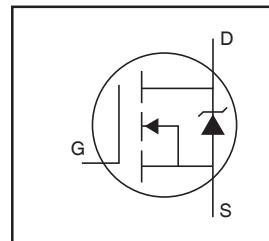


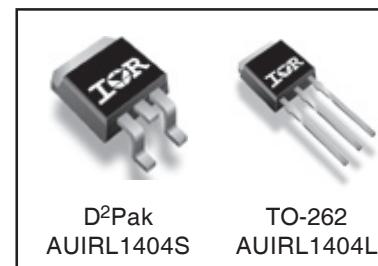
AUIRL1404S
AUIRL1404L
HEXFET® Power MOSFET

Features

- Advanced Planar Technology
- Logic-Level Gate Drive
- Low On-Resistance
- Dynamic dV/dT Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Repetitive Avalanche Allowed up to T_{jmax}
- Lead-Free, RoHS Compliant
- Automotive Qualified *



$V_{(BR)DSS}$	40V
$R_{DS(on)}$ max.	4mΩ
I_D	160A ⑥



G	D	S
Gate	Drain	Source

Description

Specifically designed for Automotive applications, this Stripe Planar design of HEXFET® Power MOSFETs utilizes the latest processing techniques to achieve low on-resistance per silicon area. This benefit combined with the fast switching speed and ruggedized device design that HEXFET power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in Automotive and a wide variety of other applications.

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
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	160 ⑥	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	110 ⑥	
I_{DM}	Pulsed Drain Current ①	640	
P_D @ $T_A = 25^\circ\text{C}$	Power Dissipation	3.8	W
P_D @ $T_C = 25^\circ\text{C}$	Power Dissipation	200	
	Linear Derating Factor	1.3	W/°C
V_{GS}	Gate-to-Source Voltage	±20	V
E_{AS}	Single Pulse Avalanche Energy ②	520	mJ
I_{AR}	Avalanche Current ①	95	A
E_{AR}	Repetitive Avalanche Energy ①	20	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.0	V/ns
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds		

Thermal Resistance

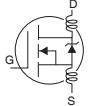
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.75	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient (PCB mounted) ⑦	—	40	

HEXFET® is a registered trademark of International Rectifier.
*Qualification standards can be found at <http://www.irf.com/>

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{DSS}}$	Drain-to-Source Breakdown Voltage	40	—	—	V	$V_{\text{GS}} = 0\text{V}$, $I_D = 250\mu\text{A}$
$\Delta V_{(\text{BR})\text{DSS}}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.038	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1\text{mA}$
$R_{\text{DS}(\text{on})}$	Static Drain-to-Source On-Resistance	—	—	4.0	$\text{m}\Omega$	$V_{\text{GS}} = 10\text{V}$, $I_D = 95\text{A}$ ④
		—	—	5.9		$V_{\text{GS}} = 4.3\text{V}$, $I_D = 40\text{A}$ ④
$V_{\text{GS}(\text{th})}$	Gate Threshold Voltage	1.0	—	3.0	V	$V_{\text{DS}} = V_{\text{GS}}$, $I_D = 250\mu\text{A}$
g_{fs}	Forward Transconductance	93	—	—	S	$V_{\text{DS}} = 25\text{V}$, $I_D = 95\text{A}$
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{\text{DS}} = 40\text{V}$, $V_{\text{GS}} = 0\text{V}$
		—	—	250		$V_{\text{DS}} = 32\text{V}$, $V_{\text{GS}} = 0\text{V}$, $T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{\text{GS}} = 20\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-200		$V_{\text{GS}} = -20\text{V}$

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

Q_g	Total Gate Charge	—	—	140	nC	$I_D = 95\text{A}$ $V_{\text{DS}} = 32\text{V}$ $V_{\text{GS}} = 5.0\text{V}$, See Fig 6 ④
Q_{gs}	Gate-to-Source Charge	—	—	48		
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	60		
$t_{\text{d}(\text{on})}$	Turn-On Delay Time	—	18	—		
t_r	Rise Time	—	270	—	ns	$V_{\text{DD}} = 20\text{V}$ $I_D = 95\text{A}$ $R_G = 2.5\Omega$, $V_{\text{GS}} = 4.5\text{V}$ $R_D = 0.25\Omega$ ④
$t_{\text{d}(\text{off})}$	Turn-Off Delay Time	—	38	—		
t_f	Fall Time	—	130	—		
L_D	Internal Drain Inductance	—	4.5	—		Between lead, 6mm (0.25in.)
L_S	Internal Source Inductance	—	7.5	—	nH	Between lead, and center of die contact
C_{iss}	Input Capacitance	—	6600	—		
C_{oss}	Output Capacitance	—	1700	—		
C_{rss}	Reverse Transfer Capacitance	—	350	—		$f = 1.0\text{MHz}$, See Fig.5
C_{oss}	Output Capacitance	—	6700	—		$V_{\text{GS}} = 0\text{V}$, $V_{\text{DS}} = 1.0\text{V}$, $f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	1500	—	pF	$V_{\text{GS}} = 0\text{V}$, $V_{\text{DS}} = 32\text{V}$, $f = 1.0\text{MHz}$
$C_{\text{oss eff.}}$	Effective Output Capacitance ⑤	—	1500	—		$V_{\text{GS}} = 0\text{V}$, $V_{\text{DS}} = 0\text{V}$ to 32V

