CLP30-200B1

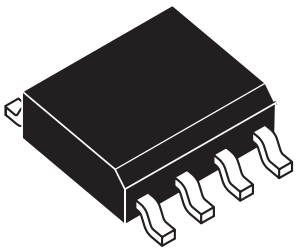
Application Specific Discretes
A.S.D™

OVERVOLTAGE & OVERCURRENT PROTECTION FOR TELECOM LINE

MAIN APPLICATIONS

Any telecom equipment submitted to transient overvoltages and lightning strikes such as :

- Analog and ISDN line cards
- PABX



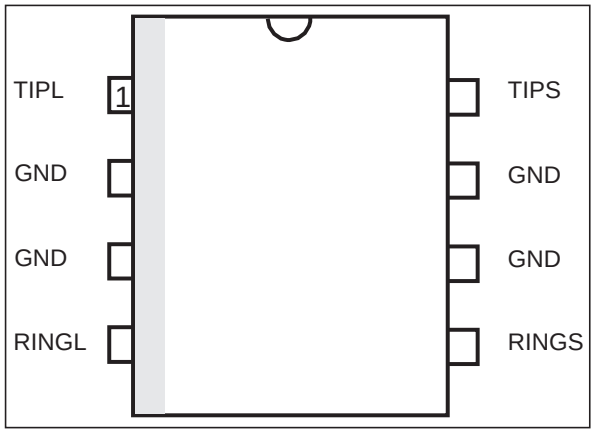
SO8

DESCRIPTION

The CLP30-200B1 is designed to protect telecommunication equipment. It provides both a transient overvoltage protection and an overcurrent protection.

The external components (balanced resistors, ring relays contact, ...) needed by the CLP30-200B1 protection concept require very low power rating. This results in a very cost effective protection solution.

SCHEMATIC DIAGRAM (Top view)



FEATURES

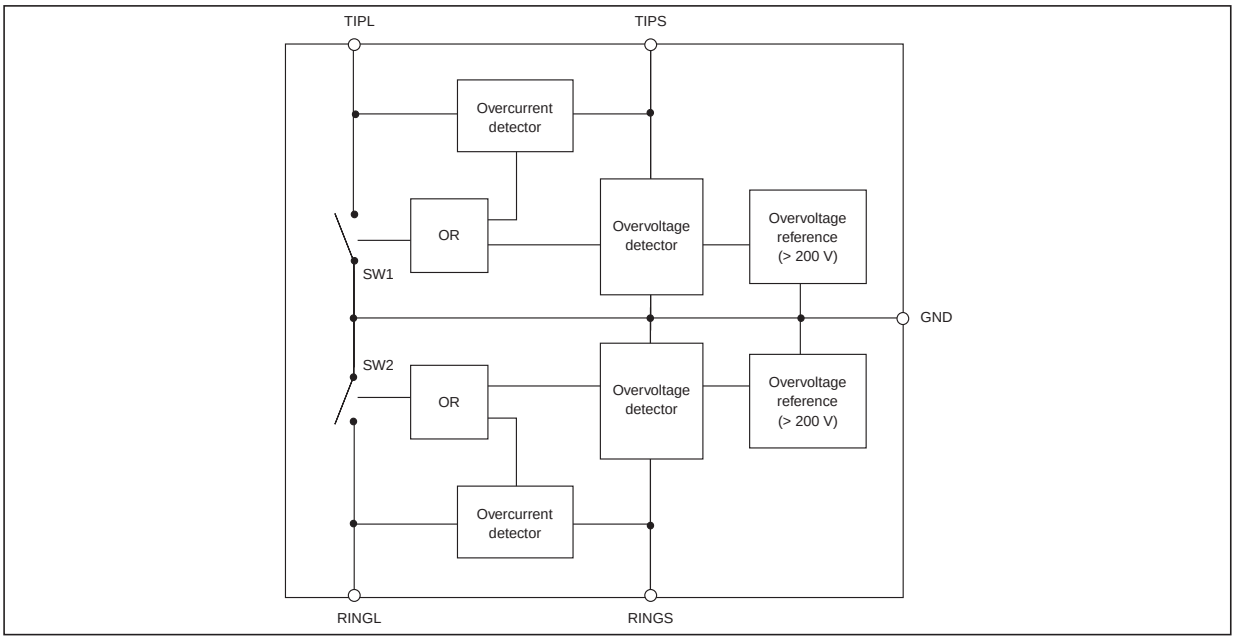
- Dual bidirectional protection device.
- High peak pulse current :
  I_{PP} = 40A (5/310 µs SURGE)
  I_{PP} = 30A (10/1000 µs SURGE)
- Max. voltage at switching-on : 290V
- Min. current at switching-off : 150mA

BENEFITS

- Voltage and current controlled suppression.
- Surface Mounting with SO8 package.
- Very low power rating of external components on line card : balanced resistors, ring relay, low voltage SLIC protection.

