

GENERAL DESCRIPTION

This data sheet will show how to remove Phantom Power consumption. It may not be necessary to use **Magic Switch** (Fig1) and an equivalent circuit (Fig2) has been provided in the data sheet. The Phantom Power consumption due to EMI Cap.'s discharge resistor can be removed by a pretty simple circuit as describe in the block diagram. However, **Magic Switch** could be most cost-effective, layout easy.....choice for designing zero no load consumption application.

Magic Switch, it behaves like a magic switch or a low-pass filter. Magic switch allows DC passes and AC is blocked. Magic switch is a low pass filter. It allows frequency more than 20 Hz to pass (AC plug-in Magic switch turn off) with ~ Zero Input Power. When frequency small than 20Hz, Magic switch is turn on discharge EMI's Cap.

Magic switch power consumption is approaching to 0mW when line voltage appears.

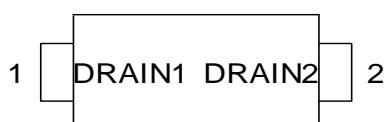
Note : When 270VAC input: Magic Switch consumption is approaching~5.8mW

FEATURES

- ◆ Remove Phantom Power consumption
- ◆ 4 terminal with > 5 mm space on package and PCB
- ◆ 2 terminal with >3 mm space on package (IC inside) and PCB
- ◆ Meet safety IEC 60065/60950/62368
- ◆ Break down voltage ~1KV
- ◆ Design for lightning surge sensitive environment
- ◆ One product works with any EMI's capacitor filter design
- ◆ Most cost effective, Layout easy solution, easily to meet Erp lot6 tier 2 requirement
- ◆ SOD-123 packages for Adaptor / Desktop Application
- ◆ The package is polarity insensitive.
- ◆ Application for Cx Cap ~ 8uF
- ◆ Operating Voltage 90~300VAC

PIN CONFIGURATION

SOD-123 TOP View



Product and Packing Information

Part No.	Package Type	Packing Type	Marking
CMD02XIU	SOD-123	3K pcs / 7" reel	D2xx

*Note: xx : year & date code

ABSOLUTE MAXIMUM RATINGS (TA=25°C, unless otherwise specified)

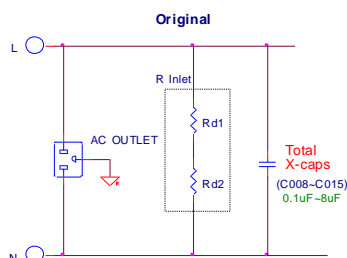
PARAMETER	Symbol	RATINGS	Unit
Turn on ID Max. Current Continues	(Rd1+Rd2>300VAC*1.414/2mA=212Kohm)	2	mA
Turn on ID Max. Current Peak Current (0.5sec)	(Rd1+Rd2>300VAC*1.414/5mA=85Kohm)	5	mA
Turn on ID Max. Current Peak Current (100ms)	(Rd1+Rd2>300VAC*1.414/20mA=21Kohm)	20	mA
Package Power Dissipation @ TA ≤ 25°C (SOD-123)	Pd	0.5	W
Drain1 to Drain2 Voltage	VDSS	1000	V
Junction Temperature	TJ	+150	°C
Storage Temperature	TSTG	-55~+150	°C
Junction to Ambient *	θJA	250	°C/W
Case Temperature	θJC	50	°C/W
Operation Junction Temperature		-40 ~ +125	°C

Note : 1. Surface Mounted on 1in² pad area, t ≤ 10sec

2. Operating Ambient Temperature is 85±2°C

APPLICATION CIRCUIT:

Original application



Magic Switch application

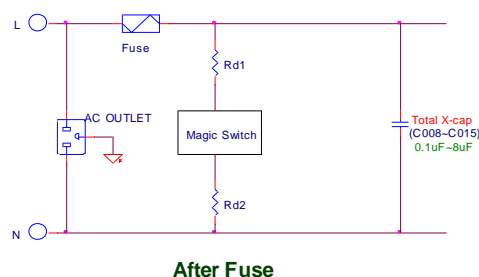
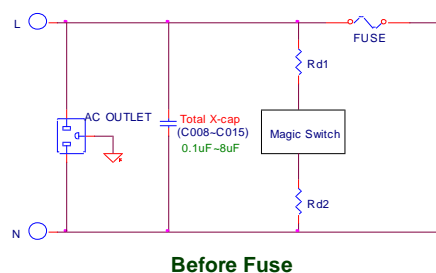


Figure 1. Magic switch application

SIMPLIFIED BLOCK DIAGRAM : Equivalent Circuit

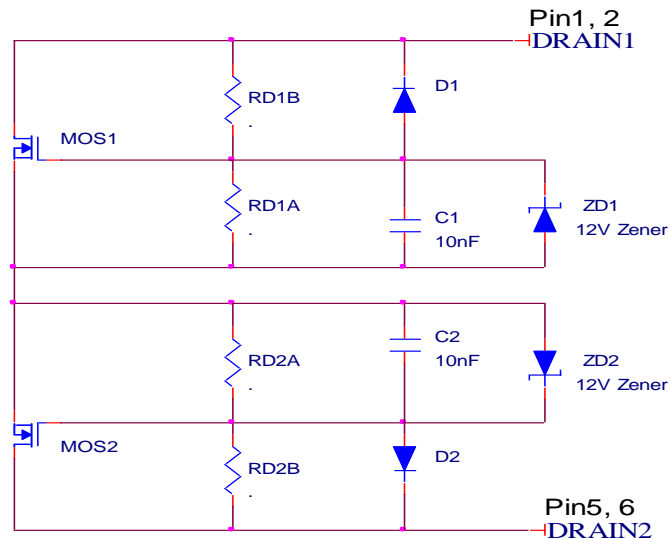


Figure 2. Magic Switch equivalent circuit

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, $T_A = 25^\circ\text{C}$.

PARAMETER	SYMBOL	TEST CONDITIONS	Magic Switch			
			Min	Typ	Max	Unit
Breakdown Voltage						
Drain1 to Drain2	BV _{DSS}		-	1	-	KV
Internal 1KV MOSFET turn On delay time						
1KV MOSFET On delay time	Ton delay	Vd1d2 = 127V, Rd1=Rd2= 250K (Figure1)	-	-	280	mS
1KV MOSFET Rdson						
1KV MOSFET Rdson	Rdson	Vgs = 12V @ room temp	-	60	-	Kohm
Discharge Time test (400V discharged to 60V)						
400V to 60V discharging time test	Tdischarging	Rd1+Rd2=250K; Cx =0.68uF	-	0.5	-	S
Magic switch supply current without turning on 1kv MOSFET						
Magic Switch current @ line Frequency =47 Hz	I supply ac	Vin = 230 Vac and Frequency =47Hz	-	-	20	uA

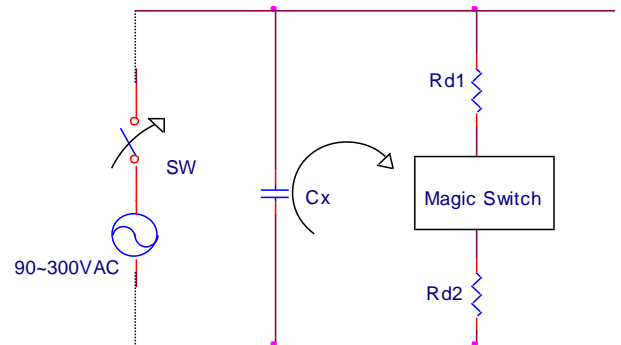
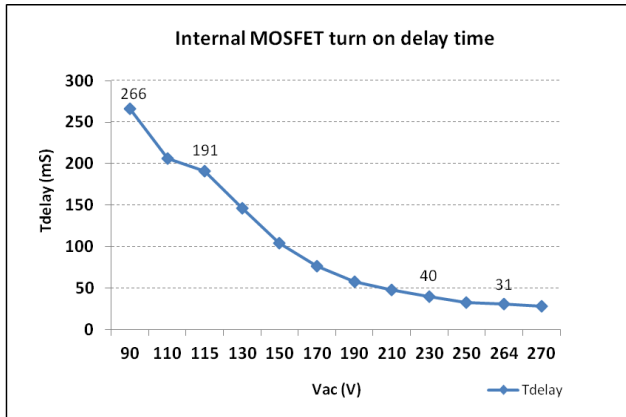
Note for 1KV Mosfet On delay time: $T_{on\ delay}$ is inversely proportional to V_{d1d2} , $T_{on\ delay}$ is around 25~40ms in $V_{d1d2}=380V$

