AP1510

PWM CONTROL 3A STEP-DOWN CONVERTER

Features

- Input voltage: 3.6V to 23V
- Output voltage: 0.8V to V_{CC}
- Duty ratio: 0% to 100% PWM control
- Oscillation frequency: 300KHz typ.
- Soft-start, Current Limit, Enable function
- Thermal Shutdown function
- Built-in internal SW P-channel MOS
- SOP-8L **Pb-Free** Package
- Lead Free Finish/RoHS Compliant (Note 1)

General Description

AP1510 consists of step-down switching regulator with PWM control. These devices include a reference voltage source, oscillation circuit, error amplifier, and internal PMOS.

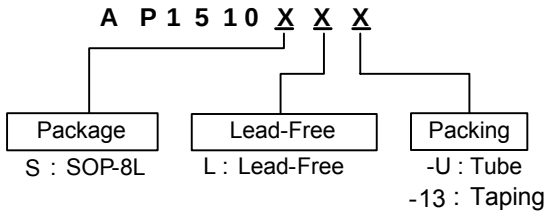
AP1510 provides low-ripple power, high efficiency, and excellent transient characteristics. The PWM control circuit is able to vary the duty ratio linearly from 0 up to 100%. This converter also contains an error amplifier circuit as well as a soft-start circuit that prevents overshoot at startup. An enable function, an over current protect function and a short circuit protect function are built inside, and when OCP or SCP happens, the operation frequency will be reduced from 300KHz to 30KHz. Also, an internal compensation block is built in to minimum external component count.

With the addition of an internal P-channel Power MOS, a coil, capacitors, and a diode connected externally, these ICs can function as step-down switching regulators. They serve as ideal power supply units for portable devices when coupled with the SOP–8L mini-package, providing such outstanding features as low current consumption. Since this converter can accommodate an input voltage up to 23V, it is also suitable for the operation via an AC adapter.

Applications

- Cellular Phones
- PC Motherboard
- LCD Monitor
- Graphic Card
- DVD-Video Player
- Telecom Equipment
- ADSL Modem
- Printer and other Peripheral Equipment
- Microprocessor core supply
- Networking power supply

Ordering Information



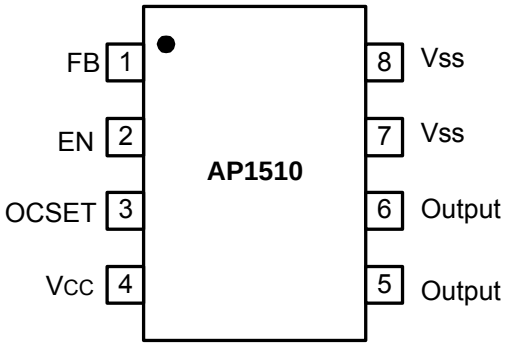
Note: 1. RoHS revision 13.2.2003. Glass and High Temperature Solder Exemptions Applied, see *EU Directive Annex Notes 5 and 7*.

Device (Note 2)	Package Code	Packaging	Tube		13" Tape and Reel	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix
AP1510S	S	SOP-8L	100	- U	2500/Tape & Reel	-13

Note: 2. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.

