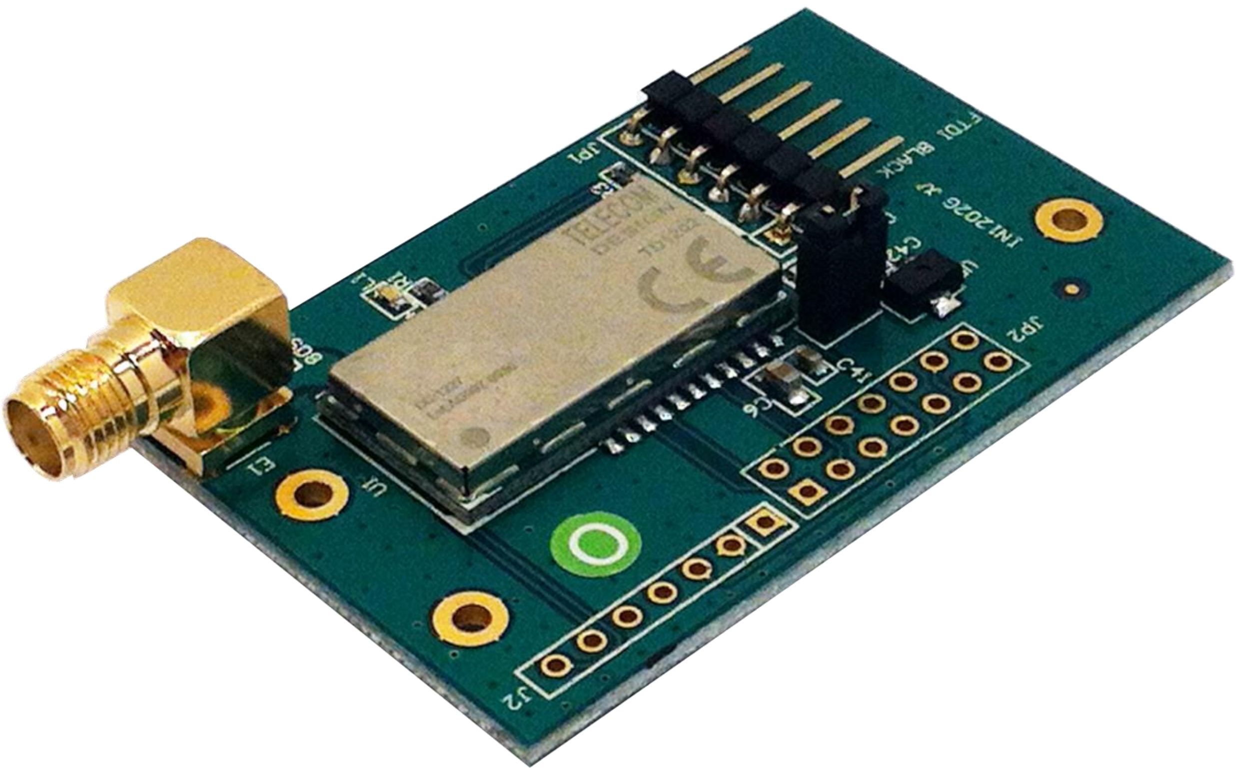
TD12xx/TD15xx/TD16xx EVB

EVB for LGA25 TDnext Modules *Rev 1.1* *User's Guide*

EVALUATION BOARD USER'S GUIDE FOR TDnext LGA25 MODULE



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1 Overview

This document provides a User's Guide for the Telecom Design LGA25 Modules evaluation board (**LGA25 EVB**) dedicated. As an overview, this chapter gives the scope of this document and lists the board's features. The document's organization is then detailed. **This EVB is available for these following modules**:

Table 1. TDnext LGA25 Modules compatible with LGA25 EVB

Part Number	Description
TD1207R	**ISM SIGFOX™ gateway module** 128K Flash/ 16K RAM / TCXO, with fixed AT command set
TD1208R	**ISM SIGFOX™ gateway module** 128K Flash/ 16K RAM / TCXO, with fixed AT command set, user customizable firmware
TD1508	**US ISM SIGFOX™ gateway module** 128K Flash/32KRAM TCXO

1.1 Scope

The LGA25 EVB provides a development and demonstration platform for LGA25 TDnext modules and software tools. This guide focuses on the LGA25 evaluation board as a development platform for the TDnext LGA25 Modules.

