Type1SC
TB User Guide

LTE CAT-M1 / NB-IoT TB

Revision History

Revision	Date	Change Description
1.0	06/15/2022	Initial version

Table of Contents

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Scope

This document provides the general operation instructions for the Murata Cat-M1/NB-IoT Test Board (TB) with headers CN4, CN7, J1 and J3 installed, as shown below. Please ensure that the board is the correct version prior to using this document.

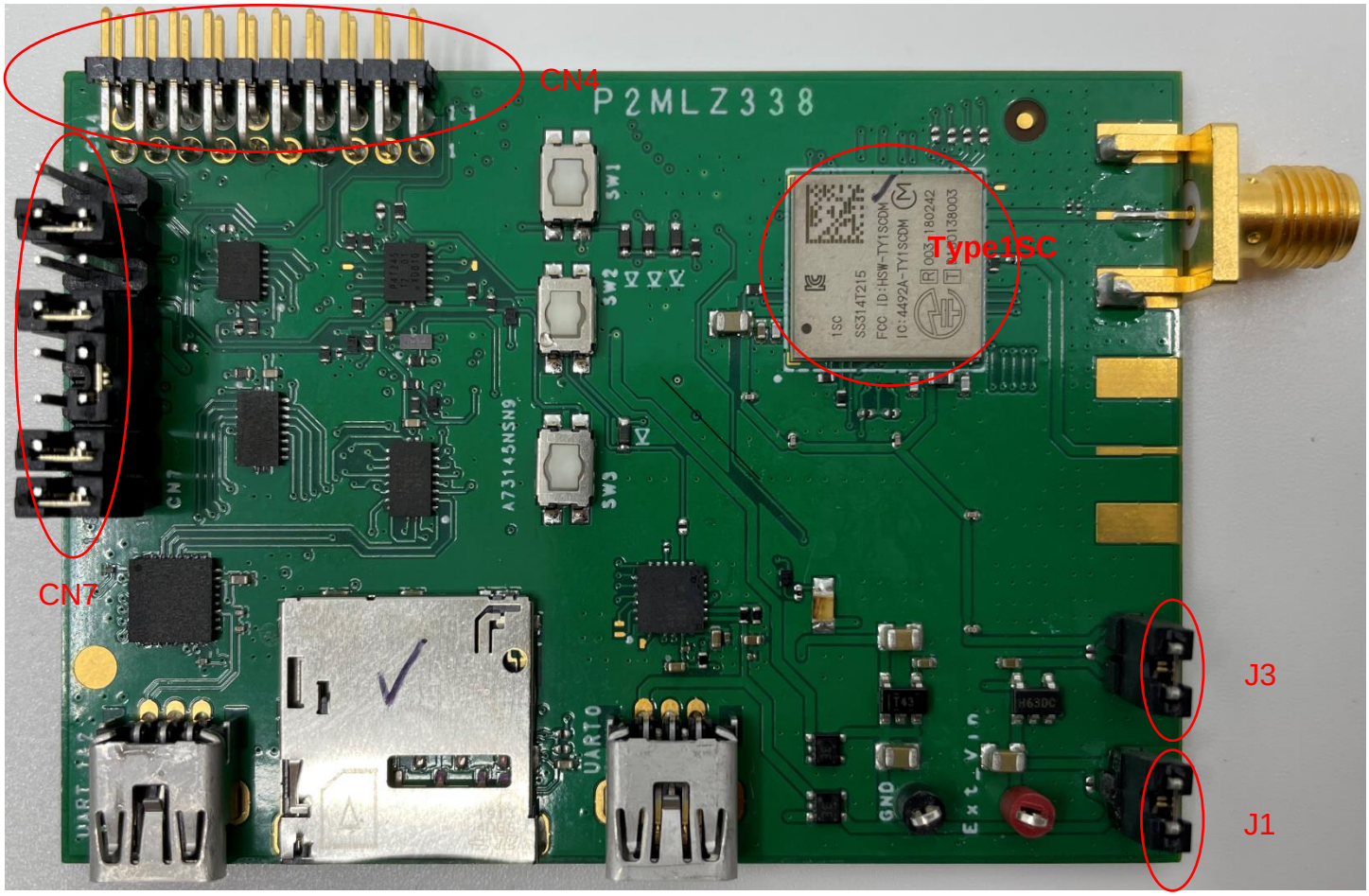


Figure 1 Evaluation Board with Type1WG

1.2 Audience

This document is intended for software/firmware, hardware and systems engineers to evaluate and develop applications with Murata's Type1SC LTE Cat M1/NB-IoT module.

1.3 Contact Info and Support

For general contact, technical support services, technical questions and report documentation errors contact Murata Technical Support at: ciotsupport@murata.com.

1.4 Text Conventions

Danger – This information MUST be followed or catastrophic equipment failure or bodily injury may occur.

Caution/Warning
Alerts the user to important points about using the TB; if these points are not followed, the TB and end user equipment may fail or malfunction.

