

K-BUS[®] KNX IP Router

User manual-Ver.1

BNIPR-00/00.1

KNX/EIB Intelligent Installation Systems



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1. Summary

The IP Router can be used as line or backbone coupler. It provides a data connection between the upper KNXnet/IP line (main line or backbone) and the lower TP KNX bus line (sub line). The basic functionality of the IP Router is to couple the Ethernet with one or more KNX-TP lines. The IP Router features a galvanic isolation between the Ethernet and the KNX-TP line(s). Due to its flexibility the IP Router can be used as a line coupler e.g. to connect several KNX TP lines via Ethernet. And it can be used as a backbone coupler to connect several TP areas or different TP installation systems via Ethernet.

The main task of the IP Router is filtering the traffic according to the installation hierarchy. For group oriented communication the traffic is filtered according to the built-in filter tables.

With the ETS or any other KNX compatible commissioning tool the IP Router can be used as the programming interface. For this purpose the device provides up to 4 additional physical addresses that can be used for tunneling. The IP Router has no KNX communication objects for itself.

The IP Router is a Tunneling and Routing device. These features are described in the following sections in detail. The device front panel consists of seven LEDs and two buttons as illustrated below. The device offers a detailed internal diagnosis by displaying all operational states in different Operation Modes with three pairs of LEDs. The LEDs show the variety of device states like Bus OK, traffic, errors/faulty communication NACK, BUSY on the bus, state of the filter table, and etc.

The IP Router is a modular installation device. It can be installed in the distribution board on 35mm mounting rails according to EN 60 715.

This manual provides the technical information about the IP Router as well as assembly and programming in detail for users, and explains how to use the interface device by the application examples.

1.1 Function overview

The IP Router has the follow functions:

- The IP Router is one of the rare KNX IP routers on the market that supports long messages up to **240 bytes**. In combination with the line coupler and the long messages are made possible (e.g. for energy metering applications).
- The IP Router favourably replaces a line coupler or an area coupler. Using LAN as a fast medium to exchange telegrams between lines and/or areas is the great advantage.
- The IP Router works without external power supply.
- Providing tunneling protocols and a connection point for the ETS (or any other tool to enable commissioning and monitoring) the ETS address for tunneling is not necessarily the one that is already configured. Four parallel connections are possible, one separate address for each and every connection.
- IACK on own sent out messages (ETS configurable).
- After no IACK response on a sent message the IP Router can repeat it up to three times. For physically addressed or for group addressed telegrams this can be configured via ETS independently. In case of an IACK response there will be no repetition. The failure mechanism of a negative IACK or BUSY is still maintained hereby.
- Programmable automatic switch on of the filter table after timeout.
- For a predefined amount of time (ETS configurable) it is possible to switch off the filter table with pressing a button on the device. So, without reconfiguring the device with the ETS the filter table can be switched off by a button press which is necessary for running fast diagnostics on site. Filtering of messages can temporarily be disabled by pressing the “Function” button. This eases commissioning and debugging of the system. Without an ETS download a temporary access to other lines is possible. After the timeout an automatic switching the filter table on is implemented (the timeout is configurable in the ETS). This avoids forgetting to reactivate the filter.
- UPnP is available to discover the device in the IP network. That is only possible with a proper network installation in terms of topology. With the KNXnet/IP Search Request the ETS can recognize the device as a communication interface.
- For networks with a high bus load a high internal amount of communication buffers is suitable.
- The IP Router is featuring a high internal amount of communication buffers being capable of smoothing peaks in the communication load course.
- The IP Router’s ETS database entries are available for the ETS3.0f and upward.
- The IP Router supports KNXnet/IP, ARP, ICMP, IGMP, HTTP, UPnP discovery, UDP/IP, TCP/IP, DHCP und Auto IP.

1.2 Tunneling

The presence of the Internet Protocol (IP) has led to the definition of KNXnet/IP. KNXnet/IP provides the means for point-to-point connections like “KNXnet/IP Tunneling” for ETS and/or between a supervisory system and a KNX installation.

The KNXnet/IP Device Management provides configuring KNXnet/IP devices via the KNX network effectively. Additionally, with this the time required for network configurations is reduced.

1.3 Routing

Routing is the way of interconnecting KNX lines or areas via IP network(s) using KNXnet/IP. In IP networks the KNXnet/IP Routing defines how KNXnet/IP routers communicate with each other.

1.4 KNX IP Routers

The IP Router is a KNX IP router. KNX IP routers are highly similar to TP line couplers. The only exception is that they use the communication medium Ethernet as their main line. However, it is also possible to integrate KNX end devices via IP directly. This makes the Ethernet a KNX medium.

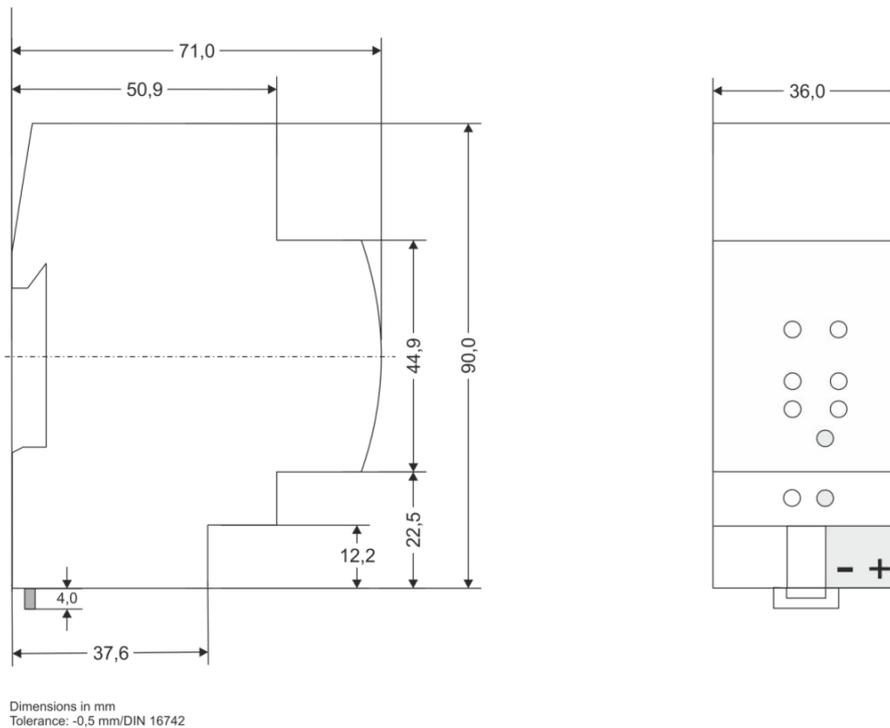
2. Technical Properties & Dimension and Circuit Diagram

