

## GENERAL DESCRIPTION

OB2001 is a high performance and tightly integrated secondary side synchronous rectification controller and driver used for secondary side rectification in switch mode power supply system. It drives 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. OB2001 can support low system output voltage down to 2V at constant current mode.

It is suitable for multiple mode applications including discontinuous conduction mode and quasi-resonant mode. With its versatility and optimization, OB2001 can be used in various switch mode power supply topologies including secondary-side control topology and primary-side control topology.

From the information on the secondary side of the isolation transformer, OB2001 generates a driving signal with dead time with respect to the primary side PWM signal to turn the integrated N-channel SR switch on and off in proximity of the zero current transition with the help of smart driver voltage control. It is optimized for 5V output voltage.

The externally adjustable minimum on time and property off time control scheme effectively avoid the ring impact induced by parasitic elements so that a reliable and noise free operation of the SR system is insured.

OB2001 is offered in SOT23-6 package.

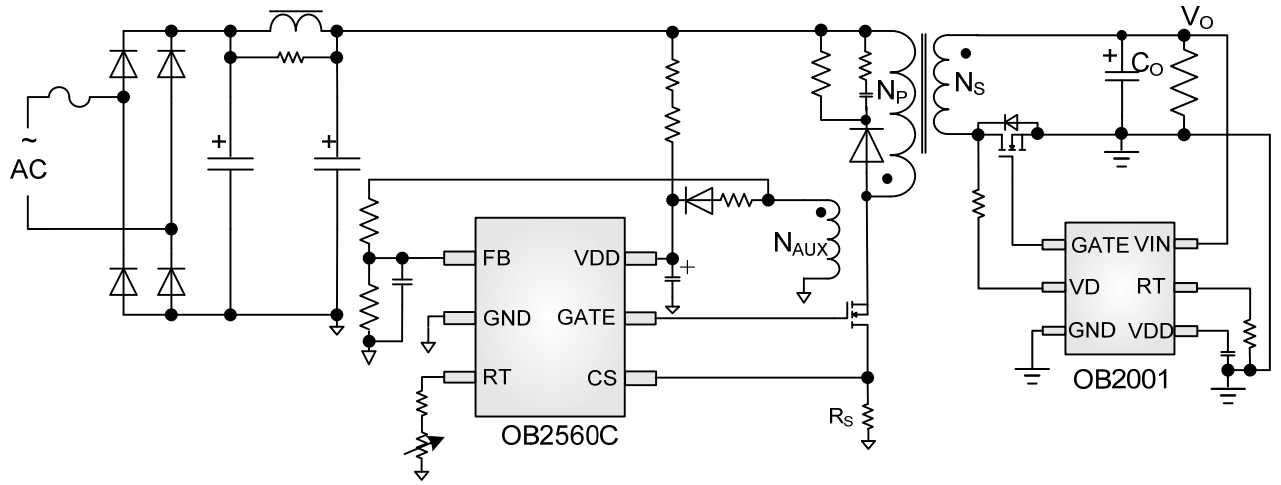
## FEATURES

- Secondary-side synchronous rectification controller optimized for 5V output system
- Suitable for DCM, QR operation
- Accurate secondary side MOSFET Vds sensing
- Low cost small size CC/CV mode support
- Up to 200kHz operation frequency
- 3A/2A peak current sink/source driver capability
- Output voltage overshoot control
- VDD UVLO protection

## APPLICATIONS

- AC/DC 5V adaptors
- Cell phone charger
- 5V Bias supply
- Low voltage rectification circuits

## TYPICAL APPLICATION

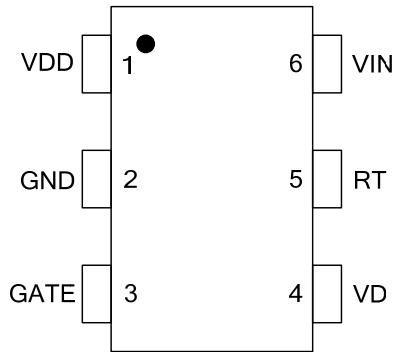


## GENERAL INFORMATION

### Pin Configuration

The OB2001 is offered in SOT23-6 package, shown as below.

