User's and Programming Guide

HP ESG-D Series Option UN8 Signal Generators TETRA Digital Modulation Format

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Contents

Contents

1 The TETRA Digital Modulation Format

This guide describes features specific to the TETRA digital modulation format
(Option UN8). This includes an overview of the TETRA communications standard, as well
as information regarding the use of TETRA format hardkeys and softkeys, functions,
operations, a SCPI command reference, and a SCPI command cross reference.

Overview

The Trans European Trunked Radio or TETRA digital communications standard defines a voice and data over-air interface between a mobile radio and the system infrastructure. This standard was designed as the basis for a private radio communications system. A central control center is linked to multiple base station sites which provide the required coverage.

The TETRA digital communications standard employs a 4:1 Time Division Multiple Access (TDMA) allowing four channels to use one carrier frequency simultaneously. The raw bit rate, 36k bits/second, is modulated using a system known as $\pi/4$ Differential Quadrature Phase Shift Keying ($\pi/4$DQPSK). This standard defines the channel separation as 25 kHz at carrier frequencies surrounding 400 MHz. The standard includes a Broadcast Control Channel, multiple Traffic Channels, and a host of other logical channel types.

The TETRA framing structure is based on a hierarchical system consisting of timeslots/bursts, TDMA frames, multiframes, and hyperframes. One Normal Uplink Burst (from mobile to base station) consists of 510 modulated bits consisting of ramp, tail, training, data, and guard bits. Four of these bursts make up one TDMA frame. Eighteen TDMA frames make up one multiframe. Frame 18 in the multiframe is dedicated to control channel signaling.

2Using Functions

This chapter contains procedures that show you how to use some of the major functions of the TETRA format.

Setting Up Internally-Generated Digital Modulation in a TETRA Format

Using this procedure you will configure the signal generator to output a π/4DQPSK digitally-modulated signal in a TETRA format with the following characteristics:

- carrier frequency set to 1.894880 GHz

- power level set to 0 dBm

- timeslot 1 activated and configured as an Uplink Control 1 channel

- a fixed 4-bit repeating sequence selected as the data pattern for timeslot 1

- timeslot 3 activated and configured as an Uplink Custom channel

- a repeating pattern of 4 1's and 4 0's selected as the data pattern for timeslot 3

Setting the Carrier Frequency

1. Preset the signal generator to normal preset conditions.

2. Press the front panel **Frequency** key. Frequency becomes the active function and the normal preset value for frequency is displayed in the active entry area.

3. Enter 1.894880 GHz using the numeric keypad and pressing the **GHz** terminator softkey. The new carrier frequency is shown in the frequency area of the display. You should see:

```
1.894 880 000 00 GHz
```

Setting the Power Level

1. Press the front panel **Amplitude** key. Amplitude becomes the active function and the normal preset value for amplitude is displayed in the active entry area.

2. Enter 0 dBm using the numeric keypad and pressing the **dBm** terminator softkey. The new power level is shown in the amplitude area of the display. You should see:

```
0.00 dBm
```

Selecting the Data Format

1. Press the front panel **Mode** key and then press the **Real Time I/Q Baseband** (if it appears), **TDMA**, and **TETRA** softkeys to select the TETRA communications standard.

2. Toggle the **Data Format Pattern Framed** softkey to **Framed**. When you select **Framed** for bursting the frame envelope, you will be transmitting framed data. This means that you will be bursting the timeslots that you have activated and there will be no RF carrier during the off timeslots. Notice that **Configure Timeslots** has become an active softkey.

Setting Up Timeslot 1

1. Observe the display and notice that the normal preset condition for timeslot #1 has the timeslot turned on and configured as an Uplink Normal traffic channel. Press the **Configure Timeslots** softkey. Next, look at the softkeys. The **Timeslot #** softkey shows that timeslot #1 is selected as the active timeslot. The **Timeslot Off On** softkey shows that timeslot #1 is turned on. Finally, the **Timeslot Type** softkey shows that timeslot #1 is configured as an Uplink Normal traffic channel.

2. Change the timeslot type to Uplink Control 1 timeslot by pressing the **Timeslot Type** softkey. Another menu of softkeys is displayed. Press **More (1 of 2)** and then press the **Up Control 1** softkey. You are automatically returned to the previous menu of softkeys. Notice that the **Timeslot Type** softkey has changed from **Up Normal** to **Up Control 1**. Also notice that the display shows timeslot #1 configured as an Uplink Control 1 timeslot.

3. Configure the data pattern for the timeslot by pressing **Configure Up Control 1**. Another menu of softkeys is displayed showing you choices for internal data generation or externally-supplied data patterns, either via the DATA connector or by downloading a binary file. Notice that the display has changed showing you a visual representation of the timeslot. Press the **Data** softkey.

4. Press **FIX4** to select a fixed 4-bit repeating sequence. The 4-bit data pattern becomes the active function and the normal preset value for FIX4 is displayed in the active entry area. Enter any binary sequence, such as 1010, using the numeric keypad and pressing the **Enter** terminator softkey. The new data pattern is displayed in the Data field near the bottom of the text area of the display. You should see:

```
Data: 1010
```

   The data pattern is also displayed below the **FIX4** softkey.

Setting Up Timeslot 3

1. Press the front panel **Return** key twice to move to the preceding menu.

2. Select timeslot #3 as the active timeslot by pressing the **Timeslot #** softkey. Timeslot # becomes the active function and the current active timeslot (#1) is displayed in the active entry area. Press the up arrow key twice to increment the timeslot # to 3.

3. Turn on timeslot #3 by toggling the **Timeslot Off On** softkey from **Off** to **On**.

4. Change the timeslot type to an Uplink Custom timeslot by pressing the **Timeslot Type** softkey. Another menu of softkeys is displayed. Press the **Up Custom** softkey. You are automatically returned to the previous menu of softkeys. Notice that the **Timeslot Type** softkey has changed from **Up Normal** to **Up Custom**. Also notice that the display now shows timeslot #3 configured as an uplink custom timeslot.

5. Configure the data pattern for the timeslot by pressing **Configure Up Custom**. Another menu of softkeys is displayed that allows you to change the data pattern for the custom timeslot. Press **Other Patterns** and then press **4 1's & 4 0's** to transmit a repeating sequence of four 1's followed by four 0's.

Turning On the TETRA Format and the Modulation

The signal generator is now configured to burst two uplink timeslots with a 0 dBm, π/4DQPSK digitally-modulated carrier at 1.894880 GHz. Follow these remaining steps to output the framed data.

1. Press **Return** once to move up one menu level until the first TETRA menu is displayed. (The first softkey in this menu is **TETRA Off On**.) Press the **TETRA Off On** softkey. The TETRA format toggles from **Off** to **On**. At this time the internal baseband generator will generate the internal data patterns that you have configured for timeslots 1 and 3. A message is displayed while this process is taking place. Notice, also, that the following display annunciators are turned on:

   - `TETRA` indicates that you have enabled the TETRA standard

   - `I/Q` indicates that I/Q modulation is being generated

   - `ENVLP` indicates that burst is activated for transmitting framed data

2. Press the front panel **RF On/Off** key to toggle RF on. Notice that the display annunciator changes from `RF OFF` to `RF ON`. The modulated signal is now available at the RF OUTPUT connector.

Table Editor Basics

Option UN8 provides several table editors that enable you to:

- build a customized digital modulation (for details on using the FSK table editor, see page)

- map I/Q symbol positions (for details, see)

- enable differential encoding (for details, see)

- create and modify FIR data filters (for details, see)

While each of these table editors performs a different function, they are all used in basically the same way, and most of the table editors have several editing softkeys in common.

Common Edit Functions

Edit Item   Enables you to use the front panel knob and arrow keys to edit the value of a selected entry. After highlighting the value you want to edit, select this softkey.

Insert Row   Inserts a row for data below the currently selected row.

Delete Row   Deletes the currently selected row of data.

Goto Row   Displays a new page of softkeys so that you can quickly move to the first, middle, or last row of data. This is especially helpful in a large table, or when using the filter table editor mirror function.

Load Default   Enables you to load default values into a FIR, I/Q Map, or FSK table editor.

Restore Default   Enables you to reset factory default values for the filter and the modulation type.

NOTE   Restoring the default modulation effects the current settings in the I/Q table editor, the FSK table editor, and the Differential State table editor.

Load/Store   Displays a new page of softkeys that enables you to load data from a stored file, save data to a file, or delete a stored file.

Delete All Rows   Clears all data from a table.

CAUTION   There is no "undo" command. Once you delete data from a table, you can not retrieve it.

Mapping Symbol Positions with the I/Q Table Editor

In modulation schemes defined by standards (for example, DECT, TETRA, and CDMA), symbols appear in default positions in the I/Q plane. The I/Q table editor provided in Option UN8 enables you to do the following:

- create a unique mapping of symbols

  You can create a mapping that is not supplied as a default. You can also create a non-standard mapping; this is often necessary for a proprietary modulation scheme.

- change the position of one or more symbols in a standard mapping

  This is often done to test the sensitivity of a receiver, or to create a symbol mapping that is similar to a default.

The examples in this section provide information on how to create an I/Q map (on page 2-7), how to edit a default map (on page 2-11), how to globally change a value in an I/Q table (on page 2-15), and how to use a stored I/Q map (on page 2-17).

Table Editor Basics

While the following examples provide information specific to the I/Q table editor (shown in the following figure), they do not go into detail on every possible way to edit information. The section "Table Editor Basics" on page 2-5 covers in detail many of the features common to most table editors.

Unique I and/or Q levels
A map in I or Q is limited to 16 unique levels. You can generate up to 256 unique states.

Four data bits define each symbol.

Active entry area

Define User I/Q softkey menu

FREQUENCY	AMPLITUDE
4.000 000 000 00 GHz	−135.00 dBm

Edit Item

Insert Row

Delete Row

I/Q Values			Distinct Values ▶	1	1.000000
Data	I Value	Q Value		2	−1.000000
00000000	1.000000	1.000000		3	
00000001	−1.000000	1.000000		4	
00000010	−1.000000	−1.000000		5 6 7	
00000011	1.000000	−1.000000		8 9	
00000100	----------	----------		10 11 12 13 14 15 16	

Goto Row▶

Globally Replace Selected Item

Display I/Q Map▶

More (1 of 2)

I and Q values
Levels do not have to be symmetric.

Maximum of 16 unique levels

Creating a Symbol Map

Use the following procedure to create and store a 4-symbol unbalanced QPSK.

Accessing the I/Q Table Editor

1. Preset the signal generator.

2. Press the front panel **Mode** key.

3. In the softkey menu, press **Real Time I/Q BaseBand** (if this softkey does not appear, go to step 4).

4. To display the I/Q table editor, press **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**

   The following illustration of the I/Q table editor shows the data for a 4QAM I/Q map. The initial data you will see depends on what was last used in the instrument.

Clearing Data

When you create a new I/Q map (rather than editing existing data), it is often easier to start with an empty table. Use the following steps to clear existing data from the table editor.

1. Press the softkey **More (1 of 2)** to view the second page of softkeys.

2. Press **Delete All Rows**, **Confirm Delete of All Rows**. All data is removed from the table.

3. Press **More (2 of 2)** to return to the first page of softkeys.

4. Press **Display I/Q Map**. The data list is replaced by a blank I/Q state map.

5. To redisplay the list, press **Return**. As you enter data, you can toggle between the list and the map to visually check the entries.

Entering I and Q Values

Next you will enter the coordinates of each symbol. The position of a symbol is defined by a pair of values (one representing I and the other representing Q).

Table 2-1 I and Q Values for an Unbalanced QPSK

Symbol	Data Bits	I Value	Q Value
0	0000	0.500000	1.000000
1	0001	−0.500000	1.000000
2	0010	0.500000	−1.000000
3	0011	−0.500000	−1.000000

Both the 4QAM I/Q map shown on page 2-7, and the map you create in this example have four symbols. Please note, however, that the 4QAM I/Q map uses only *two* unique values (–1.0 and 1.0) to create those symbols, while this example uses the following *four* unique values: 0.5, 1.0, –0.5, and –1.0. It is not the number of values that defines how many symbols a map has, but how those values are combined.

NOTE   The number of bits per symbol can be expressed using the following formula. Because the equation is a ceiling function, if the value of *x* contains a fraction, *x* is rounded up to the next whole number.

$$x = \left\lceil Log_2(y) \right\rceil$$

Where x = bits per symbol, and y = the number of I/Q states.

The following figure summarizes the process of entering values in the I/Q table editor. Detailed steps begin on the next page.

1. Use the arrow keys to highlight where you wish to enter a value.

2. Use the keypad to enter the desired value.

3. Press Enter to accept the value.

Because there are no values in an empty table, this list is empty.

1. Note that the entry under `I Value` is highlighted. Use the numeric keypad to type the first I value from the table on . You do not have to type the leading zero, or the zeros that follow the number 5.

   As you press the keys, the numbers display in the active entry area (if you make a mistake, use the backspace key and then retype).

2. To accept the value, press the **Enter** softkey. Note that the I value updates, the highlight moves to the first Q entry (and provides a default value of 0), and an empty row of data appears below the first row.

   Also note that `0.000000` appears as the first entry in the list of Distinct Values, and that `0.500000` appears as the second entry.

NOTE   The maximum number of distinct (unique) values that can appear in any I/Q map is 16. This is *not* the maximum number of I/Q entries; this is simply the maximum number of distinct values that you can use to create the entries. For example, if you load the default 256QAM map, you will see that 16 distinct values have been used to create far more than 16 I/Q entries.

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3. For the first `Q Value`, type 1, then press **Enter**. The Q value updates, and the highlight moves to the second I value. Now `0.500000` and `1.000000` are listed as the distinct values.

4. Enter the remaining I and Q values. Remember that you can view the I/Q map at any time (using the **Display I/Q Map** softkey, as described in "Clearing Data" on page 2-7). The figure to the right shows a completed constellation.
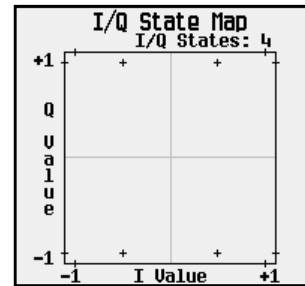
Storing the I/Q Map to Memory

Now that you have created a customized I/Q map, you can save it for future use. When the current table has not been stored, `(UNSTORED)` appears as shown in the following figure.

Indicates that the data in the
table editor has not been stored.

If you try to exit the table editor without storing, the signal generator displays the softkey:

Confirm Exit From Table Without Saving

To exit *without* saving the table, select the softkey. If you do *not* want to exit without storing the table, press **Return**.

1. In the softkey menu, press **More 1 of 2**, **Load/Store**, **Store To File**. The catalog of I/Q files appears, which lists stored files, and amount of memory used and available (in bytes).

2. To name the file, press the softkey containing the desired character, then select the softkey with that character from the subsequent menu. For example, to begin naming the file UNBALQPSK, first press the **OPQRSTU** softkey, and then press the **U** softkey.

   Note that `U` is displayed in the active entry area following the `Store to:` text.

   Continue entering the characters for the file name until `UNBALQPSK` is displayed in the active entry area.

3. When the file name is complete, press **Enter**.

   The following figure shows the results of saving the I/Q file.
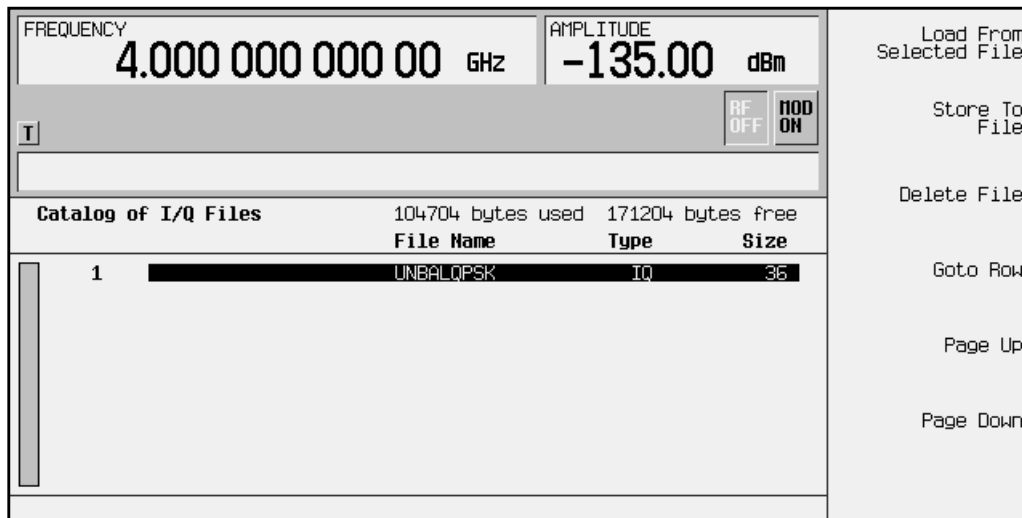
Moving an I/Q Symbol

You can manipulate symbol locations to simulate magnitude and phase errors. In this example, you will edit a 4QAM constellation to move one symbol closer to the origin.

Loading the 4QAM I/Q Map

1. Preset the signal generator.

2. Press the front panel **Mode** key.

3. In the softkey menu, press **Real Time I/Q BaseBand** (if it appears), **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **QAM**, **4QAM**. The I/Q table editor displays the data for the 4QAM I/Q map.

4. Press **More (2 of 2)** to return to the first page of softkeys.

   The following illustration of the I/Q table editor shows the data for a 4QAM I/Q map.

5. In the softkey menu, press **Display I/Q Map**. The data list is replaced by an I/Q state map (constellation diagram), as shown here.

   To redisplay the list, press **Return**. As you edit data, you can toggle between the list and the map to visually check the entries.
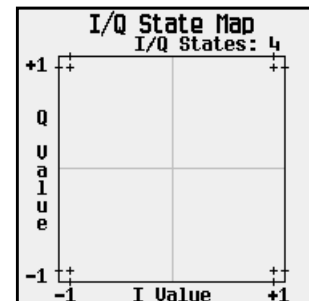
Editing I and Q Values

The following figure summarizes the process of editing values in the I/Q table editor. Detailed steps begin after the figure.

1. Use the arrow keys to highlight the value you wish to edit.

2. Use the keypad to enter the desired value.

3. Press Enter to accept the new value.

1. Note that the first I value is highlighted. Using the numeric keypad, type `0.235702`.

    As you press the keys, the numbers display in the active entry area (if you make a mistake, use the backspace key and then retype).

2. To accept the value, press the **Enter** softkey. Note that the I value updates, and the highlight moves to the first Q entry.

3. For the first Q entry, enter `0.235702` and press **Enter**.

4. In the softkey menu, press **Display I/Q Map**. Note that one symbol has moved, as shown in the following figure.
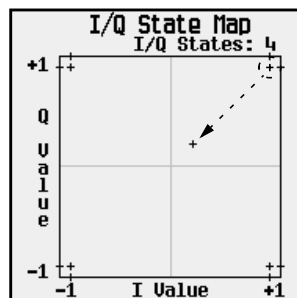
Storing the I/Q Map to Memory

You can save this modified map for future use. When the current table has not been stored, `(UNSTORED)` appears as shown in the following figure.

If you try to exit the table editor without storing, the signal generator displays the softkey:

Confirm Exit From Table Without Saving

To exit *without* saving the table, select the softkey. If you do *not* want to exit, press **Return**.

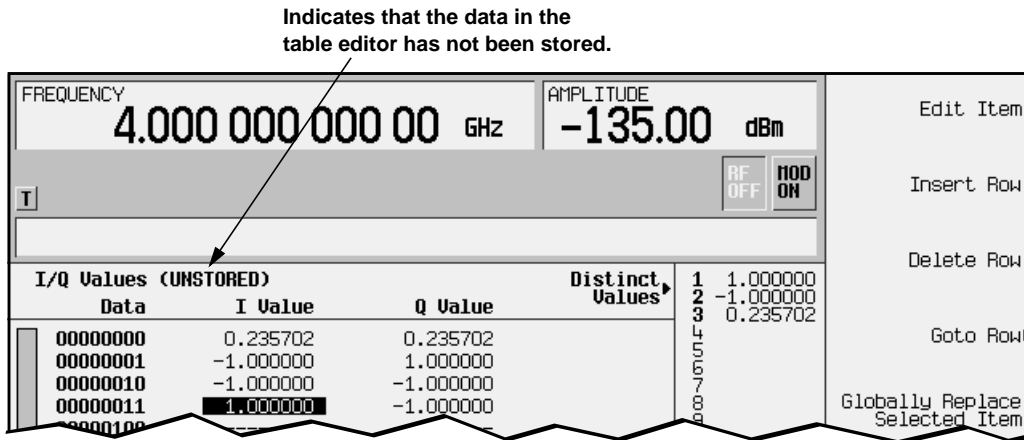1. In the softkey menu, press **More 1 of 2**, **Load/Store**, **Store To File**. The catalog of I/Q files appears, which lists stored files, and amount of memory used and available (in bytes).

2. If there are already files in the catalog, the first file is selected, and its name appears in the active entry area, as shown in the following figure. If there are no files listed, go to step 3.
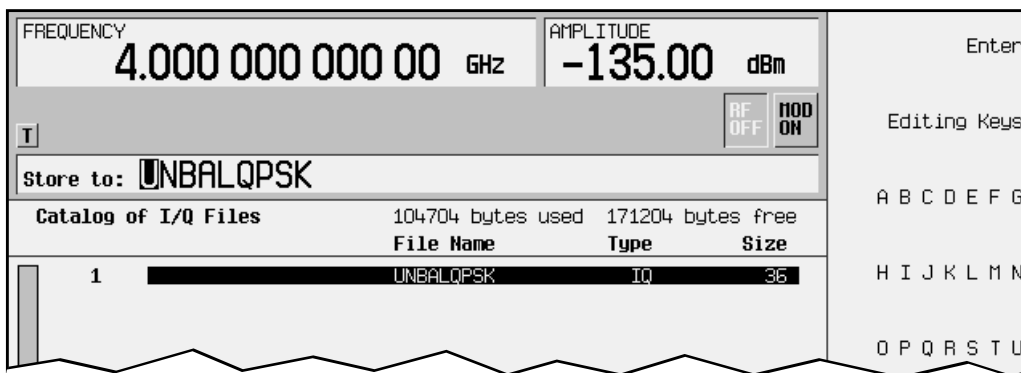
    If an existing file is selected, press the **Editing Keys** softkey, then select **Clear Text**. The previous page of softkeys returns, and only a cursor appears in the active entry area following the `Store to:` text.

3. To name the file, press the softkey containing the desired character, then select the softkey with that character from the subsequent menu. For example, to begin naming the file NEW4QAM, first press the **HIJKLMN** softkey, and then press the **N** softkey.

Note that N is displayed in the active entry area following the `Store to:` text. Continue entering the characters for the file name until `NEW4QAM` is displayed in the active entry area (use the numeric keypad for the number 4).

4. When the file name is complete, press **Enter**. The following figure shows the results of saving the I/Q file.
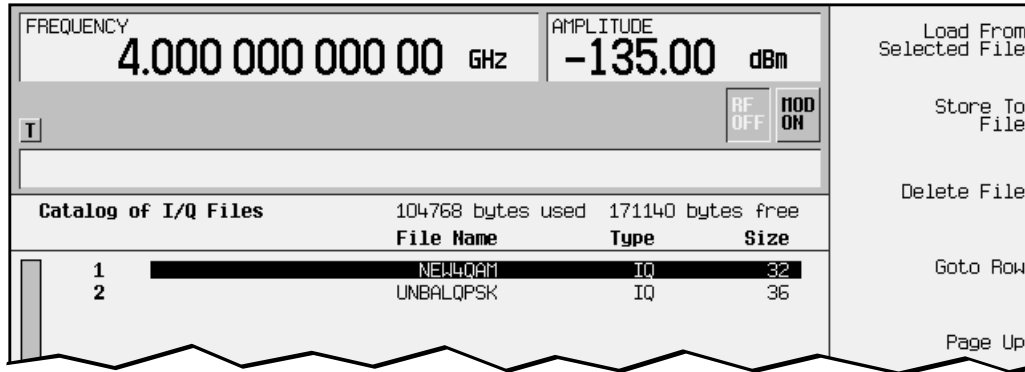
Globally Replacing an I/Q Value

When you want to change an I/Q value throughout the entire table, you can change the value once and have all occurrences of that value change to the new value. In this example, you will use the **Globally Replace Selected Item** command to globally replace I/Q values.

NOTE	When using the **Globally Replace Selected Item** command, be sure that you want *all* occurrences of the selected value changed. Also, consider the order in which you change values. For example, if you want to change all current 0.5 values to 1.0, and all current 1.0 values to −0.75, change the 1.0 values first, or all values will end up as −0.75.

Loading the 4QAM I/Q Map

1. Preset the signal generator, then press the front panel **Mode** key.

2. In the softkey menu, press **Real Time I/Q BaseBand** (if it appears), **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **QAM**, **4QAM**. The I/Q table editor displays the data for the 4QAM I/Q map, as shown in the following illustration.

3. Press **More (2 of 2)** to return to the first page of softkeys, then press **Display I/Q Map**. The data list is replaced by an I/Q state map (constellation diagram), as shown at right. To redisplay the list, press **Return**. As you edit data, you can toggle between the list and the map to visually check the entries.
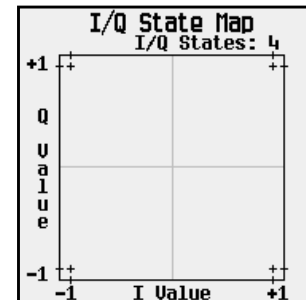
Globally Editing I and Q Values

1. Select any occurrence of the value `1.000000`, then select the softkey
   Globally Replace Selected Item.

2. Using the numeric keypad, type `0.5`, then press the **Enter** softkey.

   Note that all entries in the table that were originally `1.000000` now read `0.500000`.

3. Select any occurrence of the value `-1.000000`, then select the softkey
   Globally Replace Selected Item.

4. Using the numeric keypad, type `-0.5`, then press the **Enter** softkey.

   Note that all entries in the table that were originally `-1.000000` now read `-0.500000`.

5. In the softkey menu, press **Display I/Q Map**. Note that you have moved all of the symbols, as shown below.
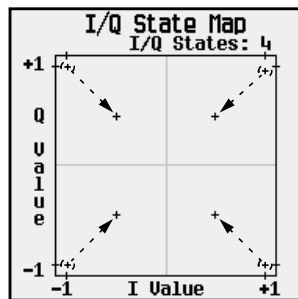
Storing the I/Q Map to Memory

As described on , you can save this modified map for future use (**Load/Store,
Store To File**).

Using a Stored I/Q Map

Once you have created and stored a customized I/Q map, you can use that information as described in the following steps.

Selecting a Stored I/Q File

1. Press the front panel **Mode** key.

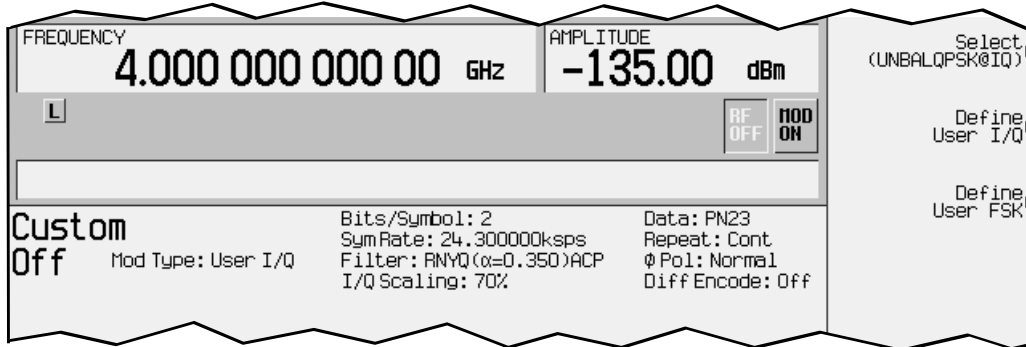2. In the softkey menu, press **Real Time I/Q BaseBand** (if it appears), **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**.

3. To display the catalog of stored I/Q files, press **Modulation Type**, **Select**, **User I/Q**.

4. Highlight the file you want to use, then press **Load From Selected File**.

   The information from the file is loaded, and User I/Q is displayed as the `Mod Type`. Also note that **(<filename>@IQ)** appears below the **Select** softkey, as shown below.

Turning On a TETRA Modulation

Once you have selected a stored modulation, use the following steps to turn it on.

5. Press the front panel **Mode** key.

6. In the softkey menu, press **Real Time I/Q BaseBand** (if it appears), **TDMA**, **TETRA**.

7. In the TETRA menu, press the softkey **TETRA Off On** to highlight **On**.

   Note that, `TETRA On` appears on the front panel, and the TETRA and I/Q annunciators turn on.

8. Press the front panel **Frequency** key and then set the desired frequency.

9. Press the front panel **Amplitude** hardkey and then set the desired amplitude.

10. If necessary, press the front panel **Mod On/Off** hardkey until the `MOD ON` annunciator appears. This applies the modulation to the carrier.