2.1 Technical data

Power supply	Operation voltage	21-30V DC, via the EIB bus
	Current consumption, EIB	<40 mA
Connections	EIB / KNX	Via bus connection terminal (black/red)
	LAN	RJ45 socket for 100 Mbit and 10 Mbit BaseT, IEEE 802.3 networks
Operating and display	LED Bus State LAN	green on: LAN line ok; green off: LAN line error or not connected; red on: manual overwrite active
	LED Bus State KNX	green on: KNX line ok; green off: KNX line not connected

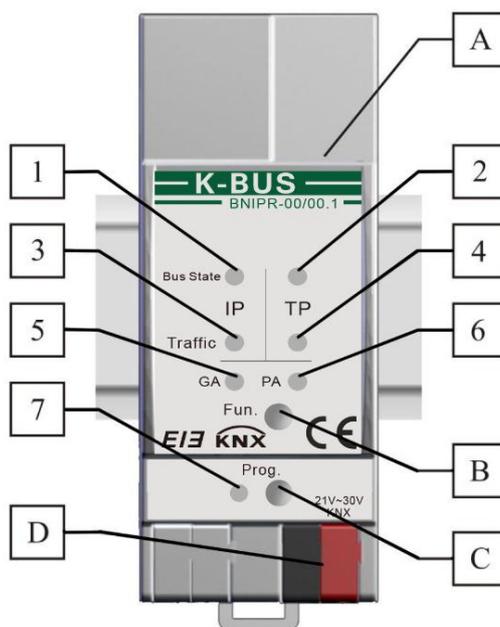
	LED Traffic on LAN	green blinking: bus traffic on LAN line ; green off: no traffic on; red blinking: transmission error on LAN line
	LED Traffic on KNX	green blinking: routed bus traffic from KNX line to LAN; green off: no traffic routed; red blinking: transmission error on KNX line.
	LED Group Address	off: LAN and KNX different; green: filter table active; green and red: route all; red: block
	LED Physical Address	off: LAN and KNX different; green: filter table active; green and yellow: route all; yellow: block
	Programming button and LED	For assignment of the physical address
	Function button	Switch to manual override
Temperature	Operation	-5 °C ... + 45 °C
	Storage	-25 °C ... + 55 °C
	Transport	- 25 °C ... + 70 °C
Ambient	Humidity	5%~93%, except condensation
Design	Modular installation device, on 35mm mounting rail	
Dimensions	90 mm×36 mm×71mm	
Weight	0.1KG	
Housing, colour	Plastic PA66 housing, grey	
Protection	IP 20, to EN 60529	
CE mark	in accordance with EMC and low voltage guidelines	
Markings	KNX/EIB	

2.2 Dimension diagram



1 SU = 18mm

2.3 Circuit diagram



1. LED Bus State LAN-- green on: LAN line ok; green off: LAN line error or not connected; red on: manual overwrite active
 2. LED Bus State KNX-- green on: KNX line ok; green off: KNX line not connected
 3. LED Traffic on LAN-- green blinking: bus traffic on LAN line ; green off: no traffic on LAN line, speed up to 10Mbit/s, red blinking: transmission error on LAN line.
 4. LED Traffic on KNX-- green blinking: routed bus traffic from KNX line to LAN; green off: no traffic routed; red blinking: transmission error on KNX line.
 5. LED GA (Group Address): Routing of group telegrams; off: LAN and KNX different; green: filter table active; green and red: route all; red: block
 6. LED PA (Physical Address): Routing of physical addressed telegrams; off: LAN and KNX different; green: filter table active; green and yellow: route all; yellow: block
 7. Programming LED: Red on: device in boot mode or addressing mode ; red blinking: LAN line error.
Upon receiving the physical address the device automatically returns from addressing mode to normal operating mode
- A. Ethernet connector
 - B. Function button: Switch to manual override via long operation (3s)
 - C. Programming button: Learning button for switching between normal operating mode and addressing mode for assigning the physical address
 - D. KNX-Bus connection

3. Planning and Application

According either to the factory default settings or the latest parameter settings downloaded from ETS (also other tools) in normal operating mode the IP Router operates as it is supposed to. The IP Router features two different modes, the “Normal Mode” and the “Boot Mode”.

3.1 Operation Modes

3.1.1 Normal Mode

	Green	Red
LED 1 Bus State LAN	Off: LAN line error or not connected On: LAN line OK	On: manual overwrite active
LED 2 Bus State KNX	Off: KNX line not connected On: KNX line OK	N.A.
LED 3 Traffic LAN	Blinking: bus traffic on LAN line Off: no traffic on LAN line Speed up to 10 Mbit/s	Blinking: transmission error on LAN line
LED 4 Traffic KNX	Blinking: Routed bus traffic from KNX line to LAN Off: no traffic routed	Blinking: transmission error on KNX line
LED 5 Group Address	Routing of group telegrams Off: LAN and KNX different, Filter table is active Green <i>and</i> red: route all	Block
LED 6 Physical Address	Routing of phys. addr. telegrams Off: LAN and KNX different, Filter table active Green <i>and</i> yellow: route all	Yellow: block
LED 7 Programming	N.A.	On: device in Boot Mode Blinking: LAN line error

3.1.2 The Function Button

The function button is used for two purposes; either to switch to manual override or to do a factory reset. It depends on the current operation mode of the IP Router and the duration of time this button is being pressed.

