

# Axiom Repeater USER MANUAL Version 0.3





3116 Vanowen St. Burbank, CA 91505 Tel: 818-840-8131 Fax: 818-840-8138 www.adrftech.com



# Glossary

The following is a list of abbreviations and terms used throughout this document.

Abbreviation/Term	Definition
AGC	Automatic Gain Control
ALC	Automatic Level Control
AROMS	ADRF' Repeater Operation and Management
	System
BTS	Base Transceiver Station
CDMA	Code Division Multiple Access
CFE	Compact Front End
CW	Continuous Wave (un-modulated signal)
DAS	Distributed Antenna System
DL	Downlink
Downlink	The path covered from the Base Transceiver
	Station (BTS) to the subscribers service area via
	the repeater
HPA	High Power Amplifier
HW	Hardware
IF	Intermediate Frequency
LNA	Low Noise Amplifier
LTE	Long Term Evolution
MS	Mobile Station
PLL	Phased Locked Loop
PS	Power Supply
RF	Radio Frequency
SQE	Signal Quality Estimate
SW	Software
UL	Uplink
Uplink	The path covered from the subscribers service
	area to the Base Transceiver Station(BTS) via the
	repeater
VSWR	Voltage Standing Wave Ratio



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Please send comments to:

E-Mail: info@adrftech.com

Phone: (818) 840-8131 (800) 313-9345 Fax: (818) 840-8138

Address:Advanced RF Technologies, Inc. Attention: Technical Publications Department 3116 Vanowen St. Burbank, CA 91505 USA www.adrftech.com

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# 1. Axiom Repeater

## 1.1 Introduction

**Four technologies in one body**: Axiom is an over-the-air repeater system that can incorporate up to 4 technologies in one body. Current supported technologies are LTE, Cellular, PCS and AWS band.

## 1.1.1 Highlights

- Can utilize up to 4 technologies simultaneously
  - o Covers the LTE band
    - 10MHz upper C block, 5MHz lower A block and 5MHz lower B block (Add Lower A+B)
  - o Covers the 60 MHz PCS band
    - Three independent RF PCS channels, each channel supports 1.25 MHz to 18.75 MHz bandwidth
  - o Covers the 25MHz Cellular band
  - o Covers the 45 MHz AWS band
- 25K/100K/Large Composite Output Power [24/30/43 dBm]
- 30 dB AGC Range @ 0.5 dB Step
- Adjustable AGC Output Power Level
- Band Selectable via Web-GUI
- Can Support Non-Contiguous Bands
- Supports Embedded Wireless Modem
- Supports Network Management Monitoring System via SNMP
- Adjustable FA (3 channels)
- Digital filtering
- Incremental Automatic Shutdown/Resumption Time: Axiom gradually increases the time span between automatic shutdown and resumption before it permanently shuts itself down
- Al compatible: Axiom is fully compatible with Applied Innovation's monitoring system.
- Versatility and Usability: Axiom gives total control to the user. Most of the control parameters, e.g., gain, output power, alarm threshold, etc. can be changed using the Web-GUI so that the user can adjust the system perfectly to the given RF environment
- Web-GUI connectivity via DHCP
- Supports DHCP; No 3<sup>rd</sup> party GUI software required
- Automated installation



## 1.1.2 Parts List

Label	Quantity	Description
A	1	Axiom Network Management System (NMS)
В	Up to 4*	Optional Axiom Modules*
С	1	AC Power Cable
D	1	Ethernet Cable (Crossover)
E	1	Documentation CD**
F	1	Ground Cable
G	8	Rack Mount Bolt/Nut

Table 1 – Parts List



\* At least 1 module must be present in order to use Axiom \*\* CD includes: User Manual, Quick-Start Guide, and Troubleshooting Guide

Figure A – Axiom Repeater Parts List



# 1.1.3 Repeater Quick View





# 2. Warnings and Hazards





# WARRANTY

Opening or tampering the Axiom will void all warranties.

Lithium Battery: CAUTION. RISK OF EXPLOSION IF BATTERY IS REPLACED BY INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO INSTRUCTIONS.

Ethernet Instructions: This equipment is for indoor use only. All cabling should be limited to inside the building.

# FCC Part 15 Class A

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.



# 3. Axiom Overview

## 3.1 Switches & Fault Indicators 3.1.1 MCU LEDs



Figure 1: MCU LED

• PWR(POWEF	R)				
Parameters		Specifications			
LED F	Repeater On	Solid Green LED On			
F	Repeater Off	LED Off			
AC Fail					
Parameters		Specifications			
LED 1	Normal	LED Off			
H	Hard fail	Solid Red LED On			
Condition for Alar	m Activation	AC fail			
<ul> <li>DC Fail</li> </ul>					
Parameters		Specifications			
LED 1	Normal	LED Off			
H	Hard fail	Solid Red LED on			
Condition for Alar	m Activation	DC fail			
After Alarm Activa	ation	Full Spectrum shutdown			
<ul> <li>TAMP (Tamp</li> </ul>	er detected)				
Parameters		Specifications			
LED Normal		Solid Green LED On			
	Soft fail	Solid Red LED On			
Condition for Alar	m Activation	Controlling Key parameter in normal operation			
Alarm Clear		Cleared by an authorized user			

#### • RMF 1,2,3,4 (Replaceable module failure)

	· ·	,
Parameters		Specifications
LED	Normal	Solid Green LED On
	Hard fail	Solid Red LED On
Condition for indic	ation	RFU Module failure per band
Condition for indic	Hard fail	Solid Red LED On RFU Module failure per band

#### • RESET (Reset engaged)

Parameters		Specifications
LED	Normal	Solid Green LED On
	Soft fail	Solid Red LED On
Condition for Alar	m Activation	Control of Software Reset
Alarm Clear		Cleared by an authorized user

#### • BATT(Battery)

Parameters		Specifications
LED	Charging	Solid Red LED On
	Full charged	Solid Green LED On
	Batt S/W off or	LED Off
	non- connection	



#### 3.1.2 RFU LEDs

Axiom has LEDs on the front panel of the repeater as shown below in Figure 2.

