



New Contact Address

in-tech smart charging GmbH

Important notice

Dear customer,

in-tech smart charging GmbH is expanding. From now on we will be based in Bitterfelder Str. 1-5 in 04129 Leipzig. Our email address smartcharging@in-tech.com and phone number +49 341 39290250 remain unchangend.

As of now mail will be received at the new address.

Yours sincerely,

in-tech smart charging GmbH



PLC Stamp micro EVB Datasheet

I2SE GmbH

February 7, 2017

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1 Revisions

Revision	Release Date	Changes
5	February 7, 2017	clarify about Raspberry Pi compatible connector
4	March 23, 2016	change EVK to EVB, remove GPIOs from X1, add order info, fix preconfigured options, add push button simple connect
3	December 11, 2015	updated section „Contact“, corrected typos, added section Preconfigured Options
2	Januar 14, 2014	updated figure 3 (fixed GPIO 0 to 3 order)
1	December 10, 2013	initial release

2 Introduction

The PLC Stamp micro gives your application access to powerline communication based on the HomePlug® Green PHY™ Chip QCA7000. You can realize point-to-point and multi-point connections depending on your application. The data will be transmitted as Ethernet packets over the power line. This gives you the opportunity to use TCP/IP or whatever network protocols you wish to use.

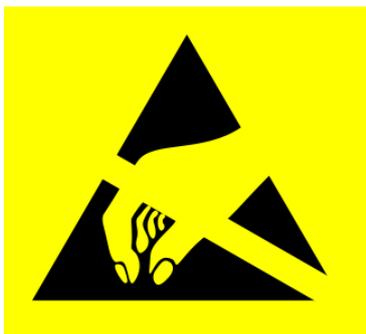
The PLC Stamp micro evaluation board includes everything you need for evaluation of power line communication with the PLC Stamp micro. It comes with jumpers for configuration of the QCA7000, LEDs to display the status, the required galvanic isolation from the power line as well as the power supply (external supply: USB).

You only need to connect your controller via SPI or UART, plug in the USB cable for the power supply and connect the evaluation board to your power line.

- based on the HomePlug® Green PHY™ PLC-Chip QCA7000
- suitable for direct connection to mains/powerline or to the CP signal in electric vehicle charging
- integrated AC isolation
- external 5 V power supply (USB)
- GPIO / UART / SPI-Interface

Parameter	Value
Power supply	5 V
Power consumption	<2 W
Data rate	max. 10 MBit/s
Reach	maximal 300 m over the Powerline
Temperature range	0 °C - +70 °C
Outline dimension	122 mm x 60 mm x 27 mm
RoHS	PLC Stamp micro EVB is manufactured RoHS compliant.

2.1 Handling



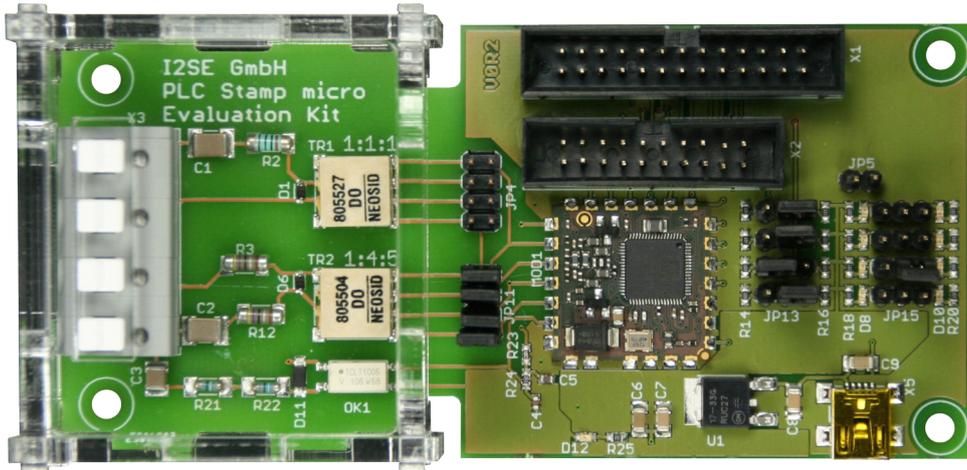


Figure 1: image of PLC Stamp micro EVB

This electronic component is sensitive to electrostatic discharge (ESD).



The circuitry on the board can be connected to high voltage. To avoid electrical shock do not touch this product when it is under voltage.

