AS2214

Primary Side PWM Controller

Features

- Low Startup Current
- Bulk and AC sensing
- Soft Start
- Single-start or auto-restart modes
- Oscillator trimmed for precision duty cycle clamp
- Standard temperature range extended to 105°C
- Remote on / off control
- Buffered Ramp for slope compensation
- Standard current mode control

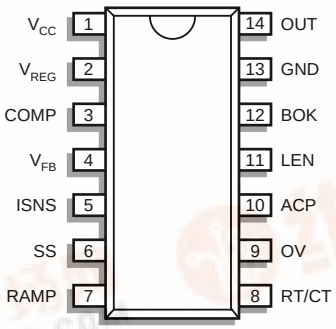
Description

The AS2214 is a full featured, pulse width modulation controller. Based on an improved AS3842, the AS2214 provides additional features that reduce component count and improve specifications in a wide range of power supply designs. The added functionality includes AC power and bulk voltage sensing, over-voltage input, as well as the ability to latch off or bounce through different fault conditions.

The PWM function is controlled by the current sense comparator for normal current mode control and a second comparator for voltage mode soft start. A buffered RAMP signal is available for slope compensation without loading the oscillator. The output stage is a high current totem pole output that sees only 85 ns delay from the PWM comparator.

The AS2214 requires less than 10µA of startup current. The undervoltage lockout (UVLO) thresholds are nominally 13.8V for turn on and 8 V for turn off. A precision 2.5 V bandgap reference serves as an input for the error amplifier. The oscillator discharge current is trimmed to provide guaranteed duty cycle clamping.