3.1.2.1 Switch to Manual Override

✧ **Long press (≈ 3 sec) in “Normal Mode”**

The default function is set by the LAN line and the (KNX) line parameters. Manual override functionality is configured in “General parameters”.

Please note:

The latest downloaded settings (parameters) and filter table are still available after switching back from “Manual operation” to “Normal operation”.

3.1.2.2 Factory Reset

✧ **Very long press (≈ 15s) in “Normal Mode”**

A factory reset is carried out by pressing the button for about 15 seconds (LEDs light red). After release, pressing it again for some seconds resets all the parameters to factory default (incl. physical address). Subsequently, the LEDs change their status.

3.1.3 The Programming Button and LED

✧ **In “Normal Mode”:**

To download the desired physical address and/or a full ETS settings download the programming button needs to be pressed. Successive pressing on the programming button will lead to turn on and off the programming LED, i.e. LED 7 which is lighting red. The blinking red programming LED indicates that the Ethernet cable is not properly connected.

3.2 KNX Telegrams in the IP Network

The IP Router sends telegrams from/to the KNX to/from the IP network in accordance with the KNXnet/IP protocol specification. According to the default setting these telegrams are sent as multicast telegrams to the multicast IP address 224.0.23.12 port 3671. The multicast IP address 224.0.23.12 is the defined address for the KNXnet/IP from the KNX Association in conjunction with the IANA. This address should be preserved and used as defined. Only if it becomes necessary due to the existing network, it could be changed in the “General Parameters” as described in KNX Multicasting Address. During commissioning, it is important to note:

- ✧ *All KNX IP devices that are intended to communicate with each other via IP network must have the same IP multicast address*
- ✧ *Multicast IP address 224.0.23.12 may need to be changed corresponding to the type of network and the setting of the network components*
- ✧ *IGMP (Internet Group Management Protocol) is used for the IP configuration to establish multicast group memberships*
- ✧ *If the IP address is changed from the IP side, it may sometimes happen that the ETS does not recognize the device anymore and the connection can no longer be established (tunneling uses IP address)*
- ✧ *As a precaution, always run a restart or change the address from the TP side*
- ✧ *Please ask your administrator if problems occur for the IP Address assignment*
- ✧ *According to the topology, the additional physical addresses (for tunnelling) always have to be assigned in the range of sub line addresses. For more information about the additional tunneling addresses please refer to Tunneling addresses (Additional Phys. Addresses).*
- ✧ *If a KNX/USB or KNX/IP interface is used to program a device of another line connected to a KNX IP Router, you should pay close attention to have the correct topology!*

3.2.1 The IP Router in a Network Installation

In a network installation the IP Router can either be used as a KNX area coupler or as a KNX line coupler.

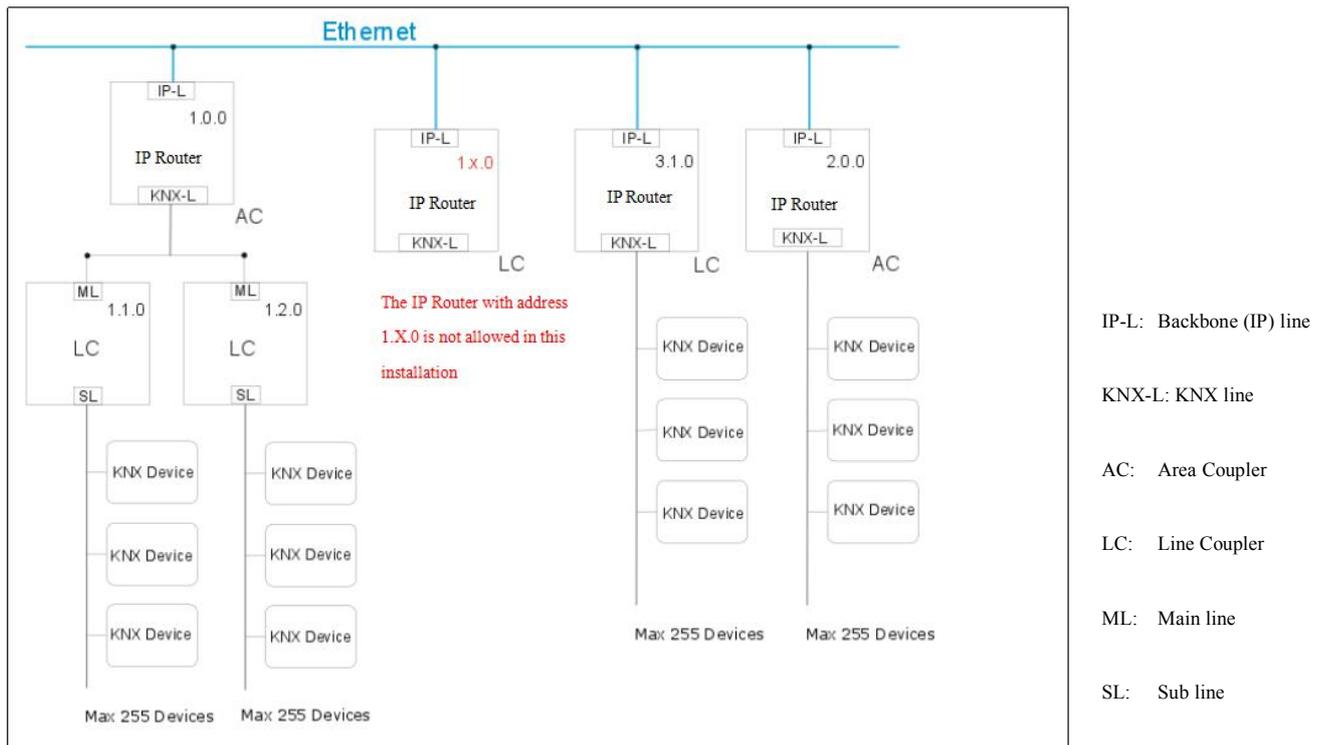
3.2.2 The IP Router as an Area Coupler

The IP Router can replace an **area coupler** in a KNX network. For this purpose it must receive the physical address of an area coupler (X.0.0, $1 \leq X \leq 15$). In the ETS up to **15 areas** can be defined with area couplers.

