1.0MHz STEP-UP DC-DC CONVERTER

NEW PRODUCT

Description

The PAM2401 is a high efficiency, current mode, fixed frequency, step-up DC/DC converter with true output disconnect and inrush current limiting. The device includes one 0.10Ω N-channel MOSFET switch and one 0.15Ω P-channel synchronous rectifier. This product has the ability to simply program the output voltage from 2.5V to 5.0V.The switching frequency is 1.0MHz, programmable current limit set by an external resistor from 1.0A to 3.0A with internal soft-start. When loading became light, the converter will automatically enter into PSM to improve the efficiency.

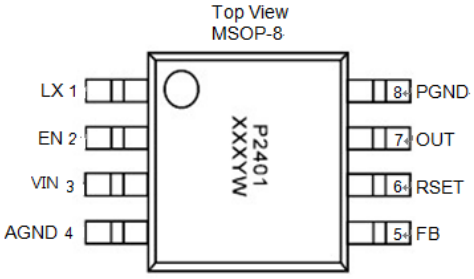
Quiescent current is only 150μA during Pulse Skip Mode operation, maximizing battery life in portable applications. Other features include : <1μA shutdown, anti-ringing control, Hiccup mode at short protection, over voltage protection and over temperature protection.

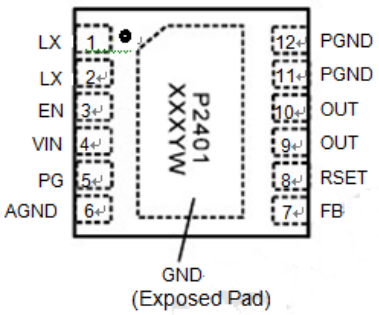
The PAM2401 is available in MSOP-8 and U-DFN3030-12 packages

Features

- Up to 95% Efficiency
- True Output Disconnect
- Inrush Current Limiting When Power On
- Output Current up to 1000mA at V_{IN} = 3V and V_{OUT} = 5.0V
- Fixed Frequency Operation Up to 1MHz
- 0.9V to 4.75V Input Range
- 2.5V to 5.0V Adjustable Output Voltage
- Guaranteed 1.0V Start-Up
- Programmable Current Limit
- Internal Soft-Start
- Internal Compensation
- Pulse Sipping Mode at Light Load Operation
- Hiccup Mode Short Protection
- Over Voltage Protection
- Over Temperature Protection
- <1μA Shutdown Current
- Power Good Indicator
- MSOP-8 and U-DFN3030-12 packages
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Pin Assignments





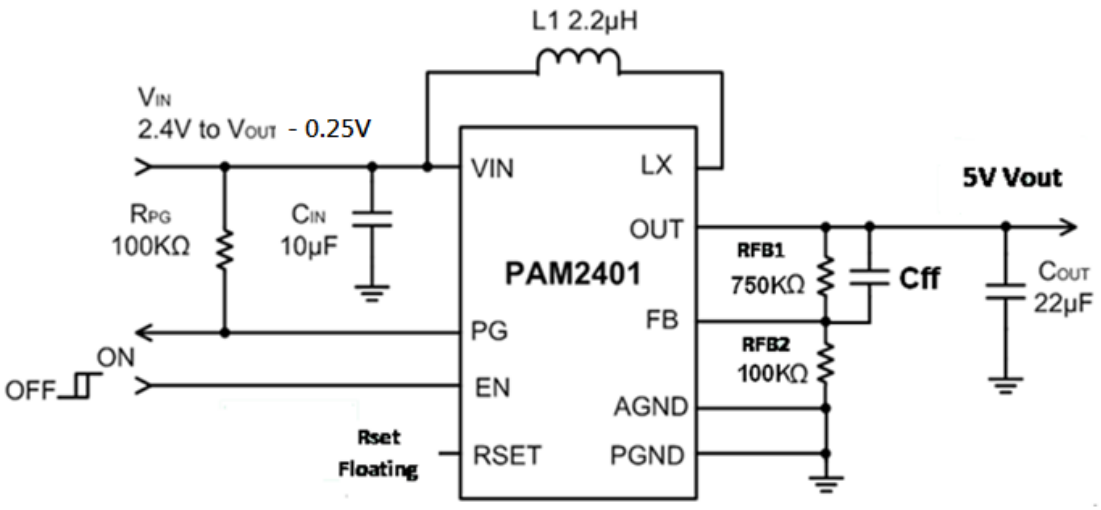
Applications

- Handheld Computers
- Cordless Phones
- GPS Receivers
- Battery Backup Supplies

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html 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.

