8800SX
TETRA Base Station
Operation

8800SX TETRA Base Station Test

- The 8800SX 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

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Setting up the 8800SX for TETRA

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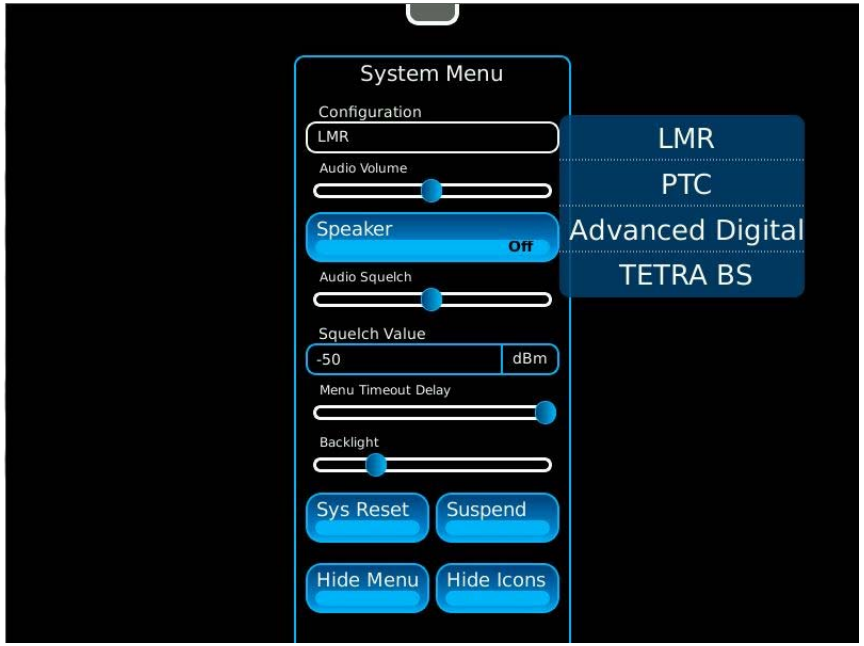
Selecting the TETRA BS (Base Station) Mode

- 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)



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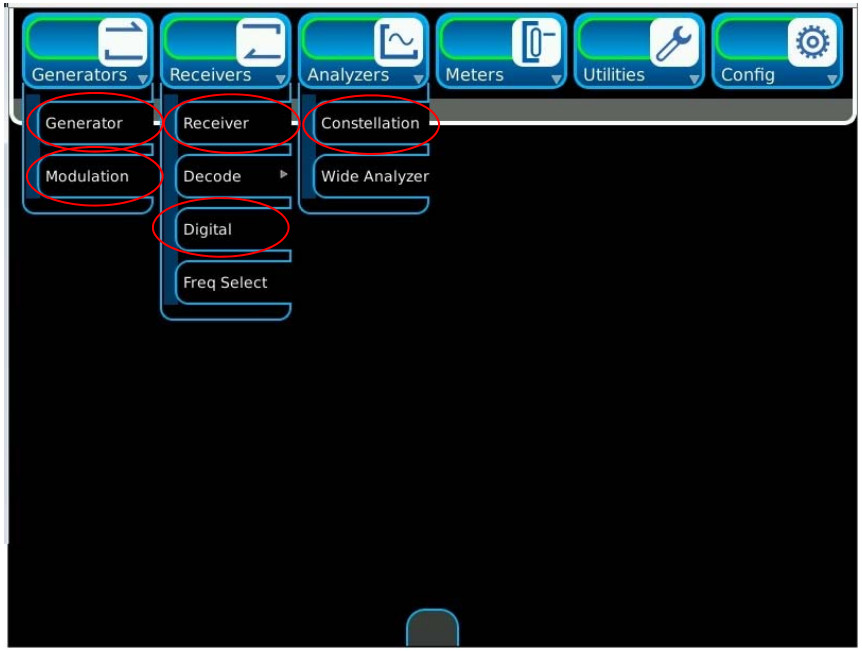
Example of setting up the screen for TETRA BS Testing

- The Diagram, shown to the right, is a partially exploded view of the menu structure of the 8800SX.
  - The red ellipses indicate the TETRA windows that are selected for the example TETRA BS test setup.



