

# FULLY PROTECTED POWER MOSFET SWITCH

# IRSF3021

## Features

- Controlled Slew Rate Reduces EMI
- Over Temperature Protection with Auto-Restart
- Linear Current-Limit Protection
- Active Drain-to-Source Clamp
- ESD Protection
- Compatible with Standard Power MOSFET
- Low Operating Input Current
- Monolithic Construction
- Logic Level Input Threshold

## Description

The IRSF3021 Lamp and DC Motor Driver is a fully protected three terminal monolithic SMART POWER MOSFET that features current limiting, over-temperature protection, gate-to-source ESD protection and gate-to-drain clamp for over-voltage protection.

The on-chip protection circuit limits the drain current in the on-state. The over-temperature circuitry turns off the POWER MOSFET when the junction temperature exceeds 165°C. The device restarts automatically once it has cooled down below the reset temperature.

The IRSF3021 is specifically designed for driving loads that require overload protection and in-rush current control while operating in automotive and industrial environments. Targeted applications include resistive loads such as lamps or capacitive loads such as airbag squibs and DC motor drives.

$V_{ds}(\text{clamp})$	50 V
$R_{ds}(\text{on})$	200 mΩ
$I_{lim}$	3.0 A
$T_{j}(\text{sd})$	165°C
EAS	200 mJ

## Applications

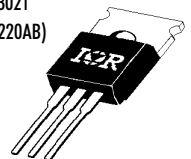
- Cabin Lighting
- Airbag System
- Programmable Logic Controller
- DC Motor Drive

## Available Packages

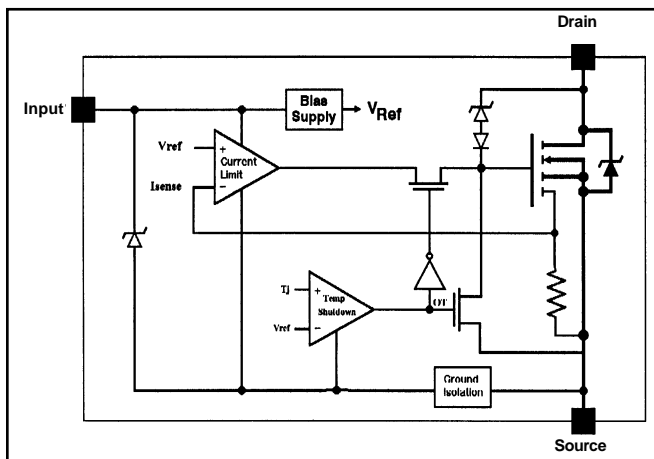
IRSF3021L  
(SOT-223)



IRSF3021  
(TO-220AB)



## IRSF3021 Block Diagram



## Absolute Maximum Ratings

Absolute Maximum Ratings indicate sustained limits beyond which damage to the device may occur. ( $T_c = 25^\circ\text{C}$  unless otherwise specified.)

		Minimum	Maximum	Units	Test Conditions
V <sub>ds, max</sub>	Continuous Drain to Source Voltage	—	50	V	
V <sub>in, max</sub>	Continuous Input Voltage	-0.3	8		
I <sub>ds</sub>	Continuous Drain Current	—	self limited		
P <sub>d</sub>	Power Dissipation	—	30	W	T <sub>c</sub> ≤ 25°C
EAS	Unclamped Single Pulse Inductive Energy	—	200	mJ	
V <sub>esd1</sub>	Electrostatic Discharge Voltage (Human Body Model)	—	4000	V	1000pF, 1.5kΩ
V <sub>esd2</sub>	Electrostatic Discharge Voltage (Machine Model)	—	1000		200pF, 0Ω
T <sub>JOP</sub>	Operating Junction Temperature Range	-40	self-limited	°C	
T <sub>Stg</sub>	Storage Temperature Range	-40	175		
T <sub>L</sub>	Lead Temperature (Soldering, 10 seconds)	—	300		

## Static Electrical Characteristics

(T<sub>c</sub> = 25°C unless otherwise specified.)

