

# AUIRLR3705Z

HEXFET® Power MOSFET

### **Features**

- Advanced Process Technology
- Logic-Level
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching

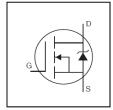
Description

Repetitive Avalanche Allowed up to Timax

Specifically designed for Automotive applications, this HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature,

fast switching speed and improved repetitive avalanche rating. These features combine to make this design an extremely efficient and reliable device for use in Automotive applications and a wide

- Lead-Free, RoHS Compliant
- Automotive Qualified \*



V <sub>DSS</sub>	55V
R <sub>DS(on)</sub> max.	8.0mΩ
D (Silicon Limited)	89A
D (Package Limited)	42A



G	D	S
Gate	Drain	Source

	G	l D	S
	Gate	Drain	Source
			-
ac	k	0	4.51

Boss nort number	Dookogo Typo	Standard Pack		Orderable Part Number
Base part number	Package Type	Form	Quantity	Orderable Part Number
ALUDI DOZOEZ	D. Dok	Tube	75	AUIRLR3705Z
AUIRLR3705Z	D-Pak	Tape and Reel Left	3000	AUIRLR3705ZTRL

## **Absolute Maximum Ratings**

variety of other applications.

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 (TA) is 25°C, unless otherwise specified.

Symbol	Parameter	Max.	Units		
I <sub>D</sub> @ T <sub>C</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V (Silicon Limited)	89			
I <sub>D</sub> @ T <sub>C</sub> = 100°C	Continuous Drain Current, V <sub>GS</sub> @ 10V (Silicon Limited)	63	A		
I <sub>D</sub> @ T <sub>C</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V (Package Limited) 42				
I <sub>DM</sub>	Pulsed Drain Current ①	360			
P <sub>D</sub> @T <sub>C</sub> = 25°C	Maximum Power Dissipation	130	W		
	Linear Derating Factor	0.88	W/°C		
$V_{GS}$	Gate-to-Source Voltage	± 16	V		
E <sub>AS</sub>	Single Pulse Avalanche Energy (Thermally Limited) ②	110			
E <sub>AS</sub> (Tested)	Single Pulse Avalanche Energy Tested Value ®	190	- mJ		
I <sub>AR</sub>	Avalanche Current ①	See Fig.15,16, 12a, 12b	Α		
E <sub>AR</sub>	Repetitive Avalanche Energy ©		mJ		
TJ	Operating Junction and	-55 to + 175			
T <sub>STG</sub>	Storage Temperature Range		°C		
	Soldering Temperature, for 10 seconds (1.6mm from case)	300			

### Thermal Resistance

Symbol	Parameter	Тур.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ®		1.14	
$R_{\theta JA}$	Junction-to-Ambient ( PCB Mount) ⑦		50	°C/W
$R_{\theta JA}$	Junction-to-Ambient		110	

HEXFET® is a registered trademark of Infineon.

<sup>\*</sup>Qualification standards can be found at www.infineon.com



## Static @ T<sub>J</sub> = 25°C (unless otherwise specified)

	Parameter	Min.	Тур.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	55			V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient		0.053		V/°C	Reference to 25°C, I <sub>D</sub> = 1mA
			6.5	8.0		V <sub>GS</sub> = 10V, I <sub>D</sub> = 42A ③
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance			11	mΩ	V <sub>GS</sub> = 5.0V, I <sub>D</sub> = 34A ③
, ,				12		V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 21A ③
$V_{GS(th)}$	Gate Threshold Voltage	1.0		3.0	V	$V_{DS} = V_{GS}, I_{D} = 250 \mu A$
gfs	Forward Trans conductance	89			S	$V_{DS} = 25V, I_D = 42A$
ı	Drain to Source Leakage Current			20	μA	$V_{DS} = 55V, V_{GS} = 0V$
I <sub>DSS</sub>	Drain-to-Source Leakage Current			250		$V_{DS} = 55V, V_{GS} = 0V, T_{J} = 125^{\circ}C$
	Gate-to-Source Forward Leakage			200	^	V <sub>GS</sub> = 16V
I <sub>GSS</sub>	Gate-to-Source Reverse Leakage			-200	nA	V <sub>GS</sub> = -16V

