

### STEVAL-IFP022V1 demonstration board for the VNI8200XP octal high side driver

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#### Introduction

The STEVAL-IFP022V1 is a demonstration board for the IPS VNI8200XP, a monolithic 8-channel high side driver featuring very low supply current, with an integrated SPI interface and a high efficiency 100 mA micropower step-down switching regulator.

The STEVAL-IFP022V1 provides a 4-row, 2-column LED matrix, allowing detection of the status of each output line. The LED matrix is supplied by the step-down regulator integrated in the VNI8200XP device. The same integrated regulator supplies the external high-speed opto-couplers, which provide the isolated interface required by industrial standards between the IPS and the host controller.

Optimized thermal performance is provided by the four layer structure of the board. In fact, four dedicated copper areas on each of the four layers result in improved sharing of power dissipation.

The STEVAL-IFP022V1 meets EFT standard requirements IEC 61000-4-2, IEC 61000-4-4, and IEC 61000-4-5.

The STEVAL-IFP022V1 can be controlled by a dedicated GUI for Windows operating systems, providing a complete user-friendly interface. To use the GUI, it is necessary to connect the communication board STEVAL-PCC009V2 between the STEVAL-IFP022V1 demonstration board and the PC.

**Figure 1. STEVAL-IFP022V1 demonstration board**



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# 1 Features

- Operating voltage from 10.5 to 33 V
- 0.7 A for each channel
- Reverse polarity protection
- High speed opto-isolation for SPI and parallel communication
- Low speed opto-isolation for device fault signaling
- Step-down converter for 3.3 V or 5 V
- Digital supply voltage
- LED matrix for channel status signaling
- Microcontroller interface
- Designed to meet EMC standard requirements: IEC 61000-4-2, IEC 61000-4-4, and IEC 61000-4-5

