ZL70590 EKG/ECG Surge Protection Device

Features

- Protects Electrocardiographic (ECG) Monitoring Equipment (ME) Against Effects of Defibrillation
- Very Small Size and Very Low Leakage
- Integrates Zener Diodes and SCRs into a Single IC
- Easily Expandable to M×5 Channels
- Facilitates Compliance with IEC 60601-2-25 and IEC 60601-2-27
- Extremely Fast Turn-On
- Five Terminals Plus Substrates
- 28-Pin QFN Package
- RoHS Compliant
- Superior Quality
- Medical-Level Traceability

Applications

- Electrocardiographic (ECG) Monitoring Equipment (ME)
- Electrocardiographs
- ECG/EKG Monitors

Description

The ZL70590 is a five-terminal IC designed to protect Electrocardiographic (ECG) Monitoring Equipment when a defibrillation event occurs. The fast-acting device integrates the zener diode and SCRs into a single, fully tested, RoHS-compliant integrated circuit. When used in the conjunction with the recommended circuit, the ZL70590 facilitates compliance with IEC 60601-2-25 and IEC 60601-2-27. The ZL70590 is based on proven technologies, is in use today in die form, and is designed to protect implantable pacemakers and neurostimulators from defibrillation events.

Ordering Information

ZL70590LDG1E QFN Package, 28-Pin, Tray Packaging

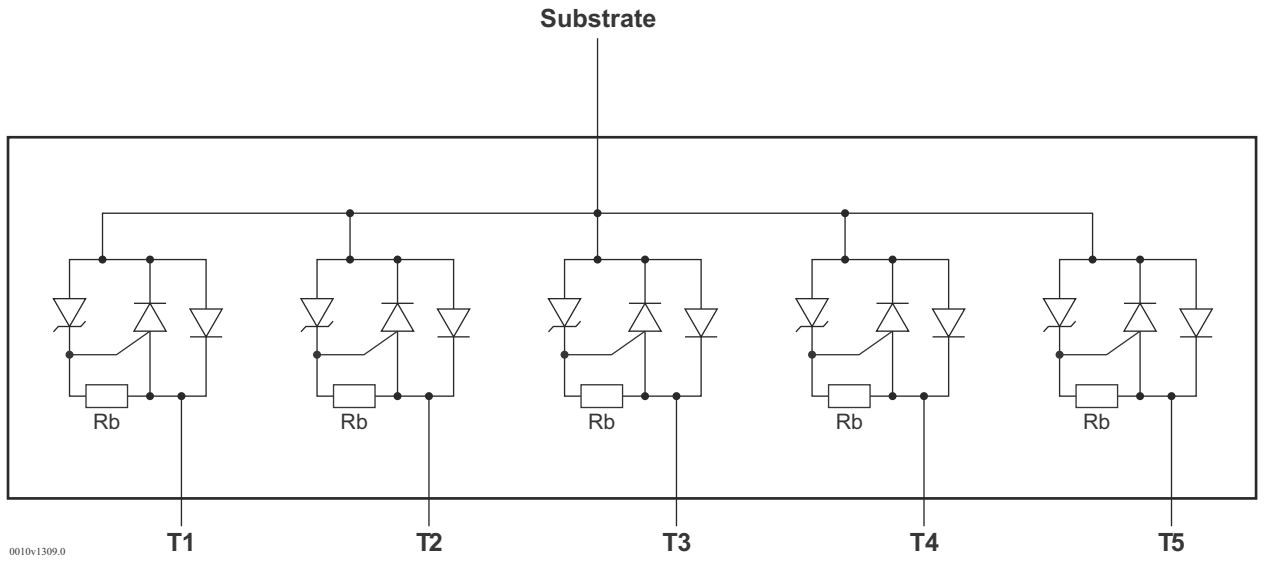

Figure 1 • **ZL70590 Schematic Diagram**

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1 – Overview

The ZL70590 is a five-branch transient surge suppressing device. An external substrate connection is provided for the purpose of extending functionality to additional transient surge suppressor circuits. This allows the number of total terminals to be extended to M × 5, where M is the number of transient surge suppressors sharing a common substrate connection. The standard delivery form is 4×5-mm, 28-pin, QFN-packaged devices delivered in tray packaging.

The protection is achieved by a self-triggering thyristor-diode device in parallel with a diode between each branch-input and an internal common node substrate. The five branches of the device are reached through terminals T1, T2 … T5. The electrical characteristic observed between any two of the inputs (T1, T2 … T5) very much resembles that of a DIAC (refer to Figure 1 on page I). When a transient current is forced between two branch-input terminals, the positive terminal is clamped to the substrate by the forward voltage of the thyristor-diode of the one branch and the negative terminal the other diode of branch. Due to the low on-state voltage of the thyristor, the power/energy stays at a safe value during the transient.

