

411-1333-201

Reunion

CTR 2400

Outdoor Microwave Transceiver Installation Guide

Release 1.1 July 1998



NORTEL
NORTHERN TELECOM

Reunion

CTR 2400

Outdoor Microwave Transceiver Installation Guide

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Publication history

July 1998

- Initial preliminary release of the document

About this guide

Purpose

This guide provides the information required to install and operate the CTR 2400 outdoor microwave transceiver.

The CTR 2400 is one of the Radio Frequency (RF) products that constitute a Nortel Reunion™ product line. The associated products include the following types of cell site equipment:

- broadband transmitters
- broadband receivers
- broadband repeaters
- broadband transceivers

Audience

The audience for this document are those who install and operate the CTR 2400. To take full advantage of this guide, you should have a basic understanding of microwave fundamentals and know how to use microwave test equipment.

Organization

This Guide is divided into seven sections:

- *Product Overview* describes the CTR's components and theory of operation.
- *Pre-Installation* describes the basics of handling the equipment upon arrival.
- *Reunion Safety Standards* provide a quick review of general safety guidelines.
- *Installing the CTR 2400* explains how to physically install the transceiver.
- *CTR 2400 Maintenance* describes basic maintenance procedures to ensure that the transceiver is operating correctly.
- *CTR 2400 Diagnostic Reference Chart* provides a quick troubleshooting guide.
- *List of terms* provides a quick reference to terms and acronyms found in the guide.

Customer Support

In addition, Nortel Broadband Wireless Access (BWA) provides 24-hour customer service and technical support to ensure your service operation is trouble-free. If you have questions or need technical support, contact Nortel Broadband Wireless Access at the following telephone numbers:

- In the USA and Canada, call toll free 1 (800) 822-6355
- Outside of North America, call (204) 631-2250
- Fax (204) 631-2475

Write Nortel at:

- Nortel
Broadband Wireless Access
37 Stevenson Road
Winnipeg, Manitoba R3H 0H9
Canada

Documents to fit Your Needs

The *CTR 2400 Installation Guide* is designed to provide complete procedural and technical information needed to install, manage and operate this equipment.

Nortel Broadband Wireless Access Customer Documentation and Training's goal is to furnish concise, efficient and effective documentation that provides the customers and/or customer service personnel with the precise information required to operate and manage the specific Nortel Broadband Wireless Access equipment acquired.

To help serve you better, please identify any information that you:

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Documentation Suite

Reunion Release 1.1 has a suite of eight documents:

Reunion System Overview, 411-1343-010

Reunion System Administration Guide, 411-1343-011

Reunion Network Node Equipment Installation Guide, 411-1313-200

Reunion NIU 6050 Network Interface Unit Installation Guide, 411-1323-200

Reunion BTR 2400 Outdoor Microwave Transceiver Installation Guide,
411-1333-200

Reunion CTR 2400 Outdoor Microwave Transceiver Installation Guide,
411-1333-201

Reunion Redundancy Switching Matrix Installation Guide, 411-1313-201

Reunion DSS 1000 (Digital System Supervisor) User Guide, 411-1343-500

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CTR 2400 Release 1.1

Product Overview

The CTR 2400 outdoor transceiver is a customer premise transceiver designed to operate in the Receiver (RX) 24.25 to 24.45 GHz and Transmitter (TX) 25.05-25.25 GHz frequency bands. It is a Nortel Reunion™ product which operates in conjunction with base station products.

The CTR 2400 transceiver is mounted on a pole or a building. It features a small size and low noise characteristics. The combination of digital modulation and low-loss mounting results in an efficient and low-cost installation. It has a high-stability reference oscillator.

