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ClearGain® Tower Mounted Amplifier System 900/1800 MHz User Manual

1379659 Rev A

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REVISION HISTORY

ISSUE	DATE	REASON FOR CHANGE
1	06/2003	New publication
2	07/2004	Update drawings
3	08/2006	Add 900 MHz Fullband product

LIST OF CHANGES

The technical changes incorporated into this issue are listed below.

PAGE	IDENTIFIER	DESCRIPTION OF CHANGE
All		Update drawings and add 900 MHz specfications.

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ABOUT THIS MANUAL

This document describes the ADC ClearGain 900/1800 MHz tower mounted amplifier system and provides complete instructions for installing this product on a communications tower.

ADMONISHMENTS

Important safety admonishments are used throughout this manual to warn of possible hazards to persons or equipment. An admonishment identifies a possible hazard and then explains what may happen if the hazard is not avoided. The admonishments — in the form of Dangers, Warnings, and Cautions — must be followed at all times. These warnings are flagged by use of the triangular alert icon (seen below), and are listed in descending order of severity of injury or damage and likelihood of occurrence.

Danger: *Danger is used to indicate the presence of a hazard that* ***will*** *cause severe personal injury, death, or substantial property damage if the hazard is not avoided.*

Warning: *Warning is used to indicate the presence of a hazard that* ***can*** *cause severe personal injury, death, or substantial property damage if the hazard is not avoided.*

Caution: *Caution is used to indicate the presence of a hazard that* ***will*** *or* ***can*** *cause minor personal injury or property damage if the hazard is not avoided.*

CERTIFICATION

ClearGain 900/1800 MHz has been tested and meets the CE requirements.

STANDARDS

The following listing is a bibliography of applicable regulatory standards:

Safety	EN60950
EMC	EN55022B
Storage	ETS3019-1-1
Transport	ETS3019-1-2
Operation	ETS3019-1-4

LIST OF ACRONYMS

ANT -- Antenna (Port on MHU)
BTS -- Base Transceiver Station
MHU -- Masthead Unit
PDU -- Power Distribution Unit
RF -- Radio Frequency
TMA -- Tower Mounted Amplifier

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1 PRODUCT OVERVIEW

1.1 General Description

The ClearGain tower mounted amplifier system is composed of some combination of three functional components: the ClearGain Power Distribution Unit (PDU), the Masthead Unit (MHU), and the Bias-T. Figure 1 shows where these components are located in a typical application on a communications tower.

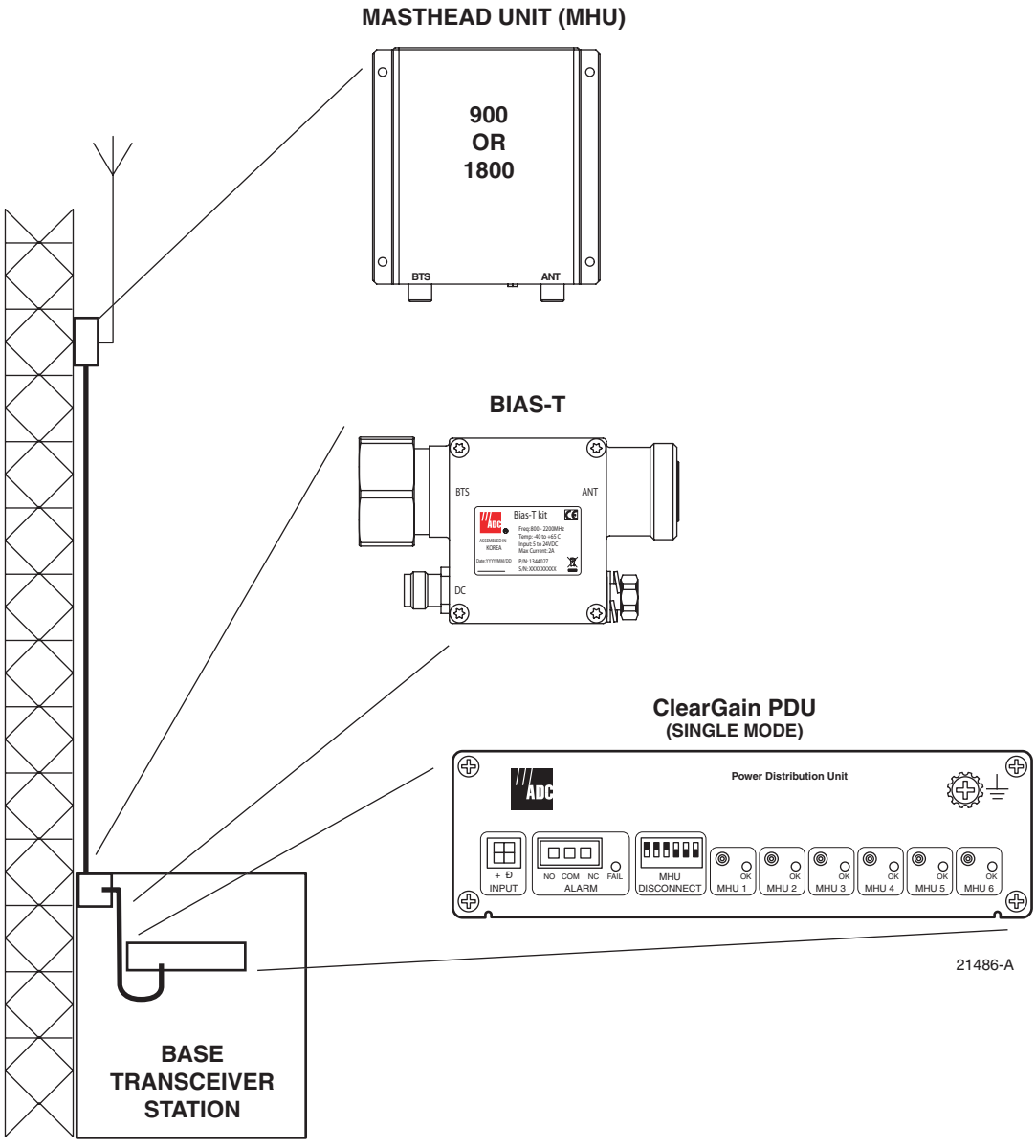


Figure 1. Functional Components of a ClearGain System

The MHU may be any of the three types shown. One PDU may support multiple MHUs of the same frequency. Each MHU requires one Bias-T. The ClearGain system also includes power cables and alarm cables.

