Why LED Lighting?

• 20% of Global Energy is used for Electricity Generation
• Over 25% of a Building Energy Consumption is used for Lighting
• With LED Lighting adoption can save 40% of lighting electricity in 2030
# LED Lighting App./Market

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<td><strong>High Power</strong></td>
<td>Troffers</td>
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<td>Street light</td>
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<td><strong>60W</strong></td>
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<td><strong>Mid Power</strong></td>
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<td>Tubes</td>
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<td><strong>25W</strong></td>
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<td><strong>Low Power</strong></td>
<td>Smart bulb</td>
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<td>Down light</td>
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</tbody>
</table>

- **Low Power**
  - Smart bulb
  - Tubes
  - Down light

- **Mid Power**
  - Down light
  - Flat light
  - Ceiling light
  - Tubes
  - Outdoors

- **High Power**
  - Troffers
  - Street light
  - Flood light
  - Outdoors
  - **60W**
## LED Lighting Power Topology Solution

### Segments

#### High Power
- Troffers
- Street light
- Flood light
- Outdoors

#### Mid Power
- Down light
- Flat light
- Ceiling light
- Tubes
- Outdoors

#### Low Power
- Smart bulb
- Tubes
- Down light

### Non-Phase-Cut Dimming

#### Non Dimming

- 60W

#### Phase-Cut Dimming

- 25W

### Power Transformer

#### Single Stage Non-isolated Topology

- Switchers

#### Single Stage Isolated Topology

- Switchers

#### Multiple stage Isolated Topology

- Switchers

### Direct AC LED Driver

#### Single Stage Non-Isolated Topology

- Switchers

#### Single Stage Isolated Topology

- Switchers

### Output Scalable Load management with PWM Dimming

- 2 Stage

### Load Scalable Dim Controller

- 2 Stage

### Load Scalable Dim Controller

- 2 Stage

### Multiple stage Isolated Topology

- Switchers

### Single Stage/ 2 stage Isolated Topology

- Switchers

### Single Stage Non-Dimming

- Switchers

### Single Stage PWM

- Switchers

### Single Stage PWM Non-Dim

- Switchers

### Single Stage PWM Non-Phase-cut Dim

- Switchers

### Single Stage PWM Non-Phase-cut Dim

- Switchers

### Single Stage PWM Non-Phase-cut Dim

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### Single Stage PWM Non-Phase-cut Dim

- Switchers
Direct AC LED Driver Solution

FL77904/5/44 Shunt Type Linear Direct AC LED Driver Switchers

Key Features
- HV Start up
- 3/4 Ch. Internal MOSFET
- Active channel communication
- Self valley fill external IP

Benefits
- Self bias without Vdd supply circuit
- Low BOM counts
- High PF/Low THD performance
- Low ripple index without degradation of PF/THD

Other Features
- FL77904: 4Ch. 8SOP <9 W @ 120 V_{AC}, <17 W @220 V_{AC}
- FL77905: 3Ch. 8SOP <9 W @ 120 V_{AC}, <17 W @220 V_{AC}
  Analog/PWM Dimming
- FL77944: 4Ch. 16SOP <18 W @120 V_{AC}, <33 W@220 V_{AC}
  Analog/PWM Dimming
- Easy current setting: Control with RCS
- Power scalability with multiple ICs

Market & Applications
- Phase-Cut Dimming LED Light
- Non Dimming LED Light
- Non-Phase-Cut Dimming LED Lighting

Evaluation Boards and Design Tools Available

Ordering & Package Information
<table>
<thead>
<tr>
<th>Ordering Part Number</th>
<th>Package</th>
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<tbody>
<tr>
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<tr>
<td>FL77905MX</td>
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</tr>
<tr>
<td>FL77944MX</td>
<td>16ESOP</td>
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</tbody>
</table>
Phase-Cut Dimming Solution

FL7734 Universal Input Phase-Cut Dimming Single Stage PSR Controller

**Key Features**
- Universal Input Φ-cut Dim.
- Controllable IIN min.
- Controllable Dimming curve
- <± 1% Line regulation PSR Control
- RCS short and open protec.

**Benefits**
- Universal input design
- Meet SSL7A & EnergyStar
- Good light uniformity and Low BOM
- High system liability

**Other Features**
- High PF, Low THD : >0.9 / <20
- Fast < 0.3 s Start-up (@ Small phase angle)
- LED Short Protection (SCP)
- LED Open Protection (OVP-VS, OVP-VDD)
- Output Diode Short Protection (OCP)
- Over Temperature Protection (TSD)

**Market & Applications**
- Phase-Cut Dimming LED Light
  - A19, PAR30/38, Down Light
  - Indoor Flat, Ceiling light

**Ordering & Package Information**

<table>
<thead>
<tr>
<th>Ordering Part Number</th>
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</thead>
<tbody>
<tr>
<td>FL7734MX</td>
<td>16SOIC</td>
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</table>
Step Dimming Driver with Mechanical Wall Switch

NCL30185 Step Dimmable QR PSR Current Mode Controller for LED Lighting

**Key Features**
- Precise current regulation accuracy (±2% typical)
- Quasi-resonant control
- Adjustable thermal foldback
- 3 Step Dimmable (70/25/5%)
- Programmable OVP

**Benefits**
- Avoids over specifying LEDs to achieve lumen output
- Higher efficiency
- Improved driver reliability
- Triac Dimmer Not Required
- User can set over voltage protection level

**Other Features**
- Current control insensitive to normal transformer variation
- Wide Vcc range (9.4-26 Vdc) to support extend VF range
- Output diode and shorted winding protection
- Cycle-by-cycle current limiting
- Open LED and shorted output protection
- Built-in Vcc overvoltage protection

