Features

- Burst Mode function
- Low startup current (4uA)
- Low operation current （1.7mA)
- Built in Leading edge blanking (LEB)
- Built in Synchronous slope compensation
- Current mode operates
- External programmable switching frequency
- Cycle by cycle Over Current Protection
- over temperature protection(OTP）
- Soft-start
- VDD over voltage protection and clamp
- under voltage lockout with hysteresis(UVLO）
- Driver Output clamped(13V)
- Soft-driver function for lower EMI
- Frequency jitter
- Constant output power limited
- Over load protection(OLP)
- Free audio noise operation

Applications

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

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

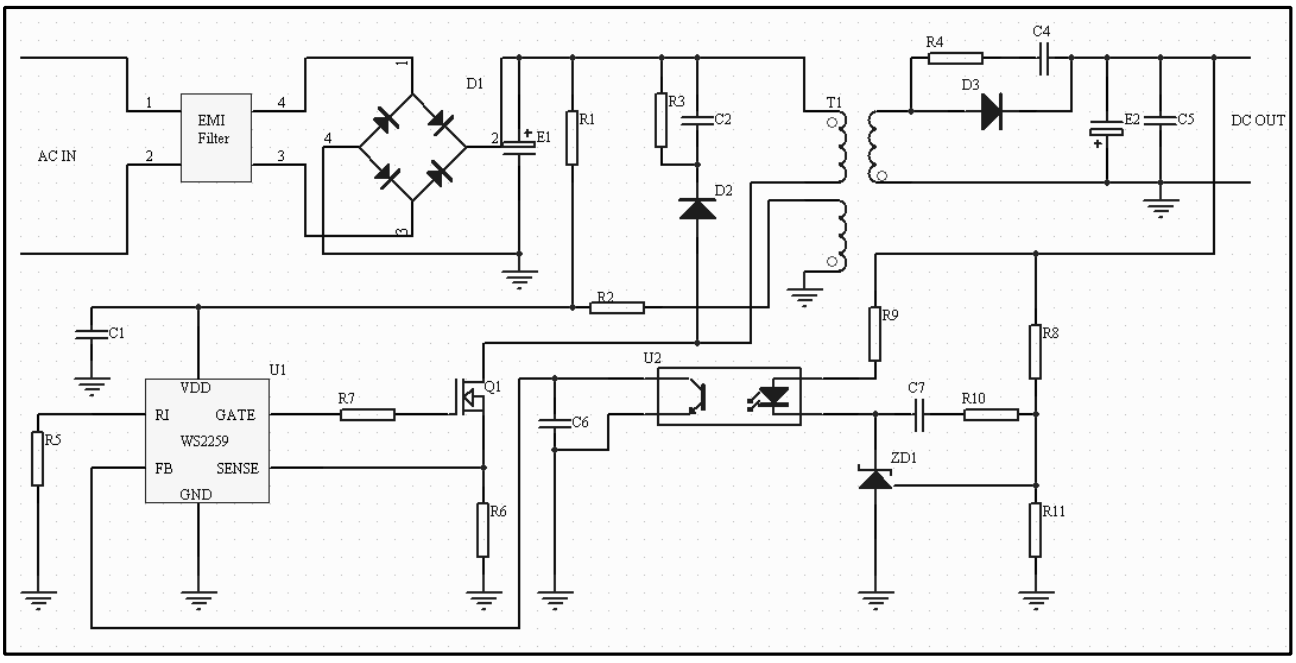
General Description

WS2259 which is optimized for high performance is a highly integrated current mode PWM control IC. It is applied for switch power of the small-sized and medium-sized for example the power adaptor. For lower the standby power and higher RoHS compliant, the IC has the Burst Mode function and very low startup current and working 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 low startup current and low operating current contribute to a reliable power on startup design with WS2259. A large value resistor could thus be used in the startup circuit to minimize the power consumption and improve the efficiency of the power convert.

