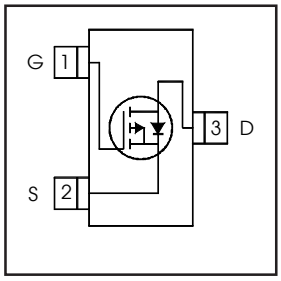
International
IOR Rectifier

IRLML6402PbF

HEXFET® Power MOSFET

- Ultra Low On-Resistance
- P-Channel MOSFET
- SOT-23 Footprint
- Low Profile (<1.1mm)
- Available in Tape and Reel
- Fast Switching
- Lead-Free
- RoHS Compliant, Halogen-Free



V_{DSS} = -20V

$R_{DS(on)}$ = 0.065Ω

Description

These P-Channel MOSFETs from International Rectifier utilize advanced processing techniques to achieve extremely 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 battery and load management.

A thermally enhanced large pad leadframe has been incorporated into the standard SOT-23 package to produce a HEXFET Power MOSFET with the industry's smallest footprint. This package, dubbed the Micro3™, is ideal for applications where printed circuit board space is at a premium. The low profile (<1.1mm) of the Micro3 allows it to fit easily into extremely thin application environments such as portable electronics and PCMCIA cards. The thermal resistance and power dissipation are the best available.

Micro3™

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRLML6402TRPbF	Micro3™ (SOT-23)	Tape and Reel	3000	IRLML6402TRPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain- Source Voltage	-20	V
I_D @ T_A = 25°C	Continuous Drain Current, V_{GS} @ -4.5V	-3.7	A
I_D @ T_A= 70°C	Continuous Drain Current, V_{GS} @ -4.5V	-2.2	
I_{DM}	Pulsed Drain Current ①	-22	
P_D @T_A = 25°C	Power Dissipation	1.3	W
P_D @T_A = 70°C	Power Dissipation	0.8	
	Linear Derating Factor	0.01	W/°C
E_{AS}	Single Pulse Avalanche Energy④	11	mJ
V_{GS}	Gate-to-Source Voltage	± 12	V
T_J, T_{STG}	Junction and Storage Temperature Range	-55 to + 150	°C

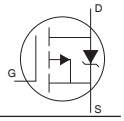
Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient③	75	100	°C/W

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	-20	—	—	V	V_{GS} = 0V, I_D = -250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	-0.009	—	V/°C	Reference to 25°C, I_D = -1mA ②
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	0.050	0.065	Ω	V_{GS} = -4.5V, I_D = -3.7A ②
		—	0.080	0.135		V_{GS} = -2.5V, I_D = -3.1A ②
$V_{GS(th)}$	Gate Threshold Voltage	-0.40	-0.55	-1.2	V	V_{DS} = V_{GS}, I_D = -250µA
g_{fs}	Forward Transconductance	6.0	—	—	S	V_{DS} = -10V, I_D = -3.7A ②
I_{DSS}	Drain-to-Source Leakage Current	—	—	-1.0	µA	V_{DS} = -20V, V_{GS} = 0V
		—	—	-25		V_{DS} = -20V, V_{GS} = 0V, T_J = 70°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	-100	nA	V_{GS} = -12V
	Gate-to-Source Reverse Leakage	—	—	100		V_{GS} = 12V
Q_g	Total Gate Charge	—	8.0	12	nC	I_D = -3.7A
Q_{gs}	Gate-to-Source Charge	—	1.2	1.8		V_{DS} = -10V
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	2.8	4.2		V_{GS} = -5.0V ②
$t_{d(on)}$	Turn-On Delay Time	—	350	—	ns	V_{DD} = -10V
t_r	Rise Time	—	48	—		I_D = -3.7A
$t_{d(off)}$	Turn-Off Delay Time	—	588	—		R_G = 89Ω
t_f	Fall Time	—	381	—		R_D = 2.7Ω
C_{iss}	Input Capacitance	—	633	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	145	—		V_{DS} = -10V
C_{rss}	Reverse Transfer Capacitance	—	110	—		ƒ = 1.0MHz

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	-1.3	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	-22		
V_{SD}	Diode Forward Voltage	—	—	-1.2	V	T_J = 25°C, I_S = -1.0A, V_{GS} = 0V ②
t_{rr}	Reverse Recovery Time	—	29	43	ns	T_J = 25°C, I_F = -1.0A
Q_{rr}	Reverse RecoveryCharge	—	11	17	nC	di/dt = -100A/µs ②

Notes:

① Repetitive rating; pulse width limited by max. junction temperature.

