General Description

The MAX30034 is a patent-pending protection device intended to (with the help of external, energy-rated resistors) absorb repetitive defibrillation and other high-energy pulses to protect sensitive electronic circuitry in ECG and other medical/industrial equipment. The device can withstand over 100,000 defib pulses without failure.

The device is intended to replace the gas-discharge tubes and transient absorbers in applications where its significant reduction in size is beneficial and its lower, well-defined on-voltage can offer higher degrees of protection to sensitive electronics.

The device uses a combination of a rugged integrated-circuit process and high-speed circuitry to ensure very fast turn-on times with trigger voltages low enough to not require secondary clamping circuitry. A low hold current of approximately 175mA ensures protection is maintained for the entire length of the high-energy transient event.

The MAX30034 is available in a small, 3mm x 5mm µMAX-8 package, and is specified over the 0°C to +70°C temperature range.

Ordering Information **appears at end of data sheet.**

µMAX is a registered trademark of Maxim Integrated Products, Inc.

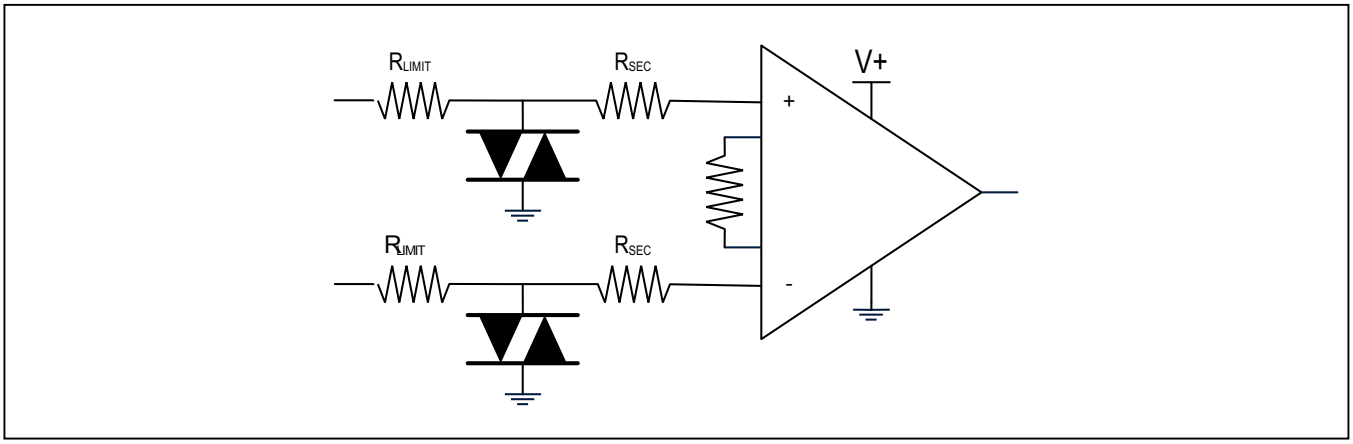
Benefits and Features

- Low Leakage Defibrilliation Protection IC Helps ECG Systems
- Low Capacitance ~ 3pF
- Low Leakage ~ 20pA at +70°C
- Fast Turn-On < 2ns
- Low On-Voltage 3.9V (typ)
- High Peak Current in Excess of 4A
- Withstands Over 100k Defibrilliation Pulses Without Failure
- 0°C to 70°C Temperature Range
- Small, 3mm x 5mm µMAX® Package

Applications

- AED Units
- Wearable Medical
- Clinical Patient Monitoring
- Industrial Equipment Protection
- Fixed Broadband Wireless Access

Typical Application Circuit



Absolute Maximum Ratings

Peak Energy per Event 40mJ
Continuous (> 1s) Current into Any Pin ..... ±50mA
Junction Temperature T_{JMAX} ..... 150°C
Continuous Power Dissipation (at T_A = 70°C) 953mW

Operating Temperature Range ..... 0°C to 70°C
Storage Temperature Range ..... -40°C to +150°C
Reflow Soldering Peak Temperature (Pb-free) ..... 260°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Package Thermal Characteristics (Note 1)

µMAX
Junction-to-Ambient Thermal Resistance (θ_{JA}) .....206°C/W
Junction-to-Case Thermal Resistance (θ_{JC}) .....8°C/W

Note 1: Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to **www.maximintegrated.com/thermal-tutorial**.