3 Reference Documents

1. PLC Stamp micro datasheet
2. Duckbill 2 SPI datasheet
3. Quick start guide - PLC bundle for Internet of Things

4 Overview

The block diagram in Figure 2 shows the components included on the evaluation board additionally to the PLC Stamp micro. The only required connections are a 5 V power supply USB mini cable, a power line cable and the connection to a SPI master controller.

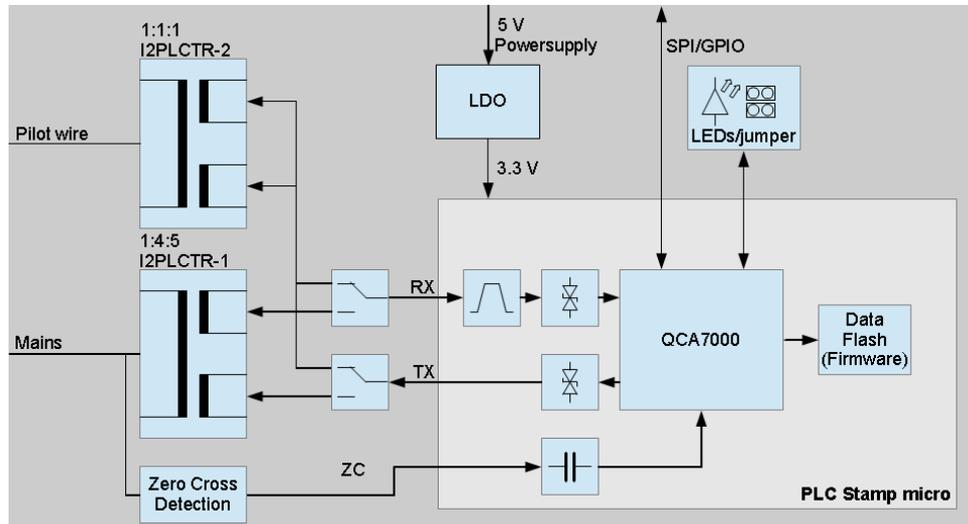


Figure 2: block diagram PLC Stamp micro EVA

5 GPIO

5.1 Power On Configuration

The QCA7000 has four GPIO which are read at boot time to get the desired configuration. Those GPIO can be configured on the Evaluation board using the jumper as shown in Figure 3 in columns 4 and 5. The Table 6 shows how to configure the QCA7000 on boot time. For a full description about what each row and column of jumpers is for you can refer to Table 4.

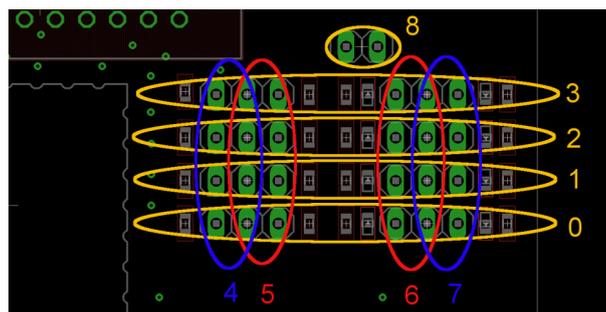


Figure 3:

5.2 General Purpose I/O Functions

The QCA7000 GPIOs can also be used as GPIO on QCA7000 runtime. They can be either used as input or output to display various states or trigger some actions. It is not possible to use these pins for external purposes like switching relays etc.

index	meaning
0	GPIO 0
1	GPIO 1
2	GPIO 2
3	GPIO 3
4	pull down
5	pull up
6	LED low active
7	LED high active
8	short QCA7000 RESET pin to GND

Table 4: GPIO legend for the evaluation board

GPIO #	pull up	pull down	Function
0	X		boot source = flash
0		X	boot source = host
1	X		not used
1		X	boot host = SPI slave
2	X		SPI slave mode = burst
2		X	SPI slave mode = legacy
3	X		not used
3		X	not used

Table 6: QCA7000 boot strap options

5.2.1 Output

This evaluation board features two LEDs for each GPIO. One LED is low active and the other is high active. In Figure 4 you can see a part of the schematic for the jumpers connected to the GPIO. The part names correspond to those labeled on the silkscreen of the PCB. All other channels are connected equally to the corresponding other GPIO.

