

LOW EMI CURRENT SENSE HIGH SIDE SWITCH

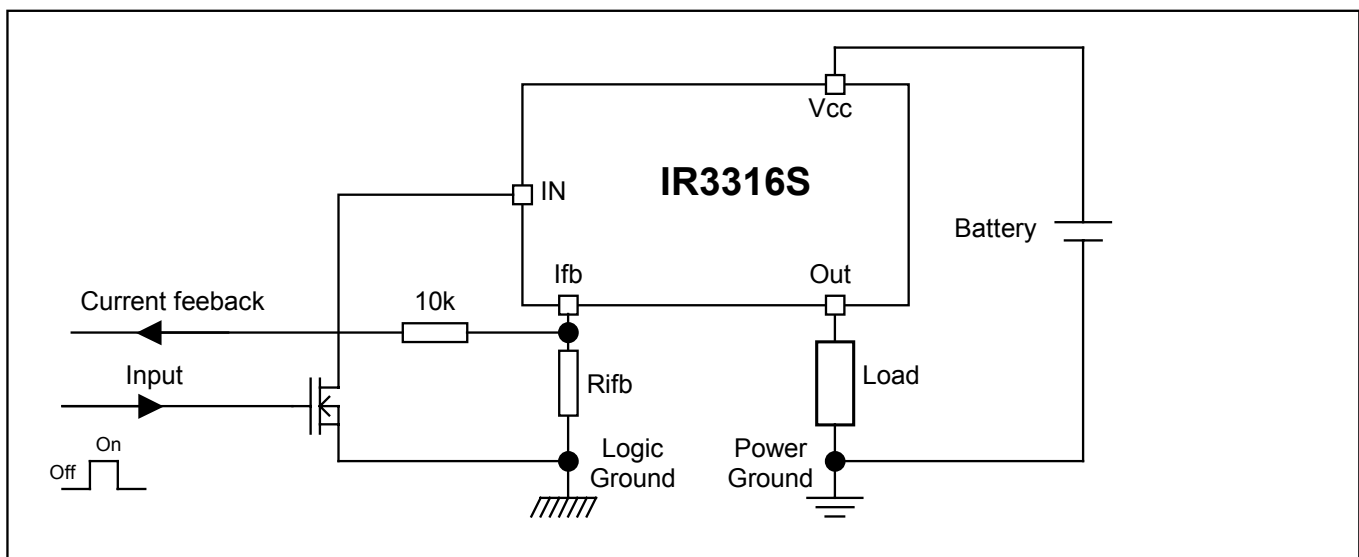
Features

- Load current feedback
- Programmable over current shutdown
- Active clamp
- ESD protection
- Input referenced to Vcc
- Over temperature shutdown
- Switching time optimized for low EMI
- Reverse battery protection

Description

The IR3316S is a fully protected 4 terminals high side switch. The input signal is referenced to Vcc. When the input voltage $V_{cc} - V_{in}$ is higher than the specified threshold, the output power Mosfet is turned on. When the $V_{cc} - V_{in}$ is lower than the specified V_{il} threshold, the output Mosfet is turned off. A current proportional to the power Mosfet current is sourced to the I_{fb} pin. Over current shutdown occurs when $V_{st} - V_{in} > 4.5V$. The current shutdown threshold is adjusted by selecting the proper R_{ifb}. 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

R _{ds(on)}	7 mΩ max.
V _{cc op.}	6 to 26V
Current Ratio	8800
Prog. I _{shutdown}	10 to 90A
V _{clamp}	40V

Packages



D²Pak
Pin 4 and 5 fused
IR3316S

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. (Tambient=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	26	
Vcc-Vfb	Maximum Ifb voltage	-16	33	
Vcc-Vout	Maximum output voltage	-0.3	37	
Ids cont.	Maximum body diode continuous current Rth=60°C/W (1)	—	2.8	A
Ids pulsed	Maximum body diode pulsed current (1)	—	100	
Pd	Maximum power dissipation Rth=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	
Tj max.	Max. storage & operating temperature junction temperature	-40	150	°C
Min Rfb	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
Rth1	Thermal resistance junction to ambient D ² -Pak Std footprint	60	—	°C/W
Rth2	Thermal resistance junction to case D ² -Pak	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
Iout	Continuous output current Tambient=85°C, Rth=60°C/W, Tj=125°C	—	7	A
Rifb	Recommended Ifb resistor (2)(3)	0.5	3.5	kΩ
Pulse min.	Minimum turn-on pulse width	1	—	ms
Fmax.	Maximum operating frequency	—	200	Hz

2) If Rifb is too low, the device can be damaged.

3) If Rifb is too high, the device may not switch on.

