

# ILD1151

Multitopology High Power LED DC/DC  
Controller for Industrial Applications

## Datasheet

Rev. 1.1, 2012-04-11

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# Multitopology High Power LED DC/DC Controller for Industrial Applications

ILD1151

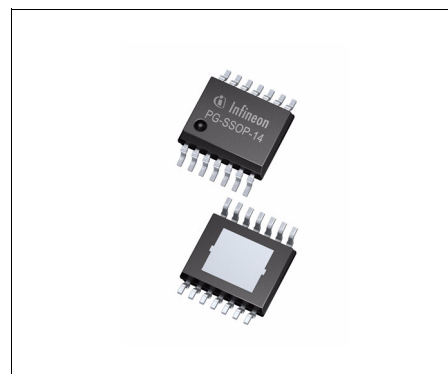
ILD1151



## 1 Overview

### Features

- Wide Input Voltage Range from 4.5 V to 45 V
- Constant Current or Constant Voltage Regulation
- Drives LEDs in Boost, Buck, Buck-Boost, SEPIC and Flyback Topology
- Very Low Shutdown Current:  $I_{q\_OFF} < 10 \mu A$
- Flexible Switching Frequency Range, 100 kHz to 500 kHz
- Synchronization with external clock source
- PWM Dimming
- Analog Dimming feature to adjust average LED current
- Internal 5 V Low Drop Out Voltage Regulator
- Open Circuit Detection
- Short to GND Protection
- Output Overvoltage Protection
- Internal Soft Start
- Over Temperature Shutdown
- Wide LED current range via simple adaptation of external components
- 300mV High Side Current Sense to ensure highest flexibility and LED current accuracy
- Available in a small thermally enhanced PG-SSOP-14 package
- Green Product (RoHS) Compliant



PG-SSOP-14

### Description

The ILD1151 is a Multitopology High Power DC/DC Controller IC with built in protection features. The main function of this device is to regulate a constant LED current. The constant current regulation is especially beneficial for LED color accuracy and longer lifetime. The controller concept of the ILD1151 allows multiple configurations such as Boost, Buck, Buck-Boost, SEPIC and Flyback by simply adjusting the external components. The ILD1151 offers the most flexible dimming options. Dimming can be achieved with analog or PWM input. The switching frequency is adjustable in the range of 100 kHz to 500 kHz and can be synchronized to an external clock source. The ILD1151 features an enable function reducing the shut-down current consumption to  $I_{q\_OFF} < 10 \mu A$ . The current mode regulation scheme of this device provides a stable regulation loop maintained by small external compensation components. The integrated soft start feature limits the current peak as well as voltage overshoot at start-up. This IC provides output overvoltage protection, device overtemperature shutdown and short circuit to GND protection.

| Type    | Package    | Marking |
|---------|------------|---------|
| ILD1151 | PG-SSOP-14 | ILD1151 |

**Applications**

- LED Controller for Industrial Applications
- Universal Constant Current and Voltage Source
- General Illumination e.g. Halogen Replacement
- Residential Architectural and Industrial Commercial Lighting for in- and outdoor
- Signal and Marker Lights for Orientation or Navigation (e.g. steps, exit ways, etc.)

For automotive and transportation applications, please refer to the Infineon® Auto LED products.

## 2 Block Diagram

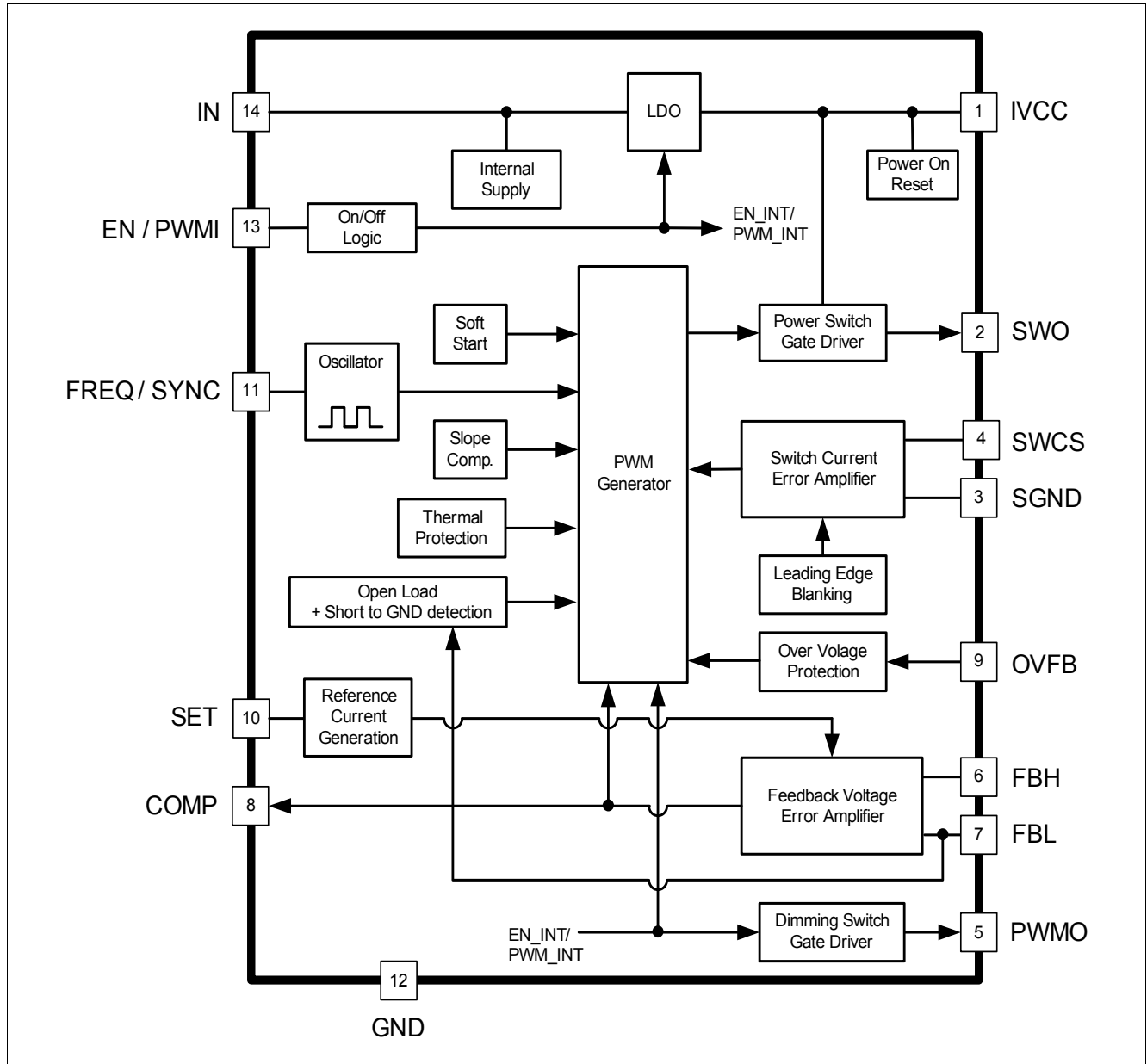


Figure 1 Block Diagram

### 3 Pin Configuration

#### 3.1 Pin Assignment

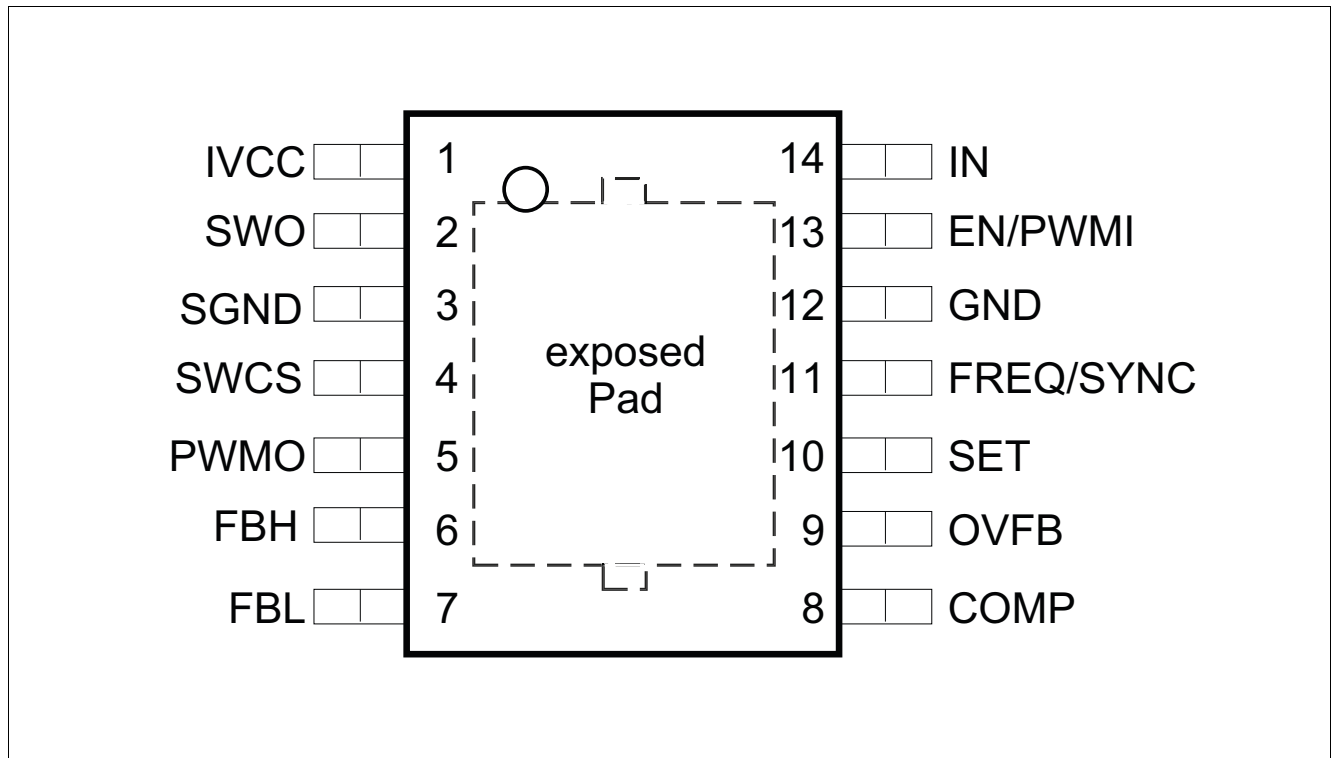


Figure 2 Pin Configuration

#### 3.2 Pin Definitions and Functions

| Pin | Symbol | Function                                                                                                                                             |
|-----|--------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | IVCC   | <b>Internal LDO Output;</b><br>Used for internal biasing and gate drive. Bypass with external capacitor close to the pin. Pin must not be left open. |
| 2   | SWO    | <b>Switch Output;</b><br>Connect to gate of external switching MOSFET                                                                                |
| 3   | SGND   | <b>Current Sense Ground;</b><br>Ground return for current sense switch                                                                               |
| 4   | SWCS   | <b>Current Sense Input;</b><br>Detects the peak current through switch                                                                               |
| 5   | PWMO   | <b>PWM Dimming Output;</b><br>Connect to gate of external MOSFET                                                                                     |
| 6   | FBH    | <b>Voltage Feedback Positive;</b><br>Non inverting Input (+)                                                                                         |
| 7   | FBL    | <b>Voltage Feedback Negative;</b><br>Inverting Input (-)                                                                                             |
| 8   | COMP   | <b>Compensation Input;</b><br>Connect R and C network to pin for stability                                                                           |

## Pin Configuration

| Pin | Symbol      | Function                                                                                                                                                                                      |
|-----|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9   | OVFB        | <b>Output Overvoltage Protection Feedback;</b><br>Connect to resistive voltage divider to set overvoltage threshold.                                                                          |
| 10  | SET         | <b>Analog Dimming Input;</b><br>Load current adjustment Pin. Pin must not be left open. If analog dimming feature is not used connect to IVCC pin.                                            |
| 11  | FREQ / SYNC | <b>Frequency Select or Synchronization Input;</b><br>Connect external resistor to GND to set frequency.<br>Or apply external clock signal for synchronization within frequency capture range. |
| 12  | GND         | <b>Ground;</b><br>Connect to system ground.                                                                                                                                                   |
| 13  | EN / PWMI   | <b>Enable or PWM Input;</b><br>Apply logic HIGH signal to enable device or PWM signal for dimming LED.                                                                                        |
| 14  | IN          | <b>Supply Input;</b><br>Supply for internal biasing.                                                                                                                                          |
| EP  |             | <b>Exposed Pad;</b><br>Connect to external heatspreading GND Cu area (e.g. inner GND layer of multilayer PCB with thermal vias).                                                              |

## 4 General Product Characteristics

### 4.1 Absolute Maximum Ratings

#### Absolute Maximum Ratings<sup>1)</sup>

$T_j = -40\text{ °C}$  to  $+125\text{ °C}$ ; all voltages with respect to ground, positive current flowing into pin  
(unless otherwise specified)

| Pos.         | Parameter                                        | Symbol                          | Limit Values |      | Unit | Conditions                                                                                                 |
|--------------|--------------------------------------------------|---------------------------------|--------------|------|------|------------------------------------------------------------------------------------------------------------|
|              |                                                  |                                 | Min.         | Max. |      |                                                                                                            |
| Voltages     |                                                  |                                 |              |      |      |                                                                                                            |
| 4.1.1        | IN<br>Supply Input                               | $V_{\text{IN}}$                 | -0.3         | 45   | V    | —                                                                                                          |
| 4.1.2        | EN / PWMI<br>Enable or PWM Input                 | $V_{\text{EN}}$                 | -40          | 45   | V    | —                                                                                                          |
| 4.1.3        | FBH-FBL<br>Feedback Error Amplifier Differential | $V_{\text{FBH}}-V_{\text{FBL}}$ | -40          | 61   | V    | The maximum delta must not exceed 61V                                                                      |
| 4.1.4        | FBH<br>Feedback Error Amplifier Positive Input   | $V_{\text{FBH}}$                | -40          | 61   | V    | The difference between $V_{\text{FBH}}$ and $V_{\text{FBL}}$ must not exceed 61V, refer to Parameter 4.1.3 |
| 4.1.5        | FBL<br>Feedback Error Amplifier Negative Input   | $V_{\text{FBL}}$                | -40          | 61   | V    | The difference between $V_{\text{FBH}}$ and $V_{\text{FBL}}$ must not exceed 61V, refer to Parameter 4.1.3 |
| 4.1.6        | FBH and FBL current                              | $I_{\text{FBL,FBH}}$            | —            | 1    | mA   | $t < 100\text{ms}$ ,<br>$V_{\text{FBH}} - V_{\text{FBL}} = 0.3\text{V}$                                    |
| 4.1.7        | OVFB                                             | $V_{\text{OVP}}$                | -0.3         | 5.5  | V    | —                                                                                                          |
| 4.1.8        | Over Voltage Feedback Input                      |                                 | -0.3         | 6.2  | V    | $t < 10\text{s}$                                                                                           |
| 4.1.9        | SWCS                                             | $V_{\text{SWCS}}$               | -0.3         | 5.5  | V    | —                                                                                                          |
| 4.1.10       | Switch Current Sense Input                       |                                 | -0.3         | 6.2  | V    | $t < 10\text{s}$                                                                                           |
| 4.1.11       | SWO                                              | $V_{\text{SWO}}$                | -0.3         | 5.5  | V    | —                                                                                                          |
| 4.1.12       | Switch Gate Drive Output                         |                                 | -0.3         | 6.2  | V    | $t < 10\text{s}$                                                                                           |
| 4.1.13       | SGND<br>Current Sense Switch GND                 | $V_{\text{SGND}}$               | -0.3         | 0.3  | V    | —                                                                                                          |
| 4.1.14       | COMP                                             | $V_{\text{COMP}}$               | -0.3         | 5.5  | V    | —                                                                                                          |
| 4.1.15       | Compensation Input                               |                                 | -0.3         | 6.2  | V    | $t < 10\text{s}$                                                                                           |
| 4.1.16       | FREQ / SYNC; Frequency and                       | $V_{\text{FREQ / SYNC}}$        | -0.3         | 5.5  | V    | —                                                                                                          |
| 4.1.17       | Synchronization Input                            |                                 | -0.3         | 6.2  | V    | $t < 10\text{s}$                                                                                           |
| 4.1.18       | PWMO                                             | $V_{\text{PWMO}}$               | -0.3         | 5.5  | V    | —                                                                                                          |
| 4.1.19       | PWM Dimming Output                               |                                 | -0.3         | 6.2  | V    | $t < 10\text{s}$                                                                                           |
| 4.1.20       | SET                                              | $V_{\text{SET}}$                | -0.3         | 45   | V    | —                                                                                                          |
| 4.1.21       | IVCC                                             | $V_{\text{IVCC}}$               | -0.3         | 5.5  | V    | —                                                                                                          |
| 4.1.22       | Internal Linear Voltage Regulator Output         |                                 | -0.3         | 6.2  | V    | $t < 10\text{s}$                                                                                           |
| Temperatures |                                                  |                                 |              |      |      |                                                                                                            |
| 4.1.23       | Junction Temperature                             | $T_{\text{j}}$                  | -40          | 150  | °C   | —                                                                                                          |

## General Product Characteristics

**Absolute Maximum Ratings<sup>1)</sup>**

$T_j = -40\text{ °C to }+125\text{ °C}$ ; all voltages with respect to ground, positive current flowing into pin  
(unless otherwise specified)

| Pos.   | Parameter           | Symbol           | Limit Values |      | Unit | Conditions |
|--------|---------------------|------------------|--------------|------|------|------------|
|        |                     |                  | Min.         | Max. |      |            |
| 4.1.24 | Storage Temperature | $T_{\text{stg}}$ | -55          | 150  | °C   | –          |

**ESD Susceptibility**

|        |                                                             |                      |    |   |    |                   |
|--------|-------------------------------------------------------------|----------------------|----|---|----|-------------------|
| 4.1.25 | ESD Resistivity of all Pins                                 | $V_{\text{ESD,HBM}}$ | -2 | 2 | kV | HBM <sup>2)</sup> |
| 4.1.26 | ESD Resistivity of IN, EN/PWMI, FBH, FBL and SET pin to GND | $V_{\text{ESD,HBM}}$ | -4 | 4 | kV | HBM <sup>2)</sup> |

1) Not subject to production test, specified by design.

