Operating Manual

BTR-24
Wireless Base Station

RTS

Thank you from Bosch

We, at Bosch Security Systems, Inc, would like to take this opportunity to thank you for choosing the RTS BTR-24 Base Station. Many of the features in this product are the result of years of development work with many of the features developed from customer feedback. We hope that your experience with this product is a pleasant one and hope to provide you with a continuing line of RTS products well into the future. In order to get the most out of your new wireless intercom system, please take a few moments to look through this operating manual before using the product for the first time.

RTS

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- RTS TW
- Audiocom

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Headsets . . . . . www.intercomheadsets.com/warranty

Customer Support

Technical questions should be directed to:

Customer Service Department
Bosch Security Systems, Inc.
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Burnsville, MN 55337 U.S.A.
Telephone: 800-863-4169
Fax: 800-323-0498
Info@rtsintercoms.com

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Table of Contents

Section 1 - Introduction

General Description

The RTS BTR-24 base station is a digital, multi-channel, wireless access point offering reliable and secure, full-duplex communication with up to 10 wireless TR-240 (or TR-24) beltpacks and almost an unlimited number of half-duplex beltpacks.

Operating in the 2.4 GHz frequency band, the BTR-24 uses the widely adopted IEEE 802.11 technology and is approved for license free use in most countries. The system also incorporates ClearScan intelligence which will automatically select the optimal radio frequency (RF) channel for communication.

The RTS BTR-24 has the ability to configure multi-level 802.11 wireless security features, such as packet encryption and MAC address filtering, to provide a highly secure wireless intercom system.

The BTR-24 base station serves as a central relay location which handles the audio traffic between TR-240 (or TR-24) beltpacks. The BTR-24 is perfectly suited for stand-alone operation and can also interface with other BTR-24 and BTR-240 base stations to extend range and provide wireless communication coverage to multiple locations.

The BTR-24 base station has an internal rechargeable Li-Ion battery that will provide up to 10 hours of uninterrupted operation.

System Features

- Uses the widely adopted 2.4GHz IEEE 802.11 WLAN technology.
- No FCC license required and no license required in most countries world-wide.
- Multi-level wireless security and audio encryption.
- ClearScan intelligence to automatically select the best RF channel to operate.
- Up to 10 wireless full-duplex TR-240 (or TR-24) beltpacks per base station and nearly an unlimited number of half-duplex beltpacks.
- Multiple options for antenna connections and accessories.
- BTR-240 base stations and BTR-24 access points can be linked together to provide a wider wireless coverage area.
- Dependable, rechargeable, wide temperature range, Li-Ion battery with low battery indicator.
- BTR-24 can be powered from external AC for endless operation in permanent installations.

Important Safety Instructions

Prior to operation, read and follow all safety instructions.

Throughout this manual, the following notations are used:

WARNING: Indicates a situation which, when not avoided, has the potential to result in death or severe injury.

CAUTION: Indicates a situation which, when not avoided, has the potential to cause the system to no longer function properly or cause equipment damage.

NOTE: Indicates important additional information.

WARNING:

To reduce the risk of fire or electrical shock, adhere to the following instructions:

- **Do not expose the system components to rain or moisture.**
- **Ensure that the power cords are in a safe and secure place that is protected from being walked on or pinched.**
- **Do not remove the cover or product casing. All technical service must be performed by qualified service personnel.**

WARNING:

Excessive sound pressure from headsets can cause hearing loss! The duration of exposure to high volumes must be shortened to reduce the chance of hearing damage. Signs of prolonged exposure to excessive audio levels include:

- **Ringing sounds heard in ears.**
- **Can no longer hear high frequency tones, if only for a short time.**

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Section 2 - BTR-24 Base Station

Controls and Connections

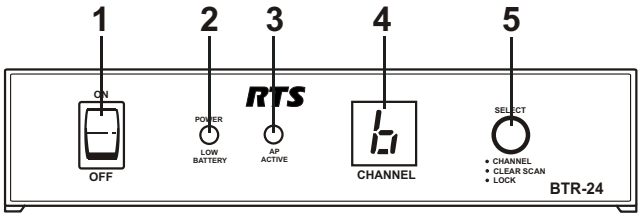

Figure 2-1
Front View

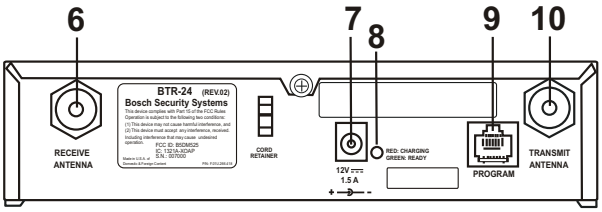

Figure 2-2
Rear View

1. **On/Off Switch** – turns the power on/off.

2. **Power / Low Battery Light** – indicates the base station has power, either from the internal battery or AC power connected to the unit.
   GREEN = Battery OK
   RED = Battery Low (approx. 30 minutes left)
   NO Light = Battery Depleted (needs charge)

3. **AP Active Light** – the green light will blink to indicate that the BTR-24 has successfully booted and is operating.

4. **RF Channel Display** – displays the current RF channel of operation.

5. **<SELECT> Button** – quickly press and release to increment the RF channel of operation.

6. **Receive Antenna Jack** – reverse "TNC" connector.

7. **Charge / Power Jack** – used to charge the internal Li-Ion battery and power the unit directly from a wall outlet. Accepts a 12VDC regulated power supply with at least a 1.5 A current capacity.

8. **Charge Light.**
   RED = Battery is charging.
   GREEN = Battery is charged.

9. **Programming Input** – RJ-45 jack for wired Ethernet connections.

10. **Transmit Antenna Jack** – reverse "TNC" connector.

Technical Specifications

RF Technology	IEEE 802.11b (Wi-Fi)
FCC License	No License Required
Frequency Band of Operation	
North America	2.412 to 2.462 GHz
Europe / China	2.412 to 2.472 GHz
Transmitter Output Power (conducted)	
North America	200 mW
Europe / China	50 mW
Security and Encryption Technology	
802.11 Wi-Fi	40-bit and 104-bit WEP
Antennas	Multiple omni and directional available
Programming Port	Ethernet (RJ-45)
Number of full-duplex beltpacks	10[1]
Number of half-duplex beltpacks	Unlimited[2]
Power Requirements	12 VDC, 1.5 Amps
BTR-24 Battery	Lithium-Ion Rechargeable
BTR-24 Battery Life	10 Hr (Typical)
BTR-24 Recharge Time	7-8 Hr (Typical)
BTR-24 Low Battery Indication	30 minutes of battery life left (Typical)
Dimensions	6" L x 7.63" W x 1.72" H (152mm x 194mm x 44mm)
Weight	2 lb. 11 oz (1.2 kg)

[1]With no interference on the RF channel of operation.
[2]Tested with over 28 half-duplex users.

Section 3 - Initial Equipment Setup

Unpacking

Unpack the RTS BTR-24 base station and retrieve the Package Contents list. Verify that all contents have been received according to the Package Contents list. Also, ensure that none of the system components have acquired any damage.

Contact the shipper or dealer immediately if anything is damaged or missing.

Operating for the First Time

The BTR-24 can be configured to use with **TR-240 (default) or TR-24** beltpacks. The BTR-24 is shipped and ready for operation with TR-240 beltpacks by default. Refer to Section 6 for instructions to change the configuration for operation with TR-24 beltpacks.

After unpacking, ensure that the BTR-24 does not have the same IP address as any other system devices. If so, refer to Section 6 for instructions on how to change the IP address.

Prior to use, the TR-240 (or TR-24) beltpacks should always have their batteries fully charged. Refer to the “Battery Charging Instructions” in their respective operating manuals.

The capacity, or number of allowable full-duplex beltpacks, is dependent upon the environment in which the system is used. When operating for the first time, it is recommended that only a few beltpacks are used to verify the system operation. Once communication has been verified with a few beltpacks, more can be added.

After system operation has been initially verified, it is strongly recommended that the user login to each of the devices and change the audio encryption key, SSID, wireless encryption key, or all, to something different from the factory defaults. This will ensure that the system is unique and other nearby system devices cannot connect and communicate. Refer to the “User Configuration” sections in each of the product operating manuals for instructions to change these settings.

Battery Charging Instructions

Prior to using the BTR-24 with battery power only, the battery should be fully charged. When the BTR-24 is in the "OFF" position, it will require approximately 7 full hours to completely charge a dead battery. A BTR-24 can also be used while charging the battery, but this will require a much longer time to completely charge.

NOTE: Battery packs should always be charged in a room temperature location.

1. Plug the AC end of the supplied 12VDC wall adapter into a standard AC wall outlet.
2. Plug the charge connector into the charge jack on the back of the base station.
3. The Charge Light on the rear panel of the BTR-24 indicates the battery charge status.

   RED = Charging in progress
   GREEN = Charging is done

Antenna Connection

The BTR-24 base station is supplied with two (2) antennas for transmitting and receiving. Both antennas are 3dBi omni-directional (Model: RA-3) with reverse polarity TNC connectors.

Attach one of the antennas to the transmitter antenna jack labeled "Transmit Antenna" on the rear panel. The antenna should be vertically aligned.

Attach the second antenna to the receiver antenna jack labeled "Receive Antenna" on the rear panel. The antenna should also be vertically aligned.

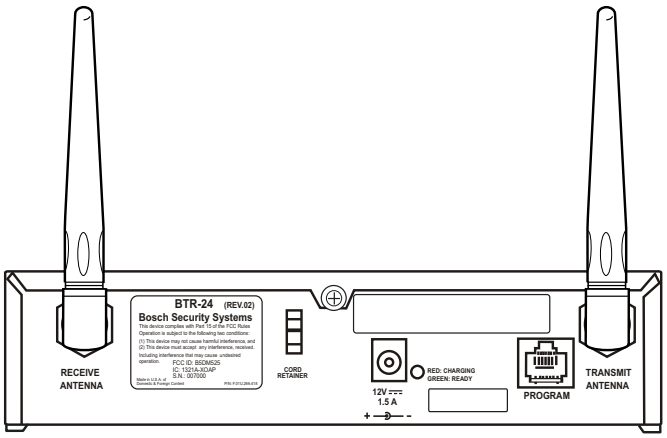

Figure 3-1
Attaching Transmit and Receive Omni-directional Antenna

Antenna Polarization

The supplied antennas are vertically polarized. This means that both the transmitting and receiving antennas should operate in the vertical position for the best performance.

Antenna Placement

Proper antenna placement has a significant effect on the overall performance of the RTS Wireless Intercom System. The following suggestions will help optimize system performance.

BTR-24 Base Station

The supplied *omni-directional* antennas have a circular antenna pattern and radiate RF signals equally in all directions. When using the omni-directional antennas, the base station should be located as close to the center of the wireless coverage area as possible.

If desired, the antennas can be remotely mounted or mounted on the front panel for a better signal path. A coax assembly with remote antennas may be required. See the "Accessories and Replacement Parts" section for ordering information.

NOTE: Antennas should never be mounted on, or next to metal, such as beams, walls with metal studs, equipment racks, etc. This will "detune" the antennas, by altering the antenna pattern characteristics, which can result in noise or loss of RF signal at the base station. This also applies to the antennas when connected directly to the base station.

NOTE: If the base station is to be located in a shielded rack mount enclosure or other poor RF location, the antennas must be mounted remotely with coax assemblies. See Figure 3-2 for antenna mounting options when using in an equipment rack.

