



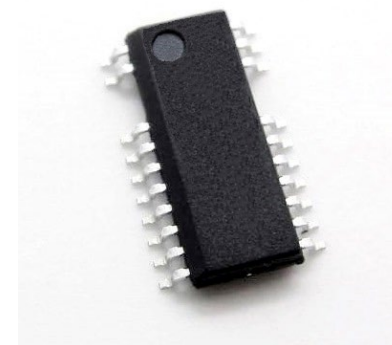
Working Together for a Greener Society

Future of Power Electronics and the Earth



Supply Control IC with Critical Conduction Mode PFC and  
LLC Current-resonant Circuits

SSC4S913



## ■ Overview

The SSC4S913 is a power supply IC that integrates a CRM-driven PFC control circuit and an LLC current-resonant circuit in a compact SSOP24 package. The LLC stage includes high- and low-side drive circuits, which directly drive external power MOSFETs in the half-bridge circuit. The PFC and LLC stages are highly interlocked in startup and standby operations, requiring no individual circuit settings. With extensive protections (e.g., the capacitive mode detection function), the SSC4S913 allows you to easily design a high-safety, high-quality power supply system. In addition to such protections, the SSC4S913 has a startup circuit that supports DC input, a function that enhances light-load efficiency, and more.

## ■ Applications

- Audiovisual Equipment (e.g., LCD TV)
- Office Automation Equipment (e.g., Server, Multifunction Printer)
- Communication Equipment
- Industrial Equipment

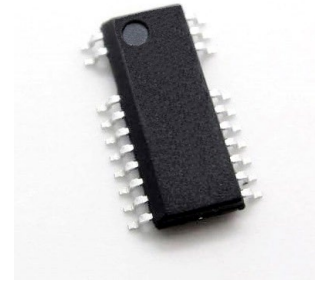


## ■ Features

- PFC and LLC Stages Controlled by a Single IC
- Interlocked PFC–LLC Stage Operations (Startup, Standby)
- AC and DC Inputs Supported
- X-capacitor Discharge (Enabled at AC Input, No Discharge Resistor Required)
- Burst Oscillation at Light Load (PFC and LLC Stages)
- Critical Conduction Mode (CRM) PFC Control
- PFC Maximum Oscillation Frequency Limitation
- LLC Capacitive Mode Detection
- LLC Soft Start
- LLC Automatic Dead Time Adjustment
- Protections
  - Input Voltage Protections (UVP, HVP)
  - PFC FB\_PFC Pin Undervoltage Protection
  - PFC Output Overvoltage Protection (FB\_PFC and OVP Pins)
  - PFC Overcurrent Protection
  - LLC High-side Driver Undervoltage Lockout
  - LLC Overcurrent Protection: Two Different Operations
  - LLC Overload Protection
  - VCC Pin Overvoltage Protection
  - Thermal Shutdown