Electrical Characteristics

(T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C. See VI curve (TOC1) for reference) (Note 2)

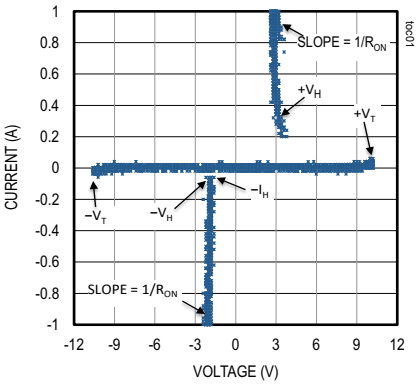
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
STATIC PERFORMANCE						
Input Off-State Operating Voltage				±8		V
Input Trigger Voltage	V_T	Either polarity		±10.3		V
Triggered Slope Resistance	R_{ON}	Slope above the holding current and voltage		0.4		Ω
Holding Current	$+I_H$			+175		mA
	$-I_H$			-70		mA
Holding Voltage	$+V_H$			+3.7		V
	$-V_H$			-1.9		V
On-Voltage		At 1A, low duty-cycle, pulse tested		3.9		V
Input Capacitance		2V applied		2		pF
Input Leakage	I_L	5V applied		0.003	1	nA
DYNAMIC PERFORMANCE						
Immunity Triggering		Either polarity, above this level of input slew rate will trigger the device when below the trigger voltage		1		V/ns
Turn-On Time		Input starts at 3.6V DC, then rises at 2V/µs. Turn-on time is from the start of the ramp to the time at which > 100mA is flowing		2		ns
Release Time		35mA to < 1µA		100		µs

Note 2: Limits are 100% tested at T_A = +25°C, unless otherwise noted. Limits over the operating temperature range are guaranteed by design and characterization.

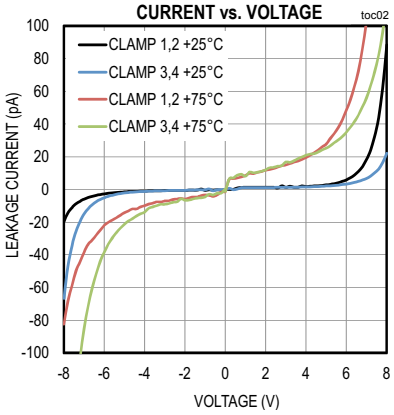
Typical Operating Characteristics

T_A = +25°C, unless otherwise noted.

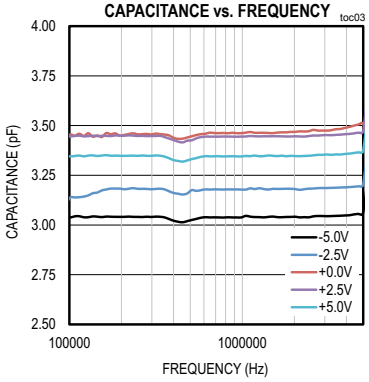
CLAMP DC TRANSFER FUNCTION
CURRENT vs. VOLTAGE



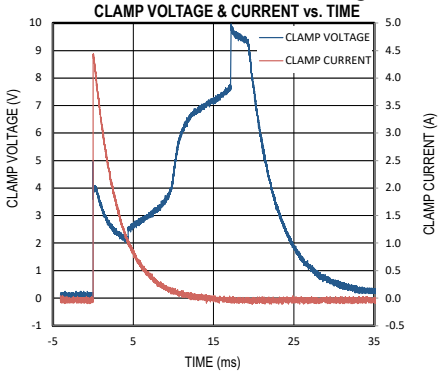
CLAMP OFF-STATE LEAKAGE
CURRENT vs. VOLTAGE



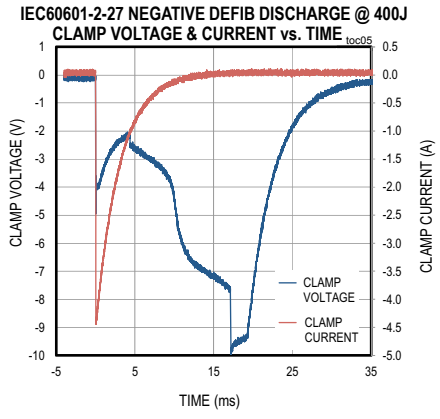
CLAMP OFF-STATE
CAPACITANCE vs. FREQUENCY



