OPTIREG™ Linear TLE4270-2
5-V low drop fixed voltage regulator

Features
- Output voltage tolerance ≤ ±2%
- 650 mA output current capability
- Low-drop voltage
- Reset functionality
- Adjustable reset time
- Suitable for use in automotive electronics
- Integrated overtemperature protection
- Reverse polarity protection
- Input voltage up to 42 V
- Overvoltage protection up to 65 V (< 400 ms)
- Short-circuit proof
- Wide temperature range
- ESD protection: ±2 kV HBM \(^1\)
- Green Product (RoHS compliant)

Potential applications
General automotive applications.

Product validation
Qualified for automotive applications. Product validation according to AEC-Q100.

Description
The OPTIREG™ Linear TLE4270-2 is a 5-V low drop fixed-voltage regulator. The maximum input voltage is 42 V (65 V, ≤ 400 ms). Up to an input voltage of 26 V and for an output current up to 650 mA it regulates the output voltage within a 2% accuracy. The short circuit protection limits the output current of more than 650 mA. The device incorporates overvoltage protection and a temperature protection which turns off the device at high temperatures.

\(^1\) ESD susceptibility, Human Body Model (HBM) according to EIA/JESD 22-A114B.
## OPTIREG™ Linear TLE4270-2
### 5-V low drop fixed voltage regulator

<table>
<thead>
<tr>
<th>Type</th>
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<tr>
<td>TLE4270-2G</td>
<td>P-TO263-5</td>
<td>4270-2G</td>
</tr>
<tr>
<td>TLE4270-2D</td>
<td>P-TO252-5</td>
<td>4270-2D</td>
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1  Block diagram

Figure 1  Block diagram
OPTIREG™ Linear TLE4270-2
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Pin configuration

2 Pin configuration

2.1 Pin assignment

Pin Symbol Function
1 I Input; block to ground directly at the IC with a ceramic capacitor.
2 RO Reset output; the open collector output is connected to the 5-V output via an integrated resistor of 30 kΩ.
3 GND Ground; internally connected to heatsink.
4 D Reset delay; connect a capacitor to ground for delay time adjustment.
5 Q 5-V output; block to ground with 22 µF capacitor, ESR < 3 Ω.
3 General product characteristics

3.1 Absolute maximum ratings

Table 1 Absolute maximum ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
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<th>Unit</th>
<th>Note or Test Condition</th>
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<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Typ.</td>
<td>Max.</td>
</tr>
<tr>
<td>Input I</td>
<td>$V_I$</td>
<td>-42</td>
<td>42</td>
<td>V</td>
</tr>
<tr>
<td>Voltage</td>
<td>$V_I$</td>
<td>-</td>
<td>65</td>
<td>V</td>
</tr>
<tr>
<td>Current</td>
<td>$I_I$</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Reset output RO</td>
<td>$V_{RO}$</td>
<td>-0.3</td>
<td>7</td>
<td>V</td>
</tr>
<tr>
<td>Current</td>
<td>$I_{RO}$</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Reset delay D</td>
<td>$V_D$</td>
<td>-0.3</td>
<td>7</td>
<td>V</td>
</tr>
<tr>
<td>Current</td>
<td>$I_D$</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Output Q</td>
<td>$V_Q$</td>
<td>-1.0</td>
<td>16</td>
<td>V</td>
</tr>
<tr>
<td>Current</td>
<td>$I_Q$</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ground GND</td>
<td>$I_{GND}$</td>
<td>-0.5</td>
<td>-</td>
<td>A</td>
</tr>
<tr>
<td>Temperatures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junction temperature</td>
<td>$T_J$</td>
<td>-</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{STG}$</td>
<td>-50</td>
<td>150</td>
<td>°C</td>
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3.2 Functional range

Table 2 Functional range

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>Values</th>
<th>Unit</th>
<th>Note or Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Typ.</td>
<td>Max.</td>
</tr>
<tr>
<td>Input voltage</td>
<td>$V_I$</td>
<td>6</td>
<td>42</td>
<td>V</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>$T_J$</td>
<td>-40</td>
<td>150</td>
<td>°C</td>
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</table>
### OPTIREG™ Linear TLE4270-2
5-V low drop fixed voltage regulator