11. If the RF is not on (the `RF OFF` annunciator is on), press the front panel **RF On/Off** key. The display annunciator changes to `RF ON`, and the modulated signal is available at the RF OUTPUT connector.

Building a Customized FSK Modulation Using the FSK Table Editor

Use this procedure to create, store, and apply a customized continuous 4-level FSK signal. You will learn to do the following:

- choose the Define User FSK setting

- create a unique file of frequency deviations

- store the custom FSK modulation to a file

- load a stored file of frequency deviations

- select a custom FSK file for use

- turn on custom FSK modulation

Table Editor Basics

While the following examples provide information specific to the FSK table editor, they do not go into detail on every possible way to edit information. The section "Table Editor Basics" on page 2-5 covers in detail many of the features common to most table editors.

Choosing the Define User FSK Setting

1. Preset the signal generator to normal preset conditions.

2. Press the front panel **Mode** hardkey. (If you have multiple options installed in your signal generator, press the **Real Time I/Q BaseBand** softkey to select Option UN8.)

3. Press **TDMA, TETRA, More (1 of 2), Modify Standard, Modulation Type, Define User FSK** to select the Define User FSK menu.

4. You will see a `Frequency Values` table with `Data` in the first column and `Freq. Deviation` in the second column. The following illustration of the FSK table editor shows the data for an 8-level FSK modulation. The initial data you see will depend on what was last used in the instrument.

Active entry area

Frequency values

Define User FSK softkey menu
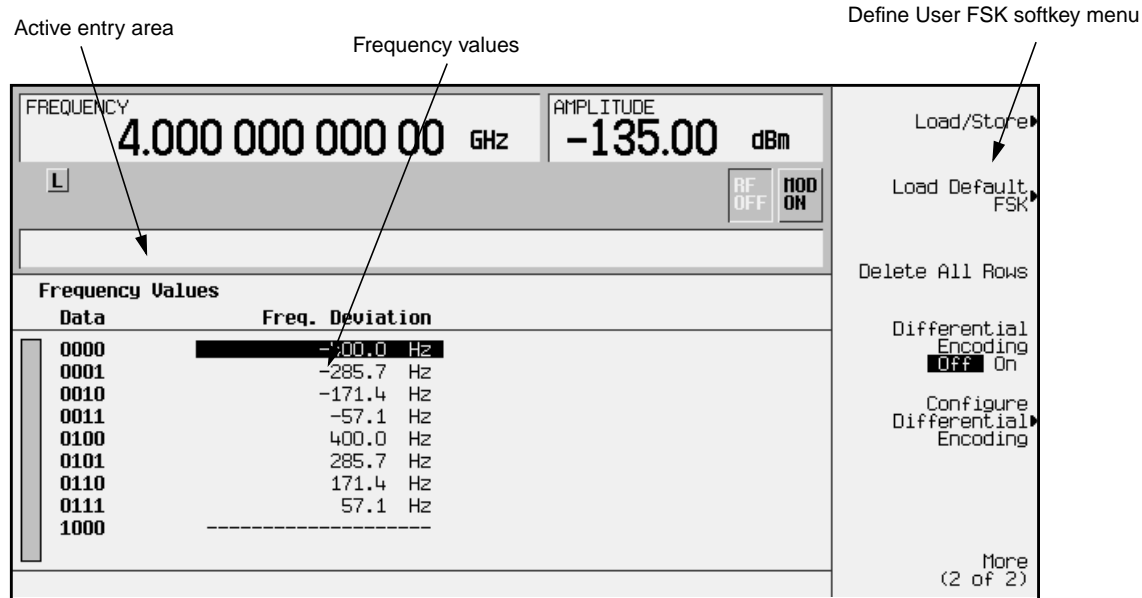
Creating a Unique FSK File of Frequency Deviations

There are two methods for creating a custom FSK file. You can either create the frequency deviations using completely original data (see Using Original Data, below), or you can load and modify a default FSK pattern (see "Modifying a Default FSK Pattern" on page 2-21).

Using Original Data

Follow these instructions to create an example of an APCO25 C4FM customized continuous 4-level FSK signal with two bits per symbol.

| NOTE	The number of bits per symbol can be expressed using the following formula. Because the equation is a ceiling function, if the value of *x* contains a fraction, *x* is rounded up to the next whole number.

$$x = \lceil Log_2(y) \rceil$$

Where x = bits per symbol, and y = the number of frequencies.

When you create new frequency values (rather than edit existing data), it is often easier to start with an empty table. To clear the existing frequency values from within the Define User FSK menu, press **More (1 of 2)**, **Delete All Rows**, **Confirm Delete Of All Rows.**

The following figure defines the areas of the display. As you enter frequency deviation values, the numbers will display in the active entry area (if you make a mistake, use the backspace key and then retype). Follow the steps below:

1. Enter the first frequency deviation value as follows:

   • Use the front panel numeric keypad to enter **600**.

   • Press the **Hz** terminator softkey to set the value at 600 Hz.

   • Notice that each time you enter a value, the Data column increments to the next binary number, up to a total of 16 data values (from binary 0000 to binary 1111).

Unstored custom frequency values

Frequency terminator softkeys

Frequency deviation active entry area
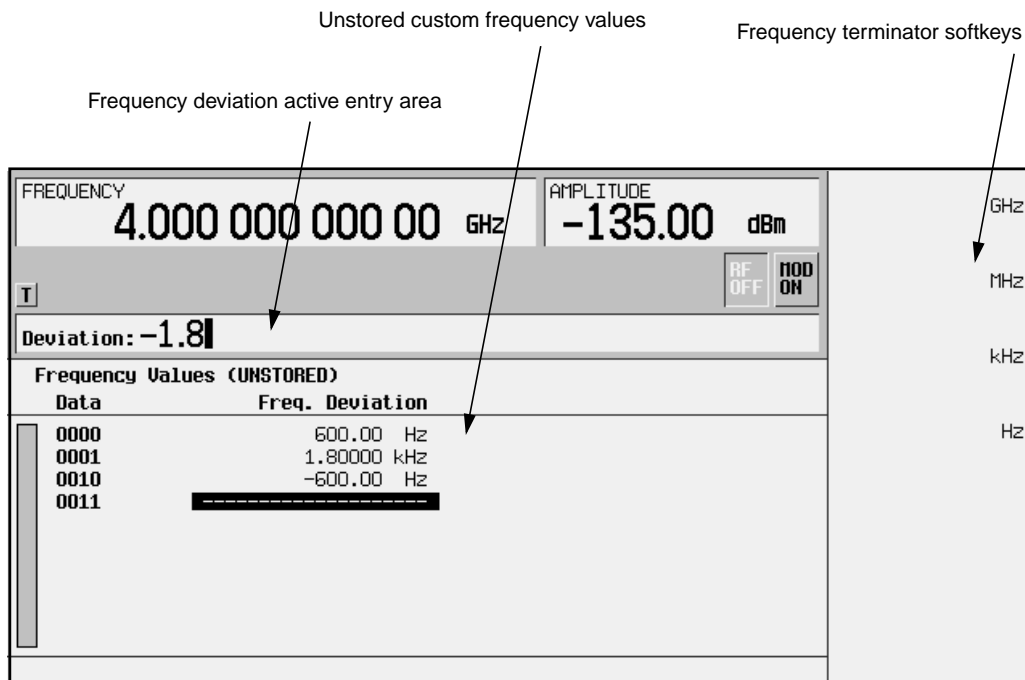
2. Continue to use the numeric keypad and the appropriate terminator softkey to enter these frequency deviation values:

   • +1.8 kHz for data row 0001

   • -600 Hz for data row 0010 (To designate a negative value, first press the **+/-** hardkey on the numeric keypad.)

   • -1.8 kHz for data row 0011

You have created an unstored file of frequency deviation values for your custom 4-level FSK file. To learn how to store the file, go to "Storing a Custom FSK Modulation to a File" on page 2-23. To learn how to modify a default FSK pattern, go to the next section.

Modifying a Default FSK Pattern

To add errors to a default modulation, load a default synchronous FSK modulation and then modify the existing frequency deviation values. If you choose to modify a default FSK modulation, you must first designate a frequency deviation value and then choose an FSK pattern. To modify a default 4-Lvl FSK pattern, follow these steps:

1. From the Define User FSK softkey menu, press **More (1 of 2)**, **Load Default FSK**.

2. Adjust the frequency deviation to `1.8 kHz`, by entering **1.8** on the numeric keypad and then pressing the **kHz** terminator softkey.

   You will see **1.8000 kHz** displayed in the `Freq:` active entry area of the display, and in bold under the **Freq Dev** softkey. See the following figure.

Active entry area   Load Default FSK softkey menu
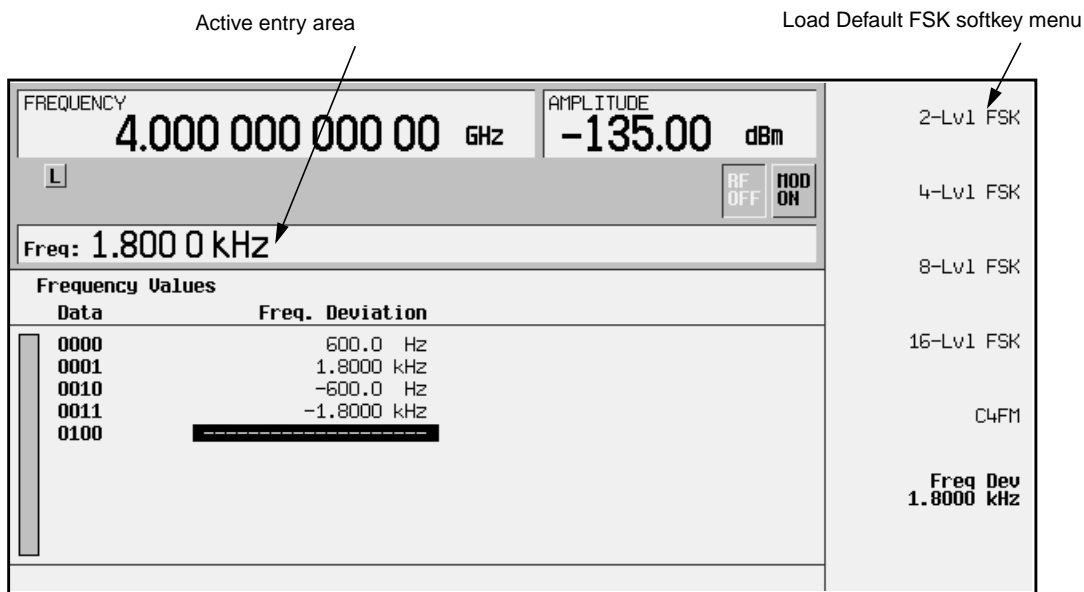
3. Press the **4-Lvl FSK** softkey. You will see the FSK table editor with the default `Frequency Values` displayed. See the following figure.

Default frequency values
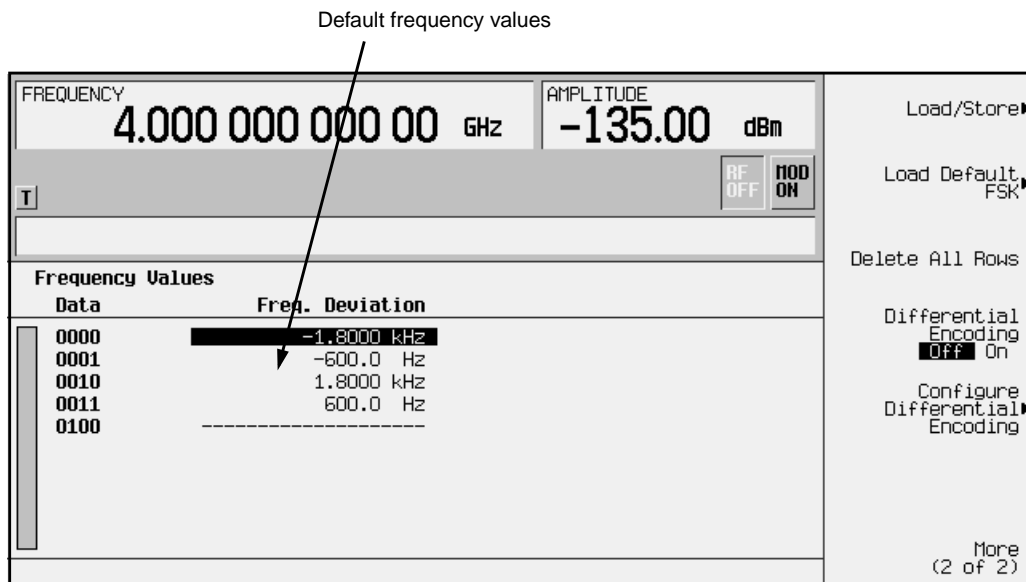
4. Use the up and down arrow keys or the front panel knob to highlight the frequency value for data row `0000`, then modify the first frequency deviation value as follows:

    *   Press **More (2 of 2)**, **Edit Item**.

    *   Turn the front panel knob to adjust the value to -1.810 kHz.

    *   Press the **Enter** terminator softkey.

    *   Notice that the highlight bar moves to data row `0001`

5. Continue as in step four or use the numeric keypad and the appropriate terminator softkey to enter the following frequency deviation values:

    *   -590 Hz for data row `0001` (To designate a negative value using the numeric keypad, first press the **+/-** hardkey.)

   *   +1.805 kHz for data row `0010`

    *   +610 Hz for data row `0011`

    You have created an unstored file of frequency deviation values for your custom 4-level FSK file. To learn how to store the file, go to the section, "Storing a Custom FSK Modulation to a File" on page 2-23.

Storing a Custom FSK Modulation to a File

Use this procedure to learn how to store a custom FSK modulation file to the instrument's memory catalog.

If you try to exit the table editor without storing, the signal generator displays the softkey:

Confirm Exit From Table Without Saving

To exit *without* saving the table, select this softkey. If you do *not* want to exit, press the **Return** hardkey.

For this example, store the frequency deviations created in the previous procedure. If you have not yet created a custom FSK modulation, refer to the previous section, "Creating a Unique FSK File of Frequency Deviations" on page 2-19.

1. In the Define User FSK menu, choose **More (1 of 2)**, **Load/Store**. The catalog of stored FSK files appears. You will also see the amount of memory used and available (in bytes).

2. Press **Store To File**. A softkey menu appears that contains letters and symbols that you can use to name your file.

3. If an existing file is highlighted in the FSK Files catalog, its name appears in the `Store to:` active entry area. To clear the filename, press **Editing Keys**, **Clear Text**. The previous page of letter and symbol softkeys returns, and only a cursor appears in the active entry area.

Active entry area   Catalog of FSK files   Memory used and free   Softkey menu with letters and symbols
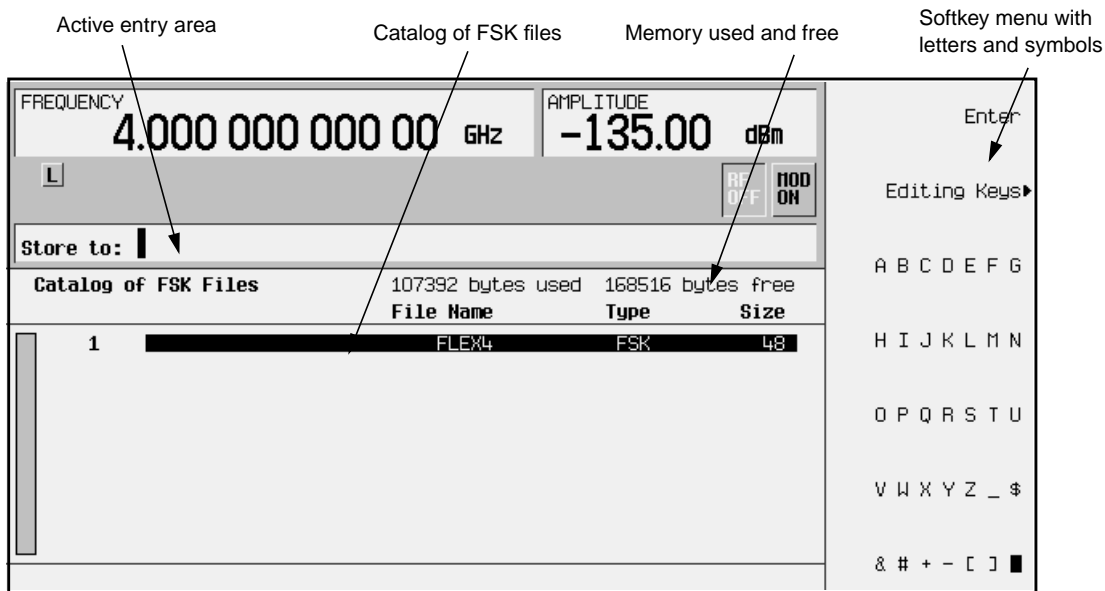
4. For this example, you'll title the file 4FSK, since this signal is a continuous 4-level FSK. The file name is created by pressing numbers on the numeric keypad, or pressing the softkey containing the desired character, then selecting the softkey with that character from the subsequent menu. For example, press number **4** on the numeric keypad. Press the **ABCDEFG** softkey, then press **F**. Note that 4F is displayed in the active entry area following the Store to: text.

5. Continue entering the characters for the file name until 4FSK is displayed in the active entry area.

6. When the file name is complete, press the **Enter** terminator softkey.

You now have a file called 4FSK stored in the instrument's non-volatile memory. The following figure shows the results of saving the FSK file.
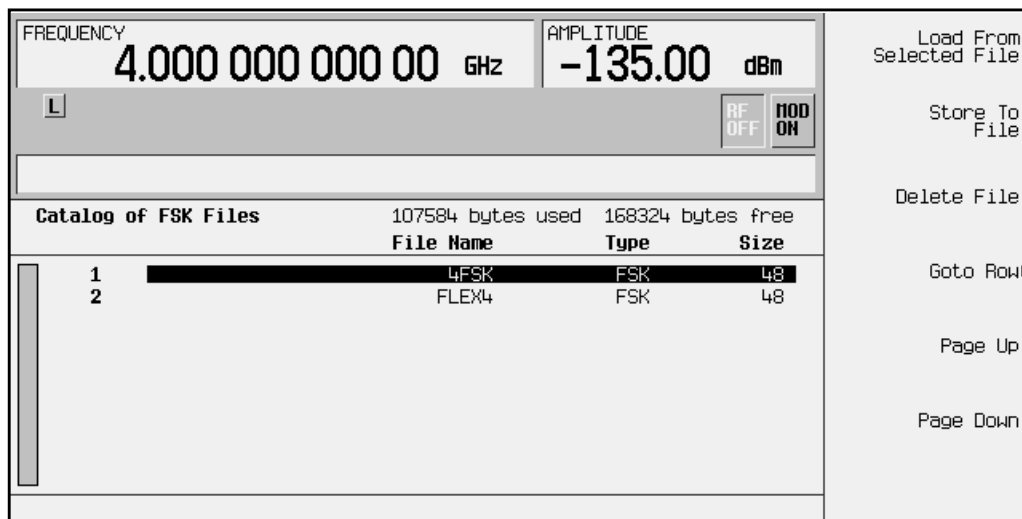
Loading the Stored FSK File

Once you have created and stored a custom FSK modulation to a file, you can edit or redefine the unique modulation by loading the file from the instrument's memory. To load a previously stored FSK file, follow these instructions:

1. Preset the signal generator to normal preset conditions.

2. Press the **Mode** hardkey. (If you have multiple options installed in your signal generator, press the **Real Time I/Q BaseBand** softkey to select Option UN8.) Then press **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User FSK**, **More (1 of 2)**, **Load/Store**.

   The Catalog of FSK Files appears.

3. Use the up and down arrow keys or the front panel knob to highlight the file called 4FSK. If there are many files in the FSK file catalog, the **Goto Row** softkeys can be helpful. See "Table Editor Basics" on page 2-5.

4. When the file is highlighted, press the **Load From Selected File** softkey. To confirm the file selection, press **Confirm Load From File.** If you change your mind, or want to choose a different file, press **Return.**

5. You will see the frequency values that you previously configured displayed in the User FSK table editor.

Selecting a Custom FSK File

Once you have created and stored a custom FSK modulation to a file, you can apply its unique characteristics for your custom modulation by selecting it. To select a custom FSK file, follow these instructions:

1. Preset the signal generator to normal preset conditions.

2. Press the **Mode** hardkey. (If you have multiple options installed in your signal generator, press the **Real Time I/Q BaseBand** softkey to select Option UN8.) Then press **TDMA, TETRA, More (1 of 2), Modify Standard, Modulation Type, Select, User FSK.**

   The `Catalog of FSK Files` appears.

3. Use the up and down arrow keys or the front panel dial to highlight the file called `4FSK`. If there are many files in the FSK file catalog, the **Goto Row** softkeys can be helpful. See "Table Editor Basics" on page 2-5.

4. When the file is highlighted, press the **Select File** softkey.

   The display returns to the Modulation Type menu. Notice that **(4FSK@FSK)** is displayed under the **Select** softkey in the Modulation Type menu, and `Mod Type: User FSK` is displayed on the front panel display.

Turning On Custom FSK Modulation

Now you are ready to apply the custom FSK modulation. If you have not yet created and selected a custom FSK modulation, return to "Building a Customized FSK Modulation Using the FSK Table Editor" on page 2-18 and follow the instructions. If you have performed all of the previous steps, proceed with the following instructions.

1. Press the **Mode** hardkey twice to return to the TETRA menu.

2. Press the **TETRA Off On** softkey until **On** is highlighted.

   Notice that `TETRA On` is displayed on the front panel and the following annunciators are enabled:

   • `TETRA` indicates that you have enabled the TETRA modulation

   • `I/Q` indicates that I/Q modulation is being generated

3. Press the front panel **Frequency** key.

   Frequency becomes the active function and the normal preset value for frequency is displayed in the active entry area.

4. Use the numeric keypad and press the **GHz** terminator softkey to enter the desired frequency, such as 1 GHZ.

   Notice that the new frequency is shown in the FREQUENCY area of the display:

   - 1.000 000 000 00 GHz

5. Press the front panel **Amplitude** hardkey.

   Amplitude becomes the active function and the normal preset value for amplitude is displayed in the active entry area.

6. Use the numeric keypad and press the **dBm** terminator softkey to enter the desired amplitude, such as 0 dBM.

   Notice that the new power level is shown in the AMPLITUDE area of the display:

   - 0.00 dBm

7. When the instrument is preset, modulation is On by default. If the MOD ON annunciator is not enabled, press the front panel **Mod On/Off** hardkey to display the annunciator and apply the custom FSK modulation to the carrier.

8. Press the front panel **RF On/Off** hardkey. Notice that the display annunciator changes from RF OFF to RF ON. The custom modulated FSK signal is now available at the RF OUTPUT connector.

Customizing the Burst Shape

The Burst Shape feature allows you to customize burst shape rise and fall times and rise and fall delays.

Burst shape maximum rise and fall time values are affected by the following factors:

*   the symbol rate

*   the modulation type

When the rise and fall delays equal 0, the burst shape is attempting to synchronize the maximum burst shape power to the beginning of the first valid symbol and the ending of the last valid symbol of the timeslot. The following figure illustrates a bursted signal in a GSM frame with a rise delay of 0 and a fall delay of +1 bit.
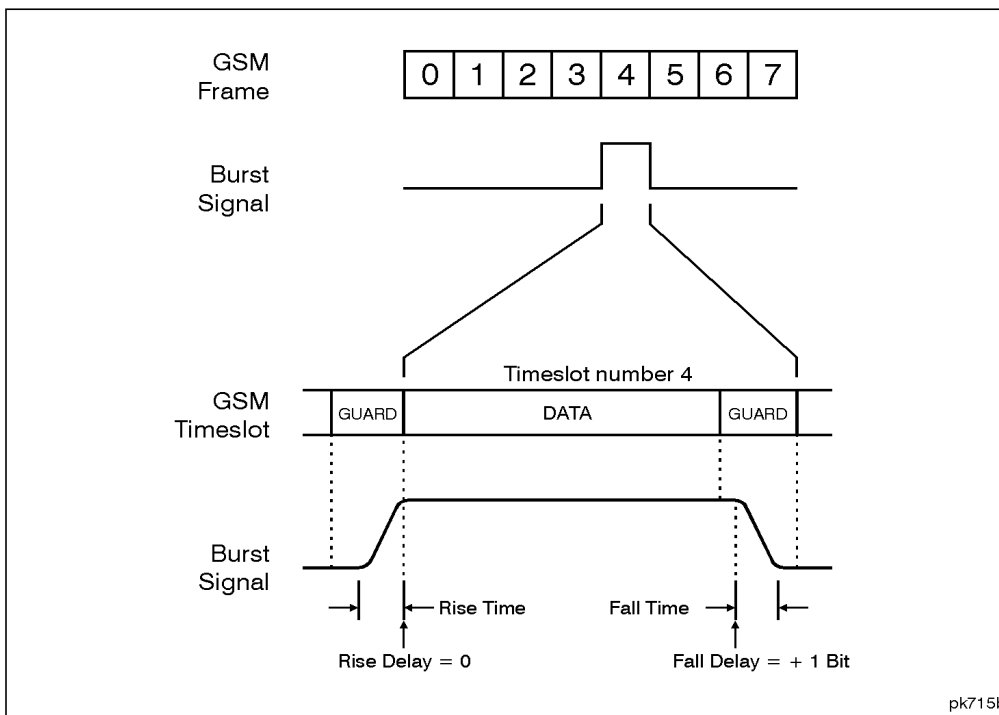
ESG firmware computes optimum burst shape based on the settings you've chosen for modulation. You can further optimize burst shape by lining up the data portion with the modulation. For example, if you're designing a new modulation scheme, do the following:

*   adjust the modulation and filtering to set the spectrum you want

*   turn on framing

*   adjust the burst rise and fall delay and rise and fall time for the timeslots

If you find that the Error Vector Magnitude (EVM) or Adjacent Channel Power (ACP) goes up when you turn bursting on, you can adjust the burst shape to assist with troubleshooting.

Use this procedure to adjust the burst shape:

1. Press the front panel **Mode** hardkey. (If you have multiple options installed in your signal generator, press the **Real Time I/Q BaseBand** softkey to select Option UN8.)

2. To choose the Burst Shape menu, press: **TDMA, TETRA, More (1 of 2), Modify Standard, Burst Shape.**
    You will see a menu of softkeys for adjusting the rise and fall times and rise and fall delays of the burst shape. The default values are displayed in bits. There is also a softkey for restoring the default burst shape. See the following figure.

3. Press the following softkeys to adjust the burst shape:

    *   Press the **Rise Time** softkey and enter a value on the numeric keypad, (for example, enter **5.0**) then press the **bits** terminator softkey.

    *   Press the **Rise Delay** softkey and enter a value on the numeric keypad, (for example, enter **-3.5**) then press the **bits** terminator softkey.

    *   Press the **Fall Time** and **Fall Delay** softkeys and enter values such as **5.0** and **3.6** respectively; then terminate each entry by pressing the **bits** terminator softkey.

Mapping Custom Differential Encoding

Differential encoding is a digital-encoding technique whereby a binary value is denoted by a signal *change* rather than a particular signal state. The signal generator is equipped with an editor that allows you to manipulate the differential state map associated with user-defined I/Q and user-defined FSK modulations. Using differential encoding, binary data can be encoded during the modulation process via transistions between states defined in the symbol table. Once the differential encoding has been configured, it is activated and applied to the current user-defined modulation.

NOTE	For a detailed explanation of differential encoding, refer to "Understanding Differential Encoding" on page 4-21.

Creating a User-Defined I/Q Modulation

Before you design a custom differential encoding scheme, you must first create a user-defined I/Q or FSK modulation. For the purposes of this example, you will create a user-defined 4QAM I/Q modulation from the signal generator's list of default I/Q maps.

1. Press **Mode, Real Time I/Q Base Band** (if this softkey appears), **TDMA, TETRA, More (1 of 2), Modify Standard, Modulation Type, Define User I/Q, More (1 of 2), Load Default I/Q Map, QAM, 4QAM.** This loads a default 4QAM I/Q modulation and displays it in the I/Q table editor.

