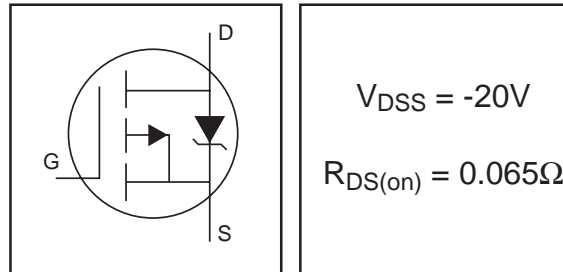


# IRLML6402

HEXFET® Power MOSFET

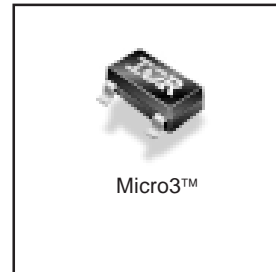
- Ultra Low On-Resistance
- P-Channel MOSFET
- SOT-23 Footprint
- Low Profile (<1.1mm)
- Available in Tape and Reel
- Fast Switching



## 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.



## Absolute Maximum Ratings

	Parameter	Max.	Units
V <sub>DS</sub>	Drain- Source Voltage	-20	V
I <sub>D</sub> @ T <sub>A</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ -4.5V	-3.7	A
I <sub>D</sub> @ T <sub>A</sub> = 70°C	Continuous Drain Current, V <sub>GS</sub> @ -4.5V	-2.2	
I <sub>DM</sub>	Pulsed Drain Current ①	-22	
P <sub>D</sub> @ T <sub>A</sub> = 25°C	Power Dissipation	1.3	W
P <sub>D</sub> @ T <sub>A</sub> = 70°C	Power Dissipation	0.8	
	Linear Derating Factor	0.01	W/°C
E <sub>AS</sub>	Single Pulse Avalanche Energy④	11	mJ
V <sub>GS</sub>	Gate-to-Source Voltage	± 12	V
T <sub>J</sub> , T <sub>STG</sub>	Junction and Storage Temperature Range	-55 to + 150	°C

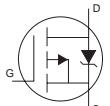
## Thermal Resistance

	Parameter	Typ.	Max.	Units
R <sub>θJA</sub>	Maximum Junction-to-Ambient③	75	100	°C/W

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	-20	—	—	V	$V_{GS} = 0V, I_D = -250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	-0.009	—	V/°C	Reference to $25^\circ\text{C}$ , $I_D = -1\text{mA}$ ②
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	0.050	0.065	$\Omega$	$V_{GS} = -4.5V, I_D = -3.7A$ ②
		—	0.080	0.135		$V_{GS} = -2.5V, I_D = -3.1A$ ②
$V_{GS(th)}$	Gate Threshold Voltage	-0.40	-0.55	-0.95	V	$V_{DS} = V_{GS}, I_D = -250\mu A$
$g_{fs}$	Forward Transconductance	6.0	—	—	S	$V_{DS} = -10V, I_D = -3.7A$ ②
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	-1.0	$\mu A$	$V_{DS} = -20V, V_{GS} = 0V$
		—	—	-25		$V_{DS} = -20V, V_{GS} = 0V, T_J = 70^\circ\text{C}$
$I_{GSS}$	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	—		$R_G = 89\Omega$
$t_f$	Fall Time	—	381	—		$R_D = 2.7\Omega$
$C_{iss}$	Input Capacitance	—	633	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	145	—		$V_{DS} = -10V$
$C_{rss}$	Reverse Transfer Capacitance	—	110	—		$f = 1.0\text{MHz}$

## 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	$T_J = 25^\circ\text{C}, I_S = -1.0A, V_{GS} = 0V$ ②
$t_{rr}$	Reverse Recovery Time	—	29	43	ns	$T_J = 25^\circ\text{C}, I_F = -1.0A$
$Q_{rr}$	Reverse Recovery Charge	—	11	17	nC	$di/dt = -100A/\mu s$ ②

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .
- ③ Surface mounted on 1" square single layer 1oz. copper FR4 board, steady state.
- ④ Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.65\text{mH}$   
 $R_G = 25\Omega, I_{AS} = -3.7A$ .