1.2 Features

The board's main features are:

- SIGFOX™ Gateway module in LGA25 package (TD1207R / TD1208R)
  - 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 (not available in the current firmware)
  - 1×LVTTL Low Power UART
  - 2×Timer input capture or output compare pins (not available in the current firmware)
  - 2×ADC input pins (not available in the current firmware)
  - 1×DAC output pin (not available in the current firmware)
  - 1×Standard ARM™ SWD debug interface (not available in the current firmware)
- 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 TDnext LGA25 signal breakout
- 1×SMA R/A antenna connector with ESD protection device
- 1×Super Blue SMT LED on TDnext LGA25 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 LGA25 EVB
- Section 4 contains the Telecom Design LGA25 EVB schematic
- Section 5 is a detailed explanation of the power supply

1.4 Relevant Documents

This document provides a hardware overview for the LGA25 EVB system. Additional information on the TDnext LGA25 modules can be found in the following documents available on the Telecom Design Web site developer's area (http://rfmodules.td-next.com/):

2 Setting Up the LGA25 EVB

This section helps you set up the LGA25 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 LGA25 EVB 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 LGA25 EVB is delivered in a box containing:

- A TTL-232R-3V3 FTDI USB to TTL Serial Cable (3.3V)-1.8m
- The LGA25 EVB Evaluation Board itself
- Antenna

Figure 1. Packing List

2.3 Requirements

In order to set up the LGA25 EVB, 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 TDnext "**TDLoader.exe**" utility program in order to reflash the TDnext LGA25 module firmware (http://rfmodules.td-next.com/)

2.4 Powering Up the Board

The LGA25 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 TDnext LGA25 Modules on the LGA25 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 antenna to the LGA25 onboard SMA socket and rotate the antenna so that it stands up, perpendicular to the LGA25 EVB board top surface
- Make sure that the current measurement strap is placed across the 2-pin header on the LGA25 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 LGA25 EVB board
- Connect the FTDI cable USB A plug into an available USB host port on the PC

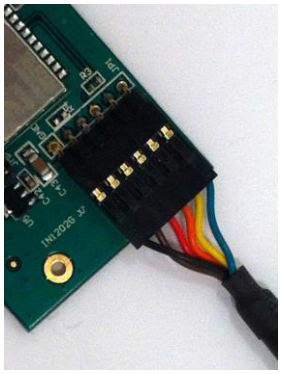

Figure 2. FTDI Cable Connection

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.

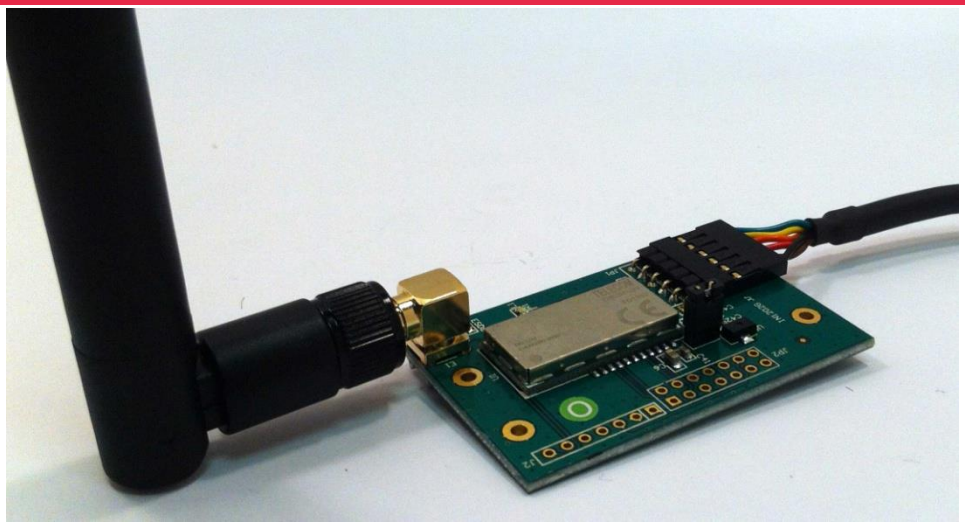

Figure 3. Getting Started

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 LGA25 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 TDxxxx
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 TDnext LGA25 module is always evolving and so is our Web portal. To be able to use your module please always perform a firmware upgrade using the latest available firmware.