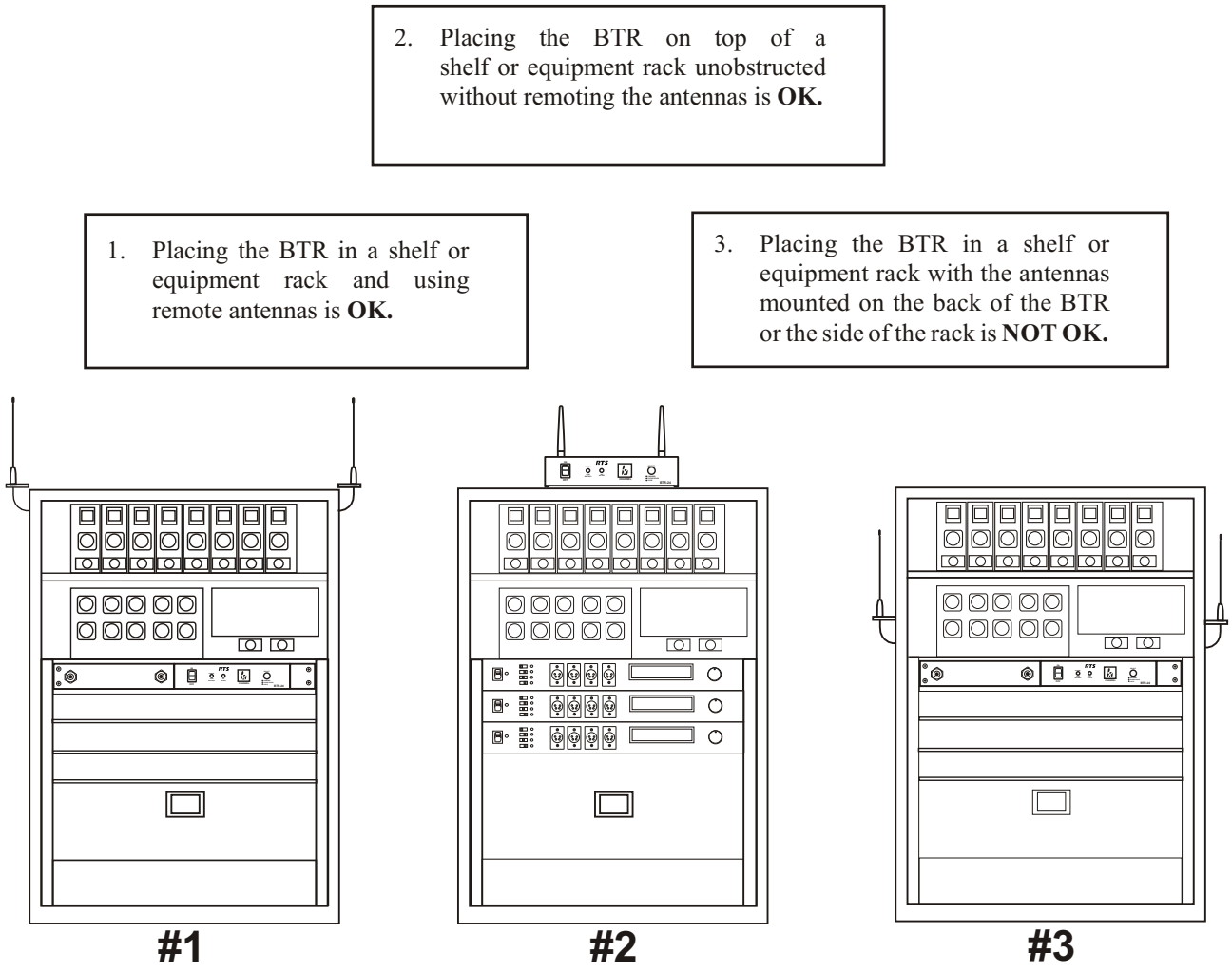

Figure 3-2
Equipment Rack Antenna Placement

TR-240 (or TR-24) Beltpack

The TR-240 (or TR-24) beltpack contains two internal antennas which are located on the sides of the beltpack. The beltpack should be worn on the belt, or attached to a pocket, at the hip with the buttons facing up. Place the beltpack in a position that allows for greatest visibility to the base station antennas.

Figure 3-3
Beltpack on Hip

NOTE: For the best RF signal path, do not allow the TR-240 (or TR-24) to be within 6 inches (15cm) of other objects while being worn on the belt.

Improving Reception and Increasing Range

The optimal and most reliable performance will result from keeping the distance from the base station and beltpacks as short and unobstructed as possible.

Line-of-sight (LOS) is where the transmitters and receivers of devices have a clear "sight" to each other, and the RF signal can travel in a straight line between those devices. The best performance will be obtained by having line-of-sight from the base station to each beltpack. This can be achieved by having the beltpack facing the base station antennas while being worn on the belt or in a pocket.

Attempting to operate the wireless intercom system through or around obstructions such as walls, ceilings, metal objects, etc., will reduce strength of the RF signal and therefore reduce system range and performance. The human body is also considered an obstruction to the RF signal.

The antennas that are supplied with the base station should provide satisfactory system performance in most applications. System range and reliability can be enhanced, however, by remotely mounting the antennas or by using alternate antennas that can be found in the "Accessories and Replacement Parts" section of this manual.

NOTE: The antennas listed in the "Accessories and Replacement Parts" section of this manual have been approved and authorized for use with the BTR-24 base station. Using an unauthorized antenna may be illegal.

System Quick Start Guide

The following is a list to quickly get the BTR-24 base station and wireless TR-240 (or TR-24) beltpacks operating.

NOTE: Additional setup information can be found in the "Operating for the First Time" section of this operating manual.

NOTE: Prior to use, the TR-240 (or TR-24) should have their batteries fully charged. Refer to the “Battery Charging Instructions” in their respective manuals.

1. Select a location for the BTR-24 base station and connect the power cord (if desired) and antennas.
   - When using omni-directional antennas, place the base station as close to the center of the coverage area as possible.
   - If external power is not available, the BTR-24 base station(s) can run off the internal battery (if already charged).
2. Turn on the base station.
   - After approximately 15 seconds, the base station will have completed the boot cycle, the active RF channel is displayed and the LED labeled "AP ACTIVE" will blink.
3. Perform a ClearScan.
   - Press and hold the <SELECT> button until the decimal point starts to blink (approx. 3 seconds) then release.
   - The display will blink "C" while ClearScan is being performed.
   - ClearScan will find and select the optimal RF channel for operation.
4. Plug headsets into the TR-240 (or TR-24) beltpacks and turn them on, one by one.
   - If the beltpack has not been previously set to wireless mode, press and hold the <TALK> button while the beltpack boots.
   - Allow a few seconds between each beltpack power on.
   - After approximately 20 seconds, a voice prompt will announce “wireless” in the beltpack headphones indicating that wireless communications has started.

The BTR-24 wireless intercom system is now ready for operation!

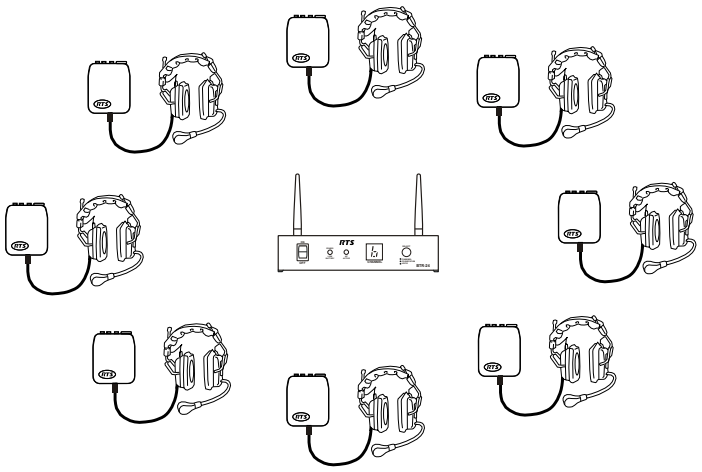

Figure 3-4
BTR-24 Supporting 8 Wireless TR-240s

Section 4 - BTR-24 Operation

BTR-24 Operation

This section discusses the operation and features of the BTR-24 base station. This section outlines the basic operation, hardware interfaces, and setup of the base station.

Basic Operation Description

The BTR-24 digital wireless intercom system offers one of the most comprehensive, user friendly and versatile set of features available in wireless intercom systems anywhere in the world.

The base station comes with the ClearScan intelligence which automatically selects the optimal RF channel for communication.

The BTR-24 base station can accommodate up to 10 full-duplex wireless TR-240 (or TR-24) beltpacks. The base station may also be used with an unlimited number of beltpacks in half-duplex operation.

Powering the Base Station

The BTR-24 base station can be powered from its internal Li-Ion battery or an external 12 VDC supply. The base station accepts a 5.5 mm by 2.5 mm plug. The source must supply at least 1.5 Amps. When the BTR-24 is plugged in using the external power supply, the internal battery will charge.

Power the base station via the front panel switch by moving the switch to the on, “ON”, position. Turn off the base station by moving the switch to the off, “OFF”, position.

NOTE: The supplied power source has been approved for use with the BTR-24. Users should only use the supplied power source when operating the BTR-24. For replacement power supplies, see the “Accessories and Replacement Parts” section for ordering information.

NOTE: When rebooting the BTR-24 base station, the power should remain off for at least 3 seconds before it is switched back on. This allows the unit time to settle and completely power down before power is reapplied.

Booting

Once the power switch on the BTR-24 has been turned on, the LED labeled "Power/Low Battery" will illuminate solid green. The base station takes approximately 15 seconds to configure and complete its boot cycle. When the base station has finished booting, the active RF channel is displayed and the LED labeled "AP ACTIVE" will blink. At this point, the TR-240 (or TR-24) beltpacks can be turned on.

RF Channel Selection

Once the BTR-24 is booted, the <SELECT> button allows the user to manually select the RF channel of operation.

While the "AP ACTIVE" LED is blinking, quickly press and release the <SELECT> button to increment the RF channel of operation. When the last channel is reached, the RF channel will cycle back to channel 1 on the next button press.

NOTE: It may take up to 5 seconds for beltpacks that are already associated with the BTR-24 to re-associate on the new RF channel.

NOTE: The RF channel of operation is remembered and BTR-24 will continue to boot on the same channel until it is set differently by the user.

ClearScan

When ClearScan is activated, the BTR-24 base station will temporarily shut down it's transmitter and begin scanning the available RF channels. The base station will determine which RF channel has the least activity and then begin transmitting on it.

Key Sequence: Press and hold <SELECT> until the decimal point begins to blink (approx. 3 seconds) then release.

The display will flash "C" while scanning. When ClearScan is complete, the display will show the current RF channel of operation and the "AP ACTIVE" light will resume blinking.

Lockout

The lockout function will prevent a user from changing the RF channel or performing ClearScan and factory reset.

Key Sequence: Press and hold <SELECT> until the decimal point begins to blink and CONTINUE to hold the button until the decimal point is on solid (approx. 10 seconds).

While lockout is activated, the decimal point will remain solid on the display. To unlock a base station, use the same key sequence and the decimal point will disappear from the display.

NOTE: The lockout feature is remembered every time the base station is booted.

Factory Reset

The BTR-24 base station has the ability to restore settings and parameters back to the factory state. The settings that are restored include the following:

- RF Channel
- User configurations (described in Section 6)
  - Login Password
  - IP address
  - SSID
  - Wireless Encryption Key
  - MAC filtering
  - Auto-ClearScan

Key Sequence: Press and hold <SELECT> while the unit is booting until the display begins flashing "F" then release.

CAUTION:

Do not remove the power to the base station while settings are being restored. This could potentially corrupt the configuration and cause the BTR-24 to fail when booting. For this reason, it is always recommended to have the BTR-24 plugged in using the external power supply when performing a factory restore.

When the factory restore is complete the base station will finish booting and resume operation.

Section 5 - System Operation

System Operation

This section describes the different system configurations of the BTR-24 base station and the TR-240 (or TR-24) beltpacks.

NOTE: The BTR-24 can be configured for use with **TR-240 (default) or TR-24** beltpacks. Refer to Section 6 for instructions to change the configuration for TR-24 beltpacks.

