# 3300 W 54 V bi-directional phase-shift full-bridge with 600 V CoolMOS™ CFD7 and XMC™ graphical user interface

## EVAL_3K3W_BIDI_PSFB

## About this document

### Scope and purpose

This document is a getting-started guide to the Graphical User Interface (GUI) for the 3300 W bi-directional Phase-Shift Full-Bridge (PSFB) DC-DC converter (EVAL_3K3W_BIDI_PSFB). The Infineon components required to follow this guide are as follows:

- EVAL_3K3W_BIDI_PSFB: Infineon Technologies AG system solution for a 3300 W bi-directional DC-DC converter achieving 98 percent efficiency in buck mode and 97 percent in boost mode. The converter has telecom-level output, realized by a PSFB topology block with bi-directional capability.

- XMC™ Link: Isolated debug probe for all XMC™ microcontrollers (KIT_XMC_LINK_SEGGER_V1). The debug probe is based on SEGGER J-Link debug firmware, which enables use with DAVE™ and all common third-party compiler/IDEs (Altium Limited, Atollic, ARM/KEIL, IAR Systems, iSystem, Rowley Associates) known from the wide ARM® ecosystem.



**Figure 1**      3300 W bi-directional PSFB



**Figure 2**      XMC™ Link isolated debug probe

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# 1 Getting started

## 1.1 Connecting to the converter with XMC™ Link

XMC™ Link is an isolated debug probe for all XMC™ microcontrollers. The debug probe is based on SEGGER J-Link debug firmware, which enables use with DAVE™ and all major third-party compiler/IDEs known from the wide ARM® ecosystem.

The XMC™ Link can be connected to the XMC™ target microcontroller by either of the debug connectors:

- 10-pin Cortex™ debug connector (2 x 5 pin, 0.05 inch, 1.27 mm)

- Eight-pin XMC™ MCU debug connector (2 x 4 pin, 0.1 inch, 2.54 mm), which supports communication between a PC/laptop and target XMC™ device via virtual COM port (UART-to-USB bridge).

**Table 1    Pin-out of the eight-pin XMC™ MCU debug connector**

| Pin | Function | Pin name |
|-----|----------|----------|
| 1 | SC | Serial wire clock (P0.15\|P1.2) |
| 2 | SD | Serial wire data (P0.14\|P1.3) |
| 3 | + | Power supply 2.5 V to 5.5 V (VDD) |
| 4 | 0 | Ground (VSS) |
| 5 | 0 | Ground (VSS) |
| 6 | + | Power supply 2.5 V to 5.5 V (VDD) |
| 7 | TX (PC to TX) | Transmission line of PC/laptop, receive line of XMC™ device (optional) |
| 8 | RX (PC to RX) | Receive line of PC/laptop, transmission line of XMC™ device (optional) |

To operate the XMC™ Link, installation of the J-Link driver is required.

1. Please download the latest version from https://www.segger.com/jlink-software.html and install it on your PC/laptop. Note: The J-Link driver is also part of the typical installation of DAVE™ and third-party tools supporting SEGGER J-Link.

2. Connect XMC™ Link with your PC/laptop using the Micro USB cable.

3. A proper connection and installation of the J-Link driver is indicated by a constantly illuminated debug LED.

4. Connect your XMC™ target board with XMC™ Link using one of the enclosed cables (Figure 3).

XMC™ Link is powered from the Micro USB plug and typically draws about 70 mA. The on-board voltage regulator IFX54441LDV33 generates the required 3.3 V for the XMC4200 microcontroller out of the 5 V USB voltage.

However, the debug probe is not designed to provide power for the target device. The target application must power the isolated part of the debugger. The isolated side the XMC™ Link draws a few mA of current from the target application (in this case the 3300 W 54 V bi-directional converter).

