



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



IPS511/IPS511S

FULLY PROTECTED HIGH SIDE POWER MOSFET SWITCH

Features

- Over temperature protection (with auto-restart)
- Short-circuit protection (current limit)
- Active clamp
- E.S.D protection
- Status feedback
- Open load detection
- Logic ground isolated from power ground

Product Summary

$R_{ds(on)}$	135m Ω (max)
V_{clamp}	50V
I Limit	5A
$V_{open\ load}$	3V

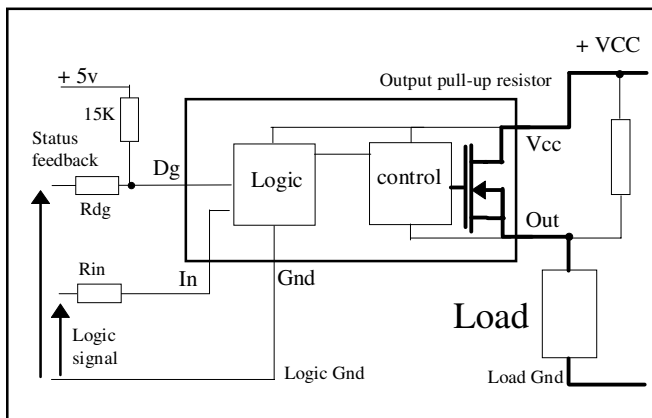
Description

The IPS511/IPS511S are fully protected five terminal high side switches with built in short circuit, over-temperature, ESD protection, inductive load capability and diagnostic feedback. The output current is controlled when it reaches I_{lim} value. The current limitation is activated until the thermal protection acts. The over-temperature protection turns off the high side switch if the junction temperature exceeds $T_{shutdown}$. It will automatically restart after the junction has cooled $7^{\circ}C$ below $T_{shutdown}$. A diagnostic pin is provided for status feedback of short-circuit, over-temperature and open load detection. The double level shifter circuitry allows large offsets between the logic ground and the load ground.

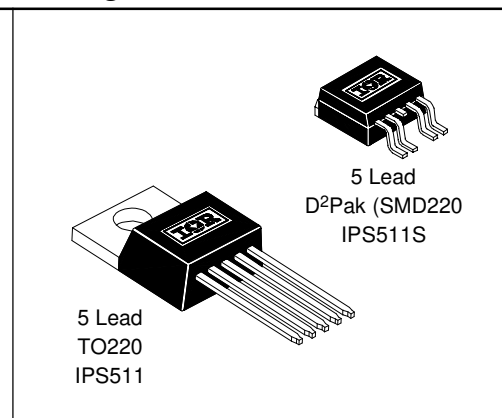
Truth Table

Op. Conditions	In	Out	Dg
Normal	H	H	H
Normal	L	L	L
Open load	H	H	H
Open load	L	H	H
Over current	H	L (limiting)	L
Over current	L	L	L
Over-temperature	H	L (cycling)	L
Over-temperature	L	L	L

Typical Connection



Packages



Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are referenced to GROUND lead. ($T_j = 25^\circ\text{C}$ unless otherwise specified).

Symbol	Parameter	Min.	Max.	Units	Test Conditions
V_{out}	Maximum output voltage	$V_{CC}-50$	$V_{CC}+0.3$	V	
V_{offset}	Maximum logic ground to load ground offset	$V_{CC}-50$	$V_{CC}+0.3$		
V_{in}	Maximum Input voltage	-0.3	5.5		
$V_{CC\ max}$	Maximum Vcc voltage	—	50		
$I_{in, max.}$	Maximum IN current	-5	10	mA	
V_{dg}	Maximum diagnostic output voltage	-0.3	5.5	V	
$I_{dg, max.}$	Maximum diagnostic output current	-1	10	mA	
$I_{sd\ cont.}$	Diode max. permanent current ⁽¹⁾	—	2.2	A	
$I_{sd\ pulsed}$	Diode max. pulsed current ⁽¹⁾	—	10		
ESD1	Electrostatic discharge voltage (Human Body)	—	4	kV	C=100pF, R=1500Ω,
ESD2	Electrostatic discharge voltage (Machine Model)	—	0.5		C=200pF, R=0Ω, L=10μH
P_d	Maximum power dissipation ⁽¹⁾ ($T_C=25^\circ\text{C}$) IPS511 ($r_{th}=80^\circ\text{C/W}$) IPS511S	—	25	W	
		—	1.56		
$T_j\ max.$	Max. storage & operating junction temp.	-40	+150	°C	
T_{lead}	Lead temperature (soldering 10 seconds)	—	300		