**Figure 2. STEVAL-IFP022V1 demonstration board**



## 2 Demonstration board characteristics

Figure 3. Schematic diagram - interface section

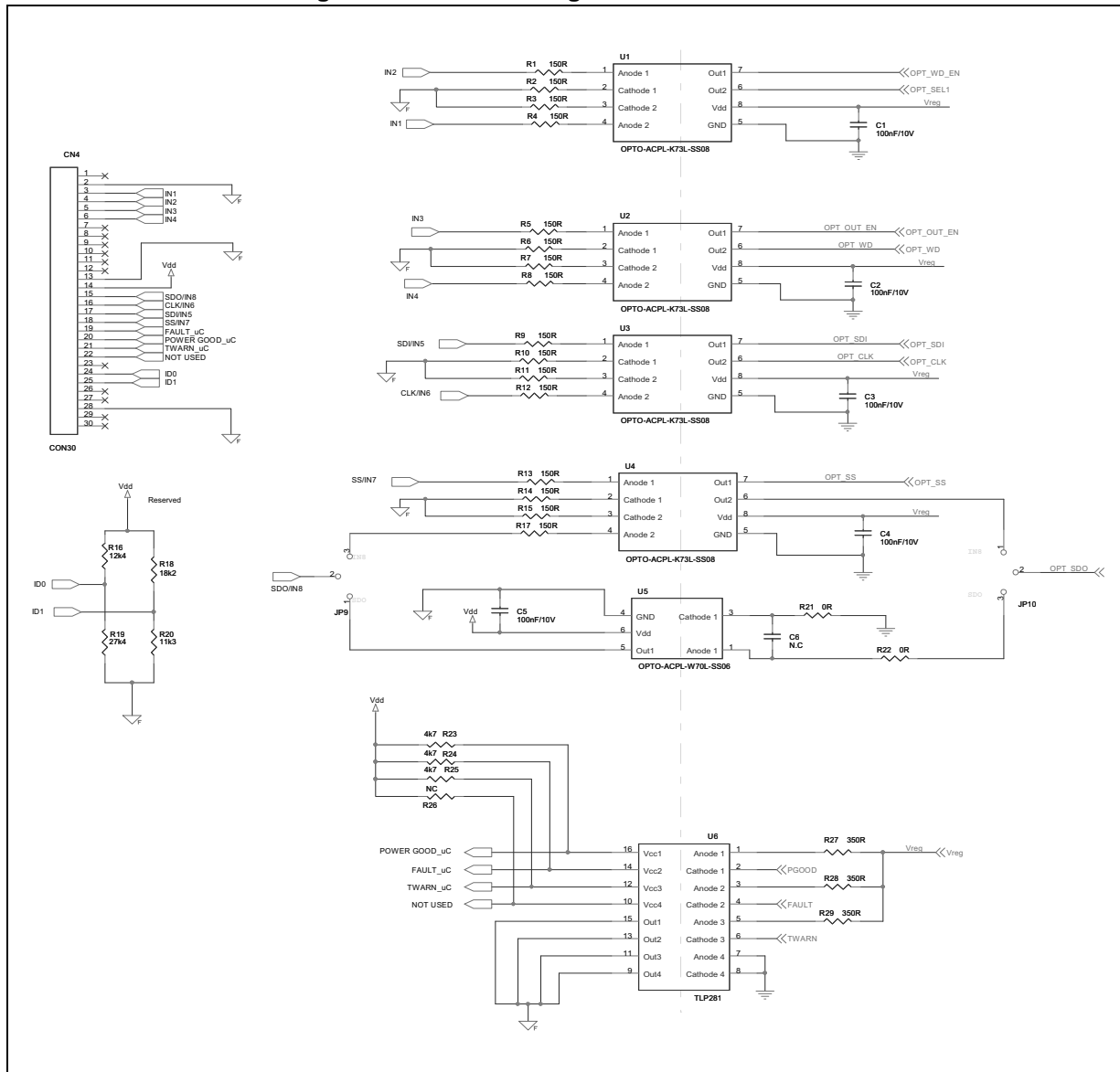


Figure 4. Schematic diagram - power section

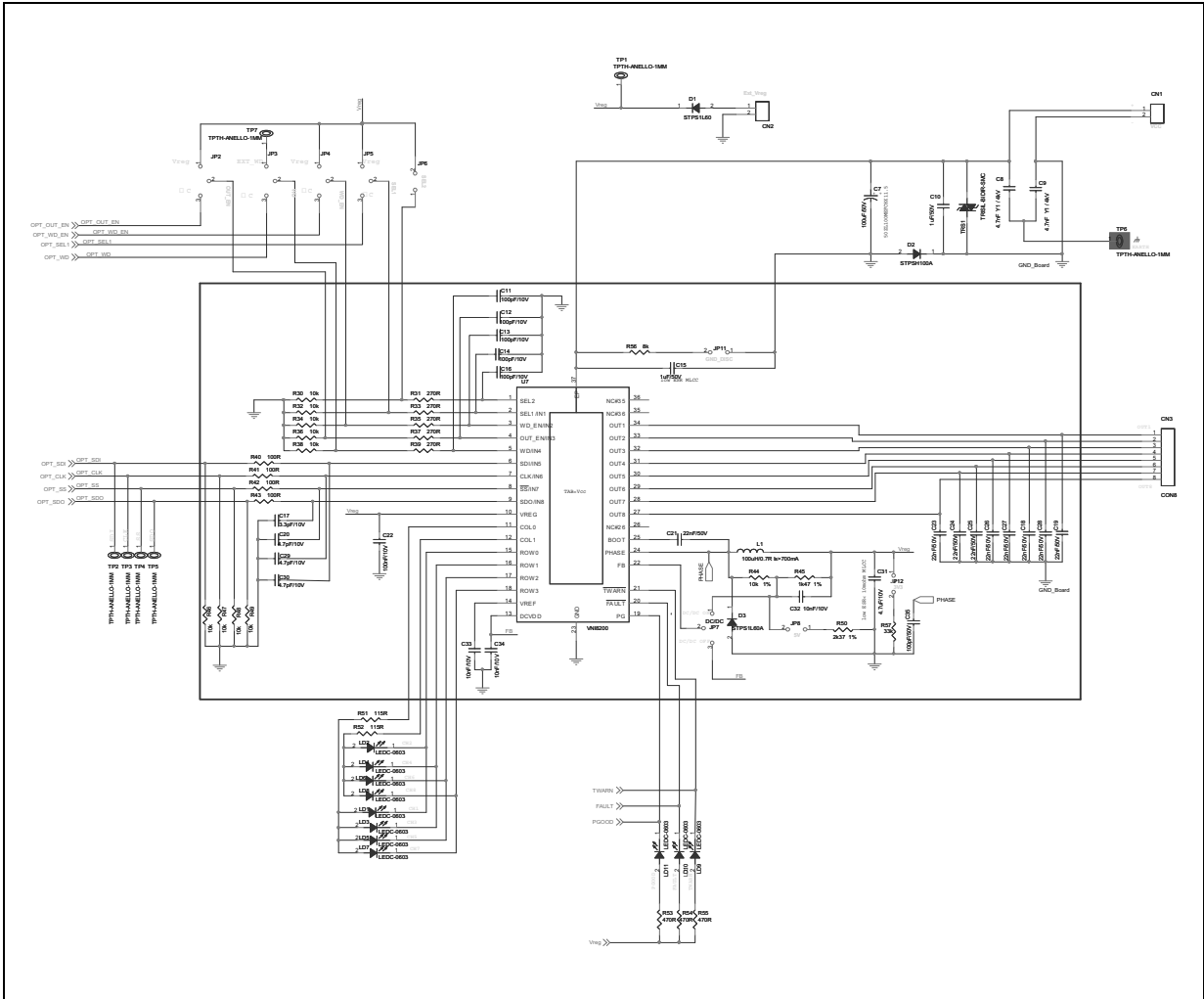


Table 1 summarizes the connectors and jumpers on the board which can be used for device driving.

