TELTONIKA T-BoxN12R

TBN-107

USER'S MANUAL V1.13

Contents

Legal Notice

1. ABOUT THIS DOCUMENT

This document describes the T-BoxN12R hardware integration, configuration and software configuration. This document should help T-BoxN12R integrators to integrate and configure the system.

The document describes the mechanical, electrical, radio frequency (RF), antenna installation, PC software installation and configuration.

Document also describes how to test and run T-BoxN12R for the first time.

Note: Form more detail information integrator should be familiar with following documents: Nokia 12 Hardware Integrators Manual, Nokia M2M Platform Software Developer's Guide, and Nokia 12 GSM Module IMlet Programming Guide. These documents you can download from Nokia web site (www.forum.nokia.com/m2m)

2. INTRODUCTION

T-BoxN12R was designed for M2M (machine-to-machine) applications or other wireless solutions. Integrated Nokia 12 GSM module enables flexible wireless communication over GSM network. Nokia 12 supports various communication bearers:

- EDGE multi-slot class 2 (2+1) and mobile station class B
- GPRS multi-slot class 6 (3+1, 2+2, 2+1) and mobile station class B
- CSD
- HSCSD
- SMS, text/data messaging
- USSD, data messaging

Nokia 12 also supports Java (J2ME) and CORBA. These features enable development of distributed wireless applications.

The T-BoxN12R has several operating modes, so it can be used for different applications. In AT mode it can be used as a wireless modem for PC to connect to the Internet. In I/O mode T-boxN12R can control external hardware by reading/writing I/O with a Java application or SMS. The functionality of T-BoxN12R can be expanded by connecting external hardware (controllers for Real-Time operation) to RS-232 interface.

All these features enable to use T-BoxN12R in wide range of applications.

3. MECHANICAL INTEGRATION

3.1. Package contents

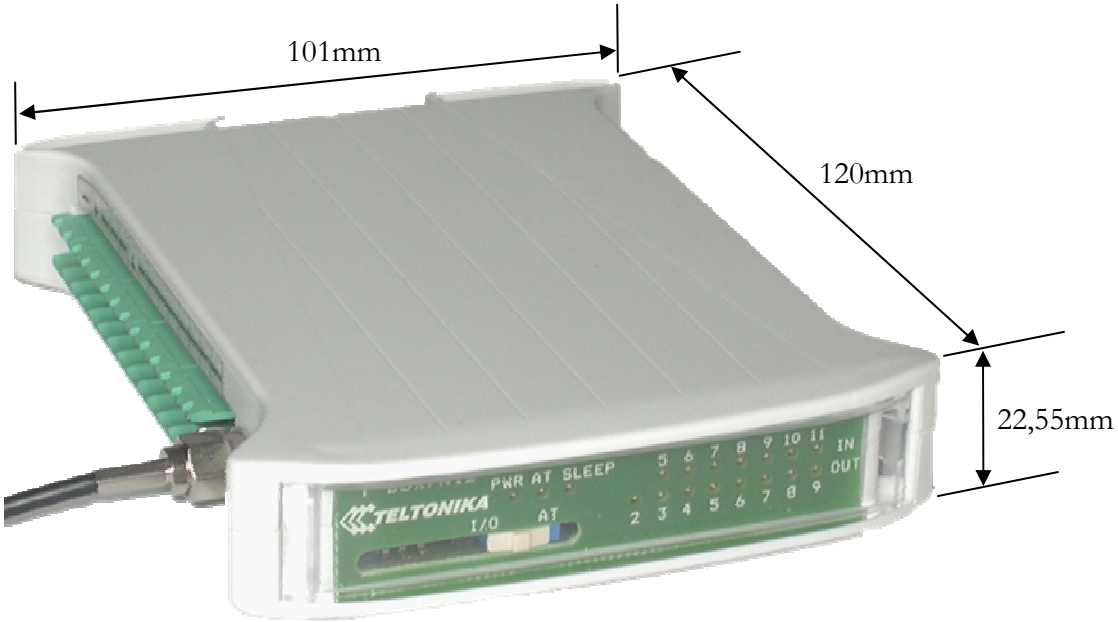
These are the contents of your package:

1) T-BoxN12R,
2) Serial cable PORT1/2 (one connector – female COM port, another – RJ45),
3) Serial cable for PORT3 (one connector – female COM port, another – RJ45),
4) GSM antenna (SMA connector),
5) 6x connectors MSTB 2,5 HC/3-ST, 3x connectors MSTB 2,5 HC/2-ST (could be additionally purchased from Teltonika or www.phoenixcontact.com),
6) A CD with Software and User's Manual.

