

GENERAL DESCRIPTION

OB8652x is a high precision offline LED lighting power switch with a GaN FET integrated. It can achieve low system cost for an isolated lighting application by primary side control in a single stage converter. It significantly simplifies the LED lighting system design by eliminating the secondary side feedback components and the opto-coupler. System cost can be reduced by improving frequency because of build-in GaN FET.

Quasi-resonant (QR) operation greatly improves the system efficiency. The advanced HV start-up technology is used to meet the start-up time and low standby power requirement. The constant output current is compensated for tolerance of transformer inductance variation.

OB8652x offers comprehensive protection coverage with auto-recovery features including LED open loop protection, LED short circuit protection, cycle-by-cycle current limiting, built-in leading edge blanking, Winding/diode short protection, VDD over voltage protection, VDD under voltage lockout (UVLO), etc.

OB8652x is offered in EASOP6/SOP8/LSOP8-7 package.

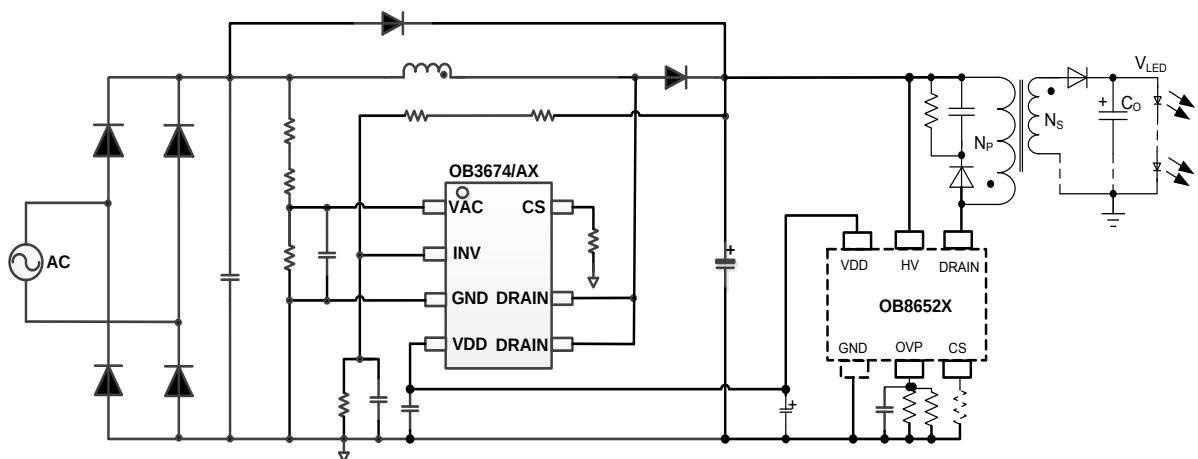
FEATURES

- Build-in GaN FET
- Low system cost and high efficiency
- High precision constant current regulation
- HV start-up and low standby power
- Low PF PSR with quasi-resonant (QR) operation
- Programmable CC regulation
- LED short circuit protection
- LED open loop protection
- Winding/diode short protection
- Cycle-by-cycle current limiting
- Built-in leading edge blanking (LEB)
- VDD under voltage lockout with hysteresis
- VDD over voltage protection
- Power up to 100W with PFC input voltage
- Thermal fold-back control

