VIAVI Solutions

Application Note

LTE-TDD Interference Analysis Using CellAdvisor

This document explores the different methods available to detect and analyze interference in an LTE-TDD channel using VIAVI Solutions® CellAdvisor™. CellAdvisor has different modes of operation, such as spectrum, time-domain, gated sweep, interference analyzer, and the LTE-TDD time domain signal analyzer, each of which offers unique ways of observing and analyzing a time domain signal. The LTE-TDD signal and any interference lying within the channel are analyzed in depth using each of the above modes of CellAdvisor.

LTE-TDD Frame Structure:

The LTE-TDD standard uses time domain duplexing for scheduling uplink (UL) and downlink (DL) transmissions, where both the UL and DL signals occupy the same frequency band and are separated in time rather than frequency. This means that, the entire bandwidth (BW) is allocated to either UL or DL signals for a predefined number of time-slots depending on the chosen subframe (UL/DL) configuration.

Table 1 shows the LTE-TDD uplink-downlink configurations. This scheme specifies the amount of time allocated for UL and DL transmissions.

10 ms

Uplink-Downlink configuration	Downlink-to-Uplink Switch-Point Periodicity	Subframe Number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Table 1 LTE-TDD DL and UL Subframe configuration

1 subframe = 1 ms

U – Uplink transmission
D – Downlink transmission
SS – Special Subframe (Required during switch between DL and UL transmission)

Figure 1 shows a screenshot of a LTE-TDD signal with special subframe configuration 1. It shows the power v. time (frame) graph of a 10 ms frame in the LTE-TDD Signal Analysis mode. In this configuration, the first subframe is allocated for DL, the second subframe for special subframe, the third and fourth subframes for UL, the fifth and sixth subframes for DL, the seventh subframe for special subframe, the eighth and ninth subframes for UL, and the tenth subframe for DL.

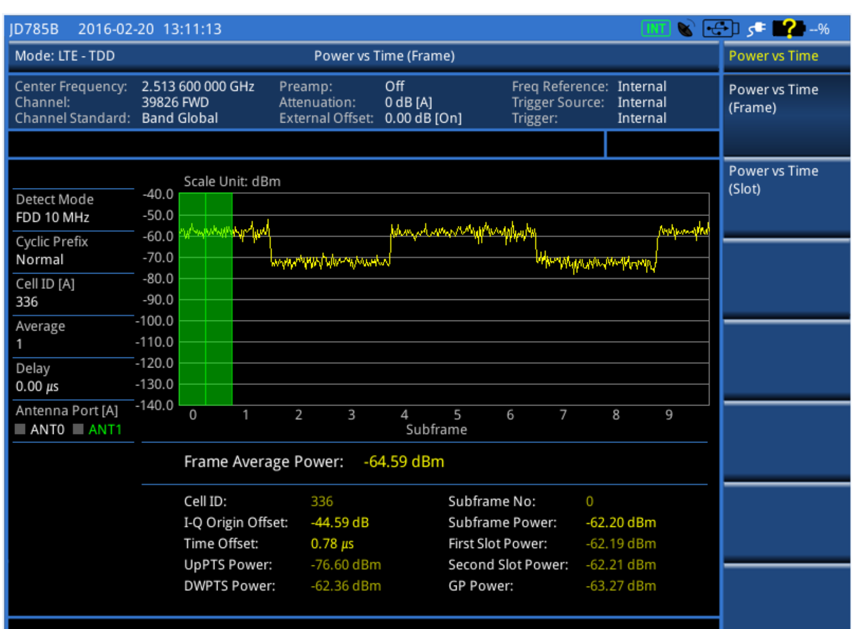


Figure 1. LTE-TDD signal with special subframe configuration 1

Interference Analysis using the CellAdvisor

1. Standard Spectrum Analyzer Mode

Connections

1. Connect your RF antenna to the Spectrum Analyzer RF In port of the JD700B series.

Configuration Settings

1. Select Mode: Spectrum Analyzer
2. Select Freq/Dist : Set the Center Frequency and Span
3. Select Channel Std: Set the relevant LTE-TDD band and input Channel Number

Figure 2 shows the spectrum of a 20 MHz LTE-TDD signal. Typically, a LTE-TDD signal shows large variations in the spectrum depending on whether the captured transmission is DL, UL, or SS during that sweep. In this figure, the sweep time is 13.96 ms which is slightly more than a frame interval (10 ms) of the LTE-TDD signal. So, it has captured multiple uplink and downlink transmissions.

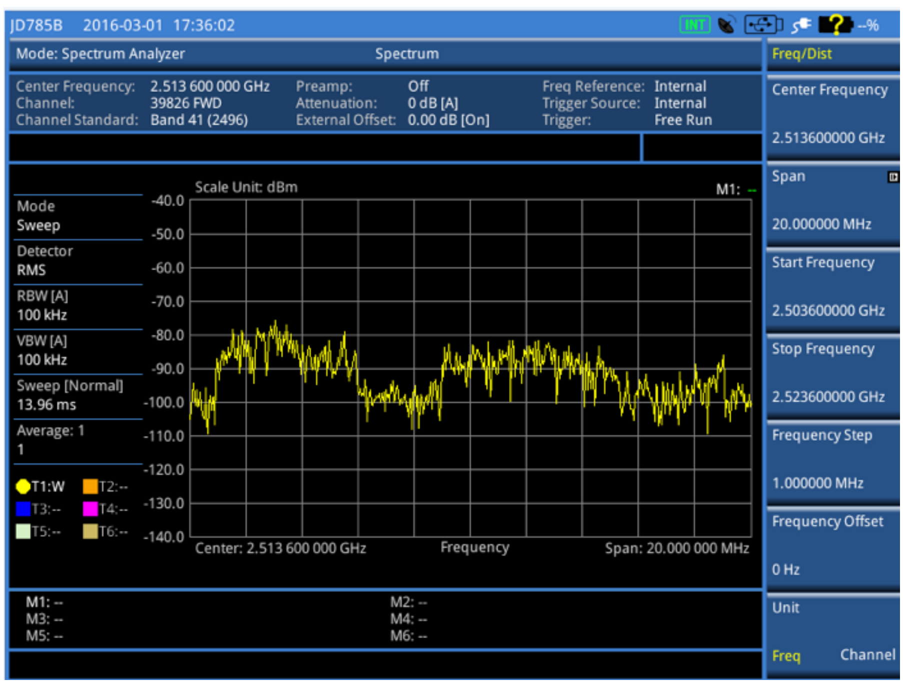


Figure 2. Spectrum of a 20 MHz LTE-TDD signal

In order to see a stable envelope of the LTE-TDD signal in the standard spectrum analyzer mode, set a high enough sweep timeto capture multiple frames of both UL and DL transmissions. **Figure 3** shows the spectrum of a LTE-TDD signal captured over multiple frames of the signal. This is achieved by reducing the resolution bandwidth (RBW) enough so that the sweep time is high enough to capture multiple instances of UL and DL transmissions. In this example, the RBW was reduced from 100 kHz to 3kHz.

NOTE: The power captured by setting up the signal in this manner is not a true indicator of the DL or UL power. However, this should give you a general idea of the shape of your spectrum and if there are any type of interferers, it be captured as well, as shown in **Figure 4**.

Figure 3. Stable LTE-TDD spectrum

Figure 4 is the spectrum of a LTE-TDD signal showing a constant CW interferer.