3.2. Dimensions

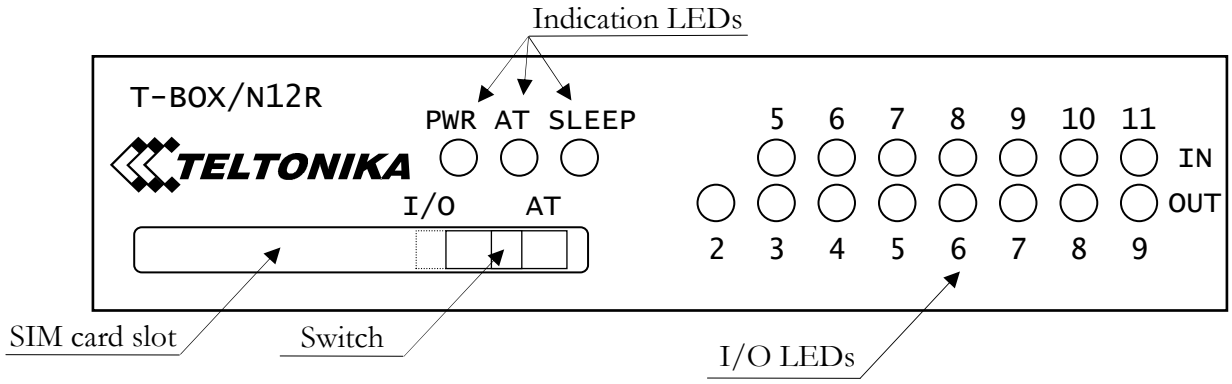
3.2.1. T-BoxN12R case

The plastic case of T-BoxN12R is light and suitable for fitting with electronic instruments that can hook to the DIN EN 50022.

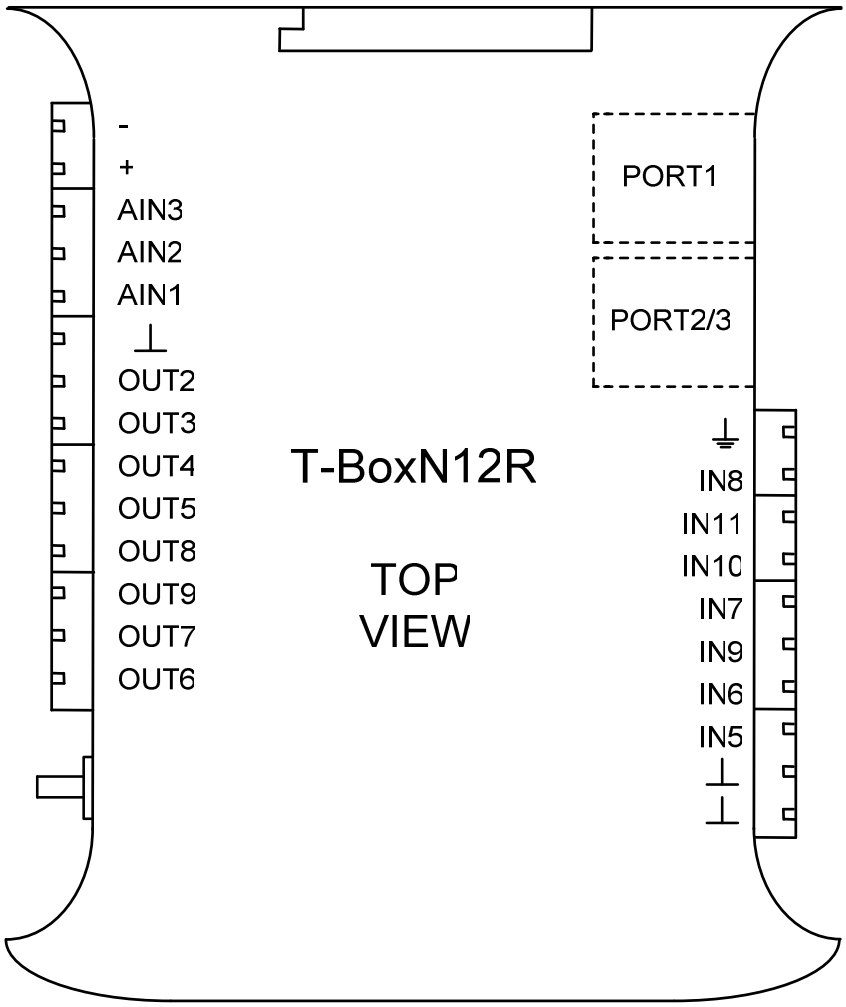


When a place for T-BoxN12R is being planned, it should be considered that GSM antenna, which is supplied in your package, should NOT be placed in metal case. The supplied antenna usually has 2 meter length cable, so if you plan to mount T-BoxN12R into a metal case, please mount the antenna outside the metal case. If cable length of 2 meters is not enough, contact our sales department (refer to page 25) to order antennas with longer cables.

