Keysight X-Series Signal Analyzers

This manual provides documentation for the following Analyzers:

MXA Signal Analyzer N9020A

EXA Signal Analyzer N9010A

Notice: This document contains references to Agilent. Please note that Agilent's Test and Measurement business has become Keysight Technologies. For more information, go to www.keysight.com.

N6149A
iDEN/WiDEN/
MotoTalk
Analyzer
Measurement
Application
Measurement
Guide

KEYSIGHT
TECHNOLOGIES

Notices

Trademark Acknowledgements

Warranty

Technology Licenses

Restricted Rights Legend

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Where to Find the Latest Information

Documentation is updated periodically. For the latest information about these products, including instrument software upgrades, application information, and product information, browse to one of the following URLs, according to the name of your product:

http://www.keysight.com/find/mxa

http://www.keysight.com/find/exa

To receive the latest updates by email, subscribe to Keysight Email Updates at the following URL:

http://www.keysight.com/find/emailupdates

Information on preventing analyzer damage can be found at:

http://www.keysight.com/find/tips

Is your product software up-to-date?

Periodically, Keysight releases software updates to fix known defects and incorporate product enhancements. To search for software updates for your product, go to the Keysight Technical Support website at:

http://www.keysight.com/find/techsupport

Table of Contents

Contents

3 Concepts

1   About the iDEN/WiDEN/MotoTalk Analyzer Measurement Application

This chapter provides overall information on the Keysight N6149A iDEN/WiDEN/MotoTalk Analyzer Measurement Application and describes the measurements made by the analyzer. Installation instructions for adding this option to your analyzer are provided in this section, in case you purchased this option separately.

What Does the Keysight N6149A iDEN/WiDEN/MotoTalk Analyzer Measurement Application Do?

The Keysight N6149A iDEN/WiDEN/MotoTalk Analyzer Measurement Application can help determine if a modulated source or transmitter is working correctly. There are standard and optional settings to enable complete analysis of the signals that conform to the Motorola iDEN/WiDEN/MotoTalk standards specifications.

The Option N6149A-2FP iDEN/WiDEN/MotoTalk Analyzer provides:

• iDEN Power Measurement

• iDEN Demod Measurement

• MotoTalk Measurement

• VSA Vector Analysis Measurement

• Monitor Spectrum Measurement

The N6149A iDEN/WiDEN/MotoTalk Analyzer measurement application supports the following standards:

• iDEN RF Interface Specification: Layer 1, version R02.00.06

• Requirement to Modify WiDEN Power Versus Time Mask

• Motorola TalkAround: RF Interface, Talk Around Protocol(8/19/2002)

2 Making iDEN/WiDEN/MotoTalk Analyzer Measurements

This chapter describes procedures used to set up measurements for analysis of various types of modulated signals. Details of the steps necessary for accurate vector signal analysis of iDEN/WiDEN/MotoTalk signals are provided.

Introduction

This chapter provides measurement procedures and also shows example results obtained using the iDEN/WiDEN/MotoTalk Analyzer measurement application. When correctly set up, the iDEN/WiDEN/MotoTalk Analyzer measurement application demodulates associated formats and performs a suite of measurements to analyze the signal modulation quality.

There are five measurements available in this mode: **Vector Analysis**, **Monitor Spectrum**, **iDEN Demod**, **iDEN Power**, and **MotoTalk**. Procedures specific to iDEN signals are shown in the following sections.

NOTE   Before you can begin making measurements, make sure you have N6149A-2FP installed.

1. Press **Mode**, and check to make sure that **iDEN/WiDEN/MotoTalk Analyzer** is available.

2. Press **Meas**, and check to make sure that all the measurements: **iDEN Demod**, **iDEN Power** and **MotoTalk** are available.

The following main subjects are presented in this chapter:

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  This section describes how to steps to perform a iDEN Demod measurement.

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  This section describes steps to perform a iDEN Power measurement.

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  This section describes steps to perform a MotoTalk measurement.

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  This section introduces error messages you may have when making a iDEN/WiDEN/MotoTalk measurement.

NOTE   For more information on how to make a Vector Analysis measurement, please refer to *89601X VXA Signal Analyzer Measurement Guide*.

For more information on how to make a Monitor Spectrum measurement, please refer to *N9060A Signal Analyzer Measurement Guide*.

Making iDEN Demod Measurements

iDEN Demod Measurement Overview

Making successful measurements of iDEN signals is easy when you follow the main steps below. The procedure overview below provides links in blue to a detailed procedure and description for each step:

"Step 1 - Set Up the Test Equipment and DUT" on page 11

This step configures the analyzer connections for an RF measurement.

"Step 2 - Select the Mode and Preset the Analyzer" on page 12

This step assures the analyzer will be set to a known state, either the factory preset or a user-configured preset.

"Step 3- Select the Mode Setup Parameters" on page 13

This step specifies the radio parameters and carriers configuration.

"Step 4- Select Measurement, Test Selection and Preset" on page 13

This step allows you to make an iDEN Demod measurement either by preset settings or desired settings.

"Step 5 - Configure the Display" on page 13

This step enables you to select different views of display.

"Step 6 - Optimize your Results" on page 19

Measurement results are available in graphical displays that can be presented in preset groups or adjusted to suit your specific application. Most results are also available in tabular format.

Step 1 - Set Up the Test Equipment and DUT

This step configures the analyzer connections for an iDEN Demod measurement.

Making the Initial Signal Connection

CAUTION   Before connecting a signal to the instrument, make sure the instrument can safely accept the signal level provided. The signal level limits are marked next to the connectors on the front panel.

Figure 2-1　　　　　　　*iDEN Demod Measurement Setup*

The device under test (DUT) is connected to the RF input port. The DUT may possibly be controlled externally by a computer. External attenuator, external trigger, and external reference are optional. Using the appropriate cables, connect the equipment as shown.

Click to Go Back to .

Step 2 - Select the Mode and Preset the Analyzer

This step assures the analyzer will be set to a known state, either the factory preset or a user-configured preset.

Step	Action	Notes
2a. Select the Mode.	Press **MODE**, **iDEN/WiDEN/MotoTalk Analyzer**.	
2b. Preset the analyzer.	a. Press the green **Mode Preset** button for the factory preset. b. To recall a user-defined Preset: Press **User Preset,** User Preset to preset the current mode.	

Click to Go Back to .

Step 3- Select the Mode Setup Parameters

This step is to select the Radio format for signals of your interest. You can select MQAM Format, Slot Format and configure the multi-carriers for WiDEN signals.

Step	Action	Notes
3a. Select Mode Setup menu.	Press **Mode Setup**, if needed.	
3b. Select radio standards menu.	Press **iDEN/WiDEN**.	
3c. Select MQAM Format.	Press **MQAM Format**, and select the format from the list.	
3d. Select Slot Format.	Press **Slot Format**, and select the format from the list.	
3e. Config the Carriers	Press **Carrier Config**, and select the configuration from the list.	Only when WiDEN slot formats are active
OR		
3f. If desired, change the color code.	a. Press **Color Code**, and enter the desired number.	

Step 4- Select Measurement, Test Selection and Preset

This step is to turn on the Tests you want to run: PvT, EVM and BER.

Step	Action	Notes
4a. Select the iDEN Demod measurement.	Press **Meas, iDEN Demod**.	
4b. Select the Test Selection.	Press **Meas Setup, Test Selection,** then turn on the Test you want to run.	
4c. Preset the remaining parameters upon your Test Selection.	Press **Meas Setup**, **Test Preset**.	

Step 5 - Configure the Display

Measurement results are available in graphical displays that can be presented in preset groups or adjusted to suit your specific application. Most results are also available in tabular format.
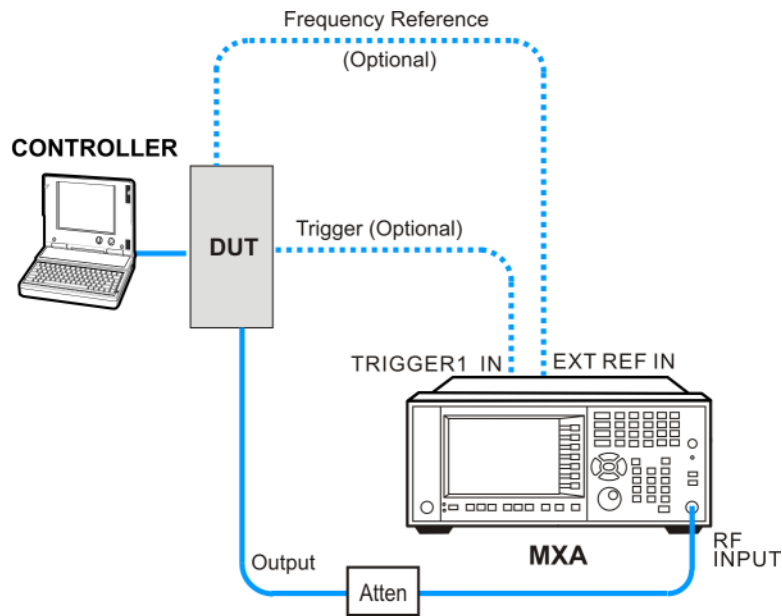
Step	Action	Notes
5a. Use a **Preset View** for fast, powerful results displays.	a. Press **View/Display**, and select a **Preset View** from a selection of useful combinations of related data trace displays.	For details of the Preset Views see Preset Views below.
OR		
5b. If desired, choose a custom screen layout.	a. Press **View/Display**, **Layout** and select a layout that will provide your desired arrangement. You can choose up to 4 panes to display your trace data.	
5c. Customize your layout by assigning a data trace to a measurement display.	a. Press **Trace/Detector**, **Select Trace**, and select the number of the trace to change. b. Press **Data** to display a menu of trace groups and select the trace data for assignment to the graph. c. Repeat trace assignment for any other traces in the layout as needed.	When you press **Trace/Detector**, **Select Trace**, the trace numbers are displayed on the screen to help you identify the traces for selection.

