1: INSTALLATION MANUAL

VX150 TO VX2

FM BROADCAST TRANSMITTER

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making digital broadcasting work

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The comparisons and other information provided in this document have been prepared in good faith based on publicly available information. For verification of materials, the reader is encouraged to consult the respective manufacturer's most recent publication on the official website or through contact with Customer Service.

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Release Control Record

ISSUE	DATE	REASON
3.0	2024-11-06	Release 3 for VX low power models. Supports hardware versions: VX150, VX300, VX600 (NARF81B) VX1 (NARF79B) VX1.5, VX2 (NARF80B) Supports software version VX SW 6.4 and later.
3.1.1	2025-03-11	Figure 1.7.1: changed RDS/SYS CTRL connector to SYS CTRL. Supports software version VX SW 7.0.0 and later.
3.1.2	2025-04-15	Updated version to match OPS and TRB manual updates

About This Manual

Technical Support

Nautel offers technical support to customers over the Internet and by telephone. Nautel's customer support team will answer your questions and work with you to identify and resolve problems.

For 24-hour technical support, call toll free at 1.877.628.8353 (in USA and Canada only) or call 1.902.823.5100 (international) or find us on the Internet at http://www.nautel.com.

For parts and tools information, see Parts and Tools, on page 1.12.1.

For extended warranty information, see Extended Warranties, on page 1.13.7.

VX Series Transmitter Manuals

The VX series documentation suite includes the following documents:

Recommendations for Transmitter Site Preparation Manual

Provides detailed information about protecting your site from lightning-related hazards.

Volume 1, VX Installation (INS) Manual

Provides instructions and reference information needed when planning and preparing for the installation of the VX series transmitter.

Volume 2, VX Operation and Maintenance (OPS) Manual

Provides instructions for operating and maintaining the VX series transmitter.

Volume 3, VX Troubleshooting (TRB) Manual

Provides instructions for troubleshooting the VX series transmitter, and replacing its sub-assemblies. It also contains detailed technical information, including parts lists, wiring information, electrical schematics and mechanical drawings.

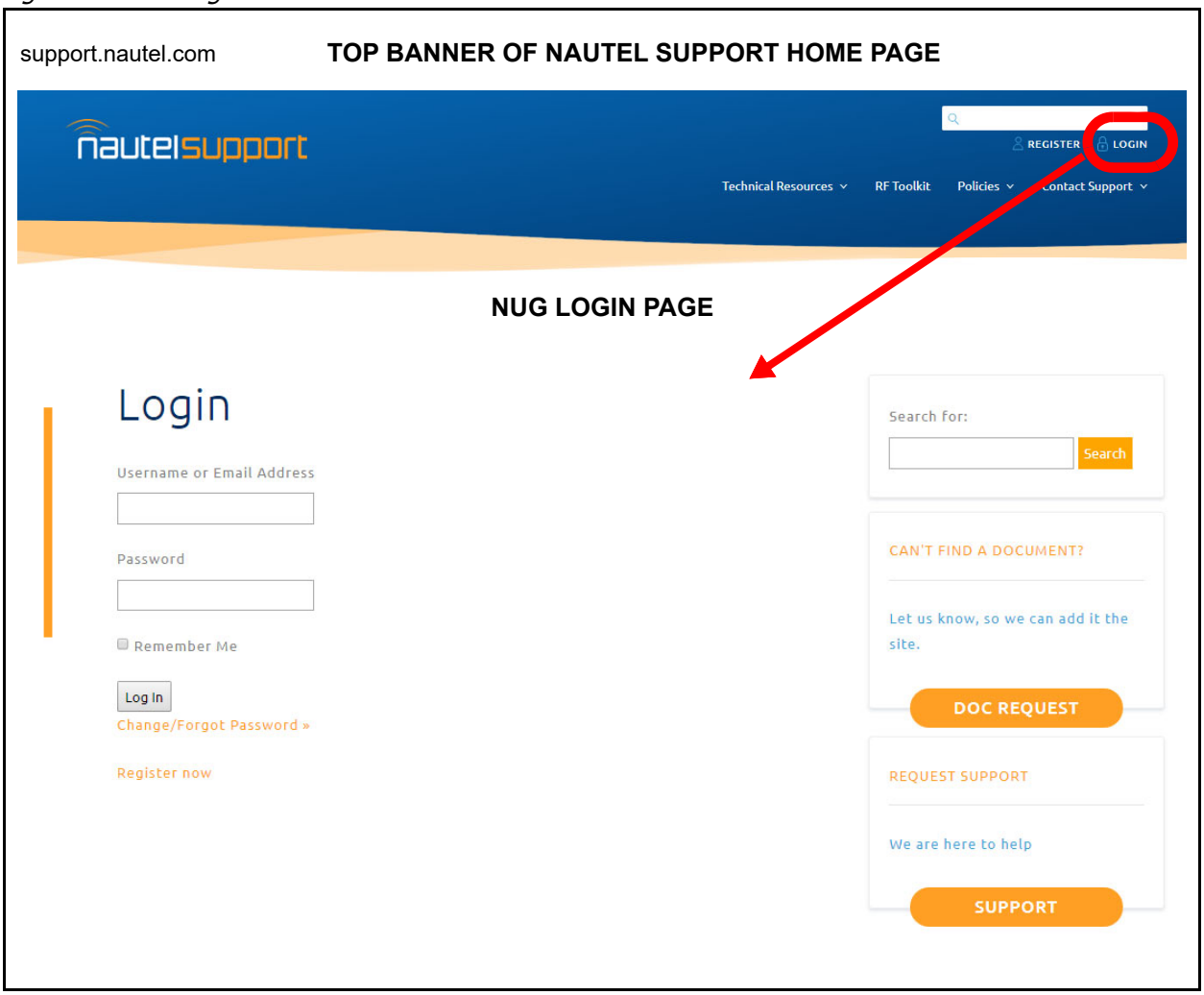
Nautel Website / Online Resources

The Nautel website provides useful resources to keep you up to date on your VX series transmitter. Frequently asked questions (FAQ), How To Videos, latest software versions are just a few of the many resources available.

Nautel User Group (NUG)

The Nautel Support website allows access to product manuals and the RF Toolkit when you create a free NUG account (see Figure below).

Figure 1: Accessing the NUG



Online Documentation

The Technical Documentation section of the Nautel Support website provides online access to all the documentation for your VX series transmitter. Documentation is provided in Acrobat (PDF) format. You can use the documentation online or print the sections that you need.

When using online documents:

- Click on blue text (hyperlinks) to jump to a related section, or to get additional information (e.g., view a term's definition).
- To search a document to find keywords, use **Find** in Acrobat Reader's **Edit** menu.
- To quickly find a specific section, click the section in the PDF file's **Bookmarks** list.

About Safety

All Nautel transmitters are designed to meet the requirements of EN60215, Safety Requirements for Radio Transmitters. The philosophy of EN60215 is that the removal of any cover or panel that can only be opened using a tool is a maintenance activity, and that any person performing a maintenance activity is expected to be trained for that activity. Under EN60215, it is assumed that trained personnel will be knowledgeable and will take precautions such as removing all power to the transmitter before accessing its components.

Electrical Hazards

To remove power from the transmitter, switch off and lock out the ac power.

DANGER - HIGH VOLTAGE

Indicates dangerous voltage (in excess of 72 volts), capable of causing a fatal electrical shock, are present on or near parts bearing this label.

WARNING: It is not enough to switch off RF power. The power line is still connected. Disconnect and lock out the upstream supply before servicing.

Mount the transmitter ac power disconnect switch/breaker close to the transmitter so that it can be reached quickly in an emergency. Clearly label the switch/breaker (e.g., EMERGENCY SWITCH).

After turning off the power, always disconnect the Ac cable from the rear of the transmitter.

WARNING: Do not use an ordinary multimeter to check for voltage, since it may have been left inadvertently on the AMP (A) range, triggering a short and an arc blast that could result in severe burns and even death.

Use only a non-contact voltage probe or a safety voltmeter (available from vendors such as Fluke, Ideal, and Teagam).

Use a proper lockout procedure to ensure that another worker cannot accidentally reapply power while you are performing maintenance on any part of the transmitter or site.

Lightning Hazards

Before opening the transmitter and touching internal parts, remove and solidly ground the antenna connection.

WARNING: It is not enough to ground the antenna terminal with the antenna still connected. Even a small impedance in the ground strap will result in lethal voltages during a lightning strike.

RF Hazards

A serious RF hazard and very high voltages exist in the vicinity of the antenna and its networks during normal operations.

Toxic Hazards

There may be devices used in this equipment that contain beryllium oxide ceramic, which is non-hazardous during normal device operation and under normal device failure conditions. These devices are specifically identified with "(BeO)" in the Description column of the Troubleshooting Manual's parts list(s).

Do not cut, crush or grind devices because the resulting dust may be hazardous if inhaled. Unserviceable devices should be disposed of as harmful waste.

Other Hazards

Ensure that appropriate fire alarms and fire extinguishers are available. Extinguishers must be suitable for use on electrical fires.

Many other site safety risks exist. It is beyond the scope of this manual to identify all the risks and procedures.

Safety Precautions

This section provides very important information about protecting the safety of personnel and equipment:

- Personal Safety - see page 1.xvii
- Site Safety - see page 1.xviii
- Equipment Safety - see page 1.xx

Personal Safety

Training

The training of any personnel who will have physical access to the site or the transmitter is very important. Personnel must be familiar with the transmitter, so that they can avoid physical danger, and be aware of hazards to themselves and the equipment.

Nautel offers a number of training courses covering the basic fundamentals of RF systems and transmitters, and the operation and maintenance of the transmitter. For more information about available courses and schedules, go to the Nautel website at http://support.nautel.com/training/, or ask your Nautel sales representative.

Site Orientation

When you give personnel access to the transmitter site (e.g., hiring new personnel, or giving access keys to personnel), perform a site orientation to ensure that they are familiar with the site, on-site procedures, and on-site hazards. Cover the following topics:

- Securing the site (locking doors and fences) to prevent unauthorized access
- How and when to call for technical support or emergency assistance
- Areas of the site and pieces of equipment that are off limits

Voltage Awareness

Ensure that all personnel that are able to access areas with high voltage circuits or high field strengths are aware of the hazards associated with high voltage. Cover the following topics:

- High voltage or high field strength areas where caution is required
- Physical risks of electric shock

- Risks for personnel with pacemakers or other medical implants
- Induced voltages in high field strength areas
- On-site risks during thunderstorms and lightning strikes
- Operation of safety interlocks (if installed)

First Aid

Nautel does not offer first aid training, since the hazards associated with high voltage and RF energy are not specific to the transmitter. However, the customer should provide first aid training to all personnel who have access to the transmitter site. First aid training should include CPR, care of burns, artificial respiration, and defibrillation if specific equipment is available on-site.

Site Safety

Controlling Access

Transmitters and antennas generate and carry dangerous voltages that can be harmful or fatal. It is very important that you control access to the site and its equipment. To secure your transmitter site, use:

- Locking steel or security doors to prevent casual access
- A perimeter fence to keep trespassers away from the antenna system and feedline
- "No Trespassing" signs
- An alarm system

Marking Hazards

Place warning signs close to any hazardous areas or systems (e.g., the feedline or the antenna system). Make the signs large enough that they cannot be missed. Provide signage in all languages used in the region. These signs are intended not only for authorized personnel, but also for emergency responders or accidental trespassers.

Qualifying Site Personnel

Make sure that personnel who have access to the site are qualified to work around electronics and high voltage systems.

Ac Power Protection

You should take steps to protect equipment from surges (over-voltage spikes) on the ac power lines. Surges may occur during thunderstorms, or because of malfunctions in the electrical distribution grid. Surge suppressors and ac power conditioners can prevent serious damage to your on-site equipment, including the transmitter.

RF Protection

Transmitters and their antenna systems create intense radio frequency fields at the transmitter site, particularly near the feedline, antenna and tower. At some sites, these fields may cause biological effects, including the heating of body tissues. Intense fields can also create dangerous high voltages on ungrounded, conductive surfaces and objects. At certain points where high voltage conductors come close to grounded conductors (e.g., at feedline junctions or on the tower), dangerous electrical arcing or overs can occur. It is very important that you take the following steps to prevent damage to equipment or personnel due to RF fields:

- Use safety interlocks to de-energize transmitters if personnel open doors or panels accessing high field areas
- Place warning signs in any locations where high fields can occur
- Train personnel about the short-term and long-term hazards of RF radiation
- Use personal RF monitors to alert personnel when hazardous RF radiation levels are present
- Physically block access to the area around the antenna system, feedline and tower
- Ground all exposed conductive surfaces or objects in high field areas

The RF connection to the transmitter output can be a serious safety hazard. Connect a 50 Ω test load during installation and commissioning. Nautel recommends using a switch to automatically connect the transmitter to the antenna system without human contact with the transmitting conductors.

Safety Interlocks

The transmitter contains an electrical interlock, which is an external circuit that turns off the RF output if any of its switches are opened.

Ac Disconnect Switch

Safe operation of the transmitter requires an ac disconnect switch. Lock the ac disconnect switch in the disconnected (open) position during the installation process.

