



Adapting ST power line modem evaluation boards to communicate over a DC bus

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Main components	
ST7540	FSK power line transceiver
L5972D	2A step down switching regulator
VIPer53	Off-line primary switch
L4971	1.5 A step down switching regulator
ST8R00	Micropower 1 A synchronous step-up DC-DC converter

Specification

- Communication directly upon DC bus or other line
- Operation from DC bus voltage from 4VDC to 300VDC
- Works with ST7540 or ST7580 power line modems requiring 12VDC.

Circuit description

ST power line modems, the ST7540 and ST7580, are designed so that they do not require mains-frequency timing signals and therefore work as well transferring data along DC power cables as on AC. Figures 1 and 2 illustrate modifications to ST7540-based power line modem evaluation board schematic diagrams that may be used with DC power lines and communicate across DC busses at high and low voltages. Wherever possible, the diagrams are exactly like the portion of those shown in the modem and DC converter application notes for the purpose of convenient direct comparison.

The capability of DC operation simplifies communication between panel, controller, and inverter networks in solar farms, as well as in networks of DC-powered equipment. This includes remote sensors and actuators, and on any DC circuit where it is desired to communicate using the existing DC bus, without the added cost of more wires or a separate 60Hz AC power transformer. Furthermore, the signal may be coupled from one bus voltage to another by means of an inexpensive LC network. This enables low-cost upgrades of existing DC-powered systems to full automation. Although these examples show the ST7540-based products, the same concepts apply equally to the ST7580 power line modem which has slightly different voltage requirements.

The circuits presented cover a converter suitable for DC bus voltages from 14V to 36V (DC converters set up for 24V), but other solutions are discussed for as low as 4V and as much as 300V. The MODEM requirement of 12 Volts DC at 1A peak for its operation is accommodated by a convenient DC-DC switching power supply. The examples presented are taken from customized evaluation packages supplied by the local ST applications lab to specific customers for their DC bus communications needs.

Figures 1 and 2 show schematically how the two types of ST7540 modem evaluation boards were modified to change their operating environment from the standard 90-300VAC power line voltage to a 14-36 Volt DC supply. To adapt the boards for use on the DC bus, the AC input power supply is disconnected and replaced by a low voltage DC/DC converter. The AC power supply can be easily disabled by disconnecting a few connections on the board, as shown in the figures. In figure 2, a STPS5L60 rectifier was placed across the DC input as protection against accidental reverse polarity.

