

The Phoenix Controls LonWorks® based controllers rely on **router (RTR) and repeater (RPT) modules** to optimize communications for the LonTalk® communications bus. Routers isolate groups of nodes into subnets, which represent groups of Celeris nodes performing specific control functions. The multi-port router (RTR104) connects four room-level networks to the building-level network through a signal connection. Repeater modules extend the building-level network when longer runs are required.

## FEATURES

- Versatile mounting—4" sq. electrical junction box; DIN rail mount
- Polarity insensitive communications wiring
- Separate terminals for incoming and outgoing power and communications connections
- Individual power and network status indicators
- Routers isolate room-level network to ensure reliable communications up to 8500 feet (2700 meters).
- Repeaters extend the building-level network beyond 425 feet.

### Additional features of the multi-port router (RTR104)

- The multi-port router (RTR104) can connect up to:
  - Four FTT-10, 78 kbps room-level networks
  - One TP-1250, 1.25 mbps building-level network
- Individual network communication status LEDs
- Built-in diagnostic function

## SPECIFICATIONS\*

### Power

- RTR100, RTR200, and RPT100:
  - 16 to 30 volts AC or DC, 2 VA maximum
  - Must be powered by Class 2 circuit
- RTR104:
  - 9-28 Vac (40-70 Hz)
  - 9-35 Vdc
  - 500 mA maximum current

### Ambient Temperature (all models)

- Operating: -40-185 °F (-40-85 °C)
- Storage: -40-185 °F (-40-85 °C)

### Humidity (all models)

10-95% RH non-condensing  
@ 122° F (50 °C)

### Dimensions

- RTR100, RTR200, and RPT100:
  - -DIN 6.3" H x 3.9" W x 1.64" D (16 cm x 10 cm x 4.2 cm)
  - -EBX 3.9"sq x 1.75" (10 cm sq x 4.4 cm)
- RTR104—3.5" H x 6.2" W x 2.6" D (8.9 cm x 15.8 cm x 6.6 cm)

### Weight

- RTR100, RTR200, and RPT100:
  - -DIN—11 oz
  - -EBX—7 oz
- RTR104—15 oz

### Communication

- RTR10x—78 kbps to 1.25 mbps
- RTR200—78 kbps to 78 kbps
- RPT—1.25 mbps to 1.25 mbps

### Approvals (all models)

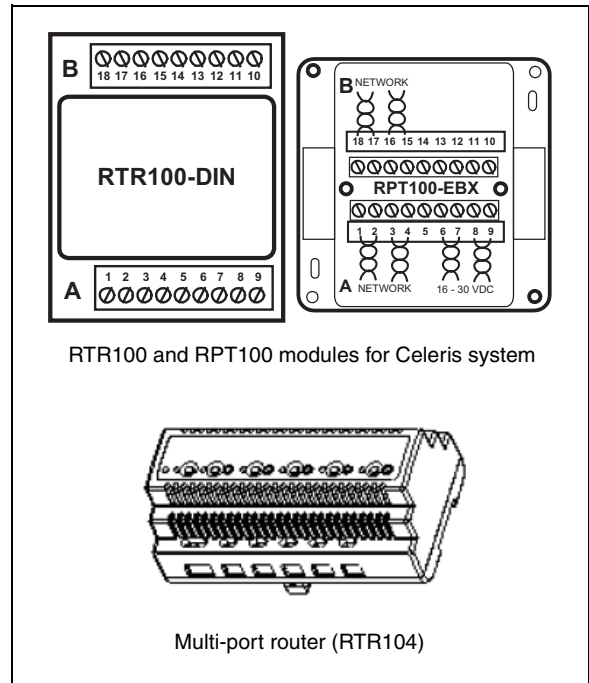
- UL/cUL 916
- CE
- FCC



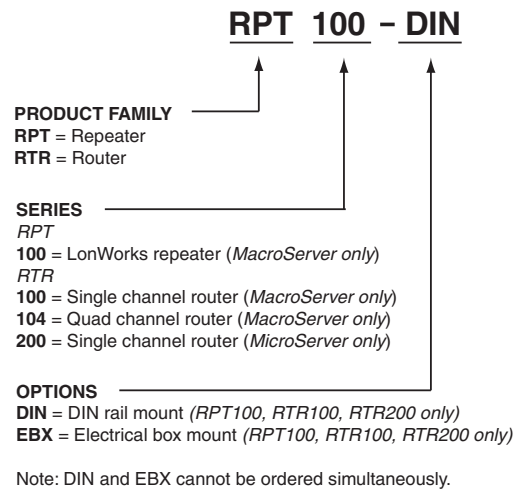
### FCC COMPLIANCE

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.



## ORDERING GUIDE



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## APPLICATIONS

### Routers

Routers are used to isolate groups of devices used for implementing desired control strategies into channels or subnets. In Celeris applications, routers establish different levels of networks:

- **Control network**—This is the room-level network where all the devices reside and device-to-device communications are used to implement the desired room-level control strategy. The network uses the LonWorks 78 kbps FTT-10 communications scheme, which is generally a single channel with a router at the “top end” of the network to connect it to the communications network.
- **Communications network**—This is the floor- or building-level network where all the network interface devices reside. The purpose of the communications network is to connect all the room-level networks to establish a data path from nodes on the room-level network to the MicroServer™ or MacroServer™ for integration to the BMS. The communications network may either be a floor- or building-level network.