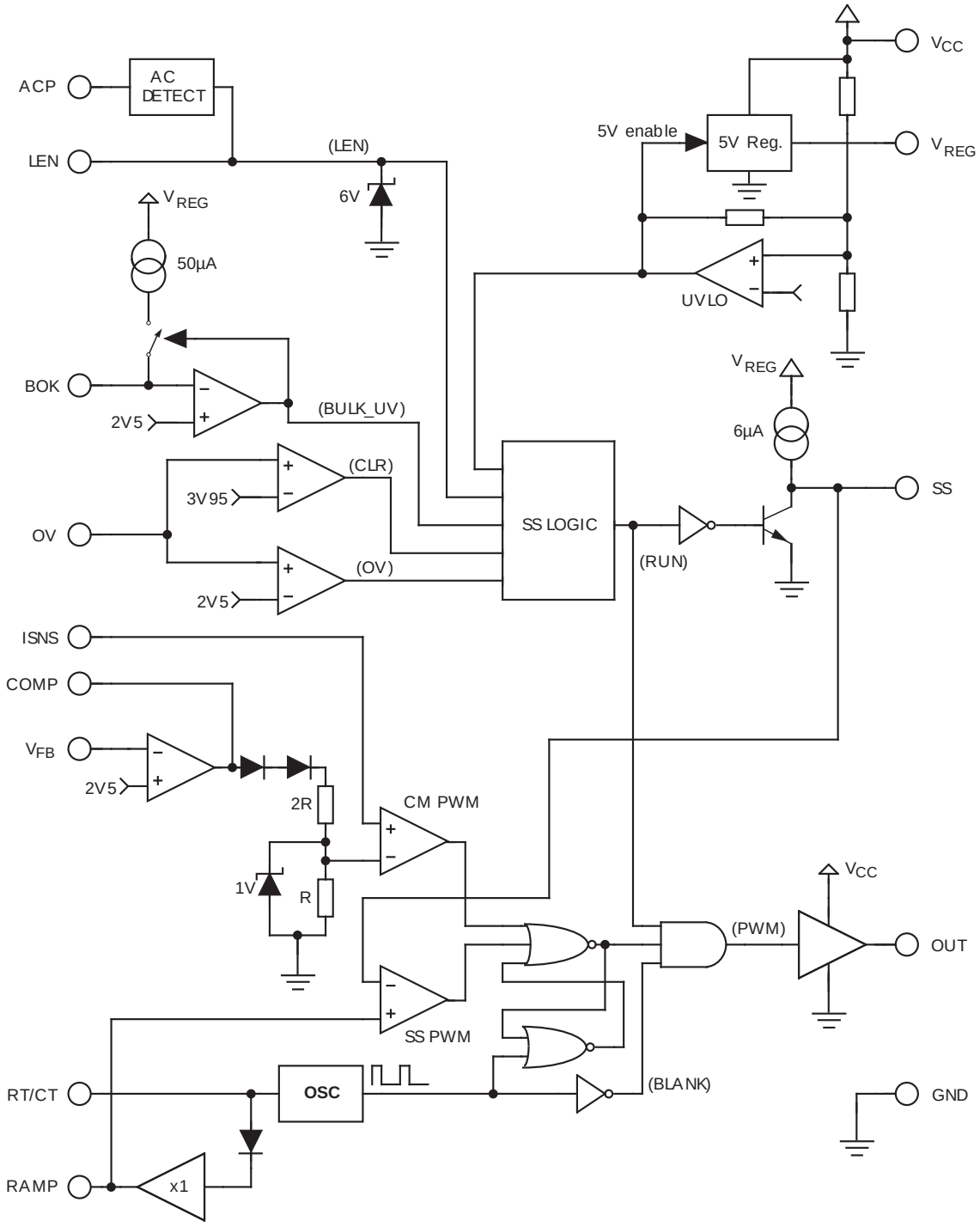
Pin Configuration — Top view



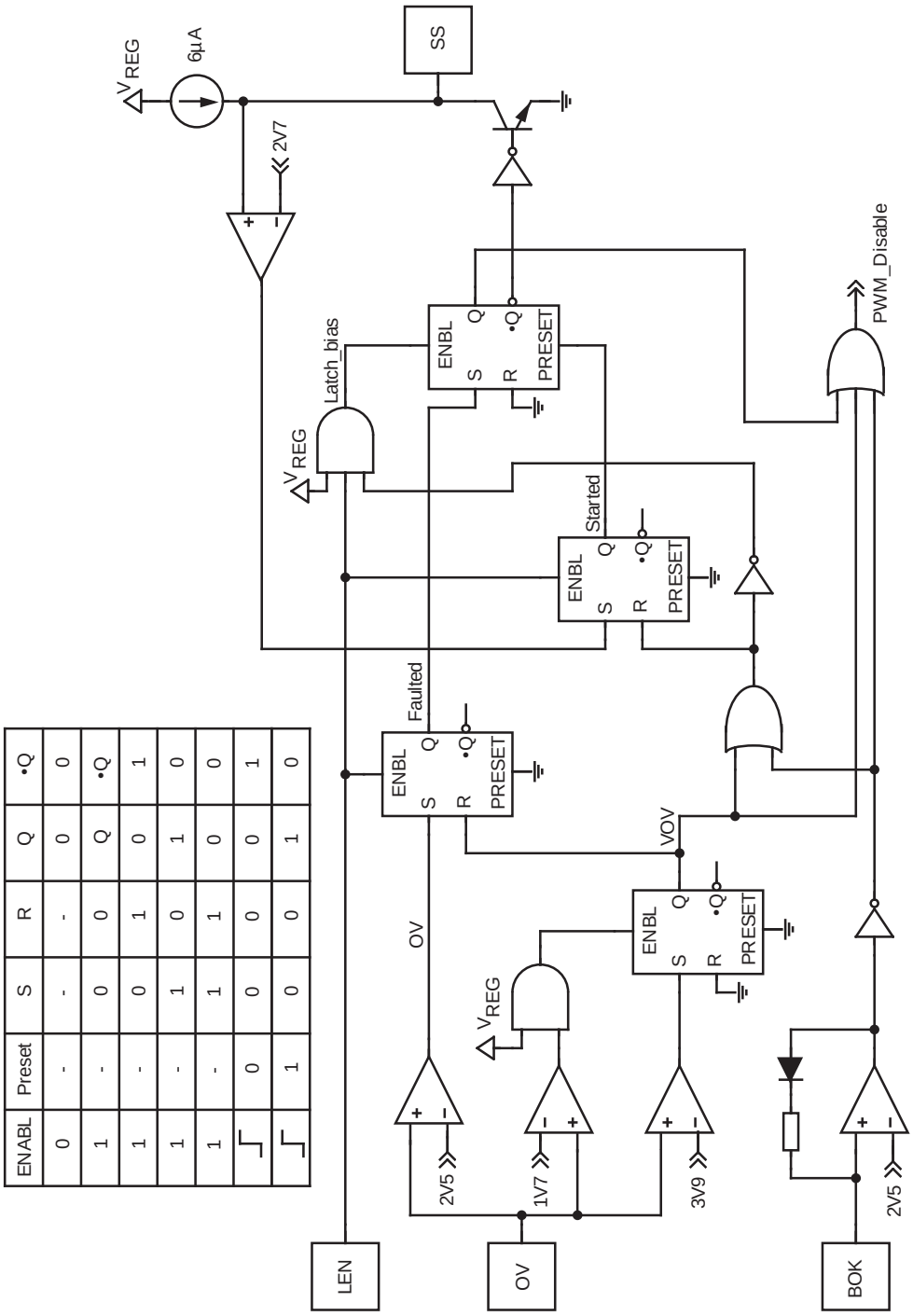
Ordering Information

Package	Temperature Range	Order Code
14-Pin Plastic DIP	0 to 105° C	AS2214N

Functional Block Diagram



AS2214 Soft Start Logic



ENABL	Preset	S	R	Q	•Q
0	-	-	-	0	0
1	-	0	0	Q	•Q
1	-	0	1	0	1
1	-	1	0	1	0
1	-	1	1	0	0
⌐	0	0	0	0	1
⌐	1	0	0	1	0

Pin Function Description

Pin Number	Function	Description
1	V_{CC}	Positive supply voltage for the IC.
2	V_{REG}	Output of 5V series regulator.
3	COMP	This pin is the error amplifier output. Typically used to provide loop compensation to maintain V_{FB} at 2.5 V.
4	V_{FB}	Inverting input of the error amplifier. The non-inverting input is a trimmed 2.5 V bandgap reference.
5	ISNS	A voltage proportional to inductor current is connected to this pin. The PWM uses this information to terminate the gate drive of the output.
6	SS	This pin provides a 6µA current source to linearly charge an external capacitor. This pin is compared to the RAMP pin in the soft start comparator, terminating output pulses when RAMP goes above the SS voltage.
7	RAMP	This pin is a level-shifted and buffered oscillator signal used to provide slope compensation to the current sense signal. The pin also serves as the non-inverting input of the soft-start comparator.
8	RT/CT	Oscillator frequency and maximum duty cycle are set by connecting a resistor (R_T) to VREG and a capacitor (C_T) to ground.
9	OV	This pin latches SS low when pulled above 2.5 V. The latch can be reset by pulling OV above 4 V then back to ground.
10	ACP	This pin detects the presence of AC signal and drives LEN high.
