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Measuring audio delay through a repeater or DAS

The Anritsu S412E LMR Master can be used to measure the audio delay through a repeater or distributed antenna system (DAS). Knowing the audio delay is important in managing simulcast systems and managing the overlap areas between an in-building DAS system and macro system transmitters.

All Anritsu hand held spectrum analyzers, including the spectrum analyzer mode in the S412E have a powerful zero span sweep capability. In zero span mode, the analyzer is tuned to one frequency. The resolution bandwidth is chosen to allow a signal of known bandwidth to enter the analyzer. The sweep time can be adjusted from a minimum of 1 ms to many minutes. The horizontal screen resolution is 551 points making the minimum horizontal screen resolution less than 2 µs. In zero span mode, the amplitude controls are the same as in swept frequency mode and the dynamic range is over 95 dB. An external trigger in connector is available to start the zero span sweep. With the use of external trigger, the analyzer can be made to function much like an oscilloscope. Triggering adjustments are available to set trigger levels and trigger delay. For more information on zero span triggering, see the spectrum analyzer measurement guide (Anritsu part number 10580–00244).

The key to the audio delay measurement is creating an audio burst that both triggers the analyzer and passes through the transmitter system to be viewed on the zero span spectrum trace. A sample configuration is shown in figure 1.

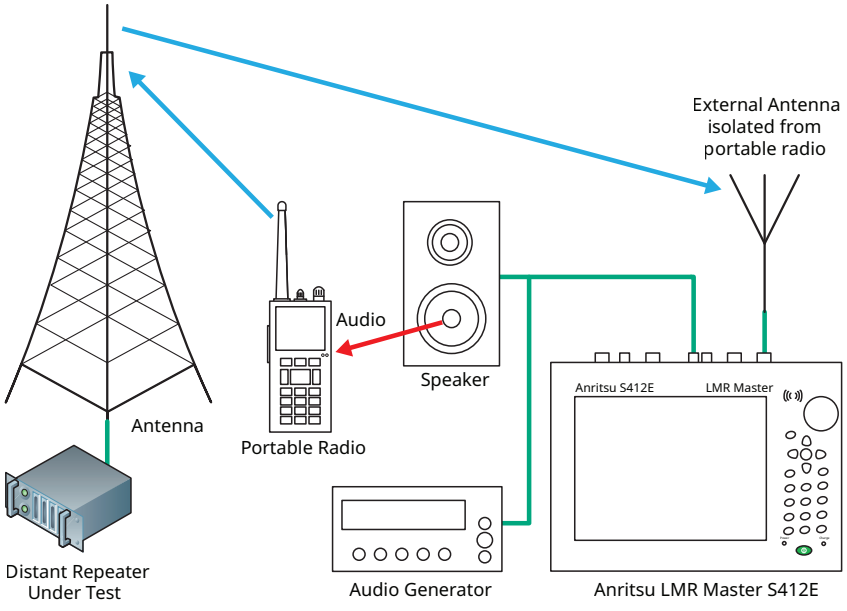

Figure 1. Block Diagram for Audio Delay Measurement.

Figure 2 shows a photograph of the test setup.

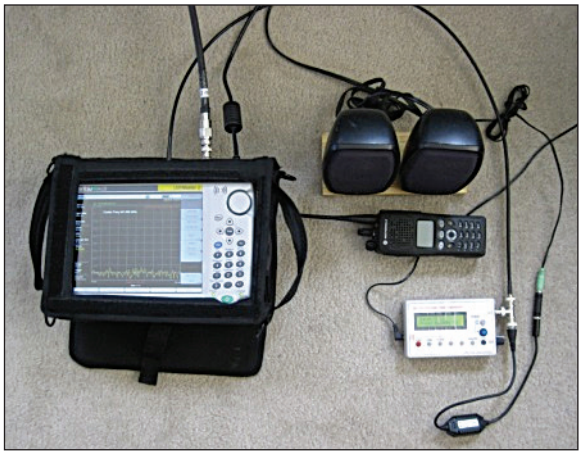

Figure 2. Photograph of the setup used for the example measurements.

It is important that the audio modulation rate be chosen to pass through the transmitter. A higher audio rate provides more time resolution on the trigger point. In the setup shown in figure 2, a 2 kHz audio rate was used to provide approximately 50 µs of time resolution.

Triggering must be set to “Single” to prevent additional triggers obscuring the view of the RF burst.

Figure 3 shows the delay through a P25 repeater running in analog mode.

