Connected smart lighting

Intelligent Mesh Based Lighting

Lighting with Power Over Ethernet

More on PoE, Power Conversion and Lighting

More on Low Power Wireless
Solutions for wireless mesh lighting

Highlights

• Energy conversion with high power factor
• Precise constant current lighting control
• Long range sub-1GHz wireless connectivity
Solution for intelligent mesh lighting

HVLED + SPIRIT1 = complete mesh lighting solution

- High power factor front end AC/DC converter
  - HVLED001B for efficient AC/DC conversion
  - Low distortion conversion at high load (<15%)
  - Primary side regulation via fly-back topology

- Precise secondary side regulation
  - Regulated current via secondary step-down
  - HVLED002 provides constant current of 1.4A from 40-70V_{out}
  - 1% deep dimming capable

- 6LowPAN wireless control with SPIRIT1
  - Sub-1GHz for remote monitoring and control
  - Controls dimming level of system
  - Android controllable
High Efficiency, High Power Factor and Low Distortion

Efficiency vs. Load

Power Factor vs. Vin

THD vs. Vin
Discrete and modular connectivity solutions for mesh lighting

**SPIRIT 1**
- RX: 9.2mA / TX: 19.5mA @ +11dBm
- Sleep/Stby: 850nA / 600nA
- Max. Out: +16dBm
- Sensitivity: -120dBm
- Mod: 2(G)FSK, OOK
- QFN20 4x4

**S2-LP / S2-LPCB**
- RX: 7mA / TX: 10mA @ +10dBm
- Sleep/Stby: 600nA / 350nA
- Max. Out: +16dBm
- Sensitivity: -124dBm
- Mod: 2(G)FSK, 4(G)FSK, OOK/ASK
- QFN24 4x4

**Chip Antenna Option**
- SPSGRF-868
- SPSGRF-915

**Connector Option**
- SPSGRFC-433
- SPSGRF-868
- SPSGRF-915

Long range Sub-1GHz wireless connectivity
Lighting with Power over Ethernet

Highlights

• Feature packed smart lighting solution
• Fully integrated PoE PD platform
• High efficiency LED lighting
• Seamless low-energy Bluetooth
• 71 W available power with IEEE 802.3bt standard
• Data and power in a single cable
• Monitor building usage
• Remote automation of intensity and temperature
• Simple and cheaper installation (below 60 SELV)
Compact 71W PoE lighting evaluation platform

STEVAL-POEL45W1

1. LED6000: Step down LED Driver
2. STPS3L60U: Shottkey rectifier
3. STTH102A: High speed diode
4. PM8805: Fully integrated PoE interface
5. VIPER012: Auxiliary power supply
6. SPBTLE-1S: Bluetooth Low Energy SoC
7. 2STF1360: Low voltage NPN
Smallest 802.3bt PoE-PD interface in the industry

Optimized PoE Solutions with PM8805

ST PM8805 Approach

- MOS bridge
- MOS bridge
- MOS bridge
- MOS bridge
- MOS Hot swap
- MOS bridge
- PoE 802.3bt interface & bridge controller

PM8805

64mm² VFQFPN

Integrated active bridges, hot-swap, and PoE controller

Traditional Approach

- Systems adopt discrete bridges with ~800mm² PCB area
High efficiency lighting with LED6000

- **Efficient and Accurate**
  - Low supply current (2mA quiescent, 10µA shutdown)
  - Pulse skipping at light load
  - Integrated dimming with ± 3% output current accuracy

- **Versatile**
  - Wide in input voltage: 4.5V to 61V
  - High load current: 3A
  - Multiple topology support
    - Buck
    - Floating Boost
    - Positive and inverting buck-boost

- **Robust**
  - Over-current and short-circuit protection
  - Thermal protection
BlueNRG modules for connected lighting and beyond

BLE Modules allow fast Time to Market and Huge Cost Savings

• Modules are designed for time to market
  • - No RF expertise required: HW/SW Connectivity is a Black-Box in your Design!
  • - Fast Prototyping and HW Design
  • - Cost efficiency for volumes up to 150kpcs per year

• Modules are pre-certified
  • - Multi-Regional Certifications and SIG End-Product Certification allowing ~15K$ cost saving
  • - Including HW Design and Certification, total cost saving up to 50~100K$!

