Installation Guide for 21Net-box (Model BL70W)

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Date	Version	Change introduced
13/04/2015	0.9	Draft version.
16/04/2015	1.0	First version
21/08/2015	1.1	Added internal components info
30/06/2016	2.0	Amended A.J.Work. Diagrams and text updated. FCC regulatory items added Safety warnings added RF specifications included Installation instructions revised
04/08/2016	2.06	amended. A.J.Work

1.Table of contents

This equipment complies with FCC radio frequency radiation exposure limits set forth for an uncontrolled environment. It shall be fix installed such as to provide the minimum distance of 100cm between its radiating structures (antennae) and nearby persons as described within this manual.

Co-location of the equipment with further radio transmitters will require additional FCC equipment authorization measures.

2.**Main features**

The 21Net box, model BL70W is computer box that has been designed for use as a mobile internet router in rolling-stock (high speed or freight trains), commercial vehicles and airplanes.

The unit contains 4 FCC approved Sierra Wireless modems type MC7354. Each modem can select one of two SIM cards and all 4 modems can operate simultaneously. The modems operate in the following bands:

GPRS 850: 824 - 849 MHz
GPRS 1900: 1850 - 1910 MHz
WCDMA/UMTS FDD BAND II: 1850 - 1910 MHz
WCDMA/UMTS Band IV: 1710 - 1755 MHz
WCDMA/UMTS FDD BAND V: 824 - 849 MHz
LTE BAND 2/25: 1850 - 1915 MHz
LTE BAND 4: 1710 - 1755 MHz
LTE BAND 5: 824 - 849 MHz
LTE BAND 13: 777 - 787 MHz
LTE BAND 17: 704 - 716 MHz
CDMA BC0: (Cellular 800 MHz)
CDMA BC1: 1850 - 1910 MHz
CDMA BC10: 816 - 824 MHz

The 21Box provides a mobile internet router and gateway, based on 4 LTE/3g modems and an Ethernet output. Routing is provided by an Intel i5 processor. GPS functionality is built in. The 21Net box does not provide any voice functionality.

The modem antenna-outputs (one pair for each modem) are directly available as N-type connectors. The GPS connector is a TNC connector on the front panel.

3.Product Safety (ESD)

Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.

4.About this document

This user manual is intended only for system integrators, it is not intended for end users. It describes the hardware functions of the 21Net-box and explains how to interface and connect the devices to the network. It also provides additional information about the special application interface that has been designed to make it easier when you configure the system for the first time.

REMARK: This manual does not include detailed information about debugging of applications that run on the 21Net-box.

5.Conventions

mono A	monospaced font type is used for explanation.
italics	Italic is used to highlight system functions.
bold	Bold type is used for emphasis (text color could be **black** or **red**)

Indicates important information or warnings concerning proper functionality of the product described in this document.

Indicates important information or warnings concerning the use of voltages that could lead to a hazardous situation which could result in personal injury, or damage or destruction of the component.

6. Important Information for North American Users

The 21Net Box is designed and intended to be installed and comissioned exclusively by 21Net approved personnel, as a modular component in larger systems. The 21Net box contains 4 Sierra Wireless MC7354 modems which have been granted modular FCC approval for mobile applications.

***Changes or modifications made to the equipment not expressly approved by 21Net may void the FCC authorization to operate the equipment.* (FCC part 15.21);**

The 21Net box contains 4 MC7354 FCC pre-certified modules, FCC ID: N7NMC7355, containing transmitter module 2417C-MC7355.