DELAY TIMER (Figure 1~4: cursor a to cursor b)

Example condition :

Input=90Vac~270Vac, $C_x=0.68\mu\text{F}$, $R_{d1}=R_{d2}=250\text{K ohm}$

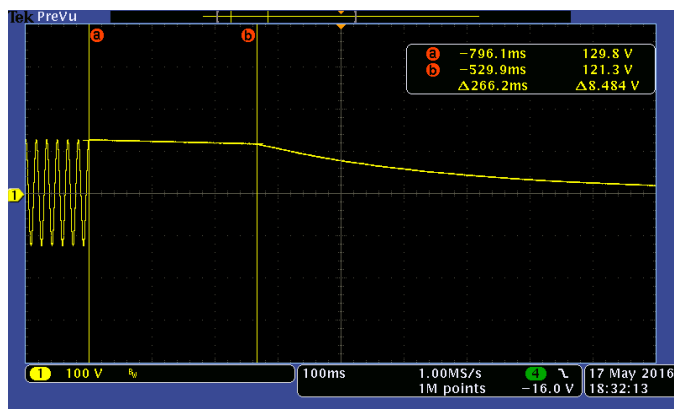
IC Test Equipment circuit



Condition : 90Vac = 127Vdc

Internal MOSFET turn on delay time $\approx 266\text{ms}$

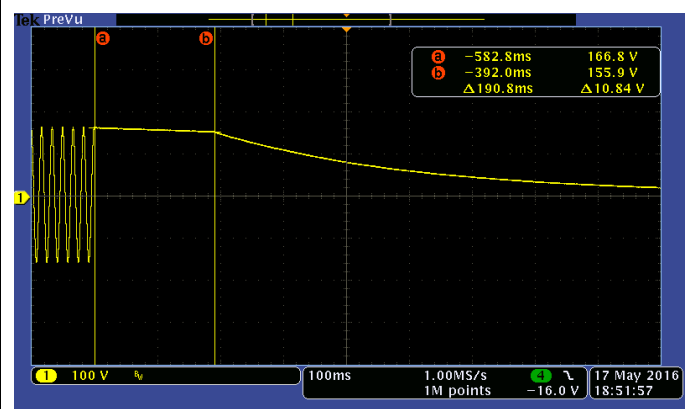
(Figure 1)



Condition : 115Vac = 163Vdc

Internal MOSFET turn on delay time $\approx 191\text{ms}$

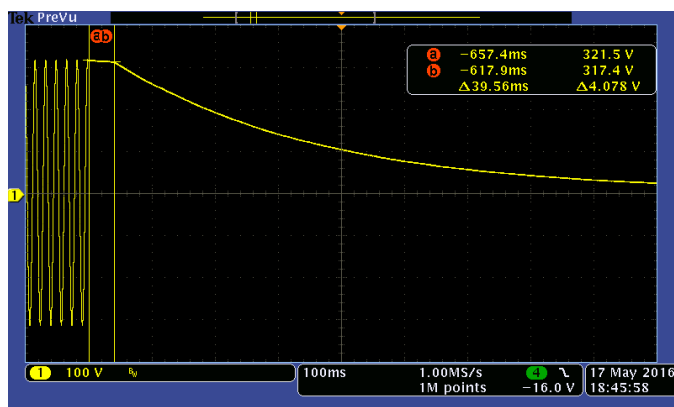
(Figure 2)



