



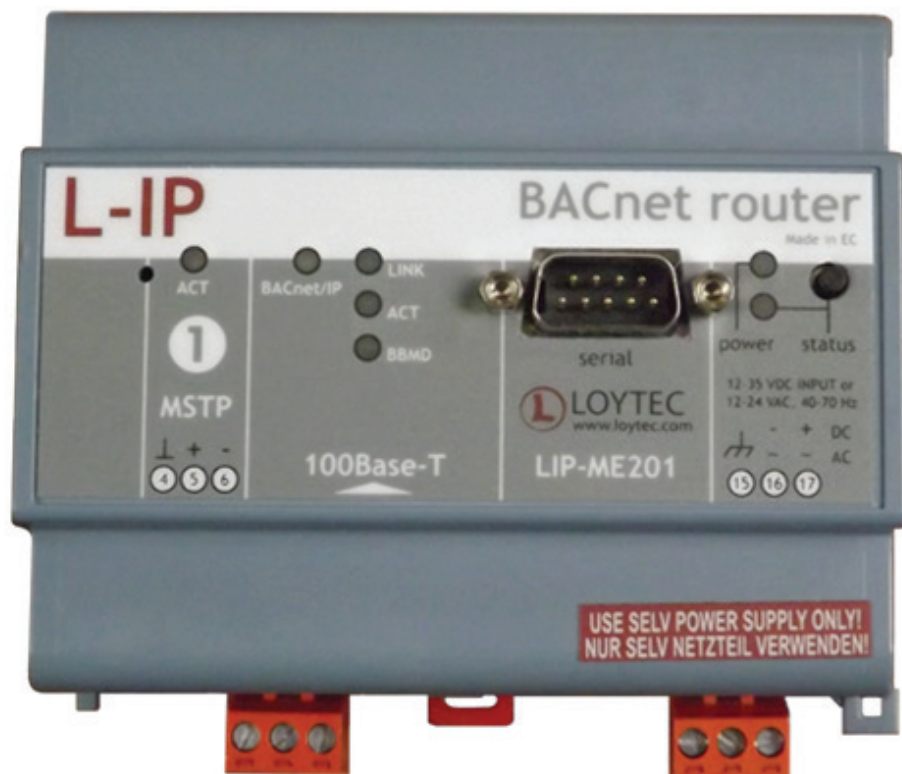
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MCS-BACNET-ROUTER 2

Installation & Reference Guide



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Revision/Disclaimer Page

Date	Author	Description of Changes
2015--03-23	DEW	Restructured manual
2016-11-17	DEW	CHANGE DWG PAGE 3
2017-07-14	DEW	Re-do Manual using Loytec quick start manual
2017-30-17	DEW	Add UL and BTL logos - remove RoHS

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Abbreviations

100BaseT	100 Mbps Ethernet network with RJ-45 plug
ACL.....	Access Control List
BACne	Building Automation and Control Network
BBMD	BACnet Broadcast Management Device
BDT.....	Broadcast Distribution Table
B/IP.	BACnet over IP (this is a BACnet data link layer)
DHCP	Dynamic Host Configuration Protocol
DNS.....	Domain Name System
DST.....	Daylight Saving Time
FD.....	Foreign Device
FTP	File Transfer Protocol
GMT.....	Greenwich Mean Time
IP	Internet Protocol
MAC.....	Media Access Control
MS/TP.....	Master/Slave Token Passing (this is a BACnet data link layer)
NAT.....	Network Address Translation
NTP.....	Network Time Protocol

Chapter - 1. Introduction

1.1. Overview

The MCS-BACNET-ROUTER2 is a BTL-certified BACnet router between MS/TP and B/IP (BACnet over IP) as well as a BBMD (BACnet Broadcast Management Device) for transportation of BACnet broadcasts over an IP network with several subnets. Additionally, it can serve as a BACnet time master and a BACnet MS/TP slave proxy. The MCS-BACNET-ROUTER2 also provides additional features such as optional write protection of the BDT, a BACnet/IP access control list and a simple BBMD communications test to troubleshoot the network. The MS/TP port supports remote Wireshark packet capture for troubleshooting the MS/TP channel.

1.1.1 Scope

This document covers MCS-BACNET-ROUTER2 devices.

For additional information on the MCS-BACNET-ROUTER2 (LIP-ME201)
<https://www.loytec.com/products/routers-nic/lip-bacnet>

Chapter - 2. Quick-Start Guide

This chapter provides the minimum list of steps necessary to setup the MCS-BACNET-ROUTER2 model MCS-BACNET-ROUTER2.

