



ClearGain® Tower and Ground- Mounted Amplifiers

A Deployment Guide
for Wireless Carriers



ClearGain® Tower and Ground Mounted Amplifiers

Deployment Guide for Wireless Carriers

As mobile usage continues to increase, service providers are faced with the challenge of optimizing and expanding their wireless networks to provide new and existing services. ADC's ClearGain® Tower and Ground-Mounted Amplifiers (TMAs and GMAs) minimize the cost of network expansion and improve quality of service (QoS), allowing service providers to increase profitability. ClearGain Tower and Ground-Mounted Amplifiers improve signal quality by boosting the uplink signal of a mobile system to increase receiver performance and improve overall coverage.



How to Use the Deployment Guide: Sections 1 through 3

The guide is divided into three easy-to-navigate sections. Although this format allows you to pick and choose which sections to view, the most effective way to use this document is to work through each section in order.

You will be asked to complete a cell-site audit, which offers the dual benefit of allowing you to document your current situation and providing ADC with the necessary information to answer your tough wireless questions.

Section 1

Evaluating your Cell Site

Section 2

Tower-Mount Amplifiers vs. Ground-Mount Amplifiers

Section 3

Case Studies: Tower and Ground-Mounted Amplifier Deployment Scenarios

Note: You will encounter many acronyms throughout this document. Although they will be defined along the way, an acronym key is provided in the appendix.

Section 1: Evaluating your Cell Site

A successful cell site deployment begins with building a solid foundation. Your partner requires a thorough understanding of your needs and priorities. In Section 1, we examine the objectives of your cell site deployment and the considerations that need to be addressed in this project.

Tower Considerations

- 1) What is the height of the tower(s) you are interested in improving?

- 2) Is wind loading a concern?
 Yes
 No
- 3) Do you currently lease the tower?
 Yes
 No, go to question 5
- 4) If you lease the tower, are you charged by the amount of equipment installed?
 Yes
 No
- 5) Have environmental/lightning concerns prohibited you from deploying TMAs in the past?
 Yes
 No
- 6) Do you have an indoor enclosure at the base of the tower that has at least 7 Rack Units of space in a 19" F Rack?
 Yes, go to question 8
 No
- 7) If not, are you able to mount a cabinet to a pole or wall at the base of the tower?
 Yes
 No

8) What kind of environment is this tower located in?

- Dense, urban
- Open, rural
- Other, please explain

Product Considerations

9) What are the most critical performance challenges you want to overcome?

- Dropped calls
- Link balance
- Mobile TX power
- Other, please explain

10) What is the tower's antenna configuration

- Omni
- Tri-sector

11) Which bands are you interested in improving?

- 800 Cellular
- 1900 PCS
- 800/1900 Dual Band
- AWS

Section 2: Tower-Mount Amplifiers vs. Ground-Mount Amplifiers

Tower-Mount Amplifiers

TMA's improve signal quality by boosting the uplink (RX) signal of a mobile system immediately after the antenna. This compensates for the loss in signal strength that occurs when the signal is passed through the coaxial feeder cable to the base transceiver station (BTS) at the base of the tower. ClearGain TMA's perform this amplification with the lowest possible noise contribution, resulting in a substantial increase in receiver performance and an improvement in overall coverage. These improvements in quality of service allow mobile subscribers to place more calls, make longer calls, and successfully complete calls in an expanded geographic area, resulting in increased revenue.

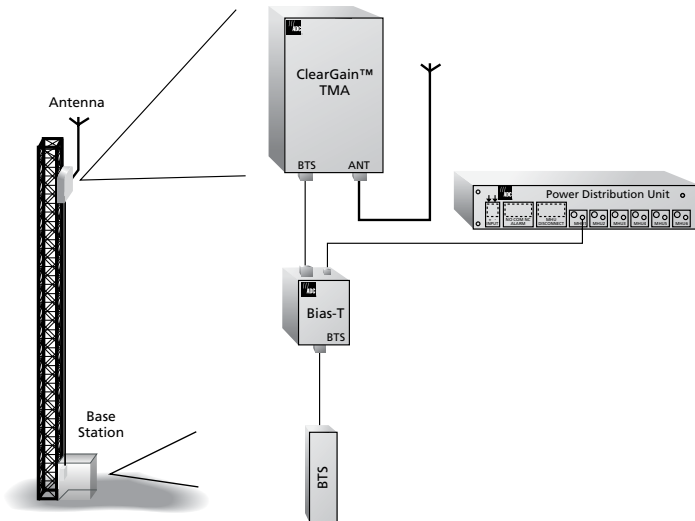
TMA Features

- Highly advanced LNA amplifies RX signal for improved receiver performance and increase in coverage
- Dual duplex feature reduces the number of feeder cable runs by providing simultaneous operation of TX and RX with low TX loss
- Advanced filtering maintains the lowest possible noise figure for improved QoS
- Slim, stackable design conserves tower space and reduces tower-related costs
- Seamless aluminum sleeve construction protects components from the elements
- Modular system is fully compatible with all base stations
- Power and alarming for up to six masthead units is provided from a single unit at the base station