Tip/Information – Provides advice and suggestions that may be useful when using the TB.

1.5 Kit Contents

The Murata LTE module evaluation package (EVK) contains the following items:

- 1 Type1SC Test Board (TB)
- 2 mini-USB cables

Figure 2 Murata LTE module test board (TB) contents

2 DESCRIPTION

The TB is an evaluation and application development kit for the Murata Type1SC LTE module. The default configuration and some major components of the TB are listed and shown below. By default, J1 and J3 jumpers are ON, and CN7 header settings select the USB/UARTs interface (see 7.1).

- Type1SC module
- 2 mini-USB ports
- 1 micro-SIM slot
- 1 Interface selector header
- 1 STMOD+ connector
- 1 LED
- 3 buttons
- SMA connector for RF testing
- Pads for accessing Murata LTE module IO pins
    - STMOD+ headers supporting 1.8V/3.3V/5V IOs for UART modem control interface
    - Interface selector headers for configuration of the module host interface

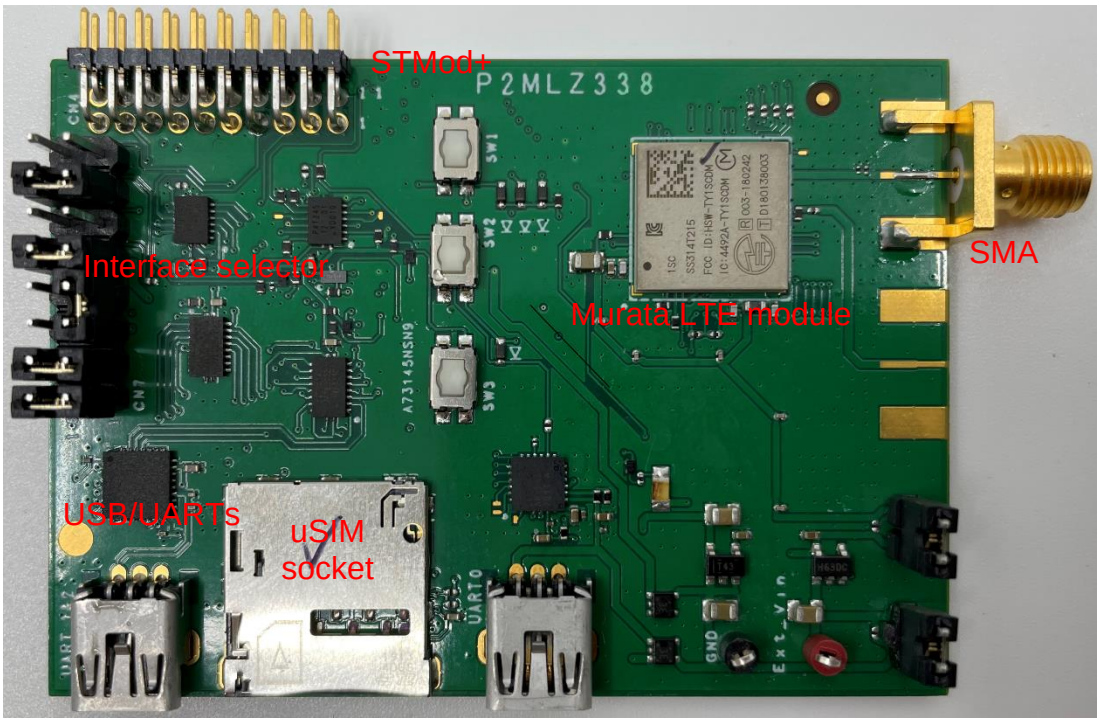


Figure 3 Murata LTE module test board (top view)

The nominal TB physical dimensions are as shown below.

Dimension	Value (mm)	Description
Height	12	TB height including connector
Length	78	TB length
Width	51	TB width

Table 1 TB dimensions

3 POWER SUPPLY

The TB power can be provided by USB hosts or an external 5V supply which is then converted by LDOs to create the 3.3V and 1.8V needed for the onboard circuits. A block diagram of the power supply connections is shown below.

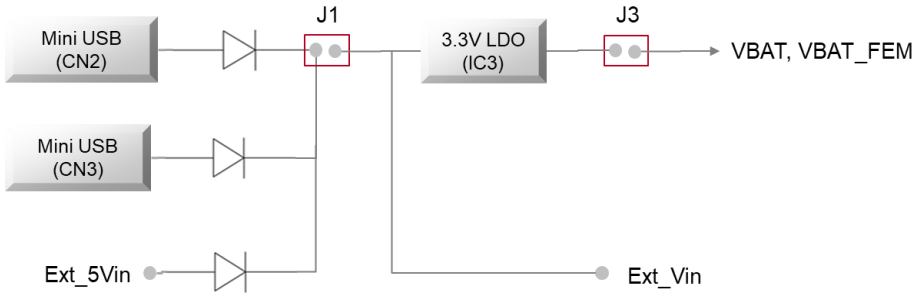


Figure 4 Power supply block diagram

Warning: Note that CN2, CN3 and Ext_5Vin have reverse current protection, but Ext_Vin does not have that protection.