View - Preset View: Test Standard

The Test Standard view provides the preset view for the set of selected tests, as defined in the Test Selection section. The exact action is dependent on the test selections.

The action performed is detailed in the table below.

- If no Test is selected the Display Layout will be "Stack 2", with the two traces shown in the "EVM or none" column.

- If a single test is selected, the Display Layout will be "Stack 2", with the two traces shown in the column below the Test.

- If Two tests are selected, the Display Layout will be "Grid 2x2", with the four traces shown in the same location as in the table below if you remove the column for the unused Test.

- If all three Tests are selected, the Display Layout will be "Grid 2x3", with the six traces shown in the same location as in the table below.

EVM or none	PvT	BER
Trace 1: IQ Meas Time constellation	Trace 3: PvT Time	Trace 5: BER Slot Summary
Trace 2: EVM Composite Summary	Trace 4: PvT Summary	Trace 6: BER Overall Summary
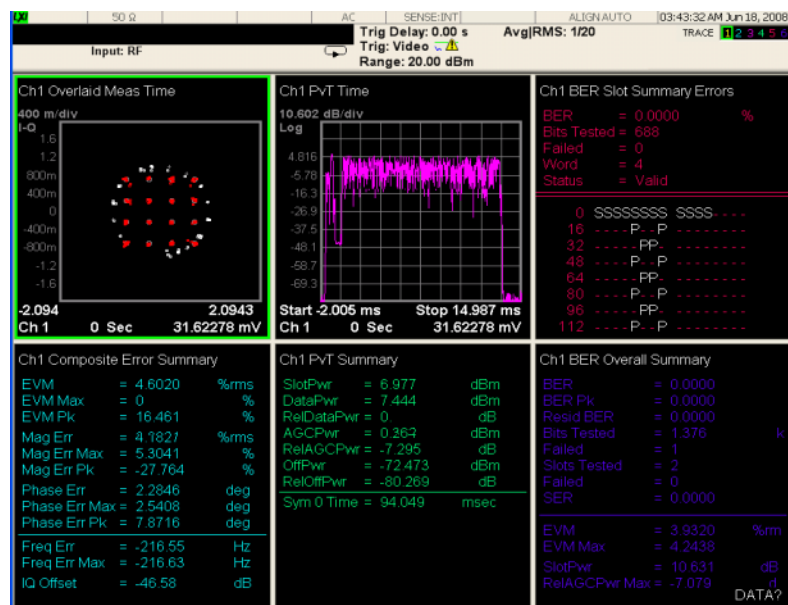
View - Preset View: PvT Rise & Fall

The PvT Rise & Fall view configures a 4 pane layout. Traces 1 displays the rising edge, and trace 3 displays the falling edge, of the iDEN burst. Those traces are setup using X-axis scaled parts of the PVT Time Meas Data. Trace 2 displays the PVT Summary. Trace 4 displays the Spectrum trace.

The default X-axis scaling setup for the PvT Time traces in the PvT Rise & Fall view is a function of the slot format.

For viewing consistency, the X-scale length is 3 ms in all cases. Note that 0.0 is the symbol time of the first modulated symbol.

Slot Format	Inbound Reserved, Enhanced 6:1, WiDEN	Inbound New 6:1	Inbound New 6:1 with Training	Inbound Random Access	Outbound
Rise Window - Start	–2 ms	–1 ms	–2 ms	–2 ms	–2 ms
Rise Window - Stop	1 ms	2 ms	1 ms	1 ms	1 ms
Fall Window - Start	12 ms	5.5 ms	4.5 ms	3.75 ms	14 ms
Fall Window - Stop	15 ms	8.5 ms	7.5 ms	6.75 ms	17 ms
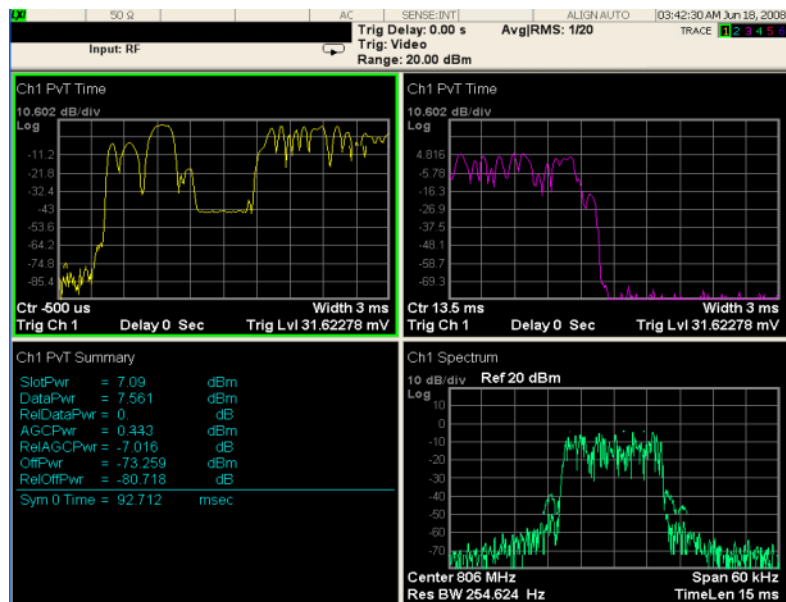
View - Preset View: EVM (Quad)

The EVM (Quad) view configures a 4 pane layout showing the constellation in Trace 1, the Spectrum in Trace 2, the Err Vect Time in Trace 3, and EVM statistics in the Composite Error Summary in Trace 4.
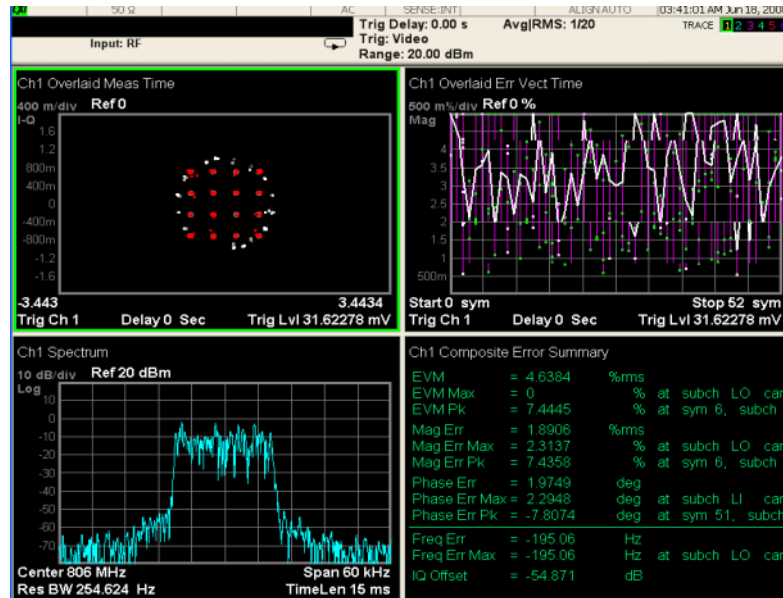
View - Preset View: EVM & Symbols

The EVM & Symbols view configures a 4 pane layout showing the IQ Meas Time constellation in trace 1, Composite Error Summary in trace 2, the Err Vect Time in trace 3, and the Symbol Table in trace 4.
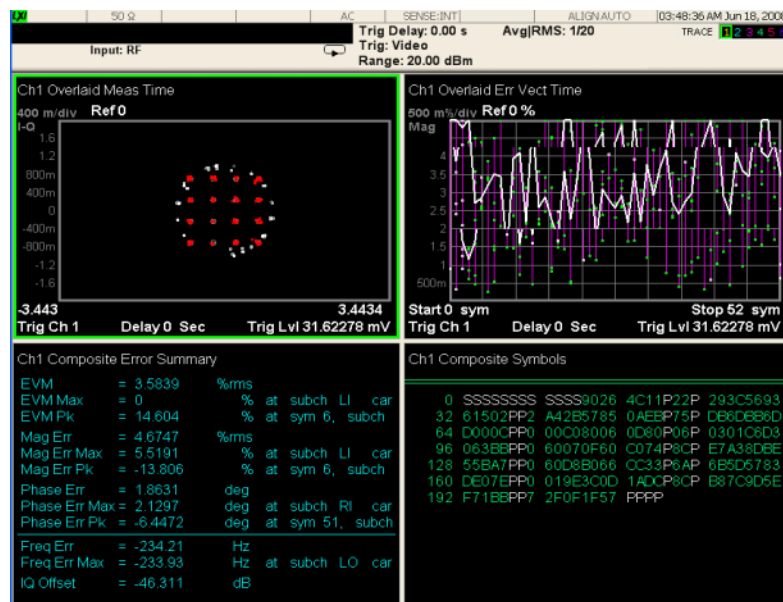
View - Preset View: WiDEN PvT

The WiDEN PvT view configures a 6 pane layout showing the 4 carriers' PvT trace in trace 1 to 4, Composite PvT trace in trace 5, and the PvT summary in trace 6.

