## GENERAL DESCRIPTION

OB2013x is a high performance and tightly integrated secondary side synchronous rectifier for switch mode power supply system. It combines a much lower voltage drop N-channel MOSFET to emulate the traditional diode rectifier at the secondary side of Flyback converter, which can reduce heat dissipation, increases output current capability and efficiency and simplify thermal design. OB2013x can support low system output voltage down to 2V at constant current mode. With its versatility and optimization, OB2013x can be used in various switch mode power supply topologies including secondary-side control topology and primary-side control topology.

The drain-to-source voltage of SR MOSFET is sensed to control the turn on and off of the SR MOSFET. To reduce SR falling time and turn off the integrated N-channel SR switch in proximity of the zero current transition, soft gate is implemented in OB2013x, which would pull down the gate voltage level before being turned off completely.

OB2013x is offered in SOP8 package.

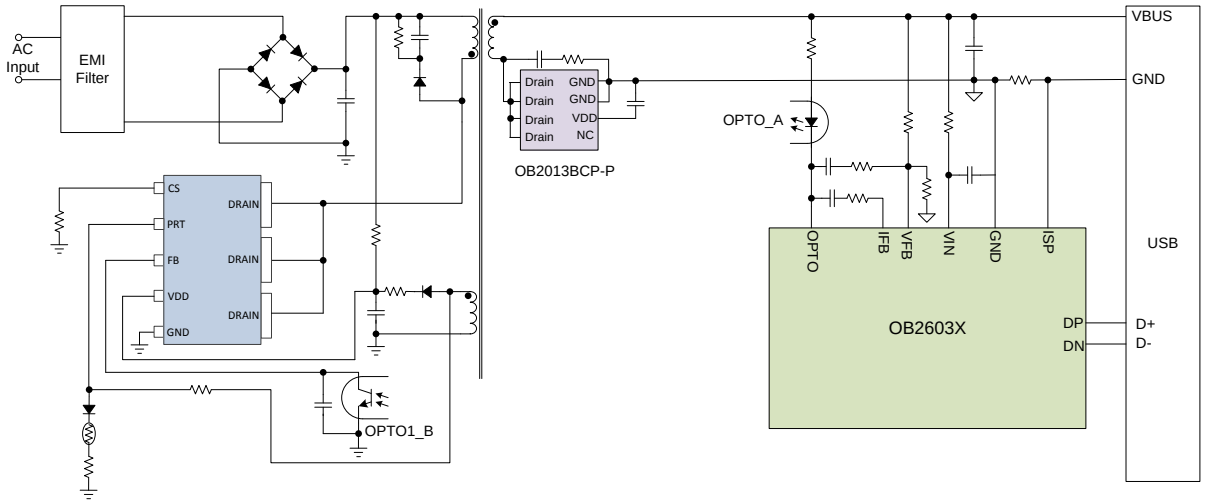
## FEATURES

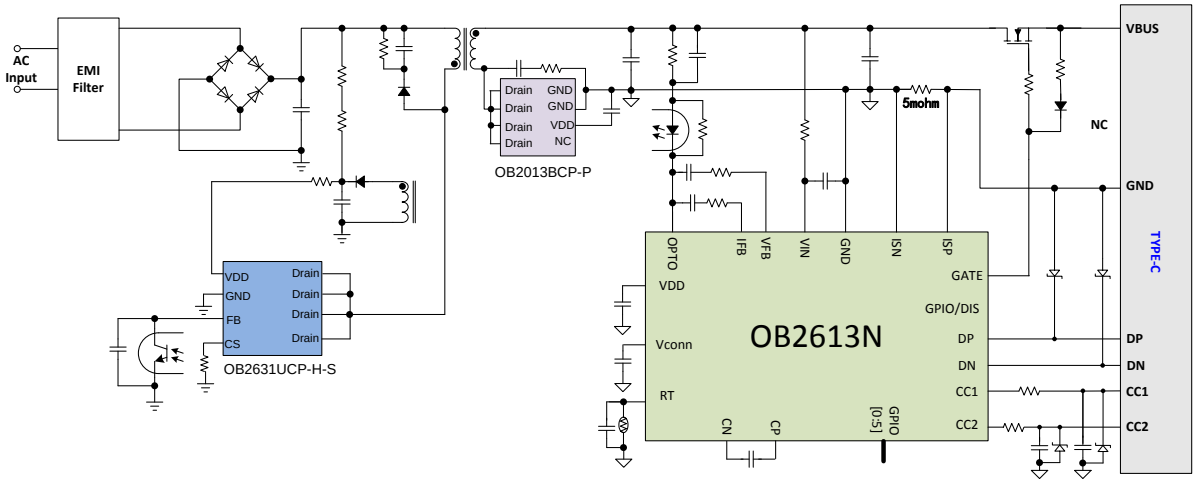
- Secondary-side synchronous rectifier optimized for 12V system output
- Suitable for CCM, DCM, QR operation
- Soft gate drive for fast and zero current turn-off
- Accurate secondary side MOSFET Vds sensing
- Vds slope detection effectively avoid the ring impact induced by parasitic elements
- Up to 200kHz operation frequency
- Support low side and high side application
- VDD UVLO protection