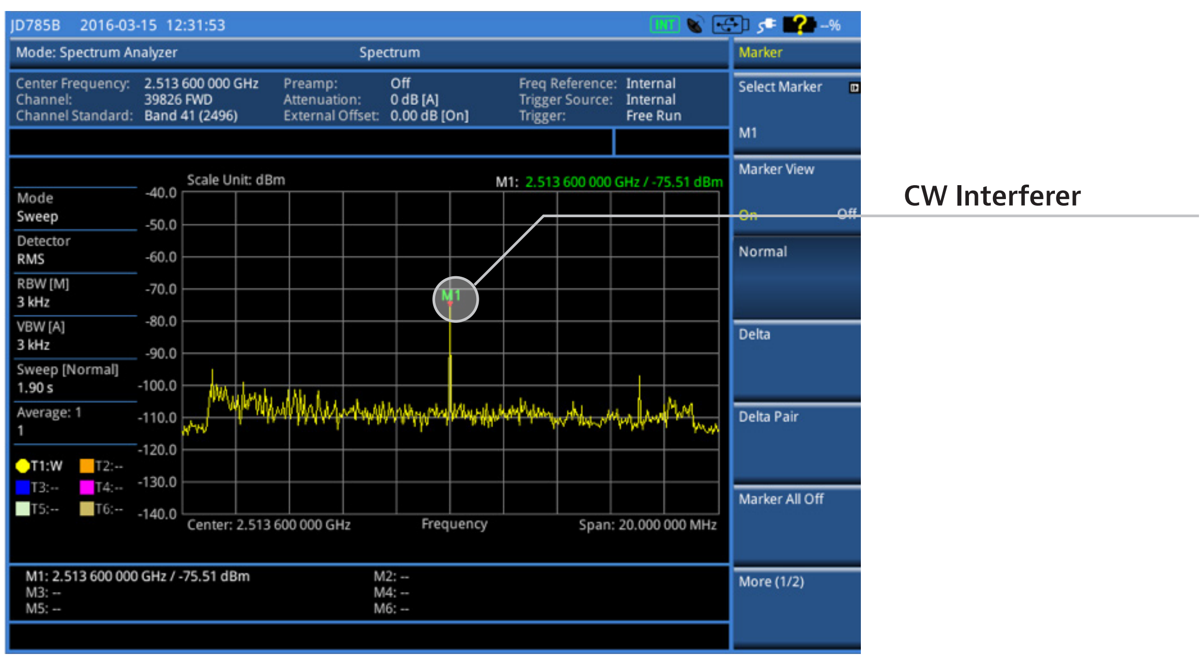


Figure 4. LTE-TDD signal in Spectrum Analyzer mode showing a CW interferer

NOTE: In the standard spectrum analyzer mode, it is not possible to capture interference occurring specifically in UL transmissions. This is because the spectrum analyzer can only analyze the signal of interest in the frequency domain, while the interference that falls only during UL transmissions would be time-varying in nature. However, if you do have an interferer that falls within the channel BW and is not time-varying, you should be able to clearly spot it in the spectrum analyzer mode as shown in the above figure. However, if the interference is only slightly above the spectrum of the LTE-TDD signal, and/or if it is time-varying, it can be difficult to spot the interference in the standard spectrum analyzer mode.

Figure 5 is the spectrum of a LTE-TDD signal shown using different trace modes: Max Hold (blue trace), Clear Write (yellow trace), and Min Hold (orange trace). The Clear Write trace mode clears the current data and displays new measurements. That is, in each sweep a new Clear Write trace is displayed. For the Max Hold and Min Hold trace modes, the instrument compares newly acquired data with the active trace and displays larger maximum values or smaller minimum values on the screen. You can set it to unlimited and hold and view maximum or minimum data for the entire duration of the time, or specify a certain amount of time up to 60 seconds. Note that the Max Hold function displays a constant envelope of the LTE-TDD signal, which is seen fluctuating rapidly when viewed using the Clear Write trace mode. The constant CW interference can be observed in all three trace modes.

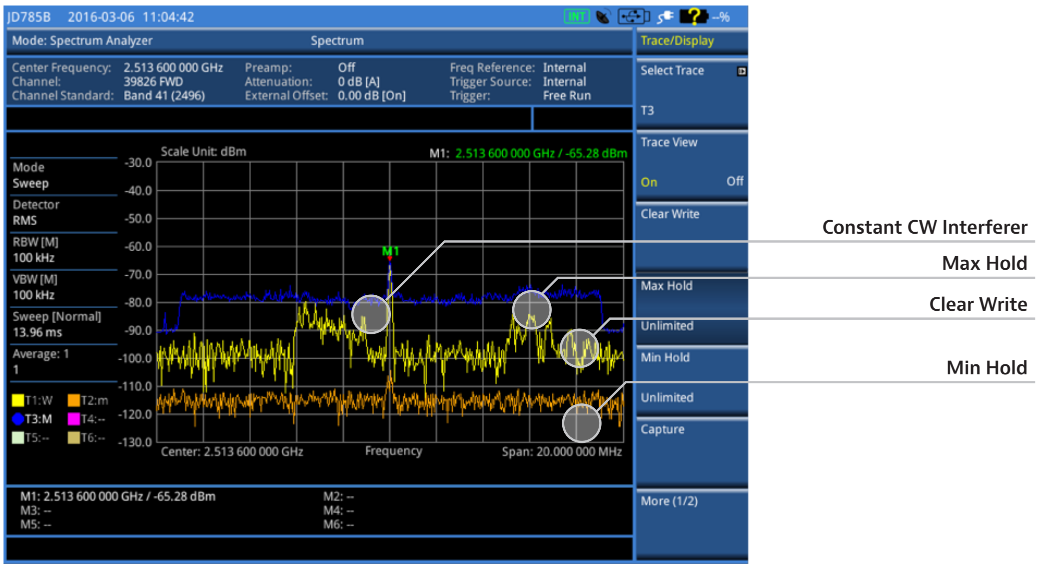


Figure 5. LTE-TDD signal in Spectrum Analyzer mode showing different trace modes

While a constant interference can be viewed using any of the trace modes, it is a good idea to use the Max Hold trace mode to view an interferer that is time-varying in nature. **Figure 6** shows the same signal as above with the Max Hold time set to unlimited. In this example, the CW interferer at M1 was intermittent. Even though the CW interference is not visible using the Min Hold function and appears only intermittently in the Clear Write trace mode, you can clearly see it using the Max Hold display which displays the maximum value of the signal up to that time.

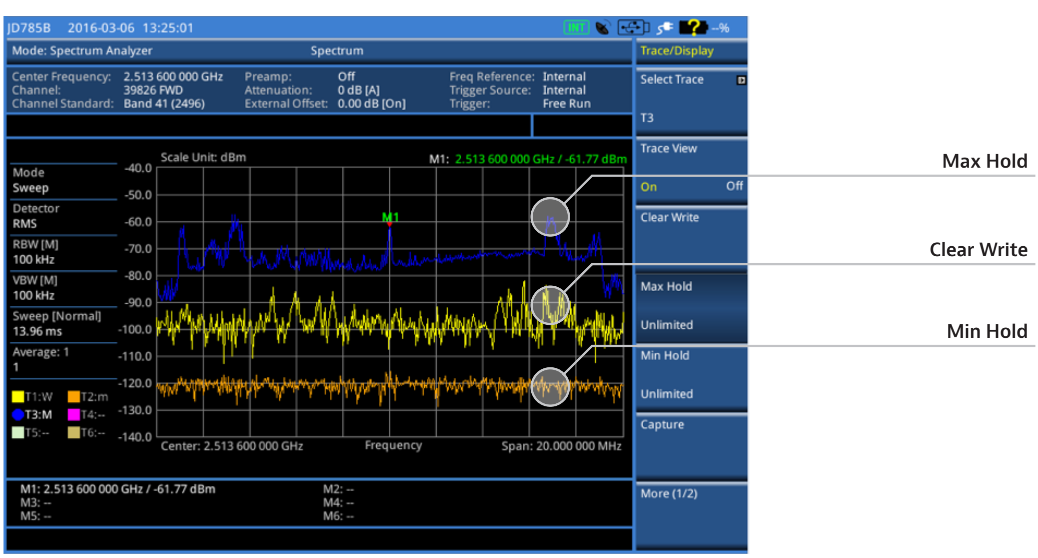


Figure 6. LTE-TDD signal in Spectrum Analyzer mode showing different trace modes

2. LTE-TDD Signal on Spectrum Analyzer- Time Domain Mode (Zero Span Analysis)

The Zero Span option is available in the Spectrum mode. What you see in this mode is the signal displayed in the time-domain. That is, the power around the center frequency within the set RBW is displayed on the screen. The zero-span mode is useful to give you a quick indication of whether there is any interference present in the channel. As per the 3GPP specification, the transmitter OFF power of an E-UTRA base station should be below –85 dBm/MHz. Therefore, when the RBW is set to 1 MHz, if the transmitter OFF power is greater than >-85dBm it is most likely due to the presence of interference in the channel. This is because presence of interference within the channel causes the noise floor of the spectrum analyzer to increase.

Connections

1. Connect your RF antenna to the spectrum analyzer RF-In port of the JD700B Series

Configuration Settings

1. Select Mode > Spectrum Analyzer
2. Press the Freq/Dist hard key and set your center frequency of interest
3. Press the Span soft key and select Zero Span
4. Press the BW/AVG hard key and set RBW = 1 MHz

Figure 7 shows the time domain view of the LTE-TDD signal seen using the zero span mode. Since this is not triggered (the trigger mode used here is free run), the signal varies with time, as the spectrum analyzer sweeps from left to right. In this figure, you can clearly see that the transmitter OFF power is > -85 dBm with the RBW set to 1 MHz. When you have interference in the channel, you can expect to see an increase in the transmitter OFF power.

