



5V/12V Synchronous-Rectified Buck Controller

Features

- Operates from a Supply Voltage of 4.5V to 12V with 3.3V to 12V V_{IN} Input Range
- Output of 0.6V for APE3212A
- Output Range of 0.8V to 80% of V_{IN} for APE3212
- Reference $\pm 1\%$ Over Line Voltage and Temperature
- Simple Single-Loop Control Design
- Voltage-Mode PWM Control
- Fast Transient Response
- High-Bandwidth Error Amplifier
- Duty Cycle 0% to 80%
- Adjustable Over-current Protection Using External Resistor
- Fixed Frequency Oscillator of 300 kHz for APE3212A and 200kHz for APE3212.
- Internal Soft Start
- Integrated Bootstrap Diode

Description

The APE3212/A is a compact synchronous-rectified buck controller specifically designed to operate at 5V or 12V supply voltage and to provide a high quality output voltage as low as 0.6V (APE3212A) or 0.8V (APE3212).

This device operates at a fixed frequency of 300kHz (APE3212A) or 200kHz (APE3212) and provides an optimal level of integration to reduce the size and cost of the power supply.

This controller integrates internal MOSFET drivers that support 12V+12V bootstrap voltages for high efficiency power conversion. The bootstrap diode is built-in to simplify the circuit design and minimize external part counts.

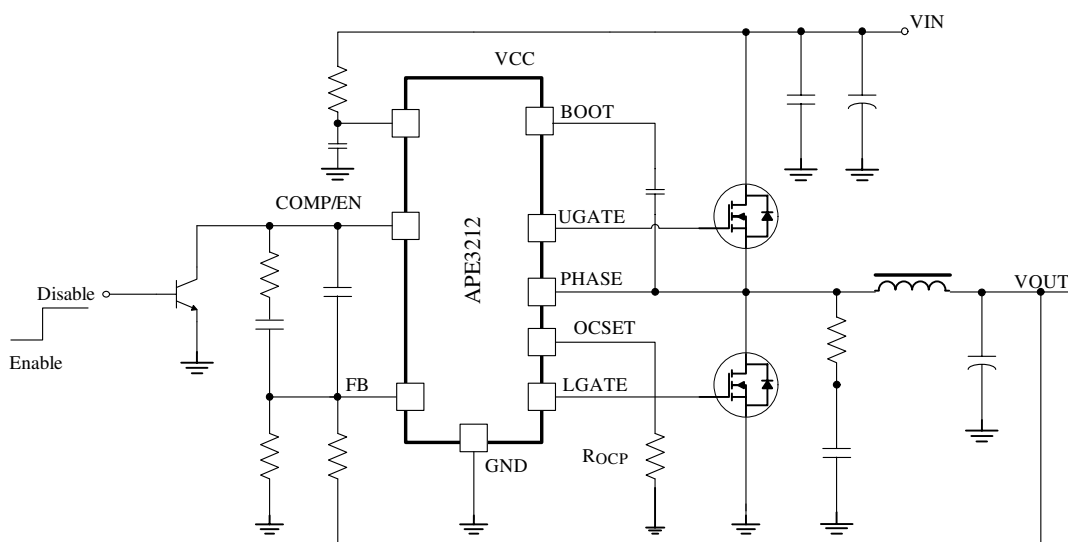
Other features include internal soft-start, under voltage protection, over current protection and thermal shutdown functions.

This part is supplied in a RoHS-compliant, halogen-free ESOP-8 package.

Applications

- Power Supplies for Microprocessors or Subsystem Power Supplies
- Cable Modems, Set Top Boxes, and DSL Modems
- Industrial Power Supplies; General Purpose Supplies
- 5V or 12V Input DC-DC Regulators
- Low-Voltage Distributed Power Supplies

Typical Application Circuit





ELECTRICAL SPECIFICATIONS

($V_{CC}=12V$, $T_A=25^{\circ}C$, unless otherwise specified)