System Overview

- The ClearGain TMA system is modular, consisting of a Masthead Unit (MHU), a Power Distribution Unit (PDU) and a Bias-T Unit. This system provides full compatibility with all base stations. The ClearGain MHU offers dual duplex operation and incorporates a highly advanced fixed-gain, low noise amplifier (LNA) and high-performance filters for added reliability. The MHU amplifies each band to maximize signal quality and optimize coverage.
- The ClearGain MHU features a slim, lightweight design. This allows two ClearGain TMAs to be mounted with one set of brackets, thereby conserving valuable and costly tower space and reducing clutter on the tower. The TMA is protected with a strong, aluminum sleeve construction designed to ensure superior weather protection and resistance to corrosion, resulting in increased reliability.
- In the ClearGain TMA system, DC power is supplied to the MHU from a ClearGain PDU. The PDU also provides alarming and monitoring of the feeder cable and up to six MHUs from a single unit. The flexible design of the ClearGain PDU allows it to be rack- or wall-mounted on the side of a BTS cabinet.
- An external Bias-T Unit is used in conjunction with the ClearGain PDU. The Bias-T inserts DC power onto the coaxial cable and extracts alarm and monitoring signals from the coaxial cable.



Ground-Mount Amplifiers

ClearGain GMAs improve signal quality by boosting the uplink (RX) signal of a mobile system. GMAs perform this amplification with the lowest possible noise contribution, resulting in a substantial increase in receiver performance and an improvement in overall coverage. These improvements in QoS allow mobile subscribers to place more calls, make longer calls, and successfully complete calls in an expanded geographic area, resulting in increased revenue.

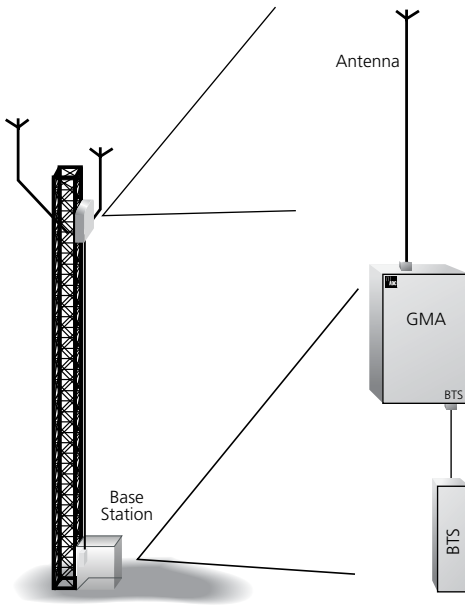
System Overview

The ClearGain GMA system is modular, consisting of an amplification module and a power distribution unit (PDU), providing full compatibility with all base stations.

The ClearGain GMA offers dual duplex operation and incorporates a highly advanced fixed-gain, low noise amplifier (LNA) and high-performance filters for added reliability.

GMA Features

- Slim, stackable design conserves rack space and eliminates tower climbs
- Highly advanced LNA amplifies RX signal for improved receiver performance and increase in coverage
- Dual duplex feature reduces the number of feeder cable runs by providing simultaneous operation of TX and RX with low TX loss
- Advanced filtering maintains the lowest possible noise figure for improved Quality of Service (QoS)
- Modular system is fully compatible with all base stations
- Power and alarming for up to three GMA units



Section 3: Case Studies: Tower and Ground-Mounted Amplifier Deployment Scenarios

Tower-Mounted Amplifiers



The Situation

Unacceptable network quality is one of the main reasons for mobile subscriber churn. With industry churn rates as high as 25 percent annually, a service provider's entire customer base could be lost in a matter of a few years. A majority of these users will cite dropped and failed calls as the primary reasons for the switch.

The cost of acquiring new subscribers to replace the existing customer base can be enormous with Subscriber Acquisition Costs (SAC) at approximately \$350-\$400 per subscriber. Improvements in quality of service can directly impact a carrier's profitability through the cost savings associated with increased subscriber retention and the additional revenue gained from increased billable minutes of use resulting from improved signal quality. This improvement in signal quality will come from a combination of better noise figures and lower interference levels.

The Problem

One of the nation's largest wireless carriers wanted to improve dropped call (DC) and failed call attempt (FCA) rates for part of its network in the southeastern United States. The region, comprising approximately 53 square miles in a densely populated residential area, included 11 CDMA Base Transceiver Station (BTS) sites.

