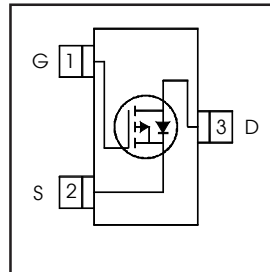


- Ultra Low On-Resistance
- P-Channel MOSFET
- SOT-23 Footprint
- Low Profile (<1.1mm)
- Available in Tape and Reel
- Fast Switching
- Lead-Free
- RoHS Compliant, Halogen-Free

**HEXFET® Power MOSFET**



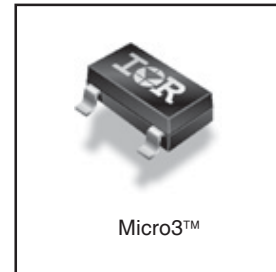
$$V_{DS} = -20V$$

$$R_{DS(on)} = 0.065\Omega$$

**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.



| 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     |
| $I_D @ T_A = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ -4.5V$ | -3.7         | A     |
| $I_D @ T_A = 70^\circ C$ | Continuous Drain Current, $V_{GS} @ -4.5V$ | -2.2         |       |
| $I_{DM}$                 | Pulsed Drain Current ①                     | -22          |       |
| $P_D @ T_A = 25^\circ C$ | Power Dissipation                          | 1.3          | W     |
| $P_D @ T_A = 70^\circ C$ | 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                     | $\pm 12$     | V     |
| $T_J, T_{STG}$           | Junction and Storage Temperature Range     | -55 to + 150 | °C    |

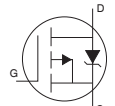
**Thermal Resistance**

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

**Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (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 $25^\circ\text{C}$ , $I_D = -1mA$ 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  | -1.2  | 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    | —     |          | $f = 1.0MHz$                                         |

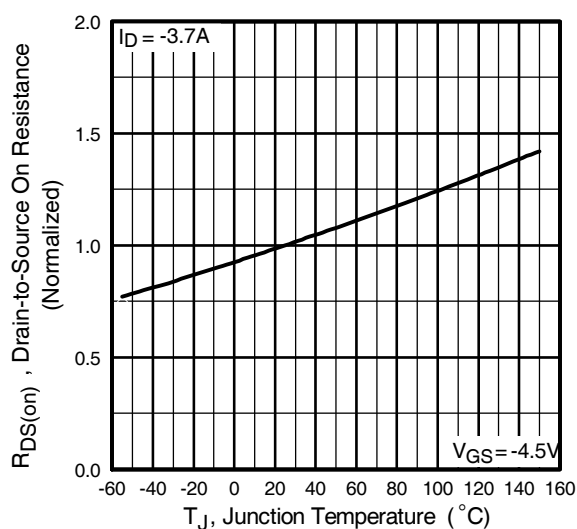
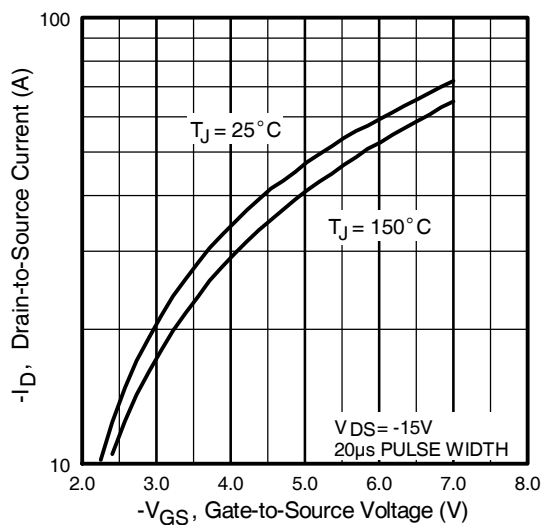
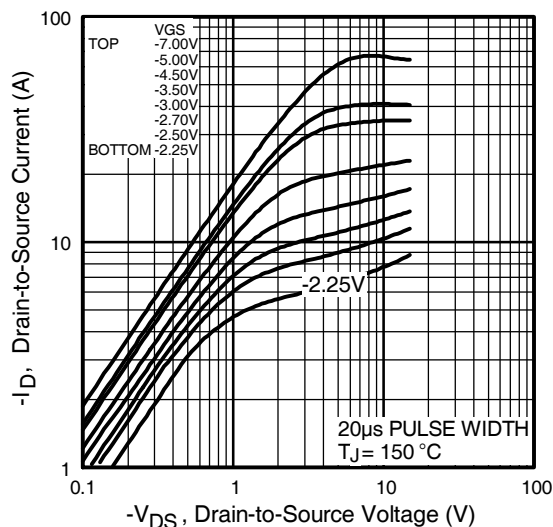
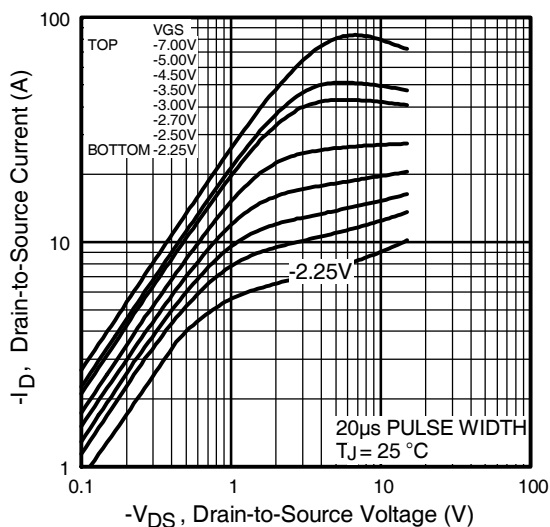
**Source-Drain Ratings and Characteristics**