   The default 4QAM I/Q modulation contains data that represent 4 symbols (00, 01, 10, and 11) mapped into the I/Q plane using 2 distinct values, 1.000000 and -1.000000. These 4 symbols will be traversed during the modulation process by the symbol table offset values associated with each symbol of data.

```
FREQUENCY                              AMPLITUDE                          Edit Item
     4.000 000 000 00  GHz       -135.00    dBm
 L                                                    RF    MOD          Insert Row
                                                      OFF   ON

                                                                         Delete Row
 I/Q Values                           Distinct   1   1.000000
     Data          I Value     Q Value   Values   2  -1.000000
                                                  3                      Goto Row
   00000000     1.000000      1.000000            4
   00000001    -1.000000      1.000000            5
   00000010    -1.000000     -1.000000            6
   00000011     1.000000     -1.000000            7                      Globally Replace
   00000100    ---------     ---------            8                        Selected Item
                                                  9
                                                 10
                                                 11
                                                 12                      Display I/Q Map
                                                 13
                                                 14
                                                 15                      More
                                                 16                      (1 of 2)
```

2. Press **More (1 of 2), Configure Differential Encoding.** This opens the Differential State Map editor. You are now prepared to create a custom differential encoding for the user-defined default 4QAM I/Q modulation.
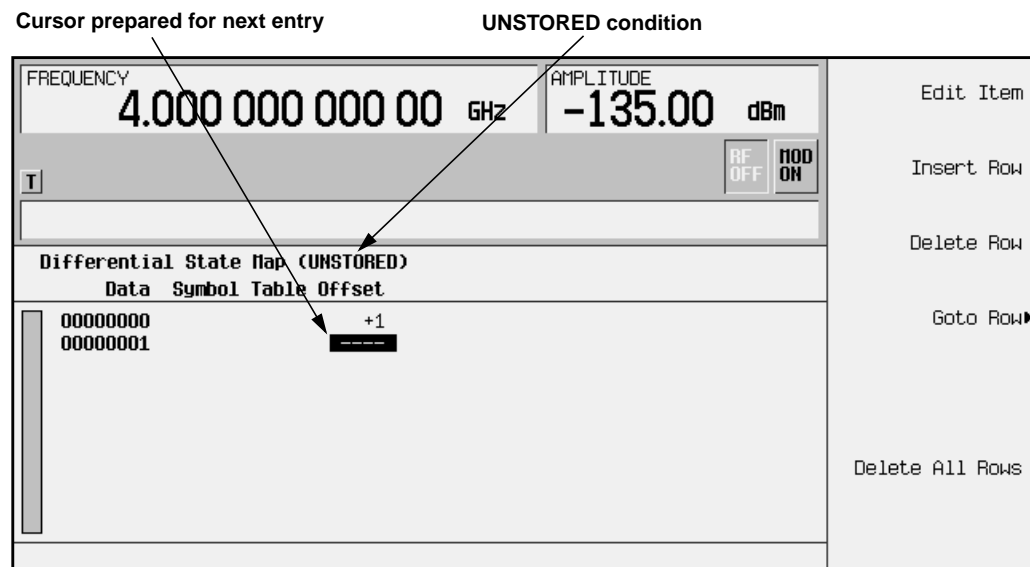
Editing the Differential State Map

The editor functions in the same manner as the I/Q and FSK table editors (explained in "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6 and "Building a Customized FSK Modulation Using the FSK Table Editor" on page 2-18). For an overview of basic table editing, see "Table Editor Basics" on page 2-5.

The following illustration shows the Differential State Map editor, along with the location of the data listing and the symbol table offset values entry area.

Data   **Symbol table offset values entry area**
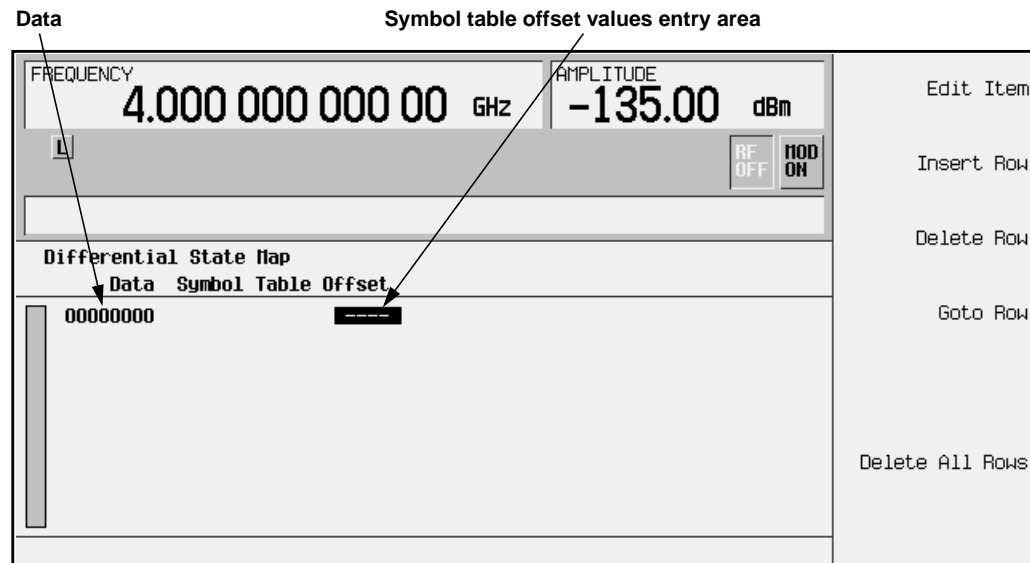
1. To encode the first symbol, add a symbol table offset of 1 by pressing **1**, **Enter**. This will rotate *forward* through the State Map by 1 value when a data value of 0 is modulated.

**Cursor prepared for next entry**   **UNSTORED condition**

NOTE	Notice that `(UNSTORED)` appears next to `Differential State Map` on the signal generator's display. Differential State Maps are associated with the user-defined modulation for which they were created. In order to save a custom Differential State Map, you must store the user-defined modulation for which it was designed. Otherwise the symbol table offset data will be purged when you press the **Confirm Exit From Table Without Saving** softkey when exiting from the I/Q or FSK table editor.

2. To encode the second symbol, add a symbol table offset of -1 by pressing **+/-**, **1**, **Enter**. This will rotate *backward* through the State Map by 1 value when a data value of 1 is modulated.

NOTE	At this point, the modulation has one bit per symbol. For the first two data values (00000000 and 00000001) only the last bits (the 0 and the 1, respectively) are significant.

3. To encode the third symbol, add a symbol table offset of 2 by pressing **2**, **Enter**. This will rotate *forward* through the State Map by 2 values when a data value of 10 is modulated.

4. To encode the fourth symbol, add a symbol table offset of 0 by pressing **0**, **Enter**. This will *not* rotate through the State Map when a data value of 11 is modulated.

NOTE	At this point, the modulation has two bits per symbol. For the data values 00000000, 00000001, 00000010, 00000011, the symbol values are 00, 01, 10 11 respectively.
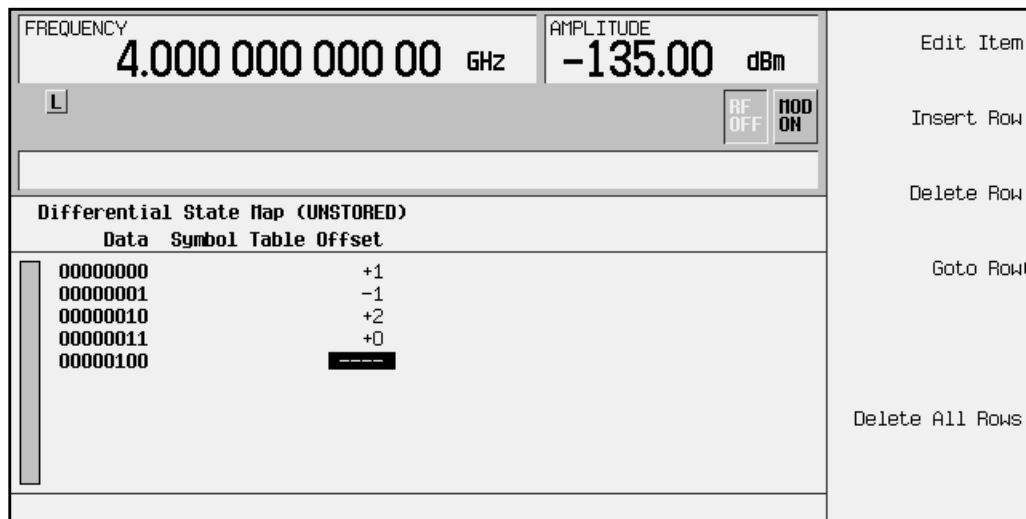
5. Press **Return** to go back to the I/Q table editor.

### Applying the Custom Differential Encoding

To apply the custom differential encoding to the user-defined 4QAM I/Q modulation, press **Differential Encoding Off On** until **On** is highlighted. The user-defined modulation will now be differentially encoded.

Creating a User-Defined FIR Filter Using the FIR Table Editor

Using this procedure you will create and store an 8-symbol, windowed sinc function filter with an oversample ratio of 4.

Accessing the Table Editor

1. Preset the signal generator to normal preset conditions.

2. Press the front panel **Mode** key.

3. If you have multiple options and the **Real Time I/Q BaseBand** softkey is visible, press it next.

4. Press **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**. The FIR table editor should now be displayed. The following illustration shows the FIR table editor.
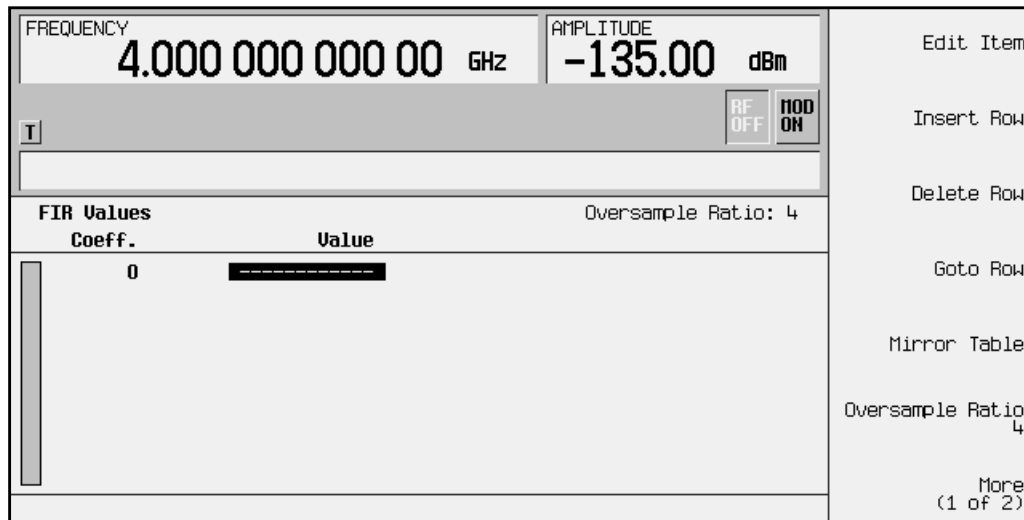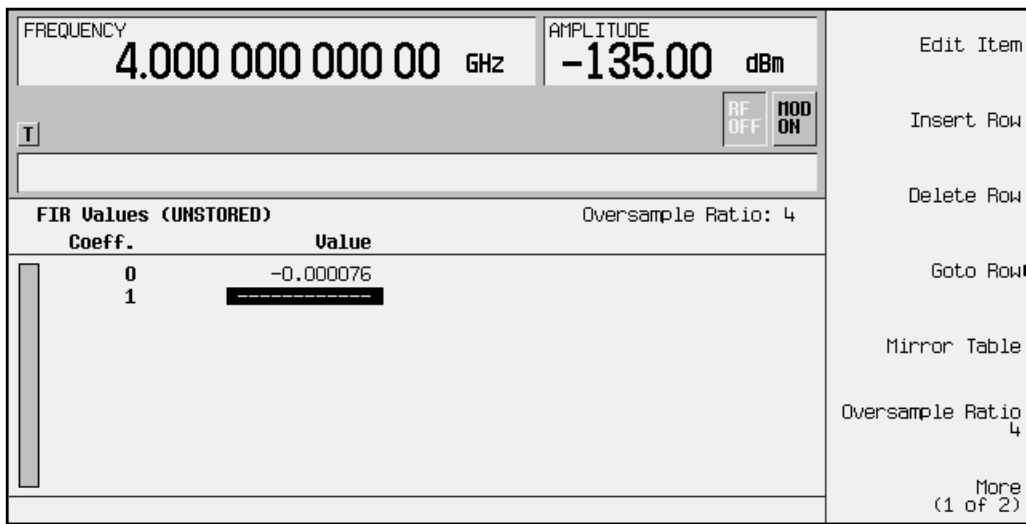
Entering the Coefficient Values

The FIR table editor creates a filter from values that you provide. In this example, the values you'll enter are listed after step 2.

1. Notice that the Value field for coefficient 0 is already highlighted. Use the numeric keypad to type the first value from the list. As you press the numeric keys, the numbers are displayed in the active entry area. (If you make a mistake, you can correct it using the backspace key.)

   Terminate your entry by pressing the **Enter** softkey. Notice that the value for coefficient 0 is now displayed in the Value field and a second row is automatically displayed with the Value field highlighted. (The following illustration shows the FIR table editor at this point in the process.)

2. Continue entering the coefficient values until all 16 are complete.

Coefficient	Value
0	−0.000076
1	−0.001747
2	−0.005144
3	−0.004424
4	0.007745
5	0.029610
6	0.043940
7	0.025852

Coefficient	Value
8	−0.035667
9	−0.116753
10	−0.157348
11	−0.088484
12	0.123414
13	0.442748
14	0.767329
15	0.972149

Duplicating the First 16 Coefficients Using Mirror Table

In a windowed sinc function filter, the second half of the coefficients are identical to the first half in reverse order. The signal generator provides a mirror table function that automatically duplicates the existing coefficient values in the reverse order.

1. Press the **Mirror Table** softkey. The last 16 coefficients are automatically generated and the first of these coefficients (number 16) is highlighted. The following illustration shows the display at this point in the process.

```
FREQUENCY                          AMPLITUDE                          Edit Item
      4.000 000 000 00  GHz        -135.00  dBm
                                                          RF   MOD    Insert Row
  T                                                       OFF  ON
                                                                     Delete Row

  FIR Values (UNSTORED)              Oversample Ratio: 4
     Coeff.            Value                                          Goto Row▶
      10            -0.157348
      11            -0.088484
      12             0.123414
      13             0.442748                                         Mirror Table
      14             0.767329
      15             0.972149
      16             0.972149                                         Oversample Ratio
      17             0.767329                                                    4
      18             0.442748
      19             0.123414                                         More
                                                                     (1 of 2)
```

Setting the Oversample Ratio

The oversample ratio (OSR) is the number of filter taps per symbol. Acceptable values range from 1 through 32, where the maximum combination of symbols and oversampling ratio allowed by the table editor is 1024. The instrument hardware, however, is actually limited to 32 symbols, an oversample ratio between 4 and 16, and 256 coefficients. So if you enter more than 32 symbols or 256 coefficients, the instrument will be unable to use the filter. If the oversample ratio is different from the internal, optimally selected one, then the filter will be resampled to the most optimal oversample ratio.

For this example, the desired OSR is 4, which is the default, so no action is necessary.

Displaying a Graphical Representation of the Filter

The signal generator has the capability of graphically displaying the filter in both time and frequency dimensions.

1. To view the filter frequency response (calculated using a fast Fourier transform), press **More (1 of 2)**, **Display FFT**. The following graph will be displayed:
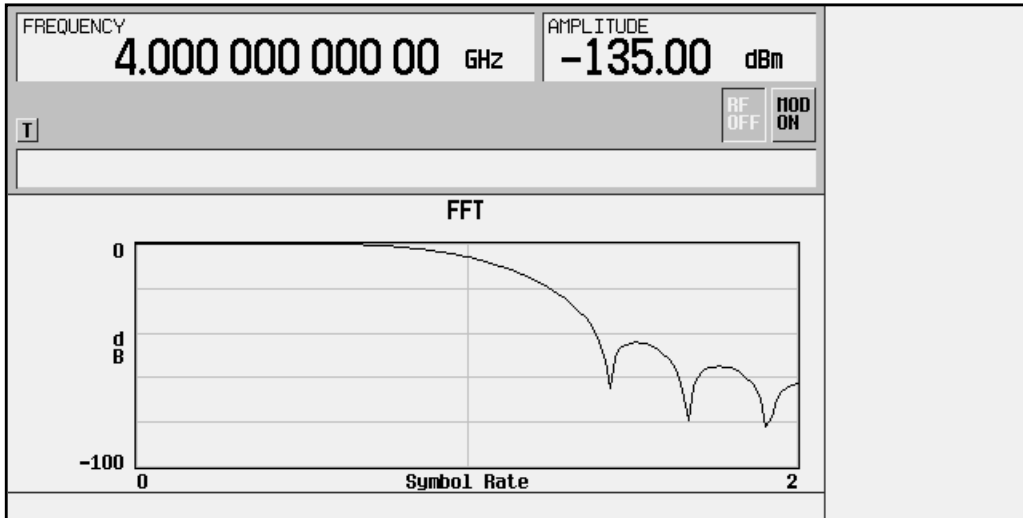
2. To return to the menu keys, press **Return**.

3. Display the filter impulse response in time by pressing **Display Impulse Response**. The following graph will be displayed:
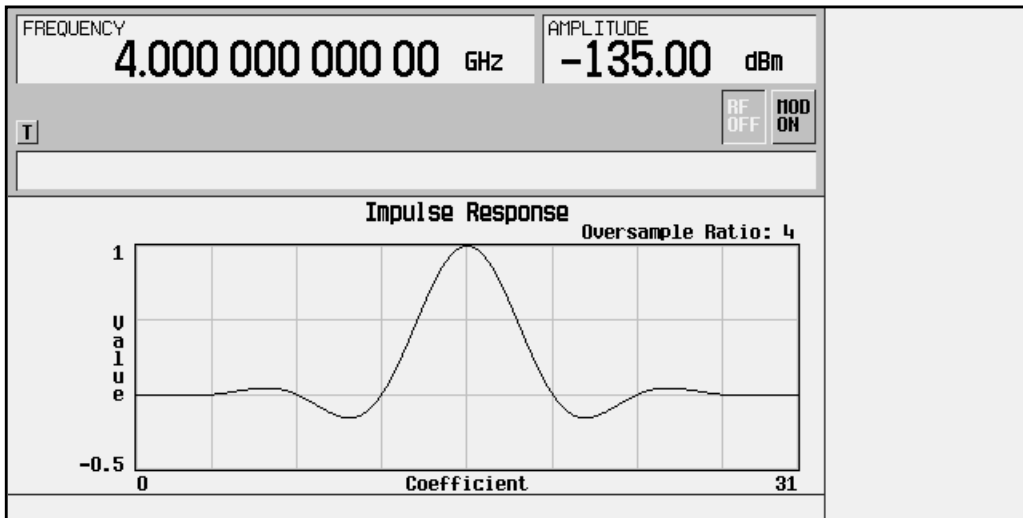
4. To return to the menu keys, press **Return**.

Storing the Filter to Memory

The filter is now complete and can be stored to non-volatile memory for future use. At any time you can check the information at the top of the FIR table editor to determine whether the current table has been stored. Your current table should display the following text: `FIR Values (UNSTORED)`. If you attempt to exit the table editor mode without first storing to a file, the signal generator will first prompt you to confirm that you want to exit without storing to a file. If you do *not* want to exit after all, press **Return**. To store the file, perform the following steps.

1. Press **Load/Store**, **Store To File**. The catalog of FIR files is displayed along with the amount of memory available.

2. For this example, you'll title the file NEWFIR1. The file name is created by pressing the softkey containing the desired character, then selecting the softkey with that character from the subsequent menu. For example, press the **HIJKLMN** softkey. Then press the bottom softkey, **N**. `N` is displayed in the active entry area following the `Store to:` text.

3. Continue entering the characters for the file name until `NEWFIR1` is displayed in the active entry area. (Use the numeric keypad to enter the number 1.)

4. Press **Enter** when the file name is complete. The contents of the current FIR table editor are stored to a file in non-volatile memory. The following illustration shows the display:
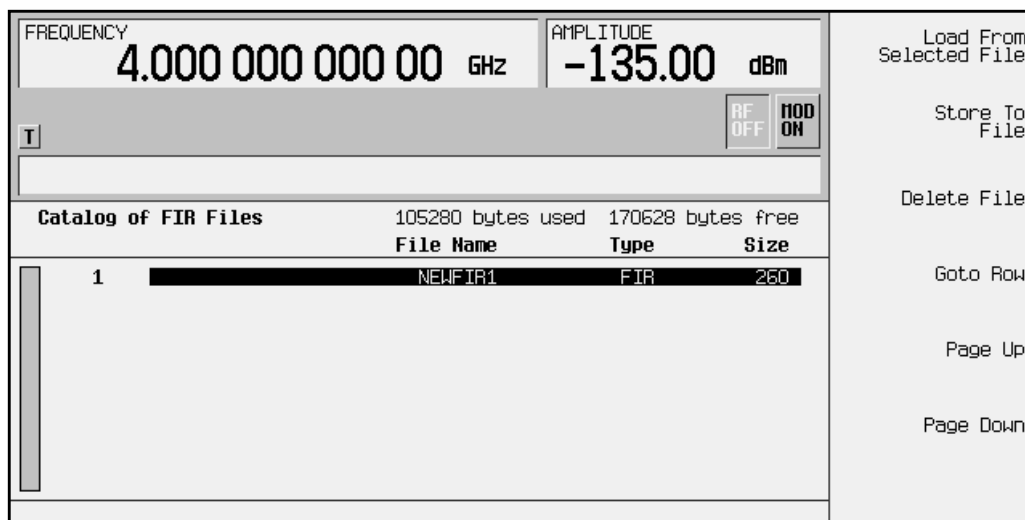
The NEWFIR1 file is the first file name listed. (If you have previously stored other FIR files, additional file names will be listed below NEWFIR1.) The file type is FIR and the size of the file is 260 bytes. The amount of memory used is also displayed. The number of files that can be saved depends on the size of the files and the amount of memory used. Memory is also shared by instrument state files and list sweep files.

This filter can now be used to customize a modulation or it can be used as a basis for a new filter design. (Refer to the additional filter examples in this chapter.)

# Modifying an FIR Filter Using the FIR Table Editor

FIR filters stored in signal generator memory can easily be modified using the FIR table editor. You can load the FIR table editor with coefficient values from user-defined FIR files stored in the signal generator's memory, or from one of the default FIR filters. Then you can modify the values, and store the new files. In this example, you'll load the FIR table editor with the values for a default Gaussian filter and then modify it.

Loading the Default Gaussian FIR File

1. Preset the signal generator to normal preset conditions.

2. Press the front panel **Mode** key.

3. If you have multiple options and the **Real Time I/Q Baseband** softkey is visible, press it next.

4. To select the Gaussian filter, press **TDMA, TETRA, More (1 of 2), Modify Standard, Filter, Define User FIR, More (1 of 2), Load Default FIR, Gaussian.**

5. Set the filter BbT to 0.300 (if **Filter BbT** is not already set to this value): Press **Filter BbT** and rotate the front panel knob until 0.300 is displayed.

6. Set the number of filter symbols to 8 (if **Filter Symbols** is not already set to this value): Press **Filter Symbols** and rotate the front panel knob until 8 is displayed.

7. Press **Generate**. The FIR table editor should now contain the coefficient values for the specified Gaussian filter.

NOTE	The actual oversample ratio during modulation is automatically selected by the instrument. A value between 4 and 16 is chosen dependent on the symbol rate, the number of bits per symbol of the modulation type, and the number of symbols.

8. Press **Display Impulse Response** for a graphic representation of the filter impulse response as shown on the following page:

9. To return to the menu keys, press **Return**.
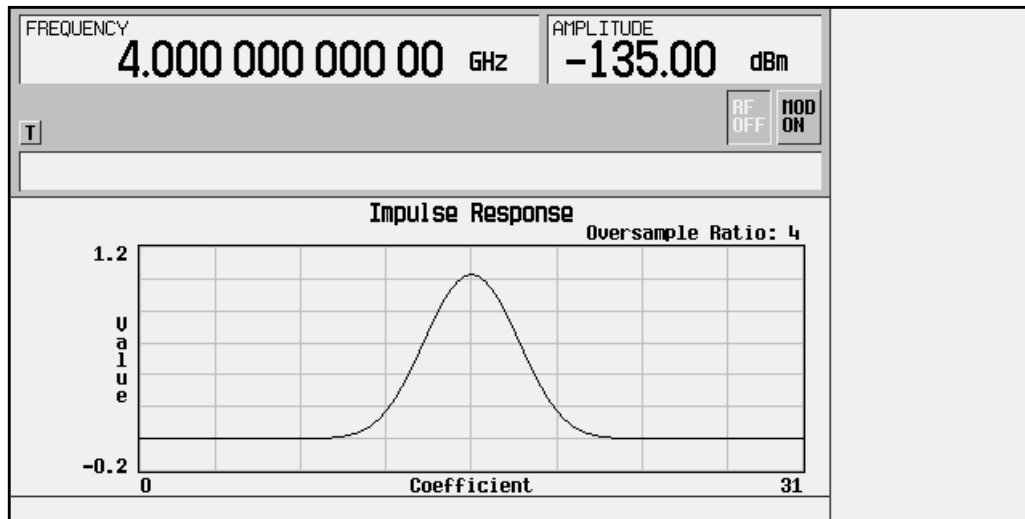
Modifying the Coefficients

1. The value for coefficient 0 should be highlighted. Use the front panel knob to scroll down until coefficient 15 is highlighted.

2. Press **0**, **Enter** to change the value of the coefficient to 0.

3. Press **Display Impulse Response** to see the effects of the change:
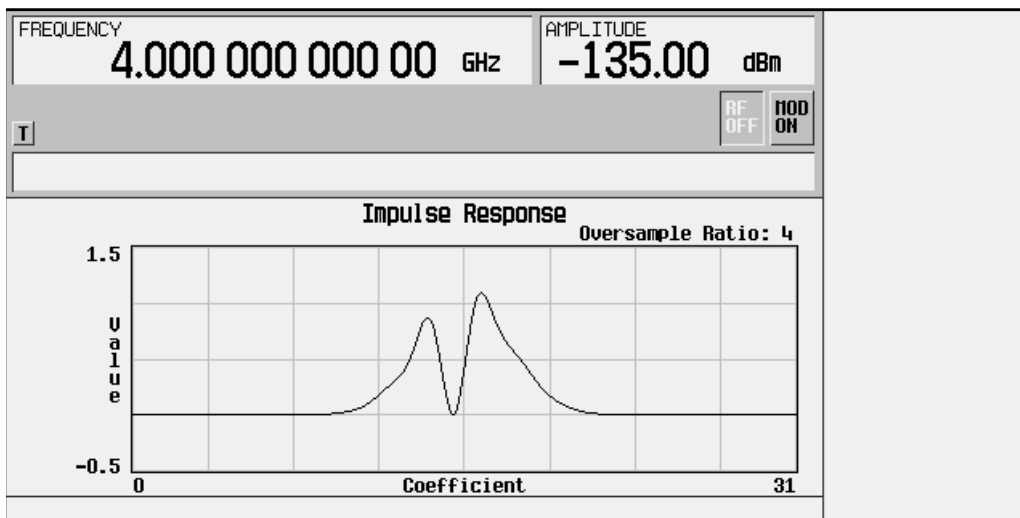
Notice that the graphic display can provide a useful troubleshooting tool (in this case indicating a missing coefficient value for a proper Gaussian response).

4. To return to the menu keys, press **Return**.

5. In addition to changing existing values, you can also insert and delete rows of coefficients and change the oversample ratio. Press **More (2 of 2)** to access these softkeys.

6. Change coefficient 15 back to its original value.
   a. Use the front panel knob to highlight row 15.
   b. Press **1**, **Enter**.

Storing the Filter to Memory

1. Press **More 1 of 2**, **Load/Store**, **Store To File**. The catalog of FIR files is displayed along with the amount of memory available.

2. Name the file NEWFIR2.

3. Press **Enter** when the file name is complete. The contents of the current FIR table editor are stored to a file in non-volatile memory, and the catalog of FIR files is updated to show the new file.

Applying a User-Defined FIR Filter to a TETRA Modulation State

Custom FIR filters can be created using the FIR table editor feature or they can be created externally and downloaded into signal generator memory. Once the filter is stored in memory, it can be selected for use with your TETRA modulation state. This example requires that at least one FIR file be already stored in memory. For an example of creating and storing an FIR filter, see "Creating a User-Defined FIR Filter Using the FIR Table Editor", earlier in this chapter.

1. Preset the signal generator to normal preset conditions.

2. Press the front panel **Mode** key.

3. If you have multiple options and the **Real Time I/Q Baseband** softkey is visible, press it next.

4. Press **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Select**, **User FIR**. The catalog of FIR files should now be displayed. The following illustration shows an example of the catalog.

In this example there are two FIR files listed: NEWFIR1, and NEWFIR2. (These files were created in the previous examples.)

5. Scroll down in the list until the desired filter is highlighted. In this example, NEWFIR2 is the desired filter. You can use the front-panel knob or the arrow keys as well as the GoTo Row function.

