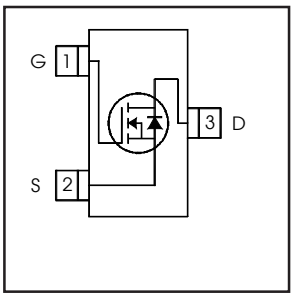
International
IOR Rectifier

# IRLML2402PbF

HEXFET® Power MOSFET

- Generation V Technology
- Ultra Low On-Resistance
- N-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

$R_{DS(on)}$ = 0.25Ω

Micro3™

## Description

Fifth Generation HEXFETs 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 a wide variety of applications.

A customized 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.

| Base Part Number | Package Type | Standard Pack | | Orderable Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| IRLML2402TRPbF | Micro3™ (SOT-23) | Tape and Reel | 3000 | IRLML2402TRPbF |

## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_A$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 4.5V | 1.2 | A |
| $I_D$ @ $T_A$ = 70°C | Continuous Drain Current, $V_{GS}$ @ 4.5V | 0.95 | |
| $I_{DM}$ | Pulsed Drain Current ① | 7.4 | |
| $P_D$ @$T_A$ = 25°C | Power Dissipation | 540 | mW |
| | Linear Derating Factor | 4.3 | mW/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 12 | V |
| dv/dt | Peak Diode Recovery dv/dt ② | 5.0 | V/ns |
| $T_J$, $T_{STG}$ | Junction and Storage Temperature Range | -55 to + 150 | °C |

## Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JA}$ | Maximum Junction-to-Ambient ④ | — | 230 | °C/W |

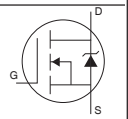
  

## Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | 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 | ––– | 0.024 | ––– | V/°C | Reference to 25°C, $I_D$ = 1mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | ––– | ––– | 0.25 | Ω | $V_{GS}$ = 4.5V, $I_D$ = 0.93A ③ |
| | | ––– | ––– | 0.35 | | $V_{GS}$ = 2.7V, $I_D$ = 0.47A ③ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 0.70 | ––– | ––– | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| $g_{fs}$ | Forward Transconductance | 1.3 | ––– | ––– | S | $V_{DS}$ = 10V, $I_D$ = 0.47A |
| $I_{DSS}$ | Drain-to-Source Leakage Current | ––– | ––– | 1.0 | µA | $V_{DS}$ = 16V, $V_{GS}$ = 0V |
| | | ––– | ––– | 25 | | $V_{DS}$ = 16V, $V_{GS}$ = 0V, $T_J$ = 125°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 | ––– | 2.6 | 3.9 | nC | $I_D$ = 0.93A |
| $Q_{gs}$ | Gate-to-Source Charge | ––– | 0.41 | 0.62 | | $V_{DS}$ = 16V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | ––– | 1.1 | 1.7 | | $V_{GS}$ = 4.5V, See Fig. 6 and 9 ③ |
| $t_{d(on)}$ | Turn-On Delay Time | ––– | 2.5 | ––– | ns | $V_{DD}$ = 10V |
| $t_r$ | Rise Time | ––– | 9.5 | ––– | | $I_D$ = 0.93A |
| $t_{d(off)}$ | Turn-Off Delay Time | ––– | 9.7 | ––– | | $R_G$ = 6.2Ω |
| $t_f$ | Fall Time | ––– | 4.8 | ––– | | $R_D$ = 11Ω, See Fig. 10 ③ |
| $C_{iss}$ | Input Capacitance | ––– | 110 | ––– | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | ––– | 51 | ––– | | $V_{DS}$ = 15V |
| $C_{rss}$ | Reverse Transfer Capacitance | ––– | 25 | ––– | | $f$ = 1.0MHz, See Fig. 5 |

## Source-Drain Ratings and Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | ––– | ––– | 0.54 | A | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | ––– | ––– | 7.4 | | |
| $V_{SD}$ | Diode Forward Voltage | ––– | ––– | 1.2 | V | $T_J$ = 25°C, $I_S$ = 0.93A, $V_{GS}$ = 0V ③ |
| $t_{rr}$ | Reverse Recovery Time | ––– | 25 | 38 | ns | $T_J$ = 25°C, $I_F$ = 0.93A |
| $Q_{rr}$ | Reverse RecoveryCharge | ––– | 16 | 24 | nC | di/dt = 100A/µs ③ |




**Notes:**

① Repetitive rating; pulse width limited by max. junction temperature. ( See fig. 11 )

② $I_{SD}$ ≤ 0.93A, di/dt ≤ 90A/µs, $V_{DD}$ ≤ $V_{(BR)DSS}$, $T_J$ ≤ 150°C

③ Pulse width ≤ 300µs; duty cycle ≤ 2%.