SOT23-6



### Absolute Maximum Ratings

| Parameter   | Value                         |
|---|-------------------------------|
| Vin pin   | -0.6V to 7V                   |
| VDD pin   | -0.6V to 7V                   |
| VD pin  | -2.5V to 50V <sup>Note2</sup> |
| Gate pin  | -0.6V to 7V                   |
| RT pin  | -0.6V to 7V                   |
| Min/Max Operating Junction Temperature T <sub>J</sub> | -40 to 150 °C                 |
| Operating Ambient Temperature T <sub>A</sub>          | -20 to 85 °C                  |
| Min/Max Storage Temperature T <sub>stg</sub>          | -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:** -2.5V applies to minimum duty cycle during normal operation only.

### Ordering Information

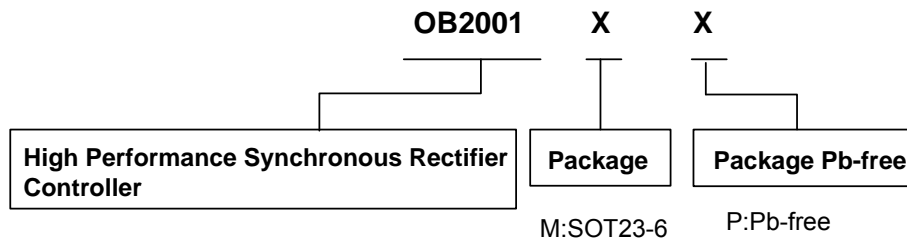
| Part Number | Description             |
|-------------|-------------------------|
| OB2001MP    | SOT23-6, Pb-free in T&R |

### Package Dissipation Rating

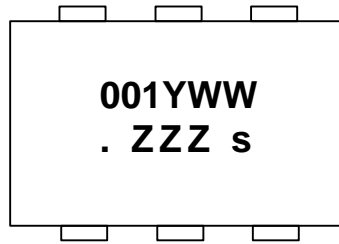
| Package | R <sub>θJA</sub> (°C/W) |
|---------|-------------------------|
| SOT23-6 | 200                     |

### Recommended Operating Range

| Symbol | Parameter          | Min/Max    |
|--------|--------------------|------------|
| VDD    | VDD Supply Voltage | 4V to 5.5V |



