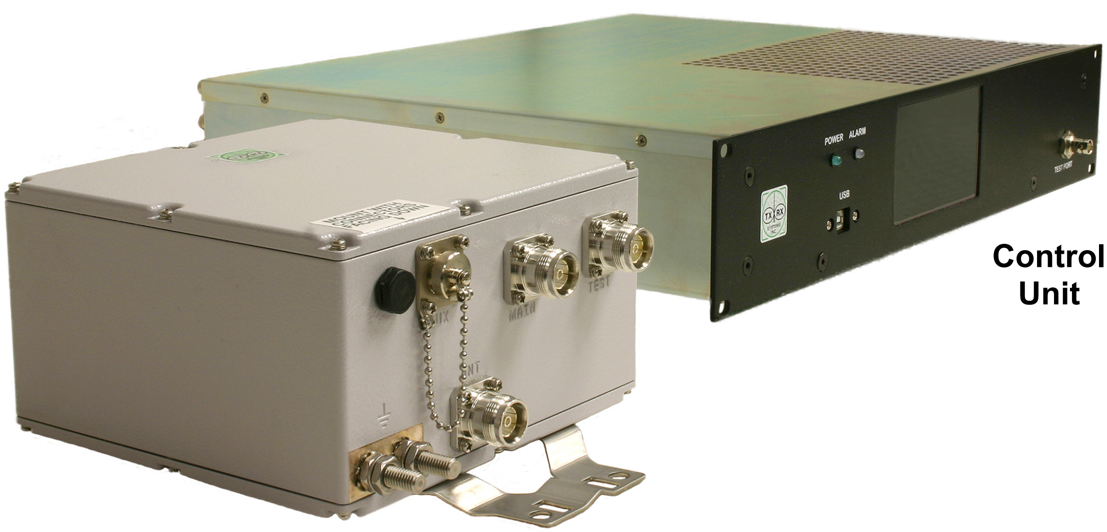
Manual
Part #
7-9620-4.0

Installation and Operation Manual for the 440 Series TTA System Model 440-XXXXXX

Complies with Motorola Solutions TTA Requirements 2018



Control Unit

TTA

**TTA available with
4.3-10 female connectors
or N-type female connectors**

TX RX Systems 8625 Industrial Parkway, Angola, NY 14006 716-549-4700 www.txrx.com

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Symbols Commonly Used

WARNING

High Voltage

CAUTION or ATTENTION

Hot Surface

NOTE — Important Information

ESD Electrostatic Discharge

VIDEO — Training Video Available

Electrical Shock Hazard

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GENERAL DESCRIPTION

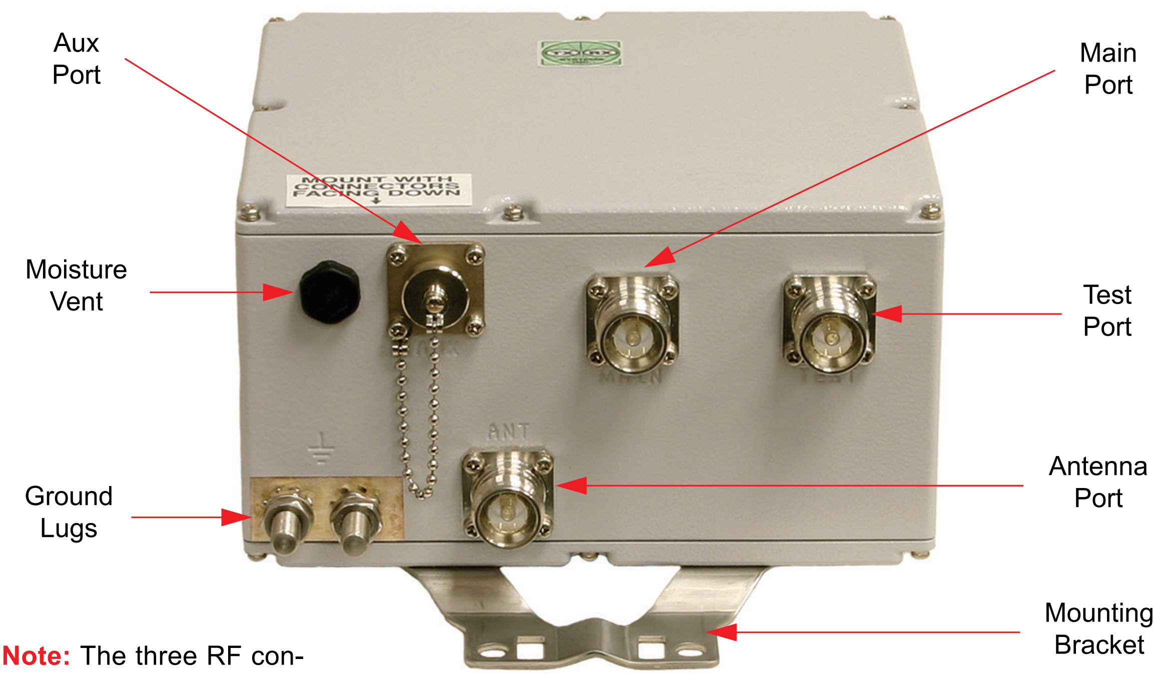
The TX RX Systems 440 Series Tower Top Amplifier System (TTA) is a high performance, low noise amplifier system designed to increase the performance of a base radio while ensuring reliable communications for critical public safety applications. This increase in sensitivity can make up for the imbalance between mobile and hand held users in critical systems and improve marginal in-building penetration.

The system is composed of two components including the Control Unit which is located in the equipment shelter and the Tower Top Amplifier (TTA) which is mounted on the tower close to the antenna. The tower top amplifier incorporates filtering and a pair of low noise quadrature coupled amplifiers. These amplifiers establish superior noise figure prior to feedline losses. The control unit incorporates filtering, system control functions, and distribution of received RF signals to the radios. Two styles of control units can be ordered, the CU style for use at sites having an Expandable Site Subsystem (ESS) and the C&DU style for sites having Stand Alone (SA) base radios. A model matrix is shown in **Table 1** which lists all of the models available in the 440 family of TTA Systems. The tower top amplifier used in your system will be the same regardless of which style control unit you have. Complete product specifications are listed in **Appendix A** (for C&DU style systems) and **Appendix B** (for CU style systems) at the back of this manual. System level specifications are listed in **Table A1 and B1** respectively.

NOTE If your antenna feedline loss is less than 1.5 dB you may want to consider the installation of a TX RX Receive Multicoupler system which does not use tower mounted amplifiers. Contact your TX RX Systems sales representative for further details.

Tower Top Amplifier (TTA)

The low-noise quadrature coupled amplifiers located in the tower top box amplify the weak received signals before the signals enter the long and lossy antenna feedline, thus preventing the line loss from degrading the signal to noise ratio. There are two identical amplification paths (A and B) in the tower top amplifier. The amplifiers used in the two amplification paths are identical and each has a quadrature design with separate bias circuits for maximum redundancy. Each of the quad-amplifiers provides two simultaneously used, essentially parallel paths of amplification. Failure of one of



Note: The three RF connectors (Main, Test, and Antenna) are either N-Type or 4.3-10 female.

Figure 1: Tower Top Amplifier unit.

Model	Description	Power
440-030221	TTA w/4.3-10 RF connectors	NA
440-034392	TTA w/ N-Type RF connectors	NA
440-030222	C&DU, 16 RF outputs, N TTA connectors	1 AC Supply
440-037644	C&DU, 16 RF outputs, 4.3-10 TTA connectors	1 AC Supply
440-032963	C&DU, 16 RF outputs, N TTA connectors	2 AC Supplies
440-037643	C&DU, 16 RF outputs, 4.3-10 TTA connectors	2 AC Supplies
440-030677	C&DU, 32 RF outputs, N TTA connectors	1 AC Supply
440-037642	C&DU, 32 RF outputs, 4.3-10 TTA connectors	1 AC Supply
440-032965	C&DU, 32 RF outputs, N TTA connectors	2 AC Supplies
440-037641	C&DU, 32 RF outputs, 4.3-10 TTA connectors	2 AC Supplies
440-030679	C&DU, 16 RF outputs, N TTA connectors	1 DC-DC Converter -48 VDC
440-037640	C&DU, 16 RF outputs, 4.3-10 TTA connectors	1 DC-DC Converter -48 VDC
440-032967	C&DU, 16 RF outputs, N TTA connectors	2 DC-DC Converters -48 VDC
440-037639	C&DU, 16 RF outputs, 4.3-10 TTA connectors	2 DC-DC Converters -48 VDC
440-030683	C&DU, 32 RF outputs, N TTA connectors	1 DC-DC Converter -48 VDC
440-037638	C&DU, 32 RF outputs, 4.3-10 TTA connectors	1 DC-DC Converter -48 VDC
440-032969	C&DU, 32 RF outputs, N TTA connectors	2 DC-DC Converters -48 VDC
440-037637	C&DU, 32 RF outputs, 4.3-10 TTA connectors	2 DC-DC Converters -48 VDC
440-030684	CU, 2 RF outputs, N TTA connectors	1 AC Supply
440-037636	CU, 2 RF outputs, 4.3-10 TTA connectors	1 AC Supply
440-032970	CU, 2 RF outputs, N TTA connectors	2 AC Supplies
440-037635	CU, 2 RF outputs, 4.3-10 TTA connectors	2 AC Supplies
440-030685	CU, 2 RF outputs, N TTA connectors	1 DC-DC Converter -48 VDC
440-037634	CU, 2 RF outputs, 4.3-10 TTA connectors	1 DC-DC Converter -48 VDC
440-032971	CU, 2 RF outputs, N TTA connectors	2 DC-DC Converters -48 VDC
440-037633	CU, 2 RF outputs, 4.3-10 TTA connectors	2 DC-DC Converters -48 VDC

Table 1: 440 Family Model Matrix.

these paths of amplification results in an overall gain reduction of only 6 dB for the effected path. The tower top amplifier design has been carefully optimized for excellent noise figure and superior intermodulation (IM) performance.

One of the amplifier paths is used to amplify the incoming signals (called the preferred amplifier) while the other is used as a backup path in the event of problems. The microprocessor in the TTA continuously monitors the current draw of the preferred amplifier path and uses a unique proprietary algorithm (Amplifier Switching Optimization Algorithm) to automatically determine the best performing amplifier path. Selection of the best amplifier path will occur automatically. A manual override for amplifier path selection is also available to the user via software interface.

Operating power for the TTA enters on the main transmission cable (antenna feedline) as an ~ +12 to +13 VDC bias which is supplied by the control unit. A test port input on the tower top box allows for the use of RF test signals for loop-back tests. Note that RF test signals applied to the TTA System are coupled into the systems signal path with a 30 dB loss. An ASIG compliant Auxiliary Port is also available on the TTA for connection to optional equipment. The Auxiliary Port is designed to provide operating voltage for and serial communications with tower mounted options. The TTA is weatherproofed. There is integrated surge protection on all ports. The Antenna port is protected against direct strikes up to 40 KA. The Main port, Test port, and the Auxiliary port are protected against direct strikes up to 20 KA. The three RF connectors (Main, Test, and Antenna) are either N-type female or 4.3-10 female depending on model purchased. A labeled photograph of the tower top unit is shown in **Figure 1**. TTA specifications are listed in **Table A2 and B2**.

Control Unit

The Control Unit is intended for 19-inch rack mounting and is not outdoors rated. There are two styles available including the ESS compatible style (called a CU) which is used at sites having an Expandable Site Subsystem and the SA compatible style (called a C&DU) which is used at sites having individually interfaced base radios. Specifications for the two different control units are listed in **Table A3 and B3.** A photograph of the front panel of the Control Unit is shown in **Figure 2**.

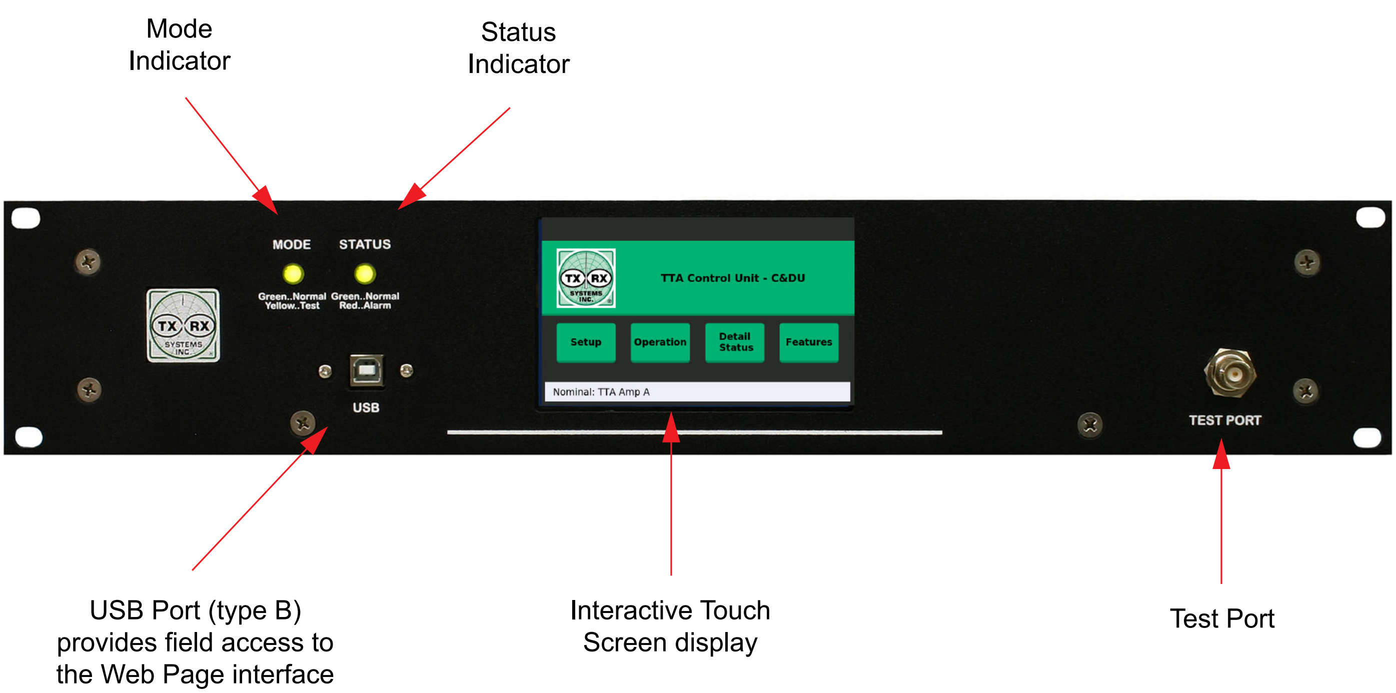


Figure 2: Control Unit front panel.

Note that the front panel of the control unit is the same for both the CU and the C&DU styles.

On the front of the control unit there is a test port input (BNC) which provides a convenient means of performing RF signal path loop-back tests. The front panel interactive touch screen display shows status information and provides an intuitive User Interface for making system adjustments. The front panel USB port provides web page access for field engineers while the status indicators give a quick overview of alarm conditions and operating mode.

C&DU

The C&DU style control unit is designed to include a receiver multicoupler function for signal distribution in addition to system controlling functions. Signal distribution is accomplished using pairs of 8-way dividers. The C&DU style control unit is available as either 16 or 32 port models as shown in table 1. A labeled photograph of the rear of the C&DU is shown in **Figure 3**.

Functional Block Diagram

The functional block diagram of the C&DU system is shown in **Figures 5 and 6**. The TTA unit is shown in figure 5 and the Control Unit (C&DU style) is shown in figure 6.

Referring to the two block diagrams the C&DU system has an RF signal path from the antenna port on the TTA (see figure 5) all the way to the RF outputs for the individual base radios (see figure 6). RF signals enter the TTA antenna port and are passed through a multi-resonator preselector filter tuned to pass 794 to 824 MHz. After filtering the signals are amplified by an LNA (either LNA A or LNA B) before passing through the port labeled "Main" and along the antenna feedline to the control unit in the equipment shelter.

The tower top has a test signal port which allows test signals from the front panel test port on the control unit to be coupled into the systems RF signal path at the input to the LNA's. There is a 30 dB loss associated with test signals injected into the system. Note also that the LNA's input can be switched via software control between either the

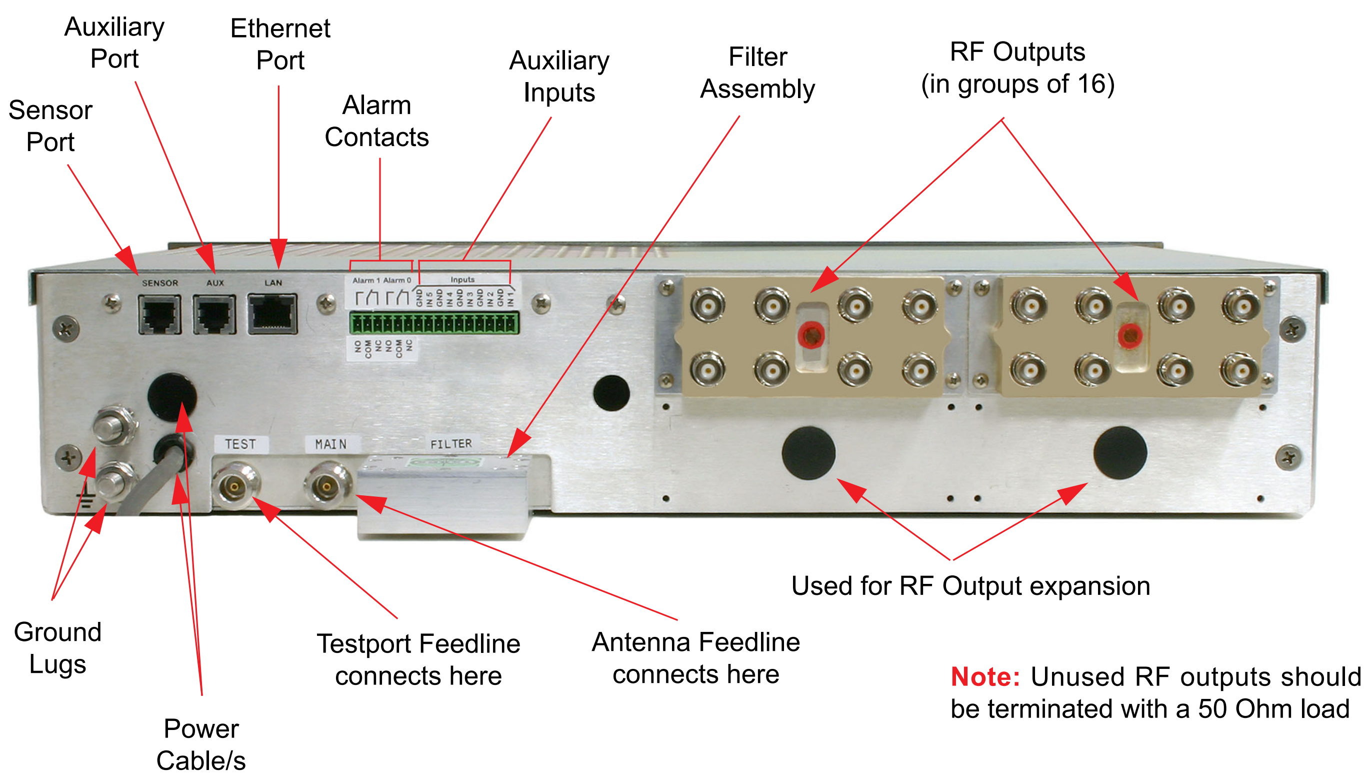


Figure 3: Rear panel view of the C&DU style Control Unit.

antenna or an internal 50 Ohm load. This feature gives field engineers the ability to perform system tests from the ground with or without site noise being coupled into the system by the antenna.

Amplified RF signals leaving the TTA are applied to the rear of the C&DU at the RF input connector labeled “Main”. The signals are then routed to an external preselector via the BNC connectors on the rear panel labeled “Filter”. The factory original preselector is a wideband ceramic filter as shown in figure 3. Optional Preselectors are available from TX RX Systems offering narrower pass bands than the default 30 MHz wide ceramic filter. Optional filters are mounted on a separate deck which must be placed in the rack close to the control unit.

Following the filter is a software controlled variable attenuator which allows adjustment of the systems gain. The attenuator is followed by a pair of amplifiers which are used to overcome the losses caused by distributing the signal to multiple output ports. The gain of the first amplifier stage is adjustable using the step attenuator. The gain of the second stage is fixed at 1 dB and can not be adjusted. Lastly, signals are then applied to a series of dividers creating individual outputs for each base radio connected to the system.

CU

The CU style control unit is designed to interface the TTA system to the ESS GTR8000 radio system and does not include a receiver distribution function. There are no individual receiver ports provided since the receive distribution function is performed in the ESS. The CU has an RF Output port for connection to the ESS cabinet along with an RF Output port for testing purposes. The CU style control unit provides system controlling functions. A labeled photograph of the rear of the CU is shown in **Figure 4**.

Functional Block Diagram

The functional block diagram of the CU system is shown in **Figures 5 and 7**. The TTA unit is shown in figure 5 and the Control Unit (CU style) is shown in figure 7.

Referring to the two block diagrams the CU system has an RF signal path from the antenna port on the TTA (see figure 5) all the way to the RF output for

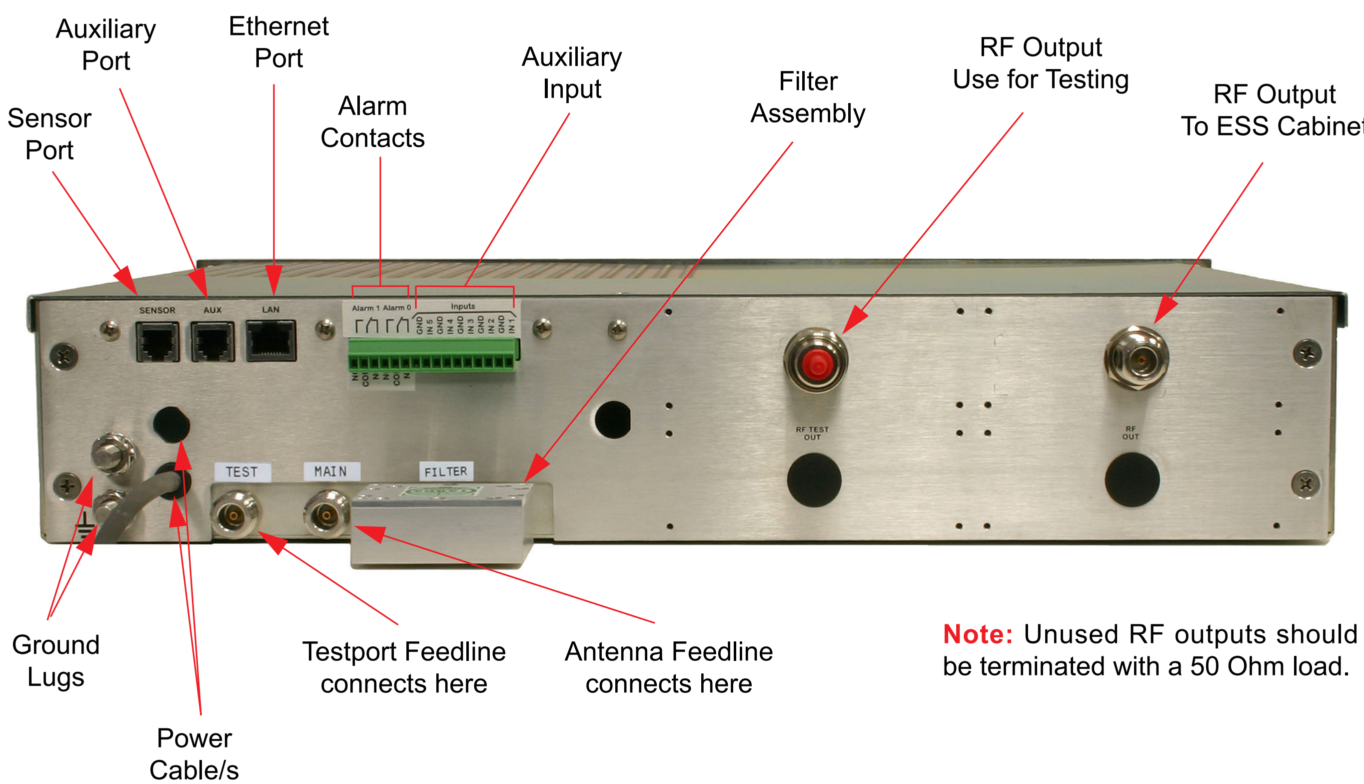


Figure 4: Rear panel view of the CU style Control Unit.

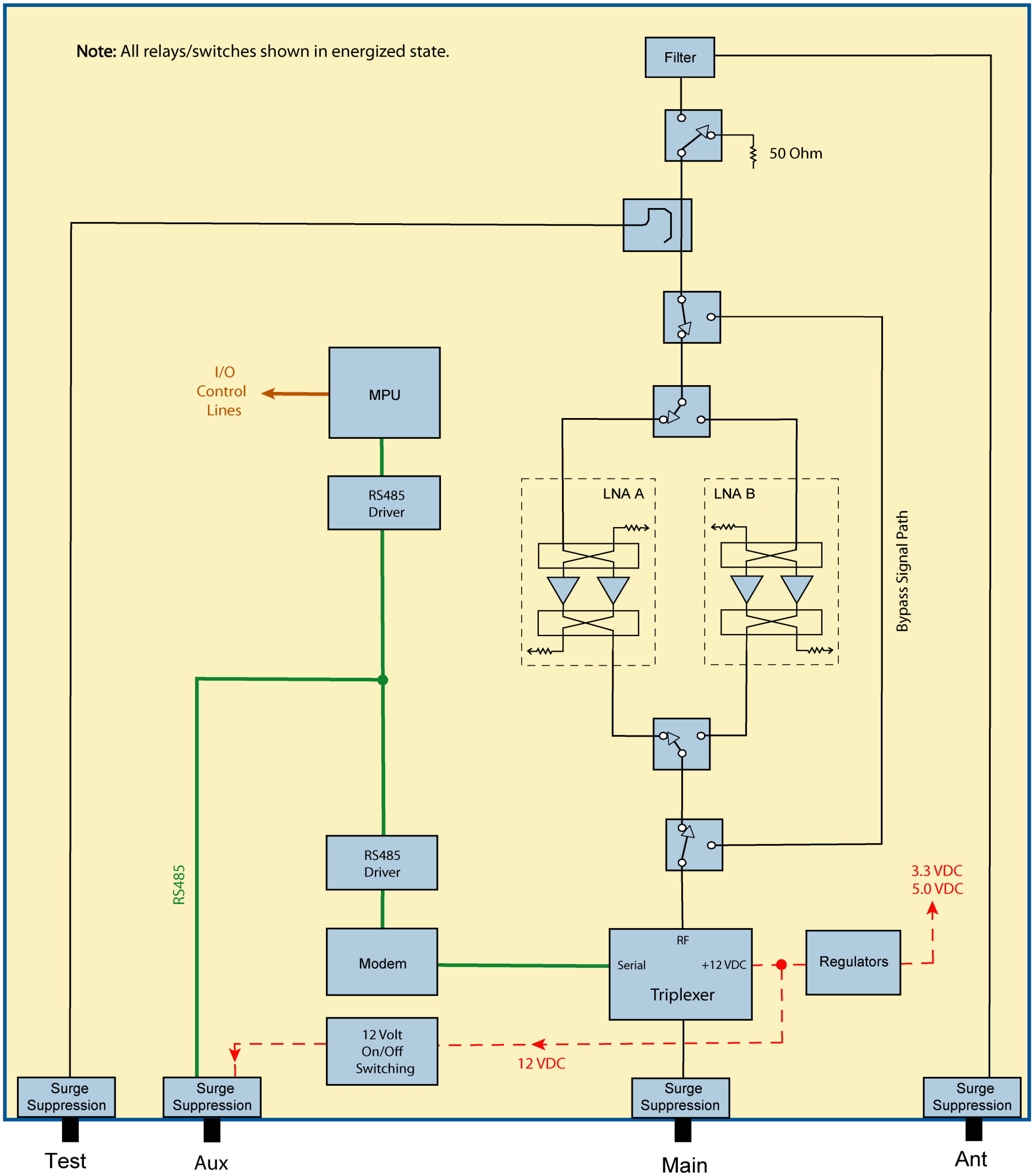


Figure 5: Functional block diagram of the TTA unit.