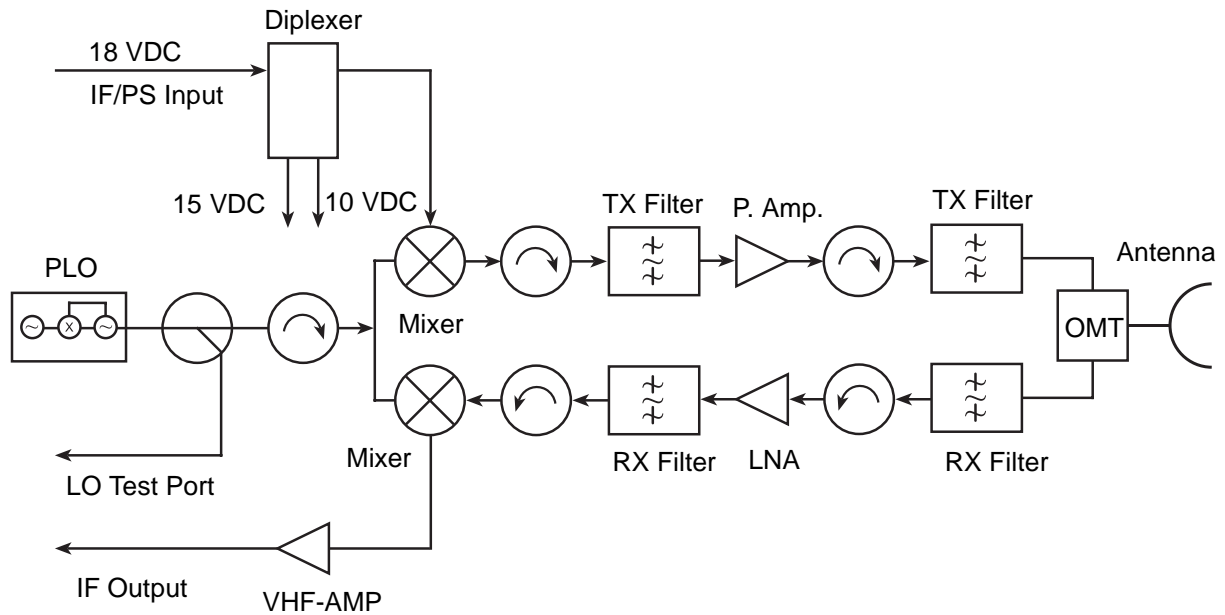
The CTR 2400 features the following attributes:

- light-weight and compact packaging designed for mounting outdoors
- solid-state upconverter and downconverter designs
- high frequency stability over a wide temperature range
- standard 18 VDC input for use around the world

The transceiver comprises the following components:

- diplexer
- power supply
- mixers
- local oscillator
- isolators
- bandpass filters
- low noise amplifier (LNA)
- power amplifier
- orthogonal mode transition (OMT)
- antenna

Figure 1-1
CTR 2400 Block Diagram



How the CTR 2400 Works

This section provides an overview of the theory of operation for the CTR 2400 outdoor transceiver.

Its installation on a pole or building enhances transmitting and receiving capabilities by avoiding the need for long expensive waveguide runs. This technique minimizes the power loss from waveguide attenuation, which results in a highly efficient, compact and cost-effective installation. Minimum maintenance is required.

The high-stability reference oscillator ensures that the transmitter and receiver remain on frequency over a wide operating range.

The radio uses a common input cable to carry the 18 VDC and transmit intermediate frequency (IF) signals. The DC power supply and the IF signals are separated by the diplexer in the radio. The radio uses a common antenna for both the transmit and receive microwave signals with orthogonal polarities.

1. The CTR transceiver's input coaxial cable carries the IF signals and the 18 VDC power supply to the diplexer. The diplexer distributes the DC power to the power supply unit and interfaces with the mixer for the IF signals.
2. The 450-650 MHz transmit IF signals enter the mixer which upconverts the signals to the 25.05-25.25 GHz band for the transmit path. The received 24.25-24.45 RF band is downconverted to a receive signal in the 150-350 MHz range.
3. The local oscillator (LO) provides local oscillator signal to the mixer. The LO uses a phase-locked dielectric resonance oscillator (DRO) with a temperature compensated crystal oscillator (TCXO).
4. The bandpass filters remove the undesired sideband signals, in both the transmit and receive paths.
5. The upconverted signal is fed into the power amplifier which provides the required gain to the microwave signals. The power amplifier output is connected to the antenna through the filter and OMT.
6. The received RF simultaneously passes through the antenna, the band pass filter, the Low Noise Amplifier (LNA), and enters the downconverter mixer.

There are three connectors on the outside of the transceiver case:

- The IF (TX) and power supply input uses a Type N female jack
- The IF (RX) output uses a Type N female jack
- Test Port uses SMA jack

CTR 2400 Specification

Table 1: CTR 2400 Specifications

TX	IF Input	RF Output
Frequency Range	450-650 MHz	25.05-25.25 GHz
P-AMP Output Level (P1)		>+24 dBm, min
P-AMP Output Level (TOI)		>30 dBm, min.
Input Impedance	50 Ohms	
Input/Output Connector	N Type Female	
Input VSWR	1.5:1, max	1.5:1, max
Gain (not including antenna)		26 dB, minimum
Gain Flatness		±1.5 dB
Frequency Stability (-40 to +50°C)		±5 ppm
RX	RF Input	IF Output
Frequency Range	24.25-24.45 GHz	150 - 350 MHz
Nominal Input Level	- 50 dBm	
Input/Output Connector		N Type Female
Output VSWR	1.5:1, max	1.5:1, max
Gain (not including antenna)		25 dB, minimum
Gain Flatness		±1.5 dB
Output Impedance		50 Ohms
Noise Figure		< 8 dB
Frequency Stability (-40 to +50°C)		±5 ppm

