chanhvinh.com

Lead-free Green

PAM8904E

18VPP OUTPUT PIEZO SOUNDER DRIVER

NEW PRODUCT

Description

The PAM8904E is a piezo sounder driver with integrated charge pump boost converter. The PAM8904E is capable of driving a ceramic/piezo sounder with $27V_{PP}$ from a 4.5V power supply. The charge pump can operate in either 1x, 2x or 3x mode.

The boost converter operates at a fixed frequency of 100kHz and provides a 3X V_{IN} output with a minimum number of external components. The PAM8904E can drive up to 47nF loading. Diodes Incorporated's unique drive technology provides a small inrush current, low EMI and high efficiency.

The PAM8904E includes built-in automatic shutdown and wake up that guarantees longer battery life. The PAM8904E features thermal shutdown, over current protection, over voltage protection and under voltage lock-out.

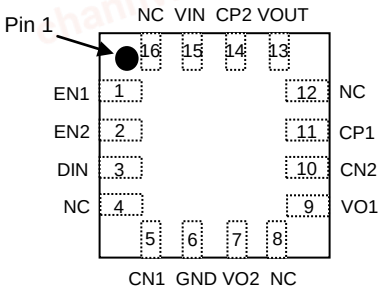
The PAM8904E is available in U-QFN3030-16 (Type B), U-QFN3030-12 (Type A) and W-QFN2020-12 (Type US) packages.

Features

- Supply Voltage Range from 1.5V to 5.5V
- $18V_{PP}$ Output from a 3V Supply
- Integrated Boost Converter Generates up to 13.5V Supply
- Input Signal 20Hz to 300kHz
- No Voltage Cross Output at Shutdown Mode
- Low Current Consumption
- Automatic Standby and Wake-up Control
- Available in Space Saving Packages U-QFN3030-16 (Type B), U-QFN3030-12 (Type A) and W-QFN2020-12 (Type US) Packages
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

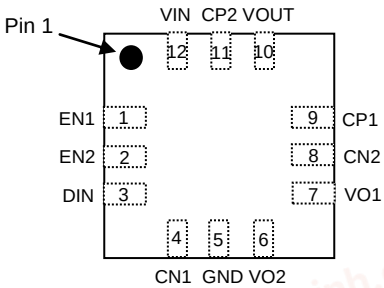
Pin Assignments

(Top View)



U-QFN3030-16 (Type B)

(Top View)



U-QFN3030-12 (Type A)/W-QFN2020-12 (Type US)

Applications

- Health Care Systems
- Alarm Clocks
- Security Devices
- Home Appliances

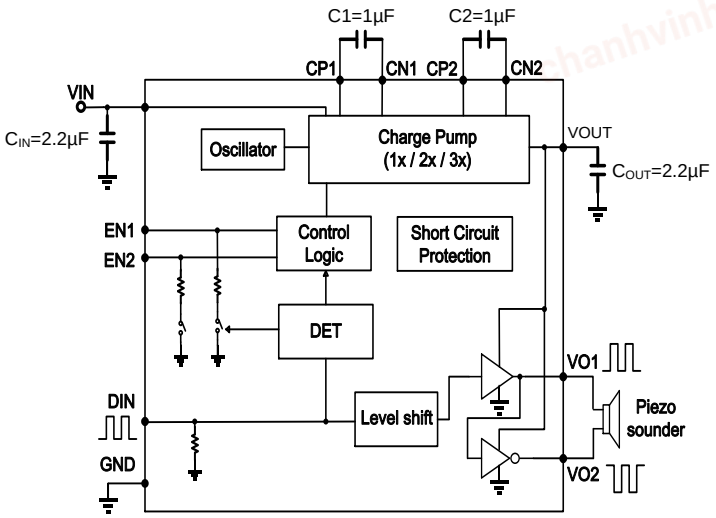
Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

