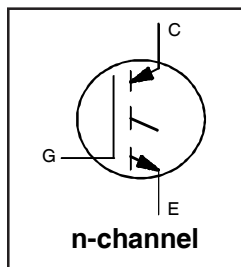


**AUIRGS30B60K**  
**AUIRGL30B60K**

**INSULATED GATE BIPOLAR TRANSISTOR**

**Features**

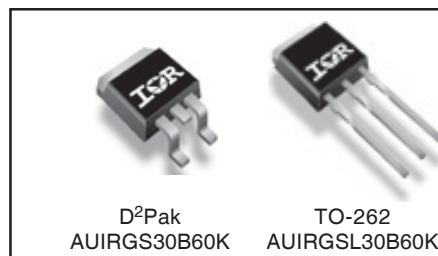
- Low  $V_{CE(on)}$  Non Punch Through IGBT Technology
- 10 $\mu$ s Short Circuit Capability
- Square RBSOA
- Positive  $V_{CE(on)}$  Temperature Coefficient
- Maximum Junction Temperature rated at 175°C
- Lead-Free, RoHS Compliant
- Automotive Qualified \*



$V_{CES} = 600V$
$I_C = 50A, T_C=100^\circ C$ at $T_J=175^\circ C$
$t_{sc} > 10\mu s, T_J=150^\circ C$
$V_{CE(on)}$ typ. = 1.95V

**Benefits**

- Benchmark Efficiency for Motor Control
- Rugged Transient Performance
- Low EMI
- Excellent Current Sharing in Parallel Operation



<b>G</b>	<b>C</b>	<b>E</b>
Gate	Collector	Emitter

**Absolute Maximum Ratings**

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature ( $T_A$ ) is 25°C, unless otherwise specified

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	78	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	50	
$I_{CM}$	Pulse Collector Current (Ref.Fig.C.T.5)	120	
$I_{LM}$	Clamped Inductive Load current ①	120	
$V_{ISOL}$	RMS Isolation Voltage, Terminal to Case, t=1 min.	2500	V
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	370	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	180	
$T_J$	Operating Junction and	-55 to +175	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	

**Thermal / Mechanical Characteristics**

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case- IGBT	—	—	0.41*	°C/W
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount, Steady State)②	—	—	40	
Wt	Weight	—	1.44	—	g

\*  $R_{\theta JC}$  (end of life) = 0.65°C/W. This is the maximum measured value after 1000 temperature cycles from -55 to 150°C and is accounted for by the physical wearout of the die attach medium.

# AUIRGS/SL30B60K

## Dynamic Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0V, I_C = 500\mu A$	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.40	—	V/°C	$V_{GE} = 0V, I_C = 1mA (25^\circ\text{C}-150^\circ\text{C})$	
$V_{CE(on)}$	Collector-to-Emitter Voltage	—	1.95	2.35	V	$I_C = 30A, V_{GE} = 15V, T_J = 25^\circ\text{C}$	5,6,7
		—	2.40	2.75		$I_C = 30A, V_{GE} = 15V, T_J = 150^\circ\text{C}$	8,9,10
		—	2.6	2.95		$I_C = 30A, V_{GE} = 15V, T_J = 175^\circ\text{C}$	
$V_{GE(th)}$	Gate Threshold Voltage	3.5	4.5	5.5	V	$V_{CE} = V_{GE}, I_C = 250\mu A$	8,9,10
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-10	—	mV/°C	$V_{CE} = V_{GE}, I_C = 1.0mA (25^\circ\text{C}-150^\circ\text{C})$	11
$g_{fe}$	Forward Transconductance	—	18	—	S	$V_{CE} = 50V, I_C = 50A, PW = 80\mu s$	
$I_{CES}$	Zero Gate Voltage Collector Current	—	5.0	250	$\mu A$	$V_{GE} = 0V, V_{CE} = 600V$	
		—	1000	2000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$	
		—	1830	3000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 175^\circ\text{C}$	
$I_{GES}$	Gate-to-Emitter Leakage Current	—	—	$\pm 100$	nA	$V_{GE} = \pm 20V, V_{CE} = 0V$	

## Static or Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.
$Q_g$	Total Gate Charge (turn-on)	—	102	153	nC	$I_C = 30A$	17
$Q_{ge}$	Gate-to-Emitter Charge (turn-on)	—	14	21		$V_{CC} = 400V$	CT1
$Q_{gc}$	Gate-to-Collector Charge (turn-on)	—	44	66		$V_{GE} = 15V$	
$E_{on}$	Turn-On Switching Loss	—	350	620	$\mu J$	$I_C = 30A, V_{CC} = 400V$	CT4
$E_{off}$	Turn-Off Switching Loss	—	825	955		$V_{GE} = 15V, R_G = 10\Omega, L = 200\mu H$	
$E_{tot}$	Total Switching Loss	—	1175	1575		$T_J = 25^\circ\text{C}$ ③	
$t_{d(on)}$	Turn-On delay time	—	46	60	ns	$I_C = 30A, V_{CC} = 400V$	CT4
$t_r$	Rise time	—	28	39		$V_{GE} = 15V, R_G = 10\Omega, L = 200\mu H$	
$t_{d(off)}$	Turn-Off delay time	—	185	200		$T_J = 25^\circ\text{C}$	
$t_f$	Fall time	—	31	40			
$E_{on}$	Turn-On Switching Loss	—	635	1085	$\mu J$	$I_C = 30A, V_{CC} = 400V$	CT4
$E_{off}$	Turn-Off Switching Loss	—	1150	1350		$V_{GE} = 15V, R_G = 10\Omega, L = 200\mu H$	12,14
$E_{tot}$	Total Switching Loss	—	1785	2435		$T_J = 150^\circ\text{C}$ ③	WF1,WF2
$t_{d(on)}$	Turn-On delay time	—	46	60	ns	$I_C = 30A, V_{CC} = 400V$	13,15
$t_r$	Rise time	—	28	39		$V_{GE} = 15V, R_G = 10\Omega, L = 200\mu H$	CT4
$t_{d(off)}$	Turn-Off delay time	—	205	235		$T_J = 150^\circ\text{C}$	WF1
$t_f$	Fall time	—	32	42		WF2	
$L_E$	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package	
$C_{ies}$	Input Capacitance	—	1750	—	pF	$V_{GE} = 0V$	16
$C_{oes}$	Output Capacitance	—	160	—		$V_{CC} = 30V$	
$C_{res}$	Reverse Transfer Capacitance	—	60	—		$f = 1.0MHz$	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 150^\circ\text{C}, I_C = 120A, V_p = 600V$	4
SCSOA	Short Circuit Safe Operating Area	10	—	—	$\mu s$	$V_{CC}=500V, V_{GE} = +15V \text{ to } 0V, R_G = 10\Omega$	CT2
						$T_J = 150^\circ\text{C}, V_p = 600V, R_G = 10\Omega$	CT3
$I_{SC}(\text{Peak})$	Peak Short Circuit Collector Current	—	200	—	A	$V_{CC}=360V, V_{GE} = +15V \text{ to } 0V$	WF3