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

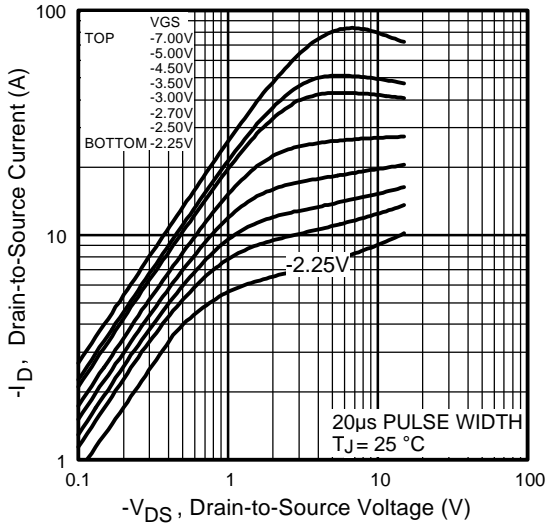


Fig 1. Typical Output Characteristics

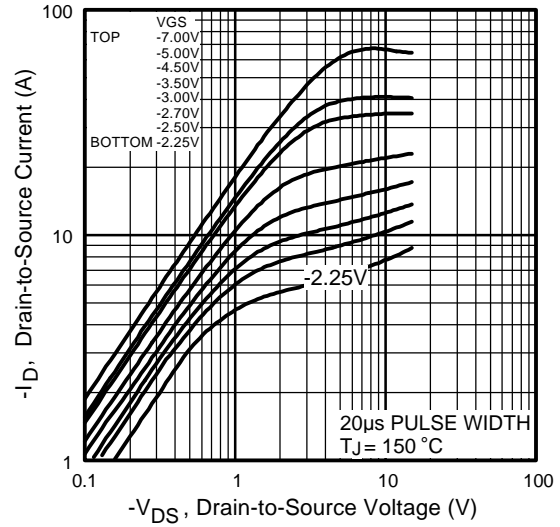


Fig 2. Typical Output Characteristics

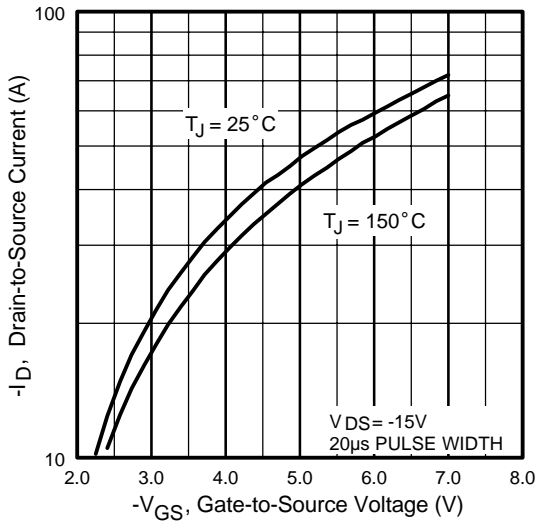


Fig 3. Typical Transfer Characteristics

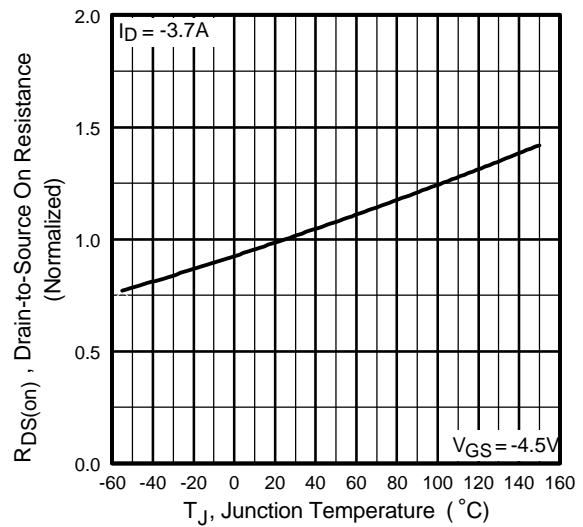
