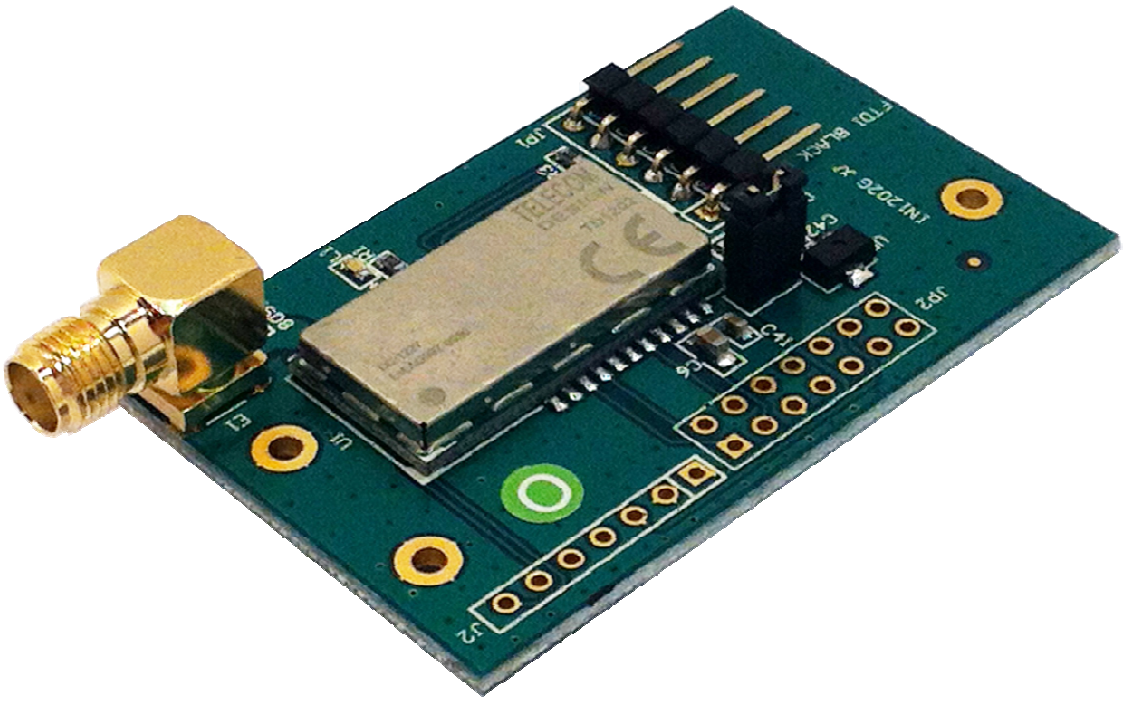
CLOUD-ON-CHIP EVALUATION BOARD USER'S GUIDE



1 Overview

Thank you for choosing the Cloud-On-Chip evaluation board from Telecom Design!

This document provides a User's Guide for the Telecom Design Cloud-On-Chip evaluation board (EVB).

As an overview, this chapter gives the scope of this document and lists the board's features.

The document's organization is then detailed.

1.1 Scope

The Cloud-On-Chip Evaluation Board provides a development and demonstration platform for Telecom Design Cloud-On-Chip SIGFOX™ gateway modules and software tools.

This guide focuses on the Cloud-On-Chip evaluation board as a development platform for the Cloud-On-Chip SIGFOX™ Gateway Module.

1.2 Features

The Cloud-On-Chip evaluation board provides a rich development platform for the Telecom Design Cloud-On-Chip SIGFOX™ Gateway module.

The board's main features are:

- Cloud-On-Chip SIGFOX™ Gateway module in LGA25 package
  - SIGFOX™ certified
  - Frequency range = ISM 868 MHz
  - Receive sensitivity =-126 dBm
  - Modulation
    - (G)FSK, 4(G)FSK, GMSK
    - OOK
  - Max output power
    - +14 dBm
  - Low active radio power consumption
    - 13/16 mA RX
    - 37 mA TX @ +10 dBm
  - Power supply = 2.3 to 3.3 V
  - LGA25 (25.4×12.7×3.81mm) Land Grid Array package
  - Up to 13 GPIOs pins
  - I^2C bus interface
  - 1×LVTTL Low Power UART
  - 2×Timer input capture or output compare pins
  - 2×ADC input pins
  - 1×DAC output pin