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	160 ⑥	A	MOSFET symbol showing the integral reverse p-n junction diode.
	Pulsed Source Current (Body Diode) ①	—	—	640		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}$, $I_S = 95\text{A}$, $V_{\text{GS}} = 0\text{V}$ ④
t_{rr}	Reverse Recovery Time	—	63	94	ns	$T_J = 25^\circ\text{C}$, $I_F = 95\text{A}$ $di/dt = 100\text{A}/\mu\text{s}$ ④
Q_{rr}	Reverse Recovery Charge	—	170	250	nC	
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- ② Starting $T_J = 25^\circ\text{C}$, $L = 0.35\text{mH}$, $R_G = 25\Omega$, $I_{\text{AS}} = 95\text{A}$. (See Figure 12)
- ③ $I_{\text{SD}} \leq 95\text{A}$, $di/dt \leq 160\text{A}/\mu\text{s}$, $V_{\text{DD}} \leq V_{(\text{BR})\text{DSS}}$, $T_J \leq 175^\circ\text{C}$
- ④ Pulse width $\leq 300\mu\text{s}$; duty cycle $\leq 2\%$.
- ⑤ $C_{\text{oss eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

⑥ Calculated continuous current based on maximum allowable junction temperature; for recommended current-handling of the package refer to Design Tip # 93-4.

⑦ 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.

Qualification Information[†]

		Automotive (per AEC-Q101) ^{††}
Qualification Level		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	3L-D2 PAK	MSL1
	3L-TO-262	N/A
ESD	Machine Model	Class M4(+/- 800V) ^{†††} (per AEC-Q101-002)
	Human Body Model	Class H2(+/- 4000V) ^{†††} (per AEC-Q101-001)
	Charged Device Model	Class C5(+/- 2000V) ^{†††} (per AEC-Q101-005)
RoHS Compliant		Yes