Thermal Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$R_{th\ 1}$	Thermal resistance junction to case	—	5	—	°C/W	TO-220
$R_{th\ 2}$	Thermal resistance junction to ambient	—	60	—		
$R_{th\ 1}$	Thermal resistance with standard footprint	—	60	—		
$R_{th\ 2}$	Thermal resistance with 1" square footprint	—	40	—		D ² PAK (SMD220)
$R_{th\ 3}$	Thermal resistance junction to case	—	5	—		

(1) Limited by junction temperature (pulsed current limited also by internal wiring)

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
V _{CC}	Continuous V _{CC} voltage	5.5	35	V
V _{IH}	High level input voltage	4	5.5	
V _{IL}	Low level input voltage	-0.3	0.9	
I _{out} T _{amb} =85°C	Continuous output current (T _{Ambient} = 85°C, T _j = 125°C, R _{th} < 60°C/W) IPS511 (T _{Ambient} = 85°C, T _j = 125°C, R _{th} = 80°C/W) IPS511	—	1.7 1.5	A
R _{in}	Recommended resistor in series with IN pin	4	6	kΩ
R _{dg}	Recommended resistor in series with DG pin	10	20	

Static Electrical Characteristics

(T_j = 25°C, V_{CC} = 14V unless otherwise specified.)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
R _{ds(on)} @T _j =25°C	ON state resistance T _j = 25°C	—	110	135	mΩ	V _{in} = 5V, I _{out} = 2.5A
R _{ds(on)} (V _{CC} =6V)	ON state resistance @ V _{CC} = 6V	—	110	135		V _{in} = 5V, I _{out} = 1A
R _{ds(on)} @T _j =150°C	ON state resistance T _j = 150°C	—	200	—		V _{in} = 5V, I _{out} = 2.5A
V _{CC oper.}	Operating voltage range	5.5	—	35	V	
V _{clamp 1}	V _{CC} to OUT clamp voltage 1	50	56	—		I _d = 10mA (see Fig.1 & 2)
V _{clamp 2}	V _{CC} to OUT clamp voltage 2	—	58	65		I _d = I _{sd} (see Fig.1 & 2)
V _f	Body diode forward voltage	—	0.9	1.2		I _d = 2.5A, V _{in} = 0V
I _{CC off}	Supply current when OFF	—	16	50	μA	V _{in} = 0V, V _{out} = 0V
I _{CC on}	Supply current when ON	—	0.7	2	mA	V _{in} = 5V
I _{CC ac}	Ripple current when ON (AC RMS)	—	20	—	μA	V _{in} = 5V
V _{dgl}	Low level diagnostic output voltage	—	0.15	0.4	V	I _{dg} = 1.6 mA
I _{oh}	Output leakage current	—	60	110	μA	V _{out} = 6V
I _{ol}	Output leakage current	0	—	25		V _{out} = 0V
I _{dg leakage}	Diagnostic output leakage current	—	—	10		V _{dg} = 5.5V
V _{ih}	IN high threshold voltage	—	2.3	3	V	
V _{il}	IN low threshold voltage	1	1.95	—		
I _{in, on}	On state IN positive current	—	70	200	μA	V _{in} = 5V
I _{n hyst.}	Input hysteresis	0.1	0.25	0.5	V	

Switching Electrical Characteristics

$V_{CC} = 14V$, Resistive Load = 5.6Ω , $T_j = 25^\circ C$, (unless otherwise specified).

