Application Note

Using the 3920 for P25 Performance Testing

The objective of this application note is to show the advantage of using the Aeroflex 3920 Radio Test Set for P25 Performance Testing. The 3920 can be an integral part in reducing the complexity and cost of performing these tests.

TIA has defined a subset of the transceiver tests (from TIA-102.CAAA-B) to be part of the P25 compliance assessment program (CAP). The purpose of the P25 compliance assessment program is to demonstrate that P25 base stations and subscriber units are compliant with a select group of requirements chosen from the P25 suite of standards.

P25 compliance consists of three legs:

1) P25 performance

2) P25 conformance

3) P25 interoperability

This app note will cover the P25 performance leg.

The TIA TR8 subcommittee has outlined the requirements for performance testing in several documents, each covering the requirement for a certain type of radio.

- Conventional mode subscriber unit – TSB-102.CBBA
- Conventional mode fixed station – TSB-102.CBBC
- Trunking mode subscriber unit – TSB-102.CBBF
- Trunking mode fixed station – TSB-102.CBBH

With this application note, we will illustrate the role of the Aeroflex 3920 Series Radio Test Set (referred to in this app note as the 3920) and other Aeroflex products in performing these vital tests. The 3920 is an integral part in these tests and can greatly simplify the process of setting up and performing the tests.

We have divided this application note into three sections. The first section will cover the receiver tests, the second section the transmitter tests and the third section the trunking tests. Each of the tests will be described along with a block diagram that illustrates the use of the 3920 in performing these tests. The general setup will always include a 3920 and the radio under test, but will also often include other test equipment.

Other equipment necessary to do these tests:

1) Aeroflex PXI-based signal generators

2) Storage oscilloscope

3) Fading simulator

4) RF combining network

5) RF load

6) RF switch

7) Audio load

8) FM demodulator

9) RF detector

10) Key switch control

Along with the test setup we will include a brief description of how to perform the tests, but the TIA-102.CAAA- B document should be the final authority on how you should perform each of the tests.

References

TIA Documents

1) TIA-102.CAAA-B, Digital C4FM/CQPSK Transceiver Measurement Methods

2) TIA-102.CAAB-B, Land Mobile Radio Transceiver Performance Recommendations - Project 25 - Digital Radio Technology C4FM/CQPSK Modulation

3) TSB-102.CBBA, Project 25 Compliance Assessment Program Definition of Compliance Assessment - Conventional Mode Subscriber Unit Transceiver Performance

4) TSB-102.CBBC, Project 25 Compliance Assessment Program Definition of Compliance Assessment - Conventional Mode Fixed Station Transceiver Performance

5) TSB-102.CBBF, Project 25 Compliance Assessment Program Definition of Compliance Assessment - Trunking Mode Subscriber Unit Transceiver Performance

6) TSB-102.CBBH, Project 25 Compliance Assessment Program Definition of Compliance Assessment - Trunked Mode Fixed Station Transceiver and Related Infrastructure Performance

Related Application Notes

1) PXI-based Radio Communications Testing

2) Understanding P25 Modulation Fidelity

Receiver Tests

Reference Sensitivity

Definition of Test

Reference sensitivity is a determination of the level of the signal that produces the standard bit error rate in the receiver. The TIA standard specifies the standard bit error rate to be 5%. This measurement is performed by generating the standard tone test pattern and then reducing the level of the RF signal until the number of errors in the receiver, as a percentage of the total number of bits transmitted, is 5%. The RF level that produces the standard bit error rate is the reference sensitivity.

Test Setup

Figure 1 illustrates the setup for this test. From this block diagram, you can see that the RF output of the 3920 is the T/R port. This port should be connected to the receive port of the receiver under test.

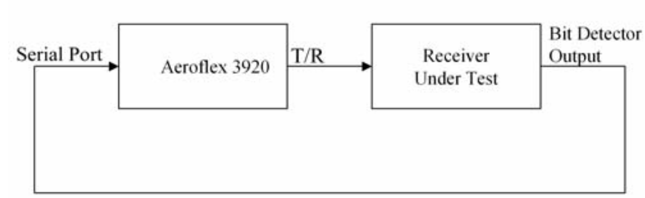

Figure 1– Reference Sensitivity Block Diagram

The bit error rate, depending on the manufacture of the radio, may be measured in different manners. Some radios have a built-in BER measurement that takes the detected bit stream from the received signal and compares it with the standard tone test pattern. Others radios have a bit detector output, and an external

BER detector measures the bit error rate. If the radio supports the latter, then the bit detector output should be connected to the serial port of the 3920 (Figure 1). Either way, the receiver under test will probably need to be switched into a test mode to perform a bit error rate test.

Setting up the 3920

The Aeroflex 3920 has the capability of both generating the standard tone test pattern and measuring receiver bit error rate from the P25 system (Figure 2). You can select the standard tone test pattern from the RF control tile pattern drop down menu. This pattern in the drop down menu is called STD 1011.

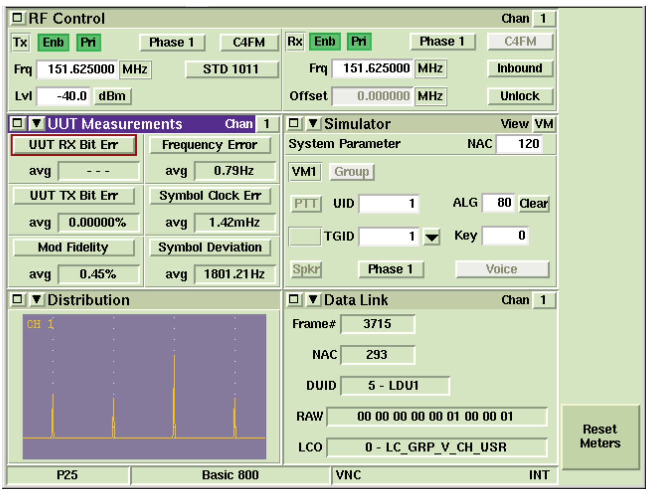

Figure 2 – P25 Screen

The 3920 serial input expects this signal to have RS-232 levels. The serial input of the 3920 should be set to ttyS0 and the baud rate must be set to 19200 baud. Setting this configuration is achieved from the ports configuration screen (Figure 3). Access this screen from the P25 configuration menu.