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

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

^{†††} Highest passing voltage

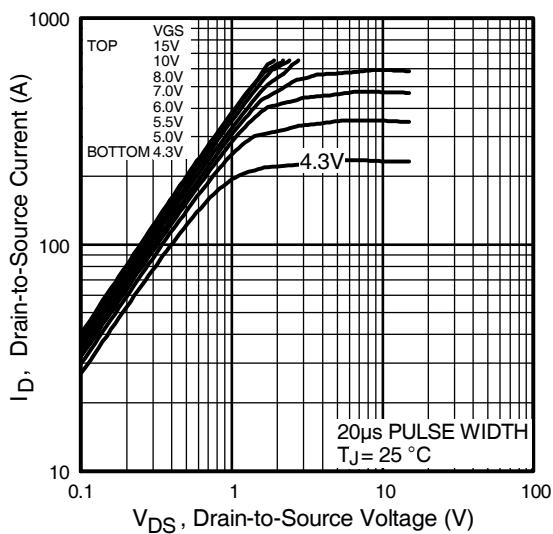


Fig 1. Typical Output Characteristics

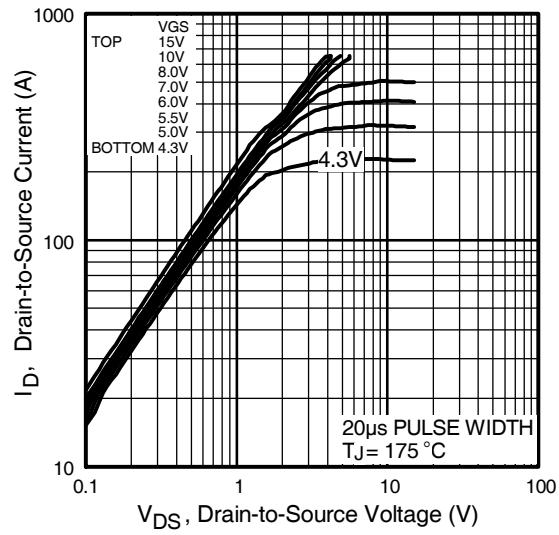


Fig 2. Typical Output Characteristics

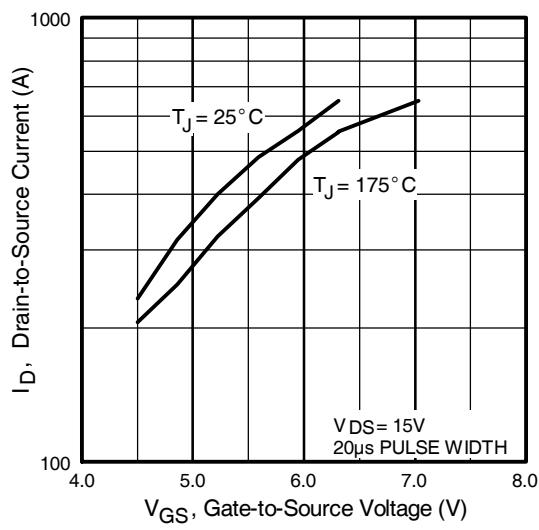


Fig 3. Typical Transfer Characteristics

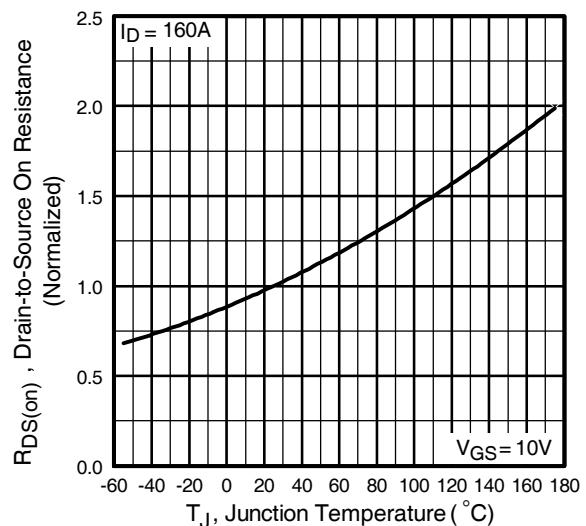


Fig 4. Normalized On-Resistance
Vs. Temperature

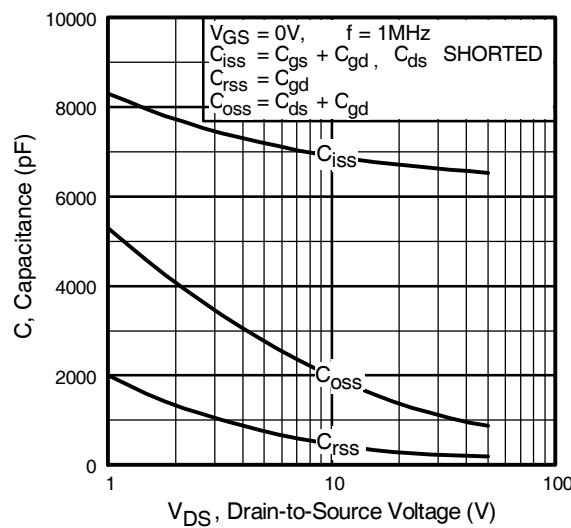