**Marking Information**

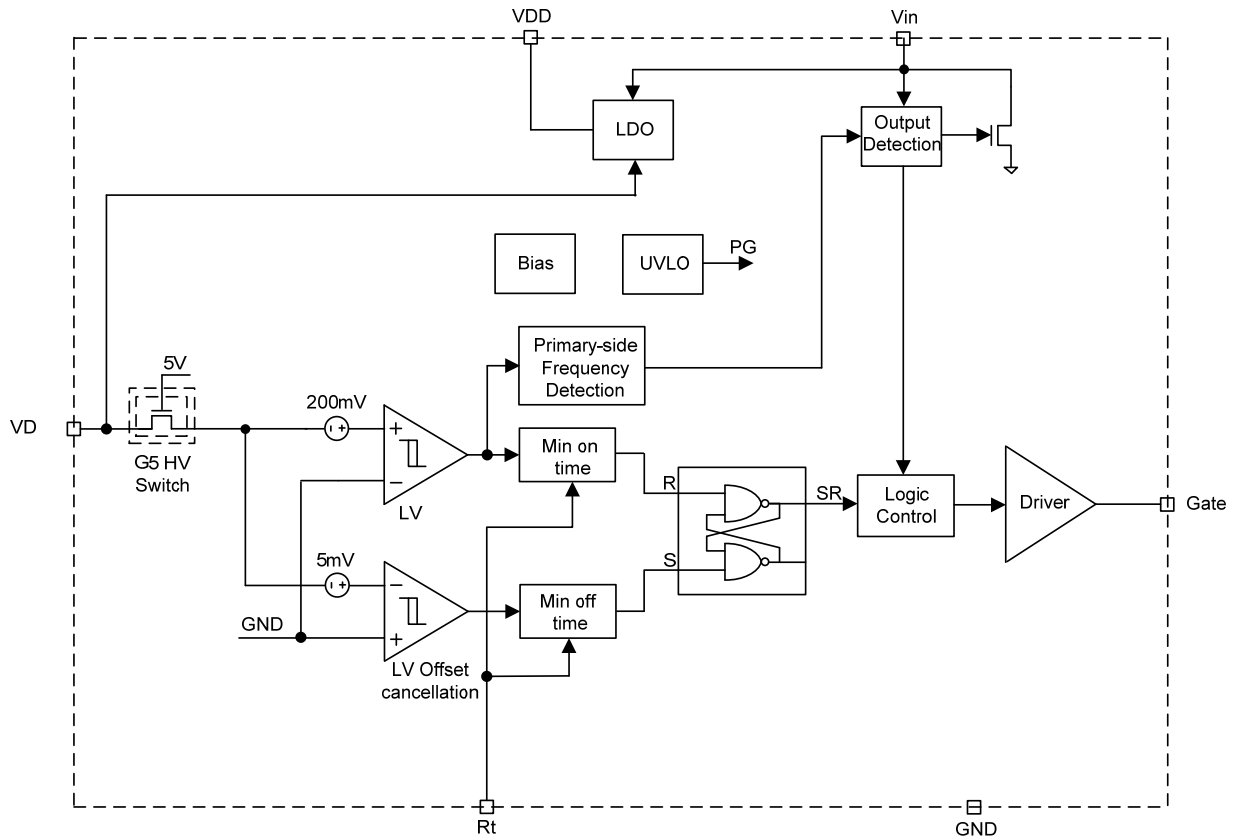


Y:Year Code  
 WW:Week Code(01-52)  
 ZZZ: Lot Code  
 s: Internal Code(Optional)

**TERMINAL ASSIGNMENTS**

| Pin Name | I/O | Description   |
|----------|-----|---|
| VD       | I   | This pin is connected to external n-channel MOSFET drain                  |
| Gate     | O   | Driver output for external N-channel MOSFET                               |
| GND      | P   | Ground.   |
| VDD      | P   | Power Supply  |
| Vin      | I   | System output voltage detection   |
| RT       | O   | Minimum on time control pin. A resistor is connected from this pin to GND |

## BLOCK DIAGRAM

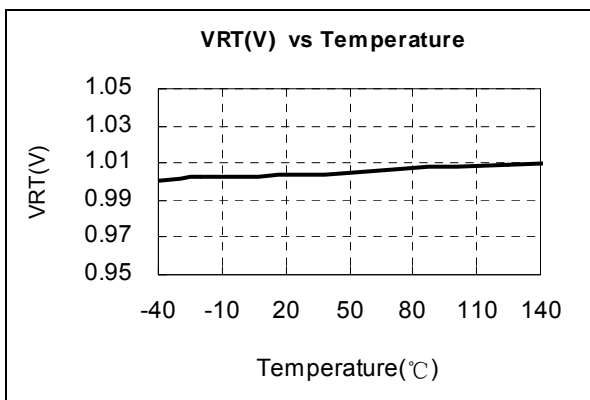
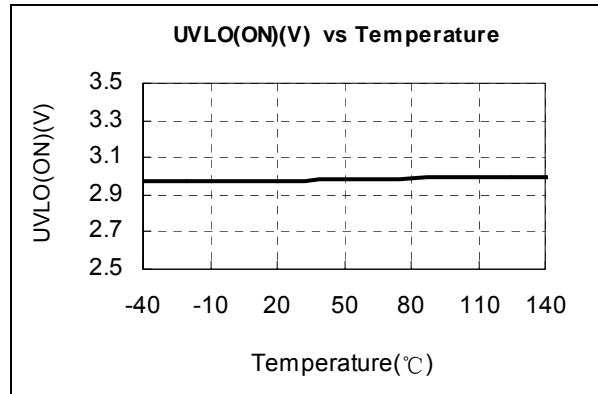
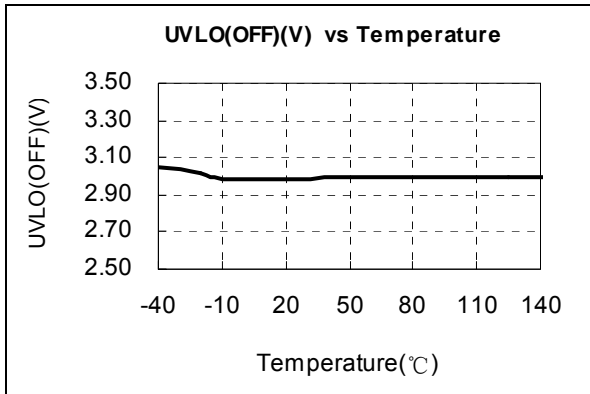


