Selection Guide

IC for LED Lighting

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https://www.sanken-ele.co.jp/en
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Isolated Flyback Convertor
- No PFC Circuit Required
- High Power Factor in Light Load (Class-C)

LC5540LD Series
DIP8

Non-isolated Buck and Buck-boost Convertor
- Low Component Count
- High Power Factor
- High Power Factor (Class-C)

LC5560LD Series
(Support of Buck, Buck-boost and Flyback circuit)
DIP8

Processes offers to meet various needs such as various form and loads of the lamp.

High Power and Smart Application
- PFC IC: SSC2016S (CRM Type)
- Main Converter: LLC Type
- Microcomputer: MD660x (8bit MCU)

Downsized PCB
- Spot light
- LED bulb
- LED fluorescent lamp
- Down light
- Ceiling light
- Street light

DC/DC
- LC5700 Series
- SOP8
- HSOP8

LED Driver IC Overview
Off-line Buck Type (Low Power Application)

Buck Converter

LC5560LD Series

- LED Bulb
- Down Light
- LED Fluorescent Lamp

Freewheeling Diodes

Buck-boost Converter

LC5560LD Series

- LED Bulb
- Down Light
- LED Fluorescent Lamp

Freewheeling Diodes

Note:
Refer to the selection guide of diode about peripheral diodes.
Off-line Flyback Type (Low to Middle Power Application)

LED Driver within power MOSFET

LC5540LD Series (Non-isolated Type)
- Down Light
- LED Fluorescent Lamp → P.9

LC5560LD Series (Isolated Type)
- LED Bulb
- Down Light
- LED Fluorescent Lamp → P.10

Note:
Peripheral diodes are shown in the selection guide of diode.
DC/DC Converter

### Buck Converter

![Buck Converter Diagram]

**LED Driver**

- **LC5710S**
- **LC5720S**

**SOP8** → [P.13]

**HSOP8** → [P.14]

### Boost Converter

![Boost Converter Diagram]

**LED Driver**

- **LC5710S**
- **LC5720S**

**SOP8** → [P.13]

**HSOP8** → [P.14]

### Buck-boost Converter

![Buck-boost Converter Diagram]

**LED Driver**

- **LC5710S**
- **LC5720S**

**SOP8** → [P.13]

**HSOP8** → [P.14]

**Note:**
- Peripheral diodes are shown in the selection guide of diode.
- Built in power MOSFET with * mark.
Notes:

• Peripheral diodes are shown in the selection guide of diode.
• PFC, LLC and PWM ICs are shown in selection guide of AC/DC Convertor and PFC.
### Off-line LED Driver IC Selection Guide

- **High Power Factor in Light Load (Class-C)**
- **No Input Electrolytic Capacitor Required**
- **Isolated and Non-isolated Type**

#### Series LC5540LD

<table>
<thead>
<tr>
<th>Series</th>
<th>$V_{IN(MAX)}$</th>
<th>Package</th>
<th>Applications</th>
<th>Features</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC5540LD</td>
<td>650 V</td>
<td>DIP8</td>
<td>• Down light&lt;br&gt;• LED fluorescent lamp</td>
<td>• Isolated type</td>
<td>P.9</td>
</tr>
</tbody>
</table>

#### Series LC5560LD

<table>
<thead>
<tr>
<th>Series</th>
<th>$V_{IN(MAX)}$</th>
<th>Package</th>
<th>Applications</th>
<th>Features</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC5560LD</td>
<td>650 V</td>
<td>DIP8</td>
<td>• LED bulb&lt;br&gt;• Down light&lt;br&gt;• LED fluorescent lamp</td>
<td>• Non-isolated type&lt;br&gt;• Dimming</td>
<td>P.10</td>
</tr>
</tbody>
</table>
No Input Electrolytic Capacitor Required, IEC61000-3-2 class-C
Isolated LED Driver IC

LC5540LD Series

Package
DIP8

Features
- No Input Electrolytic Capacitor Required
- PWM and Quasi-resonant topology
- High Efficiency
- Low Noise
- High Power Factor in Light Load (IEC61000-3-2 class C)
- Protections
  - OCP: Pulse-by-Pulse
  - OLP, OVP, and TSD: Latched Shutdown