Fig 5. Typical Capacitance Vs.
Drain-to-Source Voltage

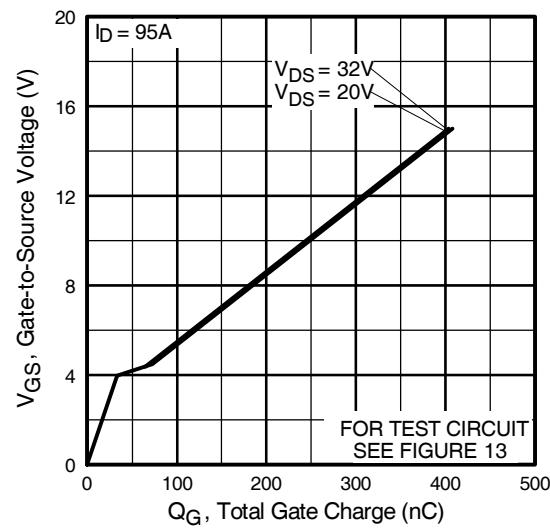


Fig 6. Typical Gate Charge Vs.
Gate-to-Source Voltage

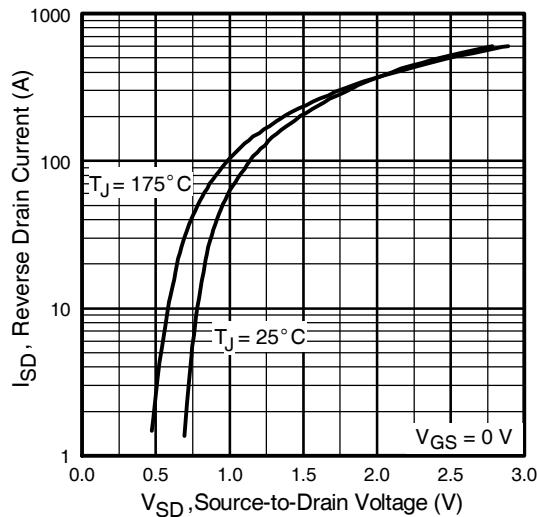


Fig 7. Typical Source-Drain Diode
Forward Voltage

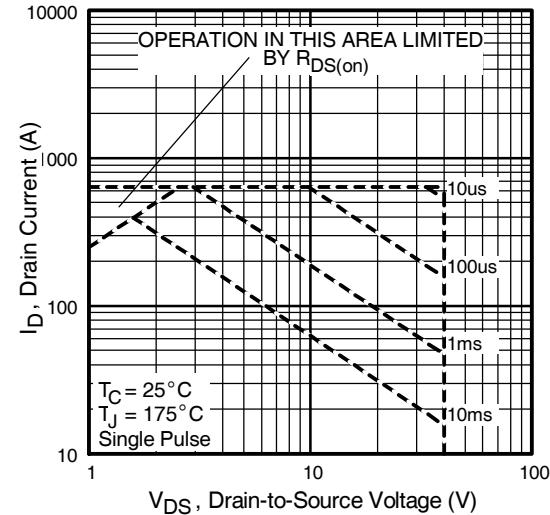


Fig 8. Maximum Safe Operating Area

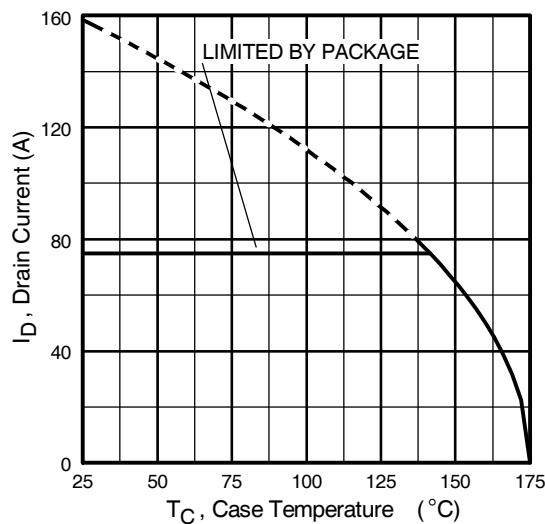


Fig 9. Maximum Drain Current Vs. Case Temperature

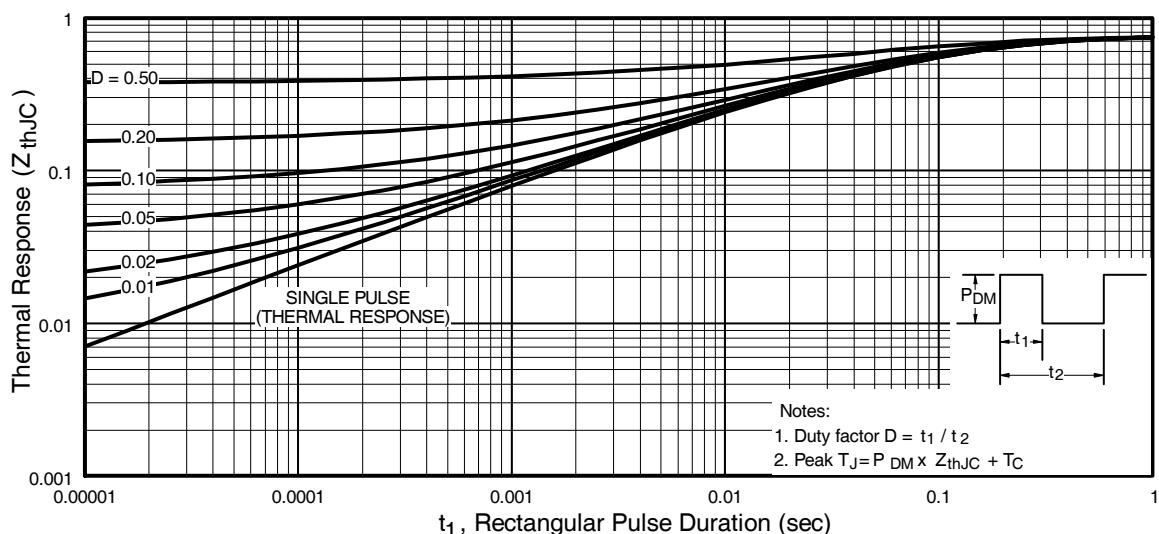
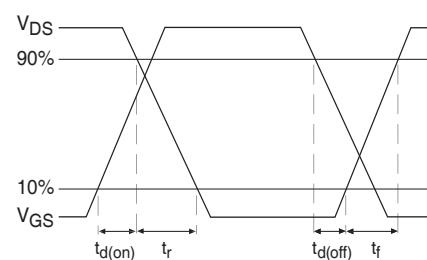
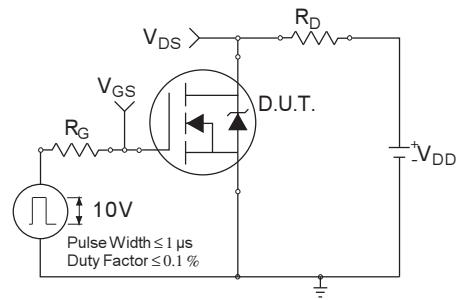