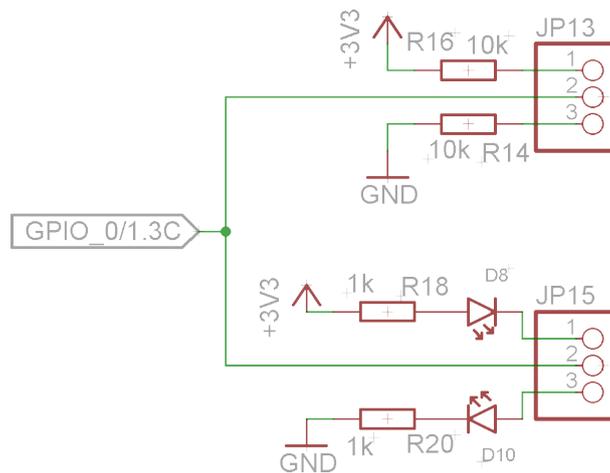


Figure 4: GPIO schematic

The GPIO can be configured to display one or more of the following signals:

- Powerline link status
- Powerline TX
- Powerline RX
- SPI TX
- SPI RX
- Pushbutton Simple Connect Status

5.2.2 Input

For input functions the GPIO are also available on the connectors X1 and X2. Some available input functions are:

- Pushbutton Simple Connect
- network membership key (NMK) randomization
- reset to factory default

5.2.3 Preconfigured Options

The firmware of the latest evaluation board is preconfigured with the following options.

GPIO #	Direction	Set Jumper ¹	LED	description	behavior
0	Output	0.6	D8	Powerline Network established	on
				Powerline disconnected	off
				push button simple connect in progress	flash slow (500 ms / 500 ms)
1	Output	1.7	D9	unused	
2	Output	2.6	D3	unused	
3	Input	3.4	-	push button simple connect	hold time: 0.5 to 3s
				NMK randomization	hold time: 5 to 8s
				reset to factory defaults	hold time: 10 to 15s

¹see Figure 3 for locating jumper

5.3 Push button simple connect

The following procedure explains how to connect a powerline ethernet adapter with a PLC Stamp micro EVB:

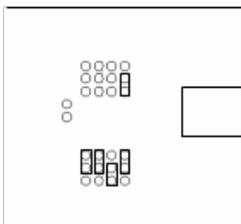


Figure 5: Pull up GPIO 3

- First make sure the powerline adapter and PLC Stamp EVB are connected to the same circuit and all jumpers are in default position (see Figure 5)
- On the PLC Stamp EVB short QCA7000 RESET pin to GND (index 8, see Figure 6) for one second in order to get a defined state

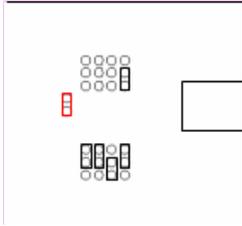


Figure 6: Reset QCA7000

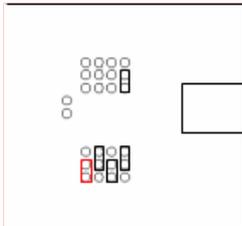


Figure 7: Pull down GPIO 3

- Set the jumper for GPIO 3 to index 4 position (see Figure 7) for just 6 seconds and then quickly back (see Figure 5)
- Now the network membership key of the PLC Stamp micro EVB should be random
- Trigger the pairing by pressing the simple connect button on the powerline adapter
- Set the jumper for GPIO 3 to index 4 position (see Figure 7) for just one second and then quickly back (see Figure 5) in order to trigger the pairing on the PLC Stamp micro EVB

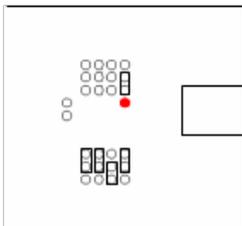


Figure 8: LED D8

- The pairing process was successful if the LED D8 is permanent on (see Figure 8)

6 Connectors

6.1 SPI/UART

This evaluation board has two SPI/UART connectors. X1 (Table 9) is a Raspberry Pi Model B compatible 26 pin connector. X2 (Table 11) is a I2SE Duckbill SPI and Qualcomm Atheros PL16 compatible 20 pin connector. But only X2 connects the four QCA7000 GPIOs. Please note that selecting between SPI and UART mode is done via different firmware of the QCA7000. In bootloader mode it always starts in SPI mode which enables you to upload new firmware.

