GENERAL DESCRIPTION

OB2237x is a high performance, high precision and low cost PWM Power switch for non-isolated buck and buck-boost application. It combines a dedicated current mode PWM controller with a high voltage power Mosfet in DIP&SOP package. Its built-in error amplifier is optimized for good overshoot and dynamic response for low cost and component count. With precise inner resistor divider, precise reference of EA， constant voltage regulation of 15V at universal AC input can be guaranteed. Frequency reduction and burst mode control is implemented for high efficiency at light load. Good EMI performance is achieved with On-Bright proprietary frequency shuffling technique and soft gate driver design. Low startup current and low operating current contribute to a reliable power on startup and low standby power consumption with OB2237x.

OB2237x offers power on soft start control and protection coverage with auto-recovery features including cycle-by-cycle current limiting, output short circuit protection, on-chip Over Temperature Protection (OTP), VDD Over Voltage Protection (OVP), Over Loading Protection(OLP) and VDD Under Voltage Lockout Protection (UVLO).

The tone energy at below 20KHz is minimized in the design so that audio noise is eliminated during operation.

OB2237x is offered in DIP8&SOP7/8&LSOP8-7 package.

FEATURES

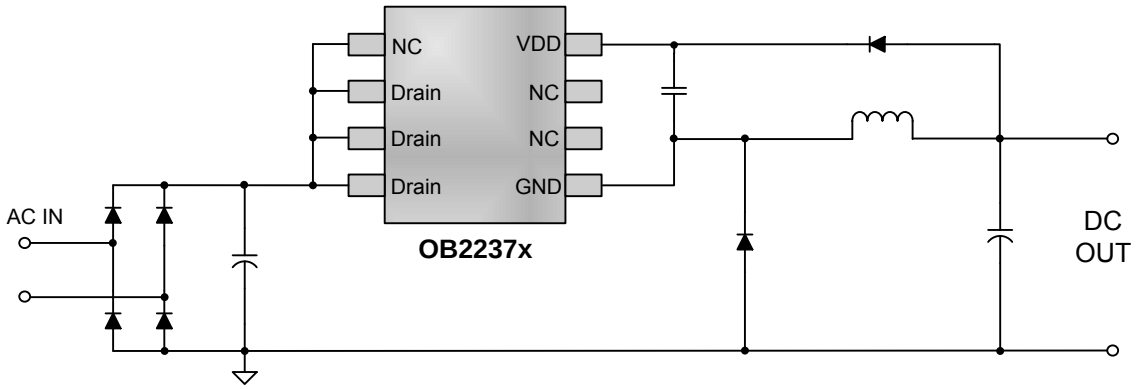
- Universal AC input range and 15V output voltage
- Low cost and less BOM for buck and buck-boost applications
- Current mode control
- 40kHz (typical) maximum switching frequency
- Frequency-reduction and burst mode control for high efficiency
- Frequency shuffling for EMI improvement
- Power on soft-start
- Built-in Leading Edge Blanking (LEB)
- Cycle-by-cycle current limiting
- Output short-circuit protection
- VDD Under Voltage Lockout with Hysteresis
- VDD OVP
- Over Loading Protection
- On-Chip OTP