The TDnext LGA25 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 TDnext LGA25 module, as only the TDnext provided "**TDLoader.exe**" utility is required.

This utility can be obtained from http://rfmodules.td-next.com/.

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

Figure 4: TD 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 LGA25 EVB board to the FTDI USB cable, you should see:

Figure 5: TD Loader Synchronizing

- If the Loader cannot get synchronized with the LGA25 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: TD Loader Upgrading

- During the upgrade process, the LGA25 EVB onboard blue LED should turn on and shortly turn off during Flash writes. It will eventually turn off and you should get:

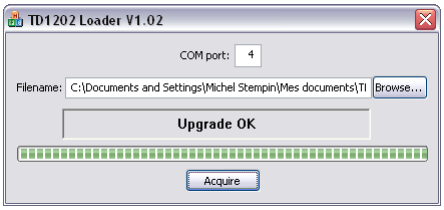

Figure 7: TD Loader Finished

2.6.2 Remote Firmware Update

Within a controlled RF manufacturing environment, the TDnext LGA25 module firmware can also be upgraded remotely by radio.
Please contact TDnext to obtain more information on the required procedure.

2.7 SIGFOX™ Transmission Test

Beside the basic purpose of controlling that the board is operational, the default firmware is able to send RF messages to the SIGFOX™ network, which can be monitored using the SIGFOX™ backend Web portal in real-time.
In order to perform a SIGFOX™ transmission test, please point your Web browser to the address http://backend.sigfox.com. Use the login and password information supplied by SIGFOX™ to access the platform.
Then, turn on temporarily character echo (so you can see what you are actually typing), enable verbose answer display, and send a message containing the 2 hexadecimal byte values 0x54 and 0x44:

```
ATE1<CR>ATQ0<CR>
OK
AT$SS=54 44<CR>
OK
```

You should see a raw message containing the 2-byte value appearing promptly in the SIGFOX™ backend Web portal display.

2.8 Cloud-on-Chip™ Transmission Test

The default firmware is also able to send RF - Sensor formatted - messages through the SIGFOX™ network, which can be monitored on the SENSOR™ Web portal in real-time.
In order to access the SENSOR™ Web portal and to your module's dashboard, you will need first to register your SIGFOX™ gateway module on the SENSOR™ platform.

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 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 before sending a registration frame:

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

You should now be able to access the SENSOR™ Web portal and your module's dashboard by pointing your Web browser to the address https://developers.insgroup.fr/dashboards/device.html and entering the registration information supplied on the LGA25 EVB sticker.
You can try to send a raw message:

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

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

3 LGA25 EVB Overview

The LGA25 EVB provides access to the different TDnext LGA25 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 LGA25 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 TDnext LGA25 module.