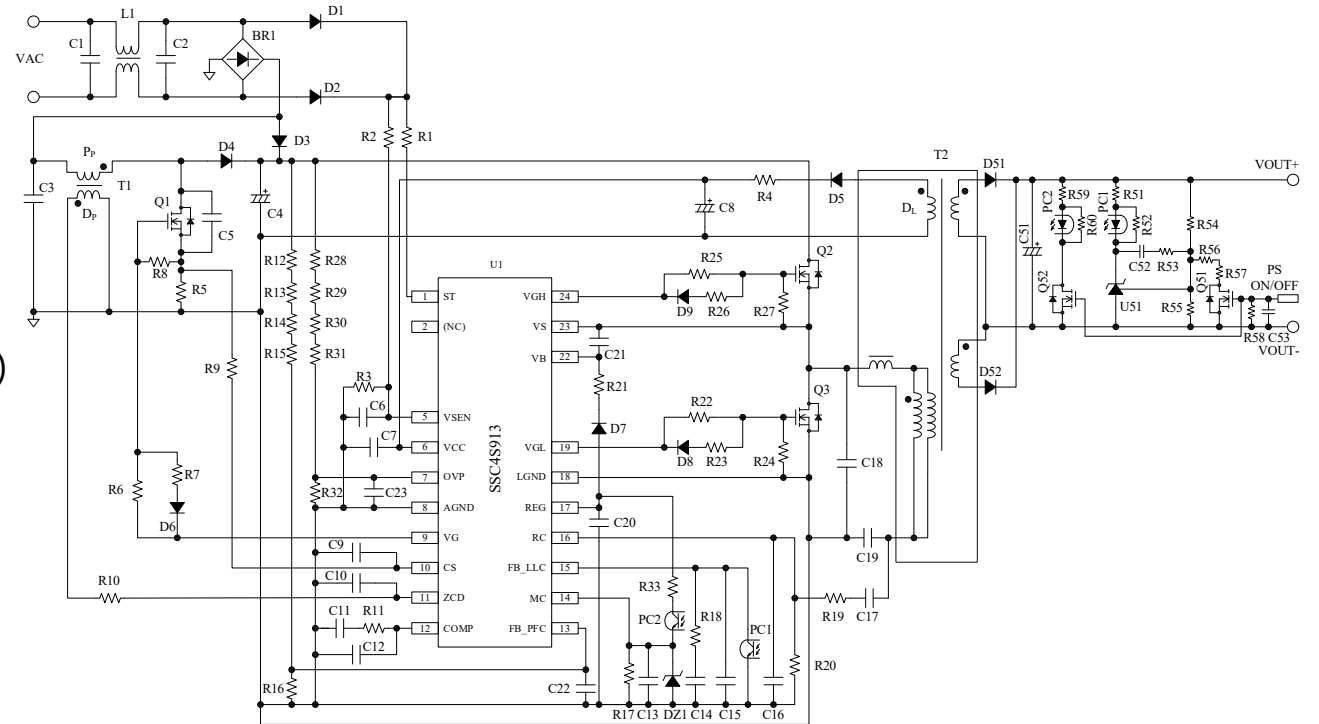
## ■ Package

SSOP24



Pb-free (RoHS compliant)

## ■ Typical Application



# Single-packaged PFC and LLC Stages

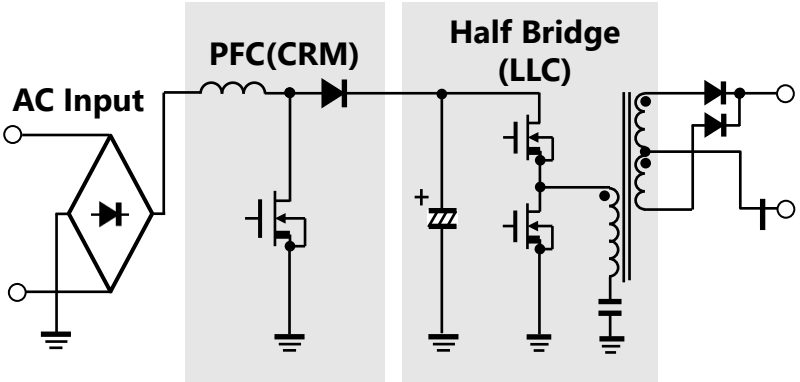
## ■ Component Count Substantially Reduced by Single Packaging

The SSC4S913 integrates the PFC and LLC stages into a single package.

As a result, component counts can be reduced by a large amount.\*

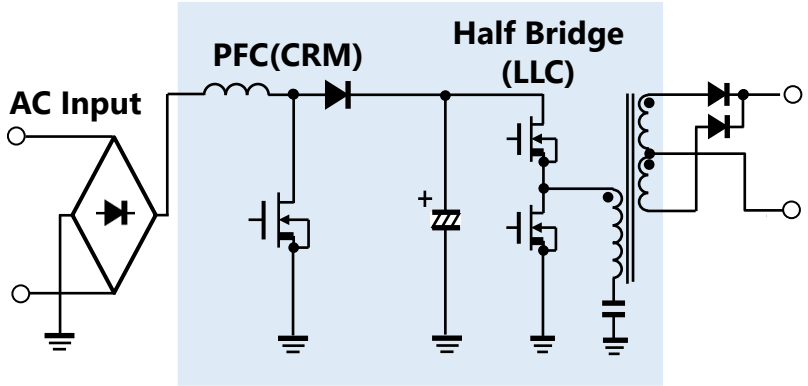
Existing

Individual control ICs are required for the PFC and LLC stages.



SSC4S913

Only a single control IC is required for the PFC and LLC stages.