Table 1. STEVAL-IFP022V1 connector and jumper description

Name	Type	Function
J6	Drop jumper	Drop jumper to select parallel or SPI interface
CN2	Digital supply	External 3.3 - 5 V supply
CN1	Power supply	Supply voltage
JP2,JP3,JP4,JP5,JP6	Drop jumpers	Drop jumper to select external reference or µC driving
JP7	Drop jumper	DC-DC disable
JP8	Drop jumper	DC-DC 5 V regulation
CN3	Power outputs	Device power outputs
CN4	30-pin connector	Microcontroller interface

Table 2. STEVAL-IFP022V1 30-pin signal connector description

Pin number	Description
1	3.3 V communication board digital output voltage
2	GND reference
3	Parallel Input pin IN1
4	Parallel input pin IN2
5	Parallel input pin IN3
6	Parallel input pin IN4
7-12	NC
13	GND reference
14	V <sub>dd</sub>
15	SPI device data out/parallel input 8
16	SPI CLK/ parallel input 6
17	SPI device data in/parallel input 5
18	Chip select/parallel input 7
19	Fault feedback for improper communication or thermal junction protection intervention
20	Power Good feedback
21	Thermal case feedback information
22	Not used
23	NC
24,25	Reserved
26,27	NC
28	GND reference
29,30	NC