The use of the 21Net box and the MC7354 modems in a final product is required to meet the following conditions, otherwise additional FCC approvals must be obtained:

1. At least 100 cm separation distance between the antenna and the user's body must be maintained at all times.

2. To comply with FCC / IC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile-only exposure condition must not exceed the level in Table 1 (below):

6.5 dBi in Cellular band
3.0 dBi in PCS band
3.0 dBi in LTE Band 2
6.0 dBi in LTE Band 4
6.5 dBi in LTE Band 5
9.0 dBi in LTE Band 13
9.0 dBi in LTE Band 17
3.0 dBi in LTE Band 25

Table 1: Maximum antenna gain (including transmission losses)

3. The output power and antenna gain in a collocated configuration must not exceed the limits and configurations stipulated in Table 2 below:

Device	Technology	Band	Frequency (MHz)	Collocated configuration	
				Maximum antenna gain (dBi)	Maximum conducted power (dBm)
Any 21Net box internal modem (MC7354 Mini Card)	LTE	2	1850–1910	3.0	See table 3
		4	1710–1755	6.0	
		5	824–849	3.0	
		13	777–787	6.0	
		17	704–716	6.0	
		25	1850–1915	3.0	
	UMTS	2	1850–1910	3.0	See table 3
		4	1710–1755	6.0	
		5	824–849	3.0	
	GSM/GPRS	Cellular (850)	824–849	3.0	See table 3
		PCS (1900)	1850–1910	3.0	
	CDMA	BC0	824–849	3.0	See table 3
		BC1	1850–1910	3.0	
		BC10	817–824	3.0	
Collocated transmitters (see note)	WLAN		2400–2500	5.0	29
			5150–5850	5.0	29
	WiMAX		2300–2400	5.0	29
			2500–2700	5.0	29
			3300–3800	5.0	29
	BT		2400–2500	5.0	15

Table 2: Collocated configuration specifications

Note (Table 2): Valid collocated transmitter combinations: WLAN+BT; WiMAX+BT.

(WLAN+WiMAX+BT is not permitted.)

Parameter	Conducted transmit power	Notes
LTE		
LTE Band 2, 4, 5, 13, 17, 25	+23 dBm ± 1 dB	
UMTS		
Band 1 (IMT 2100 12.2 kbps) Band 2 (UMTS 1900 12.2 kbps) Band 4 (AWS 1700/2100 12.2 kbps) Band 5 (UMTS 850 12.2 kbps) Band 8 (UMTS 900 12.2 kbps)	+23 dBm ± 1 dB	Connectorized (Class 3)
GPRS/EDGE		
GSM850 CS EGSM900 CS	+32 dBm ± 1 dB	GMSK mode, connectorized (Class 4; 2 W, 33 dBm)
	+27 dBm ± 1 dB	8PSK mode, connectorized (Class E2; 0.5 W, 27 dBm)
DCS1800 CS PCS1900 CS	+29 dBm ± 1 dB	GMSK mode, connectorized (Class 1; 1 W, 30 dBm)
	+26 dBm ± 1 dB	8PSK mode, connectorized (Class E2; 0.4 W, 26 dBm)
CDMA		
Band Class 0 (Cellular)	+24 dBm +0.5/-1 dB	
Band Class 1 (PCS)	+24 dBm +0.5/-1 dB	
Band Class 10 (Cellular)	+24 dBm +0.5/-1 dB	

Table 3: Conducted Transmit power tolerances

4. The 21Net box may transmit simultaneously with other collocated radio transmitters within a host system, provided the following conditions are met:

· Each collocated radio transmitter has been certified by FCC/IC for mobile application.

· At least 100 cm separation distance between the antennas of the collocated transmitters and the user's body must be maintained at all times.

7.Antenna requirements (and attenuator considerations)

The antenna type used with te 21Net box an external multi-band 2x2 MIMO antenna system as per the modem MC7354. The MIMO antenna provides diversity operation. The intended antenna is the Huber & Suhner 1399.17.0222 Sencity Rail MIMO Antenna. Alternatively the version of this antenna with GPS receive antenna is the Huber & Suhner 1399.99.0130.

A lower gain alternative would also be the Huber & Suhner 1399.17.0135 Sencity Rail low profile MIMO Antenna (1399.99.0057 with GPS).

The 4 pairs of modem antenna connectors (one pair per modem) would normally pass through a combiner/diplexer network before reaching the antenna(s). The attenuation between any antenna connector on the 21Net box and any antenna port needs to be 6dB in order to remain within the FCC limits.

