LED Illumination Solutions (2010)

- LED Driver Solution with Low Voltage Input (MR16, etc.)
- Intelligent Solar Lawn Lamp Solution
- High Voltage Spotlight/Bulb Lamp/PAR Light Solution
- Fluorescent Lamp Solution
Silan Overview

- Silan was founded in Oct. 1997 with head office in Hangzhou, China.
- In March 2003, Silan made a successful IPO as the first IC design company on the Shanghai Stock Exchange (SSE).
- At the end of the third quarter of 2010, Silan had a total assets of more than RMB2 billion.
- The total share capital of Silan amounted to 434.08 million shares.

Engaged in semiconductor IC design and manufacture, Silan provides high quality ICs and semiconductor devices to customers.

- During 13-year development, Silan has become a comprehensive company in IC design, manufacture and marketing and joined the front ranks of IC industry in China.
- Silan has become unique in the high voltage & high power special IC process developed in IDM mode.

Silan’s present three core business:
- ICs and discrete devices based on Silan’s own special process of high voltage, high power and high frequency;
- Digital audio/video SOC based on Disc servo technology;
- High-brightness LED chips;
Using product line management mode, based on IPD (integrated product development) system, Silan emphasizes the construction of the process flow and strives to make us more professional, finer and stronger.
Development mode: From platform to products

LED illumination
- Solar lawn light
- Low voltage spotlight
- High voltage spotlight
- Daylight lamp

Platforms
- DC-DC product
- AC-DC product
- IPM product

Technical platform
- Process platform
- Core Modules
- System Topology
- Package Design
- Application development

Products:
- Car GPS charger
- Adapter
- Solar lawn light
- Daylight lamp
- Low voltage spotlight
- High voltage spotlight
Core technology

- **650V constant current source (can be shutdown) design** to support low standby power AC-DC products
- **600V HVIC design** to support LLC power supply, IPM and solar inverter
- **100V Single-chip integrated technology** to support DC LED driver, car power supply and communication power supply
- **Integrated module DBC packaging technology** to support multi-chip power module design
- **Discrete devices such as HV MOSFET, IGBT, FRD, SBD** support power module design
With the powerful ability to develop its own process, Silan-IC has completed the development and verification of 0.8um 25V/60V/SCD650V BCD process which supports the design of new generation power supply, LED driver and motor driver etc.
LED product topology

- DC-DC technology platform, including topology of BUCK, BOOST, BUCK-BOOST
- AC-DC technology platform, including topology of flyback (SSR/PSR), forward, LLC etc.
- PFC technology platform, including PSR+PFC
LED driver products