© Diodes Incorporated

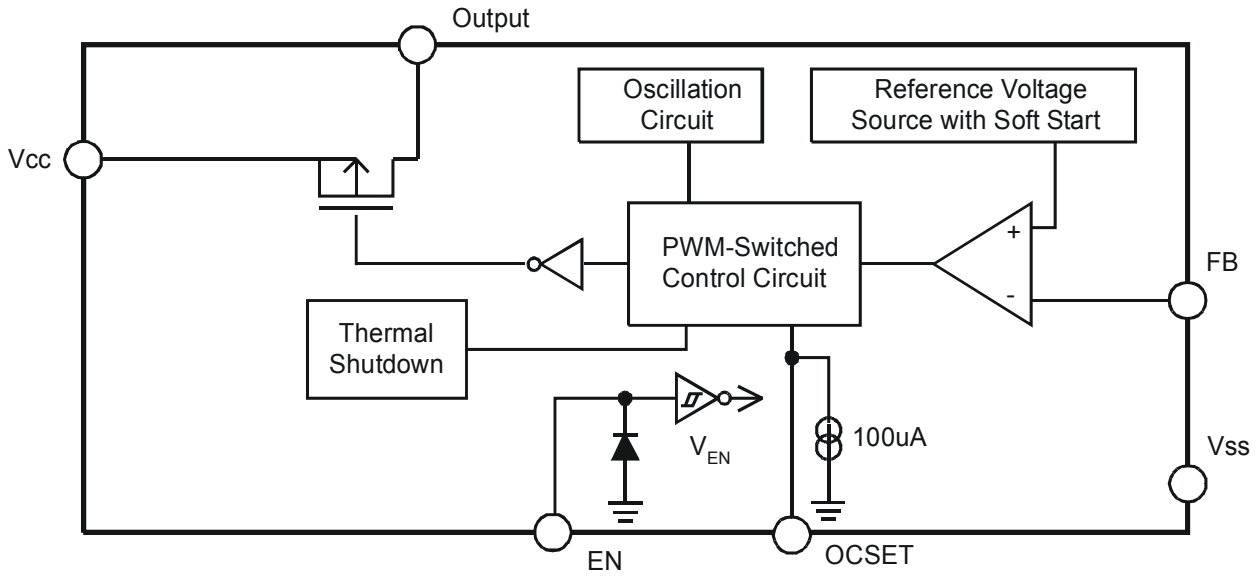
Pin Assignments



Pin Descriptions

Name	Pin	Description
FB	1	Feedback pin.
EN	2	Power-off pin H: Normal operation (Step-down operation) L: Step-down operation stopped (All circuits deactivated)
OCSET	3	Add an external resistor to set max output current.
V_{CC}	4	IC power supply pin
Output	5, 6	Switch Pin. Connect external inductor/diode here. Minimize trace area at this pin to reduce EMI.
V_{SS}	7, 8	GND Pin

Block Diagram



© Diodes Incorporated

Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
V_{CC}	V_{CC} Pin Voltage	V_{SS} - 0.3 to V_{SS} + 25	V
V_{FB}	Feedback Pin Voltage	V_{SS} - 0.3 to V_{CC}	V
V_{EN}	EN Pin Voltage	V_{SS} - 0.3 to V_{IN} + 0.3	V
V_{OUT}	Switch Pin Voltage	V_{SS} - 0.3 to V_{IN} + 0.3	V
P_D	Power Dissipation	Internally limited	mW
T_{OPR}	Operating Temperature Range	-20 to +125	°C
T_{STG}	Storage Temperature Range	-40 to +150	°C

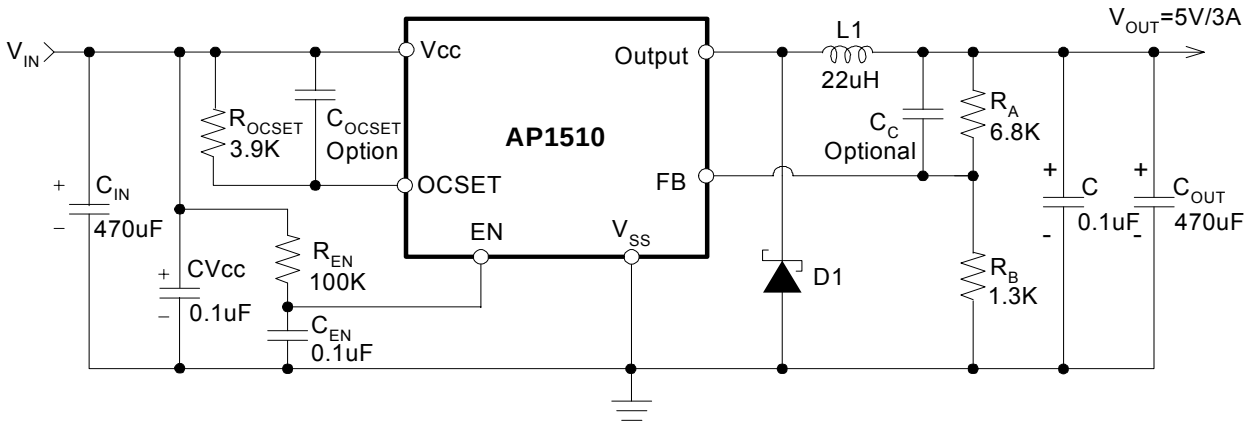
Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

