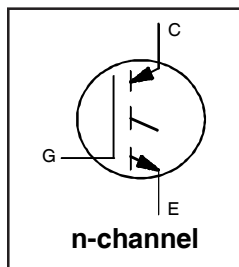


AUIRGS30B60K AUIRGL30B60K

INSULATED GATE BIPOLAR TRANSISTOR

Features

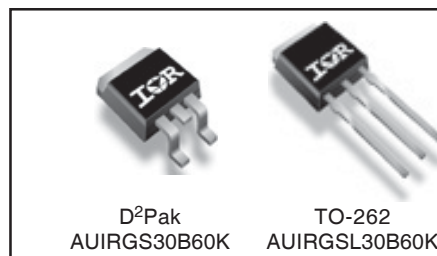
- Low $V_{CE(on)}$ Non Punch Through IGBT Technology
- 10 μ s Short Circuit Capability
- Square RBSOA
- Positive $V_{CE(on)}$ Temperature Coefficient
- Maximum Junction Temperature rated at 175°C
- Lead-Free, RoHS Compliant
- Automotive Qualified *



$V_{CES} = 600V$
 $I_C = 50A, T_C=100^\circ C$
 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



G	C	E
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	± 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	$^\circ C$
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*	$^\circ C/W$
$R_{\theta CS}$	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 $^\circ C/W$. This is the maximum measured value after 1000 temperature cycles from -55 to 150 $^\circ C$ and is accounted for by the physical wearout of the die attach medium.

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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/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1mA (25^\circ\text{C}-150^\circ\text{C})$	
$V_{CE(on)}$	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/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1.0mA (25^\circ\text{C}-150^\circ\text{C})$	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	μA	$V_{GE} = 0V, V_{CE} = 600V$	
		—	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	—	—	± 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	μJ	$I_C = 30A, V_{CC} = 400V$	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	μJ	$I_C = 30A, V_{CC} = 400V$	CT4
E_{on}	Turn-On Switching Loss	—	635	1085		$V_{GE} = 15V, R_G = 10\Omega, L = 200\mu H$	12,14
E_{off}	Turn-Off Switching Loss	—	1150	1350		$T_J = 150^\circ\text{C}$ ③	WF1,WF2
E_{tot}	Total Switching Loss	—	1785	2435	ns	$I_C = 30A, V_{CC} = 400V$	13,15
$t_{d(on)}$	Turn-On delay time	—	46	60		$V_{GE} = 15V, R_G = 10\Omega, L = 200\mu H$	CT4
t_r	Rise time	—	28	39		$T_J = 150^\circ\text{C}$	WF1
$t_{d(off)}$	Turn-Off delay time	—	205	235	nH		WF2
t_f	Fall time	—	32	42			
L_E	Internal Emitter Inductance	—	7.5	—		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	—	—	μs	$V_{CC}=500V, V_{GE} = +15V \text{ to } 0V, R_G = 10\Omega$	CT2
						$T_J = 150^\circ\text{C}, V_p = 600V, R_G = 10\Omega$	CT3
$I_{SC(Peak)}$	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 D²Pak, 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[†]

Qualification Level		Automotive (per AEC-Q101) ^{††}	
		Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		D ² PAK	MSL1 ^{†††} (per IPC/JEDEC J-STD-020)
		TO-262	N/A
ESD	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	
RoHS Compliant		Yes	

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

^{††} Exceptions to AEC-Q101 requirements are noted in the qualification report.

