

# Buck Pulse Width Modulator Stepdown Voltage Regulator

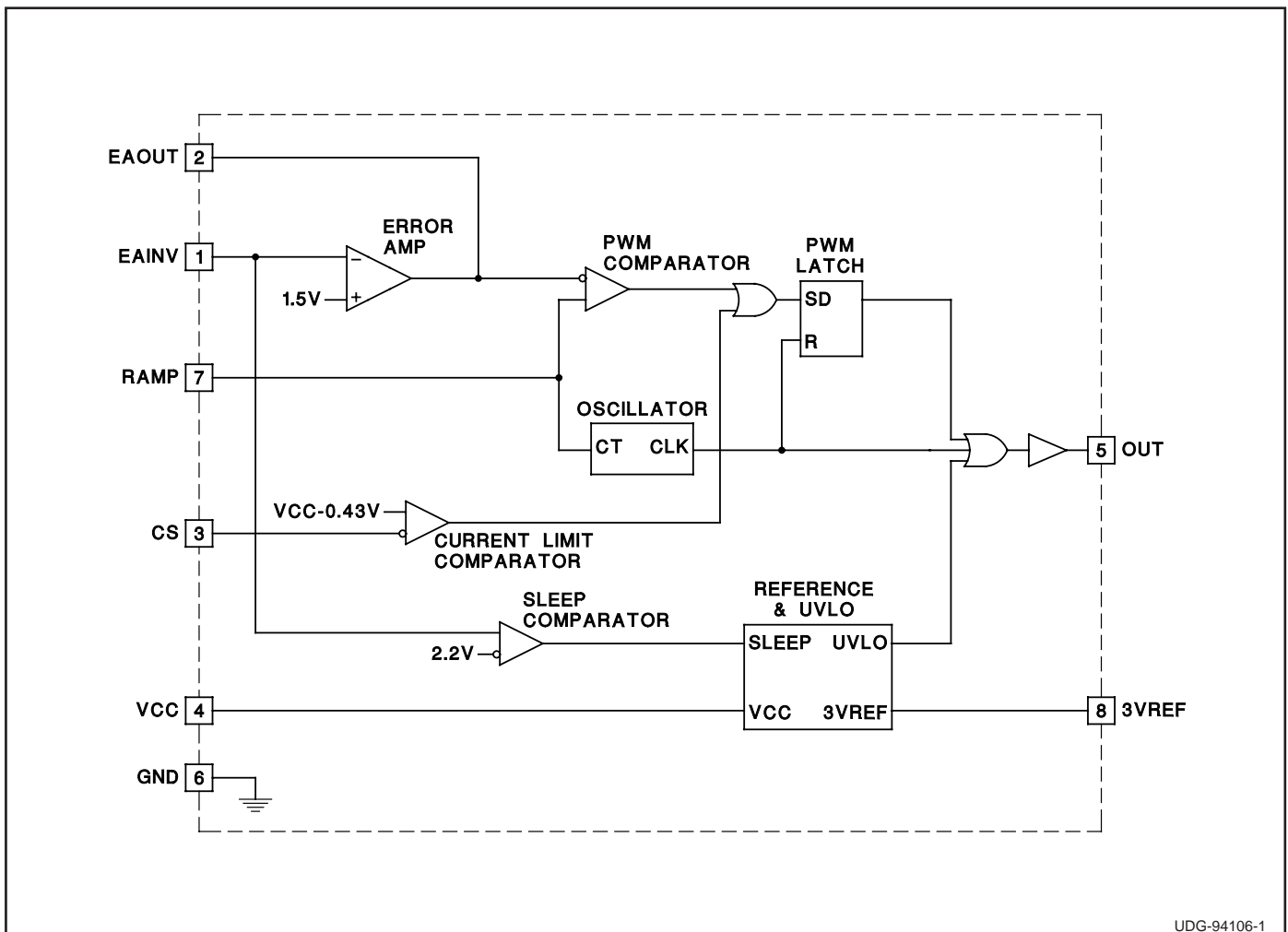
## FEATURES

- Simple Single Inductor Buck PWM Stepdown Voltage Regulation
- Drives External PMOS Switch
- Contains UVLO Circuit
- Includes Pulse-by-Pulse Current Limit
- Low 50µA Sleep Mode Current

