Preliminary Data Sheet No.PD 60144-G

International
IOR Rectifier

IPS0151/IPS0151S

FULLY PROTECTED POWER MOSFET SWITCH

Features

- Over temperature shutdown
- Over current shutdown
- Active clamp
- Low current & logic level input
- E.S.D protection

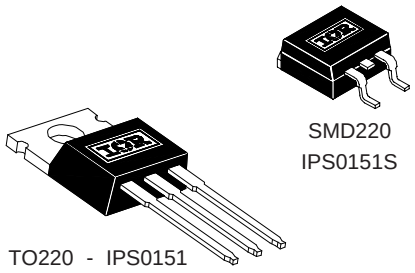
Description

The IPS0151/IPS0151S are fully protected three terminal SMART POWER MOSFETs that feature over-current, over-temperature, ESD protection and drain to source active clamp.These device combine a HEXFET POWER MOSFET and a gate driver. They offer full protection and high reliability required in harsh environments. The driver allows short switching times and provides efficient protection by turning OFF the power MOSFET when the temperature exceeds 165°C or when the drain current reaches 35A. These device restart once the input is cycled. The avalanche capability is significantly enhanced by the active clamp and covers most inductive load demagnetizations.

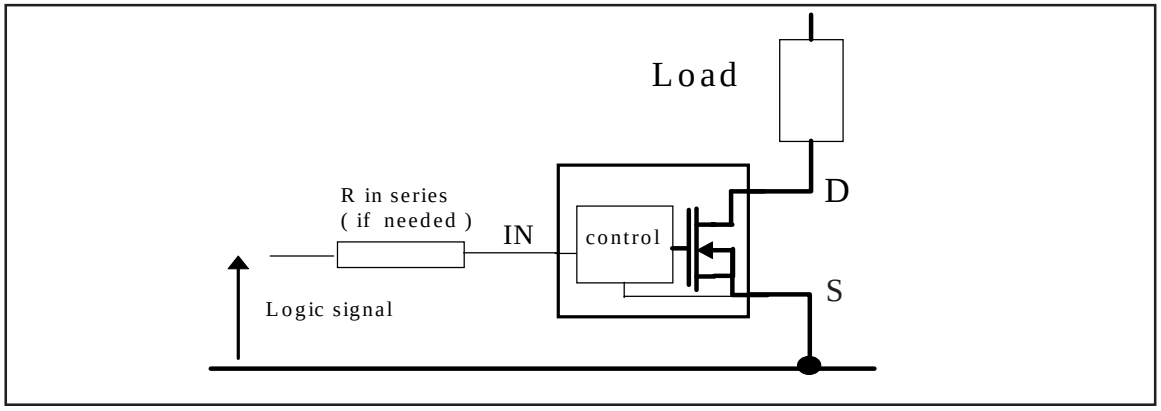
Product Summary

$R_{ds(on)}$	25mΩ (max)
V_{clamp}	50V
Ishutdown	35A
Tshutdown	165°C
T_{on}/T_{off}	1.5µs

Available Package



Typical Connection



Absolute Maximum Ratings

Absolute maximum ratings indicates sustained limits beyond which damage to the device may occur. All voltage parameters are referenced to SOURCE lead. ($T_{Ambient}$ = 25°C unless otherwise specified). PCB mounting uses the standard footprint with 70 µm copper thickness.