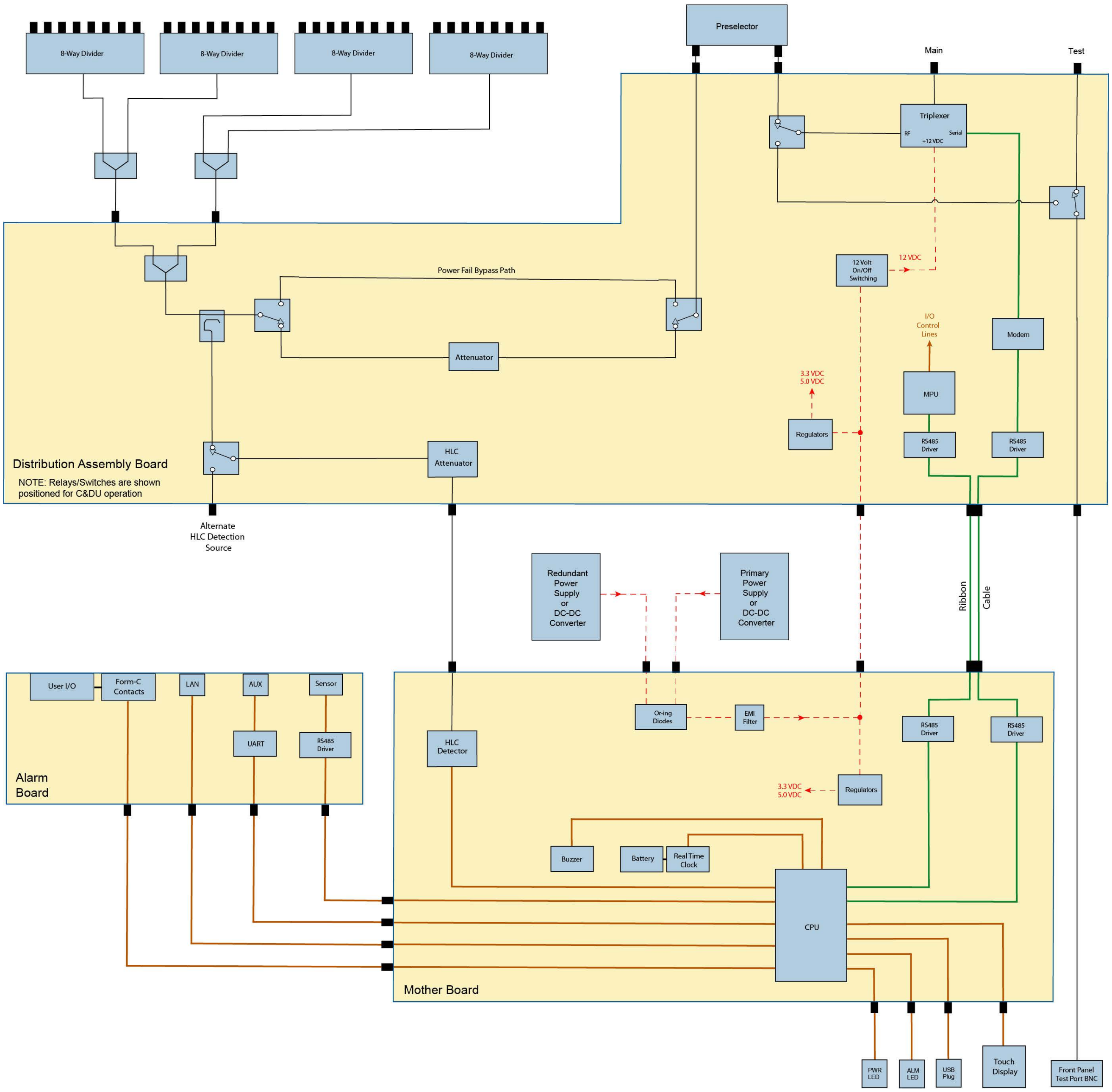


Figure 6: Functional block diagram of the C&DU style Control Unit.

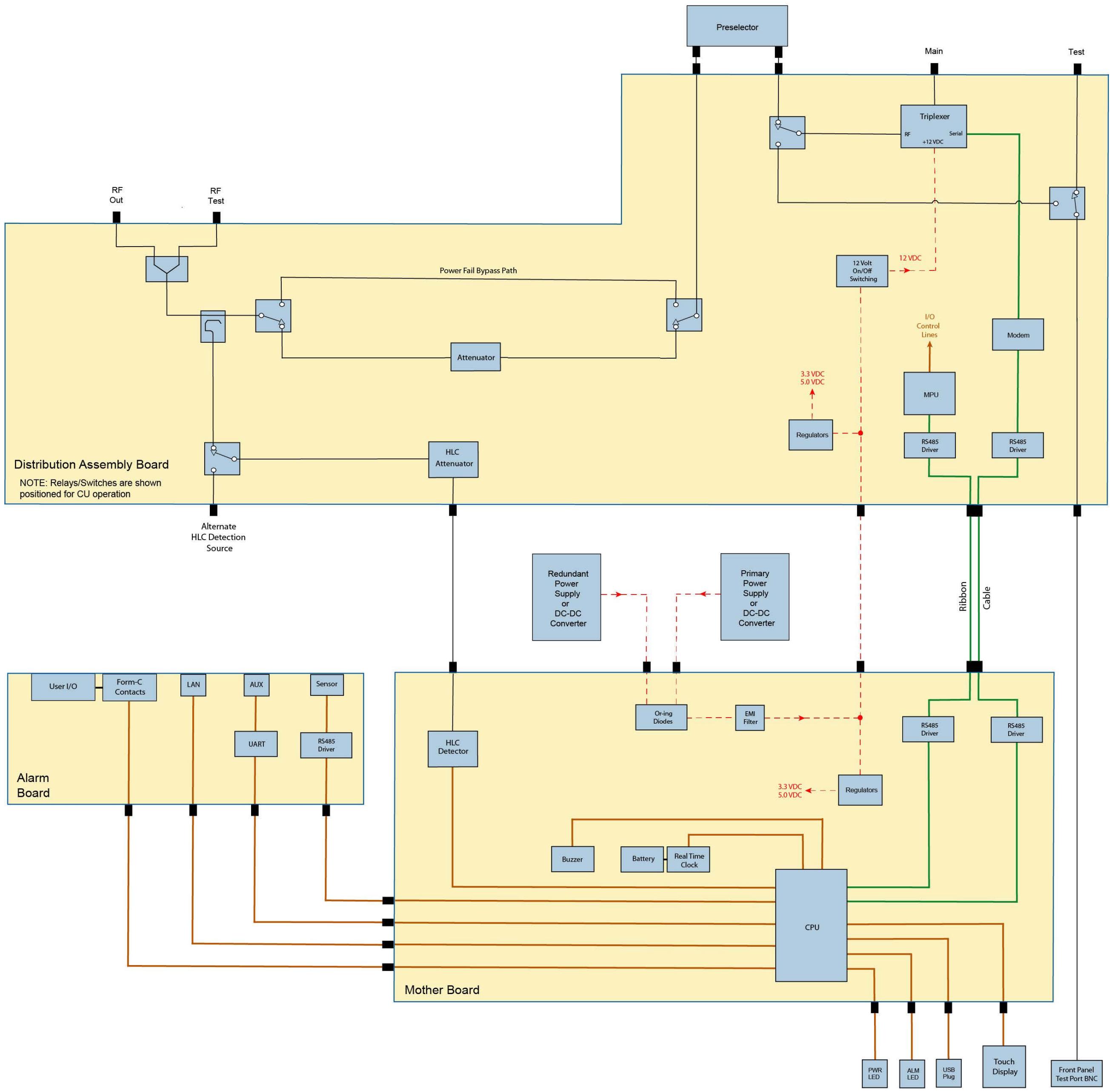


Figure 7: Functional block diagram of the CU style Control Unit.

the ESS GTR8000 (see figure 7). RF signals enter the TTA and are passed through a multi-resonator preselector filter tuned to pass 794 to 824 MHz. After filtering the signals are amplified by an LNA (either LNA A or LNA B) before passing through the port labeled “Main” and along the antenna feedline to the control unit in the equipment shelter.

The tower top has a test signal port which allows test signals from the front panel test port on the control unit to be coupled into the systems RF signal path at the input to the LNA’s. There is a 30 dB loss associated with test signals injected into the system. Note also that the LNA’s input can be switched via software control between either the antenna or an internal 50 Ohm load. This feature gives field engineers the ability to perform system tests from the ground with or without site noise being coupled into the system by the antenna.

Amplified RF signals leaving the TTA are applied to the rear of the CU at the RF input connector labeled “Main”. The signals are then routed to an external preselector via the BNC connectors on the rear panel labeled “Filter”. The factory original preselector is a wideband ceramic filter as shown in figure 4. Optional Preselectors are available from TX RX Systems offering narrower pass bands than the default 30 MHz wide ceramic filter. Optional filters are mounted on a separate deck which must be placed in the rack close to the control unit.

Following the filter is a software controlled variable attenuator which allows adjustment of the systems gain. Signals are then applied to a 2-way splitter which provides an RF output signal for the ESS cabinet as well as an RF output port for testing, such as spectrum analysis.

UNPACKING

It is important to visually inspect the system components for any shipping damages as soon as possible after taking delivery. It is the customers responsibility to file any necessary damage claims with the carrier within a short period of time after delivery (1 to 5 days). The system is well packaged for damage free shipping to any place in the world. However, a high impact during shipping can have a detrimental affect. A damaged shipping container is a sure sign of rough handling.

NOTE

The external ceramic filter is removed from the control unit at time of shipment and is included in the shipping container wrapped separately. The filter must be attached to the control unit as part of the installation process in order for the TTA system to operate correctly. Be careful not to lose the filter.

INSTALLATION

The following sub-sections of the manual discuss general considerations for installing the system. All work should be performed by qualified personal. TX RX Systems provides the Control Unit and Tower Top Amplifier. All additional parts required for installation must be supplied by the customer.

Before mounting the TTA we recommend that you record the model number and serial number of the unit for future reference. The numbers are located on a sticker attached to the outside of the unit. In addition, the 440 Series TTA System records the model number, serial number, and other important manufacturing data permanently in the TTA firmware in a file called the birth certificate. This file can be read then displayed by using the system software function called System Information.

Which ever method is used to retrieve/record the model and serial number is fine so long as it is available in the future if you call the factory for customer service support. Note; If you are relying on the electronic birth certificate information using the System Information function and you are having trouble establishing communications with the system it is important to have this info written down somewhere you can find it prior to running into trouble.

TestPort Feedline

Proper installation of this system requires the installation of a testport feedline in addition to the antenna feedline. The testport feedline is used for system testing and diagnostics.

Installing the System

Installation of the TTA system should follow the installation standards listed in **Figures 8, 9 and 10**. Lightning surge suppressors are required at the point of building entry into the equipment shelter, refer to items labeled 6, 7, and 11 in each of the figures. Proper grounding techniques must be observed for these devices to perform properly.

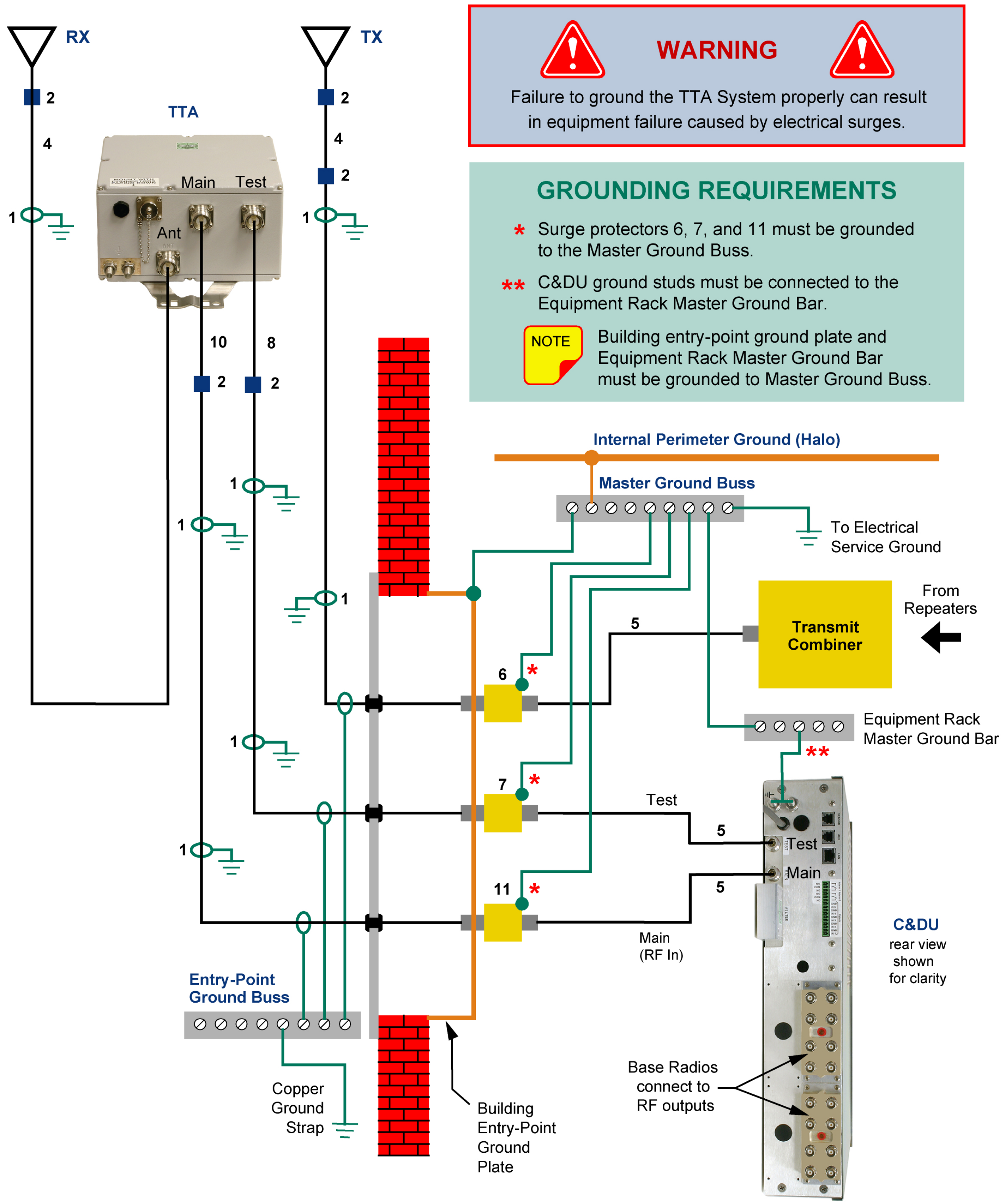


Figure 8: C&DU style system installation guidelines.

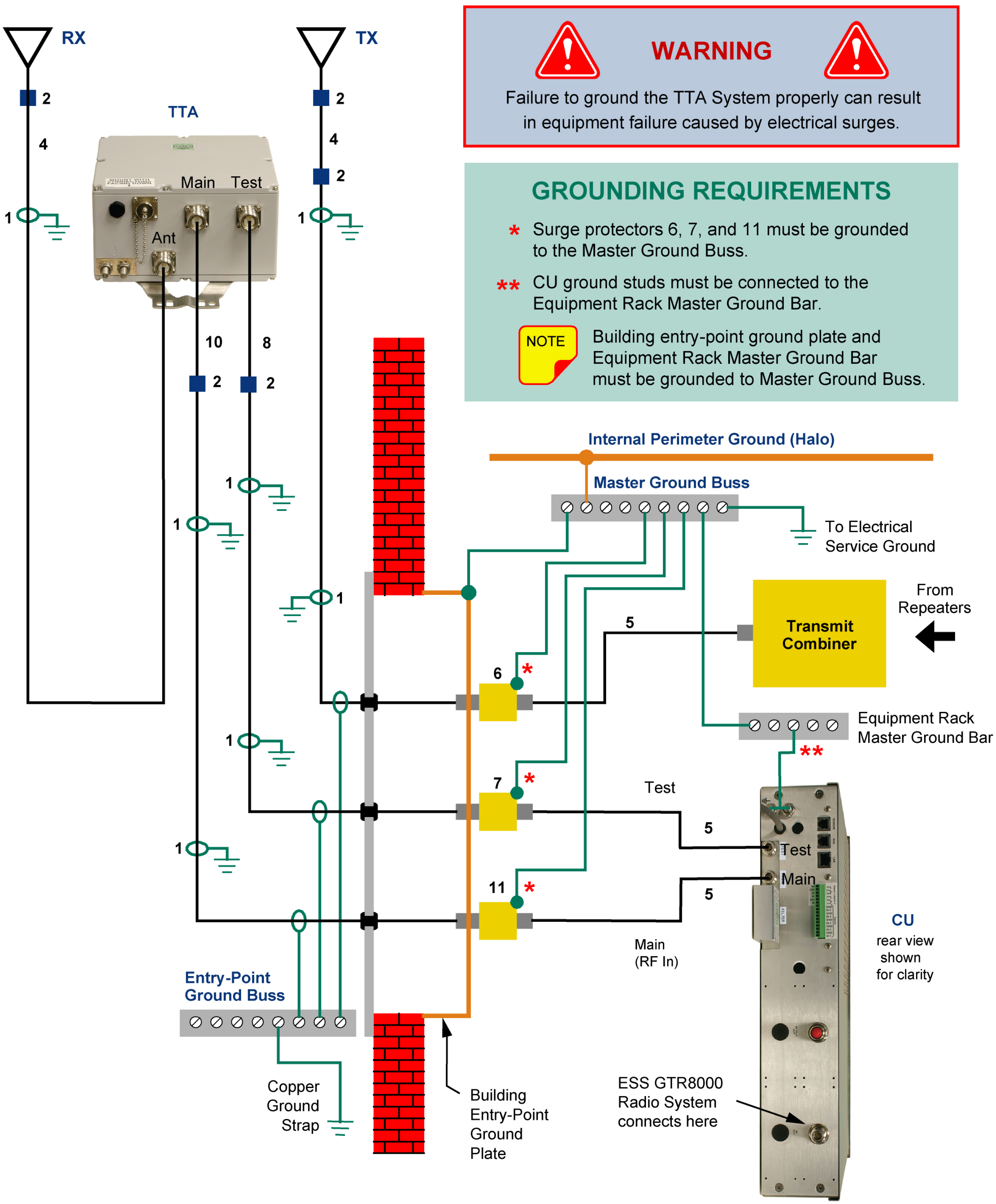


Figure 9: CU style system installation guidelines.

INSTALLATION STANDARDS

1. Main transmission and test transmission lines grounded at top, base, shelter entrance and every 75 feet.

2. All external cable connections weatherproofed.

3. Hoisting grips used every 200 feet per feedline.

4. 1/2" LDF cable (Antenna Jumper) from the antenna to the tower top unit.

5. 1/2" Superflex for all internal RF Jumpers.

6. Lightning Arrester on Antenna Feedline. (Customer Supplied)
   Motorola part number DSTSXDFMBF (Female/Male)
   Motorola part number DSTSXDFFBF (Female/Female)

7. Lightning Arrester on TestPort Feedline. (customer supplied)
   Motorola part number DS1090501WA (Male/Female)
   Motorola part number DS1090501WD (Female/Female)

8. 1/2 " LDF test port feedline.

9. TX RX Systems recommends that you follow a good industry standard guideline for site installations such as the Motorola R56 Standard. This standard depicts grounding methods which will help to ensure expected system performance, reliability, and longevity.

10. 1/2" LDF cable from tower top unit to antenna feedline.

11. Lightning Arrester with DC and 2.176 MHz Subcarrier pass through. (customer supplied)
    Motorola part number DS1090501WA (Male/Female)
    Motorola part number DS1090501WD (Female/Female)

GROUNDING REQUIREMENTS

* Lightning Arresters 6, 7 and 11 must be grounded to the Master Ground Buss.

** Control Unit ground stud must be connected to the Equipment Rack Master Ground Bar.

NOTE Building entry-point ground plate and Equipment Rack Master Ground Bar must be grounded to Master Ground Buss.

SYSTEM ENGINEER RESPONSIBLE FOR

All mounting hardware
Wall feed-through hardware

Figure 10: System installation guideline notes.

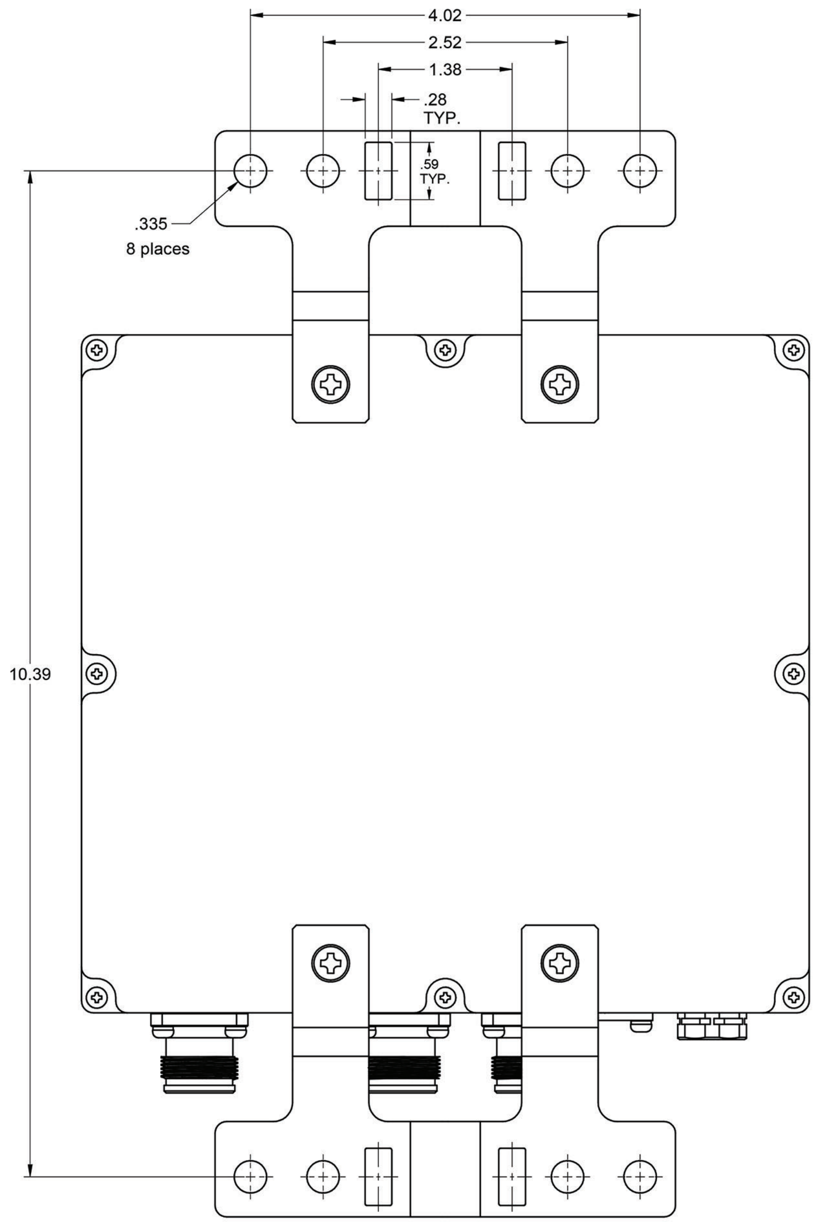


Figure 11: TTA mechanical mounting details.

See the following sections of this manual for specific installation instructions.

Installing the TTA

The TTA has mounting brackets on the back of the unit to allow for fastening to the tower, refer to **Figure 11**. For customer convenience a pair of hose clamps are included with your shipment to facilitate attachment to the tower. *However, because of the varied tower types, the customer must fabricate interface brackets between the towers frame and the TTA if interface brackets are required.* To install the TTA perform the following steps.

1) Mount a receiving antenna on the tower.

2) Run the antenna feedline as well as the testport feedline up the tower.

3) Mount the TTA on the tower at a location close to the antenna and connect the antenna jumper, antenna feedline, and the testport feedline to the unit. The three RF connectors (Main, Test,

and Antenna) are either N-type female or 4.3-10 female depending on which TTA model was ordered.

4) Connect the TTA ground lugs to a good solid ground on the tower.

NOTE To insure stability, it is important to fasten the TTA to the tower using all four mounting holes. The TTA must be mounted with the connectors and moisture vent facing **downward** to prevent water entry. After connecting the antenna jumper, antenna feedline, and the testport feedline we recommend that the connections be tightly wrapped with rubber splicing tape. This will help prevent water entry into the cables. Start the wraps on the cable several inches away from the connector and wrap **towards** the connector, this will prevent water from seeping in between the wraps of tape. Cover the connectors completely with tape.

In-building Surge Suppressors

Lightning arresters must be installed at the building entry point of the equipment shelter. One each for the antenna and testport feedlines. The following steps are required for proper installation.

1) For the testport feedline properly install a lightning arrester in the building entry-point ground plate. Use Motorola part# DS1090501WA (male/female connectors) or a Motorola part# DS1090501WD (female/female connectors). The chassis of the lightning arrester should be connected to the master ground buss with a pigtail.

2) For the antenna feedline properly install a lightning arrester in the building entry-point ground plate. Use Motorola part# DS1090501WA (male/female connectors) or a Motorola part# DS1090501WD (female/female connectors). The chassis of the lightning arrester should be connected to the master ground buss with a pigtail.

Installing the Control Unit

The Control Unit (either C&DU or CU) is designed for indoor mounting in a common 19-inch relay rack or cabinet. The following steps are required for proper installation.

1) Install the Control Unit into the rack or cabinet with four mounting screws from the hardware kit (part # 3-16509) which is included with your shipment. Make sure you use a nylon washer under the head of the screws in order to protect the front panel. Torque the mounting screws to no more than 15 in/lbs. Over tightening the mounting screws may damage the front panel.

2) Connect the Units ground lug to the Equipment Rack Master Ground Bar with a pigtail.

3) Connect the antenna inside jumper and the test-port inside jumper cables to the appropriate connectors at the back of the unit.

4) If you have a supervisory alarm system, connect its wiring harness to the alarm terminal screws (Form-C) at the back of the Control Unit. Refer to **Figure 12**. There are two sets of alarm contacts provided for convenience (Alarm 0 and Alarm 1). The alarm contact sets will change state in tandem so either or both can be connected to the supervisory alarm system. When an alarm event occurs the contacts will change state and when the event clears the contacts will change back to their original state.

5) For the C&DU, connect the base radios to the output ports on the back of the unit with high-quality 50-ohm coaxial cable such as 1/4-inch super flexible transmission line. Some flexibility in the jumper cables will prevent strain and possible damage to the connections. We also recommend the use of quality BNC connectors.

NOTE Unused RF outputs must be terminated with a good quality 50 Ohm load. This will ensure that the output signal strength is as balanced as possible between the output ports and it will improve the port-to-port isolation.

6) For the CU, connect the RF Output port to the GTR8000 system. The RF Test port should remain terminated when not in use.