6. Press **Select File**. The highlighted filter is now selected for use in your TETRA modulation state. The following illustration shows our example displayed.
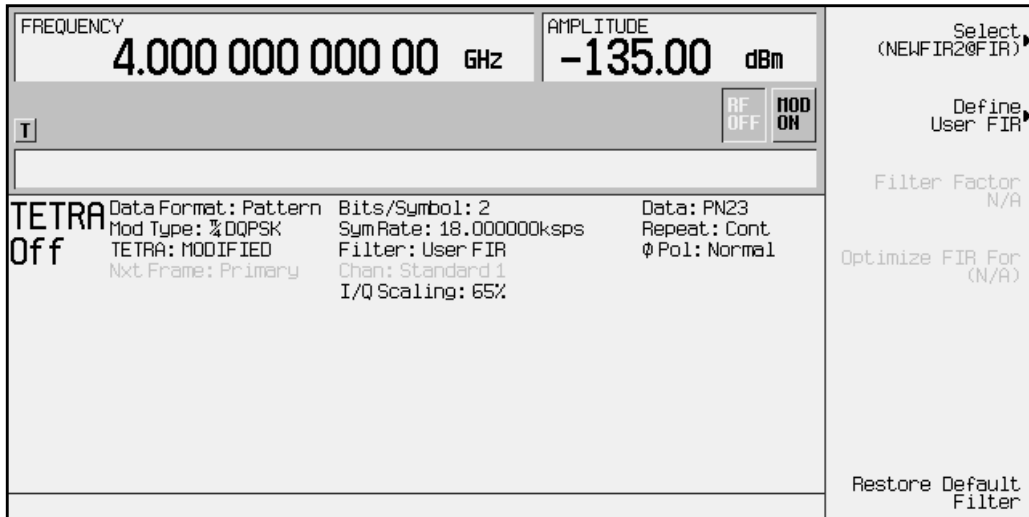
The filter you selected is NEWFIR2. You can see the name displayed below the **Select** softkey (at the top and right). In the Filter field, near the center of the display, **User FIR** is displayed to indicate that a user-defined FIR filter has been selected.

Once you have set the other modulation parameters to your satisfaction, turn on TETRA and the RF output and your user-defined filter is in use.

| NOTE | The actual oversample ratio during modulation is automatically selected by the instrument. A value between 4 and 16 is chosen dependent on the symbol rate, the number of bits per symbol of the modulation type, and the number of symbols. |

3 Softkey Reference

The following section describes briefly the **Mode** hardkey, and explains the associated softkeys that are used to activate functions specific to the TETRA standard.

Mode

Pressing the front panel **Mode** key accesses a menu of softkeys. These softkeys let you access further menus for configuring the following digital modulation formats: DECT, GSM, NADC, PDC, PHS, and TETRA. If you have multiple options and the **Real Time I/Q Baseband** softkey is visible, press it and then press **TDMA** to access the TDMA formats. If you have only Option UN8, your first menu is the TDMA formats. This chapter assumes that the **TDMA** softkey is in the first menu.

Pressing the **Mode** key twice causes the currently active mode menu to be displayed. For example, if TETRA is enabled (the **TETRA Off On** softkey is set to **On**) but the TETRA menu is not currently displayed, press **Mode** twice to display the first level menu for TETRA.
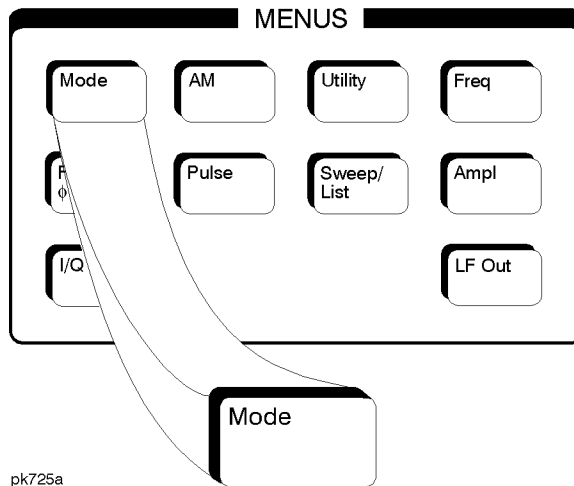
TETRA

Pressing this softkey accesses a menu of softkeys for generating data patterns that are formatted into a framed structure (where the data bits are located in fields defined by the TETRA protocol) or for generating just the data pattern where the data sequence can be output a single time or repeatedly. These softkeys are described in this section in alphabetical order.

π/4 DQPSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select π/4 DQPSK (π/4 Differential Quadrature Phase Shift Keying) for modulating a continuous stream of the selected data pattern. π/4DQPSK modulation transmits data at the rate of 2 bits per symbol. Notice that the modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select** and **PSK** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **π/4 DQPSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] P4QPSK
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a π/4 DQPSK (π/4 Differential Quadrature Phase Shift Keying) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **π/4 DQPSK**

2-Lvl FSK

This softkey appears in two different situations. To select an FSK pattern to use as your modulation, press the softkeys listed under "Selecting an FSK Modulation" below. To load a default FSK pattern into the FSK table editor and modify it, press the softkeys listed under"Modifying an FSK Pattern" below.

Selecting an FSK Modulation

Press this softkey to select 2-Level FSK (Frequency Shift Keying) for modulating a continuous stream of your selected data pattern. 2-Lvl FSK modulation transmits data at the rate of 1 bit per symbol. Notice that your modulation selection is shown in the text area of the display in the `Mod Type` field and under the **Select** softkey in the Modulation Type menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **FSK**, **2-Lvl FSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] FSK2
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Modifying an FSK Pattern

Press this softkey to load a 2-Level FSK (Frequency Shift Keying) modulation pattern into the FSK table editor. 2-Lvl FSK modulation transmits data at the rate of 1 bit per symbol. For details on using the FSK table editor, see "Building a Customized FSK Modulation Using the FSK Table Editor" on page 2-18.

Softkey Location: Press **Mode**, **TDMA**, **NADC**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User FSK**, **More (1 of 2)**, **Load Default FSK**, **2-Lvl FSK**

4 1's & 4 0's

Press this softkey to select a binary data pattern that consists of four ones followed by four zeroes. If you have selected **4 1's & 4 0's** in a pattern data transmission, both the **Data** and the **Other Patterns** softkeys will show this selection. In addition, `P4` (where "P" refers to Pattern and "4" refers to four ones and four zeroes) is displayed in the `Data` field in the top line of the text area of the display. If you have selected **4 1's & 4 0's** in a framed data transmission, both the **Data** and the **Other Patterns** softkeys will show this selection. Also, `P4` is displayed in the `Data` field located near the bottom of the text area of the display. A single output of a framed P4 data pattern consists of enough repetitions of four ones followed by four zeroes, followed by four ones and four zeroes, and so on, until the data fields in the timeslot are filled.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **Other Patterns**, **4 1's & 4 0's**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **Other Patterns**, **4 1's & 4 0's**

4 1's & 4 0's is also located in the Other Patterns menus found in every other TETRA Configure Timeslots menu.

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA P4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom P4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom P4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] P4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] P4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] P4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] P4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] P4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] P4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] P4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] P4
```

4-Lvl FSK

This softkey appears in two different situations. To select an FSK pattern to use as your modulation, press the softkeys listed under "Selecting an FSK Modulation" below. To load a default FSK pattern into the FSK table editor and modify it, press the softkeys listed under "Modifying an FSK Pattern" below.

Selecting an FSK Modulation

Press this softkey to select 4-Level FSK (Frequency Shift Keying) for modulating a continuous stream of your selected data pattern. 4-Lvl FSK modulation transmits data at the rate of 2 bits per symbol. Notice that your modulation selection is shown in the text area of the display in the Mod Type field and under the **Select** softkey in the Modulation Type menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **FSK**, **4-Lvl FSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] FSK4
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Modifying an FSK Pattern

Press this softkey to load a 4-Level FSK (Frequency Shift Keying) modulation pattern into the FSK table editor. 4-Lvl FSK modulation transmits data at the rate of 2 bits per symbol. For details on using the FSK table editor, see "Building a Customized FSK Modulation Using the FSK Table Editor" on page 2-18.

Softkey Location: Press **Mode**, **TDMA**, **NADC**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User FSK**, **More (1 of 2)**, **Load Default FSK**, **4-Lvl FSK**

4QAM

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select 4QAM (4-state Quadrature Amplitude Modulation) for modulating a continuous stream of the selected data pattern. 4QAM modulation transmits data at the rate of 2 bits per symbol. Notice that the modulation selection is shown in the text area of the display in the `Mod Type` field, and also under the **Select** and **QAM** softkeys in the Modulation Type menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **QAM**, **4QAM**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] QAM4
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a 4QAM (4-state Quadrature Amplitude Modulation) I/Q map into the I/Q table editor. For details on editing I/Q maps, see

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **QAM**, **4QAM**

8 1's & 8 0's

Press this softkey to select a binary data pattern that consists of eight ones followed by eight zeroes. If you have selected **8 1's & 8 0's** and the data format is output as a pattern only, not framed data, both the **Data** and the **Other Patterns** softkeys will show this selection. In addition, `P8` (where "P" refers to Pattern and "8" refers to eight ones and eight zeroes) is displayed in the `Data` field in the top line of the text area of the display. If you have selected **8 1's & 8 0's** and the data format is a framed transmission, both the **Data** and the **Other Patterns** softkeys will show this selection. Also, `P8` is displayed in the `Data` field located near the bottom of the text area of the display. A single output of a framed P8 data pattern consists of enough repetitions of eight ones followed by eight zeroes, followed by eight ones and eight zeroes, and so on, until the data fields in the timeslot are filled.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **Other Patterns**, **8 1's & 8 0's**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **Other Patterns**, **8 1's & 8 0's**

8 1's & 8 0's is also located in the Other Patterns menus found in every other TETRA Configure Timeslots menu.

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA P8
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom P8
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom P8
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] P8
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] P8
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] P8
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] P8
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] P8
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] P8
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] P8
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] P8
```

8-Lvl FSK

This softkey appears in two different situations. To select an FSK pattern to use as your modulation, press the softkeys listed under "Selecting an FSK Modulation" below. To load a default FSK pattern into the FSK table editor and modify it, press the softkeys listed under "Modifying an FSK Pattern" below.

Selecting an FSK Modulation

Press this softkey to select 8-Level FSK (Frequency Shift Keying) for modulating a continuous stream of your selected data pattern. 8-Lvl FSK modulation transmits data at the rate of 3 bits per symbol. Notice that your modulation selection is shown in the text area of the display in the `Mod Type` field and under the **Select** softkey in the Modulation Type menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **FSK**, **8-Lvl FSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] FSK8
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Modifying an FSK Pattern

Press this softkey to load a 8-Level FSK (Frequency Shift Keying) modulation pattern into the FSK table editor. 8-Lvl FSK modulation transmits data at the rate of 3 bits per symbol. For details on using the FSK table editor, see "Building a Customized FSK Modulation Using the FSK Table Editor" on page 2-18.

Softkey Location: Press **Mode**, **TDMA**, **NADC**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User FSK**, **More (1 of 2)**, **Load Default FSK**, **8-Lvl FSK**

8PSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select 8PSK (8-state Phase Shift Keying) for modulating a continuous stream of the selected data pattern. 8PSK modulation transmits data at the rate of 3 bits per symbol. Notice that the modulation selection is shown in the text area of the display in the Mod Type field and also under the **Select** and **PSK** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **8PSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] PSK8
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a 8PSK (8-state Phase Shift Keying) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **8PSK**

16 1's & 16 0's

Press this softkey to select a binary data pattern that consists of sixteen ones followed by sixteen zeroes. If you have selected **16 1's & 16 0's** and the data format is output as a pattern only, not framed data, both the **Data** and the **Other Patterns** softkeys will show this selection. In addition, P16 (where "P" refers to Pattern and "16" refers to sixteen ones and sixteen zeroes) is displayed in the Data field in the top line of the text area of the display. If you have selected **16 1's & 16 0's** and the data format is a framed transmission, both the **Data** and the **Other Patterns** softkeys will show this selection. Also, P16 is displayed in the Data field located near the bottom of the text area of the display. A single output of a framed P16 data pattern consists of enough repetitions of sixteen ones followed by sixteen zeroes, followed by sixteen ones and sixteen zeroes, and so on, until the data fields in the timeslot are filled.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **Other Patterns**, **16 1's & 16 0's**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **Other Patterns**, **16 1's & 16 0's**

16 1's & 16 0's is also located in the Other Patterns menus found in every other TETRA Configure Timeslots menu.

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA P16
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom P16
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom P16
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] P16
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] P16
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] P16
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] P16
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] P16
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] P16
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] P16
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] P16
```

16-Lvl FSK

This softkey appears in two different situations. To select an FSK pattern to use as your modulation, press the softkeys listed under "Selecting an FSK Modulation" below. To load a default FSK pattern into the FSK table editor and modify it, press the softkeys listed under "Modifying an FSK Pattern" below.

Selecting an FSK Modulation

Press this softkey to select 16-Level FSK (Frequency Shift Keying) for modulating a continuous stream of your selected data pattern. 16-Lvl FSK modulation transmits data at the rate of 4 bits per symbol. Notice that your modulation selection is shown in the text area of the display in the `Mod Type` field and under the **Select** softkey in the Modulation Type menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **FSK**, **16-Lvl FSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] FSK16
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Modifying an FSK Pattern

Press this softkey to load a 16-Level FSK (Frequency Shift Keying) modulation pattern into the FSK table editor. 16-Lvl FSK modulation transmits data at the rate of 4 bits per symbol. For details on using the FSK table editor, see "Building a Customized FSK Modulation Using the FSK Table Editor" on page 2-18.

Softkey Location: Press **Mode**, **TDMA**, **NADC**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User FSK**, **More (1 of 2)**, **Load Default FSK**, **16-Lvl FSK**

16PSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select 16PSK (16-state Phase Shift Keying) for modulating a continuous stream of the selected data pattern. 16PSK modulation transmits data at the rate of 4 bits per symbol. Notice that the modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select** and **PSK** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **16PSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] PSK16
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a 16PSK (16-state Phase Shift Keying) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **16PSK**

16QAM

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select 16QAM (16-state Quadrature Amplitude Modulation) for modulating a continuous stream of the selected data pattern. 16QAM modulation transmits data at the rate of 4 bits per symbol. Notice that the modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select** and **QAM** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **QAM**, **16QAM**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] QAM16
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a 16QAM (16-state Quadrature Amplitude Modulation) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **QAM**, **16QAM**

32 1's & 32 0's

Press this softkey to select a binary data pattern that consists of thirty-two ones followed by thirty-two zeroes. If you have selected **32 1's & 32 0's** and the data format is output as a pattern only, not framed data, both the **Data** and the **Other Patterns** softkeys will show this selection. In addition, P32 (where "P" refers to Pattern and "32" refers to thirty-two ones and thirty-two zeroes) is displayed in the Data field in the top line of the text area of the display. If you have selected **32 1's & 32 0's** and the data format is a framed transmission, both the **Data** and the **Other Patterns** softkeys will show this selection. In addition, P32 is displayed in the Data field located near the bottom of the text area of the display. A single output of a framed P32 data pattern consists of enough repetitions of thirty-two ones followed by thirty-two zeroes, followed by thirty-two ones and thirty-two zeroes, and so on, until the data fields in the timeslot are filled.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **Other Patterns**, **32 1's & 32 0's**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **Other Patterns**, **32 1's & 32 0's**

32 1's & 32 0's is also located in the Other Patterns menus found in every other TETRA Configure Timeslots menu.

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA P32
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom P32
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom P32
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] P32
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] P32
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] P32
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] P32
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] P32
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] P32
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] P32
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] P32
```

32QAM

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select 32QAM (32-state Quadrature Amplitude Modulation) for modulating a continuous stream of the selected data pattern. 32QAM modulation transmits data at the rate of 5 bits per symbol. Notice that the modulation selection is shown in the text area of the display in the `Mod Type` field and also under the Select and **QAM** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **QAM**, **32QAM**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] QAM32
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a 32QAM (32-state Quadrature Amplitude Modulation) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **QAM**, **32QAM**

64 1's & 64 0's

Press this softkey to select a binary data pattern that consists of sixty-four ones followed by sixty-four zeroes. If you have selected **64 1's & 64 0's** and the data format is output as a pattern only, not framed data, both the **Data** and the **Other Patterns** softkeys will show this selection. In addition, `P64` (where "P" refers to Pattern and "64" refers to sixty-four ones and sixty-four zeroes) is displayed in the `Data` field in the top line of the text area of the display. If you have selected **64 1's & 64 0's** and the data format is a framed transmission, both the **Data** and the **Other Patterns** softkeys will show this selection. In addition, `P64` is displayed in the `Data` field located near the bottom of the text area of the display. A single output of a framed P64 data pattern consists of enough repetitions of sixty-four ones followed by sixty-four zeroes, followed by sixty-four ones and sixty-four zeroes, and so on, until the data fields in the timeslot are filled.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **Other Patterns**, **64 1's & 64 0's**

Or press **Mode, TDMA, TETRA, Data Format Pattern Framed, Configure Timeslots, Configure Up Normal, Data, Other Patterns, 64 1's & 64 0's**

64 1's & 64 0's is also located in the Other Patterns menus found in every other TETRA Configure Timeslots menu.

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA P64
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom P64
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom P64
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] P64
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] P64
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] P64
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] P64
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] P64
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] P64
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] P64
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] P64
```

64QAM

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select 64QAM (64-state Quadrature Amplitude Modulation) for modulating a continuous stream of the selected data pattern. 64QAM modulation transmits data at the rate of 6 bits per symbol. Notice that the modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select** and **QAM** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode, TDMA, TETRA, More (1 of 2), Modify Standard, Modulation Type, Select, QAM, 64QAM**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] QAM64
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a 64QAM (64-state Quadrature Amplitude Modulation) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode, TDMA, TETRA, More (1 of 2), Modify Standard, Modulation Type, Define User I/Q, More (1 of 2), Load Default I/Q Map, QAM, 64QAM**

256QAM

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select 256QAM (256-state Quadrature Amplitude Modulation) for modulating a continuous stream of the selected data pattern. 256QAM modulation transmits data at the rate of 8 bits per symbol. Notice that the modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select** and **QAM** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **QAM**, **256QAM**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] QAM256
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a 256QAM (256-state Quadrature Amplitude Modulation) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **QAM**, **256QAM**

All Timeslots

Press this softkey to output a 1-bit pulse to the EVENT 1 rear panel connector that is synchronized to the first bit of each timeslot in a frame. If you have entered a value for **Sync Out Offset**, the synchronizing pulse is offset by the number of bits specified.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **More (1 of 2)**, **Sync Out**, **All Timeslots**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SOUT ALL
```

B

Press this softkey to change the 30-bit broadcast bits (B) value. To enter a value (in hexadecimal), press **B**. The broadcast bits value becomes the active function. Enter a new value using the front panel knob, up and down arrow keys, or use the numeric keypad and the **A**, **B**, **C**, **D**, **E**, and **F**

softkeys and press the **Enter** terminator softkey. The current value for broadcast bits is displayed in the B field near the bottom of the text area of the display.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Sync Cont**, **Configure Dn Sync Cont**, **B**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Sync Disc**, **Configure Dn Sync Disc**, **B**

Status after Normal Preset: 00000000

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:B
<30 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:B?

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:B
<30 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:B?
```

B1

Press this softkey to change the 14-bit broadcast bits (B1) value. To enter a value (in hexadecimal), press **B1**. The broadcast bits value becomes the active function. Enter a new value using the front panel knob, up and down arrow keys, or use the numeric keypad and the **A**, **B**, **C**, **D**, **E**, and **F** softkeys and press the **Enter** terminator softkey. The current value for broadcast bits is displayed in the B1 field near the bottom of the text area of the display.

Status after Normal Preset: 0000

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Normal Cont**, **Configure Dn Normal Cont**, **B1**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Normal Disc**, **Configure Dn Normal Disc**, **B1**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B1
<14 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B1?

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B1
<14 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B1?
```

B2

Press this softkey to change the 16-bit broadcast bits (B2) value. To enter a value (in hexadecimal), press **B2**. The broadcast bits value becomes the active function. Enter a new value using the front panel knob, up and down arrow keys, or use the numeric keypad and the **A**, **B**, **C**, **D**, **E**, and **F** softkeys and press the **Enter** terminator softkey. The current value for broadcast bits is displayed in the B2 field near the bottom of the text area of the display.

Status after Normal Preset: 0000

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Normal Cont**, **Configure Dn Normal Cont**, **B2**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Normal Disc**, **Configure Dn Normal Disc**, **B2**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal
:B2 <16 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B2?

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal
:B2 <16 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B2?
```

BBG Data Clock Ext Int

Press this softkey to select the internal data clock for the base band generator or to select an externally-supplied data clock. A data clock or symbol clock input must be supplied when external mode is selected. For more information on input and output signals, refer to Chapter 4, "Operation."

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Configure Hardware**, **BBG Data Clock Ext Int**

Status after Normal Preset: Int

SCPI Commands:

```
[:SOURce]:RADio:TETRa:BBCLock INT[1]|EXTernal[1]
[:SOURce]:RADio:TETRa:BBCLock?
```

Begin Frame

Press this softkey to output a 1-bit pulse to the EVENT 1 rear panel connector that is synchronized to the first bit of the first frame. If you have entered a value for **Sync Out Offset**, the synchronizing pulse is offset by the number of bits specified. The number of trigger pulses generated depends on the framed data patterns selected:

- If a PN9 or PN15 data pattern is selected, a single frame is generated. The data fields of the frame are filled sequentially with the PRBS data. The synchronizing pulse occurs at the beginning of the frame each time it is transmitted.

- Any combination of external data and a PN9 data pattern will cause 511 frames to be generated. The synchronizing pulse occurs at the beginning of the first of the 511 frames each time that frame is transmitted.

- Any combination of external data and a PN15 data pattern will cause a discontinuous PN15. A discontinuous PN15 pattern consists of as many complete frames of PN15 data as can be generated. The remaining bits that do not completely fill a frame are truncated. The synchronizing pulse occurs at the beginning of the first frame each time that frame is transmitted.

- Any combination of user's files and a PN15 data pattern will cause a discontinuous PN15. The synchronizing pulse occurs at the beginning of the first frame each time that frame is transmitted.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **More (1 of 2)**, **Sync Out**, **Begin Frame**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SOUT FRAME
```

Begin Pattern

Press this softkey to output a 1-bit pulse to the EVENT 1 rear panel connector that is synchronized to the first bit of your unframed data pattern (**Data Format Pattern Framed** is set to **Pattern**), and for each repetition of the pattern. If you have entered a value for **Sync Out Offset**, the synchronizing pulse is offset by the number of bits specified.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Sync Out**, **Begin Pattern**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SOUT FRAME
```

Begin Timeslot

Press this softkey to output a 1-bit signal to the EVENT 1 rear panel connector that is synchronized to the first bit of a selected timeslot. If you have entered a value for **Sync Out Offset**, the synchronizing pulse is offset by the number of bits specified. Select the timeslot by pressing **Begin Timeslot**. The timeslot number for the synchronization signal becomes the active function. Enter a value using the front panel knob, up and down arrow keys, or enter the value using the numeric keypad and press the **Enter** terminator softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **More (1 of 2)**, **Sync Out**, **Begin Timeslot**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SOUT SLOT
[:SOURce]:RADio:TETRa:SOUT:SLOT <1 - 4>
[:SOURce]:RADio:TETRa:SOUT:SLOT?
```

BPSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select BPSK (Binary Phase Shift Keying) modulation for modulating a continuous stream of the selected data pattern. BPSK modulation transmits data at the rate of 1 bit per symbol. Notice that the modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select** and **PSK** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **BPSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] BPSK
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a BPSK (Binary Phase Shift Keying) modulation I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **BPSK**

Burst Shape

Pressing this softkey accesses a menu of choices for modifying the burst shape of the framed data. In this menu, you can change the rise and fall time of the burst, in bits, and you can change the rise and fall delay of the burst, in bits. A softkey is also provided to return the default burst shape values.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Burst Shape**

Bus

Press this softkey to use the HP-IB as the pattern trigger for a single output of your unframed data pattern or as the frame trigger for a single output of your framed data. Once selected, you can trigger a single event at any time by sending a trigger command over HP-IB (*TRG) or by asserting the HP-IB GET (group execute trigger) line.

In secondary frame mode, selecting Bus allows the next frame to be toggled by the *TRG or GET command. This secondary frame will be used once the current frame has been completely transmitted.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Pattern Repeat Single Cont**, **Pattern Trigger**, **Bus**

NOTE   Pattern Repeat and Pattern Trigger functions are *not* available if you use either a PN data sequence, or an external data source.

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Frame Repeat Single Cont**, **Frame Trigger**, **Bus**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Frame**, **Secondary Frame Trigger**, **Bus**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:TRIGger[:SOURce] BUS
[:SOURce]:RADio:TETRa:SECondary:TRIGger[:SOURce] BUS
```

C4FM

This softkey appears in two different situations. To select a C4FM FSK pattern to use as your modulation, press the softkeys listed under "Selecting an FSK Modulation" below. To load a default C4FM FSK pattern into the FSK table editor and modify it, press the softkeys listed under"Modifying an FSK Pattern" below.

Selecting an FSK Modulation

Press this softkey to select C4FM for modulating a continuous stream of your selected data pattern. C4FM is an APCO 25-compliant, 4-level FSK (Frequency Shift Keying) modulation that transmits data at the rate of 2 bits per symbol. Notice that your modulation selection is shown in the text area of the display in the `Mod Type` field and under the **Select** softkey in the Modulation Type menu.

NOTE   APCO 25 (Association of Public-Safety Communications Officials - International, Inc., Project 25) is a standard setting initiative for public-safety communications.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **FSK**, **C4FM**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] C4FM
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Modifying an FSK Pattern

Press this softkey to load a C4FM FSK (Frequency Shift Keying) modulation pattern into the FSK table editor. C4FM FSK modulation transmits data at the rate of 2 bits per symbol. For details on using the FSK table editor, see "Building a Customized FSK Modulation Using the FSK Table Editor" on page 2-18.

Softkey Location: Press **Mode**, **TDMA**, **NADC**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User FSK**, **More (1 of 2)**, **Load Default FSK**, **C4FM**

Channel Band

Pressing this softkey accesses a menu of choices for assigning frequency bands based on the TETRA standard. The output frequency depends on both the channel band and channel number selections.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Freq Channels**, **Channel Band**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:FCHannel:BAND STANdard
[:SOURce]:RADio:TETRa:FCHannel:BAND?
```

Channel Number

Pressing this softkey allows you to change the channel numbers (the frame carrier frequency) based on channel numbers defined in the TETRA standard. To change the channel number, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad. The range of values allowed is 1 through 100. The output frequency depends on both the channel band and channel number selections.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Freq Channels**, **Channel Number**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:FCHannel:NUMBer <number>
[:SOURce]:RADio:TETRa:FCHannel:NUMBer?
```

Configure Differential Encoding

Press this softkey to display a menu and editor (a Differential State Map) for creating user-defined differential encoding for the user-defined modulation table being edited. Use this table to enter the Symbol Table Offset for each binary data bit.

For a detailed explanation of differential encoding, see "Understanding Differential Encoding" on page 4-21.

For information on using the Differential State Map editor, see "Mapping Custom Differential Encoding" on page 2-29.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Configure Differential Encoding**

Or press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User FSK**, **More (1 of 2)**, **Configure Differential Encoding**

SCPI Commands:

```
:MEMory:DATA:FSK "<file name>",num_states,f0,f0,...
[,diff_state,num_diff_states,diff0,diff1,...]
```

```
:MEMory:DATA:UIQ "<file name>",offsetQ,num_states,i0,q0,
i1,q1,...[,diff_state,num_diff_states,diff0,diff1,...]
```

Configure Dn Custom Cont

Pressing this softkey accesses a menu of softkeys for selecting the data pattern for a continuous downlink custom timeslot. The following figure shows an example of display graphics for a continuous downlink custom timeslot. The visual representation of the timeslot shows each field of the timeslot.

In this example:

- `Data: PN9` - Indicates that the data selection for this custom timeslot is PN9. Other selections allowed include PN15, fixed 4-bit patterns, fixed patterns of ones and zeroes, user files, or external data.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Custom Cont**, **Configure Dn Custom Cont**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom PN9|PN15|
FIX4|"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom?
```

Configure Dn Custom Disc

Pressing this softkey accesses a menu of softkeys for selecting the data pattern for a discontinuous downlink custom timeslot. The following figure shows an example of display graphics for a discontinuous downlink custom timeslot. The visual representation of the timeslot shows each field of the timeslot.

In this example:

- `R: --` - Ramp time is a 34-bit field. The text in this field is grey, indicating that you cannot change the contents of the ramp time field.

- `Data: PN9` - Indicates that the data selection for this custom timeslot is PN9. Other selections allowed include PN15, fixed 4-bit patterns, fixed patterns of ones and zeroes, user files, or external data.

