Preliminary Datasheet

1.5MHz Synchronous Step-down DC-DC Converter AP3410

General Description

The AP3410 is a high efficiency step-down DC-DC voltage converter. The chip operation is optimized by peak-current mode architecture with built-in synchronous power MOSFET switchers. The oscillator and timing capacitors are all built-in providing an internal switching frequency of 1.5MHz that allows the use of small surface mount inductors and capacitors for portable product implementations.

Integrated Soft Start (SS), Under Voltage Lock Out (UVLO), Thermal Shutdown Detection (TSD) and Short Circuit Protection are designed to provide reliable product applications.

The device is available in adjustable output voltage version ranging from 0.6V to 0.9×V_{IN} when input voltage range is from 2.5V to 5.5V, and is able to deliver up to 1.2A.

The AP3410 is available in SOT-23-5 and DFN-2×2-6 packages.

Features

- High Efficiency Buck Power Converter
- Wide Input Voltage Range: 2.5V to 5.5V
- Adjustable Output Voltage: 0.6V to 0.9×V_{IN}
- Low $R_{DS(ON)}$ Internal Switches:200mΩ (V_{IN}=5V)
- Built-in Power Switches for Synchronous Rectification with High Efficiency
- Output Current: 1.2A
- Feedback Voltage: 600mV
- 1.5MHz Constant Frequency Operation
- Thermal Shutdown Protection
- Low Dropout Operation at 100% Duty Cycle
- No Schottky Diode Required
- Input Over Voltage Protection
- Output Over Voltage Protection
- Over Current Protection
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative.**
  https://www.diodes.com/quality/product-definitions/

Applications

- Post DC-DC Voltage Regulation
- PDA and Notebook Computer

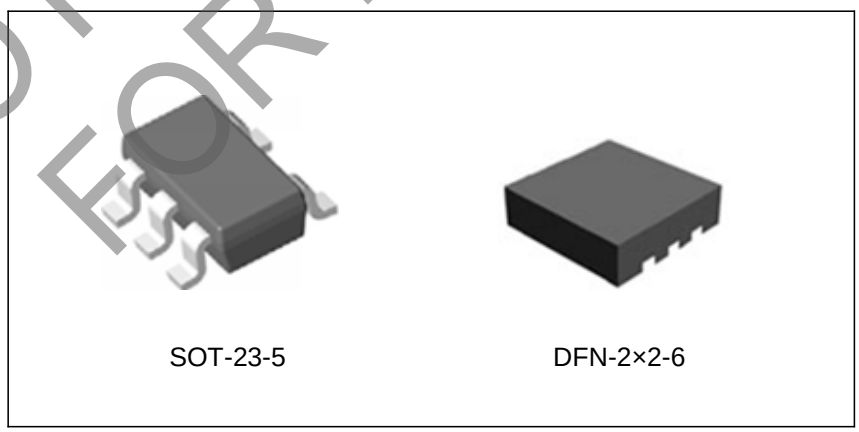
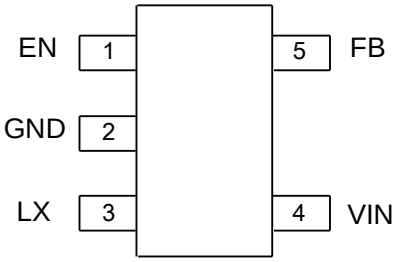


Figure 1. Package Types of AP3410

1.5MHz Synchronous Step-down DC-DC Converter AP3410

Pin Configuration

K Package
(SOT-23-5)



DN Package
(DFN-2×2-6)

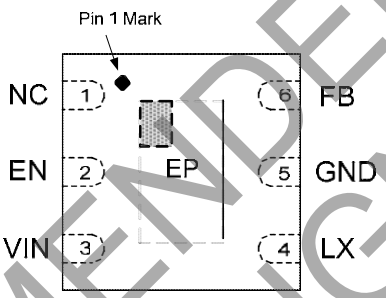


Figure 2. Pin Configuration of AP3410 (Top View)