PWR	0/P	Manual	BITF	RMF	AGC	osc	S/D	DL_CF	DL_Low	UL_CF	RSSI
$\bigcirc$											

#### Figure 2: RFU LED

#### • PWR (RFU Power)

Parameters		Specifications		
LED	Normal	Blinking Green LED		
	Alarm	Solid Red LED on		
Condition for Alarm Activation		Power fail		

#### • 0/P (Over Power)

Parameters		Specifications
	Normal	Solid Green LED On
LED	Soft fail	Blinking Red LED
	Hard fail	Solid Red LED On
Condition for Soft fail		Max power +1 < measured output < max power+2
Alarm Activation	Hard fail	measured output > max power + 2
Following	Soft fail	Only the alarm is activated and the repeater operates as normal
Alarm Activation	Hard fail	The function associated with the alarm shutdown, and the shutdown process goes into effect

#### Manual

Parameters		Specifications
	Manually HPA Off/On	PCS (Cellular) Green LED On
LED	Factory set or Reboot	PCS (Cellular) Green LED Off

#### • BITF (Built-in test failure)

Parameters		Specifications
LED	Normal	Solid Green LED on
	Hard fail	Solid Red LED on
Condition for indication		RFU Module built-in test failure

#### • RMF (Replaceable module failure)

Parameters		Specifications
LED	Normal	Solid Green LED On
	Hard fail	Solid Red LED On
Condition for indication		RFU Module failure

#### • AGC (AGC active)

Parameters		Specifications
LED	AGC On	Solid Green LED On
	AGC Off	LED Off

#### • OSC (Oscillation detected)

Parameters		Specifications
LED	Normal	Solid Green LED On
	Hard fail	Solid Red LED On



Condition for Alarm Activation	Repeater goes into oscillation
Following Alarm Activation	The portion associated with the oscillation shuts down, and at
	time of oscillation the defined procedure goes into effect

#### • S/D (Shutdown)

Parameters		Specifications
LED	Normal	Solid Green LED on
	Hard fail	Solid Red LED on
Condition for Alarm Activation		Overpower, Oscillation

#### • DL\_CF (Donor circuitry failure)

Parameters		Specifications
LED	Normal	Solid Green LED On
	Hard fail	Solid Red LED On
Condition for indication		RFU Module Donor circuitry failure

#### • DL\_Low (Donor power too low)

Parameters		Specifications
LED	Normal	Solid Green LED On
	Hard fail	Solid Red LED On
Condition for indication		Donor input level under threshold

#### • UL\_CF (Coverage circuitry failure)

		- /
Parameters		Specifications
LED	Normal	Solid Green LED On
	Hard fail	Solid Red LED On
Condition for indication		RFU Module coverage circuitry failure

#### • RSSI (DL RSSI LED bar)

Parameters		Specifications
LED	Input < -95dBm	Zero (0) bar On
	Input < -85dBm	One (1) bar On
	Input < -75dBm	Two (2) bars On
	Input < -65dBm	Three (3) bars On
	Input < -55dBm	Four (4) bars On
	Input > -55dBm	Five (5) bars On

#### 3.1.3 Alarms

Parameters	Remark
Tamper	Temper detected
AC fail	Power supply out of range
DC fail	Power supply out of range
Communication failure	Internal Communication failure
RMF	Field replaceable module failure
RESET	Reset alarm
Heartbeat	Heartbeat
OSC	Oscillation detected
UL RSSI fail	Power at coverage port too high
UL PLL fail	UL Synthesizer failure
H/W fail	Hardware failure
S/W fail	Software failure
UL Emission fail	UL Out-of-band emissions out of spec
DL RSSI fail	Donor Power too high/low



ISO fail	Low isolation
DL PLL fail	DL Synthesizer failure
DL Spur fail	DL Spurious emissions out of spec
Interfere	Interferer power exceeded



#### 3.2 Switches and Ports

#### 3.2.1 Power Switch

The AC Power on/off switch is located at the back panel of repeater. The switch should be powered on after the repeater has been installed properly.



Figure 3: Axiom Repeater Power Switch View

3.2.2 Back Up Battery Switch & Battery Port



Figure 4: Battery Switch & Battery Port

The Battery Switch can be used to provide power to the optional External Backup Battery.

If a backup battery is utilized, please connect the battery to the unit via the external battery port as shown in Figure 4.

(WARINING: If the Circuit Protector Switch is not turned OFF there may be a risk of damage or electric shock)

Note: Please contact ADRF Technical Support for assistance if you are unfamiliar with the installation procedure of our battery box.



#### 3.2.3 External Modem and Ethernet Port



Figure 5: External Modem and Ethernet Port

3.2.4 RF Ports



Figure 6: RFU RF port



Figure 7: Donor Combiner RF port



Figure 8: Server Combiner RF port

- Donor(RFU):
  - DL input port/UL output port, connected to Donor Antenna or Combiner's Donor port (Donor Combiner is optional)
- Server(RFU)
  - UL input port/DL output port, connected to Server Antenna or Combiner's Server port (Server Combiner is optional)
- Server ANT 2
  - For use with an auxiliary Server Antenna. Signal is attenuated by -15dB compared to Server Combiner's Server port.
- Donor Combiner's Donor port
  - Application for multi-band combining to 1 Ant Donor port.
- Sever Combiner's Sever port
  - Application for multi-band combining to 1 Ant Server port.



## 3.3 Modular concept

# 3.3.1 System modular concept



Figure 9: System modular concept block diagram

3.3.2 Band (RFU) modular concept



Figure 10: Band (RFU) modular concept block diagram

Part Name	BAND
RFU 1	LTE
RFU 2	Cellular
RFU 3	PCS
RFU 4	AWS



#### 3.3.3 Combining method of the various optional configuration



Figure 11: Donor combining method by selection of various optional donor combiner





No combiner

Figure 12: Coverage combining method by selection of various optional coverage combiner

AWS band modular system





#### 3.5 Installation

#### 3.5.1 Procedure

Eight mounting holes are located on 4 corners of repeater to attach it to the 19" rack. The repeater must be securely attached to a rack mount system that can sufficiently carry the weight of the Axiom.

The following steps should be followed while mounting the repeater:

#### Installation Procedure

- ① Verify that the repeater and mounting hole are in good condition.
- ② Align the repeater to the mounting holes of the rack mount system.
- ③ Screw the repeater to the rack using 8 mounting screws.
- ④ Make sure the Repeater is securely attached.
- (5) Connect the GND cable.
- 6 Connect the Antenna cable.
- 1 Connect the Power.
- (8) Using a laptop, install the Repeater.