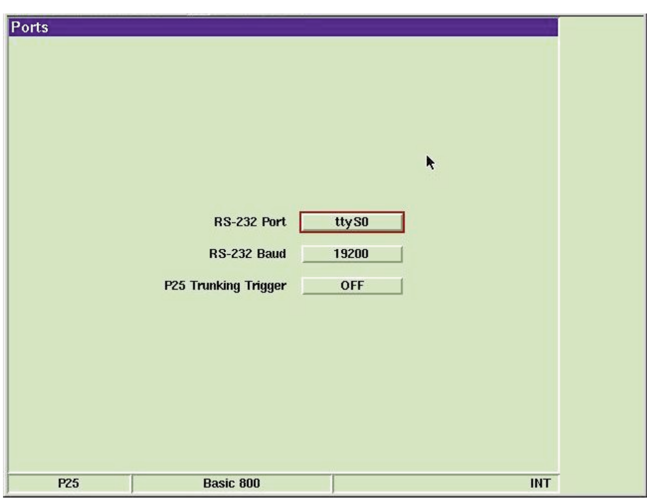

Figure 3- P25 Ports Configuration Screen

Measuring the bit error rate is done with the UUT RX bit error meter. Select this meter from any of the meter fields in the UUT measurements tile. To start the UUT RX bit error meter, maximize the UUT measurements tile, and then toggle the "Enabled/Disabled" field to Enabled (Figure 4).

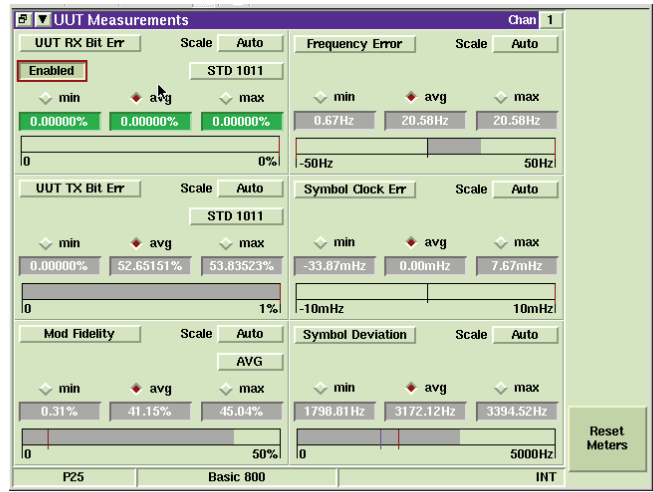

Figure 4 – UUT Measurements Tile Shown Maximized

You must also select the STD 1011 pattern from the drop down menu that is part of the UUT RX Bit Err meter. This determines which pattern the UUT RX Bit Err meter uses to compare the received bit stream against.

Performing the Test

Once the setup has been completed, performing the test is very simple. From the RF Control tile Lvl field, you can control the generate level of the 3920. Adjust this level until the RX Bit Err meter displays 5%, or in case of mobiles that calculate and report their own BER, until the mobile reports a BER of 5%.

Faded Reference Sensitivity

Definition of Test

Faded reference sensitivity is very similar to the reference sensitivity test. This test, again, measures the level of signal that produces a 5% bit error rate in the receiver under test. The only difference is the presence of a fading simulator between the 3920 and the receiver under test.

Test Setup

The test setup is shown in Figure 5. You should connect the fading simulator between the RF output of the 3920 and the input of the receiver under test. The rest of the setup is the same as the reference sensitivity test.

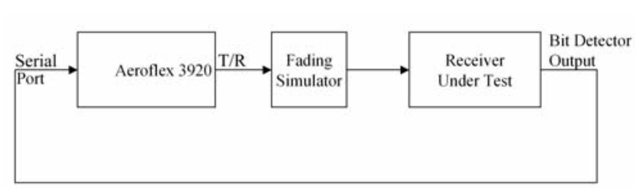

Figure 5 – Faded Reference Sensitivity Block Diagram

Setting up the 3920

The configuration of the 3920 is the same as the reference sensitivity test. The one addition is a setup of the number of samples to average. The user can select the average to be from 1 to 1,000 sample periods. The RX bit error meter uses 1,728 bits for each sample period. For the faded reference sensitivity test, the requirement is that the measurement should be made over t seconds, where t is defined as:

t = 180,000/((FMHz) (Skm/h))

FMHz is the frequency of the receiver under test in MHz.

Skm/h is the vehicle speed used for the fading simulation in kilometers per hour.

Since 1,728 samples (1 sample period) at 9,600 bps would represent a time of 180 milliseconds, to determine the number of sample periods, calculate t and divide by 0.18. An example would be testing a receiver at 405.625 MHz with a raleigh fade corresponding to a vehicle speed of 8 km/h.

t = 180,000/(8 * 405.625) = 55.47 s

and

55.47/0.18 = 308.2

Therefore, for this example, you would use 309 sample periods. You can set up the number of sample periods to average in the P25 UUT measurements limits configuration screen (Figure 6).

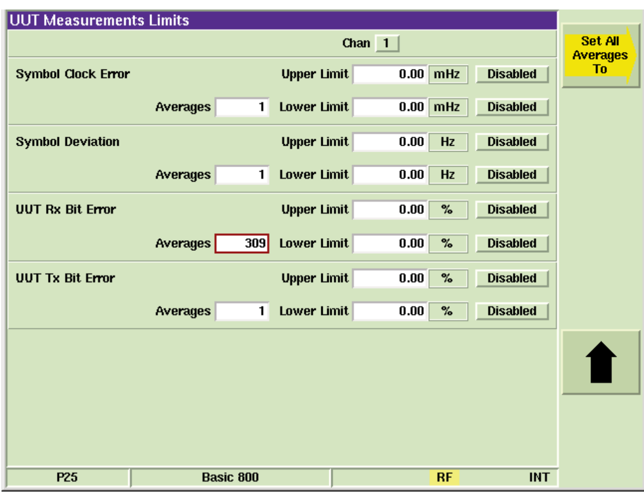

Figure 6 – UUT Measurements Limits Screen

Performing the Test

After the setup is completed, the instructions for performing this test are the same as the reference sensitivity test. Since averaging is being used for this test, to reset the meter and restart the averaging, simply press the "Reset Meter" softkey. This should probably be done each time the RF output level is changed to get an accurate average of the bit error rate.

