R2A20134ASP

Application Note

R19AN0028EJ0100
Rev.1.00
Jun 26, 2013

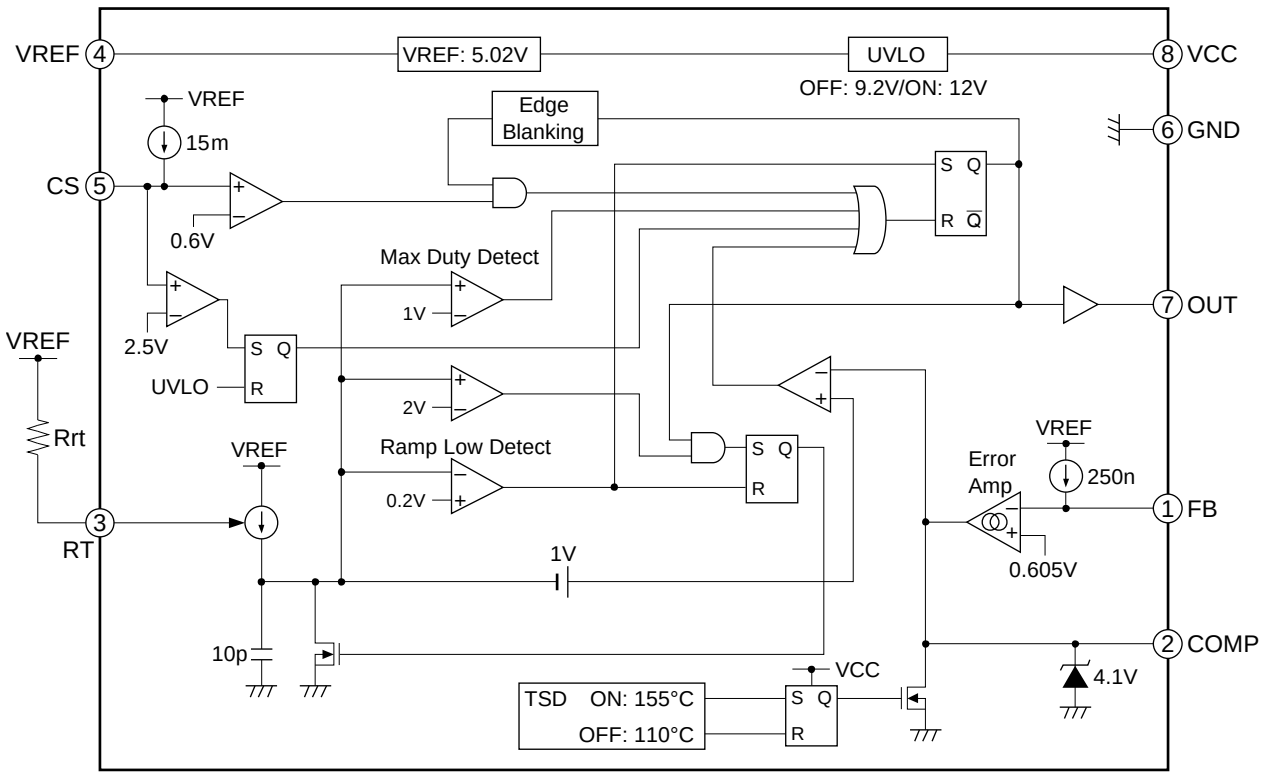
1. General Description

R2A20134ASP is a control IC for LED lighting system. This IC integrates protect functions which enables to compose high reliability LED lighting system with small numbers of components; over temperature protection (TSD), over voltage protection (OVP) and unique dual over current protection (OCP and secondary OCP). This IC operates as fixed switching frequency. Operation mode is selectable from 'Constant Peak Current Control Mode' and 'Constant ON Period Control Mode with Error Amplifier'. The 'Constant Current Control Mode' enables to reduce external components and achieve a smaller and lower cost system. The 'Constant ON Period Control Mode' applies our unique PFC technology and it achieves high PFC performance. Furthermore, R2A20134A supports isolated fly-back topology.