Protection Characteristics

Tj=25°C, Rifb=500 to 5kΩ

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Vifb-Vin@Isd	Over-current shutdown threshold	4	4.7	5.6	V	
Tsd	Over temperature threshold	—	165	—	°C	See fig. 5
OV	Over voltage protection (not latched)	26	29	33	V	
Isdf	Fixed over current shutdown	90	120	140	A	Vifb<Vifb-Vin@Isd
Isd_1k	Programmable over current shutdown 1k	30	40	50		Rifb=1kΩ
Treset	Time to reset protection	—	50	500	μs	See fig. 5
Min. pulse	Min. pulse width (no WAIT state)	400	900	2000		
WAIT	WAIT function timer	0.4	1	2	ms	See fig. 4 and 5
Rds(on) rev.	Reverse battery On state resistance	4	6.7	10	mΩ	Vcc-Vin=-14V, Iout=30A

Static Electrical Characteristics

Tj=25°C, Vcc=14V (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Vcc op.	Operating Voltage range	6	—	26	V	
Icc off	Supply leakage current	—	1.5	5	μA	Vin=Vcc, Vcc-Vout=14V, Vcc-Vifb=14V
Iin, on	On state IN positive current	1.5	3	6	mA	Vcc-Vin=14V
Vih	High level Input threshold voltage (4)	—	5.4	6.2	V	
Vil	Low level Input threshold voltage (4)	4	4.9	5.8		
Vhyst	Input hysteresis Vih-Vil	0.2	0.4	1		
Iout	Drain to source leakage current	—	1.2	5	μA	Vin=Vcc, Vcc-Vifb=0V, Vcc-Vout=14V
Rds(on)	On state resistance (5) Tj=25°C	4	5.5	7	mΩ	Iout=30A, Vcc-Vin=14V
	On state resistance (5) Tj=25°C	4	6	10		Iout=17A, Vcc-Vin=6V
	On state resistance (5) Tj=150°C	7	10.5	13.5		Iout=30A, Vcc-Vin=14V
V clamp1	Vcc to Vout clamp voltage 1	36	39	—	V	Iout=50mA
V clamp2	Vcc to Vout clamp voltage 2	—	40	43	V	Iout=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) Rds(on) is measured between the tab and the Out pin, 5mm away from the package.

Switching Electrical Characteristics

Vcc=14V, Resistive load=0.5Ω, Tj=25°C

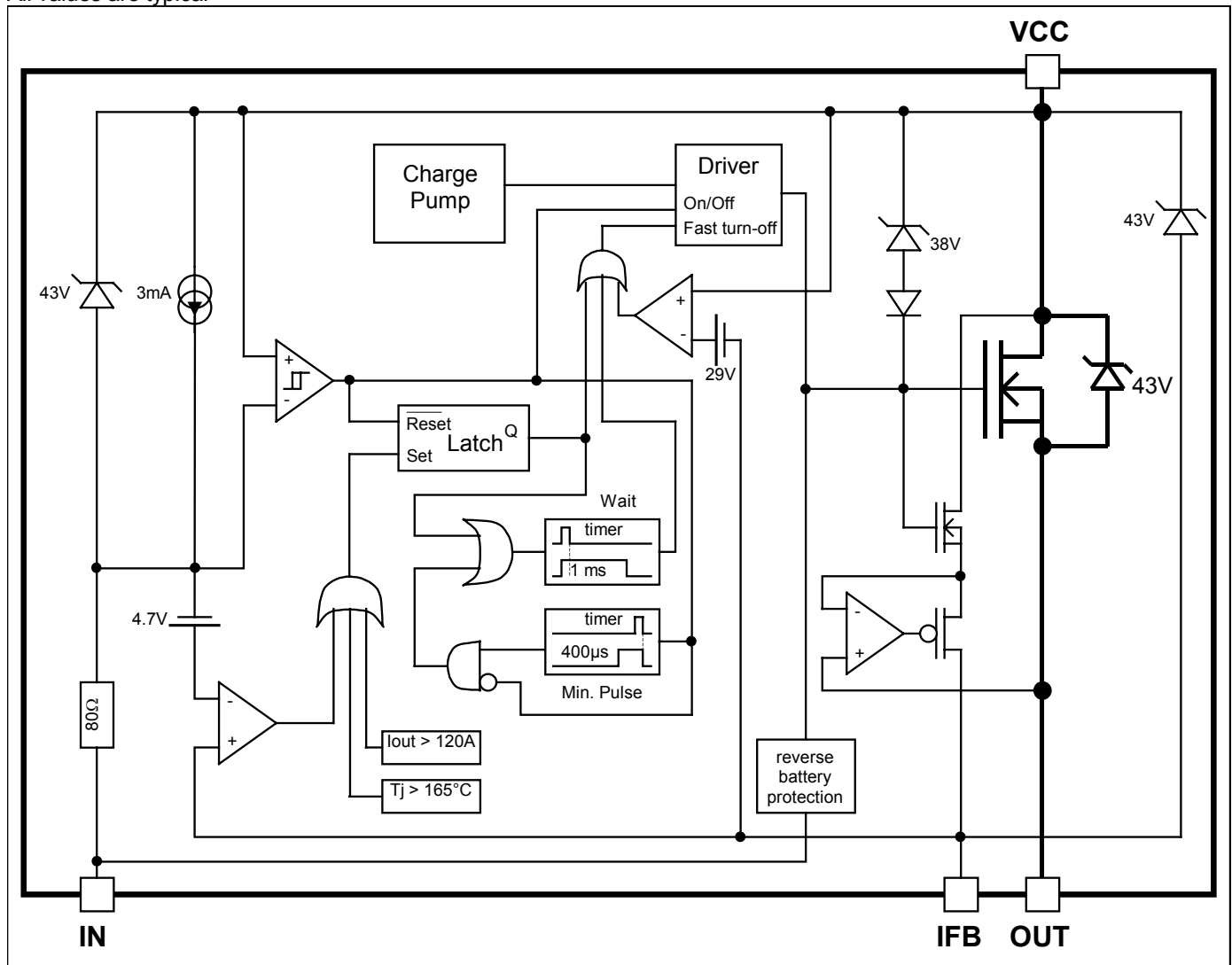
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Tdon	Turn on delay time to 10% Vcc	30	120	300	μs	See figure 2
Tr1	Rise time to Vcc-Vout=5V	20	50	125		
Tr2	Rise time to Vcc-Vout=0.1Vcc	30	80	200		
Eon	Turn on energy	—	14	—	mJ	
Tdoff	Turn off delay time	30	140	350	μs	
Tf	Fall time to Vout=10% of Vcc	35	100	250		
Eoff	Turn off energy	—	7	—	mJ	