^{†††} 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

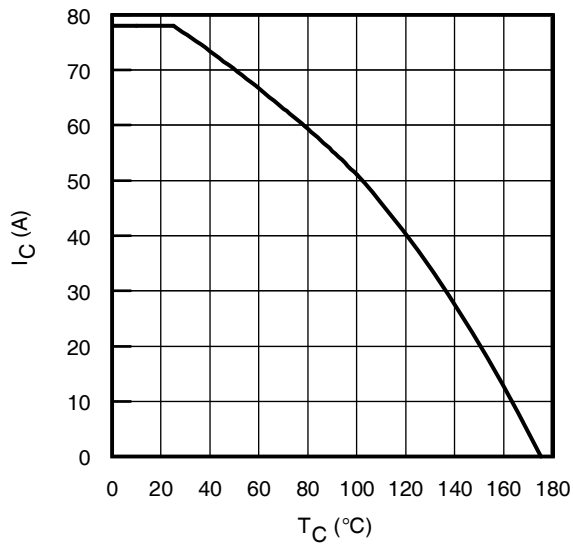


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

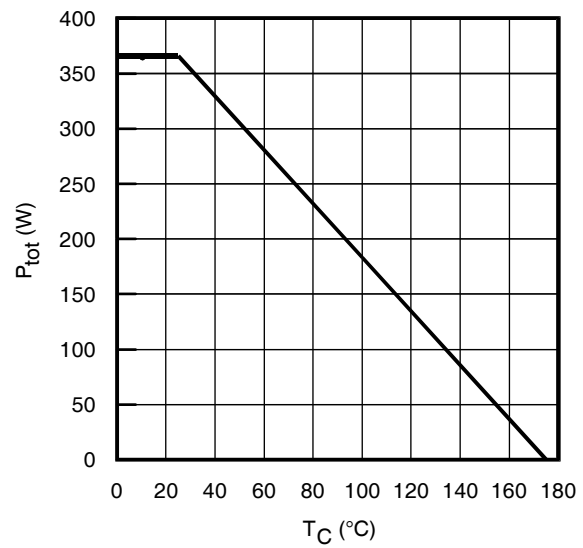


Fig. 2 - Power Dissipation vs. Case Temperature

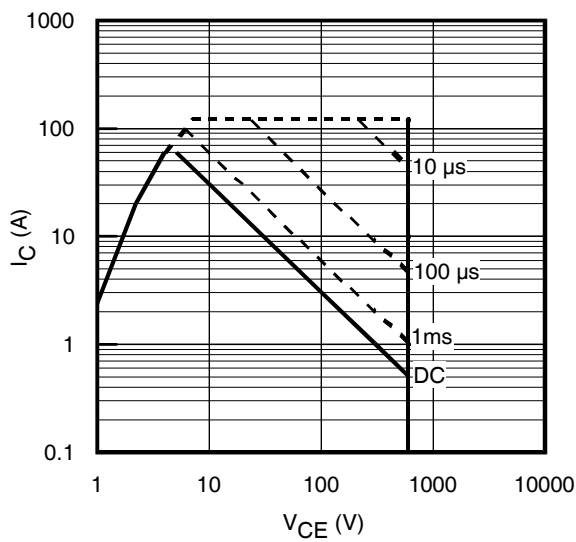


Fig. 3 - Forward SOA
 $T_C = 25^{\circ}\text{C}$; $T_J \leq 150^{\circ}\text{C}$

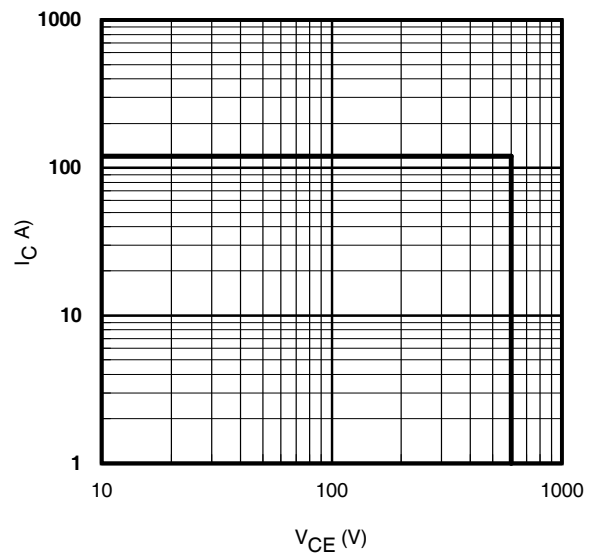


Fig. 4 - Reverse Bias SOA
 $T_J = 150^{\circ}\text{C}$; $V_{GE} = 15\text{V}$

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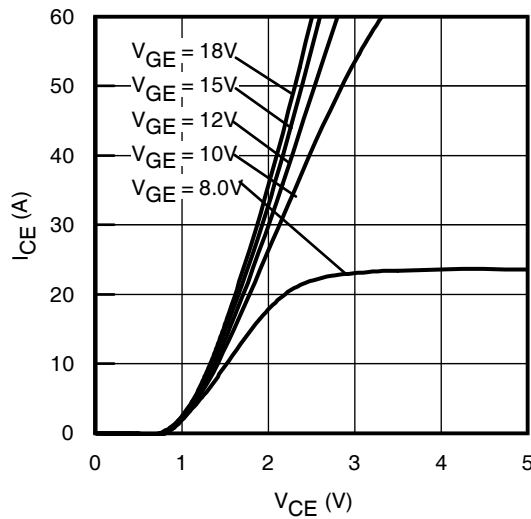


