Features

- Integrated 650V MOSFET
- Multi-Mode Operation
  CCM @ Heavy Load and Low Line
  QR-Like Operation @ Medium Load
  Green mode with Valley Skip at Light Load
  Burst Mode at No Load
- No noise work
- Fixed 65KHz(typical) switching frequency
- Ultra Low start-up and low operation current
- Power on soft-start
- Vac over voltage protection Line-ovp function
- Vac under voltage protection Brown-out function
- Over voltage protection(OVP),Over temperature protection(OTP), VDD under voltage lockout with hysteresis(UVLO)
- DIP7 Package

Applications

- AC/DC Adapter
- Cell Phone Charger
- Auxiliary power supply for PC and Server
- Linear Regulator/RCC Replacement

General Description

SP6669P is a high performance multi-mode (QR/CCM) PWM controller for flyback converter. The chip consumes very low start-up and operation current. It achieves less than 75mW standby power to meet strict standby power standard. SP6669P offers comprehensive protection coverage with auto-recovery feature including Cycle-by-Cycle current limiting, Diode Short Protection, Output over voltage protection, VDD over voltage protection (OVP), feedback loop open protection, load short circuit protection, VDD under voltage lockout with hysteresis (UVLO), Brown-out and Line-ovp function.
SP6669P is offered in DIP7 packages.

Simplified Application

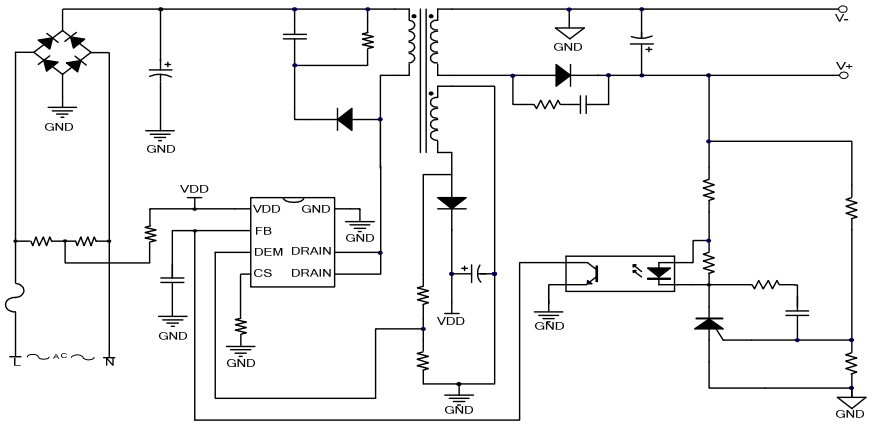
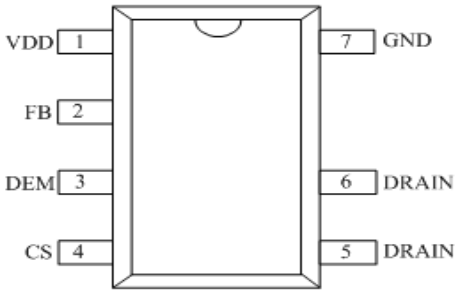


Figure 1.Simplified Application of SP6669P

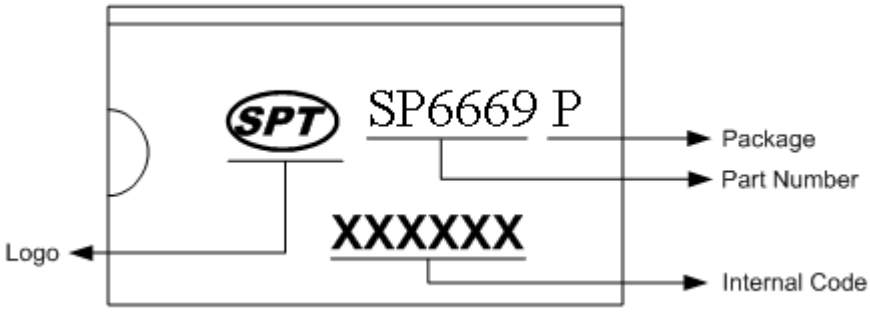
Pin Function Description



Pin No.	Pin Name	Function Description
1	VDD	Power Supply for IC
2	FB	The voltage feedback from auxiliary winding
3	DEM	Adjust output OVP trigger voltage, Brown-out trigger voltage, Line OVP trigger voltage and detect transformer core demagnetization
4	CS	Current Sense Input Pin
5,6	Drain	Connected to the Drain of Internal Power MOSFET
7	GND	Ground