Typical Application

Selection Guide

<table>
<thead>
<tr>
<th>Part Number</th>
<th>PWM Frequency</th>
<th>MOSFET V_DSS</th>
<th>R_DSO(ON)</th>
<th>P_OUT AC230V</th>
<th>P_OUT Universal</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC5545LD</td>
<td>72kHz</td>
<td>650V</td>
<td>3.95Ω</td>
<td>13W</td>
<td>10W</td>
</tr>
<tr>
<td>LC5546LD</td>
<td>60kHz</td>
<td>1.9Ω</td>
<td>20W</td>
<td>16W</td>
<td></td>
</tr>
</tbody>
</table>

Pin Configuration Definitions

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Symbol</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S/GND</td>
<td>Power MOSFET source and ground</td>
</tr>
<tr>
<td>2</td>
<td>VCC</td>
<td>Supply voltage input and OVP signal input</td>
</tr>
<tr>
<td>3</td>
<td>OCP</td>
<td>OCP and QR signal input, and OVP signal input</td>
</tr>
<tr>
<td>4</td>
<td>FB</td>
<td>Feedback signal input and OLP signal input</td>
</tr>
<tr>
<td>5</td>
<td>NF</td>
<td>No function</td>
</tr>
<tr>
<td>6</td>
<td>OVP</td>
<td>OVP signal input</td>
</tr>
<tr>
<td>7</td>
<td>—</td>
<td>Pin removed</td>
</tr>
<tr>
<td>8</td>
<td>D/ST</td>
<td>Power MOSFET drain and startup current input</td>
</tr>
</tbody>
</table>
No Input Electrolytic Capacitor Required, IEC61000-3-2 Class-C
Non-isolated LED Driver IC
LC5560LD Series

Features
- Allows Buck, Buck Boost and Flyback Circuit
- No Input Electrolytic Capacitor Required
- PWM and Quasi-resonant Topology
- High Efficiency
- Low Noise
- High Power Factor in Light Load (IEC61000-3-2 class C)
- Dimming Function
- Protections
  - OCP: Pulse-by-Pulse
  - OLP, OVP, and TSD: Latched Shutdown

Typical Application (Flyback Circuit)

Selection Guide

<table>
<thead>
<tr>
<th>Part Number</th>
<th>PWM Frequency</th>
<th>Power MOSFET</th>
<th>P_OUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC5566LD</td>
<td>60 kHz</td>
<td>650V, 1.9 Ω</td>
<td>20 W, 16 W</td>
</tr>
</tbody>
</table>

Pin Configuration Definitions

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Symbol</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S/GND</td>
<td>Power MOSFET source and ground</td>
</tr>
<tr>
<td>2</td>
<td>VCC</td>
<td>Supply voltage input and OVP signal input</td>
</tr>
<tr>
<td>3</td>
<td>OCP</td>
<td>OCP and QR signal input, and OVP signal input</td>
</tr>
<tr>
<td>4</td>
<td>COMP</td>
<td>Feedback phase-compensation input</td>
</tr>
<tr>
<td>5</td>
<td>VREF</td>
<td>Dimming control signal input</td>
</tr>
<tr>
<td>6</td>
<td>ISENSE</td>
<td>Output current sensing voltage input</td>
</tr>
<tr>
<td>7</td>
<td>—</td>
<td>Pin removed</td>
</tr>
<tr>
<td>8</td>
<td>D/ST</td>
<td>Power MOSFET drain and startup current input</td>
</tr>
</tbody>
</table>
## DC/DC LED Driver IC Selection Guide

- For Intelligent LED Lighting Application
- For LED Back Light Application
- Individual Channels Control