APPLICATIONS

- LED lighting

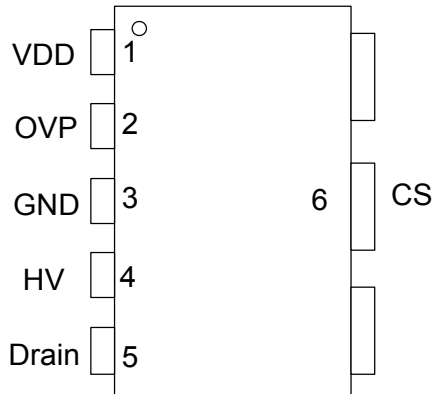
TYPICAL APPLICATION



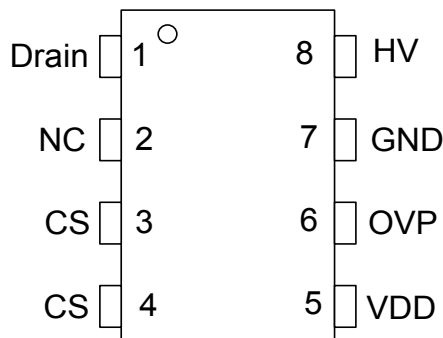
GENERAL INFORMATION

Pin Configuration

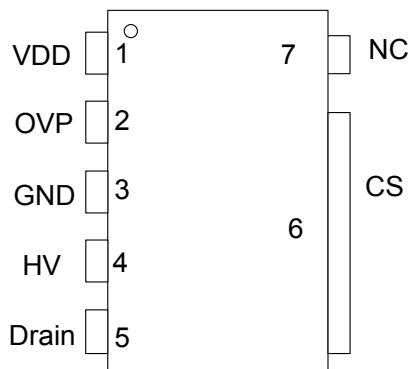
The pin map is shown as below for EASOP6.



The pin map is shown as below for SOP8.



The pin map is shown as below for LSOP8-7.



Ordering Information

Part Number	Description
OB8652VCQP-V	EASOP6, Halogen-free in Tube
OB8652VCQPA-V	EASOP6, Halogen-free in T&R
OB8652VCP-V	SOP8, Halogen-free in Tube
OB8652VCPA-V	SOP8, Halogen-free in T&R
OB8652UCP-H	SOP8, Halogen-free in Tube
OB8652UCPA-H	SOP8, Halogen-free in T&R
OB8652UCQP-H	EASOP6, Halogen-free in Tube
OB8652UCQPA-H	EASOP6, Halogen-free in T&R
OB8652CCQP-H	EASOP6, Halogen-free in Tube
OB8652CCQPA-H	EASOP6, Halogen-free in T&R
OB8652DIEP-H	LSOP8-7, Halogen-free in Tube

Note: All Devices are offered in Halogen-free Package if not otherwise noted.

