Invisible Fiber® Unit
Installation and Commissioning Guide

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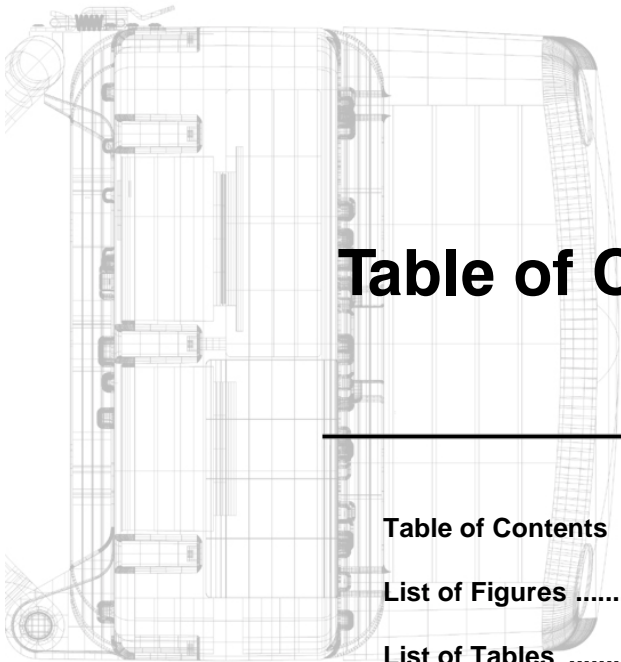## Trademark Information

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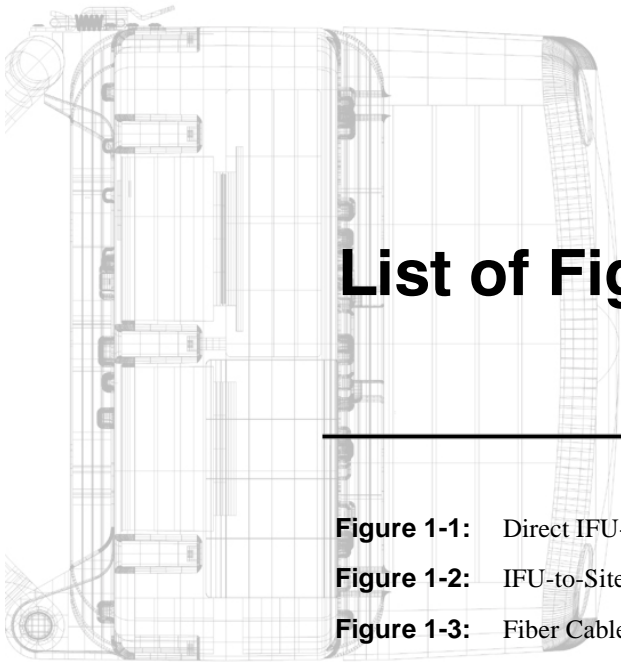
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About This Book

The Triton Network Systems, Inc. Invisible Fiber unit (IFU) delivers high-bandwidth traffic through a wireless transport. This book describes the processes required to install and commission all Triton Network Systems IFUs.

Intended Audience

This book is written for those who are involved in the "hands-on" installation of the IFU, such as installation technicians, site evaluators, project managers, and network engineers. It assumes that the reader has a basic understanding of how to install hardware, use Windows® based software, and operate test equipment. It is recommended that technicians complete the Triton Network Systems Installation and Commissioning training course prior to installing an IFU.

Overview of the IFU Installation and Testing Process

The installation and testing process is accomplished by performing a series of separate, yet interrelated, procedures, each of which is required for the successful implementation of a production IFU network. These procedures are as follows:

- Site Evaluation: Gathering specific information about potential IFU installation sites.

- IFU Configuration: Using IFU link manager software to install network- and site-specific parameters in IFUs.

- Cable and Installation: Testing and installing IFU cables and optional interface devices at installation sites.

- IFU Mounting and Alignment: Mounting IFU brackets to a pole or a wall, mounting an IFU to a bracket, and performing link alignment and radio frequency (RF) verification.

Contacting Triton Network Systems, Inc.

Direct any questions to your project liaison or:

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Fax: +1-407-903-0995
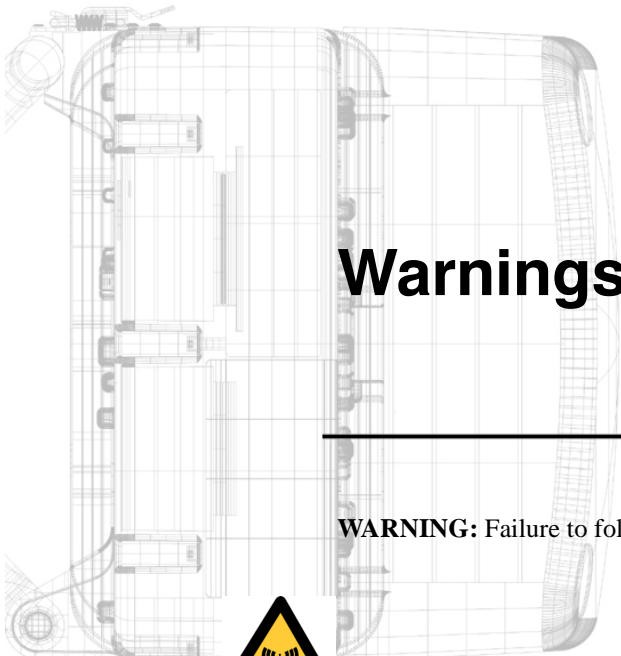
Warnings and Safety Guidelines

WARNING: Failure to follow operating instructions could result in death or serious injury.

Risk of Personal Injury from Radio Frequency Energy Exposure

This symbol indicates a risk of personal injury due to radio frequency energy exposure.

WARNING: RF Energy Exposure Limits and Applicable Rules for 28 GHz. The Triton Network Systems, Inc. 28 GHz radio is tested and evaluated for RF radiation level exposure rules and compliance with FCC 47 CFR 1.1307 and 1.1310, FCC OET - Bulletin 65, and Health Canada Safety Code 6. The Triton Network Systems, Inc. 28 GHz transceiver complies with the 50 W/m^2 (5 mW/cm^2) RF safety limits for controlled / occupational RF workers. To comply with exposure requirements for the protection of the uncontrolled / general public, a minimum separation distance of 6 meters directly in front of the Invisible Fiber® unit is required between the antenna and all persons while the transmitter is ON and operating at its maximum FCC authorized power. The Invisible Fiber® unit is ON when the red light indicator on the backside of the Invisible Fiber® unit enclosure is illuminated. Observe RF energy exposure safety limits, applicable rules, and service interruption cautions in the product manuals. Prolonged exposure to RF energy may result in serious bodily injury.

WARNING: RF Energy Exposure Limits and Applicable Rules for 38 GHz. The Triton Network Systems, Inc. 38 GHz radio is tested and evaluated for RF radiation level exposure rules and compliance with FCC 47 CFR 1.1307 and 1.1310, FCC OET - Bulletin 65, and Health Canada Safety Code 6. The Triton Network Systems, Inc. 38 GHz transceiver complies with the 50 W/m^2 (5 mW/cm^2) RF safety limits for controlled / occupational RF workers. To comply with exposure requirements for the protection of the uncontrolled / general public, a minimum separation distance of 10 meters directly in front of the Invisible Fiber® unit is required between the antenna and all persons while the transmitter is ON and operating at its maximum FCC authorized power. The Invisible Fiber® unit is ON when the red light indicator on the backside of the Invisible Fiber® unit enclosure is illuminated. Observe RF energy exposure safety limits, applicable rules, and service interruption cautions in the product manuals. Prolonged exposure to RF energy may result in serious bodily injury.

The Invisible Fiber® unit must be installed, operated, and maintained in strict accordance with the guidelines described herein and with the Invisible Fiber® unit product's operating and installation manuals and other materials accompanying the devices.

To minimize potential RF exposure and to assure continued compliance, ensure that the Invisible Fiber® unit is mounted and pointed away from pedestrian traffic, such as walkways, gathering and resting areas, and maintain the safe minimum separation distances described below. As described in the product manuals, precautions should be taken to avoid RF exposure.

It is recommended that the radio equipment operator refer to the RF exposure rules and precautions described above and other applicable rules and precautions with respect to transmitters, facilities, and operations that may affect the environment due to RF emissions for each radio equipment deployment site. In addition, the control procedures, guidelines, and assessment requirements obtained herein should become an integral part of the operator's general safety policy procedures for facilities, employees, and services.

Appropriate warning signs must be properly placed and posted at the equipment site and access entries.

The Invisible Fiber® unit has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This Invisible Fiber® unit generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. As such, there is no guarantee that interference will not occur in a particular installation. To determine if the Invisible Fiber® unit is causing interference to radio or television equipment, the owner should monitor the equipment when the Invisible Fiber® unit is turned off. The user is encouraged to try to correct the interference by performing one or more of the following measures on the radio or television antenna that may be affected:

- Reorient or relocate the receiving antenna.

- Increase the separation between the Invisible Fiber® unit and the receiver.

- Connect the Invisible Fiber® unit to an outlet on a different circuit than the circuit to which the receiver is connected.

- Consult the dealer or an experienced radio or TV technician for help.

This device complies with RSS-191 of Industry Canada. Operation is subject to the following two conditions:

- This device may not cause interference.

- This device must accept any interference, including interference that may cause undesired operation of the device.

This Class B digital apparatus complies with Canadian ICES-003.

WARNING: Changes or modifications to the Invisible Fiber® unit not expressly approved by Triton Network Systems, Inc. should be avoided and may void the user's authority to operate the equipment.

Risk of Personal Injury from Fiber Optics

This symbol indicates a risk of personal injury from fiber optic cable laser radiation.

DANGER: Invisible laser radiation. Avoid direct eye exposure to the end of a fiber, fiber cord, or fiber pigtail. The infrared light used in fiber optics systems is invisible, but can cause serious injury to the eye.

WARNING: Never touch exposed fiber with any part of your body. Fiber fragments can enter the skin and are difficult to detect and remove.

Risk of Personal Injury from Electrical Shock

This symbol indicates a risk of personal injury due to an electrical shock.

DANGER – HIGH CURRENT HAZARD: Do not turn on power before reading Triton Network Systems, Inc.'s product documentation. This device has a – 48 Vdc (5 amps operating peak per feed) direct current input.

DANGER – HIGH CURRENT HAZARD: Ensure that the – 48 Vdc power source is set to the OFF position before beginning the installation procedures for the Invisible Fiber® unit.

Other Risks of Personal Injury

This symbol indicates a risk of personal injury from a source other than electrical shock, laser radiation, or radio frequency energy exposure.

WARNING: This Invisible Fiber® unit is designed to permit the connection of the earthed conductor (ground) from the DC source circuit to the earthing conductor at the Invisible Fiber® unit. Do not switch or disconnect devices in the earthed circuit conductor between the DC source and point of connection of the earthing electrode conductor.

CAUTION – LIFTING HAZARD: Due to the weight of the Invisible Fiber® unit (up to 50 pounds), Triton Network Systems, Inc. recommends using proper lifting techniques and equipment. Lifting equipment must be capable of lifting and positioning the Invisible Fiber® unit in a safe manner.

Risk of Service Interruption

This symbol indicates a risk of service interruption or equipment damage.

CAUTION: Handle the Invisible Fiber® unit with care to avoid equipment damage.

CAUTION: Ensure the outside optical fiber connectors are environmentally protected. Failure to do so may cause contamination of the fiber surfaces.

CAUTION: The Invisible Fiber® unit contains no owner or user serviceable parts. Opening the radio unit or tampering with any of its seals voids all warranties.

CAUTION: Prior to installing an Invisible Fiber® unit, the installation site must be surveyed to assess its appropriateness or adequacy, system requirements, path analysis, signal path, and power requirements.

CAUTION: *DO NOT* lift the Invisible Fiber® unit by the attached cables, or, to avoid damaging the antenna, by the radome (front) cover.

CAUTION: Ensure the mounting bracket and Invisible Fiber® unit are installed properly according to the instructions in Triton Network Systems, Inc.'s product documentation.

CAUTION: Ensure that the – 48 Vdc power source is set to the OFF position before attaching power cables to the Invisible Fiber® unit.

CAUTION: Do not block the front of the Invisible Fiber® unit to avoid possible radio service interruption.

CAUTION: To reduce the risk of fiber optic cable damage, use the following bend radius guidelines for indoor/outdoor fiber optic cable:

- Long-term (installed): bend radius is equal to 20 times the diameter of the cable.

- Short-term (during installation): bend radius is equal to 10 times the diameter of the cable.

Other Precautions

Failure to follow the installation procedure described in the Triton Network Systems, Inc. product documentation may result in damage to the Invisible Fiber® unit and render the unit unusable. If you have any questions, contact your Triton Network Systems, Inc. project liaison or the Technical Assistance Center (TAC) at 407-903-2070.

The Invisible Fiber® unit must be installed in accordance with wall-mount or pole-mount specifications described in the Triton Network Systems, Inc. product documentation.

This equipment is not offered for sale or lease to members of the general public and is intended for sale to licensed commercial operators only. This equipment shall also be serviced and professionally installed only by trained personnel.

Triton Network Systems, Inc. is not responsible for compliance with federal and local laws, regulations, electrical codes, building codes, fire codes, and licensing agreements, except as expressly provided herein.

Avertissements et consignes de sécurité

AVERTISSEMENT : Ne pas suivre les instructions d'utilisation peut causer de sérieuses blessures et même la mort.

Risque de lésions corporelles provoquées par 'exposition à l'énergie radiofréquence

AVERTISSEMENT : Limites d'exposition à l'énergie RF et règlements applicables pour 28 GHz. La radio 28 GHz de Triton Network Systems, Inc. est testée et évaluée pour respecter les règlements sur l'exposition au niveau de radiation haute fréquence, les 47 CFR 1.1307 et 1.1310 (FCC), le Bulletin 65 (FCC OET) et le Code de sécurité 6 de Santé Canada. L'émetteur-récepteur 28 GHz de Triton Network Systems, Inc. se conforme aux limites de sécurité de 50 W/m^2 (5 mW/cm^2) pour les travailleurs à l'exposition RF contrôlée / professionnelle. Pour satisfaire aux contraintes d'exposition pour la protection du grand public à l'exposition incontrôlée, une distance de sécurité minimale de 6 mètres directement devant l'unité Invisible Fiber® unit est requise entre l'antenne et toutes personnes lorsque l'émetteur est EN MARCHE et qu'il fonctionne à la tension maximale autorisée par la FCC. L'UIF se trouve EN MARCHE quand le voyant rouge à l'arrière du boîtier de l'UIF est allumé. Observez les limites de sécurité sur l'exposition à l'énergie RF, les règlements applicables et les mises en garde sur l'interruption de service dans les manuels du produit. Une exposition prolongée à l'énergie RF risque d'entraîner des blessures corporelles graves.

AVERTISSEMENT : Limites d'exposition à l'énergie RF et règlements applicables pour 38 GHz. La radio 38 GHz de Triton Network Systems, Inc. est testée et évaluée pour respecter les règlements sur l'exposition au niveau de radiation haute fréquence, les 47 CFR 1.1307 et 1.1310 (FCC), le Bulletin 65 (OET de la FCC) et le Code de sécurité 6 de Santé Canada. L'émetteur-récepteur 38 GHz de Triton Network Systems, Inc. se conforme aux limites de sécurité de 50 W/m^2 (5 mW/cm^2) pour les travailleurs à l'exposition RF contrôlée / professionnelle. Pour satisfaire aux contraintes d'exposition pour la protection du grand public à l'exposition incontrôlée, une distance de sécurité minimale de 10 mètres directement devant l'unité Invisible Fiber® unit est requise entre l'antenne et toutes personnes lorsque l'émetteur est EN MARCHE et qu'il fonctionne à la tension maximale autorisée par la FCC. L'UIF se trouve EN MARCHE quand le voyant rouge à l'arrière du boîtier de l'UIF est allumé. Observez les limites de sécurité sur l'exposition à l'énergie RF, les règlements applicables et les mises en garde sur l'interruption de service dans les manuels du produit. Une exposition prolongée à l'énergie RF risque d'entraîner des blessures corporelles graves.

L'UIF doit être installée, exploitée et entretenue dans le respect rigoureux des directives énoncées dans la présente, des manuels d'utilisation et d'installation du produit UIF et des autres documents qui accompagnent l'appareil.

Pour minimiser l'exposition RF potentielle et pour garantir une conformité continue, assurez-vous que l'UIF est montée à l'écart des aires de trafic pédestre, comme les trottoirs et les aires de rassemblement et de repos, pointée dans une autre direction et maintenue aux distances de sécurité minimales mentionnées ci-dessous. Suivant les explications des manuels du produit, des précautions devraient être prises pour éviter l'exposition RF.

On recommande que l'exploitant de matériel radio se reporte aux règlements et précautions à prendre contre l'exposition RF énumérés ci-dessus et aux autres règlements et précautions applicables au sujet des émetteurs, des installations et des exploitations qui risquent de modifier l'environnement à cause d'émissions radioélectriques lorsqu'il prépare chaque site d'aménagement de matériel radio. De plus, les méthodes de contrôle, les directives et les contraintes d'évaluation obtenues dans la présente devraient devenir partie intégrante des modalités de la politique de sécurité générale de l'exploitant à l'égard des installations, des employés et des services.

Les bons panneaux de mise en garde devraient être placés et affichés de façon appropriée à l'emplacement du matériel et aux voies d'accès.

L'UIF a été testée et prouvée conforme aux limites pour appareil digital de classe B en vertu de la partie 15 des règlements de la FCC. Ces limites ont été établies pour fournir une protection raisonnable contre l'interférence nuisible dans les installations résidentielles. La présente UIF génère, utilise et peut rayonner de l'énergie radiofréquence; si elle n'est pas installée et utilisée selon les instructions, elle risque de créer une interférence nuisible aux radiocommunications. À ce titre, il n'existe aucune garantie qu'une interférence ne surviendra pas dans une installation particulière. Pour vérifier si l'UIF interfère avec du matériel radio ou télévisuel, le propriétaire devrait contrôler l'équipement lorsque l'UIF est en état d'arrêt. On encourage l'utilisateur à essayer de corriger l'interférence en prenant l'une des mesures suivantes ou plus sur l'antenne de radio ou de télévision qui semble touchée :

- Réorientez ou déplacez l'antenne réceptrice.

- Augmentez la distance entre l'UIF et le récepteur.

