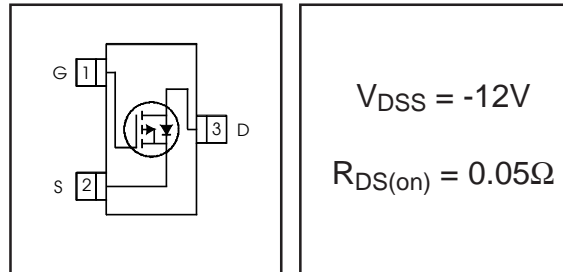


# IRLML6401

HEXFET<sup>®</sup> Power MOSFET

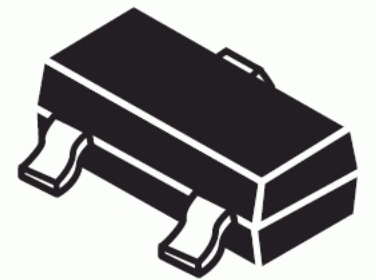
- Ultra Low On-Resistance
- P-Channel MOSFET
- SOT-23 Footprint
- Low Profile (<1.1mm)
- Available in Tape and Reel
- Fast Switching
- 1.8V Gate Rated



## 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<sup>®</sup> 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<sup>™</sup>, 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.



SOT23-3 package

## Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{DS}$	Drain- Source Voltage	-12	V
$I_D @ T_A = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -4.5V$	-4.3	A
$I_D @ T_A = 70^\circ C$	Continuous Drain Current, $V_{GS} @ -4.5V$	-3.4	
$I_{DM}$	Pulsed Drain Current <sup>①</sup>	-34	
$P_D @ T_A = 25^\circ C$	Power Dissipation	1.3	W
$P_D @ T_A = 70^\circ C$	Power Dissipation	0.8	
	Linear Derating Factor	0.01	
$E_{AS}$	Single Pulse Avalanche Energy <sup>②</sup>	33	mJ
$V_{GS}$	Gate-to-Source Voltage	$\pm 8.0$	V
$T_J, T_{STG}$	Junction and Storage Temperature Range	-55 to + 150	$^\circ C$

## Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient <sup>③</sup>	75	100	$^\circ C/W$

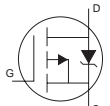
# IRLML6401



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

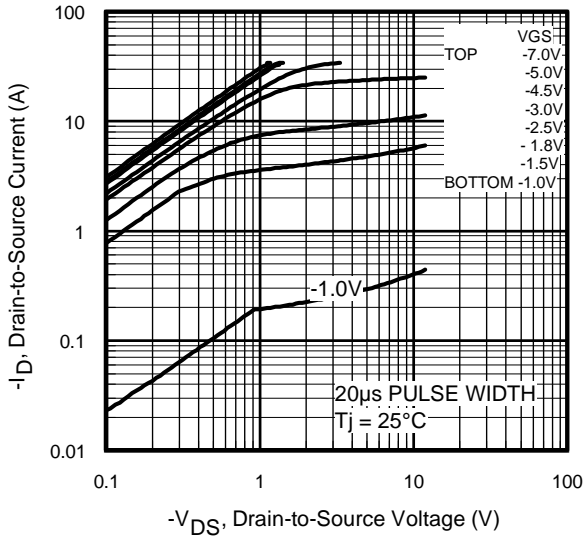
	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)DSS</sub>	Drain-to-Source Breakdown Voltage	-12	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA
ΔV <sub>(BR)DSS/ΔT<sub>J</sub></sub>	Breakdown Voltage Temp. Coefficient	—	-0.007	—	V/°C	Reference to 25°C, I <sub>D</sub> = -1mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	—	0.050	Ω	V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -4.3A ②
		—	—	0.085		V <sub>GS</sub> = -2.5V, I <sub>D</sub> = -2.5A ②
		—	—	0.125		V <sub>GS</sub> = -1.8V, I <sub>D</sub> = -2.0A 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	8.6	—	—	S	V <sub>DS</sub> = -10V, I <sub>D</sub> = -4.3A
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	-1.0	μA	V <sub>DS</sub> = -12V, V <sub>GS</sub> = 0V
		—	—	-25		V <sub>DS</sub> = -9.6V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 55°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	-100	nA	V <sub>GS</sub> = -8.0V
	Gate-to-Source Reverse Leakage	—	—	100		V <sub>GS</sub> = 8.0V
Q <sub>g</sub>	Total Gate Charge	—	10	15	nC	I <sub>D</sub> = -4.3A
Q <sub>gs</sub>	Gate-to-Source Charge	—	1.4	2.1		V <sub>DS</sub> = -10V
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	2.6	3.9		V <sub>GS</sub> = -5.0V ②
t <sub>d(on)</sub>	Turn-On Delay Time	—	11	—	ns	V <sub>DD</sub> = -6.0V
t <sub>r</sub>	Rise Time	—	32	—		I <sub>D</sub> = -1.0A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	250	—		R <sub>D</sub> = 6.0Ω
t <sub>f</sub>	Fall Time	—	210	—		R <sub>G</sub> = 89Ω ②
C <sub>iss</sub>	Input Capacitance	—	830	—	pF	V <sub>GS</sub> = 0V
C <sub>oss</sub>	Output Capacitance	—	180	—		V <sub>DS</sub> = -10V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	125	—		f = 1.0MHz