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

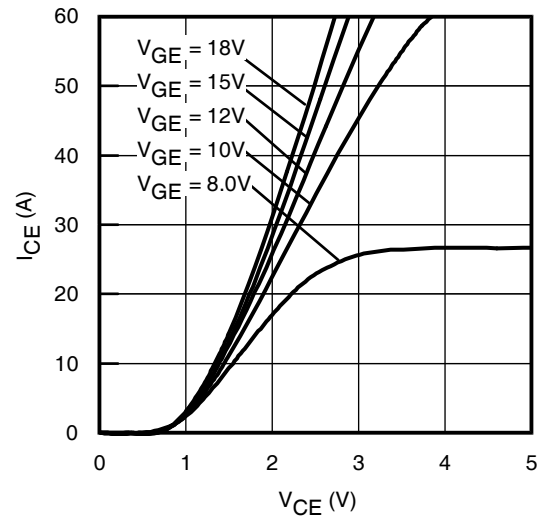


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

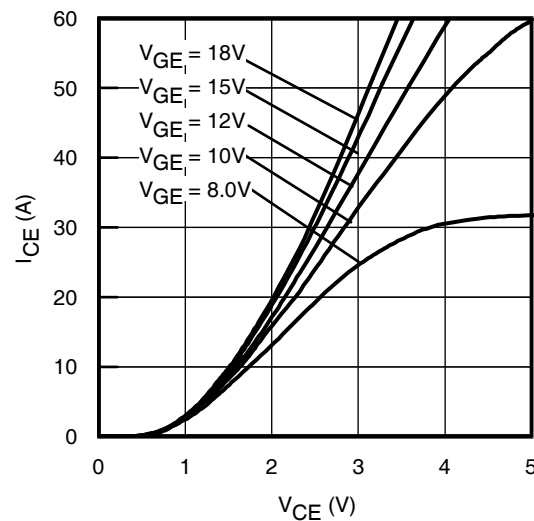


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $t_p = 80\mu\text{s}$

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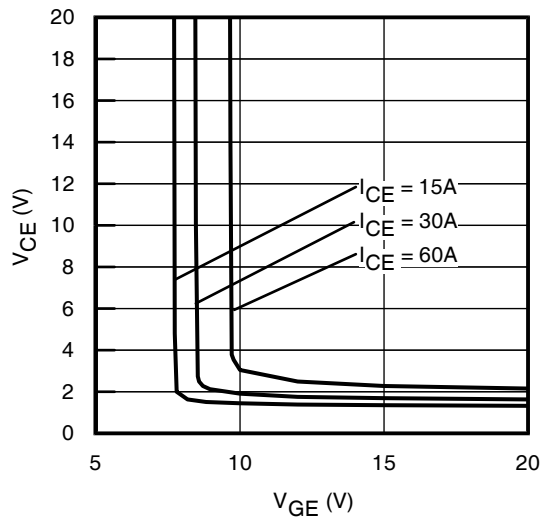