<table>
<thead>
<tr>
<th>Series</th>
<th>Output Count</th>
<th>$V_{\text{IN(MAX)}}$</th>
<th>$I_0$</th>
<th>$V_{\text{LED(MAX)}}$</th>
<th>Package</th>
<th>Features</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC101N (Current Balancer)</td>
<td>1</td>
<td>35 V</td>
<td>150 mA</td>
<td>35 V</td>
<td>DFN8</td>
<td>Balancer</td>
<td>P.12</td>
</tr>
<tr>
<td>LC5710S</td>
<td>1</td>
<td>58 V</td>
<td>1.0 A</td>
<td>58 V</td>
<td>SOP8</td>
<td>• Allows buck, buck-boost, and boost circuit</td>
<td>P.13</td>
</tr>
<tr>
<td>LC5720S</td>
<td>1</td>
<td>50 V</td>
<td>2.0 A</td>
<td>50 V</td>
<td>HSOP8</td>
<td>• Allows buck, buck-boost, and boost circuit</td>
<td>P.14</td>
</tr>
</tbody>
</table>

- Balancer
- Allows buck, buck-boost, and boost circuit
- PWM dimming
- Built-in power MOSFET
**I_{LED} = 150 mA**

**LED Current Balancer**

**LC101N**

### Package
- **DFN8**

### Features
- Current Balancer Across LED String
- Small Package (DFN8)
- Power Dissipation, P_D : 1.3 W
- No Input and Output Capacitor Required
- Maximum Dropout Voltage, ΔV_{DIF} : 350 mV
- Protections
  - OCP
  - TSD: Activation Temperature is 130 °C without Hysteresis

### Pin Configuration Definitions

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Symbol</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IN</td>
<td>Input</td>
</tr>
<tr>
<td>2, 3</td>
<td>NC</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>LED</td>
<td>Output</td>
</tr>
<tr>
<td>5</td>
<td>FB</td>
<td>LED current detection signal input (positive side)</td>
</tr>
<tr>
<td>6, 7</td>
<td>NC</td>
<td>—</td>
</tr>
<tr>
<td>8</td>
<td>LO</td>
<td>LED current detection signal input (negative side)</td>
</tr>
</tbody>
</table>

### Selection Guide

<table>
<thead>
<tr>
<th>Part Number</th>
<th>I_{LED(MAX)}</th>
<th>V_{LED MAX}</th>
<th>V_{IN}</th>
<th>V_{FB}</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC101N</td>
<td>15 mA to 150 mA</td>
<td>35 V</td>
<td>2.4 V to 35 V</td>
<td>200 mV ± 3%</td>
</tr>
</tbody>
</table>

**Typical Application**
### LC5710S

**Features**
- Allows Buck, Buck-boost, and Boost Circuit
- Maximum LED Current, \( I_{LED} : 1.0 \) A
- Adjustable Frequency Range: 100 kHz to 500 kHz
- \( V_{CS} : 100 \text{ mV} \pm 3 \% \)
- High Accuracy Dimming Control
- Maximum PWM Frequency: 20 kHz
- DC Input Voltage: 0.2 V to 2 V
- Protections
  - UVLO, OCP, TSD, LED OVP,
  - LED Open and LED Cross Connection Detection

**Typical Applications**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>( I_{LED(MAX)} )</th>
<th>( V_{IN} )</th>
<th>MOSFET ( R_{DS(ON)} )</th>
<th>( f_{OSC} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC5710S</td>
<td>1.0 A</td>
<td>5 V to 58 V</td>
<td>0.550 Ω(typ.)</td>
<td>100 kHz to 500 kHz</td>
</tr>
</tbody>
</table>

**Pin Configuration Definitions**

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Symbol</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COMP</td>
<td>Phase compensation</td>
</tr>
<tr>
<td>2</td>
<td>RT</td>
<td>Frequency adjust</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>SW</td>
<td>Switch output</td>
</tr>
<tr>
<td>5</td>
<td>VIN</td>
<td>DC input</td>
</tr>
<tr>
<td>6</td>
<td>CSP</td>
<td>LED current sense (+)</td>
</tr>
<tr>
<td>7</td>
<td>CSN</td>
<td>LED current sense (-)</td>
</tr>
<tr>
<td>8</td>
<td>DIM</td>
<td>Dimming signal input</td>
</tr>
</tbody>
</table>