2 – Electrical Specifications

Tables 2-1 through 2-4 list the electrical specifications for the ZL70590 EKG/ECG Surge Protection Device.

Absolute Maximum Ratings

***Table 2-1* • Absolute Maximum Ratings**

No	Parameter	Symbol	Limit	Unit	Notes
1.1	Maximum surge current according to Figure 2-1	ITSM	8	A	Note 1
1.2	Continuous power dissipation t > 1s	Pmax	300	mW	
1.3	Storage temperature range	Tstg	−55 to +150	°C	
1.4	Maximum junction temperature	Tj	+150	°C	

Note:

1. *Time t_p from 1ms for wire-bonded and QFN-packaged ICs.*

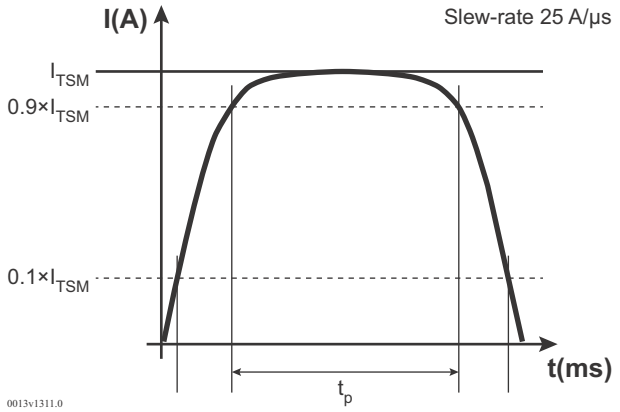


***Figure 2-1* • 1 to 10ms Surge Current Waveform**

Recommended Operating Conditions

***Table 2-2* • Recommended Operating Conditions**

No	Parameter	Symbol	Conditions	Limits		Unit	Notes
				Min	Max		
2.1	Operating temperature range	Tamb		0	+70	°C	

Static Characteristics

Table 2-3 • **Static Characteristics**
Unless Otherwise Stated: Tamb = 37°C

No	Parameter	Symbol	Conditions	Limits			Unit	Notes
				Min	Typ	Max		
3.1	Forward breakdown voltage	Vfz	Iz = 10µA	9	10.1	11	V	
3.2	Breakover voltage	Vbo	According to Figure 2-2	9	11.2	12	V	
3.3	Breakover current	Ibo	According to Figure 2-2	1	20	200	mA	
3.4	Holding current	Ih	According to Figure 2-2	1	8	200	mA	
3.5	On-state voltage	Von	Measured with a 2-ms pulse, I = 2.0A		2.9	4.1	V	
3.6	On-state dynamic resistance	dVT/dIT	Measured with a >300-µs pulse at IT = 1A and IT = 2A			1	Ω	
3.7	Off-state current	Id	Measured at 8.0V		0.2	100	nA	
3.8	Parasitic capacitance (terminal-to-terminal)	Cp	Vbias = 0V, f = 1kHz at 0.5Vrms	10		50	pF	Note 1
3.9	On-state voltage terminal to substrate	Von	Measured with a 2-ms-wide current pulse, I=2A, on parts bonded to LAT test PCB	0.0		2.8	V	
3.10	Forward diode voltage drop, substrate to terminal	Vfwd	Measured with a 2-ms-wide current pulse, I=2A, on parts bonded to LAT test PCB	0.0		1.8	V	

Note:

1. *Tests are verified during characterization (not 100% tested). These parameters are guaranteed by design.*

