
Low Noise, Regulated Charge Pump DC/DC Converter

General Description

Two times charge pump and constant switching frequency configuration with low noise characteristics, low external components makes the EMD3001 unique performance and perfect for the portable applications. Fixed regulated output voltage (EMD3001) is available for different applications with input voltage range from 2.7V to 4.5V and provide up to 100mA of output current.

Soft-start circuitry, preventing the inrush current, thermal shutdown and short circuit protection are all built-in as well. It also features with <1uA low showdown current when the device is disable.

The EMD3001 is available in a 6-pin SOT-26 and TDFN-2x2- 6 package (fixed 5V output).

Features

- Low Noise Constant Frequency Operation (2MHz)
- 100mA Output Current
- Power Range form 2.7V to 4.5V
- Shutdown Current < 1μA
- Needs No Inductors
- Soft Start Function Reduces Inrush Current And Has Slew Rate Control
- Output Voltage Regulates to 5V ± 4% or Adj.
- Uses Small Ceramic Capacitor of 1μF
- Thermal Shutdown Protects Output Over Loading
- Protects Output Shorted to Ground
- PWM dimming Control WLED Brightness
- 5V Fixed Version in SOT-26

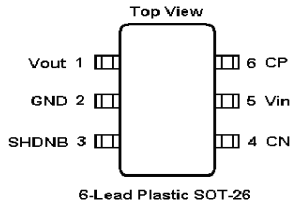
Applications

- White LED Driver
- 3V to 5V Charge Pump Conversion
- Battery Backup Supplies
- Handheld Portable Devices

Package & Ordering Information

CONNECTION DIAGRAM

SOT-26 (TOP View)

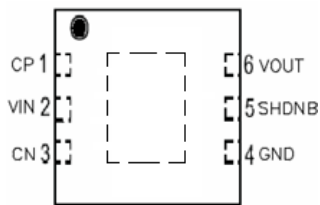


ORDER INFORMATION

EMD3001-50VC06GRR

- 50 Output Fixed voltage
- VC06 SOT-26 Package
- GRR RoHS & Halogen free (By Request)
- Rating: -40 to 85°C
- Package in Tape & Reel

TDFN-2x2-6 (TOP View)



EMD3001-50FE06NRR

- 50 Output Fixed voltage
- FE06 TDFN-2x2-6 Package
- NRR RoHS & Halogen free
- Rating: -40 to 85°C
- Package in Tape & Reel

Order, Mark & Packing Information

Package	Product ID	Marking	Packing
TDFN-2x2-6	EMD3001-50FE06NRR		3K units Tape & Reel
SOT-26	EMD3001-50VC06GRR		3K units Tape & Reel

Typical Applications

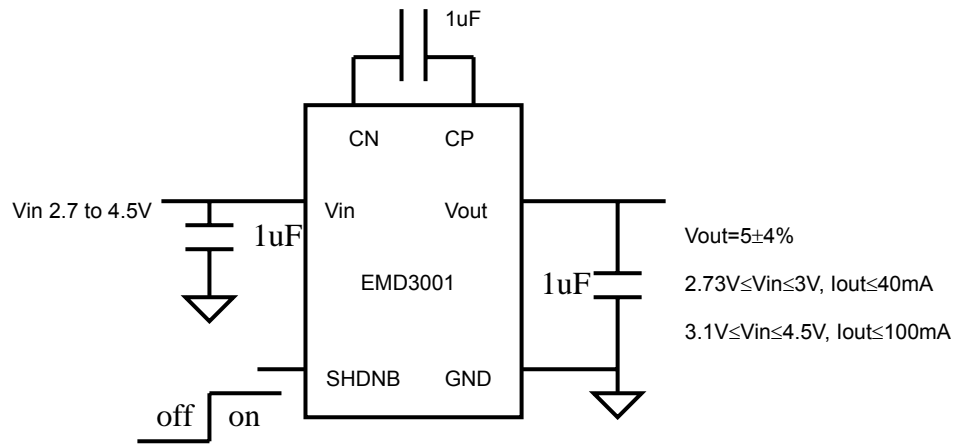


Figure 1. EMD3001 Fixed 5V, V_{IN} from 2.7V to 4.5V

Absolute Maximum Ratings

Output Current	150mA	Lead Soldering Temperature (10 sec)	300°C
V _{in} , V _{out} , SHDNB Voltage	-0.6V to +6V	Recommended Operating Conditions	
V _{out} Short Circuits Duration	Indefinite	V _{in}	2.7V to 4.5V
ESD Protection (HBM)	2KV	C _{in} , C _{out} , C _{fly}	1uF
Operating Temperature Range	-40°C to +85°C	V _{out} Loading	≤100mA
Storage Temperature Range	-65°C to +150°C		

Electrical Specifications

Specification are at T_A=25°C, V_{in}=3.6V, C_{fly}=1uF, C_{in}=1uF, C_{out}=1uF unless otherwise noted.

