Single-Stage Power Factor Corrected High Efficiency Non-Isolated Buck LED Driver

Features and Benefits

- PWM and quasi-resonant topology
- Integrated on-time control circuit (it realizes high power factor by average current control)
- Integrated soft-start circuit (reduces power stress during start-up on the incorporated power MOSFET and output rectifier)
- Integrated bias assist circuit (improves startup performance, suppresses V_{CC} voltage droop during operation, and allows use of low-rated ceramic capacitor on VCC pin)
- Integrated Leading Edge Blanking (LEB) circuit
- Integrated maximum on-time limit circuit
- Protection features:
  - ▫ Overcurrent protection (OCP): pulse-by-pulse
  - ▫ Overvoltage protection (OVP): latched shutdown
  - ▫ Overload protection (OLP): latched shutdown
  - ▫ Thermal shutdown (TSD): latched shutdown

Package: 8-pin DIP

Not to scale

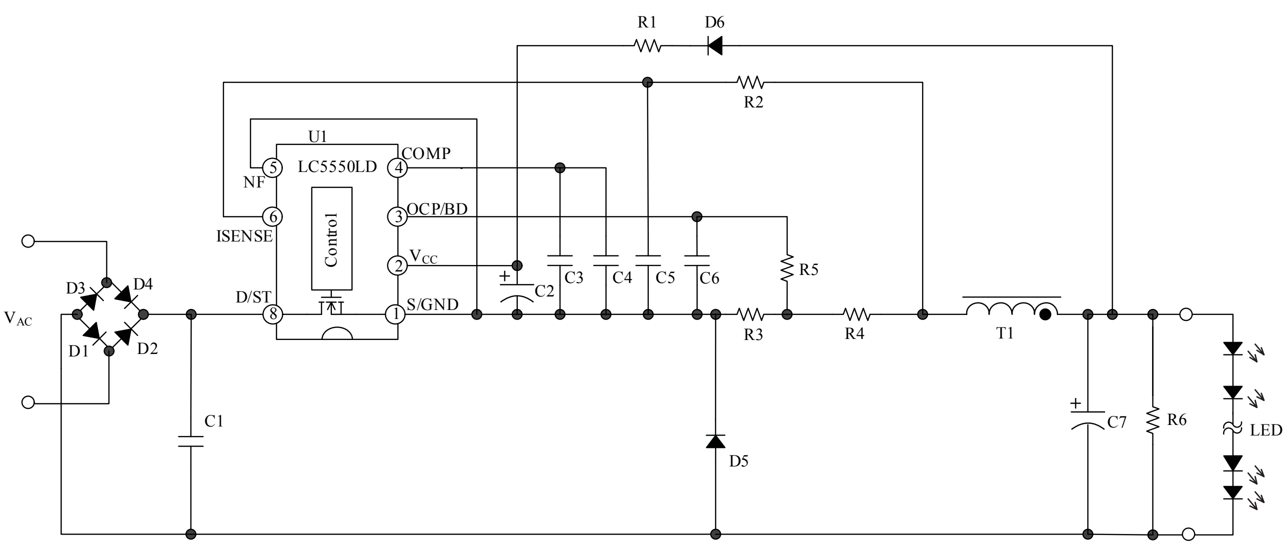
Description

LC5550LD series are PWM and quasi-resonant topology non-isolated buck LED driver ICs. They incorporate separate controller and power MOSFET chips, and are designed for input capacitorless applications. The controller adapts the average current control method for realizing high power factors. The rich set of protection features helps to realize low component counts, and high performance-to-cost power supply.

Applications

- LED lighting fixtures
- LED light bulbs

Typical Application



SANKEN ELECTRIC CO., LTD.

July 9, 2012

Selection Guide

Part Number	MOSFET V_{DSS}(min) (V)	$R_{DS(on)}$ (max) (Ω)	PWM Operation Frequency, f_{OSC}(typ) (kHz)	On-Time $t_{ON(MAX)}$(typ) (µs)
LC5555LD	650	3.95	72	9.3
LC5556LD	650	1.9	60	11.2

*Based on the thermal rating; the allowable maximum output power can be up to 120% to 140% of this value. However, maximum output power may be limited in such an application with low output voltage or short duty cycle.

The polarity value for current specifies a sink as "+," and a source as "−," referencing the IC.

