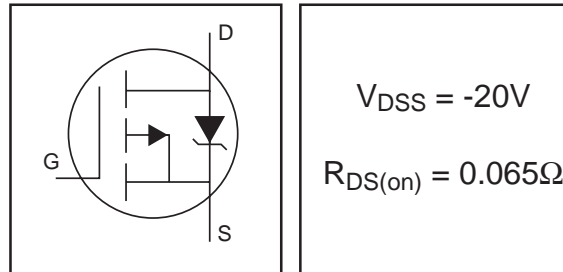


# IRLML6402

HEXFET® Power MOSFET

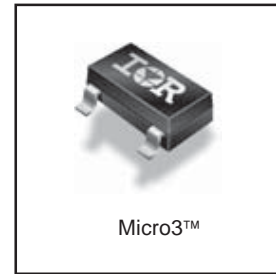
- Ultra Low On-Resistance
- P-Channel MOSFET
- SOT-23 Footprint
- Low Profile (<1.1mm)
- Available in Tape and Reel
- Fast Switching



## 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    |

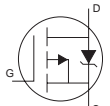
## Thermal Resistance

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

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

|  | Parameter                            | Min.  | Typ.   | Max.  | Units | Conditions  |
|--|--------------------------------------|-------|--------|-------|-------|---|
| V <sub>(BR)DSS</sub>                   | Drain-to-Source Breakdown Voltage    | -20   | —      | —     | V     | V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA                       |
| ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub> | Breakdown Voltage Temp. Coefficient  | —     | -0.009 | —     | V/°C  | Reference to 25°C, I <sub>D</sub> = -1mA ②                          |
| R <sub>DSS(on)</sub>                   | Static Drain-to-Source On-Resistance | —     | 0.050  | 0.065 | Ω     | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -3.7A ②                   |
|  |                                      | —     | 0.080  | 0.135 |       | V <sub>GS</sub> = -2.5V, I <sub>D</sub> = -3.1A ②                   |
| V <sub>GS(th)</sub>                    | Gate Threshold Voltage               | -0.40 | -0.55  | -0.95 | V     | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA         |
| g <sub>fs</sub>                        | Forward Transconductance             | 6.0   | —      | —     | S     | V <sub>DS</sub> = -10V, I <sub>D</sub> = -3.7A ②                    |
| I <sub>DSS</sub>                       | Drain-to-Source Leakage Current      | —     | —      | -1.0  | μA    | V <sub>DS</sub> = -20V, V <sub>GS</sub> = 0V                        |
|  |                                      | —     | —      | -25   |       | V <sub>DS</sub> = -20V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 70°C |
| I <sub>GSS</sub>                       | Gate-to-Source Forward Leakage       | —     | —      | -100  | nA    | V <sub>GS</sub> = -12V  |
|  | Gate-to-Source Reverse Leakage       | —     | —      | 100   |       | V <sub>GS</sub> = 12V   |
| Q <sub>g</sub>                         | Total Gate Charge                    | —     | 8.0    | 12    | nC    | I <sub>D</sub> = -3.7A  |
| Q <sub>gs</sub>                        | Gate-to-Source Charge                | —     | 1.2    | 1.8   |       | V <sub>DS</sub> = -10V  |
| Q <sub>gd</sub>                        | Gate-to-Drain ("Miller") Charge      | —     | 2.8    | 4.2   |       | V <sub>GS</sub> = -5.0V ②   |
| t <sub>d(on)</sub>                     | Turn-On Delay Time                   | —     | 350    | —     | ns    | V <sub>DD</sub> = -10V  |
| t <sub>r</sub>                         | Rise Time                            | —     | 48     | —     |       | I <sub>D</sub> = -3.7A  |
| t <sub>d(off)</sub>                    | Turn-Off Delay Time                  | —     | 588    | —     |       | R <sub>G</sub> = 89Ω  |
| t <sub>f</sub>                         | Fall Time                            | —     | 381    | —     |       | R <sub>D</sub> = 2.7Ω   |
| C <sub>iss</sub>                       | Input Capacitance                    | —     | 633    | —     | pF    | V <sub>GS</sub> = 0V  |
| C <sub>oss</sub>                       | Output Capacitance                   | —     | 145    | —     |       | V <sub>DS</sub> = -10V  |
| C <sub>rss</sub>                       | Reverse Transfer Capacitance         | —     | 110    | —     |       | f = 1.0MHz  |