## Dynamic Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

Total Gate Charge		44	66		I <sub>D</sub> = 42A
Gate-to-Source Charge		13		nC	$V_{DS} = 44V$
Gate-to-Drain Charge		22			V <sub>GS</sub> = 5.0V ③
Furn-On Delay Time		17			$V_{DD} = 28V$
Rise Time		150		20	I <sub>D</sub> = 42A
Turn-Off Delay Time		33		115	$R_G = 4.2\Omega$
Fall Time		70			V <sub>GS</sub> = 5.0V3
nternal Drain Inductance		4.5			Between lead, 6mm (0.25in.)
nternal Source Inductance		7.5			from package and center of die contact
nput Capacitance		2900			$V_{GS} = 0V$
Output Capacitance		420			V <sub>DS</sub> = 25V
Reverse Transfer Capacitance		230		nΕ	f = 1.0MHz
Output Capacitance		1550		þΓ	$V_{GS} = 0V$ , $V_{DS} = 1.0V$ $f = 1.0MHz$
Output Capacitance		320			$V_{GS} = 0V$ , $V_{DS} = 44V$ $f = 1.0MHz$
Effective Output Capacitance		500			$V_{GS}$ = 0V, $V_{DS}$ = 0V to 44V $\oplus$
	Gate-to-Source Charge Gate-to-Drain Charge Furn-On Delay Time Rise Time Furn-Off Delay Time Fall Time Internal Drain Inductance Internal Source Inductance Input Capacitance Dutput Capacitance Reverse Transfer Capacitance Dutput Capacitance Dutput Capacitance Dutput Capacitance Dutput Capacitance Dutput Capacitance	Gate-to-Source Charge ————————————————————————————————————	Gate-to-Source Charge       —       13         Gate-to-Drain Charge       —       22         Turn-On Delay Time       —       17         Rise Time       —       150         Turn-Off Delay Time       —       33         Fall Time       —       70         Internal Drain Inductance       —       4.5         Internal Source Inductance       —       7.5         Input Capacitance       —       2900         Output Capacitance       —       420         Reverse Transfer Capacitance       —       230         Output Capacitance       —       1550         Output Capacitance       —       320	Gate-to-Source Charge       —       13       —         Gate-to-Drain Charge       —       22       —         Furn-On Delay Time       —       17       —         Rise Time       —       150       —         Furn-Off Delay Time       —       33       —         Fall Time       —       70       —         Internal Drain Inductance       —       4.5       —         Internal Source Inductance       —       7.5       —         Input Capacitance       —       2900       —         Output Capacitance       —       420       —         Output Capacitance       —       230       —         Output Capacitance       —       1550       —         Output Capacitance       —       320       —	Gate-to-Source Charge       —       13       —       nC         Gate-to-Drain Charge       —       22       —         Turn-On Delay Time       —       17       —         Rise Time       —       150       —         Turn-Off Delay Time       —       33       —         Fall Time       —       70       —         Internal Drain Inductance       —       4.5       —         Internal Source Inductance       —       7.5       —         Input Capacitance       —       2900       —         Output Capacitance       —       420       —         Output Capacitance       —       230       —         Output Capacitance       —       1550       —         Output Capacitance       —       320       —

## **Diode Characteristics**

	Parameter	Min.	Тур.	Max.	Units	Conditions
ı	Continuous Source Current			42		MOSFET symbol
Is	(Body Diode)			42	_	showing the
ı	Pulsed Source Current			360	A	integral reverse
I <sub>SM</sub>	(Body Diode) ①			300		p-n junction diode.
$V_{SD}$	Diode Forward Voltage			1.3	V	$T_J = 25^{\circ}C, I_S = 42A, V_{GS} = 0V$ ③
t <sub>rr</sub>	Reverse Recovery Time		21	42	ns	$T_J = 25^{\circ}C$ , $I_F = 42A$ , $V_{DD} = 28V$
$Q_{rr}$	Reverse Recovery Charge		14	28	nC	di/dt = 100A/µs ③
t <sub>on</sub>	Forward Turn-On Time	Intrinsio	turn-or	time is	negligil	ole (turn-on is dominated by L <sub>S</sub> +L <sub>D</sub> )

## Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- $\odot$  Limited by  $T_{Jmax}$ , starting  $T_J$  = 25°C, L = 0.12mH,  $R_G$  = 25 $\Omega$ ,  $I_{AS}$  = 42A,  $V_{GS}$  =10V. Part not recommended for use above this value.
- 4  $C_{oss}$  eff. is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$
- © Limited by T<sub>Jmax</sub>, see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- © This value determined from sample failure population, starting  $T_J = 25$ °C, L = 0.12mH,  $R_G = 25\Omega$ ,  $I_{AS} = 42A$ ,  $V_{GS} = 10V$ .
- When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994



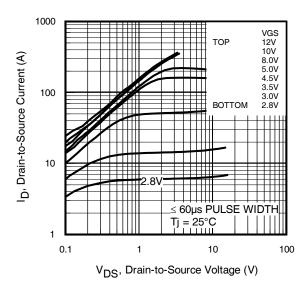


Fig. 1 Typical Output Characteristics

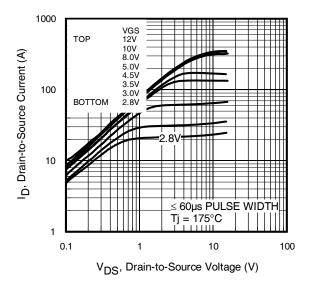


Fig. 2 Typical Output Characteristics

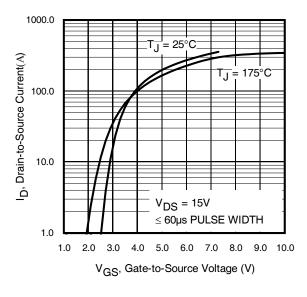
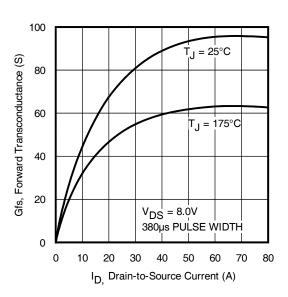
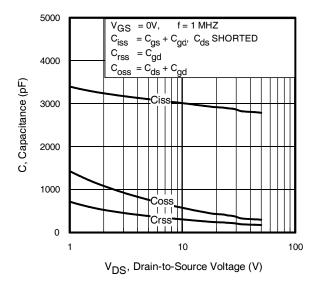


Fig. 3 Typical Transfer Characteristics

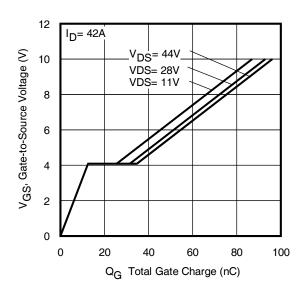


**Fig. 4** Typical Forward Trans conductance Vs. Drain Current





**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage



**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage

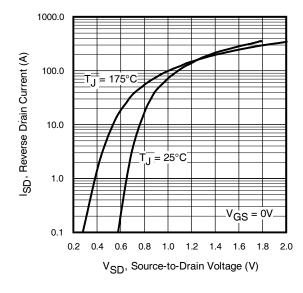


Fig. 7 Typical Source-to-Drain Diode Forward Voltage

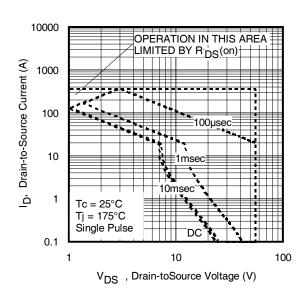
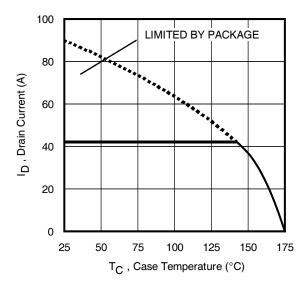
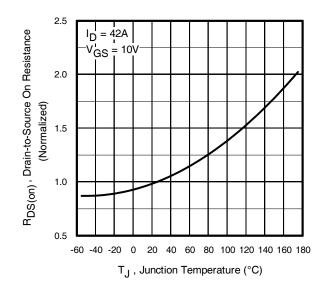