1.2 Functional Description

The basic purpose of a ClearGain tower mounted amplifier system is to amplify the uplink signal just after the antenna. This is done to compensate for the loss in signal strength that occurs in passage of the signal through the coaxial cable to the Base Transceiver Station (BTS) at the base of the tower. The ClearGain system also provides alarming and lightning protection. Figure 2 depicts how the system components are involved in system function. As shown:

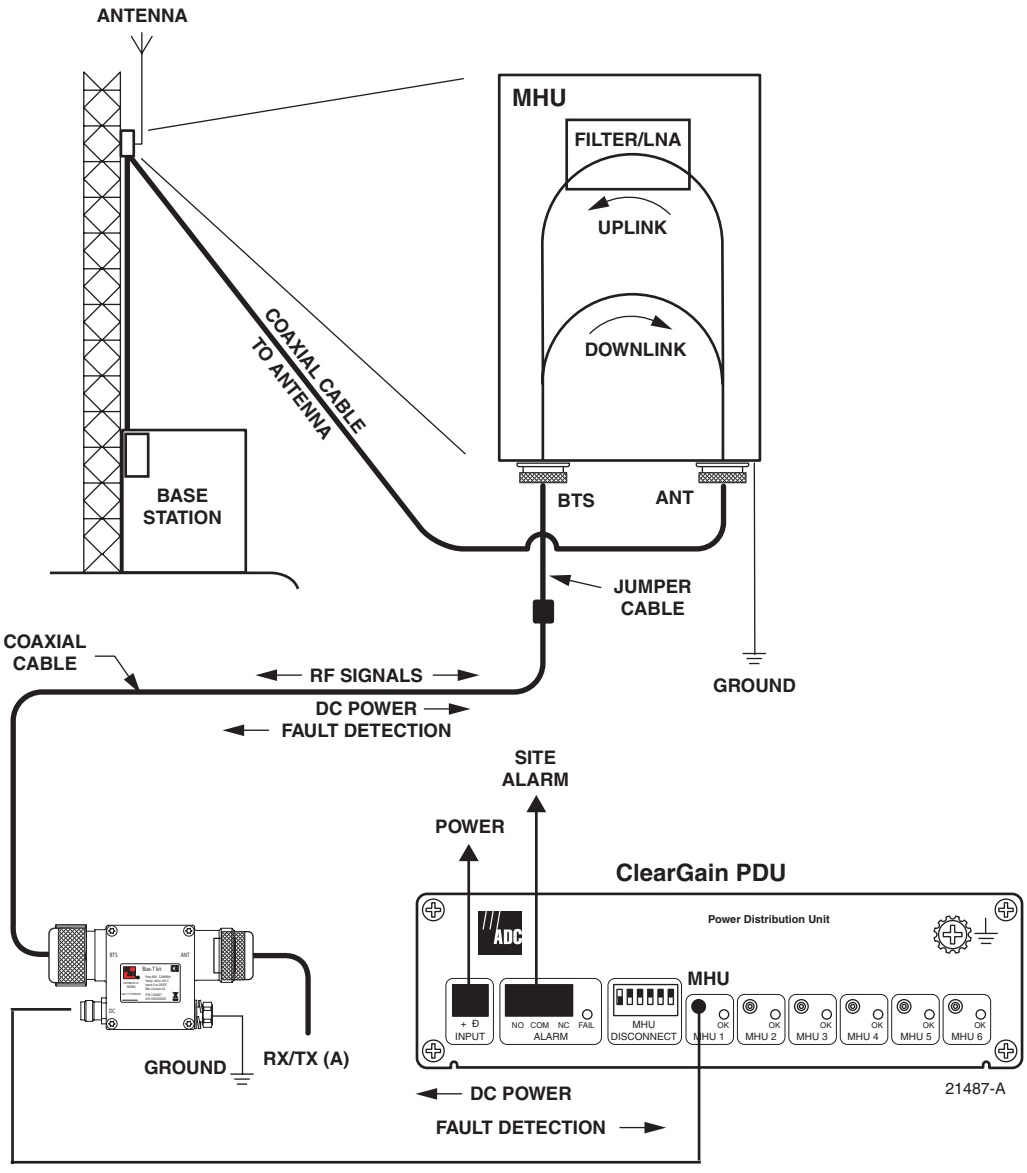


Figure 2. System Function

- **The MHU—**located on top of the tower, performs the amplifier function on the uplink signal. Two subcomponents of the MHU, an RF filter and a Low Noise Amplifier (LNA), are involved in the amplifier function. The downlink signal is not amplified.
- **The PDU—**located in the base station, provides DC current for use in the amplifier function. The PDU outputs the DC current through a front port from which it travels by way of a short linkage cable to the Bias-T. The injection of the DC current onto the coaxial cable will not cause interference with signal transmission.

  The PDU also monitors the status of all MHUs simultaneously by sensing their current draws. If any of the MHUs fails, or if there is a cut or short circuit in the coaxial cable, the PDU gives an alarm to the BTS. The PDU thus also monitors the condition of the coaxial cable, not just the MHU. The PDU also has built-in lightning protection.
- **The Bias-T—**located on the coaxial cable, is a passive device that physically injects the DC current onto the coaxial cable. The Bias-T injects the current into the center pin of the coaxial cable.

A single PDU supports multiple MHUs (with one Bias-T required for each MHU). The number of filters/LNAs supported depends on the system type.

1.3 MHU Dimensions

MHU dimensions are shown in Figure 3, Figure 4, and Figure 5.