Ordering and Marking Information

Part Number	Package Description	Top Marking	Package Form
SP6669P	DIP7, Pb-free	SP6669P	DIP7



Package Dissipation Rating

Package	θ_{JC} (℃/W)	θ_{JA} (℃/W)
DIP7	20	75

Absolute Maximum Ratings

Symbol	Description	Value	Units
V_{DRAIN_MAX}	Drain Input Voltage	650	V
V_{DD}	VDD Input Voltage	-0.3 to 40	V
V_{FB}	FB Input Voltage	-0.3 to 7	V
V_{CS}	CS Input Voltage	-0.3 to 7	V
T_J	Operating Junction Temperature	-40 to 150	℃
$T_{STORAGE}$	Min/Max Storage Temperature	-55 to 150	℃
T_L	Lead Temperature (Soldering. 10secs)	260	℃

Note: Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Symbol	Description	Value	Units
VDD	VDD Supply Voltage	9~28	V

Output Power Table

Part Number	90VAC to 265VAC	
	Adapter[1]	Open Frame[2]
SP6669P	24W	27W

Note:

1. Maximum continuous power in a typical non-ventilated enclosed adapter measured at +45℃ ambient, T_{CASE}＜120℃.
2. Maximum continuous power in an open frame design with adequate heatsinking measured at +25℃ ambient, T_{CASE} ＜120℃.