Step 6 - Optimize your Results

In this step you can finalize the presentation of your data by adjusting various parameters to make your measurement data more useful.

Step	Action	Notes
6a. Select a graph for optimization.	Use the "Next Window" key (boxes with arrows) below the display to move the green outline "focus" to activate a graph for customization.	
6b. Optimize the X Scale.	Press **SPAN X Scale**, **Scale/Div**, then use the front-panel keypad to input the scale/div, then press a units key, like μs, to complete the entry. **OR** Press **SPAN X Scale**, **More, X Scale Auto** to allow the instrument to complete the scaling.	
6c. Optimize the Y Scale.	Press **AMPTD YScale**, **Scale/Div**, then use the front-panel keypad to input the scale/div, then press a units key, like μs, to complete the entry. **OR** Press AMPTD YScale**, Auto Scale** to allow the instrument to complete the scaling.	
6d. Use **a Marker** to indicate and measure signal characteristics.	I. Press **Marker**, **Select Marker**, and select the number of the maker desired for your display. II. Press **Marker Function**, **Select Marker** to assign a function to the marker. III. Select either **Band/Interval Power**, or **Band/Interval Density**, to turn on/off the markers. IV. Adjust either the **Power Calc** settings or **Density Calc** settings, depending on which function you have selected. V. Press **Marker**, **Delta** to set a Delta marker on/off and adjust its position on the graph.	For more information on Markers see the Markers section under Measurement Setup in Help.

Step	Action	Notes
6e. Add titles, or make other changes to the measurement graphs.	I. Press **View/Display**, **Display**, **System, Settings** to adjust other parts of the display for all measurement windows. II. Press **View/Display**, **Display**, **Annotation**, to turn on/off various parts of the display annotation. III. Press **View/Display**, **Display**, **Title, Change Title** to create a title for the graph. IV. Press **View/Display**, **Display**, **Graticule** to turn graticules on/off. V. Press **View/Display**, **Display**, **Display Line** to turn a reference line on/off and adjust its position on the graph.	For more information on Display settings see the Display section under Analyzer Setup in Help.

Viewing iDEN Demod Measurement Results

Measurement results available include graphical displays of various trace data as well as tabular results available remotely. These graphic results may be viewed separately, or combined into views. For more information on Views see "Step 5 – Configure the Display" on page 13.

Graphical iDEN Demod Measurement Results

To help pin-point modulation problems, the iDEN Demod measurement provides many different graphs and numeric results tables.

You can assign any available data to any of the traces displayed on the screen. The list below of data types may also be viewed in various formats, depending on the data, like constellation, spectrum, etc.

iDEN Demod Measurement Data Includes: There are three sets of test results combined into this measurement. Each set of results has limit testing to provide a Pass or Fail test result.

- Modulation Quality Test and Measurement Results

  Several EVM results are available, including constellations, EVM versus time, EVM summary trace, etc. The EVM Test Limit is changeable.

- Bit Error Rate Test and Measurement Results

  Typical Glacier style BER results are available, including a summary trace with symbols for a user-selected analysis slot, and an overall BER summary. The BER Test Limit is changeable.

- Power Versus Time Test and Measurement Results

  The PvT trace has slot format specific limit lines. Note that 0.0 is the symbol time of the first modulated symbol.

For more information on what these data traces are, see the *N6149A iDEN/WiDEN/MotoTalk Analyzer Measurement Application User's and Programmer's Reference* section on Trace/Detector, Data.

Click to Go Back to "Making iDEN Demod Measurements" on page 11.

Example Measurement - iDEN Demod

This procedure demonstrates how to see different results views available for the iDEN Demod measurement. This example assumes the signal is correctly applied to the input.

Step 1. Press **Mode Preset**

Step 2. Press **Meas, iDEN Demod**, **Test Preset**

Step 3. View the measurement default view. (See Figure 2-2 on page 22).

Figure 2-2   *iDEN Demod and Test Standard View (Default)*
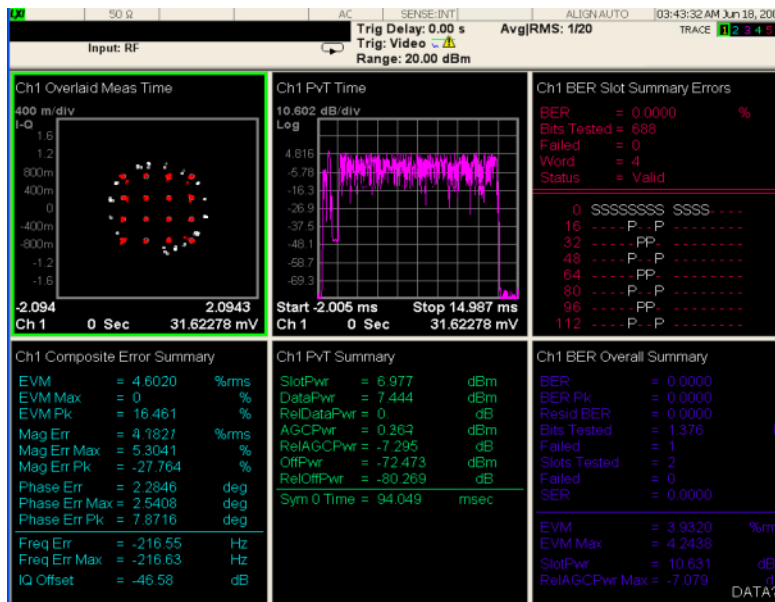
Step 4. Press **Meas Setup, iDEN Demod, Test Selection**, and toggle the **PvT, EVM and BER** to On.

Step 5. Select the PvT view in trace 1 (See Figure 2-3 on page 23)

Figure 2-3   *iDEN Demod PvT View*
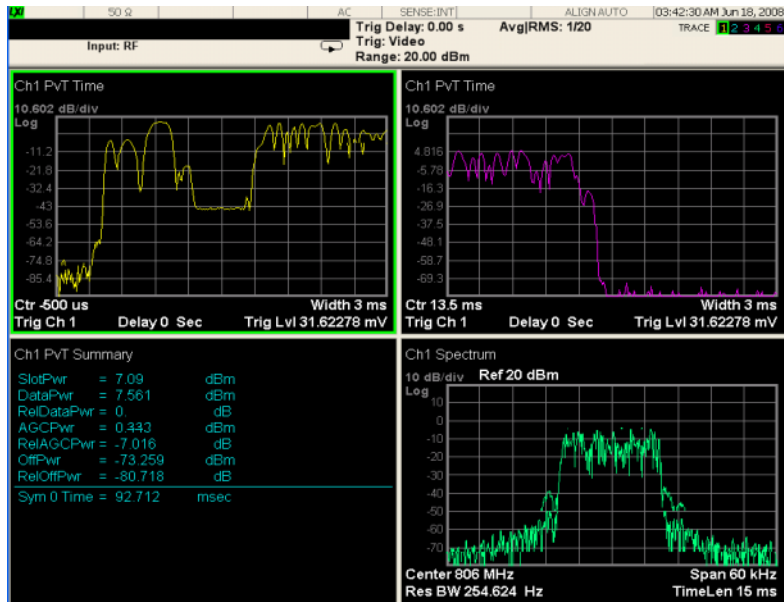
Step 6. Press the "Next Window" key to move the focus (green outline) to trace 3 or press
Trace/Detector, **Select Trace**, **Trace 3**.

Figure 2-4
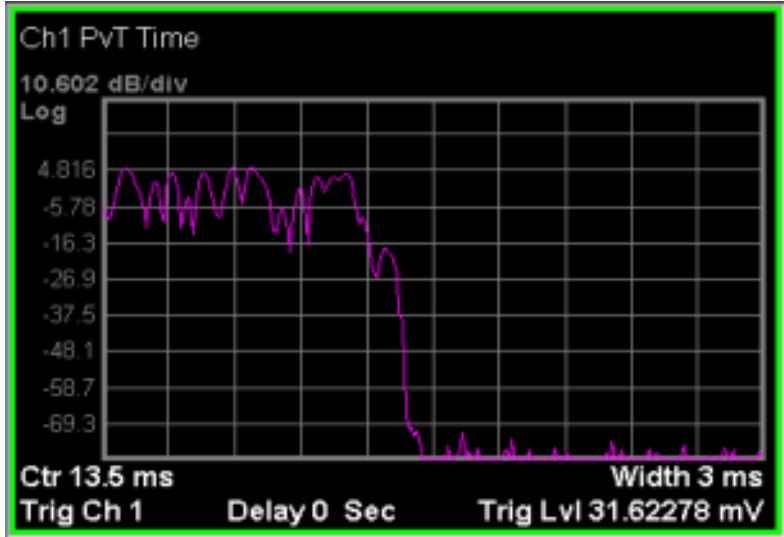
Step 7. Press **Amplitude**, **Auto Scale**. The time record of the modulating signal is now
clearly visible.

If you have a problem, and get an error message, see *Instrument Messages*.

