DIO6328E

High Efficiency 1 MHz, 2.3 A Step Up Regulator

Features

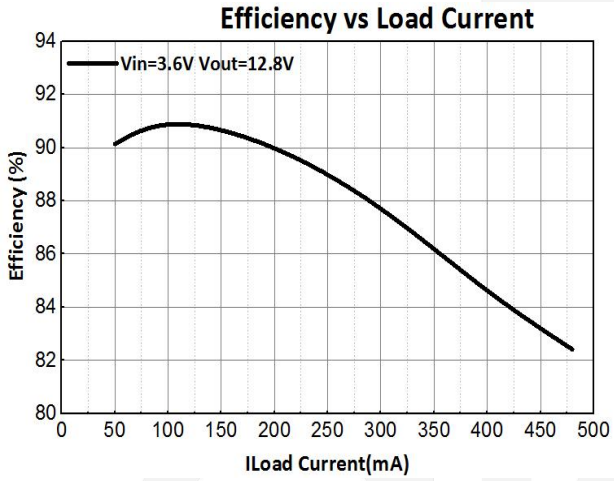
- Wide input range:
  2.3 ~ 25 V bias input, 25 V V_{OUT} max
- 1 MHz switching frequency
- Minimum on time: 100 ns typ
- Minimum off time: 100 ns typ
- Low $R_{DS(ON)}$: 0.15 Ω
- RoHS Compliant and Halogen Free
- Accurate reference: 0.6 V
- Compact package: SOT23-5, SOT23-6 and DFN3*3-10

Descriptions

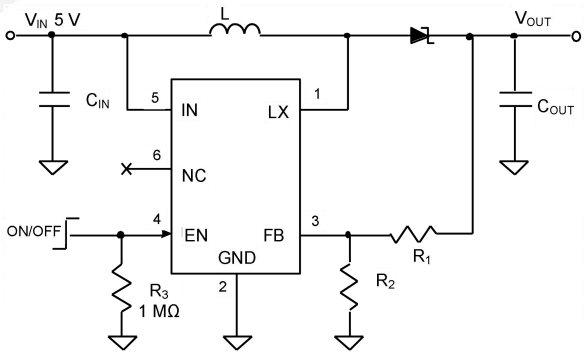
The DIO6328E is a fixed-frequency peak-current mode asynchronous boost converter. Requires an external Schottky diode. The DIO6328E works in light load mode when the load is light, and its quiescent current is about 100 μA. The 150 mΩ $R_{DS(ON)}$ of the integrated NMOS provides the high efficiency in all load conditions. The input voltage range is 2.3 V ~ 25 V. The internal operating frequency is set to 1.0 MHz.

Applications

- WLED drivers
- Networking cards powered from PCI or PCI-express slots



Typical Application



Ordering Information

Ordering Part Number	Top Marking	RoHS	MSL	T_A	Package	
DIO6328EST6	YWEJ	Green	3	-40 to 85°C	SOT23-6	Tape & Reel, 3000
DIO6328ECD10	DFC2H	Green	3	-40 to 85°C	DFN3*3-10	Tape & Reel, 5000
DIO6328EST5	2HEYW	Green	3	-40 to 85°C	SOT23-5	Tape & Reel, 3000

Pin Assignment

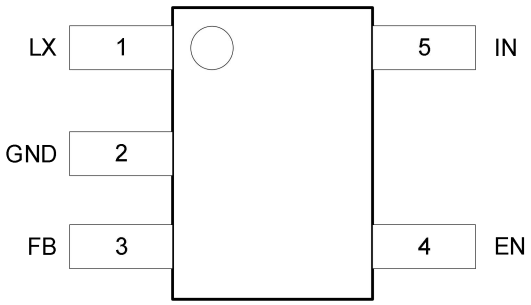


Figure 1. SOT23-5 (Top view)

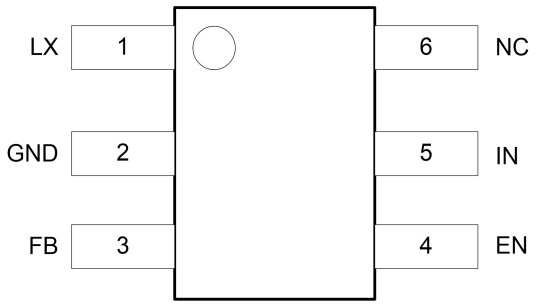


Figure 2. SOT23-6 (Top view)

