



PLC Stamp micro 2 Datasheet

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1 Revisions

Revision	Release Date	Changes
1	November 16, 2015	initial issue

2 Abstract

The PLC (PowerLine Communication) module gives your application access to powerline communication based on the HomePlug® Green PHY™ Chip QCA7000 / QCA7005. 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.

You can freely select the galvanic isolation from the powerline and the power supply so that it perfectly meets the requirements for your application.

The QCA7000 / QCA7005 by Qualcomm Atheros ensures compatibility with many other commercial powerline devices.

Parameter	Value
Power supply	3.3 V
Power consumption	0.5 W
Data rate	max. 10 MBit/s
Reach	max. 300 m via Powerline
Temperature range	-40 °C - 85 °C (industrial) / 0 °C - 70 °C (commercial)
Outline dimension	22 mm x 22 mm x 4.5 mm
Weight	3.3 g
RoHS	PLC Stamp micro 2 is manufactured in compliance with RoHS

3 Applications

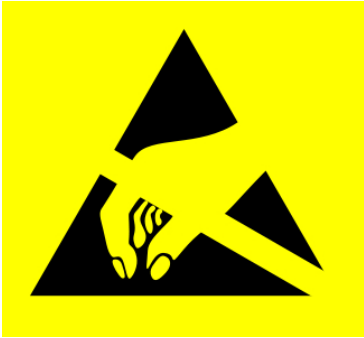
- interconnection of household appliances to the Smart Grid
- connection of smart meters to Smart Meter Gateways and/or LAN/WAN/WiFi
- connection of sensors
- connection of photovoltaic equipment
- connection of heating and air conditioning system
- coupling of machines and measurement devices
- forwarding of digital signals (remote I/O)
- coupling of RF cells for home automation

4 Interfaces

Powerline: 230 V AC, 110 V AC, DC, dead-wire 2-wire-connections

Serial interfaces: UART or SPI (order option)

5 Handling



This electronic component is sensitive to electrostatic discharge (ESD).
The module contains components with **moisture sensitivity level (MSL) 3**. Please handle them accordingly.

6 Module Overview

The block diagram in Figure 1 shows the module components in the gray box as well as the connections and external components that you need in addition.

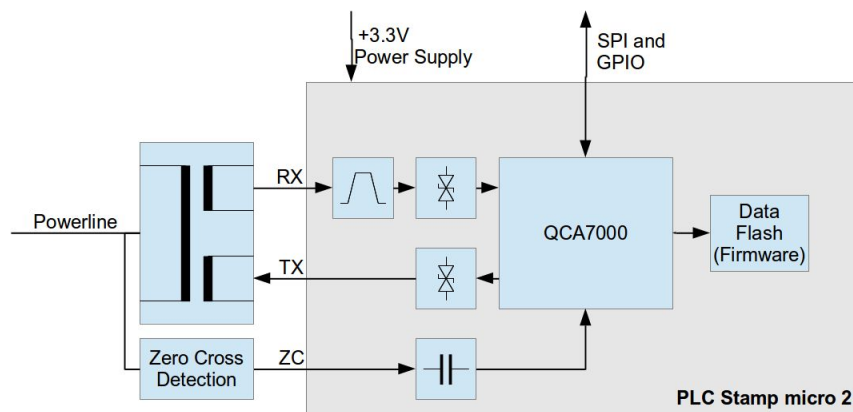


Figure 1: Block Diagram of PLC Stamp micro 2

All parts are located below a metal shield. Information about the module are printed on a high-temperature label on top of this shield.



Figure 2: Image of the Module

7 Technical Data

7.1 Absolute Maximum Ratings

SYMBOL	PARAMETER	Min.	Max.	UNIT
VDD	Digital supply voltage	-0.3	3.46	V
VDIO	Digital input voltage	-0.3	3.63	V
TSTORE	Storage temperature	-40	150	°C
RAH	Relative air humidity (not condensing)	10	90	%

7.2 Operating Conditions

SYMBOL	PARAMETER	Min.	Typ.	Max.	UNIT
VDD	Digital supply voltage	3.13	3.3	3.46	V
IDD	Current for VDD	-	150 (average)	300	mA
TCASE	Top of case temperature (industrial)	-40	-	85	°C
	Top of case temperature (commercial)	0	-	70	°C

8 Firmware and MAC Addresses

These modules are pre-programmed with firmware and parameter information block (PIB). The PIB contains the MAC addresses of the module, prescaler values defining the output power as well as settings for automotive use of the QCA7000 / QCA7005 (SLAC). The MAC address uses a prefix (organizationally unique identifier) that is assigned to I2SE. The prescaler values that are set in the production process were defined by Qualcomm for the intended application / market (see order option Parameter Optimization). Automotive variants include settings to enable SLAC for either the EVSE or the PEV side.