### Notes:

- $V_{CC} = 80\% (V_{CES}), V_{GE} = 20V, L = 28\mu H, R_G = 22\Omega$ .
- This is applied to D<sup>2</sup>Pak, when mounted on 1" square PCB (FR-4 or G-10 Material).  
For recommended footprint and soldering techniques refer to application note #AN-994.
- Energy losses include "tail" and diode reverse recovery.

# AUIRGS/SL30B60K

## Qualification Information<sup>†</sup>

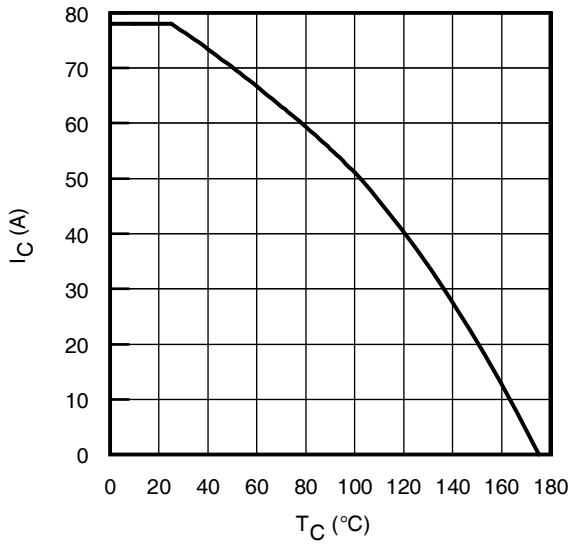
<b>Qualification Level</b>		Automotive (per AEC-Q101) <sup>††</sup>	
		Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
<b>Moisture Sensitivity Level</b>		D <sup>2</sup> PAK	MSL1 <sup>†††</sup> (per IPC/JEDEC J-STD-020)
		TO-262	N/A
<b>ESD</b>	Machine Model	Class M4 (400V) AEC-Q101-002	
	Human Body Model	Class H2 (4000V) AEC-Q101-001	
	Charged Device Model	Class C4 (1000V) AEC-Q101-005	
<b>RoHS Compliant</b>		Yes	

<sup>†</sup> Qualification standards can be found at International Rectifier's web site: <http://www.irf.com>

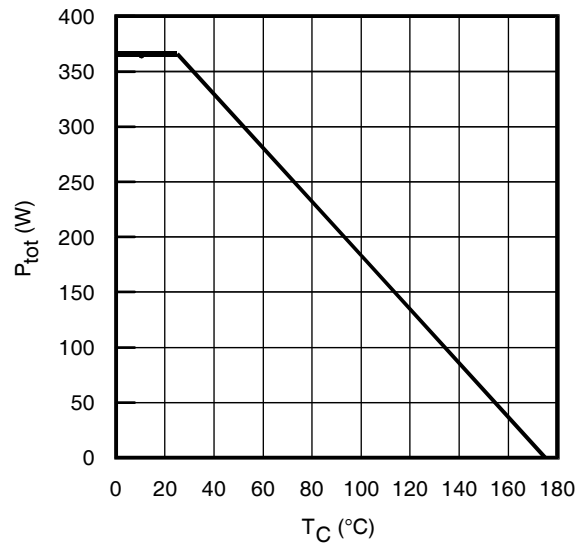
<sup>††</sup> Exceptions to AEC-Q101 requirements are noted in the qualification report.

<sup>†††</sup> Higher MSL ratings may be available for the specific package types listed here. Please contact your International Rectifier sales representative for further information.