APPLICATIONS

Low power AC/DC offline SMPS for

- Small home appliance
- Linear regulator/RCC replacement

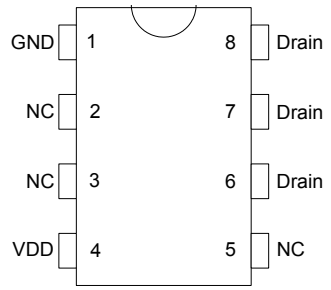
TYPICAL APPLICATION



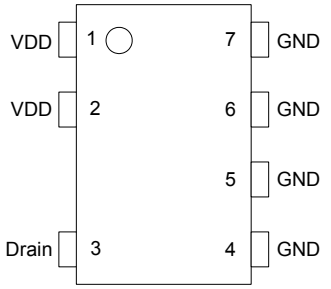
GENERAL INFORMATION

Pin Configuration

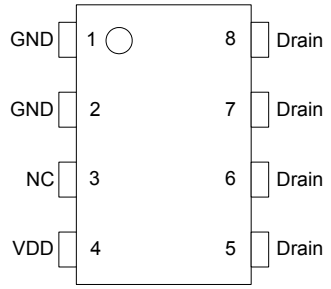
The pin map is shown as below for DIP8



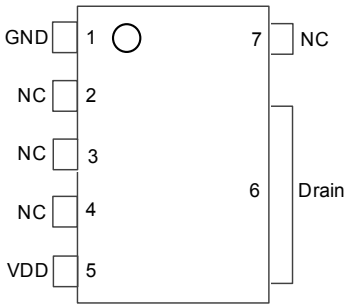
The pin map is shown as below for SOP7



The pin map is shown as below for SOP8



The pin map is shown as below for LSOP8-7



Ordering Information

Part Number	Description
OB2237NAP-H	DIP8, Halogen-free, Tube
OB2237NJP-H	SOP7, Halogen-free, Tube
OB2237NJPA-H	SOP7, Halogen-free, T&R
OB2237NCP-H	SOP8, Halogen-free, Tube
OB2237NCPA-H	SOP8, Halogen-free, T&R
OB2237RCP-H	SOP8, Halogen-free, Tube
OB2237RCPA-H	SOP8, Halogen-free, T&R
OB2237RIEP-H	LSOP8-7, Halogen-free, Tube
OB2237RIEPA-H	LSOP8-7, Halogen-free, T&R

Package Dissipation Rating

Package	RθJA (℃/W)
DIP8	70
SOP7/8	95/85
LSOP8-7	54

Note: Drain Pin Connected 100mm^2 PCB copper clad.

Recommended Operating Condition

Symbol	Parameter	Range
VDD	VDD Supply Voltage	8 to 15V

Absolute Maximum Ratings

Parameter	Value
Drain Voltage(off state)	-0.3V to Bvdss
VDD Voltage	-0.3 to 23V
Min/Max Operating Junction Temperature T_J	-40 to 150 ℃
Operating Ambient Temperature T_A	-40 to 85 ℃
Min/Max Storage Temperature T_{stg}	-55 to 150 ℃
Lead Temperature (Soldering, 10secs)	260 ℃

Note: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, 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-rated conditions for extended periods may affect device reliability.

Output Power Table

Buck/ Buck-Boost	90~264Vac (open frame)	176~264Vac (open frame)
OB2237NAP	350mA	400mA
OB2237NJP	300mA	350mA
OB2237NCP	300mA	350mA
OB2237RCP	400mA	500mA
OB2237RIEP	700mA	750mA

Note: Maximum continuous power with drain pattern connected 100mm^2 PCB copper clad, at 50℃ ambient.

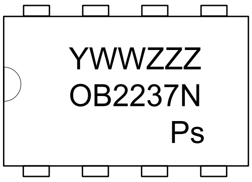
Buck/ Buck-Boost	90~264Vac (open frame)	176~264Vac (open frame)
OB2237NAP	300mA	350mA
OB2237NJP	250mA	300mA
OB2237NCP	250mA	300mA
OB2237RCP	350mA	400mA
OB2237RIEP	600mA	650mA

Note: Maximum continuous power with drain pattern connected 100mm^2 PCB copper clad, at 85℃ ambient.

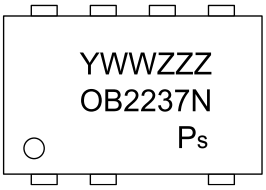
Marking Information

OB2237x X X X - X

High Precision Low Cost Power Switch	Package	Green Package	Packing	BVdss
	A: DIP8 J/C:SOP7/8 IE:LSOP8-7	P: Green (Halogen Free)	Blank:Tube A:Tape/Reel	H:650V



Y:Year Code
WW:Week Code(01-52)
ZZZ:Lot Code
P:Halogen-free Package
S:Internal Code(Optional)



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ZZZ:Lot Code
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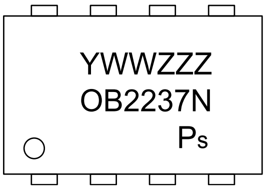
S:Internal Code(Optional)



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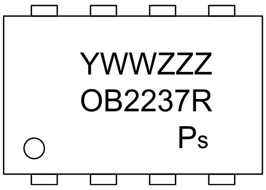
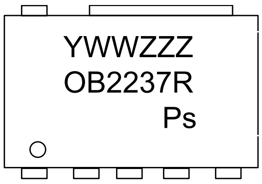
S:Internal Code(Optional)