The internal synchronous slope compensation circuit improves system large signal stability and reduces the possible subharmonic oscillation at high PWM duty cycle output. Leading-edge blanking on current sense(SENSE) 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.

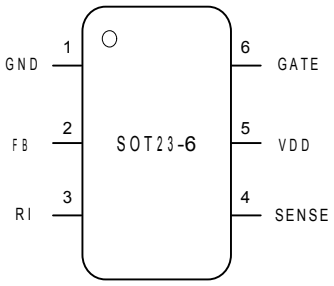
WS2259 offers complete protection coverage with automatic self-recovery feature including cycle by cycle over current protection (OCP), over load protection (OLP), over temperature protection (OTP), VDD Over Voltage Protection, under voltage lockout (UVLO). The gate-driven output is clamped to maximum 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 tone energy at below 20KHZ is minimized in the design and audio noise is eliminated during operation. The IC 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 switch power system and lower the cost.
WS2259 is offered in SOT23-6, SOP-8 and DIP-8 packages.

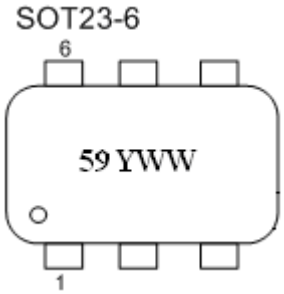
Typical Application Circuit



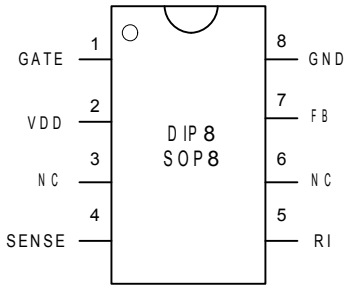
Pin Definition and Device Marking

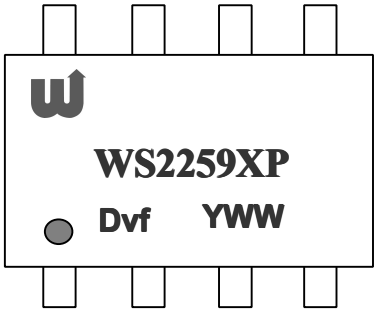
WS2259 is offered in SOT23-6, SOP-8 and DIP-8 packages，as shown below：





59: WS2259
Y: Year Code (1:2011; 2:2012……)
WW: Week Code (1-52)





X: D = DIP8 ， S = SOP8
P: P = Pb-free package
D: 芯片代码
V: 内部版本号 (可选 1-9)
f: 工厂代码
Y: Year Code (1:2011; 2:2012……)
WW: Week Code (1-52)