9 Module Pinout

PIN	Direction	Name	Description
1	SUPPLY	VDD	Supply Voltage for the Module
2	IN	RX_N	Powerline receiver input negative
3	IN	RX_P	Powerline receiver input positive
4	OUT	TX_N	Powerline transmitter output negative
5	OUT	TX_P	Powerline transmitter output positive
6	IN	ZC_IN	Zerocross detection input
7	SUPPLY	GND	Ground connection
8	SUPPLY	GND	Ground connection
9	SUPPLY	GND	Ground connection
10	-	-	not available (mechanical coding)
11	SUPPLY	GND	Ground connection
12	SUPPLY	GND	Ground connection
13	SUPPLY	GND	Ground connection
14	SUPPLY	GND	Ground connection
15	SUPPLY	GND	Ground connection
16	SUPPLY	GND	Ground connection
17	SUPPLY	GND	Ground connection
18	IN/OUT	GPIO_0	QCA7000 / QCA7005 GPIO 0
19	IN/OUT	GPIO_1	QCA7000 / QCA7005 GPIO 1
20	IN/OUT	GPIO_2	QCA7000 / QCA7005 GPIO 2
21	IN/OUT	GPIO_3	QCA7000 / QCA7005 GPIO 3
22	IN	RESET_L	Reset (low active)
23	IN/OUT	SERIAL_4	Serial_4 of QCA7000 / QCA7005
24	IN/OUT	SERIAL_3	Serial_3 of QCA7000 / QCA7005
25	IN/OUT	SERIAL_2	Serial_2 of QCA7000 / QCA7005
26	IN/OUT	SERIAL_1	Serial_1 of QCA7000 / QCA7005
27	IN/OUT	SERIAL_0	Serial_0 of QCA7000 / QCA7005
28	SUPPLY	GND	Ground connection

9.1 GPIO

9.1.1 Power-on Configuration

The QCA7000 / QCA7005 comprises four GPIO pins which are read at boot time to get the desired configuration. Table 7 shows the configuration of the QCA7000 / QCA7005 at boot time.

GPIO #	Function	Pull Up	Pull Down	Preload on Module
0	Boot Source	Flash	Host	-
1	Host Interface	-	SPI Slave	10 kOhm Pull Down
2	SPI Slave Mode	Burst	Legacy	-
3	None	-	-	-

Table 7: QCA7000 / QCA7005 Boot Strap Options

9.1.2 GPIO Functions

The GPIOs of the QCA7000 / QCA7005 have different functions after booting. They can either be used as input or output to display various states or trigger some actions. It is not possible to use these pins from your own application - only the QCA7000 / QCA7005 firmware can control these GPIOs.

The GPIOs are set up as specified in Table 9.

GPIO #	Direction	Function
0	Output	Pushbutton Simple Connect (toggling with 1Hz: simple connect mode active, off: not in simple connect mode)
1	Output	unused in default configuration
2	Output	PLC connection (high=connection established, low=no connection)
3	Input (low active)	start Pushbutton Simple Connect

Table 9: QCA7000 / QCA7005 GPIO Settings

9.2 Serial Signals

The signals SERIAL_0 to SERIAL_4 represent SPI or UART signals. Table 11 contains the UART and SPI function for each signal.

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 11: QCA7000 / QCA7005 UART/SPI Signals

Please note that the selection between SPI and UART mode is effected via different QCA7000 / QCA7005 firmware and is therefore an order option.

9.2.1 UART

The UART supports baud rates of up to 115,200 baud and comprises four signal pins: TXD, RXD, RTS and CTS.

9.2.2 SPI

The QCA7000 / QCA7005 uses SPI in mode 3: CPOL=1, CPHA=1.