3.1 USB power supply

In the default configuration, the TB is connected to a PC through at least one of the two mini-USB ports UART 1&2 (CN2) and UART 0 (CN3). These connections serve as the power sources for the TB. Additionally, UART 0 also provides the USB-UART serial interface for the AT commands. The mini-USB connector locations are as shown below in Figure 5.

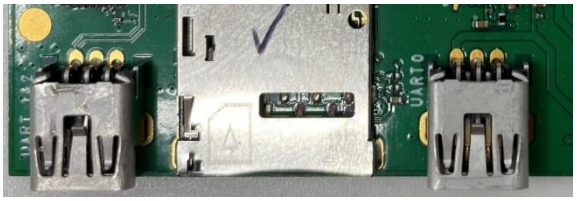


Figure 5 USB connectors' locations on TB

3.2 External 5V supply

The TB can also be powered by applying 5V to one of the following two sources.

- One pair of the Ext_5Vin pins (6 or 15) and GND pins (5 or 16) of the STMOD+ header, or
- Ext_Vin and GND pins as shown in Figure 6.

Figure 6 Ext_Vin pin location on TB

Warning: When using Ext_Vin, the external supply should be protected against reverse current flow or the USB connectors (CN2 & CN3) and Ext_5Vin must not be connected.

4 SERIAL INTERFACE

The TB exports the module UART AT port through either the USB-UART mini-USB connectors or the STMOD+ header. A block diagram for this is shown in Figure 7.

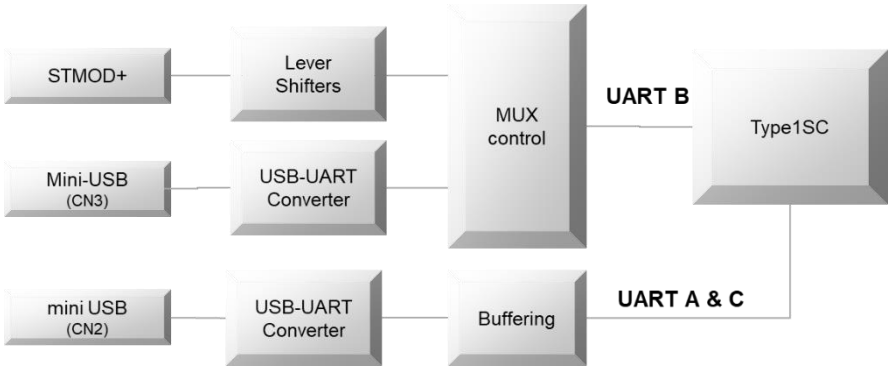


Figure 7 Exported UART interfaces

In the default configuration, USB ports UART 1&2 (CN2) and UART 0 (CN3) are connected to a PC for application testing and development; the STMOD+ interface is not used.

The host control for the modem is accomplished through the UART B interface. There are two possible options:

- Use a PC application (e.g., PuTTY): connect a mini-USB cable to UART 0 and disconnect the STMOD+ interface. See Section 7 for more instructions.
- Use the STMOD+ interface (e.g., B-U585I-IOT02A): connect MCU to the STMOD+ interface and disconnect the mini-USB cable to UART 0. See Section 6 for more information.

5 INDICATION AND SERVICES

5.1 Optical Indicator

The TB has 1 LED (SLEEP_IND) which indicates the module's sleep mode status: ON if the module is in hibernation; OFF if the module is awake. Its location on the TB is shown below.

Figure 8 LED location on TB

5.2 Buttons

The TB has three push buttons, one of which can be used to reset the module.

Figure 9 Button locations on TB

5.2.1 Reset operation (SW2)

The module can be reset by pressing button SW2.

5.2.2 Wakeup operation (SW1)

The module can be awakened from sleep mode by pressing button SW1.

5.2.3 SW3

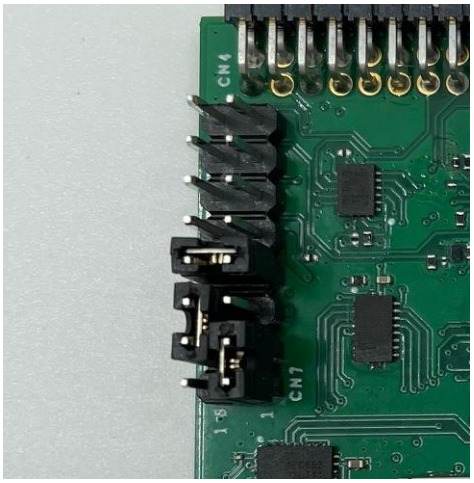
The function of this button is reserved.