Symbol	Parameter	Min.	Max.	Units	Test Conditions
V_{ds}	Maximum drain to source voltage	—	47	V	
V_{in}	Maximum Input voltage	-0.3	7		
$I_{in, max}$	Maximum IN current	-10	+10	mA	
$I_{sd\ cont.}$	Diode max. continuous current (1)			A	
	(rth=62°C/W) IPS0151	—	2.8		TO220 free air
	(rth=5°C/W) IPS0151	—	35		TO220 + good cooling
	(rth=80°C/W) IPS0151S	—	2.2		SMD220 Std footprint
$I_{sd\ pulsed}$	Diode max. pulsed current (1)	—	45		
P_d	Maximum power dissipation(1)			W	
	(rth=62°C/W) IPS0151	—	2		
	(rth=80°C/W) IPS0151S	—	1.56		
ESD1	Electrostatic discharge voltage (Human Body)	—	tbd	V	C=100pF, R=1500Ω,
ESD2	Electrostatic discharge voltage (Machine Model)	—	tbd		C=200pF, R=0Ω,
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 free air	—	55	62	°C/W	TO-220
R_{th} 2	Thermal resistance junction to case	—	2	—		
R_{th} 1	Thermal resistance with standard footprint	—	58	80		D^2PAK (SMD220)
R_{th} 2	Thermal resistance with 1" square footprint	—	35	60		
R_{th} 3	Thermal resistance junction to case	—	2	—		

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
$V_{ds\ (max)}$	Continuous drain to source voltage	—	35	V
V_{IH}	High level input voltage	4	6	
V_{IL}	Low level input voltage	0	0.5	
I_{ds} Tamb=85°C	Continuous drain current			A
	(TAmbient = 85°C, IN = 5V, rth = 60°C/W, Tj = 125°C) IPS0151	—	4.3	
	(TAmbient = 85°C, IN = 5V, rth = 80°C/W, Tj = 125°C) IPS0151S	—	3.8	
R_{in}	Recommended resistor in series with IN pin	0.2	5	kΩ
$Tr\text{-}in\ (max)$	Max recommended rise time for IN signal (see fig. 2)	—	1	µS
$Fr\text{-}Isc$ (2)	Max. frequency in short circuit condition (Vcc = 14V)	0	1	kHz

(1) Limited by junction temperature (pulsed current limited also by internal wiring)
(2) Operations at higher switching frequencies is possible. See Appl. Notes.

Static Electrical Characteristics

(T_j = 25°C unless otherwise specified.)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$R_{ds(on)}$ @Tj=25°C	ON state resistance T_j = 25°C	—	20	25	mΩ	V_{in} = 5V, I_{ds} = 10A
$R_{ds(on)}$ @Tj=150°C	ON state resistance Tj = 150°C	—	35	45		
I_{dss} @Tj=25°C	Drain to source leakage current	0	0.5	25	µA	V_{cc} = 14V, T_j = 25°C
V clamp 1	Drain to source clamp voltage 1	47	52	—	V	I_d = 20mA (see Fig.3 & 4)
V clamp 2	Drain to source clamp voltage 2	—	54	60		I_d=$I_{shutdown}$ (see Fig.3 & 4)
V_{sd}	Body diode forward voltage	—	0.85	1		I_d = 15A, V_{in} = 0V
$V_{in\ clamp}$	IN to source clamp voltage	7	8.1	9.5		I_{in} = 1 mA
V_{th}	IN threshold voltage	1	1.6	2		I_d = 50mA
$I_{in,\ on}$	Input supply current (normal operation)	25	80	200	µA	V_{in} = 5V
$I_{in,\ off}$	Input supply current (protection mode)	50	130	250		V_{in} = 5V over-current triggered

Switching Electrical Characteristics

V_{cc} = 14V, Resistive Load = 3Ω, Rinput = 50Ω, 100µsec pulse, T_j = 25°C, (unless otherwise specified).