3.2.3 The IP Router in a Mixed System

If it is necessary in a KNX system to use the IP Router at one point as an **area coupler**, e.g. office or home complex, and at another point as a **line coupler**, e.g. a remote underground garage or a pool; this is possible. It is only necessary to ensure that the IP Router used as a line coupler uses a line coupler address from a free addressing area. The following picture best illustrates the topology with IP Router routers as area and/or line couplers. Special attention needs to be paid that if a IP Router area coupler with address “1.0.0” already exists in the installation, no other IP Router line coupler (or any other KNX IP router) with address “1.X.0, $1 \leq X \leq 15$ ” is allowed to be used in that network, and of course vice versa, if a IP Router line coupler with address “1.1.0” already exists in the installation, no other IP Router area coupler (or any other KNX IP router) with address “1.0.0” is allowed to be used in that network.

A direct connection between two IP Routers is possible as well. In this case, the auto IP will assign each IP Router an IP address and the two IP Routers will communicate over either a normal or a crossed network cable.



Mixed system

3.2.4 The IP Router as A Line Coupler

The IP Router of a KNX network can assume the functionality of a **line coupler**. For this purpose it must have the physical address of a line coupler (X.Y.0, $1 \leq X \leq 15$ & $0 \leq Y \leq 15$). In the ETS up to **225 lines** can be defined (from 1.1.0 to 15.15.0).

When the coupler receives telegrams (for example during commissioning) that use physical addresses as destination addresses, it compares the physical addresses of the receiver with its own physical address and then decides whether it has to route the telegrams or not.

Due to telegrams with group addresses the coupler reacts in accordance with its parameter settings. During normal operation (default setting), the coupler only routes those telegrams whose group addresses have been entered in its filter table.

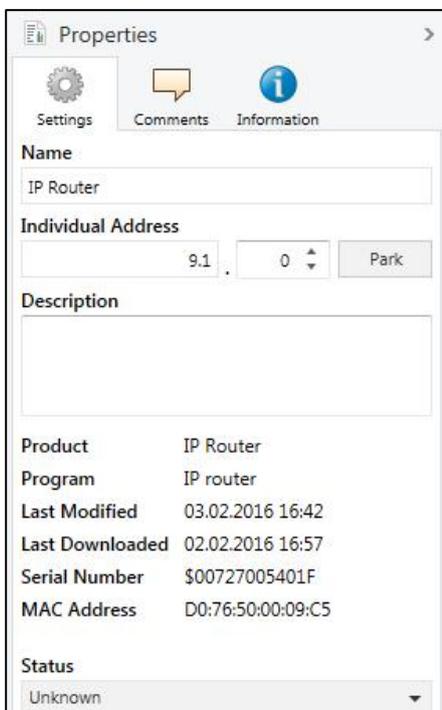
If the coupler routes a telegram and does not receive an acknowledgement, or if a bus device discovers a transmission error, the coupler repeats the telegram up to three times (depending on the corresponding parameter that is set to the device through the last ETS download). With the parameters „Repetitions if errors...“, this behaviour can be set separately for both lines. These parameters should stay with the default setting.

- ✧ *The ETS does not provide an unload procedure for the application of the IP-Router*
- ✧ *In the following description we describe parameters using screenshots created in the ETS5 version*

4. Parameter setting description in the ETS

All screen shots in this chapter represent the IP Router's database entry in ETS5.

4.1 Physical Address Assignment



To download the desired physical address and/or a full ETS setting into the device, during the procedure the programming button needs to be pressed.

(The programming button is used to put the device into “Program Mode”). With the ETS the physical address can be assigned to the device by setting the desired address in the properties window of the ETS, starting the download and pressing the programming button. After assignment the device restarts itself. (A blinking red LED 5 indicates that the Ethernet cable is not properly connected.)

To commission the device a PC with ETS and an interface connection (IP, USB) to the data bus is required. The device is supplied with the individual physical address 15.15.255. The KNX product database entry (available for ETS3 and higher) can be downloaded from our website or the KNX Online Catalog App.