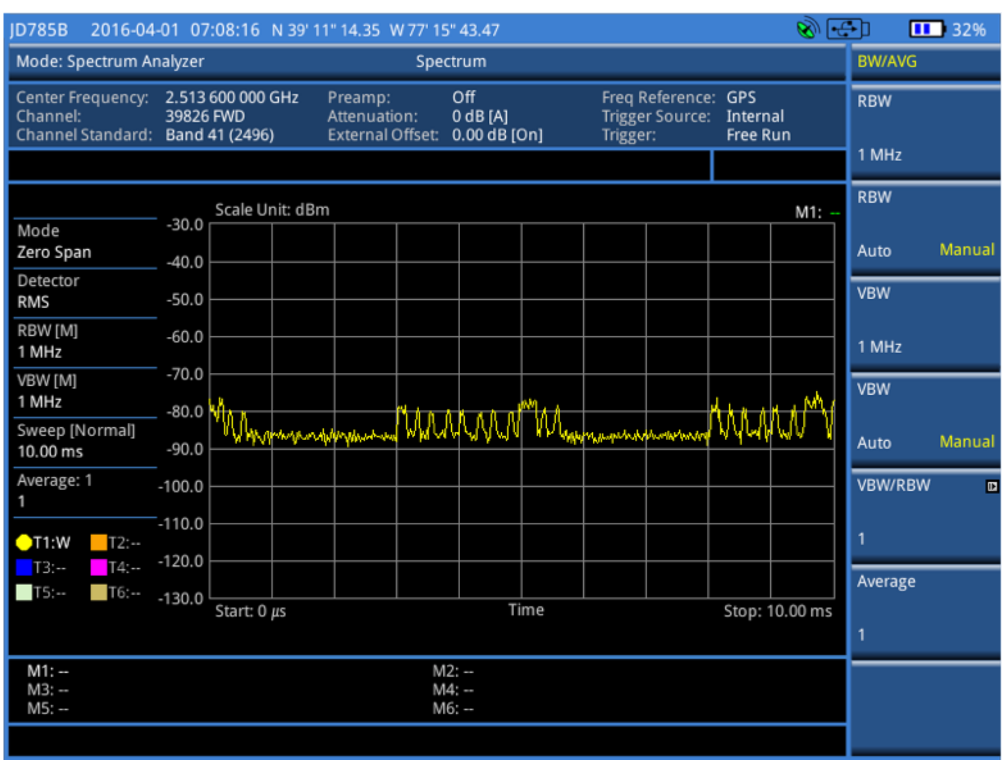


Figure 7. LTE-TDD signal in spectrum analyzer – zero span mode

Figure 8 shows the time domain view of the LTE-TDD signal in zero span mode in the presence of an interference signal. Again, the RBW is set to 1 MHz. Here, you can see that transmitter OFF power has risen to above -80 dBm.

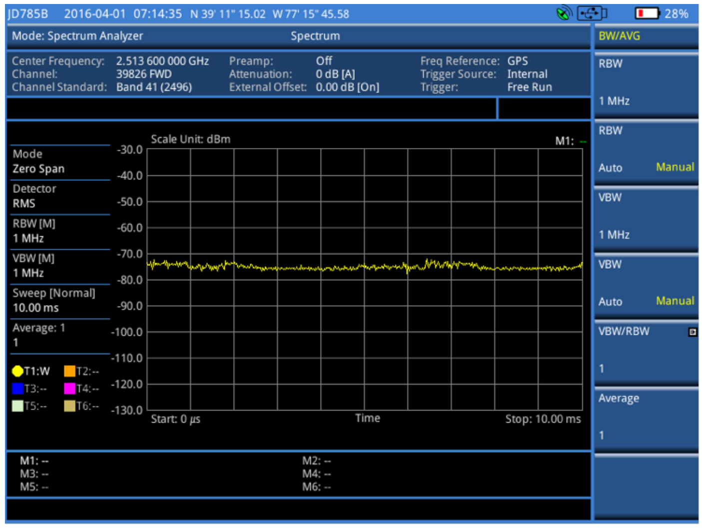


Figure 8. LTE-TDD signal in spectrum analyzer zero span mode in presence of a CW interferer

3. LTE-TDD Signal on Spectrum Analyzer Gated Sweep Mode

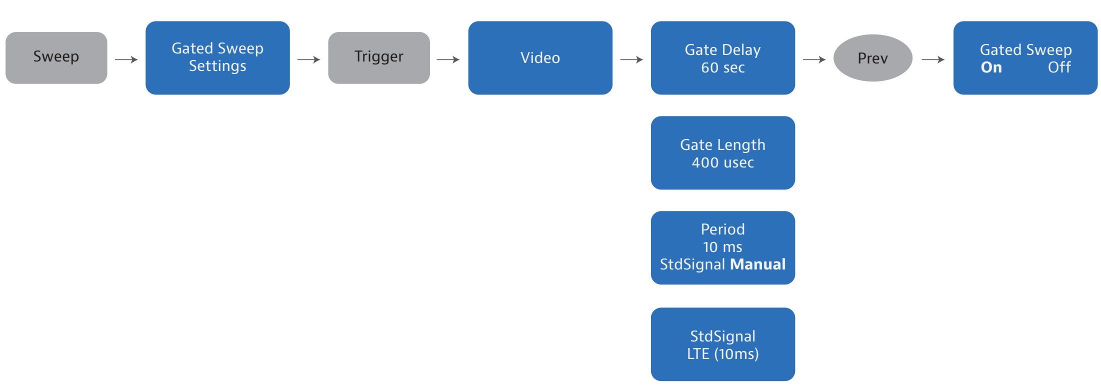
Time-gated spectrum analysis allows you to obtain spectral information about signals in the frequency domain that are separated in the time domain. The spectrum analyzer includes the ability to trigger the test in specific timing (gated sweep) in order to easily analyze UL transmissions. This makes it possible to detect interference in time-based signals.

Connections

1. Connect your RF antenna to the spectrum analyzer RF-in port of the JD700Bseries.
2. Connect a GPS antenna to the GPS port of theJD700B series.

Configuration Settings

1. Select Mode: Spectrum Analyzer (Make sure you set your Frequency, Channel, Band, etc).
2. Press the Sweep hot key and select Gated Sweep Settings
3. Press the Trigger hot key and set the Trigger to GPS
4. Go back to Gated Sweep Settings and set Gate Delay, Gate Length, and Period (10 ms) to capture the waveform
5. Go back to previous menu by pressing Prev and turn on Gated Sweep



NOTE: The gate delay and gate length are set based on the time interval that you want to monitor. For monitoring DL signals, you can set the time gate (the time difference between the gate length and gate delay) between any of the time intervals within the frame when the transmitter is ON. For monitoring UL signals set the time gate between any of the time intervals within the frame when the transmitter is OFF. Please note that if you have a LTE-TDD UE near the CellAdvisor, you should see occasional spurts of activity when the transmitter is OFF as well.

Figure 9 shows the LTE-TDD signal in zero span mode triggered to the GPS. When triggered properly, you should see a stable signal. Triggering is necessary in order to set the gate delay and gate length properly.

NOTE: In this mode, time slot 0 of a frame of the actual LTE signal may not always correspond to the first time slot that you see on the screen when triggered to GPS. If you want to ensure that the time slots are in sync, you would need to view the signal in the LTE-TDD Signal Analysis mode (option JD745B029). However, for the purposes of looking for interference, this lack of sync will not make a difference to your measurement, as long as you have set the time gate to your time interval of interest.

For example, for monitoring the downlink using the signal shown in **Figure 9**, you can set your time gate either between 0 - 2 ms or between 5 - 7 ms. For looking at the uplink, you can set the time gate anywhere between 3 - 5 ms or between 8 - 10 ms. In this figure, you can clearly see that there are two Special Subframes- the first is between 2 - 3 ms and the second special subframe is between 7 - 8 ms.