Current Sense Characteristics

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

Functional Block Diagram

All values are typical



Lead Assignments

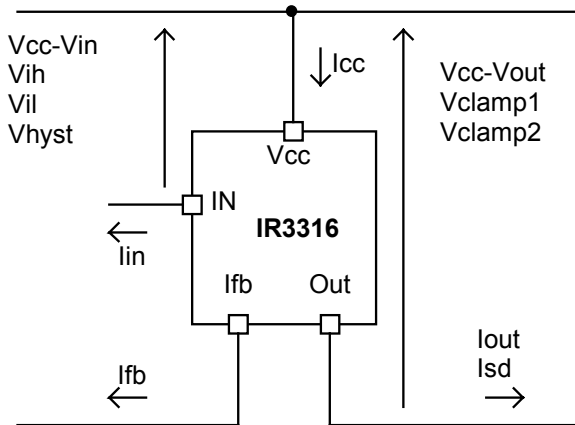
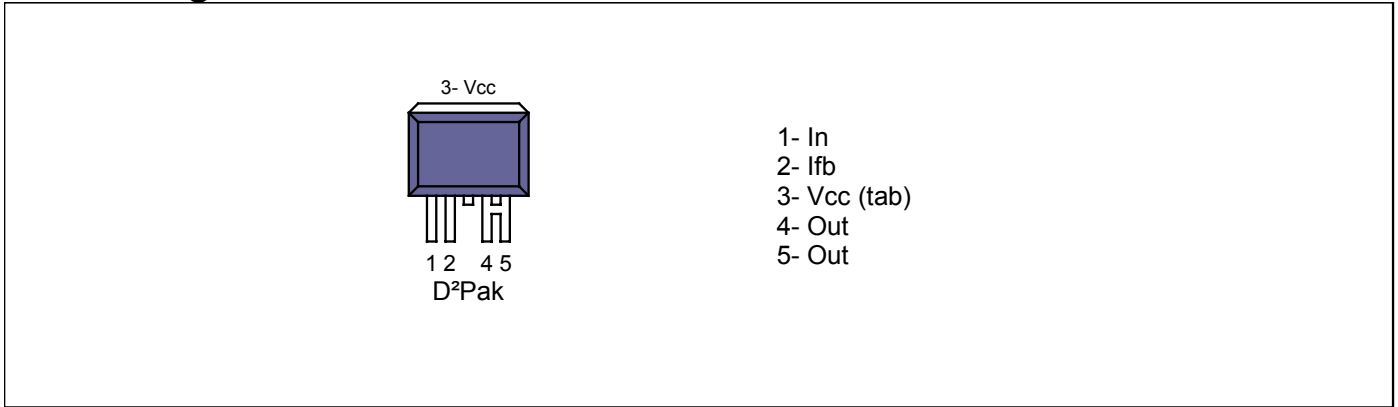