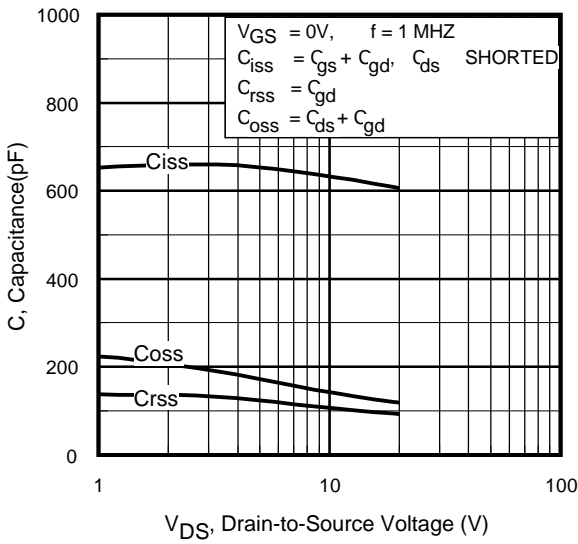
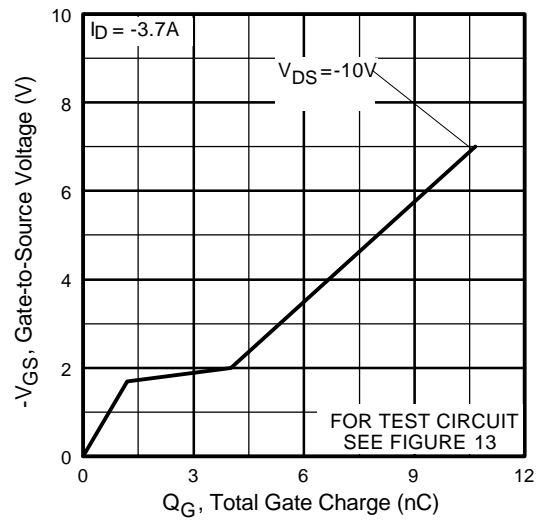


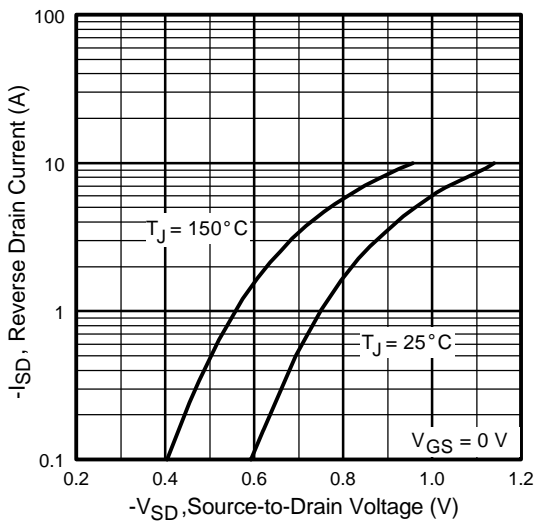
Fig 4. Normalized On-Resistance Vs. Temperature



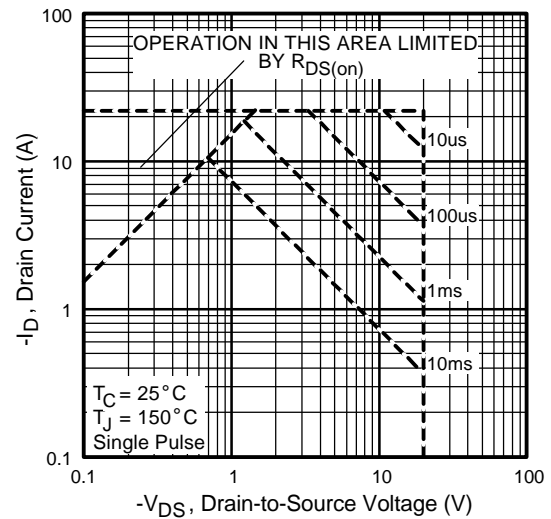
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



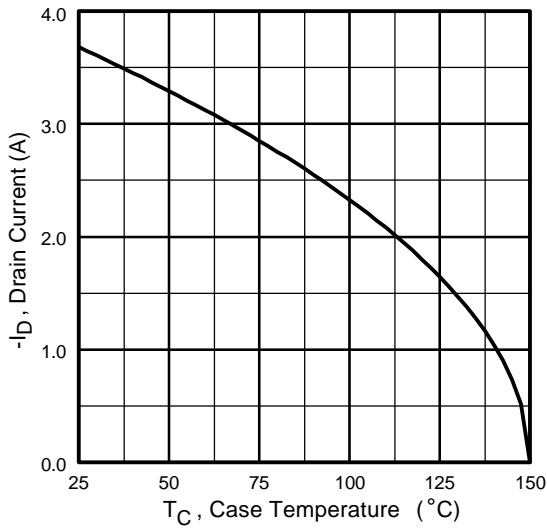
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