## Source-Drain Ratings and Characteristics

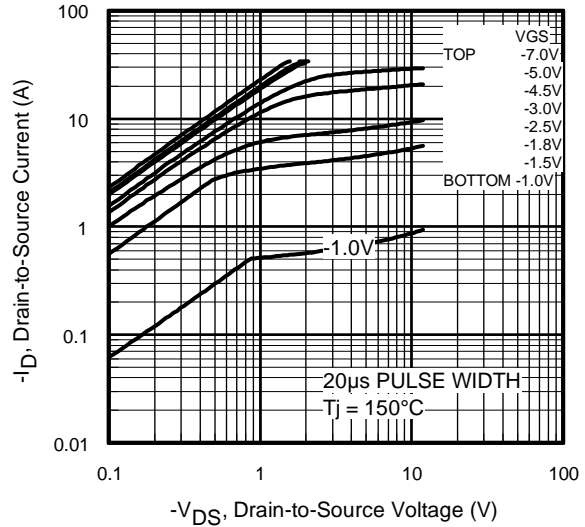
	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	-1.3	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	-34		
V <sub>SD</sub>	Diode Forward Voltage	—	—	-1.2	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = -1.3A, V <sub>GS</sub> = 0V ②
t <sub>rr</sub>	Reverse Recovery Time	—	22	33	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = -1.3A
Q <sub>rr</sub>	Reverse Recovery Charge	—	8.0	12	nC	di/dt = -100A/μs ②

### Notes:

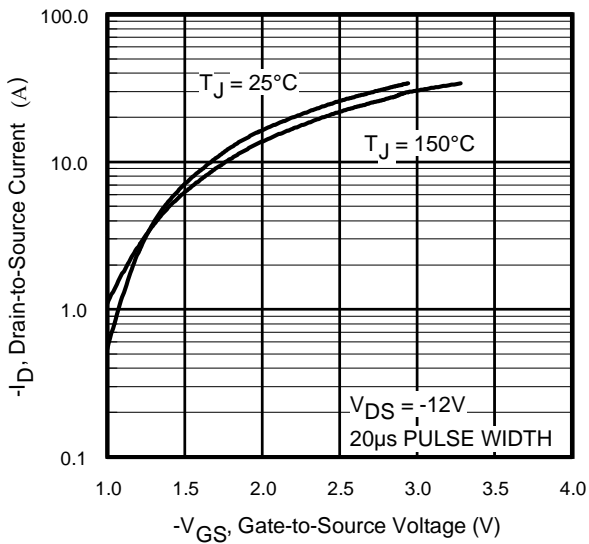
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Pulse width ≤ 300μs; duty cycle ≤ 2%.
- ③ Surface mounted on 1" square single layer 1oz. copper FR4 board, steady state.
- ④ Starting T<sub>J</sub> = 25°C, L = 3.5mH  
R<sub>G</sub> = 25Ω, I<sub>AS</sub> = -4.3A.