Equipment Safety

Electrostatic Protection

The transmitter's systems are very rugged and resistant to damage. However, it is possible for damage to occur because of high voltage electrostatic discharges during servicing. Train all service personnel to ground themselves to bleed off any static charge before opening the transmitter or touching any exposed components. Provide a grounding wand or known ground (e.g., a grounded metal table) that personnel can use to discharge themselves.

Surge Protection

Surge protection is recommended for your entire site. However, even if you do not use a surge protector on the service entrance to the site, you should install a surge protector in the transmitter's ac power feed to prevent over-voltage from entering the transmitter.

Lightning Protection

The transmitter is designed to resist lightning strike damage. However, intense or repeated strikes could damage the transmitter. We recommend that you install lightning suppression on the antenna, tower and feedline to reduce the effect of lightning strikes on the transmitter itself (and to protect the rest of your site equipment and your personnel). For detailed information about lightning protection, see the Nautel Site Preparation Manual on the provided documentation USB, or online from the Nautel website.

Physical Protection

Consider physical hazards to equipment at your site, including the transmitter. Ensure that equipment is protected from weather (e.g., rain or flooding), even during extreme weather events. Place equipment so that it is not in the path of swinging doors or high-traffic areas. Do not allow wheeled items like office chairs or tables with wheels in the transmitter room, as these may damage equipment if accidentally pushed or knocked over. Do not place the transmitter under water pipes, drains, or sprinklers. Keep any equipment that generates heat, like the transmitter, away from flammable materials like ceiling panels, cubicle dividers, and curtains.

Earthquake Protection

If the transmitter site is in a region that experiences any noticeable earthquake activity, take steps to prevent the transmitter from shifting or rocking during an earthquake. Even during minor earthquakes, rocking or movement of the transmitter is likely to damage the feedline connection, and could even cause a catastrophic failure of the ac power feed into the transmitter. During larger earthquakes, the weight of the transmitter chassis could be hazardous to nearby equipment or personnel.

SECTION 1.1: DESCRIPTION

This section provides a basic description of the VX150 to VX2 transmitters and includes the following topics:

- Capabilities
- Transmitter Configuration - see page 1.1.3
- Options - see page 1.1.3

Figure 1.1.1: VX150 to VX2 Transmitter

VX1 shown for reference

Capabilities

Power

The VX150 to VX2 transmitters are solid-state,VHF, frequency modulated broadcast transmitters that are capable of continuous RF output power up to 165 W (VX150), 330 W (VX300), 660 W (VX600), 1100 W (VX1), 1650 W (VX1.5) or 2100 W (VX2) into a maximum 1.2:1 VSWR.

Minimum power levels are as follows: 15W (VX150), 30 W (VX300), 60 W (VX600), 100 W (VX1), 150 W (VX1.5) and 200W (VX2).

The operator can vary the power continuously or switch to preset power levels using the transmitter's remote advanced user interface (AUI) or the front panel user interface (UI).

NOTE: *The VX150, VX300, and VX1 transmitters are certified under FCC LPFM Part 73 Subpart G and Part 74 Subpart L. LPFM-licensed radio stations must operate the transmitter to maintain a maximum EIRP (Effective Isotropic Radiated Power) of 100 W. To compensate for antenna system losses, the transmitter's conducted output power can be adjusted from the preset settings, as outlined in Section 2.2 of the Operation and Maintenance Manual (AUI Main Menu -> Presets).*

Frequency

The transmitter is broadband and can operate at any frequency in the FM broadcast band (87.5 - 108 MHz), into a nominal 50 ohm, unbalanced transmission line.

Antenna Tolerance

The VX transmitter will operate at rated power even with a VSWR of 1.5:1. A higher VSWR results in a protective foldback of output power. The greater the VSWR, the greater the reduction in RF power until shutdown occurs at 3:1 VSWR.

Remote Control and Monitoring

You can monitor all key parameters of VX transmitter's operation, and control common functions, such as power output and preset settings, from a remote location.

The VX series transmitter allows for discrete remote control and monitor wiring to two 9-pin D-sub connectors on the rear panel. You can also use a web browser, from any web-interfaced device, to access most of the transmitter's local functionality (excludes system parameters that must be configured locally and factory settings).

Ac Power

The VX series transmitter can operate from a nominal 50/60 Hz (between 47 and 63 Hz), single-phase ac power source at voltages between 90 and 265 V ac (VX150, VX300 and VX600 and VX1) or between 185 and 265 V ac (VX1.5 and VX2).

The VX1, VX1.5 and VX2 models can operate at reduced power at lower ac voltages (between 90 and 185 V ac).

For detailed electrical requirements (e.g., input power, maximum line current, etc.), refer to Table 1.5.1 in Section 1.5, "Electrical Requirements".

Transmitter Configuration

VX150 to VX2 transmitters are factory shipped with a base-level hardware configuration. Table 1.1.1 describes the hardware differences, and applicable options, for each model.

Table 1.1.1: VX150 to VX2 Transmitter Configurations

MODEL	AC INPUT RANGE	RF OUTPUT CONNECTOR	PA POWER SUPPLY OUTPUT	NUMBER OF POWER AMPLIFIERS	PS INTERFACE PWB
VX150	90-265 V ac	TYPE N, female	18-53 V dc (Nautel Part # UG132)	1	Nautel Part # NAPI188/01
VX300	90-265 V ac	TYPE N, female	18-53 V dc (Nautel Part # UG132)	1	Nautel Part # NAPI188/01
VX600	90-265 V ac	TYPE N, female (default) 7/16 DIN, female (option) 7/8 EIA (with optional adapter)	18-53 V dc (Nautel Part # UG132)	1	Nautel Part # NAPI188/01
VX1	90-265 V ac	7/16 DIN, female (default) 7/8 EIA (with optional adapter)	23-65 V dc (Nautel Part # UG136)	1	Nautel Part # NAPI188
VX1.5	185-265 V ac	7/16 DIN, female (default) 7/8 EIA (with optional adapter)	23-65 V dc (Nautel Part # UG136)	2	Nautel Part # NAPI188
VX2	185-265 V ac	7/16 DIN, female (default) 7/8 EIA (with optional adapter)	23-65 V dc (Nautel Part # UG136)	2	Nautel Part # NAPI188

Options

There are options available, that can be factory installed prior to equipment delivery (contact your Sales representative for more details) or easily field-installed by the user.

RF Output Connector

VX600 through VX2 models have optional RF output connector configurations that can be specified and purchased. See Table 1.1.1 for default and optional connector types.

Audio Processor

The VX series transmitter can be upgraded with an internal audio processor, available from Nautel (Nautel part # 235-5575), which is mounted on pillars on top of the power supply.

Refer to QG22001, provided with the Orban Inside kit or the detailed video on installing the Orban Audio Processor on the VX Documentation USB.

NOTE: *When an Orban audio processor is factory installed in a transmitter, Orban is disabled by default.*

Surge Protection Panel

Nautel can provide an ac power surge protection unit to aid in protecting the VX series transmitter from lightning. If purchased, refer to the surge protection unit's manual for installation details.

SECTION 1.2: PRE-INSTALLATION TASKS

This section provides a list of tasks that you must perform prior to delivery and installation of the VX series transmitter.

WARNING! FAILURE TO COMPLY WITH RECOMMENDATIONS MAY VOID YOUR MANUFACTURER'S WARRANTY. FOR MORE INFORMATION, REVIEW YOUR WARRANTY DOCUMENTS.

Preparing for Installation

To prepare for installation of an VX series transmitter, perform the following tasks:

NOTE: *For VX150, VX300, VX600 and VX1 transmitters, the ac input voltage range is 90 - 265 V ac. For VX1.5 and VX2 transmitters, RF output power is limited to 750 W when the ac input voltage is between 90 and 185 V ac*.

1. Select a location for the transmitter in the transmitter room. Determine whether additional heating, ventilating or cooling capacity is needed at the site. Identify any special requirements regarding air flow around the cabinet (for example, ducting hot air away from the cabinet, or bringing in external cooling air).

2. If this is an upgrade or replacement transmitter (that is, if the site is already set up for a transmitter), proceed to Step 6. If you are upgrading a site, verify the feedline, the lightning protection systems, and the ac power service.

NOTE: *Be aware of lightning protection issues when installing ac power and RF feedline. Lightning protection is essential to protect both personnel and equipment at your site. Refer to the Lightning Protection section of Nautel's Recommendations for Transmitter Site Preparation Manual*.

3. Install the ac power service into the planned transmitter location, and select a location for the ac surge protection panel (if purchased) near the transmitter. Consult with an electrician prior to receiving the transmitter regarding local electrical codes and special considerations based on transmitter power consumption and requirements. For detailed information, see Electrical Requirements, on page 1.5.1.

4. Install lightning protection on the antenna tower. Refer to the *Recommendations for Transmitter Site Preparation Manual*, provided with the transmitter.

5. Place a work area with a clear table surface near the transmitter. Provide electrostatic protection measures in the work area.

6. Order any accessories or optional equipment that you may need. Typical requirements include:
   - Tools - screwdrivers, nut drivers, etc. (see Parts and Tools, on page 1.12.1 for further details).
   - Test equipment - digital multimeter.
   - Peripheral equipment - PC or laptop, LAN/network connection, etc.
   - If you are using a network connection (as opposed to a direct connection with a laptop), consult with your network administrator to determine whether the VX transmitter's network feature will be enabled. If so, determine whether DHCP will be used. DHCP allows network IP addresses to be assigned automatically. To use DHCP, you must have a visible DHCP server on your network. If you are not planning to use DHCP (i.e., your network does not have a DHCP server or you are connecting directly to a laptop), you must obtain an IP address and netmask from your network administrator as well as gateway and nameserver(s) as applicable. If more than one transmitter exists on the LAN, consider port forwarding when commissioning the transmitter.
7. Terminate the transmitter end of the RF feed line with the appropriate mating connector. VX150 to VX2 transmitters can be provided with the connectors listed in Table 1.1.1 on page 1.1.3. The factory default connectors accept a male N-type connector (VX150, VX300 and VX600) or a 7/16 DIN male connector (VX1, VX1.5 and VX2). Other options and adapters are available.
8. Implement a safety interlock, if required.
9. Prepare to integrate the VX150 to VX2 transmitter into your station control circuitry, if required.
10. Train your station technicians and operators on the use and maintenance of the VX150 to VX2 transmitter.

Selecting a Location for the Transmitter

To ensure that the desired location for the VX150 to VX2 transmitter is suitable, perform the following tasks:

1. Ensure that the cabinet in which the transmitter will be installed is able to support the weight of the transmitter. See Physical Requirements, on page 1.3.1.
2. Measure the cabinet space to ensure that the transmitter will fit. See Physical Requirements, on page 1.3.1.

SECTION 1.3: PHYSICAL REQUIREMENTS

This section provides physical specifications for the VX series transmitter and its components, and lists physical site requirements. This section includes the following topics:

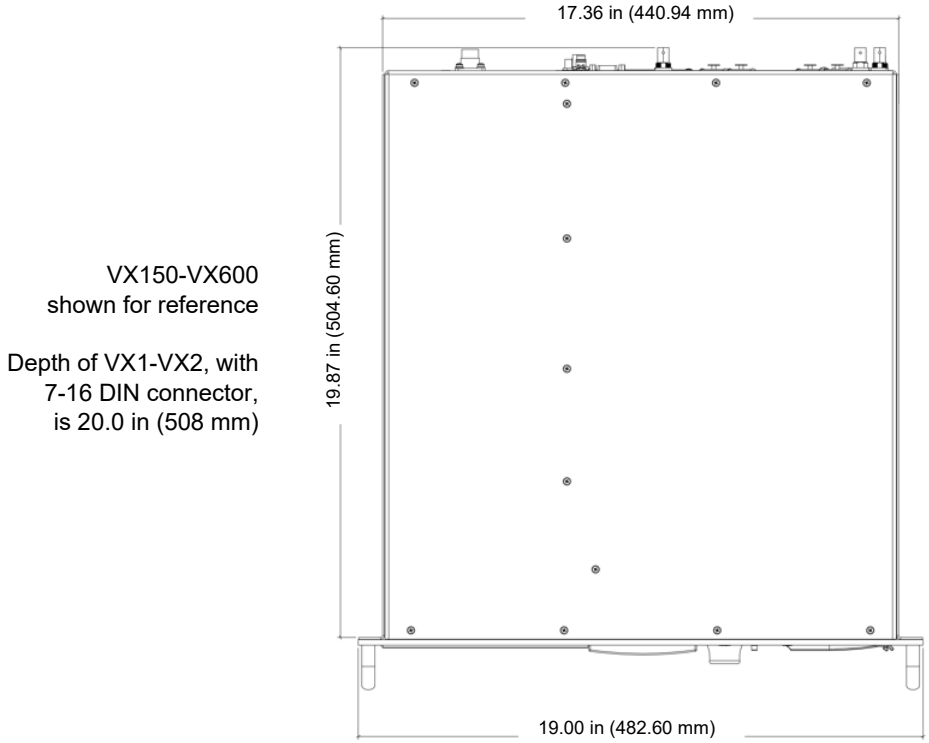
- Dimensions
- Clearances on page 1.3.2
- Weight on page 1.3.2
- Environment on page 1.3.2

Dimensions

The VX150 to VX2 transmitter has the following overall dimensions. See Figure 1.3.1.