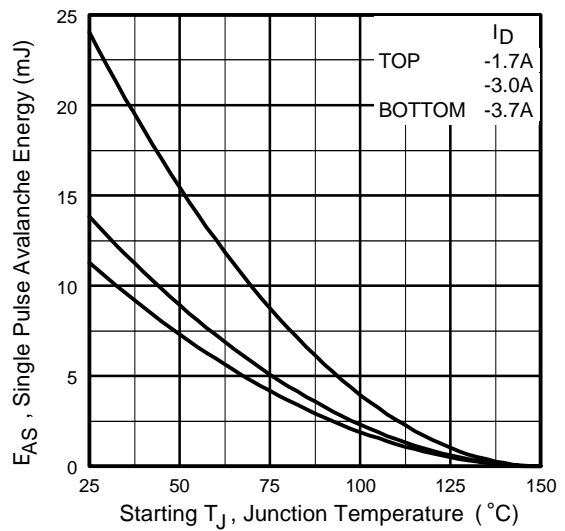
**Fig 7.** Typical Source-Drain Diode Forward Voltage



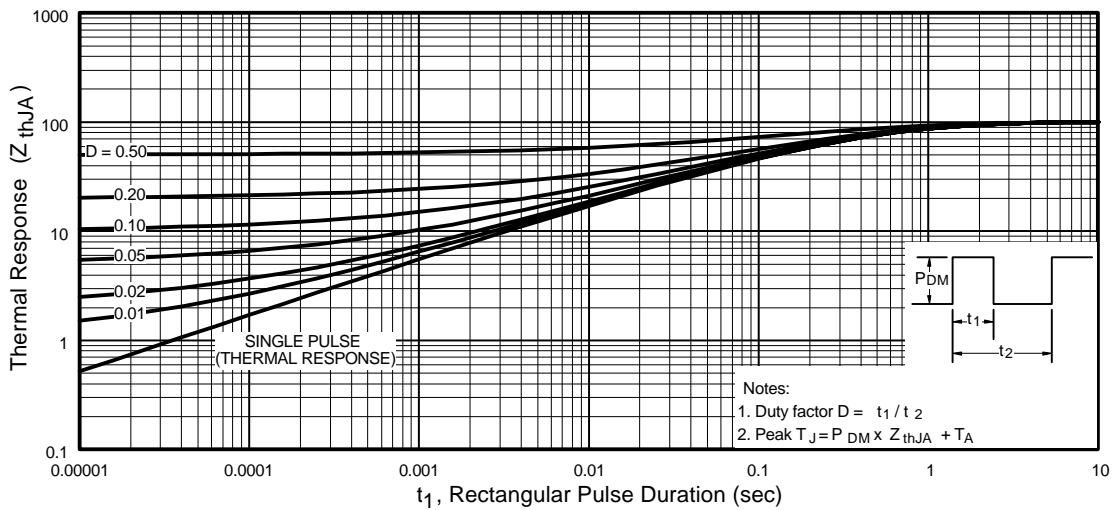
**Fig 8.** Maximum Safe Operating Area



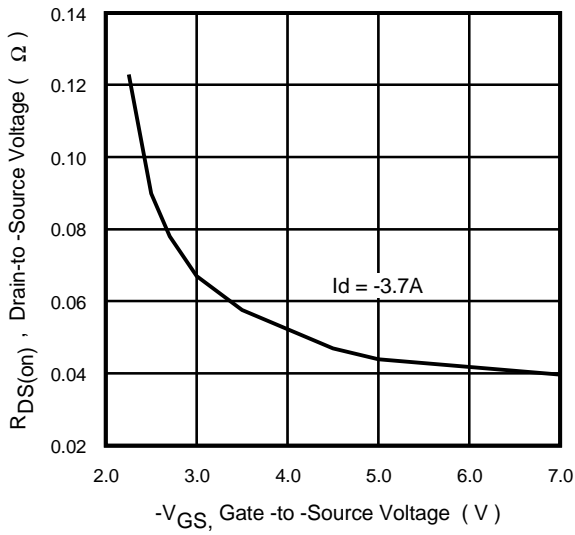
**Fig 9.** Maximum Drain Current Vs. Case Temperature