Figure 1 – Voltages and current definitions

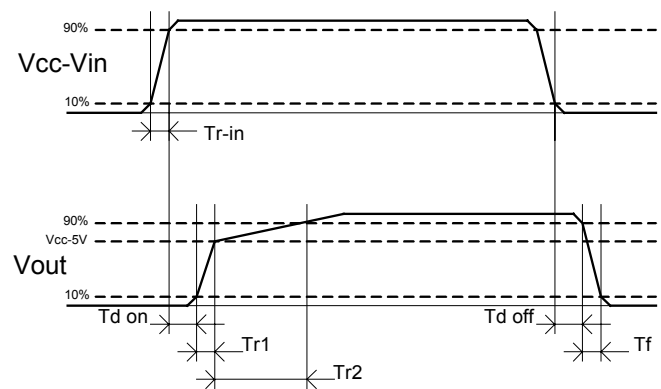


Figure 2 – Switching time definitions

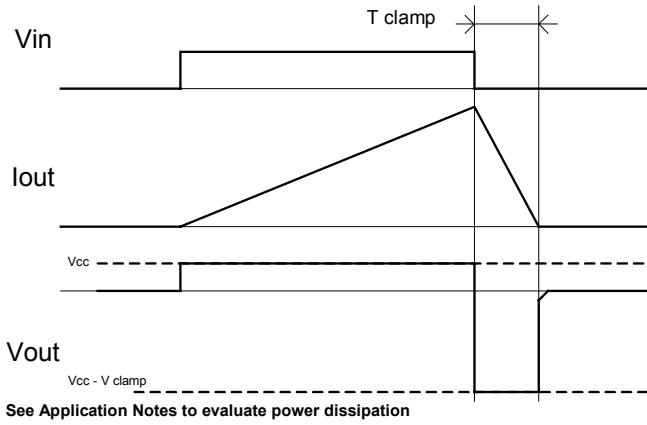


Figure 3 – Active clamp waveforms

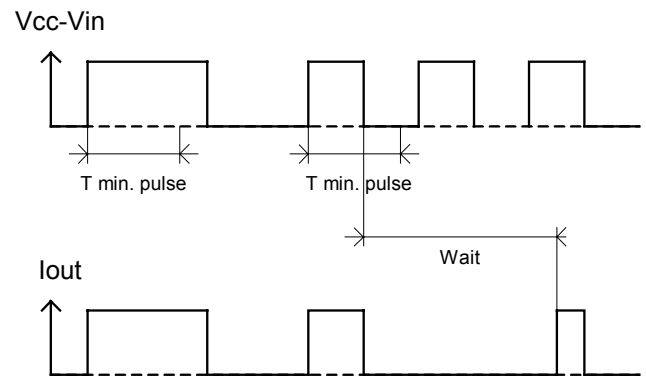


Figure 4 – Min. pulse and Wait function

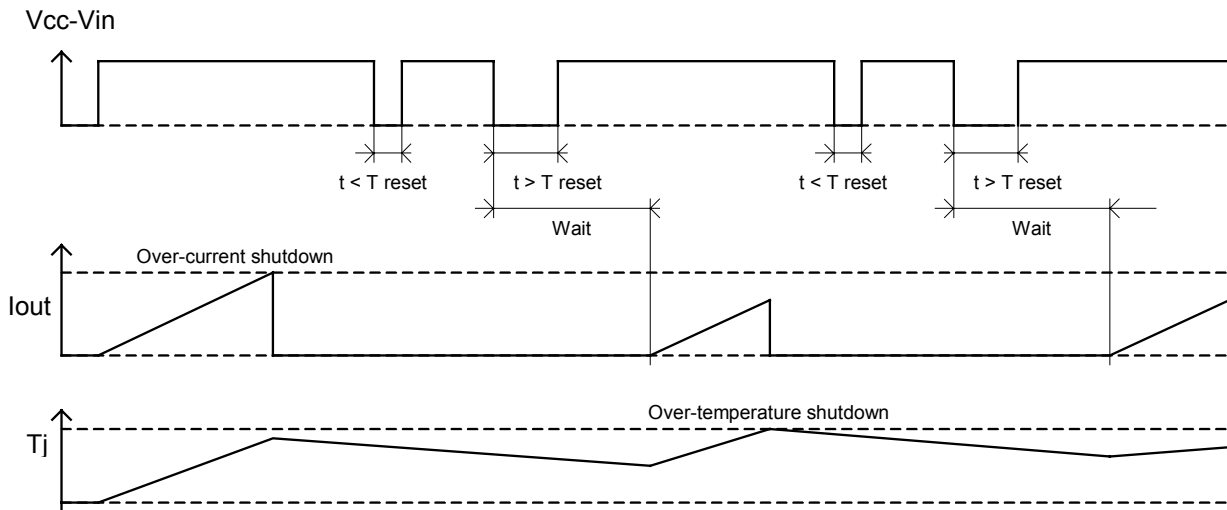


Figure 5 – Protection Timing Diagrams

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).