3.2.2. Front panel



3.2.3. Top view



4. ELECTRICAL INTEGRATION

4.1. Electrical characteristics

4.1.1. Connector pin-out

Table 1. **Connector pin-out**

Pin name	Description
-	GND
+	Device power. Voltage range from 9V to 30V DC. Power consumption: Stand by mode ~30mA@12V, peak up to 700mA@12V. As switched power regulator is used inside, the smaller the voltage, the bigger the current and vice versa (power consumption remains about the same)
AIN3	Analog input 3. Input range from 0 to 10V
AIN2	Analog input 2. Input range from 0 to 10V
AIN1	Analog input 1. Input range from 0 to 10V
⊥	GND
OUT2	Output 2. Open collector output (max. load 70mA or 200mW)
OUT3	Output 3. Open collector output (max. load 70mA or 200mW)
OUT4	Output 4. Open collector output (max. load 70mA or 200mW)
OUT5	Output 5. Open collector output (max. load 70mA or 200mW)
OUT8	Output 5. Open collector output (max. load 70mA or 200mW)
OUT9	Output 9. Open collector output (max. load 70mA or 200mW)
OUT7	Output 7. Open collector output (max. load 70mA or 200mW)
OUT6	Output 6. Open collector output (max. load 70mA or 200mW)
⊥	GND
⊥	GND
IN5	Input 5. This input is optically isolated and connected to corresponding Nokia 12 input. 0…1V – false, 2…24V – true.
IN6	Input 6. This input is optically isolated and connected to corresponding Nokia 12 input. 0…1V – false, 2…24V – true.
IN9	Input 9. This input is optically isolated and connected to corresponding Nokia 12 input. 0…1V – false, 2…24V – true.
IN7	Input 7. This input is optically isolated and connected to corresponding Nokia 12 input. 0…1V – false, 2…24V – true.
IN10	Input 10. This input is optically isolated and connected to corresponding Nokia 12 input. 0…1V – false, 2…24V – true.
IN11	Input 11. This input is optically isolated and connected to corresponding Nokia 12 input. 0…1V – false, 2V – true.

IN8	Input 8. This input is optically isolated and connected to corresponding Nokia 12 input. 0…1V – false, 2V – true.
⏚	Input ground. Input ground is separate from module ground (power supply, outputs) because inputs are optically isolated.
PORT2/3	Serial port 2. Connected to Nokia 12 port 2. Can be used as system port (M2M protocol to configure Nokia 12) only Serial port 3. Connected to Nokia 12 port 3. This port is controlled by Java application on the Nokia 12 module or GPS.
PORT1	Serial port 1. Connected to Nokia 12 port 1. Can be used for AT commands, GPS or as system port.

4.1.2. Grounding

The ground for power supply is marked as "-", for analog inputs and outputs is marked with symbol ⊥. These pins are connecter together internally.

The input ground is isolated from ⊥. Internally all ⊥ pins are connected together.

In case optical isolation is not needed the ⊥ and ⏚ can be connected together.

4.1.3. Power supply

The T-BoxN12R uses switched power regulator. Acceptable voltage range is from 9V to 30V DC.

Power consumption: Stand by mode ~30mA@12V, peak up to 700mA@12V. The smaller the voltage, the bigger the current and vice versa (power consumption remains about the same).

4.2. I/O characteristics

4.2.1. Digital Inputs

Inputs are optically isolated. Input ground is separated from common device ground and marked as ⏚. If voltage is applied between 1 V and 2 V, the logical value depends on voltage history, because digital input has hysteresis.

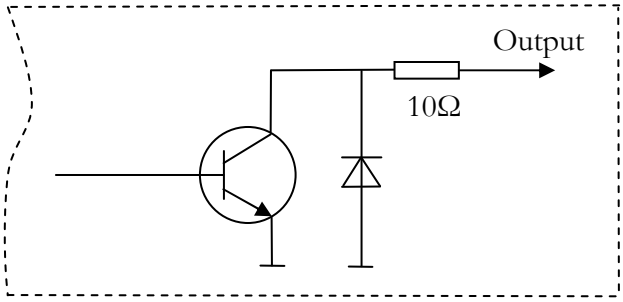
Table 2. **Logical values for voltages of digital inputs**

Voltage	Logical value
0 – 1 V	0 (False)
2 – 24 V	1 (True)

Note: When T-BoxN12R operates in AT mode (switch is in position "AT") outputs 2,3,4,5 and Inputs 5 and 6 are disabled!

4.2.2. Digital Outputs

T-BoxN12R has open collector outputs. The picture below shows the internal circuit diagram of outputs implementation:



Outputs can drive up to 70mA or 200mW load. The circuit has protection diode so outputs can directly drive relays.

Note: When T-BoxN12R operates in AT mode (switch is in position "AT") outputs 2,3,4,5 and Inputs 5 and 6 are disabled!

4.2.3. Analog Inputs

Analog inputs are designed to measure voltage in range from 0 to 10 V. As this input voltage is internally divided by 2,8, the measured values by Nokia 12 will be vary from 0 to 2,7 V.

The analog inputs have protection diodes, which protect the device from too high voltage and negative voltage.

4.3. Serial communication

T-BoxN12R provides 3 serial communication ports:

- Serial port 1. Connected to Nokia 12 port 1. This port can be used for AT commands, GPS or as system port.
- Serial port 2. Connected to Nokia 12 port 2. This port can be used as system port (M2M protocol to configure Nokia 12) only
- Serial port 3. Connected to Nokia 12 Port 3. This port is controlled by Java application on the Nokia 12 module or GPS.

There are only two RJ45 serial port connectors on the housing, which are marked as PORT1 and PORT2/3. As you can see, PORT2 and PORT3 share the same connector. This, at first glance unusual, solution was made, because usually PORT2 is used for device configuration only and is not used during normal operation.

The package contains two serial cables, marked as "PORT 1/2" and "PORT3". Refer to **Table 3** to choose the right cable and the right connector for the desired serial port.

Table 3. **Choosing the right cable and the right connector for the desired serial port**

Connector \ Cable	Cable "PORT 1/2"	Cable "PORT 1/2"	Cable "PORT 3"
Connector "PORT1"	**PORT1**		
Connector "PORT 2/3"		**PORT2**	
Connector "PORT 2/3"			**PORT3**

The signal level of all serial ports is RS232.