### 3 PCB layout

Figure 5. STEVAL-IFP022V1: component placement

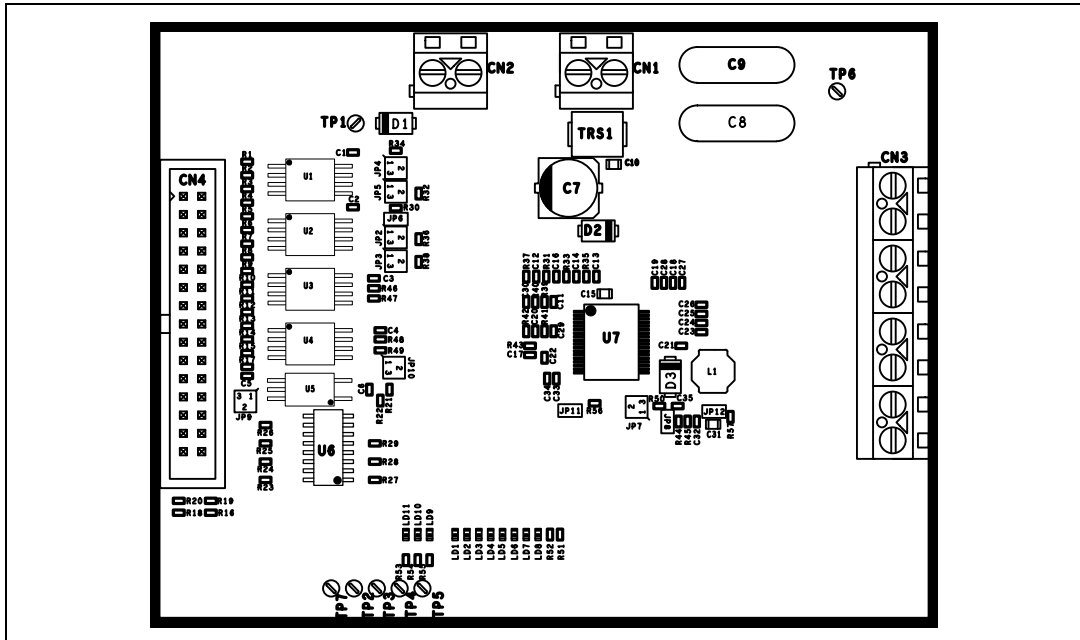


Figure 6. STEVAL-IFP022V1: top side layout

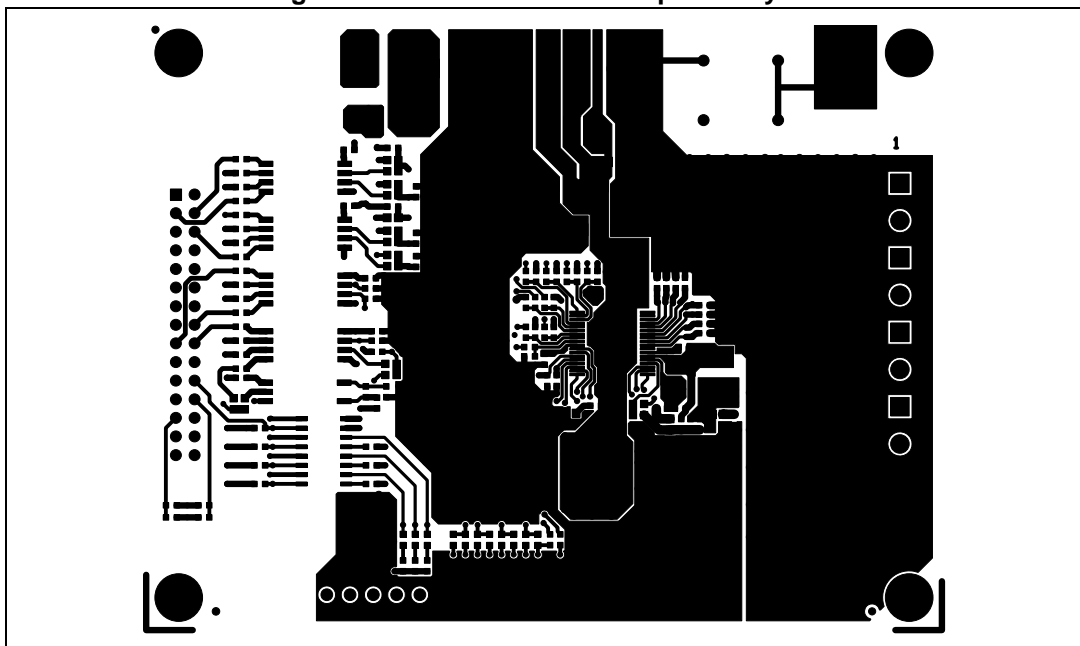


Figure 7. STEVAL-IFP022V1 internal layer 1

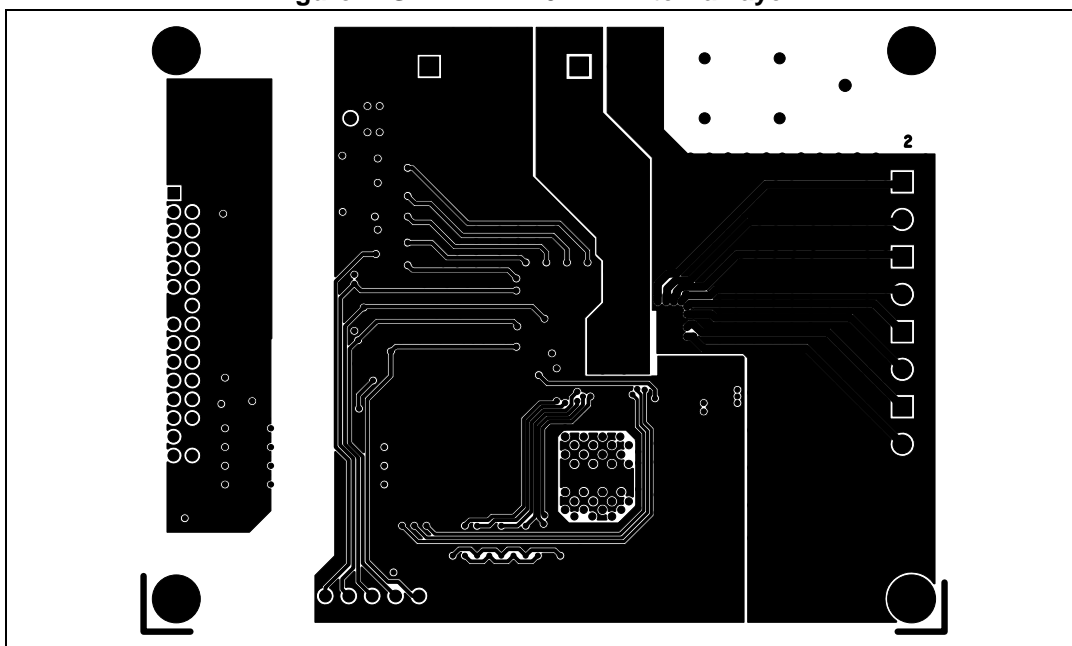


Figure 8. STEVAL-IFP022V1 internal layer 2

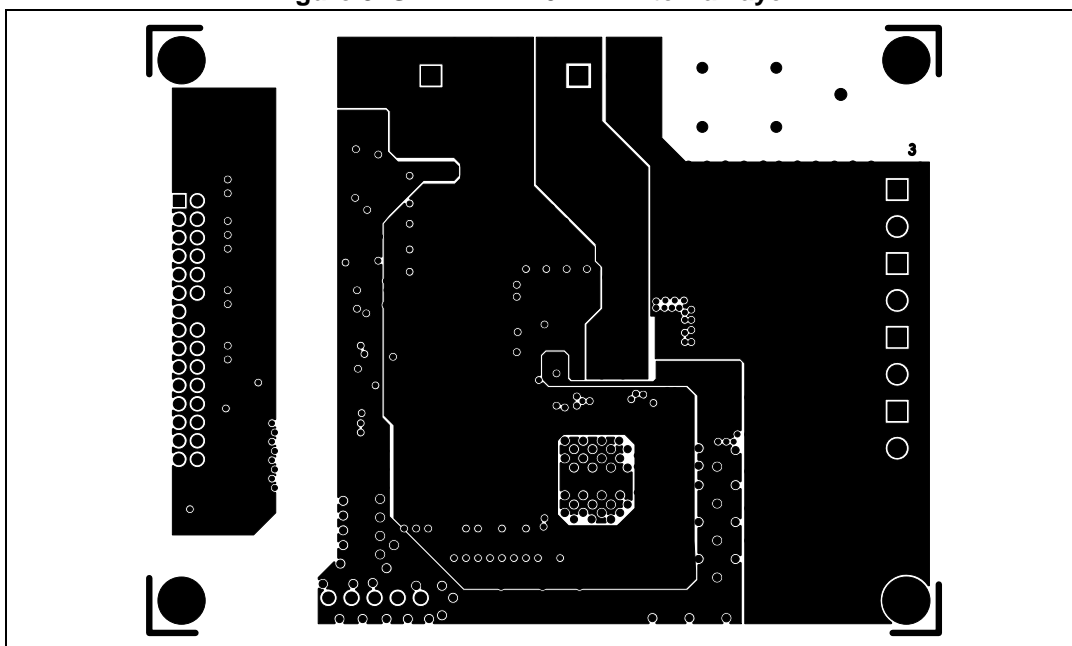
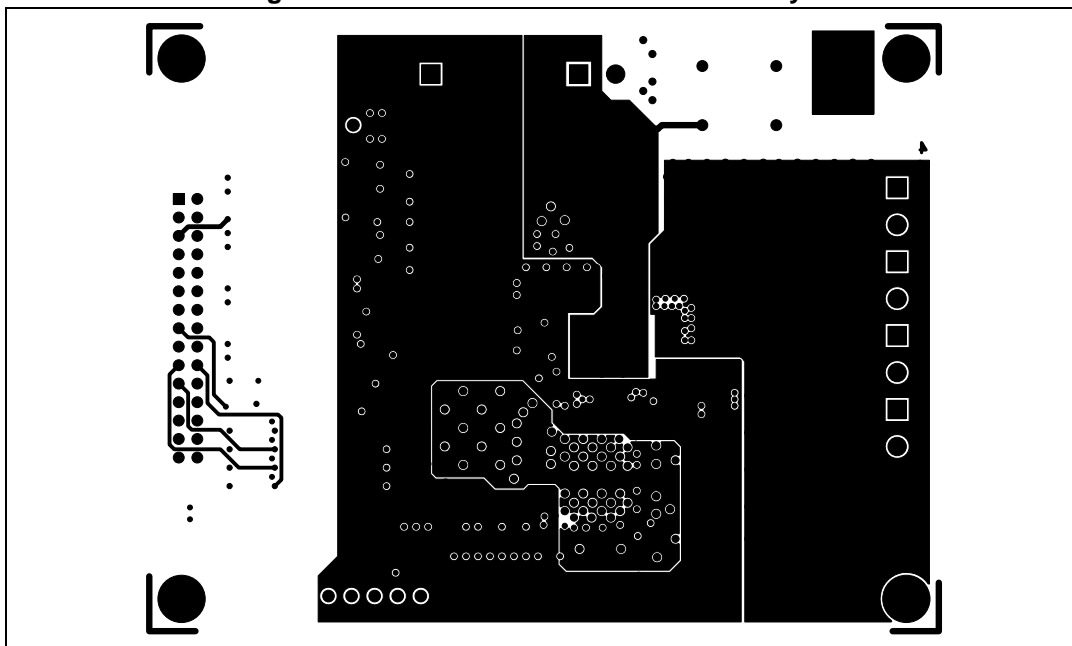




Figure 9. STEVAL-IFP022V1: bottom side layout



### 3.1 Power section

For proper handling, is recommended to set the main voltage within a range of 18 V to 33 V to prevent overheating of the Transil diode due to high reverse voltage. Digital supply voltage could be provided using the on-board DC-DC converter or using CN2 connector. This demonstration board also provides reverse polarity protection implemented by a Schottky diode and surge protection implemented using a Transil diode with 45 V clamp voltage.