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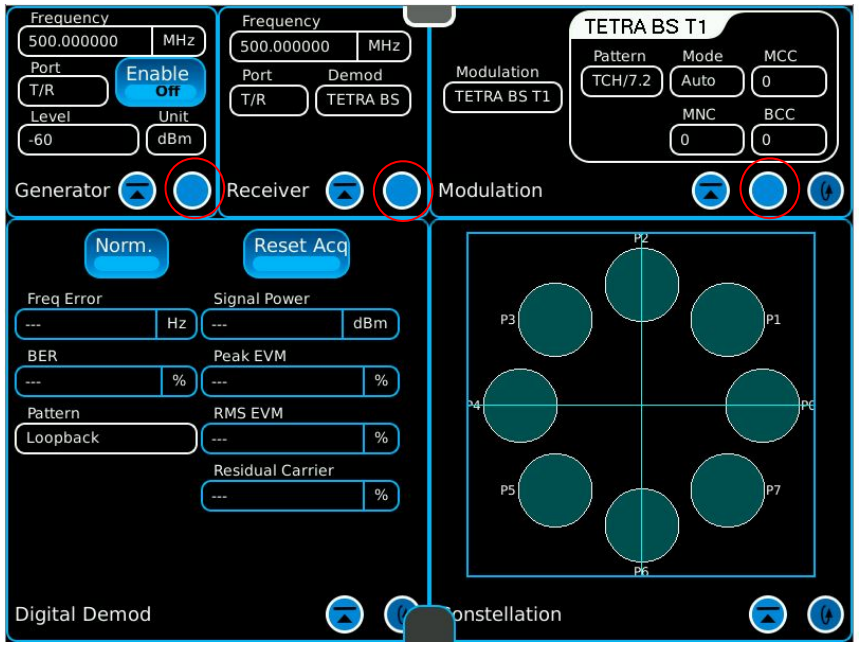
Example TETRA BS Setup

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



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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.
- These field values are the default parameters.
  - To select default parameters:
    - Press the button just below the display
    - Select “Sys Reset”

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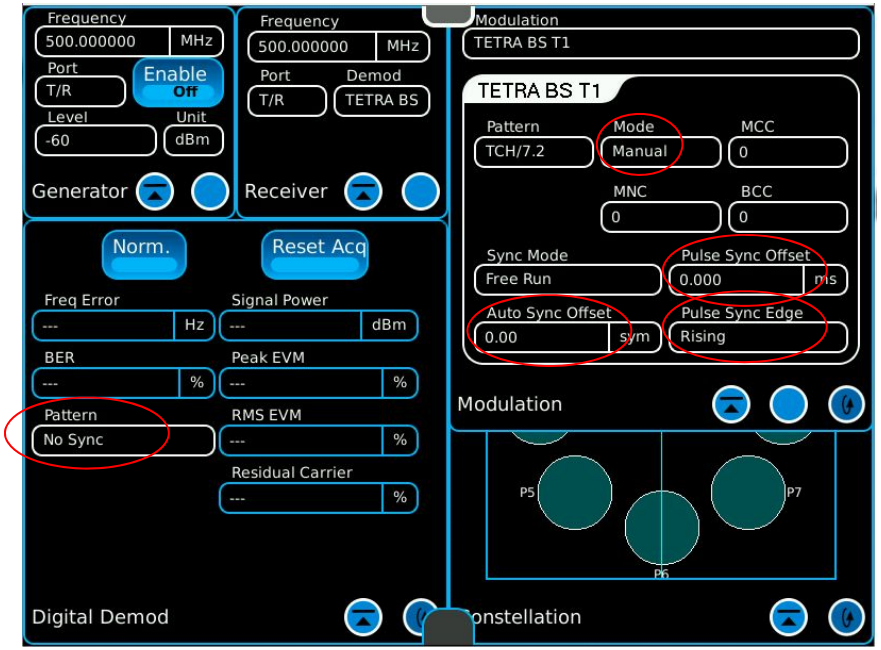
TETRA BS Setup

- Setup TETRA to match the screen to the right.
  - Modulation window changes:
    - Mode: Manual
    - Pulse Sync Offset: 0
    - Auto Sync Offset: 0
    - Pulse Sync Edge: Rising
  - Digital Demod changes:
    - Pattern: No Sync
- All other parameters are default