- Branchez l'UIF sur une sortie d'un circuit différent du circuit auquel le récepteur est branché.

- Consultez un vendeur ou un technicien en radio ou en télévision expérimenté pour obtenir de l'aide.

Cet appareil satisfait au CNR-191 d'Industrie Canada. Son exploitation fait l'objet des deux conditions suivantes :

- L'appareil ne doit pas provoquer d'interférence.

- L'appareil doit accepter toute interférence, y compris l'interférence capable d'entraîner un fonctionnement indésirable de celui-ci.

Le présent appareil digital de classe B se trouve conforme à la NMB-003 du Canada.

AVERTISSEMENT : Les changements ou les modifications de l'UIF qui ne sont pas expressément approuvés par Triton Network Systems, Inc. devraient être évités et risquent d'annuler l'autorisation de l'utilisateur à faire fonctionner

Risque de lésions corporelles provoquées par les câbles à fibres optiques

Ce symbole indique un risque de lésions corporelles provoquées par les câbles à fibres optiques.

DANGER : Rayonnement laser invisible. Éviter l'exposition directe des yeux à l'extrémité d'une fibre, d'un cordon à fibres ou d'une fibre amorce. La lumière infrarouge utilisée dans les systèmes à fibres optiques est invisible, mais peut provoquer des lésions graves aux yeux.

AVERTISSEMENT : Ne jamais laisser une fibre nue entrer en contact avec une partie quelconque du corps. Des fragments de fibre peuvent entrer dans la peau, et sont difficiles à déceler et à enlever.

Risque de lésions corporelles provoquées par la décharge électrique

Ce symbole indique un risque de lésions corporelles provoquées par la décharge électrique.

DANGER – RISQUE DE COURANT ÉLEVÉ : Ne pas mettre la tension avant de lire la documentation du produit fournie par la société Triton Network Systems, Inc. Cet appareil a une alimentation directe de – 48 V CC (courant de pointe de 5 ampères par ligne d'alimentation).

DANGER – RISQUE DE COURANT ÉLEVÉ : S'assurer que le bloc d'alimentation – 48 V CC est en position HORS TENSION avant d'aborder les procédures pour l'installation de l'unité Invisible Fiber®.

Autres risques de lésions corporelles

Ce symbole indique un risque de lésions corporelles (à part celles provoquées par la décharge électrique, par la radiation du laser, ou par l'exposition à l'énergie radiofréquence).

AVERTISSEMENT : L'unité Invisible Fiber® est conçue pour permettre la connexion du conducteur relié à la terre (prise de terre) du circuit d'alimentation CC au conducteur de mise à la terre sur l'unité Invisible Fiber®. Ne commutez ou ne débranchez pas les appareils le long du conducteur du circuit de terre entre la source d'alimentation CC et le point de connexion du conducteur de l'électrode de prise de terre.

ATTENTION - DANGER LORS DU SOULÈVEMENT : En raison du poids de l'UIF (jusqu'à 50 livres), Triton Network Systems, Inc. recommande d'utiliser des techniques et un équipement de levage appropriés. L'équipement de levage doit pouvoir soulever et placer l'UIF en toute sécurité

Risque d'interruption de service

Ce symbole indique un risque d'interruption de service ou de dommage aux à l'équipement.

MISE EN GARDE : Manipuler l'unité Invisible Fiber® avec soin pour éviter des dommages à l'équipement.

MISE EN GARDE : S'assurer que les raccords extérieurs fibre optique sont protégés contre l'environnement. L'absence d'une telle protection peut entraîner la contamination des surfaces des fibres.

MISE EN GARDE : L'unité Invisible Fiber® ne contient pas de de piéces réparables par le propriétaire ou l'usager. Ouvrir l'unité de la radio ou déranger l'un ou l'autre des fermetures de sécurité rend toute garantie nulle et non avenue.

MISE EN GARDE : Avant d'installer une unité Invisible Fiber®, il faut vérifier que les lieux de l'installation sont convenables et adéquats, déterminer les besoins du système, analyser les trajets, préciser le parcours du signal et déterminer les exigences en matière d'énergie.

MISE EN GARDE : *NE PAS* soulever l'unité Invisible Fiber® par le couvercle du radôme (couvercle avant), afin d'éviter d'endommager l'antenne.

MISE EN GARDE : S'assurer que le support de montage et l'unité Invisible Fiber® sont installés convenablement, selon les instructions figurant dans la documentation du produit fournie par la société Triton Network Systems, Inc.

MISE EN GARDE : S'assurer que le bloc d'alimentation – 48 V CC est en position HORS TENSION avant d'attacher les câbles d'alimentation à l'unité Invisible Fiber®.

MISE EN GARDE : Ne pas bloquer le devant de l'unité Invisible Fiber®, pour éviter toute interruption éventuelle du service de transmission radio.

MISE EN GARDE : Pour réduire le risque de dommage aux câbles à fibres optiques, suivre les consignes suivantes en matière de rayon de courbure des câbles à fibres optiques extérieurs ou intérieurs:

- Corbure à long terme (installée). Le rayon de courbure ne doit pas dépasser 20 fois le diamètre du câble.

- Courbure à court terme (pendant l'installation). Le rayon de courbure ne doit pas dépasser 10 fois le diamètre du câble.

Autres mises en garde

Le non-respect de la méthode d'installation décrite dans la documentation du produit de Triton Network Systems, Inc. peut résulter dans l'endommagement de l'unité Invisible Fiber® et rendre l'unité inutilisable. Si vous avez des questions quelconques, contactez votre agent de liaison d'affaire de Triton Network Systems, Inc. ou le Centre d'assistance technique (CAT) au 407-903-2070.

Il faut installer l'unité Invisible Fiber® en conformité avec les instructions de montage sur paroi murale ou sur poteau détaillées dans la documentation du produit de Triton Network Systems, Inc.

Cet équipement n'est pas fourni aux fins de vente ou de location aux membres du grand public, et il se destine à la vente aux exploitants commerciaux agréés exclusivement. L'équipement doit aussi être entretenu et installé de façon professionnelle par du personnel qualifié seulement.

Triton Network Systems, Inc. n'est pas responsable de l'observation des lois, des règlements, des codes d'installation électrique, des codes du bâtiment, des codes de prévention des incendies et des accords d'autorisation fédéraux et locaux, sauf dispositions contraires expresses dans la présente.
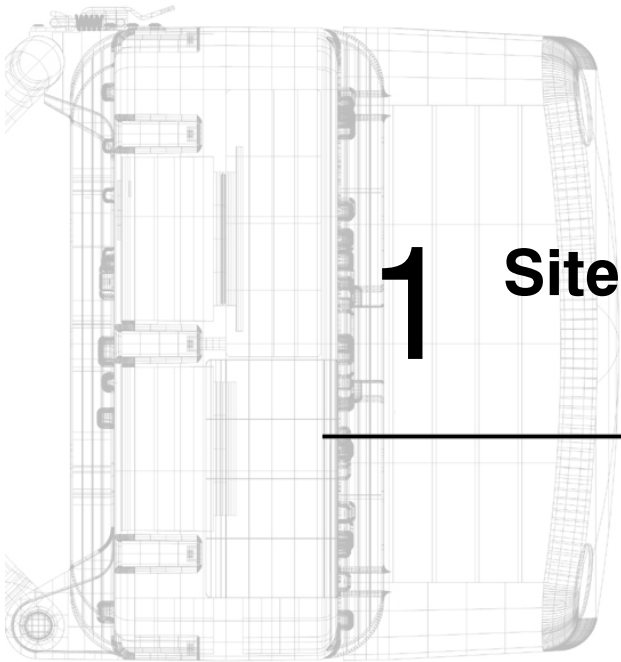
1 Site Evaluation

Chapter 1 describes the process for completing a proper site evaluation.

1.1   What Is a Site Evaluation?

A site evaluation consists of a series of procedures for gathering specific information about potential IFU locations. These processes are outlined in Section 1.4, *Site Evaluation Process*. Use these procedures to gather the required information and record that information on the site evaluation form. This information is critical to the successful design and deployment of a network.

1.2   Why Perform a Site Evaluation?

Site evaluations are required to confirm whether or not a building meets network design requirements. The main objectives are as follows:

- Confirm:
    - Line of sight for each link
    - IFU mounting locations
    - Site equipment locations
    - Cable routes
    - Any other potential RF sources
- Prepare site drawings and record site information on the site evaluation form

A site evaluation form, similar to that shown in Section 1.5, *Documenting a Site Evaluation*, should be used to record data for each site. Building data collected using a form such as this provides the information required to confirm network design, develop site drawings for equipment and cable installation, and perform interference analysis.

1.3   Preparing for a Site Evaluation

The following tools and forms are required to perform a site evaluation:

- ☐   RF and network design diagrams (as required)
- ☐   Site evaluation form
- ☐   Binoculars
- ☐   Global positioning system (GPS) or range finder
- ☐   Compass
- ☐   Measuring tape and/or wheel
- ☐   Digital camera
- ☐   Area map
- ☐   Aerial photograph
- ☐   List of potential installation sites ("targeted" buildings)

The following tasks must be completed prior to performing a site evaluation:

- Prepare the initial network design plan by performing the following:
    - Identify potential buildings by identifying targeted customers
    - Identify potential links by selecting buildings based on the high probability of line of sight

- Arrange for access with the facility personnel into the buildings, equipment rooms, and architectural plans to become familiar with the location of all ducts, risers, etc.

- Obtain the required site evaluation forms (see Section 1.5, *Documenting a Site Evaluation*).

1.4   Site Evaluation Process

The following steps must be completed to perform a successful site evaluation. Each step in the process is detailed in the following subparagraphs:

- *Ensure RF Safety Compliance*

- *Ensure Compliance With Laws, Regulations, Codes, and Agreements*

- *Establish Line of Sight Between IFUs*

- *Ensure Building Aesthetics*

- *Determine IFU Mounting Requirements*

- *Document Potential Sources of Colocation Interference*

- *Measure the Link Distance*

- *Select the Grounding Location*

- *Determine Fiber Demarcation and Surge Suppression Location (Optional)*

- *Determine Site Equipment Location and Requirements*

- *Determine the Length of Fiber Cable Assemblies*

- *Determine the Length of Power Cables*

- *Confirm Presence of AC Power*

- *Take Site Photographs*

- *Sketch the Site*

1.4.1   Ensure RF Safety Compliance

IFUs are tested for RF radiation level exposures in accordance with IEEE standards. Ensure that appropriate warning signs are properly placed and posted at the equipment site or access entry.

For a complete list of warnings and safety guidelines, refer to *Warnings and Safety Guidelines* on page xv.

1.4.2 Ensure Compliance With Laws, Regulations, Codes, and Agreements

Ensure that any installation performed as a result of the site evaluation is in full compliance with applicable federal and local laws, regulations, electrical codes, building codes, fire codes, and licensing agreements.

1.4.3 Establish Line of Sight Between IFUs

The most critical step in conducting a site evaluation is confirming clear line of sight (LOS) between a *near IFU* and a *far IFU*; if LOS does not exist, another location must be used.

> **NOTE:** Throughout this book, *near IFU* refers to the IFU at the site location being evaluated. *Far IFU* refers to the IFU at the other end of the link in the network.

IFUs in a link must have a clear view of each other, or "line of sight." Binoculars may be used to evaluate the path from the desired location of the near IFU to the desired location of the far IFU.

To confirm the line of site:

- Ensure that no obstructions are close to the transmitting/receiving path. Take into consideration trees, bridges, construction of new buildings, unexpected aerial traffic, window washing units, etc.

- Ensure that each IFU can be mounted in the position required to correctly align the IFU with its link partner (see Section A.2, *IFU Mounting Bracket*).

1.4.4 Determine IFU Mounting Requirements

Use the following information to determine the mounting location and method (wall mount or pole mount) for each IFU. After defining the mounting location for the IFU, re-confirm the line of sight.

> **NOTE:** Review the proposed installation locations with the building manager before installing IFUs.

Wall-Mount Criteria

IFUs can be mounted to a parapet wall, screen wall, or penthouse wall provided that the following criteria are met:

- The wall is structurally capable of supporting at least 90 pounds (40 kilograms) per IFU.

- The wall is structurally capable of supporting wind loading conditions of up to 125 miles (201 kilometers) per hour.

- The wall allows through-hole bolt mounting.

- The space for the IFU, its mounting bracket, and the alignment area must be at least 65 inches by 65 inches by 30 inches (165 centimeters x 165 centimeters x 76 centimeters) (W x H x D).

- A minimum of 0.5 inch (12.7 millimeters) diameter or bolts with lock washers or positive locking nuts are used.

- The minimum distance between IFUs is three feet (91 centimeters). Refer to the Triton Network Systems white paper *RF Design Guidelines for Consecutive Point Networks* for additional information about colocating IFUs.

- The bottom of the IFU is a minimum of seven feet above the roof to ensure line of site is maintained.

> **NOTE:** The Triton Network Systems preferred mounting location is on a wall, as walls are generally structurally sound.

Pole-Mount Criteria

IFUs can be mounted to a free-standing pole, or a pole attached to a wall, provided that the following criteria are met:

- The pole is capable of supporting at least 90 pounds (40 kilograms) per IFU, plus the wind loading as required by local building codes. For free-standing poles, consult the pole manufacturer for the required ballast weight to secure the pole based on wind loading requirements.

- The bottom of the IFU is a minimum of seven feet above the roof to ensure line of site is maintained

- The Triton Network Systems recommended outside diameter for a mounting pole is from 3.0 inches (7 centimeters) to 4.5 inches (11 centimeters).

- The minimum vertical distance between IFUs is three feet (91 centimeters). Refer to the Triton Network Systems white paper *RF Design Guidelines for Consecutive Point Networks* for additional information about colocating IFUs.

1.4.5   Ensure Building Aesthetics

The IFUs streamlined exterior is designed to complement building aesthetics. Ensure that the IFU can be mounted so that it is aesthetically pleasing to the environment and to the property owner. Aesthetics must be approved by the property owner and the network engineer.

Refer to *Painting Guidelines* on page A-4 for guidelines on painting an IFU enclosure.

1.4.6   Document Potential Sources of Colocation Interference

When IFUs are located on a roof or pole with other transmitters and receivers, an interference analysis may be required to determine and resolve possible interference issues. The interference analysis needs to be performed by an RF engineer. The specific information required for each transmitter and receiver includes the following:

- Transmitting and/or receiving frequency

- Type of antenna

- Distance from IFU (horizontal and vertical)

- Polarity (horizontal or vertical)

- Transmit power level

- Antenna direction

1.4.7   Measure the Link Distance

The two ways to measure link distance are as follows:

- GPS - record the latitude and longitude for the near and far IFU sites and calculate the link distance.

> **NOTE:** Record the mapping datum used by the GPS unit and ensure the same mapping datum is used for all site evaluations in a given network.

- Rangefinder - measure the link distance (imperial or metric units may be used).

Once the link distance has been measured, verify that the link distance meets the availability requirements for the link.

1.4.8   Select the Grounding Location

Identify the connection point for grounding the IFU bracket. The required grounding location is the building ground. Determine the nearest location of the building ground and measure the distance from the IFU bracket.

An earth ground strap should be run from the IFU mounting location to the building earth ground. This grounding should comply with all codes and should be kept *isolated from any building lightning protection* to prevent any damage to the IFU. If a surge suppression panel is used, it should also be grounded to the buildings earth ground, but run separately.

1.4.9   Determine Fiber Demarcation and Surge Suppression Location (Optional)

If a fiber demarcation box or a surge suppressor is being used, then the length of the cable and the cable type needs to be determined. Fiber demarcation and surge suppression can be indoors or outdoors. Surge suppression devices should be grounded to the building ground.

> **NOTE:**   Section 1.4.11, *Determine the Length of Fiber Cable Assemblies* provides guidelines for determining wether an installation site will require a fiber demarcation box.

> **NOTE:** To save and protect in-building equipment, Triton Network Systems recommends the use of a surge suppressor for GPI and power cables.

1.4.10   Determine Site Equipment Location and Requirements

Site equipment can be installed in a free-standing rack or wall-mounted cabinet. Triton Network Systems recommends a lockable cabinet for maximum physical security. A site equipment cabinet typically contains the power source for an IFU and is the primary cable termination point for the power, GPI, and fiber optic cables that are connected to an IFU.

It is possible to mount the site equipment indoors or outdoors. It is preferable to mount the site equipment in a room (such as an electrical room or a telecommunications closet) close to the IFU location.

When determining the location for a site equipment cabinet or rack, observe the following:

- Identify the riser and the horizontal cable runs from the entry point to the site equipment room.

- Ensure that there is sufficient clearance to allow a technician to access the site equipment.

- Ensure that the site equipment location meets the minimum environmental specifications for all equipment to be located in the site equipment cabinet or rack.

1.4.11   Determine the Length of Fiber Cable Assemblies

The primary consideration for selecting an outdoor cabling option is the distance and route between an IFU and the site equipment.

A single Triton Network Systems outdoor fiber cable assembly can connect an IFU directly to the site equipment when the cable run required for this connection (see Figure 1-1). If the cabling distance between the IFUs and the customer premise equipment (CPE) exceeds the maximum length of the longest available Triton Network Systems outdoor fiber cable assembly, the customer has the following options:

> **NOTE:** Contact your Triton Network Systems sales representative for available lengths of prefabricated outdoor fiber cable assemblies.

- Order outdoor fiber cable assemblies from Triton Network Systems and acquire the following additional items (see Figure 1-2):
  - A demarcation box, which provides a connection point for two IFUs installed on the same rooftop.
  - An indoor fiber cable of sufficient length to connect the demarcation box to the site equipment.

> **NOTE:** For sites without a demarcation box, back-to-back connections between IFUs on the same rooftop are made through a fiber patch panel located with the site equipment. Otherwise, the demarcation box provides the back-to-back IFU connection.

• Use a custom fiber outdoor cable assembly of sufficient length to directly connect the IFU to the site equipment interface. It is the customer's responsibility to determine the required length for custom cables and to acquire custom cables from a third-party provider. Triton Network Systems Customer Service will assist in determining proper specifications for cables if so requested by the customer.