## DESCRIPTION

The UC3573 is a Buck pulse width modulator which steps down and regulates a positive input voltage. The chip is optimized for use in a single inductor buck switching converter employing an external PMOS switch. The block diagram consists of a precision reference, an error amplifier configured for voltage mode operation, an oscillator, a PWM comparator with latching logic, and a 0.5A peak gate driver. The UC3573 includes an undervoltage lockout circuit to insure sufficient input supply voltage is present before any switching activity can occur, and a pulse-by-pulse current limit. Input current can be sensed and limited to a user determined maximum value. In addition, a sleep comparator interfaces to the UVLO circuit which turns the chip off when the input voltage is below the UVLO threshold. This reduces the supply current to only 50µA, making the UC3573 ideal for battery powered applications.

## BLOCK DIAGRAM



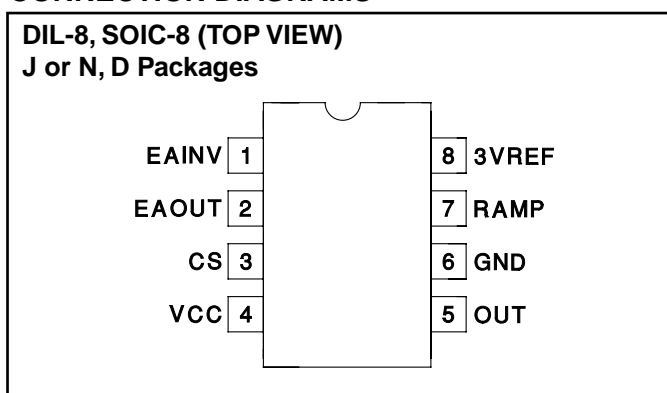
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## ABSOLUTE MAXIMUM RATINGS

VCC	.....35V
EAINV	.....-0.6V to VCC
IEAOUT	......25mA
RAMP	.....-0.3V to 4V
CS	.....-0.3V to VCC
IOU	.....-0.7A to 0.7A
I3VREF	.....-15mA
Storage Temperature	.....-65°C to +150°C
Junction Temperature	.....-65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	.....+300°C

*Currents are positive into, negative out of the specified terminal.  
Consult Packaging Section of Databook for thermal limitations  
and considerations of packages.*

## CONNECTION DIAGRAMS



**ELECTRICAL CHARACTERISTICS** Unless otherwise stated, these parameters apply for  $T_A = -55^\circ\text{C}$  to  $+125^\circ\text{C}$  for the UC1573,  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$  for the UC2573, and  $0^\circ\text{C}$  to  $+70^\circ\text{C}$  for the UC3573,  $V_{CC} = 5\text{V}$ ,  $C_T = 680\text{pF}$ ,  $T_A = T_J$ .