- **AC Input**: 85~265V
- **Tric Dimming**
- **SCR dimming**

**PFC Boost**
- SA7527
- SA7528
- SVD10N60T

**DC/DC**
- 400V Bus
- **LLC Half-Bridge**
- SDH6299

**DC/DC**
- 12/24V Bus
- **SD16808**
- **SD16809**

**Electronic Transformer and Rectifier**
- **SDH6299**
- Electronic transformer

**PFC Flyback**
- SA7527
- SD7529
- SVD4N65T

**DC/DC**
- 24/36/48V Bus
- **SD42522**
- **SD42524**
- **SD42525**
- **SD42560**
- **SD42528**
- **SD42618**

**PSR PFC**
- SD6855
- SD6856
- SD6858
- SVD2N65
- SVD4N65

**DC/DC**
- **SD42608**
- **SD42609**

**Black Parts**: Mass Production
**Red Parts**: Under design
## DC-DC LED Driver

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Application</th>
<th>Max. output power</th>
<th>Input voltage</th>
<th>Output voltage</th>
<th>Max. output current</th>
<th>CC Accuracy</th>
<th>LED Qty. in series</th>
<th>Efficiency</th>
<th>Power factor</th>
<th>Part No.</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC 12V/24V</td>
<td>MR16 spotlight secondary constant current</td>
<td>24W</td>
<td>6-36V</td>
<td>Vin*0.95</td>
<td>1000mA</td>
<td>±1.5%</td>
<td>10</td>
<td>max.96%</td>
<td>-</td>
<td>SD42522 *</td>
<td>Linear dimming</td>
</tr>
<tr>
<td>DC 12V~60V</td>
<td>Electronic transformer</td>
<td>24W</td>
<td>6-36V</td>
<td>Vin*0.95</td>
<td>1000mA</td>
<td>±1.5%</td>
<td>10</td>
<td>max.96%</td>
<td>-</td>
<td>SD42524</td>
<td>PWM dimming</td>
</tr>
<tr>
<td></td>
<td>MR16 spotlight secondary constant current</td>
<td>18W</td>
<td>6-36V</td>
<td>Vin*0.95</td>
<td>1000mA</td>
<td>±3%</td>
<td>10</td>
<td>max.96%</td>
<td>-</td>
<td>SD42525</td>
<td>hysteresis loop</td>
</tr>
<tr>
<td></td>
<td>MR16 spotlight secondary constant current</td>
<td>28W</td>
<td>6-36V</td>
<td>Vin*0.95</td>
<td>1200mA</td>
<td>±1.5%</td>
<td>10</td>
<td>max.96%</td>
<td>-</td>
<td>SD42560</td>
<td>PWM dimming</td>
</tr>
<tr>
<td></td>
<td>MR16 spotlight secondary constant current</td>
<td>24W</td>
<td>6-36V</td>
<td>Boost</td>
<td>1000mA</td>
<td>±1.5%</td>
<td>10</td>
<td>Max.95%</td>
<td>-</td>
<td>-</td>
<td>Linear dimming</td>
</tr>
<tr>
<td></td>
<td>MR16 spotlight secondary constant current</td>
<td>6W</td>
<td>Note 1</td>
<td>Buck-Boost</td>
<td>400mA</td>
<td>±2%</td>
<td>10</td>
<td>Max.82%</td>
<td>-</td>
<td>-</td>
<td>PWM dimming</td>
</tr>
<tr>
<td></td>
<td>MR16 spotlight secondary constant current</td>
<td>-</td>
<td>6-36V</td>
<td>Boost</td>
<td>Note 2</td>
<td>±2%</td>
<td>-</td>
<td>Max.95%</td>
<td>-</td>
<td>SD42618</td>
<td>PWM dimming</td>
</tr>
<tr>
<td></td>
<td>MR16 spotlight secondary constant current</td>
<td>36W</td>
<td>6-60V</td>
<td>Vin*0.95</td>
<td>1000mA</td>
<td>±2%</td>
<td>15</td>
<td>max.96%</td>
<td>-</td>
<td>SD42528</td>
<td>wide voltage input</td>
</tr>
<tr>
<td>2.4V-5.0V</td>
<td>Lawn lamp</td>
<td>0.5W</td>
<td>2.4-5.0V</td>
<td>Buck-Boost</td>
<td>150mA</td>
<td>±1%</td>
<td>1</td>
<td>Max.85%</td>
<td>-</td>
<td>SD42608</td>
<td>asynchronous charge/discharge control current reduced on</td>
</tr>
<tr>
<td>2.4V-5.0V</td>
<td>Lawn lamp</td>
<td>0.6W</td>
<td>2.4-5.0V</td>
<td>Boost</td>
<td>100mA</td>
<td>±1%</td>
<td>2</td>
<td>Max.90%</td>
<td>-</td>
<td>-</td>
<td>synchronous current reduced on schedule</td>
</tr>
<tr>
<td>DC 12V/24V</td>
<td>Backlight</td>
<td>8W</td>
<td>4.5-28V</td>
<td>40V</td>
<td>30mA</td>
<td>±3%</td>
<td>8*10</td>
<td>Max.90%</td>
<td>-</td>
<td>SD16808</td>
<td>linear dimming PWM dimming</td>
</tr>
<tr>
<td>DC 12V/24V</td>
<td>Backlight</td>
<td>23W</td>
<td>8.0-28V</td>
<td>60V</td>
<td>60mA</td>
<td>±3%</td>
<td>12*10</td>
<td>Max.90%</td>
<td>-</td>
<td>SD16809</td>
<td>linear dimming PWM dimming</td>
</tr>
</tbody>
</table>

Note 1: input voltage + output voltage <36V;
Note 2: output current is externally defined;
### AC-DC LED Driver