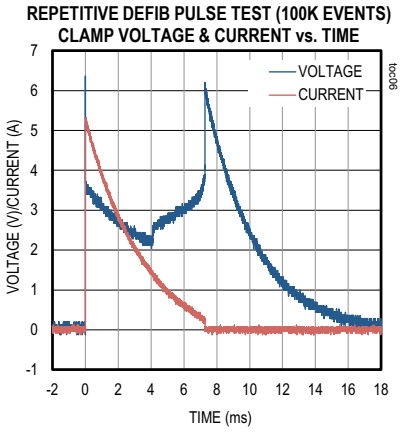
IEC60601-2-27 POSITIVE DEFIB DISCHARGE @ 400J
CLAMP VOLTAGE & CURRENT vs. TIME



IEC60601-2-27 NEGATIVE DEFIB DISCHARGE @ 400J
CLAMP VOLTAGE & CURRENT vs. TIME



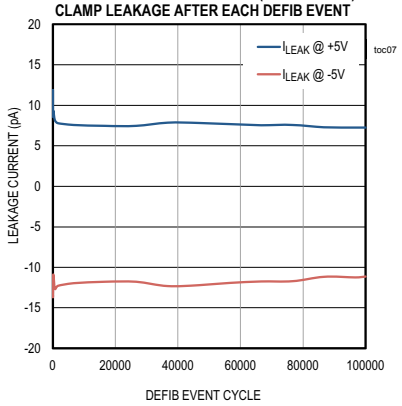
REPETITIVE DEFIB PULSE TEST (100K EVENTS)
CLAMP VOLTAGE & CURRENT vs. TIME



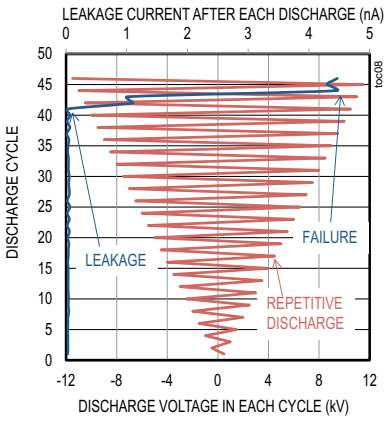
Typical Operating Characteristics (continued)

T_A = +25°C, unless otherwise noted.

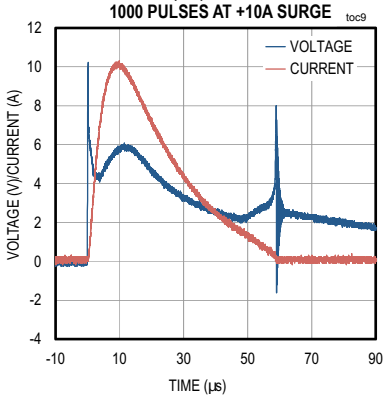
REPETITIVE DEFIB PULSE TEST (100K EVENTS)
CLAMP LEAKAGE AFTER EACH DEFIB EVENT



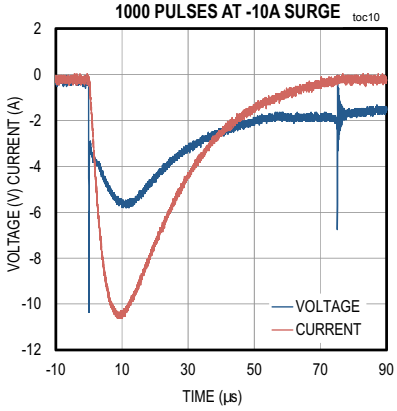
CLAMP ESD CONTACT DISCHARGE TEST
WITH HUMAN METAL MODEL



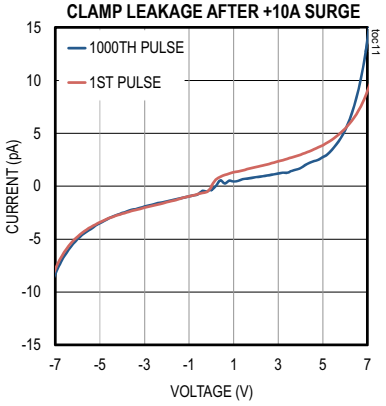
IEC 61000-4-5 (2Ω) SURGE STRESS TEST
1000 PULSES AT +10A SURGE