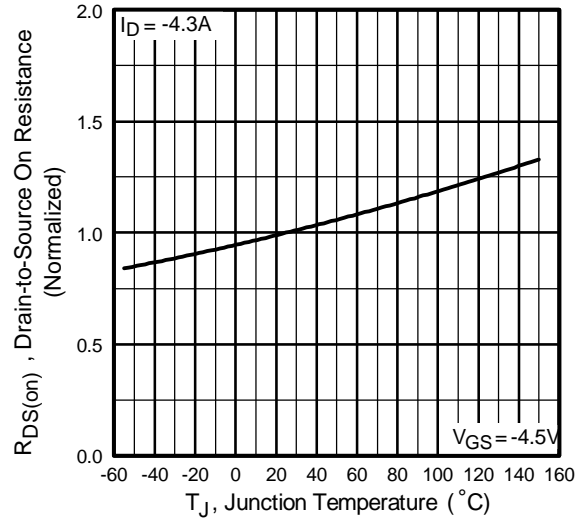
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics

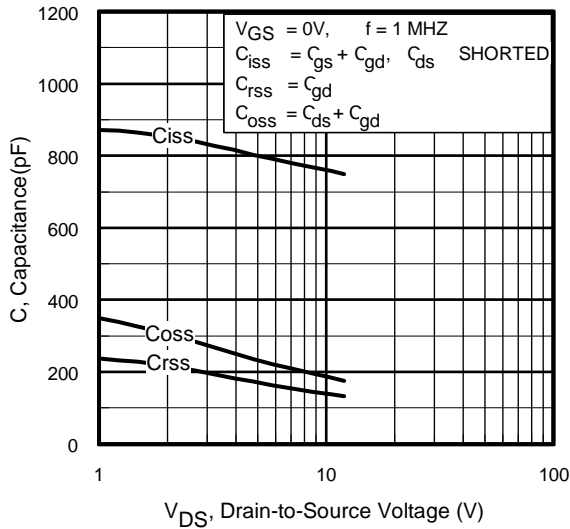


**Fig 3.** Typical Transfer Characteristics

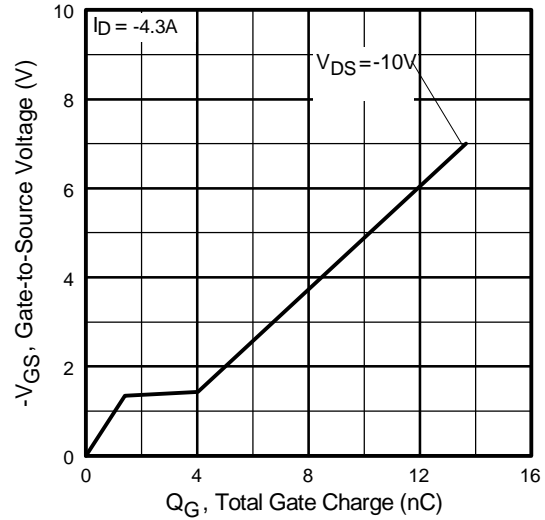


**Fig 4.** Normalized On-Resistance Vs. Temperature

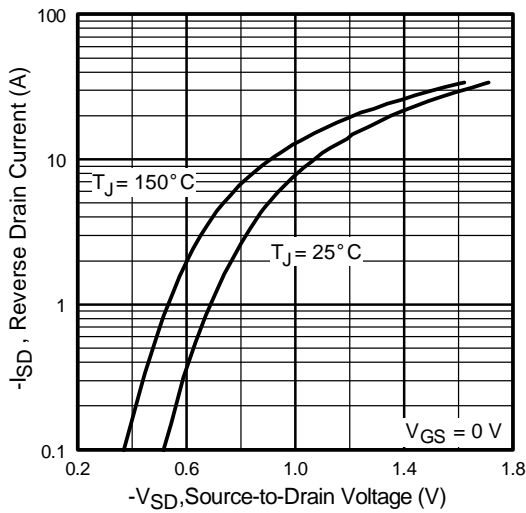