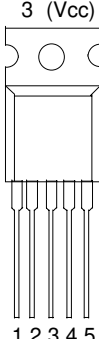
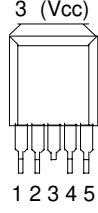
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
T_{don}	Turn-on delay time	—	7	50	μs	See figure 3
T_{r1}	Rise time to $V_{out} = V_{CC} - 5V$	—	10	50		
T_{r2}	Rise time $V_{CC} - 5V$ to $V_{out} = 90\%$ of V_{CC}	—	45	100		
dV/dt (on)	Turn ON dV/dt	—	1.3	4	$V/\mu s$	
E_{on}	Turn ON energy	—	400	—	μJ	
T_{doff}	Turn-off delay time	—	15	50	μs	See figure 4
T_f	Fall time to $V_{out} = 10\%$ of V_{CC}	—	10	50		
dV/dt (off)	Turn OFF dV/dt	—	2	6		
E_{off}	Turn OFF energy	—	80	—	μJ	
T_{diag}	V_{out} to V_{diag} propagation delay	—	5	15	μs	See figure 6

Protection Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I_{lim}	Internal current limit	3	5	7	A	$V_{out} = 0V$
T_{sd+}	Over-temp. positive going threshold	—	165	—	$^\circ C$	See fig. 2
T_{sd-}	Over-temp. negative going threshold	—	158	—	$^\circ C$	See fig. 2
V_{sc}	Short-circuit detection voltage (3)	2	3	4	V	See fig. 2
$V_{open load}$	Open load detection threshold	2	3	4	V	

(3) Referenced to V_{CC}

Lead Assignments

 <p>3 (Vcc)</p> <p>1 2 3 4 5</p> <p>5 Lead - TO220</p>	<p>1 - Ground 2 - In 3 - Vcc 4 - DG 5 - Out</p>	 <p>3 (Vcc)</p> <p>1 2 3 4 5</p> <p>5 Lead - D²PAK (SMD220)</p>
IPS511		IPS511S
Part Number		

Functional Block Diagram

All values are typical

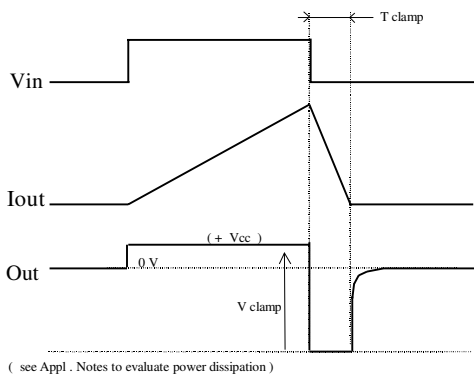
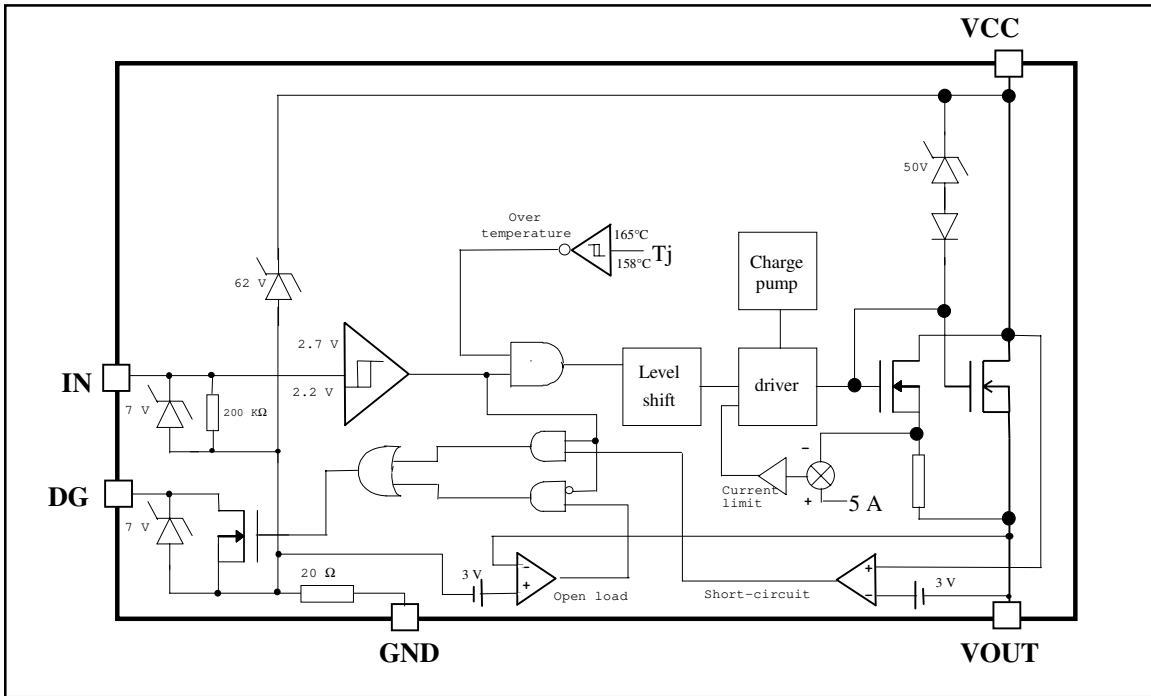