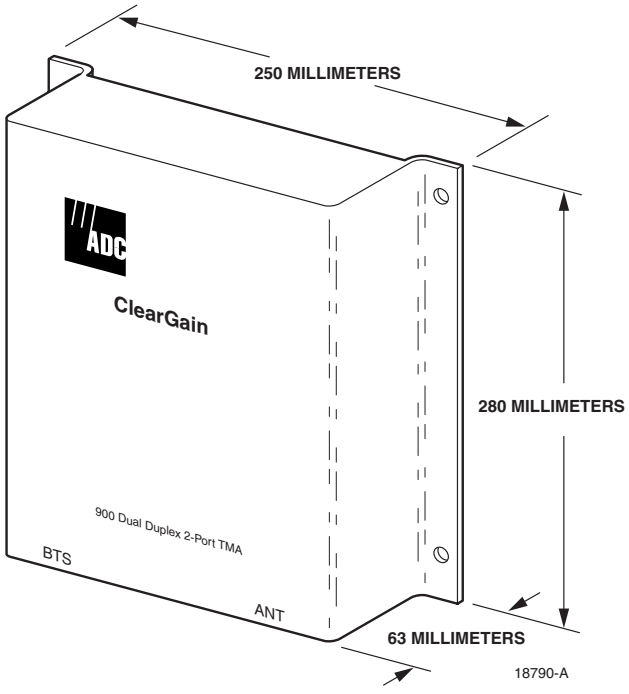


Figure 3. 900 Narrow Band MHU Dimensions

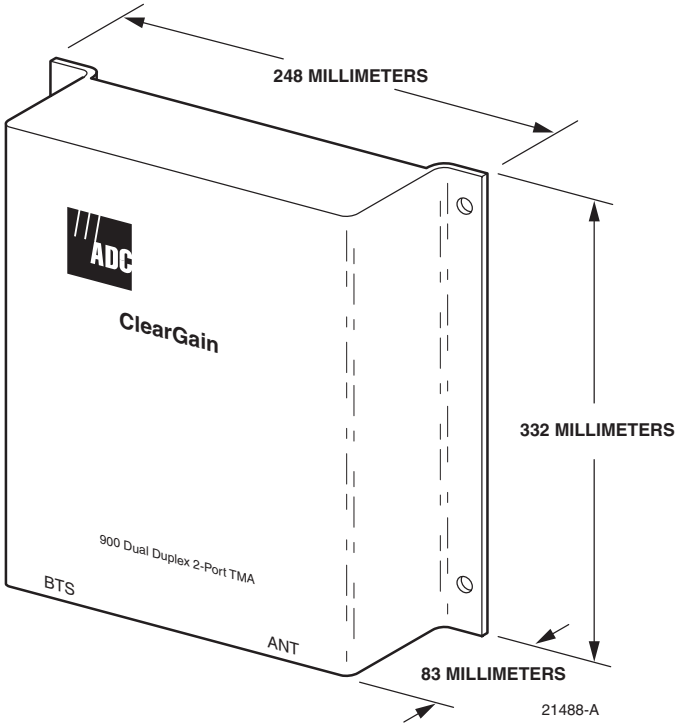


Figure 4. 900 Fullband MHU Dimensions

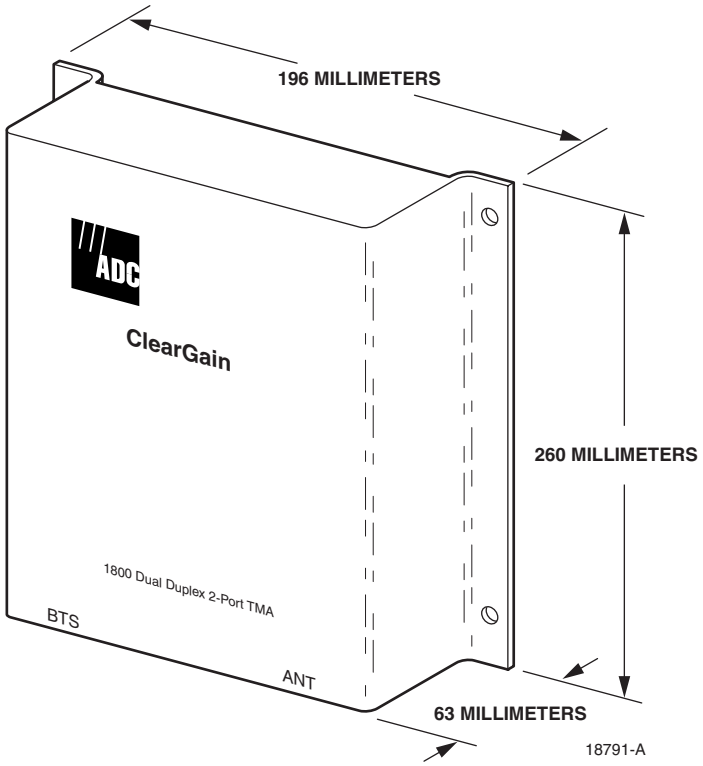


Figure 5. 1800 Narrow Band MHU Dimensions

2 SYSTEM INSTALLATION

2.1 Installation Overview

Installation consists of three main steps:

1. Installing the MHU: mechanical attachment, coaxial cables, ground cable.
2. Installing the Bias-T: mechanical attachment, coaxial cables, power cable.
3. Installing the PDU: mechanical attachment, operation power, and alarms.

2.2 Installing the Masthead Unit

U-bolts are provided for mounting the MHU. Figure 6 provides an exploded view. The kit may be used for tube diameter 30-140 mm.

