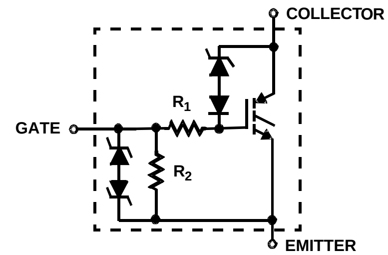
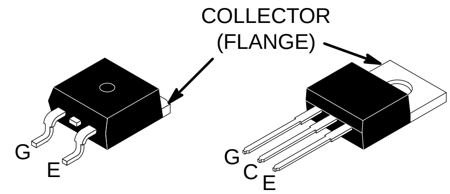
ECOSPARK® Ignition IGBT

500 mJ, 360 V, N−Channel Ignition IGBT

ISL9V5036S3ST, ISL9V5036P3-F085, ISL9V5036S3ST-F085C

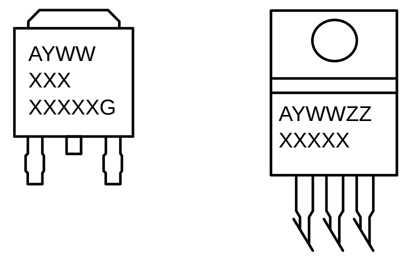




D²PAK−3 (TO−263, 3−Lead) CASE 418AJ

TO−220−3LD CASE 340AT

MARKING DIAGRAM



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

ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 8.

General Description

The ISL9V5036S3ST, ISL9V5036S3ST−F085C and ISL9V5036P3−F085 are the next generation IGBTs that offer outstanding SCIS capability in the D^2−Pak (TO−263) and TO−220 plastic package. These devices are intended for use in automotive ignition circuits, specifically as coil drivers. Internal diodes provide voltage clamping without the need for external components.

ECOSPARK devices can be custom made to specific clamp voltages. Contact your nearest **onsemi** sales office for more information.

Formerly Developmental Type 49443.

Features

- Industry Standard D^2−Pak package
- SCIS Energy = 500 mJ at T_J = 25°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
- Coil−On Plug Applications

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Collector to Emitter Breakdown Voltage (I_C = 1 mA)	BV_{CER}	390	V
Emitter to Collector Voltage − Reverse Battery Condition (I_C = 10 mA)	BV_{ECS}	24	V
At Starting T_J = 25°C, I_{SCIS} = 38.5A, L = 670 μHy	E_{SCIS25}	500	mJ
At Starting T_J = 150°C, I_{SCIS} = 30A, L = 670 μHy	$E_{SCIS150}$	300	mJ
Collector Current Continuous, at T_C = 25°C, See Figure 9	I_{C25}	46	A
Collector Current Continuous, at T_C = 110°C, See Figure 9	I_{C110}	31	A
Gate to Emitter Voltage Continuous	V_{GEM}	±10	V
Power Dissipation Total T_C = 25°C	P_D	250	W
Power Dissipation Derating T_C > 25°C		1.67	W/°C
Operating Junction Temperature Range	T_J	−40 to 175	°C
Storage Junction Temperature Range	T_{STG}	−40 to 175	°C
Max Lead Temp for Soldering (Leads at 1.6 mm from Case for 10 s)	T_L	300	°C
Max Lead Temp for Soldering (Package Body for 10s)	T_{pkg}	260	°C
Electrostatic Discharge Voltage at100 pF, 1500 Ω	ESD	4	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.