		Minimum	Typical	Maximum	Units	Test Conditions
V <sub>ds, clamp</sub>	Drain to Source Clamp Voltage	50	56	65	V	I <sub>ds</sub> = 6A, t <sub>p</sub> = 700 μs
R <sub>ds(on)</sub>	Drain to Source On Resistance	—	155	200	mΩ	V <sub>in</sub> = 5V, I <sub>ds</sub> = 2A
I <sub>dss</sub>	Drain to Source Leakage Current	—	—	250	μA	V <sub>ds</sub> = 40V, V <sub>in</sub> = 0V
V <sub>th</sub>	Input Threshold Voltage	1.0	2.0	3.0	V	V <sub>ds</sub> = V <sub>in</sub> , I <sub>ds</sub> + I <sub>in</sub> = 10mA
I <sub>i, on</sub>	Input Supply Current (Normal Operation)	—	100	300	μA	V <sub>in</sub> = 5V
I <sub>i, off</sub>	Input Supply Current (Protection Mode)	—	500	—	μA	V <sub>in</sub> = 5V
V <sub>in, clamp</sub>	Input Clamp Voltage	9	10	—	V	I <sub>in</sub> = 1mA
V <sub>sd</sub>	Body-Drain Diode Forward Drop <sup>②</sup>	—	1.5	—	V	I <sub>ds</sub> = -2A, R <sub>in</sub> = 1kΩ

## Thermal Characteristics

		Minimum	Typical	Maximum	Units	Test Conditions
R <sub>θjc</sub>	Junction to Case	—	—	4	°C/W	TO-220AB
R <sub>θjA</sub>	Junction to Ambient	—	—	60		
R <sub>θjc</sub>	Junction to PCB	—	—	40	°C/W	SOT-223
R <sub>θjA</sub>	Junction to PCB <sup>①</sup>	—	—	60		

## Switching Electrical Characteristics

(V<sub>CC</sub> = 14V, Resistive Load (R<sub>L</sub>) = 10Ω, R<sub>in</sub> = 100Ω. Specifications measured at T<sub>c</sub> = 25°C unless otherwise specified.)

		Minimum	Typical	Maximum	Units	Test Conditions
t <sub>don</sub>	Turn-On Delay Time	—	10	50	μs	V <sub>in</sub> = 0V to 5V, 50% to 90%
t <sub>r</sub>	Rise Time	—	30	80		V <sub>in</sub> = 0V to 5V, 90% to 10%
t <sub>doff</sub>	Turn-Off Delay Time	—	20	60		V <sub>in</sub> = 0V to 5V, 50% to 10%
t <sub>f</sub>	Fall Time	—	15	50		V <sub>in</sub> = 0V to 5V, 10% to 90%
SR	Output Positive Slew Rate	-4	—	4	V/μs	V <sub>in</sub> = 0V to 5V, +dV <sub>ds</sub> /dt
SR	Output Positive Slew Rate	-4	—	4		V <sub>in</sub> = 0V to 5V, -dV <sub>ds</sub> /dt

## Protection Characteristics

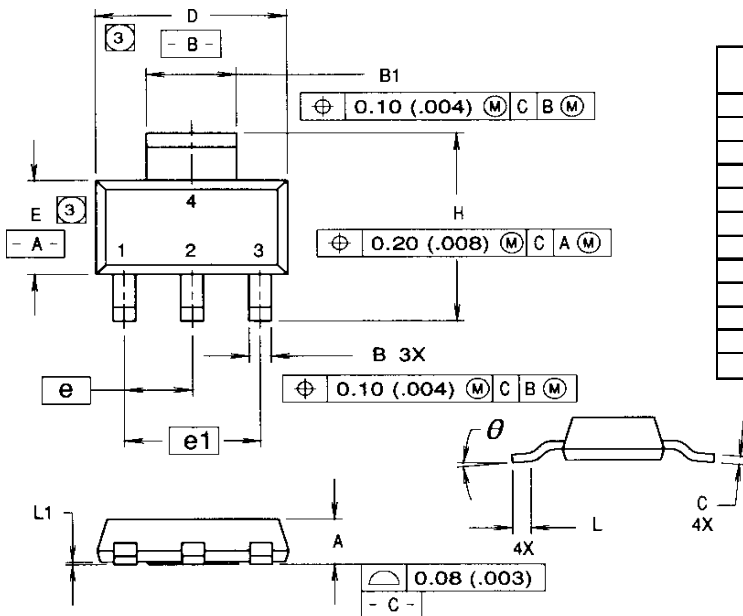
( $T_C = 25\text{ }^\circ\text{C}$  unless otherwise specified. Min/Max specifications are for  $T_C = -40\text{ }^\circ\text{C}$  to  $T_C = +125\text{ }^\circ\text{C}$  unless otherwise specified.)

