



DIGITAL TWO-WAY RADIO SYSTEM

# **EVX-R70 Repeater**

**INSTALLATION GUIDE**

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## Foreword

This manual is intended for use by experienced technicians familiar with similar types of equipment. Specifically, it contains installation information required for the Vertex Standard **9JX-R70** Repeater.

### Product Safety and RF Exposure Compliance

See Installation Requirements for Compliance with Radio Frequency (RF) Energy Exposure Safety Standards on next page.

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## **Installation Requirements for Compliance with Radio Frequency (RF) Energy Exposure Safety Standards**

### **ATTENTION!**

**This radio is intended for use in occupational/controlled conditions, where users have full knowledge of their exposure and can exercise control over their exposure to meet FCC limits. This radio device is NOT authorized for general population, consumer, or any other use.**

To ensure compliance to RF Energy Safety Standards:

- Install only Vertex Standard approved antennas and accessories
- Be sure that Product Safety and RF Safety Booklet enclosed with this radio is available to the end user upon completion of the installation of this radio

Before using this product, the operator must be familiar with the RF energy awareness information and operating instructions on the "Product Safety and RF Exposure" chapter beginning with page 4 to ensure compliance with Radio Frequency (RF) energy exposure limits.

For a list of Vertex Standard-approved antennas and other accessories, visit the following web site which lists approved accessories for your radio model:

<http://www.vertexstandard.com/lmr>

## Declaration of Conformity

This declaration is applicable to your radio only if your radio is labeled with the FCC logo shown below.

### DECLARATION OF CONFORMITY

Per FCC CFR 47 Part 2 Section 2.1077(a)



Responsible Party

Name: Vertex Standard USA, Inc.

Address: 8000 West Sunrise Blvd, Ft. Lauderdale, FL 33322

Hereby declares that the product:

Model Name: **9JX-R70**

conforms to the following regulations:

FCC Part 15, subpart B, section 15.107(a), 15.107(d) and section 15.109(a)

### Class B Digital Device

As a personal computer peripheral, 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, and
2. This device must accept any interference received, including interference that may cause undesired operation.

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



Caution

**ATTENTION!**

**BEFORE USING THIS RADIO, READ THIS CHAPTER WHICH CONTAINS IMPORTANT OPERATING INSTRUCTIONS FOR SAFE USAGE AND RF ENERGY AWARENESS AND CONTROL INFORMATION FOR COMPLIANCE WITH RF ENERGY EXPOSURE LIMITS IN APPLICABLE NATIONAL AND INTERNATIONAL STANDARDS.**

The information provided in this document supersedes the general safety information contained in user guides published prior to February 2002.

**RF Energy Exposure Awareness and Control Information, and Operational Instructions for FCC Occupational Use Requirements**

**NOTICE: This radio is intended for use in occupational/controlled conditions, where users have full knowledge of their exposure and can exercise control over their exposure to meet FCC limits. This radio device is NOT authorized for general population, consumer, or any other use.**

This 2-way radio uses electromagnetic energy in the radio frequency (RF) spectrum to provide communications between two or more users over a distance. It uses radio frequency (RF) energy or radio waves to send and receive calls. RF energy is one form of electromagnetic energy. Other forms include, but are not limited to, sunlight and x-rays. RF energy, however, should not be confused with these other forms of electromagnetic energy, which when used improperly, can cause biological damage. Very high levels of x-rays, for example, can damage tissues and genetic material.

Experts in science, engineering, medicine, health, and industry work with organizations to develop standards for safe exposure to RF energy. These standards provide recommended levels of RF exposure for both workers and the general public. These recommended RF exposure levels include substantial margins of protection.

All Vertex Standard 2-way radios are designed, manufactured, and tested to ensure they meet government-established RF exposure levels. In addition, manufacturers also recommend specific operating instructions to users of 2-way radios. These instructions are important because they inform users about RF energy exposure and provide simple procedures on how to control it.

Please refer to the following Web sites for more information on what RF energy exposure is and how to control your exposure to assure compliance with established RF exposure limits.

<http://www.fcc.gov/oet/rfsafety/rf-faqs.html>

<http://www.osha.gov/SLTC/radiofrequencyradiation/index.html>

**Federal Communication Commission Regulations**

The FCC rules require manufacturers to comply with the FCC RF energy exposure limits for mobile 2-way radios before they can be marketed in the U.S. When 2-way radios are used as a consequence of employment, the FCC requires users to be fully aware of and able to control their exposure to meet occupational requirements. Exposure awareness can be facilitated by the use of a label directing users to specific user awareness information. Your Vertex Standard 2-way radio has a RF exposure product label. Also, your Vertex Standard user manual, or separate safety booklet, includes information and operating instructions required to control your RF exposure and to satisfy compliance requirements.

