

## IR3313(S)PbF

### PROGRAMMABLE CURRENT SENSE HIGH SIDE SWITCH

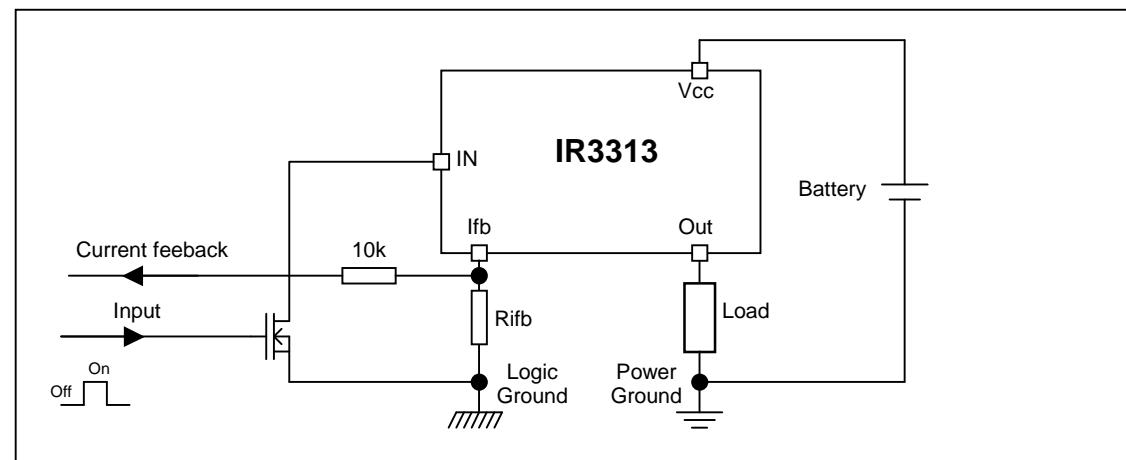
#### Features

- Load current feedback
- Programmable over current shutdown
- Active clamp
- ESD protection
- Input referenced to Vcc
- Over temperature shutdown
- Reverse battery protection

#### Description

The IR3313(S)PbF is a fully protected 4 terminals high side switch. The input signal is referenced to Vcc. When the input voltage Vcc - Vin is higher than the specified threshold, the output power Mosfet is turned on. When the Vcc - Vin is lower than the specified Vil threshold, the output Mosfet is turned off. A current proportional to the power Mosfet current is sourced to the Ifb pin. Over current shutdown occurs when Vst-Vin > 4.5V. The current shutdown threshold is adjusted by selecting the proper RIfb. Either over current and over temperature latches off the switch. The device is reset by pulling the input pin high. Other integrated protections (ESD, reverse battery, active clamp) make the switch very rugged in automotive environment.

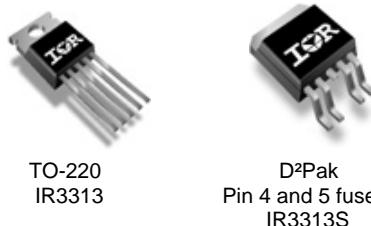
#### Typical Connection



#### Product Summary

Rds(on)	7 mΩ max.
Vcc op.	6 to 32V
Current Ratio	8800
Prog. Ishutdown	10 to 90A
Vclamp	40V

#### Packages



## Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are referenced to Vcc lead. (T<sub>ambient</sub>=25°C unless otherwise specified).

Symbol	Parameter	Min.	Max.	Units
Vcc-Vin	Maximum Vcc voltage	-16	37	V
Vcc-Vin cont.	Maximum continuous Vcc voltage	-16	32	
Vcc-Vfb	Maximum Ifb voltage	-16	33	
Vcc-Vout	Maximum output voltage	-0.3	37	
Ids cont.	Maximum body diode continuous current R <sub>th</sub> =60°C/W (1)	—	2.8	A
Ids pulsed	Maximum body diode pulsed current (1)	—	100	
Pd	Maximum power dissipation R <sub>th</sub> =60°C/W	—	2	W
ESD1	Electrostatic discharge voltage (Human body) C=100pF, R=1500Ω	—	4	kV
ESD2	Electrostatic discharge voltage (Machine Model) C=200pF, R=0Ω	—	0.5	
T <sub>j</sub> max.	Max. storage & operating temperature junction temperature	-40	150	°C
Min R <sub>fb</sub>	Minimum on the resistor on Ifb pin	0.3	—	kΩ
Ifb max.	Max. Ifb current	-50	50	mA

(1) Limited by junction temperature. Pulsed is also limited by wiring

## Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
R <sub>th1</sub>	Thermal resistance junction to ambient D <sup>2</sup> -Pak Std footprint	60	—	°C/W
R <sub>th2</sub>	Thermal resistance junction to case D <sup>2</sup> -Pak	0.7	—	
R <sub>th2</sub>	Thermal resistance junction to case TO220	0.7	—	

## Recommended Operating Conditions

These values are given for a quick design. For operation outside these conditions, please consult the application notes.