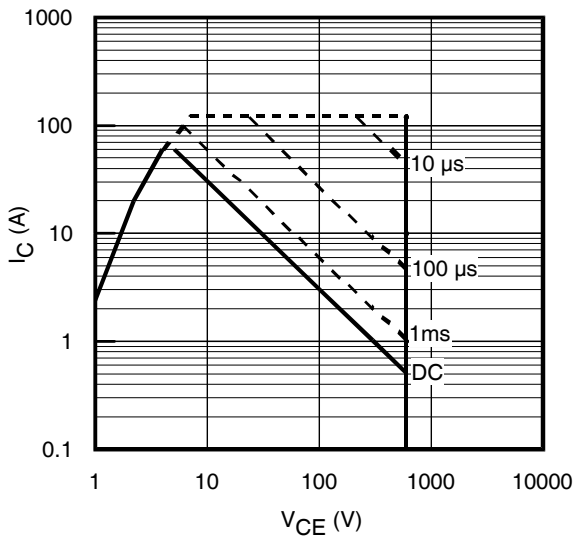
# AUIRGS/SL30B60K



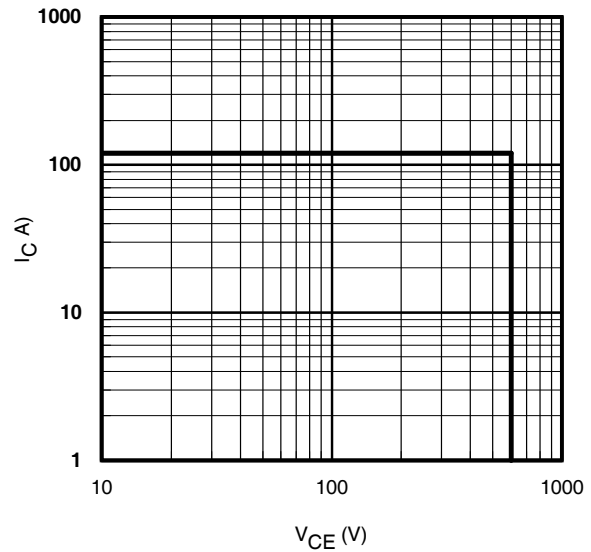
**Fig. 1** - Maximum DC Collector Current vs. Case Temperature