Standard	Peak surge voltage (V)	Voltage waveform	Required peak current (A)	Current waveform	Minimum serial resistor to meet standard (Ω)
Bellcore TR-NWT-1089 First level	2500 1000	2/10µs 10/100µs	500 100	2/10 µs 10/1000 µs	20 25
Bellcore TR-NWT-1089 Second level	5000	2/10 µs	500	2/10 µs	40
ITU-T-K20 / K21	4000 1000	10/700 µs	100 25	5/310 µs	50 0
ITU-T-K20 (IEC61000-4-2)	6000 8000	1/60 ns	ESD contact discharge ESD air discharge		0 0
VDE0433	4000 2000	10/700 µs	100 50	5/310 µs	50 5
VDE0878	4000 2000	1.2/50 µs	100 50	1/20 µs	22 0
IEC61000-4-5	4000 2000 4000	10/700 µs 1.2/50 µs 1.2/50 µs	100 50 100	5/310 µs 8/20 µs 8/20 µs	50 0 22
FCC Part 68, lightning surge type A	1500 800	10/160 µs 10/560 µs	200 100	10/160 µs 10/560 µs	17.5 12
FCC Part 68, lightning surge type B	1000	9/720 µs	25	5/320 µs	0

BLOCK DIAGRAM



Pin	Symbol	Description
1	TIPL	TIP (Line side)
2 / 3 / 6 / 7	GND	Ground
4	RINGL	RING (Line side)
5	RINGS	RING (SLIC side)
8	TIPS	TIP (SLIC side)

APPLICATION NOTE

1.INTRODUCTION

The aim of this section is to show the behavior of our new telecom line protection device.

Fig.1 : Suscriber line protection topology

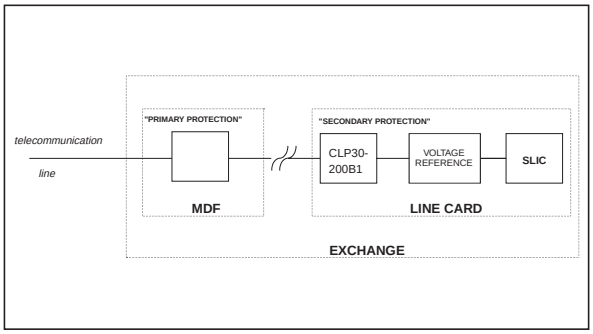


Figure 1 is a simplified block diagram of a subscriber line protection that is mainly used so far.

This shows two different things :

- A “primary protection” located on the Main Distribution Frame (MDF) eliminates coarsely the high energy environmental disturbances (lightning transients and AC power mains disturbances) for which the ITU-T-K20 requires a 4kV 10/700 µs test. This can be assumed either by gas-tubes or silicon protection such as the TLPxxM.
- A “secondary protection” located on the line card eliminates finely the remaining transients that have not been totally suppressed by the first stage. The ITU-T-K20 requires a 1 kV 10/700 µs test. At this stage, the protection is managed by the CLP30-200B1.

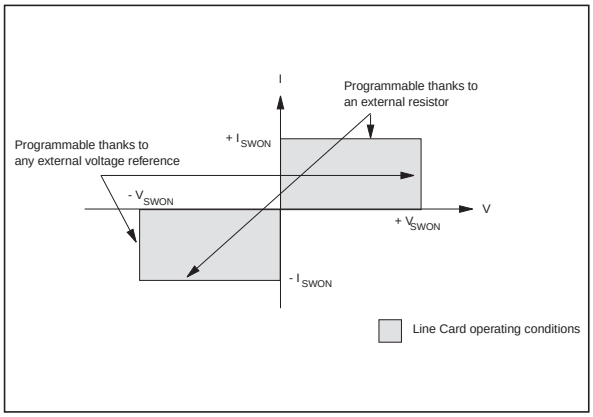
2. STMicroelectronics CLP30-200B1 CONCEPT

2.1 Evolution of the SLIC protection

Over the years, the performances of the SLICs considerably increased and therefore the need of the protection has also evolved.

The CLP30-200B1 is especially designed for the protection of this new generation of SLIC. For this, it is based on both overvoltage and overcurrent protection modes.

