1. GENERAL

1.1 Document Purpose

This document provides installation and specification information on the Westell TTMA-700850-XX series of twin, variable gain, dual-band 700/850 (700 MHz and 850 MHz bands), Tower Mounted Amplifiers (TMAs) with AISG re-inject output. A typical Westell TTMA-700850-XX series TMA is shown in Figure 1. See Table 1 for ordering information.

1.2 Document Status

Whenever this document is updated, the reason will be stated in this paragraph. Rev B. updates product labeling.

- NOTE -

Hereafter, the TTMA-700850-XX Tower Mounted Amplifier also may be referred to as the “TMA.”

1.3 Product Purpose & Description

Westell’s TMAs are cost-effective tools to extend cell site coverage and improve cell site capacity and data-throughput performance by conditioning and amplifying the user-endpoint uplink signal in an LTE radio access network. Westell’s TMAs can be used in any application which requires improved receiver sensitivity of the BTS/eNodeB.

The A90-TTMA-700850-XX product line (Models -00, -01, and -11) include design enhancements to amplify BOTH the 700 MHz and 850 MHz bands of the uplink signal, and provide filtering for BOTH the uplink and downlink signals from each frequency band as well.

1.4 Product Mounting Location

The TMA is typically installed high on a cell tower, close to the antenna. This results in improved cell-site performance by offsetting the cable loss and filtering the signals. See Paragraph 3.6 for mounting steps and Figure 8 for dimensions.

1.5 Product Features

Features of the twin dual-band TMA:

- Supports two RF dual-band paths (700 MHz and 850 MHz) in a single compact enclosure
- Completely independent sub-units, each with an advanced, balanced LNA design that supports variable gain
- Low noise figure and high return loss
- If an LNA failure is detected, the TMA will automatically enter Bypass mode and retain an unamplified connection
- IP67 compliant enclosure
- AISG re-injection on the antenna port for control of Smart-Bias-T RET Antennas eliminates the need for a second cable (Models 700850-01 and 700850-11 only)
- High reliability and performance

Figure 1. Tower Mounted Amplifier (TMA), Left/Top/Front Isometric View

Figure 2. Tower Mounted Amplifier (TMA), Right/Bottom/Front Isometric View
Figure 3. Block Diagram for TTMA-700850-XX Series

- Similar size and weight to single band TMA
- Easy upgrade or swap with no lease impact
- External AISG connector for control of non-Smart-Bias-T RET Antennas (backwards compatible)
- Includes AISG 2.0 software, with remote download from base station
- AISG received signal on BTS-1 controls both Path 1 and Path 2 TMA units
- Versatile mounting brackets with various mounting holes (can mount using screws or mounting straps/bands)
- Female, longneck, 7/16 DIN connectors at bottom; for each subunit, one for antenna connection and one for BTS
- Temperature range of -40°C to +65°C
- Weight: 22.6 pounds (23.3 with brackets)

### 2. FUNCTIONAL DESCRIPTION

The block diagram of the twin dual-band TMA is shown in Figure 3. Both TMA sub-units are controlled by one controller that receive AISG signals from the BTS-1 port.

#### 2.1 Control, Bias & Alarm Electronics

This block includes the control processor, AISG modem, and lightning protection.

#### 2.2 Pre-LNA Rx BPF

This is the pre-LNA (Low Noise Amplifier) band pass filter. This filter conditions the uplink signal from the antenna (both uplink bands, 700 MHz and 850 MHz) before the LNA.

#### 2.3 Balanced Low Noise Amplifier

This is the amplifier of the TMA and includes the bypass circuitry.
When installing, remove caps, verify connectors are free of debris, mount TMA so connectors face down. Weatherize connections after connecting cables.

Figure 4. Bottom View Showing Connectors

2.4 Post-LNA Rx BPF
This is the post-LNA band pass filter. This filter conditions the uplink signal to the eNodeB.

2.5 Tx BPF
These are the high-power transmit band pass filters. These filters condition the duplexed downlink signals (both bands) from the eNodeB to the antenna.

2.6 AISG Re-inject (and DC Pass-through)
The AISG Re-inject path (refer to Figure 3) is from the BTS connector through the two Bias-T circuits and out the Antenna port. This allows AISG to flow through the TMA RF connection. Refer to Section 3.3 for different orderable options.

2.7 Recessed Breather
The recessed breather (refer to Figure 4) is used to equalize the internal and external pressure of the TMA to reduce stress on weather seals and prevent water intrusion.

- CAUTION -
Improper grounding could be service affecting and cause service interruptions.