V_{IN}, V_{OUT}, I_O, V_{IH} and V_{IL} apply over the full operating temperature range.

Symbol	Parameter	Conditions	Min.	Typ.	Max (Specification)	Units	Note
V _{IN}	Input Voltage		2.7		4.5	V	
V _{OUT}	Output Voltage	2.7V ≤ V _{in} ≤ 3.1V, I _{OUT} ≤ 40mA	4.8	5	5.2	V	
		3.1V < V _{in} ≤ 4.5V, I _{OUT} ≤ 100mA	4.8	5	5.2	V	
I _O	Operating Supply Current	I _{OUT} =0mA, SHDNB=V _{IN}		2.5	5.9	mA	
I _{SHDN}	Shutdown Current	SHDN=0V, V _{OUT} =0V			1	μA	Note1
V _R	Output Ripple	V _{IN} =3V, I _{OUT} =100mA		40		mV _{P-P}	
η	Efficiency	V _{IN} =3V, I _{OUT} =50mA		80		%	
F _{OSC}	Switching Freq.		1	2		MHz	
V _{IH}	SHDN Input Threshold		1.2			V	
V _{IL}	SHDN Input Threshold				0.4	V	
T _{ON}	V _{out} Turn-On Time	V _{IN} =3V, I _{OUT} =0mA, 10% to 90%		0.5		ms	
R _{OL}	Open-Loop Output Resistance	V _{IN} =3V, I _{OUT} =100mA		10		Ω	Note2
I _{SHORT}	Output Short Circuit Current	V _{IN} =3.6V, V _{OUT} =0V	15		55	mA	

Note1: Due to testing limit.

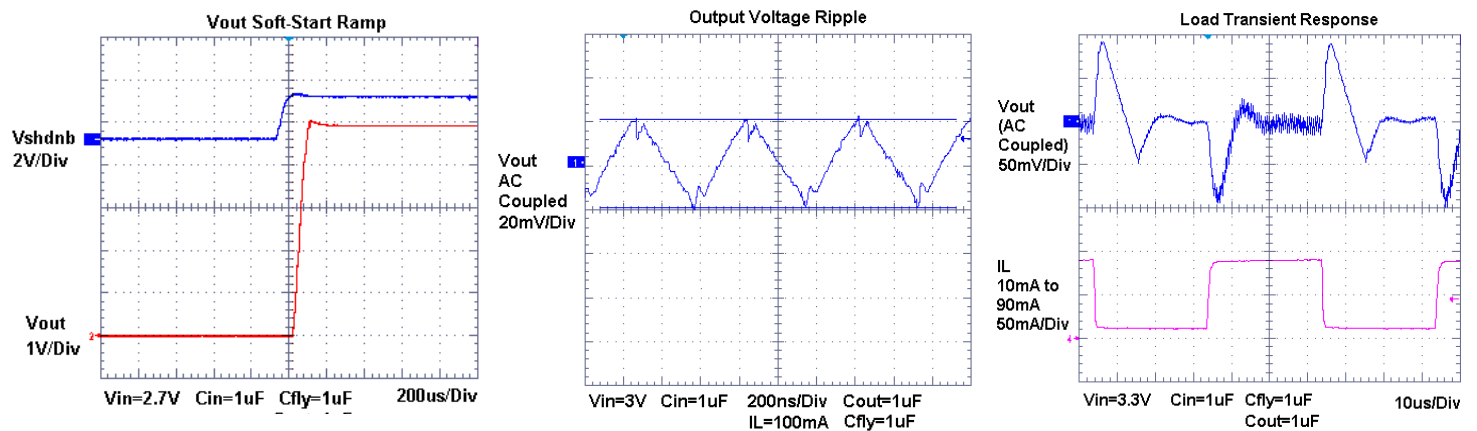
Note2: R_{OL} ≡ (2V_{in}-V_{out})/I_{out}