- 1×Standard ARM™ SWD debug interface
- Low-DropOut (LDO) 3.3V voltage regulator
- 6-pin R/A header for connecting a standard TTL-232R-3V3 FTDI USB to Serial Cable (3.3V)-1.8m
- 1×7 pin header (not mounted) for ISP (In-Situ Programming) connection
- 2×7 pin header (not mounted) for Cloud-On-Chip signal breakout
- 1×SMA R/A antenna connector with ESD protection device
- 1×Super Blue SMT LED on Cloud-On-Chip module TIM2 pin
- 1×removable current measurement strap

1.3 Organization

Each section in this document covers a separate topic, organized as follow:

- Section 1 is an overview of the board usage and features
- Section 2 provides a guide for quickly setting up the board
- Section 3 gives a hardware description of the Cloud-On-Chip EVB evaluation board
- Section 4 contains the Telecom Design Cloud-On-Chip EVB evaluation board schematic
- Section 5 is a detailed explanation of the power supply

1.4 Relevant Documents

This document provides a hardware overview for the Cloud-On-Chip Evaluation Board (EVB) system. Additional information on the Cloud-On-Chip SIGFOX™ gateway module can be found in the following documents available on the Telecom Design Web site developer's area (http://developers.insgroup.fr/):

- TD1202 Datasheet
- Cloud-On-Chip Reference Manual

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Section **Page**

2 Setting Up the Cloud-On-Chip EVB

This section helps you set up the Cloud-On-Chip EVB evaluation board for the first time.

Please consider first the electrostatic warning to avoid damaging the board, then discover the hardware and software required to operate the board.

The procedure to power up the board is given, and a description of the default board behavior is detailed.

2.1 Electrostatic Warning

The Cloud-On-Chip EVB evaluation board is shipped in a protective anti-static package.

Although the antenna connector is equipped with a proper ESD protection device and that the onboard components offer protection against ESD hazards, the board should not be exposed to high electrostatic potentials. A grounding strap or similar protective device should be worn when handling the board. Avoid touching the component pins or any other metallic element.

2.2 Packing List

The Cloud-On-Chip EVB is delivered in a box containing:

- A TTL-232R-3V3 FTDI USB to TTL Serial Cable (3.3V)-1.8m
- The Cloud-On-Chip EVB Evaluation Board itself
- A 20 cm 868 MHz-Band Swivel Antenna

Figure 1- Packing List

2.3 Requirements

In order to set up the Cloud-On-Chip EVB evaluation board, the following items are required:

- A PC running Windows XP, Windows Server 2003, Windows Vista, Windows Server 2008, Windows 7 or Windows Server 2008 R2 operating system (this is only required for being able to flash the device using the provided utility program, for a simple connection to the module, any operating system for which FTDI devices are supported should work)
- A Web browser running on the PC with access to the Internet
- A serial terminal emulation program running on the PC, such as:
  - HyperTerminal (included in Windows 9x/2000/XP)
  - PuTTY (http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html)

- RealTerm (http://realterm.sourceforge.net/)

- The FTDI Virtual COM Port Driver (VCD) which is appropriate for your machine (http://www.ftdichip.com/Drivers/VCP.htm)
- The Telecom-Design "**CoCLoader.exe**" utility program in order to reflash the Cloud-On-Chip module firmware

2.4 Powering Up the Board

The Cloud-On-Chip EVB evaluation board is self-powered by the USB port, by using an external 5 V power supply attached to the corresponding pins on the FTDI onboard header, or by opening the current consumption measurement strap and applying a 2.3 V to 3.3 V power supply unit attached to the correct pins on either the ISP or breakout header (see schematic for details).

The board has no power switch; just plug/unplug the power/USB cable to/from the board to cycle power.

2.5 Getting Started

The Cloud-On-Chip SIGFOX™ Gateway module on the Cloud-On-Chip EVB evaluation board is pre-installed with a firmware allowing an easy set up.

This firmware contains a Hayes-compatible "AT" command interpreter that also understand the SIGFOX™ compatible commands, making it easy to type in control commands and getting the corresponding answers using a simple serial terminal emulator.

In order to verify that the device is functional, please:

- Connect the SMA swivel antenna to the Cloud-On-Chip onboard SMA socket and rotate the antenna so that it stands up, perpendicular to the Cloud-On-Chip EVB board top surface
- Make sure that the current measurement strap is placed across the 2-pin header on the Cloud-On-Chip EVB board
- Connect the FTDI cable 0.1" Female Molex connector into the onboard R/A 6-pin header, so that the FTDI black wire is aligned with the label on the Cloud-On-Chip EVB board

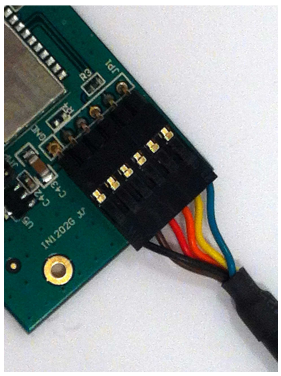

Figure 2- FTDI Cable Connection

- Connect the FTDI cable USB A plug into an available USB host port on the PC

The onboard "Super Blue" should flash briefly upon connection, indicating a Power-On Reset (POR) condition. If this is not the case, please try to unplug/replug the USB cable after controlling the connections described above.