**Compliance with RF Exposure Standard**

Your Vertex Standard two-way radio is designed and tested to comply with a number of national and international standards and guidelines (listed below) regarding human exposure to radio frequency electromagnetic energy. This radio complies with the IEEE and ICNIRP exposure limits for occupational/controlled RF exposure environment at duty factors of up to 50% talk-50% listen and is authorized by the FCC for occupational use. In terms of measuring RF energy for compliance with the FCC exposure guidelines, your radio antenna radiates measurable RF energy only while it is transmitting (during talking), not when it is receiving (listening) or in standby mode.

### Your Vertex Standard two-way radio complies with the following RF energy exposure standards and guidelines:

- United States Federal Communications Commission, Code of Federal Regulations; 47CFR part 2 sub-part J
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95.1-1992
- Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999 Edition
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6. Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz, 1999
- Australian Communications Authority Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard, 2003
- ANATEL, Brasil Regulatory Authority, Resolution 256 (April 11, 2001) "additional requirements for SMR, cellular, and PCS product certification."

### RF Exposure Compliance and Control Guidelines and Operating Instructions

To control exposure to yourself and others and to ensure compliance with the RF exposure limits, always adhere to the following procedures.

#### Guidelines:

- User awareness instructions should accompany device when transferred to other users.
- Do not use this device if the operational requirements described herein are not met.

#### Instructions:

- Transmit no more than the rated duty factor of 50% of the time. To transmit (talk), push the Push-To-Talk (PTT) button or, for radios equipped with VOX, speak into the microphone. The red LED will illuminate when the radio is transmitting. To receive calls, release the PTT button, or, for radios equipped with VOX, stop talking. The red LED will extinguish when the radio stops transmitting. Transmitting 50% of the time, or less, is important because this radio generates measurable RF energy exposure only when transmitting (in terms of measuring for standards compliance).
- **Transmit only when people outside the vehicle are at least the recommended minimum lateral distance away, as shown in Table 1, from the body of a vehicle with a properly installed antenna.** This separation distance will ensure that there is sufficient distance from a properly installed (according to installation instructions) externally-mounted antenna to satisfy the RF exposure requirements in the standards listed above.

**NOTE:** Table 1 below lists the recommended lateral distance for people in an uncontrolled environment from the body of a vehicle with an approved, properly installed transmitting antenna (i.e., monopoles over a ground plane, or dipoles) at several different ranges of rated radio power for mobile radios installed in a vehicle.

*Table 1. Rated Power of Vehicle-Installed Mobile Two-Way Radio and Recommended Minimum Lateral Distance from Vehicle Body*

Mobile Radio Rated Power (see Note)	Minimum Lateral Distance from Vehicle Body
Less than 7 watts	8 inches (20 centimeters)
7 to 15 watts	1 foot (30 centimeters)
16 to 39 watts	2 feet (60 centimeters)
40 to 110 watts	3 feet (90 centimeters)

- When a mobile radio is used in conjunction with another co-located transmitter such as a Vehicular Repeater, it is the vehicle operator's responsibility to take appropriate steps to keep bystanders at the required separation distance from the vehicle to ensure compliance with the FCC's RF energy exposure limits for the general population. See the co-located transmitter's user manual for more details.

**NOTE:** If you are not sure of the rated power of your radio, contact your Vertex Standard representative or dealer and supply the radio model number found on the radio model label. If you can not determine the rated power out, then assure 3-foot separation from the body of the vehicle. The maximum power shown on the FCC Grant may be higher than the rated power allowing for production variation.

#### **Mobile Antenna Installation Guidelines**

- These mobile antenna installation guidelines are limited to metal body motor vehicles or vehicles with appropriate ground planes.
- Antennas should be installed in the center area of the roof or the trunk lid taking into account exposure conditions of backseat passengers and according to the specific instructions and restrictions in the Radio Installation Manual along with the requirements of the antenna supplier.
- Trunk lid installations are limited to vehicles with clearly defined flat trunk lids, and in some cases, to specific radio models and antennas. See the Radio Installation Manual for specific information on how and where to install specific types of approved antennas to facilitate recommended operating distances to all potentially exposed persons.
- **Use only the Vertex Standard -approved, supplied antenna or a Vertex Standard-approved replacement antenna.** Unauthorized antennas, modifications, or attachments could damage the radio and may result in non-compliance with RF Safety Standards.

#### **Approved Accessories**

- This radio has been tested and meets RF Safety Standards when used with the Vertex Standard accessories supplied or designated for this product. Use of other accessories may result in non-compliance with RF Safety Standards.
- For a list of Vertex Standard -approved antennas, visit the following Web site, which lists approved accessories for your radio model:  
<http://www.vertexstandard.com/lmr>.