- Height: 2 RU or 3.5 in (8.9 cm)
- Width: Standard 19 in (48.3 cm) EIA rack mount [min. opening of 17.5 in (44.5 cm)]
- Depth: approximately 20 in (50.8 cm), from front panel to the end of RF output connector

Figure 1.3.1: VX150 to VX2 Transmitter Dimensions



Clearances

Check the clearance around the host cabinet to ensure that you will be able to open all doors and access panels. Ensure adequate space is available at the front of the cabinet to allow pulling out the transmitter for servicing fan filters and internal parts/assemblies. Also consider access to the rear of the cabinet for making connections to the transmitter.

NOTE: *There are no clearance restrictions for the top and bottom of the transmitter.*

Internal fans pull cooling air through air filters in the front of the transmitter. The cooling air exhausts through grills at the rear and at the right-hand side of the transmitter.

Weight

The packed (boxed) weight of the VX150 to VX2 transmitter is 38 lbs (17.2 kg).

The unpacked weight of the VX150 to VX2 transmitter is 23 lbs (10.4 kg) and the VX1.5/VX2 is 25 lbs (11.5 kg), making it safe for one person to lift the transmitter for installation and maintenance.

Environment

VX series transmitters have an equivalent ingress protection rating of IP20. The transmitter is intended to be housed inside of a building and away from any source of water or debris. The transmitters reliability can be impacted by environmental factors including water leaks, insects and wildlife, conductive dust, airborne corrosives, etc. Nautel recommends inspecting your site prior to installation to ensure any necessary maintenance is completed in advance of commissioning.

SECTION 1.4: COOLING REQUIREMENTS

This section provides information about heating and cooling requirements for the VX series transmitter site. Topics in this section include:

- Air Flow in the Transmitter
- Cooling - see page 1.4.3
- Heating - see page 1.4.3

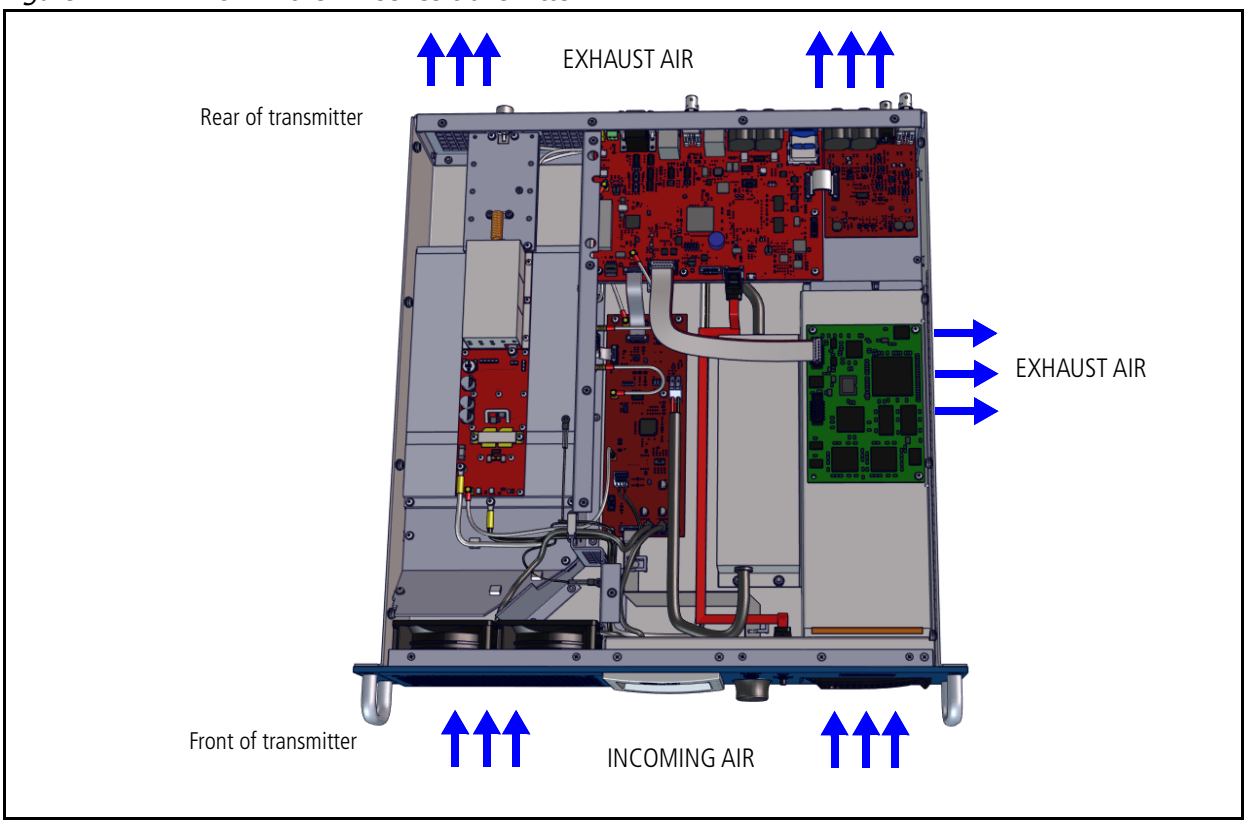
Air Flow in the Transmitter

See Figure 1.4.1 on page 1.4.2. The VX transmitter draws cool (intake) air through two variable speed fans in the front of the transmitter which adjust to maintain optimal cooling vs operating conditions. The left hand side fan (Fan 1) provides airflow for the PA heatsink. The right hand side fan (Fan 2) provides airflow for the Low Pass Filter and the Power Supply control section. Airflow is exhausted by grills in the chassis, located on the sides and rear of the transmitter. The PA Power Supply has its own internal cooling fan to draw cool (intake) air through the front of the power supply. See Table 1.4.1 for typical and maximum air flow requirements.

Table 1.4.1: Transmitter Air Flow Requirements

TRANSMITTER MODEL	TYPICAL AIRFLOW	MAXIMUM AIRFLOW
VX150-VX600	40 CFM 68 m^3/hr	130 CFM 221 m^3/hr
VX1	75 CFM 127 m^3/hr	140 CFM 238 m^3/hr
VX1.5-VX2	95 CFM 161 m^3/hr	140 CFM 238 m^3/hr

Figure 1.4.1: Air flow in the VX series transmitter



Cooling

Do not allow the transmitter room ambient air temperature to exceed 50°C (122°F) at sea level. Cooler temperatures are recommended in order to improve the reliability of the transmitter. The transmitter contains protection circuits that monitor the intake temperature and may inhibit or reduce the RF output power if the temperature exceeds the acceptable limit. At higher altitudes, derate the maximum intake air temperature as follows:

- De-rate the ambient temperature 3ºC (5.4°F) per 500 m – or 2ºC (3.6°F) per 1,000 feet – above sea level.

Example: At 1600 m (1 mile or 5280 ft) above sea level, maximum ambient temperature should not exceed 40.4ºC (104.7°F).

Ensure that hot, exhaust air from the transmitter is not drawn back into the transmitter's cool air intake.

Cooling Plant Requirements

Table 1.4.2: Cooling Plant Requirements for the VX Transmitter

TRANSMITTER (FM MODE)	OUTPUT POWER (WATTS)	TYPICAL EFFICIENCY (%)	WASTE HEAT (WATTS)	BTU/HOUR	TYPICAL AIR CONDITIONING REQUIRED IN CLOSED ROOM COOLING (TONNES)
VX150	165	51	80	273	0.023
VX300	330	65	117	399	0.033
VX600	660	74	174	594	0.049
VX1	1100	75	273	932	0.078
VX1.5	1650	73	454	1550	0.129
VX2	2100	75	552	1884	0.157

Calculating BTU Cooling Requirements

To determine the number of British thermal units (Btu) being generated per hour as waste heat, multiply the waste heat (in watts), derived from the transmitter output power and its typical efficiency, by 3.413.

Heating

The transmitter room must contain a heating system that will ensure the ambient air temperature does not drop below 0°C (32°F).

SECTION 1.5: ELECTRICAL REQUIREMENTS

This section describes electrical power and electrical protection requirements associated with the VX series transmitter. This section includes the following topics:

- Electrical Power
- Station Reference Ground - see page 1.5.3

> **CAUTION!** ***Technical pre-commissioning activities described in this section require technical decisions and the customization of electrical circuits. Do not attempt to perform these activities unless you are a certified electrician.***

NOTE: *This section provides the information required to determine your electrical and station reference ground wiring/connections and plan for their connection to the transmitter. Physical connections are made in* Completing External Connections on page 1.10.1.

Electrical Power

The VX series transmitter can operate from a nominal 50/60 Hz (between 47 and 63 Hz), 90-265 V ac single-phase ac power source. Ac power enters the transmitter through a IEC 60320, C20 type connector (Nautel part # JT202) on the rear panel. Nautel supplies a mating connector (Nautel part # JD43, 220 Vac, 20 A, type C19) which has 3 terminal connections that accepts 12-16 AWG wire.

Voltage Stability

The ac power source nominal voltage must be stable to within rated limits (see Table 1.5.1 on page 1.5.2) under all loading conditions. The transmitter contains circuitry that maintains the RF output at the preset power level for ac voltage variations within the specified range.

Power Consumption and Typical Line Currents

The input power requirement for the VX transmitter is shown in Table 1.5.1 on page 1.5.2. Use Table 1.5.1 on page 1.5.2 to determine the maximum line current and maximum inrush current values for a given ac supply voltage.

Table 1.5.1: VX Electrical Requirements

TRANSMITTER (FM MODE)	MAXIMUM INPUT POWER (VA)	AC SUPPLY (V ac)	MAXIMUM LINE CURRENT (@ 240 V ac) (AMPS)
VX150	350	1-Ph, 240 V ac (90-265)	1.5
VX300	540	1-Ph, 240 V ac (90-265)	1.7
VX600	940	1-Ph, 240 V ac (90-265)	3.9
VX1	1520	1-Ph, 240 V ac (90-265)	6.3
VX1.5	2500	1-Ph, 240 V ac (185-265)	10.4
VX2	3200	1-Ph, 240 V ac (185-265)	13.3

Maximum line current values are based on maximum RF output power, nominal ac voltage (240 V ac) and typical efficiency.

The maximum inrush current value (per line) is present for half an ac cycle (between 8 and 10 ms). It is more than four times the maximum line current and is provided to aid in planning for upstream protection.

Observe local electrical codes when determining wire size and circuit breakers.

Ac Transient Power Protection

Nautel recommends adding a bi-directional surge protector between the service entrance and the transmitter.

A surge protector panel containing suitably rated varistors is available from Nautel. If purchased, install the surge protector panel close to the station reference ground, and as close as possible to the ac service entrance.

The ac power source usually has the lowest impedance path to ground during a lightning strike and normally carries most of the lightning-induced current away from the transmitter site. When lightning hits the power source (for example, striking a transmission line near the transmitter site), a significant induced current may flow towards the transmitter. The goal of lightning protection is to route the current around the transmitter to the best available ground.

For detailed information about surge protectors and lightning protection, refer to the Lightning Protection section of Nautels' *Recommendations for Transmitter Site Preparation Manual*.

Refer to Connecting Ac Power on page 1.10.2 for instructions on adding ferrites to the ac supply.

Station Reference Ground

Install a station reference ground that provides a continuous, low impedance path to the earth.

IMPORTANT! ***The conductor must not contact the transmitter or the host cabinet at any other point.***

If a surge protector is not being used, connect the transmitter's designated safety ground point, the shield of the coaxial feedline, and the ground connection of the power source directly to the station reference ground using a low-impedance copper conductor (minimum 3/4" braid or 1 AWG wire). Ensure that the site's ac service entrance ground is directly connected to the station reference ground outside the transmitter building.

If a surge protector is being used, connect the transmitter's designated safety ground point, the shield of the coaxial feedline, and the ground connection of the power source directly to the surge protector, using a a low-impedance copper conductor (minimum 3/4" braid or 1 AWG wire). Connect the surge protector to the station reference ground using a similar low-impedance coper conductor.

Ensure that the transmitter site's grounding rods are adequate. For more information about electrical grounding protection, see Nautel's *Recommendations for Transmitter Site Preparation Manual*.

SECTION 1.6: RF OUTPUT REQUIREMENTS

This section describes requirements associated with the antenna and RF cabling to be used with the VX series transmitter. Antenna considerations include the following:

- Antenna Feed Cable
- Antenna System

For detailed information about protecting the antenna system from lightning strikes, see Nautel's *Recommendations for Transmitter Site Preparation Manual*.

NOTE: *This section provides the information required to determine your antenna feed cable and plan for its connection to the transmitter. Physical connections are made in* Completing External Connections on page 1.10.1.