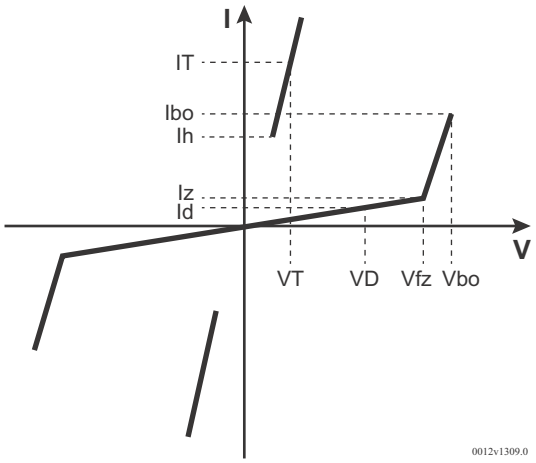


Figure 2-2 • **Terminal-to-Terminal Characteristic**

Dynamic Characteristics

Table 2-4 • **Dynamic Characteristics**
Unless otherwise stated: Tamb=37°C

No	Parameter	Symbol	Conditions	Limits			Unit	Notes
				Min	Typ	Max		
4.1	Turn-on delay	tond	Measured with a 0.2-A pulse and defined according to Figure 2-3, Vth = 8V		5	13	µs	
4.2	Maximum voltage during surge	Vpeak	Measured at peak and defined according to Figure 2-4 on page 2-4, Tamb = +25 ±5°C		13	15	V	Note 1
4.3	On-state voltage (at 8.0A)	Von	Measured with an 8.3-ms pulse, Ipeak = 8.0A; refer to Figure 2-4 on page 2-4. Value recorded at t = 13µs. Tamb = +25 ±5°C			10.3	V	Note 1
4.4	RF symmetry	Vpp	Measured with RF-test circuit between any two terminals T1 to T5; refer to Figure 2-5 on page 2-4.		4	40	mV	
4.5	Immunity to dV/dt triggering	dV/dt	Measured at 8.0 V (terminal to terminal). Defined in Figure 2-6 on page 2-4. Tamb = +25 ±5°C	1000	>2300		V/µs	Note 1

Note:

1. *Tests are verified during characterization (not 100% tested). These parameters are guaranteed by design.*