#### **Compliance and Control Guidelines and Operating Instructions for Mobile Two-Way Radios Installed as Fixed Site Control Stations**

If mobile radio equipment is installed at a fixed location and operated as a control station or as a fixed unit, the antenna installation must comply with the following requirements in order to ensure optimal performance and compliance with the RF energy exposure limits in the standards and guidelines listed on page 4:

- The antenna should be mounted outside the building on the roof or a tower if at all possible.
- As with all fixed site antenna installations, it is the responsibility of the licensee to manage the site in accordance with applicable regulatory requirements and may require additional compliance actions such as site survey measurements, signage, and site access restrictions in order to ensure that exposure limits are not exceeded.
- For additional installation information, see the guidelines for minimum separation distances provided above in the RF Exposure Compliance and Control Guidelines and Operating Instructions section of this document.

#### **Electromagnetic Interference/Compatibility**

**NOTE:** Nearly every electronic device is susceptible to electromagnetic interference (EMI) if inadequately shielded, designed, or otherwise configured for electromagnetic compatibility. It may be necessary to conduct compatibility testing to determine if any electronic equipment used in or around vehicles or near fixed site antenna is sensitive to external RF energy or if any procedures need to be followed to eliminate or mitigate the potential for interaction between the radio transmitter and the equipment or device.

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**Facilities**

To avoid electromagnetic interference and/or compatibility conflicts, turn off your radio in any facility where posted notices instruct you to do so. Hospitals or health care facilities may be using equipment that is sensitive to external RF energy.

**Vehicles**

To avoid possible interaction between the radio transmitter and any vehicle electronic control modules, such as ABS, engine, or transmission controls, the radio should be installed only by an experienced installer and the following precautions should be used when installing the radio:

1. Refer to the manufacturer's instructions or other technical bulletins for recommendations on radio installation.
2. Before installing the radio, determine the location of the electronic control modules and their harnesses in the vehicle.
3. Route all radio wiring, including the antenna transmission line, as far away as possible from the electronic control units and associated wiring.

**Driver Safety**

Check the laws and regulations on the use of radios in the area where you drive. Always obey them.

**When using your radio while driving, please:**

- Give full attention to driving and to the road.
- Pull off the road and park before making or answering a call if driving conditions so require.

**Operational Warnings****For Vehicles with an Air Bag****WARNING**

**Do not mount or place a mobile radio in the area over an air bag or in the air bag deployment area. Air bags inflate with great force.**

**If a radio is placed in the air bag deployment area and the air bag inflates, the radio may be propelled with great force and cause serious injury to occupants of the vehicle.**

**Potentially Explosive Atmospheres**

**Turn off your radio prior to entering any area with a potentially explosive atmosphere. Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.**

**The areas with potentially explosive atmospheres include fueling areas such as below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles such as grain, dust or metal powders. Areas with potentially explosive atmospheres are often, but not always, posted.**

**Blasting Caps and Blasting Areas**

**To avoid possible interference with blasting operations, turn off your radio when you are near electrical blasting caps, in a blasting area, or in areas posted: "Turn off two-way radio." Obey all signs and instructions.**

**For radios installed in vehicles fueled by liquefied petroleum gas, refer to the (U.S.) National Fire Protection Association standard, NFPA 58, for storage, handling, and/or container information. For a copy of the LP-gas standard, NFPA 58, contact the National Fire Protection Association, One Battery Park, Quincy, MA.**

## Chapter 1 Pre-Installation Considerations

Proper installation ensures the best possible performance and reliability of the **9JX-R70** Repeater. Pre-installation planning is required. This includes considering the mounting location of the repeater in relation to input power and antennas. Also consider the site environmental conditions, the particular mounting method (several available), and required tools and equipment.

If this is the first time this type of equipment is being installed, it is highly recommended that the user read this entire installation section before beginning the actual installation.

### 1.1 Installation Overview

The following information is an overview for installing the **9JX-R70** Repeater and ancillary equipment.

- Plan the installation, paying particular attention to environmental conditions at the site, ventilation requirements, and grounding and lightning protection.
- Unpack and inspect the equipment.
- Mechanically install the equipment at the site.
- Make necessary electrical and cabling connections, including the following:
  - AC input cabling
  - Coaxial cables to transmit and receive antennas
- Perform a post-installation function checkout test of the equipment to verify proper installation.
- Proceed to customize the repeater parameters per customer specifications (e.g. operating frequency, PL, codes, color code, etc.).

### 1.2 Environmental Conditions at Intended Installation Site

The repeater may be installed in any location suitable for electronic communications equipment, provided that the environmental conditions do not exceed the equipment specifications for temperature, humidity, and air quality.