Making iDEN Power Measurements

iDEN Power Measurement Overview

Making successful measurements of iDEN signals is easy when you follow the main steps below. The procedure overview below provides links in blue to a detailed procedure and description for each step:

"Step 1 - Set Up the Test Equipment and DUT" on page 11

This step configures the analyzer connections for an RF measurement.

"Step 2 - Select the Mode and Preset the Analyzer" on page 12

This step assures the analyzer will be set to a known state, either the factory preset or a user-configured preset.

"Step 3- Select the Mode Setup Parameters" on page 13

This step specifies the radio parameters and carriers configuration.

"Step 4- Select Measurement, Test Selection and Preset" on page 13

This step allows you to make an iDEN Power measurement either by preset settings or desired settings.

"Step 5 - Configure the Display" on page 13

This step enables you to select different views of display.

"Step 6 - Optimize your Results" on page 19

Measurement results are available in graphical displays that can be presented in preset groups or adjusted to suit your specific application. Most results are also available in tabular format.

Step 1 - Set Up the Test Equipment and DUT

This step configures the analyzer connections for an iDEN Power measurement.

Making the Initial Signal Connection

CAUTION	Before connecting a signal to the instrument, make sure the instrument can safely accept the signal level provided. The signal level limits are marked next to the connectors on the front panel.

Figure 2-5   *iDEN Power Measurement Setup*

The device under test (DUT) is connected to the RF input port. The DUT may possibly be controlled externally by a computer. External attenuator, external trigger, and external reference are optional. Using the appropriate cables, connect the equipment as shown.

Step 2 - Select the Mode and Preset the Analyzer

This step assures the analyzer will be set to a known state, either the factory preset or a user-configured preset.

Step	Action	Notes
2a. Select the Mode	Press **MODE**, **Vector Signal Analyzer**.	The default measurement for iDEN/WiDEN/MotoTalk Analyzer is Vector Analysis.
2b. Preset the analyzer.	Press the green **Mode Preset** button for the factory preset. **OR** To recall a user-defined Preset: Press **User Preset,** User Preset to preset the current mode.	

Step 3- Select the Radio Parameters and Config Carriers

This step is to select the Radio format for signals of your interest. You can select MQAM Format, Slot Format and configure the multi-carriers for WiDEN signals.

Step	Action	Notes
3a. Select Mode Setup menu.	Press **Mode Setup**, if needed.	
3b. Select radio standards menu.	Press **iDEN/WiDEN**.	
3c. Select MQAM Format.	Press **MQAM Format**, and select the format from the list.	
3d. Select Slot Format.	Press **Slot Format**, and select the format from the list.	
3e. Config the Carriers.	Press **Carrier Config**, and select the configuration from the list.	Only when WiDEN slot formats are active

Click to Go Back to .

Step 4- Select Measurement, Test Selection, and Preset

This step is to turn on the Tests you want to run: ACP and OBW.

Step	Action	Notes
4a. Select the iDEN Demod measurement.	Press **Meas, iDEN Power**.	
4b. Select the Test Selection.	Press **Meas Setup, Test Selection,** then turn on the Test you want to run.	
4c. Preset the remaining parameters upon your Test Selection.	Press **Meas Setup**, **Test Preset**.	

Click to Go Back to .

Step 5 - Configure the Display

Measurement results are available in graphical displays that can be presented in preset groups or adjusted to suit your specific application. Most results are also available in tabular format.
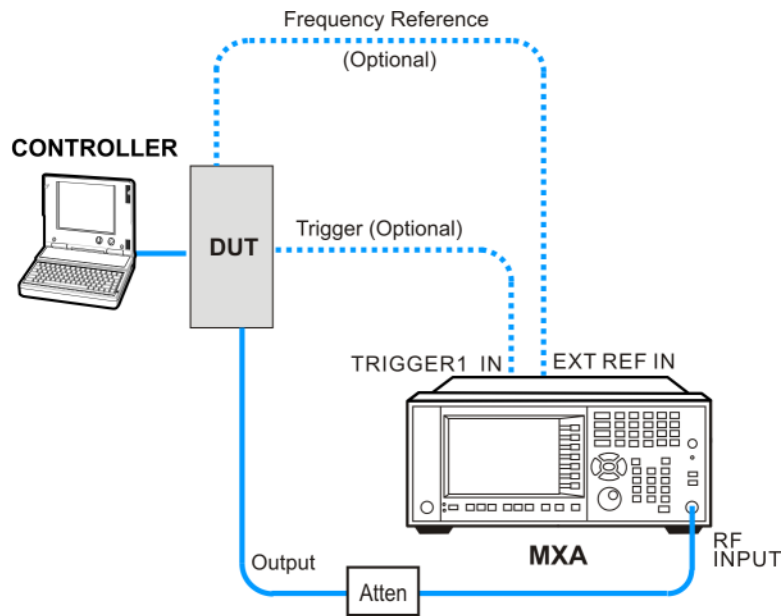
Step	Action	Notes
5a. Use a **Preset View** for fast, powerful results displays.	Press **View/Display**, and select a **Preset View** from a selection of useful combinations of related data trace displays.	For details of the Preset Views see Preset Views below.
OR		
5b. If desired, choose a custom screen layout.	Press **View/Display**, **Layout** and select a layout that will provide your desired arrangement. You can choose up to 4 panes to display your trace data.	
5c. Customize your layout by assigning a data trace to a measurement display.	I. Press **Trace/Detector**, **Select Trace**, and select the number of the trace to change. II. Press **Data** to display a menu of trace groups and select the trace data for assignment to the graph. III. Repeat trace assignment for any other traces in the layout as needed.	When you press **Trace/Detector**, **Select Trace**, the trace numbers are displayed on the screen to help you identify the traces for selection.

Preset View: Test Standard

The Test Standard view provides the preset view for the set of selected tests. The exact action is dependent on the test selections.
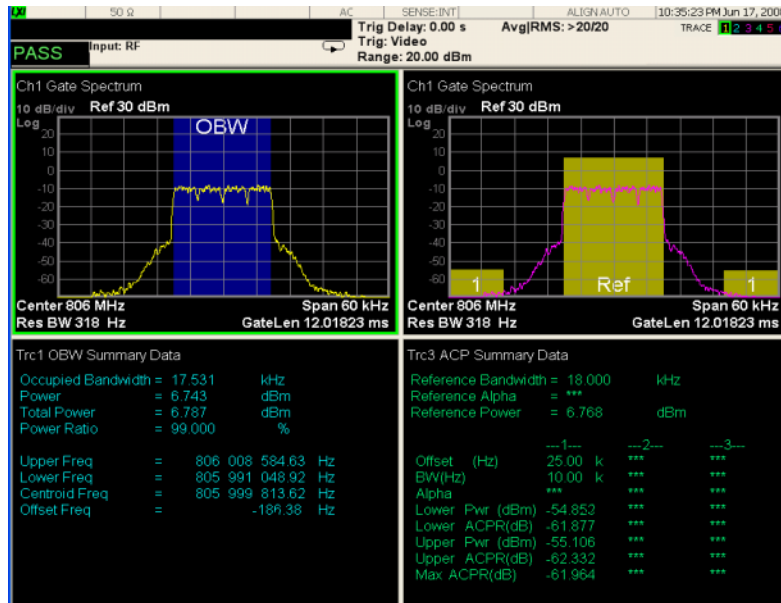
The action performed is:

• ACP Test only selected: Preset View: ACP.

• OBW Test only selected: 2 window display. Trace 1 displays the Spectrum with OBW measurement, and trace 2 displays the OBW Summary.

• Both ACP and OBW Tests selected: Preset View OBW & ACP.

Preset View: ACP

The ACP view is a 2 window display, with the Spectrum and the ACP color bars in trace 3, and the ACP Summary in trace 4. This is the default view when only the ACP test is enabled. If the ACP Test is not enabled, these traces will still be shown but the ACP Summary trace will contain no data.
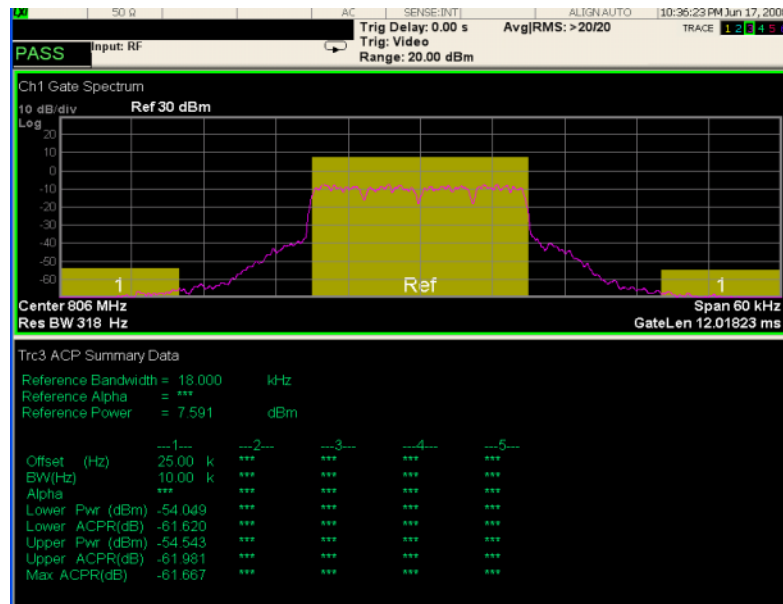
Preset View: OBW & ACP