• Modules come with scalable offer
  • Cost vs. Features and Antenna type
  • Easy migration from legacy generation SPBTLE to new generation BlueNRG-M
    • Hardware pin-to-pin compatibility and same SW resources (BlueNRG-Navigator and SDK available as well)
    • Improved performances (immunity, output power) and 10 years longevity (do not take care of inner components availability)
More on PoE, power conversion and lighting

**Highlights**

- HVLED Offline LED Drivers
- Fully integrated PoE power delivery solutions
- DC/DC LED Drivers
HVLED for smart LED lighting

HVLED Product Family

- HVLED815PF
  - 15 W
  - 7 W
  - 5 W
  - Inversed Buck Controller
  - HPF Flyback
  - THD Optimizer
  - Enhanced HPF Flyback
  - Output power @ 85 to 265 VAC input voltage
  - 800V embedded MOS

- HVLED007
  - 20 W
  - 150 W
  - 50 W
  - 75 W
  - 180 W
  - HV Startup
  - Constant Voltage / Constant Current
  - HV flyback controller
  - Low THD
  - HV Start up
  - Low power standby consumption

- HVLED001A
  - HPF Flyback
  - Enhanced HPF Flyback
  - Low BOM count
  - Constant current output

- HVLED001B
  - Inversed Buck Controller
  - HV Startup
  - Constant Voltage / Constant Current
  - HV flyback controller
  - Low THD
  - HV Start up
  - Low power standby consumption
Enhanced High Power Factor Flyback controller with CV primary-sensing and very low standby consumption

Key Features:
- 800V embedded HV start-up circuit.
- Enhanced Valley skipping at medium-light load and adaptive burst-mode
- Independent PSR and SSR control loops
- Protections against Input UVP, OVP, Output OVP and OCP, Short and Open Circuit, FB disconnection, Transformer Saturation
- Constant Voltage Loop with Primary Side Sensing
- Variable Blanking time for higher efficiency and precision
- Low Pnoload and Standby Power Consumption (<150mW)
- Product characteristic:
  - Quasi Resonant (QR) Flyback (Peak Current Mode)
  - SSOP10 package

Key Benefits:
- Low BOM count, flexible and scalable solution with high efficiency performance, low EMI and low no load consumption

Target Applications
SMPS between 20W and 150W
**High performance current mode Inversed Buck for LED Driver**

**Key Features:**
- High efficiency & LOW BOM cost with 250mV current sense reference
- Accurate constant current output (+/-2% over Temperature)
- 5V $V_{\text{REF}}$ for microcontroller supply (+/-2% over Temperature)
- Easy PWM/0-10 dimming
- Wide $V_{\text{CC}}$ range up to 30V

**Product characteristic:**
- SO8 package

**Key Benefits:**
- Low BOM count, dimming, accurate constant current output

**TARGET APPLICATIONS**
Secondary side step-down current regulator in multiple stage LED drivers
LED lighting ICs ecosystem

Datasheets
- HVLED001A
- HVLED001B
- HVLED002
- HVLED007
- HVLED805
- HVLED815PF

HVLED001B
- STLUX258A

HVLED805: 4.2 W isolated LED driver with primary side current regulation

HVLED815: 10 W wide range non-isolated high power factor LED driver

HVLED815: 10 W wide range high power factor isolated LED driver

HVLED815: 15 W European range high power factor LED driver

HVLED815: 8 W European range high power factor LED driver

HVLED815: 35 W wide input range flyback converter using HVLED001B

HVLED815PF: 35 W wide input range flyback converter using HVLED001A

HVLED001A
- STLUX325A

HVLED805: 35 W LED driver with very low THD based on HVLED007 Transition Mode Flyback controller

HVLED815PF: 9 W A19 format Triac dimmable, high power factor, non-isolated LED driver HVLED815PF

HVLED815PF: High-efficiency isolated offline LED drive with 11 W fixed output and high PF HVLED815PF

HVLED815PF: 35 W wide input range flyback converter using HVLED001A

HVLED815PF: 35 W dimmable single string LED driver using HVLED001A

HVLED815PF: 60 W wide input range flyback converter using HVLED001A

HVLED815PF: 60 W wide input range flyback converter using HVLED001A

HVLED815PF: 18 W wide input range ultra slim flyback converter using HVLED001A

HVLED815PF: 18 W tube replacement zero ripple LED driver using HVLED001A

HVLED815PF: Smart home lighting based on HVLED815PF

HVLED815PF: Smart home lighting based on HVLED815PF and SPBTLE-RF

HVLED815PF: Wide input and wide output voltage LED driver HVLED001A

HVLED815PF: 100 W LED street lighting evaluation board using the STLUX385A digital controller

HVLED815PF: STLUX385A evaluation board

Collaterals
- Flyer (4)
- Brochures (1)
- Magazine (1)