Parameter	SYM	TEST CONDITION	MIN	TYP	MAX	UNITS
Supply Input						
Supply Voltage	V_{CC}		4.5	-	13.2	V
Supply Current	I_{CC}	UGATE & LGATE OPEN; $V_{CC}=12V$, Switching	-	5	-	mA
Quiescent Supply Current	I_{CC_Q}	$V_{FB} = V_{REF} + 0.1V$, No Switching	-	4	-	mA
Power Input Voltage	V_{IN}		3	-	13.2	V
Power On Reset						
POR Threshold	V_{CCRTH}	V_{CC} rising	4	4.2	4.4	V
POR Hysteresis	V_{CCHYS}		-	0.5	-	V
Oscillator						
Free Running Frequency	f_{OSC}	For APE3212A	270	300	330	KHz
		For APE3212	180	200	220	
Ramp Amplifier	DV_{OSC}	$V_{CC}=12V$	-	1.8	-	V_{P-P}
Error Amplifier						
Open Loop DC Gain	AO	Guaranteed by Design		95	-	dB
Gain-Bandwidth Product	GBW	Guaranteed by Design	-	20	-	MHz
Slew Rate	SR	Guaranteed by Design	3	6	-	V/us
Output Source Current		$V_{FB} < V_{REF}$	80	120	-	uA
Output Sink Current		$V_{FB} < V_{REF}$	80	120	-	uA
Input Offset Voltage			-2	-	2	mV
Input Bias Current			-	0.1	10	nA
PWM Controller Gate Drives						
Upper Gate Source	I_{UG_SRC}	$V_{BOOT}-V_{PHASE}=12V$, $V_{BOOT}-V_{UGATE}=6V$	-	-1	-	A
Upper Gate Sink	I_{UG_SNK}	$V_{BOOT}-V_{PHASE}=12V$, $V_{BOOT}-V_{UGATE}=6V$	-	1.5	-	A
Upper Gate Sink	R_{UGATE}	$V_{UGATE}-V_{PHASE}=1V$	-	2	4	W
Lower Gate Source	I_{LG_SRC}	$V_{CC}-V_{LGATE}=6V$	-	-1	-	A
Lower Gate Sink	I_{LG_SNK}	$V_{LGATE}=6V$	-	1.5	-	A
Lower Gate Sink	R_{LGATE}	$V_{LGATE}=1V$	-	2	4	W
Phase Falling to LGATE Rising Delay		$V_{PHASE} < 1.2V$ to $V_{LGATE} > 1.2V$	-	30	-	ns
LGATE Falling to UGATE Rising Delay		$V_{LGATE} < 1.2V$ to $(V_{UGATE}-V_{PHASE}) > 1.2V$	-	30	-	ns
Minimum Duty Cycle			-	0	-	%
Maximum Duty Cycle			70	75	80	%
Reference Voltage						
Nominal Feedback Protection	V_{FB}	$V_{CC}=12V$, $V_{COMP}=1.6V$, APE3212A	0.594	0.6	0.606	V
		$V_{CC}=12V$, $V_{COMP}=1.6V$, APE3212	0.792	0.8	0.808	V
Protection						
Under Voltage Protection	V_{FB_UVP}		0.3	0.4	0.5	V
OCSET Source Current ^{Note1}	I_{OCSET}		-	8	-	uA
Soft-Start Interval	T_{SS}	APE3212A	-	2.5	-	ms
		APE3212	-	3.2	-	
Enable Threshold	$V_{COMP/EN}$		0.3	0.4	0.5	V