Fig.4.1: Properties window

4.2 General

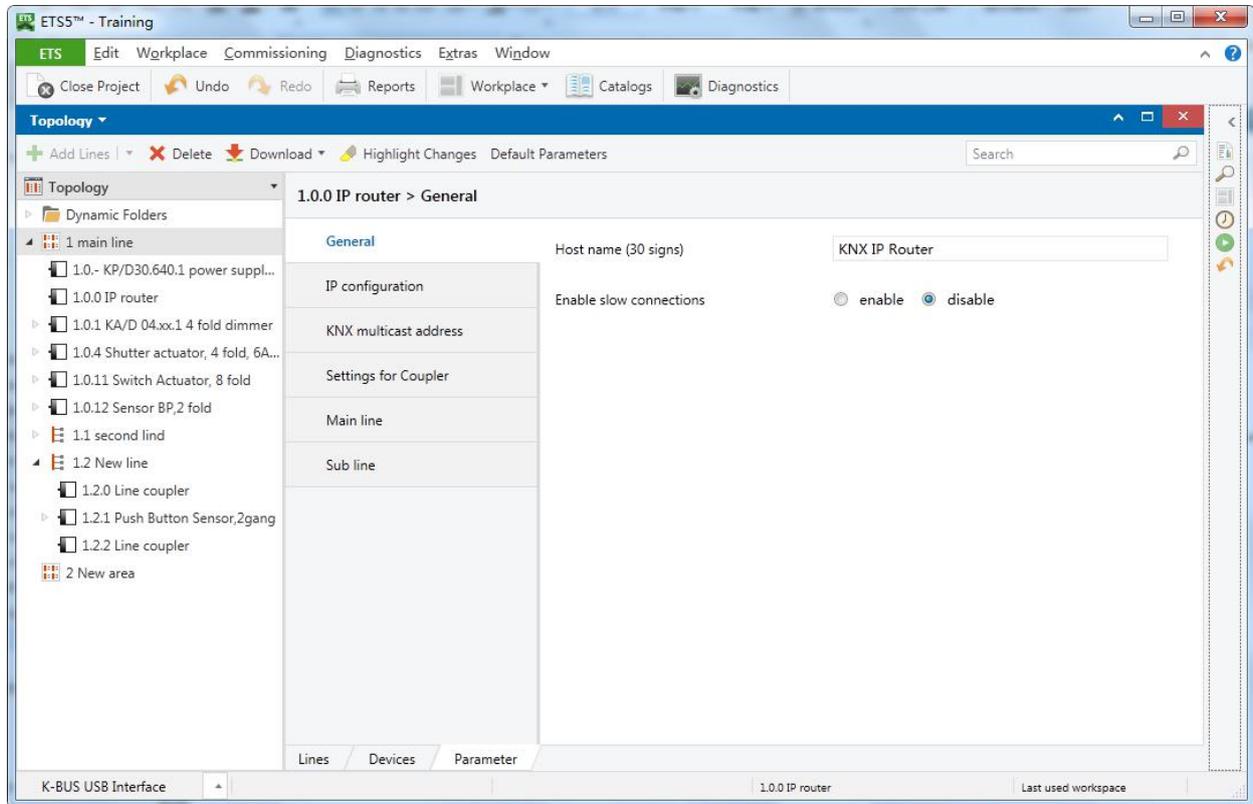


Fig. 4.2: General

ETS-Text	Selection	Comment
Host name	KNX IP Router	Field to enter the device name (30 signs max.) providing an easy search of the device with the ETS or with a KNXnet/IP visualisation system.
Enable slow connections	enable disable	Enable to support slow tunneling connections.

Please note that commissioning straight at delivery status (default settings) means:

- ✧ **The IP coupler does block all telegrams because the filter table is not defined,**
- ✧ **The fall-back time after manual operation is 120 min and**
- ✧ **The physical address is 15.15.0.**

Important notes:

- ✧ *If the host name is changed by an ETS4 download, a manual restart is recommended to take over this change.*
- ✧ *The configuration of the IP connectivity (Host name, IP address, KNX multicast address) is not updated after an ETS download. It is essential doing a manual device restart to get these values updated.*

4.3 IP Configuration

After downloading the IP parameters and the device name a manual restart has to be executed.

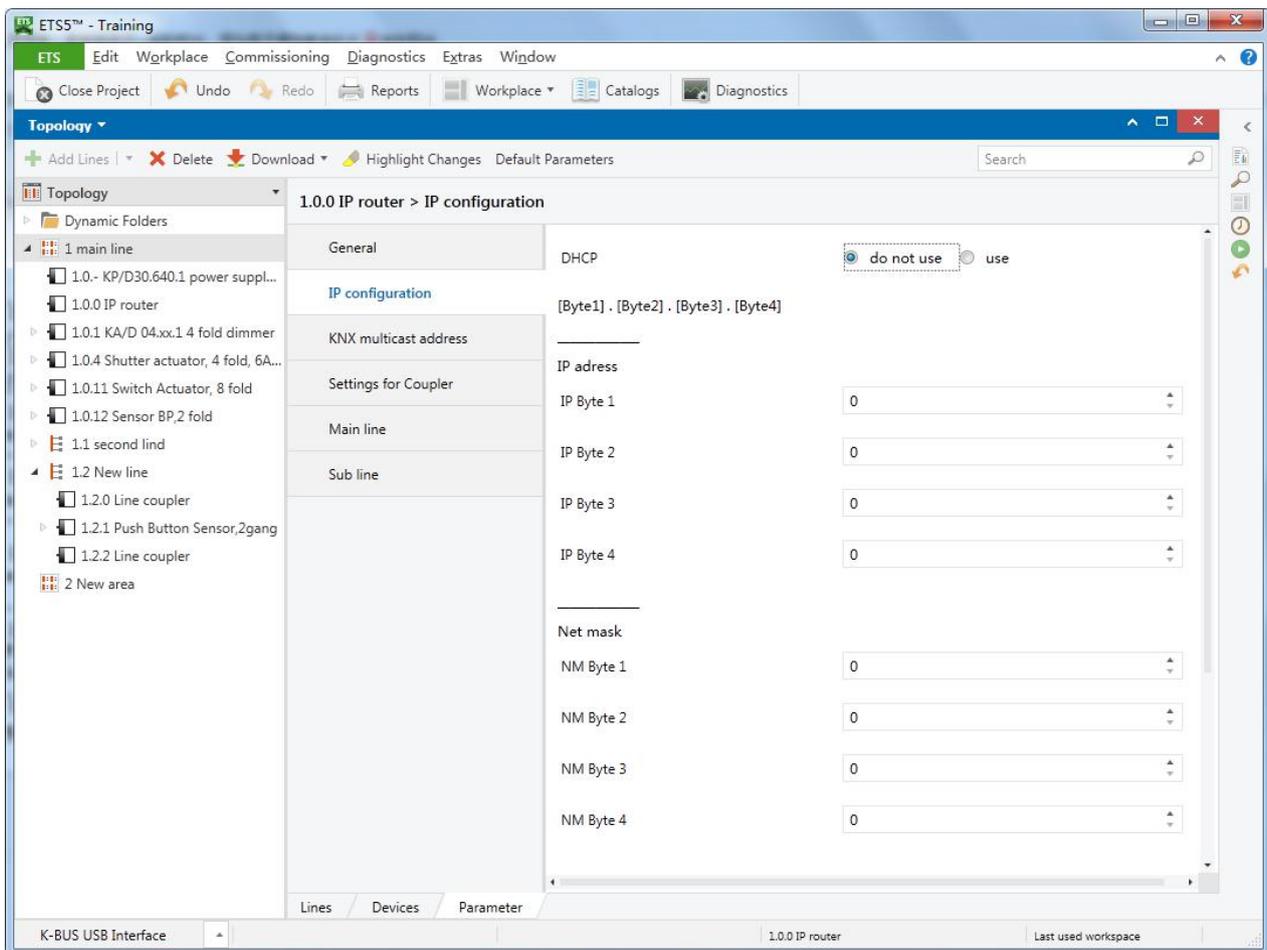


Fig 4.3: IP configuration

ETS-Text	Selection	Comment
DHCP	use	If DHCP is used, no parameterisation of IP parameters needed.
	do not use	If DHCP is not used, following parameters are to be set (see table below).