④ Surface mounted on FR-4 board, t ≤ 5sec.

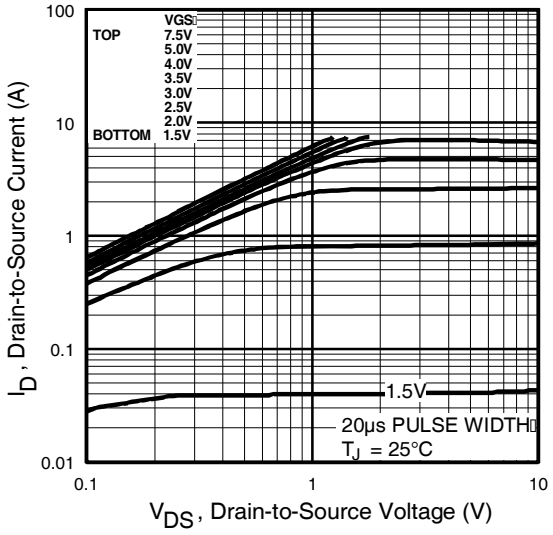



**Fig 1.** Typical Output Characteristics

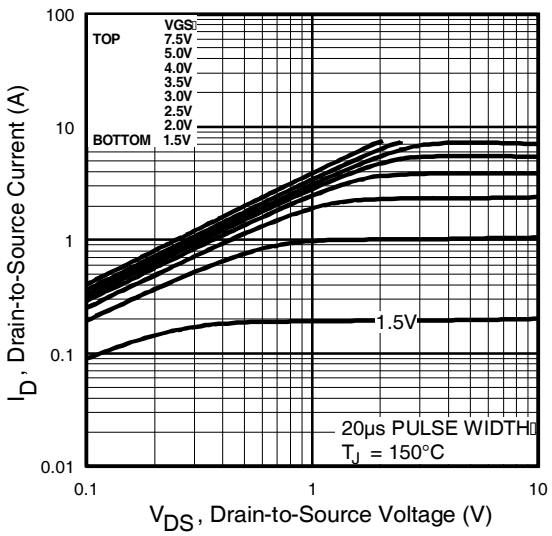



**Fig 2.** Typical Output Characteristics

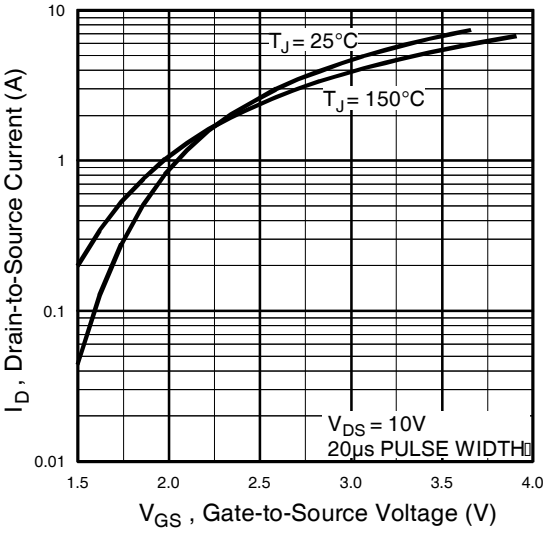



**Fig 3.** Typical Transfer Characteristics

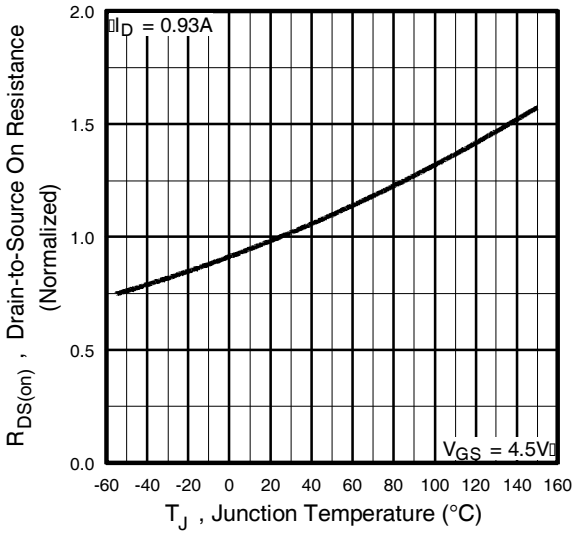



