

**IP-Router 001002****Application program usage**

Product family: System devices  
 Product type: IP-Router  
 Manufacturer: Siemens

Name: IP Router N146  
 Order-No.: 5WG1 146-1AB01

Name: IP Router N146/02  
 Order-No.: 5WG1 146-1AB02

**Functional description****Note**

In the following description the name IP Router is used when the description applies to IP Router N146 and IP Router N146/02.

The device implements the KNXnet/IP standard and connects KNX/EIB lines via data networks using the Internet Protocol (IP). Also this device offers concurrent access to the bus line from any PC or other data processing equipment.

The physical connection to the KNX/EIB is established via a bus connector terminal block. For connection to the data network (IP via 10BaseT) the device contains an RJ45 socket.

The IP Router requires additional operating power for its operation.

The IP Router N146 sources the operating power via a second terminal block (white-yellow terminals) from a safety extra low voltage (SELV) power supply AC/DC 24 V.

The IP Router N146/02 can source this operating power via the network connection from "Power over Ethernet" according to IEEE 802.3af. Alternatively, the operating power can be provided via a second terminal block (white-yellow terminals) by a safety extra low voltage (SELV) power supply AC/DC 24 V or by a bus power supply (unchoked power, DC 29V). When a SELV power supply is connected the operating power is sourced from it.

By using a LAN modem an KNX/EIB installation can be remotely accessed even if there is no direct data network connection between a PC and an IP Router. LAN modems are available on the market for standard telephone, ISDN or DSL connections.

The IP Router has these characteristics:

- Simple connection to hierarchically superimposed systems via Internet Protocol (IP)
- Direct access to the KNX/EIB installation from any access point to the IP network (KNXnet/IP Tunneling)
- Fast communication between KNX/EIB lines, areas and systems (KNXnet/IP Routing)
- Communication between buildings and facilities
- Filtering and routing of telegrams depending on
  - individual address
  - group address
- LED display of
  - operation
  - KNX/EIB communication
  - IP communication
- Simple configuration with standard ETS
- Easy connection to SCADA and Facility Management systems (see: Supported Software)

**IP Router as line / area coupler (KNXnet/IP Routing)**

Using the existing data network for communication between bus lines in non-residential buildings is a logical step. The advantages are: fast communication between KNX/EIB lines, extension of an KNX/EIB system beyond one building by using LAN and WAN connections, direct transmission of KNX/EIB data to any network user, KNX/EIB remote configuration from any network access point.

The IP Router logically connects KNX/EIB bus lines by transmitting KNX/EIB telegrams between them via a data network but separates them galvanically. This allows to run each bus line independently from other bus lines.

The IP Router can be used as line coupler or area coupler in existing *EIB* networks as well as in new KNX/*EIB* networks. The IP Router holds a filter table determining, which bus telegrams are transmitted or blocked from or to the bus line thus reducing the bus load. The filter table is automatically generated by the ETS (*EIB* Tool Software) during configuration and start-up of the system.

The individual address of the IP Router assigned by ETS automatically determines the IP Router function as a line coupler or area coupler. The definition follows these assignments:

Coupler function	Line
Area coupler	Main line 1- 15
Line coupler	Line 1- 15

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**Note**

When assigning the individual address take care that IP Router and line couplers receive the topologically correct individual address (Fig. 1, IP Router as area coupler and line coupler).

Adhere to these rules:

**Rule 1:**

In general an IP Router is used as a line coupler or an area coupler. The individual address has the format x.y.0, with x=1...15, y=1...15.

**Rule 2:**

If an IP Router is applied as an area coupler with the individual address x.0.0 then no other IP Router with the line coupler address x.y.0 (y=1...15) shall be placed topologically „below“ this IP Router (Fig. 2, IP Router N 146 as area coupler).

**Rule 3:**

If an IP Router is applied as a line coupler (e.g. with individual address 1.2.0) then no other IP Router shall be used with a superior area coupler address (e.g. 1.0.0) in this installation (Fig. 3, IP Router N 146 as line coupler).