NOTE: For all system configurations, the TR-240 (or TR-24) battery packs should be fully charged. Refer to the Battery Charging Instructions in their user manuals.

Wireless Mode

The most common configuration for the BTR-24 system is the wireless mode configuration, shown in Figure 5-1. In this set-up, the BTR-24 base station serves as the “relay” and provides wireless coverage for up to 10 full-duplex beltpacks in wireless mode.

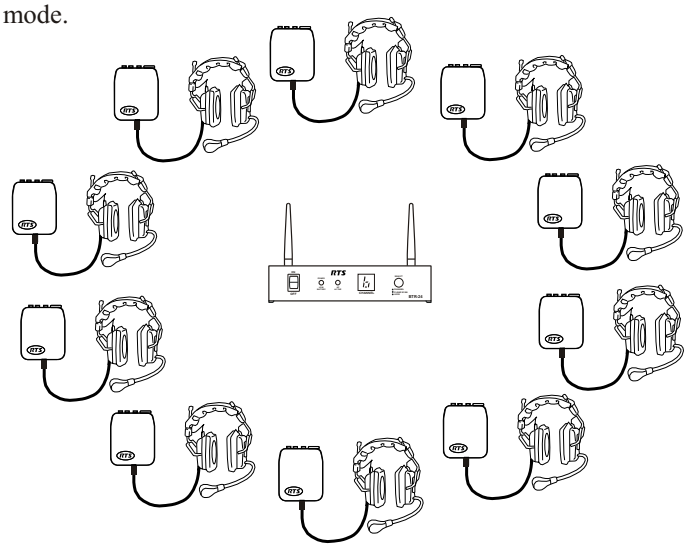

Figure 5-1
Ten Beltpacks in Wireless Mode

Set-up

1. Select a location for the BTR-24 base station and connect the power cord and antennas.

   - When using omni-directional antennas, place the base station as close to the center of the coverage area as possible.
   - If external power is not available, then the BTR-24 base station can run off its internal battery (if already charged).

2. Turn on the base station.

   - After approximately 15 seconds, the base station will have completed the boot cycle, the active RF channel is displayed and the LED labeled "AP ACTIVE" will blink.

3. Perform a ClearScan.

   - Press and hold the <SELECT> button until the decimal point starts to blink (approx. 3 seconds) then release.
   - The display will flash "C" while ClearScan is being performed.
   - ClearScan will find and select the optimal RF channel for operation.

4. Plug headsets into the TR-240 (or TR-24) beltpacks and turn them on, one by one.

   - For a wireless beltpack that has not been previously set to wireless mode, press and hold the <TALK> button while the beltpack boots.
   - Allow a few seconds between each beltpack power on.
   - After approximately 20 seconds, a voice prompt will announce "wireless" in the bletpack headphones indicating that communication has started.

Wireless Capacity Limit

Up to 10 full-duplex wireless beltpacks can be used with a single BTR-24 base station for reliable and uninterrupted communications on a clear RF channel. Many more half-duplex beltpacks can be used.

If a BTR-24 base station is loaded beyond its capacity limit, the usability becomes highly subjective. Users will begin to experience drop outs and potentially delays in the audio.

For example, a BTR-24 base station has 8 full-duplex wireless beltpacks and 28 half-duplex beltpacks. If 2 of the half-duplex beltpacks became full-duplex at the same time, the system will still be operating within the system limitations. If 4 of the half-duplex beltpacks were to become full-duplex, for a total of 12 full-duplex beltpacks, then the system would be operating beyond its loading limit and the users will begin to experience audio drop outs and potentially delays in the audio.

NOTE: The capacity limit may not be achieved if there is interference on the RF channel of operation. For further details, refer to Wireless Interference in Section 8.

Wireless and Wired Mixed-Mode

A BTR-24 base station can also support a mixture of wired and wireless TR-240 (or TR-24) beltpacks. Figure 5-2 shows an example of this type of configuration.

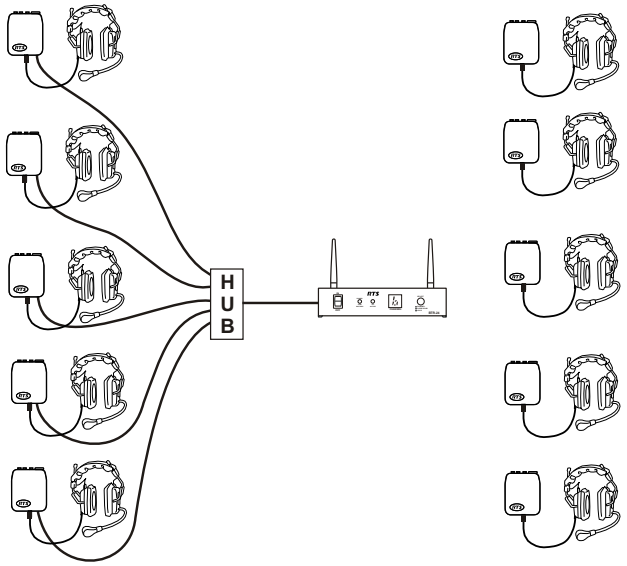

Figure 5-2
Ten TR-240's Communicating via Ethernet Infrastructure

Set-up

1. Select a location for the BTR-24 base station and connect the power cord and antennas.
   - When using omni-directional antennas, place the base station as close to the center of the coverage area as possible.
   - If external power is not available, then the BTR-24 base station can run off its internal battery (if already charged).
2. Connect the BTR-24 to all the wired TR-240s (or TR-24s) via Ethernet cables.
   - Use category 5e or better Ethernet cables that are wired to standards T-568A or T-568B (most Ethernet cables are built to these standards).
   - Do not use more than 100m (328ft) of Ethernet cable between devices.
3. Turn on the base station.
   - After approximately 15 seconds, the base station will have completed the boot cycle, and the active RF channel is displayed and the LED labeled "AP ACTIVE" will blink.
4. Perform a ClearScan.
   - Press and hold the <SELECT> button until the decimal point starts to blink (approx. 3 seconds) then release.
   - The display will flash "C" while ClearScan is being performed.
   - ClearScan will find and select the optimal RF channel for operation.
5. Plug headsets into the TR-240 (or TR-24) beltpacks and turn them on, one by one.
   - For a wireless beltpack that has not been previously set to wireless mode, press and hold the <TALK> button while the beltpack boots.
   - For a wired beltpack that has not been previously set to wired mode, press and hold the <2> button while the beltpack boots.
   - Allow a few seconds between each beltpack power on.
   - After approximately 20 seconds, a voice prompt will announce "wireless" or "wired" in the beltpack headphones indicating that communication has started.

Mixed-Mode Capacity Limit

Up to 10 full-duplex beltpacks can be used with a single BTR-24 base station for reliable and uninterrupted communications on a clear RF channel. Many more half-duplex beltpacks can be used.

If a BTR-24 base station is loaded beyond it's capacity limit, the usability becomes highly subjective. The users will begin to experience drop outs and potentially delays in the audio.

Any combination of wired and wireless beltpacks is supported as long as there are no more than 10 beltpacks overall.

NOTE: The capacity limit may not be achieved if there is interference on the RF channel of operation or the network. For further details, refer to Wireless Interference and Network Interference in Section 8.

Extended Wireless Mode

An extended wireless mode configuration is where wireless coverage is provided to multiple locations by adding a BTR-24 to an existing local area network (LAN) via Ethernet cable or through a building's Ethernet infrastructure. The BTR-24 will provide wireless coverage in its location while communicating to other network devices via Ethernet. Other network devices could be other BTR-24s, BTR-240s, and TR-240 (or TR-24) beltpacks in wired mode. This type of configuration is shown in Figure 5-3.

NOTE: The TR-24 beltpack is not fully compatible with the BTR-240 base station. When using a BTR-240 base station, only the TR-240 beltpacks may be used.

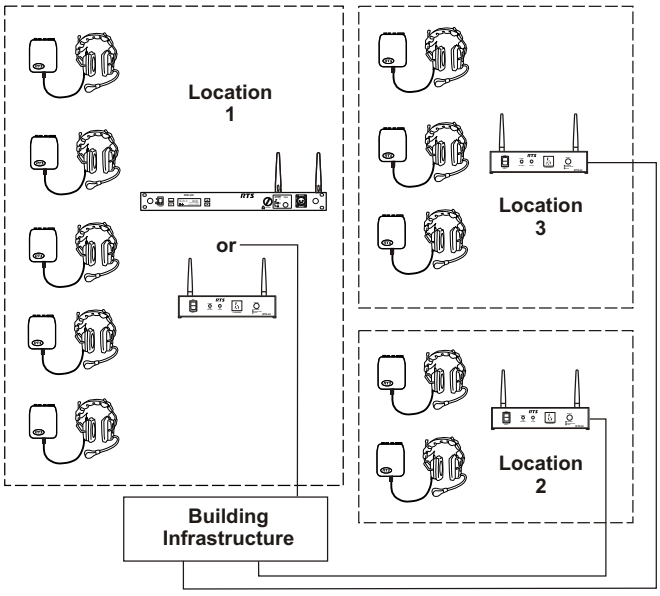

Figure 5-3
Multiple Base Stations Connected via Ethernet in Different Locations

Set-up

1. Select a location for the BTR-24 base station(s) and connect the power cord(s) and antennas.
   - For omni-directional antennas, place the BTR-24(s) as close to the center of the coverage area as possible.
   - If external power is not available, then the BTR-24 base station(s) can run off its internal battery (if already charged).
2. For Extended Wireless Mode, connect all the base stations and wired beltpacks to each other with Ethernet cables via the RJ-45 connectors.
   - Use CAT-5e or better Ethernet cables that are wired to standard T-568A or T-568B.
   - Do not use more than 100m (328ft) of Ethernet cable between devices.
   - If desired, a TR-240 (or TR-24) in wired mode can be plugged into an AC outlet for prolonged use.
3. Turn on the base station(s).
   - After approx. 15 seconds, the boot cycle will complete, the active RF channel is displayed and the LED labeled "AP ACTIVE" will blink.
4. Perform a ClearScan.
   - Press and hold the <SELECT> button until the decimal point starts to blink (approx. 3 seconds) then release.
   - The display will flash "C" while ClearScan is being performed.
   - ClearScan will find and select the optimal RF channel for operation.
5. Plug headsets into the TR-240 (or TR-24) beltpacks and turn them on, one by one.
   - For a wireless beltpack that has not been previously set to wireless mode, press and hold the <TALK> button while the beltpack boots.
   - For a wired beltpack that has not been previously set to wired mode, press and hold the <2> button while the beltpack boots.
   - Allow a few seconds between each beltpack power on.
   - After approximately 20 seconds, a voice prompt will announce "wireless" or "wired" in the beltpack headphones indicating that communication has started.

Extended Wireless Mode Capacity Limit

For BTR-24s linked with other BTR-24s without a BTR-240 base station, the total system capacity is 10 full-duplex beltpacks for reliable and uninterrupted communications on clear RF channels.

For BTR-24s linked with other BTR-24s and a single BTR-240 base station is included, the total system capacity is 8 full-duplex beltpacks for reliable and uninterrupted communications on clear RF channels. This is because the BTR-240 base station utilizes 2 full-duplex channels. When using a BTR-240 base station in the system design, only TR-240 beltpacks can be used.

If the extended wireless system is loaded beyond it's capacity limit, the usability becomes highly subjective. The users will begin to experience drop outs and potentially delays in the audio.

NOTE: The capacity limit may not be achieved if there is interference on the RF channel of operation or the network. For further details, refer to Wireless Interference and Network Interference in Section 8.

Linking Multiple Base Stations

When deploying multiple 2.4GHz 802.11 access points, such as the BTR-24 base stations, there are interference considerations that must be taken into account to ensure that users obtain the optimal performance.