NEW PRODUCT

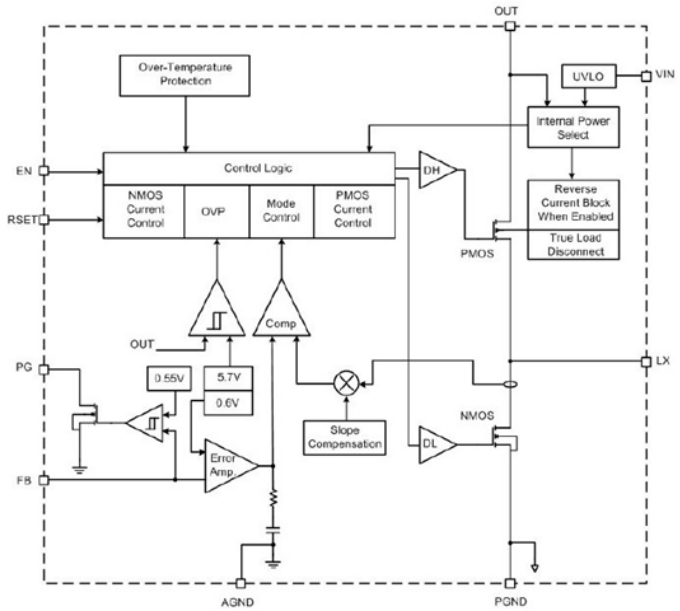
Typical Applications Circuit



Pin Descriptions

MSOP-8	U-DFN3030-12	Name	Function
1	1,2	LX	Switch Pin
2	3	EN	Enables Control Input.
3	4	VIN	Input Voltage Pin
--	5	PG	Power Good Indicator Pin, Open Drain Output
4	6	AGND	Analog Ground
5	7	FB	Feedback Pin Internally Set to 0.6V.
6	8	RSET	Current Limit Setting
7	9,10	OUT	Output Pin
8	11,12	PGND	Power Ground
	Exposed Pad	EP	Thermal Pad of the Package. Can Be Connected to PGND

Functional Block Diagram



NEW PRODUCT

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

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability. All voltages are with respect to ground.

Parameter	Rating	Unit
Input Voltage	-0.3 to +6.0	V
SW Voltage	-0.3 to +6.0	V
SHDN, FB Voltage	-0.3 to +6.0	V
V_{OUT}	-0.3 to +6.0	V
Operating Temperature Range	-40 to +85	°C
Storage Temperature Range	-65 to +125	°C
Lead Temperature (Soldering, 10 sec)	300	°C

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

Parameter	Rating	Unit
Ambient Temperature Range	-40 to +85	°C
Junction Temperature Range	-40 to +125	

Thermal Information

Parameter	Package	Symbol	Max	Unit
Thermal Resistance (Junction to Case)	MSOP-8	Θ_{JC}	75	°C/W
	U-DFN3030-12		8.5	
Thermal Resistance (Junction to Ambient)	MSOP-8	Θ_{JC}	180	
	U-DFN3030-12		60	
Internal Power Dissipation	MSOP-8	P_D	0.55	W
	U-DFN3030-12		1.66	

NEW PRODUCT

Electrical Characteristics (T_A = +25°C, V_{IN} = 3.3V, V_{OUT} = 5V, L = 2.2μH, unless otherwise noted.)