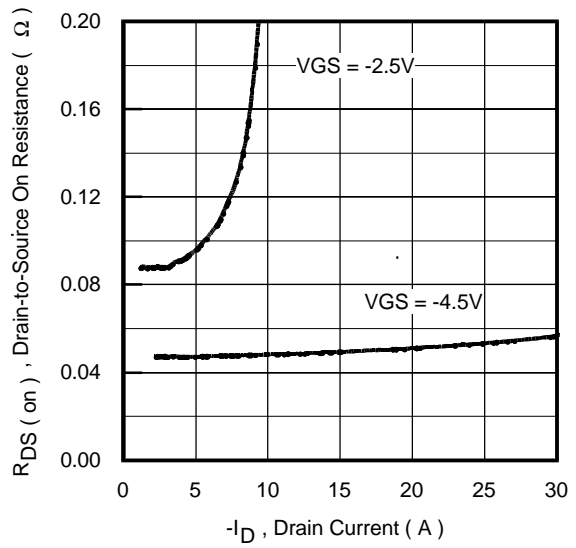
**Fig 10.** Maximum Avalanche Energy Vs. Drain Current



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



**Fig 12.** Typical On-Resistance Vs. Gate Voltage

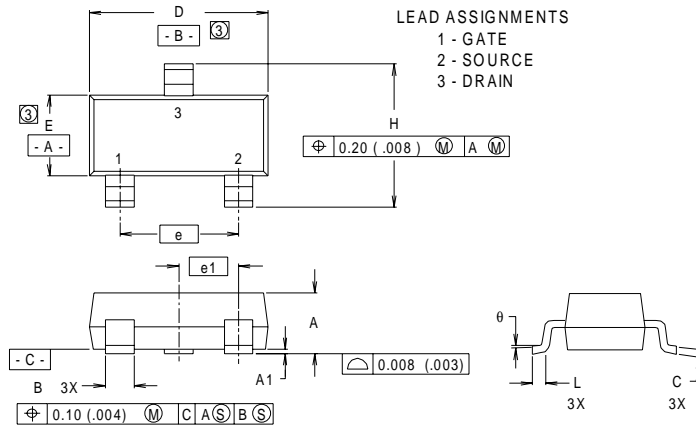


**Fig 13.** Typical On-Resistance Vs. Drain Current

## Package Outline

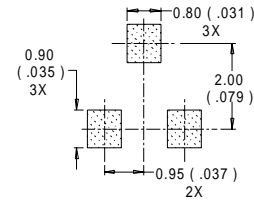
### Micro3™

Dimensions are shown in millimeters (inches)



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.032	.044	0.82	1.11
A1	.001	.004	0.02	0.10
B	.015	.021	0.38	0.54
C	.004	.006	0.10	0.15
D	.105	.120	2.67	3.05
e	.0750 BASIC		1.90 BASIC	
e1	.0375 BASIC		0.95 BASIC	
E	.047	.055	1.20	1.40
H	.083	.098	2.10	2.50
L	.005	.010	0.13	0.25
θ	0°	8°	0°	8°

#### MINIMUM RECOMMENDED FOOTPRINT

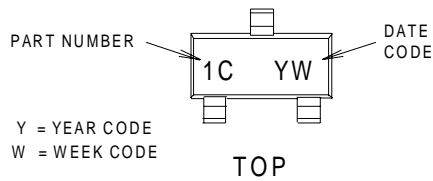


- NOTES:  
 1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982.  
 2. CONTROLLING DIMENSION : INCH.  
 3. DIMENSIONS DO NOT INCLUDE MOLD FLASH.

