Selection Guide

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

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Selection Guide of Power Management IC by Control Topology

START

Input Power

≥75W

Component Count and Noise Requirement

For low noise

LLC IC

P. 33

< 75W

≥25mW

Component Count and Noise Requirement

For low noise and low component count

Quasi-resonant IC

P. 31

< 25mW

PWM IC

P. 9

Input Power at No Load

≥25mW

Component Count and Noise Requirement

For low noise

LLC IC

P. 33

For low noise and low component count

Quasi-resonant IC

P. 31

PWM IC

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PFC IC

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PFC IC

P. 46
Selection Guide by Application

PFC
Power Factor Correction
- Large-sized printer
- Laser printer
- MFP
- Server
- Audio
- Electric bicycle charger
- Electric tool

LLC
Low Noise
Current Resonance Mode
- Sewing machine for industrial use
- Electrical piano
- Electrical water heater
- IH cooking heater
- BD recorder
- Cleaning robot
- Washing machine
- Toilet seat
- Vacuum cleaner
- Adapter
- Power conditioner
- Power supply for PC
- LCD TV
- Air conditioner
- Air purifier
- Printer
- Rice cooker
- Water purifier
- Smart meter
- Low power
- IH cooking heater
- Monitor
- Charger
- Water purifier
- Smart meter
- Low power
- IH cooking heater
- Wireless charger
- Power supply for PC
- LCD TV
- Air conditioner
- Air purifier
- Rice cooker
- Water purifier
- Smart meter
- Low power
- IH cooking heater
- Monitor
- Charger
- Water purifier
- Smart meter
- Low power
- IH cooking heater
- Wireless charger

PWM
Small Circuit
Pulse Width Modulation
Fixed Frequency Control
- Sewing machine for industrial use
- Laser printer
- Large-sized printer
- MFP
- Server
- Audio
- Electric bicycle charger
- Electric tool
- BD recorder
- Cleaning robot
- Washing machine
- Toilet seat
- Vacuum cleaner
- Adapter
- Power conditioner
- Power supply for PC
- LCD TV
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- Rice cooker
- Water purifier
- Smart meter
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- IH cooking heater
- Wireless charger
- Power supply for PC
- LCD TV
- Air conditioner
- Air purifier
- Rice cooker
- Water purifier
- Smart meter
- Low power
- IH cooking heater
- Monitor
- Charger
- Water purifier
- Smart meter
- Low power
- IH cooking heater
- Wireless charger

QR
Low Noise
Quasi-resonant Mode
Variable Frequency Control
- Sewing machine for industrial use
- Laser printer
- Large-sized printer
- MFP
- Server
- Audio
- Electric bicycle charger
- Electric tool
- BD recorder
- Cleaning robot
- Washing machine
- Toilet seat
- Vacuum cleaner
- Adapter
- Power conditioner
- Power supply for PC
- LCD TV
- Air conditioner
- Air purifier
- Rice cooker
- Water purifier
- Smart meter
- Low power
- IH cooking heater
- Monitor
- Charger
- Water purifier
- Smart meter
- Low power
- IH cooking heater
- Wireless charger
- Power supply for PC
- LCD TV
- Air conditioner
- Air purifier
- Rice cooker
- Water purifier
- Smart meter
- Low power
- IH cooking heater
- Monitor
- Charger
- Water purifier
- Smart meter
- Low power
- IH cooking heater
- Wireless charger

Power Supply Circuit Size

SGE0001 Jan. 26, 2021
For Low and Middle Power Application

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

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

*See Selection Guide of Diode about peripheral diodes.
For Low Power Application
OFF-line Controllers with Integrated Power MOSFET and the Peripheral Diodes

➢ Buck Converter

➢ Inverting Converter

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

*See Selection Guide of Diode about peripheral diodes.
For High Power Application
PFC and OFF-line Controllers and the Peripheral Diode

- **PFC IC**
  - Power Factor Correction
  - [P. 46](#)

- **LLC IC**
  - For high power application, industrial equipment, etc.
  - [P. 33](#)

- **PWM IC**
  - For auxiliary power supply
  - [P. 9](#)

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*See Selection Guide of Diode about peripheral diodes.*
Sanken provides the optimal power supply IC according to control topology. Please refer to Sanken’s website for detail information.

