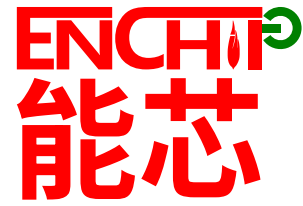# AXPM11585

5A, 30V Input, High Efficiency, Fast Synchronous Step-down Regulator

Datasheet － Apr 2022

Description

AXPM11585 is a high efficiency and fast synchronous stepdown DC-DC converter capable of delivering 5A output current. It operates over a wide input voltage range from 4.5V to 30V and integrates main switch and synchronous switch with very low Rds(on) to minimize the conduction loss. AXPM11585 adopts the instant PWM architecture to achieve fast transient responses for high step-down applications and high efficiency at light loads. In addition, it operates at pseudo-constant frequency of 500kHz under continuous conduction mode to minimize the size of inductor and capacitor.
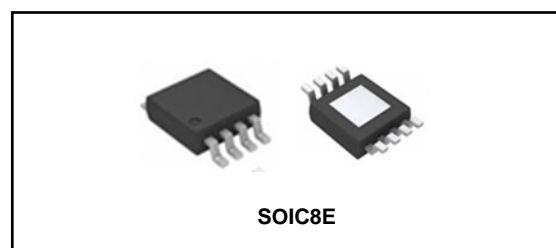
Features

- 95% efficiency at 1A 5V output
- Low Rds(on) for internal switches (top/bottom): 70/40mΩ
- 4.5-30V input voltage range
- Instant PWM architecture to achieve fast transient responses
- External soft start limits the inrush current
- Pseudo-constant frequency: 500kHz at heavy loads
- 5A continuous, 6A peak load current capability
- 1.5% 0.6V reference
- Output over current limit
- Output short circuit protection with current foldback
- Thermal shutdown and auto recovery
- RoHS Compliant and Halogen Free

Applications

- Automotive systems
- LCD TV
- Set Top Box
- Notebook
- Storage
- High power AP router
- Networking