**Diagrams**

- **Boost Converter**
- **Buck-boost Converter**
- **Buck Converter**

---

\( I_{LED} = 1.0 \text{ A}, \ V_{IN} = 5 \text{ V to 58 V} \)

LED Driver for Buck, Buck-boost, and Boost Converter

SGE0003 Apr. 28, 2020
LED Driver for Buck, Buck-boost, and Boost Converter

**LC5720S**

**Package**
- HSOP8

**Features**
- Allows Buck, Buck-boost, and Boost Circuit
- Maximum LED Current, \(I_{LED} = 1.0\) A
- Frequency: 500 kHz
- \(V_{CS} = 100\) mV ± 5%
- High efficiency, \(\eta > 90\%\) (typ.)
- Maximum PWM Dimming Frequency: 20 kHz
- Protections
  - OCP: Pulse-by-Pulse
  - OVP, TSD: Auto-restart

**Pin Configuration Definitions**

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Symbol</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COMP</td>
<td>Phase compensation</td>
</tr>
<tr>
<td>2</td>
<td>NC</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>SW</td>
<td>Output</td>
</tr>
<tr>
<td>5</td>
<td>VIN</td>
<td>DC input</td>
</tr>
<tr>
<td>6</td>
<td>CSP</td>
<td>Reference input pin of current detection</td>
</tr>
<tr>
<td>7</td>
<td>CSN</td>
<td>Negative input pin of current detection</td>
</tr>
<tr>
<td>8</td>
<td>DIM</td>
<td>PWM dimming signal input</td>
</tr>
</tbody>
</table>

**Typical Applications**

- **Boost Converter**
- **Buck-boost Converter**
- **Buck Converter**

**Selection Guide**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>(I_{LED(\text{MAX})})</th>
<th>(V_{IN})</th>
<th>MOSFET (R_{DS(\text{ON})})</th>
<th>(f_{OSC})</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC5720S</td>
<td>2.0 A</td>
<td>9.5 V to 50 V</td>
<td>0.215 Ω(typ.)</td>
<td>500 kHz</td>
</tr>
</tbody>
</table>

**Equations**

- \(I_{LED} = 2.0\) A, \(V_{IN} = 8.5\) V to 50 V
Selection Guide For High Power and Intelligent LED Lighting

- High Power Application
- PFC Circuit
- Including Microcomputer

Ceiling light with microcomputer
Down light
Street lump

<table>
<thead>
<tr>
<th>Application</th>
<th>Feature</th>
<th>Products</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFC</td>
<td>CRM control</td>
<td>PFC IC</td>
<td></td>
</tr>
<tr>
<td>Main convertor</td>
<td>✓ Low noise</td>
<td>LLC control ICs</td>
<td></td>
</tr>
</tbody>
</table>
| Auxiliary power supply | ✓ PWM control  
 ✓ Low power consumption at no load < 25mW  
 ✓ Flyback type  
 ✓ Buck type (non-isolated) | PWM control ICs   |                    |
| Microcomputer        | ✓ 8 bit MCU  
 ✓ High Performance DSP  
 ✓ High Resolution PWM | MD660x Series     | P.16               |

PFC, LLC and PWM ICs are shown in selection guide of AC/DC Convertor and PFC.
MD660x Series

MD660x is 8 bit MCU (Micro Controller Unit) for the power control application such as digital control power supply system.

◆ Rich Analog Component
Interconnections among analog components and external pins are configurable by programmable analog network. MD660x has A/D converter, analog comparators, general purpose OPAMPS.

◆ High Performance DSP Operations
MD660x has 8 bit CPU and two 16 bit Tiny DSP. CPU controls systems, Tiny DSP does calculations. Thus, parallel processing achieves.

◆ DMA Capability Between Peripherals (DSAC)
Automatic data transfer among the registers of the built-in peripheral functions. Also, automatic data transfer among the A/D converter, the Tiny DSP, and the PWM. Feedback control can be applied without the CPU, so that the CPU will focus on system processing such as anomaly detection or communications processing.

