NX100 Transmitter

Installation Manual

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The comparisons and other information provided in this document have been prepared in good faith based on publicly available information. The reader is encouraged to consult the respective manufacturer's most recent published data for verification.

Contents

Release control record

Issue	Date	Reason
3.0	2012-11-01	Release 3 of product (NARA52B)
3.1	2016-02-08	Section 9, sub-paragraph Turning on the Transmitter: improved and added various steps. Section 9, sub-paragraph Modulation Checks: added NOTE after step 4 to maintain positive and negative modulation peaks within specification.
3.2	2017-03-31	Section 2: improved and added various steps. Section 3: added clarification about phase connections and taps on transformer windings. Section 6: updated Table 6.1.

Section 1: Preparing for installation

Before installing your NX100 transmitter, perform the following steps:

1. Ensure that you have performed the pre-installation tasks described in the *NX100 Pre-installation Manual*.

2. Make sure that you received all the components. (Check your packing list.)

3. Inspect all crates and packages for damage.

4. Report any damage immediately to your Nautel sales representative and the carrier.

5. Move the crates as close as possible to the transmitter's planned location.

6. Unpack the crates in accordance with the instructions provided on the outside of the crates.

   - For each crate, remove the panel labelled **open this side**. The panel is attached using Philips head screws.

   - Remove any visible packing material, including braces, from the crate's interior.

7. Review any assembly notes or instructions contained inside the transmitter crates. (For sites requiring custom configurations, the instructions provided with the transmitter replace the instructions provided here.)

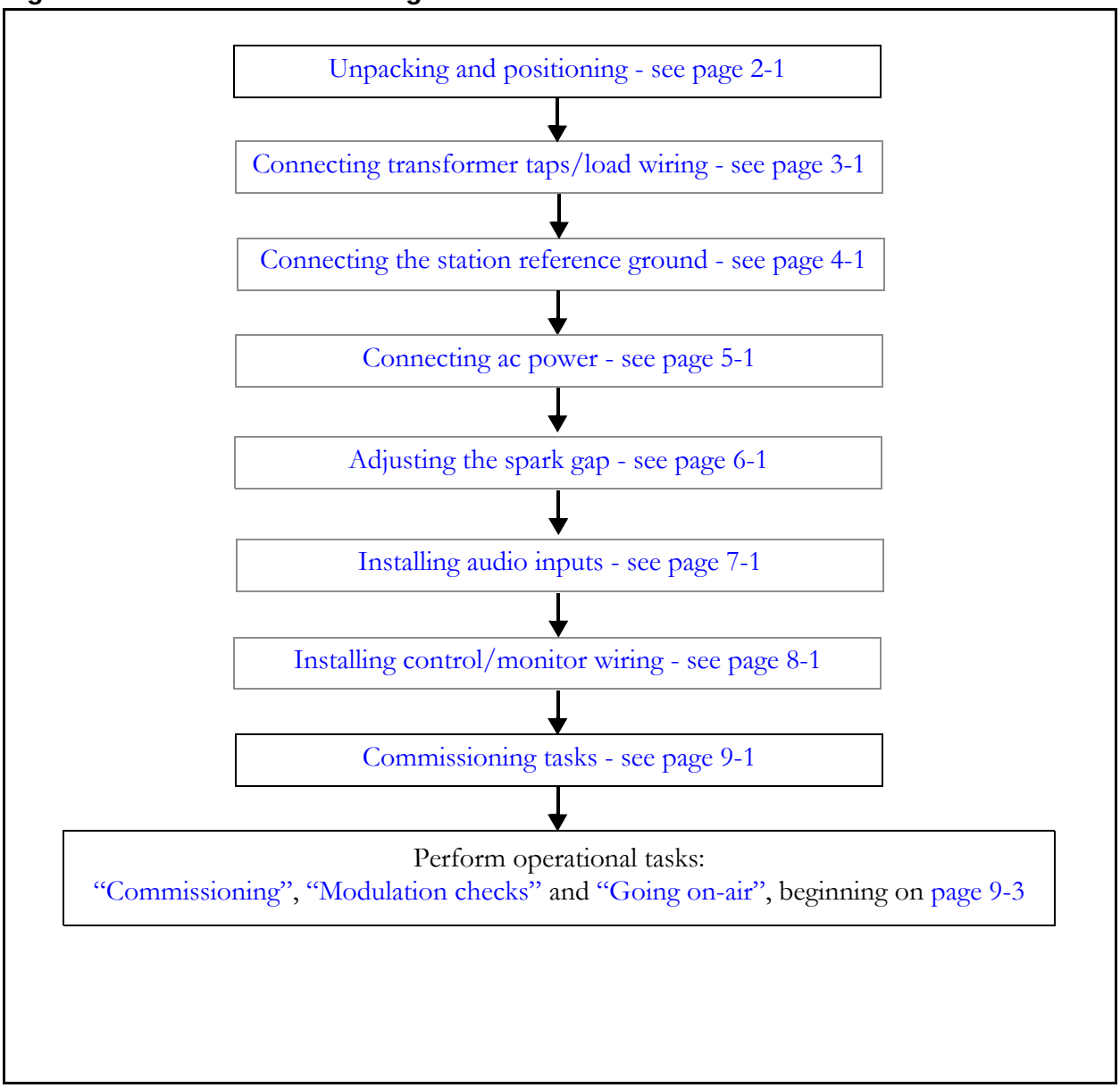
8. Gather the parts and tools you will need for installation. For a list of required tools, see "Parts and tools" on page 10-1.

9. When you are ready to install the NX100 transmitter, follow the steps shown in Figure 1.1 on page 1-2.

TIP	When you have completed a task or step, put a check mark beside the step number.

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

Figure 1.1: Flowchart - Installing the transmitter



Section 2: Unpacking and positioning

To install an NX100 transmitter, perform the following tasks:

1. Lift and slide the transmitter cabinets off the base of their crates. The NX100 contains two main crates - a control cabinet and a transformer cabinet. Crated and uncrated cabinet weights are shown in Table 2.1. An additional crate, which contains the ac safety interlock switch, may be provided.

Table 2.1: NX100 Cabinet Weights

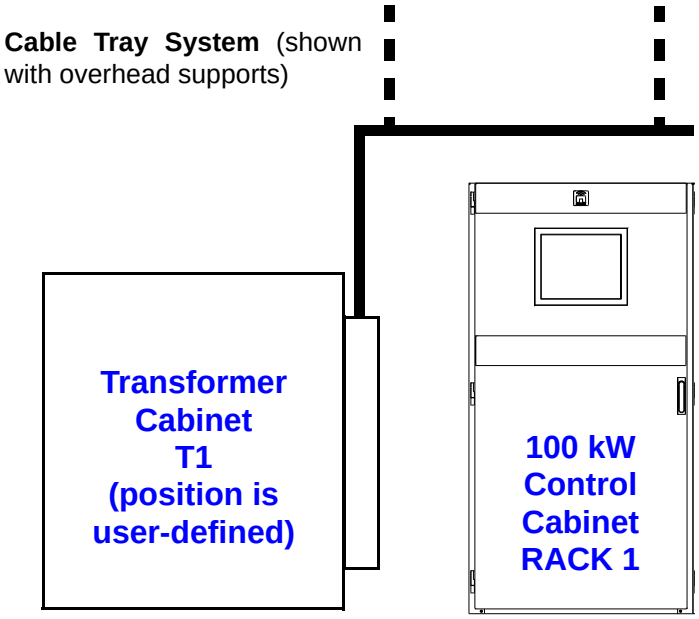
Cabinet	Crated Weight kg (lbs)	Uncrated Weight kg (lbs)
Control Cabinet	687 (1515)	567 (1250)
Transformer Cabinet	845 (1863)	753 (1659)
Ac Power Disconnect Switch	TBA (TBA)	TBA (TBA)

WARNING:
DO NOT MOVE THE TRANSFORMER CABINET UNLESS SUFFICIENT MANPOWER OR MECHANICAL ASSISTANCE IS AVAILABLE TO MOVE IT INTO POSITION WITHOUT DAMAGING THE CABINET OR CAUSING INJURY TO PERSONNEL.

2. Using necessary mechanical assistance (forklift, etc), position the two cabinets in their final location.See Figure 2.1 on page 2-2 for cabinet layout.

Note:
The position of the transformer cabinet can be determined by the user. The cabinet's location should accommodate input wiring from the ac power source (or ac power disconnect switch), output wiring to each of the transmitter cabinets, as well as a cable carrying system to support the output wiring.

Figure 2.1: NX100 Cabinet Layout



3. Verify that the ac power cable from the ac power disconnect switch reaches the entry point in the power transformer cabinet.

4. Cover the top of the transmitter, using a plastic sheet or suitable equivalent, to prevent debris and hardware from falling into the transmitter. Keep the sheet on the transmitter until Section 9, "Commissioning tasks".

5. The transmitter is factory configured for open loop cooling however, if you are using the optional closed air cooling configuration (see the NX100 Pre-Installation Manual for details), follow the installation steps below:

   - Obtain the cover plate (Nautel Part # 207-8211) packed with the NX100 ancillaries.
   - Remove the nine (9) M4 screws that secure the filter brackets to the rear door and remove the air filter and brackets (see Figure 2.2 on page 2-5).
   - Install the cover plate using the screws from the previous step in place of the removed brackets.
   - Remove the top cover plate (see Figure 2.2 on page 2-5) to uncover the intake grill necessary for the ducted incoming air.

6. Install the antenna ground switch on top of the transmitter cabinet as follows:

   - Locate the antenna ground switch (Nautel Part # 207-8320-04) that was packed with the ancillary crate for shipping.
   - Open the front door of the transmitter and unlock and open the filter door to gain access to the inside of the transmitter cabinet.
   - Remove any protective wrapping from the antenna ground switch and position it on top of the transmitter cabinet, noting proper orientation and that the aluminum rod protruding from the bottom of the antenna ground switch must pass through a clearance hole in the transmitter cabinet (see Figure 2.3 on page 2-6).
   - See Figure 2.3 on page 2-6. Temporarily remove the right-hand side cover (as viewed from the front) from the antenna ground switch, to allow access to the securing hardware. Using the hardware provided with the transmitter, secure the antenna ground switch to the top of the cabinet using 12 sets of M10 hardware (dome head bolt, split washer, flat washer, nut and acorn nut). Secure the aluminum rod to the output plate using an M10 button-head cap-screw, split washer and flat washer. Ensure hardware is tight.

7. Install the RF output connector, which was partially disassembled for shipment, on top of the antenna ground switch installed in Step 6. Re-install the antenna ground switch's right-hand side cover.

8. Close and lock the filter panel. Close the front door of the transmitter. Continue with transmitter installation.

9. Verify that the RF feed cable reaches the RF output connector on top of the control cabinet.

10. Open the rear door. Locate the arc detector assembly (A71) on the right-hand interior wall, near the low voltage power supplies (see Figure 2.4 on page 2-7). Remove the packing material that has been used to protect it from vibration damage during shipping. Close the rear door.