The interference between multiple access points on the same RF channel is called *co-channel interference (CCI)* and the interference between multiple access points on different RF channels is called *adjacent channel interference (ACI)*. These types of interference are discussed in further detail in Section 10 "RF Channels and Interference" of this manual. To avoid the effects of RF interference with multiple access points, however, a specific deployment strategy, called a cell-type architecture, is required to ensure optimal performance.

Cell-Type Architecture

A *cell-type architecture* is a deployment strategy where the BTR-24 base station provides wireless coverage for it's own co-located beltpacks only. The *coverage area* is the area around the access point in which the receiver can receive and decode the data packets with minimal error rates. The *Clear Channel Assessment (CCA) area* is the area around the access point in which the error rate of a receiver is high (out of range) but the receiver can still "sense" the environment and detect if the channel is busy before transmitting a signal.

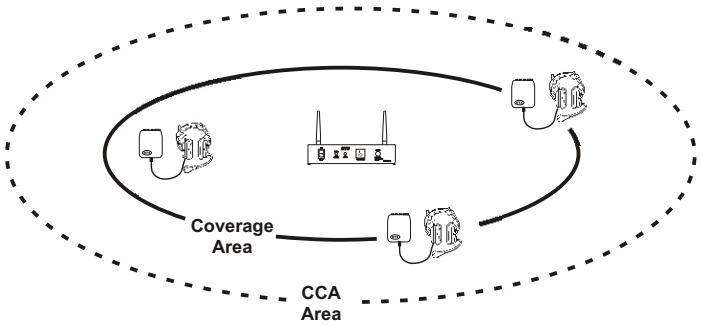

Figure 5-3
BTR-24 Coverage and CCA Areas

In a cell-type architecture, the coverage areas from multiple base stations **should not** overlap. When coverage areas do overlap, there will be interference. Interference also exists even if the base stations are operating on "non-overlapping" RF channels if the base stations are in very close proximity to each other (e.g., rack equipment).

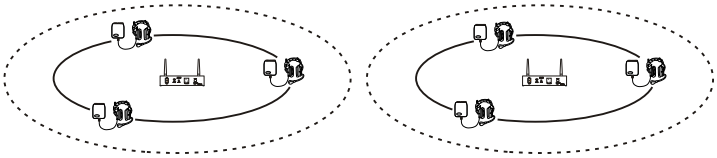

Figure 5-4
Example of Good Cell-Type Deployment

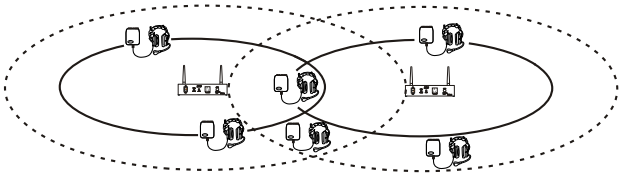

Figure 5-5
Example of Poor Cell-Type Deployment

Figure 5-4 is an example of a good cell-type deployment strategy where the coverage areas from multiple base stations do not overlap. Figure 5-5 shows an example of poor cell-type deployment where the coverage areas from multiple base stations do overlap which will cause interference.

There are many factors that affect the amount of interference that a BTR-24 will be subject to. These include:

- Channel Spacing and Utilization
- Separation Distance and Antenna Gain
- Type of Environment

Channel Spacing and Utilization

Many channels, overlapping and non-overlapping, can co-exist without noticeable interference if *channel utilization*, or amount of channel activity, is minimal. For example, a BTR-24 with ten (10) wireless full-duplex TR-240s is operating at maximum channel utilization. A second BTR-24 operating on an adjacent channel may cause minimal or no interference if there are no TR-240s associated with it. If the second BTR-24 acquires 2 wireless full-duplex TR-240s, there may be significant interference.

When deploying a BTR-24 in the presence of other BTR-24s and/or other Wi-Fi access points, it is necessary to select the RF channel that will have the least amount of energy. The ClearScan algorithm will scan nearby access points and automatically select the channel with the least activity and least amount of RF energy.

NOTE: When using multiple BTR-24s in close proximity, users **should always** operate them on different non-overlapping channels.

Separation Distance and Antenna Gain

Interference is greatly reduced as the physical separation between access points is increased. The separation distance required for multiple access points to operate without interference from each other is dependent upon the type of antennas used.

For BTR-24s operating on non-overlapping RF channels, Table 5-1 can be used as a guideline for separation distances to obtain the optimal system performance for indoor applications.

Antenna	Separation Distance
3dBi (supplied)	70ft
7dBi	165ft
11dBi (pointed at each other)	400ft
11dBi (at 45 to each other)	70ft

Table 5-1
BTR-24 Spacing for Non-Overlapping RF Channels

NOTE: When overlapping RF channels are being used, farther spacing will be required to obtain the same optimal system performance.

Type of Environment

When BTR-24 base stations are operating indoors and through walls, the interference will be greatly reduced and the separation distances required to keep them from interfering will also be reduced.

Indoor and outdoor environments behave very different because of the amount of reflections that are present. In general, for outdoor environments, every antenna gain increase (or decrease) of 6dB will cause the coverage area to double (or half). For indoor environments, every antenna gain increase (or decrease) of 9dB will cause the coverage area to double (or half).

Guidelines for Deployment Optimization with Multiple BTR-24s

- When using omni-directional antennas, place the BTR-24 base station as close to the center of the coverage area as possible.
- When possible, always operate multiple BTR-24s on different “non-overlapping” RF channels.
- Maintain a minimal separation distance (Table 5-1) between base stations, even when operating on “non-overlapping” RF channels.
- When possible, place multiple BTR-24s such that they do not have direct LOS to each other.
- Always try to ensure that wireless beltpacks are separated by at least 3ft from each other.

Network Requirements

These network requirements apply to interconnect all intercom system devices. Intercom system devices may include BTR-24 base stations, BTR-240 base stations and TR-240 (or TR-24) beltpacks. In general, the intercom system devices follow the same rules as other Ethernet networked devices. These rules are:

1. All intercom system devices must have a unique IP (internet protocol) address and cannot have the same IP address.

   Also, no other devices on the wired network can have the same IP addresses as the intercom system devices being used.

2. Use category 5e (CAT5e) or better Ethernet cables that are wired to standards T-568A or T-568B (most Ethernet cables are built to these standards).

3. When connecting intercom system devices together directly without the use of a building's network infrastructure, do not use more than 100m (328ft) of Ethernet cable between devices.

4. If using an existing building's Ethernet network, consult your network administrator as to the locations you plan on connecting the intercom system devices to the network. They can then check to make sure distance limitations of the network are met and that existing in-house routers / switches are set to pass packets for the intercom system devices.

Description	IP Type	Destination IP	Protocol
Audio 1 Packet	Multicast	239.192.168.1	UDP
Audio 2 Packet	Multicast	239.192.168.2	UDP
Audio 1 + 2	Multicast	239.192.168.3	UDP

Table 5-2
Intercom System Devices Wired Data Packets

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Section 6 - User Configuration Options

User Configuration Options

The BTR-24 base station has additional features that can be accessed by logging into the unit from a personal computer.

These features include:

- Login password
- IP Address
- SSID
- Wireless Security
  - — WEP Encryption Key
  - — MAC Filtering
- Auto-ClearScan
- Load BTR-24 Configuration

Computer Requirements

Hardware

- Laptop or desktop computer with a Network card (10/100 Based).
- Ethernet straight through cable (use the green cable supplied with the system).

Operating System

Microsoft[1] Windows[1] UP, Windows Vista[1], and Windows 7, Mac OS[1], Linux[1].

Software

Telnet or similar application that lets you communicate to a specified IP address (most all computers have the Telnet application or a similar program installed by default).

NOTE: Not all operating systems have the Telnet application enabled by default (i.e., Windows Vista and Windows 7). Consult the operating system help documents for assistance enabling this application.

Network Configuration

Use the following instructions to properly configure the computers Ethernet adapter to communicate to the BTR-24.

1. Unplug any current RJ-45 network connection from the computer.

2. Navigate to the "Network Connections" window.
   - — **Start** –> **Control Panel**
   - — Double-click on **Network Connections.**

3. Open the properties window for the "Local Area Connection".
   - — Right-click on **Local Area Connection**.
   - — Select **Properties**.

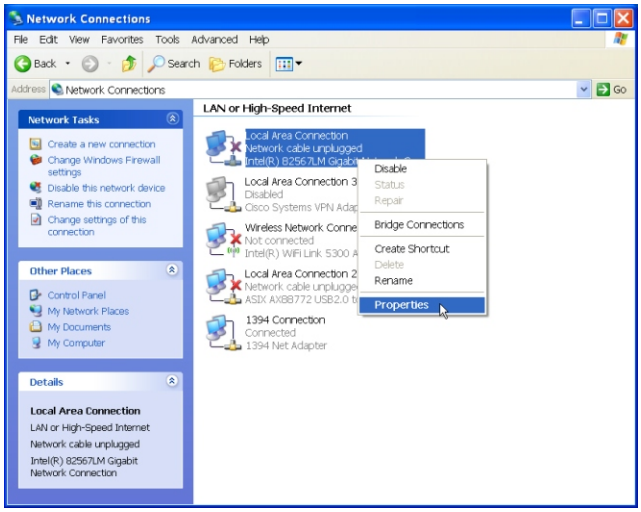

Figure 6-1
Network Connections

4. Open the properties window for "Internet Protocol (TCP/IP)".
   - — Select **Internet Protocol (TCP/IP)** with the mouse.
   - — Click on the **Properties** button.

[1] *See "Copyright Notice" on page I.*

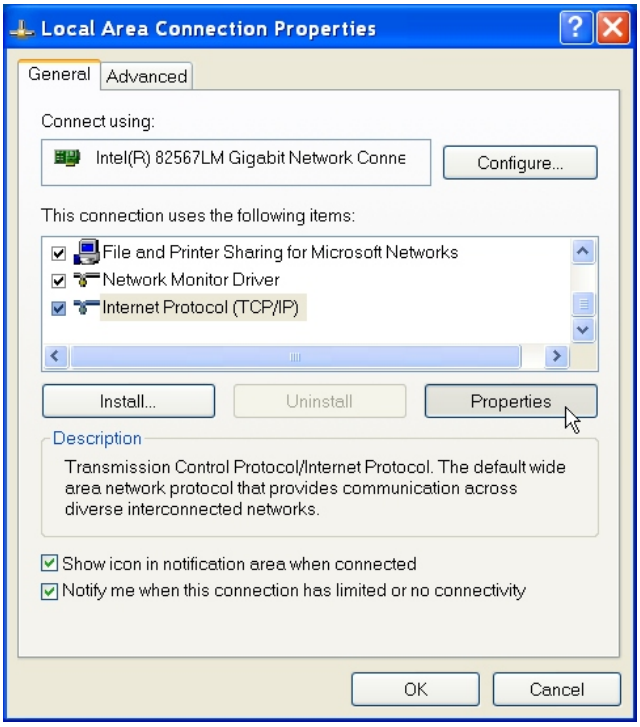

Figure 6-2
Local Area Connection Properties

NOTE: At this point, make a note of the current settings on this screen (so they can be placed back when done editing the devices).