Fig.2 : Line card protection



The **figure 2** summarises the performance of the CLP30-200B1 which basically holds the SLIC inside its correct voltage and current values.

APPLICATION CIRCUIT : CLP30-200B1 in line card

Fig.3 : CLP30-200B1 in line card

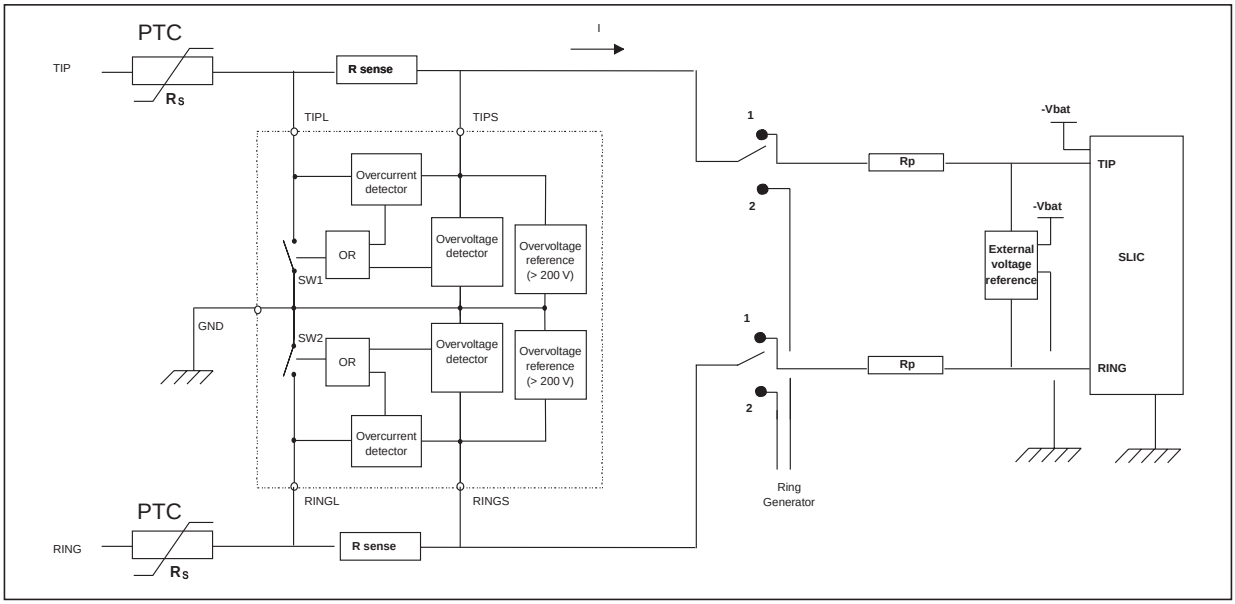
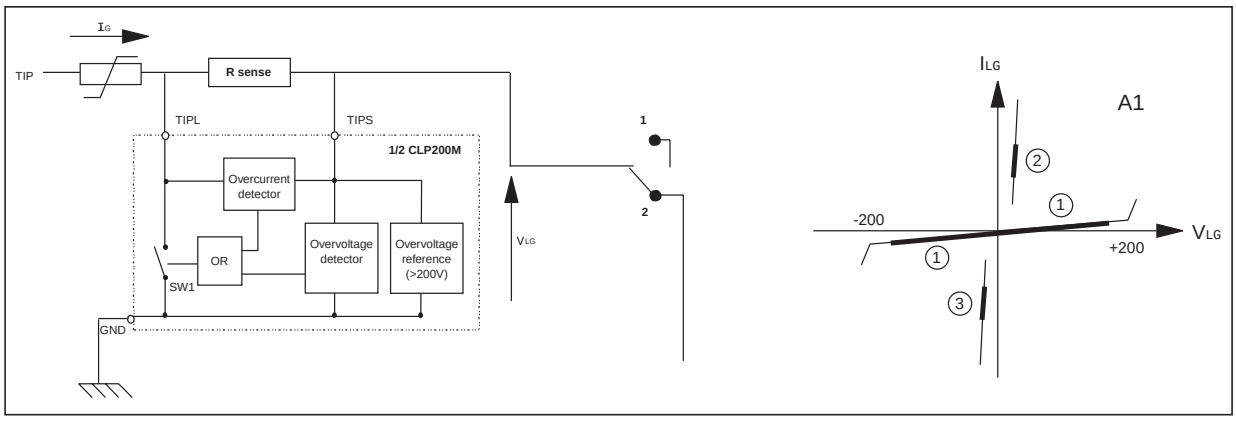


Figure above shows the topology of a protected analog subscriber line at the line card side.