11	LEN	This pin must be high to enable starting. The pin can also clear all latches by going low then high.
12	BOK	This pin monitors the bulk voltage through a resistor divider and, when BOK exceeds 2.5 V, provides a 50µA current source for hysteresis. When BOK drops below 2.5V, SS is pulled low and the hysteresis current is turned off. Auto-restart after a brown-out is possible.
13	GND	Circuit common ground.
14	OUT	This totem pole output is designed to directly drive a power MOSFET switch capable of sourcing and sinking peak currents up to 1 A.

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Reference Current	I_{REF}	200	mA
Output Current	I_{OUT}	1	A
Supply Voltage	V_{CC}	20	V
Output Voltage	V_{OUT}	20	V
Continuous Power Dissipation at 25° C	P_D	500	mW
Junction Temperature	T_J	150	°C
Storage Temperature Range	T_{STG}	−65 to 150	°C
Lead Temperature, Soldering 10 Seconds	T_L	300	°C

Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Recommended Conditions

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{CC}	10 - 15	V
Oscillator	F_{OSC}	50 - 250	kHz

Typical Thermal Resistance

Package	θ_{JA}	θ_{JC}	Typical Derating
14L PDIP	85° C/W	40° C/W	11.7 mW/°C

Electrical Characteristics

Electrical Characteristics are guaranteed over full junction temperature range (0 to 105° C). Ambient temperature must be derated based on power dissipation and package thermal characteristics. Unless otherwise specified, the conditions of test are V_{CC} = 15 V; BOK = 3 V; OV = 0V; R_T = 680 Ω; C_T = 10 nF. To override UVLO, V_{CC} should be raised above 18 V prior to test.