② Pulse width ≤ 400µs; duty cycle ≤ 2%.

③ Surface mounted on 1" square single layer 1oz. copper FR4 board, steady state.

④ Starting T_J = 25°C, L = 1.65mH R_G = 25Ω, I_{AS} = -3.7A.

** For recommended footprint and soldering techniques refer to application note #AN-994.

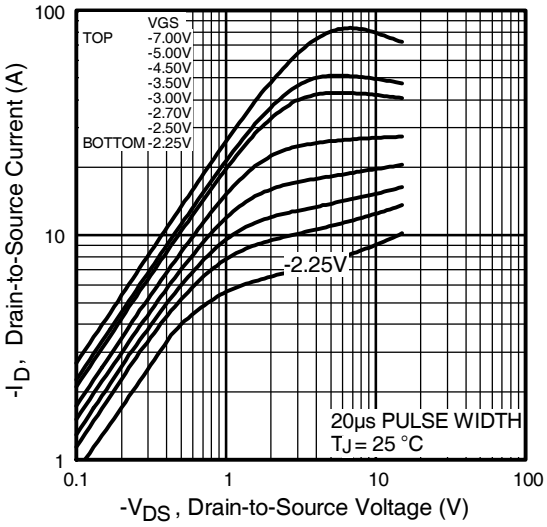


Fig 1. Typical Output Characteristics