NOTE: The maximum fiber cable length should not exceed 3,300 feet (1,000 meters) for any single cable, or a total length of 6,600 feet (2,000 meters) for any two fiber cable assemblies that connect two IFUs installed at the same site. This limitation is governed by the 10BaseFL specification, which defines a maximum segment length of 1,000 meters.
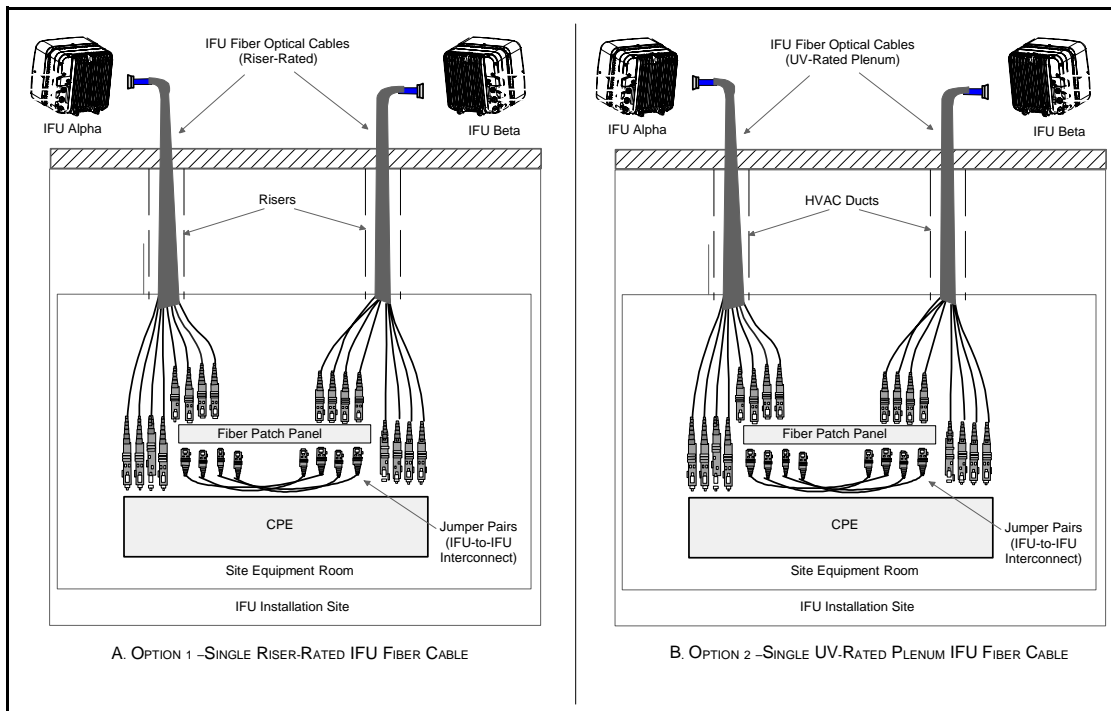
Figure 1-1: Direct IFU-to-Site Equipment Cable Connection

NOTE: Figure 1-1 and Figure 1-2 show a Fast Ethernet outdoor fiber cable, which has eight SC connectors. SONET/SDH outdoor fiber cables are similar, but use six SC connectors.

IFU Fiber Optical Cables
(Outdoor)

IFU Alpha

IFU Beta

Demarcation Box

Jumper Pairs
(IFU-to-IFU
Interconnect)

Indoor Fiber Optical Cable

CPE

Site Equipment Room

IFU Installation Site

Option 3 – Demarcation Box
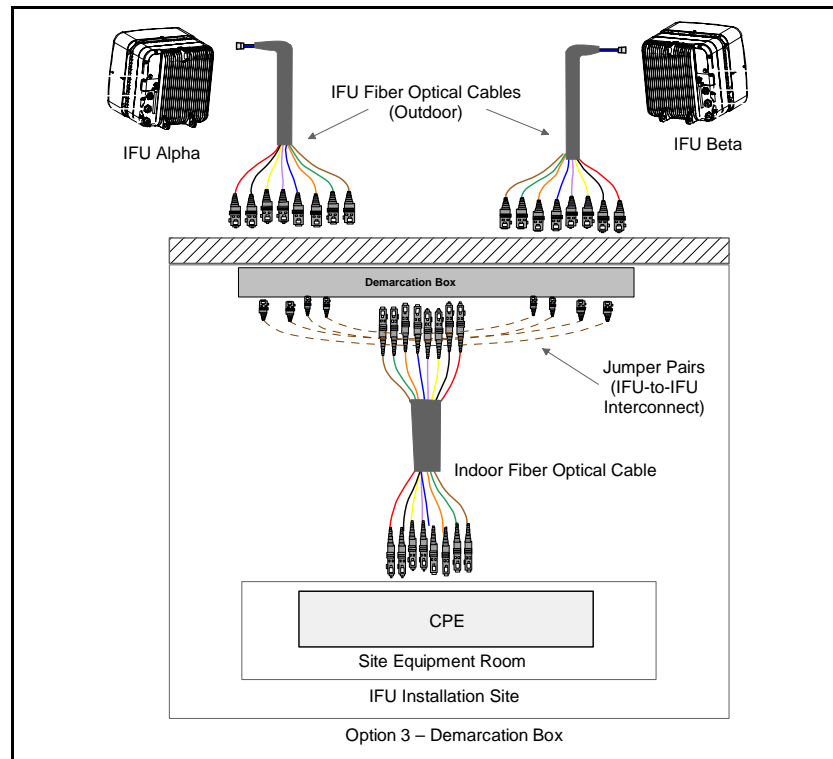
Figure 1-2:   IFU-to-Site Equipment Connection Using a Demarcation Box

Guidelines for Connecting Outdoor Fiber Cable Assemblies

Providers can either directly connect outdoor cables to the site equipment or interface to the site equipment through an intermediary connection point such as a demarcation box. The following subparagraphs provide guidelines for choosing the appropriate option.

Direct Fiber Connection (Options 1 and 2)

Use a single outdoor fiber cable assembly when the cable run between the IFU and the site equipment interface (switch, ADM, or fiber patch panel) is less than the maximum length of the longest available Triton Network Systems outdoor fiber cable assembly. The two single fiber connection options are as follows:

*   Riser-rated cable (Option 1). This option uses a single riser-rated plenum fiber cable to connect directly to the site equipment interface without the use of conduit or a demarcation box. Use Option 1 when the site engineering plan specifies that the IFU fiber cable will be installed within building riser assemblies (see Figure 1-1 A).

- UV-rated plenum cable (Option 2). This option uses a single UV-rated plenum fiber cable to connect directly to the site equipment interface without the use of conduit or a demarcation box. Use Option 2 when the site engineering plan specifies that the IFU fiber cable will be installed within building heating, ventilation and air conditioning (HVAC) ducts (see Figure 1-1 B).

> **NOTE:** Only plenum-rated cables should be installed within building HVAC ducts. Plenum-rated cables are less likely to spread poisonous gas should a fire occur within the ducting.

Demarcation Box Option (Option 3)

A demarcation box connects two outdoor IFU fiber cable assemblies with a single indoor fiber cable that connects to the site equipment. This option can support lengthy cable runs. Jumper cables at a fiber patch panel interconnect two IFUs on the same rooftop. Figure 1-2 shows this connection option.

Implementation

Triton Network Systems recommends using a demarcation box only for those installations where the distance between the IFU and the site equipment interface exceeds the maximum length of the longest available Triton Network Systems outdoor fiber cable assembly. Otherwise, the direct IFU-to-site equipment connection option is preferred, due to its lower implementation costs and superior performance characteristics. Figure 1-3 provides a flowchart to assist in selecting the appropriate fiber cabling option for any IFU installation site.
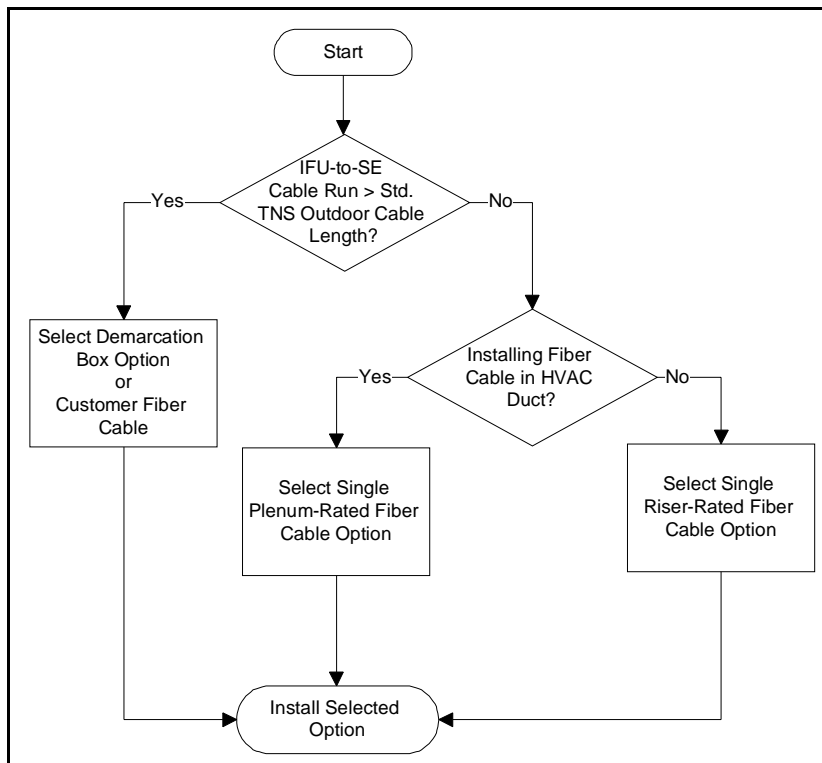
Figure 1-3:   Fiber Cable Option Selection Flowchart

1.4.12 Determine the Length of Power Cables

When Using Triton Network Systems Outdoor Power Cables

Table 1-1 and Table 1-2 show the maximum lengths of indoor power cable lengths when used with representative Triton Network Systems outdoor power cables.

**Table 1-1: Maximum Indoor Power Cable Length
with One Pair of Conductors**

Indoor Cable Gauge	Outdoor Cable Length (Feet and Meters)		
	65 Feet (20 Meters)	133 feet (40 Meters)	333 Feet (100 Meters)
10 AWG	1125.6 (343.1)	1090.0 (332.2)	992.1 (302.4)
12 AWG	557.2 (169.8)	539.6 (164.4)	491.1 (149.7)
14 AWG	446.7 (136.2)	432.5 (131.8)	393. (120.0)7

**Table 1-2: Maximum Indoor Power Cable Length
with Two Pairs of Conductors**

Indoor Cable Gauge	Outdoor Cable Length (Feet and Meters)		
	65 Feet (20 Meters)	133 feet (40 Meters)	333 Feet (100 Meters)
10 AWG	2251.2 (682.2)	2180.0 (664.5)	1984.2 (604.8)
12 AWG	1114.4 (339.7)	1079.2 (328.9)	982.3 (299.4)
14 AWG	893.3 (272.3)	865.1 (263.7)	787.4 (240.0)

When Using Customer or Third Party Outdoor Power Cables

The maximum length of an IFU power cable, if using a single-pair 12-AWG cable from the power plant to the IFU, may be determined by the following calculation and information in Table 1-3 and Table 1-4.

> **NOTE:** 1 ft = 0.305 m

The resistance in the power cable(s) from the power supply to the IFU should be no greater than 2.6 Ω (ohms). Assuming the use of an indoor and outdoor cable, the formula for the maximum allowable length of the indoor cable is:

$$d_i = \left[\frac{(2.6 - R_o)}{2 \times R'} \right] \times \left(\frac{w}{t_{Cu}} \right)$$

where:

d_i is the distance of the indoor cable run, in feet

R' is the resistance per foot of the cable used, in ohms for each standard length (see Table 1-3)

R_o is the resistance of the outdoor cable (see Table 1-4)

w is the number of pairs of wires in the indoor cable

t_{Cu} is the temperature coefficient of copper and is equal to 1.0039^{30}

In most cases, a 10, 12, or 14 gauge wire will be used in the indoor cable. Table 1-3 gives R' values for these three wire sizes.

Table 1-3: Resistance Per Foot

	10 AWG	12 AWG	14 AWG
R'	.001 Ω/ft.	.00202 Ω/ft.	.00252 Ω/ft.

Triton Network Systems provides outdoor power cables in lengths of 20 meters (65.6 feet), 40 meters (131.2 feet), and 100 meters (328.1 feet); each of these cables uses two pairs of 12-AWG wire. The resistance for each of these cables (R_o) are given in Table 1-4.

Table 1-4: Resistance of Outdoor Cables

	20 m	40 m	100 m
R_o	.07 Ω	.15 Ω	.37 Ω

If the length of the outdoor cable is specific to the installation (i.e., the outdoor cable is not a Triton Network Systems-standard cable), use the following formula to calculate R_o.

$$R_o = 2 \times R' \times d_o \times \left(\frac{t_{Cu}}{w} \right)$$

where:

d_o is the distance of the outdoor cable run (in feet)

If a single cable is used to connect the power supply and IFU, the formula for the maximum cable run (**d**) is as follows:

$$d = \left(\frac{2.6}{2 \times R'} \right) \times \left(\frac{w}{t_{Cu}} \right)$$

Example:

If the outdoor cable is 40 meters and the indoor cable is 10 AWG, using a single pair of wires, the maximum allowable indoor cable run (d_i) is calculated as follows:

$$d_i = \frac{2.6 - R_o}{2 \times R'} \times \left(\frac{w}{t_{Cu}}\right)$$

From Table 1-3, $R' = .001$ Ω/ft

From Table 1-4, $R_o = .15$ Ω

w = 1 pair

$t_{Cu} = 1.0039^{30}$ mv/°C

Therefore:

$d_i = [(2.6-.15)/2(.001)] * (1/1.0039^{30})$

$d_i = (2.45)/.002) * (1.0039^{-30})$

$d_i = 1090$ feet

$(d_i = 332$ m$)$

1.4.13   Confirm Presence of AC Power

Ensure AC power will be available to provide power to the power supply and all other electrical supplies. AC power is required within 15 feet (4.5 meters) of the site equipment location.

> **NOTE:** A NEMA L5-15R, 15A twist-lock receptacle outlet is recommended.

1.4.14   Take Site Photographs

Take photographs of the following:

*   IFU mounting location for each IFU

*   View of the other buildings in the link from the IFU mounting location

*   Site equipment mounting location

*   360 degree views from the installation site

1.4.15   Sketch the Site

Sketch the installation location of all site equipment and cable routes. Providers can use these sketches to produce the architectural and engineering drawings, which are blueprints for the installers. Recommended sketches include the following:

*   Site equipment location, including the indoor AC power source

*   Mounting locations of IFUs (wall or pole mount)

*   All cable routing

- Any other transmitters and/or receivers and other structures that could possibly impede IFU transmission

- Fiber demarcation box location (if required)

- Surge suppression location

Attach sketch to the site evaluation form (see Section 1.5, *Documenting a Site Evaluation*)

1.5 Documenting a Site Evaluation

Use the site evaluation form provided at the end of this section to document the results of your site evaluation.

Site Evaluation Form

Address	
Site Engineer	
Contact Person	
Phone	
Site No	
Site Agent	
Site Type	
IFU Roof Location	

IFU

#	Latitude	Longitude	Mapping Datum (ex. NAD27)

Roof Requirements

	Example	Information	Information	Information
IFU #	4			
Clear Line of Sight	Yes			
Mounting Method	Wall or pole			
FCC Compliance	TBD			
Collocation	Complete Table A1			
Aesthetics	Paint IFU to match wall			
IFU Azimuth	60 degrees			
GPS Reading	80 21' 48"			
Cables lengths	28 14' 35"			
Power				
Alarm	32 meters			
Fiber	32 meters			
Grounding/Lightning	32 meters			
Instructions	Provide 6 in. ground straps			
Photographs*				
Photo 1	X			
Photo 2	X			
Photo 3	X			
Sketches**				
Sketch 1	X			
Sketch 2	X			

Recommendations for Site Photographs and Sketches

*Photographs

   Photo 1 – IFU mounting location

   Photo 2 – View from the IFU mounting location to the link partner

   Photo 3 – CPE location

**Sketches

   Sketch 1 – Roof and cable routes to entry point

   Sketch 2 – Details for grounding and lightning protection

   Sketch 3 – CPE room and cable routes from entry point

Site Evaluation Form

Colocated Antennas

Parameters	Example Information	Information	Information	Information
Source	PCS			
Tx and/or Rx	TX/RX			
Frequency	2.1 GHz			
Distance from IFU	5 ft			
Owner	Sprint PCS			
Azimuth	210 degrees			
Elevation	2 degrees downtilt			
Antenna Type	Scala XXXXX			
Power	14 W			

CPE

Parameters	Example Information	Information	Information	Information
CPE room identified	Yes			
Space for cabinet	Yes			
Phone line within 20 ft	Need to install			
110 VAC available?	Need to install			
Cables	Confirm cable lengths.			
Take Photo 3	X			
Sketch 3	X			

Indoor Space Requirements

Front View

Top View

Side View

Equipment Dimensions

Equipment Cabinet

Batteries

Notes

2 IFU Configuration

Chapter 2 describes the IFU configuration procedure to be performed at the designated staging area. The staging area is a central location – warehouse, office area, etc. – where the IFU configuration attributes are loaded prior to building installation. If circumstances prevent this from being possible, IFU configuration can occur elsewhere. The instructions in this section assume that IFU configuration is performed at a central location.

Warnings

Risk of Personal Injury from Radio Frequency Energy Exposure

WARNING: RF Energy Exposure Limits and Applicable Rules for 28 GHz. The Triton Network Systems, Inc. 28 GHz radio is tested and evaluated for RF radiation level exposure rules and compliance with FCC 47 CFR 1.1307 and 1.1310, FCC OET - Bulletin 65, and Health Canada Safety Code 6. The Triton Network Systems, Inc. 28 GHz transceiver complies with the 50 W/m^2 (5 mW/cm^2) RF safety limits for controlled / occupational RF workers. To comply with exposure requirements for the protection of the uncontrolled / general public, a minimum separation distance of 6 meters directly in front of the Invisible Fiber® unit is required between the antenna and all persons while the transmitter is ON and operating at its maximum FCC authorized power. The Invisible Fiber® unit is ON when the red light indicator on the backside of the Invisible Fiber® unit enclosure is illuminated. Observe RF energy exposure safety limits, applicable rules, and service interruption cautions in the product manuals. Prolonged exposure to RF energy may result in serious bodily injury.

