

FULLY PROTECTED HIGH SIDE POWER MOSFET SWITCH

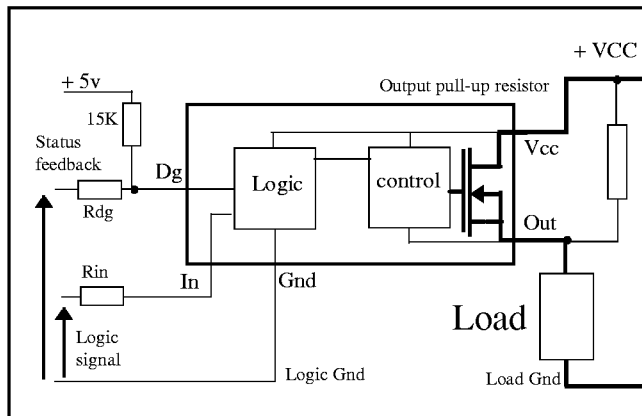
Features

- 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

Description

The IPS521G is a fully protected five terminal high side switch 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°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.

Typical Connection



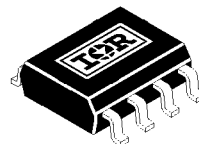
Product Summary

$R_{ds(on)}$	100mW (max)
V_{clamp}	50V
I Limit	10A
$T_{shutdown}$	165°C
$V_{open load}$	3V

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

Available Package



8 Lead SOIC - IPS521G

Absolute Maximum Ratings

Absolute maximum ratings indicates 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	7		
$I_{in, max}$	Maximum positive IN current	-1	10	mA	
V_{dg}	Maximum diagnostic output voltage	-0.3	7	V	
$I_{dg, max}$	Maximum diagnostic output current	-1	10	mA	
$I_{sd cont.}$	Diode max. permanent current ⁽¹⁾ ($r_{th} = 62^{\circ}\text{C/W}$)	—	1.4	A	
$I_{sd pulsed}$	Diode max. pulsed current ⁽¹⁾	—	10		
ESD1	Electrostatic discharge voltage (Human Body)	—	4000	V	C=100pF, R=1500 Ω ,
ESD2	Electrostatic discharge voltage (Machine Model)	—	500		C=200pF, R=0 Ω ,
P_d	Maximum power dissipation ⁽¹⁾ ($r_{th}=125^{\circ}\text{C/W}$)	—	1		
$T_j \text{ max.}$	Max. storage & operating junction temp.	-40	+150	$^{\circ}\text{C}$	

Thermal Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
R_{th1}	Thermal resistance with standard footprint	—	100	125	$^{\circ}\text{C/W}$	8 Lead SOIC
R_{th2}	Thermal resistance with 1" square footprint	—	—	80		

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} $T_c=85^{\circ}\text{C}$	Continuous output current ($T_{Ambient} = 85^{\circ}\text{C}$, $T_j = 125^{\circ}\text{C}$, $R_{th} = 100^{\circ}\text{C/W}$)	—	1.6	A
R_{in}	Recommended resistor in series with IN pin	10	20	$k\Omega$
R_{dg}	Recommended resistor in series with DG pin	10	20	