Fig. 8 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^{\circ}\text{C}$

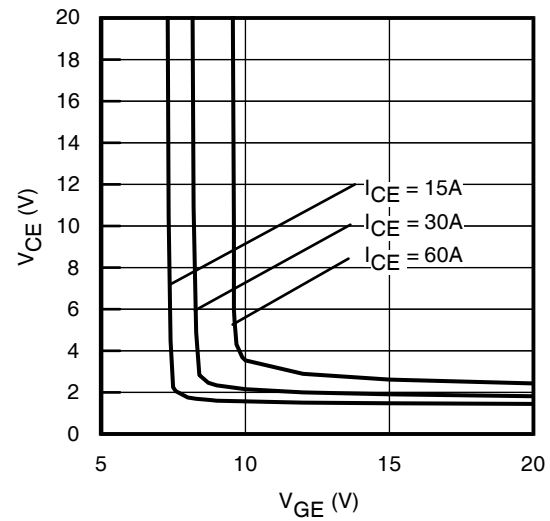


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^{\circ}\text{C}$

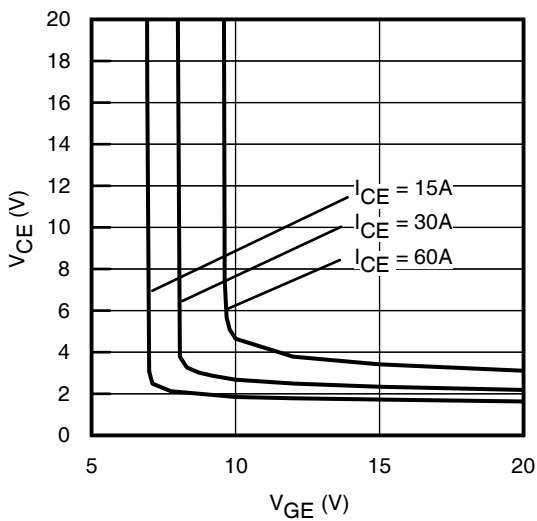


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^{\circ}\text{C}$

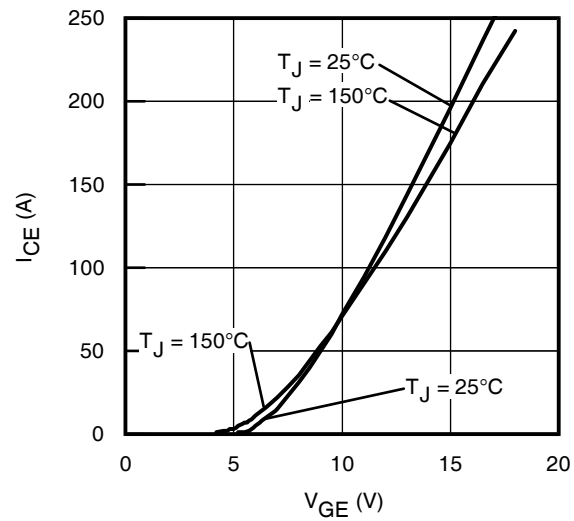


Fig. 11 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

AUIRGS/SL30B60K

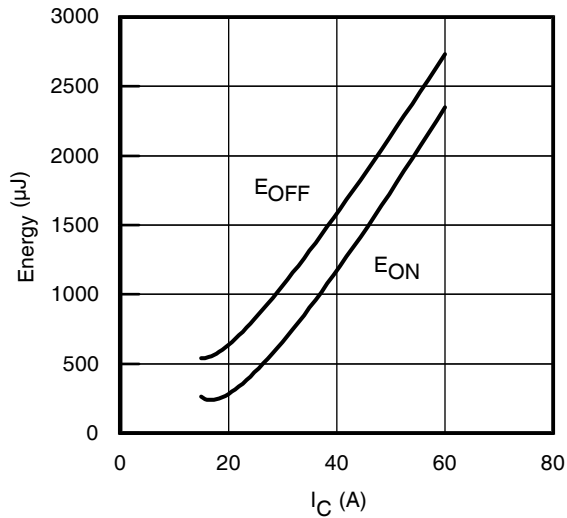


Fig. 12 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$,
 $R_G=10\Omega$; $V_{GE}=15\text{V}$

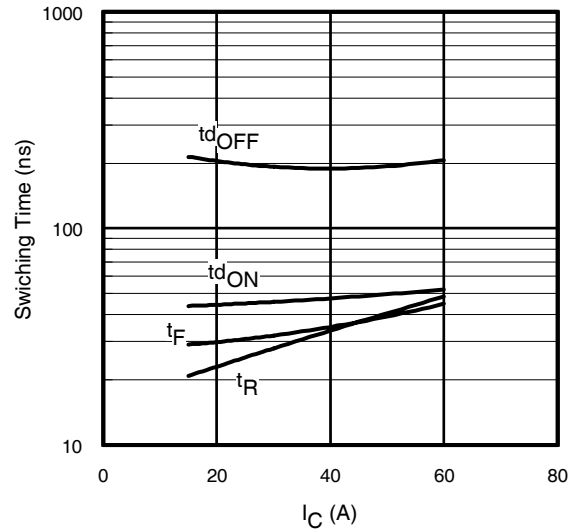


Fig. 13 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$
 $R_G=10\Omega$; $V_{GE}=15\text{V}$

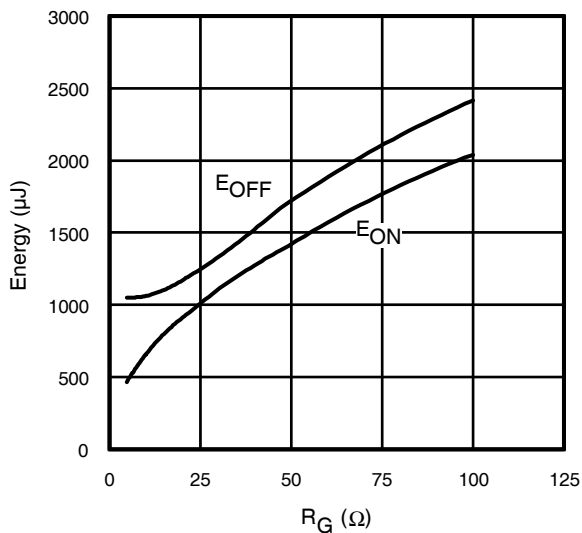


Fig. 14 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$
 $I_{CE}=30\text{A}$; $V_{GE}=15\text{V}$

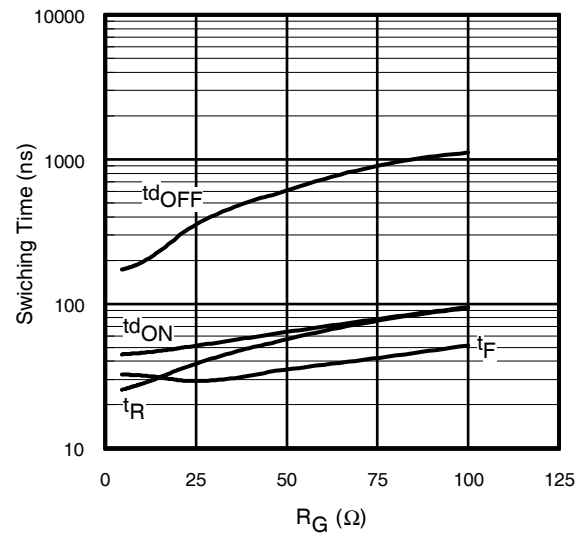


Fig. 15 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$
 $I_{CE}=30\text{A}$; $V_{GE}=15\text{V}$