2) ESD susceptibility, Human Body Model "HBM" according to ANSI/ESDA/JEDEC JS-001 (1.5kΩ, 100pF)

*Note: Stresses above the ones listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

*Note: Integrated protection functions are designed to prevent IC destruction under fault conditions described in the data sheet. Fault conditions are considered as "outside" normal operating range. Protection functions are not designed for continuous repetitive operation.*

**4.2 Functional Range**

| Pos.  | Parameter              | Symbol                                | Limit Values |                  | Unit | Conditions                                |
|-------|------------------------|---------------------------------------|--------------|------------------|------|-------------------------------------------|
|       |                        |                                       | Min.         | Max.             |      |                                           |
| 4.2.1 | Supply Voltage Range   | $V_{\text{IN}}$                       | 4.5          | 45 <sup>1)</sup> | V    | $V_{\text{IVCC}} > V_{\text{IVCC,RTH,d}}$ |
| 4.2.2 | Feedback Voltage Input | $V_{\text{FBH}};$<br>$V_{\text{FBL}}$ | 3            | 60               | V    | –                                         |
| 4.2.3 | Junction Temperature   | $T_j$                                 | -40          | 125              | °C   | –                                         |

1) Not subject to production test, specified by design.

*Note: Within the functional range the IC operates as described in the circuit description. The electrical characteristics are specified within the conditions given in the related electrical characteristics table.*

### 4.3 Thermal Resistance

Note: This thermal data was generated in accordance with JEDEC JESD51 standards. For more information, go to [www.jedec.org](http://www.jedec.org).

| Pos.  | Parameter                            | Symbol     | Limit Values |      |      | Unit | Conditions                 |
|-------|--------------------------------------|------------|--------------|------|------|------|----------------------------|
|       |                                      |            | Min.         | Typ. | Max. |      |                            |
| 4.3.1 | Junction to Case <sup>1) 2)</sup>    | $R_{thJC}$ | –            | 10   | –    | K/W  | –                          |
| 4.3.2 | Junction to Ambient <sup>1) 3)</sup> | $R_{thJA}$ | –            | 47   | –    | K/W  | 2s2p                       |
| 4.3.3 |                                      | $R_{thJA}$ | –            | 54   | –    | K/W  | 1s0p + 600 mm <sup>2</sup> |
| 4.3.4 |                                      | $R_{thJA}$ | –            | 64   | –    | K/W  | 1s0p + 300 mm <sup>2</sup> |

1) Not subject to production test, specified by design.

2) Specified  $R_{thJC}$  value is simulated at natural convection on a cold plate setup (all pins and the exposed pad are fixed to ambient temperature).  $T_a=25^{\circ}\text{C}$ ; The IC is dissipating 1W.

3) Specified  $R_{thJA}$  value is according to JEDEC 2s2p (JESD 51-7) + (JESD 51-5) and JEDEC 1s0p (JESD 51-3) + heatsink area at natural convection on FR4 board; The device was simulated on a 76.2 x 114.3 x 1.5 mm board. The 2s2p board has 2 outer copper layers (2 x 70μm Cu) and 2 inner copper layers (2 x 35μm Cu). A thermal via (diameter = 0.3 mm and 25 μm plating) array was applied under the exposed pad and connected the first outer layer (top) to the first inner layer and second outer layer (bottom) of the JEDEC PCB.  $T_a=25^{\circ}\text{C}$ ; The IC is dissipating 1W.

## 5 Switching Regulator

### 5.1 Description

The ILD1151 regulator is suitable for Boost, Buck, Buck-Boost, SEPIC and Flyback configurations. The constant output current is especially useful for light emitting diode (LED) applications. The regulator function is implemented by a pulse width modulated (PWM) current mode controller.

The PWM current mode controller uses the peak current through the external power switch and error in the output current to determine the appropriate pulse width duty cycle (on time) for constant output current. The current mode controller provides a PWM signal to an internal gate driver which then outputs to an external n-channel enhancement mode metal oxide field effect transistor (MOSFET) power switch.

The current mode controller also has built-in slope compensation to prevent sub-harmonic oscillations which is a characteristic of current mode controllers operating at high duty cycles (>50% duty).

An additional built-in feature is an integrated soft start that limits the current through the inductor and external power switch during initialization. The soft start function gradually increases the inductor and switch current over  $t_{SS}$  (Parameter 5.2.8) to minimize potential overvoltage at the output.

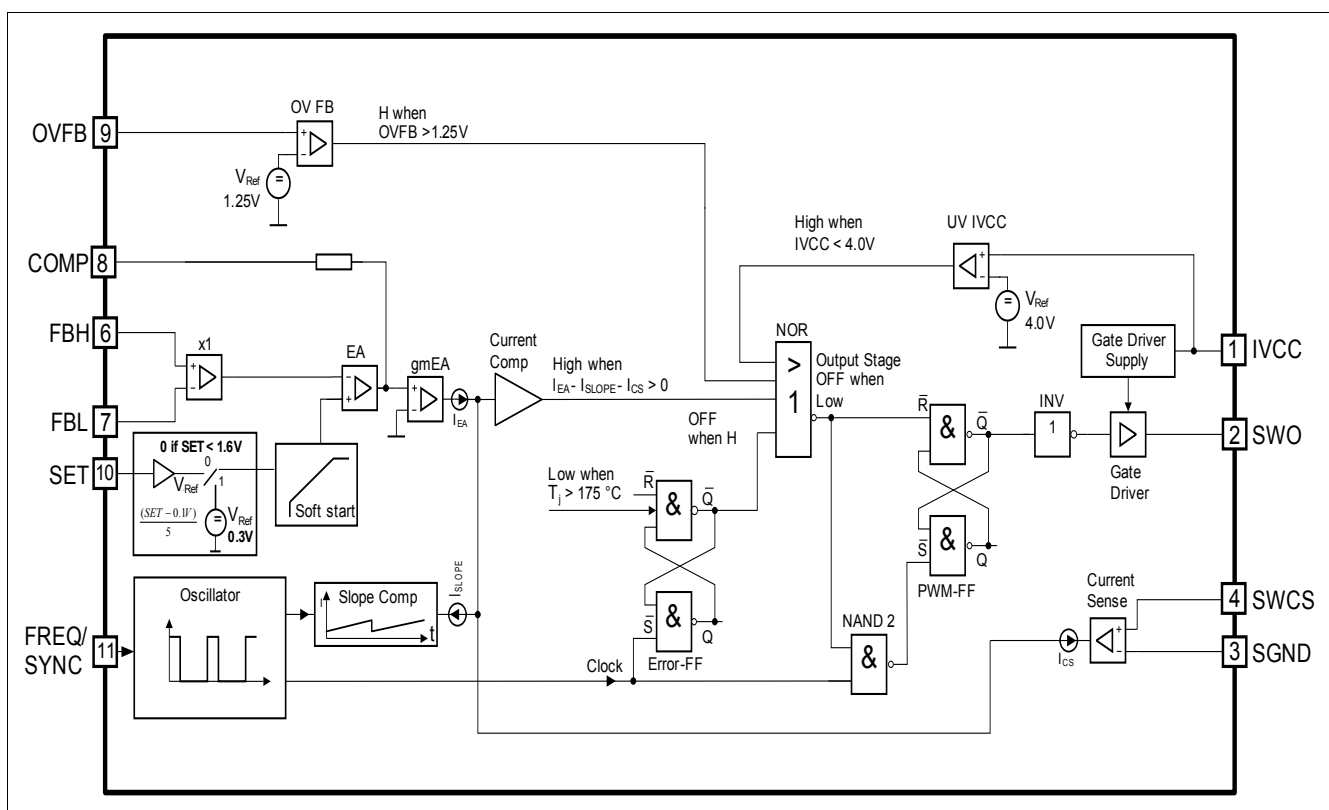


Figure 3 Switching Regulator Block Diagram

## 5.2 Electrical Characteristics

All parameters have been tested at 25°C, unless otherwise specified.

**Table 1 EC Switching Regulator**

$V_{IN} = 24V$ ;  $T_j = -40\text{ °C}$  to  $+125\text{ °C}$ , all voltages with respect to ground, positive current flowing into pin; (unless otherwise specified)

| Pos.       | Parameter                          | Symbol                                                            | Limit Values |      |       | Unit | Conditions                                                                                                                                                                 |
|------------|------------------------------------|-------------------------------------------------------------------|--------------|------|-------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |                                    |                                                                   | Min.         | Typ. | Max.  |      |                                                                                                                                                                            |
| Regulator: |                                    |                                                                   |              |      |       |      |                                                                                                                                                                            |
| 5.2.1      | Feedback Reference Voltage         | $V_{\text{REF}}$                                                  | 0.29         | 0.30 | 0.31  | V    | refer to <b>Figure 29</b><br>$V_{\text{REF}} = V_{\text{FBH}} - V_{\text{FBL}}$<br>$V_{\text{SET}} = 5\text{V}$<br>$I_{\text{LED}} = 350\text{ mA}$                        |
| 5.2.2      | Feedback Reference Voltage         | $V_{\text{REF}}$                                                  | 0.057        | 0.06 | 0.063 | V    | refer to <b>Figure 29</b><br>$V_{\text{REF}} = V_{\text{FBH}} - V_{\text{FBL}}$<br>$V_{\text{SET}} = 0.4\text{V}$<br>$I_{\text{LED}} = 70\text{mA}$                        |
| 5.2.3      | Feedback Reference Voltage Offset  | $V_{\text{REF\_offset}}$                                          | —            | —    | 5     | mV   | refer to <b>Figure 17</b> and <b>Figure 29</b><br>$V_{\text{REF}} = V_{\text{FBH}} - V_{\text{FBL}}$<br>$V_{\text{SET}} = 0.1\text{V}$<br>$V_{\text{OUT}} > V_{\text{IN}}$ |
| 5.2.4      | Voltage Load Regulation            | $(\Delta V_{\text{REF}} / V_{\text{REF}}) / \Delta I_{\text{BO}}$ | —            | —    | 5     | %/A  | refer to <b>Figure 29</b><br>$V_{\text{SET}} = 5\text{V}$ ;<br>$I_{\text{LED}} = 100\text{ to }500\text{mA}$                                                               |
| 5.2.5      | Switch Peak Over Current Threshold | $V_{\text{SWCS}}$                                                 | 130          | 150  | 170   | mV   | $V_{\text{FBH}} = V_{\text{FBL}} = 5\text{V}$<br>$V_{\text{COMP}} = 3.5\text{V}$                                                                                           |
| 5.2.6      | Maximum Duty Cycle                 | $D_{\text{MAX, fixed}}$                                           | 91           | 93   | 95    | %    | Fixed frequency mode                                                                                                                                                       |
| 5.2.7      | Maximum Duty Cycle                 | $D_{\text{MAX, sync}}$                                            | 88           | —    | —     | %    | Synchronization mode                                                                                                                                                       |
| 5.2.8      | Soft Start Ramp                    | $t_{\text{SS}}$                                                   | 350          | 1000 | 1500  | μs   | $V_{\text{FB}}$ rising from 5% to 95% of $V_{\text{FB}}$ , typ.                                                                                                            |
| 5.2.9      | IFBH Feedback High Input Current   | $I_{\text{FBH}}$                                                  | 38           | 46   | 54    | μA   | $V_{\text{FBH}} - V_{\text{FBL}} = 0.3\text{V}$                                                                                                                            |
| 5.2.10     | IFBL Feedback Low Input Current    | $I_{\text{FBL}}$                                                  | 15           | 21   | 27    | μA   | $V_{\text{FBH}} - V_{\text{FBL}} = 0.3\text{V}$                                                                                                                            |
| 5.2.11     | Switch Current Sense Input Current | $I_{\text{SWCS}}$                                                 | 10           | 50   | 100   | μA   | $V_{\text{SWCS}} = 150\text{mV}$                                                                                                                                           |
| 5.2.12     | Input Undervoltage Shutdown        | $V_{\text{IN, off}}$                                              | 3.5          | —    | 4.5   | V    | $V_{\text{IN}}$ decreasing                                                                                                                                                 |
| 5.2.13     | Input Voltage Startup              | $V_{\text{IN, on}}$                                               | —            | —    | 4.85  | V    | $V_{\text{IN}}$ increasing                                                                                                                                                 |

1) Not subject to production test, specified by design

## Switching Regulator

**Table 1 EC Switching Regulator**

$V_{IN} = 24V$ ;  $T_j = -40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$ , all voltages with respect to ground, positive current flowing into pin; (unless otherwise specified)

| Pos.                            | Parameter                         | Symbol         | Limit Values |      |      | Unit | Conditions                                                  |
|---------------------------------|-----------------------------------|----------------|--------------|------|------|------|-------------------------------------------------------------|
|                                 |                                   |                | Min.         | Typ. | Max. |      |                                                             |
| Gate Driver for external Switch |                                   |                |              |      |      |      |                                                             |
| 5.2.14                          | Gate Driver Peak Sourcing Current | $I_{SWO, SRC}$ | —            | 380  | —    | mA   | <sup>1)</sup> $V_{SWO}$ = 1V to 4V                          |
| 5.2.15                          | Gate Driver Peak Sinking Current  | $I_{SWO, SNK}$ | —            | 550  | —    | mA   | <sup>1)</sup> $V_{SWO}$ = 4V to 1V                          |
| 5.2.16                          | Gate Driver Output Rise Time      | $t_{R, SWO}$   | —            | 30   | 60   | ns   | <sup>1)</sup> $C_{L, SWO}$ = 3.3nF;<br>$V_{SWO}$ = 1V to 4V |
| 5.2.17                          | Gate Driver Output Fall Time      | $t_{F, SWO}$   | —            | 20   | 40   | ns   | <sup>1)</sup> $C_{L, SWO}$ = 3.3nF;<br>$V_{SWO}$ = 4V to 1V |
| 5.2.18                          | Gate Driver Output Voltage        | $V_{SWO}$      | 4.5          | —    | 5.5  | V    | <sup>1)</sup> $C_{L, SWO}$ = 3.3nF;                         |