Table 1 Device Summary

Order code	Package	Packing
AXPM11585	SOIC8E	Tube

SOIC8E

Contents

List of Figures

List of Tables

1   Block Diagram and Application Circuit

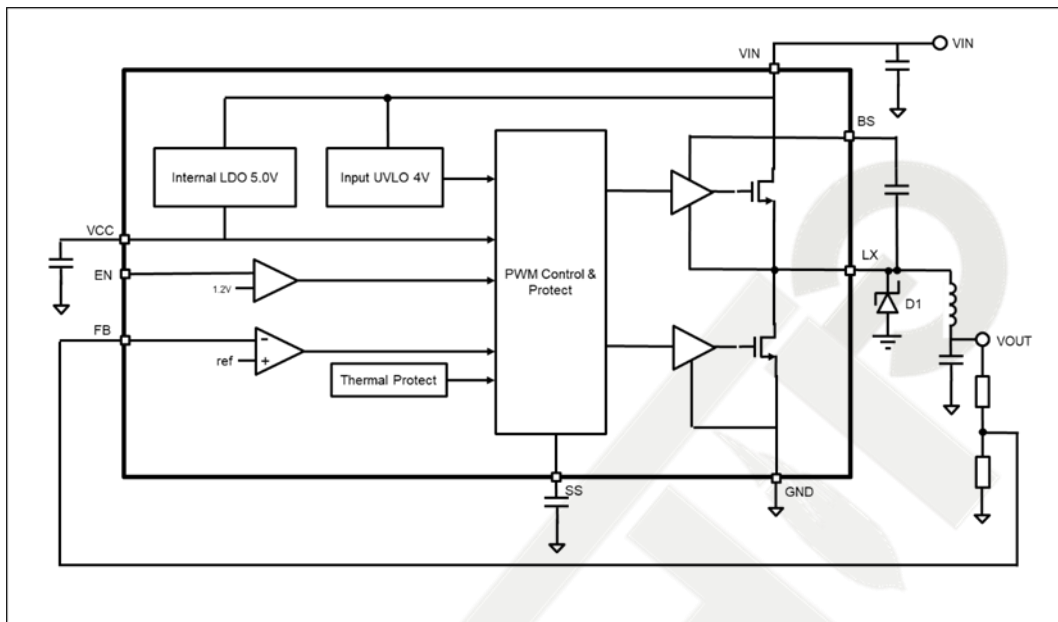**Figure 1 Block Diagram**

Figure 2 Application Circuit (typical)
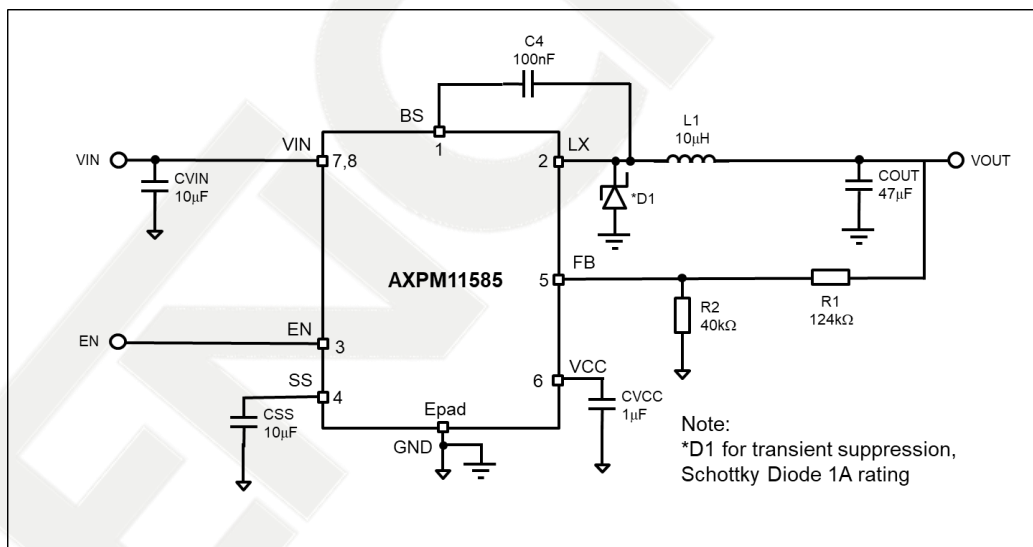
2 Pin Description

2.1 Pin Names

Figure 3 Pin Connection
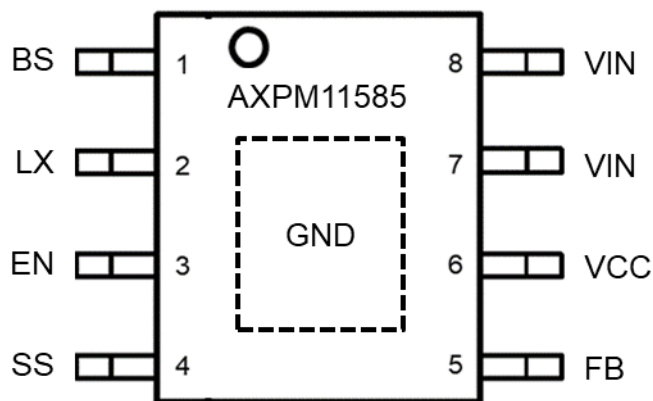
2.2 Pin Functions