OPERATION VIA TOUCH DISPLAY

The TTA system is software directed so control of the system is accomplished via user interaction with the front panel Touch Display or a Web Page interface established on a user supplied computer system. Access to the web page can be established through the front panel USB connector or a

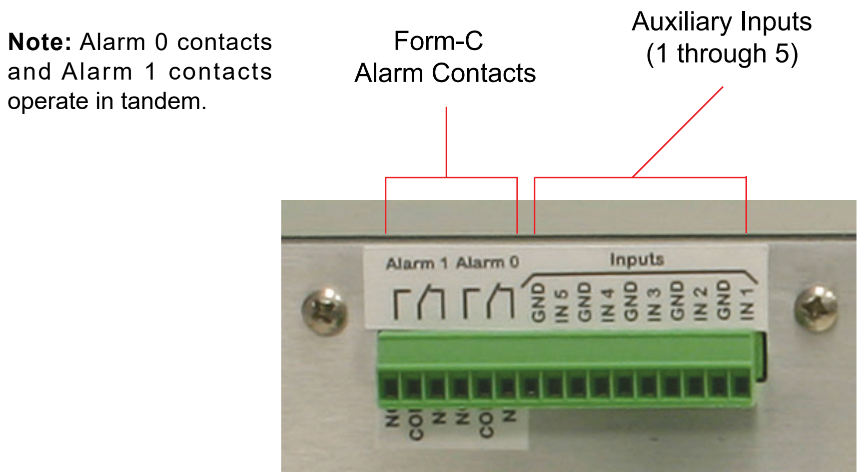


Figure 12: Alarm terminals. Normally open and normally closed terminals are available.

rear panel RJ-45 connector (labeled LAN) and will be discussed in detail in a later section of this manual. This section of the manual will discuss operation using the touch display on the front of the control unit. The touch display is a simplified interface to the system and allows basic functionality without the need for any other equipment such as a desktop or laptop computer. Full functionality of all the systems software features requires using the web page interface which needs to be done through an external computer. The full array of the web page screens are too involved to shrink down to a small display area such as the touch display.

System Power-Up

Power is applied to the system by plugging the control units AC cord/s into a suitable AC outlet (for AC supplied systems) or connecting the DC power cable/s to a suitable -48 VDC supply (for DC supplied systems). The following start-up sequence occurs.

1) At turn-on the front panel MODE LED will be yellow and the STATUS LED will illuminate red. The front panel touch-display screen will briefly flash white but will remain dark most of the time. This will last for about a half of a minute while the systems processors boot up.

2) When boot-up is complete the MODE and STATUS LED's will turn green and the front panel display will show the home screen with a message on the lower status bar saying "Not Ready". At this point the main software is initializing. When software initialization is completed (about one minute) the status bar message will change to a system status message and the systems start-up sequence is now complete.

Front Panel LED Indicators

There are two front panel LED indicators, one labeled MODE and the other labeled STATUS. These serve as the primary functional indicators of system operation. The MODE LED indicator will illuminate green whenever the system is operating as normal. When the system is performing a user initiated test this LED will turn yellow for the duration of the test. The STATUS LED is normally green but will illuminate red whenever the system has an alarm condition occurring. In the case of multiple simultaneous alarm conditions, the STATUS LED indicator is summed, so it will stay red until all the offending alarm conditions are cleared.

Home Screen

The touch display Home Screen shows the TX RX Systems company logo, a label identifying the deck as the control unit portion of the system, and a label identifying the style of control unit (either CU or C&DU). This allows for easy and correct identification of the control unit in a crowded rack environment.

The Home Screen is the starting point for interaction with the system. The Home screen is shown in **Figure 13**. Four primary functions are available

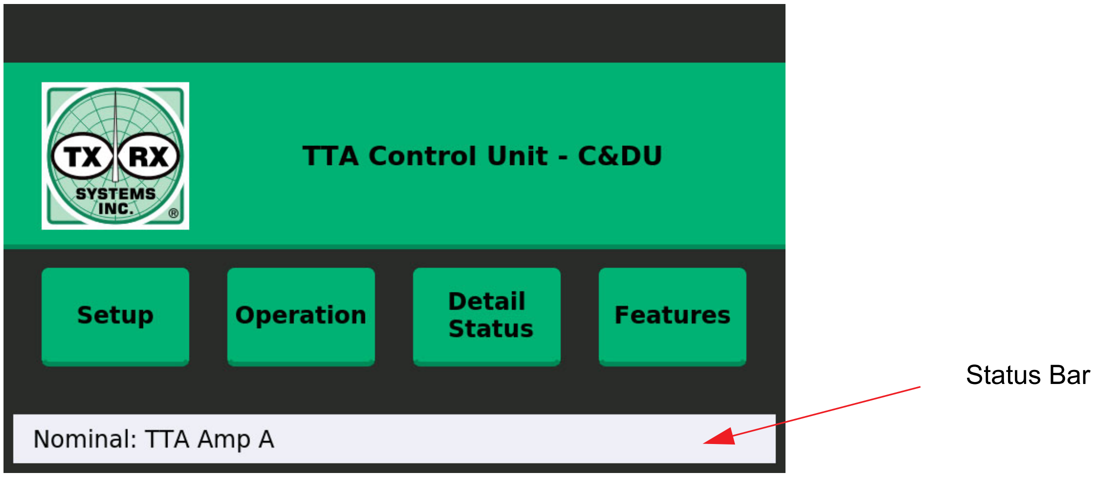


Figure 13: Home screen on touch display.

including Setup, Operation, Detail Status, and Features. Each of these functions has an associated selection button which, when pressed, will present additional display screens with additional interactive buttons. Each of these functions will be described in detail.

In addition, there is a status bar at the bottom of the screen. The status bar is used to display important system status information. With no currently active alarms the status message will indicate the decks RF path, followed by a colon, and then the TTA RF path. When an Alarm event occurs the status bar will change color and display a brief message describing the event occurring. In the case of multiple alarm events occurring at the same time the bar will display the most recent event that has occurred. Click on the status bar to call-up a new screen, the Alarm Board Screen which lists each currently active and inactive alarm event. The Alarm Board screen is discussed in detail in a later section of this manual.

NOTE

The status bar at the bottom of the touch display will change color and display a brief message when an alarm event occurs. In addition, the front panel STATUS LED will also turn red. This is to help draw the users attention to the event being listed on the status bar and help ensure that someone in the equipment shelter at the time realizes there is a problem, especially if the site is at a remote location and other forms of notification such as SNMP, SMTP, and SMS are not available or reliable at the remote site.

Setup Screen

The Setup Screen provides the user with a convenient way to setup the TTA System. The Setup screen is shown in **Figure 14**. There are seven setup activities available to the user and each has an associated button on the Setup Screen which will present additional screens and interactions. Press on the associated button to move to a particular setup function. Each of the seven setup activities will be explained individually and in detail in the following subsections of this manual.

In addition to the selection buttons there is the status bar at the bottom of the screen. The functionality of the status bar was explained earlier in the manual section titled “Home Screen”. The Back button in the upper right hand corner will return the user to the Home screen when pressed.

SYSTEM GAIN CALCULATION SCREENS

The system gain calculation screens assist the user in determining the correct attenuator adjustment that is required to meet the desired system gain level. There are small differences between a CU and C&DU calculation because the data input fields for the calculation have some differences between them. Otherwise the calculations are identical. The discussion that follows, although centered around the CU style system, is applicable to both the CU and C&DU style control units.

System Gain Calculations via the touch display are spread across three screens as shown in **Figures 15 through 17**. A basic distribution block diagram of the CU system is presented on the first two

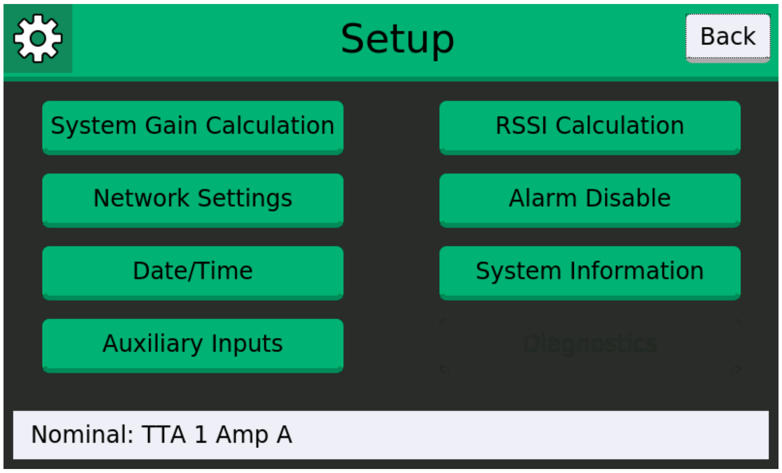


Figure 14: Setup screen on touch display.

screens (figures 15 and 16). The diagram shows all of the components and interconnecting cables at the installation site which are involved in the receive signal path between the antenna and the base radio. For the CU style system those components and cables include; Antenna Jumper Loss, TTA Gain, Antenna Feedline Loss, Surge Protector Loss, Inside Jumper Loss, CU Net Gain, RX Jumper Loss, and RMC Gain of the ESS rack.

Note that the CU Net Gain is determined by two values, the Ctrl Unit Gain and Atten Setting (the setting of the attenuator). In the C&DU style system the C&DU Net Gain is determined by three values, the Ctrl Unit Gain, Atten Setting (position of the attenuator), and Dist Unit Gain (the fixed 1 dB gain of the distribution unit). In addition, the C&DU system is different from the CU system in that it is designed to connect to individual base radios instead of an ESS rack. So there is no RMC gain value for the C&DU calculation.

Values used for the calculation are shown in boxes on the screens. Values shown in a white tile need to be entered by the system installer as they will vary based on site specifics such as cable type and length, etc. Values without a white tile are entered automatically by the CPU and are taken from the factory test record of the TTA System which is stored permanently in the system at time of manufacture.

When you first enter the system gain calculation screens you will be presented with the first screen as shown in figure 15. To move forward one screen press the Next button in the upper right corner. To move back one screen press the Back button in the upper left corner. Pressing the Home button will take you back to the Home Screen. To enter a value into the calculator press on the associated white tile. A temporary keypad will pop-up which is used to enter your value. Pressing the enter button on the keypad will place the value shown into the system gain calculator which will then be recalculated immediately to include your new value.

The calculations will appear on the third screen as shown in figure 17. An RX Overall Gain value is displayed (left-side lower box) which is determined by the summation of all the values entered on the first two screens. This number represents the gain of the entire TTA system at the present time based on the values provided for each component in the system, as well as the present attenuator setting. The values of the components are fixed due to physical design but the attenuator is adjustable. By changing the attenuator you can vary the gain of the system from the minimum possible to the maximum possible. The attenuator in this system can be varied from 0 to 15.0 dB in discrete 0.5 dB steps.

The system gain setting for your particular site needs to be adjusted so that it is equal to the Desired RX Gain. The Desired RX Gain value should be provided by your site designer and is determined based on the operational requirements for the RF site, balanced against the probability of high level RF carriers being present. The Desired RX Gain value is entered into the appropriate white

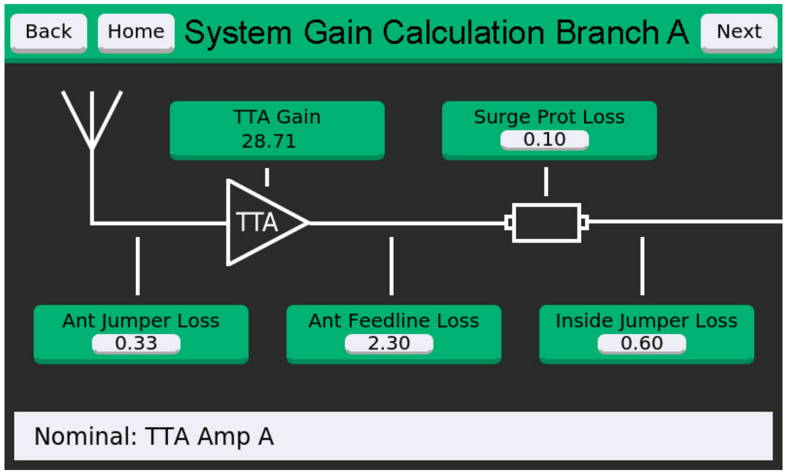


Figure 15: System Gain Calculation screen 1 on touch display.

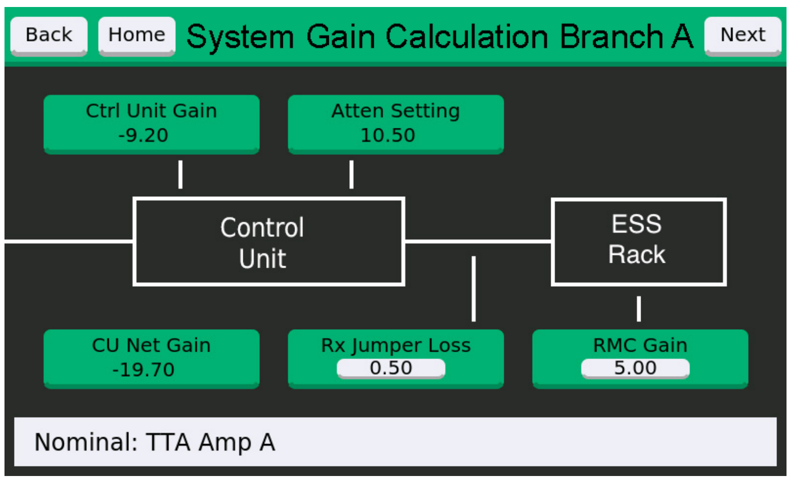


Figure 16: System Gain Calculation screen 2 on touch display.

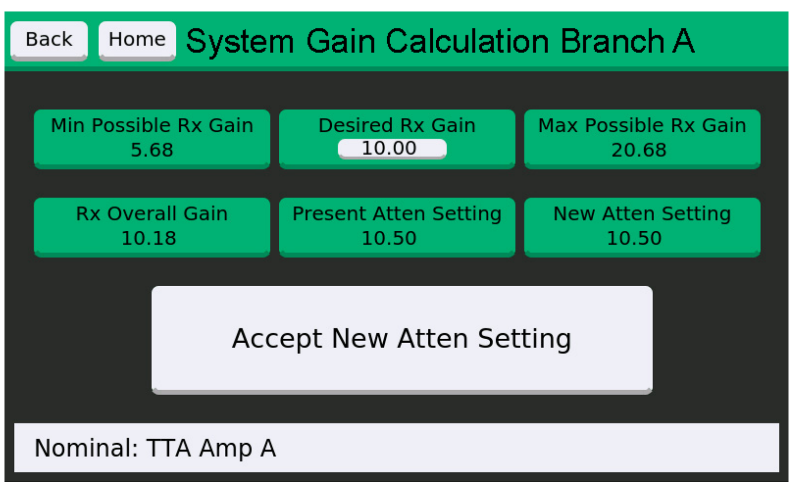


Figure 17: System Gain Calculation screen 3 on touch display.

tiled box and must be within the range of the minimum possible to the maximum possible. The Desired RX Gain value you enter will be compared against the RX Overall Gain and if there is a difference the calculator will recommend a New Attenuation Setting for the system. If you agree with the calculators recommendation then press the large white Accept New Atten Setting button towards the bottom of the screen. Once this button is pressed the system attenuator will be changed and the RX Overall Gain will become equivalent to the Desired RX Gain.

NOTE The system attenuator moves in discrete 0.5 dB increments so it will often not be possible to get an exact match between the RX Overall Gain and the Desired RX Gain. The system will round off the attenuator setting to a value that brings the RX Overall Gain as close as possible to the desired RX Gain but never less than the desired value. This means you will often have a few tenths more gain than desired but this should not impede system performance greatly.

NETWORK SETTINGS SCREENS

The Network Settings screen allows a user to view the network configuration of the LAN port on the rear of the control unit. The screen displays the current IP address, the netmask, the gateway, and whether DCHP is enabled or disabled. Refer to **Figure 18**. Pressing the Home button at the top of the screen will change the display to the Home Screen and pressing the Back button will step the display back to the previous screen. Which in this case would be the Setup Screen.

the Network Settings screen is a view only screen. To make changes to the network configuration you must use the web page interface discussed later in this manual in the section titled TCP/IP Configuration.

The red reset button in the lower left corner of the Network Settings Screen is used to reset the factory administrator password to the factory default value of “tx1-2rx”. This feature is provided for those cases where the password is forgotten or fat fingered. It allows the administrator a way to get back into the system via Ethernet. This button is only accessible from the touch display on the front panel of the deck. Someone must be physically present in the equipment shelter in order to push the button.

DATE/TIME SCREEN

The Date/Time screen allows the user to view the system clock from the front panel. See **Figure 19**. The time and date are displayed on the white tile in the center of the screen. The displayed date and time is not adjustable from the front panel touch display, it can only be viewed from the touch display. To adjust the time/date you must use the web interface. It is important to set the system clock to your correct local time because it is used to file data in the event log. Also, the time is used on SNMP, SMTP, and SMS communications from the system to the user.

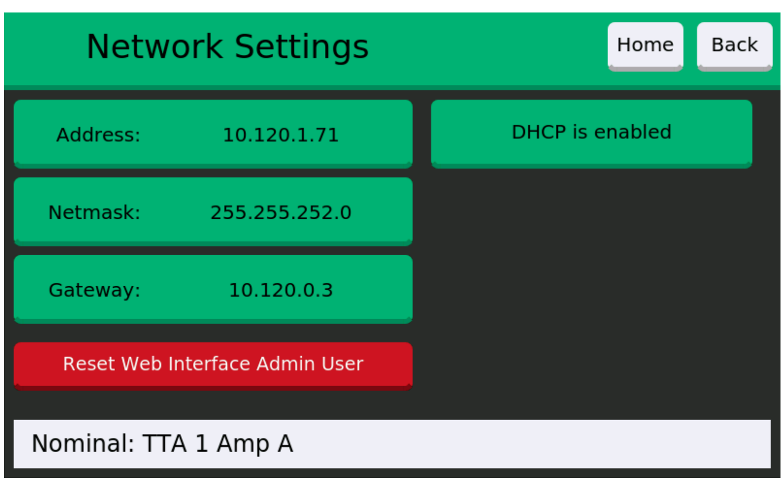


Figure 18: Network Settings screen on touch display.

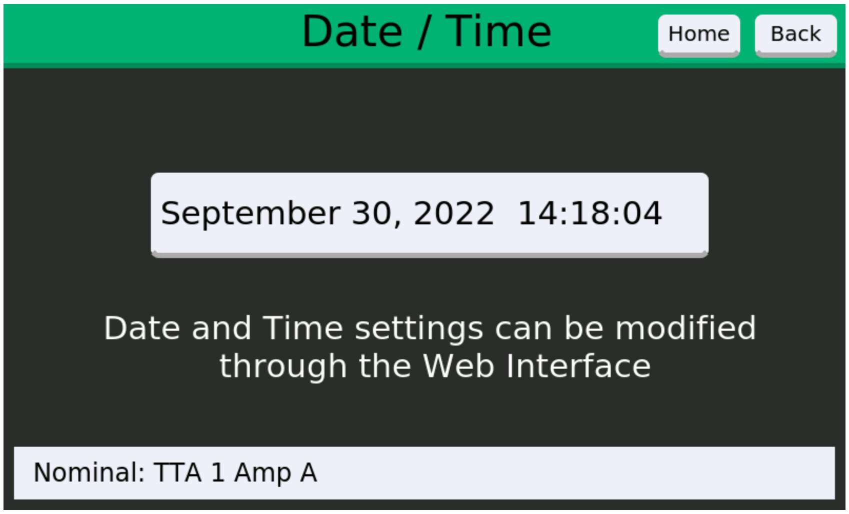


Figure 19: Date/Time screen on touch display.

The system clock is backed up by an internal battery with an expected 10 year lifespan so once set correctly for your time zone it will remain correct even if the system experiences a power interruption.

AUXILIARY INPUTS SCREEN

There are 5 auxiliary input ports on the rear panel of the control unit as shown in figure 12. The inputs are labeled IN1 through IN5. These ports allow the system installer to connect alarm outputs from third-party equipment located in the shelter into the TTA system. This will allow the TTA systems extensive reporting features (Form-C, SNMP, SMTP, and SMS) to be used by the third-party equipment for alarm notifications.

Triggering an auxiliary input requires connecting an input pin to its associated ground pin on the rear of the control unit. This contact closure would be performed by the alarm output pins of the third-party equipment. Likewise, an open collector NPN scheme could be used, whereas the open collector of the transistor would be connected to the input pin and the emitter would be collected to the ground pin. The base pin of the transistor would be connected to the alarm output of the third-party equipment.

TX RX Systems recommends the use of dry contacts for triggering auxiliary inputs. The pins on the rear of the control unit are not rated to switch voltage. They are simply looking for a continuity or no continuity situation for triggering purposes.

NOTE Under no circumstances should a voltage level be applied directly to the auxiliary input pins on the control unit. This could damage the control unit.

The Auxiliary Input screen is shown in **Figure 20**. In order to use one of the auxiliary inputs the associated Enable button must be set to the Enabled position. Once an input is enabled for use its trigger level must then be selected from the column labeled Trig Lvl. Choices are either Low or High. When logic low is selected an event condition will occur whenever the input pin makes contact with its associated ground terminal. When logic high is selected an event condition will occur whenever the input pin does not make contact with its associated ground terminal. So low represents a closed contact and high represents an open contact.

When an input pin is disabled the status icon (square on the left side of screen) that is associated with the pin will appear white on the screen. If the pin is enabled the status icon will turn green for no event detected and red whenever an event is detected. The In Lvl column indicates what the CPU is seeing at the individual auxiliary input right now. This column will update in real time as the input status changes. When the In Lvl and the Trig

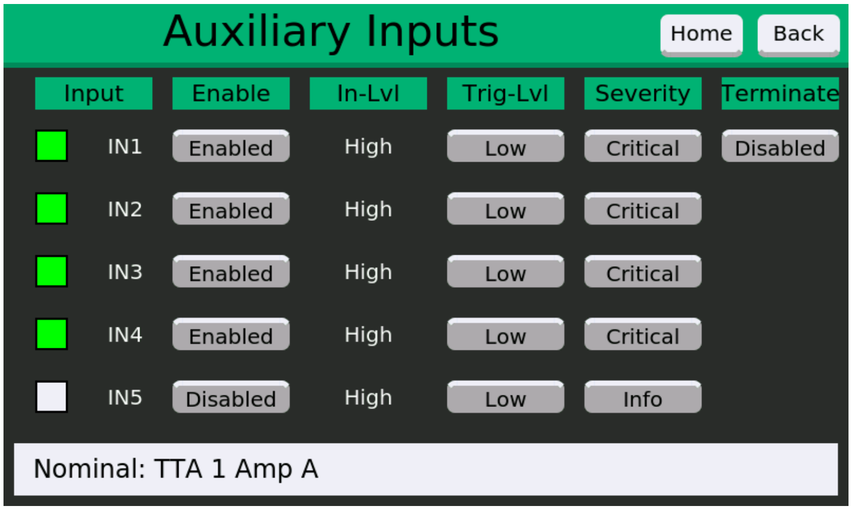


Figure 20: Auxiliary Inputs screen on touch display.

Lvl are in agreement the TTA System will generate an event and the icon will turn from green to red.

The Severity column allows the user to assign an appropriate event severity level to each individual auxiliary input pin. Events have four levels of severity including critical, severe, warning, and info. These event severity levels are used by the TTA system to determine event messaging response. This allows messaging from the TTA system to be customized for different users. For instance, supervisors probably do not need to see warning and info level messages but field engineers responsible for maintaining the system would need to see them. When you assign severity levels to the Auxiliary Inputs you will have to take into consideration who needs to be notified. This subject is discussed in further detail in a later section of this manual titled User Administration.

NOTE

When the Severity level is set to Critical or Severe a system alarm will occur when the associated input pin is triggered.

Auxiliary Input 1 (and only Input 1) has a special terminate feature. When the Terminate button is set to Enabled then Pin 1 will act as a trigger input and will no longer function as an auxiliary input. This terminate function allows the user to initiate the terminate test in the TTA. The terminate test will start when input 1 is triggered. The test will run for the default duration then the system will automatically return to normal operation. In order to initiate another test input 1 will first need to return to the not triggered state then become triggered again. This prevents the system from being stuck in the test mode if Input 1 is left triggered on by accident.

CAUTION: During the terminate test on-air signals will not pass through to the station receivers. The default duration for the terminate test is 5 minutes. If you have completed your measurements and want to end the test early then either disable the Enable button, or change the Trig Lvl for Input 1.

RSSI CALCULATION SCREENS

The RSSI calculation screen assists the user in determining the correct generator level which is required to meet a relative signal strength indication (RSSI) typically of -90 dBm. An RSSI measurement is made by injecting a test signal into the front panel test port on the control unit and measuring the test signals level at the input of the base radio receiver (in the case of a C&DU style system) or the input of the ESS cabinet (in the case of the CU style system). The calculations are identical for both the CU style and C&DU style control units. The discussion that follows, although centered around the C&DU style system, is applicable to both the CU and C&DU control units.

An RSSI (Received Signal Strength Indication) measurement can be made once the TTA system is installed and operational. Attenuation adjustments and spectrum analysis must be performed properly before an RSSI measurement is made.

RSSI Calculation via the touch display is spread across two screens as shown in **Figures 21 and 22**. A basic distribution block diagram of the C&DU system is presented on the two screens. The diagram shows all of the components and interconnecting cables at the installation site which are involved in the RSSI Calculation. When you first enter the RSSI calculation screens you will be presented with the first screen as shown in figure 21. To move between the two screens press the Next or Back buttons located on the top header of the screens.

The RSSI measurement is accomplished by injecting a test signal of known amplitude into the front panel test port connector. This test signal travels up to the tower along the test feedline into the test port of the TTA. It is coupled into the main RF signal path at the input to the LNA inside of the TTA

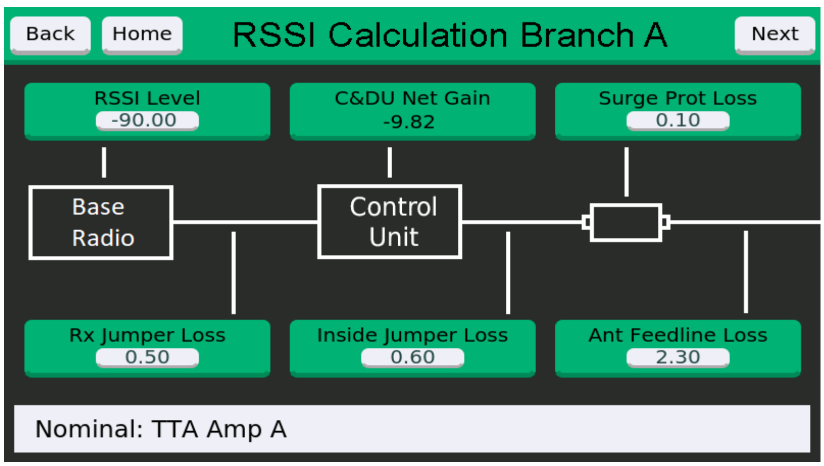


Figure 21: RSSI Calculator screen 1 on touch display.

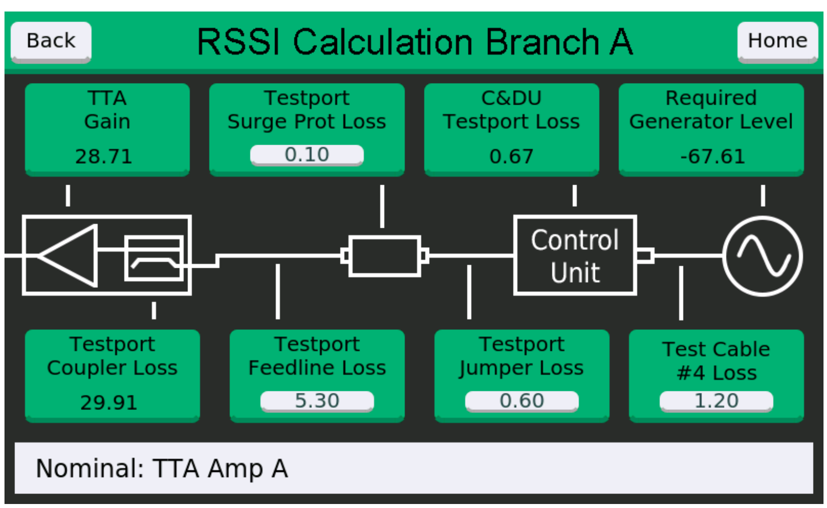


Figure 22: RSSI Calculator screen 2 on touch display.

and then travels back down from the TTA through the antenna feedline to the input of the base radio (C&DU style system) or ESS cabinet (CU style system).