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

Static Electrical Characteristics

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$R_{ds(on)}$ @ $T_j=25^\circ\text{C}$	ON state resistance $T_j = 25^\circ\text{C}$	—	80	100	mW	$V_{in} = 5\text{V}$, $I_{out} = 5\text{A}$
$R_{ds(on)}$ ($V_{CC}=6\text{V}$)	ON state resistance @ $V_{CC} = 6\text{V}$	—	80	—		$V_{in} = 5\text{V}$, $I_{out} = 2.5\text{A}$
$R_{ds(on)}$ @ $T_j=150^\circ\text{C}$	ON state resistance $T_j = 150^\circ\text{C}$	—	125	—		$V_{in} = 5\text{V}$, $I_{out} = 5\text{A}$
$V_{CC\text{ oper.}}$	Operating voltage range	5.5	—	35	V	
$V_{\text{clamp 1}}$	V_{CC} to OUT clamp voltage 1	50	56	—		$I_d = 10\text{mA}$ (see Fig.1 & 2)
$V_{\text{clamp 2}}$	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		$I_d = 2.5\text{A}$, $V_{in} = 0\text{V}$
$I_{CC\text{ off}}$	Supply current when OFF	—	16	50	mA	$V_{in} = 0\text{V}$, $V_{out} = 0\text{V}$
$I_{CC\text{ on}}$	Supply current when ON	—	0.7	2	mA	$V_{in} = 5\text{V}$
$I_{CC\text{ ac}}$	Ripple current when ON (AC RMS)	—	20	—	mA	$V_{in} = 5\text{V}$
V_{dgl}	Low level diagnostic output voltage	—	0.15	—	V	$I_{dg} = 1.6\text{ mA}$
I_{ol}	Output leakage current	—	50	—	mA	$V_{out} = 6\text{V}$
I_{ol}	Output leakage current	0	—	25		$V_{out} = 0\text{V}$
I_{dg} leakage	Diagnostic output leakage current	—	—	10		$V_{dg} = 5.5\text{V}$
V_{ih}	IN high threshold voltage	—	2.0	2.5	V	
V_{il}	IN low threshold voltage	1	1.8	—		
$I_{in, on}$	On state IN positive current	—	70	—	mA	$V_{in} = 5\text{V}$

Switching Electrical Characteristics

$V_{CC} = 14\text{V}$, Resistive Load = 2.8Ω , $T_j = 25^\circ\text{C}$, (unless otherwise specified).

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
T_{on}	Turn-on delay time	—	10	—	ms	See figure 3
T_{r1}	Rise time to $V_{out} = V_{CC} - 5\text{V}$	—	25	—		
T_{r2}	Rise time to $V_{out} = 90\%$ of V_{CC}	—	130	—		
$dV/dt\text{ (on)}$	Turn ON dV/dt	—	0.7	—	V/ms	
E_{on}	Turn ON energy	—	2000	—	mJ	
T_{off}	Turn-off delay time	—	35	—	ms	See figure 4
T_f	Fall time to $V_{out} = 10\%$ of V_{CC}	—	25	—		
$dV/dt\text{ (off)}$	Turn OFF dV/dt	—	0.9	—		
E_{off}	Turn OFF energy	—	600	—	mJ	
T_{diag}	V_{out} to V_{diag} propagation delay	—	tbd	—	ms	

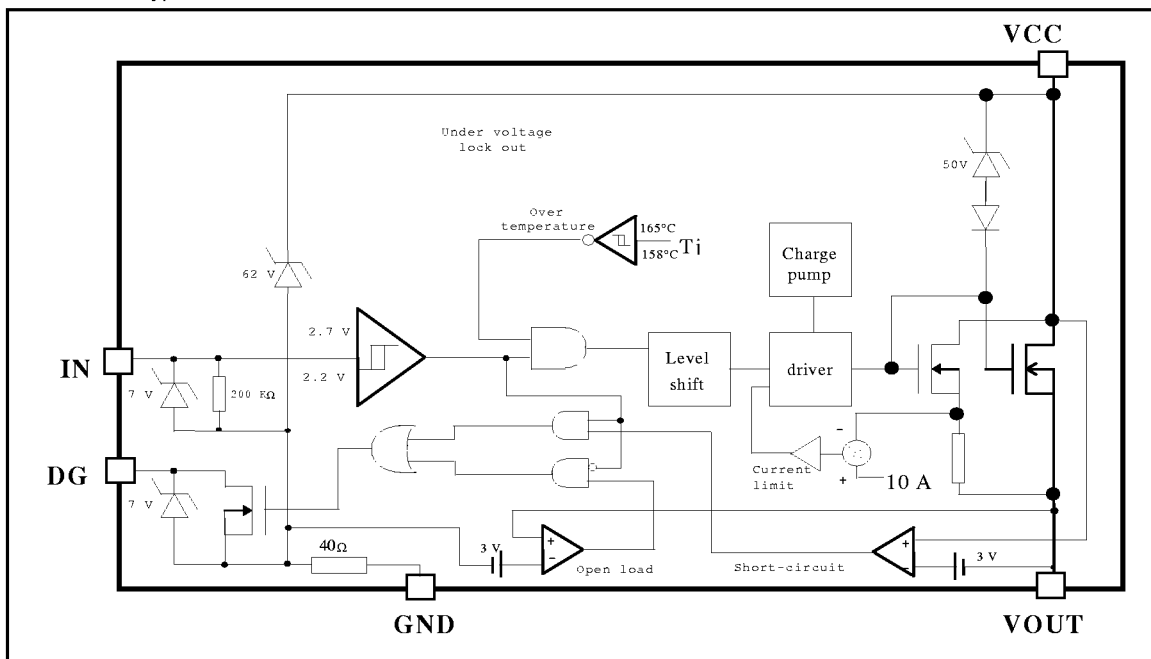
Protection Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I_{lim}	Internal current limit	—	10	—	A	$V_{out} = 0V$
T_{sd+}	Over-temp. positive going threshold	—	165	—	°C	See fig. 2
T_{sd-}	Over-temp. negative going threshold	—	158	—	°C	See fig. 2
V_{sc}	Short-circuit detection voltage (3)	—	3	—	V	See fig. 2
$V_{open\ load}$	Open load detection threshold	—	3	—	V	