X1 Pin	Name	X1 Pin	Name	X1 Pin	Name
1	not connected	10	not connected	19	SERIAL_4
2	not connected	11	not connected	20	not connected
3	not connected	12	not connected	21	SERIAL_3
4	not connected	13	not connected	22	not connected
5	not connected	14	not connected	23	SERIAL_1
6	not connected	15	not connected	24	SERIAL_2
7	not connected	16	SERIAL_0	25	GND
8	not connected	17	not connected	26	not connected
9	not connected	18	not connected		

Table 9: Raspberry Pi Model B compatible SPI connector

Note: In order to use this 26 pin connector with a newer Raspberry Pi which has a 40 pin connector a downgrade GPIO ribbon cable is available: <https://www.adafruit.com/products/1986>

X2 Pin	Name	X2 Pin	Name
1	GND	11	SERIAL_0
2	GND	12	GND
3	SERIAL_2	13	GPIO_0
4	GND	14	GND
5	SERIAL_1	15	GPIO_1
6	GND	16	GND
7	SERIAL_3	17	GPIO_2
8	GND	18	GND
9	SERIAL_4	19	GPIO_3
10	GND	20	GND

Table 11: Duckbill SPI / PL16 compatible SPI connector

The signals SERIAL_0 through SERIAL_4 are the SPI or UART signals. Please refer to the QCA7000 datasheet about more information for those interfaces. In Table 13 the UART and SPI function for each signal is described.

Signal Name	SPI function	UART function
SERIAL_0	Interrupt	
SERIAL_1	CLK	RTS
SERIAL_2	CS	CTS
SERIAL_3	MISO	TXD
SERIAL_4	MOSI	RXD

Table 13: QCA7000 UART/SPI signals

6.2 USB

This evaluation board is powered via USB. Please attach a mini USB cable between the evaluation board and a USB port of your personal computer, a self-powered USB hub or USB power supply. Please note that the evaluation board uses up to 350mA.

6.3 Powerline connector

The powerline connector X3 is connected to both of the transformers. To use the transformer TR1 (for electric vehicle charging) connect your wires to the pins 1 and 2 or X3. To use the transformer TR2 (for mains connection) connect it to the pins 3 and 4 of X3. The pin numbers of X3 are shown in figure Figure 9.

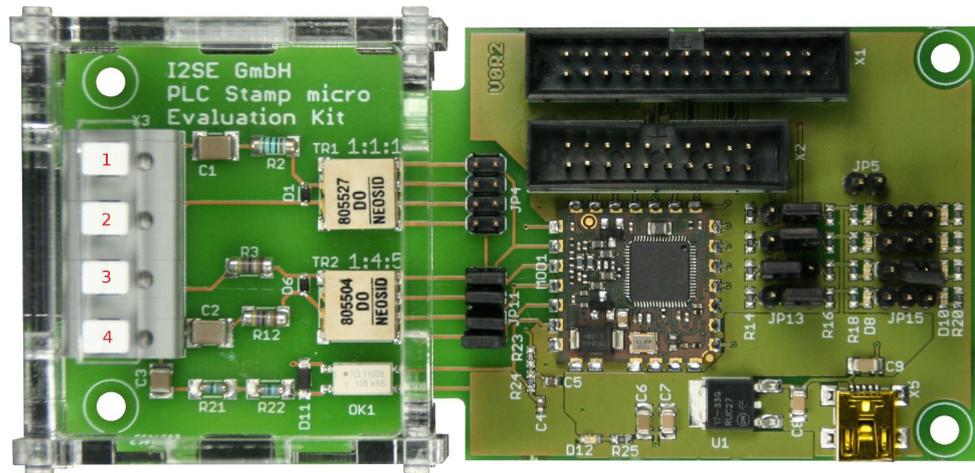


Figure 9: X3 pin numbers

7 Transformers

The evaluation board contains two different transformers. Transformer 1 (TR1) has a 1:1:1 turns ratio. It is designed for electric vehicle charging systems. The second transformer (TR2) has a 1:4:5 turns ratio. It is designed for mains connection. Both transformers are available from I2SE, please refer to Table 15 for order codes. There should be only one of both transformers connected to the PLC Stamp micro / the QCA7000. This means that you should place either all four jumpers on JP4 or all four jumpers on JP11, see Figure 10 but never jumpers on JP4 and JP11 at the same time.

Version	Order Code
1:4:5 for mains power line coupling	I2PLCTR-1
1:1:1 for Electric Vehicle and Electric Vehicle Supply Equipment	I2PLCTR-2

Table 15: transformer order codes

Please note that besides other hardware circuitry you also need different settings for the firmware of the QCA7000. That means that you have to flash a different PIB file for each application.

8 Powerline Coupling

To get the GreenPHY signals on the mains or pilot wires you have to couple them via various components. The schematic in this section shows a possible connection to both, the „CP” pilot wire as well as to mains.