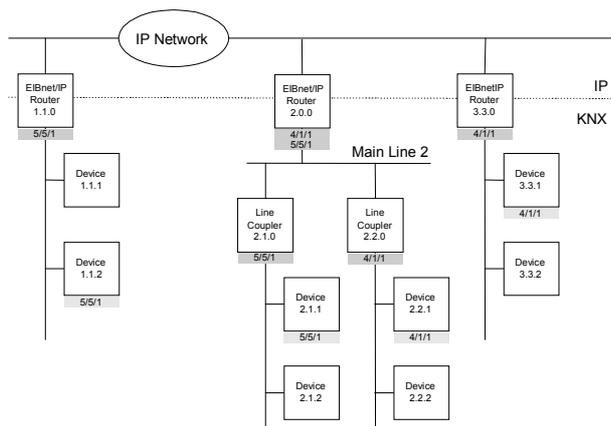


Figure 1. IP Router as area and line coupler

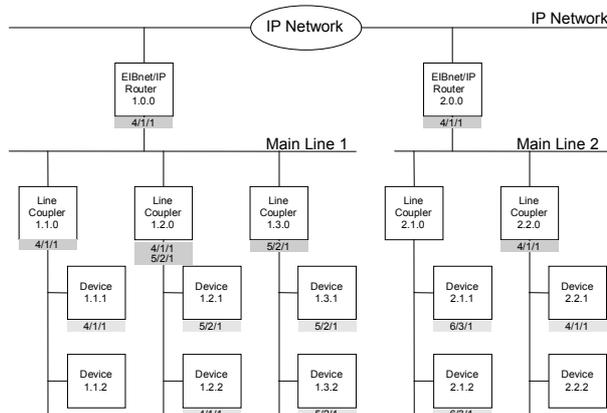


Figure 2. IP Router as area coupler

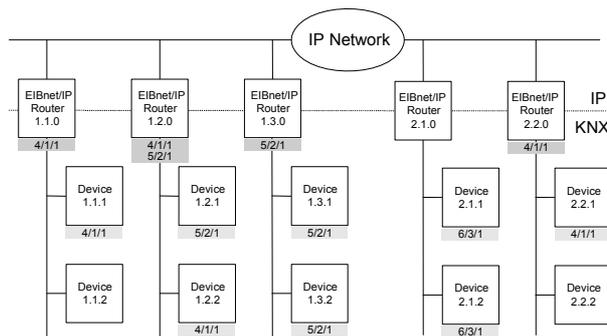


Figure 3. IP Router as line coupler

**Note**

Smooth operation of the IP Router as line coupler or back-bone coupler using KNXnet/IP Routing requires LAN network components that support IP multicasting. In particular, network / LAN routers must be configurable respectively configured to forward IP multicast datagrams. The IP multicast address 224.0.23.12 was specifically reserved for KNXnet/IP internationally for this purpose.

KNXnet/IP Tunneling interface to the bus

A direct connection between a networked PC and the bus can be established via a data network and the IP Router. This allows for accessing the bus from any access point in the data network.

The IP Router N146 provides one KNXnet/IP Tunneling connection.

The IP Router N146/02 provides up to four KNXnet/IP Tunneling connections, allowing for e.g. simultaneous configuration with ETS3 and operation of a visualization.

**IP-Router 001002****Note**

For stable communication via KNXnet/IP Tunneling the IP Router must use a separate individual address for each KNXnet/IP Tunneling connection. These additional individual addresses must be different from the individual address of the device and must not be used by any other bus device. In ETS these individual addresses should be reserved by proxy devices.

ObjectServer interface to the bus (N146/02)

A direct connection between a networked PC and the bus can also be established via a data network and the IP Router N146/02 using ObjectServer. ObjectServer compared with KNXnet/IP Tunneling provides the advantage that the communication can be maintained even over network connections with a transmission time for the datagrams of over one second (e.g. satellite connections).

Assignment of additional individual address(es)(IP Router N146)

The additional individual address is assigned with ETS (see: Setting the additional individual address of the IP Router with ETS3).

(IP Router N146/02)

Additional individual addresses are either assigned with ETS (see: Setting the additional individual address of the IP Router with ETS3) or alternatively without a tool automatically by the device itself.

The automatic address assignment for KNXnet/IP Tunneling and ObjectServer is started when the learning button is pressed during normal operation for more than 5 seconds but less than 10 seconds. The programming LED flashes during the address assignment process. The device checks which individual addresses are already used by other bus devices connected to the bus line. These addresses are not used for the address assignment.

By adding additional bus devices at a later time one or more of the additional individual addresses could be assigned twice. When during normal operation the learning button is pressed for more than 10 seconds all additional individual addresses in the IP Router N146/02 are reset to the default value (15.15.255) and the programming LED is turned off.