# IRLML6401



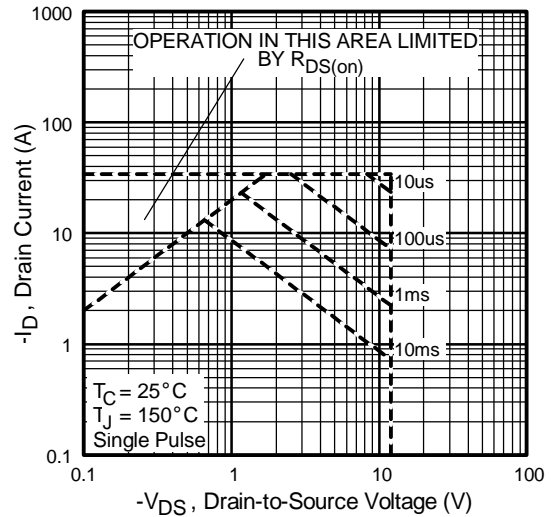
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



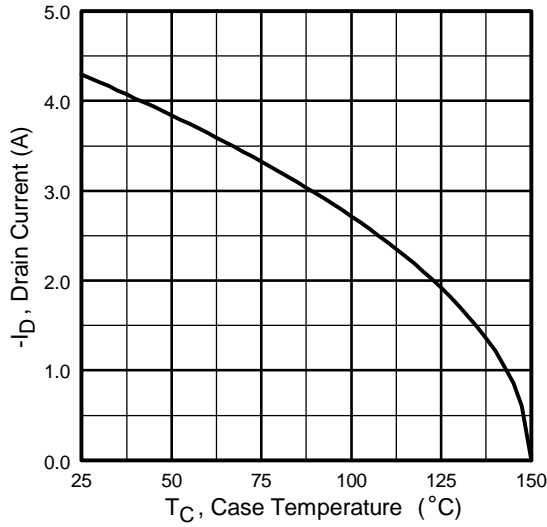
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



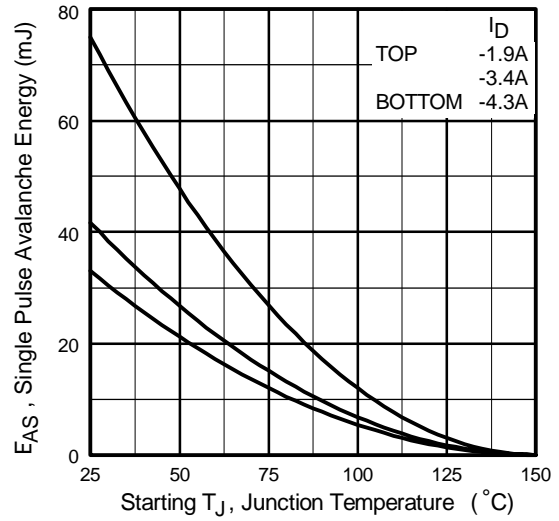
**Fig 7.** Typical Source-Drain Diode Forward Voltage