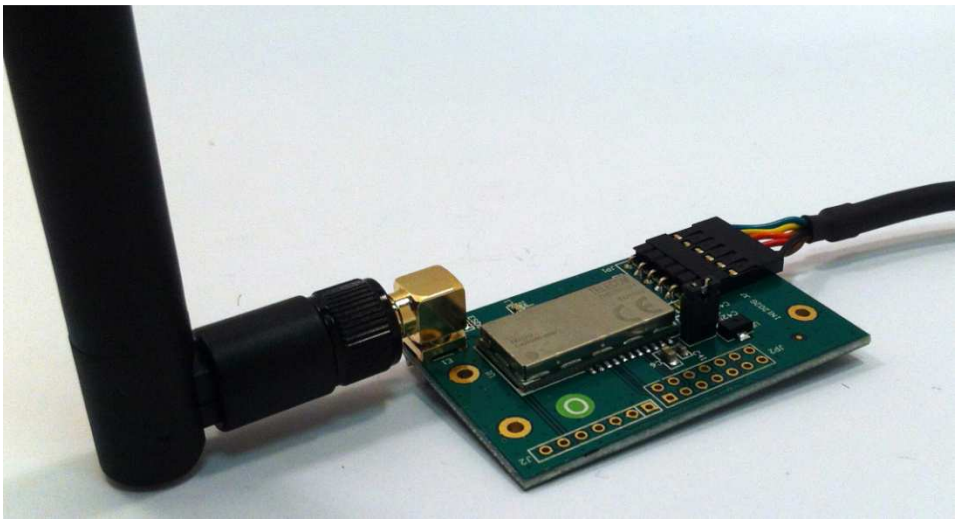

Figure 3- Getting Started

As the serial terminal emulation software will require the (virtual) port corresponding to the newly attached device, the best way to get it is to use Window's "**Device Manager**" from the Control Panel, by clicking on the "**System**" icon and selecting the "**Hardware**" tab and pressing the "**Device Manager…**" button. Please locate and unfold the "**Ports (COM & LPT)**" entry into the device tree list: you should see an "**USB Serial Port (COM*x*)**" entry corresponding to the newly attached Cloud-On-Chip EVB device. If unsure, you can safely unplug/replug the USB cable to observe the changes into the "**Device Manager**" window. Please write down this "**COM*x***" information, so you can provide it later to the serial terminal emulation software.

You can then close Windows's "**Device Manager**" window and launch your selected serial terminal emulation software, with the following serial parameters:

- Port as obtained from Window's "Device manager"
- LVTTL electrical level
- 9600 bps
- 8 data bits
- No parity
- 1 stop bit
- No hardware/software flow control

You should then be able to type in the following command (note: there may be no character echo by default):

```
AT&V<CR>
```

Where ***"<CR>"*** represent a press on the "Carriage Return" key.

You should get a result similar to:

```
Telecom Design TD1202
Hardware Version: 0F
```

```
Software Version: SOFTxxxx
S/N: yyyyyyyy
ACTIVE PROFILE
E0 V1 Q1 X1 S300:24 S301:2 S302:14 S303:1
```

2.6 Upgrading the Firmware

Your Cloud-On-Chip module is always evolving and so is our Web portal. To be able to use your TD1202 module please always perform a firmware upgrade using the latest available firmware.

The Cloud-On-Chip SIGFOX™ Gateway modules contain a built-in bootloader able to perform a full firmware upgrade locally while connected to a Windows PC computer over its UART/USB interface.

There is no need to have a full toolchain set up to upgrade at Cloud-On-Chip SIGFOX™ Gateway module, as only the Telecom Design provided "**CoCLoader.exe**" utility is required.

This utility can be obtained from http://developers.insgroup.fr.