*Note:        The converter side of the XMC™ Link is powered by the internal auxiliary bias. The auxiliary bias requires at least 100 V at the input of the converter to start up.*
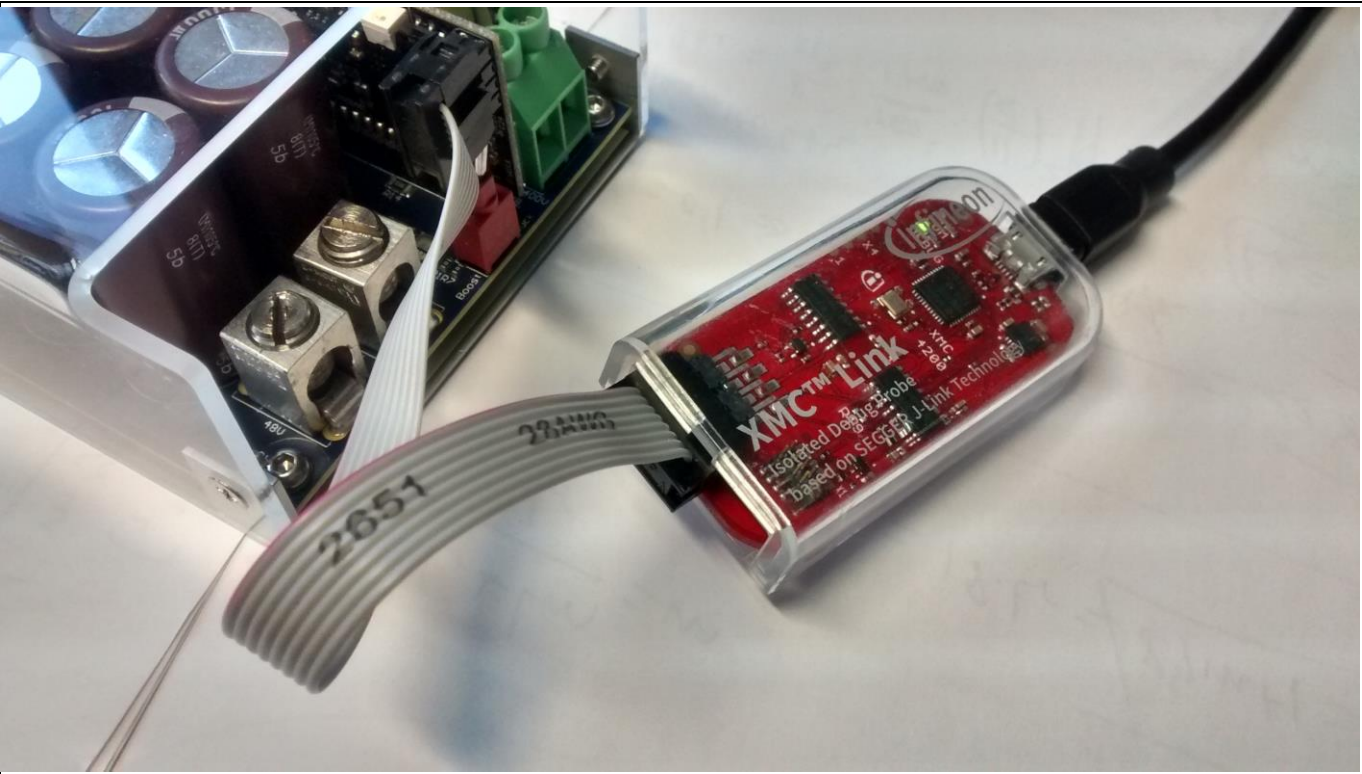
**Figure 3**     XMC™ Link connection to the control card

## 1.2     Launching the GUI

Download the software and launch the GUI application (Figure 4). A splash screen appears where the user can select the so-called basic view (Figure 5) by clicking on the "Basic" button.

*Note:          The advanced view is only available on request. Please contact your sales representative.*



| Name | Date modified | Type | Size |
|---|---|---|---|
| 📁 info | 27.11.2018 12:40 | File folder | |
| 🔧 FTD2XX_NET.dll | 07.11.2018 15:22 | Application extens... | 72 KB |
| 🗒 FTD2XX_NET | 07.11.2018 15:22 | XML Document | 108 KB |
| 🔧 Infineon.Comm.dll | 14.12.2018 10:27 | Application extens... | 14 KB |
| 🔧 Microsoft.VisualBasic.PowerPacks.Vs.dll | 26.07.2012 20:41 | Application extens... | 264 KB |
| ⓘ SMPS_GUI | 15.01.2019 10:05 | Application | 886 KB |

