

## WS2295B Switch Power Supply PWM Controller

### Features

- Low startup current (4uA)
- Low operation current (1.7mA,0.9mA operation current at no-load)
- Low Standby power
- Current mode operation
- Advanced frequency jittering control
- Secondary Rectifier Short Protection
- Cycle by cycle Over Current Protection (OCP)
- CS open protection
- Over temperature protection(OTP)
- Soft-start function
- VDD over voltage protection and clamp
- Under voltage lockout with hysteresis (UVLO)
- Wide operation voltage (7.5-34V)
- Driver Output clamped(13V)
- Soft-driver function for lower EMI
- Frequency jittering
- Constant output power limited
- Over load protection(OLP)

### Applications

Universal switch power supply and offline AC/DC flyback converter:

- Battery Charger
- Power Adaptor
- Set-Top Box Power Supplies
- Open-frame SMPS

### Description

The WS2295B is a highly integrated current mode PWM switch IC which is optimized for high performance. It is applied for small and medium-sized power supply devices, for example, the power adapter.

For lower standby power consumption and higher energy saving requirement, the IC has the Burst Mode function and very low startup current and operating current. At the condition of no load or light load, the IC operates in extended 'burst mode' to minimize switching loss by lower the switching frequency. The patented technologies of energy-saving at no-load contribute to minimize the power consumption (<75mw) and meet the efficiency standard of DoE or ErP VI.

The WS2295B applies advanced frequency jittering control to improve EMI performance at half load and light-load. Besides, it covers wide supply voltage(7.5-34V), which greatly facilitate the transformer design and the compatibility of the system.

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

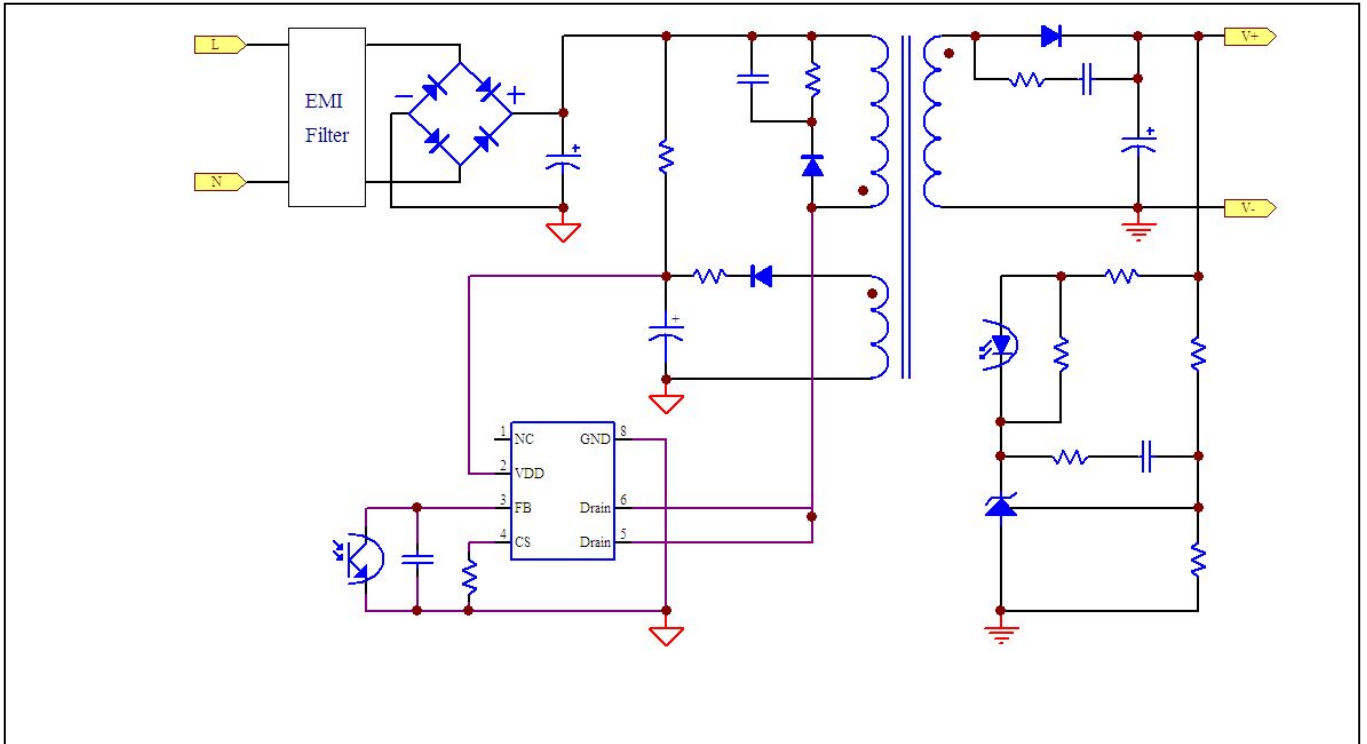
The WS2295B offers complete protection coverage with automatic self-recovery feature including cycle by cycle over current protection (OCP), over load protection (OLP), over temperature protection (OTP), VDD over Voltage Protection (OVP), under voltage lockout (UVLO), Secondary rectifier short protection. The gate-driven output is clamped to maximum 13V to protect the external MOSFET.