Signal Delay Spread Capability

Definition of Test

Signal delay spread capability is a determination of the amount of delay between two independently faded signals that will produce a 5% BER in the receiver under test. Each signal is transmitted at the standard input signal level, which is defined as -47 dBm.

Test Setup

The illustration of this test is the same as the test setup used in faded reference sensitivity (see Figure 5).

Setting up the 3920

To set up the 3920 for this test, follow the description of setting up the 3920 used in the faded reference sensitivity test.

Performing the Test

Performing this test is a matter of adjusting the delay between the two faded signals until the BER is 5%. This test is performed for faded simulations of both 8 km/h and 100 km/h.

Adjacent Channel Rejection

Definition of Test

Adjacent channel rejection is a determination of the level of an unwanted interferer in an adjacent channel that reduces the sensitivity of the receiver under test by 3 dB. The test is performed by combining a wanted signal at 3 dB above reference sensitivity with an interferer in an adjacent channel. The difference between the reference sensitivity and the level of the adjacent channel interferer is the amount of adjacent channel rejection of the receiver.

Test Setup

For this test, the 3920 is used as the generator for the wanted signal, and a signal generator, like the Aeroflex-PXI based signal generator, is used as the unwanted interferer. These two signals are combined with an RF combining network (also part of the Aeroflex PXI) and connected to the antenna of the receiver under test. The 3920 generates the standard tone test pattern, and the signal generator is modulated with the standard interference test pattern.

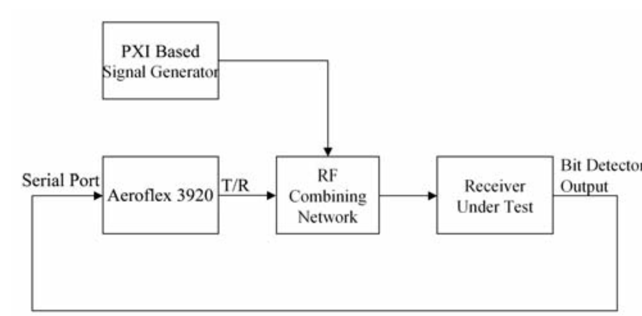

Figure 7 - Adjacent Channel Rejection Block Diagram

The setup for this test has been described in more detail in the application note "PXI-based Radio Communications Testing."

Setting up the 3920

The setup for this test is the same as the Setting up the 3920 section for the reference sensitivity test.

Performing the Test

Performing this test is a process of finding the sensitivity level without the interferer and then finding the level of the interferer that, when mixed with the wanted signal at 3 dB above sensitivity, leads to a BER of 5%. This ratio of the level of the interferer to the reference sensitivity level is used to calculate the adjacent channel rejection as well as the offset adjacent channel rejection.

Co-Channel Rejection

Definition of Test

Co-channel rejection is a determination of the level of a co-channel interferer that reduces the sensitivity of the receiver under test by 3 dB. The test is performed by combining a wanted signal at 3 dB above reference sensitivity with an interferer on the same channel. The level of the interferer is adjusted until the BER of the receiver under test is 5%. The difference between the reference sensitivity and the level of the co-channel interferer is the amount of co-channel rejection of the receiver.

Test Setup

This setup is the same as the test setup for the adjacent channel rejection test (see Figure 7).

Setting up the 3920

The setup of the 3920 is the same as the reference sensitivity test.

Performing the Test

The process of performing this test is very similar to the adjacent channel rejection test. One difference to the procedure, though, is that the interfering signal is on the same frequency as the wanted signal. After finding the reference sensitivity of the receiver, raise the level of the wanted signal by 3 dB. Then find the level of the interferer that will produce a BER of 5% in the receiver under test. The difference between the reference sensitivity and the level of the interferer is the co-channel rejection.

Intermodulation Rejection

Definition of Test

Intermodulation rejection is a determination of the level of two unwanted interferers, at 50 kHz and 100 kHz offset, that reduces the sensitivity of the receiver under test by 3 dB. The test is performed by combining a wanted signal at 3 dB above reference sensitivity with the two interferers. The level of the interferers is adjusted until the BER of the receiver under test is 5%. The difference between the reference sensitivity and the level of the two interferers is the amount of intermodulation rejection of the receiver.

Test Setup

This setup includes two signal generators used as the interferers combined with the 3920 used as the wanted signal (Figure 8). The signal generator at 50 kHz offset is unmodulated while the signal generator at 100 kHz offset is modulated with the standard interference test pattern (specified in TIA-102.CAAA-B). Using the Aeroflex PXI-based signal generators for this test is described further in the application note "PXI-based Radio Communications Testing."

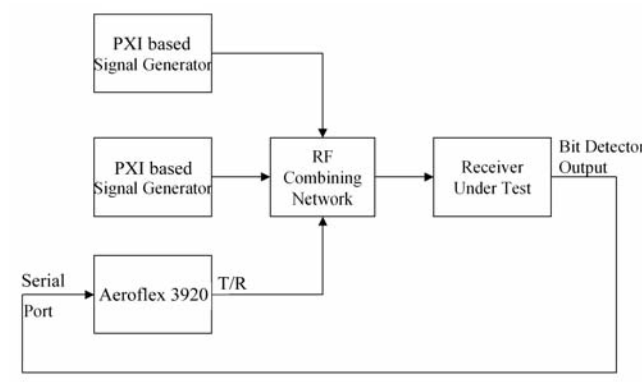

Figure 8 - Intermodulation Rejection Block Diagram

Setting up the 3920

The setup for this test is the same as the setting up the 3920 section for the reference sensitivity test.