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

<table>
<thead>
<tr>
<th>Control Topology</th>
<th>Power MOSFET</th>
<th>$P_O$</th>
<th>Control Method</th>
<th>Page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFC</td>
<td>External</td>
<td>≥75W</td>
<td>◆ Critical Conduction Mode (CRM) Operation</td>
<td>P. 46</td>
</tr>
</tbody>
</table>


**OFF-line PWM Controllers with Integrated Power MOSFET**

- 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

<table>
<thead>
<tr>
<th>Control Method</th>
<th>Series</th>
<th>Package</th>
<th>$f_{\text{OSC}}$</th>
<th>No Load Power Consumption</th>
<th>Features</th>
<th>Page #</th>
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<tbody>
<tr>
<td><strong>Flyback (Secondary Side Regulation)</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Noise in High Power</td>
<td>STR6A100xV</td>
<td>DIP8</td>
<td>67kHz/100kHz</td>
<td>&lt; 15 mW</td>
<td>Selectable Standby Operation Point. Improving Efficiency in All Load Area.</td>
<td>P. 11</td>
</tr>
<tr>
<td></td>
<td>STR6A100xVD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line Voltage Protection Model</td>
<td>STR6A100HZ</td>
<td>DIP8</td>
<td>100kHz</td>
<td>&lt; 25 mW</td>
<td>Brown in / out. Improving Efficiency in All Load Area.</td>
<td>P. 13</td>
</tr>
<tr>
<td></td>
<td>STR-A6000xZ</td>
<td>DIP8</td>
<td>67kHz/100kHz</td>
<td>&lt; 25 mW</td>
<td>Brown in / out.</td>
<td>P. 15</td>
</tr>
<tr>
<td><strong>Low Component Count Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STR3A400</td>
<td>DIP8</td>
<td>65 kHz 100 kHz</td>
<td>&lt; 15 mW</td>
<td>Low Thermal Resistance Package. Improving Efficiency in All Load Area.</td>
<td>P. 17</td>
</tr>
<tr>
<td></td>
<td>STR3A400HDL</td>
<td></td>
<td></td>
<td></td>
<td>Low Thermal Resistance Package.</td>
<td>P. 19</td>
</tr>
<tr>
<td></td>
<td>STR3A200</td>
<td>DIP8</td>
<td>67 kHz</td>
<td></td>
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<td>P. 21</td>
</tr>
<tr>
<td></td>
<td>STR4A100</td>
<td>DIP8 / SOIC8</td>
<td>65kHz/100kHz</td>
<td>&lt; 10 mW</td>
<td>Built in OCP detection resistor</td>
<td>P. 23</td>
</tr>
<tr>
<td><strong>Flyback (Primary Side Regulation)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STR5A100D</td>
<td>DIP8</td>
<td>65 kHz</td>
<td>&lt; 30 mW</td>
<td>Built in OCP detection resistor</td>
<td>P. 25</td>
</tr>
<tr>
<td><strong>Non-isolated Buck / Inverting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STR5A460</td>
<td>DIP8 / SOIC8</td>
<td>60 kHz</td>
<td>—</td>
<td>Built in OCP detection resistor $I_{\text{DLIM}}=\sim0.41$ A</td>
<td>P. 27</td>
</tr>
<tr>
<td></td>
<td>STR5A450</td>
<td>DIP8</td>
<td>60 kHz</td>
<td>—</td>
<td>Built in OCP detection resistor $I_0=1.2A$ (max.)</td>
<td>P. 29</td>
</tr>
</tbody>
</table>
# PWM Control IC Selection Guide

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

## White Goods, Adapter

<table>
<thead>
<tr>
<th>Device</th>
<th>IC Code</th>
<th>Page No.</th>
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<tbody>
<tr>
<td>Aar Conditioner</td>
<td>STR5A450</td>
<td>P. 11</td>
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<tr>
<td>Refrigerator</td>
<td>STR4A100</td>
<td>P. 13</td>
</tr>
<tr>
<td>Washing Machine</td>
<td>STR5A200</td>
<td>P. 15</td>
</tr>
<tr>
<td>Adapter</td>
<td>STR3A400*</td>
<td>P. 17</td>
</tr>
<tr>
<td></td>
<td>STR3A400HDL*</td>
<td>P. 19</td>
</tr>
<tr>
<td></td>
<td>STR3A200</td>
<td>P. 21</td>
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</tbody>
</table>

## Low Power White Goods

<table>
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<tr>
<th>Device</th>
<th>IC Code</th>
<th>Page No.</th>
</tr>
</thead>
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<tr>
<td>Microwave Oven</td>
<td>STR5A460</td>
<td>P. 23</td>
</tr>
<tr>
<td>Cleaner</td>
<td>STR5A100D</td>
<td>P. 25</td>
</tr>
<tr>
<td>Rice Cooker</td>
<td>STR5A50</td>
<td>P. 27</td>
</tr>
</tbody>
</table>