In the case where 4 MIMO antennas are connected without a combiner network, a 6dB inline attenuator needs to be placed on each of the 8x N connectors on the 21Net box before the antenna is connected. The recommended attenuator is the Mini Circuits UNAT-6+ attenuator.

Depending on the combiner network required per specific application, the attenuation between any N connector on the 21Net box and any antenna connector should be a minimum of 6dB. Inline attenuators from Mini circuits, UNAT-n+ series (where n is the required attenuation) will be required on the relevant modem port(s).

CASE STYLE: FF779

Connectors	Model
N-Type	UNAT-6+

8.Opening the unit

- To install SIM-cards you need to open the unit. The procedure to do this is described here below.

8.1.Safety

Always switch off the power before you open the unit!

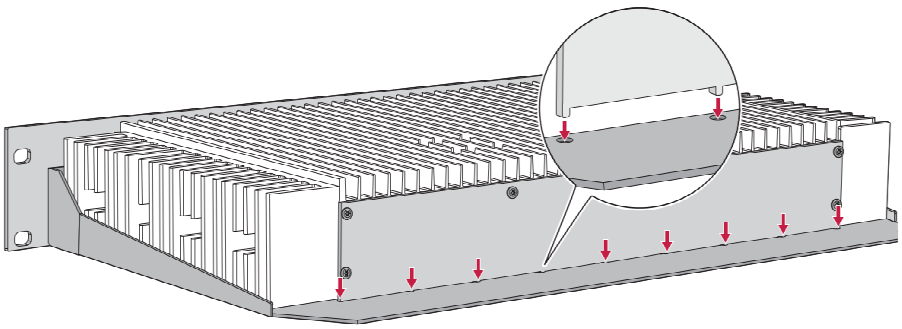
REMARK: Please observe the instructions concerning electrostatic discharge whenever you work on the inside of the unit. Strap yourself to the ground before touching any electronic component !

8.2.Tools

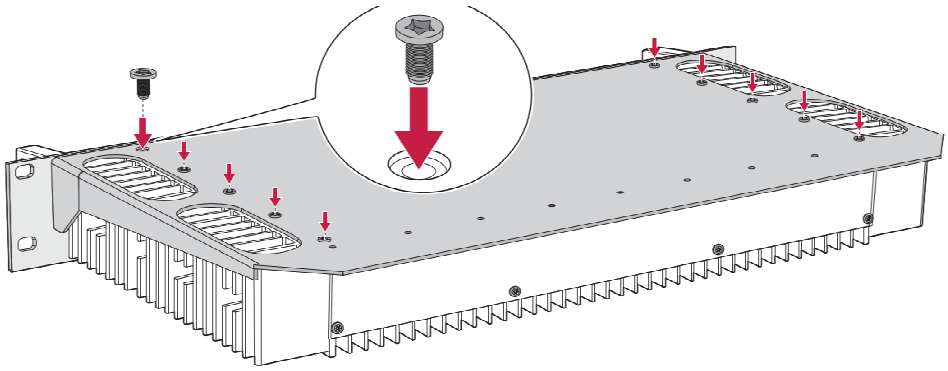
You need a Torx screwdriver model TX8 to open the box.

Start by removing the 5 screws that hold the front panel to the 19 inch chassis. There are 2 on the left side, 2 on the right side and one on the middle.

Next, remove the back panel. Six M3x8 (TX8 Torx) screws holding this panel in place with the chassis. There are small studs that are positioned inside the bottom plate of the 19 Inch chassis (see drawings below).



Now the chassis is almost free. Remove the ten M3x8 screws.