PARAMETER	SYMBOL	Test Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{IN}	No load, V_O = 5V	0.9		4.75	V
		I_O =1A , V_O = 5V	2.7		4.75	
Minimum Startup Voltage	$V_{STARTUP}$	I_O = 0.1A, V_O = 3.3V		1		V
Shutdown Supply Current	I_{SD}			0.1	1	μA
Quiescent Current	Iq	No load, switching (measured with external feedback); V_O = 5V		150		μA
Oscillator Frequency	f_{OSC}		0.8	1	1.2	MHz
Maximum Duty Cycle	D_{MAX}			87.5		%
Output-Voltage Adjust Range	V_O		2.5		5	V
FB Regulation Voltage	V_{FB}	No Load	0.588	0.6	0.612	V
Load Regulation	LDR	I_{OUT} = 1mA to 1000mA		2.5		%
Line Regulation	LNR	V_O = 2.5V to 4.75V, I_O = 0.5A		0.3		%/V
Drain-Source On-State Resistance	$R_{DS(ON)}$	P MOSFET		150	250	mΩ
		N MOSFET		100	170	mΩ
N-Channel Current Limit (Note)	I_{LIMIT}	R_{SET} Floating or R_{SET} > 200KΩ		3		A
		R_{SET} = 100KΩ		1.5		A
		R_{SET} = 66KΩ		1		A
Pre-charge Current	I-Charge	V_{OUT} +0.5V < V_{IN}		500		mA
Pre-charge Time	T-Charge	V_{OUT} +0.5V < V_{IN}		400		μs
SW Leakage Current	ILSW		0.1		2	μA
Power Good Threshold	VPG			92		%
EN Threshold High	V_H	V_{IN} = 0.9V	0.8			V
	V_H	V_{IN} = 3.3V	1.5			
EN Threshold Low	V_L	V_{IN} > 1.2V			0.2	V
Over Temperature Threshold	TOTSD			160		°C
Over Temperature Hysteresis	THYS			50		°C

Note: N-Channel current limit is guaranteed by design.

NEW PRODUCT

Application Information

Output Voltage Set Equation

The output voltage of the PAM2401, V_{OUT}, is set by an external resistor divider from VOUT to ground as shown in figure 1. The divider tap is connected to the FB pin and the typical value of the voltage at the FB pin is 0.6V. The following equation is used to set the V_{OUT}: V_{OUT} = 0.6 (1+R1/R2) For example, if output voltage of 5V is needed, with a chosen R2 value of 100kΩ ,the value of R1 can be calculated according to the equation, so a 750kΩ resistor should be chosen for R1.

Inductor Selection

To select an inductor for use in PAM2401 applications, it is worth noting that the inductor current saturation rating should be larger than the possible peak inductor current to ensure proper operation, and should have low DCR (DC resistance). Using an inductor the saturation current of which is lower than required can cause a dramatic drop in the inductance and can decay the maximum output current levels severely. For most applications, the value of the inductor should be in the range ofs 1μH to 4.7μH. Its value is chosen based on the desired ripple current.

Larger value inductors result in lower ripple currents, and smaller value inductors result in higher ripple currents. A 1.5μH or 2.2μH inductor will be the best choice for most PAM2401 applications. The following equation can also help give a good approximate value for the inductor.

$$L = \frac{V_{IN} x D}{\Delta I_L x f}$$

D Duty Cycle=1-V_{IN}/V_{OUT}, F Switching Frequency = 1.0MHz, ΔIL Ripple Current in the Inductor, i.e., 20% to 40% of the maximum inductor current (Ip).

Output and Input Capacitor Selection
Input Capacitor

At least a 10μF input capacitor is recommended to reduce the input ripple and switching noise for normal operating conditions, while a 10-22μF capacitor may be required for higher power and dynamic loads. Larger values and lower ESR (Equivalent Series Resistance) may be needed if the application require very low input ripple. It follows that ceramic capacitors are a good choice for applications. Note that the input capacitor should be located as close as possible to the IC.

Output Capacitor

A minimum output capacitor value of 22μF is recommended and may be increase to a larger value. The ESR of the output capacitor is important because it determines the peak to peak output voltage ripple by the following equation:

$$\Delta V_{OUT} >> 2\Delta I_L x RESR$$

Multilayer ceramic capacitors are an excellent choice as they have extremely low ESR and are available in small footprints.