**Fig 4.** Normalized On-Resistance Vs. Temperature

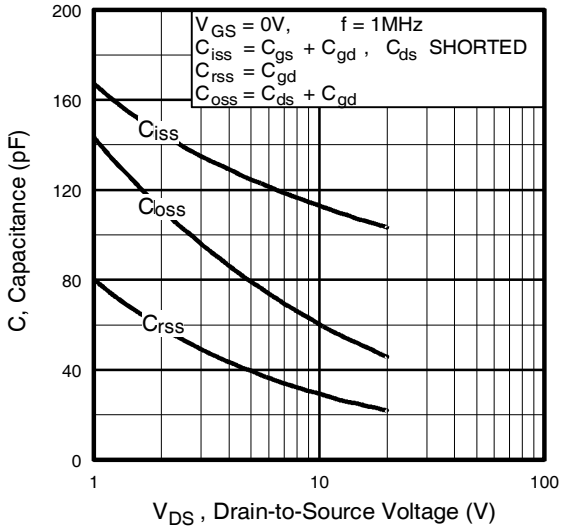



**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

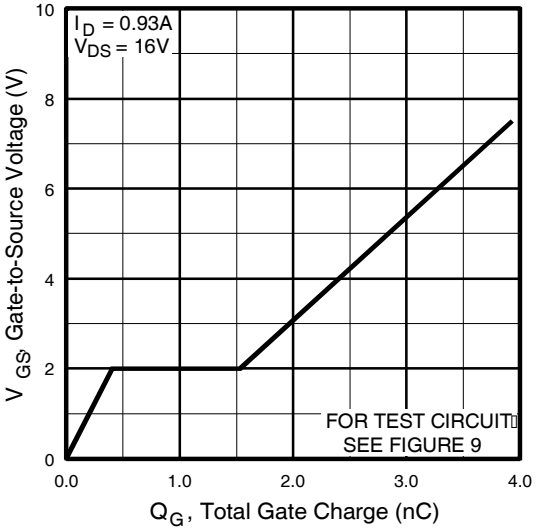



**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

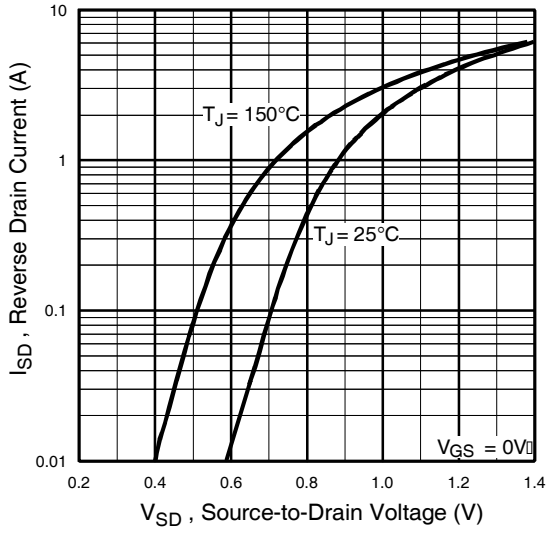