Performing the Test

This test starts with setting the level of the 3920 at 3 dB above the level of reference sensitivity. The output level of the two PXI signal generators should then be changed to the level that results in a bit error rate in the receiver under test of 5%. This resulting level minus the reference sensitivity level is the intermodulation rejection.

Signal Displacement Bandwidth

Definition of Test

Signal displacement bandwidth is a determination of the input frequency displacement that reduces the sensitivity of the receiver under test by 6 dB. The test is performed by adjusting the frequency of an input signal that is 6 dB above reference sensitivity until the BER of the receiver under test is 5%. The amount that the frequency of the input signal is changed is the signal displacement bandwidth.

Test Setup

The block diagram for this test is the same as the reference sensitivity test (Figure 1).

Setting up the 3920

The setup of the 3920 is the same as the reference sensitivity test.

Performing the Test

Adjust the level of the 3920 to 6 dB above the reference sensitivity. Next, adjust the RF frequency of the 3920 transmitter up or down from the frequency of the receiver under test until the bit error rate of the receiver is 5%.

Late Entry Unsquelched Delay

Definition of Test

Late entry unsquelched delay is a determination of the time that it takes a receiver under test to produce audio when it receives a P25 voice frame starting with LDU1 or LDU2. Late entry means that the receiver has missed the header data unit and the synchronizing preamble and must find synchronization in the middle of the message. This test is performed at both the start of LDU1 and the start of LDU2.

Test Setup

Figure 9 shows a block diagram for the setup of this test with the 3920. The 3920 Sync I/O output is the source for a trigger that is critical for this test. This trigger is used both for triggering the oscilloscope and for switching the input of the receiver under test from the RF load to the T/R output of the 3920. This trigger transitions from a low to high state whenever the 3920 begins to transmit the LDU1 or LDU2 pattern. The trigger stays high until the LDU1 or LDU2 pattern is disabled.

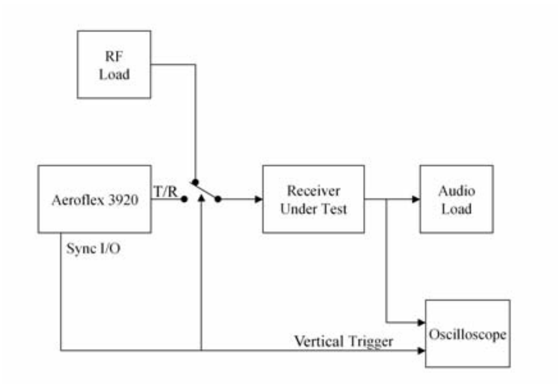

Figure 9 – Late Entry Unsquelched Delay Block Diagram

The audio output of the receiver under test should be connected to the vertical input of the oscilloscope (as well as an audio load). The oscilloscope can then be used to measure the time from the trigger input going high to the start of the audio from the receiver under test.

Setting up the 3920

The 3920 is set up in the P25 conventional mode of operation with either pattern LDU1 or LDU2 selected from the RF control tile (see Figure 10). Initially, the Enb for the transmitter is disabled, indicated when this button is grey. The level of the output of the 3920 should be set at the reference sensitivity level of the receiver under test.

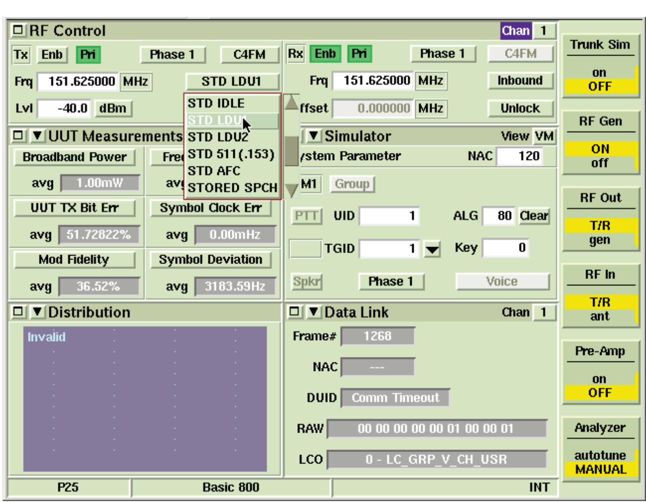

Figure 10 - P25 Setup for Late Entry Unsquelched Delay

Selecting the Enb button enables the start of the 3920 transmitting at the start of LDU1 or LDU2, whichever pattern is selected. Synchronous with the start of the pattern, the Sync I/O output transitions from a low to a high (Figure 11).

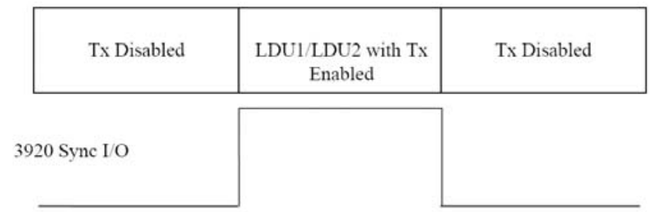

Figure 11 - LDU1/LDU2 Timing Diagram

As long as LDU1 or LDU2 is selected as the pattern and the Enb button is green, the 3920 Sync I/O output is high. When the Tx is disabled by again selecting the Enb button, the 3920 Sync I/O line returns to the low state.

Performing the Test

Start this test by selecting the Enb button on the 3920. This starts the transmission of the 3920 at the start of LDU1/LDU2 (whichever is selected) and simultaneously changes the state of the Sync I/O output from a low to a high. The time that the scope is triggered by the Sync I/O output to the time that the audio out changes to a 1011 Hz tone is the late entry unsquelched delay.