		Minimum	Typical	Maximum	Units	Test Conditions
$I_{ds(sd)}$	Current Limit	3.0	5.5	8.0	A	$V_{in} = 5V, V_{DS} = 14V$
$T_{j(sd)}$	Over Temperature Shutdown Threshold	155	165	—	$^\circ\text{C}$	$V_{in} = 5V, I_{ds} = 2A$
$V_{protect}$	Min. Input Voltage for Over-temp function	—	3	—	V	
$t_{Iresp}$	Current Limit Response Time	—	TBD	—	$\mu\text{s}$	
$I_{peak}$	Peak Short Circuit Current	—	10	—	A	
$t_{Tresp}$	Over-Temperature Response Time	—	TBD	—	$\mu\text{s}$	

### Notes:

- ① When mounted on a 1" square PCB (FR-4 or G10 material). For recommended footprint and soldering techniques, refer to International Rectifier Application Note AN-994.
- ②  $E_{AS}$  is tested with a constant current source of 6A applied for 700 $\mu\text{s}$  with  $V_{in} = 0V$  and starting  $T_j = 25\text{ }^\circ\text{C}$ .
- ③ Input current must be limited to less than 5mA with a 1k $\Omega$  resistor in series with the input when the Body-Drain Diode is forward biased.

## Case Outline — SOT-223 (IRSF3021L)



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.55	1.80	0.061	0.071
B	0.65	0.85	0.026	0.033
B1	2.95	3.15	0.116	0.124
C	0.25	0.35	0.010	0.014
D	6.30	6.70	0.248	0.264
E	3.30	3.70	0.130	0.146
e	2.30 BSC		.0905 BSC	
e1	4.60 BSC		0.181 BSC	
H	6.71	7.29	0.287	0.264
L	—	0.91	—	0.036
L1	0.02	0.10	0.0006	0.004
θ	10° MAX		10° MAX	

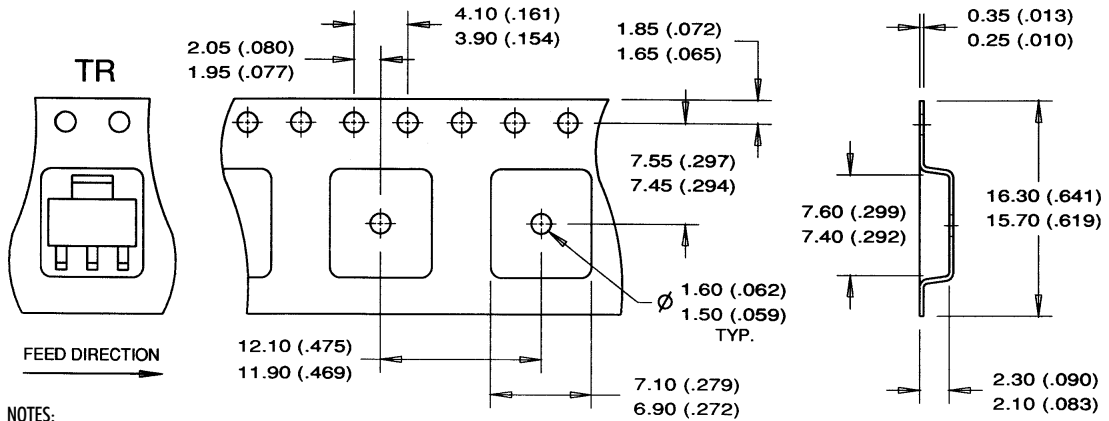
### NOTES:

1. Dimensioning and tolerancing per ANSI Y14.5M, 1982
2. Controlling dimension: INCH
3. Dimensions do not include lead flash
4. Conforms to JEDEC outline TO-261AA