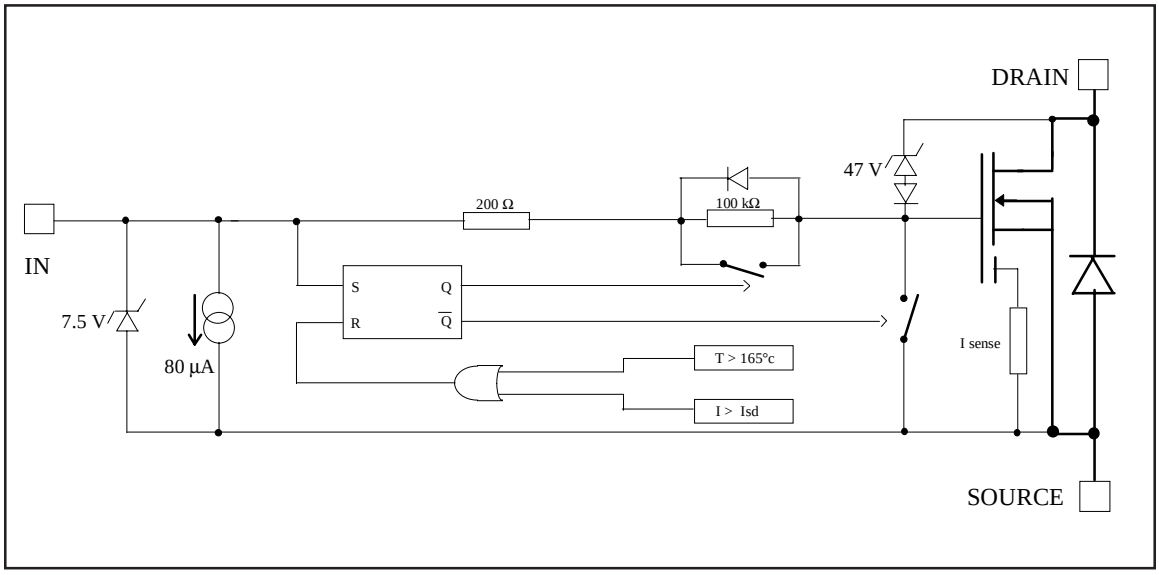
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
T_{on}	Turn-on delay time	—	0.4	—	µsec	See figure 2
T_r	Rise time	—	1.1	—		
T_{rf}	Time to 130% final $R_{ds(on)}$	—	3.8	—		
T_{off}	Turn-off delay time	—	1.2	—		See figure 2
T_f	Fall time	—	1.3	—		
Q_{in}	Total gate charge	—	30	—	nC	V_{in} = 5V

Protection Characteristics

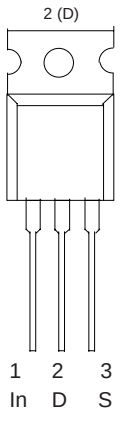
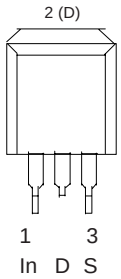
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
T_{sd}	Over temperature threshold	—	165	—	°C	See fig. 1
I_{sd}	Over current threshold	—	35	—	A	See fig. 1
$V_{in,min,prot}$	Minimum IN voltage for protection	—	3	—	V	
T_{reset}	Minimum time for protection reset		10		µs	V_{in} = 0V
EOI_OT	Short circuit energy (cf application note)		400		µJ	V_{cc} = 14V

Functional Block Diagram

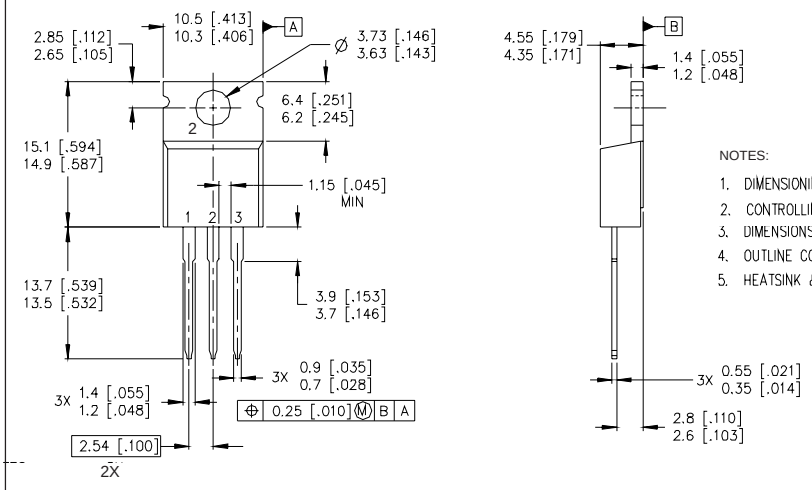
All values are typical



Lead Assignments

 TO220	 D²PAK (SMD220)
IPS0151	**IPS0151S**
Part Number	

Case Outline - TO220



NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M–1994.
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
5. HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

