

Selection Guide

■ IC for LED Lighting

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<https://www.sanken-ele.co.jp/en>

Contents

LED Driver IC Overview	P.3
Application	
• Off-line Buck Type (Low Power Application)	P.4
• Off-line Flyback Type (Low to Middle Power Application)	P.5
• DC/DC Converter	P.6
• High Power and Intelligent Application	P.7
Off-line LED Driver IC Selection Guide	P.8
DC/DC LED Driver IC Selection Guide	P.11
Selection Guide For High Power and Intelligent LED Lighting	P.15
Important Notes	P.18

LED Driver IC Overview

Downsized PCB

High Power and Smart Lighting

Spot light

LED bulb

Down light

LED fluorescent lamp

Ceiling light

Street light

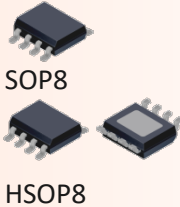


MR16



DC/DC

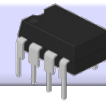
LC5700 Series



Isolated Flyback Convertor

- No PFC Circuit Required
- High Power Factor in Light Load (Class-C)

LC5540LD Series



High Power and Smart Application

PFC IC: SSC2016S (CRM Type)

Main Converter: LLC Type

Microcomputer: MD660x (8bit MCU)

DC/DC LED Driver IC

LC57xx (1ch)

Internal Power MOSFET

LC101N (1ch)

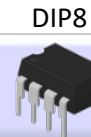
Balancer

Non-isolated Buck and Buck-boost Convertor

- Low Component Count
- High Power Factor
- High Power Factor (Class-C)

LC5560LD Series

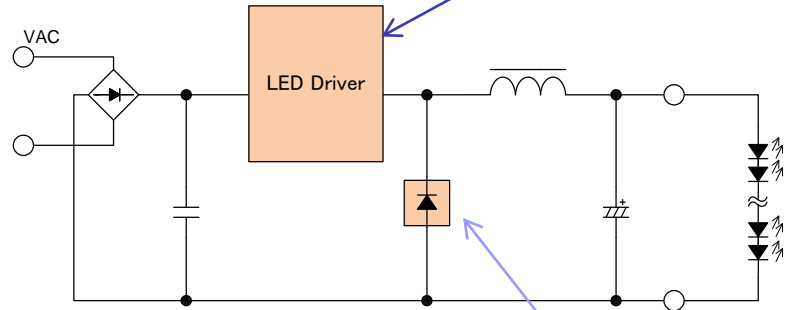
(Support of Buck, Buck-boost and Flyback circuit)



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

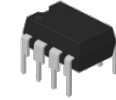
Off-line Buck Type (Low Power Application)

