UM11152

NXQ1TXH5DB1355 plugin board

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Document information

Information	Content
Keywords	NXQ1TXH5DB1355, NXQ1TXH5DB1401, NXQ1TXH5, plugin board, LPC824
Abstract	This manual describes how to use the NXQ1TXH5DB1355 board in combination with a NXQ1TXH5 design. The document describes how to connect the NXQ1TXH5DB1355 board to a PC and the NXQ1TXH5. This enables engineers to verify operation of the NXQ1TXH5 in a customer specific design. This eases the design of a wireless power transmitter using the NXQ1TXH5.

Revision history

Rev	Date	Description
v.1	20181206	first issue

1 Introduction

This document describes how to use the NXQ1TXH5DB1355 plugin board.

The NXQ1TXH5DB1355 board can be used in combination with the NXQ1TXH5DB1401 demo board or with a customer-specific design. The NXQ1TXH5DB1355 plugin board contains a microcontroller, the LPC824M201JDH20. This microcontroller interfaces between the I^2C from the NXQ1TXH5 and the UART.

The NXQ1TXH5DB1355 can be used for the following tasks:

- Read out Qi operating phase (ping, power transfer, foreign object detected, fault state)
- Verifying parameter setup via configuration resistors
- Read out chip temperature, switching frequency
- Foreign power calibration

This information helps designers with the verification and testing of their NXQ1TXH5 application.

2 NXQ1TXH5DB1355 board connections

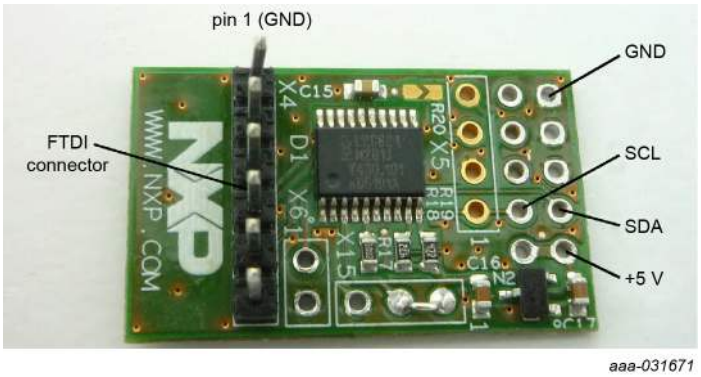

Figure 1. NXQ1TXH5DB1355 board connections

The NXQ1TXH5DB1355 board as shown in Figure 1 can be used in combination with the TTL-232R- 3V3 cable from FTDI.

Table 1 shows the pinout of the connector on the FTDI cable. The NXQ1TXH5DB1355 board only uses GND, TXD, and RXD. The FTDI cable connects to header X4 of the NXQ1TXH5DB1355 board.

Table 1. Pinout connector FTDI cable

Pin number	Name	Color	Description
1	GND	black	device ground supply pin
2	CTS#	brown	clear to send control input/handshake signal
3	VCC	red	+5 V output
4	TXD	orange	transmit asynchronous data output
5	RXD	yellow	receive asynchronous data input
6	RTS#	green	receive to send control output/handshake signal

The NXQ1TXH5DB1355 is connected to the I^2C interface of the NXQ1TXH5. The pull-up resistors for the SDA and SCL lines are already on the NXQ1TXH5DB1355 board. Connect the SDA, SCL, and GND pins of header X3 to the design with the NXQ1TXH5.

To power the components on the NXQ1TXH5DB1355 board, connect a 5 V supply to pin 9 and its GND connection. This supply can be obtained from a separate lab supply or from the NXQ1TXH5 application.

Table 2. Header X3 point

Pin number	Name	Description
1	GND	device ground supply pin
2	DATA_S	not used
3	GND	device ground supply pin
4	WS	not used
5	GND	device ground supply pin
6	BCK	not used
7	SDA	serial data
8	SCL	serial clock
9	+5V	device 5 V supply pin
10	+5V	device 5 V supply pin

3 Logging with the NXQ1TXH5DB1355 board

The UART output of the NXQ1TXH5DB1355 board can be viewed in a terminal program like Putty or Teraterm. This chapter describes how to install and set up these tools.