IP address assignment

Please consult your network administrator regarding configuration of the parameters device IP address, subnet mask, and DHCP.

(IP Router N146)

The IP address of the IP Router N146 is assigned manually using ETS, or automatically by a DHCP server in the IP network. Assignment of the IP address by a DHCP server allows for changes of the device IP address without using ETS. Configuration of the DHCP server may require the MAC address, which is printed on the device.

(IP Router N146/02)

The IP address of the IP Router N146/02 is assigned manually using ETS, automatically by a DHCP server in the IP network, or by the device itself (AutoIP). Assignment of the IP address by a DHCP server allows for changes of the device IP address without using ETS. Configuration of the DHCP server may require the MAC address, which is printed on the device. If a DHCP server is not available the device assigns itself an IP address (AutoIP).

Default factory settings

By default the KNXnet/IP Routing function is active. When two KNXnet/IP routers are connected with each other via a cross-over cable or via a network hub, bus telegrams are routed by the KNXnet/IP Router without any configuration.

The IP Router ships with these default factory settings:

- Individual address of the IP Router:  
15.15.0 (= FF00 hex)
- Filter group telegrams
- All bus telegrams are repeated in case of transmission errors
- The IP Router acknowledges routed telegrams only
- Support for devices with mis-matching individual address
- Route broadcast telegrams
- Monitor the bus line
- IP address assignment via DHCP

Behavior on bus voltage loss / recovery on the bus line

When the IP Router detects a loss of bus voltage on the bus line, this error is saved and announced via KNXnet/IP. When the IP Router detects recovery of bus voltage on the bus line, the error flag is deleted and the resumption of bus voltage is announced via KNXnet/IP.

Configuration with ETS

The IP Router can be configured with ETS2 V1.2 and later versions.

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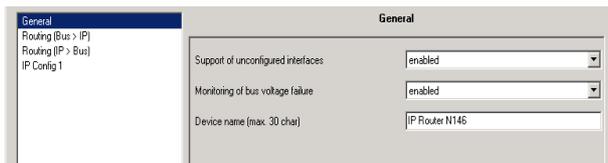
**Note**

The IP Router can be reset to the default factory settings by pressing the learning button for more than six seconds when the operation voltage is turned on. The transition to the default state is indicated by a blinking programming LED. All parameter settings are deleted by this reset action.

**Communication objects**

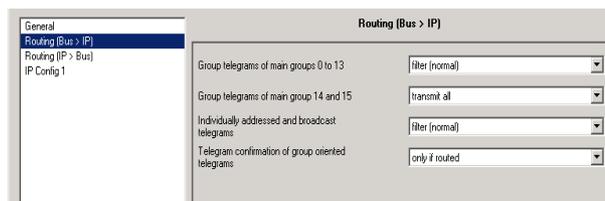
The application program does not contain any communication objects.

**Parameter General**



Parameter	Settings
<b>Support of unconfigured interfaces</b>	disabled <b>enabled</b>
By enabling this parameter RS232 interfaces with a topologically incorrect address can be supported allowing for configuration across several bus lines.	
<b>Monitoring of bus voltage failure</b>	disabled <b>enabled</b>
Bus voltage failure and bus voltage recovery can be announced via KNXnet/IP.	
<b>Device name (max. 30 char)</b>	<b>IP Router N146</b>
This parameter determines the name (max. 30 characters) of the IP Router, which is used for easy recognition of the device when searched by a KNXnet/IP visualisation or the ETS.	