Pin Description

Pin Number		Pin Name	Function
SOT-23-5	DFN-2×2-6		
1	2	EN	Chip enable pin. Active high
2	5	GND	Ground pin
3	4	LX	Switch output pin
4	3	VIN	Power supply
5	6	FB	Feedback voltage of output
	1	NC	No internal connection

Functional Block Diagram

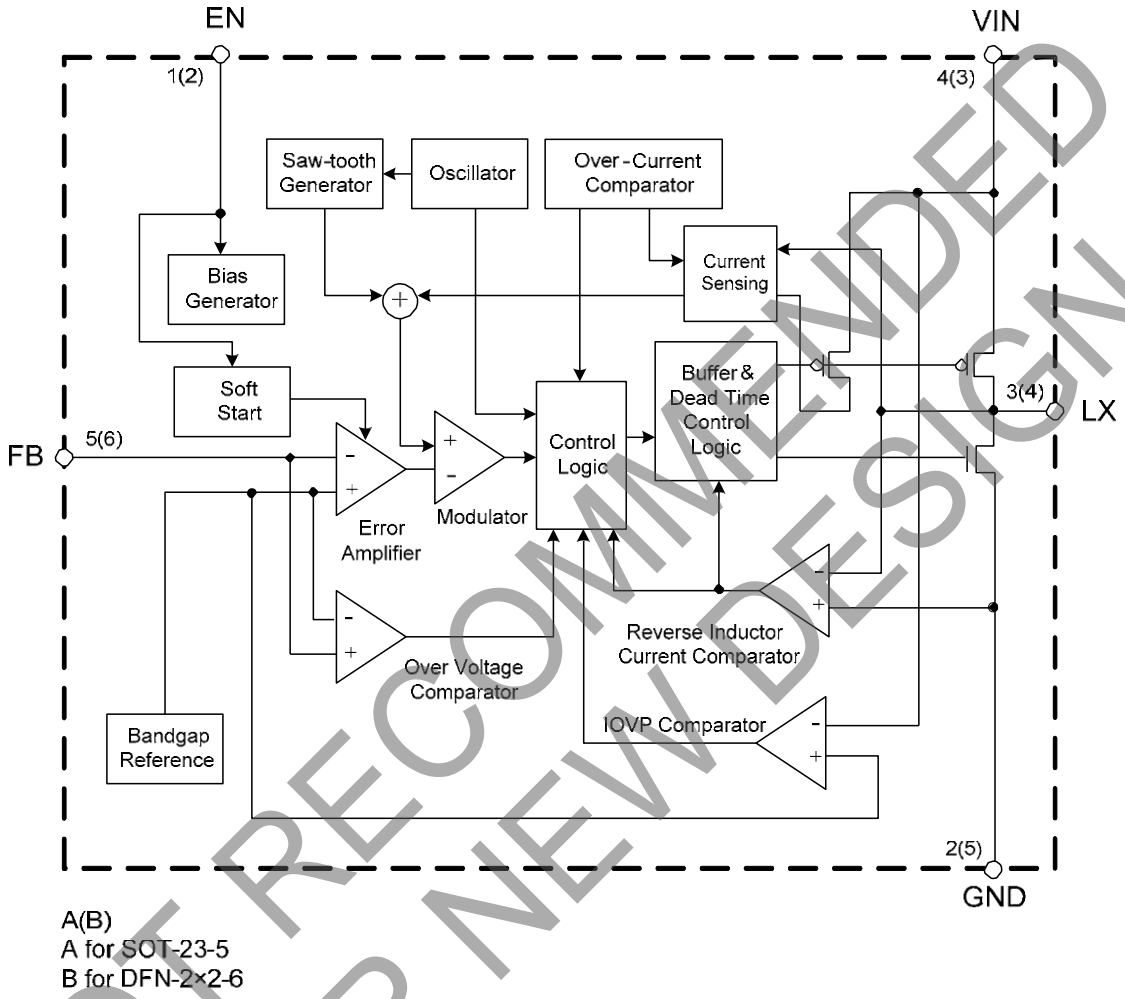
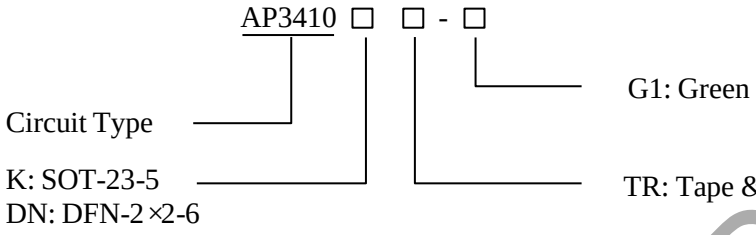