**NOTE:** The **9JX-R70** Repeater has been manufactured with a power-saving main fan. The fan powers ON temporarily as a self-check after user initially turns the repeater power ON. If the repeater's internal ambient temperature remains below 30°C (86°F), the fan does not operate. It powers ON and remains operational only after the repeater's internal ambient temperature rises above 30°C (86°F), and its speed increases as the temperatures rises. At 50°C (122°F), the fan runs at full speed.

#### 1.2.1 Operating Temperature Range

-30°C (-22°F) to +60°C (+140°F)

This is the temperature measured in close proximity to the repeater. For example, if the repeater is mounted in a cabinet, the temperature within the cabinet is measured.

#### 1.2.2 Humidity

Humidity conditions should not exceed 95% relative humidity @ 50°C (122°F).

#### 1.2.3 Air Quality

For equipment operating in an area which is environmentally controlled and with the repeater(s) rack mounted, the airborne particle level must not exceed 25 µg/m<sup>3</sup>.

For equipment operating in an area which is not environmentally controlled and with the repeater(s) cabinet mounted, airborne particle level must not exceed 90 µg/m<sup>3</sup>.



**Caution**

If the repeater is to be installed in an environment which is usually dusty, dirty, or does not meet the air quality requirements, then the air used to cool the repeater modules must be treated using appropriate filtering devices. Dust or dirt accumulating on the internal circuit boards and modules is not easily removed, and can cause such malfunctions as overheating and intermittent electrical connections.

### 1.3 Equipment Ventilation

The repeater is equipped with a cooling fan that is used to provide forced convection cooling. When planning the installation, observe the following ventilation guidelines:

- Customer-supplied cabinets must be equipped with ventilation slots or openings in the front (for air entry) and back or side panels (for air to exit). If several repeaters are installed in a single cabinet, ensure ventilation openings surrounding each repeater allow for adequate cooling.
- All cabinets must have a least 15 cm (6 inches) of open space between the air vents and any wall or other objects.
- When multiple cabinets (each equipped with several repeaters) are installed in an enclosed area, ensure appropriate ventilation and consider air conditioning or other climate control equipment to satisfy the temperature requirements stated under Section 1.2.1 Operating Temperature Range on page 8.

### 1.4 AC Input Power Requirements

The repeater is equipped with a switching power supply, and this assembly operates from 100 – 240 VAC at 47 – 63 Hz AC input power. A standard 3-prong line cord is supplied to connect the power supply to the AC source.



Caution

It is recommended that a standard 3-wire grounded electrical outlet be used as the AC source.

The outlet must be connected to an AC source capable of supplying a maximum of 280 W. For a nominal 110/120 VAC input, the AC source must supply 5 A and should be protected by circuit breaker rated at 15 A. For a nominal 220/240 VAC input, the AC source must supply 3 A and should be protected by a circuit breaker rated at 10 A.

#### 1.4.1 Circuit Overloading

Consideration should be given to the effects of overloading on overcurrent protection devices and supply wiring. Appropriate consideration of equipment ratings should be used when addressing this concern.

### 1.5 Equipment Mounting Methods

The **9JX-R70** Repeater may be mounted in a rack, bracket or cabinet (available as accessories).

### 1.6 Site Grounding and Lightning Protection



WARNING

Proper site grounding and lightning protection are vitally important considerations. Failure to provide proper lightning protection may result in permanent damage to the radio equipment.

One of the most important considerations when designing a communications site is the ground and lightning protection system. While proper grounding techniques and lightning protection are closely related, the general category of site grounding may be divided into the following section.

#### 1.6.1 Electrical Ground

Ground wires carrying electrical current from circuitry or equipment at the site is included in the category of electrical ground. Examples include the AC or DC electrical power used to source equipment located at the site, and wires or cables connected to alarms or sensors located at the site.

#### 1.6.2 RF Ground

This type of ground is related to the bypassing of unwanted radio frequency energy to earth ground. An example of RF grounding is the use of shielding to prevent or at least minimize the leakage of unwanted RF energy from communications equipment and cables.

**1.6.3 Lightning Ground**

Providing adequate lightning protection is critical to a safe reliable communications site. RF transmission cables, and AC and DC power lines must all be protected to prevent lightning energy from entering the site.

Comprehensive coverage of site grounding techniques and lightning protection is not within the scope of this instruction manual, but there are several excellent industry sources for rules and guidelines on grounding and lightning protection at communications sites.