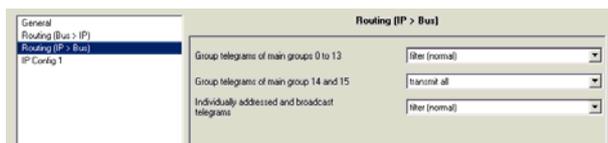
**Parameter Routing Bus → IP**



Parameter	Settings
<b>Group telegrams of main groups 0 to 13</b>	transmit all (for testing only) block <b>filter (normal)</b>
This parameter defines the filter function for group telegrams of main groups 0 to 13 received from the bus. If the default „filter (normal)“ setting is selected the respective filter table entry is checked to determine whether the group telegram should be forwarded to the IP network.	
<b>Group telegrams of main groups 14 and 15</b>	block <b>transmit all</b>
This parameter defines the filter function for group telegrams of main groups 14 and 15 received from the bus. If the default setting „transmit all“ is selected all group telegrams of main groups 14 and 15 are forwarded to the IP network. Otherwise all group telegrams of main groups 14 and 15 are blocked.	
<b>Individually addressed and broadcast telegrams</b>	transmit all (for testing only) block <b>filter (normal)</b>
This parameter defines the filter function for individually addressed and broadcast telegrams. If the default setting „filter (normal)“ is selected the telegrams are filtered based on the individual address of the IP Router. Broadcast telegrams are always forwarded unless this parameter is set to “block”. Independent of this parameter broadcast telegrams are always accepted by the IP Router itself.	
<b>Telegram confirmation of group oriented telegrams</b>	always <b>only if routed</b>
If this parameter is set to „always“ group telegrams are confirmed even if they are not forwarded onto the IP network.	

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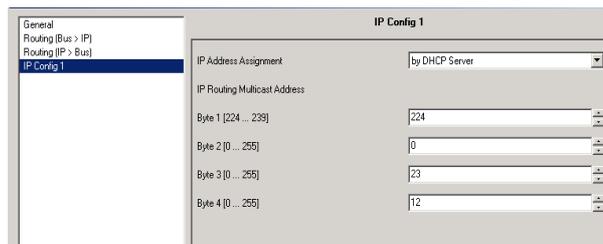
## Parameter Routing IP → Bus



Parameter	Settings
<b>Group telegrams of main groups 0 to 13</b>	transmit all (for testing only) block <b>filter (normal)</b>
This parameter defines the filter function for group telegrams of main groups 0 to 13 received from the IP network. If the default „filter (normal)“ setting is selected the respective filter table entry is checked to determine whether the group telegram should be forwarded to the bus.	
<b>Group telegrams of main groups 14 and 15</b>	block <b>transmit all</b>
This parameter defines the filter function for group telegrams of main groups 14 and 15 received from the IP network. If the default „transmit all“ setting is selected all group telegrams of main groups 14 and 15 are forwarded to the bus. Otherwise all group telegrams of main groups 14 and 15 are blocked.	
<b>Individually addressed and broadcast telegrams</b>	transmit all (for testing only) block <b>filter (normal)</b>
This parameter defines the filter function for individually addressed and broadcast telegrams. If the default „filter (normal)“ setting is selected the telegrams are filtered based on the individual address of the IP Router. Broadcast telegrams are always forwarded unless this parameter is set to “block”. Independent of this parameter broadcast telegrams are always accepted by the IP Router itself.	

## Parameter IP Configuration

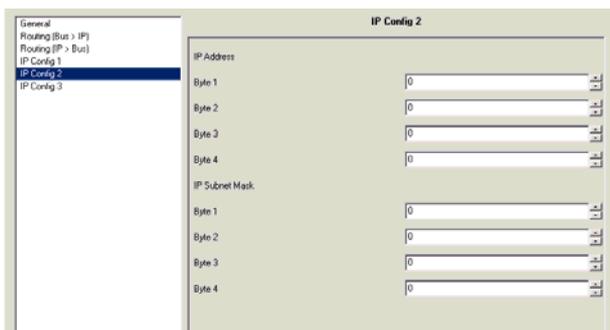
## IP Config 1



Parameter	Settings
<b>IP Address Assignment</b>	by DHCP Server manual input
This parameter determines the type of IP address assignment. By default the parameter is set for automatic assignment of the IP address by a DHCP server. If “manual input” is selected two additional tabs appear for manual input of the IP address, subnet mask, and the default gateway address.	
<b>IP Routing Multicast Address</b> <b>Byte 1 [224...239],</b> <b>Byte 2 [0...255],</b> <b>Byte 3 [0...255],</b> <b>Byte 4 [0...255]</b>	<b>224.0.23.12</b>
As with EIB group telegrams IP allows transmitting a datagram to several recipients at the same time. This so-called multicast form of IP communication requires that sender and recipient are members of the same Multicast Group and use the same Multicast Address as target address. The Multicast Address 224.0.23.12 has especially been reserved for KNXnet/IP. For general use in a network multicast addresses in the range from 239.0.0.0 to 239.255.255.255 may be used. This parameter determines the IP Routing Multicast Address for KNXnet/IP Routing. KNXnet/IP Routing forwards bus telegrams to all IP Routers that use the same IP Routing Multicast Address. The factory default setting for the IP Routing Multicast Address is <b>224.0.23.12</b> . This is the Multicast Address that IANA assigned to EIBA and reserved for this purpose. Each byte of the four byte IP Routing Multicast Address is set separately, with a value range of 0...255 for bytes 2 to 4. Permissible values for byte 1 are values of 224 to 239, because only this address range may be used for multicast transmission. If other values are entered then KNXnet/IP Routing will not work.	