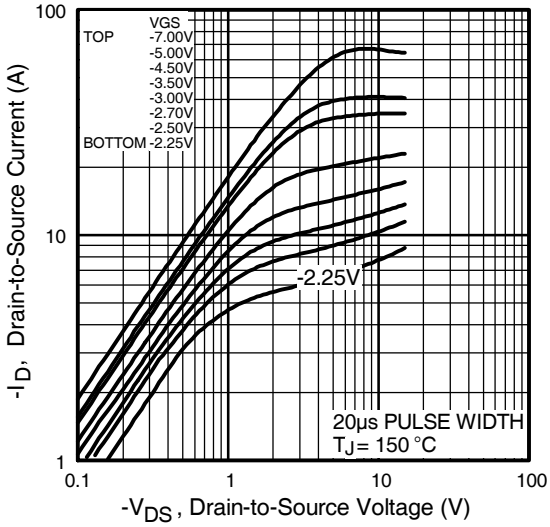


Fig 2. Typical Output Characteristics

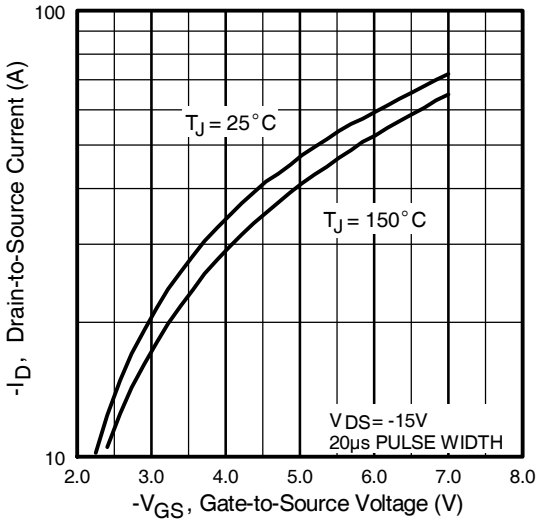


Fig 3. Typical Transfer Characteristics

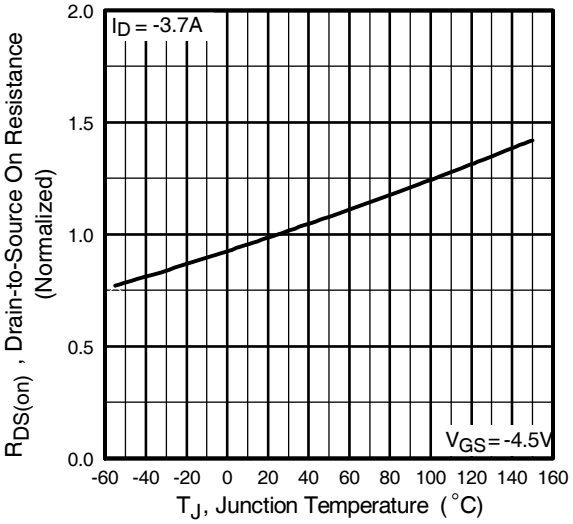


Fig 4. Normalized On-Resistance Vs. Temperature

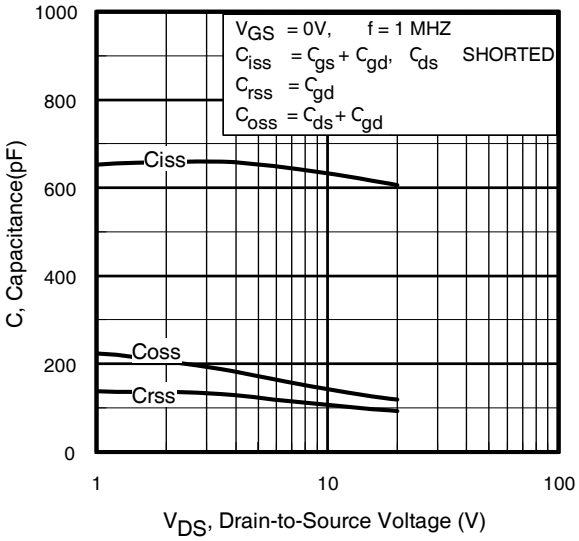


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