Antenna	CTR
Frequency	24-26 GHz
Gain	35 dBi, minimum
TX / RX wave polarity	linear, orthogonal
Beam Width (3dB)	3° max
Power Supply	CTR
Input Voltage	18 VDC, 3A, max diplexed with TX cable
Input Power	54 Watts, maximum
Environmental	CTR
Humidity	100% condensing
Operating Temperature	-40 to +50°C
Storage Temperature Range	-45 to +85°C
Mechanical	CTR
Size (Height x Diameter)	15.19" x 12.4"
Weight without brackets	7 lbs. (3.2 KG)

Note: Use the following formula to calculate the converted frequency:

$$\text{TX: } f_{\text{RF OUT}} \text{ (GHz)} = f_{\text{IF IN}} \text{ (GHz)} + 24.6$$

$$\text{RX: } f_{\text{IF OUT}} \text{ (GHz)} = 24.6 - f_{\text{RF IN}} \text{ (GHz)}$$



CTR 2400 Component Descriptions

Diplexer / Power Supply

The diplexer separates the IF input signals and the DC power supply. The isolation between the IF path and the power supply path is more than 45 dB. A transient voltage protector on the board helps to protect the transceiver from possible lightning damage.

The 18 VDC power from the diplexer is first regulated to 15 VDC for the DRO, and then regulated to 10V for all the modules.

Mixer

The CTR 2400 uses a third harmonic mixer. The mixer uses a 8.2 GHz local oscillator (LO) signal to convert the IF input signals to the 25.05-25.25 GHz microwave frequency band. The same LO is used to downconvert the incoming microwave signals to the receive IF frequency band.

Dielectric Resonance Oscillator (DRO)

The Dielectric Resonance Oscillator is equipped with a OCXO reference oscillator. When the DRO is phase-locked, it provides a 8.2 GHz microwave frequency stability derived from the reference crystal.

When the DRO is phase-locked, the phase-locked voltage at the test port on the DRO can vary from 3 VDC to 12 VDC. The voltage at the alarm test port is approximately 5 VDC.

When the DRO is unlocked, the phase-locked voltage becomes an oscillating ramp wave. The voltage at the alarm test port goes down to 0 VDC.

Isolator

Four isolators provide adequate return loss in the CTR 2400. Each isolator's maximum forward insertion loss is 0.5 dB, and its return loss is greater than 20 dB.

Bandpass Filter

The bandpass filter removes the undesired sideband elements and LO leakage, and passes the required sideband signals.

Low Noise Amplifier

The low noise amplifier (LNA) provides gain in the receive path and amplifies the received microwave signals to the mixer. The gain and noise figure of the LNA are chosen to maximize the overall dynamic range and noise performance of the CTR 2400 receiver section.

Power Amplifier

The power amplifier provides gain in the transmit path. It boosts the signals in the 25.05-25.25 GHz frequency range to the required level. The amplifier is a solid state amplifier that has high linearity within a high output power range.

Orthogonal Mode Transition (OMT)

The CTR 2400 uses the OMT to combine and separate the transmit and receive RF signals, allowing use of a common antenna for receiver and transmitter.

Antenna

The CTR 2400 uses a reflector antenna to transmit and receive RF signals. The transmitting signal polarity is defined as the direction of CTR 2400 polarity.

Note: V= vertical TX wave polarization

H= horizontal TX wave polarization

Pre-Installation

Prevention of Access

Allow only authorized personnel to access the equipment. Install the equipment in a restricted-access location or similar environment. Failure to prevent unauthorized user access invalidates the equipment warranty.

Unpacking Shipment

Use the following steps to unpack and inspect the shipment of Nortel Broadband Wireless Access equipment:

1. Copy adequate Inventory Forms
2. Check each package against the order form and packing slip to ensure that all components are received
3. Check each package for signs of damage
4. Open the package and closely inspect all components for obvious signs of damage
5. Know exactly where you are going to place the equipment, before removing them from the package
6. Carefully remove the equipment from the packaging
7. Save packing material for future use
8. Be aware of electrostatic discharge devices (ESD) requirements when handling BWA equipment



Note: For more information, refer to the Electronic Industries Association (EIA) standard, *Requirements for Handling Electrostatic-Discharge-Sensitive Devices (ESDS)*, EIA-625, as well as local and national standards.

Reunion Safety Standards

Safety and safety considerations are important while using Nortel Broadband Wireless Access equipment. The following information is provided to assist you to establish appropriate safety practices.

Safety Disclaimer

The safety standards discussed in this guide cannot address all safety issues associated with their use or all applicable regulatory requirements. You are responsible for establishing appropriate safety and health practices and to determine the applicability of regulatory limitations before their use.