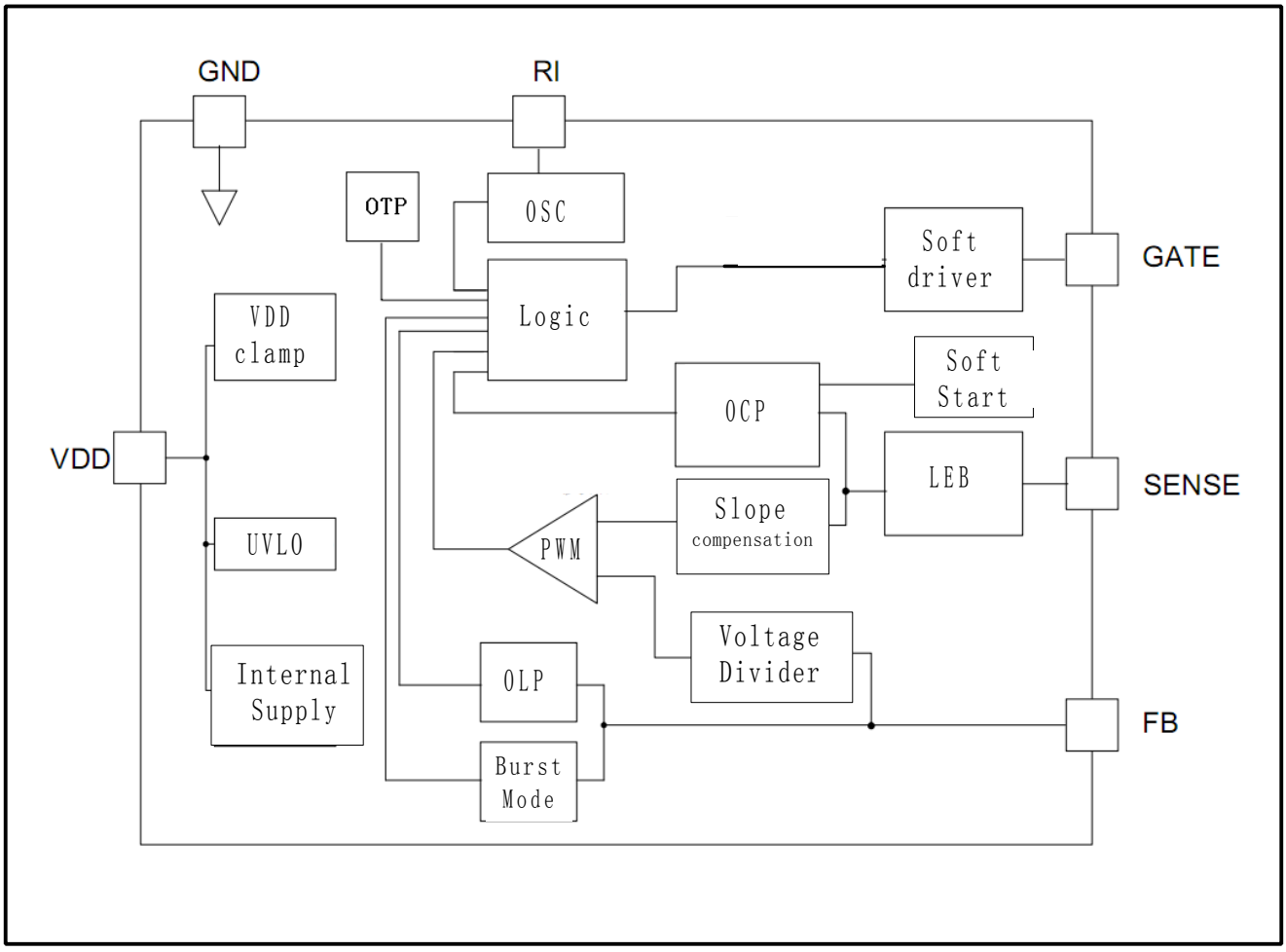
Ordering Information

Package	IC Marking Information	Purchasing Device Name
8-Pin DIP8, Pb-free	WS2259DP	WS2259DP
8-Pin SOP8, Pb-free	WS2259SP	WS2259SP
6-Pin SOT23-6, Pb-free	59XXX	WS2259YP（SOT23-6）

Pin Function Description

Pin Name	Pin No. DIP8/SOT23	Pin Type	Function Description
GATE	1 / 6	Output	Totem-pole gate drive output for the power MOSFET
VDD	2 / 5	Power	Power Supply
NC	3	Floating	Floating
SENSE	4 / 4	Current Monitoring	Current sense input.
RI	5 / 3	Frequency Setting	Internal oscillator frequency setting pin. A resistor which is connected between RI and GND sets the PWM frequency
NC	6	Floating	Floating
FB	7 / 2	Feedback Input	Feedback input pin. The PWM duty cycle is determined by voltage into this pin and the current-sense signal at Pin 4
GND	8 / 1	Ground	Ground

Block Diagram



Recommended Operating Condition

Symbol	Parameter	Value	Unit
VDD	VDD Supply Voltage	10~30	V
RI	RI Resistor	100	Kohm
T_A	Operating temperature	-20~85	℃

Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Value	Unit
VDD	DC Power Supply	30	V
V_{FB}	FB input voltage	-0.3~7	V
V_{SENSE}	SENSE input voltage	-0.3~7	V
V_{RI}	RI input voltage	-0.3~7	V
T_J	Operation Junction Temperature	-20~150	℃
T_{STG}	Storage Temperature	-40~150	℃
V_{CV}	Vcc Clamp Voltage	31	V
I_{CC}	Vcc Clamp Continuous Current	10	mA

Note 1: 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

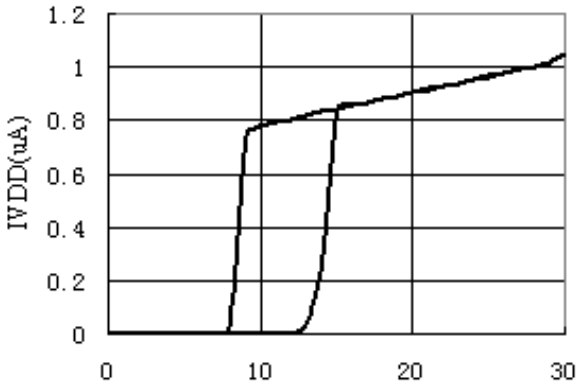
Symbol	Parameter	Value	Unit
$V_{ESD-HBM}$	Human body model on all pins	3	KV
V_{ESD-MM}	Machine model on all pins	300	V

Electrical Characteristics (T_A=25℃， VCC=16V, if not otherwise noted)

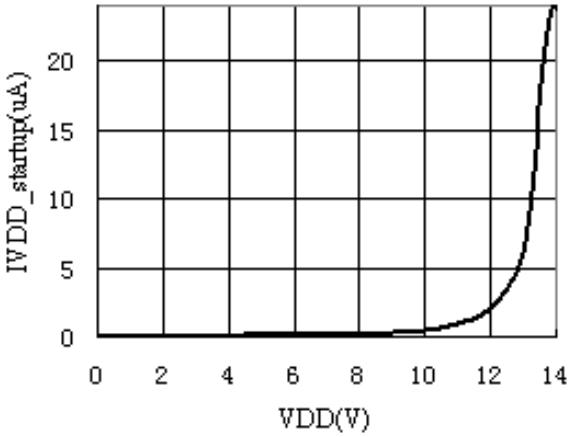
Parameter	Symbol	Test condition	Min	Typ	Max	Unit
Supply Voltage (VDD)						
Operation voltage	VDD_OP				30	V
Turn on threshold Voltage	UVLO_ON		6.8	7.5	8	V
Turn-off threshold Voltage	UVLO_OFF		13.5	14.5	15.5	V
Start up current	I_VDD_ST	VDD=13V,RI=100K		4	10	uA
Operation Current	I_VDD_OP	VDD=16V,RI=100K,V_{FB}=3V GATE with 1nF to GND		1.7	2.3	mA
	VDD_OVP			29		V
VDD Zener Clamp Voltage	VDD_Clamp	IVDD=10mA		31		V
Feedback Input Section						
V_{FB} Open Loop Voltage	V_{FB}_Open	VDD=16V,FB open,	5.4	5.9	6.4	V
FB Pin Short Current	I_{FB}_Short	FB Shorted to GND	0.3	0.45	0.6	mA
Power limiting FB Threshold	V_{TH}_PL	VDD=16V, RI=100K	3.2	3.65	4.0	V
Power limiting Debounce	T_D_PL	VDD=16V,FB open,RI=100KΩ	48	60	72	ms
Input Impedance	Z_{FB}_IN	VDD=16V,FB=2V/3V,CS open	11.5	14.5	18	kΩ
Maximum duty cycle	Max_Duty	VDD=16V,FB open, CS=0,RI=100KΩ	72	77	82	%
Current Sense Section						
Leading edge Blanking Time	TLEB			330		ns
OCP control delay	T_D_OC	GATE with 1nF to GND		70		ns
OCP threshold	T_{TH}_OC	FB＝3.2V	0.68	0.78	0.78	V
Oscillator Section						
Frequency	Fosc	VDD=16V,RI=100K,,FB=3.2V	60	65	70	khz
	Jitter period	For 65K		4		ms
	Jitter range			±5		%
Burst mode frequency	Fosc_BM	VDD=9.5V,RI=100K, FB=1V		22		khz
Frequency variation versus temp. Deviation	Δf_temp	TEMP = -20 to 85℃		5		%
Frequency variation versus VDD	Δf_VDD	VDD = 12 to 25V		5		%
RI Section						
RI voltage	V_{RI}	VDD=16V,RI=100KΩ,CS=1V	1.94	2	2.06	V
Thermal protection						
Thermal shutdown temperature	T_shutdown			150		℃
GATE Output Section						
Output voltage Low	VOL	VDD = 16V, Io = -20mA			0.8	V
Output voltage high	VOH	VDD = 16V, Io = 20mA	9			V
Output clamp voltage	VClamp	VDD = 20V	11	13	14.5	V
Rising time	Tr	VDD = 16V, GATE with 1nF to GND		250		ns
Falling time	Tf	VDD = 16V, GATE with 1nF to GND		75		ns

