HDP01-0512N

Application Specific Discretes
A.S.D.™

HARD DISK DRIVE POWER SUPPLY PROTECTION

APPLICATIONS

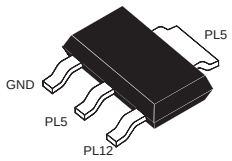
- PROTECTION FOR THE +5V AND +12V POWER LINES OF:
  - Hard disk drives
  - Floppy disk drives
  - CD-ROMs, CD-R, CD-RW
  - DVDs

FEATURES

- PROTECTION OF BOTH 5V AND 12V SUPPLY RAILS.
- MAXIMUM CURRENT ON THE 5V LINE 3A DURING 1s.
- MONOLITHIC INTEGRATION IN PLANAR TECHNOLOGY.

DESCRIPTION

This device is dedicated to the protection of the +5V power supply line against transient overvoltages due to surge of power rails up to the activation of the serial thermal protection element. It is also dedicated to the protection of the +12V rail against transient overvoltages.

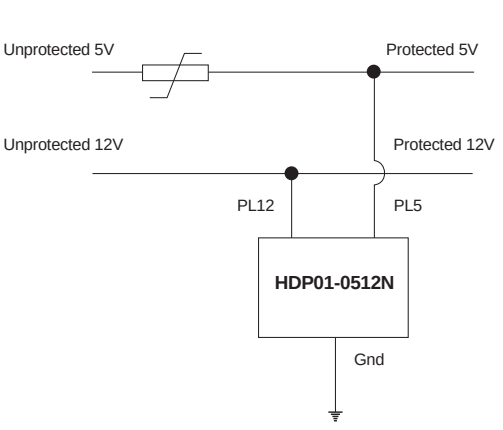


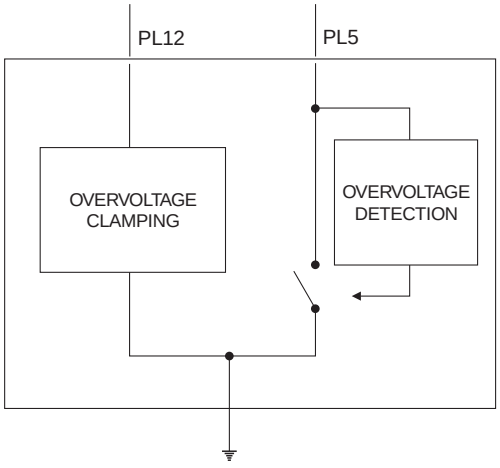
SOT223

BENEFITS

- COMPONENT COUNT REDUCTION
- PCB SURFACE REDUCTION
- SIMPLIFIED SYSTEM PROTECTION DESIGN

BASIC APPLICATION DIAGRAM





note: The element in series with the 5V line is a resettable device, like Raychem Polyswitch MiniSMD075.

TM : ASD is trademark of STMicroelectronics.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
t_{on}	Conduction time with I_{-PL5} = 3A DC (note1)	1	s
T_{op}	Operating temperature range	0 to + 75	°C
T_j	Maximum junction temperature	125	°C
T_{stg}	Storage temperature range	- 55 to + 150	°C
T_L	Lead solder temperature (10s duration)	260	°C

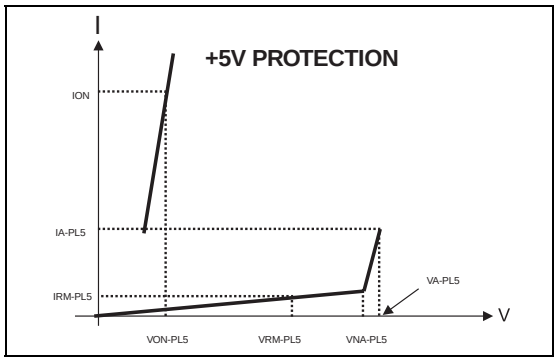
note 1 : I_{-PL5} is the current going through the 5V line (PL5)

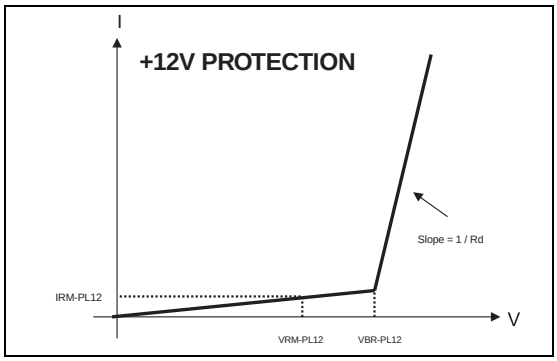
THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
Rth (j-t)	Junction to tab	30	°C/W
Rth (j-a)	Junction to ambient (note 2)	60	°C/W

note 2 : With 5cm^2 copper (e=35µm) surface under tab.