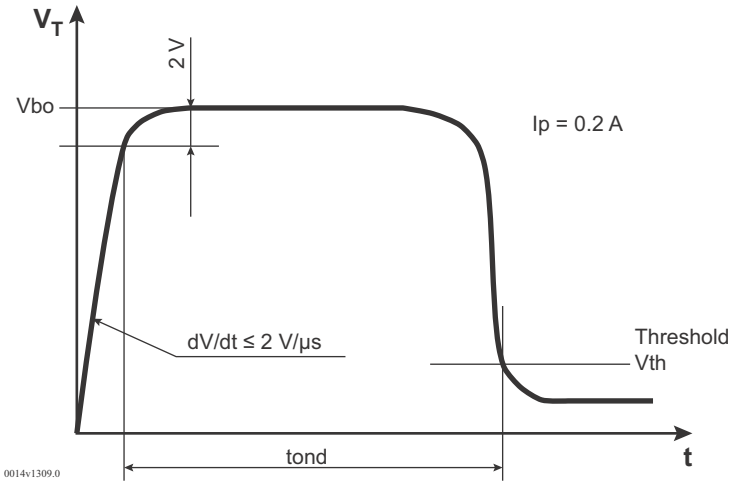


Figure 2-3 • **Turn-On Delay Definition, Test Case**

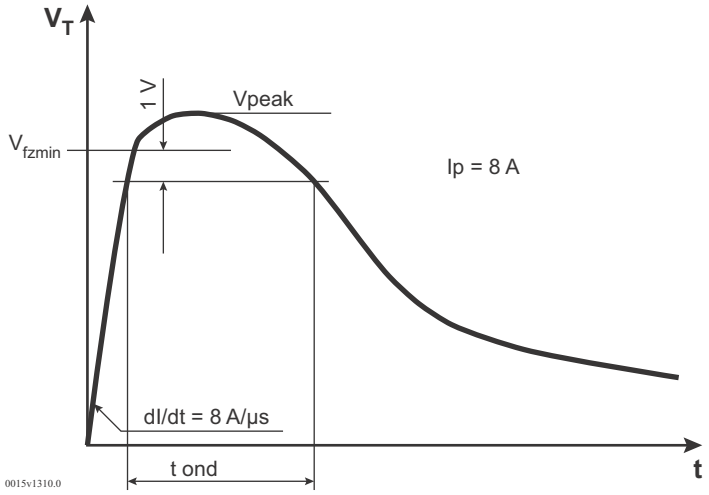


***Figure 2-4* • Turn-On Delay Definition, by Design**

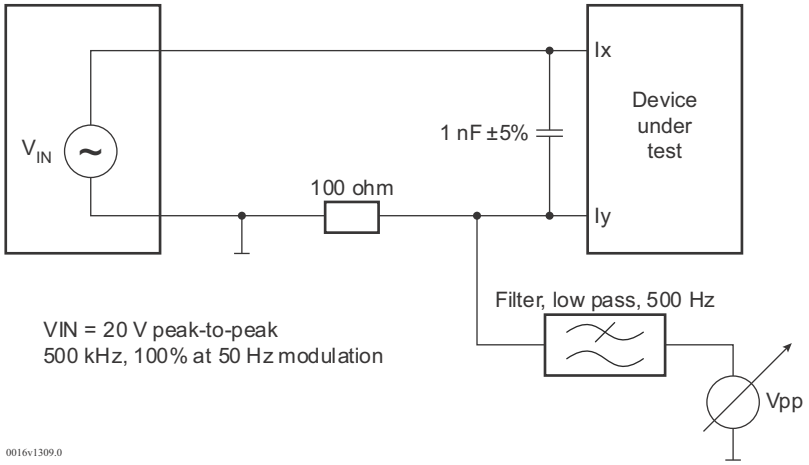


***Figure 2-5* • RF — Symmetry Test Circuit**

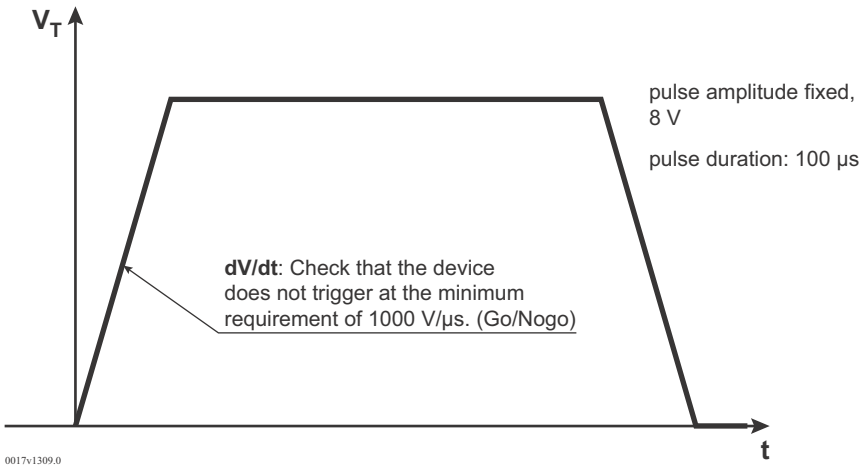


***Figure 2-6* • dV/dt Immunity Test Pulse**

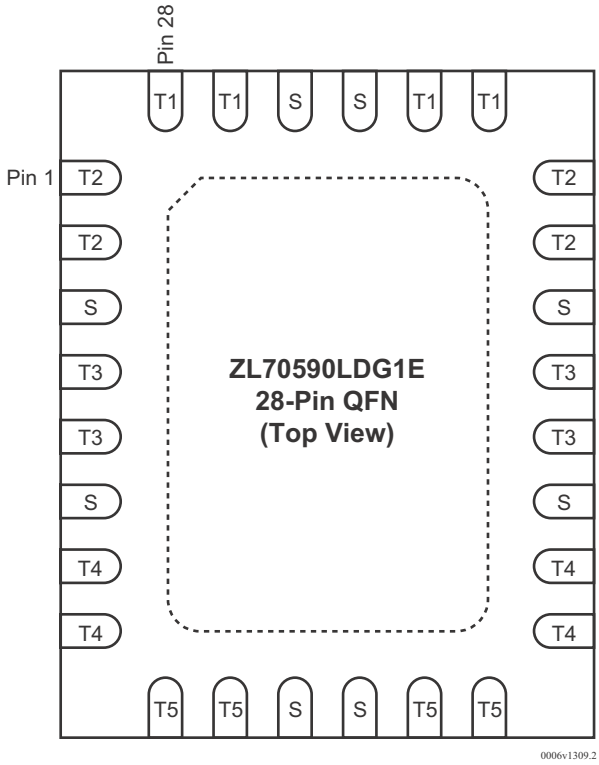
3 – Mechanical Specifications

Pin Assignments

Table 3-1 lists the functions of each pin on the ZL70590 EKG/ECG Surge Protection Device. The pin locations are shown in Figure 3-1.

Table 3-1 • **Terminal List**

Pin Name	Function
T1	Transient Surge Protection Terminal 1
T2	Transient Surge Protection Terminal 2
T3	Transient Surge Protection Terminal 3
T4	Transient Surge Protection Terminal 4
T5	Transient Surge Protection Terminal 5
Sub *or* S	Substrate Connection