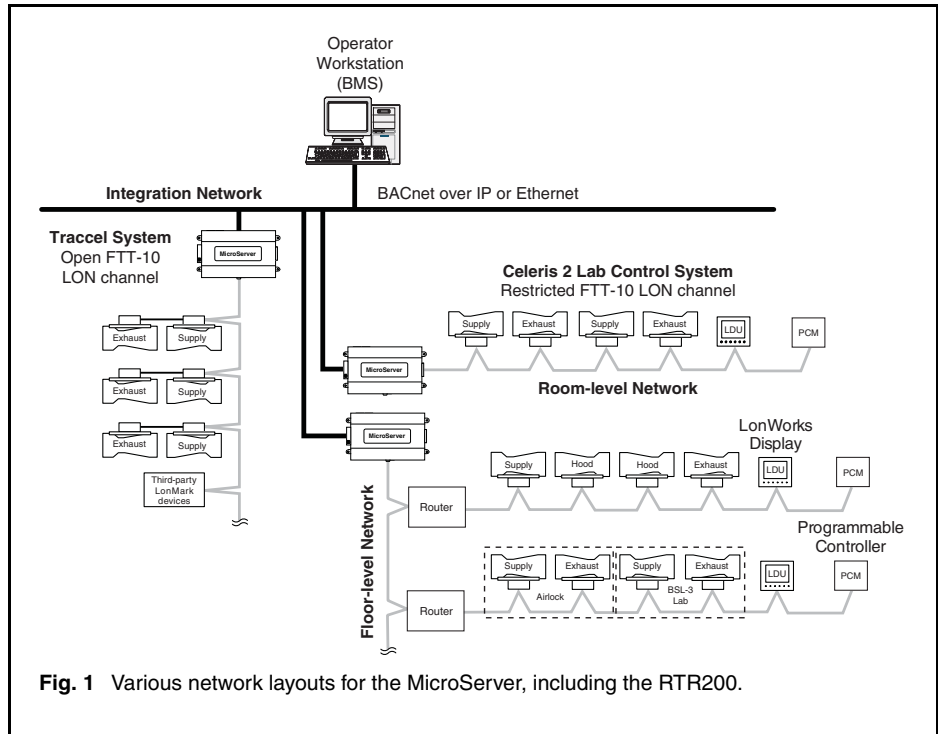


Fig. 1 Various network layouts for the MicroServer, including the RTR200.

- **Floor-level network**—This communications network uses the same 78 kbps FTT-10 communications scheme as the room-level control network. This type of network is used with the Phoenix Controls *MicroServer* and *RTR200* series routers. The floor-level network has a maximum distance of 4,500 feet (1,400 meters), which is more than adequate for the number of devices supported by a single MicroServer. Repeaters are generally not required and are *not* supported.
- **Building-level network**—This is a high-speed network (1.25 mbps) using the LonWorks TP-1250 communications schemes. This type of network is used with the Phoenix Controls *MacroServer* and *RTR104* and *RTR100* series routers. The TP-1250 network has a maximum distance of 425 feet (130 meters); however, it may be extended by adding one or more repeaters.
- **Integration network**—This is the network used by the Phoenix Controls MicroServer or MacroServer to communicate with the Building Management System (BMS). It is typically the campus or corporate intranet; however, it could also be a dedicated network for the building controls system. The MicroServer or MacroServer use the BACnet protocol over either Ethernet or IP to exchange data between the Celeris system, the BMS controllers, and operator workstations.

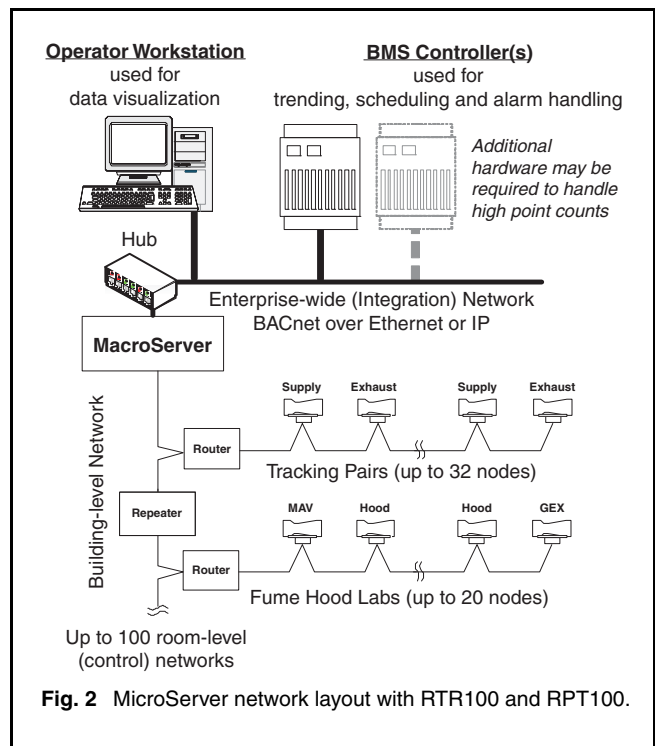


Fig. 2 MicroServer network layout with RTR100 and RPT100.

### Devices Grouped into Subnets

Grouping devices into logical subnets ensures that there is sufficient network bandwidth to carry out room-level control strategies. The type of control application desired determines the number of nodes that make up a subnet.