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance Junction−Case	$R_{\theta JC}$	0.6	°C/W

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

Parameter	Symbol	Test Condition		Min	Typ	Max	Unit
OFF STATE CHARACTERISTICS							
Collector to Emitter Breakdown Voltage	BV_{CER}	I_C = 2 mA, V_{GE} = 0 V, R_G = 1 kΩ, See Figure 15 T_J = −40 to 150°C		330	360	390	V
Collector to Emitter Breakdown Voltage	BV_{CES}	I_C = 10 mA, V_{GE} = 0 V, R_G = 0, See Figure 15 T_J = −40 to 150°C		360	390	420	V
Emitter to Collector Breakdown Voltage	BV_{ECS}	I_C = −75 mA, V_{GE} = 0 V, T_J = 25°C		30	−	−	V
Gate to Emitter Breakdown Voltage	BV_{GES}	I_{GES} = ±2 mA		±12	±14	−	V
Collector to Emitter Leakage Current	I_{CER}	V_{CER} = 250 V, R_G = 1 kΩ, See Figure 11	T_C = 25°C	−	−	25	μA
			T_C = 150°C	−	−	1	mA
Emitter to Collector Leakage Current	I_{ECS}	V_{EC} = 24 V, See Figure 11	T_C = 25°C	−	−	1	mA
			T_C = 150°C	−	−	40	
Series Gate Resistance	R_1			−	75	−	Ω
Gate to Emitter Resistance	R_2			10	−	30	kΩ
ON STATE CHARACTERISTICS							
Collector to Emitter Saturation Voltage	$V_{CE(SAT)}$	I_C = 10 A, V_{GE} = 4.0 V	T_C = 25°C See Figure 4	−	1.17	1.60	V
Collector to Emitter Saturation Voltage	$V_{CE(SAT)}$	I_C = 15 A, V_{GE} = 4.5 V	T_C = 150°C	−	1.50	1.80	V
DYNAMIC CHARACTERISTICS							
Gate Charge	$Q_{G(ON)}$	I_C = 10 A, V_{CE} = 12 V, V_{GE} = 5 V, See Figure 14		−	32	−	nC
Gate to Emitter Threshold Voltage	$V_{GE(TH)}$	I_{CE} = 1.0 mA, V_{CE} = V_{GE}, See Figure 10	T_C = 25°C	1.3	−	2.2	V
			T_C = 150°C	0.75	−	1.8	
Gate to Emitter Plateau Voltage	V_{GEP}	I_C = 10 A, V_{CE} = 12 V		−	3.0	−	V
SWITCHING CHARACTERISTICS							
Current Turn−On Delay Time−Resistive	$t_{d(ON)R}$	V_{CE} = 14 V, R_L = 1 Ω V_{GE} = 5 V, R_G = 1 kΩ T_J = 25°C, See Figure 12		−	0.7	4	μs
Current Rise Time−Resistive	t_{rR}			−	2.1	7	
Current Turn−Off Delay Time−Inductive	$t_{d(OFF)L}$	V_{CE} = 300 V, L = 2 mH, V_{GE} = 5 V, R_G = 1 kΩ T_J = 25°C, See Figure 12		−	10.8	15	
Current Fall Time−Inductive	t_{fL}			−	2.8	15	
Self Clamped Inductive Switching	SCIS	T_J = 25°C, L = 670 μH, R_G = 1 kΩ, V_{GE} = 5 V, See Figures 1, 2		−	−	500	mJ