WARNING: RF Energy Exposure Limits and Applicable Rules for 38 GHz. The Triton Network Systems, Inc. 38 GHz radio is tested and evaluated for RF radiation level exposure rules and compliance with FCC 47 CFR 1.1307 and 1.1310, FCC OET - Bulletin 65, and Health Canada Safety Code 6. The Triton Network Systems, Inc. 38 GHz transceiver complies with the 50 W/m^2 (5 mW/cm^2) RF safety limits for controlled / occupational RF workers. To comply with exposure requirements for the protection of the uncontrolled / general public, a minimum separation distance of 10 meters directly in front of the Invisible Fiber® unit is required between the antenna and all persons while the transmitter is ON and operating at its maximum FCC authorized power. The Invisible Fiber® unit is ON when the red light indicator on the backside of the Invisible Fiber® unit enclosure is illuminated. Observe RF energy exposure safety limits, applicable rules, and service interruption cautions in the product manuals. Prolonged exposure to RF energy may result in serious bodily injury.

Risk of Personal Injury from Electrical Shock

DANGER – HIGH CURRENT HAZARD: Do not turn on power before reading the Triton Network Systems' product documentation. This device has a – 48 Vdc (5 amps operating peak per feed) direct current input.

DANGER – HIGH CURRENT HAZARD: Ensure that the – 48 Vdc power source is set to the OFF position before beginning the installation procedures for the Invisible Fiber® Unit.

Other Risks of Personal Injury

CAUTION – LIFTING HAZARD: Due to the weight of the Invisible Fiber® unit (up to 50 pounds), Triton Network Systems, Inc. recommends using proper lifting techniques and equipment. Lifting equipment must be capable of lifting and positioning the Invisible Fiber® unit in a safe manner.

2.1   Materials Required

The following items are needed to configure an IFU:

- ☐ Power supply (– 48 Vdc @ 3.5 Amps)
- ☐ IFU link manager test cable
- ☐ IFU power cable
- ☐ Voltmeter with test leads
- ☐ Laptop computer, Windows 98/2000 operating system, and an Ethernet card with any necessary adapters
- ☐ IFU link manager software
- ☐ Communication software (for example, HyperTerminal or ProComm)
- ☐ Site engineering folder with site drawings

2.2   IFU Configuration Process

Using the site attributes identified in the site engineering folder, configure each IFU by completing the following procedures:

- *Verifying the IFU Model*
- *Installing IFU Link Manager*
- *Connecting the IFU to the PC and Power Source*
- *Obtaining the IFU's IP Address*
- *Configuring Windows Networking Properties*
- *Logging Into the IFU Using IFU Link Manager*
- *Configuring the IFU's Site Attributes*

2.2.1   Verifying the IFU Model

When receiving an IFU, whether at the staging location or the installation location, ensure that the model number on the IFU matches the label on the outside of the box and the model number in the site engineering folder. Verify the polarity (horizontal or vertical) and band (high or low) before installing an IFU. This information is provided in the product label at the rear of each IFU.

2.2.2   Installing IFU Link Manager

If IFU link manager software is not already installed on your PC, perform the following steps:

1. Insert the IFU link manager CD into the CD-ROM drive on your personal computer (PC). Be sure that the PC has Windows 98/2000 software installed.

2. Double click on the **My Computer** icon located on the desktop.

---

3. Double click on the CD-ROM drive associated with the computer.

4. Double click on folder v x-x-x (where x-x-x is the most current software version number). A list of files opens.

5. Double click on the file named **dInstall.bat**.

6. As the software is being installed, an MS-DOS window appears.

7. Wait for the MS-DOS window to say **Finished-dInstall** on the top of the screen and then close the MS-DOS window.

8. On your desktop, click the **Start** button. Select **Programs ➢ Windows Explorer**.

9. In Windows Explorer, select the **C:** drive and double click on the **Program Files** folder.

10. Double click on the **Triton** folder. A list of all the files within the folder appears.

11. Right click on the file named **lmngrv x-x-x.bat**. A dialogue box appears.

12. In the dialogue box, click on **Create Shortcut**. A file named **Shortcut to lmngrvx-x-x.bat** appears.

13. Click and drag the newly created file onto the desktop and then close Windows Explorer.

14. On your desktop, right click on the existing **Shortcut to lmngrvx-x-x.bat** icon. A dialogue box appears.

15. Click on **Properties**, then the **Program** tab, and then the **Change Icon** button. The Change Icon window appears.

16. In the Change Icon window, under **File name**, type in C:\Program Files\Triton\ TritonHorn.ico and click **OK**. The Triton Network Systems icon ![icon] appears in the **Change Icon** dialogue box.

17. Click **OK** and **OK** again. The Triton Horn icon appears on your desktop.

2.2.3   Connecting the IFU to the PC and Power Source

Perform the following steps to ensure the IFU is powered up and connected to your PC:

1. Connect the IFU power cable to the -48 Vdc power supply, then connect the IFU power cable to the power connector located on the rear of the IFU.

> **NOTE:** Ensure that the -48 Vdc power supply is turned off prior to connecting the IFU power cable.

2. Using the voltmeter, perform the cable continuity test provided in Section 5.2, *IFU Power Cable Test Procedure* (Fast Ethernet applications) or Section 6.2, *IFU Power Cable Test Procedure* (SONET/SDH applications). This ensures that the IFU power cable is delivering proper voltage to the IFU.

3. Connect the laptop computer to the IFU using the RJ-45 and the DB-9 connectors of the IFU test cable assembly (see Figure 2-1).
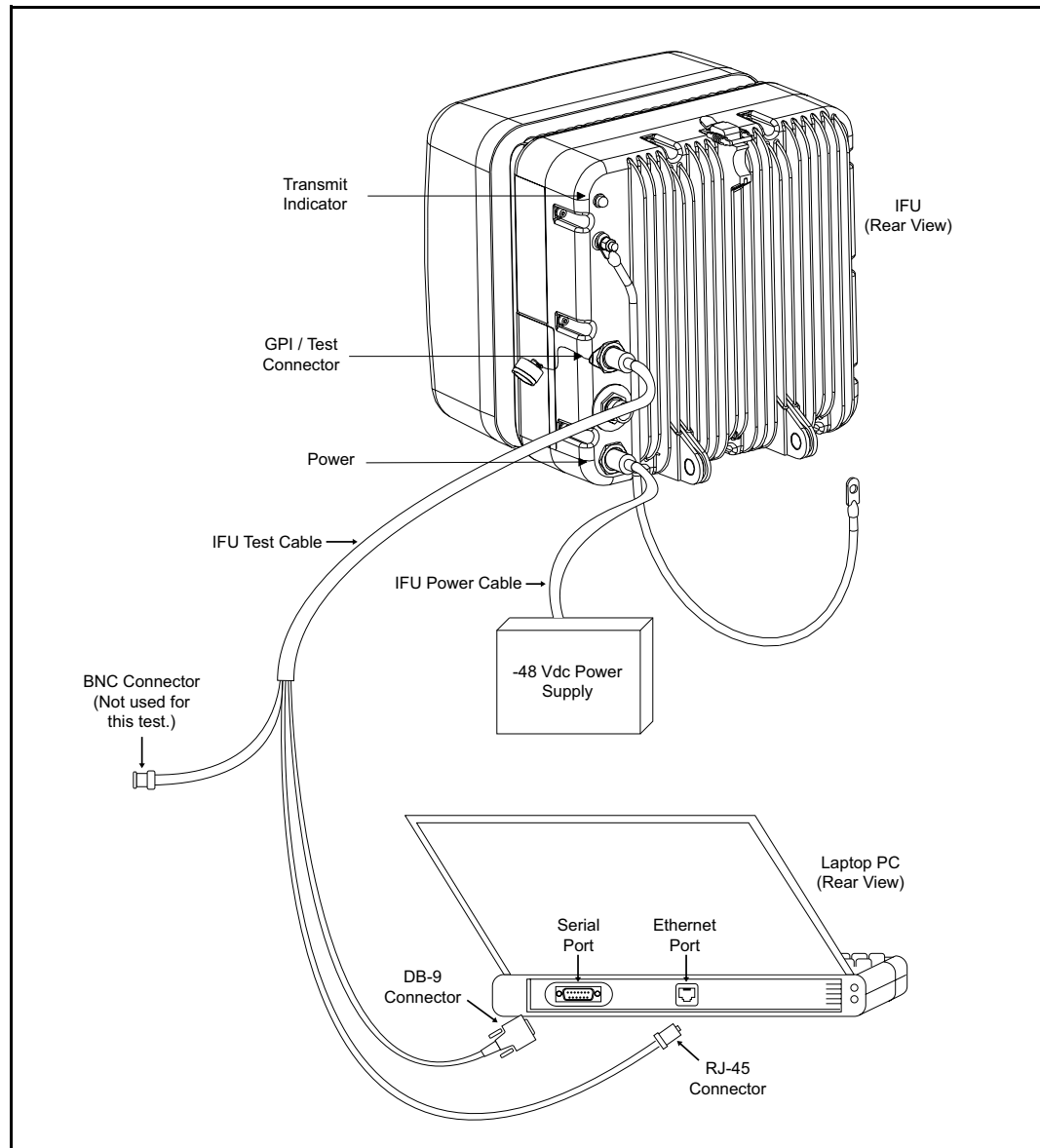
Figure 2-1: IFU Test Cable Connections

NOTE: The connector arrangement for the IFU you are installing can be different from that shown in Figure 2-1. To distinguish between the power connector and GPI/Test connector, look for the protective cap that is attached to the base of the GPI/Test connector.

2.2.4   Obtaining the IFU's IP Address

If the IFU's IP address and subnet mask are unknown, they can be identified via a terminal session using a communication software application such as HyperTerminal or ProComm. The following instructions describe how to launch a HyperTerminal session capable of displaying IFU data.

1. On your desktop, click on the **Start** button and select **Programs** ➢ **Accessories** ➢ **Communications** ➢ **HyperTerminal.**

> **NOTE:** On some operating systems, HyperTerminal is located under **Accessories.**

2. In the HyperTerminal window, click on the **Hypertrm.exe** file.

3. In the **Connection Description** box, type the name of the new connection in the **Name** field and select an icon in the **Icon** field.

> **NOTE:** The name and icon are user definable. The settings for this session can be saved using the selected name and icon.

4. Click **OK** when finished.

5. In the Connect To window, set **Connect Using** to Direct to COM1 and click **OK.**

6. In the COM1 Properties window, set the following:
    - **Bits per second** to 9600
    - **Data bits** to 8
    - **Parity** to None
    - **Stop bits** to 1
    - **Flow control** to Hardware

7. Click **OK** to start HyperTerminal. Data from the IFU will start to scroll across the HyperTerminal session. Note the IP address and the subnet mask of the IFU, then close HyperTerminal.

2.2.5   Configuring Windows Networking Properties

To successfully log into an IFU and run IFU link manager, the PC and the IFU must be in the same subnet. Use the following procedure to set up the IFU's IP address on your Windows PC.

> **NOTE:**   Before beginning these procedures, make sure the PC has a fully functional Ethernet interface, usually a PCMCIA card.

For Windows 98

1. On your desktop, click the **Start** button and select **Settings ➢ Control Panel**.

2. Double click on the **Network** icon in the Control Panel window.

3. Click on the **Configuration** tab.

4. Highlight the TCP/IP entry for the Ethernet card used to connect the IFUs and click the **Properties** button.

5. A TCP/IP Properties window appears (see Figure 2-2). Click on the **IP Address** tab.

6. Click on **Specify an IP address** to highlight the **IP Address** and **Subnet Mask** fields.

7. Enter an IP address and the subnet mask for the PC. The address and mask should allow the user to log into an IFU.

8. Click on the **Gateway** tab and verify that no IP addresses are listed under **Installed Gateways**. If there is an IP address listed, highlight the address and delete it.

9. Click **OK** and **OK** again.

10. Reboot the computer (the computer must be rebooted for the new settings to take effect).

For Windows 2000

1. On your desktop, click the **Start** button and select **Settings ➢ Control Panel**.

2. Double click on the **Network and Dial-up Connections** icon in the Control Panel window.

3. Double click on the preferred network connection icon.

4. Under the **General** tab, highlight **Internet Protocol (TCP/IP)** and click **OK**.

5. An Internet Protocol TCP/IP Properties window appears (see Figure 2-2). Select **Use the following IP address** and enter the IFUs IP address and subnet mask.

6. Click **OK** and **OK** again.

7. No reboot is required.

> **NOTE:**   The first three octets of the IP address entered must match the first three octets of the IP address. The last octet should be a number not currently used in the IFU network (refer to Figure 2-2). The subnet mask entered should match the subnet mask of the IFU. Refer to the site engineering folder for IP addresses for the PCs used to monitor and manage the network.
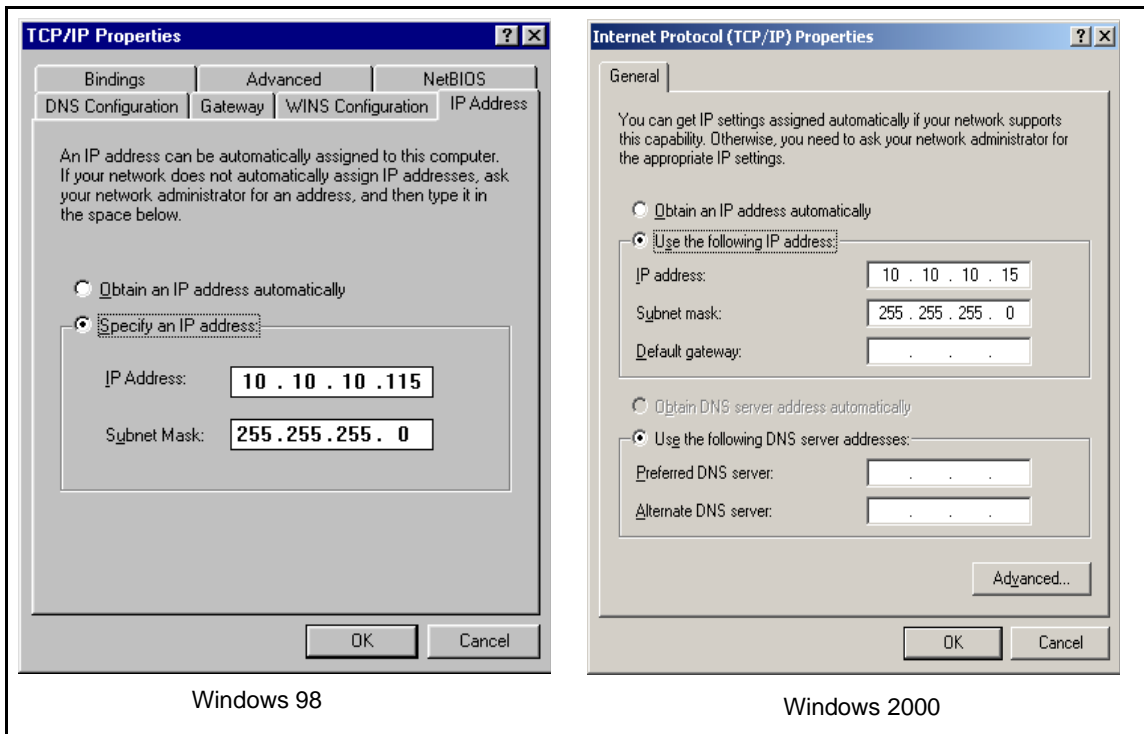
Windows 98

Windows 2000

Figure 2-2:   TCP/IP Properties Menu

2.2.6   Logging Into the IFU Using IFU Link Manager

Use the following procedure to log into an IFU using IFU link manager:

1. On your desktop, click the **Start** button and select **Programs.** Then click on the **MS-DOS Prompt** icon.

2. In the MS-DOS window, type ping xxx.xxx.xxx.xxx and press enter (xxx.xxx.xxx.xxx represents the IP address of the IFU).

   If the ping is successful, the following message will appear: Reply from xxx.xxx.xxx.xxx: bytes=a, time=<b ms, TTL=128. A successful ping implies that the IFU and the PC can communicate with one another across an Ethernet connection.

3. Double click on the **IFU Link Manager** icon and wait for IFU link manager to load.

4. Select the IFU that you wish to login to from the drop-down menu (see Figure 2-3). If there is not a network element for that IFU, simply select any IFU icon.

> **NOTE:**   If there is not an IFU icon, one must be added. Refer to *IFU Link Manager Online Help* at C:\Program Files\Triton\help\TOC.html. for information on how to add an IFU.
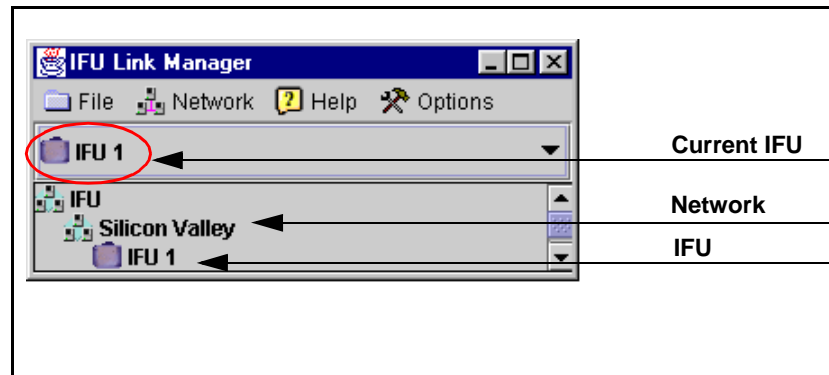
Figure 2-3:   Login IFU Name

5. On the IFU link manager toolbar, select **Network ➢ Connect.**

6. In the IFU Connect window, complete the following:
   - Verify the information in the **IP Address** field
   - Enter *engineer* in the **User ID** field
   - Enter the password assigned by the System Administrator in the **Password** field

7. Click the **Connect** button to login to the IFU. Login should take less than 30 seconds and the Link Manager Workspace window will appear (see Figure 2-4).
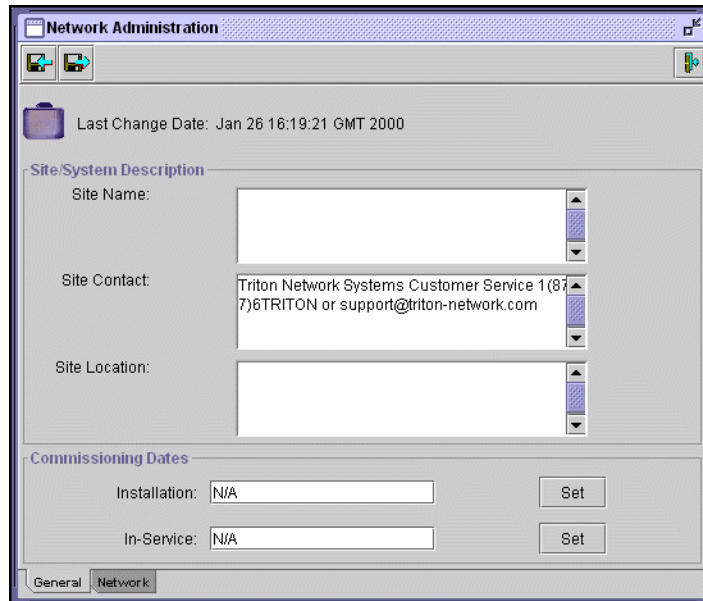
Figure 2-4:   Link Manager Workspace Window (Typical)

2.2.7   Configuring the IFU's Site Attributes

1. In the Link Manager Workspace window, select **Navigation ≻ Administration ≻ Network** to display the Network Administration window (see Figure 2-5).