Excellent EMI performance is achieved by using the frequency jitter and the soft-switching at the totem pole gate drive output. The audio energy at below 20KHz is minimized in the design and audio noise is eliminated during operation.

The WS2295B can be used as the best alternative products of the linear power supply or the RCC-mode power to improve the whole performance of the switching power system and lower the cost.

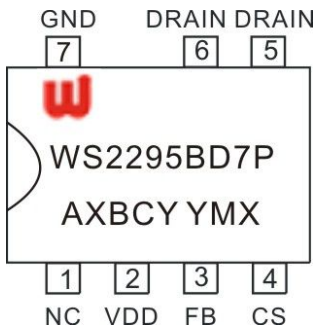
The WS2295B is available in DIP7 package.

**Typical Application Circuit**



**Pin Configuration and Marking Information**

The WS2295B is available in DIP7 Package. The top marking is shown as below:

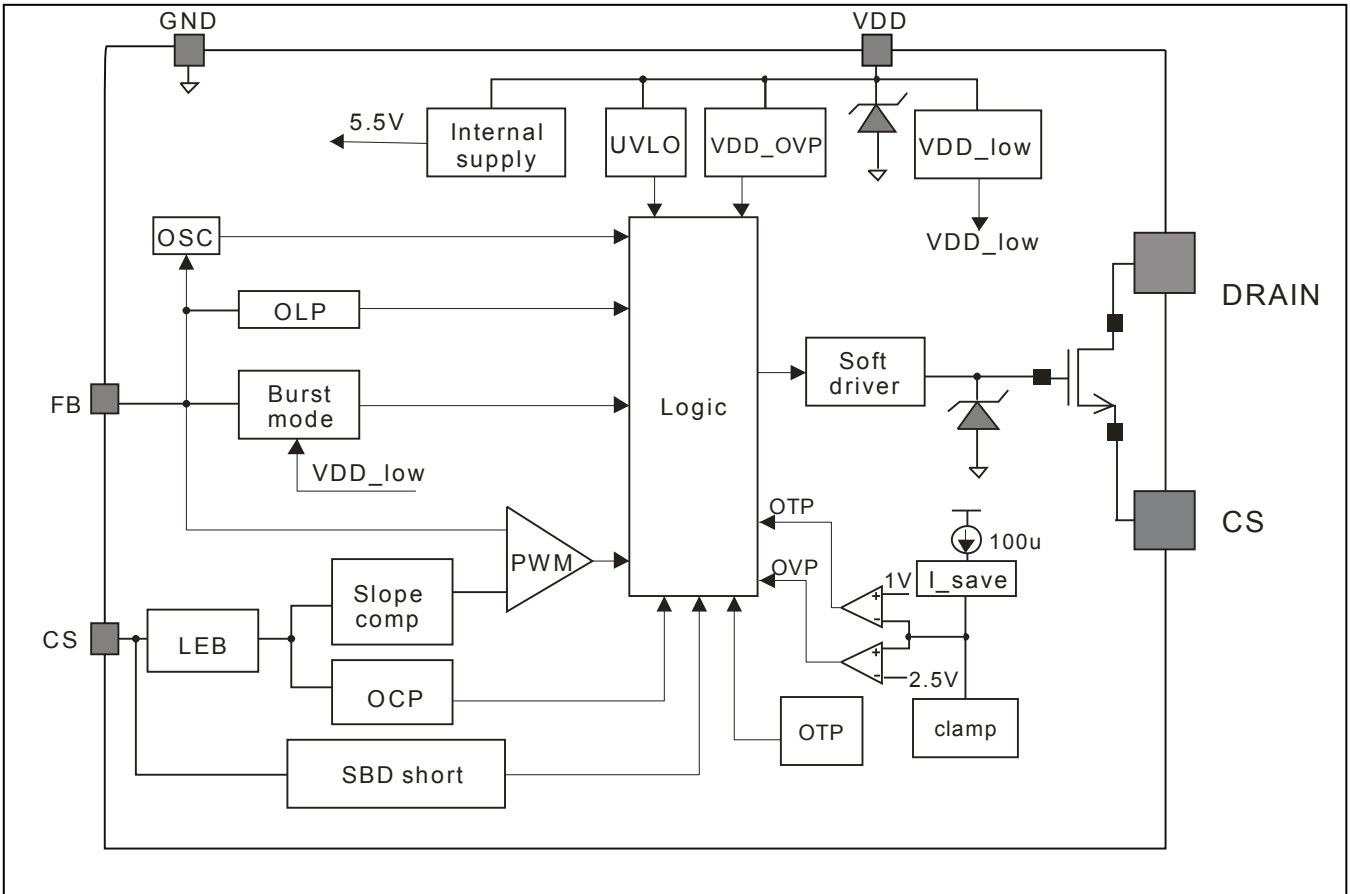


WS2295BD7P: Product Code  
 A: Product Code  
 X: Internal Code  
 BCY: Internal Code For QC  
 YMX: D/C

**Pin Definition**

Pin Name	Pin No.	Pin Type	Function Description
NC	1	NC	Hanged out
VDD	2	Power	Power Supply
FB	3	Feedback Input	Feedback input pin. The PWM duty cycle is determined by voltage into this pin and the current-sense signal at Pin 4
CS	4	Current monitoring	Current monitoring feed-back input pin.To determine whether to reach the limit value.
