

**VIAXI**

**3550R  
TETRA Base Station  
Operation**



# 3550R TETRA Base Station Test

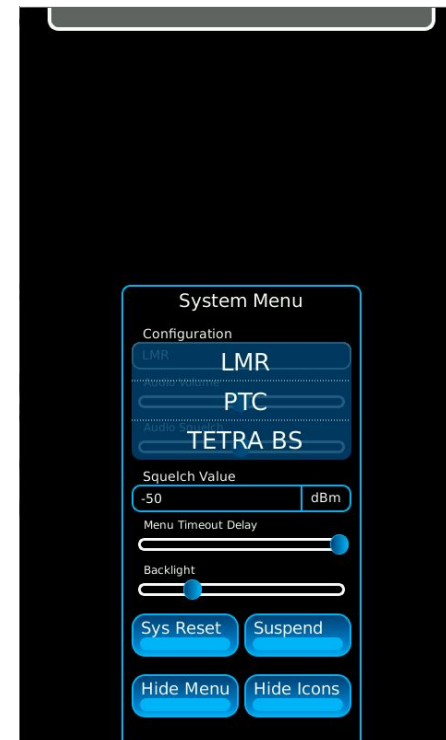
- The 3550R TETRA Base Station Test option utilizes the ETSI standard defined TETRA T1 test mode.
  - ETSI is the European Telecommunications Standards Institute
  - The ETSI document is ETSI EN 300 394-1 V3.2.1 (2012-10)
  - The TETRA T1 Test Modes for Base Stations are defined in section 5.2
    - Test Receive Mode (5.2.1.2) and Test Transmit Mode (5.2.2.3)
  - Test signal T1 for base station testing is defined in section 5.3.2
    - TETRA phase modulated ( $\pi/4$  DQPSK) signal with pseudo-random data
    - Used to perform receiver testing on TETRA Base Stations

# Setting up the 3550R for TETRA



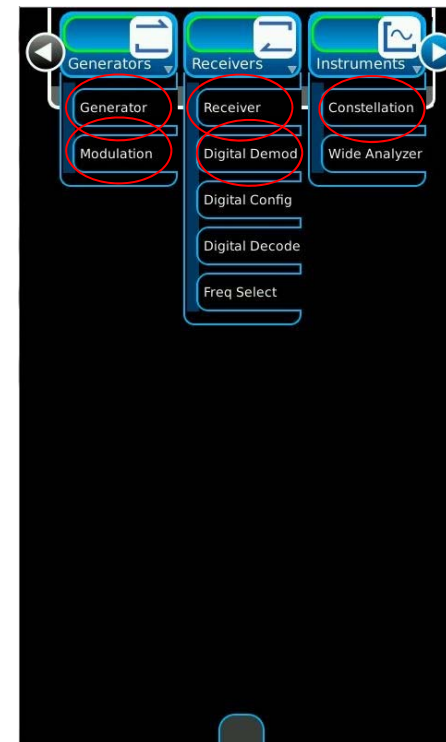
# Selecting the TETRA BS (Base Station) Mode

- Select TETRA BS Mode from the main System menu
  - Display the main System Menu by pressing the button located just below the display.
  - Touch the “Configuration” entry, and then select “TETRA BS”
    - This will switch the system to TETRA BS (system will re-boot)



# Example of setting up the screen for TETRA BS Testing

- The Diagram, shown to the right, is a partially exploded view of the menu structure of the 3550R.
  - The red ellipses indicate the TETRA windows that are selected for the example TETRA BS test setup.



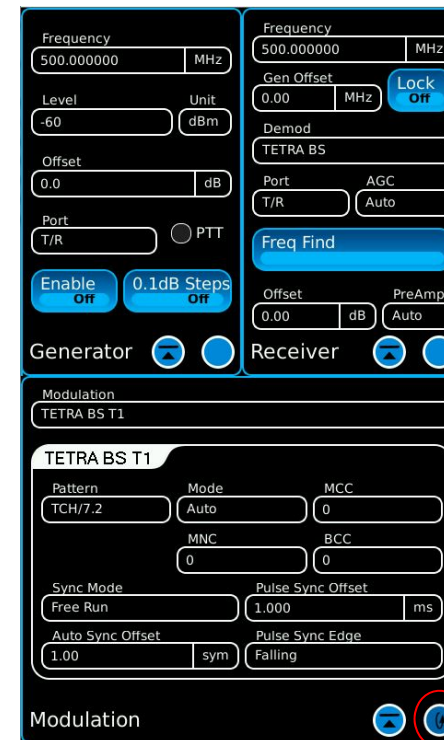
# Example TETRA BS Setup

- After selecting these windows, position them as shown in the diagram to the right.
- The Modulation and Constellation windows are behind the Digital Demod window
- The windows with the blue circles can be expanded.
  - Expanding the windows shows additional fields that are hidden when the windows are small.



