PLCA110

Integrated Solid State Surge Arrester and Solid State Relay

DESCRIPTION

CP Clare's PLCA110 device features a 1 Form A Solid State Relay integrated with a Solid State Surge Arrester in an 8 pin DIP package. The Solid State Surge Arrester is designed for secondary telecom line protection. It meets FCC Part 68 (non repetitive surges 10/560µs, 100A peak, and 800V), and provides breakover voltage (283V to 340V) and repetitive surge protection with no degradation. The relay portion offers reliable bounce free switching, ideal for handling hookswitch/dial pulse functions.

FEATURES

- Small 8-pin DIP package
- 2mW drive power (logic compatible)
- No moving parts
- Loads up to 350V AC/DC and 120mA
- $3750V_{RMS}$ input/output isolation
- Meets FCC Part 68
- Inherent surge protection
- Repetitive surges with no degradation
- Board space and cost savings
- Machine insertable, wave solderable
- Surface mount and tape & reel version available

APPLICATIONS

- Telecommunications
  - Telecom Switching
  - Tip/Ring Circuits
  - Modem Switching (Laptop, Notebook, Pocket Size)
  - Hookswitch
  - Dial Pulsing
  - Ground Start
  - Ringer Injection
- Instrumentation
  - Multiplexers
  - Data Acquisition
  - Electronic Switching
  - I/O Subsystems
  - Meters (Watt Hour, Water, Gas)
  - Medical Equipment
- Security
- Aerospace
- Industrial Control

RATINGS (@ 25°C)

Parameter	Min	Typ	Max	Units
Input Power Dissipation	-	-	150[1]	mW
Input Control Current	-	-	50	mA
Peak (10ms)	-	-	1	A
Total Package Dissipation	-	-	800[2]	mW
Isolation Voltage				
Input to Output	2500	-	-	V_{RMS}
"E" Suffix (optional)	3750	-	-	V_{RMS}
Operational Temperature	-40	-	+85	°C
Storage Temperature	-40	-	+125	°C
Soldering Temperature (10 Seconds Max)	-	-	+260	°C

[1] Derate Linearly 1.33 mW/°C.
[2] Derate Linearly 6.67 mW/°C.

For detailed information on CP Clare Semiconductor Group Products ask for our Catalog "SSP15"

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Specifications: Relay Ratings

Input Characteristics @ 25°C

PARAMETERS	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNITS
LED Current to Operate	-	I_F	2	-	50	mA
LED Voltage Drop	I_R = 10mA	V_F	0.9	1.2	1.4	V
LED Drop-Out Voltage	-	$V_{F(OFF)}$	0.8	-	-	V
Input/Output Capacitance	-	$C_{I/O}$	-	3	-	pF
Reverse LED Current	V_R = 5V	I_R	-	-	10	µA
Reverse LED Voltage	-	V_R	-	-	5	V

Output Characteristics @ 25°C

PARAMETERS	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNITS
Load Voltage	DC or Peak AC	V_L	-	-	350	V
Load Current	Continuous	I_L	-	-	120	mA
Leakage Current	V_L = 350V	I_{LKG}	-	-	1	µA
On-Resistance	I_L = 120mA	R_{ON}	15	-	35	Ω
$Turn_{ON}$ Time	I_F = 2mA	T_{ON}	-	-	5	ms
$Turn_{OFF}$ Time	I_F = 2mA	T_{OFF}	-	-	2	ms
$Turn_{ON}$ Time	I_F = 5mA	T_{ON}	-	-	3	ms
Offset Voltage	-	V_{OFF}	-	1	-	µV
Output Capacitance	-	C_{OUT}	-	25	-	pF

Specifications: Surge Arrester Ratings

Absolute Maximum Ratings @ 25°C

PARAMETERS	CONDITIONS	SYMBOL	VALUE	UNITS
Non-Repetitive Surge	10/560µs (FCC Part 68.302)	I_{TSP}	100	A_{PK}
Non-Repetitive Surge	8/20µs (ANSI Std. c.62), (Notes 1 & 2)	I_{TSP}	150	A_{PK}
Non-Repetitive Surge	50Hz On-State Current 0.7s (Notes 1 & 2)	I_{TSM}	10	A_{RMS}
Critical Rate of Rise	Initial Rate of Rise of On-State Control	di/dt	250	A/µs
Junction Temperature	-	$T_{J(MAX)}$	150	°C

Electrical Characteristics @ 25°C

PARAMETERS	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNITS
REF Zener Voltage	I_Z = 1mA	V_Z	±260	±285	±320	V
Breakover Voltage	-	V_{BO}	±283	±305	±340	V
Breakover Current	-	I_{BO}	0.15	-	0.6	A
Holding Current	-	I_H	±150	-	-	mA
Off State Leakage	V = 50V	I_D	-	-	10	µA
Off State Capacitance	V = 0V, f = 1kHz	C_{OFF}	-	-	200	pF

Notes:
1) Above 70°C derate linearly to zero at 150°C case temperature
2) This value applies when the initial case temperature is at or below 70°C. The surge may be repeated after the device has returned to thermal equilibrium.

