LIGHT

LT5280

DATA SHEET

SPEC. NO. : SZ20060802
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REV. : A/0

Approved By: Checked By: Prepared By:

LIGHT

High performance Asynchronies Boost Controller for LED Driver

General Description

The LT5280 is a High performance step-up DC/DC controller specifically designed for LCD TV and LCD application with a constant current.

The LT5280 uses current mode, fixed frequency of approximately 120 kHz architecture to regulate the output constant current through an external current sense resistor. The low feedback voltage of 400 mV can minimize the system power dissipation.

The LT5280 allows a PWM signal to reduce this regulation voltage by changing the PWM duty cycle to achieve LED brightness dimming control.

The LT5280 supports the LED open loop protection, the LED cathode short to GND protection, the Diode short circuit protection and the Inductor short circuit protection.

Other features include current limit protection, thermal shutdown protection, under-voltage lockout (UVLO), and over-voltage function.

The LT5280 is available in SOP8 package.

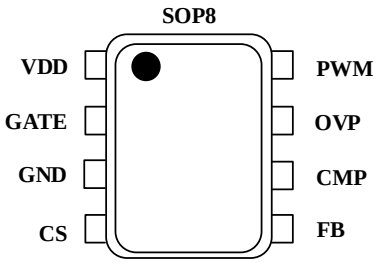
Applications

- LCD TV Backlight
- LCD Monitor Backlight
- Laptop Computer Display Backlight

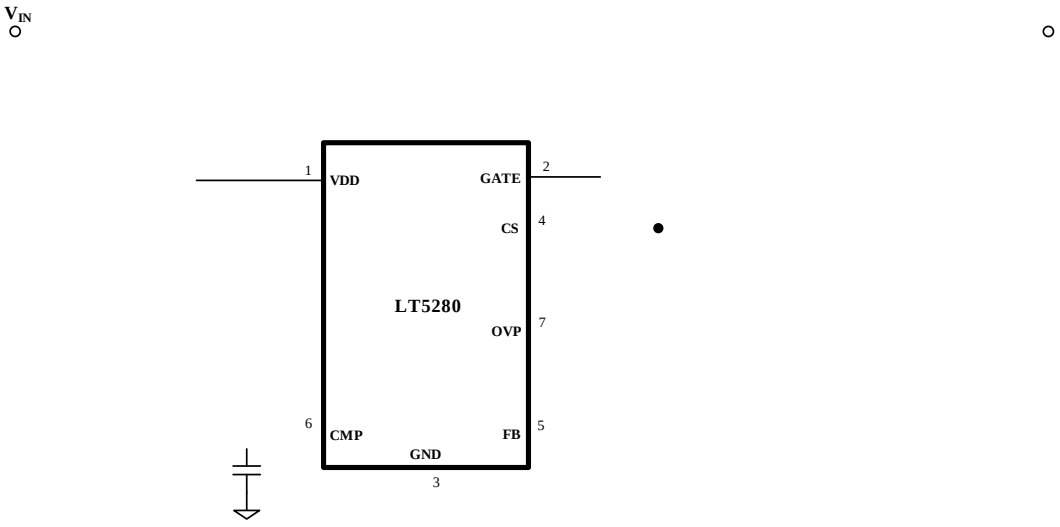
Features

- Wide Input Supply Range of 9 V ~ 35 V
- Wide Range for PWM Dimming (1 kHz~200 kHz)
- 120 kHz Switch Frequency
- 400mV Feedback Voltage
- Internal Soft-start Circuitry
- LED Open Loop Protection
- LED Cathode Short to GND Protection
- Diode Short Circuit Protection
- Inductor Short Circuit Protection
- Input Under Voltage Lockout
- Over Voltage Protection
- Current Limit Protection
- Thermal Shutdown Protection

Package



Typical Application Circuit



Absolute Maximum Ratings(1)

VDD, GATE, OVP.....-0.3 V ~ 38 V
CS, FB, CMP, PWM.....-0.3 V ~ 7 V
ESD Rating (Human Body Model).....>±2 kV(2)
Package Thermal Resistance
$_{JA}$(3).....40 °C/W

Min. Operating T_J.....-40 °C
Max. Operating T_J.....Internally Limited
Storage Temperature.....-55 °C ~ 150 °C
Lead Temperature (Soldering 10 sec.).....260 °C

(1). All voltages refer to ground unless otherwise noted; Stresses exceed those ratings may damage the device.
(2). Tested and classified as ESDA/JEDEC JDS-001-2014.
(3). Soldered to 100 mm2, 1 oz copper clad.

