Design Guide for the
Dual Diversity TTA System
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Design Components
Tower Top Amplifier (DS43283H01T) — The Tower Top Amplifier (TTA) provides the gain and first level of selectivity for the receive system. The new Dual Diversity TTA (Figure 1) is constructed in a Polyester material to reduce weight while maintaining environmental integrity. The TTA has two independent amplifier networks that amplify each branch of the diversity system. The networks are balanced to provide accurate signal balance at each branch of the Dual Diversity receive system. There are two antenna inputs (Ant A and Ant B).

Figure 1: Picture and Block Diagram of Dual Diversity TTA.
Multicoupler Control Unit (DS43283H01M) — The Multicoupler Control Unit (MCU) (Figure 2 & Figure 3) provides additional amplification to overcome the distribution loss of the Multicoupler. The MCU has the ability to distribute to 16 Dual receivers and can be expanded to 32 with an additional shelf. Each network has independent attenuators on the input and output to adjust the reserve gain and balance the networks. Each branch of the TTA is monitored within the MCU to provide alarms for any failures that may occur. Form C relay outputs are provided to interface to alarm interfaces. The standard unit is designed for 120 VAC but by adding 48 to the end of the part number (DS43283H01M48) the unit will be designed for -48 VDC.

Figure 2: MCU Picture and Block Diagram.
Figure 3: Physical and Electrical Installation of MCU.

WARNING
Failure to ground the TTA System properly can result in equipment failure caused by electrical surges.
Control Management Unit (DS43283H01C) – The Dual Diversity Control Management Unit (CMU) *(Figure 4 & Figure 5)* interfaces the TTA to the ESS GTR8000 radio system. The CMU provides two RF outputs per receive channel. One of the outputs interfaces with the ESS while the other is available for testing and Spectrum Analysis. There are no receive ports or expansion port provided since the receive distribution is included in the ESS. Each network has independent attenuators to adjust the reserve gain and balance the networks. Each branch of the TTA is monitored within the CMU to provide alarms for any failures that may occur. Form C relay outputs are provided to interface to alarm interfaces. The standard unit is designed for 120 VAC but by adding 48 to the end of the part number *(DS43283H01C48)* the unit will be designed for -48 VDC.

![CMU Picture and Block Diagram](image-url)

*Figure 4: CMU Picture and Block Diagram.*
Failure to ground the TTA System properly can result in equipment failure caused by electrical surges.

Figure 5: Physical and Electrical Installation of CMU.
Optional Narrowband Filter - The narrowband filter is designed to help limit the bandwidth of the MCU style system. The filter is not used in CMU style systems. One individual filter is required for both the “A” and “B” channel of the system. The option is shipped from the factory as shown in Figure 6 ready to be interconnected to the MCU deck. It is recommended that the optional filter be mounted in the same rack just above the MCU deck. There are a total of 9 different narrowband filters available as shown in the table below.

<table>
<thead>
<tr>
<th>Optional Filter Model #</th>
<th>Operating Range (MHz)</th>
<th>Bandwidth (MHz)</th>
</tr>
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<tbody>
<tr>
<td>89-83F-02D-03</td>
<td>792 to 806</td>
<td>3</td>
</tr>
<tr>
<td>89-83F-02D-06</td>
<td>792 to 806</td>
<td>6</td>
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<td>89-83F-02D-09</td>
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<td>792 to 806</td>
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<tr>
<td>89-86A-02D-03</td>
<td>806 to 824</td>
<td>3</td>
</tr>
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<td>89-86A-02D-05</td>
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</tr>
<tr>
<td>89-86A-02D-15</td>
<td>806 to 824</td>
<td>15</td>
</tr>
<tr>
<td>89-86A-02D-18</td>
<td>806 to 824</td>
<td>18</td>
</tr>
</tbody>
</table>

MCU Expansion Deck (75-83H-432) - The multicoupler expansion deck will increase the total multicoupler outputs of the MCU style system to 32. The expansion deck is not used with the CMU style system. The optional deck is shipped with the required interconnect cables (as shown in figure 7) and is designed to be installed in the same rack but below the MCU deck.
Design Considerations

Surge Protectors – The Dual Diversity system utilizes standard receive DC Pass surge protectors. **These surge protectors must be provided by the engineer.** The recommended surge arrestors (Figure 8) from PolyPhaser are shown in Figure 3 and Figure 5 above and designated as item 8, 9, and 11. Torquing specification obtained with proper Torque Wrenches is required to properly tighten all connectors. See Torquing Initiative document for more information. The 109 is an optimized arrestor with improved performance. The TSX protector is not only an optimized protector but also complies with our 150 dBc PIM and 25kW PIP requirements. All transmit protectors will utilize 7-16 DIN connectors.