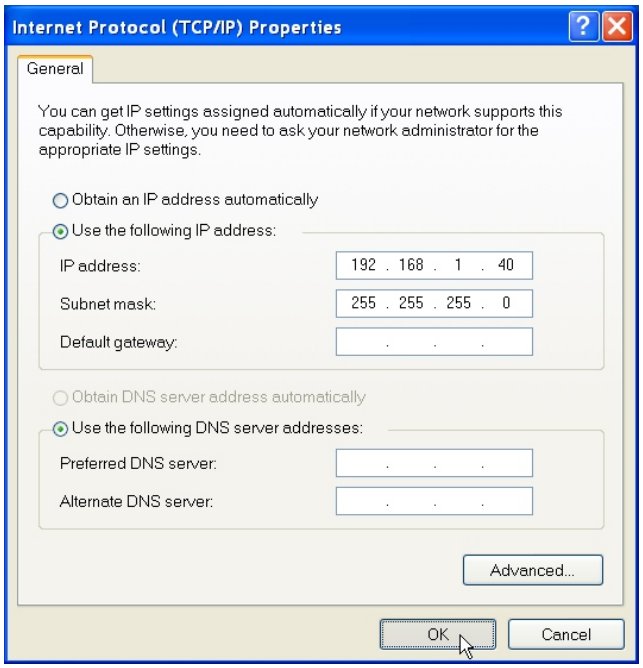

Figure 6-3
Internet Protocol (TCP/IP) Properties

5. Select the check box next to **Use the following IP address:**

6. Enter the following information:

   — IP address: **192.168.1.40**
   — Subnet mask: **255.255.255.0**

7. Once the above information is entered, hit the **OK** button to exit the Internet Protocol menu.

8. Press the **OK** or **Close** button to exit the Local Area Connections properties window.

NOTE: Depending on the computer and operating system, it may give notification that it should be restarted before the IP address changes will take effect.

Logging into a Device

Before continuing, ensure that all the steps have been successfully completed in the previous "Network Configuration" section.

1. Ensure that the BTR-24 is first powered off before connecting the Ethernet cable.

NOTE: Only the device being logged into should be connected to the computer. If using a hub, all other intercom system devices need to be powered off.

2. Identify the IP address of the BTR-24 that is going to be logged into by locating the sticker on the unit.

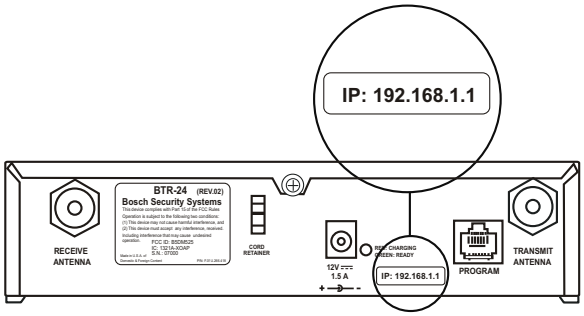

Figure 6-4
IP Address on BTR-24

3. Connect the BTR-24 to the computer by using the supplied green Ethernet cable.

4. Turn on the BTR-24 and allow it to boot completely.

5. Start a "Command Prompt" console window.

   — **Start** –> **Programs** –> **Accessories**
   — Click on **Command Prompt**.

6. In the console window, type the following command:

   — **"telnet 192.168.1.X" <Enter>**

NOTE: "X" is the last digit of the IP address on the device sticker.

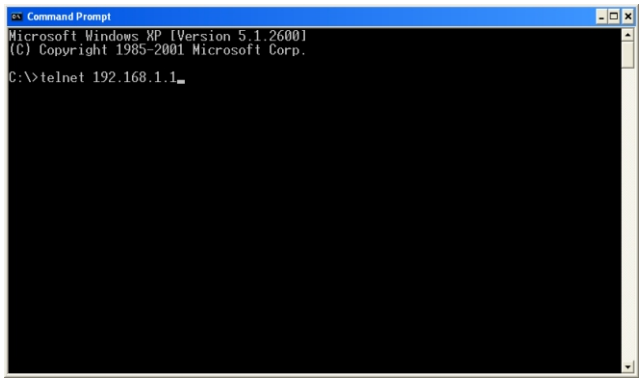

Figure 6-6
Telnet Command

7. After approximately 20 seconds, the device will respond with a login request. Enter the following information:

   — Login: **rts240 <Enter>**
   — Password: **legacy <Enter>**

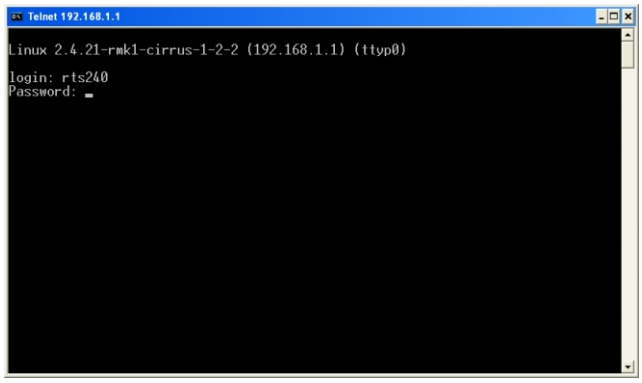

Figure 6-7
Login Screen

NOTE: The password entry does not give user feedback to the screen.

8. After a successful login, the User Menu Options will be displayed.

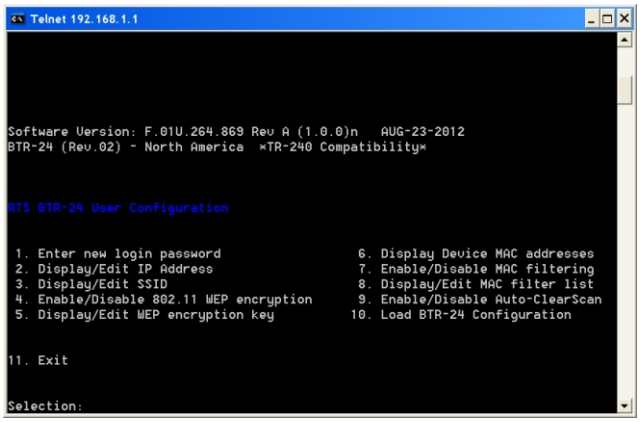

Figure 6-8
User Menu Options

NOTE: If the computer says, "failed to connect" after typing the "telnet" command in Step 6. First wait 30 seconds and try the command one more time. If that does not work, turn off the BTR-24, check the settings in the "Network Configuration" section, and repeat all the instructions in the section "Logging into a Device".

NOTE: The "backspace" keyboard button may not work on all computers using Telnet. If this is the case, use the "delete" button instead.

Software Version

From the User Menu Options screen (Figure 6-8), the software version of the unit is displayed on the top line. Please note the revision letter, number and the release date. These three items will change if the software is ever modified or upgraded. For example, the login screen in Figure 6-8 has a software revision letter of "A", revision number of "1.0.0", and a release date of "AUG 23, 2012".

The second line of the User Menu Options screen indicates the system model, region and compatibility mode. For example, Figure 6-8 indicates that this device is a BTR-24 (Rev.02), has been configured for use in North America and is compatible for operation with TR-240 beltpacks.

User Menu Options

There are several ways that a particular BTR-24 can be custom configured to the unique and specific requirements of a user. There are eleven (11) options that are available to the BTR-24.

1. Enter New Login Password

This option allows the user to change the BTR-24 login password. The maximum password length is 8 characters. The default factory password is "legacy". The user is never allowed to change the login name of "rts240".

2. Display/Edit IP Address

The IP address is a unique set of numbers to identify a particular device on a network. The **IP address must be different** on each device to operate and communicate with each other. Due to the fact that the BTR-24 and TR-240s are packaged and sold individually, it is possible that an IP address will match and need to be changed.

The IP address format for the BTR-24 is

192.168.1.**X**

where '**X**' is a number between 1 and 254.

CAUTION:

Be sure not to use the same IP address for more than one system device. ALL base stations and beltpacks must have different IP addresses in order to communicate.

NOTE: Each BTR-24 device comes with a sticker that indicates the IP address it was set at the factory. When changing the IP address, make sure to record, or write it underneath the original IP address in permanent marker.

3. Display/Edit SSID

The *Service Set Identifier (SSID)* is a phrase to identify a particular wireless network. The **SSID must be the same** on all wireless devices to communicate. The maximum SSID length is 32 characters. The SSID is upper and lower case sensitive. Any combination of letters, numbers, punctuation, and spaces can be used. For example, "Hello world, this is my SSID!" may be used as the SSID.

By default, the SSID is set to "RTS240".

CAUTION:

Write down the SSID when changed. ALL wireless base stations and beltpacks must have the same SSID entered in order to communicate.

4. Enable/Disable 802.11 WEP Encryption

The *Wired Equivalent Privacy (WEP)* encryption adds security to a wireless network by encrypting the entire 802.11 packet. This feature is used in conjunction with the audio encryption for a dual-layer encryption scheme. WEP encryption can be enabled or disabled.

By default, the WEP encryption is enabled.

5. Display/Edit WEP Encryption Key

When WEP encryption is enabled (from Menu Option 4), a paraphrase will be used to encrypt the entire 802.11 packet. The **WEP key must be the same** on all wireless devices to communicate. The paraphrase can be a 40-bit key (WEP-40) or a 104-bit key (WEP-140). The maximum WEP key length is 13 characters. The WEP key is upper and lower case sensitive. Any combination of letters, numbers, punctuation, and spaces can be used. For example, "~W]E(p*K-e#Y^" may be used as the WEP key.

By default, the WEP key is set to "bosch".

CAUTION:

Write down the WEP key when changed. ALL wireless base stations and beltpacks must have the same WEP key entered in order to communicate.

6. Display Device MAC Addresses

When connecting devices to an existing network or infrastructure, users may want to know what the *Media Access Control (MAC)* addresses are for both the wired and wireless network interfaces. By selecting this menu option, both of these MAC addresses are displayed.

7. Enable/Disable MAC Filtering

MAC address filtering is an additional layer of security to a wireless network. Each access point holds a list of wireless physical devices that are allowed (or denied) when trying to connect.

By default, MAC address filtering is disabled.

CAUTION:

MAC address filtering adds additional security, but also adds additional complexity. Only advanced users should enable this feature for setup. If done incorrectly, devices may no longer communicate.

8. Display/Edit MAC Filter List

When this menu option is selected, the current list of MAC address entries are displayed. When MAC address filtering is enabled (from Menu Option 7), the access point will "allow" only wireless physical devices from this list to connect to it. Users can add MAC addresses to the list, or delete them from the list. The maximum number of MAC address entries is 50.

NOTE: Before entering the list of MAC addresses into the access point, the user must first login to each unit and record the wireless MAC address from it (Menu Option 6).

A MAC address has the format of

XX : **XX** : **XX** : **XX** : **XX** : **XX**

where "**X**" is a hexadecimal number (numbers 0-9, and letters "A", "B", "C", "D", "E", and "F")

9. Enable/Disable Auto-ClearScan

When Auto-ClearScan is enabled, the BTR-24 will automatically perform a ClearScan and select the optimal RF channel for operation each time it is booted. When Auto-ClearScan is disabled, the BTR-24 will operate on the last RF channel set by the user.

By default, Auto-ClearScan is disabled.

10. Load BTR-24 Configuration

This menu option will load all the wireless configuration settings required for the BTR-24 to operate with TR-240 beltpacks or TR-24 beltpacks.

This menu option is primarily for users ordering a new BTR-24 (Rev.02) to work with their existing BTR-24 and TR-24 beltpacks. Those users should use this option to change the default settings for TR-24 compatibility.

Performing this operation will overwrite the factory defaults. Therefore, when a factory reset is performed, it will always maintain compatibility with the selected beltpacks.

NOTE: This operation will remove any previous wireless configuration settings.

By default, the configuration is set for operation with TR-240 beltpacks.

11. Enable/Disable Beacon Broadcast

In normal operation, a BTR-24 access point will broadcast its SSID. In doing so, it becomes visible to other nearby Wi-Fi enabled devices (i.e., computers, cell phones, etc.). Each of these devices can "see" this SSID as a possible wireless network to connect to.

In some instances, it may be desirable to hide the SSID broadcast to reduce traffic on the RF channel from other devices attempting to gain unauthorized access to the system. By disabling the beacon broadcast, the SSID of the system will no longer appear to other devices.

By default, the Beacon Broadcast is enabled.

CAUTION:

ClearScan will not avoid a RF channel that is being used by an access point with its Beacon Broadcast is disabled. Other frequency coordination efforts may be required to avoid interference among access points.