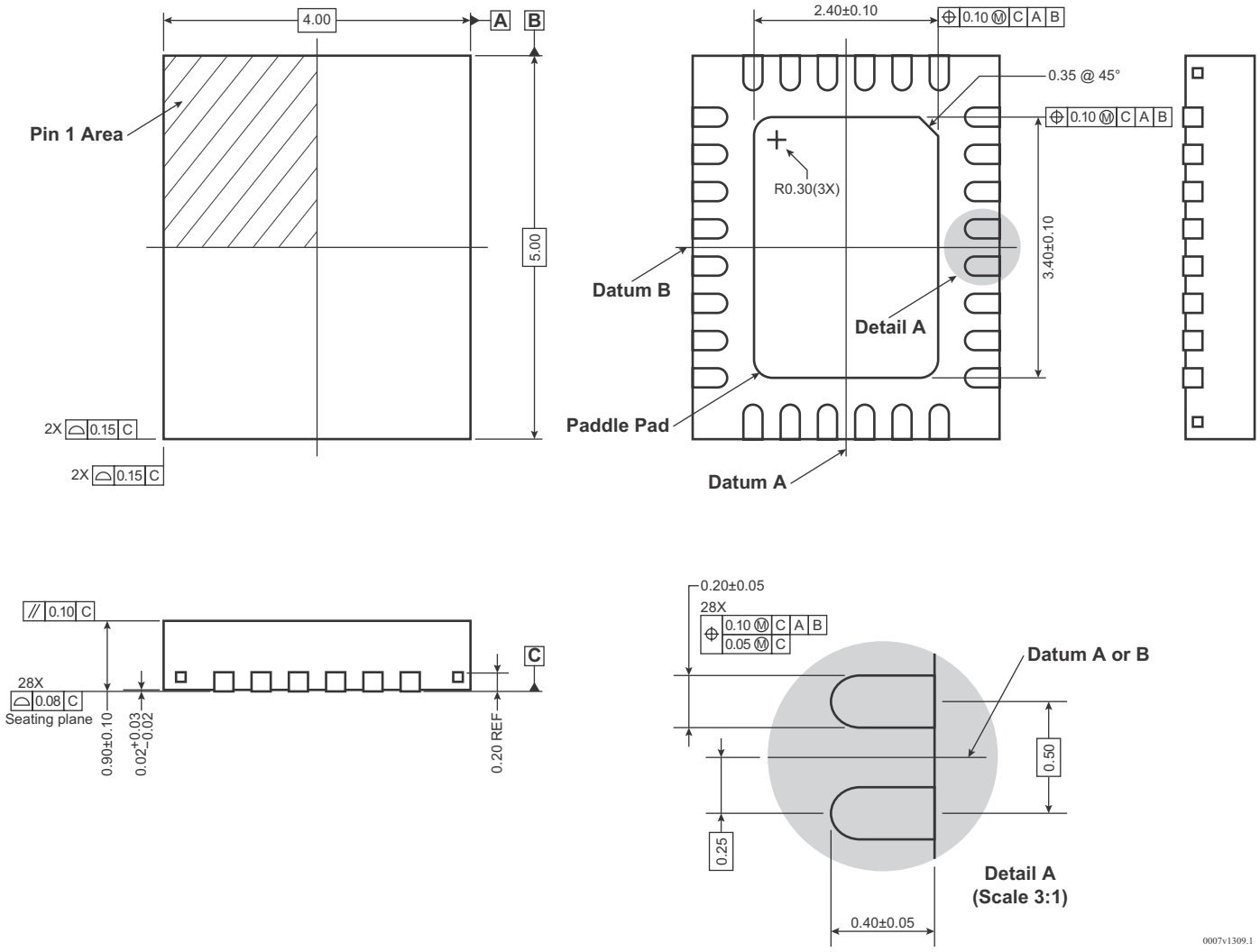
Notes:

1. *All four pins from each terminal must be electrically connected to one another on the PCB. This also applies to unused terminals.*
2. *All eight pins from the substrate connections (identified with an S) must be electrically connected to one another on the PCB.*
3. *The paddle pad, located on the bottom side of the QFN package (see Figure 3-2 on page 3-3), is electrically connected to the die substrate and may be connected on the PCB to the eight common substrate pins. In the example shown in Figure 4-3 on page 4-3, the paddle pad is not connected to the other substrate connections. This layout is recommended for single-layer PCBs. For multilayer PCBs, the customer has the option of connecting the paddle pad to the eight common substrate pins and routing the traces, connecting the terminal pins on either side of the package, underneath the PCB paddle pad.*

Figure 3-1 • **Pin Assignments for 28-Pin QFN Package**

Package Dimensions

the 28-pin QFN packaging dimensions are shown in Figure 3-2.