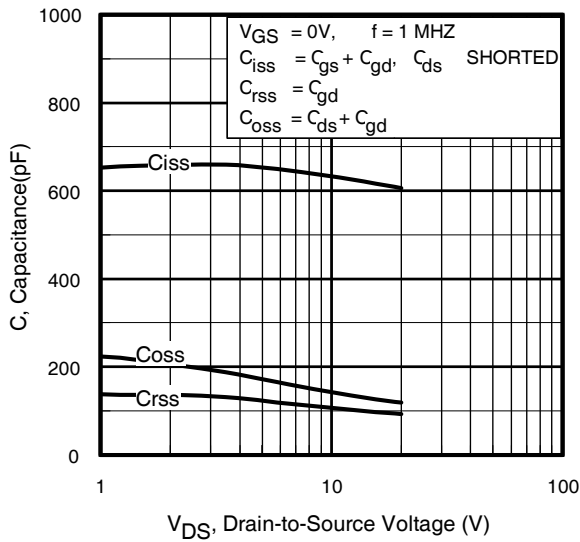
|          | Parameter                              | Min. | Typ. | Max. | Units | Conditions                                                                                                                                           |
|----------|----------------------------------------|------|------|------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | 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     | $T_J = 25^\circ\text{C}, I_S = -1.0A, V_{GS} = 0V$ 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:**

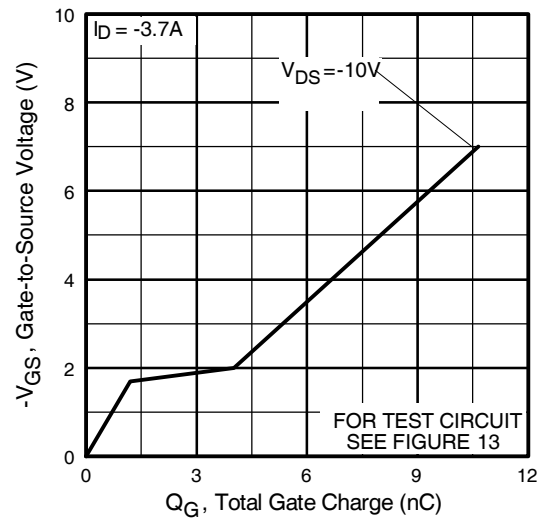
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Pulse width  $\leq 400\mu s$ ; duty cycle  $\leq 2\%$ .
- ③ Surface mounted on 1" square single layer 1oz. copper FR4 board, steady state.
- ④ Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.65mH$   
 $R_G = 25\Omega$ ,  $I_{AS} = -3.7A$ .

