SANKEN ELECTRIC CO.,LTD

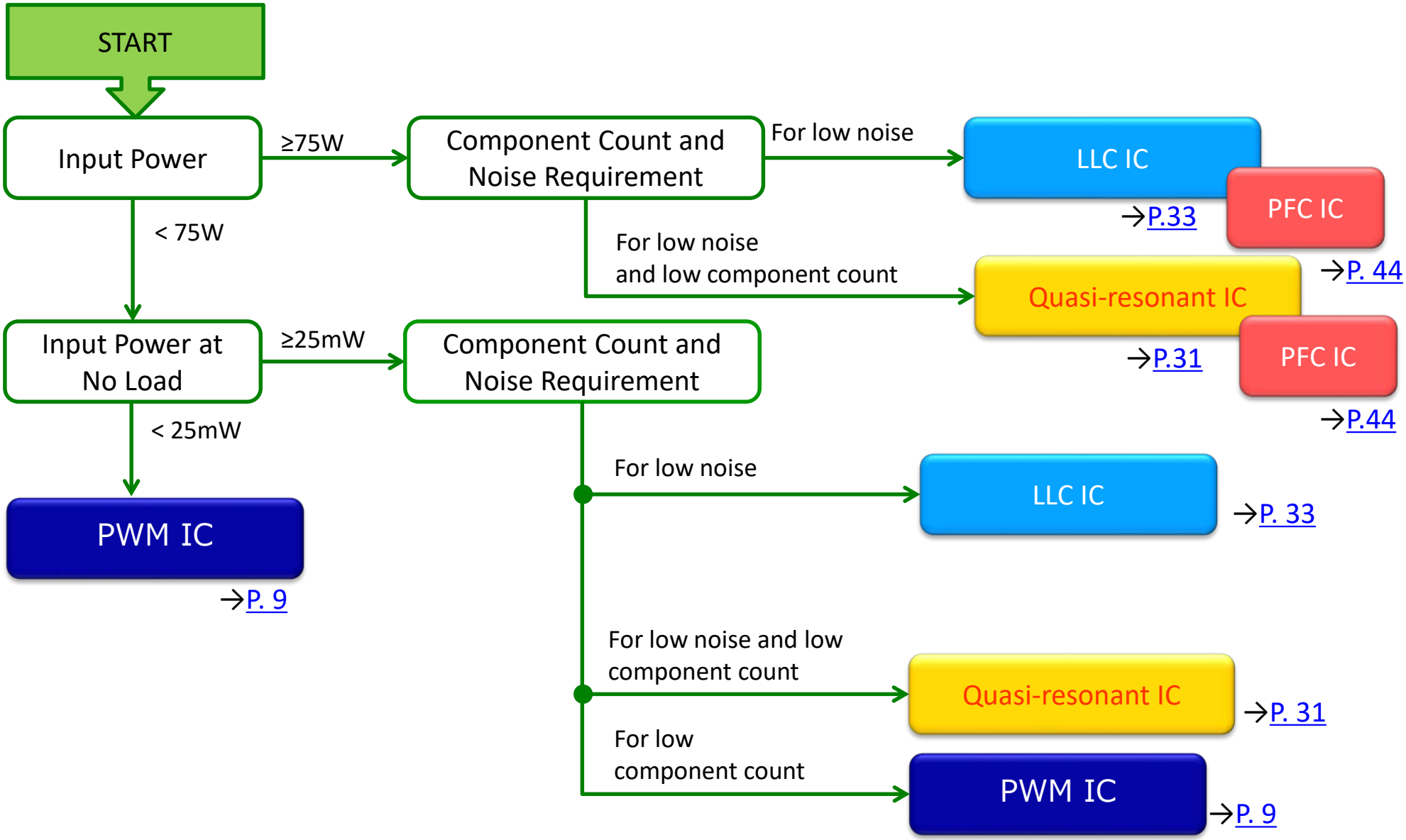
Selection Guide

- OFF-line Converter ICs
- Power Factor Control (PFC) IC

All the contents in this document are as of date of publication. Make sure that this is the latest revision of the document before use. Please check the details of the product by data sheet.
https://www.sanken-ele.co.jp/en

Contents

Selection Guide of Power Management IC by Control Topology



Selection Guide by Application

→P. 44

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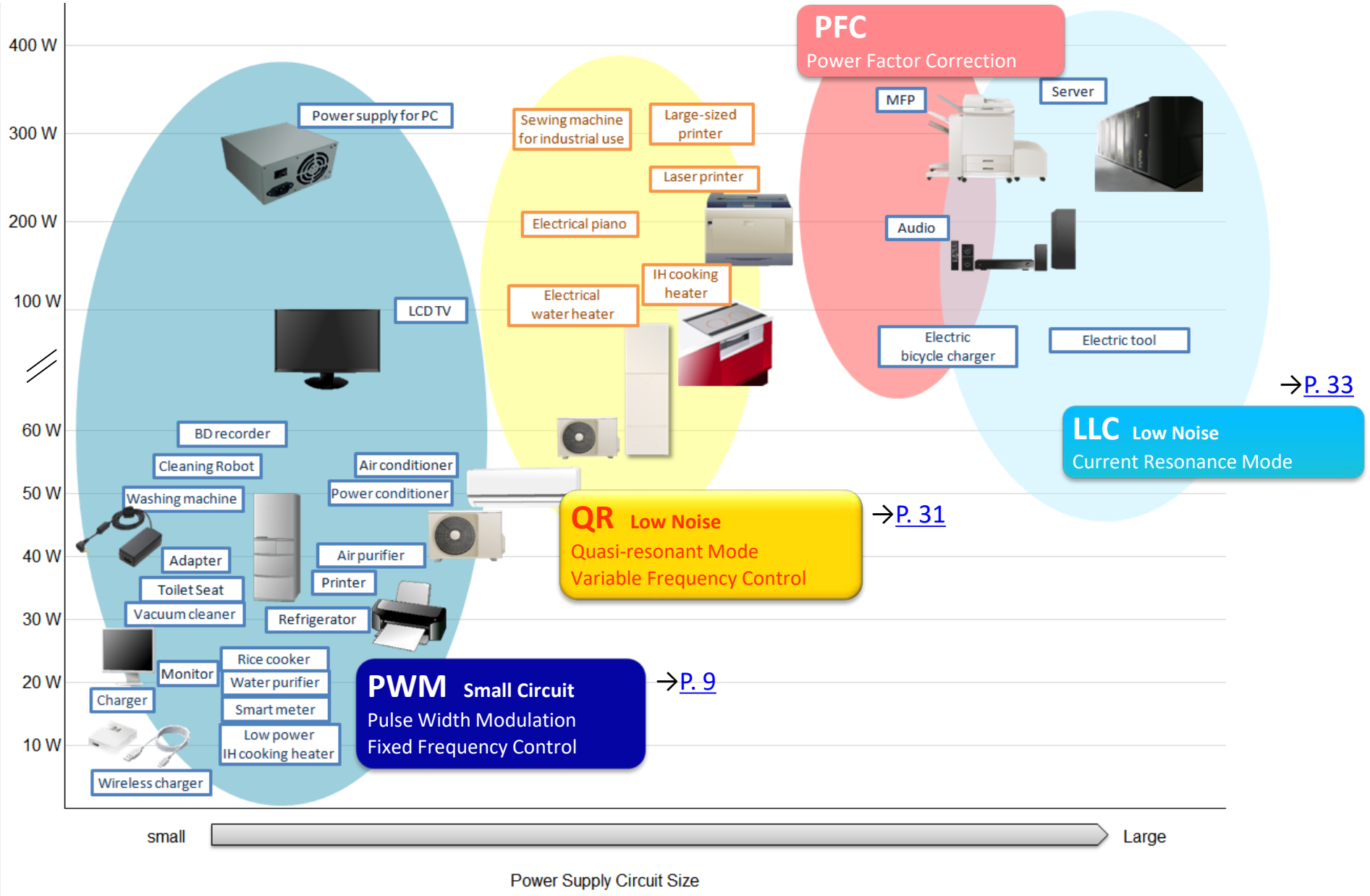

For Low and Middle Power Application
OFF-line Controllers with Integrated Power MOSFET and the Peripheral Diodes

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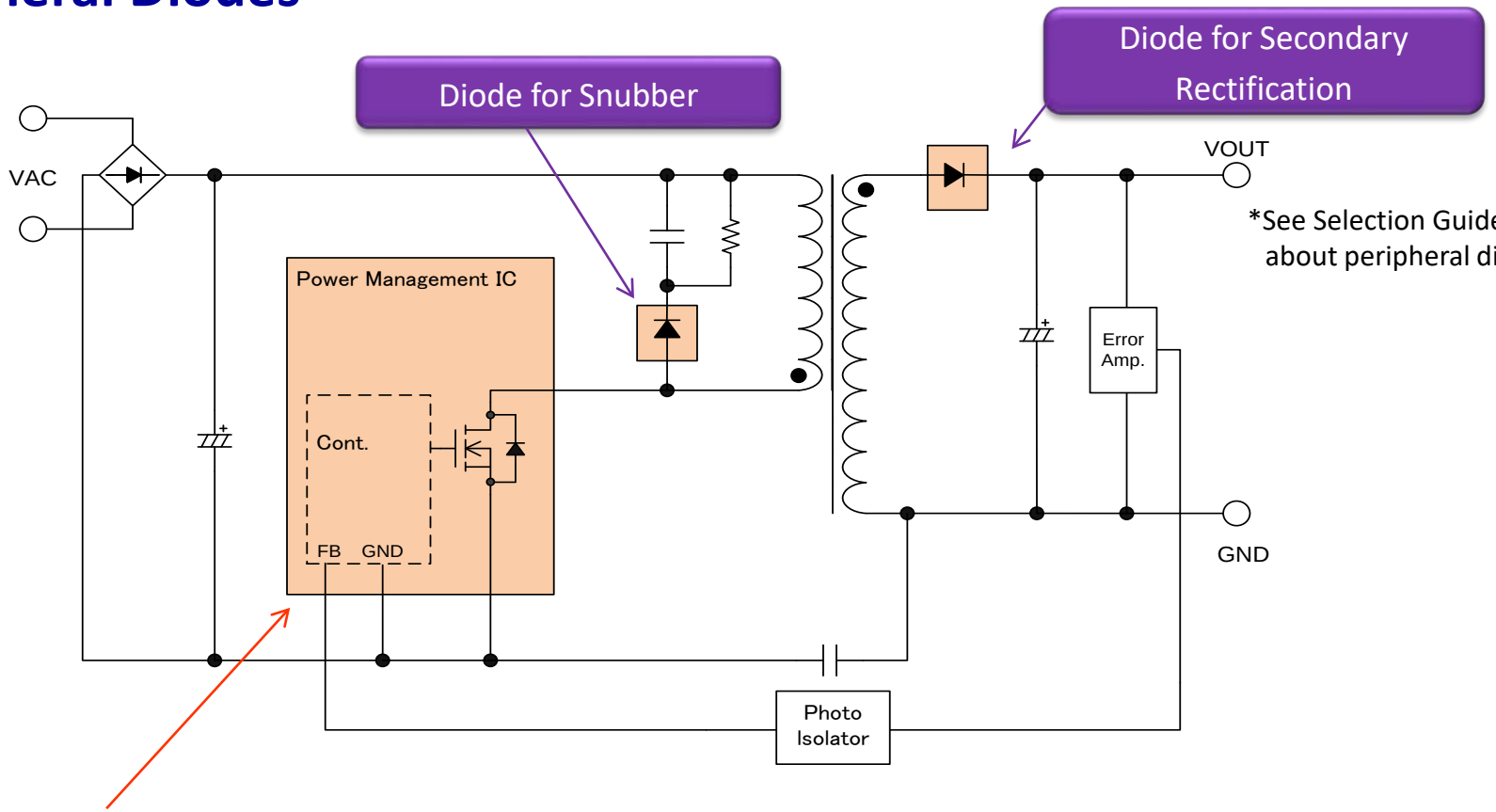

Off-line Controllers

PWM IC For low power application: Auxiliary power supply, white goods and adapter, etc. →P. 9

QR IC For middle power application: White goods and OA etc. →P. 31

For Low Power Application
OFF-line Controllers with Integrated Power MOSFET and the Peripheral Diodes

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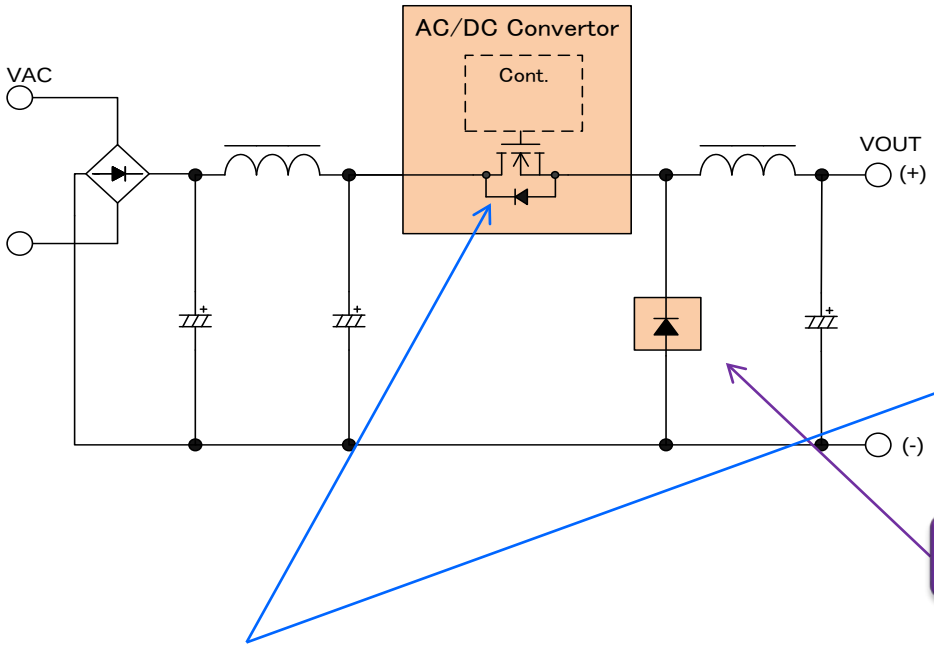
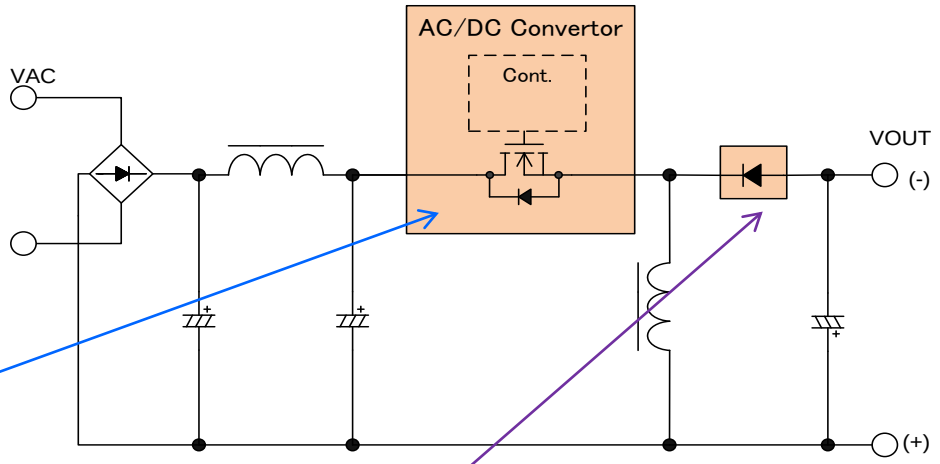
➢ Buck Converter



➢ Inverting Converter



Freewheel Diode

*See Selection Guide of Diode about peripheral diodes.