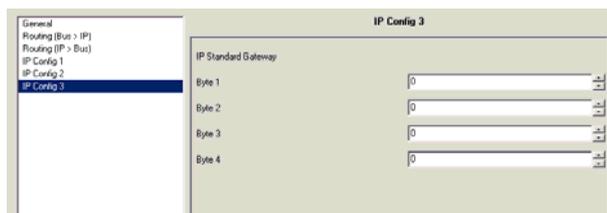
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**IP Config 2**



Parameter	Settings
<b>IP Address</b> <b>Byte 1,</b> <b>Byte 2,</b> <b>Byte 3,</b> <b>Byte 4</b>	<b>0.0.0.0</b>
<p>This parameter is only visible if manual input was chosen for IP Address Assignment. It determines the IP address of the IP Router.</p> <p>The factory default setting for the IP address is <b>0.0.0.0</b>. This default value must be replaced by a valid IP address.</p> <p>Each byte of the four byte IP Routing Multicast Address is set separately, with a value range of 0...255 for each byte.</p>	
<b>IP Subnet Mask</b> <b>Byte 1,</b> <b>Byte 2,</b> <b>Byte 3,</b> <b>Byte 4</b>	<b>0.0.0.0</b>
<p>This parameter is only visible if manual input was chosen for IP Address Assignment. It determines the IP subnet mask used by the IP Router.</p> <p>The factory default value is <b>0.0.0.0</b>. This default value must be replaced by a valid subnet mask. Valid subnet mask values are e.g. 255.255.255.0 or 255.255.240.0.</p> <p>Each byte of the four byte IP Routing Multicast Address is set separately, with a value range of 0...255 for each byte.</p>	

**IP Config 3**



Parameter	Settings
<b>IP Standard Gateway</b> <b>Byte 1,</b> <b>Byte 2,</b> <b>Byte 3,</b> <b>Byte 4</b>	<b>0.0.0.0</b>
<p>This parameter is only visible if manual input was chosen for IP Address Assignment. It determines the IP address of the IP Standard Gateway.</p> <p>The factory default value is <b>0.0.0.0</b>. This default value may be replaced by a valid IP address.</p> <p>Each byte of the four byte IP Routing Multicast Address is set separately, with a value range of 0...255 for each byte.</p> <p>The Standard Gateway transmits IP datagrams to IP devices with IP addresses outside of the local network. Use the predefined (invalid) IP address (<b>0.0.0.0</b>) if the device shall be configured without a Standard Gateway.</p>	

**IP-Router 001002****Supported Software**

Here is a list of software supporting the IP Router.

ComBridge Studio

IPAS GmbH  
 Grabenstr 149 a  
 47057 Duisburg  
 Germany  
 [<http://www.ipas-products.com>]

Visualization, Database interface,  
 Notification via email, OPC Server

ComBridge Studio is a visualization software that can use the IP Interfaces N148/21 and N148/22, the IP Router N146 and N146/02, the IP Controller N350E and the IP Viewer N151 as interface to KNX/EIB. Find more information in the GAMMA catalog or at the above listed web site.

ETS 3

KNX Association  
 De Kleetlaan 5, Bus 11  
 B-1831 Brussels-Diegem  
 Belgium  
 [<http://www.knx.org>]

Configuration of bus installations via existing data net works (ETS 3.0c or higher)

An KNXnet/IP driver is available for ETS3. When this driver is installed ETS3 may use the IP Interface N148/21, the IP Router N146, the IP Controller N350E and the IP Viewer N151 as interfaces to the bus just like a standard RS232 or USB serial interface. This function includes download of device configuration via the bus and the group monitor function of ETS3.

**Note**

The KNX Association has decided that IP routers shall not implement support for busmonitoring. The ETS3 driver currently does not support local download.

