

Step down - LED controller IC for external power stages

ILD4001

Small Signal Discretes



Never stop thinking

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**ILD4001, Step down - LED controller IC for external power stages**

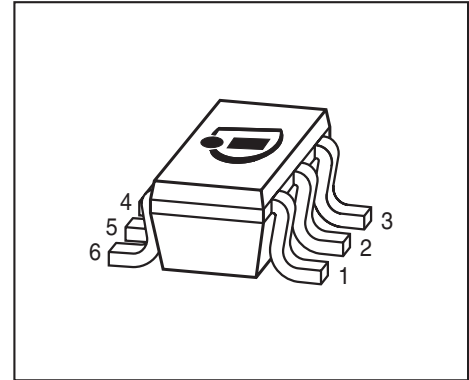
**Revision History: 2009-07-06, Rev. 1.0**

| <b>Page</b> | <b>Subjects (major changes since last revision)</b> |
|-------------|-----------------------------------------------------|
|             | I                                                   |
|             |                                                     |
|             |                                                     |

## 1 Bipolar Buck- converter LED Controller IC

### Features

- Wide Input Voltage Range: 4.5V ... 40 V
- Over voltage protection
- Temperature shut down mechanism
- Integrated push- pull stage for fast on/off- switching
- Soft- Start capability
- Low shut down current < 200nA in operating voltage range
- Multifunctional Enable Pin
- Analog and PWM dimming possible
- PWM control for LED brightness possible
- Typical 3% output current accuracy
- Minimum external component required
- Small Package: SC-74



### Applications

- LED Controller for industrial applications
- Universal Constant Current Source
- Generell 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.)

## 2 Description

The ILD4001 is a hysteretic buck LED controller IC for industrial applications realized in a bipolar IC technology. The LED Controller is capable to drive external bipolar or MOSFET power transistors by using the internal push-pull output stage.

The IC incorporates a wide input voltage range and the output current level can be adjusted with an external sense resistor.

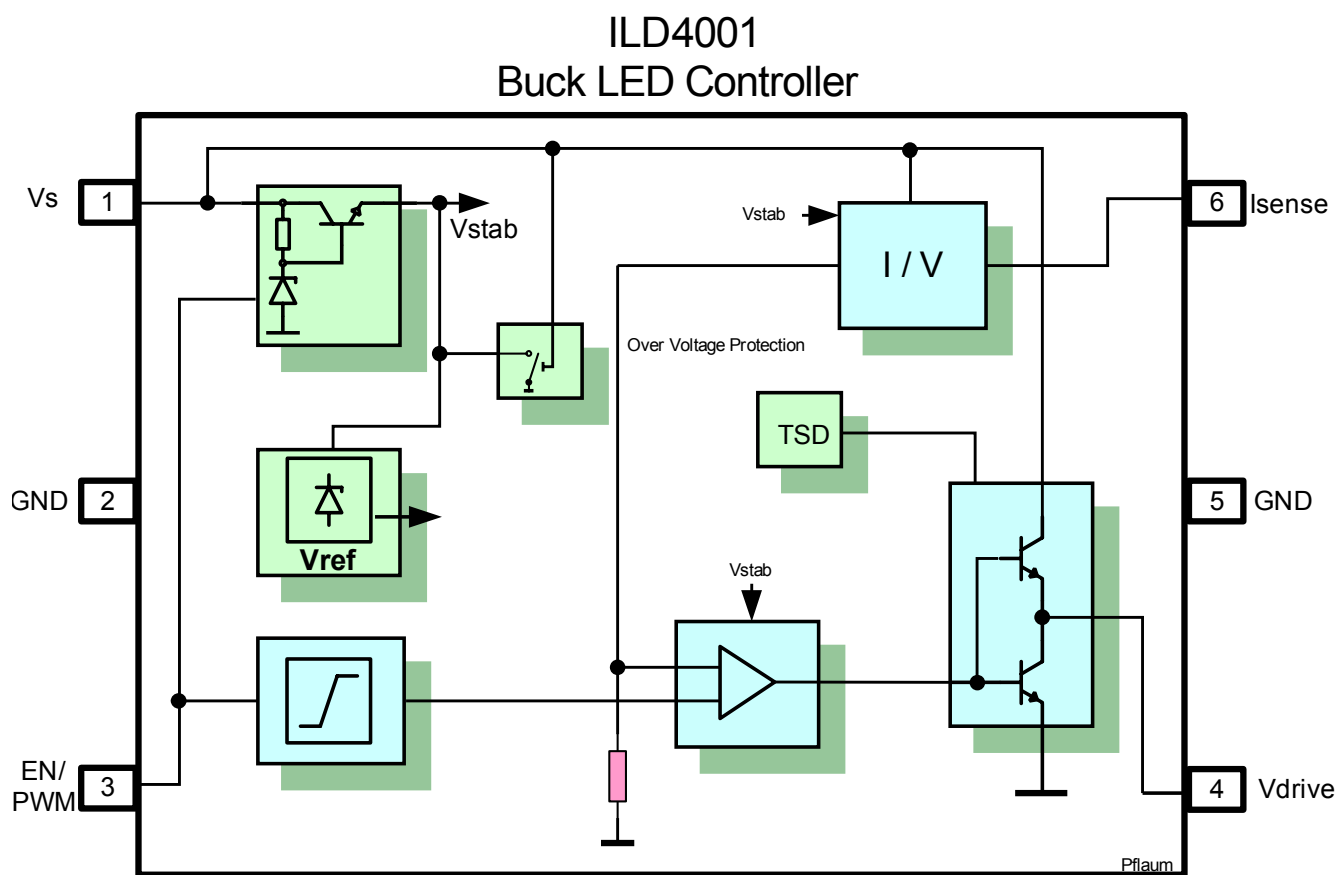
According to the multifunctional control pin the IC can be switched on and off by an external signal, which is also suitable to regulate brightness of the LEDs by PWM dimming.