- A first stage based on CLP30-200B1 manages the high power issued from the external surges. When used in ringing mode, the CLP30-200B1 operates in voltage mode and provides a symmetrical and bidirectional overvoltage protection above 200 V on both TIP and RING lines. When used in speech mode, the CLP30-200B1 operates in current mode and the activation current of the CLP30-200B1 is adjusted by R_{SENSE}.
- A second stage which is the external voltage reference device defines the firing threshold voltage during the speech mode and also assumes a residual power overvoltage suppression. This stage can be either a fixed or programmable device such as LCP1511D.

2.3 Ringing mode

Fig.4 : Switching by voltage during ringing mode.



In ringing mode (Ring relay in position 2), the only protection device involved is the CLP30-200B1.

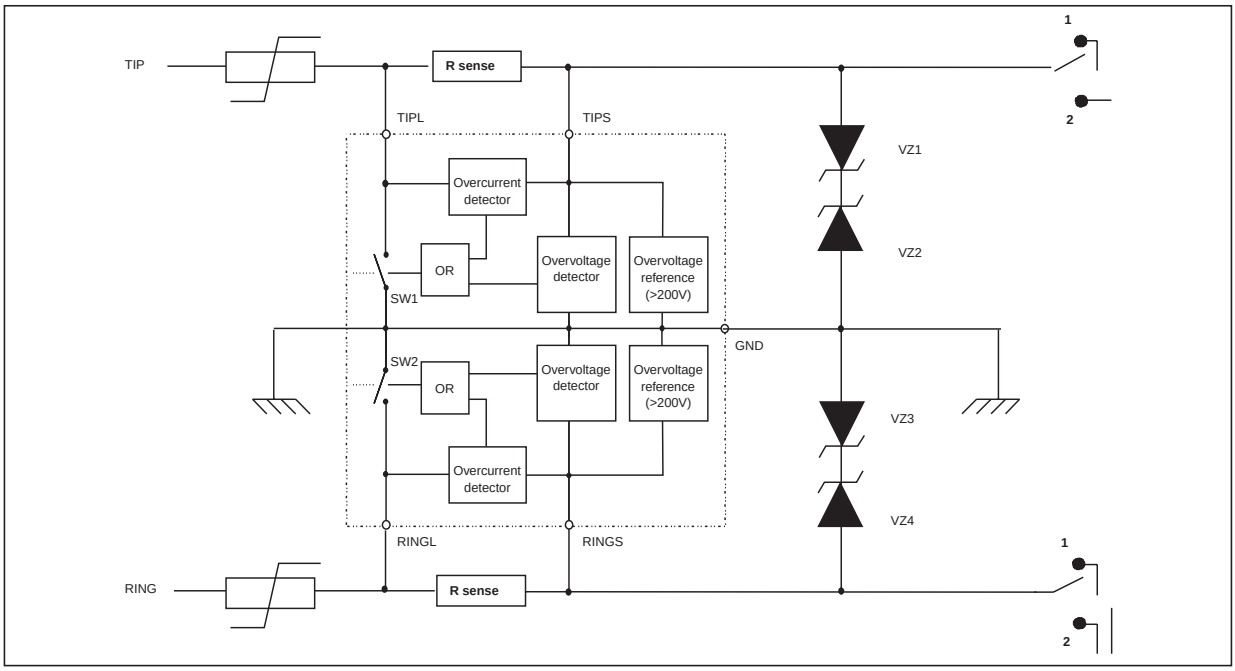
In normal conditions, the CLP30-200B1 operates in region 1 of **A1** curve, and is idle.

If an overvoltage occurring between TIP (or RING) and GND reaches the internal overvoltage reference (+/- 200V), the CLP30-200B1 acts and the line is short-circuited to GND. At this time the operating point moves to region 2 for positive surges (region 3 for negative surges). Once the surge current disappears, the device returns to its initial state (region 1).

For surges occurring between TIP and RING, the CLP30-200B1 acts in the same way. This means that the CLP30-200B1 ensures a tripolar protection.

