ZL70584 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
- Facilitates Compliance with IEC 60601-2-25 and IEC 60601-2-27
- Extremely Fast Turn-On
- Eight Terminals
- RoHS Compliant
- Superior Quality
  - Medical Level Traceability

Applications

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

Description

The ZL70584 is an eight-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 ZL70584 facilitates compliance with IEC 60601-2-25 and IEC 60601-2-27. The ZL70584 is based on proven technology— in use today— to protect implantable pacemakers and neurostimulators from defibrillation events.

Ordering Information

ZL70584UDJ2E Bumped Die, Waffle Tray

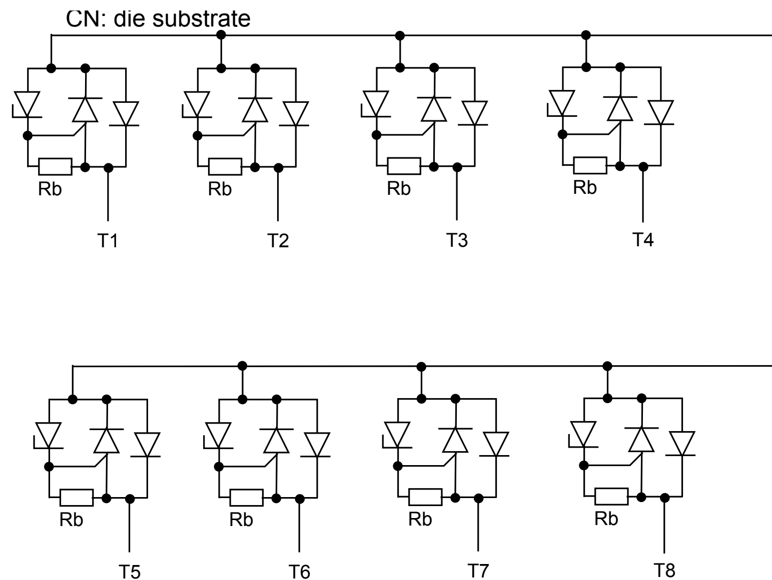

Figure 1 • **ZL70584 Schematic Diagram**

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Table of Contents

ZL70584 EKG/ECG Surge Protection Device

1 – Overview

2 – Electrical Specifications

Absolute Maximum Ratings 2-1
Recommended Operating Conditions 2-1
Static Characteristics 2-2
Dynamic Characteristics 2-3

3 – Mechanical Specifications

Pin List 3-1
Package Dimensions 3-2

4 – Typical Application Example

Evaluation Boards 4-1
Flip Chip Processing Recommendations 4-1

5 – Glossary

6 – Datasheet Information

Datasheet Categories 6-1
Safety Critical, Life Support, and High-Reliability Applications Policy 6-1

List of Figures

Figure 1 • ZL70584 Schematic Diagram I
Figure 2-1 • 1 to 10ms Surge Current Waveform 2-1
Figure 2-2 • Terminal-to-Terminal Characteristic 2-2
Figure 2-3 • Turn-On Delay Definition, Test Case 2-3
Figure 2-4 • Turn-On Delay Definition, by Design 2-4
Figure 2-5 • RF — Symmetry Test Circuit 2-4
Figure 2-6 • dV/dt Immunity Test Pulse 2-5
Figure 3-1 • Size and Bump Placement 3-2
Figure 3-2 • Bump Appearance 3-3
Figure 4-1 • Example Protection Scheme for Three Leads 4-2

List of Tables

Table 2-1 • Absolute Maximum Ratings 2-1
Table 2-2 • Recommended Operating Conditions 2-1
Table 2-3 • Static Characteristics 2-2
Table 2-4 • Dynamic Characteristics 2-3
Table 3-1 • Terminal List 3-1
Table 4-1 • Evaluation Board Ordering Information 4-1

1 – Overview

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 (CN). The eight branches of the device are reached through terminals T1, T2 ... T8. The electrical characteristic observed between any two of the inputs (T1, T2 ... T8) 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 CN 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. ZL70584 is an eight-branch transient surge suppressing device without substrate connection.