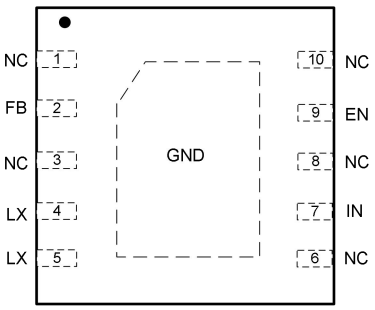


*Figure 3. DFN3*3-10 (Top view)*

Pin Descriptions

Name	Description
LX	Inductor node. Connect an inductor between IN pin and LX pin.
GND	Ground pin.
FB	Feedback pin. Connect a resistor R1 between V_{OUT} and FB, and a resistor R2 between FB and GND to program the output voltage: $V_{OUT} = 0.6V \times (R1/R2+1)$.
EN	Enable control. High to turn on the part. Don't leave it floated.
IN	Input pin. Decouple this pin to GND pin with 1μF ceramic cap.
NC	No connected.

Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Rating” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition 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.

Symbol	Parameter	Rating	Unit
	IN, EN	28	V
	LX	28	V
	All other pins	6	V
P_D	Power dissipation	0.4	W
θ_{JA}	Package thermal resistance	250	°C/W
θ_{JC}		130	°C/W
T_J	Junction temperature range	150	°C
T_L	Lead temperature	260	°C
T_{STG}	Storage temperature range	-65 to 150	°C
ESD	Human-body model (HBM)	±2	kV

Recommend Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended Operating conditions are specified to ensure optimal performance to the datasheet specifications. DIOO does not Recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Rating	Unit
	IN, LX	2.3 to 25	V
	All other pins	0 to 5.5	V
T_J	Junction temperature range	-40 to 125	°C
T_A	Ambient temperature range	-40 to 85	°C

Electrical Characteristics

Typical value: V_{IN} = 5 V, V_{OUT} = 12 V, I_{OUT} = 100 mA, T_A = 25°C, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_Q	Quiescent current	FB = 0.66 V		100		μA
I_{SHDN}	Shutdown current	EN = 0		1	5	μA
$R_{DS(ON)}$	Low side main FET R_{ON}			150		mΩ
I_{LIM}	Main FET current limit		2.3		2.9	A
f_{SW}	Switching frequency		0.8	1	1.2	MHz
V_{REF}	Feedback reference voltage		0.588	0.6	0.612	V
OVP	OUT OVP		26			V
T_{SD}	Thermal shutdown temperature			150		°C
V_{ENH}	EN rising threshold		1.4			V
V_{ENL}	EN falling threshold				0.4	V
I_{EN}	EN pin input current		0		100	nA

Note:

(1) Specifications subject to change without notice.

Typical Performance Characteristics

All typical value are at V_{IN} = 3.6 V, V_{OUT} = 12 V, L = 10 µH, C_{OUT} = 2×10 µF, T_A = 25°C, unless otherwise specified.