**Fig. 2** - Power Dissipation vs. Case Temperature

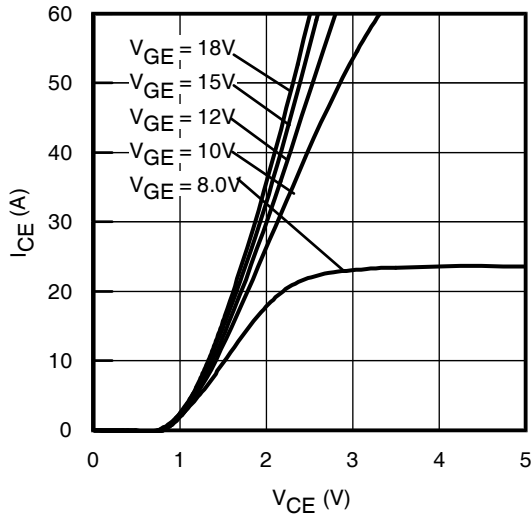


**Fig. 3** - Forward SOA  
 $T_C = 25^{\circ}C$ ;  $T_J \leq 150^{\circ}C$

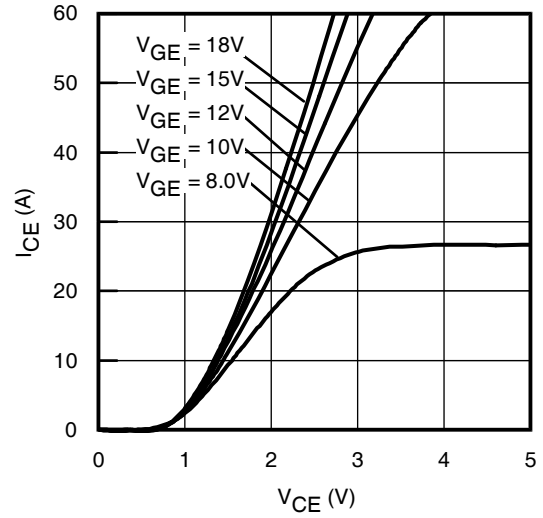


**Fig. 4** - Reverse Bias SOA  
 $T_J = 150^{\circ}C$ ;  $V_{GE} = 15V$

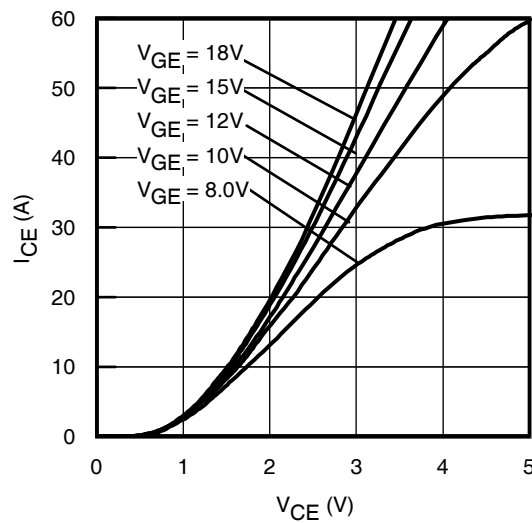
# AUIRGS/SL30B60K



**Fig. 5** - Typ. IGBT Output Characteristics  
 $T_J = -40^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$

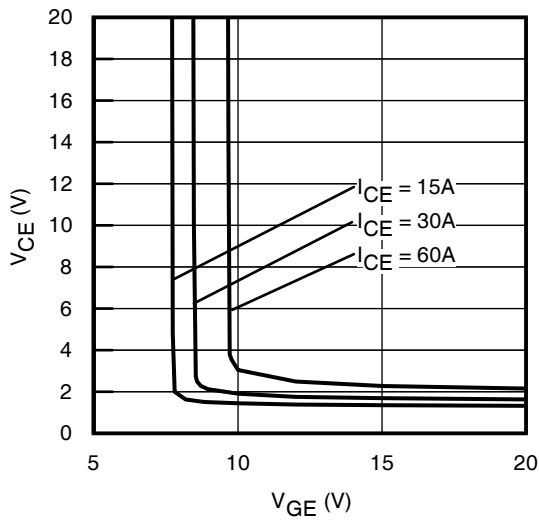


**Fig. 6** - Typ. IGBT Output Characteristics  
 $T_J = 25^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$

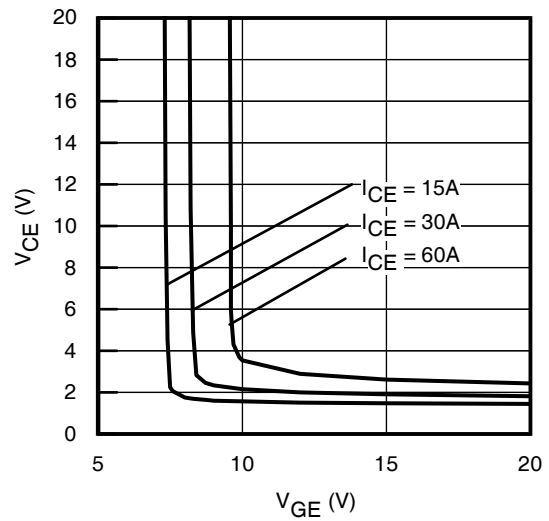


**Fig. 7** - Typ. IGBT Output Characteristics  
 $T_J = 150^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$

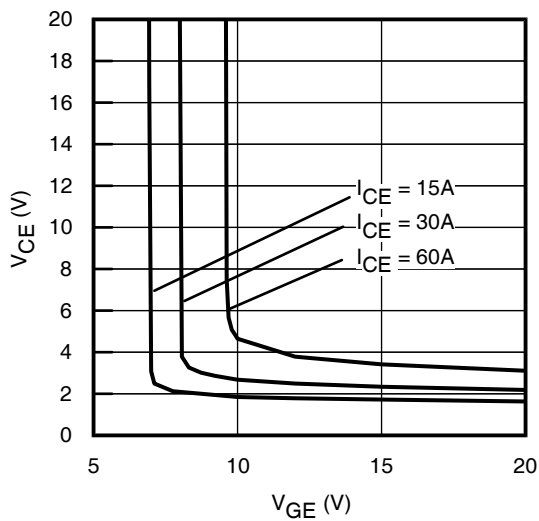
# AUIRGS/SL30B60K



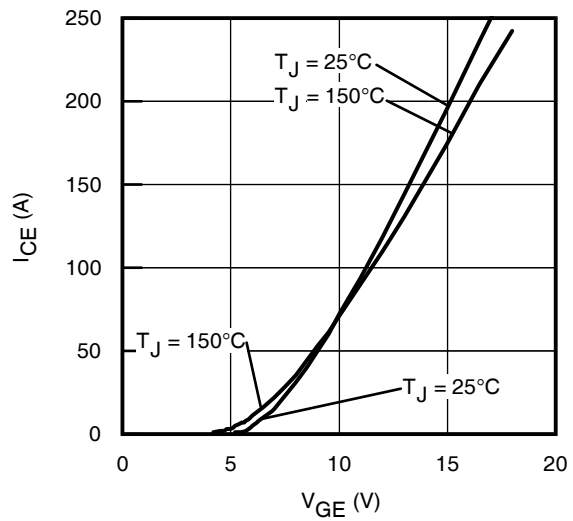
**Fig. 8** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$