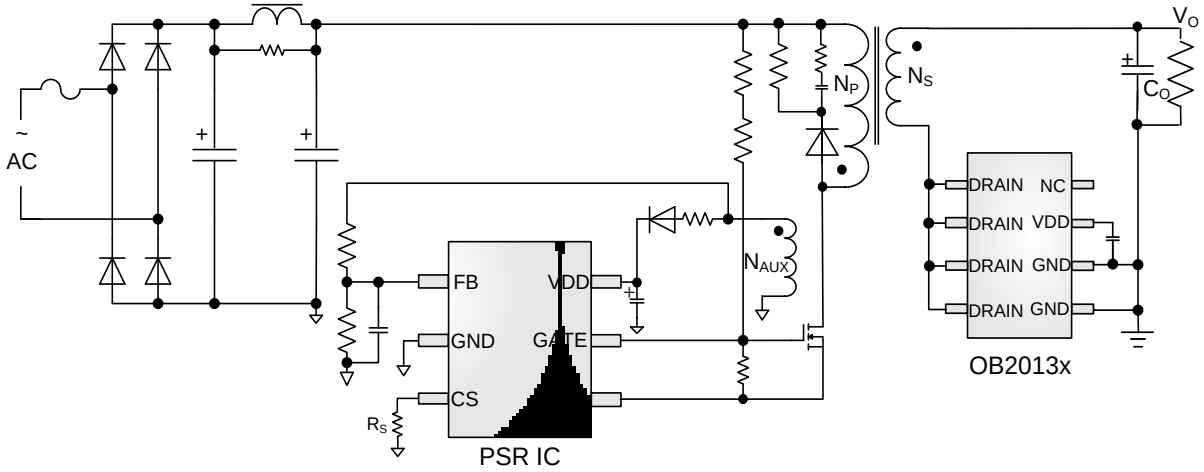
## APPLICATIONS

- AC/DC 12V adaptors
- Low voltage rectification circuits

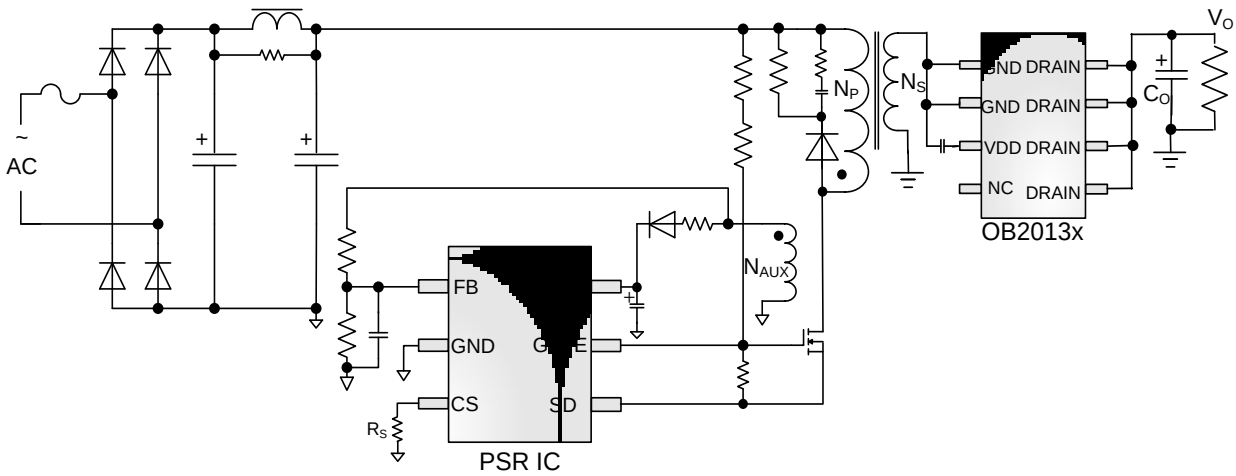
## TYPICAL APPLICATION






Low side application

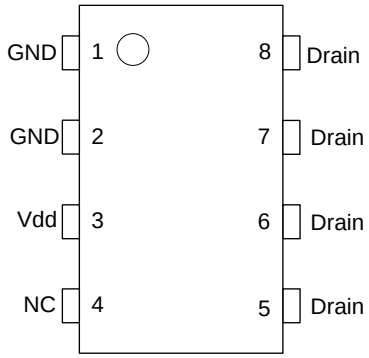



High side application

## GENERAL INFORMATION

### Pin Configuration

The OB2013x is offered in SOP8 package, shown as below.




### Ordering Information

| Part Number | Description |
|---|---|
| OB2013BCP-P | SOP8, Halogen-free in Tube |
| OB2013BCPA-P | SOP8, Halogen-free in T&R |
| OB2013CCP-P | SOP8, Halogen-free in Tube |
| OB2013CCPA-P | SOP8, Halogen-free in T&R |
| OB2013ECP-P | SOP8, Halogen-free in Tube |
| OB2013ECPA-P | SOP8, Halogen-free in T&R |

### Package Dissipation Rating

| Package | RθJA(℃/W) | RθJC(℃/W) |
|---|---|---|
| SOP8 | 85 | 25 |