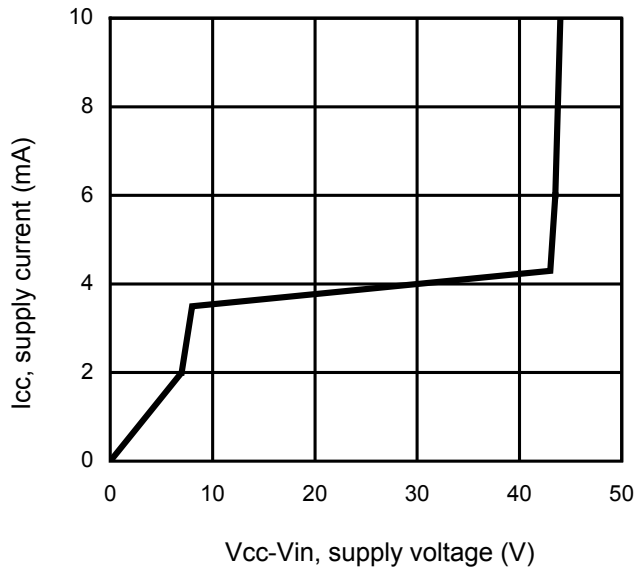


Figure 6 – I_{cc} (mA) Vs V_{cc-Vin} (V)

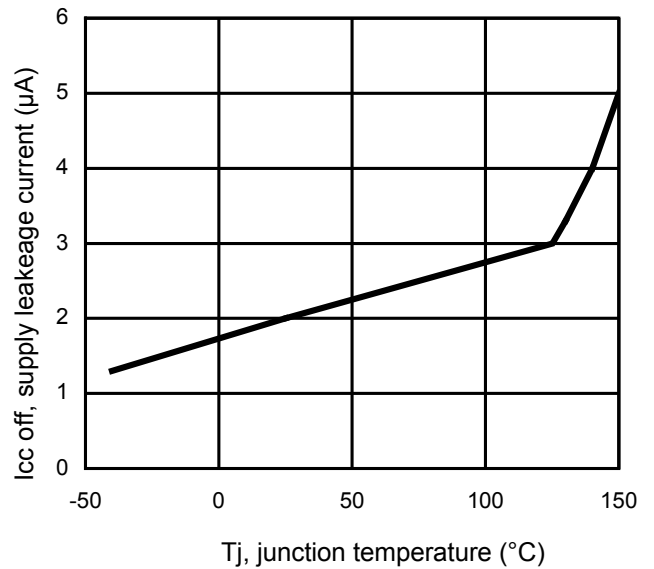


Figure 7 – $I_{cc\ off}$ (μA) Vs T_j ($^\circ\text{C}$)

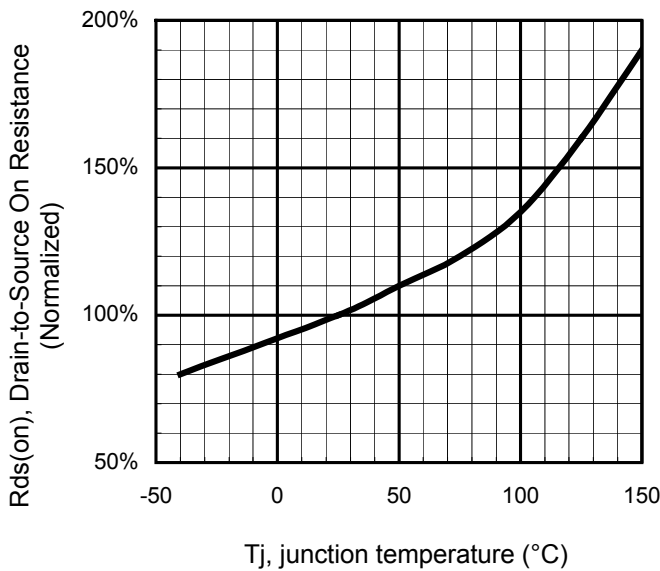


Figure 8 - Normalized $R_{ds(on)}$ (%) Vs T_j ($^\circ\text{C}$)

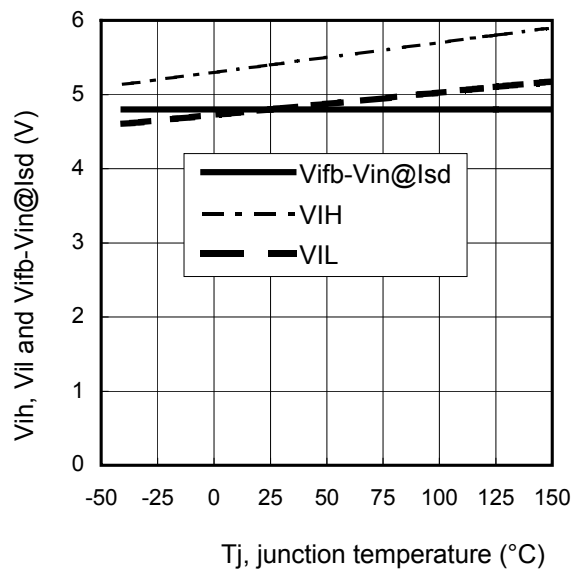


Figure 9 – V_{ih} , V_{il} and $V_{ifb-Vin@Istd}$ (V) Vs T_j ($^\circ\text{C}$)