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

- Selectable Standby Operation Point
- Audible Noise Suppression in High Power
- High Efficiency (Step Drive, Green Mode)
- Line Voltage Protection (Brown-In / out)
- Low Thermal Resistance DIP8 Package
- Low Power Consumption at No Load
- Low Component Count
- Non-isolation Type (Buck/Inverting Converter)
- Low Component Count
- Green Mode
**STR6A100xV/xVD Series**

- *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

<table>
<thead>
<tr>
<th>Part Number</th>
<th>fOSC</th>
<th>V_DSS</th>
<th>R_DS(ON)</th>
<th>P_OUT (Adaptor)</th>
<th>P_OUT (Open frame)</th>
<th>OVP, TSD operation</th>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>AC230V</td>
<td>Universal</td>
<td>AC230V</td>
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<tr>
<td>STR6A153MV</td>
<td>65 kHz</td>
<td>650 V</td>
<td>1.9 Ω</td>
<td>26 W</td>
<td>21 W</td>
<td>40 W</td>
</tr>
<tr>
<td>STR6A153MVD</td>
<td>UD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STR6A163HVD</td>
<td>UD</td>
<td></td>
<td>2.3 Ω</td>
<td>25 W</td>
<td>20 W</td>
<td>40 W</td>
</tr>
<tr>
<td>STR6A161HVD</td>
<td>100 kHz</td>
<td>700 V</td>
<td>3.95 Ω</td>
<td>20.5 W</td>
<td>15 W</td>
<td>35 W</td>
</tr>
<tr>
<td>STR6A169HVD</td>
<td></td>
<td></td>
<td>6.0 Ω</td>
<td>17 W</td>
<td>11 W</td>
<td>30 W</td>
</tr>
<tr>
<td>STR6A168HV</td>
<td></td>
<td></td>
<td>10.0 Ω</td>
<td>14 W</td>
<td>8 W</td>
<td>24 W</td>
</tr>
<tr>
<td>STR6A168HVD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
**STR6A100xV/xVD Series**

**Pin Assignment**

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

**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 or 100 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

**Typical Application Circuit**

- 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

**P_{IN} < 15 mW at No Load, PWM Off-line Switching Regulators**
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

---

<table>
<thead>
<tr>
<th>Part Number</th>
<th>( f_{OSC} )</th>
<th>Power MOSFET</th>
<th>( P_{OUT} ) (Adaptor)</th>
<th>( P_{OUT} ) (Open Frame)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( f_{OSC} )</td>
<td>( V_{DSS} )</td>
<td>( R_{DS(ON)} )</td>
<td>( P_{OUT} )</td>
</tr>
<tr>
<td>STR6A169HZ</td>
<td>100 kHz</td>
<td>6.0 Ω</td>
<td>17 W</td>
<td>11 W</td>
</tr>
<tr>
<td>STR6A161HZ</td>
<td></td>
<td>3.95 Ω</td>
<td>20.5 W</td>
<td>15 W</td>
</tr>
<tr>
<td>STR6A163HZ</td>
<td></td>
<td>2.3 Ω</td>
<td>25 W</td>
<td>20 W</td>
</tr>
</tbody>
</table>

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SGE0001 Jan. 26, 2021
**STR6A100HZ Series**

**Pin Assignment**

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

**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
P\textsubscript{IN} < 25 mW at No Load, PWM Off-line Switching Regulators

**STR-A6000xZ Series**

- 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

<table>
<thead>
<tr>
<th>Part Number</th>
<th>(f_{\text{OSC}})</th>
<th>Power MOSFET</th>
<th>(P_{\text{OUT (Adapter)}})</th>
<th>(P_{\text{OUT (Open Frame)}})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(V_{\text{DSS}})</td>
<td>(R_{\text{DS(ON)}})</td>
<td>AC230V</td>
<td>Universal</td>
</tr>
<tr>
<td>STR-A6069MZ</td>
<td>67 kHz 700 V</td>
<td>6.0 (\Omega)</td>
<td>15 W</td>
<td>10 W</td>
</tr>
<tr>
<td>STR-A6061MZ</td>
<td>67 kHz 700 V</td>
<td>3.95 (\Omega)</td>
<td>18.5 W</td>
<td>14 W</td>
</tr>
<tr>
<td>STR-A6063MZ</td>
<td>100 kHz 700 V</td>
<td>2.3 (\Omega)</td>
<td>24 W</td>
<td>19.5 W</td>
</tr>
<tr>
<td>STR-A6069HZ</td>
<td>100 kHz 700 V</td>
<td>6.0 (\Omega)</td>
<td>17 W</td>
<td>11 W</td>
</tr>
<tr>
<td>STR-A6061HZ</td>
<td>100 kHz 700 V</td>
<td>3.95 (\Omega)</td>
<td>20.5 W</td>
<td>15 W</td>
</tr>
<tr>
<td>STR-A6063HZ</td>
<td>100 kHz 700 V</td>
<td>2.3 (\Omega)</td>
<td>25 W</td>
<td>20 W</td>
</tr>
</tbody>
</table>
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