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

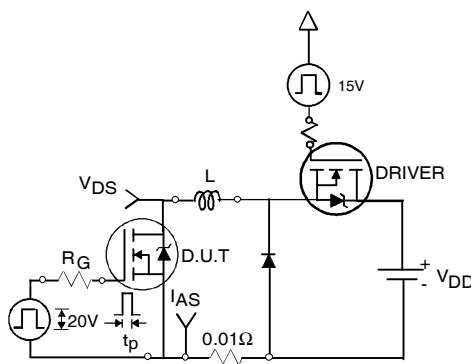


Fig 12a. Unclamped Inductive Test Circuit

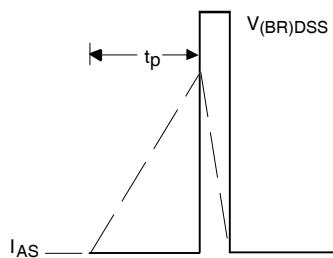


Fig 12b. Unclamped Inductive Waveforms

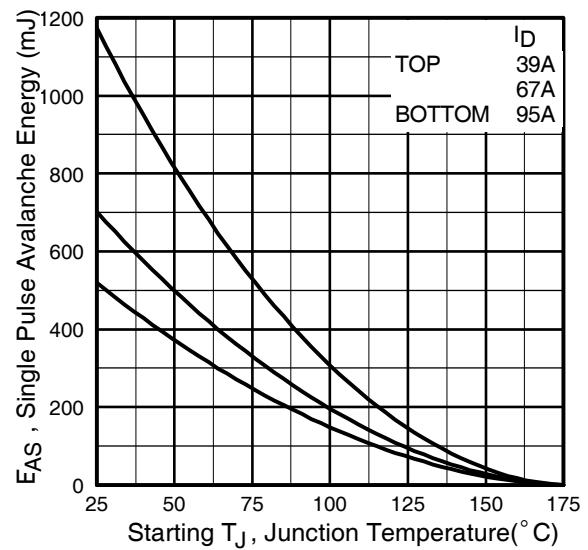


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