Electrical Characteristics(1)

(V_{IN} = 12 V, V_{PWM} = 5 V, T_A = 25 ℃, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Supply Voltage						
Input Voltage	V_{IN}		9		35	V
Input UVLO						
Input UVLO Threshold	V_{UVLO}	V_{IN} Rising	[redacted]			

Input UVLO Hysteresis 9 42.03 749DeviceGray CS.62 523.87 42.024 14. /DevieW*nBT/DeviceGray cs 0 sc /DevieW*ray CS 0 SCN 0 J 0 d 1 j 2 v

Electrical Characteristics(1) (continued)

(V_{IN} = 12 V, V_{PWM} = 5 V, T_A = 25 ℃, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Gate Driver						
Gate rise time	t_{RISE}	1nF loading		40		ns
Gate fall time	t_{FALL}	1nF loading		20		ns
Thermal Shutdown						
Thermal Shutdown Threshold(2)	T_{SDN}			150		℃

(1). Specifications over temperature range are guaranteed by design and characterization.
(2). Guaranteed by design and characterization only.

Functional Description

1. Operation

The LT5280 is a high performance asynchronous boost controller with accurately constant current output in a wide input range from 9 V to 35 V. This constant current can be programed through the FB pin connecting a sensing resistor or set by the external PWM diming duty cycle.

With the slope compensated current mode PWM control, the LT5280 provides stable switching and cycle-by-cycle current limit for protection of the external MOSFET.

2. Additional External Slope Compensation

To improve control loop stability when the operation switch duty cycles greater than 50%, LT5280 has a build-in slope compensation circuit. **Figure 11** shows the basic slope compensation principle.

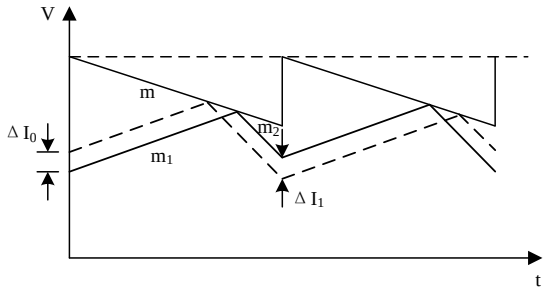


Figure 11 the Slope Compensation Principle

There is an **Equation 1** for slope compensation as below:

(1)

Where

- ***k*** is the factor of the Slope Compensation.
- ***I0*** is the difference of inductor current between the original inductor current and the perturbed current.
- ***I1*** is the difference of inductor current between the two currents after slope compensation one operational period.
- ***m*** is the slope of the compensation ramp.
- ***m1*** is the slope of the inductor rising current.
- ***m2*** is the slope of the inductor falling current.

The condition of a good compensation is that ensure the factor **k** is less than 1. Can calculate the **Equation 1** with the following equations:

(2)

(3)

(4)

Where

- f_{SW} is the Operating Frequency.
- R_S is the sensing resistor of the external MOSFET.
- V_{OUT} is the output voltage.
- V_{IN} is the input voltage.
- ***L*** is the value of the inductor.