Electrical Characteristics (V_{IN} = 12V, T_a = 25°C, unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage	--	3.6	-	23	V
V_{FB}	Feedback Voltage	I_{OUT} = 0.1A	0.784	0.8	0.816	V
I_{FB}	Feedback Bias Current	I_{OUT} = 0.1A	-	0.1	0.5	μA
I_{SW}	Switch Current	--	3.5	-	-	A
I_{SSS}	Current Consumption During Power Off	V_{EN} = 0V	-	10	-	μA
ΔV_{OUT} /V_{OUT}	Line Regulation	V_{IN} = 5V~23V, I_{OUT} = 0.2A	-	1	2	%
ΔV_{OUT} /V_{OUT}	Load Regulation	I_{OUT} = 0.1 to 3A	-	0.2	0.5	%
f_{OSC}	Oscillation Frequency	Measure waveform at SW pin	240	300	360	KHz
f_{OSC1}	Frequency of Current Limit or Short Circuit Protect	Measure waveform at SW pin	10	-	-	KHz
V_{SH}	EN Pin Input Voltage	Evaluate oscillation at SW pin	2.0	-	-	V
V_{SL}		Evaluate oscillation stop at SW pin	-	-	0.8	
I_{SH}	EN Pin Input Leakage Current	--	-	20	-	μA
I_{SL}		--	-	-10	-	μA
I_{OCSET}	OCSET Pin Bias Current	--	75	90	105	μA
T_{SS}	Soft-Start Time	--	0.3	2	5	ms
R_{DSON}	Internal MOSFET Rdson	V_{IN} = 5V, V_{FB} = 0V	-	110	150	mΩ
		V_{IN} =12V, V_{FB} = 0V	-	70	100	
EFFI	Efficiency	V_{IN} = 12V, V_{OUT} = 5V I_{OUT} = 3A	-	91	-	%
θ_{JA}	Thermal Resistance Junction-to-Ambient		-	65	-	°C/W

© Diodes Incorporated

Typical Application Circuit



Note: $V_{OUT} = V_{FB}$ x $(1+R_A/R_B)$
R_B=0.7K~5K ohm

Figure 1.

V_{IN}=12V, I_{MAX}=3A			
V_{OUT}	2.5V	3.3V	5V
L1 Value	15uH	18uH	22uH

Function Description

PWM Control
The AP1510 consists of DC/DC converters that employ a pulse-width modulation (PWM) system.

In converters of the AP1510, the pulse width varies in a range from 0 to 100%, according to the load current. The ripple voltage produced by the switching can easily be removed through a filter because the switching frequency remains constant. Therefore, these converters provide a low-ripple power over broad ranges of input voltage and load current.

Under Voltage Lockout
The under voltage lockout circuit of the AP1510 assures that the high-side MOSFET driver outputs remain in the off state whenever the supply voltage drops below 3.3V. Normal operation resumes once V_{CC} rises above 3.5V.

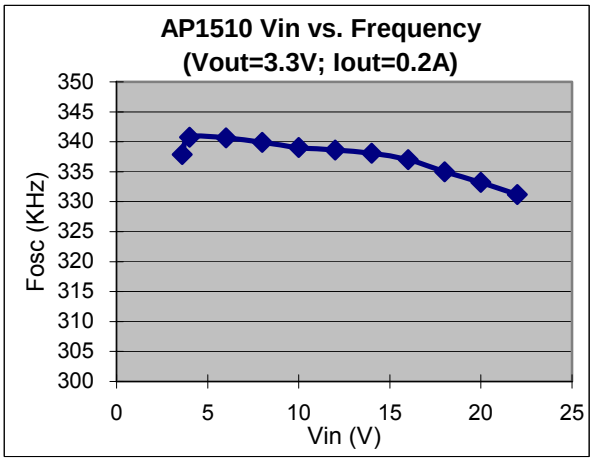
$R_{DS(ON)}$ Current Limiting
The current limit threshold is setting by the external resistor connecting from V_{CC} supply to OCSET. The internal 100uA sink current crossing the resistor sets the voltage at pin of OCSET. When the PWM voltage is less than the voltage at OCSET, an over-current condition is triggered.