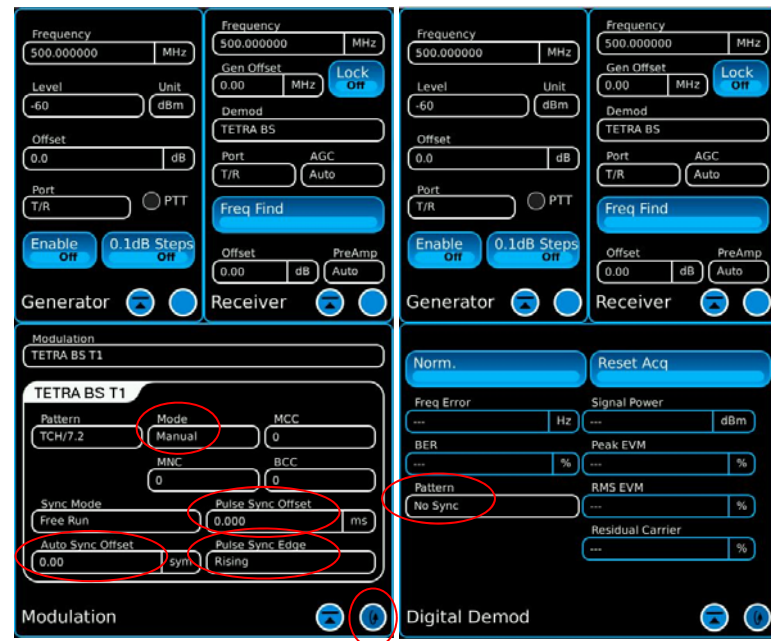
# Example TETRA BS Setup with expanded windows

- The diagram to the right shows the TETRA BS setup with windows expanded to show the extra fields.
- By touching the “Fast Stack” button, the Modulation window can be brought to the front.
- These field values are the default parameters.
  - To select default parameters:
    - Press the button just below the display
    - Select “Sys Reset”



# TETRA BS Setup

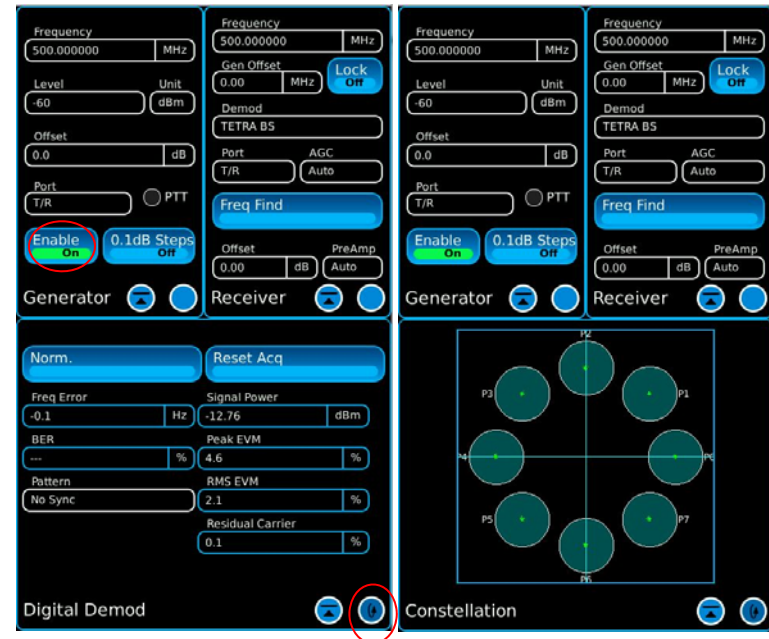
- Setup TETRA to match the screens to the right.
  - Modulation window changes:
    - Mode: Manual
    - Pulse Sync Offset: 0
    - Auto Sync Offset: 0
    - Pulse Sync Edge: Rising
  - Digital Demod window changes:
    - Touch the “Fast Stack” button to switch to the Digital Demod window
    - Pattern: No Sync





# TETRA BS Loopback operation

- Setup for loopback mode operation
  - Enable the Generator
  - Touch “Reset Acq”
- The operation should match the display in the screens to the right.
  - Press the “Fast Stack” button to toggle from the Digital Demod window to the Constellation window.

