2017



<b>DOCUMENT NUMBER:</b>	<b>98AON13818G</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>TO-220-3LD</b>	<b>PAGE 1 OF 1</b>

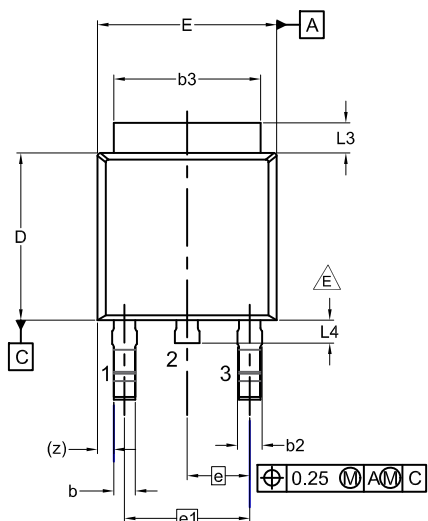
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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

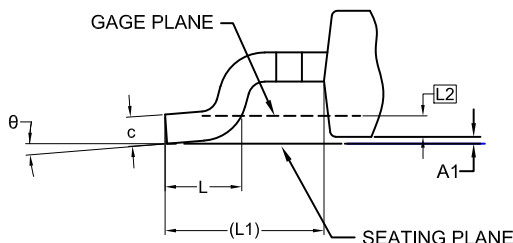


## DPAK3 (TO-252 3 LD) CASE 369AS ISSUE A

DATE 28 SEP 2022

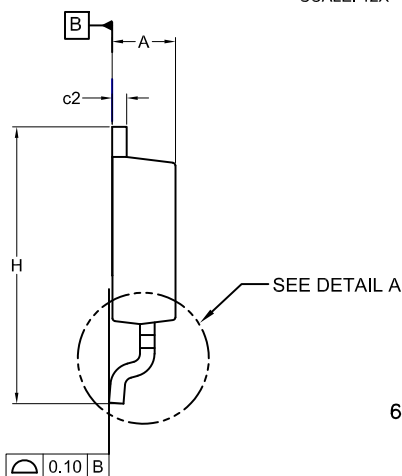
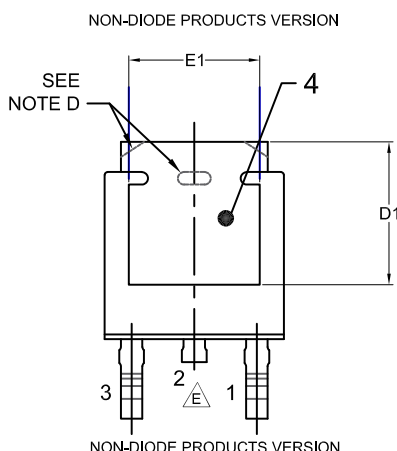


- NOTES: UNLESS OTHERWISE SPECIFIED  
A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA.  
B) ALL DIMENSIONS ARE IN MILLIMETERS.  
C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.  
D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.  
E) FOR DIODE PRODUCTS, L4 IS 0.25 MM MAX.  
F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.  
G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO228P991X239-3N.



**DETAIL A**  
(ROTATED -90°)  
SCALE: 12X

DIM	MILLIMETERS		
	MIN.	NOM.	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
theta	0°	-	10°

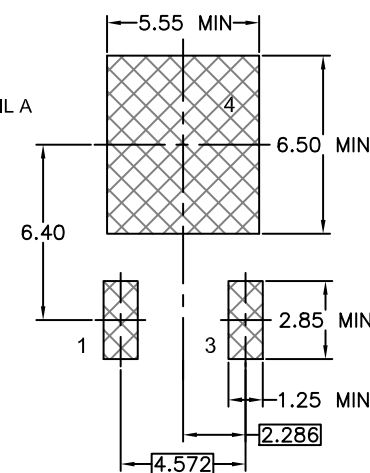


### GENERIC MARKING DIAGRAM\*



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.



### 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.

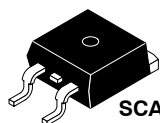
<b>DOCUMENT NUMBER:</b>	<b>98AON13810G</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>DPAK3 (TO-252 3 LD)</b>	<b>PAGE 1 OF 1</b>

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



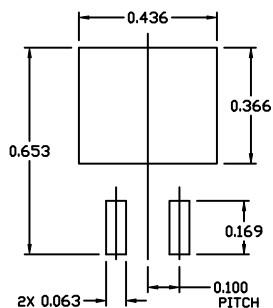
SCALE 1:1

### D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)

#### CASE 418AJ

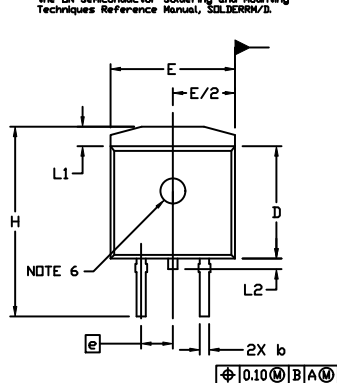
#### ISSUE F

DATE 11 MAR 2021



#### RECOMMENDED MOUNTING FOOTPRINT

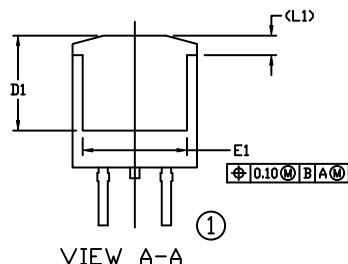
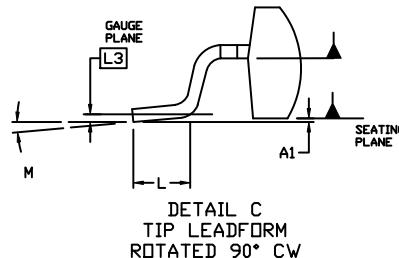
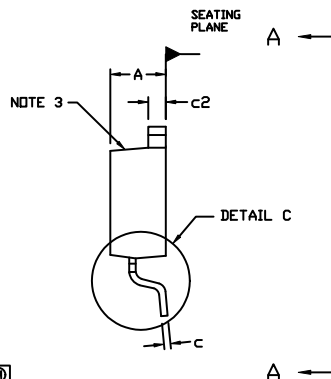
For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



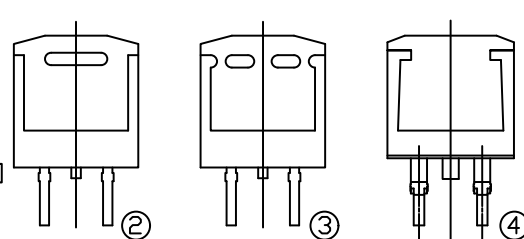
#### NOTES:

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°

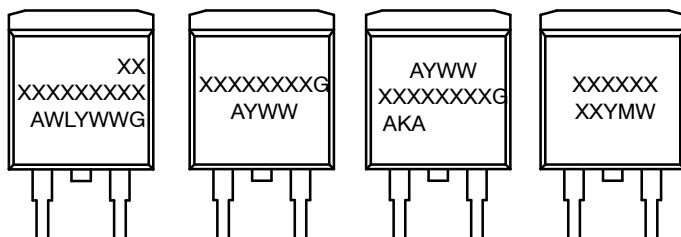


VIEW A-A



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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