Package Dissipation Rating

Package	R θ JA (°C/W)	R θ JC (°C/W)
EASOP6	68	8
SOP8	90	25
LSOP8-7	54	5

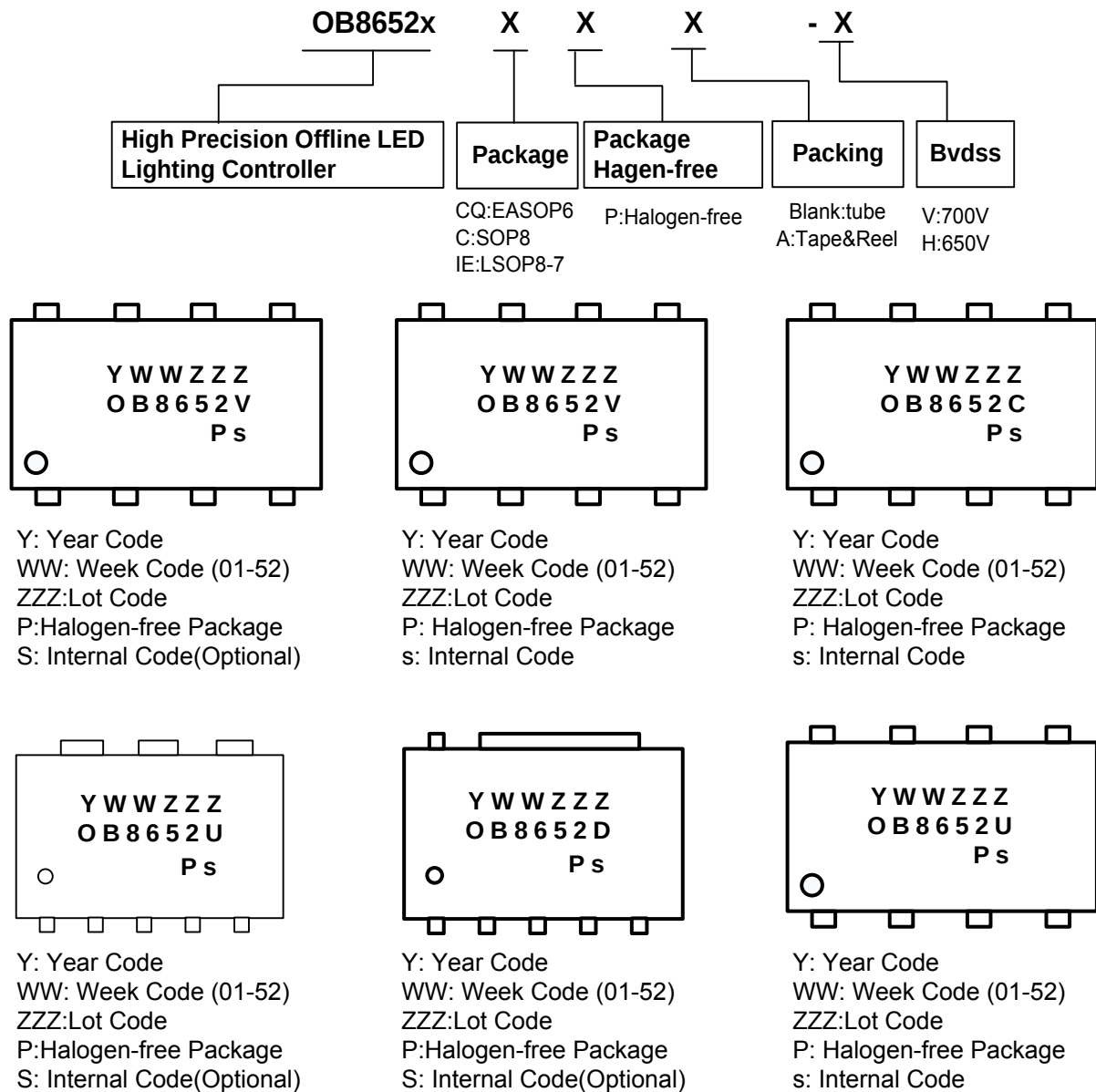
Absolute Maximum Ratings

Parameter	Value
VDD Voltage	-0.3 to 35V
OVP Voltage	-0.3 to 7V
CS Input Voltage	-0.3 to 7V
HV Input Voltage	-0.3 to 700V
Drain Voltage	-0.3 to BVdss
Pulsed Drain Voltage	-0.3 to 750V ^{Note2}
Min/Max Operating Junction Temperature T _J	-40 to 150 °C
Min/Max Storage Temperature T _{stg}	-55 to 150 °C
Lead Temperature (Soldering, 10secs)	260 °C

Note1: 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.

Note2: The pulsed Drain voltage is relaxed to 750V for surge ratings during repetitive events that are <300ns.