NEW PRODUCT

Typical Performance Characteristics (T_A = +25°C, V_{IN} = 3.3V, V_{OUT} = 5V, unless otherwise noted.)

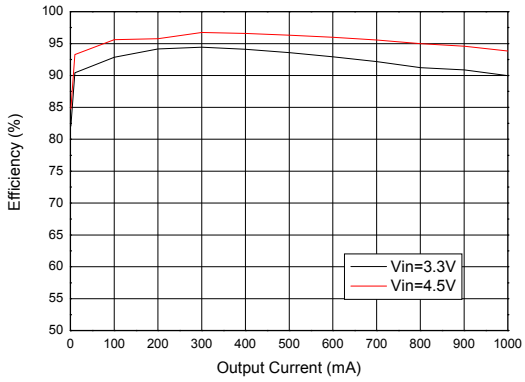


Figure 4 Efficiency vs. Output Current (MSOP-8)

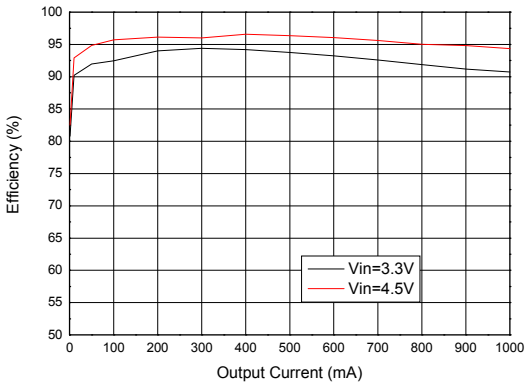


Figure 5 Efficiency vs. Output Current (U-DFN)