LC5550LD Absolute Maximum Ratings Unless specifically noted, T_A is 25°C

Characteristic	Symbol	Notes		Pins	Rating	Unit
Drain Current[1]	I_{DPeak}	LC5555LD	Single pulse	8 – 1	2.5	A
		LC5556LD	Single pulse	8 – 1	4.0	A
Single Pulse Avalanche Energy[2]	E_{AS}	LC5555LD	I_{LPeak} = 2.0A, V_{DD} = 99 V, L = 20 mH	8 – 1	47	mJ
		LC5556LD	I_{LPeak} = 2.7A, V_{DD} = 99 V, L = 20 mH	8 – 1	86	mJ
Input Voltage for Control Part (MIC)	V_{CC}			2 – 1	35	V
OCP/BD Pin Voltage	V_{OCP}			3 – 1	−2.0 to 5.0	V
COMP Pin Voltage	V_{COMP}			4 – 1	−0.3 to 7.0	V
ISENSE Pin Voltage	V_{SEN}			6 – 1	−0.3 to 5.0	V
Allowable Power Dissipation of MOSFET[3]	P_{D1}	Mounted on a 15 mm × 15 mm PCB		8 – 1	0.97	W
Operating Ambient Temperature	T_{OP}			—−	55 to 125	°C
Storage Temperature	T_{stg}			—−	55 to 125	°C
Channel Temperature	T_{ch}			—	150	°C

[1]Refer to MOSFET Safe Operating Area Curve.
[2]Refer to MOSFET Avalanche Energy Derating Coefficient Curve.
[3]Refer to MOSFET Temperature versus Power Dissipation Curve.

LC5550LD Electrical Characteristics of Control Part (MIC) Unless specifically noted, T_A is 25°C, V_{CC} is 18 V

Characteristic	Symbol	Test Conditions		Pins	Min.	Typ.	Max.	Unit
Power Supply Startup Operation								
Operation Start Voltage	$V_{CC(ON)}$			2 – 1	13.8	15.1	17.3	V
Operation Stop Voltage*	$V_{CC(OFF)}$			2 – 1	8.4	9.4	10.7	V
Circuit Current in Operation	$I_{CC(ON)}$			2 – 1	–	–	4.7	mA
Startup Circuit Operation Voltage	$V_{STARTUP}$			8 – 1	18	21	24	V
Startup Current	$I_{CC(STARTUP)}$	V_{CC} = 13 V		2 – 1	−8.5	−4.0	−1.5	mA
Startup Current Threshold Biasing Voltage*	$V_{CC(BIAS)}$			2 – 1	9.5	11.0	12.5	V
Normal Operation								
PWM Operation Frequency	f_{OSC}	LC5555LD		8 – 1	60	72	84	kHz
		LC5556LD			50	60	70	kHz
Maximum On-Time	$t_{ON(MAX)}$	LC5555LD		8 – 1	8.0	9.3	11.2	μs
		LC5556LD			9.0	11.2	13.4	μs
COMP Pin Control Minimum Voltage	$V_{COMP(MIN)}$			4 – 1	0.30	0.55	0.80	V
Error Amplifier Reference Voltage	$V_{SEN(TH)}$			6 – 1	–0.21	–0.2	–0.19	V
Error Amplifier Source Current	$I_{SEN(SOURCE)}$			4 – 1	−36	−24	−12	μA
Error Amplifier Sink Current	$I_{SEN(SINK)}$			4 – 1	12	24	36	μA
Leading Edge Blanking Time	$t_{ON(LEB)}$			3 – 1	–	600	–	ns
Quasi-Resonant Operation Threshold Voltage-1	$V_{BD(TH1)}$			3 – 1	0.14	0.24	0.34	V
Quasi-Resonant Operation Threshold Voltage-2	$V_{BD(TH2)}$			3 – 1	0.11	0.16	0.21	V
Protected Operation								
OCP/BD Pin Overcurrent Protection (OCP) Threshold Voltage	V_{OCP}			3 – 1	−0.92	−0.8	−0.68	V
OCP.BD Pin Source Current	I_{OCP}			3 – 1	−120	−40	−10	μA
OCP/BD Pin Overvoltage Protection (OVP) Operation Voltage	$V_{BD(OVP)}$			3 – 1	2.2	2.6	3.0	V
Overload Protection (OLP) Threshold Voltage	$V_{COMP(OLP)}$			4 – 1	4.1	4.5	4.9	V
VCC Pin OVP Threshold Voltage	$V_{CC(OVP)}$			2 – 1	28.5	31.5	34.0	V
Thermal Shutdown Activating Temperature	$T_{J(TSD)}$			–	135	–	–	°C

*$V_{CC(BIAS)} > V_{CC(OFF)}$ always.

