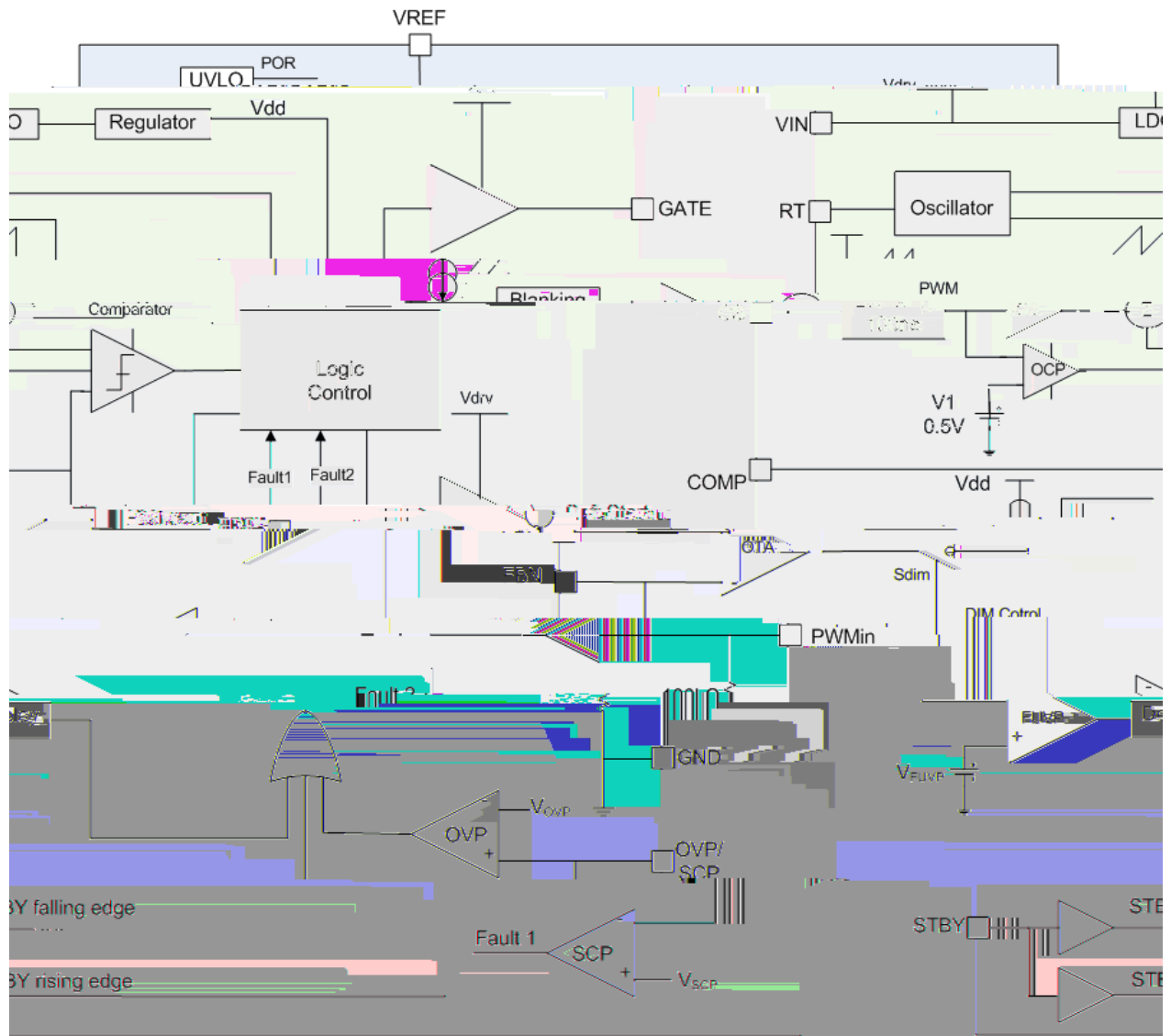
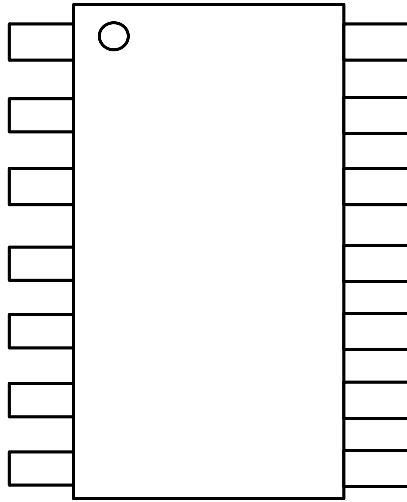