Design Resources
- Application Note (8)
- Design Note (1)
- User Manual (1)
- Software Development Tools (2)

Evaluation Tools
- EVALHVLED805
  - HVLED805: 4.2 W isolated LED driver with primary side current regulation
- EVALHVLED007W35F
  - 35 W LED driver with very low THD based on HVLED007 Transition Mode Flyback controller
- EVALHVLED815W10A
  - HVLED815: 10 W wide range non-isolated high power factor LED driver
- EVALHVLED815W10F
  - HVLED815: 10 W wide range high power factor isolated LED driver
- EVALHVLED815W15
  - HVLED815: 15 W European range high power factor LED driver
- EVALHVLED815W8CV
  - HVLED815: 8 W European range high power factor LED driver
- EVAL-PSR01B-35W
  - 35 W wide input range flyback converter using HVLED001B
- STEVAL-ILL037V1
  - 3.2 W LED power supply based on HVLED805
- STEVAL-ILL045V1
  - 9 W, A19 format Triac dimmable, high power factor, non-isolated LED driver HVLED815PF
- STEVAL-ILL055V1
  - High-efficiency isolated offline LED drive with 11 W fixed output and high PF HVLED815PF
- STEVAL-ILL069V2
  - 35 W wide input range flyback converter using HVLED001A
- STEVAL-ILL070V4
  - 35 W dimmable single string LED driver using HVLED001A
- STEVAL-ILL074V1
  - 60 W wide input range flyback converter using HVLED001A
- STEVAL-ILL074V2
  - 60 W wide input range flyback converter using HVLED001A
- STEVAL-ILL076V2
  - 18 W wide input range ultra slim flyback converter using HVLED001A
- STEVAL-ILL080V1
  - 18 W tube replacement zero ripple LED driver using HVLED001A
- STEVAL-ILL082V1
  - Smart home lighting based on HVLED815PF
- STEVAL-ILL083V1
  - Smart home lighting based on HVLED815PF and SPBTLE-RF
- STEVAL-ILL085V1
  - Wide input and wide output voltage LED driver HVLED001A
- STEVAL-ILL066V2
  - 100 W LED street lighting evaluation board using the STLUX385A digital controller
- STEVAL-ILL075V1
  - STLUX385A evaluation board
Integrated PoE solutions for powered devices

PM8805 (100W)

- POLARITY PROTECTION (Dual active bridge)
- HOT-SWAP MOSFET
- 802af/at/bt PoE INTERFACE

System in package

NEW In production

PM8804

- PWM FLYBACK FORWARD CONTROLLER

NEW In production

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PM8800A (13W) / PM8803, PM8801 (30W)

- POLARITY PROTECTION (Dual full diode or active bridge)
- HOT-SWAP MOSFET
- 802af/at/bt PoE INTERFACE

Monolithic

HTSSOP16/20/24

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99.9 W input power
IEEE 802.3bt

12.95 W input power
IEEE 802.3af

25.5 W input power
IEEE 802.3at
High integration with PM8805

PoE IEEE 802.3bt Interface – Power Devices

- Dual Active Bridge
  - 8 robust 100V N-channel MOSFETs with 150 mΩ MOSFET
  - Output indication of the activated bridge (T0/T1/T2)
- Hot-Swap MOSFET
  - Robust 100 V, 0.1 Ω high side N-ch
  - Embedded protections to operate inside SOA
- PoE Interface controller
  - Support 802.3af/at/bt
  - Support power level for Type 3(60 W) and Type 4 (99.9 W) PSE
  - Support 5 events classification
Very high integration versus competition

Design Optimization

- Optimized exposed PADs for improved thermal resistance
- LV-HV creepage assured
- PCB area and BOM are drastically reduced (10x)

Competitors adopt discrete bridges with ~800mm² PCB area

PM8805

PMOS Bridge 1

PMOS Bridge 2

POE 802.3bt controller

43L VFQFPN 8.0x8.0 with 6 exposed PADs

NEW In production
48 V PWM controller - Companion Chip for PM8805 PoE interface

PWM current mode controller
- Cycle-by-cycle current limit
- Input voltage up to 75 V DC
- Opto-coupler connection
- Embedded start-up (20 mA)
- Slope compensation
- Programmable fixed frequency (up to 1 MHz)

Dual low side complementary gate drivers (1 A)
- Programmable dead time between GATE 1 & 2, 10 to 200 ns
- GATE2 optionally turned OFF for reduced consumption