<u>IP address</u>	0-255.0-255.0-255.0-255	IP Byte 1 to 4: manual input.
<u>Net mask</u>	0-255.0-255.0-255.0-255	NM Byte 1 to 4: manual input.
<u>Gateway</u>	0-255.0-255.0-255.0-255	GW Byte 1 to 4: manual input.

4.4 KNX Multicasting Address

The multicast address **224.0.23.12** is the defined address for the KNXnet/IP from the KNX Association in conjunction with the IANA. This address shall only be changed if it becomes necessary due to the existing network.

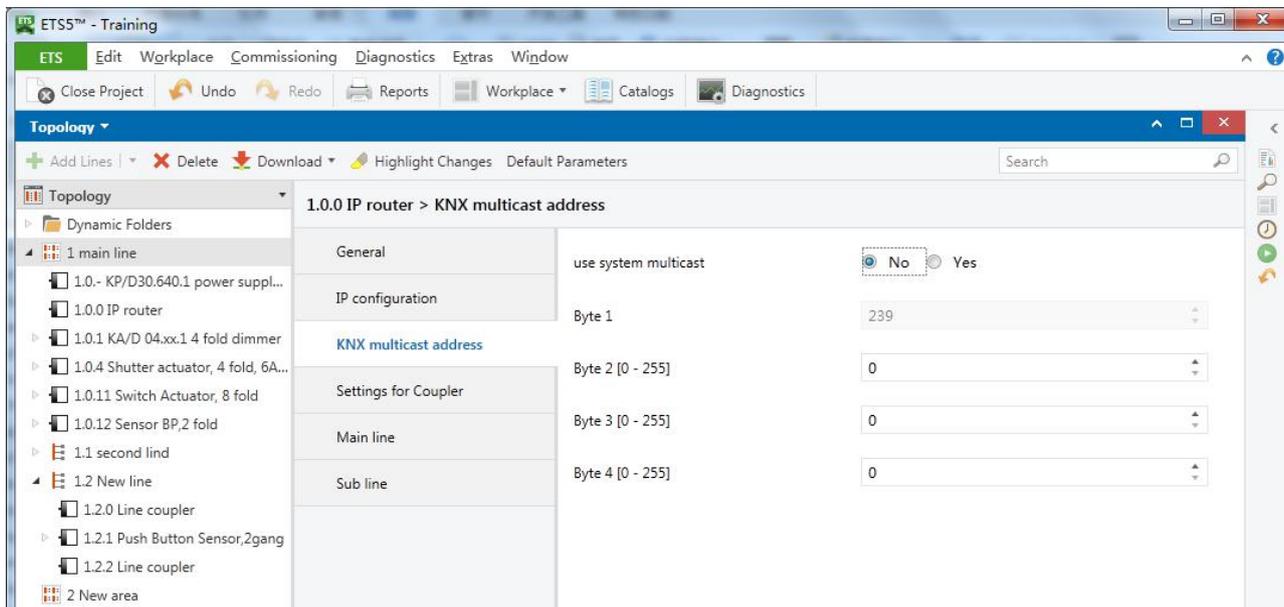


Fig. 4.4: KNX multicast address

ETS-Text	Range	Comment
Use system multicast	No Yes	If “no” is selected, the address is <u>to be defined</u> physically.
Byte 1 (of the IP routing multicast address) <i>This range is reserved for the IP multicast address.</i>	System: [224] Physical: [239]	If System multicast address is used, "224" is permanently set. If Physical multicast address is used, "239" is permanently set.
Byte 2 [0 - 255] (of the IP routing multicast address)	0-255 [0]	Can only be set manually if a physical multicast address is used.
Byte 3 [0 - 255] (of the IP routing multicast address)	0-255 [23]	Can only be set manually if a physical multicast address is used.
Byte 4 [0 - 255] (of the IP routing multicast address)	0-255 [12]	Can only be set manually if a physical multicast address is used.

Note: *During commissioning it should be regarded that all KNX IP devices intended to communicate with each other via IP must use the same IP routing multicast address.*