**Table 3. STEVAL-IFP022V1 electrical specifications (recommended values)**

Parameter	Description	Test Condition	Typ	Unit
$V_{CC}$	Main supply voltage		24	V
$V_{reg}$	Digital voltage supply		5	V
$I_{VCC}$	Current consumption	DC/DC OFF $V_{reg} = 5$ V SPI OFF channel OFF	5	mA
		DC/DC ON $V_{reg} = 5$ V SPI ON channel OFF	15	mA
$V_{clamp}$	Supply voltage clamp		48	V
$R_{th}$	Thermal resistance		15	°C/W

### 3.2 Step-down converter

The step-down converter has been designed to generate a regulated voltage of 3.3 V/5 V to supply internal circuitry, the opto-coupler and other VNI8200XP devices if necessary (if this latter configuration is used, diode D1 must be bypassed). To set regulated voltage, the drop jumper JP8 must be left open to obtain 3.3 V regulation, and closed to obtain 5 V regulation. Instead, to turn on or turn off the DC-DC converter it is necessary to close JP7 on the related side; moreover, in case of 3.3 V regulation the jumper JP12 has to be closed. At test point TP1, it is possible to check the regulated voltage.

### 3.3 Digital interface

The STEVAL-IFP022V1 provides the possibility to perform device driving using parallel communication or synchronous communication with a maximum speed of 4.5 MHz, through a 30-pin connector. In the following paragraphs, the steps required to properly manage the evaluation tool will be described in greater detail.

#### 3.3.1 Parallel interface

To select the parallel interface, the drop jumper JP6 should be left open, whereas JP10 has to be soldered on the side identified with the label "IN8". After this step, it is possible to manage all signals for parallel communication using the 30-pin connector. In parallel configuration, the input pin connected to drop jumpers JP2, JP4, JP5 and JP3 could be managed by a microcontroller or kept fixed to a reference. Leaving drop jumpers open, the correspondent input is pulled down, while soldering on the other reference it is possible to always have a high input, or in case of a WD signal, the possibility to provide a square wave at different periods.

### 3.3.2 SPI communication

To select SPI communication, the drop jumper JP6 has to be closed, whereas the two drop jumpers identified with labels JP10 and JP9, must be soldered on the side identified with the label "SDO".

In this mode, the watchdog reset function is available.

This functionality can be controlled by a microcontroller by soldering drop jumpers JP3 and JP4 on side with the label "μC", or may be control externally by soldering JP3 and JP4 on the opposite side, fixing these signals to another reference.

Regarding the other two drop jumpers "OUT\_EN" and "SEL1", the same considerations as those explained above are valid.

## 3.4 Thermal management

Improvement in thermal management has been achieved by distributing the power dissipation on  $V_{CC}$  using four layer realization. This solution permits to reach a  $R_{th}$  value equal to 15 °C/W with around 16 cm<sup>2</sup> copper area on the bottom layer, around 6 cm<sup>2</sup> on each of the other layers. The copper thickness is 70 μm.

## 3.5 EMC robustness

The STEVAL-IFP022V1 satisfies all requirements established by IEC 61000-4-2, IEC 61000-4-4, and IEC 61000-4-5, respectively, for ESD (Air discharge and Contact Discharge), Burst on outputs and supply line and Surge tests on output and supply line.

## 4 PC communication using STEVAL-PCC009V2 connection and HSD GUI interface

As described in the previous section, this demonstration board is populated with a 30-pin connector to provide easy microcontroller interfacing, which is represented by STEVAL-PCC009V2. This board, through a GUI interface permits STEVAL-IFP022V1 communication and driving in parallel mode as well as serial mode.

