

## Secondary-Side Constant Current and Constant Voltage Controller with PWM / Linear Dimming

### DESCRIPTION

The TS19340CS14 provides an integrated solution using built in switch mode constant current (CC) and constant voltage (CV) regulation for isolation smart LED lighting applications. The built in PWM and linear dimming functions allows the designer to replace many external discrete components used for dimming schemes. The PWM frequency is configurable from 100Hz-10kHz through selection of the compensation capacitor. The linear dimming cut off voltage is configurable using a resistor divider at the CCO pin

### FEATURES

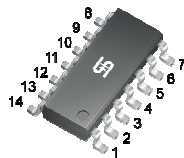
- Secondary-side CC and CV Control
- High accuracy internal voltage reference
- Build in PWM & Linear dimming functions
- LED current cut-off function
- Built-in 3.3V reference for dimming Power
- Compliant to RoHS Directive 2011/65/EU and in Accordance to WEEE 2002/96/EC.
- Halogen-free according to IEC 61249-2-21

### APPLICATION

- LED lighting
- Intelligent lighting management



**SOP-14**

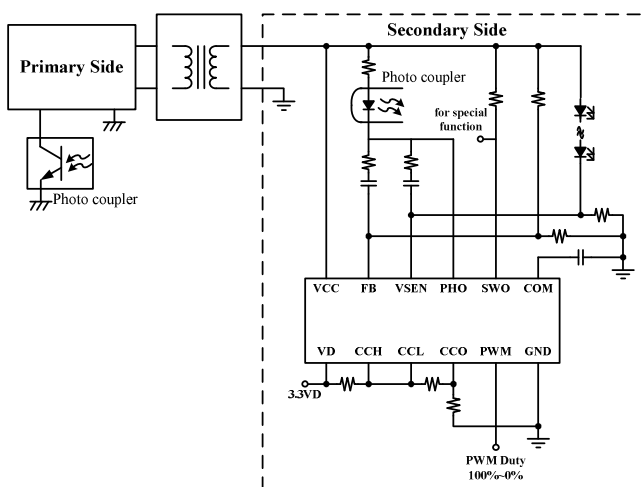


### Pin Definition:

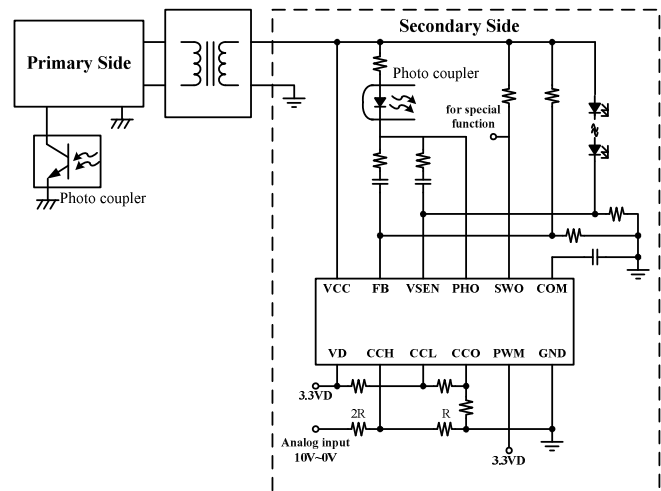
- |                   |                      |
|-------------------|----------------------|
| 1. V <sub>D</sub> | 14. V <sub>CC</sub>  |
| 2. CCH            | 13. FB               |
| 3. CCL            | 12. V <sub>SEN</sub> |
| 4. CCO            | 11. PHO              |
| 5. PWM            | 10. N/C              |
| 6. N/C            | 9. SWO               |
| 7. GND            | 8. COM               |