Notes:

1. *Body size: 4×5×0.90mm. Pitch: 0.50mm.*
2. *Dimensioning and tolerance is in conformance to ASME Y14.5-1994. All dimensions are in millimeters (° in degrees).*
3. *Dimension of lead width applies to metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip (both rows). If the terminal has optional radius on the end of the terminal, the lead width dimension should not be measured in that radius area.*

Figure 3-2 • **QFN Mechanical Package Outline (Size and Pad Placement)**

4 – Typical Application Example

IEC 60601-2-25 and IEC 60601-2-27 define the basic safety and essential performance of electrocardiographs. In the differential and common mode tests per the IEC specification, the current applied into the lead combination is defined by capacitance, inductance, and either a 100-ohm resistor (if the impedance is large) or a 50-ohm resistor plus the circuit impedance (if the impedance is low). In the case of the ZL70590, the impedance is high, therefore the 100-ohm resistor defines the waveform.

When protecting multiple lines, the schematic is modified to include all additional lines. Figure 4-1 on page 4-2 is an example of a protection scheme for three leads. Observe that one channel of the ZL70590 is used to connect to the system ground. This is to protect the circuit when tested in common mode.

Daisy-Chaining the ZL70590 Using the Substrate Connection

The ZL70590 has provisions for connecting two, three, or more devices together to create the functional equivalent of a surge protection device with 10, 15, or M×5 terminals (channels). This is achieved by making a common substrate connection, on the circuit board, between ZL70590 devices as shown in the example in Figure 4-2 on page 4-3. Observe that the common substrate can also be used for protection against surges, provided that it is at or near the lowest system voltage (typically Vss).

A suggested single-layer PCB layout, incorporating two daisy-chained ZL70590 devices, for a 12-lead EKG is shown in Figure 4-3 on page 4-3.