**Figure 4**     GUI execution file

**Figure 5        Splash screen with selection of GUI versions**

While the advanced view allows the parametrization of many of the converter parameters (Figure 6), the basic view is mostly intended for monitoring the sensed values and status of the converter (Figure 7), with the exception of the output voltage set-point, which can be adjusted in both versions.
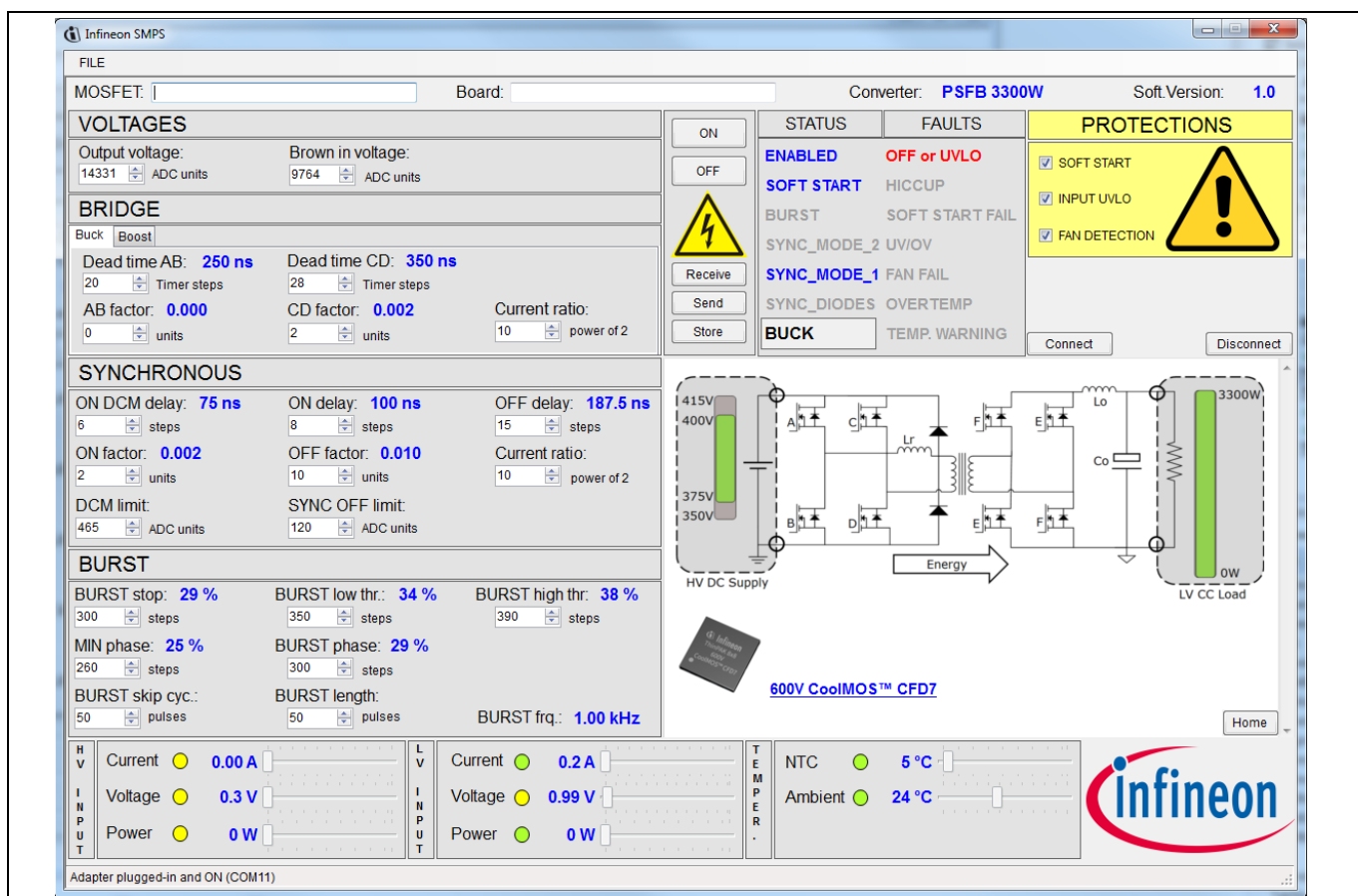