2.1. Hardware Installation and IP Connection

- Connect power, Ethernet, and MS/TP.
- Connect the Console (Section 8.2.1) and configure the IP address, netmask, and gateway or connect to the MCS-BACNET-ROUTER2 over the Web interface right away and setup the IP configuration there.
- In both cases, reboot the MCS-BACNET-ROUTER2 to commit the new IP settings (use corresponding menu item either in console menu or Web interface).

Important!

The default IP address 192.168.1.254 is only set for configuration access. It must be changed in order to make the device functional.

2.2. **Configuration of the** MCS-BACNET-ROUTER2

- Connect to the MCS-BACNET-ROUTER2 using the new IP address in a Web browser.
- ➔ • Click on Config and enter the default administrator password '**loytec4u**'. Note, that older firmware versions used 'admin' as the password.
- Click on BACnet Config and setup the BACnet Device Configuration).
- Click on Port Config and setup the BACnet/IP and BACnet MS/TP port configuration
- If the MCS-BACNET-ROUTER2 should also act as a BBMD, click on BACnet BDT and setup the Broadcast Distribution Table.
- Reboot the MCS-BACNET-ROUTER2 to commit the changes.

2.3. MS/TP Protocol Analyzer

The MCS-BACNET-ROUTER2 is equipped with a built-in MS/TP protocol capture facility. This facility can be used for offline logging, which stores a log file on the device, or online remote logging with Wireshark. With remote capture a Wireshark protocol analyzer on the PC can capture a live log of the MS/TP channel. For doing so, the remote capture has to be enabled. See Section 8.3 for more details.

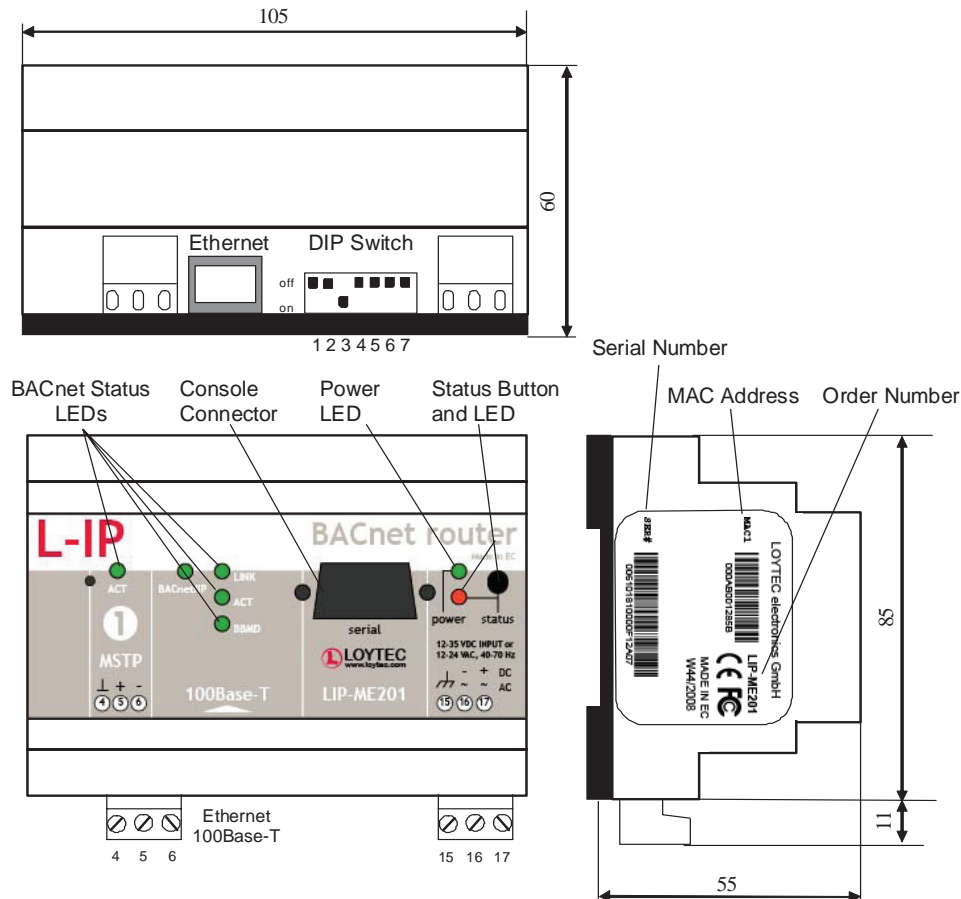
2.4. Reset to Factory Defaults

In case the password of the device has been forgotten you may need to reset the device back to factory defaults to gain access again. On the MCS-BACNET-ROUTER2 press the service button and power-cycle the device. Keep the button pressed until the port LEDs illuminate orange permanently. Release the button within five seconds from that time on to reset the device to factory defaults.