General Safety

Ensure that installation personnel are trained on CPR (Cardio Pulmonary Resuscitation), as well as on local, regional and national safety standards.

When working on Nortel Broadband Wireless Access equipment, follow these guidelines:

- Keep your work site clean and free of clutter.
- Wear close fitting clothing.
- Remove jewelry such as rings, bracelets, or watches.
- Where it is possible to dislodge small pieces, wear eye protection.
- Place equipment or cabinets on level surfaces.
- Wear a safety belt when climbing a tower and installing equipment on a tower.
- Work in pairs so that you have someone to help in case of an emergency.

Electrical Safety

Locate the main power shut-off switch controlling the equipment you are working on. This is important in the event of an accident, so you can quickly cut the power.

Disconnect all power when working on power supplies.

In an emergency (electrocution):

- shut the power off.
- have someone call for emergency medical assistance
- start CPR



Warning

Do not move in front of the antenna, nor look directly into the face of the antenna when the CTR 2400 is running.

Installing the CTR 2400

Installation involves two separate operations:

- installing the tower equipment
- installing the indoor equipment

For information about installing the antenna(s) and such aspects as line of sight, antenna mast spacing, coverage angle, etc., refer to the Network Engineering Package and the Design Document.

Installing the Tower Equipment

Install the CTR 2400 microwave transceiver as follows:

1. Mount the CTR 2400 to a stable pole using the supplied mounting brackets. The mounting brackets accommodate poles with outside diameters from 2" to 4.5". See Figures 1-5 and 1-6.

The CTR 2400 requires 18 VDC (3A) power supply unit.

2. Connect the IF/power supply input cable to the CTR's N-type IF IN 18 VDC port. See Figures 1-3 and 1-4.
3. Connect the RX cable from the CTR's N-type IF OUT port to the RMM RX port. See Figures 1-3 and 1-4.
4. Seal all connections using Coax-Seal® or equivalent, cold shrink or hot shrink tubing.
5. Ground all RF cables at the recommended spacing intervals. (Refer to tower and cable manufacturers' specifications).
6. Ensure that all feed lines are securely attached to the support structure. Plan for drip (service) loops on all cables.



Warning

Do not turn on the power supply until the installation is complete. After you install the equipment, check the cable connections.

Installing Indoor Equipment

Install the indoor equipment associated with the CTR 2400 microwave transceiver as follows:

1. Connect power inserter unit VHF port to RMM TX port as shown in Figure 1-2.
2. Connect CTR 2400 IF/PS cable to the CPI 9000 output port (PS/VHF).
3. Connect CTR 2400 RX cable to RMM RX port.
4. Connect the CPI 9000 to -48 VDC socket.
5. Refer to *Reunion NIU 6050 Network Interface Unit Installation Guide*, 411-1323-201 and the *Network Engineering Package*.