DRIAN	5/6	Drain	The drain terminal of Power MOSFET,connected with the transformer primary side.
GND	7	Ground	Ground

**Internal Block Diagram**



**Ordering Information**

Package	Marking	Part Number
7-Pin DIP-7, Pb-free	WS2295BD7P	WS2295BD7P (DIP-7)

**Output Power**

Product	230VAC±15%	85-265VAC
	Adapter1	Adapter1
WS2295B	18W	12W

**NOTE:**The above data was tested in the adapter which in ambient temperature of 50 degrees Celsius and enough heat radiation

**Recommended Operation Conditions**

Symbol	Parameter	Value	Unit
VDD	VDD Supply Voltage	10~30	V
T <sub>A</sub>	Operating temperature	-20~85	°C

**Absolute Maximum Ratings**

Symbol	Parameter	Value	Unit
VDD	DC Power Supply	34.5	V
V <sub>FB</sub>	FB input voltage	-0.3~7	V

V <sub>SENSE</sub>	SENSE input voltage	-0.3~7	V
V <sub>DRAIN</sub>	DRAIN pin voltage	-0.3~600	V
T <sub>J</sub>	Operation Junction Temperature	-20~150	°C
T <sub>STG</sub>	Storage Temperature	-40~150	°C
V <sub>CV</sub>	Vcc Clamp Voltage	35.5	V
I <sub>CC</sub>	Vcc Clamp Continuous Current	10	mA

**Note:** Stresses above 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 in the Recommended Operating Conditions section are not implied. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.