Off-line Controllers

PWM IC

Power supply for small consumer electronics and motor control, and auxiliary power supply for lighting etc.

→STR5A460 Series P. 27
→ STR5A450 Series P. 29

For High Power Application
PFC and OFF-line Controllers and the Peripheral Diode

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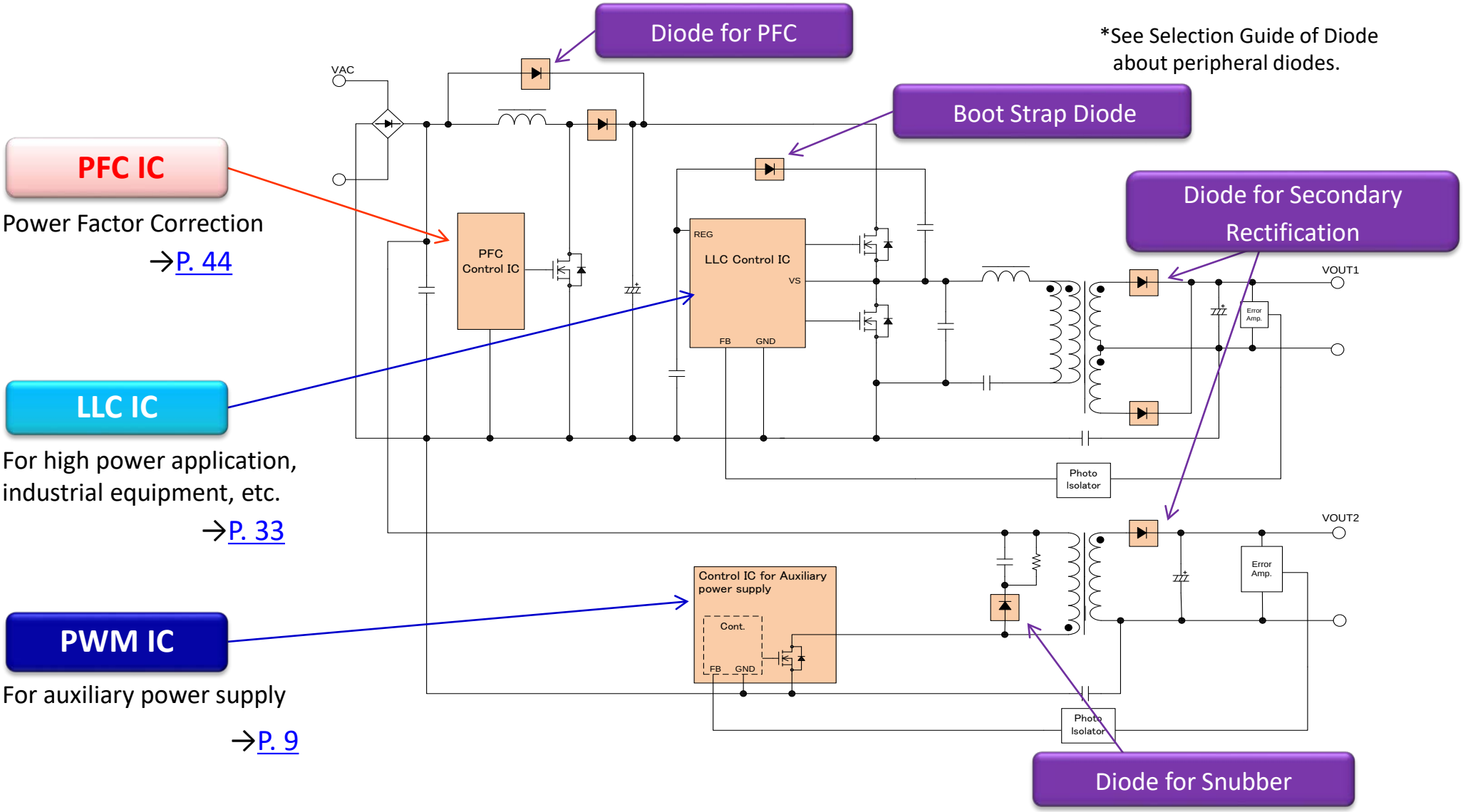

Power Supply ICs

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Sanken provides the optimal power supply IC according to control topology.
Please refer to Sanken's website for detail information.

Control Topology	Power MOSFET	P_O	Circuit Size	P_{IN} at No Load	Noise	Control Method	Page #
PWM	Built-in	Lower	Most Compact	Fewest	Large	Fixed frequency	P. 9
Quasi-resonant	External		Compact	Fewer	Low (Bottom-on control)	Variable frequency	P. 31
LLC	External	Higher	Large	Few	Lowest	Current resonance	P. 33

	Power MOSFET	P_O	Control Method	Page #
PFC	External	≥75W	◆ Critical Conduction Mode (CRM) Operation	P. 44

OFF-line PWM Controllers with Integrated Power MOSFET

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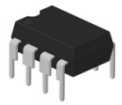
- For low power, auxiliary power supply, white goods and adapter etc.
- Low standby power and low component count
- PWM: Pulse Width Modulation, fixed frequency control

DIP8



SOIC8

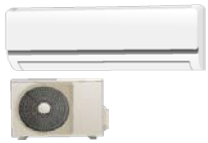
Control Method		Series	Package	f_{OSC}	No Load Power Consumption	Features	Page #
Flyback (Secondary Side Regulation)	Low Noise in High Power	STR6A100MV STR6A100HVD	DIP8	67kHz/100kHz	< 15 mW	Selectable Standby Operation Point . Improving Efficiency in All Load Area.	P. 11
	Line Voltage Protection Model	STR6A100HZ	DIP8	100kHz	< 25 mW	Brown in / out Improving Efficiency in All Load Area.	P. 13
		STR-A6000xZ	DIP8	67kHz/100kHz	< 25 mW	Brown in / out	P. 15
	Low Component Count Model	STR3A400 STR3A400HDL	DIP8	65 kHz 100 kHz	< 15 mW	Low Thermal Resistance Package. Improving Efficiency in All Load Area.	P. 17 P. 19
		STR3A200	DIP8	67 kHz		Low Thermal Resistance Package.	P. 21
		STR4A100	DIP8 / SOIC8	65kHz/100kHz	< 10 mW	Built in OCP detection resistor	P. 23
Flyback (Primary Side Regulation)		STR5A100D	DIP8	65 kHz	< 30 mW	Built in OCP detection resistor	P. 25
Non-isolated Buck / Inverting		STR5A460	DIP8 / SOIC8	60 kHz	—	Built in OCP detection resistor I_{DLIM}=～0.41 A	P. 27
		STR5A450	DIP8	60 kHz	—	Built in OCP detection resistor I_O=1.2A(max.)	P. 29

PWM Control IC Selection Guide

*For ErP Lot 7 (Tier 2), DoE Level VI propose

White Goods, Adapter

Aar Conditioner



Refrigerator

Washing Machine

Adapter

STR6A100MV/HVD* →P. 11

STR6A100HZ * →P. 13

STR-A6000xZ →P. 15

- ✓ Selectable Standby Operation Point
  Audible Noise Suppression in High Power
- ✓ High Efficiency (Step Drive, Green Mode)

- ✓ Line Voltage Protection
  (Brown-In / out)

STR3A400* →P. 17

STR3A400HDL* →P. 19

STR3A200 →P. 21

- ✓ Low Thermal Resistance DIP8 Package
- ✓ Low Power Consumption at No Load
- ✓ Low Component Count

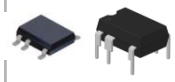
Low Power White Goods

Microwave Oven

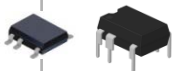
Cleaner

Rice Cooker

STR4A100 →P. 23



STR5A100D
(Primary Side Sensing) →P. 25



STR5A460 (Buck / Inverting Converter) →P. 27

STR5A450 (Buck/Inverting Converter)

→P. 29

- ✓ Low Power Consumption at No Load
- ✓ Low Component Count
- ✓ Green Mode (STR5A100D)

- ✓ Non-isolation Type (Buck/Inverting Converter)
- ✓ Low Component Count
- ✓ Green Mode

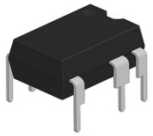
10 20 30 40 50 60 70 80

Maximum Output Power (Open Frame, Universal) (W)

STR6A100xV Series

Package

DIP8



- Improving Efficiency in All Load Area
  - For External Power Supply Regulation (EU: ErP Lot 7 (Tier 2), U.S.: DoE Level VI Propose)
  - Green Mode: Oscillation Frequency Decreases to Reduce the Switching Loss in Light Load
  - Step Drive Control: VRM of Secondary Rectification Diodes Can Be Set to Lower Value Than Usual → Low VF
- Adjustable standby operating point
- No Load Power Consumption < 15mW
- Protections
  - OCP is Pulse-by-Pulse, Built-in two types of OCPs
  - OLP is Auto-restart
  - OLP and TSD are Latched Shutdown or Auto-restart

Selection Guide

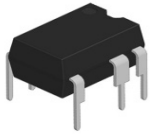
UD : Under development

Part Number	f_{OSC}	Power MOSFET		P_{OUT} (Adaptor)		P_{OUT} (Open frame)		OVP, TSD operation
		V_{DSS}	$R_{DS(ON)}$	AC230V	Universal	AC230V	Universal	
STR6A153MV	65 kHz	650 V	1.9 Ω	26 W	21 W	40 W	28 W	Latched Shutdown
STR6A163HVD UD	100 kHz	700 V	2.3 Ω	25 W	20 W	40 W	28 W	Auto-restart
STR6A161HVD			3.95 Ω	20.5 W	15 W	35 W	23.5 W	
STR6A169HVD			6.0 Ω	17 W	11 W	30 W	19.5 W	

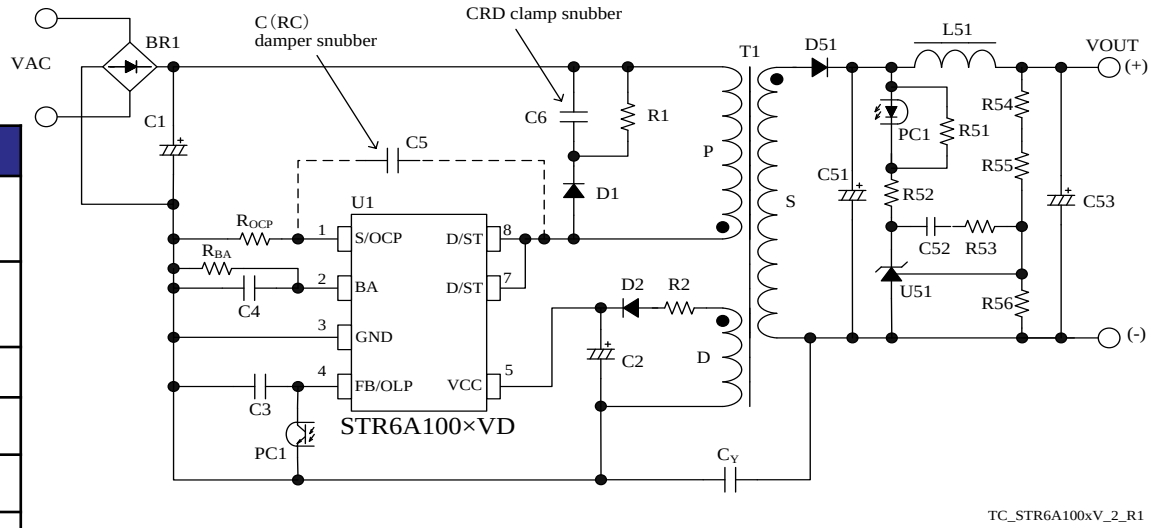
STR6A100xV Series

Package

DIP8



Typical Application Circuit



Pin Assignment

Pin No.	Symbol	Function
1	S/OCP	Power MOSFET Source and Overcurrent Protection
2	BA	Input of Selectable Standby Operation Point Signal
3	GND	Ground
4	FB/OLP	Feedback Control and Overload Protection
5	VCC	Power supply Input and Overvoltage Protection
6	—	(Pin Removed)
7	D/ST	Power MOSFET Drain and Startup Current Input
8		

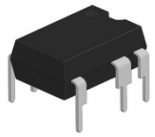
Features

- ◆ Step Drive Control
- ◆ Adjustable standby operating point
- ◆ Automatically Changed Operation Mode in Response to Load Conditions
  - Fixed Switching Frequency Mode in normal operation (67kHz or100 kHz) .
  - Green Mode, 25 kHz to 67kHz or100 kHz in middle to light load.
  - Burst Oscillation Mode in Light Load Soft Start Function
- ◆ No Load Power Consumption < 15mW
- ◆ Random Switching Function
- ◆ Slope Compensation Function
- ◆ Leading Edge Blanking Function
- ◆ Bias Assist Function
- ◆ Two Chip Structure (Avalanche Energy Guaranteed)
- ◆ Protections
  - Overcurrent Protection (OCP): Pulse-by-Pulse, Two Types of OCPs
  - Overload Protection (OLP): Auto-restart with Delay Timer
  - Overvoltage Protection (OVP): Latched Shutdown or Auto-restart
  - Thermal Shutdown (TSD): Latched Shutdown or Auto-restart with Hysteresis