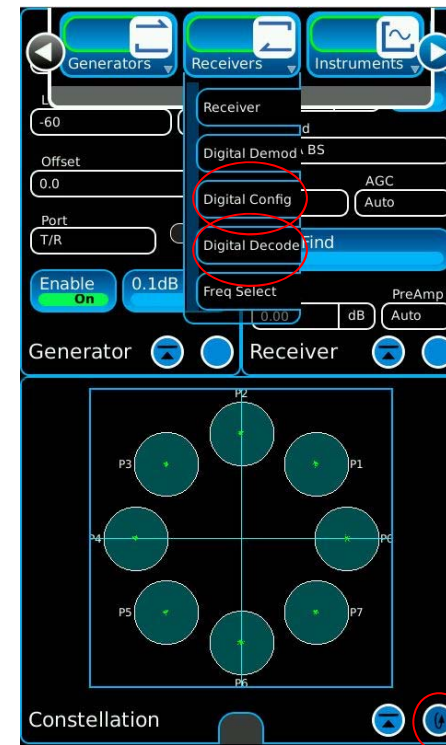


# TETRA Over- The-Air Testing



# Setting up for TETRA BS OTA (Over-The-Air) Testing

- Select two additional screens for performing OTA transmitter testing
  - From the Receivers drop down menu, select Digital Decode and Digital Config
- Move both of these new windows to the lower half.
  - The “fast stack” button can be used to move through the windows.



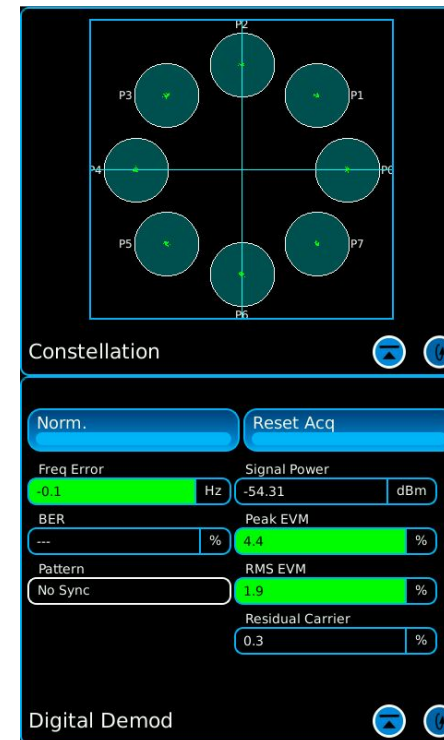
# TETRA BS OTA Testing

- In the Receiver window:
  - Enter the frequency of the TETRA Base Station transmitter
  - Select the Ant Port if testing a live base station OTA (Over-The-Air).
- In the Digital Config window, select Upper and Lower Limit Values for each parameter.
  - Turn “Limit State” On and the measurement field will indicate pass or fail (green/red indication).



# TETRA BS OTA Measurements

- The Digital Demod indicates if the measurements pass by highlighting them in green.
  - If the measurement is too high, then it is highlighted in red.
  - If the measurement is too low, then it is highlighted in blue.
  - Only applies to “Freq Error” in this scenario since the other 3 parameters on the screen can only fail if they are too high.
- The Constellation window should be moved to the upper half.



# TETRA BS Digital Decode

- This screen to the right shows a 3550R setup to decode the base station identity parameters.
  - The base station identity parameters consist of:
    - Mobile Country Code (MCC)
    - Mobile Network Code (MNC)
    - Base Color Code (BCC)
  - Set the Pattern to “Training Sequence 1” or “Training Sequence 2”.



# TETRA Testing Using T1 Mode



## Testing TETRA Base Stations in T1 Test Mode

- The 3550R supports comprehensive testing of base stations by utilizing the TETRA T1 test mode.
- This test mode enables quick and easy testing of both the transmitter and the receiver.
- Although this test mode is defined in the TETRA standard, it leaves some implementation details to the manufactures of the base stations.
- Details on how the manufacture implements test modes are available from the manufacture.
- The 3550R supports all manufacture methods of implementation.