Depending on the value of the switching inductor the switching frequency and the voltage ripple could be set.

The precise internal bandgap stabilizes the circuit and provides stable current conditions over temperature range.

Furthermore, over voltage protection and temperature shut down mechanism enforce the IC to protect attached LEDs.

Additional features are included to protect the LED's from overload, short circuit events as well as from over voltage. The LED's can be also protected against thermal overload by thermally coupling the LED's to the ILD4001.



ILD4001\_Block diagram.vsc

**Figure 1**      **Block diagram**

### Pin Definition

### Table 1 Pin definition and function

| Pin number | Pin Symbol      | Function                                                               |
|------------|-----------------|------------------------------------------------------------------------|
| 1          | $V_s$           | Supply Voltage                                                         |
| 2          | <i>GND</i>      | IC ground                                                              |
| 3          | <i>EN / PWM</i> | Multifunctional Pin; Power On control voltage pin ( <i>PWM input</i> ) |
| 4          | $V_{drive}$     | Push- Pull Switch Output                                               |
| 5          | <i>GND</i>      | IC ground                                                              |
| 6          | $I_{sense}$     | LED current sense pin                                                  |

## Maximum Ratings

**Table 2** Maximum ratings

| Parameter                                         | Symbol         | Limit Value | Unit             |
|---------------------------------------------------|----------------|-------------|------------------|
| Supply voltage                                    | $V_s$          | 45          | V                |
| Average Output current                            | $I_{out}$      | 30          | mA               |
| Total Power Dissipation; $T_s = xx^\circ\text{C}$ | $P_{tot}$      | tbf         | mW               |
| Junction temperature                              | $T_J$          | 150         | $^\circ\text{C}$ |
| Storage temperature range                         | $T_{STG}$      | -65... 150  | $^\circ\text{C}$ |
| ESD capability Human Body Model <sup>1)</sup>     | $V_{ESD\_HBM}$ | 2000        | V                |
| ESD capability Machine Model <sup>2)</sup>        | $V_{ESD\_MM}$  | 400         | V                |

1) For ESD testing, the chip was mounted in a SC74 package on an application board, where GND is electrically connected to the chip GND

2) For ESD testing, the chip was mounted in a SC74 package, where GND is electrically connected to the chip GND