Down by 21 pcs



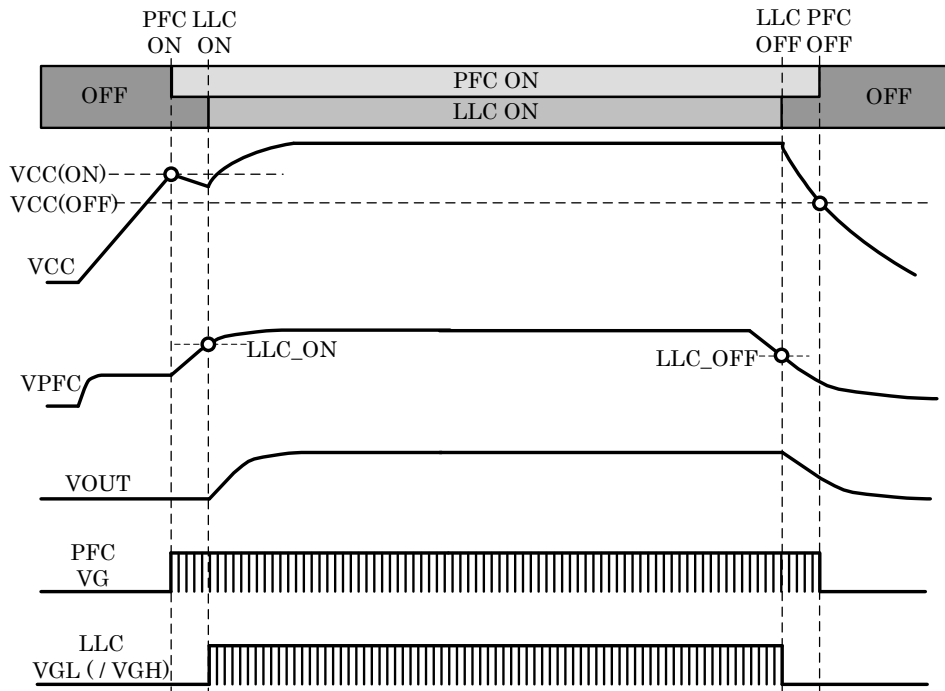
- PFC-LLC interlocking parts: -7 pcs
- IC-included adjustment parts: -5 pcs
- Overlapping parts: -2 pcs
- Other parts: -7 pcs

\* When compared with our own typical application.

# Interlocked PFC-LLC Stage Operations

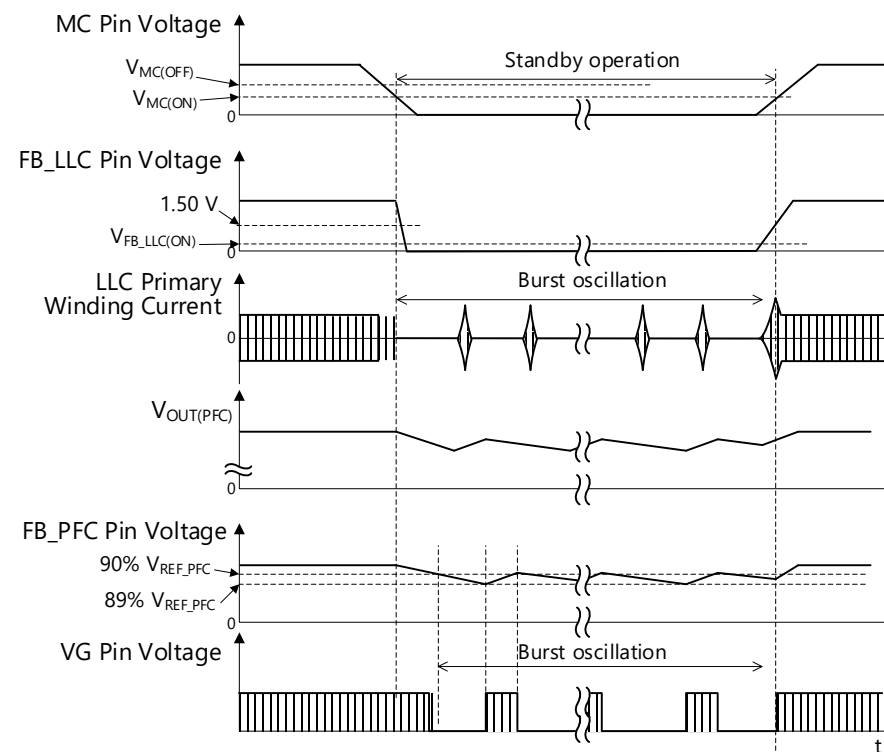
## ■ Interlocked Startup and Shutdown Operations

When the PFC stage output voltage reaches a given value at startup, the LLC stage operation starts. This sequence prevents startup failures. Once the IC detects a decrease in the PFC stage output voltage, the LLC stage operation stops before entering capacitive mode. This shutdown sequence avoids hard switching caused by any capacitive mode operation.