Symbol	Parameter	Min.	Max.	Units
I <sub>out</sub>	Continuous output current	—	23	A
	T <sub>ambient</sub> =85°C, R <sub>th</sub> =5°C/W, T <sub>j</sub> =125°C			
	T <sub>ambient</sub> =85°C, R <sub>th</sub> =60°C/W, T <sub>j</sub> =125°C			
R <sub>ifb</sub>	Recommended Ifb resistor (2)(3)	0.3	3.5	kΩ
Pulse min.	Minimum turn-on pulse width	1	—	ms
Fmax.	Maximum operating frequency	—	200	Hz

2) If R<sub>ifb</sub> is too low, the device can be damaged.

3) If R<sub>ifb</sub> is too high, the device may not switch on.

## Protection Characteristics

T<sub>j</sub>=25°C, R<sub>ifb</sub>=500 to 3.5kΩ

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
V <sub>ifb</sub> -V <sub>in</sub> @I <sub>sd</sub>	Over-current shutdown threshold	4	4.7	5.6	V	
T <sub>sd</sub>	Over temperature threshold	—	165	—	°C	See fig. 5
OV	Over voltage protection (not latched)	33	35	39	V	
I <sub>sd</sub> f	Fixed over current shutdown	90	120	140	A	V <sub>ifb</sub> <V <sub>ifb</sub> -V <sub>in</sub> @I <sub>sd</sub>
I <sub>sd</sub> _1k	Programmable over current shutdown 1k	30	40	50		R <sub>ifb</sub> =1kΩ
T <sub>reset</sub>	Time to reset protection	—	50	500	μs	See fig. 5
Min. pulse	Min. pulse width (no WAIT state)	200	400	1200		
WAIT	WAIT function timer	0.4	1	2	ms	See fig. 4 and 5
R <sub>ds(on)</sub> rev.	Reverse battery On state resistance	4	6.7	10	mΩ	V <sub>cc</sub> -V <sub>in</sub> =-14V, I <sub>out</sub> =30A

## Static Electrical Characteristics

T<sub>j</sub>=25°C, V<sub>cc</sub>=14V (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
V <sub>cc</sub> op.	Operating Voltage range	6	—	32	V	
I <sub>cc</sub> off	Supply leakage current	—	1.5	5	μA	V <sub>in</sub> =V <sub>cc</sub> , V <sub>cc</sub> -V <sub>out</sub> =14V, V <sub>cc</sub> -V <sub>ifb</sub> =14V
I <sub>in</sub> , on	On state IN positive current	1.5	3	6	mA	V <sub>cc</sub> -V <sub>in</sub> =14V
V <sub>ih</sub>	High level Input threshold voltage (4)	—	5.4	6.2	V	
V <sub>il</sub>	Low level Input threshold voltage (4)	4	4.9	5.8		
V <sub>hyst</sub>	Input hysteresis V <sub>ih</sub> -V <sub>il</sub>	0.2	0.4	1		
I <sub>out</sub>	Drain to source leakage current	—	1.2	5	μA	V <sub>in</sub> =V <sub>cc</sub> , V <sub>cc</sub> -V <sub>ifb</sub> =0V, V <sub>cc</sub> -V <sub>out</sub> =14V
R <sub>ds(on)</sub>	On state resistance (5) T <sub>j</sub> =25°C	4	5.5	7	mΩ	I <sub>out</sub> =30A, V <sub>cc</sub> -V <sub>in</sub> =14V
	On state resistance (5) T <sub>j</sub> =25°C	4	6	10		I <sub>out</sub> =17A, V <sub>cc</sub> -V <sub>in</sub> =6V
	On state resistance (5)(6) T <sub>j</sub> =150°C	7	10.5	13.5		I <sub>out</sub> =30A, V <sub>cc</sub> -V <sub>in</sub> =14V
V clamp1	V <sub>cc</sub> to V <sub>out</sub> clamp voltage 1	36	39	—	V	I <sub>out</sub> =50mA
V clamp2	V <sub>cc</sub> to V <sub>out</sub> clamp voltage 2	—	40	43		I <sub>out</sub> =30A

(4) Input thresholds are measured directly between the input pin and the tab. Any parasitic resistance in common between the load current path and the input signal path can significantly affect the thresholds.