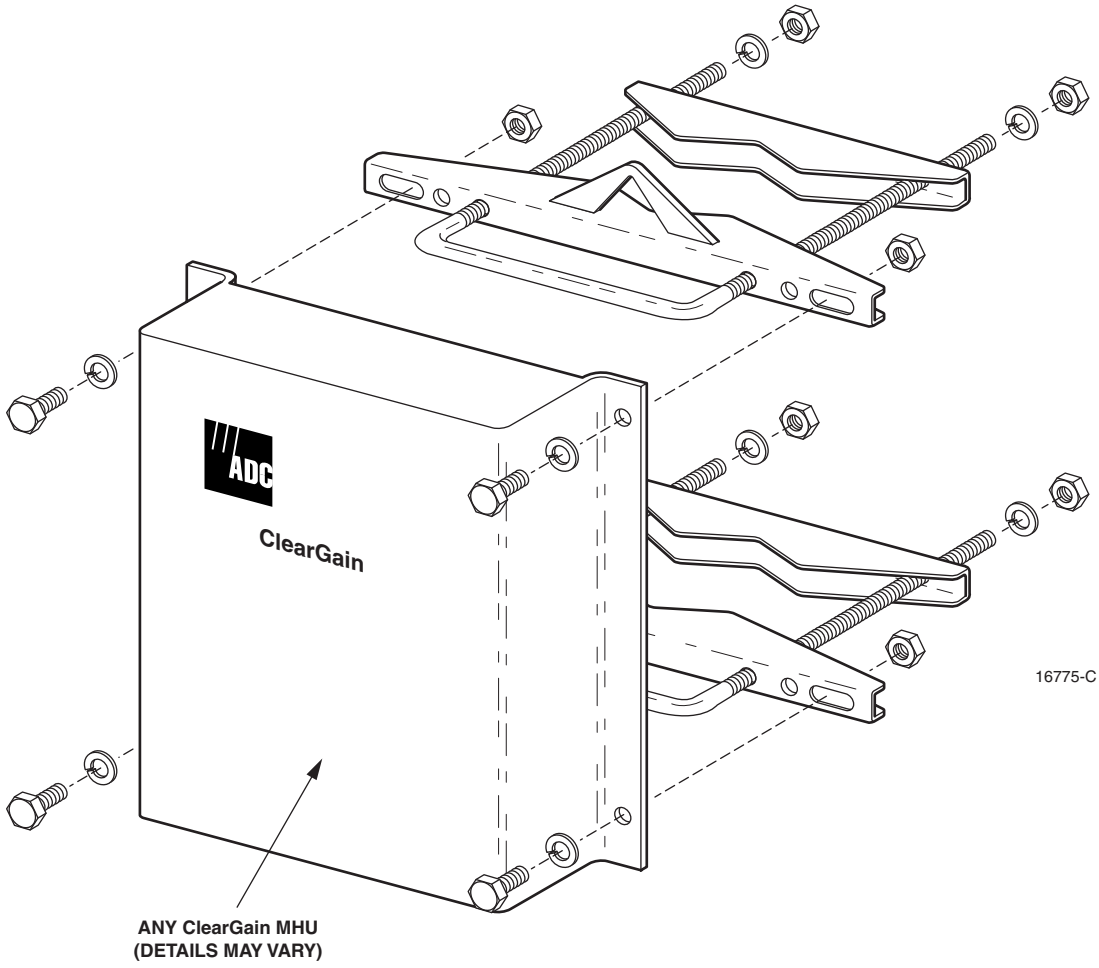


Figure 6. MHU Long Bolt Mounting Bracket Kit Components

2.2.1 Installation of the MHU on the Mast

Note: All hardware is specified in metric units.

Before any installation, check that the ClearGain MHU has no visible damages or defects.

Note: The ClearGain MHU must always be installed so that the connectors point downward. Not more than a 45-degree installation angle is recommended.

1. Place the MHU so that the bracket can be attached to the unit.

Note: The threads are sensitive to damage.

2. Place one half of the bracket (the half with the lifting hook) behind the MHU using two M8 bolts or long bolts.
3. Fasten the long screws, nuts, washers, and brackets.
4. Before going up to the mast, verify that the remaining washers and nuts are not left on the ground. Temporarily remove the connector protector plugs, inspect the 7/16 DIN connectors for damage, and return the connector protector plugs to their respective connectors.
5. Place the ClearGain MHU as close to antenna as possible. Attach the rest of the fasteners to the bracket system. Fasten the remaining washers and nuts. Verify that the MHU is tightly in place.

2.2.2 Installing the MHU Ground Cable

Good grounding of the ClearGain MHU is important to protect the unit against voltage surges. These surges could be caused by, for example, lightning. Install the ground cable as follows:

1. Connect the ground cable to MHU side using M5 attachment screw and washer.
2. Connect the other end of the cable to a good ground (site ground) with a reliable joint.

GROUNDING and BONDING CONSIDERATIONS

- Grounding is very important in tower applications. Shipped with each MHU, is a #6 AWG, 3-foot ground cable with single hole crimp lug connectors on both ends. Installation hardware is provided to attach one end to the MHU.
- Keep ground wire as short and direct (no loops or knots) as possible, secure it to a good ground point (metal to metal).
- Following local grounding practices the single hole lug is usually re-terminated by the tower crew with a double hole lug and bolted to a dedicated tower ground bus.
- In the absence of a dedicated ground, the tower structure itself can be used by using a exothermic weld joint (not very common) or a mechanical ground clamp. If a clamp is used, it must be very tight and protected from corrosion effects with a corrosion preventative compound. It is recommended that the ground integrity/resistance at any mechanical junction be checked during periods of regular tower maintenance.
- If ground cable length is too short, customer may make a longer ground cable (#6 AWG) as long as all the mechanical connections are tight and clean.

2.2.3 Installing Coaxial Cables

Caution: *Before connecting any coaxial cables, ensure that the BTS transmitter output is turned off and that precautions are taken to ensure that the transmitter cannot be activated during the equipment installation.*

Two short coaxial jumpers should be pre-made. One will connect the BTS port to the hardline and the other will connect the ANT port to the antenna.

Most installations require two good quality flexible coax jumpers, normally terminated with 7/16DIN-7/16DIN plug connectors. Check gender of hardline and check if Antenna pigtail is present, adjust accordingly for a correct match.

The coaxial feeder that runs from the base station should be hooked to the BTS port of the MHU using a jumper cable. The reason for the jumper cable is to ensure that mechanical forces caused by temperature change will not damage the MHU connectors. Tighten the connectors to 25–30 Nm (18.43–22.13 ft-lbs.) torque.

To improve the reliability of the connection, the connector joint can be protected. This can be done, for example, by installing specific weatherproof tape over the cable connectors.

Loose cable should be fixed to the tower using cable brackets.

2.3 PDU Installation

2.3.1 Mechanical Attachment of PDU

Warning: *Never install the Power Distribution Unit in a wet location or during a lightning storm. When installing or modifying communication lines, disconnect lines at the interface before working with uninsulated lines or terminals to prevent electrical shock.*

The PDU should be mounted in accordance with local code using appropriate hardware (customer provided). The PDU has two mounting holes on either side, as shown in Figure 7. Below are guidelines for standard wall mount, masonry wall mount, and rack mount of the PDU.

2.3.1.1 Standard Wall Mount

When mounting the PDU on a wooden or metal surface, it is recommended that it be installed on pressure-treated plywood (customer provided) with a minimum thickness of 1.9 cm. The plywood should be firmly secured to the wall studs.

2.3.1.2 Masonry Wall Mount

When mounting the PDU on a masonry surface, it is important that the bolts (especially the upper bolts) be located as close as possible to the center of bricks or blocks. Masonry mounting screws are not provided.