Y:Year Code
WW:Week Code(01-52)
ZZZ:Lot Code
P:Halogen-free Package
S:Internal Code(Optional)



Y:Year Code
WW:Week Code(01-52)
ZZZ:Lot Code
P:Green Package(Halogen-free)
s:Internal Code(Optional)

TERMINAL ASSIGNMENTS

DIP8

Pin Num	Pin Name	I/O	Description
1	GND	P	Ground
2/3	NC	NC	It should be floating or connect GND during normal operation state
4	VDD	I	Power Supply and Output Voltage Feedback
5	NC	NC	It should be floating or connect Drain during normal operation state
6/7/8	Drain	I	Power Mosfet Drain pins.

SOP7

Pin Num	Pin Name	I/O	Description
1/2	VDD	I	Power Supply and Output Voltage Feedback
3	Drain	I	Power Mosfet Drain pins.
4/5/6/7	GND	P	Ground

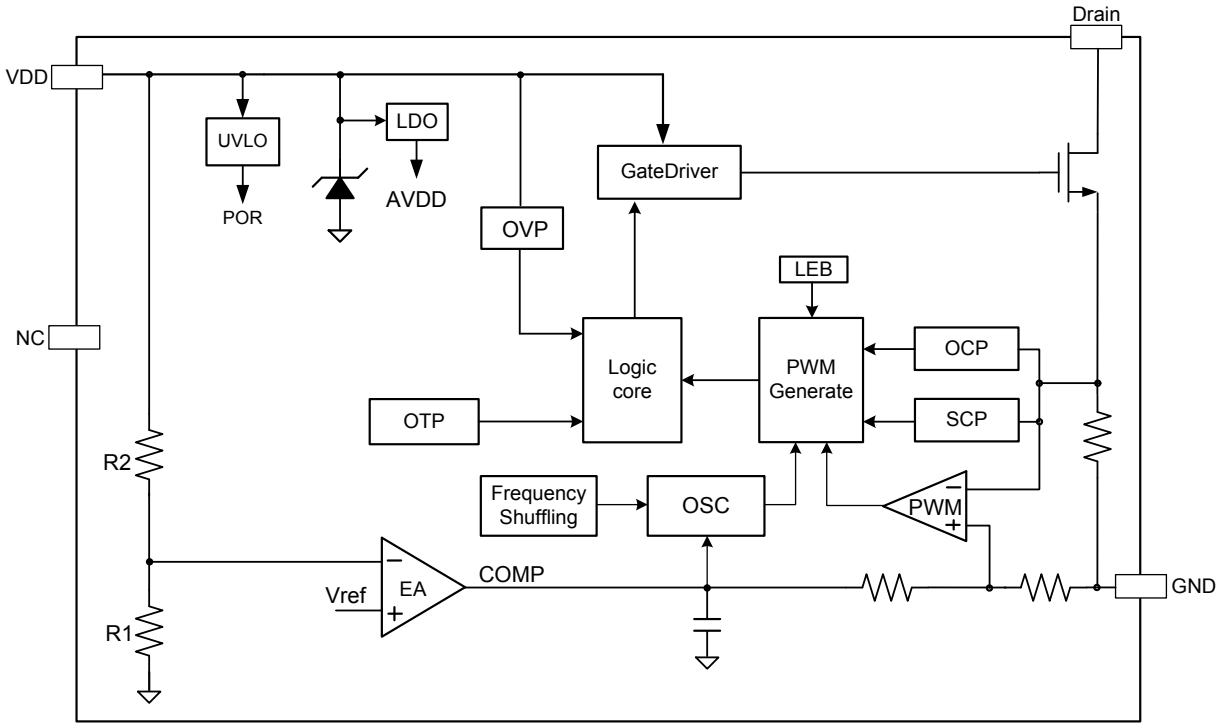
SOP8

Pin Num	Pin Name	I/O	Description
1/2	GND	P	Ground
3	NC	NC	It should be floating or connect GND during normal operation state
4	VDD	I	Power Supply and Output Voltage Feedback
5/6/7/8	Drain	I	Power Mosfet Drain pins.