Chapter - 3. Hardware Installation

3.1. Enclosure

The MCS-BACNET-ROUTER2 enclosure is 107 mm wide for DIN rail mounting, following DIN 43 880 (see Figure 1).



3.2. Product Label

The product label on the side of the MCS-BACNET-ROUTER2 contains the following information (see Figure 1):

- MCS-BACNET-ROUTER2 Order Number,
- Serial Number with bar-code (SER#),
- Ethernet MAC Address with bar-code (MAC1).

Unless stated otherwise, all bar codes are encoded using "Code 128". An additional label is also supplied with the MCS-BACNET-ROUTER2 for documentation purposes.

3.3. Mounting

The device comes prepared for mounting on DIN rails following DIN 50 022. The device can be mounted in any position. However, an installation place with proper airflow must be selected to ensure that the MCS-BACNET-ROUTER2's temperature does not exceed the specified range (see Chapter 10).

3.4. LED signals

3.4.1 Power LED

The MCS-BACNET-ROUTER2 power LED lights up green when power is supplied to terminals 16 and 17.

3.4.2 Status LED

The MCS-BACNET-ROUTER2 is equipped with a red status LED (see Figure 1). This LED is normally off. If the fall-back image is executed, the status LED flashes red once every second.

3.4.3 MSTP Activity LED

The MS/TP port has a three-color MSTP Activity LED (see Figure 1). Table 1 shows the different LED patterns of the port and their meaning. A permanent color reflects a state. Flicker is for 25 ms when there is activity on the MS/TP data link layer.

Behavior	Description	Comment
GREEN permanently, flicker off	Multi-Master, token ok, flicker when traffic	Normal condition on a multi-master MS/TP network.
ORANGE flicker	Sole master, flicker when traffic	Normal condition on a single-master MS/TP network.
RED permanent, flicker GREEN	Token lost state, flicker when transmit attempt	Cable might be broken.
RED flash fast	Transmission or receive errors	This indicates bad cabling.

Table 1: MS/TP Activity LED Patterns

3.4.4 Ethernet Link LED

The Ethernet Link LED lights up green whenever an Ethernet cable is plugged-in and a physical connection with a switch, hub, or PC can be established.

3.4.5 Ethernet Activity LED

The Ethernet Activity LED lights up green for 6 ms whenever a packet is transmitted or received or when a collision is detected on the network cable.

3.4.6 BACnet/IP LED

The BACnet/IP LED flashes green for 25 ms when BACnet packets are transmitted or received over the BACnet/IP interface.

3.4.7 BBMD LED

The BBMD LED is permanent green if BBMD is enabled. Otherwise, it is off.

3.5. Status Button

The MCS-BACNET-ROUTER2 is equipped with a status button (see Figure 1). When pressing the status button shortly during normal operation of the MCS-BACNET-ROUTER2, it sends a BACnet “I-Am” message on all active BACnet data link layers.

The status button can also be used to switch the device back to factory default state. Press the service button and power-cycle the device. Keep the button pressed until the port LEDs illuminate orange permanently. Release the button within five seconds from that time on to reset the device to factory defaults. Alternatively, the device can be switched back to factory defaults over the console user interface.

1.1 DIP Switch Settings

The DIP switch assignment for the MCS-BACNET-ROUTER2 is shown in Table 2. Please leave all switches at default state.

DIP Switch #	Function	Factory Default
1	Must be OFF	OFF
2	Must be OFF	OFF
3	Must be ON	ON
4	Must be OFF	OFF
5	Must be OFF	OFF
6	Must be OFF	OFF
7	Must be OFF	OFF

Table 2: DIP Switch Settings for MCS-BACNET-ROUTER2

1.2 Terminal Layout and Power Supply

The MCS-BACNET-ROUTER2 provides screw terminals to connect to the network as well as to the power supply. The screw terminals can be used for wires of a maximum thickness of 1.5 mm²/AWG12. The device can either be DC or AC powered.