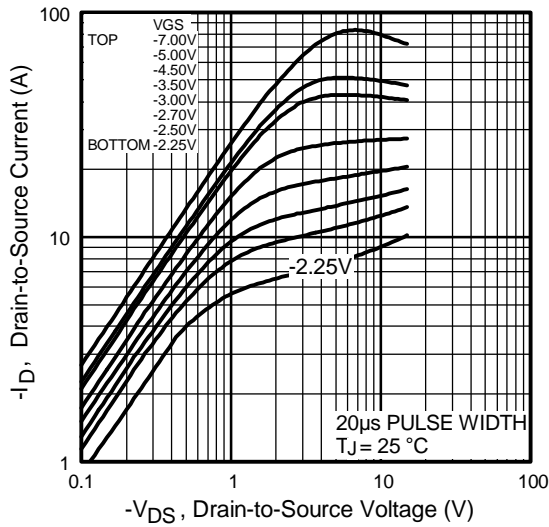
## Source-Drain Ratings and Characteristics

|                 | Parameter                              | Min. | Typ. | Max. | Units | Conditions   |
|-----------------|--|------|------|------|-------|--|
| I <sub>S</sub>  | Continuous Source Current (Body Diode) | —    | —    | -1.3 | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I <sub>SM</sub> | Pulsed Source Current (Body Diode) ①   | —    | —    | -22  |       |  |
| V <sub>SD</sub> | Diode Forward Voltage                  | —    | —    | -1.2 | V     | T <sub>J</sub> = 25°C, I <sub>S</sub> = -1.0A, V <sub>GS</sub> = 0V ②  |
| t <sub>rr</sub> | Reverse Recovery Time                  | —    | 29   | 43   | ns    | T <sub>J</sub> = 25°C, I <sub>F</sub> = -1.0A  |
| Q <sub>rr</sub> | Reverse Recovery Charge                | —    | 11   | 17   | nC    | di/dt = -100A/μs ②   |

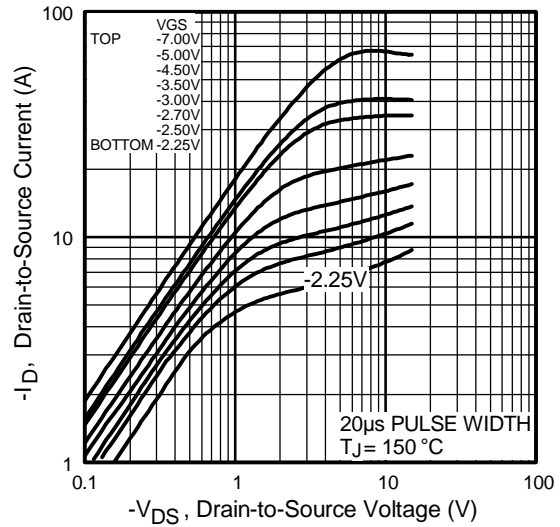
### Notes:

- 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<sub>J</sub> = 25°C, L = 1.65mH  
R<sub>G</sub> = 25Ω, I<sub>AS</sub> = -3.7A.

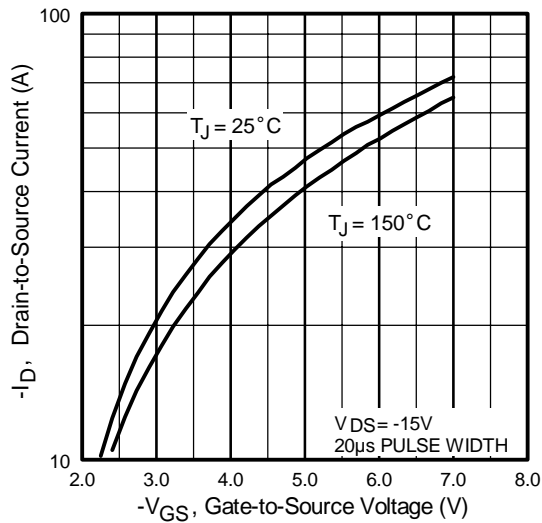
\*\* For recommended footprint and soldering techniques refer to application note #AN-994.