6 STMOD+ INTERFACE

The TB exports the STMOD+ header for access to the module UART and IOs for host MCU control. The external MCU signals are level-shifted to/from the 1.8V levels required by the module.

6.1 STMOD+ interface selection with ST MCU platform

The TB simplifies product development with the ST X-Cube-Cellular SDK and ST MCU development platforms, such as the STM32L496G-DISCO and B-U585I-IOT02A. To use the TB with one of these boards, configure the Interface selector header (CN7) as follows.



Jumper connection		Description
2	1	Isolate UART B from USB UART converter
13	4	Connect 4 to 13 to select 3.3V host I/O.
14	15	Connect 15 to 14 for X-Cube-Cellular.
NC	12	LDO controlled by STMOD+ (CN4.9).
NC	7	Wakeup controlled by STMOD+ (CN7.14).

Table 2 STMOD+ CN7 configuration for X-Cube-Cellular

6.2 STMOD+ interface selection for other MCU platforms

To use the STMOD+ interface with other MCU platforms, configure the Interface selector header (CN7) as follows.

Jumper connection		Description
2	1	Isolate UART B from USB UART converter
3 (1.8V) 5 (5V) 13 (3.3V)	4	Connect 4 to one of (3, 5, 13) to select IO reference voltage (IO_REF) used by the host MCU.
14 (N/A/B/C) 16 (E)	15	Select no sleep (N) or HIFC mode A, B, C or E. To select mode E, also ensure that R10 & R12 are installed (20KΩ).
NC 5	12	(Optional) LDO controlled by STMOD+ CN4.9 (12 is NC) or Ext_Vin (12 connected to 5).
NC	7	Wakeup controlled by STMOD+ CN7.14
NC 9	8	(Optional) Connect 8 to 9 to receive modem reset indication in STMOD+ CN7.20.

Table 3 STMOD+ CN7 configuration

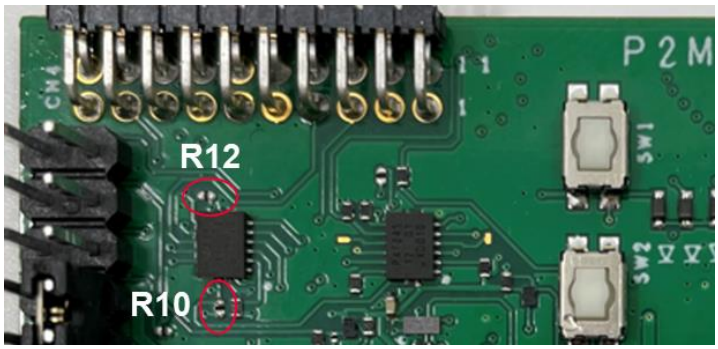


Figure 10 R10 & R12 locations on TB

6.3 STMOD+ pin assignment

The pin assignment for the STMOD+ interface is shown in Table 4.

I/O level is defined by IO_REF (using CN7) to be either 1.8V/3.3V/5V

Pin ID	Signal	Function	Direction	Description
1	UART0_RTS_IO	Modem UART RTS	M→H	Connect to UART0_RTS through level shifter
2	UART0_RX_IO	Modem UART RX	H→M	Connect to UART0_RX through level shifter
3	UART0_TX_IO	Modem UART TX	M→H	Connect to UART0_TX through level shifter
4	UART0_CTS_IO	Modem UART CTS	H→M	Connect to UART0_CTS through level shifter
5,16	GND	GND	H—M	Shared GND
6,15	Ext_5Vin	5V input	H→M	5V input to diode D6 to J1 to 3V3 LDO (Optional)
7,8				Reserved; not connected to module
9	LDO_EN	LDO enable	H→M	3V3 LDO enable signal. If not used, leave NC or float on Host
10				Reserved; not connected to module
11	SC_SWP_IO	Host wakeup	M→H	HIFC host wakeup (D2H) through level shifter
12	PMU_SHUTDOWN_IO	Modem reset	H→M	Modem HW reset through diode
13				Reserved; not connected to module
14	PMU_WAKEUP_IO	Modem wakeup	H→M	HIFC modem wakeup (H2D) through level shifter
15,6	Ext_5Vin	5V input	H→M	5V input to diode D6 to J1 to 3V3 LDO (Optional)
16,5	GND	GND	H—M	Shared GND
17-19				Reserved; not connected to module
20	PWM0_RST_IND_IO	Module reset indicator	M→H	Connected to CN7; to connect this signal to the module through the level shifter, must place jumper CN7.8-9. (Optional)

Table 4 STMOD+ header: CN4

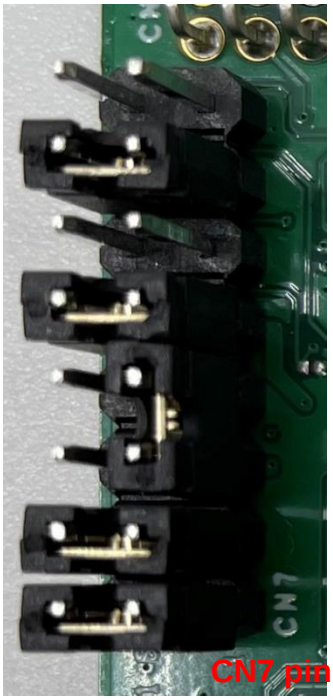
7 STARTUP PROCEDURE

Unpack the EVK package and use the following steps to setup the reference PC environment and configure the TB. The ensuing discussions are based on a PC running Windows 10 Pro.