STR6A100HZ Series

Package

DIP8



- Improving Efficiency in All Load Area
  - For External Power Supply Regulation (EU: ErP Lot 7 (Tier 2), U.S.: DoE Level VI Propose)
  - Green Mode: Oscillation Frequency Decreases to Reduce the Switching Loss in Light Load
  - Step Drive Control: VRM of Secondary Rectification Diodes Can Be Set to Lower Value Than Usual → Low VF
- Brown-in and Brown-out Function
- No Load Power Consumption < 25mW
- Protections
  - OCP is Pulse-by-Pulse, Built-in Two Types of OCPs
  - OLP is Auto-restart
  - OVP and TSD are Latched Shutdown

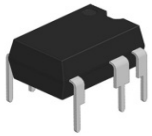
Selection Guide

Part Number	f_{OSC}	Power MOSFET		P_{OUT} (Adaptor)		P_{OUT} (Open Frame)	
		V_{DSS}	$R_{DS(ON)}$	AC230V	Universal	AC230V	Universal
STR6A169HZ	100 kHz	700V	6.0 Ω	17 W	11 W	30 W	19.5 W
STR6A161HZ			3.95 Ω	20.5 W	15 W	35 W	23.5 W
STR6A163HZ			2.3 Ω	25 W	20 W	40 W	28 W

STR6A100HZ Series

Package

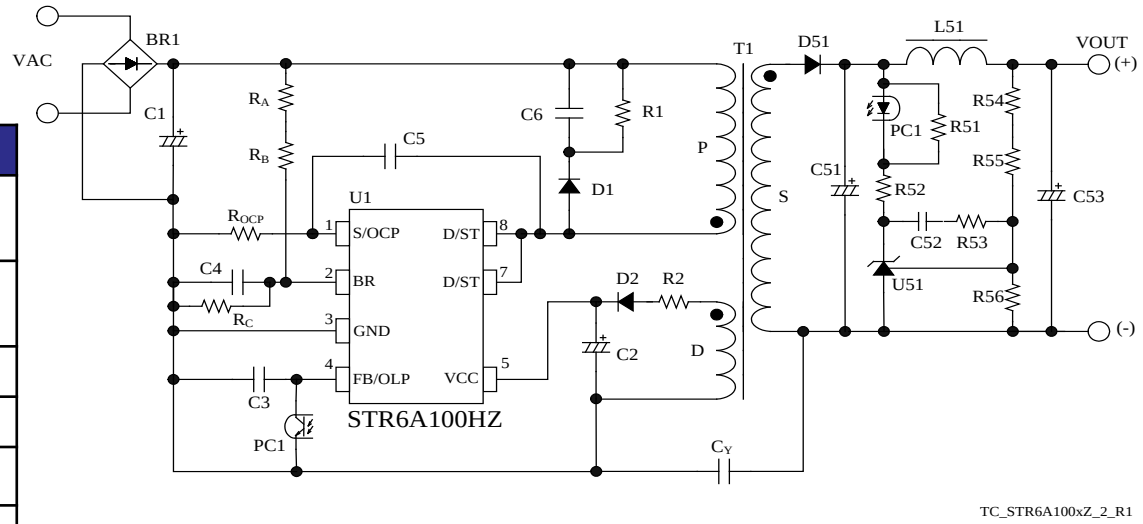
DIP8



Pin Assignment

Pin No.	Symbol	Function
1	S/OCP	Power MOSFET Source and Overcurrent Protection
2	BR	Brown-in and Brown-out Detection Voltage Input
3	GND	Ground
4	FB/OLP	Feedback Control and Overload Protection
5	VCC	Power supply Input and Overvoltage Protection
6	—	(Pin Removed)
7	D/ST	Power MOSFET Drain and Startup Current Input
8		

Typical Application Circuit

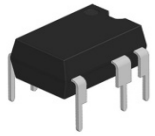


Features

- ◆ Brown-In and Brown-Out Function
- ◆ Step Drive Control
- ◆ Automatically Changed Operation Mode in Response to Load Conditions
  - Fixed Switching Frequency Mode, 100 kHz in Normal Operation.
  - Green Mode, 25 kHz to 100 kHz in Middle to Light Load
  - Burst Oscillation Mode in Light Load
- ◆ No Load Power Consumption < 25mW
- ◆ Soft Start Function
- ◆ Random Switching Function
- ◆ Slope Compensation Function
- ◆ Leading Edge Blanking Function
- ◆ Bias Assist Function
- ◆ Two Chip Structure (Avalanche Energy Guaranteed)
- ◆ Protections
  - Overcurrent Protection (OCP): Pulse-by-Pulse, Built-in Two Types of OCPs
  - Overload Protection (OLP): Auto-restart with Delay Timer
  - Overvoltage Protection (OVP): Latched Shutdown
  - Thermal Shutdown (TSD): Latched Shutdown

STR-A6000xZ Series

Package
DIP8



- No Load Power Consumption < 25mW
- Brown-in and Brown-out Function
- Protections
  - OCP is Pulse-by-Pulse, Built-in Two Types of OCPs
  - OVP, OLP and TSD are All Auto-restart
    TSD Has Temperature Hysteresis

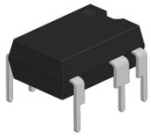
Selection Guide

Part Number	f_{OSC}	Power MOSFET		P_{OUT} (Adapter)		P_{OUT} (Open Frame)	
		V_{DSS}	$R_{DS(ON)}$	AC230V	Universal	AC230V	Universal
STR-A6069MZ	67 kHz	700 V	6.0 Ω	15 W	10 W	26 W	17 W
STR-A6061MZ			3.95 Ω	18.5 W	14 W	31 W	21 W
STR-A6063MZ			2.3 Ω	24 W	19.5 W	37.5 W	26 W
STR-A6069HZ	100 kHz	700 V	6.0 Ω	17 W	11 W	30 W	19.5 W
STR-A6061HZ			3.95 Ω	20.5 W	15 W	35 W	23.5 W
STR-A6063HZ			2.3 Ω	25 W	20 W	40 W	28 W

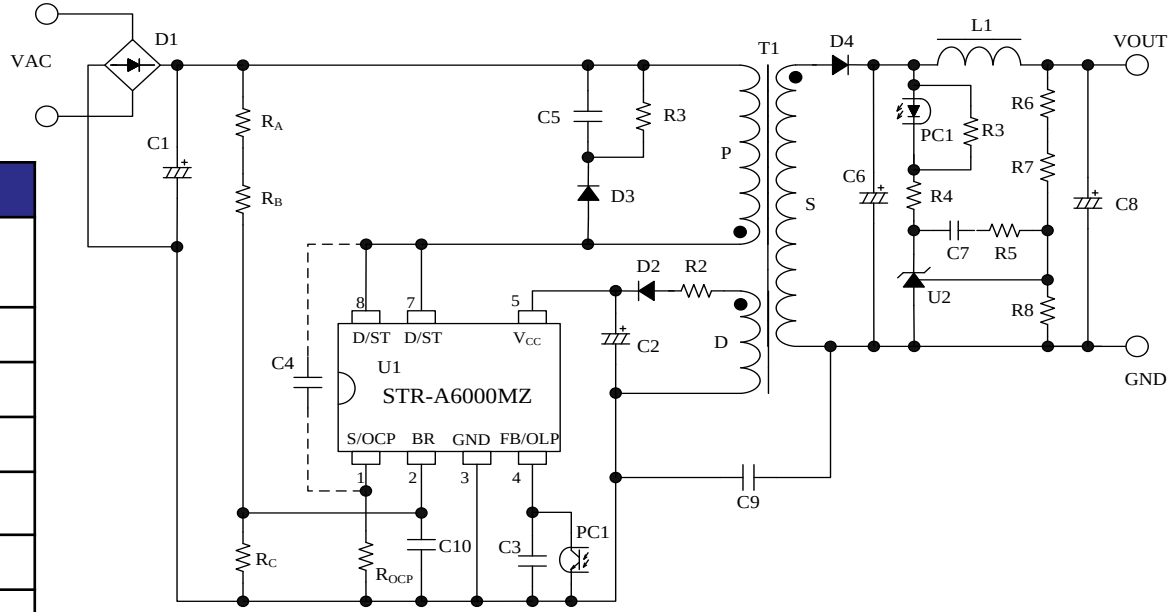
STR-A6000xZ Series

Package

DIP8



Typical Application Circuit



Pin Assignment

Pin No.	Symbol	Function
1	S/OCP	Power MOSFET Source and Overcurrent Protection
2	BR	Brown-in and Brown-out Control
3	GND	Ground
4	FB/OLP	Feedback Control and Overload Protection
5	VCC	Power supply Input and Overvoltage Protection
6	—	(Pin Removed)
7	D/ST	Power MOSFET Drain and Startup Current Input
8		

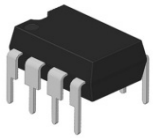
Features

- ◆ Brown-in and Brown-out Function
- ◆ Auto Standby Function
  - Normal Operation: PWM Mode
  - Standby Operation: Burst Oscillation Mode
- ◆ No Load Power Consumption < 25mW
- ◆ Audible Noise Suppression Function for Standby Mode
- ◆ Bias Assist Function
- ◆ Random Switching Function
- ◆ Slope Compensation Function
- ◆ Leading Edge Blanking Function
- ◆ Two Chip Structure (Avalanche Energy Guaranteed)
- ◆ Protections
  - Overcurrent Protection (OCP): Pulse-by-Pulse, Built-in Two Types of OCPs
  - Overload Protection (OLP): Auto-restart with Delay Timer
  - Overvoltage Protection (OVP): Auto-restart
  - Thermal Shutdown (TSD): Auto-restart with Hysteresis

STR3A400 Series

Package

DIP8



- Improving Efficiency in All Load Area
  - For External Power Supply Regulation (EU: ErP Lot 7 (Tier 2), U.S.: DoE Level VI Propose)
  - Green Mode: Oscillation Frequency Decreases to Reduce the Switching Loss in Light Load
  - Step Drive Control: VRM of Secondary Rectification Diodes Can Be Set to Lower Value Than Usual → Low VF
- No Load Power Consumption < 15mW
- Low Thermal Resistance Package
- Protections
  - OCP is Pulse-by-Pulse, Built-in two types of OCPs
  - OLP is Auto-restart
  - OVP and TSD are Latched Shutdown or Auto-restart

Selection Guide

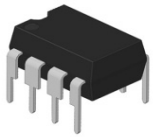
Part Number	OVP / TSD Operation
STR3A4xx	Latched Shutdown
STR3A4xxD	Auto-restart

Part Number	f_{OSC}	Power MOSFET		P_{OUT} (Adapter)		P_{OUT} (Open Frame)	
		V_{DSS} (min.)	$R_{DS(ON)}$ (max.)	AC230V	Universal	AC230V	Universal
STR3A451	65 kHz	650 V	4.0 Ω	29.5 W	19.5 W	37 W	23 W
STR3A451D							
STR3A453			1.9 Ω	37 W	27.5 W	53 W	35 W
STR3A453D							
STR3A455			1.1 Ω	45 W	35 W	65 W	44 W
STR3A455D							

STR3A400 Series

Package

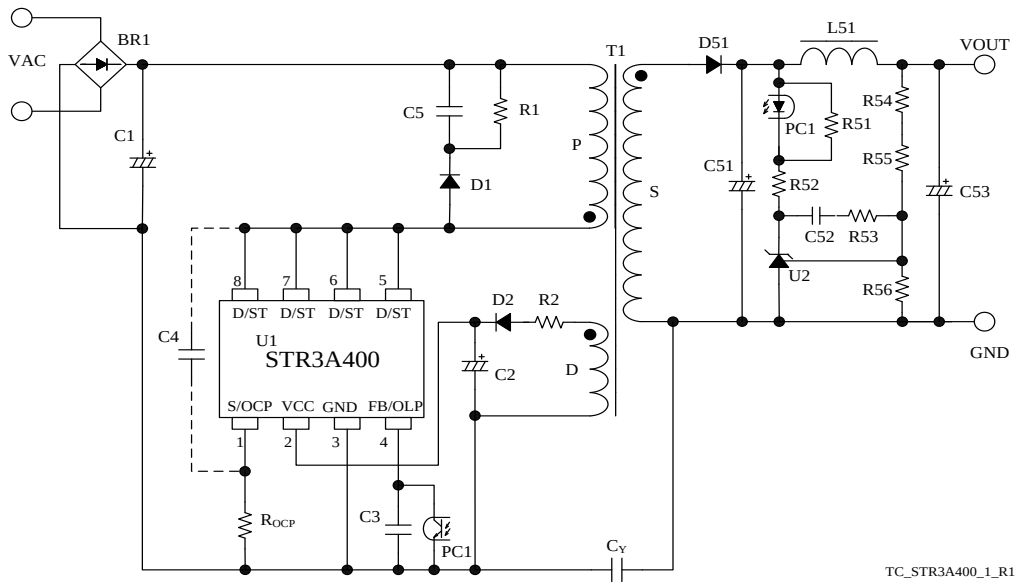
DIP8



Pin Assignment

Pin No.	Symbol	Function
1	S/OCP	Power MOSFET Source and Overcurrent Protection
2	VCC	Power supply Input and Overvoltage Protection
3	GND	Ground
4	FB/OLP	Feedback Control and Overload Protection
5~8	D/ST	Power MOSFET Drain and Startup Current Input

Typical Application Circuit



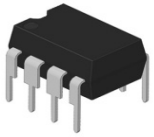
Features

- ◆ Step Drive Control
- ◆ Low Thermal Resistance Package
- ◆ Automatically Changed Operation Mode in Response to Load Conditions
  - Fixed Switching Frequency Mode, 65 kHz in Normal Operation
  - Green Mode, 30 kHz to 65 kHz in Middle to Light Load
  - Burst Oscillation Mode in Light Load
- ◆ No Load Power Consumption < 15mW
- ◆ Soft Start Function
- ◆ Bias Assist Function
- ◆ Random Switching Function
- ◆ Slope Compensation Function
- ◆ Leading Edge Blanking Function
- ◆ Two Chip Structure (Avalanche Energy Guaranteed)
- ◆ Protections
  - Overcurrent Protection (OCP): Pulse-by-Pulse, Two Types of OCPs
  - Overload Protection (OLP): Auto-restart
  - Overvoltage Protection (OVP): Auto-restart or Latched Shutdown
  - Thermal Shutdown (TSD): Auto-restart with Hysteresis or Latched Shutdown