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Application</th>
<th>Max. output power</th>
<th>Input voltage</th>
<th>Max. output current</th>
<th>CC accuracy</th>
<th>Efficiency</th>
<th>Power factor</th>
<th>Part No.</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>85V-265V</td>
<td>High-voltage spotlight</td>
<td>5W</td>
<td>85V-265V</td>
<td>1000mA</td>
<td>±5%</td>
<td>75%(3*1W)</td>
<td>-</td>
<td>SD6855</td>
<td>PSR Driver TR</td>
</tr>
<tr>
<td></td>
<td>Bulb lamp</td>
<td>7W</td>
<td>85V-265V</td>
<td>1000mA</td>
<td>±5%</td>
<td>77%(3*1W)</td>
<td>-</td>
<td>SD6856</td>
<td>PSR Driver MOSFET</td>
</tr>
<tr>
<td></td>
<td>PAR lamp</td>
<td>12W</td>
<td>85V-265V</td>
<td>1000mA</td>
<td>±5%</td>
<td>-</td>
<td>-</td>
<td>SD6858</td>
<td>PSR PFC dimming</td>
</tr>
<tr>
<td>85V-265V</td>
<td>Fluorescent lamp</td>
<td>36W</td>
<td>85V-265V</td>
<td>-</td>
<td>-</td>
<td>87%</td>
<td>&gt;0.96</td>
<td>SA7527</td>
<td>PFC</td>
</tr>
<tr>
<td>Fluorescent lamp</td>
<td>36W</td>
<td>85V-265V</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>87%</td>
<td>&gt;0.96</td>
<td>SD7529</td>
<td>PFC</td>
</tr>
<tr>
<td>85V-265V</td>
<td>Street lamp</td>
<td>100W</td>
<td>85V-265V</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>SDH6128</td>
<td>PFC+PWM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150W</td>
<td>85V-265V</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>SD7528</td>
<td>PFC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150W</td>
<td>85V-265V</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>SDH6299</td>
<td>LLC</td>
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</tbody>
</table>
Silan’s LED driver solution

1. LED driver solution with low-voltage input (MR 16 etc.)
2. Intelligent solar lawn lamp driver solution
3. High-voltage spotlight, bulb lamp, PAR lamp driver solution
4. Fluorescent lamp driver solution
### 1. Low-voltage input LED driver solution

#### Applications
- LED Spotlight
- Landscape Lighting
- LED Street Lamp

#### Power Supply
- 6V-75V

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Topology</th>
<th>Operating voltage</th>
<th>Output current</th>
<th>VIN-VOUT</th>
<th>MOSFET</th>
<th>CC accuracy</th>
<th>PWM dimming</th>
<th>Linear dimming</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD42522/4</td>
<td>BUCK, average</td>
<td>6V~36V</td>
<td>1A(Max)</td>
<td>0.5V@350mA</td>
<td>0.5V@48V</td>
<td>±1.5%</td>
<td>no/yes</td>
<td>no/yes</td>
<td>SOP8</td>
</tr>
<tr>
<td>SD42522/4EH</td>
<td>BUCK, average</td>
<td>6V~36V</td>
<td>1A(Max)</td>
<td>0.5V@350mA</td>
<td>0.6@60V</td>
<td>±1.5%</td>
<td>no/yes</td>
<td>no/yes</td>
<td>ESOP8</td>
</tr>
<tr>
<td>SD42525</td>
<td>BUCK, hysteresis loop</td>
<td>6V~36V</td>
<td>1A(Max)</td>
<td>0.8V@350mA</td>
<td>0.8@48V</td>
<td>±3%</td>
<td>no</td>
<td>no</td>
<td>SOT89</td>
</tr>
<tr>
<td>SD42560</td>
<td>Buck-Boost average</td>
<td>6V~36V</td>
<td>1.5A(Max)</td>
<td>*</td>
<td>0.25@48V</td>
<td>±1.5%</td>
<td>yes</td>
<td>yes</td>
<td>ESOP8</td>
</tr>
<tr>
<td>SD42618</td>
<td>BOOST, average</td>
<td>6V~36V</td>
<td>Externally defined</td>
<td>*</td>
<td>Externally defined</td>
<td>±1.5%</td>
<td>yes</td>
<td>yes</td>
<td>SOP16</td>
</tr>
<tr>
<td>SD42528</td>
<td>BUCK, average</td>
<td>6V~30V</td>
<td>1A(Max)</td>
<td>0.5V@350mA</td>
<td>0.6@75V</td>
<td>±1.5%</td>
<td>yes</td>
<td>yes</td>
<td>ESOP8</td>
</tr>
</tbody>
</table>

Typ. maximum operating voltage: 36V, max. operating voltage: 60V, product with 100V is under design.

The whole product series, including topology of BUCK, BOOST and BUSK-BOOST.

36V 1A BUCK structure
48V/60V MOSFET
3 strings MR16/stage lamp/secondary CC

36V 1A BUCK hysteresis loop
48V MOSFET
3 strings MR16, landscape lighting

36V BOOST structure
external power MOSFET
electronic transformer lighting
secondary CC

60V 1A BUCK structure
75V MOSFET
T8-T10, street lamp

Typ. maximum operating voltage: 36V, max. operating voltage: 60V, product with 100V is under design.
1.0 Average current mode, hysteretic mode, constant-on mode

**Inductive current**

- Fixed frequency ON
- Turn off if the peak value is up to threshold value

**Average current**

- Average inductive current
  - lavg
  - Toff
  - Ton

**Hysteretic mode**

- Turn off when higher then the upper threshold value

- Rising slopes of inductive current are different with different power supplies and different loads, and Id1 is different, as the same, Id2 is different in different conditions.