**1.6.4 Equipment Grounding**

The repeater is equipped with a ground screw located on the rear of the repeater power supply module. This screw is used to connect the repeater to the site grounding. All antenna cables, and AC and DC power cabling, should be properly grounded and lightning protected by following the rules and guidelines provided in the above reference. Failure to provide proper lightning protection may result in permanent damage to the radio equipment.

## Chapter 2 Mechanical Installation

This section describes the procedures to unpack and mechanically install the **9JX-R70** Repeater. A variety of mounting methods are possible depending on which type of cabinet or rack (if any) has been selected to house the repeater(s).



Caution

Be sure to observe proper electrostatic discharge precautions if modules must be removed from the repeater.

### 2.1 Unpacking Equipment

The following items are packed together in the box:

- **9JX-R70** Repeater
- AC Line Cord
- **9JX-R70** Repeater Installation Guide (This Booklet)



WARNING

**Inspect the equipment for damage immediately after unpacking, and make a report of the extent of any damage to the transportation company and to Vertex Standard.**

### 2.2 Transferring Equipment from Shipping Container to Rack or Cabinet

The repeater is shipped in a box. Upon delivery, the equipment must be removed from the container and transferred to a rack or cabinet.

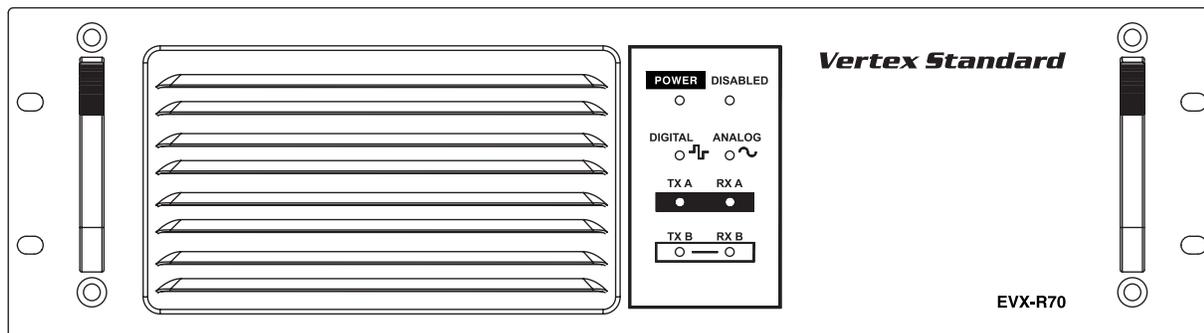
**NOTE:** Customer-supplied cabinets and racks must have mounting rail and hole spacing compatible with EIA Universal 48.3 cm (19 inches) specifications. Cabinets must provide adequate ventilation (see “Environmental Conditions at Intended Installation Site” on page 4) and must meet the following minimum criteria:

- 41.3 cm (16.25 inches) deep
- 48.3 cm (19 inches) wide
- 13.4 cm (5.25 inches) high
- Two mounting rails 5 cm (2 inches) from the front of the cabinet with front mounting holes 5.7 cm (2.25 inches) apart (center to center).

Contact Vertex Standard Technical Support for specific question(s) regarding mounting equipment in customer-supplied cabinets.