STR3A400HDL Series

Package

DIP8



- Improving Efficiency in All Load Area
  - For External Power Supply Regulation (EU: ErP Lot 7 (Tier 2), U.S.: DoE Level VI Propose)
  - Green Mode: Oscillation Frequency Decreases to Reduce the Switching Loss in Light Load
  - Step Drive Control: VRM of Secondary Rectification Diodes Can Be Set to Lower Value Than Usual → Low VF
- No Load Power Consumption < 15mW
- Low Thermal Resistance Package
- Protections
  - OCP is Pulse-by-Pulse, Built-in two types of OCPs
  - OLP is Auto-restart
  - OVP and TSD are Latched Shutdown or Auto-restart

Selection Guide

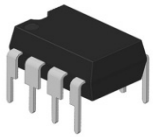
UD : Under development

Part Number	f_{OSC}	Power MOSFET		P_{OUT} (Adapter)		P_{OUT} (Open Frame)	
		V_{DSS} (min.)	$R_{DS(ON)}$ (max.)	AC230V	Universal	AC230V	Universal
STR3A461HDL UD	100 kHz	700 V	4.2 Ω	28 W	21 W	38 W	26 W
STR3A462HDL			3.2 Ω	31 W	24 W	42 W	30 W
STR3A463HDL UD			2.2 Ω	34 W	26 W	48 W	34 W
STR3A475HDL		800 V	1.7 Ω	39 W	29 W	57 W	36 W

STR3A400HDL Series

Package

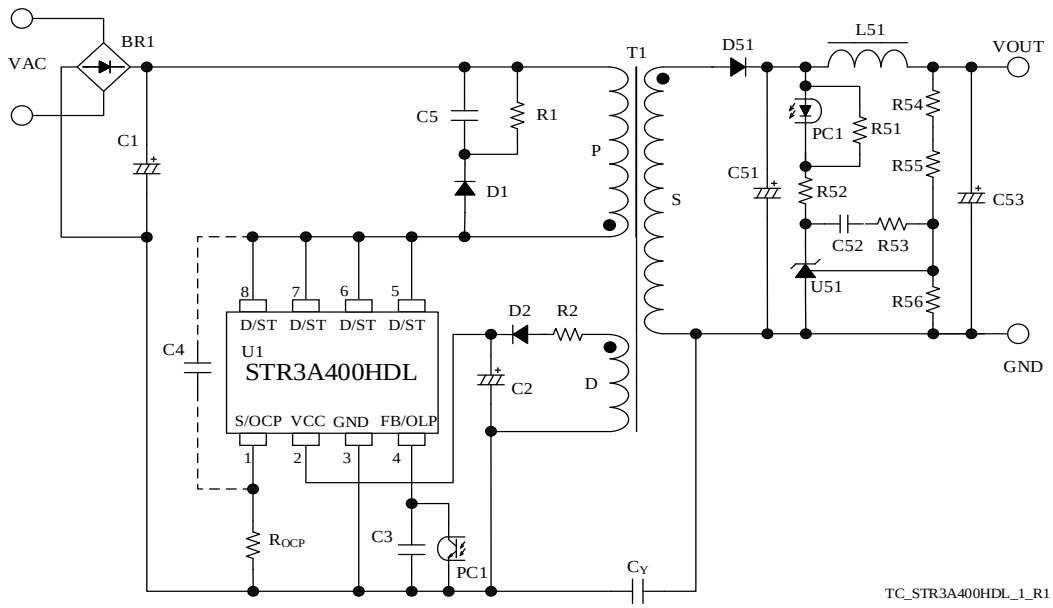
DIP8



Pin Assignment

Pin No.	Symbol	Function
1	S/OCP	Power MOSFET Source and Overcurrent Protection
2	VCC	Power supply Input and Overvoltage Protection
3	GND	Ground
4	FB/OLP	Feedback Control and Overload Protection
5~8	D/ST	Power MOSFET Drain and Startup Current Input

Typical Application Circuit

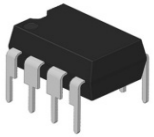


Features

- ◆ Step Drive Control
- ◆ Low Thermal Resistance Package
- ◆ Automatically Changed Operation Mode in Response to Load Conditions
  - Fixed Switching Frequency Mode, 100 kHz in Normal Operation.
  - Green Mode, 30 kHz to 100 kHz in middle to light load.
  - Burst Oscillation Mode in Light Load
- ◆ No Load Power Consumption < 15mW
- ◆ Soft Start Function
- ◆ Bias Assist Function
- ◆ Random Switching Function
- ◆ Slope Compensation Function
- ◆ Leading Edge Blanking Function
- ◆ Two Chip Structure (Avalanche Energy Guaranteed)
- ◆ Protections
  - Overcurrent Protection (OCP): Pulse-by-Pulse, Two Types of OCPs
  - Overload Protection (OLP): Auto-restart
  - Overvoltage Protection (OVP): Auto-restart
  - Thermal Shutdown (TSD): Auto-restart with Hysteresis

STR3A200 Series

Package
DIP8



- No Load Power Consumption < 15mW
- Low Thermal Resistance Package
- Protections
  - OCP is Pulse-by-Pulse, Built-in Two Types of OCPs
  - OLP is Auto-restart
  - OVP is Auto-restart or Latched Shutdown
  - TSD is Auto-restart with Temperature Hysteresis or Latched Shutdown

Selection Guide

Part Number	OVP / TSD Operation
STR3A2xx	Latched Shutdown
STR3A2xxD	Auto-restart

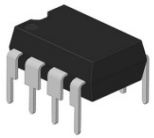
UD : Under development

Part Number	$f_{OSC(AVG)}$	Power MOSFET		P_{OUT} (Adapter)		P_{OUT} (Open Frame)	
		V_{DSS}	$R_{DS(ON)}$	AC230V	Universal	AC230V	Universal
STR3A251 UD	67 kHz	650 V	4.0 Ω	29.5 W	19.5 W	37 W	23 W
STR3A251D							
STR3A253 UD			1.9 Ω	37 W	27.5 W	53 W	35 W
STR3A253D							
STR3A255 UD			1.1 Ω	45 W	35 W	65 W	44 W
STR3A255D							

STR3A200 Series

Package

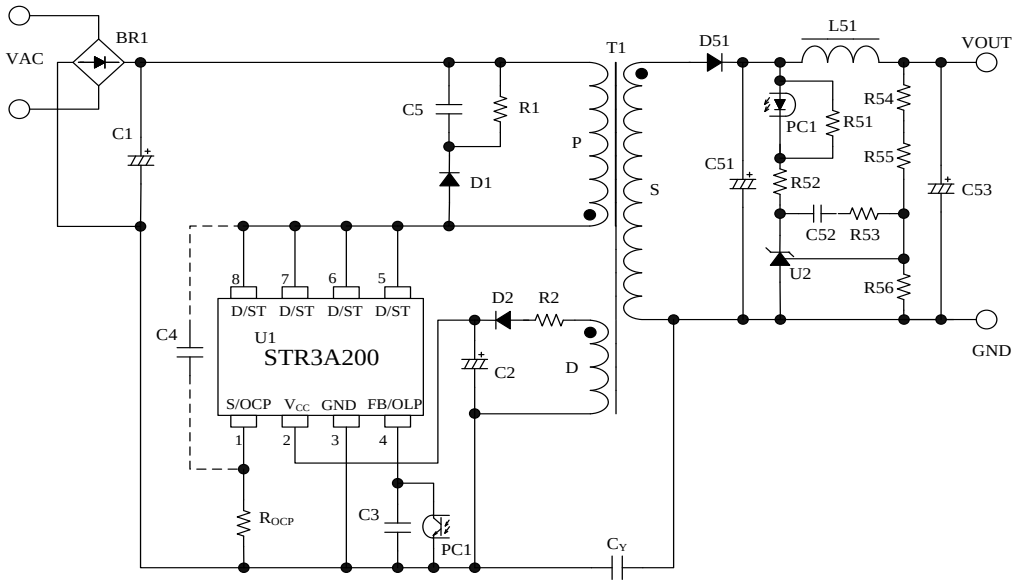
DIP8



Pin Assignment

Pin No.	Symbol	Function
1	S/OCP	Power MOSFET Source and Overcurrent Protection
2	VCC	Power supply Input and Overvoltage Protection
3	GND	Ground
4	FB/OLP	Feedback Control and Overload Protection
5	D/ST	Power MOSFET Drain and Startup Current Input
6		
7		
8		

Typical Application Circuit



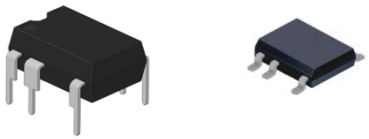
Features

- ◆ Low Thermal Resistance Package
- ◆ Soft Start Function
- ◆ Operation Mode
  Normal Operation: PWM Mode
  Standby Operation: Burst Oscillation Mode
- ◆ No Load Power Consumption < 15mW
- ◆ Random Switching Function
- ◆ Slope Compensation Function
- ◆ Leading Edge Blanking Function
- ◆ Bias Assist Function
- ◆ Two Chip Structure (Avalanche Energy Guaranteed)
- ◆ Protections
  - Overcurrent Protection (OCP): Pulse-by-Pulse, Built-in Two Types of OCPs
  - Overload Protection (OLP): Auto-restart with Delay Timer
  - Overvoltage Protection (OVP): Latched Shutdown or Auto-restart
  - Thermal Shutdown (TSD): Latched Shutdown or Auto-restart with Hysteresis

STR4A100 Series

Package

DIP8 SOIC8



- No Load Power Consumption < 10 mW
- High Voltage Sense MOSFET
- One Chip Structure (Eliminating External Components)
- $V_{D/ST}$ (max.) = 730 V
- Protections
  - OCP is Pulse-by-Pulse
  - OVP, OLP and TSD are All Auto-restart

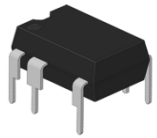
Selection Guide

Part Number	Package	f_{OSC}	Power MOSFET $R_{DS(ON)}$	$I_{DLIM(H)}$	P_{OUT} (Adapter)		P_{OUT} (Open Frame)	
					AC230V	Universal	AC230V	Universal
STR4A162S	SOIC8	65 kHz	24.6 Ω	0.365 A	5 W	4 W	7 W	5.5 W
STR4A162D	DIP8				5.5 W	4.5 W	7.5 W	6 W
STR4A164D	DIP8		12.9 Ω	0.520 A	8 W	6 W	10 W	8.5 W
STR4A164HD	DIP8	100 kHz	12.9 Ω	0.485 A	9 W	7 W	13 W	10.5 W

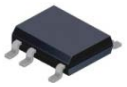
STR4A100 Series

Package

DIP8



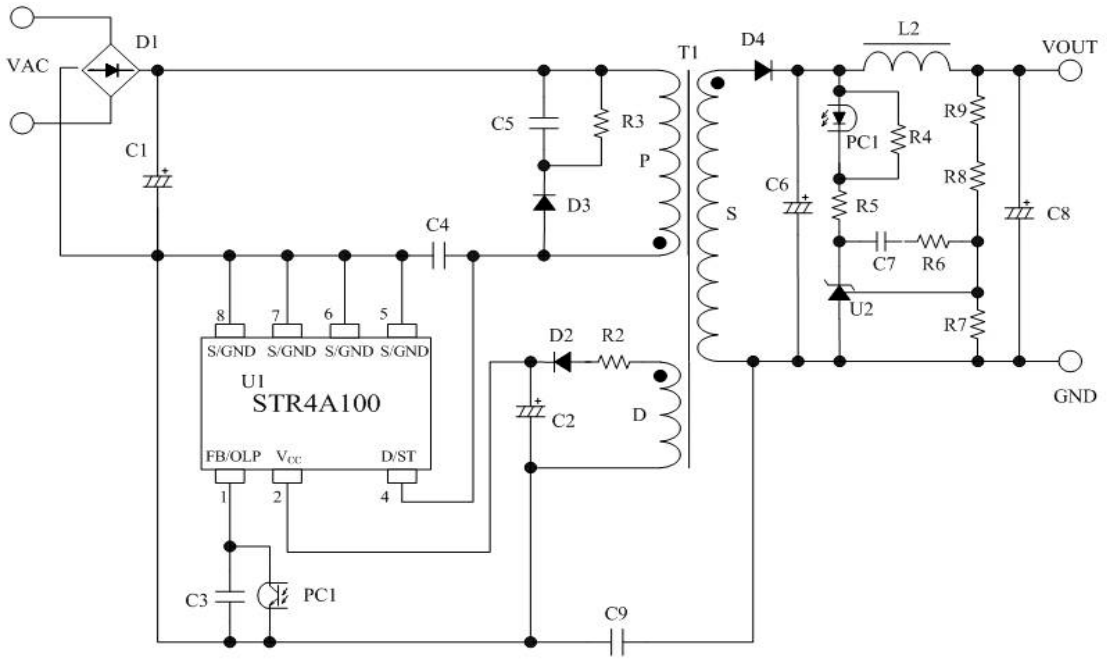
SOIC8



Pin Assignment

Pin No.	Symbol	Function
1	FB/OLP	Feedback Control and Overload Protection
2	VCC	Power supply Input and Overvoltage Protection
3	—	(Pin Removed)
4	D/ST	Power MOSFET Drain and Startup Current Input
5	S/GND	Power MOSFET Source and Ground
6		
7		
8		

Typical Application Circuit

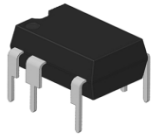


Features

- High Voltage Sense MOSFET
- One Chip Structure (Eliminating External Components)
- Auto Standby Function
  Normal Operation: PWM Mode
  Standby Operation: Burst Oscillation Mode
- No Load Power Consumption < 10 mW
- Soft Start Function
- Bias Assist Function
- Random Switching Function
- Slope Compensation Function
- Leading Edge Blanking Function
- Protections
  - Overcurrent Protection (OCP): Pulse-by-Pulse, with Input Compensation Circuit
  - Overload Protection (OLP): Auto-restart with Delay Timer
  - Overvoltage Protection (OVP): Auto-restart
  - Thermal Shutdown (TSD): Auto-restart

STR5A100D Series

Package
DIP8



- No Load Power Consumption < 30mW
- High Efficiency in Light Load (Green-Mode)
- Few External Components Count
  - Primary Side Regulation (No Optocoupler)
  - One Chip Structure
  - High Voltage Sense MOSFET
- $V_{D/ST}$ (max.) = 730 V
- Protections
  - OCP is Pulse-by-Pulse
  - OVP and TSD are Auto-restart

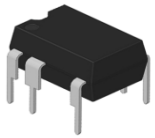
Selection Guide

Part Number	f_{OSC}	Power MOSFET $R_{DS(ON)}$	$I_{DLIM(H)}$	P_{OUT} (Adapter)		P_{OUT} (Open Frame)	
				AC230V	Universal	AC230V	Universal
STR5A162D	65 kHz	24.6 Ω	0.285 A	4 W	3.5 W	5 W	4.5 W
STR5A164D		13 Ω	0.41 A	6.0 W	5.5 W	8.5 W	7 W