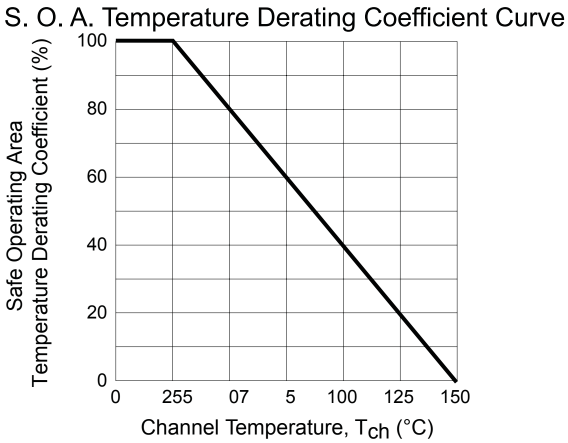
LC5550LD Electrical Characteristics of MOSFET Unless specifically noted, T_A is 25°C

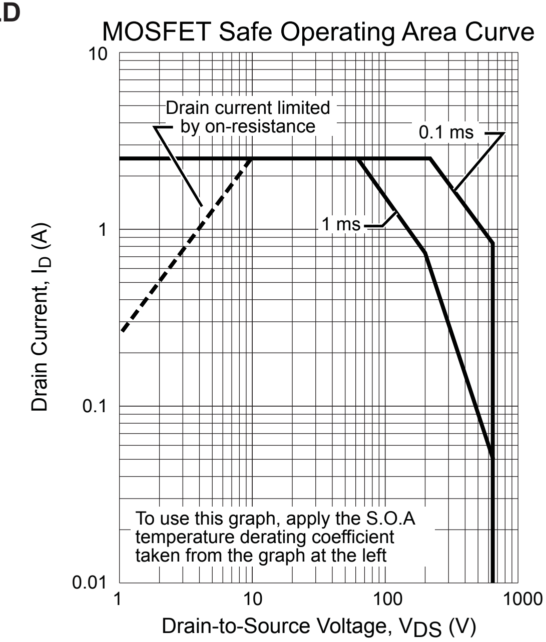
Characteristic	Symbol		Test Conditions	Pins	Min.	Typ.	Max.	Unit
Drain-to-Source Breakdown Voltage	V_{DSS}			8 – 1	650	—	—	V
Drain Leakage Current	I_{DSS}			8 – 1	—	—	300	μA
On-Resistance	$R_{DS(ON)}$	LC5555LD		8 – 1	——		3.95	Ω
		LC5556LD			——		1.9	Ω
Switching Time	t_f	LC5555LD		8 – 1	——		250	ns
		LC5556LD			——		400	ns
Thermal Resistance*	$R_{\theta ch\text{-}c}$	LC5555LD		—	——		42	°C/W
		LC5556LD			——		35.5	°C/W

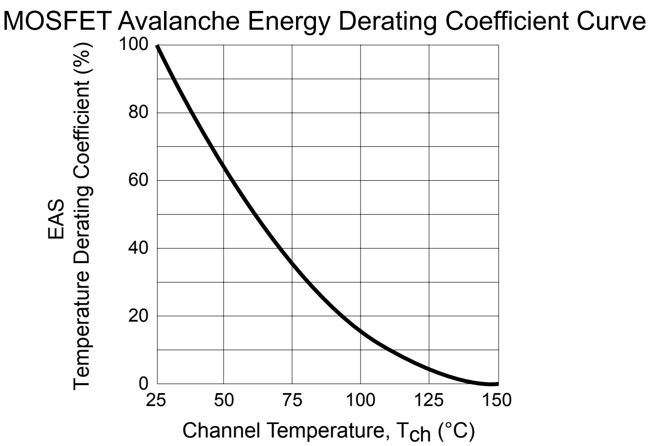
*The thermal resistance between the channels of the MOSFET and the case. T_C measured at the center of the case marked side.