Figure 10. GUI interface SPI 16-bit communication

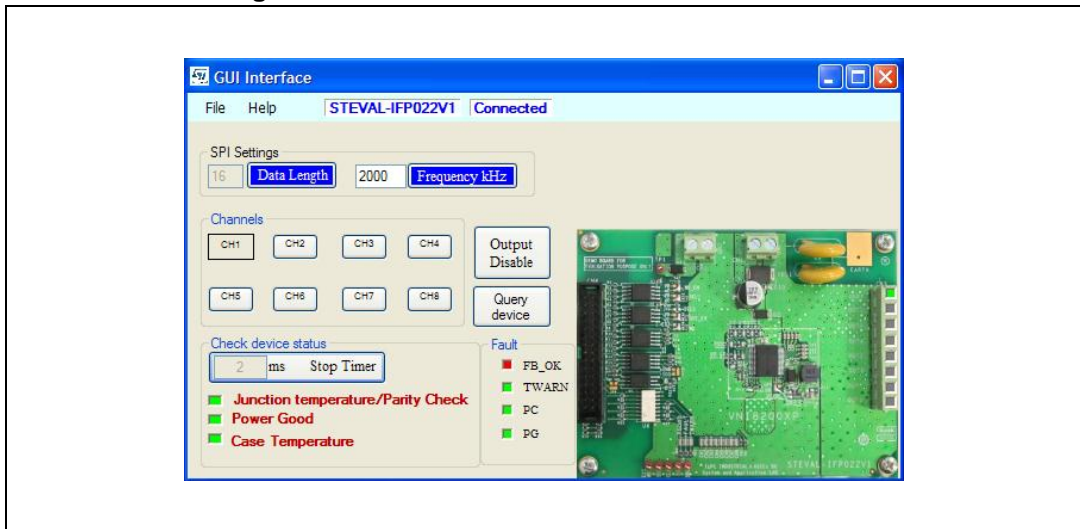
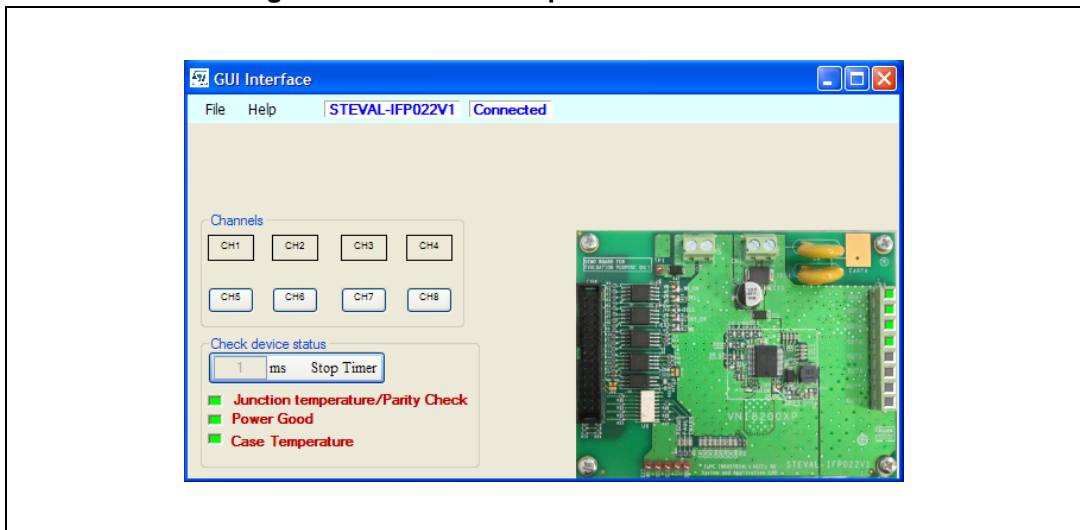


Figure 11. GUI interface parallel communication



## 5 Bill of material

**Table 4. Bill of material - interface section**

Components	Description	Type	Part number	Manufacturer
C1, C2, C3, C4, C5	100 nF/10 V	Ceramic SMT 0603	GRM188R71H104JA93D	Murata
C6	NC	Ceramic SMT 0603	GRM188R71H104JA93D	Murata
J1	CON30	30-pin connector		
J2	IN8	Drop jumper		
J3	SDO	Drop jumper		
R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R17	150R	Resistor		
R16	12K4	Resistor		
R23, R24, R25,	4K7	Resistor		
R26	NC	Resistor		
R18	18K2	Resistor		
R19	27K4	Resistor		
R20	11K3	Resistor		
R21	0R	Resistor		
R22	0R	Resistor		
R27, R28, R29	350R	Resistor		
U1, U2, U3, U4	ACPL-K73L-000E	Opto-coupler SMD	ACPL-K73L-000E	Avago Technologies
U5	ACPL- W070L-000E	Opto-coupler SMD	ACPL-W070L-000E	Avago Technologies
U6	TLP281	Opto-coupler SMD	TLP281-4	Toshiba

**Table 5. Bill of material - power section**

Components	Description	Type	Part number	Manufacturer
D4, D5, D6, D7, D8, D9, D10, D11	Green LED	LED SMD		
C7	100 uF/50 V	Electrolytic capacitor	EEEF1H101AP	Panasonic
C8,C9	4.7 nF Y1 / 4 kV 500 V <sub>ac</sub>	Ceramic single layer	VY1472M63Y5UQ6*V0	Vishay
C15	1 uF/50 V	Ceramic SMT	GRM31MR71H105KA88L	Murata
C10	1 uF/50 V	Ceramic		
C11, C12, C13, C14, C16,	100 pF/10 V	Ceramic		