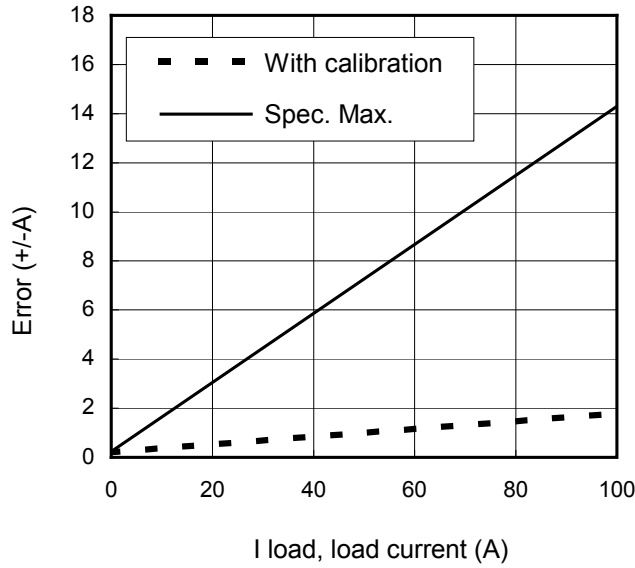


Figure 10 – Error (+/- A) Vs I load (A)

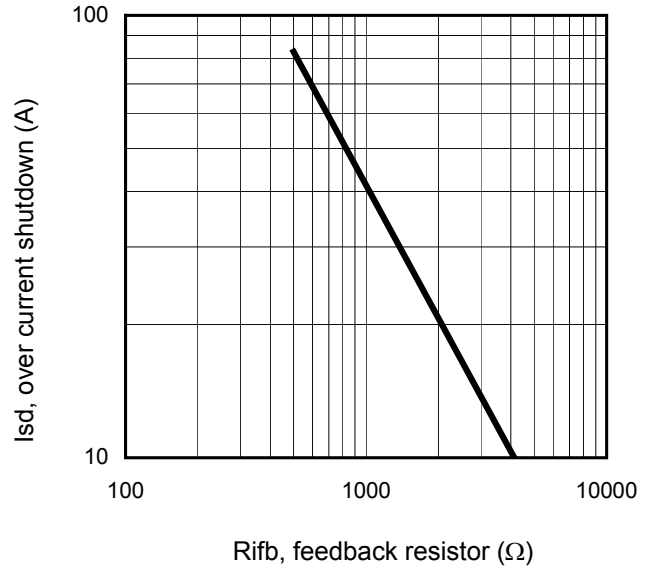


Figure 11 – Ids (A) Vs Rifb (Ω)

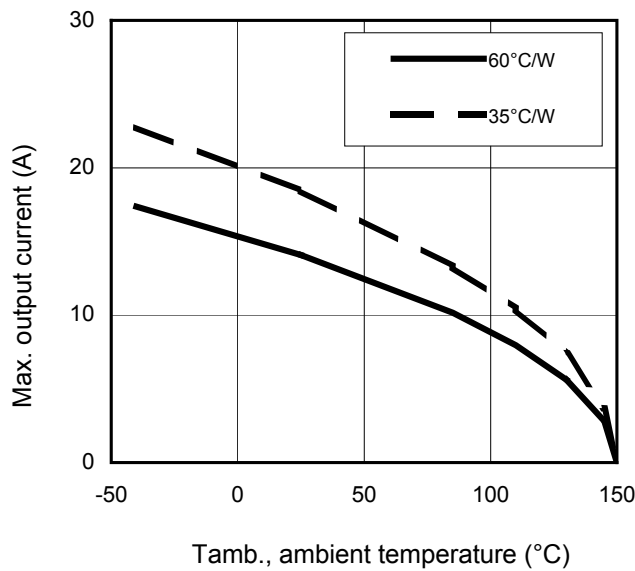


Figure 12 – Max. iout (A) Vs Tamb. (°C)

