International
IOR Rectifier

IPS521G

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

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

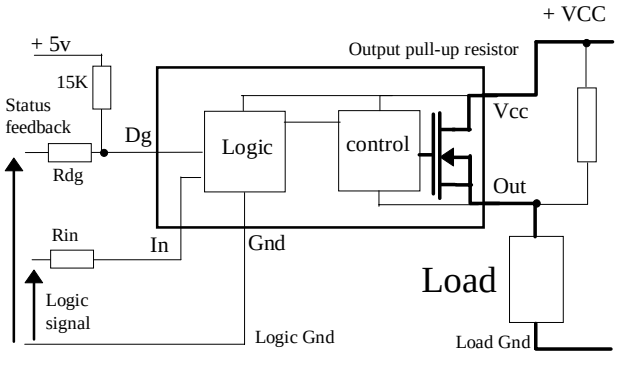
Description

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 Tshutdown. It will automatically restart after the junction has cooled 7°C below Tshutdown. 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.

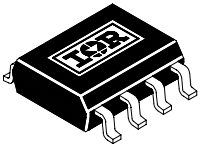
Truth Table

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



Available Package



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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°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) (rth = 62°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=1500Ω,
ESD2	Electrostatic discharge voltage (Machine Model)	—	500		C=200pF, R=0Ω,
P_d	Maximum power dissipation(1) (rth=125°C/W)	—	1		
T_j max.	Max. storage & operating junction temp.	-40	+150	°C	

Thermal Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
R_{th1}	Thermal resistance with standard footprint	—	*100*	125	°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} Tc=85°C	Continuous output current (TAmbient = 85°C, Tj = 125°C, R_{th} = 100°C/W)	—	1.6	A
R_{in}	Recommended resistor in series with IN pin	10	20	kΩ
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°C, V_{cc} = 14V unless otherwise specified.)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$R_{ds(on)}$ @Tj=25°C	ON state resistance T_j = 25°C	—	80	100	mW	V_{in} = 5V, I_{out} = 5A
$R_{ds(on)}$ (V_{cc}=6V)	ON state resistance @ V_{cc} = 6V	—	80	—		V_{in} = 5V, I_{out} = 2.5A
$R_{ds(on)}$ @Tj=150°C	ON state resistance Tj = 150°C	—	125	—		V_{in} = 5V, I_{out} = 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	mA	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	—	mA	V_{in} = 5V
V_{dgl}	Low level diagnostic output voltage	—	0.15	—	V	I_{dg} = 1.6 mA
I_{ol}	Output leakage current	—	50	—	mA	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	—	2.0	2.5	V	
V_{il}	IN low threshold voltage	1	1.8	—		
$I_{in,\ on}$	On state IN positive current	—	70	—	mA	V_{in} = 5V

Switching Electrical Characteristics

V_{cc} = 14V, Resistive Load = 2.8W, T_j = 25°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} - 5V	—	25	—		
T_{r2}	Rise time to V_{out} = 90% of V_{cc}	—	130	—		
$d_{V/dt\ (on)}$	Turn ON $d_{V/dt}$	—	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	—		
$d_{V/dt\ (off)}$	Turn OFF $d_{V/dt}$	—	0.9	—	V/ms	
E_{off}	Turn OFF energy	—	600	—	mJ	
T_{diag}	V_{out} to V_{diag} propagation delay	—	tbd	—	ms	