### Absolute Maximum Ratings

| Parameter | Value |
|---|---|
| Vdd pin | -0.6V to 7V |
| Drain pin | -2.5V to BVdss Note3 |
| Min/Max Operating Junction Temperature TJ | -40 to 150 ℃ |
| Operating Ambient Temperature $T_A$ | -20 to 85 ℃ |
| Min/Max Storage Temperature Tstg | -55 to 150 ℃ |
| Lead Temperature (Soldering, 10secs) | 260 ℃ |

**Note1:** -0.6V is self-clamped

**Note2:** 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.

**Note3:** -2.5V applies to minimum duty cycle during normal operation only.

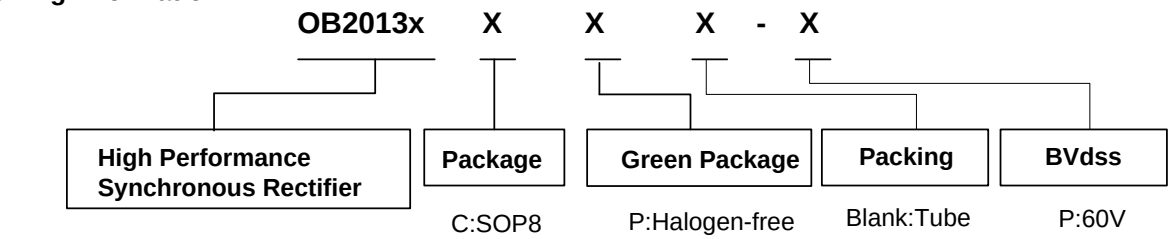
### Output Power Table Note4/5

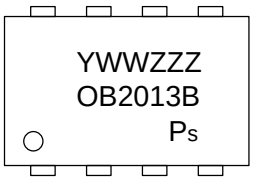
| Part Number | Maximum Output Current |
|---|---|
| OB2013B | 3A |
| OB2013C | 2A |
| OB2013E | 1.5A |

**Note4:** Maximum practical continuous power in a charger designed with sufficient drain pattern as a heat sink, at 40℃ ambient.