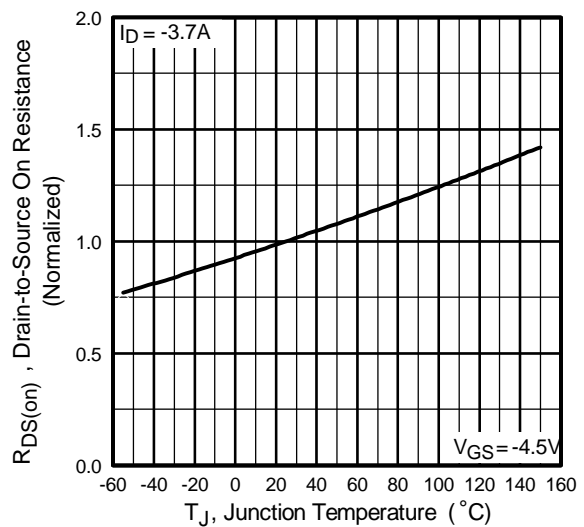
**Fig 1.** Typical Output Characteristics



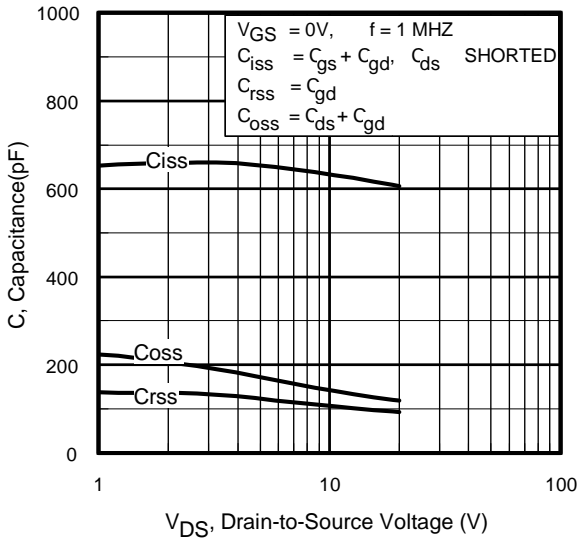
**Fig 2.** Typical Output Characteristics



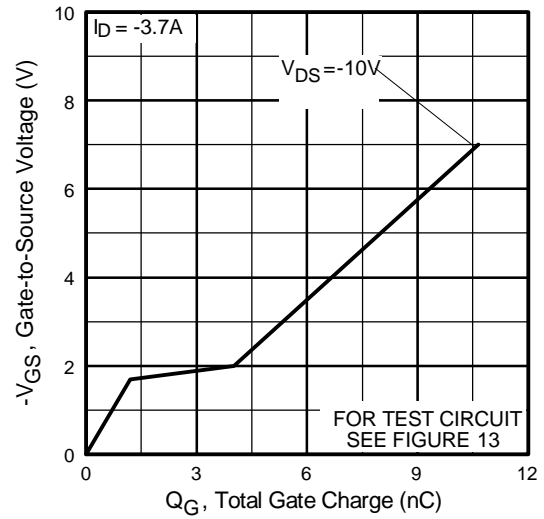
**Fig 3.** Typical Transfer Characteristics



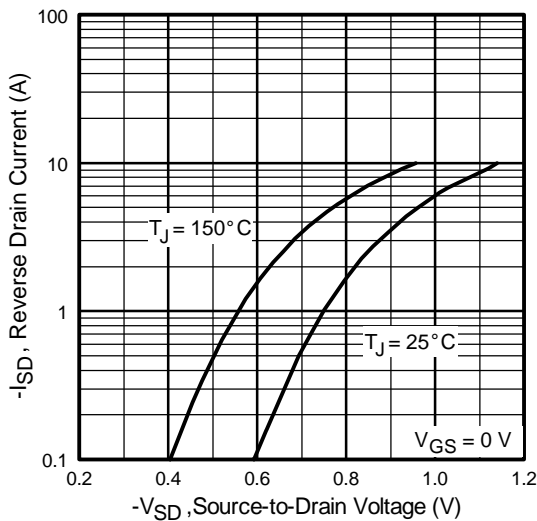
**Fig 4.** Normalized On-Resistance Vs. Temperature