SGE0001 Jan. 26, 2021
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

<table>
<thead>
<tr>
<th>Part Number</th>
<th>OVP / TSD Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>STR3A4xx</td>
<td>Latched Shutdown</td>
</tr>
<tr>
<td>STR3A4xxD</td>
<td>Auto-restart</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part Number</th>
<th>fOSC (min.)</th>
<th>Power MOSFET</th>
<th>POUT (Adapter)</th>
<th>POUT (Open Frame)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STR3A451</td>
<td>65 kHz</td>
<td>650 V</td>
<td>4.0 Ω</td>
<td>29.5 W</td>
</tr>
<tr>
<td>STR3A451D</td>
<td>65 kHz</td>
<td>650 V</td>
<td>1.9 Ω</td>
<td>37 W</td>
</tr>
<tr>
<td>STR3A453</td>
<td>65 kHz</td>
<td>650 V</td>
<td>1.1 Ω</td>
<td>45 W</td>
</tr>
<tr>
<td>STR3A453D</td>
<td>65 kHz</td>
<td>650 V</td>
<td>1.1 Ω</td>
<td>45 W</td>
</tr>
<tr>
<td>STR3A455</td>
<td>65 kHz</td>
<td>650 V</td>
<td>1.1 Ω</td>
<td>45 W</td>
</tr>
<tr>
<td>STR3A455D</td>
<td>65 kHz</td>
<td>650 V</td>
<td>1.1 Ω</td>
<td>45 W</td>
</tr>
</tbody>
</table>

SanKen
**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**

---

**Pin Assignment**

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

---

**Typical Application Circuit**

---

**Package**

DIP8

---

**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

---

**P_{IN} < 15 mW at No Load, PWM Off-line Switching Regulators**

---

SGE0001  Jan. 26, 2021
PIN < 15 mW at No Load, PWM Off-line Switching Regulators

STR3A400HDL Series

- 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

<table>
<thead>
<tr>
<th>Part Number</th>
<th>fOSC</th>
<th>Power MOSFET</th>
<th>P_{OUT} (Adapter)</th>
<th>P_{OUT} (Open Frame)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>V_{DSS} (min.)</td>
<td>R_{DS(ON)} (max.)</td>
<td>AC230V</td>
</tr>
<tr>
<td>STR3A461HDL</td>
<td>100 kHz</td>
<td>700 V</td>
<td>4.2 Ω</td>
<td>28 W</td>
</tr>
<tr>
<td>STR3A462HDL</td>
<td>100 kHz</td>
<td>700 V</td>
<td>3.2 Ω</td>
<td>31 W</td>
</tr>
<tr>
<td>STR3A463HDL</td>
<td>100 kHz</td>
<td>700 V</td>
<td>2.2 Ω</td>
<td>34 W</td>
</tr>
<tr>
<td>STR3A475HDL</td>
<td>100 kHz</td>
<td>800 V</td>
<td>1.7 Ω</td>
<td>39 W</td>
</tr>
</tbody>
</table>

UD: Under development
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

Pin Assignment

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

Typical Application Circuit

P<sub>IN</sub> < 15 mW at No Load, PWM Off-line Switching Regulators

STR3A400HD Series

Package

DIP8

Pin Assignment

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S/OCP</td>
<td>Power MOSFET Source and Overcurrent Protection</td>
</tr>
<tr>
<td>2</td>
<td>VCC</td>
<td>Power supply Input and Overvoltage Protection</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>FB/OLP</td>
<td>Feedback Control and Overload Protection</td>
</tr>
<tr>
<td>5~8</td>
<td>D/ST</td>
<td>Power MOSFET Drain and Startup Current Input</td>
</tr>
</tbody>
</table>
**STR3A200 Series**

- 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

<table>
<thead>
<tr>
<th>Part Number</th>
<th>OVP / TSD Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>STR3A2xx</td>
<td>Latched Shutdown</td>
</tr>
<tr>
<td>STR3A2xxD</td>
<td>Auto-restart</td>
</tr>
</tbody>
</table>