**Fig. 9** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$

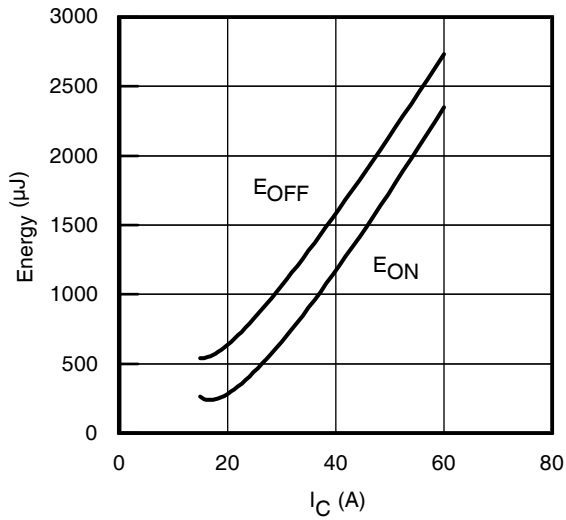


**Fig. 10** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 150^\circ\text{C}$

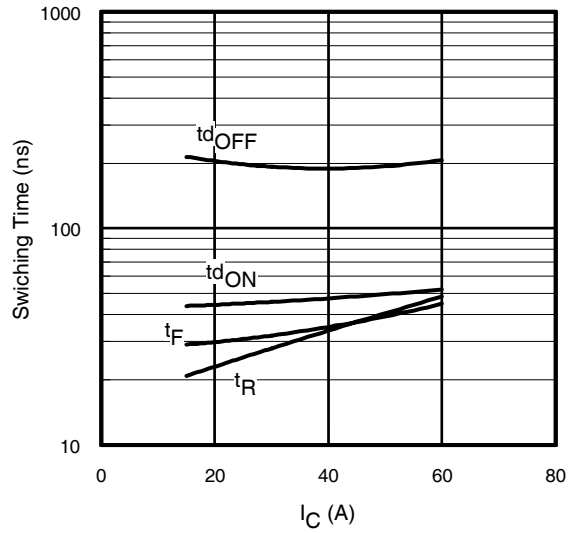


**Fig. 11** - Typ. Transfer Characteristics  
 $V_{CE} = 50\text{V}$ ;  $t_p = 10\mu\text{s}$

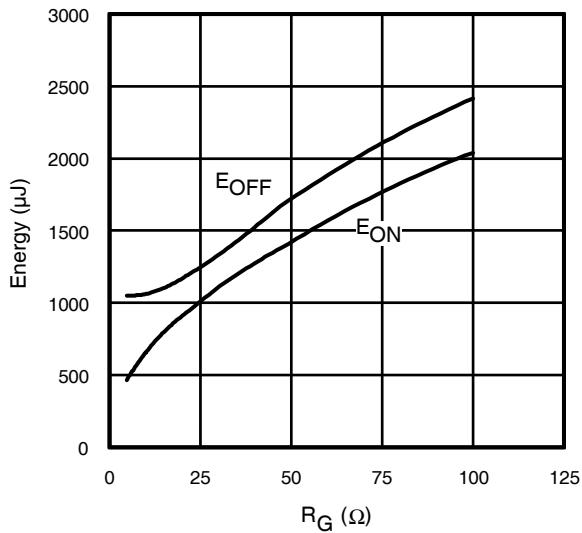
# AUIRGS/SL30B60K



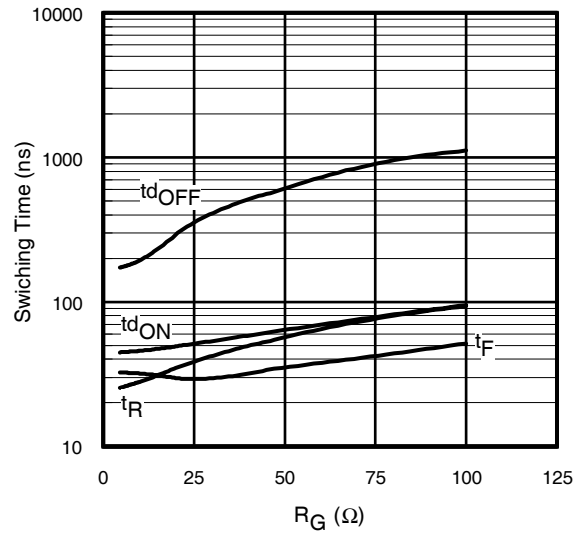
**Fig. 12** - Typ. Energy Loss vs.  $I_C$   
 $T_J = 150^\circ\text{C}$ ;  $L = 200\mu\text{H}$ ;  $V_{CE} = 400\text{V}$ ,  
 $R_G = 10\Omega$ ;  $V_{GE} = 15\text{V}$



**Fig. 13** - Typ. Switching Time vs.  $I_C$   
 $T_J = 150^\circ\text{C}$ ;  $L = 200\mu\text{H}$ ;  $V_{CE} = 400\text{V}$   
 $R_G = 10\Omega$ ;  $V_{GE} = 15\text{V}$

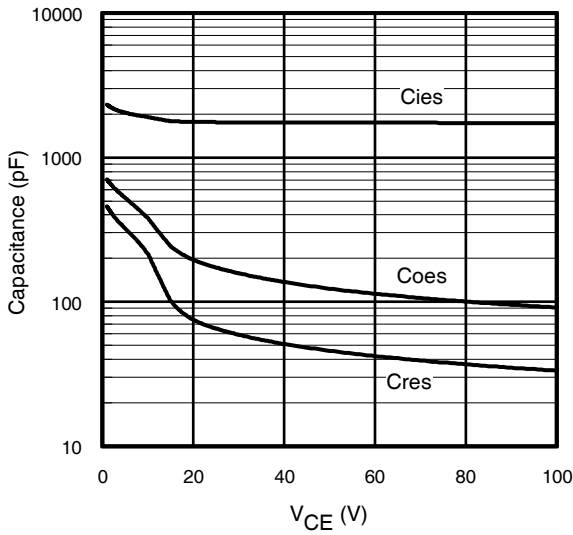


**Fig. 14** - Typ. Energy Loss vs.  $R_G$   
 $T_J = 150^\circ\text{C}$ ;  $L = 200\mu\text{H}$ ;  $V_{CE} = 400\text{V}$   
 $I_{CE} = 30\text{A}$ ;  $V_{GE} = 15\text{V}$

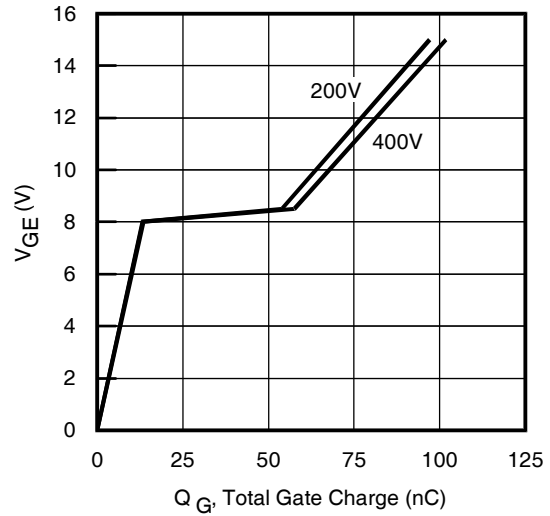


**Fig. 15** - Typ. Switching Time vs.  $R_G$   
 $T_J = 150^\circ\text{C}$ ;  $L = 200\mu\text{H}$ ;  $V_{CE} = 400\text{V}$   
 $I_{CE} = 30\text{A}$ ;  $V_{GE} = 15\text{V}$