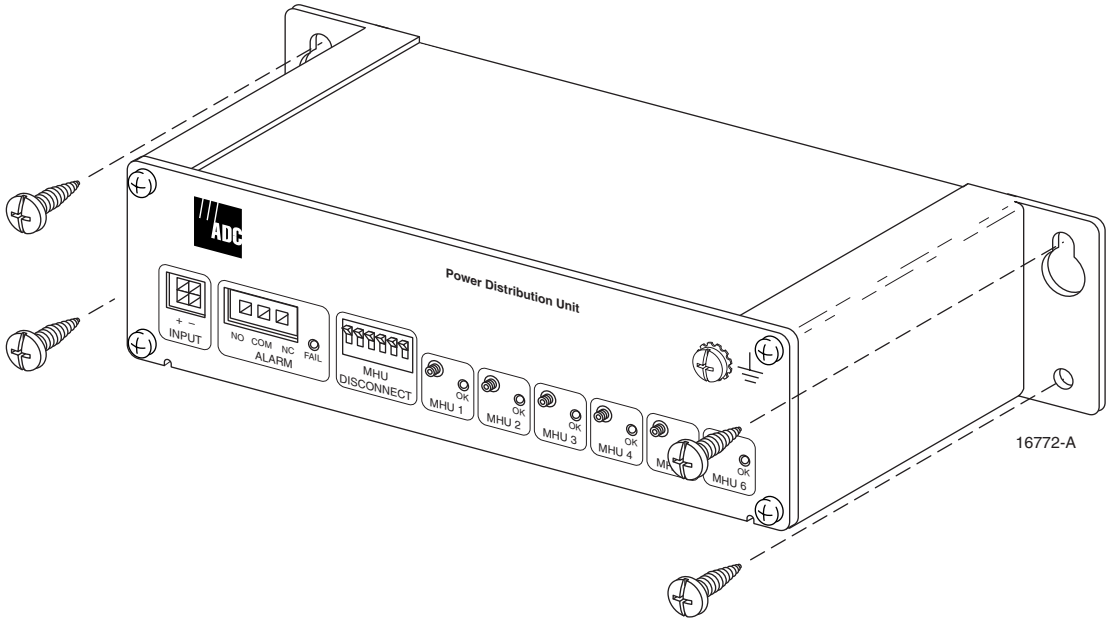


Figure 7. Example of PDU Standard Wall Mount

2.3.1.3 Rack Mount

A mounting bracket, shown in Figure 8, is available that will allow the PDU to be mounted on a19-inch rack. If mounting the PDU on a rack, refer to the installation drawing provided with the mounting bracket.

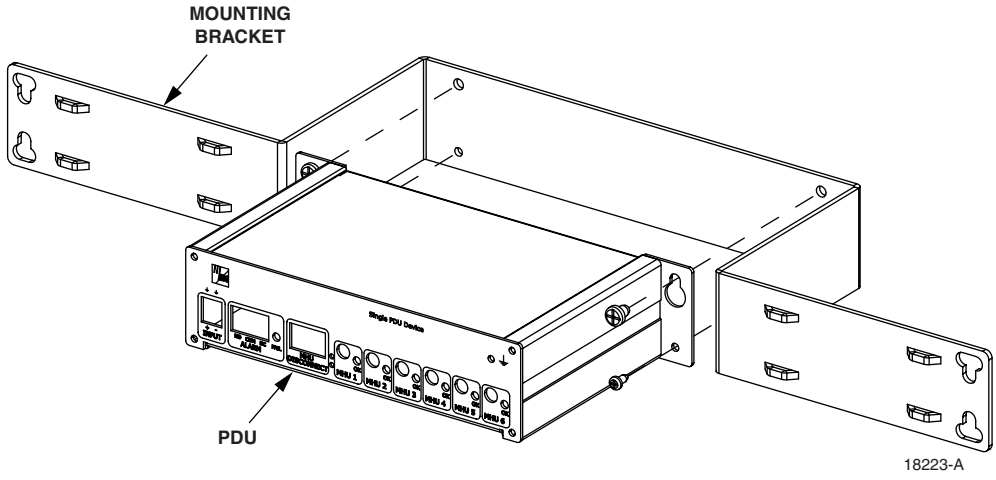


Figure 8. PDU Rack Mount Bracket

2.3.2 Installation of PDU Cables

There are three PDU cables: the ground cable, the alarm cable, and the power cable. Figure 9 shows the cable terminations on the front of the PDU. Connect the cables as follows:

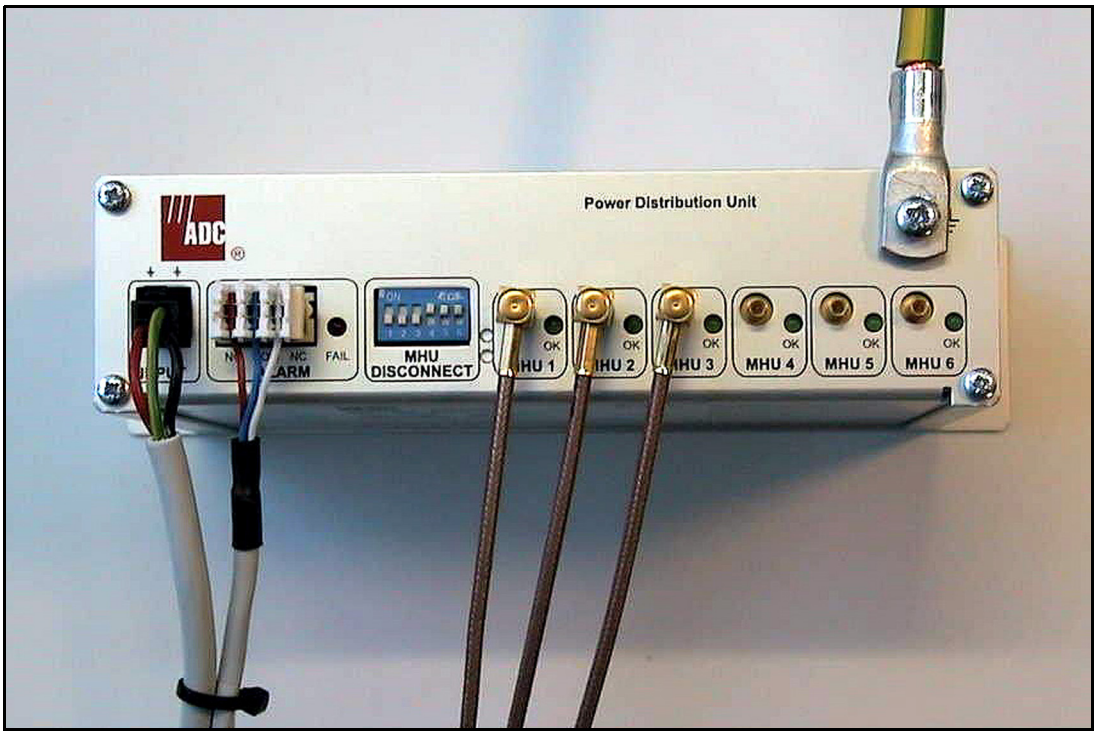


Figure 9. Cable Terminations on Front of PDU
(Left to Right: Power Cable, Alarm Cable, Three MHU Cables, Ground Cable)

1. Connect the ground cable under the grounding screw on the PDU front panel. Connect the other end of the cable to the site grounding pole.
2. Connect the alarm cable leads to the base station or site alarm system. Use either "Normally Open" or "Normally Closed" contacts. Figure 10 shows the PDU alarm logic
3. Connect the other end of the alarm cable to the PDU "ALARM" connector.
4. Connect the power cable to the site DC power connector. (The power cable has three leads. Red is positive, Black is negative, and Yellow/Green is for ground.)
5. Connect the power cable to the "INPUT" connector on the PDU front panel.