**Figure 6        GUI advanced view**
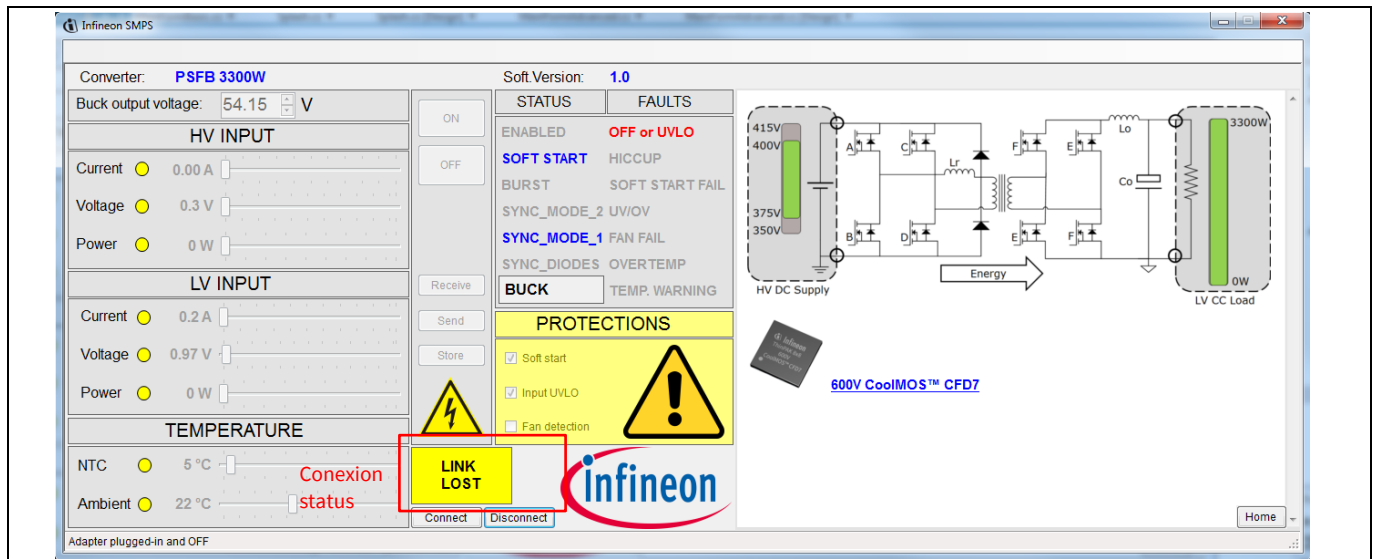
**Figure 7**    **3300 W bi-directional PSFB**

*Note:*          *The warning message "Link lost" in Figure 7 indicates that the connection to the converter is broken. Please check the cabling and retry to re-establish the link with the button "Connect", if it does not re-establish automatically.*

# 2    Setting up parameters

## 2.1    Output voltage adjustment

The nominal output voltage of the converter can be adjusted within the range of 53 V to 59.8 V. Select the new voltage setting by typing in the "Buck output voltage" text field (Figure 8). After typing follow the GUI indications:

1. Click the "Send" button (Figure 8). The new output voltage setting is updated into the controller card but it will be lost when the converter turns off.

2. Click the "Store" button (Figure 9). The new output voltage setting is stored in the Flash memory of the controller card; it won't be lost after the converter turns off.

3. The storing function takes some time, during which the GUI is disabled. A "Storing" message appears during that time (Figure 10).
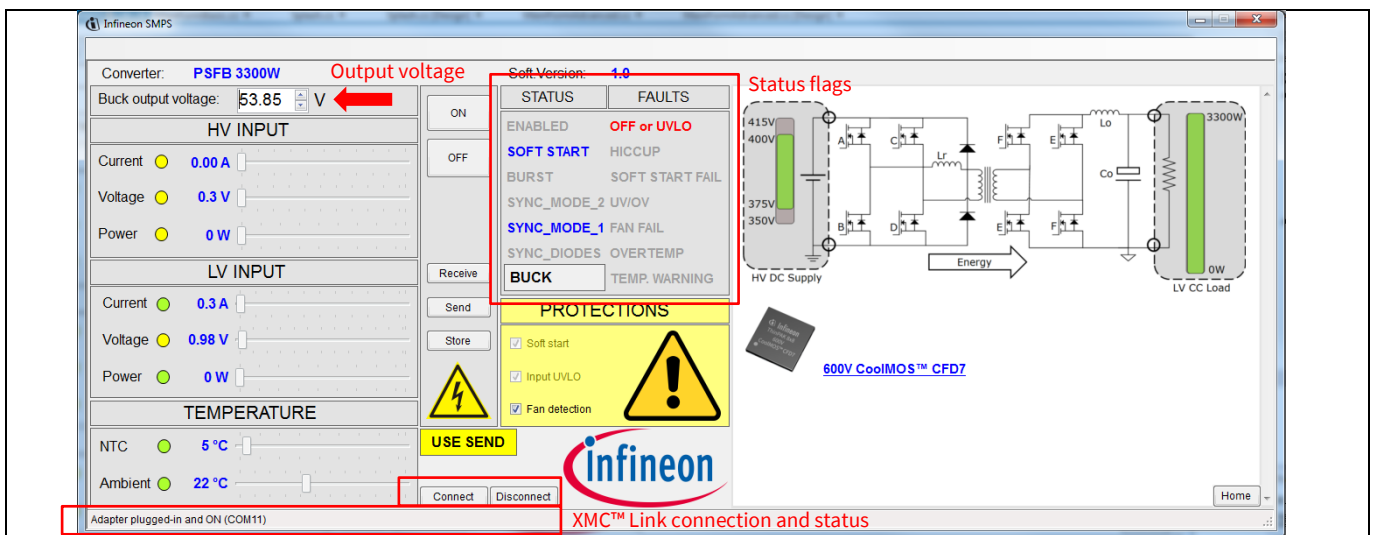