- CC characteristics are OK with three structures in ideal status.

**Constant ON**

- Turn off after ON period
1.0 Comparison of average current mode, hysteretic mode and constant-on mode

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Average current mode</th>
<th>Hysteretic mode</th>
<th>Constant on mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load regulation</td>
<td>Load has little effect on open-loop gain, and output current has small change</td>
<td>( \Delta I = -\frac{\Delta V_{out}}{2*L} \times (T_{d1} + T_{d2}) )</td>
<td>( \Delta I = -\left(\frac{T_{d2}}{L} + \frac{K}{2<em>L</em>V_{in}}\right) \times \Delta V_{out} )</td>
</tr>
<tr>
<td>Line regulation</td>
<td>Supplier voltage little effect on open-loop gain, and output current has small change</td>
<td>( \Delta I = \frac{\Delta V_{in}}{2*L} \times T_{d1} )</td>
<td>( \Delta I = \frac{V_{o}<em>K}{2</em>L*V_{in}^2} \times \Delta V_{in} )</td>
</tr>
<tr>
<td>Current ripple ( V_{out} \times T_{off} )</td>
<td>( \frac{\Delta V}{R_{s}} )</td>
<td>( \frac{V_{in} - V_{out} \times K}{L \times V_{in}} )</td>
<td></td>
</tr>
<tr>
<td>current vs. external inductor</td>
<td>In continuous mode, the effect on current caused by inductor can be ignored</td>
<td>( \Delta I = -\frac{V_{in}<em>T_{d1} - V_{out} \times (T_{d1} + T_{d2})}{2</em>L^2} \times \Delta L )</td>
<td>( \Delta I = \left(\frac{V_{out}}{L^2} \times T_{d2} - \frac{K}{2<em>L^2} + \frac{K</em>V_{out}}{2<em>L^2</em>V_{in}}\right) \times \Delta L )</td>
</tr>
</tbody>
</table>

\( \Delta I \): current change  
\( \Delta V_{out} \): output voltage change  
\( T_{d1} \): off-delay  
\( T_{d2} \): on-delay  
\( L \): inductance  
\( \Delta L \): inductance change  
\( \Delta V \): hysteresis voltage  
\( R_{s} \): sense resistance  
\( V_{out} \): output voltage  
\( T_{off} \): off time  
\( T_{on} \): on time  
\( K \): time coefficient for fixed on

Conclusion

<table>
<thead>
<tr>
<th></th>
<th>Average current mode</th>
<th>Hysteretic mode</th>
<th>Constant on mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line regulation</td>
<td>Good</td>
<td>Bad</td>
<td>Bad</td>
</tr>
<tr>
<td>Load regulation</td>
<td>Good</td>
<td>Bad</td>
<td>Bad</td>
</tr>
<tr>
<td>Current ripple</td>
<td>Small</td>
<td>Large</td>
<td>Affected by Ton</td>
</tr>
<tr>
<td>current vs. external inductor</td>
<td>can be ignored</td>
<td>great influence</td>
<td>great influence</td>
</tr>
<tr>
<td>Frequency</td>
<td>Fixed frequency</td>
<td>inverted frequency</td>
<td>inverted frequency</td>
</tr>
<tr>
<td>dimming response</td>
<td>common</td>
<td>Fast</td>
<td>Fast</td>
</tr>
<tr>
<td>Loop</td>
<td>complex</td>
<td>simple</td>
<td>simple</td>
</tr>
</tbody>
</table>

MR16, Electronic transformer, secondary constant current

Vin: input voltage  
K: time coefficient for fixed on
1.1 Buck LED driver– SD42522/4

**Features**

1. 6V~36V input voltage range
2. Buck average current mode
3. Maximum 1A output current
4. Efficiency up to 96%
5. Excellent constant current accuracy ±1.5%
6. Built-in temperature shutdown and over current protection
7. Frequency jitter
8. Linear/PWM dimming, and the ratio is 500:1
9. Temperature balance

**Application**

MR16 (1*1W,1*3W,3*1W)

LED illumination secondary CC (Max. 24W)

**Package:** SOP8/ESOP8

MR16, Electronic transformer, secondary constant current
1.1 Buck LED driver– SD42522/4 (continued)