2 – Electrical Specifications

Tables 2-1 through 2-4 list the electrical specifications for the ZL70584 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	12	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 varies from 1ms for bonded chips without any thermal heat sink to 10ms for flip chip mounted chips with underfill.*

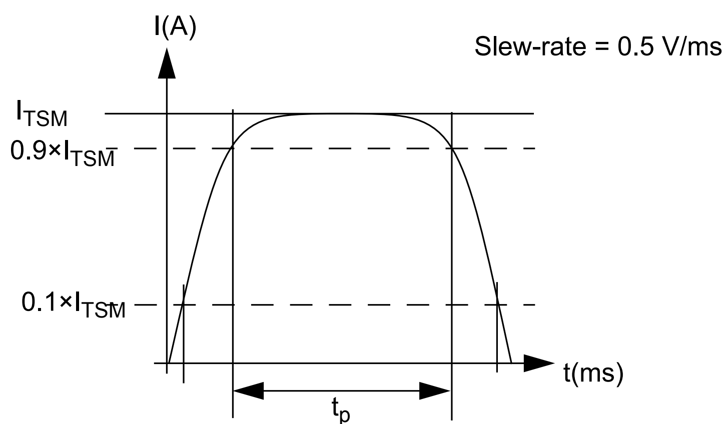

***Figure 2-1* • 1 to 10ms Surge Current Waveform**

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

Note:

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

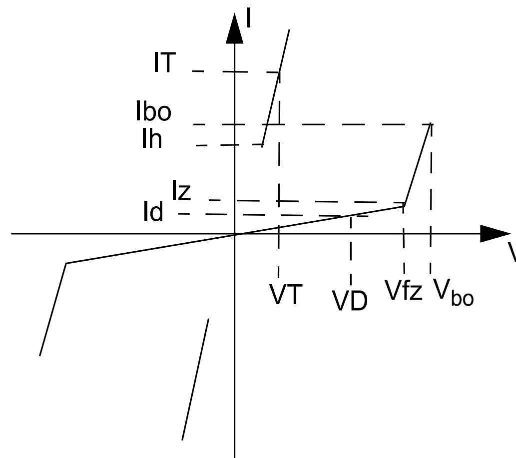

Figure 2-2 • **Terminal-to-Terminal Characteristic**

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 12.0A)	Von	Measured with a 8.3ms pulse, Ipeak = 12.0A; 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 T8; 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 2-5. 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.*