Typical Operating Characteristics

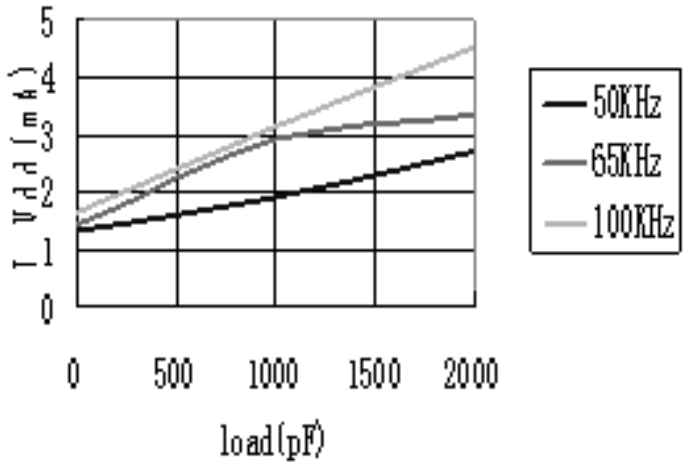
IVDD vs VDD



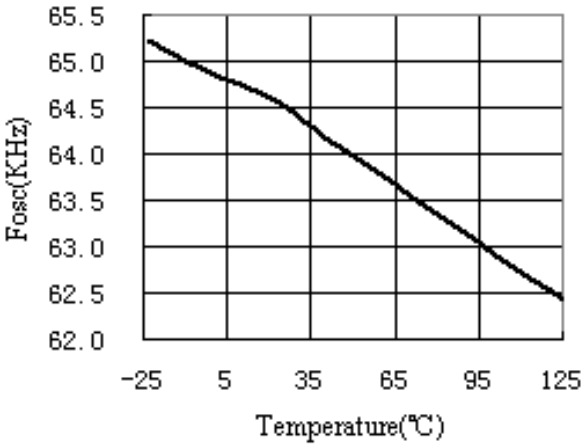
IVDD_startup vs VDD



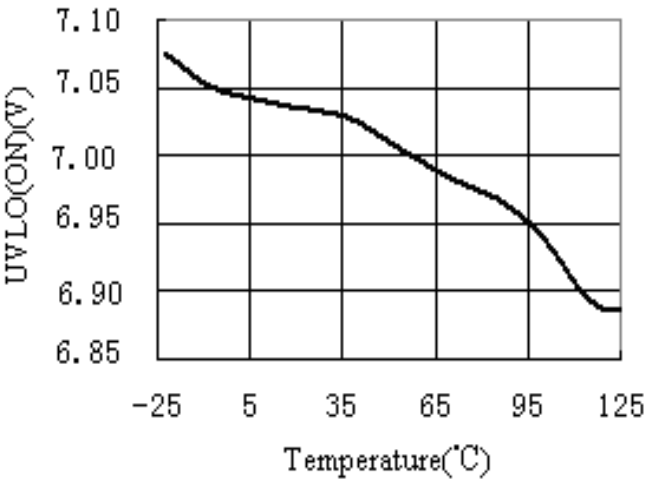
I_Vdd vs Gate load



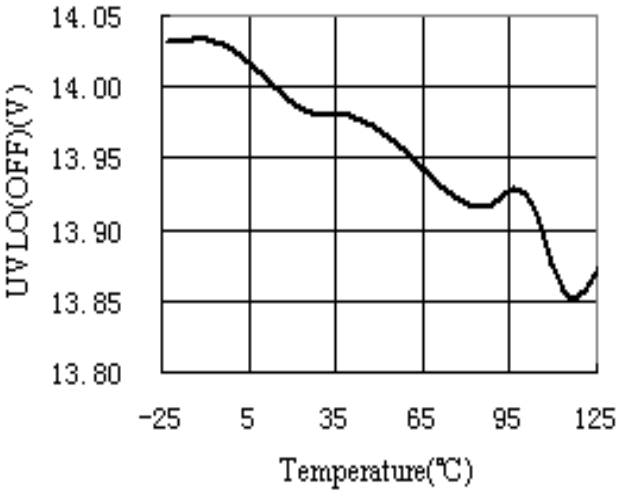
Fosc vs Temperature



UVLO(ON) vs Temperature



UVLO(OFF) vs Temperature



Function Description

WS2259 is a highly integrated current mode PWM control IC which is optimized for high performance. It is applied for switch power of the small-sized and medium-sized for example the power adaptor. The low startup current, operation current and burst mode function at the condition of no load and low load can decrease the standby power of the system, and improve the power convert efficiency. The internal synchronous slope compensation, 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. WS2259 also have multiform general recovery protection mode. The main function is described as below.

Startup Current and Startup Control

Startup current of WS2259 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 provides reliable startup in application. For the design of AC/DC adaptor with universal input range, a startup resistor of 2 MΩ, 1/8 W could be used together with a VDD capacitor to provide a fast startup and low power dissipation solution.

Operating Current

The operating current of WS2259 is very low .Good efficiency is achieved with low operating current together with extended burst mode control circuit which can easy the design 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 dive output switches only when VCC 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 standby current of WS2259 is low as 800uA, Thus the standby of WS2259 can be low than 100mW. The frequency control also eliminates the audio noise at any loading conditions.

Oscillator Operation

A resistor connected between RI and GND sets the charge/discharge time of the constant current source to the internal cap and thus the PWM oscillator frequency is determined. The relationship between RI and switching frequency follows the below equation:

$$F_{OSC} = \frac{6500}{RI(Kohm)}(Khz)$$

If RI floating, the frequency will be internal set at 50 KHz

Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in WS2259. The switch current is detected by a sense resistor into 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 limit comparator is disabled and cannot turn off the external MOSFET during the blanking period. PWM duty cycle is determined by voltage level into 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.