Figure 1-2
Diagram showing CTR 2400 indoor set-up

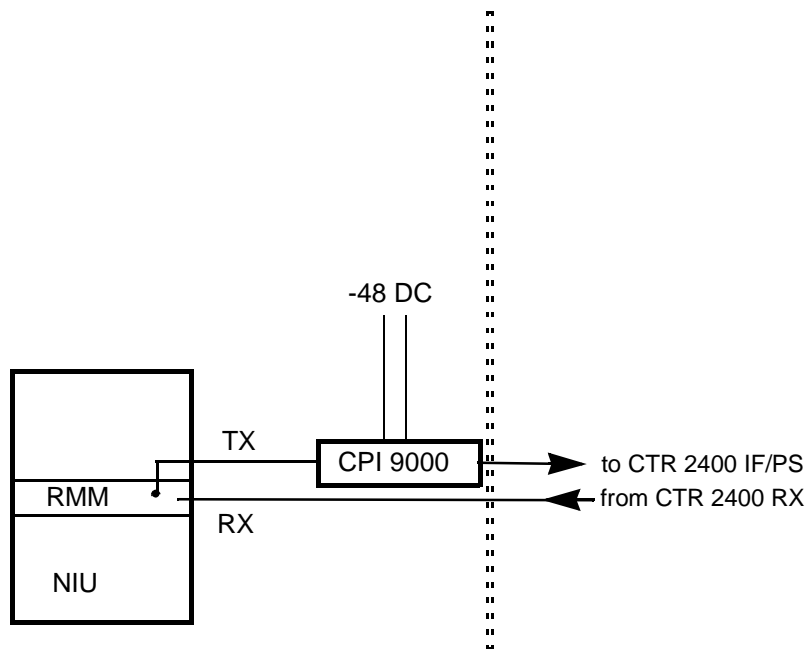


Figure 1-3
CTR 2400 Side View

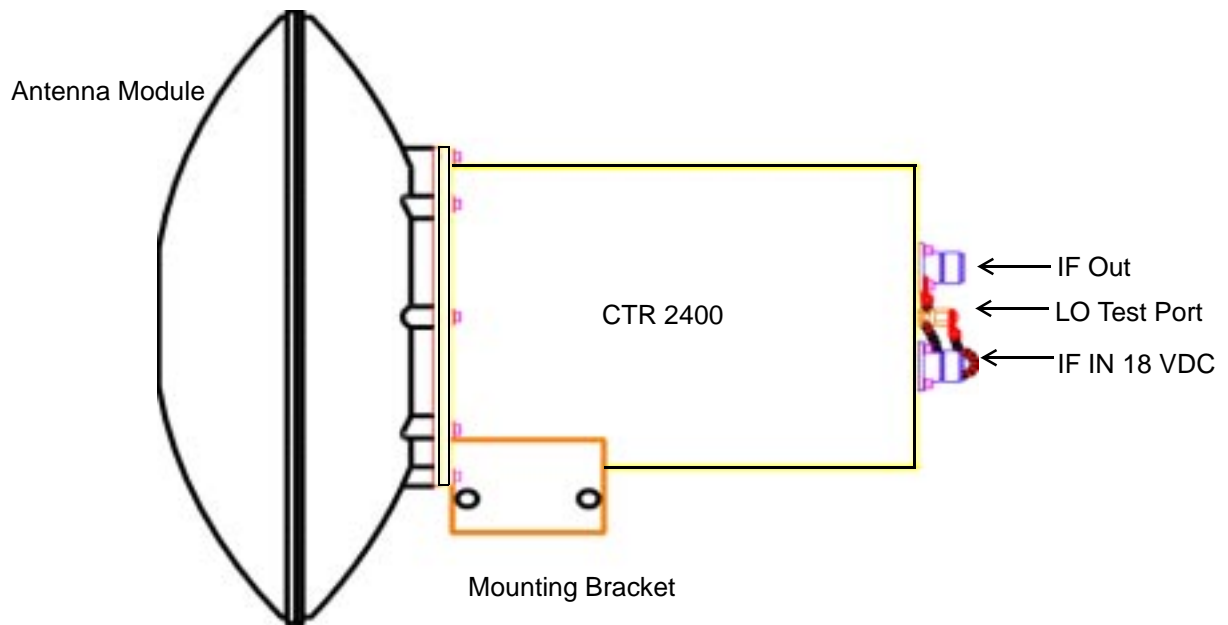
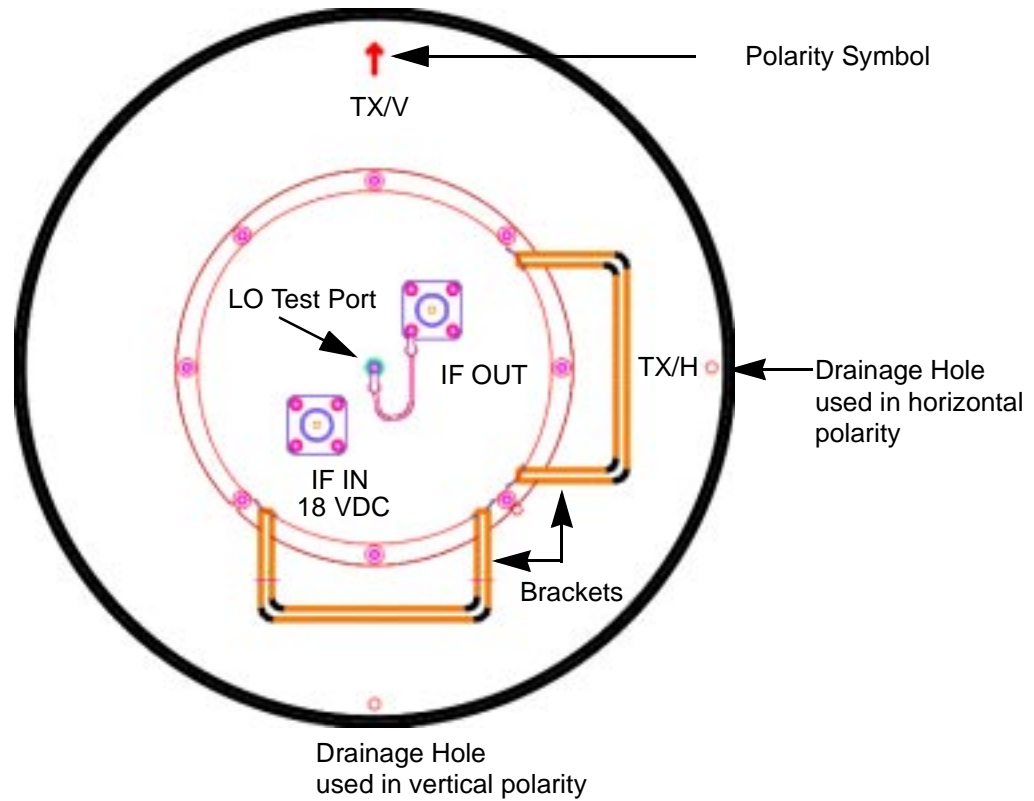