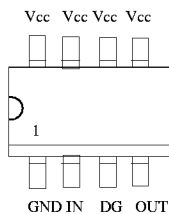
(3) Referenced to V_{CC}

Functional Block Diagram

All values are typical

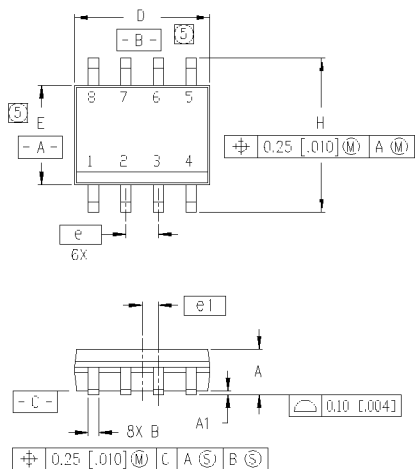


Lead Assignments



8 Lead SOIC

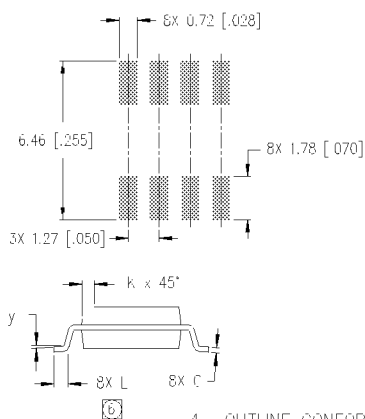
Case Outline - 8 Lead SOIC



NOTES.

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]

RECOMMENDED FOOTPRINT



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0668	1.35	1.75
Al	.0404	.0098	1.00	0.25
B	.014	.018	0.36	0.46
C	.0075	.0098	0.19	0.25
D	.189	.196	4.80	4.98
E	.150	.157	3.81	3.99
e	.050	BASIC	1.27	BASIC
e1	.025	BASIC	0.635	BASIC
H	.2284	.2440	5.80	6.20
k	.011	.019	0.28	0.48
L	.016	.050	0.41	1.27
y	0"	8"	0"	8"

4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
5. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS
MOLD PROTRUSIONS NOT TO EXCEED 0.25 [.006]
6. DIMENSION IS THE LENGTH OF LEAD FOR
SOLDERING TO A SUBSTRATE