2. Block Diagram

Fixed Frequency Operation Mode (connecting Rrt to VREF)

When resistor Rrt of RT pin is connected to GND pin, the IC operates in fixed switching frequency mode that MOSFET is turned ON by integrated oscillator. Frequency of integrated oscillator is adjustable with changing resistor Rrt condition. In this control mode, this IC operates as discontinuous current mode (DCM).

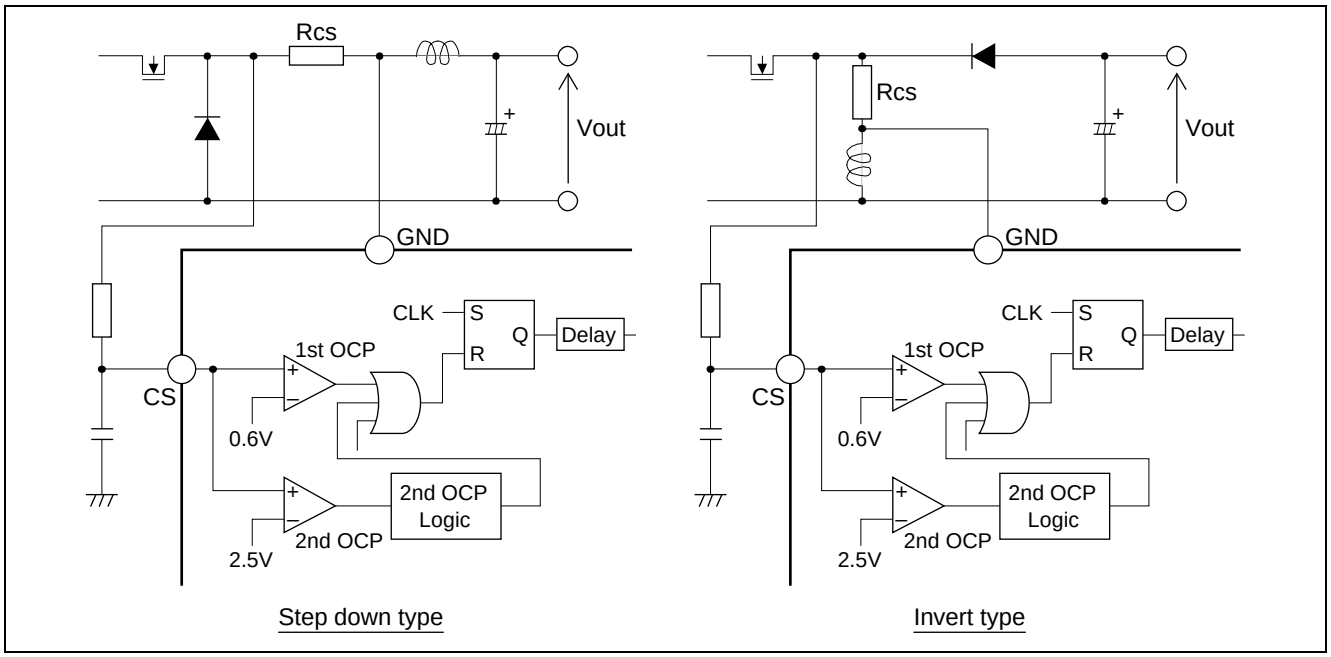


Note: CRM (critical conduction mode) operation is NOT supported by R2A20134A, as differs from R2A20134. Therefore, gate drive pulse is NOT output from OUT pin even if Rrt is connected to IC GND.