Buck Converter



LC5560LD Series

→P.10

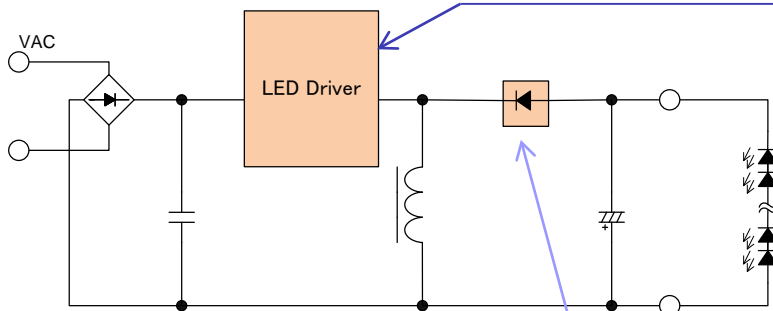


DIP8

- ✓ LED Bulb
- ✓ Down Light
- ✓ LED Fluorescent Lamp

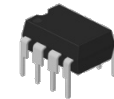
Freewheeling Diodes

Buck-boost Converter



LC5560LD Series

→P.10



DIP8

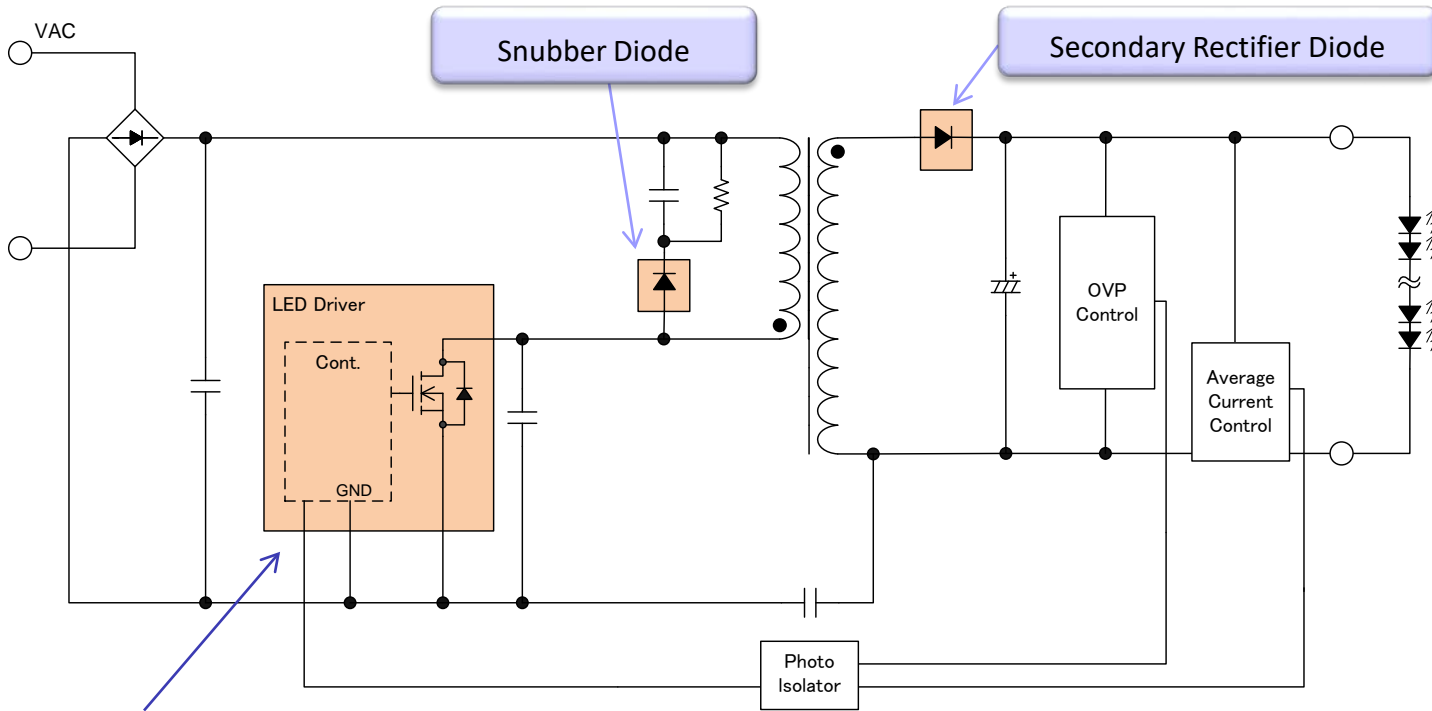
- ✓ LED Bulb
- ✓ Down Light
- ✓ LED Fluorescent Lamp

Freewheeling Diodes

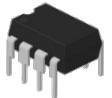
Note:

Refer to the selection guide of diode about peripheral diodes.

Off-line Flyback Type (Low to Middle Power Application)



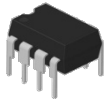
LED Driver within power MOSFET



DIP8

LC5540LD Series (Non-isolated Type)

- ✓ Down Light
- ✓ LED Fluorescent Lamp → [P.9](#)



DIP8

LC5560LD Series (Isolated Type)

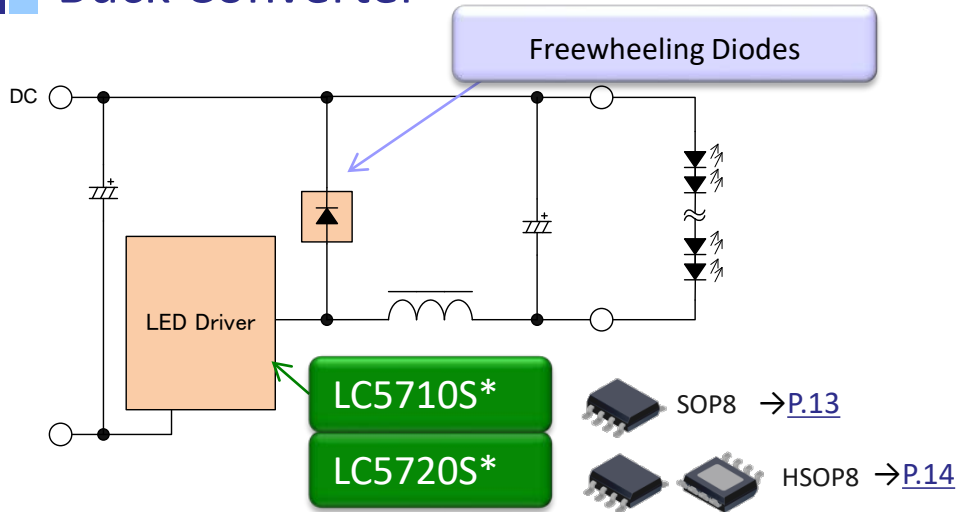
- ✓ LED Bulb
- ✓ Down Light
- ✓ LED Fluorescent Lamp → [P.10](#)

Note:

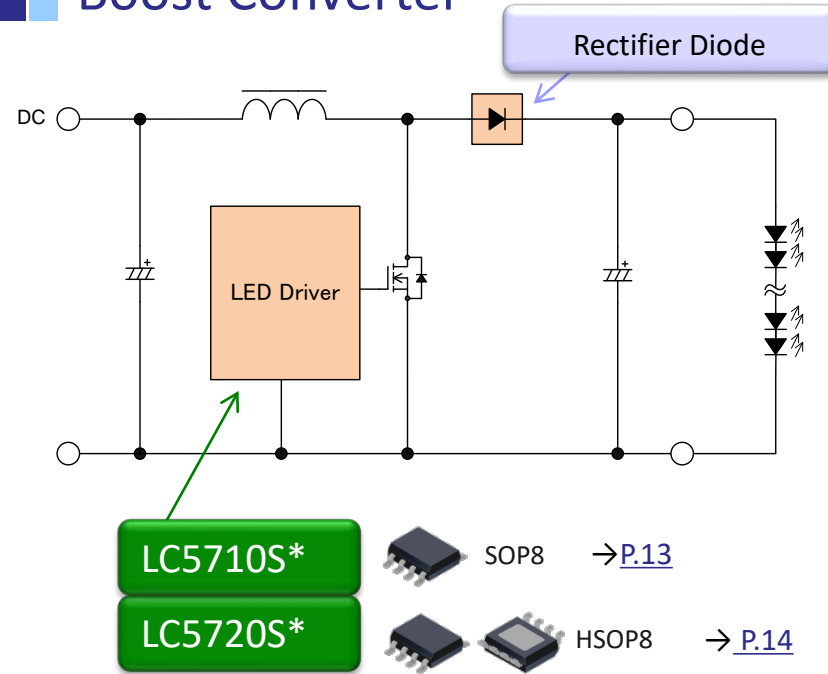
Peripheral diodes are shown in the selection guide of diode.