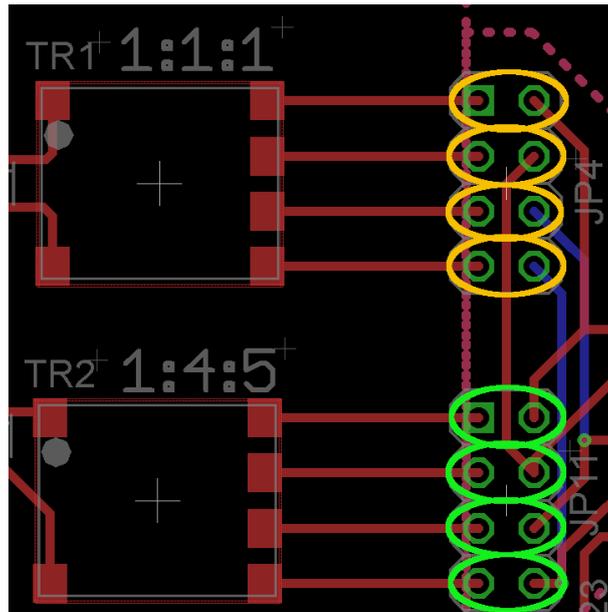


Figure 10: Jumper for choosing transformers

The optocoupler for zero cross detection always needs to be connected to mains if you need it. For electro vehicle charging you might want to use the zero cross detection circuit on the EVSE side while you can spare it on the PEV side.

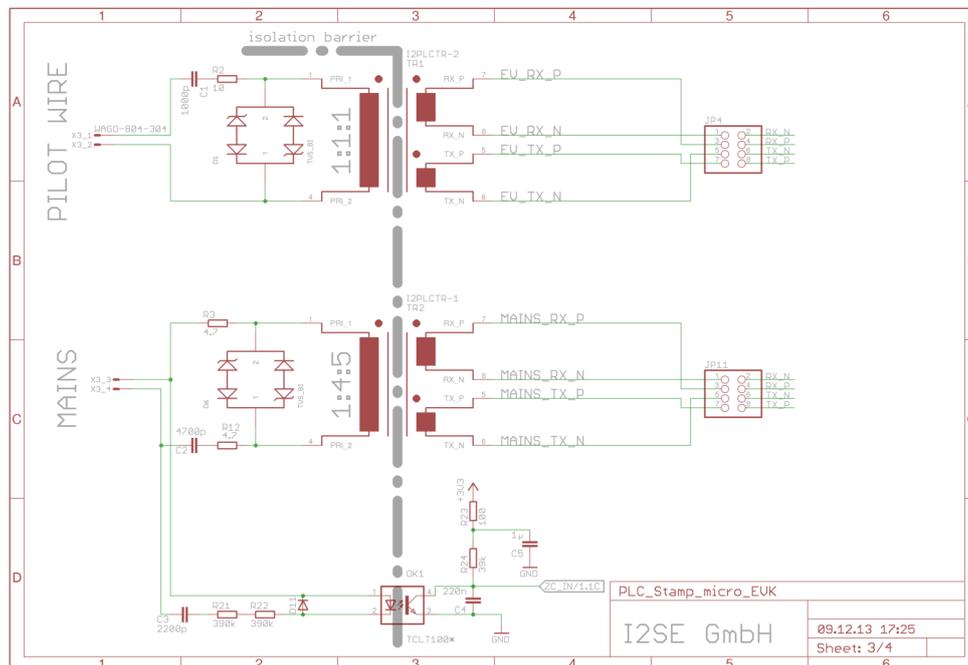


Figure 11: Coupling circuitry for PLC Stamp micro

For further information about the coupling circuit please refer to the Qualcomm Atheros QCA7000 documentation or contact I2SE for design support.

9 Software

The PLC Stamp micro EVB comes with firmware and settings flashed that enable you to get it up and running with mains connection in SPI mode as fast as possible. Users who want to use it with connection to pilot wire in electric vehicle charging need to flash other settings.

The flashed firmware is always the newest available at the time of production with the default settings for Europe and SPI mode.

10 Technical Data

10.1 Absolute Maximum Ratings

SYMBOL	PARAMETER	Min.	Max.	UNIT
VDD	Digital supply voltage	-0.03	16	V
VDIO	Digital input voltage	-0.3	3.63	V

10.2 Operating conditions

SYMBOL	PARAMETER	Min.	Typ.	Max.	UNIT
VDD	Digital supply voltage	4.7	-	15	V

11 Order Information

The following variants of this product are available:

Order code	availability
I2PLCAMC-ISC-001-EVB	standard

12 Contact

Website: <http://www.i2se.com>

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