STR5A100D Series

Package

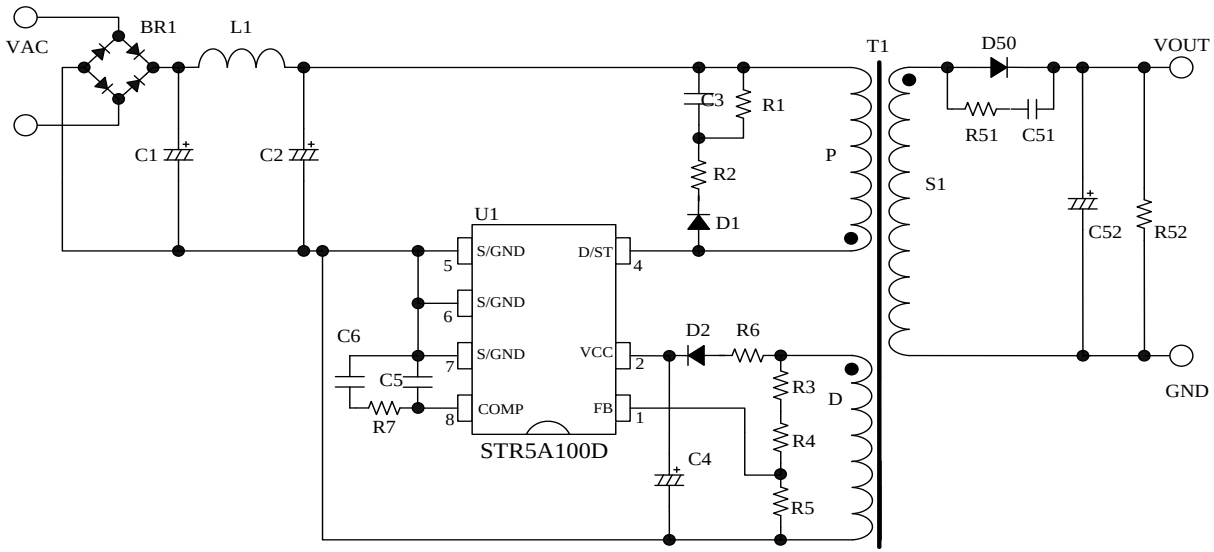
DIP8



Pin Assignment

Pin No.	Symbol	Function
1	FB	Feedback Control
2	VCC	Power supply Input and Overvoltage Protection
3	—	(Pin Removed)
4	D/ST	Power MOSFET Drain and Startup Current Input
5	S/GND	Power MOSFET Source and Ground
6		
7		
8	COMP	Input of Phase Compensation

Typical Application Circuit



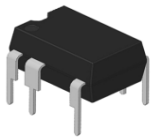
Features

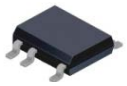
- ◆ Primary Side Regulation (No Optocoupler)
- ◆ High Voltage Sense MOSFET
- ◆ One Chip Structure (Eliminating External Components)
- ◆ Auto Standby Function
  - Normal Operation: PWM Mode
  - Light load operation: Green-mode
  - Standby Operation: Burst Oscillation Mode
- ◆ No Load Power Consumption < 30mW
- ◆ Built-in Startup Circuit
- ◆ Random Switching Function
- ◆ Leading Edge Blanking Function
- ◆ Protections
  - Overcurrent Protection (OCP): Pulse-by-Pulse
  - Overvoltage Protection (OVP): Auto-restart
  - Thermal Shutdown (TSD): Auto-restart

STR5A460 Series

Package

DIP8 SOIC8





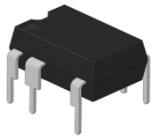
- I_{DLIM} = 0.41 A
- Non-Isolated Buck and Inverting Converter Solution
- Positive or negative output configuration
- High Efficiency in Light Load (Green-Mode and Burst Oscillation Mode)
- Few External Components Count
  - High Voltage Sense MOSFET
  - Build-in Error Amplifier
- $V_{D/ST}$ (max.) = 700 V
- Protections
  OCP is pulse-by pulse
  OLP, OVP and TSD are All Auto-restart

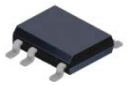
Selection Guide

Part Number	Package	f_{OSC}	Power MOSFET $R_{DS(ON)}$	I_{DLIM}
STR5A464D	DIP8	60 kHz	13.6 Ω	0.41 A
STR5A464S	SOIC8			

STR5A460 Series

Package

DIP8 

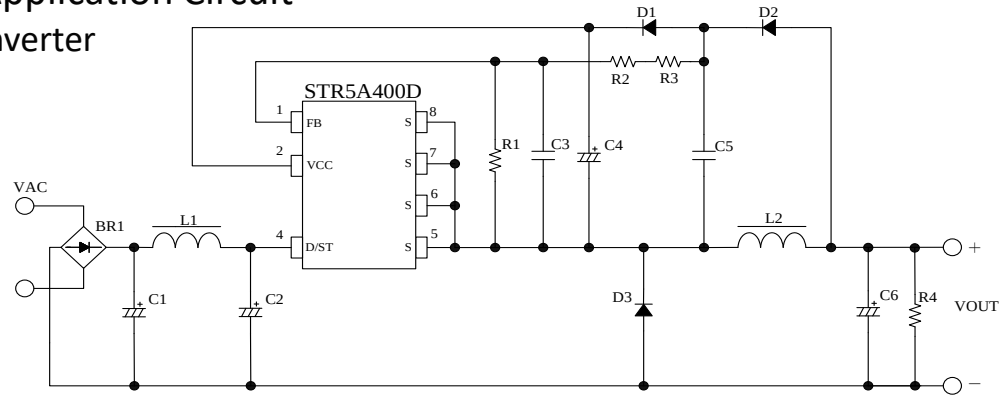
SOIC8 

Pin Assignment

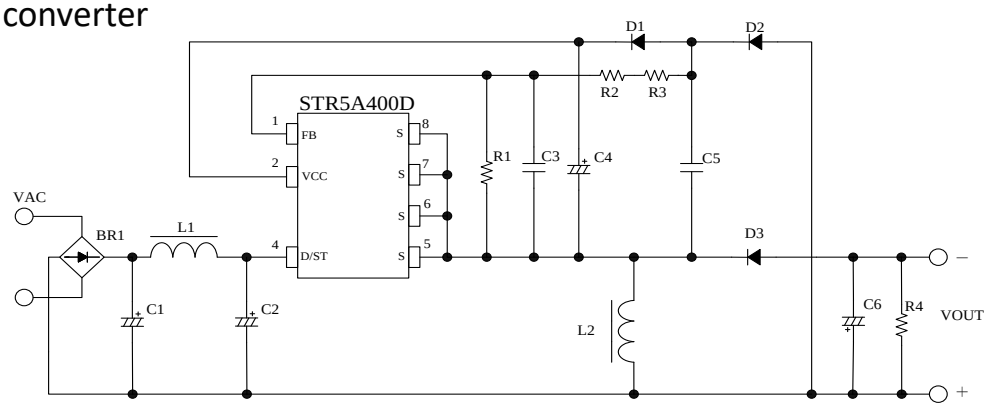
Symbol	Pin No.		Function
	DIP8	SOIC8	
FB	1	2	Constant Voltage Control Signal Input
VCC	2	1	Power Supply Voltage Input for Control Part and Overvoltage Protection Signal Input
—	3		(Pin Removed)
D/ST	4		Power MOSFET Drain and Startup Current Input
S	5 ~ 8		Power MOSFET Source and Ground

Typical Application Circuit

▪ Buck converter



▪ Inverting converter

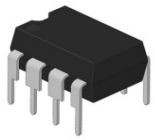


Features

- ◆ High Voltage Sense MOSFET
- ◆ One Chip Structure (Eliminating External Components)
- ◆ Operation Mode Is Changed in Response to Load Conditions
  - Fixed Switching Frequency Mode, 60 kHz (typ.)
  - Green Mode, 23 kHz (typ.) to 60 kHz (typ.)
  - Burst Oscillation Mode
- ◆ Build-in Error Amplifier
- ◆ Built-in Startup Circuit
- ◆ Leading Edge Blanking Function
- ◆ Protection
  - -Overcurrent Protection (OCP): Pulse-by-Pulse
  - Overload Protection (OLP): Auto-restart
  - Overvoltage Protection (OVP): Auto-restart
  - Thermal Shutdown (TSD): Auto-restart

STR5A450 Series

Package
DIP8



- Maximum Output Current is 1.2 A
- Non-Isolated Buck and Inverting Converter Solution
- High Efficiency in Light Load (Green-Mode and Burst Oscillation Mode)
- Few External Components Count
  - Build-in Error Amplifier
- V_{DSS} (min.) = 650 V
- Protections
  OCP is pulse-by pulse.
  OLP, OVP and TSD are All Auto-restart.

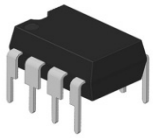
Selection Guide

Part Number	Package	f_{OSC}	Power MOSFET $R_{DS(ON)}$	$I_{OUT(MAX)}$ (V_{OUT} = 24 V)
STR5A451D	DIP8	60 kHz	4.0 Ω	0.7 A
STR5A453D			1.9 Ω	0.9 A

STR5A450 Series

Package

DIP8

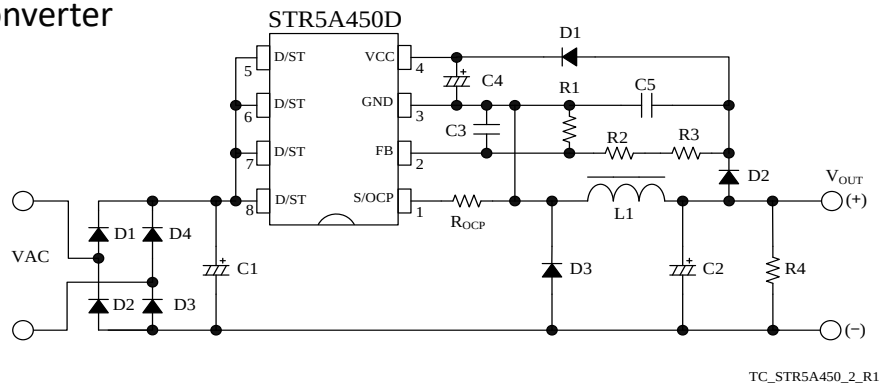


Pin Assignment

Pin No.	Symbol	Function
1	S/OCP	Power MOSFET Source and Overcurrent Protection (OCP) Signal Input
2	FB	Constant Voltage Control Signal Input
3	GND	Ground
4	VCC	Power Supply Voltage Input for Control Part and Overvoltage Protection (OVP) Signal Input
5	D/ST	Power MOSFET Drain and Startup Current Input
6		
7		
8		

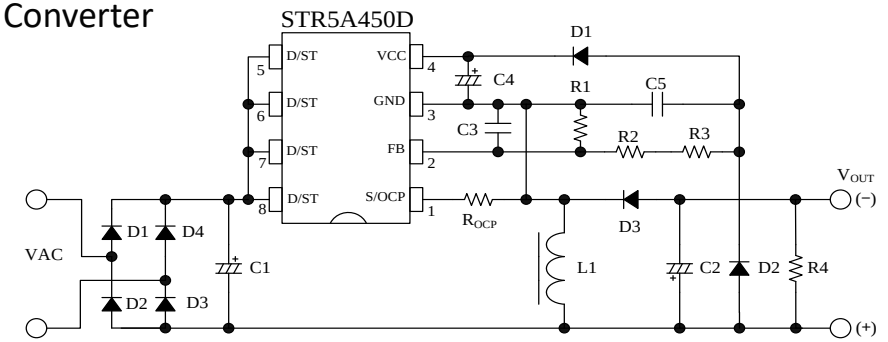
Typical Application Circuit

▪ Buck Converter



TC_STR5A450_2_R1

▪ Inverting Converter



TC_STR5A450_3_R1

Features

- ◆ Operation Mode Is Changed in Response to Load Conditions,
  - Fixed Switching Frequency Mode, 60 kHz (typ.)
  - Green Mode, 23 kHz (typ.) to 60 kHz (typ.)
  - Burst Oscillation Mode
- ◆ Build-in Error Amplifier
- ◆ Built-in Startup Circuit
- ◆ Leading Edge Blanking Function
- ◆ Protection
  - -Overcurrent Protection (OCP): Pulse-by-Pulse, with Input Compensation Circuit
  - Overload Protection (OLP): Auto-restart
  - Overvoltage Protection (OVP): Auto-restart
  - Thermal Shutdown (TSD): Auto-restart

Off-line Quasi-resonant (QR) Controllers

Back to contents

- For Middle Power Application: White Goods and OA, Etc.
- High Efficiency Operation Across the Full Range of Loads Is Achieved by Multi-Mode Control
- Low Noise Due to Bottom on Switching

Series	Package	Features	Page #
SSC1S311A SSC1S312A	SOIC8 	➢ Low Power Consumption at No Load (< 30 mW) ➢ Few External Components Count (Built-in Startup Circuit)	P. 32

SSC1S310A Series

Package
SOIC8

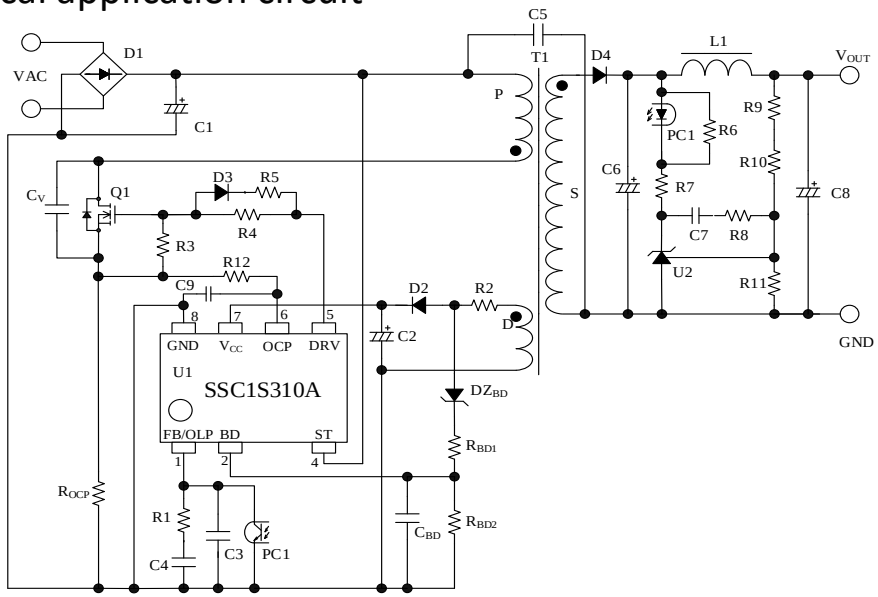
Selection Guide

Part Number	OLP, OVP, TSD Operation
SSC1S311A	Auto-restart
SSC1S312A	Latched Shutdown