**Figure 8**       **Use the "Send" button after modifying a parameter to actually update it in the controller**
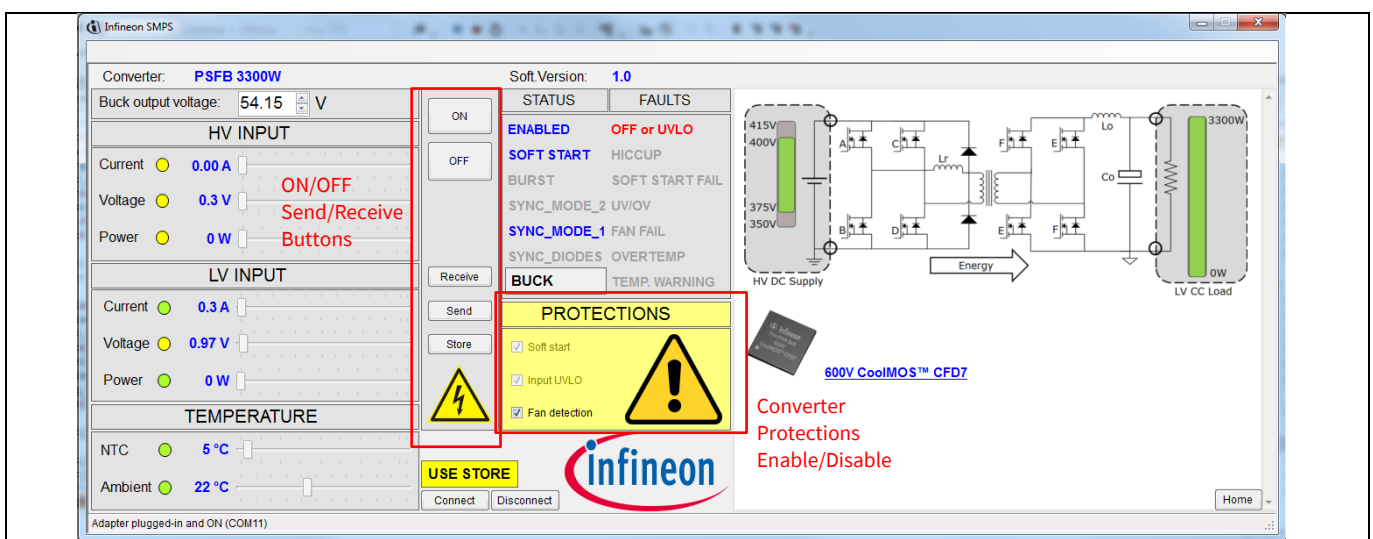