© Diodes Incorporated

chanhvinh.com

NEW PRODUCT

Typical Applications Circuit



Pin Descriptions

Pin Number		Pin Name	I/O/P	Function
U-QFN3030-16 (Type B)	U-QFN3030-12 (Type A)/ W-QFN2020-12 (Type US)			
1	1	EN1	I	Charge pump mode select 1
2	2	EN2	I	Charge pump mode select 2
3	3	DIN	I	Signal Input
4	—	NC	—	No Connection
5	4	CN1	I	Capacitor 1 Negative Terminal
6	5	GND	P	Ground
7	6	VO2	O	Positive Output
8	—	NC	—	No Connection
9	7	VO1	O	Negative Output
10	8	CN2	I	Capacitor 2 Negative Terminal
11	9	CP1	I	Capacitor 1 Positive Terminal
12	—	NC	—	No Connection
13	10	VOUT	O	Boost Output
14	11	CP2	I	Capacitor 2 Positive Terminal
15	12	VIN	P	Power Supply
16	—	NC	—	No Connection

© Diodes Incorporated

chanhvinh.com

NEW PRODUCT

Absolute Maximum Ratings (@ T_A = +25°C, unless otherwise specified.)

Symbol	Characteristics	Value	Unit
V_{IN}	Supply Voltage	-0.3 to +6.0	V
V_{OUT}	Output Voltage	15	V
V_{EN1}, V_{EN2}	EN1, EN2 Voltage	GND -0.3 to V_{IN} +0.3	V
T_A	Operating Free-Air Temperature Range	-40 to +85	°C
T_J	Operating Junction Temperature Range	-40 to +150	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C

Recommended Operating Conditions (@ T_A = +25°C, unless otherwise specified.)

Symbol	Characteristics		Min	Max	Unit
V_{IN}	Supply Voltage	—	1.5	5.5	V
V_{IH}	High-Level Input Voltage	EN1, EN2	1.2 to V_{IN} +0.3		V
V_{IL}	Low-Level Input Voltage	EN1, EN2	-0.3	+0.4	V
T_A	Operating Free-Air Temperature		-40	+85	°C

Thermal Information

Symbol	Parameter	Package	Max	Unit
θ_{JA}	Thermal Resistance (Junction to Ambient)	U-QFN3030-16 (Type B)	35	°C/W
		U-QFN3030-12 (Type A)	35	
		W-QFN2020-12 (Type US)	68	
θ_{JC}	Thermal Resistance (Junction to Case)	U-QFN3030-16 (Type B)	14	°C/W
		U-QFN3030-12 (Type A)	14	
		W-QFN2020-12 (Type US)	25	

© Diodes Incorporated

chanhvinh.com

NEW PRODUCT

Electrical Characteristics (@T_A = +25°C, V_{IN} = 3.0V, C_{PIEZO} = 47nF, f_{DIN} = 3.2kHz, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OUT}	Output Voltage Range	(Note 4)	1.5	—	13.5	V
V_{OUT1}	Output Voltage	1x Mode	2.8	—	3	V
V_{OUT2}		2x Mode	5.2	—	6	V
V_{OUT3}		3x Mode (Note 5)	7.2	—	9	V
V_{OUT4}		3x Mode (V_{IN} = 2.7V)	6.8	7	8.0	V
I_{DD11}	Operating Current 1	1x Mode, C_{PIEZO} = No Load	—	43	—	µA
I_{DD12}		2x Mode, C_{PIEZO} = No Load	—	118	—	µA
I_{DD13}		3x Mode, C_{PIEZO} = No Load	—	220	—	µA
I_{DD21}	Operating Current 2	1x Mode, Single-ended application	—	0.48	—	mA
I_{DD22}		2x Mode, Single-ended application	—	1.9	—	mA
I_{DD23}		3x Mode, Single-ended application	—	4.3	—	mA
I_{DD31}	Operating Current 3	1x Mode, Differential application	—	1.7	—	mA
I_{DD32}		2x Mode, Differential application	—	6.4	—	mA
I_{DD33}		3x Mode, Differential application	—	14.2	—	mA
I_{SD}	Shutdown Current	DIN = 0V	—	0.008	1	µA
f_{IN}	Input Frequency	Rectangular pulse	—	3.2	—	kHz
f_{OSC}	Oscillating Frequency	—	70	100	130	kHz
t_{ON1}	VOUT Start Delay Time	1x Mode, From DIN signal High to 90% V_{OUT} steady state	—	470	—	µs
t_{ON2}		2x Mode, From DIN signal High to 90% V_{OUT} steady state	—	1.76	—	ms
t_{ON3}		3x Mode From DIN signal High to 90% V_{OUT} steady state	—	1.91	—	ms
t_{OFF}	Shutdown Delay Time	DIN = H- > L	—	42	—	ms
I_{SC}	Output Short-Circuit Current	—	—	49	—	mA
V_{IH}	Control Terminal Voltage H	EN1, EN2, DIN pins	0.8*V_{IN}	—	V_{IN}	V
V_{IL}	Control Terminal Voltage L	EN1, EN2, DIN pins	0	—	0.2*V_{IN}	V
I_{IH1}	Control Terminal Current 1	DIN = 3V	—	—	5	µA
I_{IH2}	Control Terminal Current 2	V_{EN1}, V_{EN2} = 3V, DIN = 3V	—	—	5	µA
I_{IH3}	Control Terminal Current 3	V_{EN1}, V_{EN2} = 3V, DIN = 0V	—	—	1	µA