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

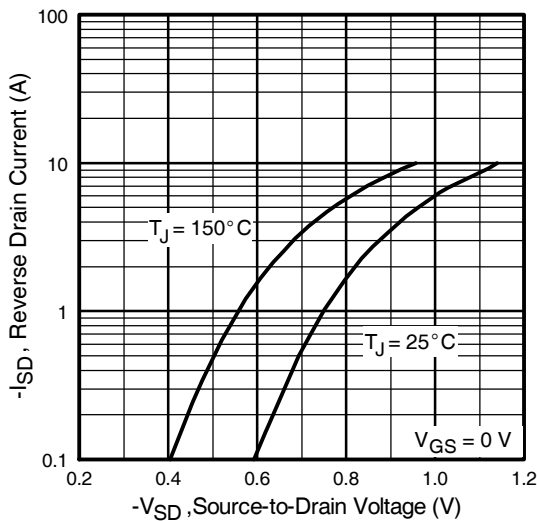




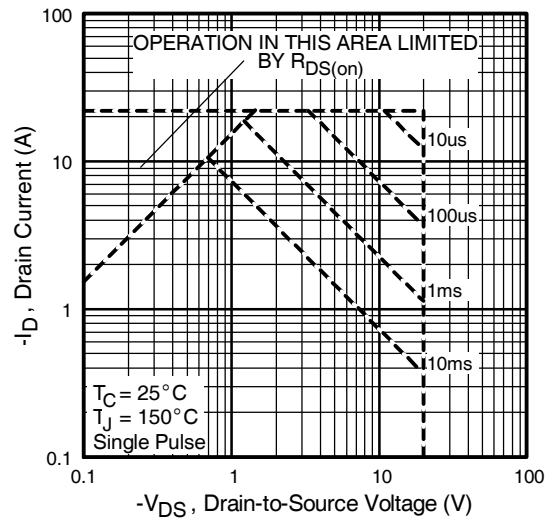
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



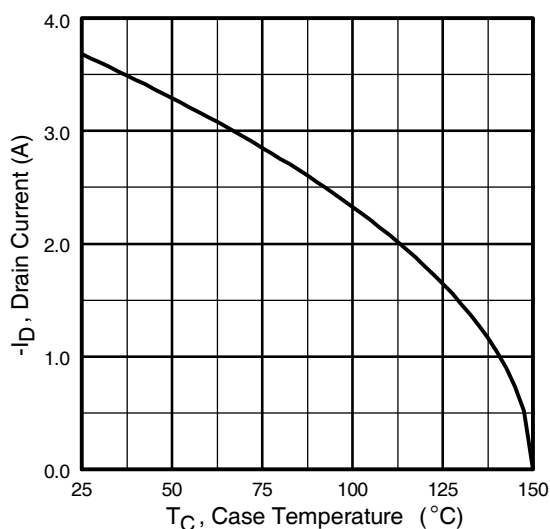
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



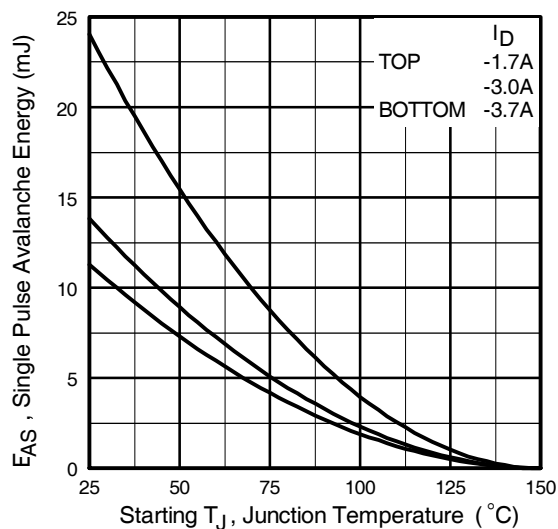
**Fig 7.** Typical Source-Drain Diode Forward Voltage