### ELECTRICAL CHARACTERISTICS

(T<sub>A</sub> = 25°C, VDD=5V, unless otherwise noted)

| Symbol                           | Parameter   | Test Conditions   | Min  | Typ  | Max  | Unit |
|----------------------------------|---|---|------|------|------|------|
| <b>Supply Voltage (VDD)</b>      |   |   |      |      |      |      |
| I_Vdd_operation                  | Operation current   | Frequency@Vd=65KHz, VD<br>D=5V, 1nF Cap load at<br>GATE.    |      | 1.5  | 2.0  | mA   |
|                                  |   | Frequency@Vd=2KHz, VDD<br>=5V, No load at GATE.             |      | 0.5  | 0.7  | mA   |
| Vdd_regulation_mini              | Minimum Vdd regulation<br>voltage   |   |      | 4.2  |      | V    |
| UVLO(ON)                         | VDD Under Voltage Lockout<br>Entry  |   | 2.8  | 3.0  | 3.2  | V    |
| UVLO(OFF)                        | VDD Under Voltage Lockout<br>Exit (Recovery)  |   | 2.9  | 3.1  | 3.3  | V    |
| <b>VD Detection Section</b>      |   |   |      |      |      |      |
| Vth_SR_act                       | SR MOSFET turn on threshold<br>voltage detection at VD  |   |      | -200 |      | mV   |
| Vth_SR_deact                     | SR MOSFET turn off threshold<br>voltage detection at Vd   |   |      | -5   |      | mV   |
| Tdelay_on                        | SR MOSFET turn-on<br>propagation delay  |   |      |      | 100  | ns   |
| Tdelay_off                       | SR MOSFET turn-off<br>propagation delay   |   |      |      | 75   | ns   |
| T_minimum_on                     | SR MOSFET minimum on time   | RT=25KΩ   |      | 1.9  |      | Us   |
| <b>RT Section</b>                |   |   |      |      |      |      |
| Vrt                              | Voltage reference at RT pin   |   | 0.95 | 1    | 1.05 | V    |
| <b>Overshoot Control Section</b> |   |   |      |      |      |      |
| Vo_High_clamp_1 <sup>st</sup>    | System output 1st overshoot<br>clamp control trigger voltage at<br>Vin with SR frequency lower<br>than 7.5KHz |   |      | 5.65 |      | V    |
| Vo_High_clamp_2 <sup>nd</sup>    | System output 2 <sup>nd</sup> overshoot<br>clamp control trigger voltage at<br>Vin                            |   |      | 6.15 |      | V    |
| Ivo_High_clamp                   | System output overshoot clamp<br>current  |   |      | 100  |      | mA   |
| <b>GATE driver Section</b>       |   |   |      |      |      |      |
| VOH                              | Output high level @ VDD=5V  |   | 4.5  |      |      | V    |
| VOL                              | Output low level @ VDD=5V   |   |      |      | 1    | V    |
| Rds_on                           | Pull-up driver  |   |      | 2.5  |      | Ω    |
|                                  | Pull-down driver  |   |      | 1.5  |      | Ω    |
| Isouce                           | Source current  |   |      | 2    |      | A    |
| Isink                            | Sink current  |   |      | 3    |      | A    |
| Tf                               | Falling time  | Gate voltage falling from 4V<br>to 1V @ C <sub>L</sub> =1nF |      | 30   |      | ns   |
| Tr                               | Rising time   | Gate voltage rising from 1V<br>to 4V @ C <sub>L</sub> =1nF  |      | 30   |      | ns   |

