

GENERAL DESCRIPTION

OB2353 combines a dedicated current mode PWM controller with integrated high voltage power MOSFET. It is optimized for high performance low standby power and cost effective offline flyback converter applications in sub 10W range.

OB2353 PWM frequency operates in the fixed and trimmed. At no load or light load the frequency is internal adjusted, the IC operates in Extended 'burst mode' to minimize switching loss. Lower standby power and higher conversion efficiency is thus achieved.

VDD low startup current and low operating current contribute to a reliable power on startup design with OB2353. A large value resistor could thus be used in the startup circuit to minimize the standby power.

The internal slope compensation improves system large signal stability and reduces the possible sub-harmonic oscillation at high PWM duty cycle output. Leading-edge blanking on current sense (CS) input removes the signal glitch due to snubber circuit diode reverse recovery and thus greatly reduces the external component count and system cost in the design.

OB2353 offers complete protection coverage with automatic self-recovery feature including Cycle-by-Cycle current limiting (OCP), over load protection (OLP), VDD over voltage clamp and under voltage lockout (UVLO). Excellent EMI performance is achieved with On-Bright proprietary frequency shuffling technique together with soft switching control at the totem pole gate drive output.

The tone energy at below 20KHZ is minimized in the design and audio noise is eliminated during operation. OB2353 is offered in SOP-8 package.

FEATURES

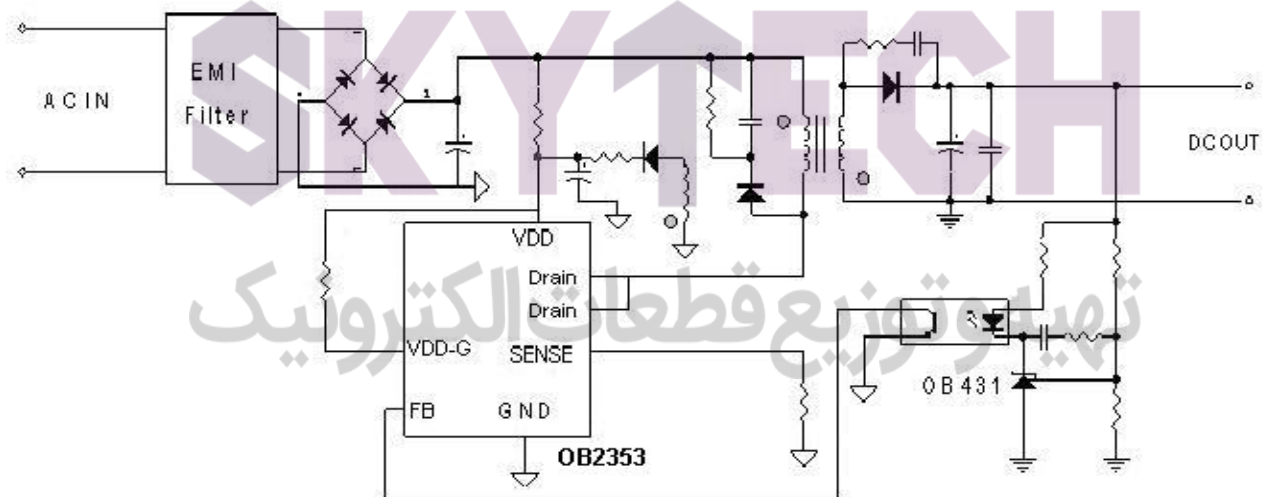
- Optimized for sub 10W Applications
- Single Chip 650V Sense FET Power Switch for Package.
- Soft Start with 4mS
- Frequency shuffling for EMI
- Extended Burst Mode Control For Improved Efficiency and Minimum Standby Power Design
- Audio Noise Free Operation
- Fixed 50KHZ Switching Frequency
- Internal Synchronized Slope Compensation
- Low VDD Startup Current and Low Operating Current
- Leading Edge Blanking on Current Sense Input
- Good Protection Coverage With Auto Self-Recovery
 - VDD Over Voltage Clamp and Under Voltage Lockout with Hysteresis (UVLO)
 - On-Bright Proprietary Line Input Compensated Cycle-by-Cycle Over-current Threshold Setting For Constant Output Power Limiting Over Universal Input Voltage Range.
 - Overload Protection (OLP).
 - Over voltage Protection(OVP)