Figure 3. Functional Block Diagram of AP3410

1.5MHz Synchronous Step-down DC-DC Converter AP3410

Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing Type
SOT-23-5	-40 to 85℃	AP3410KTR-G1	GHW	Tape & Reel
DFN-2×2-6	-40 to 85℃	AP3410DNTR-G1	CJ	Tape & Reel

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value		Unit
Input Voltage for the MOSFET Switch	V_{IN}	0 to 6.0		V
Enable Input Voltage	V_{EN}	-0.3 to V_{IN}+0.3		V
LX Pin Switch Current	I_{LX}	1.8		A
Power Dissipation (on PCB, T_A=25℃)	P_D	SOT-23-5	0.4	W
		DFN-2×2-6	1.89	
Thermal Resistance (Junction to Ambient, Simulation)	θ_{JA}	SOT-23-5	250	℃/W
		DFN-2×2-6	53	
Thermal Resistance (Junction to Case, Simulation)	θ_{JC}	SOT-23-5	130	℃/W
Operating Junction Temperature	T_J	155		℃
Storage Temperature	T_{STG}	-55 to 150		℃
Operating Temperature	T_{OP}	-40 to 85		℃
ESD (Machine Model)	V_{MM}	200		V
ESD (Human Body Model)	V_{HBM}	2000		V

Note 1: Stresses greater than 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 under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply Input Voltage	V_{IN}	2.5	5.5	V
Operating Ambient Temperature	T_A	-40	85	℃
Operating Junction Temperature	T_J	-40	125	℃

Electrical Characteristics

V_{IN}=V_{EN}=5V, V_{OUT}=1.2V, V_{FB}=0.6V, L=2.2μH, C_{IN}=4.7μF, C_{OUT}=10μF, T_A=25℃, unless otherwise specified.

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		2.5		5.5	V
Shutdown Current	I_{OFF}	V_{EN}=0			0.1	μA
Active Current	I_{ON}	V_{FB}=0.55V		220		μA
Regulated Feedback Voltage	V_{FB}		0.588	0.6	0.612	V
Regulated Output Voltage Accuracy	$\Delta V_{OUT}/V_{OUT}$	V_{IN}=2.5V to 5.5V, I_{OUT}=0 to 1.2A	-3		3	%
Peak Inductor Current	I_{PK}		1.5	1.9		A
Oscillator Frequency	f_{OSC}	V_{IN}=2.5V to 5.5V	1.2	1.5	1.8	MHz
PMOSFET $R_{DS(ON)}$	$R_{DS(ON)P}$	V_{IN}=5V		200		mΩ
NMOSFET $R_{DS(ON)}$	$R_{DS(ON)N}$	V_{IN}=5V		200		mΩ
EN High Level Input Voltage	V_{EN_H}		1.5			V
EN Low Level Input Voltage	V_{EN_L}				0.4	V
EN Input Current	I_{EN}				0.1	μA
Soft Start Time	t_{SS}			400		μs
Maximum Duty Cycle	D_{MAX}		100			%
Under Voltage Lock Out Threshold	V_{UVLO}	Rising		2.3		V
		Falling		2.1		
		Hysteresis		0.2		
Thermal Shutdown	T_{SD}	Hysteresis=30℃		155	160	℃

Typical Performance Characteristics

V_{IN}=5V, T_A=25 ℃, unless otherwise noted.