- MOUNTING BRACKET NOTE -
Do not remove the mounting bracket(s).

- CAUTION -
Do not apply power until all connections are complete.

- CAUTION -
Risk of electric shock. Differential voltages of up to 260V can exist on telecommunications lines.

3. INSTALLATION

3.1 Determine Power Options
The TTMA-700850-XX is powered by applying DC voltage to the center pin of the 7/16 DIN connector labeled BTS. There are several options for providing the power:

- eNodeB
- Westell Rack-Mount AISG Controller B99-AISG-RM3
- Westell’s A99-AISG-CNTRL-A portable AISG controller kit to power the TMA for running AISG commands

Westell AISG controllers supply the DC voltage to power the TMA via Westell’s Current Injector Modem (CIM). The CIM injects the DC voltage onto the center pin of its 7/16 DIN connector labeled BTS-1. To power the TMA, the CIM can be connected to the TMA or can be connected via RF jumper cable. For deployments where the eNodeB provides power, a CIM is not needed as power is injected onto the center pin of the RF cable leading to the BTS-1 port of the TMA directly by the eNodeB.

3.2 TMA Operating Mode
The TMA operates in AISG mode. It will continuously monitor the AISG bus for activity.

3.3 Determine DC/AISG Re-Inject on ANT Ports
The TTMA-700850 product line includes three models that can be ordered corresponding with the DC/AISG Re-Inject feature available for the Path-1 and Path-2 ANT Ports. It can be determined by the following part numbers:

The “700850-xx” Extension Definition:

- A90-TTMA-700850-00 = TMA-1 and TMA-2 both have NO AISG Re-Inject (No AISG connection BTS-to-ANT; and DC is blocked on both TMA-1 and TMA-2.)
- A90-TTMA-700850-01 = TMA-1 has AISG Re-Inject (and DC passes through), TMA-2 has NO BTS-to-ANT connection
- A90-TTMA-700850-11 = TMA-1 and TMA-2 both have the AISG Re-Inject feature (AISG connection BTS-to-ANT port; and DC passes through from BTS to ANT on both Path 1 and Path 2)
3.4 Verifying Functionality Prior to Mounting

Prior to mounting the TMA on the tower, verify proper operation of each sub-unit by following the steps listed in either Paragraph 3.4.1 or 3.4.2 below, depending on the powering method.

3.4.1 Powered from a Westell AISG Controller using CIM

- CAUTION -
Do not apply power until all connections are complete.

When power is from an AISG Controller (such as a Westell AISG-RM3 controller or an AISG-CNTRL-A controller kit), follow the steps below. Note that these steps should be performed for each sub-unit of the twin TMA.

1. Either directly or via a feeder cable, connect the connector labeled ‘ANT’ of the CIM to the connector labeled ‘BTS-1’ on the TMA. Note that depending on the model of CIM used, an adapter may be required.
2. Using an AISG cable provided with the AISG controller, connect the cable to the male AISG connector on the CIM. Connect the other end of the AISG cable to the AISG controller.
3. Apply power to the AISG controller.
4. Using the AISG controller software, verify that the TMA is operational and that no alarms are present.
5. If alarms are present, verify all connections. If all connections are correct, replace TMA.

3.4.2 Powered from an eNodeB without CIM

- CAUTION -
Do not apply power until all connections are complete.

Verification of the TMA operation when used with an eNodeB as the power source is beyond the scope of this document. The basic steps are shown below.

1. Connect the connector labeled ‘BTS-1’ on the TMA to the eNodeB.
2. Power up the TMA using the eNodeB command line interface.
3. Check for alarms using the eNodeB command line interface.
4. If alarms are present, verify all connections. If all connections are correct, replace TMA.

3.5 Determining the Final Installation Location

The exact location of the TMA will vary by installation; it is typically pole mounted outdoors though it may be wall-mounted. The TMA can be located close to the antenna on the tower, or closer to the BTS/eNodeB. The TMA can be mounted with mounting screws/bolts inserted through the small round mounting holes (see Figure 8 for dimensions) or with pole mounting straps routed through the larger, square, cut-out holes in the mounting brackets.

Because the current to drive the TMA must pass from the CIM to the TMA there cannot be a discontinuity in the DC path between the CIM and associated TMA (such as a shorted quarter wave lightning protection device).

3.6 Mounting the TMA

Mount the TMA per company practice or the steps below and using Figure 5 as a guideline. The TMA may be pole (tower) or wall mounted, using bolts/screws or straps. Themounting and hardware surface must be capable of supporting the weight of the TMA and be weather-resistant and suitable for extended outdoor use. The correct orientation of the TMA is with the connectors pointing down. Use Figure 6 as a reference as needed.