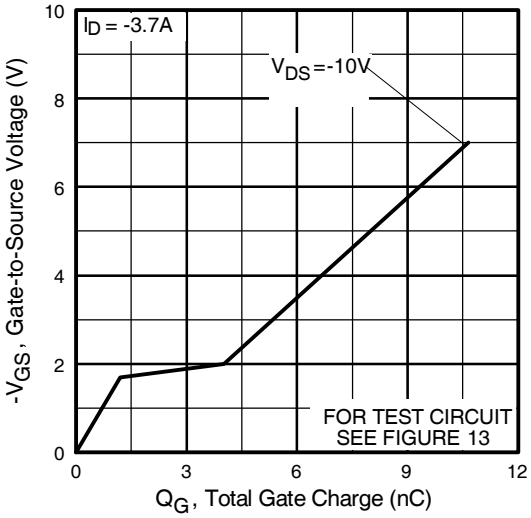


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

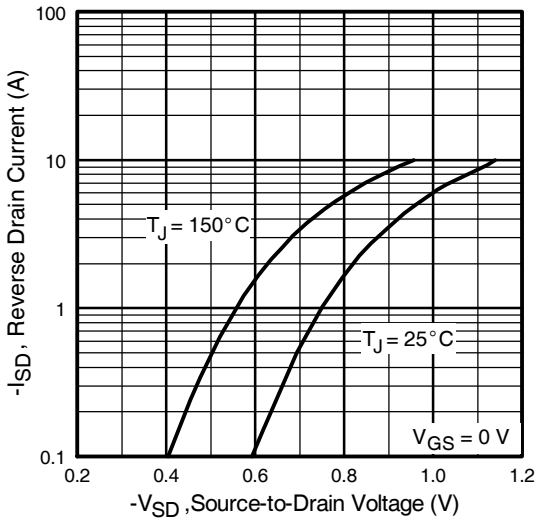


Fig 7. Typical Source-Drain Diode Forward Voltage

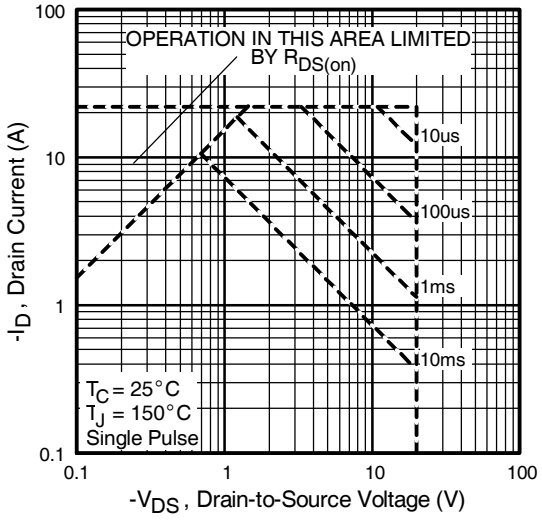


Fig 8. Maximum Safe Operating Area

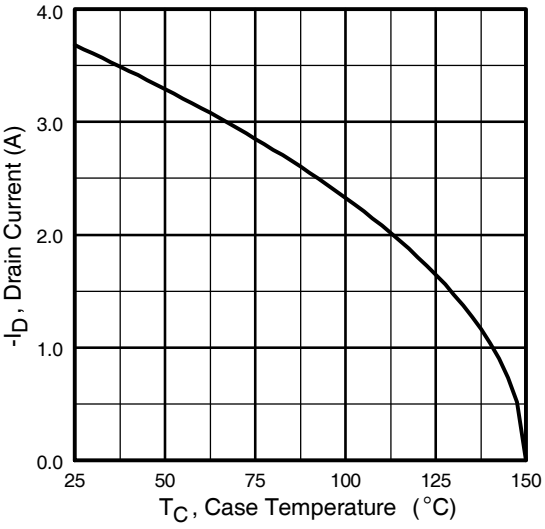


Fig 9. Maximum Drain Current Vs. Case Temperature