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

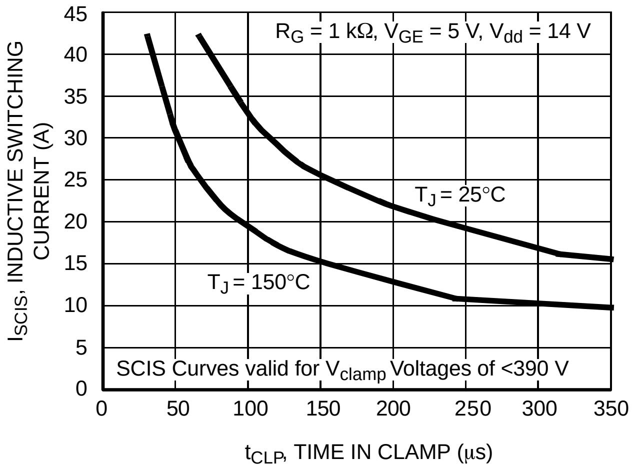


Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp

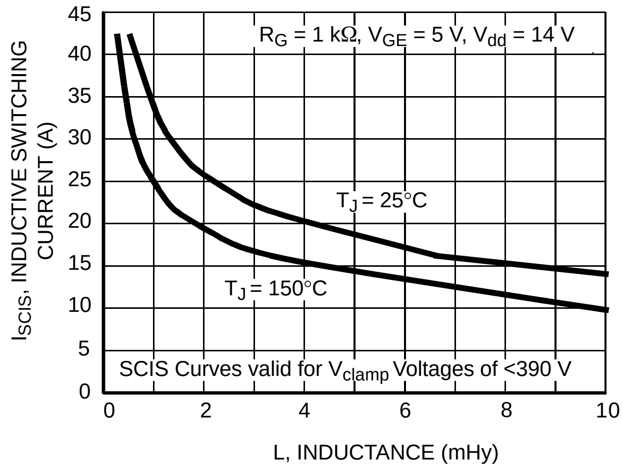


Figure 2. Self Clamped Inductive Switching Current vs. Inductance

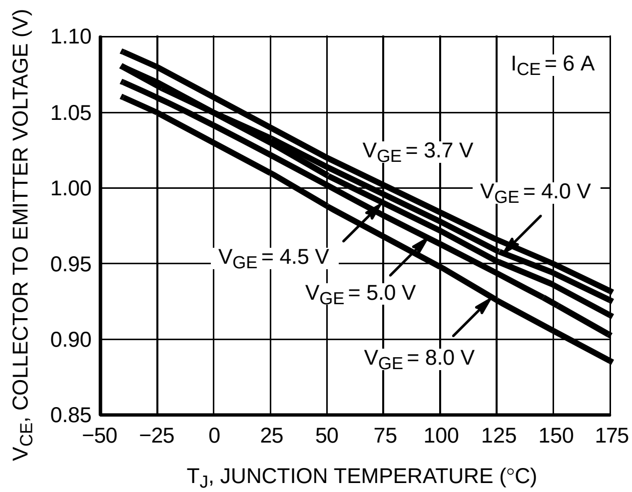


Figure 3. Collector to Emitter On−State Voltage vs. Junction Temperature

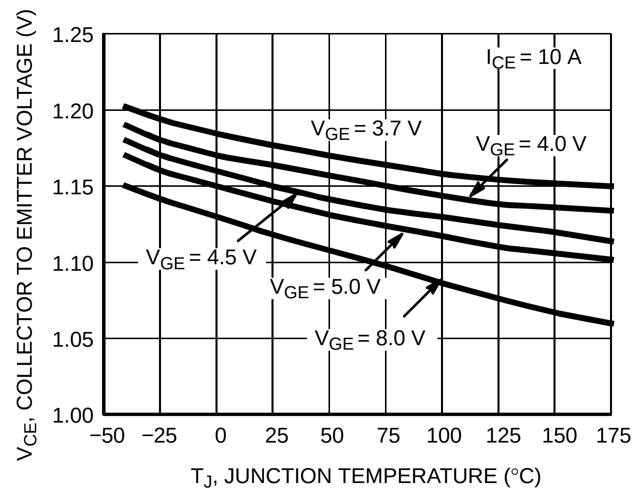


Figure 4. Collector to Emitter On−State Voltage vs. Junction Temperature

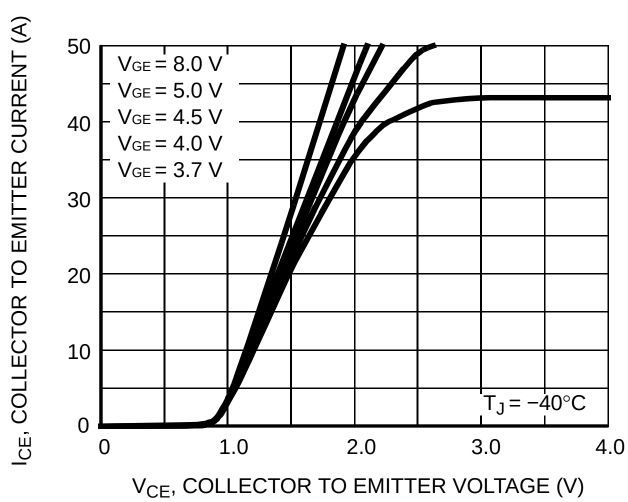


Figure 5. Collector Current vs. Collector to Emitter On−State Voltage

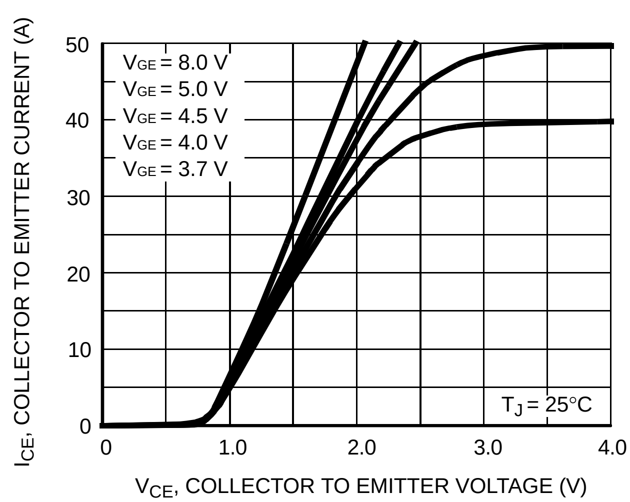


Figure 6. Collector Current vs. Collector to Emitter On−State Voltage

TYPICAL CHARACTERISTICS (continued)