Antenna Feed Cable

The antenna feed line interconnecting the transmitter and the antenna system should be a suitably rated coaxial cable. The RF output is configured, by default, to accept a male N-type connection (VX150, VX300 and VX600) or a male 7/16 DIN connection (VX1, VX1.5 and VX2).

Antenna System

Ideally, the antenna system should present 50 ± j0 ohms impedance at the carrier frequency and have sufficient bandwidth to allow transmission of the modulated carrier. The transmitter will function at rated power while operating into a maximum VSWR of 1.5:1, after which the transmitter begins to fold back the RF output (up to a VSWR of 3.0:1). The transmitter's SWR Foldback threshold has a factory default setting of 1.5, but is has a user adjustable range of 1.1 to 1.5. Circuitry within the transmitter will prevent damage to the transmitter from high VSWR loads.

If the measured SWR exceeds 1.5:1 but not 3.0:1, the transmitter will reduce the RF power.

Refer to the Operations and Maintenance manual for SWR threshold details.

SECTION 1.7: PROGRAM INPUTS

IMPORTANT! The transmitter's USB ports are not designed to act as charging ports.

The VX series transmitter accepts a variety of analog and digital program inputs. This section describes the requirements associated with the audio feeds to the transmitter. All connections are made at the rear of the transmitter (see VX150 to VX2 - Rear Panel Connections on page 1.7.3). Where D-sub connectors are used as the interface, Nautel provides associated mating connectors in the ancillary parts kit to facilitate customer connections.

NOTE: *This section provides information to determine your program inputs and plan for connection to the transmitter. Physical connections are made in* Completing External Connections on page 1.10.1.

- Analog Inputs
  - Left and Right Inputs - see page 1.7.1
  - MPX/SCA Inputs - see page 1.7.2
- Digital Inputs - see page 1.7.2
  - AES/EBU Inputs - see page 1.7.2
- Other Features - see page 1.7.2
  - Carrier Frequency and Pilot Phase Control (10 MHz and 1 PPS IN) - see page 1.7.2
  - Pilot Out - see page 1.7.2

Analog Inputs

Each VX series transmitter exciter accepts the following analog inputs:

Left and Right Inputs

Balanced analog left/right or monaural input (left only) (30 Hz to 15 kHz, -12 to +12 dBu) can be applied to *ANALOG AUDIO IN*, 3-pin female XLR connectors. Connect (+) to pin 2, (-) to pin 3 and shield to pin 1 on the XLR connector. The VX series transmitter's remote AUI or front panel UI allows for configuration of the audio input mode (left, right or stereo). Provision is made for adjustment of the input sensitivity and pre-emphasis, adjustable between -12 and +12 dBu. The input impedance for each input is 600 ohms.

NOTE: *Transmitters are factory set to provide 100% modulation (± 75 kHz) with an analog L/R input level of precisely 0.78 V rms (0 dBu).*

MPX/SCA Inputs

There are two MPX/SCA inputs on the rear of the VX transmitter that accept a baseband audio signal that can include composite audio, RDS and SCA signals. The two balanced inputs (30 Hz to 100 kHz) are provided on the *MPX/SCA1 IN* and *MPX/SCA2 IN* female BNC connectors and are user configurable to be an MPX or MPX SCA input. The input impedance for each input is 10 kohms.

If an MPX composite signal is the signal source, the level is factory set at 3.5 V pk-pk for ± 75 kHz carrier deviation, and is adjustable between 1.0 V and 5 V pk-pk.

If an MPX SCA is the signal source, the level is factory set at 3.5 V pk-pk for ± 7.5 kHz deviation, and is adjustable between 1.0 V and 5 V pk-pk

NOTE: *If the main program source is an MPX input, meters for MPX SCA will display "N/A".*

Digital Inputs

Each VX series transmitter exciter accepts the following digital inputs:

AES/EBU Inputs

The VX series transmitter accepts AES/EBU digital audio via the *AES/EBU IN 1* and *AES/EBU IN 2*, 3-pin female XLR connectors (110 ohm balanced; supports sample rates between 32 to 192 kHz). Connect (+) to pin 2, (-) to pin 3 and shield to pin 1 on the XLR connectors. The VX series transmitter's remote AUI or front panel UI allows for configuration of the audio input mode (left, right or stereo) and level (in dBfs). Default factory setting is -4.0 dBFS which produces 100% modulation and is adjustable between -25.0 and 0.0 dBfs.

Other Features

Carrier Frequency and Pilot Phase Control (10 MHz and 1 PPS IN)

Each VX series transmitter provides carrier frequency and pilot phase control from a precision GPS reference on the exciter's *10 MHz IN* female BNC connector (between 0.5 V and 2 V pk-pk sine wave input; 50 ohm input impedance) and *1 PPS IN* female BNC connector (5 V TTL input level, 10 kohm input impedance).

Pilot Out

Each VX series transmitter provides a 1 V pk-pk (default), 19 kHz pilot signal on the *19 kHz OUT* female BNC connector. The output level is adjustable from 0 - 2.7 V pk-pk through the Remote AUI or the Front Panel UI.

PROGRAM INPUTS

Connector, Type/Gender	Input/Output	Specifications
ANALOG AUDIO IN XLR, female	Balanced left/right composite input	30 Hz to 15 kHz; adjustable between -12 to +12 dBm (nominal 0 dBm for ±75 kHz deviation, 600 ohm input impedance
MPX/SCA1 BNC, female	MPX SCA1 input	Composite baseband signal or SCA modulated sub-carrier from external SCA generator. 30 Hz to 100 kHz; 1 to 5 V pk-pk (nominal 3.5 V pk-pk for ±75 kHz deviation or 3.5 V pk-pk for 7.5 kHz deviation), 10 kohm input impedance
MPX/SCA2 BNC, female	MPX SCA2 input	Composite baseband signal or SCA modulated sub-carrier from external SCA generator. 30 Hz to 100 kHz; 1 to 5 V pk-pk (nominal 3.5 V pk-pk for ±75 kHz deviation or 3.5 V pk-pk for 7.5 kHz deviation), 10 kohm input impedance
AES/EBU IN 1 XLR, female	AES/EBU digital audio input	Left and/or right audio input, -25 to 0 dBfs, 110 ohms balanced; supports sample rates between 32 and 192 kHz
AES/EBU IN 2 XLR, female	AES/EBU digital audio input	Left and/or right audio input, -25 to 0 dBfs, 110 ohms balanced; supports sample rates between 32 and 192 kHz
10MHz IN BNC, female	10 MHz GPS reference	0.5 to 2 V pk-pk sine wave, 50 ohm input impedance
1 PPS IN BNC, female	1 PPS input	Provides phase control for GPS reference, 5 V TTL, 10 kohm input impedance
PILOT SAMPLE OUT BNC, female	19 kHz pilot sample	1.0 V pk-pk (sine wave)

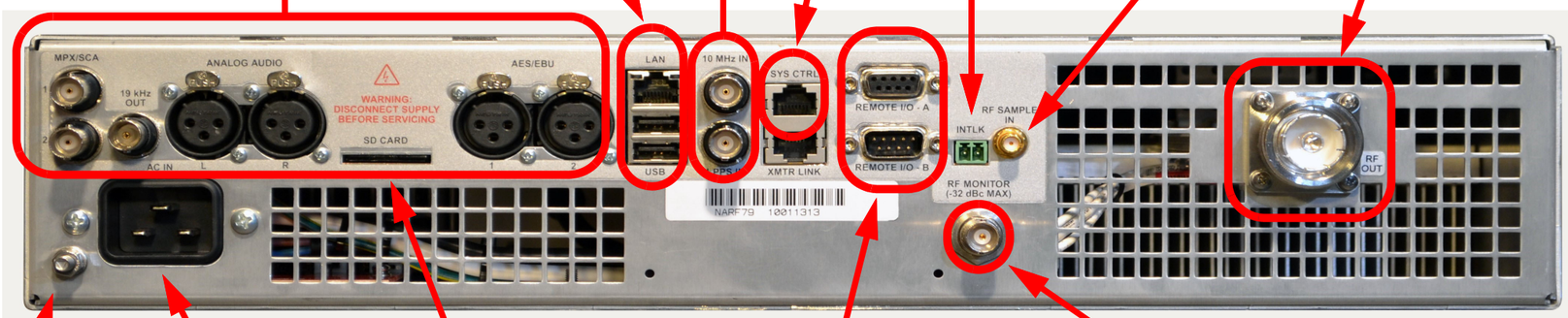
SYS CTRL
Connect a Cat-5e to serial adapter to allow RS-232 control

RF SAMPLE IN
Not used for VX150 to VX2

RF OUTPUT (Standard)
Female N-type connector (VX150, VX300 and VX600) or Female 7/16 DIN connector (VX1, VX1.5 and VX2). Use a suitably rated coaxial cable.

LAN/USB INTERFACE
Allows web-based AUI control. See *Section 1.8* for more information

EXTERNAL INTERLOCK
Mating connector (Nautel part # JR52) not shown, but supplied by Nautel)



SD CARD SLOT
SD card contains the OS and stores presets and calibration data for the transmitter.
Do not remove the SD Card.

REMOTE CONTROL/ MONITORING
REMOTE I/O-A 9-pin female D-sub
7 Digital Inputs (see *Section 1.8* for factory defaults)
1 Ground pin (see *Section 1.8*)
1 +12 V Input

REMOTE I/O-B 9-pin male D-sub
6 Digital Outputs (see *Section 1.8* for factory defaults)
2 Analog Outputs (see *Section 1.8* for factory defaults)
1 +12 V Output (see *Section 1.8*)

RF MONITOR SAMPLE
True RF sample of the RF output (-33 dB typical), relative to the carrier level. Intended for modulation monitoring. Not intended for harmonic spectral compliance testing.

SAFETY GROUND STUD
Connect a low-impedance conductor (minimum 3/4-inch braid or 1 AWG wire) to the site's station reference ground.

Conductor must not contact the transmitter or host cabinet at any other point.

AC INPUT
90-265 V ac (VX150-VX1) or 185-265 V ac (VX1.5/VX2), 47-66 Hz, 1-phase ac

Connect the customer manufactured ac line cord (Nautel part # JD43 connector provided in the ancillary kit)

See *Section 1.5* for more ac input power requirements

Figure 1.7.1: VX150 to VX2 - Rear Panel Connections

SECTION 1.8: CONTROL AND MONITOR WIRING

This section describes the types of control and monitoring for the VX150 to VX2 transmitter. All connections are made to the rear panel of the transmitter (see VX150 to VX2 - Rear Panel Connections on page 1.7.3). Consider the following information and plan for the necessary requirements (wiring, remote switches/ indicators, LAN, etc.):

- Front Panel UI Control
- Remote Inputs - see page 1.8.2
- Remote Outputs - see page 1.8.4
- Analog Outputs - see page 1.8.6
- Web Based AUI Control - see page 1.8.8
- SNMP Control/Monitoring - see page 1.8.9
- External Interlock - see page 1.8.9

NOTE: *This section provides the information required to determine your control and monitor wiring and plan for their connection to the transmitter. Physical connections are made in* Completing External Connections on page 1.10.1.

Front Panel UI Control

The VX1's front panel user-interface (UI) lets you locally control a number of transmitter functions and set parameters.

For detailed information about the front panel UI, refer to the VX Operation and Maintenance Manual. In addition, the front panel UI lets you define and control the on/off status, the preset RF power level, and protection reset for latched alarms remotely using a conventional remote control interface (see Remote Inputs - see page 1.8.2 and Remote Outputs - see page 1.8.4) or a LAN (see Web Based AUI Control - see page 1.8.8.

Remote Inputs

You can connect up to seven (7) remote inputs to the **REMOTE I/O-A, 9**-pin female D-sub connector on the rear panel of the transmitter (see VX150 to VX2 - Rear Panel Connections on page 1.7.3), which allow you to remotely control various operational characteristics of the transmitter. Each input is factory set to a control at Nautel, but they are user-configurable using the remote AUI and the FPUI.

See Table 1.8.1 on page 1.8.3 for a list of the preset inputs, their default functional descriptions and their associated pins on the **REMOTE I/O-A, 9**-pin female D-sub connector. Refer to the VX Operations and Maintenance Manual for instructions on changing the remote input settings. Unless otherwise noted these inputs are only accepted by the transmitter if remote control is enabled. That setting can only be made by a local user using the front panel UI. All inputs are active when a ground (0 V) is applied, if configured as such.

The external remote input circuits interface with the transmitter via the REMOTE I/O-A 9-pin female D-sub connector and then with internal opto-couplers. The opto-couplers buffer and isolate the external circuits and prevent any unwanted transients from affecting the transmitter.

The Exciter PWB (A1) contains a jumper (E1) that lets you select an internal or external dc power supply for all remote inputs. The default setting of the jumper is the transmitter's internal 12 V supply (12V-OP, pins 2 and 3). To use an external supply, place the E1 jumper on pins 1 and 2 (12 V) and connect an external 12 V supply between pins 6 and 7 (ground). The switching circuits for the remotely controlled functions must be the equivalent of a normally open (momentary) switch. Configure the switches to operate as a single-ended input using the transmitter's 12 V dc supply as the source or as a differential input using an external dc power supply (+12 V) applied to the J6A on the Exciter PWB (A1).