Figure 1 - Active clamp waveforms

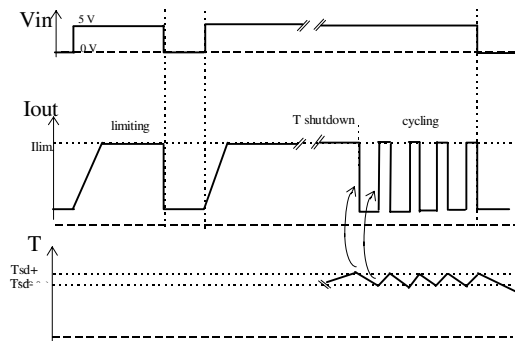


Figure 2 - Protection timing diagram

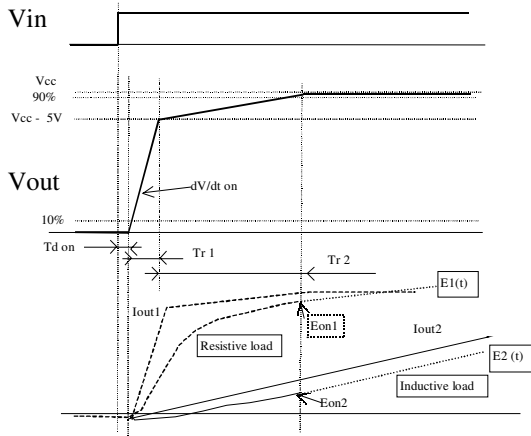


Figure 3 - Switching times definition (turn-on)
Turn on energy with a resistive or an inductive load

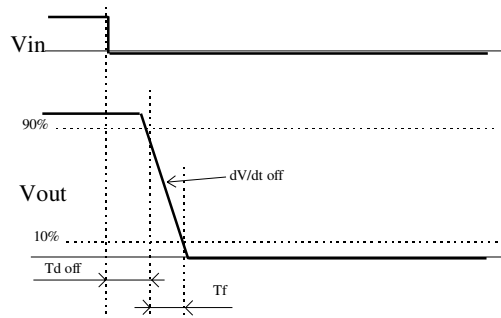


Figure 4 - Switching times definition (turn-off)