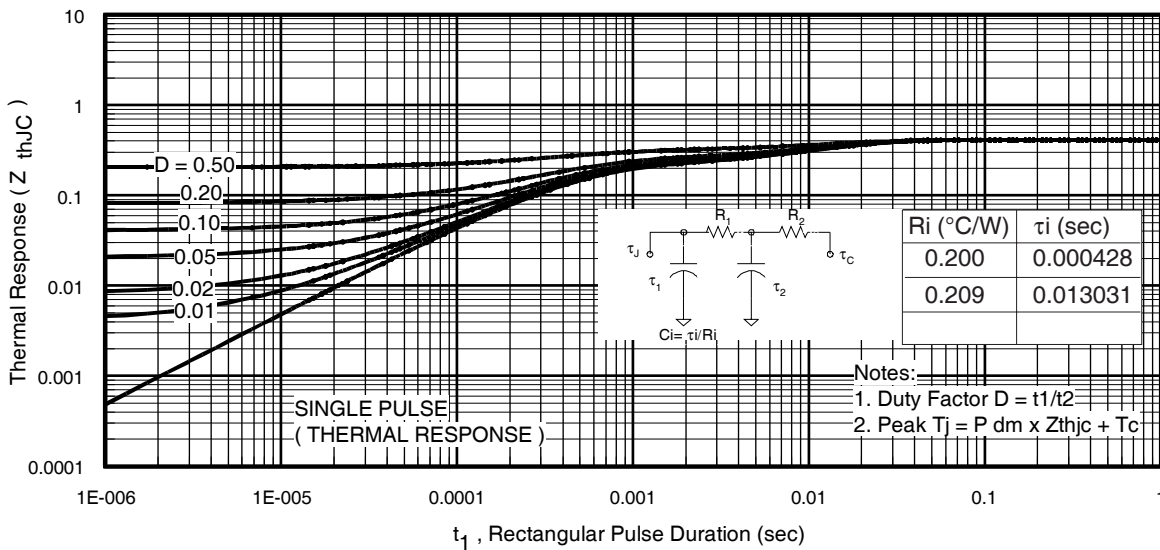
# AUIRGS/SL30B60K



**Fig. 16-** Typ. Capacitance vs. V<sub>CE</sub>  
V<sub>GE</sub>= 0V; f = 1MHz



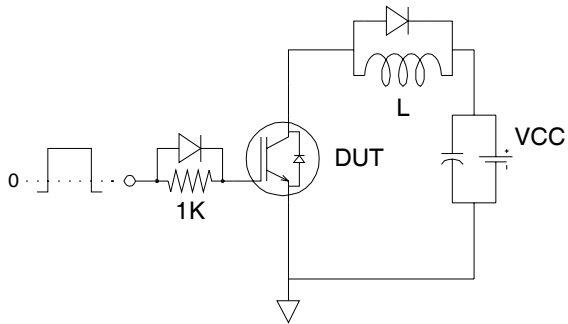
**Fig. 17 -** Typical Gate Charge vs. V<sub>GE</sub>  
I<sub>CE</sub> = 30A; L = 600μH



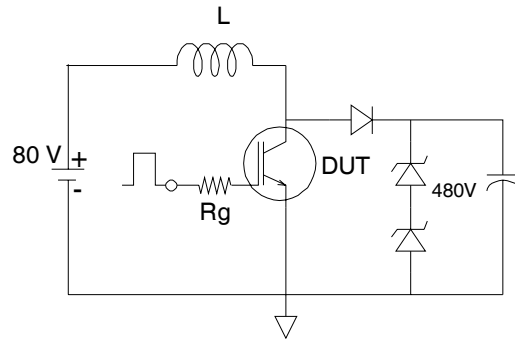
**Fig 18.** Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)



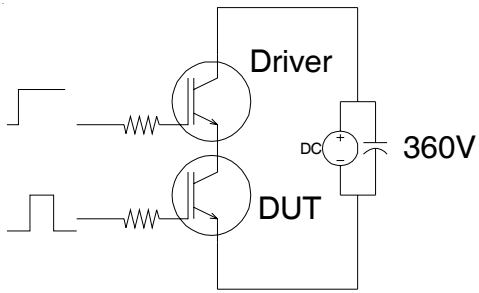
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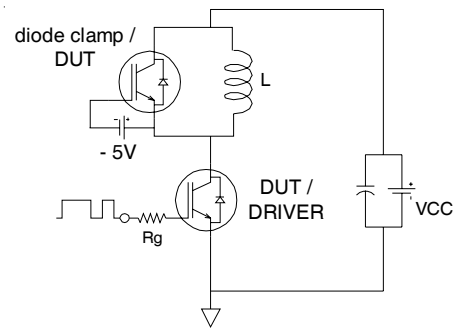
**Fig.C.T.1** - Gate Charge Circuit (turn-off)



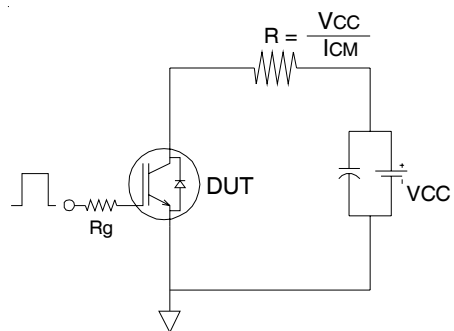
**Fig.C.T.2** - RBSOA Circuit



**Fig.C.T.3** - S.C.SOA Circuit



**Fig.C.T.4** - Switching Loss Circuit



**Fig.C.T.5** - Resistive Load Circuit

# AUIRGS/SL30B60K

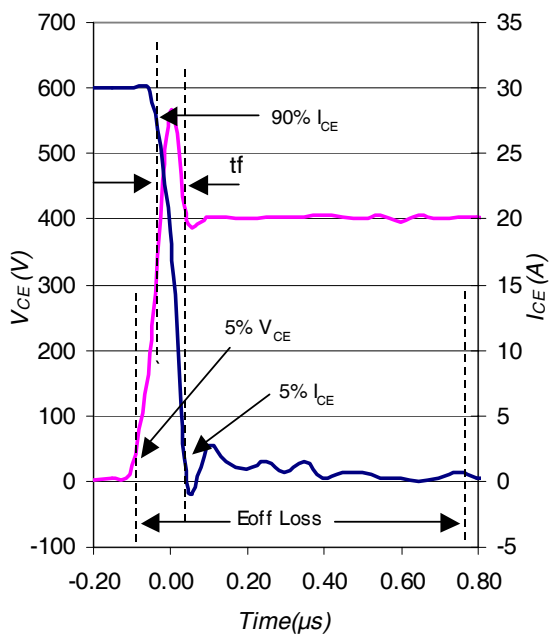


Fig. WF1- Typ. Turn-off Loss Waveform  
 @  $T_J = 150^\circ\text{C}$  using Fig. CT.4

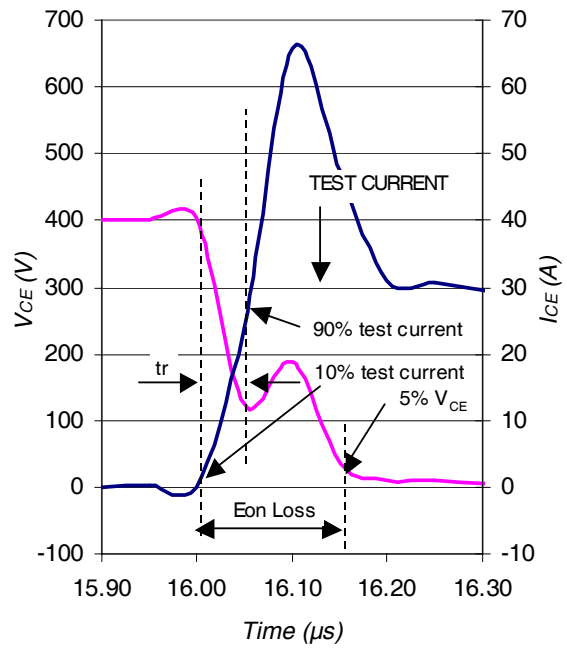


Fig. WF2- Typ. Turn-on Loss Waveform  
 @  $T_J = 150^\circ\text{C}$  using Fig. CT.4