Pin Descriptions

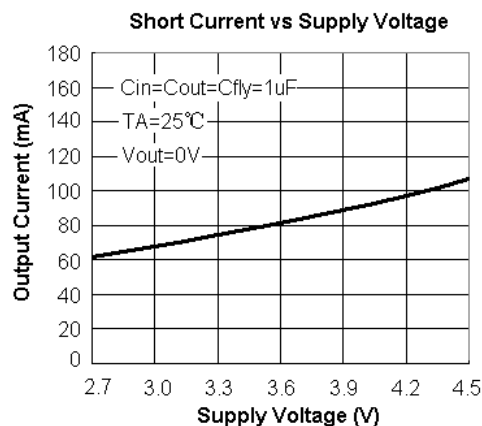
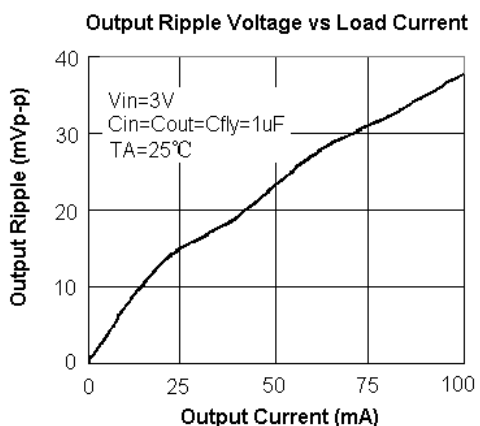
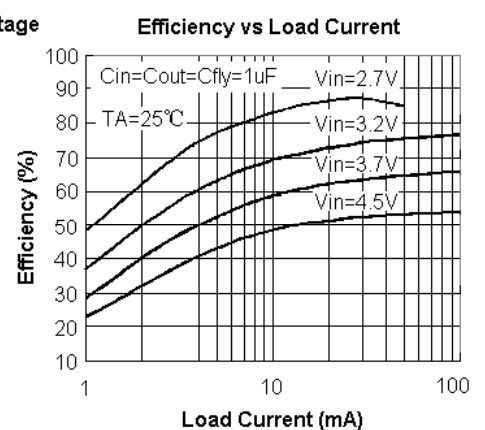
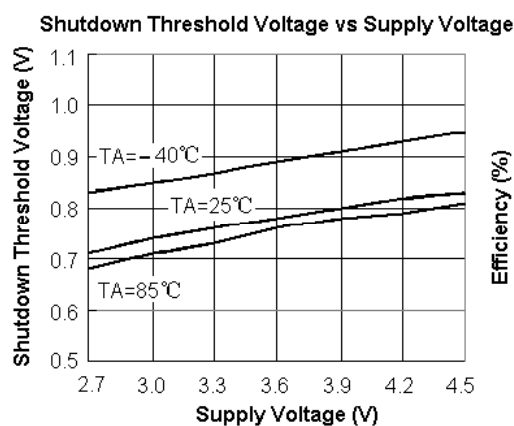
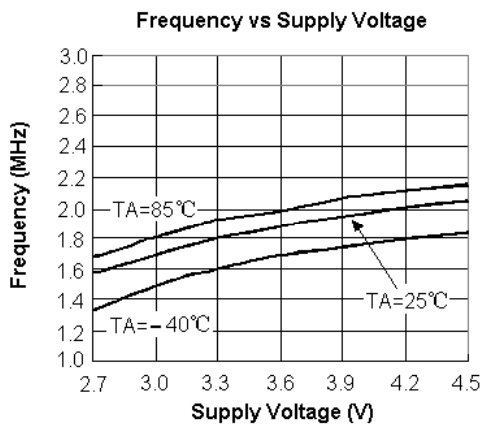
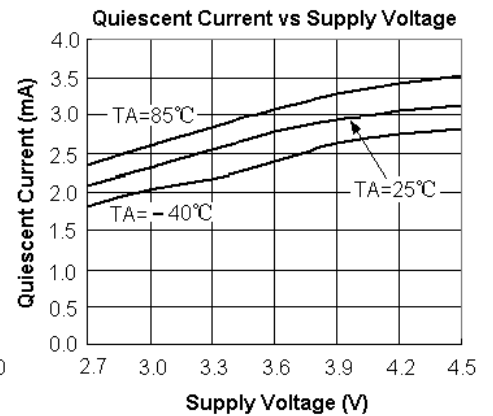
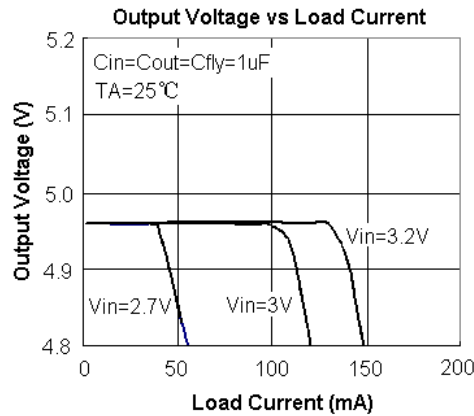
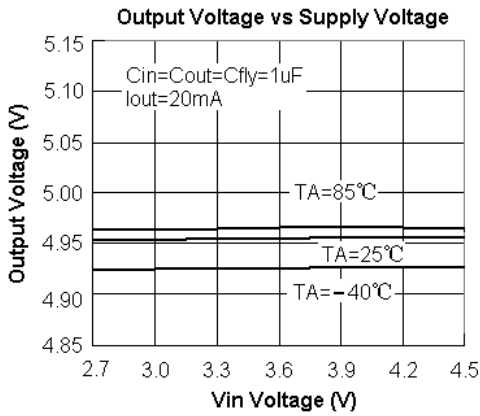
Pin Name	Pin Order EMD3001	Description
CP	6	Positive terminal connection of the fly capacitor.
Vin	5	Input supply voltage.
CN	4	Negative terminal connection of the fly capacitor.
SHDNB	3	High to enable and low to disable the EMD3001.
Vout	1	Output of regulating.
GND	2	Grounding reference of all I/O pin.