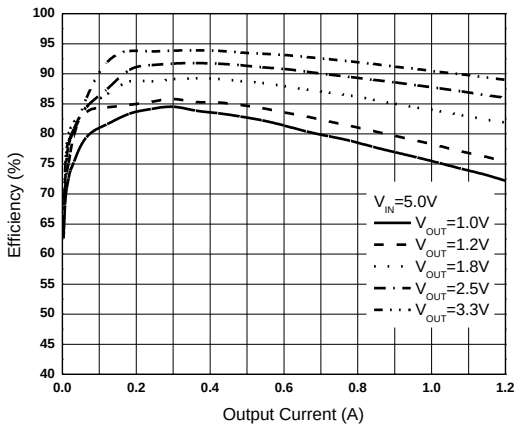


Figure 4. Efficiency vs. Output Current

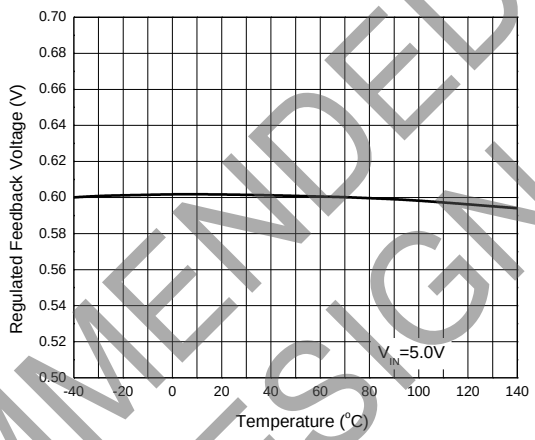


Figure 5. Regulated Feedback Voltage vs. Temperature

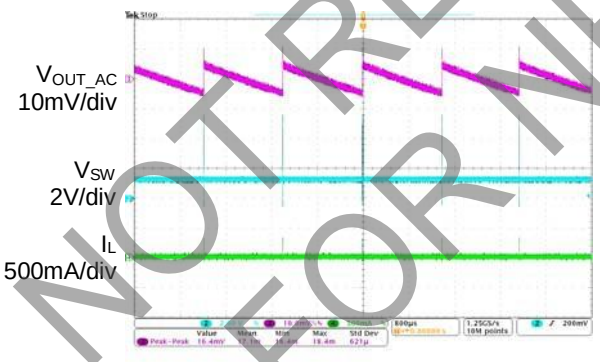


Figure 6. Output Ripple (I_{OUT}=0A)

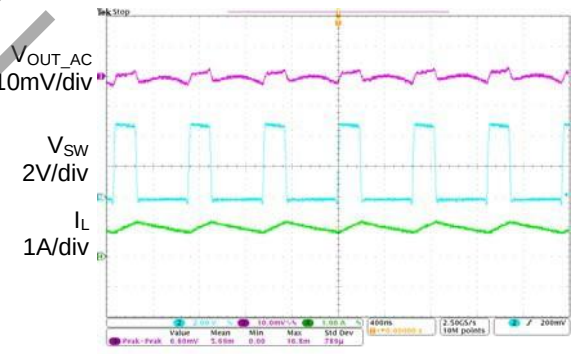


Figure 7. Output Ripple (I_{OUT}=1.2A)

Typical Performance Characteristics (Continued)

V_{IN}=5V, T_A=25 ℃, unless otherwise noted.