**General product characteristics**

#### 3.3 Thermal resistance

**Table 3 Thermal resistance**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
<th>Note or Test Condition</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junction ambient</td>
<td>$R_{th,JA}$</td>
<td>–</td>
<td>–</td>
<td>65</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>–</td>
<td>79</td>
<td>K/W</td>
</tr>
<tr>
<td>Junction case</td>
<td>$R_{th,JC}$</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td>K/W</td>
</tr>
</tbody>
</table>

1) Mounted on PCB, 80 x 80 x 1.5 mm\(^3\); 35 µ Cu; 5 µ Sn; footprint only; zero airflow.
4 Functional description

4.1 Circuit description

The control amplifier compares a reference voltage, which is kept highly accurate by resistance adjustment, to a voltage that is proportional to the output voltage and drives the base of a series transistor via a buffer. Saturation control as a function of the load current prevents any over-saturation of the power element.

The IC also incorporates a number of internal circuits for protection against:
- Overload
- Overvoltage
- Overtemperature
- Reverse polarity

4.2 Electrical characteristics

Table 4 Electrical characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
<th>Note or Test Condition</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Typ.</td>
<td>Max.</td>
<td></td>
</tr>
<tr>
<td>Output voltage</td>
<td>$V_Q$</td>
<td>4.90</td>
<td>5.00</td>
<td>5.10</td>
<td>V_4.0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_Q$</td>
<td>4.90</td>
<td>5.00</td>
<td>5.10</td>
<td>V_4.0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output current limiting</td>
<td>$I_{Q_{\text{max}}}$</td>
<td>650</td>
<td>850</td>
<td>–</td>
<td>V_Q = 0 V</td>
</tr>
<tr>
<td>Current consumption $I_q = I_t - I_Q$</td>
<td>$I_q$</td>
<td>–</td>
<td>1</td>
<td>1.5 mA</td>
<td>$I_Q = 5 \text{ mA}$</td>
</tr>
<tr>
<td></td>
<td>$I_q$</td>
<td>–</td>
<td>55</td>
<td>75 mA</td>
<td>$I_Q = 550 \text{ mA}$</td>
</tr>
<tr>
<td></td>
<td>$I_q$</td>
<td>–</td>
<td>70</td>
<td>90 mA</td>
<td>$I_Q = 550 \text{ mA}; V_I = 5 \text{ V}$</td>
</tr>
<tr>
<td>Drop voltage</td>
<td>$V_{DR}$</td>
<td>–</td>
<td>350</td>
<td>700 mV</td>
<td>$I_Q = 550 \text{ mA}^1$</td>
</tr>
<tr>
<td>Load regulation</td>
<td>$\Delta V_{Q_{\text{Lo}}}$</td>
<td>–</td>
<td>25</td>
<td>50 mV</td>
<td>$I_Q = 5 \text{ to } 550 \text{ mA}; V_I = 6 \text{ V}$</td>
</tr>
<tr>
<td>Line regulation</td>
<td>$\Delta V_{Q_{\text{Li}}}$</td>
<td>–</td>
<td>12</td>
<td>25 mV</td>
<td>$V_I = 6 \text{ to } 26 \text{ V}$</td>
</tr>
<tr>
<td>Power supply ripple rejection</td>
<td>$PSRR$</td>
<td>–</td>
<td>54</td>
<td>– dB</td>
<td>$I_f = 100 \text{ Hz}$; $V_f = 0.5 \text{ Vpp}$</td>
</tr>
</tbody>
</table>