LSOP8-7

Pin Num	Pin Name	I/O	Description
1	GND	P	Ground
2/3/4	NC	NC	It should be floating or connect GND during normal operation state
5	VDD	I	Power Supply and Output Voltage Feedback
6	Drain	I	Power Mosfet Drain pins.
7	NC	NC	It should be floating or connect Drain during normal operation state

BLOCK DIAGRAM

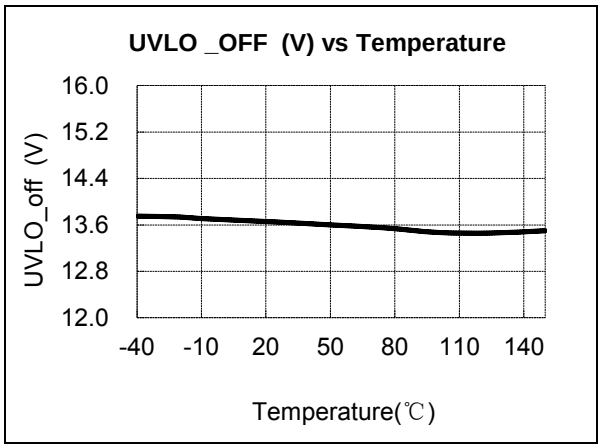


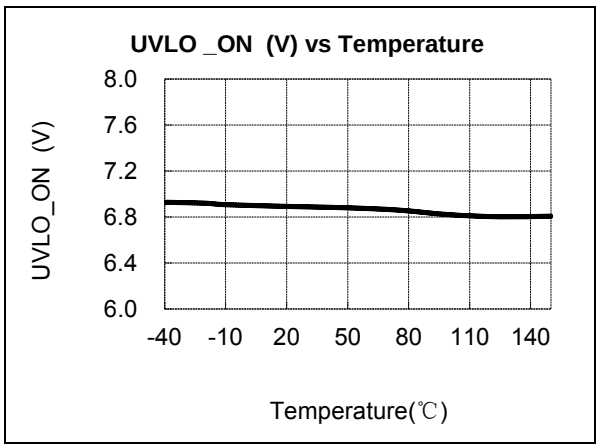
ELECTRICAL CHARACTERISTICS

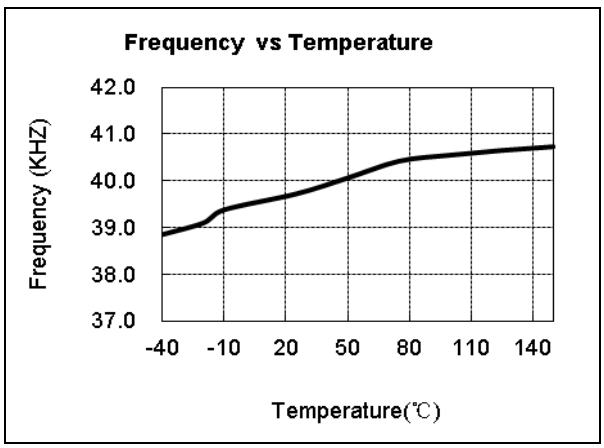
(T_A = 25℃, VDD=15V, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VDD) Section						
$I_{\_startup}$	Standby Current1	VDD=0.1V		150		uA
	Standby Current2	VDD=UVLO（off）-0.5V		1.5		mA
$I_{\_VDD\_op}$	Operation Current	Operation supply current VDD=$VOUT_{SET}$	-	1.0	2.0	mA
		Operation supply current VDD=20V		0.45	0.6	mA
UVLO_ON	VDD Under Voltage Lockout Enter	VDD falling, gate disappear	6.5	7.0	7.5	V
UVLO_OFF	VDD Under Voltage Lockout Exit	VDD rising	12.5	13.5	14.5	V
OVP	Over voltage protection Threshold	Ramp VDD until gate shut down		20.5		V
VDD Regulatio Voltage	In normal regulation, VDD will be regulated to average of 15V			15.0		V
Frequency Section						
Freq_Max	IC Maximum frequency		36	40	44	KHz
∆f/Freq	Frequency shuffling range			+/-8		%
F_shuffling	Shuffling frequency			75		Hz
Dmax	Maximum Duty Cycle		47	50	53	%
F_Burst	Burst Mode Switch Frequency			20		KHz
Protection Section						
Td_olp	Over Loading Debounce Time			130		ms
OTP	Power MOSFET temperature for exiting over temperature protection			123		℃
	Power MOSFET temperature for entering over temperature protection			153		℃
Current Sense Input Section						
Ith_oc	Over current detection threshold	OB2237NAP/ NJP/NCP		0.9		A
		OB2237RCP/ RIEP		1.5		A
TLEB	LEB time	OB2237x		300		nS
Td_oc	OCP propagation delay	OB2237x		120		nS
Power Mosfet Section						
BVdss	MOSFET Drain-Source Breakdown Voltage	OB2237x	650			V
Rdson	On Resistance	OB2237NAP		13		Ω
		OB2237NJP		13		Ω
		OB2237NCP		13		Ω
		OB2237RCP		4.2		Ω
		OB2237RIEP		3.3		Ω