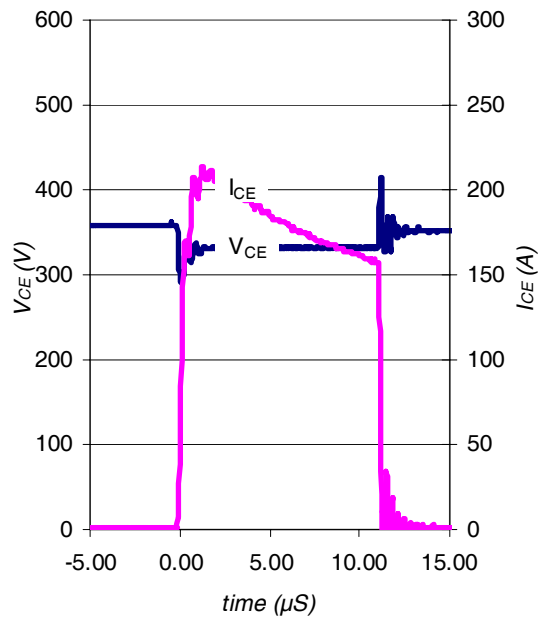
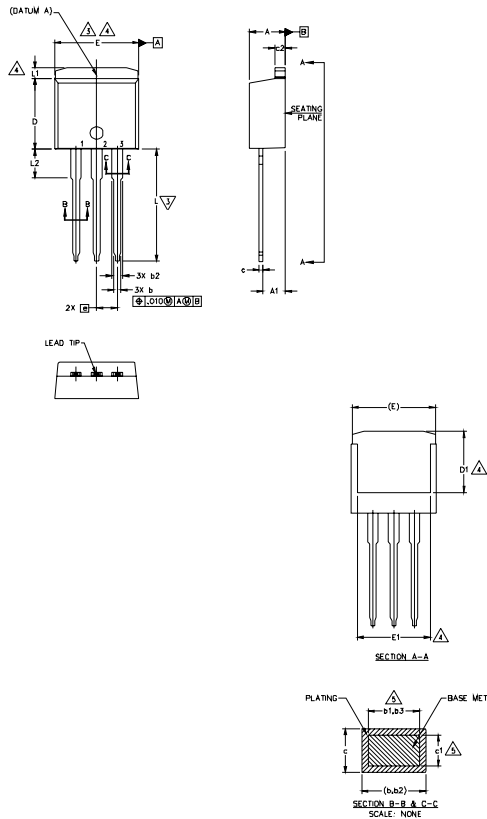


Fig. WF3- Typ. S.C Waveform  
 @  $T_C = 150^\circ\text{C}$  using Fig. CT.3

## TO-262 Package Outline

Dimensions are shown in millimeters (inches)



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. CONTROLLING DIMENSION: INCH.
7. OUTLINE CONFORM TO JEDEC TO-262 EXCEPT A1(max.), b(min.) AND D1(min.) WHERE DIMENSIONS DERIVED THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	5
A1	2.03	3.02	.080	.119	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	5
c1	0.38	0.58	.015	.023	
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	-	.270	-	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	-	.245	-	4
e	2.54 BSC	-	.100 BSC	-	4
L	13.46	14.10	.530	.555	
L1	-	1.65	-	.065	
L2	3.56	3.71	.140	.146	

**LEAD ASSIGNMENTS**

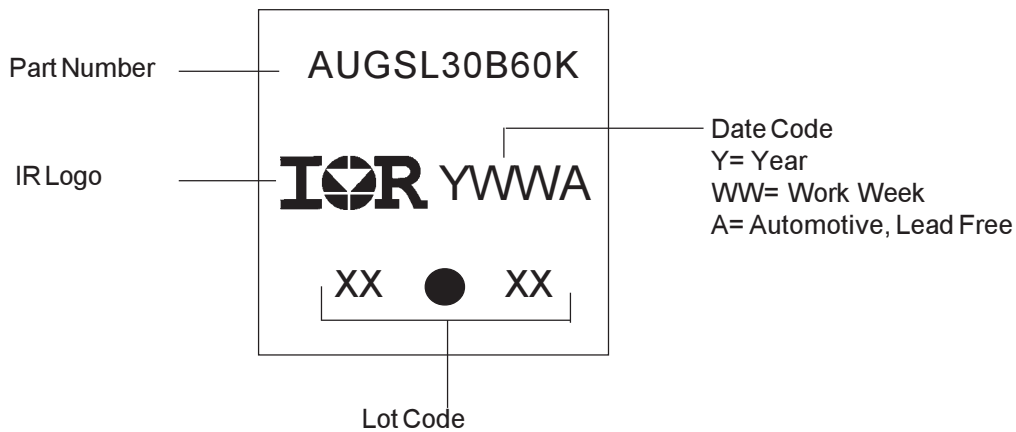
**HEXFEEET**

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

**IGBTs, CoPACK**

- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

## TO-262 Part Marking Information

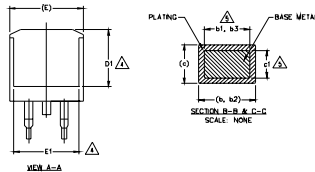
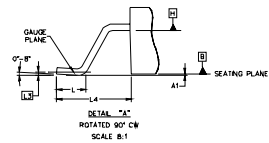
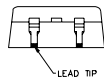
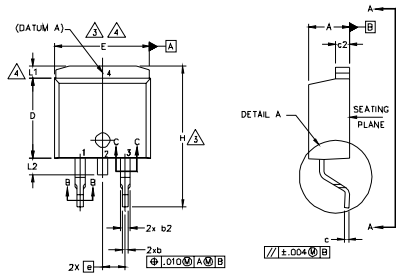