Do not connect to the STMOD+ interface; by default, the USB-UART interface is selected.

7.1 USB-UART interface selection

This is the default configuration with the CN7 jumper settings shown below:



Jumper connection		Description
16	1	SLEEP_IND isolates USB UART
15	2	Disconnect STMOD+ UART I/F
4	3	1.8V I/O reference for level shifters
12	5	3V3 LDO enabled
10	7	USB UART RTS connect to WAKEUP

Table 5 Default CN7 connections (selects USB-UART interface)

7.2 Install PuTTY

Download and install PuTTY for Windows from https://www.putty.org. This is the recommended serial port console for PC serial communication with the module.

7.3 Connection to PC

Connect two USB cables from a PC to the two mini-USB ports labeled UART 1&2 (CN2) and UART 0 (CN3) to supply power to the board.

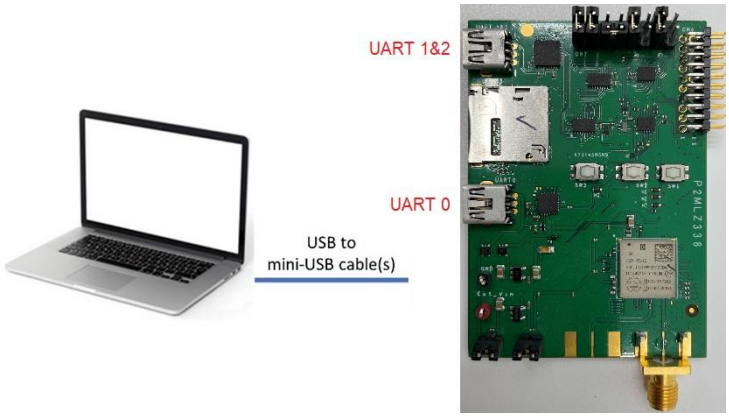


Figure 11 TB setup

The driver may install automatically for ports associated with UART 1&2, but that can be ignored.

The AT port is provided by UART 0. If the driver for UART B associated with UART 0 is not automatically installed, then use the following steps to installed it manually.

- Open the following web page: https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers.
- Download the latest version of universal driver for Windows 10.
- Unzip the downloaded zip file, and run CP210xVCPInstaller_x64.exe to install the driver.

After the above steps, the AT COM port should be shown in Device Manager (e.g., COM13, 115200 baud). See below an example screenshot of the Device Manager.