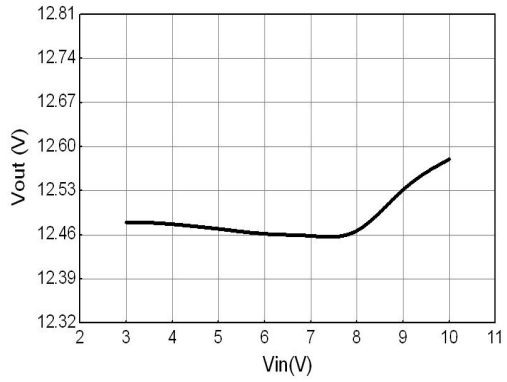


Figure 4. Line regulation at 200 mA

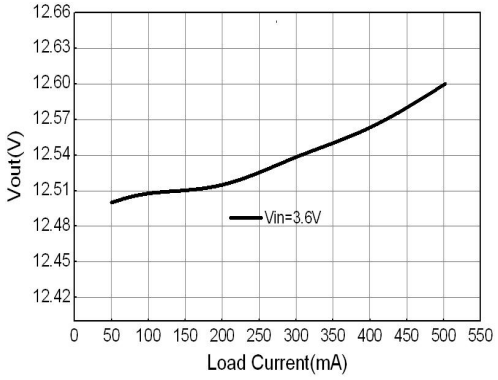


Figure 5. Load regulation

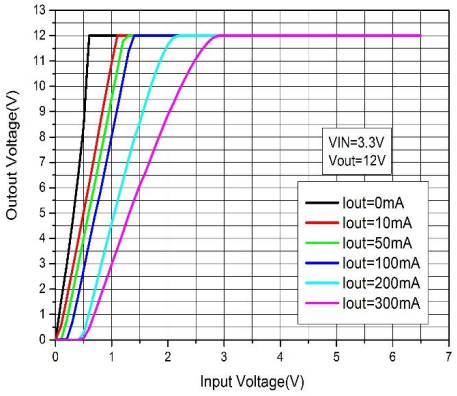


Figure 6. Output voltage vs. Input voltage

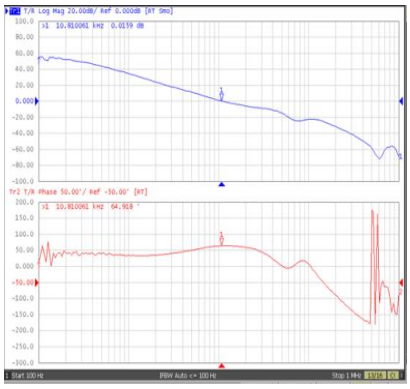


Figure 7. Phase margin (V_{IN} = 5 V, Load = 100 mA)