The built-in slope compensation may be inadequate to stable the control loop under some conditions, the LT5280 supports an additional external Slope Compensation as **Figure 12**:

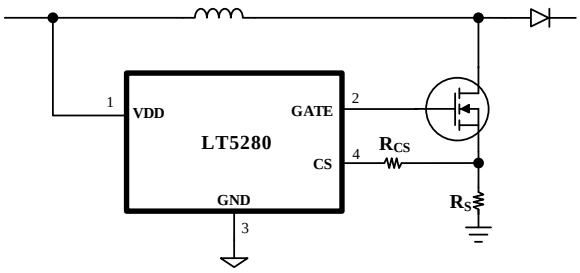


Figure 12 the Additional External Slope Compensation

The slope of the compensation ramp **m** is changed to **Equation 5** by the additional external Slope Compensation as below:

(5)

Where

- R_{CS} is the resistor between CS pin and external MOSFET.

3. Input Under-voltage Lockout (UVLO)

An input UVLO circuit prevents the converter from starting the operation until the input voltage rises above the typical UVLO threshold of 8.3 V. And when input decrease to a hysteresis voltage of 600 mV, The LT5280 will be lockout until to input reaching 8.3 V again.

4. Soft-start

The LT5280 implements the soft-start function to reduce the inrush current during startup. The soft-start begins once the input voltage raises above typical UVLO threshold, the soft-start Slope is typically 22 mV/ms.

5. LED Current Setting

The loop of Boost structure will keep the FB pin voltage equal to the reference voltage V_{REF}. Therefore, when R_{FB} connects FB pin and GND, and consider the PWM pin apply a continuous high level voltage, the current flows from V_{OUT} through LED and R_{FB} to GND will be decided by the current on R_{FB}, which is equal to following equation:

(6)

6. Dimming Control

For the brightness dimming control of the LT5280 , the IC provides typically 400mV feedback voltage when the PWM pin is pulled constantly high. However, PWM pin allows a PWM signal to reduce this regulation voltage by changing the PWM duty cycle to achieve LED brightness dimming control. The relationship between the duty cycle and FB voltage can be calculated as following equation.

(7)

Where

- ***D*** is the PWM dimming frequency.

This frequency of PWM dimming frequency varies in the range from 1kHz to 100kHz . An internal low pass filter is used to filter the pulse signal, and then the reference voltage can be made by connecting the output of the filter to the error amplifier for the FB pin voltage regulation. and the VA

approach a DC signal, so the LED current is a DC current which provides the smooth display performance and eliminates the audio noise.

The following **Figure 13** shows the LT5280 has an extreme dimming linearity.

Figure 13 the Extreme Dimming Linearity

7. Cycle by Cycle Peak Current Limit Protection

The peak current limit prevents the LT5280 from high inductor current and drawing excessive current from the input voltage rail. It also can protect the external MOSFT from over current situation.

8. OVP Protection

The Over Voltage Protection is detected by the OVP pin, connected to the resistors divider between V_{OUT} to GND. Once LED open or other abnormal operation, V_{OUT} goes over the setting voltage and the voltage of OVP pin is rising above OVP threshold, the LT5280 will stop switching and the MOSFET will be turned off. Then, the V_{OUT} will be clamped to be near the setting voltage. This function will latch the IC until the V_{IN} or PWM restarts.

9. Short Circuit Protection

There are 4 types of short circuit protection: LED cathode short to GND Protection, the diode short circuit protection, the inductor short circuit protection and V_{OUT} short circuit protection.