APPLICATIONS

Offline AC/DC flyback converter for

- Battery Charger
- PDA power supplies
- Digital Cameras
- Power Adaptor
- Set-Top Box Power Supplies
- Open-frame SMPS

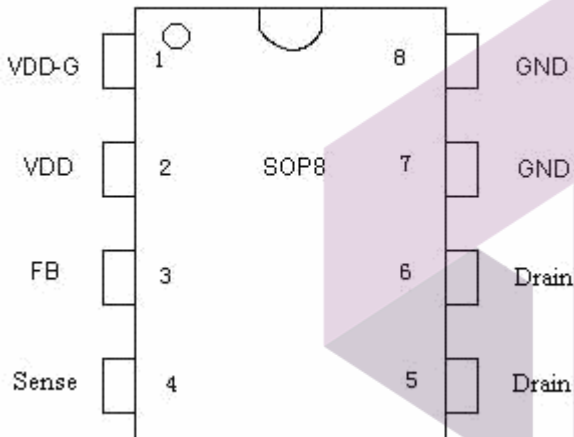
TYPICAL APPLICATION



GENERAL INFORMATION

Pin Configuration

The OB2353 is offered in SOP8 package, shown as below.



| Part Number | Description |
|-------------|--------------------------|
| OB2353CP | SOP8, Pb-free |
| OB2353CP/A | SOP8, Pb-free, Tape&Reel |

Package Dissipation Rating

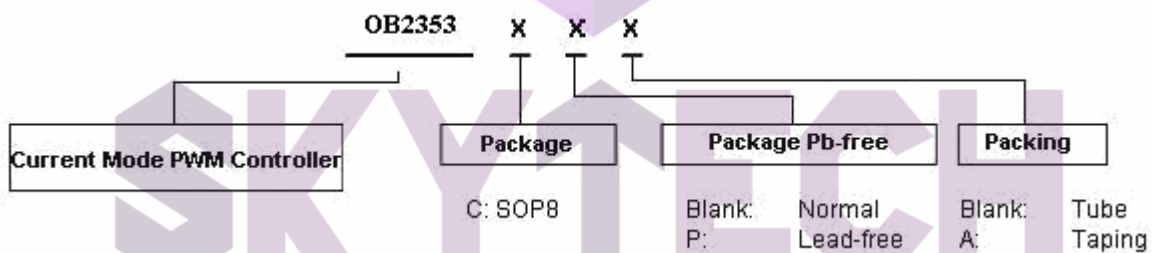
| | R _{θJA} (°C/W) |
|------|----------------------------|
| SOP8 | 150 |

Absolute Maximum Ratings

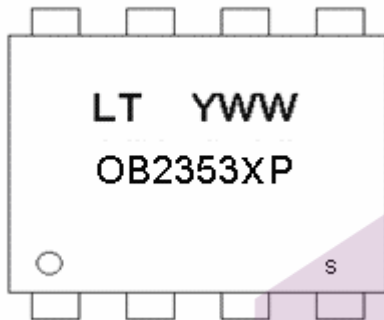
| Parameter | Value |
|---|---------------|
| Drain Input Voltage | 650V |
| VDD Input Voltage | 32 V |
| VDD-G Input Voltage | 32 V |
| VDD Input DC Current | 10mA |
| V _{FB} Input Voltage | -0.3 to 7V |
| V _{SENSE} Input Voltage to Sense Pin | -0.3 to 7V |
| Min/Max Operating Junction Temperature T _J | -20 to 150 °C |
| Min/Max Storage Temperature T _{stg} | -55 to 160 °C |
| Lead Temperature (Soldering, 10secs) | 260 °C |

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.