4.3.1. PORT 1

Port 1 provides asynchronous channel. This port can be used with full 8 signal RS-232 handshaking signals. The baud rate for Port 1 may be between 1200 and 230400 bit/s.

Baud rate 230400 bit/s can be used only with AT command mode and autobauding.

Port 1 can operate in the following modes:

- GPS Receiver,
- System Protocol – for configuring T-BoxN12R using M2M mode,
- AT Command Mode – for connecting Internet, configuring device using AT mode,
- HW Detection – mode is selected by switch.

The mode of PORT1 is selected by changing settings in configuration software (Nokia 12 Configurator, which is found in the CD) and by changing switch, which is found on the front panel. Refer to Table 4 to see, how to choose the desired mode.

The default value for this port in configuration is HW Detection.

Table 4. **Choosing the right mode of switch and the setting in configuration to have the desired mode of PORT1**

Configuration \ Switch	AT	I/O
System Protocol	System protocol	-
General IO	-	I/O mode
AT	AT mode	-
GPS receiver	GPS receiver mode	-
HW detection	AT mode[1]	I/O mode

[1] In AT mode outputs 2,3,4,5 and Inputs 5 and 6 are disabled!

Note: After changing the position of the switch, please reboot T-BoxN12R (power off and on again) for the changes to take effect.

The T-BoxN12R provides all signals for the industry standard DB9 RS-232C connection.

Note: A special RJ45-DB9F cable is required in order to connect the device to the PC. The cable is supplied in the package.

4.3.2. PORT 2

Port 2 provides the second asynchronous channel with a simple handshaking capability (only RTS and CTS). The baud rate for Port 2 can be set to 9600, 19200, 38400, 57600 or 115200 bit/s. Port 2 is the default port for using the M2M System Protocol. However, if Port 1 is configured to use the M2M System Protocol, Port 2 cannot be used for anything.

Note: A special RJ45-DB9F cable is required in order to connect the device to the PC. The cable is supplied in the package.

4.3.3. PORT 3

Port 3 provides the third asynchronous channel with no hardware handshakes. The baud rate for Port 3 can be set between 1200 and 115200 bit/s.

Port 3 can be used to control external device by Java application. Also it can be software configured to use with GPS.

Note: A special RJ45-DB9F cable is required in order to connect the device to the PC. The cable is supplied in the package.

4.3.4. Pin-out description of the serial port connectors

Table 5. **PORT1 Pin-out description**

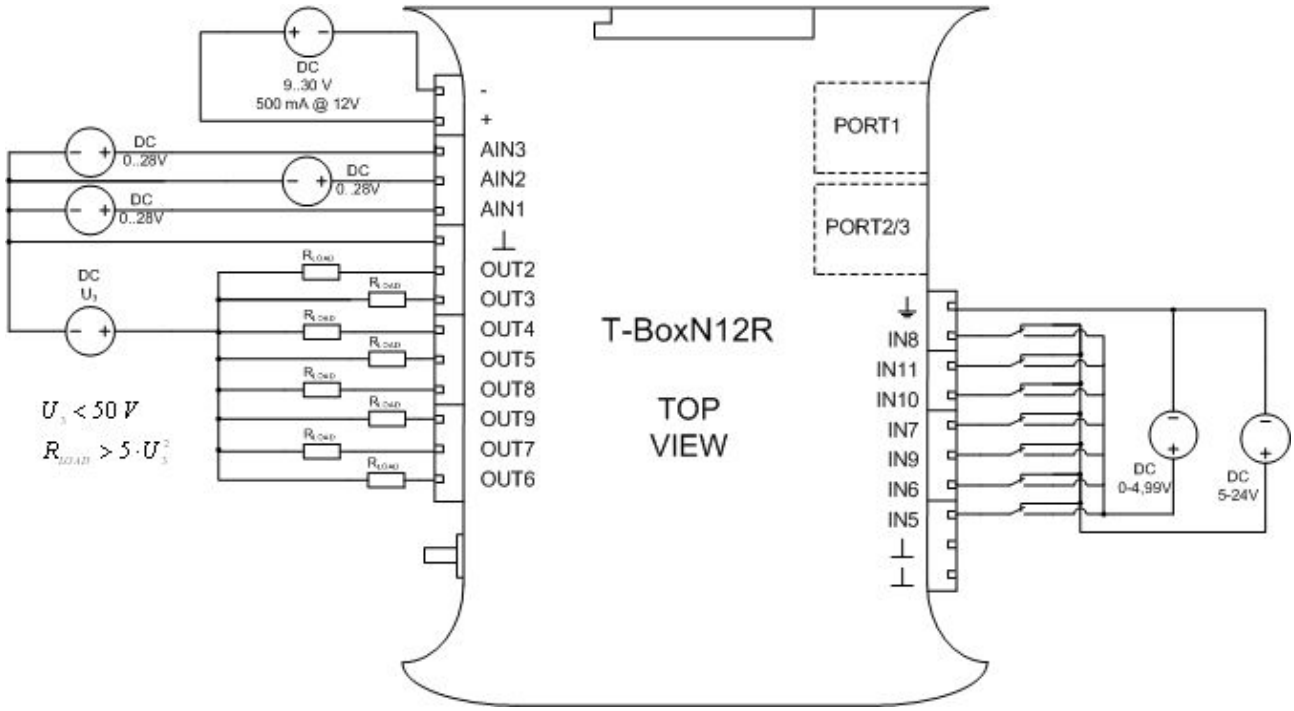
RJ45 Pin number	Description	Direction
1	DSR	Output
2	DCD	Output
3	DTR	Input
4	GND	-
5	RXD	Input
6	TXD	Output
7	CTS	Output
8	RTS	Input