4.5 Setting for coupler

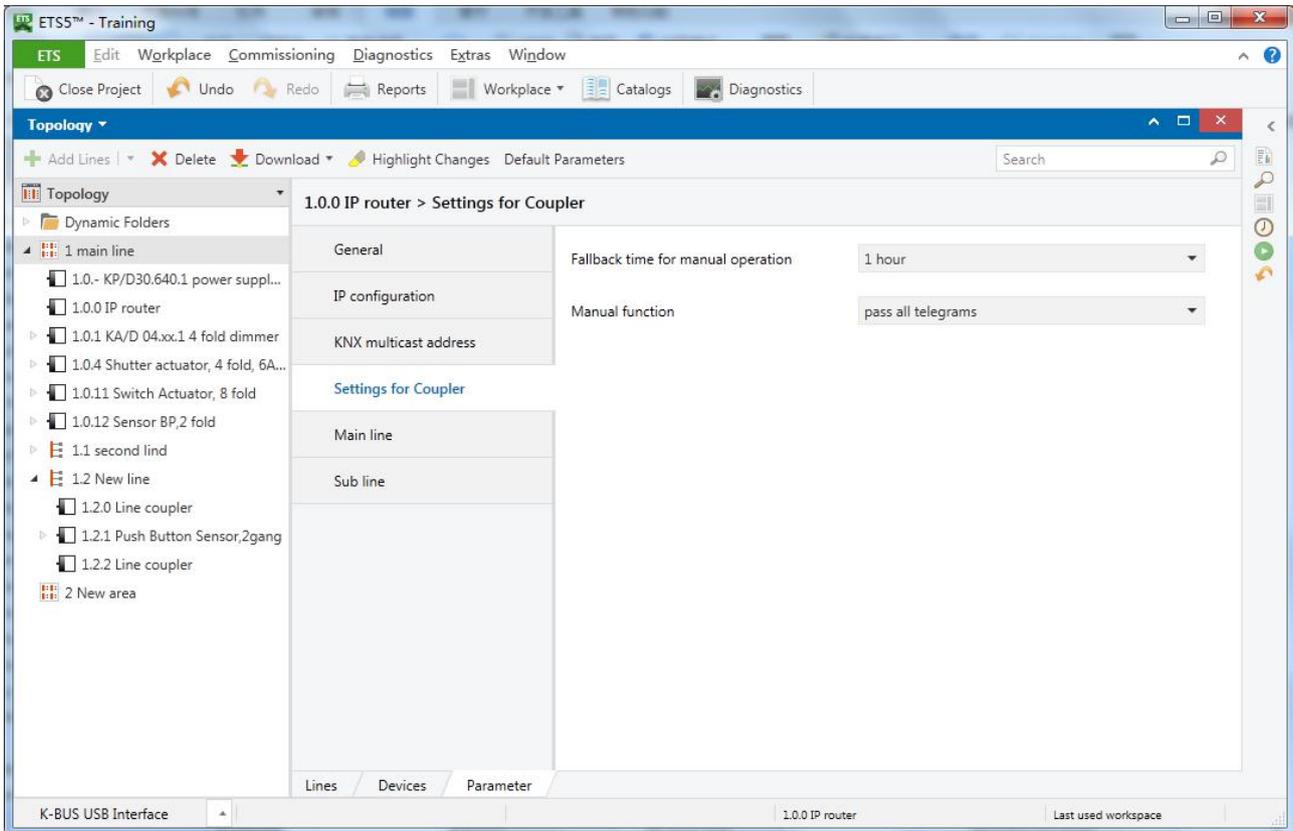


Fig. 4.5: settings for coupler

ETS-Text	Selection	Comment
Fallback time for manual operation	10 min, 1 hour, 4 hours, 8 hours	Time duration required to exit from “manual operation”.
Manual function	Disabled Pass all telegrams Pass physical telegrams Pass group telegrams	Telegram routing configuration for the manual function.

4.5 Main Line

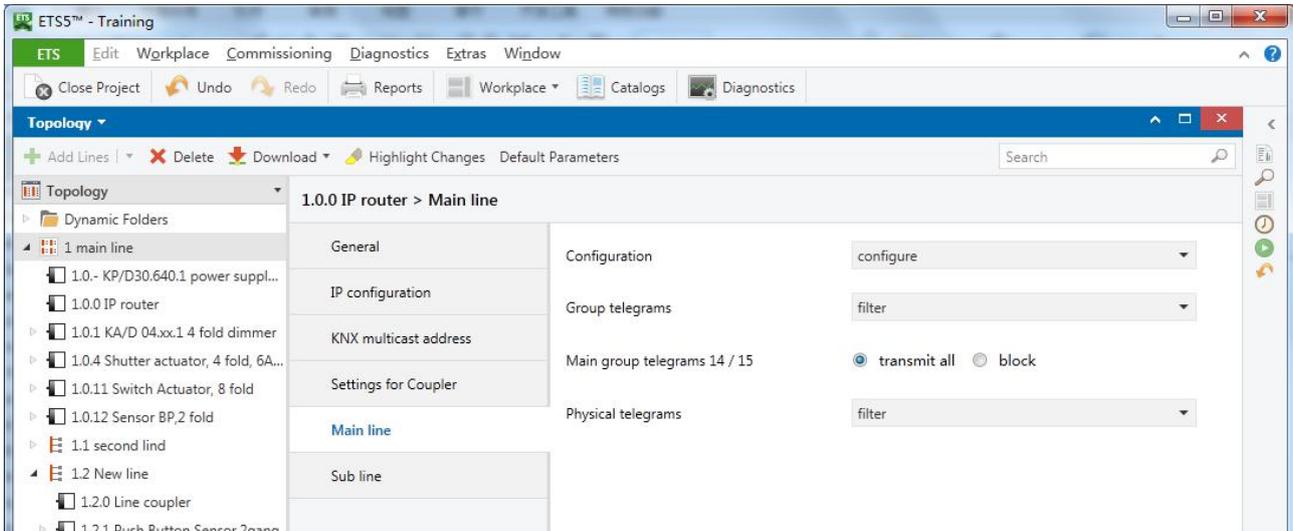


Fig. 4.6: Main line

ETS-Text	Selection	Comment
Configuration	groups: filter, physical: block groups, physical: filter groups: route, physical: filter groups, physical: route configure	- Block : no telegram is routed. - Filter : Only telegrams are routed which are entered in the filter table. - Route : the telegrams are routed. - Configure : the following parameters can be set physically. This parameter is to be set depending on the planned configuration.
Group telegrams	1. transmit all(not recommended) 2. block 3. filter	1. All group telegrams are transmitted. 2. No group telegram is transmitted. 3. Only group telegrams entered in the filter table are routed. ETS3/4 produces the filter table automatically.
Main group telegrams 14/15	1. transmit all(not recommended) 2. block 3. filter	1. Group telegrams with the sub group >13 (e.g. 14/1) are routed. 2. Group telegrams with the sub group > 13 (e.g. 14/1) are not routed. 3. Group telegrams with the sub group >13 are routed only if they are entered in the filter table . The ETS produces the filter table automatically.
Physical telegrams	1. transmit all(not recommended) 2. block 3. filter	1. All physical telegrams are transmitted. 2. No physical telegram is transmitted. 3. Only physical telegrams are routed based on physical address.