Test Cable – The test cable connects the Control Unit with the TTA. This allows the TTA to be tested from the bottom of the tower but emulates a signal at the input to the TTA. The Test Cable should be constructed with LDF4 or equivalent ½” Heliax. Superflex cable is never recommended for outside use. A surge protector must be installed at the exit to the building.

Testing and Alignment – Testing the TTA system involves following the 5-Step procedure for each network of the Diversity system. The Reserve gain is adjusted according to the procedure. After both sections of the system are aligned the exact difference between each network must be determined. Using the network with the highest signal increase the attenuator until both networks have the same signal level at their output.

Standalone or interface to other radios – The MCU was designed to allow individual radios to be connected to the TTA system. The ESS can also be utilized to interface external receivers and allow radio expansion outside the ESS.
Frequently Asked Questions (FAQ)

Q – Can the ESS supply distribution to other radios outside the ESS cabinet?
A – Yes. The signal is taken from one of the unused ports on the Site RMC and distributed to other radios. Careful adjustment of gain must be considered and balanced sensitivity must be verified after installation. Distribution power splitting must be done with separate Power splitting.

Q – Can an ESS cabinet be fed from an MCU?
A – Yes. When the ESS is connected to the MCU there must be an additional 3 dB attenuator installed between the MCU and ESS to balance the extra amplification in the ESS.

Q – Should the unused ports on the MCU be terminated?
A – No. Internal splitters maintain isolation without the need for external termination. However, unused expansion ports must be externally terminated.

Q – Can the Dual Diversity TTA be ordered and used on a single receive system?
A – Yes. The Dual Diversity TTA is identical in gain, selectivity, and performance to the standard 428 and 428B. If a customer plans to migrate to Astro 25 Phase 2 they may want to install the new Dual Diversity TTA now to allow migration at a later date. The two branches can be installed with two antennas, two receive cables, and two branches of amplification. The second branch (Rx B) would not be connected to the ESS until the migration occurs.

Q – Is the PolyPhaser for the main receive line the same as the one used on the current 428 TTA?
A – No. The PolyPhaser surge protector used in the 428 contains a data modem to combine telemetry data on the RF line. The new TTA does not require a separate data line because the data is applied directly to the RF cable.

Q – Is the Surge Protector used on the receive line included with the TTA?
A – No. The new TTA combines the data within the Control Unit and does not require a data modem. For this reason the responsibility of supplying the surge protector falls on Motorola. The engineer must include the receive line surge protector in their design.

Q – Could two 428 TTA systems be used instead of the Dual Diversity TTA?
A – Yes. While from an engineering and Physics standpoint this would work, but you would need two test cables and the balance between the two would never be as good as the single Dual Diversity TTA. Additionally the Dual Diversity TTA sells for around 1.7 times the price of the 428 instead of double if you ordered two 428 systems.
Background Material and other resources

Dual Diversity TTA and MCU marketing sheet
BTG (TxRx) marketing sheet containing the detailed technical specifications on the Dual Diversity TTA and MCU shelf.

Dual Diversity TTA and CMU marketing sheet
BTG (TxRx) marketing sheet containing the detailed technical specifications on the Dual Diversity TTA and CMU shelf.

Dual Diversity TTA Manual
BTG (TxRx) manual detailing all of the information required to install, optimize, and troubleshoot the Dual Diversity TTA.

Dual Diversity Best Practices for P25 Phase 2 Whitepaper
This Whitepaper describes the detailed information required for Diversity design as it relates to P25 Phase 2. Detailed information on antenna placement, coverage improvement, and design guidelines are contained in this document.

5 Step Program for Receiver Multicoupler verification
http://compass.mot.com/doc/351187695/Five_Step_Program_v7_0.pdf
This document describes the test procedure for testing, aligning, and troubleshooting TTA systems. This document should be used for every TTA acceptance test plan.

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