Features

- Auto standby function
  No load power consumption < 30mW
- Auto burst function
  Normal operation: Quasi-resonant
  Standby operation: Burst oscillation mode
  (1 bottom skip)
- Leading edge blanking function
- Built-in Startup Circuit
- Protection functions
  Overcurrent Protection (OCP): Pulse by pulse
  Overload Protection (OLP)
  Overvoltage Protection (OVP)
  Thermal Shutdown (TSD)

Typical application circuit



Pin assignment

Pin No.	Symbol	Function
1	FB/OLP	Feedback control and Overload Protection signal input
2	BD	Bottom detection signal input and input compensation detection signal input
3	—	(Pin removed)
4	ST	Startup current input
5	DRV	Gate drive output
6	OCP	Overcurrent Protection signal input
7	VCC	Power supply input and Overvoltage Protection signal input
8	GND	Ground

OFF-line LLC Controller

Back to contents

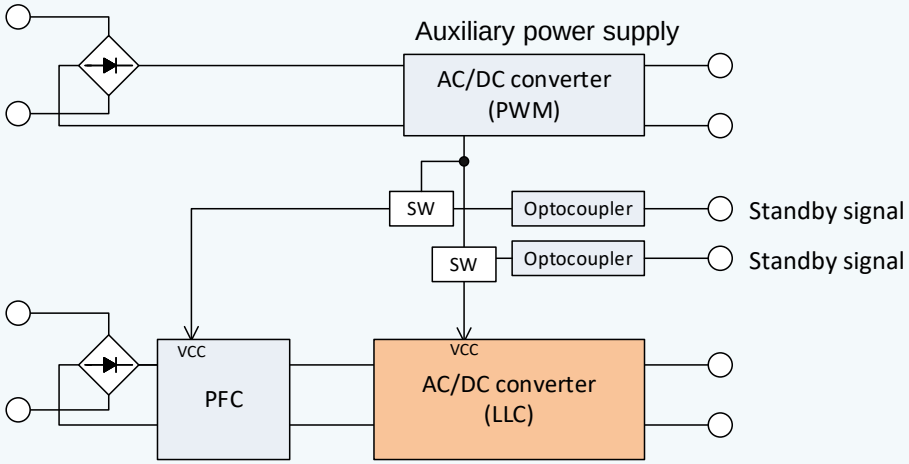
- For High Power Application: Industrial Equipment etc.
- Current Resonant, Low Noise
- Providing 2-Type ICs according to an Application

*See the Selection Guide of Diode about peripheral diodes.

Type 1: External Auxiliary Power Supply

◆ To reduce standby power (P_{IN} ≤ 30 mW)

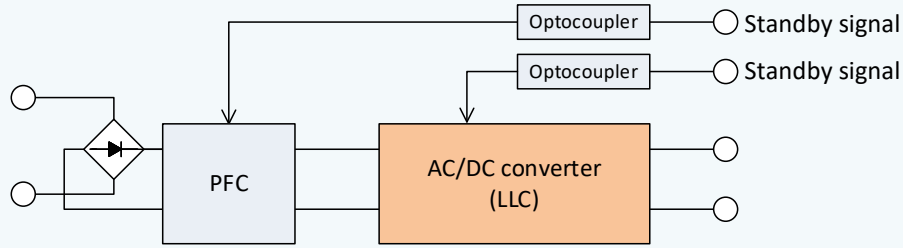
■ SSC3S931→P. 35



Type 2: Built-in Standby Function

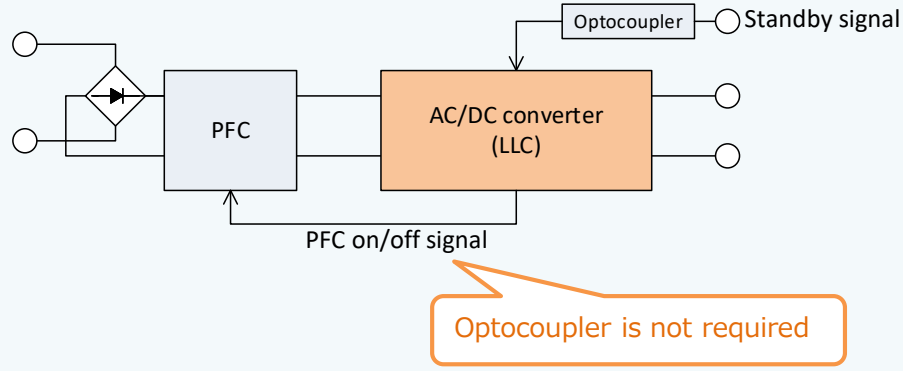
◆ To reduce external components

■ SSC3S900→P. 37



■ SSC3S921→P. 39

■ SSC3S927→P. 41



OFF-line LLC Controller Selection Guide

Sanken's LLC controllers provide for the safe resonance operation by the standard functions including standby mode, capacitive mode detection, and automatic dead time adjustment. In addition, these LLC controllers have enough protection functions including undervoltage lockout, overcurrent, overvoltage and thermal shutdown.
You can select an optimal IC for your application using the following table.

Part Number	Standby Operation	Output Power at Light load	PFC ON/OFF[2]	Universal Input	Protection Operation[3]	Remarks	Page#
SSC3S931	External auxiliary power supply	—	No	No	Latched shutdown	✓ Optocoupler open protection ✓ No high voltage capacitor for dead time detection	P.35
SSC3S901	Internal standby function (Changed by external signal)	100 mW[1]	No	Yes	Auto-restart		P.37
SSC3S902					Latched shutdown		
SSC3S921		125 mW[1]	Yes	No	Auto-restart	✓ REG overvoltage protection (Latched shutdown)	P.39
SSC3S927		150 mW	Yes	No	Auto-restart	✓ Improving light load efficiency (X-capacitor discharge function) ✓ Input overvoltage protection (HVP) ✓ REG overvoltage protection ✓ Realizing the power boost for output current	P.41

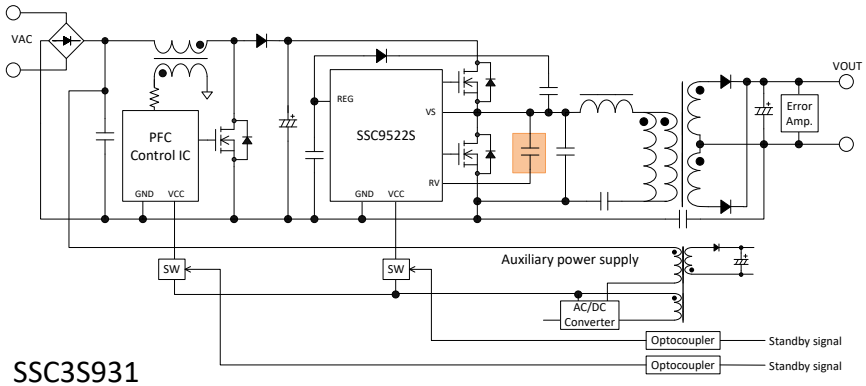
[1] P_{IN} = 0.27 W, as a reference with discharge resistor of 1MΩ for across the line capacitor.
[2] When the IC becomes into standby operation, the IC outputs PFC circuit stop signal. It achieves an optocoupler reduction for PFC circuit stop.
[3] Overload protection (OLP), overvoltage protection (OVP) and Thermal Shutdown (TSD).

SSC3S931

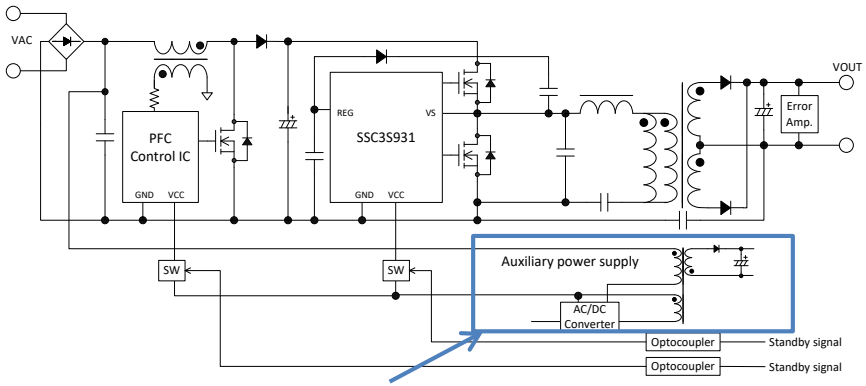
Package

SOP18

■ Existing LLC IC



■ SSC3S931



The IC is the type of using external auxiliary power supply, and is optimal for low no-load power consumption application. (PWM control IC, $P_{IN} \leq 30$ mW)

The product achieves high efficiency and few external components count.

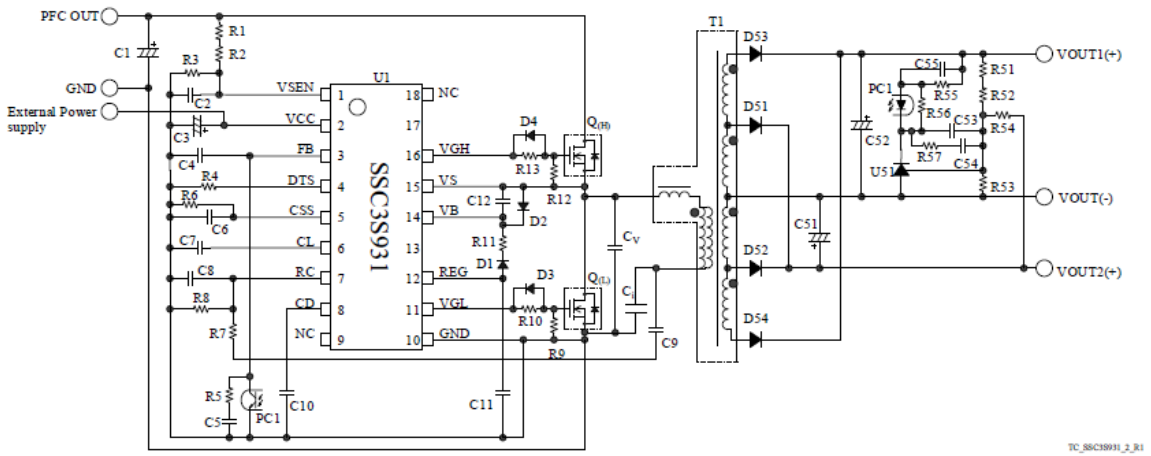
- Capacitive Mode Detection Function:
  Improving the ability of transformer output power
- Wide operating range (11.9 V ≤ VCC ≤ 32 V)
  Flexible transformer design when VCC is supplied by an auxiliary power supply
- No high voltage capacitor for dead time detection
- Optocoupler Open Protection

Features

- Floating drive circuit
- Soft-start Function
- Capacitive Mode Detection Function
- Reset Detection Function
- Automatic Dead Time Adjustment Function
- Protections
  - High-side driver UVLO : Auto-restart
  - VCC Pin Overvoltage Protection (VCC_OVP): Latched Shutdown
  - Overcurrent Protection (OCP) : Peak drain current detection, 2 step detections, auto-restart
  - Input Overvoltage Protection (HVP) : Latched Shutdown
  - Input Undervoltage Protection (UVP): Auto-restart
  - Overload Protection (OLP) : Latched Shutdown
  - Thermal Shutdown (TSD): Latched Shutdown
  - Optocoupler Open Protection (OOP): Latched Shutdown

SSC3S931

Typical Application Circuit



Electrical Characteristics

Parameter	Value
VCC Pin Maximum Ratings	35 V
$V_{CC(ON)}$	11.9 V (typ.)
$V_{CC(OFF)}$	10.0 V (typ.)
Minimum Oscillation Frequency	31.5 kHz (typ.)
Maximum Oscillation Frequency	300 kHz (typ.)
Maximum Source Current	-540 mA (typ.)
Maximum Sink Current	1.50 A (typ.)
V_{REG}	10.0 V (typ.)