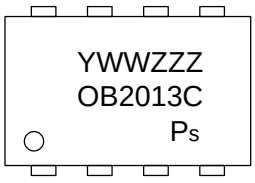
**Note5:** Maximum practical continuous power in a charger designed with sufficient drain pattern as a heat sink and double-sided PCB at 40℃ ambient.

### Marking Information

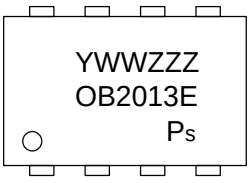



Y:Year Code
WW:Week Code(01-52)
ZZZ:Lot Code
P:Halogen-free Package
S:Internal Code(Optional)




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

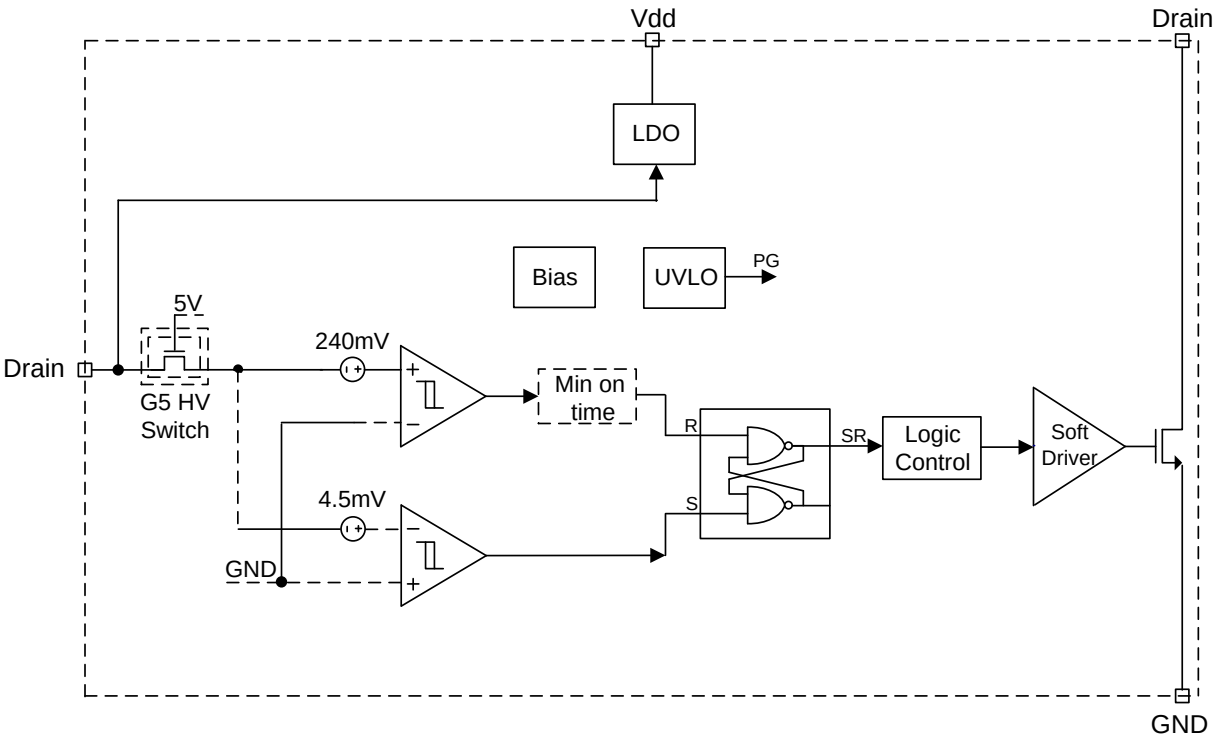



Y:Year Code
WW:Week Code(01-52)
ZZZ:Lot Code
P:Halogen-free Package
S:Internal Code(Optional)

## TERMINAL ASSIGNMENTS

| Pin Name | I/O | Description |
|---|---|---|
| GND | P | Ground |
| Drain | I/O | SR Mosfet drain pin. This pin is connected to secondary-side winding of transformer |
| Vdd | P | Power Supply |
| NC | NC | Not connected |