01-0021 08

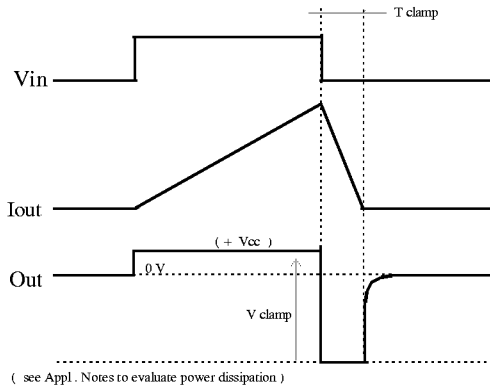


Figure 1 - Active clamp waveforms

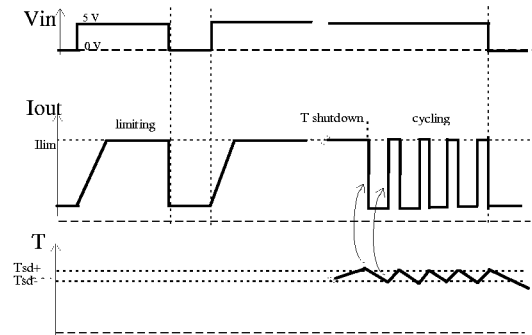


Figure 2 - Protection timing diagram

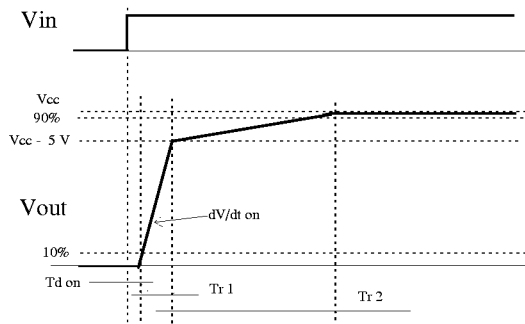


Figure 3 - Switching times definition (turn-on)

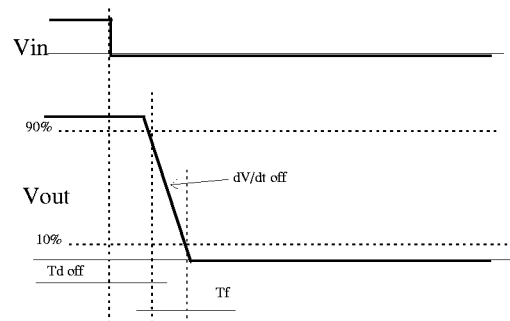


Figure 4 - Switching times definition (turn-off)

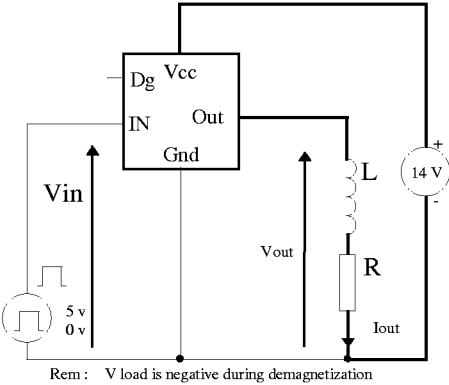


Figure 5 - Active clamp test circuit

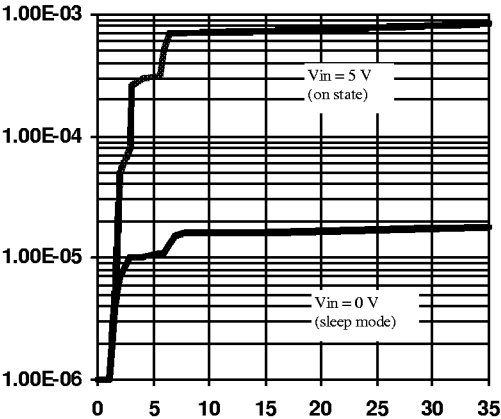


Figure 6 - Icc (mA) Vs Vcc (V)

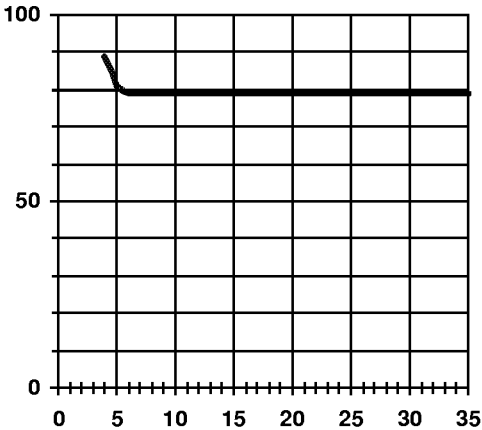


Figure 7 - Rds(on) (mΩ) Vs Vcc (V)