Figure 21 (first RSSI Calculation screen) shows the signal path from the Main port of the TTA down to the receiver (left to right on the block diagram). Figure 22 (second RSSI Calculation screen) shows the signal path from the engineers signal generator connected to the front panel of the control unit, up to the Test port of the TTA (left to right on the block diagram). All of the system components involved in the RSSI calculation are represented on the two block diagrams by a box. Values used for the RSSI calculation are shown in the boxes on the screens. Values shown in a white tile need to be entered by the system installer as they will vary based on site specifics such as cable type and length, etc. Values without a white tile are entered automatically by the CPU and are taken from the factory test record which is stored permanently in the system at time of manufacture.

NOTE

Values in the main RF signal path (down from the tower) are the same in both the System Gain Calculation discussed earlier and the RSSI Calculation. In regards to the main RF signal path values, the two calculation screens are interactive. Such that changing one of these component values in one calculator will instantly be changed in the other calculator. This feature is provided as a user convenience.

To enter a value into the RSSI calculation press on the associated white tile. A temporary keypad will pop-up which is used to enter your value. Pressing the enter button on the keypad will place the value shown into the calculator which will be recalculated immediately to include your new value. The goal of the RSSI calculation to is determine the correct test signal generator level that is required to meet the desired RSSI measurement level (typically -90 dBm).When all of the values required are properly entered into the calculator the expected signal generator level will be displayed at the top right hand area of the second screen in a box titled Required Signal Generator Level

An additional discussion of the RSSI measurement process for either the C&DU and CU style systems is presented later in this manual in a section titled “Operational Tests”.

ALARM DISABLE SCREEN

The Alarm Disable screen gives the user the ability to temporarily disable the alarm function if they need to do work on the system that might trigger alarms and they do not want those alarms to propagate via SNMP, SMTP, or SMS to various alarm recipients. The alarms can not be turned off permanently but they can be disabled from 1 to 10 minutes.

Refer to **Figure 23** which shows the Alarm Disable screen. The large button in the center of the screen is used to turn the alarms off temporarily. The length of time the alarms are off is determined by

Figure 23: Alarm Disable screen on touch display.

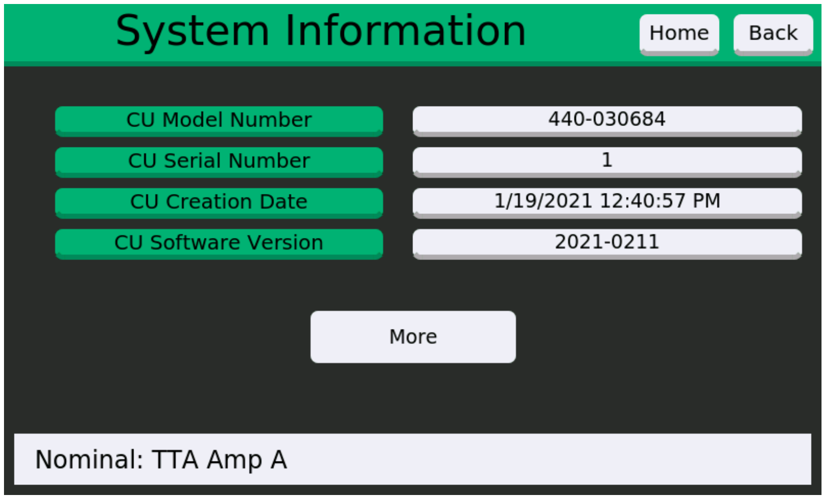


Figure 24: System Information screen on touch display.

the counter value under the button. The counter can be increased or decreased (1 to 10 minutes in half minute intervals) using the arrow buttons. When the button shows the word disable the alarm function is on and working normally. When the button shows the word enable the alarm function is off and the associated timer will begin counting down. In addition, the background of the button will turn red. When the counter times out the alarm function will turn back on and the background color will change to white.

SYSTEM INFORMATION SCREEN
The System Information screen is a convenient way for the user to call-up identifying information about the TTA system. Three screens can be presented, one for the System called CU, one for the RF electronics in the deck called DA, and one for the tower top box called TTA. To move from one screen to the next press the More button. The information presented includes; Model Number, Serial Number, Date of Manufacture, and Software version. This information is stored permanently within the TTA system at the time of manufacture. Refer to **Figure 24**.

Operation
The Operation screen allows the user to select which TTA amplifier is active (preferred) as well as initiate test modes. Referring to **Figure 25**, amplifier selection is done with the two buttons on the left side of the screen labeled "Prefer Amp A" and "Prefer Amp B". The button for the currently active amplifier will be green and the inactive amplifier will be white. To make the inactive amplifier the active amp press the associated button and the operational preference will change. This change takes several seconds before the relay switching is completed. Test modes include; amplifier termination, bypassing, and antenna sweeping. Each of these test modes will be discussed below.

TERMINATE A/B TEST
This feature is used during testing to eliminate site noise from test measurements. The input of either tower top amplifier can be switched to an internal 50 Ohm load for diagnostic purposes. Termination is initiated using the associated button on the Operation screen. When the terminate button is pressed a numeric entry pad will be displayed which allows the user to select how long the termination test mode will remain active. Enter the amount of time you need to perform the test then press the Enter button to begin. The front panel mode indicator light will turn yellow for the duration of the test and a message describing the test will appear on the touch displays status bar. When the selected time runs out the terminate test mode will end. Pressing the Cancel button in the lower left corner at any time will end the test early.

CAUTION: During the Terminate A/B Test on-air signals will NOT pass through to the station receivers.

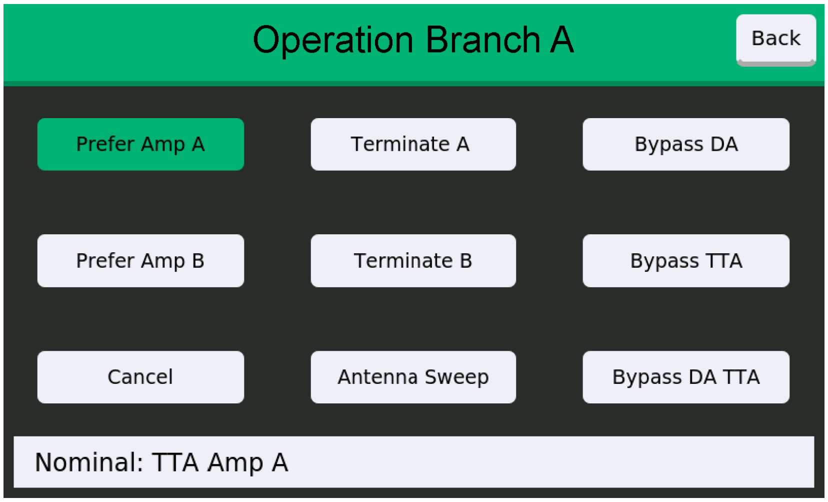


Figure 25: Operation screen on touch display.

BYPASS TEST

These choices are used to test the bypass functions available in the system. Three tests are available including; bypass the DA (distribution assembly located in the control unit), bypass the TTA, or bypass both the DA and TTA at the same time.

During the Bypass DA test the Main port on the control unit is connected directly to the RF output/s port/s on the control unit. During the Bypass TTA test the TTA Antenna port is connected directly to the TTA Main port. And during the Bypass DA TTA test the Antenna port on the TTA is connected directly to the RF output/s port/s on the control unit.

Bypass tests are initiated using the associated button on the Operation screen. When the bypass button is pressed a numeric entry pad will be displayed which allows the user to select how long the bypass test will remain active. Enter the amount of time you need to perform the test then press the Enter button to begin. The front panel mode indicator light will turn yellow for the duration of the test and a message describing the test will appear on the touch displays status bar.When the selected time runs out the bypass test will end. Pressing the Cancel button in the lower left corner at any time will end the test early.

ANTENNA SWEEP

This feature allows the user to sweep the antenna from the front panel Test Port on the control unit.

CAUTION: During this test on-air signals will NOT pass through to the station receivers.

The system is designed with an antenna sweep function which allows the antenna to be connected directly to the front panel test port. This will allow for sweeping the antenna from the convenience of the front panel. In this mode of operation the front panel test port is re-routed to the main antenna feedline and the amplifier circuits in the TTA become bypassed creating an RF signal path between the front panel test port on the control unit and the antenna port on the TTA.

Antenna sweep is initiated using the associated button on the Operation screen. When the antenna sweep button is pressed a numeric entry pad will be displayed which allows the user to select how long the sweep test will remain active. Enter the amount of time you need to perform the test then press the Enter button to begin. The front panel mode indicator light will turn yellow for the duration of the test and a message describing the test will appear on the touch displays status bar. When the selected time runs out the antenna sweep test will end. Pressing the Cancel button in the lower left corner at any time will end the test early.

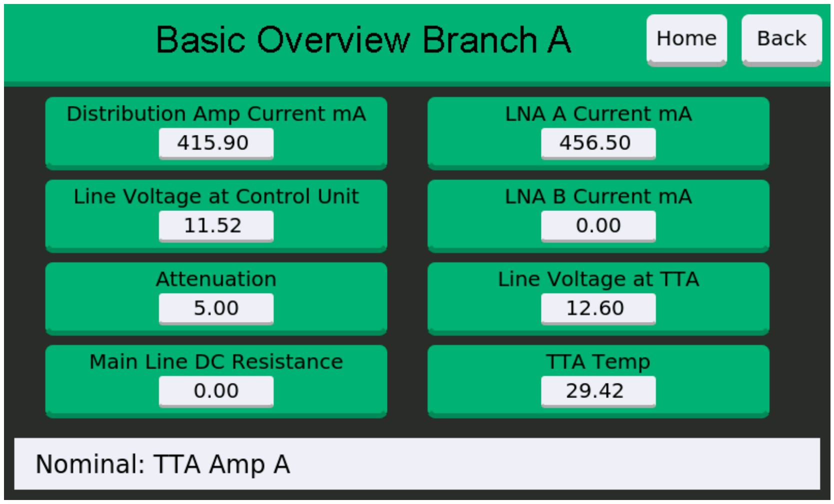


Figure 26: Basic Overview screen on touch display.

Detail Status Screen
The Detailed Status screen gives the user the ability to take a closer look at system operation using two screens, a basic overview showing the key measured parameters in the system and an alarm board screen showing a list of alarm activity.

BASIC OVERVIEW SCREEN
The Basic Overview screen is shown in **Figure 26** and is designed to provide the user with a convenient view of the overall performance of the system. Key measurements in the system are presented including voltage at the bottom and top of the main antenna feedline, calculated resistance of the main antenna feedline, current draw of each amplifier circuit in the system, temperature of the TTA, and attenuation setting. All of the measured values update in real time. For the TTA amplifiers the active amplifier will show a current value because it is powered on, but the backup amplifier will show no current draw because it is turned off.

Only the active amplifier in the TTA is powered up during normal operation. The standby amplifier is kept turned off until it is needed. There is a brief exception to this operating scheme for maintenance purposes. Once every 24 hours for about 2 minutes both the active and standby amplifier will both be turned on. This is so that the TTA microprocessor can assess the operational ability of the standby amplifier in case it is called into service. The test is performed automatically and has no

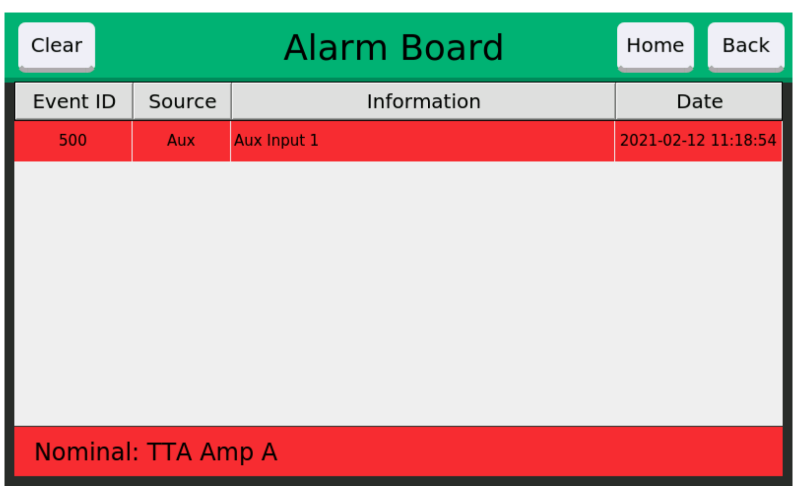


Figure 27: Alarm Board screen on touch display.

effect on the operation of the system. However, during this 2 minute test period there will be additional current draw by the TTA. The increased current draw will be apparent in the system logs but is completely normal.

ALARM BOARD SCREEN

The alarm board screen is designed to give the user a quick situational overview of what the major problems are. All alarms are listed on this screen in the descending order of which they occurred. Each alarm event is listed as a separate row on the table. The columns provide information about the alarm including an Event ID, Source, Information, and Date. Refer to **Figure 27**.

The Event ID code is a unique value for each individual event that can be recognized by the system. The Source describes where the error code came from within the systems architecture. The Information is a human readable equivalent of the error code which is provided so users will not need to look up individual error codes to decipher meaning. The text from the Information column is also included as part of both SMTP (emails) and SMS (text messages). Lastly, the Date is a time stamp that lists when the source device reported the event to the CPU.

If the alarm is currently active it's back ground will be red. If the alarm has cleared, say a temporary over temperature condition, then it's back ground will be yellow. Active alarms (red) can not be removed from the screen. Previous alarms that are now inactive (yellow) can only be removed if the user presses the Clear button in the upper left corner of the screen. This forces the user to acknowledge that they know the temporary condition occurred. All alarm events are recorded in the systems event log for future review and analysis.

Features Screen

The Features screen provides access to any user interactive features or options that are installed on the system. Installed options that do not have a user interaction, such as a narrowing filter or port expansions do not appear on this screen. Click on the box for the feature or option you want to interact with and subsequent screens will be displayed as appropriate.

HIGH LEVEL CARRIER DETECTION SCREEN

The High Level Carrier Detection feature is a circuit board added to the system that continuously monitors the composite signal strength of the systems passband. The monitoring point is at the RF Output/s of the control unit. Refer to the control unit block diagrams shown in figure 6 (C&DU) or figure 7 (CU).

The High Level Carrier Detection screen is shown in **Figure 28**. The screen has an enable/disable button called Alarm Enable on the upper right side which allows the user to turn the HLC alarming feature on/off by pressing the button. In addition, there is a button titled Buzzer Enable which can be used to turn on/off the built-in HLC Alarm buzzer.

The two boxes on the upper left side of the screen indicate the user selectable Alarm Threshold level

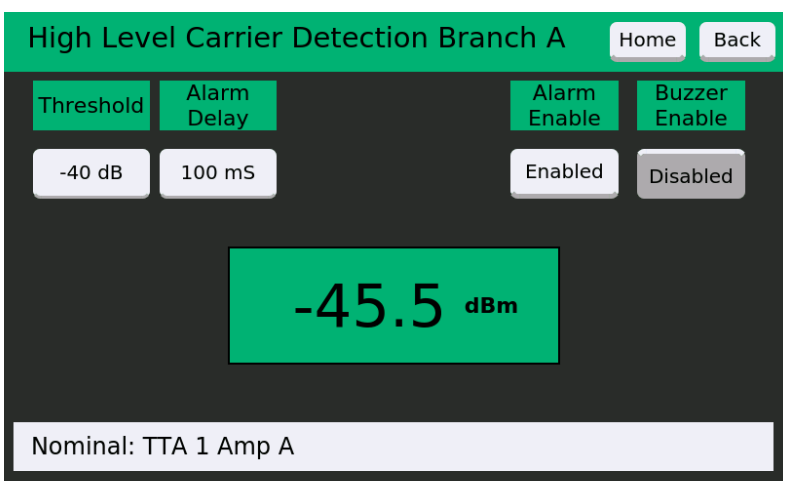


Figure 28: High Level Carrier Detection screen on touch display. (no alarm)

and the user selectable Alarm Delay. Whenever the composite signal strength is above the user selectable Alarm Threshold Level (typically -35 dBm for the C&DU style systems or -40 dBm for the CU style systems) an alarm event is generated. Whenever the signal strength drops back below the user selectable threshold level the alarm event will be cleared. Note that the minimum signal level that can be detected by the HLC circuit is -53 dBm composite for the CU style system and -63 dBm composite for the C&DU style. The Alarm Delay indicates how long the HLC signal must be present above the threshold before an alarm event is triggered.

The measured HLC value is displayed in real time in the large box in the middle of the screen. When the measured HLC is below the minimum detectable level an Out of Range message is displayed in the large box. If the HLC value is above the alarm threshold the background color of the large box will be red and an alarm event is generated. Refer to **Figure 29** which shows the HLC screen during an alarming condition. In addition, the buzzer which is built-in to the control unit will sound off in order to draw the attention of anyone that is in the equipment shelter at the time.

HLC alarm events are fixed at the severe level which can not be changed by the user. High Level Carrier detections are considered an alarm event and the control unit will respond accordingly. The front panel alarm LED will turn red and the touch display status bar will also turn red. The systems Form-C contacts will change state and the system will generate SNMP, SMTP, and SMS messages.

The signal strength being monitored by the HLC circuit is recorded in a history log which can be viewed via the web page interface and is discussed in detail in a later section of this manual titled Historical HLC.

ETHERNET CONNECTIVITY

The TTA system offers web-based Ethernet connectivity via the front panel USB port or the rear panel LAN port. The initial customer interface to the control unit should be done with a laptop computer at the time of installation. This will provide complete access to all of the software screens in the system and will allow for proper system setup. Key setup screens such as configuring passwords, configuring SNMP, etc. are not accessible from the front panel touch display.

Connect a service laptop to the control unit using the front panel USB port. The rear panel LAN port is used for connecting to networks so that the control unit can be accessed from a distant location such as your office. The control unit is capable of interfacing with both ports simultaneously so the service engineer has easy front panel access to the control unit web page even if the rear panel LAN is cabled up to a network.

Connecting your service laptop to the control unit via the front panel USB port is very straight forward. Connect an available USB port on your lap-

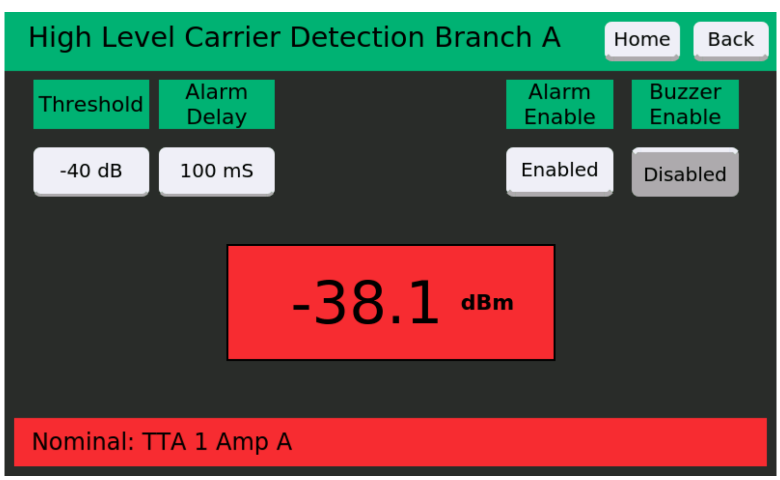


Figure 29: High Level Carrier Detection screen on touch display. (with alarm)

top to the USB port on the control unit with a type-A to type-B USB cable. Open a web browser on your laptop (we recommend Chrome or Firefox) and enter the front panel USB port factory default IP address (**https://192.168.7.2**) into the search bar at the top of the browser. The IP address of the front panel USB port is fixed in system memory and can not be changed or modified. The control unit will configure your laptop automatically to establish the link. If your web browser presents any certificate warnings it is safe to accept the risk because this is a direct connection between your service laptop and the control unit.

In order to connect the rear LAN port to a network all that is required is an active Ethernet cable. Simply plug the network cable into the LAN port on the rear of the control unit. The control unit ships from the factory setup for a DCHP connection. Which means the network will assign an available IP address to the control deck when the network first detects that it has been connected. If you want to view the assigned IP address use the touch display Setup/Network Settings buttons

NOTE The IP address of the rear panel LAN port can be configured but the front panel USB which is designed for use by the on-site service engineer will always remain at its factory default IP address.

WEB PAGE INTERFACE

Once an Ethernet link is established between your computer and the control unit a login window will be presented as shown in **Figure 30**.

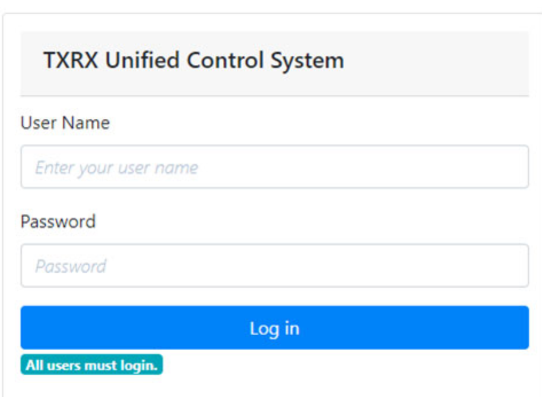


Figure 30: Login page.

To gain access to the system enter the user name and the password into the appropriate boxes. The factory default user name is **admin** and the factory default password is **tx1-2rx**. The default name and password will allow you to login into the system as the factory default administrator giving you full administrative rights and access to all web pages. It is recommended that the factory default password is changed after system commissioning so proper system security can be established. Refer to a later section of this manual titled “User Administration” for a complete discussion regarding setting up users at varying security levels. Once past the login page you will be presented with the System Overview web page which provides a convenient overview of the TTA Systems structure and its current status.

The web pages in the 440 TTA System are all structured with an upper header, menu selections on a side-bar to the left side, and page specific information in the center. The upper header lists the web pages title and below that the site name provided the site name has been entered into the site information web page by the user. If the user does not enter a site name into the system it will not appear on the upper header.

Three icons appear on the right side of the upper header labeled Heartbeat, Alarms, and HLC. The heartbeat icon will pulsate in sync with the heartbeat signal generated by the CPU in the TTA system. This provides you with two important pieces of information, one is that the CPU program in the TTA system is executing and two is that you have an active link established via your Ethernet connection with the TTA system.

The alarm icon will mirror whatever state the front panel STATUS LED is presently showing. Green represents no alarm conditions and red represents an active alarm condition. A description of the front panel Alarm indicator can be found in an earlier section of this manual titled “Front Panel LED Indicators”. The HLC icon is gray whenever the HLC alarming function is turned off, green when the alarming function is turned on and no alarm is occurring, but will turn red when an HLC (High Level Carrier) is detected.

Next to the icons there is a message area titled RF Path Branch A. Underneath the title are brief messages about the status of the RF path through the distribution assembly (DA) in the control unit and which amplifier is selected in the TTA. There is a second message area titled Site Type which indicates whether the system is an SA or ESS style.

The menu items that appear on the left margin of the screen allow the user to navigate easily between the menu selections. Menu selections with similar functionality are clustered into menu groups. The menu groups include Status, Operation, Site Setup, Alarm Setup, Tools, Network and SNMP, Logs and Analytics, Features, About, and Diagnostic Data. Each group and its associated menu selections will be discussed in detail in the following subsections of the manual.

Status

The Status group of menu items provides the user with a convenient way to look at what is going on in the system right now. There are three menu selections including; System Overview, Dash Board, and Alarm Board. The data displayed on these three web pages updates in real time.

SYSTEM OVERVIEW

The System Overview page is shown in **Figure 31**. This page presents a graphical display of the system in a block diagram format. each major subassembly in the system is represented by a block. The color of the block represents the status of that subassembly. When the subassembly is shown as green it is functioning normally but will turn red if there is an alarm condition associated with that particular subassembly.

The block diagram will update with each system heartbeat and is interactive with the Dashboards web page. When you mouse click on one of the boxes you are transferred automatically to the appropriate area on the Dashboard.

DASHBOARDS

The Dashboards present a functional view of each subassembly in the TTA System and updates with each heartbeat. Measured parameters are presented in a graphical and numerical format for each measured parameter in each subassembly in a horizontal fashion. Refer to **Figure 32**. The major sub-assemblies include the TTA 1 (the tower top amplifier unit), DA 1 (the control unit assembly responsible for processing the RF signals, HLC 1 (control unit circuit responsible for detecting high level carriers), CU 1 (control unit CPU), Main Line Status (measurements of the antenna feedline), and AUX 1 (status indicators for the five auxiliary inputs).

The meter graphics will be green when the values are in the normal range and will change to red when the values are in an alarm range. The circular icons for HLC and the Auxiliary Inputs will be gray when their alarm function is turned off, green when the alarm function is turned on and the status is normal but will change to red if the feature alarms. An active amplifier will show a current

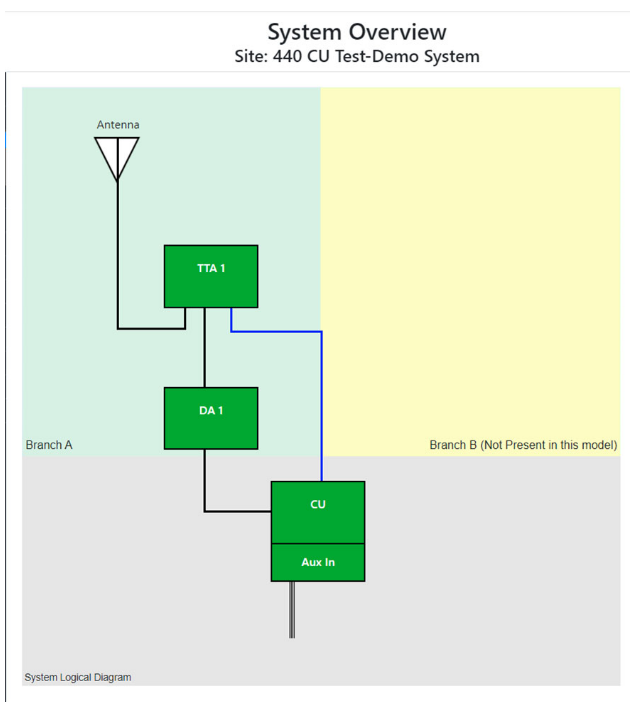


Figure 31: System Overview page.
Note: This is also the default page of the Web Interface.

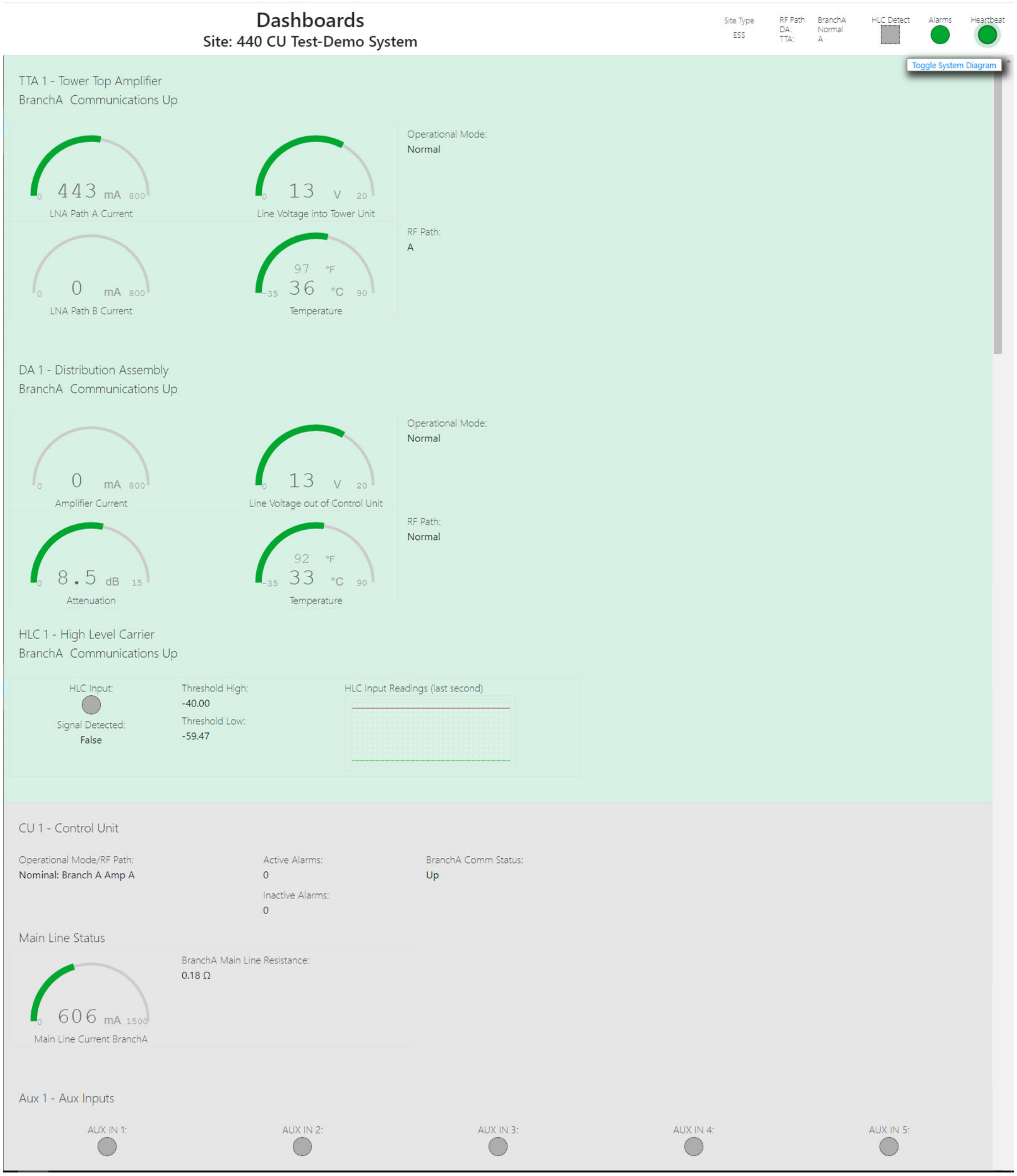


Figure 32: Dashboards page.

value because it is powered on, but an inactive amplifier will be dark and show no current draw because it is turned off.