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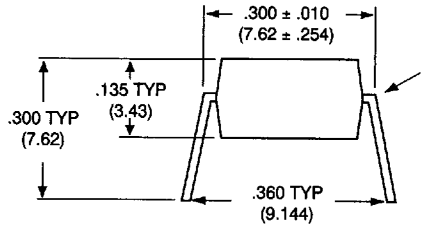
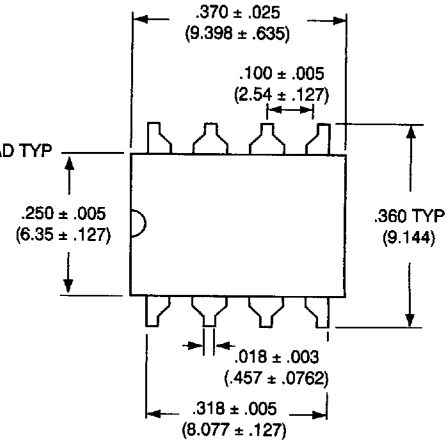
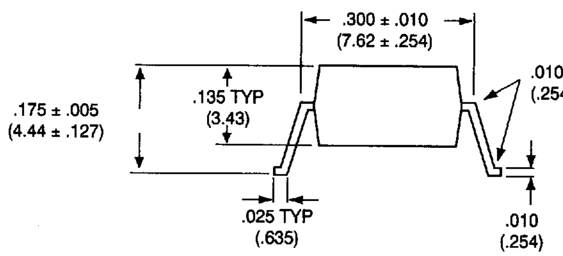
MECHANICAL DIMENSIONS

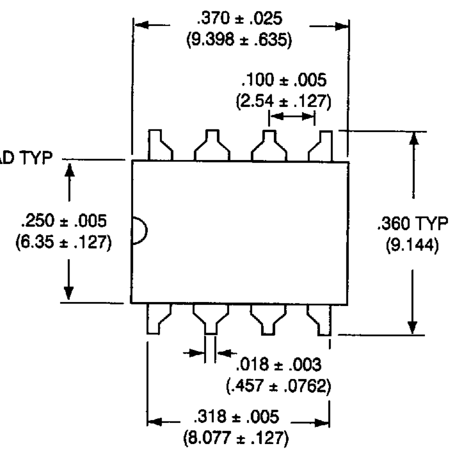
Through Hole 8-Pin (Standard)





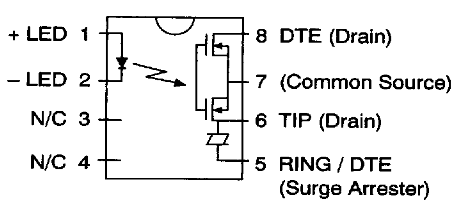
Surface Mount 8-Pin ("S" Suffix)





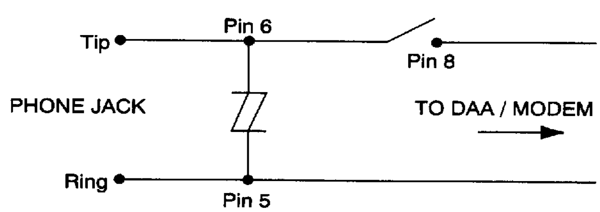
DIMENSIONS
Inches
(mm)

PACKAGE PINOUT



EXAMPLE CIRCUIT

How to Connect PLCA110 Output



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Introduction

This application note describes the advantages of using CP Clare's PLCA110 integrated Solid State Relay and Solid State Surge Arrester (SSSA). The combination of these discrete components in one package allows a single 8 pin device to serve both functions, while providing the advantages of reduced pc board space and $3750V_{RMS}$ input/output isolation, meeting FCC Part 68 requirements[1]. In addition to providing a complete overview of the PLCA110, this Application Note describes its use for telecommunication applications in accordance with agency (UL, CSA, BSI, etc.) requirements.

Description

The PLCA110 is an integrated Solid State Relay and Solid State Surge Arrester for use in AC or DC circuits where switching and protection against excessive line transients are required. The relay portion of the device consists of an infrared LED optically coupled to a photovoltaic chip which in turn drives two (2) enhancement mode MOSFET chips. By packaging the Solid State Relay and Surge Arrester together extra components are eliminated, which both decreases required pc board space and improves system reliability.