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Error Amplifier						
Input Voltage	V_{FB}	T_J = 25°C	2.465	2.500	2.535	V
Input Bias Current	I_{BIAS}			-0.1	-1	µA
Voltage Gain	A_{VOL}	2 ≤ V_{COMP} ≤ 4 V	65	90		dB
Transconductance	G_m			1		mA/mV
Unity Gain Bandwidth	GBW		0.8	1.2		MHz
Power Supply Rejection Ratio	PSRR	12 ≤ V_{CC} ≤ 18 V	60	70		dB
Output Sink Current	I_{COMPL}	V_{FB} = 2.7 V; V_{COMP} = 1.1 V	2	6		mA
Output Source Current	I_{COMPH}	V_{FB} = 2.3 V; V_{COMP} = 5 V	0.5	1.0		mA
Output Swing High	I_{COMPH}	V_{FB} = 2.3 V; R_L = 15 Ω to GND	5	5.5		V
Output Swing Low	I_{COMPL}	V_{FB} = 2.7 V; R_L = 15 Ω to V_{REG}		0.7	1.1	V

Electrical Characteristics (cont'd)

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Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
5 V Regulator						
Output Voltage	V_{REG}	I_{REG} = 1 mA, T_J= 25° C	4.90	5.00	5.10	V
Line Regulation	PSRR	12 ≤ V_{CC} ≤ 18 V		5	15	mV
Load Regulation		1≤ I_{REG} ≤ 20mA		5	15	mV
Temperature Stability	TC_{REG}			0.2	0.4	mV/°C
Total Output Variation		Line, Load,Temperature	4.85		5.15	V
Long-Term Stability		Over 1,000 hrs at 25°C		5	25	mV
Output Noise Voltage	V_{NOISE}	10 ≤ f ≤ 100kHz, T_J = 25°C		50		µV
Maximum Source Current	I_{MAX}	V_{REG} = 4.8 V	30	120	180	mA
Oscillator						
Initial Accuracy	F_{OSC}	T_J =25°C	108	120	132	kHz
Voltage Stability		12 ≤ V_{CC} ≤ 18 V		0.2	1	%
Temperature Stability	TC_F	T_{MIN} ≤ T_J ≤ T_{MAX}		5		%
Amplitude	V_{OSC}	VRT/CT peak-to-peak		1.55		V
Upper Trip Point	V_H			2.80		V
Lower Trip Point	V_L			1.25		V
Discharge Current	I_{DSC}		7.50	8.70	9.50	mA
Duty cycle Limit		R_T =680 Ω, C_T =10nF, T_J =25°C	46	50	54	%
Over-Temperature Shutdown	T_{OT}			140		°C
Soft Start Comparator						
SS Charge Current	I_{SS}	V_{SS} ≤ V_{RAMP}	-4	-6	-10	µA
SS Discharge Current	I_{Dsc} SS	V_{SS} = 1 V, V_{OV} > 2.5V	2	8		mA
SS Lower Clamp	$V_{SS\ Low}$			0.6		V
RAMP High Level	V_{RAMPH}	T_J =25°C		2.15		V
RAMP Low Level	V_{RAMPL}	T_J =25°C		0.6		V
RAMP Levels TC		Note: RAMP wavefrom is the same as the RT/CT wavefrom, but level shifted down one diode drop		-2		mV/°C
RAMP Sink Current	I_{RAMPL}	T_J =25°C	–0.1	–0.2		mA
RAMP Source Current	I_{RAMPH}	T_J =25°C	1			mA
Propagation Delay to Output	t_{PB}			85	150	ns

Electrical Characteristics (cont'd)