DC/DC Converter

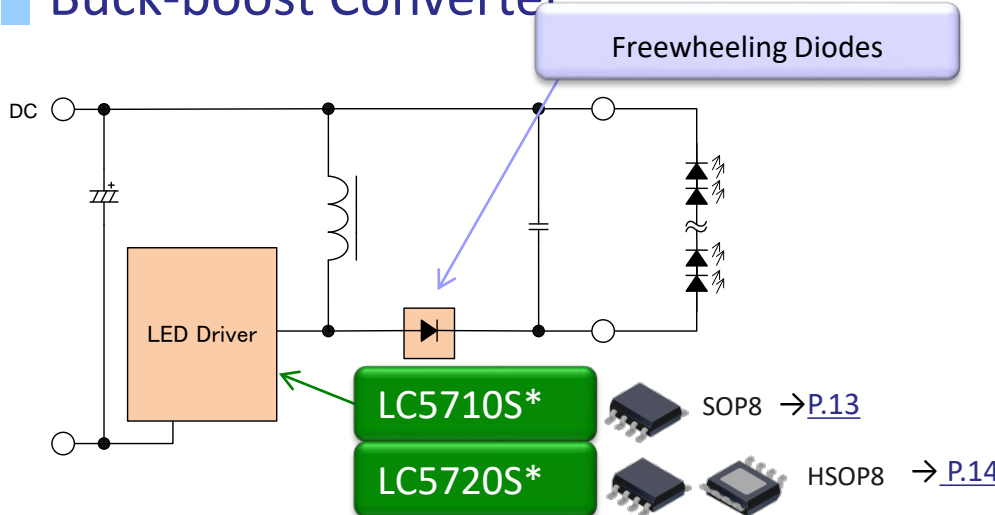
Buck Converter



Boost Converter



Buck-boost Converter

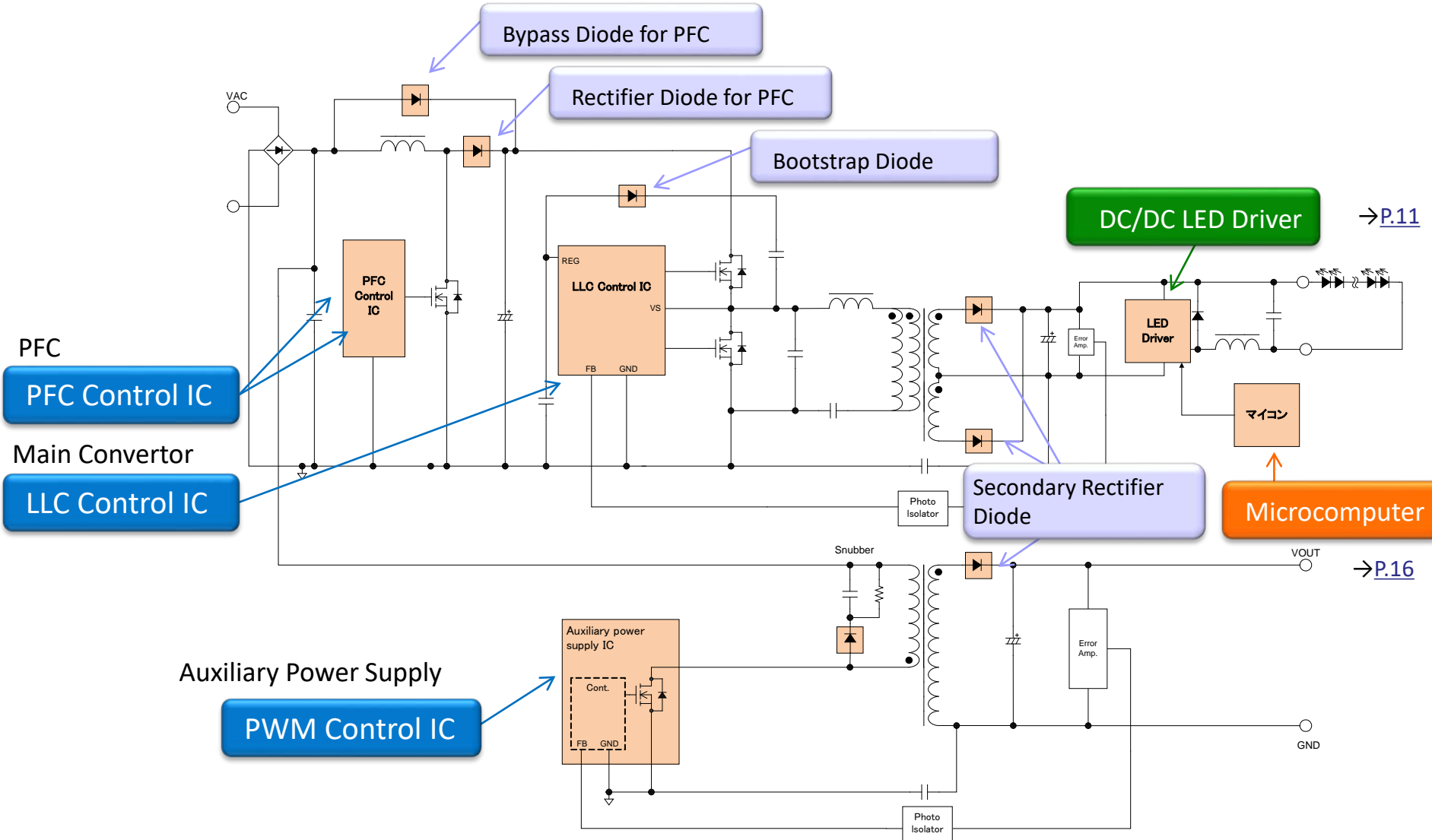


Note:

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



High Power and Smart Application



Notes:

- Peripheral diodes are shown in the selection guide of diode.
- PFC, LLC and PWM ICs are shown in selection guide of AC/DC Converter 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

Ceiling light



Street light



LED bulb

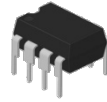
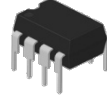


Down light



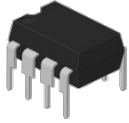
LED fluorescent lamp



Series	$V_{IN(MAX)}$	Package	Applications	Features	Page
LC5540LD	650 V	DIP8 	<ul style="list-style-type: none"> • Down light • LED fluorescent lamp 	<ul style="list-style-type: none"> • Isolated type 	P.9
LC5560LD	650 V	DIP8 	<ul style="list-style-type: none"> • LED bulb • Down light • LED fluorescent lamp 	<ul style="list-style-type: none"> • Non-isolated type • Dimming 	P.10

No Input Electrolytic Capacitor Required, IEC61000-3-2 class-C Isolated LED Driver IC LC5540LD Series

Package
DIP8



Selection Guide

Part Number	PWM Frequency	MOSFET		P _{OUT}	
		V _{DSS}	R _{DS(ON)}	AC230V	Universal
LC5545LD	72kHz	650V	3.95Ω	13W	10W
LC5546LD	60kHz		1.9Ω	20W	16W

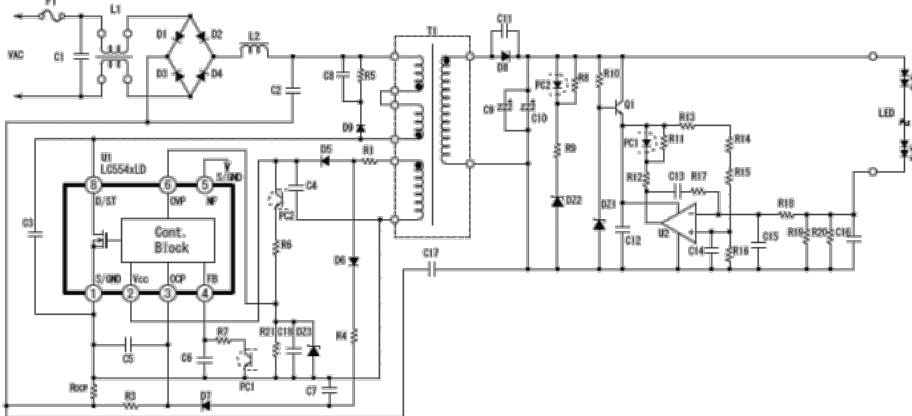
Features

- 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

Pin Configuration Definitions

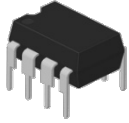
Pin Number	Symbol	Functions
1	S/GND	Power MOSFET source and ground
2	VCC	Supply voltage input and OVP signal input
3	OCP	OCP and QR signal input, and OVP signal input
4	FB	Feedback signal input and OLP signal input
5	NF	No function
6	OVP	OVP signal input
7	—	Pin removed
8	D/ST	Power MOSFET drain and startup current input