## Chapter 3 Indicators and Connectors

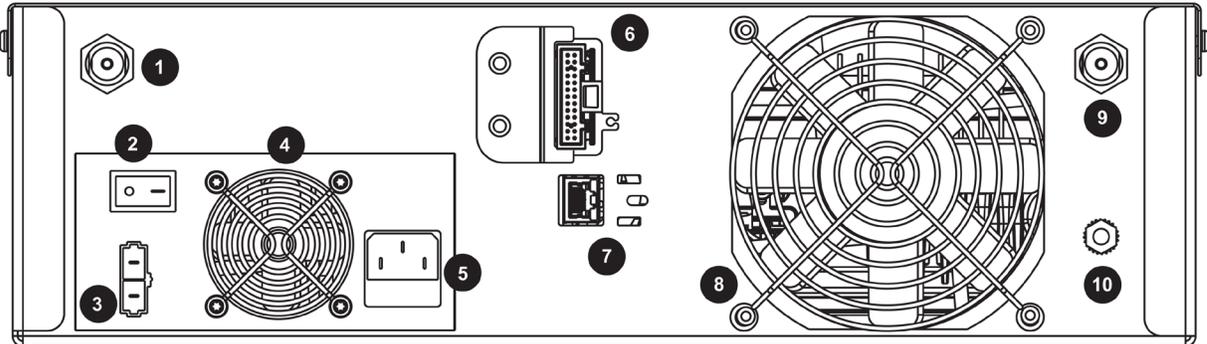
### 3.1 Front Panel



#### 3.1.1 LED Indicator Descriptions

LED	Status	Description
POWER	Solid GREEN	Repeater powered by AC.
	Solid RED	Repeater powered by backup battery.
	Off	Repeater powered off.
DISABLED	Solid RED	Repeater function disabled.
	Blinking RED	Repeater in self-test mode.
	Off	Repeater in normal operation mode.
DIGITAL	Solid BLUE	Repeater in Digital Mode.
ANALOG	Solid YELLOW	Repeater in Analog Mode.
TX A	Solid GREEN	Repeater transmitting (Analog).
	Solid GREEN	Repeater transmitting on Slot A (Digital).
RX A	Solid YELLOW	Repeater receiving (Analog).
	Solid YELLOW	Repeater receiving on Slot A (Digital).
TX B	Solid GREEN	Repeater transmitting on Slot B (Digital).
RX B	Solid YELLOW	Repeater receiving on Slot B (Digital).

## 3.2 Rear Panel



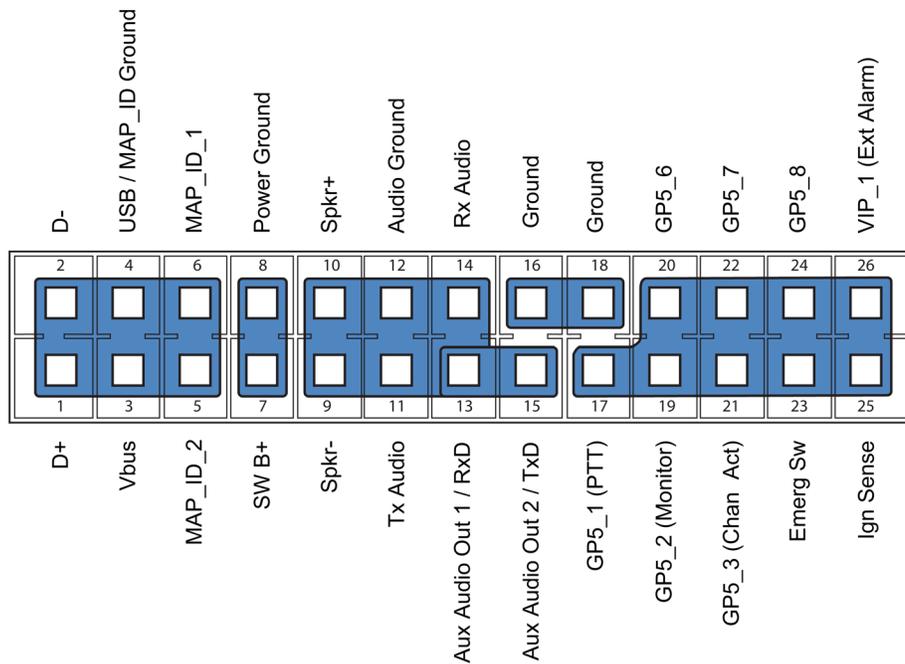
### 3.2.1 Rear Panel Part

No	Item	Description
1	Rx Connector	BNC (Female).
2	Power Supply On/Off Switch	Turns on or off the power to the repeater from AC input.
3	Battery Backup Connector (DC Input)	Backup battery supplies backup power to the repeater. The battery is an optional accessory. The repeater will trickle charge battery, but an external charger is recommended to equalize battery after a prolonged use. Auto switching from AC to battery with loss of AC power is a function of the standard repeater power supply. Supply will automatically switch back to AC operation upon the return of AC power. The front panel power LED switches from green to red when on battery power.
4	Power Supply Fan	Runs continuously to cool the repeater.
5	Main Power Supply Connector (AC Input)	100 - 240 Volts.
6	Rear Accessory Connector	Programming cable plugs in here.
7	Ethernet Connector	100Base-TX (RJ45).
8	Main Fan	Variable speed. Idles at room temperature. Speeds up with extended use of the repeater.
9	Tx Connector	Type-N (Female).
10	Ground Screw	Must be connected to System Ground.

### 3.2.2 Rear Accessory Connector

The rear accessory connector is located above the ethernet connector. Most of the Vertex Standard-approved accessories are supplied with female terminals crimped to a 20-gauge wire specifically designed to fit the housing of the rear accessory connector.

Insert the female terminal into the accessory connector housing in the appropriate locations. The accessory connector housing is provided together with the accessory. Connect the accessory connector housing to the rear accessory connector on the back of the repeater. Do not use other generic terminals in the housing. Generic terminals can cause electrical intermittences and may cause damage to the housing.