Table 5. Bill of material - power section (continued)

Components	Description	Type	Part number	Manufacturer
C17	3.3 pF/10 V	Ceramic		
C18, C19, C21, C23, C24, C25, C26, C27, C28	22 nF/50 V	Ceramic		
C20, C29, C30	4.7 pF/10 V	Ceramic		
C22	100 nF/10 V	Ceramic		
C31	4.7 uF/10 V	Ceramic SMT	GRM21BR71A475KA73L	Murata
C32, C33, C34	10 nF/10 V	Ceramic		
C35	100 pF/50 V	Ceramic		
D1,D3	STPS1L60A	Schottky diode SMD		ST
D2	STPS1H100A	Schottky diode SMD		ST
D12, D13, D14	RED LED	LED SMD		
CN2	Ext <sub>reg</sub>	2-way screw connector		
CN1	V <sub>CC</sub>	2-way screw connector		
JP2	OUT_EN	Drop jumper		
JP3	WD	Drop jumper		
JP4	WD_EN	Drop jumper		
JP5	SEL1	Drop jumper		
JP6	SEL2	Drop jumper		
CN3	CON8	8-way screw connector		
J8	5 V	Drop jumper		
J7	DC-DC	Drop jumper		
JP11	GND_DISC	Drop jumper		
JP12	3V3	Drop jumper		
L1	100 uH/0.7R I <sub>s</sub> > 700 mA	Inductor	LQH6PPN101M43L	Murata
R30, R32, R34, R36, R38, R46, R47, R48, R49	10 k	Resistor		
R31, R33, R35, R37, R39,	270R	Resistor		
R40, R41, R42, R43	100R	Resistor		
R56	8 k	Resistor		
R44	10 k 1%	Resistor		
R45	1k47 1%	Resistor		

Table 5. Bill of material - power section (continued)

Components	Description	Type	Part number	Manufacturer
C17	3.3 pF/10 V	Ceramic		
C18, C19, C21, C23, C24, C25, C26, C27, C28	22 nF/50 V	Ceramic		
C20, C29, C30	4.7 pF/10 V	Ceramic		
C22	100 nF/10 V	Ceramic		
C31	4.7 uF/10 V	Ceramic SMT	GRM21BR71A475KA73L	Murata
C32, C33, C34	10 nF/10 V	Ceramic		
C35	100 pF/50 V	Ceramic		
D1,D3	STPS1L60A	Schottky diode SMD		ST
D2	STPS1H100A	Schottky diode SMD		ST
D12, D13, D14	RED LED	LED SMD		
CN2	Ext <sub>reg</sub>	2-way screw connector		
CN1	V <sub>CC</sub>	2-way screw connector		
JP2	OUT_EN	Drop jumper		
JP3	WD	Drop jumper		
JP4	WD_EN	Drop jumper		
JP5	SEL1	Drop jumper		
JP6	SEL2	Drop jumper		
CN3	CON8	8-way screw connector		
J8	5 V	Drop jumper		
J7	DC-DC	Drop jumper		
JP11	GND_DISC	Drop jumper		
JP12	3V3	Drop jumper		
L1	100 uH/0.7R I <sub>s</sub> > 700 mA	Inductor	LQH6PPN101M43L	Murata
R30, R32, R34, R36, R38, R46, R47, R48, R49	10 k	Resistor		
R31, R33, R35, R37, R39,	270R	Resistor		
R40, R41, R42, R43	100R	Resistor		
R56	8 k	Resistor		
R44	10 k 1%	Resistor		
R45	1k47 1%	Resistor		

Table 5. Bill of material - power section (continued)

Components	Description	Type	Part number	Manufacturer
R50	2k37 1%	Resistor		
R51, R52	115R	Resistor		
R53, R54, R55	470R	Resistor		
R57	33 k	Resistor		
TP1	Vreg	Test point 1 mm		
TP2	SDI	Test point 1 mm		
TP3	CLK	Test point 1 mm		
TP4	SS	Test point 1 mm		
TP5	SDO	Test point 1 mm		
TP7	WD	Test point 1 mm		
TRS1	SM15T33CA	Transil		ST
U7	VNI8200XP			ST



## 6 Reference documents

- VNI8200XP datasheet
- IEC 61000-4-4 standard
- IEC 61000-4-5 standard
- IEC 61000-4-2 standard

## 7 Revision history

Table 6. Document revision history

Date	Revision	Changes
24-Jun-2013	1	Initial release.

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