- Line regulation/load regulation

Figure 1: the CC accuracy is controlled within ±1.0% with different input voltages and different loads

- Conversion efficiency

Figure 2: inductance vs. constant current (hysteretic mode is marked in red)

Figure 3: efficiency is up to 96%
Temperature balance

\[ V_{\text{ADJ}} > 1.22\text{V} \quad I_{\text{out}} = \frac{0.088}{R_s} \times V_{\text{ADJ}} \]

\[ V_{\text{ADJ}} < 1.22\text{V} \quad I_{\text{out}} = \frac{0.088}{R_s} \times 1.22 \]

Figure 4: LED temperature can be reflected on thermal resistor. Temperature balance is available through selecting proper R1/NTC.

● Low-voltage current characteristics

Figure 5: current will not exceed the preset value with low dropout.

● Frequency jitter

Figure 6: frequency jitter for low EMI. Generally, magnetic beads are needed for flywheel diode, then the peak value will be increased. MOSFET: 48V/60V
1.1 Buck LED driver– SD42522/4 (continued)

- MR16(3*1W)
- 2*18W External fluorescent lamp

![Diagram of MR16(3*1W) and 2*18W External fluorescent lamp]

Figure 7: PWM+PFC+SD42522
1.2 Buck (hysteretic mode) LED driver– SD42525

**Features**

1. 5V~36V input voltage range
2. Buck hysteretic mode
3. Maximum 1A output current
4. Efficiency up to 96%
5. Excellent constant current accuracy ±3%
6. Built-in temperature shutdown and over current protection
7. Linear/PWM dimming, the ratio is 1000:1
8. Built-in line voltage compensation (patent), improving the line regulation
9. Low dropout overshoot current compensation (patent)

**Application**

MR11/16 (1*1W,1*3W,3*1W)

**Package:** SOT89/SOT23

MR16, Electronic transformer, secondary constant current
1.2 Buck (hysteretic mode) LED driver– SD42525 (continued)

- **Line regulation and load regulation**

SD42525 voltage regulation (line voltage compensation)

**MR11/16(3*1W)**

- **Low dropout overshoot current**

Voltage regulation in common hysteretic mode

Current before/after compensation
1.3 Buck-boost LED driver-SD42560

**Features**

1. 5V~36V input voltage range
2. *Buck-boost average current mode*
3. Maximum 1.2A output current (Buck mode)
4. *Efficiency up to: Buck 96%/ Boost 95%/Buck-Boost 83%*
5. Excellent constant current accuracy ±1.5%
6. Threshold value of over voltage protection: 40V(Boost/Buck-Boost)
7. Built-in temperature shutdown and over current protection
8. PWM dimming and the ratio is 500:1
9. Frequency jitter

**Application**

- MR16 (4*1W, 5*1W)
- Electronic transformer
- Solar LED illumination

**Package:** SOP8/ESOP8
1.3 Buck-boost LED driver-SD42560 (Continued)

- **Boost / Buck / Buck-Boost**

- **Buck-Boost mode**

- **Conversion efficiency (Buck-Boost)**

- **CC accuracy (Buck-Boost)**

- **Efficiency (%)**

- **Output Current Change Rate (%)**

- **Input Voltage (V)**

- **Output Current (mA)**

- **IOUT=350mA**

MR16, Electronic transformer, secondary constant current
1.3 Buck-boost LED driver-SD42560 (Continued)

Application of electronic transformer

In LED illumination powered by electronic transformer, the frequent questions are failure in power on and power shortage with light load. SD42560 adopts Buck-Boost for enlarging operating voltage range and improving the energy efficiency. Other patents relating to electronic transformer are under application.

- **MR16 (AC 12V 5*1W)**

Figure 1. waveform output from electronic transformer

Figure 2. uncontinuous waveform from electronic transformer with light load.

Waveform (6V～14V) after rectification

Abnormal waveform after rectification will cause power shortage
1.4 Boost LED driver – SD42618

**Features**

1. 6V~36V input voltage range
2. Boost average current mode
3. External MOSFET, and the current is decided by sense resistor
4. Built-in short-circuit protection
5. Built-in over voltage protection (the threshold value is externally defined)
6. Built-in temperature shutdown and over current protection
7. PWM/linear dimming
8. Frequency jitter
9. Thermal balance compensation

**Application**

LED illumination secondary constant current
(External MOSFET)
Electronic transformer

**Package:** SOP16
1.4 Boost LED driver – SD42618 (Continued)

**Conversion efficiency**

![Conversion efficiency graph]

**CC accuracy**

![CC accuracy graph]