NOTE Only the active amplifier in the TTA is powered on. The standby amplifier is kept turned off until it is selected. There is a brief exception to this operating scheme for maintenance purposes. Once every 24 hours for about 2 minutes both the active and standby amplifier will both be turned on. This is so that the TTA microprocessor can assess the operational ability of the standby amplifier in case it is called into service. The test is performed automatically and has no effect on the operation of the system. However, during this 2 minute test period there will be additional current draw by the TTA. The increased current draw will be apparent in the system logs but is completely normal.

ALARM BOARD

The Alarm Board screen lists all of the currently active Alarm events in the system as well as any previously active alarms that the user has not yet acknowledged as having occurred. The Alarm Board screen is designed to give the user a quick situational overview of what the major problems are. Active alarm events (those that are happening right now) are displayed in red and inactive alarm events (alarms that occurred but then cleared) are displayed as white.

Detailed information for each event on the list is provided including active level (either active or inactive) date and time stamp, source of the alarm within the system, severity (critical or severe), information which is a brief description of the alarm, and the event ID which is a unique code for each individual event that can be recognized by the system software. The brief description listed in the information column is a human readable equivalent of the error code and is provided so that users will not need to look up individual error codes to decipher meaning. The brief description is also included as part of both SMTP (emails) and SMS (text messages).

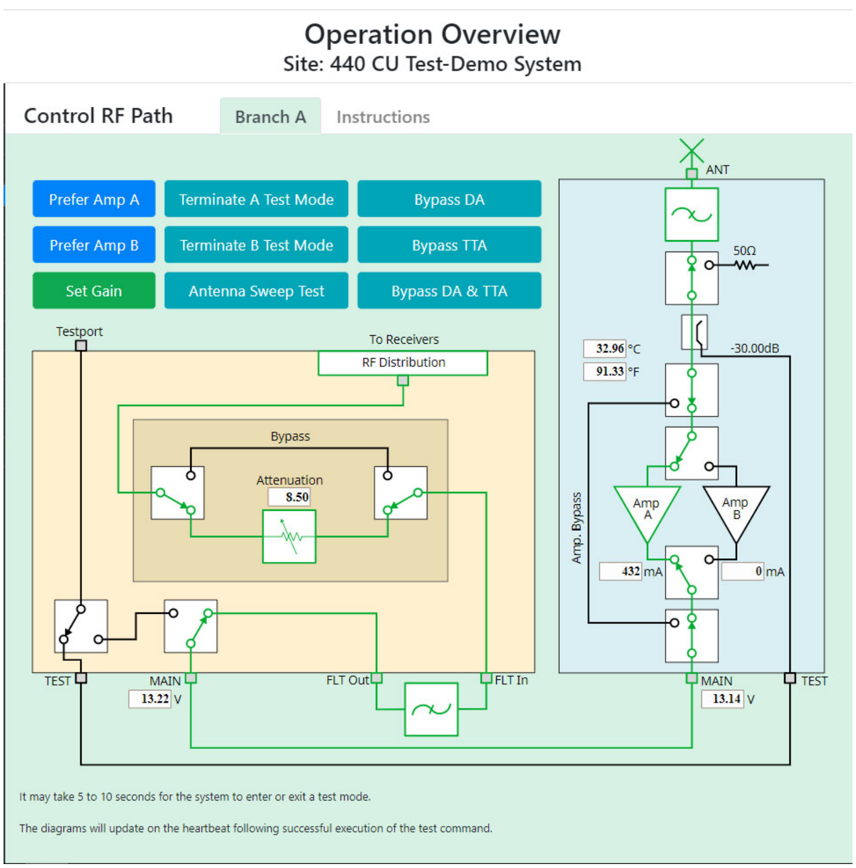


Figure 33: Operation Overview page.

When an alarm condition is resolved the active level for the alarm is changed to inactive and the background color is changed to white. Inactive alarms will remain on the alarm board until the user clears them by pressing the blue “clear inactive alarms” button. This ensures that alarms do not come and go without the user knowing about them. Note that all events are permanently recorded in the systems event log so if an event is cleared from the alarm board it will always remain in the system event log.

Operation Overview

The Operation Overview page is shown in **Figure 33**. It provides a simplified signal flow diagram of the TTA System. Signal flow is shown by the green color path and it will change as the user makes operational selections such as changing the preferred amplifier or performing an antenna sweep test, etc. Key measurement points in the system such as temperature, current, voltage, and attenuation have an associated value box which updates in real time. The instruction tab below the site name will present an excerpt of this manual for convenience.

The area of the page called Control RF Path presents a group of buttons allowing the user to select which TTA amplifier is active (preferred) as well as initiate test modes. Amplifier selection is done with the two buttons on the left side of the page labeled “Prefer Amp A” and “Prefer Amp B”. To make the inactive amplifier the active amp press the associated button and the operational preference will change. This change takes about 10 - 20 seconds before the relay switching is completed. Test modes include; amplifier termination, bypassing, and antenna sweeping. Each of these test modes will be discussed below.

In addition, there is a Set Gain button (green) which when selected will present a pop-up window asking if you want to manually adjust the attenuator or use the System Gain Calculation function. To set the attenuator manually enter the desired value into the box or use the arrow keys. Select the Set Attenuation button (yellow) to make the change. If you decide to use the calculator then select the Use the Gain Calculator button (blue) and the system will move you over to the System Gain Calculation page which is discussed in detail in a later subsection of this manual.

TERMINATE A/B TEST

This feature is used during testing to eliminate site noise from test measurements. The input of either tower top amplifier can be switched to an internal 50 Ohm load for diagnostic purposes. Termination is initiated using the associated button on the page. When the terminate button is pressed a pop-up window will appear which allows the user to select how long the termination test will remain active. The amount of time the test will be active is shown and can be adjusted by entering a value into the box. To begin the termination select the confirm (green) button. A countdown time will appear that shows how much time is left for the test. Pressing the cancel (red) button will terminate the test early. When the timer runs out to zero the test will end.

CAUTION: During this test on-air signals will NOT pass through to the station receivers.

BYPASS TEST

These choices are used to test the bypass functions available in the system. Three tests are available including; bypass the DA (distribution assembly located in the control unit), bypass the TTA, or bypass both the DA and TTA at the same time.

During the Bypass DA test the Main port on the control unit is connected to the RF output/s port/s on the control unit. During the Bypass TTA test the TTA Antenna port is connected directly to the TTA Main port. And during the Bypass DA TTA test the Antenna port on the TTA is connected directly to the RF output/s port/s on the control unit. The Bypass DA TTA test is the same situation that would occur if the TTA system experienced a power failure.

Bypass tests are initiated using the associated button on the Operation page. When the bypass button is pressed a pop-up window will appear which allows the user to select how long the bypass will remain active. The amount of time the test will be active is shown and can be adjusted by entering a value into the box. To begin the bypass select the confirm (green) button. A countdown time will appear that shows how much time is left for the test. Pressing the cancel (red) button will terminate the test early. When the timer runs out to zero the test will end.

ANTENNA SWEEP TEST

The TTA system is designed with an antenna sweep function which allows the antenna to be connected directly to the front panel test port. This will allow for sweeping the antenna from the convenience of the front panel. In this mode of operation the front panel test port is re-routed to the main antenna feedline and the amplifier circuits in the TTA become bypassed creating an RF signal path between the front panel test port on the control unit and the antenna port on the TTA.

CAUTION: During this test on-air signals will NOT pass through to the station receivers.

Antenna sweep is initiated using the associated button on the Operation page. When the sweep button is pressed a pop-up window will appear which allows the user to select how long the test will remain active. The amount of time the test will be active is shown and can be adjusted by entering a value into the box. To begin the test select the confirm (green) button. A countdown time will appear that shows how much time is left for the test. Pressing the cancel (red) button will terminate the test early. When the timer runs out to zero the test will end.

NOTE The 30 MHz wide system filter located in the TTA is not bypassed during the antenna sweep test. Therefore your sweep signal will show a low return loss except within the passband of the filter which is 794 to 824 MHz. What you will see in your sweep is a 30 MHz window of the antenna at the filters passband and not the entire passband of the antenna. The antenna sweep test does not provide a precise measurement of the antenna because of the intervening filter but instead should be used as a go or no-go indication. If the sweep within the passband of the filter meets specification consider the antenna as likely good.

Site Setup

The Site Setup Group of menu items will allow the automatic calculation of system gain, allow entry of site information, time and SMTP configuration, and setup user administration details. Each of these functions has an associated web page and each will be discussed in detail in the subsections below.

SYSTEM GAIN CALCULATION

The System Gain Calculation page assists the user in calculating the correct attenuator adjustment that is required to meet the desired system gain level. There are small differences between a CU and C&DU calculation because the data input fields for the two types of system have some differences. Otherwise the calculations are identical.

Attenuation Adjustments

Care needs to be taken to avoid high level power (either on or off channel) from entering into the LMR receivers. To ensure that high level carrier risk is managed, System Engineers and System Technologists determine an appropriate amount of desired Receive Overall Gain for the site. The value chosen is determined based on the operational requirements for the RF site, balanced against the probability of high level RF carriers being present.

Receive Overall Gain is defined as the gain in the TTA system above and beyond what is required to overcome the losses in the TTA system, as measured from the output of the receive antenna to the input of an individual base radio receiver. The correct attenuator setting for achieving the desired Receive Overall Gain of the system varies slightly between the C&DU style system and the CU style system. The correct adjustments for each type of system are discussed separately.

C&DU Calculation

Figure 34 shows the System Gain Calculation page for the C&DU style system. A distribution block diagram is presented (towards the top of the page) which shows all of the components and interconnecting cables at the installation site which are involved in the receive signal path between the antenna and the base radio. For the C&DU style system those components and cables include; Antenna Jumper Loss, TTA Gain, Antenna Feedline Loss, Surge Protector Loss, Inside Jumper Loss, C&DU Overall Gain, and RX Jumper Loss. Note that the C&DU Overall Gain consists of Control Unit Gain, Attenuator Setting, and Distribution Unit Gain. The Distribution Unit Gain is fixed at 1 dB by design.

Below the blocks in the diagram are boxes that hold loss/gain values of the components and cables. Boxes that are open on their sides will have values entered automatically by the CPU from data

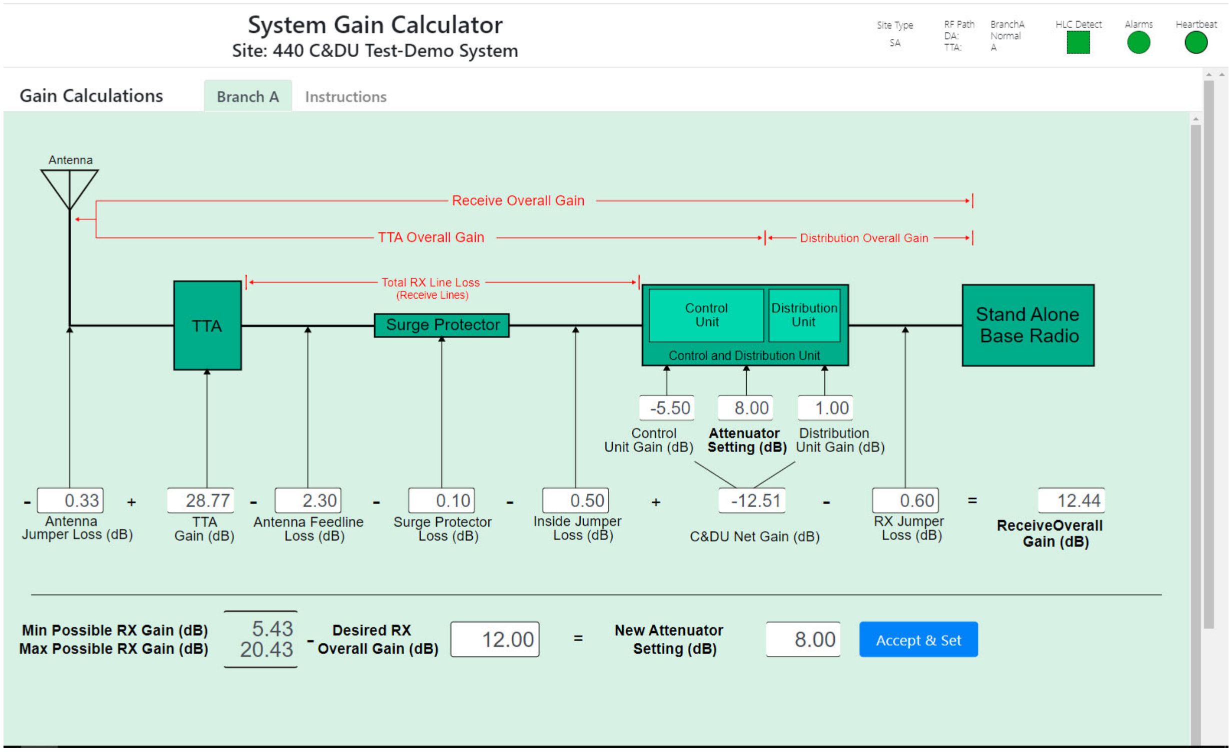


Figure 34: System Gain Calculation page for the C&DU style system.

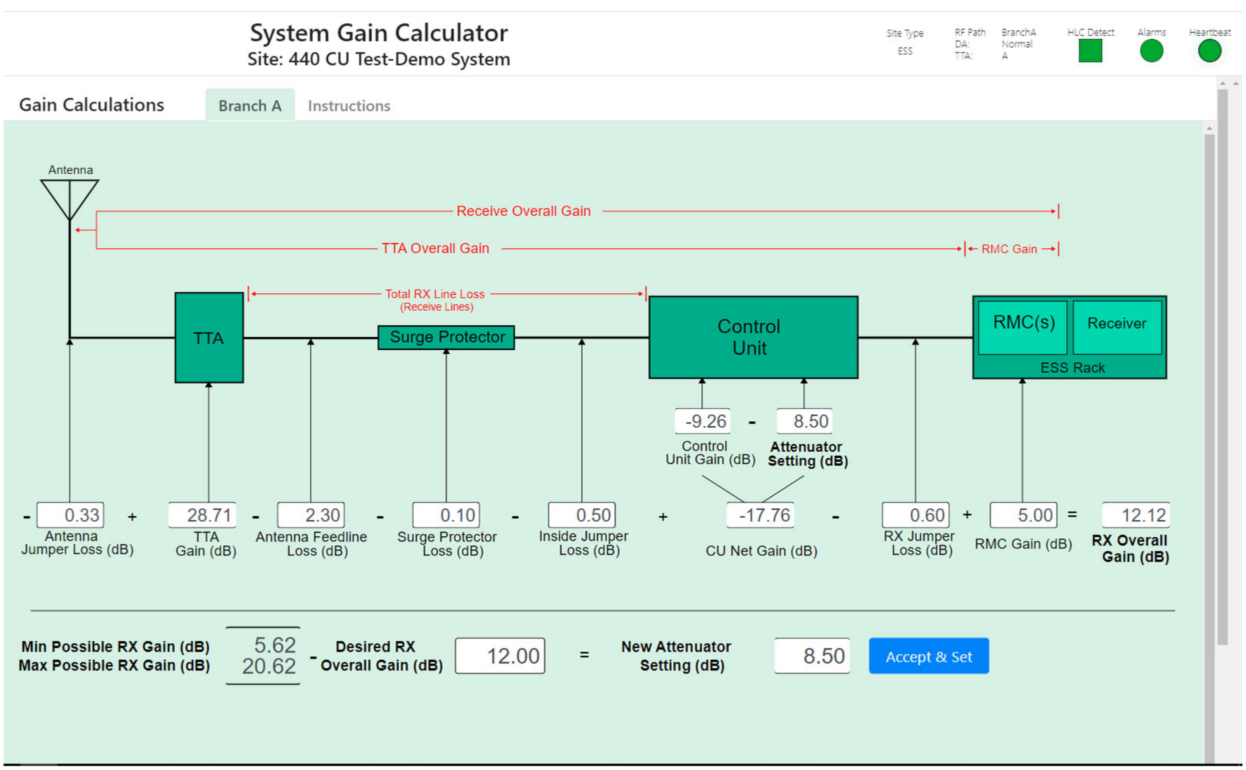


Figure 35: System Gain Calculation page for the CU style system.

it has stored in memory or data that it can calculate. The user can not enter values into these open sided boxes. Closed sided boxes are for gain/loss values that the user must supply. Placing your cursor in the box will cause it to outline in blue, type in the new value then place your cursor outside the box and the new value will be saved in memory. As soon as the value is saved the calculator totals will update automatically.

The cable losses (Antenna Jumper, Antenna Feedline, Inside Jumper, and RX Jumper) as well as the loss of the in-building surge protector should be measured by the system installer. The gain of the TTA, Control Unit, and Distribution Unit are fixed by design and are retrieved by the CPU from the Factory Test Record which is permanently stored in the systems memory at the time of manufacture. The Attenuator is user programmable and has a 15.0 dB dynamic range adjustable in 0.5 dB increments.

As the loss values for the cables and components are entered into their boxes the CPU will add them to the Receive Overall Gain value shown on the right side of the equals sign in the calculation. If all of the user provided values in the calculation are entered correctly the RX Overall Gain value shown in the equation will be the actual RX Overall Gain of the system. The RX Overall Gain then needs to be adjusted to equal the Desired RX Overall Gain as determined by the system designer. This is accomplished by changing the programmable attenuator. The adjustment of the programmable attenuator in order to set the system equal to the Desired RX Overall Gain is shown on the bottom portion of the page.

The gain/loss values in the calculation allowed the CPU to determine the Min Possible RX Gain and the Max Possible RX gain of the system. Because the CPU knows the minimum attenuator setting possible (0 dB) and the maximum attenuator setting possible (15 dB). The Desired RX Overall Gain needs to be entered into the box by the system installer. Once the users Desired RX Overall Gain is entered the CPU will determine the best attenuator setting which brings the system gain as close as possible to the desired value. An exact match is often not possible because the system can only adjust in 0.5 dB increments. So the calculator will always recommend an attenuator setting that brings the gain as close as possible to the desired value but never below the desired value.

Clicking the blue Accept and Set button brings up a confirmation window, selecting the green confirm button will adjust the attenuator to the recommended setting. It is important to make sure that all of the values shown in boxes on the page are correct before accepting the CPU's recommendation.

CU Calculation

Figure 35 shows the System Gain Calculation page for the CU style system. A distribution block diagram is presented (towards the top of the page) which shows all of the components and interconnecting cables at the installation site which are involved in the receive signal path between the antenna and the base radio. For the CU style system those components and cables include; Antenna Jumper Loss, TTA Gain, Antenna Feedline Loss, Surge Protector Loss, Inside Jumper Loss, CU Overall Gain, RX Jumper Loss, and RMC Gain (ESS cabinet). Note that the CU Overall Gain consists of Control Unit Gain and the Attenuator Setting.

Below the diagram are boxes that hold loss/gain values of the components and cables. Boxes that are open on their sides will have values entered automatically by the CPU from data it has stored in memory or data that it can calculate. The user can not enter values into these open sided boxes. Closed sided boxes are for gain/loss values that the user must supply. Placing your cursor in the box will cause it to outline in blue, type in the new value then place your cursor outside the box and the new value will be saved in memory. As soon as the value is saved the calculator totals will update automatically.

The cable losses (Antenna Jumper, Antenna Feedline, Inside Jumper, and RX Jumper) as well as the loss of the in-building surge protector should be measured by the system installer. The gain of the TTA and Control Unit are fixed by design and are retrieved by the CPU from the Factory Test Record which is permanently stored in the systems memory at the time of manufacture. RMC Gain inside the ESS cabinet should be adjusted by the system installer to 5.0 dB. The Attenuator is user programmable and has a 15.0 dB dynamic range adjustable in 0.5 dB increments.

As the loss values for the cables and components are entered into their boxes the CPU will add them to the Receive Overall Gain value shown on the right side of the equals sign in the calculation. If all of the user provided values in the calculation are entered correctly the RX Overall Gain value shown in the equation will be the actual RX Overall Gain of the system. The RX Overall Gain then needs to be adjusted to equal the Desired RX Overall Gain as determined by the system designer. This is accomplished by changing the programmable attenuator. The adjustment of the programmable attenuator in order to set the system equal to the Desired RX Overall Gain is shown on the bottom portion of the page.

The gain/loss values in the calculation allowed the CPU to determine the Min Possible RX Gain and the Max Possible RX gain of the system. Because the CPU knows the minimum attenuator setting possible (0 dB) and the maximum attenuator setting possible (15 dB). The Desired RX Overall Gain needs to be entered into the box by the system installer. Once the users Desired RX Overall Gain is entered the CPU will determine the best attenuator setting which brings the system gain as close as possible to the desired value. An exact match is often not possible because the system can only adjust in 0.5 dB increments. So the calculator will always recommend an attenuator setting that brings the gain as close as possible to the desired value but never below the desired value.

Clicking the blue Accept and Set button brings up a confirmation window, selecting the green confirm button will adjust the attenuator to the recommended setting. It is important to make sure that all of the values shown in boxes on the page are correct before accepting the CPU's recommendation.

SITE INFORMATION

The Site Information page is used to enter site specific information into the system and includes; Site name, contact, location, and the sites latitude and longitude. The site name is an important label and should be filled in by the user. It will appear on all screens shown on the web page interface and the front panel touch display. It is most helpful when users are logged in to the system from a remote location. In addition, it is used in all messages sent from the TTA system to users including; SNMP, SMTP, and SMS. In a multi-site territory it can be very confusing to receive such messages and not know exactly which site they are coming from.

Additional information that can be entered/stored on the site information page includes description and serial number. Site notes can also be entered and the box size for the notes can be expanded by selecting the drag symbol in the lower right corner of the box and dragging downward. Information displayed in the gray shaded boxes can not be changed by the user. Labels for each box on the page have a note in parenthesis below the label that provides necessary SNMP locating information for that particular box. This locating information is required when connecting the TTA system as a node in a managed alarm monitoring network.

To make changes to the information in the non-shaded boxes, place your cursor in the box and type in the changes. To save changes select the blue button at the bottom of the page labeled save site info. Verify the change by selecting the OK button on the resulting pop-up message. The data entered into the Site Information page is saved in nonvolatile memory and will be reloaded whenever the TTA system is power cycled.

TIME AND SNTP CONFIGURATION

This page allows the user to set the system clock. The clock can be set manually by the user or automatically from the Internet using the Simple Network Time Protocol (SNTP). The box labeled time control method is used to select between manual or automatic. Click on the drop down arrows to choose between real time clock (the manual method) and SNTP (the automatic method). It is important to set the system clock because it is used to file data in the event log. Also, the time is used on SNMP, SMTP, and SMS communications from the system to the user.

NOTE

The Real Time Clock is backed up by an internal battery with an expected 10 year lifespan so once it is set the time will remain correct even if the system experiences a power interruption.

To set the system clock manually press the calendar icon at the end of the box labeled "Real Time Clock Date" and a change tool will pop-up as shown in **Figure 36**. Set the time and date using the tool then select the green button with the check mark to load the new setting into the system.

The system needs to know the time zone of the site's location in order to compensate for Day Light Savings. Click on the arrow in the Time Zone box (towards the top of the web page) and chose the correct time zone setting from the available list.

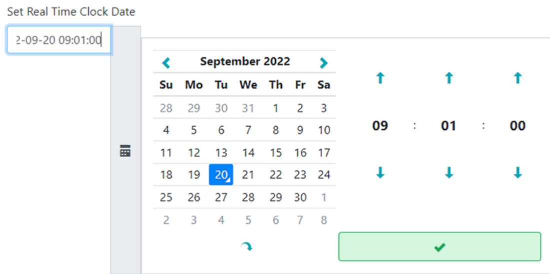


Figure 36: Date and Time change tool.

To set the system clock automatically from the Internet you must have an established Internet connection and provide the information necessary for the TTA system to locate a time server site on the Internet so that time information can be retrieved from it. Enter the IP address of your preferred SNTP server into the box that is provided. A good reliable server is (ntp.ubuntu.com). Enter a fall back server IP address which will be used by the system in case your preferred server can not be reached. Set values for Max Root distance and the Max/Min Poll Intervals.

The Max Root Distance is the maximum acceptable root distance, where the root distance is the maximum time error from all sources. A source is considered selectable only if its root distance is less than this maximum. This box requires you input a time interval (in seconds). As an example, 5 seconds is a reasonable value, meaning that the maximum default allowable error is 5 seconds.

The Max/Min Poll Interval is the minimum and maximum poll intervals for NTP messages. Together, these define a range of possible poll intervals, from which the time control system selects an optimal interval between time update requests to the time servers. Each setting requires that you input a time interval (in seconds). The minimum poll interval must not be smaller than 16 seconds. The maximum poll interval must be larger than the minimum poll interval. As an example, a reasonable minimum poll interval is 32 seconds, and a reasonable maximum poll interval is 2048 seconds.

Press the blue Submit Change Button at the bottom of the screen to set the system clock using the time server information you provided.

CAUTION: The front panel touch display is a scaled down user interface and as such does not have SNTP configuration available. When the system clock is set from the touch display it will be a manual type setting which will override an existing SNTP configuration. The system will switch from SNTP if its configured that way over to a real time clock setting format.

USER ADMINISTRATION

The User Administration page is used to enroll users into the system, administer passwords, and define login and message sending parameters for each individual registered user. The User Administration page is only accessible by Administrator level users who are expected to manage access to the system for all other users.

When you first log into the system, as discussed earlier in this manual in the section titled “Web Page Interface” by using the factory default user name (admin) and factory default password (tx1-2rx), you will enter as the first Administrator. This will allow you to setup other users and most importantly modify the default password of the first administrator. The first administrator password (tx1-2rx) was factory loaded into the system as a means to initially get you in so that you could setup the security of the system. If you do not change the first administrators default password it creates a considerable security risk.

Registered users are listed on the screen in a row format, one row for each individual registered user as shown in **Figure 37**. The first column on the left side of each row is an enable/disable icon. When the icon is green the user is enabled, if the icon is gray the user is disabled but still registered and that users row will also be highlighted in gray. To completely remove a user from the system use the red delete button at the bottom right side of the row.