Gate Driver

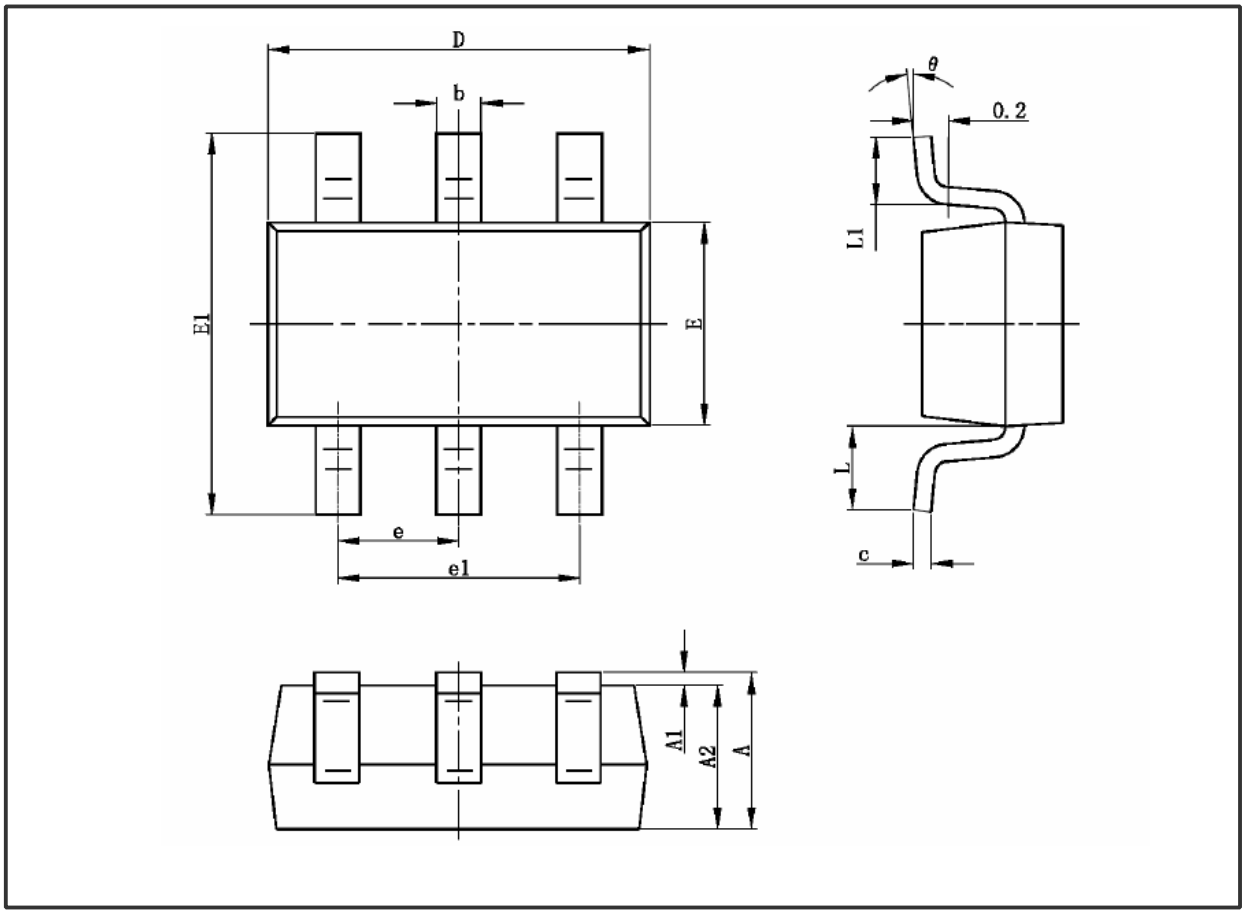
GATE pin of WS2259 is connected to the gate of an external power switch. The gate drive strength which is too weak leads to over switch loss of MOSFET while too strong gate drive output compromises in the over EMI. A good tradeoff between output strength and dead time control is achieved through the design of the built-in totem pole gate in WS2259. The low standby dissipation and good EMI system design is easier to achieve through this dedicated devise. For MOSFET gate protection, an internal 13V clamp is added at higher than expected VCC input.

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), Under Voltage Lockout on VDD (UVLO), Over Temperature Protection (OTP), and VDD Over Voltage Protection & VDD clamp.