Circuit Operation

When using the PLCA110 in a typical application, the relay side of the device will supply fast, reliable SPST solid state switching while the surge arrester will provide the necessary protection against line to line transients (metallic) which would damage circuits under normal conditions. Figure 1 shows PLCA110 placement in a typical telecommunications circuit. The connection of the tip and ring lines may be made to either pin 5 or 6 since the unit is bidirectional; both lines will be protected from line to line pulses or transients. Since Pin 6 has one wire of the telephone circuit connected to it (hookswitch input) the circuit can be completed by placing the hookswitch output to pin 8.

As illustrated in figure 2, normal circuit operation is allowed as long as the voltage across the SSSA does not exceed a particular maximum value (V_{BO}).

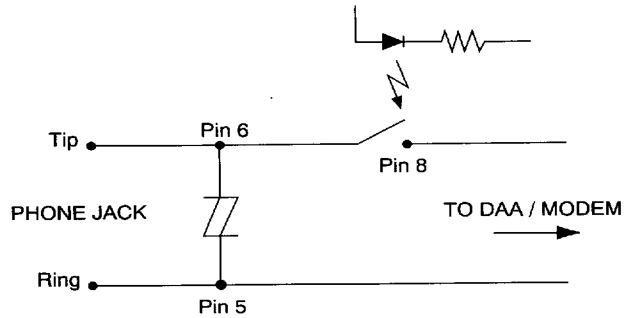

Figure 1. Typical Telecommunications Application

Under normal operating conditions, the circuit sees the SSSA as an open circuit. When a surge is impressed across the circuit, the voltage across the SSSA rises, usually quite rapidly. Upon reaching the breakover voltage (V_{BO}), the SSSA goes into a zener mode, which holds the voltage at a constant level (V_Z). Under these conditions, the current begins to rise. Once it reaches its breakover point (I_{BO}), the SSSA switches to a low impedance state and acts like a "voltage crowbar." This drops the voltage across the device to approximately ±3V maximum (V_T). The SSSA remains in the ON state as long as the voltage across the SSSA exceeds the breakover voltage. As the surge subsides, the current drops to holding current value (I_H) of the SSSA, which switches to the OFF state, becoming a high impedance (open circuit) to the circuit until the next surge is sensed.

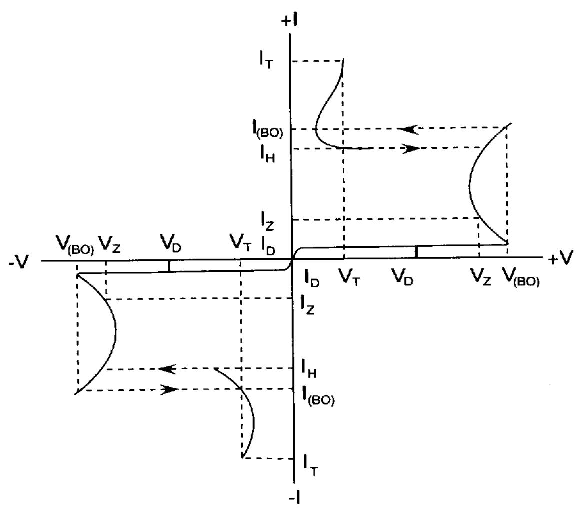

Figure 2. Transfer Characteristics of the SSSA

[1] There are obvious limits to the surge pulse, but the PLCA110 is designed to be fully compliant with FCC Part 68 requirements.

The SSSA within the PLCA110 can withstand the metallic surge pulse waveform which is defined by FCC Part 68 requirements. Figure 3 below depicts the waveform specification in graphical form, which is an 800V peak-surge, with a maximum risetime to crest of 10μs and a 560μs minimum decay time to halfcrest.

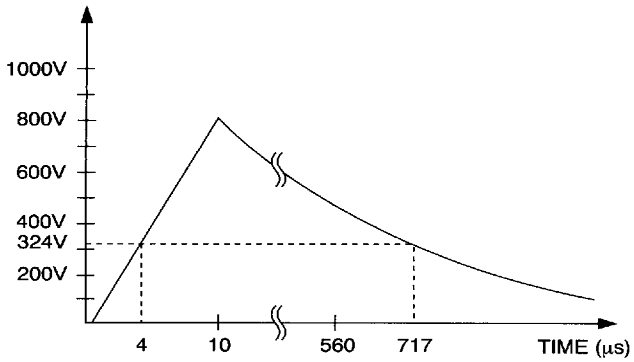

Figure 3. Metallic Surge Pulse Waveform

Why Use A Solid State Surge Arrestor?