Receiver Throughput Delay

Definition of Test

Receiver throughput delay is a measurement of the time that it takes a receiver to produce audio when receiving a P25 signal. The measurement is made by switching the P25 signal from the standard silence pattern to the standard tone test pattern. A scope is triggered synchronous with the pattern change, and the time from the trigger to the start of the audio is the receiver throughput delay.

Test Setup

Figure 12 illustrates the setup for performing this test with the 3920. The Sync I/O output of the 3920 is used to trigger the oscilloscope when the pattern changes from the standard silence test pattern to the standard tone test pattern. The T/R port of the 3920 connects to the antenna port of the receiver under test. The audio output of the receiver under test is terminated into an audio load and routed to a vertical input of the oscilloscope.

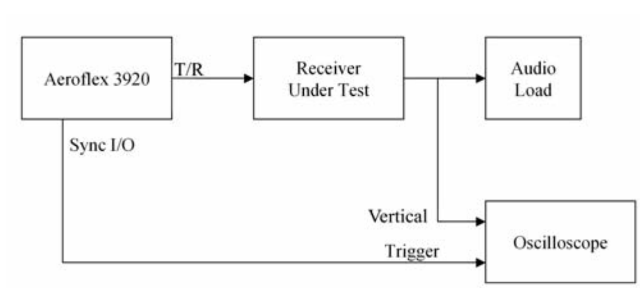

Figure 12 - Receiver Throughput Delay Block Diagram

Setting up the 3920

This test is performed from the P25 system in the 3920. Figure 13 shows the initial setup for this test. The transmitter should be enabled and the STD SILENCE pattern should be selected from the transmit pattern drop down menu.

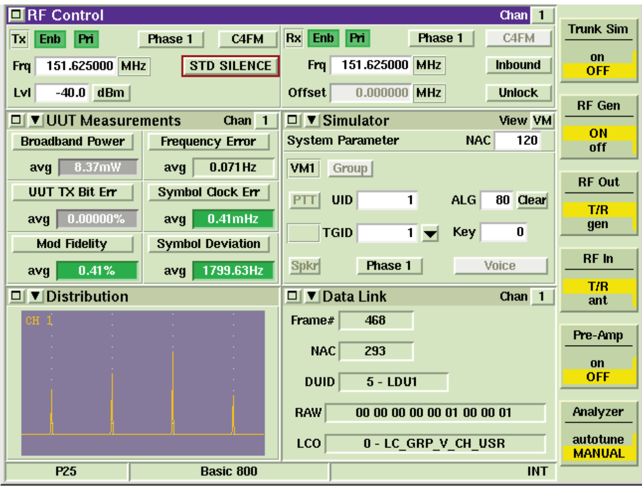

Figure 13 - 3920 Setup for Receiver Throughput Delay

The next pattern selected should be the standard tone test pattern. This pattern is called STD 1011 in the transmit pattern drop down menu. When the pattern switches from STD SILENCE to STD 1011, the Sync I/O output switches from a low to a high and stays high until the STD SILENCE pattern is reselected (Figure 14).

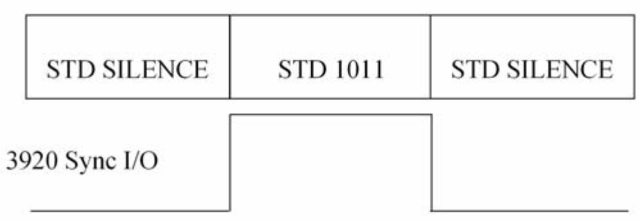

Figure 14 - STD SILENCE/STD 1011 Timing Diagram

Performing the Test

This test is performed by switching the pattern from STD SILENCE to STD 1011 and with the use of the oscilloscope, measuring the time from the Sync I/O going high to the time that the audio goes from silence to a 1011 Hz tone.

Transmitter Tests

Frequency Deviation for C4FM

Definition of Test

Frequency deviation for C4FM is a measurement of the FM deviation that results from two specified patterns. The first is a low deviation pattern that should result in a deviation of less than 1037 Hz, but greater than 848 Hz. The second is a high deviation pattern that should result in a deviation of less than 3111 Hz, but greater than 2544 Hz.

Test Setup

The block diagram for this test is very simple (Figure 15). Connect the output of the transmitter under test to the T/R port of the 3920.

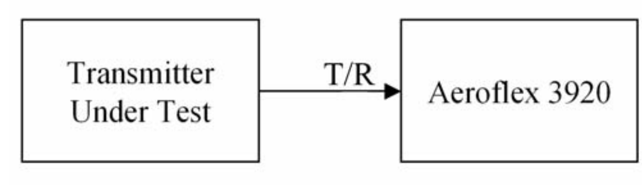

Figure 15 - Frequency Deviation Block Diagram

Setting up the 3920

The analog duplex system on the 3920 should be selected for this test, as this is simply a measurement of the amount of FM deviation. Figure 16 is an illustration of the setup of the 3920 for performing an FM deviation test. The standard states that the audio filters for this measurement should be set with a high pass corner of 15 Hz and a low pass corner of 3 kHz with the de-emphasis filters turned off. On the 3920, this means that the 3 kHz lp filter should be selected and the modulation should be set to FM. You should also select Pk hold in the FM Dev meter.

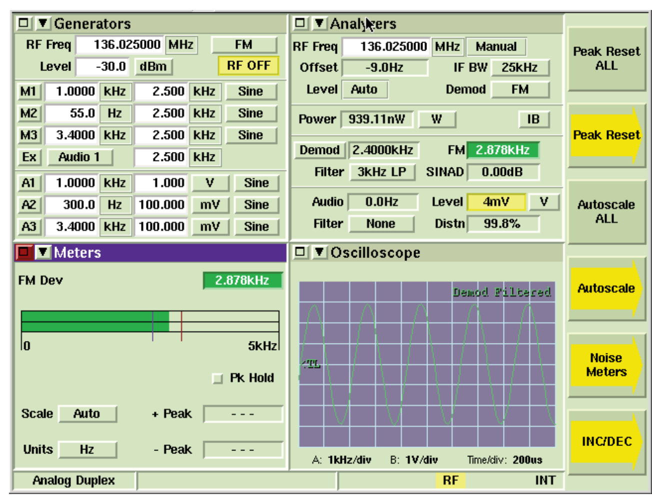

Figure 16 - 3920 Configuration for FM Deviation

Performing the Test

The transmitter under test should be modulated with the standard transmitter symbol rate pattern. After the FM deviation meter settles, press the peak reset all softkey. After a few seconds, record the plus and minus peak deviation. Next modulate the transmitter with the standard low deviation test pattern. Reset the peak deviations by pressing the peak reset all softkey. After a few seconds, record the plus and minus peak deviation.