Reset generator

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
<th>Note or Test Condition</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Typ.</td>
<td>Max.</td>
<td></td>
</tr>
<tr>
<td>Switching threshold</td>
<td>$V_{RT}$</td>
<td>4.5</td>
<td>4.65</td>
<td>4.8 V</td>
<td>–</td>
</tr>
<tr>
<td>Reset high voltage</td>
<td>$V_{ROH}$</td>
<td>4.5</td>
<td>–</td>
<td>– V</td>
<td>–</td>
</tr>
<tr>
<td>Reset low voltage</td>
<td>$V_{ROL}$</td>
<td>–</td>
<td>60</td>
<td>– mV</td>
<td>$R_{\text{int}} = 30 \text{ k}\Omega^2$; $1.0 \text{ V} \leq V_Q \leq 4.5 \text{ V}$</td>
</tr>
<tr>
<td></td>
<td>$V_{ROL}$</td>
<td>–</td>
<td>200</td>
<td>400 mV</td>
<td>$I_R = 3 \text{ mA}, V_Q = 4.4 \text{ V}$</td>
</tr>
<tr>
<td>Reset pull-up</td>
<td>$R_{\text{int}}$</td>
<td>18</td>
<td>30</td>
<td>46 k$\Omega$</td>
<td>Internally connected to Q</td>
</tr>
</tbody>
</table>
Functional description

Table 4   Electrical characteristics (cont’d)

$V_I = 13.5\, \text{V}; \, T_j = -40\text{ to } 125^\circ\text{C} \text{ (unless otherwise specified)}$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
<th>Note or Test Condition</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge current</td>
<td>$I_{D,c}$</td>
<td>8</td>
<td>14</td>
<td>25 µA</td>
<td>$V_D = 1.0, \text{V}$</td>
</tr>
<tr>
<td>Upper reset timing threshold</td>
<td>$V_{DU}$</td>
<td>1.4</td>
<td>1.8</td>
<td>2.3 V</td>
<td></td>
</tr>
<tr>
<td>Lower reset timing threshold</td>
<td>$V_{DL}$</td>
<td>0.2</td>
<td>0.45</td>
<td>0.8 V</td>
<td>$V_Q &lt; V_{RT}$</td>
</tr>
<tr>
<td>Delay time</td>
<td>$t_{rd}$</td>
<td>–</td>
<td>13</td>
<td>– ms</td>
<td>$C_D = 100, \text{nF}$</td>
</tr>
<tr>
<td>Reset reaction time</td>
<td>$t_{rr}$</td>
<td>–</td>
<td>–</td>
<td>3 µs</td>
<td>$C_D = 100, \text{nF}$</td>
</tr>
</tbody>
</table>

**Overvoltage protection**

| Turn-off voltage                   | $V_{I, ov}$ | 42      | 44   | 46 V                  | –      | P_4.0.21 |

1) Drop voltage = $V_I - V_Q$ (measured when the output voltage has dropped 100 mV from the nominal value obtained at 13.5 V input).

2) Reset peak is always lower than 1.0 V.
4.3 Typical performance graphs

Typical performance characteristics

**Output voltage $V_Q$ vs. junction temperature $T_j$**

![Graph showing $V_Q$ vs. $T_j$ with $V_i = 13.5$ V at $T_j = 160^\circ$C.]

**Output voltage $V_Q$ vs. input voltage $V_i$**

![Graph showing $V_Q$ vs. $V_i$ with $R_L = 25$ Ω.]

**Output current $I_Q$ vs. junction temperature $T_j$**

![Graph showing $I_Q$ vs. $T_j$ with $I_Q_{max}$ from 0 to 1200 mA at $T_j = 160^\circ$C].

**Output current $I_Q$ vs. input voltage $V_i$**

![Graph showing $I_Q$ vs. $V_i$ with $T_j = 125^\circ$C and $25^\circ$C.]}
OPTIREG™ Linear TLE4270-2
5-V low drop fixed voltage regulator

Functional description

Current consumption $I_q$ vs. output current $I_Q$

![Graph showing $I_q$ vs. $I_Q$](image1)

Current consumption $I_q$ vs. output current $I_Q$

![Graph showing $I_q$ vs. $I_Q$](image2)

Current consumption $I_q$ vs. input voltage $V_i$

![Graph showing $I_q$ vs. $V_i$](image3)

Drop voltage $V_{DR}$ vs. output current $I_Q$

![Graph showing $V_{DR}$ vs. $I_Q$](image4)
Functional description

Typical performance characteristics

Charge current $I_{D,c}$ vs. junction temperature $T_j$

![Graph showing $I_{D,c}$ vs. $T_j$]

$V_I = 13.5$ V
$V_D = 1$ V

Upper reset timing threshold $V_{DU}$ vs. junction temperature $T_j$

![Graph showing $V_{DU}$ vs. $T_j$]