Table 6. **PORT2/3 Pin-out description**

RJ45 Pin number	Description	Direction
1	RXD (Port 3)	Input
2	TXD (Port 3)	Output
3	NC	-
4	GND	-
5	RXD	Input
6	TXD	Output
7	CTS	Output
8	RTS	Input

4.4. Sample electrical connection

4.4.1. Sample scheme



5. JAVA (J2ME) OVERVIEW

5.1. Introduction

Java technology enables writing applications to M2M devices in Java programming language. These Java applications can then be downloaded over-the-air to M2M devices for execution. This enables rapid application development and deployment.

Traditionally, M2M application development for remote assets had to be done with C language. This meant that the application download and update was quite tricky. Also, embedded C development required special software and hardware tools. Applications developed with C language could not be executed directly within the M2M device. Instead they required external hardware for execution.

Java applications can be developed with publicly available tools and tested with software simulators. Due to the portable and dynamic nature of Java, Java applications can be downloaded and updated dynamically. Also, since the Nokia 12 GSM module includes Java Virtual Machine, the Java applications can be executed in the Nokia 12 GSM module without external hardware.

Java is an excellent choice in an M2M application when remotely controlled I/O is not enough. The customer can have additional logic in the Nokia 12 GSM module itself. When the interface from the Nokia 12 GSM module to a device is purely I/O, no complicate protocols are needed. If a separate application HW is difficult to design or expensive to manufacture, Java enables effective application development and fast time to market.

Form more information about programming Nokia 12 see the documentation provided from Nokia.

5.2. Supported Java API

The Nokia 12 GSM module supports several APIs for Java application. In addition to the APIs of the IMP profile, APIs to connect external devices using M2M system connector capabilities are offered as well as useful additional APIs for wireless connectivity. IMP offers also the functionality for using persistence memory and advanced application model to make intelligent M2M solutions with the Nokia 12 GSM module.

List of supported APIs

- Wireless Messaging API (JSR-120)
- Serial API
- ORB API
- IO API
- HTTP API (included in IMP)
- Socket API
- RMS API (included in IMP)

6. M2M SYSTEM PROTOCOL OVERVIEW

The Nokia 12 GSM module is part of the Nokia M2M Platform solution. The M2M system mode enables operating on the Nokia M2M Platform.

The platform connects applications in a corporate intranet to the remote assets of the corporation utilising a selection of GSM bearers and Internet technology.

Open interfaces and support for multiple GSM bearers (and even changing the bearers dynamically) make it possible to adjust to changes in networks, tariffs and also to the requirements of new applications. As change is constant in the communication field, it is important to have a certain degree of independency between the applications and the communication technology.

7. INTRODUCTION TO INTEGRATED TCP/IP STACK

In data communication, there is always need for low level communication protocols to ensure reliable data transmission. The protocol stacks are difficult and expensive to implement so the Nokia 12 GSM module provides in-build TCP/IP and UDP/IP transport layer protocol stacks. Standard socket interface is also implemented in the Nokia 12 GSM module to enable usage of these stacks. Also client HTTP protocol is supported for fetching www-pages from a server.

TCP is a connection-oriented protocol that provides a reliable flow of data between two applications over networks supporting IP protocol. Currently, TCP/IP can be used with GSM data calls and GPRS. The TCP/IP protocol implementation in the Nokia 12 GSM module is highly optimised for wireless networks.

The versatility of the TCP/IP protocol makes it ideal for a very wide range of applications. TCP/IP is used in many well-known applications, such as Web browsers, Telnet, and FTP. Also, many proprietary applications use TCP/IP to transmit data reliably.

The reliable nature of TCP/IP means that the need for applications to ensure that data transmissions succeed is minimised. TCP/IP uses a checksum mechanism to ensure that data is transmitted without errors. Also, TCP/IP incorporates mechanisms for re-transmitting packets that get lost in networks. These features mean that the customer applications need not to worry about the details of data transmissions. Since TCP/IP is widely used, it is very well documented.

8. DOCUMENTS PROVIDED BY NOKIA

Nokia provides a full set of documents regarding M2M platform. Here is the list of most common and recommended document. Please be familiar with these documents before you start to integrate T-Box.

- Nokia 12 Hardware Integration Manual
- Nokia 12 IMlet Programming Guide
- Nokia 12 product specification
- Nokia 12 user control mode guide
- Nokia M2M Software Developer's Guide
- Nokia 12 AT Command Guide
- M2M System Protocol 2 Specification

The most up to date version of these documents you can download form Nokia website (www.forum.nokia.com/m2m).

9. SOFTWARE

9.1. Nokia 12 Configurator

The Nokia 12 Configurator software is used to configuration and software upload to the module.