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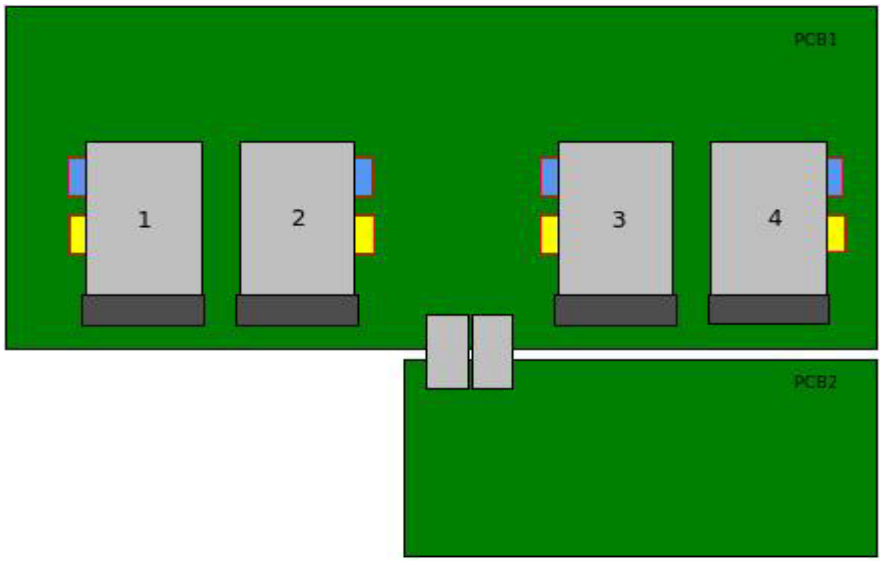
The chassis can be detached from the box and the inside parts become visible.

9.Inside the box

The inside the unit are 4 mini PCI-Express modems. Each modem serves 2 SIM holders. The modems have a number (marked from 1 till 4 on the drawing below). This way you know which SIM should belong to which modem.

9.1.Locating Modems & SIMs

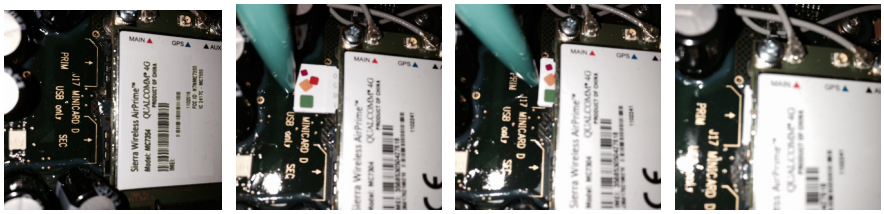
The SIM card-models are micro-SIMs. The SIM-holders are located under the modem modules. SIM-holder1, the primary SIM, is marked with a blue color on the drawing, SIM-holder2 is marked with a yellow color.



9.2.Inserting SIM cards

The pictures below show you how to place the SIM cards in the holder (the photos below show the placement of a microSIM in SIM-holder 1)

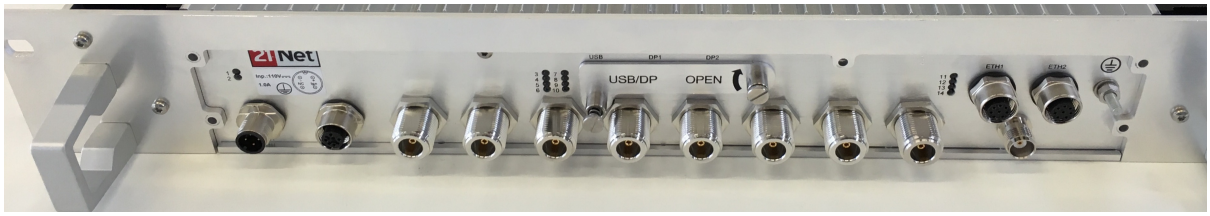
locate the modem -> slide SIM in holder -> push gently inside till click -> verify if SIM is locked



Once the SIM is locked you hear a click. To remove the SIM push gently to the locked SIM and gently pull the SIM outwards.

9.3.Connecting antennas & GPS

There are 8 N-type connectors for the 3g/4g antenna system. The GPS antenna connector is TNC.