Block Diagram

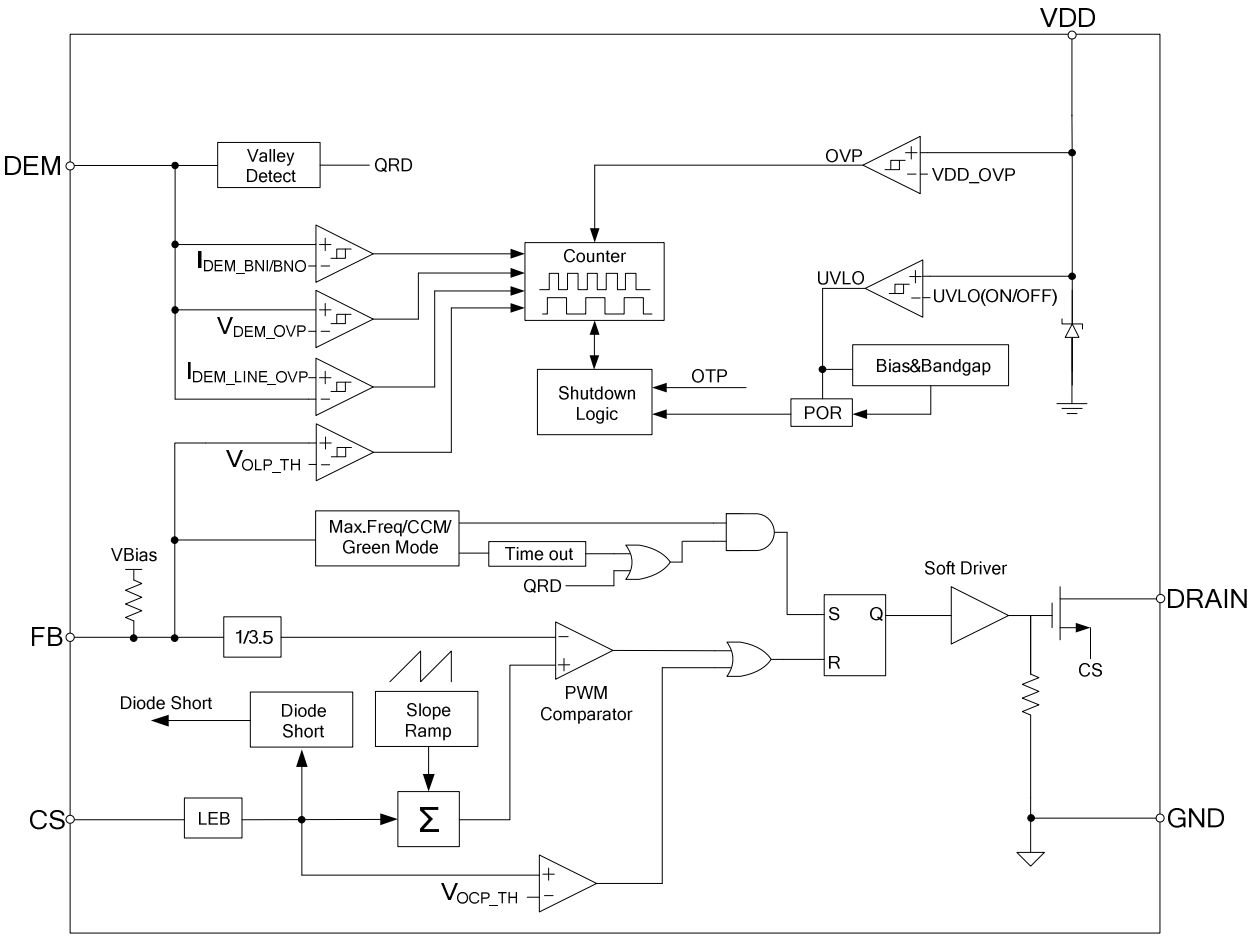


Figure 2.Block diagram of SP6669P

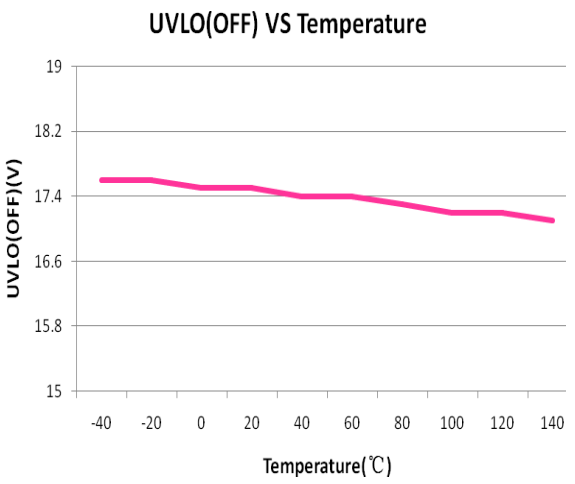
Electrical Characteristics

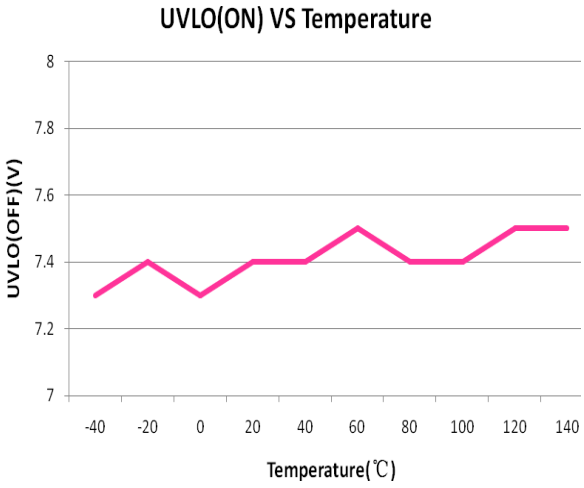
VDD=18V, TA=25℃, unless otherwise noted.