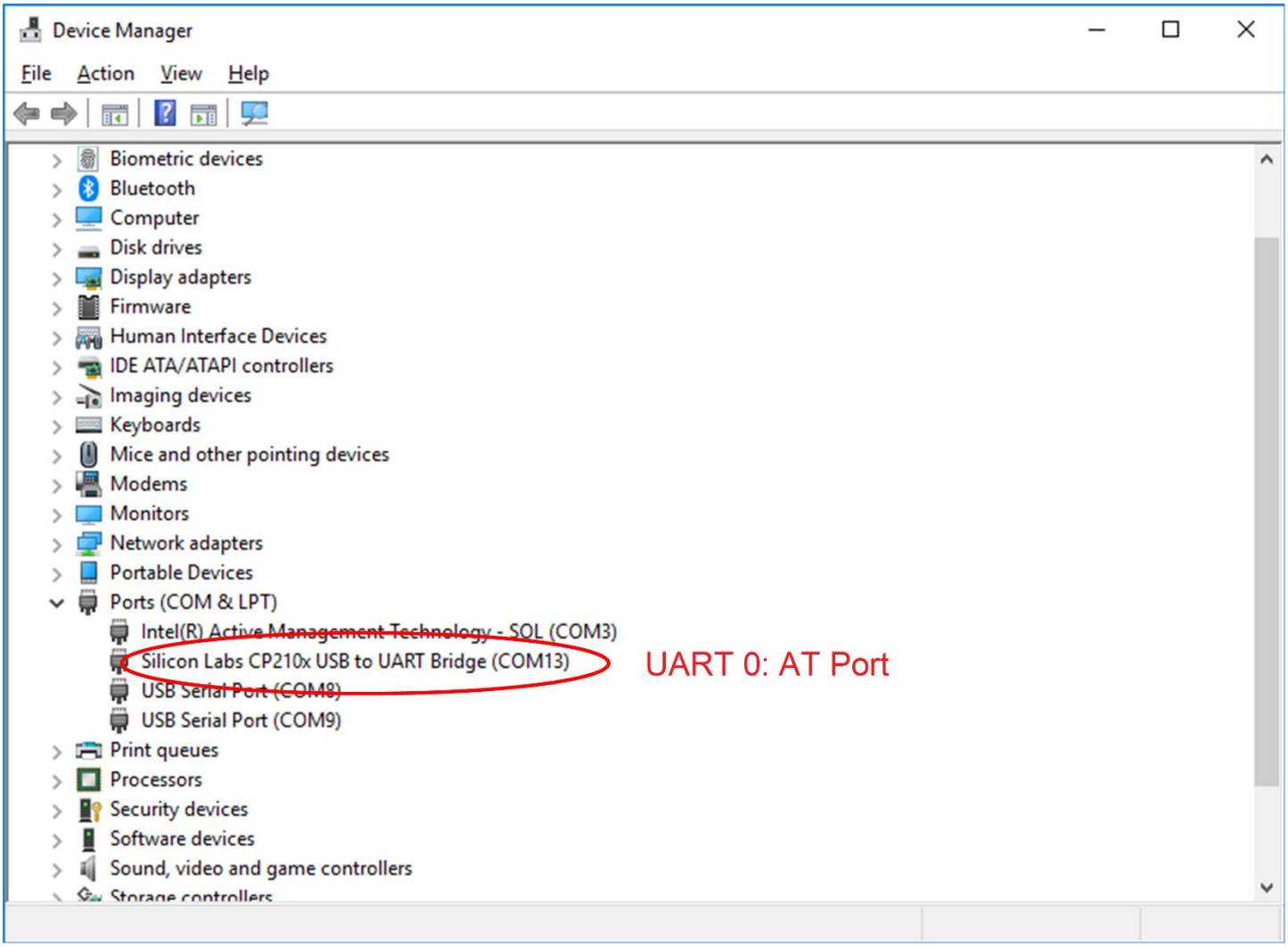


Figure 12 AT COM port assignment shown in Device Manger

7.4 AT port

By default, UART B is the dedicated AT port. Start a PuTTY session and connect to the AT port.

The baud and flow control of PuTTY session, respectively, need to be set to 115200 8N1 and "None".

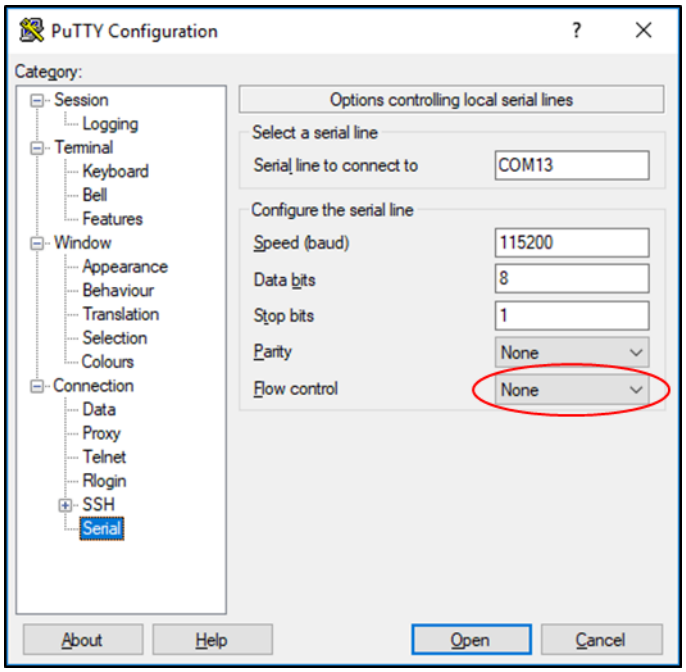


Figure 13 PuTTY configuration for AT port

The module supports a subset of standard 3GPP AT commands and a set of proprietary commands.

- Standard AT commands start with “AT<x>”, where <x> is not ‘%’
- Proprietary AT commands start with “AT%”.

Here is a short list of some useful AT commands.

- AT+CGMI to read name of manufacturer
- AT+CGMM to read model number
- AT+CGSN to read IMEI number
- AT+CGMR to read software version

7.5 Establishing the LTE connection

LTE connectivity is controlled by the ECM (Embedded Connection Manager) module in the firmware. By default, automatic LTE connection by ECM is enabled. For normal operation, the host should enable ECM using AT%SETACFG followed by ATZ as shown below. The new setting is saved in NVM and used at subsequent power up.

```
AT%SETACFG="modem_apps.Mode.AutoConnectMode",true
OK
ATZ
OK
```

Figure 14 Enable automatic LTE connection control

After the configuration is set as described above, ECM automatically attempts to connect to the LTE network after boot-up.

Now, connect an LTE antenna or an LTE tester to the SMA connector, insert a SIM card, reset the TB, and wait until LTE connection is established. The following diagram shows "AT+CEREG?" being used to poll the registration status. It is also possible to enable the "+CEREG" registration status URC to monitor the status change.