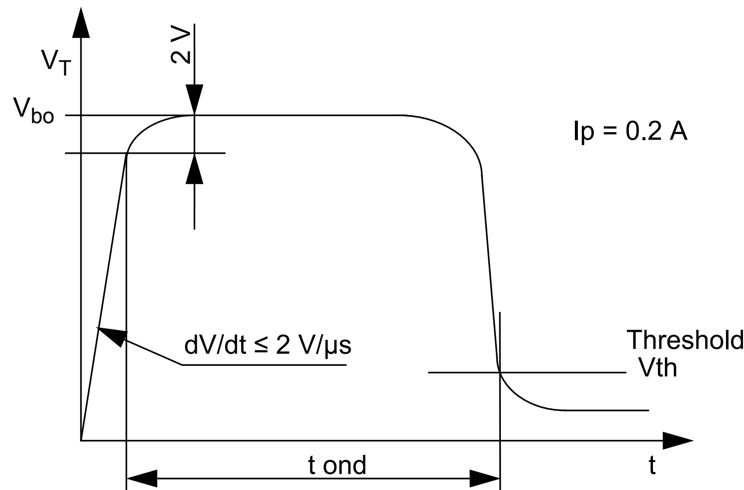

Figure 2-3 • **Turn-On Delay Definition, Test Case**

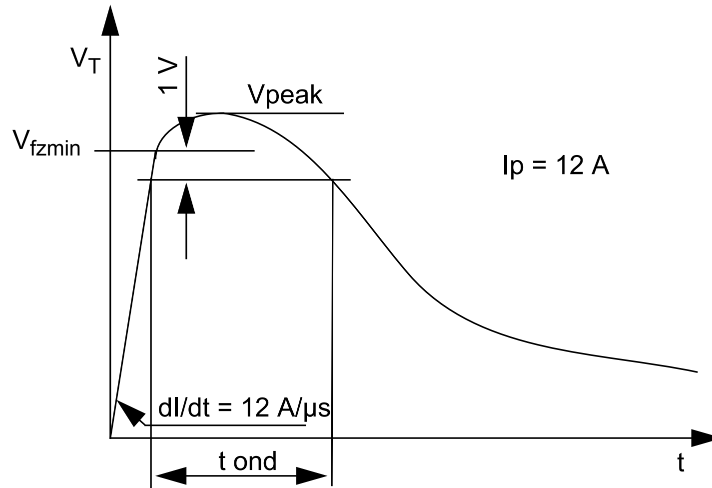

Figure 2-4 **• Turn-On Delay Definition, by Design**

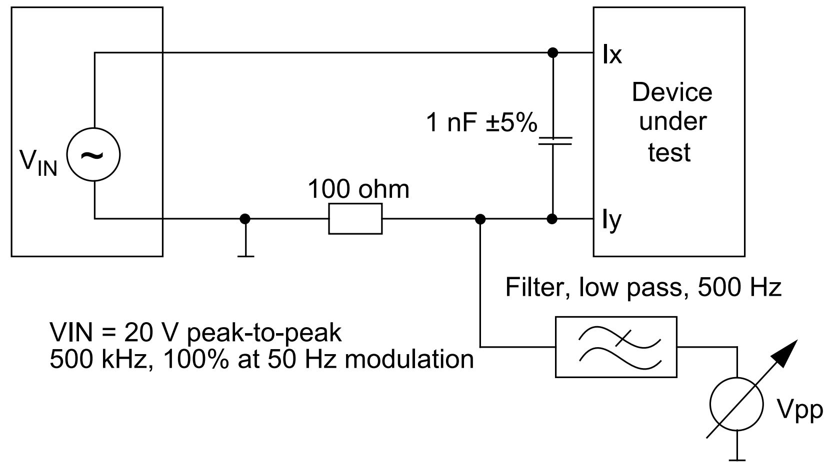

Figure 2-5 **• RF — Symmetry Test Circuit**

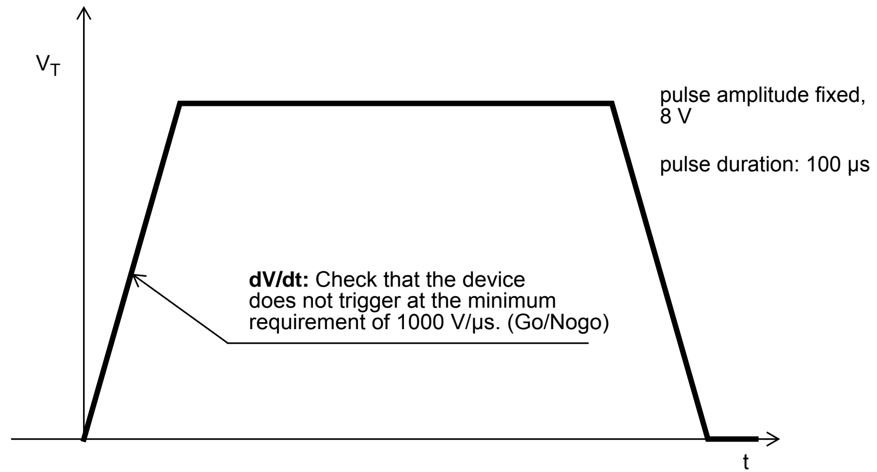

***Figure 2-6* • dV/dt Immunity Test Pulse**

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3 – Mechanical Specifications

Pin List

Table 3-1 lists the functions of each pin on the ZL70584 EKG/ECG Surge Protection Device.

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
T6	Transient Surge Protection Terminal 6
T7	Transient Surge Protection Terminal 7
T8	Transient Surge Protection Terminal 8

Package Dimensions

Die thickness is 528 ±50 µm. Size and solder bump placement are shown in Figure 3-1. Solder bump pitch is as follows:

- Between solder bumps on same terminal: 519 µm
- Between different terminals: 650 µm

Bump side-view is shown in Figure 3-2 on page 3-3.