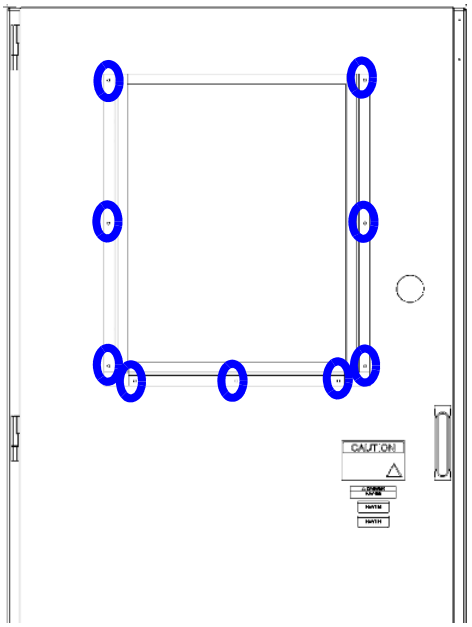
WARNING:
TAKE SPECIAL CARE WHEN HANDLING THE UV SENSOR WHILE REMOVING THE PACKING MATERIAL SO IT DOES NOT RECEIVE IMPACT SHOCK. DO NOT ALLOW SKIN CONTACT WITH THE GLASS FACE. WEAR CLEAN GLOVES TO ENSURE NO OILS FROM YOUR SKIN CONTACT THE SURFACE OF THE GLASS.

11. Obtain four stiffener brackets [Nautel Part # 207-8296 (qty 1), 207-8296-01 (qty 1) and 207-8296-02 (qty 2)] for each transmitter cabinet from the ancillary kit. Install them on the top of each cabinet as shown in Figure 2.5 on page 2-8. Use the existing hardware that secures the exhaust duct's grill to secure the stiffener brackets. These brackets provide additional mechanical strength to the top of the cabinet(s).

12. Locate the cable tray parts kit that was provided to support the cables that will connect ac power between the ac power disconnect switch and the primary for the power transformer, and also between the secondary of the power transformer and the transmitter cabinets. These parts may have been provided by Nautel (Cable Tray Parts List # 207-8385-**) or purchased from an alternate vendor. Install the cable tray system according to your transmitter system dimensions. If the cable tray kit was purchased from Nautel, refer to Section 5 - Electrical Requirements of the *NX100 Pre-installation Manual* for standard drawings and parts lists or to the provided system manual for custom drawings and parts lists - to aid in the installation.

Figure 2.2: Installing Rear Plate and Removing Top Cover Plate - Closed Air Cooling

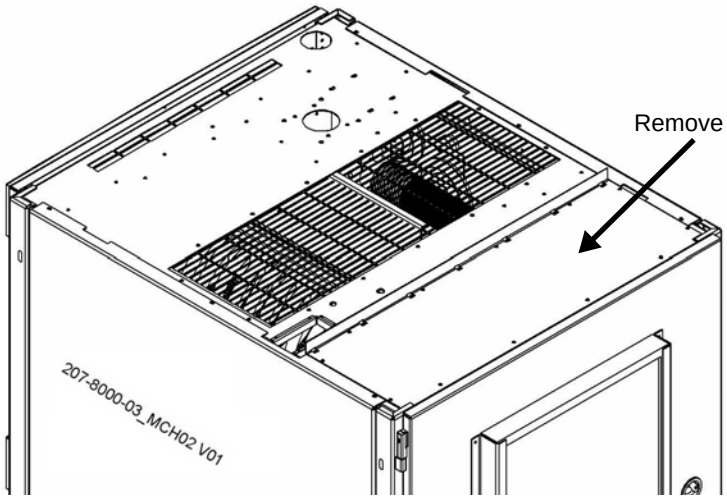
Partial Rear View



Remove the 9 M4 screws that secure the filter bracket.

Use same holes and hardware to install cover plate.

Partial Top View



Remove top cover plate.

Figure 2.3: Installing Antenna Ground Switch

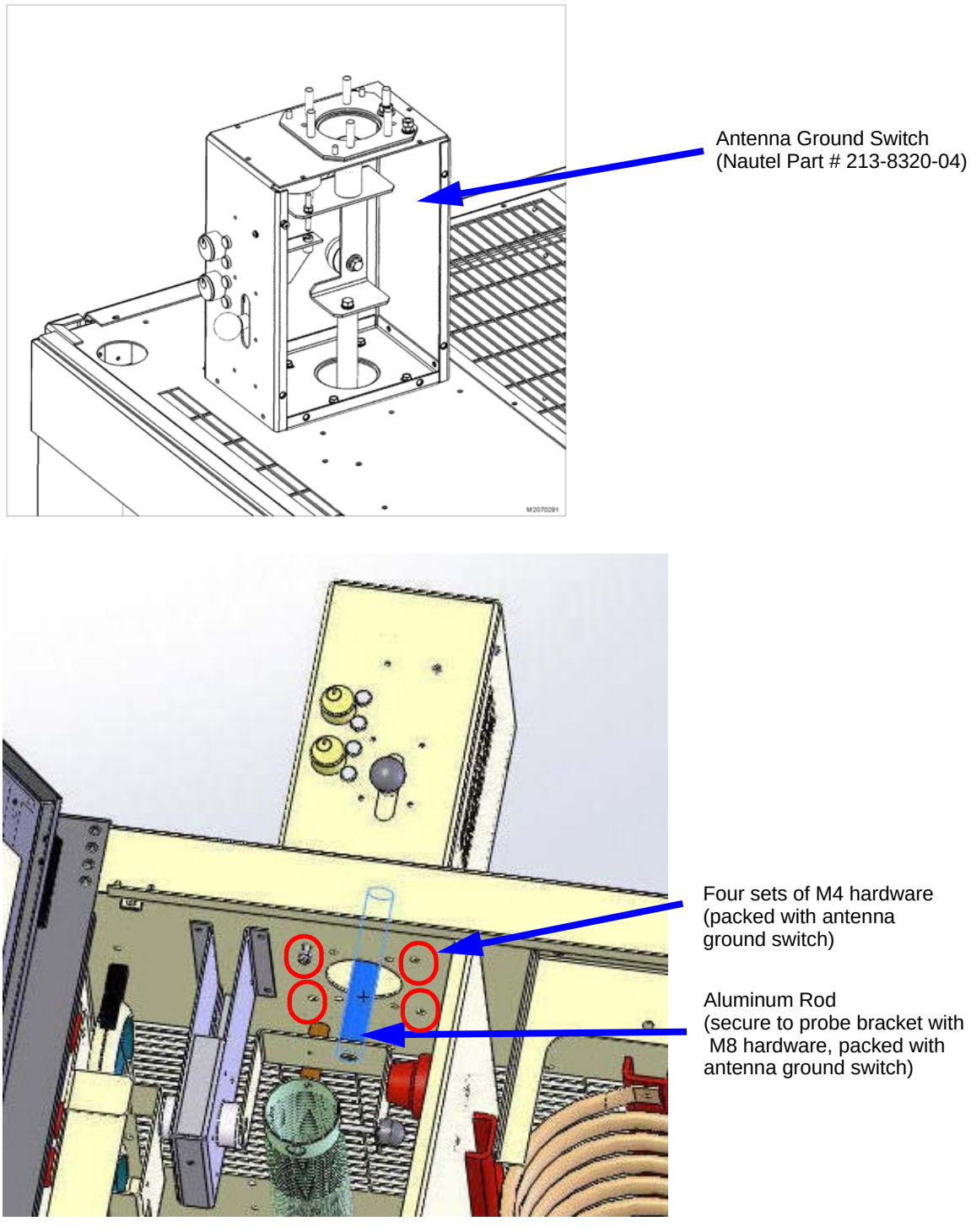
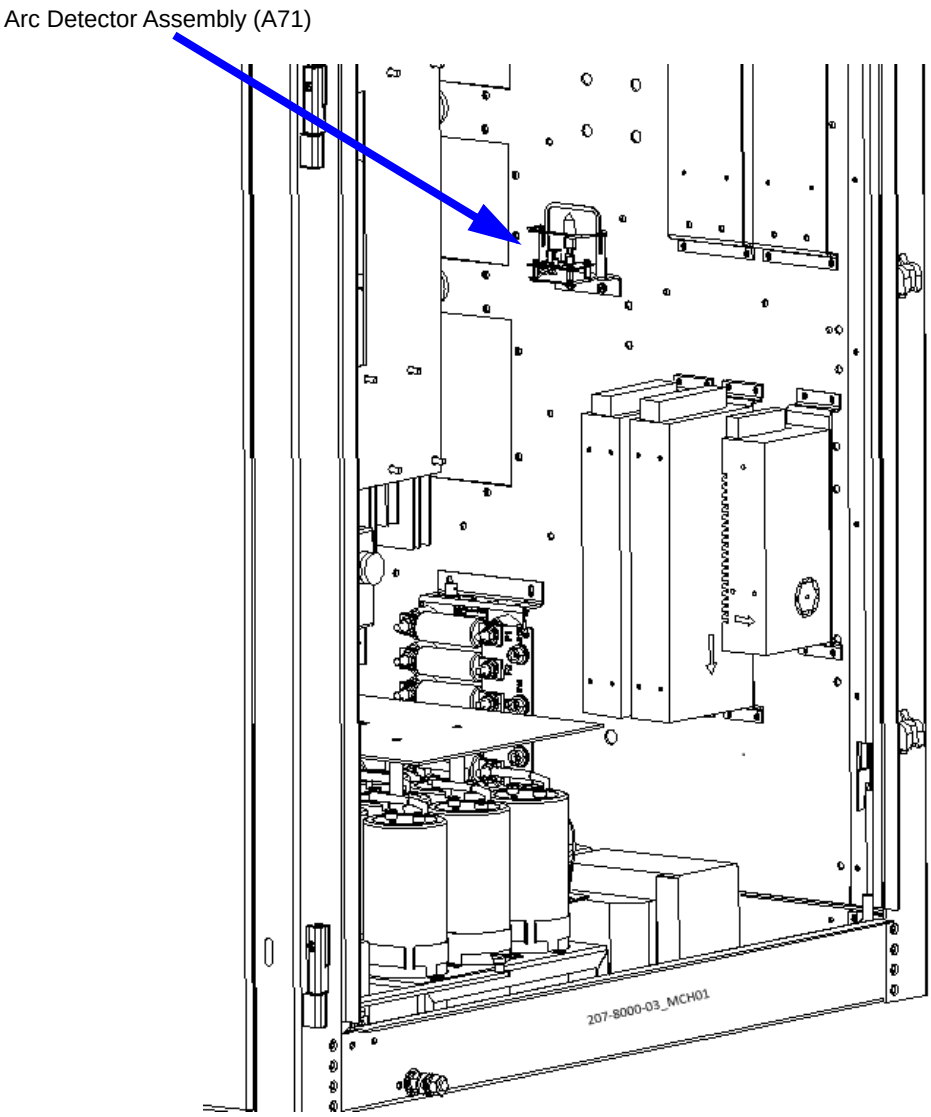
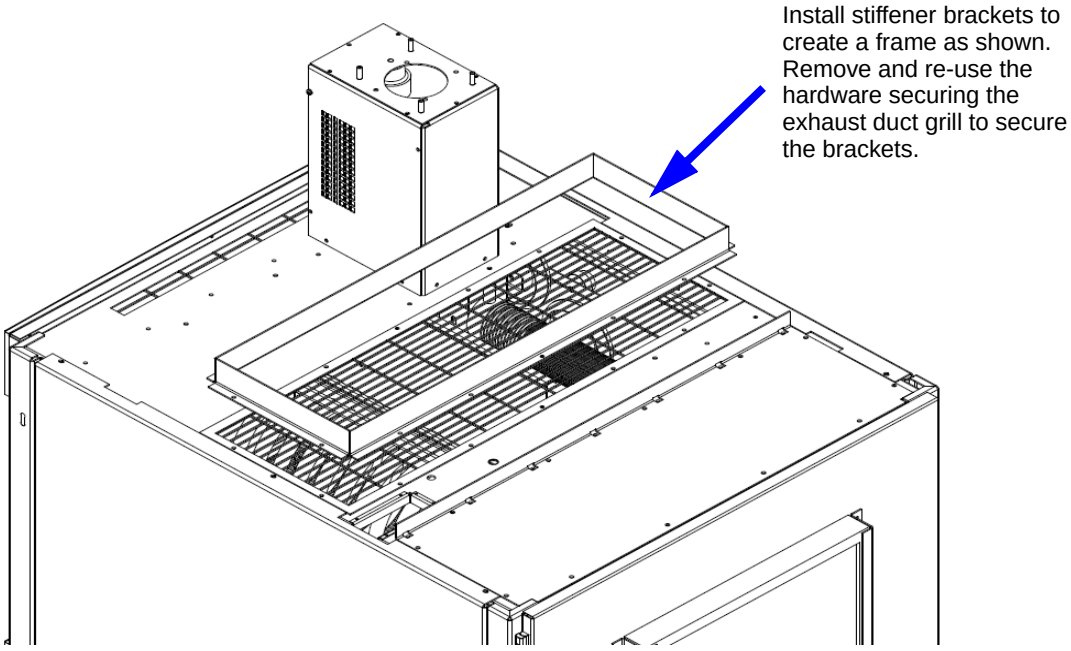


Figure 2.4: Location of Arc Detector Assembly



Partial Rear View; Rear Door Removed for Clarity

Figure 2.5: Installing Stiffener Brackets



Single-cabinet transmitter shown. For multi-cabinet transmitters, repeat installation for each cabinet.