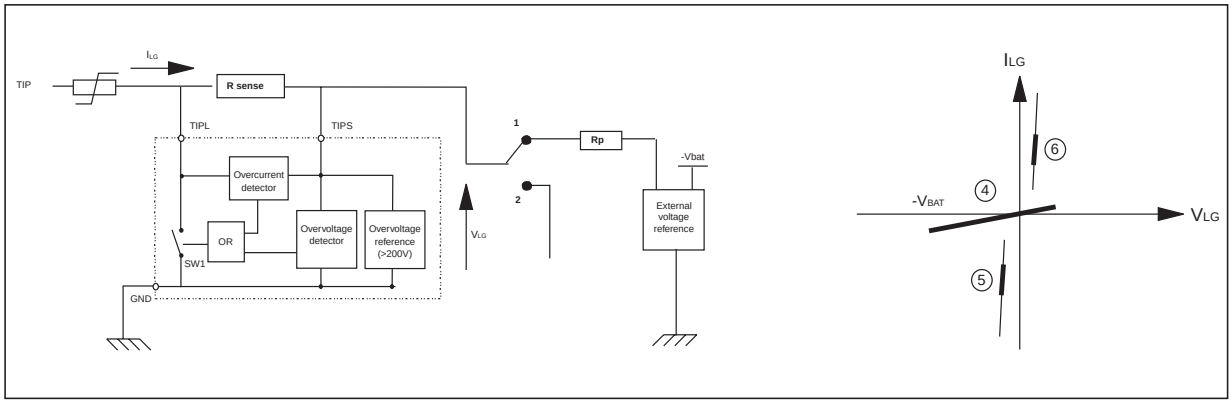
When used alone, the CLP30-200B1 acts at the internal overvoltage reference level (+/- 200 V). Furthermore, it is possible to adjust this threshold level to a lower voltage by using up to 4 fixed external voltage reference (V_{Z1} to V_{Z4}) (see fig.5).

Fig.5 : Methode to adjust the reference voltage.



2.4 Speech mode

Fig.6 : Switching by current during speech mode.



In speech mode (Ring relay in position 1), the protection is provided by the combination of both CLP30-200B1 and the external voltage reference device (for example LCP1511D).

In normal conditions, the working point of this circuit is located in region 4 of **A2** curve : the CLP30-200B1 is idle.

When a surge occurs on the line, the external voltage reference device clamps at GND or $-V_{bat}$ respectively for positive and negative surges. This generates a current which is detected by R_{SENSE} and causes the protection to act : the line is short-circuited to GND. The operating point moves to region 6 for positive surges or region 5 for negative surges.

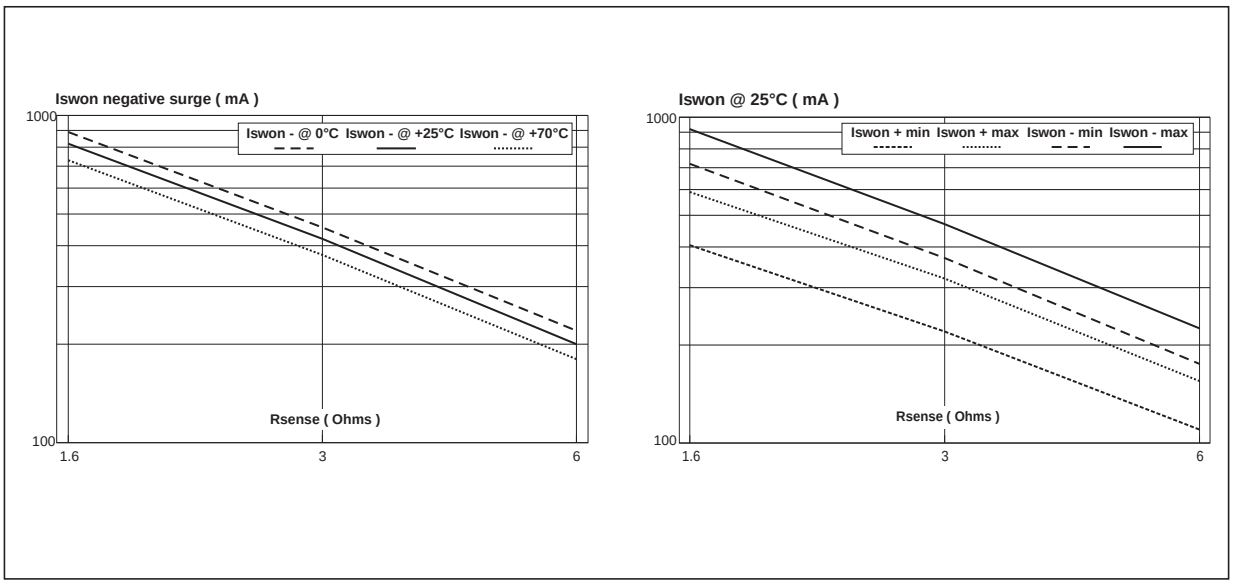
Once the surge current falls below the switching-off current I_{SWOFF}, the CLP30-200B1 returns to its initial state (region 4).