Fig 8. Maximum Safe Operating Area







**Fig 9.** Maximum Drain Current Vs. Case Temperature

**Fig 10.** Normalized On-Resistance Vs. Temperature

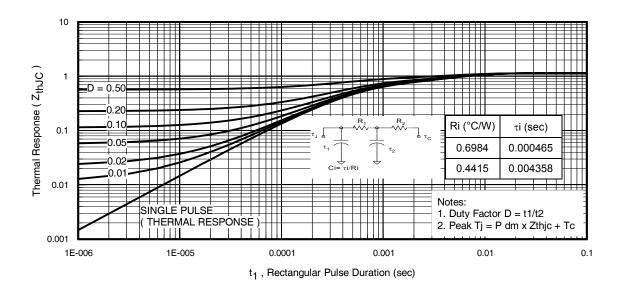


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case



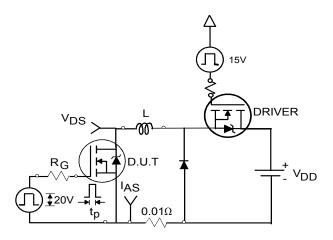


Fig 12a. Unclamped Inductive Test Circuit

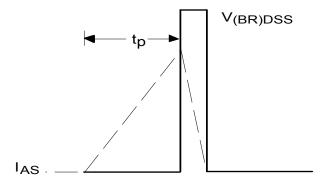


Fig 12b. Unclamped Inductive Waveforms

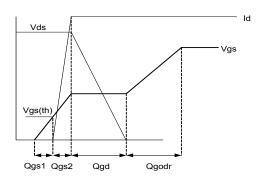


Fig 13a. Gate Charge Waveform

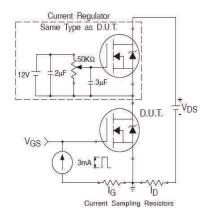
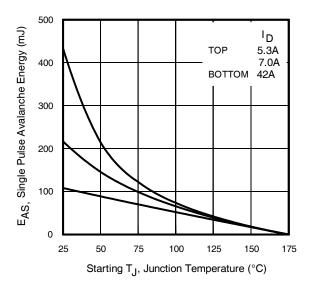


Fig 13b. Gate Charge Test Circuit



**Fig 12c.** Maximum Avalanche Energy vs. Drain Current

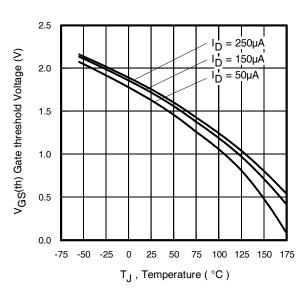


Fig 14. Threshold Voltage Vs. Temperature



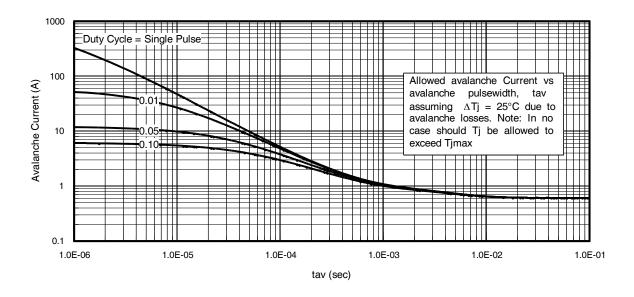
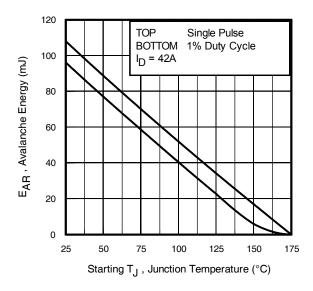


Fig 15. Typical Avalanche Current Vs. Pulse width



**Fig 16.** Maximum Avalanche Energy Vs. Temperature

### Notes on Repetitive Avalanche Curves , Figures 15, 16:

## (For further info, see AN-1005 at www.infineon.com)

- Avalanche failures assumption:
   Purely a thermal phenomenon and failure occurs at a temperature far in excess of T<sub>imax</sub>. This is validated for every part type.
- 2. Safe operation in Avalanche is allowed as long as  $T_{jmax}$  is not exceeded.
- 3. Equation below based on circuit and waveforms shown in Figures 12a, 12b.
- 4. PD (ave) = Average power dissipation per single avalanche pulse.
- 5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
- 6. lav = Allowable avalanche current.
- 7.  $\Delta T$  = Allowable rise in junction temperature, not to exceed  $T_{jmax}$  (assumed as 25°C in Figure 15, 16).

tav = Average time in avalanche.