Condition : 230Vac = 325Vdc

Internal MOSFET turn on delay time $\approx 40\text{ms}$

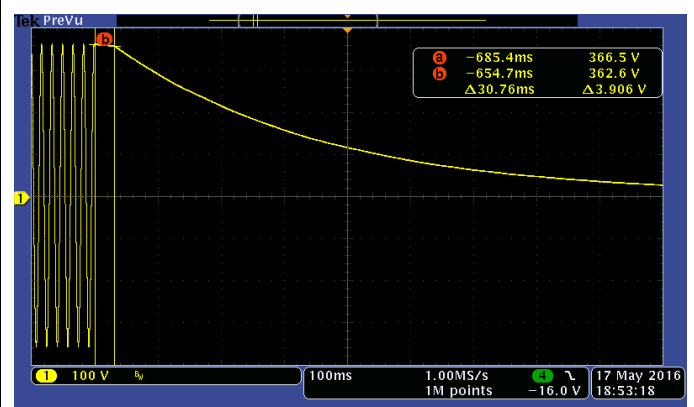
(Figure 3)



Condition : 264Vac = 373Vdc

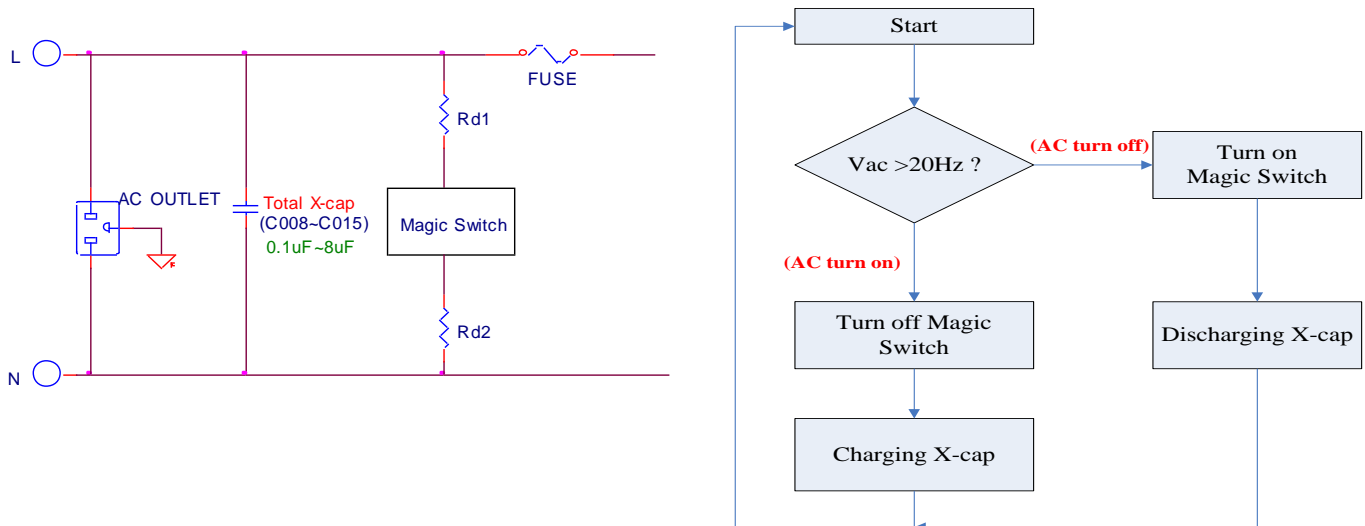
Internal MOSFET turn on delay time $\approx 31\text{ms}$

(Figure 4)



DESCRIPTION

Magic switch is designed to replace the discharging resistor of EMI filter. Magic switch is one product to fit for any EMI's capacitor Design. Magic switch is a low-pass filter. When the input frequency is lower than 20Hz (AC plug out), the two-integrated 1KV MOSFETS will be turned on and when the input frequency is higher than ~ 20Hz(AC plug in), the two-integrated 1KV MOSFET will be off.