Terminal	Function
4	BACnet MS/TP Ground
5	BACnet MS/TP Non-Inverting Input
6	BACnet MS/TP Inverting Input
8	Ethernet 100BaseT
15	Earth Ground
16, 17	Power Supply 12-35 VDC or 12-24 VAC ± 10% Do not connect terminal 17 to earth ground!

Table 3: MCS-BACNET-ROUTER2 Terminals

3.6. Wiring

If BACnet over MS/TP is enabled, the MS/TP network segment must be properly terminated with an LT-04 network terminator connected at each of the two ends of the segment media.

Important:

When using 2-wire MS/TP, earth ground must be connected to both terminal 15 and 16 (see Figure 2a). Never connect terminal 17 to earth ground!

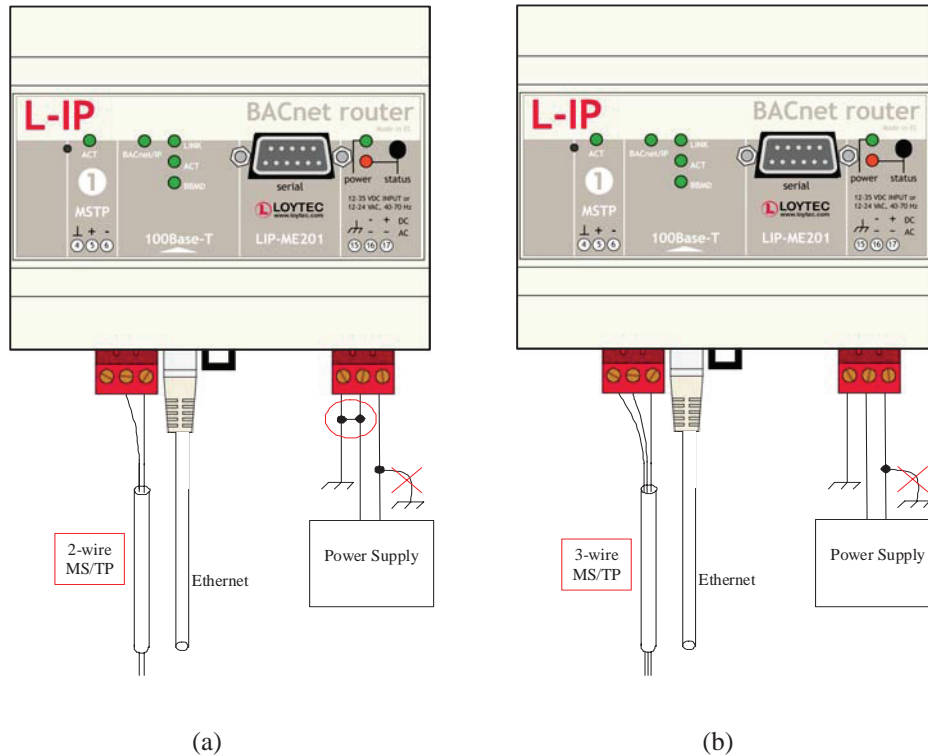
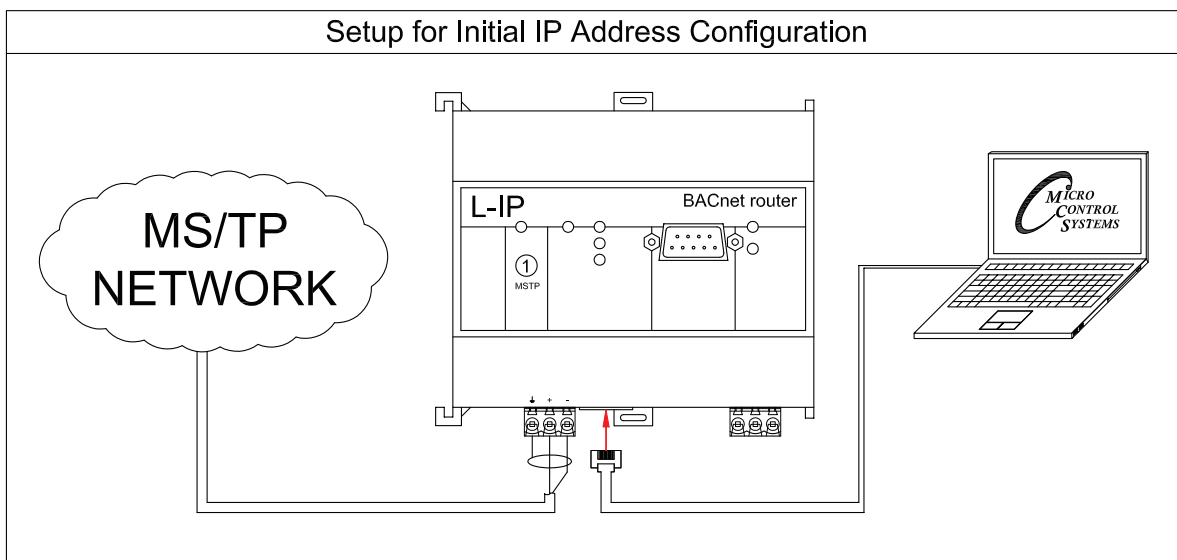