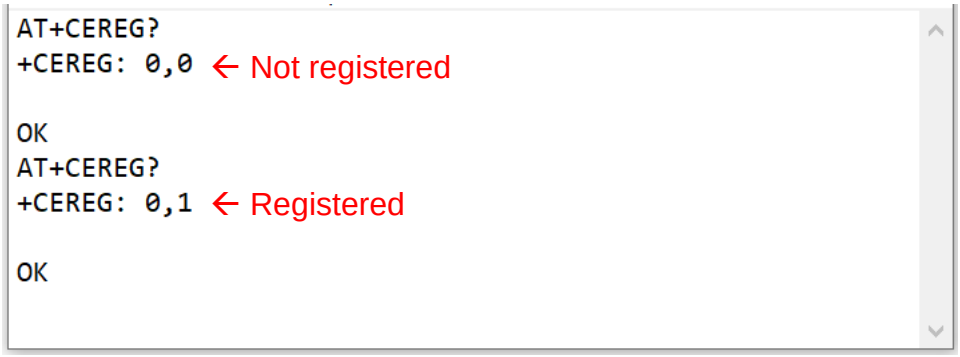


Figure 15 Network registration

7.6 Performing basic network application tasks

After the modem has successfully connected to the LTE network as described in the previous section, the host can use AT commands to communicate with the IP network if the SIM card is provisioned with such capability.

7.6.1 Resolve destination IP address

The AT command AT%DNSRSLV can be used to resolve the IP address of a given URL, as shown by the following example:

```
AT%DNSRSLV=0,"yahoo.com"
%DNSRSLV:0,"98.138.219.232"
%DNSRSLV:1,"2001:4998:C:1023::5"

OK
```

7.6.2 Ping an IP address

The AT command AT%PINGCMD can be used to ping the specified IP address, as shown by the following example:

```
AT%PINGCMD=0,"98.138.219.232"
%PINGCMD:1,"98.138.219.232",313,50

OK
```

7.6.3 Perform TCP data transfer

It is also possible to establish a TCP connection to transfer data with a peer, as shown by the following example which send an HTTP GET and then read some of the server's response:

```
AT%SOCKETCMD="ALLOCATE",0,"TCP","OPEN","98.138.219.232",80
%SOCKETCMD:1

OK

AT%SOCKETCMD="ACTIVATE",1
OK

AT%SOCKETDATA="SEND",1, 18,"474554202F20485454502F312E300D0A0D0A"
%SOCKETDATA:1,28

OK

%SOCKETEV:1,1

AT%SOCKETDATA="RECEIVE",1,1000
%SOCKETDATA:1,1000,5834,"485454502F312E302034303020486F7374204865616
4657220526571756972656 40D0A446174653A204672692C20323120536570203230313
1382032313A30333A323820474D540D0A5669613A20687474702F312E31206D65646
9612D726F757465722D6670313030382E70726F642E6D656469612E6E65312E79616
86F6F2E636F6D20284170616368655472616666696353657276657220 5B6320732066
6205D290D0A5365727665723A204154530D0A43616368652D436F6E74726F6C3A206
E6F2D73746F72650D0A436F6E74656E742D547970653A20746578742F68746D6C0D0
A436F6E74656E742D4C616E677561676 53A20656E0D0A582D4672616D652D4F70746
96F6E733A2053414D454F524947494E0D0A436F6E74656E742D4C656E6774683A203
63533330D0A0D0A3C21444F43545950452068746D6C3E0A3C68746D6C206C616E673
D22656E2D7573223E0A20203C686561643E0A202020203C6D65746120687474702D6
5717569763D22636F6E74656E742D747970652220636F6E74656E743D22746578742
F68746D6C3B20636861727365743D5554462D38223E0A202020203C6D65746120636
861727365743D227574662D38223E0A202020203C7469746C653E5961686F6F3C2F7
469746C653E0A202020203C6D657461206E616D653D2276696577706F72742220636
F6E74656E743D2277696474683D6465766963652D77696474682C696E697469616C2
D7363616C653D312C6D696E696D616C2D7569223E0A202020203C6D6574612068747
4702D65717569763D22582D55412D436F6D70617469626C652220636F6E74656E743
D2249453D656467652C6368726F6D653D31223E0A202020203C7374796C653E0A202
020202020202068746D6C207B0A2020202020202020202020206865696768743A20313030253
B0A2020202020207D0A202020202020626F6479207B0A2020202020202020202020626
1636B67726F756E643A20236661666166632075726C2868747470733A2F2F732E796
96D672E636F6D2F6E6E2F696D672F7361642D70616E64612D32303134303232303303
633312E706E67292035302520353025 3B0A2020202020202020202020626 1636B67726
F756E642D73697A653A20636F7665723B0A2020202020202020202020686 5696768743
A20313030253B0A2020202020202020202020746578742D616C69676E3A2063656E746
5723B0A2020202020202020202020666F6E743A203330302031387078202268656C766
574696361206E657565222C2068656C7665746963612C207665726 4616E612C20746
1686F6D612C20617269616C2C2073616E732D73657269663B0A2020202020202020202
0206D617267696E3A20303B0A2020202020207D0A202020202020"

OK
```