## ■ Interlocked Standby Operation

In standby mode, both the PFC and LLC stages enter burst oscillation operations to reduce switching losses. When the LLC stage shifts to burst oscillation operation, so does the PFC stage, allowing the IC to control the output voltage and reduce losses.

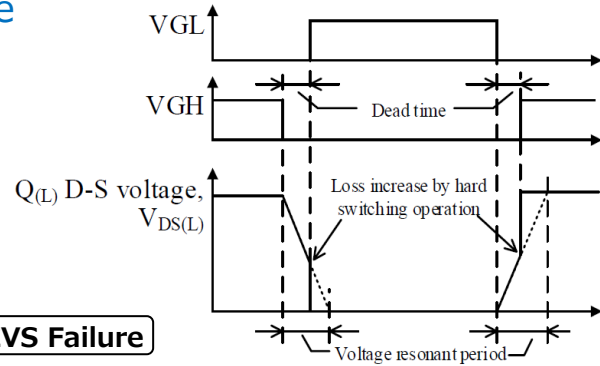


# Other Key Functions

## 1. Automatic Dead Time Adjustment Function

Detects a voltage-resonant period to automatically control the zero voltage switching (ZVS) operations of the high- and low-side power MOSFETs.

- ✓ Requires no dead time adjustment



Waveforms at ZVS Failure

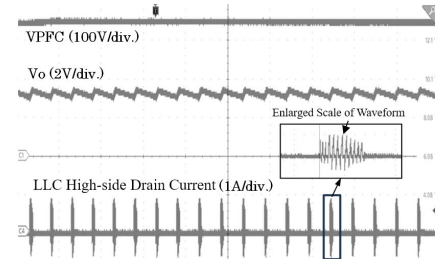
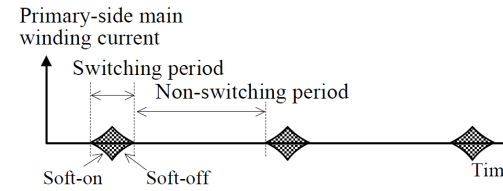
## 2. Standby Function

Performs the burst oscillation during the standby operation.

- ✓ Decreases the switching loss at light load

The soft-on/soft-off function prevents drain currents from varying steeply during the burst oscillation. Controls switching frequencies with the internal reference signal during the burst oscillation.

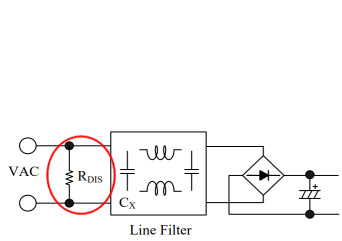
- ✓ Minimizes audible transformer noise



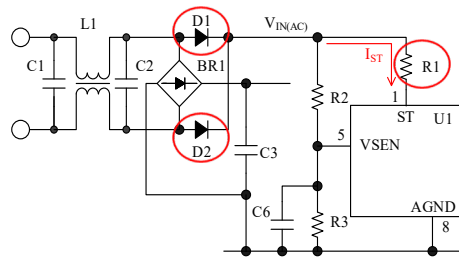
## 3. X-capacitor Discharge Function (AC Input Mode)

Requires no discharge resistor R<sub>DIS</sub> (IEC62368-1 compliant). A typical line filter configuration needs R<sub>DIS</sub> that is connected to an X-capacitor in parallel and is always power-consuming.

- ✓ Increases circuit efficiencies



Typical Line Filter Circuit



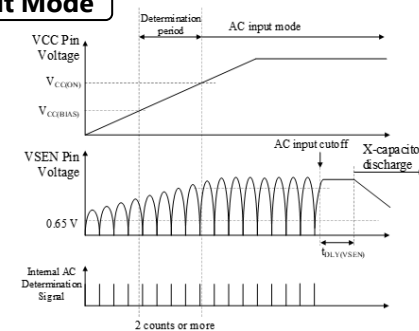
R<sub>DIS</sub> removed; D<sub>1</sub>, D<sub>2</sub>, R<sub>1</sub> connected to the ST pin.