Figure 2: Connecting the LIP-ME201: (a) 2-wire MS/TP, (b) 3-wire MS/TP



Chapter - 4. Web Interface

The MCS-BACNET-ROUTER2 comes with a built-in Web server and a Web interface to configure the MCS-BACNET-ROUTER2 and extract statistics information. The Web interface allows configuring the IP settings, BACnet and other configuration settings.

4.1. Device Information and Account Management

In a Web browser, enter the default IP address 192.168.1.254 of the MCS-BACNET-ROUTER2. Note that if your PC has an IP address in a subnet other than 192.168.1.xxx, you must open a command tool and enter the following route command to add a route to device.

To Add a Route to the Device

1. Windows **START 7 Run**
2. Enter 'cmd' and click **OK**.
3. In the command window enter the command line
4. route add 192.168.1.254 %COMPUTERNAME%
5. In Windows7 replace %COMPUTERNAME% with the PC's actual IP address.
6. Then open your Web browser and type in the default IP address '192.168.1.254'.
7. The device information page should appear as shown in Figure 3.

The screenshot displays the 'Device Info' page of the web interface. On the left, there is a navigation menu with options: Device Info, Config, Statistics, Reset, Contact, and Logout. The main content area features a table titled 'General Info' with the following data:

General Info	
Product name	L-IP BACnet Router
Product code	LIP-ME201
Firmware	L-IP BACnet Primary Image
Version	1.2.0
Build date	2010-05-07 11:54:08
Serial number	011101-000AB001C4AE
Free memory	11830K, 622K
Free flash	14121K
CPU load	0.0%
System temperature	40.0°C
Supply voltage	23.8V

In the bottom right corner, there is a logo for 'goahead WEB SERVER'.

Figure 3: Device Information Page.

The device information page shows information about the MCS-BACNET-ROUTER2 and the current firmware version. It also contains operational parameters, such as free memory, system temperature and supply voltage.

4.2. Login and Passwords

Click through the menus on the left hand side to become familiar with the different screens. If you click on **Config** in the left menu, you will be asked to enter the administrator password in order to make changes to the settings as shown in Figure 4. Enter the default administrator password 'loytec4u' and select **Login**. Note, that previous firmware versions used 'admin' as the default password.

Figure 4: Enter 'loytec4u' as the default administrator password.

The Config menu opens. Click on **Passwords** in the Config menu, which opens the password configuration page as shown in Figure 5. The device has three user accounts: (1) **guest** allows the user to view certain information only, e.g., the device info page. By default the guest user has no password. (2) **operator** is able to read more sensible information such as calendar data. (3) **admin** has full access to the device and can make changes to its configuration. Note that the user accounts are also used to log on to the FTP and Telnet server.

Figure 5: Password Configuration Screen.

Please change the administrator password in order to protect yourself from unwanted configuration changes by anyone else. To do so, select the **admin** account in the drop-down box and enter the new password. If the administrator password is left empty, password protection is turned off and everyone can access the MCS-BACNET-ROUTER2 without entering a password. Click on **Change password** to activate the change.

4.3. Device Configuration

The device configuration pages allow viewing and changing the device settings of the LIP- ME201. Here are some general rules for setting IP addresses, port numbers, and time values:

- An empty IP address field disables the entry.
- An empty port number field sets the default port number.
- An empty time value field disables the time setting.

4.3.1 System Configuration

The system configuration page is shown in Figure 6. This page allows configuring the device's system time and other system settings. The **TCP/IP Configuration** link is a shortcut to the Ethernet port configuration. Follow that link to change the IP settings of the device.