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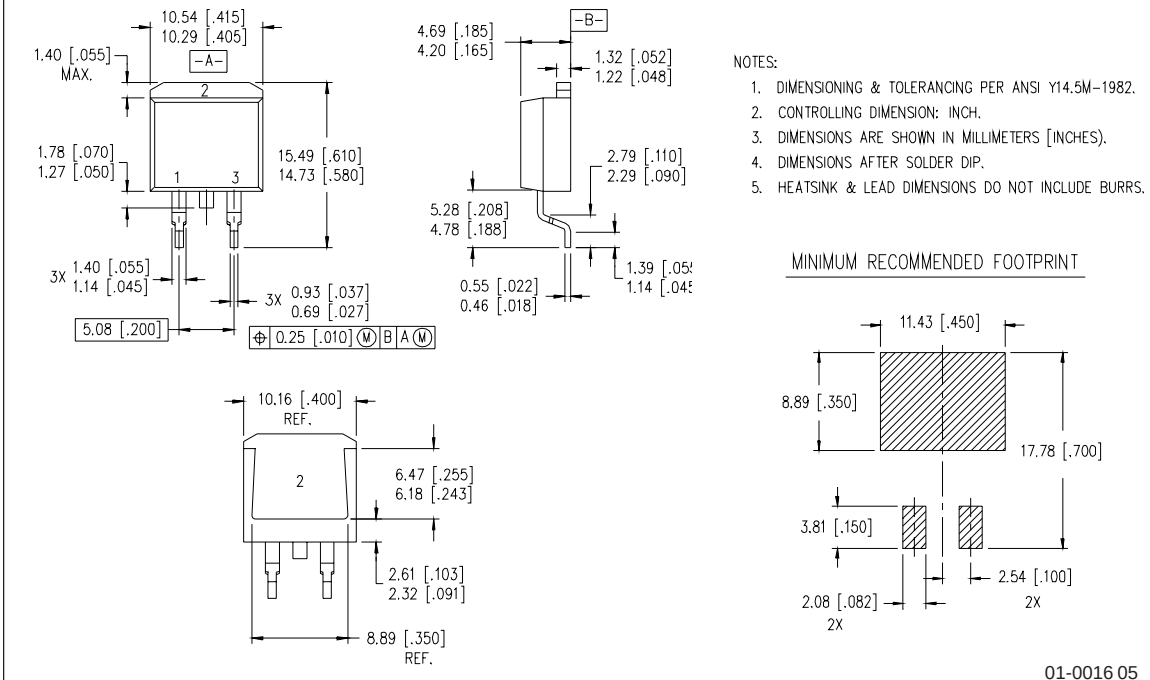
Case Outline - D²PAK (SMD220)



NOTES:

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M–1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. DIMENSIONS AFTER SOLDER DIP.
5. HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