- VERIFYING FUNCTIONALITY NOTE -
Follow the steps in Paragraph 3.4 to verify proper functionality prior to mounting the unit.

3.6.1 Mounting the TMA to a Wall

The TMA may be mounted to a wall, for example, such as when mounting on a rooftop parapet. In this case the screw holes on the mounting bracket can be used. Screws are not supplied. The mounting of the TMA to a wall will vary by situation so only the installer can decide the details of the mounting. However, particular attention to grounding will be required as the wall itself will not provide an adequate ground connection.

3.6.2 Mounting the TMA to a Pole

Follow the steps below to mount the TMA to a pole, as shown in Figure 5.

1. Gather tools and equipment. The following tools may be needed to mount the kit.
- Standard installation tools and hardware including wrenches, screwdrivers, torque tool and bits, and cable ties, per company practice and mounting surface type
- Grounding wire, and other grounding tools and materials, per company practice
- 7/16 jumper cables
- Connection weatherizing materials such as weatherized tape or sleeving and hose clamps
- Cable management tools, per company practice
- Wrench (for ground bolt and RF connectors)
2. Unpack and inspect the unit. Unpack the unit from the shipping box and inspect it for any damage (report damages to the shipping company and to Westell).
3. **Remove the covers.** Remove the plastic covers that protect the connectors at the bottom of the TMA.

- **CHECK 7/16 DIN TMA CONNECTORS NOTE** - Verify that the TMA is free of any visual defects prior to installation. In particular, check that the 7/16 DIN TMA connectors are free from damage.

4. **Pre-attach mounting hardware on the TMA.** Prior to ascending the tower, the hose clamps or mounting straps (not provided) should be prepared and pre-assembled on the mounting bracket, ready for pole/tower attachment.

- **GROUNDING NOTE** - Always follow the National Electrical Code (NEC) rules, local safety precautions, and standard operating procedures for grounding the equipment when installing, upgrading, repairing or maintaining equipment. Any instructions or information contained herein is subordinate to local codes, operating procedures or practices.

5. **Prepare/pre-assemble ground cable.** The TMA must be grounded. Therefore a ground cable (not provided) must be prepared prior to installation. Next to the BTS-1 ports is a stud and nuts attached to the body of the TMA for ground cable attachment. The other end of the ground cable must be attached to a good ground point on the tower structure. Grounding is not to be attached to the mounting brackets.

6. **Raise TMA to mounting height/location on the pole or tower.**

7. **Verify proper orientation.** Make sure the RF connectors of the TMA are vertical (plumb) in the final mounting location.

8. **Attach TMA to the pole/tower.** Route one end of a mounting band/strap or hose clamp through the slotted holes in the mounting brackets, route the end through the tightening mechanism of the clamp or fastener, then tighten the band, strap, or clamp around the pole, per manufacturer instructions and/or company practice.

9. **Finalize the Ground connection.** Finalize the ground connections to the TMA by connecting a company-approved ground lug/strap and cable to the ground stud. Next to the BTS-1 port is a bolt attached to the body of the TMA for ground cable attachment.

10. **Connect feeder cable to “BTS-1”.** Identify and locate the feeder cable that routes from the CIM/eNodeB. On the sub-unit, connect the feeder cable to the female, 7/16, DIN connector on the TMA labeled “BTS-1.”

11. **Connect jumper cable to “ANT-1”.** Identify if a jumper cable runs from the TMA to the antenna. If one is not already installed, install a short jumper with some stress relief between the antenna and the TMA. This eliminates the large stresses due to thermally driven changes in the coaxial cable. Connect the jumper cable to the female, 7/16, DIN connector marked “ANT-1.”

- **CHECK DC BLOCK NOTE** - Verify that the Antenna is DC-blocked prior to installation. If not, please add one DC Block between the TMA and the Antenna.

12. **Protect the connections on BTS-1 to ANT-1 subunit.** Weatherize the connections made in all steps above, per company practice.

13. **Connect feeder cable to “BTS-2”.** Identify and locate the feeder cable that routes from the eNodeB. On the sub-unit, connect the feeder cable to the female, 7/16, DIN connector marked “BTS-2.”

14. **Connect jumper cable to “ANT-2”.** Identify if a jumper cable runs from the TMA to the antenna. If one is not already installed, install a short jumper with some stress relief between the antenna and the TMA. This eliminates the large stresses due to thermally driven changes in the coaxial cable. Connect the jumper cable to the female, 7/16, DIN connector marked “ANT-2.”