Modulation Fidelity

Definition of Test

Modulation fidelity is a measurement of the degree of closeness that the modulation follows the ideal theoretical modulation. The result of this measurement is three separate but related parameters. The standard refers to these three parameters as frequency offset, deviation and rms deviation error. To find out more about this measurement and the three parameters, see the application note, "Understanding P25 Modulation Fidelity."

Test Setup

The setup for this test is similar to the frequency deviation for C4FM test shown in Figure 15. The transmitter under test should be connected to T/R port of the 3920.

Setting up the 3920

The P25 system is selected on the 3920 to perform the modulation fidelity test. The UUT measurements tile includes the meters to measure the three parameters associated with modulation fidelity. These three meters are labeled:

1) Frequency error (called frequency offset in the standard)

2) Symbol deviation (called deviation in the standard)

3) Modulation fidelity (called rms deviation error in the standard)

Figure 17 shows the setup of the 3920 P25 screen with the UUT measurements tile maximized. This tile includes these three meters that display the modulation fidelity parameters.

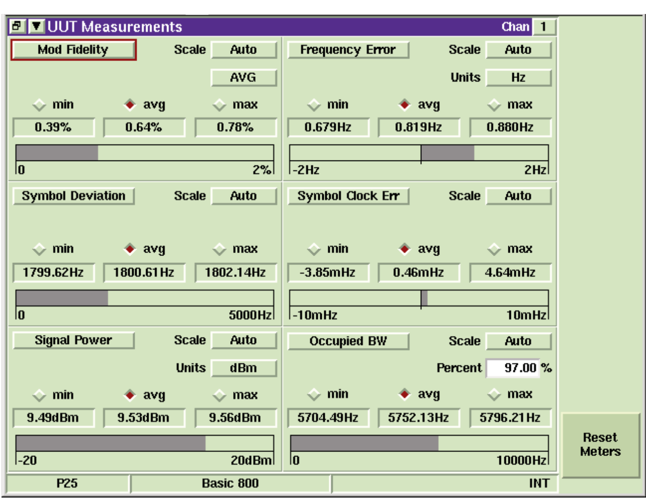

Figure 17 - P25 Screen Showing UUT Measurement Tile

Performing the Test

Modulate the transmitter with the standard transmitter test pattern. Record Mod Fidelity, Symbol Deviation and Frequency Error.

Trunking Tests

Trunking Control Channel Slot Times

Definition of Test

Trunking control channel slot times is a determination of how well a subscriber radio positions an inbound signaling packet burst into a trunking control channel slot. The inbound signaling packet for this test is a channel request message that the radio sends whenever the PTT is pressed. Measurements are made of the position of the start of the RF burst as well as the start of the synchronization word. These measurements are made with respect to the position of the slot boundaries. The slot boundaries are located at the point that the status bits, which are interleaved throughout the control channel, indicate busy or idle. This may be every 37.5 or 45 ms, depending on whether the busy/idle status bits are spaced at 5 or 6 micro-slots. The start of the RF burst and the synchronization word must occur no later than 4.15 ms after a slot boundary for a 37.5 ms slot or 11.65 ms for a 45 ms slot. The burst must end no later than 1.57 ms before the next slot boundary.

Test Setup

The block diagram for the trunking control channel slot times test is shown in Figure 18. The antenna connection of the radio under test should be connected both to the 3920 and an RF load. The 3920 is used for the trunking simulation and to generate the slot boundary indications. The slot boundary output of the 3920 is the Sync I/O port and should be connected to one of the vertical inputs of the oscilloscope. The output of the RF load is routed to an RF detector and an FM demodulator. The RF detector will be used to determine the location of the burst. The FM demodulator will be used to find the location of the synchronization word. Finally, a key control switch is used to both key up the radio under test and trigger the oscilloscope.

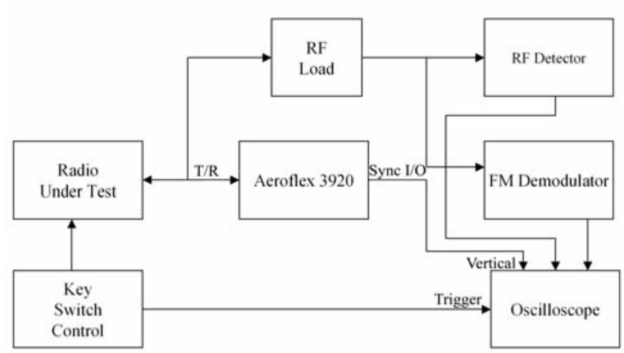

Figure 18 - Trunking Control Channel Slot Times Block Diagram

Setting up the 3920

In order to perform this test, the P25 system in the 3920 should be selected. The P25 system should be set up for P25 trunking operation. This can be most easily accomplished by recalling the sample setup for P25 trunking and then making the modifications necessary for working with the radio under test. These modifications include setting up a channel plan (Figure 19) that matches the channel plan of the radio and then selecting a control channel and voice channel. An example of a 3920 P25 screen setup for trunking operation is shown in Figure 20.

