

IRLML2502GTRPBF-VB Datasheet

N-Channel 20 V (D-S) MOSFET

PRODUCT SUMMARY

V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A) ^e	Q_g (Typ.)
20	0.022 at $V_{GS} = 4.5$ V	6 ^a	8.8 nC
	0.028 at $V_{GS} = 2.5$ V	6 ^a	
	0.039 at $V_{GS} = 1.8$ V	5.6	

FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Trench Power MOSFET
- 100 % R_g Tested
- Compliant to RoHS Directive 2002/95/EC



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- DC/DC Converters
- Load Switch for Portable Applications



ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V_{DS}	20	V
Gate-Source Voltage	V_{GS}	± 12	
Continuous Drain Current ($T_J = 150$ °C)	$T_C = 25$ °C	6 ^a	A
	$T_C = 70$ °C	5.1	
	$T_A = 25$ °C	5 ^{b, c}	
	$T_A = 70$ °C	4 ^{b, c}	
Pulsed Drain Current	I_{DM}	20	
Continuous Source-Drain Diode Current	$T_C = 25$ °C	1.75	
	$T_A = 25$ °C	1.04 ^{b, c}	
Maximum Power Dissipation	$T_C = 25$ °C	2.1	W
	$T_C = 70$ °C	1.3	
	$T_A = 25$ °C	1.25 ^{b, c}	
	$T_A = 70$ °C	0.8 ^{b, c}	
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to 150	°C
Soldering Recommendations (Peak Temperature)		260	

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient ^{b, d}	R_{thJA}	80	100	°C/W
Maximum Junction-to-Foot (Drain)	R_{thJF}	40	60	

Notes:

- Package limited
- Surface Mounted on 1" x 1" FR4 board.
- $t = 5$ s.
- Maximum under steady state conditions is 125 °C/W.
- Based on $T_C = 25$ °C.

SPECIFICATIONS T _J = 25 °C, unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = 250 μA	20			V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	I _D = 250 μA		25		mV/°C
V _{GS(th)} Temperature Coefficient	ΔV _{GS(th)} /T _J			- 2.6		
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA	0.45		1.0	V
Gate-Source Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 8 V			± 100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 20 V, V _{GS} = 0 V			1	μA
		V _{DS} = 20 V, V _{GS} = 0 V, T _J = 70 °C			10	
On-State Drain Current ^a	I _{D(on)}	V _{DS} ≤ 5 V, V _{GS} = 4.5 V	20			A
Drain-Source On-State Resistance ^a	R _{DS(on)}	V _{GS} = 4.5 V, I _D = 5.0 A		0.022		Ω
		V _{GS} = 2.5 V, I _D = 4.7 A		0.028		
		V _{GS} = 1.8 V, I _D = 4.3 A		0.039		
Forward Transconductance ^a	g _{fs}	V _{DS} = 10 V, I _D = 5.0 A		24		S
Dynamic ^b						
Input Capacitance	C _{iss}	V _{DS} = 10 V, V _{GS} = 0 V, f = 1 MHz		865		pF
Output Capacitance	C _{oss}			105		
Reverse Transfer Capacitance	C _{rss}			55		
Total Gate Charge	Q _g	V _{DS} = 10 V, V _{GS} = 5 V, I _D = 5.0 A		12	18	nC
		V _{DS} = 10 V, V _{GS} = 4.5 V, I _D = 5.0 A		8.8	14	
Gate-Source Charge	Q _{gs}			1.1		
Gate-Drain Charge	Q _{gd}			0.7		
Gate Resistance	R _g	f = 1 MHz	0.5	2.4	4.8	Ω
Turn-On Delay Time	t _{d(on)}	V _{DD} = 10 V, R _L = 2.2 Ω I _D ≅ 4 A, V _{GEN} = 4.5 V, R _g = 1 Ω		8	16	ns
Rise Time	t _r			17	26	
Turn-Off Delay Time	t _{d(off)}			31	47	
Fall Time	t _f			8	16	
Turn-On Delay Time	t _{d(on)}	V _{DD} = 10 V, R _L = 2.2 Ω I _D ≅ 4 A, V _{GEN} = 5 V, R _g = 1 Ω		5	10	
Rise Time	t _r			13	20	
Turn-Off Delay Time	t _{d(off)}			21	32	
Fall Time	t _f			6	12	
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I _S	T _C = 25 °C			1.75	A
Pulse Diode Forward Current	I _{SM}				20	
Body Diode Voltage	V _{SD}	I _S = 4 A, V _{GS} = 0 V		0.75	1.2	V
Body Diode Reverse Recovery Time	t _{rr}	I _F = 4 A, dI/dt = 100 A/μs, T _J = 25 °C		12	20	ns
Body Diode Reverse Recovery Charge	Q _{rr}			5	10	nC
Reverse Recovery Fall Time	t _a			7		ns
Reverse Recovery Rise Time	t _b			5		

Notes:

a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$

b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Output Characteristics



Transfer Characteristics



On-Resistance vs. Drain Current and Gate Voltage



Capacitance



Gate Charge



On-Resistance vs. Junction Temperature

Figure 10-10 is a graph showing the drain current (I_S - Source Current in Amperes) versus the drain-source voltage (V_{SD} - Source-to-Drain Voltage in Volts) for the 2N3866 JFET. The y-axis is logarithmic, ranging from 0.1 to 100 A. The x-axis is linear, ranging from 0.0 to 1.2 V. Two curves are plotted for different temperatures:

- $T_J = 150\text{ }^{\circ}\text{C}$ (Upper curve)
- $T_J = 25\text{ }^{\circ}\text{C}$ (Lower curve)

The graph illustrates that the drain current increases with both drain-source voltage and temperature. The 150 °C curve is consistently higher than the 25 °C curve for a given voltage.