## Part Marking Information

### Micro3™

EXAMPLE : THIS IS AN IRLML6302



YEAR	Y	WORK WEEK	W
2001	1	01	A
2002	2	02	B
2003	3	03	C
1994	4	04	D
1995	5		
1996	6		
1997	7		
1998	8		
1999	9		
2000	0	24	X
		25	Y
		26	Z

YEAR	Y	WORK WEEK	W
2001	A	27	A
2002	B	28	B
2003	C	29	C
1994	D	30	D
1995	E		
1996	F		
1997	G		
1998	H		
1999	J		
2000	K	50	X
		51	Y
		52	Z

PART NUMBER EXAMPLES:  
 1A = IRLML2402  
 1B = IRLML2803  
 1C = IRLML6302  
 1D = IRLML5103

DATE CODE EXAMPLES:  
 YW W = 9503 = 5C  
 YW W = 9532 = 5F

WORK WEEK = (1-26) IF PRECEDED BY LAST DIGIT OF CALENDER YEAR  
 WORK WEEK = (27-52) IF PRECEDED BY LETTER

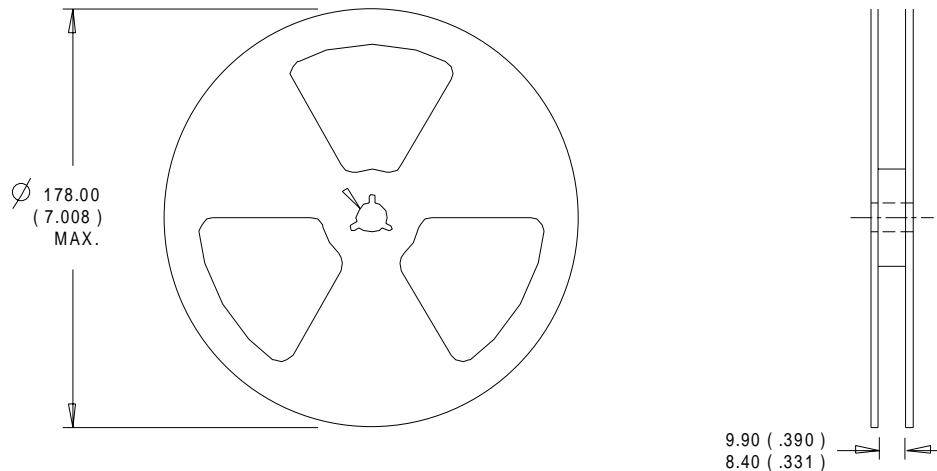
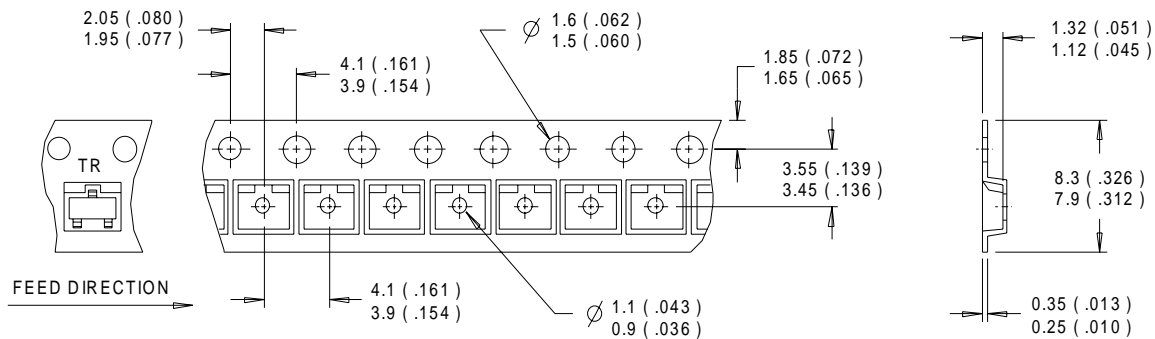
# IRLML6402

International  
**IR** Rectifier

## Tape & Reel Information

### Micro3™

Dimensions are shown in millimeters (inches)



### NOTES:

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

International  
**IR** Rectifier

**WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, Tel: (310) 322 3331

**IR GREAT BRITAIN:** Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020

**IR CANADA:** 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200

**IR GERMANY:** Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590

**IR ITALY:** Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111

**IR FAR EAST:** K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo Japan 171 Tel: 81 3 3983 0086

**IR SOUTHEAST ASIA:** 1 Kim Seng Promenade, Great World City West Tower, 13-11, Singapore 237994 Tel: ++ 65 838 4630

**IR TAIWAN:** 16 Fl. Suite D. 207, Sec. 2, Tun Haw South Road, Taipei, 10673, Taiwan Tel: 886-2-2377-9936

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