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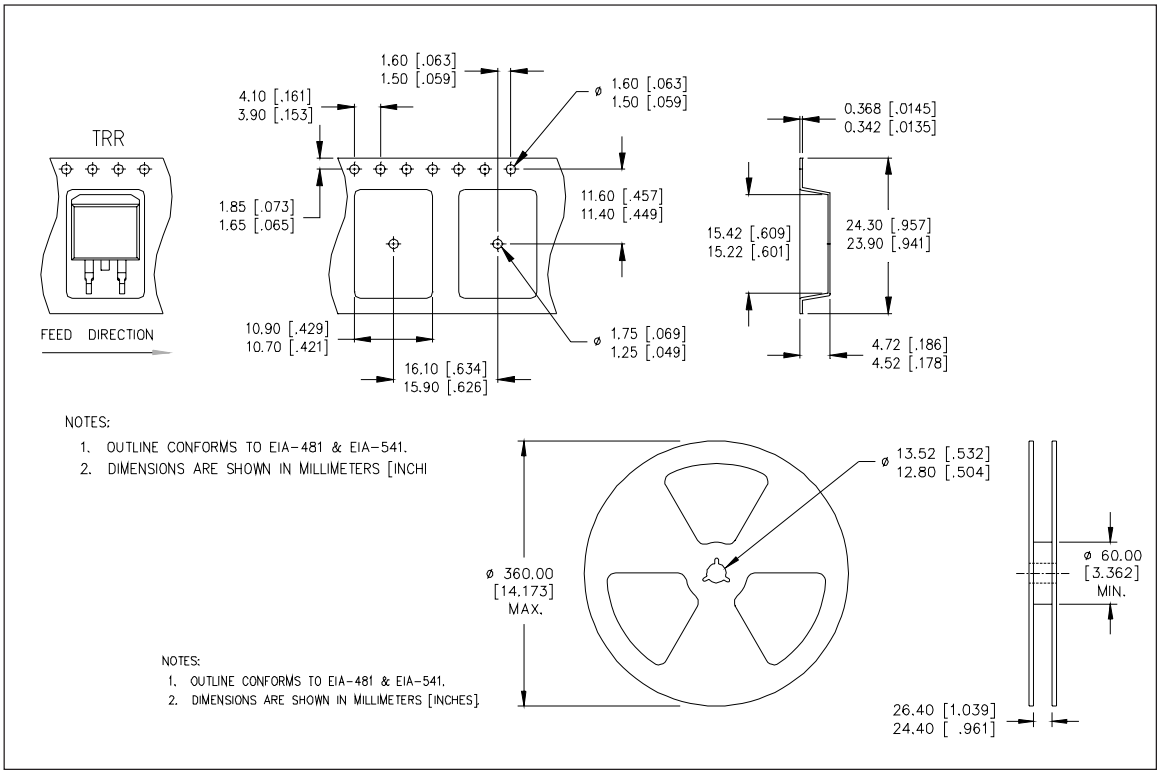
Tape & Reel - D^{2}PAK (SMD220)