Inputs are toggled between states by an active pulse unless otherwise noted. To ensure proper operation, the active pulse duration should be a minimum of 500 ms. Refer to the Operations and Maintenance Manual to see the various logic control options for remote inputs and outputs.

Remote Input Connections

Remote inputs 1 through 7, as required, connect to the pins of REMOTE I/O-A 9-pin female D-sub connector on the rear of the transmitter. See Table 1.8.1 on page 1.8.3 to determine the input pin associated with each remote input, the default remote inputs and their functions.

Nautel provides a D-sub mating connector (Nautel Part # JS224) and connector shell (Nautel Part # JS225) in the Ancillary kit to facilitate customer connections to the controller, as applicable. The JS224 connector accepts 24-30 AWG wire.

When the remote input is configured for logic '0', a negative logic (current-sink-to-ground) command must be applied to the appropriate remote input (1 through 7). To avoid a ground loop, obtain the ground from pin 7).

Table 1.8.1: Factory Defined (Default) Remote Inputs

REMOTE INPUT #	INPUT (CHANNEL)	FUNCTION	PIN OF REMOTE I/O-A
1	RF On	Same as pressing the RF On button. Tells the transmitter to provide RF power if possible.	1
2	RF Off	Same as pressing the RF Off button. Tells the transmitter to disable RF power.	2
3	Preset 1 Select	Selects preset 1 as active.	3
4	Preset 2 Select	Selects preset 2 as active.	4
5	Power Trim +	Increases the power level of the current preset. Apply a momentary ground input to increase the power by 1% of rated, or apply a longer duration ground input to increase power by 1% every 0.5 s.	5
6	Power Trim -	Decreases the power level of the current preset. Apply a momentary ground input to decrease the power by 1% of rated, or apply a longer duration ground input to decrease power by 1% every 0.5 s.	8
7	Protect Reset	Causes a reset for latched alarms.	9
-	+12 V In		6
-	Ground	Common ground connection shared between remote inputs and remote outputs.	7

NOTE: *Default control logic for remote inputs is Falling Edge.*

Remote Outputs

Six (6) remote outputs, that indicate either the presence of various alarms or the status of operator controlled circuits, are available for remote monitoring on the REMOTE I/O-B 9-pin male D-sub connector on the rear panel of the transmitter (see VX150 to VX2 - Rear Panel Connections on page 1.7.3). Each output is factory set to a control at Nautel, but they are user-configurable using the remote AUI and the FPUI. See Table 1.8.2 on page 1.8.5 for a list of the factory preset outputs, their descriptions and their associated output pins on the REMOTE I/O-B 9-pin male D-sub connector.

A switching device for each remote output, configurable through the front panel UI, provides the desired active logic state, when a true condition exists.

For example, if a remote output is configured as Output Low When On (see the VX Operations and Maintenance Manual for the specific text displayed on the front panel UI), then the remote output's switching circuit will provide a current-sink-to-ground when a logic true (on) condition exists and an open collector for a logic false (off) condition.

Each switching circuit must present impedance between the switching device and a dc voltage source that limits current flow to no more than 20 mA. Each circuit's positive voltage source must not exceed 24 V dc. The internal +15 V supply is capable of providing 250 mA for all active status outputs. If you require more current capability, use an appropriate external power supply.

Remote Output Connections

Remote outputs 1 through 6, as required, connect to terminals of REMOTE I/O-B 9-pin male D-sub connector on the rear panel of the transmitter. See Table 1.8.2 on page 1.8.5 to determine the output pin associated with each remote output.

Nautel provides a D-sub mating connector (Nautel Part # JS223) and connector shell (Nautel Part # JS225) in the Ancillary kit to facilitate customer connections to the controller, as applicable. The JS223 connector accepts 24-30 AWG wire.

NOTE: *The REMOTE I/O-B D-sub connector has no ground pins. There is a ground on pin 7 of the REMOTE I/O-A connector, which can be shared, as required.*

Table 1.8.2: Factory Defined Remote Outputs

REMOTE OUTPUT #	DEFAULT OUTPUT (CHANNEL)	FUNCTION	PIN OF REMOTE I/O-B
1	RF On Status	Indicates the on/off status of the transmitter's RF power stage. By default, the output is low (current-sink-to -ground) when RF is on (enabled) and high (open collector) when RF is off (disabled). Alternate control setting: 'Output Low When RF Off'.	1
2	RF Output Fault	Indicates if fault is occurring that is inhibiting or limiting the RF output. By default, the output is low (current-sink-to -ground) when an RF output fault exists and high (open collector) when no RF output fault exists. Alternate control setting: 'Output Low When No Fault'	2
3	Preset 1 Status	Indicates the status of preset power level 1. By default, the output is low (current-sink-to -ground) when Preset 1 is selected and high (open collector) when Preset 1 is not selected. Alternate control setting: 'Output Low When No Preset 1'.	3
4	Preset 2 Status	Indicates the status of preset power level 2. By default, the output is low (current-sink-to -ground) when Preset 2 is selected and high (open collector) when Preset 2 is not selected. Alternate control setting: 'Output Low When No Preset 2'.	4
5	Remote Status	Indicates the local/remote control status of the transmitter. Changes can only be made remotely if the transmitter's remote control is enabled. The local user's control of the transmitter is unaffected, without restriction. The output is low (current-sink-to-ground) when remote control is enabled and high (open collector) when remote control is disabled. Alternate control setting: 'Output Low When Local' (where remote control is disabled).	6
6	Summary Alarm	The output is low (current-sink-to-ground) when any alarm is occurring (true condition) and high (open collector) when there is no alarm (false condition). Alternate control setting: 'Output Low When False'.	7
	+12 V Out	Provides a pull-up supply for open-drain remote outputs, to a maximum current of 250 mA.	5

NOTE: *Typical control logic for remote outputs is Output Low When True.*

NOTE: *When using any Remote Output connections, a ground connection must be established on J6A pin 7.*

Analog Outputs

The transmitter provides two sample signals that let you monitor performance. The sources of these analog outputs are pre-defined and are not user-configurable. See Table 1.8.3 on page 1.8.6 for a list of these outputs, their descriptions and their associated output terminals on the REMOTE I/O-B 9-pin male D-sub connector on the rear panel of the transmitter (see VX150 to VX2 - Rear Panel Connections on page 1.7.3).

The outputs are op-amp buffered outputs from an internal digital-to-analog converter (DAC). The dc voltage of each output is between 0 and 10 V (full-scale deflection can be scaled by the user; 5 V is default), and varies within the real limits of the parameter being monitored. The monitoring circuit's impedance for each analog output must be greater than 1,000 ohms.

Analog Output Connections

The two analog outputs connect to pins of 8 and 9 of REMOTE I/O B (9-pin male D-sub connector) on the rear panel of the transmitter. See Table 1.8.3 to determine the pin or terminal associated with each analog output.

Nautel provides a D-sub mating connector (Nautel Part # JS223) and connector shell (Nautel Part # JS225) in the Ancillary kit to facilitate customer connections to the controller, as applicable. The JS223 connector accepts 24-30 AWG wire.

Table 1.8.3: Analog Outputs

ANALOG OUTPUT	DESCRIPTION	PIN OF REMOTE I/O-B
Forward Power	Reports a sample of the transmitter's forward power. This dc voltage is a linear function and is full-scale (default is 5 V; user-configurable from 0 to 10 V) when the forward power is the transmitter's nameplate power multiplied by 1.1 (150 W for VX150, 300 W for VX300, 600 W for VX600, 1000 W for VX1, 1500 W for VX1.5, 2000 W for VX2).	8
Reflected Power	Reports a sample of the transmitter's reflected power. This dc voltage is a linear function and is full-scale (default is 5 V; user-configurable from 0 to 10 V) when the reflected power is 10% of the transmitter's nameplate power (see forward power levels above; e.g., 100 W for VX1.	9

NOTE: *When using any Remote Output connections, a ground connection must be established on J6A pin 7.*

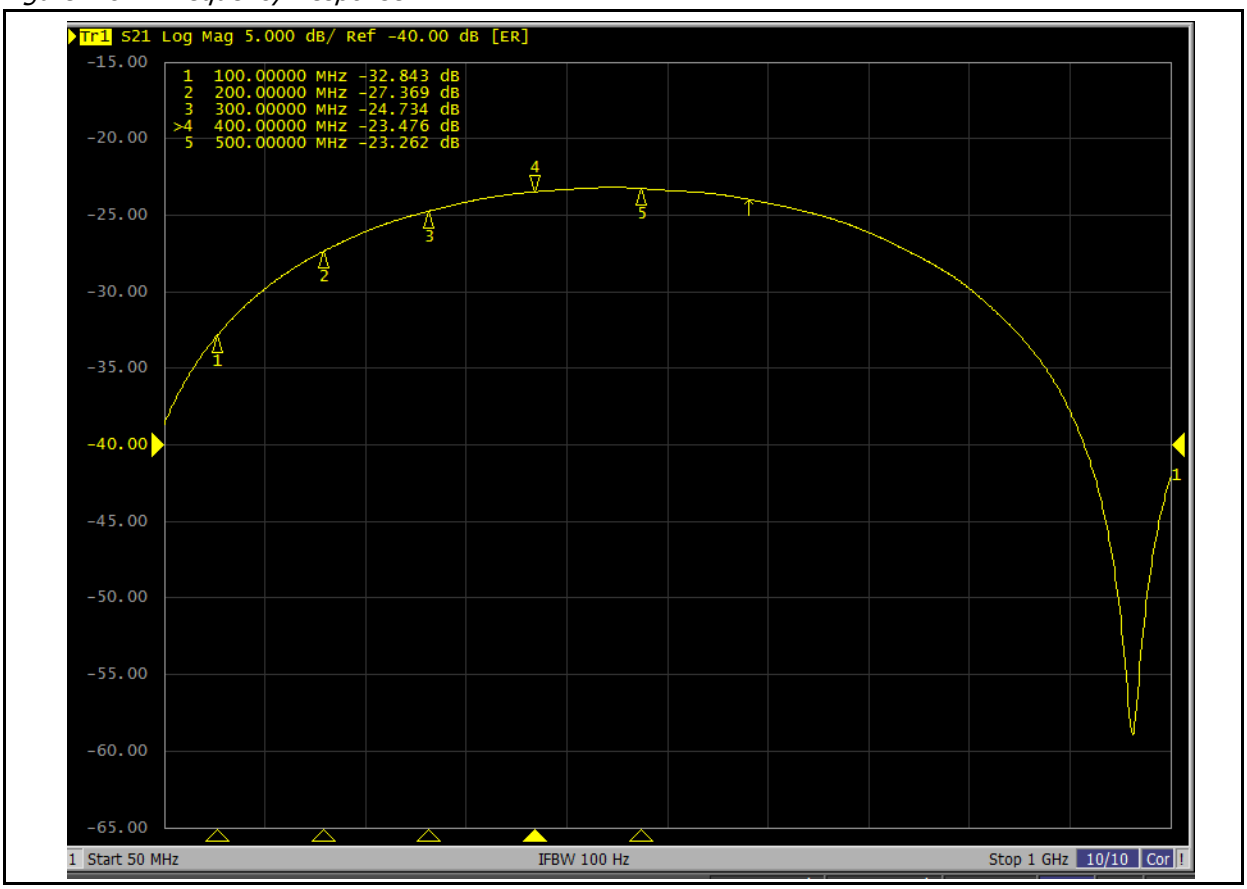
RF Monitor Sample

A true RF sample of the RF output voltage waveform is available for external monitoring on the RF MONITOR BNC connector on the rear panel of the transmitter (see VX150 to VX2 - Rear Panel Connections on page 1.7.3). The coupler yields approximately -33 dB (± 1 dB), relative to the carrier level, at the FM broadcast carrier frequency (87.5 - 108 MHz).

The RF monitor sample is intended for reference use only. Nautel recommends the use of an externally calibrated spectrum analyzer and an external characterized directional coupler to perform certification tests.

NOTE: *There is a "boost" in the coupler response at higher order (harmonic) frequencies. This boost can be up to +10 dB relative to the carrier frequency. Subtract the boost value, determined from Figure 1.8.1 from any harmonic measurements made from the sample port, noting that there is up to ± 3 dB tolerance on the boost values.*

Figure 1.8.1: Frequency Response



Web Based AUI Control

An Ethernet port is available on the **LAN** connector on the rear panel of the transmitter (see VX150 to VX2 - Rear Panel Connections on page 1.7.3). This port allows a user with proper authentication to remotely control and interrogate the VX series transmitter's operational status. Most of the functionality is available on the remote AUI and front panel UI, provided the user has been granted proper authorization. Refer to the VX Operations and Maintenance Manual for details on setting user permissions and for a menu tree that shows all functions/features of the AUI and front panel UI.

IMPORTANT! Nautel recommends shielded Cat5e cable, as a minimum, for this connection.

CAUTION!
When connecting to a Nautel transmitter, both HTTP and HTTPS protocols are supported. If using HTTP, the data traffic is not encrypted, meaning your username/password could be compromised. For security reasons, Nautel recommends using HTTPS whenever possible.