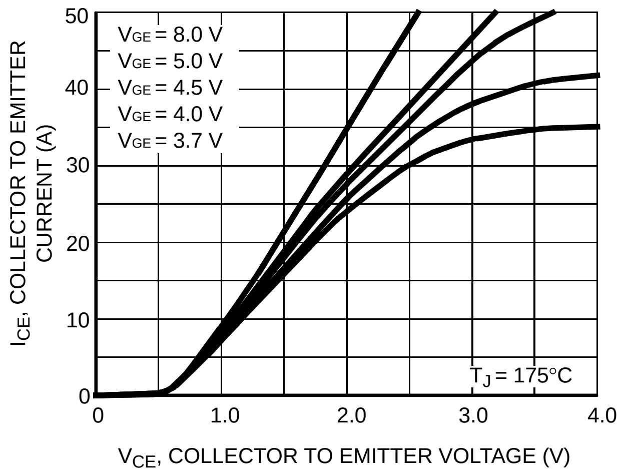


Figure 7. Collector to Emitter On−State Voltage vs. Collector Current

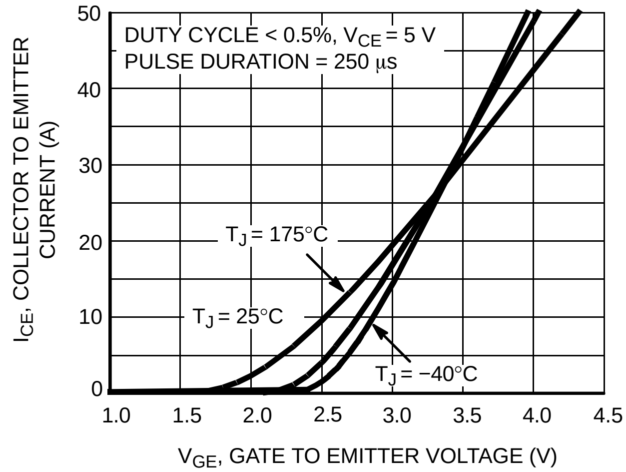


Figure 8. Transfer Characteristics

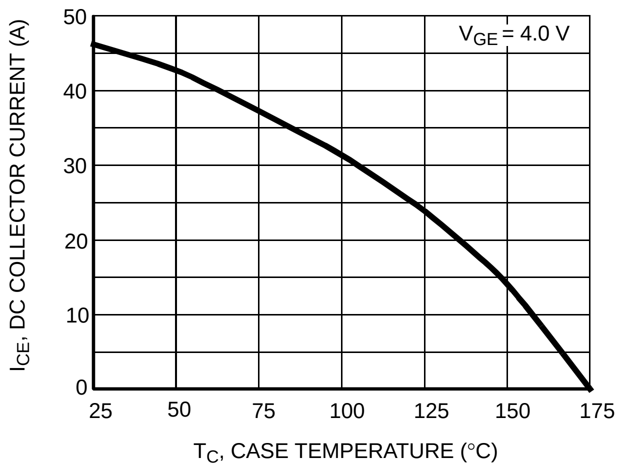


Figure 9. DC Collector Current vs. Case Temperature

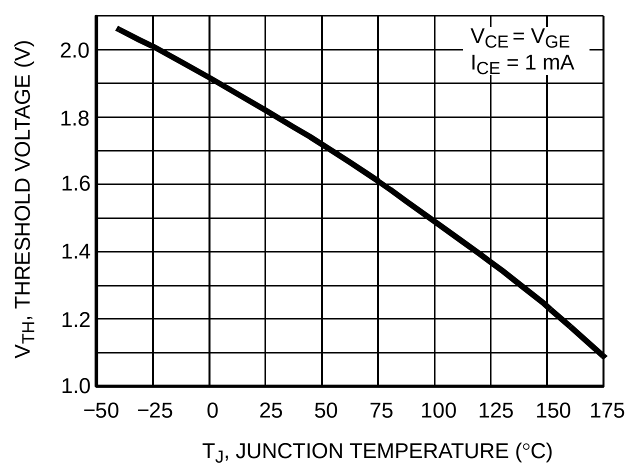


Figure 10. Threshold Voltage vs. Junction Temperature

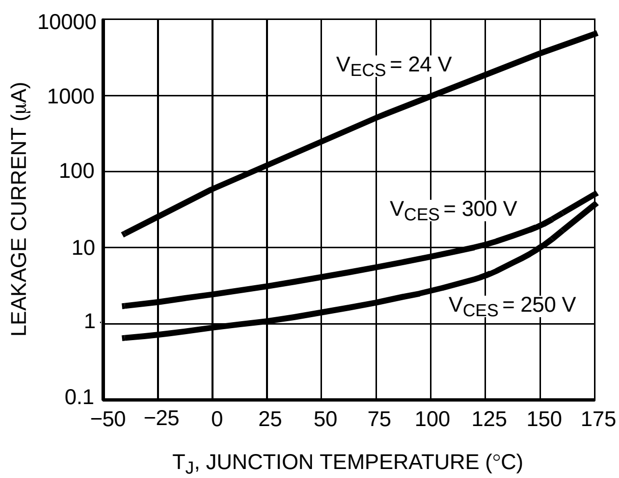


Figure 11. Leakage Current vs. Junction Temperature

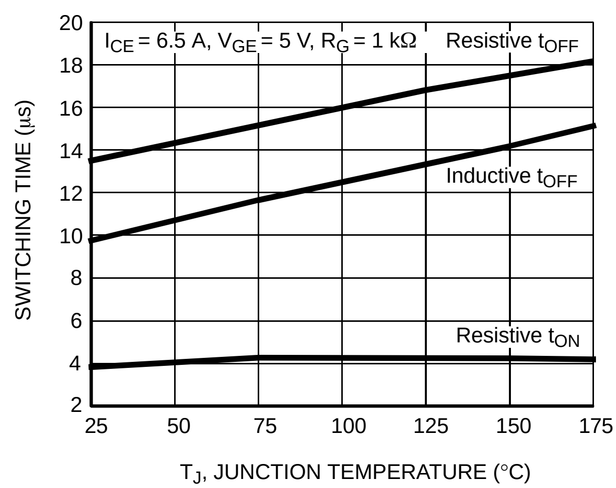


Figure 12. Switching Time vs. Junction Temperature

TYPICAL CHARACTERISTICS (continued)