SPI should be used in burst mode, meaning that the Chip Select signal is kept low during a complete SPI message. The SPI CLK period should not be less than 83.3 ns resulting in a maximum clock frequency of 12 MHz.

9.3 Recommended Footprint

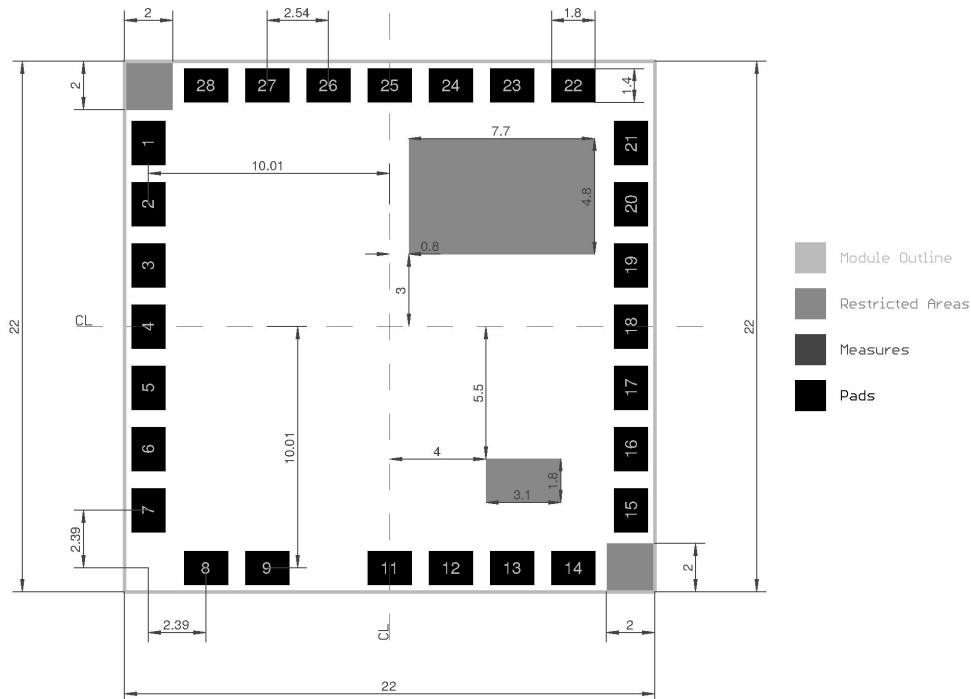


Figure 3: PLC Stamp micro 2 Footprint

Notes:

1. All dimensions are in mm.
2. Pads are all of the same size.
3. Distances between pads are equal if not otherwise specified in the drawing.
4. The drawing in Figure 3 shows the top view on the footprint (as if you look through the module).
5. Restricted areas should be kept free of copper on the base PCB.
6. The module outline shows the ideal measures - tolerance is not included.

10 Getting Started

You will have to make some choices for the use of the PLC Stamp micro 2 before you start developing the hardware. Which serial interface do you want to use: UART is much easier to use, but less robust and slower (maximum baud rate). SPI is more robust due to its synchronous nature, which, however, makes it harder to use. SPI can be used for a faster transfer of data to the QCA7000 / QCA7005 (maximum serial clock frequency). In general, the use of SPI is the best choice, which is why it is used in the default order variant.

To which medium do you want to couple the HomePlug GreenPHY signal? Depending on your choice, there might be different insulation and transient protection requirements. The signal can be coupled to a clean transmission line for which there are no heavy insulation requirements and no transients to be suppressed. On the other side,

there may be a CAT IV / 3 Phase / 230 V for communication. The latter medium requires more thought regarding insulation and transient protection.

Are there any sources of noise or capacitive sinks in your transmission line? Both can have an impact on the signal quality. Sources of noise in the region of 2 and 30 MHz should be avoided. Power supplies or equipment like solar inverters might have capacitors between L and N, which will effectively lead to a short circuit in the PLC frequencies. A possible implementation of the coupling circuit is shown in Figure 4 for coupling to mains and in Figure 5 for automotive applications. These schematics are both freely based on the QCA7000 / QCA7005 Add-In reference schematic by Qualcomm Atheros.