**Note:** For the most current drawing please refer to IR website at <http://www.irf.com/package/>

# AUIRGS/SL30B60K

## D<sup>2</sup>Pak (TO-263AB) Package Outline

Dimensions are shown in millimeters (inches)



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	-	.270	-	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	-	.245	-	4
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	-	1.65	-	.066	
L2	1.27	1.78	-	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	

LEAD ASSIGNMENTS

HEXFET

- 1.- GATE
- 2, 4.- DRAIN
- 3.- SOURCE

IGBTs, CoPACK

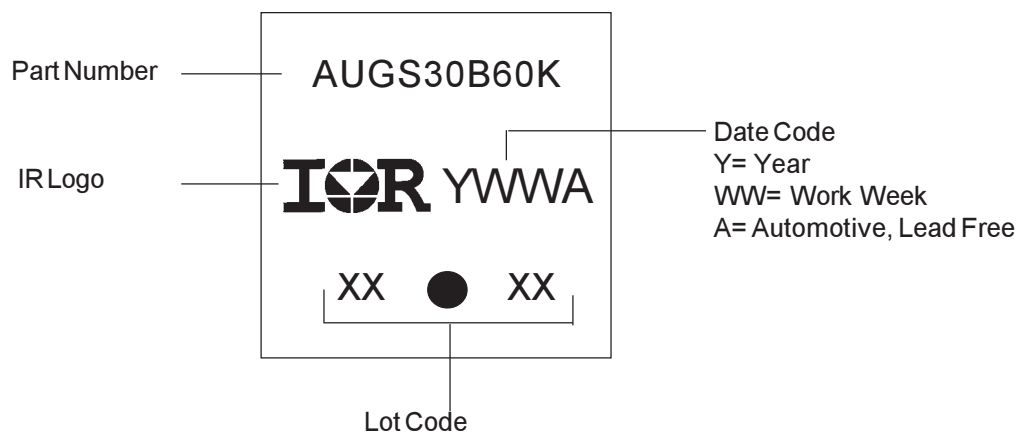
- 1.- GATE
- 2, 4.- COLLECTOR
- 3.- EMITTER

DIODES

- 1.- ANODE \*
- 2, 4.- CATHODE
- 3.- ANODE

\* PART DEPENDENT.

## D<sup>2</sup>Pak (TO-263AB) Part Marking Information

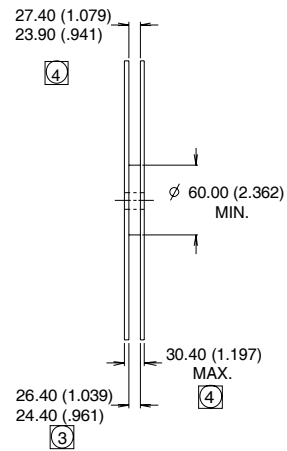
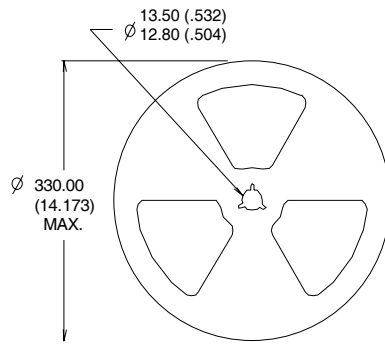
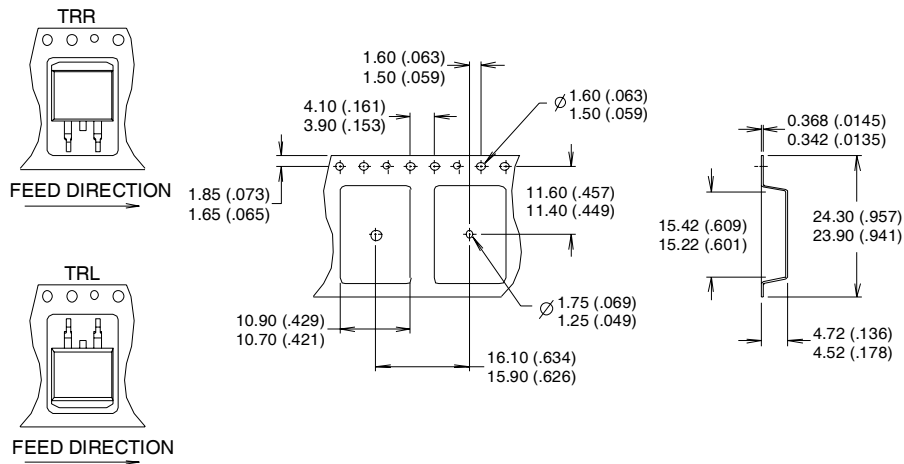


**Note:** For the most current drawing please refer to IR website at <http://www.irf.com/package/>

# AUIRGS/SL30B60K

## D<sup>2</sup>Pak (TO-263AB) Tape & Reel Information

Dimensions are shown in millimeters (inches)



- NOTES:
1. COMFORMS TO EIA-418.
  2. CONTROLLING DIMENSION: MILLIMETER.
  - ③ DIMENSION MEASURED @ HUB.
  - ④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.

# AUIRGS/SL30B60K

## Ordering Information

Base part number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRGS30B60K	TO-262	Tube	50	AUIRGS30B60K
AUIRGS30B60K	D2Pak	Tube	50	AUIRGS30B60K
		Tape and Reel Left	800	AUIRGS30B60KTRL
		Tape and Reel Right	800	AUIRGS30B60KTRR

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