ELECTRICAL CHARACTERISTICS (Tamb=25°C)





ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)
PROTECTION OF 5 V LINE (PL5)

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
V_{NA}-PL5	Non activation voltage between PL5 and Gnd at I_{RM}=100µA	6.0			V
V_A-PL5	Activation voltage between PL5 and Gnd		7.0	7.4	V
I_{RM}-PL5	Leakage current between PL5 and Gnd at V_{RM} =5V			1	µA
IA-PL5	Activation current between PL5 and Gnd			10	mA
V_{ON}-PL5	Voltage drop on active state at I_{ON}=3A		1.3		V

PROTECTION OF 12 V LINE (PL12)

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
V_{BR}-PL12	Breakdown voltage at I_R=1mA	14		16	V
I_{RM}-PL12	Leakage current between PL12 and Gnd at V_{RM} =12V			1	µA
Rd	Dynamic resistance. Square pulse Ipp=3A, tp = 2.5µs		2.5		Ω

Fig. 1: Non repetitive surge peak on-state current versus pulse duration (rectangular waveform).

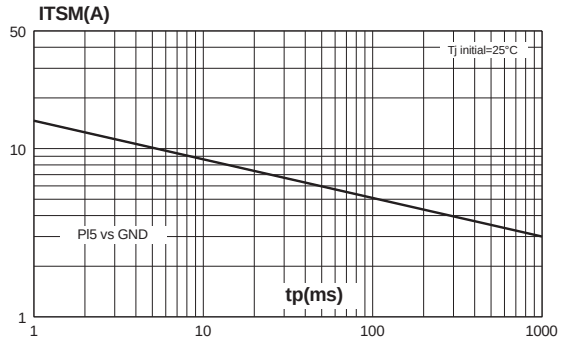


Fig. 2: Peak pulse power dissipation versus exponential pulse duration (Tj initial = 25°C).

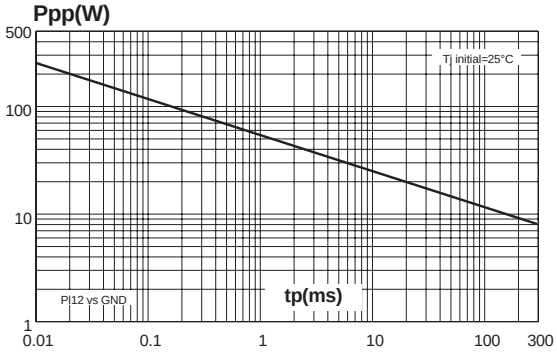


Fig. 3: Typical clamping voltage versus peak pulse current (rectangular waveform, tp=2.5µs).

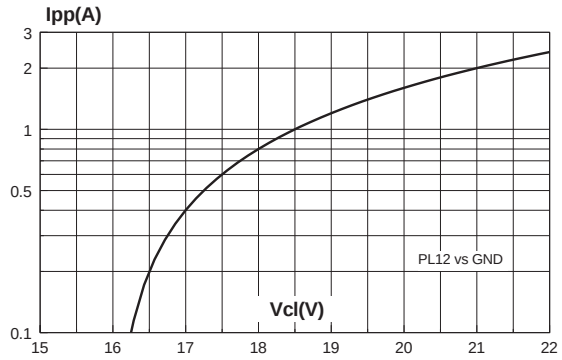
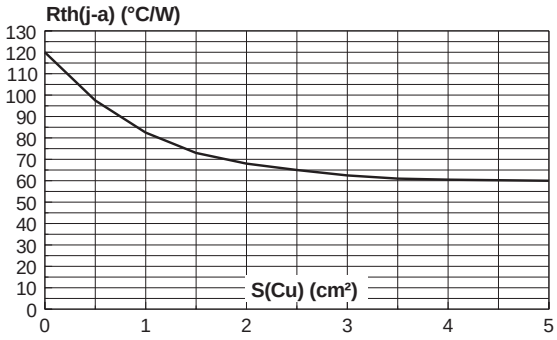
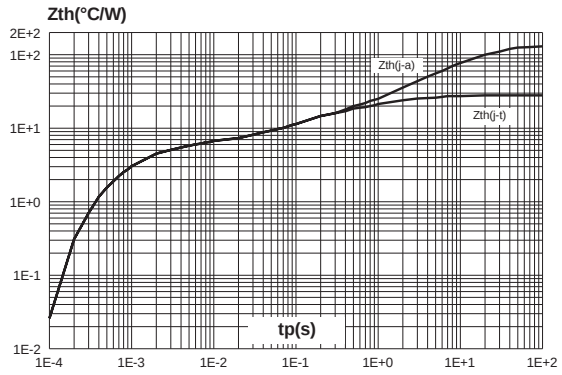


Fig. 4: Thermal resistance junction to ambient versus copper surface under tab (Epoxy printed circuit board FR4, copper thickness: 35µm).