**Fig 7.** Typical Source-Drain Diode Forward Voltage

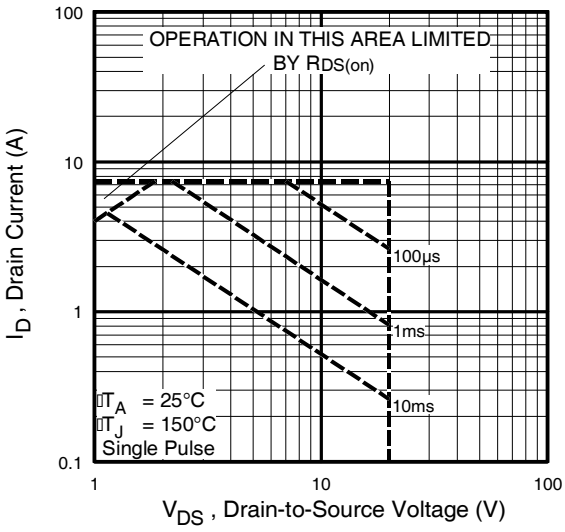



**Fig 8.** Maximum Safe Operating Area

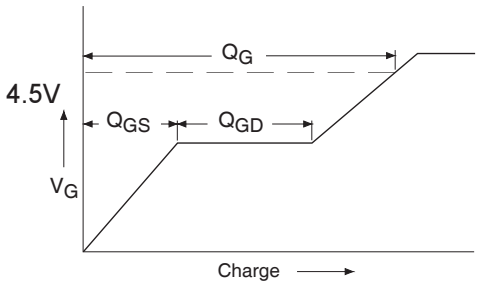



**Fig 9a.** Basic Gate Charge Waveform

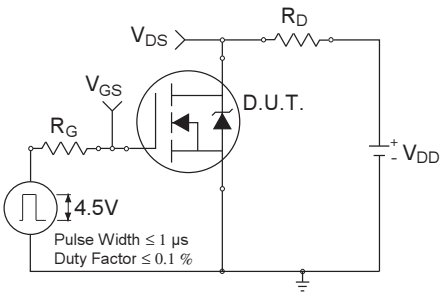