3.1 Installation

- Download and install the FTDI driver from http://www.ftdichip.com/Drivers/VCP.htm
- Install Teraterm from http://ttssh2.osdn.jp

Figure 2. NXQ1TXH5DB1355 board connected to NXQ1TXH5DB1401 board

- Connect the NXQ1TXH5DB1355 board to the NXQ1TXH5DB1401 board as indicated in Figure 2.
- Start Teraterm and select the right COM port
- Go to Setup > Serial port and set the values as indicated in Figure 3.

Figure 3. Serial port settings in terminal program

- Supply power to the NXQ1TXH5DB1401 board and you see the message as indicated in Figure 4.

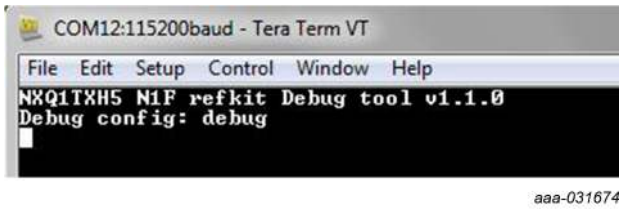

Figure 4. Message after power-up

- Place a receiver on the charging pad.
- Click in the black terminal screen and type “version” followed by pressing the Enter key. The word “version” is not displayed on the screen when local echo is off.

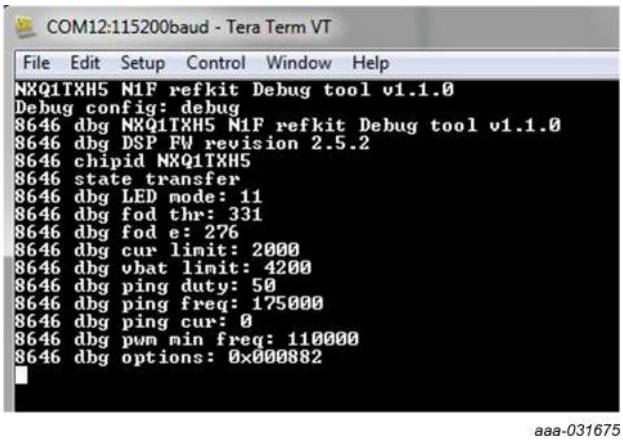

Figure 5. Message after typing “version” (see Section 4.1 for an explanation)

- Click in the black screen and type "log" followed by clicking Enter. The word "log" is not displayed on the screen when local echo is off.

You see messages scrolling by as indicated in Figure 6.

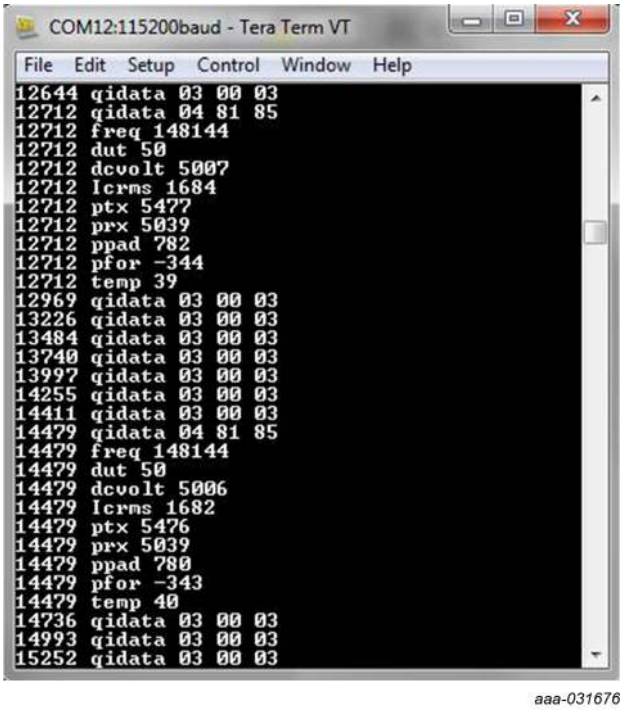

Figure 6. Messages scrolling over the screen during charging (see Section 4.2 for an explanation)

4 Commands and messages

This chapter explains the two commands that can be sent from a terminal to the NXQ1TXH5DB1355 board and the response to those two commands.

4.1 Version

The values that are shown after typing "version" can be used to verify if the correct parameters are set with the configuration resistors.