For laboratory spaces where make-up air control for hoods and one-second speed of response is required, there are:

- One pressurization zone per router
- A maximum of 20 nodes per zone

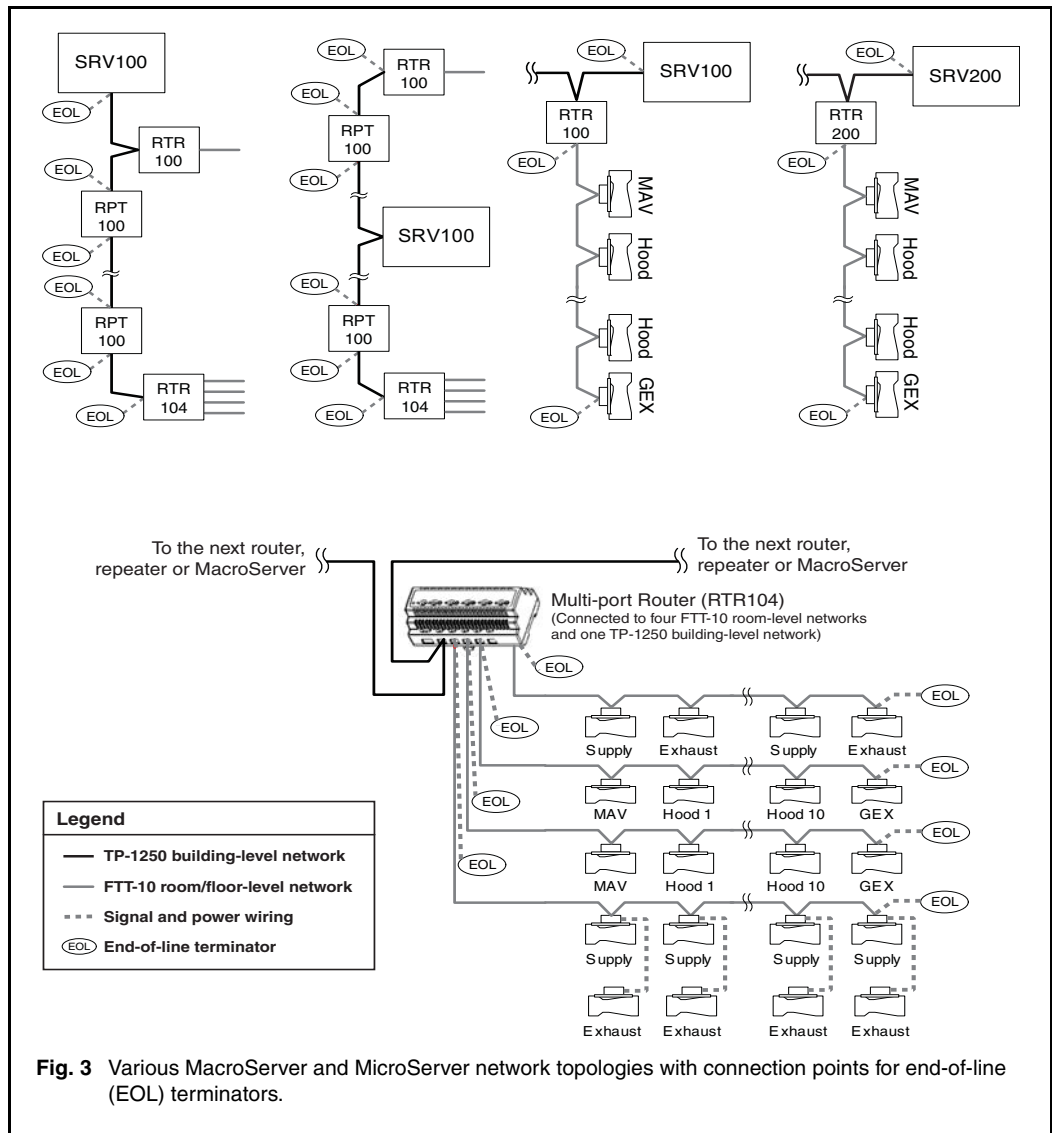
For tracking pair applications where speed of response is not critical, there may be:

- Multiple pressurization zones per router
- Up to 32 nodes per router

### Network Topology

As for how the networks are laid out (see Figure 3):

- Each room-level control network is wired in a bus topology and requires two FTT-10 end-of-line terminators, which are included with routers purchased from Phoenix Controls.
- The floor-level communications network is wired in a bus topology and requires two FTT-10 end-of-line terminators, which are included with MicroServer purchased from Phoenix Controls.
- Each segment of the building level communications network is wired in a bus topology and requires two TP-1250 end-of-line terminators, which are included with each repeater and MacroServer purchased from Phoenix Controls.
- The enterprise integration network follows the architecture laid out by the Information Technology professionals involved with the project. All that is required for Phoenix Controls to connect the MicroServer or MacroServer to this network is a 10base T, 100 base Tx, or 1000 base Tx connection.



## RTR100 and RTR104

Routers are used with the Phoenix Controls MacroServer to:

- Segregate or isolate room-level networks
- Boost the communications speed from 78 kbps on the room-level FTT-10 network to 1.25 mbps for the TP-1250 building-level network (see Figure 4)

## RTR200

Routers used with the Phoenix Controls MicroServer are used strictly to isolate communications traffic. The RTR200 uses 78 kbps FTT-10 on the room-level and floor-level networks (see Figure 4).

## Repeaters

Repeaters are used only with the MacroServer to extend the TP-1250 1.25 mbps network beyond 425 feet (130 meters). There is no limit to how many repeaters may be used on the TP-1250 channel (see Figure 5).

## OPERATION

### Routers

Routers isolate communications on the room-level network or channel from communications on the building-level network or channel. Routers monitor communications on both channels and will only pass messages from one channel to the other if the

message is specifically addressed to cross the router. Messages on the room-level network will be passed only to the floor or building-level network if these are bound to a device on that network, or to a device on another room-level network. An example is room-level data that is passed to the MicroServer or MacroServer for integration to the BAS. Similarly, messages on the building-level network will only be passed to the room-level network if specifically addressed to a node on that channel.