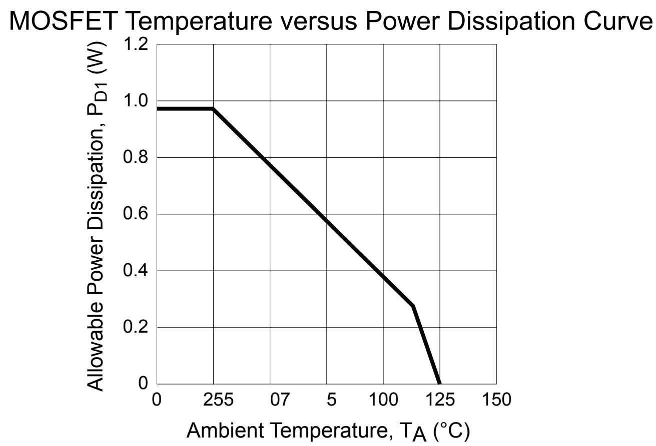
Characteristic Performance

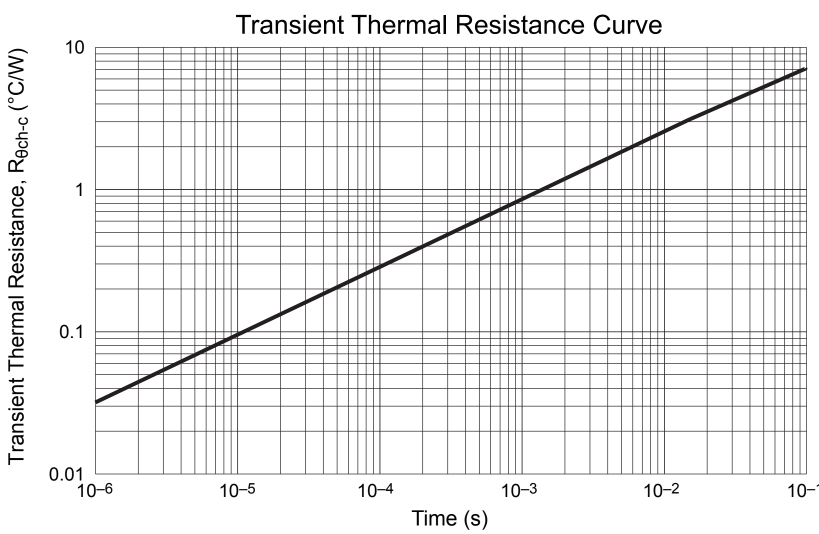
LC5555LD







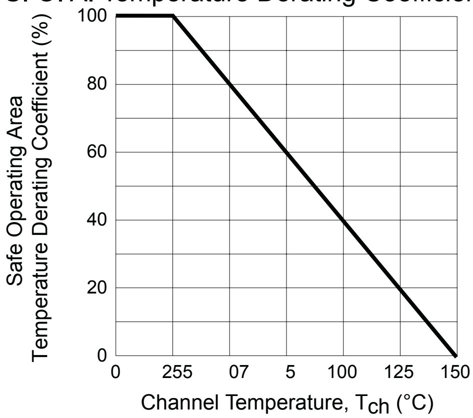




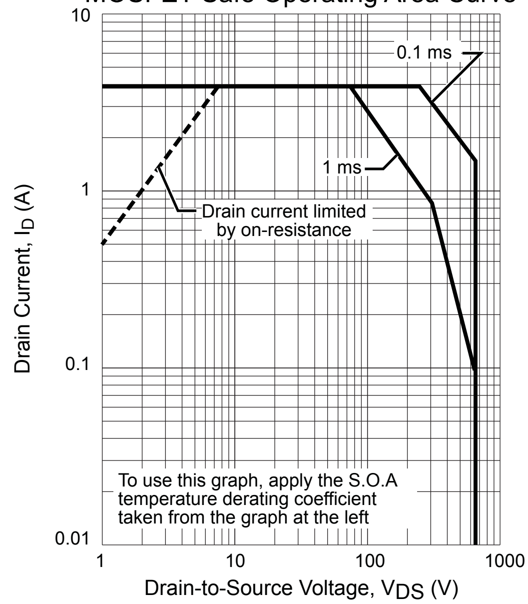
Characteristic Performance

LC5556LD

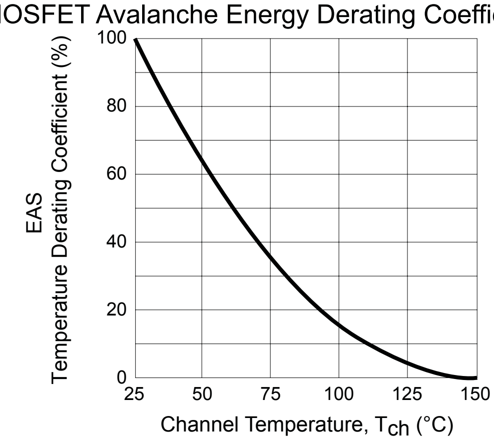