### LEAD ASSIGNMENTS

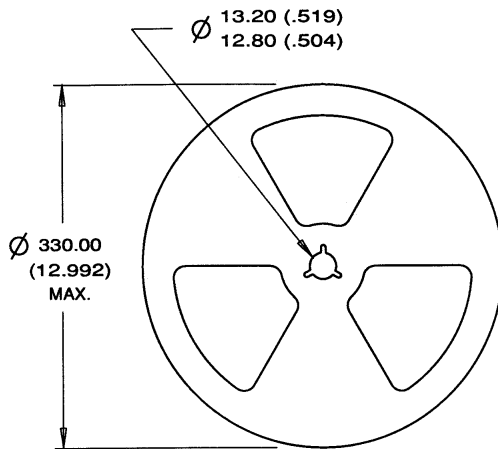
1. Gate
2. Drain
3. Source
4. Drain

**Tape and Reel — SOT-223 (IRSF3021L)**



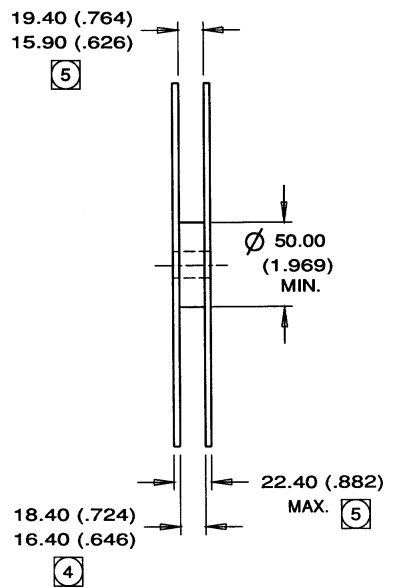
**NOTES:**

1. Controlling dimension: MILLIMETER
2. Conforms to outline EIA-481 and EIA-541
3. Each  $\phi$  330.00 (13.00) reel contains 2,500 devices.

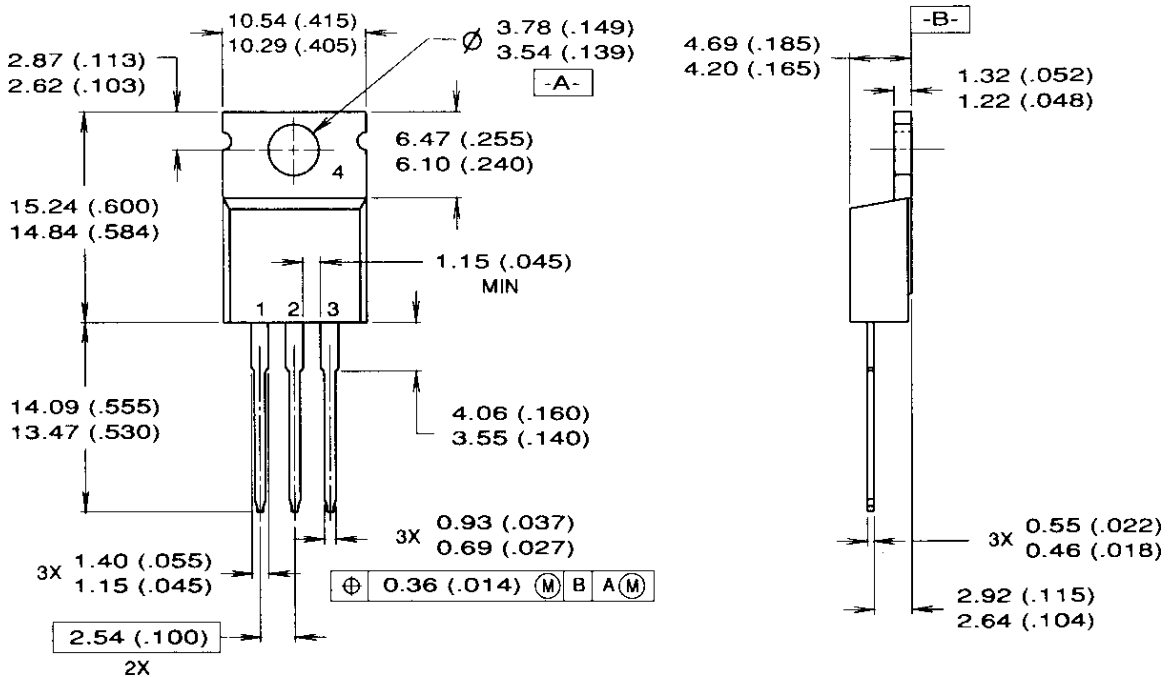


**NOTES:**

1. Controlling dimension: MILLIMETER
2. Conforms to outline EIA-481-1
- ③ Dimension measured at hub
- ④ Includes flange distortion at outer edge



## Case Outline — TO-220AB (IRSF3021)



### NOTES:

1. Dimensioning and tolerancing per ANSI Y14.5M, 1982
2. Controlling dimension: INCH
3. Dimensions shown are in millimeters (inches)
4. Conforms to JEDEC outline TO-251AA
5. Dimension does not include solder dip. Solder dip max. +0.16 (.006)

### LEAD ASSIGNMENTS

1. Gate
2. Drain
3. Source
4. Drain