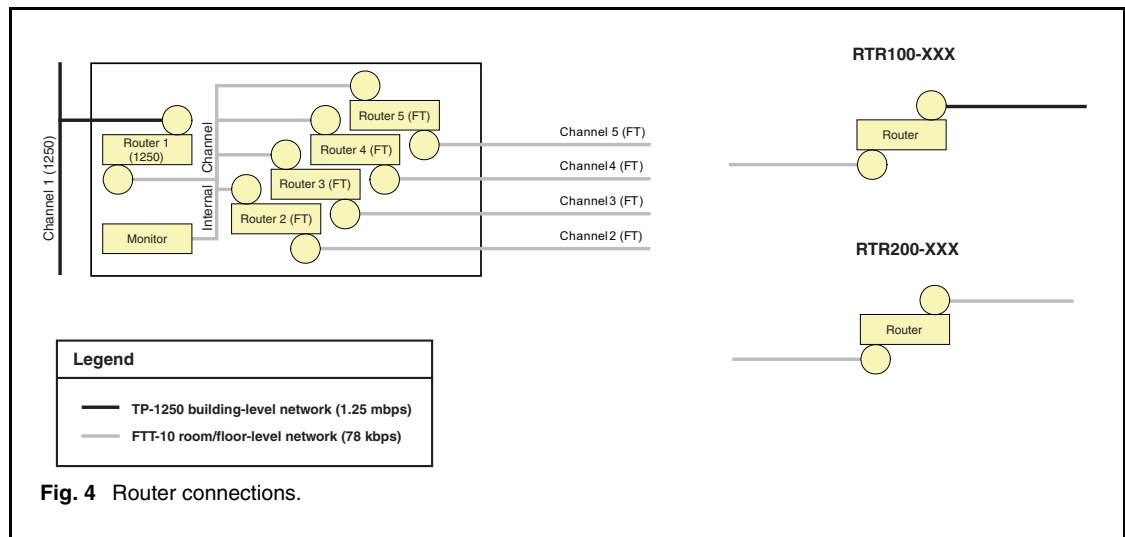


Fig. 4 Router connections.

### Repeaters

Repeaters are used only on projects using a Phoenix Controls MacroServer. These are building-level network devices, specifically intended to increase the distance data can travel on the 1.25 mbps building-level network. Each TP-1250 building-level network segment is limited to 425 feet of cable. If the building-level network must extend beyond 425 feet, a RPT100 would be used to boost or retransmit the communications signal, which extends the network an additional 425 feet. Any message received on the A channel is passed to the B channel immediately. You can use as many RPT100s as necessary on the building-level network.

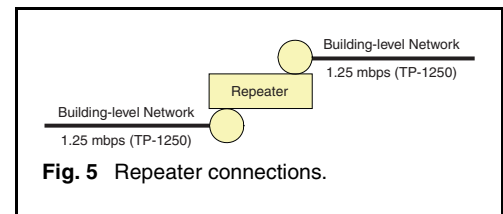


Fig. 5 Repeater connections.

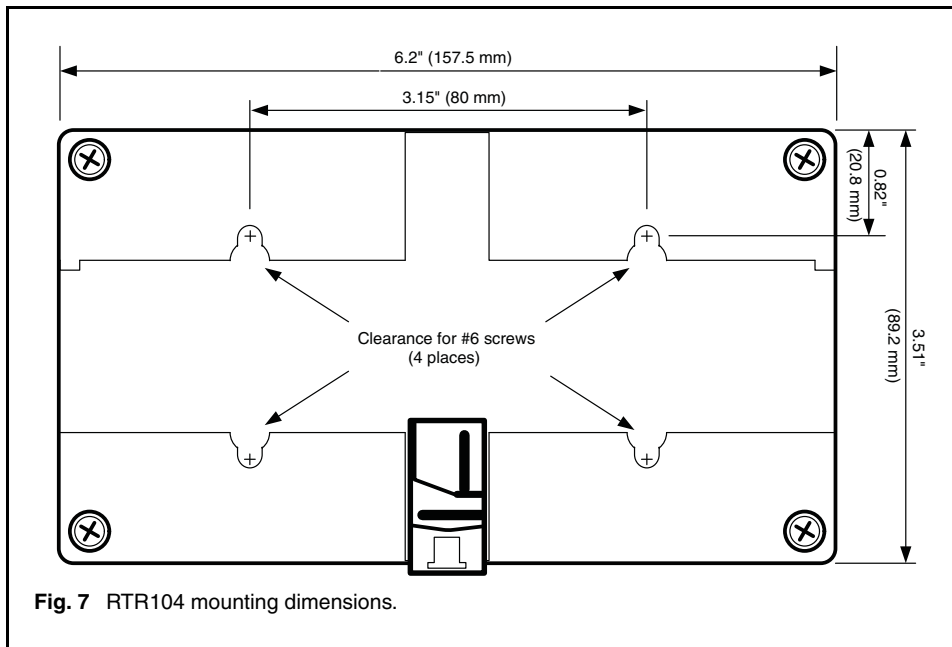
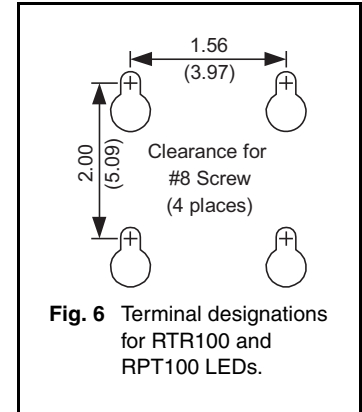
## INSTALLATION

RTR100, RTR200, and RPT100 devices are available with the following mounting options:

- -EBX—Provides a mounting base and terminal housing that attaches to a standard four-inch square electrical box (minimum depth 2").
- -DIN—Provides a mounting base and terminal housing that may be mounted on either a 35-mm DIN rail or screws (not included) (see Figure 6).