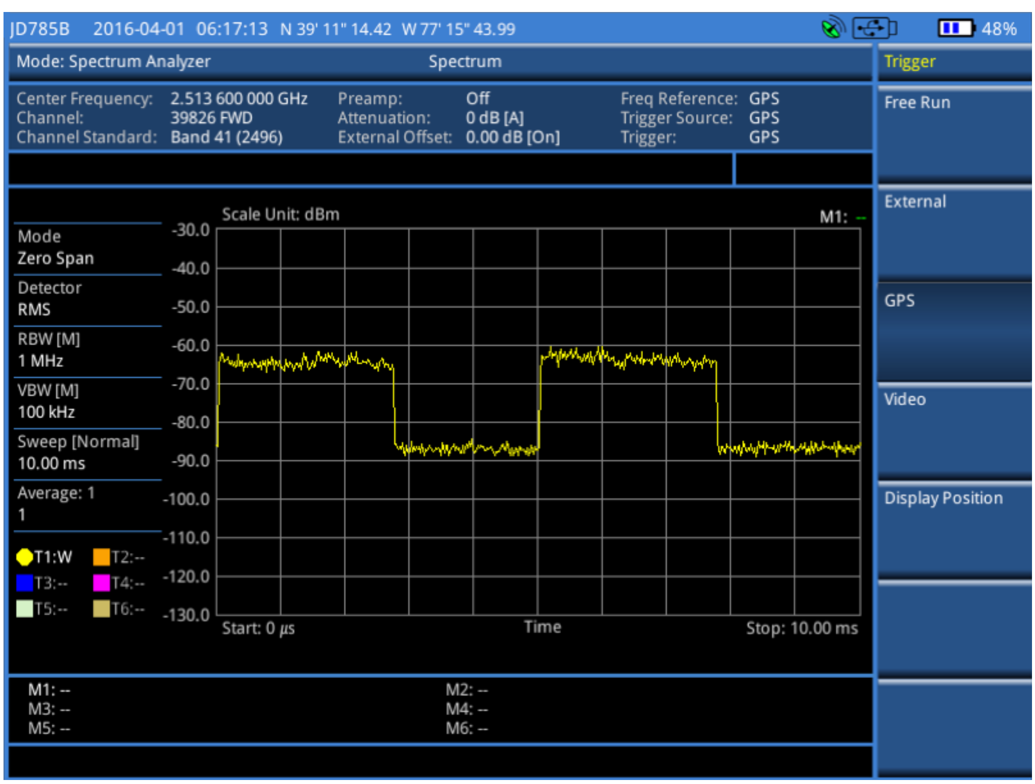


Figure 9. GPS triggered LTE-TDD signal in spectrum analyzer zero span mode

Figure 10 shows the GPS triggered LTE-TDD signal in zero span mode showing the Gated Sweep settings. This menu allows you to set the time gate which is the time interval between the Gate Delay and Gate Length. Once you set the time gate, the next step is to turn on Gated Sweep by pressing the “Prev” key.

Note that the signal is smoother in **Figure 9** compared to that shown in **Figure 10**. This smoothing can be achieved by setting the Video Bandwidth (VBW) slightly smaller than the RBW. VBW determines how much smoothing is performed by the spectrum analyzer’s video filter after the collected RF signal is converted to a video signal for display. The settings to VBW can be accessed through the BW/AVG hard key.

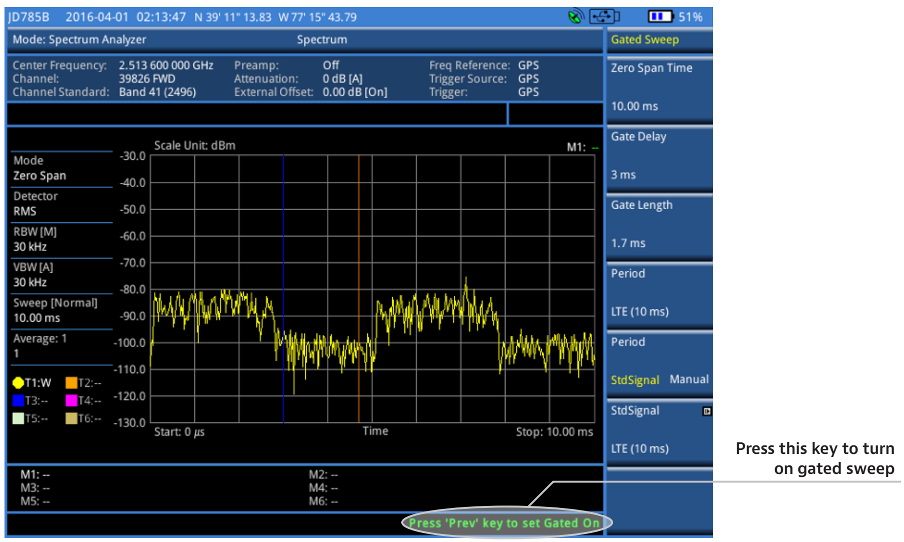


Figure 10. GPS triggered TD-LTE signal in spectrum analyzer zero span mode showing gated sweep settings

Figure 11a shows the LTE-TDD spectrum with Gated Sweep set to Off. **Figure 11b** shows the spectrum of the LTE-TDD signal with Gated Sweep turned On. Gated Sweep can be toggled On and Off. With Gated Sweep turned off, the displayed spectrum is that of the entire signal covering all the time slots. With Gated Sweep turned on, the displayed spectrum is only that which falls within the configured time gate. For example, **Figure 11b** shows the spectrum of the signal with the time gate configured to cover uplink time slots between 3 - 4.7 ms. Now, if an interferer falls within this time gate, you can clearly see the interference as shown in **Figure 12**.

Figure 11a. LTE-TDD spectrum with gated sweep set to off

Figure 11b. LTE-TDD spectrum with gated sweep set to on

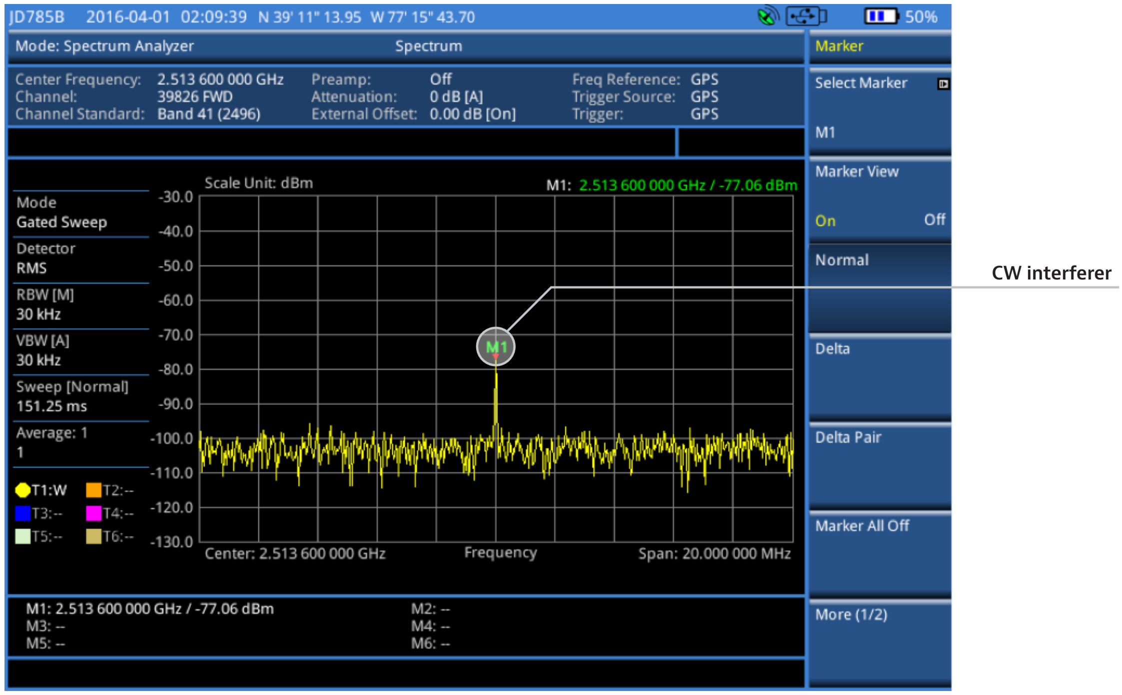


Figure 12. LTE-TDD signal in gated sweep mode, showing CW interference in the uplink

4. Interference Analyzer (Option JD745B011)

Connections

1. Connect your RF antenna to the **Spectrum Analyzer RF In** port of the JD700Bseries.

2. Connect a GPS antenna to the **GPS** port of theJD700B series.

Configuration Settings

1. Press the Mode hard key.

2. Press the Interference Analyzer soft key. The Spectrum mode is selected by default.

3. To change the mode within the Interference Analyzer, press the MEASURE hotkey and then select the measurement mode: Spectrum, Spectrogram, Dual Spectrogram, RSSI, Interference Finder, or Spectrum Replayer.

NOTE: The first mode under the Interference Analyzer is the Spectrum mode. The spectrum analyzer in the interference analyzer mode is same as in the general spectrum analyzer mode. The reason for this mode being repeated here is to minimize the need to switch back and forth between the Spectrum Analyzer and the Interference Analyzer modes for viewing the spectrum.

Spectrogram

The Spectrogram is particularly useful when attempting to identify periodic or intermittent signals as it captures spectrum activity over time and uses various colors to differentiate spectrum power levels. When the directional antenna is used to receive the signal, you will see a change in the amplitude of the tracked signals as you change the direction of the antenna and see a change in the Spectrogram colors. The source of the signal is located in the direction that results in the highest signal strength.

The Spectrogram is especially useful for detecting intermittent interference signals, which can otherwise be difficult to detect as intermittent signals most likely occur at uncertain times and durations. Using the spectrogram, you can continuously monitor and record the spectrum and see the power variations of the spectrum over time.