Notes: 4. It is possible to drive VOUT, VO1 and VO2 to 3x V_{DD}. A supply voltage of 4.5V of more should not be used in 3x mode as this will exceed the maximum output voltage rating.

5. When designed under 3x mode, it should be carefully noted that the V_{OUT} absolute maximum value should not exceed 13.5V.

© Diodes Incorporated

chanhvinh.com

NEW PRODUCT

Application Information

Charge Pump Mode Setting

The Charge Pump Mode (CPM) pins EN1 and EN2 are used to set the charge pump into mode 1x V_{DD}, 2x V_{DD}, 3x V_{DD} or they can be used to put the PAM8904E in to a forced low current shutdown mode.

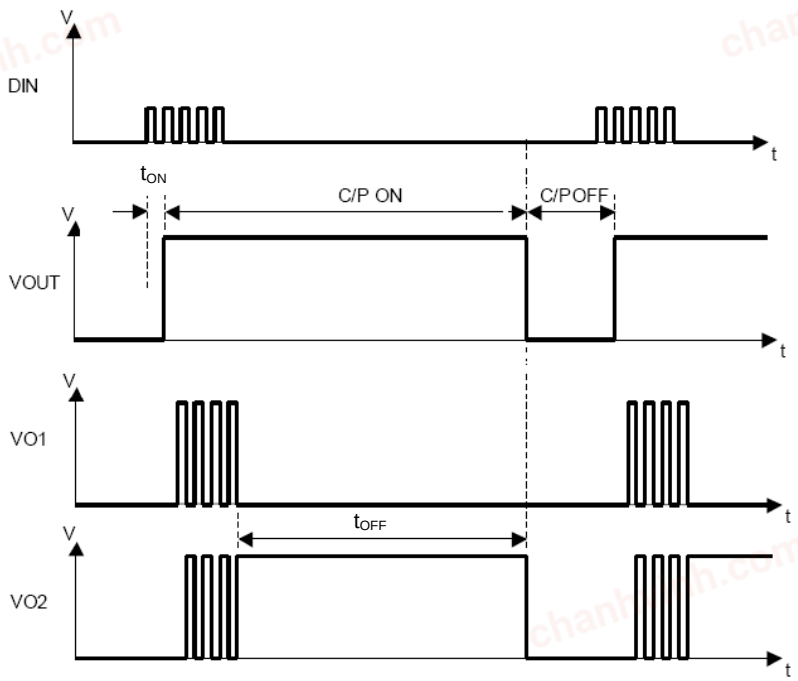
DIN	EN1	EN2	MODE
0	—	—	Shutdown Mode
1	0	0	Shutdown Mode
1	0	1	1x Mode
1	1	0	2x Mode
1	1	1	3x Mode

V_{DD} Range	Mode
1.5V to 4.5V	1x, 2x and 3x
1.5V to 5.5V	1x, 2x

Timing Chart and Device Operation

When one or both of the EN pins are pulled high, the device enters normal operation mode, refer to the above table for the mode selection. Once the PAM8904E senses a valid signal on the DIN pin, the charge pump will start and provide the desired voltage on the VOUT pin and the output drive VO1 and VO2 start to function after time t_{ON} which is typically between 470µs and 2s depending on the mode chosen. Once the input signal on DIN is removed, the PAM8904E senses this and waits typically 42ms to ensure the signal has been removed. If there is no further valid signal within the time period t_{OFF}, the PAM8904E enters into a low current standby mode.