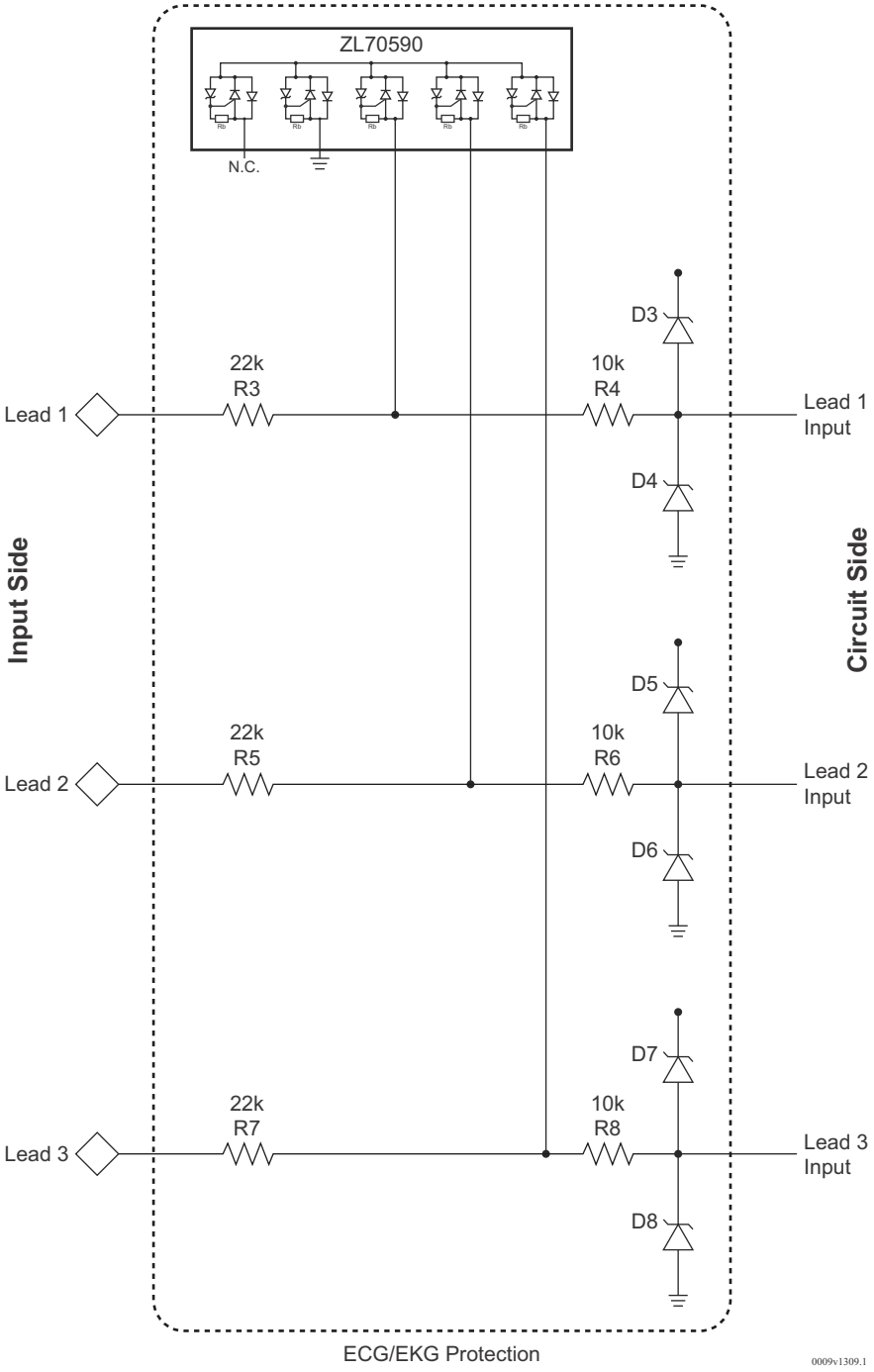


Figure 4-1 • **Example Protection Scheme (Three-Lead EKG Example Shown)**

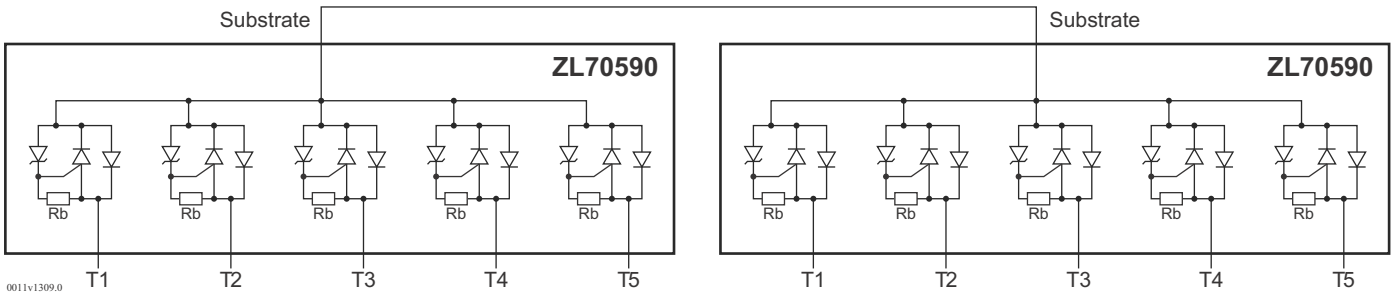


Figure 4-2 • **Daisy-Chaining Example Using ZL70590 Substrate Connection**

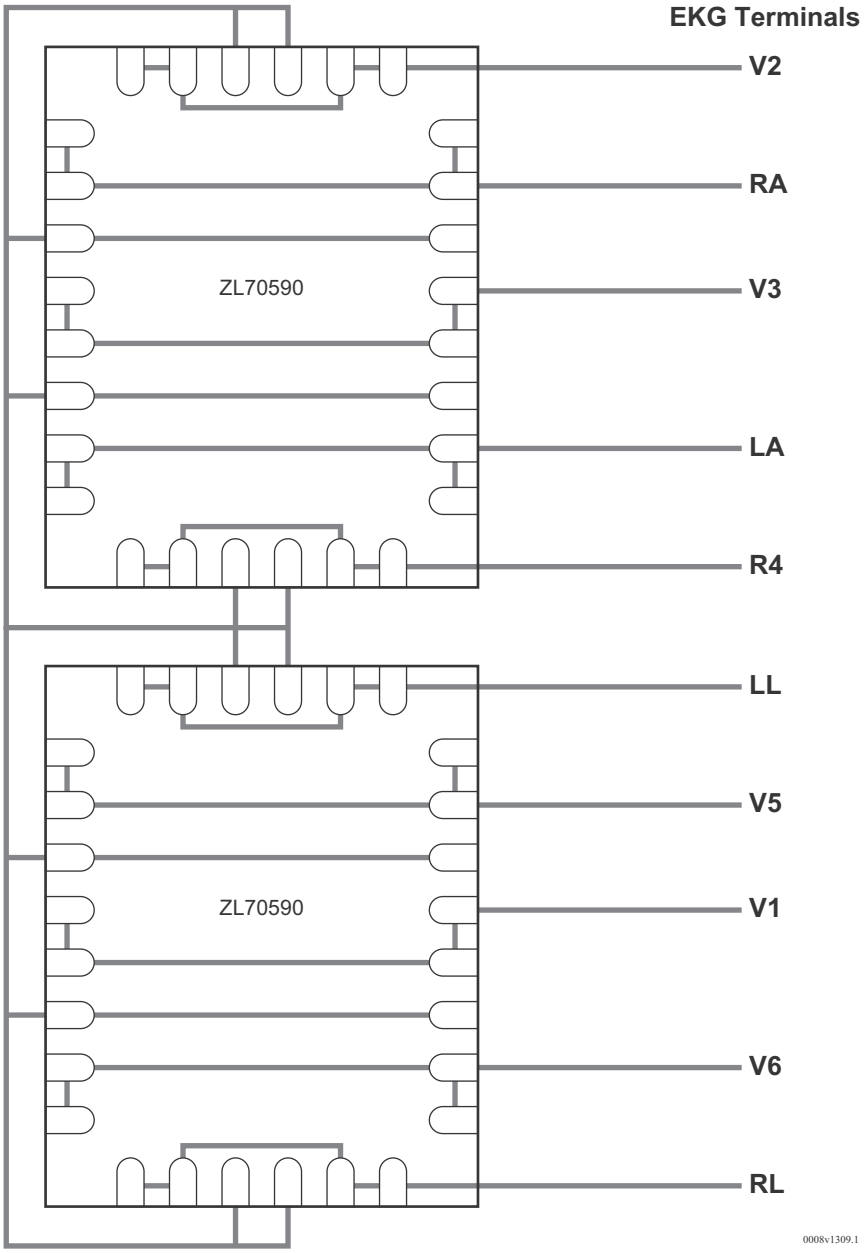


Figure 4-3 • **ZL70590 Suggested PCB Layout for Single-Layer PCB (12-Lead EKG Example Shown)**

5 – Glossary

Term	Explanation
ECG or EKG	Electrocardiogram
IC	Integrated circuit
IEC	International Electrotechnical Commission
IEC 60601-2-25	Medical electrical equipment – Part 2-25: Particular requirements for the basic safety and essential performance of electrocardiographs
IEC 60601-2-27	Medical electrical equipment – Part 2-27: Particular requirements for the basic safety and essential performance of electrocardiographic monitoring equipment
ME	Monitoring equipment
RF	Radio frequency
RoHS	The Restriction of the use of certain Hazardous Substances in electrical and electronic equipment regulations ("the RoHS regulations")
SCRs	Silicon-controlled rectifier

6 – Datasheet Information

List of Changes

The following table lists substantive changes that were made in the ZL70590 EKG/ECG Surge Protection Device datasheet (145972).

Revision	Changes	Page
Revision 2, Production (November 2013)	Added QFN packaging under "Features" and updated "Ordering Information" to reflect new packaging.	I
	In "Chapter 1 – Overview", corrected number of branches to five. Also changed wording for standard delivery form to reflect new packaging.	1-1
	In Table 2-1, changed maximum surge limit to 8. Also modified Note 1 regarding maximum surge limit.	2-1
	In Figure 2-1 changed slew rate.	2-1
	In Table 2-4, changed amperage for on-state voltage (under both *Parameter* and *Conditions* columns).	2-3
	In Figure 2-4, changed amperage (for both *dI/dt* and *Ip*).	2-4