- **LED mode**
  Indicates the LED mode that is selected with the resistor that is connected to the CNF4 pin.
- **fod thr**
  Indicates the threshold level for the foreign object power (FOD_T in mW) that is selected with the resistor to the CNF3 pin.
- **fod e**
  Indicates the value of the equivalent loss resistance (FOD_E in mOhm) that is set with the resistor to the CNF2 pin.
- **cur limit**
  Indicates the current limit (mA) that is set with the resistor to the CNF1 pin.
- **vbat limit**
  Indicates the voltage (mV) where the Smart Power Limiting (SPL) becomes active.
- **ping duty**
  Duty cycle during the ping.
- **ping freq**
  Frequency during the ping.
- **pwm min freq**
  Minimum operating frequency of the NXQ1TXH5.

Figure 7 shows the connection of the configuration resistors. For more information on this topic, see the application note "NXQ1TXH5/101 one-chip 5 V Qi wireless transmitter" (Ref. 1), which is available from the NXP website.

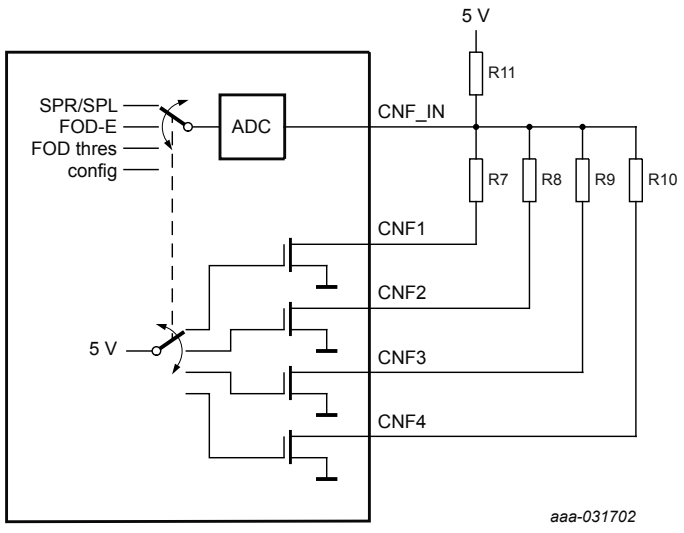

Figure 7. NXQ1TXH5 configuration

4.2 log

The log command is used to toggle the logging on and off. When the logging is on, the NXQ1TXH5DB1355 board sends the commands which are explained below to the terminal.

The number at the beginning of each line is the timestamp. It is the time (in msec) that has passed since the receiver was placed on the charger. The keywords after timestamp can be:

- **freq**
  Operating frequency (Hz) of the charger.
- **dut**
  Duty cycle (%) of the full bridge in; generally, it is at 50 %.
- **dcvolt**
  Supply voltage (mV) of the NXQ1TXH5.
- **Icrms**
  RMS current (mA) through the coil. The calculation of this current is based on the voltage that is measured on pin VSEN.
- **ptx**
  Input power (mW) of the full bridge. It excludes the dissipation in LEDs.
- **prx**
  Received power (mW) that the receiver reports. This power is not the power received in the load, but the power received in the magnetic field.
- **ppad**
  Calculated loss in the charger (mW). ppad = FOD_E * $Icrms^2$ / 1000. When the value of FOD_E is not correct, the calculated loss is wrong.
- **pfor**
  Calculated foreign power (mW). pfor = ptx − ppad − prx.
- **temp**
  Temperature (°C) of the NXQ1TXH5 chip.
- **qidata: <headerid> <data> <checksum>**
  – <headerid> specified in the Qi specification
  – <data> payload, length is dependent on headerid.
  – <checksum>, the exor function of the headerid and all data bytes

Two important qidata messages are described below:

- qidata **03** 00 03 control error packet (CEP) message
  The first byte indicates the message ID, in this case the CEP message. The second byte shows the content of the message. It is a two's complement signed integer that ranges from −128 to +127.
  – Values > 0 indicate that the receiver wants to receive (much) more power.
  – Values < 0 indicate that the receiver wants to receive (much) less power.
  During most of the time the receiver receives the correct amount of power, so the CEP message is "03 00 03".
- qidata **04** 81 85 received power packet (RPP) message
  The first byte indicates the message, in this case the RPP message. The second byte shows the content of the message. It is an unsigned integer that ranges between 0 and 256. The received power can be calculated with Equation 1:

$$prx = \left(\frac{Received\ \ value}{128}\right) \times \left(\frac{Maximum\ \ power\ \ value}{2}\right) \times 10^{Power\ \ Class} \quad W \tag{1}$$

When the receiver is placed on the charger, it sends the values for the "maximum power value" and "power class" to the charger in the configuration packet (0x51).