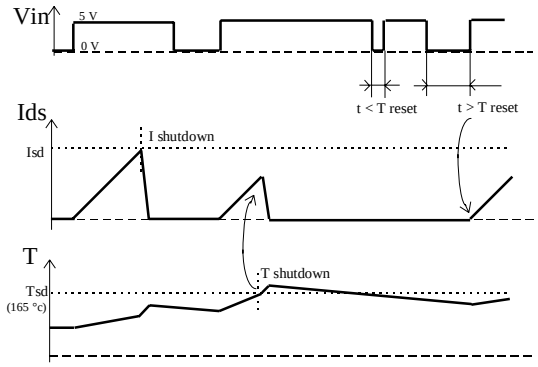


Figure 1 - Timing diagram

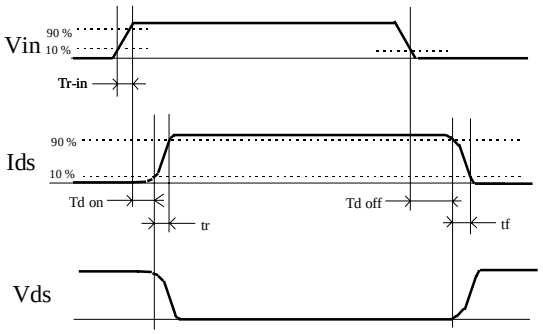


Figure 2 - IN rise time & switching time definitions

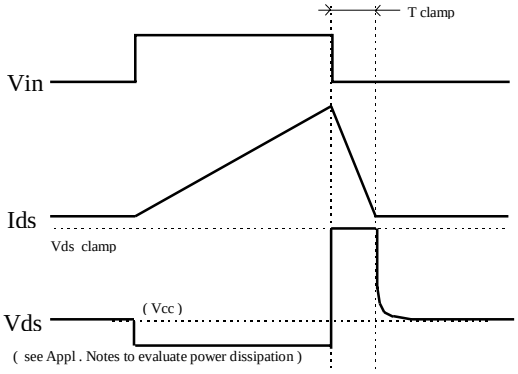


Figure 3 - Active clamp waveforms

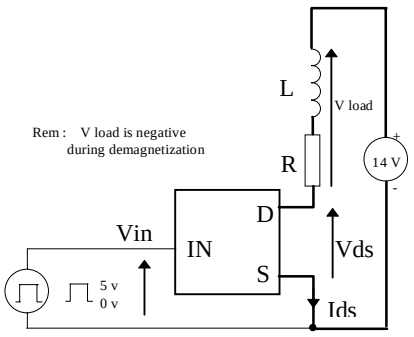


Figure 4 - Active clamp test circuit

All curves are typical values with standard footprints. Operating in the shaded area is not recommended.

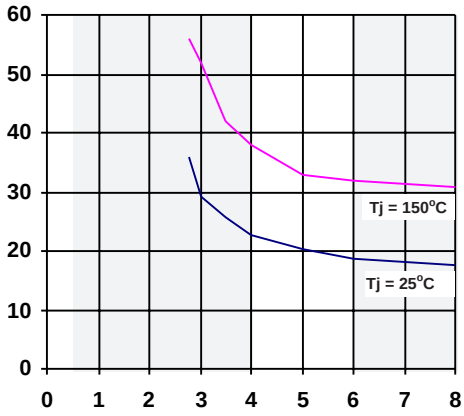


Figure 5 - Rds ON (mΩ) Vs Input Voltage (V)

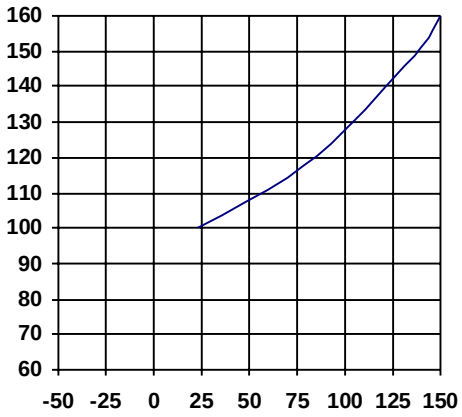


Figure 6 - Normalised Rds ON (%) Vs Tj (ºC)

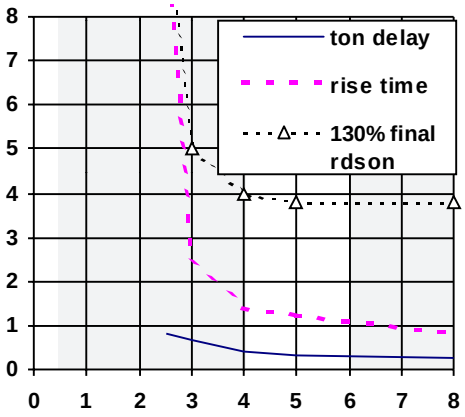


Figure 7 - Turn-ON Delay Time, Rise Time & Time to 130% final $R_{ds(on)}$ Vs Input Voltage (V)

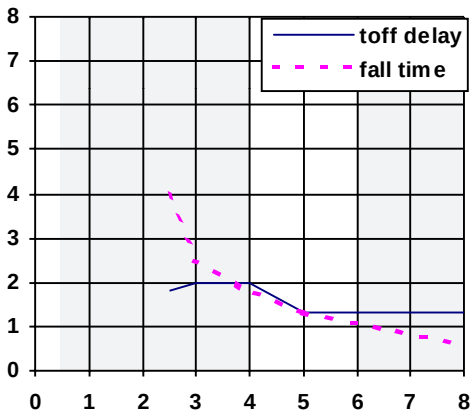


Figure 8 - Turn-OFF Delay Time & Fall Time (us) Vs Input Voltage (V)