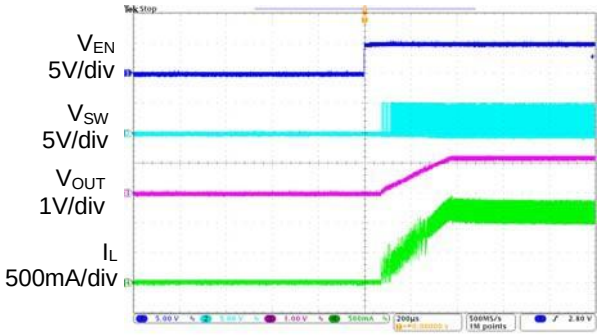


Figure 8. Enable Turn On (I_{OUT}=1.2A)

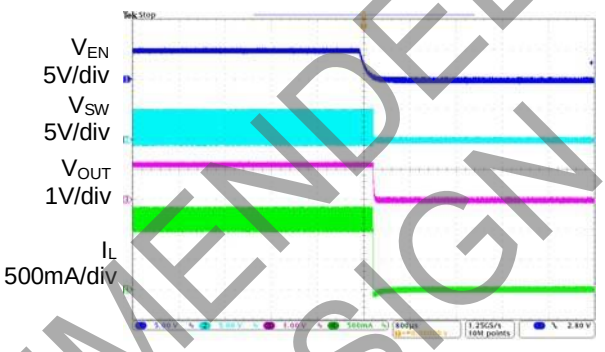


Figure 9. Enable Turn Off (I_{OUT}=1.2A)

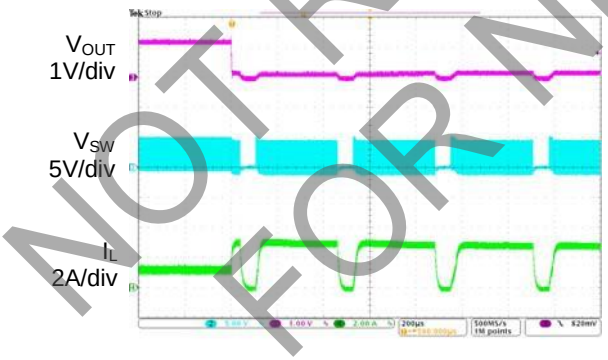


Figure 10. Short Circuit Protection (I_{OUT}=1.2A)

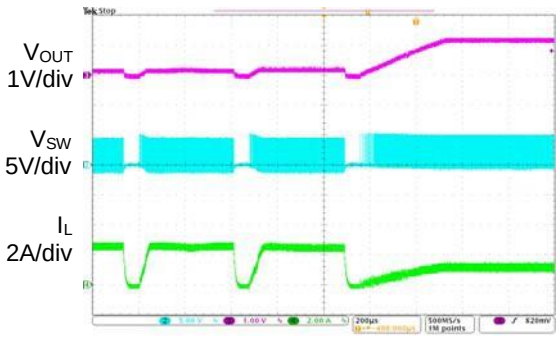


Figure 11. Short Circuit Protection Recovery (I_{OUT}=1.2A)