Section 3: Connecting transformer taps/ load wiring

1. Before connecting ac wiring to the transformer, set the line voltage tap selections. Based on your line to line voltage under full load, select the appropriate tap position identified on the labels mounted on the terminal board end of the transformer. One label identifies the tap number and the line-to-line voltage. Another label identifies the tap. All phase connections must be set to the same tap (see Figure 3.1 on page 3-2 and Table 3.1). If necessary, use the hardware already on each of the three phase connections to connect them to the new tap positions, noting that the end of each phase connection consists of four copper straps (see Figure 3.2 on page 3-2). Ensure the four copper straps for each phase are evenly split (i.e., two on top of loop, two on bottom), and secured to both sides of the tap. Be sure to scrape any excess epoxy off the electrical joint area.

> ***Note***:
> *It is important to choose the correct tap based on the loaded line-to-line voltage (i.e., the line voltage present when the NX100 is operating at full power and full modulation) for maximum peak modulation capability and maximum efficiency. If the loaded line-to-line voltage falls between two tap settings, choose the higher voltage tap (this will maximize the NX100's power factor).*

Table 3.1: Three-phase primary winding tap nominal voltages (rms, phase-to-phase)

Voltage (V ac)	Tap
340	6
360	5
380	4
400	3
420	2
440	1

2. Remove the back cover from the transformer cabinet.

Figure 3.1: NX100 power transformer line voltage tap layout

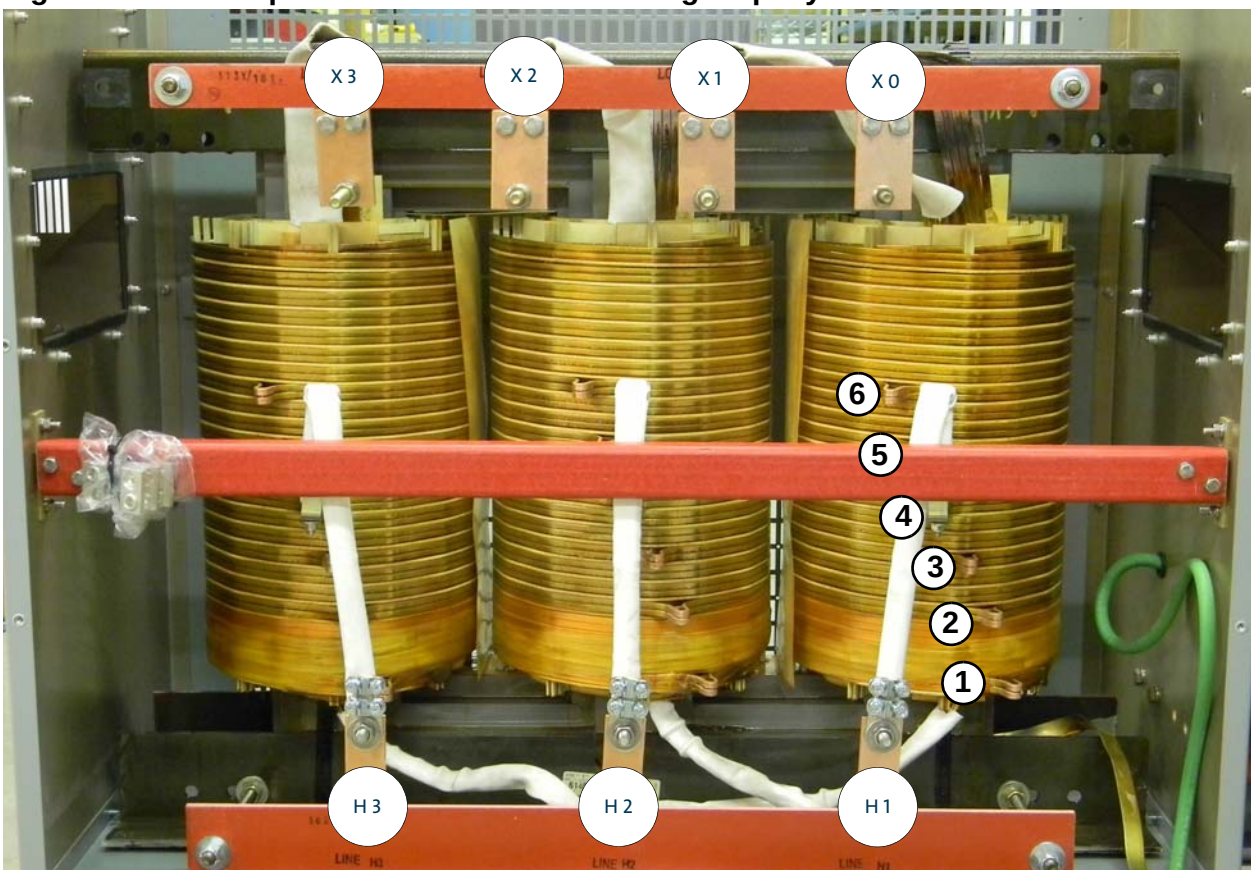
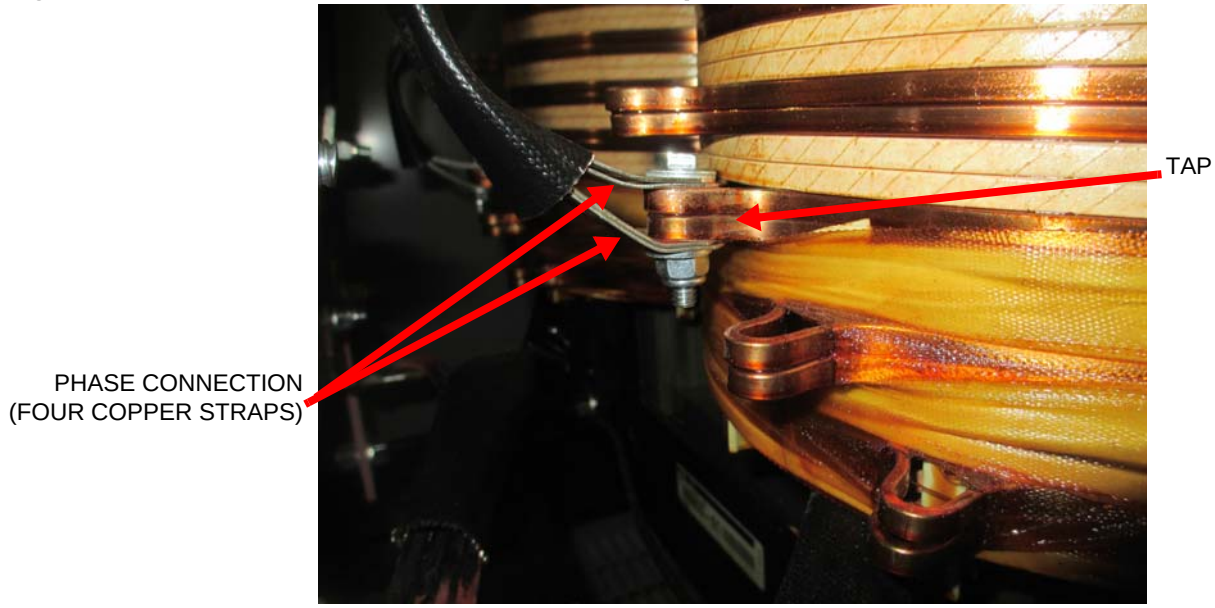


Figure 3.2: Phase connection to transformer tap



3. Locate or obtain the wiring to make the four-wire electrical connections between the transformer and the main cabinet. This wiring may be supplied by Nautel and packed in the main cabinet or packed in the ancillary crate. If it is not provided by Nautel, it must be obtained by the user. In this case, select the wiring based on the recommendations in the Electrical Requirements section of the *NX100 Pre-installation Manual*.

4. Route the larger wires (for each of the three phases) in Step 3 from the back of the transformer to the top of the main cabinet, down through its ac cable duct, to the ac terminals (see Figure 3.3 on page 3-4). Connect the three-phase wires between the X1, X2 and X3 terminals on the power transformer (see Figure 3.1 on page 3-2) and the AC1, AC2 and AC3 terminals in the main cabinet, respectively.

WARNING: DO NOT CONNECT THE X0 TERMINAL OF THE POWER TRANSFORMER TO GROUND. CONNECT AS DETAILED IN STEP 6.

5. Remove the lexan cover over the ac terminals (see Figure 3.3 on page 3-4).

6. Route the smaller wire (for neutral) in Step 3 from the back of the transformer cabinet to the top of the main cabinet, down through the ac cable duct, to the standoff terminal labeled Xo (see Figure 3.3 on page 3-4). Connect this wire between the Xo terminal of the power transformer (see Figure 3.1 on page 3-2) and the Xo terminal in the main cabinet.

7. Re-install the lexan cover removed in Step 5.

8. Leave the main cabinet's back door open to allow for station reference ground connection in Section 4, "Connecting the station reference ground" on page 4-1.

9. Leave the transformer cabinet's back cover off to allow for ac power connection in Section 5, "Connecting ac power" on page 5-1.