**Market & Applications**
- LED Bulbs and tubes
- LED Drivers
- LED Luminaires

**Ordering & Package Information**

<table>
<thead>
<tr>
<th>Ordering Part Number</th>
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<tr>
<td>NCL30188BDR2G</td>
<td>Auto Recoverable</td>
<td>8 SOIC</td>
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</tbody>
</table>
Non-Phase-Cut Dimming Single Stage Solution

NCL30186 QR PSR Current Mode Controller for LED Lighting with Smart Analog/Dimming Capability

**Key Features**
- Precise current regulation accuracy (±2% typical)
- Quasi-resonant control
- Adjustable thermal foldback
- Analog or PWM dimming
- Wide Vcc Range

**Benefits**
- Avoids over specifying LEDs to achieve lumen output
- Higher efficiency
- Improved driver reliability
- Supports “Smart” Lighting
- Supports wide LED forward voltage range

**Other Features**
- Current control insensitive to normal transformer variation
- Wide Vcc range (9.4-26 Vdc) to support extend VF range
- Output diode and shorted winding protection
- Cycle-by-cycle current limiting
- Open LED and shorted output protection
- Built-in Vcc overvoltage protection

**Market & Applications**
- Non-Phase-Cut Dimming LED Lighting
  - A19, PAR30/38, Down Light
  - Indoor Flat, Ceiling light

**Ordering & Package Information**

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<td>NCL30186BR2G</td>
<td>Auto Recoverable</td>
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</table>
Non-Dimming Single Stage Solution

NCL30288 Power Factor Corrected Primary Side Controller in TSOP-6

**Key Features**
- Precise current regulation accuracy (±3% typical)
- Quasi-resonant control
- Active PF Correction
- Robust protection suite
- Universal Mains (90-305V)
- <22 eBOM components

**Benefits**
- Avoids over specifying LEDs to achieve lumen output
- Higher efficiency
- Exceeds global power quality standards
- Eases safety testing
- Wide operating coverage
- Low profile design

**Other Features**
- <10% THD @ 230Vac
- <500ms Start Up Time
- Output Ripple <40% Pk to Pk
- Dual OVP protection
- No Optocoupler needed for Isolated Topology

**Market & Applications**
- Non Dimming LED Light
- Non-Phase-Cut Dimming LED Lighting

**Ordering & Package Information**

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Non-isolated buck-boost topology can also be supported.
Multiple Power Stage Solution – PFC+QR PWM Combo

FL7921 Voltage Mode CRM PFC+QR PWM Combo IC

**Key Features**
- HV start up
- THD optimizer
- Over power compensation

**Benefits**
- Fast start up
- High PF / Low THD
- Wide in/output operating

**Other Features**
- PFC Function Always ON Regardless of PWM Load Condition for high PF at Light Load
- Internal Minimum \( t_{OFF} \) 8 µs for QR PWM Stage
- Internal 9.5 ms Soft-Start Time for PWM
- Brown-out Protection
- Auto-Recovery OCP, OLP, OTP & OVP
- Adjustable OTP with external NTC through RT pin

**Market & Applications**
- Non Dimming LED Light
- Non-Phase-Cut Dimming LED Lighting

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</tbody>
</table>
Multiple Power Stage Solution – PFC+QR PWM Combo

NCL30030 Current Mode CRM PFC+QR PWM Combo IC

Key Features
- HV start up
- Multiplier
- ‘Digital’ Boost Follower
- Programmable Thermal Shutdown

Benefits
- Fast start up
- Improved THD performance
- Improved efficiency for wide mains applications
- Protects supply from overheating

Other Features
- High Voltage Pin for fast startup time and line sensing
- 4 ms Soft-Start Timer
- Feed-Forward for improved operation across line/load
- PFC Off control for smart lighting applications
- -40 to 125 ºC for outdoor lighting applications

Market & Applications
- Non Dimming LED Light
- Non-Phase-Cut Dimming LED Lighting

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<tr>
<td>NCL30130B3DR2G</td>
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</table>
Multiple Power Stage Solution – LCC Resonant HB

NCL30059 High Voltage Half-Bridge Controller for LED Lighting Application

**Key Features**
- Minimum frequency adjust accuracy 3%
- Brown-out input
- 100 ms PFC delay timer

**Benefits**
- Accurate Brightness Control
- High System Reliability
- Easy Design

**Other Features**
- Wide operating frequency range: 25 kHz ~ 250 kHz
- Adjustable brown out protection
- Low start up current of 50 μA
- Latched input
- Thermal shut down function

**Market & Applications**
- High Power In/Out door light
- Flood light
- Street Light

**Evaluation Board Highlights**
- 90 – 277 VAC Input, 0-50 VDC Output
- >0.95 PF, <20% THD @ Universal Input
- >90% Total Efficiency
- <±2% precise CC tolerance

**Ordering & Package Information**

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</table>
Multiple Power Stage Solution – Flyback+Buck

FL7740 (Single Stage CV PSR PWM IC) + FL7760 (Wide ADIM Buck PWM IC)

- **FL7740 Single Stage CV PSR Controller**
  - Precise CV regulation: ±2%.
  - Fast line/load transient response: ±10%.
  - Low Standby Power consumption: <0.15W at no-load.
  - >0.9 PF at Half load & 305V AC condition

- **FL7760 60 V CCM Dimmable Buck Controller**
  - Input voltage range: 8 V_{DC} ~ 60 V_{DC}
  - Wide Dimming Range
    - Analog: 5~100%.
    - PWM: 1~100% (@2KHz)

- **Market & Applications**
  - Smart Luminaries
  - Low profile Power Supply

50 W – 2Ch. Buck EVB Available