- **Input voltage (V)**
  - **Efficiency (%)**
  - **Output current (mA)**
  - **LED count**

- **Input voltage (V)**
  - **Change in output current (%)**

**IOUT=350mA**

**MR16, Electronic transformer, secondary constant current**
1.5 Buck LED driver – SD42528

**Features**

1. 6V~60V input voltage range
2. Buck average current mode
3. Maximum 1.0A output current
4. Efficiency up to 96%
5. Excellent constant current accuracy ±2%
6. Built-in temperature shutdown and over current protection
7. PWM dimming and the ratio is 500:1
8. Frequency jitter
9. Thermal balance compensation

**Application**

- T8-T10 secondary constant current (Max. 36W)
- Street lamp
- Automobile illumination

**Package:** ESOP8
1.5 Buck LED driver – SD42528 (Continued)

**Conversion efficiency**

![Efficiency vs. Input Voltage Graph]

**CC accuracy**

![Change in Output Current Graph]

**T8-T10 Application (secondary constant current)**

![Image of the application circuitry with PFC and SD42528 marked]
### 2. LED driver for intelligent solar lawn lamp

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Solar Lawn Light</td>
<td>2.4V-5.5V</td>
<td></td>
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</tbody>
</table>

#### Solar lawn lamp system
- Consists of solar battery, rechargeable battery, photosensitive switch and LED illumination etc.
- Lithium Iron Phosphate Battery is widely used in solar LED lawn lamp because of its reliability, high temperature resistant, charging/recharging with large current and no memory effect. Silan's solution is especially for Lithium Iron Phosphate Battery.

#### Part No. Specifications

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Topology</th>
<th>Operating voltage</th>
<th>Output current</th>
<th>CC accuracy</th>
<th>Charge function</th>
<th>Photosensitive detection</th>
<th>Fixed current reduce</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD42608</td>
<td>SPEIC+CC</td>
<td>2.4V-5.0V</td>
<td>0.15A</td>
<td>±1%</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>SOP16</td>
</tr>
<tr>
<td>SD42609</td>
<td>BOOST+CC</td>
<td>2.4V-5.5V</td>
<td>0.2A</td>
<td>±1%</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>SOP16</td>
</tr>
</tbody>
</table>

- **BOUN-BOOST structure**
  - Flexible application
  - Efficiency is average with full voltage range
  - Intelligent illumination control

- **BOOST+CC topology**
  - Single string LED connected in parallel
  - Highest efficiency when input voltage is 2.8-3.4V
  - Intelligent illumination control

---

*Company Confidential, don’t copy*
2.1 LED driver for intelligent solar lawn lamp – SD42608

**Features**

1. 2.4V~5V input voltage (Lithium Iron Phosphate Battery)
2. **Buck-Boost average current mode**
3. Maximum 150mA output current
4. **Efficiency up to: Boost 90% / Buck-Boost 85%**
5. Excellent constant current accuracy ± 1%
6. Enable controlled by environment light
7. External set for selecting operating mode
8. Timing can be set through pin

**Application**

Solar lawn lamp

- Automatic control during charging on rechargeable batteries (Li-ion battery, Lithium Iron Phosphate Battery etc.) by solar battery
- Automatic control on operating mode, such as driver off, LED current reducing after exact timing.
- LED current can be externally set for application with different types; the current is constant with full-range input.
- Automatic control is available through automatic detection (such as feedback of photosensitive resistance or voltage of solar battery)
- Various protections: input under-voltage/over voltage/over temperature protections
- Low standby current (not working during daytime) to reduce ineffective power dissipation.

**Package:** SOP16
2.1 LED driver for intelligent solar lawn lamp – SD42608 (Continued)

- **Line regulation**
  - Change in output current (%)
  - Input voltage (V) vs. Change in output current (%)

- **Mode selection**
  - Pin TIMER and Pin MODE
  - Table:
    - **Mode**
      - Time
      - Output current (RS=1Ω)
    - **Connected to GND**
      - 0~4h: 100mA
      - After 4h: 25mA
    - **Connected to BAT**
      - 0~4h: 100mA
      - After 4h: 0mA
    - **Floating**
      - 0~6h: 100mA
      - After 6h: 25mA
    - **Connected to GND or floating**
      - 0~6h: 100mA
      - After 6h: 0mA

- **Conversion efficiency**
  - Boost drives 2LED
  - Input voltage (V) vs. Conversion efficiency (%)
2.2 LED driver for intelligent solar lawn lamp-SD42609