Typical Application



No Input Electrolytic Capacitor Required, IEC61000-3-2 Class-C Non-isolated LED Driver IC LC5560LD Series

Package
DIP8



Selection Guide

Part Number	PWM Frequency	Power MOSFET		P _{OUT}	
		V _{DSS}	R _{DS(ON)}	AC230V	Universal
LC5566LD	60 kHz	650V	1.9 Ω	20 W	16 W

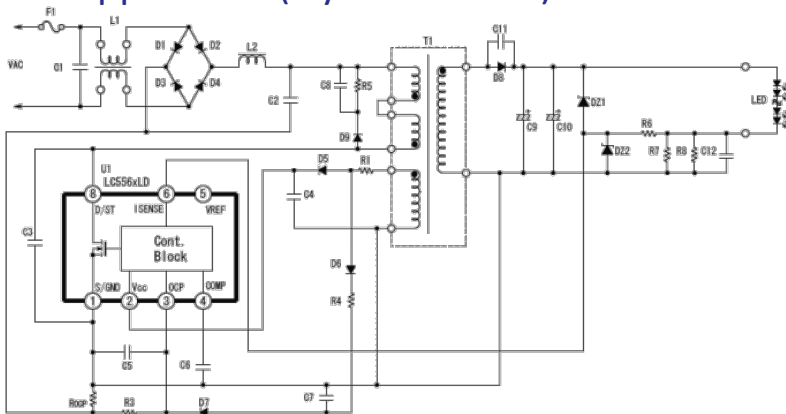
Features

- 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

Pin Configuration Definitions

Pin Number	Symbol	Functions
1	S/GND	Power MOSFET source and ground
2	VCC	Supply voltage input and OVP signal input
3	OCP	OCP and QR signal input, and OVP signal input
4	COMP	Feedback phase-compensation input
5	VREF	Dimming control signal input
6	ISENSE	Output current sensing voltage input
7	—	Pin removed
8	D/ST	Power MOSFET drain and startup current input

Typical Application (Flyback Circuit)



DC/DC LED Driver IC Selection Guide

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

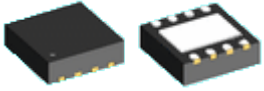


Series	Output Count	$V_{IN(MAX)}$	I_O	$V_{LED(MAX)}$	Package	Features	Page
LC101N (Current Balancer)	1	35 V	150 mA	35 V	DFN8 	Balancer	P.12
LC5710S	1	58 V	1.0 A	58 V	SOP8 	<ul style="list-style-type: none"> • Allows buck, buck-boost, and boost circuit • PWM dimming • Built-in power MOSFET 	P.13
LC5720S	1	50 V	2.0 A	50 V	HSOP8 	<ul style="list-style-type: none"> • Allows buck, buck-boost, and boost circuit • PWM dimming • Built-in power MOSFET 	P.14

$I_{LED} = 150 \text{ mA}$
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

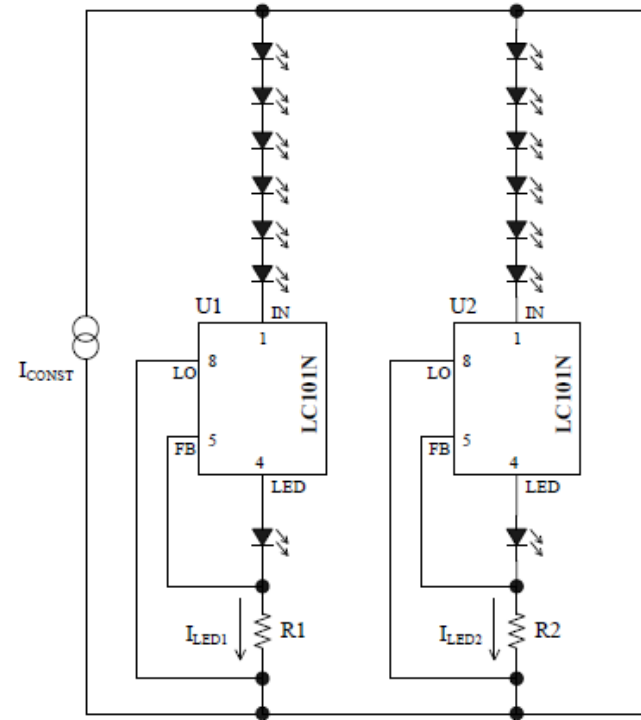
Selection Guide

Part Number	$I_{LED(MAX)}$	$V_{LED \text{ MAX}}$	V_{IN}	V_{FB}
LC101N	15 mA to 150 mA	35 V	2.4 V to 35 V	200 mV \pm 3%