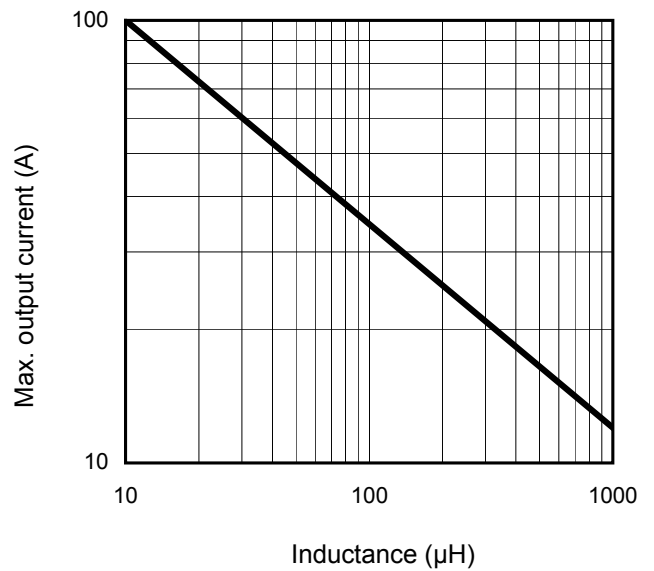


Figure 13 – Max. iout (A) Vs inductance (μH)

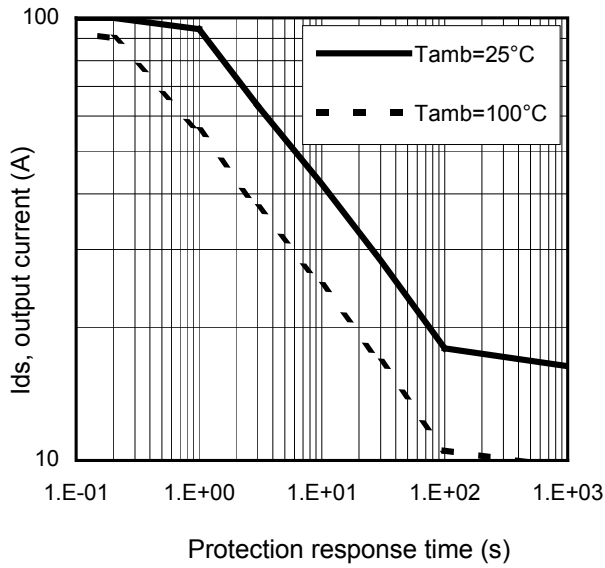


Figure 14 – Ids (A) Vs over temperature protection response time (s)