Configuration Settings

1. Select Mode: Interference Analyzer (Set your Frequency, Channel, Band, etc).
2. Select Measure > Spectrogram
3. Press the Measure Setup hot key.
4. Press the Time Interval soft key to set the amount of time between each trace measurement. That is, if you set a Time Interval of 5 s, the spectrogram waits for a period of 5 seconds after displaying a trace line on the screen. For looking at intermittent signals, it is recommended to set the Time Interval at the default value of 0 s in order to not miss the intermittent signals.
5. Toggle the Time Cursor soft key and select On to set the time cursor on a specific trace position. Enabling the time cursor puts the measurement on hold and you can make post-processing analysis for each measurement over time.
6. To start a new measurement, press the Reset/Restart soft key.

Figure 13 shows the spectrogram of a 20 MHz LTE-TDD signal with no interferers. The horizontal linear X-axis of the spectrogram is frequency and the vertical line or Y-axis is time. The color identification (Spectrogram) indicates power level of the tracked signal. As the signal strength increases, the color on the spectrogram changes accordingly.

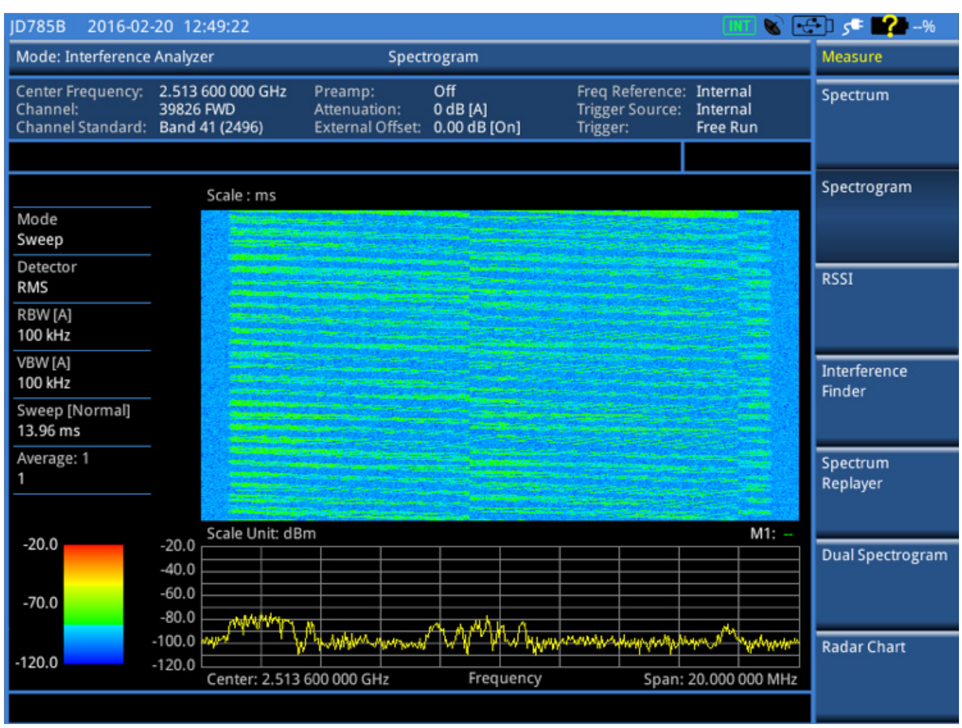


Figure 13. Spectrogram view of a 20 MHz LTE-TDD signal with no interferers (non-gated)

Figure 14 shows the spectrogram of a 20 MHz LTE-TDD signal with intermittent interferences within the channel. In this mode, any interference can be tracked easily by the color change in the spectrogram.

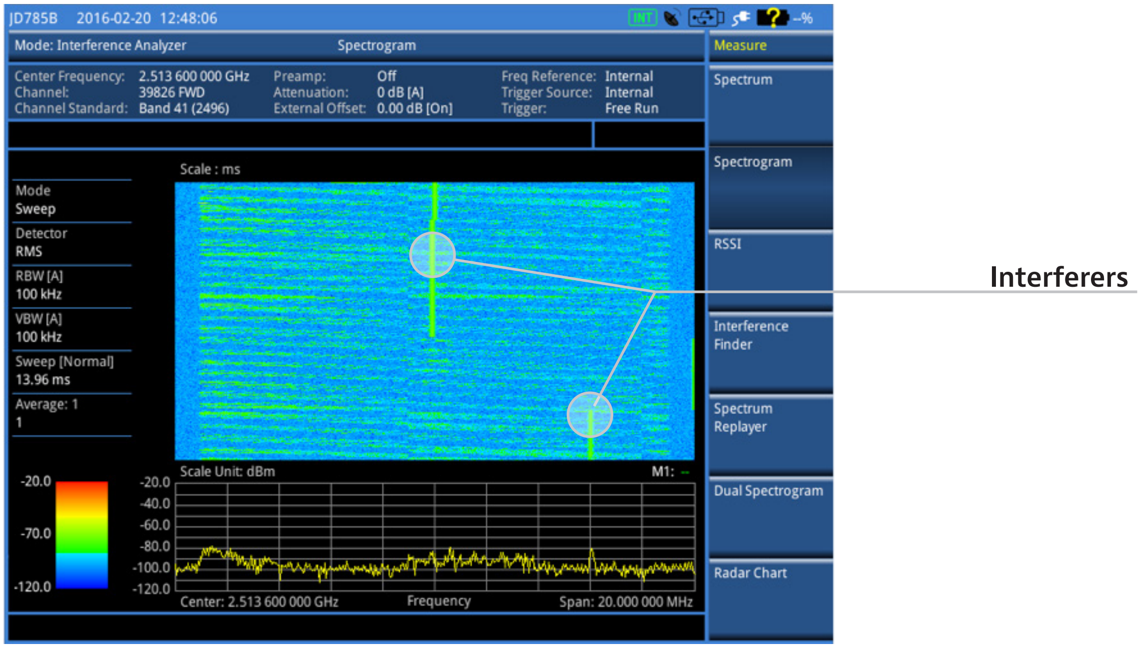


Figure 14. Spectrogram view showing intermittent interferences within the channel

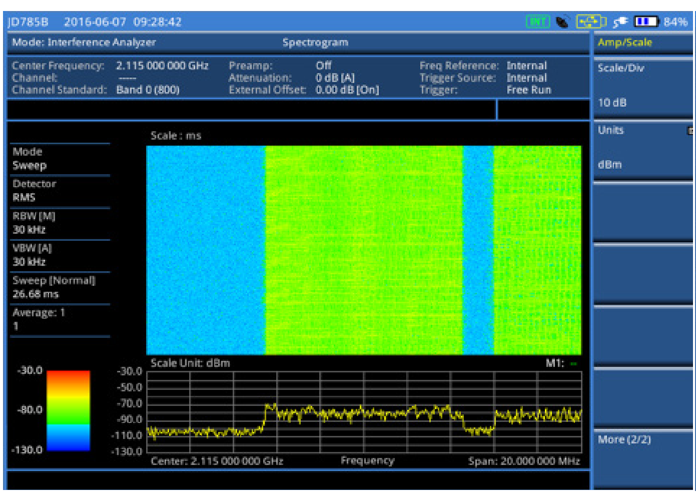


Figure 15a. Spectrogram view with scale/div set to 10 dB/div

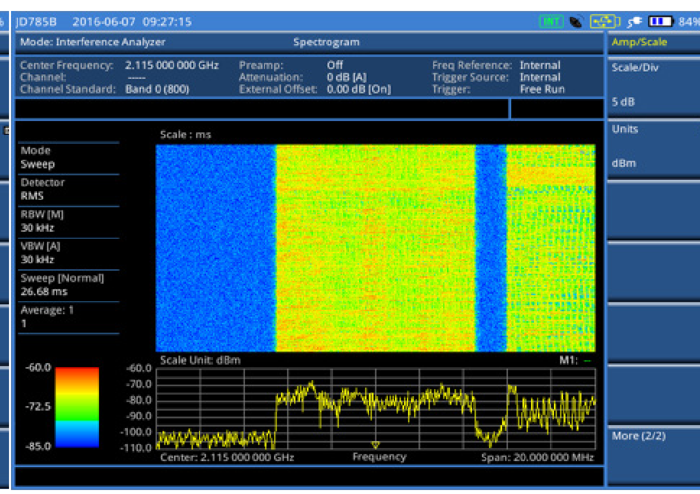


Figure 15b. Spectrogram view with scale/div set to 5 dB/div

Figures 15a and 15b show the spectrogram with different Scale/Div setting in the Amplitude Menu. **Figure 15a** shows the spectrogram when the Scale/Div is set to 10 dB/div, whereas **Figure 15b** shows the spectrogram when the Scale/Div is set to 5 dB/div. Changing the scale/div to 5 dB allows you to analyze low level signals better as shown below in **Figure 15b**. In this example, the Scale/Div is originally set to the default value 10 dB/div. By lowering down scale division to 5 dB, small differences in signal levels will be more visible. To change the scale/div: To change the scale/div: Press Amp/Scale > More > Set Scale/Div to 5.