Pin Configuration Definitions

Pin Number	Symbol	Functions
1	IN	Input
2, 3	NC	—
4	LED	Output
5	FB	LED current detection signal input (positive side)
6, 7	NC	—
8	LO	LED current detection signal input (negative side)

Typical Application

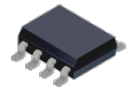


$I_{LED} = 1.0 A, V_{IN} = 5 V$ to 58 V
LED Driver for Buck, Buck-boost, and Boost Converter

LC5710S

Package

SOP8



Selection Guide

Part Number	$I_{LED(MAX)}$	V_{IN}	MOSFET $R_{DS(ON)}$	f_{osc}
LC5710S	1.0 A	5 V to 58 V	0.550 Ω (typ.)	100 kHz to 500 kHz

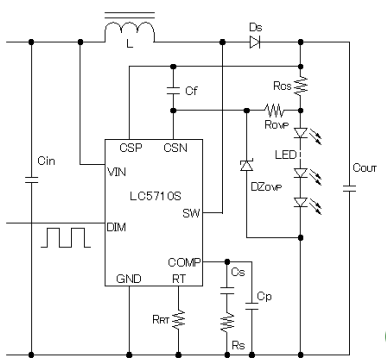
Features

- Allows Buck, Buck-boost, and Boost Circuit
- Maximum LED Current, $I_{LED} : 1.0 A$
- Adjustable Frequency Range: 100 kHz to 500 kHz
- $V_{CS} : 100 mV \pm 3 \%$
- 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

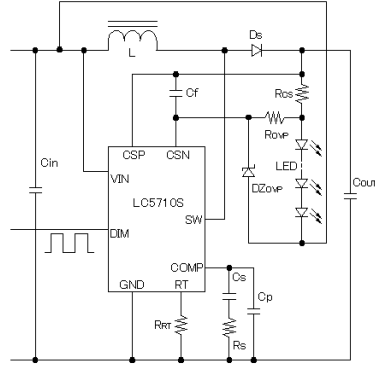
Pin Configuration Definitions

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

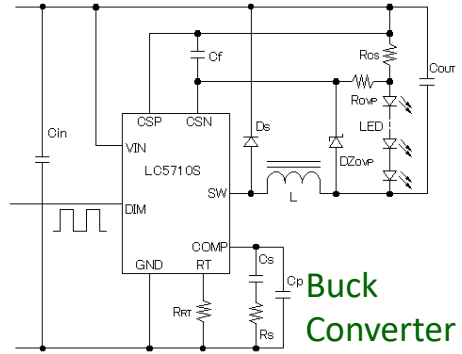
Typical Applications



Boost Converter



Buck-boost Converter



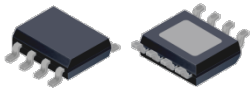
Buck Converter

$I_{LED} = 2.0\text{ A}$, $V_{IN} = 8.5\text{ V to }50\text{ V}$
LED Driver for Buck, Buck-boost, and Boost Converter

LC5720S

Package

HSOP8



Selection Guide

Part Number	$I_{LED(MAX)}$	V_{IN}	MOSFET $R_{DS(ON)}$	f_{osc}
LC5720S	2.0 A	9.5 V to 50 V	0.215 Ω (typ.)	500 kHz

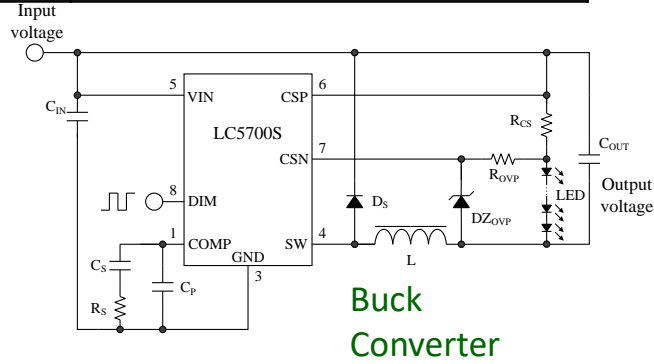
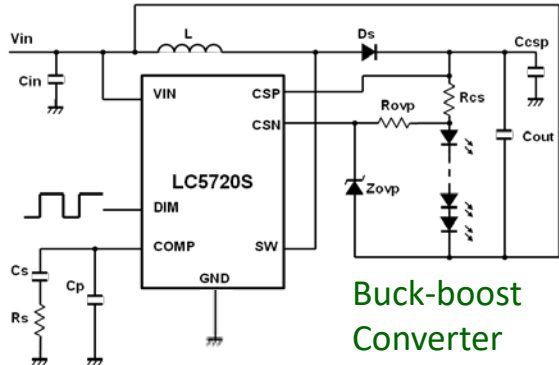
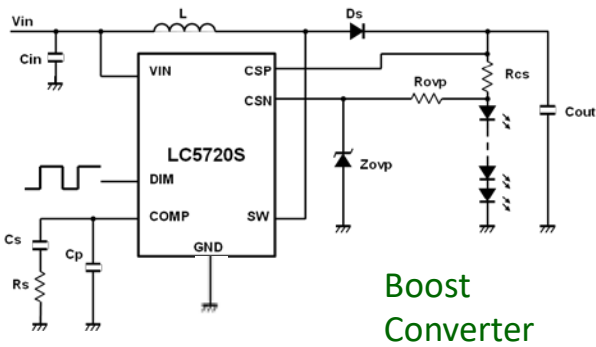
Features