Note: $R_{th(j-a)} = (T_{jMax} - T_{amb}) / P_{Max}$

Fig. 5: Thermal impedance junction to ambient and junction to tab versus pulse duration.

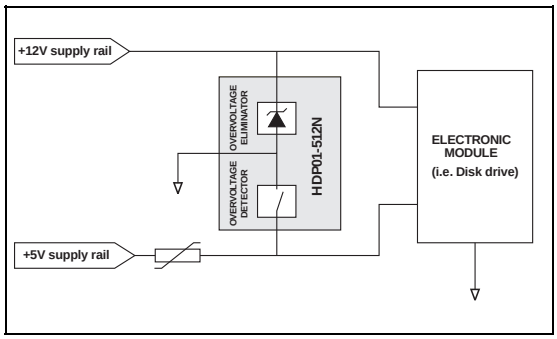


APPLICATION INFORMATION

DESCRIPTION

The HDP01-0512N has been specially designed to protect equipment supplied by both +5 and +12 Volt power rails such as hard disk drives, CD-ROMs, DVDs, floppy disk drives with the topology indicated in figure A.1.

Fig. A.1: typical application schematic.



This protection device is able to protect both +5 and +12 Volts power rails against transients and rails inversion.

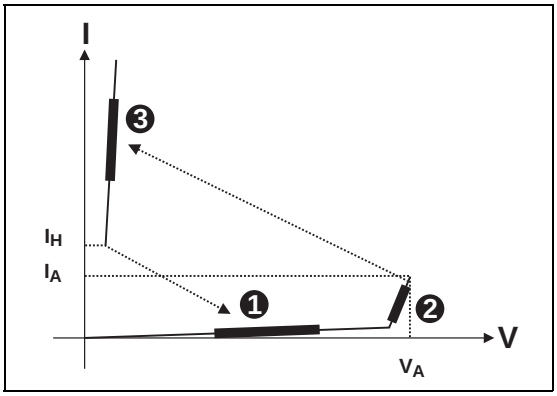
The internal +5V protection is achieved with a crowbar structure whereas the +12V one is secured by a clamping structure.

ABOUT THE +5V PROTECTION

In normal conditions, (region ❶ of figure A.2) the +5V protection (PL5 termination) of the HDP01-0512N connected to the +5V rail, is in idle state and its leakage current is 1µA max at +5V @ 25°C. Upon occurrence of transients, the HDP01-0512N eliminates the overvoltage by clamping up to a maximum of +7.4V (region ❷) since the current induced by the transient does not exceed the activation current I_A min (10mA).

If the I_A min current value is passed, the internal +5V protection trips in crowbar mode (region ❸) and then a short circuit appears on the +5V rail .

Fig. A.2: Current and voltage characteristic of the +5V protection.



The arrows indicate the way the device is activated from point ❷ to point ❸ , and the way it goes back in idle state, point ❸ to point ❶

Thanks to this behavior the electronic module (i.e. disk drive) connected to the +5V rail is safe.

As soon as the transient disappears and assuming that the current in the +5V power supply rail is under the holding current $I_H$min value (10mA) of the +5V protection, the HDP01-0512N gets back in idle state and the protected electronic module turns back on. As in many cases the current delivered by the +5V power supply is higher than the I_H min current value of the HDP01-0512N, it is necessary to use a serial protection on the +5V rail (i.e. resettable fuse), connected before the HDP protection. This will prevent the HDP01-0512N from being damaged by an over-rated dissipated power. The choice of the serial protector is led by both peak current and current duration the HDP01-0512N is able to support. The serial protection shall fulfill the next condition :

$$i^2t \text{ serial protection} < I_{TSM} \text{ @ tp of +5V HDP protection.}$$

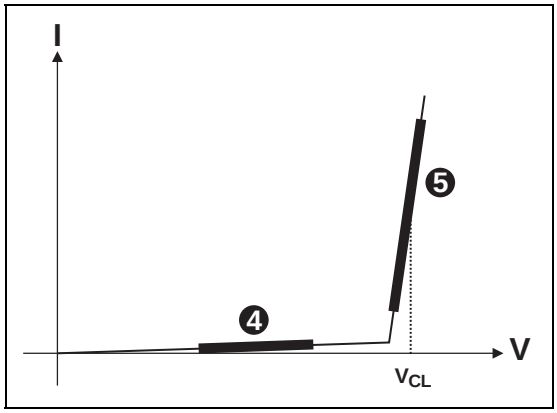
The I_{TSM} value as a function of the pulse duration tp for the HDP01 device is given on the figure 1 of this datasheet.

In the case the supply cables of the +12V and +5V are reversed, the +5V (PL5) internal protection of the HDP01-512N immediately shorts circuits +5V rail and ensures on efficient protection of the electronic module.