Furthermore, the CLP30-200B1 switches when an overvoltage, either positive or negative, occurs either :

- simultaneously on both TIP and RING lines versus GND.
- between TIP and RING.
- on TIP (or RING) versus GND.

The choice of the switching-on current is function of the R_{SENSE} resistors.

Fig . 7a and 7b : Switching-on current versus R_{SENSE}



This current (typically above 150 mA) should not activate the protection device CLP30-200B1.

Therefore the level of activation is to be chosen just below this limit (typically 200mA). This level is adjusted through R_{SENSE}.

Figures 7a and 7b enable the designers to choose the right R_{SENSE} value.

Example: The choice of $\mathbf{R_{SENSE} = 3\ \Omega}$ ensures a negative triggering of -280 mA min and -380mA max.

In this case, the positive triggering will be 220mA min and 320mA max.

Thanks to the CLP30-200B1 topology, the surge current in the line is reduced after it.

Because the remaining surge energy is low, the power ratings of R_P, the relay contacts and the external voltage reference device may be kept low. This results in a significant cost reduction for the whole system.

ABSOLUTE MAXIMUM RATINGS (R_{SENSE} = 3 Ω,T_{amb} = 25°C)

Symbol	Parameter		Value	Unit
I_{PP}	Line to GND peak pulse current 10/1000 µs (open circuit voltage wave shape 10/1000 µs) 5/310 µs (open circuit voltage wave shape 10/700 µs)		30 45	A
I_{TSM}	Non repetitive surge peak on-state current F = 50 Hz	t_p = 10 ms t_p = 200 ms t_p = 1 s	8.5 4.5 3.5	A
T_{stg} T_j	Storage temperature range Maximum junction temperature		-40 to +150 150	°C
T_L	Lead temperature for soldering during 10 s.		260	°C

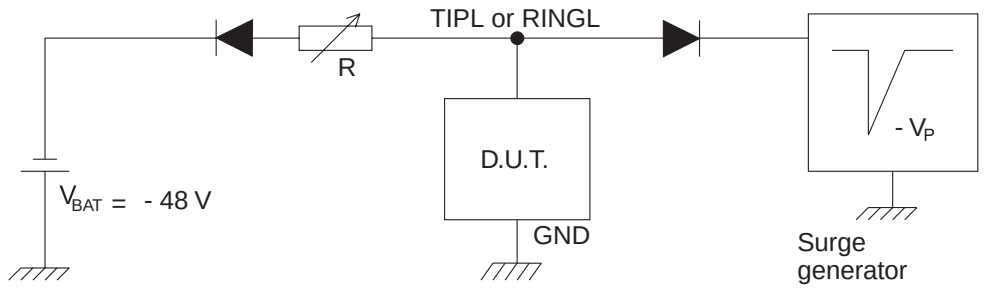
ELECTRICAL CHARACTERISTICS (R_{SENSE} = 3 Ω, and T_{amb} = 25 °C)

Symbol	Parameter	Test condtions	Min	Max	Unit
I_{LGL}	Line to GND leakage current	V_{LG} = 200 V Measured between TIP (or RING) and GND		10	µA
V_{LG}	Line to GND operating voltage		200		V
V_{SWON}	Line to GND voltage at SW1 or SW2 switching-on	Measured at 50 Hz between TIPL (or RINGL) and GND,one cycle		290	V
I_{SWOFF}	Line to GND negative current at SW1 or SW2 switching-off	Refer to test circuit fig 9	150		mA
I_{SWON}	Line current at SW1 or SW2 switching-on	Positive surge Negative surge	220 370	320 470	mA
C	Line to GND capacitance	V_{LG} = 0V V_{OSC}= 200mV_{RMS} F = 1MHz		100	pF

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
$R_{th(j-a)}$	Junction to ambient	170	°C/W

Fig.8 : TEST CIRCUIT FOR I_{SWOFF} PARAMETER : GO - NO GO TEST



This is a GO-NO GO test which allows to confirm the switch-off current (I_H) level in functional test circuit.

TEST PROCEDURE
- Adjust the current level at the I_{SWOFF} value by short circuiting the D.U.T
- Fire the D.U.T with a surge current : I_{PP} = 10 A, 10/1000 µs
- The D.U.T will come back to the off-state within a duration of 50 ms max.

Fig. 9 : Typical variation of switching-on current (positive or negative) versus R_{SENSE} resistor and junction temperature (see test condition Fig. 11).