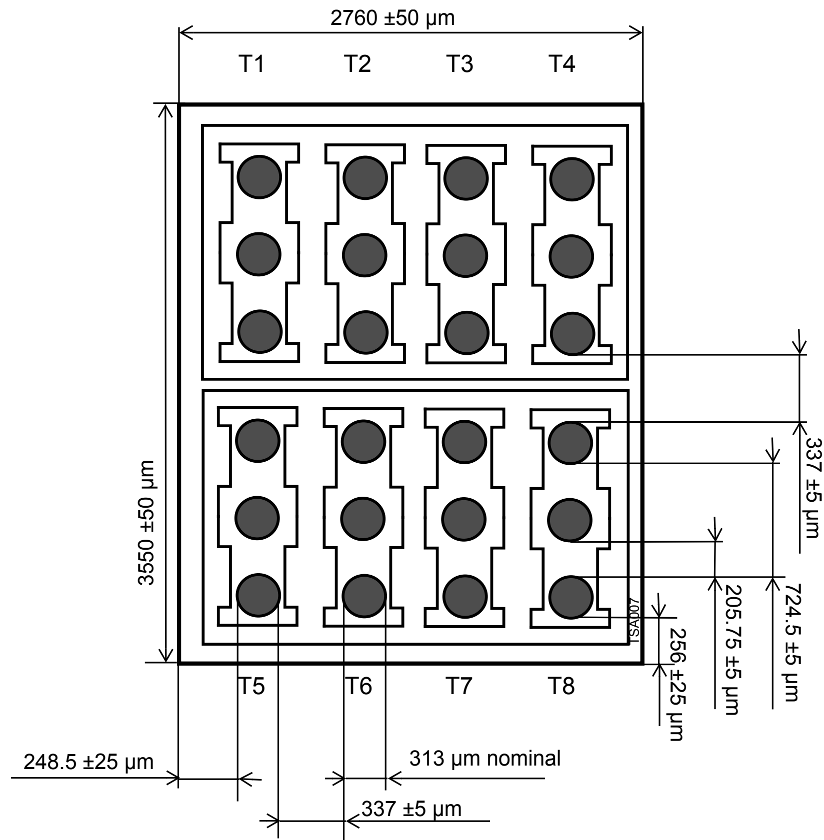
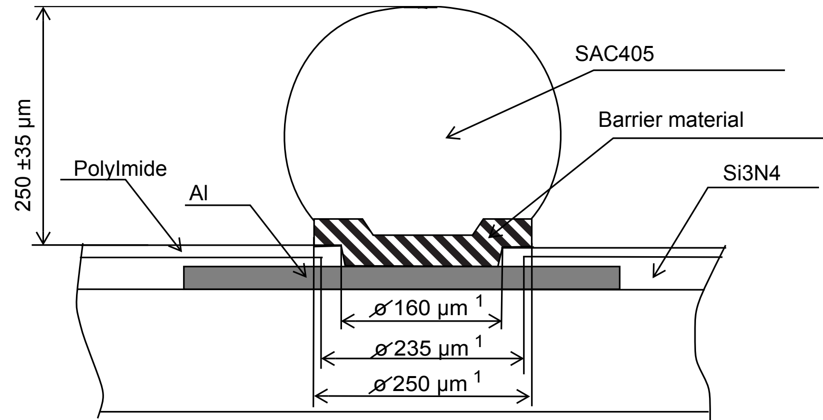


Figure 3-1 • **Size and Bump Placement**



Note:

1. *Reference only*

Figure 3-2 • **Bump Appearance**

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 ZL70584, the impedance is high, therefore the 100-ohm resistor defines the waveform.

When protecting multiple lines (up to seven plus common with the ZL70584) 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 ZL70584 is used to connect to the system ground. This is to protect the circuit when tested in common mode.

Evaluation Boards

For bench evaluation purposes, Microsemi offers surge protection devices mounted on a test substrate (with no surrounding circuitry). Each surge protection device terminal and substrate terminal (if present) is accessible by two through-hole solder pins attached to either side of the test substrate. Ordering information is listed in Table 4-1. Evaluation boards are for testing and evaluation purposes only and may not be RoHS compliant.

***Table 4-1* • Evaluation Board Ordering Information**

Surge Protection Device Part Number	Evaluation Board Part Number	Evaluation Board Description
ZL70584UDJ2E	ZLE70584MAD	Eval Board, Surge Protection, ZL70584

Flip Chip Processing Recommendations

The surge protection devices described in this document are designed for flip chip assembly. The face or active surface of the chip is covered with small lead-free solder bumps designed to connect to solder pads on the surface of a circuit board via reflow soldering. For best results, an underfill should be added to fill in the gap between the die and circuit board to reduce thermal stresses imposed on the solder joint. Microsemi does not offer a recommended circuit board pad pattern for these devices. However, there are two approaches to consider when designing the circuit board pad pattern. One method is to layout a pattern of individual pads matched to each solder bump. A second method is to design a pattern of rectangular pads large enough to connect all of the pads for a single terminal. No matter the method used, all of the solder bumps associated with an individual terminal must be connected together via the circuit board. If unfamiliar with flip chip processing, Microsemi recommends that the customer seek advice from a consultant or subcontractor familiar with the process.