NOTE: For analyzing interference in the uplink time slots which is relatively low power transmission, it is sometimes useful to reduce the noise floor or DANL (Displayed Average Noise Level) of the CellAdvisor in order to be able to view the signals close to the noise floor. DANL is tied to the RBW. Decreasing the RBW by a factor of 10, for example from 100 kHz to 10 kHz also reduces the DANL by 10 dB. However, please note that reducing the RBW also increases the sweep time.

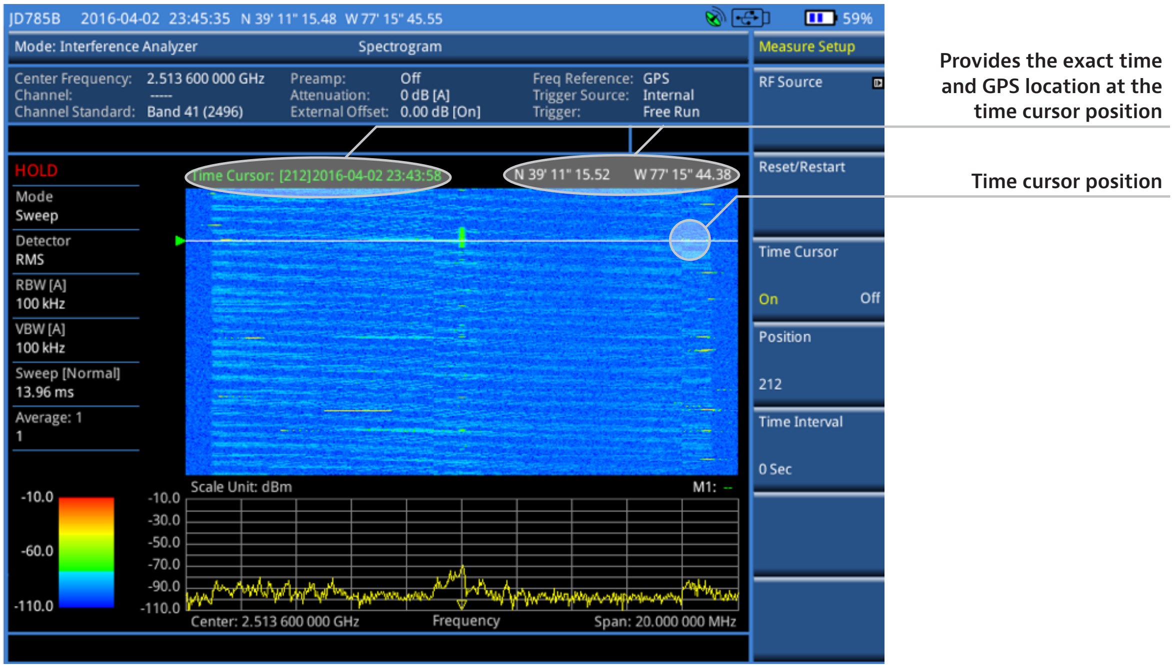


Figure 16. Spectrogram view showing time and location of interferer using the time cursor

Figure 16 is the spectrogram of the LTE-TDD signal showing time and location information of an intermittent interferer using the Time Cursor. Toggling the Time Cursor On, allows you to set the time cursor on a specific trace position on the spectrogram display. You can see the location and time information change as you change the time cursor.

Spectrogram with Gated Sweep ON

Uplink Interference in the LTE-TDD signal may cause frequent call drops, noisy voice or cause problems even during the call setup process. Since the interference signal lies on the Uplink, which goes up and down frequently based on the number of users in the channel, it is very difficult to identify or isolate interference signal from the data using the standard spectrum analyzer. Using the gated sweep function in the spectrogram is ideal for hunting Uplink Interference signal. The waterfall diagram reveals that the interference signal (usually single tone) from the Uplink data (usually wideband) by setting the time-gate only during the signal/frequency of interest. Using Gated Sweep, only the signal between the Time Gate is displayed on the spectrogram.

Configuration Settings

1. Select Mode: Interference Analyzer (Make sure you set your Frequency, Channel, Band, etc).
2. Select Measure > Spectrogram
3. Press the Sweep > Gated Sweep Settings
4. Press the Trigger > GPS
5. Go back to Gated Sweep Settings and Set the Gate Delay and Gate Length
6. Press “Prev” to turn on Gated Sweep

Figure 17a Shows the spectrogram view when the Gated Sweep is turned Off. With Gated Sweep turned off, the displayed spectrogram covers the entire LTE-TDD channel over all ten Subframes. **Figure 17b** shows the spectrogram view when the Gated Sweep is turned ON. With Gated Sweep turned on, the displayed spectrum is only that which falls within the configured time gate. Now, if an interferer falls within this time gate, you can clearly discern the interference as shown in **Figure 18**.