Note1: EMD3001 regulates output to 5V and has no feedback pin. Only GND is available.

Typical Performance Characteristics



Typical Performance Characteristics



Function Block Diagram

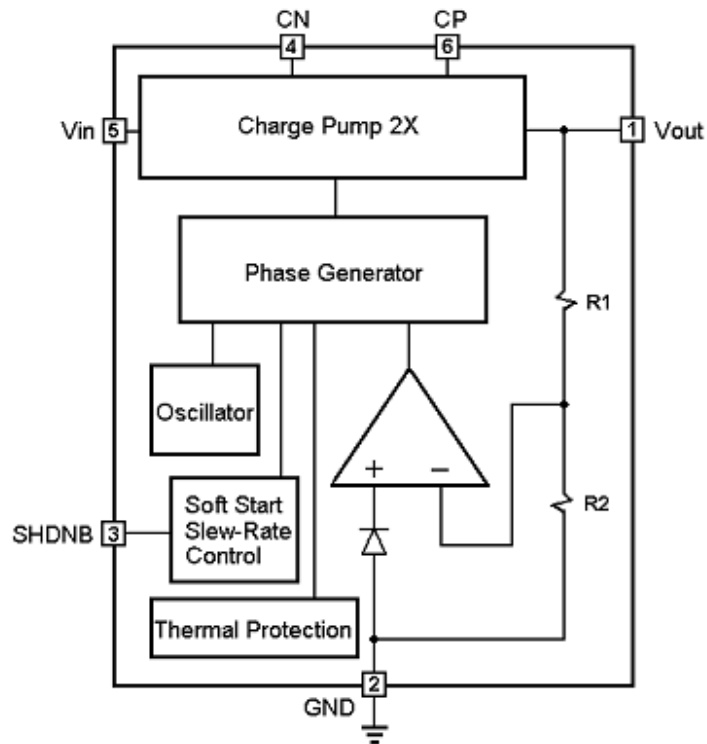


Figure 2. EMD3001 Functional Block Diagram

Operation

Charge-pump operation

The EMD3001 configures a 2X charge-pump and regulates Vout to 5V. Sensing the output voltage through internal divided resistors and modulating the charge current by error amplifier's signal are used to regulate the output voltage. The EMD3001 uses a 2MHz-frequency non-overlapping clock phase to pump the fly capacitor then store the charge to the output capacitor and regulate the output voltage cited above.

Shutdown Current

When shutdown is been trigger by low state signal on SHDNB, the output and CP voltage of EMD3001 will pull to ground to guarantee that shutdown current less than 1 μ A in very short time.

Soft-Start and Slew-Rate control

The soft-start slew-rate function can reduce the inrush current during the input power ramping time. The start-up time is almost less than 0.5ms in typical condition. During the EMD3001 start-up, the input power will charge a constant current to the fly capacitor and output capacitor.