**Figure 9**       **Use the "Store" button to permanently store new parameters in the Flash memory of the controller**
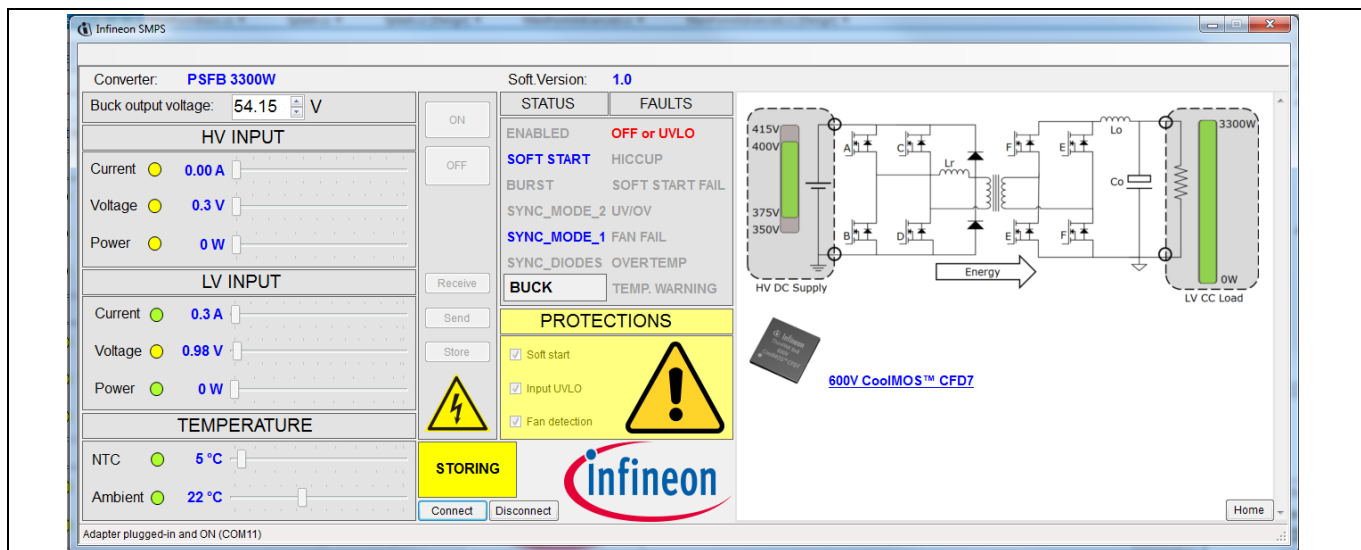
**Figure 10 The user interface confirms the parameters are being stored with the message "Storing"**

*Note:* *The "Store" button is only enabled while the converter is not running. Use the "Off" button to turn it off, then store the parameters, then use the "On" button to resume converter operation.*

## 2.2 Enable/disable protections

In the so-called basic view it's only possible to enable/disable the "fan detection" protection. When the box is checked (Figure 11) the converter's controller can detect a faulty fan (fan not spinning), and stop the converter to protect it from possible thermal stress.

*Note:* *The fan is often supplied externally in some efficiency measurements, with the controller of the fan tachometer sensing lines disconnected. In that scenario the protection can be disabled while the user should ensure proper air flow.*
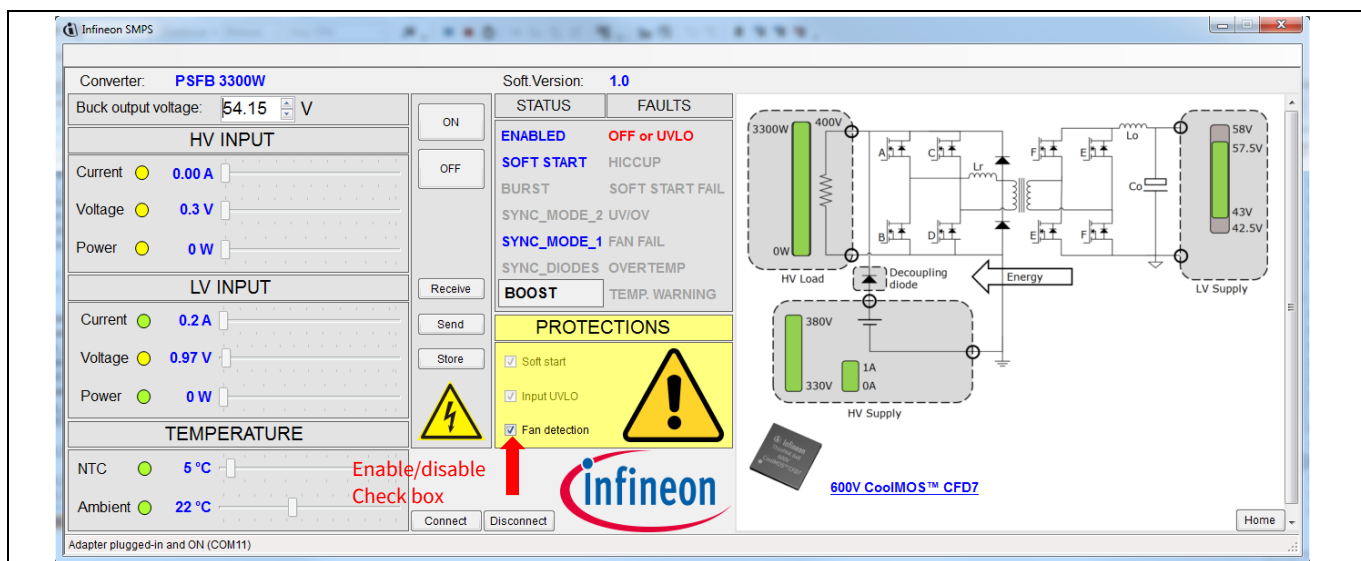