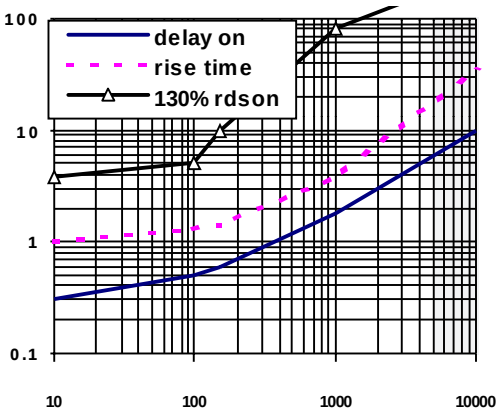


Figure 9 - Turn-ON Delay Time, Rise Time & Time to 130% final $Rds_{(on)}$ Vs IN Resistor (Ω)

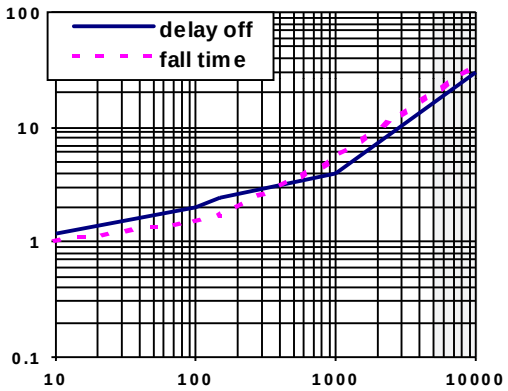


Figure 10 - Turn-OFF Delay Time & Fall Time (us) Vs IN Resistor (Ω)

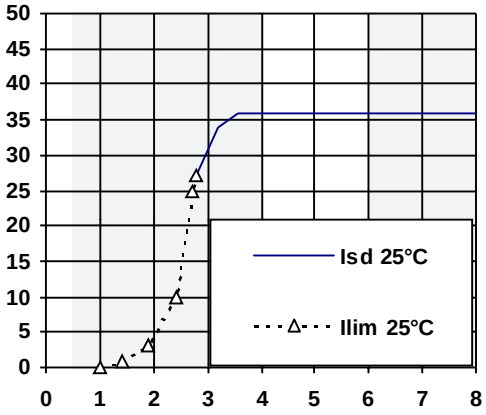


Figure 11 - Current Iim. & Ishutdown (A) Vs Vin (V)

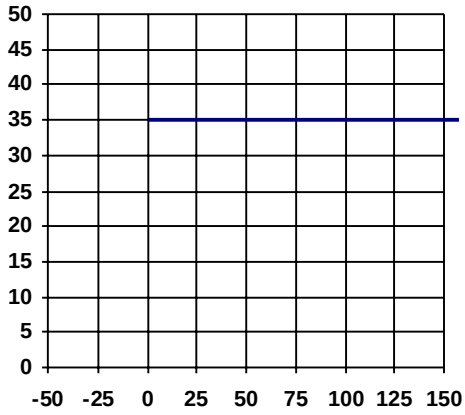


Figure 12 - Over-current (A) Vs Temperature (°C)