Short-Circuit and Thermal Protected

To Prevent been damaged by shorting output to ground, the EMD3001 has built-in short-circuit protection to limit the output current up to about 25mA ~ 50mA. And when the loading is getting too large, out of absolute maximum ratings of EMD3001, there is a thermal protected circuitry to prevent too large current flowing through EMD3001 to the output terminal.

Capacitor Selection

Cfly, Cin and Cout capacitors should utilize the low ESR (Equivalent Series Resistance) ceramic capacitor.

The charge pump strength is controlled by the flying capacitor, 1 μ F is recommended. For reducing noise and ripple purpose, tantalum and aluminum material capacitors is not recommended. Cin and Cout should use the low ESR (<0.1 Ω) ceramic capacitor for degrade the noise and ripple, 1 μ F is recommended. The value of Cin, Cout, Cfly will impact on several important parameters of EMD3001 such as output ripple, start-up time, charge pump strength and loop stability.

Application Circuits

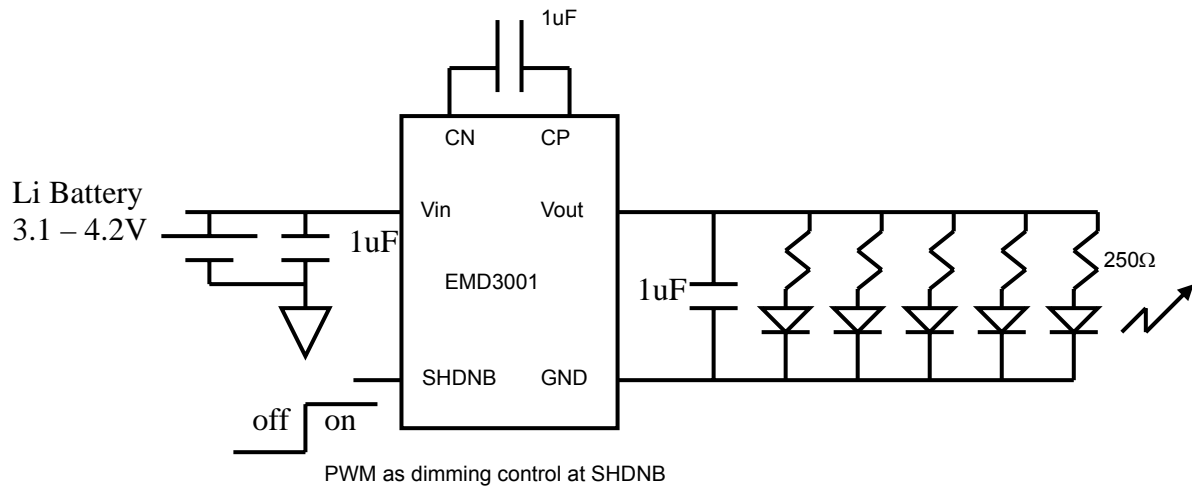


Figure 3. Lithium-Ion Battery to 5V White or Blue LED Driver

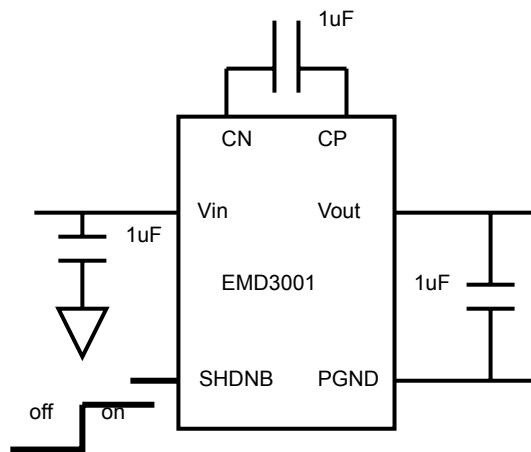
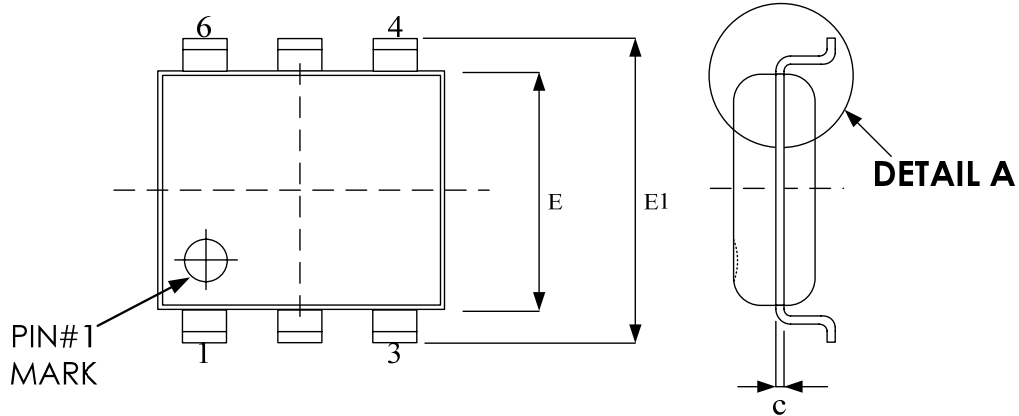
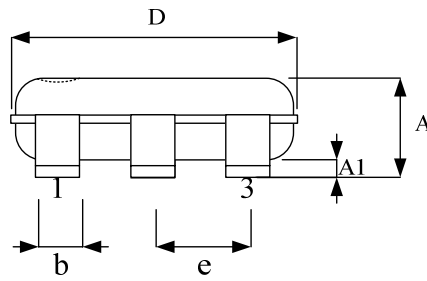