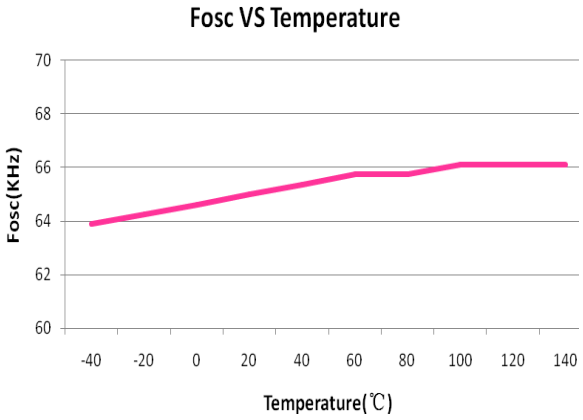
Symbol	Description	Test Conditions	Min.	Typ.	Max.	Units
Supply Voltage Section						
$I_{start-up}$	Start Up Current	VDD=$V_{UVLO(OFF)}$-1V	0	1	2	uA
I_{OP1}	Operating Current	FB=3.5V		1.8		mA
I_{OP2}	Operating Current	FB=0.5V		0.5		mA
UVLO(ON)	VDD Under Voltage Lockout Enter	VDD Going Down	7	7.5	8	V
UVLO(OFF)	VDD Under Voltage Lockout Exit	VDD Going Up	16	17	18	V
VDD_OVP	VDD Over Voltage Protection		30	31.5	33	V
VDD_ET	Extended Burst Mode Voltage		7.7	8.2	8.7	V
Current Sense Input Section						
V_{TH_OC}	Over Current Threshold			0.45		V
$V_{TH\_OC\_CLAMP}$	Over Current Threshold Clamp Voltage			0.72		V
T_{LEB}	Leading-edge Blanking Time			300		nS
T_{D_OUTPUT}	Delay To Output			90		nS
$T_{SOFTSTART}$	Soft Start Time			2.5		ms
FB Input Section						
I_{FB_SHORT}	FB pin Short Circuit Current	Short FB to GND		210		uA
V_{FB_OPEN}	FB pin Open Loop Voltage		4.6	5.1	5.6	V
A_{VCS}	PWM input gain			3.5		V/V
D_{max}	Maximum Duty			80		%
V_{SMAX}	Maximum Frequency Threshold		1.6	1.7	1.8	V
V_{FB_GREEN}	Green Mode Threshold			2.1		V
$V_{FB\_BURST\_L}$	Threshold Voltage Exits Burst Mode			1.33		V
$V_{FB\_BURST\_H}$	Threshold Voltage Enters Burst Mode			1.23		V
V_{OLP_TH}	Over Load Protection Threshold		4	4.4	4.8	V
T_{D_OLP}	Over Load Protection Delay Time			60		ms
Demagnetic detection(DEM)						
I_{BROWN_OUT}	Threshold current of Under-current Protection			100		uA
T_{D_BNO}	Delay Time of Under-current Protection			30		ms
$I_{\_LINEOVP}$	Threshold current of Over-current Protection			440		uA
$T_{D\_LINEOVP}$	Delay Time of Over-current Protection			120		ms
V_{DEM_OVP}	Over-voltage Protection			3		V
T_{D_OVP}	Delay Time			6		Cycles
Oscillator						
F_{OSC}	Normal Oscillation Frequency		60	65	70	KHz
$\triangle f_{\_TEMP}$	Frequency Temperature Stability			1		%

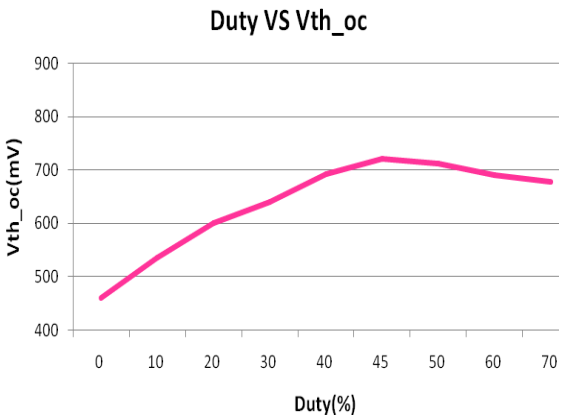
△f_VDD	Frequency VDD Voltage Stability			1		%
F_SHUFFLING	Shuffling Frequency			32		Hz
F_BURST	Burst Mode Switch Frequency			23		KHz
△f_OSC	Jitter Frequency		-6		+6	%
Drain						
RDS(ON)	Static Drain To Source On Resistance				1.8	Ω
BVDSS	Drain-Source Breakdown Voltage		650			V
Over Temperature Protection(OTP)						
T_{OTP}	Over Temperature Trigger Point			150		℃
T_HY	Hysteresis			30		℃