**Note**

After installing the ETS3 driver and selecting the IP Interface N148/21 or the IP Router N146 as communication interface a windows message may pop up announcing that a "Class" is unknown. In this case install the Microsoft .Net Framework that you can download from the Microsoft software update site (file size: approx. 25MB).

**Note**

When an IP Router is unloaded this unloading process may fail with the error message "An internal error occurred". Subsequently, no other device can be configured and ETS displays the error message "An internal error occurred.". When attempting to check the "Settings" in menu "Extras → Options → Communication" the error message "Severe error" appears. The problem is solved by either selecting a different interface or by closing and restarting ETS.

**Note**

If the communication to the KNX bus fails when a KNXnet/IP Tunneling connection exists then, even if the KNX bus is reconnected, a connection to the bus cannot be established and a download fails. The problem is solved by either selecting a different interface or by closing and restarting ETS. Then a connection to the previously used IP device (IPInterface N148/21 resp. N148/22 or IP Router N146 resp. N146/02) can be established. The same behavior shows if the power to the IP device fails.

**Note**

If the IP Router N146/02 is used as an interface to the bus and its own configuration is downloaded via the bus then ETS displays the error message "The device with the individual address %1 cannot be found.". The download is not executed. The problem is solved by either selecting a different interface or by closing and restarting ETS. Then a connection to the IP Router N146/02 can be established.

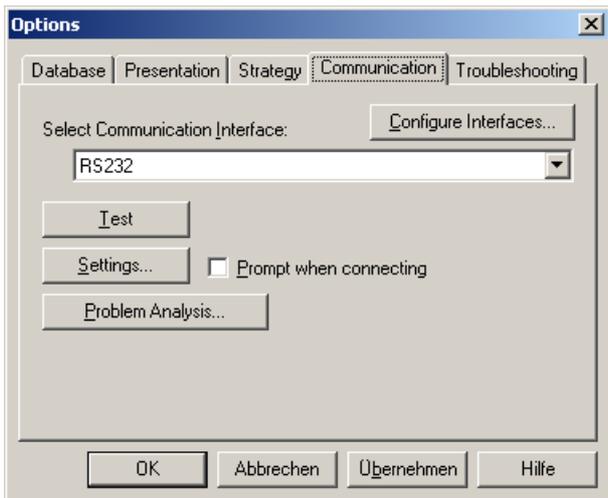
Application Program Description

August 2009

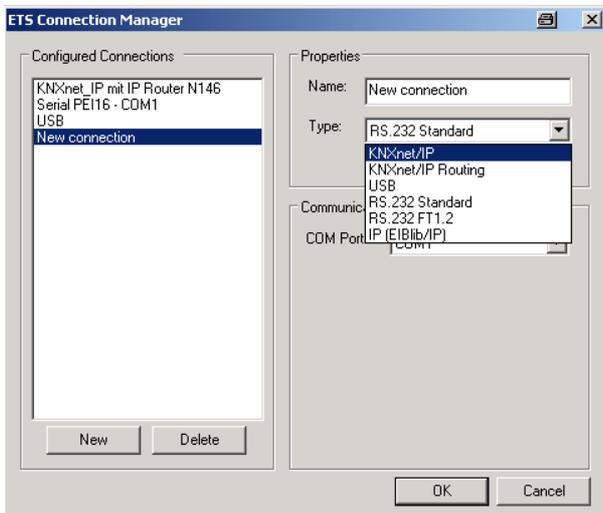
**IP-Router 001002**

**Setting the communication interface in ETS3**

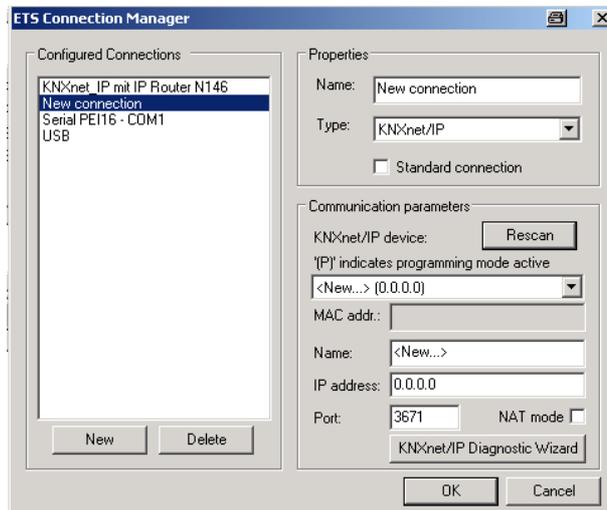
In ETS3 select Extras→ Options.  
In the Options window select the Communication tab.