Figure 14: Axiom-25/100 Mounting Instructions





Figure 15: Axiom-LRG Mounting Instructions



## 3.5.2 Grounding

A ground cable is included in the box. The ground cable should be connected to the Right side of Axiom before the repeater is turned on.



Figure 16: Ground Cable Connection



#### 3.5.3 Antenna Separation/Isolation

Separation between the antennas is necessary to prevent oscillation. Oscillation occurs when the signal entering the system continually reenters, due to the lack of separation between the donor and server antennas. In other words, the signal is being fed back into the system. This creates a constant amplification of the same signal. As a result, the noise level rises above the signal level.



To prevent feedback, the donor and server antennas must be separated by an appropriate distance to provide sufficient isolation. Isolation is attained by separating antennas a sufficient distance so that the output of one antenna does not reach the input of the other. This distance is dependent on the gain of the repeater.

A sufficient isolation value is  $13 \sim 15$  dB greater than the maximum gain of the repeater. For example, if the gain of the repeater is 50 dB, then an isolation of 63  $\sim 65$  dB or greater is required. In the same manner, because the Axiom has a maximum gain of 80 dB in case of Axiom 25K, it requires an isolation of at least 93  $\sim 95$  dB.



#### 3.5.4 Line of Sight

The donor antenna which points towards the base station typically has a narrow beam antenna pattern. As a result, a slight deviation away from the direction of the BTS can lead to less than optimum results. In addition, obstacles between the repeater and the BTS may impair the repeater from obtaining any BTS signal. As a result, the repeater cannot transmit signal to the coverage area. Therefore, a direct line of sight to the BTS for the donor antenna is vital to the function of a repeater. For the same reason, placing the server antenna in direct line of sight of the coverage area is also necessary.





# 4. Axiom Web-GUI Setup

The Web-GUI allows the user to communicate with the repeater either locally or remotely. To connect to the repeater locally, you will need a laptop with an Ethernet port and a RJ-45 crossover cable. To connect to the repeater remotely, you will need to have an active internet connection and the repeater must have either an internal modem or an Omnibox (ADRF Modem Box) connected to the repeater.

4.1 Repeater/PC Connection Using Web-GUI

- A. Verify that your Local Area Connection is set to Obtain an IP address automatically under the Internet Protocol (TCP/IP) properties
  - If you are connecting to the unit remotely, then skip steps A and B.
- B. Connect the RJ-45 crossover cable between the laptop's Ethernet port and the repeater's Ethernet port
- C. Launch Microsoft Internet Explorer (Version 7.0 or below)
- D. Type the following IP address into the address bar of Microsoft Internet Explorer: http://192.168.63.1
  - If you are connecting to the unit remotely, then type the IP address of the modem to connect to the unit
- E. The following login screen will appear:

	Main	Status	Control	Install	System	Help	Logout
ADRF Sille ID: ADRF	ARONG Login Username: Pastword						
Advanced RF Technologies, Inc. supplies innovative coverage and store to be deep variates	- assessmental	Login					
service providers around the world.	Copyright (\$ 21 Tal (813)86-81	12-2010 Advir 11, Toll Free Hi	vad IF Technolog entrer (1-000-113-	pet, The   3115 V 1940   <u>technopo</u>	Scowen St. + Durh ungkaltfischuron	ank, CA 91125   <u>http://www.</u> a	+USA. drftech.com
Miroleas Coverage Nas Never Been So Easy							

If you are not the Administrator, please type in your assigned username & password which you should have received from the Administrator.

The default username and password for the General User is adrf & adrf, respectively.

If the username & password is typed in incorrectly, the following screen will appear:





## 4.2 Status Tab

- Band: Displays the bands that are currently being utilized
- **Power & Gain**: Displays the Input, Gain, and Output for both Downlink and Uplink
- Alarm: Displays eight (8) alarms with three different status conditions (Normal, Soft Fail or Hard Fail).



• Message Board: Displays the 20 most recent events.



- Clear: Clears the content that is currently being displayed on the Message Board
- Log File: Downloads the system Log File (events and alarms) to your computer
- Alarm History: Downloads the Alarm History log (alarms only) to your computer
- Installation: Displays whether or not the installation routine has been run (Not Installed or Installed)
- Modem: Displays the status of the modem
  - Disabled- No internal modem is present
  - Not Connected- Internal modem is detected, but no connection to the network has been established
  - Connected- Internal modem is detected and a connection to the network has been established
- **Repeater Info**: Displays the serial number, latitude, longitude, firmware version, Web-GUI version
- Modem Info: Displays the ESN (DEC), MDN, and IP Address of the internal modem
- **Repeater Location**: Displays the address where the repeater is installed
- Technical Support: Displays ADRF's Technical Support contact information



## • Installer Contact Info: Displays the installer's name, phone and e-mail address

Note: Once successfully logged in, the repeater model name and the site/cascade ID will be displayed on the top of all the windows (except for the Main Window).

and and the summary summary					ADRF IN	onate Operation & Nonseporated Syst
am-75	700 Band			Message Board	Repeat	er Info
ID : ADRF	tard	Scout Bruk	LENA.	2010-02-15 07:23:14 (LTE) Downlink Signi	ENot Det	# SH Service Unit
			-	2010-02-15 07:23:14 (LTE) Uptrik Signal N 2010-02-15 07:23:04 (LTE) Terrors 1 Aler	ot Detect	ode
xm-25-HHS	Manual R. Parks			2010-02-15 07:20:06 (LTE) 10:061 1 Main 2010-02-15 07:20:06 (LTE) Uplink Stgnal N	ot Detect Lung	Nuite -
Axies-25-708	Fower & Gain			2010-02-15 07:23:06 (Ltc) Countries Signe 2010-02-15 07:23:03 (CelkJar) Downlink S	Ignal Not Pinni	aira
Axiom-25-C	hours future 1	CONTRACTOR A	102.0	2010-02-15 07-23:03 [Cell.for] Uplink Sign 2010-02-15 07-22:55 [Cell.for] Uplink Sign	al Not De web	aut Ine
Axiom-25-P	schor (neui)	-10414	-100.0	2010-02-15 07:22:55 [Celular] Tamper   /	Jarm Set	
Axiom-25-A	Gain (dB)	50.0	\$0.0	2010-02-15 07:22:54 [Celular] Downlink 1	ignal Not Modern	Info
	Output [dBm]	-26.3	-129.4	2010-02-15 07:22:51 PC3] Uptink Stgnal N	ot Deteci	
od RF Technologies, Inc instanding unner age I to leading wholes ministers aniumit the	hnologies, Inc. s excerning g externis ansumd the Over/Under Current Oscillation		der Temperature IF Power	2010-02-15 07:22:44 (PCS) Tamper 1 Alarm Set 2010-02-15 07:22:43 (PCS) Upink: Signal Not Detect 2010-02-15 07:22:40 (PCS) Downlink: Signal Not Det 2010-02-15 07:22:40 (AVS) Downlink: Signal Not Det 2010-02-15 07:22:40 (AVS) Upink: Signal Not Det	n Set ot Detect # Not Det al Not Det lot Detec	
100 C 100	VSWR.	Sign	al Not Detect	2010-02-15 07:22:32 (4WS) Uplink Signal I	lot Detec	al Concort
to coverage	Link Fal		RSSE	·	Phone: P	660-313-9045
	Resot Engaged	Tana	per Detected	Cisar	Log File Cmail: to	chaupportr@-addfrects.com
	Pan Alarm					
	Normal	Set Par	ind fut	Yes Joined	Rever Installe Company Installer Phone Encode	r Contact Info