Figure 2-5:   Network Administration Window (General Tab)

2. Select the **General** tab and complete following:
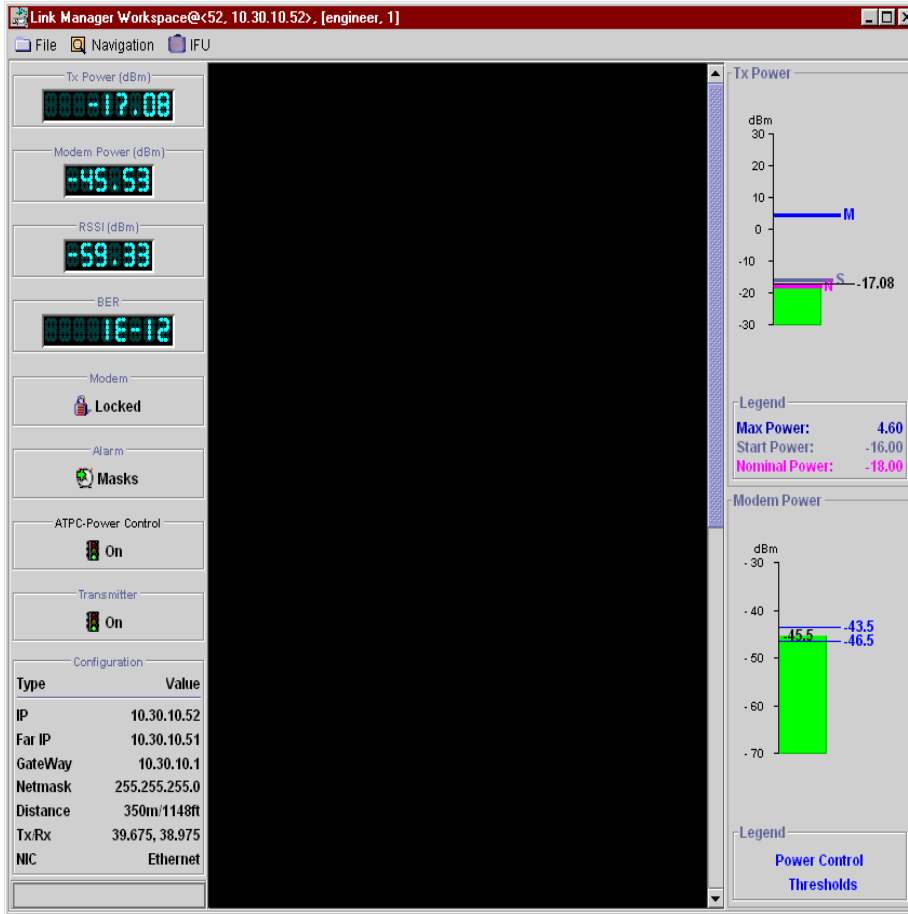
- Enter site information in the **Site Name**, **Site Contact**, and **Site Location** fields as required.

- Click the **Set** button beside the **Installation** and/or **In-Service** fields to automatically generate the system date and time. If you want to enter a date on your own, enter the date without selecting set.

NOTE: If NTP has been defined on the Link Administration window, IFU link manager will use the time on the NTP server. If you do not have NTP running, IFU link manager accesses the system time and sets the text field to the value returned by the system clock.

3. Click the **Save** icon to save the data and then select the **Network** tab (see Figure 2-6).
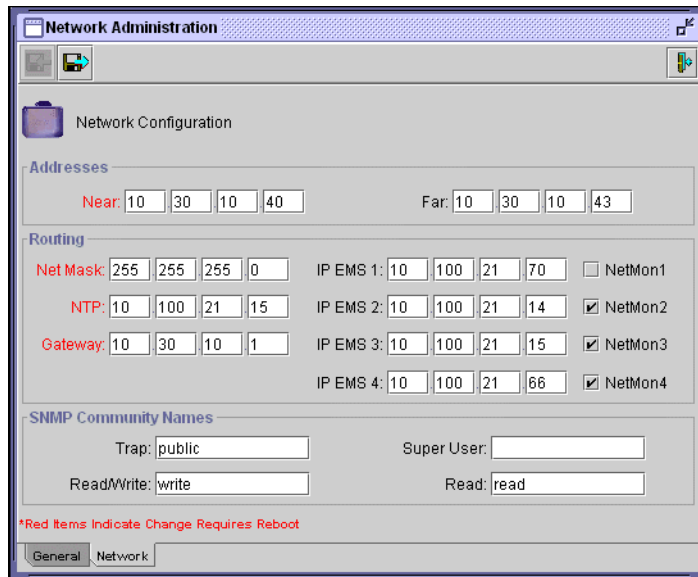
Figure 2-6: Network Administration Window (Network Tab)

4. Enter the following Network Administration site attributes from the site engineering folder:

- ▫ **Addresses**
  - • **Near** - near IFU IP address
  - • **Far** - IP address for the link partner of the near IFU
- ▫ **Routing**
  - • **Net Mask** - subnet mask of the IFU
  - • **NTP** - network time protocol server
  - • **Gateway** - gateway IP address for the IFU
  - • **IP EMS (1-4)** - IP element management station (1-4)

NOTE: The IP EMS fields are optional, but it is likely that at least one will be used. Each IP EMS field has a check box next to it, if the box is checked, NetMon messages will be sent to the associated EMS address.

- ▫ **SNMP Community Names**
  - • **Trap**
  - • **Read/Write**
  - • **Super User**
  - • **Read**

5. Click the **Save** icon ![icon] to save the attributes.

6. Exit the Network Administration window by clicking on the **Exit** icon ![icon] .

7. In the Link Manager Workspace window, select **Navigation ➢ Radio ➢ Link** to display the Link Administration window (see Figure 2-7).
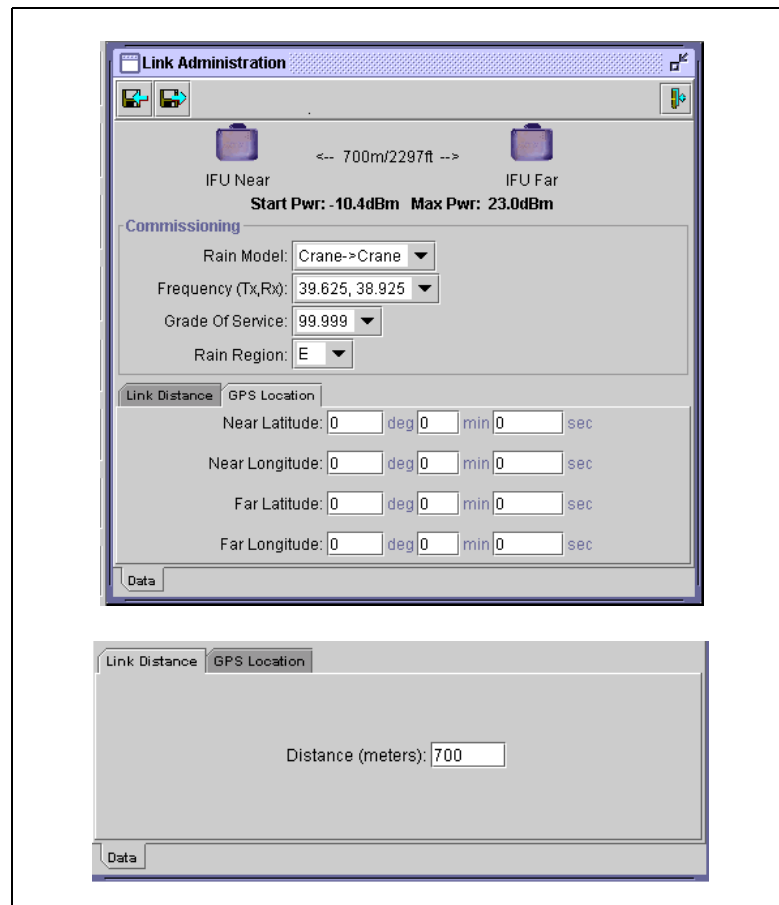
Figure 2-7: Link Administration Window

8. Enter the following Link Administration site attributes from the site engineering folder:

   ▫ **Rain Model** - statistical model that predicts rainfall in a given region

   ▫ **Frequency (Tx, Rx)** - transmit and receive frequency for the IFU

   ▫ **Grade of Service** - desired availability for the link

   ▫ **Rain Region** - geographic location of the IFU

9. Select the **Link Distance** tab and enter link distance. Link distance can be input directly or calibrated using the GPS coordinates. If both link distance and GPS location are entered, the IFU defaults to the link distance.

   ▫ **Link Distance** (link distance in meters)

   ▫ **GPS Location** (Near Latitude, Near Longitude, Far Latitude, and Far Longitude)

NOTE: For more information on the provisioning attributes described in Step 4 through Step 9, see C:\Program Files\Triton\help\TOC.html and click on the *Provisioning Network Attributes* link.

> **NOTE:** If the staging site and the installation site are the same location, proceed to Chapter 4, *Mounting and Aligning an IFU*.

10. Click the **Save** icon ▢ to save the attributes.

11. Exit the Link Administration screen by clicking the **Exit** icon ▢ .

12. Exit the Link Manager Workspace window by clicking on the **Exit** icon ▢ in the Link Manager Workspace window.

13. Exit IFU link manager by selecting **File ➢ Exit** in the Main window.

14. Turn off the -48 Vdc power supply.

15. Turn off the PC.

16. Disconnect the IFU power cable from the power connector on the rear of the IFU.

17. Confirm that the correct installation address is on the packing box and the packing box label matches the IFU data plate, which is located on the back of the IFU.

18. Use the original packing material to ship the IFU to the installation site. If the packing material is not available, contact Triton Network Systems (refer to Section 7.3, *Packing an IFU for Shipment*).

2.3   Documenting IFU Configuration

Use the IFU configuration form provided at the end of this section, or a similar form, to document the results of the IFU configuration procedure.

1

Link ID #

IFU Type (A/B)
A=Low band, Horizontal polarization, odd serial number
B=High band & Vertical polarization, even serial number

IFU ID #
Site Name
IFU S/N:

Network Administration - IFU __

Addresses
Near IP:
Far IP:

Routing:
Net Mask
NTP:
Gateway:
IP EMS 1
IP EMS 2
IP EMS 3
IP EMS 4

SNMP Community Names
Trap:
Read/Write
Super User
Read:

Link Administration - IFU __

Commissioning:
Rain Model
Frequency   TX: RX:
Grade of Service
Rain Region

Link Distance
Distance (meters):
OR

GPS Location
Near Latitude   deg   min   sec
Near Longitude   deg   min   sec
Far Latitude   deg   min   sec
Far Longitude   deg   min   sec

2

IFU Type (A/B)
IFU ID #
Site Name
IFU S/N:

Network Administration - IFU __

Addresses
Near IP:
Far IP:

Routing:
Net Mask
NTP:
Gateway:
IP EMS 1
IP EMS 2
IP EMS 3
IP EMS 4

SNMP Community Names
Trap:
Read/Write
Super User
Read:

Network Administration - IFU __

Commissioning:
Rain Model
Frequency   TX: RX:
Grade of Service
Rain Region

Link Distance
Distance (meters):
OR

GPS Location
Near Latitude   deg   min   sec
Near Longitude   deg   min   sec
Far Latitude   deg   min   sec
Far Longitude   deg   min   sec

3 Cable Installation

Chapter 3 provides the schematics and instructions for installing
IFU fiber and power cables, surge suppressors, and fiber
demarcation boxes.

Warnings

Risk of Service Interruption

CAUTION: Ensure the outside optical fiber connectors are environmentally protected. Failure to do so may cause contamination of the fiber surfaces.

CAUTION: To reduce the risk of fiber optic cable damage, use the following bend radius guidelines for indoor/outdoor fiber optic cable:

◆ Long-term (installed): bend radius is equal to 20 times the diameter of the cable.

◆ Short-term (during installation): bend radius is equal to 10 times the diameter of the cable.

Risk of Personal Injury from Electrical Shock

DANGER – HIGH CURRENT HAZARD: Do not turn on power before reading Triton Network Systems, Inc.s' product documentation. This device has a – 48 Vdc (5 amps operating peak per feed) direct current input.

DANGER – HIGH CURRENT HAZARD: Ensure that the – 48 Vdc power source is set to the OFF position before beginning the installation procedures for the Invisible Fiber® unit.

3.1   Materials Required

The following items are required for connecting a roof-mounted IFU to building equipment.

☐   IFU power cable

☐   Outdoor fiber cable

☐   GPI cable (optional)

☐   Fiber optic cable connector cleaning supplies

☐   Tie-wraps, UV-rated

☐   Architecture and engineering drawings from site engineering folder

NOTE: Prior to installing the fiber optic cable, ensure that it has been tested for continuity.

3.2   Fiber and Power Demarcation Equipment Installation

Some installations require a surge suppressor or fiber demarcation box. The installation of this equipment must be in accordance with all local and federal laws. Install this equipment per the accompanying instructions and architectural and engineering drawings.

> **NOTE:** Triton Network Systems recommends the use of a surge suppressor for in-building equipment protection.

3.3   Routing and Connecting Cables

The following cables have screw type connectors that connect easily to the IFU. Sections 3.3.1 through 3.3.4 describe how to connect these cables at the surge suppression and fiber demarcation equipment.

- Power

- Outdoor fiber

- GPI (optional)

3.3.1   Guidelines for Routing Cables

Observe the following requirements to correctly install all associated IFU cables:

- Ensure that the cables are routed according to the architectural and engineering drawings.

- Refer to the site engineering folder for the proper cable lengths.

- When using the conduit, ensure that it has the capacity to allow all of the cables to pass through freely. This will ensure that there will be no damage to the fiber after it has been pulled.

- Ensure that all of the cables for the installation are pulled at one time using the recommended industry fiber pulling method.

- Once the fiber cables have been pulled through the conduit, perform the fiber continuity test appropriate to your application to ensure that none of the fibers were damaged in the pull.
    - For Fast Ethernet multimode applications, refer to Section 5.1, *Fast Ethernet Fiber Continuity Test Procedure*.
    - For SONET/SDH single-mode applications, refer to Section 6.1, *SONET/SDH Single-Mode Fiber Continuity Test Procedure*.

- Test the power cable after installation.
    - For Fast Ethernet multimode applications, refer to Section 5.2, *IFU Power Cable Test Procedure*.
    - For SONET/SDH single-mode applications, refer to Section 6.2, *IFU Power Cable Test Procedure*.

- Ensure that the fiber cable bend radius during installation is no less than 10 times the diameter of the cable. Once installed, ensure that the fiber cable bend radius is no less than 20 times the diameter of the cable.

> **NOTE:** A three-foot service loop should be left at the IFU mounting location, both sides of the fiber demarcation box (if used), as well as the site equipment cabinet.

- Have qualified professionals perform fiber connecting or splicing.

- Ensure that the power cable bend radius allows for a three-foot service loop at the IFU mounting location and a twelve-inch service loop at the surge suppressor.

- Ensure power cable shielding has been grounded. For the in-building power cable, ensure that one end of the shielding is grounded.

3.3.2   Connecting Power Cables

Note the following for Figures 3-1 and 3-2:

- The colors listed in the figures are for Triton Network Systems supplied cables.

- The surge suppressor is optional. Follow all local and federal laws regarding surge suppression use.

- Pin A through pin D represent the IFU power cable ports labeled on the connector.