RTR104 has an integral 35-mm DIN rail mount, or it can be installed with two mounting screws (see Figure 7).

After mounting and making electrical connections, apply power and press the service pin to configure the device on the network.



## WIRING

Wire all network devices as per wiring diagrams below in the following order:

1. Connect communications cables and end-of-line terminators as required.
2. Connect the power cable.

### Phoenix Controls Wiring Recommendations

- Use cables recommended by Phoenix Controls.
- Stranded wire is strongly recommended for ease of installation.
- Follow good wiring practices:
  - Do not run the communications cable in the same conduit or wire way as the power cables.
  - If the communications cables must cross power cables, it is best to do so at a 90-degree angle.
  - Shield or drain wires, if required, should be wrapped with insulating tape to prevent contact with exposed conductors or contacts.
  - Maintain a consistent color code or polarity all the way through the wiring system.
  - All connections must meet the requirements of an NEC Class 2 circuit.
  - Local and national electrical codes take precedence.

#### Notes:

If devices will be commanded on the Celeris network while operating on emergency power, the routers and repeaters must also be placed on emergency power.

If devices will be commanded on the Celeris network during a transition from normal to emergency power, the routers and repeaters must be placed on an uninterruptible power source and an emergency power circuit.

For room-level communications:

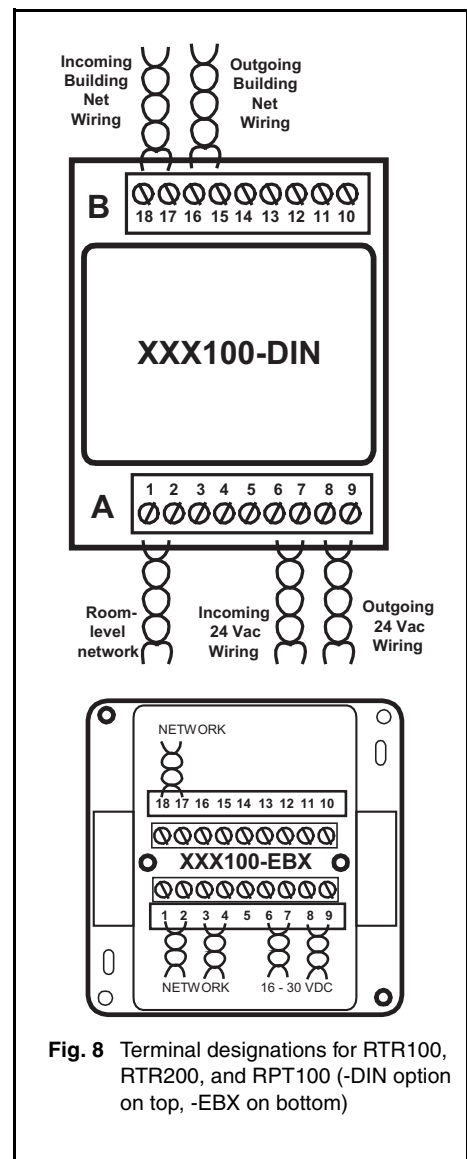
- Attach the FTT-10 room level network wiring to the terminals on the router module.
  - For the RTR100 and RTR200, use terminals 1 and 2 or the A side of the router (see Figure 8).
  - For the RTR104, use terminals 6 and 7, or 8 and 9, or 10 and 11, or 12 and 13 (see Figure 9).

#### Notes:

On the RTR100 and RTR200 router modules, there are duplicate floor-level communications connections that may be used for incoming and outgoing network cabling or connecting an end-of-line terminator.

On the RTR104 module, there are individual room-level communications connections. Incoming and outgoing network cabling or connecting an end-of-line terminator may require placing two conductors under each terminal.

- Network communications cables are polarity insensitive; however, consistent color-coding should be observed to simplify wiring and troubleshooting.
- The network cable must be an unshielded twisted pair cable either 22 AWG (0.65 mm) NEMA Level IV, or Beldon 8471 or equivalent cable. These cables have been tested and approved by Echelon. For more information about other approved cable types, contact Phoenix Controls.
- Use a bus topology for connecting Celeris controllers to the room-level network.
- Network segments may not exceed 4500 feet (1400 meters) in length for Level IV (22 AWG) cable or 8500 feet (2700 meters) for approved 16 AWG cable.



**Fig. 8** Terminal designations for RTR100, RTR200, and RPT100 (-DIN option on top, -EBX on bottom)

- Since the router is typically the end of the room-level network, an FTT-10 end-of-line terminator (403-500-003) should also be connected to the communications terminals.

For floor-level communications (MicroServer applications only):

- Attach the FTT-10 floor level network wiring to terminals 15 and 16, or 17 and 18, or the B side of the router (see Figure 8).

**Note:**

On the RTR200 router module, there are duplicate floor-level communications connections that may be used for incoming and outgoing network cabling or connecting an end-of-line terminator.

- Network communications cables are polarity insensitive; however, consistent color-coding should be observed to simplify wiring and troubleshooting.
- The network cable must be an unshielded twisted pair cable either 22 AWG (0.65 mm) NEMA Level IV, or Beldon 8471 or equivalent cable. These cables have been tested and approved by Echelon. For more information about other approved cable types, contact Phoenix Controls.
- Use a bus topology for connecting routers to the floor-level network.
- Network segments may not exceed 4500 feet (1400 meters) in length for Level IV (22 AWG) cable or 8500 feet (2700 meters) for approved 16 AWG cable.
- Determine if this network device represents the end of the floor-level network. If so, an FTT-10 end-of-line terminator (403-500-003) should also be connected to the communications terminals.