1) Not subject to production test, specified by design

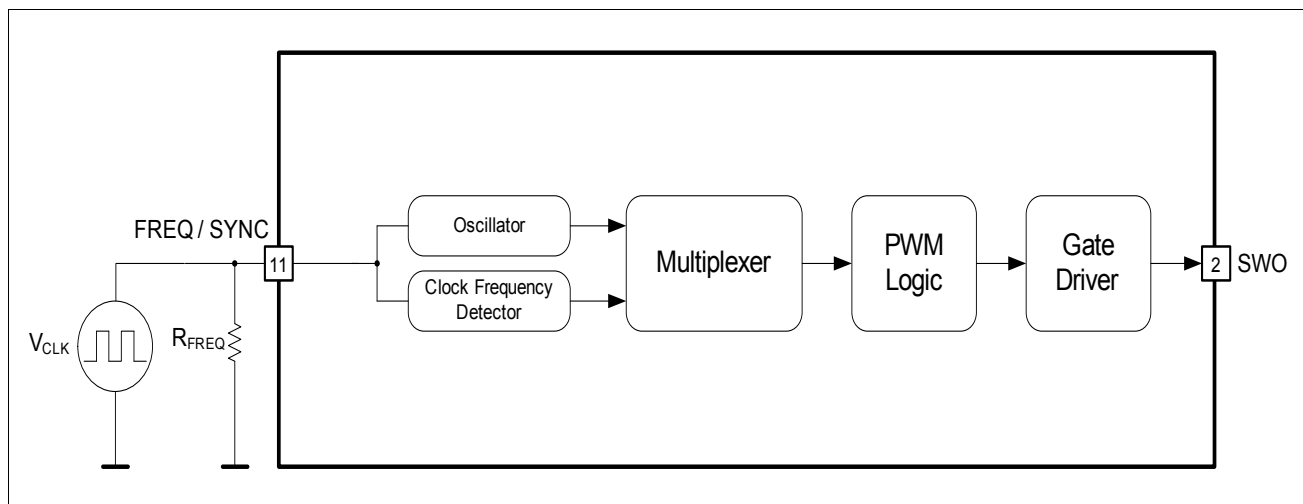
## 6 Oscillator and Synchronization

### 6.1 Description

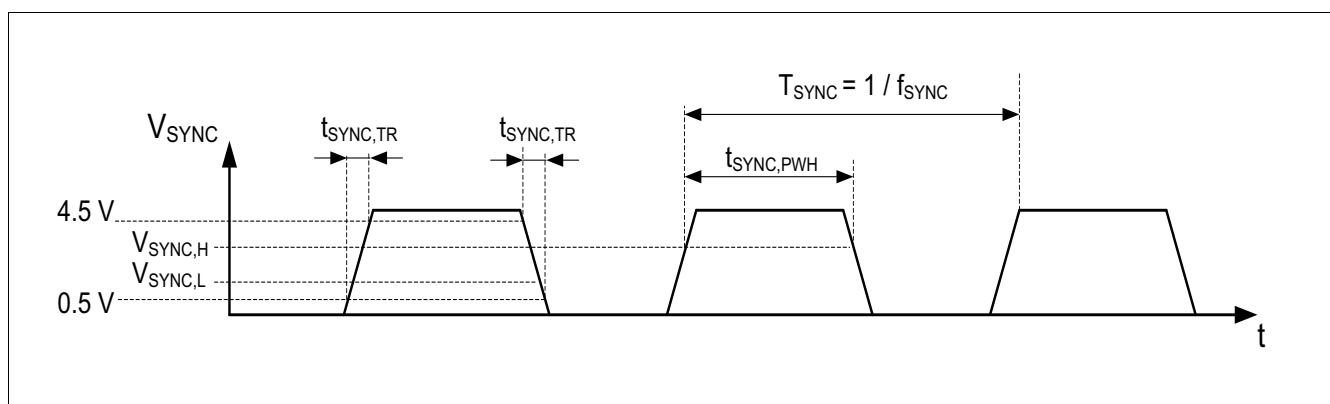
The internal oscillator is used to determine the switching frequency of the boost regulator. The switching frequency can be selected from 100 kHz to 500 kHz with an external resistor to GND. To set the switching frequency with an external resistor the following formula can be applied.

$$R_{FREQ} = \frac{1}{\left(141 \times 10^{-12} \left[\frac{s}{\Omega}\right]\right) \times \left(f_{FREQ} \left[\frac{1}{s}\right]\right)} - \left(3.5 \times 10^3 [\Omega]\right) [\Omega]$$

In addition, the oscillator is capable of changing from the frequency set by the external resistor to a synchronized frequency from an external clock source. If an external clock source is provided on the pin FREQ/SYNC, then the internal oscillator synchronizes to this external clock frequency and the boost regulator switches at the synchronized frequency. The synchronization frequency capture range is 250 kHz to 500 kHz.



**Figure 4 Oscillator and Synchronization Block Diagram and Simplified Application Circuit**



**Figure 5 Synchronization Timing Diagram**

## 6.2 Electrical Characteristics

All parameters have been tested at 25°C, unless otherwise specified.

**Table 2 EC Oscillator and Synchronization**

$V_{IN} = 24V$ ;  $T_j = -40\text{ °C}$  to  $+125\text{ °C}$ , all voltages with respect to ground, positive current flowing into pin; (unless otherwise specified)

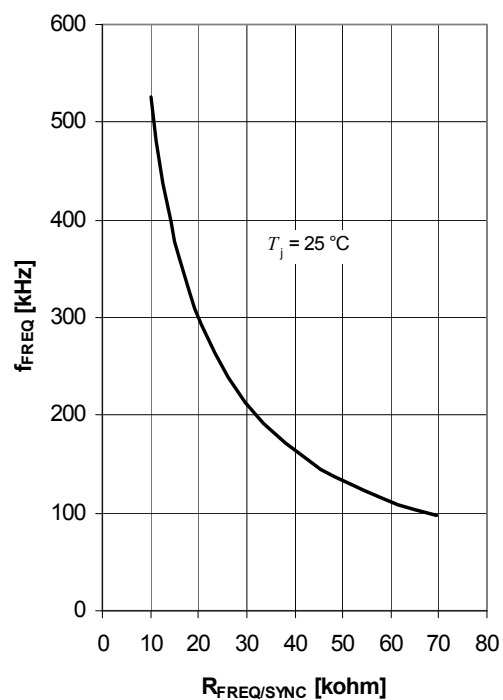
| Pos.            | Parameter                                     | Symbol                | Limit Values |      |      | Unit          | Conditions                           |
|-----------------|-----------------------------------------------|-----------------------|--------------|------|------|---------------|--------------------------------------|
|                 |                                               |                       | Min.         | Typ. | Max. |               |                                      |
| Oscillator:     |                                               |                       |              |      |      |               |                                      |
| 6.2.1           | Oscillator Frequency                          | $f_{\text{FREQ}}$     | 250          | 300  | 350  | kHz           | $R_{\text{FREQ}} = 20\text{k}\Omega$ |
| 6.2.2           | Oscillator Frequency Adjustment Range         | $f_{\text{FREQ}}$     | 100          | –    | 500  | kHz           |                                      |
| 6.2.3           | FREQ / SYNC Supply Current                    | $I_{\text{FREQ}}$     | –            | –    | -700 | $\mu\text{A}$ | $V_{\text{FREQ}} = 0\text{V}$        |
| 6.2.4           | Frequency Voltage                             | $V_{\text{FREQ}}$     | 1.16         | 1.24 | 1.32 | V             | $f_{\text{FREQ}} = 100\text{kHz}$    |
| Synchronization |                                               |                       |              |      |      |               |                                      |
| 6.2.5           | Synchronization Frequency Capture Range       | $f_{\text{SYNC}}$     | 250          | –    | 500  | kHz           | –                                    |
| 6.2.6           | Synchronization Signal High Logic Level Valid | $V_{\text{SYNC,H}}$   | 3.0          | –    | –    | V             | 1) 2)                                |
| 6.2.7           | Synchronization Signal Low Logic Level Valid  | $V_{\text{SYNC,L}}$   | –            | –    | 0.8  | V             | 1) 2)                                |
| 6.2.8           | Synchronization Signal Logic High Pulse Width | $t_{\text{SYNC,PWH}}$ | 200          | –    | –    | ns            | 1) 2)                                |

1) Synchronization of external PWM ON signal to falling edge

2) Not subject to production test, specified by design

## Typical Performance Characteristics of Oscillator

Switching Frequency  $f_{SW}$  versus  
Frequency Select Resistor to GND  $R_{FREQ/SYNC}$





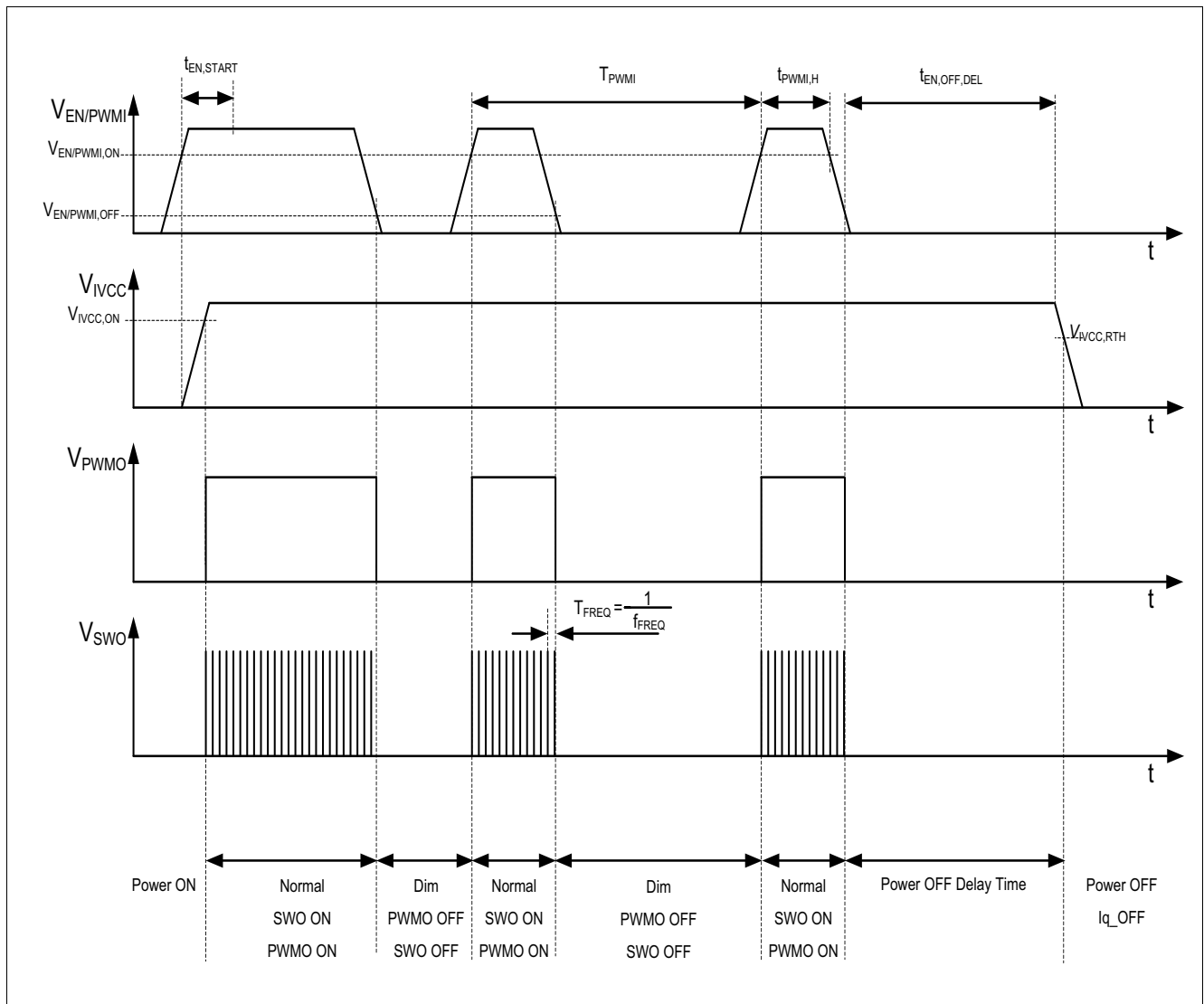


Figure 7 Timing Diagram Enable and LED Dimming

## 7.2 Electrical Characteristics

All parameters have been tested at 25°C, unless otherwise specified.

Table 3 EC Enable and Dimming

V<sub>IN</sub> = 24V; T<sub>j</sub> = -40 °C to +125 °C, all voltages with respect to ground, positive current flowing into pin; (unless otherwise specified)

| Pos.              | Parameter                         | Symbol                   | Limit Values |      |      | Unit | Conditions |
|-------------------|-----------------------------------|--------------------------|--------------|------|------|------|------------|
|                   |                                   |                          | Min.         | Typ. | Max. |      |            |
| Enable/PWM Input: |                                   |                          |              |      |      |      |            |
| 7.2.1             | Enable/PWMI<br>Turn On Threshold  | $V_{\text{EN/PWMI,ON}}$  | 3.0          | –    |      | V    | –          |
| 7.2.2             | Enable/PWMI<br>Turn Off Threshold | $V_{\text{EN/PWMI,OFF}}$ | –            | –    | 0.8  | V    | –          |

## Enable and Dimming Function

**Table 3 EC Enable and Dimming**

$V_{IN} = 24V$ ;  $T_j = -40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$ , all voltages with respect to ground, positive current flowing into pin; (unless otherwise specified)

| Pos.  | Parameter                      | Symbol            | Limit Values |      |      | Unit          | Conditions            |
|-------|--------------------------------|-------------------|--------------|------|------|---------------|-----------------------|
|       |                                |                   | Min.         | Typ. | Max. |               |                       |
| 7.2.3 | Enable/PWMI Hysteresis         | $V_{EN/PWMI,HYS}$ | 50           | 200  | 400  | mV            | <sup>1)</sup>         |
| 7.2.4 | Enable/PWMI High Input Current | $I_{EN/PWMI,H}$   | –            | –    | 30   | $\mu\text{A}$ | $V_{EN/PWMI} = 16.0V$ |
| 7.2.5 | Enable/PWMI Low Input Current  | $I_{EN/PWMI,L}$   | –            | 0.1  | 1    | $\mu\text{A}$ | $V_{EN/PWMI} = 0.5V$  |
| 7.2.6 | Enable Turn Off Delay Time     | $t_{EN,OFF,DEL}$  | 8            | 10   | 12   | ms            | –                     |
| 7.2.7 | PWMI Min Duty Time             | $t_{PWMI,H}$      | 4            | –    | –    | $\mu\text{s}$ | –                     |
| 7.2.8 | Enable Startup Time            | $t_{EN,START}$    | 100          | –    | –    | $\mu\text{s}$ | <sup>1)</sup>         |

### Gate Driver for Dimming Switch:

|        |                                        |                |     |     |     |    |                                                              |
|--------|----------------------------------------|----------------|-----|-----|-----|----|--------------------------------------------------------------|
| 7.2.9  | PWMO Gate Driver Peak Sourcing Current | $I_{PWMO,SRC}$ | –   | 230 | –   | mA | <sup>1)</sup> $V_{PWMO} = 1V$ to $4V$                        |
| 7.2.10 | PWMO Gate Driver Peak Sinking Current  | $I_{PWMO,SNK}$ | –   | 370 | –   | mA | <sup>1)</sup> $V_{PWMO} = 4V$ to $1V$                        |
| 7.2.11 | PWMO Gate Driver Output Rise Time      | $t_{R,PWMO}$   | –   | 50  | 100 | ns | <sup>1)</sup> $C_{L,PWMO} = 3.3nF$ ; $V_{PWMO} = 1V$ to $4V$ |
| 7.2.12 | PWMO Gate Driver Output Fall Time      | $t_{F,PWMO}$   | –   | 30  | 60  | ns | <sup>1)</sup> $C_{L,PWMO} = 3.3nF$ ; $V_{PWMO} = 4V$ to $1V$ |
| 7.2.13 | PWMO Gate Driver Output Voltage        | $V_{PWMO}$     | 4.5 | –   | 5.5 | V  | <sup>1)</sup> $C_{L,PWMO} = 3.3nF$ ;                         |

### Current Consumption

|        |                                                |              |   |   |    |               |                                                                              |
|--------|------------------------------------------------|--------------|---|---|----|---------------|------------------------------------------------------------------------------|
| 7.2.14 | Current Consumption, Shutdown Mode             | $I_{Q\_OFF}$ | – | – | 10 | $\mu\text{A}$ | $V_{EN/PWMI} = 0.8V$ ;<br>$T_j \leq 105^{\circ}\text{C}$ ; $V_{IN} = 16V$    |
| 7.2.15 | Current Consumption, Active Mode <sup>2)</sup> | $I_{Q\_ON}$  | – | – | 7  | mA            | $V_{EN/PWMI} \geq 4.75V$ ;<br>$I_{BO} = 0mA$ ;<br>$V_{SWO} = 0\%$ Duty Cycle |

1) Not subject to production test, specified by design

2) Dependency on switching frequency and gate charge of boost and dimming switch.

## 8 Linear Regulator

### 8.1 Description

The internal linear voltage regulator supplies the internal gate drivers with a typical voltage of 5V and current up to  $I_{LIM,min}$  (Parameter 8.2.2). An external output capacitor with ESR lower than  $R_{IVCC,ESR}$  (Parameter 8.2.5) is required on pin IVCC for stability and buffering transient load currents. During normal operation the external boost and dimming MOSFET switches will draw transient currents from the linear regulator and its output capacitor. Proper sizing of the output capacitor must be considered to supply sufficient peak current to the gate of the external MOSFET switches.

#### Integrated undervoltage protection for the external switching MOSFET:

An integrated undervoltage reset threshold circuit monitors the linear regulator output voltage ( $V_{IVCC}$ ) and resets the device in case the output voltage falls below the IVCC Undervoltage Reset switch OFF Threshold ( $V_{IVCC,RTH,d}$  Parameter 8.2.7). The Undervoltage Reset threshold for the IVCC pin helps to protect the external switches from excessive power dissipation by ensuring the gate drive voltage is sufficient to enhance the gate of an external logic level N-channel MOSFET.