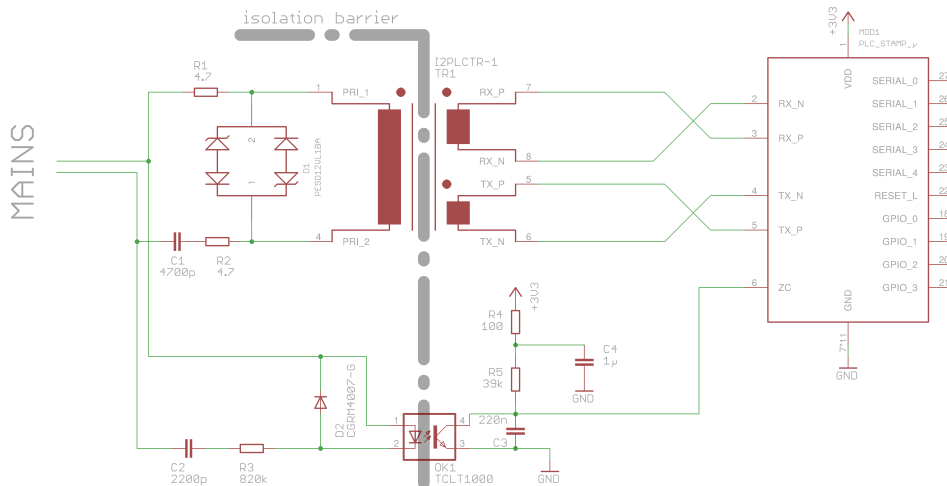


Figure 4: Reference Schematic for PLC Coupling to Mains

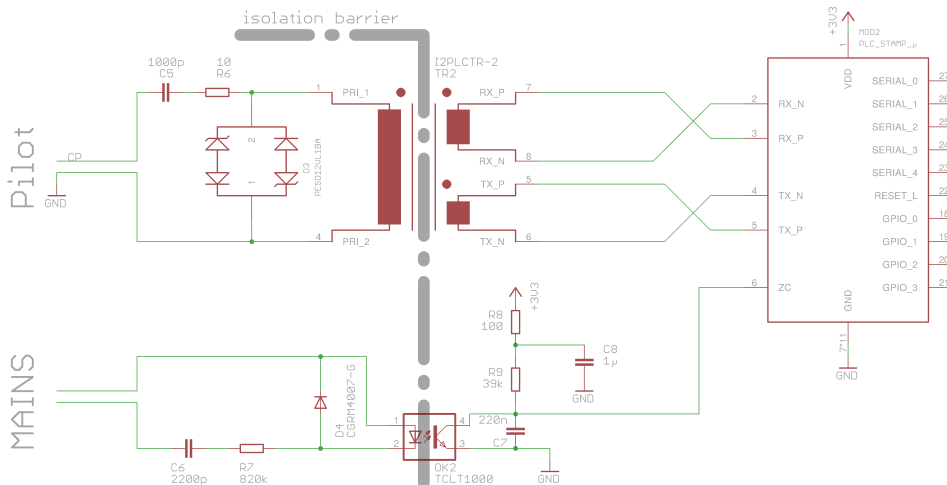


Figure 5: Reference Schematic for PLC Coupling to the Pilot Signal

Capacitors C1, C2, C5, C6 need to be selected according to your environment. They are presented with almost full voltage from your communication lines. If connected to mains, X1 types need to be used. Please also remember to take all other product safety related topics into consideration.

When using a dead wire connection, you can use the circuit in Figure 5. If you are not sure if the signals will couple to other lines where PLC communication is used, you should connect the zero cross detector in the lower part of the schematic to your mains port.

I2SE provides you with all non-standard parts you will need to implement this design into your own application. Section „Available Accessories” contains further references to these parts.

An easy way to put PLC Stamp micro 2 into operation is to use it with the evaluation kit offered by I2SE. Please contact your distributor for further information.

11 Module Marking

Each Module is marked with a label containing the following data:

1. Order Code
2. QCA7000 / QCA7005 MAC Address (printed with a separating colon every two digits, the DataMatrix code contains the digits without separator)
3. Serial Number
4. Production Date Code: WWYY
5. Device Security Key
6. 2D DataMatrix code containing the above information as a list of space separated values

Additionally each label contains:

1. I2SE Banner
2. Pin 1 Marking

An example is shown in Figure 6.