Figure 1. 14-36VDC operation of EVAL7540-2 with EVAL5972D converter

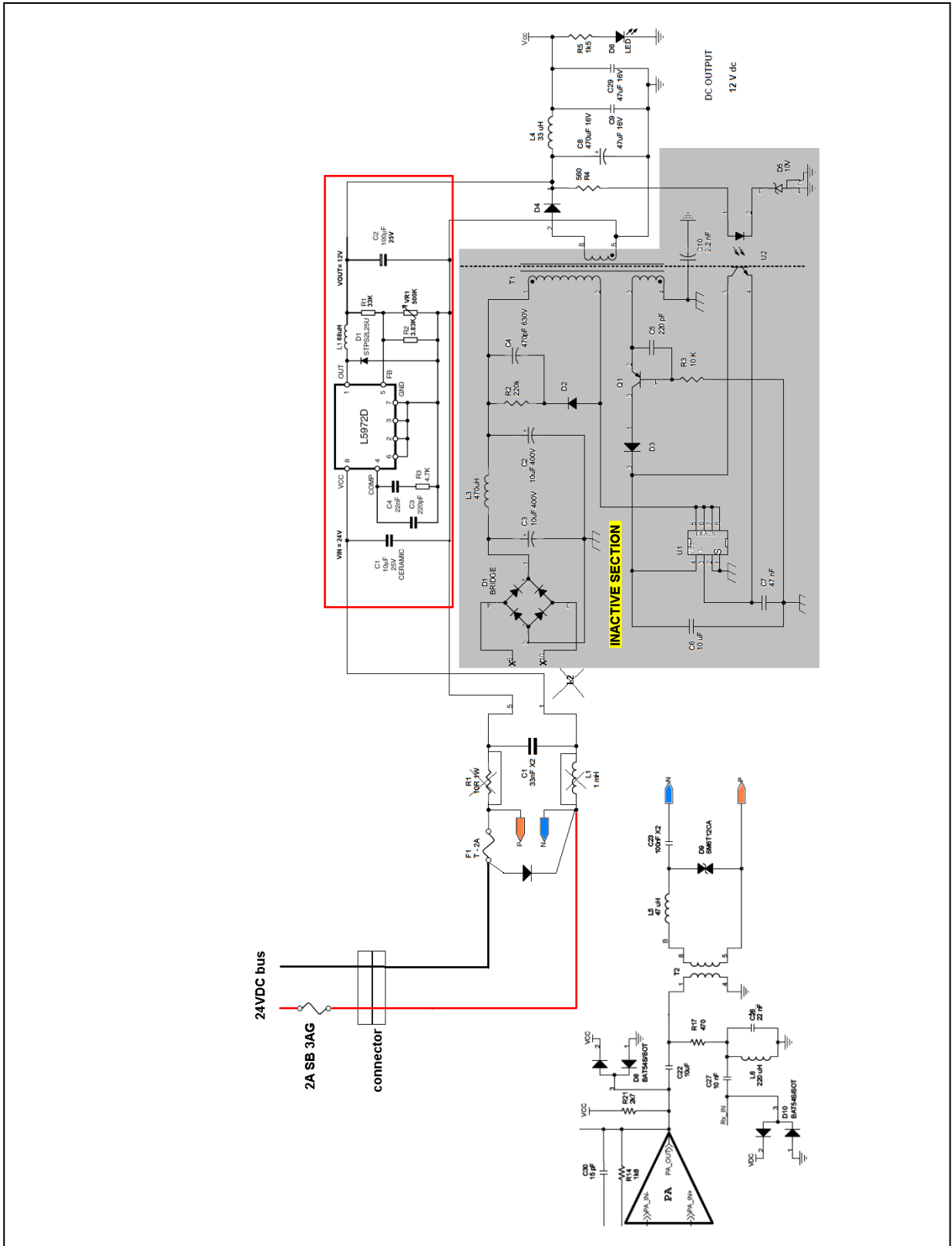


Figure 2. 24VDC operation of STEVAL-IHP03V1 with EVAL5972D converter

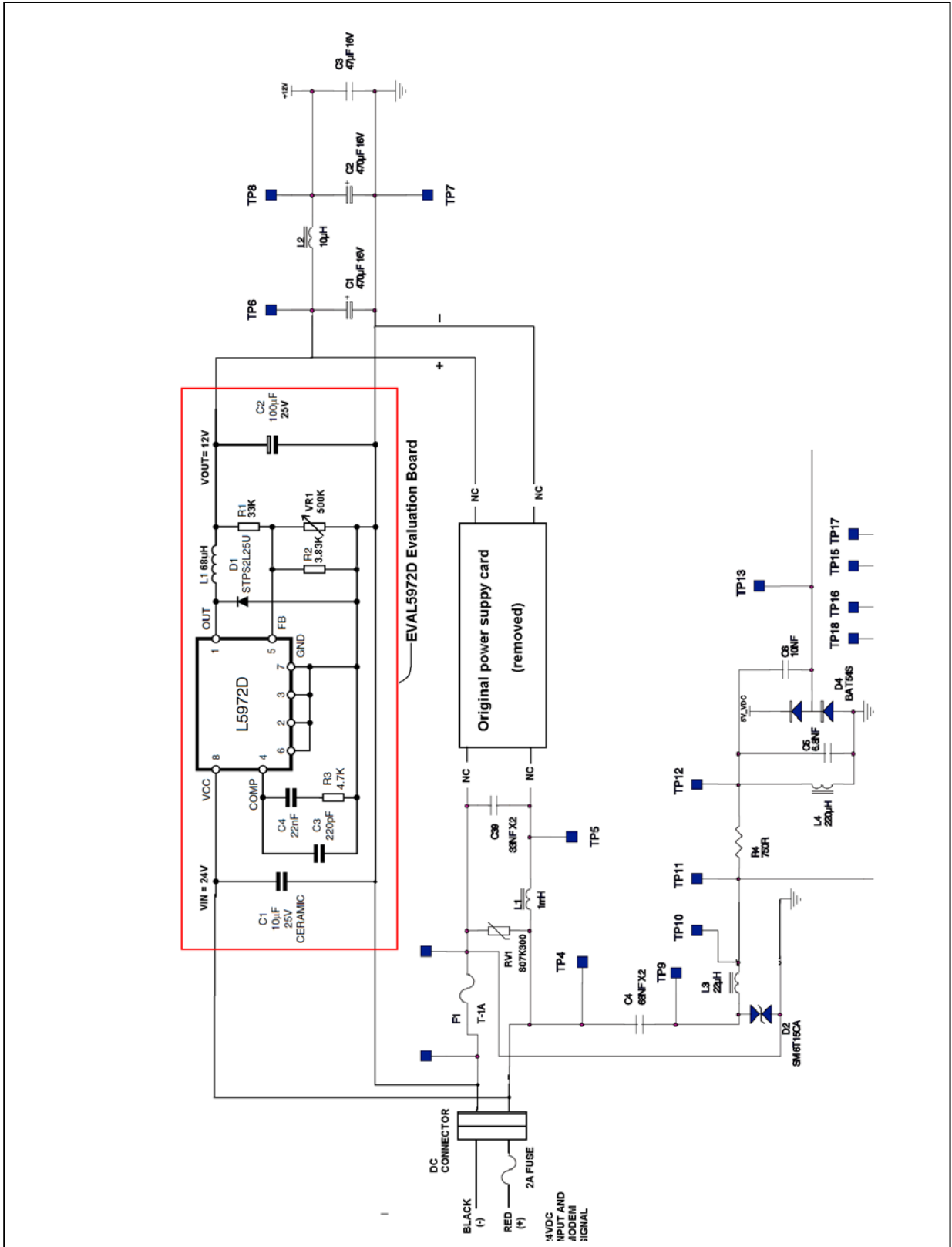


Figure 3 shows the arrangement of an L4971 that was used with