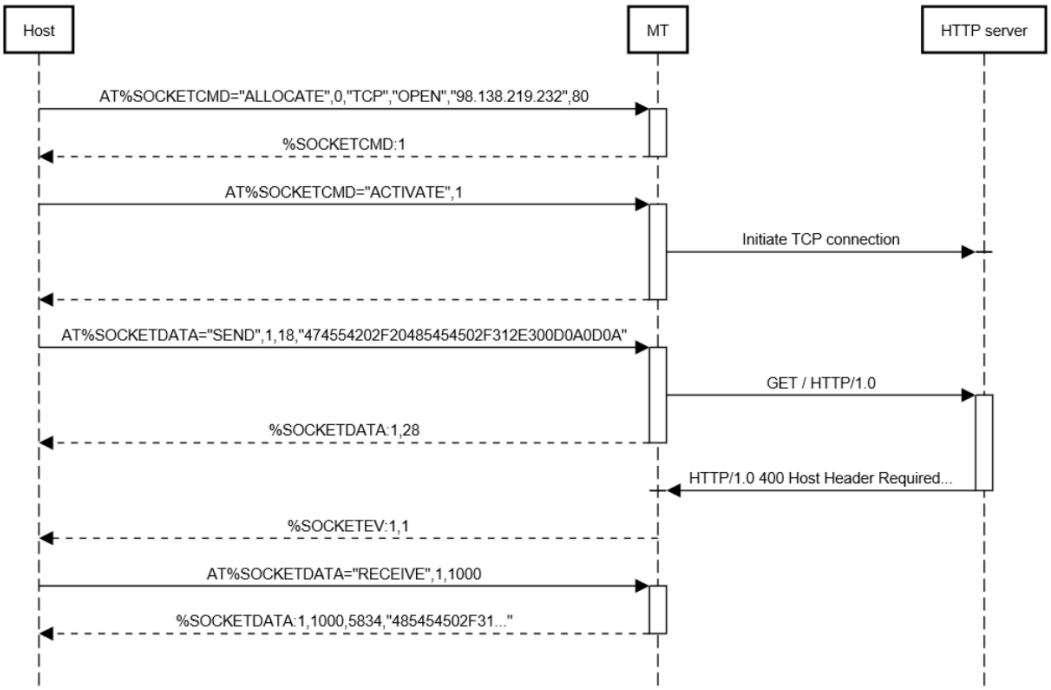


Figure 16 Sample TCP data transfer

8 SAFETY RECOMMENDATIONS

8.1 Disposal of this product in the European Union

For private households: Information on Disposal for Users of WEEE

This symbol on the product(s) and / or accompanying documents means that used electrical and electronic equipment (WEEE) should not be mixed with general household waste. For proper treatment, recovery and recycling, please take this product(s) to designated collection points where it will be accepted free of charge. Alternatively, in some countries, you may be able to return your products to your local retailer upon purchase of an equivalent new product. Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

Please contact your local authority for further details of your nearest designated collection point. Penalties may be applicable for incorrect disposal of this waste, in accordance with your national legislation.

For professional users in the European Union: If you wish to discard electrical and electronic equipment (EEE), please contact your dealer or supplier for further information.

8.2 Disposal of this product in other countries outside the European Union

This symbol is only valid in the European Union (EU). If you wish to discard this product please contact your local authorities or dealer and ask for the correct method of disposal.

9 ACRONYMS

ADC	Analog-to-digital converter
AT	Abbreviation for Attention
BPS	Bits per second
COM	Abbreviation for communication
CTS	Clear-To-Send
DNS	Do Not Stuff
TB	Test/evaluation Board
EVK	Evaluation Kit
FTP	File Transfer Protocol
FW	Abbreviation for firmware
GND	Abbreviation for ground
HW	Abbreviation for hardware
ICCID	Integrated Circuit Card Identifier
IoT	Internet of Things
I/O or IO	Input/Output
IO_REF	Input/Output voltage reference
LDO	Low-drop out regulator
LED	Light-emitting Diode
LTE	Long-Term Evolution
MCU	Abbreviation for microcontroller
PC	Personal Computer
PMU	Power Management Unit
PPP	Point-to-Point Protocol
PWM	Pulse Width Modulation
RAM	Random Access Memory
ROM	Read Only Memory
RF	Radio Frequency
SIM	Subscriber Identity Module
SMA	A type of RF connector
SW	Abbreviation for software
USB	Universal Serial Bus
UART	Universal Asynchronous Receiver Transmitter
VBAT	Voltage of the Battery
VIN	Input Voltage