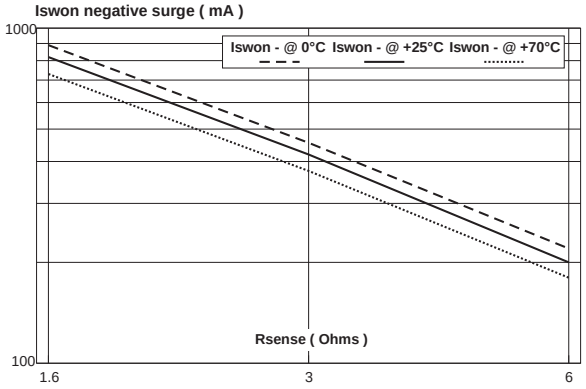


Fig. 10 : Variation of switching-on current versus R_{SENSE} at 25 °C.

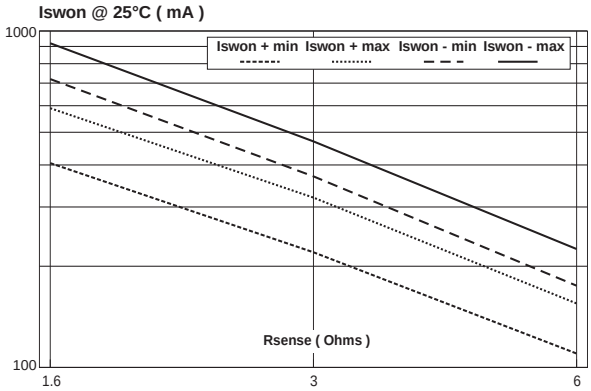


Fig. 11 : I_{SWON} MEASUREMENT
- ISWON = I1 when the CLP30-200B1 switches on (I1 is progressively increased using R)
- Both TIP and RING sides of the CLP30-200B1 are checked
- RL = 10Ω.

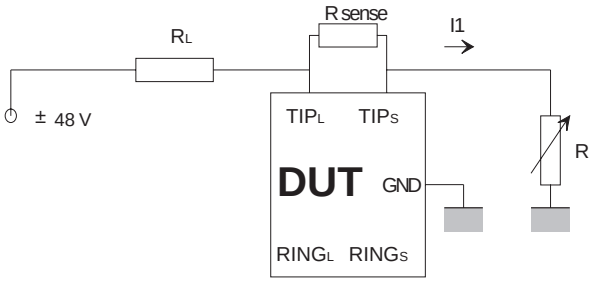


fig. 12 : Relative variation of switching-off current versus junction temperature (for R_{SENSE} between 3 and 10 Ω).

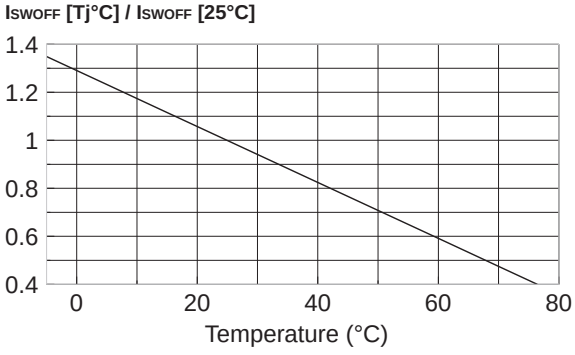


Fig. 13 : Relative variation of switching-off current versus R_{SENSE} (between 3 and 10 Ω).

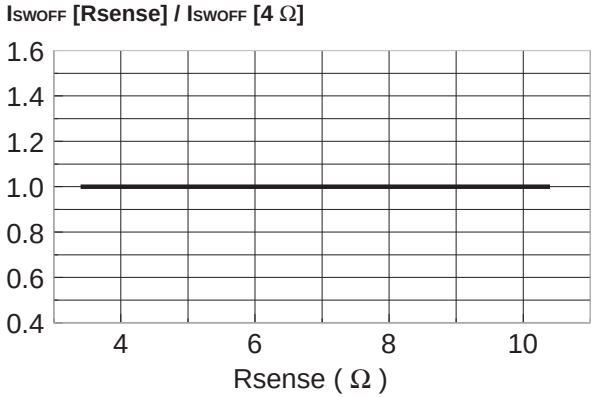


Fig. 14 : Relative variation of switching-on voltage versus dV/dt with an external resistor of 3 Ω.