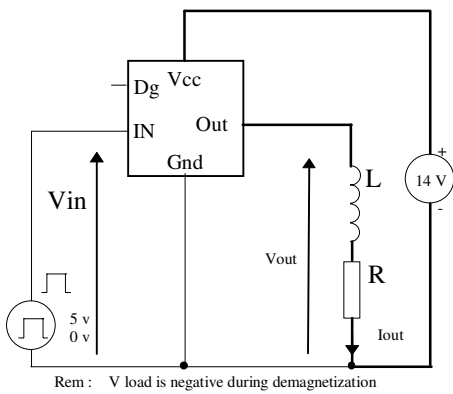


Figure 5 - Active clamp test circuit

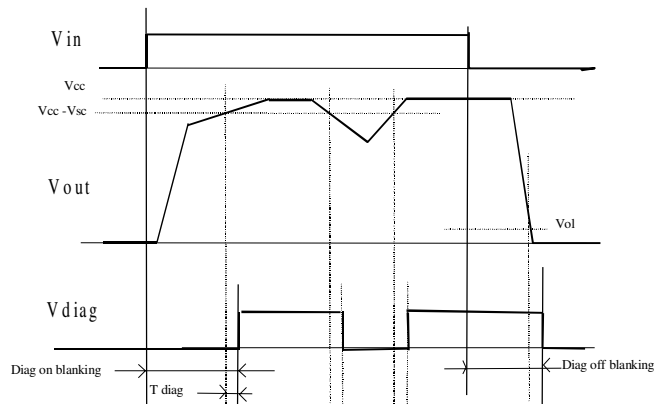


Figure 6 - Diagnostic delay definitions

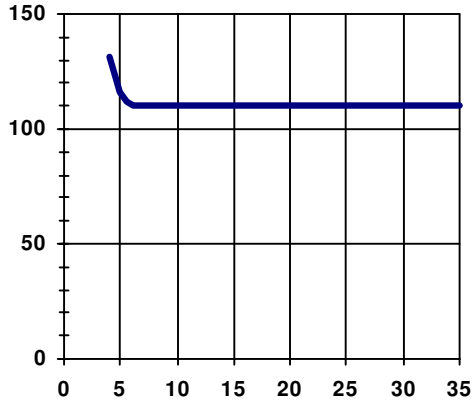


Figure 7 - R_{ds(on)} (mΩ) Vs V_{CC} (V)

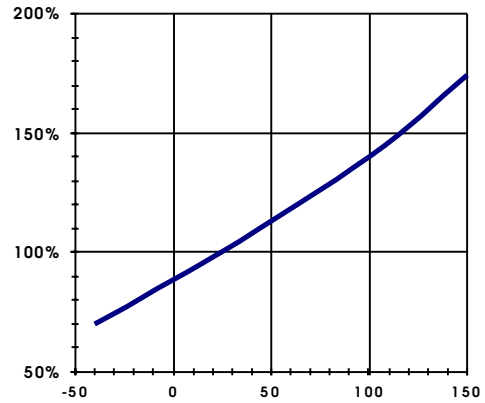


Figure 8 - Normalized R_{ds(on)} (%) Vs T_j (°C)

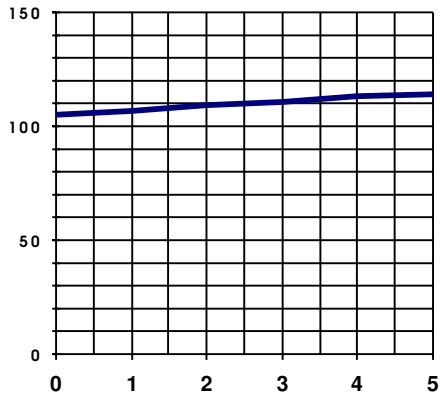


Figure 9 - R_{ds(on)} (mΩ) Vs I_{out} (A)

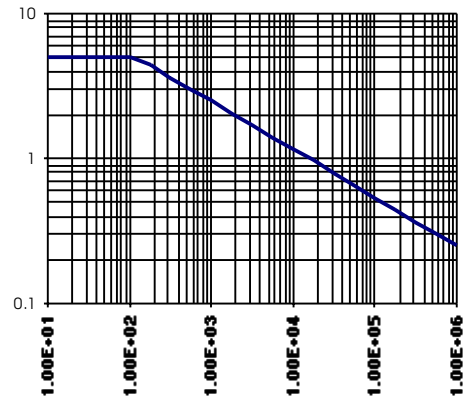


Figure 10 - Max. I_{out} (A) Vs Load Inductance (μH)