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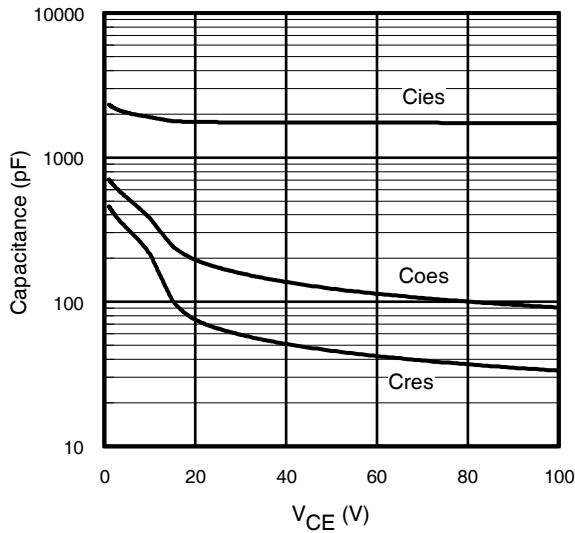


Fig. 16- Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

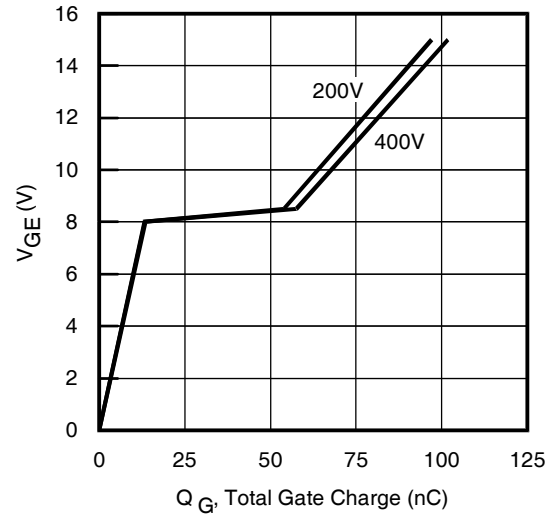


Fig. 17 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 30A$; $L = 600\mu H$

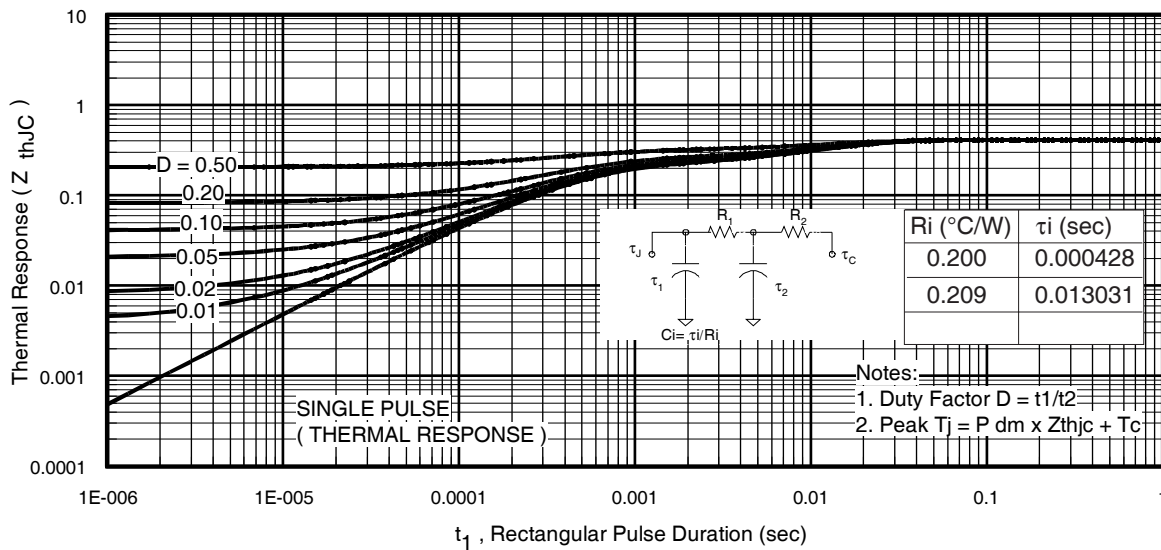


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

AUIRGS/SL30B60K

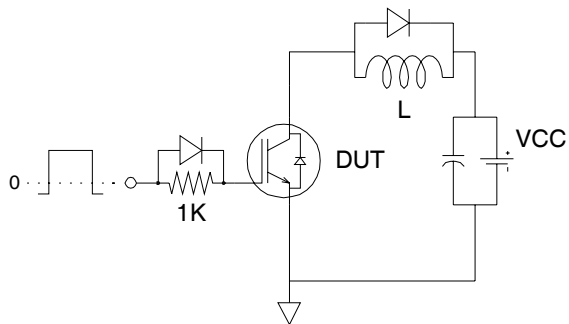


Fig.C.T.1 - Gate Charge Circuit (turn-off)