(5) Rdson is measured between the tab and the Out pin, 5mm away from the package.

(6) Guaranteed by design

## Switching Electrical Characteristics

V<sub>cc</sub>=14V, Resistive load=0.5Ω, T<sub>j</sub>=25°C

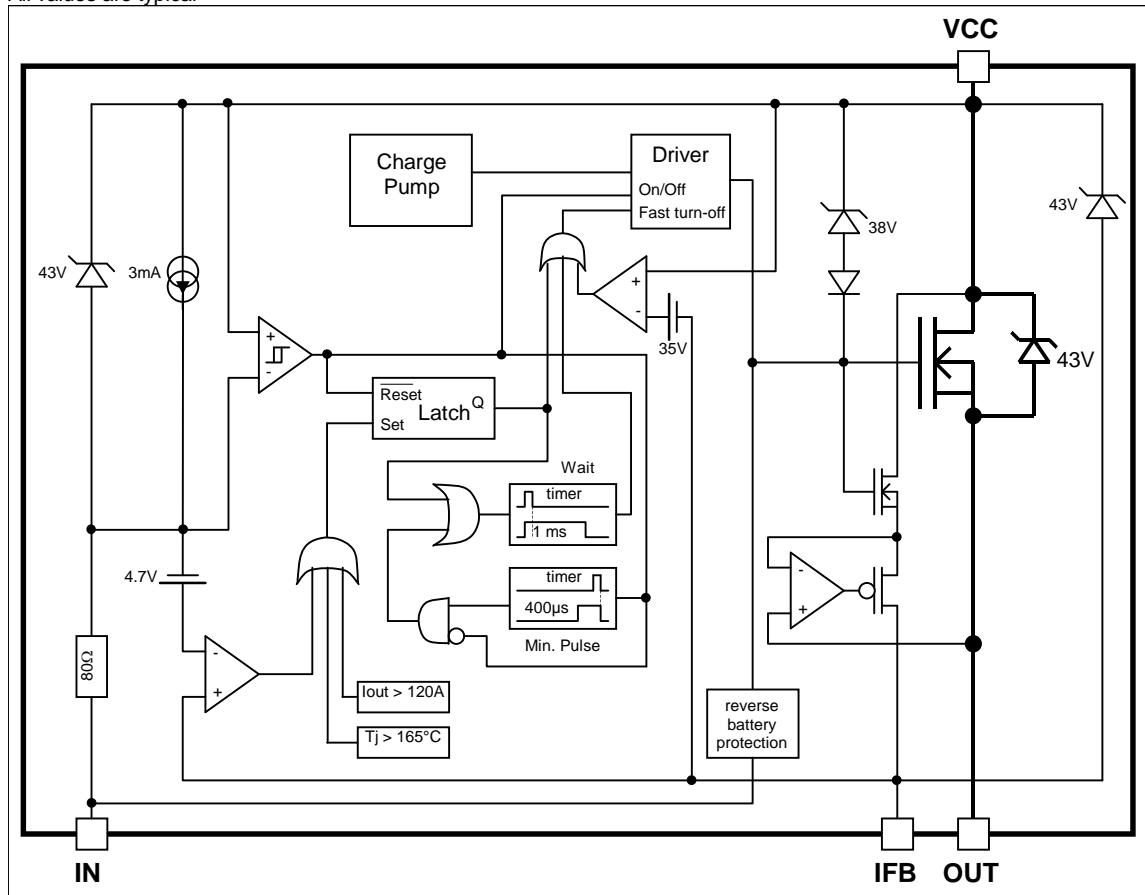
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
T <sub>d</sub> on	Turn on delay time to 10% V <sub>cc</sub>	8	32	80	μs	See figure 2
T <sub>r</sub> 1	Rise time to V <sub>cc</sub> -V <sub>out</sub> =5V	3	16	40		
T <sub>r</sub> 2	Rise time to V <sub>cc</sub> -V <sub>out</sub> =0.1V <sub>cc</sub>	10	40	100		
E <sub>on</sub>	Turn on energy	—	4.5	—		
T <sub>d</sub> off	Turn off delay time	20	80	200		
T <sub>f</sub>	Fall time to V <sub>out</sub> =10% of V <sub>cc</sub>	8	32	80		
E <sub>off</sub>	Turn off energy	—	2	—		

## Current Sense Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Ratio	I Load/lifb current ratio	7,500	8,800	9,950	—	T <sub>j</sub> =25°C, R <sub>fb</sub> =500Ω, I <sub>out</sub> =60A
Ratio_TC	I Load/lifb variation aver temperature(6)	-5	—	+5	%	T <sub>j</sub> =-40°C to 150°C
Offset	Load current diagnostic offset	-0.22	0	+0.2	A	I <sub>out</sub> =2A
Trst	lifb response time (low signal)	—	1	—	μs	90% of the I <sub>out</sub> step