3. Description for Functional Block

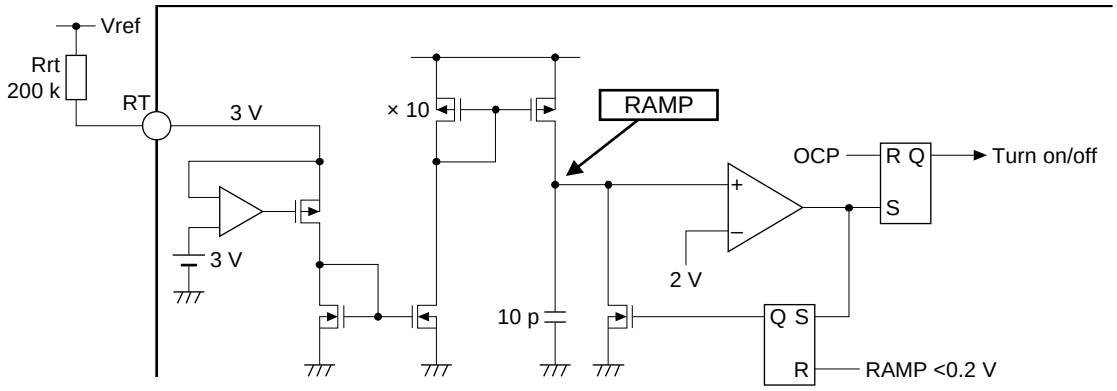
3.1 Dual Over Current Protection (pulse-by-pulse type & latch type)

R2A20134A integrates OCP and 2nd OCP as a dual over current protection. OCP is a pulse-by-pulse type over current protection which detects inductor current with external sensing resistor Rcs. OCP turns off MOSFET when CS terminal voltage reaches to 0.6 V. 2nd OCP is a latch type over current protection. It turns off MOSFET as latched stop, when CS terminal voltage reaches to 2.5 V. To avoid false detection such as noise, 2nd OCP works when CS terminal voltage reaches to 2.5 V four times in succession synchronously to gate driving pulse. This latched stop condition will be released if IC is turned off (when Vcc drops lower than Vuvll; Vcc < Vuvll).



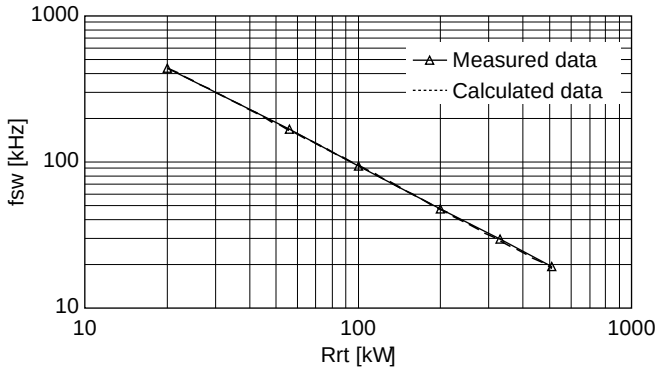
3.2 Built-in Oscillator

When resistor Rrt is connected between RT terminal and GND terminal, the IC operation is set to fixed frequency mode and built-in oscillator starts oscillation. This built-in oscillator sets MOSFET ON timing. Maximum ON duty is 50%, with 48 kHz switching frequency.



The relation between external resistor Rrt of RT terminal and switching frequency fout of OUT terminal is shown in the right figure. This relation can be calculated with following formula;

$$fout\ [\text{kHz}] = \frac{1}{(105 \times 10^{-9} \times Rrt) + (200 \times 10^{-6})} \quad (1)$$

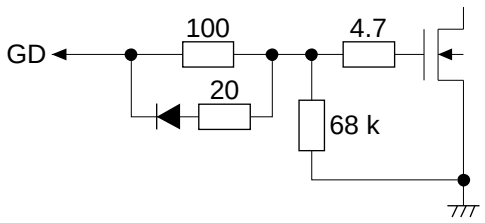


3.3 Error Amplifier

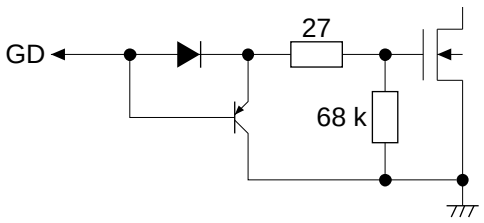
Trans conductance amplifier is used as error amplifier. Its output current is defined by voltage difference between internal reference voltage and the voltage of FB pin.

3.4 Gate Driving Output

Totem pole output circuit is integrated in OUT pin. Its Maximum drive current is 900 mA (peak). Basically, it is possible to drive MOSFET directly, however, it is recommended that the drive circuit condition is optimized for MOSFET characteristic. This IC drives MOSFET as zero current switching. Therefore, turn-off speed mainly affects power loss than turn-on speed.