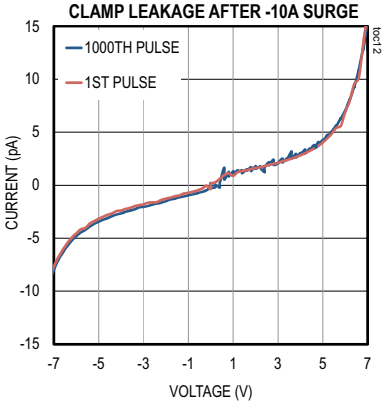
IEC 61000-4-5 (2Ω) SURGE STRESS TEST
1000 PULSES AT -10A SURGE



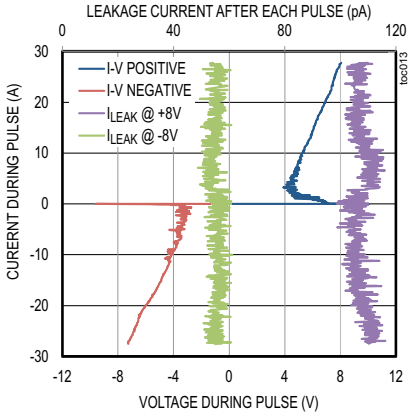
IEC 61000-4-5 (2Ω) SURGE STRESS TEST
CLAMP LEAKAGE AFTER +10A SURGE



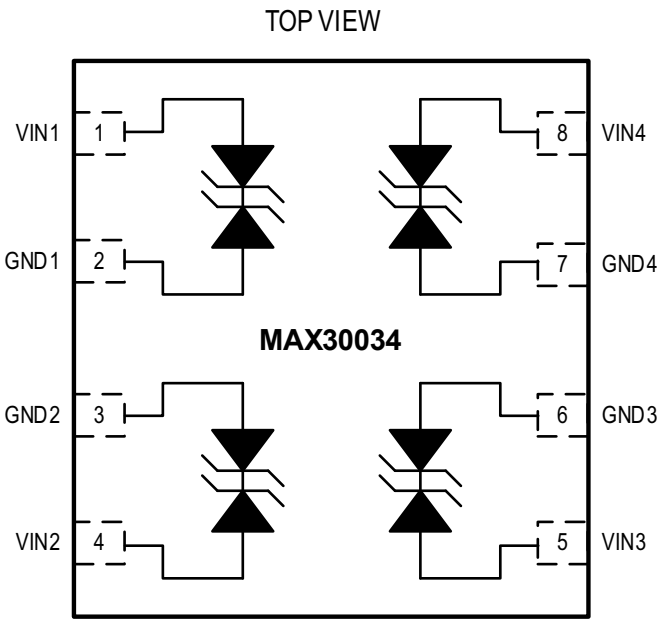
IEC 61000-4-5 (2Ω) SURGE STRESS TEST
CLAMP LEAKAGE AFTER -10A SURGE



100ns TRANSMISSION LINE PULSER TEST
CLAMP CURRENT vs. VOLTAGE & LEAKAGE



Pin Configuration



Pin Descriptions

PIN	NAME	FUNCTION	COMMENTS
1	V_{IN1}	Clamp input 1	Tie to the input voltage to be clamped
2	GND	Ground	Tie to board GND
3	GND	Ground	Tie to board GND
4	V_{IN2}	Clamp input 2	Tie to the input voltage to be clamped
5	V_{IN3}	Clamp input 3	Tie to the input voltage to be clamped
6	GND	Ground	Tie to board GND
7	GND	Ground	Tie to board GND
8	V_{IN4}	Clamp input 4	Tie to the input voltage to be clamped
EP	GND	Exposed paddle	Tie to board GND

Detailed Description

The MAX30034 defibrillation pulse protectors are specifically designed to protect the input of ECG and respiration detection circuits from a maximum discharge of 400J with the maximum allowable shunted energy into the ECG protection circuit. These devices operate as bidirectional voltage trigger clamps. When the voltage across the terminals of the device goes above approximately +10.3V or below -10.3V, the impedance across the device drops from well over $10^{10}\Omega$ to less than 1Ω. This drop of impedance across the device conducts sufficient current so as to clamp the voltage across its terminals to protect the input of sensitive electronics. TOC1 illustrates the VI characteristic of the MAX30034.