For building-level communications (MacroServer applications only):

*Routers*

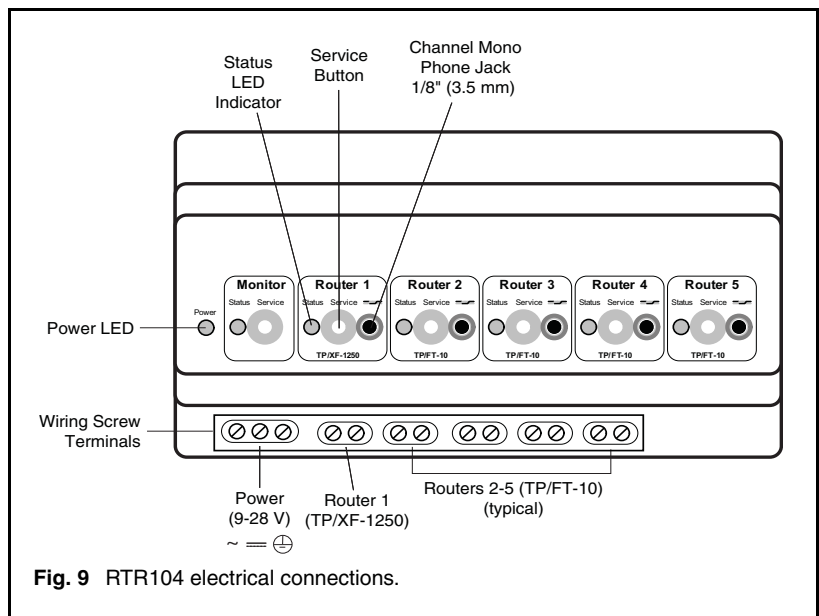
- Attach the TP-1250 building level network wiring to the terminals on the router module.
  - On the RTR100, use terminals 15 and 16, or 17 and 18 of the B side of the router (see Figure 8).
  - On the RTR104, use terminals 4 and 5 (see Figure 9).

**Notes:**

On the RTR100 module, there are duplicate floor-level communications connections that may be used for incoming and outgoing network cabling or connecting an end-of-line terminator.

On the RTR104 module, there are individual room-level communications connections. Incoming and outgoing network cabling or connecting an end-of-line terminator may require placing two conductors under each terminal.

- Network communications cables are polarity insensitive; however, consistent color-coding should be observed to simplify wiring and troubleshooting.
- The network cable must be an unshielded twisted pair 22 AWG (0.65 mm) NEMA Level IV cable. This cable is the only type that has been tested and approved by Echelon. For more information about approved cable types, contact Phoenix Controls.
- Use a bus topology for connecting routers to the building-level network.
- Network segments may not exceed 425 feet (130 meters) in length for Level IV (22 AWG) cable or 8500 feet (2700 meters) for approved 16 AWG cable.
- Determine if this network device represents the end of the floor-level network. If so, a TP-1250 end-of-line terminator (403-500-002) should also be connected to the communications terminals.



**Fig. 9** RTR104 electrical connections.

## Repeaters

- Each RPT100 has an A and B channel. For consistency and to aid in troubleshooting, connect:
  - Incoming communications to terminals 1 and 2 ,or the A side (see Figure 8)
  - Outgoing communications to terminals 17 and 18, or the B side (see Figure 8)
- Network communications cables are polarity insensitive; however, consistent color-coding should be observed to simplify wiring and troubleshooting.
- The network cable must be an unshielded twisted pair 22 AWG (0.65 mm) NEMA Level IV cable. This cables cable is the only cable that has been tested and approved by Echelon. For more information about approved cabled, contact Phoenix Controls.
- Use a bus topology for connecting routers to the building-level network.
- Network segments may not exceed 425 feet (130 meters) in length.
- By definition, repeaters connect two network segments together and represent the last device on each channel. Therefore, a TP-1250 end of line terminator, which ships with the device (403-500-002), should be connected to both:
  - The A side to terminals 3 and 4 (see Figure 8)
  - The B side to terminals 15 and 16 (see Figure 8)
- There is no limit on how many repeaters are used to extend the TP-1250 network.

For power connections:

- The RTR100, RTR200 and RPT100 may all be powered by 16 to 30 volts AC or DC.
  - Connect incoming power connections to terminals 6 and 7 (see Figure 8).
  - If multiple devices will be powered from the same source, or daisy-chained, connect the power to the next device to terminals 8 and 9.
  - Maintain a consistent polarity throughout the system.
- The RTR104 may be powered by 9-28 Vac or 9-35 Vdc.
  - Connect incoming power connections to terminals 1 and 2 (see Figure 9).
  - If multiple devices will be powered from the same source, or daisy-chained, place two conductors under each terminal.
- Maintain consistent polarity throughout the system.

## TERMINAL DESIGNATIONS

Terminal	Function		
	RTR100 and 200 (see Figure 8)	RPT100 (see Figure 8)	RTR104 (see Figure 9)
1	Incoming FTT-10 Net A	Incoming TP-1250 Net A	Incoming power-L1/+
2	Incoming FTT-10 Net B	Incoming TP-1250 Net B	Incoming power-L2/-
3	No connection	End-of-line terminator (orange wire)	Earth Ground
4	No connection	End-of-line terminator (orange wire)	Router 1 (TP-1250) Net A
5	No connection	No connection	Router 1 (TP-1250) Net B
6	Incoming power-L1/+	Incoming power-L1/+	Router 2 (TP/FT-10) Net A
7	Incoming power-L2/-	Incoming power-L2/-	Router 2 (TP/FT-10) Net B
8	Power to next device-L1/+	Power to next device-L1/+	Router 3 (TP/FT-10) Net A
9	Power to next device-L2/-	Power to next device-L2/-	Router 3 (TP/FT-10) Net B
10	No connection	No connections	Router 4 (TP/FT-10) Net A
11	No connection	No connection	Router 4 (TP/FT-10) Net B
12	No connection	No connection	Router 5 (TP/FT-10) Net A
13	No connection	No connection	Router 5 (TP/FT-10) Net B
14	No connection	No connection	
15	Outgoing TP-1250 Net A	End-of-line terminator (orange wire)	
16	Outgoing TP-1250 Net B	End-of-line terminator (orange wire)	
17	Incoming TP-1250 Net A	Outgoing TP-1250 Net A	
18	Incoming TP-1250 Net B	Outgoing TP-1250 Net B	