Marking Information



TERMINAL ASSIGNMENTS for EASOP6

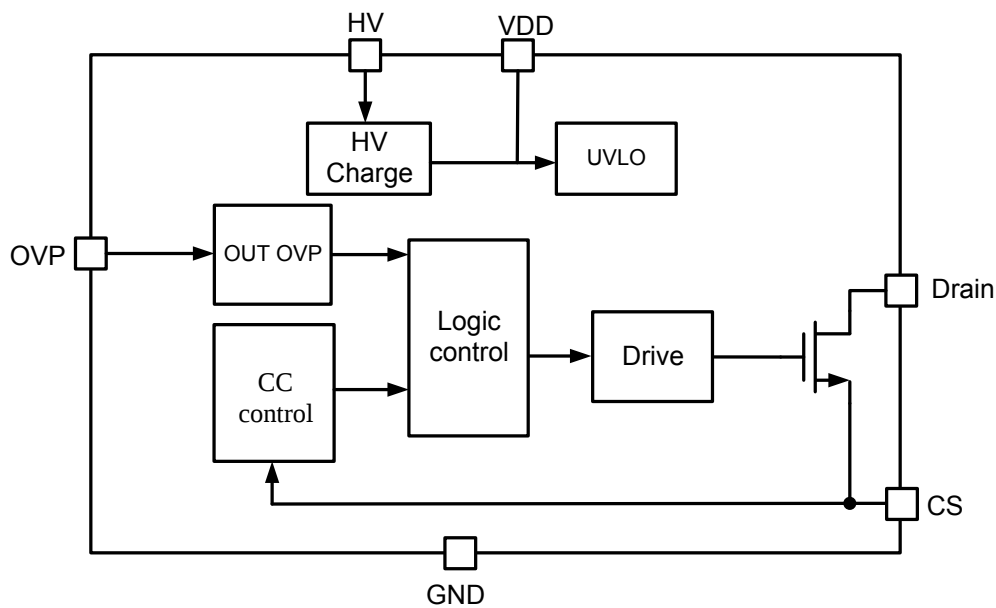
Pin Num	Pin Name	I/O	Description
1	VDD	P	Power supply input
2	OVP	I/O	Over voltage protection setting
3	GND	P	Power Ground
4	HV	P	HV power supply
5	Drain	P	GaN Drain terminal
6	CS	I/O	Current sense input.

TERMINAL ASSIGNMENTS for SOP8

Pin Num	Pin Name	I/O	Description
1	Drain	P	GaN Drain terminal
2	NC		
3/4	CS	I/O	Current sense input.
5	VDD	P	Power supply input
6	OVP	I/O	Over voltage protection setting
7	GND	P	Power Ground
8	HV	P	HV power supply

TERMINAL ASSIGNMENTS for LSOP8-7

Pin Num	Pin Name	I/O	Description
1	VDD	P	Power supply input
2	OVP	I/O	Over voltage protection setting
3	GND	P	Power Ground
4	HV	P	HV power supply
5	Drain	P	GaN Drain terminal
6	CS	I/O	Current sense input.
7	NC		

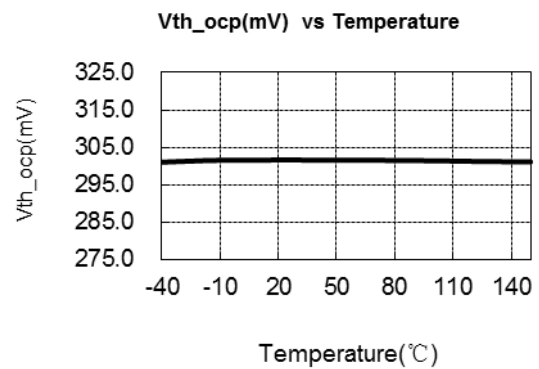
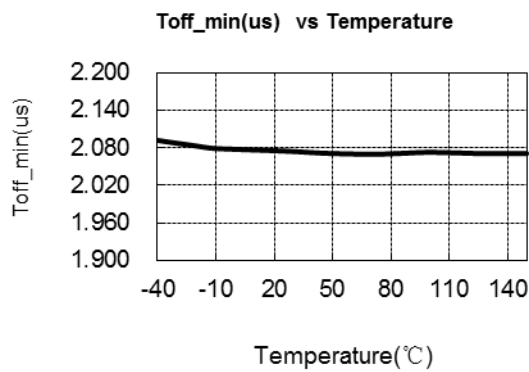
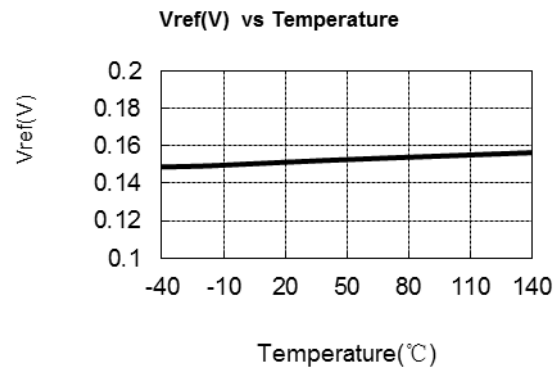
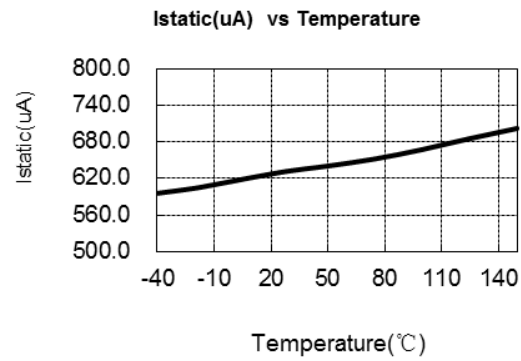
BLOCK DIAGRAM