an input voltage ranging from 15 to 55VDC. The 12VDC output of the L4971 circuit connects to the same 12V point as in the schematics in figures 1 and 2.

Figure 3. 15 to 55VDC operation using L4971

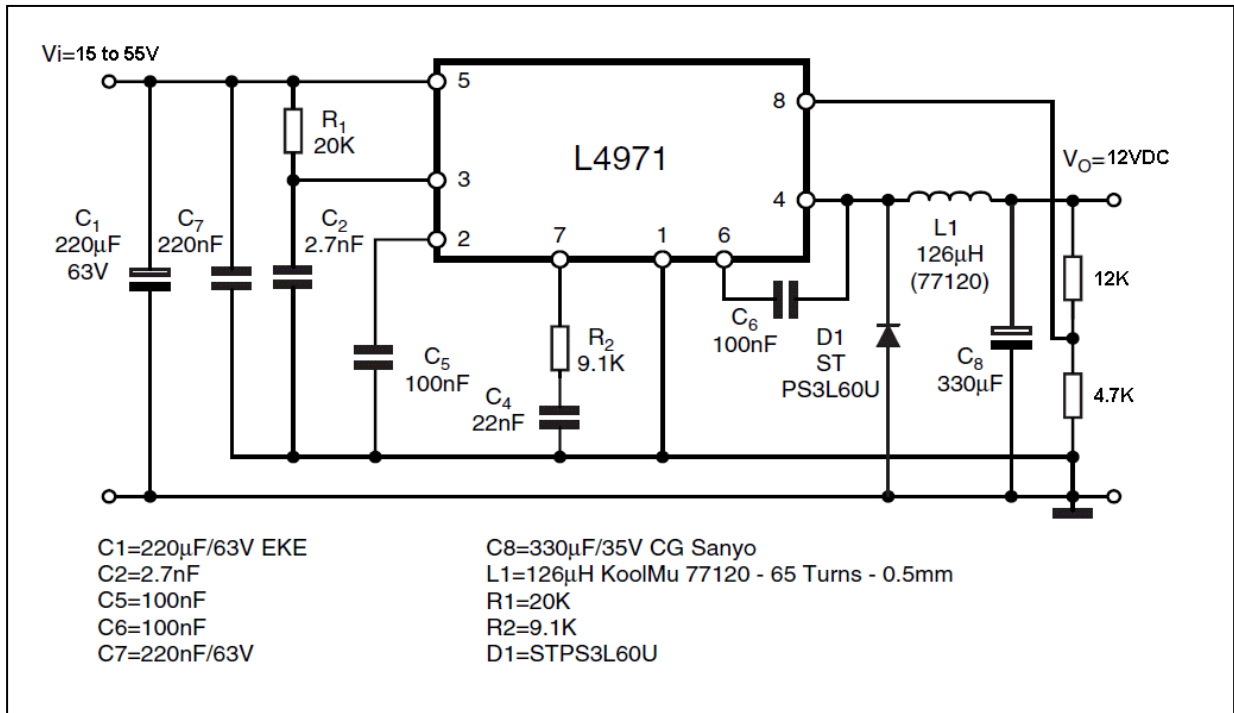
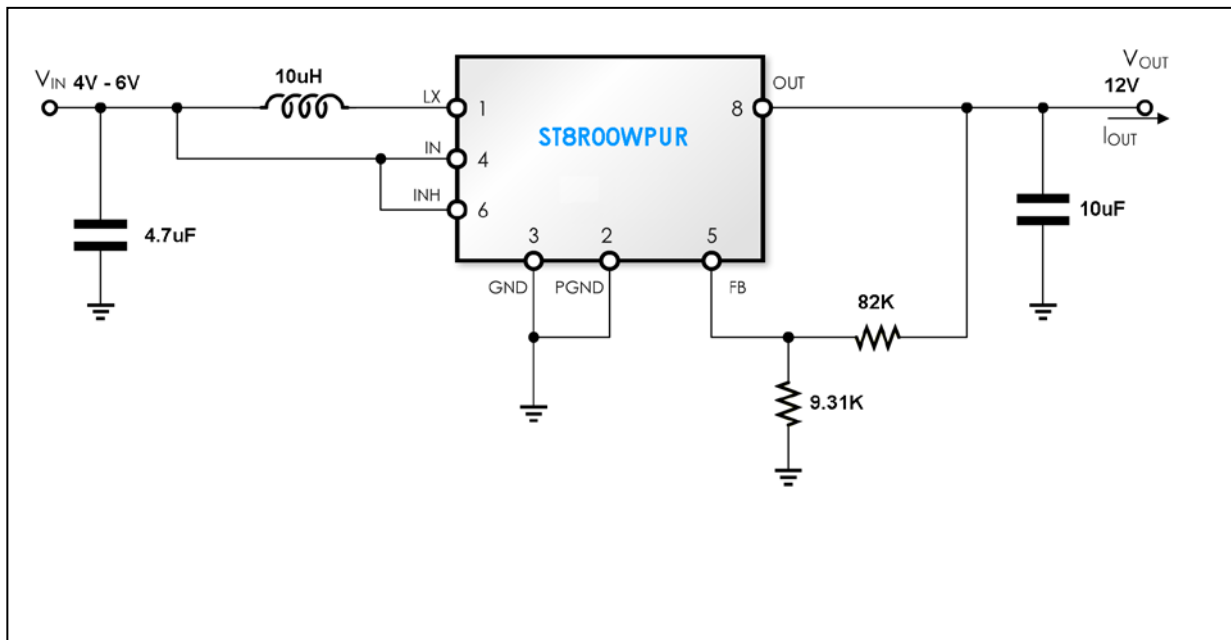