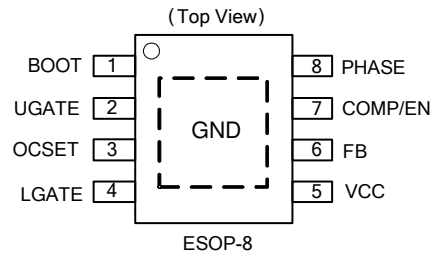
Note1: See OCP Current Setting, Page 4



OCP Current Setting

R_{OCP} (Ω)	Open	42K	26K	10K
V_{OCP} (mV)	-375	-320	-200	-80
I_{OCP} (A)	37.5	32	20	8

Pin Configuration

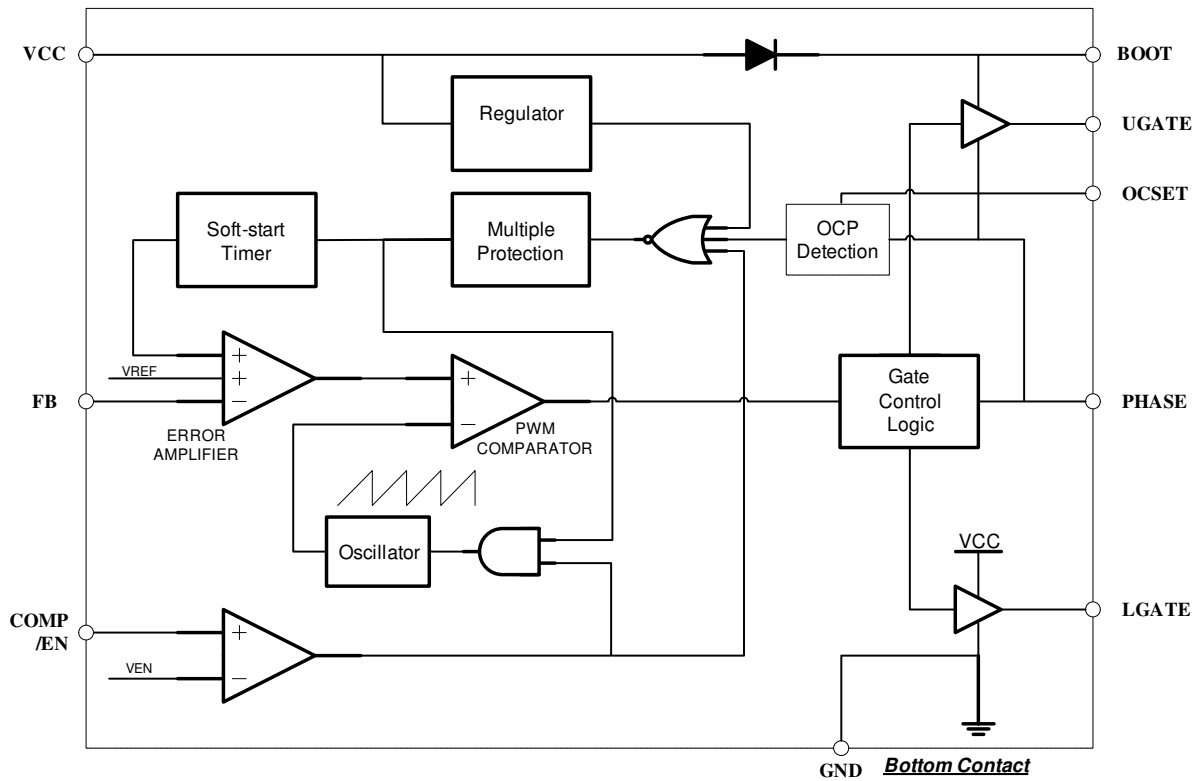


Pin Descriptions

PIN SYMBOL	PIN DESCRIPTION
BOOT	Bootstrap Supply for the floating upper gate driver. Connect the bootstrap capacitor C_{BOOT} between BOOT pin and the PHASE pin to form a bootstrap circuit. The bootstrap capacitor provides the charge to turn on the upper MOSFET. Typical values for C_{BOOT} range from 0.1 μ F to 0.47 μ F. Ensure that C_{BOOT} is placed near the IC.
UGATE	Upper Gate Driver Output. Connect this pin to the gate of upper MOSFET. This pin is monitored by the adaptive shoot-through protection circuitry to determine when the upper MOSFET has turned off.
GND	Signal and Power Ground for the IC through Bottom Contact. All voltage levels are measured with respect to this pin. Tie this pin to the ground island/plane through the lowest impedance connection available.
LGATE	Lower Gate Driver Output. Connect this pin to the gate of lower MOSFET. This pin is monitored by the adaptive shoot-through protection circuitry to determine when the lower MOSFET has turned off.
VCC	Supply Voltage. This pin provides the bias supply for the APE3212 and the lower gate driver. An internal regulator will supply bias if VCC rises above 6.5V. Connect a well-decoupled 4.5V to 13.2V supply voltage to this pin. Ensure that a decoupling capacitor is placed near the IC.
FB	Feedback Voltage. This pin is the inverting input to the error amplifier. A resistor divider from the output to GND is used to set the regulation voltage. Use this pin in combination with the COMP/EN pin to compensate the voltage control feedback loop of the converter.
OCSET	This Pin should be connected to ground with resistor R_{OCP} to set the over-current limit, as defined in the OCP Current Setting table above.
COMP/EN	Error Amplifier Output. This is the output of the error amplifier (EA) and the non-inverting input of the PWM comparator. Use this pin in combination with the FB pin to compensate the voltage-control feedback loop of the converter. Pulling COMP/EN to a level below 0.4V nominal disables the controller and causes the oscillator to stop, and the UGATE and LGATE outputs to be held low.
PHASE	PHASE Switch Node. Connect this pin to the source of the upper MOSFET and the drain of the lower MOSFET. This pin is used as the sink for the UGATE driver, and to monitor the voltage drop across the lower MOSFET for over-current protection. This pin is also monitored by the adaptive shoot-through protection circuitry to determine when the upper MOSFET has turned off. A Schottky diode between this pin and ground is recommended to reduce negative transient voltages which are common in a power supply system.
Exposed Pad	For ESOP-8 package. The exposed pad should be well soldered to the PCB for effective heat conduction. Connect the exposed pad to ground.