CHARACTERIZATION PLOTS







OPERATION DESCRIPTION

OB2237x is a cost effective PWM power switch optimized for off-line non-isolated buck or buck-boost applications for small home appliances and linear regulator replacement. It operates in current mode and regulates output voltage with dedicated features. High integration can afford low cost and component count solution.

Startup Current and Start up Control
Startup current of OB2237x is designed to be very low so that VDD could be charged up above UVLO threshold and starts up quickly.

Operating Current
The Operating current of OB2237x is as low as 1.0mA (typical). Good efficiency is achieved with the low operation current together with 'Multi-mode' control features.

PWM operation
The maximum switching frequency of OB2237x is internally fixed at 40KHz (typical). No external frequency setting components are required for PCB design simplification.

At light load or zero load condition, most of the power dissipation in a switching mode power supply is from switching loss on the MOSFET. The magnitude of power loss is in proportion to the switching frequency. Lower switching frequency leads to the reduction on the power loss and thus conserves the energy. The frequency reduction and burst mode operation are implemented to achieve high efficiency at light load. The minimum switching frequency is 20KHz (typical).

Frequency shuffling for EMI improvement
The frequency shuffling (switching frequency modulation) is implemented in OB2237x. The oscillation frequency is modulated so that the tone energy is spread out. The spread spectrum minimizes the conduction band EMI and therefore eases the system design.

Soft Start
OB2237x features an internal 75 cycles (typical) soft start to soften the electrical stress occurring in the power supply during startup. It is activated during the power on sequence. After VDD reaches UVLO(OFF), the switching frequency is gradually increased from 10KHz to 40KHz. Every restart up is followed by a soft start.

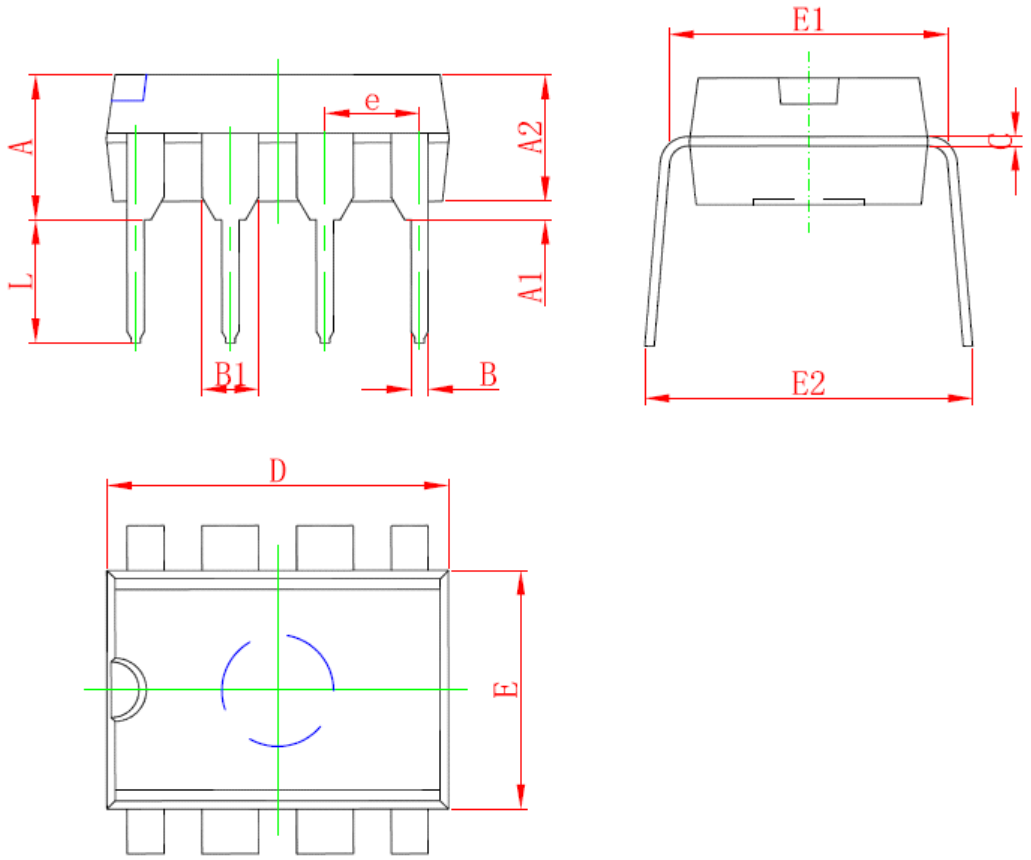
Current Sensing and Leading Edge Blanking
Cycle-by-Cycle current limiting is offered in OB2237x current mode PWM control. The switch current is detected by a sense resistor within the OB2237x. An internal leading edge blanking circuit chops off the sensed voltage spike at initial internal MOSFET on state. The PWM duty cycle is determined by the current sense input voltage and the EA output voltage.