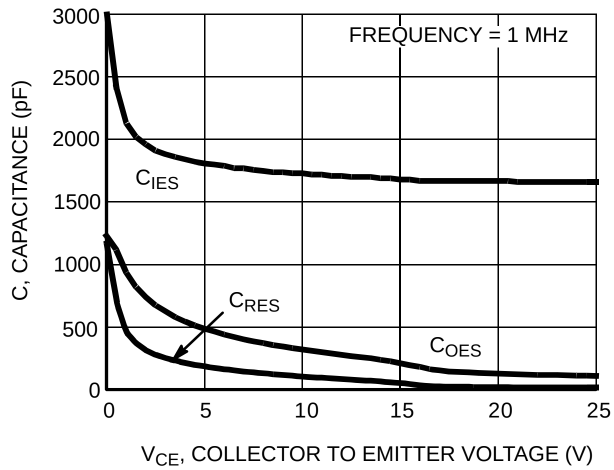


Figure 13. Capacitance vs. Collector to Emitter Voltage

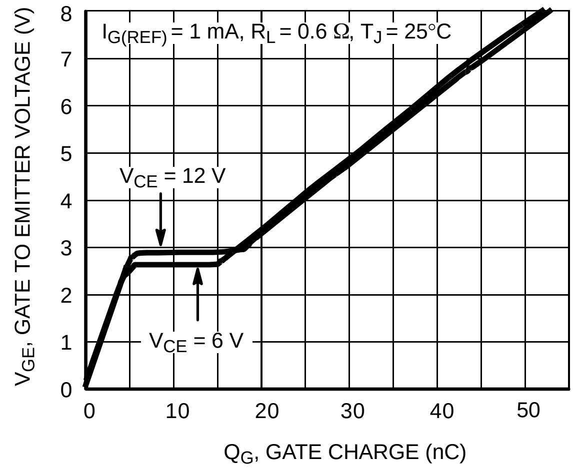


Figure 14. Gate Charge

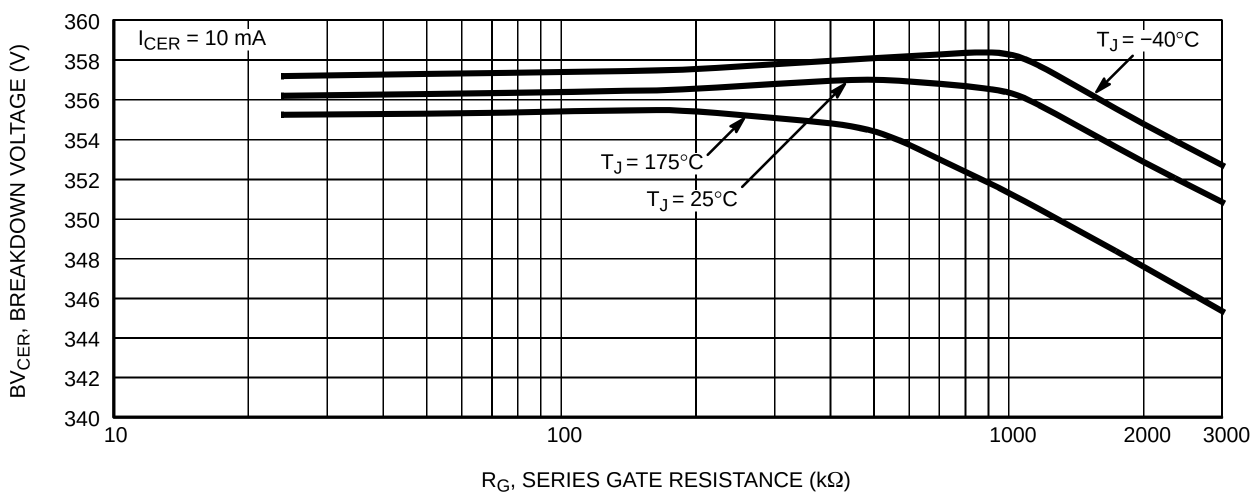


Figure 15. Breakdown Voltage vs. Series Gate Resistance

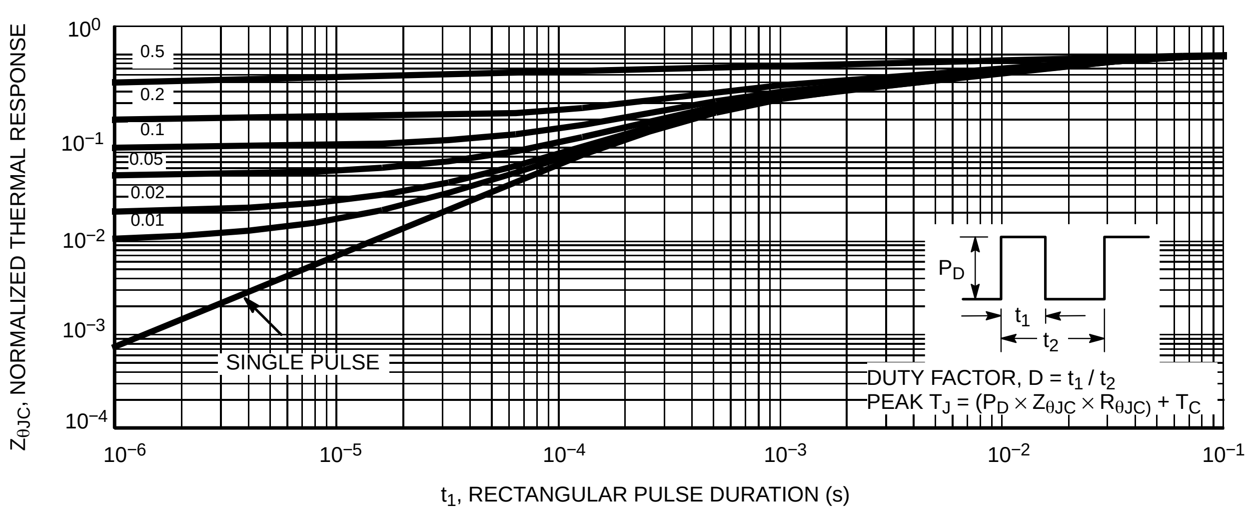


Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case

TEST CIRCUITS AND WAVEFORMS

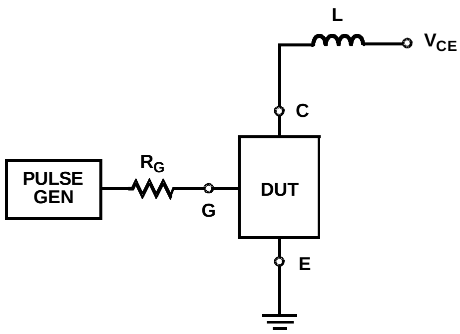


Figure 17. Inductive Switching Test Circuit

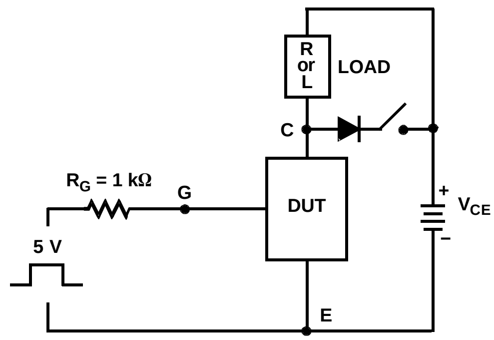