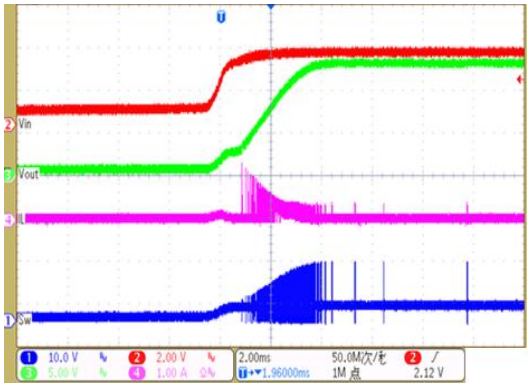


Figure 8. Power on at No load

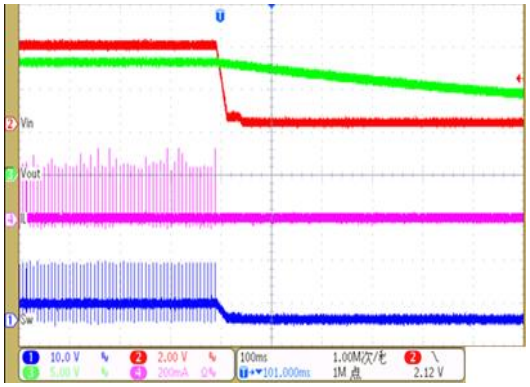


Figure 9. Power off at No load

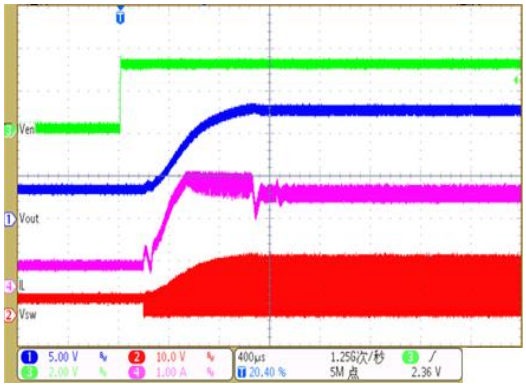


Figure 10. Enable start up at Load = 0.45 A

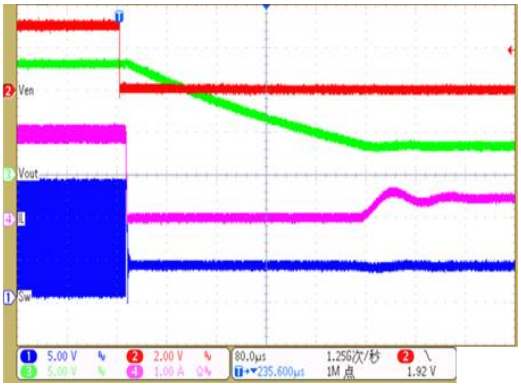


Figure 11. Enable shut down at Load = 0.45 A

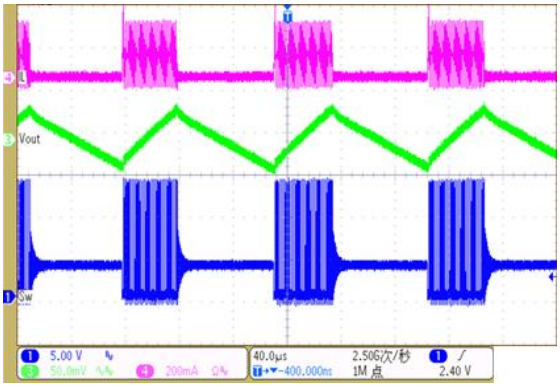


Figure 12. Ripple burst mode at Load = 0.03 A

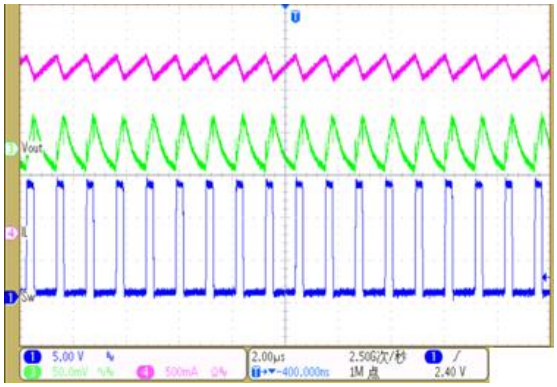


Figure 13. Ripple CCM mode at Load = 0.2 A

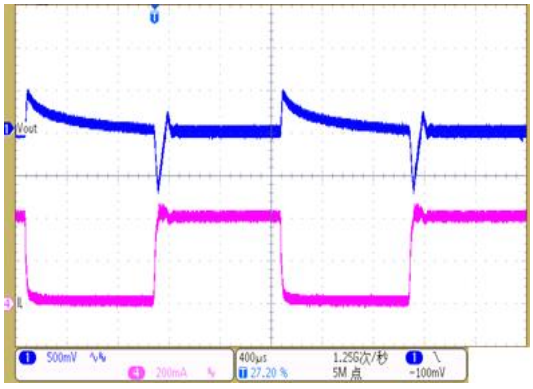


Figure 14. Load transient (Load = 0 -> 400 mA)

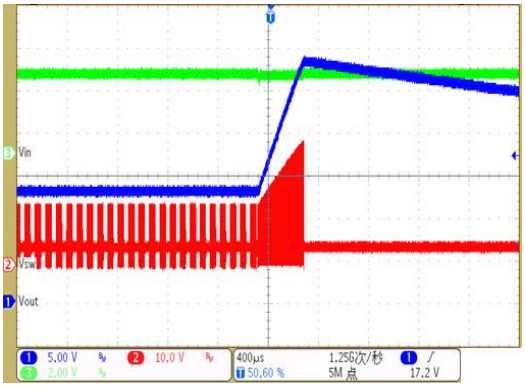


Figure 15. Output overvoltage protection (Load = 0.01 A)

Application Information

Because of the high integration in the DIO6328E IC, the application circuit based on this regulator IC is rather simple. Only input capacitor C_{IN}, output capacitor C_{OUT}, inductor L and feedback resistor (R_1 and R_2) need to be selected for the targeted applications specifications.

Feedback resistor dividers R_1 and R_2:

Choose R_1 and R_2 to program the proper output voltage. To minimize the power consumption under light loads, it is desirable to choose large resistance values for both R_1 and R_2. A value of between 10 kΩ and 1 MΩ is recommended for both resistors. If R_2 = 10 kΩ is chosen, then R1 can be calculated to be:

$$R_1 = \frac{(V_{OUT} - 0.6V) \times R_2}{0.6V} \quad (1)$$

Input capacitor C_{IN}:

The ripple current through input capacitor is calculated as:

$$I_{CIN\_RMS} = \frac{V_{IN} \times (V_{OUT} - V_{IN})}{2\sqrt{3} \times L \times f_{SW} \times V_{OUT}} \quad (2)$$

To minimize the potential noise problem, place a typical X7R or better grade ceramic capacitor really close to the IN and GND pins. Care should be taken to minimize the loop area formed by C_{IN}, and IN/GND pins.