9.2. Modem Drivers for Nokia 12

Modem drivers have to be installed when T-BoxN12R is used as a modem for PC.

Note: When installing modem driver ensure that T-BoxN12R is connected to your PC. Modem has to be connected to the PC during the boot of the PC. Otherwise the OS will not find the modem. This issue is specific for particular operating systems (MS Windows XP, MS Windows 2000).

9.3. Nokia 12 IMP 1.0 Concept Simulator

Concept simulator is used for testing IMlets before loading them to module. This helps to speed up the development of Java applications.

9.4. Eclipse

Eclipse is an open extensible IDE, which is needed if you want to write IMlets yourself. It could be found at www.eclipse.org .

Also you need a plug-in for Eclipse, called EclipseME, which could be found at http://eclipseme.sourceforge.net .

10. TROUBLESHOOTING

10.1. T-BoxN12R doesn't power up

If the device powers up well, the "PWR" LED should be always on and output LEDs should be blinking one after another in a row. **Note: the output LEDs are blinking, because a JAVA IMlet is pre-installed to your T-BoxN12R. If you load your own IMlet, it will not blink.**

1) Please make sure you have connected the power supply wires to T-BoxN12R according the scheme on the device (positive terminal of power supply to pin 17 and GND to pin15) and that these wires are firmly holding in the connector.

2) Please make sure your power supply (AC/DC converter or battery) is at least 12V and at least 500mA @ 12V.

10.2. Nokia Configurator couldn't connect to T-BoxN12R

1) Please make sure that you plug one end of serial cable **marked PORT2/3** (found in the package) to PORT2 of the device and the other end to a free COM port of your PC.

2) Please check if PWR LED is always on and the output LEDs are blinking after another in a row. This means that the device has proper powering and that it functions well. If you don't see this, it means that you should check powering of the device. If the powering is really OK, the device is probably out of order and you should contact technical support. **Note: the output LEDs are blinking, because a JAVA IMlet is pre-installed to your T-BoxN12R. If you load your own IMlet, it will not blink.**

3) Please make sure that settings in Nokia Configurator (CD with this program is in the package) are the same as shown in Figure 1. The settings could be changed by clicking "File->Preferences". **Note: You must select the PC serial communication port, which you have connected the T-BoxN12R to.**

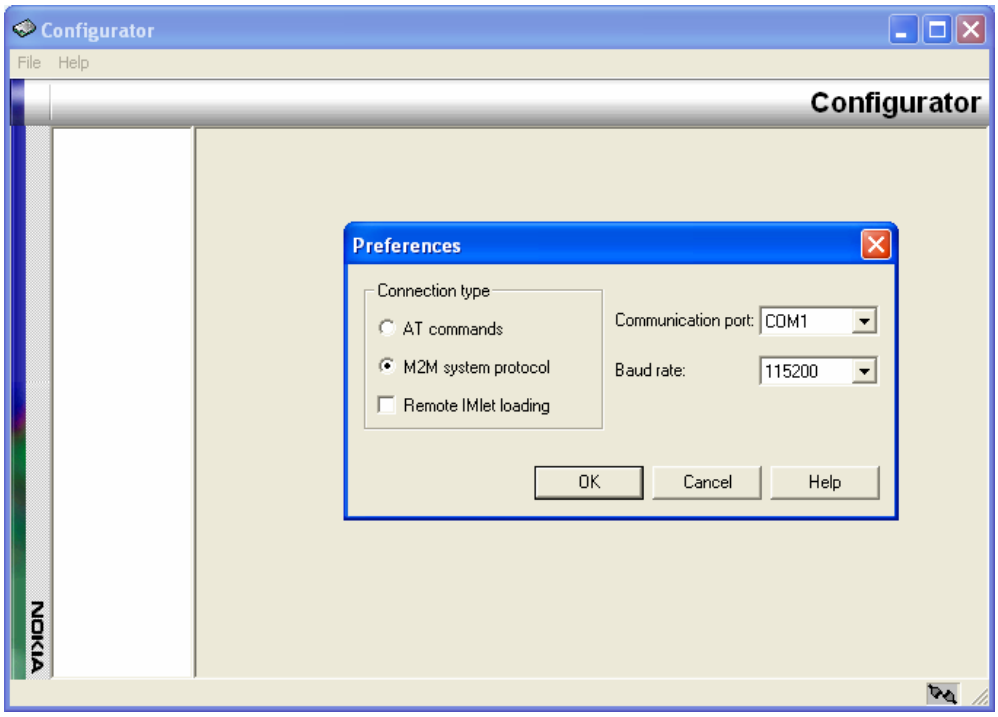


Figure 1. **Nokia Configurator window with required settings**

If the connection is OK, you should a window as shown in Figure 2. The green-blue connector in the lower right corner of the window denotes that the connection was established.