$V_I = 13.5$ V
5 Application information

The IC regulates an input voltage in the range of $V_i = 5.5\,\text{V}$ to $36\,\text{V}$ to $V_{Q,\text{nom}} = 5.0\,\text{V}$. Up to $26\,\text{V}$ it produces a regulated output current of more than $650\,\text{mA}$. Above $26\,\text{V}$ the save-operating-area protection allows operation up to $36\,\text{V}$ with a regulated output current of more than $300\,\text{mA}$. Overvoltage protection limits operation at $42\,\text{V}$. The overvoltage protection hysteresis restores operation if the input voltage has dropped below $36\,\text{V}$. A reset signal is generated for an output voltage of $V_Q < 4.5\,\text{V}$. The delay for power-on reset can be set externally with a capacitor.

![Test circuit](image1)

**Figure 3** Test circuit

![Application circuit](image2)

**Figure 4** Application circuit

5.1 Design notes for external components

An input capacitor $C_i$ is necessary for compensation of line influences. The resonant circuit consisting of lead inductance and input capacitance can be damped by a resistor of approx. $1\,\Omega$ in series with $C_i$. An output capacitor $C_Q$ is necessary for the stability of the regulating circuit. Stability is guaranteed at values of $C_Q \geq 22\,\mu\text{F}$ and an ESR of $< 3\,\Omega$.
5.2 Reset circuitry

If the output voltage decreases below 4.5 V, an external capacitor \( C_D \) on pin 4 (D) will be discharged by the reset generator. If the voltage on this capacitor drops below \( V_{DL} \), a reset signal is generated on pin 2 (RO), i.e. reset output is set low. If the output voltage rises above the reset threshold, \( C_D \) will be charged with constant current. After the power-on-reset time the voltage on the capacitor reaches \( V_{DU} \) and the reset output will be set high again. The value of the power-on-reset time can be set within a wide range depending of the capacitance of \( C_D \).

5.3 Reset timing

The power-on reset delay time is defined by the charging time of an external capacitor \( C_D \) which can be calculated as follows:

\[
C_D = \frac{\Delta t \times I_{D,c}}{\Delta V}
\]  

(5.1)

Definitions:

- \( C_D \) = delay capacitors
- \( \Delta t \) = reset delay time \( t_{rd} \)
- \( I_{D,c} \) = charge current, typical 14 µA
- \( \Delta V = V_{DU} \), typical 1.8 V

\( V_{DU} \) = upper reset timing threshold at \( C_D \) for reset delay time

\[
t_{rd} = \Delta V \times C_D / I_{D,c}
\]  

(5.2)

The reset reaction time \( t_{rr} \) is the time it takes the voltage regulator to set the reset out LOW after the output voltage has dropped below the reset threshold. It is typically 1 µs for delay capacitor of 47 nF. For other values for \( C_D \) the reaction time can be estimated using the following equation:

\[
t_{rr} \approx 20 \text{ s/F} \times C_D
\]  

(5.3)

**Figure 5** Reset time response
OPTIREG™ Linear TLE4270-2
5-V low drop fixed voltage regulator

Package information

6 Package information

Figure 6  P-TO263-5 (plastic transistor single outline)\(^1\)

Figure 7  P-TO252-5 (plastic transistor single outline)\(^1\)

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).

Further information on packages
https://www.infineon.com/packages

1) Dimensions in mm.
# Revision history

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Changes</th>
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<tr>
<td>1.9</td>
<td>2020-02-25</td>
<td>Editorial changes, including rearranged content.</td>
</tr>
<tr>
<td>1.8</td>
<td>2007-11-09</td>
<td><strong>Page 1:</strong> Changed ESD specification from “&gt;4000V” to “±2 kV HBM” according to PCN No. 2007-08</td>
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| 1.7     | 2007-03-20 | Initial version of RoHS-compliant derivate of TLE 4270. Change of product name to TLE4270-2 due to modified chip layout and size.  
**Page 1:** AEC certified statement added  
**Page 1** and **Page 15:** RoHS compliance statement and Green product feature added  
**Page 1** and **Page 15:** Package changed to RoHS compliant version  
Legal Disclaimer updated |
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