D = Duty cycle in avalanche =  $t_{av} \cdot f$ 

ZthJC(D, tav) = Transient thermal resistance, see Figures 13)

$$\begin{split} P_{D \; (ave)} &= 1/2 \; (\; 1.3 \cdot BV \cdot I_{av}) = \Delta T / \; Z_{thJC} \\ I_{av} &= 2\Delta T / \; [1.3 \cdot BV \cdot Z_{th}] \\ E_{AS \; (AR)} &= P_{D \; (ave)} \cdot t_{av} \end{split}$$



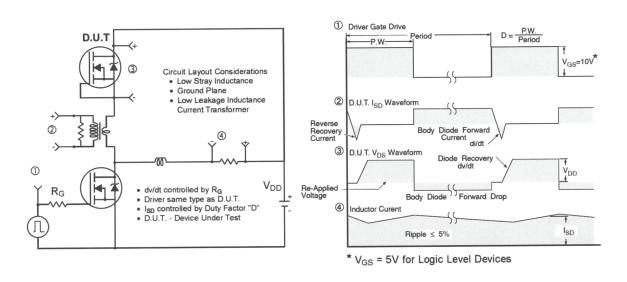


Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

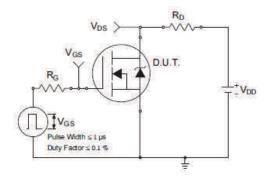


Fig 18a. Switching Time Test Circuit

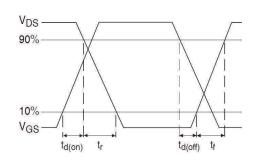
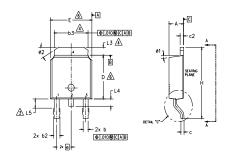


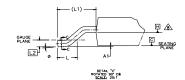
Fig 18b. Switching Time Waveforms

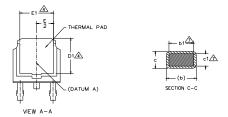


## D-Pak (TO-252AA) Package Outline (Dimensions are shown in millimeters (inches))









#### NOTES:

- 1.- DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
- 2.- DIMENSION ARE SHOWN IN INCHES [MILLIMETERS].
- 3- LEAD DIMENSION UNCONTROLLED IN L5.
- A- DIMENSION D1, E1, L3 & b3 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
- 5.— SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.
- bildension D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005 [0.13] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
- A- DIMENSION 61 & c1 APPLIED TO BASE METAL ONLY.
- ♠ DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
- 9.- OUTLINE CONFORMS TO JEDEC OUTLINE TO-252AA.

Name
B
A 2.18 2.39 .086 .094 A1 - 0.13005 b 0.64 0.89 .025 .035 b1 0.65 0.79 .025 .031 7 b2 0.76 1.14 .030 .045 b3 4.95 5.46 .195 .215 4 c 0.46 0.61 .018 .024 c1 0.41 0.56 .016 .022 7 c2 0.46 0.89 .018 .035 D 5.97 6.22 .235 .245 6
A1         -         0.13         -         .005           b         0.64         0.89         .025         .035           b1         0.65         0.79         .025         .031         7           b2         0.76         1.14         .030         .045           b3         4.95         5.46         .195         .215         4           c         0.46         0.61         .018         .024           c1         0.41         0.56         .016         .022         7           c2         0.46         0.89         .018         .035           D         5.97         6.22         .235         .245         6
b 0.64 0.89 .025 .035 b1 0.65 0.79 .025 .031 7 b2 0.76 1.14 .030 .045 b3 4.95 5.46 .195 .215 4 c 0.46 0.61 .018 .024 c1 0.41 0.56 .016 .022 7 c2 0.46 0.89 .018 .035 D 5.97 6.22 .235 .245 6
b1         0.65         0.79         .025         .031         7           b2         0.76         1.14         .030         .045           b3         4.95         5.46         .195         .215         4           c         0.46         0.61         .018         .024         .024         .016         .022         7           c2         0.46         0.89         .018         .035         .035         .056         .056         .022         .235         .245         6
b2 0.76 1.14 .030 .045 b3 4.95 5.46 .195 .215 4 c 0.46 0.61 .018 .024 c1 0.41 0.56 .016 .022 7 c2 0.46 0.89 .018 .035 D 5.97 6.22 .235 .245 6
b3     4.95     5.46     .195     .215     4       c     0.46     0.61     .018     .024       c1     0.41     0.56     .016     .022     7       c2     0.46     0.89     .018     .035       D     5.97     6.22     .235     .245     6
c     0.46     0.61     .018     .024       c1     0.41     0.56     .016     .022     7       c2     0.46     0.89     .018     .035       D     5.97     6.22     .235     .245     6
c1     0.41     0.56     .016     .022     7       c2     0.46     0.89     .018     .035       D     5.97     6.22     .235     .245     6
c2     0.46     0.89     .018     .035       D     5.97     6.22     .235     .245     6
D 5.97 6.22 .235 .245 6
- ·   - · ·         - · -
D1 5.21 - 205 - 4
E 6.35 6.73 .250 .265 6
E1 4.32170 - 4
e 2.29 BSC .090 BSC
H 9.40 10.41 .370 .410
L 1.40 1.78 .055 .070
L1 2.74 BSC .108 REF.
L2 0.51 BSC .020 BSC
L3 0.89 1.27 .035 .050 4
L4 - 1.02040
L5   1.14   1.52   .045   .060   3
\( \text{\alpha} \)   0 \( \text{\alpha} \)   10 \( \text{\alpha} \)   0 \( \text{\alpha} \)   10 \( \text{\alpha} \)
ø1 0° 15° 0° 15°
ø2 25° 35° 25° 35°