- $\pm 1\%$  Vref Voltage Accuracy to set LED Current
  - PWM Controlled Dimming
  - Soft Start Limits In-Rush Current
  - Open Feedback Protection
  - Open LED Protection
  - Short LED Protection
  - LED String Cathode Short to ground Protection
  - Max Duty Cycle Above 90%
  - SOIC-14 Package
  - This is a Pb-Free Device
- 
- TFT-LCD TV Panels
  - LCD Monitor Panels





			$\mu$
			$\mu$


o o o

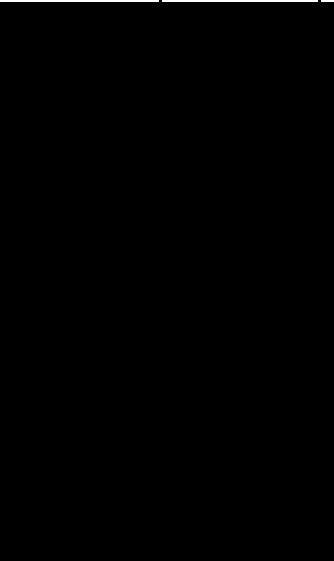
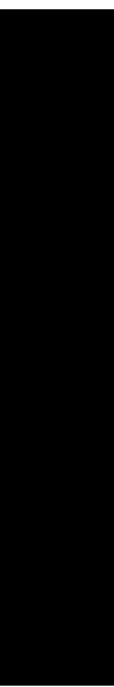
--	--	--	--	--	--	--

			o			
$\Delta$						
		-	-			

		$\mu$				
		$\mu$				

		-	-	-		
		-	-	-		
						$\Omega$
						$\Omega$
$\pm\Delta$				-		

--	--	--	--	--	--	--



o

o

o

--	--	--	--	--	--	--





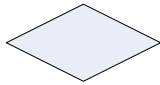
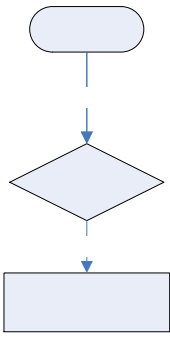
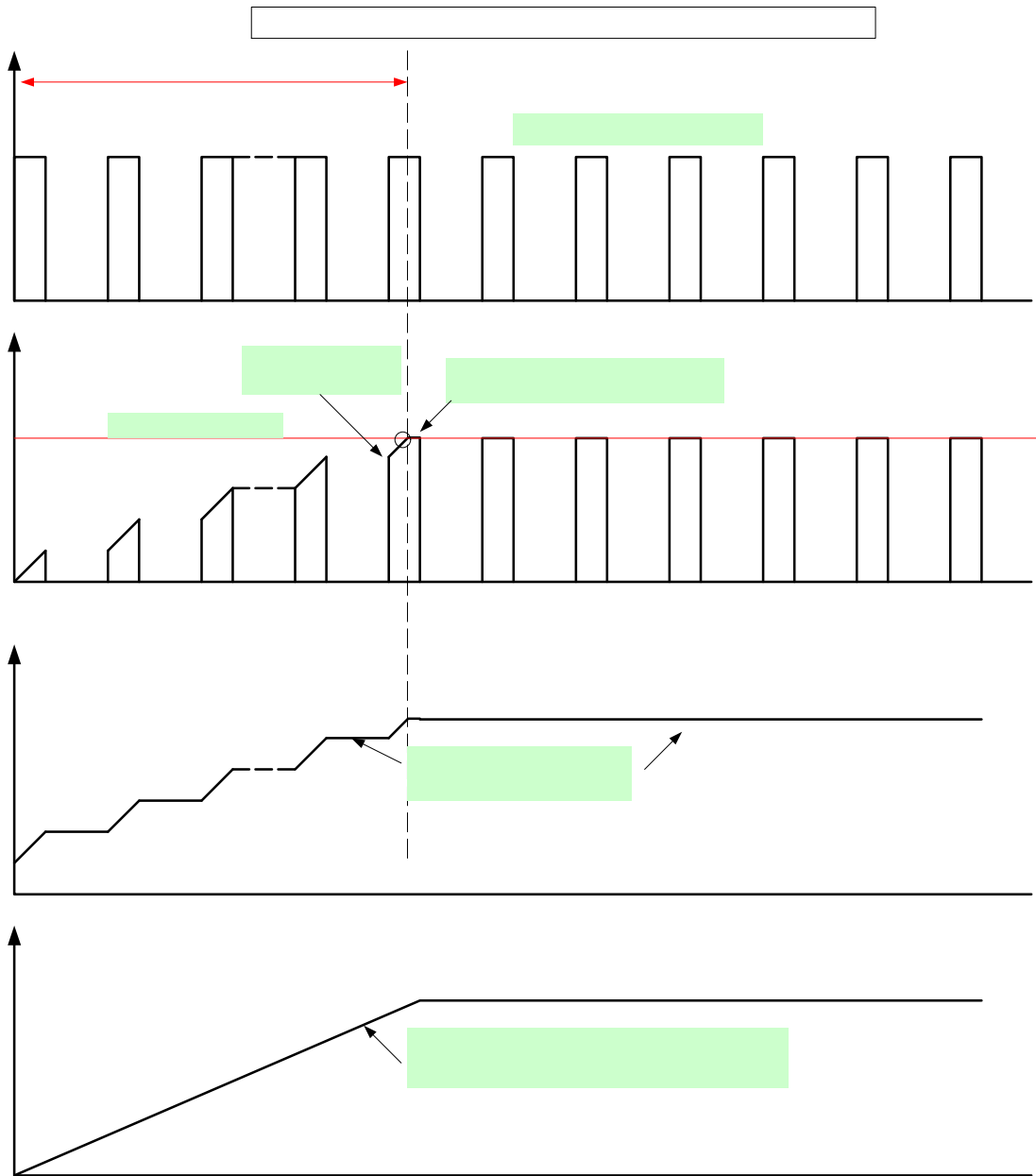