The time sync source can be set to **auto**, **manual**, **NTP**, **BACnet**. In the **auto** mode, the device switches to the first external time source that is discovered. Possible external time sources are NTP, BACnet. The option **manual** allows setting the time manually in the fields **Local Time** and **Local Date**. In **manual** mode, the device does not switch to an external time source. Note, that if **NTP** is selected, the NTP servers have to be configured on the IP Configuration page (see Section 4.2.4).

The time zone offset must be defined independently of the time source. It is specified as the offset to GMT in hours and minutes (e.g., Vienna/Austria is +01:00, New York/USA is

-06:00). For setting the daylight saving time (DST) predefined choices are offered for Europe and USA/Canada. DST can be switched off completely by choosing **none** or set manually for other regions. In that case, start and end date of DST must be entered in the fields below.

The screenshot shows the 'Config System' interface for a LOYTEC device. The page is titled 'Config System' and includes a navigation menu on the left with options like 'Device Info', 'Config', 'Statistics', 'L-Web', 'Reset', 'Contact', and 'Logout'. The main content area is titled 'networks under control' and contains several configuration sections:

- Date/Time**: Includes fields for 'Time sync source' (set to 'auto'), 'Local Date' (2010-04-27), 'Local Time' (12:05:14), and 'UTC Date/Time' (2010-04-27 12:05:14). There are also fields for 'Timezone offset' (+00:00) and 'Daylight saving time (DST)' (None).
- Earth Position**: Includes fields for 'Latitude' (48° 13' 14" N), 'Longitude' (16° 20' 05" E), and 'Altitude' (200 m).
- CSV Files**: Includes a 'CSV delimiter' dropdown menu.

Buttons for 'Save Date/Time', 'Get Date/Time', 'Save Earth Position', 'Get Earth Position', 'Save CSV Settings', and 'Get CSV Settings' are provided for each section.

Figure 6: System Configuration Page, e.g., for Vienna, Austria.

The next section on the page allows to configure the device's earth position. This setting defines the longitude, latitude and elevation of the device. The latitude and longitude are entered as degrees, minutes, and seconds. The altitude is entered in meters height above sea level. This setting is used for an astronomical clock. For fixed locations such as a building, the position can be entered on this page.

The CSV delimiter setting can be ignored on the MCS-BACNET-ROUTER2.

4.3.2 Backup and Restore

A configuration backup of the MCS-BACNET-ROUTER2 device can be downloaded via the Web interface. Click the backup link as shown in Figure 7 to start the download. The LIP- ME201 device assembles a single file including all required files. A file requestor dialog allows specifying the location where the backup file shall be stored.

To restore the device settings, simply select a previously generated backup file in the **Restore Configuration** section of the page by clicking the button next to the **Filename** field. Then press the **Restore** button.

The backed up configuration data consists of:

- Device settings (Passwords, IP settings, BDT, ACL, etc.),

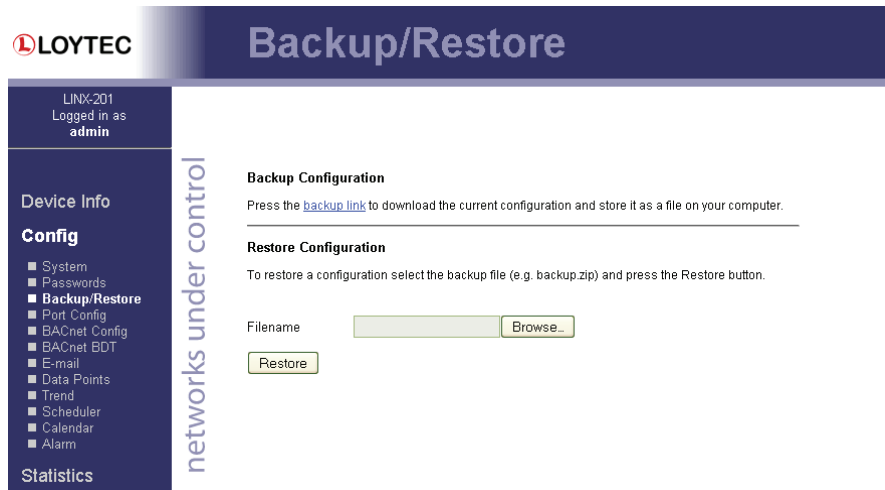


Figure 7: Backup/Restore page.