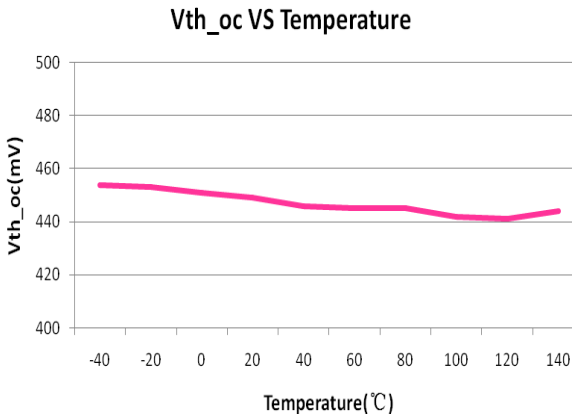
Typical Performance Characteristics

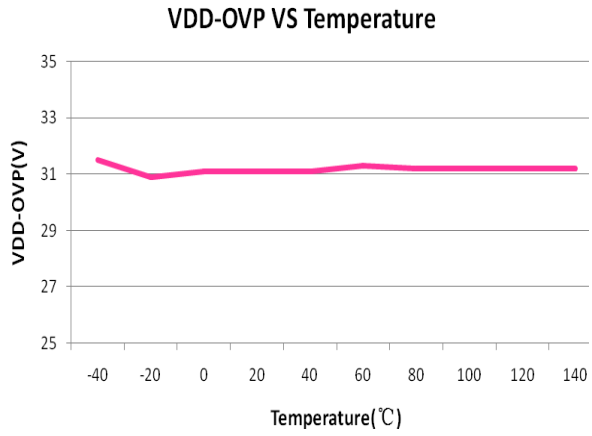




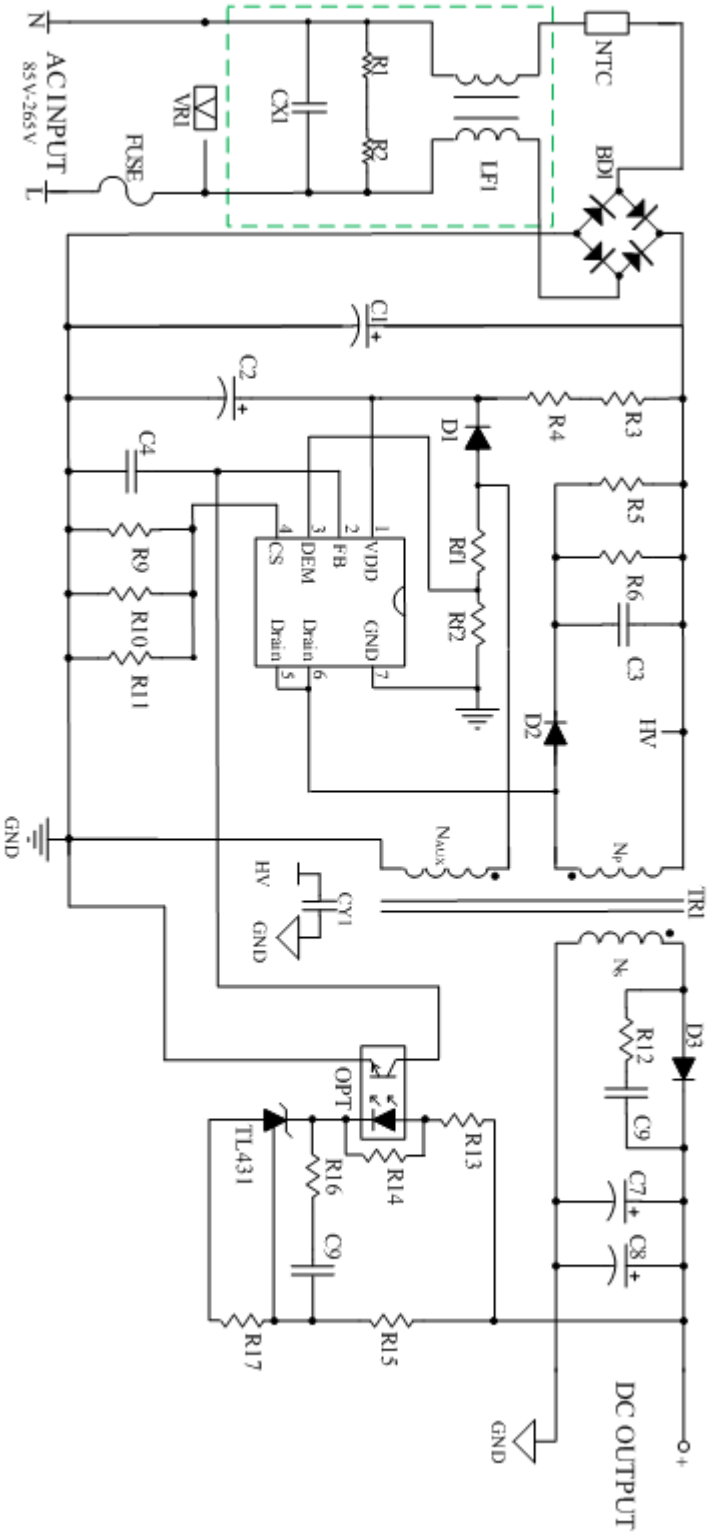








Applications Example



Functional Description

SP6669P is a high performance multi-mode(QR/CCM) PWM controller for flyback converter. The load is feed back to the controller, and the controller automatically adjusts the operation mode for improve efficiency.

Fast Start up Control

Startup current of SP6669P is designed to be very low, so very low start-up current allows the PWM controller to increase the value of start-up resistor and then reduce the power dissipation on it.

Operating Current

The Operating current of SP6669P is as low as 1.8mA (typical). Good efficiency is achieved with the 'Extended burst mode' control features.

Soft Start

SP6669P features an internal 2.5ms (typical) soft start to soften the electrical stress occurring in the power supply during startup. As soon as VDD reaches UVLO(OFF), the peak current is gradually increased from nearly zero to the maximum level ,and every restart is followed by a soft start.

Multi-Mode Operation

SP6669P is a multi-mode QR/CCM controller. At light load conditional, the voltage of FB is lower than V_{FB_GREEN} and the system operates in green mode for high power conversion efficiency, the frequency is 25KHz. As the output load current is increased, voltage of FB is increased, the IC operates in QR mode, in this mode, voltage of FB determines the maximum operating frequency, IC will be operated at the first valley after maximum frequency. The output load current is further increased, the IC operates in CCM mode, the maximum frequency is 65KHz.

Frequency shuffling

A built-in frequency shuffling is constructed in SP6669P.The oscillation frequency is modulated so that the tone energy is spread out. The spread spectrum minimizes the conduction band EMI and therefore eases the system design.

Burst Mode Operation

A light load or no load condition, most of the power dissipation in a switching mode power supply is from switching loss on the MOSFET, the core loss of the transformer and the loss on the snubber circuit. The magnitude of power loss is in proportion to the switching frequency. Lower switching frequency leads to the reduction on the power loss and thus conserves the energy.

The switching frequency reduces at light or no load condition to improve the conversion efficiency, the FB in put drops below Burst Mode threshold level and device enters Burst Mode control. The gate pin will be disabled immediately under such condition, enhancing power saving.

Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in SP6669P current mode PWM control. The switch current is detected by a sense resistor into the sense pin. An internal leading edge blanking circuit chops off the sensed voltage spike at initial internal power MOSFET on state due to snubber diode reverse recovery and surge gate current of internal power MOSFET so that the external RC filtering on sense input is no longer needed. The current limiting comparator is disabled and cannot turn off the internal power MOSFET during the blanking period. The PWM duty cycle is determined by the current sense input voltage and the FB input voltage.