### Power MOSFET

<table>
<thead>
<tr>
<th>Part Number</th>
<th>$f_{\text{OSC(AVG)}}$</th>
<th>Power MOSFET</th>
<th>$P_{\text{OUT}}$ (Adapter)</th>
<th>$P_{\text{OUT}}$ (Open Frame)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STR3A251</td>
<td>67 kHz</td>
<td>$V_{\text{DSS}}$ = 650 V, $R_{\text{DS(ON)}}$ = 4.0 Ω</td>
<td>$P_{\text{OUT}}$ (Adapter) = 29.5 W, 19.5 W</td>
<td>$P_{\text{OUT}}$ (Open Frame) = 37 W, 23 W</td>
</tr>
<tr>
<td>STR3A251D</td>
<td>Under development</td>
<td>$R_{\text{DS(ON)}}$ = 1.9 Ω</td>
<td>$P_{\text{OUT}}$ (Adapter) = 37 W, 27.5 W</td>
<td>$P_{\text{OUT}}$ (Open Frame) = 53 W, 35 W</td>
</tr>
<tr>
<td>STR3A253</td>
<td>Under development</td>
<td>$R_{\text{DS(ON)}}$ = 1.1 Ω</td>
<td>$P_{\text{OUT}}$ (Adapter) = 45 W, 35 W</td>
<td>$P_{\text{OUT}}$ (Open Frame) = 65 W, 44 W</td>
</tr>
</tbody>
</table>
STR3A200 Series

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

Pin Assignment

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

Typical Application Circuit

\[\text{Typical Application Circuit Image}\]
P_{IN} < 10 \text{ mW at No Load, PWM Off-line Switching Regulators}

**STR4A100 Series**

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

---

**Selection Guide**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>$f_{OSC}$</th>
<th>$R_{DS(ON)}$</th>
<th>$I_{DLIM(H)}$</th>
<th>$P_{OUT}$ (Adapter) AC230V</th>
<th>$P_{OUT}$ (Adapter) Universal</th>
<th>$P_{OUT}$ (Open Frame) AC230V</th>
<th>$P_{OUT}$ (Open Frame) Universal</th>
</tr>
</thead>
<tbody>
<tr>
<td>STR4A162S</td>
<td>SOIC8</td>
<td>65 kHz</td>
<td>24.6 Ω</td>
<td>0.365 A</td>
<td>5 W</td>
<td>4 W</td>
<td>7 W</td>
<td>5.5 W</td>
</tr>
<tr>
<td>STR4A162D</td>
<td>DIP8</td>
<td></td>
<td>12.9 Ω</td>
<td>0.520 A</td>
<td>5.5 W</td>
<td>4.5 W</td>
<td>7.5 W</td>
<td>6 W</td>
</tr>
<tr>
<td>STR4A164D</td>
<td>DIP8</td>
<td></td>
<td>12.9 Ω</td>
<td>0.485 A</td>
<td>8 W</td>
<td>6 W</td>
<td>10 W</td>
<td>8.5 W</td>
</tr>
<tr>
<td>STR4A164HD</td>
<td>DIP8</td>
<td>100 kHz</td>
<td>12.9 Ω</td>
<td></td>
<td>9 W</td>
<td>7 W</td>
<td>13 W</td>
<td>10.5 W</td>
</tr>
</tbody>
</table>
**STR4A100 Series**

**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

**Pin Assignment**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FB/OLP</td>
<td>Feedback Control and Overload Protection</td>
</tr>
<tr>
<td>2</td>
<td>VCC</td>
<td>Power supply Input and Overvoltage Protection</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>(Pin Removed)</td>
</tr>
<tr>
<td>4</td>
<td>D/ST</td>
<td>Power MOSFET Drain and Startup Current Input</td>
</tr>
<tr>
<td>5</td>
<td>S/GND</td>
<td>Power MOSFET Source and Ground</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Typical Application Circuit**

**Package**

- DIP8
- SOIC8

**Applications**

- PIN < 10 mW at No Load, PWM Off-line Switching Regulators
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

<table>
<thead>
<tr>
<th>Part Number</th>
<th>$f_{OSC}$</th>
<th>Rs(ON)</th>
<th>Idlim(H)</th>
<th>POUT (Adapter)</th>
<th>POUT (Open Frame)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AC230V</td>
<td>AC230V</td>
</tr>
<tr>
<td>STR5A162D</td>
<td>65 kHz</td>
<td>24.6 Ω</td>
<td>0.285 A</td>
<td>4 W</td>
<td>5 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.5 W</td>
<td>4.5 W</td>
</tr>
<tr>
<td>STR5A164D</td>
<td></td>
<td>13 Ω</td>
<td>0.41 A</td>
<td>6.0 W</td>
<td>8.5 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.5 W</td>
<td>7 W</td>
</tr>
</tbody>
</table>
**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