ABOUT THE +12V PROTECTION

The +12V internal protection (PL12 termination) eliminates all transients appearing on the +12V supply rail. In normal conditions (region 4 of figure A.3) its leakage current is 1µA maximum at 12V @ 25°C. When a surge occurs on the +12V rail, the overvoltage is clamped (region 5) and the electronic module connected to this rail is protected.

Fig. A.3: Current and voltage characteristic of the +12V protection.



The clamping voltage (Vcl) is depending on several parameters which are :

- current induced by the transient (Ipp)
- ambient temperature effect (αT)
- breakdown voltage of the protection (V_{BR})
- dynamic resistance of the protection (Rd)

To evaluate the clamping voltage appearing on the +12V rail when a transient occurs, the next formula is needed :

$Vcl = V_{BR}max + Rd*I_{PP}$ with a typical Rd equals to 2.5Ω

I_{PP} is the peak current given by the transient which is :

$I_{PP} = (Vtransient - Vcl)/Rs$ ⇒ Vtransient = peak voltage of the transient

⇒ Rs is the series resistance of the surge generator.

If, for example, we consider a 50V combined surge 1.2/50µs - 8/20µs, as defined by the standard IEC1000-4-5, the Vcl is calculated as:

$Vcl = 16 + 2.5*I_{PP}$ and $I_{PP} = (50 - Vcl) / 42$ $R_S = 42\ \Omega$ (generator impedance)

then it comes up with Vcl = 17.9V and I_{PP} = 0.7A

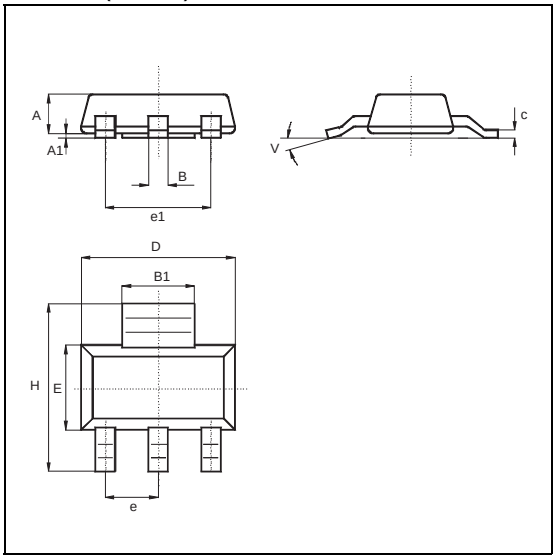
The impact of the temperature on the clamping voltage can be considered as to be :

$Vcl(T°C) = Vcl(25°C) * (1 + \alpha T(T°C-25°C))$ where T°C is the ambient temperature for which the module shall run.

The HDP01-0512N +12V protection has a power dissipation capability that is given in the figure 2 of this datasheet named "Peak pulse power versus exponential pulse duration". This figure is necessary to determine if the power involved in the +12V protection does not exceed the maximum power the HDP01 +12V protection can support. For example, considering the last calculation where Vcl=17.9 and I_{PP}=0.7A, the peak power is in that case 12.5W ($Vcl*I_{PP}$) for a 20µs exponential surge duration. If we compare this value to the curve of figure 2, then we see the dissipated power is much lower than the +12V protection limit (200W @ 20µs) this tells us the +12V protection of the HDP01-0512N can easily withstand such a 12.5W surge.

PACKAGE MECHANICAL DATA

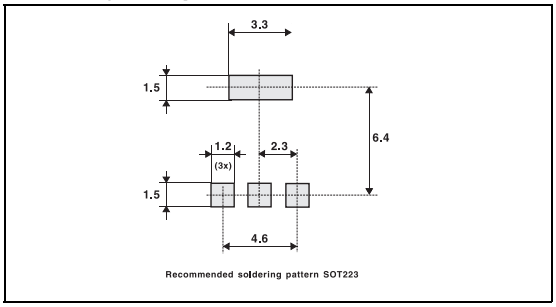
SOT223 (Plastic)



REF.	DIMENSIONS					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.80			0.071
A1		0.02			0.001	
B	0.60	0.70	0.80	0.024	0.027	0.031
B1	2.90	3.00	3.10	0.114	0.118	0.122
c	0.24	0.26	0.32	0.009	0.010	0.013
D	6.30	6.50	6.70	0.248	0.256	0.264
e		2.3			0.090	
e1		4.6			0.181	
E	3.30	3.50	3.70	0.130	0.138	0.146
H	6.70	7.00	7.30	0.264	0.276	0.287
V	10° max					

FOOT PRINT DIMENSIONS (in millimeters)

SOT223 (Plastic)



MARKING

Order code	Marking	Package	Weight	Packing	Base Qty
HDP01-0512NRL	HD1	SOT223	0.123 g	Tape & reel	1000pcs