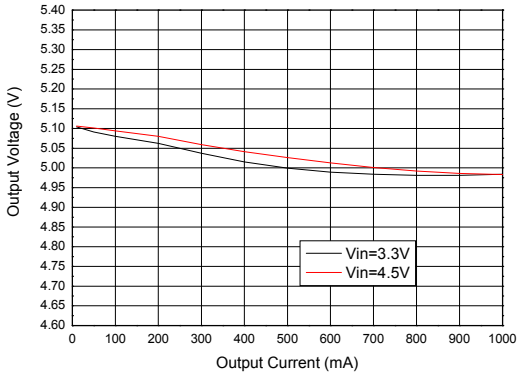


Figure 6 Output Voltage vs. Output Current

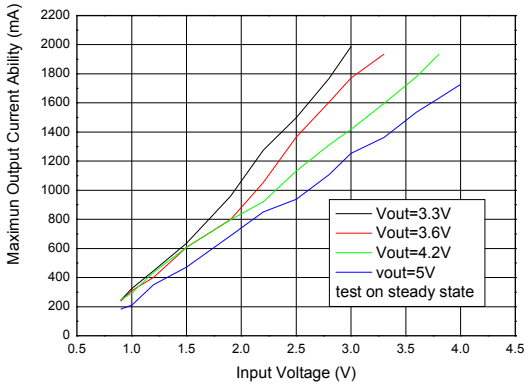


Figure 7 Maximum Output Current vs. Input Voltage

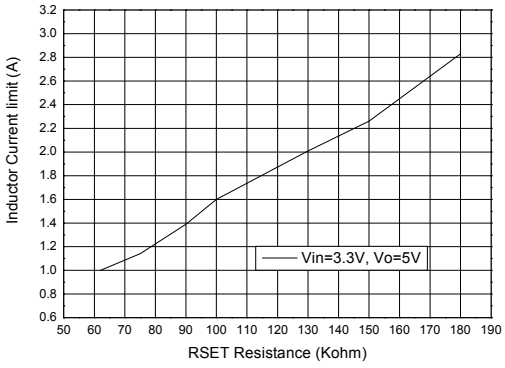


Figure 8 Inductor Current Limit vs. RSET Resistance

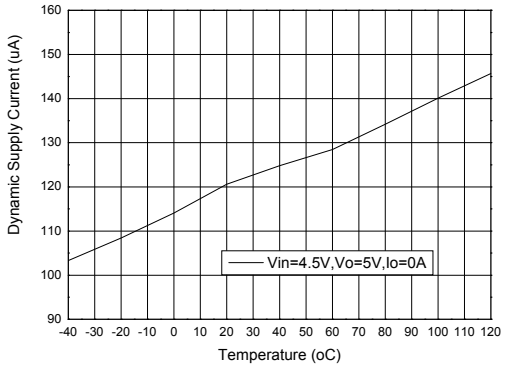


Figure 9 Dynamic Supply Current vs. Temperature

NEW PRODUCT

Typical Performance Characteristics (cont.) (T_A = +25°C, V_{IN} = 3.3V, V_{OUT} = 5V, unless otherwise noted.)

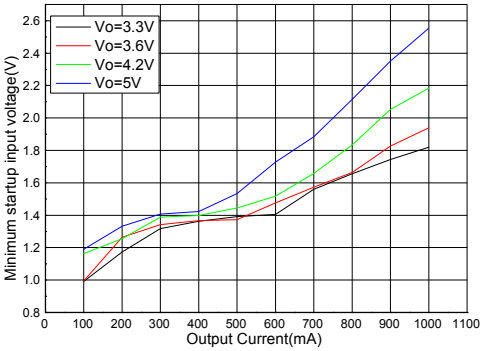


Figure 10 Minimum Startup Input Voltage vs. Output Current

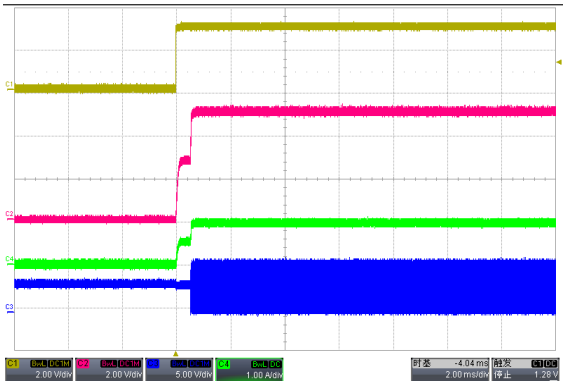


Figure 11 Enable Turn On (I_O = 1A)
(CH1: Enable; CH2: V_{OUT}; CH3:SW; CH4: I_O)

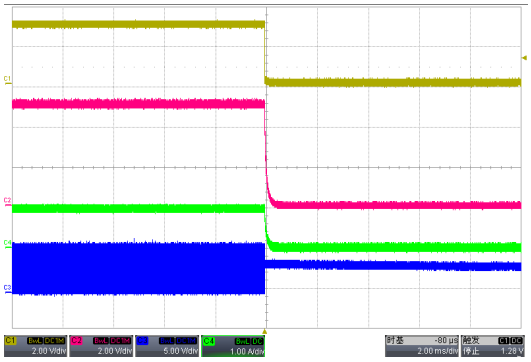


Figure 12 Enable Turn Off (I_O = 1A)
(CH1: Enable; CH2:V_{OUT}; CH3:SW; CH4:Io)

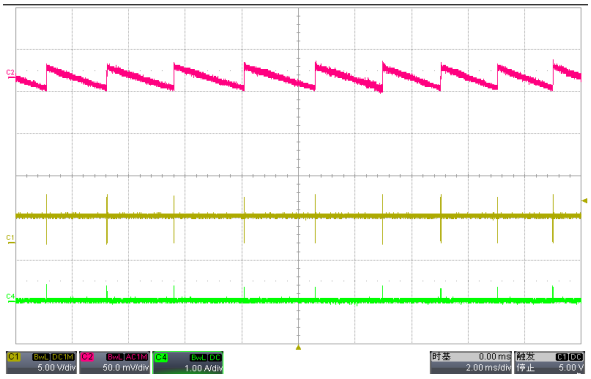


Figure 13 Output Ripple (I_O = 0A)
(CH1:SW; CH2: V_{OUT-AC}; CH4:IL)