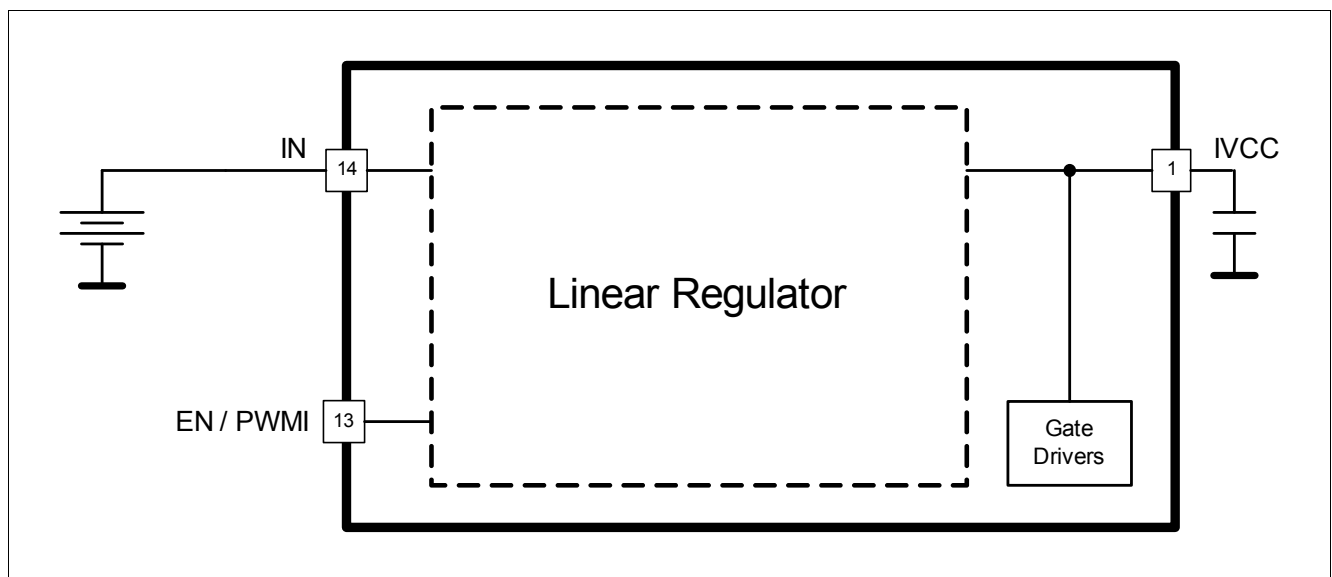


Figure 8 Voltage Regulator Block Diagram and Simplified Application Circuit

## 8.2 Electrical Characteristics

All parameters have been tested at 25°C, unless otherwise specified.

**Table 4 EC Line Regulator**

$V_{IN} = 24V$ ;  $T_j = -40\text{ °C}$  to  $+125\text{ °C}$ , all voltages with respect to ground, positive current flowing into pin; (unless otherwise specified)

| Pos.  | Parameter                                    | Symbol           | Limit Values |      |      | Unit | Conditions                                                   |
|-------|----------------------------------------------|------------------|--------------|------|------|------|--------------------------------------------------------------|
|       |                                              |                  | Min.         | Typ. | Max. |      |                                                              |
| 8.2.1 | Output Voltage                               | $V_{IVCC}$       | 4.85         | 5    | 5.15 | V    | $6V \leq V_{IN} \leq 45V$<br>$0.1mA \leq I_{IVCC} \leq 50mA$ |
| 8.2.2 | Output Current Limitation                    | $I_{LIM}$        | 51           | –    | 90   | mA   | $V_{IN} = 13.5V$<br>$V_{IVCC} = 4.5V$                        |
| 8.2.3 | Drop out Voltage                             | $V_{DR}$         | –            | –    | 0.5  | V    | $V_{IN} = 4.5V$<br>$I_{IVCC} = 25mA$                         |
| 8.2.4 | IVCC Buffer Capacitor                        | $C_{IVCC}$       | 0.47         | 1    | 100  | μF   | <sup>1) 2)</sup>                                             |
| 8.2.5 | IVCC Buffer Capacitor ESR                    | $R_{IVCC,ESR}$   | –            | –    | 0.5  | Ω    | <sup>1)</sup>                                                |
| 8.2.6 | Undervoltage Reset Headroom                  | $V_{IVCC,HDRM}$  | 100          | –    | –    | mV   | $V_{IVCC}$ decreasing<br>$V_{IVCC} - V_{IVCC,RTH,d}$         |
| 8.2.7 | IVCC Undervoltage Reset switch OFF Threshold | $V_{IVCC,RTH,d}$ | 3.6          | –    | 4.0  | V    | <sup>3)</sup> $V_{IVCC}$ decreasing.                         |
| 8.2.8 | IVCC Undervoltage Reset switch ON Threshold  | $V_{IVCC,RTH,i}$ | –            | –    | 4.5  | V    | $V_{IVCC}$ increasing                                        |

1) Not subject to production test, specified by design

2) Minimum value given is needed for regulator stability; application might need higher capacitance than the minimum.

3) Selection of external switching MOSFET is crucial and the  $V_{IVCC,RTH,d}$  min. as worst case  $V_{GS}$  must be considered.

## 9 Protection and Diagnostic Functions

### 9.1 Description

The ILD1151 has integrated circuits to diagnose and protect against output overvoltage, open load, open feedback and overtemperature faults. Additionally the FBH and FBL potential is monitored and in case the LED load short circuits to GND (see description [Figure 15](#)) the regulator stops the operation and protects the system. In case any of the six fault conditions occur the PWM0 and IVCC signal will change to an active logic LOW signal to communicate that a fault has occurred (detailed overview in [Figure 9](#) and [Figure 10](#) below). [Figure 11](#) illustrates the various open load and open feedback conditions. In case of an overtemperature condition the integrated thermal shutdown function turns off the gate drivers and internal linear voltage regulator. The typical junction shutdown temperature is 175°C ( $T_{j,SD}$  Parameter [9.2.2](#)). After cooling down the IC will automatically restart. Thermal shutdown is an integrated protection function designed to prevent IC destruction and is not intended for continuous use in normal operation ([Figure 13](#)). To calculate the proper overvoltage protection resistor values an example is given in [Figure 14](#).

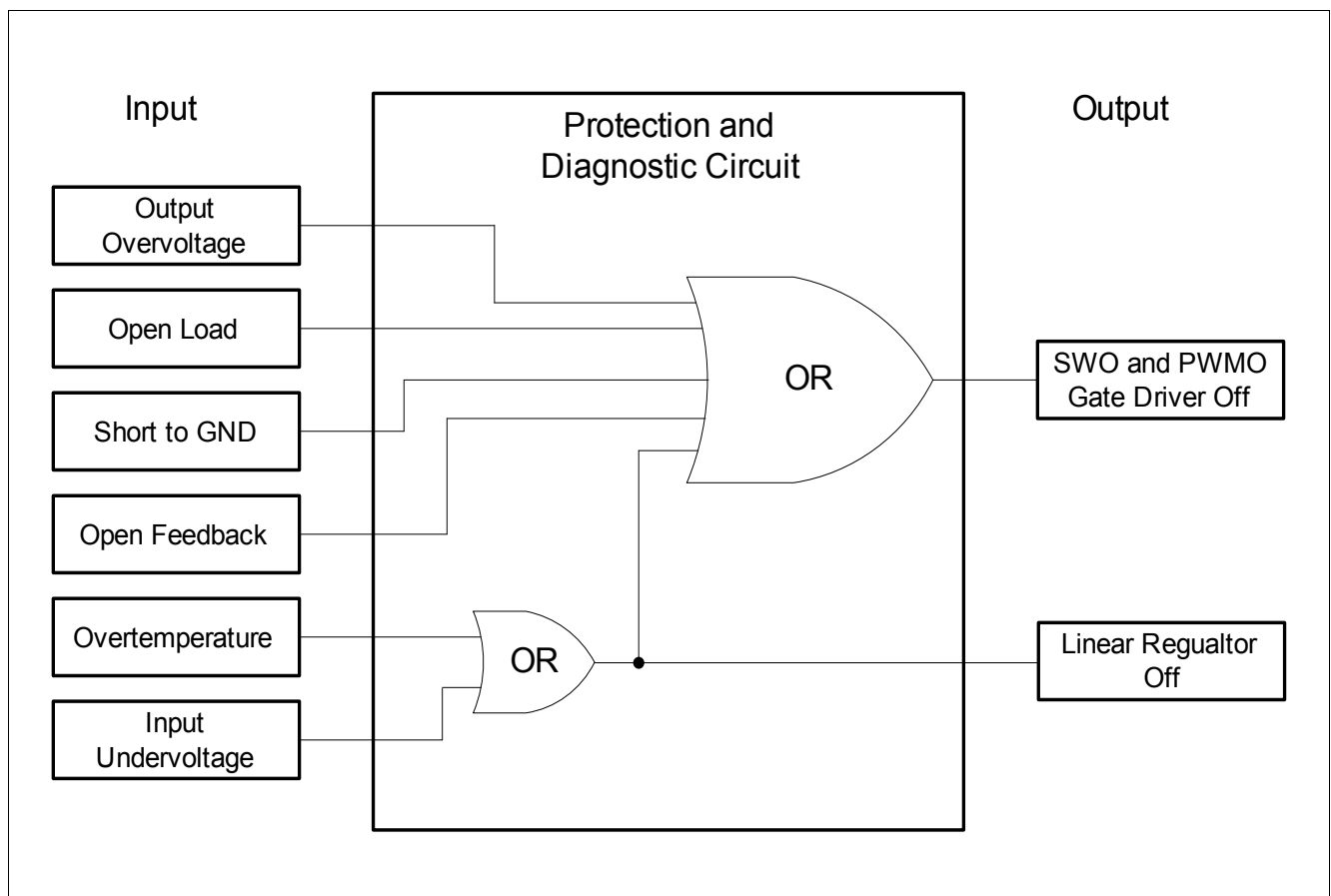


Figure 9 Protection and Diagnostic Function Block Diagram

| Input                    |        | Output |          |          |
|--------------------------|--------|--------|----------|----------|
| Condition                | Level* | SWO    | PWMO     | IVCC     |
| Overvoltage @ Output     | False  | Sw*    | H or Sw* | Active   |
|                          | True   | L      | L        | Active   |
| Open Load                | False  | Sw*    | H or Sw* | Active   |
|                          | True   | L      | L        | Active   |
| Short to GND @ LED chain | False  | Sw*    | H or Sw* | Active   |
|                          | True   | L      | L        | Active   |
| Open Feedback            | False  | Sw*    | H or Sw* | Active   |
|                          | True   | L      | L        | Active   |
| Overtemperature          | False  | Sw*    | H or Sw* | Active   |
|                          | True   | L      | L        | Shutdown |
| Undervoltage @ Input     | False  | Sw*    | H or Sw* | Active   |
|                          | True   | L      | L        | Shutdown |

\*Note:

Sw = Switching

False = Condition does not exist

True = Condition does exist

Figure 10 Diagnosis Truth Table

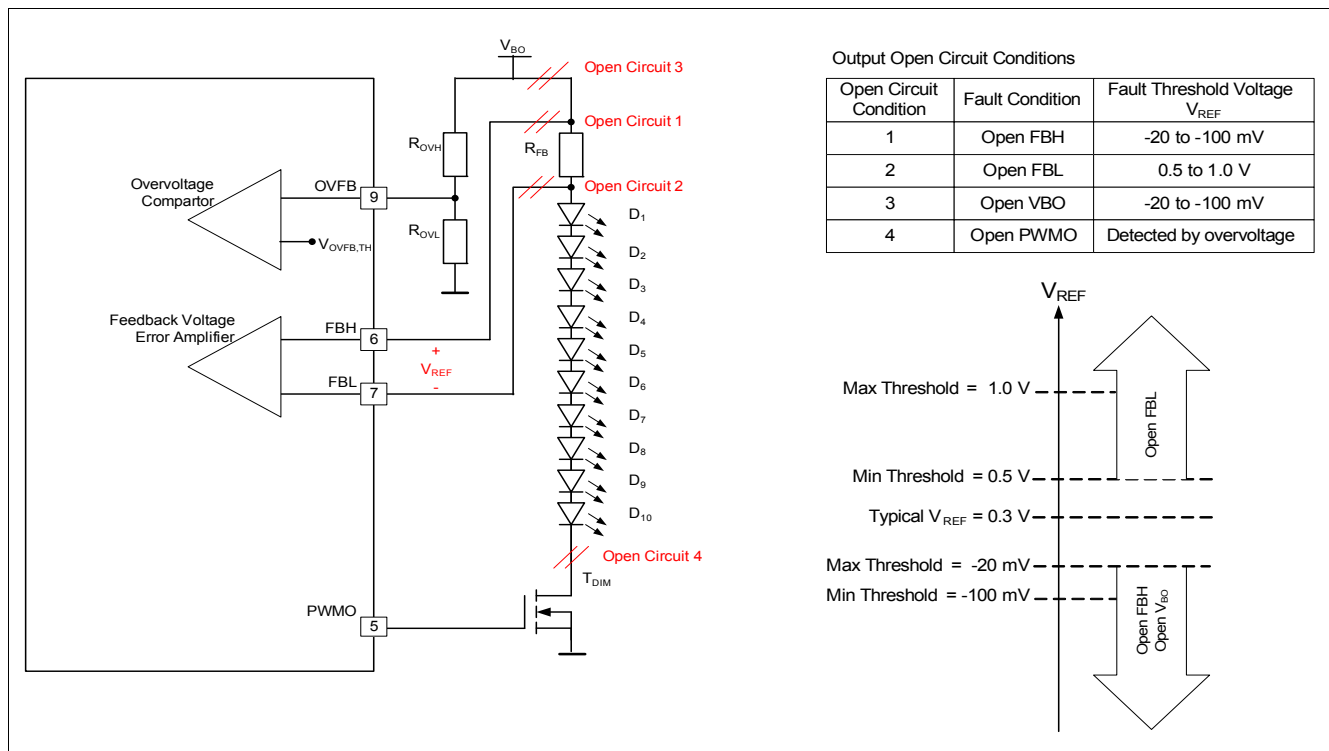


Figure 11 Open Load and Open Feedback Conditions

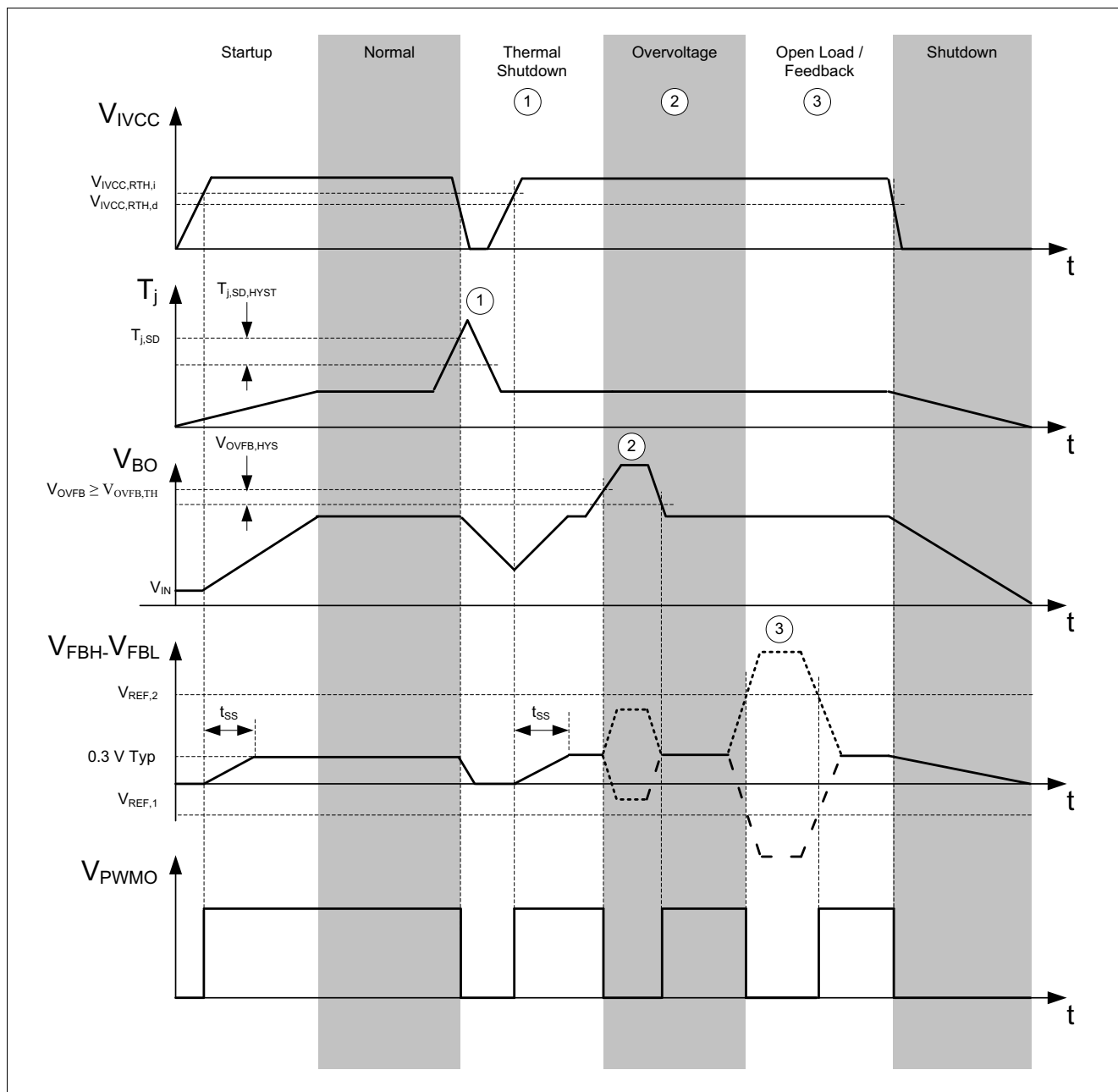
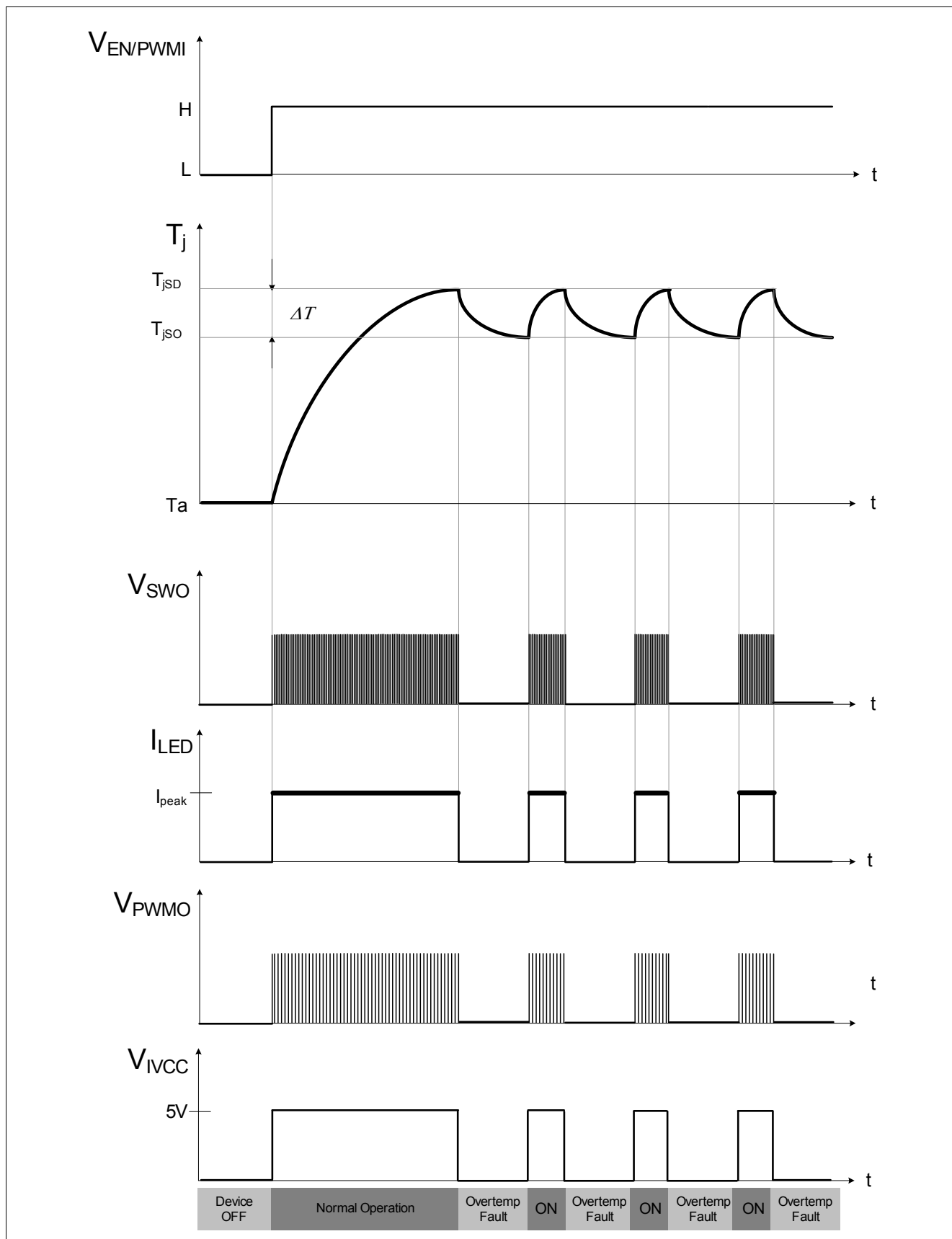


Figure 12 Open load, Overvoltage and Overtemperature Timing Diagram



**Figure 13** Device overtemperature protection behavior



## 9.2 Electrical Characteristics

All parameters have been tested at 25°C, unless otherwise specified.

**Table 5 EC Protection and Diagnosis**

$V_{IN} = 24V$ ;  $T_j = -40\text{ °C}$  to  $+125\text{ °C}$ , all voltages with respect to ground, positive current flowing into pin; (unless otherwise specified)

| Pos.                                    | Parameter                                                 | Symbol             | Limit Values |      |      | Unit | Conditions                                                                        |
|-----------------------------------------|-----------------------------------------------------------|--------------------|--------------|------|------|------|-----------------------------------------------------------------------------------|
|                                         |                                                           |                    | Min.         | Typ. | Max. |      |                                                                                   |
| Short Circuit Protection                |                                                           |                    |              |      |      |      |                                                                                   |
| 9.2.1                                   | FBH and FBL Short-Circuit fault sensing common mode range | $V_{FBL,FBH\_S2G}$ | 1.5          | –    | 2    | V    | refer to <b>Figure 15</b><br>$V_{FBH}=V_{FBL}$<br>decreasing                      |
| Temperature Protection:                 |                                                           |                    |              |      |      |      |                                                                                   |
| 9.2.2                                   | Over Temperature Shutdown                                 | $T_{j,SD}$         | 160          | 175  | 190  | °C   | <sup>1)</sup> refer to <b>Figure 13</b>                                           |
| 9.2.3                                   | Over Temperature Shutdown Hystereses                      | $T_{j,SD,HYST}$    | –            | 15   | –    | °C   | <sup>1)</sup>                                                                     |
| Overvoltage Protection:                 |                                                           |                    |              |      |      |      |                                                                                   |
| 9.2.4                                   | Output Over Voltage Feedback Threshold Increasing         | $V_{OVFB,TH}$      | 1.21         | 1.25 | 1.29 | V    | refer to <b>Figure 14</b>                                                         |
| 9.2.5                                   | Output Over Voltage Feedback Hysteresis                   | $V_{OVFB,HYS}$     | 50           | –    | 150  | mV   | <sup>1)</sup> Output Voltage decreasing                                           |
| 9.2.6                                   | Over Voltage Reaction Time                                | $t_{OVPRR}$        | 2            | –    | 10   | µs   | Output Voltage decreasing                                                         |
| 9.2.7                                   | Over Voltage Feedback Input Current                       | $I_{OVFB}$         | -1           | 0.1  | 1    | µA   | $V_{OVFB} = 1.25V$                                                                |
| Open Load and Open Feedback Diagnostics |                                                           |                    |              |      |      |      |                                                                                   |
| 9.2.8                                   | Open Load/Feedback Threshold                              | $V_{REF,1,3}$      | -100         | –    | -20  | mV   | refer to <b>Figure 11</b><br>$V_{REF} = V_{FBH} - V_{FBL}$<br>Open Circuit 1 or 3 |
| 9.2.9                                   | Open Feedback Threshold                                   | $V_{REF,2}$        | 0.5          | –    | 1    | V    | $V_{REF} = V_{FBH} - V_{FBL}$<br>Open Circuit 2                                   |

<sup>1)</sup> Specified by design; not subject to production test.

*Note: Integrated protection functions are designed to prevent IC destruction under fault conditions described in the data sheet. Fault conditions are considered as “outside” normal operating range. Protection functions are not designed for continuous repetitive operation.*

## 10 Analog Dimming

This pin is influencing the Feedback Voltage Error Amplifier by generating an internal current accordingly to an external reference voltage ( $V_{SET}$ ). If the analog dimming feature is not needed this pin must be connected to IVCC or external > 1.6V supply. Different application scenarios are described in [Figure 18](#). This pin can also go outside of the ECU for instance if a thermistor is connected on a separated LED Module and the Analog Dimming Input is used to thermally protect the LEDs. For reverse battery protection of this pin an external series resistor should be placed to limit the current.

### 10.1 Purpose of Analog Dimming:

1) It is difficult for LED manufacturers to deliver LEDs which have the same Brightness, Colorpoint and Forward Voltage Class. Due to this relatively wide spread of the crucial LED parameters customers order LEDs from one or maximum two different colorpoint classes. The LED manufacturer must preselect the LEDs to deliver the requested colorpoint class. Those preselected LEDs are matched in terms of the colorpoint but a variation of the brightness remains. To correct the brightness deviation an analog dimming feature is needed. The mean LED current can be adjusted by applying an external voltage  $V_{SET}$  at the SET pin.

2) If the DC/DC application is separated from the LED loads the ECU manufacturers aim is to develop one hardware which should be able to handle different load current conditions (e.g. 80mA to 400mA) to cover different applications. To achieve this average LED current adjustment the analog dimming is a crucial feature.

### 10.2 Description

Application Example:

Desired LED current = 400mA. For the calculation of the correct Feedback Resistor  $R_{FB}$  the following equation can be used: This formula is valid if the analog dimming feature is disabled and  $V_{SET} > 1.6V$ .

$$I_{LED} = \frac{V_{REF}}{R_{FB}} \rightarrow R_{FB} = \frac{V_{REF}}{I_{LED}} \rightarrow R_{FB} = \frac{0.3V}{400mA} = 750m\Omega$$

A decrease of the average LED current can be achieved by controlling the voltage at the SET pin ( $V_{SET}$ ) between 0V and 1.6V. The mathematical relation is given in the formula below:

$$I_{LED} = \frac{V_{SET} - 0,1V}{5 * R_{FB}}$$

If  $V_{SET}$  is 100mV the LED current is only determined by the internal offset voltages of the comparators. For this example  $I_{LED} = 0A$  if  $V_{SET} < 100mV$ . Refer to the concept drawing in [Figure 17](#).

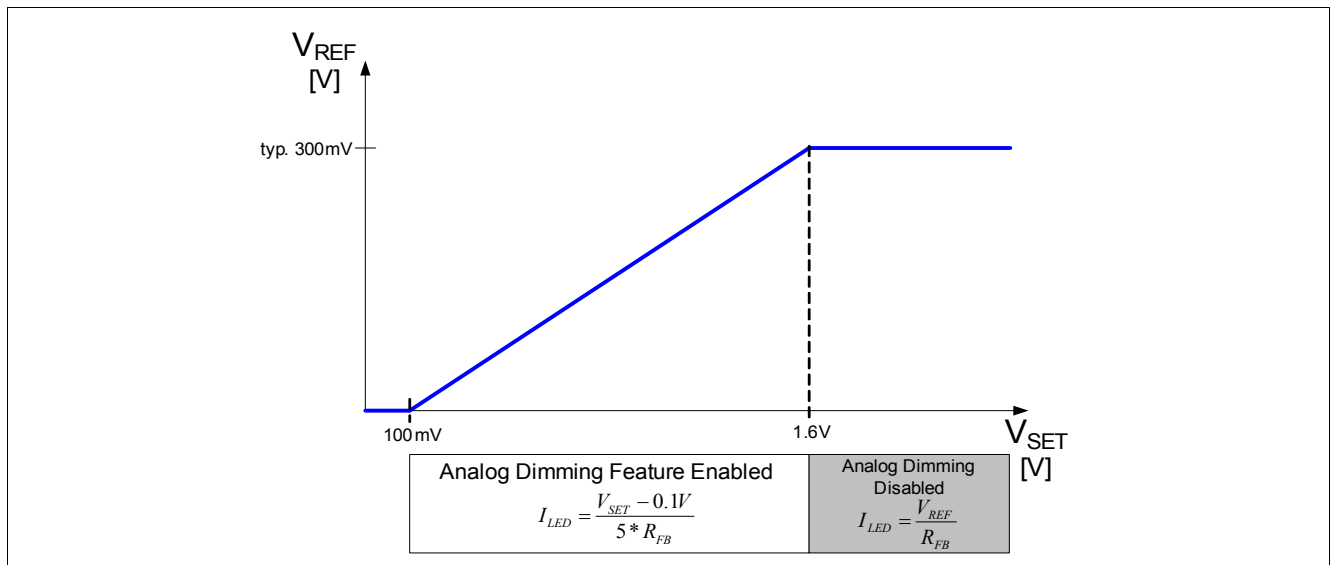


Figure 16 Voltage  $V_{SET}$  versus LED current

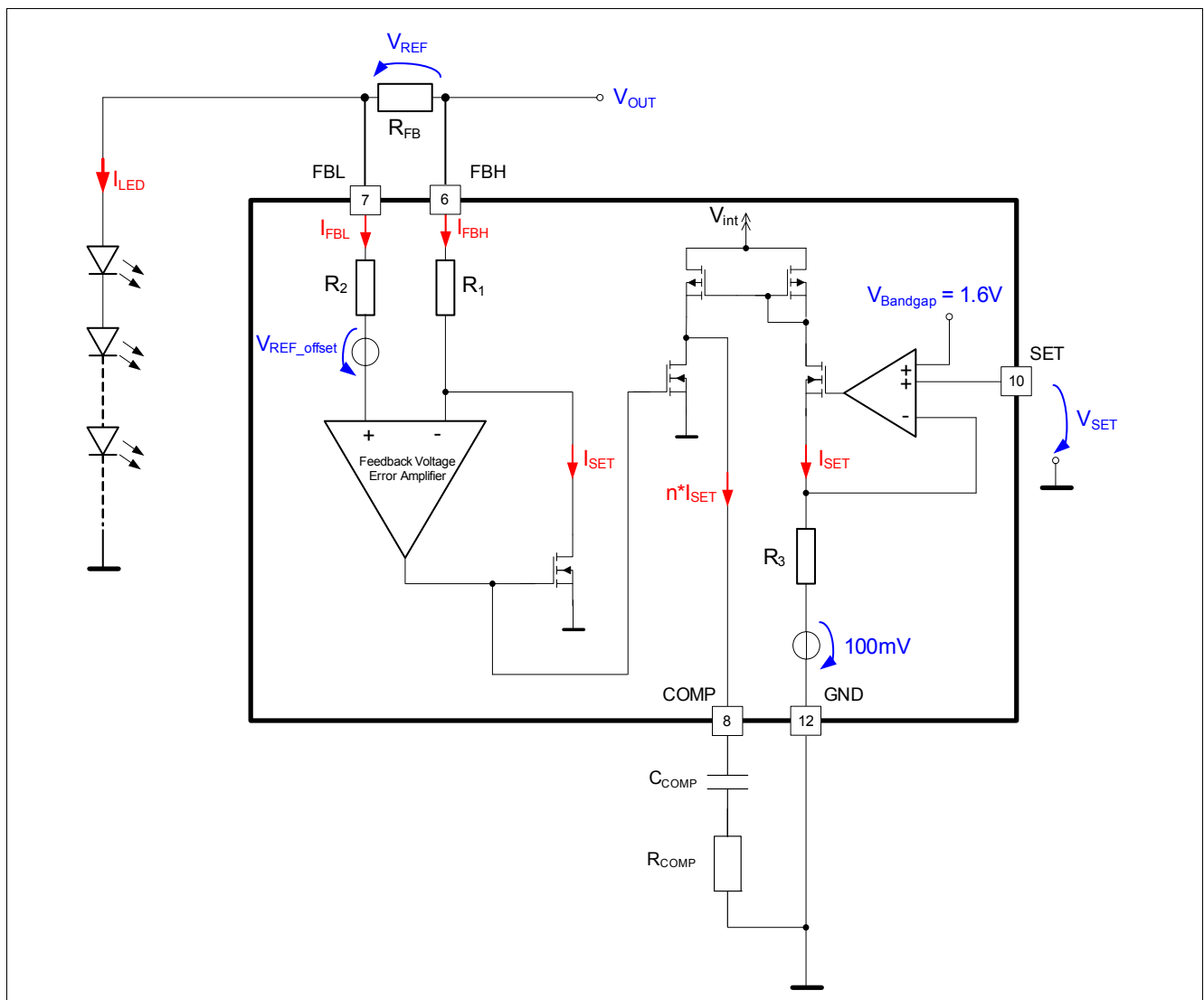


Figure 17 Concept Drawing Analog Dimming

**Multi-purpose usage of the Analog dimming feature**

- 1)** A  $\mu\text{C}$  integrated digital analog converter (DAC) output or a stand alone DAC can be used to supply the SET pin of the ILD1151. The integrated voltage Regulator ( $V_{\text{IVCC}}$ ) can be used to supply the  $\mu\text{C}$  or external components if the current consumption does not exceed 25mA.
- 2)** The analog dimming feature is directly connected to the input voltage of the system. In this configuration the LED current is reduced if the input voltage  $V_{\text{IN}}$  is decreasing. The DC/DC boost converter is changing (increasing) the switching duty cycle if  $V_{\text{IN}}$  drops to a lower potential. This is causing an increase of the input current consumption. If applications require a decrease of the LED current in respect to VIN variations this setup can be chosen.
- 3)** The usage of an external resistor divider connected between IVCC (integrated 5V regulator output and gate buffer pin) SET and GND can be chosen for systems without  $\mu\text{C}$  on board. The concept allows to control the LED current via placing cheap low power resistors. Furthermore a temperature sensitive resistor (Thermistor) to protect the LED loads from thermal destruction can be connected additionally.
- 4)** If the analog dimming feature is not needed the SET pin must be connected directly to  $>1.6\text{V}$  potential (e.g. IVCC potential)
- 5)** Instead of an DAC the  $\mu\text{C}$  can provide a PWM signal and an external R-C filter is producing a constant voltage for the analog dimming. The voltage level is depending on the PWM frequency ( $f_{\text{PWM}}$ ) and duty cycle (DC) which can be controlled by the  $\mu\text{C}$  software after reading the coding resistor placed at the LED module.