## Thermal resistance

**Table 3** Thermal resistance

| Parameter               | Symbol     | Value | Unit |
|-------------------------|------------|-------|------|
| Junction - solder point | $R_{thJS}$ | tbf   | K/W  |

### 3 Electrical Characteristics

#### 3.1 DC Characteristics

4.5 V <  $V_S$  < 40 V; - 40 °C <  $T_J$  < 150 °C, all voltages with respect to ground; positive; current flowing into pin; unless otherwise specified

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

**Table 4 DC Characteristics**

| Parameter                                    | Symbol              | Values |        |      | Unit | Note / Test Condition                               |
|----------------------------------------------|---------------------|--------|--------|------|------|-----------------------------------------------------|
|                                              |                     | Min.   | Typ.   | Max. |      |                                                     |
| Overall current consumption                  | $I_{S_{short}}$     | tbf    | tbf    |      | mA   | $V_S = 4.5 \text{ V};$<br>$I_{out} = 10 \text{ mA}$ |
| Overall current consumption                  | $I_{S_{short}}$     | tbf    | tbf    |      | mA   | $V_S = 40 \text{ V}; I_{out} = 10 \text{ mA}$       |
| Overall current consumption                  | $I_{S_{short}}$     |        |        | tbf  | μA   | $V_S = 45 \text{ V}; I_{out} = 10 \text{ mA}$       |
| Overall current consumption open load        | $I_{S_{open load}}$ |        | tbf    |      | μA   | $V_S = 4.5 \text{ V}; I_{out} = 0 \text{ mA}$       |
| Overall current consumption open load        | $I_{S_{open load}}$ |        | tbf    |      | μA   | $V_S = 40 \text{ V}; I_{out} = 0 \text{ mA}$        |
| Overall current consumption open load        | $I_{S_{open load}}$ |        | tbf    |      | μA   | $V_S = 45 \text{ V}; I_{out} = 0 \text{ mA}$        |
| Overall standby current consumption          | $I_{S_{standby}}$   |        |        | 200  | nA   | EN = 0 V; $V_S = 4.5 \text{ V}$                     |
| Overall standby current consumption          | $I_{S_{standby}}$   |        |        | 200  | nA   | EN = 0 V; $V_S = 40 \text{ V}$                      |
| Input Current of multifunctional control pin | $I_{EN}$            | 20     | 40     | 70   | μA   | at any condition                                    |
| Current of Sense input                       | $I_{sense}$         |        |        | 200  | nA   | at any Output current                               |
| Voltage of Sense input                       | $V_{sense}$         |        | 100    |      | mV   |                                                     |
| Sense threshold hysteresis                   | $V_{sensehys}$      |        | +/- 15 |      | %    |                                                     |
| Over voltage Protection                      | $V_{s, OV}$         | 42     |        |      | V    | $I_{out} \rightarrow 0 \text{ A}$                   |
| Lowest sufficient voltage overhead           | $V_{CE}$            |        | 1.2    |      | V    | $I_{out} < 10 \text{ mA}$                           |
| Temperature shut down                        | $Th_{TSD}$          | 115    | 125    | 135  | °C   | $I_{out} \rightarrow 0 \text{ A};$ refer to $T_J$   |

## 3.2 AC Characteristics

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

**Table 5 AC Characteristics**

| Parameter                   | Symbol      | Values |      |      | Unit | Note /<br>Test Condition                                                                                                                                          |
|-----------------------------|-------------|--------|------|------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             |             | Min.   | Typ. | Max. |      |                                                                                                                                                                   |
| Switching frequency         | $F_{sw}$    |        | 200  |      | kHz  | $V_s = 12\text{ V}$<br>3 LEDs in series<br>$R_{sense} = 100\text{ m}\Omega$<br>$L = 100\text{ }\mu\text{H}$<br>$V_{EN} = 3\text{ V}$<br>$I_{LED} = 350\text{ mA}$ |
| Maximum switching frequency | $F_{swmax}$ |        | 500  |      | kHz  | recommended                                                                                                                                                       |