Figure 3.3: NX100 Ac Power Connections to Cabinet

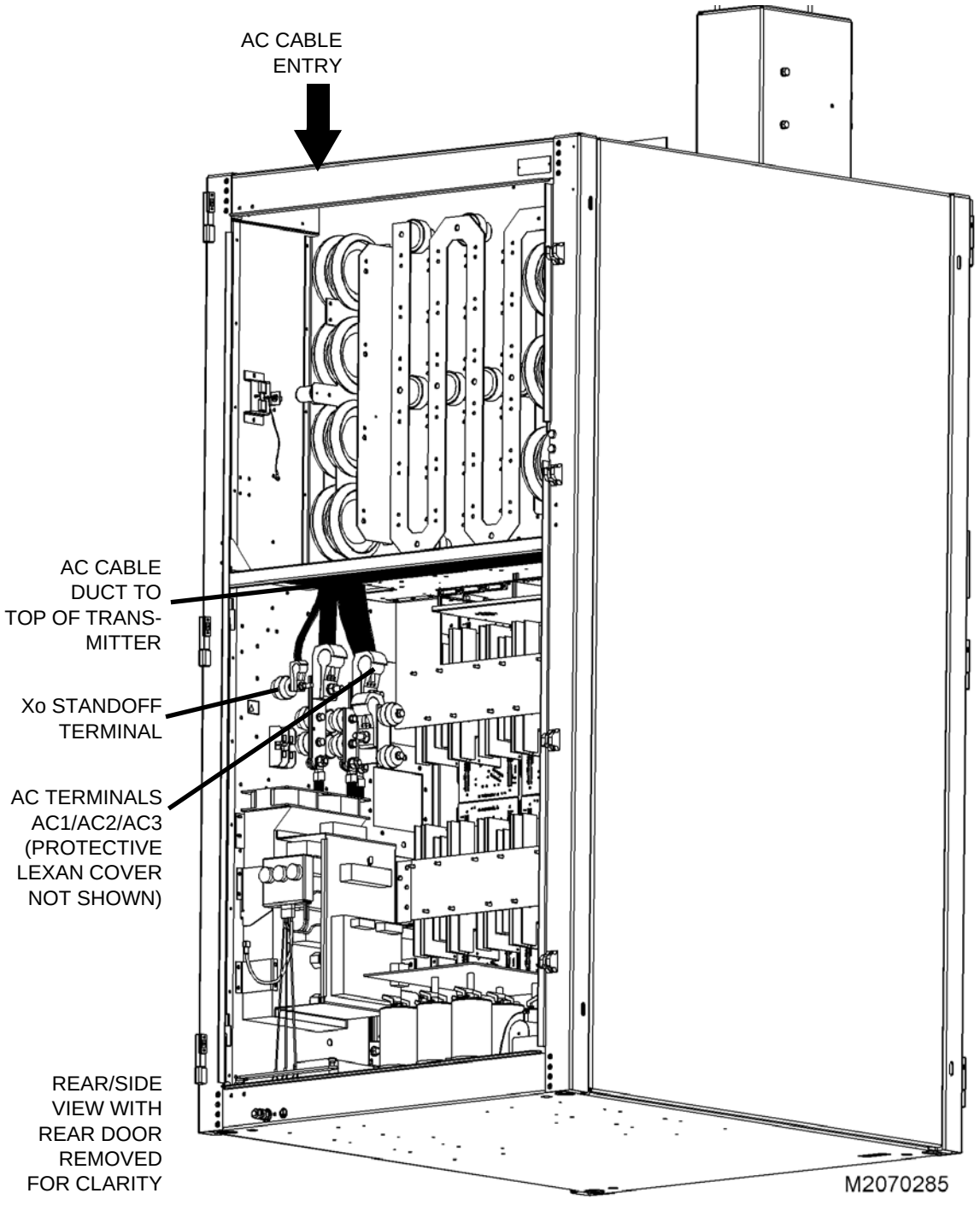
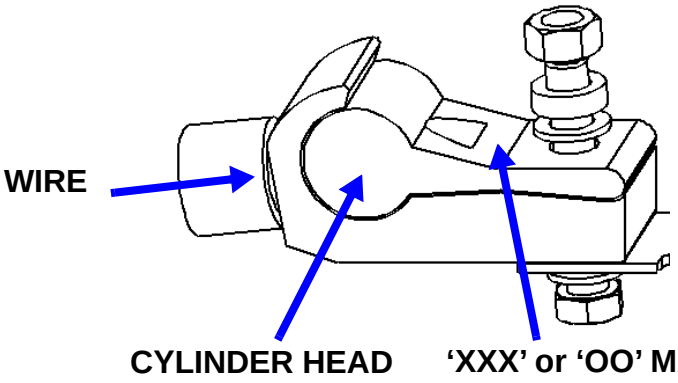


Figure 3.4: Installing Cytolok Cable Connectors



TWO SIZES USED:

Nautel Part # JA92 for 1/0 AWG wire
Nautel Part # JA93 for 535 MCM wire
(NOTE: JA93 can be used for 500-600 MCM)

Cytoloks connectors can be found in the ancillary kit.

INSTALLATION INSTRUCTIONS:

1. Select the proper connector for the wire/cable being used (see size options above).

2. Use the Easy Gauge supplied with each Cytolok connector to establish the insulation strip length (see both types below).

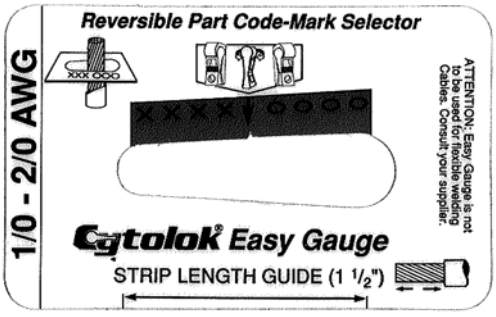
3. Insert the stripped cable end into the gauge's largest end. Move the cable until it contacts the gauge on both sides. The gauge will indicate either "XXXX" or "OOOO"

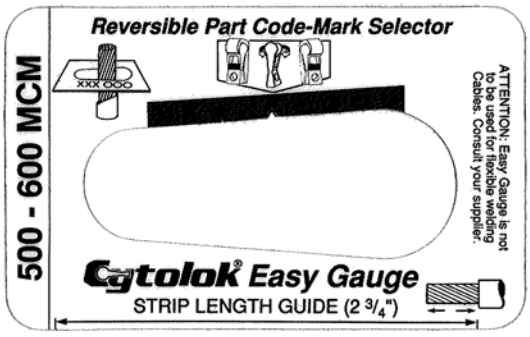
4. Insert the cylindrical head into the hooked shaped part with the "XXX" or "OO" visible, as determined in step 3.

5. With the bore in the two connector pieces lined up, insert the cable until into the opening until it reaches the end of the cylindrical component.

6. Attach Cytolok connector to its securing stud. Use a standard wrench (torque wrench not required), tighten the connector until both of its metal pieces are in contact. Tighten an additional 1/4 to 1/2 turn to assure complete closure.

7. Due to the spring action of the connector, Belleville and spring washers are not required.





Section 4: Connecting the station reference ground

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

Note:
Proper grounding configuration is critical for protecting transmitter circuitry from lightning strikes. See the Electrical Requirements section of the *NX100 Pre-Installation Manual* or the *Recommendations for Transmitter Site Preparation Manual* for information on proper grounding and lightning protection recommendation. Failure to follow these guidelines may void your warranty.

1. Locate the safety ground stud assembly for the output cabinet. It has been set back in its final location at the bottom left rear of the cabinet.

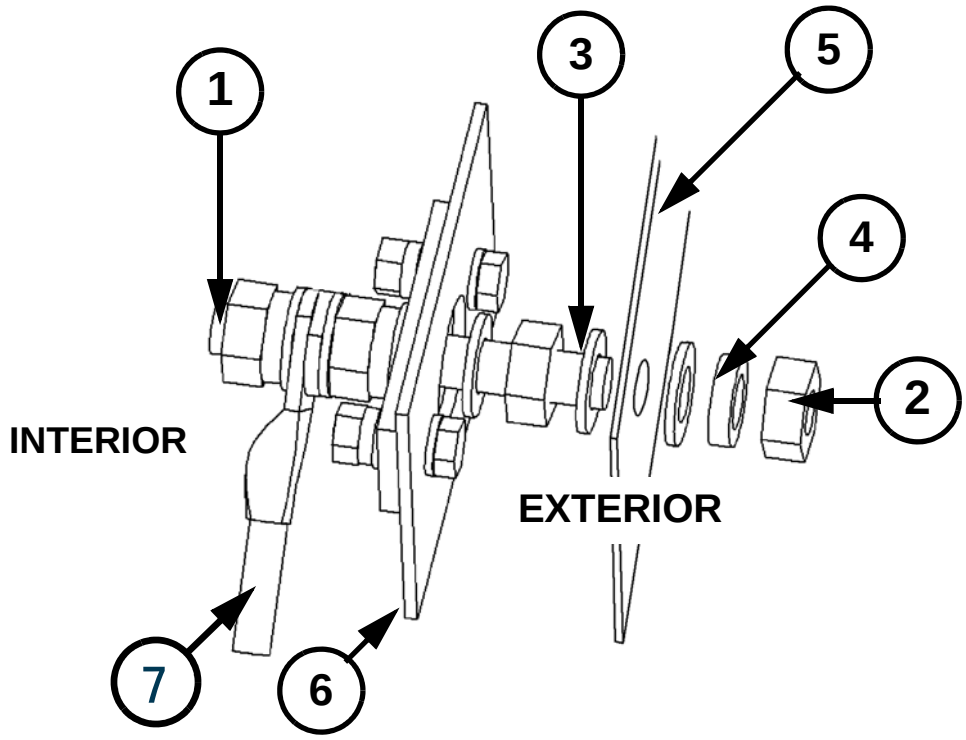
2. Remove the two nuts holding it to the phenolic bar.

3. Re-assemble as shown in Figure 4.1. Attach a continuous, low impedance conductor (minimum four-inch copper strap, or equivalent wire) between the station reference ground and the stud assembly (E1) in the output cabinet. Ensure the reference ground conductor is at least 3 mm (1/8 in) from the cabinet's exterior.

4. Attach a continuous, low impedance conductor (minimum four-inch copper strap, or equivalent wire) between the stud assembly (E1) in the output cabinet and the transformer cabinet's ground stud. Ensure the reference ground conductor is at least 3 mm (or 1/8 in) from any cabinet's exterior.

5. Firmly tighten all hardware.

Figure 4.1: Safety Ground Stud Assembly Detail



1) M10 BRASS STUD

2) M10 NUT

3) M10 FLAT WASHER

4) M10 SPLIT WASHER

5) EXTERIOR REFERENCE GROUND CONDUCTOR

6) CABINET FRAME

7) CABINET GROUND WIRE

Section 5: Connecting ac power

Connect ac power to the ac power disconnect switch and then to the transmitter, as follows:

DANGER: Ensure ac power is disconnected and locked out at the source before proceeding.

WARNING: Ensure that wiring sizes are appropriate. ac wiring must be installed by a qualified, locally-certified electrician.

1. Run the ac power cable from the ac power source to the ac power disconnect switch. The preferred entry point is through the top of the ac power disconnect switch. Cabinet punches or hole saws will be required to cut the entry holes for the conduits.

2. Open the ac power disconnect switch's front door. Connect the ac line input from the power source to the top L1 (Line 1), L2 (Line 2) and L3 (Line 3) input terminals. Connect the ac ground to the top ground terminal.

3. Connect the ac power disconnect switch's load wiring to the bottom T1 (Line 1), T2 (Line 2) and T3 (Line 3) terminals. Connect the ac ground to the bottom ground terminal.

4. If applicable, connect EMERGENCY STOP switch wiring between the + and - terminals of TB2, near the bottom of the ac power disconnect switch. This circuit must present a closed contact between these terminals to allow ac power to be applied to the transmitter. In some cases, Nautel may provide an EMERGENCY STOP switch. Close the ac power disconnect switch's front door.

5. Route the load wiring from the ac power disconnect switch to the transformer cabinet, passing all the conductors, as a group, through a ferrite toroid (Nautel Part # LX63, provided in the ancillary kit)..

Note:
The preferred entry point for ac input wiring is through a hole in the primary side of the transformer cabinet. There is a cable tray wiring interface cover on the primary side to connect to your cable tray system, as applicable. Temporarily remove the cover to pass the primary wiring into the transformer cabinet.

6. Connect the ac power ground to the station reference ground.

7. Verify that the station reference ground and the transformer ground stud are connected to the safety ground stud assembly at the back of the control cabinet.