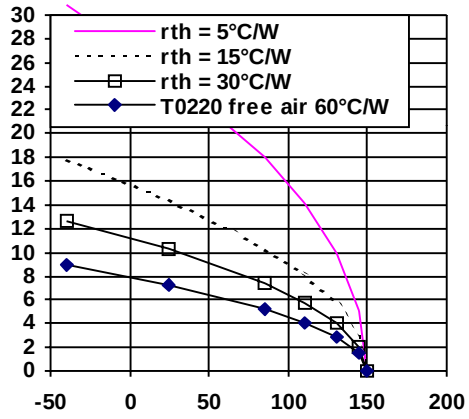


Figure 13a - Max.Cont. Ids (A) Vs Amb. Temperature (ºC) - IPS0151

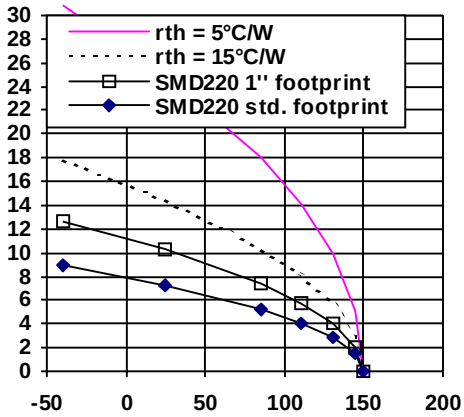


Figure 13b - Max.Cont. Ids (A) Vs Amb. Temperature (ºC) - IPS0151S

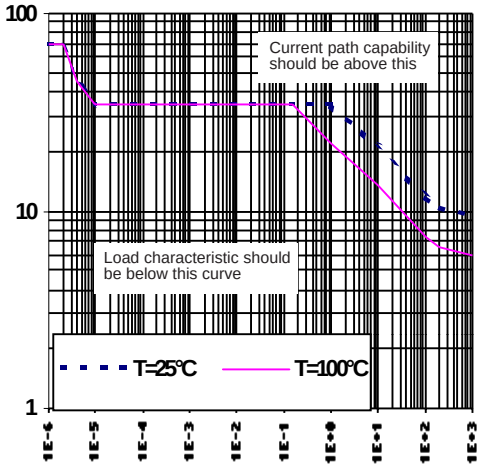


Figure 14 - Ids (A) Vs Protection Resp. Time (s) IPS0151 & IPS0151S

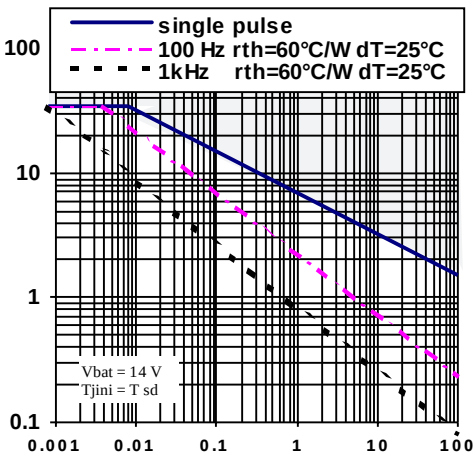


Figure 15 - Iclamp (A) Vs Inductive Load (mH)

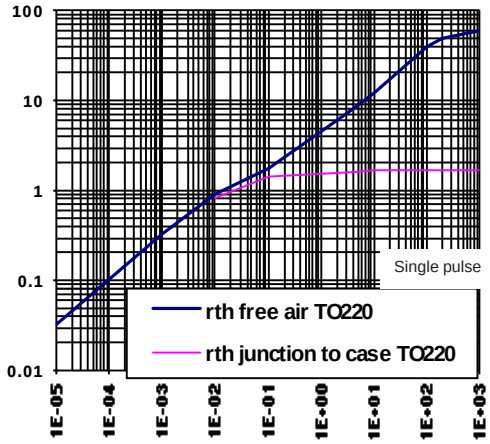


Figure 16a - Transient Thermal Imped. (ºC/W) Vs Time (s) - IPS0151

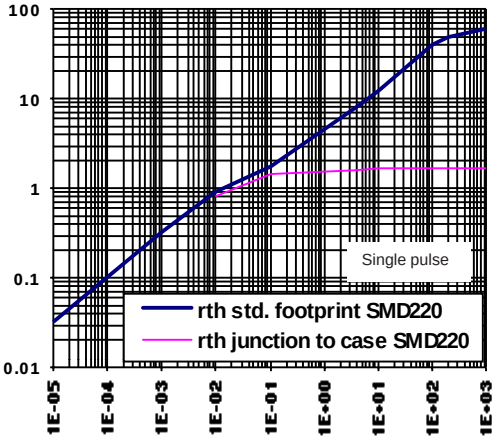


Figure 16b - Transient Thermal Imped. (ºC/W) Vs Time (s) - IPS0151S

International
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