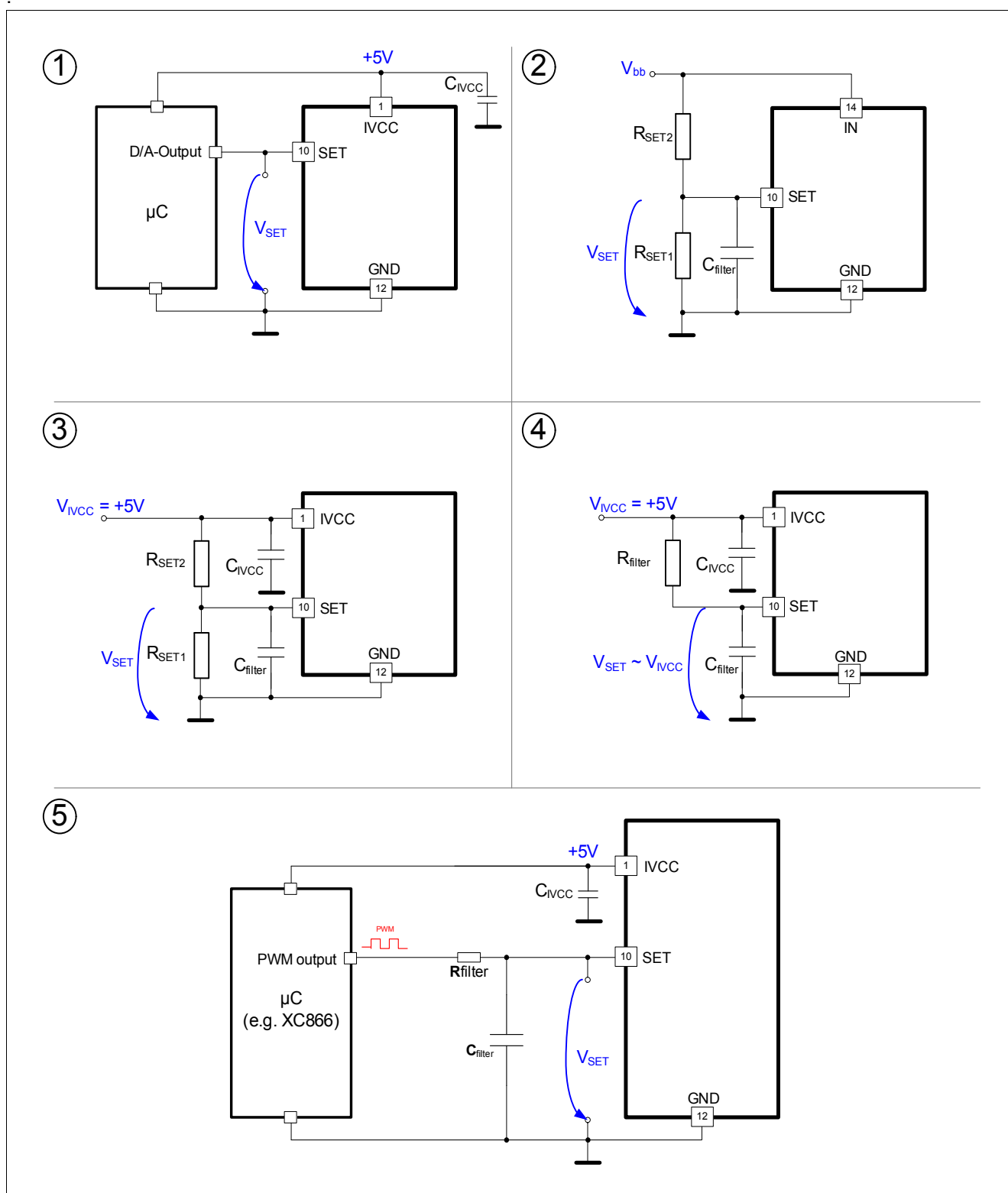


Figure 18 Analog Dimming in various applications

### 10.3 Electrical Characteristics

All parameters have been tested at 25°C, unless otherwise specified.

**Table 6 EC Analog Dimming**

$V_{IN} = 24V$ ;  $T_j = -40\text{ °C}$  to  $+125\text{ °C}$ , all voltages with respect to ground, positive current flowing into pin; (unless otherwise specified)

| Pos. | Parameter | Symbol | Limit Values |      |      | Unit | Conditions |
|------|-----------|--------|--------------|------|------|------|------------|
|      |           |        | Min.         | Typ. | Max. |      |            |

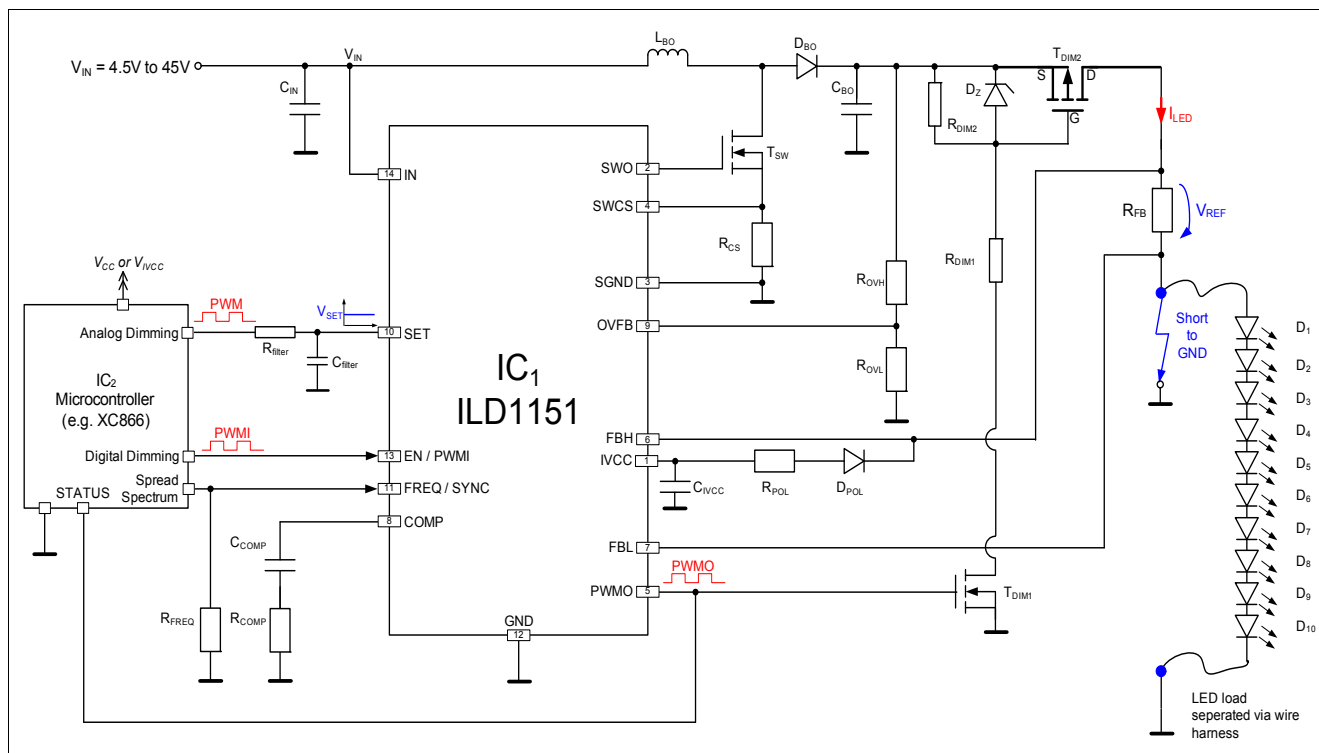
#### Analog Dimming Range

|        |                       |           |   |   |     |   |                                                  |
|--------|-----------------------|-----------|---|---|-----|---|--------------------------------------------------|
| 10.3.1 | SET programming range | $V_{SET}$ | 0 | – | 1.6 | V | <sup>1)</sup> refer to <a href="#">Figure 16</a> |
|--------|-----------------------|-----------|---|---|-----|---|--------------------------------------------------|

1) Specified by design; not subject to production test.

## 11 Application Information

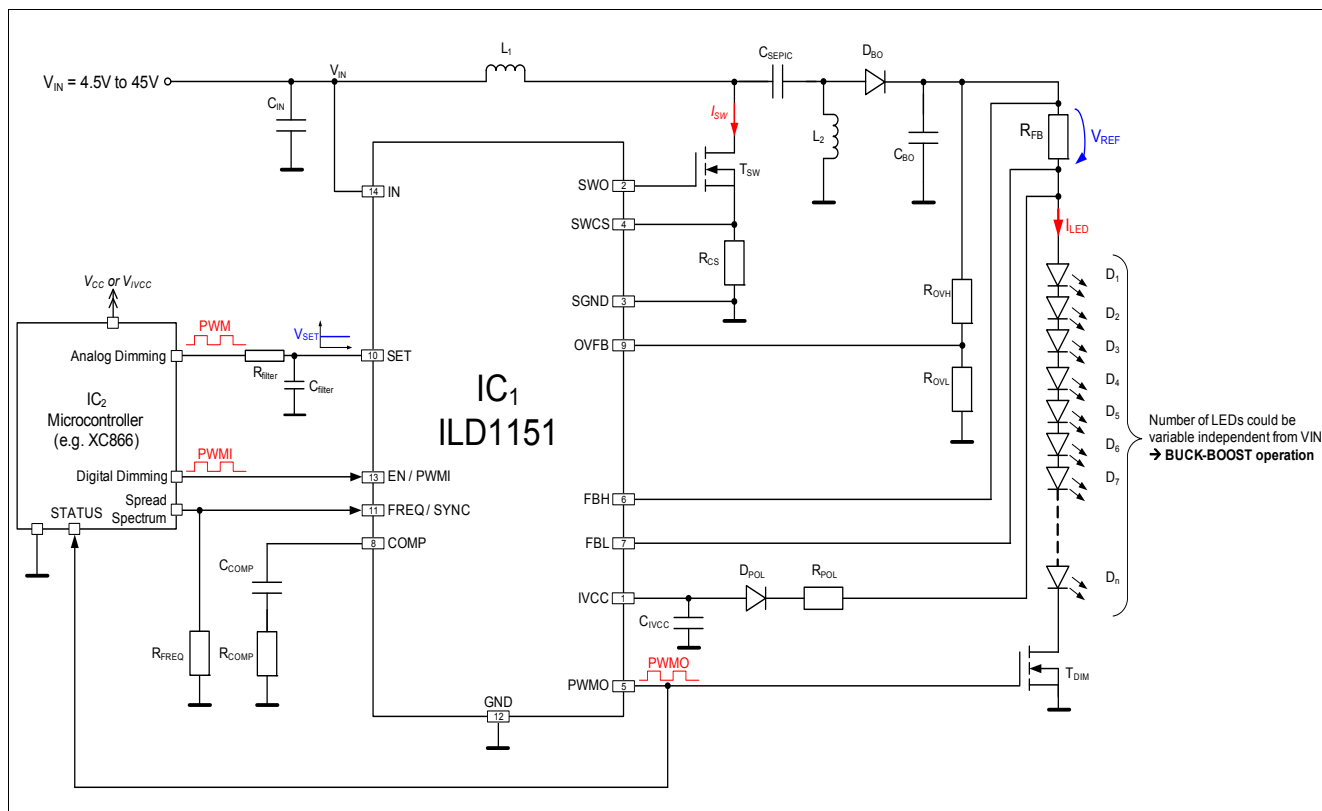
*Note: The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device.*



**Figure 19 Boost to Ground Application Circuit - B2G + Short Circuit protection (Boost configuration)**

| Reference Designator                                       | Value                                    | Manufacturer | Part Number           | Type       | Quantity |
|------------------------------------------------------------|------------------------------------------|--------------|-----------------------|------------|----------|
| D <sub>1 - 10</sub>                                        | White                                    | Osram        | LUW H9GP              | LED        | 10       |
| D <sub>BO</sub>                                            | Schottky , 3 A, 100 V <sub>R</sub>       | Vishay       | SS3H10                | Diode      | 1        |
| D <sub>Z</sub>                                             | 5V or 10V                                | Vishay       | ZENER                 | Diode      | 1        |
| D <sub>POL</sub>                                           | 80V Diode                                | Infineon     | BAS 1603W             | Diode      | 1        |
| C <sub>IN</sub> , C <sub>BO</sub>                          | 100 uF, 50V                              | Panasonic    | EEEFK 1H101GP         | Capacitor  | 2        |
| C <sub>COMP</sub>                                          | 10 nF                                    | EPCOS        | X7R                   | Capacitor  | 1        |
| C <sub>VCC</sub>                                           | 1uF , 6.3V                               | EPCOS        | MLCC CCNPZC105KBW X7R | Capacitor  | 1        |
| IC <sub>1</sub>                                            | --                                       | Infineon     | ILD1151               | IC         | 1        |
| IC <sub>2</sub>                                            | --                                       | Infineon     | XC866                 | IC         | 1        |
| L <sub>BO</sub>                                            | 100 uH                                   | Coilcraft    | MSS1278T-104ML        | Inductor   | 1        |
| R <sub>DIM1+2</sub> , R <sub>POL</sub> , R <sub>COMP</sub> | 10 kΩ, 1%                                | Panasonic    | ERJ3EKF 1002V         | Resistor   | 4        |
| R <sub>FB</sub>                                            | 820 mΩ, 1%                               | Panasonic    | ERJ14BQFR82U          | Resistor   | 1        |
| R <sub>FREQ</sub>                                          | 20 kΩ, 1%                                | Panasonic    | ERJ3EKF 2002V         | Resistor   | 1        |
| R <sub>OVH</sub>                                           | 33.2 kΩ, 1%                              | Panasonic    | ERJ3EKF 3322V         | Resistor   | 1        |
| R <sub>OV L</sub>                                          | 1 kΩ, 1%                                 | Panasonic    | ERJ3EKF 1001V         | Resistor   | 1        |
| R <sub>CS</sub>                                            | 50 mΩ, 1%                                | Panasonic    | ERJB 1CFR05U          | Resistor   | 1        |
| T <sub>SW</sub>                                            | 100V N-ch, 35A                           | Infineon     | IPG20N10S4L-22        | Transistor | 1        |
| T <sub>DIM1</sub> , T <sub>DIM2</sub>                      | 60V Dual N-ch (3.1A) and P-ch. enh. (2A) | Infineon     | BSO615CG              | Transistor | 1        |
|                                                            | alternativ: 100V N-ch (0.37A),           | Infineon     | BSP 123               | Transistor | 1        |
|                                                            | alternativ: 60V P-ch (1.9A)              | Infineon     | BSP 171P              | Transistor | 1        |