Figure 4. Regulates To 5V System

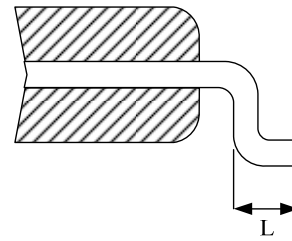
Package Outline Drawing SOT-23-6



TOP VIEW



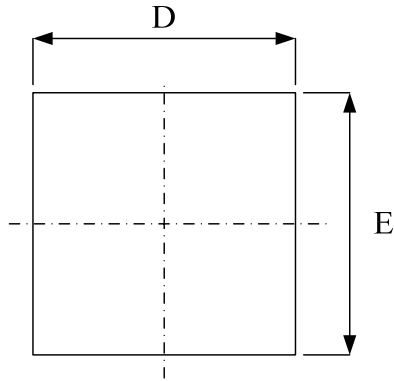
SIDE VIEW



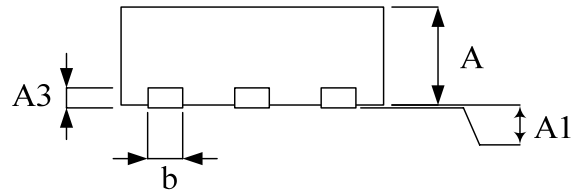
DETAIL A

Symbol	Dimension in mm	
	Min.	Max.
A	0.90	1.45
A1	0.00	0.15
b	0.30	0.50
c	0.08	0.25
D	2.70	3.10
E	1.40	1.80
E1	2.60	3.00
e	0.95 BSC	
L	0.30	0.60

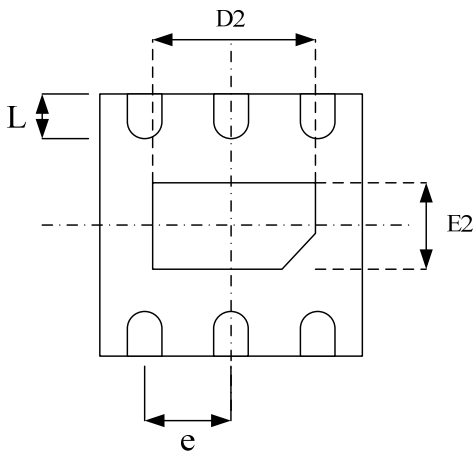
Package Outline Drawing
TDFN-6L (2x2 mm)



TOP VIEW



SIDE VIEW



BOTTOM VIEW

Symbol	Dimension in mm	
	Min	Max
A	0.70	0.80
A1	0.00	0.05
A3	0.18	0.25
b	0.25	0.35
D	1.90	2.10
E	1.90	2.10
e	0.65 BSC	
L	0.20	0.45

Exposed pad option

	Dimension in mm	
	Min	Max
D2	1.35	1.45
E2	0.55	0.65

Revision History

Revision	Date	Description
4.0	2009.05.12	EMP transferred from version 3.1
4.1	2009.10.20	Add the TDFN-2x2-6 package information
4.2	2013.01.07	1. Modify GRR definition (page 2) 2. Modify SOT23-6 and TDFN-2x2-6 package outline drawing (page 10,11)
4.3	2015.09.22	1. Modify IQ Spec TBD→5.9mA (page 4) 2. Modify Application Circuits 2.7V→3.1V、100Ω→250Ω (page 9)

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