Figure 4 shows an ST8R00 as a boost converter operating from 4 to 6VDC and making 12VDC at 1A for the power line modem.

For DC bus voltages in the range of 90 to 300 V, off line controllers like the VIPer53 can be used to derive the 12V DC voltage from the high voltage bus. A VIPer53 circuit, like on the STEVAL-ISA029V1 evaluation board can be connected in the same way as the external buck regulators shown in Figures 1 and 2. When using the evaluation board, the DC bus is connected to the + and – sides of the bridge and the 12V output is connected directly to the 12 V on the board.

For DC bus voltages in the range of 140 to 300, the Viper12 circuit on the evaluation board may be used directly without modifications.

Figure 4. 4 to 6VDC Operation using ST8R00



Support material

Related design support material
STMicroelectronics eDesign Suite – https://my.st.com
STEVAL-ISA029V1, Compact power supply for DVD/set-top box demonstration board with three Vout (-30 V, +3.3 V, +12 V)
STEVAL-ISA048V2 1 A adjustable Vout PWM synchronous step-up DC-DC converter demonstration board based on the ST8R00W
EVAL4971 , L4971 1.5 A Step Down Switching Regulator Evaluation Board
EVAL5972D L5972D Up to 2A Step Down Switching Regulator Evaluation Board
ST7540, DS4668: FSK power line transceiver
Documentation
Datasheet, ST8R00, Micropower 1 A synchronous step-up DC-DC converter
Datasheet, L4971 1.5A step down switching regulator
Application Note, AN937: Designing with L4971, 1.5 A high efficiency DC-DC converter
Application Note, AN2627: ST8R00 synchronous boost converter with output current cut-off function
Datasheet, VIPer53E, DS4980: Off-line primary switch
Datasheet, L5972D, 2A switch step down switching regulator
Application note, AN1517: Designing with the L5972D high efficiency DC-DC converter
Application note, AN2451: ST7540 FSK powerline transceiver design guide for AMR
Application note, AN3970: PLM smartplug V2 getting started
Application note, AN3287: PLM smartplug guide to getting started
Application note, AN3046: Multimaster field-bus applications in homes and buildings
User Manual, UM0240: ST industrial communication board - EVALCOMMBOARD
User Manual, UM1458: STEVAL-IHP002V2: PLM smartplugV2 hardware
User Manual, UM1459: STEVAL-IHP002V2: PLM smartplugV2 firmware
User Manual, UM1005: STEVAL-IHP002V1: PLM smartplug demonstration board
User Manual, UM0239: ST7540 power line modem demokit graphical user interface (GUI)
User Manual, UM1006: PLM smartplug firmware

Revision history

Date	Version	Changes
23-Aug-2012	1	Initial draft

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