**Table:** Rear Accessory Connector Pin Functions

Pin No.	Pin Name	Pin Function	Pin No.	Pin Name	Pin Function
1	D+	USB + (Data)	14	Rx Audio	Receive Live Audio <sup>2</sup>
2	D-	USB - (Data)	15	AUX Audio 2	Public Address 2
3	VBUS	USB Power (5V from USB accessory/cable)	16	GND	Ground
4	USB/MAP_ID GND	USB/MAP_ID Ground	17	GP5-1 (PTT)	5V Level GPIO, PTT Input <sup>1</sup>
5	MAP_ID_2	Accessory Identifier	18	GND	Ground
6	MAP_ID_1	Accessory Identifier	19	GP5-2 (Monitor)	5V Level GPIO, Monitor Input <sup>3</sup>
7	SW B+	Switched Battery Voltage	20	GP5-6	5V Level GPIO
8	PWRGND	Ground	21	GP5-3	5V Level GPIO, Channel Activity Function
9	SPKR-	Speaker - (3.2 ohm minimum impedance)	22	GP5-7	5V Level GPIO
10	SPKR+	Speaker + (3.2 ohm minimum impedance)	23	EMERGENCY	Emergency Switch Input
11	Tx Audio	Rear External Microphone Input <sup>4</sup>	24	GP5-8	No connection
12	Audio GND	Audio Ground	25	IGN SENSE	No connection
13	AUX Audio 1	Public Address 1	26	VIP-1	12V Tolerant, 5V GPIO, External alarm

- 1 Pulling this line to ground activates the PTT function, thus activating the AUX\_MIC input.
- 2 Fixed level (independent of volume level) received audio signal, including alert tones. Flat or de-emphasis are programmed by the Programming Software. Output voltage is approximately 330 mVrms for 1kHz of deviation.
- 3 This input is used to detect when a rear microphone accessory is taken off-hook.
- 4 This microphone signal is independent of the microphone signal on the front microphone connector. The nominal input level is 80mVrms for 60% deviation. The DC impedance is 660 ohms and the AC impedance is 560 ohms.

## Chapter 4 Electrical Connections

After the **9JX-R70** Repeater has been mechanically installed, electrical connections must be made. This involves making the following connections:

- AC power cord, and
- antenna coaxial cables

Figure 4-1 shows the position of the various connectors and connections on the rear panel of the repeater.

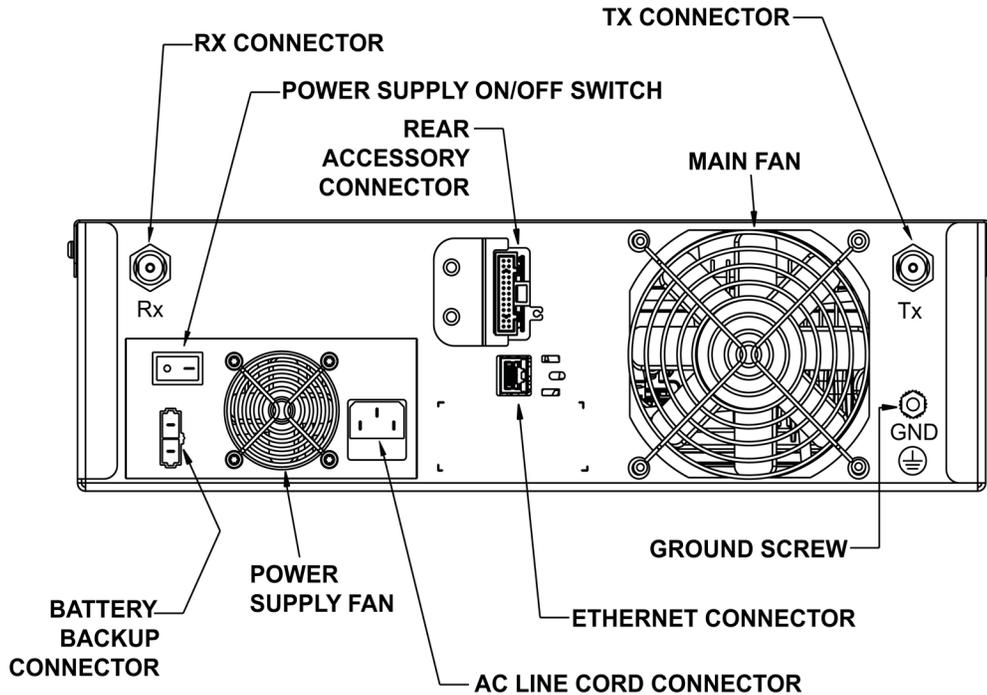


Figure 4-1: Locations of Connectors on the Rear Panel of the Repeater

### 4.1 Power Supply Connections

#### 4.1.1 AC Input Power Connection



Caution

Do NOT apply AC power to the repeater at this time. Make sure that the circuit breaker associated with the AC outlet is turned to OFF.