#### 4.2.1 Status: Axiom-xx-700



#### 4.2.2 Status: Axiom-xx-C

DA			-							ADRY Remains Down	tion & Management Ser
r	Cellular Band			_	-	Measage Do	bard			Repeater Info	
• •	0 end		or rank		upini	2010-02-15	5 07:23:14 (t	TE] Dowellas S	griel Not Det	Republic C/H	Sangle Unit
	**		-		1.44	2010-02-15	5 07:23:14 p. 5 07:23:06 p.	TE] Uption Sign TE] Tattonr 1 A	al Not Detect larm Set	C Labide	
HIMS	Tarren an anna ann					2010-02-15	5 07:23:06 J.	TEJ Liptinik Sign	al Not Detect	Longitude	
m-25-700	Power & Gain					2010-02-15	5 07:23:06 JL 5 07:23:00 IC	.TE] Downitrik St Selkähr! Downitr	gnal Not Det # #. Sterval Not :	Valouala	30000-4 / 30000-4
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#### 4.2.4 Status: Axiom-xx-A

	Main Status	Cont	rol Install	Syster	n Help Log	out	4	AROMS	
COLUMN IF TRANSPORT							ADRF Ramets Open	otion & Management Syste	
iom-25	AWS Dand			Message B	bard		Repeater Info		
E WIMPH	tint			2010-02-15	07:22:14 (LTE) Downtrek S	Ignal Not Det	Repeater 5/N	Sergle Unit	
				2010-02-11	07:23:14 (LTE) Uplink Sign	ial Not Detect	Lattude		
Axiom-25-MMS			H	2010-02-1	07123:06 [LTE] Uplink Sigr	val Not Detect	Longitude		
Axiom 25 708	(aa) (	1441		2010-02-19	07:23:06 [LTE] Downlink 5 07:23:03 [Cellular] Downli	lignal Not Det IE rik Signal Not	Fernisare	300004/300004	
Axiom-25-C				2010-02-11	07:23:03 [Cellular] Upmik.	Signal Not De	was duit	2.0.4	
Axiom-25-P Axiom-25-A	Power & Gain	(contrint)	Uphris :	2010-02-11	07:22:55 (Celular) Tampe 07:22:54 (Celular) Downin	r 1 Alarm Set rik Signal Not	Modern Info		
	Input [dBm]	-110.3	103.5	2010-02-15 07:22:51 [PCS] Uptink Signal Not Detect 2010-02-15 07:22:51 [PCS] Downlink Signal Not Det		2010-02-15 07:22:51 PC3 Uptrivi signal Not Detect 2010-02-15 07:22:51 PC3 Downlink Signal Not Det Repeater Local		tion	
unced RF Technologies, Inc.	Gain (dB)	50.0	50.0	2010-02-15 07/22:44 (PCS) Tamper 1 Alarm Set.			Kepcater Location		
tions to leading senders	Output (dim)	-43.1	-44.5	2010-02-11	07:22:40 (PCS) Downlink S	Ignal Not Det	Select One		
id.	Alarm			2010-02-19	507:22:40 (AWS) Downinik 507:22:40 (AWS) Uplinik Sig	Signal Not Del nal Not Detec			
eless Coverage	Over/Under Current	E Over/Under Temperatur		2010-02-15	507:22:02 [AWS] Upter Stg	nal Not Detec	Technical Suppo	ərt	
n Never Been Su Easy	Oscillation		RF Power	1			Physical 3-800-313-1	245	
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	Link Fail	Unk Fail RSSI			Madera				
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	Fan Alarm			Dyfalled		Power	Company		
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#### 4.3 Control Tab

General Setting

Gener	al Setting		
	AGC ON		Downlink HPA ON
	Uplink Tracking ON		Uplink HPA ON
		(	Apply

- o AGC ON: Enables or disables AGC (Automatic Gain Control)
  - Uplink Tracking ON: Enables or disables the Uplink Tracking FeatureUplink Tracking adjusts the Uplink Gain to meet the Uplink Tracking Offset
- value
   Downlink HPA ON: Enables or disables the DL HPA
- **Uplink HPA ON**: Enables or disabled the UL HPA
- System

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Deheet	Eastony Catting
neuuul	ractory setting

• Reboot: Clicking the reboot button will have the following popup show up:



- Click OK to reboot the repeater or click Cancel to exit out
- o Factory Setting: Resets the repeater to the original factory settings

Message It	ow webpage	LEED MALE
0	Factory Setting will change repeater's sett values. To change the repeater setting, slick OK	ings to the factory default To quit, click Cancel
	C	OK Cancal



Oscillation Check Setting

Oscillation Check Setting

Oscillation Check ON	
Periodic Time [sec] (1 ~ 3600, 1 Step)	3600
	Apply

- o Oscillation Check ON: Enables or disables oscillation check
- **Periodic Time:** Allows the use to specify how often the repeater runs the oscillation check

#### AGC Control Time Setting

AGC Check Time [Sec]	01
AGC Attack Time [Sec]	0.1 🔹
• AGC Release Time [Sec] (0.1 ~ 3600, 0.1 Step)	0.1
	Apply