Magic switch has 4 or 2 terminals. Magic switch's two 1KV MOSFET connects 2 external discharging resistor when input frequency < 20Hz. Magic switch's two 1KV MOSFET disconnects 2 external discharging resistor when input frequency is > 20Hz.

The total value of two external resistor value should be determined by the $(Rd1+Rd2) \times Cx$ time constant, If Tdischarge time need small than 0.5Sec. Therefore, $Tdischarge = (Rd1+Rd2) \times Cx < 0.5Sec$. Cx is the EMI x capacitor. In actual application, using Magic Switch just need select external discharge resistor Rd1 and Rd2 from table1. Finally, X-capacitor discharge to 37% voltage is (Tdischarge time+Ton delay time)

For application:

The EMI Capacitor Tdischarge time equation: $V2=V1 \times e^{(-T/RC)}$, V2 is discharge voltage, V1 is initial voltage. If your Tdischarge time select=0.6sec. From table 1 you can obtain Cx and (Rd1+Rd2).

The X capacitor discharge to 37% voltage=(Tdischarge time +Ton delay time)≈0.9sec

Product	Magic Switch (for any EMI capacitor)											
Calculate discharge resistor & discharge time	Comparison sheet											
Total X Capacitor (uF) : C _x	0.1	0.22	0.47	0.68	1	1.5	2	2.5	3	5	8	
Discharging Time (S) : T _p (RC time constant)	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	
Total Discharge Resistor (KΩ) : R _{d1} +R _{d2}	6980	3140	1438	975	644	409	292	222	175	81	28	
Discharge Resistor (KΩ) : R _{d1} =R _{d2}	3490	1570	719	488	322	205	146	111	87	40	14	
Select Discharge Resistor (KΩ) : R _{d1} =R _{d2} (Pay attention to surge current)	3000	1300	620	430	270	180	120	91	75	33	10	
AC Input (V) : V _i (Spec: 80~300Vac)	80	300	80	300	80	300	80	300	80	300	80	300
Discharge Ratio (%) (Spec: ~37%)	37	37	37	37	37	37	37	37	37	37	37	
Discharge to V ₂ (V) (80V or 300V ×1.414×37%)	42	157	42	157	42	157	42	157	42	157	42	157
Delay time max. =280mS (Datasheet Spec.)	0.28	0.03	0.28	0.03	0.28	0.03	0.28	0.03	0.28	0.03	0.28	0.03
Delay time min. =30mS (Datasheet Figure 4)	0.28	0.03	0.28	0.03	0.28	0.03	0.28	0.03	0.28	0.03	0.28	0.03
Total Discharge Time (Worse case: 80Vac)	0.883	0.633	0.862	0.612	0.887	0.637	0.902	0.652	0.877	0.627	0.906	0.656
IEC 60950 (Internal delay time + C _x discharge time to 37%) within 1Sec.												
IEC 62368 (ES1 Class) <60Vdc within 2 Sec.	60	1.215	1.175	1.225	1.254	1.204	1.262	1.204	1.213	1.262	1.262	1.282