## BLOCK DIAGRAM



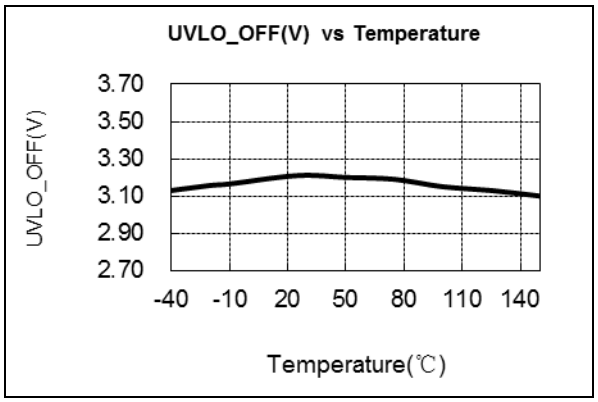
## ELECTRICAL CHARACTERISTICS

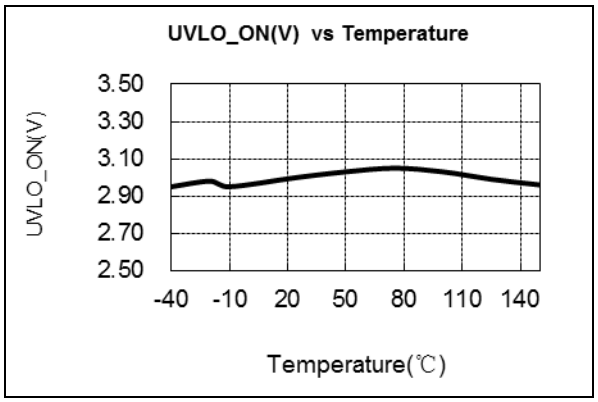
($T_A$ = 25℃, Vin=5V, unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| **Supply Voltage (Vin)** | | | | | | |
| I_Vin_operation | Operation current | Frequency@Drain=65KHz, Vdd=5V | | 1.2 | 1.5 | mA |
| | | Frequency@Drain=2KHz, Vdd=5V | | 0.5 | 0.8 | mA |
| Vdd_regulation_mini | Minimum Vdd regulation voltage | Vdd regulation voltage with 5V output @Drain<300Hz | | 4.0 | | V |
| Vdd_regulation | Vdd regulation voltage | Vdd regulation voltage with 12V output @Drain<300Hz | | 5.2 | | V |
| UVLO(ON) | Vdd Under Voltage Lockout Entry | | 2.8 | 3.0 | 3.2 | V |
| UVLO(OFF) | Vdd Under Voltage Lockout Exit (Recovery) | | 3.0 | 3.2 | 3.4 | V |
| **Drain Section** | | | | | | |
| Vth_SR_act | SR MOSFET turn on threshold voltage detection at Drain | | | -240 | | mV |
| Vth_SR_deact | SR MOSFET turn off threshold voltage detection at Drain | | | -4.5 | | mV |
| Vds_regulation | Vds regulation voltage | | | -38 | | mV |
| Tvds_slope_det_widown | Vds slope detection time window | | | 160 | | ns |
| T_minimum_on | SR MOSFET minimum on time | | 1.2 | 1.5 | 1.8 | us |
| Tdelay_on | SR MOSFET turn-on propagation delay | SR MOSFET turn-on fast path | | 50 | | ns |
| | | SR MOSFET turn-on slow path | | 210 | | ns |
| Tdelay_off | SR MOSFET turn-off propagation delay | | | | 30 | ns |

| **SR Mosfet Section** | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** / **Product** | **BVdss(V)** MOSFET Drain-Source Breakdown Voltage | | | **Rds,on(mΩ)** On resistance | | |
| | Min | Typ. | Max | Min | Typ. | Max |
| OB2013BCP-P | 60 | | | | 13 | |
| OB2013CCP-P | 60 | | | | 20 | |
| OB2013ECP-P | 60 | | | | 30 | |

## CHARACTERIZATION PLOTS



## Operation Description

OB2013x is a high performance and versatile synchronous rectifier. It drives a much lower voltage drop N-channel MOSFET to emulate the traditional diode rectifier, which can reduce heat dissipation, increase output current capability and efficiency, and simplify the thermal design.