## Phoenix Controls Recommended Cables

Cable Type	Plenum Rated	Function	Wire Gauge	Primary Vendor/Part #	Alternate Vendor/Part #	Color Code	Notes
2C Round	No	24 Vac power to LOSEA or Pneumatic (110' max at load 1, 2)	18	Belden 9409		1: Red 2: Black	Must be stranded
		24 Vac power to HiSea (288' max at load 1, 2)	14	Belden 9411			
2C Round	Yes	24 Vac power to LOSEA or Pneumatic (110' max at load 1, 2)	18	Belden 82740	Windy City NP002360	1: Red 2: Black	Must be stranded
		24 Vac power to HiSea (288' max at load 1, 2)	14	Windy City NP007960			
TP	No	FTT-10 (4500') TP1250 (425')	22	Windy City 107500	Connect Air W221P-1002	1: White/Blue stripe 2: Blue/White stripe	For more alternatives visit: echelon.com
		FTT-10 (8800')	16	Windy City 109600			
TP	Yes	FTT-10 (4500') TP1250 (425')	22	Windy City 105500	Connect Air W221P-2001	1: White/Blue stripe 2: Blue/White stripe	For more alternatives visit: echelon.com
		FTT-10 (8800')	16	Windy City 109500			
3C Round	No	Signal	22	Belden 8443		1: Red 2: Black 3: Green	Must be stranded
3C or 4C Round	Yes	Signal	22	Belden 88444	Windy City 004380	1: Red 2: Black 3: Green 4: White (not used as 3C)	Must be stranded
4C Round	No	Signal	22	Belden 8444	Manhattan M13304	1: White 2: Green 3: Black 4: Red	Must be stranded
5C Round	No	Signal	22	Belden 8445	Manhattan M13305	1: White 2: Brown 3: Black 4: Red 5: Green	Must be stranded
8C	No	Signal	22	Belden 9421	Manhattan M13308	1: White 2: Orange 3: Black 4: Red 5: Green 6: Yellow 7: Blue 8: Brown	No substitutes
8C	Yes	Signal	22	Comtran 4956		1: White 2: Orange 3: Black 4: Red 5: Green 6: Yellow 7: Blue 8: Brown	No substitutes

Cable Type	Plenum Rated	Function	Wire Gauge	Primary Vendor/Part #	Alternate Vendor/Part #	Color Code	Notes
3C MS/TP	No	Shielded	22	Belden 3106A (120 ohm)		1: White with Orange stripe 2: Orange with White stripe 3: Blue with White stripe	Shielded with drain
4C MS/TP	Yes	Armored Shielded	22	Belden 1269A (100 ohm)		1: Red 2: Blue 3: Black 4: Yellow	Foil and braided shield with drain
4C MS/TP	Yes	Armored Shielded	22	Belden 123107A (100 ohm)		1: White with Blue stripe 2: Blue with White stripe 3: White with Orange stripe 4: Orange with White stripe	Foil and braided shield with drain
4C MS/TP	Yes	Armored Shielded	24	Belden 82842 (100 ohm)		1: White with Blue stripe 2: Blue with White stripe 3: White with Orange stripe 4: Orange with White stripe	Foil and braided shield with drain Low smoke
4C MS/TP	Yes	Shielded	24	Belden 82729 (100 ohm)		1: White with Blue stripe 2: Blue with White stripe 3: White with Orange stripe 4: Orange with White stripe	Shield with drain
4C MS/TP	Yes	Shielded	24	Belden 88102 (100 ohm)		1: White with Blue stripe 2: Blue with White stripe 3: White with Orange stripe 4: Orange with White stripe	Shield with drain

## MAINTENANCE

The router and repeater modules require no maintenance. If the unit does not appear to operate, contact Phoenix Product Support for assistance.

The RTR100, RTR200 and RPT100 consist of a router or repeater module, and a mounting base plate. Replacement modules may be ordered from Phoenix Controls by specifying the appropriate module from the list below.

Each network interface device is shipped with the appropriate end-of-line terminator:

- The RTR100 and RTR200 ship with two FTT-10 end-of-line terminators for the room-level network.
- The RTR104 is shipped with eight end-of-line terminators, two for each room-level network.
- The RPT100 is shipped with two TP-1250 end-of-line terminators for the building-level network.

If a terminator is lost or damaged, replacements can be ordered from Phoenix. Select the replacement from the following table.:

Replacement Part	Part Number
RTR100 module	RTR100-NBX
RTR200 module	RTR200-NBX
RPT100 module	RPT100-NBX
FTT-10 end-of-line terminator	403-500-003
TP-1250 end-of-line terminator	403-500-002

## TROUBLESHOOTING

Status indicator on the front of the RTR/RPT module may be used to provide an indication that the devices are powered, commissioned and passing data. Additional LED states may indicate a fault condition.