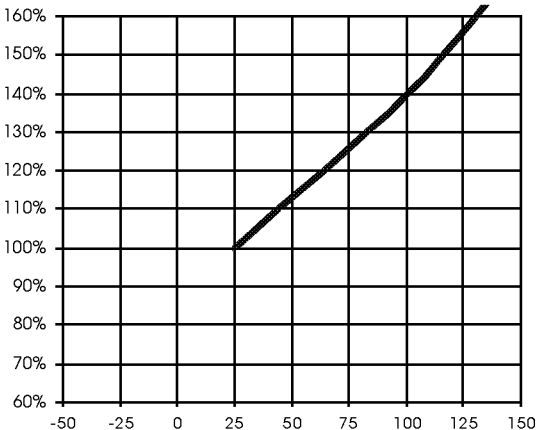


Figure 8 - Normalized Rds(on) Vs Tj (°C)

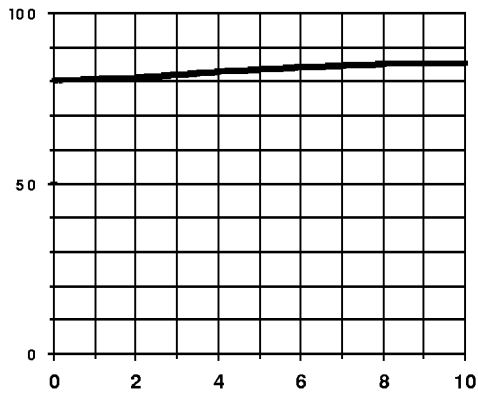


Figure 9 - $R_{ds(on)}$ (mΩ) Vs I_{out} (A)

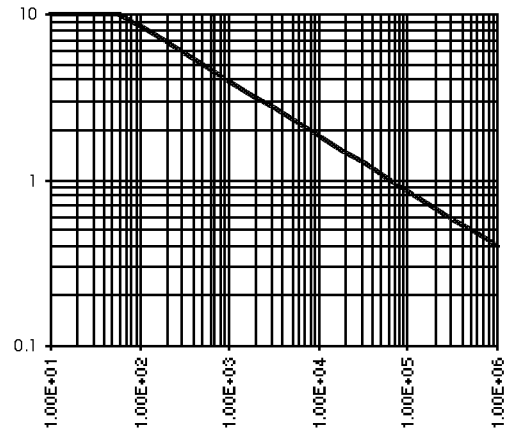


Figure 10 - Max. I_{out} (A) Vs Load Inductance (μH)

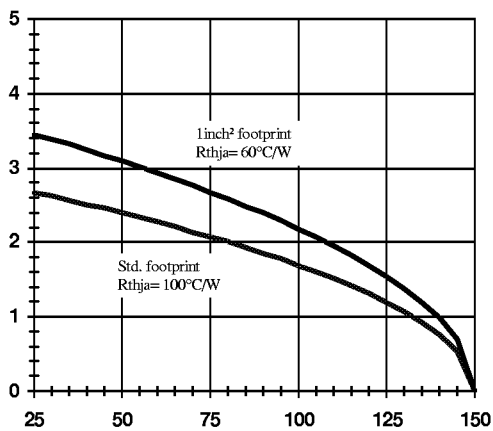


Figure 11 - Max load current (A) Vs T_{amb} (°C)

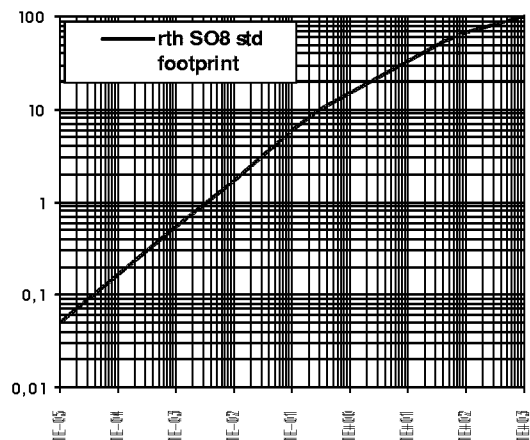


Figure 12 - Transient Thermal Impedance (°C/W) Vs Time (s)

International
IOR Rectifier

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