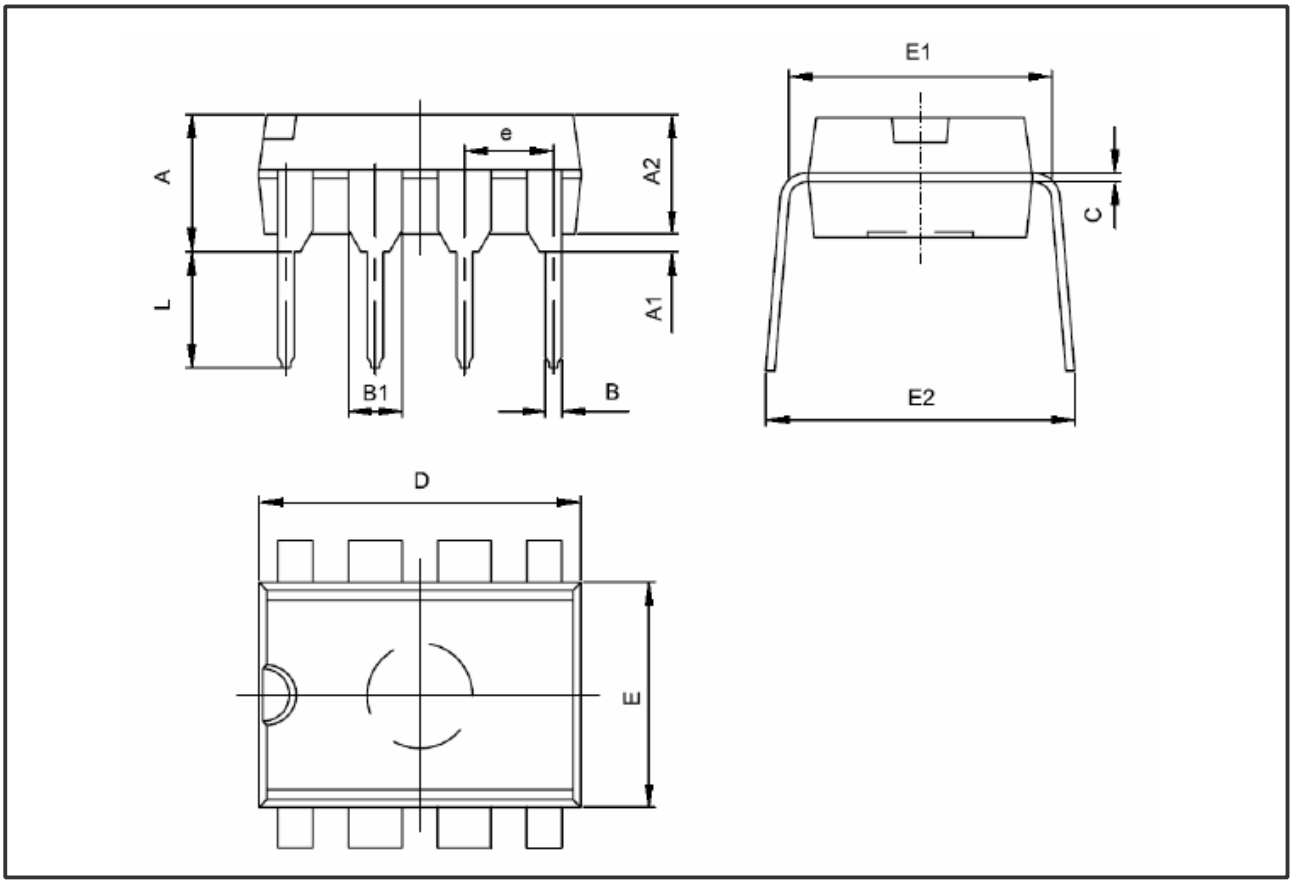
Internal line voltage compensation of OCP help to achieve constant output power limit over the universal input voltage range.

SOT23-6 Package Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

DIP-8 Package Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	4.310	0.146	0.170
A1	0.510		0.020	
A2	3.200	3.600	0.126	0.142
B	0.360	0.560	0.014	0.022
B1	1.524(TYP)		0.060(TYP)	
C	0.204	0.360	0.008	0.014
D	9.000	9.400	0.354	0.370
E	6.200	6.600	0.244	0.260
E1	7.620(TYP)		0.300(TYP)	
e	2.540(TYP)		0.100(TYP)	
L	3.000	3.600	0.118	0.142
E2	8.200	9.400	0.323	0.370

SOP-8 Package Dimension

Unit: mm