**ESD Information**

Symbol	Parameter	Value	Unit
V <sub>ESD-HBM</sub>	Human body model on all pins	3	KV
V <sub>ESD-MM</sub>	Machine model on all pins	300	V

**Electrical Characteristics**

Supply Voltage (VDD)						
symbol	parameter	Test condition	Min	Typ	Max	Unit
VDD_OP	Operation voltage				34	V
UVLO_ON	Turn on threshold Voltage		7.2	7.9	9.0	V
UVLO_OFF	Turn-off threshold Voltage		14.0	15.0	16.0	V
I_VDD_ST	Start up current	VDD=13V		4	10	uA
I_VDD_OP	Operation Current	VDD=16V, V <sub>FB</sub> =3V GATE with 1nF to GND		1.7	2.5	mA
VDD_OVP				34.5		V
VDD_Clamp	VDD Zener Clamp Voltage	IVDD=10mA		35.5		V
Feedback Input Section						
V <sub>FB_Open</sub>	V <sub>FB</sub> Open Loop Voltage	VDD=16V,FB open,	4.3	5.0	5.6	V
I <sub>FB_Short</sub>	FB Pin Short Current	FB Shorted to GND	0.22	0.315	0.41	mA
V <sub>TH_PL</sub>	Power limiting FB Threshold	VDD=16V	3.2	3.65	4.0	V
T <sub>D_PL</sub>	Power limiting Debounce	VDD=16V, FB open	48	60	72	ms
Z <sub>FB_IN</sub>	Input Impedance	VDD=16V, FB=2V/3V, CS open	13	16.5	20	kΩ
Current Sense Section						
TLEB	Leading edge Blanking Time			330		ns
T <sub>D_OC</sub>	OCP control delay	GATE with 1nF to GND		70		ns
V <sub>TH_OC</sub>	OCP threshold	FB=3.4V	0.690	0.740	0.790	V
Max_OC	Max_OCP for line comp	FB=3.4V	0.9	0.95	1	V
V <sub>th_SBD</sub>	CS threshold for SBD short	VDD=16V		2.0		V
T <sub>d_SBD</sub>	Delay of SBD short protect	8 PWM cycle		8		CLK
Oscillator Section						

Fosc	Frequency	VDD=16V, FB=3.2V	60	65	70	khz
D_max	Max duty	VDD=16V, FB=3.2V	68	75	82	%
Jitter period		For 65K		4		ms
Jitter range		For 65K		±5		%
Fosc_BM	Burst mode frequency	VDD=16V, Fb fall from 2V to burst		22		khz
Δf_temp	Frequency variation versus temp. Deviation	TEMP = -20 to 85°C		5		%
Δf_VDD	Frequency variation versus VDD	VDD = 12 to 25V		5		%
<b>Thermal protection</b>						
T_shutdown	Thermal shutdown temperature			150		°C
<b>Power MOSFET Section</b>						
BVdss	MOSFET Drain-Source breakdown voltage		600			V
Ron	Static Drain to Source on resistance	WS2295B		3.4	4.5	ohm
IDSS	Output clamp voltage				10	uA

## Application Information

The WS2295B is a highly integrated and high performance current mode PWM switch IC. It is applied for small and medium-sized power (<18W) supply devices, for example, the power adapter and chargers. The low startup current, operation current and burst mode function at the condition of no load and light load can decrease the standby power of the system, and improve the power conversion efficiency. The patented technologies of energy-saving at no-load and RT pin energy-saving contribute to minimize the power consumption (<75mw) and meet the efficiency standard of DoE or ErP VI. The internal synchronous slope compensation and the leading edge blanking function of the Sense pin not only decrease the component number, but also improve the stability of the system and avoid the harmonics generation. The WS2295B also has multiform auto-recovery protection. The main functions are described as below.