Timing Chart



© Diodes Incorporated

chanhvinh.com

NEW PRODUCT

Application Information (continued)

Output Configuration

The PAM8904E is able to be configured either in a differential or a single ended configuration.

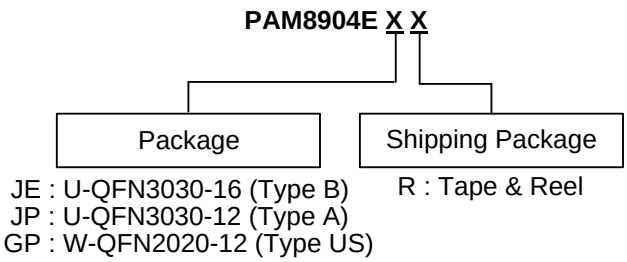
Short-Circuit Protection

The PAM8904E has short circuit protection circuitry on the outputs to prevent damage. Once a short circuit is detected on the outputs, the chip will limit the total current to protect the output device. This is not a latched fault; once the short is removed, the normal operation is restored.

Thermal Protection

If the junction temperature of the PAM8904E exceeds +150°C the device will enter overtemperature shutdown. The outputs and the charge pump will be switched off. Once the junction temperature cools down to its normal operating condition, the IC will re-start automatically.

Ordering Information

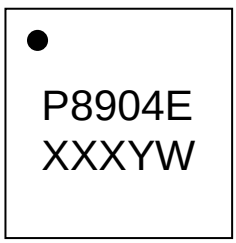


Part Number	Package Type	Shipping
PAM8904EJER	U-QFN3030-16 (Type B)	3,000/Tape & Reel
PAM8904EJPR	U-QFN3030-12 (Type A)	3,000/Tape & Reel
PAM8904EGPR	W-QFN2020-12 (Type US)	3,000/Tape & Reel

Marking Information

U-QFN3030-16 (Type B) / U-QFN3030-12 (Type A)

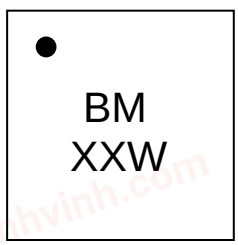
(Top View)



P8904E: Product Code
XXX: Internal Code
Y: Year 0~9
W: Week: A~Z: 1~26 Weeks
a~z: 27~52 Weeks
z Represents 52 and 53 Weeks

W-QFN2020-12 (Type US)

(Top View)



BM: PAM8904E
XX: Internal Code
W: Week: A~Z: 1~26 Weeks
a~z: 27~52 Weeks
z Represents 52 and 53 Weeks