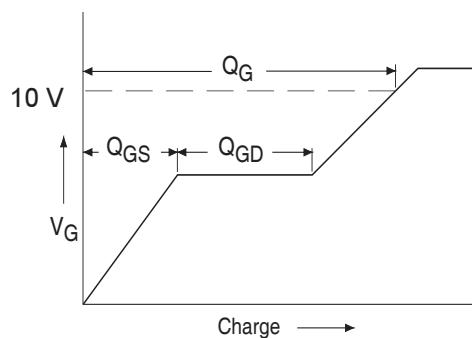


Fig 13a. Basic Gate Charge Waveform

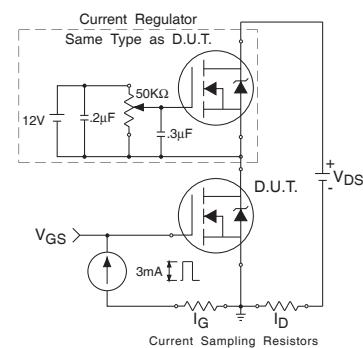
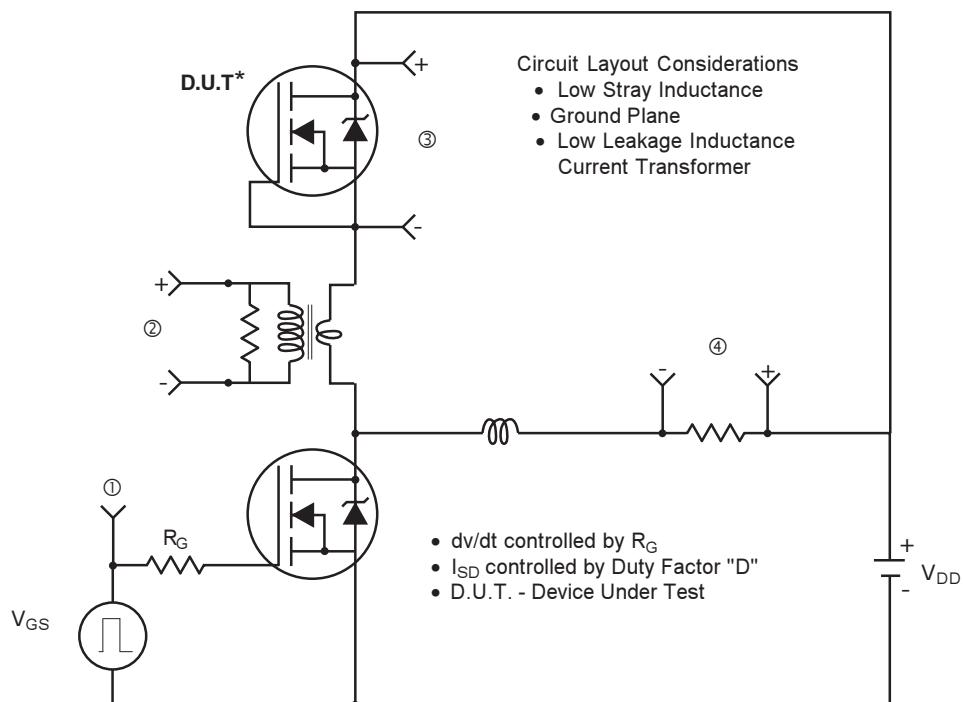
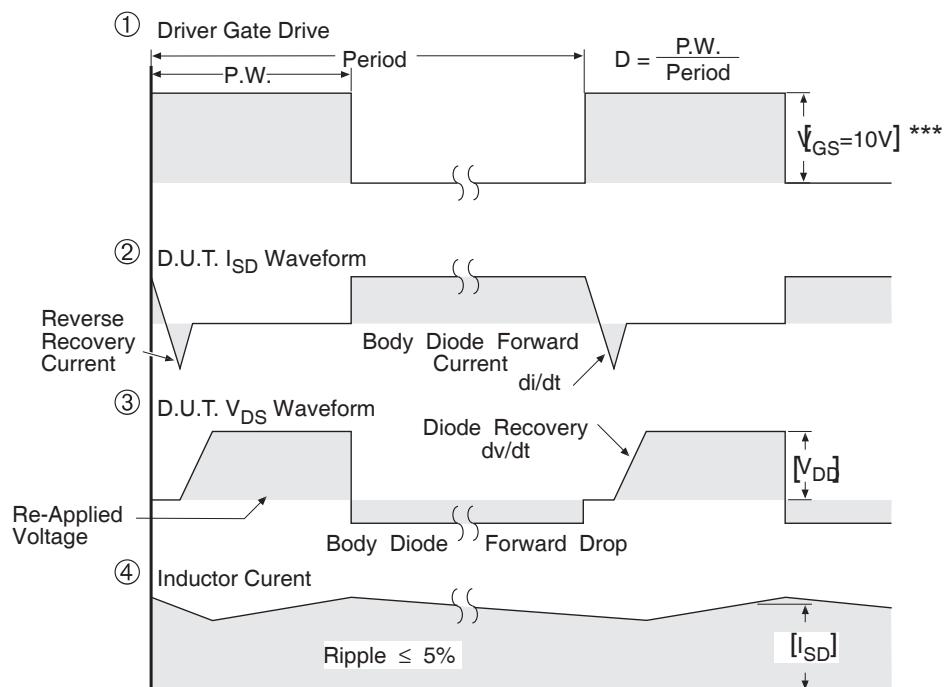


Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit

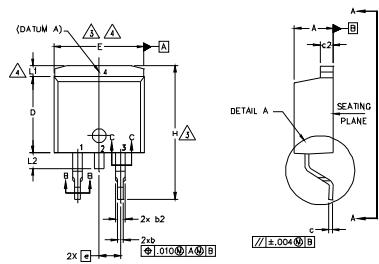
* Reverse Polarity of D.U.T for P-Channel