4.3.3 Port Configuration

This menu allows configuring the device's communications ports. For each communication port, which is available on the device and shown on the label (e.g., Port 1, Port 2, Ethernet), a corresponding configuration tab is provided by the Web UI. An example is shown in Figure 8. Each port tab contains a selection of available communication protocols. By selecting a checkbox or radio button the various protocols can be enabled or disabled on the communication port. Some ports allow exclusive protocol activation only, other ports (e.g., the Ethernet port) allow multiple protocols bound to that port.

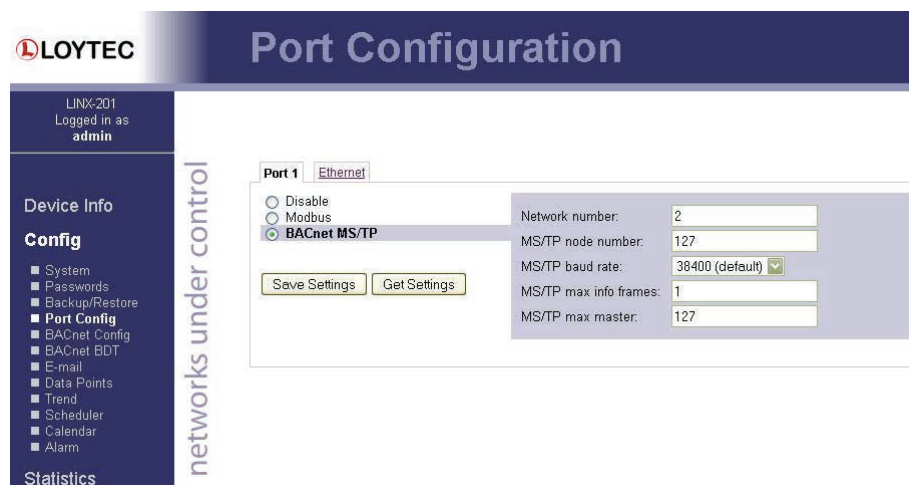


Figure 8: Port Configuration Page.

When selecting a protocol on a communication port, the protocol's communication parameters are displayed in a box on the right-hand side. To save the settings of the currently opened protocol, click the **Save Settings** button. Pressing **Get Settings** retrieves the current settings from the device.

4.3.4 IP Configuration

The TCP/IP configuration is done under the Ethernet port tab as shown in Figure 9. The mandatory IP settings, which are needed to operate the device, are marked with a red asterisk (IP address, netmask, gateway). The **Enable DHCP** checkbox switches between manual entry of the IP address, netmask, and gateway address, and automatic configuration from a DHCP server.

Hostname and **Domainname** are optional entries and can be left empty. For some DHCP configurations it may be necessary to enter a hostname. Please contact your system administrator on how to configure DHCP to acquire an IP address. Further, you can configure up to 3 Domain Name Servers. Currently these entries are not used.

Figure 9: IP Configuration Page.

The device comes configured with a unique MAC address. This address can be changed in order to clone the MAC address of another device. Please contact your system administrator to avoid MAC address conflicts.

The device can be configured to synchronize its clock with NTP time. Enter the IP address of a primary and, optionally, a secondary NTP server. The device will use NTP as a time source if the time sync source in the system configuration page is set to **NTP** (see Section 4.2.1). The field **NTP status** below the NTP server settings displays the current NTP synchronization status (**out-of-sync**, or **in-sync**).

If the device is operated with a 10 Mbit/s-only hub, the link speed should be switched from **Auto Detect** to **10Mbps/Half-Duplex**. With modern 100/10 Mbit/s switches, this setting can be left at its default.

Other standard protocols that are bound to the Ethernet interface are FTP, Telnet, and HTTP (Web server). By deselecting the checkbox, those protocols can be individually disabled. The standard UDP/TCP ports can be changed in the respective protocol settings. An example for the FTP server is shown for FTP in Figure 10. The FTP server is used for instance to update the firmware (see Section 7.1). Note that HTTP for the Web server can only be disabled on the console interface or by using the device configuration of the Configurator.

Figure 10: FTP server configuration on the Ethernet port.

4.3.5 BACnet Device Configuration

Figure 11 shows the BACnet device configuration page. This configuration page allows setting the **Device ID**, which is the instance part of the Object_Identifier property of the BACnet Device object. The field **Device name** holds the name of the BACnet device object (property Object_Name).