© Diodes Incorporated

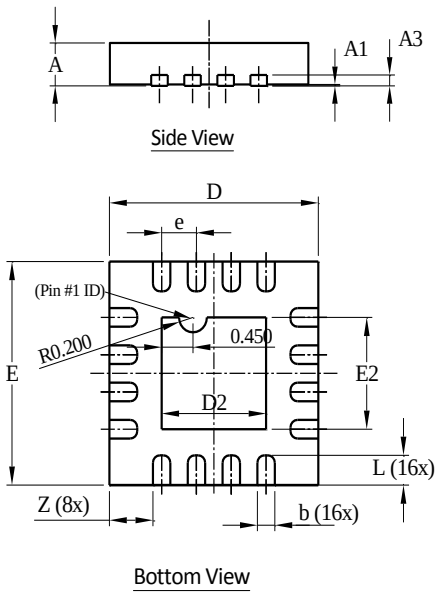
chanhvinh.com

NEW PRODUCT

Package Outline Dimensions

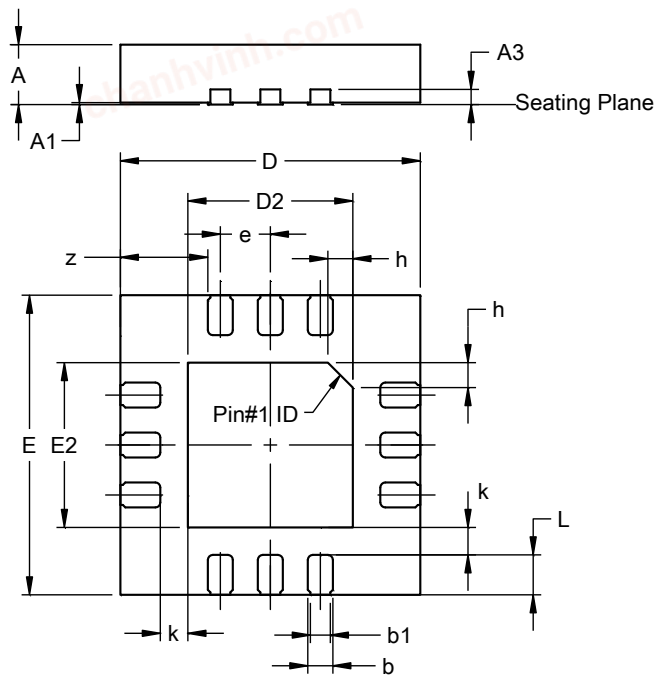
Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) Package Type: U-QFN3030-16 (Type B)



U-QFN3030-16 Type B			
Dim	**Min**	**Max**	**Typ**
A	0.55	0.65	0.60
A1	0	0.05	0.02
A3	-	-	0.15
b	0.18	0.28	0.23
D	2.95	3.05	3.00
D2	1.40	1.60	1.50
E	2.95	3.05	3.00
E2	1.40	1.60	1.50
e	-	-	0.50
L	0.35	0.45	0.40
Z	-	-	0.625
All Dimensions in mm			

(2) Package Type: U-QFN3030-12 (Type A)



U-QFN3030-12 (Type A)			
Dim	**Min**	**Max**	**Typ**
A	0.55	0.65	0.60
A1	0.00	0.05	0.02
A3	--	--	0.152
b	0.20	0.35	0.25
b1	0.15	0.25	0.20
D	2.95	3.05	3.00
D2	1.55	1.75	1.65
E	2.95	3.05	3.00
E2	1.55	1.75	1.65
e	--	--	0.50
h	--	--	0.25
L	0.35	0.45	0.40
k	--	--	0.275
z	--	--	0.875
All Dimensions in mm			

© Diodes Incorporated

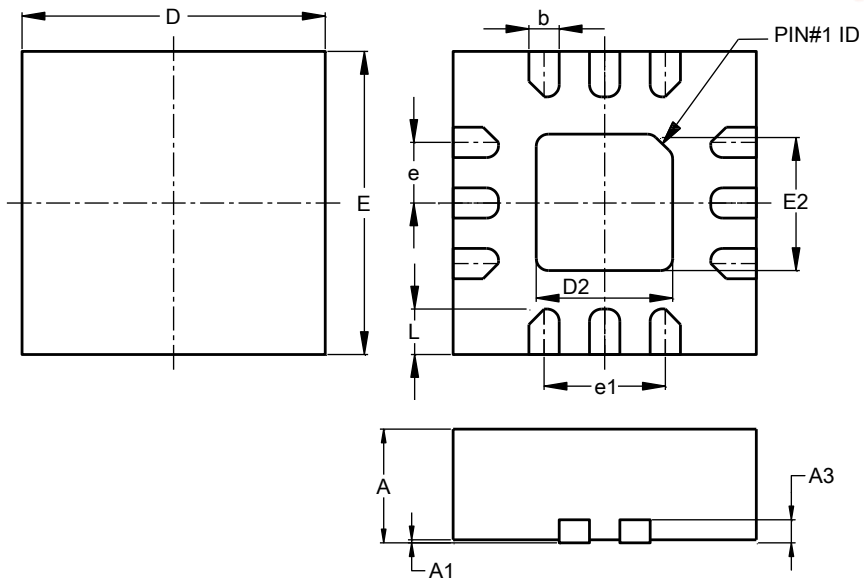
chanhvinh.com

NEW PRODUCT

Package Outline Dimensions (continued)

Please see http://www.diodes.com/package-outlines.html for the latest version.