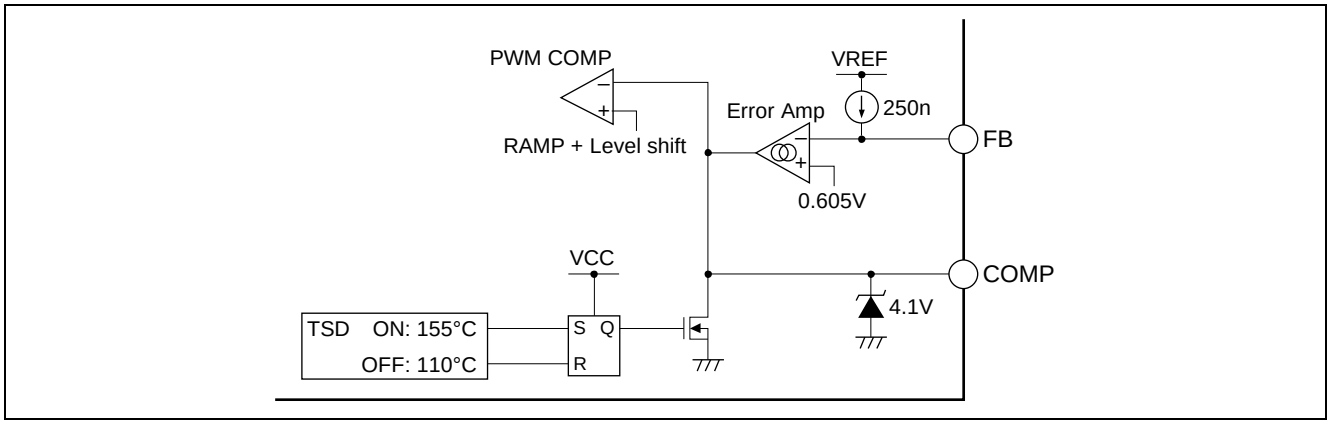
Drive circuit example 1



Drive circuit example 2

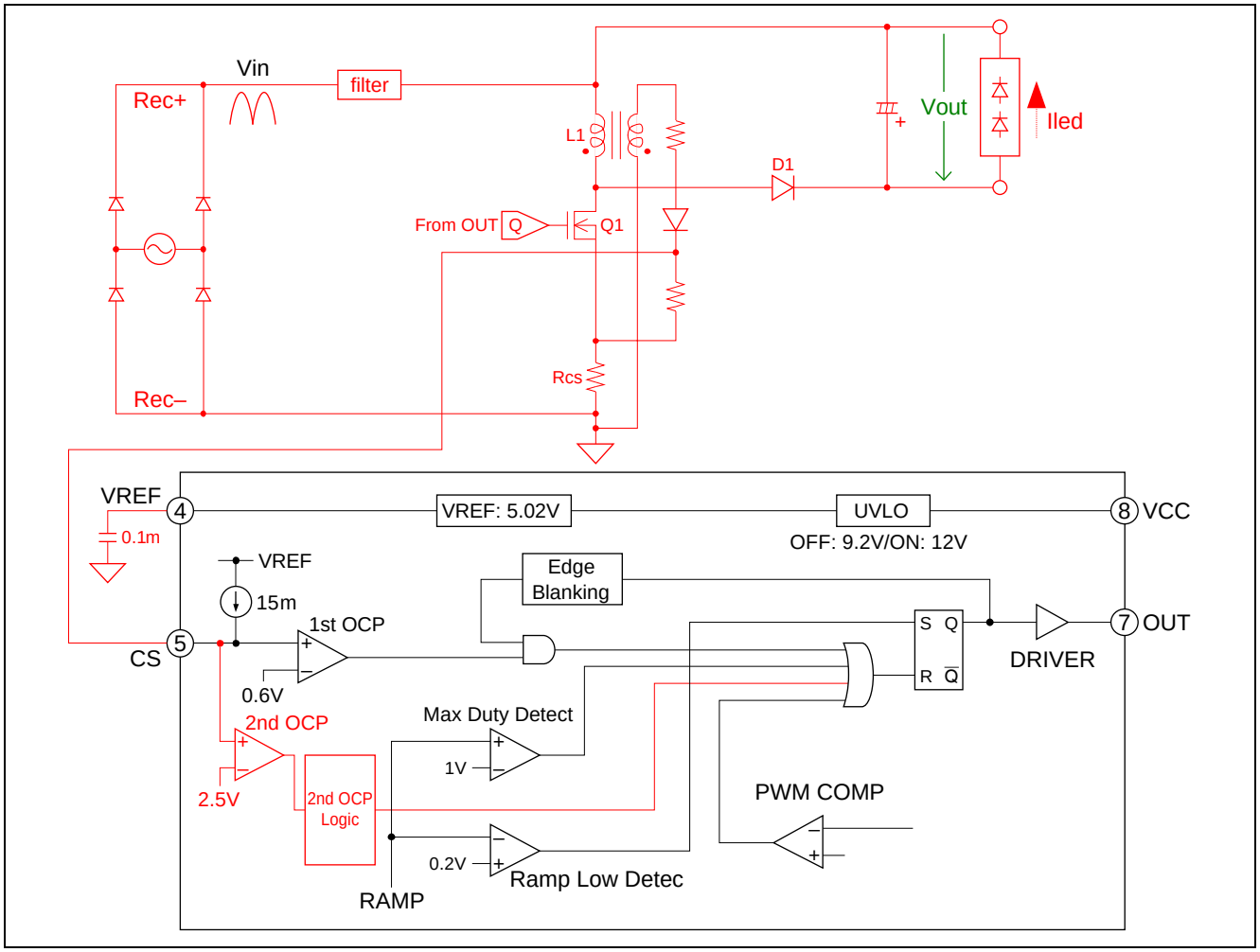
3.5 Over Heat Protection

This IC integrates over heat protection (TSD) to avoid abnormal operation in over heated condition. When chip temperature exceeds 155°C (typ.), COMP pin voltage will be forced to drop below RAMP offset voltage. Then, the gate driving pulse output from OUT pin is forced to stop. This dropped COMP voltage is kept as latched condition. Once TSD start working, it isn't released unless chip temperature will drop below 110°C (typ.) which is TSD release temperature or VCC voltage will drop below 3 V.



3.6 Over Voltage Protection

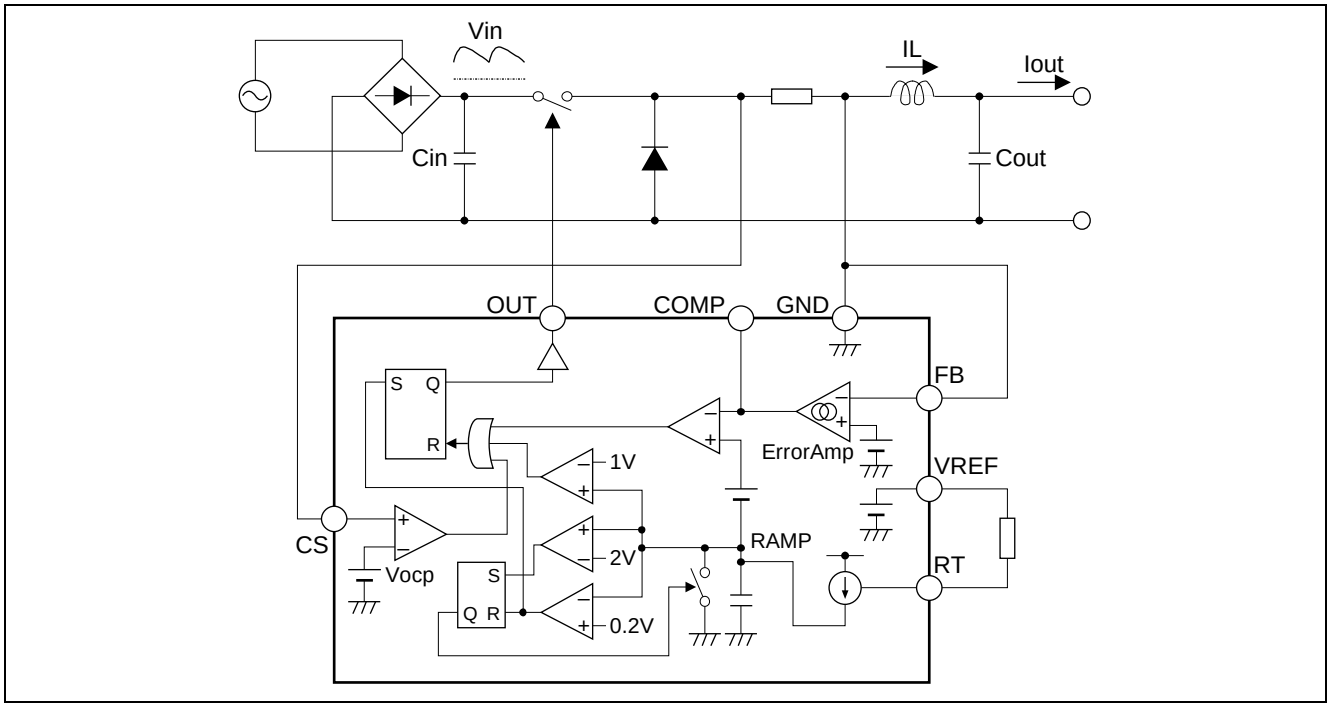
This IC integrates over voltage protection by using 2nd OCP function. when abnormal voltage rising caused by LED open mode failure or over current caused by inductor short mode failure are detected via auxiliary winding, gate driving pulse will be forced to stop as latched condition. This OVP works when CS pin voltage exceeds 2.5 V. To avoid false detection such as noise, OVP works when CS terminal voltage reaches to 2.5 V four times in succession synchronously to gate driving pulse. However, in the case that CS pin voltage exceeds 2.5 V for longer period than double of a switching cycle, OVP immediately starts working. This latched stop condition will be released if IC is turned off (when Vcc drops lower than Vuvll; Vcc < Vuvll).