The OBW & ACP view is a 4 window layout. Trace 1 displays the Spectrum with OBW measurement, and trace 2 displays the OBW Summary. Trace 3 displays the Spectrum with ACP measurement, and trace 4 displays the ACP Summary. This is the default view when OBW and ACP tests are enabled. If the OBW Test is not enabled, these traces will still be shown but the OBW Summary trace will contain no data and the ACP measurement will not be visible on the Spectrum. If the ACP Test is not enabled, these traces will still be shown but the ACP Summary trace will contain no data and the ACP measurement will not be visible on the Spectrum.
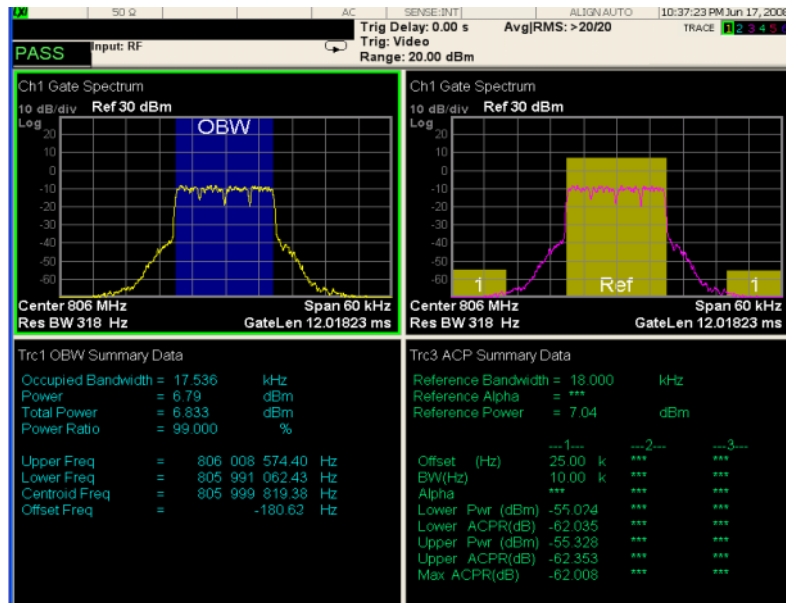
Preset View: ACP & Burst

The ACP & Burst view is a 2 window layout. Trace 5 displays the Spectrum with ACP measurement, and trace 6 displays Main Time.   If the ACP Test is not enabled, the ACP measurement will not be visible on the Spectrum trace.

Step 6 - Optimize your Results

In this step you can finalize the presentation of your data by adjusting various parameters to make your measurement data more useful.

Step	Action	Notes
6a. Select a graph for optimization.	Use the "Next Window" key (boxes with arrows) below the display to move the green outline "focus" to activate a graph for customization.	
6b. Optimize the X Scale.	Press **SPAN X Scale**, **Scale/Div**, then use the front-panel keypad to input the scale/div, then press a units key, like **μs**, to complete the entry. **OR** Press **SPAN X Scale**, **More, X Scale Auto** to allow the instrument to complete the scaling.	
6c. Optimize the Y Scale.	Press **AMPTD YScale**, **Scale/Div**, then use the front-panel keypad to input the scale/div, then press a units key, like **μs**, to complete the entry. **OR** Press AMPTD YScale**, Auto Scale** to allow the instrument to complete the scaling.	
6d. Use **a Marker** to indicate and measure signal characteristics.	I. Press **Marker**, **Select Marker**, and select the number of the maker desired for your display. II. Press **Marker Function**, **Select Marker** to assign a function to the marker. III. Select either **Band/Interval Power**, or **Band/Interval Density**, to turn on/off the markers. IV. Adjust either the **Power Calc** settings or **Density Calc** settings, depending on which function you have selected. V. Press **Marker**, **Delta** to set a Delta marker on/off and adjust its position on the graph.	For more information on Markers see the Markers section under Measurement Setup in Help.

Step	Action	Notes
6e. Add titles, or make other changes to the measurement graphs.	I. Press **View/Display**, **Display**, **System, Settings** to adjust other parts of the display for all measurement windows.	For more information on Display settings see the Display section under Analyzer Setup in Help.
	II. Press **View/Display**, **Display**, **Annotation**, to turn on/off various parts of the display annotation.	
	III. Press **View/Display**, **Display**, **Title, Change Title** to create a title for the graph.	
	IV. Press **View/Display**, **Display**, **Graticule** to turn graticules on/off.	
	V. Press **View/Display**, **Display**, **Display Line** to turn a reference line on/off and adjust its position on the graph.	

Click to Go Back to .

Viewing iDEN Power Measurement Results

This section provides some examples of Analog Demod measurement results of an FM signal. Results available include graphical displays of various trace data as well as tabular results available remotely. These graphic results may be viewed separately, or combined into views. For more information on Views see .

Graphical iDEN Power Measurement Results

To help pin-point modulation problems, the iDEN Demod measurement provides many different graphs and numeric results tables. The following procedure shows you how to obtain the results displays (defined below).

You can assign any available data to any of the traces displayed on the screen. The list below of data types may also be viewed in various formats, depending on the data, like eye diagrams, constellation, spectrum, etc.

iDEN Power Measurement Data Includes:

- Occupied Bandwidth Results

  OBW results are available, including a color bar highlighting the occupied bandwidth, and an OBW summary trace.

- Adjacent Channel Power Results

  ACP results are available, including color bars on a spectrum trace highlighting the reference channel and the adjacent channels, and an overall ACP summary.

Click to Go Back to .

Example Measurement - iDEN Power

This procedure demonstrates how to see different results views available for the iDEN Power measurement. This example assumes the signal is correctly applied to the input.

Step 1. Press **Mode Preset**

Step 2. Press **Meas, iDEN Power**, **Test Preset**

Step 3. View the measurement default view. (See Figure 2-6 on page 34).

Figure 2-6   *iDEN Power and Test Standard View (Default)*
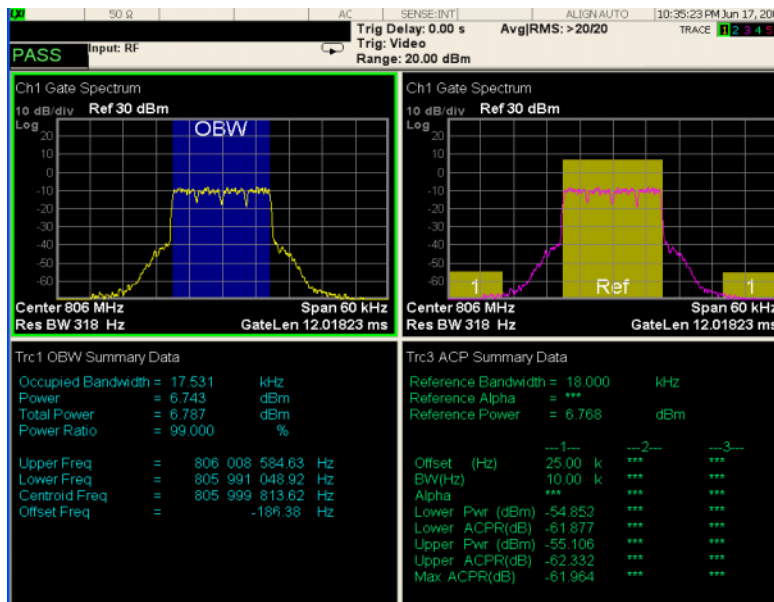
Step 4. Press **Meas Setup, iDEN Power, Test Selection**, and toggle the **ACP and OBW** to On.

Step 5. Select the ACP view in trace 1. (See Figure 2-7 on page 35)

Figure 2-7   *iDEN Power ACP View*
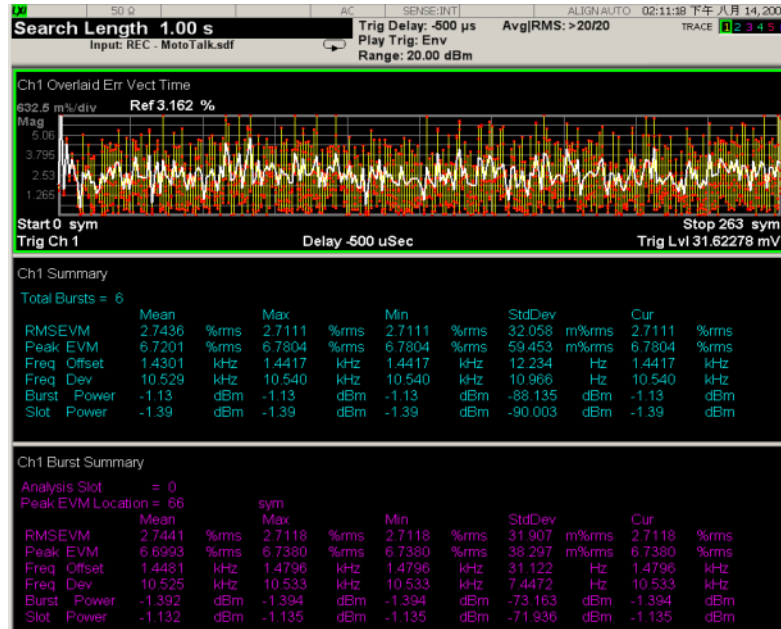
Step 6. Press the "Next Window" key to move the focus (green outline) to trace 3 or press **Trace/Detector**, **Select Trace**, **Trace 3**.