◆ System Support Functions
FLASH Memory, Timer, Serial Communications, Oscillators, Reset Circuits, etc.

【 Block Diagram 】

◆ Development Support Software
- IDE_MS660x : Program Development Environment
- SKDSP : Digital Filters for Tiny DSP
  Program generation for the phase compensator

◆ Development Support Hardware
- OCD I/F board (Interface for writing flash)
- CHEWING GUM (Evaluation board)
## MD660x Series

### Packages

<table>
<thead>
<tr>
<th>Product</th>
<th>QFN-40</th>
<th>LQFP-64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>10×10 (0.5pitch)</td>
<td>6×6 (0.5pitch)</td>
</tr>
</tbody>
</table>

### Power Supply Voltage
- Digital DVCC : 3.3V
- Analog AVCC : 3.3V

### Operation Frequency
- 50MHz (max.)

### Analog Function
- Analog interconnection : User configurable
- High speed analog comparator
- General OPAMP : Stand-alone, unity gain selectable

### Digital Function
- Digital GPIO : 5V tolerant
- FLASH memory with Cache Function and Security Function
- One wire Debug Interface
  - The reading and writing of internal resource, the control of execution, the break of program execution and the writing of FLASH can be processed by one wire debug line.
- Interrupt Controller
  - Interrupt priority of 2 level, Independent vectors for each interrupt source, all GPIO can be set interrupt input.

### Product Specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MD6601FNVL*</th>
<th>MD6601FNV*</th>
<th>MD6602FNV*</th>
<th>MD6602FPV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Common</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Package</td>
<td>QFN-40</td>
<td>QFN-40</td>
<td>LQFP-64</td>
<td></td>
</tr>
<tr>
<td>Power Consumption(Typ.)</td>
<td>Digital : 150mW</td>
<td>Digital : 165mW</td>
<td>Analog : 20mW</td>
<td>Analog : 20mW</td>
</tr>
<tr>
<td><strong>Analog Function</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 bit A/D Converter</td>
<td>2 units, 4MSPS / unit, Dual Sample-hold mode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 bit A/D Converter</td>
<td>1 unit, 1MSPS / unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D/A Converter</td>
<td>12 bit voltage output × 1channel</td>
<td>10 bit voltage output × 4 channel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog Comparator</td>
<td>4 units</td>
<td>6 units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Purpose OPAMP</td>
<td>2 units</td>
<td>4 units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Sensor</td>
<td>The voltage according to temperature is output and is read by A/D converter.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Digital Function</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 bit 8051CPU</td>
<td>8051 / 8052 instruction compatible, execution cycle : 1 cycle (min.), 3 cycle (avg.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLASH Memory</td>
<td>16 KB</td>
<td>32 KB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal RAM</td>
<td>2 unit, 16 bit (MUL, MAC, DIV)</td>
<td>2 unit, 16 bit (Min./Max. saturation, constant register)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tiny DSP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Resolution PWM</td>
<td>2 phase PWM × 4 pairs, 1ns resolution (for duty and cycle), Duty Cut, Cycle Cut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSAC</td>
<td>8ch</td>
<td>16ch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 bit Timer</td>
<td>2 units, 16 bit counter Generates Interrupts</td>
<td>4 units, 16 bit counter Output Compare / Input Capture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPI / I2C / UART</td>
<td>Each 1 unit</td>
<td>Each 1 unit (Individual configurable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPIO</td>
<td>Digital × 12</td>
<td>Digital × 12</td>
<td>Analog × 16</td>
<td>Analog × 20</td>
</tr>
<tr>
<td></td>
<td>Analog × 16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WDT</td>
<td>1 unit (Watch Dog Timer to generate internal reset or interrupt request)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LVD</td>
<td>Low voltage detection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POR</td>
<td>Power on reset circuit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRC</td>
<td>Internal reference clock generator (10MHz)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLL</td>
<td>Frequency multiplication by 4 of external (crystal) clock, IRC clock (50 MHz max.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Packing specifications is reel. The others are tray.
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