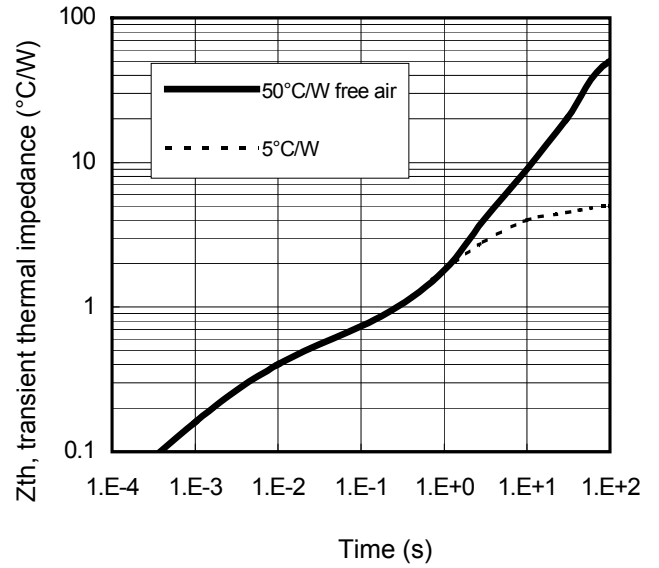
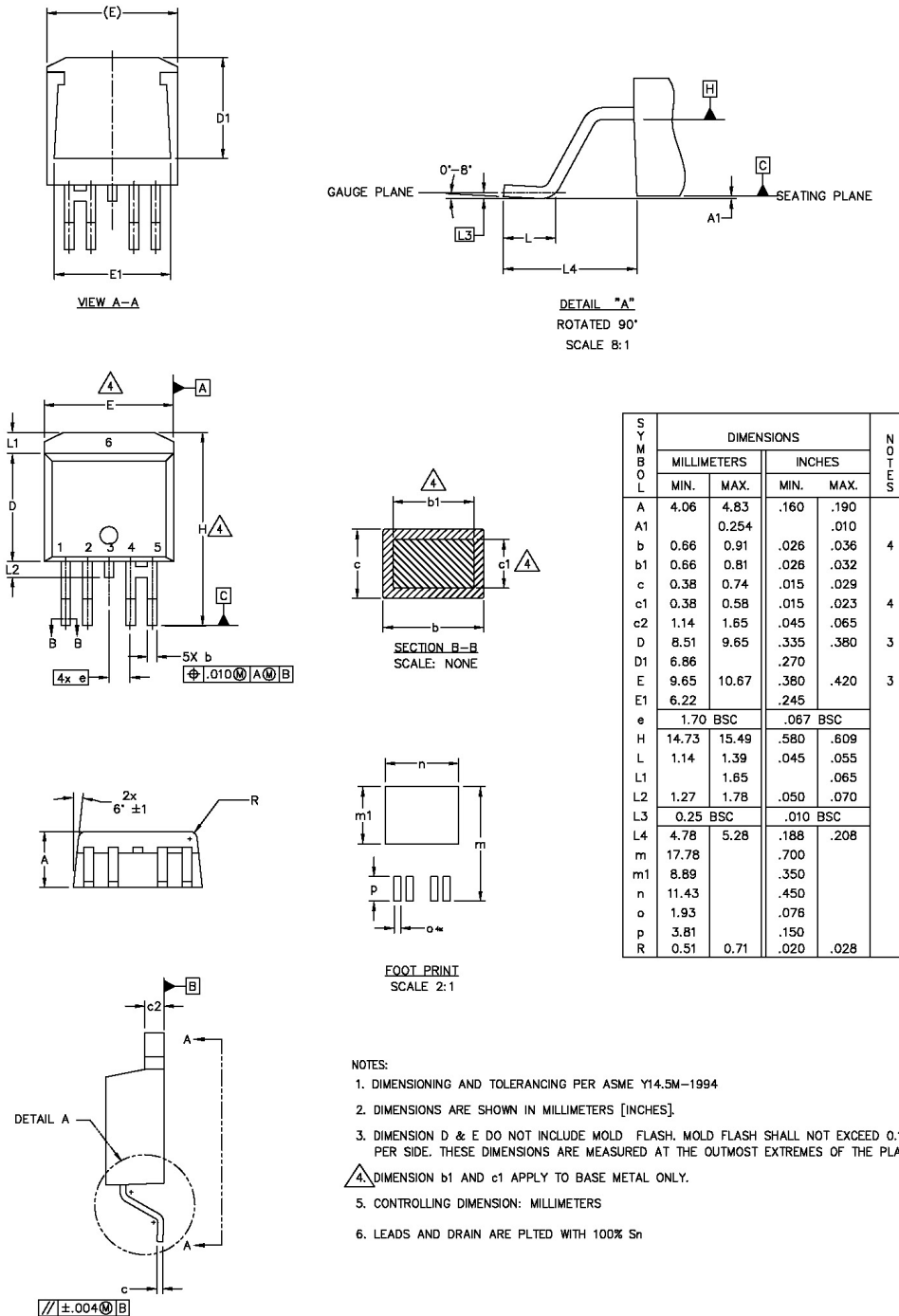
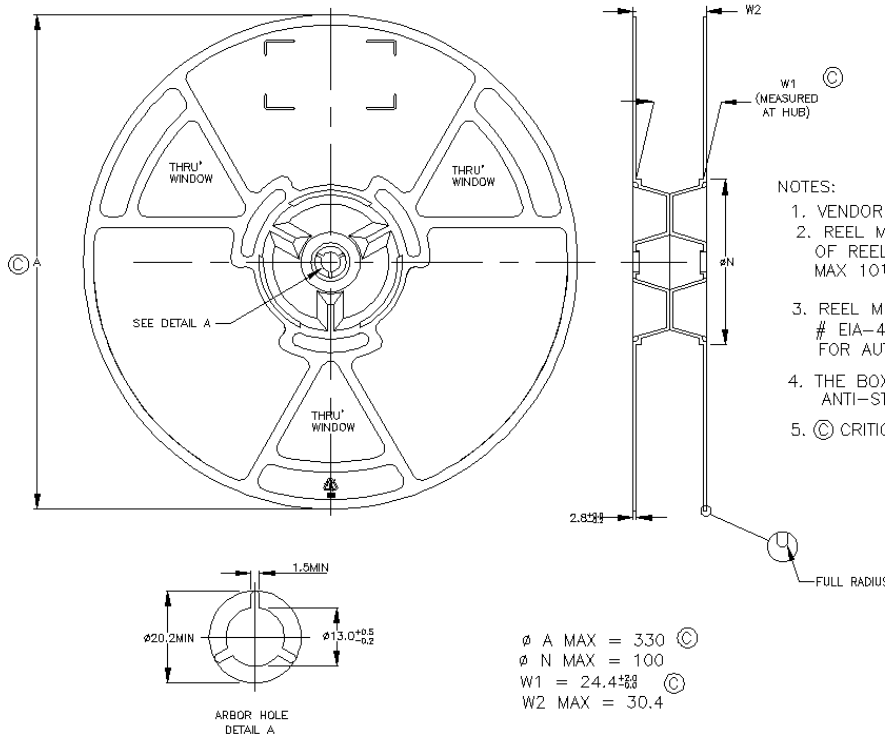


Figure 15 – Transient thermal impedance (°C/W) Vs time (s)

Case Outline 5 Lead - D2PAK



Tape & Reel 5 Lead - D2PAK



Note: For the most current drawings please refer to the IR website at:
<http://www.irf.com/package/>