8. Connect the ac line input to the H1 (Line 1), H2 (Line 2) and H3 (Line 3) input terminals on the transformer (see Figure 4.1 on page 4-2). Connect the ac ground to the transformer's ground stud.

9. Optionally (if purchased), install the ac transient surge protection system.

Section 6: Adjusting the spark gap

The NX100's RF output filter contains a spark gap that must be adjusted - based on site altitude - to provide protection against excessive voltage (i.e., lightning) on the RF output.

If the altitude of the transmitter site is known prior to transmitter delivery, then the spark gap is adjusted at Nautel. If this is the case, it may only be necessary to verify the spark gap setting.

WARNING:
THE AC VOLTAGES PRESENT IN THE TRANSMITTER CAN BE FATAL. EXERCISE EXTREME CAUTION.

1. Determine the altitude of the transmitter site (in feet).

2. Make sure that the ac power is switched off and locked out. Refer to the Operating section of the *NX100 Operations and Maintenance Manual* for instructions on using the ac disconnect or safety interlock switch, which is provided by Nautel.

3. Gain access to the RF output spark gap, noting it is in the top section of the cabinet.

4. Locate the spark gap (see Figure 6.1 on page 6-2). Using a feeler gauge, measure the air gap between the spark gap balls.

5. The air gap should be 0.18 inches multiplied by the scale factor listed in Table 6.1, "Altitude Scale Factor" on page 6-3 for the altitude determined in Step 1. If not, loosen the locking nut on the bottom carbon hemisphere, adjust the position of the spark gap ball for the required gap and then tighten the locking nut.

6. Close and secure the filter door using M5 screws.

Figure 6.1: RF Output Spark Gap Location

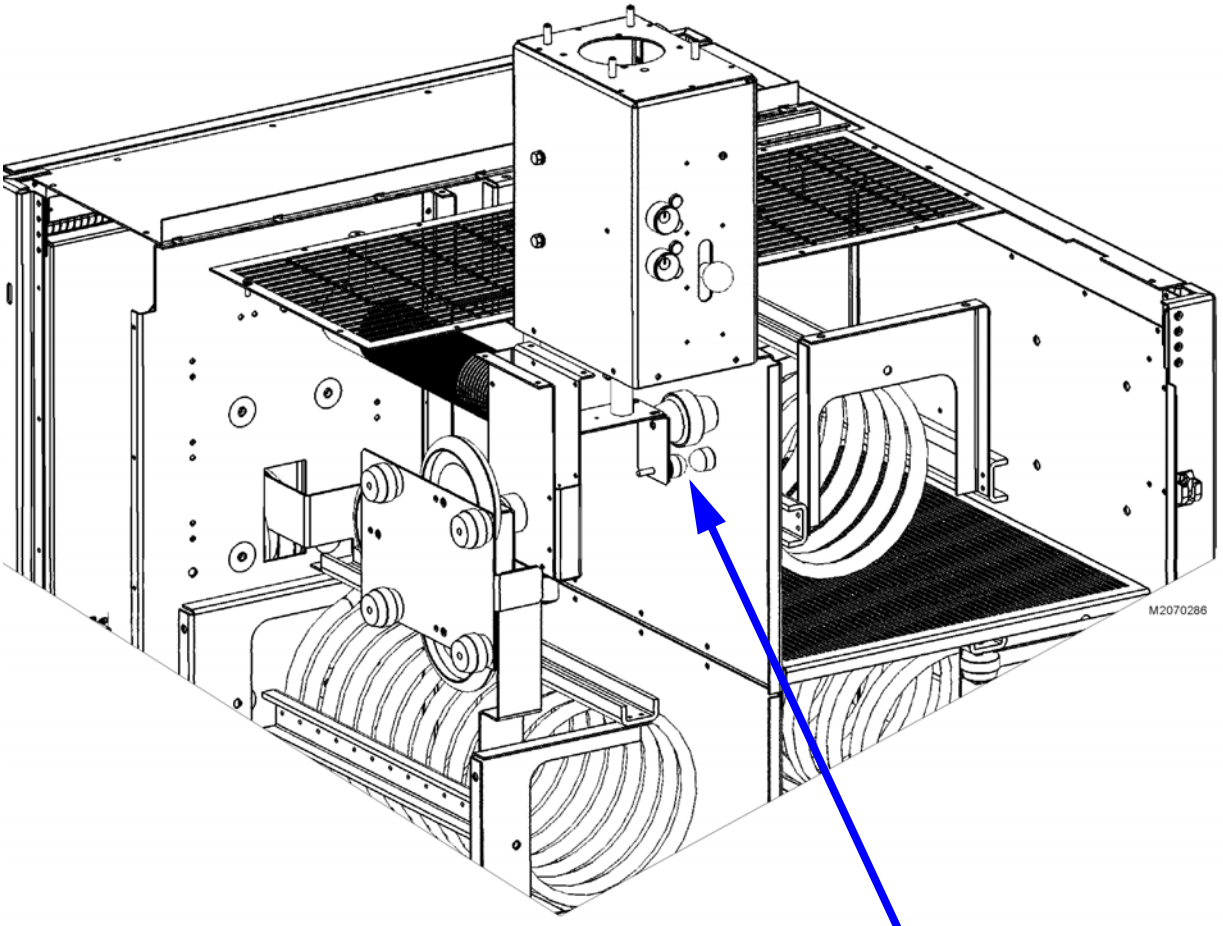


Table 6.1: Altitude Scale Factor

Altitude (ft)	Spark Gap Scale Factor (multiply gap by...)
0	1.00
1,000	1.05
2,000	1.10
3,000	1.15
4,000	1.20
5,000	1.26
6,000	1.32
7,000	1.39
8,000	1.46
9,000	1.54
10,000	1.62
11,000	1.70
12,000	1.80
13,000	1.90

Section 7: Installing audio inputs

This section describes how to route audio input wiring to the NX100's exciters.

Planning complete?

1. Make sure you have read and fully understood the audio input options described in the *NX100 Pre-installation Manual* before proceeding.

2. Make sure the audio input wires are long enough to allow routing through the top of the transmitter cabinet and down to the exciter panel.

Routing cables

1. Route all audio cables from their audio sources to the top of the transmitter.

2. Get two ferrite toroids (one each of Nautel Part # LXP44 and LP23) from the ancillary kit.

3. Pass all audio input cables through the ferrite toroids obtained in Step 2. If practical, wires should pass through a minimum of two times (two turns) (see Figure 7.1 on page 7-2). An entrance is provided at the top of the transmitter to accept audio input wiring (see Figure 7.2 on page 7-2). Position the ferrite toroids just outside, or just inside, the audio input entry hole.

4. Route the audio input cables through the entry hole and toward the exciter panel (A11), located behind the front door (see Figure 7.3 on page 7-3). If possible, install exciter mating connectors after passing cables through the audio input entry hole.

5. With the audio input cables near their destination, cut each wire to the required length and install connectors, as necessary.

6. Remove plastic cap-plugs from the connectors on the exciter panel, if applicable.

7. Connect the appropriate audio input cable(s) to the connector(s) described in Section 7 of the *NX100 Pre-installation Manual*.