Click on „Configure Interfaces“.

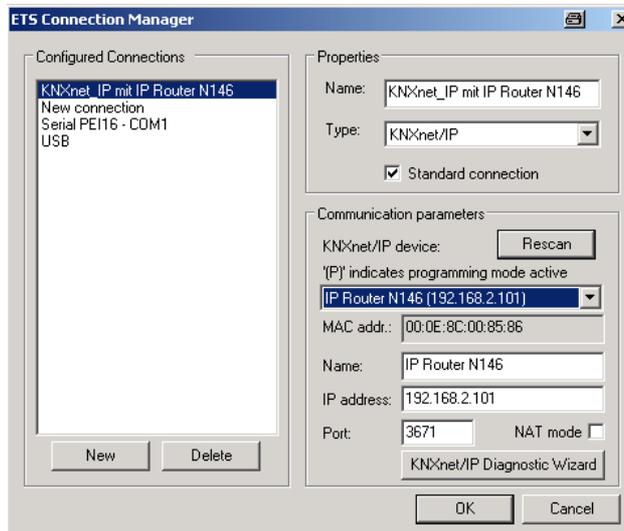


Generate a new interface and select the type KNXnet/IP. ETS3 automatically searches for all reachable IP Routers N146.



- (1) Select an IP Router N146 from the list.
- (2) Assign a name to this new interface.

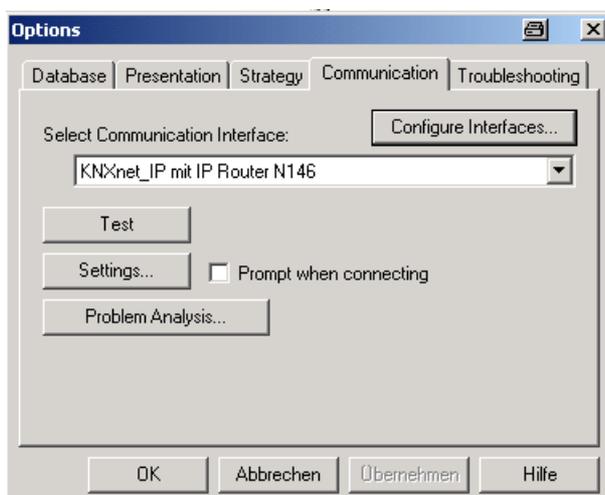
The result could look like this.



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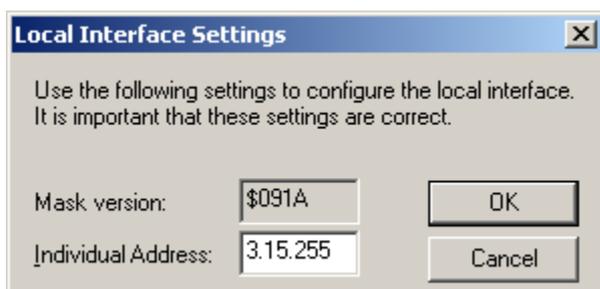
### Setting the additional individual address of the IP Router with ETS3

For a stable communication with the IP Router via KNXnet/IP Tunneling an additional individual address must be set using ETS3.



Click on Settings.

ETS3 fetches the current setting of the additional individual address from the IP Router.



The factory setting of the additional individual address of the IP Router is 15.15.255.

Enter the desired additional individual address and acknowledge this entry by clicking on OK.

ETS 3 sets the value in the IP Router N146 and closes the window.

### Note

When entering the additional individual address take care that this individual address is not used by another bus device. A Dummy device with this individual address should be inserted in the ETS project.

### General Notes

- The operating instructions must be handed over to the client.
- A faulty device shall be sent with a Return Good Note for Service provided by the appropriate Siemens sales office to the following address:  
SIEMENS AG, Siemensstr. 10, D-93055 Regensburg
- If you have further questions about the product, please contact our Technical Support:  
☎ +49 (0) 180 50 50-222  
(0,14 €/min. from the German landline network, deviating mobile communications prices are possible)  
☎ +49 (0) 180 50 50-223  
E-Mail: [support.automation@siemens.com](mailto:support.automation@siemens.com)  
✉ <http://www.siemens.com/automation/service&support>

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**Space for notes**