Remote Access

The only access to the remote AUI is through the connector labeled **LAN** on the rear panel of the transmitter. The customer's browser must support HTML5 to view the remote AUI.

For security purposes, Nautel recommends you place your transmitter behind a firewall router. To allow remote AUI access to a transmitter behind a firewall, the firewall must allow TCP traffic through the following ports:

- TCP port 80 for HTTP or TCP port 443 for HTTPS: required to allow the web browser operating on the remote computer to access the web server operating on the transmitter.
- TCP port 7005: Used for RDS/RBDS communication.
- TCP ports 161 and 162: Used for Agents and Traps SNMP, respectively.
- UDP port 123: Used as the NTP port for time synchronization.

Once your transmitter is isolated behind a firewall, there are a variety of standard network management techniques that can be used to establish a connection, including routing tables and a virtual private network (VPN).

Detailed information about network management is beyond the scope of this manual. Selecting a specific technique often depends on your existing network configuration. Nautel recommends that the planning, implementation and ongoing support of a network that includes a transmitter be undertaken by a team that includes at least one member with suitable knowledge of network management.

NOTE: *If you have more than one transmitter on the same LAN, you will need to use port forwarding to allow access to individual transmitters on the network.*

SNMP Control/Monitoring

SNMP (Simple Network Management Protocol) is a request-response protocol where the client and agent communicate using binary packets. For Nautel transmitters, SNMP is used to communicate transmitter control commands (e.g., RF on/off, active preset, power adjustments, etc.) as well as monitor data such as alarm states and meter values. Nautel supports SNMPv1 and SNMPv2c for VX transmitters.

Nautel provides the central software component, the SNMP agent, which is a program that runs on the transmitter. The SNMP agent interacts with SNMP client software applications, which range from simple MIB browser applications like the free one provided by iReasoning© to customized solutions such as those provided by Burk©. Nautel does not provide SNMP client software.

Access to SNMP control/monitoring is through the connector labeled LAN on the rear panel of the transmitter. When you log into the remote AUI, you can access the **Settings -> SNMP** page to set the SNMP Agent Port number, Read Community and Write Community passwords and SNMP Trap information.

If you are planning to use SNMP, contact Nautel to obtain MIB files for your client software or are available through Nautel's FTP site: ftp://www3.nautel.com/pub/SNMP_MIBs/

Email Server

The transmitter's remote AUI allows you to configure an email notification feature, which can initiate emails to specified users when specific alarm or status conditions occur (refer to the VX Operations and Maintenance Manual for details).

The VX series transmitter supports email servers that are both unsecure and secure; requiring authentication (user name/password) as well as encryption. Consult with your network administrator for more details.

External Interlock

An external safety interlock is provided on the **INTLK** terminal block on the rear panel of the transmitter. This connection allows you to connect an external safety interlock circuit that provides an emergency RF inhibit control for the VX transmitter. It must present a short circuit (low impedance) between the terminals when the interlock circuit is intact and it is safe to enable the RF output. It must present an open circuit when any interlock switch is activated and the RF output should be inhibited. A mating connector (Nautel part # JR52) and shorting jumper (Nautel part # JB56) are supplied with the transmitter to facilitate this connection.

SECTION 1.9: UNBOXING AND INSTALLING THE TRANSMITTER

Unboxing the Transmitter

Before installing your VX150 to VX2 transmitter, perform the following steps:

1. Ensure that you have read and understood the planning requirements described in the previous sections of this manual.
2. Inspect the shipping box for damage. Report any damage immediately to your Nautel sales representative and the carrier.
3. Unpack the box. Remove all items from packing and place them on a suitable work area. Check your packing list to make sure that you received all the components, including the VX150 to VX2 transmitter, the VX150 to VX2 Quick Start Guide, VX Series USB (contains technical manual set, Unboxing and First Time Setup videos) and Ancillary kit.
4. Assemble your parts and tools. For a list of required tools, see Parts and Tools, on page 1.12.1.
5. When you are ready to install the VX series transmitter, proceed to Mounting the Transmitter, on page 1.9.2.

NOTE: *The VX150 to VX2 Quick Start Guide provides a more streamlined method to unpack, install and commission your transmitter. If you used the Quick Start Guide to successfully commission your transmitter, Nautel recommends you use the information in this Installation Manual to verify your installation or for more in depth information, as required.*

CAUTION! ***FAILURE TO COMPLY WITH RECOMMENDATIONS MAY VOID YOUR MANUFACTURER'S WARRANTY. FOR MORE INFORMATION, REVIEW YOUR WARRANTY DOCUMENT.***

Mounting the Transmitter

To mount the VX150 to VX2 transmitter in a cabinet, refer to the following installation aids provided with the VX transmitter:

- Unpacking/Installation Video (located on the USB device that also contains the technical documentation suite): step-by-step video that shows how to unpack your VX transmitter and properly mount it in a cabinet.
- VX150 to VX2 Quick Start Guide: full-colour foldout guide and video (located on the USB device that also contains the technical documentation suite) that provides instructions to install the VX transmitter in a cabinet and achieve on-air operation.

NOTE: *Unless otherwise specified, all hardware referenced in the Unpacking/Installation video or the VX150 to VX2 Quick Start Guide is included in the VX150 to VX2's Ancillary kit (Nautel Part # 235-8010).*

SECTION 1.10: COMPLETING EXTERNAL CONNECTIONS

This section provides instructions to complete the user-provided connections to the rear panel of the VX150 to VX2 transmitter (see VX150 to VX2 - Rear Panel Connections on page 1.7.3), that were described in previous sections, including:

- Connecting Ac Power - see page 1.10.2
- Connecting Station Reference Ground - see page 1.10.3
- Installing and Connecting the RF Feed Cable - see page 1.10.4
- Connecting Remote Control/Monitor Wiring - see page 1.10.5

NOTE: *The VX150 to VX2 Quick Start Guide provides a more streamlined method to unpack, install and commission your transmitter. If you used the Quick Start Guide to successfully commission your transmitter, Nautel recommends you use the information in this Installation Manual to verify your installation or for more in depth information, as required.*

Connecting Ac Power

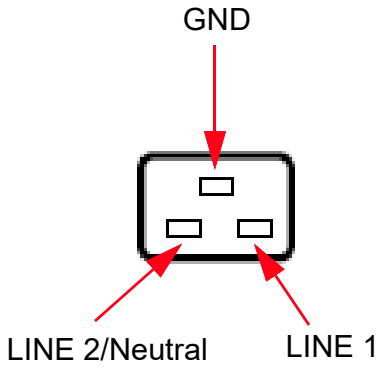
To connect ac power to the transmitter, perform the following steps:

WARNING! ENSURE THAT WIRING SIZES ARE APPROPRIATE. AC WIRING MUST BE INSTALLED BY A QUALIFIED, LOCALLY-CERTIFIED ELECTRICIAN.

DANGER! ***ENSURE AC POWER IS DISCONNECTED AND LOCKED OUT AT THE SOURCE BEFORE PROCEEDING.***

1. Make sure you have completed the planning requirements described in Electrical Requirements on page 1.5.1 before proceeding.
2. Switch off the ac power at the service entrance.
3. Obtain the ac power connector (Nautel part # JD43), provided in the Ancillary kit.
4. Connect the ac power cable to the JD43 connector as follows (see Figure 1.10.1 for details):
   - Connect the ac power cable's line or line /neutral wires to the two **Line** terminals on the connector and tighten the Phillips screws.
   - Connect the ac power cable's ground wire to the ground terminal on the connector and tighten the Phillips screw.
   - Obtain a clip-on ferrite (Nautel part # LX68 or LX69) from the Ancillary kit and install over the customer provided ac cord, in close proximity to the JD43 connector.
5. Route the user-provided ac power cable from the service entrance to the rear panel of the transmitter.

Figure 1.10.1: JD43 Ac mains connector



Example with assembled cable

Connecting Station Reference Ground

To connect to the station reference ground, perform the following steps:

1. Make sure you have completed the planning requirements described in Station Reference Ground, on page 1.5.3 before proceeding.

2. Locate the safety ground stud for the transmitter on the rear panel (see VX150 to VX2 - Rear Panel Connections on page 1.7.3).

3. Attach a continuous, low impedance copper conductor (minimum 3/4" braid or 1 AWG wire) between the station reference ground and safety ground stud. Ensure the station reference ground conductor is at least 3 mm (1/8 in) from the exterior of the transmitter or host cabinet.

   CAUTION! ***IT IS IMPORTANT THAT THE CONDUCTOR ATTACHED TO THE STATION GROUND DOES NOT CONTACT THE TRANSMITTER CHASSIS AT ANY OTHER POINT.***

4. For information about grounding the lightning protection, see the Lightning Hazards, on page xvi. For detailed information about lightning protection, see Nautel's *Recommendations for Transmitter Site Preparation Manual*, available on the USB documentation provided with the transmitter or online from the Nautel website.

5. Firmly tighten all hardware.

Installing and Connecting the RF Feed Cable

Prepare and install an RF feed coaxial cable as follows:

WARNING! ENSURE THAT AC POWER IS NOT BEING APPLIED TO THE TRANSMITTER DURING THIS PROCEDURE.

NOTE: *Nautel recommends that you perform the commissioning procedure in* Section 1.11, "Commissioning", *which connects the transmitter to a dummy load, before connecting the transmitter to its antenna system*.

When installing an antenna feedline for the VX150 to VX2 transmitter, perform the following tasks:

1. Make sure you have completed the planning requirements described in Section 1.6, "RF Output Requirements" before proceeding. Ensure that the RF feedline that will connect the transmitter to the antenna system is suitably rated.

2. Connect the VX transmitter's RF output to a dummy load, if available, during the commissioning procedure's initial turn on. If the RF feed cable is not connected to a switching circuit that permits antenna/dummy load selection, connect the RF feed cable for the dummy load to the transmitter's RF output until transmitter commissioning is complete.

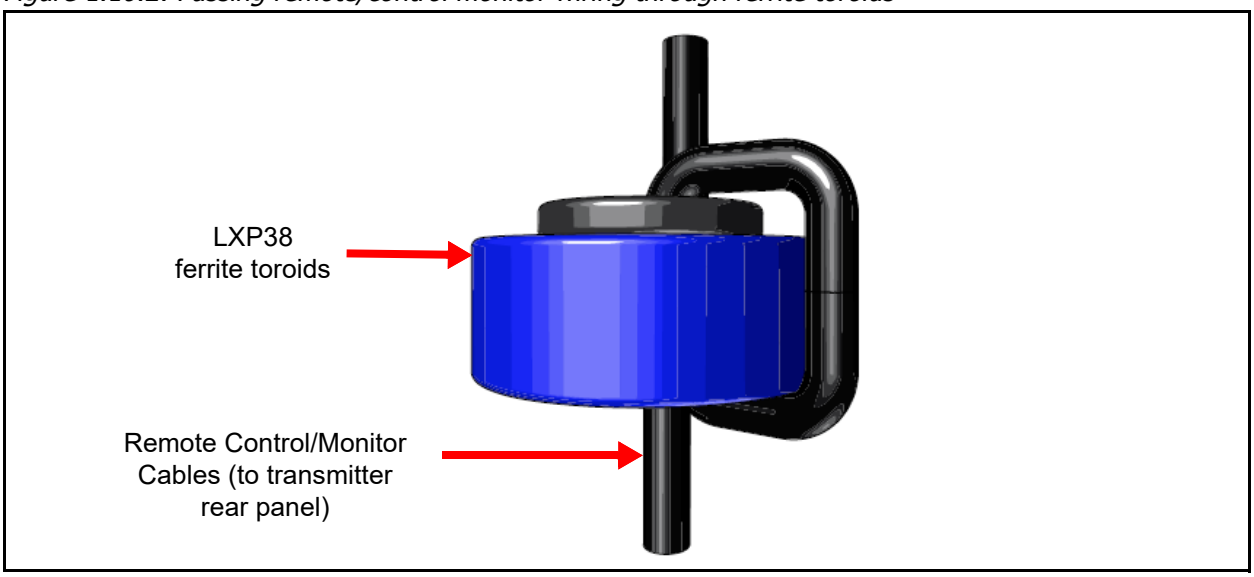
3. Mate the RF feed cable's connector to the RF OUT connector on the rear panel of the VX transmitter (see VX150 to VX2 - Rear Panel Connections on page 1.7.3). Refer to the Recommendations for Transmitter Site Preparation manual, supplied with your VX transmitter.

NOTE: *Nautel can provide a ferrite toroid for the antenna feed cable (Nautel part # LP23). Contact Nautel to purchase.*

Connecting Remote Control/Monitor Wiring

1. Make sure you have completed the planning requirements described in Control and Monitor Wiring on page 1.8.1 before proceeding.
2. Route all remote control/monitor cables to the rear panel of the transmitter.
3. Obtain two ferrite toroids (Nautel Part # LXP38, 19 mm inner diameter) from the Ancillary kit.
4. Pass all remote control and monitor cables through the ferrite toroids obtained in Step 3. If practical, wires should pass through a minimum of two times (two turns) (see Figure 1.10.2).