ELECTRICAL CHARACTERISTICS

(TA = 25°C, VDD=16V, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VDD) Section						
Istatic	Static current	no loading		0.7		mA
UVLO(OFF)	VDD under voltage lockout exit			14		V
VDD_LOW	VDD under voltage when gate pre off			8.8		V
VDD_OVP	VDD Over Voltage Protection			27		V
VDD_CLAMP	VDD clamp voltage			26		V
Current Sense Input Section						
TLEB	LEB time			200		ns
Vth_ocp	Over Current Threshold			300		mV
OVP Section						
Vo_ovp	Vout voltage when OVP	Rovp=15K ohm, dem>2us, N=3		46		V
Vo_scp	Vout voltage when SCP	Rovp=15K ohm, dem>2us, N=3		5		V
QR Section						
Fmax	Maximum Clamping Frequency			250		KHz
Toff_max	Maximum Off Time			100		us
Toff_min	Minimum Off Time			2		us
Ton_max	Maximum On Time			5		us
Error Amplifier Section						
Vref	Error Amplifier Reference Voltage		0.147	0.150	0.153	V
OTP Section						
T _{thermal}	Thermal regulation threshold			140		°C

Product \ Parameter	BVdss(V) Drain-Source Breakdown Voltage			Id (A) Drain-Source Peak Current		
	Min	Typ.	Max	Min	Typ.	Max
OB8652VCQP-V	700					1.2
OB8652VCP-V	700					1.2
OB8652UCP-H	650					0.7
OB8652UCQP-H	650					0.7
OB8652CCQP-H	650					1.75
OB8652DIEP-H	650					2.6

CHARACTERIZATION PLOTS

OPERATION DESCRIPTION

OB8652x is a primary-side-control fly-back PWM power switch specialized for LED lighting application with a GaN FET integrated. It operates in primary side sensing and regulation, thus opto-coupler and TL431 are not required. OB8652x works at Quasi-Resonant operation with maximum working frequency clamping, which can improve the efficiency of LED lighting system design.

Start up Control

OB8652x integrates HV startup circuit. When power on, HV startup circuit charges the capacitor connecting between VDD and ground from HV pin. When the VDD voltage is higher than UVLO(OFF), OB8652x is turned on. When the VDD voltage is lower than VDD_LOW, OB8652x stops switching. At the startup, OB8652x operates at open loop and over-current protection is set cycle-by-cycle until close loop is built up.

LED Constant Current Regulation

The LED output current can be approximated as:

$$I_{LED} = \frac{N}{2} \cdot \frac{V_{ref}}{R_{CS}} \quad (1)$$

N — Turn ratio of primary side winding to secondary side winding.

R_{CS} — The sensing resistor connected between the GaN FET source and GND.

V_{ref} — Internal reference voltage.

Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting (OCP) is offered in OB8652x. The switching current is detected by a sense resistor connected between the CS pin and GND. An internal leading edge blanking circuit chops off the sense voltage spike at initial GaN on state due to snubber diode reverse recovery. The current limit comparator is disabled at this blanking time and thus the initial GaN cannot be turned off during this blanking time.

VDD Over Voltage Protection

When VDD is higher than 27V (typical), VDD OVP protection is triggered and OB8652x stops switching. The fault condition can not be removed until the VDD is powered down.