Output capacitor C_{OUT}:

The output capacitor is selected to handle the output ripple noise requirements. Both steady state ripple and transient requirements must be taken into consideration when selecting this capacitor. For the best performance, it is recommended to use X7R or better grade ceramic capacitor with 25 V rating and greater than 10 μF capacitance.

Output inductor L:

There are several considerations in choosing this inductor.

1. Choose the inductance to provide the desired ripple current. It is suggested to choose the ripple current to be about 40% of average input current. The inductance is calculated as:

$$L = \left(\frac{V_{IN}}{V_{OUT}}\right)^2 \frac{(V_{OUT} - V_{IN})}{f_{SW} \times I_{OUT,\,MAX} \times 40\%} \quad (3)$$

Where f_{SW} is the switching frequency and $I_{OUT,MAX}$ is the maximum load current.

The DIO6328E regulator IC is quite tolerant of different ripple current amplitude. Consequently, the final choice of inductance can be slightly off the calculation value without significantly impacting the performance.

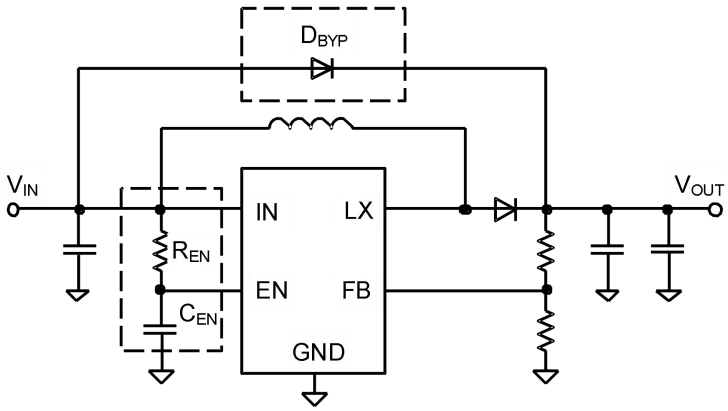
2. The saturation current rating of the inductor must be selected to be greater than the peak inductor current under full load conditions.

$$I_{SAT,\,MIN} > \left(\frac{V_{OUT}}{V_{IN}}\right) \times I_{OUT,\,MAX} + \left(\frac{V_{IN}}{V_{OUT}}\right)^2 \frac{(V_{OUT} - V_{IN})}{2 \times f_{SW} \times L} \quad (4)$$

3. The DCR of the inductor and the core loss at the switching frequency must be low enough to achieve the desired efficiency requirement. It is desirable to choose an inductor with DCR < 50 mΩ to achieve a good overall efficiency.

Applications with large bulk capacitance

In applications with large bulk capacitance on the output, a very high inrush current can be seen flow into the IC and cause any unexpected damage, a Zener diode connected from power input to the output or an RC delay circuit added on EN pin of the IC can be used. Refer to the circuit below.



Layout design:

The layout design of DIO6328E regulator is relatively simple. For the best efficiency and minimum noise problems, we should place the following components close to the IC: C_{IN}, L, R_1 and R_2.

1) It is desirable to maximize the PCB copper area connecting to GND pin to achieve the best thermal and noise performance. If the board space allowed, a ground plane is highly desirable.

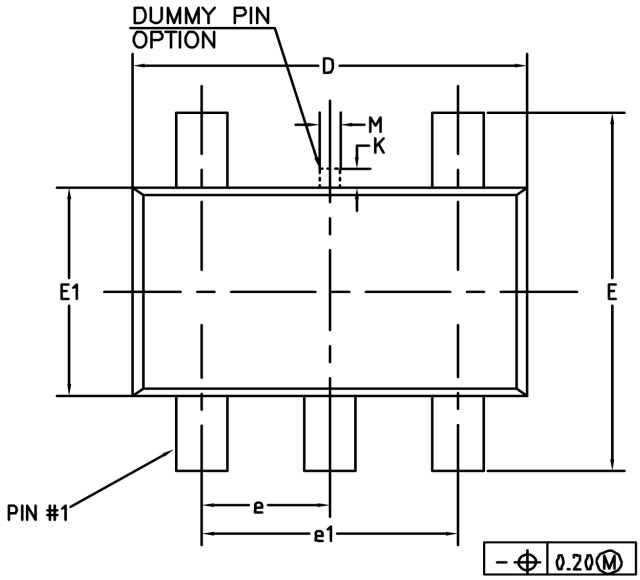
2) C_{IN} must be close to pins IN and GND. The loop area formed by C_{IN} and GND must be minimized.