Note: *The parameter “transmit all” for Group telegrams and Physical telegrams is intended only for testing purposes and should not be set for normal operation.*

4.6 Sub Line

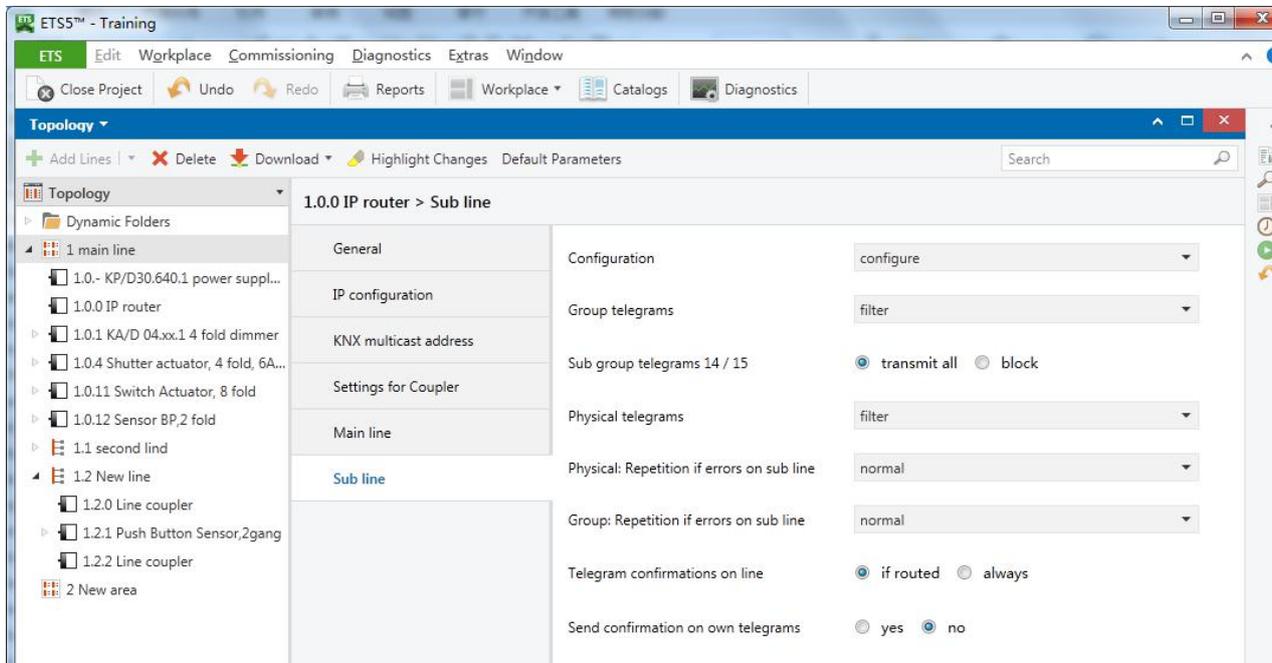


Fig. 4.7: Sub line

Note: *If the parameter “Send confirmation on own telegrams” is set to “yes”, with sending any own routed telegram the MECip will systematically send an ACK.*

ETS-Text	Selection	Comment
Configuration	groups: filter, physical: block groups, physical: filter groups: route, physical: filter groups, physical: route configure	- Block : no telegram is routed. - Filter : Only telegrams are routed which are entered in the filter table. - Route : the telegrams are routed. - Configure : the following parameters can be set physically. This parameter is to be set depending on the planned configuration.
Group telegrams	1. transmit all (not recommended) 2. block 3. filter	1. All group telegrams are transmitted. 2. No group telegram is transmitted. 3. Only group telegrams entered in the filter table are routed. ETS3/4 produces the filter table automatically.
Sub group telegrams 14/15	1. transmit all (not recommended) 2. block 3. filter	1. Group telegrams with the sub group > 13 (e.g. 14/1) are routed. 2. Group telegrams with the sub group > 13 (e.g. 14/1) are not routed. 3. Group telegrams with the sub group > 13 are routed only if they are entered in the filter table. The ETS produces the filter table automatically.
Physical telegrams	1. transmit all (not recommended) 2. block 3. filter	1. All physical telegrams are transmitted. 2. No physical telegram is transmitted. 3. Only physical telegrams are routed based on physical address.
Physical: Repetition if errors on sub line	1. no 2. normal 3. reduced	If a transmission error (e.g. due to missing receiver) is found when sending a physical telegram on the sub line: 1. The physical telegram is not repeated. 2. The physical telegram is repeated up to 3 times. 3. The physical telegram will be repeated only one time.
Group: Repetition if errors on sub line	1. no 2. normal 3. reduced	If a transmission error (e.g. due to missing receiver) is found when sending a group telegram on the sub line: 1. The group telegram is not repeated. 2. The group telegram is repeated up to 3 times. 3. The group telegram will be repeated only once.
Telegram confirmations on line	1. if routed 2. always	1. Only telegrams which are to be routed are confirmed on the sub line (ACK). 2. Each telegram on the sub line is confirmed (ACK).
Send confirmation on own telegrams	yes no	1. Every telegram on the sub line is confirmed with its own ACK (from the Line coupler). 2. No confirmation with own ACK

5. State of Delivery

The IP Router is delivered with the following default factory settings:

Physical address	15.15.0
Physical address for tunneling connections	15.15.241 15.15.242 15.15.243 15.15.244
<i>IP configuration</i>	
IP address assignment	DHCP/Auto IP
IP routing multicast address	224.0.23.12
<i>Main Line (IP to KNX)</i>	
Group telegrams 0-13	Filter
Main group telegrams 14/15	Filter
Physical telegrams	Filter
<i>Sub Line (KNX to IP)</i>	
Group telegrams 0-13	Filter
Main group telegrams 14/15	Filter
Physical telegrams	Filter
Physical: Repetition if errors on sub line	normal
Group: Repetition if errors on sub line	normal
Telegram confirmations on line	if routed
Send confirmation on own telegrams	no