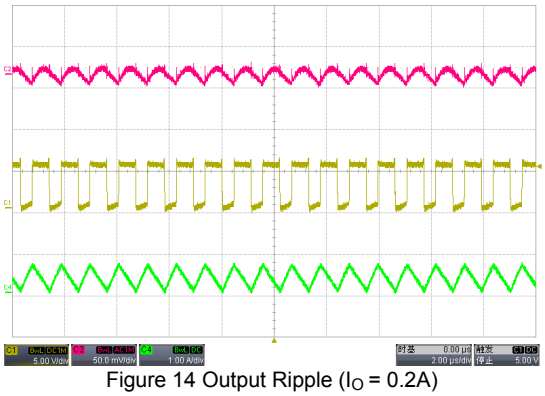


Figure 14 Output Ripple (I_O = 0.2A)
(CH1: SW; CH2:V_{OUT-AC}; CH4:IL)

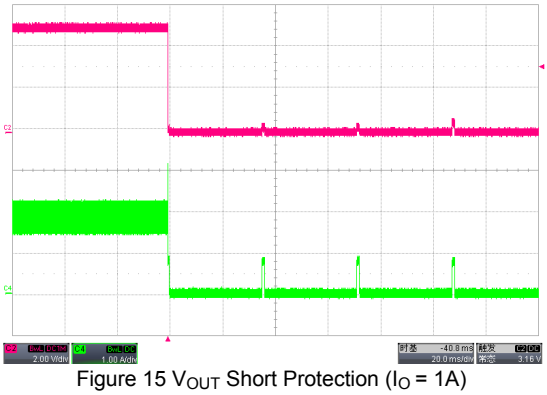


Figure 15 V_{OUT} Short Protection (I_O = 1A)
(CH2:V_{OUT}; CH3:IL)

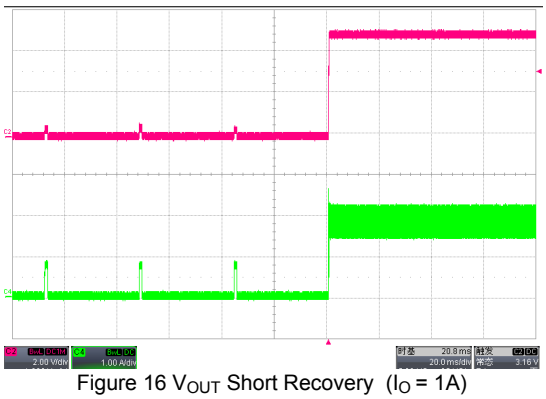


Figure 16 V_{OUT} Short Recovery (I_O = 1A)
(CH2: V_{OUT}; CH3: IL)

NEW PRODUCT

Ordering Information

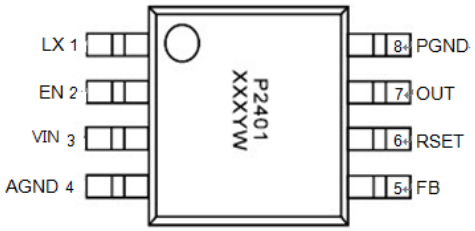
PAM2401 X X XXX

Package Type	Number of Pins	Output Voltage
S: MSOP-8 Y: U-DFN3030-12	C: 8 P: 12	ADJ: ADJ

Part Number	Marking	Package Type	Standard Package
PAM2401SCADJ	P2401 XXXYW	MSOP-8	2,500 units/ Tape & Reel
PAM2401YPADJ	P2401 XXXYW	U-DFN3030-12	3,000 units/ Tape & Reel