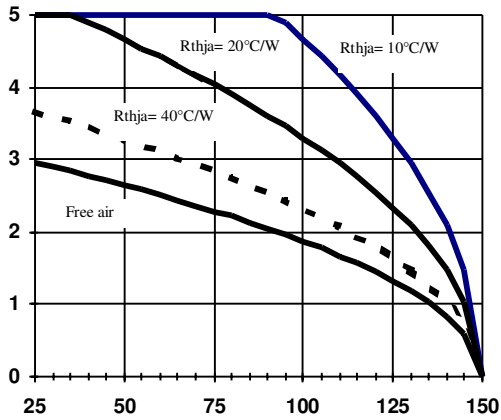


Figure 11a - Max load current (A) Vs Tamb (°C)
IPS511

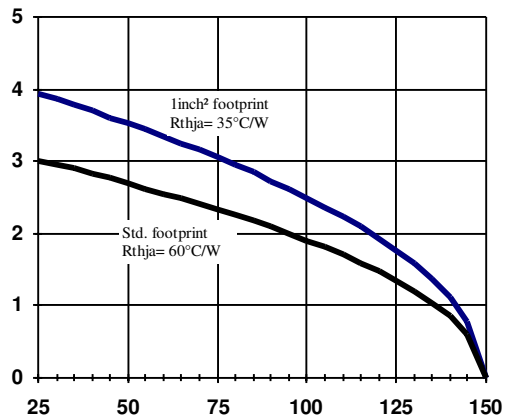


Figure 11b - Max load current (A) Vs Tamb (°C)
IPS511S

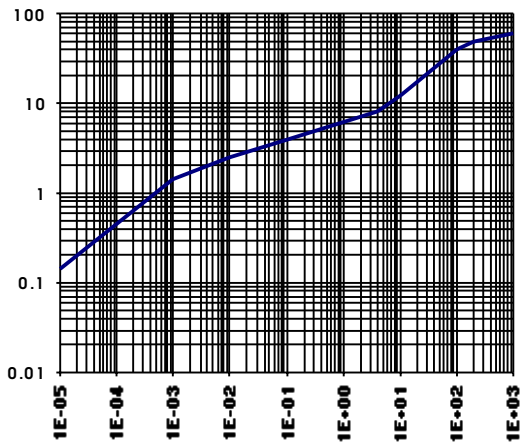


Figure 12 - Transient Thermal Impedance (°C/W)
Vs Time (S)

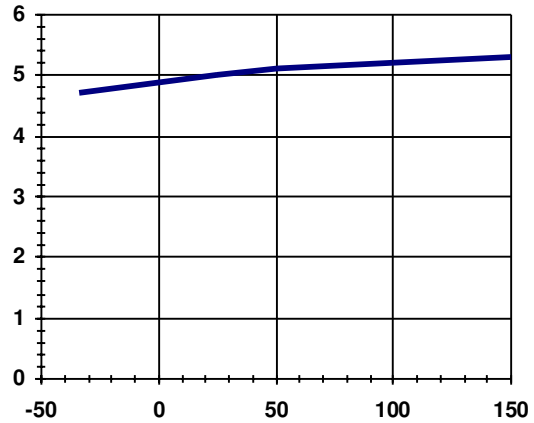


Figure 13 - Ilim (A) Vs Tj (°C)

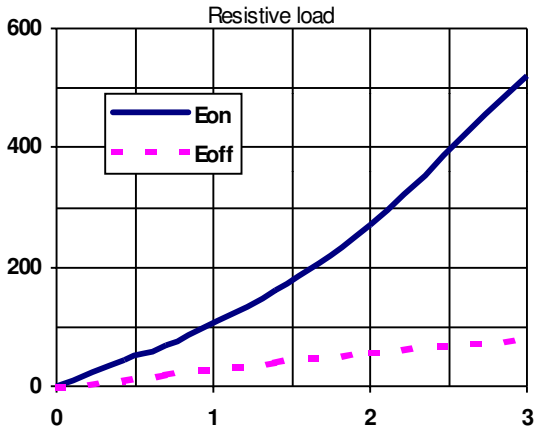


Figure 14 - Eon, Eoff (μJ) (A) Vs Iout (A)

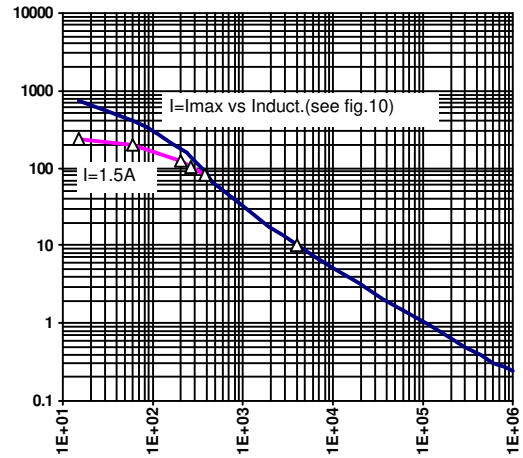


Figure 15 - Eon (μJ) Vs Load Inductance (μH)
(see Fig. 3)