Step 7. Press **Amplitude**, **Auto Scale**. The time record of the modulating signal is now clearly visible.

If you have a problem, and get an error message, see *Instrument Messages*.

Making MotoTalk Measurements

MotoTalk Measurement Overview

This step configures the analyzer connections for making a MotoTalk measurement.

This step assures the analyzer will be set to a known state, either the factory preset or a user-configured preset.

 This step allows you to make a MotoTalk measurement either by preset settings or desired settings.

This step enables you to select different views of display.

Measurement results are available in graphical displays that can be presented in preset groups or adjusted to suit your specific application. Most results are also available in tabular format.

Step 1 - Set Up the Test Equipment and DUT

This step configures the analyzer connections for an RF measurement.

Making the Initial Signal Connection

CAUTION   Before connecting a signal to the instrument, make sure the instrument can safely accept the signal level provided. The signal level limits are marked next to the connectors on the front panel.

Figure 2-8   *MotoTalk Measurement Setup*
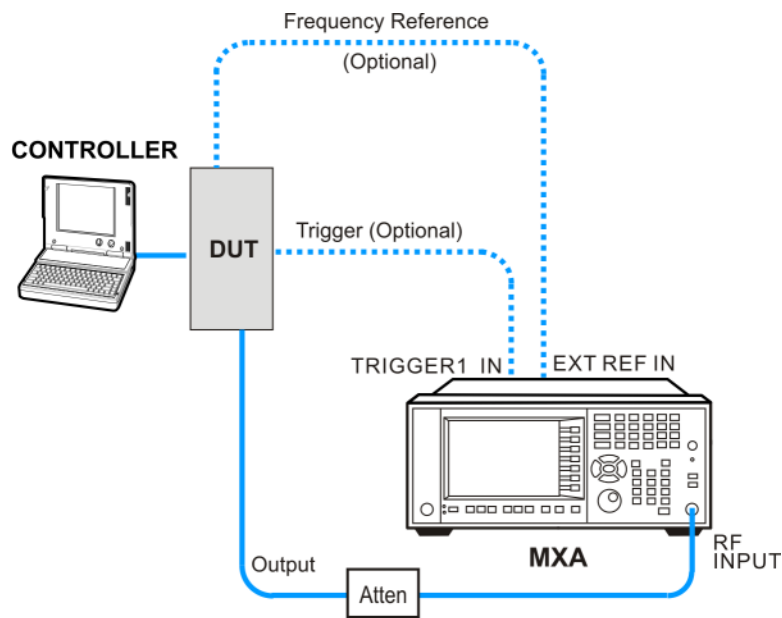
The device under test (DUT) is connected to the RF input port of the analyzer. The DUT may possibly be controlled externally by a computer. External attenuator, external trigger, and external reference are optional. Using the appropriate cables, connect the equipment as shown.

Click to Go Back to "Making MotoTalk Measurements" on page 36.

Step 2 - Select the Mode and Preset the Analyzer

This step assures the analyzer will be set to a known state, either the factory preset or a user-configured preset.

Step	Action	Notes
2a. Select the Mode.	Press **MODE**, **iDEN/WiDEN/MotoTalk Analyzer**.	
2b. Preset the analyzer.	Press the green **Mode Preset** button for the factory preset. **OR** To recall a user-defined Preset: Press **User Preset,** User Preset to preset the current mode.	

Click to Go Back to "Making MotoTalk Measurements" on page 36.

Step 3- Select Measurement, Test Selection and Preset

This step is to turn on the Tests you want to run: EVM and Power measurements.

Step	Action	Notes
3a. Select the MotoTalk measurement.	Press **Meas, MotoTalk**.	
3b. Preset the remaining parameters upon your Test Selection.	Press **Meas Setup**, **Test Preset**.	
3c. Select the Analysis Slot.	Press **Meas Setup**, **Analysis Slot**.	
3d. If desired, select Advanced menu or Average Setup menu to adjust the parameters for your testing.	Press **Meas Setup**, **More**, **Average Setup** or **Advanced**.	After changing the measurement settings, you need to press **Restart** or **Meas**, **MotoTalk** to perform the measurement again.

Click to Go Back to "Making MotoTalk Measurements" on page 36

Step 4 - Configure the Display

Measurement results are available in graphical displays that can be presented in preset groups or adjusted to suit your specific application. Most results are also available in tabular format.

Step	Action	Notes
4a. Use a **Preset View** for fast, powerful results displays.	Press **View/Display**, and select a **Preset View** from a selection of useful combinations of related data trace displays.	For details of the Preset Views see Preset Views below.
OR		
4b. If desired, choose a custom screen layout.	Press **View/Display**, **Layout** and select a layout that will provide your desired arrangement. You can choose up to 4 panes to display your trace data.	
4c. Customize your layout by assigning a data trace to a measurement display.	I. Press **Trace/Detector**, **Select Trace**, and select the number of the trace to change. II. Press **Data** to display a menu of trace groups and select the trace data for assignment to the graph. III. Repeat trace assignment for any other traces in the layout as needed.	When you press **Trace/Detector**, **Select Trace**, the trace numbers are displayed on the screen to help you identify the traces for selection.

Preset View: Test Standard

The Test Standard key changes the Layout to "Stack 3" with the following trace assignments and Formats:

1. Error Vector Time Averaged trace for all of the bursts found

2. Error Summary: Averaged summary results for all of the bursts found

3. Slot Error Summary: Summary result for the burst specified by "Analysis Slot"

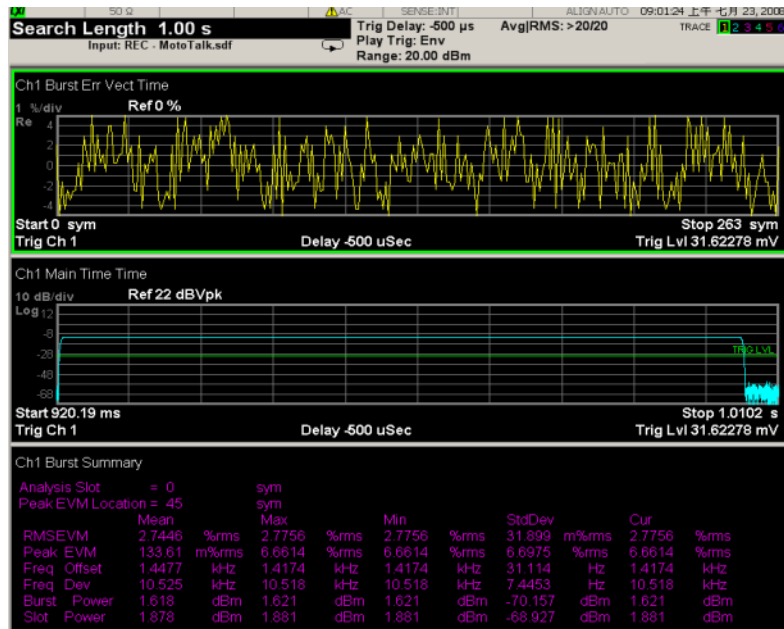**Preset View: Slot**

The Test Standard key changes the Layout to "Stack 3" with the following trace assignments and Formats:

1. Slot Error Vector Time: Error Vector trace for the specific burst specified by "Analysis Slot"

2. Time: The time trace of the slot specified by "Analysis Slot"

3. Slot Error Summary result for the burst specified by "Analysis Slot"

Step 5 - Optimize your Results

In this step you can finalize the presentation of your data by adjusting various parameters to make your measurement data more useful.

Step	Action	Notes
5a. Select a graph for optimization.	Use the "Next Window" key (boxes with arrows) below the display to move the green outline "focus" to activate a graph for customization.	
5b. Optimize the X Scale.	Press **SPAN X Scale**, **Scale/Div**, then use the front-panel keypad to input the scale/div, then press a units key, like μs, to complete the entry. **OR** Press **SPAN X Scale**, **More, X Scale Auto** to allow the instrument to complete the scaling.	
5c. Optimize the Y Scale.	Press **AMPTD YScale**, **Scale/Div**, then use the front-panel keypad to input the scale/div, then press a units key, like μs, to complete the entry. **OR** Press AMPTD YScale**, Auto Scale** to allow the instrument to complete the scaling.	
5d. Use **a Marker** to indicate and measure signal characteristics.	I. Press **Marker**, **Select Marker**, and select the number of the maker desired for your display. II. Press **Marker Function**, **Select Marker** to assign a function to the marker. III. Select either **Band/Interval Power**, or **Band/Interval Density**, to turn on/off the markers. IV. Adjust either the **Power Calc** settings or **Density Calc** settings, depending on which function you have selected. V. Press **Marker**, **Delta** to set a Delta marker on/off and adjust its position on the graph.	For more information on Markers see the Markers section under Measurement Setup in Help.

Step	Action	Notes
5e. Add titles, or make other changes to the measurement graphs.	I. Press **View/Display**, **Display**, **System, Settings** to adjust other parts of the display for all measurement windows.	For more information on Display settings see the Display section under Common Functions in Help.
	II. Press **View/Display**, **Display**, **Annotation**, to turn on/off various parts of the display annotation.	
	III. Press **View/Display**, **Display**, **Title, Change Title** to create a title for the graph.	
	IV. Press **View/Display**, **Display**, **Graticule** to turn graticules on/off.	
	V. Press **View/Display**, **Display**, **Display Line** to turn a reference line on/off and adjust its position on the graph.	