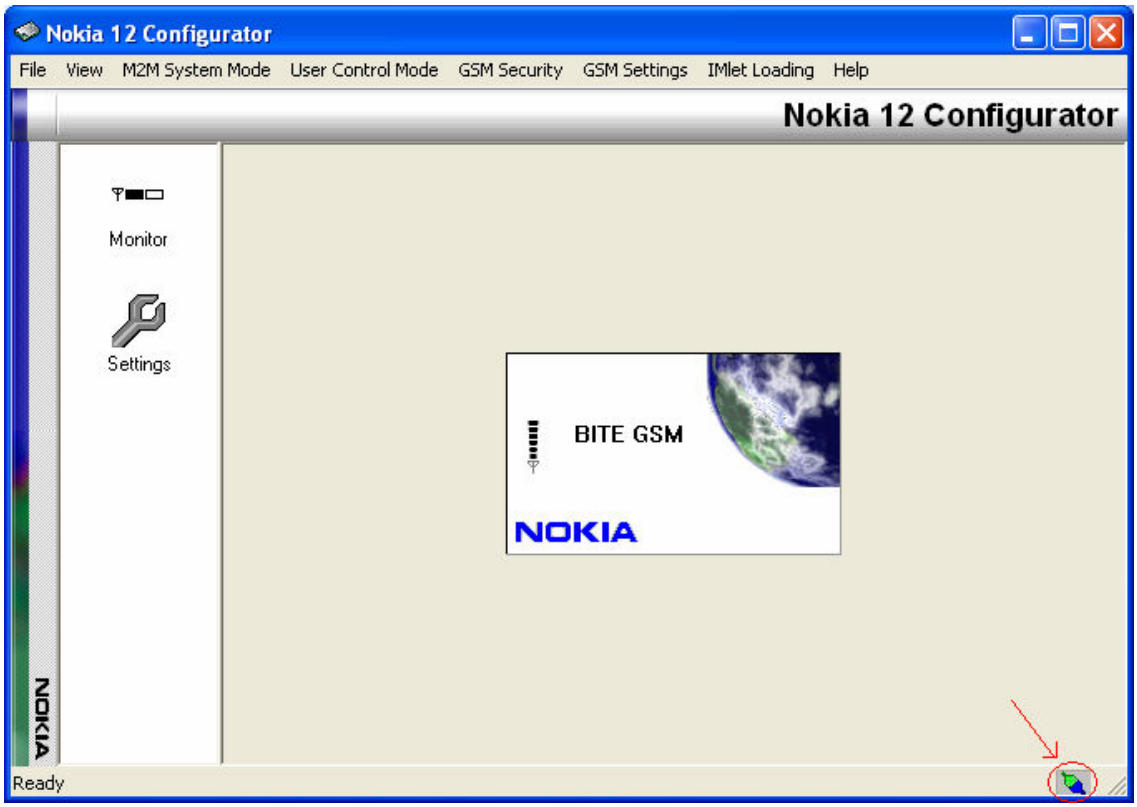


Figure 2. **Nokia Configurator window, which is seen after connection establishment**

4) If you are not sure which COM port you connected T-BoxN12R to, you could try to detect that with Hyper Terminal utility. This program is usually found in Windows 98/ME/200/XP. You should find it in "Start->Programs->Accessories->Hyper Terminal". If you can't find it, it could possibly be not installed. You should click "File->Properties" in the main Hyper Terminal window. Select the first possible COM port and click "Configure". You should select the settings as shown in Figure 3. Then click "OK" to close "COMx Properties" window and click "OK" to close "Properties" window. Then click "Call->Call". You should see something similar to Figure 4. New characters should appear instantly. If they do, the selected COM port is the one, to which T-BoxN12R is connected. If not, there is no connection and you should try the

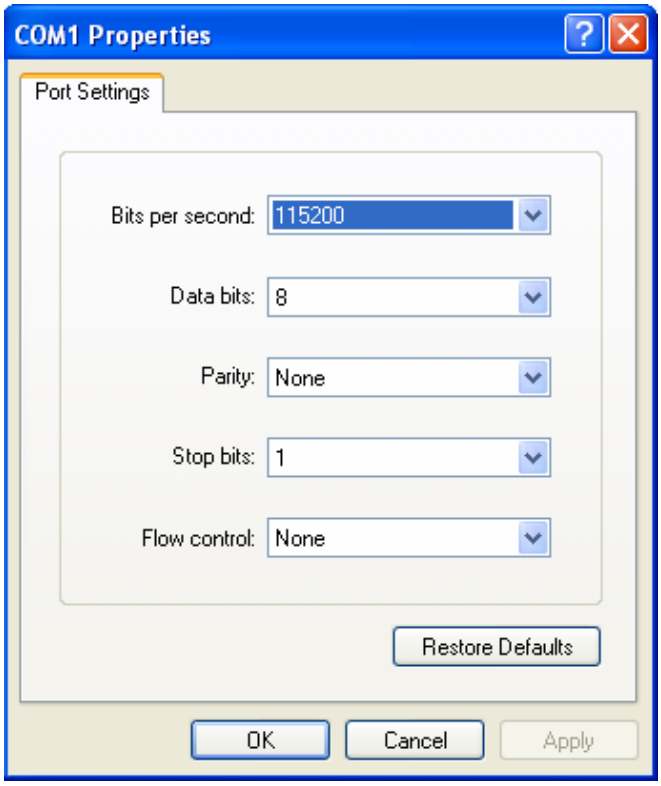


Figure 3. **Hyper Terminal "Properties"**

other available COM ports, until you succeed. To exit the program, click "Call->Disconnect" and then "File->Exit".