**CHARACTERIZATION PLOTS**



## Operation Description

OB2001 is a high performance and tightly integrated secondary side synchronous rectification controller operating in DCM and QR mode and driver in switch mode power supply system. It drives a much lower voltage drop N-channel MOSFET to emulate the traditional diode rectifier, which can reduce heat dissipation, increases output current capability and efficiency, and simplify thermal design.

### Startup and under voltage lockout(UVLO)

OB2001 implements UVLO function during startup. When VDD rises above UVLO(off), the IC wakes up from under voltage lock out state and enter normal operation. When VDD drops below UVLO(on), the IC enter under voltage lock out state again and the SR gate is pulled low by 10K resistor on chip. In addition, there is a hysteresis window between UVLO(off) and UVLO(on) to make system work reliably.

### Synchronization rectifier

OB2001 controls the turn-on and turn-off of synchronization rectifier MOSFET (SR MOSFET) by detection of drain-source voltage. 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 about -700mV. As soon as OB2001 detects this negative voltage, the driver voltage is pulled high to turn on the SR MOSFET after very short delay time about 100nS, refer to Fig.1.

After the SR MOSFET is turned on, the drain voltage of SR MOSFET begins to rise based on its R<sub>dson</sub> and secondary-side current. The drain voltage becomes higher with demagnetization going on. When the drain voltage rises above -5mV, the driver voltage will be pulled down to ground very quickly, refer to Fig.1

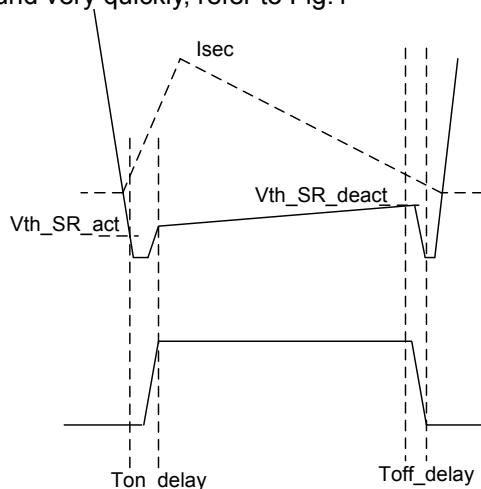


Fig.1 SR MOSFET turn-on and turn-off timing

### Adjustable minimum on time

OB2001 offers adjustable minimum on time control. This timer can avoid effectively false turn-off due to high frequency interference caused by parasitic element at the start of secondary-side demagnetization.

$$T_{onmin} = 8 \cdot RT \cdot 10E(-11)$$

### Adaptive minimum off time

At the end of demagnetization, SR MOSFET will be turn off. The remaining current will flow through body diode again, which may result in negative voltage (about -700mV) appears at drain and SR MOSFET will turn on again. In addition, the resonance oscillation between the magnetization inductance and parasitic capacitance after demagnetization may cause negative drain voltage. These may turn on SR MOSFET by mistake. To avoid above mis-turn-on of SR MOSFET, constant minimum off time can be used to screen it. But it may disturb SR MOSFET operation. For reliable SR operation, proprietary adaptive minimum off time control is implemented in OB2001, which can guarantee reliable synchronous rectification operation in DCM, QR.

### Output overshoot clamp

For poor system design, there is usually output overshoot during startup and load transient. To facilitate system design, OB2001 can detect output overshoot condition and prevent overshoot happen. When output voltage rises to meet the inner threshold, OB2001 will open a discharge path from Vin to ground to clamp the system output voltage, so the system output overshoot can be prevented.