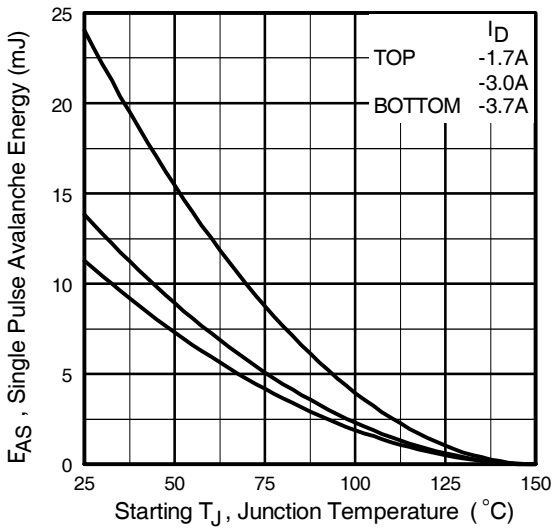


Fig 10. Maximum Avalanche Energy Vs. Drain Current

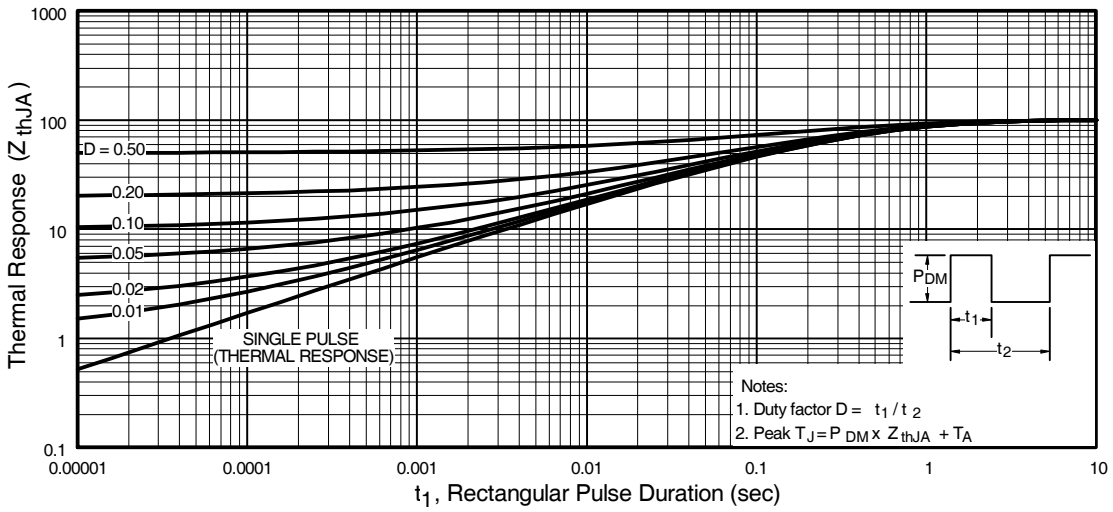


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

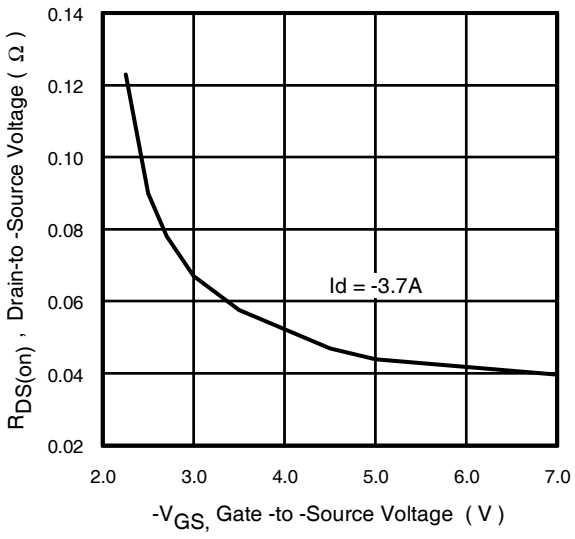


Fig 12. Typical On-Resistance Vs. Gate Voltage

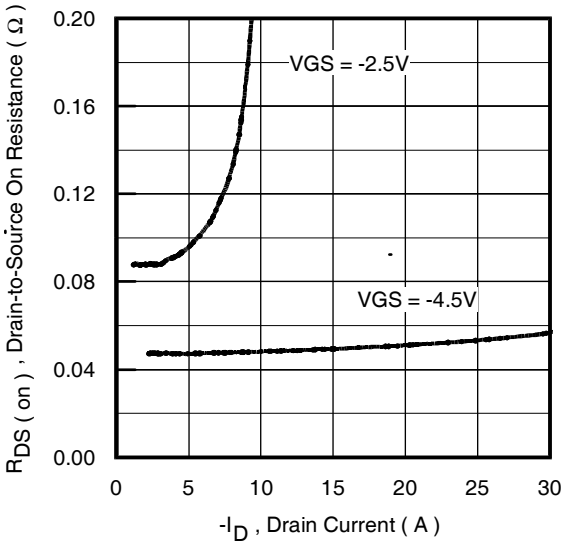
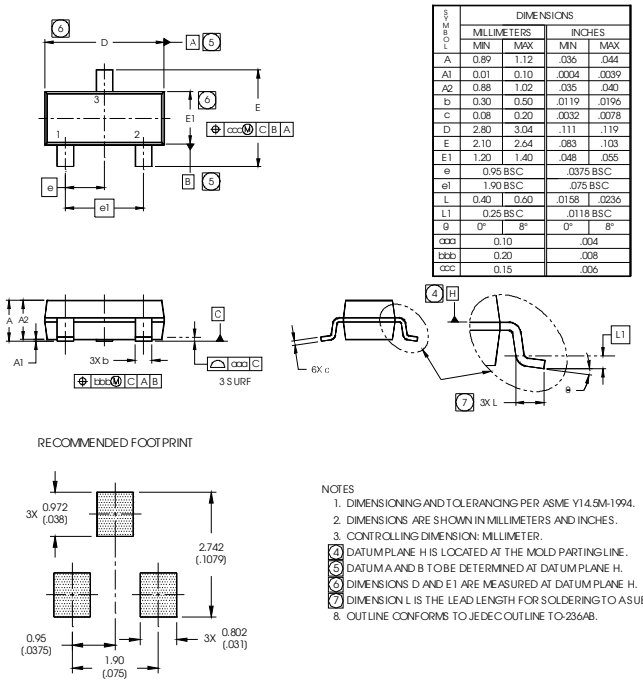