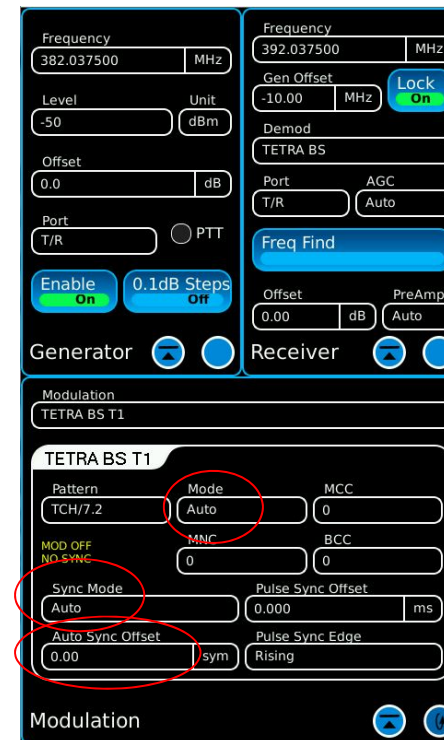


# TETRA T1 Test Modes

- The method for making receiver measurements vary by manufacture.
- There are basically two different methods of making receiver measurements.
  - These different methods are based on the mechanism that the test instrument employs to synchronize with the TETRA base station.
  - On the 3550R, these two methods are called:
    - Auto Synchronization Mode
    - Pulse Synchronization Mode

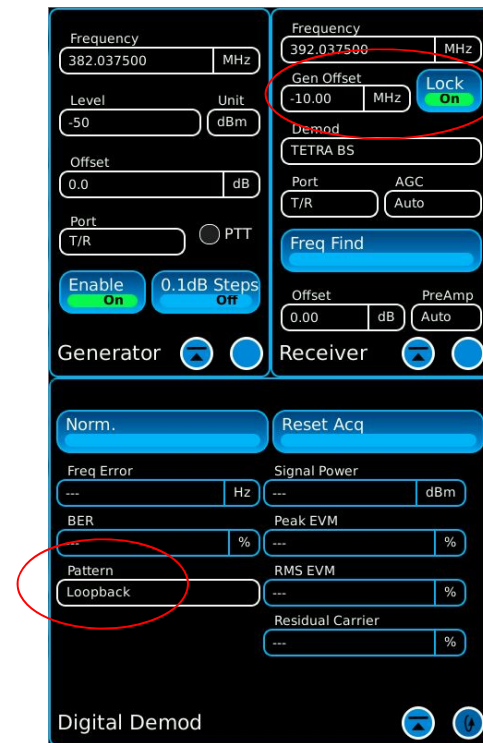
# TETRA Receiver Testing in Auto Sync Mode

- The diagram to the right illustrates the fields that should be setup for performing receiver testing in Auto Sync Mode.
  - The fields outlined in red must be selected.
  - The “Mode” field should be set to “Auto” so that the 3550R uses the MCC, MNC, and BCC values received from the base station.
  - “Auto Sync Offset” value should be set according to the manufacture.



# TETRA Receiver Testing in Auto Sync Mode

- Other fields to setup:
  - Set the “Pattern” field, in the Digital Demod window, to “Loopback”.
  - Some base stations may loopback the data into the transmit path.
  - The “Gen Offset” field may be used to lock an offset, for example of 10 MHz, between the receiver and generator frequency.



# TETRA Receiver Testing in Auto Sync Mode

- When the 3550R begins to receive the signal from the base station:
  - The “MOD OFF / NO SYNC” goes away (if 3550R Generator is enabled).
  - The 3550R transmits the TCH/7.2 pattern, synchronized to the BS.
    - If the base station loops the data back, the BER field can be used to measure the BER of the BS.
    - Alternatively, the BS reports the BER via the manufacture defined method.



# TETRA Receiver Testing in Pulse Sync Mode

- This mode of receiver testing uses a pulse trigger from the base station for synchronization.
  - The Mode selection should be set to “Manual”
  - Set MCC, MNC, and BCC according to the manufacture.
  - Set Sync Mode to “Pulse”
  - Set Pulse Sync Offset according to the manufacture. It is often “0 ms”
  - Set Pulse Sync Edge to “Rising”