S. O. A. Temperature Derating Coefficient Curve



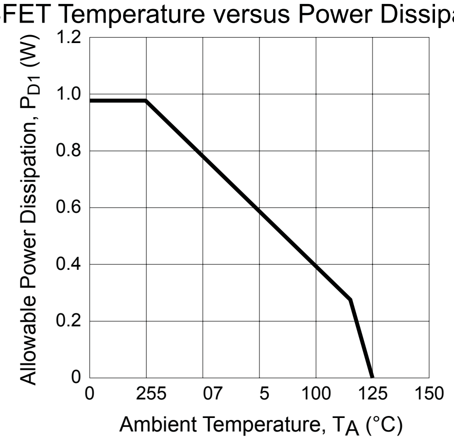
MOSFET Safe Operating Area Curve



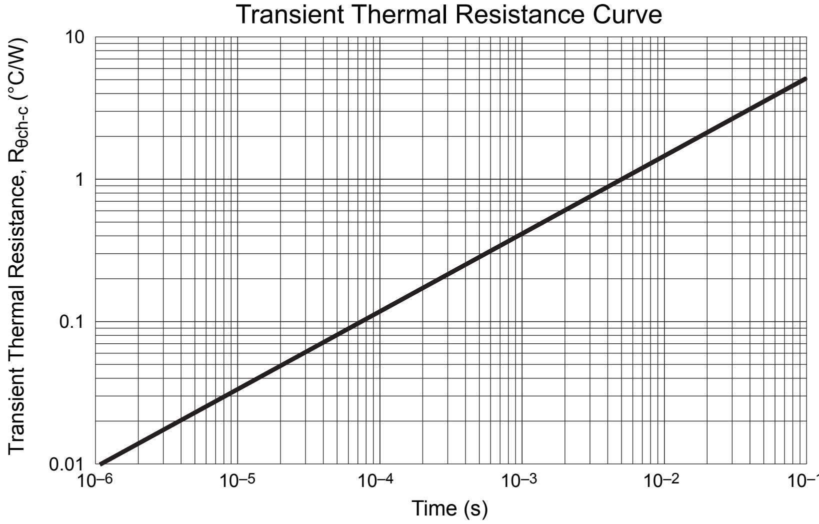
MOSFET Avalanche Energy Derating Coefficient Curve



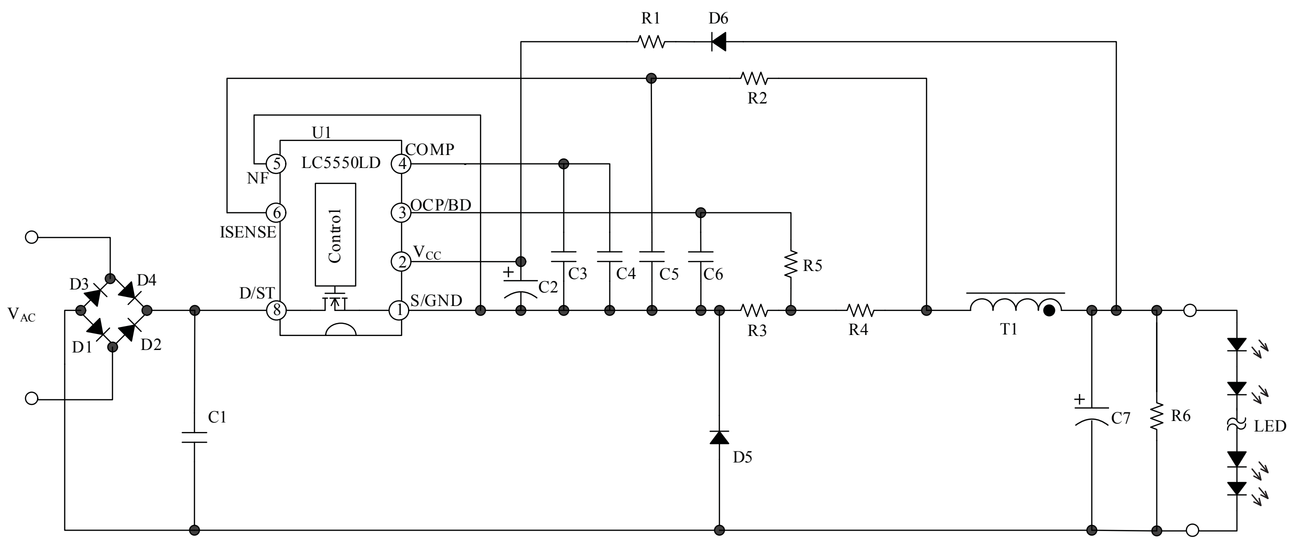
MOSFET Temperature versus Power Dissipation Curve