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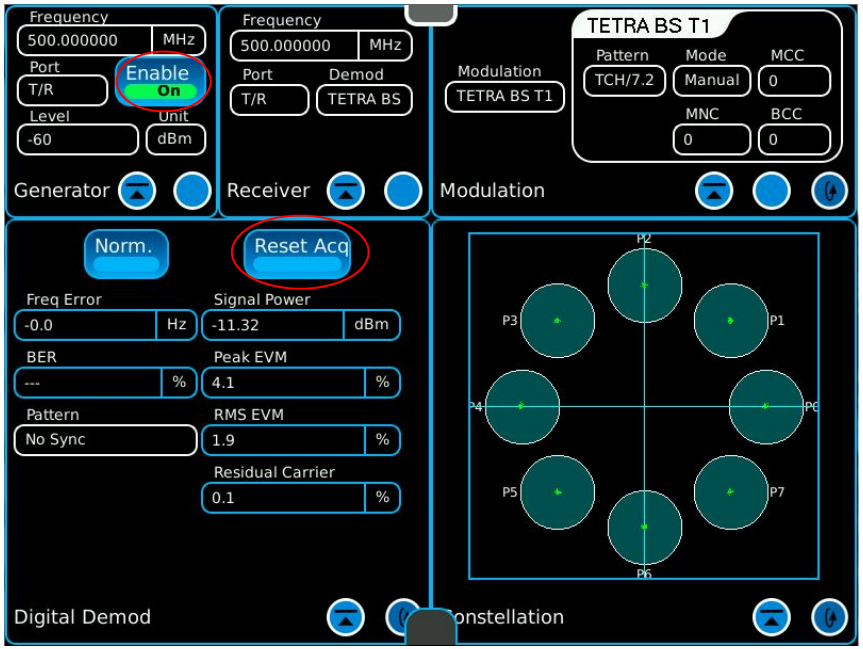
TETRA BS Loopback operation

- Setup for loopback mode operation
  - Enable the Generator
  - Minimize the Modulation Window by pressing the blue circle.
  - Touch “Reset Acq”
- The operation should match the display in the screen to the right.



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TETRA Over-The-Air Testing

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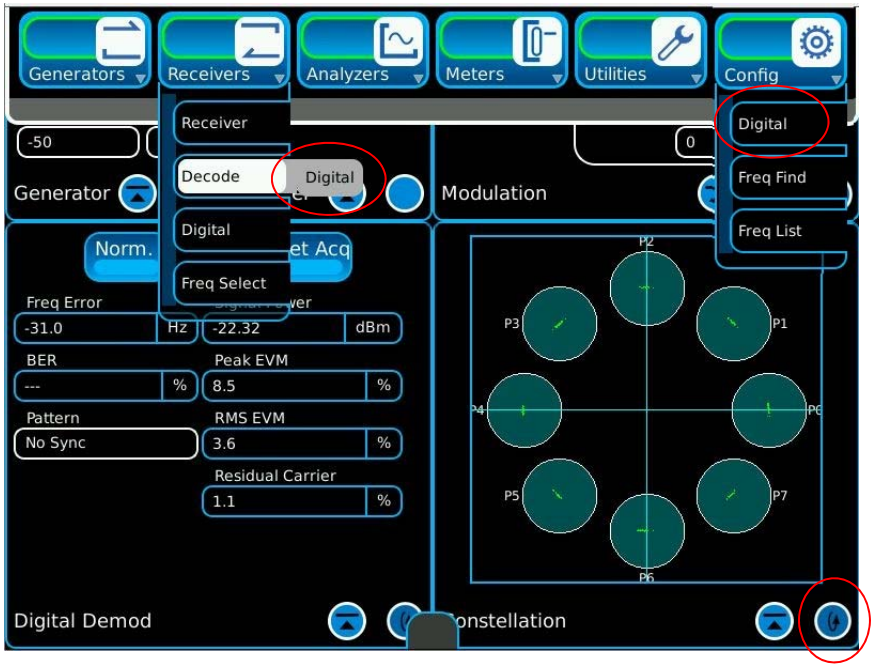
Setting up for TETRA BS OTA (Over-The-Air) Testing

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



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TETRA BS OTA Testing

- Expand 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).