Typical Application

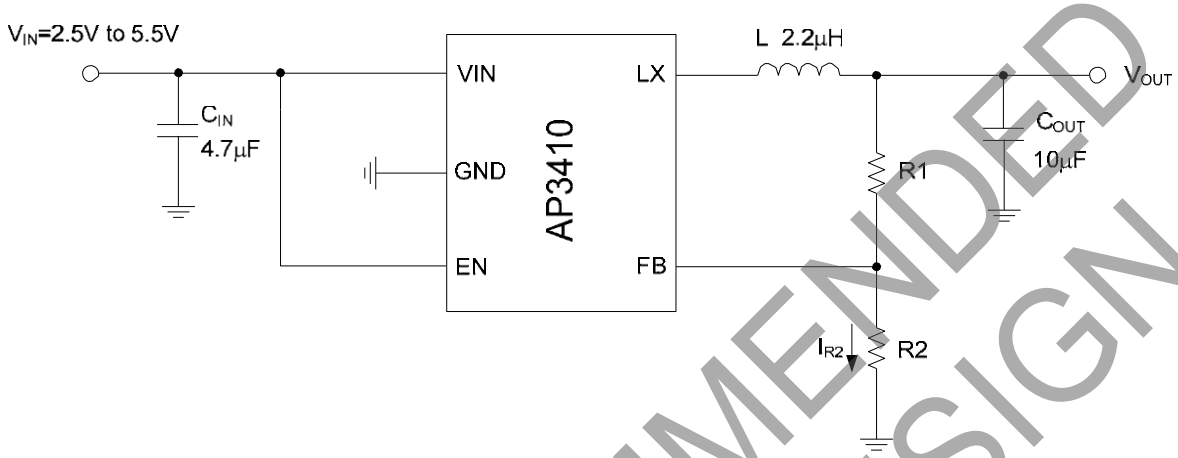


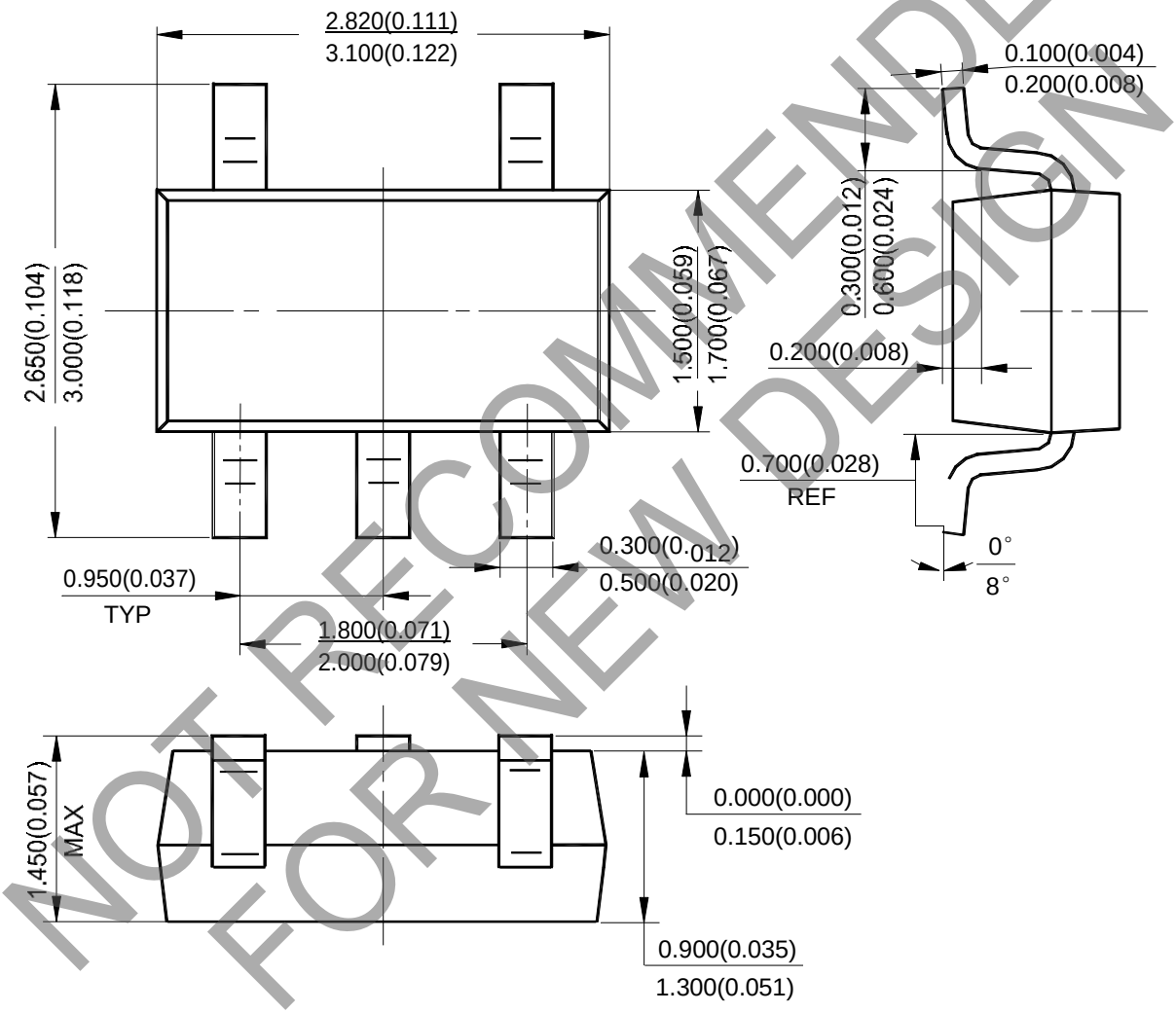
Figure 12. Typical Applications of AP3410