- `G: --` - Guard time is a 14-bit field. The text in this field is grey, indicating that you cannot change the contents of the guard time field.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Custom Disc**, **Configure Dn Custom Disc**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom PN9|PN15|
FIX4|"<file name>"|EXT|P4|P8|P16|P32|P64

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom?
```

Configure Dn Normal Cont

Pressing this softkey accesses a menu of softkeys for configuring a timeslot as a downlink continuous normal timeslot. The following figure shows an example of display graphics for a downlink continuous normal timeslot. The visual representation of the timeslot shows each field of the timeslot as it is defined by the TETRA standard.

In this example:

- `TS1: 1AD (always)` - Indicates that the 12-bit training sequence field always contains hexadecimal 1AD. The text in this field is grey, indicating that you cannot change the contents of this first training sequence field.

- `PA: Phase Adjustment` - There are two 2-bit phase adjustment fields. The text in this field is grey, indicating that you cannot change the contents of either phase adjustment field.

- `Data: PN9` - Indicates that the data selection for both 216-bit data fields is PN9. Other selections allowed include PN15, fixed 4-bit patterns, fixed patterns of ones and zeroes, user files, or external data.

- `B1: 0000` - Indicates that the 14-bit broadcast bits field contains hexadecimal 0000. Press the **B1** softkey in the Configure Dn Normal Cont menu to change the value of the broadcast bits field.

- `TS2: 343A74` - Indicates that this 22-bit training sequence field contains hexadecimal 343A74. Press the **TS** softkey in the Configure Dn Normal Cont menu to change the value of this second training sequence field.

- `B2: 0000` - Indicates that the 16-bit broadcast bits field contains hexadecimal 0000. Press the **B2** softkey in the Configure Dn Normal Cont menu to change the value of the broadcast bits field.

- `TS3: 2DC (always)` - Indicates that this 10-bit training sequence field always contains hexadecimal 2DC. The text in this field is grey, indicating that you cannot change the contents of this third training sequence field.

Softkey Location: Press **Mode, TDMA, TETRA, Data Format Pattern Framed, Configure Timeslots, Timeslot Type, More (2 of 2), Dn Normal Cont, Configure Dn Normal Cont**

Configure Dn Normal Disc

Pressing this softkey accesses a menu of softkeys for configuring a timeslot as a downlink discontinuous normal timeslot. The following figure shows an example of display graphics for a downlink discontinuous normal timeslot. The visual representation of the timeslot shows each field of the timeslot as it is defined by the TETRA standard.

In this example:

- `R: --` - Ramp time is a 10-bit field. The text in this field is grey, indicating that you cannot change the contents of the ramp time field.

- `TS1: 1 (always)` - Indicates that this 2-bit training sequence field always contains hexadecimal 1. The text in this field is grey, indicating that you cannot change the contents of this first training sequence field.

- `PA: Phase Adjustment` - There are two 2-bit phase adjustment bits fields. The text in this field is grey, indicating that you cannot change the contents of either phase adjustment field.

- `Data: PN9` - Indicates that the data selection for both 216-bit data fields is PN9. Other selections allowed include PN15, fixed 4-bit patterns, fixed patterns of ones and zeroes, user files, or external data.

- `B1: 0000` - Indicates that the 14-bit broadcast bits field contains hexadecimal 0000. Press the **B1** softkey in the Configure Dn Normal Disc menu to change the value of the broadcast bits field.

- `TS2: 343A74` - Indicates that this 22-bit training sequence field contains hexadecimal 343A74. Press the **TS** softkey in the Configure Dn Normal Disc menu to change the value of this second training sequence field.

- `B2: 0000` - Indicates that the 16-bit broadcast bits field contains hexadecimal 0000. Press the **B2** softkey in the Configure Dn Normal Disc menu to change the value of the broadcast bits field.

- `TS3: 2 (always)` - Indicates that the 2-bit training sequence field always contains hexadecimal 2. The text in this field is grey, indicating that you cannot change the contents of this third training sequence field.

- `G: --` - Guard time is an 8-bit field. The text in this field is grey, indicating that you cannot change the contents of the guard time field.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Normal Disc**, **Configure Dn Normal Disc**

Configure Dn Sync Cont

Pressing this softkey accesses a menu of softkeys for configuring a timeslot as a downlink continuous synchronization timeslot. The following figure shows an example of display graphics for a downlink continuous synchronization timeslot. The visual representation of the timeslot shows each field of the timeslot as it is defined by the TETRA standard.

In this example:

- `TS1: 1AD (always)` - Indicates that this 12-bit training sequence field always contains hexadecimal 1AD. The text in this field is grey, indicating that you cannot change the contents of this first training sequence field.

- `PA: Phase Adjustment` - There are two 2-bit phase adjustment fields. The text in this field is grey, indicating that you cannot change the contents of either phase adjustment field.

- `FCOR: FF0000000000000000FF` - Indicates that 80-bit frequency correction field contains hexadecimal FF0000000000000000FF. Press the **FCOR** softkey in the Configure Dn Sync Cont menu to change the value of the frequency correction bits field.

- `SYNC: 000000000000000000000000000000` - Indicates that 120-bit synchronization block bits field contains hexadecimal 000000000000000000000000000000. Press the **SSB** softkey in the Configure Dn Sync Cont menu to change the value of the synchronization block bits field.

- `STS: 30673A7067` - Indicates that 38-bit synchronization training sequence field contains hexadecimal 30673A7067. Press the **STS** softkey in the Configure Dn Sync Cont menu to change the value of the synchronization training sequence field.

- `B: 00000000` - Indicates that the 30-bit broadcast bits field contains hexadecimal 00000000. Press the **B** softkey in the Configure Dn Sync Cont menu to change the value of the broadcast bits field.

- `Data: PN9` - Indicates that the data selection for the 216-bit data field is PN9. Other selections allowed include PN15, fixed 4-bit patterns, fixed patterns of ones and zeroes, user files, or external data.

- `TS3: 2DC (always)` - Indicates that this 10-bit training sequence field always contains hexadecimal 2DC. The text in this field is grey, indicating that you cannot change the contents of this third training sequence field.

Softkey Location: Press **Mode, TDMA, TETRA, Data Format Pattern Framed, Configure Timeslots, Timeslot Type, More (2 of 2), Dn Sync Cont, Configure Dn Sync Cont**

Configure Dn Sync Disc

Pressing this softkey accesses a menu of softkeys for configuring a timeslot as a downlink discontinuous synchronization timeslot. The following figure shows an example of display graphics for a downlink discontinuous synchronization timeslot. The visual representation of the timeslot shows each field of the timeslot as it is defined by the TETRA standard.

In this example:

- `R: --` - Ramp time is a 10-bit field. The text in this field is grey, indicating that you cannot change the contents of the ramp time field.

- `TS1: 1 (always)` - Indicates that the 2-bit training sequence field always contains hexadecimal 1. The text in this field is grey, indicating that you cannot change the contents of this first training sequence field.

- `PA: Phase Adjustment` - There are two 2-bit phase adjustment fields. The text in this field is grey, indicating that you cannot change the contents of either phase adjustment field.

- `FCOR: FF0000000000000000FF` - Indicates that the 80-bit frequency correction field contains hexadecimal FF0000000000000000FF. Press the **FCOR** softkey in the Configure Dn Sync Disc menu to change the value of the frequency correction bits field.

- `SSB: 000000000000000000000000000000` - Indicates that the 120-bit synchronization block bits field contains hexadecimal 000000000000000000000000000000. Press the **SSB** softkey in the Configure Dn Sync Disc menu to change the value of the synchronization block bits field.

- `STS: 30673A7067` - Indicates that the 38-bit synchronization training sequence field contains hexadecimal 30673A7067. Press the **STS** softkey in the Configure Dn Sync Disc menu to change the value of the synchronization training sequence field.

- `B: 00000000` - Indicates that the 30-bit broadcast bits field contains hexadecimal 00000000. Press the **B** softkey in the Configure Dn Sync Disc menu to change the value of the broadcast bits field.

- `Data: PN9` - Indicates that the data selection for the 216-bit data field is PN9. Other selections allowed include PN15, fixed 4-bit patterns, fixed patterns of ones and zeroes, user files, or external data.

- `TS3: 2 (always)` - Indicates that this 2-bit training sequence field always contains hexadecimal 2. The text in this field is grey, indicating that you cannot change the contents of this third training sequence field.

- `G: --` - Guard time is an 8-bit field. The text in this field is grey, indicating that you cannot change the contents of the guard time field.

Softkey Location: Press **Mode, TDMA, TETRA, Data Format Pattern Framed, Configure Timeslots, Timeslot Type, More (2 of 2), Dn Sync Disc, Configure Dn Sync Disc**

Configure Frame

Pressing this softkey accesses a menu of choices for controlling the entire selected frame. These frame-wide functions include scramble operating state, scramble seed data, secondary frame operating state, recalling and saving secondary frame states, and secondary frame state triggering options.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Frame**

Configure Hardware

Pressing this softkey accesses a menu that allows you to select a particular latch or hardware configuration to meet your specific needs.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Configure Hardware**

Configure Timeslots

Pressing this softkey accesses a menu of choices for configuring the various frame functions. This menu allows you to select the individual timeslot states and types. Choose from uplink normal, control, and custom channels, or downlink continuous or discontinuous normal, custom or synchronization channels. Next, use the subsequent menus to configure the timeslot fields. Scramble capability is also available in this menu and the PN9 data pattern can be set to normal or quick for downlink timeslots. This softkey is inactive until you set **Data Format Pattern Framed** to **Framed.**

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**

Configure Up Control 1

Pressing this softkey accesses a menu of softkeys for configuring a timeslot as an uplink subslot 1 control timeslot. Up control 1 is half of a timeslot in length. Either subslot 1 or subslot 2 can be filled, but not both. The following figure shows an example of display graphics for an uplink subslot 1 control timeslot. The visual representation of the timeslot shows each field of the timeslot as it is defined by the TETRA standard.

In this example:

- `R: --` - Ramp time is a 34-bit field. The text in this field is grey, indicating that you cannot change the contents of the ramp time field.

- `T: B (always)` - Indicates that both of the 4-bit tail fields always contain hexadecimal B. The text in this field is grey, indicating that you cannot change the contents of the tail bits fields.

- `Data: PN9` - Indicates that the data selection for both 84-bit data fields is PN9. Other selections allowed include PN15, fixed 4-bit patterns, fixed patterns of ones and zeroes, user files, or external data.

- `TS: 2743A743` - Indicates that the 30-bit training sequence field contains hexadecimal 2743A743. Press the **TS** softkey in the Configure Up Control 1 menu to change the value of the training sequence field.

- `G: --` - There are two guard time fields. The first is a 15-bit field for subslot 1. The second is a 255-bit field that fills subslot 2. The text in this field is grey, indicating that you cannot change the contents of the guard time fields.

Softkey Location: Press **Mode, TDMA, TETRA, Data Format Pattern Framed, Configure Timeslots, Timeslot Type, Up Control 1, Configure Up Control 1**

Configure Up Control 2

Pressing this softkey accesses a menu of softkeys for configuring a timeslot as an uplink subslot 2 control timeslot. Up control 2 is half of a timeslot in length. Either subslot 1 or subslot 2 can be filled, but not both. The following figure shows an example of display graphics for an uplink subslot 2 control timeslot. The visual representation of the timeslot shows each field of the timeslot as it is defined by the TETRA standard.

In this example:

- `R: --` - Ramp time is a 34-bit field. The text in this field is grey, indicating that you cannot change the contents of the ramp time field.

- `T: B (always)` - Indicates that both of the 4-bit tail fields always contain hexadecimal B. The text in this field is grey, indicating that you cannot change the contents of the tail bit fields.

- `Data: PN9` - Indicates that the data selection for both 84-bit data fields is PN9. Other selections allowed include PN15, fixed 4-bit patterns, fixed patterns of ones and zeroes, user files, or external data.

- `TS: 2743A743` - Indicates that the 30-bit training sequence field contains hexadecimal 2743A743. Press the **TS** softkey in the Configure Up Control 2 menu to change the value of the training sequence field.

- `G: --` - There are two guard time fields. The first is a 255-bit field that fills subslot 1. The second is a 15-bit field for subslot 2. The text in this field is grey, indicating that you cannot change the contents of either guard time field.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **Up Control 2**, **Configure Up Control 2**

Configure Up Custom

Pressing this softkey accesses a menu of softkeys for selecting the data pattern for an uplink custom timeslot. The following figure shows an example of display graphics for an uplink custom timeslot. The visual representation of the timeslot shows each field of the timeslot.

In this example:

- `R: --` - Ramp time is a 34-bit field. The text in this field is grey, indicating that you cannot change the contents of the ramp time field.

- `Data: PN9` - Indicates that the data selection for this custom timeslot is PN9. Other selections allowed include PN15, fixed 4-bit patterns, fixed patterns of ones and zeroes, user files, or external data.

- `G: --` - Guard time is a 14-bit field. The text in this field is grey, indicating that you cannot change the contents of the guard time field.

Softkey Location: Press **Mode, TDMA, TETRA, Data Format Pattern Framed, Configure Timeslots, Timeslot Type, Up Custom, Configure Up Custom**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom PN9|PN15|
FIX4|"<file name>"|EXT|P4|P8|P16|P32|P64

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom?
```

Configure Up Normal

Pressing this softkey accesses a menu of softkeys for configuring a timeslot as an uplink normal timeslot. The following figure shows an example of display graphics for an uplink normal timeslot. The visual representation of the timeslot shows each field of the timeslot as it is defined by the TETRA standard.

In this example:

- `R: --` - Ramp time is a 34-bit field. The text in this field is grey, indicating that you cannot change the contents of the ramp time field.

- `T: B (always)` - Indicates that both of the 4-bit tail fields always contain hexadecimal B. The text in this field is grey, indicating that you cannot change the contents of the tail bits fields.

- `Data: PN9` - Indicates that the data selection for both 216-bit data fields is PN9. Other selections allowed include PN15, fixed 4-bit patterns, fixed patterns of ones and zeroes, user files, or external data.

- `TS: 343A74` - Indicates that the training sequence field contains hexadecimal 343A74. Press the **TS** softkey in the Configure Up Normal menu to change the value of the training sequence field.

- `G: --` - Guard time is a 14-bit field. The text in this field is grey, indicating that you cannot change the contents of the guard time field.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **Up Normal**, **Configure Up Normal**

D8PSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select D8PSK (Differential 8-state Phase Shift Keying) for modulating a continuous stream of the selected data pattern. D8PSK modulation transmits data at the rate of 3 bits per symbol. Notice that the modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select** and **PSK** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **D8PSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] D8PSK
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a D8PSK (Differential 8-state Phase Shift Keying) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **D8PSK**

Data

Pressing this softkey accesses a menu of choices for internal data generation (PN9, PN15, fixed 4-bit repeating sequences, set patterns of ones and zeroes) or you can choose to supply your own data (download a binary file or input data using the DATA INPUT connector). This softkey is available in the TETRA menu to select a data pattern for modulated transmissions that are not framed. With **TETRA Off On** set to **On** and **Data Format Pattern Framed** set to **Pattern**, the signal generator then outputs either a single occurrence (**Pattern Repeat Single**) or a continuous stream (**Pattern Repeat Cont**) of your choice of data. This softkey is also available for timeslot configuration. Choose from the same menu of selections for configuring the timeslot data fields.

NOTE   Pattern Repeat and Pattern Trigger functions are *not* available if you use either a PN data sequence, or an external data source.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**

Data is also located in all of the other Configure Timeslots menus except the uplink and downlink configure custom menus.

Status after Normal Preset: PN23

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA]?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA]?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA]?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA]?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA]?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA]?
```

Data Format Pattern Framed

Press this softkey to toggle between **Data Format Pattern** and **Data Format Framed** modes. When you select **Framed**, you will be transmitting your framed data pattern in a TETRA format.

When you select **Data Format Pattern**, you will be transmitting a continuous stream of your selected data pattern. Select the data pattern using the **Data** softkey. The **Data** softkey is activated when you select **Data Format Pattern** and inactivated when you select **Data Format Framed.**

The **Data Format Pattern Framed** softkey is coupled to the **Burst Envelope Off On** softkey in the I/Q menu. At any time that TETRA is enabled (**TETRA Off On** is set to **On**) and **Data Format Framed** is selected, the ENVLP annunciator is turned on in the display (indicating that **Burst Envelope On** is also selected). The following figure shows the display graphics that appear when the TETRA menu is accessed, **Data Format Pattern Framed** is set to **Framed**, and you are not configuring a timeslot:
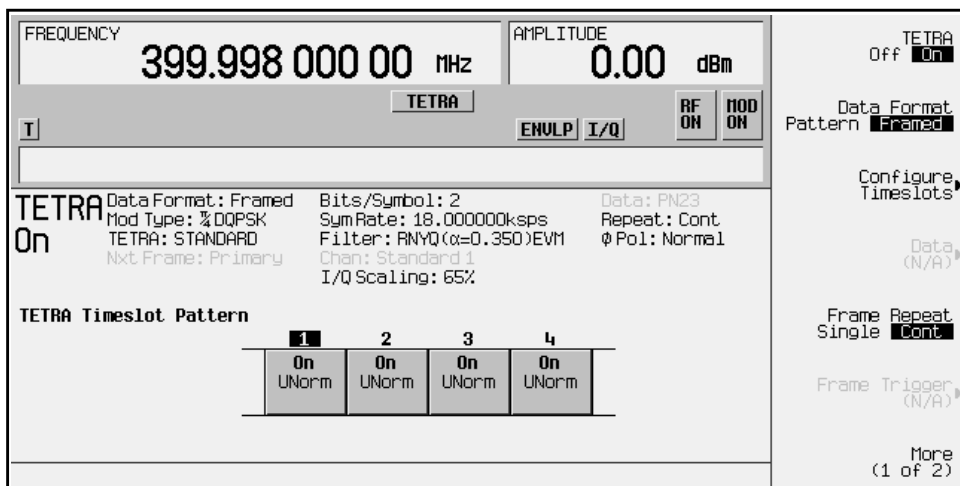
In this example:

- `TETRA On` - Indicates that TETRA is enabled. This field changes to `TETRA Off` when **TETRA Off On** is set to **Off**.

- `Data Format: Framed` - Indicates that the data pattern is a framed transmission. This field changes to `Data Format: Pattern` when **Data Format Pattern Framed** is set to **Pattern** indicating that you are transmitting a continuous stream of your selected data pattern.

- `Mod Type: π/4DQPSK` - Indicates that π/4DQPSK modulation is being internally generated.

- `TETRA: STANDARD` - Indicates that the structure of the TETRA transmission follows the standard as defined by the TETRA protocol. This field changes to `TETRA: MODIFIED` when any of the TETRA format characteristics are changed.

- `Nxt Frame: Primary` - Indicates that the next frame triggered will be the primary frame. When secondary frame is turned on and the primary frame has been triggered, this field changes to `Nxt Frame: Secondary`. In this example, this field is grey, indicating that the secondary frame state is turned off.

- `Bit/Symbol: 2` - Indicates that 2 bits per symbol are required according to the TETRA standard.

- `SymRate: 18.000ksps` - The symbol rate is set according to the TETRA standard. This can be changed in the Symbol Rate menu. A * next to the value indicates that it differs from the standard.

- `Filter: RNYQ (α=0.35)EVM` - Indicates that root Nyquist filter (root raised cosine) is selected, with an alpha of 0.35, and the filter is set for optimizing error vector magnitude. A * next to the alpha value indicates that it differs from the standard. If you select optimization for adjacent channel power, `EVM` toggles to `ACP`. This field changes to `Filter: NYQ(α=0.35)` if you select the Nyquist filter (raised cosine).

- `Chan: Standard 1` - Indicates that channel 1 of the standard frequency channel band is selected. This field changes to reflect whichever channel is selected. In this example, the text is grey, indicating an inactive function.

- `I/Q Scaling: 65%` - Indicates that the I/Q scaling is set to 65%.

- `Data: PN23` - Indicates that a PN23 sequence has been selected for transmitting without framing. In this example, the text in this field is grey, indicating an inactive function (framed mode is on). Other selections allowed include other PN sequences, fixed 4-bit patterns, fixed patterns of ones and zeroes, TETRA-specific patterns, user files, or external data.

- `Repeat: Cont` - Indicates that the data pattern repeat is set to continuous mode. If you select single mode, this field changes to `Repeat: Single`.

- `Phase Pol: Normal` - Indicates the direction of rotation of the phase modulation vector. If you select inverted mode, this field changes to `Phase Pol: Invert`.

- The visual representation of the TETRA timeslot pattern shows, in this case, that timeslot 1 is on and configured as an uplink normal timeslot. Timeslots 2, 3, and 4 are off and configured as uplink normal timeslots. The timeslot pattern is displayed only when **Data Format Pattern Framed** is set to **Framed.**

To configure the timeslots, press the **Configure Timeslot** softkey. The **Configure Timeslot** softkey is activated when you select **Data Format Framed** and is inactivated when you select **Data Format Pattern.**

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**

Status after Normal Preset: Pattern

SCPI Commands:

```
[:SOURce]:RADio:TETRa:BURSt[:STATe] ON|OFF|1|0
[:SOURce]:RADio:TETRa:BURSt[:STATe]?
```

Define User FIR

Press this softkey to access a table editor for creating and modifying FIR filters. The FIR table editor allows a maximum filter length of 1024 taps (32 symbols with a maximum oversampling ratio of 32). The instrument hardware, however, is actually limited to 32 symbols, an oversample ratio between 4 and 16, and 256 coefficients. So if you enter more than 32 symbols or 256 coefficients, the instrument will be unable to use the filter. If the oversample ratio is different from the internal, optimally selected one, the filter will be resampled to the most optimal oversample ratio. Examples of using the FIR table editor are provided in the "Using Functions" chapter.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**

SCPI Commands:

```
:MEMory:DATA:FIR "<file name>",osr,coefficient
{,coefficient}
```

```
:MEMory:DATA:FIR? <"filename">
```

Define User FSK

Pressing this softkey displays the FSK table editor, where you can define custom asymmetric (or symmetric) FSK modulation patterns. The FSK table editor enables you to define a frequency deviation and load a default symmetric FSK pattern (2-Lvl, 4-Lvl, 8-Lvl, 16-Lvl, or C4FM) or create a modulation pattern based on user-defined frequency values.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User FSK**

SCPI Commands:

```
:MEMory:DATA:FSK "<file name>",num_states,f0,f1,...
[,diff_state,num_diff_states,diff0,diff1,...]
```

Define User I/Q

Pressing this softkey displays the I/Q table editor, where you can directly define symbol positions. The I/Q table editor enables you to create custom constellation diagrams that you can save to an I/Q file catalog (see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6).

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**

SCPI Commands:

```
:MEMory:DATA:IQ "<file name>",offsetQ,num_states,i0,q0,
i1,q1,...[,diff_state,num_diff_states,diff0,diff1,...]
```

Delete All Rows

Press this softkey to erase the current table values. Be careful with this softkey, because there is no "undo" key.

Delete All Rows is located in the table editor menus.

Delete File

Pressing this softkey will delete the highlighted file from the displayed catalog.

Delete File is located in the catalogs of files.

Delete Row

Press this softkey to delete the highlighted row in a table editor.

Delete Row is located in the table editor menus.

Differential Encoding Off On

Press this softkey to change the operational state of the user-defined Differential Encoding.

For a detailed explanation of differential encoding, see "Understanding Differential Encoding" on page 4-21.

For information on using the Differential State Map editor, see "Mapping Custom Differential Encoding" on page 2-29.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Differential Encoding Off On**

Or press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User FSK**, **More (1 of 2)**, **Differential Encoding Off On**

SCPI Commands:

```
:MEMory:DATA:IQ "<file name>",offsetQ,num_states,i0,q0,
i1,q1,...[,diff_state,num_diff_states,diff0,diff1,...]

:MEMory:DATA:FSK "<file name>",num_states,f0,f1,...
[,diff_state,num_diff_states,diff0,diff1,...]
```

Display FFT

Press this softkey to display a graphical representation of the filter frequency response (calculated using a fast Fourier transform). The following is an example of the frequency response of a root Nyquist filter with an oversample ratio of 4.
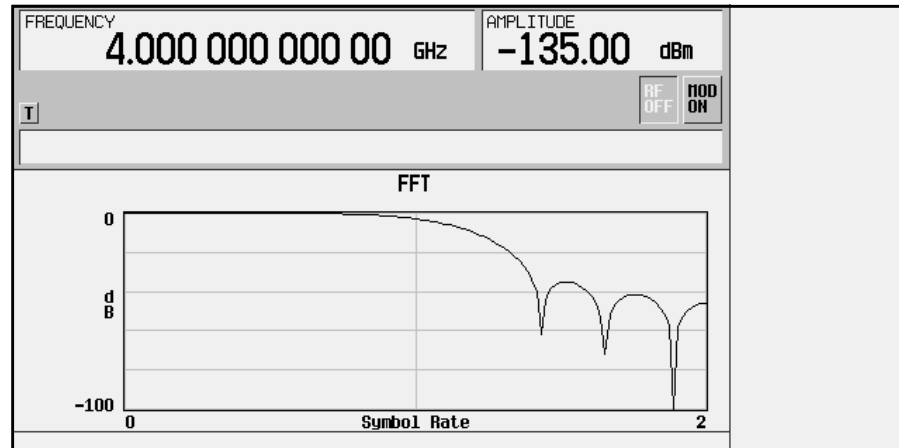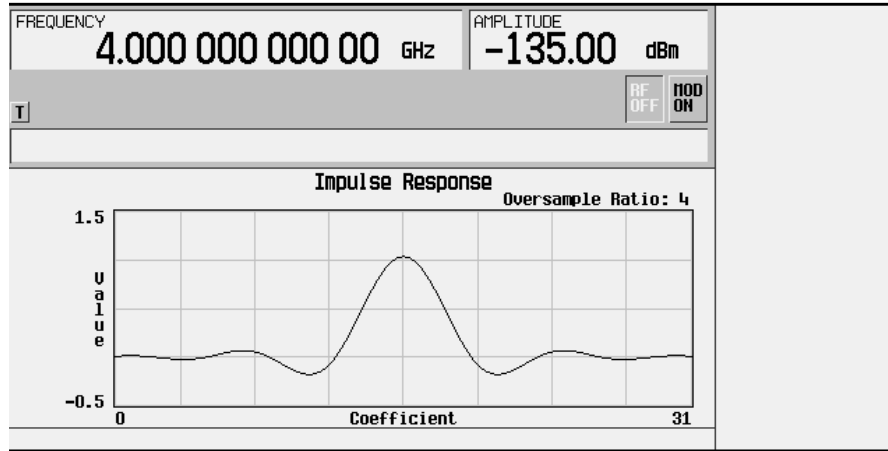

To return to the FIR table editor and the menu keys, press **Return**.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **More (1 of 2)**, **Load Default FIR**, **Root Nyquist**, (or any other filter selection), **Generate**, **Display FFT**

Display Impulse Response

Press this softkey to display a graphical representation of the filter impulse response in time. The following is an example of the impulse response of a root Nyquist filter with an oversample ratio of 4.

To return to the FIR table editor and the menu keys, press **Return**.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **More (1 of 2)**, **Load Default FIR**, **Root Nyquist**, (or any other filter selection), **Generate**, **Display Impulse Response**

Display I/Q Map

Pressing this softkey displays an I/Q constellation map diagram of the current set of I/Q points. You can use this display as you create or modify a constellation map in the I/Q table editor (as described in "Clearing Data" on page 2-7).

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **Display I/Q Map**

Dn Custom Cont

Press this softkey to select a downlink continuous custom timeslot type for the active timeslot. A downlink continuous custom timeslot is configured using an internally-generated data pattern, a downloaded sequence of bits stored in a user file, or by supplying external data. This custom timeslot is provided for users' flexibility but it is not a standard TETRA timeslot.

Downlink timeslots cannot be mixed with uplink timeslots. If you already have any timeslots designated as uplink, they will be changed to downlink when any other timeslot is designated as downlink. The following table shows the timeslot type interchanges that will occur if the frame was designated as uplink and then either continuous downlink or discontinuous downlink is selected.

From Uplink Timeslot	To Continuous Downlink Timeslot	To Discontinuous Downlink Timeslot
Up Custom	Dn Custom Cont	Dn Custom Disc
Up Control 1	Dn Custom Cont	Dn Custom Disc
Up Control 2	Dn Custom Cont	Dn Custom Disc
Up Normal	Dn Normal Cont	Dn Normal Disc

When you have selected **Dn Custom Cont** for a timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your configuration.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Custom Cont**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DCCustom
```

Dn Custom Disc

Press this softkey to select a downlink discontinuous custom timeslot type for the active timeslot. A downlink discontinuous custom timeslot is configured using an internally-generated data pattern, a downloaded sequence of bits stored in a user file, or by supplying external data. This custom timeslot is provided for users' flexibility but it is not a standard TETRA timeslot.

Downlink timeslots cannot be mixed with uplink timeslots. If you already have any timeslots designated as uplink, they will be changed to downlink when any other timeslot is designated as downlink. The following table shows the timeslot type interchanges that will occur if the frame was designated as uplink and then either continuous downlink or discontinuous downlink is selected.

From Uplink Timeslot	To Continuous Downlink Timeslot	To Discontinuous Downlink Timeslot
Up Custom	Dn Custom Cont	Dn Custom Disc
Up Control 1	Dn Custom Cont	Dn Custom Disc
Up Control 2	Dn Custom Cont	Dn Custom Disc
Up Normal	Dn Normal Cont	Dn Normal Disc

When you have selected **Dn Custom Disc** for a timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your configuration.