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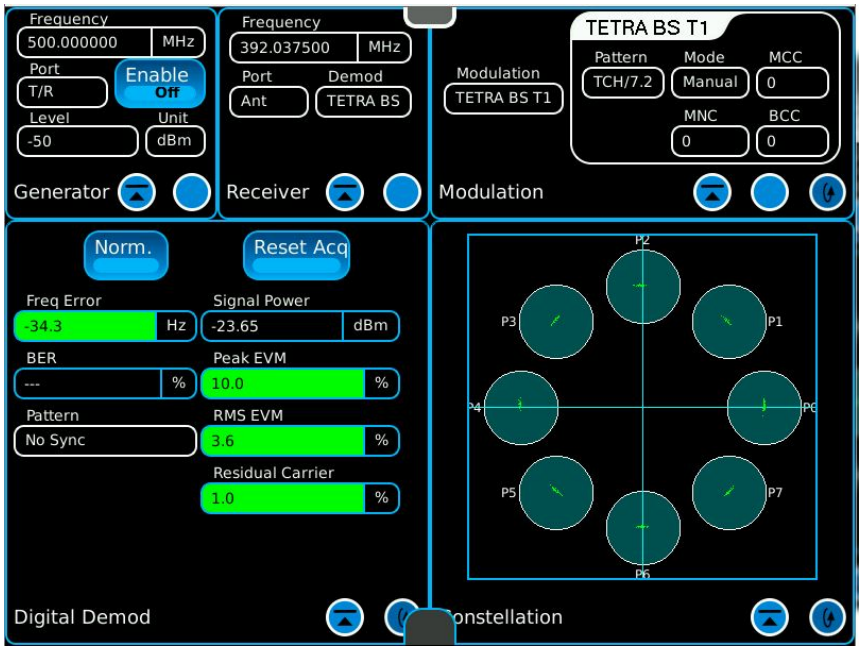
TETRA BS OTA Measurements

- 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.



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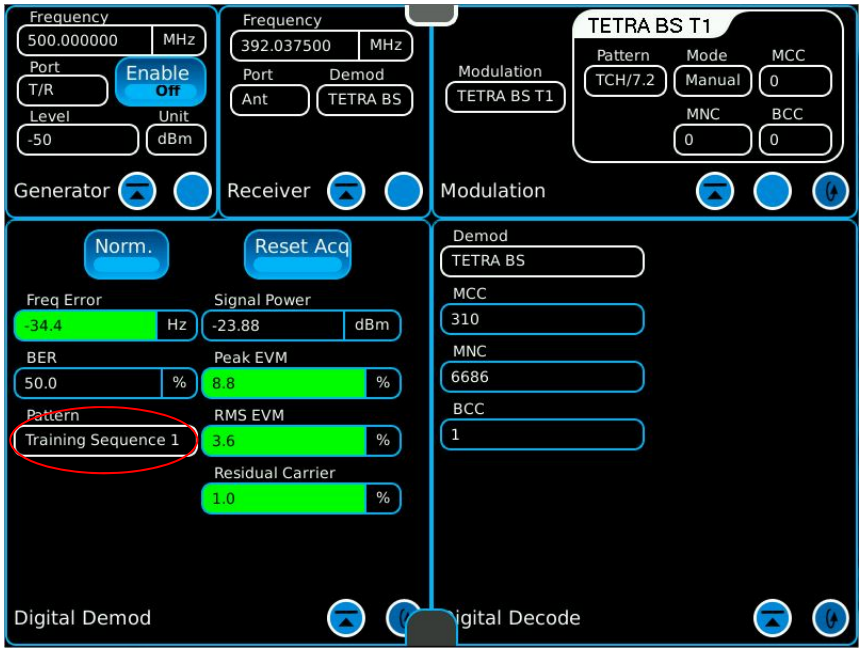
TETRA BS Digital Decode

- This screen to the right shows a 8800SX 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”.



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TETRA Testing Using T1 Mode

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Testing TETRA Base Stations in T1 Test Mode

- The 8800SX 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 8800SX supports all manufacture methods of implementation.

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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 8800SX, these two methods are called:
    - Auto Synchronization Mode
    - Pulse Synchronization Mode

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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 8800SX uses the MCC, MNC, and BCC values received from the base station.
    - “Auto Sync Offset” value should be set according to the manufacture.