Table 1. Component Guide

V_{OUT} (V)	R1 (kΩ)	R2 (kΩ)	L (µH)
3.3	450	100	2.2
2.5	320	100	2.2
1.8	200	100	2.2
1.2	100	100	2.2
1.0	66	100	2.2

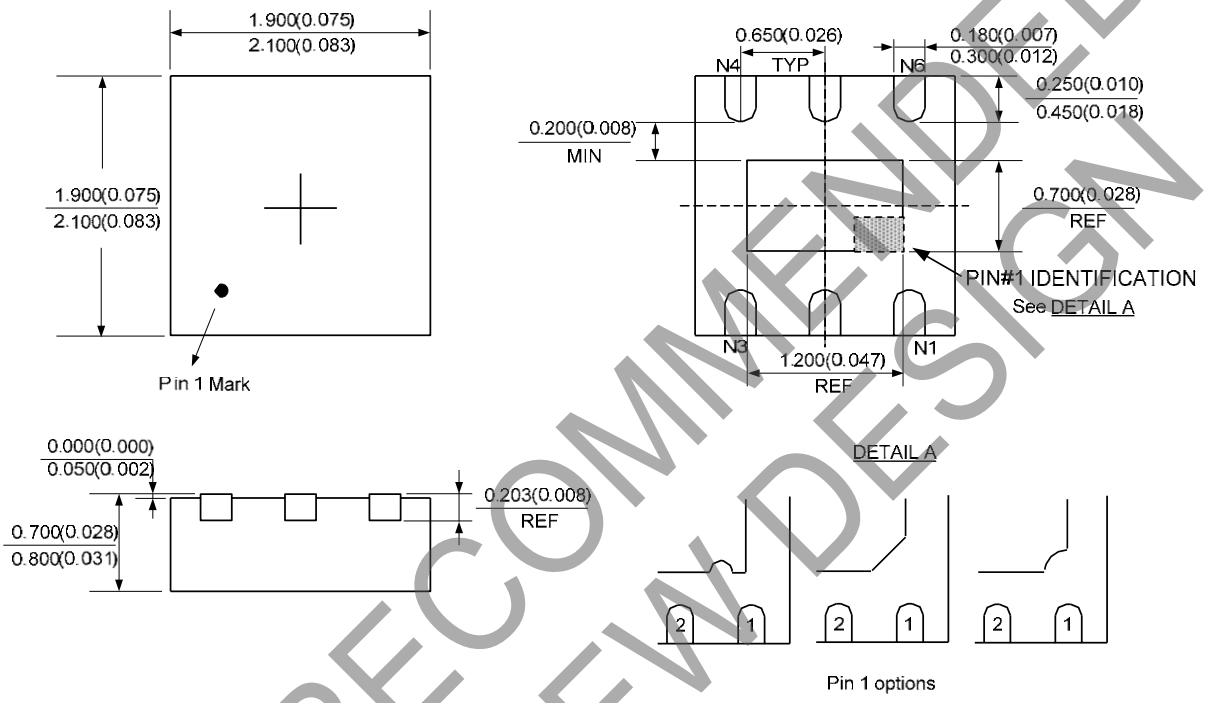
Mechanical Dimensions

SOT-23-5 **Unit: mm(inch)**



Mechanical Dimensions (Continued)

DFN-2×2-6 **Unit: mm(inch)**



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.