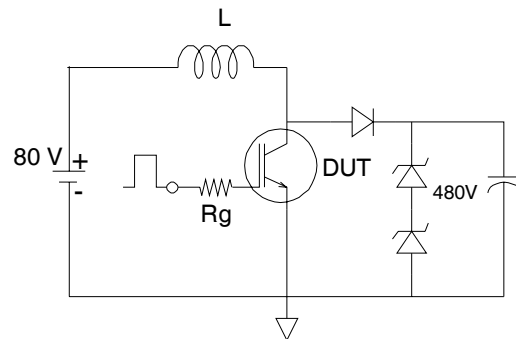


Fig.C.T.2 - RBSOA Circuit

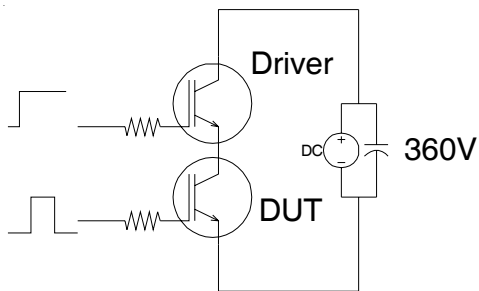


Fig.C.T.3 - S.C.SOA Circuit

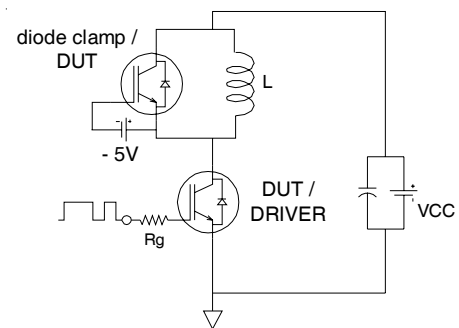


Fig.C.T.4 - Switching Loss Circuit

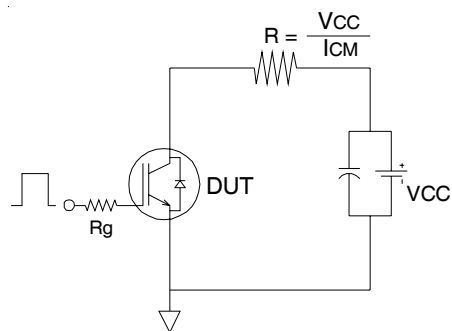


Fig.C.T.5 - Resistive Load Circuit

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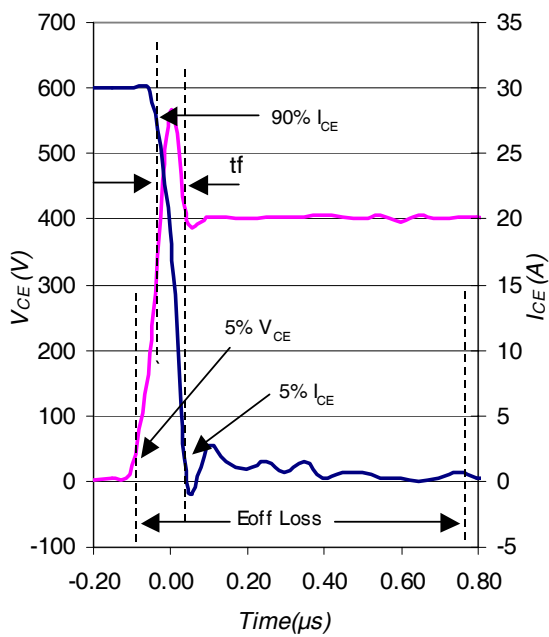


Fig. WF1- Typ. Turn-off Loss Waveform
@ $T_J = 150^{\circ}\text{C}$ using Fig. CT.4

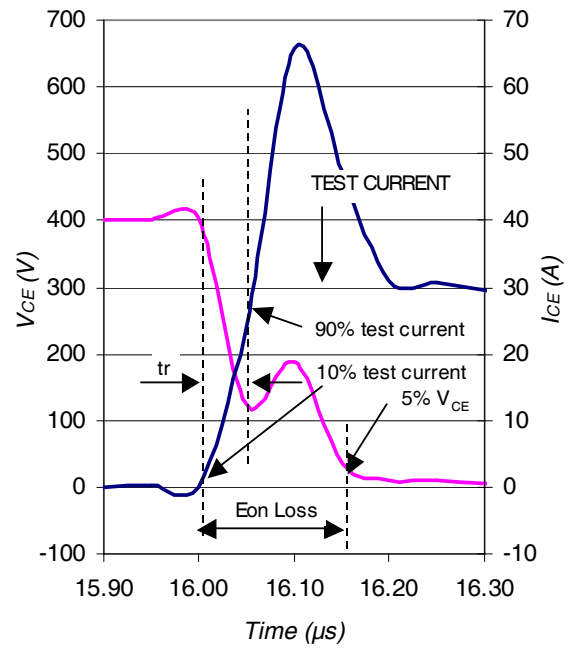


Fig. WF2- Typ. Turn-on Loss Waveform
@ $T_J = 150^{\circ}\text{C}$ using Fig. CT.4