Figure 1.10.2: Passing remote/control monitor wiring through ferrite toroids



5. With the remote control/monitor cables near their destination, cut each wire to the required length, and install connectors, as necessary.
6. Connect the appropriate control/monitor cable(s) to the REMOTE I/O-A and REMOTE I/O-B D-sub connectors as described in Control and Monitor Wiring on page 1.8.1. Nautel provides D-sub mating connectors (Nautel part #'s JS223 and JS224) and connector shell (Nautel Part # JS225) in the Ancillary kit to facilitate connections to the transmitter, as applicable.
7. For the transmitter's external interlock control, route a shielded cable to the **INTLK** connector. Use the mating connector (Nautel part # JR52) is supplied in the Ancillary kit to facilitate this connection.
8. For web based control of the transmitter, route an Ethernet (shielded Cat5) cable to the **LAN** connector.

SECTION 1.11: COMMISSIONING

WARNING! Before applying ac power and turning on the transmitter, you must customize some circuits to the station's power source and operating requirements. Do not perform this pre-commissioning unless you are a station engineer or a competent electronics technician.

The transmitter contains solid-state devices that may be damaged if subjected to excessive heat or high-voltage transients. Ensure that circuits are not overdriven or disconnected from their loads while turned on.

The transmitter was precisely calibrated and tested during manufacturing. Do not change any adjustments other than those specified.

This section contains the following procedures:

- Pre-Commissioning Tasks - see page 1.11.2
- Commissioning - see page 1.11.3
  - Network Setup - see page 1.11.3
  - Preset Audio Setup - see page 1.11.4
  - Turning on the Transmitter - see page 1.11.6
  - Going On-Air - see page 1.11.7

Pre-Commissioning Tasks

1. Terminate the transmitter's RF output into a precision, 50 Ω, resistive dummy load that is adequately rated for the maximum expected total power output.

2. Verify all program inputs are connected to the back of transmitter.

   WARNING! If a jumper is placed between the INTLK inputs on the rear panel of the transmitter, safety features controlled by the external interlocks will be disabled. A fail-safe method of alerting personnel to this fact should be implemented. Voltages which are dangerous to life will be present on the RF output stages and the antenna system if the transmitter is turned on.

3. Ensure the external interlock is closed. Nautel ships the VX150 to VX2 with an external interlock mating connector and jumper (Nautel part # JR52/JB56) that has a short circuit between the two contacts.

NOTE: *The JR52 Interlock connector will also accept 14-30 AWG wire sizes.*

Commissioning

NOTE: *The following procedures require the use of the transmitter's front panel user interface (FPUI). If you require assistance to navigate the FPUI, refer to the VX Operation & Maintenance Manual for more information.*

Network Setup

CAUTION!
When connecting to a Nautel transmitter, we support both HTTP and HTTPS protocols. If using HTTP, the data traffic is not encrypted, meaning your username/password could be compromised. For security reasons, Nautel recommends using HTTPS whenever possible.

If you wish to remotely control the transmitter via a network or directly through a laptop, configure your network parameters as follows:

1. Verify that the networking (DHCP on or off) decisions outlined in Preparing for Installation on page 1.2.1 have been made. To use DHCP, you must have a visible DHCP server on your network. If you are not planning to use DHCP (i.e., your network does not have a DHCP server), you must obtain an IP address and netmask from your network administrator as well as gateway and nameserver(s) as applicable.

2. From the Front Panel UI, go the Network screen (see Figure 1.11.1 on page 1.11.4).

3. Ensure your network or laptop is connected to the **LAN** connector on the rear of the transmitter (see Web Based AUI Control on page 1.8.8).

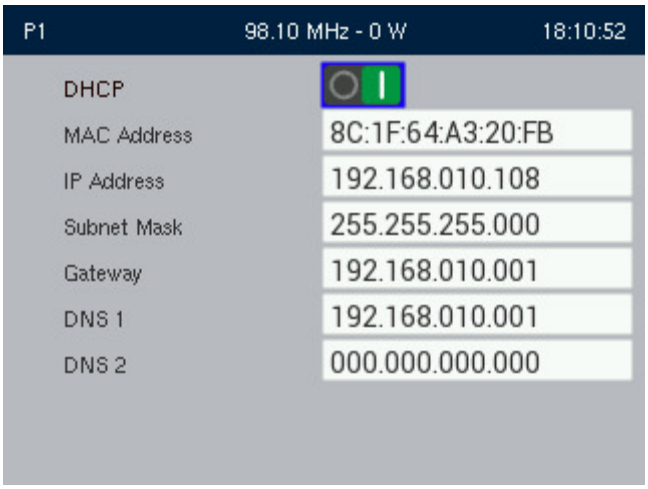
4. If your network has a DHCP server and DHCP is set to **ON** (factory default), IP addresses will be automatically assigned. Verify this has occurred by viewing the **IP Address** and **Netmask** address sub-menus (**Gateway** and **Nameserver** addresses are optional; view as applicable). The **MAC Address** field cannot be modified.

5. If your network does not have a DHCP server or you wish to assign static IP addresses (i.e., direct connection with a laptop), set DHCP to **OFF**. Enter the appropriate addresses in the **IP Address**, **Subnet Mask**, **Default Gateway** and **Default Nameserver** fields, as applicable.

NOTE: *Refer to Settings -> Network section of the Operations and Maintenance Manual for more information.*

6. Once you have established an IP address, you can login to the remote AUI, which allows you to remotely control and monitor the VX transmitter. See the "Operating the Transmitter" section of the Operations and Maintenance Manual for detailed AUI information.

Figure 1.11.1: Network Settings screen



All IP addresses shown are for reference purposes only

MAC Address: Set during factory testing; cannot be modified

DHCP or Static IP: Set to DHCP if your network has a DHCP server. Automatically assigns IP, netmask, gateway and nameservers. Set to Static IP if you do not have a DHCP server or if you wish to assign static addresses.

IP Address: Specify the IP address. Consult with your network administrator.

Gateway: Specify the gateway address. Consult with your network administrator.

Nameserver: Specify a nameserver (or DNS) to enable the use of host names. If no nameserver is entered, only direct IP addresses can be used to configure the email server and any live streams such as Shoutcast.

Preset Audio Setup

The following section describes initial setup and configuration of basic audio parameters in the transmitters preset. You can modify these parameters via the Front Panel UI or remote AUI. For more information refer to the *VX Operation & Maintenance Manual.*

1. Ensure your connected audio source is playing audio. Nautel recommends using a constant amplitude signal that represents your peak program audio.
2. Navigate to the **Meters** menu and identify the respective audio meter for your selected source. Record the reading from the meter. For best performance, the target peak level should be approximately 0 dBu (analog), -4 dBFS (digital), or 3.5 V pp (MPX).

3. Navigate to the **Presets** menu and edit the active preset:
   - Under Audio:
     - Ensure the audio source matches the input you have connected.
     - If you are broadcasting stereo audio, ensure the selected Audio Mode is Stereo. Otherwise choose between Mono L, Mono R, or Mono L+R. Skip this step if using MPX.
     - Adjust the (Digital, Analog, MPX) Level to match the value recorded from the meter in Step 2. This should produce 100% modulation at that signal level. Increase this value if less modulation is desired. Decrease this value if more modulation is desired. Ensure the signal never exceeds +4 dB above this configured level (e.g., if the scaling is set to +2 dBu, ensure peaks never exceed +6 dBu), else clipping and distortion of the signal may occur.
     - For Analog or Digital audio inputs configure pre-emphasis to 50 us or 75 us as desired. If the signal is already pre-emphasized, leave this set to 0 us.
   - Under RDS:
     - Configure Static/Dynamic RDS as desired.
   - Under Other Settings:
     - If pre-emphasis in the previous steps was set to 50 us or 75 us, Nautel strongly recommends enabling the AGC Limiter to prevent over-modulation. The AGC should be set to the desired maximum % modulation, and the time constant can be adjusted between 100 ms and 1 s to adjust the rate of decay of the limiter.
     - If using the Orban Audio Processor, enable it here and select your processor preset.
     - If configuring the Hard Limiter, ensure the level is adequately above your normal modulation to avoid clipping under normal circumstances.
   - Save preset changes.
   - Ensure the desired modulation is achieved. Consider listening to the signal using a test radio to verify audio performance.

Common audio issues and their causes:

- ISSUE: The audio sounds distorted and crackly
  - CAUSE: Most likely clipping due to overdriving the signal in some stage. Try reducing the level into the transmitter or increasing the scaling in the preset.
- ISSUE: The audio sounds dull, 'more bass, less treble'
  - CAUSE: You may need to apply pre-emphasis to overcome de-emphasis in the receiver.
- ISSUE: The audio sounds 'less bass, more treble'
  - CAUSE: You may be applying too much pre-emphasis to an already pre-emphasized signal. Check if the audio is being pre-emphasized upstream of the transmitter by an audio processor. If so, set the pre-emphasis in the transmitter to 0 us.

Turning on the Transmitter

You can also refer to the VX Quick Start Guide Unboxing and First Time Setup videos for additional details to turn on the transmitter.

1. Switch on the ac power at the service entrance to turn on the transmitter.
2. Perform the steps outlined in the VX150 to VX2 Quick Start Guide (found in the shipping box) or the Unboxing and First Time Setup videos (found on the VX Series USB) for details on setting up the initial preset when the transmitter is turned on for the first time.
3. Check the alarm and status indications in the Alarms section on the FPUI. See the VX Operation and Maintenance Manual.
4. Disable remote control (the Remote button on the front panel will be illuminated red).
5. Using the FPUI, select a preset and set to minimum RF output power.
6. Press **RF On**. The **RF On** button will turn green.
7. Increase the power to normal operating levels while monitoring for alarms.
8. Set up or select the desired operating preset. See the VX Operation and Maintenance Manual.
9. Set the correct time and date on the FPUI display. See the VX Operation and Maintenance Manual.

Going On-Air

WARNING! If a jumper is placed between the INTLK inputs on the rear panel of the transmitter, safety features controlled by the external interlocks will be disabled. A fail-safe method of alerting personnel to this fact should be implemented. Voltages which are dangerous to life will be present on the RF output stages and the antenna system if the transmitter is turned on.

IMPORTANT! Before going on the air, if you want the safety interlocks to operate properly, the shorting jumpers installed in Pre-Commissioning Tasks, on page 1.11.2**,** Step 3 **should be removed (if installed).**

1. Turn RF off and remove the jumper from the Interlock connector on the rear panel.
2. Connect the transmitter's RF output to an antenna system (or verify that the current connection is intact).
3. Re-install the jumper in the Interlock connector and turn RF on.
4. Verify audio input levels using the Front Panel UI.
5. Use the Front Panel UI to begin transmitter operations. For detailed instructions, refer to the VX Operation and Maintenance Manual.
   - Set for desired power level.
   - Turn the RF on via the Front Panel UI.

SECTION 1.12: PARTS AND TOOLS

This section describes parts associated with the VX150 to VX2 transmitter, and tools needed during installation and routine operation. Topics include:

- Contacting Nautel
- Parts Supplied by Nautel - see page 1.12.2
- Parts Not Supplied by Nautel - see page 1.12.2
- Parts Ordering - see page 1.12.2
- Module Exchange Program - see page 1.12.3
- Tools for Installation - see page 1.12.3

Contacting Nautel

You can reach Nautel to order parts or for technical assistance at:

Nautel Limited
10089 Peggy's Cove Road
Hackett's Cove, NS Canada B3Z 3J4
Phone: +1.877.628.8353 (Canada/US)
+1.902.823.5100 (International)

Fax: +1.902.823.3183

Email: support@nautel.com

Web: www.nautel.com

Parts Supplied by Nautel

Ancillary Parts Kit

An ancillary parts kit is shipped with the VX150 to VX2. This kit contains items needed during the installation process. The kit includes toroids, screws and miscellaneous hardware.

Documentation

See "VX150 to VX2 Transmitter Manuals" in the "About this Manual" section.

Parts Not Supplied by Nautel

Some parts and materials required to complete installation are not supplied by Nautel. The parts you need vary with the installation requirements. The list of parts you normally provide yourself during installation include:

- A suitable 50 Ω RF output coaxial cable, terminated by the proper connector, complete with center male connector at the transmitter end.
- All external control and monitor wiring, including the associated terminating devices, conduit and conduit clamps.
- All electrical power cables, including conduit, terminating devices, and conduit clamps.
- Special tools, if required (e.g., torque wrench).

Parts Ordering

You can order replacement parts from the Customer Service Department, or directly from Nautel through the Nautel website.

Module Exchange Program

Nautel offers a module exchange program for customers who require expedited servicing and replacement of faulty modules. The module exchange program provides immediate replacement of failed modules with refurbished modules. May not be applicable to all customers.

The replacement module is shipped to the customer as soon as the customer reports the failure. The customer then returns the failed module to Nautel using the same shipping package.