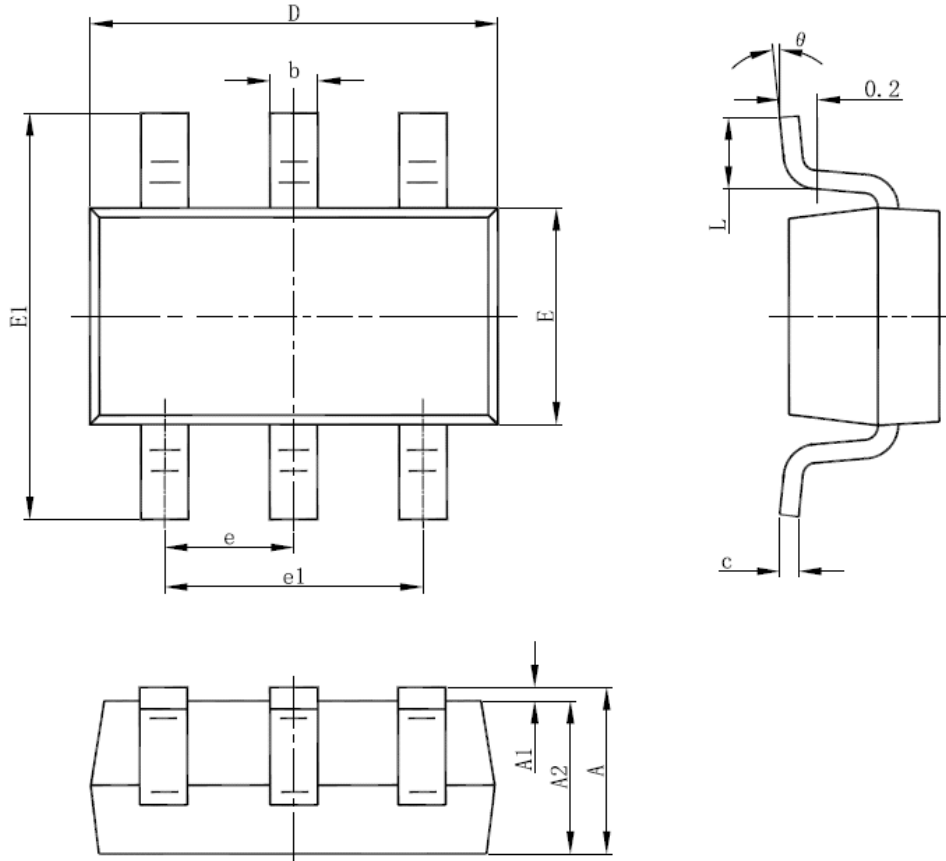
### Gate driver

For good and efficient synchronous rectification operation, the SR MOSFET should be turned on/off in very short time. Therefore strong driver capability is needed. OB2001 can offer typical source capability 2A and typical sink capability 3A. This guarantees fast turn-on and turn-off of SR MOSFET.



**PACKAGE MECHANICAL DATA**

**SOT-23-6L PACKAGE OUTLINE DIMENSIONS**



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 1.000                     | 1.450 | 0.039                | 0.057 |
| A1     | 0.000                     | 0.150 | 0.000                | 0.006 |
| A2     | 0.900                     | 1.300 | 0.035                | 0.051 |
| b      | 0.300                     | 0.500 | 0.012                | 0.020 |
| c      | 0.080                     | 0.220 | 0.003                | 0.009 |
| D      | 2.800                     | 3.020 | 0.110                | 0.119 |
| E      | 1.500                     | 1.726 | 0.059                | 0.068 |
| E1     | 2.600                     | 3.000 | 0.102                | 0.118 |
| e      | 0.950 (BSC)               |       | 0.037 (BSC)          |       |
| e1     | 1.800                     | 2.000 | 0.071                | 0.079 |
| L      | 0.300                     | 0.600 | 0.012                | 0.024 |
| theta  | 0°                        | 8°    | 0°                   | 8°    |

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