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

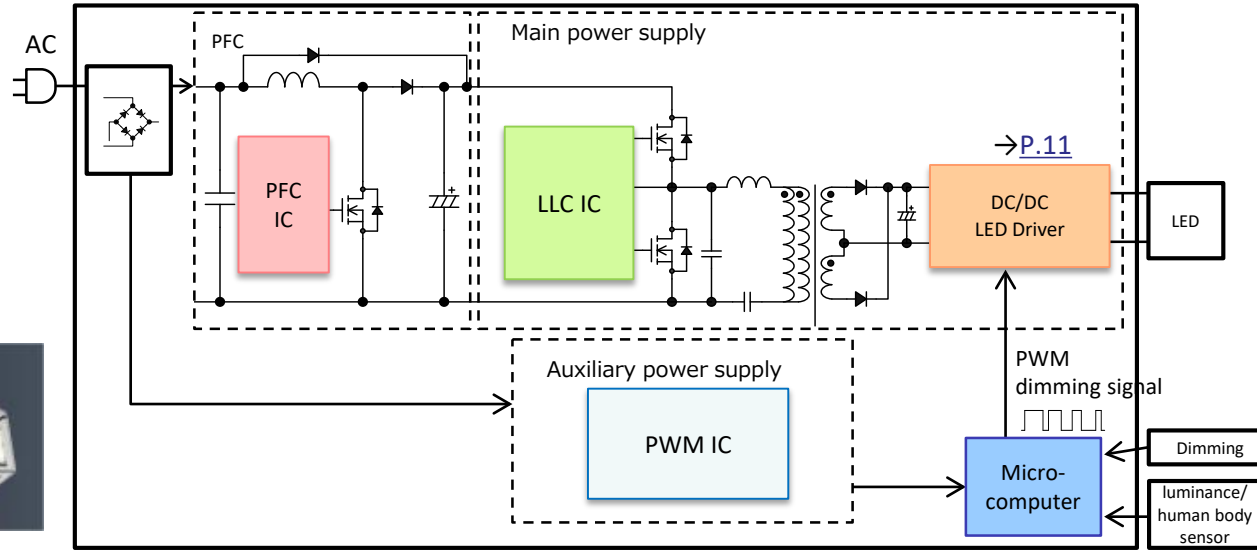
Pin Configuration Definitions

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

Typical Applications



- High Power Application
- PFC Circuit
- Including Microcomputer



Ceiling light with microcomputer



Street lamp



Down light



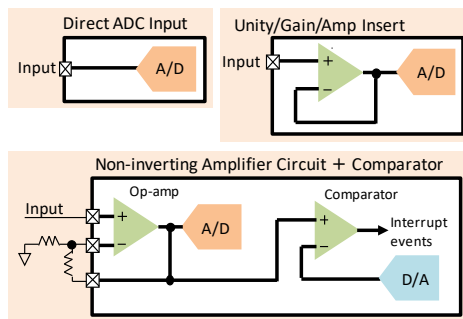
Application	Feature	Products	Page
PFC	CRM control	PFC IC	PFC, LLC and PWM ICs are shown in selection guide of AC/DC Converter and PFC.
Main convertor	✓ Low noise	LLC control ICs	
Auxiliary power supply	<ul style="list-style-type: none"> ✓ PWM control ✓ Low power consumption at no load < 25mW ✓ Flyback type ✓ Buck type (non-isolated) 	PWM control ICs	
Microcomputer	<ul style="list-style-type: none"> ✓ 8 bit MCU ✓ High Performance DSP ✓ High Resolution PWM 	MD660x Series	P.16

MD660x Series

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

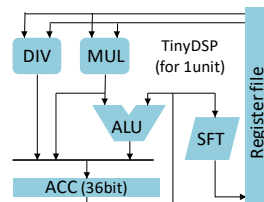
Rich Analog Component

Interconnections among analog components and external pins are configurable by programmable analog network. MD660x has A/D converter, analog comparators, general purpose OPAMPs.