(3) Package Type: W-QFN2020-12 (Type US)

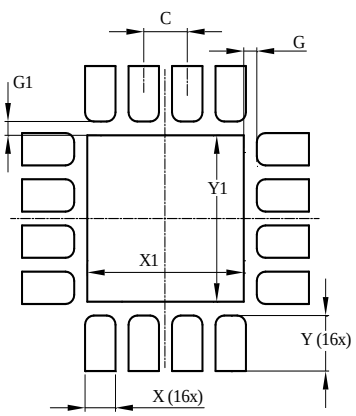


W-QFN2020-12 (Type US)			
Dim	**Min**	**Max**	**Typ**
A	0.700	0.800	0.750
A1	0.00	0.050	--
A3	0.203REF		
b	0.150	0.250	0.200
D	1.950	2.050	2.000
D2	0.850	0.950	0.900
E	1.950	2.050	2.000
E2	0.850	0.950	0.900
e	0.400 BSC		
e1	0.800 REF		
L	0.250	0.350	0.300
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) Package Type: U-QFN3030-16 (Type B)



Dimensions	Value (in mm)
C	0.500
G	0.150
G1	0.150
X	0.350
X1	1.800
Y	0.600
Y1	1.800

© Diodes Incorporated

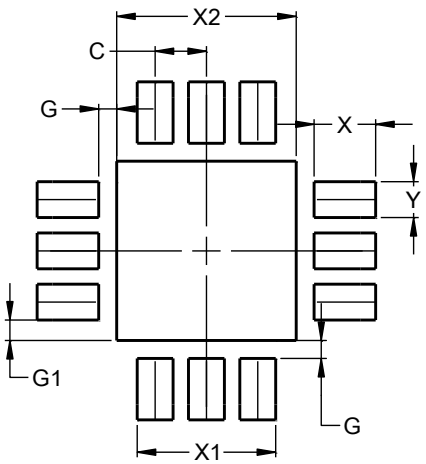
chanhvinh.com

NEW PRODUCT

Suggested Pad Layout (continued)

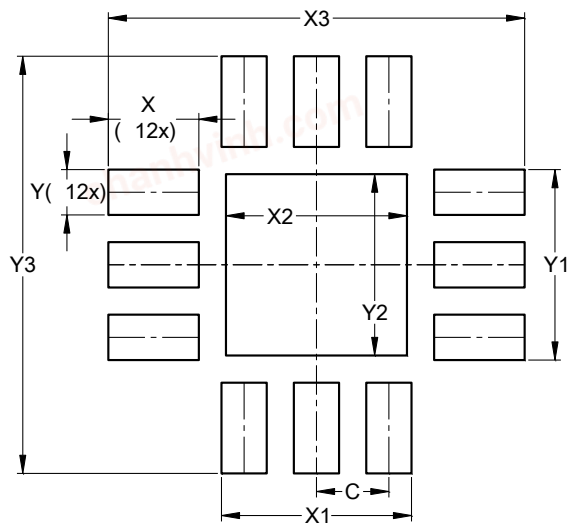
Please see http://www.diodes.com/package-outlines.html for the latest version.

(2) Package Type: U-QFN3030-12 (Type A)



Dimensions	Value (in mm)
C	0.500
G	0.175
G1	0.200
X	0.600
X1	1.350
X2	1.750
Y	0.350
Y1	1.750

(3) Package Type: W-QFN2020-12 (Type US)



Dimensions	Value (in mm)
C	0.400
X	0.500
X1	1.050
X2	1.000
X3	2.300
Y	0.250
Y1	1.050
Y2	1.000
Y3	2.300

© Diodes Incorporated

chanhvinh.com

NEW PRODUCT

IMPORTANT NOTICE

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel. Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes Incorporated.

LIFE SUPPORT

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or
2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

Copyright © 2019, Diodes Incorporated

www.diodes.com