The MAX30034 do not dissipate the majority of the defibrillation pulse energy, rather they clamp the voltage at the input to a low voltage, forcing the majority of the defib energy to be dissipated in an external energy rated resistor, R_{LIMIT}. This external energy-rated resistor should be sized to limit the energy absorbed by the ECG system to within the limits specified by IEC and AAMI requirements.

The voltage across the MAX30034, when triggered on, is approximately $V_{ON} = 3.5V + I_{CLAMP} \times R_{ON}$, where I_{CLAMP} is the current flowing through the MAX30034 and will be given by $I_{CLAMP} = V_{APPLIED}/R_{LIMIT}$. R_{ON} is the MAX30034 on state impedance given in the electrical characteristics table. Thus the current in the MAX30034, produces a power dissipation in the device of $P_{MAX30034} = 3.5V \times I_{CLAMP} + R_{ON} \times I_{CLAMP2}$. The peak energy per defib pulse must be kept below the maximum shown in the absolute maximum ratings.

Before the MAX30034 go into a clamp state, the voltage can briefly exceed 10.3V (typ). So a secondary protection resistor (R_{SEC}) between the MAX30034 and the ECG input circuit is recommended. Virtually all modern circuitry have ESD protection at their inputs to clamp the input to an acceptably low voltage. These clamps are generally designed to protect the input against limited ESD and latch-up events. Thus RSEC should be sized to limit the current into the ECG input to levels below the absolute maximum rating of the device and would typically be part of the input filtering network. Generally R_{SEC} would be as low as a few hundred ohms and dissipate very little energy during a defib event. For example, if the instrumentation amplifier supply is 3V, then $R_{SEC} > (10.3V - 3.7V)/I_{MAX}$, where I_{MAX} is the maximum current specified in the instrumentation amplifier data sheet.

MAX30034 will fall out of the conduction state and return to a low-leakage off-state once the terminal current drops below the hold current, of approximately +175mA or -55mA. When in the off state, the MAX30034 exhibit extremely low leakage, typically less than 10pA at room temperature as well as low capacitance, typically 3.3pF. Thus the device has little or no impact on the characteristics of the ECG input signal-conditioning network.

In addition to defib protection, the MAX30034 is an extremely fast device. Thus, it is capable of also serving as an IEC61000-4-2 high ESD protection device, eliminating the need for multiple protection components at the front-end of an ECG system. TOC8 illustrates multiple direct (R_{LIMIT} = 0Ω) HMM ESD hits at various voltages. The HMM ESD model is essentially an IEC61000-4-2 ESD model with a hard GND connection and contact discharge. Thus, it represents a worst-case IEC61000-4-2 scenario. As can be seen from TOC8, the MAX30034 are able to tolerate a worst case IEC61000-4-2 contact discharge to well over 8kV without damage.

The MAX30034 are “snap-back” type clamp structures and are specifically designed for applications where the normal circuit impedance is high enough that the minimum hold current cannot be supported, such as ECG defib protection. In such a case the MAX30034 are guaranteed to turn off when the transient condition is removed and will not remain in a clamp condition causing potential damage.

If the MAX30034 were to be used in an application where the circuit impedance was low enough to support the minimum hold current, such as a power supply clamping application, then the devices could result in excessively high DC current to flow once triggered by an overdrive condition. In such a situation, the MAX30034 could be destroyed and could destroy other circuitry in the process.

To ensure that the intended circuit is appropriate for use with the MAX30034, analyze the target circuit with a short circuit in place of the MAX30034. If the current in that short circuit is less than the minimum hold current, then the MAX30034 would work for that application.

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX30034CUA+	0°C to +70°C	8 µMAX

+Denotes lead(Pb)-free/RoHS compliant package.

Chip Information

PROCESS: CMOS

Package Information

For the latest package outline information and land patterns (footprints), go to **www.maximintegrated.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	OUTLINE NO.	LAND PATTERN NO.
TDFN	U8+4	**21-0036**	**90-0092**

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	3/16	Initial release	—
1	8/17	Removed MAX30031, MAX30032, and MAX30033 part numbers	1–8

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.

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