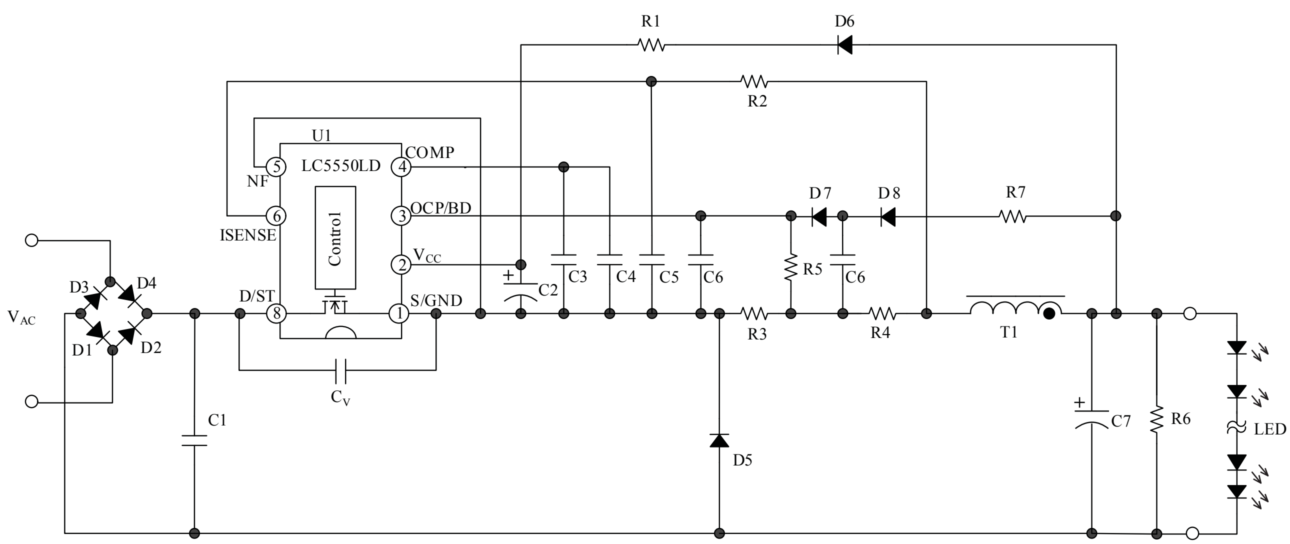
Transient Thermal Resistance Curve



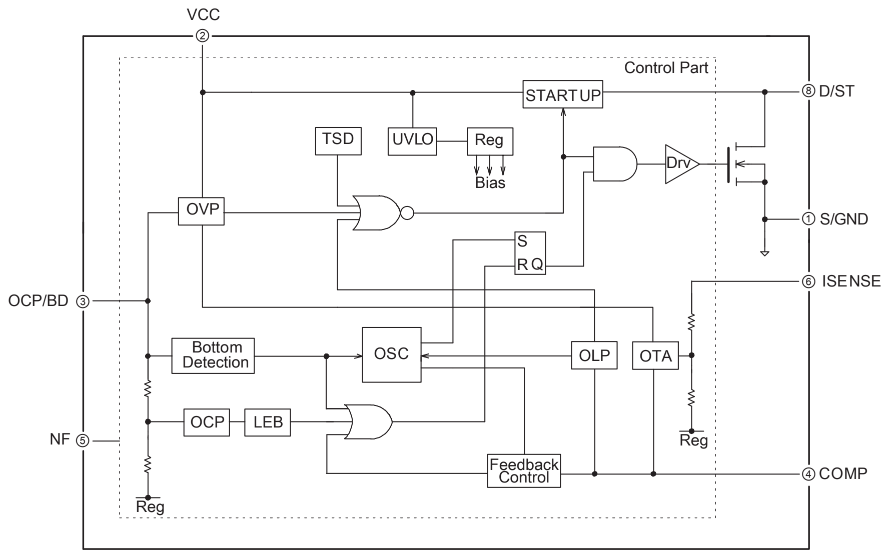
Typical Application Circuit 1, PWM Topology



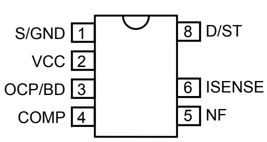
Typical Application Circuit 2, Quasi-Resonant Topology



