Smart Lighting Solutions

NCL310x0 – Smart LED Driver
Connected Lighting – Fastest growing PoE segment

What is Connected Lighting and why?

- Smarter Building Management
- Efficient use of power
- Integration of sensors (room occupancy, temperature, humidity, CO/CO₂, ...)
- CAGR >27%
- Adressable with PoE and KNX devices
- New product line under development

Smart Lighting Market - Growth Rate by Region (2019 - 2024)

Regional Growth Rates
- High
- Mid
- Low

Source: Mordor Intelligence

- Study Period: 2019-2025
- Base Year: 2019
- Fastest Growing Market:
  - Asia Pacific
- Largest Market: Europe
- CAGR: 27.1%
What the NCL31000 Brings to Intelligent Lighting

Connectivity, Integration, Control and Position Location

**Connectivity**
- IEEE 802.3bt PoE-PD w/ NCP1095/NCP1096
- RF compatible
- SPI/I2C serial interface
- Visual Light Comms

**Increased Integration**
- Efficient LED driver
- 3.3 buck converter
- 2.5-24V adjustable buck
- Power metrology

**Lighting Control**
- True dimming to dark
- Color Blending through dual channel capability
- Environmental settings

**Indoor Positioning**
- Compatible with Signify technology
- Accuracy within 30cm
- Enabled with VLC
- Communication with mobile phone
Market & Applications

- **Outdoor Lighting**
  - Connected Street Lighting
  - Architectural Lighting

- **Indoor Lighting**
  - Office Lighting
  - Industrial Lighting
  - Theater Lighting
  - Therapeutic Lighting

- **Backlighting**
  - Professional displays
  - High end Displays
NCL31000 - Integrated LED Driver

System Power, LED driver and Metrology IC

**Unique Features & Benefits**

- Input Voltage from 35V to 57V
- 97% efficient Buck Controller LED driver
- Integrated 3V3 Buck Converter (150mA) for companion MCU.
- Integrated Adjustable Buck Converter 2.5-24V
- SPI or I2C interface for RF connectivity
- Active Fault protection and diagnosis for LED shorts/opens,
  - Over/Under Voltage, Over Current, LED Temperature
- Visual Light Communication capable, Yellow-Dot ready, up to 10kb/s
- Linear, high bandwidth dimming to zero (full range linearity 0.05% INL)
- Deep dimming down to 1mA or 0.033% @3A full scale current
- Digital Dimming over I2C/SPI (Warm Boot)
- High accuracy diagnostic functions to measure voltages/currents
- Junction temperature range of -40°C to +125°C
- Available in 48-pin QFN 7x7

**Other Features & Specifications**

- Source is capable to drive high-power LED luminaires beyond 100W
- Embedded V/I measurements of the input and output stage, to calculate P_{IN}, P_{OUT} and system \eta
- Microcontroller communication over SPI or I2C interface
- Optional Spread Spectrum for conducted EMI reduction

**Typical Application Schematic**

**Markets & Applications**

- Smart LED Lighting
  - Human Centric Lighting
  - Communication Lighting
  - Energy saving lighting Systems
- IoT Home appliances
System Architecture Example

**NCL31000**
- **Input voltage**: 35 ~ 57V
- **LED Current**: Up to 3A
- **DCDC1**: 3.3V fixed, 150mA max
- **DCDC2**: Adjustable, 2.5 ~ 24V

**VDD2 Configurations**

<table>
<thead>
<tr>
<th>$V_{OUT}$ (V)</th>
<th>$I_{OUT}$ (mA)</th>
<th>$R_{CS}$ (mΩ)</th>
<th>$L$ (μH)</th>
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<td>560</td>
<td>220</td>
<td>100</td>
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<tr>
<td>3.3</td>
<td>515</td>
<td></td>
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<tr>
<td>5</td>
<td>510</td>
<td>200</td>
<td></td>
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<tr>
<td>7.2</td>
<td>415</td>
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<td>335</td>
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<td>15</td>
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</tr>
<tr>
<td>24</td>
<td>230</td>
<td>390</td>
<td>470</td>
</tr>
</tbody>
</table>

Dynamic max LED current is ~2.8A (3A DC)
Combined with 57Vin max => 160W max lighting power
Example: 48Vin x 2.8A = 135W

Public Information
• Photophone work at Bell Labs during the 1880-ies predates radio

• VLC is a data communication technology which uses visible light as a carrier, with low data rates (kb/s)

• Lifi: 500 Mbit/s with a white LED over a distance of 5 metres (16 ft), and 100 Mbit/s over longer distance using five LEDs demonstrated in lab conditions
What is YellowDot?

- YellowDot is an **indoor position location technology**
- Each LED ballast has a unique identifier that indicates the position within a building
- LED ballast signals through **visual light communication (VLC)** to a camera on a phone or tablet
- Phone’s camera **detects the code** and **reveals the position**
- **Accuracy to within 30cm; BLE accuracy is 3 meters**
- Certification requires a range of tests; passing allows the use of the YellowDot trademark to a luminaire
- Has two defined data rates: 1kb/s and 2kb/s
NCL31000 LED Driver full solution Efficiency (>97%)

Power efficiency vs led current

- Max: 97.2%

Parameters:
- fs=400kHz
- sku=3
- dev=ncl31000
NCL3100x in the Smart Lighting KIT (LIGHTING-1-GEVK)

- **EMI Filter**
- **Diode Bridge Rectifier GBU6K 4**
- **Flyback Controller FL7740MX**
- **Power MOSFET 800V FCPF400N80Z**

**LIGHTING-POWER-AC-GEVB**

- **BLE RSL15**
  **LIGHTING-CONNECTIVITY-GEVB**

**Sensors:**
- Emergency Lights
- Occupancy etc

**NCL31000**
- 5V
- 55V
- 3.3V

**NCL31001**
- **MOSFETs FDMA037 NVTFS6H88xx**

**NCL31000-DUAL-GEVB**

- **MOSFETs FDC8602**

**LIGHTING-LED-GEVK**

- **LED string**
- **LED string**

**NCL3100x** in the Smart Lighting KIT (LIGHTING-1-GEVK)

Public Information
NCL31000 PoE System Diagram

Sensors: Emergency Lights, Occupancy etc

5V

3.3V

Ethernet Conn

MPSFETs FDC8602

Greenbridge2 FDMQ8205

Greenbridge2 FDMQ8205

802.3bt PoE PD Controller NCP1095

LED string

MPSFETs FDMA037 NVTFS6H88xx

NCL31000 VLC/LED Driver

Ethernet Conn

Ethernet Conn

Ethernet Conn

Microcontroller

Ethernet PHY

Public Information
NCL31000ASGEVB – Demo Board

- Arduino Shield compatible evaluation board
  - VLC/Yellow Dot capable
  - LED Power capability beyond 100W
  - Input voltage up to 57V
  - I2C/SPI for MCU daughter card
  - Efficiency of total solution ~97%  
    - Incl EMC, DC-DC's, Diagnostics etc
  - Very suitable for measuring/debugging

- GUI:  
  Strata interface under development