### 3.3 Digital Signals

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

**Table 6 Digital Control Parameter (EN)**

| Parameter                                 | Symbol          | Values |      |      | Unit | Note / Test Condition                                                  |
|-------------------------------------------|-----------------|--------|------|------|------|------------------------------------------------------------------------|
|                                           |                 | Min.   | Typ. | Max. |      |                                                                        |
| Multifunctional control pin voltage range | $U_{Pon}$       | -0.3   |      | 40   | V    |                                                                        |
| Control voltage for power on              | $U_{On}$        | 2      | 2.2  | 40   | V    | full LED current                                                       |
| Control voltage for power off             | $U_{Off}$       | -0.3   |      | 0.6  | V    |                                                                        |
| Control voltage for analog dimming        | $U_{dim}$       | 1      |      | 2    | V    | linear dimming                                                         |
| PWM signal frequency                      | $f_{PWM}$       |        |      | 1000 | Hz   | $t_{duty\ cycle} = 1\%$ ; signal level reaches 100% in on and off mode |
| PWM Duty cycle                            | $t_{duty\ PWM}$ | 5      |      |      | %    | $f = 5\text{ KHz}$ ; signal level reaches 100% in on and off mode      |
| PWM voltage                               | $U_{PWM}$       |        |      | 40   | V    |                                                                        |

### 3.4 Transient Parameters

$4.5\text{ V} < V_S < 40\text{ V}$ ;  $-40\text{ °C} < T_J < 150\text{ °C}$ , all voltages with respect to ground; positive; current flowing into pin; unless otherwise specified

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

**Table 7 Digital Control Parameter (EN)**

| Parameter     | Symbol    | Values |      |      | Unit | Note / Test Condition                                                |
|---------------|-----------|--------|------|------|------|----------------------------------------------------------------------|
|               |           | Min.   | Typ. | Max. |      |                                                                      |
| Response Time | $T_{ON}$  |        | 10   |      | μs   | EN: 0 -> 5 V @ $t_{rise} < 20\text{ ns}$<br>$I_{Out} = 10\text{ mA}$ |
|               | $T_{OFF}$ |        | 10   |      | μs   | EN: 5 V -> 0 @ $t_{fall} < 20\text{ ns}$<br>$I_{Out} = 10\text{ mA}$ |