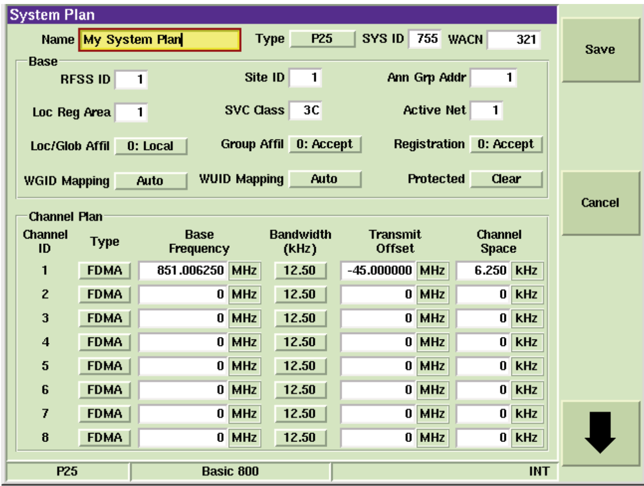

Figure 19 - Channel Plan Configuration Screen

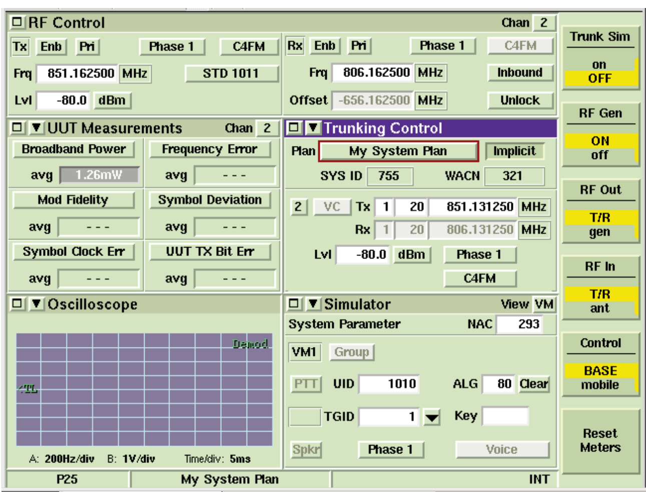

Figure 20 - P25 Screen Setup for Trunking Operation

During trunking simulation, there are two selections for trunking triggers. One of them is slot boundaries. The slot boundaries for P25 coincide with the status bits indicating busy or idle and, in the 3920, occur every six micro-slots. In the triple TSBK, shown below, the slot boundaries are micro-slots 2 and 8. Since they occur every six micro-slots, in the next TSBK, the slot boundaries would be 4 and 10, and in subsequent TSBK, the slot boundaries would continue to rotate through the message, always at a spacing of six micro-slots. The 3920 indicates the timing of these slot boundaries by generating a 208 uS pulse out the Sync I/O port.

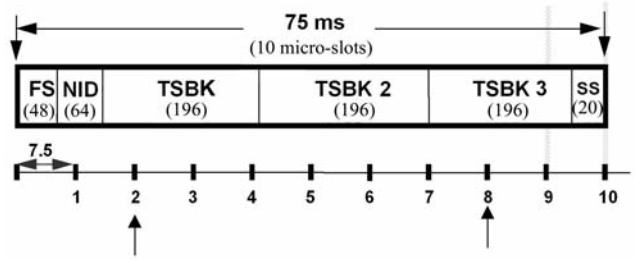

Figure 21 - Slot Boundary Trigger Position

The selection for the slot boundaries trigger is in the P25 trunking trigger drop down menu in the ports configuration screen (Figure 22).

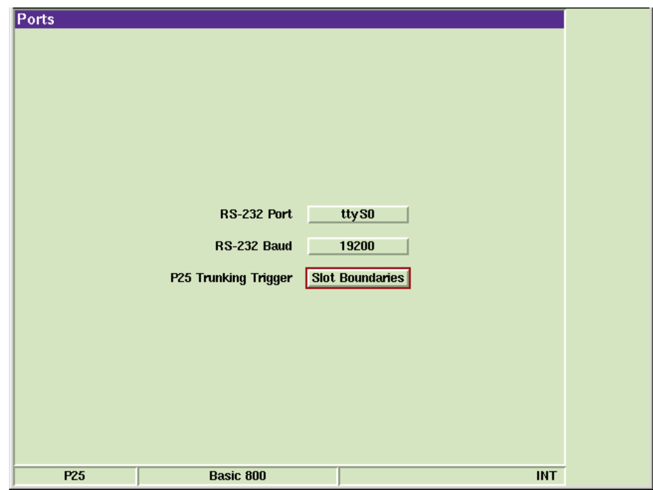

Figure 22 - Ports Configuration Screen

Performing the Test

This test begins with the 3920 in trunking simulation mode. The radio under test is keyed with the key control switch, which also sends a trigger to the oscilloscope. With the oscilloscope triggered, the slot boundaries and the burst (output of the RF detector) from the radio under test are displayed. The time from the slot boundary to the start of the RF burst and the time from the end of the RF burst to the next slot boundary should be recorded. The test is repeated with the output of the FM demodulator routed to the oscilloscope. In this case, the time from the slot boundary to the sync word is measured. The position of the sync word must be determined by examining the FM demod on the oscilloscope. It can be a bit difficult to locate the sync word in the FM demodulated signal on the oscilloscope. It will look something like Figure 23.

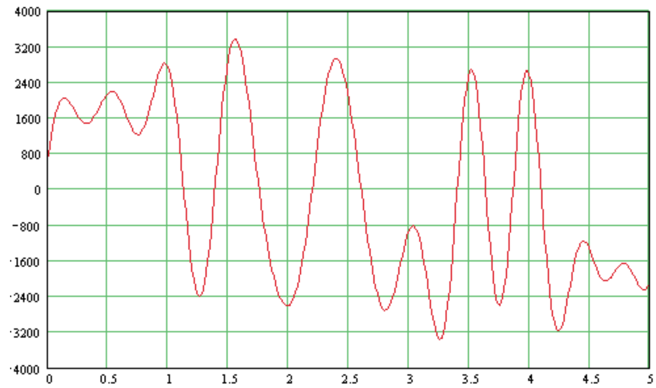

Figure 23 - FM Demod of the P25 Sync Word (units for x is milliseconds, units for y is Hz)

Trunking Request Time

Definition of Test

Trunking request time is a measurement of the time that it takes a subscriber radio to send a channel request message after the user presses push-to-talk. This measurement is made from the time the user presses push-to-talk to the start of the slot that contains the channel request message.