Launch the "CoCLoader.exe" utility. This will open a dialog window similar to this:

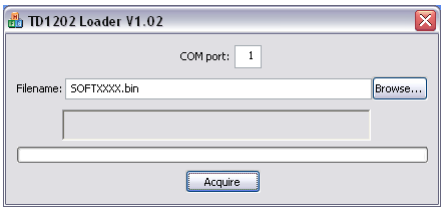

Figure 4- Cloud-On-Chip Loader Dialog

2.6.1 Local Firmware Upgrade

In order to perform a local firmware upgrade, please:

- Make sure the FTDI cable is connected on the PC end
- Provide the COM port number, as obtained from the "**Device Manager**" in section 2.5 "Getting Started" above
- Paste the firmware file absolute file name or browse to it using the "**Browse…**" button
- Press the "**Acquire**" button to start the upgrade process
- If not already connected, please connect the Cloud-On-Chip EVB board to the FTDI USB cable, you should see:

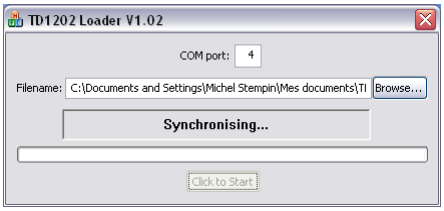

Figure 5- TD1202 Loader Synchronizing

- If the Loader cannot get synchronized with the Cloud-On-Chip EVB, try to unplug/replug the board on the FTDI cable 0.1" Female Molex connector side and retry. You should then get:

Figure 6- Cloud-On-Chip Loader Upgrading

- During the upgrade process, the Cloud-On-Chip EVB onboard blue LED should turn on, and eventually, it should turn off and you should get:

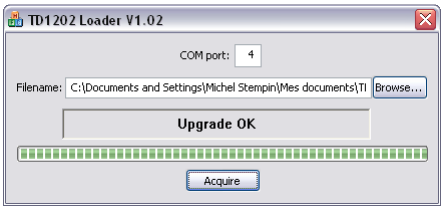

Figure 7- Cloud-On-Chip Loader Finished

2.6.2 Remote Firmware Update

Within a controlled RF manufacturing environment, the Cloud-On-Chip module firmware can also be upgraded remotely by radio.

Please contact Telecom Design to obtain more information on the required procedure.

2.7 Sensor Registration

Beside the basic purpose of controlling that the board is operational, this firmware is able to send RF - Sensor formatted - messages through the SIGFOX™ network, which can be monitored on the Sensor Web portal in real-time. To access this portal please point your Web browser to the address https://developers.insgroup.fr/dashboards/device.html.

To be able to register on this portal and gain access to your module's dashboard, you will first need to register your Cloud-On-Chip module on Sensor.

To do so please turn on temporarily character echo (so you can see what you are actually typing), enable verbose answer display, and make sure your Cloud-On-Chip module is configured as a Transmitter.

```
ATE1<CR>ATQ0<CR>
OK
ATS500=2<CR>
OK
AT&W
OK
ATZ
OK
```

Please wait a few seconds for the module to reboot and then send a Register frame:

```
AT$REG<CR>
OK
```

You should now be able to access the dashboard and actually see your module information by registering using the information supplied on the device sticker.

You can try to send a Raw message:

```
AT$RAW=54 44<CR>
OK
```

You should get a Raw message containing the 2-byte value appearing promptly in your dashboard.

3 Cloud-On-Chip EVB Overview

The Cloud-On-Chip Evaluation Board (EVB) provides access to the different Cloud-On-Chip SIGFOX™ gateway module interfaces, USB connectivity using a standard FTDI LVTTL RS232 ⇔ USB cable, and development flashing/debugging facility using the standard ARM™ SWD debug interface, as well as an integrated regulated power supply.

The Cloud-On-Chip EVB can be powered from USB or from the dedicated power pins on the available headers, with the capability to measure the current consumption of the target Cloud-On-Chip module.