Note that the first Administrator and first Observer can not be deleted or disabled. They are required for proper system operation. The first administrator account should be taken over by the TTA system supervisor when the system is installed. These two first accounts can have their password reset to the factory default “tx1-2rx” from the front panel only,

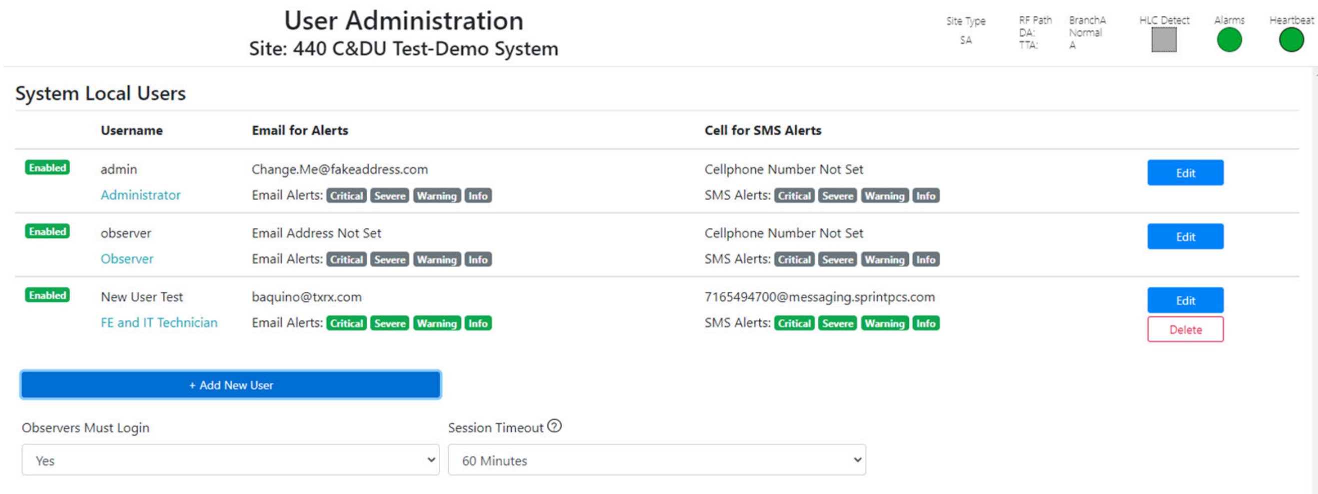


Figure 37: User Administration page.

as discussed earlier in this manual in the section titled "Network Settings".

NOTE

The first administrator account in conjunction with the front panel password reset button provide a method of regaining access into the system in the event you forget the administrator password. But using this method will require physical access to the front panel of the control unit.

The next column lists the name of the user and underneath that the security access level that user has been granted. The access level are described below.

Administrators can see/change anything on the system.

Observers can see device performance pages but can not make any changes.

Field Engineer can see and change only those items specifically related to RF operation or system setup. But not including network connectivity items.

IT Technician can see and change only those items specifically related to network connectivity and system configuration, but can not change anything RF-related.

FE and IT Technician is an access level for situations where the field engineer is also responsible for setting up and maintaining network connectivity at the site. This access level can see/change anything on the system except the User Administration web page.

The third column shows user information for email messaging. This includes the email address of the user and below that are icons showing which message types they can receive from the TTA system. There are four levels of alerts used in the system including critical, severe, warning, and info.

Critical events represent a high certainty that radio coverage is lost. Severe represent events where the system can no longer tell if radio coverage is present so immediate interaction with the system by the engineering staff will be required. Warning events occur when a measured parameter such as current or voltage has drifted outside its normal range. Info represents that something has happened such as the performance of a system housekeeping task. All types of message levels are recorded permanently in the systems event log.

If the message type icon is green it means those types of messages will be sent and if it is gray those types of messages will not be sent. This allows messaging from the TTA system to be customized for different users. For instance, supervisors probably do not need to see warning and info level messages but field engineers responsible for maintaining the system would need to see them.

Likewise, the fourth column is setup similar to the third column but manages SMS (text) messages. The cell phone number for the user is listed and underneath that are the associated message type icons for sending texts.

Changes to the users registration row can be made by pressing the blue edit button at the end of the row. A detailed information panel will appear containing the complete profile of the user. To change the data in one of the boxes place your cursor in the box and type in the changes. The slide buttons at the bottom of the detailed information panel can be selected or deselected by placing your cursor on the symbol and selecting. When they are blue it means that feature is selected and will be performed by the system as required. When you are done setting up the user press the blue save button at the bottom of the panel.

New users can be added to the system by pressing the large blue ADD NEW USER button found at the bottom of the registered user rows. A detailed information panel will appear for the new user with all of the data fields blank. After filling in all the data fields and positioning the slide buttons as desired press the blue save button at the bottom of the panel to create the new user.

The two boxes at the very bottom of the User Administration page are used to define system behavior when dealing with a logging-in user. The first box determines if Observer level users must log-in or not. If the associated box has a yes in it then anyone connecting to the TTA system will have to enter their password to proceed to any page. If the box has a no in it then anyone connecting to the IP address of the TTA system can proceed as an observer by selecting the green access button at the bottom of the login box. To select yes or no use the arrow on the right side of the box to make your choice. The Session Timeout box determines the amount of time an idle user can remain logged on to the system. It takes care of the problem of someone logging on to the system but forgetting to log off. Use the arrow button on the right side of the box to show a drop down table listing the available choices.

Alarm setup

The Alarm Setup group of menu items is used to configure the functionality of HLC and Auxiliary Inputs as well as setup connectivity fields for alarm messaging (both SMTP and SMS).

HLC AND AUXILIARY INPUTS

There are 5 auxiliary input ports on the rear panel of the control unit as shown in figure 12. The inputs are labeled IN1 through IN5. These ports allow the system installer to connect alarm outputs from third party customer equipment located in the shelter into the TTA system. This will allow the TTA systems extensive reporting features (Form-C, SNMP, SMTP, and SMS) to be used by the third party equipment for alarm notifications.

To trigger an auxiliary alarm, connect an input pin to its associated ground pin on the rear of the con-

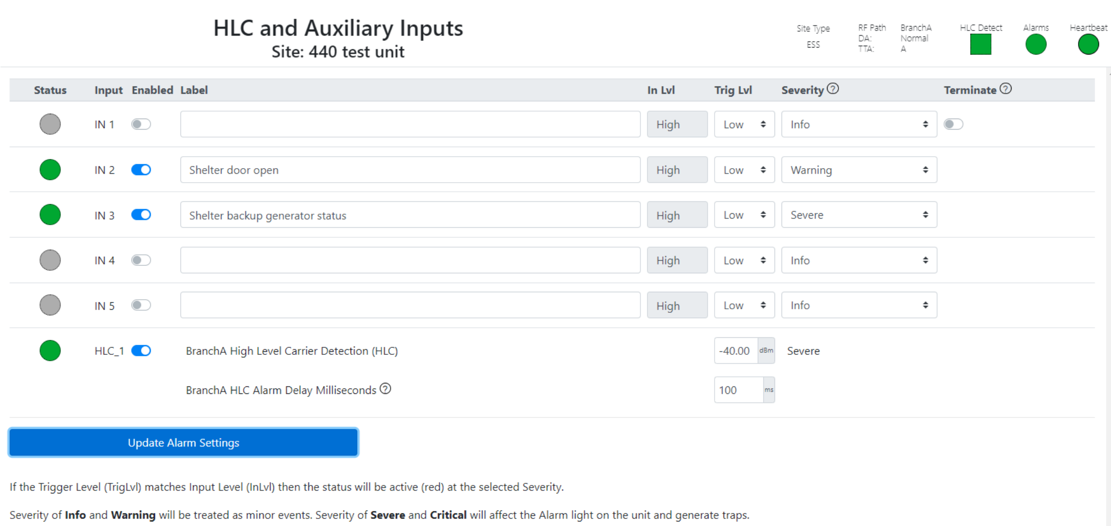


Figure 38: HLC and Auxiliary Inputs page.

trol unit. This contact closure would be performed by the alarm output of the third party equipment. Likewise, an open collector NPN scheme could be used, whereas the open collector of the transistor would be connected to the input pin and the emitter would be collected to the ground pin. The base pin of the transistor would be connected to the alarm output of the third party equipment.

CAUTION: Under no circumstances should a voltage level be applied directly to the auxiliary input pins on the control unit. This could damage the control unit.

The HLC and Auxiliary Input page is shown in **Figure 38**. In order to use one of the auxiliary inputs the associated Enabled/Disabled slide button must be set to the Enabled position. To change the setting on the slide button place your cursor over the button and click select. When the slide button is blue it is enabled and when the button is white it is disabled.

Once an input is enabled for use its trigger level must then be selected from the column labeled Trig Lvl. Choices are either Low or High and can be selected for each individual input pin by pressing the arrow symbol in the associated box then choosing from the drop down list that will be displayed. When logic low is selected an alarm condition will occur whenever the input pin makes contact with its associated ground terminal. When logic high is selected an alarm condition will occur whenever the input pin does not make contact with its associated ground terminal. So low represents a closed contact and high represents an open contact.

Auxiliary Input 1 (and only Input 1) has a special terminate feature. When the Terminate slide button is selected Pin 1 will act as a trigger input that initiates the terminate test for the preferred amplifier in the TTA. When the terminate function is enabled then Input 1 will not function as an auxiliary input. The Terminate test will start when input 1 is triggered. The test will run for the default test duration (5 minutes) then the system will automatically return to normal operation. If you want to end the test earlier use the cancel button on the countdown timer located on the Operation Overview web page. In order to initiate another test input 1 will need to return to not triggered in order to reset the test function. This prevents the system from being stuck in the test mode if input 1 is left triggered on by accident. Both the front panel mode indicator LED and the web page heartbeat icon will turn yellow while the terminate test is running.

NOTE

TX RX Systems recommends the use of dry contacts for triggering auxiliary pins. The pins on the rear of the unit are not rated to switch voltage. They are simply looking for a continuity or no continuity situation for triggering purposes.

When an input pin is disabled the status icon (circle on the left side of screen) that is associated with the pin will appear dark on the screen. If the pin is enabled the status icon will turn green for no alarm detected and red whenever an alarm is detected. The Label boxes will accept an alpha numeric entry and are provided to help the user keep track of what each auxiliary input represents at that particular site location. The label will be included with SNMP, SMTP, and SMS notifications sent to the users.

The In Lvl column indicates what the CPU is seeing at the individual auxiliary inputs right now. This column will update in real time as the input status changes. When the In Lvl and the Trig Lvl are in agreement the TTA System will generate an event. As mentioned in the earlier discussion about the User Administration web page, events have four levels of severity including critical, severe, warning, and info. The Severity column allows the user to assign an appropriate level to each individual auxiliary input pin. To make an assignment press the arrow symbol in the associated severity box then choose from the drop down list that will be displayed.

Below the five Auxiliary Inputs there is a row for HLC (High Level Carrier). The slide button is used to enable or disable HLC alarming. When the slide button is blue alarming is enabled and when it is white alarming is disabled. The actual HLC measurement is made at the TTA Systems RF output/s port/s at the rear of the control unit and is a composite power measurement of the systems passband. The severity level for an HLC detection is fixed at severe.

When changes are made to the HLC and Auxiliary Input web page the blue button at the bottom of the

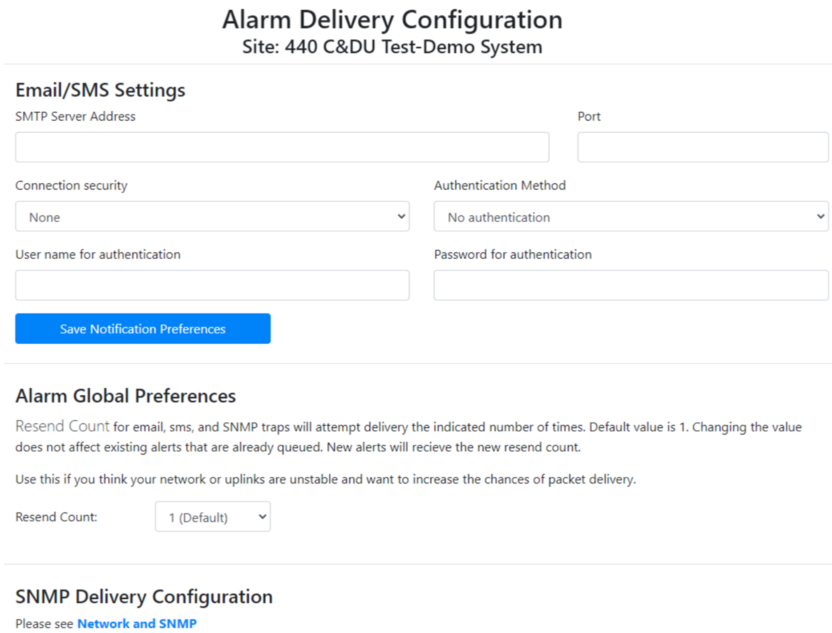


Figure 39: Alarm Delivery Configuration page.

page labeled Update Alarm Setting must be selected in order to initiate and save the changes. None of your changes will take effect if the update button is not selected.

ALARM DELIVERY CONFIGURATION

The Alarm Delivery Configuration page is used to set preferences for SMTP (email) and SMS (text) communications. Refer to **Figure 39**. The same preferences are used for both SMTP as well as SMS.

In order to send SMTP and SMS messages the TTA system needs to know the IP address of the server responsible for distributing the message (SMTP Server Address), the port that the server will be expecting traffic from the TTA system to arrive at (Port), the connection security level you wish to use (Connection Security), the method for authentication (Authentication Method), also the user name for authentication as well as the password for authentication.

The server IP address and listening port need to be typed into the associated boxes on the page. Security level for both Connection Security and Authentication Method are chosen using the drop down menus which are listed when you select the arrow symbol in their box. For Connection Security the choices available are None, STARTTLS, and SMTPS. For Authentication Method the choices available include No Authentication, Normal Password, and Encrypted Password. In addition, the User Name for Authentication and the Password for Authentication will need to be typed into the associated boxes.

Once the TTA system knows the preferences for sending messages it will need to know which messages to send to each registered TTA system user. This is decided on the User Administration web page which was discussed in detail in an earlier section of this manual.

When changes are made to the Alarm Delivery Configuration web page the blue button at the bottom of the page labeled Save Notification Preferences must be selected in order to initiate and save the changes. None of your changes will take effect if the save button is not selected.

On the bottom of the web page is an area called Alarm Global Preferences which allows the user to set the number of times each SMTP and SMS message is sent. Use this if you think your network or up-links are unstable and you want to increase the chances of packet delivery. The default amount is 1 time but can be increased up to a maximum of 5 times. The value can be selected using the arrow symbol in the box which provides a drop down list to chose from.

Tools

The Tools group of menu items provides the user with an RSSI calculation page, a way to reboot devices connected to the system as well as upload new software versions. In addition, it gives the user a way to review factory test information for both the TTA and Control Unit.

RSSI CALCULATION

The RSSI Calculation page assists the user in determining the correct generator level required to meet a relative signal strength indication (RSSI) typically of -90 dBm. An RSSI measurement is made by injecting a test signal into the front panel test port on the control unit and measuring the test signal level at the input of the base radio receiver (in the case of a C&DU style system) or the input of the ESS cabinet (in the case of the CU style system). The calculations are identical for both the CU style and C&DU style control units.

An RSSI measurement can be made once the TTA system is installed and operational. Attenuation adjustments and spectrum analysis must be performed properly before an RSSI measurement is made. The RSSI measurement is accomplished by injecting a test signal of known amplitude into the front panel test port connector. This test signal travels up the tower along the test path through the test feedline into the test port of the TTA. It is coupled into the main signal path at the input to the LNA inside of the TTA and travels back down from the TTA through the antenna feedline to the input of the base radio (C&DU style system) or ESS cabinet (CU style system). Prior to making an RRSI measurement you should terminate the preferred amplifier to eliminate site noise from the measurement. Refer to the subsection titled “Terminate A/B” earlier in this manual for details regarding the terminate function.

Figure 40 shows the RSSI Calculation page for the C&DU system and **Figure 41** shows the RSSI Calculation page for the CU system. A system distribution block diagram is presented on the page which shows all of the components and interconnecting cables at the installation site which are involved in calculating RSSI. The top portion of the distribution diagram shows the signal path from the Main port of the TTA down to the receiver (left to right on the diagram). The bottom portion of the distribution diagram shows the signal path from the signal generator connected to the front panel of the control unit up to the Test port of the TTA (right to left on the diagram).

Below and above the diagram are boxes that hold loss/gain values of the components and cables. Boxes that are open on their sides will have values entered automatically by the CPU from data it has stored in memory or data that it can calculate. The user can not enter values into these open sided boxes. Closed sided boxes are for gain/loss values that the user must supply. Place your cursor in the box and type in the new value. When all of the values required are entered the expected signal generator level will be displayed at the bottom right hand area of the screen in a box labeled Required Generator Level.

NOTE

Values in the main signal path (down from the tower) are the same in both the System Gain Calculation discussed earlier and the RSSI Calculation. In regards to the main signal path values, the two calculation screens are interactive. Such that changing one of these component values in one calculator will instantly change in the other calculator. This feature is provided as a user convenience.

DEVICE MANAGEMENT

The Device Management screen provides the user with a way to restart or reboot the software running on the major components in the system including the Control Unit and TTA. The Distribution Amplifier which is an important subassembly within the control unit and has it own microprocessor but can only be rebooted by power cycling the control unit. Each device in the system is shown on the screen in a vertical row with a label to identify the device including control unit (CU), Tower Top Amplifier (TTA), and Distribution Amplifier (DA).

To restart or reboot the software press the associated button for that device. The procedure will take place immediately and any messaging information that needs to be passed back to you will appear at the bottom of the web page in the area labeled System Response. The control unit has two buttons. The first is a restart procedure that will restart the main TTA System software (called CPROC)

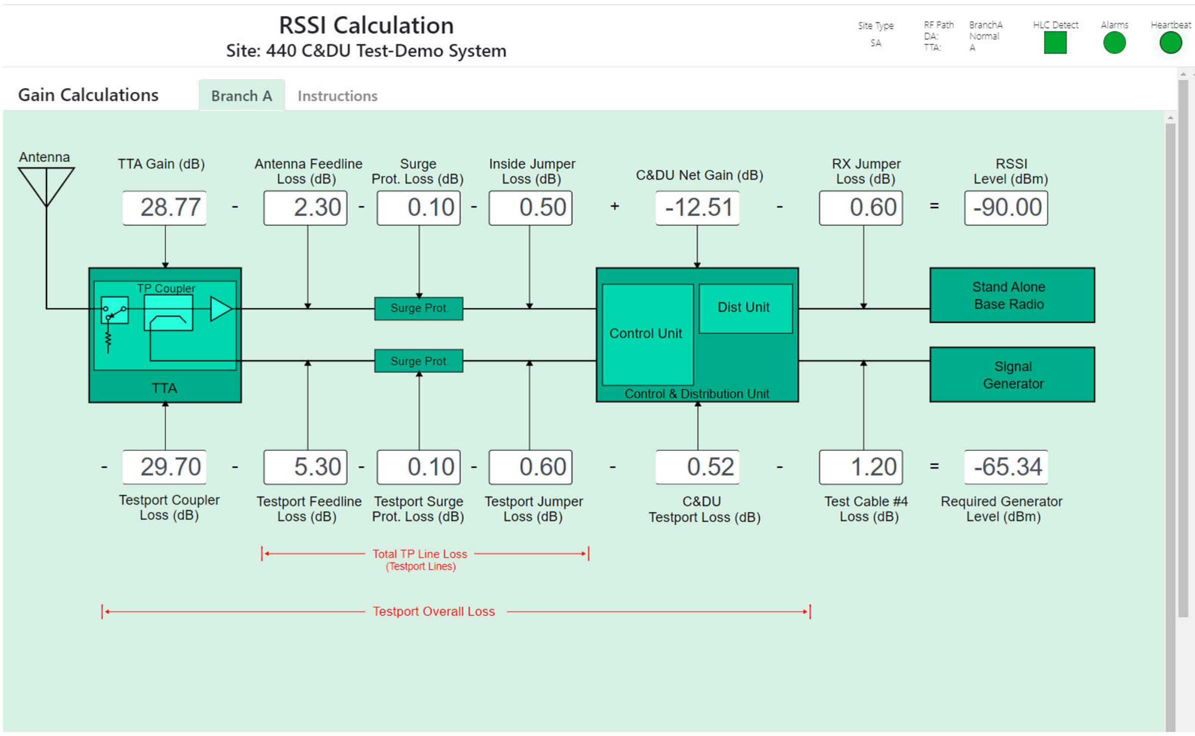


Figure 40: RSSI Calculation page for the C&DU style system.

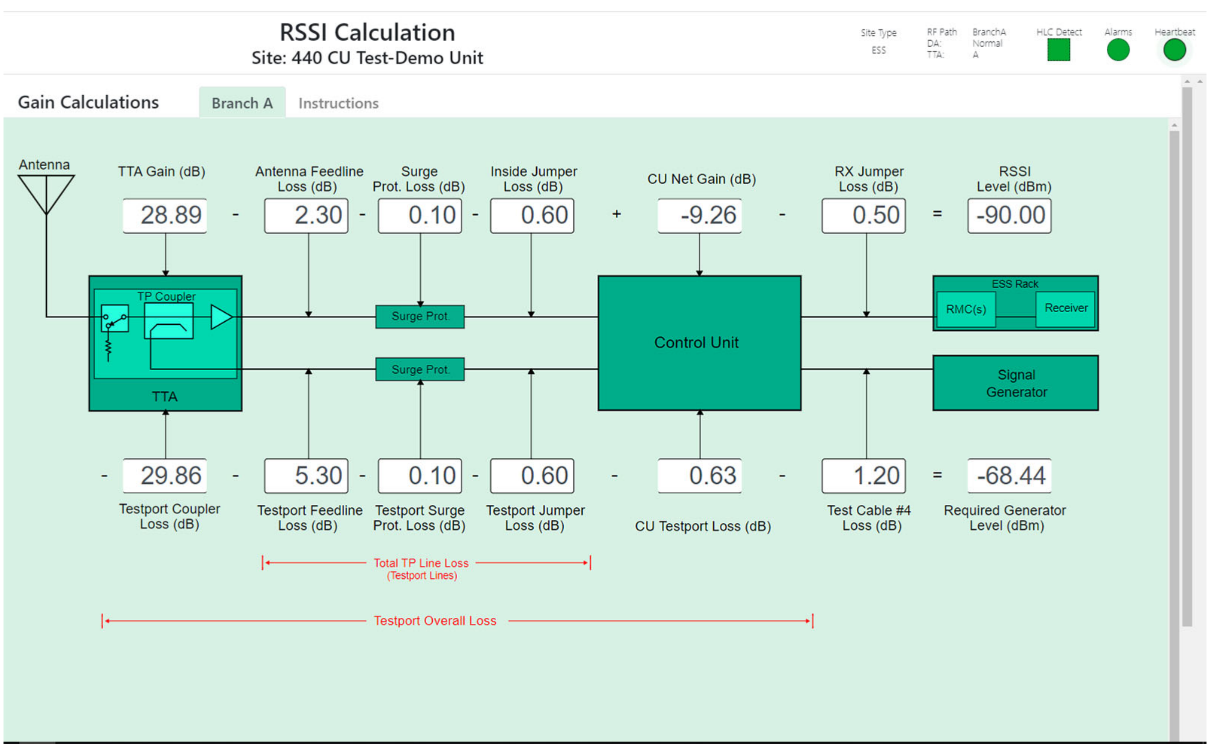


Figure 41: RSSI Calculation page for the CU style system.

that is running on the CPU card in the control unit. The second button is a reboot function that reboots the CPU card itself at the Linux operating system level. Neither of these buttons when selected will interrupt radio coverage. However, the CU reboot button does temporarily interrupt user notifications and logging functions. Note that rebooting the TTA unit will interrupt radio coverage briefly during the TTA reboot process. As such, this button is colored red as a warning.

Support Assistance is a group of additional device management functions that require assistance from factory personnel. The functions include updating CPU software, updating amplifier firmware, resetting files to factory default values, deleting logs, and establishing remote maintenance links with factory personnel. In each case these functions can have a significant impact on the operation of the TTA system and as such should not be performed with guidance from the factory. If the need arises for you to use one of these functions then factory personnel will provide you with the password and walk you through the processes.

FACTORY TEST RECORD

The Factory Test Record page calls up the actual test values that were measured in the factory on the date of manufacture. The factory test record for both the TTA and the Control Unit are presented. Each record is stored permanently in that units memory and can not be modified once the unit ships from the factory. Therefore the Factory Test Record screen is read only and there are no user interactions associated with this screen other than viewing.

On the Factory Test Record screen each measured specification is listed on the left side of the screen. Across from the specification are the actual factory measured values as taken just before shipment. The factory measured values are retrieved by the systems CPU and used by various calculations such as Setting System Gain and measuring RSSI.

Network

The Network and SNMP group of menu items allow the system to be setup for network connectivity and SNMP functionality. The settings in this group of menu items should be made by a knowledgeable IT technician to ensure proper network interfacing of the TTA system.

TCP/IP CONFIGURATION

The TCP/IP Configuration page is used to enter the network configuration settings of the LAN port on the rear panel of the TTA system. The TTA systems rear LAN port can operate as either DCHP or manual. To switch between manual and DCHP place your cursor on the arrow on the topmost entry box and click select. A drop down menu will appear with the available choices.Place your cursor over the desired choice and click select to make that choice active.

When manual settings is active the user is responsible for entering the network parameter values for IP address, Netmask, Gateway, and DNS Servers. Values can be entered by clicking in the associated box and typing. When all of the entry boxes on the screen are setup correctly select the yellow button at the bottom of the screen to submit the changes and restart the network. The current IP address of the rear LAN port on the TTA System is listed on each web page just underneath the TX RX Systems company logo on the left-side of the web page. In addition, the rear panel LAN port address can also be viewed on the touch display in the network settings screen.

The IP address of the rear LAN port of the TTA system will need to be changed by the user at the time the system is installed to an address suitable for the users network. However, the user should consult with their IT department for recommendations on selecting a new IP address before making any changes especially if they plan on using DCHP.

The Dynamic Host Control Protocol (DCHP) is a standardized networking protocol used on IP networks for dynamically distributing network configuration parameters, such as IP addresses for interfaces and services. With DCHP selected, computers request IP addresses and networking parameters automatically from a DCHP server reducing the need for a network administrator or a user to configure these settings manually. Note the user should consult with their IT Department before determining that DCHP is going to be used at the site.

SNMPV3 USERS

Simple Network Management Protocol (SNMP) is an Internet-standard protocol for managing devices on IP networks. The SNMP features of the TTA System are designed to provide reliable Internet

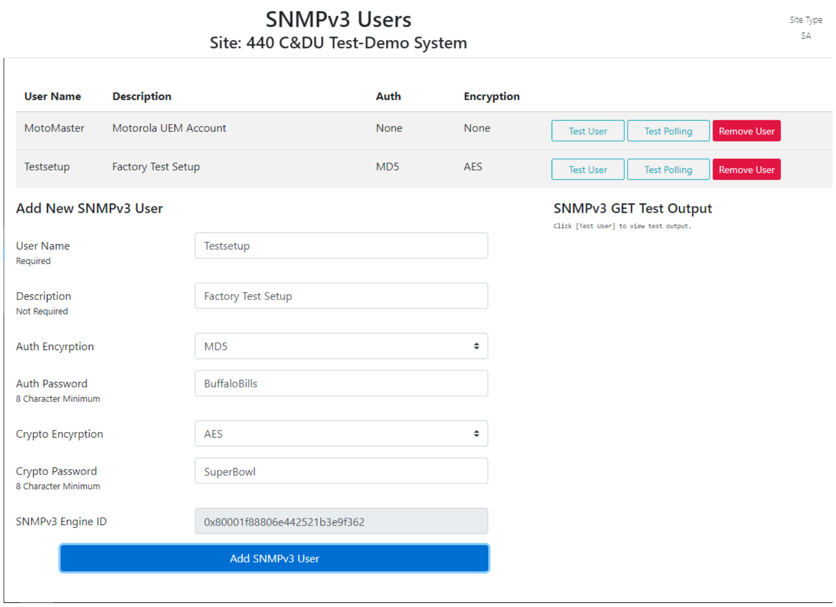


Figure 42: SNMPv3 Users page.

notification of an alarm occurrence or a change in operational status as well as allows configuration of the TTA System by a network monitoring system.