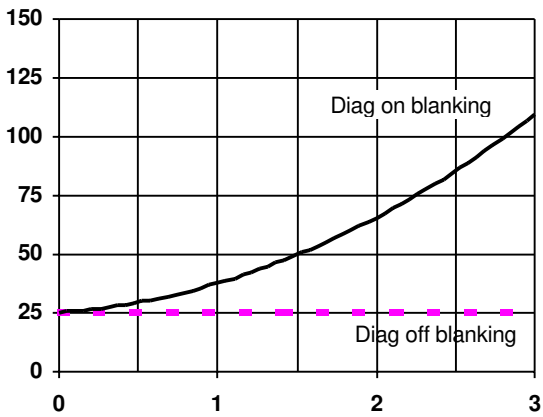


Figure 16 - Diag Blanking time (μS) Vs Iout (A)
(resistive load - see Fig. 6)

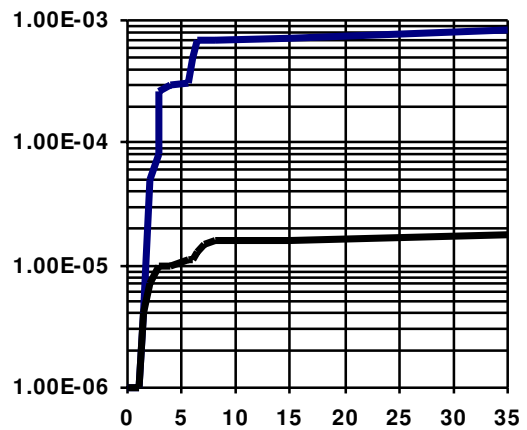


Figure 17 - Icc (mA) Vs Vcc (V)