15. **Protect the connections on BTS-2 to ANT-2 subunit.** Weatherize the connections made in all steps above, per company practice.

16. **Connect AISG Daisy Chain Cable.** For RET applications, an AISG daisy chain cable (not provided) can be used to provide power and AISG control signals to the RET actuator. To connect the cable, remove the weatherized cap from the AISG connector on the bottom of the TMA located between the BTS-1 and BTS-2 connectors, and securely connect the daisy chain cable.
3.7 Adjusting the TMA Gain

All Westell Variable Gain TMAs support AISG protocol version 2.0 for changing the gain level. If the external AISG connector is used for control, an AISG 2.0 compliant control device such as Westell’s B99-AISG-RM3 Rack Mount AISG Controller is required to change the gain setting of the TMA. Operation of an AISG control device is beyond the scope of this document. Refer to the device manufacturer for instructions on changing TMA gain.

Note that the default gain setting is 13dB.

4. TROUBLESHOOTING

There are no visual indicators on the TMA to indicate if it is functioning correctly. If the TMA is powered using an AISG control device, the device may indicate an alarm condition. If AISG communication can’t be established with an AISG control device, verify that AISG communications is started within 3 minutes of power-on (see Paragraph 3.2). In all cases, the primary cause of failures is a faulty connection either at the connection of the RF feeder cable to the TMA or from the power source to the Current Injector Modem. Check all cable connections to ensure proper installation.

For troubleshooting beyond the indicators on the AISG controller device, the engineer should use diagnostic equipment that measures VSWR and transfer characteristics of the TMA, cables, and antennas.

In the case of using an A90-TTMA-700850-01 or -11, the possibility of having a shorted connection on the ANT port of the TMA needs to be investigated. This can be done by removing the cable from the ANT port and trying to restart the TMA.

5. CUSTOMER & TECHNICAL SERVICES

If technical or customer assistance is required, contact Westell by calling or using one of the following options:

Voice: 800-377-8766
email: support@westell.com

Westell recommends that its products be recycled at the end of their product life. For Westell products that have reached their product End Of Life (EOL), please recycle and dispose of the products per your company practice, per local recycling programs and local codes, and per state statutes.

6. WARRANTY & REPAIRS

6.1 Warranty. Westell warrants this product to be defect-free at shipment time. Westell also warrants this product to be fully functional for the time period specified by the terms and conditions governing the sale of the product. Equipment repairs/modification attempts by an unauthorized person will void the warranty.

6.2 Repair and Return. Westell will repair or replace defective Westell equipment without cost during the warranty period if the unit is defective for reasons other than abuse, improper use, or improper installation. To return defective equipment, first request a Return Material Authorization (RMA) number from Westell (use one of the options shown below). Once an RMA number is obtained, return the defective unit (freight prepaid), with a brief problem description, to the address we will provide to you when you contact us.

   email: CSP@westell.com

Replacements will be shipped in the fastest manner consistent with the urgency of the situation. Westell will continue to repair or replace faulty equipment beyond the warranty period for a nominal charge. Contact Westell for details.

7. SPECIFICATIONS

7.1 Ordering Information

To order units, call the telephone number shown in Part 5 and please specify a specific model number shown in Table 1.

Westell sells a complete line of TMAs. Call Westell for further information.

Table 1. Ordering and Option Information

<table>
<thead>
<tr>
<th>Part #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A90-TDMA-700850-00</td>
<td>Dual duplex, twin, dual band (700 MHz and 850 MHz) Tower Mounted Amplifier with AISG 2.0 controlled variable gain, software download, and an AISG connector; Path-1 and Path-2 have NO AISG Re-Inject (No AISG connection BTS-to-ANT) and no DC passes through from BTS to ANT.</td>
</tr>
<tr>
<td>A90-TDMA-700850-01</td>
<td>Dual duplex, twin, dual band (700 MHz and 850 MHz) Tower Mounted Amplifier with AISG 2.0 controlled variable gain, software download, and an AISG connector; BTS-1 to ANT-1 (Path-1 TMA) has AISG Re-Inject and DC passes through Path 1, Path-2 TMA has NO BTS-to-ANT Connection and no DC passes through on Path 2 TMA.</td>
</tr>
<tr>
<td>A90-TDMA-700850-11</td>
<td>Dual duplex, twin, dual band (700 MHz and 850 MHz) Tower Mounted Amplifier with AISG 2.0 controlled variable gain, software download, and an AISG connector; both Path 1 and Path 2 TMAs sides have AISG Re-Inject (AISG connection BTS-to-ANT port) and DC passes through on both Path 1 and Path 2 TMA units.</td>
</tr>
</tbody>
</table>

7.2 Specifications

The specifications are listed in Table 2. See Figure 8 for two-dimensional drawings and additional product dimensions.