Internal Synchronized Slope Compensation

Built-in slope compensation circuit adds voltage ramp to the current sense voltage across the CS pin. This greatly improves the close loop stability at CCM and prevents the sub-harmonic oscillations.

Driver

For most power control circuit, too weak the gate drive strength results in higher conduction and switch loss of MOSFET while too strong gate drive results in the compromise of EMI.

A good trade off is achieved through the built-in totem pole gate design with right output strength and dead time control. The low idle loss and good EMI system design is easier to achieve with this dedicated control scheme

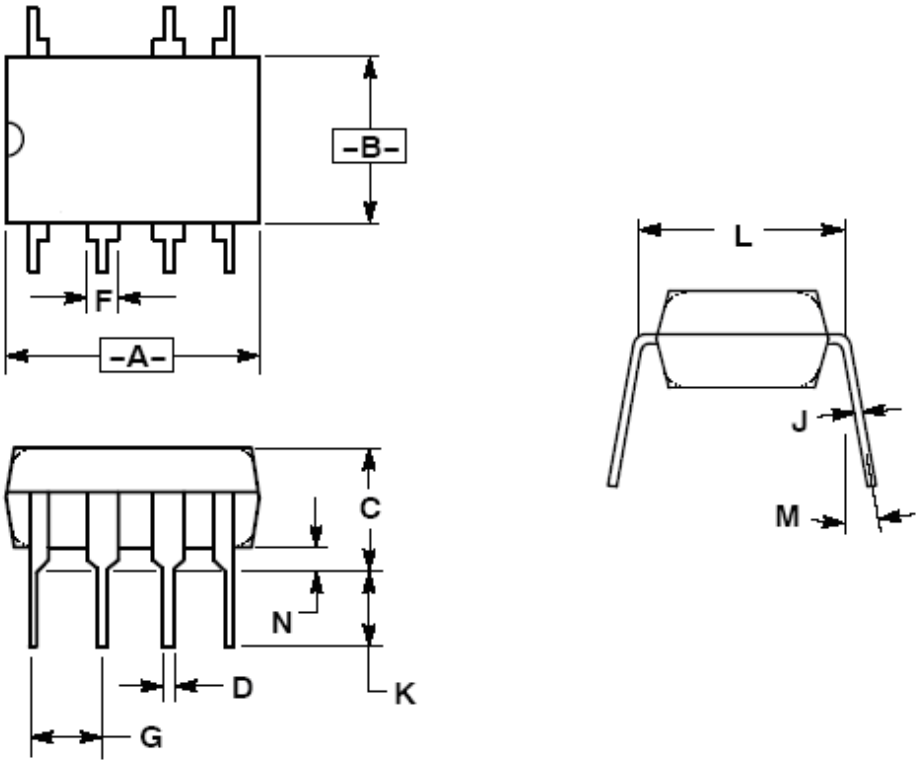
Protection Control

Good power supply system reliability is achieved with its

rich protection features including Cycle-by-Cycle current limiting, Diode Short Protection, Output over voltage protection (OVP), VDD over voltage protection(OVP), feedback loop open protection, short circuit protection, under voltage lockout(UVLO), Brown-out and Line-ovp function, OTP etc.

VDD is supplied by transformer auxiliary winding output. The output of SP6669P is shut down when VDD drops below UVLO limit and Switcher enters power on start-up sequence thereafter.

Package Information（Units:mm）



SYMBOL	MILLIMETER			SYMBOL	MILLIMETER		
	MIN	NOM	MAX		MIN	NOM	MAX
A	9.05	9.25	9.45	J	0.25	—	0.31
B	6.15	6.35	6.55	K	3.0	—	—
C	3.6	3.8	4	L	7.62BSC		
D	0.44	—	0.53	M	0	—	0.84
F	1.52BSC			N	0.51	—	—
G	2.54BSC						

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- The information contained herein is subject to change without notice.

Revision History

Change Date	Rev.	Description of Change
2017-6-1	1.0	Datasheet Release