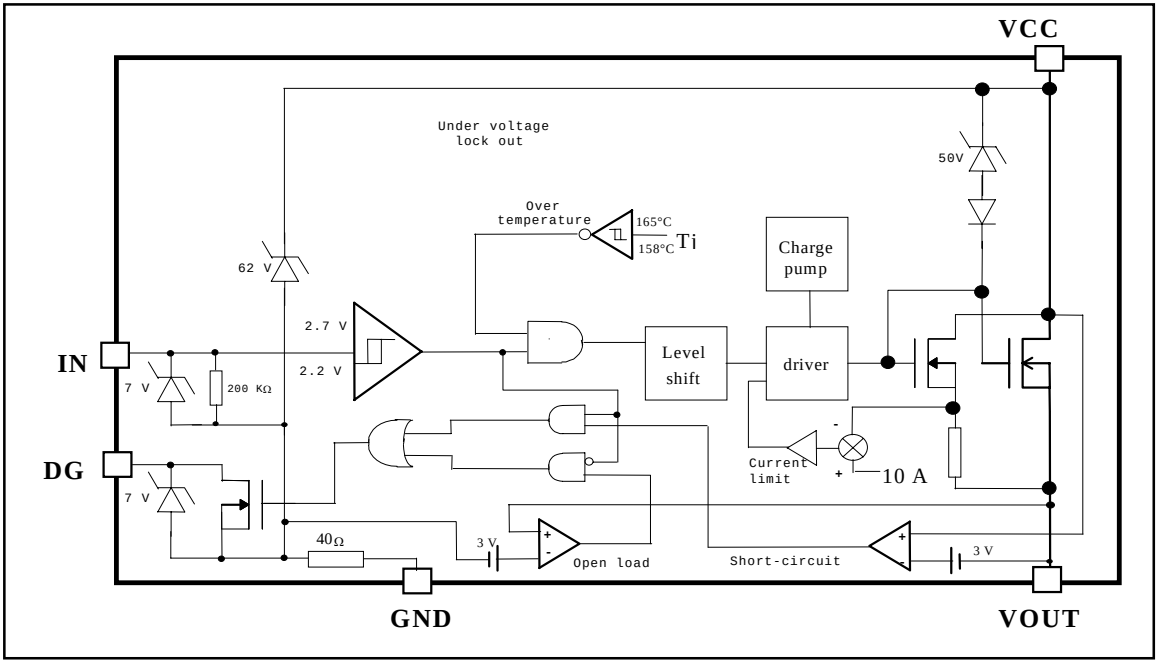
Protection Characteristics

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	

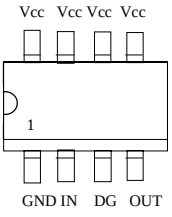
(3) Referenced to V_{cc}

Functional Block Diagram

All values are typical



Lead Assignments



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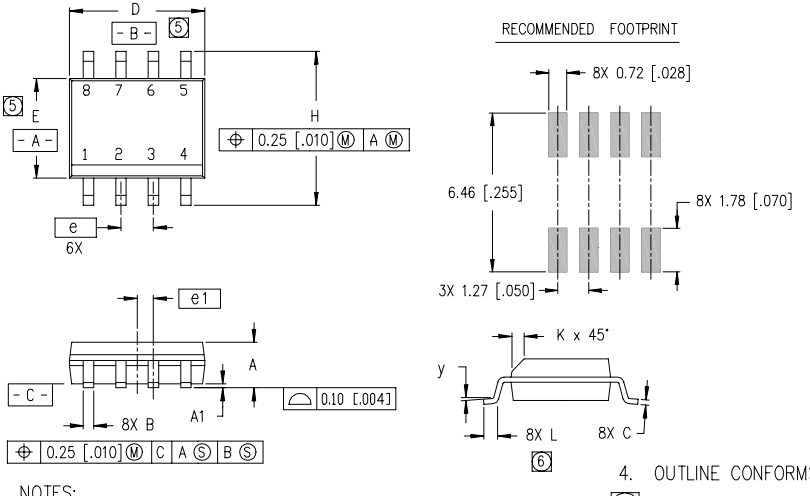
Case Outline - 8 Lead SOIC



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	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°

NOTES:

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

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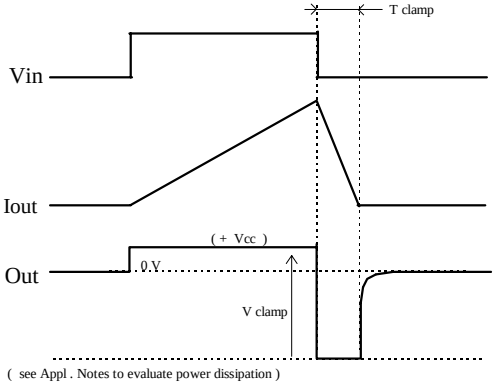