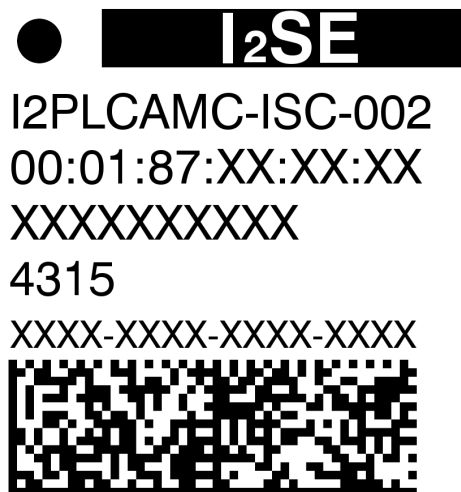


Figure 6: Example Label for PLC Stamp micro 2

12 Order Information

The following table provides an overview of the available PLC Stamp micro 2 variants.

Order code	Chip	Temperature Range / °C	Serial Interface	Parameter Optimization	Availability
I2PLC AMC-ISC-002	QCA7000	-40 - 85	SPI	CE Class B	standard
I2PLC AMC-ISN-002	QCA7000	-40 - 85	SPI	North America	on request
I2PLC AMC-ISE-002	QCA7000	-40 - 85	SPI	Automotive EVSE	on request
I2PLC AMC-ISP-002	QCA7000	-40 - 85	SPI	Automotive PEV	on request
I2PLC AMC-IUC-002	QCA7000	-40 - 85	UART	CE Class B	on request
I2PLC AMC-IUN-002	QCA7000	-40 - 85	UART	North America	on request
I2PLC AMC-IUE-002	QCA7000	-40 - 85	UART	Automotive EVSE	on request
I2PLC AMC-IUP-002	QCA7000	-40 - 85	UART	Automotive PEV	on request
I2PLC AMC-CSC-002	QCA7000	0 - 70	SPI	CE Class B	on request
I2PLC AMC-CSN-002	QCA7000	0 - 70	SPI	North America	on request
I2PLC AMC-CSE-002	QCA7000	0 - 70	SPI	Automotive EVSE	on request
I2PLC AMC-CSP-002	QCA7000	0 - 70	SPI	Automotive PEV	on request
I2PLC AMC-CUC-002	QCA7000	0 - 70	UART	CE Class B	on request
I2PLC AMC-CUN-002	QCA7000	0 - 70	UART	North America	on request
I2PLC AMC-CUE-002	QCA7000	0 - 70	UART	Automotive EVSE	on request
I2PLC AMC-CUP-002	QCA7000	0 - 70	UART	Automotive PEV	on request
I2PLC BMC-ISC-002	QCA7005	-40 - 85	SPI	CE Class B	on request
I2PLC BMC-ISN-002	QCA7005	-40 - 85	SPI	North America	on request
I2PLC BMC-ISE-002	QCA7005	-40 - 85	SPI	Automotive EVSE	on request
I2PLC BMC-ISP-002	QCA7005	-40 - 85	SPI	Automotive PEV	on request
I2PLC BMC-IUC-002	QCA7005	-40 - 85	UART	CE Class B	on request
I2PLC BMC-IUN-002	QCA7005	-40 - 85	UART	North America	on request
I2PLC BMC-IUE-002	QCA7005	-40 - 85	UART	Automotive EVSE	on request
I2PLC BMC-IUP-002	QCA7005	-40 - 85	UART	Automotive PEV	on request

Table 13: PLC Stamp micro 2 Order Codes

Product Family Code	Chip		Temperature Range	Serial Interface	Parameter Optimization	Version
I2PLC	A: QCA7000	MC-	I: Industrial (-40 - 85 °C)	S: SPI	C: CE Class B	-002
	B: QCA7005		C: Commercial temperature range (0 - 70 °C) - only for QCA7000	U: UART	N: north america	
					E: Automotive EVSE	
					P: Automotive PEV	

Table 15: PLC Stamp micro 2 Order Code Compilation

12.1 Available Accessories

I2SE provides you with tested powerline transformers, which are part of the reference designs. Please refer to further documentation for a full specification of these transformers.

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

13 Contact

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

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