Figure 7.1: Passing Audio Input Wiring Through Ferrite Toroids

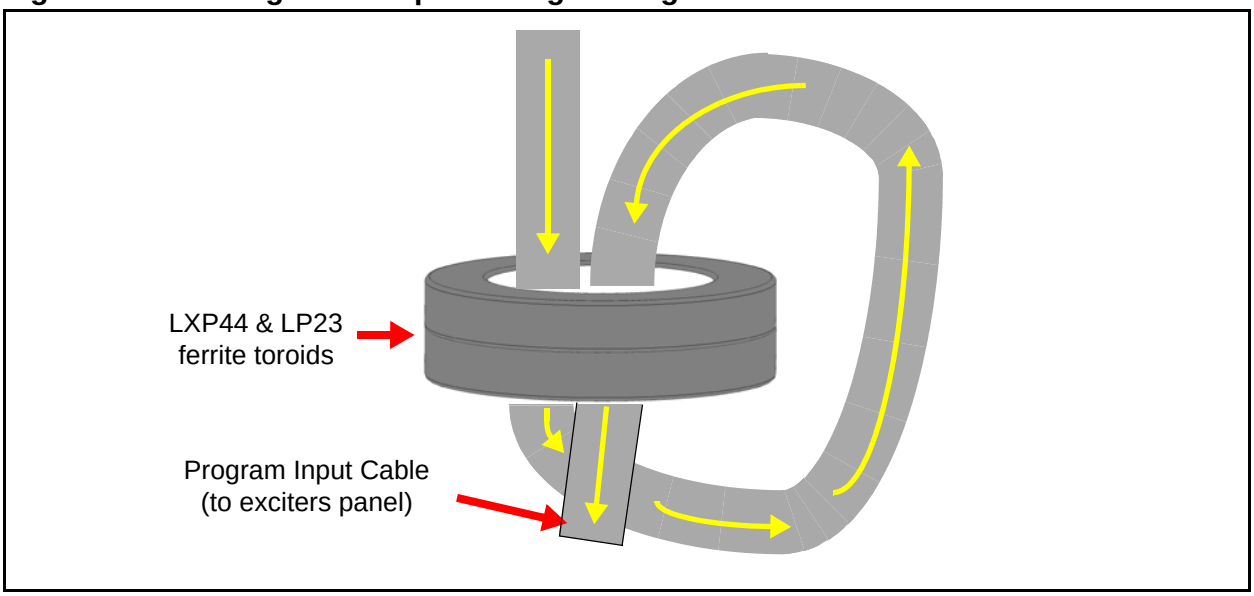


Figure 7.2: Audio Cable Entry

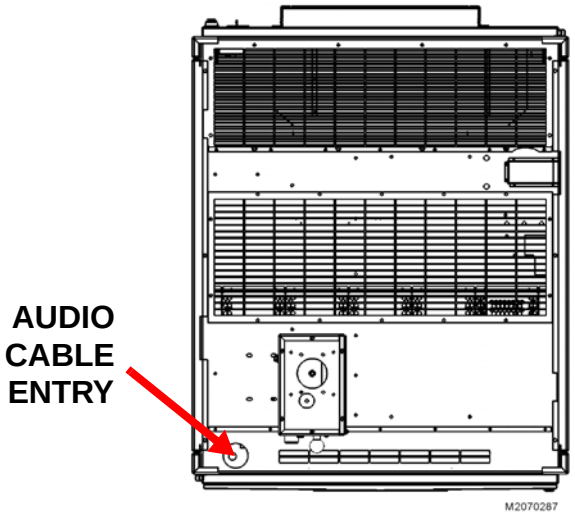
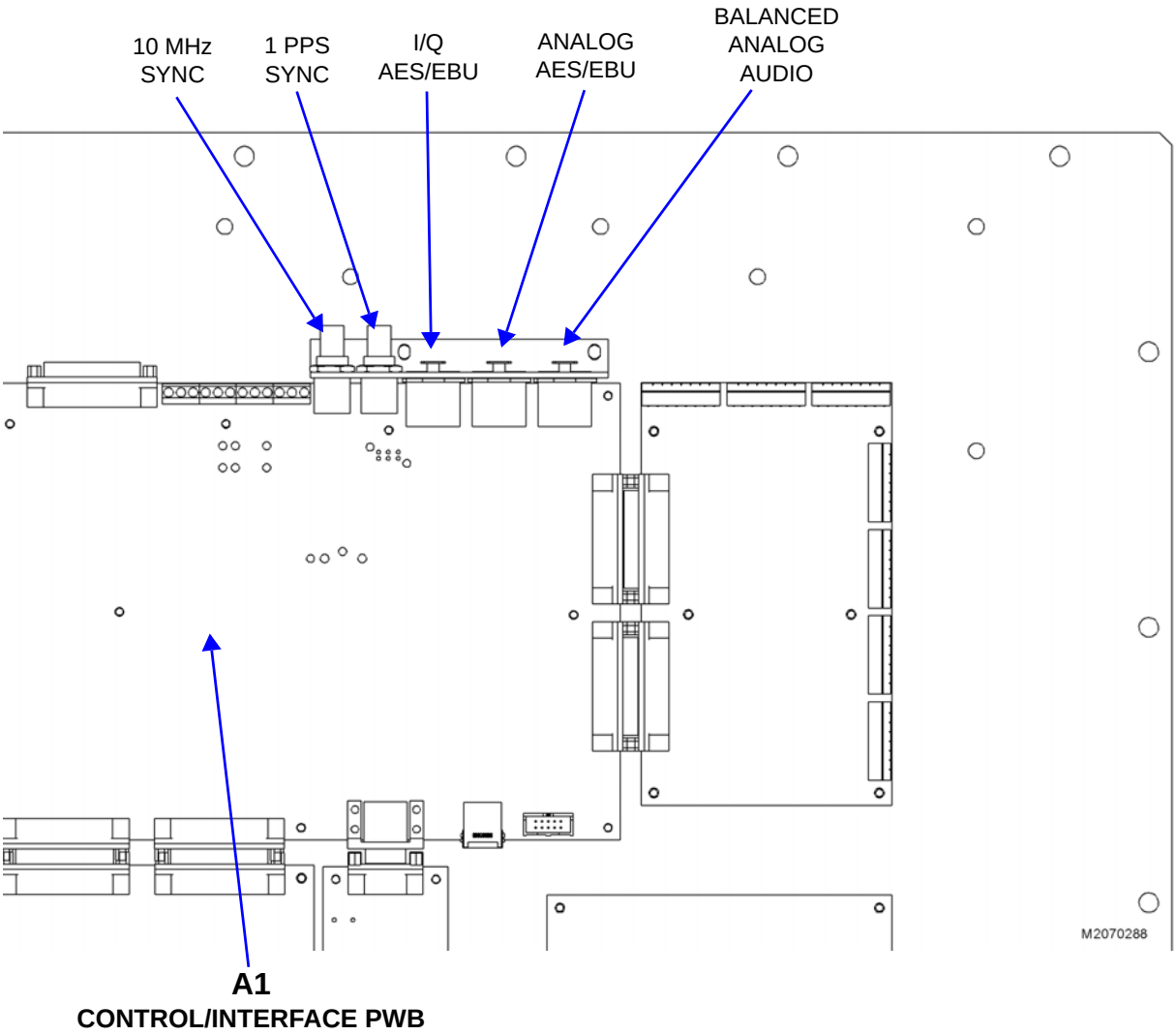


Figure 7.3: Audio Connections (Exciter Panel shown)

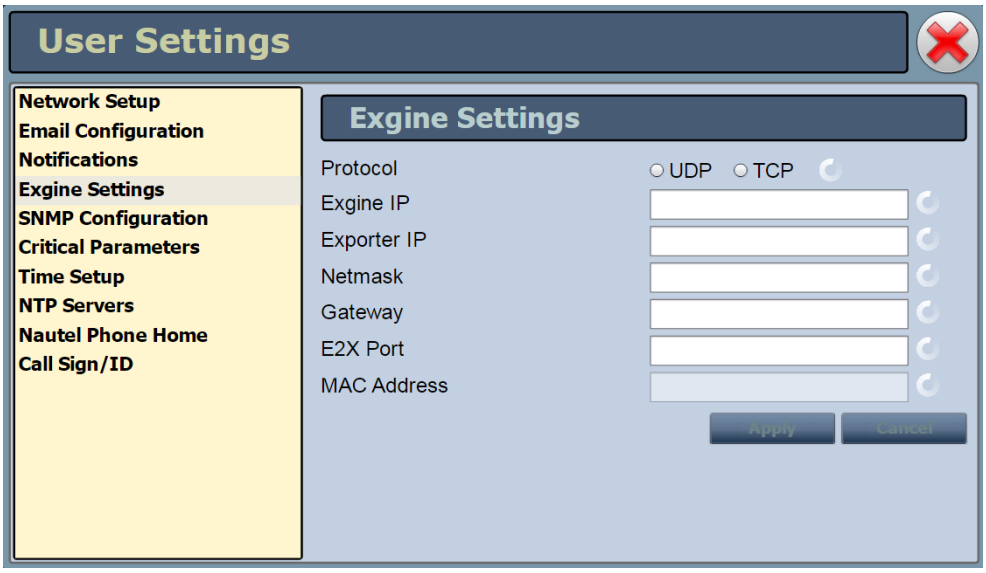


SETTING EXGINE AUDIO PARAMETERS

Use the transmitter's AUI to set and adjust Exgine audio parameters as follows (refer also to the Operating section of the *NX100 Operations and Maintenance Manual*):

From the AUI select **Menu -> User Settings -> Exgine Settings**. The menu in Figure 7.4 will appear.

Figure 7.4: Exgine Settings menu

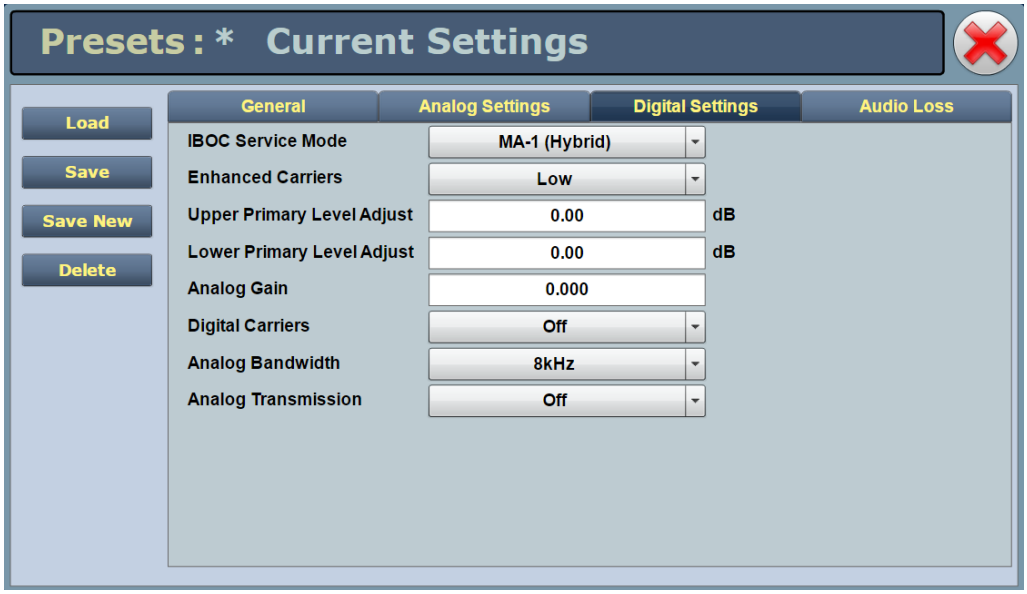


– Select Protocol and enter Exgine IP settings (see the associated Exporter manual for assistance).

From the AUI select **Menu -> Presets -> Digital Settings**. The menu in Figure 7.5 on page 7-5 will appear.

– Set the IBOC Service Mode (MA1 for hybrid; MA3 for all-digital).
– Adjust carrier levels by changing the values of the Upper Primary Level Adjust and Lower Primary Level Adjust fields.
– Adjust the analog gain by changing the value of the Analog Gain field.
– Set Digital Carriers to On or Off.
– Set Analog Transmission to On or Off.

Figure 7.5: Digital Settings menu



Section 8: Installing control/monitor wiring

This section describes how to route wiring associated with the remote control and monitoring of the NX100 transmitter.

Planning complete?

1. Make sure you have read and fully understood the control and monitoring options described in the *NX100 Pre-installation Manual* before proceeding.

2. Make sure the control/monitor wires are long enough to allow routing through the top of the transmitter cabinet and down to the exciter panel.

Routing cables

1. Route all remote control/monitor cables to the top of the transmitter.

2. Get two (2) ferrite toroids (one each of Nautel Part # LXP44 and LP23) from the ancillary kit.

3. Pass all remote control/monitor cables through the ferrite toroids obtained in Step 2. If practical, wires should pass through a minimum of two times (two turns) (see Figure 8.1 on page 8-2). An entrance is provided at the top of the transmitter to accept remote control/monitor wiring (see Figure 8.2 on page 8-2). Position the ferrite toroids just outside, or just inside, the remote control/monitor entry hole.

4. Route the remote control/monitor cables through the cable entry hole and toward the remote interface PWB (A11A4) on the exciter panel (see Figure 8.3 on page 8-3).

5. With the audio input cables near their destination, cut each wire to the required length and install connectors, as necessary.

6. If you are using web based control for the transmitter, route an Ethernet cable to the motherboard (A65A1U1) on the back of the front door. Connect the Ethernet cable to the left-hand (**LAN1**) connector on the motherboard (see Figure 8.4 on page 8-4). Secure the cable to the existing cable harness using tyraps provided in the ancillary kit.