Ordering Information



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Marking Information


X: C for SOP8;
 P: Pb-free Package;
 Y: Year Code (0-9)
 WW: Week Code (1-52)
 s: Optional Internal Code

TERMINAL ASSIGNMENTS

| Pin Name | I/O | Description |
|----------|-----|--|
| GND | P | Ground |
| FB | I | Feedback input pin. The PWM duty cycle is determined by voltage level into this pin and the current-sense signal at Pin 3. |
| VDD-G | P | Power Supply specially for Internal Gate Driver |
| SENSE | I | Current sense input pin. |
| VDD | P | Chip DC power supply pin. |
| Drain | P | The Drain pin is designed to connect directly to the primary lead of the transformer and is capable of switching a maximum of 650V |



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ELECTRICAL CHARACTERISTICS

 (T_A = 25°C if not otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---------------------------------------|---|--|------|------|------|------|
| Supply Voltage (VDD) | | | | | | |
| I_VDD_Startup | VDD Start up Current | VDD=14.5V, Measure Leakage current into VDD | | 5 | 20 | uA |
| I_VDD_Operation | Operation Current | VDD=16V, V _{FB} =3V | | 1.6 | | mA |
| UVLO(ON) | VDD Under Voltage Lockout Enter | | 8.7 | 9.7 | 10.7 | V |
| UVLO(OFF) | VDD Under Voltage Lockout Exit (Recovery) | | 14.9 | 15.9 | 16.9 | V |
| OVP(ON) | Over voltage protection voltage | VDD=16V, CS=0V, FB=3V Ramp up VDD until gate clock is off | 28.5 | 30 | 31.5 | V |
| VDD_Clamp | VDD Zener Clamp Voltage | I _{DD} = 10 mA | 31 | 32 | 33 | V |
| Feedback Input Section(FB Pin) | | | | | | |
| V _{FB_Open} | V _{FB} Open Loop Voltage | | 5.4 | 5.7 | 6.0 | V |
| I _{FB_Short} | FB pin short circuit current | Short FB pin to GND and measure current | | 1.45 | | mA |
| V _{TH_0D} | Zero Duty Cycle FB Threshold Voltage | VDD=16V | | 0.8 | | V |
| V _{TH_PL} | Power Limiting FB Threshold Voltage | | | 3.7 | | V |
| T _{D_PL} | Power limiting Debounce Time | | | 50 | | mSec |
| Z _{FB_IN} | Input Impedance | | | 4 | | Kohm |
| Current Sense Input(Sense Pin) | | | | | | |
| Soft start time | | | | 4 | | ms |
| T _{blanking} | Leading edge blanking time | | | 270 | | ns |
| Z _{SENSE_IN} | Input Impedance | | | 40 | | Kohm |
| T _{D_OC} | Over Current Detection and Control Delay | From Over Current Occurs till the Gatedrive output start to turn off | | 120 | | nSec |
| V _{TH_OC} | Internal Current Limiting Threshold Voltage | FB=3.3V VDD=16V | 0.72 | 0.77 | 0.82 | V |
| Oscillator | | | | | | |
| F _{OSC} | Normal Oscillation Frequency | VDD = 16V | 45 | 50 | 55 | KHZ |
| Δf_Temp | Frequency Temperature Stability | VDD = 16V | | 5 | | % |
| Δf_VDD | Frequency Voltage Stability | VDD = 16-20V | | 5 | | % |