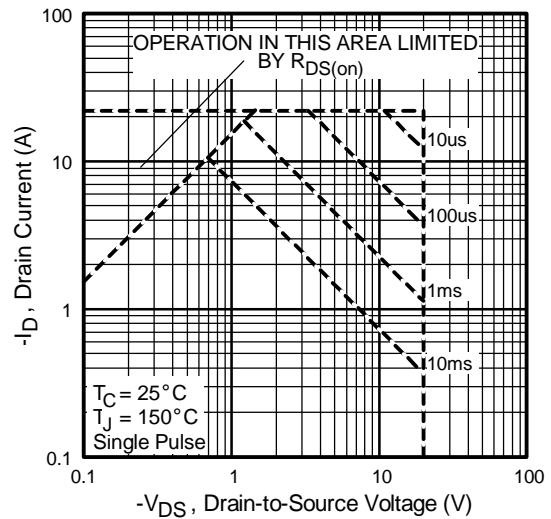
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



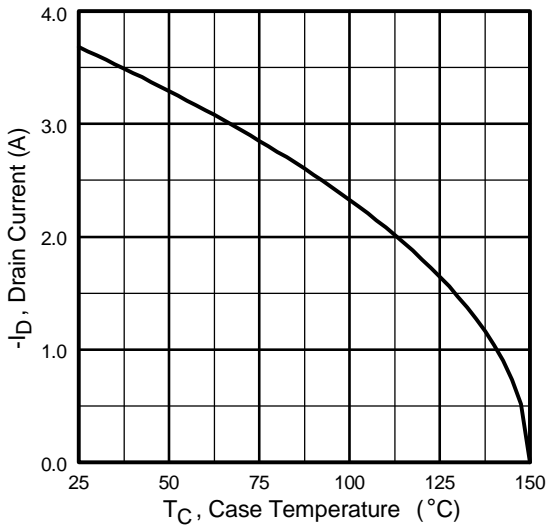
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



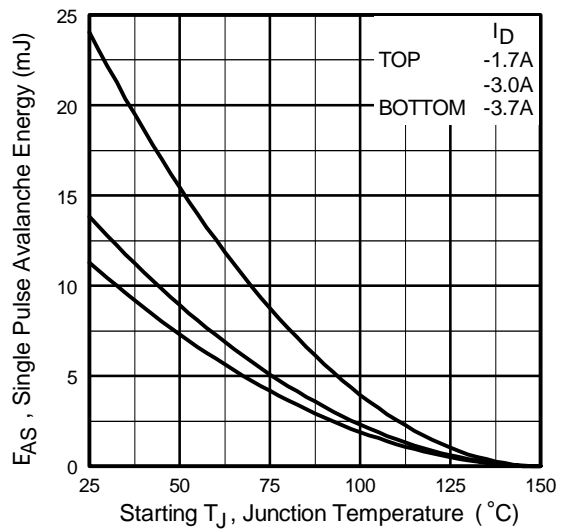
**Fig 7.** Typical Source-Drain Diode Forward Voltage