Figure 18. t_{ON} and t_{OFF} Switching Test Circuit

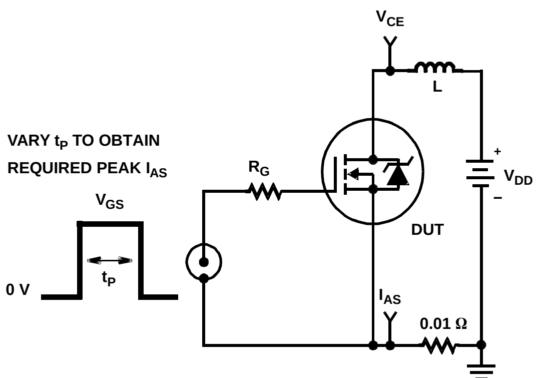


Figure 19. Energy Test Circuit

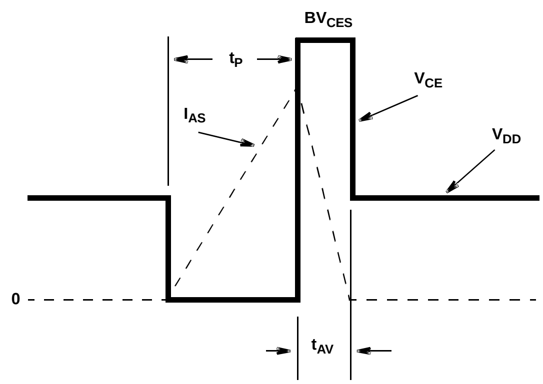


Figure 20. Energy Waveforms

SPICE THERMAL MODEL

ISL9V5036S3ST / ISL9V5036P3−F085 / ISL9V5036 S3ST−F085C

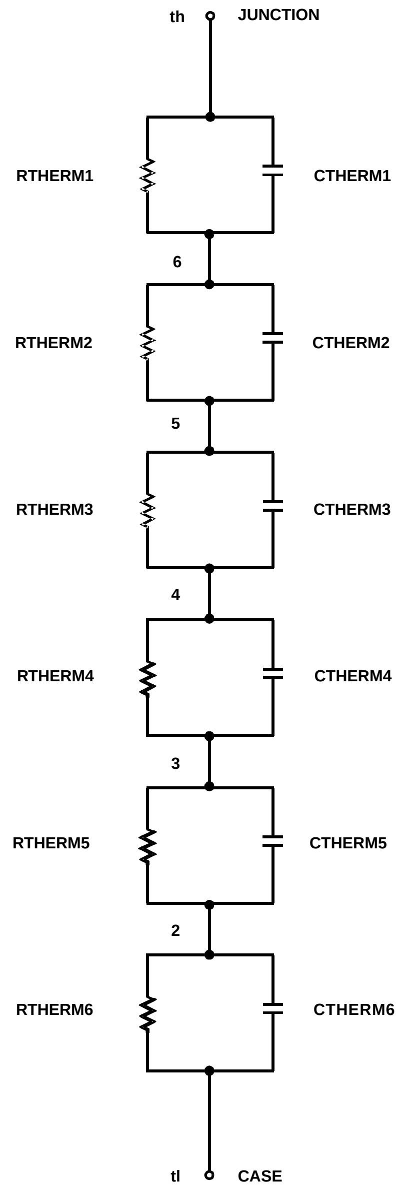
```
CTHERM1 th 6 4.0e2
CTHERM2 6 5 3.6e-3
CTHERM3 5 4 4.9e-2
CTHERM4 4 3 3.2e-1
CTHERM5 3 2 3.0e-1
CTHERM6 2 tl 1.6e-2

RTHERM1 th 6 1.0e-2
RTHERM2 6 5 1.4e-1
RTHERM3 5 4 1.0e-1
RTHERM4 4 3 9.0e-2
RTHERM5 3 2 9.4e-2
RTHERM6 2 tl 1.9e-2
```