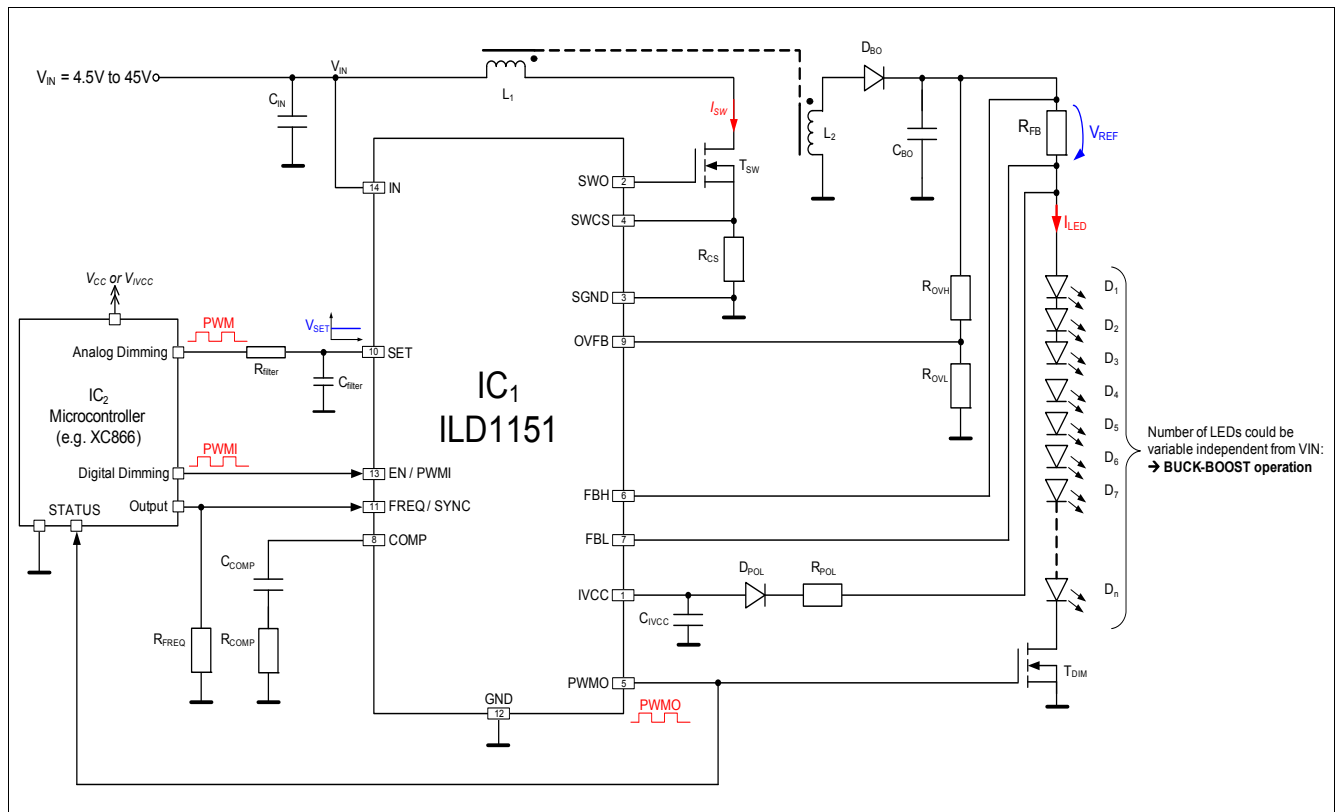
**Figure 20 Bill of Materials for B2G Application Circuit**



**Figure 21 SEPIC Application Circuit (Buck-Boost configuration)**

| Reference Designator                 | Value                             | Manufacturer | Part Number    | Type       | Quantity |
|--------------------------------------|-----------------------------------|--------------|----------------|------------|----------|
| D <sub>1 - n</sub>                   | White                             | Osram        | LUW H9GP       | LED        | variable |
| D <sub>BO</sub>                      | Schottky, 3 A, 100 V <sub>R</sub> | Vishay       | SS3H10         | Diode      | 1        |
| D <sub>POL</sub>                     | 80V Diode                         | Infineon     | BAS 1603W      | Diode      | 1        |
| C <sub>SEPIC</sub>                   | 3.3 uF, 20V                       | EPCOS        | X7R, Low ESR   | Capacitor  | 1        |
| C <sub>IN</sub> , C <sub>BO</sub>    | 100 uF, 50V                       | Panasonic    | EEEFK1H101GP   | Capacitor  | 2        |
| C <sub>COMP</sub>                    | 10 nF                             | EPCOS        | X7R            | Capacitor  | 1        |
| C <sub>IVCC</sub>                    | 1uF , 6.3V                        | EPCOS        | X7R            | Capacitor  | 1        |
| IC <sub>1</sub>                      | --                                | Infineon     | ILD1151        | IC         | 1        |
| IC <sub>2</sub>                      | --                                | Infineon     | XC866          | IC         | 1        |
| L <sub>1</sub> , L <sub>2</sub>      | 47 uH                             | Coilcraft    | MSS1278T-473ML | Inductor   | 2        |
|                                      | alternativ: 22uH coupled inductor | Coilcraft    | MSD1278-223MLD | Inductor   | 1        |
| R <sub>COMP</sub> , R <sub>POL</sub> | 10 kΩ, 1%                         | Panasonic    | ERJ3EKF 1002V  | Resistor   | 2        |
| R <sub>FB</sub>                      | 820 mΩ, 1%                        | Panasonic    | ERJ14BQFR82U   | Resistor   | 1        |
| R <sub>FREQ</sub>                    | 20 kΩ, 1%                         | Panasonic    | ERJ3EKF 2002V  | Resistor   | 1        |
| R <sub>OVH</sub>                     | 33.2 kΩ, 1%                       | Panasonic    | ERJ3EKF 3322V  | Resistor   | 1        |
| R <sub>OVL</sub>                     | 1 kΩ, 1%                          | Panasonic    | ERJ3EKF 1001V  | Resistor   | 1        |
| R <sub>CS</sub>                      | 50 mΩ, 1%                         | Panasonic    | ERJB 1CFR05U   | Resistor   | 1        |
| T <sub>DIM</sub> , T <sub>SW</sub>   | Dual N-ch enh. (60V, 20A)         | Infineon     | IPG20N06S4L-26 | Transistor | 1        |
|                                      | alternativ: 100V N-ch, 35A        | Infineon     | IPD35N10S3L-26 | Transistor | 2        |
|                                      | alternativ : 60V N-ch, 2.6A       | Infineon     | BSP318S        | Transistor | 2        |

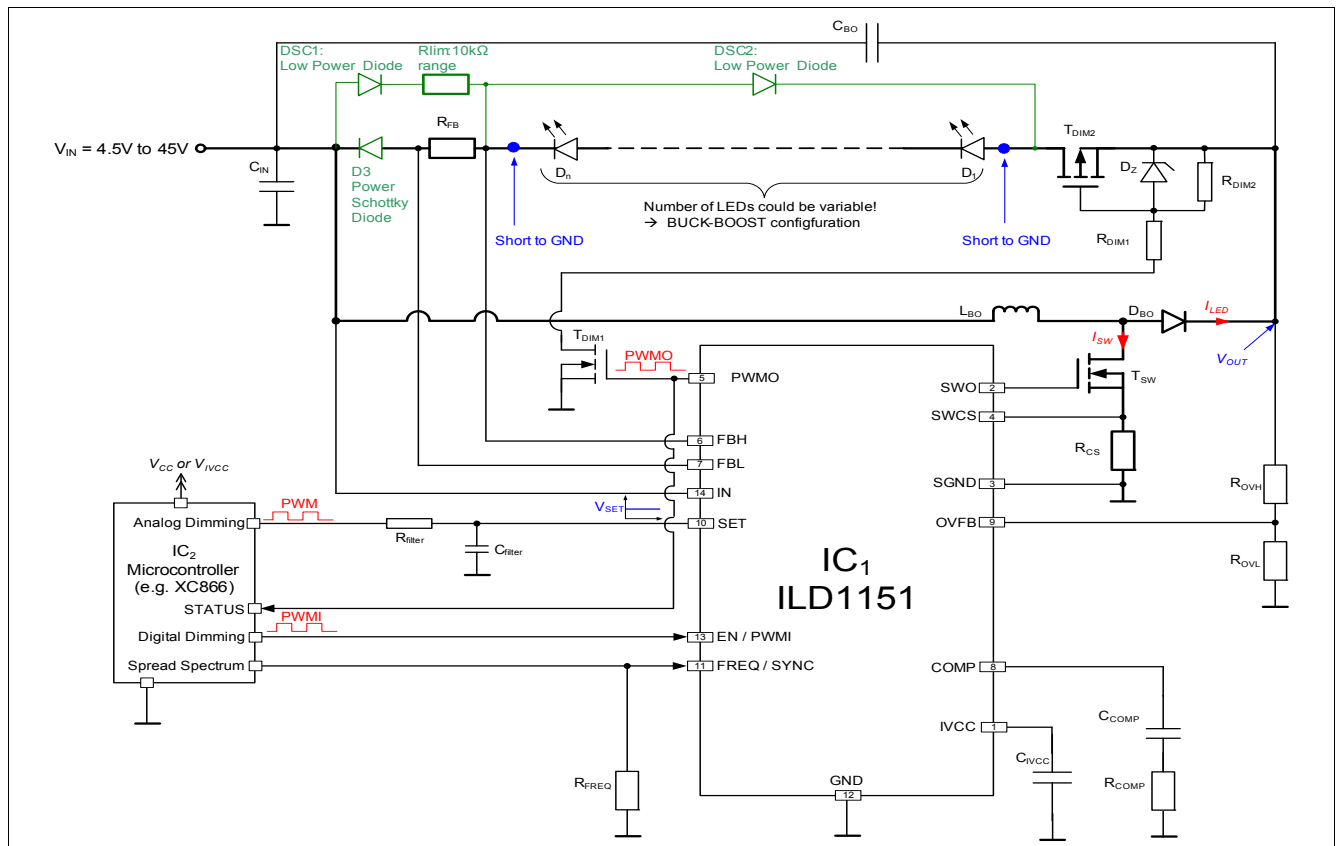
**Figure 22 Bill of Materials for SEPIC Application Circuit**



**Figure 23 Flyback Application Circuit (Buck-Boost configuration)**

| Reference Designator                 | Value                             | Manufacturer   | Part Number          | Type       | Quantity |
|--------------------------------------|-----------------------------------|----------------|----------------------|------------|----------|
| D <sub>1</sub> - n                   | White                             | Osram          | LUW H9GP             | LED        | variable |
| D <sub>BO</sub>                      | Schottky, 3 A, 100 V <sub>R</sub> | Vishay         | SS3H10               | Diode      | 1        |
| C <sub>BO</sub>                      | 3.3 uF, 50V (100V)                | EPCOS          | X7R, Low ESR         | Capacitor  | 1        |
| C <sub>IN</sub>                      | 100 uF, 50V                       | Panasonic      | EEEFK1H101GP         | Capacitor  | 1        |
| C <sub>COMP</sub>                    | 47 nF                             | EPCOS          | X7R                  | Capacitor  | 1        |
| C <sub>IVCC</sub>                    | 1 uF, 6.3V                        | EPCOS          | X7R                  | Capacitor  | 1        |
| IC <sub>1</sub>                      | --                                | Infineon       | ILD1151              | IC         | 1        |
| IC <sub>2</sub>                      | --                                | Infineon       | XC866                | IC         | 1        |
| L <sub>1</sub> , L <sub>2</sub>      | 1 µH / 9 µH                       | EPCOS          | Transformer EHP 16   | Inductor   | 1        |
| R <sub>COMP</sub> , R <sub>POL</sub> | 10 kΩ, 1%                         | Panasonic      | ERJ3EKF 1002V        | Resistor   | 2        |
| D <sub>POL</sub>                     | 80 V Diode                        | Infineon       | BAS 1603W            | Diode      | 1        |
| R <sub>FB</sub>                      | 820 mΩ, 1%                        | Isabellenhütte | SMS – Power Resistor | Resistor   | 1        |
| R <sub>FREQ</sub>                    | 10 kΩ, 1%                         | Panasonic      | ERJ3EKF 1002V        | Resistor   | 1        |
| R <sub>OVH</sub>                     | 56.2 kΩ, 1%                       | Panasonic      | ERJ3EKF 5622V        | Resistor   | 1        |
| R <sub>OVL</sub>                     | 1.24 kΩ, 1%                       | Panasonic      | ERJ3EKF 1241V        | Resistor   | 1        |
| R <sub>CS</sub>                      | 5 mΩ, 1%                          | Isabellenhütte | SMS - Power Resistor | Resistor   | 1        |
| T <sub>DIM</sub> , T <sub>SW</sub>   | Dual N-ch enh. (60V, 20A)         | Infineon       | IPG20N06S4L-26       | Transistor | 1        |
|                                      | alternativ: 100V N-ch, 35A        | Infineon       | IPG20N10S4L-22       | Transistor | 2        |
|                                      | alternativ : 60V N-ch, 2.6A       | Infineon       | BSP318S              | Transistor | 2        |

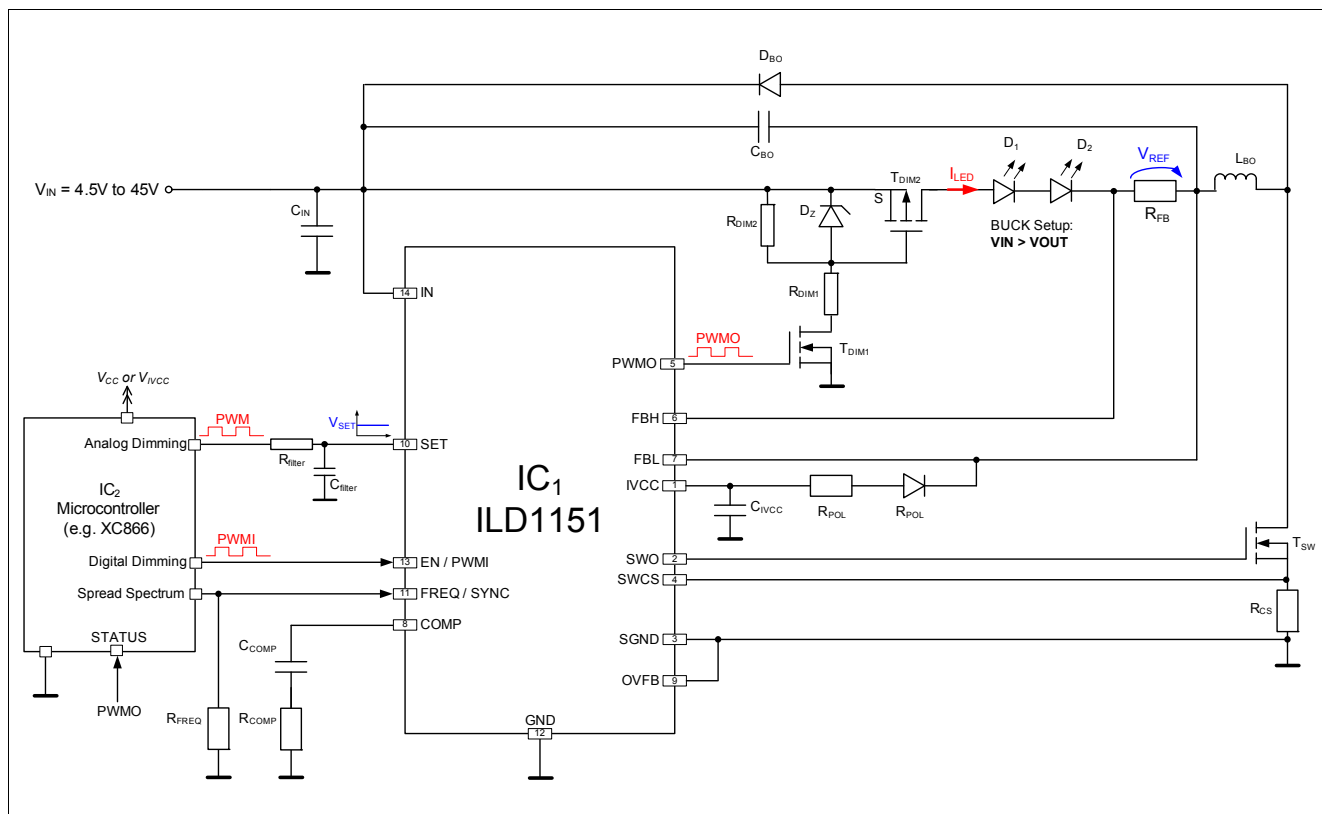
**Figure 24 Bill of Materials for Flyback Application Circuit**