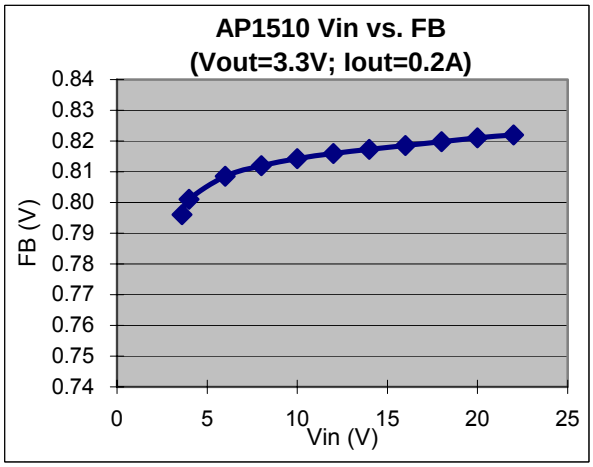
$$I_{LOAD} \times R_{DS(ON)} = I_{OCSET} \times R_{OCSET}$$

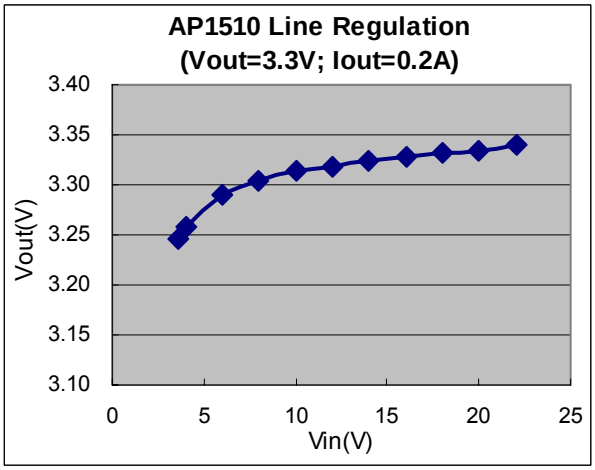
See above formula for setting the current limit value.