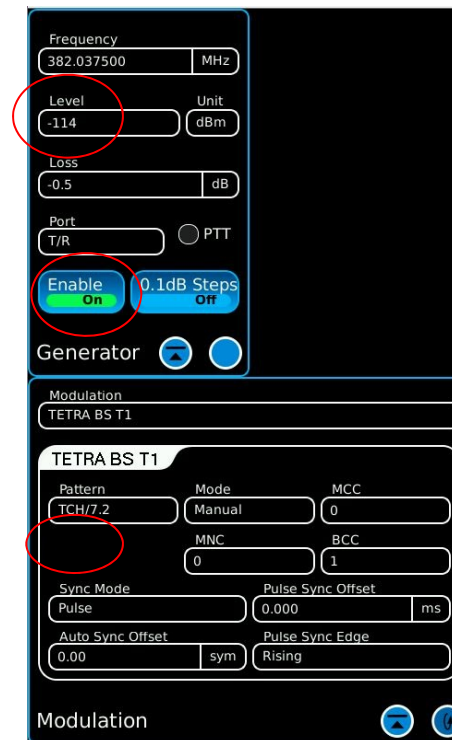
The screenshot displays a configuration interface for TETRA receiver testing. The top section, labeled 'Generator', includes fields for Frequency (382.037500 MHz), Level (-114 dBm), Loss (-0.5 dB), and Port (T/R). Below these are buttons for 'Enable On' and '0.1dB Steps Off'. The bottom section, labeled 'Modulation', is titled 'TETRA BS T1' and contains several parameters: Pattern (TCH/7.2), Mode (Manual), MCC (0), MNC (0), BCC (1), Sync Mode (Pulse), Pulse Sync Offset (0.000 ms), Auto Sync Offset (0.00 sym), and Pulse Sync Edge (Rising). Red circles highlight the Level, Loss, Mode, MNC, BCC, Sync Mode, Pulse Sync Offset, and Pulse Sync Edge fields.

# TETRA Receiver Testing in Pulse Sync Mode

- Connect a cable from the trigger out of the base station to the BNC trigger input adapter of the 3550R.
  - If the Generator is Enabled, the “MOD OFF / NO SYNC” indication in the Modulation tile will go away.
- The 3550R should now be transmitting.
  - Adjust the Generate level to find the sensitivity of the BS.

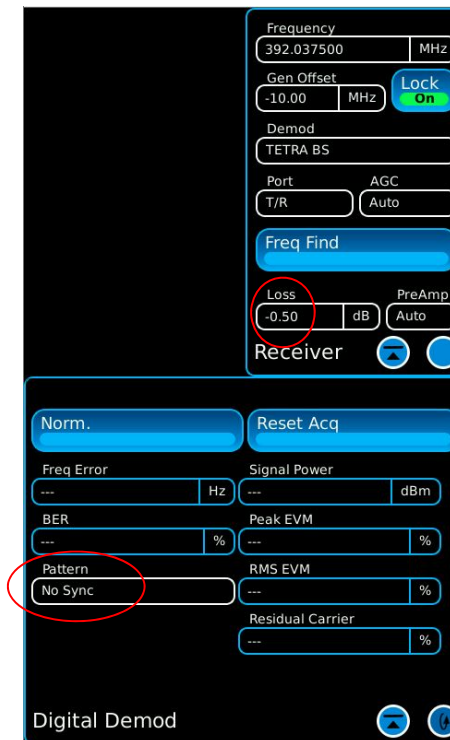


Note: Generator must be enabled for the 3550R to transmit.



# TETRA BS Transmitter Setup in T1 Test Mode

- A typical screen configuration for testing a TETRA transmitter is shown to the right.
  - The Receiver window is expanded to show all of the fields.
    - Set the Loss field with the cable loss value. Should be a negative value.
  - The Pattern field should be set to “No Sync”.



# TETRA BS Transmitter Testing in T1 Test Mode

- Enable the transmitter of the base station with a T1 signal.
  - The procedure to enable the transmitter is manufacture dependent.
- Verify the measurements meet the specification of the BS manufacture and the TETRA standard.





# TETRA Standard for Base Stations

- The TETRA standard specifies the following limits under normal conditions:
  - Transmitter
    - Peak EVM: < 30%
    - RMS EVM: < 10%
    - Residual Carrier < 5%
    - Freq Error
      - $\leq \pm 0.2$  ppm ( $\leq 520$  MHz) ( $\pm 78$  Hz at 390 MHz)
      - $\leq \pm 0.1$  ppm ( $> 520$  MHz) ( $\pm 80$  Hz at 800 MHz)
    - Signal power  $\leq \pm 2.0$  dB of nominal value specified for the BS
  - Receiver
    - Static reference sensitivity: -115 dBm



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