Table 2 Pin Functions

Pin number	Pin name	Description
1	BS	Boot-strap Pin. Supply high side gate driver. Decouple this pin to LX pin with 0.1µF ceramic cap.
2	LX	Inductor pin. Connect this pin to the switching node of inductor.
3	EN	Enable control. The device has an accurate 1.2V falling threshold that will allow the user to program the accurate turn-on delay by adding RC before the EN pin.
4	SS	Soft start programming pin. Connect a capacitor from this pin to ground to program the soft start time. Tss=Css*0.6V/10µA.
5	FB	Output Feedback Pin. Connect this pin to the centre point of the output resistor divider to program the output voltage: Vout=0.6*(1+R1/R2).
6	VCC	Internal 5V LDO output. Power supply for internal analog circuits and driving circuit. Add a 1µF bypass capacitor to GND. VCC tracks Vin voltage if Vin<5V.
7, 8	VIN	Input Supply. This supplies power to all the internal control circuitries. A decoupling capacitor to ground must be placed close to this pin to minimize switching spikes.
Epad	GND	Ground pin.

3. Electrical Specifications

3.1 Absolute Maximum Ratings

Table 3 Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
VIN, LX, BS, EN	Voltage	-0.3 to +33	V
VCC, FB, SS, BS-LX	Voltage	-0.3 to 6.0	V
Ptot	Power dissipation Tamb = +25°C	3.3	W
Tj	Junction temperature	150	°C
Tstg	Storage temperature	-55 to +150	°C

3.2 Thermal Data

Table 4 Thermal Data

Symbol	Parameter	Value	Unit
Rth j-case	Thermal resistance junction-to-case Max.	10	°C/W

3.3 ESD and Latch Up

Table 5 ESD and Latch Up

Symbol	Parameter	Value	Unit
All pins	ESD HBM	±2,000	V
All pins	ESD CDM	±500	V
All pins	Latch Up JESD78, Class A	≥ 100	mA

3.4 Electrical Characteristics

VIN = 12V; VEN = 2.5V; VOUT = 5V; Tamb = +25℃; unless otherwise specified.

Table 6 Electrical Characteristics

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
Toper	Operating temperature		-20	-	+85	℃
VIN	Supply voltage		4.5	-	30	V
VOUT	Output voltage		0.8	-	28	V
VFB	Feedback Voltage	4.5V < VIN < 30V	0.591	0.600	0.609	V
Rds(on)	Top switch on resistance	VBST – VSW = 5V		70		mΩ
	Bottom switch on resistance			40		mΩ
Ilim	Current limit		5			A
UVLO	VIN UVLO Threshold				4	V
UVLOhys	VIN UVLO Hysteresis			0.2		V
Tss	Soft start time	Tss = CSS*0.6V/10µA CSS=1µF		60		ms
F_{SW}	Oscillator frequency	IOUT = 200mA		500		kHz
Isd	Shutdown Supply Current	VEN = 0V		4	10	µA
Iq	Quiescent Supply Current	No load, VFB = VREF*105%		200		µA
Tsd	Thermal shutdown			150		℃
Tsd-hys	Thermal shutdown Hysteresis			20		℃
Toff-min	Minimum off time			80		ns
Ton-min	Minimum on time			120		ns
VEN-th	EN falling threshold		1.1	1.2	1.3	V
VEN-hys	EN hysteresis			0.1		V

4 Functional Description

4.1 Overview

AXPM11585 is a synchronous buck regulator IC that integrates the PWM control, top and bottom switches on the same die to minimize the switching transition loss and conduction loss. With ultra-low Rds(on) power switches and efficient PWM control, this regulator IC can achieve the highest efficiency and the highest switch frequency simultaneously to minimize the external inductor and capacitor size, and thus achieving the minimum solution footprint. AXPM11585 provides protection functions such as cycle by cycle current limiting and thermal shutdown protection. It will sense the output voltage conditions for the fault protection.

4.2 PWM Control

Due to the high integration in the AXPM11585, the application circuit based on this regulator IC is rather simple. Only input capacitor CVIN, output capacitor COUT, output inductor L1 and feedback resistors (R1 and R2) need to be selected for the targeted applications. AXPM11585 integrates the compensation components to achieve good stability and fast transient responses.