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNITS
<b>Reference Section</b>					
3VREF		2.94	3	3.06	V
Line Regulation	$V_{CC} = 4.75$ to $30\text{V}$		1	10	mV
Load Regulation	$I_{3VREF} = 0$ to $-5\text{mA}$		1	10	mV
<b>Oscillator Section</b>					
Frequency	$V_{CC} = 5\text{V}$ , $30\text{V}$	85	100	115	kHz
<b>Error Amp Section</b>					
EAINV	$EAOUT = 2\text{V}$	1.45	1.5	1.55	V
IEAINV	$EAOUT = 2\text{V}$		-0.2	-1	$\mu\text{A}$
AVOL	$EAOUT = 0.5\text{V}$ to $3\text{V}$	65	90		dB
EAOUT High	$EAINV = 1.4\text{V}$	3.6	4	4.4	V
EAOUT Low	$EAINV = 1.6\text{V}$		0.1	0.2	V
IEAOUT	$EAINV = 1.4\text{V}$ , $EAOUT = 2\text{V}$	-350	-500		$\mu\text{A}$
	$EAINV = 1.6\text{V}$ , $EAOUT = 2\text{V}$	7	20		mA
Unity Gain Bandwidth	$T_J = 25^\circ\text{C}$ , $F = 10\text{kHz}$	0.6	1		MHz
<b>Current Sense Comparator Section</b>					
Threshold (referred to VCC)		-0.39	-0.43	-0.47	V
Input Bias Current	$CS = V_{CC}$		150	800	nA
CS Propagation Delay			400		ns
<b>Gate Drive Output Section</b>					
OUT High Saturation	$I_{OUT} = 0$		0	0.3	V
	$I_{OUT} = -10\text{mA}$		0.7	1.5	V
	$I_{OUT} = -100\text{mA}$		1.5	2.5	V
OUT Low Saturation	$I_{OUT} = 10\text{mA}$		0.1	0.4	V
	$I_{OUT} = 100\text{mA}$		1.5	2.2	V
Rise Time	$T_J = 25^\circ\text{C}$ , $C_{LOAD} = 1\text{nF} + 3.3\text{ Ohms}$		30	80	ns
Fall Time	$T_J = 25^\circ\text{C}$ , $C_{LOAD} = 1\text{nF} + 3.3\text{ Ohms}$		30	80	ns
<b>Pulse Width Modulator Section</b>					
Maximum Duty Cycle	$EAINV = 1.4\text{V}$		92	96	%
Minimum Duty Cycle	$EAINV = 1.6\text{V}$			0	%
Modulator Gain	$EAOUT = 1.5\text{V}$ to $2.5\text{V}$	25	35	45	%/V
<b>Undervoltage Lockout Section</b>					
Start Threshold		3.5	4.2	4.5	V
Hysteresis		100	200	300	mV

**ELECTRICAL CHARACTERISTICS (cont.)** Unless otherwise stated, these parameters apply for  $T_A = -55^\circ\text{C}$  to  $+125^\circ\text{C}$  for the UC1573,  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$  for the UC2573, and  $0^\circ\text{C}$  to  $+70^\circ\text{C}$  for the UC3573,  $V_{CC} = 5\text{V}$ ,  $C_T = 680\text{pF}$ ,  $T_A = T_J$ .

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNITS
<b>Sleep Mode Section</b>					
Threshold		1.8	2.2	2.6	V
<b>Supply Current Section</b>					
$I_{VCC}$	$V_{CC} = 30\text{V}$		9	12	mA
$I_{VCC}$	$V_{CC} = 30\text{V}, EAINV = 3\text{V}$		50	150	$\mu\text{A}$

## PIN DESCRIPTIONS

**3VREF:** Precision 3V reference. Bypass with 100nF capacitor.

**CS:** Peak current limit sense pin. Senses the current across a current sense resistor placed between  $V_{CC}$  and source of the PMOS Buck switch. OUT will be held high (PMOS buck switch off) if  $V_{CC} - CS$  exceeds 0.4V.

**EAINV:** Inverting input to error amplifier. VOUT sense feedback connected to this pin. The non-inverting input of the error amplifier is internally connected to

$$\frac{3VREF}{2} \text{ volts.}$$

Connecting the EAINV pin to an external voltage greater than 2.6V commands the chip to go into a low current sleep mode.