## 4. AC/DC Input Support

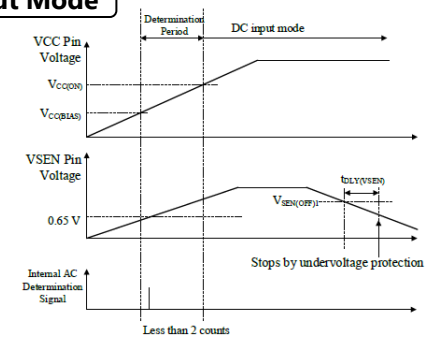
Determines whether the input voltage is AC or DC to enable the X-capacitor discharge function if AC and disable it if DC.

- ✓ Improves design-friendliness

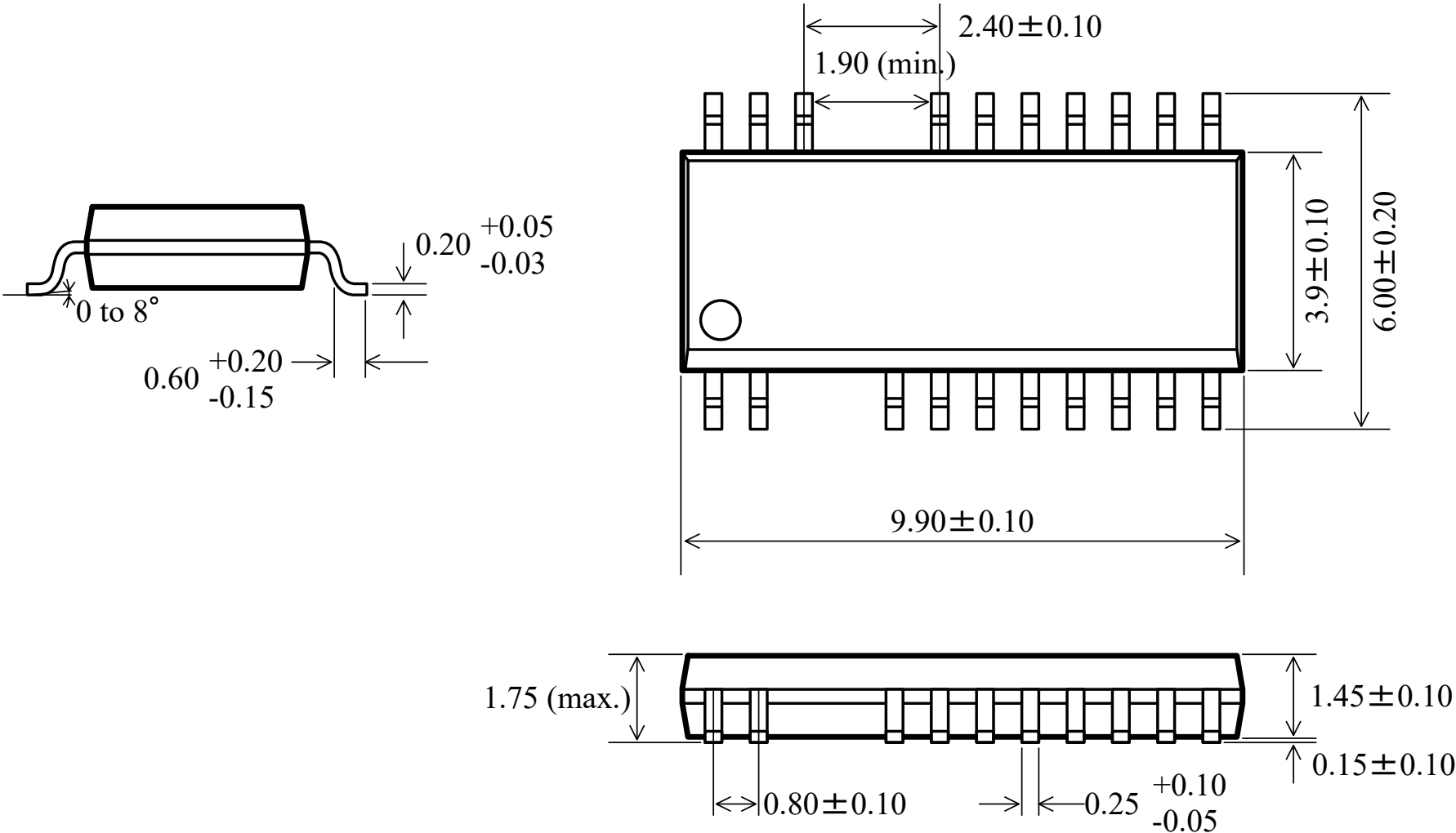
### AC Input Mode



### DC Input Mode



## ■ SSOP24



Unit: mm



## Important Notes

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