**Figure 25 Boost to Battery Application Circuit - B2B + Short Circuit protection (Buck-Boost config.)**

| Reference Designator                                                         | Value                                    | Manufacturer | Part Number           | Type       | Quantity |
|------------------------------------------------------------------------------|------------------------------------------|--------------|-----------------------|------------|----------|
| D <sub>1-n</sub>                                                             | White                                    | Osram        | LUW H9GP              | Diode      | variable |
| D <sub>BO</sub> , D <sub>3</sub>                                             | Schottky, 3 A, 100 V <sub>R</sub>        | Vishay       | SS3H10                | Diode      | 2        |
| D <sub>SC1</sub> , D <sub>SC2</sub>                                          | Low Power Diode                          | Infineon     | BAS 16-03W            | Diode      | 2        |
| D <sub>Z</sub>                                                               | Zener Diode                              | --           | --                    | Diode      | 1        |
| C <sub>BO</sub>                                                              | 100 uF, 80V                              | Panasonic    | EEVFK1K101Q           | Capacitor  | 1        |
| C <sub>IN</sub>                                                              | 100 uF, 50V                              | Panasonic    | EEEFK1H101GP          | Capacitor  | 1        |
| C <sub>COMP</sub>                                                            | 10 nF                                    | EPCOS        | X7R                   | Capacitor  | 1        |
| C <sub>IVCC</sub>                                                            | 1 uF, 6.3V                               | EPCOS        | MLCC CCNPZC105KBW X7R | Capacitor  | 1        |
| IC <sub>1</sub>                                                              | --                                       | Infineon     | ILD1151               | IC         | 1        |
| IC <sub>2</sub>                                                              | --                                       | Infineon     | XC866                 | IC         | 1        |
| L <sub>BO</sub>                                                              | 100 uH                                   | Coilcraft    | MSS1278T-104ML        | Inductor   | 1        |
| R <sub>COMP</sub> , R <sub>DIM1</sub> , R <sub>DIM2</sub> , R <sub>lim</sub> | 10 kΩ, 1%                                | Panasonic    | ERJ3EKF 1002V         | Resistor   | 4        |
| R <sub>FB</sub>                                                              | 820 mΩ, 1%                               | Panasonic    | ERJ14BQFR82U          | Resistor   | 1        |
| R <sub>FREQ</sub>                                                            | 20 kΩ, 1%                                | Panasonic    | ERJ3EKF 2002V         | Resistor   | 1        |
| R <sub>OVH</sub>                                                             | 33.2 kΩ, 1%                              | Panasonic    | ERJP06F5102V          | Resistor   | 1        |
| R <sub>OVL</sub>                                                             | 1 kΩ, 1%                                 | Panasonic    | ERJ3EKF 1001V         | Resistor   | 1        |
| R <sub>CS</sub>                                                              | 50 mΩ, 1%                                | Panasonic    | ERJB1CFR05U           | Resistor   | 1        |
| T <sub>DIM1</sub> , T <sub>DIM2</sub>                                        | 60V Dual N-ch (3.1A) and P-ch. enh. (2A) | Infineon     | BSO615CG              | Transistor | 1        |
|                                                                              | alternativ: 100V N-ch (0.37A),           | Infineon     | BSP123                | Transistor | 1        |
|                                                                              | alternativ: 60V P-ch (1.9A)              | Infineon     | BSP171P               | Transistor | 1        |
| T <sub>SW</sub>                                                              | N-ch, OptiMOS-T2 100V, 35A               | Infineon     | IPD35N10S3L-26        | Transistor | 1        |
|                                                                              | alternativ: 60V N-ch, 30A                | Infineon     | IPD30N06S4L-23        | Transistor | 1        |
|                                                                              | alternativ: 60V N-ch, 2.6A               | Infineon     | BSP318S               | Transistor | 1        |

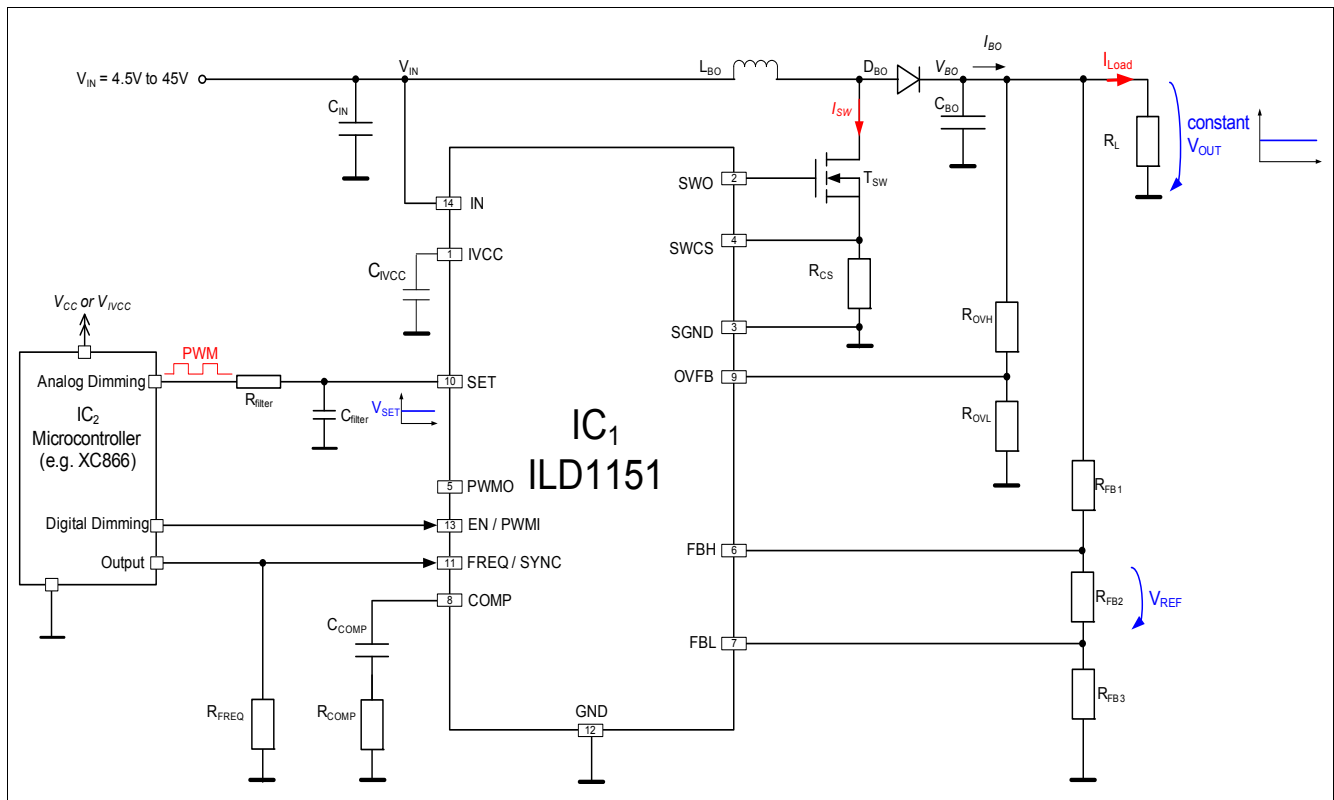
**Figure 26 Bill of Materials for B2B Application Circuit**



**Figure 27 Buck Application Circuit + Short Circuit protection**

| Reference Designator                                       | Value                             | Manufacturer   | Part Number           | Type       | Quantity |
|------------------------------------------------------------|-----------------------------------|----------------|-----------------------|------------|----------|
| D <sub>1-2</sub>                                           | White                             | Osram          | LE UW Q9WP            | LED        | 2        |
| D <sub>BO</sub>                                            | Schottky, 3 A, 100 V <sub>R</sub> | Vishay         | SS3H10                | Diode      | 1        |
| D <sub>Z</sub>                                             | 10V                               | Vishay         | Zener Diode           | Diode      | 1        |
| D <sub>POL</sub>                                           | 80V Diode                         | Infineon       | BAS1603W              | Diode      | 1        |
| C <sub>BO</sub>                                            | 4.7 uF, 50V                       | EPCOS          | X7R                   | Capacitor  | 1        |
| C <sub>IN</sub>                                            | 100 uF, 50V                       | Panasonic      | EEEFK 1H101GP         | Capacitor  | 1        |
| C <sub>COMP</sub>                                          | 47 nF                             | EPCOS          | X7R                   | Capacitor  | 1        |
| C <sub>IVCC</sub>                                          | 1 uF , 6.3V                       | EPCOS          | MLCC CCNPZC105KBW X7R | Capacitor  | 1        |
| IC <sub>1</sub>                                            | --                                | Infineon       | ILD1151               | IC         | 1        |
| IC <sub>2</sub>                                            | --                                | Infineon       | XC866                 | IC         | 1        |
| L <sub>1</sub>                                             | 22 µH                             | Coilcraft      | MSS1278 T             | Inductor   | 1        |
| R <sub>DIM1+2</sub> , R <sub>COMP</sub> , R <sub>POL</sub> | 10 kΩ, 1%                         | Panasonic      | ERJ3EKF 1002V         | Resistor   | 4        |
| R <sub>FB</sub>                                            | 820 mΩ, 1%                        | Isabellenhütte | SMS – Power Resistor  | Resistor   | 1        |
| R <sub>FREQ</sub>                                          | 20 kΩ, 1%                         | Panasonic      | ERJ3EKF 2002V         | Resistor   | 1        |
| R <sub>CS</sub>                                            | 50 mΩ, 1%                         | Isabellenhütte | SMS - Power Resistor  | Resistor   | 1        |
| T <sub>DIM1</sub>                                          | 60V, 0.28A                        | Infineon       | BSS138                | Transistor | 1        |
| T <sub>DIM2</sub>                                          | -60V, -1.9A                       | Infineon       | BSP171                | Transistor | 1        |
| T <sub>SW</sub>                                            | 30V, 22A                          | Infineon       | IPB22N03S4L-15        | Transistor | 1        |
|                                                            | alternativ : 60V N-ch, 2.6A       | Infineon       | BSP318S               | Transistor | 1        |

**Figure 28 Bill of Materials for Buck Application Circuit**



**Figure 29 Boost Voltage Application Circuit**

| Reference Designator                | Value                             | Manufacturer | Part Number           | Type       | Quantity |
|-------------------------------------|-----------------------------------|--------------|-----------------------|------------|----------|
| D <sub>BO</sub>                     | Schottky, 3 A, 100 V <sub>R</sub> | Vishay       | SS3H10                | Diode      | 1        |
| C <sub>BO</sub>                     | 100 uF, 80V                       | Panasonic    | EEVFK1K101Q           | Capacitor  | 1        |
| C <sub>IN</sub>                     | 100 uF, 50V                       | Panasonic    | EEEFK1H101GP          | Capacitor  | 1        |
| C <sub>COMP</sub>                   | 10 nF                             | TBD          | TBD                   | Capacitor  | 1        |
| C <sub>IVCC</sub>                   | 1 uF, 6.3V                        | Panasonic    | MLCC CCNPZC105KBW X7R | Capacitor  | 1        |
| IC <sub>1</sub>                     | --                                | Infineon     | ILD1151               | IC         | 1        |
| IC <sub>2</sub>                     | --                                | Infineon     | XC886                 | IC         | 1        |
| L <sub>BO</sub>                     | 100 uH                            | Coilcraft    | MSS1278T-104ML_       | Inductor   | 1        |
| R <sub>COMP</sub>                   | 10 kΩ                             | TBD          | TBD                   | Resistor   | 1        |
| R <sub>FB1</sub> , R <sub>FB3</sub> | 51 kΩ, 1%                         | Panasonic    | ERJ3EKF5102V          | Resistor   | 1        |
| R <sub>FB2</sub>                    | 1 kΩ, 1%                          | Panasonic    | ERJ3EKF 1001V         | Resistor   | 1        |
| R <sub>FREQ</sub>                   | 20 kΩ, 1%                         | Panasonic    | ERJ3EKF2002V          | Resistor   | 2        |
| R <sub>OVH</sub>                    | 51 kΩ, 1%                         | Panasonic    | ERJP06F5102V          | Resistor   | 1        |
| R <sub>OVL</sub>                    | 1 kΩ, 1%                          | Panasonic    | ERJ3EKF 1001V         | Resistor   | 1        |
| R <sub>CS</sub>                     | 50 mΩ, 1%                         | Panasonic    | ERJB1CFR05U           | Resistor   | 1        |
| T <sub>SW</sub>                     | N-ch, 75 V, 65 mΩ                 | Infineon     | IPD22N08S2L-50        | Transistor | 1        |

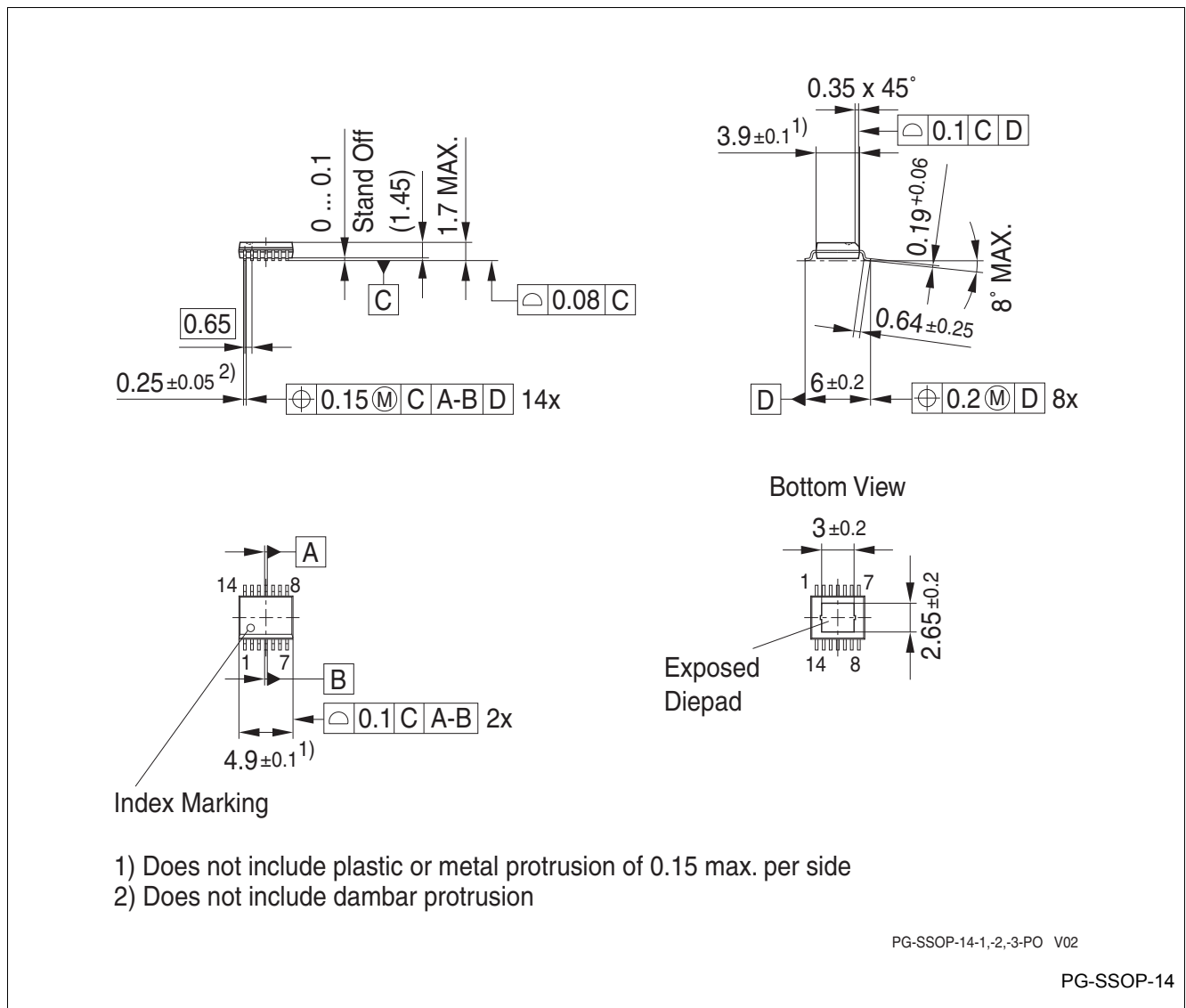
**Figure 30 Bill of Materials for Boost Voltage Application Circuit**

*Note: This is a very simplified example of an application circuit. The function must be verified in the real application.*

## 11.1 Further Application Information

- For further information you may contact <http://www.infineon.com/>
- Application Note: ILD1150 / ILD1151 DC-DC Multitopology Controller IC for Industrial Applications  
"Dimensioning and Stability Guideline - Theory and Practice"

## 12 Package Outlines



**Figure 31 PG-SSOP-14**

### Green Product (RoHS compliant)

To meet the world-wide customer requirements for environmentally friendly products and to be compliant with government regulations the device is available as a green product. Green products are RoHS-Compliant (i.e. Pb-free finish on leads and suitable for Pb-free soldering according to IPC/JEDEC J-STD-020).

For further package information, please visit our website:

<http://www.infineon.com/packages>.

Dimensions in mm

## 13 Revision History

| Revision | Date       | Changes                                                                                       |
|----------|------------|-----------------------------------------------------------------------------------------------|
| 1.0      | 2011-02-10 | Initial Datasheet                                                                             |
| 1.1      | 2012-04-11 | Page 3: RoHS Logo update<br>Page 3: Topology update<br>Application Information chapter update |

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