Gate Driver
The internal power MOSFET in OB2237x is driven by a dedicated gate driver for power switch control. Too weak the gate drive strength results in higher conduction and switch loss of MOSFET while too strong gate drive compromises EMI.
A good tradeoff is achieved through the built-in totem pole gate design with right output strength control.

Protection Control
Good power supply system reliability is achieved with its rich protection features including cycle-by-cycle current limiting, Output short circuit protection, on-chip Over Temperature Protection (OTP), VDD Over Voltage Protection (OVP), Over Loading Protection(OLP) and VDD Under Voltage Lockout Protection (UVLO).

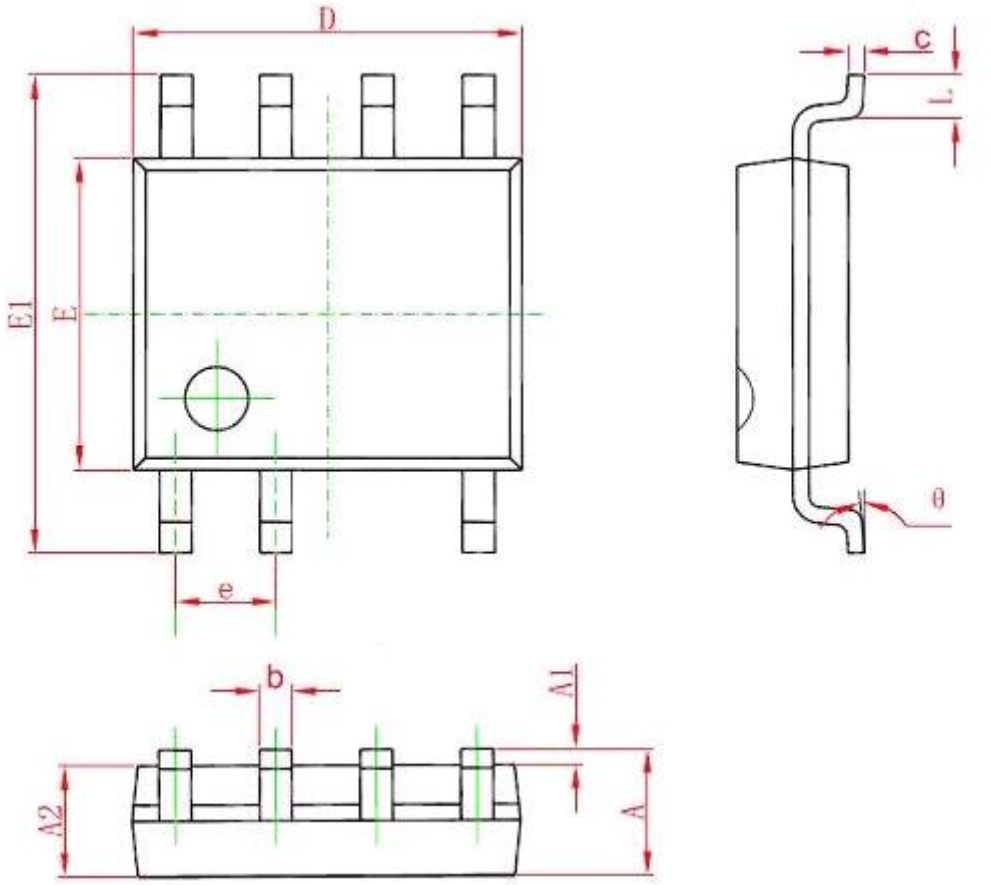
PACKAGE MECHANICAL DATA

DIP8 PACKAGE OUTLINE DIMENSIONS



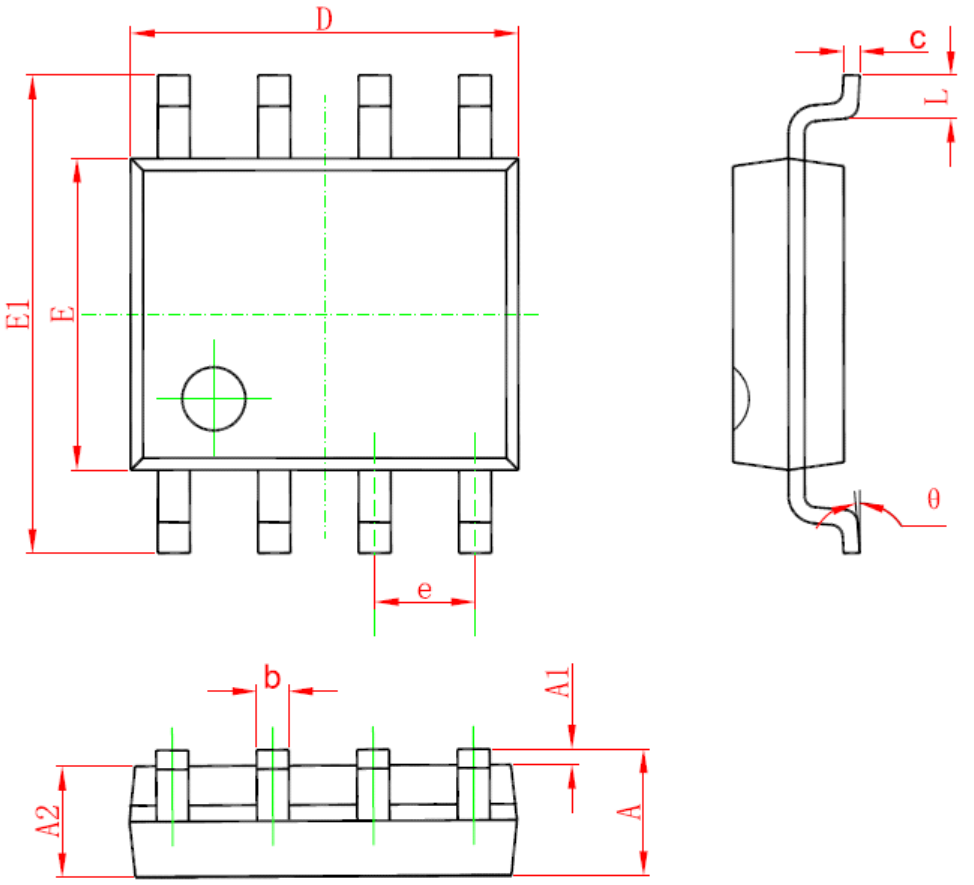
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	5.334	0.146	0.210
A1	0.381		0.015	
A2	2.921	4.953	0.115	0.195
B	0.350	0.650	0.014	0.026
B1	1.524 (BSC)		0.06 (BSC)	
C	0.200	0.360	0.008	0.014
D	9.000	10.160	0.354	0.400
E	6.096	7.112	0.240	0.280
E1	7.320	8.255	0.288	0.325
e	2.540 (BSC)		0.1 (BSC)	
L	2.921	3.810	0.115	0.150
E2	7.620	10.920	0.300	0.430