**Notes:** MSL 3 (Moisture Sensitivity Level) per J-STD-020

### TYPICAL APPLICATION CIRCUIT



**PWM Dimming Application Circuit**



**Linear Dimming Application Circuit**

<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_A = 25^\circ\text{C}$ unless otherwise specified) <sup>(Note 1)</sup>			
<b>PARAMETER</b>	<b>SYMBOL</b>	<b>LIMIT</b>	<b>UNIT</b>
Power Supply Pin	$V_{CC}$	40	V
PHO Voltage to GND	$V_{PHO}$	-0.3 to 40	V
SWO Voltage to GND	$V_{SWO}$	-0.3 to 40	V
FB Voltage to GND	$V_{FB}$	-0.3 to 5.5	V
VSEN Voltage to GND	$V_{VSEN}$	-0.3 to 5.5	V
COM Voltage to GND	$V_{COM}$	-0.3 to 5.5	V
CCH Voltage to GND	$V_{CCH}$	-0.3 to 5.5	V
CCL Voltage to GND	$V_{CCL}$	-0.3 to 5.5	V
CCO Voltage to GND	$V_{CCO}$	-0.3 to 5.5	V
PWM Voltage to GND	$V_{PWMB}$	-0.3 to 5.5	V
Junction Temperature Range	$T_J$	-40 to +150	$^\circ\text{C}$
Storage Temperature Range	$T_{STG}$	-65 to +150	$^\circ\text{C}$
Lead Temperature (Soldering 10 sec)	$T_{LEAD}$	260	$^\circ\text{C}$
Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	0.833	W
ESD Rating (Human Body Mode) <sup>(Note 2)</sup>	HBM	2	kV

<b>THERMAL PERFORMANCE</b> <sup>(Note 3)</sup>			
<b>PARAMETER</b>	<b>SYMBOL</b>	<b>LIMIT</b>	<b>UNIT</b>
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	120	$^\circ\text{C/W}$

<b>RECOMMENDED OPERATING CONDITION</b> ( $T_A = 25^\circ\text{C}$ unless otherwise specified) <sup>(Note 4)</sup>			
<b>PARAMETER</b>	<b>SYMBOL</b>	<b>LIMIT</b>	<b>UNIT</b>
Power Supply Pin	$V_{CC}$	38	V
PHO Voltage to GND	$V_{PHO}$	-0.3 to 38	V
SWO Voltage to GND	$V_{SWO}$	-0.3 to 38	V
FB Voltage to GND	$V_{FB}$	-0.3 to 5	V
VSEN Voltage to GND	$V_{VSEN}$	-0.3 to 5	V
COM Voltage to GND	$V_{COM}$	-0.3 to 5	V
CCH Voltage to GND	$V_{CCH}$	-0.3 to 5	V
CCL Voltage to GND	$V_{CCL}$	-0.3 to 5	V
CCO Voltage to GND	$V_{CCO}$	-0.3 to 5	V
PWM Voltage to GND	$V_{PWM}$	-0.3 to 5	V
Operating Junction Temperature Range	$T_J$	-40 to +125	$^\circ\text{C}$
Operating Ambient Temperature Range	$T_{OPA}$	-40 to +85	$^\circ\text{C}$