Click to Go Back to .

Viewing MotoTalk Measurement Results

This section provides some examples of MotoTalk measurement results. Results available include graphical displays of various trace data as well as tabular results available remotely. These graphic results may be viewed separately, or combined into views. For more information on Views see and .

MotoTalk Measurement Data Includes:

A number of results are available, including the default displays: the Error Vector vs. Time display, the main Time display, and the scalar results shown in the Error Summary table. In addition, other, more detailed displays are available.

Click to Go Back to .

Example Measurement - MotoTalk

This procedure demonstrates how to see different results views available for the MotoTalk measurement. This example assumes the signal is correctly applied to the input.
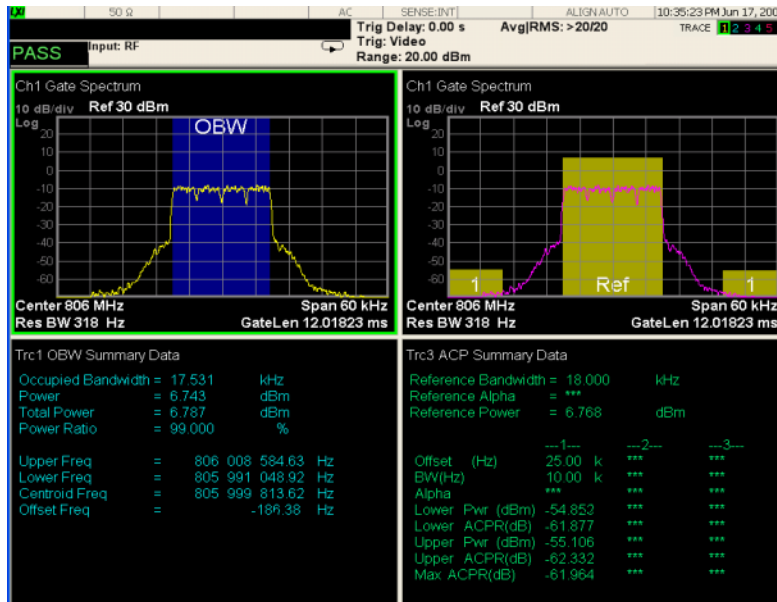
Step 1. Press **Mode Preset**

Step 2. Press **Meas, MotoTalk**, **Test Preset**

Step 3. View the measurement default view. (See).

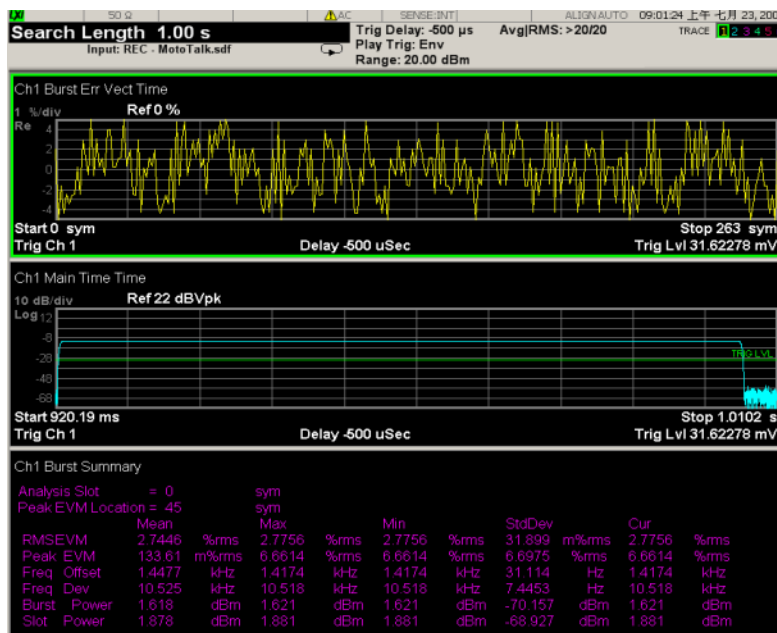*Figure 2-9*　　　　　　　　*MotoTalk and Test Standard View (Default)*

Step 4.　Select the Slot view. (See Figure 2-7 on page 35)

Figure 2-10　　　　　　*MotoTalk Slot View*

If you have a problem, and get an error message, see *Instrument Messages*.

Troubleshooting iDEN/WiDEN/MotoTalk Measurements

The following table provides some possible causes and remedies to a common signal analyzer measurement problem- failure to lock onto a signal for demodulation.

For information on error messages see *Instrument Messages*.

Table 2-1   *Demodulation Fails to Lock on Signal*

Possible Causes	Solutions
Signal not present	Check connections
Carrier too far from center frequency	Adjust center frequency
Input is over-loaded or under ranged	Adjust input range
Frequency span is too narrow	Increase frequency span
Signal is pulsed	Set pulse search ON
Signal is pulsed and result length is longer than pulse	Decrease result length
Signal is too noisy	Try selecting the Low SNR Enhancement checkbox (Advanced Tab of Demod Properties). Must be in a modulation format that supports Low SNR Enhancement.
Wrong symbol rate	Enter correct symbol rate (not bit rate)
Wrong filter selections	Select proper meas and ref filters, & correct setting for alpha/BT.
Wrong modulation format	Select correct modulation format
I/Q offset too large	Reduce LO feedthrough (or DC offset for I+jQ receiver)
I/Q misaligned using I+jQ receiver	Ensure that ch1 and ch2 trigger delays are correct

3 Concepts

This chapter describes the concepts and theory of iDEN/WiDEN/MotoTalk formats. Also included are modulation formats that can be demodulated by the N6149A iDEN/WiDEN/MotoTalk Analyzer and an explanation of how measurements are performed by the instrument. A list of related Keysight documents is provided for further reference.

Introduction

This chapter provides a variety of digital modulation concepts to help you to better understand the features and measurements performed by the signal analyzer.

"What is iDEN" on page 49, explains the basic concepts of the iDEN, WiDEN and MotoTalk standards.

"iDEN Power and Demod Measurement Concepts" on page 52, explains the iDEN digital modulation as well as the methods by which a digital baseband signal is modulated onto an RF carrier.

"MotoTalk Measurement Concepts" on page 54 covers the MotoTalk modulation and measurement concepts.

What is iDEN

iDEN (Motorola's Integrated Digital Enhanced Network) is a trademark of the Motorola Company.

The iDEN standard combines four communication technologies into a single network: radio, telephone, messaging, and data communications capabilities. The basic mode of operation in the iDEN system is Time Division Multiple Access (TDMA). The modulation for iDEN is called multiple carrier-QAM (M-QAM). The modulated signal consists of four frequency division multiplexed sub-channels, each carrying a M-ary_QAM signal, like16-QAM or 64-QAM signal. The sub-channel approach allows you to use a lower symbol rate which provides resistance to time dispersion.

Fixed Network Equipment (FNE) The land-based side of the iDEN RF Interface.

Full Slot A full 15 ms slot

Inbound From Subscriber Unit to FNE.

Outbound From FNE to Subscriber Unit.

What is WiDEN

WiDEN (Wideband iDEN) is similar to iDEN Enhanced 6:1 format in the following ways:

- Both slot formats use the same symbol mapping.

- Both slot formats use the same sync and pilot definitions.

- Both slot formats use the same BER test sequence. However, in WiDEN the same sequence of BER words is transmitted on all active carriers. However, the sequence starting point is offset from carrier to carrier. For example, when four carriers are transmitted the sequence transmitted on each carrier is offset by four words from the previous carrier. In this case the BER word sequence transmitted in four active slots (possibly separated by inactive slots) would be:

  — Carrier 0 word sequence: 0, 1, 2, 3

  — Carrier 1 word sequence: 4, 5, 6, 7

  — Carrier 2 word sequence: 8, 9, a, b

  — Carrier 3 word sequence: c, d, e, f

- Both slot formats are 15 ms long.

WiDEN is dissimilar to iDEN Enhanced 6:1 format in the following ways:

- WiDEN allows 1 to 4 25 kHz carriers.

- WiDEN allows arbitrary slots within a frame to be active.

- The training sequence is different between the two slot formats.

- The training waveform is DC centered with respect to the composite signal and may or may not be present. For WiDEN this means that the training waveform is often not centered with respect to any given carrier.

- WiDEN adds an SGC pulse for the benefit of the base station at a point in time where there is no data or any other information being transmitted by the mobile. WiDEN can simultaneously transmit up to four carriers at 25 kHz spacing.

You can perform WiDEN signal analysis under any of the allowed carrier combinations. When multiple carriers are present, all carriers will be analyzed at the same time.

There are five distinct carrier configurations for WiDEN inbound signals. These configurations are shown in Figure 3-1.