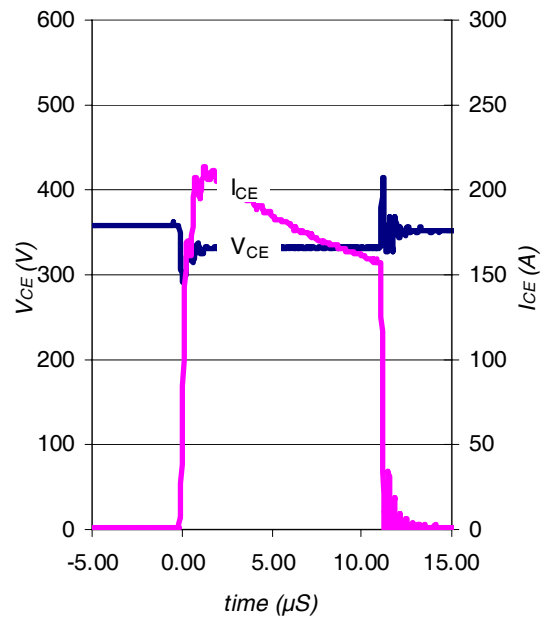
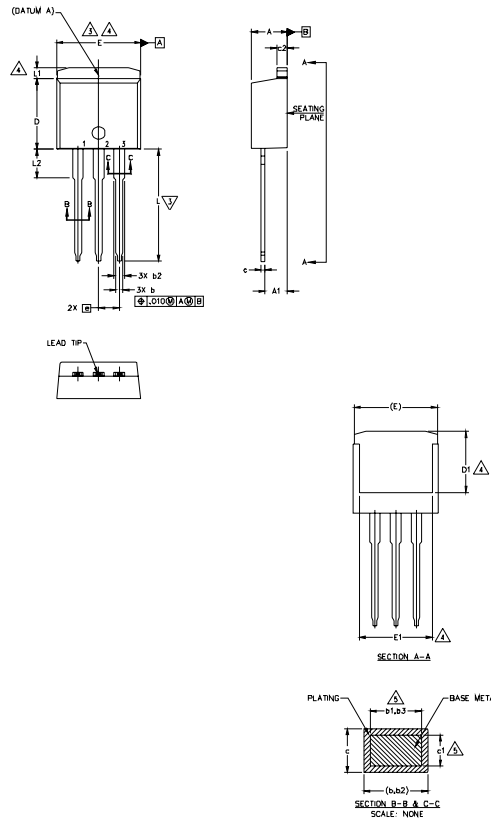


Fig. WF3- Typ. S.C Waveform
@ $T_C = 150^{\circ}\text{C}$ using Fig. CT.3

AUIRGS/SL30B60K

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 [0.005"] 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	
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		4
L	13.46	14.10	.530	.555	
L1	—	1.65	—	.065	
L2	3.56	3.71	.140	.146	

LEAD ASSIGNMENTS

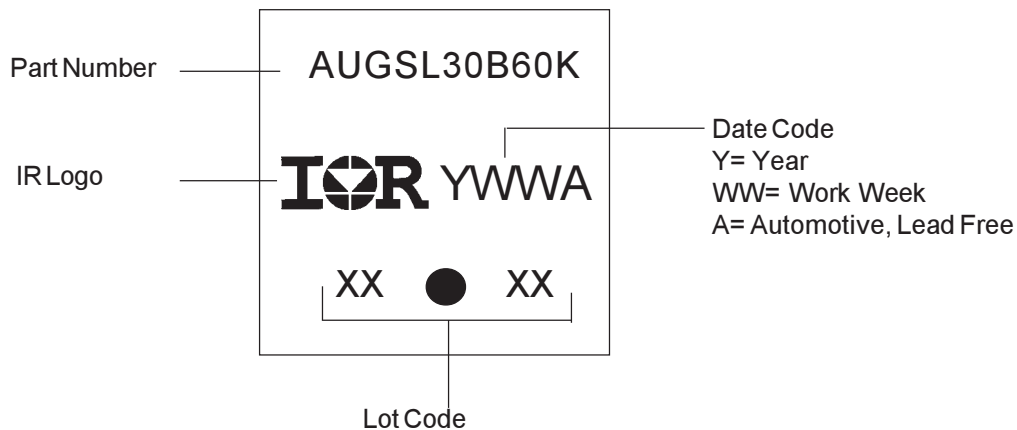
HEXFET

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

IGBTs, CoPACK

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

TO-262 Part Marking Information

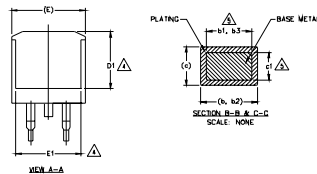
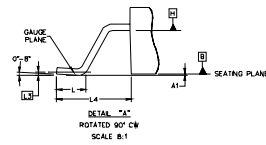
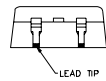
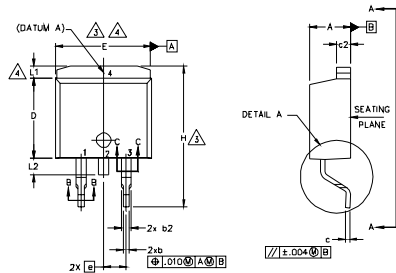