**Startup and under voltage lockout (UVLO)**

OB2013x implements UVLO function during startup. When Vdd rises above UVLO(off), refer to Fig.1 the IC wakes up from under voltage lock out state and enter normal operation. When Vdd drops below UVLO(on), refer to Fig.2 the IC enter under voltage lock out state again and the SR gate is pulled low by 51K resistor on chip. In addition, there is a hysteresis window between UVLO(off) and UVLO(on) to make system work reliably.

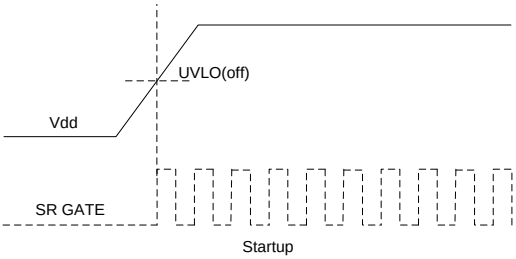



Fig.1 System start up timing diagram

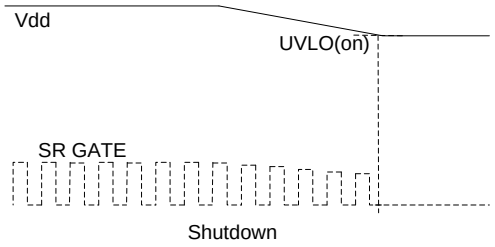



Fig.2 System shut down timing diagram

**Synchronization rectifier**

OB2013x controls the turn-on and turn-off of synchronization rectifier MOSFET (SR MOSFET) by detection of drain-source voltage of SR MOSFET. When demagnetization of transformer starts, the secondary-side current will flow through the body diode of SR MOSFET and the voltage at the drain will drop to below -700mV (typical). As soon as OB2013x detects this negative voltage, the driver voltage is pulled high to turn on the SR MOSFET .

After the SR MOSFET is turned on, the drain voltage of SR MOSFET begins to rise based on its Rdson and secondary-side current. The drain voltage becomes higher with demagnetization goes on. When the drain voltage rises above SR turn off threshold -4.5mv (typical), the gate of SR MOSFET will be pulled down to ground very quickly after short turn-off delay, refer to Fig.3.

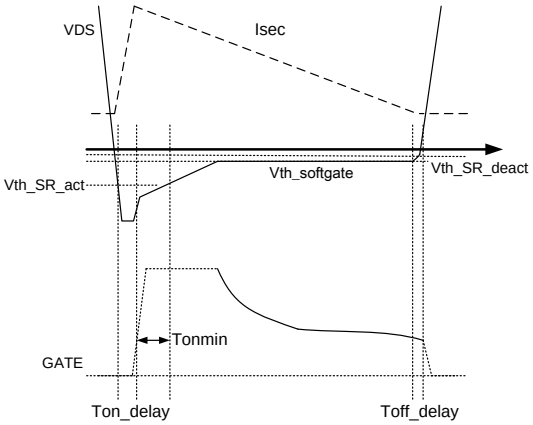



Fig.3 Synchronous Rectification Operation

**Soft Gate Control**

Once the SR MOSFET is turned on, the gate drive voltage would vary depending on Vds voltage. With the decrease of the secondary-side current, the VDS will rise above Vds_regulation -38mV (typical), and the soft gate control would be enabled. Then the gate voltage is pulled lower to enlarge the Rds(on) of the synchronous MOSFET, therefore VDS is adjusted to remain at -38mV during the rest of demagnetization time. The soft gate scheme can guarantee zero current turn off and save the pull-down time resulting in higher turn-off speed.

**Minimum on time**

To avoid effectively false turn-off due to high frequency interference caused by parasitic element at the start of secondary-side demagnetization, OB2013x offers a blanking time(minimum turn-on time) of 1.5μs.