- o AGC Check Time: The frequency at which the system checks the AGC level
- AGC Attack Time: Time it takes to lower the gain to match the AGC level
- o AGC Release Time: Time it takes to raise the gain to match the AGC level

#### Manual Gain Control

4anual Gain Control	
💿 Downlink Gain [dB]	50.0 💌
Uplink Gain [dB]	50.0 💌
Downlink AGC Level [dBm]	20.0 💌
Uplink AGC Level [dBm]	20.0 💌
Uplink Tracking Offset [dB]	3.0 💌
	Apply

- o Downlink Gain: Allows the DL gain to be adjusted manually when AGC is OFF
- Uplink Gain: Allows the UL gain to be adjusted manually when AGC is OFF
- o Downlink AGC Level: Allows the user to set the DL gain when AGC is enabled
- Uplink AGC Level: Allows the user to set the UL gain when AGC is enabled
- **Uplink Tracking Offset:** This offset value determines how many dB lower the uplink gain value will be relative to the downlink gain value



## • Main Gain Control Range

Control	Modules	25K	100K	Large	Note
Downlink Gain	-	50~80	60~90	65~95	0.5dB step, default:
					Minimum Level
Uplink Gain	-	50~80	60~90	65~95	0.5dB step, default:
					Minimum Level
	LTE &	15 ~ -14	25 ~ -4	38 ~ 8	0.5dB step, default:
Downlink ACC Loval	CELL				Maximum Level
	PCS &	20 ~ -9	30 ~ 0	43 ~ 13	0.5dB step, default:
	AWS				Maximum Level
	LTE &	15 ~ -14	25 ~ -4	25 ~ -4	0.5dB step, default:
Unlink AGC Level	CELL				Maximum Level
	PCS &	20 ~ -9	30 ~ 0	30 ~ 0	0.5dB step, default:
	AWS				Maximum Level
Uplink Tracking	-	10 ~ 0	10 ~ 0	10 ~ 0	0.5dB step, default:
Offset					3dB

# • Oscillation & AGC time Control Range

Control	Modules	25K	100K	Large	Note
Oscillation Period	-	1~3600sec	1~3600sec	1~3600sec	1sec step, default:
time					3600sec
AGC Check Time	-	0.1 ~ 1 sec	0.1 ~ 1 sec	0.1 ~ 1 sec	Not use
AGC Attack Time	-	0.1 ~ 1 sec	0.1 ~ 1 sec	0.1 ~ 1 sec	Not use
ACC Poloaso Timo	-	0.1 ~	0.1 ~	0.1 ~	0.1 sec step, default:
		3600sec	3600sec	3600sec	0.1 sec

# • Alarm Control Range

Control	Modules	25K	100K	Large	Note
Downlink Signal Low	-	-30~-90	-30~-90	-30~-90	0.5dB step, default: -
Alarm					85dB
Downlink Signal not	-	-80~-110	-80~-110	-80~-110	0.5dB step, default: -
Detect Alarm					85dB
Downlink RF Power	-	0 ~ 10	0 ~ 10	0 ~ 10	0.5dB step, default:
Alarm					6dB
Uplink RF Power	-	0 ~ 10	0 ~ 10	0 ~ 10	0.5dB step, default:
Alarm					6dB



#### Alarm Setting Alarm Setting

<ul> <li>Downlink Signal Low</li> <li>[dBm]</li> </ul>	-85.0 💌
<ul> <li>Downlink Signal</li> <li>Not Detected [dBm]</li> </ul>	-85.0 💌
Downlink RF Power [dB]	6.0 💌
<ul> <li>Uplink RF Power [dB]</li> </ul>	6.0 💌
Reset Engaged	OFF 💌
Tamper Detected	ON 💌
	Apply

- **Downlink Signal Low:** Allows the user to specify how weak the signal can be before triggering a "Downlink Signal Low" soft-fail alarm
- **Downlink Signal Not Detected:** Allows the user to specify the how weak the signal can be before triggering a "Signal Not Detected" soft-fail alarm
- Downlink RF Power: Allows the user to set a maximum deviation value for the downlink RF power
  - For example, if the input signal is -50 dBm and the gain is set to 60 dB, the expected output power should be 10 dBm. If the Downlink RF Power alarm value is set to 6dB, then if the output power is below 4 dBm, then this will trigger a soft-fail alarm
- Uplink RF Power: Allows the user to set a maximum deviation value for the uplink RF power
  - For example, if the input signal is -50 dBm and the gain is set to 60 dB, the expected output power should be 10 dBm. If the Uplink RF Power alarm value is set to 6dB, then if the output power is below 4 dBm, then this will trigger a soft-fail alarm
- **Reset Engaged:** Allows the Reset Engaged functioned to be enabled or disabled
- Tamper Detected: Allows the tamper detection feature to be enabled or disabled



#### 4.3.1 Control: Axiom-xx-700

Mom Status	Control Inst.	il System Help L	ngnut
General Setting		Manual Gain Control	
E ASCON E	Downink, HPA ON	- Downitrik Gath (dB)	60.0 💌
Elipters Tracking ON	Upimá: HPA CN	= Opene Gero (20)	50.0 💌
	Apply	# Constant and Lines 1984	15.0 +
		B Lines, ACC Lines (Eds).	15.0 +
System		Upmik Tracking Offset (85)	30 •
Rebet	Factory Setting		Apply
Discillation Check Setting Oscillation Check ON Feriodic Time (Sec) (1 - Se00, 1 Sep)	3600	Alarm Setting Downtrik Signal Low (dfin) Downtrik Signal	-85.0 •
1	Apply	Diservitels RF Power (35)	60 .
		<ul> <li>Lipink RF Power (st)</li> </ul>	6.0 -
AGC Control Time Setting		· Reset Engaged	OFF .
III AGC Overa Time (Sec)	0.1	Tamper Detected	ON T
III AGC Attack Time (Sec)	0.1 -		200200000
$= \frac{\text{AGC Retraine Time (Sec)}}{(0.1 \times 3800, 0.1 \text{ Step})}$	0.1		Apply
	Anto		
			Control     Control       London     London       System     London       Periodic Three (London     London       London     London       Addition     London       London     London