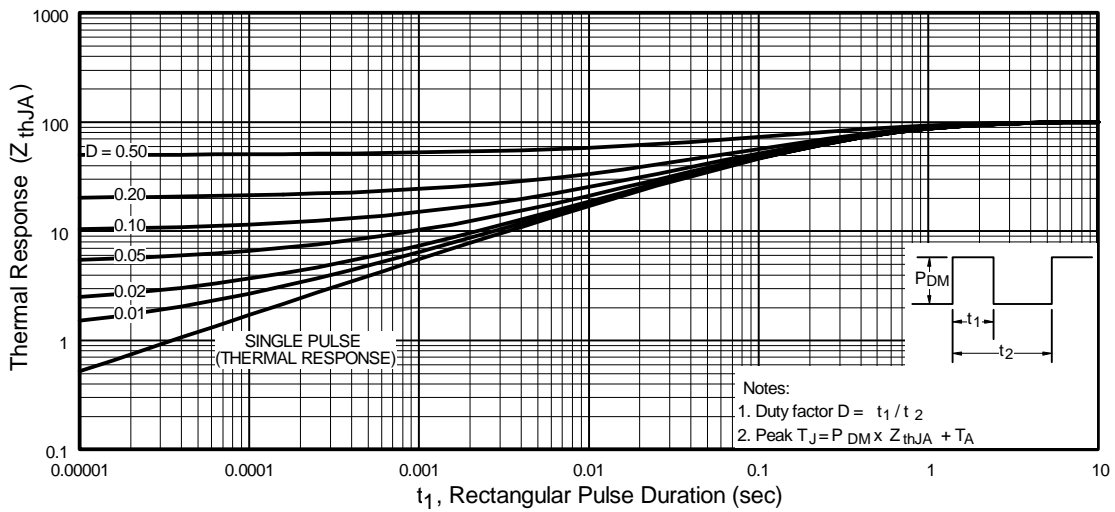
**Fig 8.** Maximum Safe Operating Area



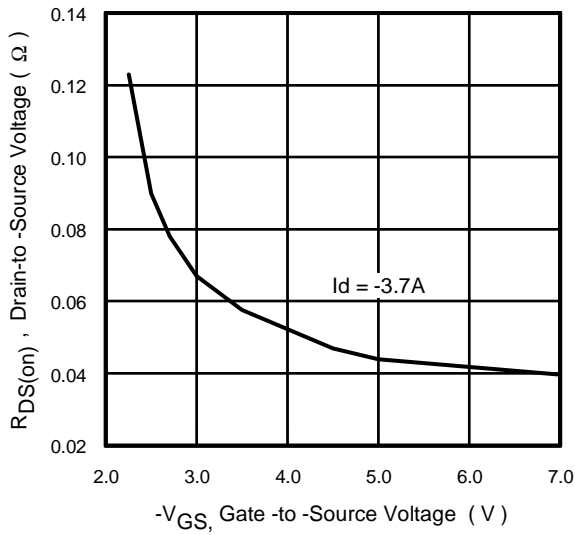
**Fig 9.** Maximum Drain Current Vs. Case Temperature



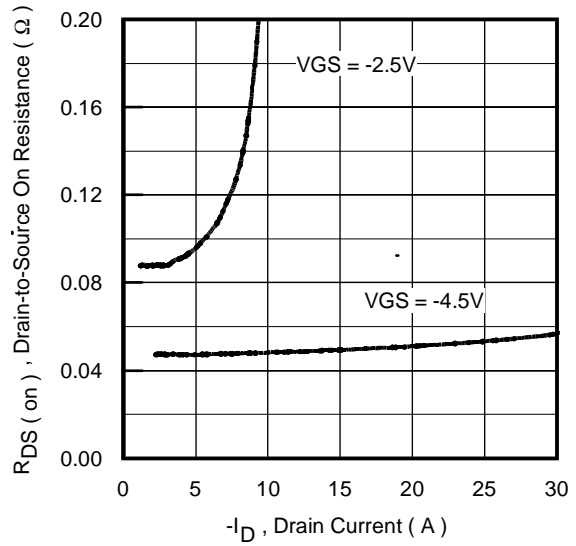
**Fig 10.** Maximum Avalanche Energy Vs. Drain Current



**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



# IRLML6402

## Part Marking Information

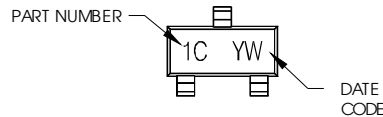
Micro3™

International  
**IRF** Rectifier

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

EXAMPLE: THIS IS AN IRLML6302

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



PART NUMBER CODE REFERENCE:

- 1A = IRLML2402
- 1B = IRLML2803
- 1C = IRLML6302
- 1D = IRLML5103
- 1E = IRLML6402
- 1F = IRLML6401
- 1G = IRLML2502
- 1H = IRLML5203

DATE CODE EXAMPLES:

- YWW = 9503 = 5C
- YWW = 9532 = EF

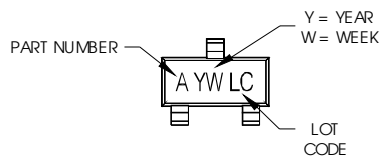
| YEAR | Y | WORK WEEK | W |
|------|---|-----------|---|
| 2001 | 1 | 01        | A |
| 2002 | 2 | 02        | B |
| 2003 | 3 | 03        | C |
| 1994 | 4 | 04        | D |
| 1995 | 5 |           |   |
| 1996 | 6 |           |   |
| 1997 | 7 |           |   |
| 1998 | 8 |           |   |
| 1999 | 9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

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

| 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 |

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

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



PART NUMBER CODE REFERENCE:

- A = IRLML2402
- B = IRLML2803
- C = IRLML6302
- D = IRLML5103
- E = IRLML6402
- F = IRLML6401
- G = IRLML2502
- H = IRLML5203

| 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 |

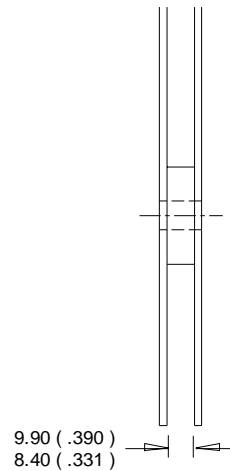
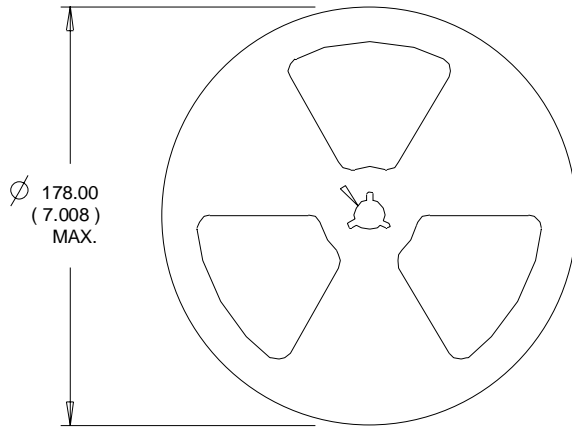
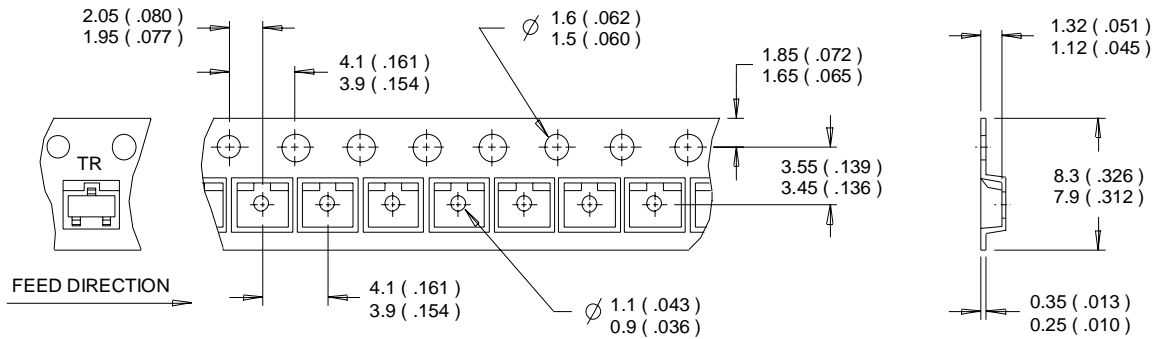
W = (27-52) IF PRECEDED BY A LETTER

| 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 |

## Tape & Reel Information

Micro3™

Dimensions are shown in millimeters (inches)



NOTES:

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

Data and specifications subject to change without notice.

International  
**IOR** Rectifier

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