3.1 Layout

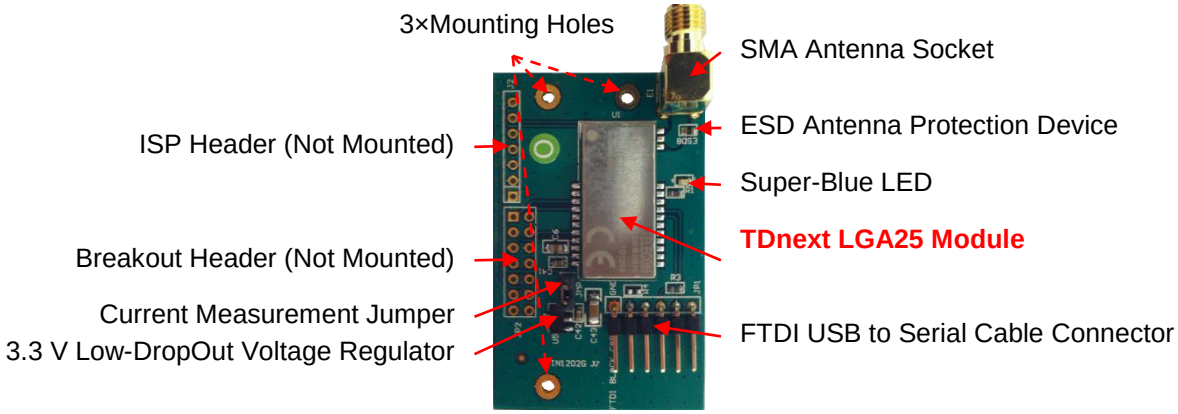

Figure 8: LGA25 EVB Top View

3.2 Block Diagram

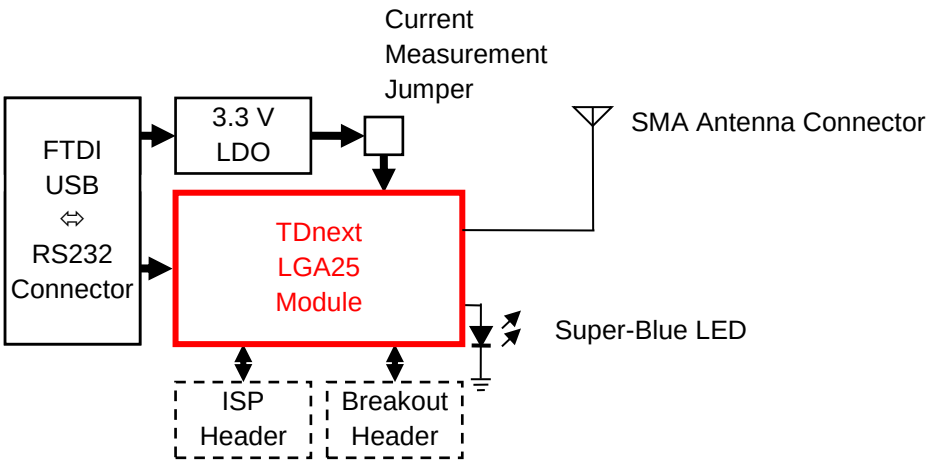

Figure 9 : LGA25 EVB Block Diagram

3.3 Hardware Description

3.3.1 FTDI USB to Serial Cable Connector

The LGA25 EVB 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 LGA25 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 should be visible on the upper side of the black Molex connector, see **Figure 2**.
The LGA25 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 LGA25 EVB board contains a 3.3 V low drop out voltage regulator with proper decoupling for delivering power supply to the TDnext LGA25 module.
This voltage regulator is sufficient for powering the TDnext LGA25 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 LGA25 EVB board that enables current measurement by replacing it with a micro-ammeter.
This jumper can also be used to isolate the TDnext LGA25 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 TDnext LGA25 Module

TDnext LGA25 devices are high performance with low current consumption. 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 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 TDnext LGA25 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 TDnext LGA25 module, please refer to the Datasheet of the module concerned or to the "*TDxxxx Reference Manual*" documents.

3.3.5 Super-Blue LED

An SMT Super-Blue LED is connected to the TIM2 pin of the TDnext LGA25 module through a series current-limiting resistor.
At module reset, this LED is driven by the TDnext LGA25 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 TDnext LGA25 module 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 LGA25 EVB board features a common right-angle SMA socket to easily connect a 50 Ω impedance matched antenna or cable.
An appropriate 50 Ω antenna is provided with the LGA25 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 LGA25 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:

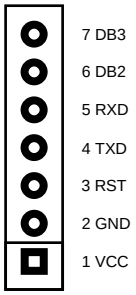

Figure 10 : ISP Header Pinout

Table 2: ISP Header Pinout

Pin	Pin Name	I/O	Description
1	VCC	VCC	**+2.3 to +3.3 V Supply Voltage Input**
2	GND	GND	**Connect to PCB ground**
3	RST	I	**Active Low RESET input signal**
4	TXD	O	**Low-Power UART Data Transmit Signal**
5	RXD	I	**Low-Power UART Data Receive Signal** This signal is internally pulled up by an integrated resistor.
6	DB2	I/O	**SWDIO (SWD Data I/O) Signal**
7	DB3	I	**SWDCLK (SWD Clock) Signal**

Note: Pin 1 is outlined on the LGA25 EVB PCB top silkscreen J2 footprint as a square mark.