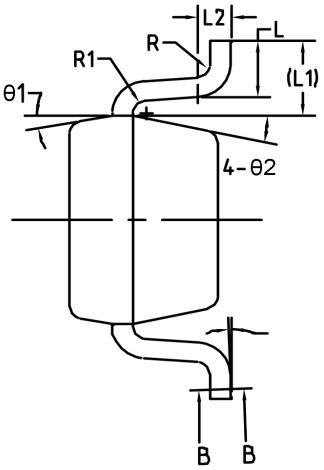
3) The PCB copper area associated with LX pin must be minimized to avoid the potential noise problem.

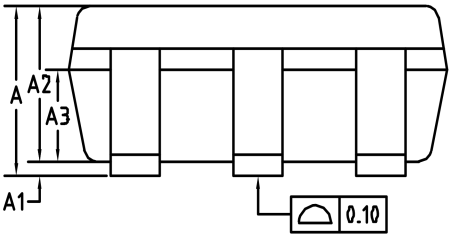
4) The components R_1 and R_2, and the trace connecting to the FB pin must NOT be adjacent to the LX net on the PCB layout to avoid the noise problem.

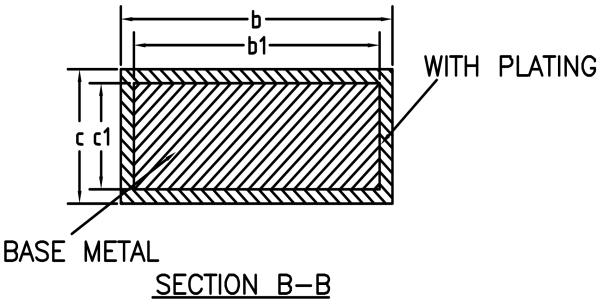
5) If the system chip interfacing with the EN pin has a high impedance state at shutdown mode and the IN pin is connected directly to a power source such as a Li-Ion battery, it is desirable to add a pull down 1Mohm resistor between the EN and GND pins to prevent the noise from falsely turning on the regulator at shutdown mode.