	In Table 3-1, added *S* as an alternate pin name and modified "Function" column for the substrate connections.	3-1
	Inserted new Figure 3-1 to show pin assignments graphically. To reflect new figure, also changed "Pin Name" heading to "Pin Assignments" and added a reference to the figure in text.	3-1, 3-2
	Rewrote "Package Dimensions" section, including replacing Figure 3-2, to reflect new QFN packaging.	3-3
	Removed "Evaluation Boards" section in "Chapter 4 – Typical Application Example".	4-1
	Modified Figure 4-1 to show connections to terminals (vs. substrate) and nonconnected terminal.	4-2
	Changed Figure 4-2 to reflect new part number.	4-3
	Inserted new Figure 4-3 to show single-layer PCB example with 12 leads. Also added a reference to the figure in text.	4-3
	Under "List of Changes", corrected document number.	6-1
Revision 1, Advance (January 2013)	Initial release	All

Datasheet Categories

Categories

In order to provide the latest information to designers, some datasheet parameters are published before data has been fully characterized from silicon devices. The data provided for a given device is designated as either "Product Brief," "Advance," "Preliminary," or "Production." The definitions of these categories are as follows:

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Advance

This version contains initial estimated information based on simulation, other products, devices, or speed grades. This information can be used as estimates, but not for production. This label will only be used when the data has not been fully characterized.

Preliminary

The datasheet contains information based on simulation and/or initial characterization. The information is believed to be correct, but changes are possible.

Production

This version contains information that is considered to be final.

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