*** $V_{GS} = 5.0V$ for Logic Level and 3V Drive Devices

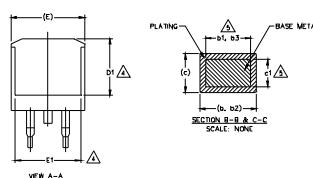
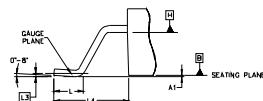
Fig 14. For N-channel HEXFET® power MOSFETs

D²Pak 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 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	
	MM	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
b2	1.14	1.78	.045	.070
b3	1.14	1.73	.045	.068
c	0.38	0.74	.015	.029
c1	0.38	0.58	.015	.023
c2	1.14	1.65	.045	.065
D	8.38	9.65	.330	.380
D1	6.86	—	.270	—
E	9.65	10.67	.380	.420
E1	6.22	—	.245	—
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

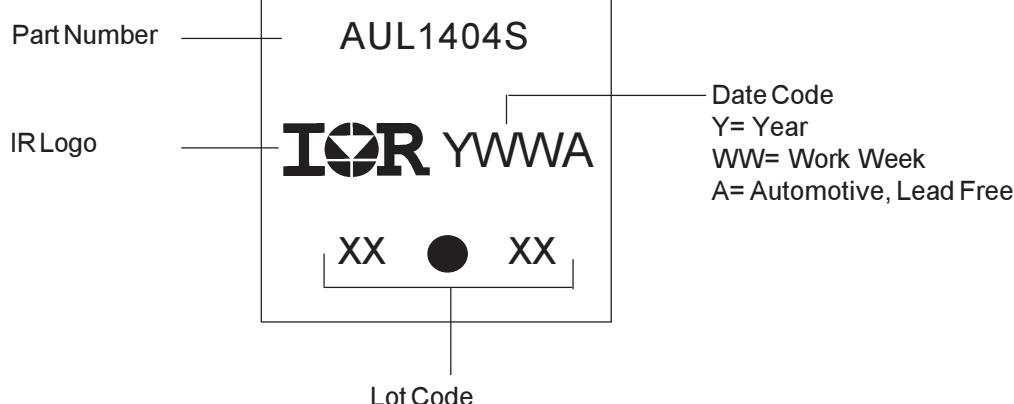
1. GATE
- 2, 4. COLLECTOR
3. Emitter

DIODES

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

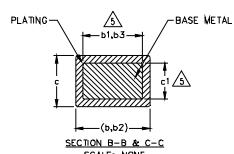
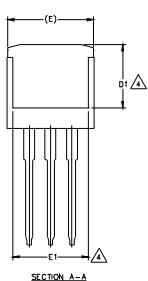
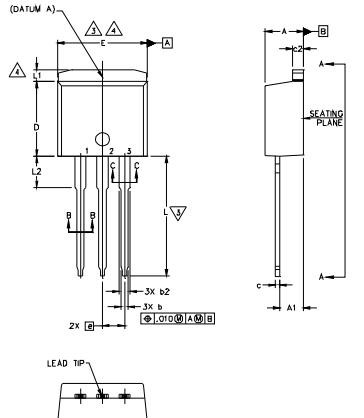
* PART DEPENDENT.

D²Pak Part Marking Information



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

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.

S Y M B O L	DIMENSIONS				N O T E S	
	MILLIMETERS		INCHES			
	MIN.	MAX.	MIN.	MAX.		
A	4.06	4.83	.160	.190		
A1	2.03	3.02	.080	.119		
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		
L	13.46	14.10	.530	.555		
L1	—	1.65	—	.065	4	
L2	3.56	3.71	.140	.146		