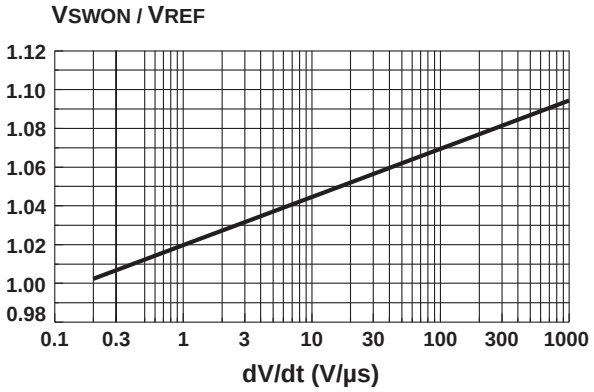


Fig. 15 : Relative variation of internal reference voltage versus junction temperature (I_{LG} =1mA).

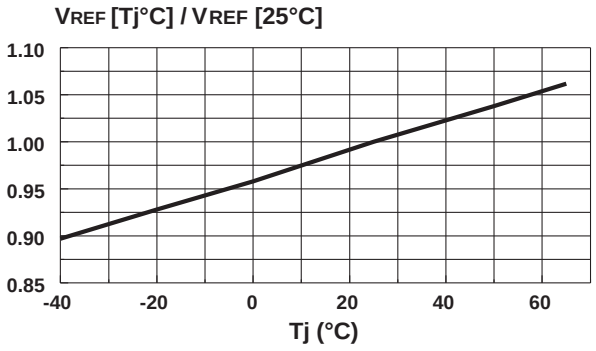


Fig. 16 : Capacitance (TIP/GND) versus applied voltage (typical values).

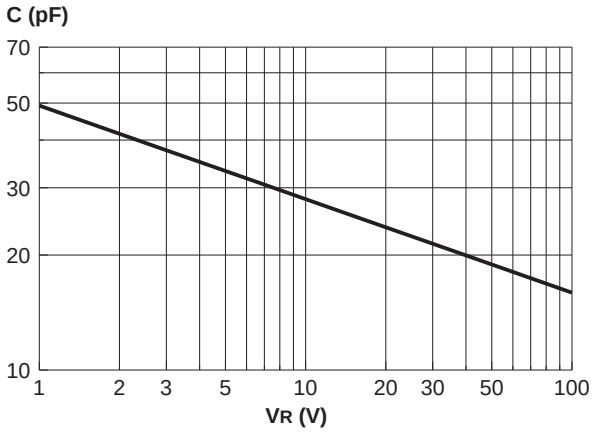
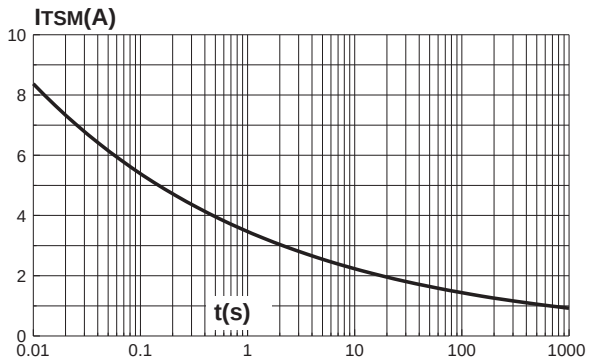
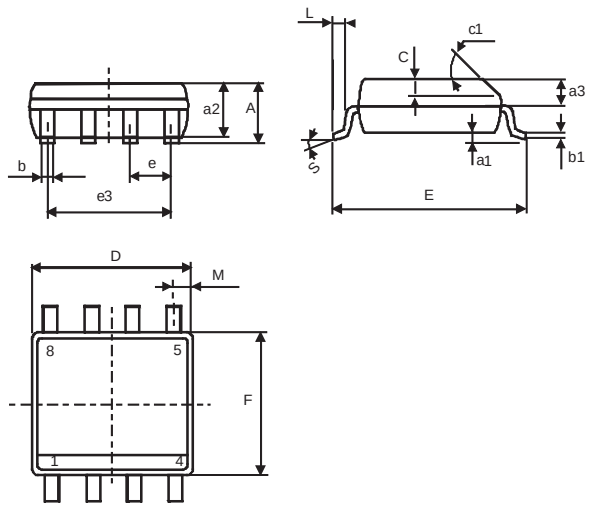


Fig. 17 : Surge peak current versus overload duration (maximum values)**.**



PACKAGE MECANICAL DATA
SO8 plastic



REF.	DIMENSIONS					
	Millimetres			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.025		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25	0.50	0.50	0.010		0.020
c1	45° (typ)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.15		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8° (max)					

MARKING

Ordering code	Marking	Package	Weight	Base qty	Delivery mode
CLP30-200B1	CLP30	SO-8	0.08g	100	Tube
CLP30-200B1RL	CLP30	SO-8	0.08g	2500	Tape & Reel