Functional Block Diagram



Pin-out Diagram

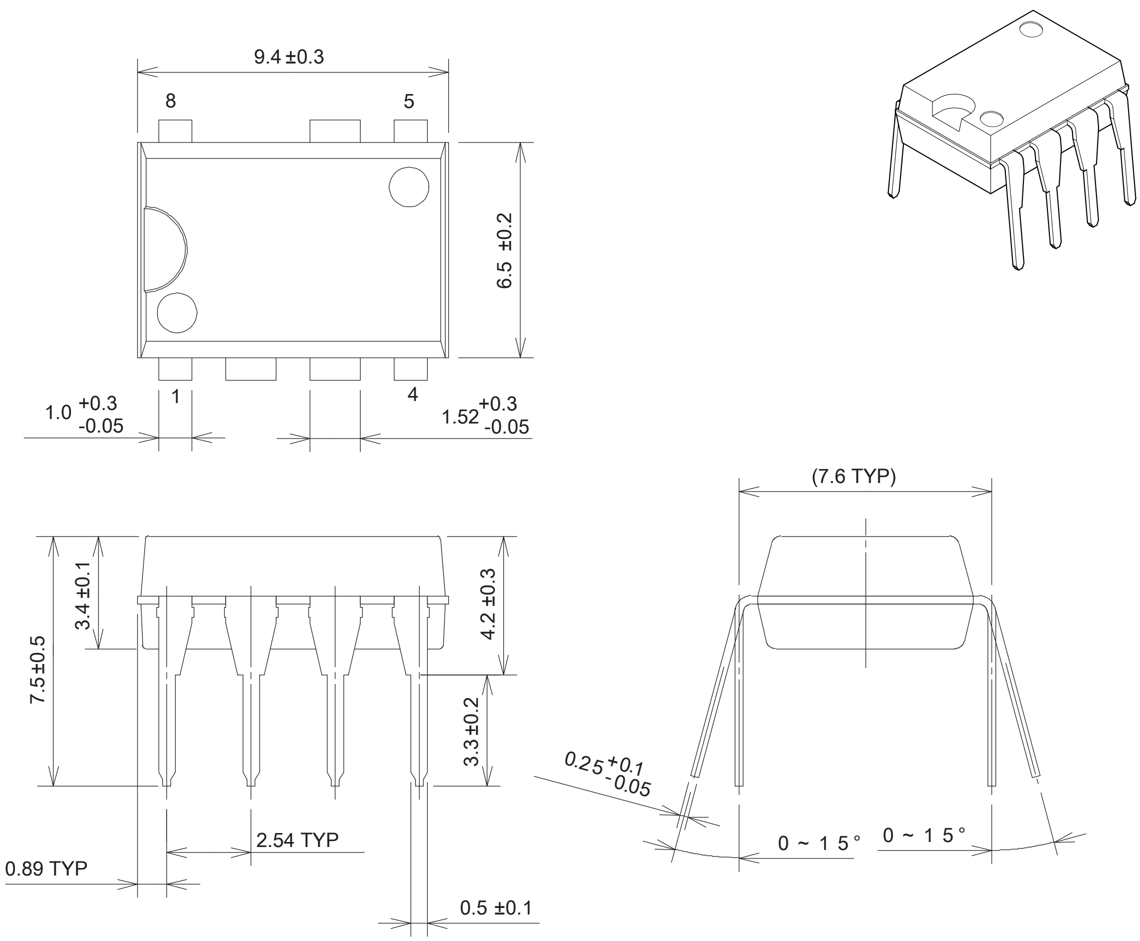


Pin List Table

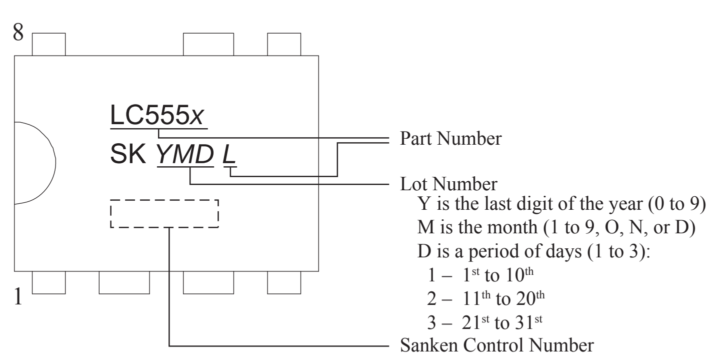
Number	Name	Function
1	S/GND	MOSFET source and GND pin for the Control Part
2	VCC	Supply voltage input and Overvoltage Protection (OVP) signal input
3	OCP/BD	Overcurrent Protection (OCP), quasi-resonant signal input, and Overvoltage Protection (OVP) signal input
4	COMP	Feedback phase-compensation input
5	NF	No function; must be externally connected to S/GND pin with as short a trace as possible, for stable operation of the IC
6	ISENSE	Output current sensing voltage input
7	–	Pin removed
8	D/ST	MOSFET drain pin and input of the startup current

Package Diagram

DIP8 package



Unit: mm



Pb-free. Device composition compliant with the RoHS directive.

Because reliability can be affected adversely by improper storage environments and handling methods, please observe the following cautions.

Cautions for Storage

- Ensure that storage conditions comply with the standard temperature (5°C to 35°C) and the standard relative humidity (around 40% to 75%); avoid storage locations that experience extreme changes in temperature or humidity.
- Avoid locations where dust or harmful gases are present and avoid direct sunlight.
- Reinspect for rust on leads and solderability of the products that have been stored for a long time.

Cautions for Testing and Handling

When tests are carried out during inspection testing and other standard test periods, protect the products from power surges from the testing device, shorts between the product pins, and wrong connections. Ensure all test parameters are within the ratings specified by Sanken for the products.

Remarks About Using Silicone Grease with a Heatsink