Pin Assignment

No.	Symbol	Functions	No.	Symbol	Functions
1	VSEN	Mains input voltage detection signal input	10	GND	Ground
2	VCC	Supply voltage input for the IC with VCC pin overvoltage protection (VCC_OVP)	11	VGL	Low-side gate drive output
3	FB	Feedback signal input for constant voltage control and optocoupler open protection (OOP) signal input	12	REG	Supply voltage output for gate drive circuit
4	DTS	Dead time control selection: a fixed on the minimum value, or an automatically adjustment	13	—	(Pin removed)
5	CSS	Soft-start setting capacitor connection	14	VB	Supply voltage input for high-side driver with UVLO
6	CL	Overload detection (OLP) capacitor connection	15	VS	Floating ground for high-side driver
7	RC	Resonant current detection signal input and overcurrent protection (OCP) signal input	16	VGH	High-side gate drive output
8	CD	Delay time setting capacitor connection for optocoupler open protection (OOP)	17	—	(Pin removed)
9	NC	Not connected	18	NC	Not connected

SSC3S900 Series

Package

SOP18

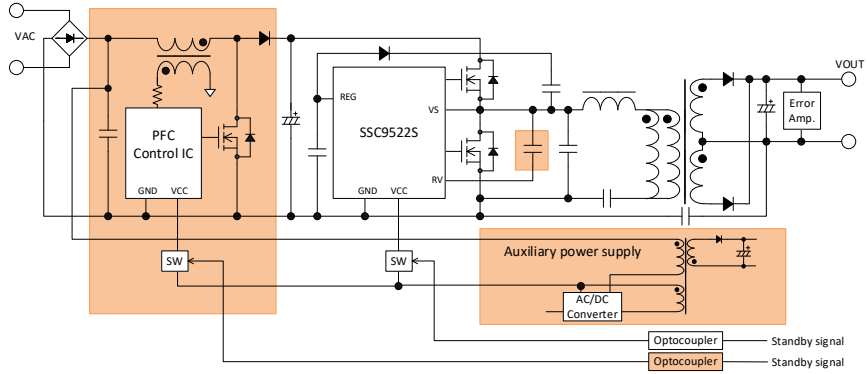
High efficiency and Few External Components Count

- No Auxiliary Power Supply by Internal Standby Function
- 80 VAC to 265 VAC Input without PFC Circuit < 75 W
- No High Voltage Capacitor for Dead Time Detection

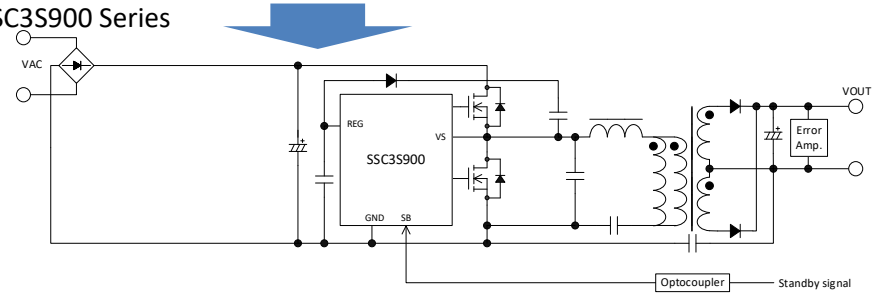
Selection Guide

Part Number	OLP, OVP, TSD Operation
SSC3S901	Auto-restart
SSC3S902	Latched Shutdown

■ Existing LLC IC



■ SSC3S900 Series



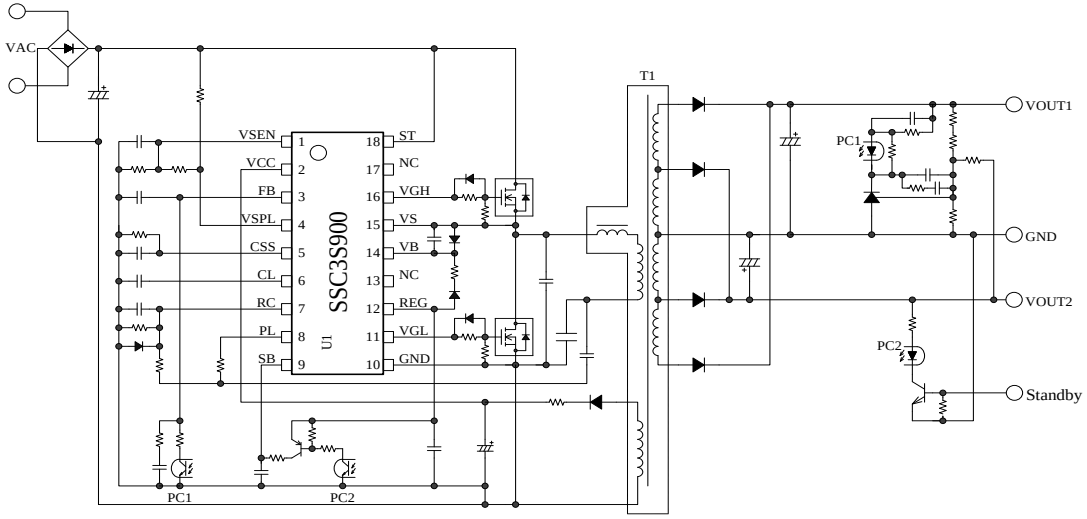
Features

◆ Standby Mode Change Function
(Changes to Standby Mode by External Signal)
- Standby Operation: Burst Mode
- Output Power at Light Load: P_O = 100 mW (P_{IN} = 0.27 W)
- Soft-on and Soft-off Function: Reduces Audible Noise

◆ Floating Drive Circuit
◆ Soft-start Function
◆ Capacitive Mode Detection Function
◆ Reset Detection Function
◆ Automatic Dead Time Adjustment Function
◆ Brown-in and Brown-out Function
◆ Input Electrolytic Capacitor Discharge Function
◆ Protections
- High-side driver UVLO: Auto-restart
- Overcurrent Protection (OCP): Peak Drain Current Detection, 2 Step Detections, Auto-restart
- Overload Protection (OLP) with Input Compensation : Latched Shutdown or Auto-restart
- Overvoltage Protection (OVP): Auto-restart
- Thermal Shutdown (TSD): Latched Shutdown or Auto-restart

SSC3S900 Series

Typical Application Circuit



Electrical Characteristics

Parameter	Value
VCC Pin Maximum Ratings	35 V
$V_{CC(ON)}$	14 V (typ.)
$V_{CC(OFF)}$	9.8 V (typ.)
Minimum Oscillation Frequency	32 kHz (typ.)
Maximum Oscillation Frequency	300 kHz (typ.)
Maximum Source Current	-540 mA (typ.)
Maximum Sink Current	1.5 A (typ.)

Pin Assignment

No.	Symbol	Functions	No.	Symbol	Functions
1	VSEN	The Mains Input Voltage Detection Signal Input	10	GND	Ground
2	VCC	Supply voltage input for the IC, and Overvoltage Protection Signal Input	11	VGL	Low-Side Gate Drive Output
3	FB	Feedback Signal Input for Constant Voltage Control	12	REG	Supply Voltage Output for Gate Drive Circuit
4	VSPL	The Input Voltage Detection Signal Input for OLP Input Voltage Compensation	13	(NC)	—
5	CSS	Soft-Start Capacitor Connection	14	VB	Supply Voltage Input for High-Side Driver
6	CL	OLP Input Voltage Compensation Capacitor Connection	15	VS	Floating Ground for High-Side Driver
7	RC	Resonant Current Detection Signal Input, and Overcurrent Protection Signal Input	16	VGH	High-Side Gate Drive Output
8	PL	Resonant Current Detection Signal Input for OLP Input Voltage Compensation	17	(NC)	—
9	SB	Standby mode change Signal Input	18	ST	Startup Current Input

SSC3S921

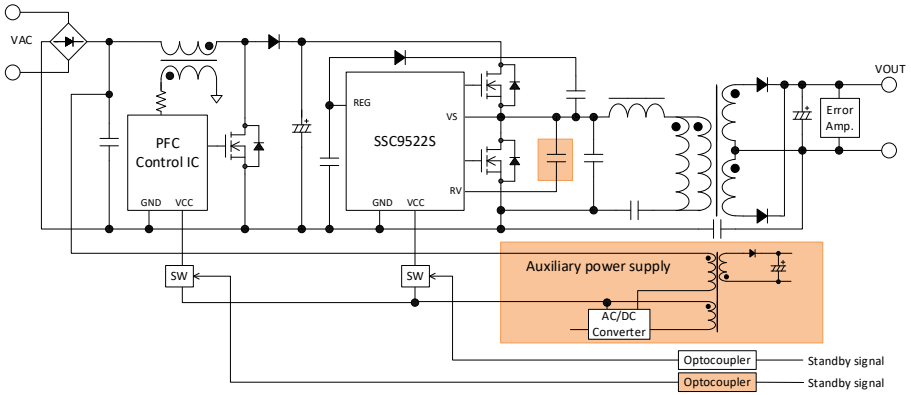
Package

SOP18

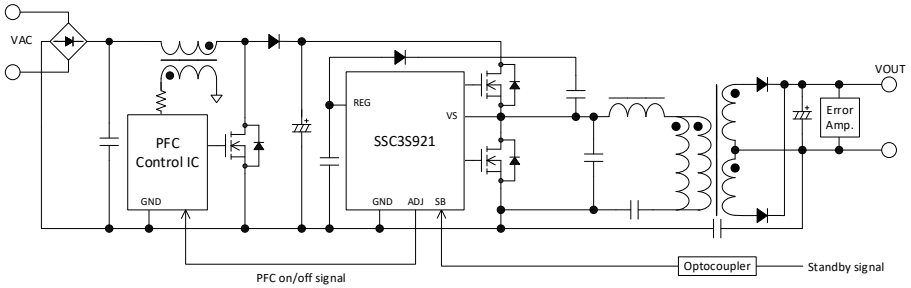
High efficiency and Few External Components Count

- No Auxiliary Power Supply by Internal Standby Function
- Standby Signal Output for PFC Off
- No High Voltage Capacitor for Dead Time Detection

■ Existing LLC IC



■ SSC3S921

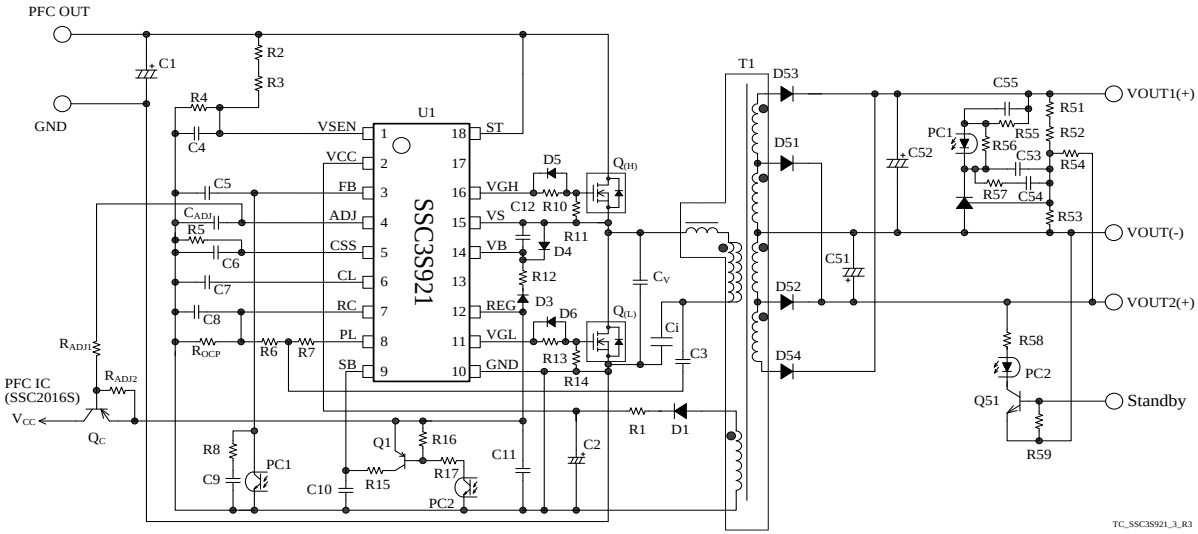


Features

- ◆Standby Mode Change Function
  (Changes to Standby Mode by External Signal)
  - ・Standby Operation: Burst Mode
  - ・Output Power at Light Load: P_O = 125 mW (P_{IN} = 0.27 W)
  - ・Soft-on and Soft-off Function: Reduces Audible Noise
- ◆Standby Signal Output for PFC Off
- ◆Floating Drive Circuit
- ◆Soft-start Function
- ◆Capacitive Mode Detection Function
- ◆Reset Detection Function
- ◆Automatic Dead Time Adjustment Function
- ◆Brown-in and Brown-out Function
- ◆Input Electrolytic Capacitor Discharge Function
- ◆Protections
  - High-side driver UVLO: Auto-restart
  - Overcurrent Protection (OCP): Peak Drain Current Detection, 2 Step Detections, Auto-restart
  - Overload Protection (OLP) : Auto-restart
  - Overvoltage Protection (OVP): Auto-restart
  - Thermal Shutdown (TSD): Auto-restart

SSC3S921

Typical Application Circuit



Electrical characteristics

Parameter	Value
VCC Pin Maximum Ratings	35 V
$V_{CC(ON)}$	17 V (typ.)
$V_{CC(OFF)}$	8.9 V (typ.)
Minimum Oscillation Frequency	31.5 kHz (typ.)
Maximum Oscillation Frequency	300 kHz (typ.)
Maximum Source Current	-540 mA (typ.)
Maximum Sink Current	1.5 A (typ.)
V_{REG}	10.0 V (typ.)

Pin Assignment

No.	Symbol	Functions	No.	Symbol	Functions
1	VSEN	The Mains Input Voltage Detection Signal Input	10	GND	Ground
2	VCC	Supply voltage input for the IC, and Overvoltage Protection Signal Input	11	VGL	Low-Side Gate Drive Output
3	FB	Feedback Signal Input for Constant Voltage Control	12	REG	Supply Voltage Output for Gate Drive Circuit
4	ADJ	PFC on/off Signal Output	13	—	(Pin Removed)
5	CSS	Soft-Start Capacitor Connection	14	VB	Supply Voltage Input for High-Side Driver
6	CL	OLP Input Voltage Compensation Capacitor Connection	15	VS	Floating Ground for High-Side Driver
7	RC	Resonant Current Detection Signal Input, and Overcurrent Protection Signal Input	16	VGH	High-Side Gate Drive Output
8	PL	Resonant Current Detection Signal for OLP	17	—	(Pin Removed)
9	SB	Standby mode change Signal Input	18	ST	Startup Current Input

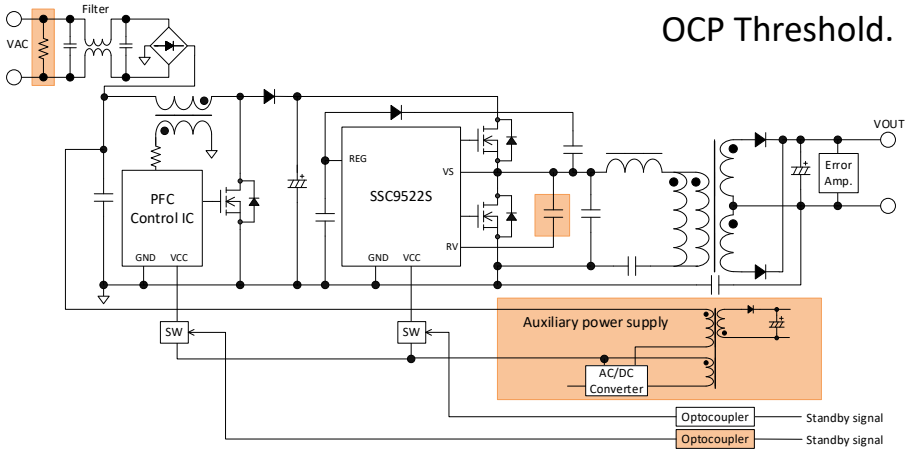
SSC3S927

Package
SOP18

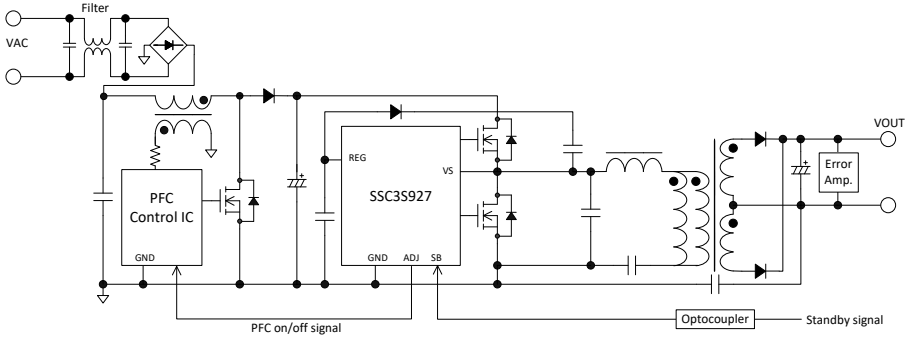
High efficiency and Few External Components Count

- Improving Light Load Efficiency by X-capacitor Discharge Function
- No Auxiliary Power Supply by Internal Standby Function
- Standby Signal Output for PFC Off
- No High Voltage Capacitor for Dead Time Detection
- Power Boost for Output Current Is Achieved by Wide Operational Range Due to Increasing OCP Threshold.