Figure 1 - Active clamp waveforms

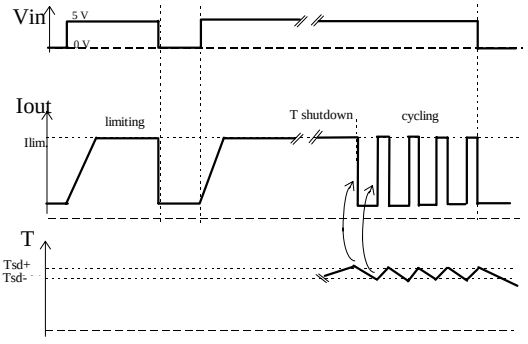

Figure 2 - Protection timing diagram

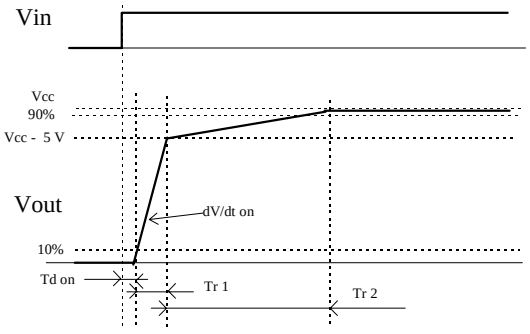

Figure 3 - Switching times definition (turn-on)

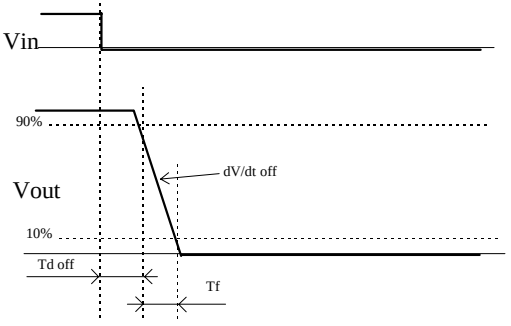

Figure 4 - Switching times definition (turn-off)

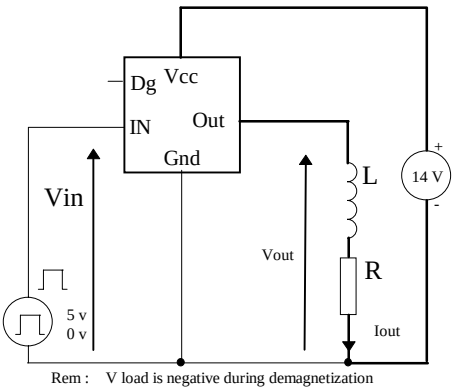

Figure 5 - Active clamp test circuit

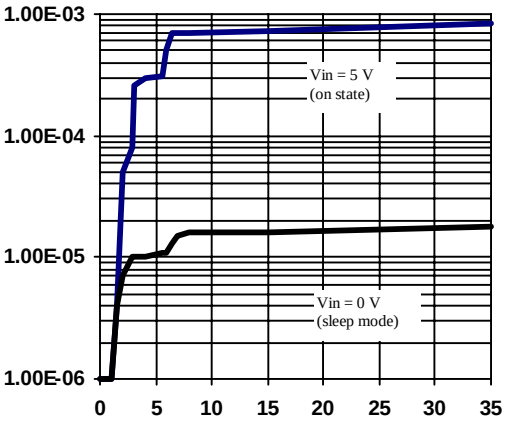

Figure 6 - Icc (mA) Vs Vcc (V)

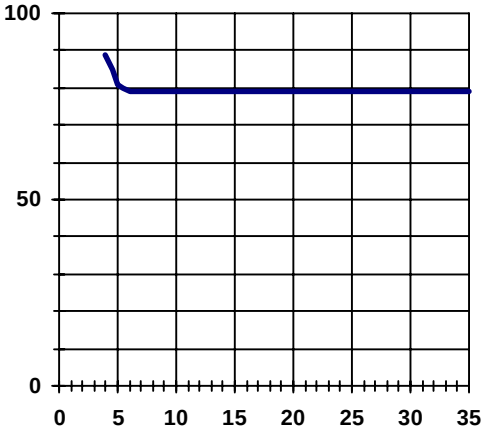

Figure 7 - $R_{ds(on)}$ (mW) Vs V_{cc} (V)