Programmable LED Open Circuit Protection / OVP

The OB8652x provide programmable output over voltage protection. When LED string is open, output over voltage protection is triggered and OB8652x stops switching. The fault condition can not be removed until the VDD is powered down. The threshold voltage of OVP is set by a resistor R_{ovp} connected between OVP pin and ground. The resistance is given by

$$R_{ovp} = \frac{N \cdot V_{o_ovp} + 300V}{29.1mA} \quad (2)$$

Where N is the ratio of transformer between primary winding and secondary winding, V_{o_ovp} is the output voltage when output is open. And the resistance range of R_{ovp} should be 11.5K~23K for V_{o_ovp} setting.

LED Short Circuit Protection

When LED string is short, LED short circuit protection is triggered and OB8652x stops switching. The fault condition can not be removed until the VDD is powered down.

Winding/diode short protection

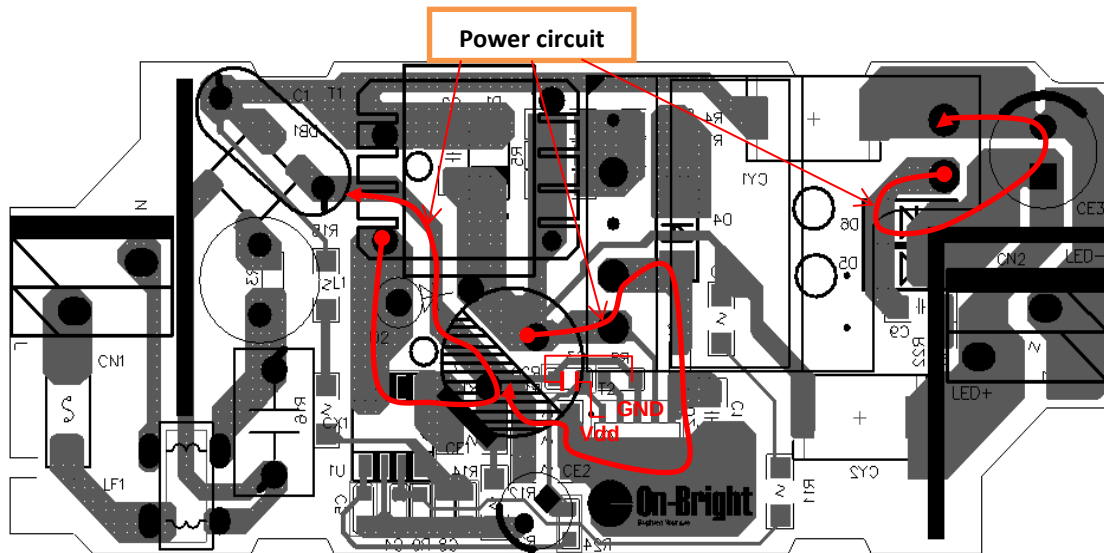
When winding/diode is short, winding/diode short protection is triggered and OB8652x stops switching. The fault condition can not be removed until the VDD is powered down.

Thermal Fold-back Protection

OB8652x provides thermal fold-back function to control LED output current. When temperature is up to 140°C (typical) and the output current of system will be adjusted according to the sensed temperature. The output current will be reduce to about half of the setting value at 160°C (typical).