NOTE: This feature was added in firmware version A(1.2.0) which was released in 07/2013.

12. Exit

This menu option will exit the login and closes the Telnet connection to the BTR-24. If any changes were made, the unit must be rebooted before they take effect.

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Section 7 - Maintenance and Care

Li-Ion Batteries

The internal Li-Ion battery used in the BTR-24 is an excellent source of power for portable long-term use in both indoor and outdoor applications. It has a high energy density (energy per weight) compared to other rechargeable battery technologies (NiCd, NiMH, Alkaline, gel Cells), is low maintenance, and offers superior performance at low temperatures.

Battery Care

To ensure the long life and safe handling of the Li-Ion battery within the BTR-24, please note and adhere to the following precautions:

1. Store the BTR-24 in a clean, cool, dry location away from heat.

2. Do not burn or expose the BTR-24 to excessive heat such as direct sunlight, fire, or other heat sources.

3. Do not disassemble, puncture, crush or subject the BTR-24 to excessive impact.

4. Dispose of a BTR-24 in proper Li-Ion recycling location.

Long Term Battery Storage

Li-Ion batteries retain nearly all their capacity if stored for long term in dry, cool temperatures with only 30% to 50% of their full charge capacity. They can loose up to 20% capacity if stored for long term immediately after being fully charged.

The phrase “long term storage” is defined as no use of the device for 1 month or longer. Care should be taken for Li-Ion batteries when moving them into long term storage.

For the best performance, RTS recommends that the BTR-24 be charged to 30 – 50% of capacity before being placed in storage. This is the typical battery capacity left after 4–6 hours of full-duplex wireless usage.

To place a BTR-24 into long term storage:

1. After the last event:
   a. If the BTR-24 was used for 4 hours or less then **do not** recharge the battery pack.
   b. If the BTR-24 was used for more than 4 hours then recharge the pack for two hours (via direct charge).
2. Store the BTR-24 in a clean, cool, dry location away from heat. The recommended temperature range of the storage location is 32 – 77 ºF (0 – 25ºC). The temperature of the storage location **should not** rise above or below the recommended storage temperature.
3. Every 6 months, charge the BTR-24 for 3 hours (via direct charge) then remove them from charging. Do not fully charge. This procedure prevents the battery packs from over discharging and helps maintain the battery’s performance.

Cleaning

The BTR-24 system should only be cleaned with a soft and damp cloth. Never spray chemicals or cleaning solvents directly onto the units.

Temperature and Humidity

The BTR-24 system is robust and designed to work in a wide range of environmental conditions. When possible, the BTR-24s should be stored and used in an environment as close to indoor room temperature and humidity conditions as possible.

NOTE: Always perform system setup and configuration **indoors** and **before** deployment. Especially for operation of the devices in temperatures that are near the system limitations.

The devices should never be exposed directly to extreme weather conditions. The BTR-24 base station and power supply should be located where they will not have exposure to dust and moisture.

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Section 8 - RF Channels & Interference

802.11 RF Channels

Figure 8-1 displays the entire 802.11 RF channel spectrum for 2.4GHz. In North America, the BTR-24 system has the ability to operate on any RF channel between 1 and 11. In Europe and China, the BTR-24 system has the ability to operate on any RF channel between 1 and 13.

Although there are several different frequency channel settings, there is overlap between the channels. In North America, there are three non-overlapping channels available (Channels 1, 6, and 11). In Europe and China, there are more non-overlapping channels available.

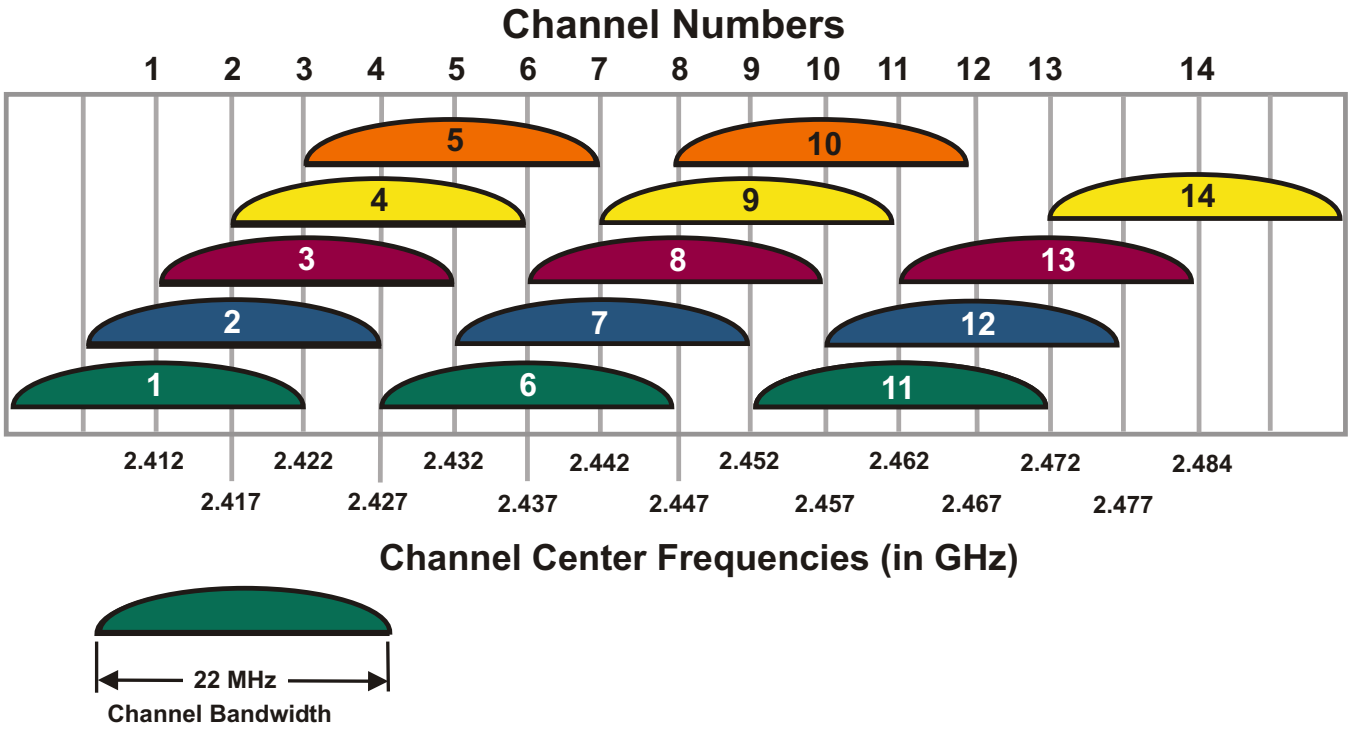

Fig 8-1
BTR-24 RF Channelization Scheme

802.11 "Non-Overlapping" Channels

Each of the RF channels in the 2.4GHz spectrum has a "22MHz bandwidth" which allows channels 1, 6 and 11 to exist with no overlap.

In reality, the 802.11 protocol for 2.4GHz does not actually define a "width" of the channel. It does, however, define a "spectral mask", or channel shape, to which a transmitter must conform. The specific requirements are that the signal must be at least -30dB at ±11MHz from the center frequency. This defines the "main lobe" and is where the "22MHz bandwidth" is derived. The signal must also be at least -50dB at ±22MHz from the center frequency and beyond.

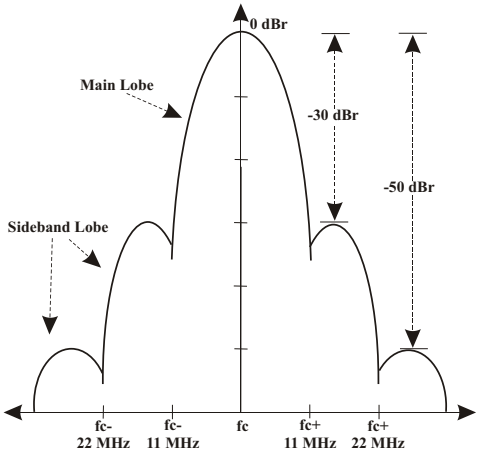

Figure 8-2
802.11 Transmitter Spectral Mask at 2.4GHz

Figure 8-3 shows that the "non-overlapping" RF channels actually do overlap at lower signal levels. The reality is that even though the overlap of "non-overlapping" RF channels is measured at -30dB or -50dB, those levels are still strong enough to cause interference, especially when in close proximity to each other.

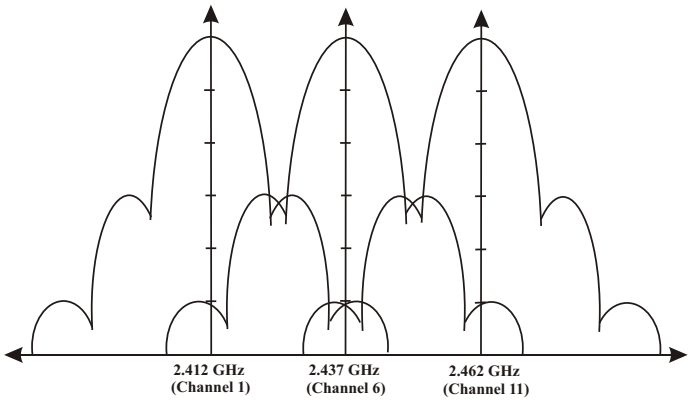

Figure 8-3
Actual Spectrum of "Non-overlapping" RF Channels

CSMA-CA

The reason devices can communicate without collisions in the environment is a mechanism in the 802.11 protocol called Carrier Sense Multiple Access-Collision Avoidance (CSMA-CA). Before a device transmits an 802.11 packet over the wireless channel, the device performs a Clear Channel Assessment (CCA) which is a measurement of the amount of energy in the channel. If the CCA fails, the device identifies the channel as busy and has to back-off/wait to send it's transmission until the channel is all clear.

The CSMA-CA mechanism is also the reason why interference must be avoided. When using overlapping channels, or "non-overlapping" channels, portions of the spectrum are shared and transmissions can be heard by all devices. The CCA of a device will fail if it detects a strong enough interfering signal, even if that it is not intended for that device.

Data vs. Real-time Audio

Interference can exist with any IEEE 802.11 WLAN. In many areas, users may find several near-by access points to which they can connect, all of them may even be on non-overlapping RF channels. The difference is the application of data vs. real-time audio.

For data applications in the presence of RF interference, the effect may be slightly longer download/upload speeds while the devices are waiting for the channel to become clear. This may even go un-noticed to a user when browsing the internet or downloading files.

For a real-time audio application, like the BTR-24 system, devices cannot simply wait for extended periods of time for the channel to become clear. If the channel is not clear after a specific waiting period, the information packet is simply dropped. When this happens, the result is a "tick" or "pop" in the received audio. For speech applications, an occasional tick or pop may be tolerable, but for systems with a lot of interference, consecutive ticks and pops present themselves in the form of audio "break-up" which may render the system unacceptable or unusable.

802.11 Wireless / RF Interference

The BTR-24 system offers many benefits by operating in the 2.4GHz ISM frequency band. The main reason is that it allows users to operate without a license requirement in most countries. The 802.11 protocol also has world-wide acceptance which permits users to travel with their system to locations where 802.11 devices are allowed.

Along with the many benefits of the 802.11 technology, there are some constraints. Because the 802.11 protocol is license-free and so widely adopted, there exist numerous devices that utilize these frequencies all over the world. These devices must coexist and share the RF spectrum. When multiple devices that are sharing the RF spectrum are located in close proximity to each other, they create wireless interference.

Wireless interference for 2.4GHz could come from a wide variety of sources including: Bluetooth enabled devices, microwave ovens, cordless telephones, cellular phones with Wi-Fi capabilities, and other nearby Wi-Fi access points.

In the presence of wireless interference, users of the BTR-24 system may experience performance degradation. Performance degradation may be in the form of capacity reduction, wireless range reduction, or audio quality degradation in the form of "break-up".