---

**Pin Assignment**

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

---

**Typical Application Circuit**

[Diagram of the typical application circuit for STR5A100D Series]
High Efficient Off-line PWM Buck and Inverting converter

STR5A460 Series

- $I_{DLIM} = 0.41$ 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
- $V_{D/ST} \text{ (max.)} = 700$ V
- Protections
  - OCP is pulse-by pulse
  - OLP, OVP and TSD are All Auto-restart

Selection Guide

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>$f_{OSC}$</th>
<th>Power MOSFET</th>
<th>$I_{DLIM}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>STR5A464D</td>
<td>DIP8</td>
<td>60 kHz</td>
<td>13.6 Ω</td>
<td>0.41 A</td>
</tr>
<tr>
<td>STR5A464S</td>
<td>SOIC8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
High Efficient
Off-line PWM Buck and Inverting converter

STR5A460 Series

Package
DIP8  SOIC8

Pin Assignment

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

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

Typical Application Circuit

- Buck converter

- Inverting converter
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

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>( f_{OSC} )</th>
<th>Power MOSFET ( R_{DS(ON)} )</th>
<th>( I_{OUT(MAX)} ) (( V_{OUT} = 24 ) V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STR5A451D</td>
<td>DIP8</td>
<td>60 kHz</td>
<td>4.0 ( \Omega )</td>
<td>0.7 A</td>
</tr>
<tr>
<td>STR5A453D</td>
<td>DIP8</td>
<td></td>
<td>1.9 ( \Omega )</td>
<td>0.9 A</td>
</tr>
</tbody>
</table>
High Efficient
Off-line PWM Buck and Inverting converter

**STR5A450 Series**

**Pin Assignment**

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

**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
- Build-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

- 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

<table>
<thead>
<tr>
<th>Series</th>
<th>Package</th>
<th>Features</th>
<th>Page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSC1S311A</td>
<td>SOIC8</td>
<td>Low Power Consumption at No Load (&lt; 30 mW)</td>
<td>P 32</td>
</tr>
<tr>
<td>SSC1S312A</td>
<td>SOIC8</td>
<td>Few External Components Count (Built-in Startup Circuit)</td>
<td></td>
</tr>
</tbody>
</table>
Low Noise, No Load Power Consumption < 30mW
Quasi-resonant (QR) Off-line Switching Regulators

SSC1S310A Series

Package
SOIC8

Selection Guide

<table>
<thead>
<tr>
<th>Part Number</th>
<th>OLP, OVP, TSD Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSC1S311A</td>
<td>Auto-restart</td>
</tr>
<tr>
<td>SSC1S312A</td>
<td>Latched Shutdown</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FB/OLP</td>
<td>Feedback control and Overload Protection signal input</td>
</tr>
<tr>
<td>2</td>
<td>BD</td>
<td>Bottom detection signal input and input compensation detection signal input</td>
</tr>
<tr>
<td>3</td>
<td>—</td>
<td>(Pin removed)</td>
</tr>
<tr>
<td>4</td>
<td>ST</td>
<td>Startup current input</td>
</tr>
<tr>
<td>5</td>
<td>DRV</td>
<td>Gate drive output</td>
</tr>
<tr>
<td>6</td>
<td>OCP</td>
<td>Overcurrent Protection signal input</td>
</tr>
<tr>
<td>7</td>
<td>VCC</td>
<td>Power supply input and Overvoltage Protection signal input</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>
**OFF-line LLC Controller**

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

### Type 1: External Auxiliary Power Supply

- To reduce standby power ($P_{IN} \leq 30$ mW)