In practice, "Power Class" is 0 and the "Maximum power value" is 10 so the RPP value must be multiplied with 39.06 mW to get the value for prx.

The third byte indicates a checksum: it is the ExOr of the first 2 bytes.

If a Qi 1.0 receiver is placed on the charger, then there is no power reported by the receiver but the charger assumes prx = 5 W for the FOD calculation.

The logging also gives information about the state in which the charger is:

- State transfer: The charger is charging
- State fod: The charger is in protection because the fod is triggered
- State fatal: The charger is in protection because the receiver has sent a Qi error message e.g. "internal fault", "battery fault", etc.
- State overtemp: The charger is in protection because the internal or external overtemperature protection from the charger has been triggered.

5 Schematic

Figure 8 shows the schematic of the NXQ1TXH5DB1355 board. It contains an LDO to create the 3.3 V supply voltage for the LPC824 microcontroller and the pull-up resistor of the I^2C connection.

Header X4 exposes a UART connection to the FTDI cable to connect to the PC.

Header X5 and header X3 contain the I^2C signals to connect to the wireless power transmitter with the NXQ1TXH5.

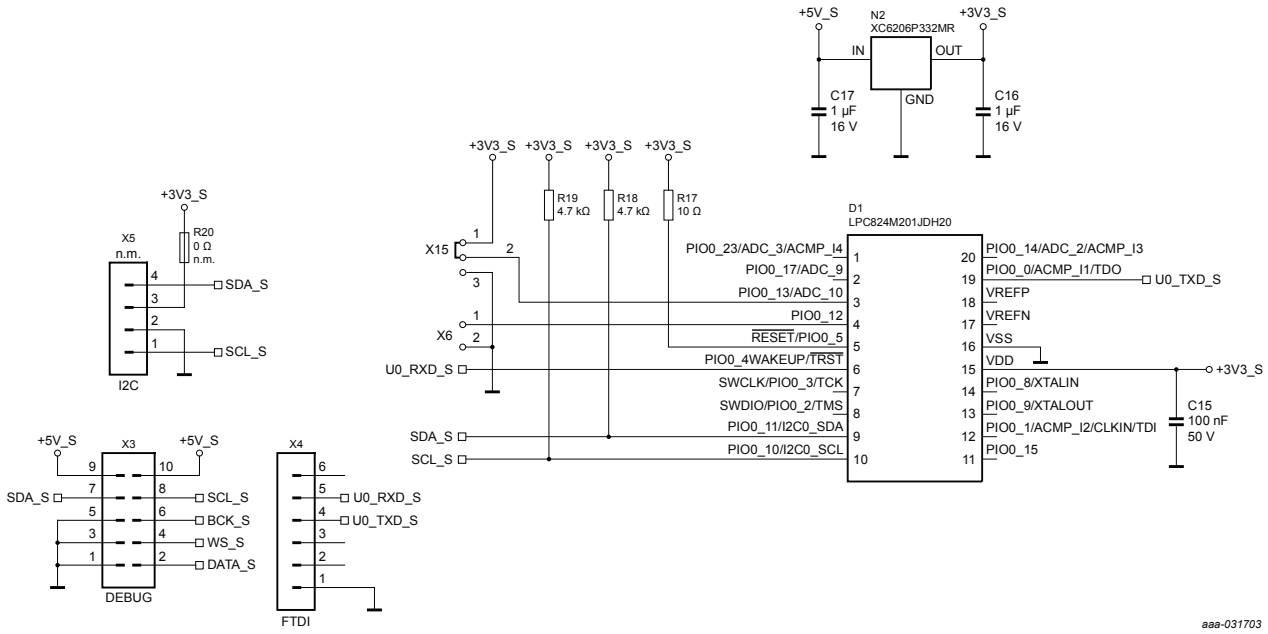

Figure 8. Schematic NXQ1TXH5DB1355 board

6 References

[1] **AN11775 application note** — NXQ1TXH5/101 one-chip 5 V Qi wireless transmitter; 2016, NXP Semiconductors

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