Low Power Off Line SMPS Switcher Freq Shuffling

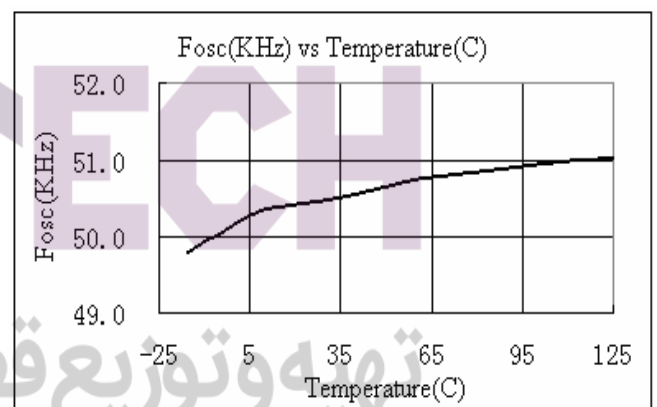
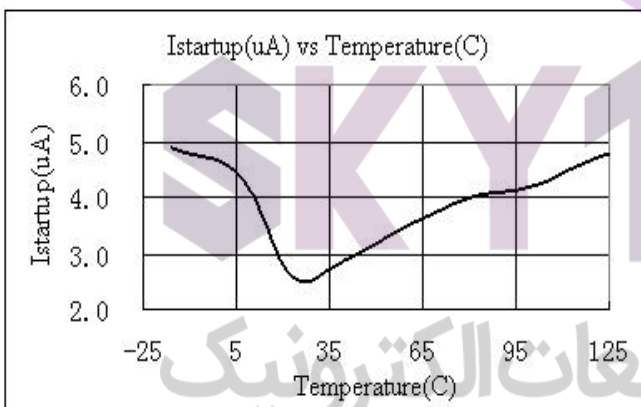
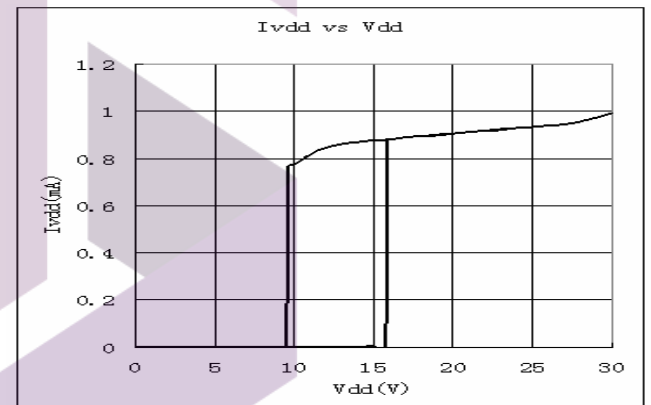
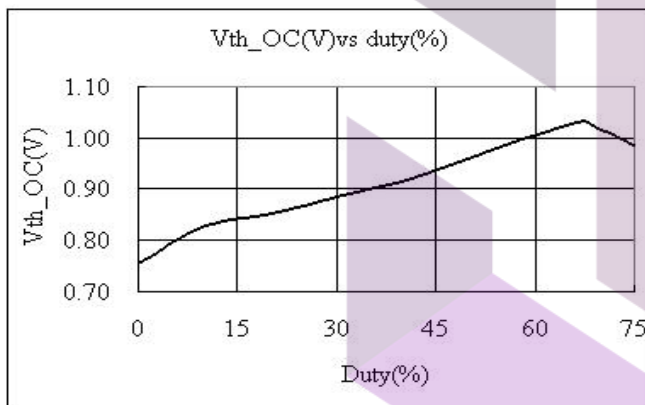
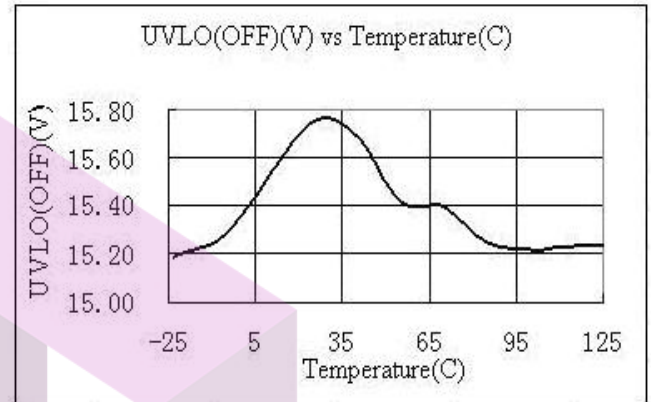
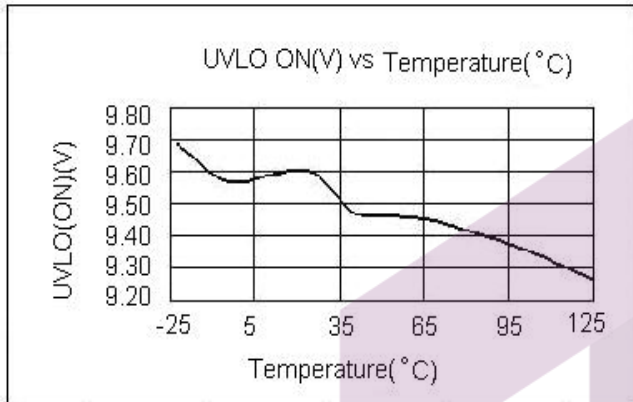
| | | | | | | |
|----------------------------|--|----------------------------|-----|----|-----|----------|
| D_max | Maximum duty cycle | FB=3.3V, CS =0V VDD=16V | 70 | 80 | 90 | % |
| F_Burst | Burst Mode Base Frequency | VDD = 16V | | 22 | | KHZ |
| Mosfet Section | | | | | | |
| Vds | Drain-Source Breakdown Voltage | | 650 | | | V |
| RDS(on) | Static Drain-Source On-Resistance | | | 12 | 15 | Ω |
| Idp | Drain current-peak | | | | 0.9 | A |
| Frequency Shuffling | | | | | | |
| Δf_{OSC} | Frequency Modulation range /Base frequency | | -4 | | 4 | % |