### Startup Current and Startup Control

Startup current of the WS2295B is designed to be very low (4uA) so that VDD could be charged up above UVLO threshold level and starts up quickly. A large value startup resistor can therefore be used to minimize the power loss, predigest the design of startup circuit and provide reliable startup in application. For the design of AC/DC adaptor with universal input range, a 1206 resistor of 1.5 MΩ could be used together with a VDD capacitor to provide a fast startup and low power dissipation solution.

### Operating Voltage

The WS2295B covers wide supply voltage from 7.7V to 34V, which helps easing the transform design, and a same transform can be used to design different output voltage, so that the compatibility is improved

### Operating Current

The operating current of the WS2295B is very low. Good efficiency is achieved with low operating current together with extended burst mode control circuit which can decrease the value of VDD capacitor.

### Soft-start

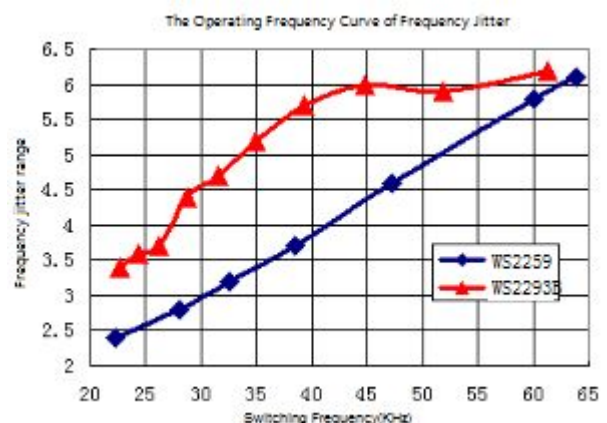
As soon as VDD reaches UVLO (on), the soft-start function operates; the peak current is then gradually increased from zero. Every restart attempt is followed by 4ms soft-start.

### Burst Mode

At very light load or no load condition, the IC operates in Burst Mode. In this condition, the voltage at FB is below burst mode threshold level, thus system goes into burst mode. The gate drives output switching only when VDD voltage drops below a preset level or FB input is active to output an on state. Otherwise the gate drive remains at off state to minimize the switching loss thus reduce the standby power consumption. The frequency control also eliminates the audio noise at any load conditions.

### Advanced Frequency Jittering Control

The WS2295B integrates the maximum operating frequency of 65 KHz. The frequency jittering range is in proportion to the switching frequency in traditional PWM controller, so that at half load or light load, the switching frequency is decreased, and the frequency jittering range is also decreased, which deteriorates the EMI performance. The WS2295B applies advanced frequency jittering control to keep better EMI performance at all load condition.



### Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in WS2295B. The switching current is detected by a sense resistor at the SENSE pin. The internal Leading-edge blanking chops off the sense voltage spike at initial MOSFET on state due to snubber diode circuit reverse recovery and thus reduce the external RC filter circuit. The current limitation comparator is

disabled and cannot turn off the external MOSFET during the blanking period. PWM duty cycle is determined by voltage level at SENSE pin and FB pin.

#### **Internal Synchronized Slope Compensation**

Built-in slope compensation circuit adds slope voltage 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.

#### **CS Open Protection & Secondary Rectifier Short Protection**

When the CS pin is opened, the WS2295B will shut down after a few cycles. When the secondary rectifier is short, the WS2295B will be in protection state after 8 pulse periods of VDD. The controller enters into UVLO auto recovery until the fault is removed.

#### **Gate Driver**

GATE pin of the WS2295B is connected to the gate of an external MOSFET. If the gate drive capacity is too weak

will cause higher switching loss of MOSFET, while too strong gate drive output cause EMI problem. A good tradeoff between output capacity and dead time control is achieved through the design of the built-in totem pole driver in the WS2295B. The low standby dissipation and good EMI system design is easier to achieve through this dedicated device. For MOSFET gate protection, an internal 13V clamp is added.