The wireless carrier had two options: Build additional expensive BTS sites, or enhance the existing sites to improve signal strength and reduce interference for a fraction of the cost.

The ADC Solution

The wireless carrier turned to its longtime business partner, ADC, for help. Network technicians analyzed a cluster of 11 BTS sites for a two-week period. Each BTS site included a three-sector, diversity tower with the average height of each tower at 180 feet. Dropped Call (DC) and Failed Call Attempt (FCA) data was gathered on each sector of each tower.

DC and FCA rates were unacceptable for many of the BTS sites within the cluster. In fact, field tests revealed that more than five percent of all mobile calls in the region experienced service failure—with some areas reporting service loss as high as 10 percent. Insufficient uplink sensitivity at the base station was deemed to be responsible for the reduced signal strength throughout the coverage areas. There did not appear to be significant interference issues at most of the BTSs.

Since CDMA can be both uplink and downlink limited and ADC has shown that the use of a tower-mounted amplifier can improve both the capacity and the coverage of each BTS*, technicians installed ClearGain® Tower-Mounted Amplifiers (TMAs) as close as possible to each receive antenna on the towers. The ClearGain TMAs reduced the composite Noise Figure, which increased the uplink signal sensitivity of each BTS site. This, in turn, resulted in:

1. An increase in the allowable path loss (and therefore coverage area), or
2. An increase in capacity for a fixed coverage area, or
3. A reduction in mobile transmit power for a given coverage/capacity combination, which resulted in longer mobile phone battery life.

Benefits Realized by Customer

Technicians tabulated DCs and FCAs for two weeks after the TMAs were installed. Representatives from the wireless carrier were ecstatic with the results—as were their customers.

The ClearGain TMAs were estimated to expand service coverage area by up to 40 percent. Signals were able to reach users on the outermost areas of the region, even during periods of intense demand, e.g., weekday rush hour. As a result, the number of DCs decreased by approximately 21 percent after the ClearGain installation. The number of FCAs also decreased by approximately 21 percent.

Mobile phone users in the region can now place more calls, make longer calls and successfully complete more calls in an expanded geographic area. As a result, the wireless carrier has minimized customer churn and maximized revenue opportunities.

*Reference ADC white paper „CDMA Coverage and Capacity” by Dr. Phil Wala, 17 October, 2006. Ground-Mount Amplifiers:



Ground-Mounted Amplifier

The Problem

A large Tier II Carrier in the Midwestern United States wanted to explore options for improving dropped calls (DCs) and increasing minutes of use (MOU) with its customers. The region was a large rural area with several CDMA Base Transceiver Station (BTS) Sites. One way to achieve this was to decrease mobile transmit power for its customers in order to prolong battery life. The customer wanted an economical solution as possible.

The wireless carrier had two options: Build additional BTS sites, or enhance the existing sites to improve dropped calls and mobile transmit power.

The ADC Solution

The wireless carrier turned to ADC for help. Technicians analyzed the network and located a three-sector cell site that would be a good candidate for improving mobile transmit power and dropped calls. The tower height was 150 feet. Mobile Transmit Power and Dropped Call (DC) data was gathered on each sector of the tower.

Since CDMA can be both uplink and downlink limited and ADC has shown that the use of a TMAs and GMAs can improve both capacity and coverage, technicians installed ClearGain Ground-Mount Amplifiers at the base of the towers. This highly economical solution reduced composite noise figure, which increased the uplink signal sensitivity of the BTS. This resulted in a reduction in mobile transmit power and an improvement in dropped call rates.

Benefits Realized by Customer

The tower's performance was benchmarked prior to the ADC ClearGain GMA installation. After the GMA installation, data was recorded and the customer was extremely pleased with the results.

The ClearGain GMAs improved the coverage and quality of calls at the tower. The GMA also allowed for a better link balance by improving the uplink by approximately 13 dB. Again, signals were able to reach users on the outermost areas of the region. As a result, the number of DCs decreased.

Mobile phone users in the region can now place more calls, make longer calls and successfully complete more calls in an expanded geographic area. As a result, the wireless carrier has increased customer satisfaction and maximized revenue opportunities.



Appendix

Acronym Key

You will encounter many acronyms throughout this document. Although they will be defined along the way, the following acronym key is provided as an ongoing reference tool.

ARPU	Average revenue per user
BER	Bit error rate
BTS	Base Station Transceiver
CDMA	Code Division Multiple Access; 2G digital standard
dB	Decibel
dBm	Decibel referred to 1 milliwatt
GSM	Global System for Mobile communications; 2G digital standard
QoS	Quality of service
RF	Radio Frequency
TMA	Tower-Mounted Amplifier
GMA	Ground-Mounted Amplifier



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