**Fig 10a.** Switching Time Test Circuit

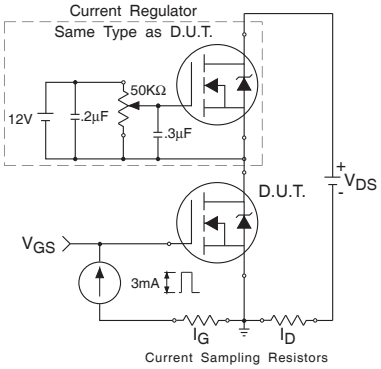



**Fig 9b.** Gate Charge Test Circuit

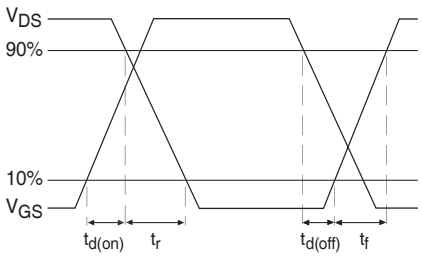



**Fig 10b.** Switching Time Waveforms

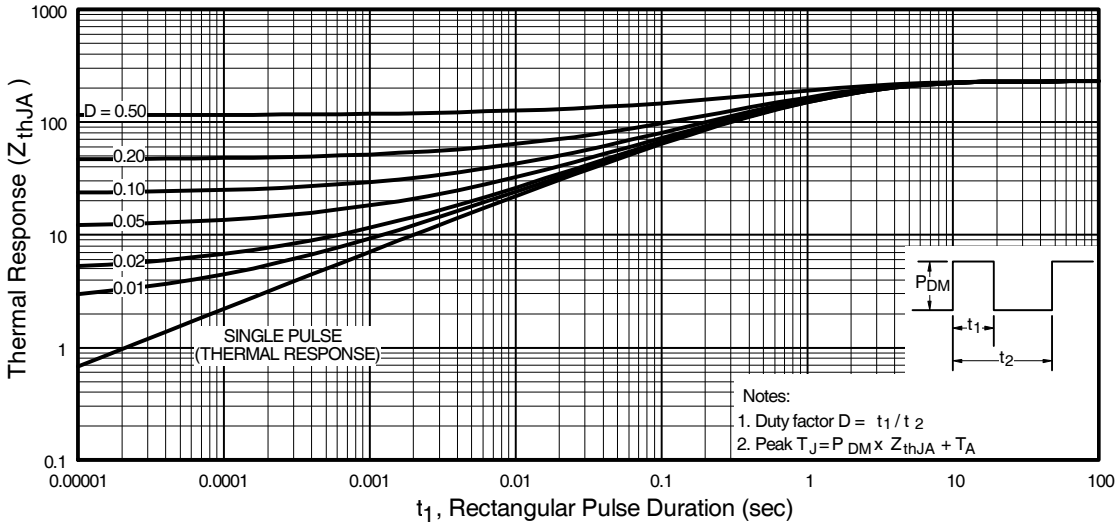
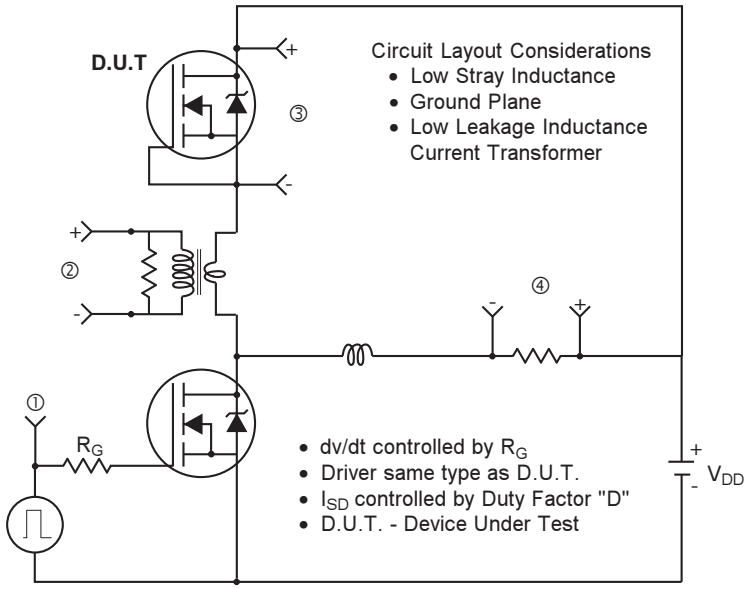
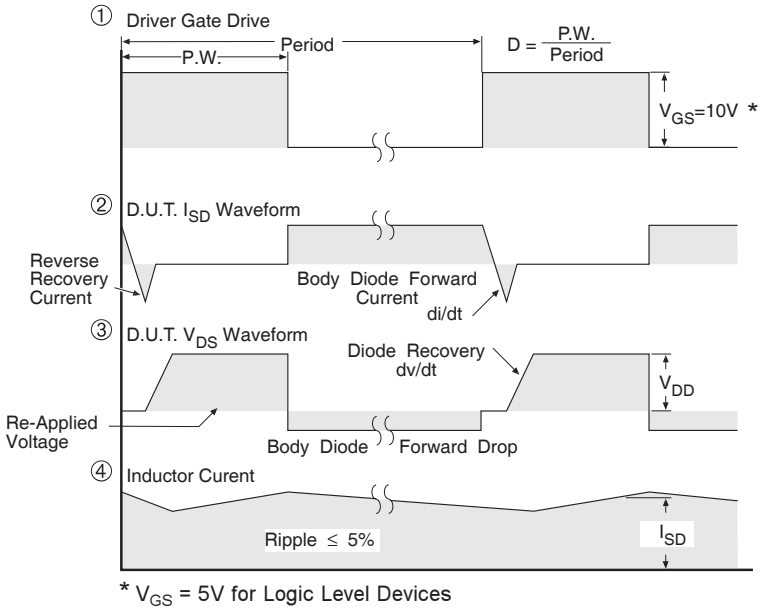