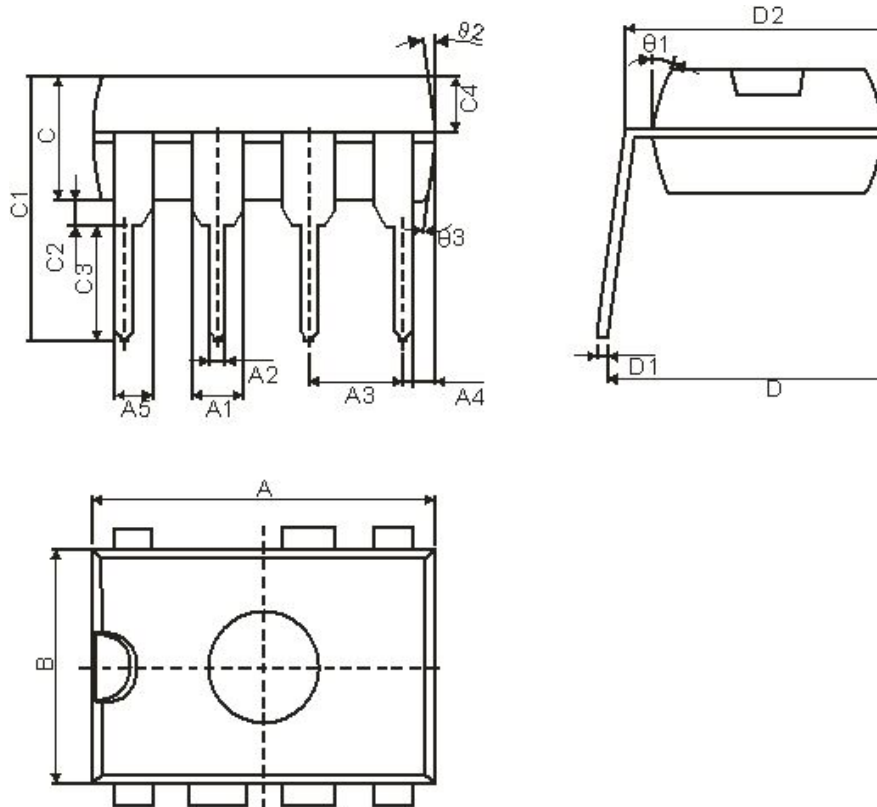
#### **Protection Controls**

Good power supply system reliability is achieved with auto-recovery protection features including Cycle-by-Cycle current limiting (OCP), Over Load Protection (OLP), Over Temperature Protection (OTP), CS open protection, Secondary Rectifier Short Protection, Under Voltage Lockout on VDD (UVLO), , and VDD over Voltage Protection & VDD clamp.

Internal line voltage compensation of OCP helps to achieve constant output power limit over the universal input voltage range.

**Package Information**

**DIP7 Package Outline Dimensions**



Winsemi				
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	9.00	9.50	0.354	0.374
B	6.10	6.60	0.240	0.260
C	3.0	3.4	0.118	0.134
A1	1.474	1.574	0.058	0.062
A2	0.41	0.53	0.016	0.021
A3	2.44	2.64	0.096	0.104
A4	0.51TYP		0.02TYP	
A5	0.99TYP		0.04TYP	
C1	6.6	7.30	0.260	0.287
C2	0.50TYP		0.02TYP	
C3	3.00	3.40	0.118	0.134
C4	1.47	1.65	0.058	0.065
D	7.62	9.3	0.300	0.366
D1	0.24	0.32	0.009	0.013
D2	7.62TYP		0.3TYP	



**NOTE:**

1. We strongly recommend customers check carefully on the trademark when buying our product, if there is any question, please don't be hesitate to contact us.
2. Please do not exceed the absolute maximum ratings of the device when circuit designing.
3. Winsemi Microelectronics Co., Ltd reserved the right to make changes in this specification sheet and is subject to change without prior notice.

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