## Functional Block Diagram

All values are typical



## Lead Assignments

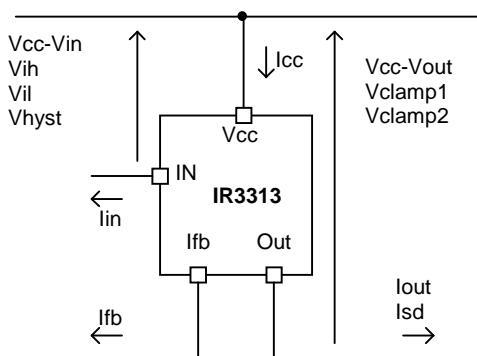
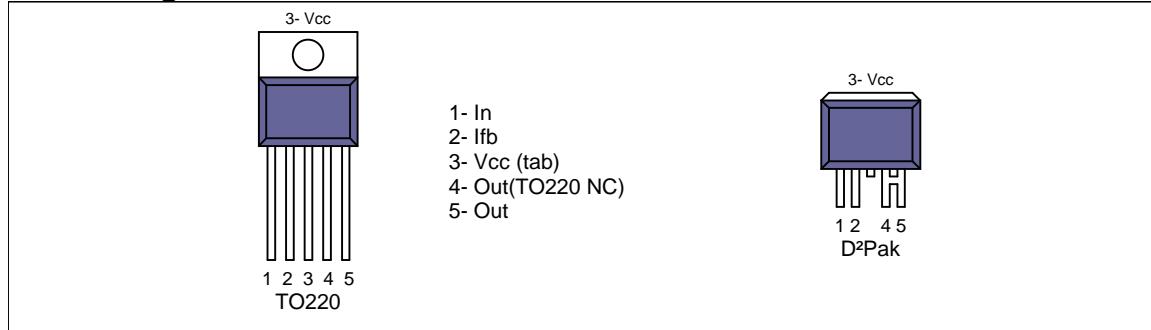


Figure 1 – Voltages and current definitions

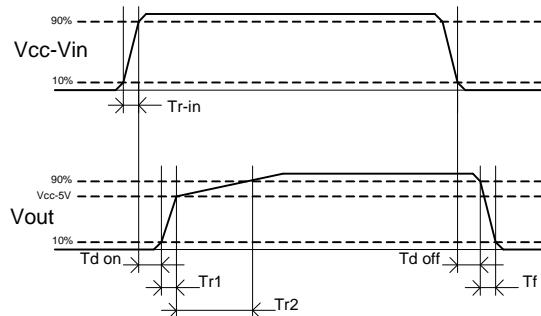
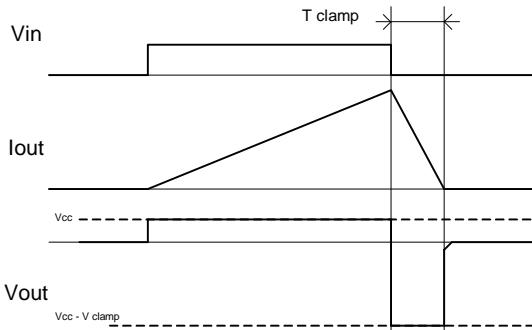
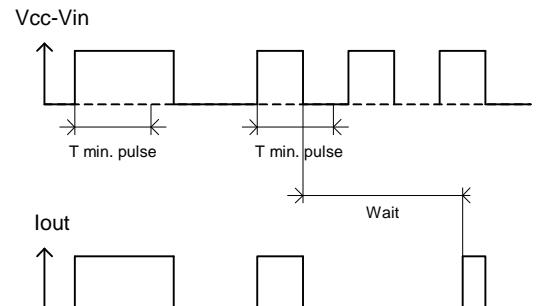