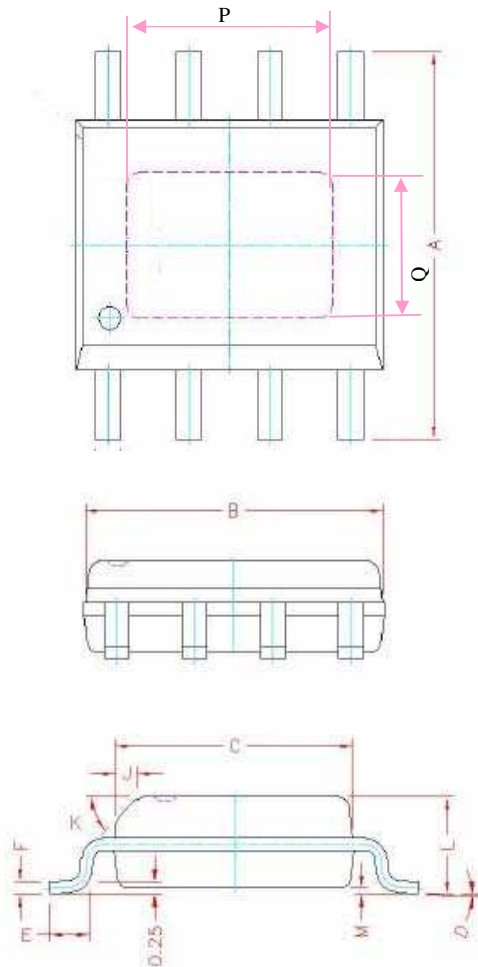


Block Diagram





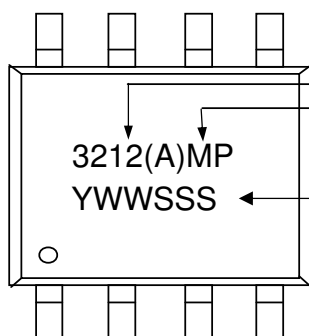
Package Dimensions: ESOP-8



SYMBOLS	Millimeters		
	MIN	NOM	MAX
A	5.80	6.00	6.20
B	4.80	4.90	5.00
C	3.80	3.90	4.00
D	0°	4°	8°
E	0.40	0.65	0.90
F	0.19	0.22	0.25
M	0.00	0.08	0.15
H	0.35	0.42	0.49
L	1.35	1.55	1.75
J	0.375 REF.		
K	45°		
G	1.27 TYP.		
P	3.15	3.25	3.35
Q	2.25	2.35	2.45

1. All dimensions are in millimeters.
2. Dimensions do not include mold protrusions.

Marking Information



Product : APE3212, APE3212A
 Package code :
 MP = RoHS-compliant, halogen-free ESOP-8
 Date/lot code (YWWSSS)
 Y: Last digit of the year
 W: Work week
 SSS: Lot code sequence