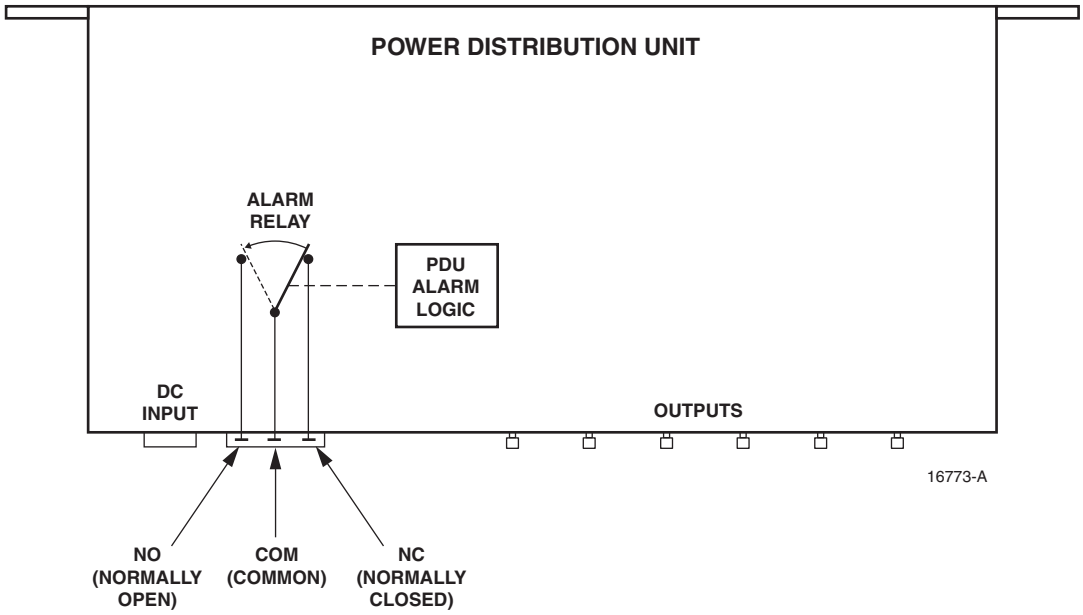


Figure 10. PDU Alarm Logic

2.3.3 Setting the DIP Switch on the PDU

The PDU has a DIP switch to disconnect unused MHU outputs (see Figure 11). For the MHU outputs that are used, the DIP switch must be in the "down" position. Unused outputs must be disconnected by setting the DIP switch to "ON".

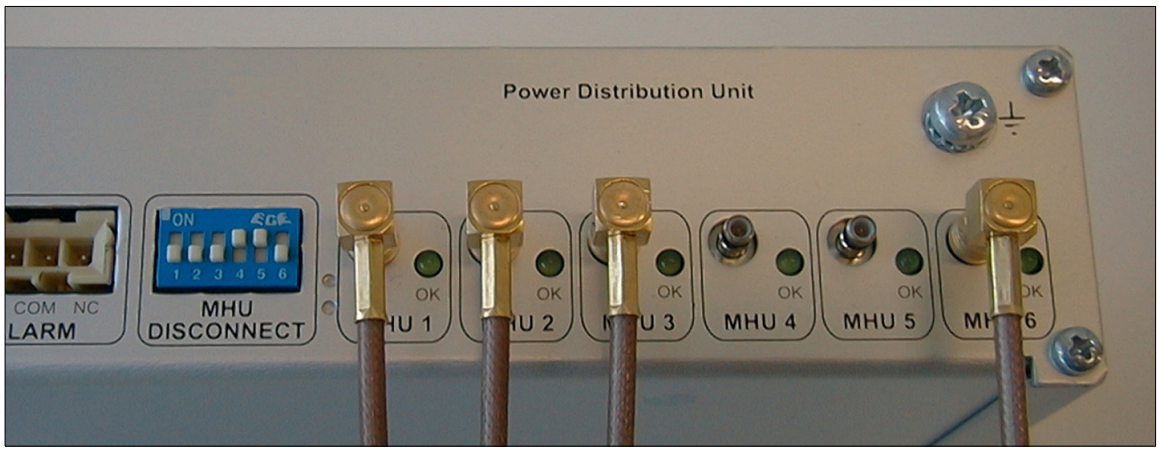


Figure 11. Example of DIP Switch Setting on the PDU (Switches 1, 2, 3, and 6 Set to "Down" to Indicate Use of MHU Ports 1, 2, 3, and 6)

2.4 Bias-T Installation

2.4.1 Mechanical Attachment and Cable Connections

⚠ **Caution:** *Prior to installing any Bias-T unit, ensure that the BTS transmitter output is turned off and that precautions are taken to ensure that the transmitter cannot be activated during the equipment installation.*

The BIAS-T is designed to fasten directly into BTS coax-connector or directly to the feeder cable. Integrated lightening protection is built into each Bias-T unit. There is no additional mounting hardware required. Connect the Bias-T as follows:

1. Connect the ground cable to the Bias-T grounding pole (see Figure 12).

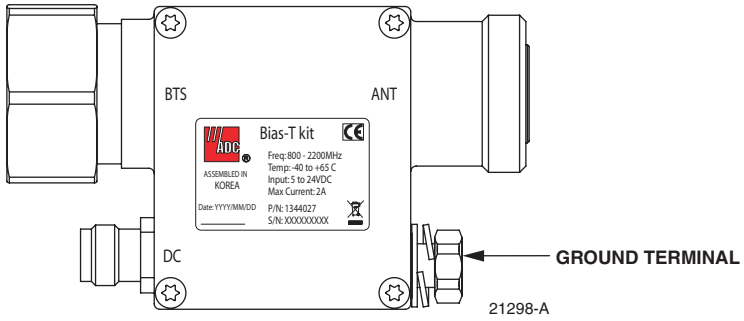


Figure 12. Bias-T Ground Cable Connection

2. Connect the other end of the ground cable to the site grounding pole.
3. Connect the BIAS-T “BTS” connector directly into the BTS coax-connector.
4. Connect the coaxial run going to the MHU to the “ANT” port of the BIAS-T.
5. Connect the mini coax cable to the SMB connector of the BIAS-T unit.
6. Connect the other end of the mini coax cable to the PDU front panel SMB connector TMA1…6 (whichever is being used).

2.4.2 Additional Lightning Protection

If operator chooses to install further lightning protection between the MHU and Bias-T, it must allow the DC voltage to pass through the lightening protector.

3 TROUBLESHOOTING

When something is wrong with the system, the red alarm LED on the PDU is activated and the PDU alarm output is activated. In such a case, troubleshoot for problems as follows:

1. Check that the power is fed into the PDU. PDU alarm output is activated if there is no DC fed in it, or if DC is out of the range (20-50 VDC) or polarity is incorrect.