3.1 Layout

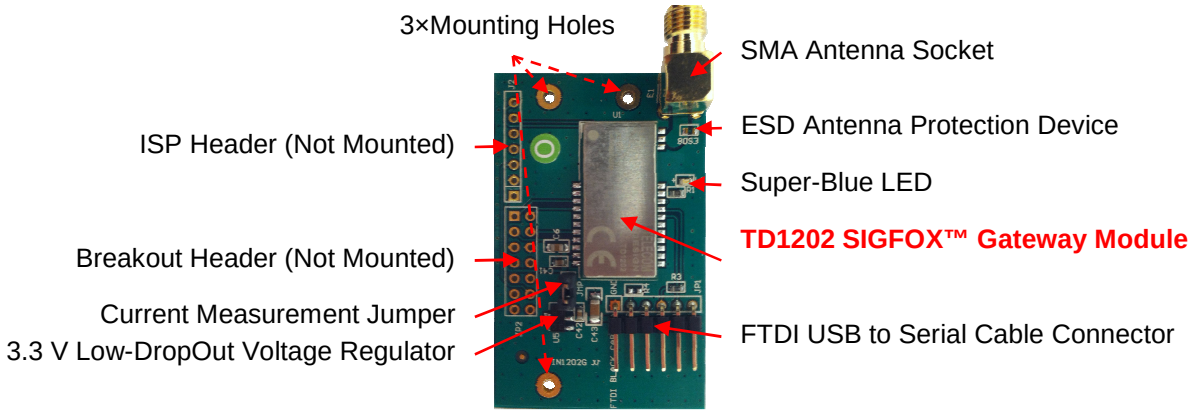

Figure 8- Cloud-On-Chip EVB Top View

3.2 Block Diagram

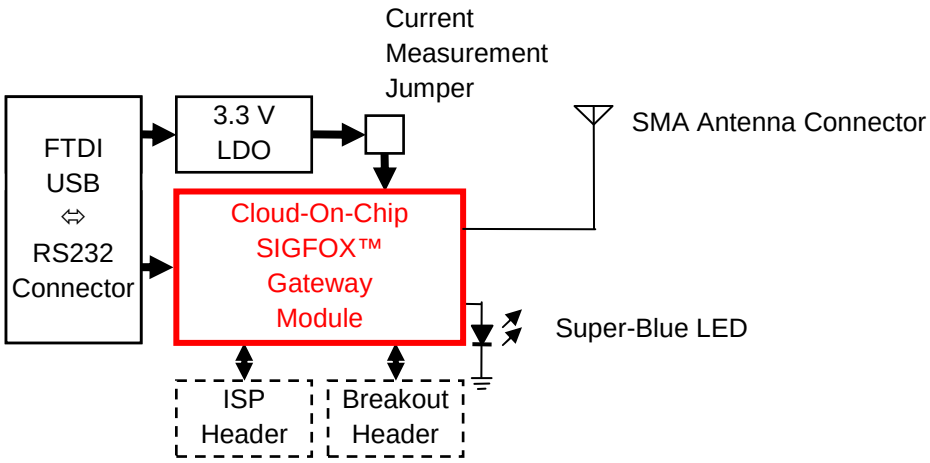

Figure 9- TD1202 EVB Block Diagram

3.3 Hardware Description

3.3.1 FTDI USB to Serial Cable Connector

The Cloud-On-Chip EVB evaluation board is equipped with a 1×6 0.1” pitch R/A header compatible with FTDI’s TTL-232R-3V3 TTL to USB Serial Converter cable. One such cable is included within the Cloud-On-Chip EVB.

The cable datasheet can be found on FTDI’s support website at:

http://www.ftdichip.com/Support/Documents/DataSheets/Cables/DS_TTL-232R_CABLES.pdf

Note: This cable has no orientation key, so there is a chance that it can be plugged in the wrong way. The cable crimps Cloud-On-Chip be visible on the upper side of the black Molex connector, see Figure 2- FTDI Cable Connection.

The Cloud-On-Chip EVB board is protected against accidental cable reverse connections by series current-limiting resistors on RXD and CTS signals.

3.3.2 3.3 V Low Drop Out Voltage Regulator

The Cloud-On-Chip EVB board contains a 3.3 V low drop out voltage regulator with proper decoupling for delivering power supply to the TD1202 module.

This voltage regulator is sufficient for powering the Cloud-On-Chip module itself, but it is not suitable for powering other high power loads that may be connected to it.

3.3.3 Current Measurement Jumper

A convenient jumper (labeled "**JMP**") is present on the Cloud-On-Chip EVB board that enables current measurement by replacing it with a micro-ammeter.

This jumper can also be used to isolate the Cloud-On-Chip module from the output of the 3.3V LDO voltage regulator, thus allowing the module to be power by a separate 2.3 V to 3.3 V external power supply connected to either the ISP or breakout headers.

3.3.4 Cloud-On-Chip SIGFOX™ Gateway Module

Telecom Design's Cloud-On-Chip devices are high performance, low current SIGFOX™ gateways. The combination of a powerful radio transceiver and a state-of-the-art ARM Cortex M3 baseband processor achieves extremely high performance while maintaining ultra-low active and standby current consumption.

The Cloud-On-Chip device offers an outstanding RF sensitivity of –126 dBm while providing an exceptional output power of up to +14 dBm with unmatched TX efficiency.

The Cloud-On-Chip device versatility provides the gateway function from a local Narrow Band ISM network to the long-distance Ultra Narrow Band SIGFOX™ network at no additional cost.

The broad range of analog and digital interfaces available in the Cloud-On-Chip module allows any application to interconnect easily to the SIGFOX™ network.

The LVTTL low-energy UART, the I2C bus, the multiple timers with pulse count input/PWM output capabilities, the 2 high-resolution/high-speed ADCs and single DAC, along with the numerous GPIOs can control any kind of external sensors or activators.