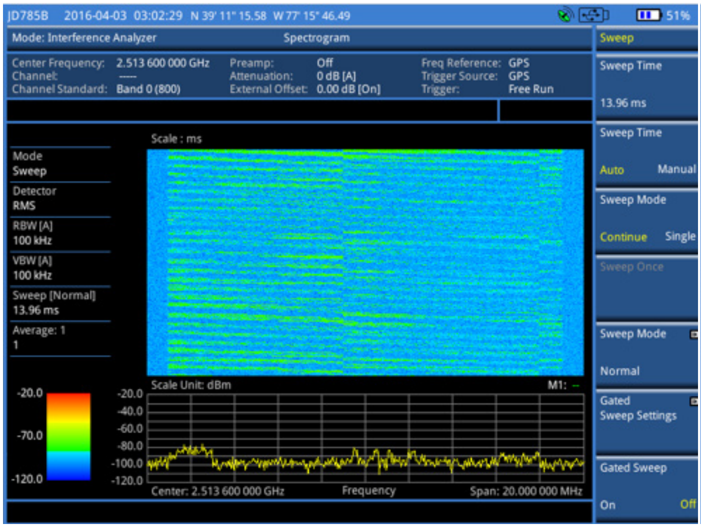


Figure 17a. Spectrogram view with gated sweep turned off

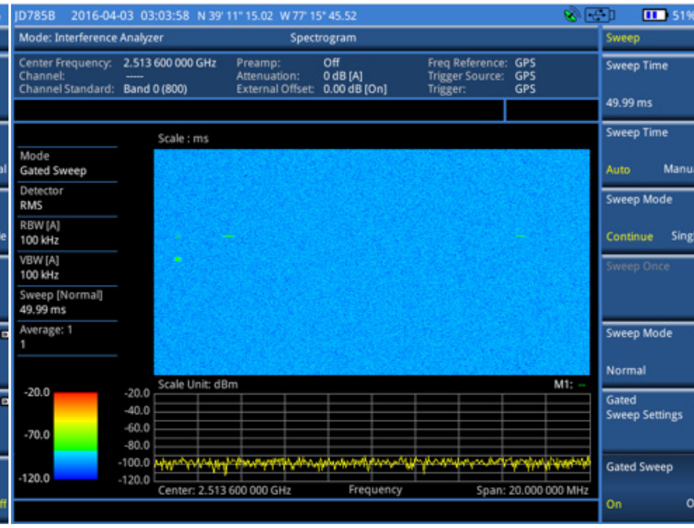


Figure 17b. Spectrogram view with gated turned sweep on

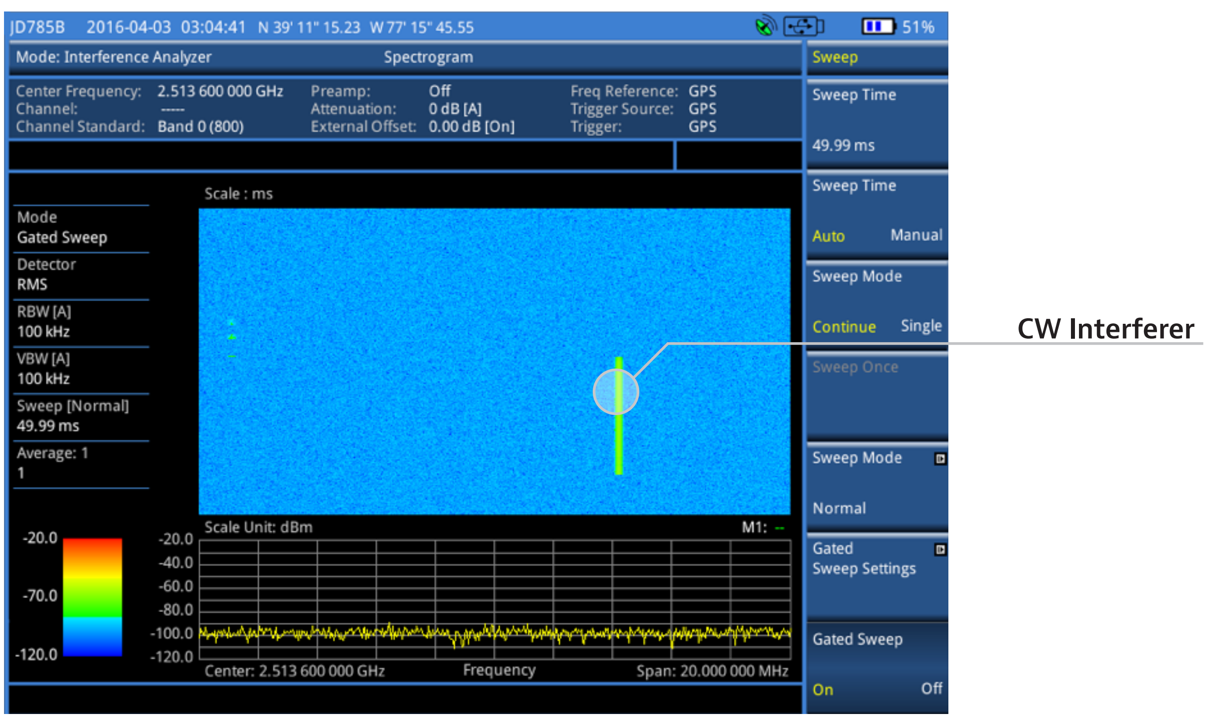


Figure 18. Spectrogram view in gated sweep mode showing CW interference in the uplink

Dual Spectrogram

The Dual Spectrogram mode is useful to compare two spectrograms displayed simultaneously on the screen. Settings such as Frequency, RBW, VBW, Markers, Amplitude Scale, and Time Interval between traces can be set independently for the two Windows labelled "Left" and "Right" under Active Window

Configuration Settings

1. Select Mode: Interference Analyzer (Make sure you set your Frequency, Channel, Band, etc).
2. Select Measure > Dual Spectrogram
3. Press Measure Setup > Active Window
4. Select either Left or Right under Active Window in order to apply individual settings such as Frequency, RBW, VBW, Scale/Div, Markers, Limit (through Limit hot key) and Time Interval between each Trace.

Figures 19a and 19b show the Dual Spectrogram view of a channel at 2 GHz. **Figure 19a** is a Dual Spectrogram view showing settings used for the Left Active Window. Here, the frequency is set to 2 GHz and the RBW and VBW are each set to 30 kHz. Also notice that the Scale/Div is set to 5 dB/div.

Figure 19b is a Dual Spectrogram view showing settings used for the Right Active Window. Here, the frequency is set to 1 GHz and the RBW and VBW are each set to 100 kHz. Also the Scale/Div is set to 10 dB/div.

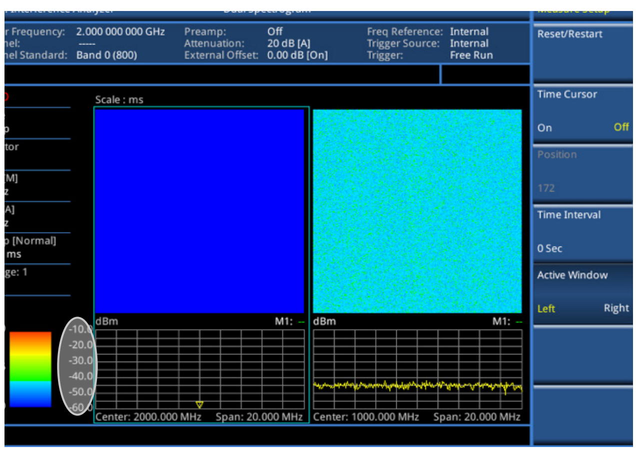


Figure 19a. Dual Spectrogram view showing settings for left active window

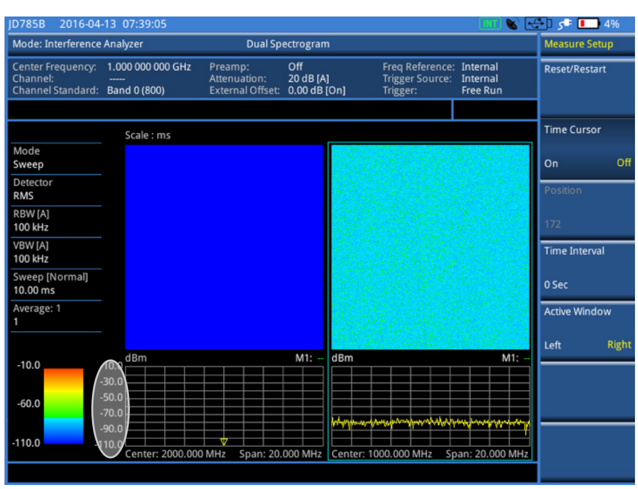


Figure 19b. Dual Spectrogram view showing settings for right active window

5. Uplink Interference Tracking with Signal Analysis (Option JD745B029)

Connections

1. Connect your RF antenna to the spectrum analyzer RF-in port of the JD700B Series
2. Connect a GPS antenna to the GPS port of theJD700B series.

Configuration Settings

1. Press Mode and select Signal Analyzer
2. Select LTE-TDD (The Spectrum mode is selected by default)
3. Press Measure and then select the measurement mode option to choose from the following choices:
   – Spectrum, RF Analysis, Power vs Time, Modulation Analysis, Auto Measure , Power Statistics CCDF, More (1/2) > Carrier Aggregation, More (1/2) > OTA
4. Select Mode: Spectrum Analyzer
5. Select Freq/Dist : Set the Center Frequency and Span
6. Select Channel Std: Set the relevant LTE-TDD band and input Channel Number

LTE-TDD Spectrum Mode

The Spectrum mode is selected by default when you select the LTE-TDD Signal Analyzer. There is a difference between the Spectrum mode within the LTE-TDD Signal Analyzer compared to the general Spectrum mode. The LTE-TDD signal analysis option is optimized to analyze the signal in the time domain. This mode allows you to specify the Subframe number that you want to analyze and the LTE-TDD signal analyzer automatically configures the Trigger and Gate settings to set the time gate around the chosen Subframe and the displayed the spectrum is that of the specified Subframe and not of the entire 10 ms frame.

Measurement Setup

1. Press Measure and select Spectrum
2. Press the Measure Setup hot key
3. Select Bandwidth softkey to set the BW of the LTE-TDD channel
4. Select the Subframe number to be measured
5. Toggle the Cell ID soft key and select Auto or Manual as desired:

   Auto: Lets the instrument detect the Cell ID for the LTE signal automatically.

   Manual: Sets a specific Cell ID for the LTE signal manually in order to speed up the synchronization with a BTS.
6. Guard Period (Used to check if there is any interference signal within the guard period based on the 3GPP standard)

Figure 20 shows the spectrum of Subframe 0 in the LTE-TDD Signal Analysis mode.

As the LTE-TDD Signal Analysis option already provides time-triggered measurement for analyzing Subframe 0, you don't need to configure additional Gated Sweep settings to capture this signal. This mode therefore provides the display of the Subframe specific spectrum. For example, if Subframe 5 is transmitting Uplink and you want to check for interference in this Subframe, then on selecting Subframe 5, the spectrum displays any interference found in the time interval when the Uplink on Subframe 5 is being transmitted. This figure also shows the spectrum in two Trace Modes- Max Hold (Yellow Trace) and Min Hold (Orange Trace). When you have a constant interference very close to your signal of interest, you can discern this interference better using the Min Hold trace mode, compared to either the Max Hold or Clear Write trace modes.

