3 kW three-channel interleaved PFC reference design based on the STNRGP01 digital controller

**Features**

- Input voltage range: 90 to 265 V<sub>AC</sub>
- Line frequency range: 47 to 63 Hz
- Maximum output power: 3 kW at 230 V
- Output voltage: 400 V
- Power factor: > 0.98 at 20% load
- Total Harmonic Distortion: <5% at 20% load
- Mixed-signal average current mode control, CCM fixed frequency operation
- Switching Frequency: 111 kHz
- Cycle-by-cycle regulation (analog current control loop)
- Input voltage and load feed-forwards
- Phase shedding
- Burst-mode operation
- Overvoltage protection
- Thermal protection
- Status indicator LEDs
- Inrush current limiter function
- Cooling function

**Description**

The STEVAL-IPFC01V1 3 kW interleaved PFC reference design is based on the STNRGP01 digital controller and includes a separate power board, control board and programming board. The STNRGP01 is a digital configurable ASIC developed by STMicroelectronics, which can drive up to three channels in an interleaved PFC for industrial applications.

The STNRGP01 digital controller on the control board implements mixed signal (analog/digital) average current mode control in CCM at fixed frequency. The analog section ensures cycle-by-cycle current regulation, while digital control manages the non-time critical operations. You can use the eDesignSuite software available on the ST website to configure the STNRGP01 to satisfy the specifications of each interleaved PFC.
1. I/O measurement signals
2. Analog circuitry
3. Power stage
4. Digital control section with STNRGPF01 digital controller

The STEVAL-IPFC01V1 implements mixed signal (analog/digital) control, so the converter can manage a range of input and output conditions and still remain highly responsive to fast transients in input signals. The inner current loop is a hardware analog proportional-integral (PI) compensator that ensures the highest possible bandwidth and cycle-by-cycle sensing and regulation. The outer voltage loop is performed by a digital PI controller with fast dynamic response.
Figure 2. STEVAL-IPFC01P1 schematic - input section
Figure 3. STEVAL-IPFC01P1 schematic - auxiliary power supply
Figure 4. STEVAL-IPFC01P1 schematic - boost interleaving section
Figure 5. STEVAL-IPFC01C1 schematic
Figure 6. STEVAL-IPFC01A1 schematic
## Revision history

<table>
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<tr>
<th>Date</th>
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<tr>
<td>11-Sep-2018</td>
<td>1</td>
<td>Initial release.</td>
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<tr>
<td>02-Jan-2019</td>
<td>2</td>
<td>Updated Figure 1. STEVAL-IPFC01V1 block diagram and Figure 4. STEVAL-IPFC01P1 schematic - boost interleaving section.</td>
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<td>09-Sep-2019</td>
<td>3</td>
<td>Throughout document: minor text edits Updated Figure 3. STEVAL-IPFC01P1 schematic - auxiliary power supply</td>
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