Figure 11: BACnet Device Configuration.

Important:

The device ID and device name must be unique within the BACnet internetwork.

Further, the description and location can be configured. These configuration items correspond to the properties Description, and Location respectively of the BACnet Device object. For tuning BACnet application timing parameters, set **APDU timeout**, **APDU segment timeout**, and **APDU retry count**. The timeout values are entered in seconds allowing decimal notation, e.g. "7.5".

On the settings for BACnet/IP refer to Section 4.2.6. For configuring the MS/TP data link refer to.

Note:

If this page displays the message "Device communication is disabled via BACnet network!" the device has been externally disabled. Reboot the device to activate communication again.

4.3.6 BACnet/IP Configuration

The BACnet/IP protocol is available on the Ethernet port. To enable BACnet/IP on the device, select the BACnet/IP check box on the Ethernet tab of the port configuration page.

The BACnet/IP protocol settings are displayed in the settings box on the right-hand side as shown in Figure 12. The **Network Number** of the BACnet/IP port must be configured to operate the built-in router. If the

BACnet/IP network uses a non-default UDP port number other than 47808/0xBAC0, enter this port in the **BACnet/IP port** field. Enter '0' in this field for switching back to the default setting.

Figure 12: BACnet/IP Configuration.

In the field **BACnet/IP mode** the operation mode of the device is selected:

- **Device** (Default): In this mode the device operates as a regular BACnet/IP device on the local network without other advanced features.
- **Foreign Device** (FD): In this mode, the device registers at an existing BBMD in the BACnet/IP network as a foreign device. It is used, if the device is located as a single BACnet/IP device on a remote IP subnet or behind a NAT router. If operated as a foreign device behind a NAT router, port forwarding to the BACnet/IP port (UDP, default port 0xBAC0) and optionally to the Web server and FTP server port (TCP, default port 80 and 21) must be setup in the NAT router. If foreign device is selected, the following, additional settings must be made:
 - **FD BBMD IP address** and **FD BBMD port**: IP address and port of the remote BBMD the device registers at as a foreign device.
 - **FD re-registration**: A foreign device must periodically re-register at a BBMD. Here you can setup the corresponding interval. The default is 1800 seconds.
 - **FD retry timeout** and **FD retries**: Here you can specify the behavior, if registration does not work instantly. These values should be left at default: 30000ms / 3 retries.
- **Broadcast Management Device (BBMD)**: Same as 'Device' but the BBMD function is enabled). For BBMD-only function, MS/TP can also be disabled.

For debugging purposes, the BACnet/IP port can be disabled independently of the MS/TP port.

4.3.7 MS/TP Configuration

Figure 13: MS/TP Configuration.

The BACnet MS/TP protocol can be enabled on the device's port Port1. To enable it, click the BACnet MS/

TP radio button as shown in Figure 13. The MS/TP port on the LIP- ME201 is enabled by default. The MS/TP protocol settings are displayed in the settings box on the right-hand side as shown in Figure 13. Mandatory settings are the **MS/TP node number** and the **MS/TP baud rate**. The MS/TP node number determines the physical address of the device on the MS/TP channel and must be in the range from '0' to the number configured with the **MS/TP max master** configuration option. It must be unique within the MS/TP channel. The latter parameter defines the maximal number of MS/TP master devices on the MS/TP channel. The Baud rate on the MS/TP channel can be set to 9600, 19200, 38400, and 76800 Baud.

Important:

All masters on the MS/TP channel must have the same setting for MS/TP max master. Decreasing the default value 127 of MS/TP max master may reduce latency on the MS/TP bus.

It is strongly recommended to leave the **MS/TP max info frames** and the **MS/TP max master** configuration options at their default settings. In any case the **MS/TP max master** number must be high enough to include the highest MS/TP node number of all masters on the channel. Slave devices may have a higher MS/TP node number than **MS/TP max master**.

To operate with slow devices on the MS/TP network set the **Network Timing** option to slow. This increases a number of timeouts, which is needed by some devices, but slows down network communication. If communication problems occur in standard mode, try setting the slow mode.

The **Network Number** of the MS/TP port must be set to a non-zero value in order to operate the build-in BACnet/IP-BACnet MS/TP router.

For additional information on the MCS-BACNET-ROUTER2 (LIP-ME201)

<https://www.loytec.com/products/routers-nic/lip-bacnet>



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