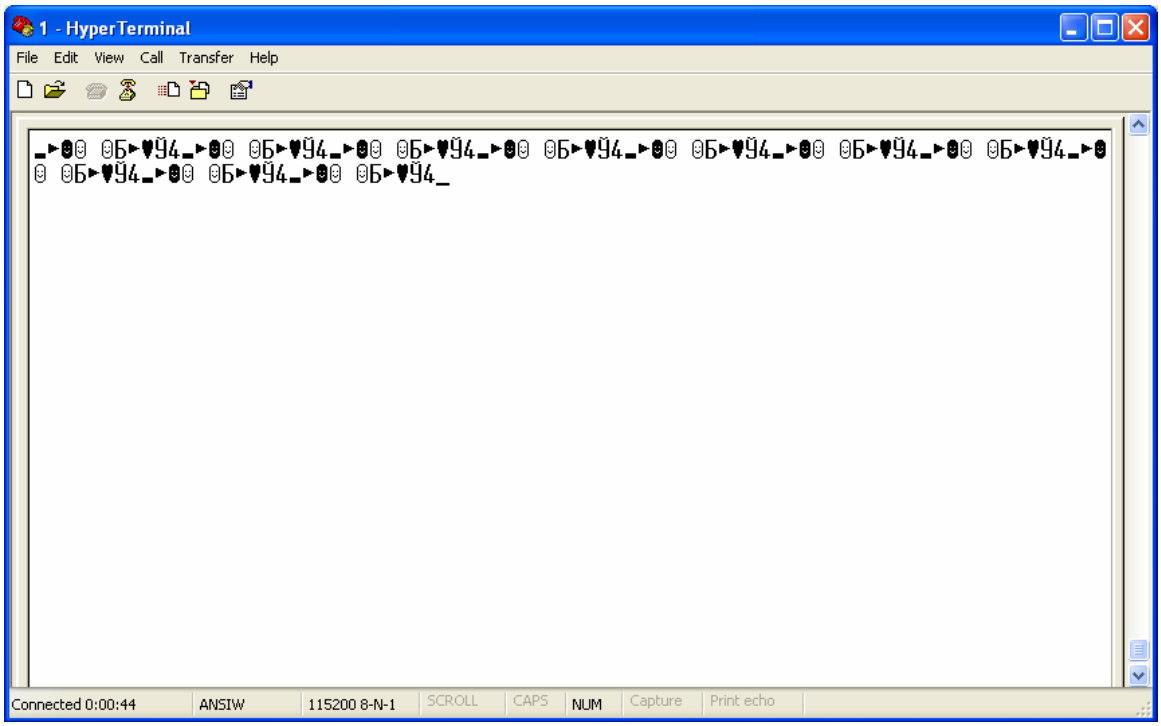


Figure 4. **Hyper Terminal window when T-BoxN12R is connected to the selected port**

5) Please try to plug the cable to another PC COM port and change the settings in Nokia Configurator accordingly. **Note: after plugging the cable to another COM port, please restart the T-BoxN12R. To do that you need to switch off the power, wait for at least 2-3 seconds and switch it on again.**

6) Please be sure you wait at least 20-30 seconds after clicking "OK" in Nokia Configurator settings.

7) It may happen that your computer's COM port is not functioning well, so if you have possibilities, before contacting technical support, please try to use another computer (preferably with another operating system) for connecting to T-BoxN12R. You may also try using a USB-COM or PCI-COM adapter as a COM port.

11. TECHNICAL SPECIFICATIONS

11.1. Mechanical specifications and operating conditions

Parameter	Min	Typical	Max	Unit
Size		120 x 101 x 22,55		mm
Weight		148 ± 10		g
Operating temperature (absolute maximum)	-25		+70	ºC
Storage temperature	-40		+85	ºC

11.2. Absolute maximum ratings

Parameter	Max	Unit
Maximum digital input voltage[3]	440	V
Maximum analog input voltage (DC)[3]	440	V
Maximum digital output voltage		

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

11.3. Electrical parameters

Parameter	Min	Typical	Max	Unit
Power supply voltage	+9		+30	V
Average power consumption		360		mW
Peak power consumption[1]		8400		mW
Digital output high voltage[2]		3,8		V
Digital output low voltage[2]		0		V
Digital output current[2]			70	mA
Digital output load[2]			200	mW
Digital input low voltage[3]	0		4,99	V
Digital input high voltage[3]	5		24	V
Digital input resistance[3]	22			kΩ
Analog input voltage range[4]	0		27	V
Analog input resistance	22			kΩ

[1] such power consumption takes no longer than 1,2 ms

[2] OUT2, OUT3, OUT4, OUT5, OUT6, OUT7, OUT8, OUT9

[3] IN5, IN6, IN7, IN8, IN9, IN10, IN11

[4] AIN1, AIN2, AIN3

12. TECHNICAL SUPPORT

If you encounter any problems when using our products, please refer to Troubleshooting on page 20. If you do not find a solution for your problem, please contact our technical support by writing an e-mail to support@teltonika.lt . We will be pleased to help you.

If you are interested in other products from Teltonika, please visit our website www.teltonika.lt, where you will find our newest products.

If you are interested in product pricing or want to order our products with different antennas, connectors or built-in programs, please contact our sales department by writing an e-mail to sales@teltonika.lt .