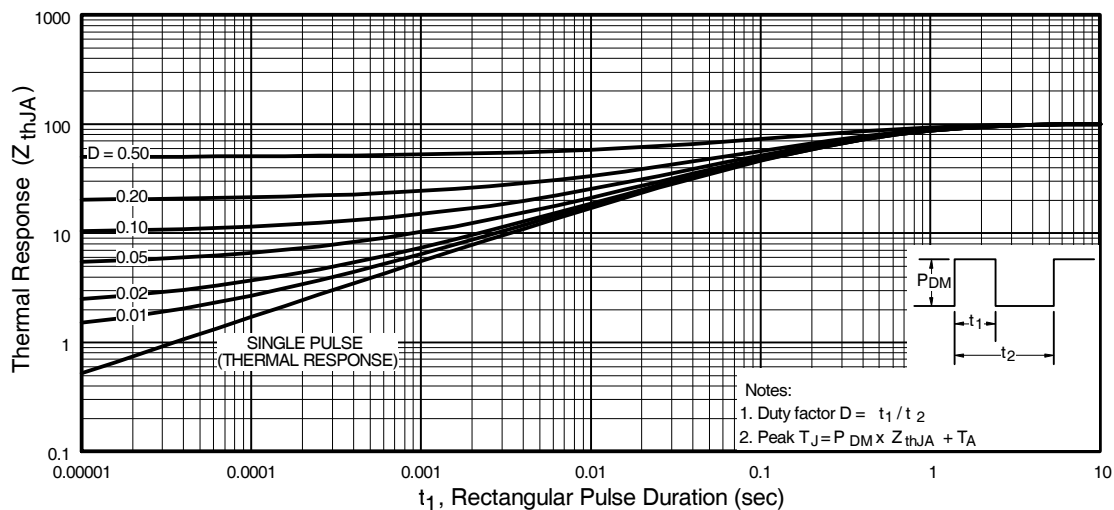
**Fig 8.** Maximum Safe Operating Area



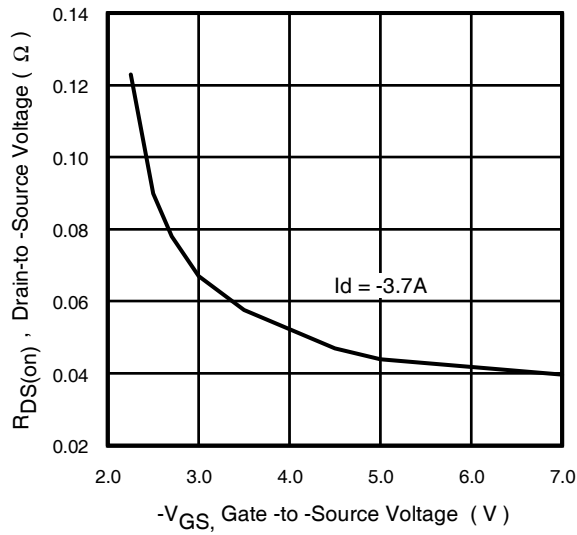
**Fig 9.** Maximum Drain Current Vs. Case Temperature



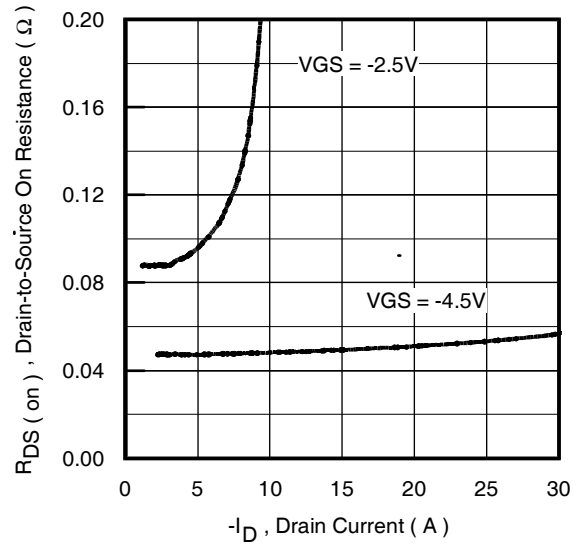
**Fig 10.** Maximum Avalanche Energy Vs. Drain Current



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



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



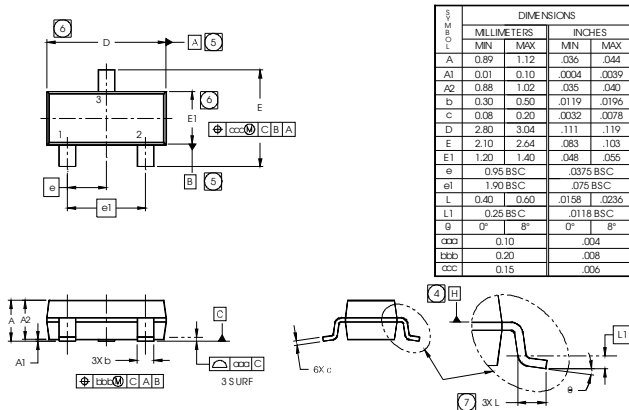
**Fig 13.** Typical On-Resistance Vs. Drain Current



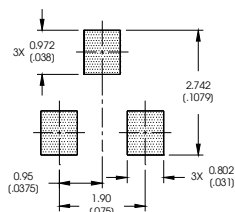
# IRLML6402PbF

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

Dimensions are shown in millimeters (inches)