Figure 10 is a line graph showing the relationship between On-Resistance ($R_{DS(on)}$) and Gate-to-Source Voltage (V_{GS}) for a MOSFET at a constant drain current $I_D = 5\text{ A}$. The y-axis represents $R_{DS(on)}$ in Ohms (Ω), ranging from 0.02 to 0.06. The x-axis represents V_{GS} in Volts (V), ranging from 0 to 8. Two curves are plotted for different temperatures: $T_J = 125\text{ }^{\circ}\text{C}$ (upper curve) and $T_J = 25\text{ }^{\circ}\text{C}$ (lower curve). Both curves show a sharp decrease in on-resistance as V_{GS} increases from 1 V to 2 V, followed by a more gradual decrease. The on-resistance is higher at $125\text{ }^{\circ}\text{C}$ than at $25\text{ }^{\circ}\text{C}$ for any given V_{GS} .

V_{GS} (V)	$R_{DS(on)}$ (Ω) at $T_J = 125\text{ }^{\circ}\text{C}$	$R_{DS(on)}$ (Ω) at $T_J = 25\text{ }^{\circ}\text{C}$
1.5	> 0.06	> 0.06
2.0	0.048	0.032
3.0	0.042	0.028
4.0	0.039	0.027
6.0	0.037	0.026
8.0	0.036	0.025

T_J (°C)	$V_{GS(th)}$ (V)
-50	0.78
0	0.68
50	0.58
100	0.48
150	0.28

A line graph showing the power dissipation of a 100 W incandescent lamp over time. The vertical axis is labeled 'Power (W)' and ranges from 0 to 32 with major grid lines every 8 units. The horizontal axis is labeled 'Time (s)' and is on a logarithmic scale with major ticks at 0.001, 0.01, 0.1, 1, 10, and 100. The curve starts at 32 W at 0.001 s and decreases rapidly, passing through approximately 16 W at 0.01 s, 8 W at 0.1 s, and 4 W at 1 s. It continues to decay more slowly, reaching approximately 1 W at 100 s.

Time (s)	Power (W)
0.001	32
0.01	16
0.1	8
1	4
10	2
100	1

Figure 10 is a log-log plot showing the Power Dissipation Characteristics of the device. The Y-axis represents Drain Current (I_D) in Amperes (A), ranging from 0.01 to 100. The X-axis represents Drain-to-Source Voltage (V_{DS}) in Volts (V), ranging from 0.1 to 100. The plot is for $T_A = 25^\circ\text{C}$ and Single Pulse.

The plot shows two main regions of operation:

- Limited by $R_{DS(on)}$ ***: This region is defined by the solid line, which is horizontal at $I_D = 5\text{ A}$ for $V_{DS} < 0.1\text{ V}$, then rises linearly to $I_D = 15\text{ A}$ at $V_{DS} = 1\text{ V}$, and then falls linearly to $I_D = 0.1\text{ A}$ at $V_{DS} = 10\text{ V}$.
- BVDSS Limited**: This region is defined by the dashed line, which is horizontal at $I_D = 15\text{ A}$ for $V_{DS} < 1\text{ V}$, then falls linearly to $I_D = 0.1\text{ A}$ at $V_{DS} = 10\text{ V}$.

The plot is divided into regions for different pulse widths, indicated by the dashed lines:

- 100 μs
- 1 ms
- 10 ms
- 100 ms
- 1 s, 10 s
- DC

* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

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TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Current Derating*



Power Derating, Junction-to-Foot



Power Derating, Junction-to-Ambient

* The power dissipation P_D is based on $T_{J(max)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



SOT-23 (TO-236): 3-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	0.89	1.12	0.035	0.044
A ₁	0.01	0.10	0.0004	0.004
A ₂	0.88	1.02	0.0346	0.040
b	0.35	0.50	0.014	0.020
c	0.085	0.18	0.003	0.007
D	2.80	3.04	0.110	0.120
E	2.10	2.64	0.083	0.104
E ₁	1.20	1.40	0.047	0.055
e	0.95 BSC		0.0374 Ref	
e ₁	1.90 BSC		0.0748 Ref	
L	0.40	0.60	0.016	0.024
L ₁	0.64 Ref		0.025 Ref	
S	0.50 Ref		0.020 Ref	
q	3°	8°	3°	8°

ECN: S-03946-Rev. K, 09-Jul-01
DWG: 5479

RECOMMENDED MINIMUM PADS FOR SOT-23



Recommended Minimum Pads
Dimensions in Inches/(mm)

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