- Figure 3-2 shows two four-conductor cables. One eight-conductor cable could also be used.
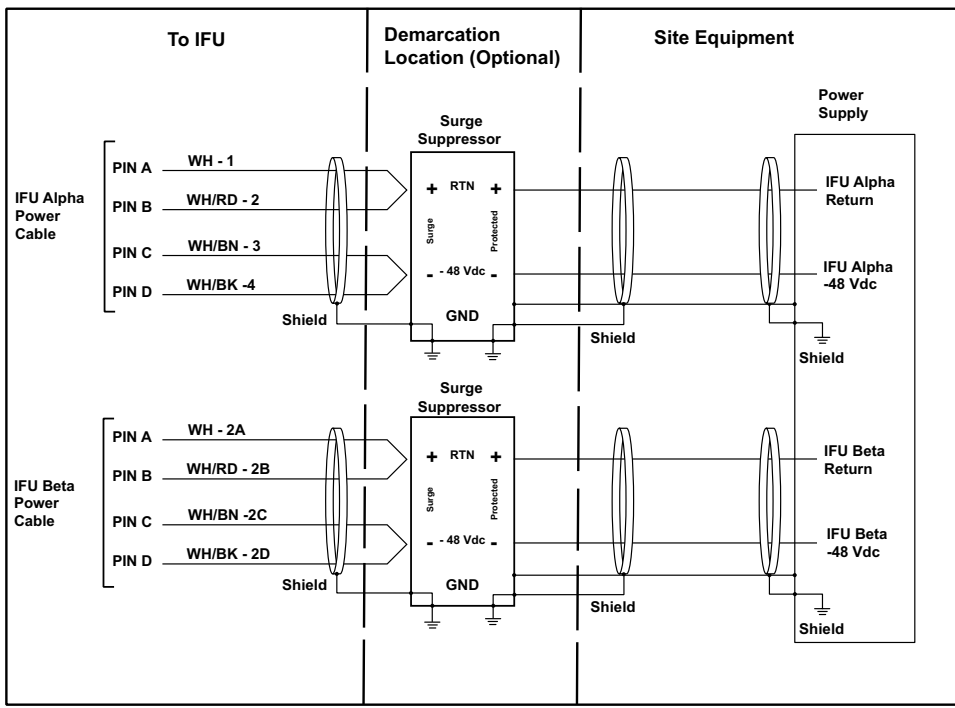
**Figure 3-1:   Typical IFU Power Termination Wiring Diagram
(single wire pair in building for each IFU)**
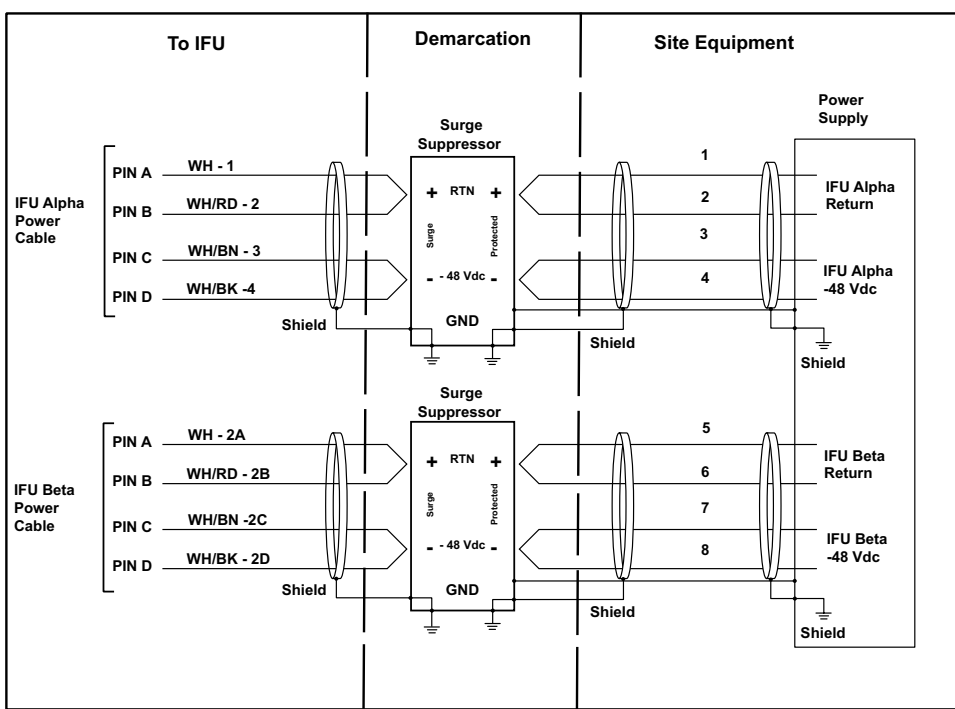
**Figure 3-2:   Typical IFU Power Termination Wiring Diagram
(dual wire pair in building for each IFU)**

3.3.3   Connecting Outdoor Fiber Cables

The following figures provide outdoor fiber interconnection information for IFUs:

*   Figure 3-3 provides a cable configuration diagram for Fast Ethernet and SONET/SDH multimode fiber cables.

*   Figure 3-4 provides a typical wiring diagram that shows how the Fast Ethernet and SONET/SDH multimode fiber cables connect a pair of IFUs to site equipment.

*   Figure 3-5 provides cable configuration diagrams for SONET/SDH single-mode fiber cables.

*   Figure 3-6 provides a typical wiring diagram that shows how the Fast Ethernet and SONET/SDH single-mode fiber cables connect a pair of IFUs to site equipment.

> **NOTE:** Figures 3-3 through 3-6 show the fiber cable colors used for fiber optic cable assemblies provided by Triton Network Systems. Cables sourced from other providers may not use the same color conventions.

> **NOTE:** Figures 3-4 and 3-6 show multimode fiber jumper cables.
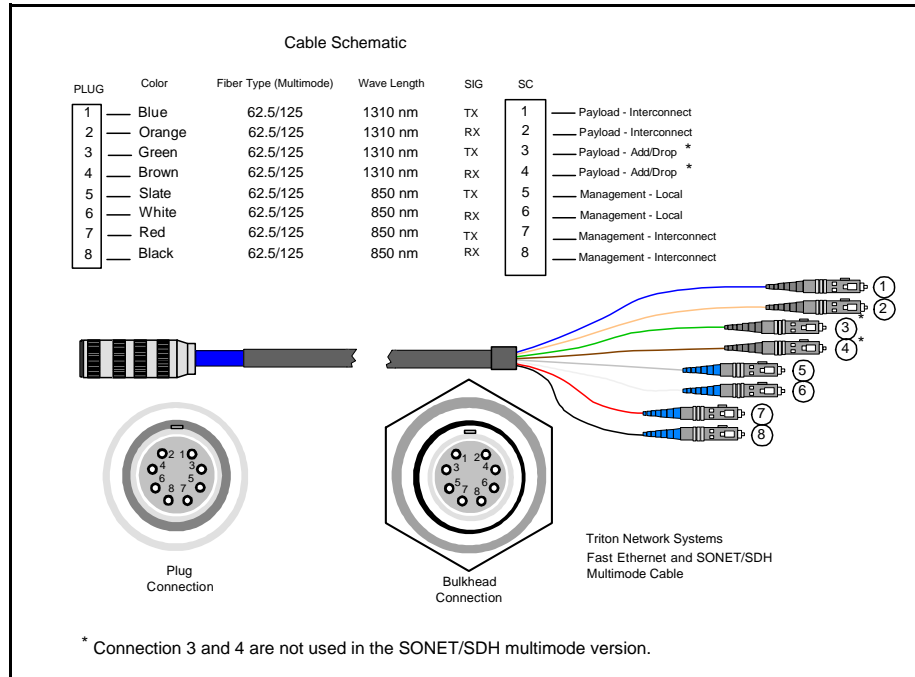
**Figure 3-3:   Fast Ethernet and SONET/SDH Multimode
Outdoor Fiber Cable Identification**
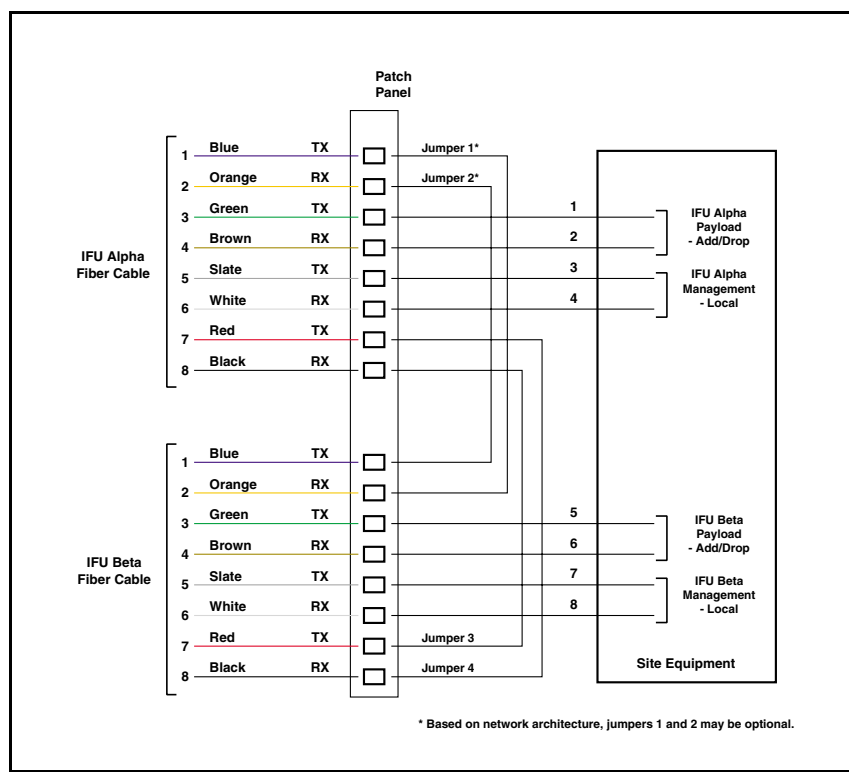
**Figure 3-4:   Fast Ethernet and SONET/SDH Multimode
Outdoor Fiber Cable Wiring Diagram**

3-7
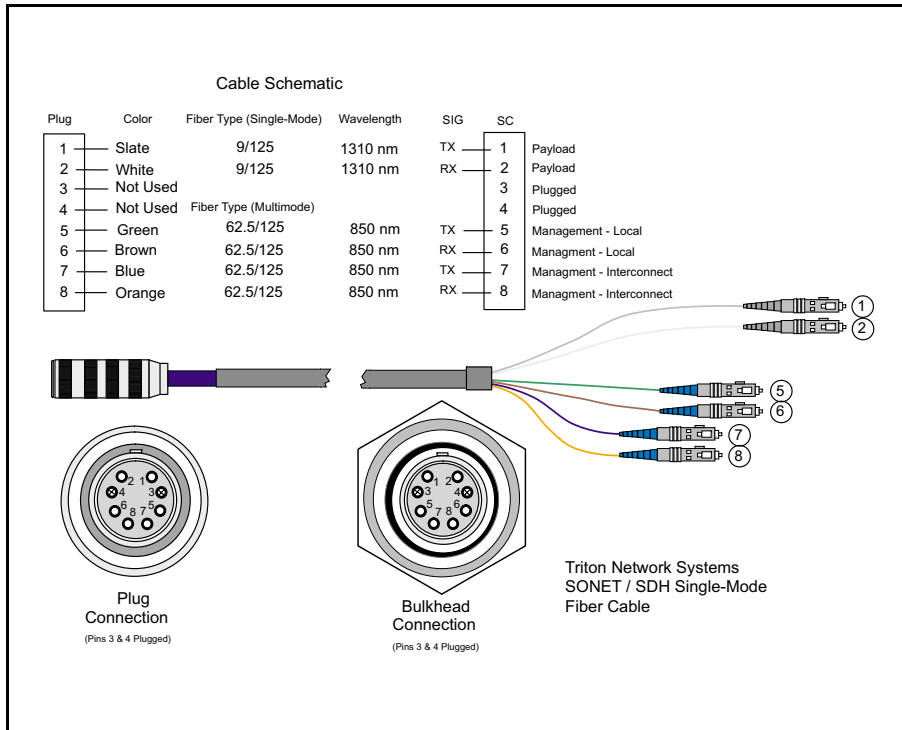
Figure 3-5: SONET/SDH Single Mode Outdoor Cable Identification
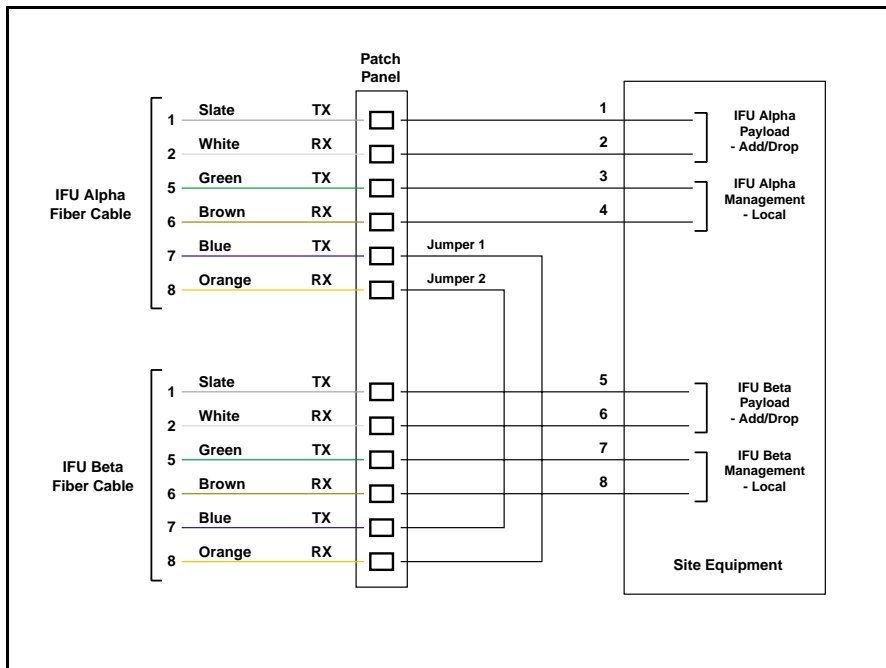
Figure 3-6: SONET/SDH Single Mode Outdoor Cable Wiring Diagrams

3.3.4   Connecting GPI Cables

When GPI cables are utilized there will be one GPI cable routed from each IFU mounting location to the surge suppressor. Only one GPI cable is necessary to connect the site equipment to the surge suppressor.

> **NOTE:** The GPI cable allows dry contact alarm connections to be routed to the IFU and monitored by the network operations center (NOC).

Figure 3-7 shows typical wiring for a GPI cable used in an alarm application. When referring to this figure, note the following:

- All alarm relays are shown in non-alarmed condition with normally open contacts.

- Add heat shrink to resistor leads.

- Resistors are rated at ¼ Watt, five percent.

- Cable assemblies are shielded as shown in Figure 3-7.
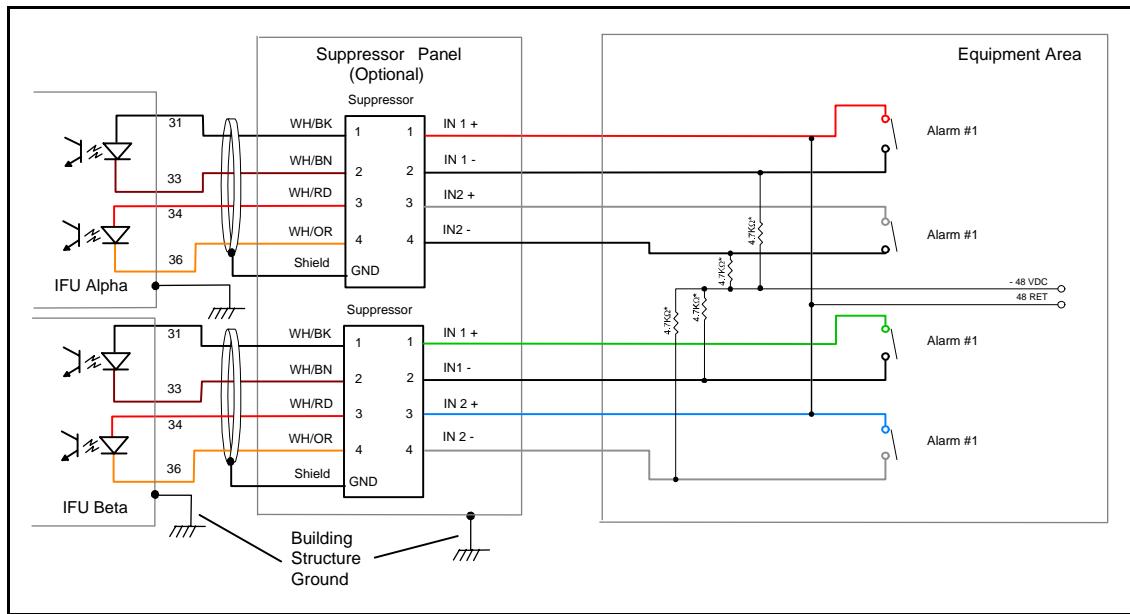
Figure 3-7:   Typical GPI Alarm Wiring Diagram

3.4   Installing Battery Cables

> **CAUTION:** Ensure that the power supply is turned off before performing this procedure.

3.4.1   Battery Cable Connection

The standard battery pack provided by Triton Network Systems provides a four-hour back up in case of facility power loss. Batteries should be connected as shown in Figure 3-8.
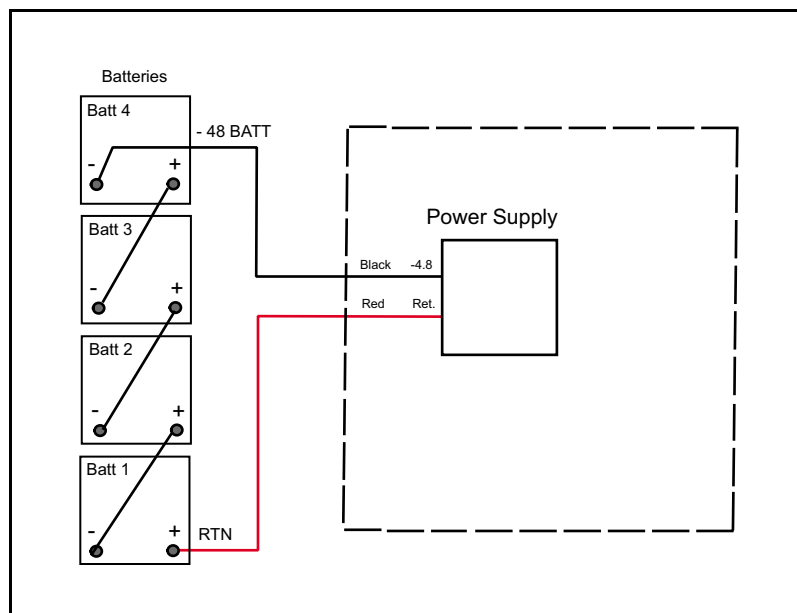
Figure 3-8:   Battery Connection Wiring Diagram
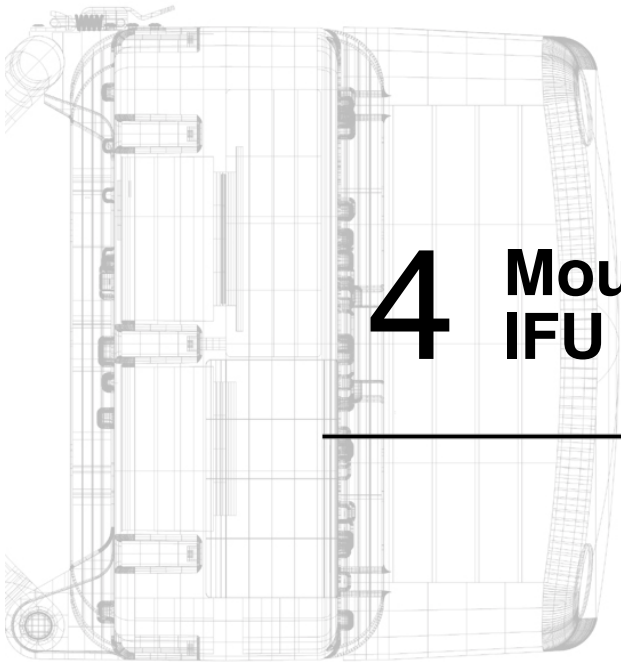
4 Mounting and Aligning an IFU

Chapter 4 provides the procedures for installing the IFU bracket and mounting and aligning an IFU. (This procedure uses the same process to install one or many IFUs).