- When silicone grease is used in mounting the products on a heatsink, it shall be applied evenly and thinly. If more silicone grease than required is applied, it may produce excess stress.
- Volatile-type silicone greases may crack after long periods of time, resulting in reduced heat radiation effect. Silicone greases with low consistency (hard grease) may cause cracks in the mold resin when screwing the products to a heatsink.

  Our recommended silicone greases for heat radiation purposes, which will not cause any adverse effect on the product life, are indicated below:

Type	Suppliers
G746	Shin-Etsu Chemical Co., Ltd.
YG6260	Momentive Performance Materials Inc.
SC102	Dow Corning Toray Co., Ltd.

Soldering

- When soldering the products, please be sure to minimize the working time, within the following limits:
  260±5°C 10±1 s (Flow, 2 times)
  380±10°C 3.5±0.5 s (Soldering iron, 1 time)
- Soldering should be at a distance of at least 1.5 mm from the body of the products.

Electrostatic Discharge

- When handling the products, the operator must be grounded. Grounded wrist straps worn should have at least 1 MΩ of resistance from the operator to ground to prevent shock hazard, and it should be placed near the operator.
- Workbenches where the products are handled should be grounded and be provided with conductive table and floor mats.
- When using measuring equipment such as a curve tracer, the equipment should be grounded.
- When soldering the products, the head of soldering irons or the solder bath must be grounded in order to prevent leak voltages generated by them from being applied to the products.
- The products should always be stored and transported in Sanken shipping containers or conductive containers, or be wrapped in aluminum foil.