#### LEAD ASSIGNMENTS

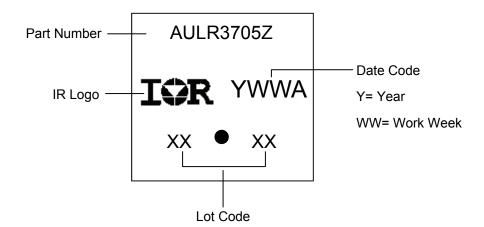
#### **HEXFET**

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

#### IGBT & CoPAK

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

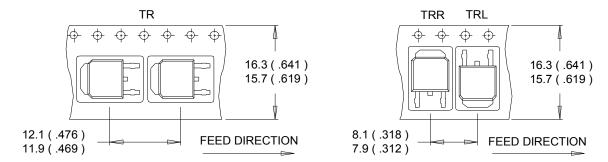
## D-Pak (TO-252AA) Part Marking Information



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

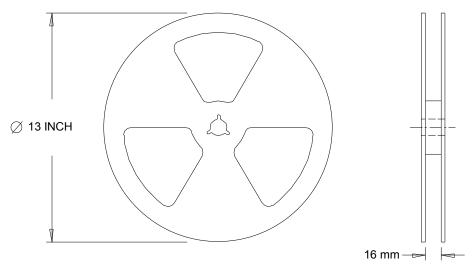


## D-Pak (TO-252AA) Tape & Reel Information (Dimensions are shown in millimeters (inches))



### NOTES:

- 1. CONTROLLING DIMENSION: MILLIMETER.
- 2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
- 3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



## NOTES:

1. OUTLINE CONFORMS TO EIA-481.

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



### **Qualification Information**

	ion imormation						
		Automotive					
		(per AEC-Q101)					
Qualificat	ion Level	Comments: This part number(s) passed Automotive qualification. Infine Industrial and Consumer qualification level is granted by extension of the his Automotive level.					
Moisture	Sensitivity Level	D-Pak MSL1					
	Machine Madel	Class M4 (+/- 425V) <sup>†</sup>					
	Machine Model	AEC-Q101-002					
FOD	Lluman Dady Madal		Class H1C (+/-2000V) <sup>†</sup>				
ESD	Human Body Model		AEC-Q101-001				
	Charged Davies Madel	Class C5 (+/-1125V) <sup>†</sup>					
	Charged Device Model	AEC-Q101-005					
RoHS Cor	mpliant		Yes				

<sup>†</sup> Highest passing voltage.

## **Revision History**

Date	Comments
	Updated datasheet with corporate template
12/14/2015	Corrected ordering table on page 1.
	<ul> <li>Corrected typo R<sub>θJA</sub> (PCB mount) from "40°C/W" to "50°C/W" on page 1.</li> </ul>

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