**EAOUT:** Output of error amplifier. Use EAOUT and EAINV for loop compensation components.

**GND:** Circuit Ground.

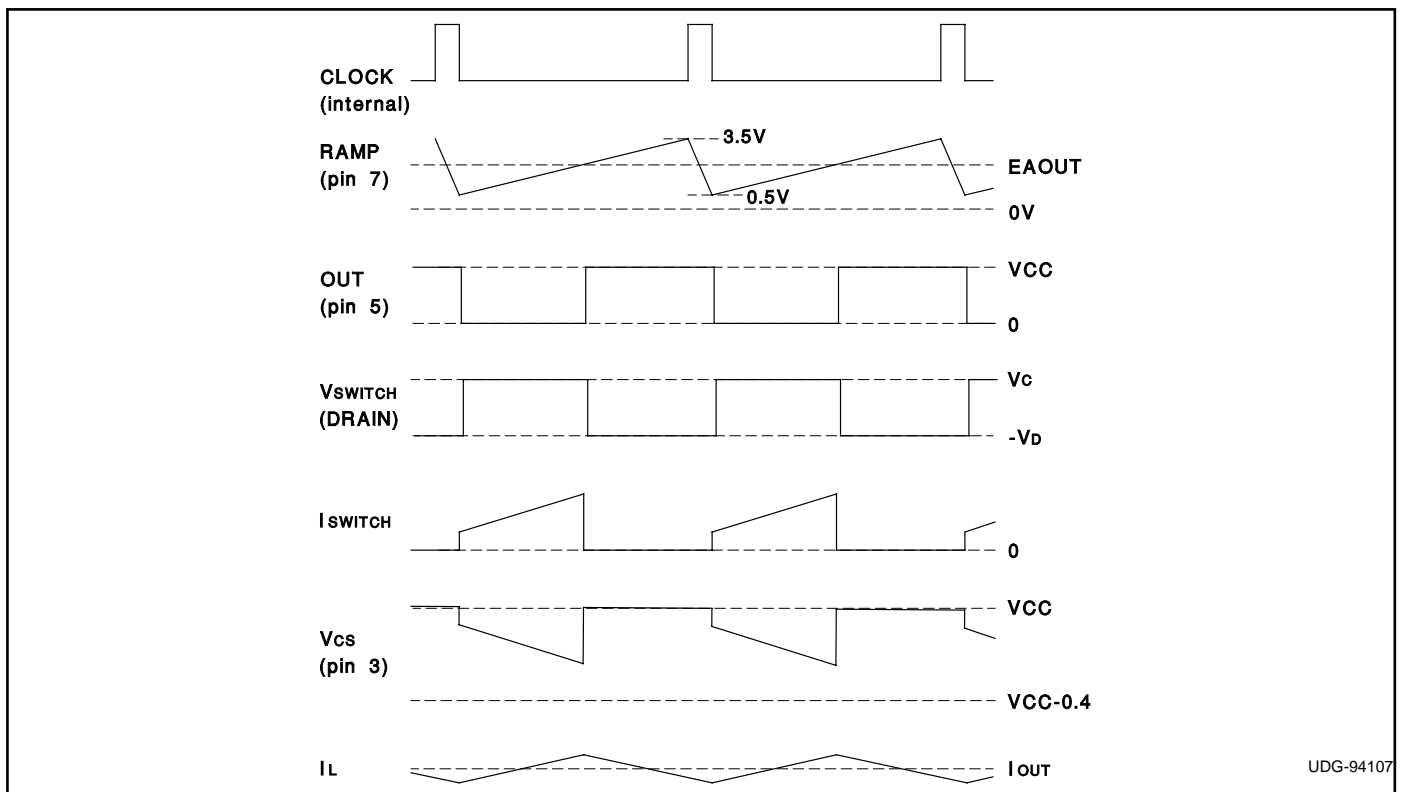
**OUT:** Gate drive for external PMOS switch connected between  $V_{CC}$  and the flyback inductor. OUT drives the gate of the PMOS switch between  $V_{CC}$  and GND.

**RAMP:** Oscillator and ramp for pulse width modulator. Frequency is set by a capacitor to GND by the equation

$$F = \frac{1}{15\text{k} \cdot C_{RAMP}}$$

Recommended operating frequency range is 10kHz to 200kHz.

**VCC:** Input voltage supply to chip. Range is 4.75V to 30V. Bypass with a 1 $\mu\text{F}$  capacitor.



Typical Waveforms

TYPICAL APPLICATION: 12V TO 5V BUCK CONVERTER