Featuring an AES encryption engine and a DMA controller, the powerful 32-bit ARM Cortex-M3 baseband processor can implement highly complex and secure protocols in an efficient environmental and very low consumption way.

To obtain more information regarding the Cloud-On-Chip SIGFOX™ Gateway module, please refer to the "*TD1202 Datasheet*" or to the "*Cloud-On-Chip Reference Manual*" documents.

3.3.5 Super-Blue LED

An SMT Super-Blue LED is connected to the TIM2 pin of the Cloud-On-Chip SIGFOX™ Gateway module through a series current-limiting resistor.

At module reset, this LED is driven by the Cloud-On-Chip module during the bootloader check for approximately 200 ms, to indicate that a firmware update is taking place.

It is strongly recommended that a similar configuration is adopted upon Cloud-On-Chip integration into a custom design, if the firmware upgrade feature is desirable.

Beside its use as a bootloader indicator, this LED can be used for other purposes without any restriction.

3.3.6 SMA Antenna Connector

The Cloud-On-Chip EVB board features a common right-angle SMA socket to easily connect a 50 Ω impedance matched antenna or cable.

An appropriate 50 Ω / 20 cm swivel antenna is provided with the Cloud-On-Chip EVB. Other devices, such as test / measurement equipments can also be connected to this socket using the correct RF cables.

The antenna connector is protected against ESD (Electro-Static Discharge) hazards by a small SMT RF-class ESD protection device placed closed to the socket base with a good discharge evacuation path to ground.

3.3.7 ISP Header

The Cloud-On-Chip EVB evaluation board contains a single-in-line 7×1 0.1" pitch header (not mounted), as a convenient low pin count ISP (In Situ Programming/Debugging) interface, and consisting in:

- 3.3 V power supply and ground
- 2-wire UART RXD/TXD signals
- RESET input signal
- 2-wire ARM® SWD (Single Wire Debug) DB3 (SWDCLK) and DB2 (SWDIO) signals

The connector pinout is given in the following figure and table:

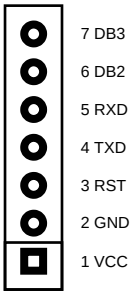

Figure 10- ISP Header Pinout

Table 1- ISP Header Pinout

Pin	Pin Name	I/O	Description
1	VCC	VCC	**+2.3 to +3.3 V Supply Voltage Input** The recommended VCC supply voltage is +3.0V.
2	GND	GND	**Connect to PCB ground**
3	RST	I	**Active Low RESET input signal** This signal resets the TD1202 module to its initial state. If not used, this signal can be left floating, as it is internally pulled up by an integrated resistor.
4	TXD	O	**Low-Power UART Data Transmit Signal** This signal provides the UART data going from the TD1202 module out to the host application processor. This signal is internally pulled up by an integrated resistor.
5	RXD	I	**Low-Power UART Data Receive Signal** This signal provides the UART data coming from the host application processor going to the TD1202 module. This signal is internally pulled up by an integrated resistor.
6	DB2	I/O	**SWDIO (SWD Data I/O) Signal** This signal provides the SWD programming/debugging signal interface to the integrated TD1202 ARM® CPU. This pin may be configured to perform various functions.

7	DB3	I	**SWDCLK (SWD Clock) Signal** This signal provides the SWD clock signal to the integrated TD1202 ARM® CPU. This pin may be configured to perform various functions.

Note: Pin 1 is outlined on the Cloud-On-Chip EVB PCB top silkscreen J2 footprint as a square mark.

3.3.8 Breakout Header

The Cloud-On-Chip EVB board features a 2×7 0.1" pitch header (not mounted) that provides access to all the available Cloud-On-Chip module interface pins, and consisting in:

- 2 × 3.3 V power supply and ground
- 2 × I^2C bus SDA and SCL signals
- 1 × timer input capture / output compare pins
- 1 × RESET input signal
- 1 × ADC analog input signals
- 1 × DAC analog output signal
- 5 × GPIO digital signals
- 1 × Reserved signal

The connector pinout is given in the following figure and table:

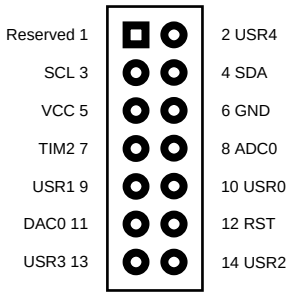

Figure 11- Breakout Header Pinout

Table 2- Breakout Header Pinout

Pin	Pin Name	I/O	Description
1	Reserved	I/O	**Reserved pin – Do not connect**
2	USR4	I/O	**General Purpose Low-Power Digital I/O** This pin may be configured to perform various functions.
3	SCL	I/O	**General Purpose Low-Power Digital I/O** This pin may be configured to perform various functions, including the I^2C clock (SCL) function.
4	SDA	I/O	**General Purpose Low-Power Digital I/O** This pin may be configured to perform various functions, including the I^2C DATA (SDA) function.
5	VCC	PWR	**Connect to 3.3 V power supply line**
6	GND	GND	**Connect to PCB ground**
7	TIM2	I/O	**General Purpose Low-Power Digital I/O** This pin may be configured to perform various functions, including the timer input capture / output compare #2 function.