Softkey Location: Press **Mode, TDMA, TETRA, Data Format Pattern Framed, Configure Timeslots, Timeslot Type, More (2 of 2), Dn Custom Disc**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DDCustom
```

Dn Normal Cont

Press this softkey to select downlink continuous normal as the timeslot type for the active timeslot.

Downlink timeslots cannot be mixed with uplink timeslots. If you already have any timeslots designated as uplink, they will be changed to downlink when any other timeslot is designated as downlink. The following table shows the timeslot type interchanges that will occur if the frame was designated as uplink and then either continuous downlink or discontinuous downlink is selected.

From Uplink Timeslot	To Continuous Downlink Timeslot	To Discontinuous Downlink Timeslot
Up Custom	Dn Custom Cont	Dn Custom Disc
Up Control 1	Dn Custom Cont	Dn Custom Disc
Up Control 2	Dn Custom Cont	Dn Custom Disc
Up Normal	Dn Normal Cont	Dn Normal Disc

When you select **Dn Normal Cont** for a timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your selection.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Normal Cont**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DCNormal
```

Dn Normal Disc

Press this softkey to select downlink discontinuous normal as the timeslot type for the active timeslot.

Downlink timeslots cannot be mixed with uplink timeslots. If you already have any timeslots designated as uplink, they will be changed to downlink when any other timeslot is designated as downlink. The following table shows the timeslot type interchanges that will occur if the frame was designated as uplink and then either continuous downlink or discontinuous downlink is selected.

From Uplink Timeslot	To Continuous Downlink Timeslot	To Discontinuous Downlink Timeslot
Up Custom	Dn Custom Cont	Dn Custom Disc
Up Control 1	Dn Custom Cont	Dn Custom Disc
Up Control 2	Dn Custom Cont	Dn Custom Disc
Up Normal	Dn Normal Cont	Dn Normal Disc

When you select **Dn Normal Disc** for a timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your selection.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Normal Cont**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DDNormal
```

Dn Sync Cont

Press this softkey to select downlink continuous synchronization as the timeslot type for the active timeslot.

Downlink timeslots cannot be mixed with uplink timeslots. If you already have any timeslots designated as uplink, they will be changed to downlink when any other timeslot is designated as downlink. The following table shows the timeslot type interchanges that will occur if the frame was designated as uplink and then either continuous downlink or discontinuous downlink is selected.

From Uplink Timeslot	To Continuous Downlink Timeslot	To Discontinuous Downlink Timeslot
Up Custom	Dn Custom Cont	Dn Custom Disc
Up Control 1	Dn Custom Cont	Dn Custom Disc
Up Control 2	Dn Custom Cont	Dn Custom Disc
Up Normal	Dn Normal Cont	Dn Normal Disc

When you select **Dn Sync Cont** for a timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your selection.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Sync Cont**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DCSync
```

Dn Sync Disc

Press this softkey to select downlink discontinuous synchronization as the timeslot type for the active timeslot.

Downlink timeslots cannot be mixed with uplink timeslots. If you already have any timeslots designated as uplink, they will be changed to downlink when any other timeslot is designated as downlink. The following table shows the timeslot type interchanges that will occur if the frame was designated as uplink and then either continuous downlink or discontinuous downlink is selected.

From Uplink Timeslot	To Continuous Downlink Timeslot	To Discontinuous Downlink Timeslot
Up Custom	Dn Custom Cont	Dn Custom Disc
Up Control 1	Dn Custom Cont	Dn Custom Disc
Up Control 2	Dn Custom Cont	Dn Custom Disc
Up Normal	Dn Normal Cont	Dn Normal Disc

When you select **Dn Sync Disc** for a timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your selection.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Sync Cont**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DDSync
```

Edit Item

Press this softkey to select the highlighted value for editing in the current table editor. After you select the item this way, you can use the front panel RPG and arrow keys to edit the value.

Edit Item is located in the table editor menus.

Ext

Press this softkey in the data selection menus to select external data. With **Ext** selected, you should apply the data signal to the DATA INPUT connector. If you have selected **Ext** as a data pattern for modulated transmissions that are not framed (**Data Format Pattern Framed** is set to **Pattern**), Ext is displayed in the Data field in the top line of the text area of the display. If you have selected **Ext** for configuring the timeslot data fields, **EXT** is displayed in the Data field located near the bottom of the text area of the display. In framed mode, the external data is gated to the data regions of the timeslot.

Another **Ext** softkey is located in the Frame Trigger and Pattern Trigger menus. Press **Ext** in either of these two menus to select external triggering for your data pattern. Apply a TTL input to the rear panel PATTERN TRIG IN connector to trigger your frame or pattern data.

In secondary frame mode, selecting external trigger toggles which frame will be transmitted once the current frame has been completely transmitted.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **Ext**

Or press **Mode**, **TDMA**, **TETRA**, **Pattern Repeat Single Cont**, **Pattern Trigger**, **Ext**

NOTE

Pattern Repeat and Pattern Trigger functions are *not* available if you use either a PN data sequence, or an external data source.

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **Ext**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Frame Repeat Single Cont**, **Frame Trigger**, **Ext**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Frame**, **Secondary Frame Trigger**, **Ext**

Ext is also located in the Uplink and Downlink Configure Custom menu and in the Data menus found in every other TETRA Configure Timeslots menu.

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA EXT
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom EXT
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom EXT
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]
EXT
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] EXT
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA]
EXT
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA]
EXT
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] EXT
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] EXT
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] EXT
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA]
EXT
```

```
[:SOURce]:RADio:TETRa:TRIGger[:SOURce] EXT
[:SOURce]:RADio:TETRa:SECondary:TRIGger[:SOURce] EXT
```

Ext Data Clock Normal Symbol

Press this softkey to toggle the external data clock use between **Normal** and **Symbol**. When you select **Normal**, you must supply a signal (either a clock or a pulse) to the DATA CLOCK INPUT connector to clock the DATA and SYMBOL SYNC signals. (An unlock will occur if external data is selected and these signals are not supplied.) When you select **Symbol**, no signal is required at the DATA CLOCK INPUT connector. Instead, the data is clocked on both the rising and falling edges of the SYMBOL SYNC signal.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Configure Hardware**, **Ext Data Clock Normal Symbol**

Status after Normal preset: Normal

SCPI Commands:

```
[:SOURce]:RADio:TETRa:EDCLock SYMBol|NORMal
[:SOURce]:RADio:TETRa:EDCLock?
```

Ext Delay Bits

Press this softkey to specify the number of bits for the external trigger delay. When **Ext Delay Off On** is set to **On**, a value greater than 0 will delay the transmission of the triggered data after the external trigger event by the number of bits specified. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Enter** terminator softkey. The range of values allowed is 0 through 65,535 bits. This softkey is inactive until the trigger selection is set to **Ext.**

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Frame Repeat Single Cont**, **Frame Trigger**, **Ext**, **Ext Delay Bits**

Or press **Mode**, **TDMA**, **TETRA**, **Pattern Repeat Single Cont**, **Pattern Trigger**, **Ext**, **Ext Delay Bits**

NOTE   Pattern Repeat and Pattern Trigger functions are *not* available if you use either a PN data sequence, or an external data source.

Status after Normal Preset: 0

SCPI Commands:

```
[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal
:DELay <value>

[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay?
```

Ext Delay Off On

Press this softkey to toggle the external trigger delay on and off. When this function is turned on, the transmission of the triggered data will be delayed after the external trigger event by the number of bits specified by the **Ext Delay Bits** softkey. This function is only available when the trigger selection is set to **Ext**.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Frame Repeat Single Cont**, **Frame Trigger**, **Ext**, **Ext Delay Off On**

Or press **Mode**, **TDMA**, **TETRA**, **Pattern Repeat Single Cont**, **Pattern Trigger**, **Ext**, **Ext Delay Off On**

NOTE   Pattern Repeat and Pattern Trigger functions are *not* available if you use either a PN data sequence, or an external data source.

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay
:STATe ON|OFF|1|0

[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay
:STATe?
```

Fall Delay

Press this softkey to edit the burst shape fall delay. The default value is 0.000 bits. To change it, press this softkey and enter a new value (minimum and maximum values depend upon modulation type and symbol rate). Use the front panel knob, up and down arrow keys, or enter a value using the numeric keypad; then press the **bits** terminator softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Burst Shape**, **Fall Delay**

Status after Normal Preset: 0.000 bits

SCPI Commands:

```
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:DELay <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:DELay?
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FDELay <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FDELay?
```

Fall Time

Press this softkey to edit the burst shape fall time. The default value is 7.814 bits. To change it, press this softkey and enter a new value (minimum and maximum values depend upon modulation type and symbol rate). Use the front panel knob, up and down arrow keys, or enter a value using the numeric keypad; then press the **bits** terminator softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Burst Shape**, **Fall Time**

Status after Normal Preset: 7.814 bits

SCPI Commands:

```
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:TIME <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:TIME?
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FTIMe <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FTIMe?
```

FCOR

Press this softkey to change the 80-bit frequency correction bits (FCOR) value. The preset hexadecimal value (when normal preset is selected) for the frequency correction bits reflects the TETRA standard, however you can enter a new value by pressing this softkey. To enter a value (in hexadecimal), press **FCOR**. The frequency correction bits value becomes the active function. Enter a new value using the front panel knob, up and down arrow keys, or use the numeric keypad and the **A**, **B**, **C**, **D**, **E**, and **F** softkeys and press the **Enter** terminator softkey. The current value for frequency correction bits is displayed in the FCOR field near the bottom of the text area of the display.

Status after Normal Preset: FF0000000000000000FF

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Sync Cont**, **Configure Dn Sync Cont**, **FCOR**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Sync Disc**, **Configure Dn Sync Disc**, **FCOR**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync
:FCOR <80 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:FCOR?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync
:FCOR <80 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:FCOR?
```

Filter

Press this softkey to access menus for selecting a filter type, restoring the default filter, and for defining a unique FIR filter. The Filter menu also lets you adjust the filter alpha (when Nyquist or root Nyquist filters are selected) or bandwidth time product (for Gaussian filters). In addition, you can also optimize the filter for the best EVM or ACP.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**

Filter Alpha

Press this softkey to change the FIR filter's alpha parameter in either the Filter menu or the Load Default FIR menus.

In the Filter menu, the **Filter Alpha** softkey changes the alpha parameter of the selected root Nyquist or Nyquist filter. To enter a new value, rotate the front-panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Enter** terminator softkey. The range of values allowed is 0.000 through 1.000.

This key only appears *after* choosing a root Nyquist or Nyquist filter. If a Gaussian filter is in use, you will see **Filter BbT**. If any other filter is in use, this key is replaced with a grayed-out key labeled **Filter Factor N/A**.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Filter Alpha**

Status after Normal Preset: 0.350

SCPI Commands:

```
[:SOURce]:RADio:TETRa:ALPHa <value>
[:SOURce]:RADio:TETRa:ALPHa?
```

In the Load Default FIR menus, the **Filter Alpha** softkey changes the alpha parameter of the root Nyquist or Nyquist filter coefficients loaded into the FIR table editor. After entering the alpha value, press **Generate** to modify the filter coefficients in the table editor.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **More (1 of 2)**, **Load Default FIR**, **Root Nyquist** (or **Nyquist**), **Filter Alpha**

Status after Normal Preset: 0.350

Filter BbT

Press this softkey to change the bandwidth-multiplied-by-bit-time (BbT) filter parameter in either the Filter menu or the Load Default FIR menu.

In the Filter menu, the **Filter BbT** softkey changes the BbT parameter of the selected Gaussian filter. To enter a new value, rotate the front-panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Enter** terminator softkey. The range of values allowed is 0.100 through 1.000.

This key only appears *after* choosing a Gaussian filter. If a root Nyquist or Nyquist filter is in use, you will see **Filter Alpha**. If any other filter is in use, this key is replaced with a grayed-out key labeled **Filter Factor N/A**.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Select**, **Gaussian**, **Filter BbT**

Status after Normal Preset: 0.500

SCPI Commands:

```
[:SOURce]:RADio:TETRa:BBT <value>
[:SOURce]:RADio:TETRa:BBT?
```

In the Load Default FIR menu, the **Filter BbT** softkey changes the BbT parameter of the Gaussian filter coefficients loaded into the FIR table editor. After entering the BbT value, press **Generate** to modify the filter coefficients in the table editor.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **More (1 of 2)**, **Load Default FIR**, **Gaussian**, **Filter BbT**

Status after Normal Preset: 0.500

Filter Factor N/A

This grayed-out softkey is displayed when a filter is in use that doesn't contain an adjustable alpha or BbT parameter (such as the rectangle filter or a user-defined FIR filter). This softkey changes to either **Filter Alpha** or **Filter BbT** if the appropriate root Nyquist, Nyquist, or Gaussian filter is selected for use.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Select**, **More (1 of 2)**, **Rectangle** (or select a User FIR file), **Filter Factor N/A**

Filter Symbols

Press this softkey to define the number of symbols for the filter to be loaded into the FIR table editor. The FIR table editor allows a maximum filter length of 1024 coefficients with a maximum oversample ratio of 32 and a maximum of 32 symbols. If you create an FIR filter with greater than 16 symbols, however, the maximum symbol rate will be decreased by half. To change the number of symbols, rotate the front-panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Enter** terminator softkey. The range of values allowed is 1 through 32.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **More (1 of 2)**, **Load Default FIR**, **Root Nyquist** (or **Nyquist**, **Gaussian**, or **Rectangle**), **Filter Symbols**

Status after Normal Preset: 8

FIX4

Press this softkey to select a 4-bit repeating sequence data pattern. Press **FIX4** and the 4-bit pattern becomes the active function. Enter your desired 4-bit pattern using the front panel knob, up and down arrow keys, or enter the value using the numeric keypad and press the **Enter** terminator softkey. If you have selected **FIX4** as a data pattern for modulated transmissions that are not framed (**Data Format Pattern Framed** is set to **Pattern**), FIX4 is displayed in the Data field in the top line of the text area of the display. If you have selected **FIX4** for configuring the timeslot data fields, your 4-bit pattern is displayed in the Data field located near the bottom of the text area of the display.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **FIX4**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **FIX4**

FIX4 is also located in the uplink and downlink configure custom menu and in the Data menus found in every other TETRA Configure Timeslots menu.

Status after Normal Preset: 0000

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA FIX4
[:SOURce]:RADio:TETRa:DATA:FIX4 <0-15>
[:SOURce]:RADio:TETRa:DATA:FIX4?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom:FIX4 <0-15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom:FIX4?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom:FIX4 <0-15>
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom:FIX4?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]
:FIX4 <0-15>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]:FIX4?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA]
:FIX4 <0-15>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA]:FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA]
:FIX4 <0-15>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA]:
FIX4?

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA]
:FIX4 <0-15>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA]
:FIX4?

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA]
:FIX4 <0-15>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA]:FIX4?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA]:FIX4 <0-15>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA]:FIX4?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA]:FIX4 <0-15>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA]:FIX4?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] FIX4
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA]
:FIX4 <0-15>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA]:FIX4?
```

Frame Repeat Single Cont

Press this softkey to toggle between a single output of framed data and continuous transmission of frames. Selecting **Single** will output the following sequences:

- 4-Bit Patterns (FIX4) - A single frame is generated. The 4-bit pattern repeats until the data fields are completely filled. Each trigger transmits the same frame.

- Other Patterns (fixed patterns of equal quantities of ones and zeroes) - A single frame is generated. The selected pattern repeats until the data fields are completely filled. Each trigger transmits the same frame.

- PN9 - A single frame is generated. The data fields are filled with the leading bits of the PN9 sequence. A trigger causes the frame to be transmitted. The data fields of this frame are then filled sequentially with the next series of PN9 data bits. A trigger causes the frame to be transmitted. This process continues, transmitting the entire PN9 sequence frame by frame. The last bit of the PN9 sequence in a data field is immediately followed by the first bit of a second PN9 sequence.

- PN15 - A single frame is generated. The data fields are filled with the leading bits of the PN15 sequence. A trigger causes the frame to be transmitted. The data fields of this frame are then filled sequentially with the next series of PN15 data bits. A trigger causes the frame to be transmitted. This process continues, transmitting the entire PN15 sequence frame by frame. The last bit of the PN15 sequence in a data field is immediately followed by the first bit of a second PN15 sequence.

- User File - The user's file should have the appropriate data to fill an integer number of timeslots. If not, the remaining bits are truncated. Depending on the size of the file, more than one frame can possibly be generated.

- External Data - External data is clocked into the data fields of the timeslot. A single frame is generated.

Combinations of these data patterns may cause some patterns to be truncated. Refer to the section titled "Operation," for the details of the data dependencies.

Selecting **Cont** with framed data causes the frames to be transmitted continuously.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Frame Repeat Single Cont**

Status after Normal Preset: Continuous

SCPI Commands:

```
[:SOURce]:RADio:TETRa:REPeat SINGle|CONTinuous
[:SOURce]:RADio:TETRa:REPeat?
```

Frame Trigger

Pressing this softkey accesses a menu of choices for triggering your framed pattern. You can choose to trigger using the front panel **Trigger** key, an external trigger supplied to the PATTERN TRIG IN connector, or by a *TRG command or GET (group execute trigger) signal sent over HP-IB. This softkey is inactive until **Data Format Pattern Framed** is set to **Framed** and **Frame Repeat Single Cont** is set to **Single**.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Frame Repeat Single Cont**, **Frame Trigger**

Status after Normal Preset: Trigger Key

SCPI Commands:

```
[:SOURce]:RADio:TETRa:TRIGger[:SOURce]?
```

Freq Channels

Pressing this softkey accesses a menu of choices for assigning channel numbers and channel bands based on the TETRA standard.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Freq Channels**

Freq Channels Off On

Pressing this softkey enables or disables the Frequency Channels mode. Once enabled, the instrument's RF output will be controlled by the frequency channel and frequency band settings in the Freq Channels menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Freq Channels**, **Freq Channels Off On**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:FCHannel[:STATe] ON|OFF|1|0
[:SOURce]:RADio:TETRa:FCHannel[:STATe]?
```

Freq Dev

This softkey appears in two different situations. To select symmetric FSK frequency deviation, press the softkeys listed under "Selecting an FSK Modulation" below. To load a default FSK pattern into the FSK table editor and modify the frequency deviation, press the softkeys listed under "Modifying an FSK Pattern" below.

Selecting an FSK Modulation

Press this softkey to select symmetric FSK frequency deviation. The default frequency deviation is 400 Hz. To change it, press this softkey and enter the desired value (0 Hz is the minimum value; the maximum value depends upon the symbol rate). Use the front panel knob, up and down arrow keys, or enter a value using the numeric keypad; then press the **GHz**, **MHz**, **kHz**, or **Hz** terminator softkey. Notice that the modulation selection is displayed under the **Select** softkey and the frequency deviation is displayed under the **FSK** softkey in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type, Select, FSK, Freq Dev**

Status after Normal Preset: 400.00 Hz

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation:FSK[:DEViation]
<val><unit>

[:SOURce]:RADio:TETRa:MODulation:FSK[:DEViation]?
```

Modifying an FSK Pattern

Press this softkey to define a custom frequency deviation convention in the FSK table editor. The default frequency deviation is 400 Hz. For details on using the FSK table editor, see "Building a Customized FSK Modulation Using the FSK Table Editor" on page 2-18.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type, Define User FSK, More (1 of 2), Load Default FSK, Freq Dev**

FSK

Pressing this softkey accesses a menu of FSK (Frequency Shift Keying) modulation types for modulating a continuous stream of your selected data pattern. You can choose between 2-Lvl FSK, 4-Lvl FSK, 8-Lvl FSK, 16-Lvl FSK, and C4FM; you can also change the default frequency deviation.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type, Select, FSK**

Gaussian

Press this softkey to select the Gaussian pre-modulation filter in either the Select (filter) menu or the Load Default FIR menu.

In the Select (filter) menu, pressing the **Gaussian** softkey selects this FIR filter for use in your custom modulation setup. The default filter bandwidth-multiplied-by-bit time product (BbT) is automatically set to 0.500. You can change the filter BbT to any value between 0.100 and 1.000 by pressing the **Filter BbT** softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Select**, **Gaussian**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:FILTer GAUSsian
[:SOURce]:RADio:TETRa:FILTer?
```

In the Load Default FIR menu, pressing the **Gaussian** softkey followed by **Generate** loads the FIR table editor with the coefficient values for the Gaussian filter. The filter BbT and number of filter symbols are defined with the softkeys in this menu. If you change either parameter after loading the filter coefficients, press the **Generate** softkey again to reload the FIR table.

The impulse response and the frequency response of the default Gaussian filter with a BbT of 0.500 and an oversample ratio of 4 are shown in the following graphs:
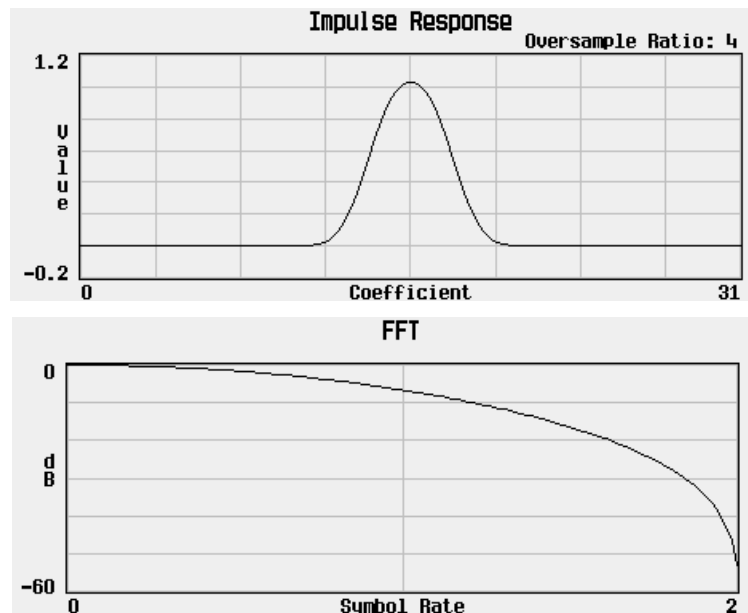
Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **More (1 of 2)**, **Load Default FIR**, **Gaussian**

Globally Replace Selected Item

Press this softkey, found in the Define User I/Q menu, to globally replace the selected value throughout the data table. For instance, if you have defined a Q Value of -1, and wish to change it to +1, highlight the -1 value and select Globally Replace Selected Item. All values of -1 (in both the I and the Q column) will be replaced with a value of +1.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **Globally Replace Selected Item**

Goto Row

Press this softkey to display softkeys that enable you to select a row or page in a table or list of items.

Goto Row is located in the table editor menus and in the catalogs of files.

Goto Bottom Row

Press this softkey to move the selection bar to the bottom row in the current table or list of items.

Goto Bottom Row is located in the table editor menus and in the catalogs of files.

Goto Middle Row

Press this softkey to move the selection bar to the middle row in the current table or list of items.

Goto Middle Row is located in the table editor menus and in the catalogs of files.

Goto Top Row

Press this softkey to move the selection bar to the top row in the current table or list of items.

Goto Top Row is located in the table editor menus and in the catalogs of files.

Gray Coded QPSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select Gray Coded QPSK (Quadrature Phase Shift Keying) for modulating a continuous stream of your selected data pattern. Gray Coded QPSK modulation transmits data at the rate of 2 bits per symbol. The constellations for this modulation type are

designed so that the symbols differ by only one bit between transitions. Notice that your modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select**, **PSK**, and **QPSK and OQPSK** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **QPSK and OQPSK**, **Gray Coded QPSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] GRAYQPSK
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a Gray Coded QPSK (Quadrature Phase Shift Keying) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **QPSK and OQPSK**, **Gray Coded QPSK**

Insert Row

Press this softkey to insert a new row directly above the highlighted row in the currently active table.

Insert Row is located in the table editor menus.

I/Q Scaling

Use this softkey to adjust the amplitude of the I/Q outputs (for better ACP). This adjustment is not available if you are using MSK or FSK modulation. The range is 1 through 10000%.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Configure Hardware**, **I/Q Scaling**

Status after Normal Preset: 65%

SCPI Commands:

```
[:SOURce]:RADio:TETRa:IQ:SCALe <value>
[:SOURce]:RADio:TETRa:IQ:SCALe?
```

IS95 OQPSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select IS95 OQPSK (Offset Quadrature Phase Shift Keying) for modulating a continuous stream of your selected data pattern. IS95 OQPSK modulation transmits data at the rate of 2 bits per symbol. Notice that your modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select**, **QPSK and OQPSK**, and **PSK** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **QPSK and OQPSK**, **IS95 OQPSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] IS95OQPSK
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load an IS95 OQPSK (Offset Quadrature Phase Shift Keying) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **QPSK and OQPSK**, **IS95 OQPSK**

IS95 QPSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select IS95 QPSK (Quadrature Phase Shift Keying) for modulating a continuous stream of your selected data pattern. IS95 QPSK modulation transmits data at the rate of 2 bits per symbol. Notice that your modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select**, **QPSK and OQPSK**, and **PSK** softkeys in the Modulation Type menus.
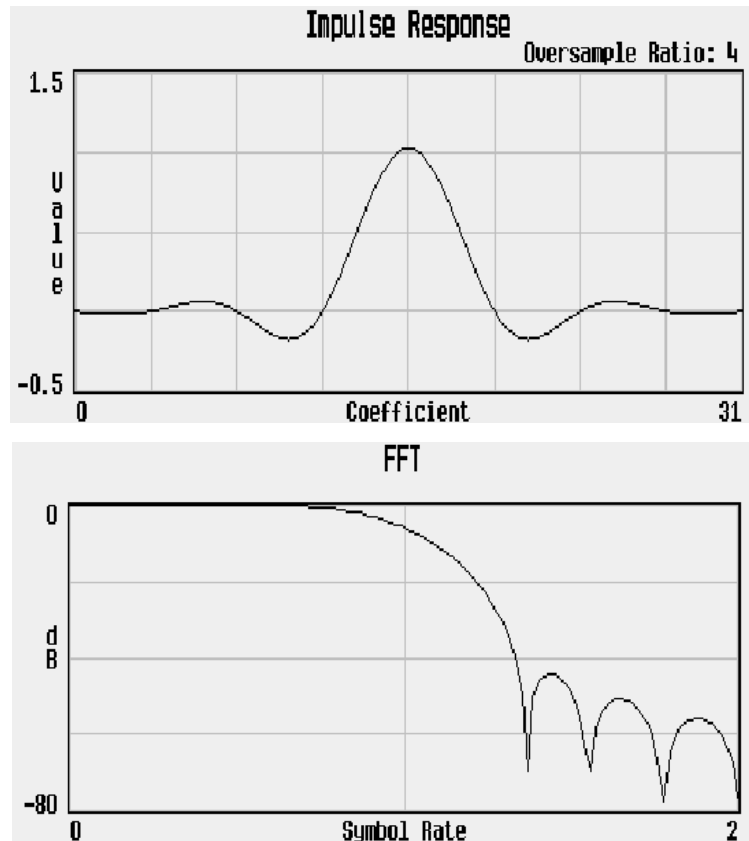
Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **QPSK and OQPSK**, **IS95 QPSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] IS95QPSK
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load an IS95 QPSK (Quadrature Phase Shift Keying) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **QPSK and OQPSK**, **IS95 QPSK**

Load Default FIR

Press this softkey to access a menu for automatically filling the FIR table editor with coefficient values from pre-defined filters such as root Nyquist, Nyquist, Gaussian and Rectangle. The default filter parameters can also be selected in this menu allowing you to choose the filter alpha or BbT and the number of filter symbols.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **More (1 of 2)**, **Load Default FIR**

Load Default FSK

Press this softkey to select a default symmetric FSK modulation. You can select from 2-Lvl, 4-Lvl, 8-Lvl, 16-Lvl FSK, or C4FM and configure the frequency deviation for the FSK modulation selected.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User FSK**, **More (1 of 2)**, **Load Default FSK**

Load Default I/Q Map

Press this softkey to select a standard I/Q mapping from a set of either PSK or QAM modulations.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**

Load From Selected File

In a table editor Load/Store menu, press this softkey to replace the current information in the table editor with the information in the highlighted file.

Load From Selected File is located in the catalogs of files.

Load/Store

Press this softkey to display a menu for loading tables from, and storing tables to, non-volatile memory. Non-volatile memory enables you to retain files for future use after an instrument power cycle.

Mirror Table

Press this softkey to mirror the FIR table entries such that the table doubles in size and the values in the top half of the table are duplicated in the bottom half of the table in reverse order.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **Mirror Table**

Modify Standard

Pressing this softkey displays a menu of choices that enables you to modify the following aspects of the standard transmission:

- filter characteristics (including user-defined FIR filters)

- symbol rate

- modulation type (including user-defined modulations)

- burst shape characteristics (rising edge time and delay; falling edge time and delay)

- phase polarity

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**

Modulation Type

Pressing this softkey accesses a menu that enables you to customize the current modulation type. You can define the modulation format, build a symbol mapping, or change the symbol table offset.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**

Status after Normal Preset: π/4 DQPSK

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] BPSK|QPSK|
IS95QPSK|GRAYQPSK|OQPSK|IS95OQPSK|P4DQPSK|PSK8|PSK16|
D8PSK|MSK|FSK2|FSK4|FSK8|FSK16|C4FM|QAM4|QAM16|QAM32|
QAM64|QAM256|UIQ|UFSK

[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

MSK

Press this softkey to select MSK (Minimum Shift Keying) modulation for modulating a continuous stream of your selected data pattern. MSK modulation transmits data at the rate of 1 bit per symbol. When you select MSK, Notice that your modulation selection is shown in the text

area of the display in the `Mod Type` field and also under the **Select** softkey in the Modulation Type menu. The phase deviation appears under the **MSK** softkey in the Modulation Type menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **MSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] MSK
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Nyquist

Press this softkey to select the Nyquist (raised cosine) pre-modulation filter in either the Select (filter) menu or the Load Default FIR menu.