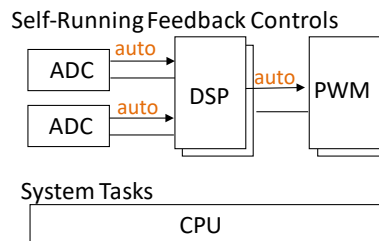
High Performance DSP Operations

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)

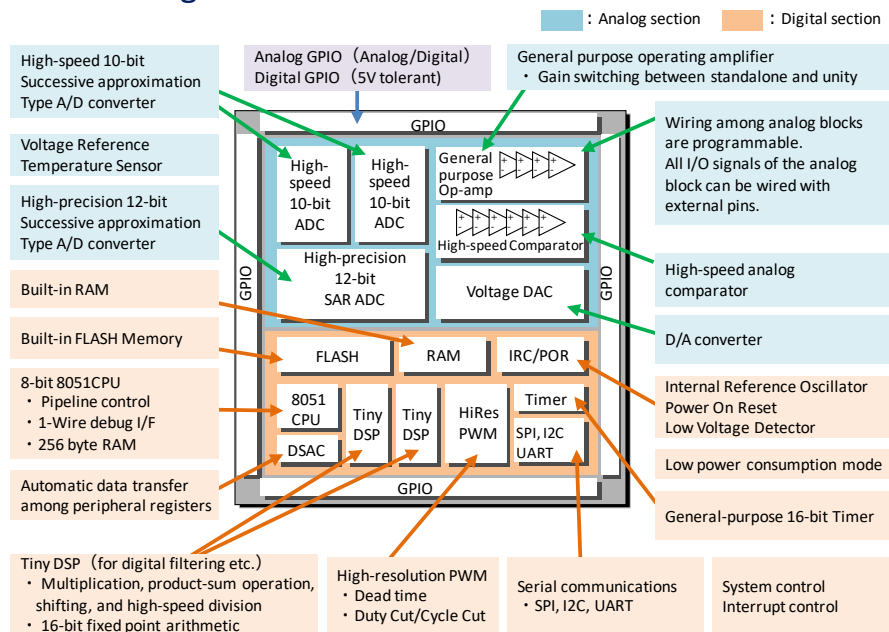
Automatic data transfer among the registers of the built-in peripheral functions. Also, automatic data transfer among the A/D converter, the Tiny DSP, and the PWM. Feedback control can be applied without the CPU, so that the CPU will focus on system processing such as anomaly detection or communications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



System Support Functions

FLASH Memory, Timer, Serial Communications, Oscillators, Reset Circuits, etc.

Block Diagram



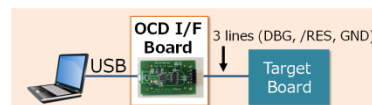
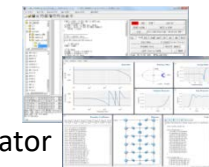
Development Support Software

- 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

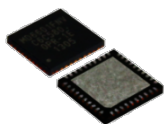
Packages

LQFP-64



10×10 (0.5pitch)

QFN-40



6×6 (0.5pitch)

Unit : mm

◆ 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

* Packing specifications is reel. The others are tray.

	Parameter	MD6601FNVL* MD6601FNV	MD6602FNVL* MD6602FNV	MD6602FPV
Common	Package	QFN-40	QFN-40	LQFP-64
	Power Consumption(Typ.)	Digital : 150mW Analog : 20mW	Digital : 165mW Analog : 20mW	
Analog Function	10 bit A/D Converter	2 units, 4MSPS / unit, Dual Sample-hold mode		
	12 bit A/D Converter	1 unit, 1MSPS / unit		
	D/A Converter	12 bit voltage output × 1channel	10 bit voltage output × 4 channel	
	Analog Comparator	4 units	6 units	
	General Purpose OPAMP	2 units	4 units	
	Voltage Reference	1.2 V output, middle point analog ground		
Temperature Sensor	The voltage according to temperature is output and is read by A/D converter.			
Digital Function	8 bit 8051CPU	8051 / 8052 instruction compatible, execution cycle : 1 cycle (min.), 3 cycle (avg.)		
	FLASH Memory	16 KB	32 KB	
	Internal RAM	1 KB (+ fast RAM(256B) directly connected to CPU)		
	Tiny DSP	2 unit, 16 bit (MUL, MAC, DIV)	2 unit, 16 bit (Min./Max. saturation, constant register)	
	High Resolution PWM	2 phase PWM × 4 pairs, 1ns resolution (for duty and cycle), Duty Cut, Cycle Cut		
	DSAC	8ch	16ch	
	16 bit Timer	2 units, 16 bit counter Generates Interrupts	4 units, 16 bit counter Output Compare / Input Capture	
	SPI / I2C / UART	Each 1 unit	Each 1 unit (Individual configurable)	
	GPIO	Digital × 12 Analog × 16	Digital × 12 Analog × 16	Digital × 26 Analog × 20
	WDT	1 unit (Watch Dog Timer to generate internal reset or interrupt request)		
	LVD	Low voltage detection		
	POR	Power on reset circuit		
	IRC	Internal reference clock generator (10MHz)		
PLL	Frequency multiplication by 4 of external (crystal) clock, IRC clock (50 MHz max.)			

Important Notes



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- No anti-radioactive ray design has been adopted for the SanKen Products.
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