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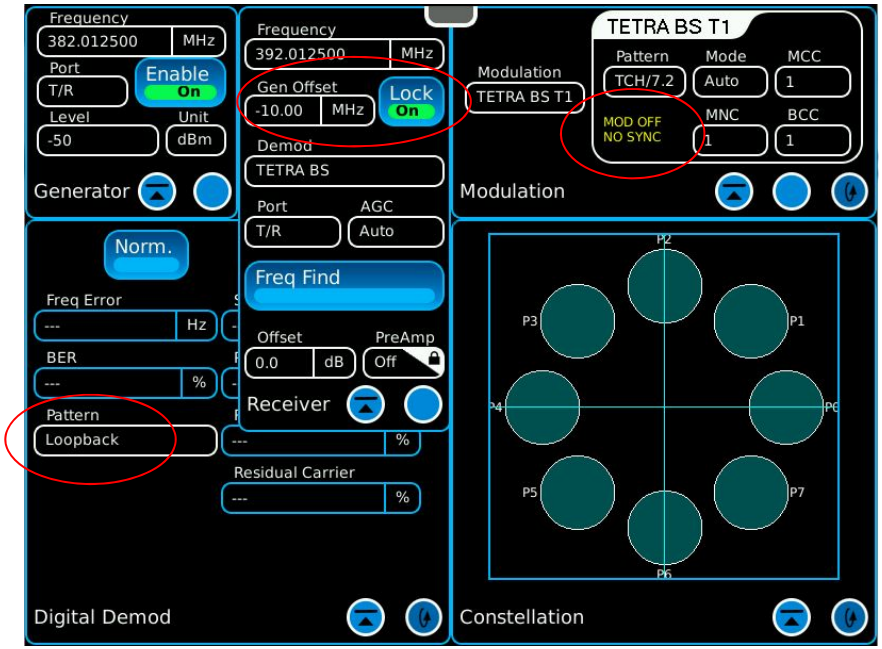
TETRA Receiver Testing in Auto Sync Mode

- 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.
- “MOD OFF, NO SYNC” indicates that the 8800SX is not transmitting, since it not synchronized to the base station.



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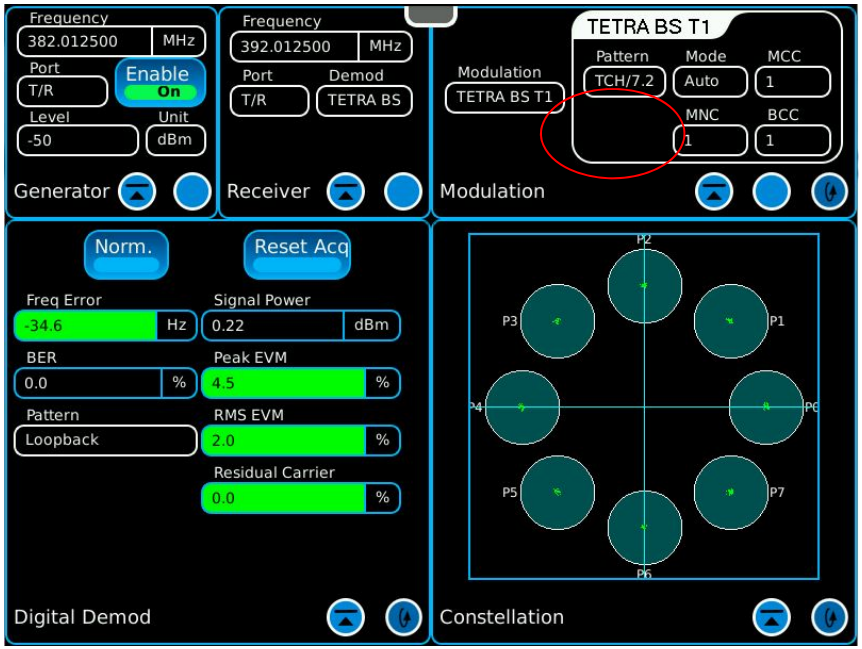
TETRA Receiver Testing in Auto Sync Mode

- When the 8800SX begins to receive the signal from the base station:
  - The “MOD OFF / NO SYNC” goes away (if Generator is enabled).
  - The 8800SX 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.



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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”

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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 8800SX.
  - If the Generator is Enabled, the “MOD OFF / NO SYNC” indication in the Modulation tile will go away.
- The 8800SX should now be transmitting.
  - Adjust the Generate level to find the sensitivity of the BS.

Note: Generator must be enabled for the 8800SX to transmit.