How to Avoid RF Interference?

In some environments, RF interference can be controlled, and in others, it cannot. There are numerous ways that a BTR-24 system operator can avoid a significant impact to RF interference.

1. Analyze the Environment

   - The ClearScan intelligence in the BTR-24 will scan the environment for surrounding Wi-Fi access points and select the optimal RF channel to operate. A ClearScan should be performed prior to the event. If a user suddenly experience performance degradation while operating, it is possible that a new source of RF interference became present and ClearScan could be run again.

   - There are many RF site surveying tools available that will detect more 2.4GHz interference than other Wi-Fi access points. This could be used to identify an optimal RF channel to operate on.

2. Prevent the Interference from Transmitting

   - In some cases, it may be possible to find the source of interference and shut it down. Other Wi-Fi devices may include nearby laptop/desktop computers or Wi-Fi enabled mobile phones. These devices should be shut down or their Wi-Fi capabilities could be temporarily disabled when operating near a BTR-24 system. Other non-Wi-Fi devices would be Blue tooth headsets, microwave ovens, and cordless telephones. These devices should also be turned off and not operating near a BTR-24 system.

3. BTR-24 Location and Antennas

   - The omni-directional antennas supplied with the BTR-24 provide a wireless coverage area in a circle around the BTR-24 equally in all directions which gives wireless users the ability to roam in all directions. This also means that the antennas will pick up interference from all these directions. Make sure the BTR-24 is located at the center of the wireless coverage area.

   - If the users are co-located, a directional antenna may be used as a better antenna option. This will provide a wireless coverage area in one direction and prevent coverage and interference from other directions.

   - Ensure that a BTR-24 is spaced far enough away from interfering sources including other access points and other BTR-24s, even if operating on "non-overlapping" RF channels. Refer to Table 5-1 in Section 5 for separation distances.

   - Prevent a BTR-24 from having LOS to other BTR-24s or access points, even if operating on "non-overlapping" RF channels.

4. BTR-240 and BTR-24 Cell Type Deployment

   - Multiple base stations (BTR-240s and BTR-24s) can be deployed and linked to provide a wider coverage area or wireless coverage in separate locations.

   - If users are co-located in multiple areas and/or separated by a large distance, linking multiple base stations with smaller antenna gains would be a better option than a single base station with large antenna gain to minimize interference and provide the same coverage area.

   - Keep coverage areas separate and do not allow coverage areas from multiple BTR-240s, BTR-24s or other access points to overlap.

5. Reduce the Number of Full-Duplex Users

   - Any users that do not really need to be in full-duplex mode (transmitting all the time), should be placed in half-duplex mode (transmitting only while the <TALK> button is pressed). This reduces the capacity load and will perform significantly better in an environment that contains interference.

6. Move Wireless Users to Wired

   - If wireless users are located near the base station and do not need roaming capabilities, they could be attached to the base station via Ethernet cable. This would reduce the wireless capacity load and perform significantly better in an environment that contains interference.

Wired / Network Interference

The BTR-24 system allows both wireless and wired users to operate at the same time. Similar to wireless interference, wired users may experience performance degradation if operating over an existing Ethernet infrastructure that has a lot of traffic.

How to Avoid Network Interference?

When connected to an existing Ethernet infrastructure, it will be difficult to control the network interference because many users may be connected. If other connected users are performing any operations such as video streaming or large file downloads and transfers, this may render the performance of the BTR-24 and wired TR-240s (or TR-24s) unusable.

1. Use a Dedicated Network for the BTR-24 System

    - The recommended and absolute best option for the BTR-24 system is to use a dedicated network for wired devices. In this scenario, only intercom system devices will be connected and performance will not be degraded.

2. Reduce the Number of Full-Duplex Users

    - Any users that do not need to be in full-duplex mode (transmitting all the time), should be placed in half-duplex mode (transmitting only while the <TALK> button is pressed). This reduces the network capacity load and will perform significantly better on an Ethernet infrastructure that contains interference.

Section 9 - Hardware Specifications

Program

The Program connector is a standard 8-pin modular jack (RJ-45). This port is to be used with standard Ethernet cables of Category 5e or better. The program connector has automatic crossover detection so both straight and crossover cables can be used. Refer to Figure 9-1 for the wiring diagram of the program port.

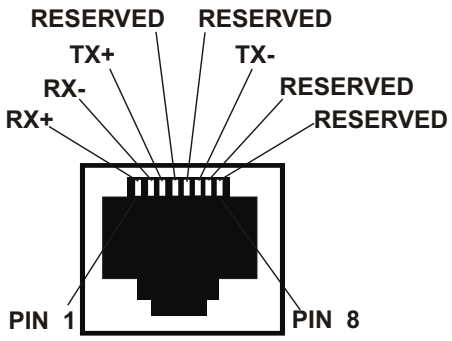

Figure 9-1
Program Wiring Diagram

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Section 10 - Troubleshooting

Prior to troubleshooting, please reread the sections of this manual to ensure the system is properly set-up. The following table contains troubleshooting tips that may be helpful in solving the problem.

If you are unable to solve the problem, contact the manufacturer or dealer from whom you purchased the system for assistance.

Problem	Possible Cause	Solution
RF range of all the beltpacks is less than normal and/or beltpacks are experiencing “break-up” of audio in an area where they have worked well in the past.	• Antenna(s) not connected to the BTR-24.	• Connect the antenna(s) to the BTR-24. The antenna connectors on the rear panel of the BTR-24 are labeled transmit (TX) and receive (RX). If antenna has cables, make sure the correct cable of the antenna goes to the corresponding connector on the BTR-24.
	• The two antenna connections are not connected to the right connectors on the BTR-24.	• If the antenna has cables, they are labeled transmit (TX) and receive (RX). The antenna connectors on the rear panel of the BTR-24 are also labeled TX and RX. Antennas with cables must be connected to the properly labeled port.
	• RF interference has occurred.	• Review Section 8 of this manual and sub-section titled “802.11 Wireless Interference” for instructions on how to avoid RF interference.
When the BTR-24 power switch was turned on, the unit's power light came on but the system never booted-up after 25 seconds. - or - Shortly after booting, the BTR-24 display appears to be stuck on "18 ".	• The BTR-24 internal battery is exhausted. • On boot, an error occurred and the unit could not finish the boot cycle	• Turn off the BTR-24 and plug in the power supply to charge the battery. Wait three seconds before turning the power back on again. The BTR-24 can also be used while charging the battery, but it will take much longer to reach the full charge.
The BTR-24 display is flashing "E" and there is no communication between beltpacks.	• An error occurred while setting wireless parameters which is preventing the BTR-24 from normal operation. Possibly on boot, after changing RF channel, or performing ClearScan.	• Turn off the power to the BTR-24, wait three seconds, and then power on again. If problem persists, contact the manufacturer or dealer from whom the system was purchased for assistance.

Problem	Possible Cause	Solution
One or more of the wireless beltpacks do not communicate to each other.	• The TR-240 (or TR-24) did not boot in wireless mode.	• Review the operating manual for the TR-240 (or TR-24) for instructions on how to boot the beltpack in wireless mode. Ensure that the <TALK> button is held down the whole time the unit is booting.
	• The TR-240 (or TR-24) is not in full-duplex.	• If the Channel button lights(s) on the TR-240 (or TR-24) are blinking, the TR-240 (or TR-24) is in half-duplex (listen-only). Review the operating manual for the TR-240 (or TR-24) for instructions on how to engage the microphone path and place the beltpack in full-duplex.
	• There is a network configuration problem.	• Review Section 6 of this manual and the sub-section titled "User Configuration". There are several potential sources for network configuration error that will not allow devices to communicate: – IP addresses of units are the same – SSID do not match – Encryption is not enabled/disabled on all devices. – WEP encryption keys do not match. – MAC address filtering (if enabled) has not been configured properly and is blocking the device. • If the network configuration problem cannot be identified, perform a Factory Reset on **all** devices to restore all the factory defaults. Review the manuals for each device for instructions on how to perform a factory reset.
Extremely loud static is heard on some or all of the system devices.	• The audio encryption key on the devices do not match.	• Review the beltpack operating manual for instructions on how to view and modify the audio encryption key.
Cannot login to the unit via telnet.	• Login password was forgotten.	• Perform a Factory Reset on the device to reset the password to the factory default. Review Section 4 of this manual for instructions on how to perform a factory reset.
	• There is a problem with the network configuration on the computer that is trying to telnet into the device.	• Review Section 6 of this manual and the sub-section titled "Network Configuration" and ensure all instructions have been followed.

Problem	Possible Cause	Solution
"Echo" is heard in base station or beltpacks.	• Acoustical Echo	• Disable the <TALK> buttons of each TR-240 (or TR-24) device one-by-one to identify if the echo is coming from one particular source. • When the echo source(s) have been identified, try the following echo avoidance techniques at that device: – Use a headset with a better acoustical isolation between headphones and boom microphone. – Ensure all active devices have headsets attached. – Reduce the headset volume. – Reduce the microphone gain. – Reduce the sidetone level. – Increase the squelch level of the beltpack (see the TR-240 operating manual).
After changing the RF channel or running a Clear-Scan beltpack(s) no longer communicate. The Out of Range alert is heard in the beltpack(s).	• Beltpack(s) did not re-associate on the new RF channel.	• The beltpack(s) that did not re-associate will need to be rebooted.

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Section 11 - Regulatory Information

FCC and Industry Canada

The BTR-24 complies with Part 15 of FCC rules and Industry Canada RSS-210.

Le BTR-24 est conforme à la Partie 15 des règlements de la FCC et Industrie Canada RSS-210.

Operation is subject to the following conditions:

1. This device may not cause harmful interference.

2. This device must accept any interference received, including interference that may cause undesired operation.

3. Use only the manufacturer or dealer supplied beltclip and/or accessories for this device.

5. This device must not be co-located or operated in conjunction with any other antenna or transmitter.

To comply with FCC and Industry Canada RF exposure requirements a separation distance of at least 20 cm (7.9 inches) should be maintained between the antennas of the BTR-24 base station and all persons.

Pour se conformer aux exigences FCC et Industrie Canada l'exposition aux RF sur une distance de séparation d'au moins 20 cm (7,9 pouces) doit être maintenue entre les antennes de la station de base BTR-24 et toutes les personnes.

CAUTION:

Any changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

ATTENTION:

Tout changement ou modification non expressément approuvée par la partie responsable de la conformité pourraient annuler l'autorité de l'utilisateur à utiliser cet équipement.

EU Compliance Information

This equipment is in compliance with the following directives;

2011/65/EU RoHS Directive
2002/96/EC WEEE Directive

Please dispose of the base station and beltpacks at the end of its operational life by taking it to your closest collection point or recycling center.

This equipment is intended for use in professional intercom applications.

The European version of the BTR-24 is intended to be operated in (ISO 3166-1, 2 letter country code):

AT	BE	CY	CZ	DK	EE	FI	FR
DE	GR	HU	IE	IT	LV	LT	LU
MT	NL	PL	PT	SK	SI	ES	SE
GB	IS	LI	NO	CH	BG	RO	TR

Almost all EU and other European countries have made the 2.4 GHz band available for use with this type of wireless equipment. However, the requirements for any country may change. Always check with the local authorities for the latest status of regulations in the 2.4 GHz band.

The following country has additional restrictions or requirements:

France
If the product is used outdoors, output power must be restricted in some parts of the band. The table below details the information. Please check with http://www.arcep.fr/ for more details or any recent compliance changes.

France
Dans le cas d'une utilisation en extérieur, la puissance de sortie est limitée pour certaines parties de la bande. Reportezvous à la table ou visitez le site Web http://www.art-telecom.fr/ pour de plus amples détails.