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CHARACTERIZATION PLOTS

(The characteristic graphs are normalized at Ta=25°C)



OPERATION DESCRIPTION

The OB2353 is a Low Power Off Line SMPS Switcher optimized for offline flyback converter applications in sub 10W power range. The extended burst mode control greatly reduces the standby power consumption and helps the design easily to meet the international power conservation requirements.

- **Startup Current and Start up Control**

Startup current of OB2353 is designed to be very low so that VDD could be charged up above UVLO threshold level and device starts up quickly. A large value startup resistor can therefore be used to minimize the power loss yet reliable startup in application. For AC/DC adaptor with universal input range design, a 2 M Ω , 1/8 W startup resistor could be used together with a VDD capacitor to provide a fast startup and yet low power dissipation design solution.

- **Operating Current**

The Operating current of OB2353 is low at 2mA. Good efficiency is achieved with OB2353 low operating current together with extended burst mode control features.

- **Frequency shuffling for EMI improvement**

The frequency Shuffling (switching frequency modulation) is implemented in OB2353. The oscillation frequency is modulated with a random source so that the tone energy is spread out. The spread spectrum minimizes the conduction band EMI and therefore eases the system design.

- **Extended Burst Mode Operation**

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 transistor, the core loss of the transformer and the loss on the snubber circuit. 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.

At no load or light load the frequency is internally adjusted. The switch frequency reduces at light/no load condition to improve the conversion efficiency. At light load or no load condition, the FB input drops below burst mode threshold level and device enters Burst Mode control. The Gate drive output switches only when VDD voltage drops below a preset level and FB input is active to output an on

state. Otherwise the gate drive remains at off state to minimize the switching loss and reduces the standby power consumption to the greatest extent. The frequency control also eliminates the audio noise at any loading conditions.

- **Oscillator Operation**

The switching frequency of OB2353 is internally fixed at 50KHZ. No external frequency setting resistor is required for PCB design simplification.

- **Current Sensing and Leading Edge Blanking**

Cycle-by-Cycle current limiting is offered in OB2353 current mode PWM control. The switch current is detected by a sense resistor into the sense pin. An internal leading edge blanking circuit chops off the sense voltage spike at initial internal mosfet on state due to snubber diode reverse recovery and surge gate current of internal Mosfet so that the external RC filtering on sense input is no longer needed. The current limit comparator is disabled and cannot turn off the internal Mosfet during the blanking period. The PWM duty cycle is determined by the current sense input voltage and the FB input voltage.

- **Internal Synchronized Slope Compensation**

Built-in slope compensation circuit adds voltage ramp onto the current sense input voltage for PWM generation. This greatly improves the close loop stability at CCM and prevents the sub-harmonic oscillation and thus reduces the output ripple voltage.

- **Drive**

OB2353 driver internal Mosfet gate for power switch control. Too weak the gate drive strength results in higher conduction and switch loss of mosfet while too strong gate drive results the compromise of EMI

A good tradeoff is achieved through the built-in totem pole gate design with right output strength and dead time control. The low idle loss and good EMI system design is easier to achieve with this dedicated control scheme. An internal 16V clamp is added for internal Mosfet gate protection at higher than expected VDD input.

• Protection Controls

Good power supply system reliability is achieved with its rich protection features including Cycle-by-Cycle current limiting (OCP), Over Load Protection (OLP) and over voltage clamp, Under Voltage Lockout on VDD (UVLO).

With On-Bright Proprietary technology, the OCP is line voltage compensated to achieve constant output power limit over the universal input voltage range.

At overload condition when FB input voltage exceeds power limit threshold value for more than TD_PL, control circuit reacts to shut down the internal power Mosfet. Device restarts when VDD voltage drops below UVLO limit.