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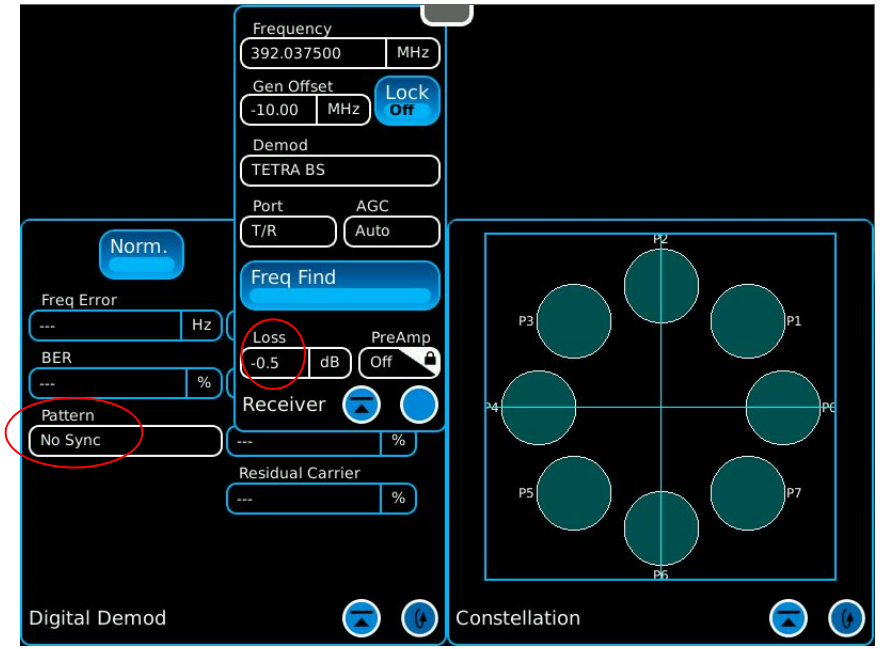
TETRA BS Transmitter Setup in T1 Test Mode

- 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”.



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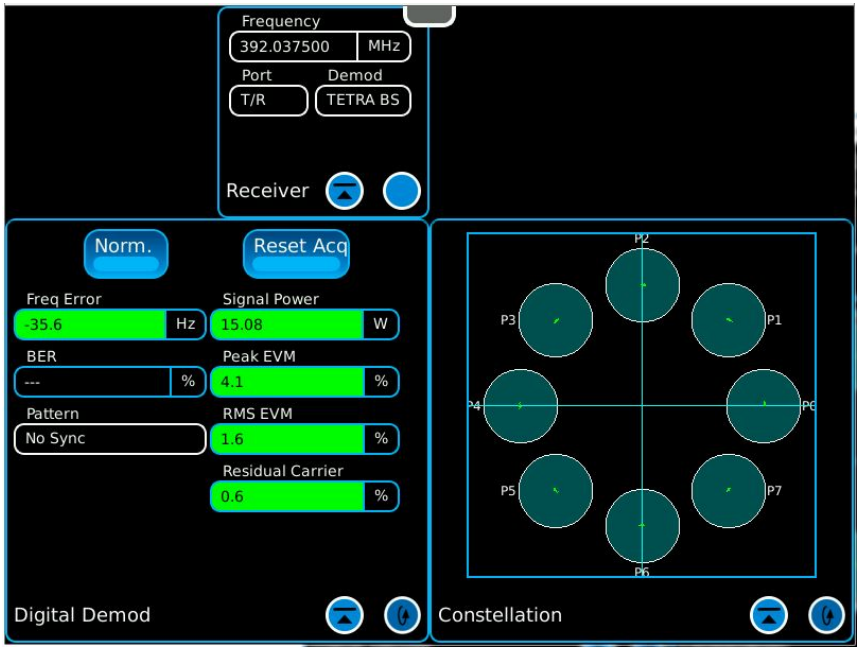
TETRA BS Transmitter Testing in T1 Test Mode

- 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.



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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
      - ≤ ±0.2 ppm (≤ 520 MHz) (± 78 Hz at 390 MHz)
      - ≤ ±0.1 ppm (> 520 MHz) (± 80 Hz at 800 MHz)
    - Signal power ≤ ±2.0 dB of nominal value specified for the BS
  - Receiver
    - Static reference sensitivity: -115 dBm

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