The TTA system supports the older V1 SNMP standard and the newest V3 SNMP standard. V1 is the simplest and most basic of the versions and is provided for legacy support only. A major weakness of v1 is security. V3 adds a security feature and it should be used whenever possible and especially if you plan to transmit information across unsecured links.

The SNMPv3 Users web page is used to setup formatting for traps that are sent from the TTA system to the network. Multiple users can be setup and each user can have a different format if desired. Users are listed at the top of the web page horizontally in a table format with a gray background. The first user listed is a factory setup for the Motorola UEM account. To setup a new user you will need to fill in the 6 white boxes below the table then select the blue button labeled Add SNMPv3 User. The new user will then be added to the bottom of the table.

Items that need to be setup include User Name, Description, Authentication Encryption/Password, Crypto Encryption/Password. Authentication Encryption is used to verify that the person receiving the trap is the person the trap is intended for. Authentication Encryption choices are MD5, SHA, or No Authorization, with SHA being the strongest type. Crypto Encryption is used to protect the contents of the trap from unauthorized receivers. Crypto Encryption choices are AES, DES, or No Priv, (meaning no cryptography is being used), with AES being the strongest type.

The Agent ID is a value that uniquely identifies the TTA system and does not need to be entered because it is a fixed factory loaded value. For traps that use authentication and/or crypto the network monitoring system needs to be configured to receive traps from the specified agent ID. Refer to **Figure 42** which shows the SNMPv3 Users web page.

NOTE

When the network monitoring system is interfaced with the TTA system it will have the ability to view and change site information stored in the TTA system. Refer to the Site Information web page discussed earlier in this manual.

Two test buttons are available for each user including Test User and Test Polling. If you select the Test User button the TTA system will send a test trap to itself in order to verify that the user is setup as specified. When you select the Test Polling but-

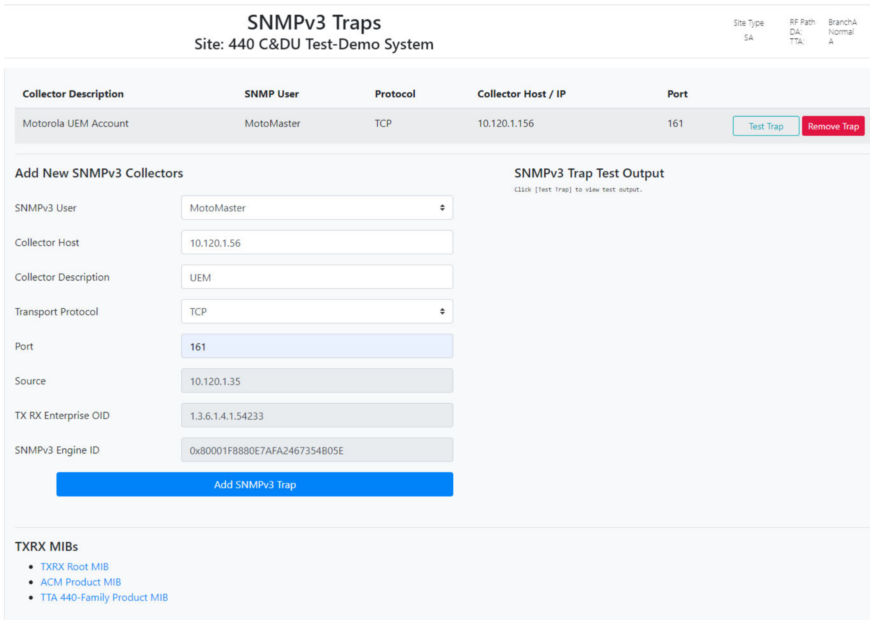


Figure 43: SNMPv3 Traps page.

ton the TTA system will test itself to make sure that a network monitoring program will be able to poll the TTA system and retrieve status information.The results of the tests are displayed in the white area of the web page under the label SNMPv3 GET Test Output. To delete a user from the system select the associated red Remove User button.

SNMPV3 TRAPS

The SNMPv3 Traps web page is used to setup and keep track of external computers (network management systems) that the TTA System is authorized to send trap messages too. The authorized external computers are called collectors and are listed at the top of the web page horizontally in a table format with a gray background. Multiple collectors can be setup if desired. To setup a new collector you will need to fill in the required fields in the boxes below the table then select the blue button labeled Add SNMPv3 Trap. The new collector will then be added to the bottom of the table.

Items that need to be setup include SNMPv3 User, Collector Host, Collector Description, Transport Protocol, and Port. The SNMPv3 User box has an arrow on the right side of the box which will present a drop down list of all of the Users from the SNMPv3 Users web page discussed earlier. Click on the desired User from the list and that User will be entered into the box. The formatting for that User will be used when traps are sent to this particular collector. Collector Host needs to be the IP address of the collector. Collector Description should be a convenient label that identifies the collector so you can keep track of where the traps are being sent. Transport Protocol box has an arrow on the right side of the box which will present a drop down list of the available protocol choices, either TCP or UDP. TCP provides a way to deliver (and receive) an ordered and error-checked stream of information packets over the network. UDP is to deliver a faster stream of information by doing away with error-checking. The last box that needs to be filled is the Port assignment.

Three boxes with a gray background are also presented and list the Source (IP address of the TTA System), TXRX Enterprise OID (a unique number representing the TXRX Corporation), and the SNMPv3 Engine ID (used for identification). These boxes do not need to be filled in because they are fixed factory loaded values. Refer to **Figure 43** which shows the SNMPv3 Traps web page.

The Network Management System will use SNMP manager software to provide a GUI style interface so that the traps sent from the TTA System can be received and displayed for viewing. The SNMP manager software chosen and used by the customer is up to the customers discretion. SNMP manager software packages will need to be properly configured in order to successfully receive messages from the TTA system. Ask your IT specialist for assistance setting up your SNMP Manager software on your destination computer (Collector).

At the bottom of the SNMPv3 Traps web page are links to TXRX MIB files which can be downloaded for use in your chosen SNMP Manager software package. The MIB files allow the SNMP manager software to sort out the trap messages into an understandable message format.

A Test Trap button is available for each collector. If you select the test button the TTA system will send a test trap to the Network Management System to verify that the new collector is setup correctly. The results of the test are displayed in the white area of the web page under the label SNMPv3 Trap Test Output. To delete a new collector from the list click select the associated red Remove Trap button.

SNMPV1 TRAPS

A major weakness of version 1 is security. Community strings – the equivalent of passwords – are transmitted in clear text and there is no support for authentication. This creates risk that your community strings could become compromised. SNMP Version 1 is provided as legacy support only. Please consider converting to SNMP Version 3.

The SNMPv1 Traps web page is used to setup and keep track of external computers (network management systems) that the TTA System is authorized to send trap messages too. The authorized external computers are called collectors and are listed at the top of the web page horizontally in a table format with a gray background. Multiple collectors can be setup if desired. To setup a new collector you will need to fill in the required fields in the boxes below the table then select the blue button labeled Add SNMPv1 Trap. The new collector will then be added to the bottom of the table.

Items that need to be setup include Collector Host, Community Name, Collector Description, Transport Protocol, and Port. Collector Host needs to be the IP address of the collector. Community Name provides primitive security by allowing or denying access to the information. In SNMPv1 all data transmissions (including the Community Name) are sent "in-the-clear", that is, unencrypted. Collector Description should be a convenient label that identifies the collector so you can keep track of where the traps are being sent. Transport Protocol box has an arrow on the right side of the box which will present a drop down list of the available protocol choices, either TCP or UDP. TCP provides a way to deliver (and receive) an ordered and error-checked stream of information packets over the network. UDP is to deliver a faster stream of information by doing away with error-checking. The last box that needs to be filled is the Port assignment.

Two boxes with a gray background are also presented and list the Source (IP address of the TTA System), and TXRX Enterprise OID (a unique number representing the TXRX Corporation). These boxes do not need to be filled in because they are fixed factory loaded values.

A Test Trap button is available for each new collector. If you select the test button the TTA system will send a test trap to the Network Management System to verify that the new collector is setup correctly. The results of the test are displayed in the white area of the web page under the label SNMPv1 Trap Test Output. To delete a new collector from the list click select the associated red Remove Trap button.

SNMP TEST CONSOLE

The SNMP test console will assist you in verifying that communications are properly configured. The test console provides a means of triggering alerts and sending out SNMP packets. You can verify delivery with packet sniffers and other tools.

To initiate one of the tests select the arrow in the box that says “Select a test to proceed” and a drop down list will be presented. Select the test of interest and the instructions for performing that test will be presented. The results from each test will be listed in the lower right-side of the web page. There are a total of seven tests to choose from that are divided into three groups including;

SNMPv3 GET - tests retrieving a selected OID from the TTA System.

SNMPv3 SET - tests setting the value of an OID in the TTA system.

SNMPv3 TRAP - tests sending a packet to a collector you have configured in the system.

SNMPv3 GET TABLE - tests retrieving the system status table from the TTA System.

SNMPv1 TRAP - tests sending a packet to a collector you have configured in the system.

Alarms Transient - Tests sending an alert payload as if the system was distressed. The trap sent has simulated test data.

Alarms Assert - Tests setting system state fully on a system object. This is an end to end test of the reporting system.

Logs and Analytics

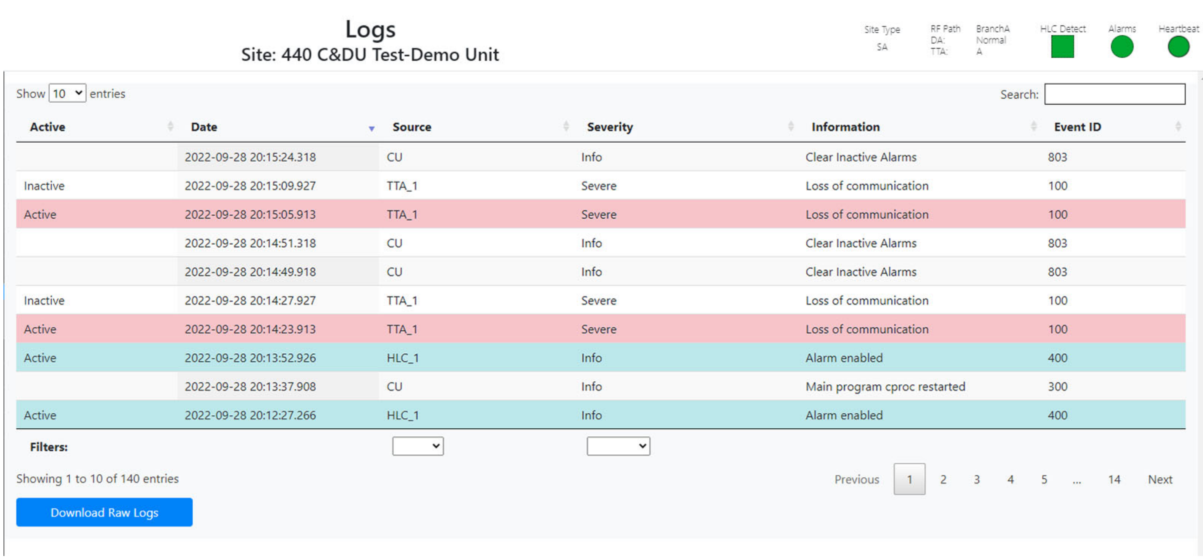
The Logs and Analytics group of menu items are used to view the TTA systems event log and download performance data for analytic analysis.

LOGS

The CPU keeps an historical log of all events that occur in the TTA system. The log can be viewed by selecting the Logs submenu. An example of a log being displayed is shown in **Figure 44**. In the upper left corner of the page is a box labeled Show # of Entries. Select the arrow in the box to show a drop down list of the number of entries that can be displayed at one time. The total number of entries currently in the log is listed at the bottom left of the web page just above the blue button. In addition, in the lower right hand corner of the page is a counter the breaks the entire log into blocks for viewing. The size of each block in determined by the value chosen in the show # of entries box. To view any block click on the block number and that block of entries will be displayed for viewing.

Each event in the log is presented in horizontal rows across the page with one row for each separate event. An event with a red background indicates an alarm response occurred for that event (SNMP, SMTP, SMS, and Form-C contacts were initiated). A white background means the event is inactive and blue represents a function has been enabled. Specific information for the event is listed in the following columns; Active, Date, Source, Severity, Information, and Event ID. To the right of each column title is an arrow which allows you to sort the displayed events by type or by ascending or descending order. This allows the event log to be displayed in numerous fashions as per the needs of the viewer.

The Active column lists the current status of the event and can be either active, inactive, or blank depending on importance of the event. The Date column is a time stamp of when the event occurred. Source lists which major subassembly or function within the TTA system was responsible for posting the event and can include CU, DA_1, TTA_1, HLC_1, or Aux. The column labeled Severity lists the severity level of the event which can be either Info, Warning, Severe, or Critical. Information provides a brief human readable description of the event. And Event ID is a code number used by



Logs
Site: 440 C&DU Test-Demo Unit

Site Type SA | RF Path DA: TTA: | BranchA Normal A | HLC Detect | Alarms | Heartbeat

Show 10 entries | Search:

Active	Date	Source	Severity	Information	Event ID
	2022-09-28 20:15:24.318	CU	Info	Clear Inactive Alarms	803
Inactive	2022-09-28 20:15:09.927	TTA_1	Severe	Loss of communication	100
Active	2022-09-28 20:15:05.913	TTA_1	Severe	Loss of communication	100
	2022-09-28 20:14:51.318	CU	Info	Clear Inactive Alarms	803
	2022-09-28 20:14:49.918	CU	Info	Clear Inactive Alarms	803
Inactive	2022-09-28 20:14:27.927	TTA_1	Severe	Loss of communication	100
Active	2022-09-28 20:14:23.913	TTA_1	Severe	Loss of communication	100
Active	2022-09-28 20:13:52.926	HLC_1	Info	Alarm enabled	400
	2022-09-28 20:13:37.908	CU	Info	Main program cproc restarted	300
Active	2022-09-28 20:12:27.266	HLC_1	Info	Alarm enabled	400

Filters:

Showing 1 to 10 of 140 entries | Previous 1 2 3 4 5 ... 14 Next

Download Raw Logs

Figure 44: Event Log page.

the CPU and system software to keep track of and sort individual events within the system.

In addition to sorting using the arrows associated with each row title there are two sort filters available. One each for the Source and Severity columns. The filters are located at the bottom of the columns and each has a box with an arrow. Select the arrow and a drop down list will appear with the sort choices. Select one of the choices from the drop down list to resort the table in accordance with your selection. Lastly, there is a search box in the upper right corner of the page which allows you to search the event log for a specific term. Enter a term into the search box and the table will be reformatted showing all entries containing the term.

The blue Download Raw Logs button at the bottom of the web page is used to download the entire event log as a comma delimited text file into the users computer. The notepad file can be saved or loaded into an XL spreadsheet for further analysis.

PERFORMANCE
The Performance page allows the user to download logged performance information from the CPU memory. Performance measurements from the TTA system are stored in a log format by the CPU on a continuous basis. The performance data download consists of a text document containing comma delimited measured values.

The Performance web page has a separate download button for each log file that is available including event log, equipment readings, and HLC readings. To download one of the available files click on the appropriate blue button and the file will then download automatically as a comma delimited text file into the users computer. Events are recorded as they occur. Equipment readings are recorded every 30 seconds. HLC data is recorded each second. One month of data is stored internally and one week of data is available for download from this interface.

The Download Raw Event Logs button is used to download the entire event log as a comma delimited text file into the users computer. The Download Historical Equipment Reading button will download the entire HLC measurements into a comma delimited text file on the users computer. And the Download Historical HLC Readings will download the HLC value only along with a 10 digit UNIX time stamp into a comma delimited text file on the users computer. The files can be saved or loaded into an XL spreadsheet for further analysis.

System Logs and Performance Logs can be deleted to increase disk space by using the yellow buttons at the bottom of the web page.

HISTORICAL HLC
This feature will plot the HLC data for a user selected day in a graphical format for review and analysis. Creating the graph for the selected day is a four step process that you need to follow in a step-by-step fashion.

Step 1 - select the arrow on the right side of the date selection box and a list will drop down of the dates available for review. Select a date.

Step 2 - Select the blue Download button and data for the chosen date will be downloaded into your computer. Save the file into your download folder.

Step 3 - Choose the downloaded file. The name of the chosen file will appear next to the gray “Chose File” button. Make sure it is the correct file that you downloaded.

Step 4 - Select the blue chart button and the HLC data from the date you picked will be displayed on the web page.

The HLC value is shown on the graph as the solid blue line. The HLC high threshold is dotted red and the minimum detectable HLC level is shown as dotted green. When you place your cursor on the graph selectable tools will appear in the upper right hand side of the graph which can be used to manipulate the displayed data.

Features
The Feature group provides a menu item for each Enhancement/Expansion that is currently installed in the TTA system.

HIGH LEVEL CARRIER DETECT
The High Level Carrier detection feature is a circuit board added to the system that continuously monitors the composite signal strength of the systems passband. The monitoring point is at the RF Output/s of the Control Unit. Refer to the control unit block diagrams shown in figure 6 (C&DU) or figure 7 (CU). Whenever the composite signal strength is above the user selectable trigger threshold (typically -35 dBm for the C&DU style system or -40

dBm for the CU style system) an alarm event is generated. Whenever the signal strength drops back below the threshold level the alarm event will be cleared. Note that the minimum signal level that can be detected by the HLC circuit is -53 dBm composite for the CU style system and -63 dBm composite for the C&DU style.

The High Level Carrier Detect page displays a moving chart showing high level carrier activity. The chart is displayed in 10 second intervals. The time axis (horizontal) moves from the right to the left. The vertical axis of the chart shows the amplitude of the detected composite signal. Any system messages regarding HLC, such as HLC Alarms are enabled, will be listed in the notes above the graph. The HLC value is shown on the graph as the solid blue line. The HLC high threshold is dotted red and the minimum detectable HLC level is shown as dotted green.

About

The about group provides a menu item for each of two pages that provide additional relevant information.

SYSTEM INFORMATION

The System Information page gives quick access to basic information about the system including creation date, model number, serial number, and software version currently running in the system. Data is provided for the Control Unit as a whole, the Distribution Assembly within the control unit and the TTA.

ABOUT TX RX

This web page provides information about TX RX Systems and the services we offer to our customers.

Diagnostic Data

The Diagnostic Data group provides menu items for tools/features related to diagnostic features available in the TTA System.

RAW SYSTEM DATA

This web page shows a complete data listing of all operational measurements and settings within the TTA system. The data is updated in real time as fresh measurements are made. The purpose of this page is to give Field Service support personal at TX RX Systems the ability to see exactly how the system is operating internally. When making field service calls to the factory for support customers may be asked to allow factory personal access to this information to aid in providing troubleshooting advice.

OPTIMIZING THE SYSTEM

When the TTA system is installed there are adjustments and test procedures which must be followed in order to ensure optimum performance of the system. The process includes:

Attenuation Adjustment
Spectrum Analysis
Operational Tests
  RSSI Measurement
  Sensitivity with TTA Load Connected
  Sensitivity with Antenna Connected

Optimization testing should be done in a methodical manner in order to provide the correct performance evaluation and ensure that the information obtained is correct. For each procedure it is important that the data be recorded accurately and is available anytime assistance is required or when performance is in question. Before a receive system problem is suspected, the appropriate operational tests must be performed. Before operational tests for RSSI and sensitivity can be verified, the programmable attenuation setting and spectrum analysis must be performed. If these are not correct, the RSSI, sensitivity, and degradation may appear out of acceptance.

SPECTRUM ANALYSIS

Obtaining good sensitivity requires an understanding of the signal levels applied to the receiver. A receiver, like any electronic device, has a dynamic range of operation. As long as this dynamic range is maintained, the specifications of the receiver are maintained. When the levels applied to the receiver exceed this range, the sensitivity, intermodulation rejection, as well as the adjacent channel selectivity will deteriorate. To properly perform a Spectrum Analysis, a spectrum analyzer must be connected to the RF output of the control unit as if it were a receiver, essentially monitoring what the receiver sees. In the case of a C&DU style system one of the RF outputs is typically left unused so the spectrum analyzer can be connected there. In the case of the CU style system there is an RF Output used as a test connector that is available.

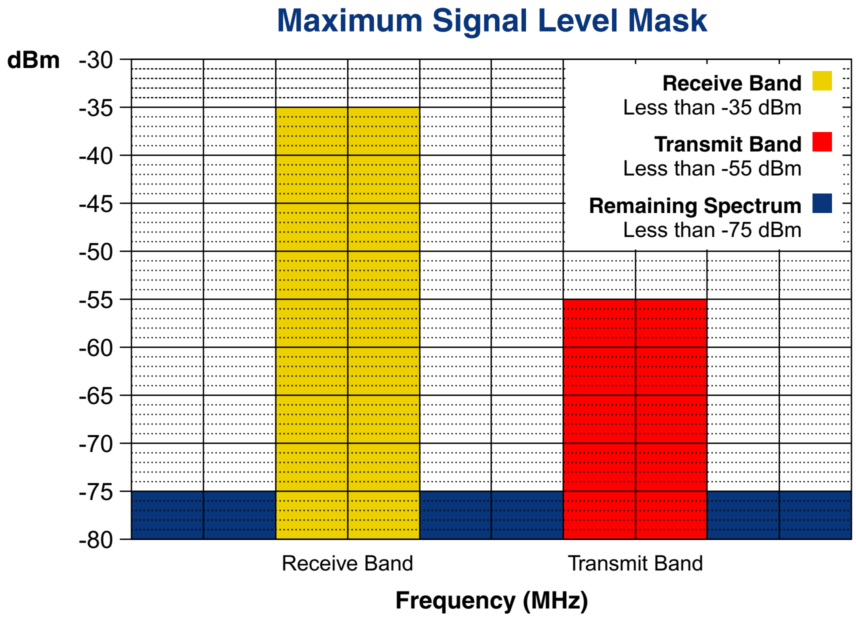


Figure 45: Maximum permissible signal levels at receiver output of control unit.

Unused RF output ports on either style control unit should always be terminated with a 50 Ohm load.

Figure 45 is a graph which indicates the maximum desired measured-signal levels both inside and outside of the transmit and receive bands. The systems preselector as well as antenna space isolation are the dominant factors that determine the signal levels observed. Excessively strong receive signals indicate the need for additional attenuation. There are three areas of the spectrum that must be evaluated:

1) **Receive Band** - The spectrum where the receive frequencies reside must not have carriers above -35 dBm for the C&DU style system or above -40 dBm for the CU style system. These are the carriers that are intended to enter the receiver. If subscribers or control stations are near the infrastructure the levels can be very high. If the levels are above the acceptable threshold, the gain of the system must be reduced or the source of the high level carrier must be reduced.

2) **Transmit Band** - The highest carrier that the receive system will consistently see is its own transmitter. The preselector of the receive system must adequately remove these carriers to prevent over-drive. The goal of the preselector is to reduce all transmit carriers below -55 dBm. If the level of a transmitter is above -55 dBm the preselector is not adequately performing its job and must be changed.

3) **All Other Frequencies** - The receiver is designed to monitor very low signals and there must be a minimum amount of undesired energy exposure. The systems preselector has very sharp selectivity and must reduce all carriers outside the bandwidth below -75 dBm except as indicated above.

Procedure for Spectral Analysis

Spectral analysis will verify the signals arriving at the receiver as well as validate the attenuation adjustment. To perform a spectral analysis of the site follow the steps listed below.

1) Make sure that the TTA systems variable attenuator is properly adjusted.

2) For the C&DU style system connect the spectrum analyzer to one of the distributed RF output ports (BNC connector) on the rear of the control unit. For the CU style system connect the spectrum analyzer to the RF output test port (N-type connector) on the rear of the control unit.

3) Test cable loss to the spectrum analyzer needs to be accounted for. Measure the loss of the cable that will be connecting the spectrum analyzer to the control unit. This loss must be added to your measurements.

3) Setup the spectrum analyzer as follows;

   Span = 700 - 800 MHz
   Resolution = 50 KHz
   RF Attenuation = 0 dBm
   Reference Level = -20 dBm
   Peak (Max) Hold = ON

4) Monitor the spectrum for 30 minutes (during peak hours).

OPERATIONAL TESTS

To insure that the TTA system is installed and functioning correctly both gain and noise testing should be performed at the system level. If the system passes these tests there can be a high confidence that all of the sub assemblies and interconnecting cables in the system are functional. An RSSI (Received Signal Strength Indication) measurement is used to verify gain/losses in the system and sensitivity measurements are used to test noise. Each type of testing is discussed in detail in the following sections.

RSSI

The RSSI measurement will document the RF signal generator level that is required to produce, in the base radio receiver, a received signal strength indication (typically -90 dBm). The -90 dBm level is chosen as the test threshold because it is high enough above the noise floor so that noise has a minimal influence on the measurement.

An RSSI (Received Signal Strength Indication) measurement can be made once the TTA system is installed and operational. Attenuation adjustments and spectrum analysis must be performed before an RSSI measurement is made. The purpose of the RSSI measurement is two-fold. First, it provides a sanity check on the gain/loss values in the distribution block diagram discussed earlier in this manual. Secondly, it provides a baseline measurement that can be replicated in the future to determine if the gains/losses have changed.

An RSSI measurement is made by injecting a test signal into the front panel test port on the control unit and measuring the test signals level at the input of the base radio receiver (in the case of a C&DU style system) or the input of the ESS cabinet (in the case of the CU style system). The TTA system can assist the field engineer in performing an RSSI measurement by calculating the expected signal generator level required. The calculation can be performed using the touch display or the web page interface. Each method was discussed in earlier sections of this manual. In addition, the TTA system retains the gain/loss values used in the calculation so they are available for future tests.

Sensitivity (and Degradation)

Before sensitivity and degradation can be verified, attenuation adjustments and spectrum analysis must be performed. If these are not correct, the sensitivity and degradation may appear out of tolerance.

The sensitivity tests will measure the full range of performance from the maximum achievable to real-world performance in the presence of RF site noise. These tests are necessary, not only to insure proper performance, but also to serve as a bench mark for future evaluations and trouble-shooting.

Two types of sensitivity measurements will need to be made, sensitivity with load connected and sensitivity with antenna connected. Sensitivity with load connected is a measurement without the presence of site noise while sensitivity with antenna connected is a measurement that includes site noise. The difference between the two is the system degradation.

FRONT PANEL TEST PORT USAGE

The front panel test port provides a convenient means of performing sensitivity tests of the system. The port is connected to the TTA through the test feedline allowing signals generated at ground level to be injected into an isolated 30 dB port at the input of either TTA amplifier circuit.

TOWER TOP AMPLIFIER INPUTS

Under normal operating conditions RF signals pass from the antenna to the input of the selected (preferred) tower top amplifier. In addition, the input of each tower top amplifier can also be switched to an internal 50 Ohm load for testing purposes. The front panel test port remains connected (through its isolated 30 dB input) to the tower top amplifier input path regardless of whether the amplifier input is connected to the antenna or the internal load. Refer to the block diagram of the TTA shown in figure 5. This design layout allows system sensitivity testing to be done with and without site noise being coupled into the system through the antenna.

SENSITIVITY (LOAD CONNECTED)

Sensitivity with a load connected to the selected amplifier input is the maximum sensitivity achievable because any possible interfering signals are blocked from entering the LNA while the measurement is being made.

To determine sensitivity with load connected the signal level into the first amplifier in the RF signal path must be known. The easiest way to achieve this is to inject a test signal into the Test Port (located on the front panel of the control unit) and measure the BER of a test receiver. The sensitivity can only be measured while the active LNA in the TTA is connected to the internal load. Once you have made the measurement the actual sensitivity can be calculated. **Figure 46** shows the formula for calculating the sensitivity as well as a worked through example.

Performing the sensitivity measurement is very similar to performing the RSSI measurement as discussed in the previous section of this manual. To measure the sensitivity with the load connected perform the following steps;

CAUTION: During this test on-air signals will NOT pass through to the station receivers.