The antenna numbering is from left to right, and is always paired as MAIN (M) and AUX(A). The connections from left to right therefore are : [M1 - A1] [M2 - A2] [M3 - A3] [M4 - A4]

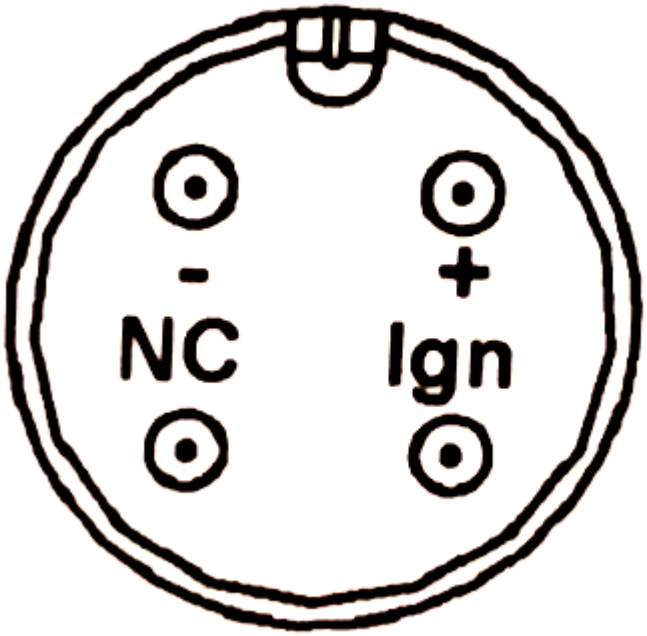
GPS: The unit is equipped with a GNSS receiver module with 32 channels. The module supports GPS signal detection for Glonass and Galileo satellites. The box supports passive and active antennas. In case you choose for an active antenna, the 5 V dc antenna power is supplied by the box.

10.Connecting power

Our 21Net model “BL70W” is supplied with a nominal input voltage of 24Vdc (operating voltage range is 10 to 50.4 Vdc)

The power connector is at the left hand side of the unit, as shown below:

Pin layout



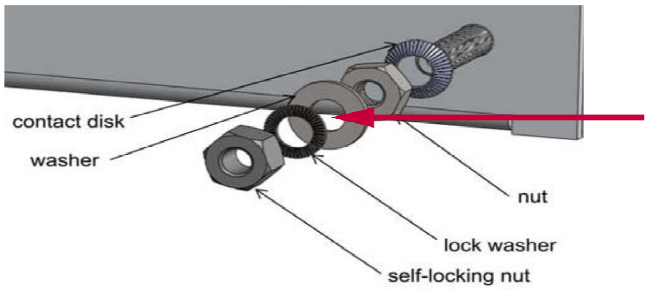
REMARK: When you don't have any intention to use the ignition signal, you need to connect the "Ign" pin to the +24v line in order for the unit to operate.

10.1.Grounding the 21Net box

The 21Net-box features an earthing stud on the right side of the front panel.

An earthing cable has to be connected to the earthing stud before any other connections! For disassembling the system, the earthing cable has to be detached last.

Take an earthing cable with a cross section of at least 0.75 mm2 . Slide the cable onto the stud between the washer and the lock washer as indicated in the following picture.



10.1.1.Train Id and Unit Id

The 21Net box is delivered pre-configured, including the unique train-ID and Unit-ID. These parameters are be agreed before supply and set by a 21Net technician prior to installation.

Configuration supplied for the wrong train - Please contact 21Net

11.Technical Data

11.1.The Mass Storage

• One microSDTM card slot

- Via USB 2.0

• One mSATA slot

- SATA Revision 2.x support

- Transfer rates up to 300 MB/s (3 Gbit/s)

• Serial ATA (SATA)

- One port for 2.5" hard-disk/solid-state drive mounted within the unit's

- SATA Revision 2.x support

- Transfer rates up to 300 MB/s (3 Gbit/s)