# 4.3.2 Control: Axiom-xx-C

Constant of Constant of Carlos	Main Status Control In	stall System Help Li	igout
xioui-75 Re ID : ADDI	General Setting	Manual Gain Control	
	AGC ON DOWNING HPA ON	E Downitck Gain (28)	50.0
	Eliphink Tracking ON Eliphink HPA ON	I Upitek, Gain (dfl)	50.0
Axiom-25-HHS		IN DOMESTIC ADD LODG	11.0 +
Axion-25-700	Apply	# Q01 RC D3(10)	11.0 +
Axiom-25-P	System	III Uplink Tracking Offset [86]	3.0 .
Axiom-25-A	Heboot Factory Setting		1.41.4
intess Coverage las Never Been So Easy	Periudic Time (sec) (1 ~ 3600, 1 Step)	Downine Signal	-85.0
Indiana Casarada	Periudic Time (Jec) 3600	= [dfm]	-85.0
and the second second second	Apply	Not Detected (dBir)	60 5
		Ucivé IF Power 181	60 .
			0.0
	AGC Control Time Setting	· Reset Engaged	OFF .
	AGC Control Time Setting	Reset Engaged     Tanger Detected	OFF
	AGE Control Time Setting # AGE Check Time Sec] 0.1 m # AGE Attack Time Sec] 0.1 m	Reset Engaged     Tanper Detected	OFF ON
	AGE Control Time Setting = AGC Check Time Sec]  = AGC Attack Time Sec]  = AGC Attack Time Sec]  = AGC Release Time (Sec)  = (0.1 ~ 3600, 0.1 (tep))  = 0.1	Reset Engaged     Targer Detected	OFF ON Apply



#### 4.3.3 Control: Axiom-xx-P

ADH	Main Status	Control In	llote	System	Help	Logoul	
xioe-25	General Setting		м	anual Gain Co	ntrol		
	BASCON ED	Downlink HPA ON		E Downink	Gam (dB)	50.0	
Andrew WE start	EUphrek Tracking ON	Uplini, HPA ON		👘 Uplinik Gar	n (18)	60.0	
Axiom-25-788		Test.		· Diverse i	100 Line (194	20.0	*
Azium-25-C		7481		· 12011-202	360.000	28.0	+
Axiom-25-P	System			- Uptrik Tra	cking Offset (d)	0.0	•
Axion-25-A	Tebost	Factory Setting			1	Apply	
reiness Countrage as Never Been In Easy	Periodic Time (sec) (1 - 3600, 15tep)	3600 Agaly		(Stin) Downtrik Not Deter	lighai ited (dim)	-85.0	
				I live of	Bruser MRI	6.0	12
	AGC Control Time Setting			Becet Erg	moded	OFF	1
	· AGC Check Time (Sec)	0.1 .	ri - I	Tanper D	etected	ON	
	AGC Attack Time (Sec)	0.1 .	Č.			- Lines	-
	AGC Release Time (Sec)	0.1				4494	-
	(0.1 ~ 3600, 0.1 Step)						

## 4.3.4 Control: Axiom-xx-A

ow-25 ID : ADRE	General Setting			Manual Gain Ca	ntrol		
	E ASC ON E	Downlink 194	ÓN	= Downlink	Gain (dl)	50.0	
	ETUDINK Tracking ON	DERK HEA OF	N.	Uplink Gar	in (dil)	50.0	
A 1000 72 1015			-	@ Downed.		20.0	1+
Axiom-25-C		Apply	_	#338A.65	Control (control)	20.0	-
Axiom-25-P	System			- Uprice fire	oking Offset (98)	3.0	
Axiom 25-A	Reboot	Factory Settle	<b>a</b> /			1000	
Are instructive coverage tors to leading whether or providers around the 4-	Diciliation Check Setting	3600		Alarm Setting = Downine Jalinj	Signal Low	-65.0	
An annually coverage one to leading whether on providers wound the di- loss Coverage s Never Gent So Easy	Deciliation Check Setting	3600		Alarm Setting Downina jslin] Downina Not Detec	Signal Low Signal ted (dSm)	-85.0	
Art annouative observage spora to leading withdea on providers anound the di- oless Careerage s Never Been So Easy	Deciliation Check Setting	3600 Aepty		Alarm Setting Downlink Bilm Downlink Not Deter Downlink	Signal Low Signal Low (30m) Aff Power (30)	-05.0 -06.0 6.0	
Art annoughes coveringe more to leading withdea or providers would the di- di- tess Coveringe s Never faces So Easy	Deciliation Check Setting Coollistion Check ON Periodic Time (pec) (1 = 3600, 1 Step)	3600 Apply		Alarm Setting Biling Downlink Not Detec Downlink Uptink RF	Signal Low Signal ted (stim) Af Power (sti) Power (sti)	-05.0 -06.0 6.0	
Art immutative coveringe mon to leading withdea or providers ensured the di- dess Canenage s Never Bees So Easy	AGC Control Time Setting	3600 Apply		Alarm Setting Downing Downing Downing Downing Downing Downing Perset Eng	Signal Low Signal tod (dSin) RF Power (dS) Power (dS) saged	-85.0 -85.0 6.0 6.0 ON	
Art minutative observation rora to leading withdeat on providers would the dr. Ness Concerning a Never Serve So Easy	Deciliation Check Setting           Coolilation Check Of           Periodic Time (sec)           (1 - 3600, 1 31ep)   AGC Control Time Setting           # AGC Oneck Time (sec)	3600 Aeely 0.1		Alarm Setting Downlink  Silin    Downlink Not Detec   Downlink   Upting AF   Reset Eng   Tanger D	Signal Low Signal ted (dSm) AF Power (dS) Power (dS) aged etected	-85.0 -86.0 6.0 0N 0N	
Art minutative observage rora to leading whiches on providers around the di- oless Ceneroge s Never deem So Easy	Deciliation Check Setting           Coolilation Check ON           Periodic Time (sec)           (1 - 3600, 1000)   AGE Control Time Setting  # AGE Oteck Time (sec) # AGE Attack Time	2600 Apply 0.1 0.1		Alarm Setting Downiva Bilinj Downiva Not Detec Downiva Downiva Downiva Downiva Not Peter Downiva Not Detec	Signal Low Signal ted (dSm) Alf Power (dS) Power (dS) Alged efected	-85.0 -85.0 -6.0 -6.0 -6.0 -0N -0N	



## 4.4 Install Tab

- Band Selection: Allows the user to select the band(s) they would like to utilize
- SNMP: Type in the assigned site/cascade ID and manager IP address. Default Site ID and Manager IP address are ADRF and 100.10.10.100, respectively.