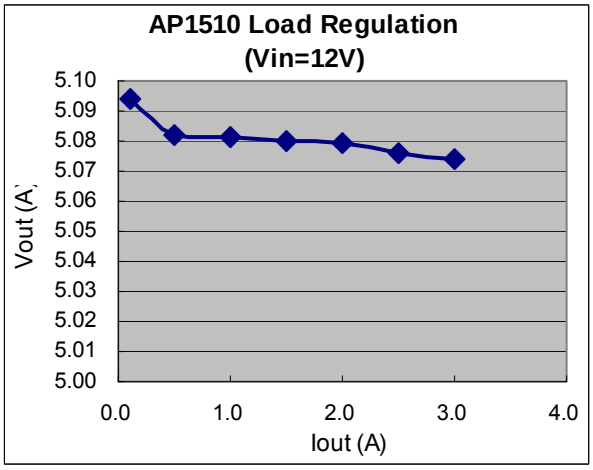
© Diodes Incorporated

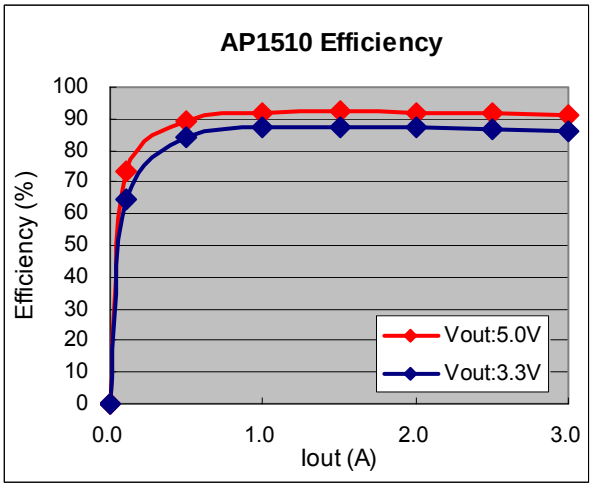
Typical Performance Characteristics







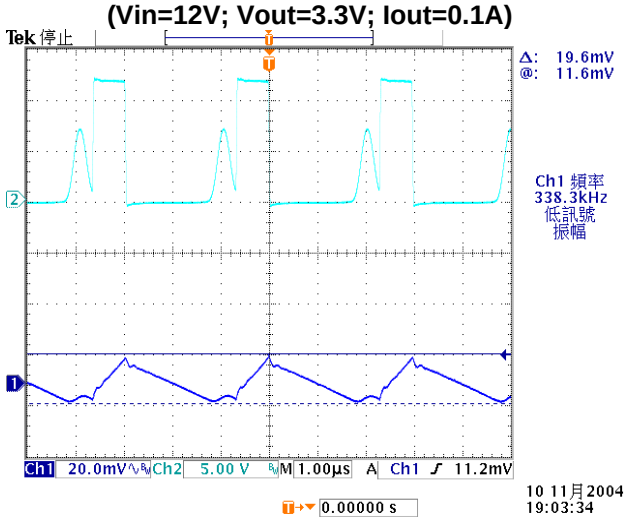




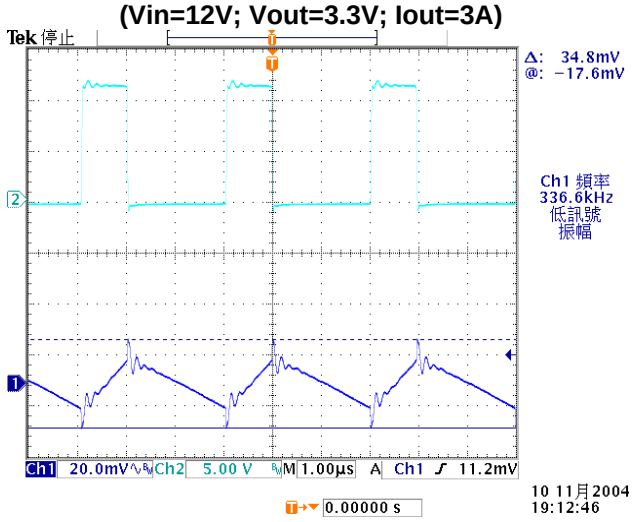
© Diodes Incorporated

Typical Performance Characteristics (Continued)

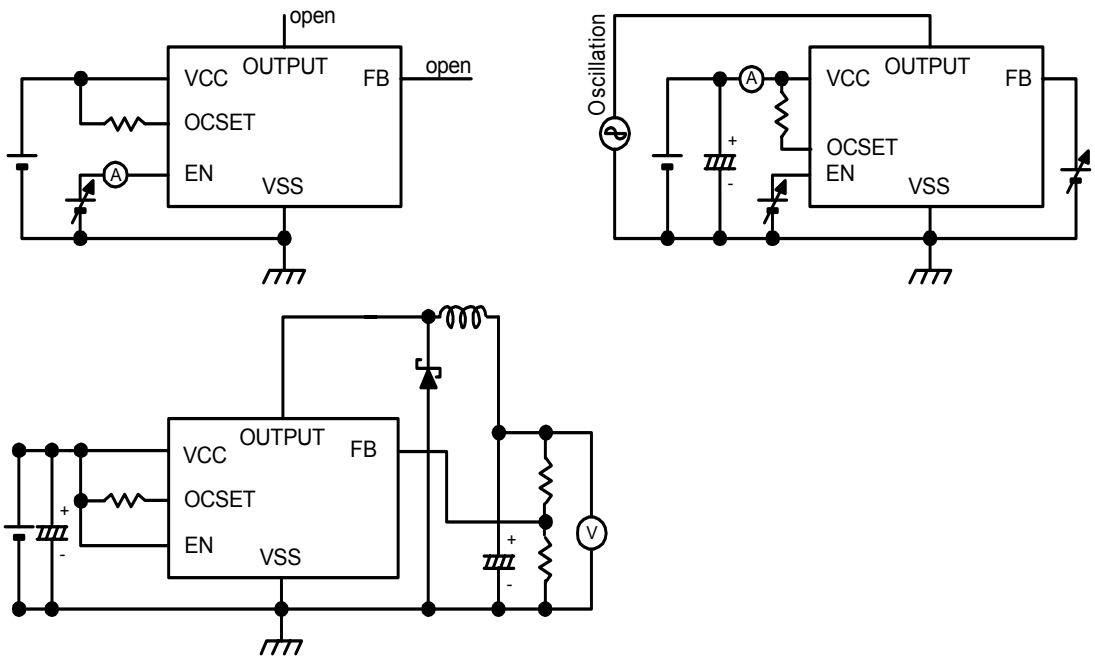
AP1510 Vout Ripple
(Vin=12V; Vout=3.3V; Iout=0.1A)