Warnings

Risk of Personal Injury from Radio Frequency Energy Exposure

WARNING: RF Energy Exposure Limits and Applicable Rules for 28 GHz. The Triton Network Systems, Inc. 28 GHz radio is tested and evaluated for RF radiation level exposure rules and compliance with FCC 47 CFR 1.1307 and 1.1310, FCC OET - Bulletin 65, and Health Canada Safety Code 6. The Triton Network Systems, Inc. 28 GHz transceiver complies with the 50 W/m^2 (5 mW/cm^2) RF safety limits for controlled / occupational RF workers. To comply with exposure requirements for the protection of the uncontrolled / general public, a minimum separation distance of 6 meters directly in front of the Invisible Fiber® unit is required between the antenna and all persons while the transmitter is ON and operating at its maximum FCC authorized power. The Invisible Fiber® unit is ON when the red light indicator on the backside of the Invisible Fiber® unit enclosure is illuminated. Observe RF energy exposure safety limits, applicable rules, and service interruption cautions in the product manuals. Prolonged exposure to RF energy may result in serious bodily injury.

WARNING: RF Energy Exposure Limits and Applicable Rules for 38 GHz. The Triton Network Systems, Inc. 38 GHz radio is tested and evaluated for RF radiation level exposure rules and compliance with FCC 47 CFR 1.1307 and 1.1310, FCC OET - Bulletin 65, and Health Canada Safety Code 6. The Triton Network Systems, Inc. 38 GHz transceiver complies with the 50 W/m^2 (5 mW/cm^2) RF safety limits for controlled / occupational RF workers. To comply with exposure requirements for the protection of the uncontrolled / general public, a minimum separation distance of 10 meters directly in front of the Invisible Fiber® unit is required between the antenna and all persons while the transmitter is ON and operating at its maximum FCC authorized power. The Invisible Fiber® unit is ON when the red light indicator on the backside of the Invisible Fiber® unit enclosure is illuminated. Observe RF energy exposure safety limits, applicable rules, and service interruption cautions in the product manuals. Prolonged exposure to RF energy may result in serious bodily injury.

Risk of Personal Injury from Electrical Shock

DANGER – HIGH CURRENT HAZARD: Ensure that the – 48 Vdc power source is set to the OFF position before beginning the installation procedures for the Invisible Fiber® unit.

Other Risks of Personal Injury

CAUTION – LIFTING HAZARD: Due to the weight of the Invisible Fiber® unit (up to 50 pounds), Triton Network Systems, Inc. recommends using proper lifting techniques and equipment. Lifting equipment must be capable of lifting and positioning the Invisible Fiber® unit in a safe manner.

4.1   Materials Required

The following items are needed to complete IFU installation:

- ☐ IFU handling strap
- ☐ IFU mounting bracket with snap ring kit
- ☐ Right-angled snap ring pliers (for external snap ring)
- ☐ 9/16 in. wrenches or sockets (2)
- ☐ Large flat head screwdriver
- ☐ Binoculars
- ☐ Anti-seize paste (as required)
- ☐ Tie-wraps, UV-rated (as required)
- ☐ IFU test cable
- ☐ 10BaseFL to 10BaseT Media Converter (as required)
- ☐ BNC-banana interface cable
- ☐ Digital voltmeter (measures DC voltage up to 100V, accuracy 0.3% or better)
- ☐ Laptop computer, Windows 98/2000 operating system, and an Ethernet card with any necessary adapters
- ☐ IFU link manager software
- ☐ Site engineering folder (with link budgets)

4.2   Mounting an IFU Bracket

Mount the IFU bracket in the location specified in the site engineering folder using bolts as indicated (see Figure 4-1 for a typical wall mount and Figure 4-2 for a typical pole mount).

Triton Network Systems recommends using the following items to install an IFU bracket:

- ☐ Bracket hole pattern width 4.5 in.s (114.3 mm) (see Figure 4-1)
- ☐ 4.5 in. (11 cm) O.D. pole (minimum pole size is 3 in. (7 cm) O.D. pole
- ☐ 1/2 in. (1 cm) diameter U-Bolt, 4.5" (11 cm) wide, 6.5 in. (16 cm) long galvanized steel for 4.5 in. (11 cm) O.D. poles
- ☐ 3/8 in. (9 mm) diameter U-bolt, stainless steel SAE GR5 or ASTM 325
- ☐ Bracket hole pattern length 10.9 in. (276 mm) (see Figure 4-1)
- ☐ Anti-seize paste applied to the mounting bracket bolt threads to prevent seizing
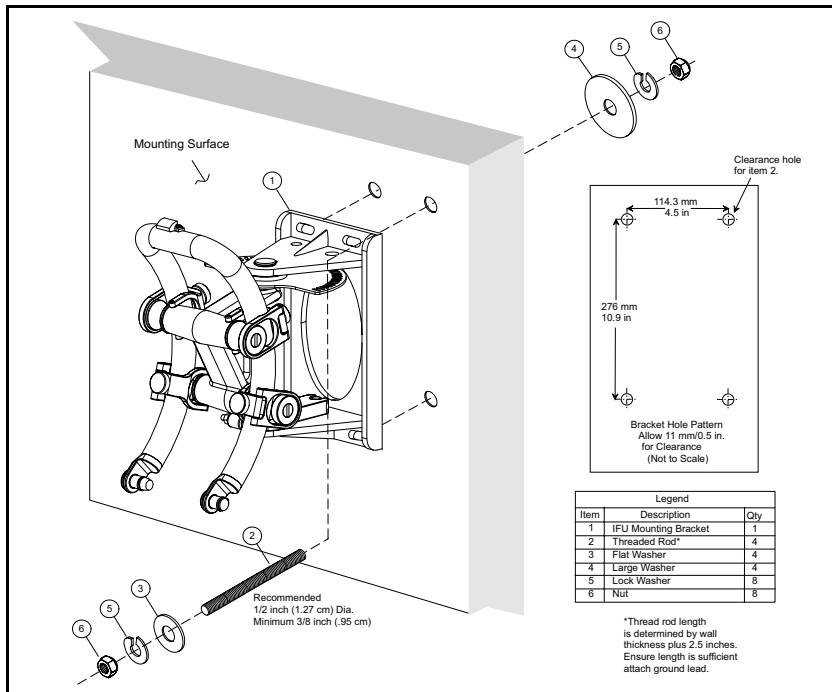
Figure 4-1: Attaching an IFU Bracket to a Wall (Typical)
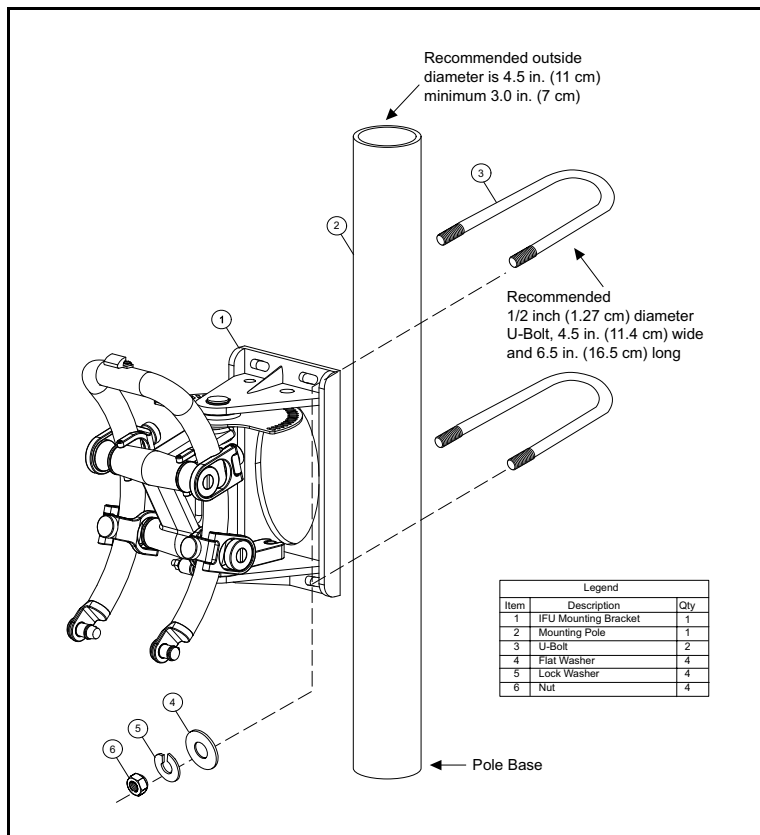
Figure 4-2: Attaching an IFU Bracket to a Pole (Typical)

4.3   Mounting an IFU

IFUs are installed in the location specified by each site drawing.

4.3.1   Installing and Adjusting an IFU Sling

Follow each step of this procedure only if an IFU sling is not already secured to an IFU when the IFU shipping container is opened. Otherwise, use this procedure as a guideline to ensure that the IFU sling has been properly secured to the IFU.

1.   If the sling is not already placed over an IFU, carefully remove the sling from its container.

2.   Inspect the sling for any damage or wear that could adversely affect the operation or performance of the sling, such as rips, tears, cuts, frays, holes, or other similar damage.

3.   Place the IFU on a flat surface and slide the sling under the back side of the IFU, away from the radome.

4.   Position the sling on the IFU with its identification label facing outwards (see Figure 4-3).

Figure 4-3:   IFU Correctly Positioned in an IFU Sling (Front View)

5.   Ensure that the sling is centered around the backside of the IFU. When properly positioned, the top handle and side handles of the sling should be in the positions shown in Figure 4-3. The opened end of the sling should be positioned towards the back of the IFU, opposite the radome.

6.   Slide the extended strap through the buckle. Insert the strap under, over, and through the buckle (see Figure 4-4). Pull the strap tight and knot or bury the slack for additional safety.

Figure 4-4: IFU Correctly Positioned in an IFU Sling (Rear View)

7. Before lifting the IFU, ensure the strap fits snugly around the IFU and the strap through the buckle is secured.

8. If using a carabiner fitting, place the fitting or snap-ring hook fitting through the handle on top of the sling (see Figure 4-5).

Figure 4-5: Correct IFU Hoisting Position When Using a Carabiner

9. To remove the sling, loosen the strap from the buckle and carefully pull the strap forward until released from the IFU. The sling should not be pulled from under a load when the load is resting on the sling.

10. Neatly fold the sling and store it in a cool, dry, dark place to prevent environmental damage.

4.3.2   Mounting the IFU

Use the following procedure and refer to Figure 4-6 to mount an IFU on a mounting bracket:

1. Make sure that the model number of the IFU (located on the aft housing assembly) matches the model number referenced on the site drawing in the site engineering folder.

2. Remove the snap rings form the mounting studs and ensure that the mounting bracket is mechanically stable, plumb, and level.

3. Position the IFU eyelets (8) on the mounting studs (7) and engage the top clamp (9).

4. Re-install a snap ring (3) on each mounting stud.

5. Position the building ground cable, IFU ground cable, flat washer (4), and lock washer (5) on the bottom bolt of the mounting bracket (1) and install the nut (6).

Legend		
Item	Description	Qty
1	IFU Mounting Bracket	1
2	IFU	1
3	Snap Ring	2
4	Flat Washer	1
5	Lock Washer	1
6	Nut	1
7	Mounting Stud	2
8	Eyelet	2
9	Top Clamp	1
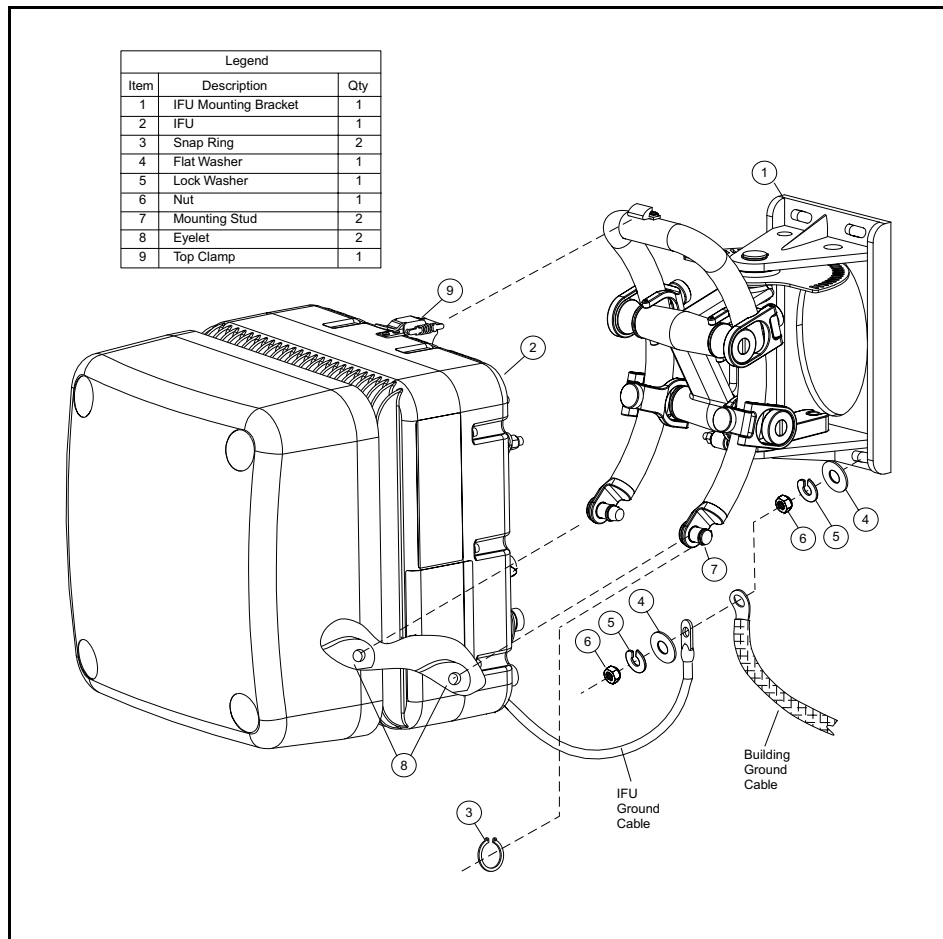
Figure 4-6:   Mounting the IFU

4.3.3   Attaching IFU Cables

1. Remove the dust caps from the power, GPI (optional), and fiber optic cables.

2. Connect the power, GPI (optional), and fiber optic cables to the IFU locations as shown in Figure 4-7.

> **NOTE:** To prevent shearing of the fiber, hold the base of the fiber cable with one hand and secure it on the connector by rotating the twist lock with your other hand.

3. Secure the power, GPI (optional), and fiber optic cables to the building with tie-wraps as needed.
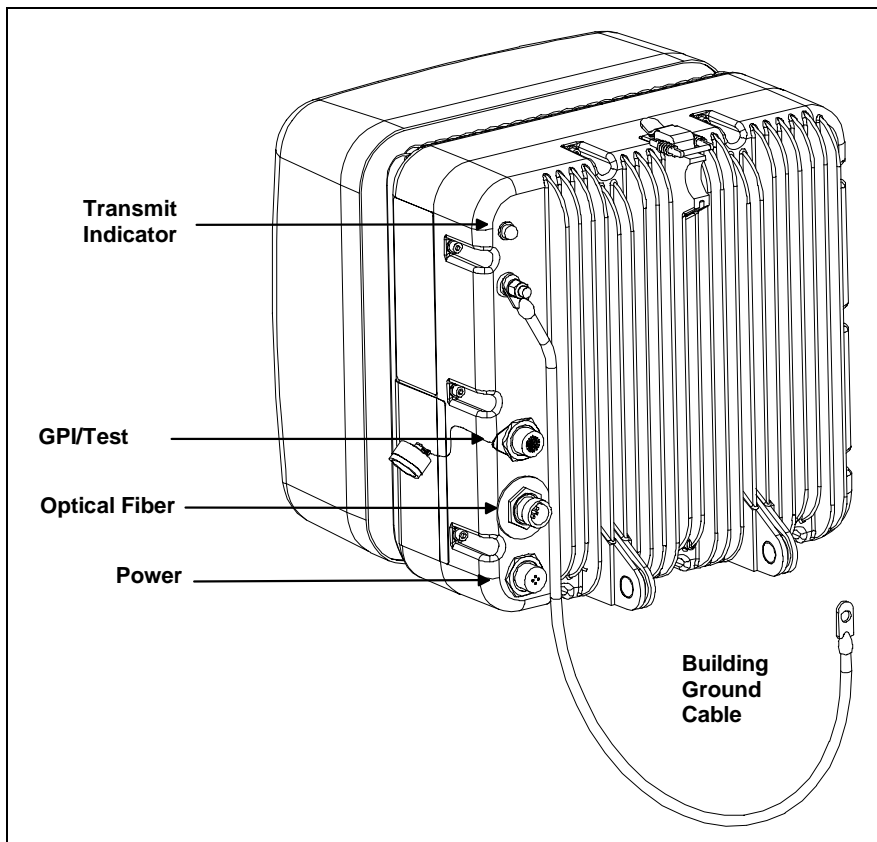
Figure 4-7:   IFU Cable Connections (IFU Alignment)

> **NOTE:** The connector arrangement for the IFU you are installing can be different from that shown in Figure 4-7. To distinguish between the power connector and GPI/Test connector, look for the protective cap that is attached to the base of the GPI/Test connector (refer to Appendix A, *Specifications for Triton Network Systems Products* for Generation I and Generation II product specifications).

4.4   IFU Alignment

The alignment procedure should be performed for one IFU at a time. Do not attempt to align both the near and far IFUs in a link simultaneously. This procedure requires personnel to be present at both the near and far IFU.

4.4.1   Alignment Setup

Use the following procedure and refer to Figure 4-8 to set up an IFU for alignment:

1. Loosen the four vertical alignment screws, the horizontal alignment nut, and visually align the near IFU to the far IFU.

    Repeat Step 1 for the far IFU.

2. Remove the protective cap from the GPI/Test port on the IFU and connect the IFU test cable as follows:

> **NOTE:** If the GPI/Test cable is in use, unplug the GPI/Test cable from the IFU and connect the IFU test cable.

   - Test cable connector to the GPI/Test port of the IFU
   - BNC connector to the BNC-banana interface adapter cable (for voltmeter)
   - RJ-45 connector to the Ethernet port of the laptop computer

> **NOTE:** If the installation environment is not conducive to laptop use, a routed fiber cable via a 10BaseFL to 10BaseT media converter to the laptop will be needed.

3. Turn on the voltmeter and select the appropriate DC voltage range.

4. Power up the IFU and laptop computer and launch IFU link manager.

> **NOTE:** Upon application of power, the LED light will flash once. Bootup will complete within two minutes.