Figure 2 – Switching time definitions

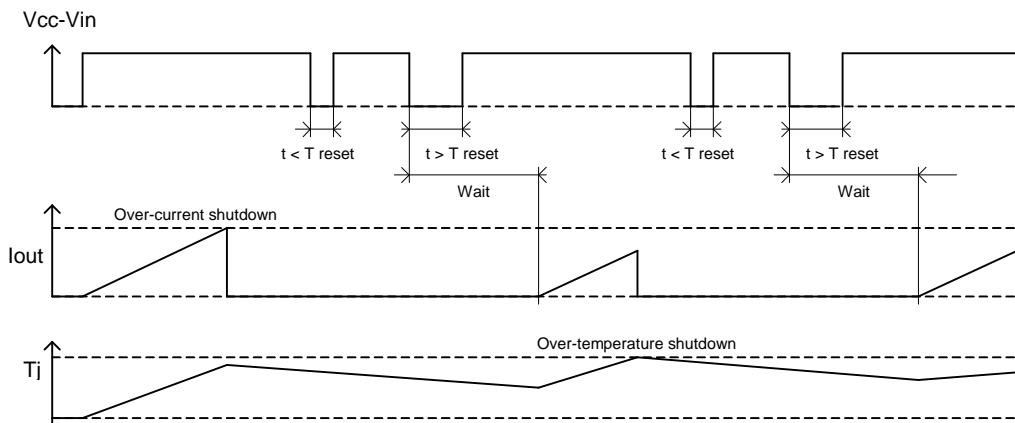


See Application Notes to evaluate power dissipation

**Figure 3 – Active clamp waveforms**

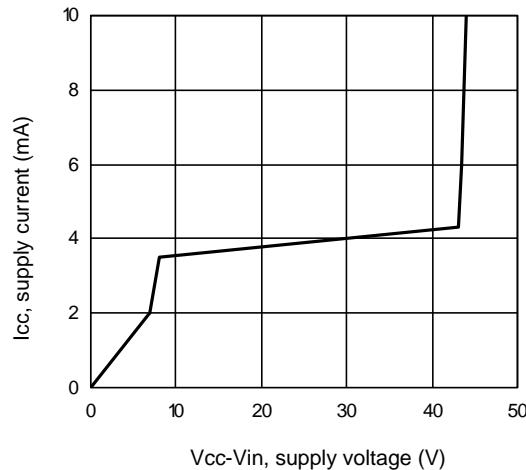


**Figure 4 – Min. pulse and Wait function**

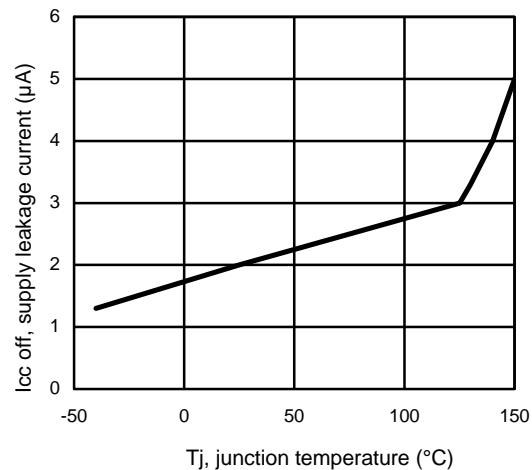


**Figure 5 – Protection Timing Diagrams**

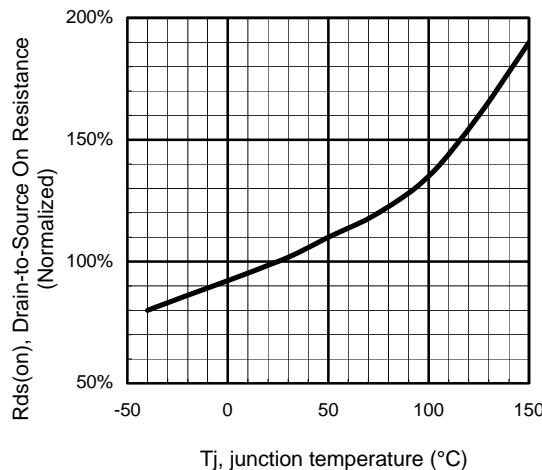
All curves are typical characteristics. Operation in hatched areas is not recommended.  $T_j=25^\circ\text{C}$ ,  $R_{ifb}=500\text{ohm}$ ,  $V_{cc}=14\text{V}$  (unless otherwise specified).



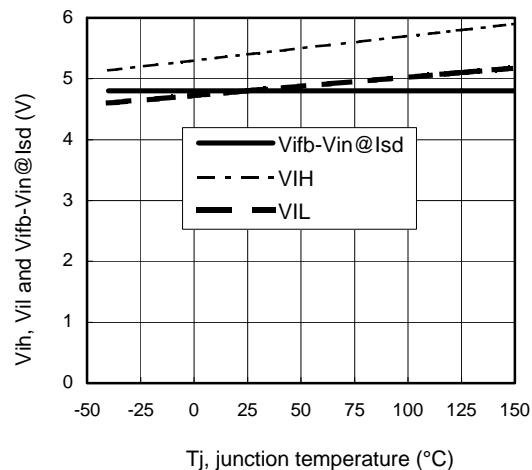
**Figure 6 –  $I_{cc}$  (mA) Vs  $V_{cc}-V_{in}$  (V)**