Area	RF Channel	RF Power, EiRP
Indoors (no restrictions)	1 - 13	100mW
Outdoors	1 - 7	100mW
Outdoors	8 - 13	10mW

Antenna Configurations

The European version of the BTR-24 has a typical output power of the 50mW. The EiRP (Effective isotropic Radiated Power) limit for the European Union is 100mW, however, always check the regulations within the country of use. The standard, 3dB gain, omni-pattern antennas shipped with the European version of the BTR-24, combined with its output power, are under this limit. However, some applications may require the installation of remote antennas by the use of extension coaxial cables. For this purpose the European BTR-24 has been approved for use with kits in Table 11-1. The kits contain an antenna, coaxial cable(s) of a length to make the EiRP compliant with the European Union regulations, and an adapter for coupling the antenna / antenna pigtail to the coaxial cable.

The user must install only the kits listed below. **Combinations of extension coaxial cables and antennas that result in a radiated power level exceeding 100mW EiRP are illegal in the European Union.**

The user will find more information on these kits in Section 12, “Accessories and Replacement Parts”.

China Compliance Information

The China version and European version of the BTR-24 are the same product. This BTR-24 has a typical output power of the 50mW. The EiRP (Effective isotropic Radiated Power) limit for China is 100mW. The standard, 3dB gain, omni-pattern antennas shipped with the European/China version of the BTR-24, combined with its output power, are under this limit. However, some applications may require the installation of remote antennas by the use of extension coaxial cables. For this purpose the China version of the BTR-24 has been approved for use with kits in Table 11-1. The kits contain an antenna, coaxial cable(s) of a length to make the EiRP compliant with the European Union and Chinese regulations, and an adapter for coupling the antenna / antenna pigtail to the coaxial cable.

Combinations of extension coaxial cables and antennas that result in a radiated power level exceeding 100mW EiRP are illegal in China.

Antenna Kit	Description	BTR-24 (European/China) Output, dBm	Cable Loss, dB	Antenna Gain, dB	Maximum Transmitted Power, dBm
RA-5E	5dBi gain, omni, magnetic mount antenna with 1.2m (4 ft) pigtail and an additional 1.5m (5 ft) of coaxial cable and an adapter.	+17 (50mW)	2.4	5	+19.6 (91mW EiRP)
RA-7E	7dBi gain, omni, with AB-24 antenna mounting bracket and 4.6m (15ft) of coaxial cable.	+17 (50mW)	4.2	7	+19.8 (96mW EiRP)
FP-11E	11dBi gain, directional, flat panel antenna with 7.6m (25ft) of coaxial cable and adapter.	+17 (50mW)	8.2	11	+19.8 (96mW EiRP)
ANT-FBE	11dBi dual flat panel antenna with dual pieces of 7.6m (25ft) coaxial cable and two adapters.	+17 (50mW)	8.2	11	+19.8 (96mW EiRP)

Table 11-1
Approved antenna kits for use in the European Union and China that ensure an EiRP of 100mW or less.

EU Declaration of Conformity

The version of the BTR-24 which displays the "CE" mark on the product label are compliant with the essential requirements of the R&TTE Directive of the European Union. The Declaration of Conformity is displayed below:

Security Systems

BOSCH

CE

EC-Declaration of Conformity

The undersigned, representing the following manufacturer

Manufacturer

Bosch Security Systems, Inc.

Address:

8601 East Cornhusker Highway, Lincoln, NE 68507 USA

Tel.: +1 402-467-5321
Fax: +1 402-467-3279

Authorized representative in Europe where technical construction file is held:

EVI Audio GmbH, Sachsenring 60, D-94315, Straubing, Germany

hereby declare that the following RTS branded product(s)

Material No / CTN / description:
F01U120576 / BTR-24-EUR / Wireless Intercom Base Station

Frequency Band: 2.412 – 2.472 GHz, IEEE 802.11b channels 1 – 13.

is (are) in conformity with the regulations of the following marked EC-directive(s) and bear(s) the CE mark accordingly

	reference number	title
☐	2004/108/EC	EMC Directive (EMC)
☐	2006/95/EC	Low-Voltage Directive (LVD)
☒	2011/65/EU	Restriction of the use of certain Hazardous Substances (RoHS)
☒	1999/5/EC	Radio equipment and Telecommunications Terminal Equipment (R&TTE)

The conformity of the product(s) with (above ticked) EC directives is provided by the compliance with the following standard(s):

Standard(s) / date	
SPECTRUM (Art. 3(2)):	EN 300 328 v1.7 (2006-10)
EMC (Art. 3(1)(b)):	EN 301 489-1 v1.8.1 (2008-04), EN 301 489-17 v2.1.1 (2009-05)
SAFETY & HEALTH (Art. 3(1) (a)):	EN 60950-1:2006 + A1:2010, EN 50385:2002

Year of affixing the CE-mark: 2007

Place, date:

Bosch - Lincoln, Oct. 11, 2012

Manager, Business Line
Printed first name + last name:
Ralph Strader ST-CO/PRM2

R+D Manager, Business Line
Printed first name + last name:
Keith Jenkins ST-CO/ENG2.4

Document No.: REG000467002 *Version:* 1.00

Section 12 - Accessories and Replacement Parts

Model Number	Part Number	Description
TR-240	F01U168687 North America F01U168689 Euro F01U168691 China	TR-240 beltpack with **4-pin male XLR** jack, rechargeable battery and charger/power supply.
	F01U169594 North America F01U169596 Euro F01U169598 China	TR-240 beltpack with **4-pin female XLR** jack, rechargeable battery and charger/power supply.
BTR-24	F01U120575 North America F01U120576 Euro / China	BTR-24 Base Station and power supply.
RA-3	F01U144918	Omni Antenna (3dB) with TNC reverse polarity plug connector.
RA-7	F01U117871	Omni Antenna (7dB) with TNC reverse polarity plug connector.
AB-24	F01U117875	Antenna mounting bracket for omni antennas with 6 ft (1.8m) coax cable.
RA-7E	F01U117876	Kit. Omni Antenna (7dB), with TNC reverse polarity plug connector, AB-24 antenna mount bracket with 4.6m (15 ft) coaxial cable.
RA-5	F01U144919	Omni Antenna (5dB) magnetic mount with 4 ft (1.2m) pigtail and TNC reverse polarity plug connector.
RA-5E	F01U117877	Kit. Omni Antenna (5dB), magnetic mount with TNC reverse polarity plug connector, plus 1.5m (5 ft) coaxial, cable and TNC reverse polarity coupler (jack to jack).
FP-11	F01U117872	Flat Panel Directional antenna (11dB) with TNC reverse polarity plug connector.
FP-11E	F01U144923	Kit. Flat panel directional antenna (11 dB), with TNC reverse polarity plug connector, 7.6m (25 ft) coaxial, cable and TNC reverse polarity coupler (jack to jack).
ANT-FP	F01U117869	Dual Diversity, Flat Patch Antenna with Dual Coax, 11dBi.
ANT-FBE	F01U144924	Kit. Dual Diversity, Flat Patch Antenna (11dB) with dual coax and TNC reverse polarity plug connector, two 7.6m (25 ft) coaxial, cables and two TNC reverse polarity couplers (jack to jack).
ANT-FPM	F01U117868	Metal Tilt and Swivel Antenna Mounting bracket for ANT-FP Antenna. Use for permanent mount of ANT-FP Flat Panel Antenna.

Model Number	Part Number	Description
RPT-3	F01U144920	3 ft. (0.9m) coax with TNC reverse polarity plug connectors.
RPT-10	F01U117873	10 ft. (3m) coax with TNC reverse polarity plug connectors.
TNC-RP	F01U144921	TNC reverse polarity coupler. Coupler is a reverse polarity jack to jack.
	F01U145150	Communications Cable, Ethernet CAT. 5e Cable, 3 ft. (09m).
24-PS	F01U144926	North American power supply/charger for TR-240, 100-240 VAC input, 12VDC 1.5A output, 5.5 x 2.5 x 11mm plug.
24-PSE	F01U117878	Euro, UK, China, Japan and Australian/ New Zealand power supply/charger comes with interchangeable plug sets for the different regions. Power supply is for TR-240 100-240 VAC input, 12 VDC. 1.5A output, 5.5 x 2.5 x 11 mm plug.

Section 13 - Glossary

ACI	Adjacent Channel Interference. The interference between multiple access points on different RF channels.
Acoustic Echo	The coupling of audio from a headset back into it's own attached microphone, or another microphone nearby. Result from using a digital intercom system with latency when (1) headsets are used with poor acoustical isolation between the headphones and boom microphone; (2) multiple users are located very close to each other; (3) by having a device with the microphone path enabled without an attached headset; (4) by one user having their volume or microphone gain settings too high.
Capacity	The number of full-duplex TR-240s that can be associated with a specific access point for reliable and uninterrupted communications.
CCA	Clear Channel Assessment. When a wireless device senses the environment for energy on it's frequency before it transmits the signal. If the CCA fails, the device determines that the channel is busy and will back-off / wait before attempting to send the signal again.
CCA Area	The area around an access point where the error rate of the receivers is high, "out of range", but the receiver can still sense the environment and detect if the channel is busy before transmitting it's signal.
CCI	Co-channel Interference. The interference between multiple access points on the same RF channel.
Cell-Type Architecture	WLAN deployment strategy with multiple access points operating on non-overlapping RF channels, with non-overlapping coverage areas.
Channel Utilization	The amount of activity on a particular wireless RF channel.
ClearScan	Intelligence that selects the optimal radio frequency channel to operate.
Coverage Area	Area around an access point where the receivers of devices can accurately receive and decode the data packets with a minimal error rate.
De-tune	When the characteristics of the antenna become un-optimized for the frequency of use and results in RF signal loss. Typically occurs when antenna is used near large metal objects.
Echo	When a user's voice is heard in the headset at a noticeable time interval after they have actually spoke. Occurs from any digital system with audio latency.
Ethernet	(IEEE 802.3) standard for implementing local area networks.
Full-duplex	Mode of operation when a device has simultaneous talk and listen capabilities.
Half-duplex	Mode of operation when a device has listen-only capabilities.
IEEE 802.11	Set of standards for implementing wireless local area networks developed by the Institute of Electrical and Electronics Engineers.
IP address	Internet Protocol address. A unique set of numbers to identify a particular device on a network.
LAN	(Wired) Local Area Network.
Latency	Time interval from when audio is sent from a device until it is received by another device.
LCD	Liquid Crystal Display.
LED	Light Emitting Diode.

License Free	Device uses frequency bands that do not require the user to obtain an approval for use. Specifically, the 2.4GHz ISM frequency band for 802.11 WLAN.
LOS	Line-of-Sight. When the transmitters and receivers of wireless devices have a clear "sight" to each other by having no obstructions in-between them. RF signals can travel in a straight line between those devices.
MAC address	Media Access Control address. Unique identifier for a particular physical device on a network.
Multicast	Delivery of a network information packet to a group of destination devices simultaneously in a single transmission.
Omni-directional	Pertaining to antennas where the power is radiated uniformly in all directions.
RF channel	Radio Frequency channel. Set of frequencies in which the device transmits and receives.
SSID	Service Set Identifier. A phrase used to identify a particular wireless network.
Squelch Level	A specified level of audio that must be met, or exceeded, in order for that audio to be transmitted.
WEP	Wired Equivalent Privacy. An encryption algorithm for security on wireless networks.
Wi-Fi	A wireless product that is based on the IEEE 802.11 standards.
Wired Mode	The TR-240's Ethernet port is active and the radio is deactivated. TR-240's in wired mode can communicate to other TR-240's in wired mode without a BTR-240 or BTR-24base station.
Wireless Mode	The TR-240's radio is active and the Ethernet port is deactivated. A BTR-240 or BTR-24 base station serves as the access point and provides wireless coverage for communication between the TR-240's.
WLAN	Wireless Local Area Network. Defined by the 802.11 protocol.

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