4.3 Internal VCC Regulator

There is a 5V reference, VCC, internally generated, for powering internal analog and drive circuits. This pin should be bypassed to ground with a 1µF ceramic capacitor. This pin may be used with an external DC load of 20mA or less.

4.4 Enable Control

AXPM11585 has a dedicated enable control pin (EN). With high enough input voltage, the device can be enabled and disabled by EN which has positive logic. Its falling threshold is 1.2V. When EN is pulled down below 1.2V, the device is put into the lowest shut down current mode of <4µA. By means of external RC connected to EN pin, it Is possible to program the delay turn on time upon driving EN high.

4.5 Under Voltage Lockout (UVLO)

Under voltage lockout (UVLO) is implemented to protect the device from operating at insufficient supply voltage. The UVLO rising threshold is about 4V with 0.2V hysteresis.

4.6 Soft start

The soft start is implemented to prevent the converter output voltage from overshooting during start up. Soft start is programmed by connecting a capacitor from soft start programming pin to ground. Tss=Css*0.6V/10µA.

4.7 Thermal Shutdown

Thermal shutdown is implemented to prevent the device from operating at exceedingly high temperatures. When the silicon die temperature is higher than its upper threshold, it shuts down the whole device. When the temperature is lower than its lower threshold, the device is enabled again.

4.8 Bootstrap

The power MOSFET driver is powered by an external bootstrap capacitor. The bootstrap capacitor is charged and regulated to about 5V by the dedicated internal bootstrap regulator. The BS capacitor provides the gate driver voltage for internal high side MOSEFET. A 100nF low ESR ceramic capacitor connected between BS pin and LX pin is recommended.

4.9 Internal VCC LDO

There is a 5V reference, VCC, internally generated. This pin should be bypassed to ground with a 1µF ceramic capacitor. This pin may be used with an external DC load of 20mA or less.

5   Components Selection

5.1   Setting the Output Voltage

The output voltage is set using a resistive voltage divider from the output voltage to FB pin. It is given as follows:

$$VOUT = VFB \times \frac{R1 + R2}{R2}$$

5.2   Inductor

There are several considerations in choosing the inductor.

1)   Choose the inductance to provide the desired ripple current. It is suggested to choose the ripple current to be about 40% of the maximum output current. The inductance is calculated as:

$$L = \frac{Vout\left(1 - \frac{Vout}{Vinmax}\right)}{Fsw * Ioutmax * 40\%}$$

where F_{SW} is the switching frequency and I_{outmax} is the maximum load current. The AXPM11585 regulator IC is quite tolerant of different ripple current amplitude. Consequently, the final choice of inductance can be slightly off the calculation value without significantly impacting the performance.

2)   The saturation current rating of the inductor must be selected to be greater than the peak inductor current under full load conditions.

$$Isatmin > \frac{Ioutmax + Vout\left(1 - \frac{Vout}{Vinmax}\right)}{2 * Fsw * L}$$

3)   The DCR of the inductor and the core loss at the switching frequency must be low enough to achieve the desired efficiency requirement. It is desirable to choose an inductor with DCR<10mΩ to achieve a good overall efficiency.

5.3   Input Capacitor

To minimize the potential noise problem, place a typical X5R or better grade ceramic capacitor close to the VIN and GND pins. Care should be taken to minimize the loop area formed by CVIN, and VIN/GND pin. 10µF low ESR ceramic capacitor is recommended.

5.4   Output Capacitor

The output capacitor is selected to handle the output ripple noise requirements. Both steady state ripple and transient requirements must be taken into consideration when selecting this capacitor. For the best performance, it is recommended to use X5R or better grade ceramic capacitor greater than 47µF capacitance.