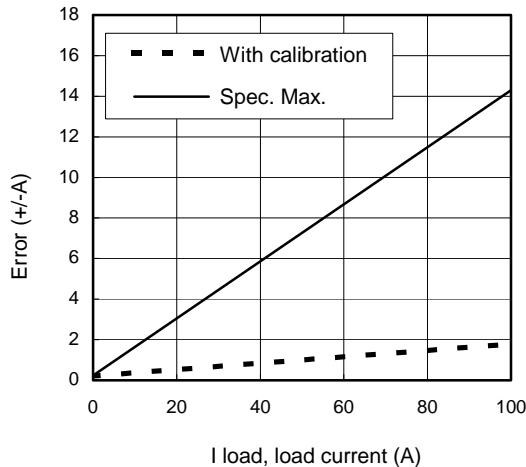
**Figure 7 –  $I_{cc\ off}$  ( $\mu\text{A}$ ) Vs  $T_j$  ( $^\circ\text{C}$ )**



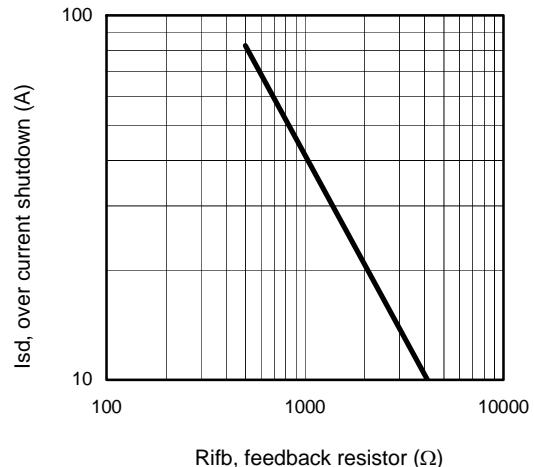
**Figure 8 - Normalized  $R_{ds(on)}$  (%) Vs  $T_j$  ( $^\circ\text{C}$ )**



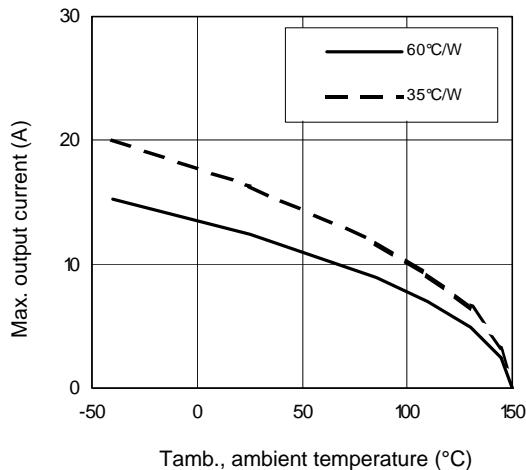
**Figure 9 –  $V_{ih}$ ,  $V_{il}$  and  $V_{ifb}-V_{in}@I_{sd}$  (V) Vs  $T_j$  ( $^\circ\text{C}$ )**



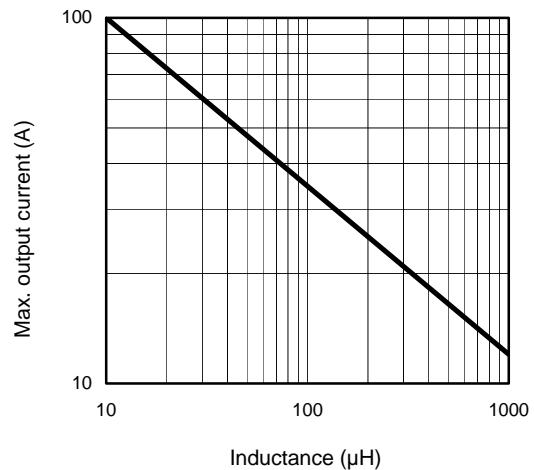
**Figure 10 – Error ( $\pm$ /A) Vs I load (A)**



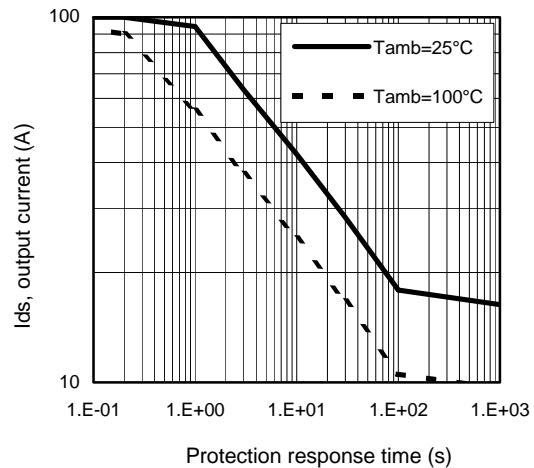
**Figure 11 – Ids (A) Vs Rifb ( $\Omega$ )**