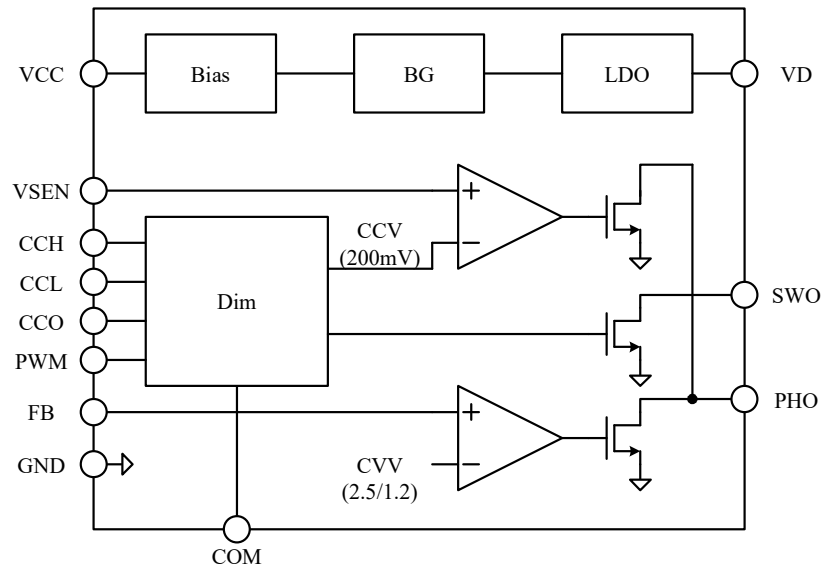
<b>ELECTRICAL SPECIFICATIONS</b> ( $T_A = 25^\circ\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
<b>Supply Voltage</b>						
Turn-on Voltage	$V_{CC\_ON}$		11.2	12.0	12.8	V
Turn-off Voltage	$V_{CC\_OFF}$		7.1	7.6	8.1	V
Quiescent Current	$I_Q$	$V_{CC}=10\text{V}$	--	22	--	$\mu\text{A}$
Operation Supply Current	$I_{CC}$	$V_{CC}=20\text{V}$	--	400	--	$\mu\text{A}$
3.3V Voltage reference	$V_{DREF}$	$I_O=5\text{mA}$	3.2	3.3	3.4	V
VCC Over Voltage Protection	$V_{CC\_OVP}$		--	35	--	V
CCH Over Voltage Protection	$V_{CCH\_OVP}$		--	4.2	--	V
<b>GM Amplifier</b>						
Voltage reference1	$CV_H$		2.4	2.53	2.66	V
Voltage reference2	$CV_L$		1.15	1.21	1.27	V
Voltage reference3	CCV		196	200	204	mV
<b>Driver</b>						
Dropout Voltage (PHO)	$VOL_{PHO}$	$I_O = 20\text{mA}$	--	0.55	--	V
Dropout Voltage (SWO)	$VOL_{SWO}$	$I_O = 20\text{mA}$	--	0.48	--	V

**Note:**

- Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
- Devices are ESD sensitive. Handling precaution recommended.
- Thermal Resistance is specified with the component mounted on a test board with low effective thermal conductivity in free air at  $T_A=25^\circ\text{C}$ .
- The device is not guaranteed to function outside its operating conditions.