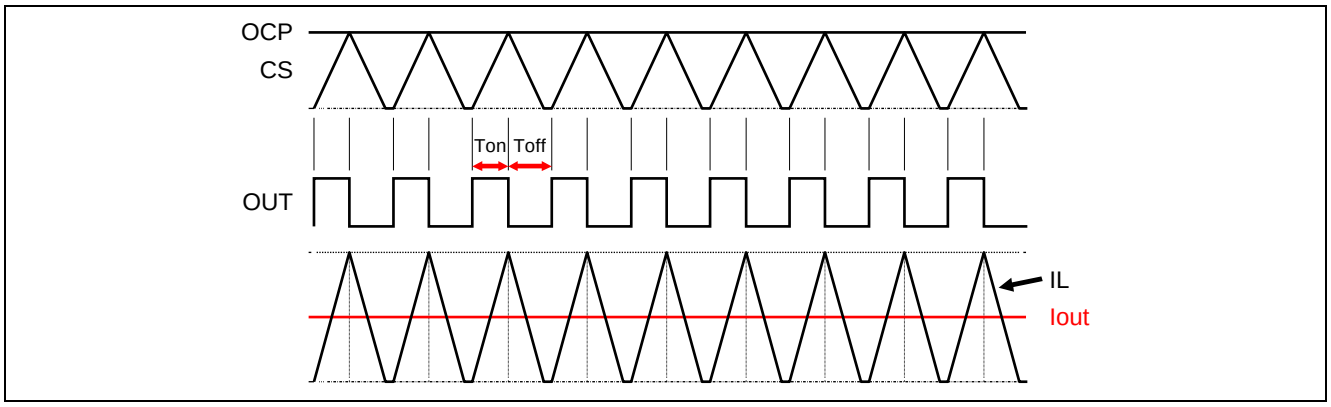
4. Application Example

4.1 Constant Peak Current Control Mode (fixed frequency control with peak current control)

The following is block diagram of buck converter circuit controlled by peak current control mode. Inductor peak current (= output current) is kept constant by over current protection function detecting inductor current by CS pin.