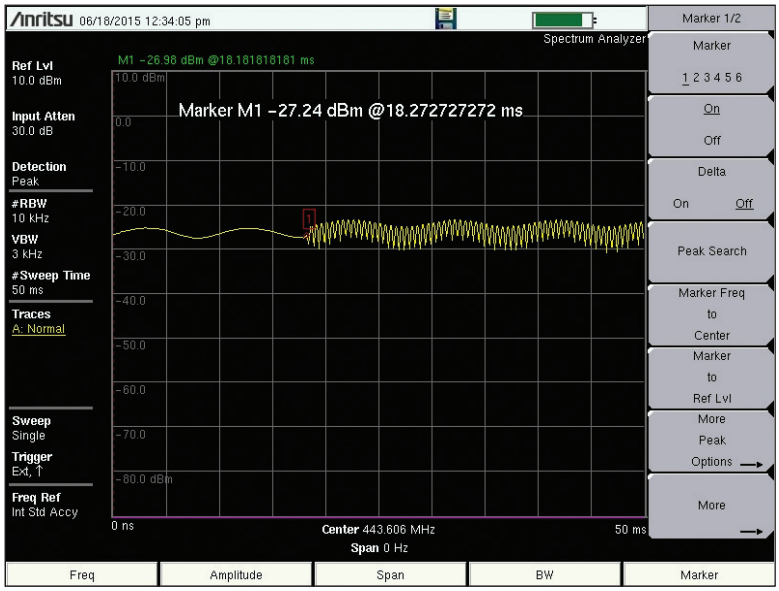

Figure 3. Delay through a Motorola Quantar in NBFM mode. The slower audio waveform before the 2 kHz burst is the 105 Hz PL tone from the repeater.

Figure 4 shows delay for the same P25 repeater but using trigger delay and faster sweep to provide more time resolution.

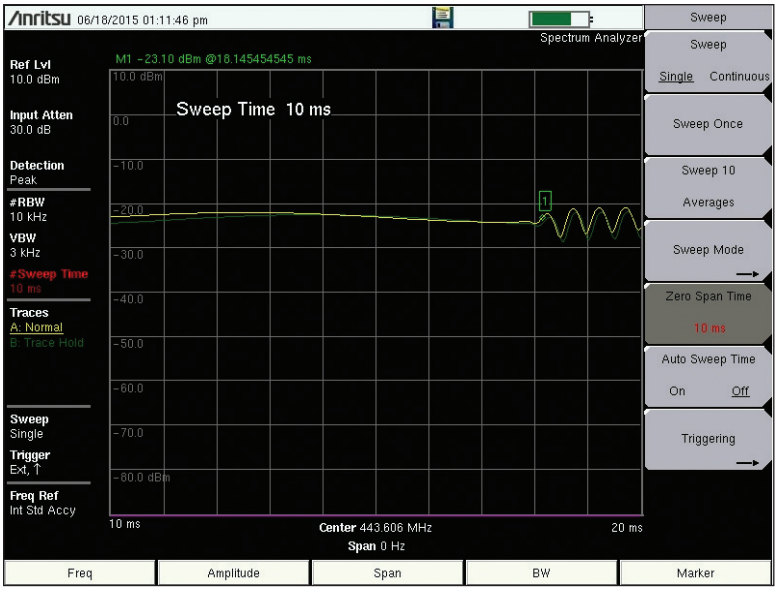

Figure 4. Delay through a Motorola Quantar with 10 MS trigger delay. Note the green trace is a reference and the yellow trace a second measurement with a 40 us audio delay to the speaker.

Figure 5 shows the audio delay through a traditional analog repeater.

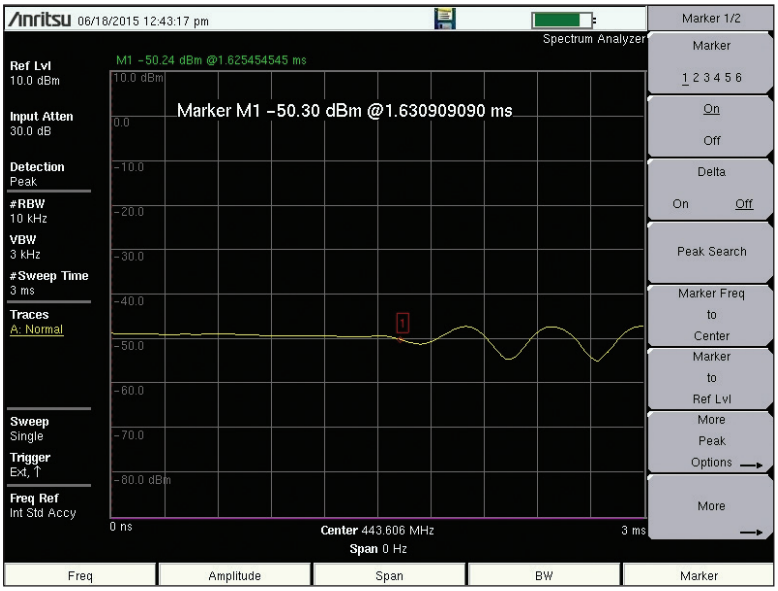

Figure 5. Audio Delay through a Motorola GR1225 analog repeater.

Summary

Measurement of audio delay through a repeater or DAS system can provide critical information to manage signal quality in overlap areas. The S412E LMR Master offers a powerful spectrum analyzer with zero span mode and external triggering to support these measurements.

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