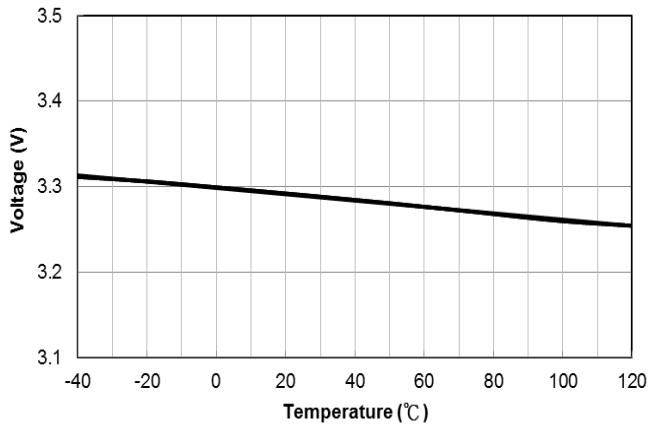
**ORDERING INFORMATION**

PART NO.	PACKAGE	PACKING
TS19340CS14 RLG	SOP-14	2,500pcs / 13"Reel

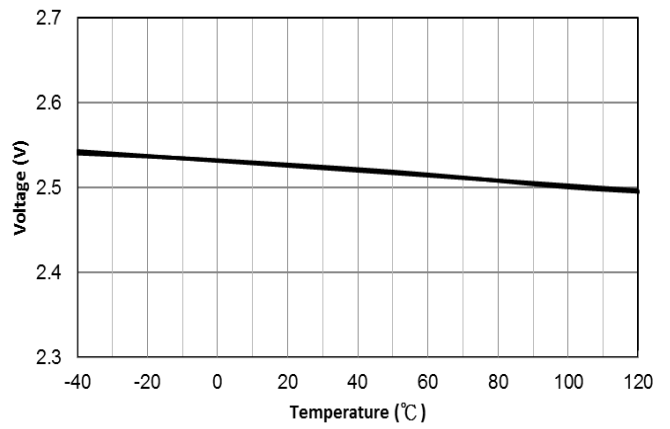
**FUNCTION BLOCK**

**PIN DESCRIPTION**

PIN NO.	NAME	FUNCTION
1	VD	3.3V low drop out voltage
2	CCH	Constant current high limit voltage
3	CCL	Constant current low limit voltage
4	CCO	LED current cut-off voltage
5	PWM	PWM input pin
6	N/C	No connection
7	GND	Ground
8	COM	PWM pulse filter pin
9	SWO	Open drain output of the comparator for LED current cut-off function
10	N/C	No connection
11	PHO	Open drain output of the two internal operational amplifier for photo coupler
12	V <sub>SEN</sub>	Current sense pin
13	FB	Voltage sense pin
14	V <sub>CC</sub>	Power supply pin

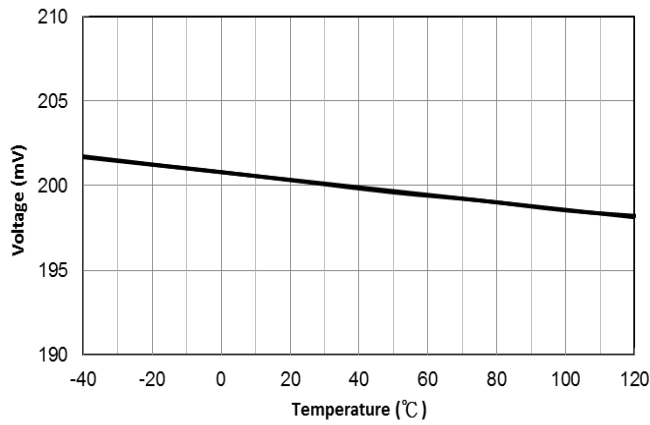
**CHARACTERISTICS CURVES**



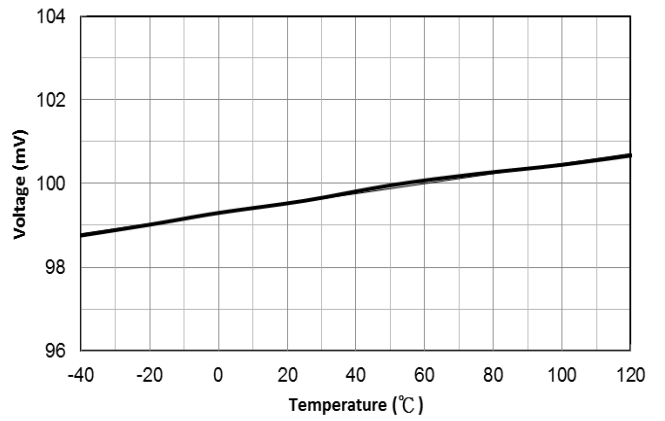
**Figure 1.  $V_{DREF}$  vs. Junction Temperature**



**Figure 2.  $CV_H$  vs. Junction Temperature**



**Figure 3. CCV vs. Junction Temperature**



**Figure 4.  $CCH=1.6V$  vs. Junction Temperature**

## APPLICATION INFORMATION

### Function Description

The TS19340 is a secondary-side CC/CV shunt regulator for LED lighting dimming application. It has a built-in 3.3V low drop-out voltage (VD pin) for external dimming control. The LED current setting level for PWM and linear functions can be adjusted by the CCH (maximum), CCL (minimum), and CCO (cut-off) pins. When LED current is cut-off, the IC will change the CV reference voltage (2.53V → 1.21V) and the SWO will be pulled low.