Physical Dimensions: SOT23-5



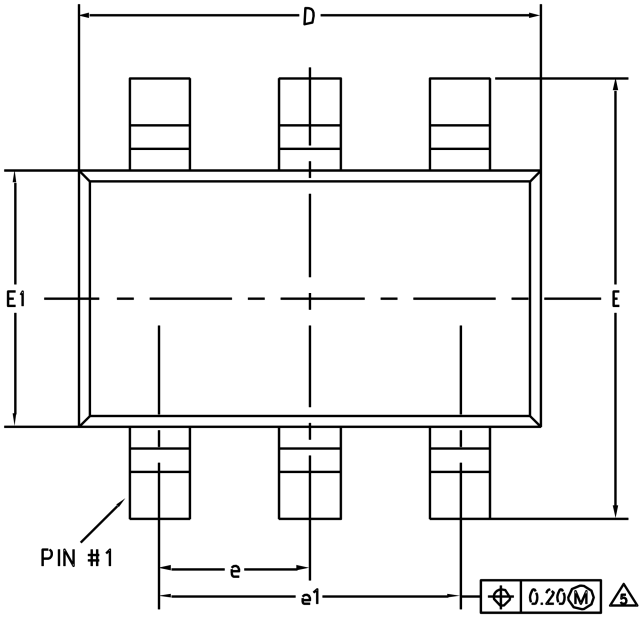


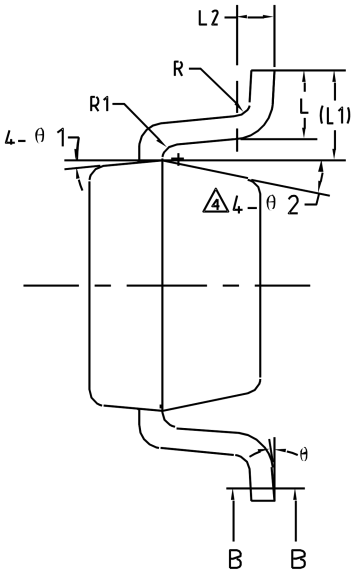


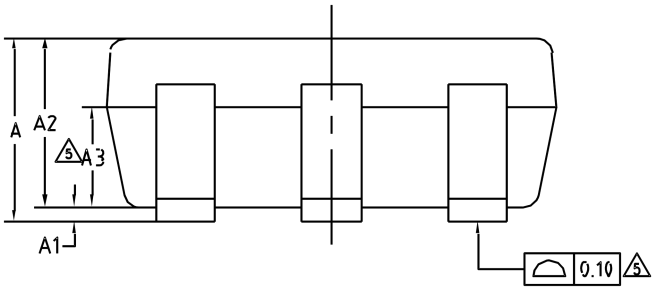


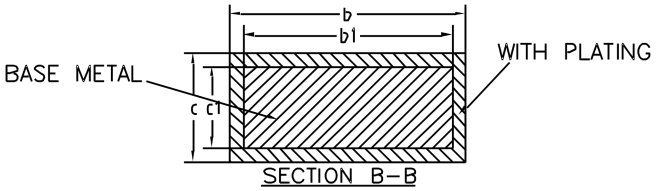
Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.25
A1	0	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.45
b1	0.35	0.38	0.41
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
K	0	-	0.25
L	0.30	0.40	0.60
L1	0.59 REF		
L2	0.25 BSC		
M	0.10	0.15	0.25
R	0.05	-	0.20
R1	0.05	-	0.20
θ	0°	-	8°
θ1	8°	10°	12°
θ2	10°	12°	14°

Physical Dimensions: SOT23-6



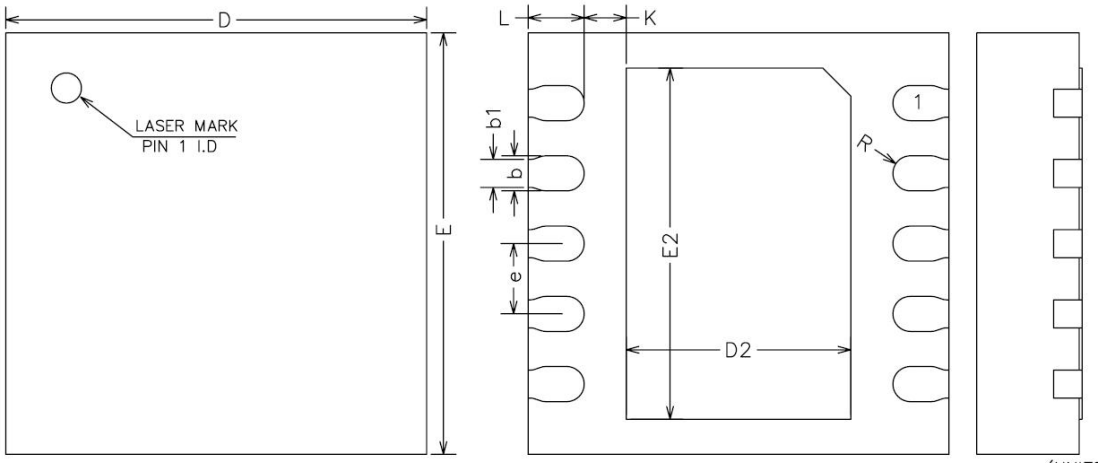


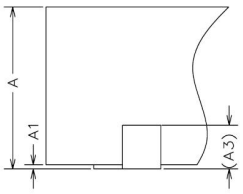




Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.25
A1	0	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.50
b1	0.36	0.38	0.45
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.35	0.45	0.60
L1	0.59 REF		
L2	0.25 BSC		
R	0.10	-	-
R1	0.10	-	0.25
θ	0°	-	8°
θ1	3°	5°	7°
θ2	6°	-	14°

Physical Dimensions: DFN3*3-10





Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	0.70	0.75	0.80
A1	0	0.02	0.05
A3		0.20 REF	
b	0.20	0.25	0.30
b1		0.20 REF	
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D2	1.50	1.60	1.70
E2	2.40	2.50	2.60
e	0.40	0.50	0.60
K	0.20	-	-
L	0.30	0.40	0.50
R	0.13	-	-

CONTACT US

Dioo is a professional design and sales corporation for high-quality and performance analog semiconductors. The company focuses on industry markets, such as, cell phone, handheld products, laptop, and medical equipment and so on. Dioo's product families include analog signal processing and amplifying, LED drivers and charger IC. Go to http://www.dioo.com for a complete list of Dioo product families.

For additional product information or full datasheet, please contact with our sales department or representatives.