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

## Peak Diode Recovery dv/dt Test Circuit



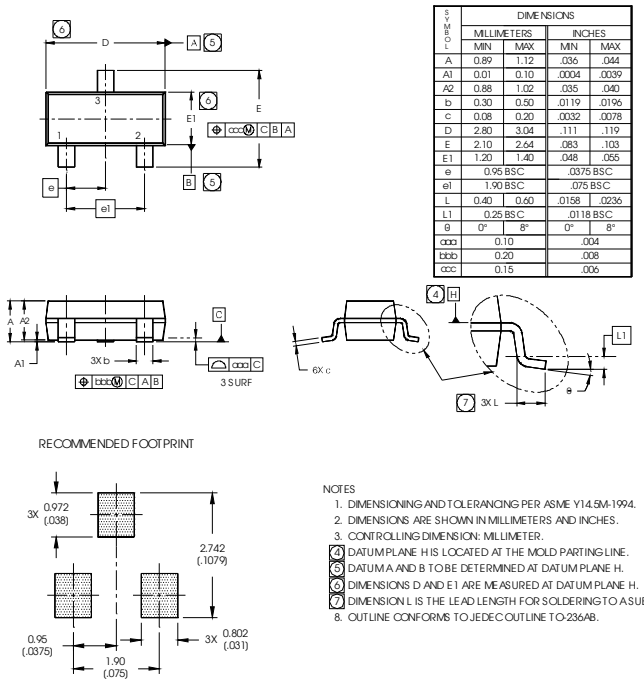




* $V_{GS}$ = 5V for Logic Level Devices

**Fig 12.** For N-Channel HEXFETS

## 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° |
| ccc | 0.10 | | .004 | |
| bbb | 0.20 | | .008 | |
| ccc | 0.15 | | .006 | |

RECOMMENDED FOOTPRINT

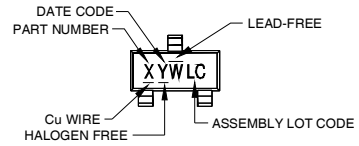



NOTES

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

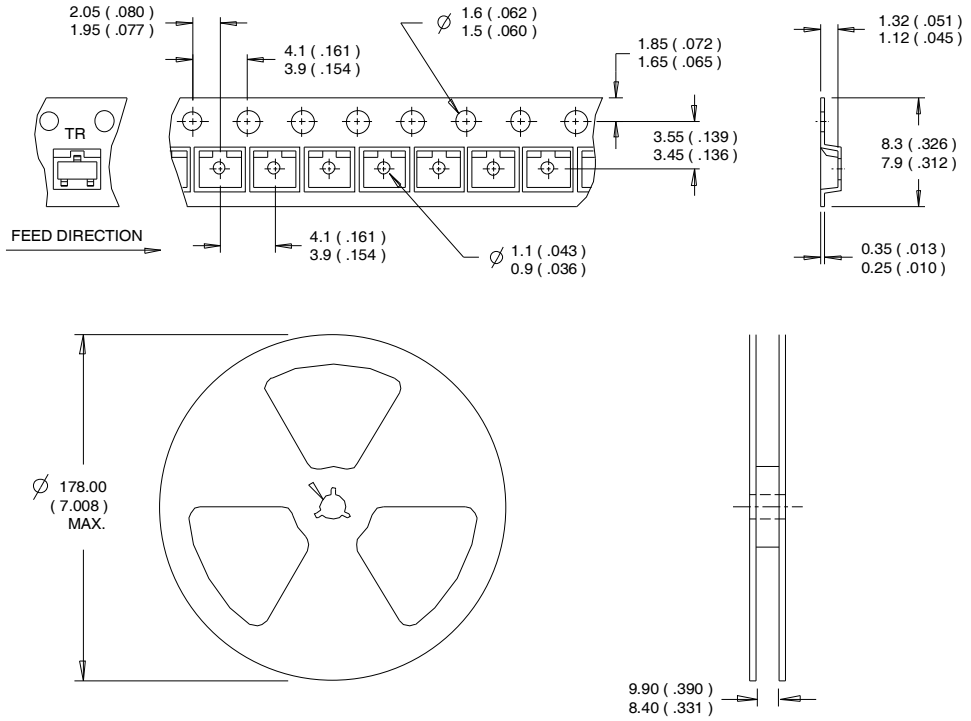
| YEAR | Y | WORK WEEK | W |
|---|---|---|---|
| 2011 2001 | A | 27 | A |
| 2012 2002 | B | 28 | B |
| 2013 2003 | C | 29 | C |
| 2014 2004 | D | 30 | D |
| 2015 2005 | E | ↓ | ↓ |
| 2016 2006 | F | | |
| 2017 2007 | G | | |
| 2018 2008 | H | | |
| 2019 2009 | J | | |
| 2020 2010 | K | 50 | X |
| | |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

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

# Micro3™ 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 |
|---|---|
| 4/24/2014 | • Updated data sheet with new IR corporate template.<br>• Updated package outline & part marking on page 7.<br>• Added Qualification table -Qual level "Consumer" on page 9.<br>• Added bullet point in the Benefits "RoHS Compliant, Halogen -Free" on page 1. |

## IMPORTANT NOTICE

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