## 4 Application Circuit

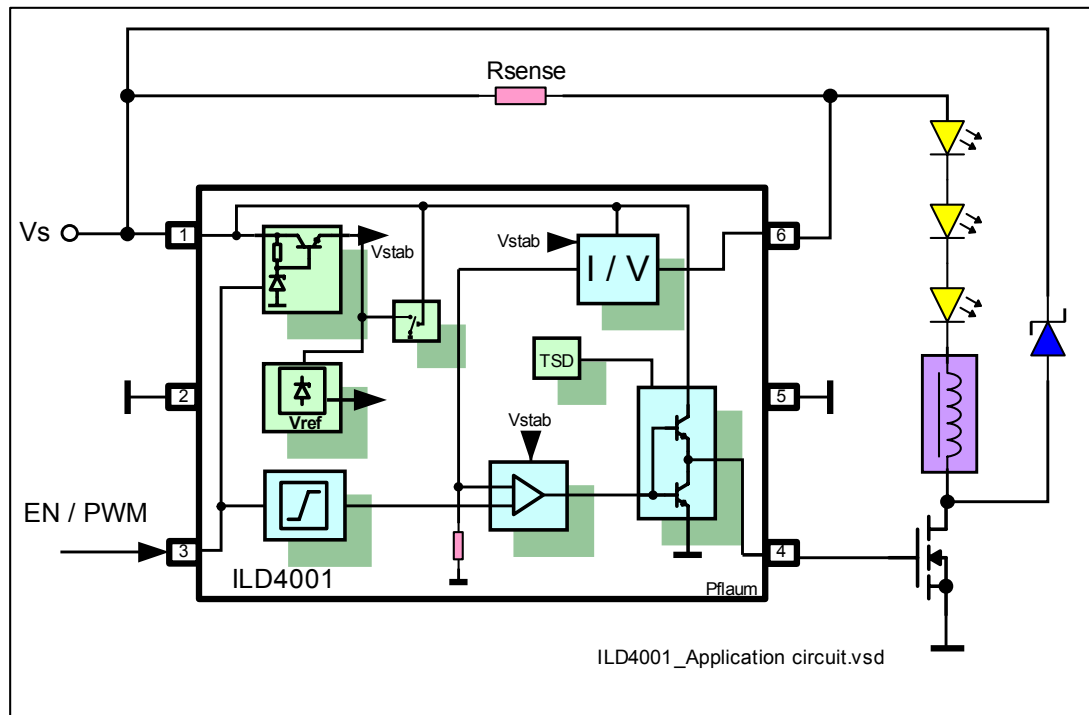


Figure 2 ILD4035; Application Circuit

## 5 Package Information

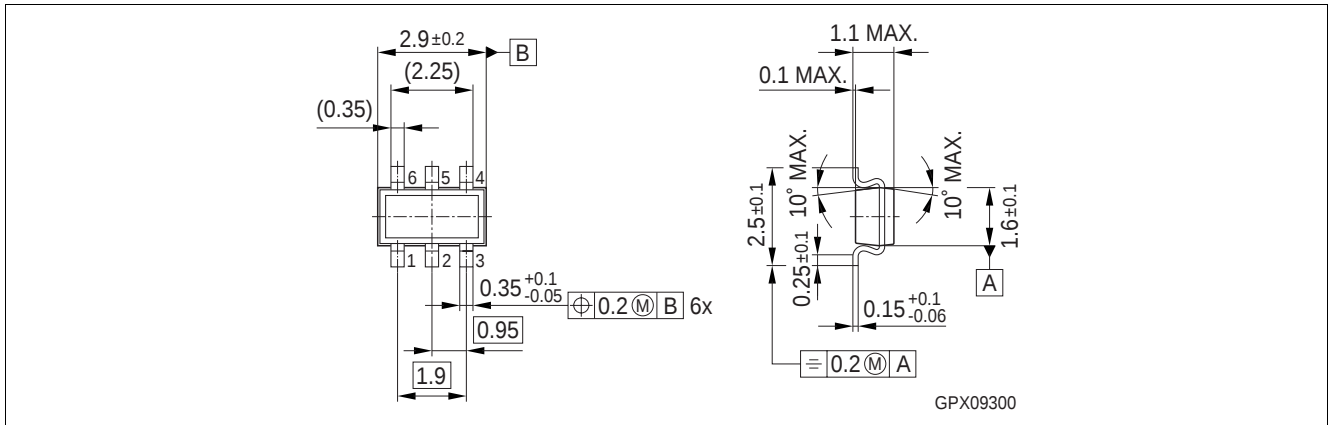


Figure 3 Package Outline; SC74

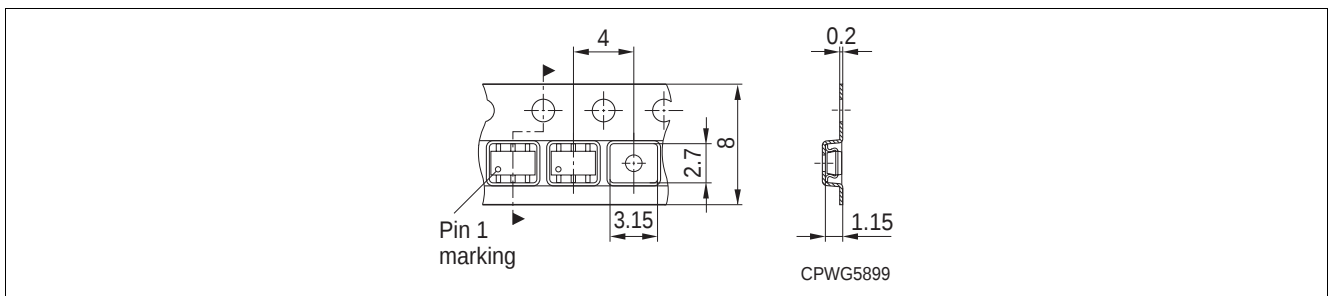


Figure 4 Tape loading



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