**Features**

1. **2.4V~5V input voltage range**
2. **Boost+constant current synchronous mode**
3. **Maximum 200mA output current**
4. **Efficiency up to 90%(single lamp)**
5. **Excellent constant current accuracy ±1%**
6. **Enable controlled by environment light**
7. **External set for selecting operating mode**
8. **Timing can be set through pin**

**Application**

Solar lawn lamp

**Package:** SOP16
2.2 LED driver for intelligent solar lawn lamp-SD42609 (Continued)

- **Line regulation**

  ![Line regulation graph]

- **Conversion efficiency**

  ![Conversion efficiency graph]

- **Mode selection**

<table>
<thead>
<tr>
<th>Pin MODE</th>
<th>Mode</th>
<th>Time</th>
<th>Output current (Rs=1Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected to GND</td>
<td>0~5h</td>
<td>80 mA</td>
<td></td>
</tr>
<tr>
<td>5~10h</td>
<td>40 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 10h</td>
<td>0mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connected to BAT</td>
<td>0~6h</td>
<td>100 mA</td>
<td></td>
</tr>
<tr>
<td>6~12h</td>
<td>50 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After h</td>
<td>0mA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The highest efficiency is available with 2.8~3.4V input.
## 3. PSR PFC LED controller

<table>
<thead>
<tr>
<th>Applications</th>
<th>Output Power</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td>HV spotlight</td>
<td>3W-7W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAR lamp</td>
<td>5W-12W</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Output power:** 3-5W external driver
- **HV spotlight**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Start mode</th>
<th>Control mode</th>
<th>MOSFET</th>
<th>Output power (Max.)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD6855</td>
<td>Resistor</td>
<td>PFM</td>
<td>External</td>
<td>3W-5W</td>
<td>SOT23-6</td>
</tr>
<tr>
<td>SD6856</td>
<td>Resistor</td>
<td>PFM</td>
<td>External</td>
<td>5W-7W</td>
<td>SOT23-6</td>
</tr>
<tr>
<td>SD6858</td>
<td>Resistor</td>
<td>PFM</td>
<td>External</td>
<td>5W-12W</td>
<td>SOP8</td>
</tr>
</tbody>
</table>

**Output power:** 5-12W
- **External driver**
- **MOSFET**
- **PFC function**
- **Triac dimming**
- **HV spotlight, bulb lamp, PAR lamp**
3.1 PSR LED driver – SD6855 (transistor), SD6856 (MOSFET)

**Features**
1. Low start current: < 3uA
2. PFM mode
3. Successive current limit
4. CV/CC control mode
5. Over voltage, under voltage, open-circuit and over temperature protections
6. CC accuracy: ±5%
7. Output power: 5W (transistor), 7W (MOSFET)
8. No need of opto-coupler and 431

**Application**
- Spotlight, bulb lamp, PAR lamp

**Package:** SOT23-6

---

- **Resistor start**, the low start current is helpful to reduce power dissipation and improve the efficiency.
- **Resistor:** 5M-10M

- **Output voltage** should be set considering the LED quantity to ensure VO>LED VF and to make the IC working in CC mode. Also, the no-load voltage should be taken into consideration.

- **R4** is used for adjusting current consistency with high/low voltage inputs.

- **R8** is used for controlling no-load voltage

---

**Formulae:**
- \( VCC = (Vo + Vd1) \frac{ns2}{ns1} - Vd3 \)
- \( Io = \frac{1}{2} Ds \frac{Vpk}{R5 \cdot ns1} \)

---

**Diagram:**
- The IC diagram shows the internal connections and components. Detailed labeling includes:
  - VCC
  - FB
  - DRV
  - GND
  - ISEN
  - R4
  - R5
  - C1
  - C2
  - D1
  - D2
  - D3
  - Q1
  - L1
  - R1
  - C3
  - R2
  - R3
  - R6
  - R7
  - R8
  - R9

---

**Application Diagram:**
- The application diagram illustrates the device's integration into spotlights, bulb lamps, and PAR lamps. The output voltage setting and current consistency are highlighted.

---

**LED works in CC mode:**
- The LED works in constant current mode, ensuring stable output regardless of changes in voltage or load conditions.

---

**Graph:**
- A graph shows the output voltage output in relation to output current, indicating the device's performance under varying conditions.