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

AUIRGS/SL30B60K

D²Pak (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	4
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

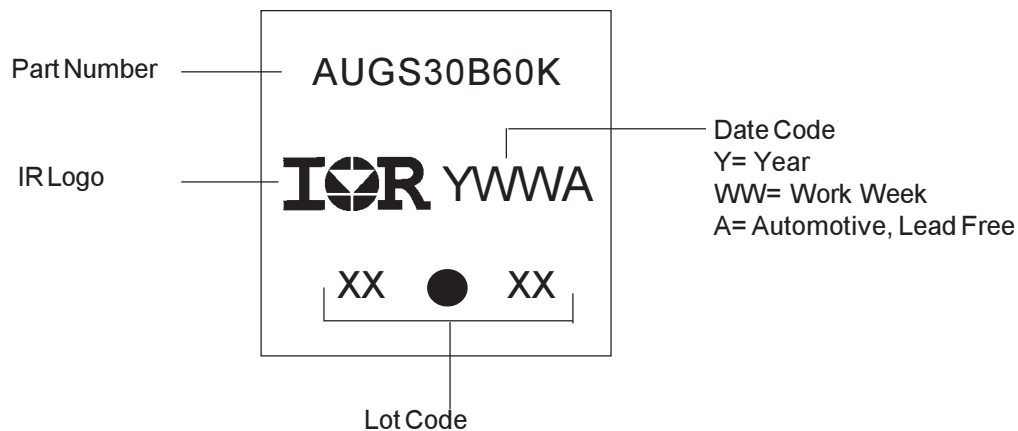
1. - GATE
- 2, 4. - COLLECTOR
3. - EMITTER

DIODES

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

* PART DEPENDENT.

D²Pak (TO-263AB) Part Marking Information

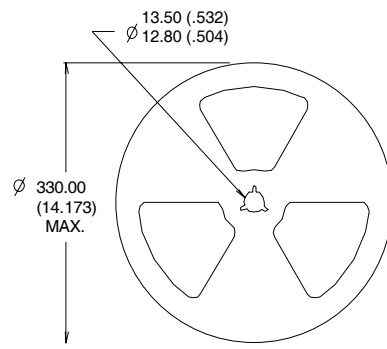
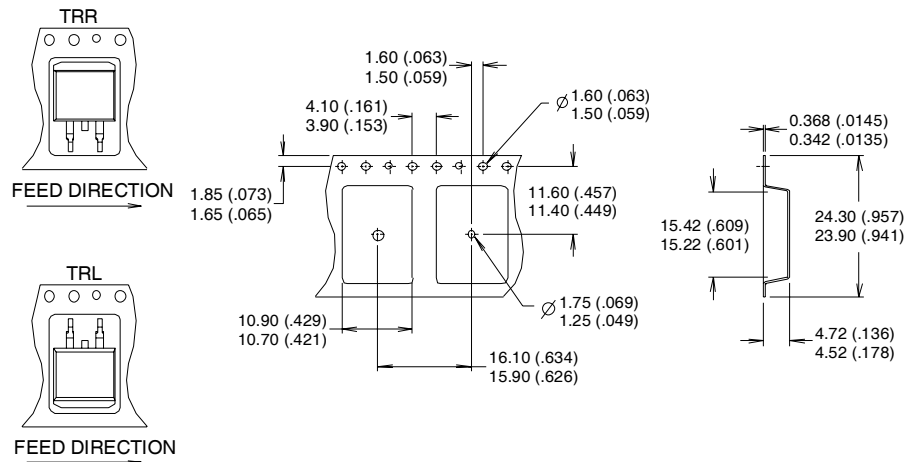


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

AUIRGS/SL30B60K

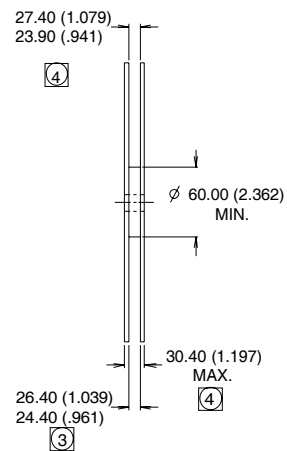
D²Pak (TO-263AB) Tape & Reel Information

Dimensions are shown in millimeters (inches)



NOTES:

1. CONFORMS 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	
AUIRGS�30B60K	TO-262	Tube	50	AUIRGS�30B60K
AUIRGS30B60K	D2Pak	Tube	50	AUIRGS30B60K
		Tape and Reel Left	800	AUIRGS30B60KTRL
		Tape and Reel Right	800	AUIRGS30B60KTRR

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WORLD HEADQUARTERS:

233 Kansas St., El Segundo, California 90245

Tel: (310) 252-7105