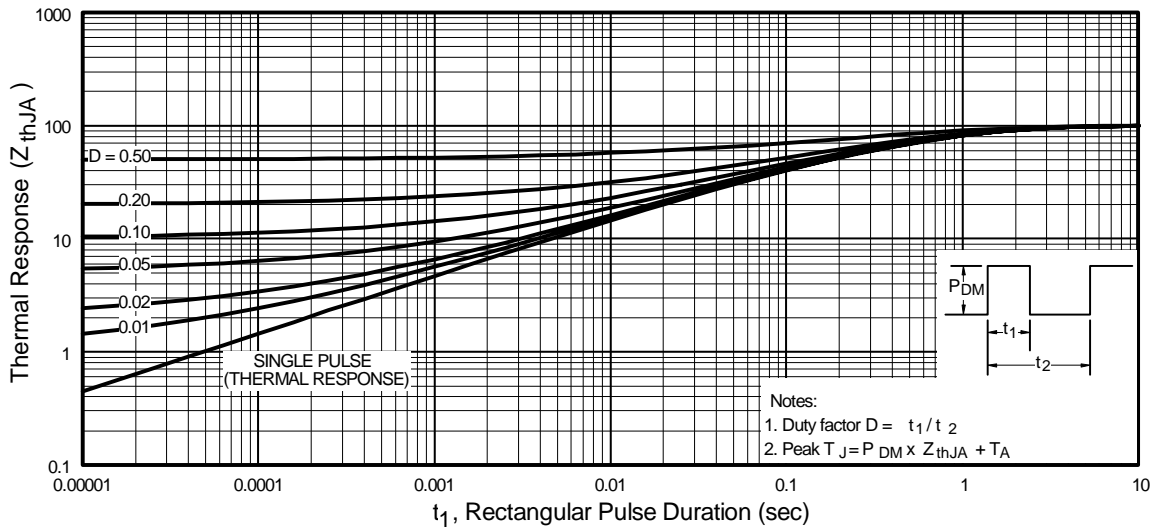
**Fig 8.** Maximum Safe Operating Area



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

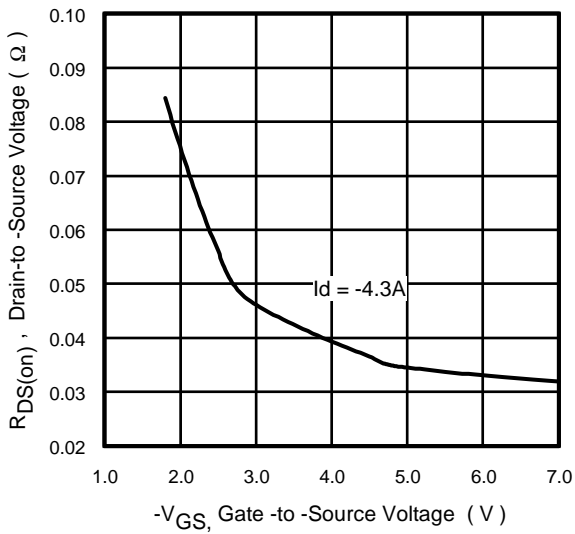


**Fig 10.** Maximum Avalanche Energy Vs. Drain Current

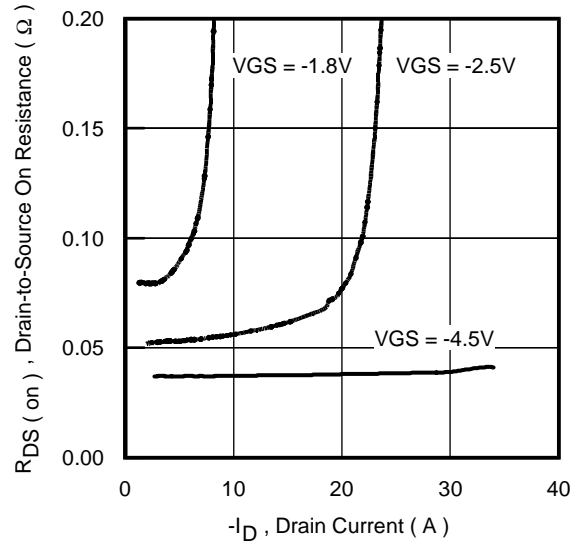


**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

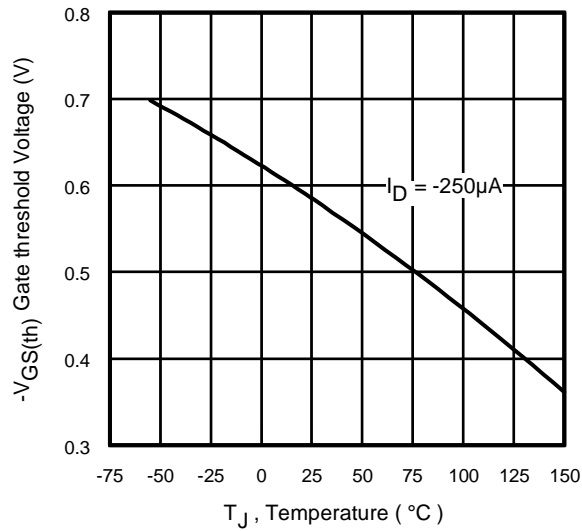
# IRLML6401



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



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



**Fig 14.** Typical Threshold Voltage Vs. Junction Temperature

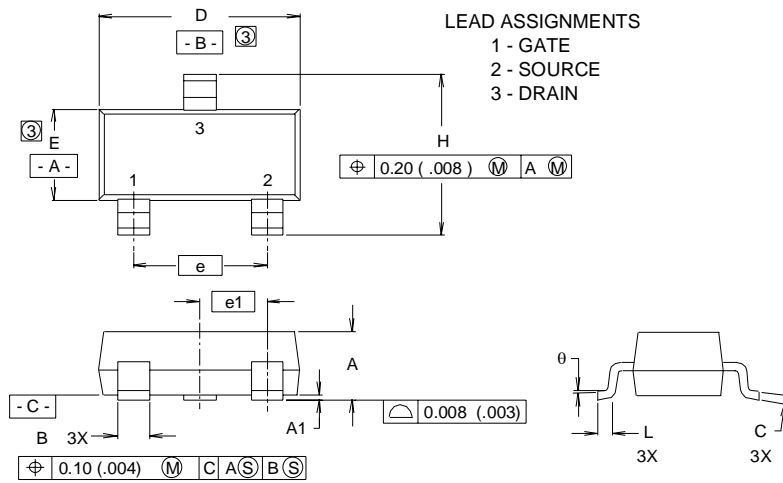


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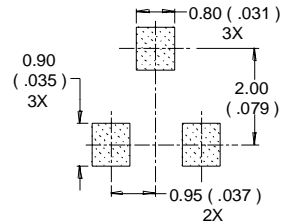
## Micro3™ Package Outline

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.

# IRLML6401

## Part Marking Information

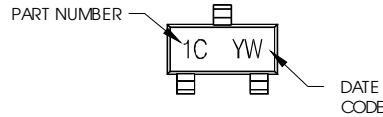
Micro3™



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

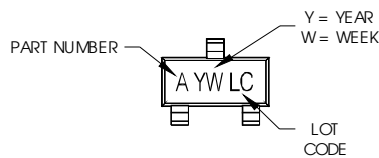
YEAR	Y	WORK WEEK	W
2001	1	01	A
2002	2	02	B
2003	3	03	C
1994	4	04	D
1995	5		
1996	6		
1997	7		
1998	8		
1999	9		
2000	0	24	X
		25	Y
		26	Z

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





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MAIN SITE(China):

**SHENZHEN CYT OPTO-ELECTRONIC TECHNOLOGY CO.,LTD.**

Address: Rm201-205, Building 4, Software park, Gaoxin center 2nd Rd, Nanshan District, Shenzhen

TEL:+86-755-86168222 FAX:+86-755-86168622 Technical support:+86-755-86169530

Business mail address: [cyt@szcyt.com](mailto:cyt@szcyt.com) Website: [www.szcyt.com](http://www.szcyt.com)