11.2.Graphics

• Integrated in processor and chipset

• Maximum resolution: 2560 x 1600 pixels

• Via two DisplayPort® interfaces

11.3.Front I/O

• 2 DisplayPort® 1.1a interfaces

- AUX channels and hot plug detection

• 2 Gigabit Ethernet

- Via M12 connectors

- Electrically isolated

• 2 USB 2.0

- Via Series A connector

• 7 general purpose inputs

- Input voltage range from 0 V up to 154 V independent of the power supply

- Input signal frequency max. 10 Hz

11.4.I/O specifications

• 2 relay outputs

- Max. switching current 0..30 V: 2 A

- Max. switching current 30..72 V: 0.9 A
- Max. switching current 72..154 V: 0.3 A
- Max. switching voltage: 154 V
- Max. switching frequency: 1 Hz
- Minimum life time @ 1A, 30V, 20 cpm: 100.000
- Electrically isolated

• 2 Photocouplers

- Max. switching voltage: 154 V
- Max. current: 120 mA (switching and continuous)

• 1 odometer input

- For counting odometer pulses of a maximum frequency of 2 kHz

• 1 IBIS slave interface

- Baud rate up to 19.2 kBaud
- Electrically isolated

• GNSS interface

- Frequency band: GPS (L1), Glonass (L1, FDMA), Galileo (E1)
- Standards: NMEA, RTCM 104
- 32-channel GNSS architecture
- Accuracy: 1.5 m
- A-GPS
- Time-To-First-Fix – cold start: lower than 35 s
- Time-To-First-Fix – warm start / aided start: 1s
- Odometer input for GNSS receiver

• RS232

- D-Sub connector at front panel
- Data rates up to 115 200 bit/s
- 60-byte transmit/receive buffer
- Handshake lines: RTS, CTS
- Electrically isolated

• RS422/485

- D-Sub connector at front panel
- Full or half duplex
- Electrically isolated

• 2 SA-Adapter slots for legacy serial I/O

- For RS232, RS422/485 or IBIS master

• 1 SA-Adapter slot for RS232, RS422/485, IBIS or CAN

• 14 status LEDs

- 4 for Ethernet link and activity status
- 2 for general board status

- 8 user LEDs

11.5.PCI Express® Mini Card slots

• The 21Net box contains four 4G modems

- Mobile service standards: GSM (2G), UMTS (3G), LTE (4G)
- Support for 2 SIM cards per modem

11.6.Real-Time Clock

• Buffered by Gold Cap for up to 72 h

11.7.Electrical Specifications

• Supply voltage comes in different models

- 10 to 50.4 Vdc input voltage range
- EN 50155 power interruption class S2

• Power consumption: 24 Watt typ (35 Watt with 4 active modems and system under load)

11.8.Mechanical Specs

The Box is available with a 19 inch rack-mountable frame. The unit dimensions without this frame are:

- Height 66 mm x Width 390 mm x Length 215 mm
- Weight: approx. 3 kg

11.9.Environmental Specifications

• Temperature range (operation):

- -40°C to 70°C (screened), with up to 85°C for 10 minutes according to class Tx (EN 50155) at fanless operation.

• Temperature range (storage): -40..+85°C

• Relative humidity (operation): max. 95% non-condensing.

• Relative humidity (storage): max. 95% non-condensing.

• Altitude: -300 m to +3,000 m

• Shock: 50 m/s2, 30 ms (EN 61373).

• Vibration (function): 1 m/s2, 5 Hz – 150 Hz (EN 61373).

• Vibration (lifetime): 7.9 m/s2, 5 Hz – 150 Hz (EN 61373).

• Conformal coating of internal components.

- • Compliant to protection class IP43 according to DIN60529 when mounted with connectors down.

11.10.MTBF

- • 198 000 h @ 40°C according to IEC/TR 62380 (RDF 2000)

11.11.Safety

• Flammability

- UL 94V-0

• Fire Protection

- EN 45545-2

• Electrical Safety

- - EN 50153 and EN 50155

11.12.EMC Conformity (Automotive)

• ECE R10 (E-mark)

• ISO 10605 (ESD)

11.13.EMC Conformity (railway)

• EN 50121-3-2