2. Every output has a green LED, and it must be on if the output is used. Check that all the green LED's on the used outputs are on.
3. If one of the used outputs has a LED off, there is something wrong with the PDU, Bias-T, MHU, or the feeder cable.
4. Disconnect the mini coaxial cable from the PDU and measure from the connector, that the PDU feeds 12VDC to the Bias-T. Do this measurement using a multimeter (Voltage measurement, DC). If there is 11-13 VDC found from the connector, there is something wrong with the Bias-T, MHU, or cables.
5. Shut the transmit power OFF from the BTS, and disconnect the coaxial cable from the Antenna side of the Bias-T. Measure that the Bias-T feeds 12VDC to the MHU.

4 TROUBLESHOOTING 2-PORT CLEARGAIN DUAL DUPLEX TOWER MOUNTED AMPLIFIERS

If trouble is visually indicated by LED's or no illumination on a specific TMA, swap Bias-T cables on PDU ports to see if trouble remains or moves. Reference Figure 13.

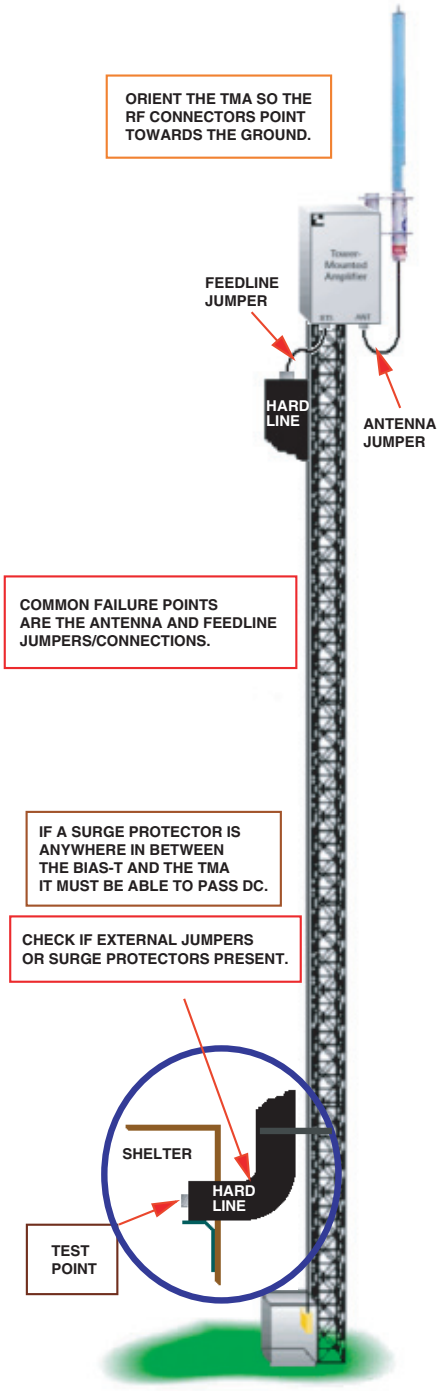
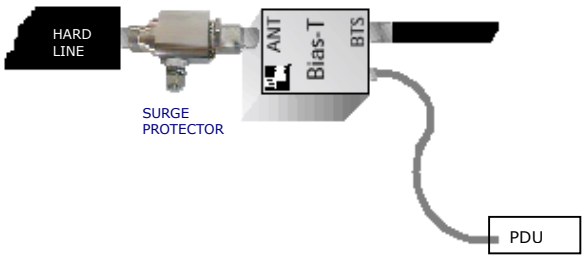


Figure 13. Tower Mounted Amplifiers

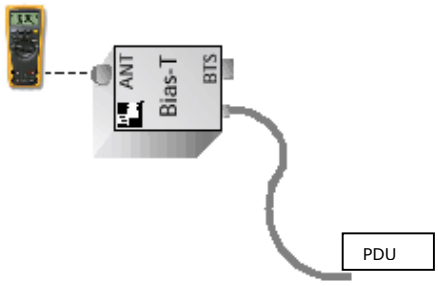
4.1 Troubleshooting

1. Observe and record PDU LED status. Disable or disconnect RF from BTS. Remove any surge protectors. Disconnect Bias-T from the antenna feedline/hardline/jumper/protector.



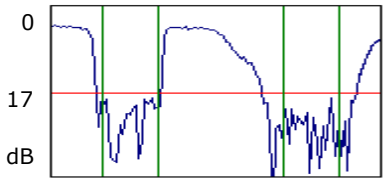
2. Multimeter checks:

   a. Measure voltage on the Bias-T _____ VDC. Normal is 13VDC.



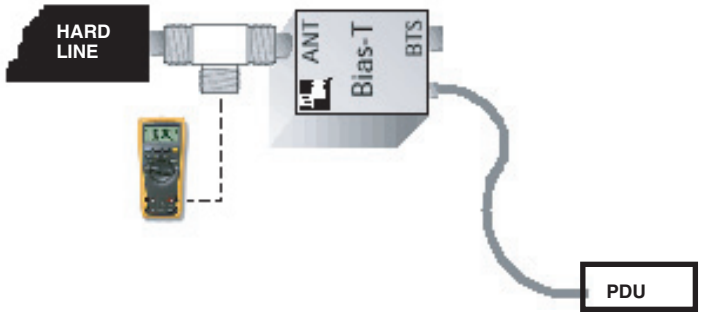
   b. Measure resistance of the feedline _____ Ohms. Normal is High or Very high Ω (KΩ/MΩ).

3. Antenna/cable analyzer checks. Measure the *in-band* RL/VSWR of the system _____dB or ratio. Check distance to Fault for anomalies.



Typical RL Sweep

4. Re-connect Bias-T with a T adapter. Verify voltage on the T adapter _____VDC. Normal is 13VDC.



PDU DC supply (18-56 VDC with 5A fuse/breaker).

5. Re-connect to original configuration and return to service. PDU should illuminate a green LED for each active TMA if there are no faults in the system.
6. Check with operators for improved performance.

4.2 Troubleshooting Hints

- If voltage is outside of the normal range, trace it back towards the fault.
- If no resistance or low resistance, check protector, feedline, jumpers and TMA.
- If high resistance, check to see if TMA is installed or for a discontinuity up to the TMA.
- Normal in-band RL should be greater than 14dB. If less than 14dB, check protector, feedline, jumpers and antenna.
- Mark receive and transmit bands to verify correct filtering.
- Check distance to fault to identify any anomalies on the feedline.