Protections
- Delayed Over Load protection with automatic restart
- Feedback disconnection protection on VC pin
- Severe Over Current protection with latch after 4 events.
- Thermal Shutdown

Package
- VFQFPN 3.0x3.0x1.0 16L pitch 0.5

Voltage converter for:
- POE Powered Devices
- Telecom/Server PSU
Full ecosystem of PoE PD evaluation kits

PoE 802.3bt class 5

Fly-back
PM8805 + PM8804

5 V – 8 A (STEVAL-POE002V1, AN5174)

PoE 802.3bt class 8

up to 100W Active Forward
PM8805 + PM8804

3 output options:
- 12 V – 8 A (STEVAL-POE005V1, AN5207)
- 5 V – 20 A (STEVAL-POE003V1, AN5190, STEVAL-ISA204V1, PM8804, DB3958)
- 3.3 V – 20 A (STEVAL-POE006V1, AN5237)

PoE 802.3bt class 8

Small connector
PM8805

STEVAL-POE001V1, DB3668

PoE 802.3bt class 5

PoE Lighting
PM8805 + LED6000 + VIPER01 + SPBTLE-1S

STEVAL-POE045W1
DB3730
UM2545
ANDROID APP
FIRMWARE
Single ROW LED drivers

- **LED6001 Boost**: >4A
- **LED2001**: 4A
- **LED6000**: 4A
- **LED5000**: 4A
- **LED2000**: 3A
- **ST1CC40**: 3A
Up to 61V DC-DC converters for LED

- High Brightness LED drivers
- Halogen Light Replacement
- Street Lighting
- Signage

Supporting multiple topologies: buck, floating boost, negative and positive buck-boost

LED driving with PWM dimming and ± 3% output current accuracy

DCDC Converters up to 3A $I_{\text{OUT}}$ (in buck), MLCC compatible for lower cost BOM

**LED5000**

- **DCDC converter:**
  - Input voltage: 5.5V to 48V
  - Switching frequency: 850kHz
  - FB voltage 200mV
  - Inhibit pin for zero consumption (1.6μA Typ.)

- **LED driving:**
  - PWM Dimming with deep resolution

**LED6000**

- **DCDC converter:**
  - Input voltage: 4.5V to 61V
  - FB voltage 250mV
  - Pulse skipping at light load
  - External synchronization for multi-device operation

- **Additional programmability:**
  - Adj. switching frequency: 0.25-1.5MHz
  - Adj. peak current limit from 0.85A up to 4.5A
3V - 18V converters for single row LED

Minimizing application size through smaller components and higher efficiency:
- Smaller & cheaper external component: 850 kHz fixed switching frequency & ceramic C_{OUT}
- Embedding compensation network & synchronous rectification switch
- 100 mV typ. current sense voltage drop → lower dissipation on R_{SENSE}

Reliable and self protected application through:
- Internal current limiting, thermal shutdown, output short circuit protection
- Thermally enhanced HSOP8 for high current option

**ST1CC40**
- **Inhibit** for low consumption (6μA)
- Output current: **up to 3A**

**LED2000**
- **PWM Dimming**
- Output current: **up to 3A**

**LED2001**
- **PWM Dimming**
- Output current: **up to 4A**
More on communication radios

**Highlights**

- Sub-1GHz Radio Integrated Circuits & Modules
- Low Energy Bluetooth
Low-power RF focus technologies

- **Security**
- **Interoperability**
- **BT SIG Standard**
- **Open Radio**
- **Low latency**
- **High Throughput**
- **Mesh topology**
- **Large scale**
- **BT SIG Standard**
- **Global and Reliable**
- **Geolocation**
- **Connectionless**
- **European standard**
- **Star topology**
- **Master/slave**
- **Mesh topology**
- **Large scale**
- **Installation Flexibility - IPv6**

**Applications:**

- Wearable, Healthcare, Smart Appliances
- Toys, Gaming and Remote Controllers
- Sensor networks, Home Appliances and Industrial
- Asset Tracking and Sensor-to-Cloud
- Remote Metering and Energy Management
- Sensor networks, home and industrial automation
Low-power RF ecosystem