Figure 1-4
The CTR 2400 Back View-Showing Input and Output Points



V: vertical TX wave polarization
H: horizontal TX wave polarization

Figure 1-5
CTR 2400 Mounted to a Pole-Back View

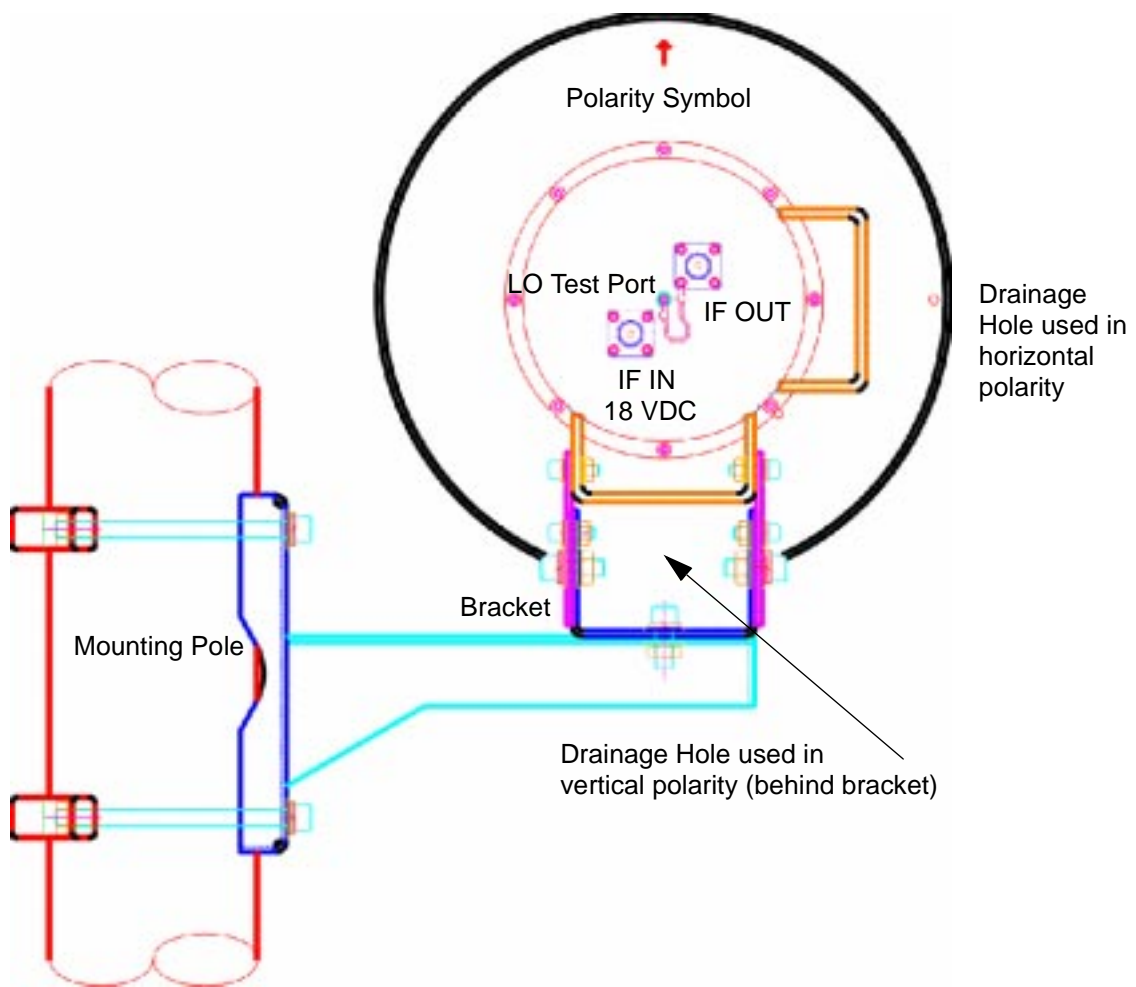