■ Existing LLC IC



■ SSC3S927

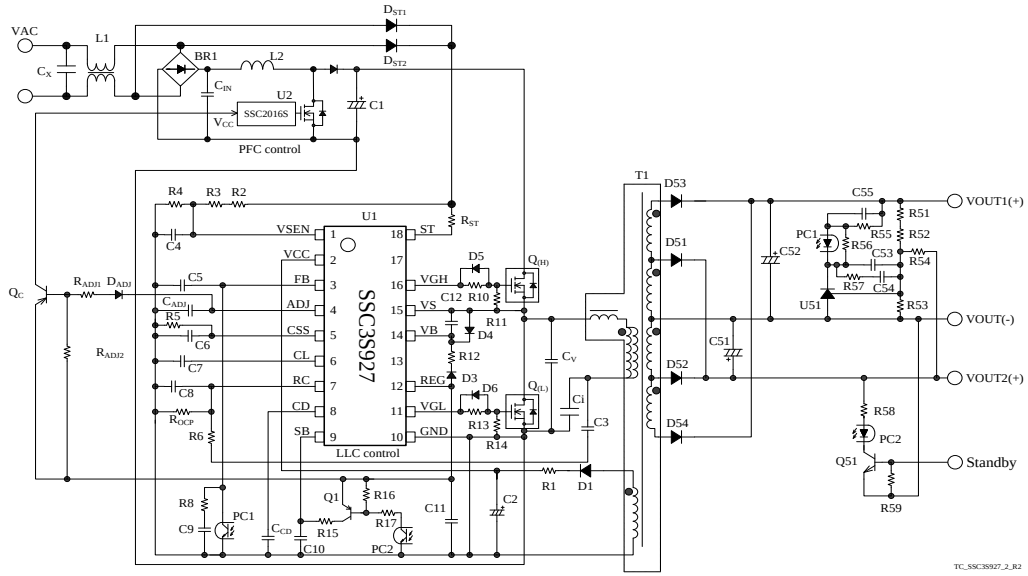


Features

- ◆ Standby Mode Change Function
  (Changes to Standby Mode by External Signal)
  - ・Standby Operation: Burst Mode
  - ・Output Power at Light Load: P_O = 150 mW (P_{IN} = 0.27 W)
  - ・Soft-on and Soft-off Function: Reduces Audible Noise
- ◆ Standby Signal Output for PFC Off
- ◆ Floating Drive Circuit
- ◆ Soft-start Function
- ◆ Capacitive Mode Detection Function
- ◆ Reset Detection Function
- ◆ Automatic Dead Time Adjustment Function
- ◆ X-capacitor Discharge Function
- ◆ Protections
  - High-side driver UVLO: Auto-restart
  - Overcurrent Protection (OCP): Peak Drain Current Detection, 2 Step Detections, Auto-restart
  - Input Voltage Detection Function
    Input Overvoltage Protection (HVP): Auto-restart
    Input Undervoltage Protection (UVP) : Auto-restart
  - REG Overvoltage Protection (REG_OVP): Auto-restart
  - Overload Protection (OLP) , Overvoltage Protection (OVP) , Thermal Shutdown (TSD): Auto-restart

SSC3S927

Typical Application Circuit



Electrical Characteristics

Parameter	Value
VCC Pin Maximum Ratings	35 V
$V_{CC(ON)}$	17 V (typ.)
$V_{CC(OFF)}$	8.9 V (typ.)
Minimum Oscillation Frequency	31.5 kHz (typ.)
Maximum Oscillation Frequency	300 kHz (typ.)
Maximum Source Current	-540 mA (typ.)
Maximum Sink Current	1.5 A (typ.)
V_{REG}	10.0 V (typ.)

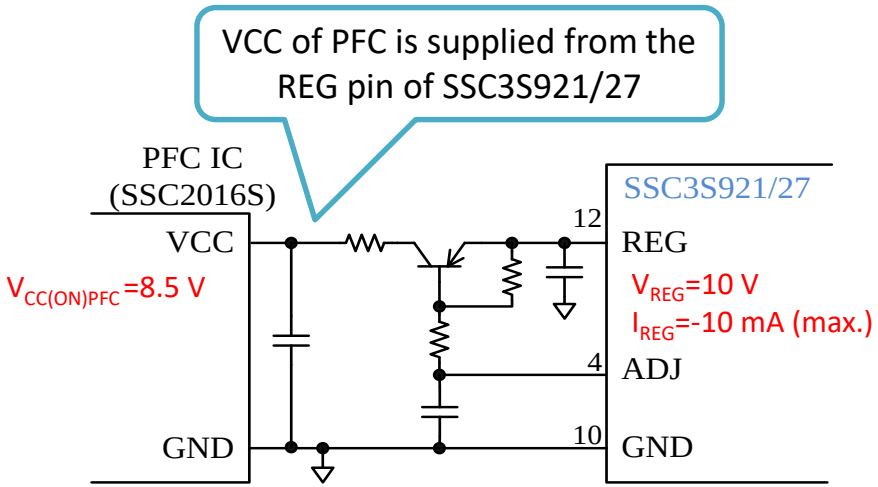
Pin Assignment

No.	Symbol	Functions	No.	Symbol	Functions
1	VSEN	The Mains Input Voltage Detection Signal Input	10	GND	Ground
2	VCC	Supply voltage input for the IC, and Overvoltage Protection Signal Input	11	VGL	Low-Side Gate Drive Output
3	FB	Feedback Signal Input for Constant Voltage Control	12	REG	Supply Voltage Output for Gate Drive Circuit
4	ADJ	PFC on/off Signal Output	13	—	(Pin Removed)
5	CSS	Soft-Start Capacitor Connection	14	VB	Supply Voltage Input for High-Side Driver
6	CL	Overload detection capacitor connection	15	VS	Floating Ground for High-Side Driver
7	RC	Resonant current detection Signal Input, and Overcurrent Protection (OCP) Signal Input	16	VGH	High-Side Gate Drive Output
8	CD	Delay time setting capacitor connection	17	—	(Pin Removed)
9	SB	Standby mode change Signal Input	18	ST	Startup Current Input

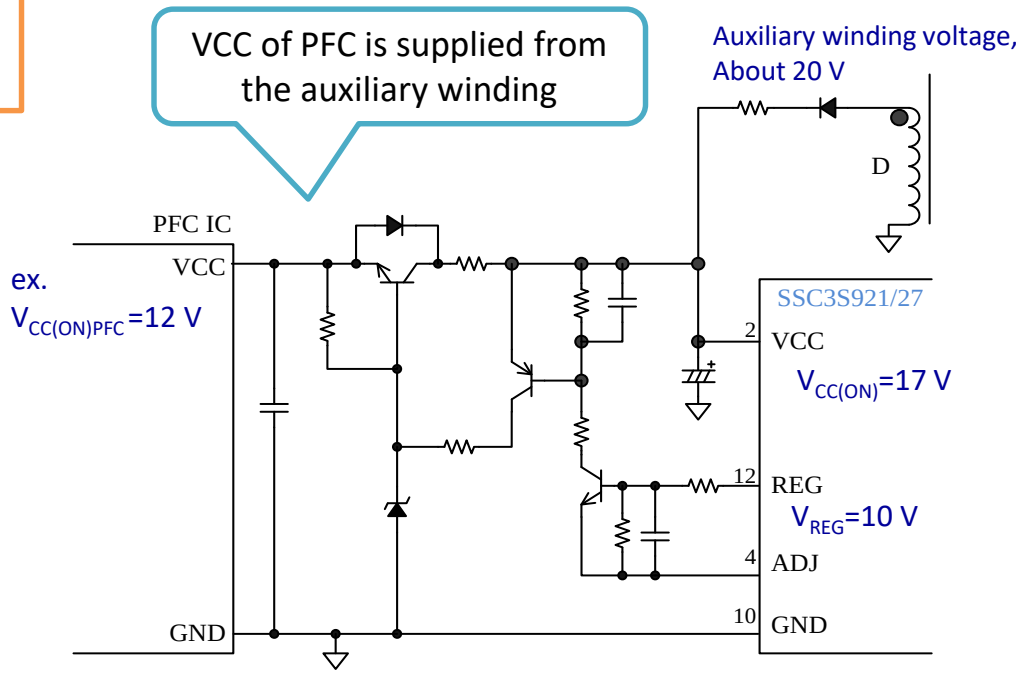
Using SSC3S921/27(LLC) and SSC2016S(PFC)

Sanken's PFC IC SSC2016S (P.45) has low VCC threshold voltage of 8.5 V (typ.). It is lower than general PFC IC. Thus, SSC2016S can be operated by SSC3S921/27 REG voltage of 10 V (typ.).
By PFC ON/OFF Function of SSC3S921/27, The operation of SSC2016S can be stopped when SSC3S921/27 becomes standby operation.
Combination of SSC3S921/27 and SSC2016S can achieve the following simple circuit.

- ✓ Simple Circuit.
- ✓ PFC Operation Synchronous with the Standby Operation of SSC3S921/27.



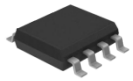
PFC IC ON/OFF Circuit using SSC2016S



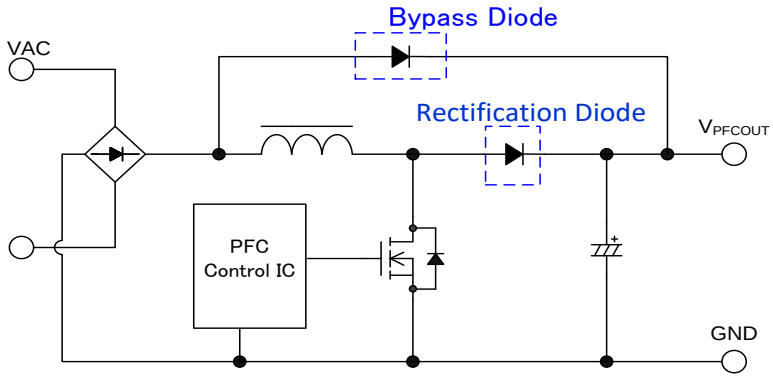
PFC IC ON/OFF Circuit using General PFC IC

Power Factor Correction (PFC)

Back to contents

Products	Package	Operation Mode	P_{OUT}	Remarks	Page #
SSC2016S	SOIC8 	Critical Conduction Mode (CRM) Operation	~200 W	Maximum Switching Frequency Limitation Function	P. 45

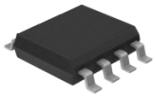
Diode for PFC (Refer to the Selection Guide of Diode)



SSC2016S

Package

SOIC8



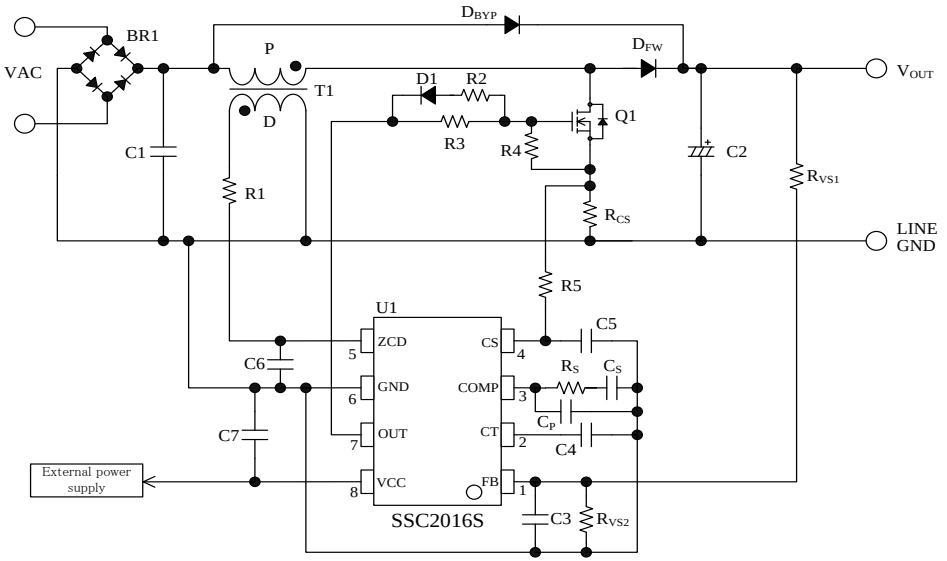
Part Number	$V_{CC(ON)}$	$V_{FB(REF)}$	I_{OUT} Source	I_{OUT} Sink
SSC2016S	8.5 V	2.50 V	−500 mA	1000 mA

- Critical Conduction Mode (CRM)
- For PFC Circuit up to 200 W of Output Power
- Light Load Efficiency Is Improved by Maximum Switching Frequency Limitation Function
- Low Standby Power (No Input Voltage Sensing Resistors Required)

Pin Assignment

Pin No.	Symbol	Functions
1	FB	Feedback, OVP and UVLO Signal Input
2	CT	Timing capacitor connection
3	COMP	Phase compensation
4	CS	Overcurrent protection Signal Input
5	ZCD	ZCD Signal Input and delay time adjustment
6	GND	Ground
7	OUT	Gate drive output
8	VCC	Power supply input for control circuit

Circuit



TC_SSC2016S_1_R2

Features

- Critical Conduction Mode (CRM)
- Low Standby Power (No Input Voltage Sensing Resistors Required)
- Maximum Switching Frequency Limitation Function
- Maximum on-Time Limiting Function
- Restart Function

- Protections
  - Overcurrent Protection 1(OCP1): Pulse-by-Pulse
  - Overcurrent Protection 2(OCP2): Latched Shutdown
  - Overvoltage Protection (OVP): Auto-restart
  - FB Pin Undervoltage Protection (FB_UVP): Auto-restart
  - Thermal Shutdown (TSD): Auto-restart

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