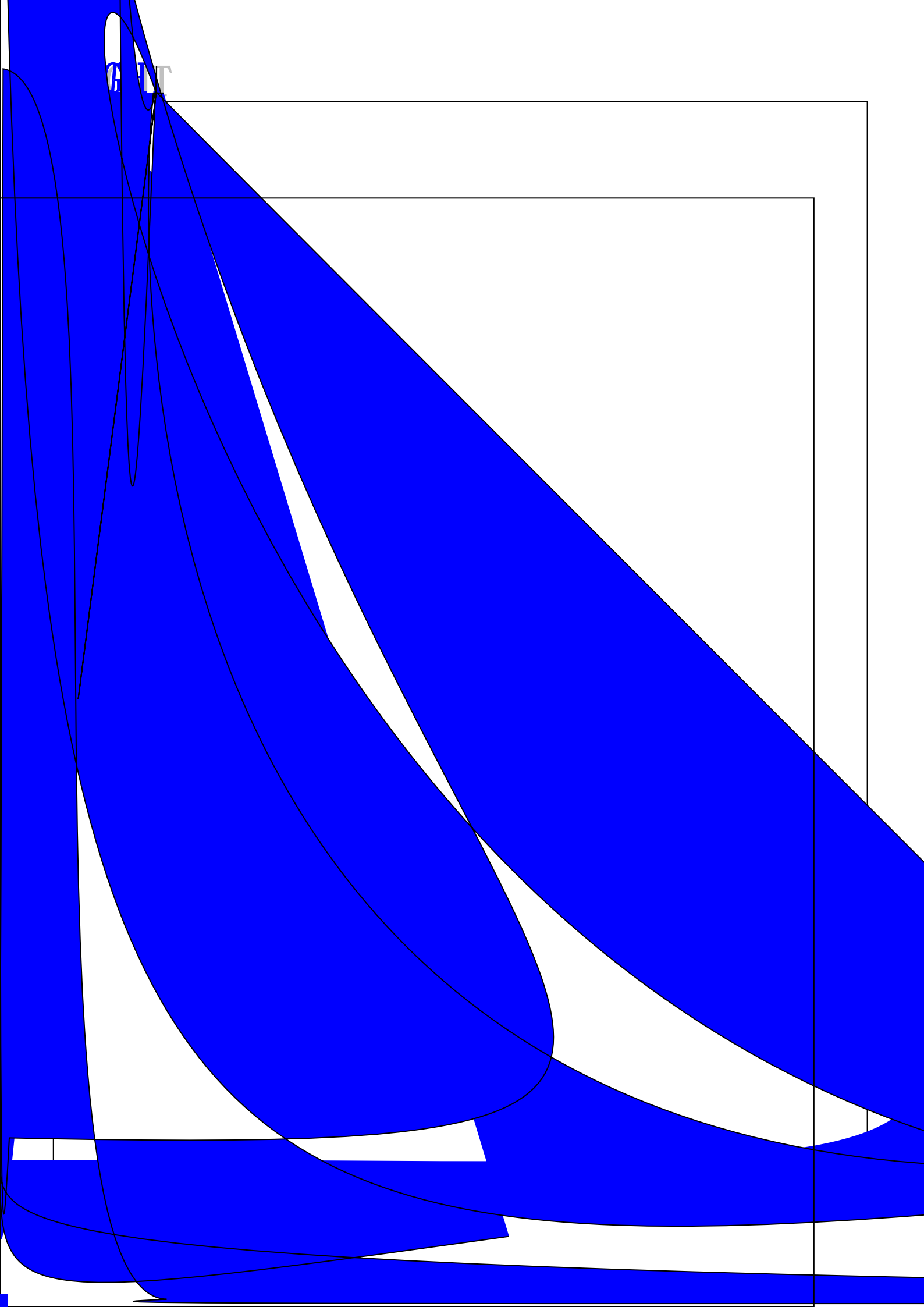
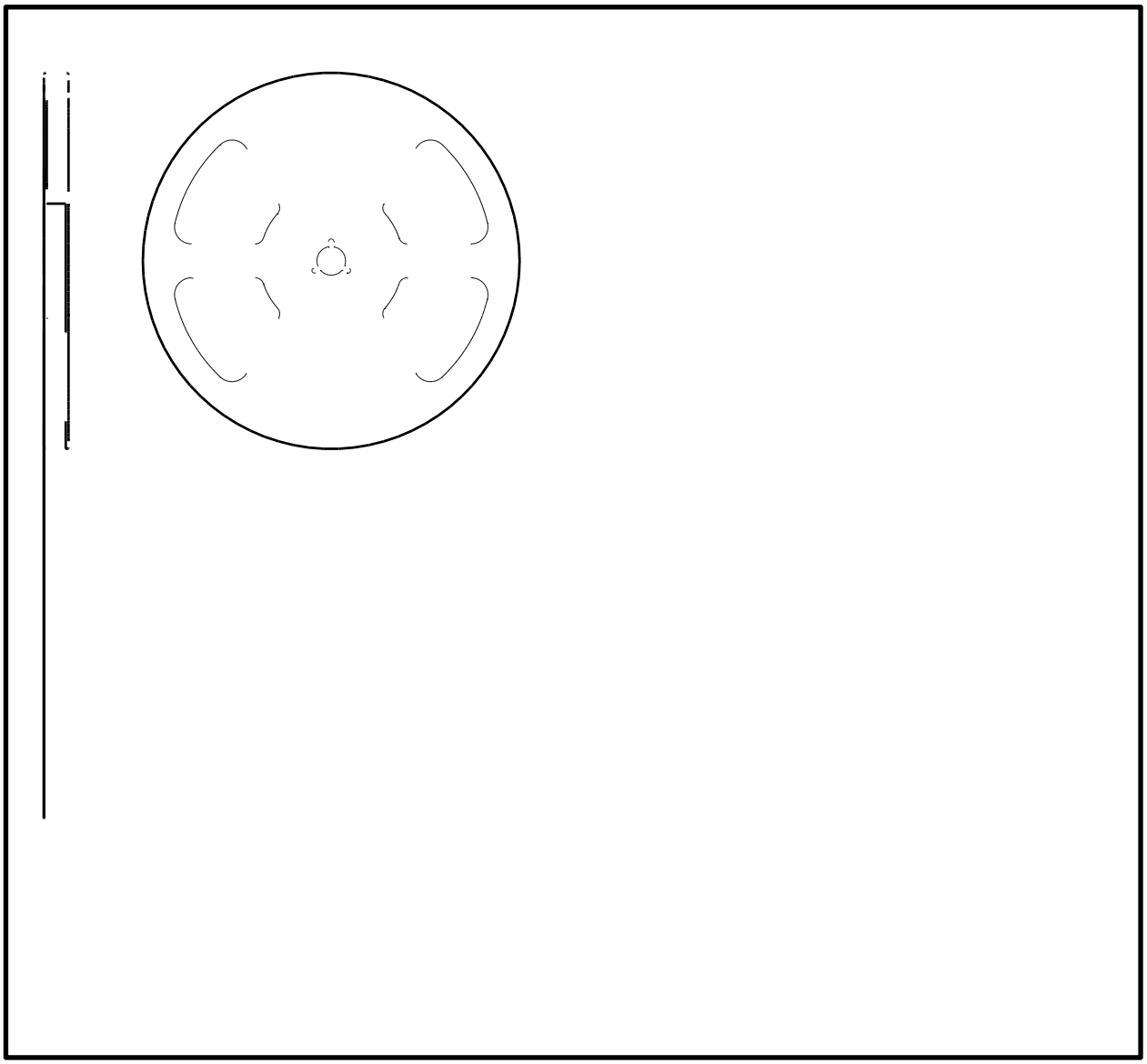
When LED cathode is shorted to GND, the LT5280 output voltage will be increasing above the OVP threshold, and trigger the OVP protection. But under other conditions, if the output is limited by OCP protection before the output reach the OVP voltage, the MOSFET will never be turned off, and the large current goes through both Schottky diode and MOSFET. The LT5280 keep monitoring the voltage of COMP pin, if this voltage is continuously above 3.2 V (typical) for 20ms (typical), the MOSFET will be latched.

When the Schottky diode or the inductor shorts, the LT5280 is monitoring the voltage of CS pin voltage cycle by cycle, if this voltage is above 1.2V (typical) for continuous 17 cycles, the MOSFET will be latched.

When the V_{OUT} shorts, the voltage of OVP pin will drop below 0.3V (typical), the MOSFET is turned off until the V_{IN} or PWM restarts.

10. Thermal Shutdown

A thermal shutdown is implemented to prevent the damage due to excessive heat and power dissipation. Typically, the thermal shutdown happens at the junction temperature of



Tape and Reel Information