Figure 1-6
CTR 2400 Mounted on a Pole - Side View

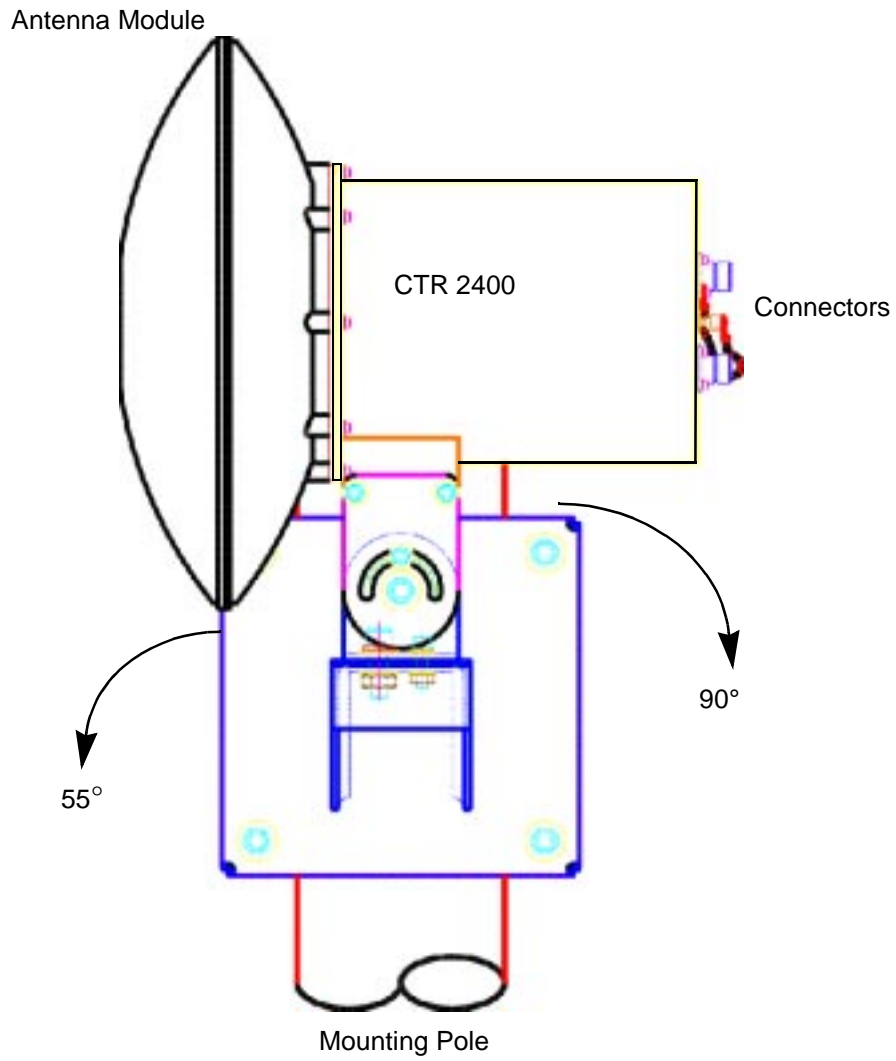


Figure 1-7
CTR 2400 Side View with Brackets

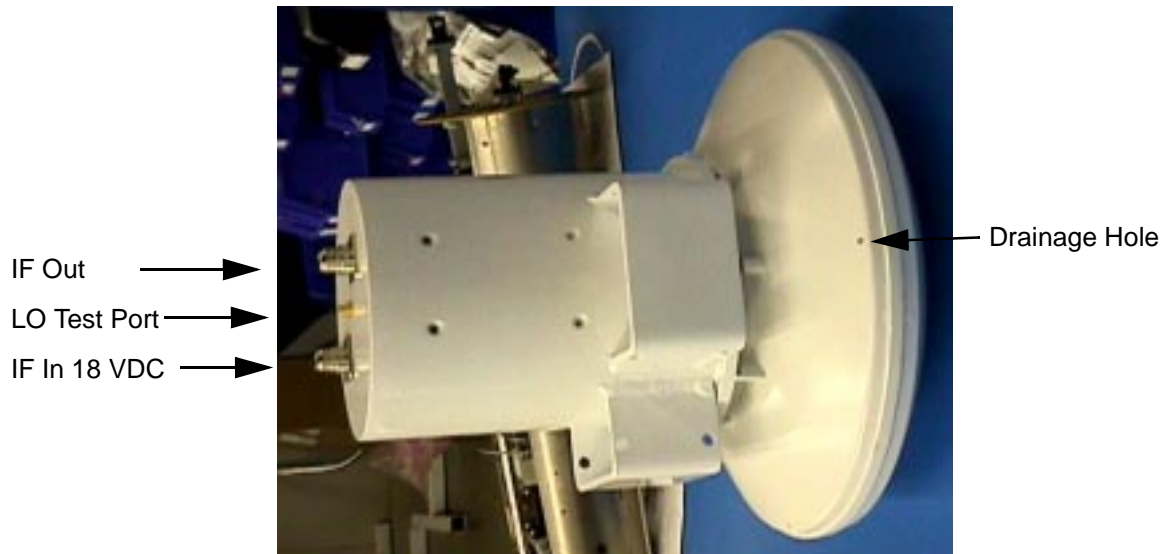
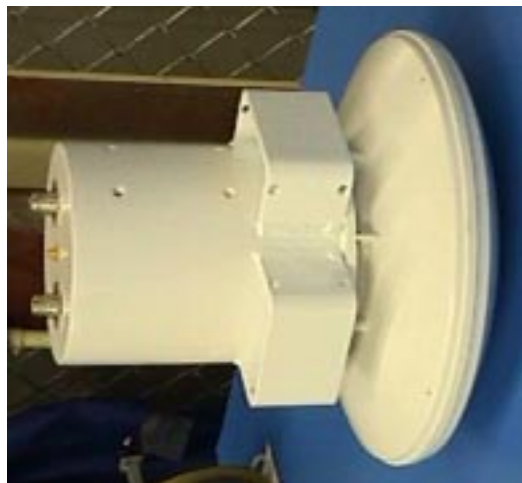