**Figure 11 User interface view in buck mode converter operation**

# 3 Converter monitoring

## 3.1 Sense monitoring

The GUI monitors some of the sensed controller values, which are separated into three main blocks (Figure 12):

- Converter input: the input current is estimated from a current sensing transformer placed before the high-voltage primary-side full-bridge; the input voltage is measured with a precision safety-isolated amplifier; the input power is estimated out of the current and voltage measurements.

- Converter output: the output current of the converter is measured through shunts placed in the return path; the output voltage of the converter is measured before the current sense shunts (there is a certain voltage droop along the load range); the output power is estimated out of the current and voltage measurements.

- Converter temperature: the temperature of the converter is measured at two points:

    o Ambient temperature is estimated out of the XMC™ 4200 integrated die temperature sensor.

    o Internal temperature of the converter is measured with a NTC sensor glued to the main transformer, the hottest spot of the converter.
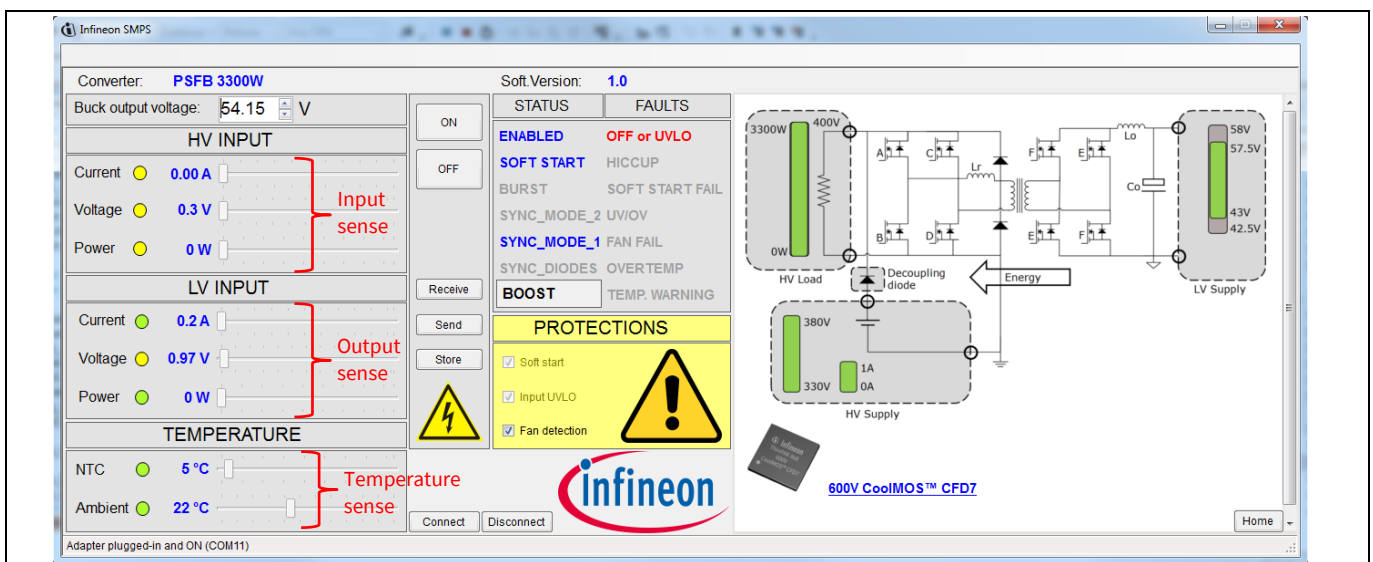


**Figure 12** **GUI view in boost mode converter operation**

## 3.2 Status monitoring

The status panel is divided into two main columns: status and faults (Figure 7). Flags in the "Status" group indicate a normal running mode (several of the flags can be activated at the same time):

- Enabled: the converter is enabled to start whenever the input and/or output voltages fall within the allowed ranges. If the converter is forced off by the GUI it won't start up.
- Soft-start: the converter is ready to go through the soft-start sequence.
- Burst: the converter is running in so-called burst mode (very lightor no load).
- Sync_mode_2: synchronous rectifiers are activated.
- Sync_mode_1: synchronous rectifiers are activated in so-called Discontinuous Conduction Mode (DCM).
- Sync_diodes: synchronous rectifiers are deactivated (light load).