Test Setup

A block diagram for this test is shown in Figure 24. A key control switch is used to both key the radio under test and simultaneously trigger the oscilloscope. The antenna of the radio under test should be connected to the 3920 and an RF load. The output of an RF detector, connected to the output of the RF load, should be connected to one of the vertical inputs of the oscilloscope. The other vertical input should be connected to the Sync I/O output of the 3920.

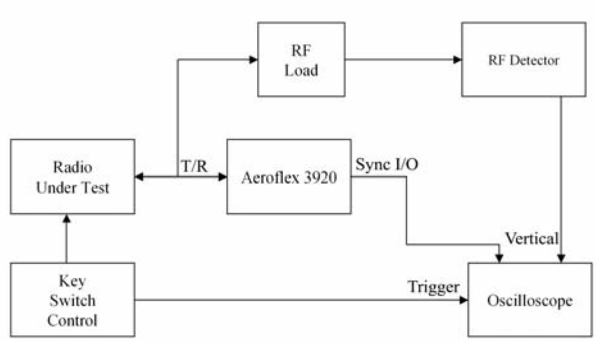

Figure 24 - Trunking Request Time Block Diagram

Setting up the 3920

The 3920 should be in the P25 mode of operation, so that it can be set up for trunking control channel simulation. The setup for this test is identical to the setup of the 3920 for the trunking control channel slot times test.

Performing the Test

The user initiates this test by triggering the push-to-talk and the oscilloscope with the key control switch. The oscilloscope displays the slot boundary indications from the 3920 and the RF burst from the RF detector. The time from the trigger to the slot boundary indication that precedes the RF burst is the trunking request time.

Transmitter Time to Key on Traffic Channel

Definition of Test

Transmitter time to key on traffic channel is a measurement of the time from when the subscriber unit receives a channel grant message to the time that it starts transmitting on a voice channel. Two measurements are made. The first is to the time that the subscriber unit's transmitter is keyed on. The next is to the time that the subscriber unit starts modulation.

Test Setup

The block diagram for the transmitter time to key on traffic channel test is shown in Figure 25. The Sync I/O output of the 3920 should be connected to the trigger input of the oscilloscope. The output of the RF detector and the FM demodulator should be connected to the vertical inputs of the oscilloscope. The antenna of the radio under test is connected to the T/R port of the Aeroflex 3920. It should also be connected through an RF load to the RF detector and the FM demodulator.

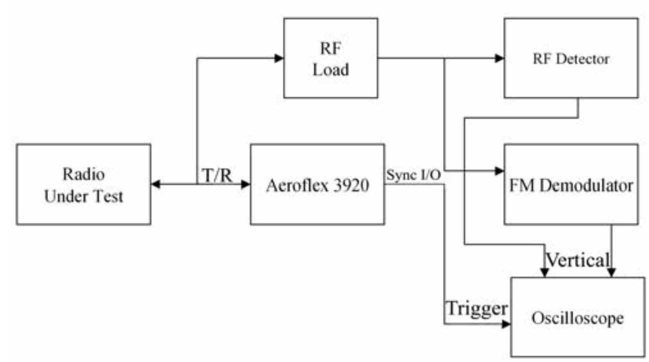

Figure 25 – Transmitter Time to Key on Traffic Channel Time Block Diagram

Setting up the 3920

The setup for this test is very similar to the "Setting up the 3920" for trunking control channel slot times. The only difference is in the selection of the trunking trigger. In this test, you will use the channel grant trunking trigger, also selected from the ports configuration screen (see Figure 22). For this trigger, the 3920 generates a 208 uS pulse out the Sync I/O port that is synchronous with the first symbol of the channel grant message (Figure 26). The 3920 uses the triple TSBK messages format and the channel grant message is always in the first TSBK.

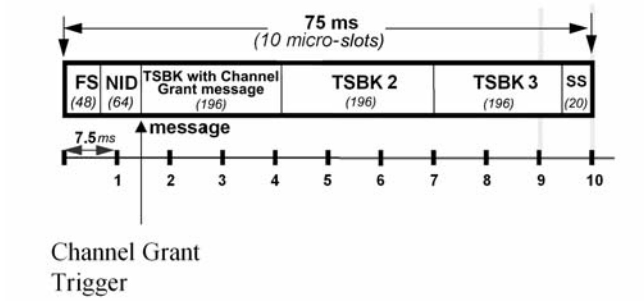

Figure 26 - Channel Grant Trigger Location

Performing the Test

This test begins with the user pressing the push-to-talk on the radio under test. When the 3920 receives the channel request message, it responds by sending a channel grant message to the radio under test and also triggering the oscilloscope with the channel grant trigger. When the radio keys on the traffic channel the RF detector provide an envelope of the RF burst to one of the vertical inputs of the oscilloscope. The FM demodulator supplies the timing for the location of the synchronization word. The location of the synchronization word must, again, be determined from the FM demod of the synchronization word. A diagram of what the FM demodulation of the sync word should look like can be seen in Figure 23. The time from the channel grant trigger to where the output of the RF detector reaches 50% of max is the RF time to key on the working channel. The time from the channel grant trigger to the start of the synchronization word is the encoder transmit time to key on a working channel.

Conclusion

As has been seen from this application note, the Aeroflex 3920 can greatly simplify the P25 performance tests that are required by the Telecommunications Industry Association TR8 committee. And further, by using the Aeroflex 3920, you can minimize the amount of equipment necessary to do these tests, making the cost to implement these tests much less. Together with the Aeroflex PXI line of RF Modular Instruments, you will be able to simply and efficiently implement these tests.

For more information on the Aeroflex 3920 Series Radio Test set go to:
www.aeroflex.com/3920

For more information on the Aeroflex PXI, go to:
www.aeroflex.com/ats/products/category/PXI.html

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