In the Select (filter) menu, pressing the **Nyquist** softkey selects this FIR filter for use in your custom modulation setup. The default filter alpha is automatically set to 0.350. You can change the filter alpha to any value between 0 and 1 by pressing the **Filter Alpha** softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Select**, **Nyquist**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:FILTer NYQuist
[:SOURce]:RADio:TETRa:FILTer?
```

In the Load Default FIR menu, pressing the **Nyquist** softkey followed by **Generate** loads the FIR table editor with the coefficient values for the Nyquist filter. The filter alpha and number of filter symbols are defined with the softkeys in this menu. If you change either parameter after loading the filter coefficients, press the **Generate** softkey again to reload the FIR table.

The impulse response and the frequency response of a Nyquist filter with an alpha of 0.350 and an oversample ratio of 4 are shown in the following graphs.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **More (1 of 2)**, **Load Default FIR**, **Nyquist**

Offset Q Off On

Press this softkey to change the operational state of the user I/Q offset Q, which defines whether the Q output is delayed by 1/2 symbol from the I output.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User IQ**, **More (1 of 2)**, **Offset Q Off On**

Status after Normal Preset: Off

SCPI Commands:

```
:MEMory:DATA:UIQ "<file name>",offsetQ,num_states,i0,q0,
i1,q1,...[,diff_state,num_diff_states,diff0,diff1,...]
```

Optimize FIR For EVM ACP

Press this softkey to optimize the filter for minimized error vector magnitude (select EVM) or to minimized adjacent channel power (select ACP). The EVM selection provides the most ideal passband. The ACP selection improves stopband rejection. This feature only applies to root Nyquist, and Nyquist filters. The softkey is grayed out when any other filter is selected.

Status after Normal Preset: EVM

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Optimize FIR For EVM ACP**

SCPI Command:

```
[:SOURce]:RADio:TETRa:CHANnel EVM|ACP
[:SOURce]:RADio:TETRa:CHANnel?
```

OQPSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select OQPSK (Offset Quadrature Phase Shift Keying) for modulating a continuous stream of your selected data pattern. OQPSK modulation transmits data at the rate of 2 bits per symbol. Notice that your modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select**, **QPSK and OQPSK**, and **PSK** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **QPSK and OQPSK**, **OQPSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] OQPSK
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a OQPSK (Offset Quadrature Phase Shift Keying) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **QPSK and OQPSK**, **OQPSK**

Other Patterns

Pressing this softkey accesses a menu of data pattern selections. Each of the selections in this menu is a pattern of equal quantities of ones and zeroes (such as four ones and four zeroes).

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **Other Patterns**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **Other Patterns**

Other Patterns is also located in the uplink and downlink configure custom menu and in the Data menus found in every other TETRA Configure Timeslots menu.

Oversample Ratio

Press this softkey to identify the oversample ratio for your user-defined FIR filter. Acceptable values range from 1 to 32. The oversample ratio may, however, be resampled by the instrument to a value from 4 through 16 based on the values set for the number of symbols, the symbol rate, and the number of bits per symbol of the modulation type. Generally, the higher the symbol rate, the lower the oversample ratio allowed. The following table describes the maximum oversample ratio allowed for each modulation type:

Modulation Type	BPS	Maximum OSR	
		≤ 16 Symbols	> 16 Symbols
BPSK MSK 2-LVL FSK	1	16	8
QPSK IS95 QPSK ISAT QPSK OQPSK IS95 OQPSK	2	16	8
8PSK D8PSK 8-LVL FSK	3	15	6
16PSK 16QAM	4	16	8
32QAM	5	15	5
64QAM	6	15	6
	7	14	7
256QAM	8	16	8

Status after Normal Preset: 4

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **Oversample Ratio**

Page Down

Pressing this softkey displays the next page of entries.

Page Down is located in the table editors and in the catalogs of files.

Page Up

Pressing this softkey displays the previous page of entries.

Page Up is located in the table editors and in the catalogs of files.

Pattern Repeat Single Cont

Set this softkey to **Single** to output one occurrence of a modulated data pattern that is not framed. Select the trigger event for the output using the **Pattern Trigger** softkey. Toggle to **Cont** to output a continuous stream of your data pattern.

NOTE   Pattern Repeat and Pattern Trigger functions are *not* available if you use either a PN data sequence, or an external data source.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Pattern Repeat Single Cont**

Status after Normal Preset: Continuous

SCPI Commands:

```
[:SOURce]:RADio:TETRa:REPeat SINGle|CONTinuous
[:SOURce]:RADio:TETRa:REPeat?
```

Pattern Trigger

Pressing this softkey accesses a menu of choices for triggering a modulated data pattern that is not framed. You can choose to trigger using the front panel **Trigger** key, an external trigger supplied to the PATTERN TRIG IN connector, or by a *TRG command or GET (group execute trigger) signal sent over HP-IB. This softkey is inactive until **Pattern Repeat Single Cont** is set to **Single**.

NOTE   Pattern Repeat and Pattern Trigger functions are *not* available if you use either a PN data sequence, or an external data source.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Pattern Repeat Single Cont**, **Pattern Trigger**

Status after Normal Preset: Trigger Key

SCPI Commands:

```
[:SOURce]:RADio:TETRa:TRIGger[:SOURce]?
```

Phase Dev

Press this softkey to select the MSK (Minimum Shift Keying) phase deviation. The default phase deviation is 90˚. To change it, press this softkey and enter the desired value (from 0˚ to 100˚) using the front panel knob, up and down arrow keys, or enter the value using the numeric keypad; then press the **deg** terminator softkey. Notice that the phase deviation appears under the **MSK** softkey in the Modulation Type menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **MSK**, **Phase Dev**

Status after Normal Preset: 90.0 deg

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation:MSK[:PHASe] <val><unit>
[:SOURce]:RADio:TETRa:MODulation:MSK[:PHASe]?
```

Phase Polarity Normal Invert

Press this softkey to reverse the direction of rotation of the phase modulation vector. Choose **Invert** and the in-phase component will lag the quadrature-phase component by 90° in the resulting modulation. The inverted selection also applies to the I OUT and Q OUT signals.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Phase Polarity Normal Invert**

Status after Normal Preset: Normal

SCPI Commands:

```
[:SOURce]:RADio:TETRa:POLarity[:ALL] NORMal|INVerted
[:SOURce]:RADio:TETRa:POLarity[:ALL]?
```

PN9

Press this softkey to select the PN9 pseudorandom bit pattern. If you have selected **PN9** as a data pattern for modulated transmissions that are not framed (**Data Format Pattern Framed** is set to **Pattern**), PN9 is displayed in the Data field in the top line of the text area of the display. If you have selected **PN9** for configuring the framed timeslot data fields, PN9 is displayed in the Data field located near the bottom of the text area of the display.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **PN Sequence**, **PN9**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **PN Sequence**, **PN9**

PN9 is also located in the uplink and downlink configure custom menu and in the Data menus found in every other TETRA Configure Timeslots menu.

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA PN9
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom PN9
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom PN9
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] PN9
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] PN9
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] PN9
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] PN9
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] PN9
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] PN9
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] PN9
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] PN9
```

PN11

Press this softkey to select an internally-generated PN11 pseudorandom bit pattern. Notice that PN11 is displayed in the Data field in the top line of the text area of the display.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **PN Sequence**, **PN11**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA PN11
[:SOURce]:RADio:TETRa:DATA?
```

PN15

Press this softkey to select the PN15 pseudorandom bit pattern. If you have selected **PN15** as a data pattern for modulated transmissions that are not framed (**Data Format Pattern Framed** is set to **Pattern**), PN15 is displayed in the Data field in the top line of the text area of the display. If you have selected **PN15** for configuring the framed timeslot data fields, PN15 is displayed in the Data field located near the bottom of the text area of the display.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **PN Sequence**, **PN15**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **PN Sequence**, **PN15**

PN15 is also located in the uplink and downlink configure custom menu and in the Data menus found in every other TETRA Configure Timeslots menu.

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA PN15
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom PN15
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom PN15
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] PN15
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] PN15
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] PN15
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] PN15
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] PN15
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] PN15
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] PN15
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] PN15
```

PN20

Press this softkey to select an internally-generated PN20 pseudorandom bit pattern. Notice that PN20 is displayed in the Data field in the top line of the text area of the display.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **PN Sequence**, **PN20**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA PN20
[:SOURce]:RADio:TETRa:DATA?
```

PN23

Press this softkey to select an internally-generated PN23 pseudorandom bit pattern. Notice that PN23 is displayed in the Data field in the top line of the text area of the display.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **PN Sequence**, **PN23**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA PN23
[:SOURce]:RADio:TETRa:DATA?
```

PN Sequence

Press this softkey to display a menu of choices for pseudorandom internal data generation.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **PN Sequence**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **PN Sequence**

PN Sequence is also located in the Data menus found in every other TETRA Configure Timeslots menu.

Status after Normal Preset: PN23

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA PN9|PN11|PN15|PN20|PN23|FIX4|
"<file name>"|EXT|P4|P8|P16|P32|P64

[:SOURce]:RADio:TETRa:DATA?
```

PSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Pressing this softkey displays a menu of PSK (Phase Shift Keying) modulation types for modulating a continuous stream of the selected data pattern. You can choose from QPSK and OQPSK, BPSK, π/4 DQPSK, 8PSK,16PSK, and D8PSK.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**

Loading an I/Q Map

Pressing this softkey displays a menu of PSK (Phase Shift Keying) modulation types that you can load into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**

QAM

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Pressing this softkey displays a menu of QAM (Quadrature Amplitude Modulation) modulation types for modulating a continuous stream of the selected data pattern. You can choose from 4QAM, 16QAM, 32QAM, 64QAM, and 256QAM.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **QAM**

Loading an I/Q Map

Pressing this softkey displays a menu of QAM (Quadrature Amplitude Modulation) modulation types that you can load into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **QAM**

QPSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Press this softkey to select QPSK (Quadrature Phase Shift Keying) for modulating a continuous stream of your selected data pattern. QPSK modulation transmits data at the rate of 2 bits per symbol. Notice that your modulation selection is shown in the text area of the display in the `Mod Type` field and also under the **Select**, **QPSK and OQPSK**, and **PSK** softkeys in the Modulation Type menus.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **QPSK and OQPSK**, **QPSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] QPSK
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

Loading an I/Q Map

Press this softkey to load a QPSK (Quadrature Phase Shift Keying) I/Q map into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **QPSK and OQPSK**, **QPSK**

QPSK and OQPSK

This softkey appears in two different situations, enabling you to either select a modulation, or load an I/Q map into the I/Q table editor.

Selecting a Modulation

Pressing this softkey accesses a menu of QPSK (Quadrature Phase Shift Keying) and OQPSK (Offset Quadrature Phase Shift Keying) modulation types for modulating a continuous stream of your selected data pattern. You can choose between QPSK, IS95 QPSK, Gray Coded QPSK, OQPSK, and IS95 OQPSK.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **PSK**, **QPSK and OQPSK**

Loading an I/Q Map

Pressing this softkey displays a menu of QPSK (Quadrature Phase Shift Keying) and OQPSK (Offset Quadrature Phase Shift Keying) modulation types that you can load into the I/Q table editor. For details on editing I/Q maps, see "Mapping Symbol Positions with the I/Q Table Editor" on page 2-6.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **PSK**, **QPSK and OQPSK**

Recall Secondary Frame State

Pressing this softkey recalls the last instrument state saved as the data pattern for the secondary frame. When the secondary frame state is turned on, the secondary frame will be generated using the recalled instrument state. For more information, see Chapter 4, "Operation."

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Frame**, **Recall Secondary Frame State**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SECondary:RECall
```

Rectangle

Press this softkey to select the one-symbol wide rectangle pre-modulation filter in either the Select (filter) menu or the Load Default FIR menu.

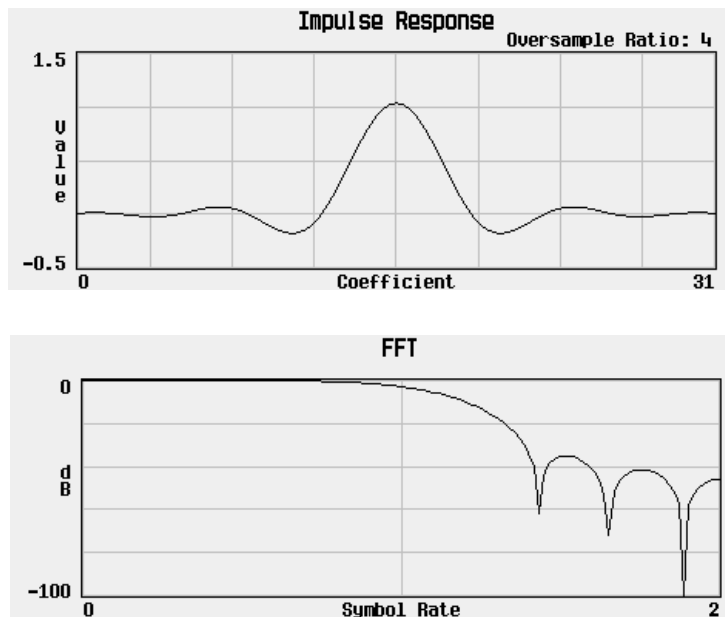In the Select (filter) menu, pressing the **Rectangle** softkey selects this FIR filter for use in your custom modulation setup.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Select**, **More (1 of 2)**, **Rectangle**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:FILTer RECTangle
[:SOURce]:RADio:TETRa:FILTer?
```

In the Load Default FIR menu, pressing the **Rectangle** softkey followed by **Generate** loads the FIR table editor with the coefficient values for the rectangle filter. The number of filter symbols are defined with the **Filter Symbols** softkey in this menu. The default is a one-symbol wide rectangle in an eight-symbol wide filter. If you change the number of symbols after loading the filter coefficients, press the **Generate** softkey again to reload the FIR table.

The impulse response and the frequency response of the default rectangle filter are shown in the following graphs:
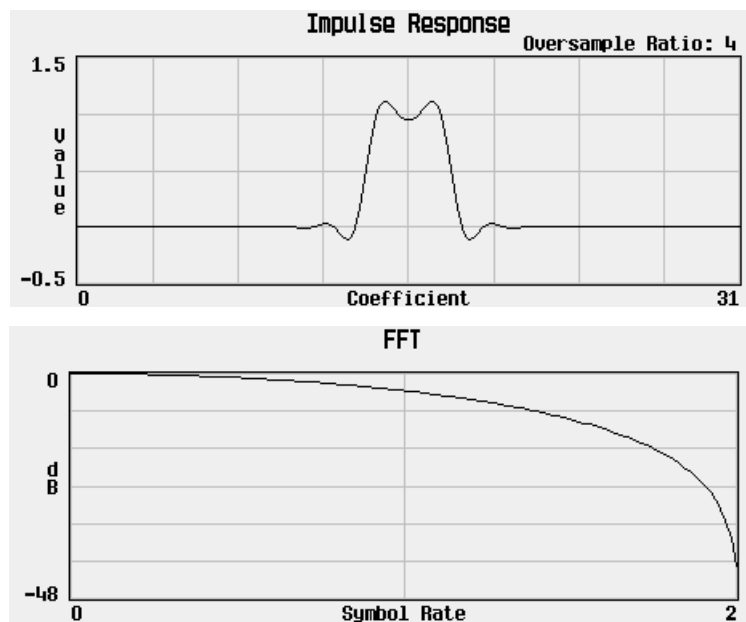
Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **More (1 of 2)**, **Load Default FIR**, **Rectangle**

Restore Default Burst Shape

Press this softkey to reset the burst shape characteristics to their default values (rise time = 9.376 bits, rise delay = -1.000 bits, fall time = 7.814 bits, fall delay = 0.000 bits). This softkey is a convenience feature for quickly resetting the burst shape. You can also change each of the burst characteristics individually by using the **Rise Time**, **Rise Delay**, **Fall Time**, and **Fall Delay** softkeys in this menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Burst Shape**, **Restore Default Burst Shape**

Restore Default Filter

Press this softkey to replace the current FIR filter with the default filter (root Nyquist α = 0.350).

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Restore Default Filter**

Restore Default Modulation Type

Press this softkey to restore the default modulation type for the format currently selected. For a custom format, π/4 DQPSK is the default modulation type.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Restore Default Modulation Type**

Restore Default Symbol Rate

Press this softkey to reset the transmission symbol rate to the default value (18.000 ksps). This softkey is a convenience feature for quickly resetting the symbol rate. You can also change the symbol rate by pressing the **Symbol Rate** softkey.

Status after Normal Preset: 18.000 ksps

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Symbol Rate**, **Restore Default Symbol Rate**

Restore TETRA Factory Default

Press this softkey to reset TETRA configuration to the factory default values. This softkey is a convenience feature for quickly resetting all TETRA values.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **(More 1 of 2)**, **Restore TETRA Factory Default**

Rise Delay

Press this softkey to edit the burst shape rise delay. The default value is -1.000 bits. To change it, press this softkey and enter a new value (minimum and maximum values depend upon modulation type and symbol rate). Use the front panel knob, up and down arrow keys, or enter a value using the numeric keypad; then press the **bits** terminator softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Burst Shape**, **Rise Delay**

Status after Normal Preset: -1.000 bits

SCPI Commands:

```
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:DELay <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:DELay?
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RDELay <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RDELay?
```

Rise Time

Press this softkey to edit the burst shape rise time. The default value is 9.376 bits. To change it, press this softkey and enter a new value (minimum and maximum values depend upon modulation type and symbol rate). Use the front panel knob, up and down arrow keys, or enter a value using the numeric keypad; then press the **bits** terminator softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Burst Shape**, **Rise Time**

Status after Normal Preset: 9.376 bits

SCPI Commands:

```
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:TIME <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:TIME?
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RTIMe <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RTIMe?
```

Root Nyquist

Press this softkey to select the root Nyquist (root-raised cosine) pre-modulation filter in either the Select (filter) menu or the Load Default FIR menu.

In the Select (filter) menu, pressing the **Root Nyquist** softkey selects this FIR filter for use in your custom modulation setup. The default filter alpha is automatically set to 0.350. You can change the filter alpha to any value between 0 and 1 by pressing the **Filter Alpha** softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Select**, **Root Nyquist**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:FILTer RNYQuist
[:SOURce]:RADio:TETRa:FILTer?
```

In the Load Default FIR menu, pressing the **Root Nyquist** softkey followed by **Generate** loads the FIR table editor with the coefficient values for the Nyquist filter. The filter alpha and number of filter symbols are defined with the softkeys in this menu. If you change either parameter after loading the filter coefficients, press the **Generate** softkey again to reload the FIR table.

The impulse response and the frequency response of a root Nyquist filter with an alpha of 0.350 and an oversample ratio of 4 are shown in the following graphs.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Define User FIR**, **More (1 of 2)**, **Load Default FIR**, **Root Nyquist**

Save Secondary Frame State

Pressing this softkey saves the last instrument state as TETRA_SECONDARY_STATE and moves the data pattern to the end of the data generator memory, where it can be used as the secondary frame. When the secondary frame state is turned on, the secondary frame will be generated as needed, using the saved instrument state. For more information, see Chapter 4, "Operation."

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Frame**, **Save Secondary Frame State**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SECondary:SAVE
```

Scramble Off On

Press this softkey to enable the scramble capability. When
Scramble Off On is set to **On**, the data in the related fields will be
scrambled using the seed value set with the **Scramble Seed** softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**,
Configure Timeslots, **Configure Frame**, **Scramble Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:RADio:TETRa:BURSt:SCRamble[:STATe] ON|OFF|1|0
[:SOURce]:RADio:TETRa:BURSt:SCRamble[:STATe]?
```

Scramble Seed

Press this softkey to set the scramble seed value. The scramble seed
specifies the starting point in the PRBS generator for the scramble. To
enter a value (in hexadecimal), press **Scramble Seed**. The scramble seed
value becomes the active function. Enter a new value using the front
panel knob, up and down arrow keys, or use the numeric keypad and
the **A**, **B**, **C**, **D**, **E**, and **F** softkeys and press the **Enter** terminator softkey.
The range of values allowed is hexadecimal 00000000 through
FFFFFFFF.

The 32-bit scramble seed consists of four fields. The two least
significant bits are defined by the TETRA standard to always be 1.
(They must be specified anyway.) The remaining 30 bits are the
extended color code which is divided into three fields: mobile country
code, mobile network code, and color code. The two least significant bits
are appended to the color code so if, for example, you set a color code of
1, a scramble seed of 7 is required.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**,
Configure Timeslots, **Configure Frame**, **Scramble Seed**

Status after Normal Preset: FFFFFFF

SCPI Commands:

```
[:SOURce]:RADio:TETRa:BURSt:SCRamble:SEED <32-bit val>
[:SOURce]:RADio:TETRa:BURSt:SCRamble:SEED?
```

Secondary Frame Off On

Press this softkey to toggle the secondary frame operating state. The
secondary frame is a data pattern that coexists with the primary (the
pattern that can be modified from the front panel or modified using
SCPI commands). This secondary pattern is a copy of the selected
primary pattern. It cannot be modified; it can only be turned on and off,
or modified in its entirety. When the secondary frame is selected, the

current instrument state is saved to memory. This file is named using the format (TETRA) as the prefix and SECONDARY_STATE as the suffix, with a resulting file named TETRA_SECONDARY_STATE. When the secondary frame is activated, the secondary pattern is generated from the specification saved in the instrument state file and moved to the end of the data generator memory. For more information, see Chapter 4, "Operation."

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Frame**, **Secondary Frame Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SECondary[:STATe] ON|OFF|1|0
[:SOURce]:RADio:TETRa:SECondary[:STATe]?
```

Secondary Frame Trigger

Pressing this softkey accesses a menu of choices for triggering your framed pattern. You can choose to trigger using the front panel **Trigger** key, an external trigger supplied to the PATTERN TRIG IN connector, or by a *TRG command or GET (group execute trigger) signal sent over HP-IB. For more information, see Chapter 4, "Operation."

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Frame**, **Secondary Frame Trigger**

Status after Normal Preset: Ext

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SECondary:TRIGger[:SOURce] KEY|
EXT|BUS
```

```
[:SOURce]:RADio:TETRa:SECondaryTRIGger[:SOURce]?
```

Select

There are two softkeys named Select, one in the Filter menu and one in the Modulation type menu. In the Filter menu, you can select a pre-modulation filter type; in the Modulation type menu, you can select a modulation.

Selecting a Filter

In the Filter menu, press this softkey to access a menu for selecting the pre-modulation filter type. The pre-defined choices are root Nyquist, Nyquist, Gaussian, and Rectangle. In addition to the pre-defined filters, you can access the catalog of files stored in the signal generator memory. You can select any filter that you have either created externally and downloaded into memory, or that you have created internally in the Define User FIR menu and then subsequently stored.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Select**

Status after Normal Preset: Root Nyquist

SCPI Commands:

```
[:SOURce]:RADio[:TETRa]:FILTer RNYQuist|NYQuist|
GAUSsian|RECTangle|"<file name>"

[:SOURce]:RADio[:TETRa]:FILTer?
```

Selecting a Modulation

In the Modulation Type menu, press this softkey to accesses a menu for defining the modulation type. The choices are PSK, MSK, FSK, QAM, User I/Q and User FSK. In addition to the pre-defined modulations, you can access a catalog of FSK or I/Q files stored in the signal generator memory, where you can select a modulation that you have created and stored in either the Define User FSK or Define User I/Q menu.

Status after Normal Preset: π/4 DQPSK

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**

Select File

Press this softkey to select a file in the displayed catalog of binary files. To make your selection, first scroll through the list, using the front panel knob or up and down arrow keys, until the desired file is highlighted. Press **Select File** and the highlighted file is specified as your data selection. If you have selected a custom file as a data pattern for modulated transmissions that are not framed (**Data Format Pattern Framed** is set to **Pattern**), UserFile is displayed in the Data field in the top line of

the text area of the display. If you have selected a custom file for configuring timeslot data fields, the file name you selected is displayed in the `Data` field located near the bottom of the text area of the display.

Select File is located in the catalogs of files.

SCPI Commands:

```
[:SOURce]:RADio:TETRa:DATA "<file name>"
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom "<file name>"
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom "<file name>"

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal
[:DATA] "<file name>"

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync
[:DATA] "<file name>"

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom
[:DATA] "<file name>"

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal
[:DATA] "<file name>"

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync
[:DATA] "<file name>"

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA]
"<file name>"

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA]
"<file name>"

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal
[:DATA] "<file name>"
```

SSB

Press this softkey to change the 120-bit synchronization block bits (SSB) value. To enter a value (in hexadecimal), press **STS**. The synchronization block bits value becomes the active function. Enter a new value using the front panel knob, up and down arrow keys, or use the numeric keypad and the **A**, **B**, **C**, **D**, **E**, and **F** softkeys and press the **Enter** terminator softkey. The current value for synchronization block bits is displayed in the SSB field near the bottom of the text area of the display.

Status after Normal Preset: 000000000000000000000000000000

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Sync Cont**, **Configure Dn Sync Cont**, **SSB**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Sync Disc**, **Configure Dn Sync Disc**, **SSB**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync
:SSB <120 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:SSB?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync
:SSB <120 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:SSB?
```

Standard

Press this softkey select the TETRA standard frequency band. The TETRA standard frequency band contains channels 1 through 100.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Freq Channels**, **Channel Band**, **Standard**

Status after Normal Preset: Standard

SCPI Commands:

```
[:SOURce]:RADio:TETRa:FCHannel:BAND STANdard
[:SOURce]:RADio:TETRa:FCHannel:BAND?
```

Store To File

Press this softkey to store the selected custom configuration to a file in non-volatile memory for later recall and use.

Store To File is located in the catalogs of files.

STS

Press this softkey to change the 38-bit synchronization training sequence bits (STS) value. The preset hexadecimal value (when normal preset is selected) for the synchronization training sequence bits reflects the TETRA standard, however you can enter a new value by pressing this softkey. To enter a value (in hexadecimal), press **STS**. The synchronization training sequence value becomes the active function. Enter a new value using the front panel knob, up and down arrow keys, or use the numeric keypad and the **A**, **B**, **C**, **D**, **E**, and **F** softkeys and press the **Enter** terminator softkey. The current value for synchronization training sequence is displayed in the STS field near the bottom of the text area of the display.

Status after Normal Preset: 30673A7067

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Sync Cont**, **Configure Dn Sync Cont**, **STS**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **More (2 of 2)**, **Dn Sync Disc**, **Configure Dn Sync Disc**, **STS**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync
:STS <38 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:STS?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync
:STS <38 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:STS?
```

Symbol Rate

Press this softkey to set the transmission symbol rate. The default symbol rate is 18.000 ksps. To change it, enter the desired value using the front panel knob, up and down arrow keys, or enter the value using the numeric keypad; then press the **Msps**, **ksps**, or **sps** terminator softkey. Values range from 47.684 sps through 12.500000000 Msps but will vary depending on the modulation type.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Symbol Rate**

Status after Normal Preset: 18.000 ksps

SCPI Commands:

NOTE The BRATe SCPI command sets the bit rate. The bit rate is adjusted to reflect symbol rate dependent on the number of bits per symbol for the modulation type.