Fig 13. Typical On-Resistance Vs. Drain Current

Micro3 (SOT-23) (Lead-Free) Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.89	1.12	.036	.044
A1	0.01	0.10	.0004	.0039
A2	0.88	1.02	.035	.040
b	0.30	0.50	.0119	.0196
c	0.08	0.20	.0032	.0078
D	2.80	3.04	.111	.119
E	2.10	2.64	.083	.103
E1	1.20	1.40	.048	.055
e	0.95 BSC		.0375 BSC	
e1	1.90 BSC		.075 BSC	
L	0.40	0.60	.0158	.0236
L1	0.25 BSC		.0118 BSC	
θ	0°	8°	0°	8°
aaa	0.10		.004	
bbb	0.20		.008	
ccc	0.15		.006	

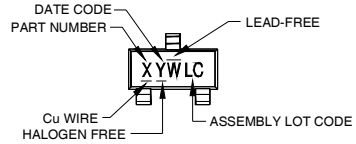
RECOMMENDED FOOT PRINT

NOTES

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
2. DIMENSIONS ARE SHOWN IN MILLIMETERS AND INCHES.
3. CONTROLLING DIMENSION: MILLIMETER.
4. DATUM PLANE H IS LOCATED AT THE MOLD PARTING LINE.
5. DATUM A AND B TO BE DETERMINED AT DATUM PLANE H.
6. DIMENSIONS D AND E1 ARE MEASURED AT DATUM PLANE H.
7. DIMENSION L IS THE LEAD LENGTH FOR SOLDERING TO A SUBSTRATE.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-236AB.

Micro3 (SOT-23 / TO-236AB) Part Marking Information

Notes: This part marking information applies to devices produced after 02/26/2001



X = PART NUMBER CODE REFERENCE:

A = IRLML2402	S = IRLML6244
B = IRLML2803	T = IRLML6246
C = IRLML6302	U = IRLML6344
D = IRLML5103	V = IRLML6346
E = IRLML6402	W = IRFML8244
F = IRLML6401	X = IRLML2244
G = IRLML2502	Y = IRLML2246
H = IRLML5203	Z = IRFML9244
I = IRLML0030	
J = IRLML2030	
K = IRLML0100	
L = IRLML0060	
M = IRLML0040	
N = IRLML2060	
P = IRLML9301	
R = IRLML9303	

DATE CODE EXAMPLE:
YWW = 432 = DF
YWW = 503 = 5C

W = (1-26) IF PRECEDED BY LAST DIGIT OF CALENDAR YEAR

YEAR	Y	WORK WEEK	W
2011 2001	1	01	A
2012 2002	2	02	B
2013 2003	3	03	C
2014 2004	4	04	D
2015 2005	5	↓	↓
2016 2006	6		
2017 2007	7		
2018 2008	8		
2019 2009	9		
2020 2010	0	24	X
		25	Y
		26	Z