5. Log on to the near IFU.

6. Use IFU link manager to set the near IFU radio transmitter to on.

7. Ensure that AdTPC is off and that the transmitter is set to "start power."

8. Verify that transmitter (Tx) is on by the presence of an illuminated red LED indicator.

    Repeat Step 2 through Step 8 for the far IFU.
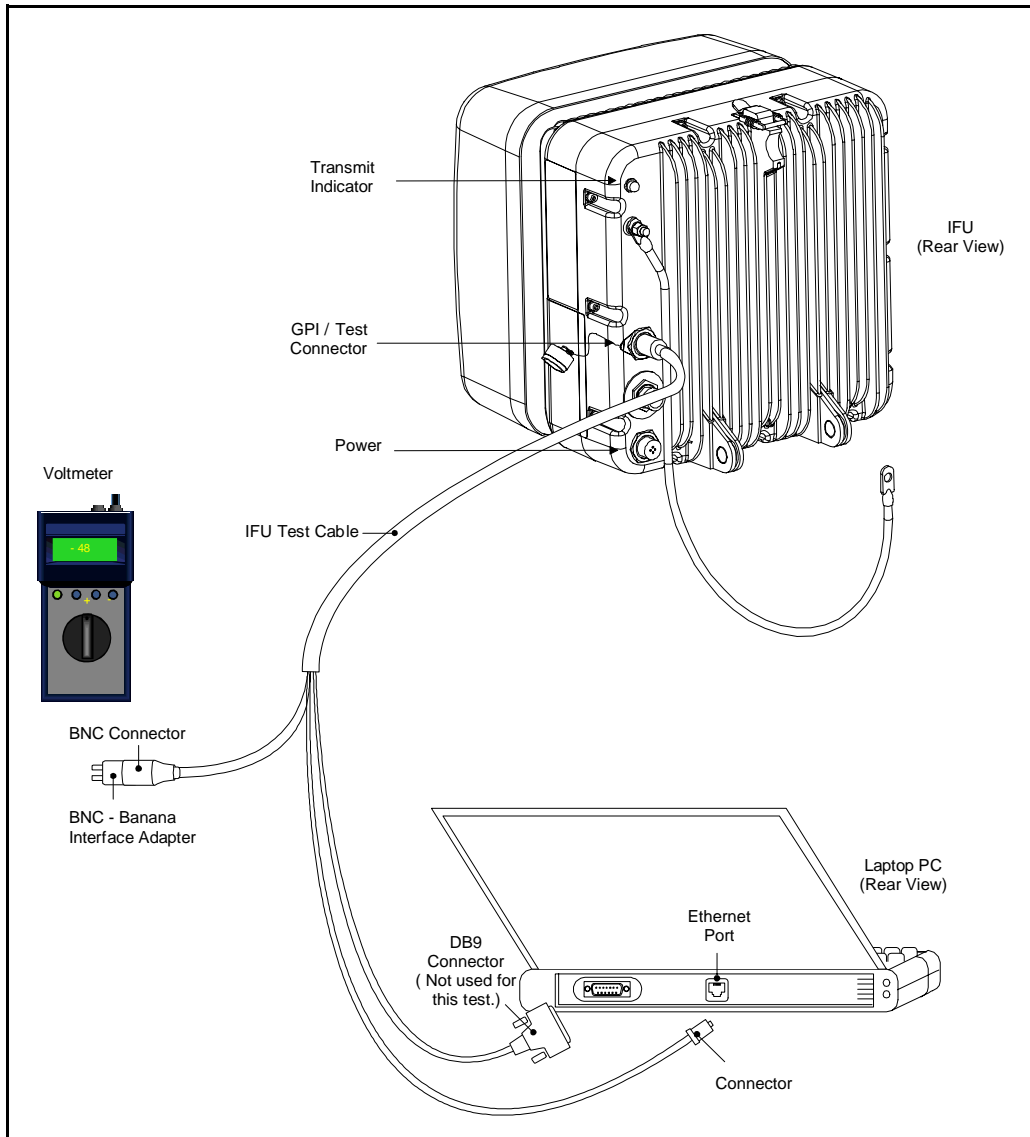
Figure 4-8:   IFU Test Cable Connections for Alignment Test

4.4.2   IFU Alignment Procedure

1. Loosen the horizontal alignment nut on the mounting bracket.

2. Sweep the IFU a minimum of 10 degrees horizontally and note the highest of the peaks.

> **NOTE:** As you sweep the antenna, you will notice the voltmeter display fluctuates. Once you attain modem lock, the voltmeter display will stabilize. This is a feature of the IFU which allows you to identify when modem lock occurs. (It is possible to achieve modem lock on a side lobe. Therefore, it is necessary to complete the full alignment procedure to ensure proper alignment on the main lobe.)
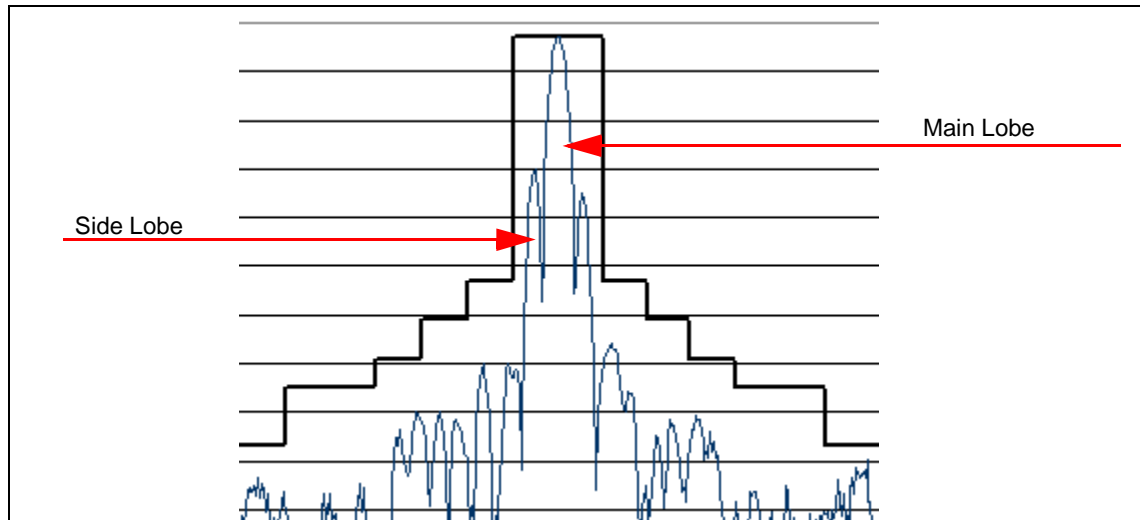
Figure 4-9:   Example of An Antenna Pattern

3.   Move the IFU to the highest peak position as indicated by the voltmeter display.

4.   Hand-tighten the horizontal alignment nut on the IFU mounting bracket.

5.   Loosen the four vertical alignment screws on the mounting bracket.

6.   Sweep the IFU a minimum of 10 degrees vertically and note the highest of the peaks.

7.   Move the IFU to the highest peak position as indicated by the voltmeter display.

Repeat Step 1 through Step 7 for the far IFU.

NOTE: If no peaks appear on the voltmeter, refer to Section 4.6, *Alignment Troubleshooting*.

8.   Repeat Steps 1 through 7 until a succession of peaks appear on the voltmeter (see Figure 4-9). Note the highest of peaks and move the IFU to the peak position as indicated by the voltmeter display.

9.   Hand-tighten the four vertical alignment screws on the IFU mounting bracket.

NOTE: Alignment is an iterative process. After performing Step 1 through Step 9, Triton Network Systems recommends "fine tuning" the link (see Steps 10 through 13).

10. On the near IFU, loosen the horizontal alignment nut. Using a screwdriver, as illustrated in Figure 4-10, move the IFU side-to-side to get the peak value on the voltmeter.

11. Tighten the horizontal alignment nut.

12. On the near IFU, loosen the four vertical alignment screws. Using a screwdriver, as illustrated in Figure 4-10, move the IFU up and down to get the peak value on the voltmeter.
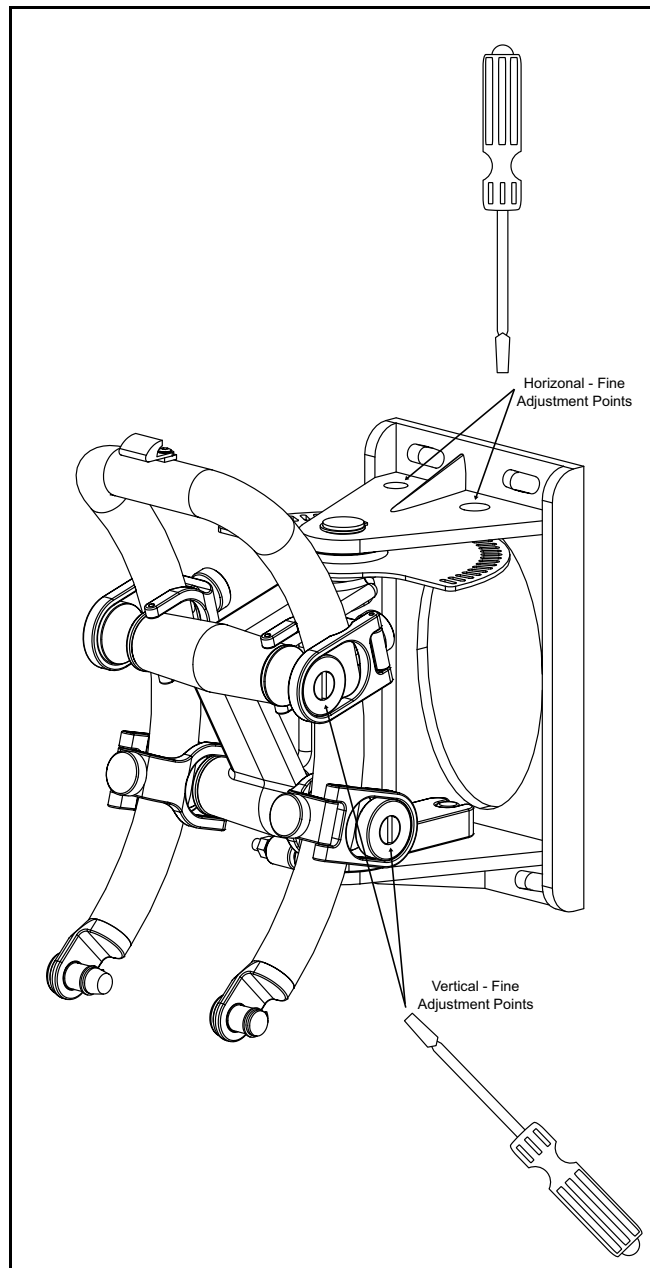
Figure 4-10:   Fine Alignment Technique

13. Tighten the four vertical alignment screws.

Repeat Step 10 through Step 13 for the far IFU.

14. Using IFU link manager, verify modem lock on both IFUs.

15. Using IFU link manager, turn on AdTPC for both the near and the far IFUs.

16. Verify that AdTPC reads **Power Control**, indicating that power control is on and active.

Repeat Step 14 through Step 16 for the far IFU.

4.5   Link Verification

RF link verification is based on meeting the following objectives:

*   Minimizing RF Tx power for dense deployment

*   Avoiding "side lobe" link alignment

*   Achieving rapid deployment by verifying link at the time of installation

The RF link verification procedure focuses on the RSSI and modem power display for IFU wireless links. Traditional industry practices utilize path loss calculations to determine RF link verification, which requires the use of both Tx and Rx power measurements.

However, in an Invisible Fiber system, which uses a closed loop AdTPC method, only the RSSI or modem power of the link partner determines the actual transmit power. The Tx display in IFU link manager, therefore, is for reference purposes only.

The Tx power display does play a role during installation to determine whether or not the link is aligned on a side lobe.

In a correctly aligned link, the Tx power should be within 3 dB of nominal power. To verify Tx power, refer to the Tx Power graph in the upper-right corner of the IFU link manager Workspace window.

> **NOTE:** Refer to your project manager or liaison for commissioning procedures specific to your network.

4.5.1   Prior to Link Verification

Prior to link verification, the following must to be completed:

*   IFUs installed according to the procedures described in Section 4.3, *Mounting an IFU*

*   IFUs aligned according to the procedures described in Section 4.4, *IFU Alignment*

*   IFU link manager V1.3 or higher installed

4.5.2   RF Link Verification Procedure

Verify AdTPC Operation and Minimum Power Conditions

To verify that power control is operational via the received signal strength indicator (RSSI), first ensure that AdTPC is enabled. View the modem power graph on the lower right of the IFU link manager Workspace window. If modem power is within the threshold settings, proceed to *Verify Main Beam Alignment*. Otherwise, check the IFU setup.

Verify Main Beam Alignment

Use Tx power to determine if you are aligned on a side lobe. First, make sure AdTPC is turned on. Second, record the Tx power on both sides of the link. If (Tx_1 - nominal Tx) < 3.5 dB or (Tx_2 - nominal Tx) < 3.5 dB, proceed to *Verify Link Integrity*. Otherwise, realign the link.

> **NOTE:** If main beam alignment and modem power are verified, minimum Tx power is being transmitted.

Verify Link Integrity

To verify link integrity, compare the bi-directional link data. First, make sure AdTPC is turned on. Second, record the Tx power on both sides of the link. If the absolute value of ((Tx_1 - Tx_2) + ($RSSI_1$ - $RSSI_2$)) < 8 dB, then proceed to *Verify Closed Loop Link Balance*. Otherwise, contact the Triton Network Systems Technical Assistance Center (TAC) at 1-866-687-4866.

Verify Closed Loop Link Balance

To check for basic link symmetry, compare the closed loop AdTPC link balance. First, make sure that AdTPC is turned on. If ($RSSI_1$ - $RSSI_2$) < 4 dB or ($RSSI_2$ - $RSSI_1$) < 4 dB, then the RF link is acceptable. Otherwise, contact the Triton Network Systems Technical Assistance Center (TAC) at 1-866-687-4866.

4.6   Alignment Troubleshooting

4.6.1   No Peaks Appear on the Voltmeter During Alignment

Start Power - the power at which the IFU transmits when AdTPC is off - is calculated based on clear-air path loss over the given hop distance. When extra attenuation (such as rain or glass) is present during alignment, the receive IFU may require a higher power level. In this situation, IFU link manager allows for incremental increases in the start power.

For further information on how to incrementally increase start power, refer to *IFU Link Manager Online Help* at C:\Programs\Triton\help\TOC.html.

4.6.2   No Side Lobes Appear on the Voltmeter During Alignment

If two equal peaks (no side lobes) appear on the voltmeter during alignment, perform the following steps:

If two equal peaks appear while sweeping the horizontal plane:

1.   Move the IFU to the null spot in the middle of the two equal peaks.

2.   Tighten the horizontal alignment nut.

3.   Loosen the four vertical screws on the bracket.

4. Move the IFU up and down (using fine motions) until you obtain a peak reading on the voltmeter.

5. Tighten the four vertical alignment screws on the bracket.

6. Tighten the horizontal alignment nut.

If two equal peaks appear while sweeping the vertical plane:

1. Move the IFU to the null spot in the middle of the two equal peaks.

2. Tighten the four vertical alignment screws on the bracket.

3. Loosen the horizontal alignment nut.

4. Move the IFU side-to-side (using fine motions) until you obtain a peak reading on the voltmeter.

5. Tighten the horizontal alignment nut.

6. Tighten the four vertical alignment screws on the bracket.

4.7   Post-Installation Audit

Use the post-installation audit form provided at the end of this section, or a similar form, to document the results of the cable installation and IFU mounting and alignment procedures.

Post Installation Audit Form

Site Name	**Date**
Site Address	**Site Engineer**
Building No	**Site Type**

		Roof Requirement	IFU A	IFU B
Roof Requirements	1	IFU correctly located and secured.	? Yes ? No ? N/A	? Yes ? No ? N/A
	2	Clear line of sight between link.	? Yes ? No	? Yes ? No
	3	IFU brackets installation correct.	? Yes ? No	? Yes ? No
	4	IFU grounding correct.	? Yes ? No	? Yes ? No
	5	IFU location FCC compliant.	? Yes ? No	? Yes ? No
	6	IFU to demarc power cable correct.	? Yes ? No ? N/A	? Yes ? No ? N/A
	7	IFU to demarc alarm cable correct.	? Yes ? No ? N/A	? Yes ? No ? N/A
	8	IFU to demarc fiber cable and connectors correct.	? Yes ? No ? N/A	? Yes ? No ? N/A
	9	IFU aesthetics acceptable.	? Yes ? No	? Yes ? No
	10	Fiber demarc box secured.	? Yes ? No ? N/A	? Yes ? No ? N/A
	11	All connections to and from demarc box correct.	? Yes ? No ? N/A	? Yes ? No ? N/A
	12	Ground panel secured.	? Yes ? No	? Yes ? No
	13	Power and alarm cables to and from ground panel correct.	? Yes ? No	? Yes ? No
	14	Photo 1 - IFU mounted location.	? Yes ? No	? Yes ? No
	15	Photo 2 – Demarc box.	? Yes ? No ? N/A	? Yes ? No ? N/A
	16	Photo 3 – Ground plate with surge suppressors.	? Yes ? No	? Yes ? No

		Site Requirement	Site Equipment
Site Requirements	1	Site equipment cabinet or rack secured.	? Yes ? No ? N/A
	2	Cables and connectors secured.	? Yes ? No ? N/A
	3	Phone line within 20 feet of cabinet or rack.	? Yes ? No ? N/A
	4	110 Vac installed	? Yes ? No ? N/A
	5	Photograph of site equipment.	? Yes ? No ? N/A
	6	Battery installation correct.	? Yes ? No ? N/A
	7	Circuit panel Identification Number	

		Test Requirement	Test Within Specifications	
			Yes	No
Link Requirements	1	Verify AdTPC operation & minimum power conditions • Modem power within threshold settings?	Perform Step C.2	Check IFU setup.
	2	Verify main beam alignment • $(Tx_1 - \text{nominal } Tx) < 3/5$ dB? • $(Tx_2 - \text{nominal } Tx) < 3/5$ dB?	Perform Step C.3	Realign link.
	3	Verify link integrity • $((Tx_1 - Tx_2) + (RSSI_1 - RSSI_2)) < 8$ dB?< 3.5 dB?	Perform Step C.4	Notify TAC or Project manager.
	4	Verify closed loop balance • Modem power within threshold settings?	Test Complete	Notify TAC or Project manager.

Notes