5 MHU SPECIFICATIONS

5.1 DD900 Narrow Band Masthead Unit

Table 1 provides typical specifications for the DD900 Full Band Masthead Unit.

Table 1. DD900 Narrow Band Masthead Unit

CATEGORY	PARAMETER	SPECIFICATION
ELECTRICAL	Nominal impedance of RF input and outputs	50 Ohm
	Frequency Range	
	TX	935–960 MHz or 925–950 MHz
	RX	890–915 Mhz or 880–905 Mhz
	Duplex Filter Bandwidth	25 MHz
	Passband (RX)	
	Gain	12 dB
	Noise Figure	1.4 dB typical
	Dynamic Range	
	Input at 1 dB compression	3.0 dB
	IIP3	+15 dBm
	Insertion Loss of TX Path (TX to Antenna)	0.2 dB
FILTER	Passband Return Loss	
	TX Band	20 dB
	RX Band	20 dB
	Intermodulation	–120 dBm
POWER HANDLING	Maximum Input Power at Each BTS Input	
	RMS Power TX	200 W
	Peak Power TX	1.44 kW
	Duration	20 microseconds
	Period Between Peaks	550 microseconds
	Fault Management	Bypass
POWER	Operational Voltage	7 to 15 VDC
	Operational Current	150 mA
	Alarm Current Level	175 ± 5 mA
PHYSICAL	Dimensions (HxWxD)	280 x 250 x 85 mm
	Weight	5.5 kg
	Color	Silver
	Housing	Aluminum
ENVIRONMENTAL	Operating Temperature	–40° C to +65° C
	Outdoor Protection	IP65
QUALITY	MTBF	< 500,000 hours
	Lightening Protection	IEC 801-5 and IEC 1312

5.2 DD900 Full Band Masthead Unit

Table 2 provides typical specifications for the DD900 Masthead Unit.

Table 2. DD900 Full Band Masthead Unit

CATEGORY	PARAMETER	SPECIFICATION
ELECTRICAL	Nominal impedance of RF input and outputs	50 Ohm
	Frequency Range	
	TX	925–960 MHz
	RX	880–915 Mhz
	Duplex Filter Bandwidth	35 MHz
	Passband (RX)	
	Gain	12 dB
	Noise Figure	1.4 dB typical
	Dynamic Range	
	Input at 1 dB compression	+3.0 dB
	IIP3	+15 dBm
	Insertion Loss of TX Path (TX to Antenna)	0.2 dB
FILTER	Passband Return Loss	
	TX Band	18 dB
	RX Band	18 dB
	Intermodulation	–115dBm
POWER	Operational Voltage	7 to 15 VDC
	Operational Current	140 mA ± 10 mA
	Alarm Current Level	350 ± 10 mA
PHYSICAL	Dimensions (HxWxD)	332 x 250 x 83 mm
	Weight	6.6 kg
	Color	Silver
	Housing	Aluminum
ENVIRONMENTAL	Operating Temperature	–40° C to +65° C
	Outdoor Protection	IP65
QUALITY	MTBF	< 500,000 hours
	Lightening Protection	IEC 801-5 and IEC 1312

5.3 DD1800 Masthead Unit

Table 3 provides typical specifications for the DD1800 Masthead Unit.

Table 3. DD1800 Narrow Band Masthead Unit

CATEGORY	PARAMETER	SPECIFICATION
FILTERS	RX (up link) frequency range	1710–1755, 1720–1765, or 1740–1785 MHz
	TX (down link) frequency range	1805–1850, 1815–1860, or 1835–1880 MHz
	Insertion Losses	
	1800 Tx	0.2 dB
	UMTS Rx and Tx	0.2 dB
	900 Rx and Tx	0.1 dB
	Intermodulation at RX Band	–120 dBm
	Power Handling Capability	500W RMS, 10 kW peak
	Return Loss	20dB
LNA WITH (FILTER)	Gain	12 dB fixed
	Passband ripple	± 0.5 dB
	Noise Figure	1.5 dB
	IIP3	+ 13 dBm
	Bypass Loss Typical	< 2.0dB, RF relay connection
PHYSICAL	Dimensions (HxWxD)	196 x 260 x 63 mm
	Weight	5 kg
	Color	Silver
CONNECTORS	Antenna Connector	7/16 DIN receptor
	BTS Connector	7/16 DIN receptor
INTERMODULATION	Intermodulation	–120 dBm
ENVIRONMENTAL	Operating Temperature	–40° C to +65° C
	Outdoor Protection	IP65
QUALITY	MTBF	< 500,000 hours
	Lightening Protection	IEC 801-5 and IEC 1312

6 CUSTOMER INFORMATION AND ASSISTANCE

PHONE:

U.S.A. OR CANADA
Sales: 1-800-366-3891 Extension 73000
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Wireless Extension 73476

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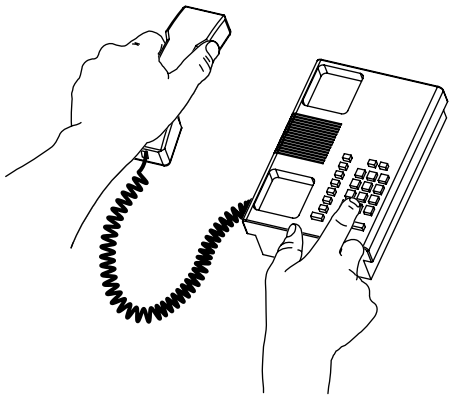
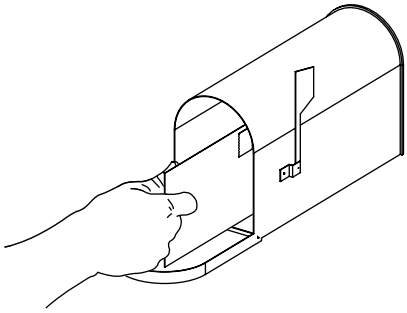


WRITE:

ADC TELECOMMUNICATIONS, INC
PO BOX 1101,
MINNEAPOLIS, MN 55440-1101, USA

ADC TELECOMMUNICATIONS (S'PORE) PTE. LTD.
100 BEACH ROAD, #18-01, SHAW TOWERS.
SINGAPORE 189702.

ADC EUROPEAN CUSTOMER SERVICE, INC
BELGICASTRAAT 2,
1930 ZAVENTEM, BELGIUM



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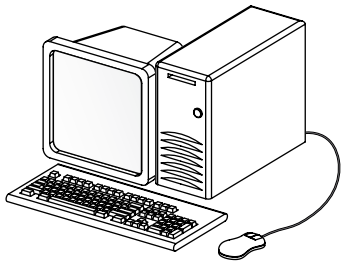

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