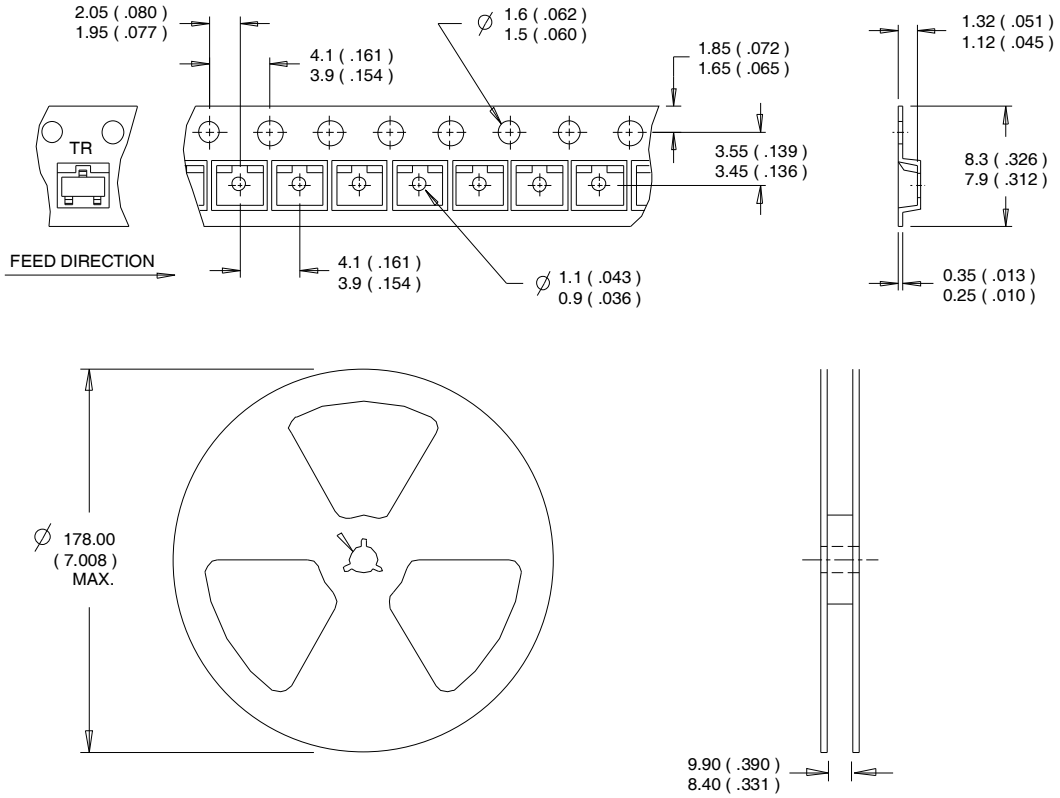
W = (27-52) IF PRECEDED BY A LETTER

YEAR	Y	WORK WEEK	W
2011 2001	A	27	A
2012 2002	B	28	B
2013 2003	C	29	C
2014 2004	D	30	D
2015 2005	E	↓	↓
2016 2006	F		
2017 2007	G		
2018 2008	H		
2019 2009	J		
2020 2010	K	50	X
		51	Y
		52	Z

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

Micro3™(SOT-23/TO-263AB) Tape & Reel Information

Dimensions are shown in millimeters (inches)



NOTES:
1. CONTROLLING DIMENSION : MILLIMETER.
2. OUTLINE CONFORMS TO EIA-481 & EIA-541.

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

Qualification information†

Qualification level	Consumer (per JEDEC JESD47F†† guidelines)	
Moisture Sensitivity Level	Micro3™ (SOT-23)	MSL1 (per JEDEC J-STD-020D††)
RoHS compliant	Yes	

† Qualification standards can be found at International Rectifier's web site: http://www.irf.com/product-info/reliability
†† Applicable version of JEDEC standard at the time of product release

Revision History

Date	Comment
4/28/2014	• Updated data sheet with new IR corporate template. • Updated package outline & part marking on page 7. • Added Qualification table -Qual level "Consumer" on page 9. • Added bullet point in the Benefits "RoHS Compliant, Halogen -Free" on page 1.

International
IOR Rectifier

IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA
To contact International Rectifier, please visit http://www.irf.com/whoto-call/

IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie") .

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.