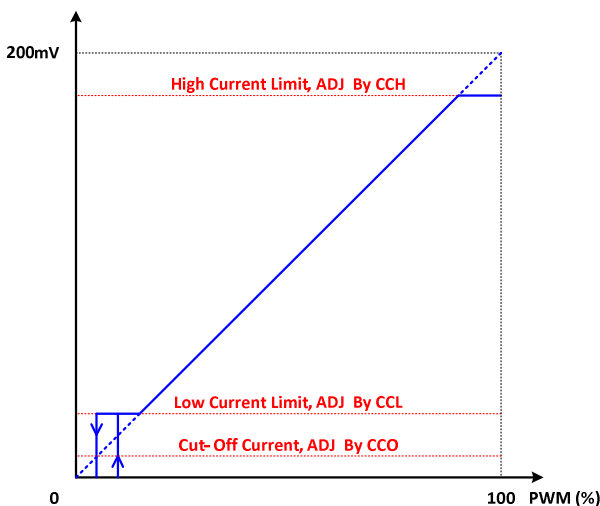


Figure 5: LED Current Ratio vs. PWM Duty Ratio

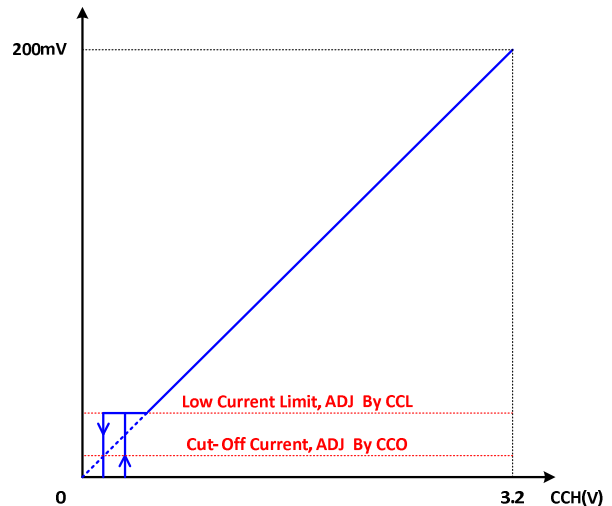


Figure 6: LED Current Ratio vs. Linear Dimming Voltage

### Pin Detail

#### Pin 1: VD

The IC has built-in 3.3V LDO for setting the dimming function and external MCU.

#### Pin 2 : CCH

The CCH pin is for the constant current high limit function. The pin function is shown in Figure 5 and Figure 6. The functional working voltage range is from 3.2V to 0V. The pin connects to internal 5V reference voltage or high voltage level when the function is not used.

The LED high limit current is shown as follows:

$$I_{LED(High\ Limit)} = \frac{V_{CCH}}{16 \times R_S} (A)$$

#### Pin 3: CCL

The CCL pin is for the constant current low limit function. The pin function is shown in Figure 5 and Figure 6. The functional working voltage range is from 3.2V to 0V. The pin connects to ground when the function is not used.

The LED low limit current is shown as follows:

$$I_{LED(Low\ Limit)} = \frac{V_{CCL}}{16 \times R_S} (A)$$

#### Pin 4: CCO (PWM / Linear)

The CCO pin is for the LED current cut-off function. The pin function is shown in Figure 5 and Figure 6. The functional working voltage range is from 3.2V to 0V. The pin pulls to ground when the function is not used.

The LED cut-off current is shown as a formula following:

$$I_{LED(Cut\ Off)} = \frac{V_{CCO}}{16 \times R_S} (A)$$

## APPLICATION INFORMATION (CONTINUE)

### Pin Detail

#### **Pin 5: PWM**

The pin is for PWM dimming function control. The pin should be connected to internal 5V reference voltage when using linear dimming function. Recommend operation frequency range from 100Hz to 10kHz.

The LED current vs. PWM duty ratio is shown as a formula following:

$$I_{LED(PWM)} = PWM\_Duty\_Ratio \times \frac{0.2}{R_S} (A)$$

#### **Pin 6 : N/C**

No connection.

#### **Pin 7: GND**

GND is the reference node of internal circuit.

#### **Pin 8: COM**

The COM pin is for PWM pulse filter. The PWM duty ratio will be converted to 3.2V (Duty=100%) ~ 0V (Duty=0%). A suitable capacitor should be connected between the COM and ground.

#### **Pin 9: SWO**

The pin is an open drain output of the comparator for LED current cut-off function. The SWO pin will be pulled low when the LED current is cut-off.

#### **Pin 10: N/C**

No connection.