## Converter monitoring

Flags in the "Faults" group indicate an abnormal condition, which has caused or will cause the converter to come to a halt (with the exception of the temperature warning, which still permits the converter to run):

- Off or UVLO: the converter is not running because of an unspecified reason: input and/or output voltages out of range, forced off by the GUI, or latched up by any protection.
- Hiccup: the converter is running in so-called hiccup mode. The load current is above the maximum with the converter trying to re-start but stopping again. The converter will resume to a normal state if the load decreases within the valid range.
- Soft-start fail: the converter detected an abnormal condition during the soft-start sequence and latched up.
- UV/OV: the converter detected the output voltage going out of the valid range (above or under) and latched up.
- Fan fail: the converter didn't detect the fan spinning and latched up.
- Over-temp: the internal temperature of the converter rose above the maximum. The converter latched up.
- Temp. warning: the internal temperature is high, but still within the allowed range. The converter still runs in this mode.

# 4 Browser

The panel on the right-hand side is an embedded web browser where the user can navigate through additional related content (Figure 13). Use the "Home" button to come back to the initial converter page.
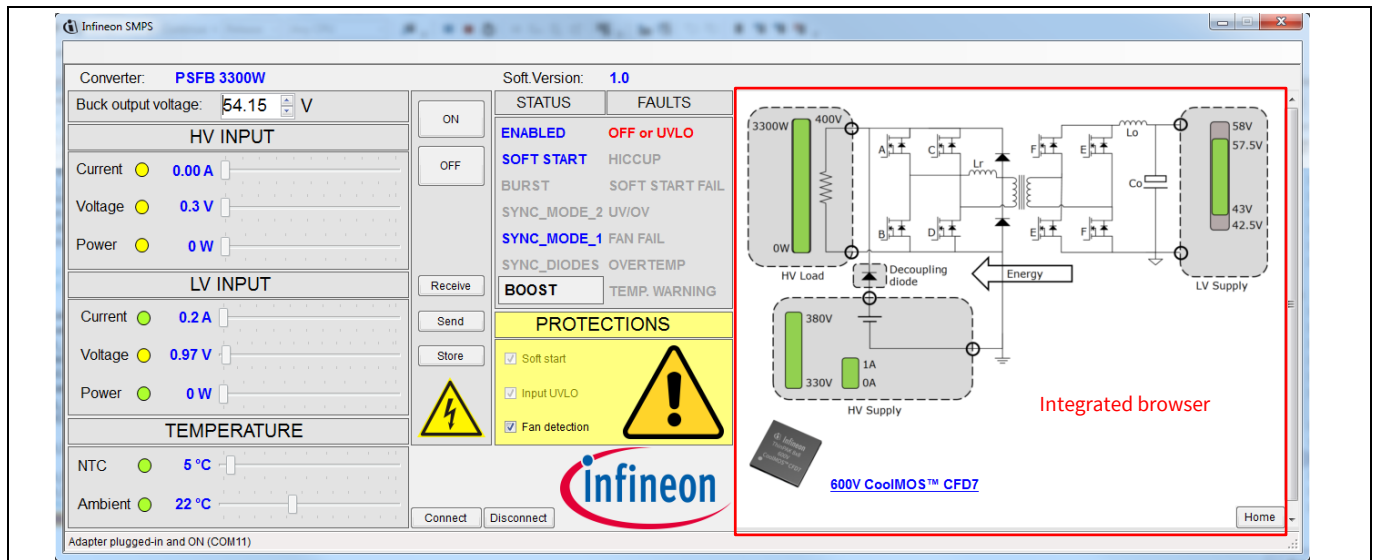


**Figure 13** **The right-hand panel of the GUI is an embedded web browser, which links to additional help content**

# 5    References

[1]    "3300 W 54 V bi-directional phase-shift full-bridge with 600 V CoolMOS™ CFD7 and XMC™", AN_1809_PL52_1809_081412

[2]    "800 W ZVS phase-shift full-bridge evaluation board. Using 600 V CoolMOS™ CFD7 and digital control by XMC4200", AN_201709_PL52_027

[3]    "1400 W ZVS phase-shift full-bridge evaluation board. Using 600 V CoolMOS™ CFD7 and digital control by XMC4200", AN_201711_PL52_003

## Revision history

**Major changes since the last revision**

| Page or reference | Description of change |
| --- | --- |
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