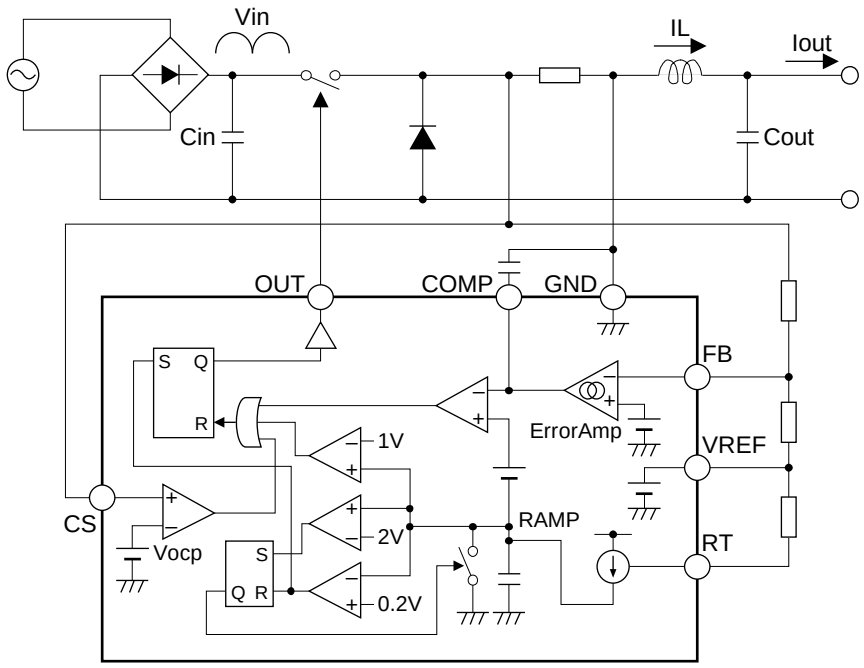


The peak current through inductor is kept constant in the range where Vin exceeds Vout (Vin > Vout). If the capacitance of input capacitor Cin is large enough to keep always the condition as "Vin > Vout", peak current through inductor is kept constant. That is, output current ripple is reduced efficiently in this control mode. Furthermore, less external components is required because built-in error amplifier is not used in this control mode.



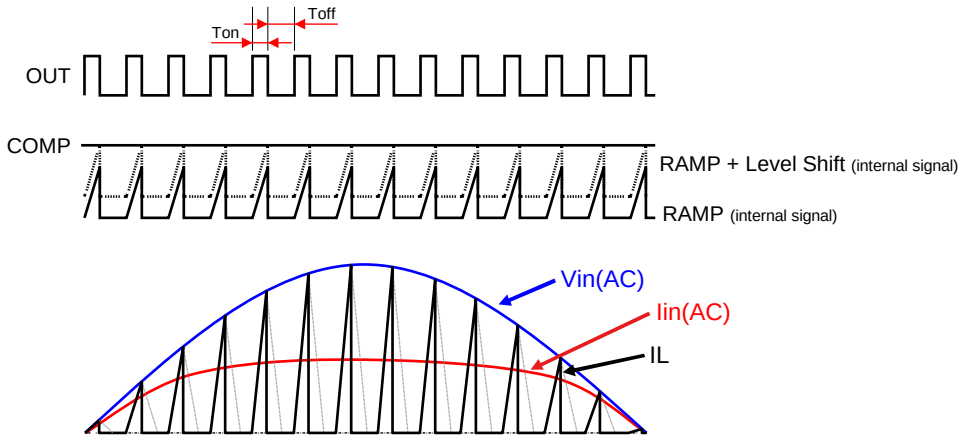
4.2 Constant ON Period Control Mode (fixed frequency & averaged current control with error amplifier)

The following is block diagram of buck converter circuit controlled by error amplifier control mode. The error amplifier controls ON period of MOSFET by inductor current flow information input to FB pin, so as to keep inductor current (output current) constant.



In error amplifier control mode, ON period is constant in normal operation. Peak inductor current changes as proportional to input voltage because on period is constant. Therefore, this operation mode achieves good power factor correction performance.

$$di(t) = \frac{v(t)}{L} dt$$ * if the length of on period is the same, peak inductor current is proportional to input voltage.



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Revision Record

		Description	
Rev.	**Date**	**Page**	**Summary**
Rev.1.00	Jun 26, 2013	—	First edition issued

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