8	ADC0	I/O	**General Purpose Low-Power Digital I/O** This pin may be configured to perform various functions, including the ADC analog input #0 function.
9	USR1	I/O	**General Purpose Low-Power Digital I/O** This pin may be configured to perform various functions.
10	USR0	I/O	**General Purpose Low-Power Digital I/O** This pin may be configured to perform various functions.
11	DAC0	I/O	**General Purpose Low-Power Digital I/O** This pin may be configured to perform various functions, including the DAC analog output #0 function.
12	RST	I	**Active Low RESET input signal** This signal resets the TD1202 module to its initial state. If not used, this signal can be left floating, as it is internally pulled up by an integrated resistor.
13	USR3	I/O	**General Purpose Low-Power Digital I/O** This pin may be configured to perform various functions.
14	USR2	I/O	**General Purpose Low-Power Digital I/O** This pin may be configured to perform various functions.

4 Cloud-On-Chip EVB Schematics

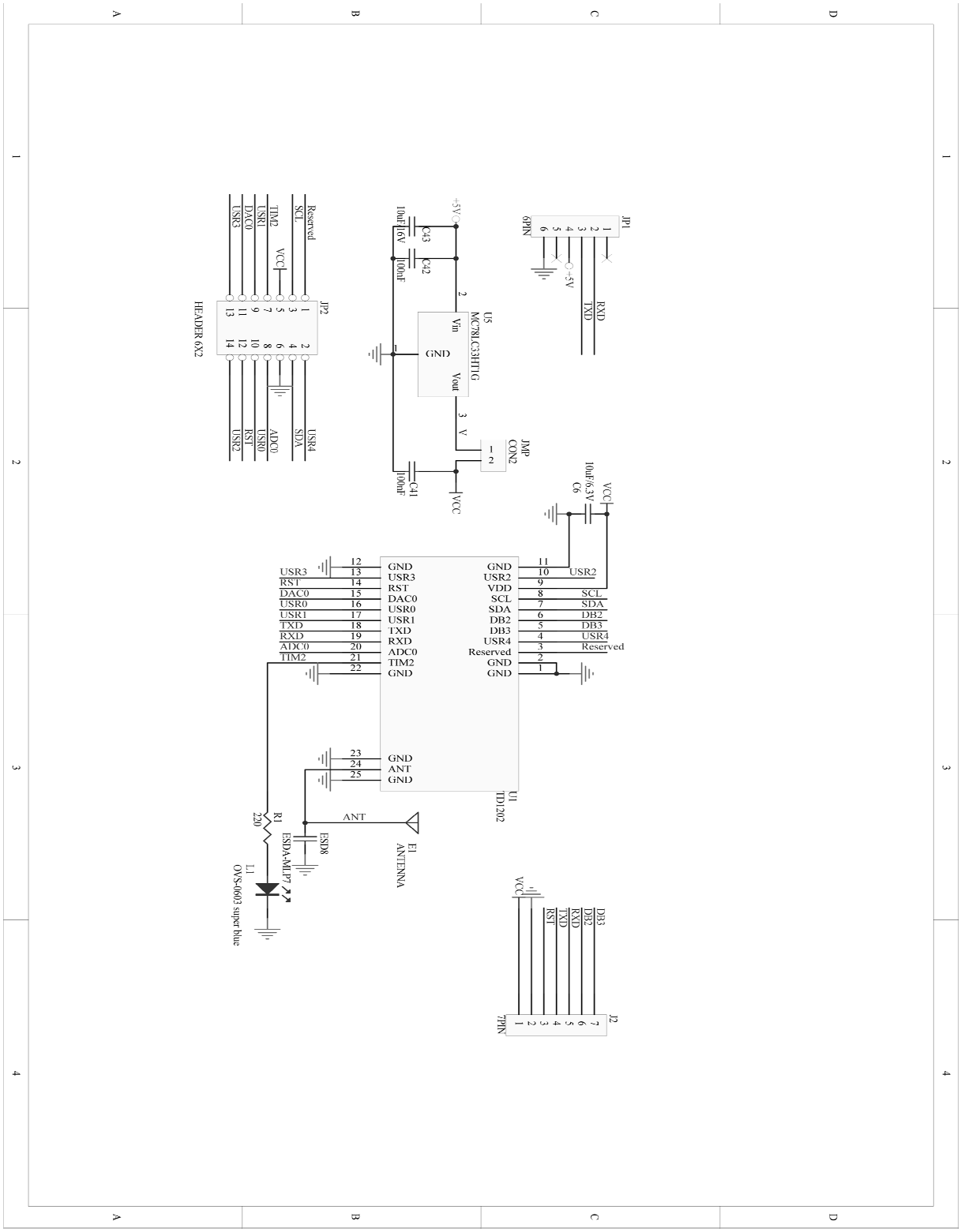

Figure 12- Cloud-On-Chip EVB Schematic

5 Mechanical Drawing

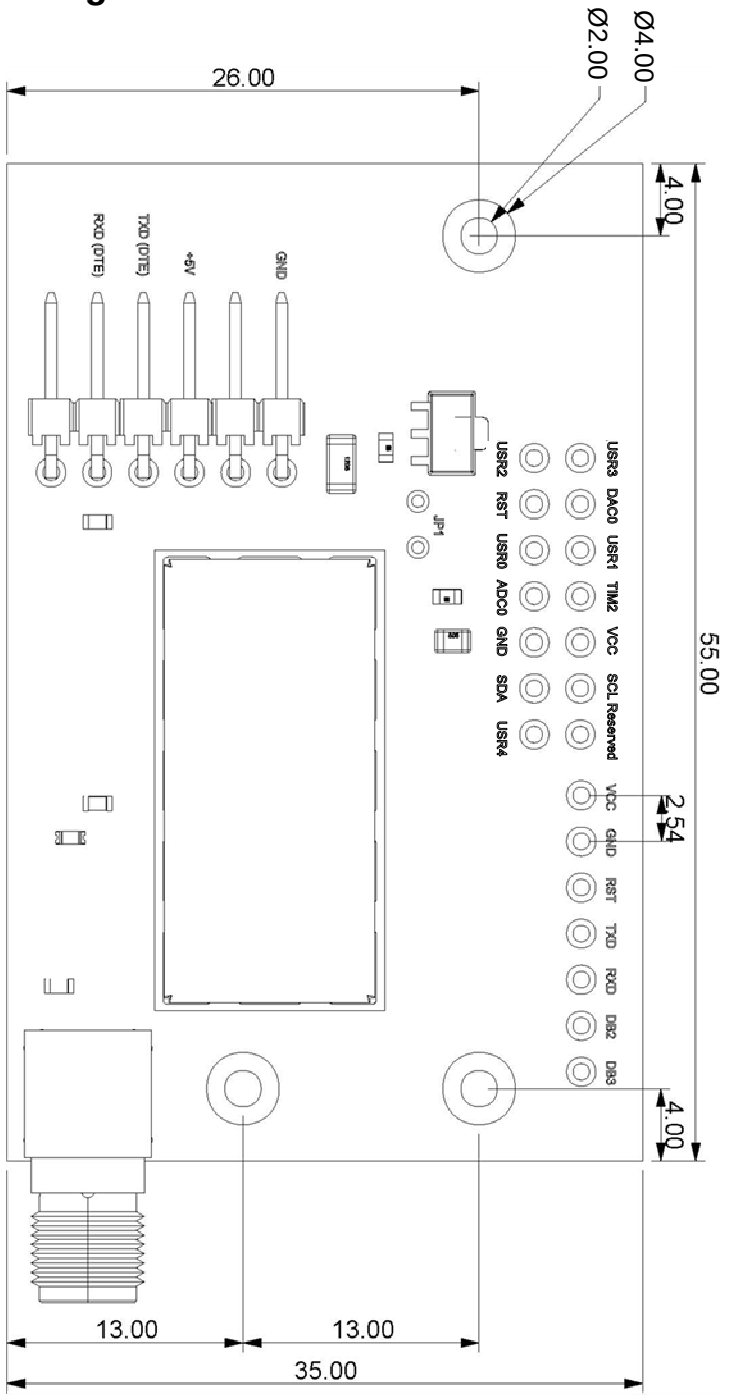

Figure 13- Cloud-On-Chip EVB Mechanical Drawing

Notes:

1. All dimensions are shown in millimeters (mm) unless otherwise noted.

DOCUMENT CHANGE LIST

Revision 1.0

- First Release

NOTES:

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