LEAD ASSIGNMENTS

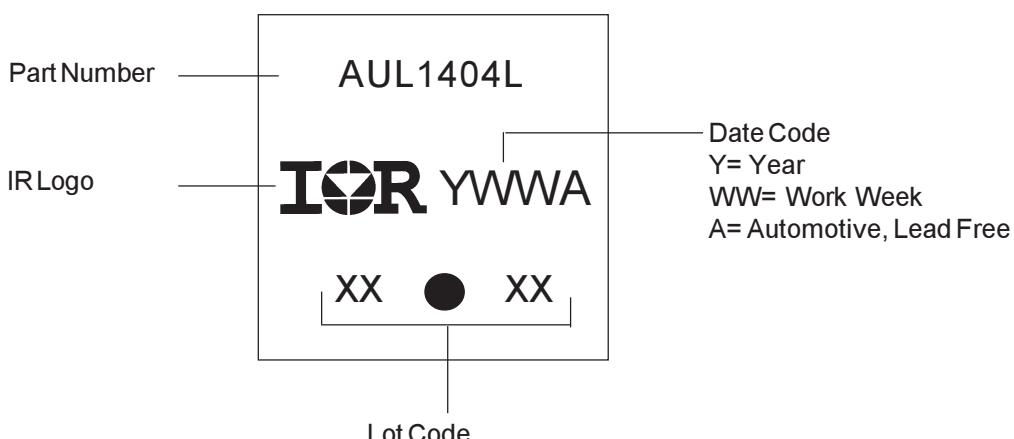
HEXFET

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

IGBTs, CoPACK

1. GATE
2. COLLECTOR
3. Emitter
4. COLLECTOR

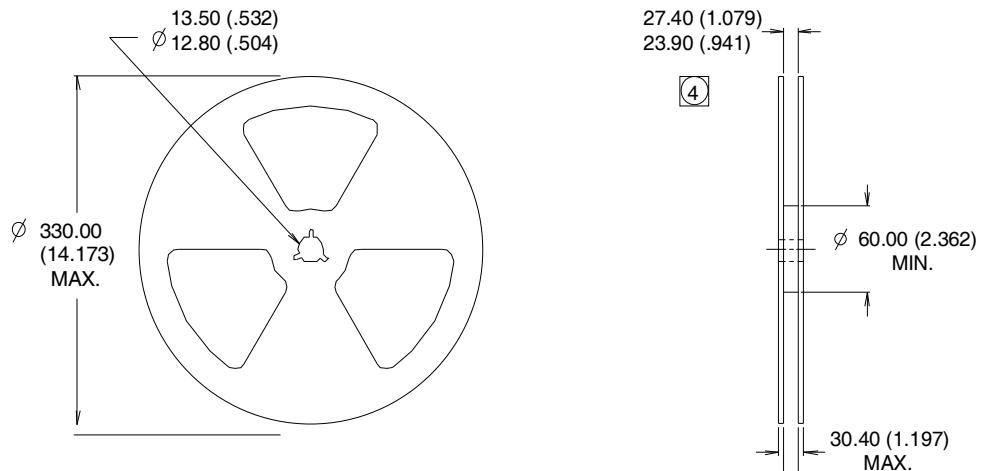
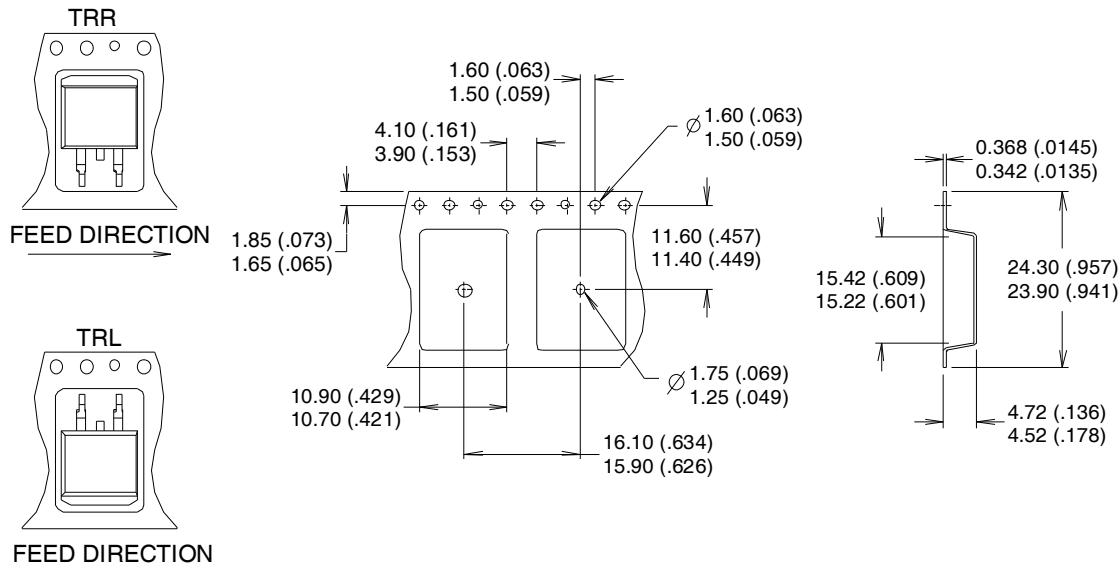
TO-262 Part Marking Information



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

D²Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



NOTES :

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

Ordering Information

Base part	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRL1404L	TO-262	Tube	50	AUIRL1404L
AUIRL1404S	D2Pak	Tube	50	AUIRL1404S
		Tape and Reel Left	800	AUIRL1404STRL
		Tape and Reel Right	800	AUIRL1404STRR

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IR warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with IR's standard warranty. Testing and other quality control techniques are used to the extent IR deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

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