6   Package Information

Figure 4 SOIC8E Mechanical Data and Package Dimensions

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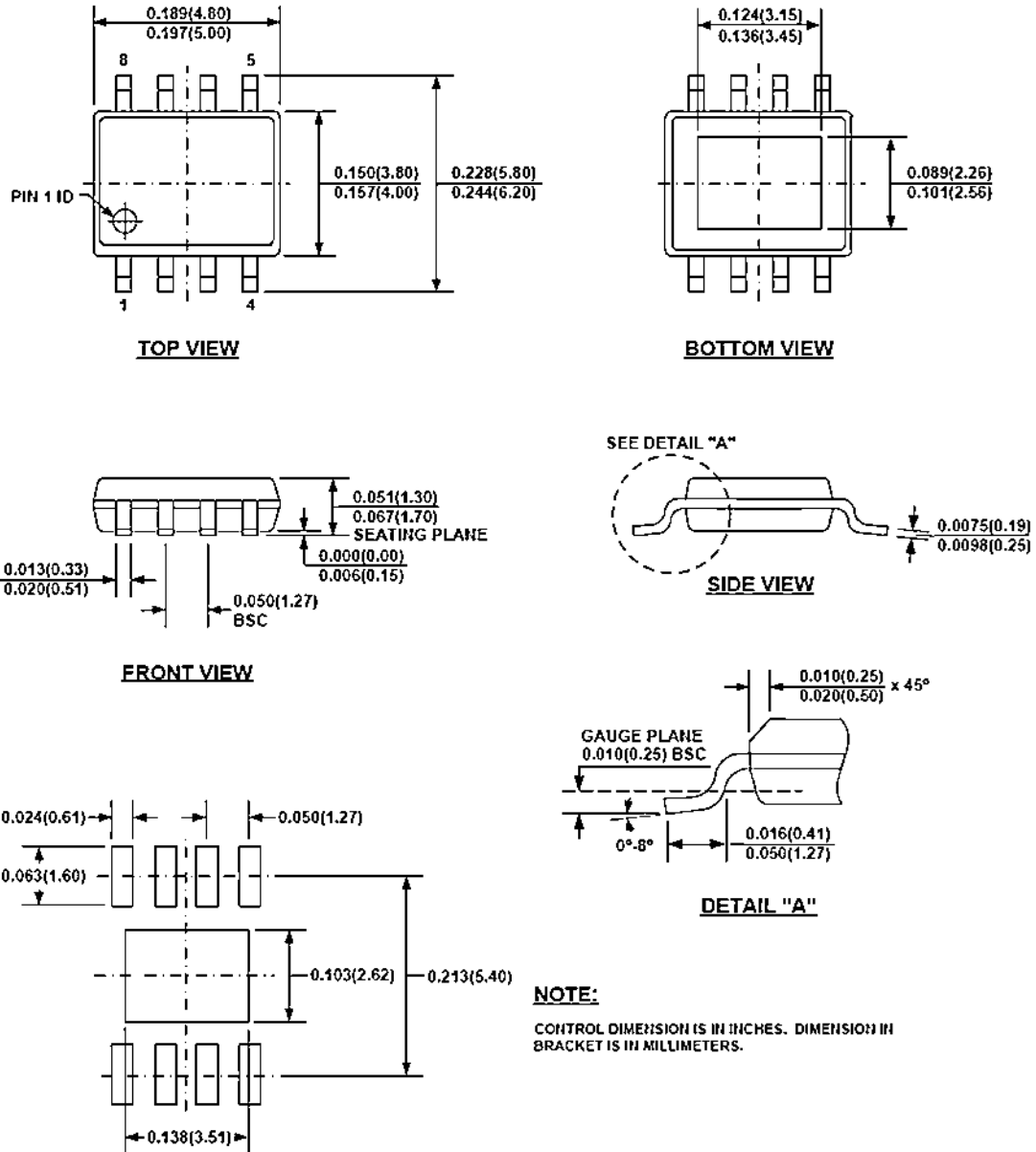
7 Revision History

Table 7 Document Revision History

Date	Version	Description
Apr 2021	1.00	First version.
Apr 2022	1.10	Revised Application Circuit