Table 2. TMA Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>700 MHz</th>
<th>850 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>776-787 MHz</td>
<td>824-849 MHz</td>
</tr>
<tr>
<td>Return Loss (active mode)</td>
<td>&gt; 18 dB</td>
<td></td>
</tr>
<tr>
<td>Return Loss (bypass mode)</td>
<td>&gt; 16 dB Min</td>
<td></td>
</tr>
<tr>
<td>Bypass Insertion Loss</td>
<td>1.3 dB (700 MHz), 1.0 dB 850 MHz typical</td>
<td></td>
</tr>
<tr>
<td>Variable Gain</td>
<td>3-13 dB</td>
<td></td>
</tr>
<tr>
<td>Gain Flatness</td>
<td>± 1.0 dB</td>
<td></td>
</tr>
<tr>
<td>Noise Figure</td>
<td>1.75 dB (700 MHz), 1.60 dB (850 MHz)</td>
<td></td>
</tr>
<tr>
<td>Output 3rd Order Intercept Point (IP3)</td>
<td>+27 dBm</td>
<td></td>
</tr>
<tr>
<td>Total Group Delay</td>
<td>700 MHz: 350 µSec typ or &lt; 500 µSec 850 MHz: 300 µSec typ or &lt; 430 µSec</td>
<td></td>
</tr>
<tr>
<td>Insertion Loss</td>
<td>0.30 dB typical</td>
<td></td>
</tr>
<tr>
<td>Return Loss</td>
<td>18 dB Min</td>
<td></td>
</tr>
<tr>
<td>RX-band Rejection</td>
<td>&gt; 30 dB</td>
<td></td>
</tr>
<tr>
<td>Power Handling AVG</td>
<td>250 W</td>
<td></td>
</tr>
<tr>
<td>Power Handling Peak</td>
<td>2.5 kW</td>
<td></td>
</tr>
<tr>
<td>Passive Intermodulation (PM)</td>
<td>-153 dBc</td>
<td></td>
</tr>
<tr>
<td>Total Group Delay</td>
<td>&lt; 80 nSec</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Specification</td>
<td></td>
</tr>
<tr>
<td>Power Consumption</td>
<td>280 mA @ 12 Vdc</td>
<td></td>
</tr>
<tr>
<td>Surge Protection: DC Path</td>
<td>8/20 µs 5 kA pulse arrester 75 V, and 1.5 kW TVS 33 V</td>
<td></td>
</tr>
<tr>
<td>Lightning Protection</td>
<td>Internal shorted stubs</td>
<td></td>
</tr>
<tr>
<td>Reverse DC Voltage Protection</td>
<td>−30 VDC</td>
<td></td>
</tr>
<tr>
<td>DC Supply</td>
<td>+9 to +30 Vdc</td>
<td></td>
</tr>
<tr>
<td>Alarm Management</td>
<td>AISG 2.0</td>
<td></td>
</tr>
<tr>
<td>AISG Voltage drop, BTS to AISG port</td>
<td>1.5 V max. at 2 A</td>
<td></td>
</tr>
<tr>
<td>AISG connector current rating</td>
<td>&lt; 4 A peak, 2.5 A continuous</td>
<td></td>
</tr>
<tr>
<td>Operating Temp. Range</td>
<td>−40 °C to +65 °C</td>
<td></td>
</tr>
<tr>
<td>IP Rating</td>
<td>IP67</td>
<td></td>
</tr>
<tr>
<td>MTBF</td>
<td>1,000,000 hours</td>
<td></td>
</tr>
<tr>
<td>Salt Fog Test</td>
<td>30 days per GR-487 CORE, Issue-4, section 3.40.1</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>RF Connector</td>
<td>Female 7/16” DIN long neck, bottom of unit</td>
<td></td>
</tr>
<tr>
<td>AISG Connector</td>
<td>AISG 8-pin IEC 60130-9 female, bottom of unit</td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>Pedestal / Pole Mount</td>
<td></td>
</tr>
<tr>
<td>Dimensions (W x D x H)</td>
<td>6.7” x 9” x 10.7” (6.7 x 10.2 x 11.8” with brackets)</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>22.6 pounds (23.3 with brackets)</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>Powder coating, CARDINAL T009-GR230</td>
<td></td>
</tr>
</tbody>
</table>

All values are typical. All specifications are subject to change without notice.
Figure 8. Dimensions and Views