#### **Pin 11: PHO**

The PHO pin is for transferring secondary-side voltage/current signal for the primary-side controller. It is an open drain output of the two internal OP-AMPs for an external photo coupler. A capacitor and a resistor in series should be connected between PHO and FB for constant voltage control, and a capacitor and a resistor in series should be connected between PHO and  $V_{SEN}$  for constant current control.

#### **Pin 12: VSEN**

The  $V_{SEN}$  pin is for LED constant current control. The  $V_{SEN}$  reference voltage will be adjusted by the PWM/CCH/CCL setting. The illustration is shown in Figure 5 and Figure 6.

The maximum LED Current is in the formula as follows:

$$I_{LED(max)} = \frac{0.2}{R_S} (A)$$

#### **Pin 13: FB**

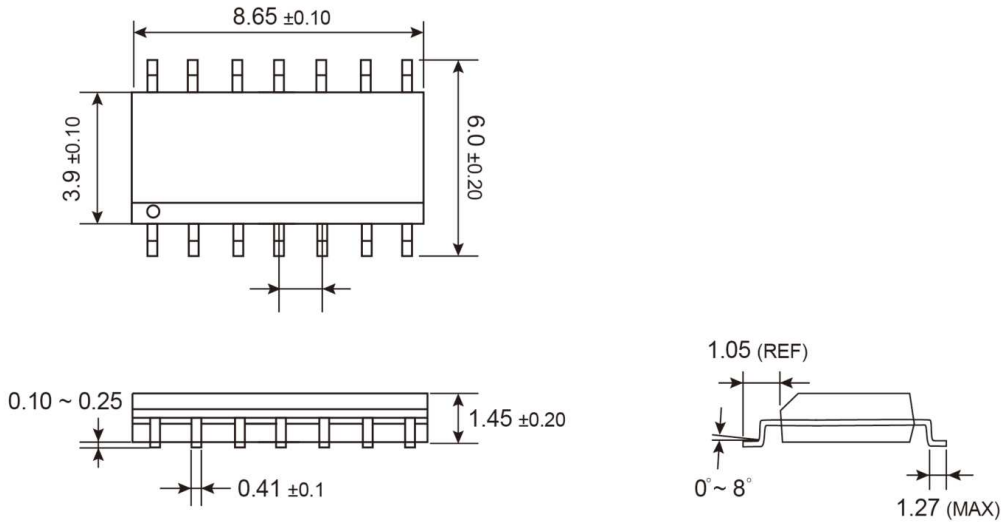
The FB pin is for LED constant voltage control. The FB reference voltage will be 2.53V when the LED current is not cut-off, and it will be 1.21V when the LED current is cut-off

#### **Pin 14: V<sub>CC</sub>**

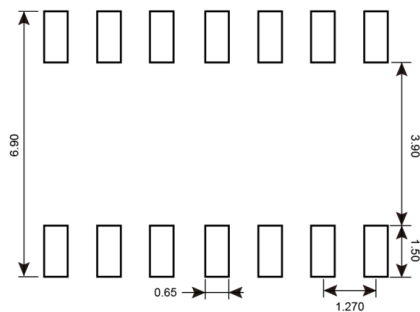
Power supply for the controller during normal operation. The controller will start up when  $V_{CC}$  reaches 12V (typical) and will shut-down when  $V_{CC}$  voltage is below 7.6V (typical). A decoupling capacitor should be connected between the  $V_{CC}$  and GND pin as close as possible.

**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)

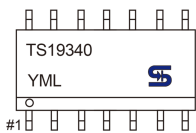
**SOP-14**



**SUGGESTED PAD LAYOUT** (Unit: Millimeters)



**MARKING DIAGRAM**



- Y** = Year Code
- M** = Month Code for Halogen Free Product
  - O** =Jan    **P** =Feb    **Q** =Mar    **R** =Apr
  - S** =May    **T** =Jun    **U** =Jul    **V** =Aug
  - W** =Sep    **X** =Oct    **Y** =Nov    **Z** =Dec
- L** = Lot Code (1~9, A~Z)



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