SABER THERMAL MODEL

SABER thermal model
ISL9V5036S3ST / ISL9V5036P3−F085 / ISL9V5036 S3ST−F085C

```
template thermal_model th tl
thermal_c th, tl
{
ctherm.ctherm1 th 6 = 4.0e2
ctherm.ctherm2 6 5 = 3.6e-3
ctherm.ctherm3 5 4 = 4.9e-2
ctherm.ctherm4 4 3 = 3.2e-1
ctherm.ctherm5 3 2 = 3.0e−1
ctherm.ctherm6 2 tl = 1.6e-2
rtherm.rtherm1 th 6 = 1.0e-2
rtherm.rtherm2 6 5 = 1.4e-1
rtherm.rtherm3 5 4 = 1.0e-1
rtherm.rtherm4 4 3 = 9.0e-2
rtherm.rtherm5 3 2 = 9.4e-2
rtherm.rtherm6 2 tl = 1.9e-2
}
```



PACKAGE MARKING AND ORDERING INFORMATION

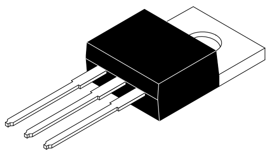
Device	Device Marking	Package	Shipping†
ISL9V5036S3ST	V5036S	D2PAK−3 (TO−263, 3−Lead) (Pb−Free)	800 / Tape & Reel
ISL9V5036P3−F085	V5036P	TO−220−3LD (Pb−Free)	50 Units / Tube

DISCONTINUED (Note 1)

ISL9V5036S3ST−F085C	V5036SC	D2PAK−3 (TO−263, 3−Lead) (Pb−Free)	800 / 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.

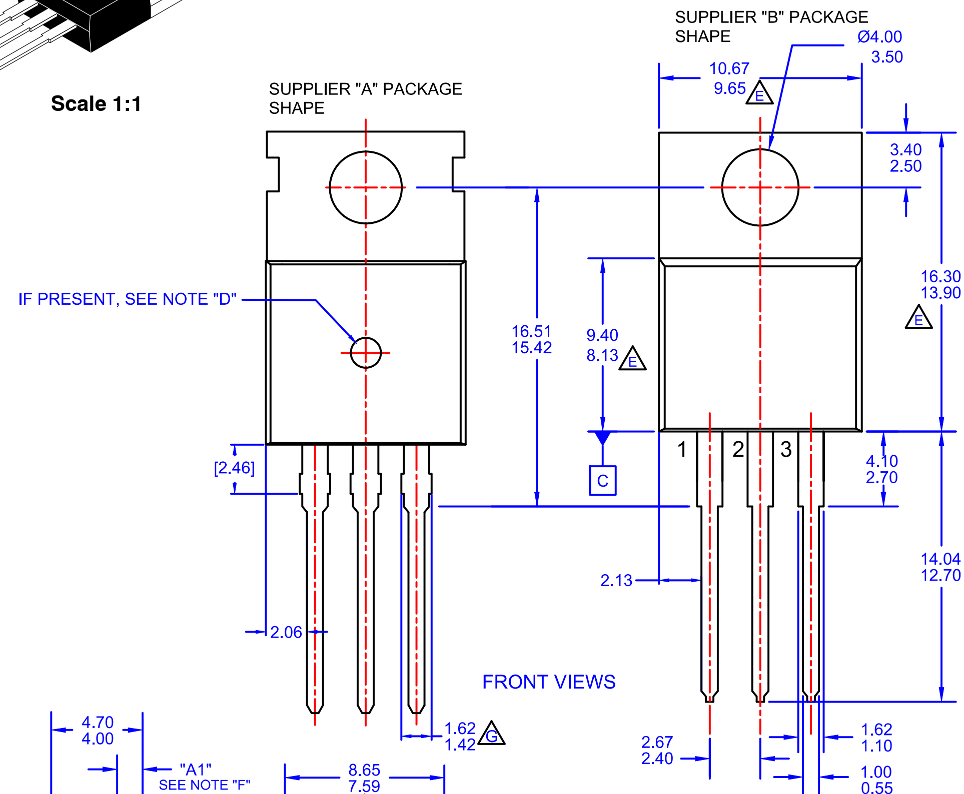
1. **DISCONTINUED:** This device is not recommended for new design. Please contact your **onsemi** representative for information. The most current information on this device may be available on www.onsemi.com.