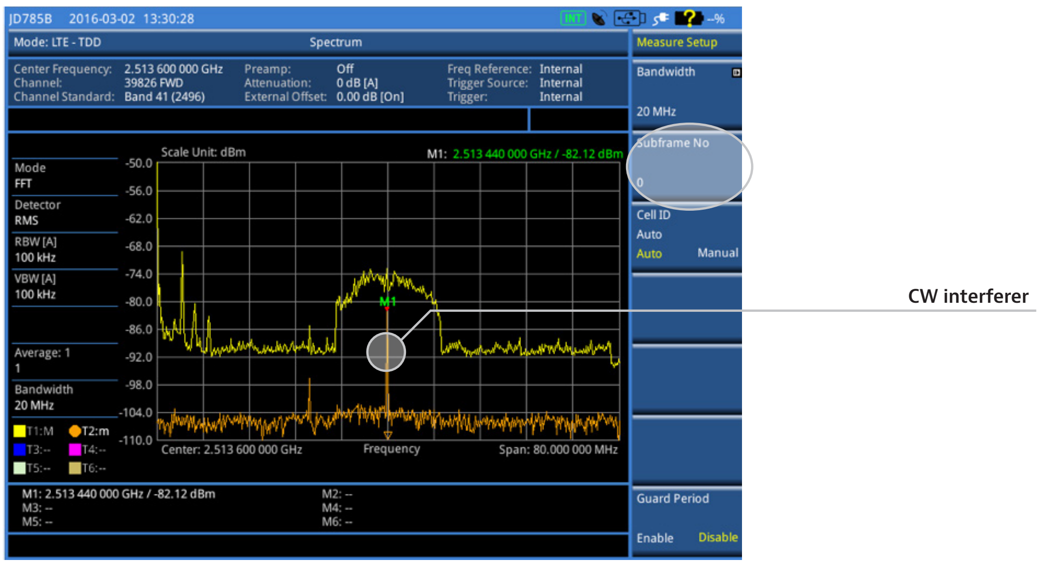


Figure 20. Spectrum view of subframe 0 in the LTE-TDD signal analysis mode

Power vs. Time measurements

The Power vs. Time measurement measures the modulation envelope in the time domain, showing the signal rise and fall shape of LTE signal and the power of each time slot in an LTE signal. This mode further has two measurement sub-modes- Power v Time (Frame) and Power v Time (Slot).

Configuration Settings

1. Select Mode > Signal Analyzer > LTE-TDD
2. Press Measure > Power vs Time > Power vs Time (Frame)
3. Press the Measure Setup hotkey.
4. Select Bandwidth softkey to set the BW of the LTE-TDD channel
5. Select the Subframe number to be measured,
6. Toggle the Cell ID soft key and select Auto or Manual as desired:

7. Optional. Press the Miscellaneous soft key, and then do the following as needed:
   – To select the number of antenna ports, toggle the MIMO soft key and select 2x2 or 4x4. This MIMO (Multiple Input Multiple Output)setting is activated only if the option 031 LTE-Advanced TDD is installed with a license number. If not, the instrument sets this option to 2x2by default. A 2x1 or 4x1 RF combiner is also required to able to test on MIMO channels.
   – To assign a antenna port number automatically or manually, press the Antenna Port soft key and select the option: Auto, 0, 1, 2,and 3.

Power vs. Time (Frame)

The Power vs. Time (Frame) measures the modulation envelope in the time domain, showing the power of each time slot in an LTE signal. This function can be used as an indicator to check if there is any in-channel interference by looking at the received noise level during the transmitter off period (in 3GPP specification, transmitter off power should be lower than -85 dBm).

Figures 21a and 21b show the Power vs. Time (Frame) plot of a LTE-TDD signal showing the power levels in Subframe 3. When no interference is present in the channel, this power should fall below -85 dBm, as shown in **Figure 21a**. When an in-channel interference is present in the channel, the noise floor of the analyzer tends to raises proportionally to the strength of the interference. Stronger the interference, the higher the noise floor will rise above -85 dBm. **Figure 21b** show the Power vs. Time (Frame) plot of the LTE-TDD signal, this time in presence of an in-channel interference. The noise level in Subframe 3 is now around -55 dBm.

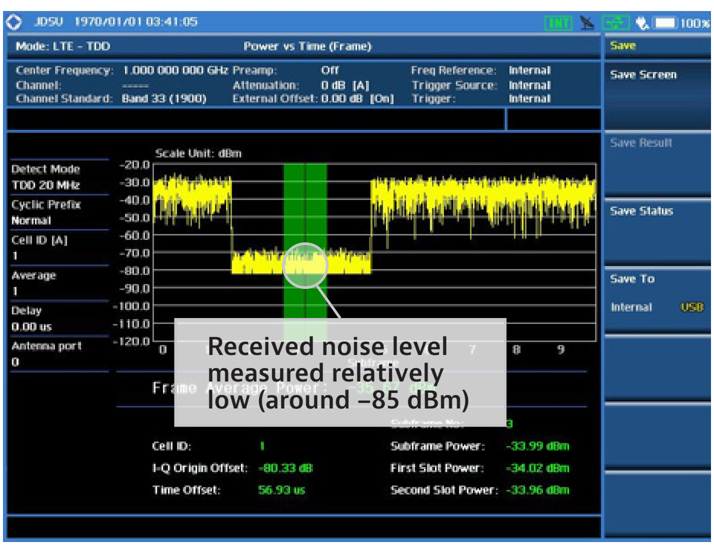


Figure 21a. Power vs. Time (Frame) plot of a LTE-TDD signal

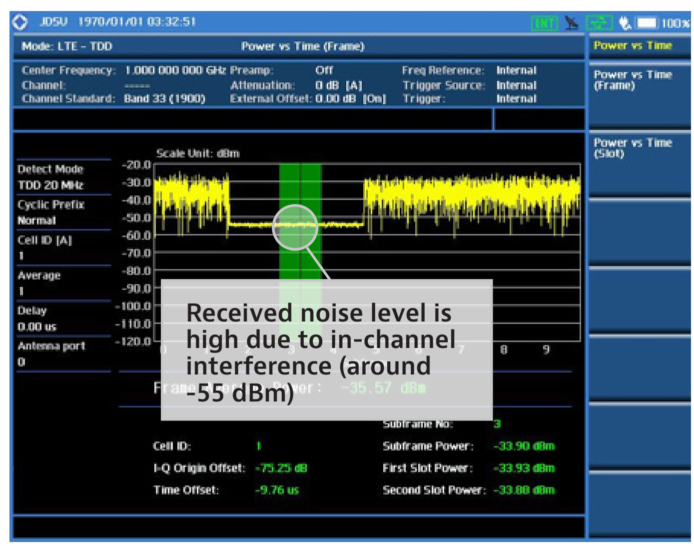


Figure 21b. Power vs. Time (Frame) plot in presence of in-channel interference

The source of interference can occur anywhere in the LTE-TDD channel. In order to find out if it is present in all the Subframes or only in the Uplink, you can now select the specific Subframe and check the corresponding Subframe Spectrum. For example, **Figure 22a** shows the spectrum of Subframe 1 of the signal in presence of in-channel interference that is shown in **Figure 21b**, and you can see that there is no sign of any interference during transmission of Subframe 1. However, when you select Subframe 3, that is the time slot of the uplink transmission, you can clearly see the presence of interference as shown in **Figure 22b**.

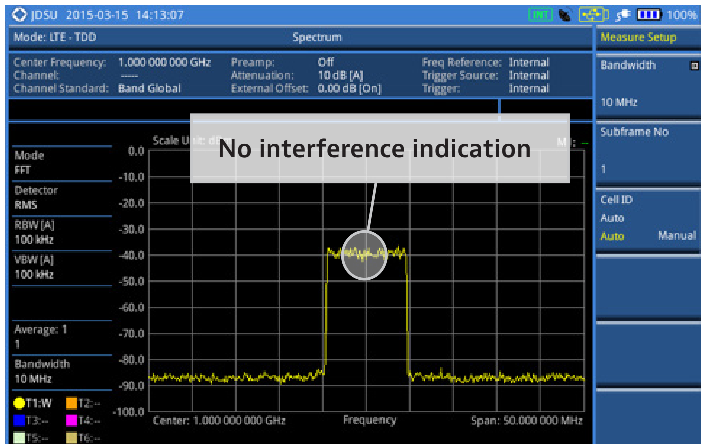


Figure 22a. Spectrum of Subframe 1 showing no presence of interference during the timeslot

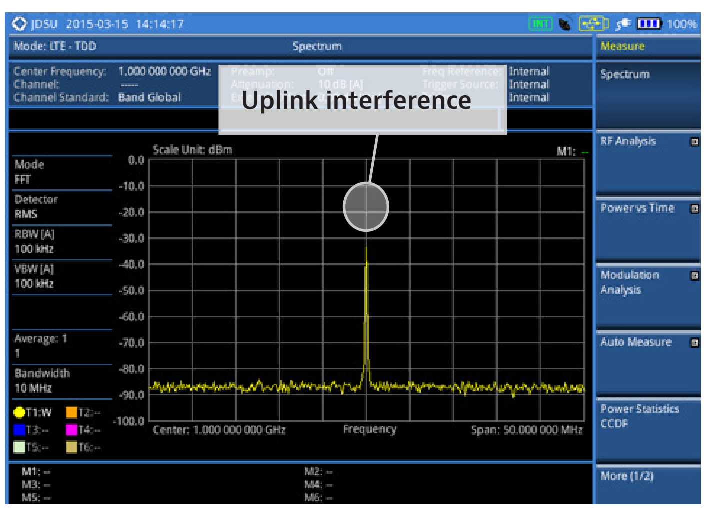


Figure 22b. Spectrum of Subframe 3 showing interference during the time slot

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