**RF CHIPSET**

- **GRAPHICAL UI**
  - RF Power Simulator
  - GUI PC application

- **SW DEVELOPMENT**
  - IAR Systems Tools
  - KEIL
  - BlueNRG/Spirit NAVIGATOR

- **PROTOCOLS / SW IP**
  - MOTION SW libraries
  - VOICE SW libraries

- **iOS/Android SDK**
  - BLUENRG-MESH TRIPLE SDK
  - Android SDK
  - iOS SDK

**EVALUATION KIT and DEVELOPMENT TOOLS**

**RF MODULES**
Remote monitoring with Sub-1GHz radio

**SPIRIT1**
- RX: **9.2mA** / TX: **19.5mA** @ +11dBm
- Sleep/Stby: **850nA** / **600nA**
- Max. Out: +16dBm
- Sensitivity: -120dBm
- Mod: 2(G)FSK, OOK
- QFN20 4x4

**S2-LP / S2-LPCB**
- RX: **7 mA** / TX: **10mA** @ +10dBm
- Sleep/Stby: **600nA** / **350nA**
- Max. Out: +16dBm
- Sensitivity: -124dBm
- Mod: 2(G)FSK, 4(G)FSK, OOK/ASK
- QFN24 4x4

Home and Building automation
Smart Metering
Alarm Systems
Industrial Monitoring and Control
SPIRIT modules portfolio

**Antenna option**
- Two carrier frequency versions: 868 MHz and 915 MHz
- Including high efficient chip antenna, filter and balun BALF-SPI-01D3
- CE/RED qualified [-868], FCC and IC modular approval certified [-915]

**Connector option**
- Three carrier frequency versions: 433 MHz, 868 MHz and 915 MHz
- Including U.FI. connector, filter and balun BALF-SPI-01D3 [-868 & -915] or BALF-SPI-02D3 [-433]
- CE/RED qualified [-433 & -868], FCC and IC modular approval certified [-915]

- Up to +11.6 dBm output power
- -118 dBm Rx sensitivity
- 4-wires SPI interface to external host
- Shutdown line
- 4 programmable GPIOs
- Included AES-128 security co-processor
- Modulation schemes: 2-FSK, GFSK, MSK, GMSK, OOK and ASK
- Packet format: Basic, MBUS and STack
- Forward Error Correction (FEC with interleaving)

- Low Duty Cycle (LDC) mode with automatic acknowledgement
- Embedded CSMA/CA protocol, based on listen-before-talk
- Automatic CRC handling
- Whitening and de-whitening of data
- Small form factor: 13.5 x 11.5 x 2 mm
- Industrial temperature range: -40 °C to +85 °C
- Power supply voltage from 1.8V to 3.6V

Based on SPIRIT1
BlueNRG-mesh brings smart-home to your fingertips

Easily connecting appliances and fixtures to iOS/Android

- Bluetooth Mesh 1.0 certified Profile Library and Bluetooth LE stack
- Two-layer security (128-bit AES-CCM and 256-bit ECDH protocol)
- Low-power and Friendship supported
- Provisioned node database transfer among smartphones via Email and Cloud application
- Embedded FW and Mobile SDK to build both your Android and iOS Apps
- Reduces development costs and accelerates time-to-market
BlueNRG modules accelerate time to market

2019 new BLE module catalog

- Based on BlueNRG-MS
- Based on BlueNRG-2

PRODUCT EVOLUTION

- SPBTLE-RFTR (BT4.1, 2015)
- SPBTLE-RF0TR (BT4.1, 2016)
- SPBTLE-1S (BT4.2, 2017)
- BLUENRG-M0L (BT5.0, 2018)
- BLUENRG-M2SP (BT5.0, 2019)

- SPBTLE-RFTR (BT4.1, 2015)
- SPBTLE-RF0TR (BT4.1, 2016)
- SPBTLE-1S (BT4.2, 2017)
- BLUENRG-M0L (BT5.0, 2018)
- BLUENRG-M2SP (BT5.0, 2019)
BlueNRG modules portfolio

BlueNRG-M0L
BlueNRG-M0A

- Based on BlueNRG-MS
- Including high efficient chip antenna, filter and balun BALF-NRG-01D3
- BLE4.2 certification
- Up to +6 dBm output power
- 5-wires SPI interface to external host

BlueNRG-M2SA
BlueNRG-M2SP

- Based on BlueNRG-2
- Including high efficient chip antenna [-M2SA] or PCB antenna [-M2SP], filter and balun BALF-NRG-02D3
- BLE5.0 certification
- Up to +5 dBm [-M2SA] or +7 dBm [-M2SP] output power
- Extensive peripheral set

- Bluetooth SIG End Product certification
- CE/RED qualified, FCC/IC/TELEC modular approval certified
- -85 dBm Rx sensitivity

- Small form factor: 13.5 x 11.5 x 2 mm
- Industrial temperature range: -40 °C to +85 °C
- Power supply voltage from 1.7V to 3.6V