3.3.8 Breakout Header

The LGA25 EVB board features a 2×7 0.1" pitch header (not mounted) that provides access to all the available TDnext LGA25 module interface pins, and consisting in:

- 2 × 3.3 V power supply and ground
- 2 × I^2C bus SDA and SCL signals (not available in current firmware)
- 1 × timer input capture / output compare pins (not available in current firmware)
- 1 × RESET input signal
- 1 × ADC analog input signals (not available in current firmware)
- 1 × DAC analog output signal (not available in current firmware)
- 5 × GPIO digital signals
- 1 × Reserved signal

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

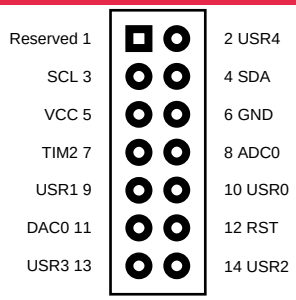

Figure 11: Breakout Header Pinout

Table 3- 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 (not available in current firmware).
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) functio (not available in current firmware)n.
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 (not available in current firmware).
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 (not available in current firmware).
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 (not available in current firmware).
12	RST	I	**Active Low RESET input signal** 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 LGA25 EVB Schematics

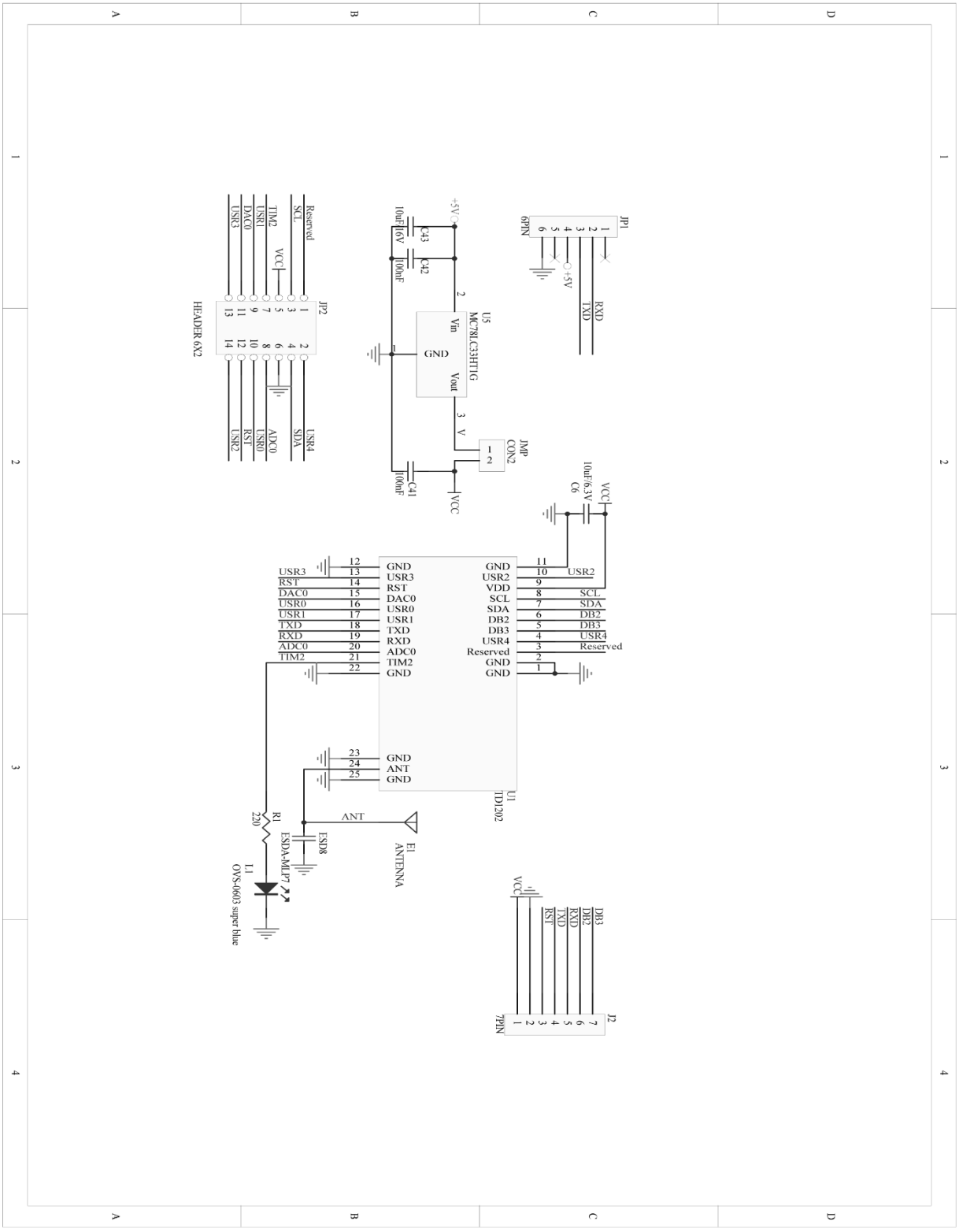

Figure 12: LGA25 EVB Schematic

5 Mechanical Drawing

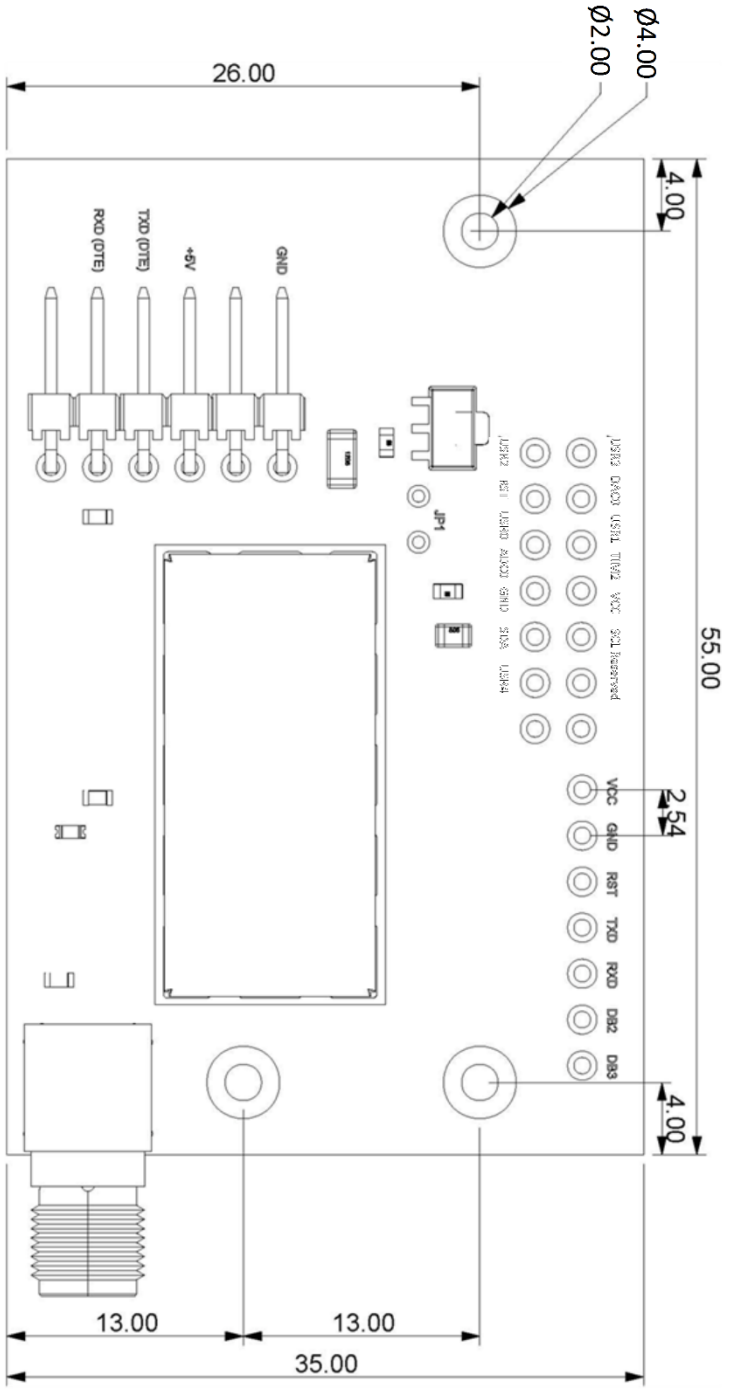

Figure 13: LGA25 EVB Mechanical Drawing

Note:

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

DOCUMENT CHANGE LIST

Revision 1.0

- TD12xx/TD15xx/TD16xx EVB User's Guide

Revision 1.1

- TD1508 added

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