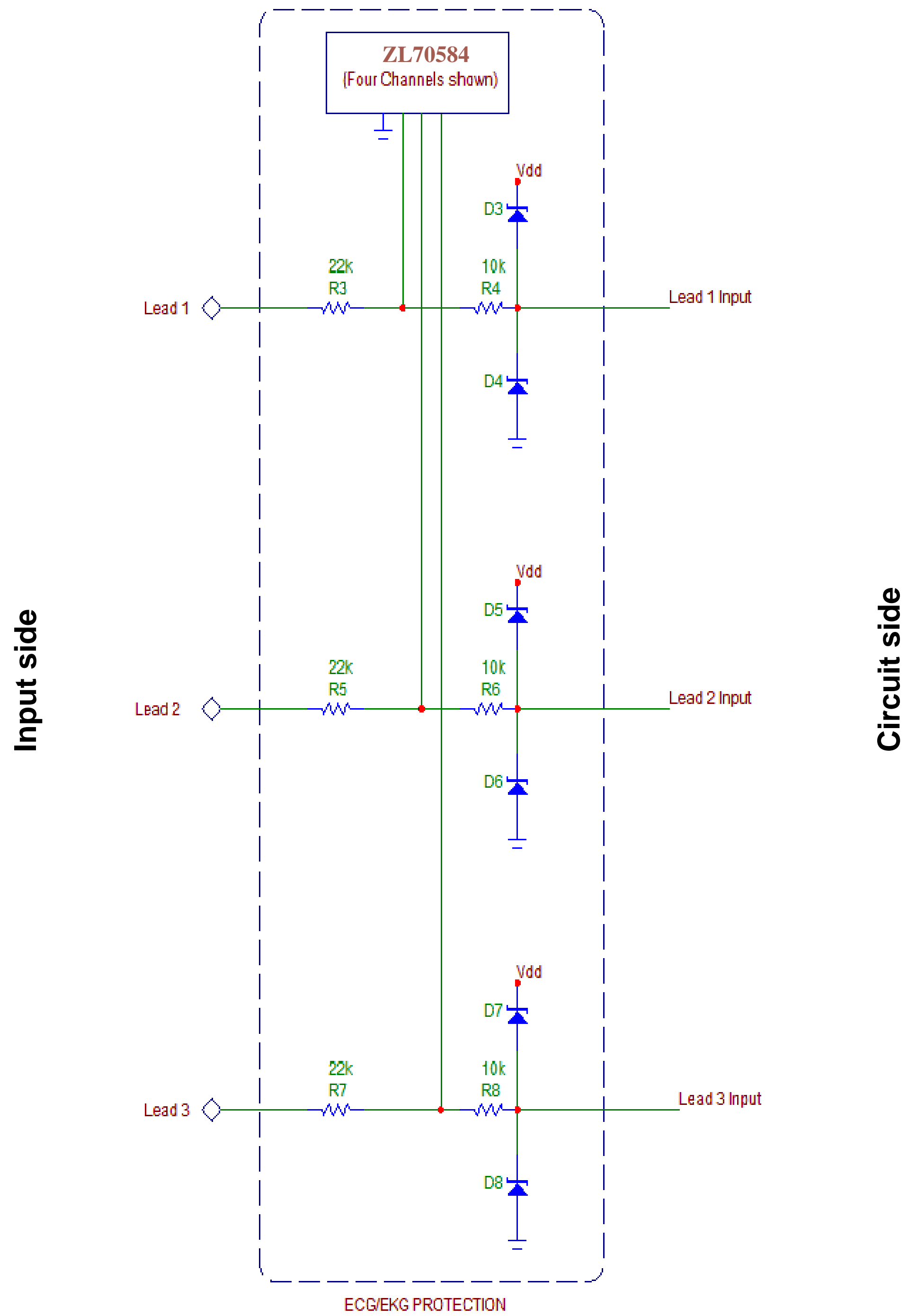


Figure 4-1 • **Example Protection Scheme for Three Leads**

5 – Glossary

Term	Explanation
ECG *or* EKG	Electrocardiograph *or* Electrocardiographic
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

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6 – Datasheet Information

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:

Product Brief

The product brief is a summarized version of a datasheet (advance or production) and contains general product information. This document gives an overview of specific device and family information.

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.

Safety Critical, Life Support, and High-Reliability Applications Policy

The products described in an advance status document may not have completed the Microsemi qualification process. Products may be amended or enhanced during the product introduction and qualification process, resulting in changes in device functionality or performance. It is the responsibility of each customer to ensure the fitness of any product (but especially a new product) for a particular purpose, including appropriateness for safety-critical, life-support, and other high-reliability applications. Consult the Microsemi CMPG Products Group Terms and Conditions for specific liability exclusions relating to life-support applications. A reliability report covering all of the CMPG Products Group's products is available from Microsemi upon request. Microsemi also offers a variety of enhanced qualification and lot acceptance screening procedures. Contact your local sales office for additional reliability information.

Microsemi Corporate Headquarters
One Enterprise, Aliso Viejo CA 92656 USA
Within the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996

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