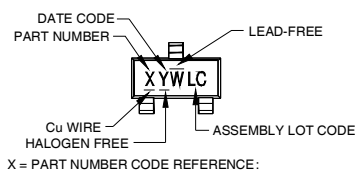
RECOMMENDED FOOT PRINT



- 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 = IRLML8244 |
| F = IRLML6401 | X = IRLML2244 |
| G = IRLML2502 | Y = IRLML2246 |
| H = IRLML5203 | Z = IRLML9244 |
| 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 | 01        | A |
| 2012 | 2002 | 02        | B |
| 2013 | 2003 | 03        | C |
| 2014 | 2004 | 04        | D |
| 2015 | 2005 | 05        | E |
| 2016 | 2006 | 06        | F |
| 2017 | 2007 | 07        | G |
| 2018 | 2008 | 08        | H |
| 2019 | 2009 | 09        | I |
| 2020 | 2010 | 10        | J |

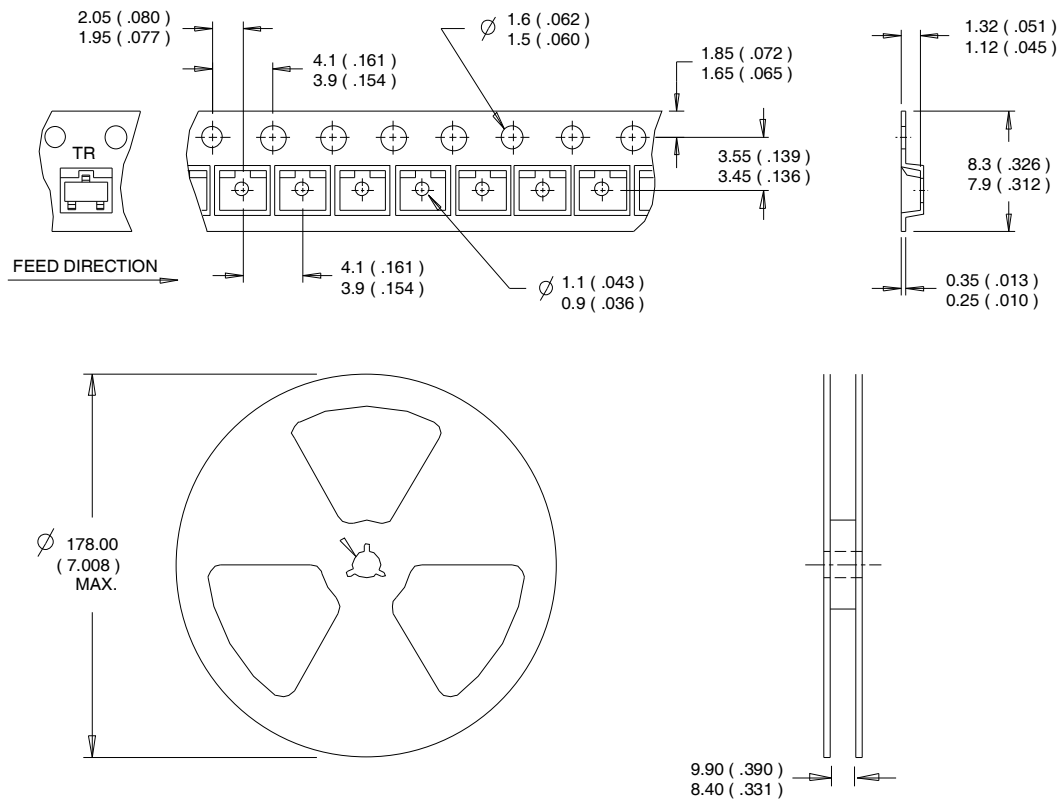
W = (27-52) IF PRECEDED BY A LETTER

| YEAR | Y    | WORK WEEK | W |
|------|------|-----------|---|
| 2011 | 2001 | 27        | A |
| 2012 | 2002 | 28        | B |
| 2013 | 2003 | 29        | C |
| 2014 | 2004 | 30        | D |
| 2015 | 2005 | 31        | E |
| 2016 | 2006 | 32        | F |
| 2017 | 2007 | 33        | G |
| 2018 | 2008 | 34        | H |
| 2019 | 2009 | 35        | I |
| 2020 | 2010 | 36        | J |

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<sup>†</sup>**

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

<sup>†</sup> Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/product-info/reliability>

<sup>††</sup> Applicable version of JEDEC standard at the time of product release

**Revision History**

| Date      | Comment                                                                                                                                                                                                                                                                                                                                 |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4/28/2014 | <ul style="list-style-type: none"> <li>• Updated data sheet with new IR corporate template.</li> <li>• Updated package outline &amp; part marking on page 7.</li> <li>• Added Qualification table -Qual level "Consumer" on page 9.</li> <li>• Added bullet point in the Benefits "RoHS Compliant, Halogen -Free" on page 1.</li> </ul> |

International  
 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/>