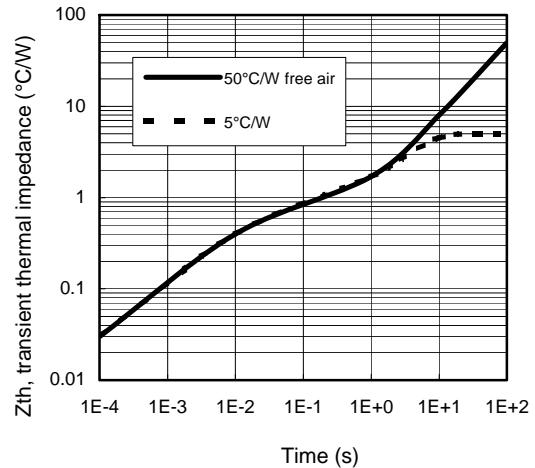
**Figure 12 – Max. Iout (A) Vs Tamb. ( $^{\circ}$ C)**



**Figure 13 – Max. Iout (A) Vs inductance ( $\mu$ H)**

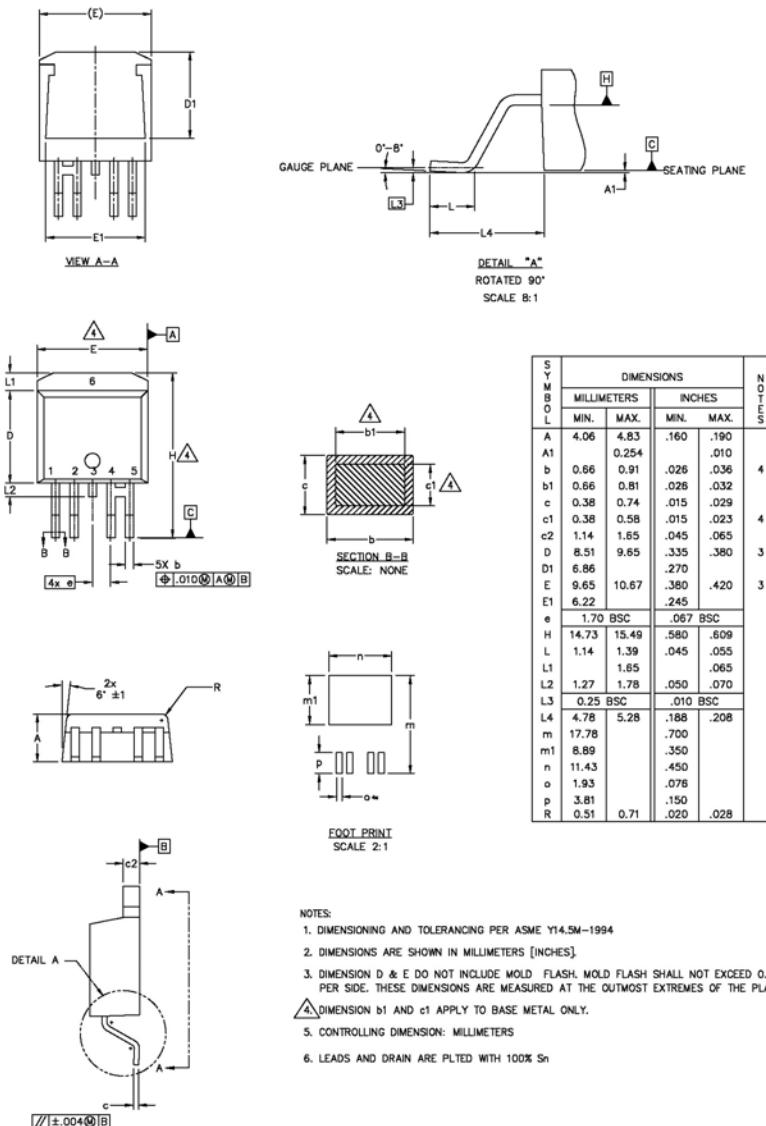


**Figure 14 – Ids (A) Vs over temperature protection response time (s)/ Rth=60°C/W**

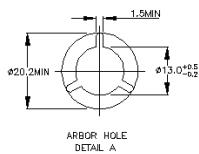
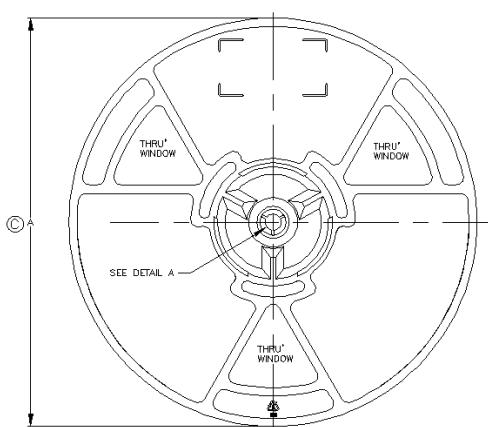