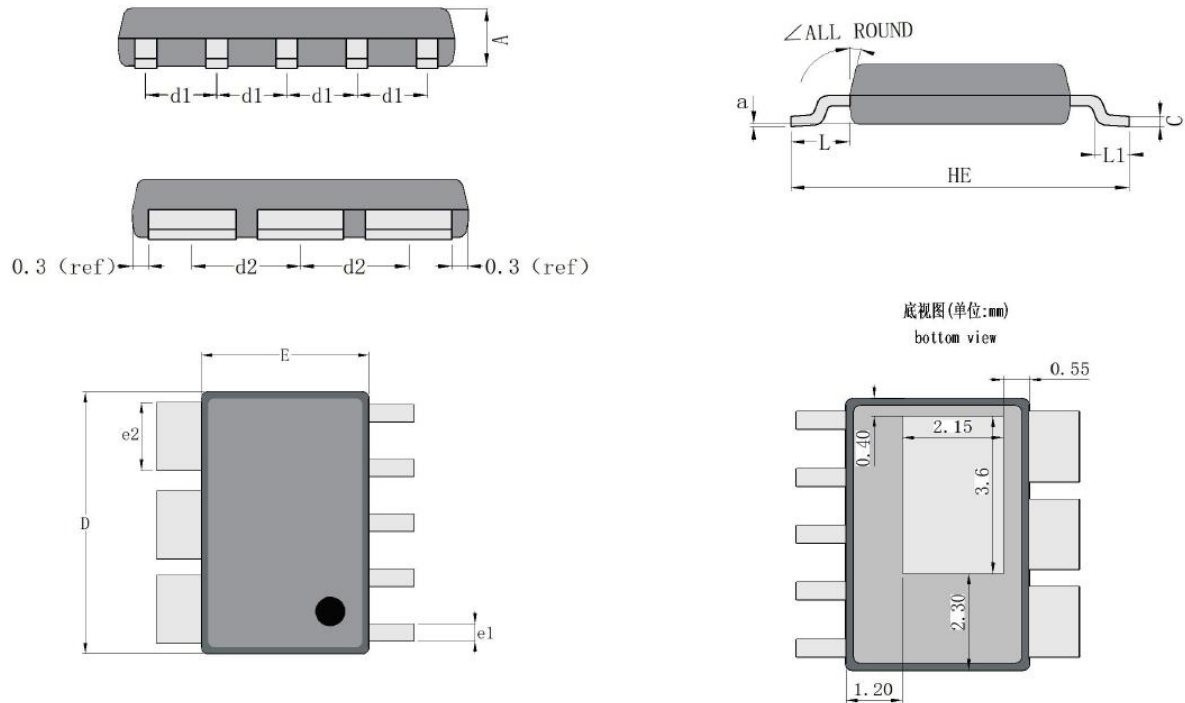
Layout Consideration

- 1) As shown in the picture, the power loop should be as small as possible to reduce the high-frequency noise.
- 2) The capacitor should be placed to the nearest location between VDD and GND pins.
- 3) In order to reduce interference from power ground, The ground of CS resistor should be connected with the IC GND first, then tied together at negative pole of the input capacitor.