NWP	
Site ID	
Comment	
	Set

- Location: Displays the physical address where the repeater is installed  $$_{\mbox{\tiny Location}}$$ 

Latitude	
Longitude	
	Set

• Auto Installation: Runs the automated installation routine that will run basic checks to ensure that the repeater can function in the environment

ADF	Main Status	Control Install	System H	elp Logout	ARON	ЛS
					4105 Seculo Operation 8. Naturpene	et System
Axiom-25 Site ID:	LTE Band Selection				Repeater Location Info	
	A	8	c	A+8	Company	
Axiom-25-HHS					Address	
Ax300-25-/08	TROMP		NUMBER OF STREET		04	
Axiom-25-C	Site ID		Depender IP:	PO2.168.3C.8	Tale Select One	-
Axiom-25-V	Comment		Submit Hall	293-295-295-0	21P Code	
Axioo-25-A		1000	Geterrep	112.169.62.254		
Advanced RF Tashvologies, Inc. supplet invocative score upp		. Sar		Det	Repeater Installer Info	
schatters he leading weeks: service providers around the	Location				Company	
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Wreless Coverage	Longitude				- Fred	
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	Creample @ 2010 Adva	and RP Technologies, Inc. (200	vanowen St Barbarii - G	A 1005 - U.S.A.		
	in Coldenia 117 Linguate (et	Link Frank 11-298(11) (00)018	1010 1010 ANTI-CON   (1121/	ALL		

4.4.1 Install: Axiom-xx-700



#### 4.4.2 Install: Axiom-xx-C

	cilular Band 5	ielection									Repe	ater	Locatin
8.1	A1+A2+81+	12	Å1		21	A1+A3	81+	12	81+8	215	Crep	-	
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	Longitude					12-10-12		_			E-inal		
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#### 4.4.4 Install: Axiom-xx-A





#### 4.5 System

The System tab allows the user to perform firmware updates, add/remove user accounts, and change the login credentials of the Administrator.

4.5.1 System: Firmware Update

• To perform a firmware update, click on the System tab and the following screen will show up.

mware u	ndate / Acc	ount Managemer	at / New accor	int / Adminis	trator			
inimare a	paace / <u>noo</u>	ourie Managomor	10 7 14000 00000	and 7 Homme	<u>eracor</u>			
	•	File Name				Browse		
	Click Upgra	ide to update th	e repeater firr	nware, or cli	ck Cancel	to abort th	e upgrade	

- Click on the Browse... button and locate the firmware file
- Click on the Upload button to perform the firmware update
- Once the firmware update is complete, the following popup message will appear:

Message fr	om webpage
4	Firmware upgrade successfully completed! Web browser will be closed automatically! Please relogin the repeater after a few minutes.
	ОК

#### 4.5.2 System: Account Management

The Account Management section will allow the Administrator to delete any user account. Please note that the Account Management section is only available if you are logged into the system as the Administrator. To delete a user account click on the Account Management link and under the Delete column, click on the delete button.

Main Status Control Install System Help Logout

Firmware update / Account Management / New a	ccount / Administrator
--	------------------------

1	admin	admin	administrator	-
2	adrf	adrf	user	adrf

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#### 4.5.3 System: New Account

The New account section allows the Administrator to create a new user account. Please note that the New account section is only available if you are logged into the system as the Administrator. To create a new user account click on the New account link and fill in the fields highlighted in yellow as shown below.

Main	Status	Control	Install	System	Help	Logout	
irmware up	date / Account /	<u>Management</u> / M	/ew account /	Administrator			
	0	New Use	r Name				
	0	Passv	vord				
	0	Confirm p	assword				
		Please a	dd a new login r	iame and passv	vord		
		4	spply	Cancel			
Topyright @	2002-2010 Advanc	d PE Tochnolog	ies Toc 1 3116 V	nowen St. • Bu	bank C& 91505	• 11 S A	

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#### 4.5.4 System: Administrator

The Administrator section allows the Administrator to change their login credentials. Please note that the Administrator section is only available if you are logged into the system as the Administrator. To change the login/password of the administrator, click on the Administrator link and fill in the sections highlighted in yellow as shown below.

Main Status Control Install System Help Logout

nware update / <u>Account Ma</u>	nagement / <u>New account</u>	/ Administrator	
•	New Administrator		
	Password		
	Confirm password		
	Please add a new log	in name and password	
	Apply	Cancel	

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# 4.6 Help

If an internet connection is available, clicking on the Help Tab will redirect the user to our Technical Support page.



# 4.7 Logout

Clicking the Logout button will log the current user off the system.



# 5. Maintenance Guide for Axiom Repeater

#### **5.1 Periodic Inspection Checklist**

- a) Check for loose connections between the repeater and antennas. If connections are loose, make sure that all connections are tightly fastened properly.
- b) Cables and connectors are in good condition.
- c) Ensure that the repeater brackets are in good. condition and that the repeater is securely fastened

#### 5.2 Preventive Measures for Optimal Operation

#### 5.2.1 Recommendations

• Perform the *Periodic Inspection Checklist* quarterly or semi-annually.

#### 5.2.2 Precautions

- Do not operate the repeater with the antennas in extremely close proximity to one another as this may cause damage to the repeater.
- Do not change the parameters unless instructed to do so by an authorized supervisor.
- Do not move the repeater unless instructed to do so by an authorized supervisor.
- Do not detach any cables to the repeater unless repair of respective components is necessary.



# 6. Warranty and Repair Policy

#### 6.1 General Warranty

The Axiom carries a Standard Warranty period of two (2) years unless indicated otherwise on the package or in the acknowledgment of the purchase order.

#### 6.2 Limitations of Warranty

Your exclusive remedy for any defective product is limited to the repair or replacement of the defective product. Advanced RF Technologies, Inc. may elect which remedy or combination of remedies to provide in its sole discretion. Advanced RF Technologies, Inc. shall have a reasonable time after determining that a defective product exists to repair or replace the problem unit. Advanced RF Technologies, Inc. warranty applies to repaired or replaced products for the balance of the applicable period of the original warranty or ninety days from the date of shipment of a repaired or replaced product, whichever is longer.

#### 6.3 Limitation of Damages

The liability for any defective product shall in no event exceed the purchase price for the defective product.

#### 6.4 No Consequential Damages

Advanced RF Technologies, Inc. has no liability for general, consequential, incidental or special damages.