1) The signal generator and the Bit Error Rate (BER) meter/computer need to be connected to the control unit. The signal generator connects to the front panel test port with test cable #4. For the C&DU style system connect a test receiver to one of the RF output ports and the BER meter/computer to the test receiver. For the CU style system connect the BER meter/computer to the GTR8000**.**

2) Be sure the signal generator is setup for a proper pattern for BER testing.

3) From the touch display or web page interface press the terminate test button associated with

Actual Sensitivity is calculated using the following formula:

$$\text{Actual Sensitivity (dBm)} = IS_{LEVEL}\ (dBm) + TL_{LOSS}\ (dB) + TP_{LOSS}\ (dB)$$

Where:

IS_{LEVEL} is the Injected Signal Level
TL_{LOSS} is the TestPort Signal Path Loss
TP_{LOSS} is the TestPort Coupler Loss of the TTA

Example:

If the TestPort Signal Path Loss (includes; test cable, control unit testport loss, jumper, surge protector, and feedline) is 7.2 dB, the Test Port Coupler Loss is 30 dB and the Injected Signal acquires BER at a level of -86.8 dBm, then the Actual Sensitivity would be -124 dBm.

Figure 46: Calculating actual sensitivity.

the active amplifier. This will connect the input of the active tower top amplifier to the internal 50 Ohm termination preventing site noise from entering the system. The RF signal path through the TTA will be interrupted and on-air signals will not be passed to the station receivers while test termination is occurring.

4) Adjust the signal strength from the signal generator until the required BER point is reached. This determines the systems sensitivity without the presence of site noise. This value should be recorded for future reference.

NOTE It is very important that sensitivity always be measured to a recognized benchmark such as the bit error rate. Do not use your ear or other subjective techniques.

5) Return the amplifier to its non-terminated state after taking the measurement.

SENSITIVITY (ANTENNA CONNECTED)
Sensitivity with the antenna connected is the sensitivity as seen by the subscriber. This represents the Talk-in coverage component of the infrastructure. To determine the sensitivity with antenna connected the signal level into the first amplifier in the RF signal path must be known. The easiest way to achieve this is to inject a test signal into the Test Port (located on the front panel of the control unit) and measure the BER of a test receiver. The sensitivity can only be measured while the active LNA in the TTA is connected to the antenna. Once you have made the measurement the actual sensitivity can be calculated. Refer to figure 46 which shows the formula for calculating the sensitivity as well as a worked through example.

The sensitivity with antenna connected measurement should be taken under normal conditions as well as with all transmitters producing full power. All transmitters keyed will show the worse case situation. To test the systems sensitivity with the antenna connected to the active amplifier perform the following steps;

1) The signal generator and the Bit Error Rate (BER) meter/computer need to be connected to the control unit. The signal generator connects to the front panel test port with test cable #4. For the C&DU style system connect a test receiver to one of the RF output ports and the BER meter/computer to the test receiver. For the CU style system connect the BER meter/computer to the GTR8000.

2) Be sure the signal generator is setup for a proper pattern for BER testing.

3) Under normal conditions the antenna is connected to the amplifiers so no software interactions via the front panel are required.

4) Adjust the signal strength from the signal generator until the required BER point is reached. This determines the systems sensitivity with the presence of site noise. This value should be recorded. for future reference.

NOTE It is very important that sensitivity always be measured to a recognized benchmark such as the bit error rate. Do not use your ear or other subjective techniques.

DEGRADATION
The difference between the sensitivity (load-connected) and the sensitivity (antenna-connected) is the system degradation which can be caused by noise or interference (such as a user on an active channel). At 800 MHz it is unusual to have degradation greater than 2 dB (and even this is rare). The degradation value should be recorded for future reference. Degradation levels in excess of 1 to 2 dB should be investigated, as this will decrease the range and performance of the system.

SYSTEM TROUBLESHOOTING

System trouble shooting is centered around isolating the problem to a major component of the system. The major components include the antenna, TTA, Control Unit, and finally the cabling that interconnects these major components. The best way to get a detailed overview of the system is by viewing the System Overview page which is discussed in detail in an earlier section of this manual.

Performance problems characterized by poor receiver sensitivity and possibly accompanied by activation of the alarm system are possibly indications of RF interference or component problems. Most performance difficulties manifest as an intermittent or continuous loss of effective receive channel sensitivity sometimes accompanied by audible interference in FM systems or dropouts in digital radios. Sensitivity loss on a continuous basis is more likely to indicate a hardware problem which may produce an alarm condition.

Two of the most common reasons for TTA system alarms are direct lightning strikes and vandalism. It is possible to shut the system down, especially if a common component such as a transmission line or antenna is damaged.

The TTA incorporates lightning surge protection but no practical amount of protection can prevent catastrophic failure as the result of a direct hit. Lightning surge protection is very effective in preventing damage from nearby strikes and smaller direct hits. in addition, lightning arresters used in the system do not last forever and can eventually fail, especially after a direct hit. A damaged arrester can cause low gain. An arrester with lightning damage will exhibit increased insertion loss, poor return loss and may appear as a DC short on the main or test lines.

Damage to the TTA system caused by hunters or target-shooters in remote locations is not uncommon. Penetrating bullets may open or short transmission lines. Operating voltage is applied to the tower top unit via the main transmission line. In addition, the main transmission line carries RF as well as serial communications, so serious damage to this cable can prevent system operation.

PERIODIC MAINTENANCE

The following procedures can be followed as part of a periodic maintenance program.

1) TX RX Systems recommends that tests for establishing the performance level of the system, as outlined in this manual, be performed every six months.

2) Because it is possible that the current alarms *may not* detect a fault affecting RF gain, we recommend measuring RSSI and system sensitivity every six months and comparing these values against earlier recorded values.

3) A yearly inspection of the tower top unit is also recommended. Make sure the moisture relief opening is unobstructed. Inspect and tighten any loose ground connections. Insure that the feedline cable connections at the tower top unit are properly sealed with tape.

4) All feedline connections should be inspected for tightness and waterproofing integrity for their entire length. Water seeping into the transmission lines will cause system degradation.

RECOMMENDED SPARE PARTS

It is recommended that one TTA Unit and one Control Unit be kept on hand for emergency repairs.Troubleshooting a malfunctioning TTA system without the availability of spares for swapping is difficult and may lead to excessive and unwanted system downtime.

OPTIONAL EQUIPMENT

Optional equipment can be purchased from TX RX Systems in order to increase the performance of your TTA system. At the present time this includes a narrowband filter as well as a multicoupler expansion kit. The narrow band filter is designed to help limit the bandwidth of the system. The multicoupler expansion deck will increase the total multicoupler outputs from 16 to 32.

Narrow Band Filter

There are a total of five different narrowband filters available for use with your TTA system. Each of the filters can operate across the systems bandwidth of 794 to 824 MHz. Each filter offers a different amount of narrowing as shown in **Table 2**.

Filter Part Number	Passband
89-030691	3 MHz
89-030692	6 MHz
89-030693	9 MHz
89-030694	15 MHz
89-030695	18 MHz

Table 2: 440 Series Optional Filters.

The optional filter is connected to the back of either the C&DU or CU style system at the ports labeled Pin and Pout on the rear of the unit. A wideband 30 MHz ceramic filter is attached to these ports when the Control Unit is shipped from the factory. Remove the ceramic filter (BNC connectors) and connect the narrowing filter in its place.

It is recommended that the narrowing filter be mounted in the same rack just below the control unit. The optional filter will require 1 “rack unit” of space.

NOTE

Electrical power to the control unit should be turned off during installation of the optional filter.

Multicoupler Expansion Kit

The optional multicoupler expansion kit will increase the number of receiver connections from 16 to 32. The system gain will remain constant for all receivers. The kit part number is 75-034867 and is only used on SA style systems.

The expansion kit consists of two additional 8-way dividers which are mounted to the rear panel of the control unit. The control unit does not need to be removed from the rack in order to install the additional dividers. Instructions on how to install the expansion kit are included with the kit.

Appendix A

(C&DU style system)

TTA-SA-SR-16,32 specifications are listed in Table A1 through A3. Specifications listed in this document represent worse case performance across the entire operating frequency range and the entire operating temperature range. Specifications which are shown in italics are in addition to the Motorola 2018 TTA Design Requirements and are provided for customer convenience.

Specified Parameter	Value
System Gain	23 dB min, adjustable to 10 dB or less
System Noise Figure	≤ 2.8 dB
User Type	Public Safety Critical Infrastructure
Frequency Band(s)	7/800 MHz
System Passband	794 to 824 MHz (30 MHz)
System Gain Flatness	≤ 1.25 dB
System Selectivity	BW 3 dB = 36.82 MHz, Q = 21.98 BW 6 dB = 38.81 MHz, Q = 20.85 BW 60 dB = 55.87 MHz, Q = 14.49 Shape Factor = 1.44 @ 60 dB - 6 dB
Adjustable Attenuation Range	15.0 to 0 dB
Adjustable Attenuation Step Size	0.5 dB
Optional Redundant Power Supply	Yes
Test Port	Yes (front panel of C&DU)
Preselector	Yes
System TX Band Rejection	≥ 110 dB
Internal Termination Test Mode	Yes
Antenna Test Mode	Yes
Bypass (Failure) Mode	Yes
Bypass Mode System Loss	< 23 dB
Internal Storage of Test Data	Yes (all factory test data and birth certificate information is permanently stored in flash memory)
Auto Receive Overall Gain Setup	Yes (either touch display or web interface)
High Level Carrier Monitor	Yes (events are logged)
AC Current	~300 mA (@ 110 VAC)
DC Current	~1 A (@ -48 VDC), ~2.6 A (@ 12 VDC)

Table A1: TTA-SA-SR-16,32 System Specifications.

Specified Parameter	Value
Gain	28.0 dB minimum
Noise Figure	≤ 2.5 dB
Type of Amplifier	Quadrature Coupled
Amplifier Redundancy	2 Independent Quadrature Coupled Amplifiers
Amplifier Switching	Automatic upon failure detection
Type of Amplifier / Test Mode Switching	Hermetic Relays and Solid State Switch
Amplifier Input 3rd order IP	> 16 dBm
Return Loss on all RF Ports	> 15 dB
Power Requirements	Power derived from RX cable
Operating Temp Range (full spec)	- 30° C to + 60° C
Operating Temp Range (degraded spec)	-40° C to +70° C
Lightning Protection Main and Test Ports	20kA IEC61000-4-5 8/20μS multiple strike 3 kA 10/350μS
Lightning Protection Antenna Port	40kA IEC61000-4-5 8/20μS single strike 3 kA 10/350μS
Grounding Studs	Double Stud, M8 (3/4" spacing)
Test Port Coupling (Test In to Antenna In)	30 dB +/- 2 dB
Test Port Coupling Flatness	≤ 0.25 dB
Internal Termination Accuracy	< 0.1 dB difference int to ext termination
Connector type (all RF ports)	4.3-10 female or N-Type female
Connector Spacing (X and Y planes)	2.0" center to center
Enclosure	NEMA 4X Aluminum (epoxy painted)
Size Maximum (H x W x D)	Approx. 8.0"H x 7.5"W x 4.25"D
Weight Maximum	11 lbs.
TTA Unit Factory Test Record	Electronically stored

Preselector *Frequency Range* *Stopband Rejection (low side)* *Stopband Rejection (high side)*	794 - 824 MHz > 60 dB @ 762 - 776 MHz > 60 dB @ 851 - 2500 MHz

Table A2: TTA-SA-SR-16,32 Tower Top Amplifier Specifications.

Specified Parameter	Value
Gain (with 0 dB of attenuation)	≤ -5.0 dB (Ctrl section -6.0 dB/Dist section 1.0 dB)
Noise Figure	≤ 12.5 dB (Ctrl section 12.3 dB/Dist section17.5 dB)
Type of Amplifier	Quadrature Coupled
Amplifier Redundancy	None
Amplifier Output 3rd order IP	> 45 dBm
RF Port Return Loss	> 15 dB
Adjustable Attenuator Type	Electronic
TTA Connectors Type (rear facing)	4.3-10 female or N-Type female
TTA Connector Spacing (X and Y planes)	1.25” center to center minimum
Number of RX Output Ports	16 or 32
RX Output Connectors Type (rear facing)	BNC-Female
RX Output Connector Spacing (X and Y planes)	0.850” center to center minimum
RX to RX Port Isolation	> 20 dB
External Filter Ports	Yes
External Filter Port Connector Type	BNC-Female
Test Port In Connector Type (front facing)	BNC-Female
ESD Protection	IEC61000-4-2 level 3
Grounding Studs	Double Stud, M8 (3/4” spacing)
Status Indicator	Front Panel LCD and bi-color LED
Alarm Contact	Form-C
Ethernet Port	On rear panel (includes SNMP)
Power Requirements	90 - 240 VAC 50/60 Hz (or) -48 VDC
Operating Temperature Range (full Specs)	0° C to +50° C (Non-Condensing Humidity)
Enclosure	Standard EIA 19” Rack Mounting
Size Maximum (H x W x D)	3.5” (2 RU) x 19.0” x 16.5” with filter
C&DU Factory Test Record	Electronically stored
Weight	< 15 lbs.

Table A3: TTA-SA-SR-16,32 Control & Distribution Unit Specifications.

Appendix B

(CU style system)

TTA-ESS-SR-2 specifications are listed in Table B1 through B3. Specifications listed in this document represent worse case performance across the entire operating frequency range and the entire operating temperature range. Specifications which are shown in italics are in addition to the Motorola 2018 TTA Design Requirements and are provided for customer convenience.

Specified Parameter	Value
System Gain	18 dB min, adjustable to 5 dB or less
System Noise Figure	≤ 2.8 dB
User Type	Public Safety Critical Infrastructure
Frequency Band(s)	7/800 MHz
System Passband	794 to 824 MHz (30 MHz)
System Gain Flatness	≤ 1.25 dB
System Selectivity	BW 3 dB = 36.71 MHz, Q = 22.04 BW 6 dB = 39.01 MHz, Q = 20.74 BW 60 dB = 56.56 MHz, Q = 14.32 Shape Factor = 1.45 @ 60 dB - 6 dB
Adjustable Attenuation Range	15.0 dB to 0 dB
Adjustable Attenuation Step Size	0.5 dB
Optional Redundant Power Supply	Yes
TestPort	Yes (front panel of CU)
Preselector	Yes
System TX Band Rejection	≥ 110 dB
Internal Termination Test Mode	Yes
Antenna Test Mode	Yes
Bypass (Failure) Mode	Yes
Bypass Mode System Loss	< 10 dB
Internal Storage of Test Data	Yes (all factory test data and birth certificate information is permanently stored in flash memory)
Auto Receive Overall Gain Setup	Yes (either touch display or web interface)
High Level Carrier Monitor	Yes (events are logged)
AC Current	~300 mA (@ 110 VAC)
DC Current	~1 A (@ -48 VDC), ~2.6 A (@ 12 VDC)

Table B1: TTA-ESS-SR-2 System Specifications.

Specified Parameter	Value
Gain	28.0 dB minimum
Noise Figure	≤ 2.5 dB
Type of Amplifier	Quadrature Coupled
Amplifier Redundancy	2 Independent Quadrature Coupled Amplifiers
Amplifier Switching	Automatic upon failure detection
Type of Amplifier / Test Mode Switching	Hermetic Relays and Solid State Switch
Amplifier Input 3rd order IP	> 16 dBm
Return Loss on all RF Ports	> 15 dB
Power Requirements	Power derived from RX cable
Operating Temp Range (full spec)	- 30° C to + 60° C
Operating Temp Range (degraded spec)	-40° C to +70° C
Lightning Protection Main and Test Ports	20kA IEC61000-4-5 8/20µS multiple strike 3 kA 10/350µS
Lightning Protection Antenna Port	40kA IEC61000-4-5 8/20µS single strike 3 kA 10/350µS
Grounding Studs	Double Stud, M8 (3/4” spacing)
Test Port Coupling (Test In to Antenna In)	30 dB +/- 2 dB
Test Port Coupling Flatness	≤ 0.25 dB
Internal Termination Accuracy	< 0.1 dB difference int to ext termination
Connector type (all RF ports)	4.3-10 female or N-Type female
Connector Spacing (X and Y planes)	2.0” center to center
Enclosure	NEMA 4X Aluminum (epoxy painted)
Size Maximum (H x W x D)	Approx. 8.0”H x 7.5”W x 4.25”D
Weight Maximum	11 lbs.
TTA Unit Factory Test Record	Electronically stored

Preselector *Frequency Range* *Stopband Rejection (low side)* *Stopband Rejection (high side)*	794 - 824 MHz > 60 dB @ 762 - 776 MHz > 60 dB @ 851 - 2500 MHz

Table B2: TTA-ESS-SR-2 Tower Top Amplifier Specifications.

Specified Parameter	Value
Gain (with 0 dB of attenuation)	≤ -10.0 dB
Noise Figure	NA
Type of Amplifier	NA
Amplifier Redundancy	NA
Amplifier Output 3rd order IP	NA
RF Port Return Loss	> 15 dB
Adjustable Attenuator Type	Electronic
TTA Connectors Type (rear facing)	4.3-10 female or N-Type female
TTA Connector Spacing (X and Y planes)	1.25” center to center minimum
Number of RX Output Ports	2
RX Output Connectors Type (rear facing)	N-Female
RX Output Connector Spacing (X and Y planes)	1.625” center to center minimum
RX to RX Port Isolation	> 20 dB
External Filter Ports	Yes
External Filter Port Connector Type	BNC-Female
Test Port In Connector Type (front facing)	BNC-Female
ESD Protection	IEC61000-4-2 level 3
Grounding Studs	Double Stud, M8 (3/4” spacing)
Status Indicator	Front Panel LCD and bi-color LED
Alarm Contacts	Form-C
Ethernet Port	On rear panel (includes SNMP)
Power Requirements	90 - 240 VAC 50/60 Hz (or) -48 VDC
Operating Temperature Range (full Specs)	0° C to +50° C (Non-Condensing Humidity)
Enclosure	Standard EIA 19” Rack Mounting
Size Maximum (H x W x D)	3.5” (2 RU) x 19.0” x 16.5” with filter
CU Factory Test Record	Electronically stored
Weight	< 15 lbs.

Table B3: TTA-ESS-SR-2 Control Unit Specifications.

DESCRIPTION OF SYSTEM SPECIFICATIONS

System Gain – The Gain from the TTA antenna input to the Control Units (CU or C&DU) output. It is specified as the maximum acceptable gain when user adjustable attenuation is set to its lowest value (0 dB) and the minimum acceptable gain when the user adjustable attenuation is set to its highest value (15 dB).

System Noise Figure – The minimum acceptable noise figure as measured from the TTA antenna port to the Control (CU or C&DU) RF output port/s.

User Type – A description of the typical type of user of the RF site.

Frequency Band (s) – For North America the licensed bands for users are typically VHF, UHF, 700/800, or 900 MHz.

System Passband - The specific passband of the TTA system and the frequency range over which the system gain, system noise figure, and system gain flatness specification must be met. A variety of optional narrow band filters are available which can be easily connected to the control unit in order to narrow the systems passband if necessary.

System Gain Flatness – The maximum variation in gain across the systems passband.

System Selectivity – The 3 dB and 60 dB bandwidth. The system selectivity specifications define the systems ability to filter out interference from sources operating at nearby frequencies. In some operating frequency bands this specification is not specified as high power devices are not expected in the adjacent frequencies.

Adjustable Attenuation Range – The range of user adjustable attenuation that may be introduced into the RF signal path to accomplish a user desired Receive Overall Gain.

Adjustable Attenuation Step Size – The minimum step size for user configurable attenuators.

Optional Redundant Power Supply – Indicates if the system can be provided with a redundant power supply (or) DC-DC converter using a separate power source.

Testport – Indicates if the product has a testport feature. The testport provides a convenient means of injecting test signals into the input of the TTA amplifiers.

Preselector – Indicates if a preselector is designed into the system. Preselectors are physically incorporated in the TTA design and are situated after the antenna input port of the TTA to prevent entry into the later TTA gain stage(s) of out of band signals with particular emphasis on transmitters associated with the base radio receivers. Note that TX Band Rejection requirements are met by using multiple filters at different points in the TTA System. Optional add-on filters that provide narrower pass bands are available and can be connected externally at the control unit rear panel.

System TX Band Rejection – Specifies the minimum amount of rejection the TTA system applies to signals in the associated transmit band. The specification applies across the entire TX band that is associated with the RX passband.

Internal Termination Test Mode – Indicates if the input to the amplifiers in the TTA can be switched between the antenna and an internal 50 Ohm load. This facilitates determining the amount of noise present in the external environment. A time out function is implemented with this feature to insure the system reverts back to normal operation after a reasonable interval to insure the system is not accidentally left in a test mode that interrupts coverage.

Antenna Test Mode – A test condition whereby the normal RF signal path in the TTA and the control unit are bypassed causing the Rx Antenna to be connected to the control units front panel testport connector. This feature facilitates antenna feedline and antenna sweep testing.

Bypass (**Failure) Mode** – A power off or catastrophic condition whereby the TTA system is automatically bypassed and the Rx Antenna is effectively directly connected to the Rx output(s) on the control unit.

Bypass Mode System Loss – The amount of loss while in the bypass mode, the loss from the TTA antenna input to the RF output(s) of the control unit. This measurement assumes the TTA is directly connected to the control unit without any intervening cables (such as feedline, surge protector, inside jumper).

Internal Storage of Test Data – A feature whereby measured factory test data is stored electronically within the TTA System hardware as opposed to being supplied as a paper document that ships with the system.

Auto Rx Overall Gain Setup – A feature whereby measured factory test data, stored within the TTA System hardware, in conjunction with user supplied data on jumpers and desired Receive Overall Gain is used to calculate and set the TTA Systems adjustable attenuator.

High Level Carrier Monitor – A feature whereby the total RF power being delivered to the receiver system is monitored. At a threshold of -40 dBm total power at the CU output (ESS style systems) or -35 dBm total power at the C&DU output (SA style systems) the control unit delivers a visual and audible indication. An SNMP trap is also generated which includes the time and duration of the high level carrier event.

AC Current – The total AC current draw of the control unit and TTA, for AC powered models.

DC Current – The total DC current draw of the control unit and TTA, for DC powered models.

Note: All specified parameters are measured over the system passband and over the operating temperature range where full specifications are maintained. Any user adjustable attenuation shall be set to 0.

DESCRIPTION OF TOWER TOP AMPLIFIER SPECIFICATIONS

Gain – The gain of the TTA as measured from the antenna port to the main port.

Noise Figure - The noise figure of the TTA as measured from the antenna port to the main port.

Type of Amplifier – Describes the amplifier design type used in the TTA.

Amplifier Redundancy – Describes the redundancy scheme used in the TTA.

Amplifier Switching – Describes the method used to control the switching of TTA amplifiers.

Type of Amplifier / Test Mode Switching – The type of switching device used for amplifier selection and test mode switching.

Amplifier Input 3rd OIP – The amplifier input 3rd order intercept point will be less than the listed value.

Return Loss on all RF Ports – The return loss of all RF ports on the TTA (antenna, main, and test) will be less than the listed value.

Power Requirements – DC operating voltage is applied to the TTA via the main transmission line. The system will work properly with up to 5 Ohms of DC resistance in the feedline used to power the TTA.

Operating Temperature Range (full spec) – The acceptable operating temperature range of the TTA. Within this range the TTA will maintain operation to the specifications listed in this document.

Operating Temperature Range (degraded spec) – When operating the TTA at the degraded temperature range the specifications listed in this document may degrade by 25% or 1 dB.

Lightning Protection – Describes if lightning protection levels for all ports of the TTA.

Grounding Studs – Describes the type of external grounding stud available on the TTA. Note: This ground stud must be securely connected to a proper tower ground in order to insure reliable operation of the TTA system.

Test Port Coupling (Test In to Antenna In)– Determined by finding the difference between the TTA "Test In to Main Out" and the gain of the TTA (Antenna In to Main Out). The "Test In to Main Out" is measured for the channel (will be a negative value) then is subtracted from the gain for that channel (will be a positive number) to determine the test port coupling loss for that particular channel.

Test Port Coupling Flatness – This is the testport coupling variation across the system passband. The maximum coupling minus the minimum coupling achieved across the system passband.

Internal Termination Accuracy – Indicates the accuracy of the 50 Ohm termination resistor. The resistor facilitates measurements of degradation caused by external noise and serves as a reference when troubleshooting.

Connector Type – The type of connector used on all RF ports of the TTA. Drip loops should be used when connecting to the ports on the TTA.

Connector Spacing – The minimum center to center distance between all connectors in both the X and Y planes.

Enclosure – Describes the type of enclosure used for the TTA.

Size Maximum – The height, width, and depth of the TTA.

Weight Maximum – Weight of the TTA.

TTA Unit Factory Test Record – Describes if test data is stored in the product or is provided as a paper copy.

Preselector – Lists basic specifications for the preselector filter that is built-in to the TTA including the frequency range, insertion loss, return loss, and the stop band rejection of the filter assembly.

DESCRIPTION OF CONTROL UNIT SPECIFICATIONS

Gain – The gain of the control unit as measured from the Main In port to the RF output port(s).

Noise - The noise figure of the control unit as measured from the Main In port to the RF output port(s).

Type of Amplifier – The type of amplifier used in the Control Unit.

Amplifier Redundancy - Describes if amplifier redundancy is used in the Control Unit.

Amplifier Output 3rd OIP – The amplifier output 3rd order intercept point of the Control Unit amplifiers will be less than the listed value.

RF Port Return Loss – Return Loss of all RF ports on the Control Unit.

Adjustable Attenuator Type – Describes the type of adjustable attenuator used.

TTA Connectors Type – Connector type used on the rear panel of the Control Unit that interconnect to the TTA (Main and Test).

TTA Connector Spacing - The minimum center to center distance between connectors used on the rear panel of the Control Unit that interconnect to the TTA (Main and Test), in both the X and Y planes.

Number of Rx Output Ports – Describes the number of Rx output ports on the rear of the Control Unit.

Rx Output Connectors Type – Connector type used on the rear panel of the Control Unit that interconnect to the base radio receivers.

Rx Output Connector Spacing - The minimum center to center distance between connectors used on the rear panel of the Control Unit that interconnect to the base radio receivers.

Rx to Rx Port Isolation – The amount of isolation between any two receiver ports.

External Filter Ports – Describes if connectors are available on the Control Unit to allow a narrowing filter to be conveniently added into the signal path for the purpose of narrowing the systems passband.

External Filter Port Connector Type – The connector type used for the external filter input and output.

Testport Input Connector Type – Connector type on the front panel of the control unit for the testport.

ESD Protection – Lists the ESD level of protection designed into the control unit. This insures the unit is capable of surviving normal handling during installation or use.

Grounding Stud – Describes the type of external grounding stud available on the control unit. Note: This ground stud must be securely connected to a proper ground in order to insure reliable operation of the TTA system.

Status Indicators – A visual indication on the front panel of the control unit of the operational status of the TTA System.

Alarm Contacts – Type of contacts available for external monitoring of the TTA system.

Ethernet Port – Indicates if the system has an Ethernet port available on the control unit. The port is an RJ45 connector that provides 10 or 100 Base-T networking. The Ethernet port is used to support direct or remote access to a Web Interface GUI and other features such as SNMP, SMTP, and SMS.

Power Requirements – Lists the AC and DC power requirement for the control unit.

Operating Temperature Range – The acceptable operating temperature range of the control unit. Within this range the control unit will maintain operation to the specifications listed in this document.

Enclosure – The control unit is intended to be mounted in a standard 19” rack.

Size Maximum – The height, width, and depth of the control unit.

Control Unit Factory Test Record - Describes if test data is stored in the product or is provided as a paper copy.

Weight – Weight of the control unit.

Changes to this Manual

Product part numbering in photographs and drawings is accurate at time of printing. Part number labels on TX RX products supersede part numbers given within this manual. Information is subject to change without notice.

We have made every effort to ensure this manual is accurate. If you discover any errors, or if you have suggestions for improving this manual, please send your comments to our facility to the attention of the Technical Publications Department. This manual may be periodically updated. When inquiring about updates to the manual refer to the manual part number and revision number which can be found in the revision table.

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