### Troubleshooting the RTR100, RTR200, RPT100 (see Figures 10 and 11)

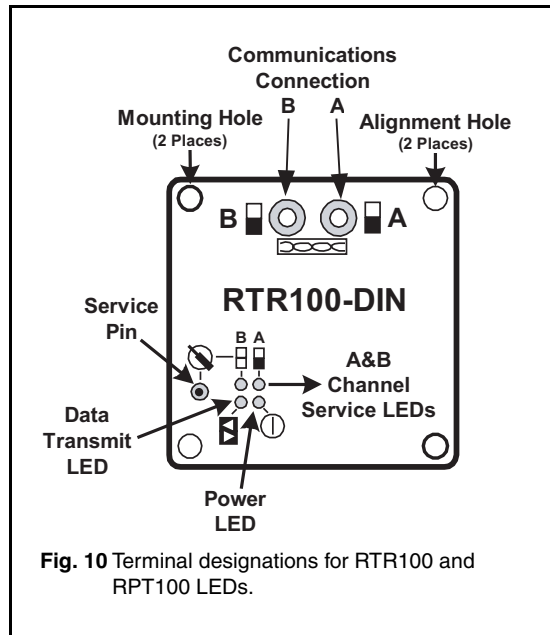
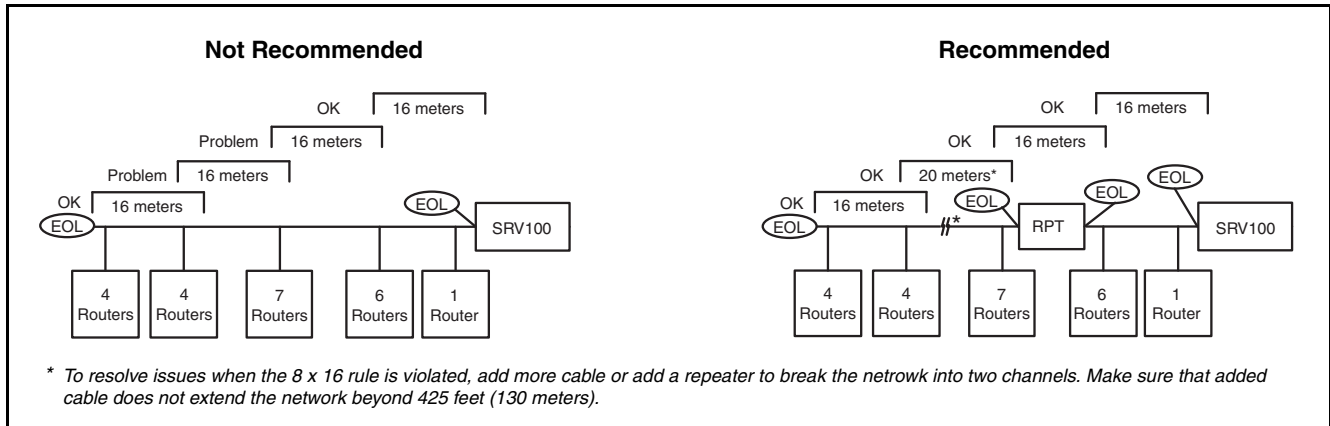
Problem	Possible Cause/Solution
Data is not reaching the MacroServer or MicroServer.	<p>A. One or more router or repeater modules are not powered.</p> <ul style="list-style-type: none"> <li>• Verify whether the power indicator is illuminated on all router and repeater modules. If not: <ul style="list-style-type: none"> <li>• Check the power connections on the device.</li> <li>• Check the previous device.</li> <li>• Check the next device.</li> </ul> </li> <li>• Remove the router or repeater module from the housing and double-check the power to the terminals.</li> </ul> <p>B. One or more router or repeater modules are not yet commissioned.</p> <ul style="list-style-type: none"> <li>• If the device is commissioned, the A and B channel LEDs will be extinguished.</li> <li>• If the A and B channel LEDs are alternating ON and OFF, the device is not commissioned. Use the Phoenix Commissioning Tool to commission the device.</li> </ul> <p>C. Data is not passing through the device.</p> <ul style="list-style-type: none"> <li>• Check the communications LED. <ul style="list-style-type: none"> <li>• If the LED is flashing, then the data is being passed across the device. Use the Phoenix Point Viewer to verify whether data is reaching the MicroServer or MacroServer. If the Point Viewer cannot read data from the network, check the domain ID.</li> <li>• If the LED is not flashing but the power is ON and the device is commissioned: <ul style="list-style-type: none"> <li>• This could indicate an open connection. Check all connections.</li> </ul> </li> </ul> </li> <li>or</li> <li>• The data has not been mapped to the gateway. Check the map file using the Phoenix Commissioning Tool.</li> </ul>

If these steps do not resolve the difficulty, contact Phoenix Product Support for assistance.

### 8 x 16 Rule for TP1250 Communications Channels

The 8 x 16 rule, simply stated, is that no more than 8 devices can be connected to the TP1250 building-level network over a length of cable less than 16 meters (52 feet) long. A high concentration of TP1250 devices may cause signal reflection, which will interfere with normal communications. In the Celeris network, routers (the B Side), repeaters and the server count as devices.

The diagram below shows acceptable node densities, along with those that could present problems.



### Troubleshooting the RTR104

Status	Monitor Function	Router Function
Green on	Configured, no errors	Configured, no traffic, no errors
Green flashing (slow)*	Repeater mode	Configured, traffic, no errors
Yellow on	Offline	Disabled or offline
Yellow flashing (slow)*	Not configured	Not configured
Orange flashing (fast)*	Alarm logged	In alarm

\*Slow is defined as on for one second/off for one second. Fast is defined as on for 0.5 second and off for 0.5 second.