**PCB Layout Consideration**

The following rules should be followed in OB2013x PCB Layout:

**The Area of Power Loop**: The area of the secondary current loop including the OB2013x and the output capacitor should be as small as possible to reduce EMI radiation. And the PCB trace must be wide and short for thermal consideration, refer to Fig.4.

**Bypass Capacitor:** The bypass capacitor on Vdd should be placed as close as possible to the Vdd pin. And the negative node of Vdd capacitor should be connected directly to the GND pin (White region as shows in Fig.4).

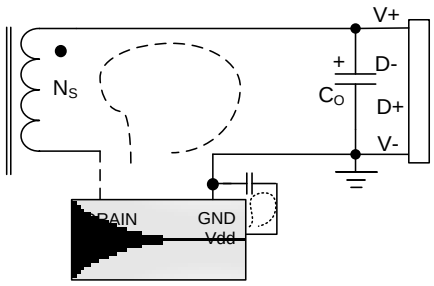
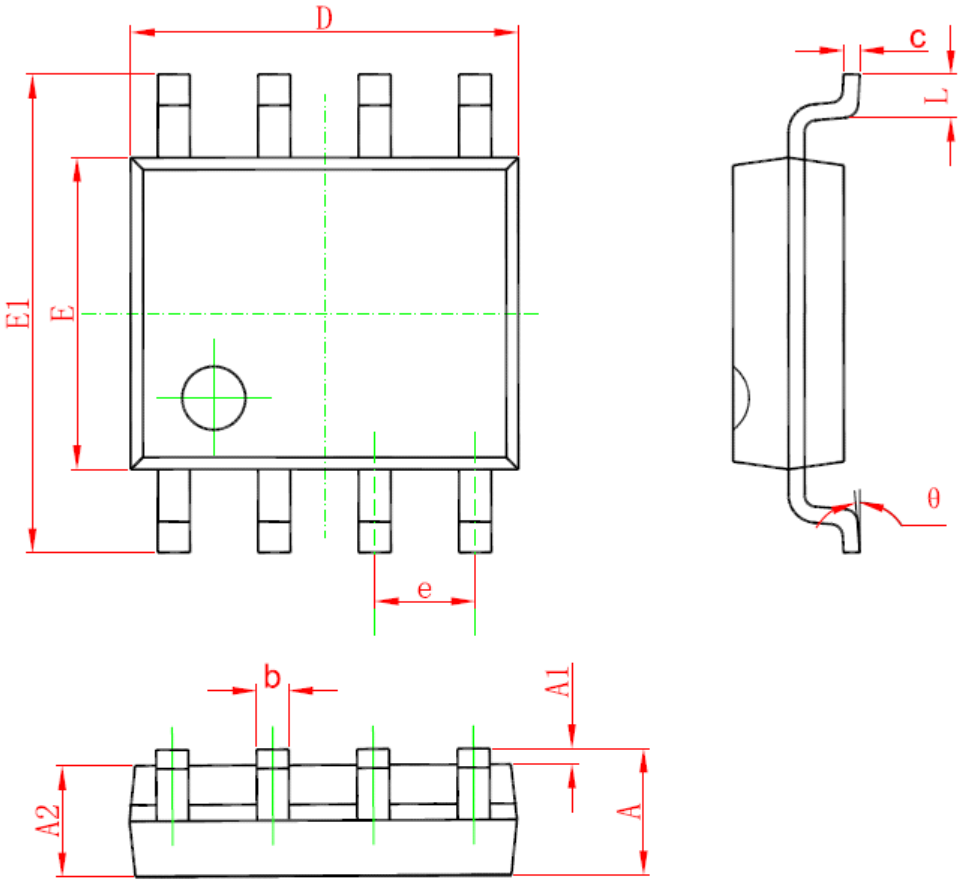



Fig.4 Proper Loop at the Secondary Side of the Flyback with OB2013x

## PACKAGE MECHANICAL DATA

### 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 | 0.100 | 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 | 0º | 8º | 0º | 8º |

## 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.

WARRANTY INFORMATION
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.

LIFE SUPPORT
On-Bright Electronics Corp.'s products are not designed to be used as components in devices intended to support or sustain human life. On-bright Electronics Corp. will not be held liable for any damages or claims resulting from the use of its products in medical applications.

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.