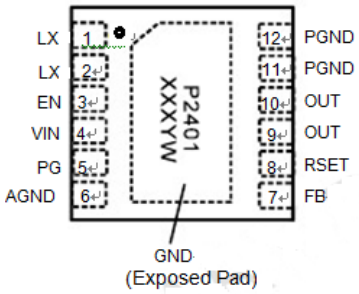
Marking Information

Top View
MSOP-8



X: Internal Code
Y: Year
W: Week

Top View
U-DFN3030-12

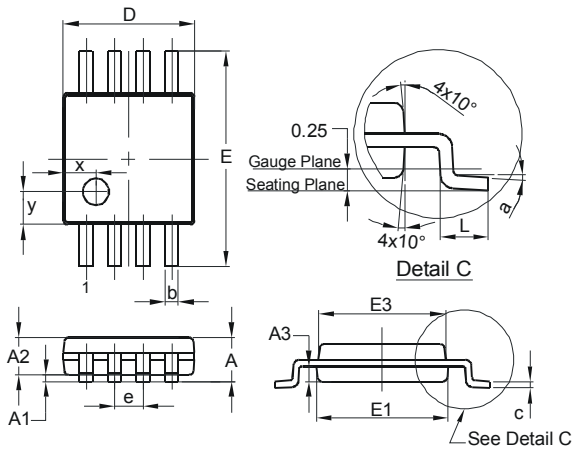


NEW PRODUCT

Package Outline Dimensions (All dimensions in mm.)

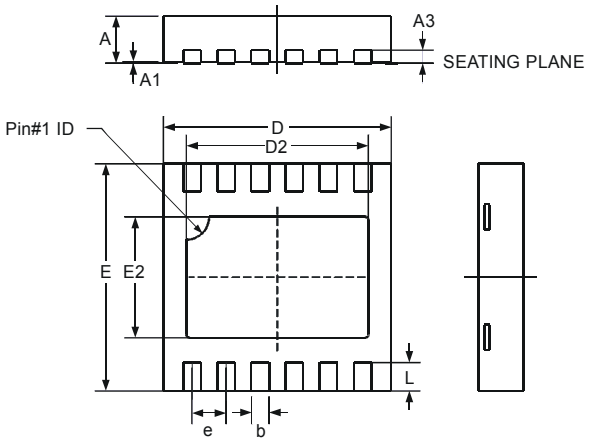
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.

(1) MSOP-8



MSOP-8			
Dim	Min	Max	Typ
A	-	1.10	-
A1	0.05	0.15	0.10
A2	0.75	0.95	0.86
A3	0.29	0.49	0.39
b	0.22	0.38	0.30
c	0.08	0.23	0.15
D	2.90	3.10	3.00
E	4.70	5.10	4.90
E1	2.90	3.10	3.00
E3	2.85	3.05	2.95
e	-	-	0.65
L	0.40	0.80	0.60
a	0°	8°	4°
x	-	-	0.750
y	-	-	0.750
All Dimensions in mm			

(2) U-DFN3030-12

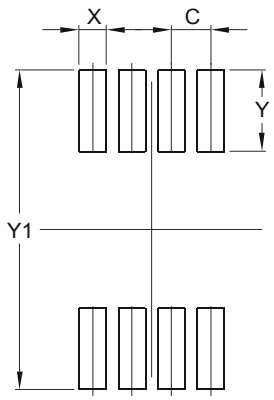


U-DFN3030-12			
Dim	Min	Max	Typ
A	0.57	0.63	0.60
A1	0	0.05	0.02
A3	—	—	0.15
b	0.18	0.28	0.23
D	2.90	3.10	3.00
D2	2.30	2.50	2.40
e	—	—	0.45
E	2.90	3.10	3.00
E2	1.50	1.70	1.60
L	0.25	0.55	0.40
All Dimensions in mm			

Suggested Pad Layout

Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.

(1) MSOP-8



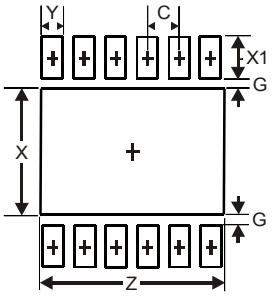
Dimensions	Value (in mm)
C	0.650
X	0.450
Y	1.350
Y1	5.300

NEW PRODUCT

Suggested Pad Layout (cont.)

Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.

(2) U-DFN3030-12



Dimensions	Value (in mm)
Z	2.60
G	0.15
X	1.80
X1	0.60
Y	0.28
C	0.45

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Authorized Distributor

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PAM2401SCADJ PAM2401YPADJ