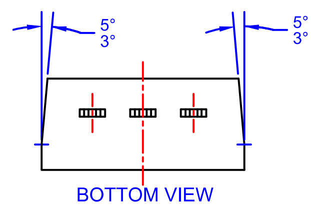


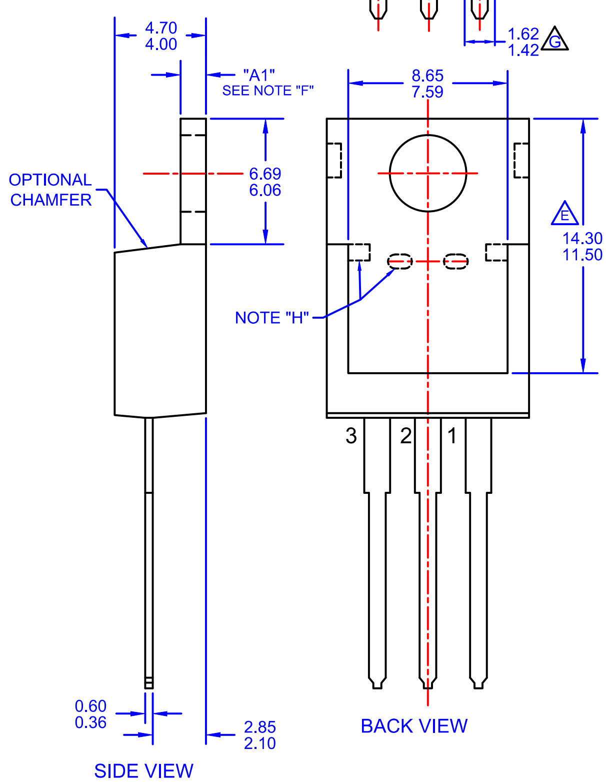
Scale 1:1

TO−220−3LD
CASE 340AT
ISSUE A

DATE 03 OCT 2017







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)
E) DOES NOT COMPLY JEDEC STANDARD VALUE.
F) "A1" DIMENSIONS AS BELOW:
SINGLE GAUGE = 0.51 - 0.61
DUAL GAUGE = 1.10 - 1.45
G) PRESENCE IS SUPPLIER DEPENDENT
H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

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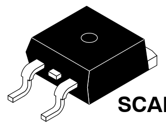
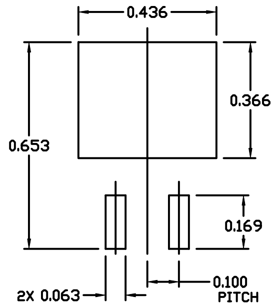
DESCRIPTION:	**TO−220−3LD**	**PAGE 1 OF 1**



SCALE 1:1

D²PAK−3 (TO−263, 3−LEAD)
CASE 418AJ
ISSUE F

DATE 11 MAR 2021



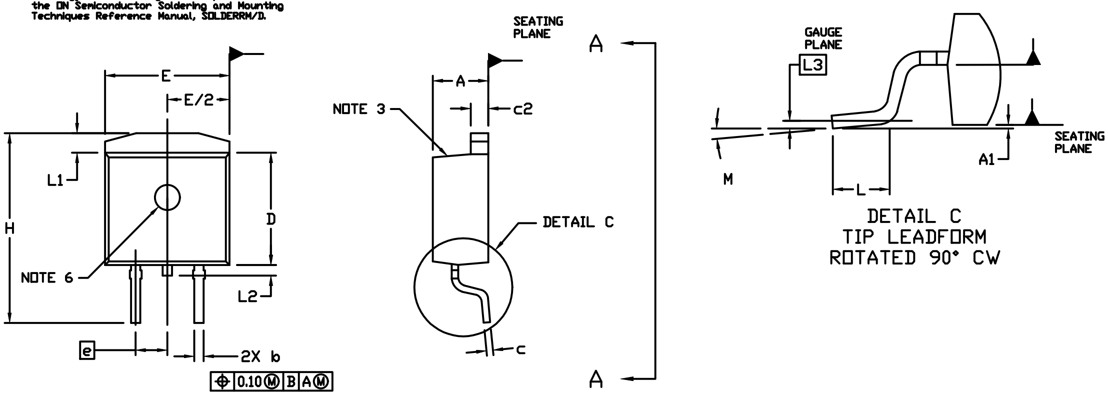
RECOMMENDED
MOUNTING FOOTPRINT

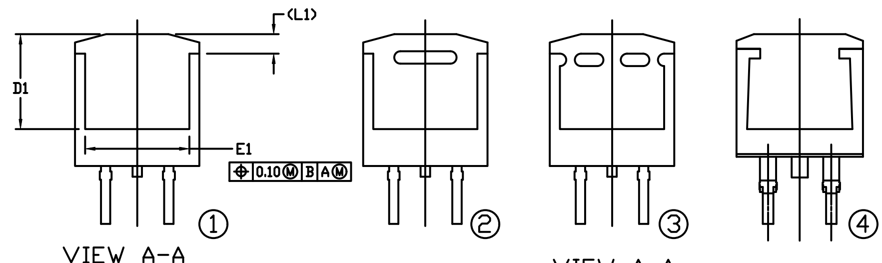
* For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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.

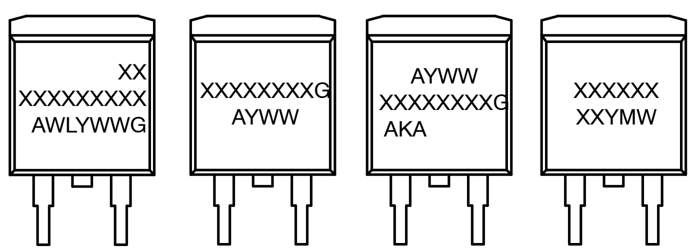
DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.160	0.190	4.06	4.83
A1	0.000	0.010	0.00	0.25
b	0.020	0.039	0.51	0.99
c	0.012	0.029	0.30	0.74
c2	0.045	0.065	1.14	1.65
D	0.330	0.380	8.38	9.65
D1	0.260	---	6.60	---
E	0.380	0.420	9.65	10.67
E1	0.245	---	6.22	---
e	0.100 BSC		2.54 BSC	
H	0.575	0.625	14.60	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
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.

DOCUMENT NUMBER:	98AON56370E	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	D²PAK−3 (TO−263, 3−LEAD)	PAGE 1 OF 1

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at
www.onsemi.com/support/sales

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