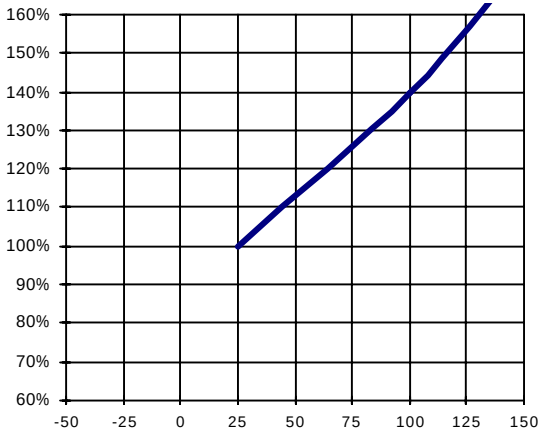

Figure 8 - Normalized $R_{ds(on)}$ Vs T_j (^oC)

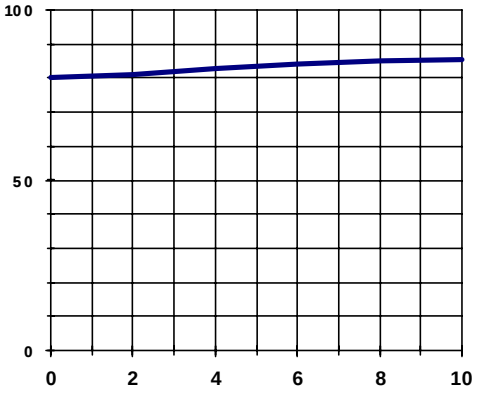

Figure 9 - Rds(on) (mW) Vs I_{out} (A)

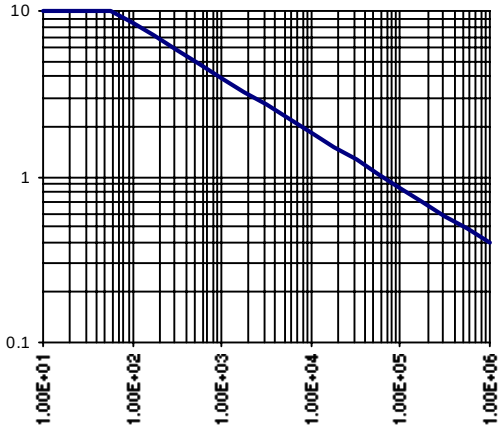

Figure 10 - Max. I_{out} (A) Vs Load Inductance (uH)

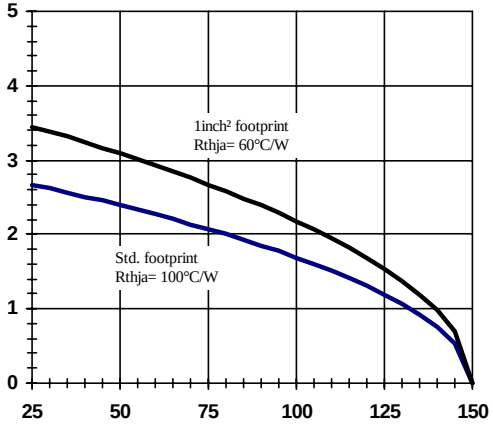

Figure 11 - Max load current (A) Vs Tamb (^{O}C)

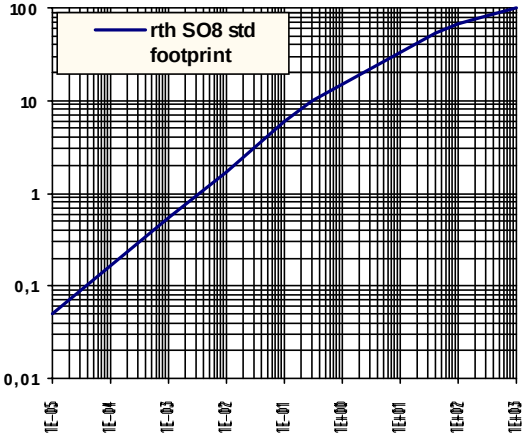

Figure 12 - Transient Thermal Impedance (^{O}C/W) Vs Time (s)

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