Figure 1-8
CTR 2400 Side View with Brackets



CTR 2400 Maintenance

Establish a regular check procedure. This quickly identifies any problem which might develop. There are no repairable internal components in the CTR 2400. Therefore, the checks focus on the exterior features of the transceiver unit.

Mechanical Checks

Check the following mechanical areas to prevent problems.

1. Check the bolts and fasteners which hold the transceiver, waveguides, and antenna. Vibrations due to wind can cause bolts and fasteners to loosen. Verify that equipment is secure and properly mounted. If the bolts or fasteners are loose, tighten them carefully. Use lock and spring washers.
2. Check to ensure that all connections between the transceiver and antenna remain watertight. If water enters the waveguide or coaxial connections, it can cause attenuation of the microwave signals. If water is detected, call Nortel Broadband Wireless Access.
3. Visually inspect all equipment for signs of external damage. If signs of damage are detected, call Nortel Broadband Wireless Access.



Note: If you detect an unsolvable problem during the electrical and mechanical inspections, contact Nortel Broadband Wireless Access so that action can be taken to rectify the problem.

Grounding

Grounding refers to a conducting body, for example the earth, used as a common return for an electronic circuit and as an arbitrary zero of potential.

Grounding communication equipment limits voltage due to lightning, line surges or unintentional contact with higher voltage lines, by providing an alternative path. It minimizes damage to both the actual RF equipment and the indoor equipment to which it is connected.

Grounding Reunion RF equipment is critical to ensure proper system operation, as well as protection of personnel and equipment.

The CTR 2400 does not have a ‘ground point or stud.’ Its mounting to the pole serves as the ‘ground.’

Also, the cables are ‘shielded’ or armored, and do not have a ground point/stud.

CTR 2400 Diagnostic Reference Chart

Symptom	Possible Cause	Check Procedure
Output power low	1. VHF input signal level low.	a. Check VHF signal level. b. Check coaxial cable. c. Check cable connectors. d. Check antenna for blockage (e.g. guano)
No power		a. check main fuse power b. check cable connections

If you detect any problem during the electrical and mechanical checks, contact Nortel Broadband Wireless Access so that action can be taken to rectify the problem.



Note: Warranty void if seal is opened. This means do not attempt to remove cover.

List of terms

AC

Alternating Current

AWG

American Wire Gauge

DBMS

Digital Broadband Microwave System

DC

Direct Current

DRO

Dielectric Resonance Oscillator

EIA

Electronic Industries Association

ESD

Electrostatic Discharge

FCC

Federal Communications Commission

IC

Industry Canada

IF

Intermediate Frequency

kHz

kilohertz, one thousand hertz or cycles per second

LO

Local Oscillator

LNA

Low Noise Amplifier

LNB

Low Noise Block Downconverter

MHz

MegaHertz, one million hertz or cycles per second

NIU

Network Interface Unit

OCXO

Oven-Controlled Crystal Oscillator

OMT

Orthogonal Mode Transition

PA

Power Amplifier

PI

Power Inserter

PS

Power Supply

QAM

Quadrature Amplitude Modulation, which entails modulating frequency

RF

Radio Frequency

RMM

Radio Modem Module

TCXO

Temperature Compensated Crystal Oscillator

VAC

Voltage Alternating Current

VDC

Voltage Direct Current (Volts Direct Current)

VHF

Very High Frequency

Reunion
CTR 2400
Installation Guide

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