Figure 7 below shows an example of a soft start when the device is powered up from standby with a PWM input. The PWM signal here is at 100 Hz with a duty cycle of 30%. In this case the LED reaches 100% of its programmed value in 100 ms. This time can be decreased if the PWM signal runs at a higher duty cycle.



Since external transistors are required for the boost converter and PWM dimming functions, the device contains an internal 10 V regulator to drive the gate of these transistors. In the case of the PWM transistor this also functions as a level translator for the PWM<sub>in</sub> input pin. When selecting external components it is important that the transistor has enough gate drive to ensure low  $R_{DS(on)}$  for the expected current.

The device contains an accurate 5 V reference that can supply up to 10 mA and can be accessed through the VREF pin. It can be used to program the LED feedback voltage by using a resistor divider on the FBP pin. This reference is only active when STBY = low. When the device is in standby mode the VREF pin voltage will drop to 4.2 V typical with a minimum of 3.5 V. The VREF will return to 5 V immediately when STBY is driven high.

If the steady state duty cycle and switching frequency combine to generate short Ton times (low VOUT/VIN converter ratio), the converter will skip some cycles to regulate VOUT which will increase output voltage ripple. The timing limit is set by the intrinsic loop propagation delay and the switching frequency will be limited by the minimum ON time and OFF time.

For a given application, it is necessary to know the input voltage at the inductor (VININDUCTOR), the output current (IOUT) set by RFBN and the voltage on the FBP pin, and the switching frequency (Fsw). The inductor can be chosen using the formula below:

$$L < \frac{V_{FBP} \times V_{IN\_INDUCTOR}}{I_{OUT} \times F_{sw}} \times \left( \frac{V_{FBP}}{V_{IN\_INDUCTOR}} - 1 \right)$$

The minimal inductor value is determined with the desired peak current flowing through the inductor. Using the chosen inductor value the steady state duty cycle and peak inductor current can be calculated:

$$I_{L\_PEAK} = \sqrt{\frac{V_{FBP} \times V_{IN\_INDUCTOR}}{L \times F_{sw}} \times \left( \frac{V_{FBP}}{V_{IN\_INDUCTOR}} - 1 \right)}$$

And the inductor peak current is now:

$$I_{L\_PEAK} \times$$

Calculating the output voltage ripple will size the output capacitor value. The output voltage ripple equation below takes into account the parasitic impedance (ESR) of this output capacitor:

$$\Delta V = \frac{I_{\text{ripple}}}{C} \left( \frac{1}{f} \right) + I_{\text{ripple}} \times \text{ESR}$$

$$\Delta V = \frac{I_{\text{ripple}}}{C} \times \left( \frac{1}{f} + \text{ESR} \right) + I_{\text{ripple}} \times \text{ESR}$$



Combining Equations 2 and 16 gives the following expression for  $I_{OUT}$ :

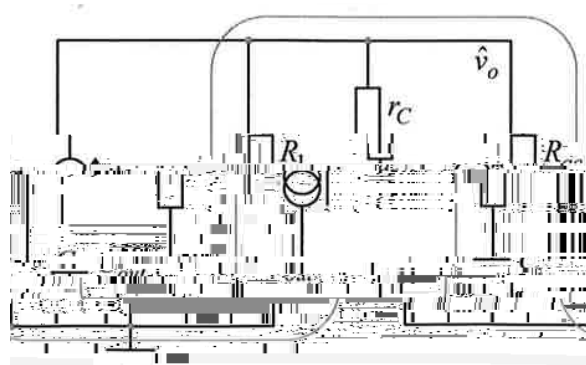
$$= \frac{\times \times}{\times ( - ) \times ( \times )}$$