- SSC3S931 → P. 35
- SSC3S932 → P. 37

### Type 2: Built-in Standby Function

- To reduce external components

- SSC3S900 → P. 39
- SSC3S921 → P. 41
- SSC3S927 → P. 43

*See the Selection Guide of Diode about peripheral diodes.*
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.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Standby Operation</th>
<th>Output Power at Light load</th>
<th>PFC ON/OFF(2)</th>
<th>Universal Input</th>
<th>Protection Operation(3)</th>
<th>Remarks</th>
<th>Page#</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSC3S931</td>
<td>External auxiliary power supply</td>
<td>—</td>
<td>No</td>
<td>No</td>
<td>Latched shutdown</td>
<td>✓ Optocoupler open protection ✓ No high voltage capacitor for dead time detection</td>
<td></td>
</tr>
<tr>
<td>SSC3S932</td>
<td>Auto-restart/ Latched shutdown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P.37</td>
</tr>
<tr>
<td>SSC3S901</td>
<td>100 mW(1)</td>
<td>No</td>
<td>Yes</td>
<td>Auto-restart</td>
<td></td>
<td></td>
<td>P.39</td>
</tr>
<tr>
<td>SSC3S902</td>
<td>125 mW(1)</td>
<td>Yes</td>
<td>No</td>
<td>Auto-restart</td>
<td>✓ REG overvoltage protection (Latched shutdown)</td>
<td></td>
<td>P.41</td>
</tr>
<tr>
<td>SSC3S921</td>
<td>Internal standby function (Changed by external signal)</td>
<td>150 mW</td>
<td>Yes</td>
<td>No</td>
<td>Auto-restart</td>
<td>✓ Improving light load efficiency (X-capacitor discharge function) ✓ Input overvoltage protection (HVP) ✓ REG overvoltage protection ✓ Realizing the power boost for output current</td>
<td></td>
</tr>
</tbody>
</table>

(1) $P_W = 0.27 \text{ W}$, as a reference with discharge resistor of $1\Omega$ 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).
The IC is the type of using external auxiliary power supply, and is optimal for low no-load power consumption application. (PWM control IC, $P_{IN} \leq 30\, mW$)

**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

The product achieves high efficiency and few external components count.

- Capacitive Mode Detection Function: Improving the ability of transformer output power
- Wide operating range ($11.9\, V \leq VCC \leq 32\, V$)
  Flexible transformer design when VCC is supplied by an auxiliary power supply
- No high voltage capacitor for dead time detection
- Optocoupler Open Protection
Built-in Standby Function, Standby Signal Output and X-capacitor Discharge Function
LLC Off-line Switching Regulator

**SSC3S931**

**Pin Assignment**

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

**Electrical Characteristics**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC Pin Maximum Ratings</td>
<td>35 V</td>
</tr>
<tr>
<td>$V_{CC(ON)}$</td>
<td>11.9 V (typ.)</td>
</tr>
<tr>
<td>$V_{CC(OFF)}$</td>
<td>10.0 V (typ.)</td>
</tr>
<tr>
<td>Minimum Oscillation Frequency</td>
<td>31.5 kHz (typ.)</td>
</tr>
<tr>
<td>Maximum Oscillation Frequency</td>
<td>300 kHz (typ.)</td>
</tr>
<tr>
<td>Maximum Source Current</td>
<td>-540 mA (typ.)</td>
</tr>
<tr>
<td>Maximum Sink Current</td>
<td>1.50 A (typ.)</td>
</tr>
<tr>
<td>$V_{REG}$</td>
<td>10.0 V (typ.)</td>
</tr>
</tbody>
</table>
LLC Off-line Switching Regulator

SSC3S932

Package
SOP18

Existing LLC IC

SSC3S932

The product achieves high efficiency and few external components count.

- Capacitive Mode Detection Function:
  Improving the ability of transformer output power

- Wide operating range \((11.9\ V \leq VCC \leq 32\ V)\)
  Flexible transformer design when VCC is supplied by an auxiliary power supply

- No high voltage capacitor for dead time detection

- Optocoupler Open Protection

- Auto-restart or latched shutdown selected by the RT pin setting

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): Auto-restart/Latched shutdown
  - Overcurrent Protection (OCP) : Peak drain current detection, 2 step detections, auto-restart
  - Input Overvoltage Protection (HVP) : Auto-restart/Latched shutdown
  - Input Undervoltage Protection (UVP): Auto-restart
  - Overload Protection (OLP) : Auto-restart /Latched shutdown
  - Thermal Shutdown (TSD): Auto-restart /Latched shutdown
  - Optocoupler Open Protection (OOP): Auto-restart /Latched shutdown

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

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

### Electrical Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC Pin Maximum Ratings</td>
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</tr>
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<td>$V_{CC(OFF)}$</td>
<td>10.0V (typ.)</td>
</tr>
<tr>
<td>Minimum Oscillation Frequency</td>
<td>31.5 kHz (typ.)</td>
</tr>
<tr>
<td>Maximum Oscillation Frequency</td>
<td>300 kHz (typ.)</td>
</tr>
<tr>
<td>Maximum Source Current</td>
<td>-540 mA (typ.)</td>
</tr>
<tr>
<td>Maximum Sink Current</td>
<td>1.50 A (typ.)</td>
</tr>
<tr>
<td>$V_{REG}$</td>
<td>10.0 V (typ.)</td>
</tr>
</tbody>
</table>
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

### 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
**Built-in Standby Function, For Universal Design**
**LLC Off-line Switching Regulator**