---

**Silan 士兰微电子**
- HV spotlight, bulb lamp, PAR lamp
3.2 PSR LED driver – SD6855(transistor), SD6856 (MOSFET)(Continued)

Driver MOSFET features high efficiency, suitable for large power needed
3.1 PSR PFC LED driver – SD6858

Features

1. Integrated PFC function
2. SCR dimming
3. Built-in soft start
4. Built-in VCC under voltage protection
5. Cycle-by-cycle current limit
6. Output short-circuit and over-voltage protections
7. Maximum output power: 12W

Application

Spotlight, bulb lamp, PAR lamp

Package: SOP8

Patent of PSR PFC CC control with dimming is under application
4. PFC LED controller

<table>
<thead>
<tr>
<th>Applications</th>
<th>Output Power</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED fluorescent lamp</td>
<td>12W-36W</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

**Applications**
- LED fluorescent lamp
- 12W-36W

**Part No.**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA7527</td>
<td>CRM PFC controller</td>
</tr>
<tr>
<td>SD7529</td>
<td>No-load standby/OCP/source over current</td>
</tr>
</tbody>
</table>

**Part Numbers**
- BCD1525
- BCD10700

**Part Description**
- SA7527: CRM PFC controller
- SD7529: No-load standby/OCP/source over current

**Fluorescent light**

**Part No. Description**

To reduce no-load standby power dissipation
To increase OCP to increase source over current protection
4.1 PFC LED driver—SD7529

- **Features**

1. **Low start current:** 30uA
2. **High-quality linear multiplier**
3. **Over voltage adjustment with high accuracy.**
4. **Built-in soft start**
5. **Source over current protection**
6. **Output short-circuit protection**
   (patent is under application)

- **Application**

  - Built-in 18W fluorescent lamp
  - Built-in 18W*2 fluorescent lamp

- **Package:** SOP8
4.2 15W-18W isolated single-stage PFC driver solution

**Features (10 strings 550mA)**

- 85～265V input voltage range
- PF>0.96
- Change in output current is less than ±3% with full-range input
- Efficiency: >86%
- Standby power dissipation< 0.5W
- Output voltage ripple< 1.35V
- Output current ripple< 175mA
- Co=330uF*3
- H=12mm, W=18mm, L=260mm

PFC output ripple is large and it is needed to reduce ripple by large output capacitor Co

**Figure 1 Block diagram**

**Figure 2 Schematic diagram of single-stage LED fluorescent lamp driver**
Single-stage DEMO test results (25 °C)

Figure 3 Output voltage ripple and current ripple

Figure 4 Input voltage ripple and current ripple

Figure 5 Efficiency

DEMO appearance
4.3 15W-18W isolated two-stage PFC driver solution

**Features (10 strings 550mA)**

- 85~265V input voltage range
- PF>0.96
- Output current is less than ±1.5% with full-range input
- Efficiency: >85%
- Standby power dissipation< 0.5W- >0.3W
- Output voltage ripple < 200mV
- Output current ripple< 20mA
- Co=330uF*1
- H=12mm,W=18mm,L=260mm

**Patent of two-stage solution without opto-coupler/431 is under application**
SCR dimming patent is under application

**Figure 1 Block diagram for two stage solution**

**Figure 2 Schematic diagram of two-stage LED fluorescent lamp driver**

BUCK structure is used for decreasing ripple and reducing PFC output capacitance.
Two-stage DEMO test results (25 °C)

**Figure 3** Output voltage ripple and current ripple

**Figure 4** Input voltage ripple and current ripple

**Figure 5** Efficiency

**DEMO appearance**
Features of LED driver products

High reliability:
A. BICMOS/BCD is adopted for improving ESD, Latch Up ability and voltage withdraw of IC
B. Various protections available: thermal shutdown, load abruptly connected/disconnected
C. Few peripheral components, especially no use of short-life component, such as opto-coupler, output electrolytic capacitor etc.

High power density:
BCD technology with internal MOSFET and high-efficiency system structure are adopted for improving power density, meeting requirements of LED illumination with small volume.

High CC accuracy:
Average current mode is used for improving CC accuracy.

Wide voltage range:
Maximum voltage with BUCK structure can be up to 60V, and the objective is 100V.
**Advantage of LED driver product**

- **High performance-cost ratio:**
  
  Driver product features high performance-cost ratio, and IDM mode is also adopted for low cost.

- **System solution support:**
  
  LED illumination is a new field and the application solution should be supported by IC company. Silan has the professional AE/FAE groups covering Hangzhou/Shenzhen/Taipei/ Korea Seoul, providing services for customers.

- **Perfect solution:**
  
  Silan has whole LED product line and provide perfect solutions for customers, including AC input, DC input, discrete devices of CRD, MOSFET etc.

**Hangzhou AE manager:** Cai Yoongjun  
Tel: 0571-88210880

**Shenzhen FAE manager:** Cao Jingping  
Tel: 0755-83476058
Thank you!