Table 1. Discharge resistor select

DISCHARGE TIMING TEST

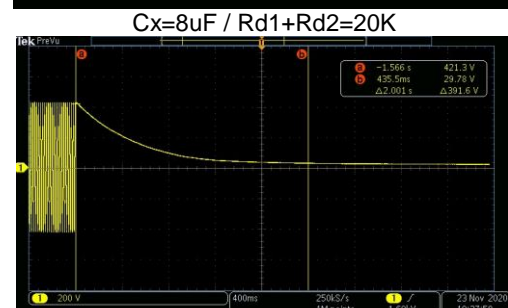
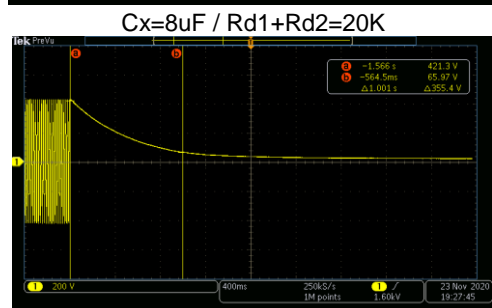
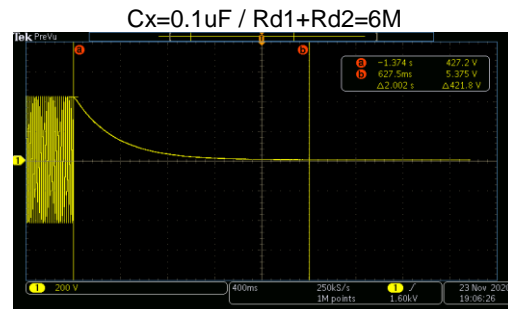
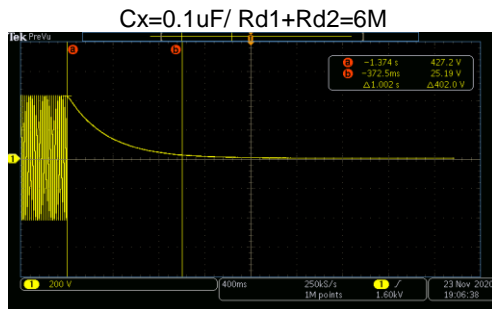
Condition : 300VAC , Cx = 0.1uF and 8uF

The minimum Rd1+Rd2=20K ohm and the maximum Cx=8uF

The maximum Rd1+Rd2=6M ohm and the minimum Cx=0.1uF

Tdischarge time <1sec (Meet safety IEC 60950)

Tdischarge time <2sec (Meet safety IEC 62368)

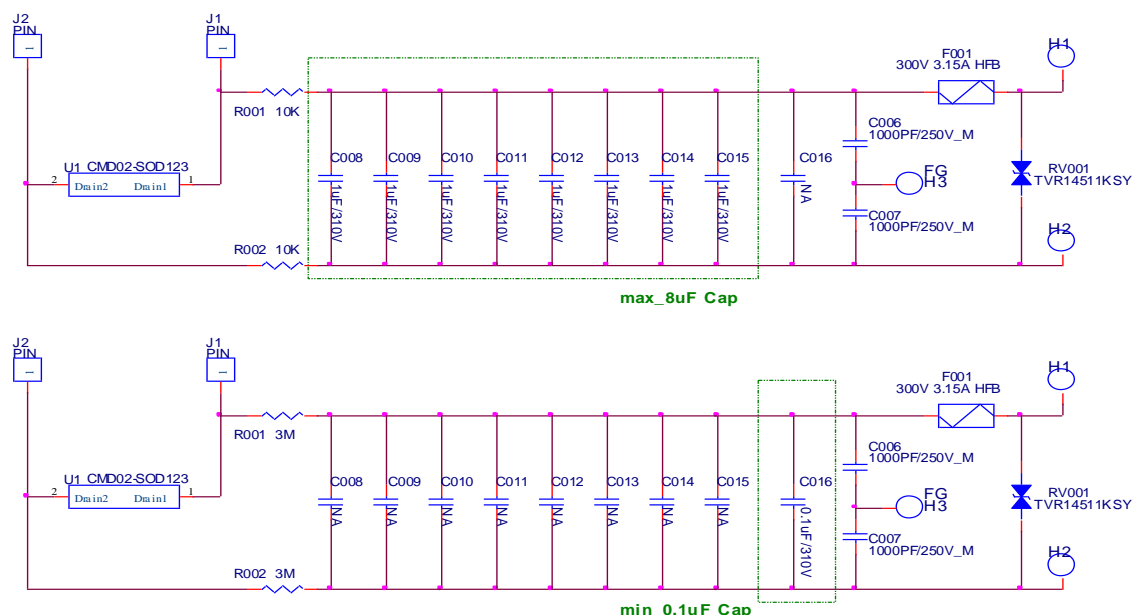


A Csurge ~ 47pF capacitor should be added to parallel with Magic switch for strenuous lightning surge test. The Csurge is added to suppress the voltage across Magic Switch.