**NOTE:** The AC source must be installed near the equipment and must be easily accessible.

Each repeater ships with a 2.438 m (8 feet) 3-conductor line cord that connects the repeater to a 110/120/220/240 VAC source. Figure 4-1 shows the location where the AC line cord connects to the repeater. Insert the 3-prong plug into a 110/120/220/240 VAC grounded outlet.

If an alternate line cord is required, obtain a suitable line cord, with fittings approved by the safety testing agency in the end-use country, from a certified electrical parts supplier.

### 4.1.2 Ground Connection

The repeater is equipped with a ground screw located on the rear of the repeater. Connect the site ground cable to the ground screw.

 The repeater should only be connected to a battery supply that is in accordance with the applicable electrical codes for the end use country; for example, the National Electrical Code ANSI/NFPA No. 70 in the U.S.

### 4.1.3 Battery Backup Connection

The **9JX-R70** Repeater offers the capability of connecting to battery backup power in the event of an AC power failure.

The battery backup system is connected to the repeater through the DC connector mounted at the rear of the repeater (see Figure 4-2).

The repeater power supply will trickle charge the backup battery. If the battery is significantly discharged, it is recommended that an external charger be used to charge the battery.

 The repeater is to be connected to a battery charger that is in accordance with the applicable electrical codes for the end use country; for example, the National Electrical Code ANSI/NFPA No.70 in the U.S.

 Unplug the battery from the repeater when charging the battery with an external charger.



Figure 4-2: Making Connections to a Backup Battery

## 4.2 RF Antenna Connections

The transmit and receive antenna RF connection are made using two separate connectors. Coaxial cables from the receive and transmit antenna must be connected to the Type-N (Tx) and BNC (Rx) connectors. The position of these connectors is shown in Figure 4-1. For repeater use, the antennas need adequate isolation between them, or if one antenna is used, the duplexer needs to have adequate isolation between the Tx and Rx ports. The isolation requirements are unique to each band and are shown in the table below:

Frequency Band	Bandwidth	Isolation
VHF	136-174 MHz	85 dB
UHF 1	403-470 MHz	75 dB
UHF 2	450-512 MHz	85 dB

If the duplexer isolation is not adequate, a preselector may also be used.



Caution

The repeater can key up at any time due to input from a subscriber unit or a CW ID. Please ensure that all power is switched off before disconnecting the transmit antenna.

### 4.2.1 Duplexer Selection

The selection of a duplexer is critical to system performance. The use of a notch (band reject) duplexer is possible in some systems that are not located at high RF density sites.

The duplexer must be able to handle at least 50 W continuously. For the best system performance, the insertion loss should be less than 2 dB. If the repeater is used in higher RF density sites, the use of a pass-notch duplexer is recommended.

### 4.2.2 Antenna Selection

The selection of the antenna is critical to system performance. The selected antenna must be 50 Ohm impedance and capable of at least 50 Watts. Gain antennas may be used to increase system coverage. Please take note of licensing restrictions when selecting gain antennas. Some services or regions may have antenna gain or system ERP limitations.

The antenna must be connected to the duplexer with a high grade 50 Ohm transmission line (hard-line). The line must have connectors to match the connectors on the duplexer and antenna.



Caution

It is important that all antenna cables are grounded at the point they enter the building.



Caution

The antenna design is the customer's responsibility. All aspects of the antenna design must comply with the relevant local regulations.

## Chapter 5 Post-Installation Checklist

After the **9JX-R70** Repeater has been mechanically installed and all electrical connections have been made, power may now be applied and the repeater checked for proper operation.

### 5.1 Applying Power

Before applying power to the repeater, make sure all boards are securely seated in the appropriate connectors on the backplane and that all RF cables are securely connected.

Turn ON the circuit breaker controlling the AC outlet that is supplying power to the repeater Power Supply Module.

### 5.2 Verifying Proper Operation

Operation of the repeater can be verified by:

- observing the state of the 8 LEDs located on the front panel, and
- exercising radio operation.



Caution

Some repeater components can become extremely hot during operation. Turn off all power to the repeater and wait until sufficiently cool before touching the repeater.

#### 5.2.1 Front Panel LEDs

After turning ON the repeater power (or after a repeater reset), the 8 LEDs on the repeater front panel:

- Light for about one second to indicate that they are functional, then
- Go off for one second, then
- Indicate the operational status of the repeater.

### 5.3 Archiving

#### 5.3.1 Copying the Repeater Codeplug Data to a Computer

Backup the repeater's codeplug data by using the Programming Software on a computer.





Part 15.21: Changes or modifications to this device not expressly approved by Vertex  
Standard could void the user's authorization to operate this device.



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