**SSC3S900 Series**

**Typical Application Circuit**

**Electrical Characteristics**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC Pin Maximum Ratings</td>
<td>35 V</td>
</tr>
<tr>
<td>$V_{CC(ON)}$</td>
<td>14 V (typ.)</td>
</tr>
<tr>
<td>$V_{CC(OFF)}$</td>
<td>9.8 V (typ.)</td>
</tr>
<tr>
<td>Minimum Oscillation Frequency</td>
<td>32 kHz (typ.)</td>
</tr>
<tr>
<td>Maximum Oscillation Frequency</td>
<td>300 kHz (typ.)</td>
</tr>
<tr>
<td>Maximum Source Current</td>
<td>-540 mA (typ.)</td>
</tr>
<tr>
<td>Maximum Sink Current</td>
<td>1.5 A (typ.)</td>
</tr>
</tbody>
</table>

**Pin Assignment**

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

**Features**

- Standby Mode Change Function
  (Changes to Standby Mode by External Signal)
  - Standby Operation: Burst Mode
  - Output Power at Light Load: $P_O = 125 \text{ mW (}P_{IN} = 0.27 \text{ W)}$
  - 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
Pin Assignment

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

Electrical characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC Pin Maximum Ratings</td>
<td>35 V</td>
</tr>
<tr>
<td>$V_{CC(ON)}$</td>
<td>17 V (typ.)</td>
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<tr>
<td>$V_{CC(OFF)}$</td>
<td>8.9 V (typ.)</td>
</tr>
<tr>
<td>Minimum Oscillation Frequency</td>
<td>31.5 kHz (typ.)</td>
</tr>
<tr>
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</tr>
<tr>
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<tr>
<td>Maximum Sink Current</td>
<td>1.5 A (typ.)</td>
</tr>
<tr>
<td>$V_{REG}$</td>
<td>10.0 V (typ.)</td>
</tr>
</tbody>
</table>
Built-in Standby Function, Standby Signal Output and X-capacitor Discharge Function
LLC Off-line Switching Regulator

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.

Features
- Standby Mode Change Function
  (Changes to Standby Mode by External Signal)
  - Standby Operation: Burst Mode
  - Output Power at Light Load: \( P_O = 150 \text{ mW} \) (\( P_{IN} = 0.27 \text{ W} \))
  - 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

Existing LLC IC

High efficiency and Few External Components Count

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  - Standby Operation: Burst Mode
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- 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
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Existing LLC IC
## SSC3S927

### Typical Application Circuit

![Typical Application Circuit](image)

### Electrical Characteristics

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<th>Value</th>
</tr>
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<td>Maximum Sink Current</td>
<td>1.5 A (typ.)</td>
</tr>
<tr>
<td>$V_{REG}$</td>
<td>10.0 V (typ.)</td>
</tr>
</tbody>
</table>

### Pin Assignment

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

SGE0001  Jan. 26, 2021
Sanken’s PFC IC SSC2016S (P.47) 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 ON/OFF Circuit**

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

VCC of PFC is supplied from the auxiliary winding.

PFC IC ON/OFF Circuit using SSC2016S

VCC of PFC is supplied from the REG pin of SSC3S921/27

PFC IC ON/OFF Circuit using General PFC IC

\[ V_{CC(ON)} = 12 \text{ V} \]

\[ V_{VCC} = 17 \text{ V} \]

\[ V_{REG} = 10 \text{ V} \]

\[ I_{REG} = -10 \text{ mA (max.)} \]
**Power Factor Correction (PFC)**

<table>
<thead>
<tr>
<th>Products</th>
<th>Package</th>
<th>Operation Mode</th>
<th>P(_{\text{OUT}})</th>
<th>Remarks</th>
<th>Page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSC2016S</td>
<td>SOIC8</td>
<td>Critical Conduction Mode (CRM) Operation</td>
<td>~200 W</td>
<td>Maximum Switching Frequency Limitation Function</td>
<td>P. 47</td>
</tr>
</tbody>
</table>

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

![Diagram of PFC Circuit]

- **VAC**
- **Bypass Diode**
- **Rectification Diode**
- **GND**
Power Factor Correction (PFC) IC of CRM Operation

**SSC2016S**

**Packaging**
SOIC8

<table>
<thead>
<tr>
<th>Part Number</th>
<th>$V_{CC(ON)}$</th>
<th>$V_{FB(REF)}$</th>
<th>$I_{OUT Source}$</th>
<th>$I_{OUT Sink}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSC2016S</td>
<td>8.5 V</td>
<td>2.50 V</td>
<td>−500 mA</td>
<td>1000 mA</td>
</tr>
</tbody>
</table>

**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

**Circuit**

**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**

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

**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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SGE0001 Jan. 26, 2021
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