Figure 8.1: Passing Audio Input Wiring Through Ferrite Toroids

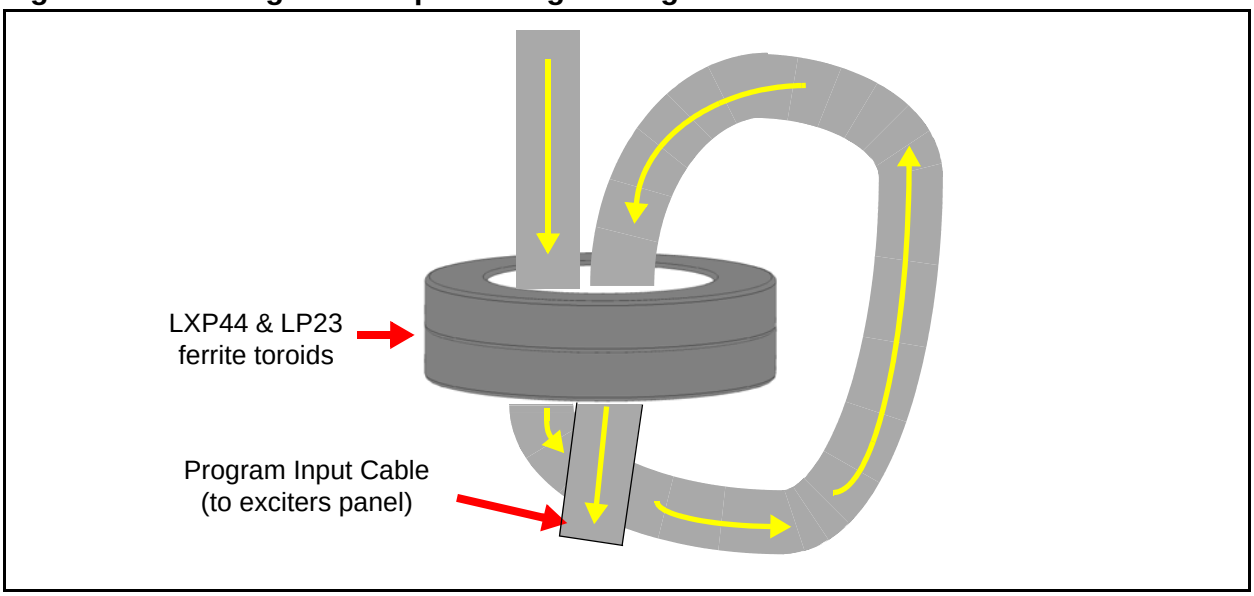
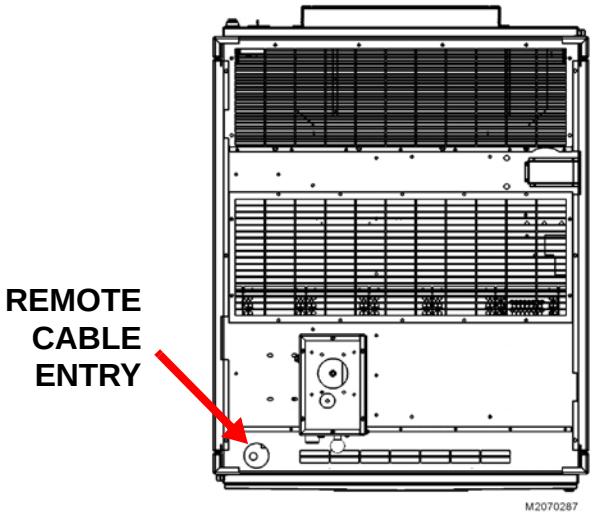
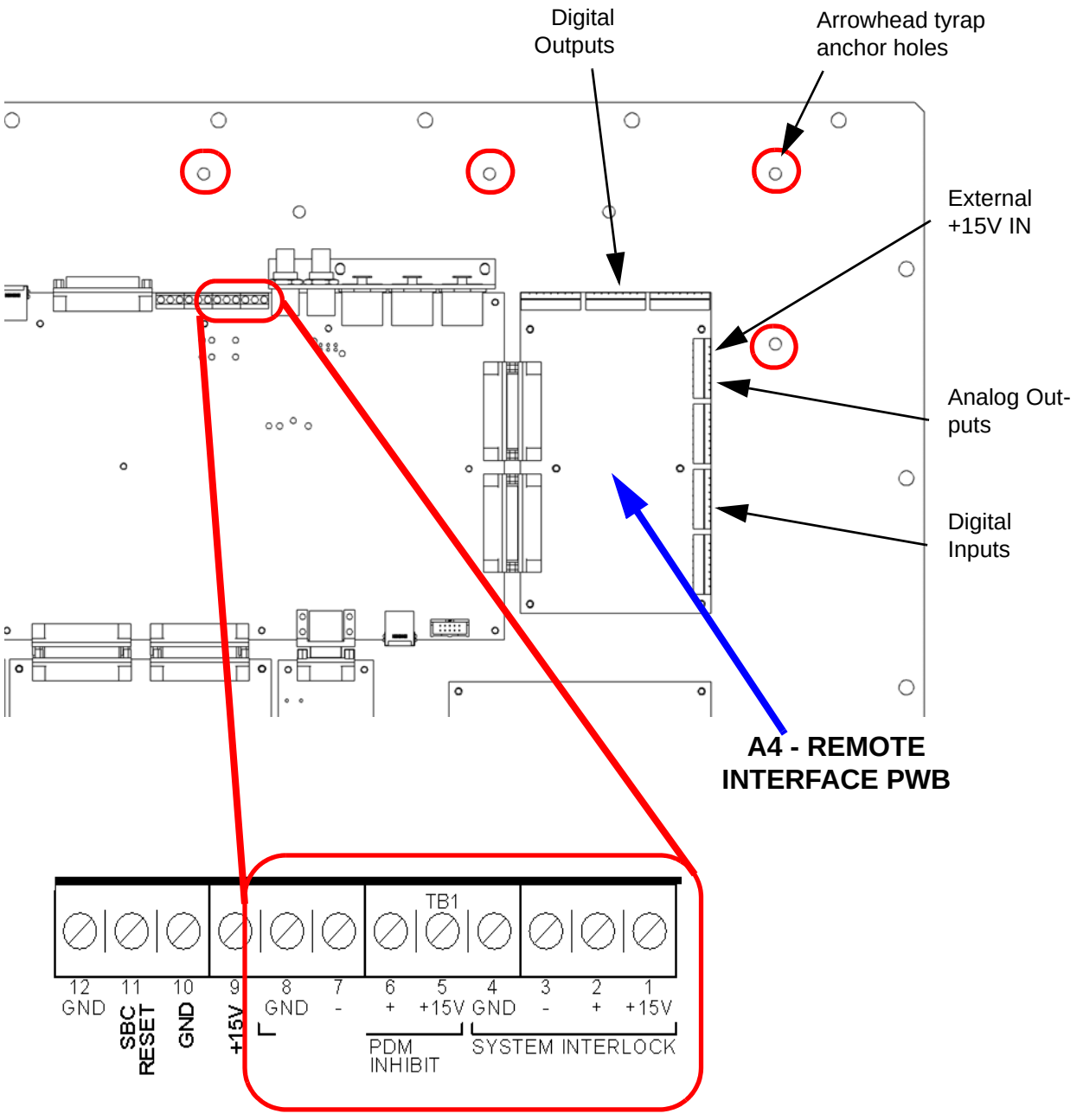


Figure 8.2: Remote Cable Entry



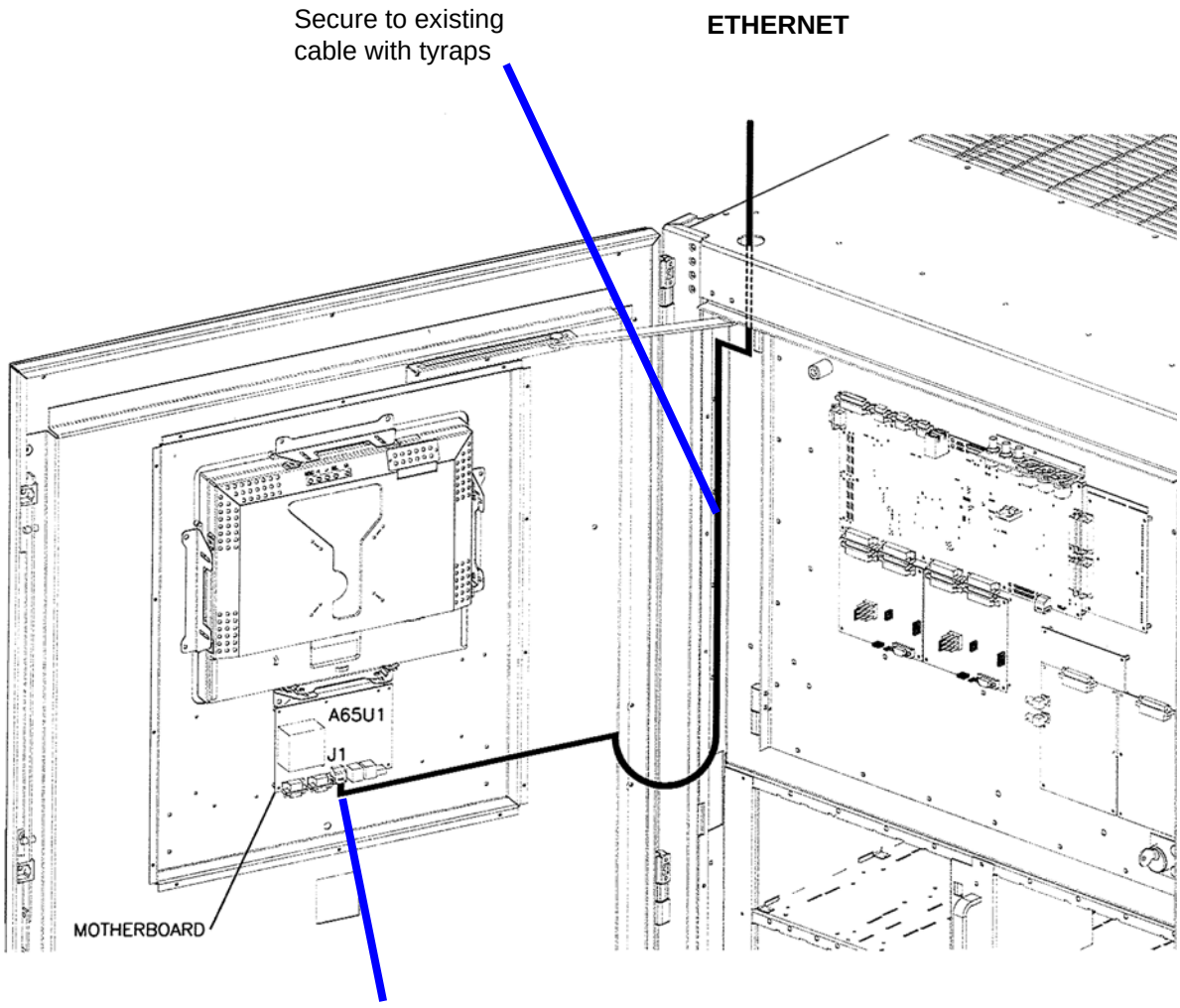
7. Connect the appropriate control/monitor cable(s) to the connector(s) described in Section 8 of the *NX100 Pre-installation Manual*.. Secure wires to the existing cabling and to the panel using arrowhead tyraps provided in the ancillary kit (see Figure 8.3 on page 8-3 to locate tyrap anchor hole locations).

Figure 8.3: Remote Interface Connections



External System Interlock and
PDM Inhibit connections, as applicable

Figure 8.4: Web Interface Connection



Section 9: Commissioning tasks

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

Pre-commissioning tasks

1. Confirm the ac power source's nominal, loaded, phase-to-phase, rms voltage.

2. Ensure that ac power source is switched off at the safety interlock switch.

WARNING: If you do not observe this precaution, you could be seriously injured or killed by the voltages on the circuit breaker and the transformer terminals.

3. Identify which primary winding taps should be used and connected to the transformer's ac power input (Line) terminals. See Table 4.1 on page 4-1.

4. Confirm that the taps are configured correctly.

5. Remove the rear filters from the transmitter and spray them with filter coat adhesive spray (Nautel Part # HQ59), located in the ancillary kit. Re-install the rear filters on the transmitter.

CAUTION:
REMOVE AIR FILTERS BEFORE USING THE FILTER COAT ADHESIVE SPRAY. THE SPRAY WILL CONTAMINATE THE INSIDE OF THE TRANSMITTER, CAUSE ACCELERATED DUST/DIRT BUILDUP AND COMPROMISE CRITICAL SPACINGS FOR VOLTAGE BREAKDOWN.

6. Terminate the transmitter's RF output into a precision, 50 Ω, resistive dummy load that is able to dissipate the RF power being applied to it: 150 kW total required.

7. Verify that all panels are installed, and ensure that their attaching hardware is firmly tightened.

8. Remove the protective sheet covering the top of the transmitter that was added in Section 2, "Unpacking and positioning".

WARNING:
IF JUMPERS ARE PLACED BETWEEN INTERLOCK TERMINALS TB1-1/2 AND TB1-3/4 ON THE CONTROL/INTERFACE PWB, 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.

9. Connect the dummy load's interlock or, if necessary, simulate the closing of all external interlocks. This requires a short circuit between TB1-1 and TB1-2 and between TB1-3 and TB1-4 of the control/interface PWB. Ensure all networks connected to the transmitter's RF output are properly covered.

10. In lieu of normal station programming, connect an analog audio generator, preset to 1000 Hz at zero output (turned off), to connector J12 on the control/interface PWB, or an AES signal generator to connector J11 on the control/interface PWB.