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Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Housekeeping						
BOK UV Threshold	V_{BOK} UV	V_{REG} = 5 V	2.500	2.537	2.575	V
BOK UV Hysteresis Current	$I_{HYST\ BOK}$	V_{BOK} = 2.6 V	42	50	58	µA
BOK Input Bias Current	$I_{OFF\ BOK}$	V_{BOK} = 2.4 V		0.1	1.0	µA
OV Threshold	V_{OV}		2.50	2.80	3.10	V
OV Clear Threshold	V_{OVH}		3.80	4.00	4.50	V
OV Reset Threshold	V_{OVL}		1.10	1.75	2.20	V
OV Bias Current	$I_{BIAS\ OV}$	V_{REG} = 5 V, $V_{OV} \leq$ OV Threshold * For Vov > OV Reset Threshold, see characteristic curve	-1	-0.2	1	µA
ACP Voltage	V_{ACP}	I_{ACP} = 10 µA		1.3		V
ACP Voltage	V_{ACP}	I_{ACP} = -10 µA		-1.2		V
LEN Charge Current	I_{LEN}	I_{ACP} = 10 µA; V_{LEN} = 0 V	-30	-45	-65	µA
LEN Charge Current	I_{LEN}	I_{ACP} = -10 µA; V_{LEN} = 0 V	-30	-50	-65	µA
Minimum Voltage for LEN Functionality	$V_{LEN\ MIN}$			3.6	4.5	V
LEN Logic Reset Voltage	V_{LEN}	This level reflects one diode drop of hysteresis from $V_{LEN\ min}$		3.0		V
LEN Regeneration Current	I_{LENrgn}			-10		µA
LEN Clamp	V_{LEN}	I_{ACP} = 5 µA	5.2	5.9	6.6	V
LEN Bias Current	$I_{BIAS\ LEN}$	V_{LEN} = 5 V, I_{ACP} = 0 µA * For LEN input current over full range, see characteristic curve.		8		µA
Current Sense Comparator						
Transfer Gain	AV_{ISNS}	-0.2 ≤ V_{ISNS} ≤ 0.8 V	2.85	3.00	3.15	V/V
I_{SNS} Level Shift	V_{LS}	V_{ISNS} = 0 V		1.50		V
Maximum Input Signal		V_{COMP} =+5 V	1.00	1.08	1.20	V
Power Supply Rejection Ratio	PSRR	12 ≤ V_{CC} ≤ 18 V		70		dB
Input Bias Current	I_{BIAS}			-1	-10	µA
Propagation Delay to Output	t_{PB}			85	150	ns

Electrical Characteristics (cont'd)

Electrical Characteristics are guaranteed over full junction temperature range (0 to 105° C). Ambient temperature must be derated based on power dissipation and package thermal characteristics. Unless otherwise specified, the conditions of test are V_{CC} = 15 V; BOK = 3 V; OV = 0V; R_T = 680 Ω; C_T = 10 nF. To override UVLO, V_{CC} should be raised above 18 V prior to test.

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Under Voltage Lockout						
Startup Threshold	V_{CC} (ON)		12.5	14.0	15.8	V
Minimum Operating Voltage after Trun-on	V_{CC} (OFF)		7.3	8.0	8.5	V
Startup Current	I_{CC}	V_{CC} = 12 V; V_{ACP} = V_{LEN} = 0 V		2	10	µA
Startup Current	I_{CC}	V_{CC} = 12V; I_{ACP} = 5 µA		225	300	µA
Operating Supply Current	I_{CC}			12	20	mA
Maximum Operating Supply Voltage	$V_{CC\ Max}$				18	V
Output Impedance to GND in UVLO State	Z_{OUT}	V_{CC} = 6 V		22.0		kΩ
Output						
Output Low Level	V_{OL}	I_{SINK} = 20 mA		0.1	0.4	V
Output Low Level	V_{OL}	I_{SINK} = 150 mA		1.5	2.2	V
Output High Level	V_{OH}	I_{SOURCE} = 20 mA	13	13.5		V
Output High Level	V_{OH}	I_{SOURCE} = 150 mA	12	13		V
Rise Time	t_R	C_L = 1 nF		50	150	ns
Fall Time	t_F	C_L = 1 nF		50	150	ns
Maximum Duty Cycle	D_{MAX}		94	97	100	%
Minimum Duty Cycle	D_{MIN}		0			%

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