**Figure 15 – Transient thermal impedance (°C/W) Vs time (s)**

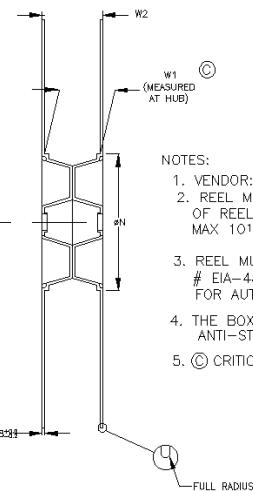
**Case Outline 5 Leads - D2PAK – Automotive Q100 PbF MSL1 qualified**



**Tape & Reel 5 Lead - D2PAK (SMD220)**



ARBOR HOLE  
DETAIL A

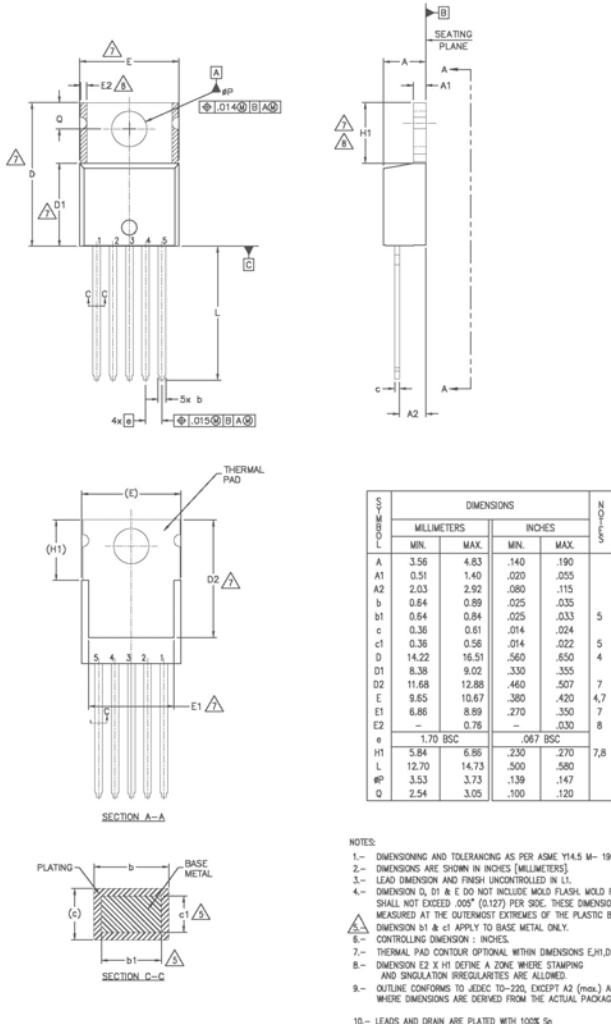


NOTES:

1. VENDOR: OPTIONAL
2. REEL MUST HAVE ANTI-STATIC COATING SURFACE RESISTIVITY OF REEL (AS PER EIA-541) min:  $10^3$  ohm/SQUARE; MAX  $10^{12}$  ohm/SQUARE
3. REEL MUST ALSO MEET REQUIREMENTS OF EIA STANDARD # EIA-481A, TAPEING OF SURFACE-MOUNT COMPONENTS FOR AUTOMATIC PLACEMENT.
4. THE BOX OF PACKING MUST CONTAIN THE REELS INSIDE AN ANTI-STATIC BAG.
5. (C) CRITICAL

$\phi$  A MAX = 330 (C)  
 $\phi$  N MAX = 100  
 W1 = 24.4 (C)  
 W2 MAX = 30.4

## Case Outline 5 Leads – TO220 – Automotive Q100 PbF qualified



International  
**IR** Rectifier

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245 Tel: (310) 252-7105  
Data and specifications subject to change without notice.

D2Pak is MSL1 qualified.

*This product has been designed and qualified for the Automotive [Q100] market.* 08/03/2010