Commissioning

Turning on the transmitter

1. Switch on the ac power at the service entrance to turn on the transmitter.

2. Check the alarm and status indications on the control cabinet's AUI using the **Transmitter Status** page of the AUI.

3. Check the output of the +5, +15 and -15 V power supplies on the AUI (click **Meters**, then select **Rack 1** and the appropriate power supply).

4. Check the ac sample voltage on the AUI (click **Meters**, then select **Rack 1** and then select AC Sample). It should be between 310 V and 335 V. If not, change the transformer tap setting (see Section 4, "Connecting transformer taps/load wiring").

5. Select **Local** control.

6. Set the active preset's power output to 10,000 W as follows:

   - Go to the AUI's **Menu** -> **Presets** page. Press the **Load** button on the left side of the ***Presets*** page to display a window containing a list of other presets. Select the "Analog AM" preset and press **OK**.

   - In the preset's **Output Power** field, enter 10 kW and press **Save**.

   - In the **Transmitter** block in the AUI's top banner, press the bar that contains the active preset name and the drop-down arrow. The **Activate Preset** window will appear, which contains a list of all preset options. Select the "Analog AM" preset and press **Activate** to enable the preset as the transmitter's active preset.

7. Verify the **AM Source** is set to **Unused** in the AUI's **Presets** page's **Analog Settings** tab.

8. Press **RF On**. The **RF On** button will turn green.

9. Check the output of the +48 V power supply on the AUI (**Meters**, **Rack 1**).

10. If you wish to remotely control the transmitter via a network or directly through a laptop, use the AUI to configure your network parameters. See the "Operating the Transmitter" section of the NX100 *Operations and Maintenance* Manual for detailed information.

NOTE: If you are not using a network, set DHCP to DISABLE and manually set the IP address to 0.0.0.0. This disables the "Host Network Down" alarm.

11. Check for alarms using the Transmitter Status page of the AUI.

12. Increase the power to the desired setpoint (use the method in Step 6) while monitoring the PA voltage. Ensure the PA voltage remains within ±10% of the following calculated value:

$$PA\ Volts = \sqrt{\frac{Pout}{100\ kW}} \times 167\ V \times \frac{400\ V}{B + Voltage}$$

13. Check the reflected power level. It should be near 0 W.

14. Check for alarms using the Transmitter Status page of the AUI.

15. Set up your desired presets using the Presets page, noting you can create up to 62 presets. See the "Operating the Transmitter" section of the NX100 Operations & Maintenance Manual for detailed information set up preset modes. See the *NX100 Operations and Maintenance Manual.*

16. Set the time and date on the AUI display. See the *NX100 Operations and Maintenance Manual.*

17. Using a web browser go to ftp://www3.nautel.com/NX_Series/ to make sure your software version is the latest available. Check the existing software version using the AUI's System Settings-> Upgrade Software page. If necessary, update your software. See the "Standard Maintenance" section of the NX100 Operations & Maintenance Manual for detailed information.

18. To improve overall system security, change the login password for the AUI display. Nautel factory sets the AUI with a default login password. See the *"Changing the password"* section of the *NX100 Operations and Maintenance Manual.*

19. If you wish to participate in the Nautel Phone Home feature, which allows Nautel support personnel to monitor, analyze and proactively troubleshoot your transmitter, use the remote AUI to enable the use of Phone Home. See the "Operating the Transmitter" section of the NX100 *Operations and Maintenance* Manual for detailed information.

20. If you purchased the Exgine option (i.e., an Exgine PWB is installed on the exciter panel), use the AUI to configure your Exgine parameters. See the "Operating the Transmitter" section of the NX100 *Operations and Maintenance* Manual for detailed information.

21. Use the local or remote AUI to configure your desired remote inputs and outputs. See the "Operating the Transmitter" section of the NX100 *Operations and Maintenance* Manual for detailed information.

Modulation checks

Verify that the RF output is appropriately modulated when audio is applied:

1. Connect an appropriate modulation monitor to the control/interface PWB's RF MONITOR connector (J7). The RF monitor level is factory set. Ensure there is sufficient attenuation installed between the RF MONITOR connector and the modulation monitor.

2. From the AUI's Presets menu, select the desired preset and verify the AM Source is set for your audio signal generator.

3. Verify that an audio signal generator is connected to J11 (AES) or J12 (analog) on the control/interface PWB, and that its output is preset to 1,000 Hz at a zero output level (turned off).

4. Turn on the audio signal generator and increase the output level of the audio signal generator until a modulation depth of 100% is attained, as indicated on the modulation monitor. The audio signal generator's output level should be at the user-defined input level (e.g., 10 dBm) set in the preset.

5. Verify that the RF output's modulation envelope is acceptable.

6. Set the output level of the audio signal generator to zero (turned off).

7. Turn off the RF power stage: press RF Off. The RF Off button will turn red and the Rf On button will turn grey.

8. Disconnect the audio signal generator from J11 or J12 on the control/interface PWB.

Going on-air

WARNING:
If jumpers are placed between interlock terminals TB1-1/2 and TB1-3/4 on the control/interface PWB, 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 9-1, Step 9 should be removed.

When the commissioning tests are successfully completed, connect the studio audio to the transmitter's audio input connector, connect the RF output to its antenna system, and complete any emission tests that are required.

1. Turn off the power using the ac disconnect switch, if one is being used, or else at the ac source.

2. Connect the transmitter's RF output to an antenna system (or verify that the current connection is intact). Ensure that a ferrite toroid (Nautel Part # LX63) is installed on the RF coaxial hardline at the transmitter's output.

3. Turn the transmitter's ac power back on.

4. Connect the desired modulation source to the transmitter (see Section 7, "Planning audio inputs" of the Pre-Installation Manual for connection options).

NOTE: If analog modulation is being applied, it is recommended that negative modulation peaks do not exceed -96% and positive peaks should not exceed 135% to minimize audio distortion caused by signal clipping.

5. Use the AUI controls to begin transmitter operations. For detailed instructions, refer to the *NX100 Operating and Maintenance Guide*.

Section 10: Parts and tools

This section describes parts associated with the NX100 transmitter, and tools needed during installation and routine operation. Topics include:

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 NX100. This kit contains hardware needed during the installation process. The kit includes toroids, spare fuses, screws and other miscellaneous hardware.

Documentation

See "NX100 transmitter manuals" on page xii

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.
- A plastic sheet (or suitable equivalent), used to cover the top of the transmitter during installation to prevent debris and hardware from falling into the transmitter.

Parts ordering

You can order replacement parts from your Nautel sales agent, or directly from Nautel through the Nautel website.

Module replacement program

Nautel offers a module replacement program for customers who require expedited servicing and replacement of faulty modules. The module replacement program provides immediate replacement of failed modules with refurbished modules.

- 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
- Philips screwdrivers, sizes #1 and #2
- Pliers
- Wire cutters
- Slot screwdriver, 5 mm (3/16 inch)
- Metric and Imperial socket set up to 24 mm (15/16 inch)
- Metric and Imperial wrench set up to 25 mm (1 inch)
- Feeler gauge (to measure spark gap)
- Torque wrench (capable of up to 275 in-lbs or 31 N-m)

Section 11: Pre-installation / Installation assistance

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

- Pre-installation consulting
- Installation and commissioning service
- Online documentation - see page 11-3
- On-site support - see page 11-3
- Training - see page 11-3
- Standard warranty - see page 11-4
- Extended warranties - see page 11-8

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 NX100 transmitter. For support, contact Nautel Customer Service and request assistance ("On-site support" on page 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 breaker panel or the building's service entrance. If local electrical codes allow Nautel personnel to connect the transmitter to the ac supply, using the customer's cable, that task is included in this service. Otherwise, the customer must ensure that an approved electrician is present for this task.

- 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. Go to http://www.nautel.com/login-nug to access documents. See "Nautel website / Online resources" on page xii of the *Pre-Installation Manual* for details.

On-site support

If you require on-site assistance, Nautel's field support specialists can help you prepare your site and ensure that your NX100 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 Center. 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; whichever 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.
201 Target Industrial Circle
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 operates a factory rebuilt, module exchange service which takes full advantage of the high degree of module redundancy in Nautel equipment. This module exchange service is operated from Nautel's factory in Bangor, Maine and Hackett's Cove, Nova Scotia. These two locations allow us to provide a quick turn around service to keep our customers on the air. During the transmitter's warranty period, up to thirteen months from shipment, repair and exchange of modules is at no charge to the customer. When the warranty has expired, a charge of 80% of the list price for all exchanged modules is made. If the faulty module is returned to Nautel within 30 days, a credit is issued reducing this charge by one half to 40% of the list price. USA customers are required to contact our Bangor, Maine facility. Canadian and overseas customers should contact our Nova Scotia, Canada facility.

Equipment being returned to Nautel

For all equipment being returned to Nautel and all requests for repairs or replacements:

- Obtain an RMA number from Nautel (you must have an RMA number to return equipment)
- Mark the item as 'field return'
- Mark the item with the RMA number assigned by Nautel
- Address the item to the appropriate Nautel facility

Complete and accurate information regarding the equipment being returned will ensure prompt attention and will expedite the dispatch of replacements. Refer to the nameplate on the transmitter and/or the appropriate module/assembly to obtain name, type, part and serial number information. Refer to the parts list of this manual or the appropriate service instruction manual for additional ordering information.

The following information should accompany each request (* denotes minimum required information):

- *Model and serial number of equipment
- *Name of part/assembly
- Serial number of part/assembly
- *Complete reference designation of part/assembly

- *Nautel's part number of part/assembly
- *OEM's part number of part/assembly
- Number of hours in use
- Nature of defect
- *Return shipping address

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
- Return shipping

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 12: List of terms

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

ADC. Analog to Digital Converter.

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 microphones). One cable carries both left and right-channel audio data to the receiving device.

B+. The high voltage dc generated by the transmitter's ac power supply for use within the transmitter. The B+ voltage is used to supply the transmitter's modulators and other transmitter circuitry.

Cutback. A reduction in RF output power, caused by a total power limit fault or the occurrence of three shutbacks within a five second period.

DAC. Digital to Analog Converter.

DAM. Dynamic Amplitude Modulation.

DCC. Dynamic Carrier Control.

DRM. Digital Radio Mondiale. A set of digital audio broadcasting technologies designed to work existing AM radio channels.

DSP. Digital Signal Processing.

FPGA. Field Programmable Gate Array.

HD Radio. HD Radio is another term for In Band On Channel (IBOC) technology. HD Radio is a trademark of iBiquity Digital Corporation.

IBOC. Nautel In-Band-On-Channel technology provides high quality digital audio over existing AM radio channels.

IPM. Incidental Phase Modulation

Latching alarm. An alarm that, while active, keeps the transmitter in an 'RF inhibited' state. This type of alarm (e.g., High SWR Shutdown) require a reset - locally or remotely - to attempt to restore transmitter operation.

NE IBOC. Nautel's In-Band-On-Channel signal generator. See IBOC. Required for NX series IBOC installations.

PDM. Pulse Duration Modulation.

Preset. A setting that controls power level, active exciter, and power scheduler status on a time-of-day and date basis. Exciters can be configured on a preset for a specific operating mode (for example, Exciter A - conventional AM, and Exciter B - IBOC). The NX100 allows you to pre-program multiple presets.

Shutback. A complete loss of RF output power, caused by any one of a variety of faults, including high VSWR, low B+ voltage, high RF current, RF drive failure, external interlock or spark gap.

Surge protection board. 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 forward voltage to reverse voltage on the feedline and antenna system. An ideal VSWR of 1:1 provides maximum transmitter-antenna efficiency.

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