#### 6.5 Additional Limitation on Warranty

Advanced RF Technologies, Inc. standard warranty does not cover products which have been received improperly packaged, altered, or physically damaged. For example, broken warranty seal, labels exhibiting tampering, physically abused enclosure, broken pins on connectors, any modifications made without Advanced RF Technologies, Inc. authorization, will void all warranty.

#### 6.6 Return Material Authorization (RMA)

No product may be returned directly to Advanced RF Technologies, Inc. without first getting an approval from Advanced RF Technologies, Inc. If it is determined that the product may be defective, you will be given an RMA number and instructions in how to return the product. An unauthorized return, i.e., one for which an RMA number has not been issued, will be returned to you at your expense. Authorized returns are to be shipped to the address on the RMA in an approved shipping container. You will be given our courier information. It is suggested that the original box and packaging materials should be kept if an occasion arises where a defective product needs to be shipped back to Advanced RF Technologies, Inc. To request an RMA, please call (800) 313-9345 or send an email to techsupport@adrftech.com.



# 7. Appendix A: Specifications Electrical Specifications

lter	n		Remark			
		Upper C	DL : 74	6~757MHz		
			UL: //	6~787MHz		
	700MHz	Lower A	UL: 72	8~734MHz 8~704MHz		
		Lower P	DL:73			
Frequency		Lower B	UL : 704~710MHz			
	Cellular		DL:869~894MH	Z		
	PCS					
	AWS	C	DL:2110~2155M	Hz		
	7410	l	UL : 1710~1755MHz			
		25K	100K	Large		
	PCS, AWS	20dBm	30dBm	43(DL)/30(UL)dB		
Output Power	700MHz, CELL	15dBm		38(DL)/25(UL)dB		
			25dBm	m		
Gain	DL	80dB	90dB	95dB		
	UL	80dB	90dB	95dB		
Gain contr	ol range					
	DL	-65~-35dBm	-65~-35dBm	-57~-27dBm		
Input Power	UL	-65~-35dBm	-65~-35dBm	-57~-27dBm		
Input I ower	DL	-60~-30dBm	-60~-30dBm	-52~-22dBm	PCS& AWS	
	UL	-60~-30dBm	-60~-30dBm	-52~-22dBm	1000/100	
Ripp	le	≤ ±3dB	≤ ±3dB	≤ ±3dB		
	700MHz					
		≤-46				
	Cellular	≤-55				
		≥-130				
Spurious	DOC	≤-45				
	PC5	≤-50 > 12	0BC/30KHZ@±1.9 dBm/1MHz@±2.2	28IVIHZ 25MHz		
		<-15 <-15	dBc/30kHz@±2.2	25KHz		
	AWS	<-50	dBc/30kHz @+1.9	98MHz		
		≥-130	dBm/1MHz @±2.2	25MHz		
NF	-	≤ 6dB	≤ 6dB	≤ 6dB		
Dela	ay	≤ 6us	≤ 6us	≤ 6us		
MIMO Port	Isolation		30dBc	1		
Frequency	700MHz		150Hz			
. ,					1	



Stability	Cellular		150Hz				
	PCS		300Hz				
	AWS						
Input VSW/P	DL						
input vowit	UL						
EVN	N		≤ 12.5%				
	700MHz						
	Cellular	30dBc @					
FILLER KOII-OTT	PCS						
	AWS						
Power S	ource						
Operating Te	mperature						
Operating	Humidity		5~90%RH				
Size		12.2" x 19" x 20" inches	12.2" x 19" x 20" inches	12.2" x 19" x 20" inches			
				17.5" x 19" x 20" inches	Large Only		
Woid	sht	130 lbs	130 lbs	130 lbs			
VVCIE	SIIC			130 lbs	Large Only		
		60 W @ Per Band	130 W @Per	430 W @ Per Band			
Power Co	nsume	Max	Band Max	Max			
		250 W / Total	500 W / Total	1650 W / Total			
		Band Max	Band Max	Band Max			

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP2 C.S0011-C Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Mobile Stations

[3] 3GPP2 C.S0010-C Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Base Stations

[4] 3GPP TS 36.104 3rd Generation Partnership Project; Technical Specification Group Radio Access Network;

Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception Title 47, primarily sections 27 and 90, Title 47 section 27.53 part g

[5] 3GPP2 C.S0051.0 "Minimum Performance Standards for cdma2000 Repeaters" or latest version.



# **Appendix B: Mechanical Drawing**



Figure 18: Axiom mechanical drawing



# C.1 System Block Diagram

Appendix C: Axiom Overview









Figure 21: MCU



#### **Power Supply**

It provides DC power to each module within the repeater.

#### Controller

It is responsible for monitoring the status of each module and controls the parameters.

#### PCS Up / Down Converter Module

The downlink RF signal that enters through the cavity filter is converted to IF frequency, which is later converted back to RF frequency through SAW filtering.

#### Cellular Up / Down Converter Module

The downlink RF signal that enters through the cavity filter is converted to IF frequency, which is later converted back to RF frequency through SAW filtering.

#### PCS Duplexer

It consists of two BPFs (band-pass filters): PCS TX (1930  $\sim$  1990 MHz) & RX (1850  $\sim$  1910 MHz)

#### Triplexer

Combines Cellular and PCS signals. It consists of three BPFs (band-pass filters): PCS and Cellular TX and RX.

#### Modem Module

Contains the CDMA 2000 modem (Kyocera M200).



# Appendix D: Shutdown Retry Logic

The function of the built-in shutdown routine is to protect the repeater from any further damage from a hard-fail that the system may be experiencing.

Within 5 seconds of a hard-fail alarm being detected, the repeater will start the shutdown routine. The repeater will shut down by powering of the HPAs (high-powered amplifiers) for 30 seconds.

After 30 seconds have elapsed, the repeater will power on the HPAs and check to see if the hard-fail alarm still exist. If the hard-fail alarm still exists, then the repeater will shut down for 1 minute (double the time of the previous shutdown time).

After 1 minute has elapsed, the repeater will power on the HPAs and check to see if the hard-fail alarm still exist. If the hard-fail alarm still exists, then the repeater will shut down for 2 minutes (double the time of the previous shutdown time).

The shutdown routine will repeat itself a total of 10 times. If the hard-fail alarm still exists after the  $10^{th}$  retry, then the repeater will turn on its HPAs permanently until a reset is performed.