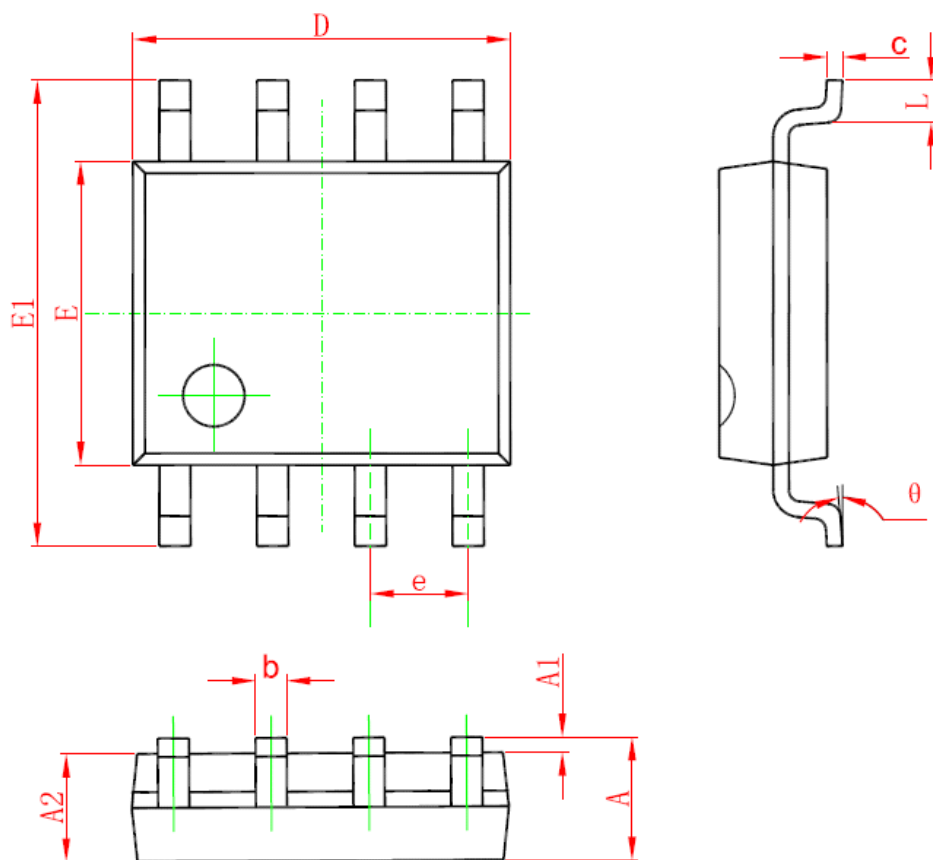
PACKAGE MECHANICAL DATA

EASOP6

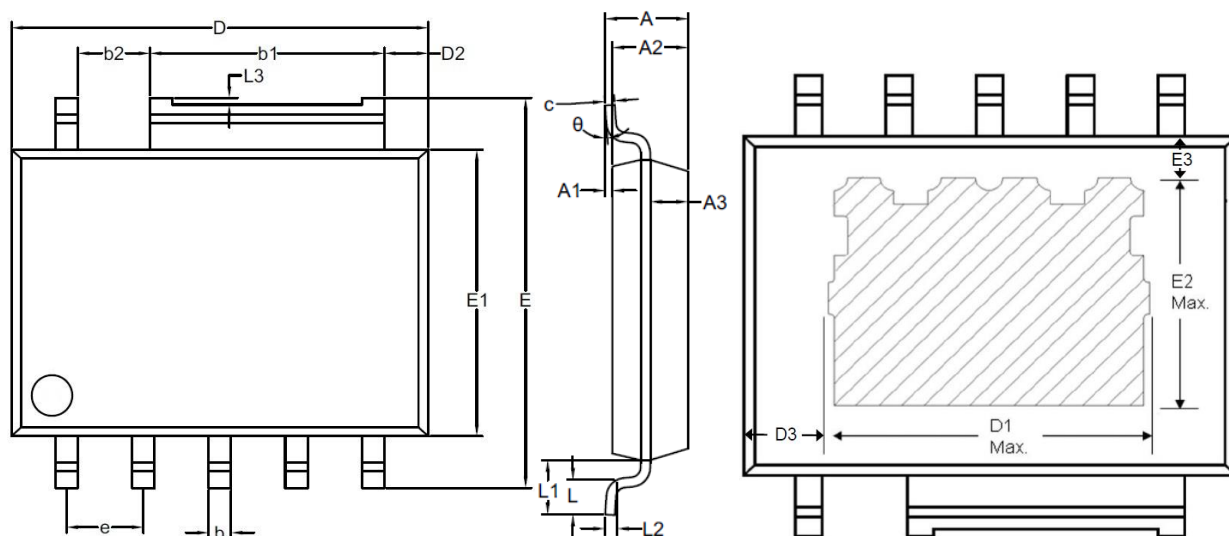


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.05	1.25	0.041	0.049
C	0.15	0.22	0.006	0.009
D	6.00	6.40	0.236	0.252
E	3.70	4.10	0.146	0.161
HE	5.90	6.10	0.232	0.240
d1	1.25	1.35	0.049	0.053
d2	1.95	2.05	0.077	0.081
e1	0.35	0.45	0.014	0.018
e2	1.55	1.65	0.061	0.065
L	0.95	1.15	0.037	0.045
L1	0.40	0.80	0.016	0.031
a	0.20 (REF)		0.008 (REF)	

SOP8



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°

LSOP8-7


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

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