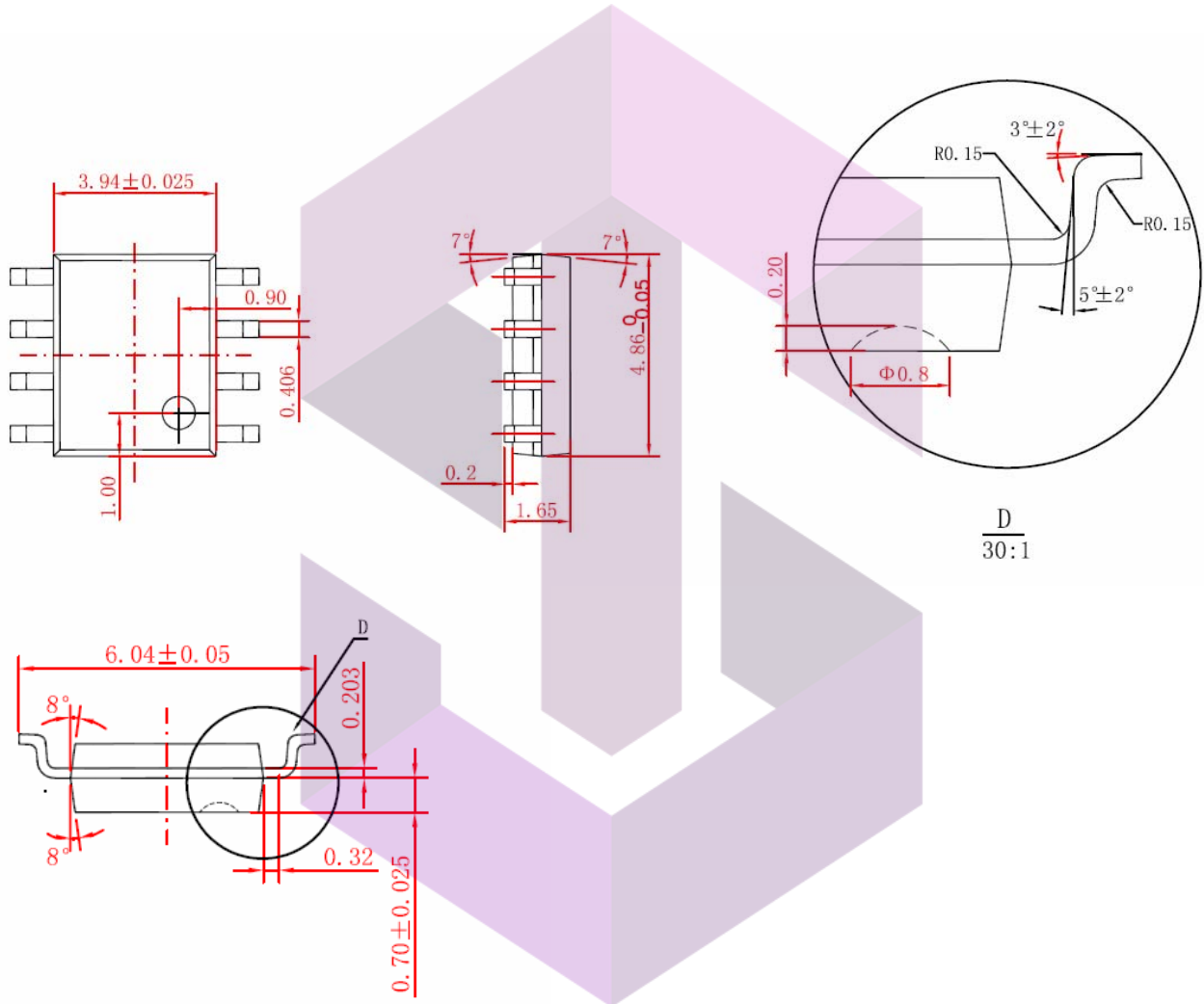
VDD is supplied by transformer auxiliary winding output. It is clamped when VDD is higher than 30V. The internal mosfet is shut down when VDD drops below 9.7V UVLO limit and device enters power on start-up sequence thereafter.


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PACKAGE MECHANICAL DATA

8-Pin Plastic SOP



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