AP1510 Vout Ripple
(Vin=12V; Vout=3.3V; Iout=3A)



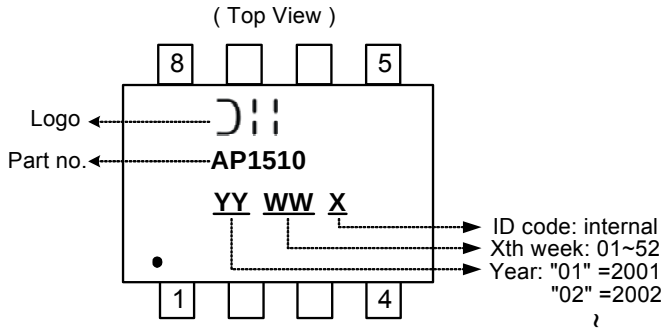
Test Circuit



© Diodes Incorporated

Marking Information

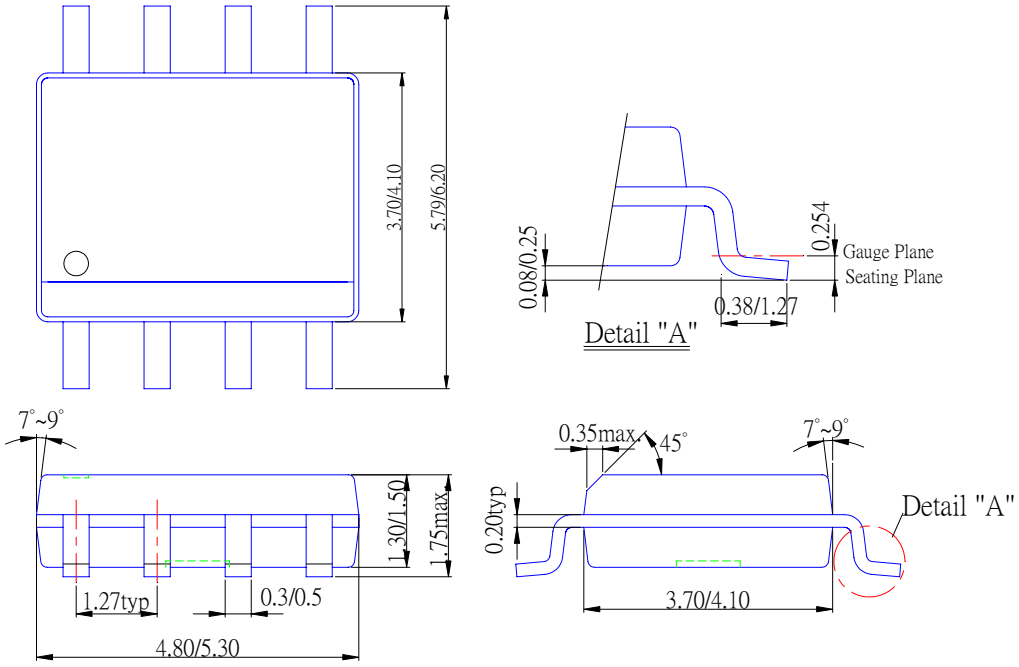
(1) SOP-8L



Device	Package	Identification Code
AP1510S	SOP-8L	AP1510

Package Information (in mm)

Package Type: SOP-8L



© Diodes Incorporated

IMPORTANT NOTICE

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to any product herein. Diodes Incorporated does not assume any liability arising out of the application or use of any product described herein; neither does it convey any license under its patent rights, nor the rights of others. The user of products 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 our website, harmless against all damages.

LIFE SUPPORT

Diodes Incorporated products are not authorized for use as critical components in life support devices or systems without the expressed written approval of the President of Diodes Incorporated.

© Diodes Incorporated