Surge protection, although not always required by federal regulations, can be vital in protecting electronic circuits from line disturbances. These disturbances are referred to as transients, surges, glitches, or spikes. Without warning, these glitches will often damage equipment or cause major malfunction. The degree of damage can vary from data loss to the total destruction of the electronic equipment. Equally destructive are transients inflicted on telecommunication lines, which in addition to damaging expensive telephone equipment, can often place an end user in considerable danger. In order to avoid equipment damage or dangerous conditions, various devices are employed to protect the equipment and users from transient conditions, including:

- Solid State Surge Arrester
- Varistor/MOV (Voltage Dependent Resistor)
- Gas Discharge Tube (GDT)

Each device has advantages and disadvantages.

Solid State Surge Arrester — The SSSA functions as a voltage controlled "crowbar/foldback" device. When activated, it will switch from a "high off state resistance" to essentially become a short circuit. It will continue in this state until the current flowing through it is less than the minimum holding current for the SSSA, at which time it will reset itself. Since it can withstand high currents, delatching is guaranteed once the surge has subsided. It is extremely reliable and offers these advantages over other types of protection:

- Can be used in AC or DC applications
- Fastest response time of any device
- No moving parts
- Lower leakage current than other means of surge protection
- Lower power dissipation
- Tighter defined clamping voltage
- Non-degenerative
- Only device available that can exceed 268V FCC ringing requirements and protect a component rated at 350V

Varistor/MOV — MOV's are usable in both AC and DC applications because of their electrical symmmetry. Although their response time is comparable to the SSSA, they will degrade over time depending on the energy level, surge duration and frequency of occurrence. Physically they are large in size and their electrical design results in wide variations of clamping voltage. This is proven by the fact that surges from low impedance sources are allowed to leak at higher voltages at the protected connections than other devices with the same voltage rating.

Gas Discharge Tubes — Gas Discharge Tubes[2] (GDTs) are cylindrical tubes filled with compressed

[2] For more information on CP Clare gas tube arrestors reference CP Clare Catalog 220

gases. Once a breakover voltage has been reached, an electrical arc forms internally (gas ionization), providing a path to consume the surge. Mainly used as primary protection in telecom circuits, designs can actually benefit by using them in conjunction with the SSSA. This is due to the ability of the gas tubes to sink extremely high amounts of current and therefore take the brunt of the surge. Because of their slower response time, more loosely defined specifications, and dependency of the breakdown voltage to the rate of rise of the transient, a more reliable design is achieved by using a SSSA and GDT in combination to realize the benefits of both devices.

Telecommunications Application

The PLCA110 is ideal for use in a number of telecommunication applications, including tip/ring circuits. UL1459, 2nd Ed., CSA 225 and EN60950 require telecom products to comply with the "Overvoltage" and "Fire Hazard" test, respectively.

The intent of these tests is to simulate the resultant fault in the event that power lines run alongside were to cross telephone cables and insulation breakdown was to occur. The National Electrical Code (NEC) requires protection to be provided for voltages in excess of 600V on telephone cables, but does not require anything for voltages up to 600V. Figure 4 shows a typical 2-wire telephone configuration where a 10Ω, 0.25W metal film resistor provides overcurrent protection. The PLCA110 is the perfect solution for protecting against line to line transients (V_{BO}= ±283V minimum, ±340V maximum) and providing the necessary SPST switching capabilities for phone operation. Not only does the PLCA110 provide real estate and cost savings, but it is an acceptable solution for meeting UL and CSA requirements in this common "metallic" surge protection application.

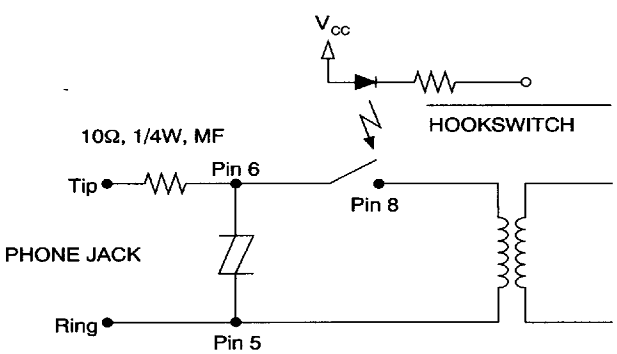

Figure 4. Typical Two Wire Application

Summary

The PLCA110 is an effective way of combining surge protection and solid state switching in one component. The surge arrester portion is designed to protect two wire telecommunication (metallic) applications against transients caused by lightning strikes and AC power lines. In addition, it is guaranteed to suppress and withstand the listed international lightning surges in both polarities. The relay portion on the device is fast, requires little drive power, contains no moving parts and provides bounce free switching. With all these features and the confidence of solid state reliability (>15 billion cycles) the PLCA110 is the perfect device for saving board space and complying with UL, CSA, IEC and FCC agency requirements when designing telecommunication products.