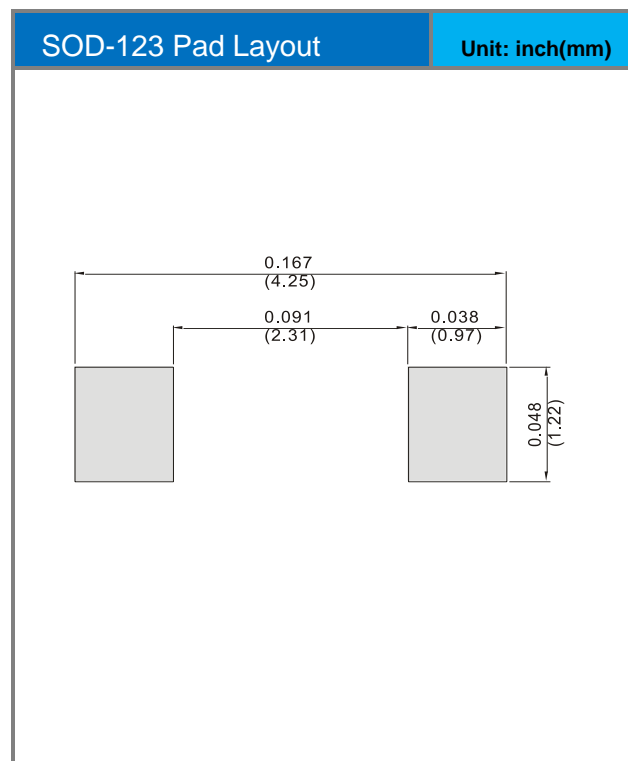
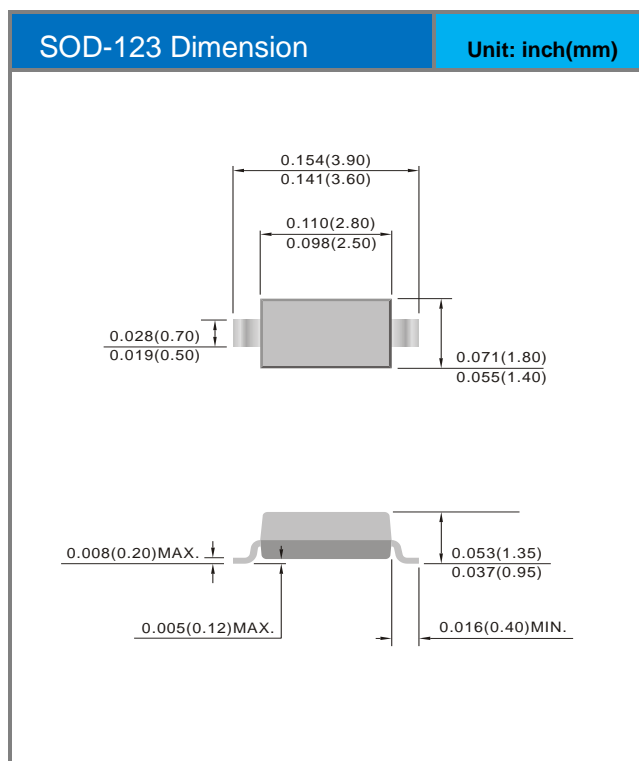
Magic switch 4/2 terminal package provides minimum 50/3 mm space for PCB layout. Magic Switch is designed for lightning surge sensitive environment.

Without Magic Switch, the equivalent circuit on the simplified block figure has been provided and it will have the similar good performance. However, Magic Switch is more cost-effective and easy layout.

TEST CIRCUIT



PACKAGE DIMENSION



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