Figure 3-1   *WiDEN Inbound Carrier Configurations*
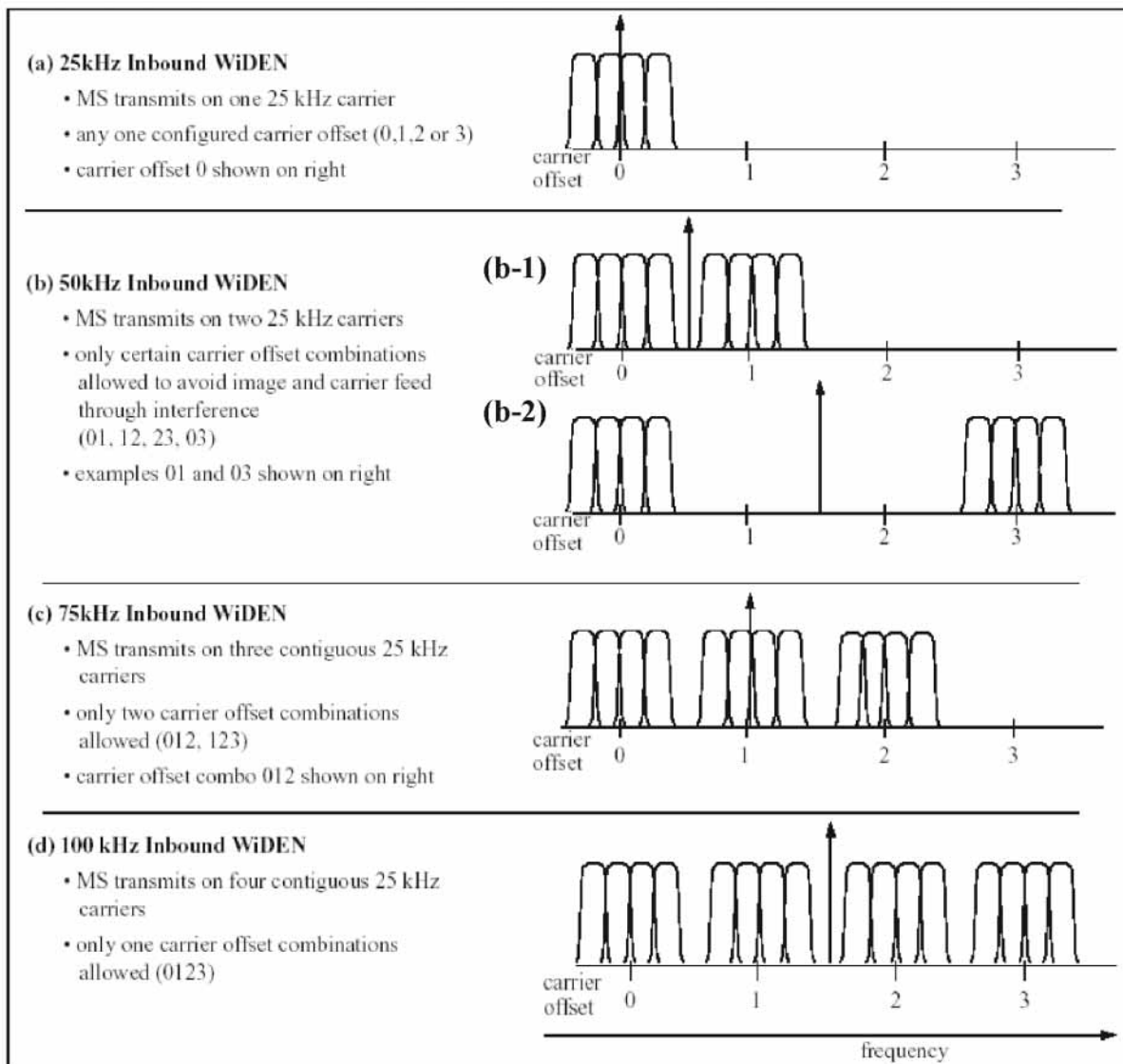
What is MotoTalk

MotoTalk is a trademark of Motorola Company. It supports mobile-to-mobile communications between a pair or group of MotoTalk radios on a single logical channel in simplex fashion (walkie-talkie).

MotoTalk uses orthogonal, continuous-phase, 8-level Frequency Shift Keying (8-FSK) modulation format. A Gaussian pre-modulation filter is applied to the baseband symbols to reduce adjacent channel splatter. In addition, an envelope windowing function is applied to each slot, so that the slot begins and ends with smooth transitions.

Because MotoTalk is deployed in the 900 MHz Industrial, Scientific, and Medical (ISM) band, frequency hopping rules governed by FCC regulations are followed. The highlights are as follows:

- A pseudorandom sequence is employed for frequency selection, and each burst is sent on a different frequency.

- Preamble and Sync Slot Bursts are ALWAYS sent in the same order and on the same frequencies each time. There are three of each, and they are always the first 6 bursts of any transmission.

- The traffic bursts are carried on frequencies determined by the pseudorandom sequence, and the first traffic burst always picks up the sequence where the final burst of that transmitter's previous transmission left off. The seed sent in the Sync Slot ID Block points to the position in the sequence of the first burst of the upcoming sequence.

- In order to ensure uniform distribution of frequencies for voice mode, the pseudorandom sequence generator reduces the likelihood of selecting the Preamble/Sync-Slot frequencies during short transmissions or the early portion of long transmissions.

- A similar process is used in data mode, but the weighting factor is different for selecting Preamble/Sync frequencies during traffic since data transmissions are always the same length.

iDEN Power and Demod Measurement Concepts

The modulation formats supported by iDEN Power and Demod measurements are:

- iDEN – single carrier TDMA, with multiple slot formats

- WiDEN – multiple carriers TDMA, with multiple carrier formats

iDEN consists of several slot formats, in both inbound and outbound directions, but uses only one carrier.

WiDEN has only one inbound and one outbound slot formats, but has has multiple carrier configuration. iDEN and WiDEN are supported in the same measurement.

For WiDEN signals, you can select the carrier configuration from the following list:

- 25 kHz WiDEN

- 50 kHz WiDEN

- 75 kHz WiDEN

- 100 kHz WiDEN

- 50 kHz Outer WiDEN

The iDEN Power measurement provides two test:

- Occupied Bandwidth (OBW)

- Adjacent Channel Power (ACP)

The iDEN Demod measurement provides three tests:

- Error Vector Magnitude (EVM)

- Power Versus Time (PvT)

- Bit Error Rate (BER)

When performing a factory preset measurement, you will get PASS or FAIL indicators for standard test setup.

One acquisition can be used to run all the tests to minimize the testing time. Each set of results has limiting testing and provides a PASS/FAIL indicator.

OBW test measures the bandwidth occupied by a given percentage of the total mean power of a signal. It also reports signal bandwidth and RF output power when the radio's output terminals are connected to the standard terminal load.

ACP test measures the power in the reference band, and power in up to five adjacent channel bands. You can configure the reference channel width and the adjacent channel bands.

EVM test results include constellation, EVM versus Time, EVM summary trace, and so on. You can also specify the Analysis Subchannel and WiDEN Carrier to measure specific results.

PvT tests compare the signal envelope to specific limit lines. The average power between the peak of the first modulated symbol and the peak of the last modulated symbol is calculated and displayed.

BER test results include a slot summary and an overall summary.

MotoTalk Measurement Concepts

MotoTalk measurements provide the modulation analysis functionality for signals that conform to the MotoTalk standards specification.

One MotoTalk slot is comprised of Ramp-up symbols, Burst symbols, Ramp-down symbols, and transition switching section. The 90 ms window is called a Talk-Around slot.

Each Talk-Around slot will transmit 256 8-FSK traffic symbols, at 3200 symbols/sec, which requires 80 ms. The remaining 10 ms is reserved for various forms of overhead.

*Figure 3-2*   *Talk-Around Basic Slot Frame*

MotoTalk defines three burst types: Traffic Burst, Sync Burst and Preamble Burst. All bursts have an identical duration (85.625 ms).

Traffic Bursts contain at least one instance of a length-8 Sync Word, which is used to provide symbol synchronization.

NOTE   MotoTalk measurements only provide modulation analysis functionality for Traffic Bursts.

Figure 3-3   *Talk-Around Traffic Burst*
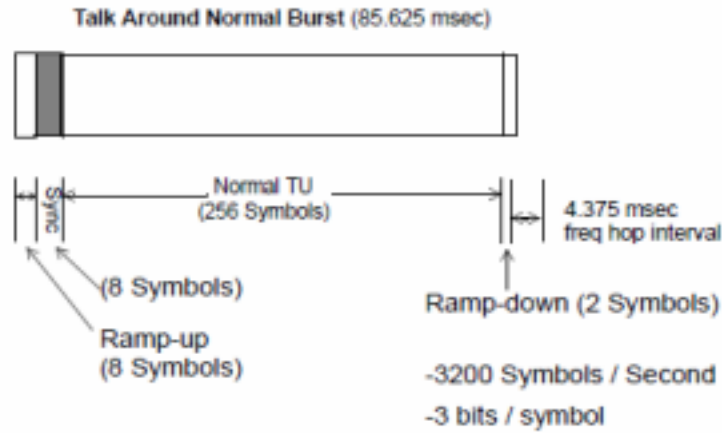
Measurement Algorithm Overview

- Set the Search Length and acquire at least one complete Traffic Burst.

- Locate the Traffic Burst using Burst/Pulse Search algorithm and synchronize to the Sync Word.

- If no Traffic Burst is located, the measurement is done.

- Compute all the power over the burst, excluding 2 ramp-down symbols at each end and average per the average settings.

- Compute all the power over the entire 90 ms slot and average per the average settings.

- Perform demodulation and compute the modulation analysis results.

- In particular, compute Frequency Error, EVM and Peak (symbol by symbol) EVM and average the results.

- Repeat the measurement by searching next burst.