IPS511/IPS511S

International
IR Rectifier

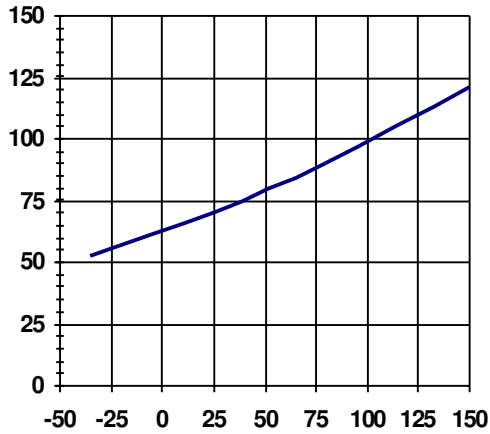
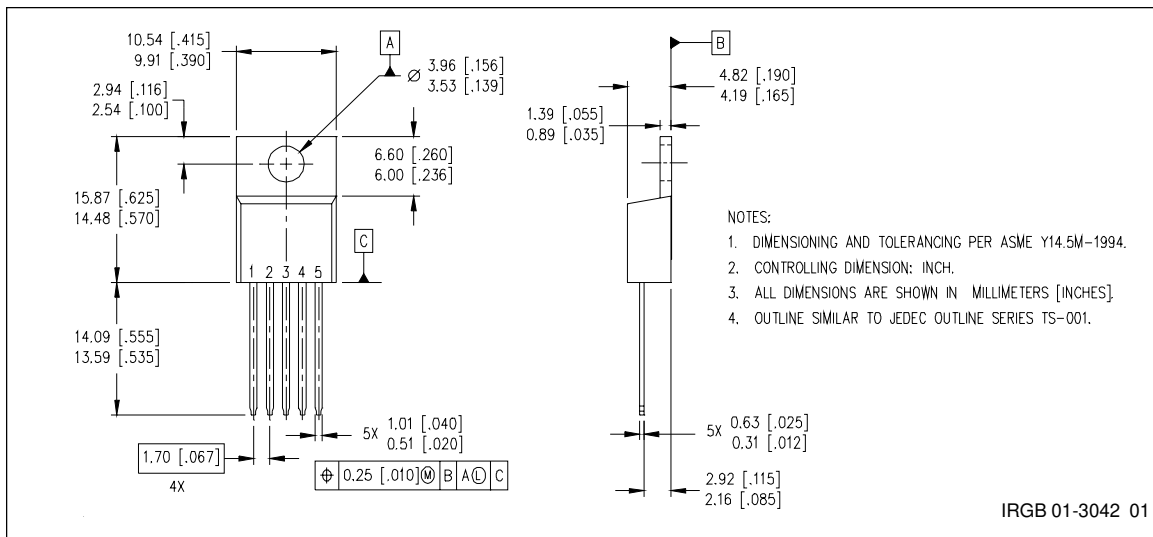
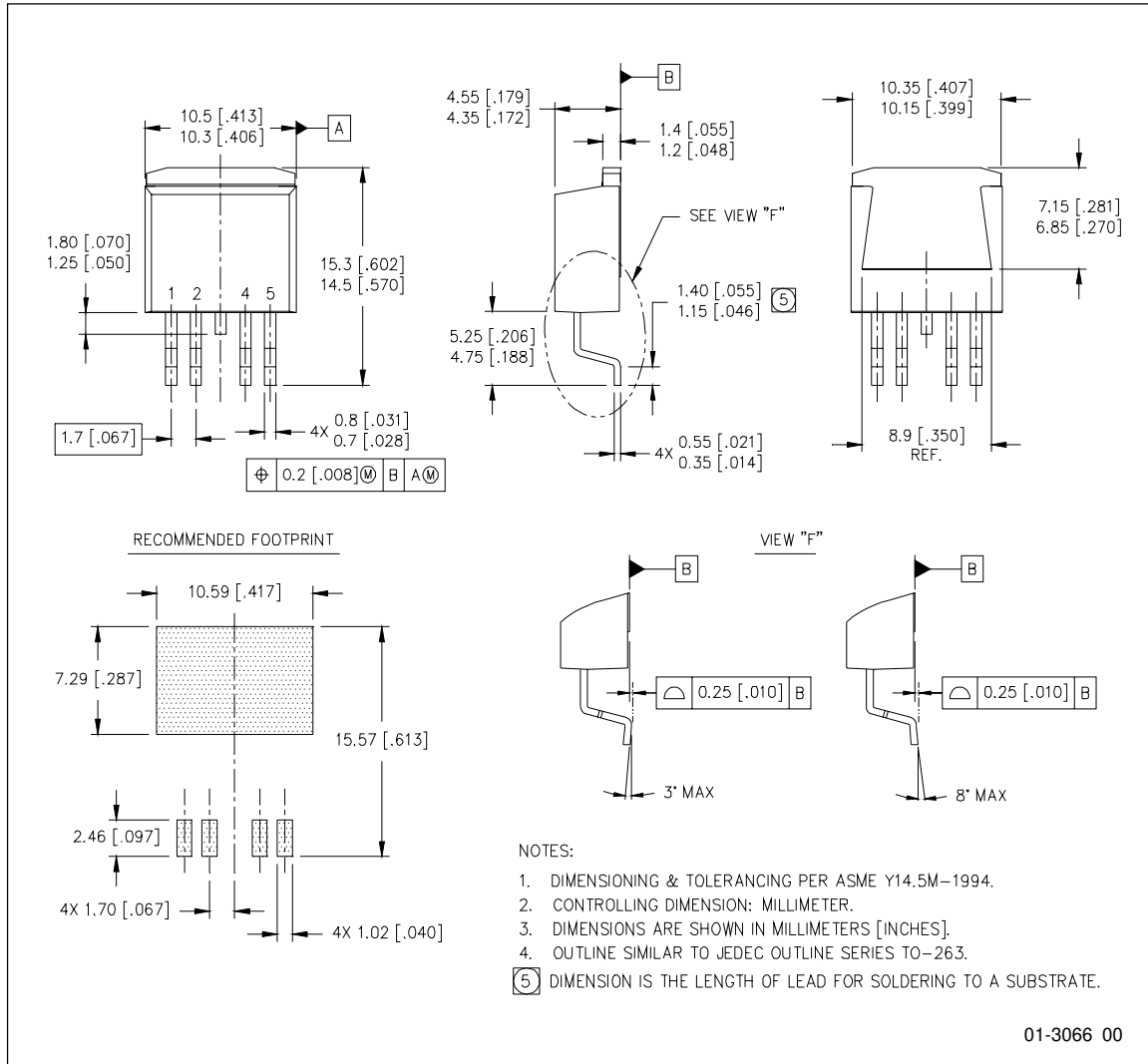


Figure 18 - I_{in} @ V_{in} = 5V (μA) Vs T_j (°C)

Case Outline 5 Lead - TO220



Case Outline 5 Lead - D²PAK (SMD220)



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