To obtain the small signal equation, partial derivatives of the output current are calculated with respect to the control voltage  $V_c$  and the output voltage  $V_{OUT}$ .

$$\frac{\partial}{\partial} = \frac{\times \times}{( - ) \times ( \times )}$$

$$\frac{\partial}{\partial} = \frac{\times \times}{\times ( - ) \times ( \times )} = -$$

From the AC model below the control to output transfer function can be calculated:



$$= \frac{\times}{\times} = \frac{\times}{\times} \times \frac{\times}{\times}$$

$$= \frac{\times}{\times} \times \frac{\times}{\times}$$

$$= \frac{\left( \frac{\times}{\times} \right) \times}{\left( \frac{\times}{\times} \right) + \times} = \frac{\times}{\times} \times \frac{\times}{\times \left( \frac{\times}{\times} \right)}$$

Where

$$= \frac{\times}{\times}$$

$$= \frac{\times \left( \frac{\times}{\times} \right) \times \left( \frac{\times}{\times} \right)}{\times \times} = -$$

The dynamic resistance  $r_{AC(LED)}$  is evaluated using the LED specification.

$$= \frac{\times}{\times}$$

The control to output transfer function is expressed following the formula below:

$$= \frac{s + \dots}{s + \dots}$$

Where

$$\begin{aligned}
 &= \frac{\partial}{\partial} \times \dots = \frac{\dots \times \dots}{(\dots - \dots) \times (\dots \times \dots)} \times \frac{\dots}{+} \\
 &= \sqrt{\frac{\dots \times \dots \times \dots}{(\dots - \dots)}} \times \frac{\dots}{\times} \times \frac{\dots}{+} \\
 &= \frac{\dots}{\pi \times (\dots + \dots) \times \dots}
 \end{aligned}$$

There is also a right half plane zero:

$$= \frac{\dots}{\pi \times \dots \times \dots}$$

As the boost converter also operates in DCM, there is also a right half plane zero regulated to high frequency:

$$= \frac{\dots}{\pi \times \dots}$$

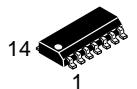
Type II compensation is used to compensate the two dominant poles  $f_p$  of the control to output transfer function. The compensator zero has to be placed at the  $f_p$  frequency of the transfer function.

$$= \frac{\dots}{\pi \times \dots + \dots \times \dots} = \frac{\dots}{\pi \times \dots \times \dots}$$

The simplified equation to set the switching frequency using resistor  $R_T$ :

=

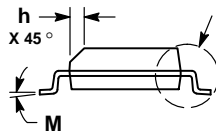
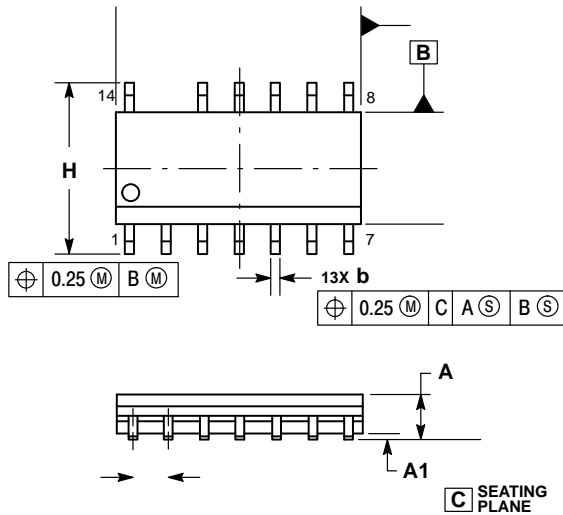




SCALE 1:1

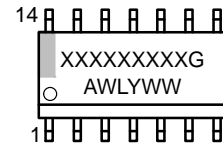
**SOIC 14 NB**  
**CASE 751A-03**  
**ISSUE L**

DATE 03 FEB 2016



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
  4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
  5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

**GENERIC MARKING DIAGRAM\***



- XXXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- Y = Year
- WW = Work Week
- G = Pb-Free Package

STYLES ON PAGE 2



**SOIC 14**  
CASE 751A-03  
ISSUE L

DATE 03 FEB 2016

STYLE 7:  
PIN 1. ANODE/CATHODE  
2. COMMON ANODE  
3. COMMON CATHODE  
4. ANODE/CATHODE  
5. ANODE/CATHODE

**onsemi**, **onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi**

---

---