SOP7 PACKAGE OUTLINE DIMENSIONS



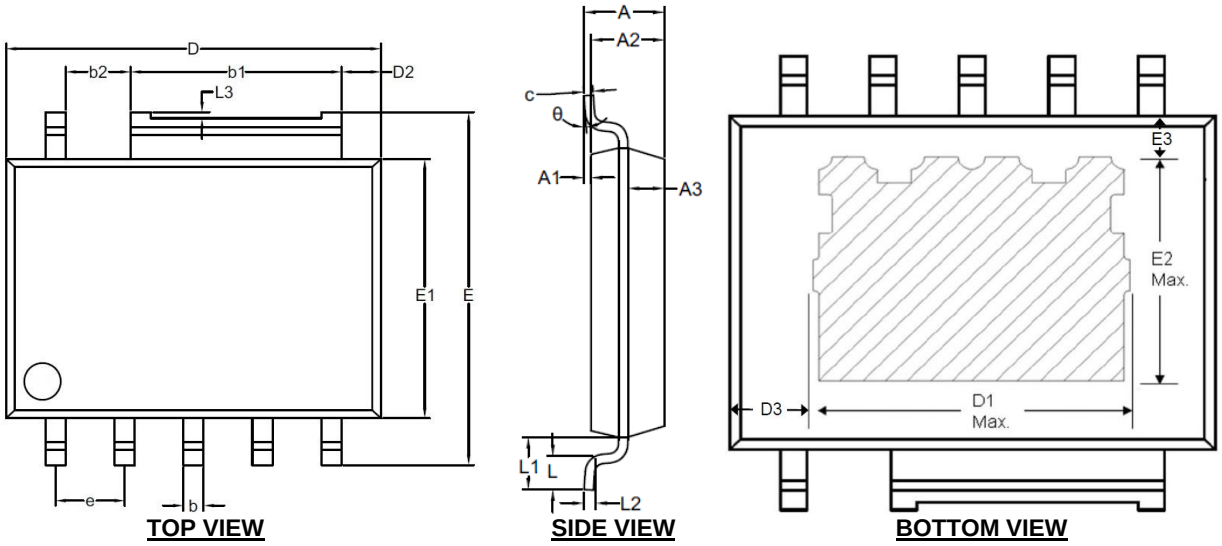
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	4.700	5.150	0.185	0.203
E	3.700	4.100	0.146	0.161
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOP8 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Min
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.150	0.185	0.203
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.05 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

LSOP8-7 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.60	1.95	0.063	0.077
A1	0.05	0.15	0.002	0.006
A2	1.50	1.70	0.059	0.067
A3	0.75	0.85	0.030	0.033
b	0.48	0.56	0.019	0.022
b1	5.18	5.26	0.204	0.207
b2	1.57	-	0.062	-
c	0.18	0.25	0.007	0.010
D	9.15	9.35	0.360	0.368
D1*	-	5.60	-	0.220
D2	0.865	1.085	0.034	0.043
D3	1.73	1.93	0.068	0.076
E	8.55	8.75	0.337	0.344
E1	6.25	6.45	0.246	0.254
E2*	-	3.85	-	0.152
E3	1.10	1.30	0.043	0.051
e	1.70 (BSC)		0.067 (BSC)	
L	0.69	0.79	0.027	0.031
L1	1.15 (REF)		0.045 (REF)	
L2	0.25 (REF)		0.010 (REF)	
L3	-	0.15	-	0.006
θ	0°	8°	0°	8°

IMPORTANT NOTICE

RIGHT TO MAKE CHANGES
On-Bright Electronics Corp. reserves the right to make corrections, modifications, enhancements, improvements and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

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On-Bright Electronics Corp. warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with its standard warranty. Testing and other quality control techniques are used to the extent it deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.
On-Bright Electronics Corp. assumes no liability for application assistance or customer product design. Customers are responsible for their products and applications using On-Bright's components, data sheet and application notes. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

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MILITARY
On-Bright Electronics Corp.'s products are not designed for use in military applications. On-Bright Electronics Corp. will not be held liable for any damages or claims resulting from the use of its products in military applications.