Tools for Installation

The tools you need during transmitter installation include the following:

Digital voltmeter (recommend 1000 V, CAT-III rating)

- Phillips screwdrivers, sizes #1 and #2
- Flathead screwdriver (3/16”) for ac connections
- small Flathead screwdriver (3/32”) for Interlock connection
- torque wrench, capable of 15 in-lbs (1.7 N-m)
- Pliers, needle-nose and lineman
- Wire cutters/strippers
- 8 mm nut driver, socket or wrench for station ground
- Electrician’s knife

SECTION 1.13: PRE-INSTALLATION / INSTALLATION ASSISTANCE

Nautel provides a number of support options to help you during pre-installation/installation planning and preparation:

- Pre-Installation Consulting
- Installation and Commissioning Service
- Online Documentation - see page 1.13.2
- On-Site Support - see page 1.13.3
- Training - see page 1.13.3
- Standard Warranty - see page 1.13.4
- Extended Warranties - see page 1.13.7

Pre-Installation Consulting

Nautel field support specialists are available to answer questions and work with you to ensure that your site will be ready for the installation of your VX150 to VX2 transmitter. For support, contact Nautel Customer Service and request assistance (On-Site Support, on page 1.13.3).

Installation and Commissioning Service

Nautel offers an installation and commissioning service to customers who want assistance with configuring and commissioning a new Nautel transmitter. After the customer completes the transmitter assembly and installation, Nautel technical personnel will spend up to three days on-site to help make the ac power, RF and remote connections, and to assist with the configuration and testing of Nautel equipment.

The customer is responsible for ensuring that the following stages of installation have been completed, prior to the arrival of Nautel personnel:

- Ac power wiring for the transmitter has been installed and connected at the transmitter and at the breaker panel or the building's service entrance.
- The customer has prepared the RF coaxial cable – used to connect the transmitter to the antenna – and installed the required connector. The customer has also installed the RF coaxial cable in place and connected it to the antenna, while leaving the transmitter end of the cable unconnected.

- Where required, all remote control and monitoring cables have been installed and connected to the station equipment (e.g., modulation monitor, frequency monitor, and power meter).
- The site has been made ready for the equipment, and adequate protection against lightning and lightning-induced transients has been provided.
- The transmitter has been unpacked, closely checked for any damage caused by shipping, and then assembled.
- The following test equipment has been made available at the site:
  - Two-channel oscilloscope (with probes)
  - Audio signal generator
  - Distortion analyzer
  - Spectrum analyzer
  - Modulation monitor
  - Frequency counter
  - 50 Ω test load (rated for 150% of carrier power, VSWR less than 1.1:1)

Nautel's service representative takes full responsibility for commissioning the transmitter, validating all external interfaces (i.e., the ac supply, RF output, remote control and monitoring equipment) and checking out the equipment prior to activation. The service representative turns on the transmitter, performs all adjustments and set-up procedures, and carries out proof of performance tests at the site. These tests ensure that the transmitter is operating normally in compliance with its specifications. The service representative also provides a demonstration and a short explanation of the operation of the transmitter. Finally, the customer signs an Acceptance of Installation Certificate that provides feedback to Nautel regarding the commissioning service.

Online Documentation

Nautel provides documentation online to customers, letting you familiarize yourself with specifications, operation, maintenance and troubleshooting prior to the delivery of your equipment.

- Documentation is provided standard on USB and delivered with the transmitter.

On-Site Support

If you require on-site assistance, Nautel's field support specialists can help you prepare your site and ensure that your VX150 to VX2 transmitter installation can proceed as quickly as possible. For more information about on-site support, including scheduling and pricing, contact Nautel Customer Service:

- Telephone: +1.902.823.5100
- Fax: +1.902.823.3183
- Email: support@nautel.com

After business hours (Atlantic time or Eastern time in North America), requests sent by fax or email will be acknowledged within one working day.

Training

Nautel's SBE-certified broadcast training programs satisfy your day-to-day knowledge requirements. Students participating in Nautel's broadcast transmitter or RF basics training programs earn one SBE credit for each completed day of training.

Nautel's comprehensive selection of training programs will help customer staff develop valuable skill sets, reduce downtime, and make the most of the customer's technology investment.

Nautel training programs are made up of individual modules that can be 'mixed and matched' to meet the customer's specific training needs. All Nautel training courses are available at the Nautel Training Centre. Training can also be provided at the customer's facility, and training the customer's technical staff on the customer's transmitter.

All training courses at the Nautel Training Centre combine classroom and hands-on laboratory work to ensure a balanced learning experience.

Nautel training courses feature:

- Limited class sizes to ensure maximum student participation and access to equipment
- Emphasis on need-to-know, day-to-day knowledge
- Labs that focus on the tasks most often performed at the transmitter site

Many of our classes also include diagnostic lab exercises.

Standard Warranty

Nautel guarantees all mechanical and electrical parts of Nautel Transmitters for a period of forty-eight months, and all other Nautel manufactured equipment (including Importers and Exporters) for a period of twelve months from date of shipment, provided the equipment has been installed, operated and maintained in accordance with Nautel's recommendations, and the equipment has not been misused, neglected or modified. Nautel's liability is limited, at the absolute discretion of Nautel, to repairing or replacing returned equipment that to the satisfaction of Nautel has been found defective.

Warranty for third-party items is provided by the Original Equipment Manufacturer. Exercise of such warranty shall be between the Buyer and the Third-Party.

1. Properly qualified technical personnel must install, maintain, and repair the equipment in accordance with Nautel recommendations and good engineering practice.
2. A "Part Failure" shall be deemed to have occurred when the part has become defective, or does not have the characteristics required for the specified equipment performance:
   a. when the equipment is operated within the design parameters, and
   b. when the equipment is installed and adjusted according to Nautel's prescribed procedures as stated in the instruction manual.
3. Nautel shall provide replacements for all "Parts" to the Buyer when they become defective during the warranty period, and upon the return of the defective part. Replacement parts warranty to be 90 days or end of original warranty; which ever comes first.
4. If the Buyer receives a replacement module, as part of Nautel's module exchange program, the old module must be returned to Nautel within 30 days of receipt of the new module, at the buyers expense. If the old module is not received after 30 days, the customer will be invoiced. The buyer is responsible for installing the replacement/repaired module in the transmitter.
5. In the event that a "Part" fails during the warranty period and causes damage to a subassembly which cannot be readily repaired in the field, the entire subassembly so damaged may be returned to Nautel for repair. The repairs will be made without charge to the Buyer.
6. Written authorization must be obtained before returning any equipment or goods for any reason. Equipment or goods returned under this warranty shall be delivered to Nautel's premises at the Buyer's expense. Where no-charge warranty replacements or repairs are provided under items 2, 3, 4, or 5, Nautel will pay that part of the shipping costs incurred in returning the part/assembly to the Buyer. Note: the Buyer is responsible for any and all import fees, duties or taxes.

7. Nautel does not warrant or guarantee, and will not be liable for:
   a. defects or failures caused in whole or in part by abuse, misuse, unauthorized repair attempts, unauthorized alteration or modification of the equipment;
   b. equipment built to customer specifications that is later found not to meet customer needs or expectation;
   c. performance of equipment when it is used in combination with other equipment not purchased, specified, or approved by Nautel;
   d. damages and performance limitations due to outside forces such as lightning, excessive heat or cold, excessive ac surges or high corrosive environments;
   e. changes made by personnel other than Nautel authorized personnel, including charges incurred; and
   f. for any costs for labor performed by the customer without Nautel's prior written approval.

8. Nautel does not warrant that software:
   a. is free or errors, bugs or defects;
   b. will be compatible with third party software;
   c. results, output or data provided through or generated by the software are accurate, complete, or reliable; and
   d. errors found will be corrected.

9. Nautel shall have the right and shall be provided full access to investigate whether failures have been caused by factors beyond its control.

10. In no event shall Nautel be liable for any consequential damages arising from the use of this equipment.

11. This warranty is in lieu of all other express warranties of Nautel, whether express or implied, and Nautel does not assume, nor is any other person authorized to assume on Nautel's behalf, any other obligation or liability.

12. Third party items ordered, the guarantee/warranty of these items will be from the manufacturer of these items. Exercise of such warranty shall be between the Buyer and the third party provider.

13. Nautel provides telephone and email support for its products for the life of the product at no charge. After the warranty period, parts and on-site support for the equipment are offered at a rate to be determined upon request.

Technical Assistance

Nautel's field service department provides telephone technical assistance on a 24 hour, seven days a week basis. Requests by other media (fax or e-mail) will be responded to the next working day if received after Nautel's normal working hours. Contact the appropriate field service centre:

Nautel Limited
10089 Peggy's Cove Road
Hackett's Cove, NS Canada B3Z 3J4
Phone: +1.902.823.3900 or
Toll Free: +1.877.6NAUTEL (6628835) (Canada & USA only)
Fax: +1.902.823.3183

Nautel Inc.
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Bangor, Maine USA 04401
Phone: +1.207.947.8200
Fax: +1.207.947.3693

Customer Service (24 hour support)
+1.877.628.8353 (Canada & USA only)

+1.902.823.5100 (International)

Email: support@nautel.com
Web: www.nautel.com

Module Exchange Service

In order to provide Nautel customers with a fast and efficient service in the event of a problem, Nautel provides - for North American customers only - a factory rebuilt, module exchange service which takes full advantage of the high degree of module redundancy in Nautel equipment. May not be applicable to all customers.

For complete details on this service, see http://support.nautel.com/policies/repairs-exchange/

Extended Warranties

Nautel's standard four-year warranty provides excellent coverage and satisfies most customers' needs. However, if you want extended coverage, Nautel offers one and two-year Extended Warranty Plans to cover electrical and mechanical repairs or replacements for all Nautel equipment.

Coverage

The Extended Warranty Plan includes:

- A module exchange program for many common modules and circuit boards (North America only)
- Toll-free hotline (North America only)
- Necessary labor performed by Nautel authorized personnel to repair the product back to factory specifications
- Necessary components
- Modifications to correct performance problems
- Shipping of modules/circuit boards to customer

Details

Extended Warranty Plans must be purchased prior to the expiration of original four-year warranty.

One-year Extended Warranty Plans add an additional year (12 months) of coverage after the end of the customer's standard four-year warranty. The two-year plan adds an additional two years (24 months).

Only repairs done at Nautel's facilities or by Nautel authorized personnel will be covered by the Extended Warranty Plans.

You must ship faulty products back to Nautel, prepaid, and in the original package or in a package that provides equivalent protection.

Nautel can choose to repair or replace equipment.

Purchasing a One or Two-Year Extended Warranty Plan

If the transmitter is still covered by its original four-year warranty period, you can contact Nautel by telephone, fax, mail, or email with the model number, serial number and date of purchase.

Once you purchase a Nautel Extended Warranty Plan, you receive an extended warranty plan certificate, plan number, and a toll-free number (North America only) to call for any service-related issues.

Using the Extended Warranty Plan

Contact Nautel's Canadian or U.S. service facility by phone, fax, or email as soon as a problem occurs. The following will be required when contacting Nautel:

- Extended warranty plan number
- Product model number
- Serial number
- Brief description of the problem

If Nautel’s service technicians are unable to solve the problem over the telephone, Nautel will give you an RMA number. You then return the module or circuit board to a Nautel service facility so that Nautel can provide a replacement. Do not ship a component back to Nautel until you have an RMA number.

SECTION 1.14: LIST OF TERMS

This section defines some of the terms that are used in Nautel documentation.

AES/EBU. Audio Engineering Society/European Broadcasting Union (AES/EBU) is the name of a digital audio transfer standard. The AES/EBU digital interface is usually implemented using 3-pin XLR connectors (the same type connector used in professional micros). One cable carries both left-channel and right-channel audio data to the receiving device.

Cutback. A reduction in RF output power, caused by the occurrence of multiple shutbacks within a pre-defined period.

DHCP. Dynamic Host Carrier Protocol.

DSP. Digital Signal Processing.

EEPROM. Electrically Erasable Programmable Read-Only Memory.

Foldback. A reduction in RF output power, caused by adverse load conditions (high VSWR). No shutbacks or cutbacks have occurred.

FPUI. The Front Panel User Interface is the transmitter's front panel display that allows for extensive local control and monitoring of the transmitter.

LED. Light Emitting Diode (also referred to as lamp).

LVPS. Low Voltage Power Supply. A module or modules used in the ac-dc power stage that generates the low level dc supply voltage for the transmitter.

Preset. A setting that controls power level, frequency and audio parameters. The VX150 to VX2 allows you to pre-program multiple presets.

PWB. Printed Wiring Board.

Remote AUI. The Remote AUI allows for extensive remote control and monitoring of the transmitter.

Shutback. A complete, but temporary loss of RF output power, caused by any one of a variety of faults, including high VSWR.

Shutdown. A complete and permanent loss of RF output power. Typically follows repeated cutback, foldback or shutback events.

Surge protection panel. An electrical panel that protects equipment from electrical surges in the ac power supply, antenna or site ground caused by lightning strikes.

VSWR. Voltage standing wave ratio. This is an expression of the ratio of reverse voltage to forward voltage on the feedline and antenna system. An ideal VSWR of 1:1 provides maximum transmitter-antenna efficiency.

VX150 TO VX2 INSTALLATION MANUAL

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