```
[:SOURce]:RADio:TETRa:SRATe <value>
[:SOURce]:RADio:TETRa:SRATe?
[:SOURce]:RADio:TETRa:BRATe <value>
[:SOURce]:RADio:TETRa:BRATe?
```

Sync Out

Press this softkey to reveal a menu of choices for outputting a 1-bit synchronization signal to the EVENT 1 rear panel connector. In this menu you can choose to set the synchronization signal to occur at the beginning of a data pattern, at the beginning of a frame, at the beginning of a selected timeslot, or at the beginning of each timeslot in a frame.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Sync Out**

Status after Normal Preset: Begin Pattern

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SOUT?
```

Sync Out Offset

Press this softkey to move the synchronization signal forward or back from the beginning of the data pattern, frame, or timeslot. To set the number of bits of offset, press **Sync Out Offset** and synchronization offset becomes the active function. Enter the desired value using the front panel knob, up and down arrow keys, or enter the value using the numeric keypad and press the **Enter** terminator softkey. The range of values allowed is −509 through +509 bits.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **More (1 of 2)**, **Sync Out**, **Sync Out Offset**

Status after Normal Preset: 0 bits

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SOUT:OFFSet <value>
[:SOURce]:RADio:TETRa:SOUT:OFFSet?
```

TETRA Off On

Press this softkey to enable the TETRA communications standard. Setting **TETRA Off On** to **On** sets up the internal hardware to generate the structure that follows the TETRA standard. The internal I/Q modulator generates π/4DQPSK digital modulation and the `TETRA` and `I/Q` annunciators are turned on in the display. Although the digital modulation is enabled with this softkey, the RF carrier is modulated by the enabled modulation only when you have also set **Mod On/Off** to **On**.

Setting **TETRA Off On** to **On** presets the following softkeys in the I/Q menu: **I/Q Off On** is set to **On** and **I/Q Source** is set to **Int I/Q**. You can override these selections in the I/Q menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **TETRA Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:RADio:TETRa[:STATe] ON|OFF|1|0
[:SOURce]:RADio:TETRa[:STATe]?
```

Timeslot

Press this softkey to select a timeslot to be configured. Choose any of the four timeslots. Enter the timeslot number using the front panel knob, the up and down arrow keys, or enter the number using the numeric keypad and press the **Enter** terminator softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot #**

Status after Normal Preset: 1

Timeslot Ampl Main Delta (Option UNA only)

Press this softkey to toggle the selected timeslot RF output power as main or alternate (delta). To configure the alternate amplitude, use the menu provided by pressing Ampl, Alternate Amplitude. Here you will find a set of softkeys that will allow you to configure the alternate amplitude's state, delta, and triggering functions. When a format is activated, the necessary coupling is done automatically to provide best configuration for Alternate Amplitude Control. This feature is only available with the Alternate Power Control, Option UNA.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Ampl Main Delta**

Status after Normal Preset: Main

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:POWer MAIN|DELTa
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:POWer?
```

Timeslot Off On

Press this softkey to toggle the active timeslot on and off. For example, to turn on timeslot 2, select the timeslot by pressing the **Timeslot #** softkey in this same menu. Enter the number 2 to make timeslot 2 active. Then turn this timeslot on by toggling **Timeslot Off On** to **On**. Notice that the visual representation of the timeslot pattern now shows timeslot 2 turned on.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Off On**

Status after Normal Preset: On (timeslot 1), Off (timeslots 2 - 4)

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:STATe ON|OFF|1|0
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:STATe?
```

Timeslot Type

Pressing this softkey accesses a menu of choices for setting the timeslot type for the active timeslot. You can choose to set any timeslot to be an uplink normal, control 1, control 2, or custom timeslot. You can also select from downlink continuous or discontinuous normal, custom, or synchronization timeslots. When you have selected the type for the timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your selection.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**

Status after Normal Preset: Uplink Normal (for all timeslots)

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE]?
```

Trigger In Polarity Neg Pos

This softkey is used to configure the polarity of the signal at the TRIGGER IN BNC connector that triggers an event. **Pos** refers to the rising edge and **Neg** refers to the falling edge.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Frame**, **Secondary Frame Trigger**, **Trigger In Polarity Neg Pos**

Status after Normal Preset: Pos

Trigger Key

Press this softkey to select the front panel **Trigger** key as the pattern trigger for a single output of a modulated data transmission that is not framed (**Data Format Pattern Framed** is set to **Pattern**). You can also select the **Trigger** key as the frame trigger for toggling between your primary and/or secondary framed data (**Data Format Pattern Framed** is set to **Framed**). Once selected, you can trigger a single event at any time by pressing the **Trigger** key.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Pattern Repeat Single Cont**, **Pattern Trigger**, **Trigger Key**

NOTE

Pattern Repeat and Pattern Trigger functions are *not* available if you use either a PN data sequence, or an external data source.

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Frame Repeat Single Cont**, **Frame Trigger**, **Trigger Key**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Frame**, **Secondary Frame Trigger**, **Trigger Key**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:TRIGger[:SOURce] KEY
[:SOURce]:RADio:TETRa:SECondary:TRIGger[:SOURce] KEY
```

TS

Press this softkey to change the training sequence (TS). The preset hexadecimal value (when normal preset is selected) for TS reflects the TETRA standard, however you can enter a new value by pressing this softkey. To enter a value (in hexadecimal), press **TS**. The training sequence value becomes the active function. Enter a new value using the front panel knob, up and down arrow keys, or use the numeric keypad and the **A**, **B**, **C**, **D**, **E**, and **F** softkeys and press the **Enter** terminator softkey. The current value for training sequence is displayed in the TS field near the bottom of the text area of the display.

Status after Normal Preset: 343A74 (uplink normal, downlink normal continuous and discontinuous), 2743A743 (uplink control 1 and 2)

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **TS**

TS is also located in the uplink configure control 1 and control 2 menus and in the downlink configure normal continuous and discontinuous menus.

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal
:TSEQuence <30 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:TSEQuence?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal
:TSEQuence <30 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:TSEQuence?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1
:TSEQuence <30 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1:TSEQuence?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2
:TSEQuence <30 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2:TSEQuence?
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal
:TSEQuence <22 bit value>

[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal:TSEQuence?
```

Up Control 1

Press this softkey to select uplink control subslot 1 as the timeslot type for the active timeslot.

Uplink timeslots cannot be mixed with downlink timeslots. If you already have any timeslots designated as downlink, they will be changed to uplink when any other timeslot is designated as uplink. The following table shows the timeslot type interchanges that will occur if the frame was designated as downlink and then uplink is selected.

From Continuous Downlink Timeslot	From Discontinuous Downlink Timeslot	To Uplink Timeslot
Dn Custom Cont	Dn Custom Disc	Up Custom
Dn Normal Cont	Dn Normal Disc	Up Normal
Dn Sync Cont	Dn Sync Disc	Up Custom

When you select **Up Control 1** for a timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your selection.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **Up Control 1**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] UC1
```

Up Control 2

Press this softkey to select uplink control subslot 2 as the timeslot type for the active timeslot.

Uplink timeslots cannot be mixed with downlink timeslots. If you already have any timeslots designated as downlink, they will be changed to uplink when any other timeslot is designated as uplink. The following table shows the timeslot type interchanges that will occur if the frame was designated as downlink and then uplink is selected.

From Continuous Downlink Timeslot	From Discontinuous Downlink Timeslot	To Uplink Timeslot
Dn Custom Cont	Dn Custom Disc	Up Custom
Dn Normal Cont	Dn Normal Disc	Up Normal
Dn Sync Cont	Dn Sync Disc	Up Custom

When you select **Up Control 1** for a timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your selection.

Softkey Location: Press **Mode, TDMA, TETRA, Data Format Pattern Framed, Configure Timeslots, Timeslot Type, Up Control 2**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] UC2
```

Up Custom

Press this softkey to select an uplink custom timeslot type for the active timeslot. An uplink custom timeslot is configured using an internally-generated data pattern, a downloaded sequence of bits stored in a user file, or by supplying external data. The uplink custom timeslot is provided for users' flexibility but it is not a standard TETRA timeslot.

Uplink timeslots cannot be mixed with downlink timeslots. If you already have any timeslots designated as downlink, they will be changed to uplink when any other timeslot is designated as uplink. The following table shows the timeslot type interchanges that will occur if the frame was designated as downlink and then uplink is selected.

From Continuous Downlink Timeslot	From Discontinuous Downlink Timeslot	To Uplink Timeslot
Dn Custom Cont	Dn Custom Disc	Up Custom
Dn Normal Cont	Dn Normal Disc	Up Normal
Dn Sync Cont	Dn Sync Disc	Up Custom

When you have selected **Up Custom** for a timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your configuration.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **Up Custom**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] UCUStom
```

Up Normal

Press this softkey to select uplink normal as the timeslot type for the active timeslot.

Uplink timeslots cannot be mixed with downlink timeslots. If you already have any timeslots designated as downlink, they will be changed to uplink when any other timeslot is designated as uplink. The following table shows the timeslot type interchanges that will occur if the frame was designated as downlink and then uplink is selected.

From Continuous Downlink Timeslot	From Discontinuous Downlink Timeslot	To Uplink Timeslot
Dn Custom Cont	Dn Custom Disc	Up Custom
Dn Normal Cont	Dn Normal Disc	Up Normal
Dn Sync Cont	Dn Sync Disc	Up Custom

When you select **Up Normal** for a timeslot, the visual representation of the timeslot pattern on the display is immediately updated to show your selection.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Timeslot Type**, **Up Normal**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] UNORmal
```

User File

Press this softkey to display the catalog of binary files stored in the signal generator's memory. You can select a custom file from this catalog for your data pattern. Scroll through the listed files and when your selection is highlighted, press the **Select File** softkey. If you have selected **User File** as a data pattern for modulated transmissions that are not framed (**Data Format Pattern Framed** is set to **Pattern**), `UserFile` is displayed in the `Data` field in the top line of the text area of the display. If you have selected **User File** for configuring timeslot data fields, the file name you selected is displayed in the `Data` field located near the bottom of the text area of the display.

User's files should exactly fill the data fields in a framed transmission. (Create the files to fill an integer number of frames.) If the end of the user's file does not coincide with the end of a frame, data will be truncated in one of the following ways:

- Enough frames will be generated to transmit as much of the data pattern as will fit into complete frames. The remaining bits of the data pattern (which are too few to completely fill a frame) are truncated.

- If two files of unequal sizes are selected for the same framed transmission, enough frames will be generated to transmit as much of the data pattern of the largest file as will fit into complete frames. The remaining bits of the data pattern are truncated. The smaller file will be repeated as many times as necessary to completely fill these frames. Data will be truncated for the smaller file to coincide with the end of the last frame.

- If a user's file and a PN9 or PN15 file are selected for the same framed transmission and the user's file is shorter than the PN9/15, enough frames will be generated to transmit the PN9/15. The end of the PN9/15 data will coincide with the end of the last frame. The smaller user's file will be repeated as many times as necessary to completely fill these frames. Data will be truncated for the smaller file to coincide with the end of the last frame.

- If a user's file and a PN9 file are selected for the same framed transmission and the user's file is longer than the PN9, enough frames will be generated to transmit as much of the data pattern as will fit into complete frames. The remaining bits of the data pattern (which are too few to completely fill a frame) are truncated. The PN9 data will be repeated as many times as necessary to completely fill these frames.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **Data**, **User File**

Or press **Mode**, **TDMA**, **TETRA**, **Data Format Pattern Framed**, **Configure Timeslots**, **Configure Up Normal**, **Data**, **User File**

User File is also located in the uplink and downlink configure custom menu and in the Data menus found in every other TETRA Configure Timeslots menu.

User FIR

Press this softkey to display the catalog of FIR filter files stored in the signal generator's memory. You can select a custom filter from this catalog for your pre-modulation filter. Scroll through the listed files and when your selection is highlighted, press the **Select File** softkey. Notice that `User FIR` is shown in the `Filter` field of the display and the file name is listed in the second line of the **Select** softkey.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Filter**, **Select**, **User FIR**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:FILTer "<file name>"
[:SOURce]:RADio:TETRa:FILTer?
```

User FSK

Press this softkey to display the catalog of FSK files stored in the signal generator's memory. You can select a custom file from this catalog for your FSK modulation. Scroll through the listed files until your selection is highlighted, then press the **Select File** softkey. Notice that `User FSK` is shown in the `Mod Type` field of the display and **User FSK** appears in bold, along with the selected file name, in the Select Modulation Type sub-menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **User FSK**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation:UFSK "<file name>"
[:SOURce]:RADio:TETRa:MODulation:UFSK?
[:SOURce]:RADio:TETRa:MODulation:[:TYPE] UFSK
[:SOURce]:RADio:TETRa:MODulation:[:TYPE]?
```

User I/Q

Press this softkey to display the catalog of I/Q files where you can select a prestored configuration to use for the modulation type. Scroll through the listed files and when your selection is highlighted, press **Select File**. Notice that `User I/Q` is shown in the `Mod Type` field of the display, and **User I/Q** appears in bold in the Select Modulation Type sub-menu.

Softkey Location: Press **Mode**, **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Select**, **User I/Q**

SCPI Commands:

```
[:SOURce]:RADio:TETRa:MODulation:UIQ "<file name>"
[:SOURce]:RADio:TETRa:MODulation:UIQ?
[:SOURce]:RADio:TETRa:MODulation:[:TYPE] UIQ
[:SOURce]:RADio:TETRa:MODulation:[:TYPE]?
```

4 Operation

This section contains detailed information that will help you learn how to operate your signal generator.

Framed Data Pattern Transmissions

Signal generators equipped with Option UN8 can be configured to generate framed data transmissions in TETRA. Many data patterns can be internally-generated (PN9, PN15, fixed 4-bit repeating sequences, set patterns of ones and zeroes) or you can choose to supply your own data (download a binary file or input data using the DATA INPUT connector). If you elect to supply your own data file, it should be created to exactly fill the data fields of your chosen timeslots. If the end of the file does not coincide with the end of a frame, data will be truncated in one of the following ways:

- Enough frames will be generated to transmit as much of the data pattern as will fit into complete frames. The remaining bits of the data pattern (which are too few to completely fill a frame) are truncated.

- If two files of unequal sizes are selected for the same framed transmission, enough frames will be generated to transmit as much of the data pattern of the largest file as will fit into complete frames. The remaining bits of the data pattern are truncated. The smaller file will be repeated as many times as necessary to completely fill these frames. Data will be truncated for the smaller file to coincide with the end of the last frame.

- If a user's file and a PN9 file are selected for the same framed transmission and the user's file is shorter than the PN9, 511 frames will be generated to transmit the PN9. The end of the PN9 data will coincide with the end of the 511th frame. The smaller user's file will be repeated as many times as necessary to completely fill these 511 frames. Data will be truncated for the smaller file to coincide with the end of the last frame.

- If a user's file and a PN9 file are selected for the same framed transmission and the user's file is longer than the PN9, enough frames will be generated to transmit as much of the data pattern as will fit into complete frames. The remaining bits of the data pattern (which are too few to completely fill a frame) are truncated. The PN9 data will be repeated as many times as necessary to completely fill these frames.

The signal generator has the capability of transmitting the framed data continuously or outputting a single frame. If only one timeslot is on, selecting a single framed transmission will output the following sequences:

- 4-Bit Patterns (FIX4) - A single frame is generated. The 4-bit pattern repeats until the data fields are completely filled. Each trigger transmits the same frame.

- Other Patterns (fixed patterns of equal quantities of ones and zeroes) - A single frame is generated. The selected pattern repeats until the data fields are completely filled. Each trigger transmits the same frame.

- PN9 - A single frame is generated. The data fields are filled with the leading bits of the PN9 sequence. A trigger causes the frame to be transmitted. The data fields of this frame are then filled sequentially with the next series of PN9 data bits. A trigger causes the frame to be transmitted. This process continues, transmitting the entire PN9 sequence frame by frame. The last bit of the PN9 sequence in a data field is immediately followed by the first bit of a second PN9 sequence.

- PN15 - A single frame is generated. The data fields are filled with the leading bits of the PN15 sequence. A trigger causes the frame to be transmitted. The data fields of this frame are then filled sequentially with the next series of PN15 data bits. A trigger causes the frame to be transmitted. This process continues, transmitting the entire PN15 sequence frame by frame. The last bit of the PN15 sequence in a data field is immediately followed by the first bit of a second PN15 sequence.

- User File - The user's file should have the appropriate data to fill an integer number of timeslots. If not, the remaining bits are truncated. Depending on the size of the file, more than one frame can possible be generated.

- External Data - External data is clocked into the data fields of the timeslot. A single frame is generated.

Using Secondary Frames

The secondary frame is a copy of a selected framed data pattern. The framed data from which the copy was made now becomes the primary frame. Once the secondary frame is saved, it cannot be modified; it can only be turned on or off or a new secondary frame can be saved over the current secondary frame. The primary frame can now be modified to transmit data which differs from the data being transmitted by the secondary frame. You can now toggle between the primary and secondary frames, resulting in two different modulation patterns at the output. Since some data patterns may occupy multiple frames, one frame type will not toggle to the other until the absolute end of the currently transmitting frame's data pattern.

Generating the Secondary Frame Pattern

To generate a secondary frame, the digital TDMA standard must be on (**TETRA Off On** set to **On** or execute the remote command `:RADio:TETRa[:STATe] ON`). When the secondary frame is saved using the **Save Secondary Frame State** softkey (or the remote command `:RADio:TETRA:SECondary:SAVE`), the current instrument state is saved to the memory catalog using a file name consisting of the digital standard name (in this case `TETRA`) followed by `_SECONDARY_STATE`. When the secondary frame is activated (by setting the Secondary Frame Off On softkey to **On**, or by using the remote command `:RADio:TETRA:SECondary[:STATe] ON`), the secondary frame is generated using the instrument state stored in the file name `TETRA_SECONDARY_STATE`.

Once the pattern has been generated, it is moved to the end of the data generator memory. The primary pattern is then regenerated and can, if necessary, be modified to differ from the secondary pattern.

NOTE   If the two patterns cannot simultaneously fit into memory, the secondary pattern is turned off.

Triggering the Secondary Frame

Once the primary and secondary frames are generated, a specific trigger event can be selected to toggle the frame being modulated on the RF signal between primary and secondary. Your choices for the specific trigger event include the front panel **Trigger** key, an execute trigger command on the HP-IB interface bus, or an external triggering signal applied to the rear panel TRIGGER IN connector. You can set this specific trigger event by choosing one of these from the softkeys under the **Secondary Frame Trigger** softkey or by sending the SCPI command `:RADio[:TETRa]:SECondary:TRIGger[:SOURce]` and appending it with either `KEY`, `EXT`, or `BUS`. If you choose external triggering, you can control the polarity of the trigger signal using the **Trigger In Polarity Neg Pos** softkey or by sending the remote command `:TRIGger[:SEQuence]:SLOPe`, and appending it with either `POSitive` or `NEGative`.

The actual transition occurs at the absolute end of the current data pattern. Depending on which frame type is in the queue, the instrument displays the next frame as `Nxt Frame: Primary` or `Nxt Frame: Secondary`.

The Effects of Secondary Frame on Instrument State Settings

The next frame is automatically set to primary when the secondary frame state is turned off, or when the activated standard is turned off. Standards that are turned off always show the next frame as primary.

When the next frame is shown as primary, any changes made to the current instrument state are seen at the RF output only after the primary framed pattern has been regenerated. While this process is being completed, the output will not conform to specification. When the next frame is shown as secondary, any changes made to the current instrument state are seen at the RF output only after the frame has switched back to primary. Remember that any changes made will only apply to the primary frame, regardless of which frame type is in the queue; the secondary frame cannot be modified.

All instrument state settings affect only one frame, either primary or secondary; except for the data format, the digital standard's operational state, the timeslot PN's and scramble which remain the same in both the primary and secondary frame data. If the primary frame's data is toggled from **Framed** to **Pattern**, then the secondary frame is turned off. The operational state of the digital standard (TETRA Off On) affects both the primary and the secondary frames.

The effect of changing the primary scramble state or scramble seed while the secondary state exists are as follows:

- The primary frame's scramble state/seed and the secondary frame's scramble state/seed do not affect each other; they are independently adjustable.

- If neither of the frames are using external data, then the order of the PN types within the secondary frame must match the order in the primary frame.

  - Example 1 - If the primary frame has PN9 in timeslot 1 and the secondary frame has PN15 in timeslot 1, then there is a conflict.

  - Example 2 - If the primary frame has PN15 in timeslot 1, and the secondary frame has FIX4 in timeslot 1 and PN9 in timeslot 2, then there is a conflict. If timeslot 1 of the primary frame were changed to PN9, then timeslot 2 of the secondary frame would not conflict with timeslot 1 of the primary frame.

If any of the following conflicts occur, the secondary frame is turned off:

- The primary frame in pattern RAM is a different digital standard than the one in which the selected secondary frame state was created.

- Creating a secondary frame with a non-framed data pattern.

- Turning all timeslots off in either the primary or secondary frames. A secondary frame cannot have all the timeslots turned off.

- Mixing continuous and discontinuous frames between the primary and secondary frames.

- The firmware is unable to read the secondary frame instrument state file.

The frame repeat is changed to continuous when the secondary state is turned on. If the secondary frame is being generated externally, then the primary frame will use quick PN9-generated patterns. If the primary frame is being generated from external data, and the secondary frame is using any hardware-generated data, then the secondary frame is regenerated using software patterns. Both of these situations frequently lead to framed patterns that are too large to coexist.

Data Dependencies

There are some situations where combinations of data patterns, or usage of particular data patterns, will cause the data to be truncated or discontinuous. Because a discontinuous data pattern will make bit error rate testing invalid, it is important to be aware of these situations.

- Any time a downlink timeslot type is selected for a TETRA frame and the data pattern chosen is PN15, the PN15 pattern will be discontinuous. A discontinuous PN15 pattern consists of as many complete frames of PN15 data as can be generated. The remaining bits that do not completely fill a frame are truncated.

- Any combination of external data and a PN15 data pattern will cause a discontinuous PN15 pattern.

- Any combination of user's files and a PN15 data pattern will cause a discontinuous PN15 pattern.

Digital Modulation Input/Output Relationships

Signal generators equipped with Option UN8 can be configured to internally generate pattern or framed data, the baseband generator's clock can be internally or externally supplied, and the external data clock can be set to a normal bit clock or a symbol clock for the TETRA format. Combinations of these selections will affect the inputs required and the outputs available as shown in the following tables. (All connectors are located on the rear panel with Option 1EM.)

Table 4-1 Pattern Data Mode

Data	BBG Data CLK	External Data Clock	Front Panel Inputs			Rear Panel Outputs		
			DATA CLOCK	SYMBOL SYNC	DATA	DATA CLK OUT	SYMBOL SYNC OUT	DATA OUT
Internal	Internal	NA	NA	NA	NA	Internal Bit Clock	Internal Symbol Clock	Internally Generated Data
Internal	External	Normal	User's Bit Clock	NA	NA	Internal Bit Clock	Internal Symbol Clock	Internally Generated Data
Internal	External	Symbol	User's Symbol Clock	NA	NA	Internal Bit Clock	Internal Symbol Clock	Internally Generated Data
External	Internal	NA	NA	User's Symbol Clock [1]	User's External Data[1]	Internal Bit Clock	User's Symbol Clock	User's External Data
External	External	Normal	User's Bit Clock	User's Symbol Clock	User's External Data	Internal Bit Clock	User's Symbol Clock	User's External Data
External	External	Symbol	User's Symbol Clock [2]	User's Symbol Clock[2]	User's External Data	Internal Bit Clock	User's Symbol Clock	User's External Data

1. The front panel SYMBOL SYNC and DATA inputs must be clocked by the internal bit clock output from the rear panel DATA CLK OUT.
2. When the user's symbol clock is supplied to the DATA CLOCK input, it must also be supplied to the SYMBOL SYNC input via a tee.

Table 4-2   Framed Data Mode

Data	BBG Data Clock	External Data Clock	Front Panel Inputs			Rear Panel Outputs		
			DATA CLOCK	SYMBOL SYNC	DATA	DATA CLK OUT	SYMBOL SYNC OUT	DATA OUT
Internal	Internal	NA	NA	NA	NA	Internal Bit Clock	Internal Symbol Clock	Framed Internally Generated Data
Internal	External	Normal	User's Bit Clock	NA	NA	Internal Bit Clock	Internal Symbol Clock	Framed Internally Generated Data
Internal	External	Symbol	User's Symbol Clock	NA	NA	Internal Bit Clock	Internal Symbol Clock	Framed Internally Generated Data
External [1]	Internal	NA	NA	NA	User's External Data [2]	Internal Bit Clock	Internal Symbol Clock	Internally Framed User's External Data
External[1]	External	Normal	User's Bit Clock	NA	User's External Data	Internal Bit Clock	Internal Symbol Clock	Internally Framed User's External Data
External[1]	External	Symbol	User's Symbol Clock	NA	User's External Data	Internal Bit Clock	Internal Symbol Clock	Internally Framed User's External Data

1. In all configurations where data is externally supplied, the rear panel EVENT 2 output must be used to gate the data into the internally generated frame data.
2. The front panel DATA input from the user's external data source must be clocked by the internal bit clock output from the rear panel DATA CLK OUT and be correctly phased with SYMBOL SYNC OUT.

Data Clock Timing Patterns

The following timing diagram shows the following information:

- external DATA CLOCK INPUT signal in normal and symbol modes

- SYMBOL SYNC INPUT signal in continuous and single modes

- symbol bits (2 bits per symbol)

- DATA INPUT pattern

Notice that the data should change (zero to one or one to zero) on the rising edge of the data clock and the data must be stable on the falling edge of the data clock.

```
Ext Data Clock
    Normal      ____|‾|_____|‾|_____|‾|_____|‾|_____|‾|____
    Symbol      ____|‾‾‾‾|_____|‾‾‾‾|_____|‾‾‾‾|_____

Symbol Sync
    Continuous  ____|‾‾|_____|‾‾|_____|‾‾|_____
    Single      ___|‾‾‾‾‾|_____

    Symbol Bit    |    1    |    2    |    1    |    2    |

    Data        =====X=======X=======X=======X=======X======
```
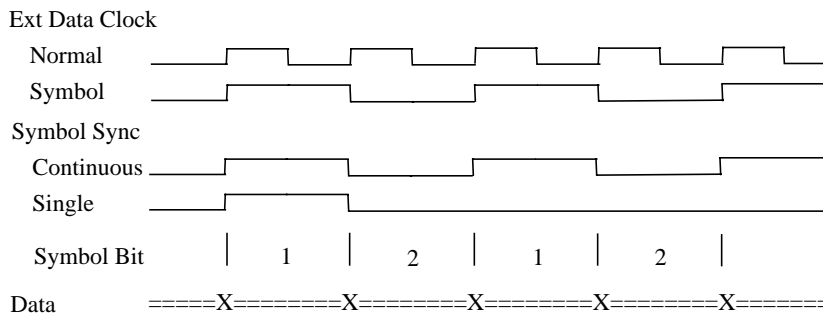
where X is data transition; = is data valid 0 or 1

Internally Framed External User Data

The following timing diagram shows the following information:

- DATA CLOCK OUT signal

- SYMBOL SYNC OUT signal in continuous mode (only applies to digital modulation modes with 2 bits per symbol)

- EVENT 2 OUT signal

- internal data pattern

- external data pattern

```
Data Clock Out    _|‾|_|‾|_|‾|_|‾|_|‾|_|‾|_|‾|_|‾|_|‾|_|‾|_|‾|_|‾|_

Symbol Sync Out   __|‾‾|__|‾‾|__|‾‾|__|‾‾|__|‾‾|__|‾‾|__|‾‾|__

Event 2 Out       ___|‾‾‾‾‾‾‾‾‾‾‾‾‾‾|_____|‾‾‾‾‾‾‾‾

Internal Data     ===x===x===x===x===x XXXXXXXXXXXXXXXXXXXXXXXX x===x===x

Ext. Data Input   XXXXXXXXXXXXXXXx===x===x===x===x===x===x===x===x XXXXXX
```
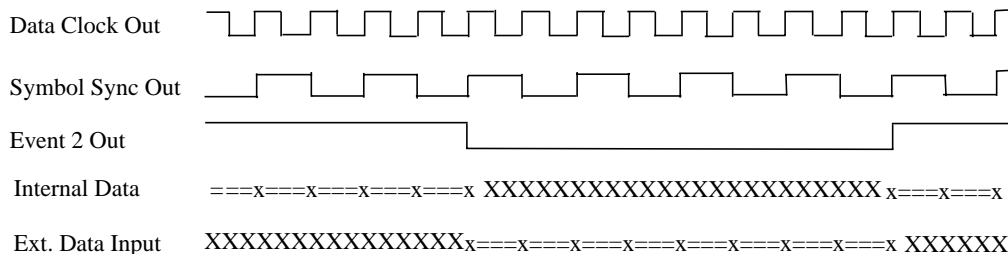
where x is data transition; = is data valid 0 or 1; X is data "don't care"

Frame/Pattern Triggering

The PATTERN TRIG IN connector is used to trigger the internal digital modulation data generator to start an unframed, continuous data pattern or a framed data output. This input accepts a CMOS low to CMOS high edge trigger. The minimum trigger input pulse width, high or low, is 100 ns.

NOTE	Pattern Repeat and Pattern Trigger functions are *not* available if you use either a PN data sequence, or an external data source.

The input trigger edge is latched and then sampled by the falling edge of the data bit clock to synchronize the trigger with the data bit clock timing.

The minimum delay from the trigger rising edge to the first bit of the frame is 1.5 to 2.5 bit clock periods. Trigger delay resolution is one data bit clock period. Setting the trigger delay equal to the frame bit count minus two will allow the frame to start within plus or minus one half of a bit clock of the trigger edge.

For example: The TETRA frame bit count total is 2040. If you set the delay to 2038, the frame will start within one half of a bit clock of the trigger edge.

You can also set the external delay bits function to a value greater than zero. One data bit clock period of delay is added per external delay bit to the start of the frame from the trigger. For delays set longer than the frame length, after a delay period is triggered, subsequent trigger pulses occurring up to seven bit clocks before that delay period ends will be ignored.

NOTE	The phase and frequency of the trigger and the frame start can be held constant by using the same frequency reference for both the signal generator and the external trigger source. To keep the phase constant but *not* aligned, use the HP ESG-D Series internal 10 MHz reference or an external 10 MHz reference for both sources. To keep the phase constant *and* aligned, use the HP ESG-D Series internal data clock or an external data clock for both sources.

Three examples follow with timing diagrams to demonstrate the frame/pattern triggering function. In all examples, external delay is off, the frame trigger is external, and the frame repeat function is set to single. (A continuous setting always causes the frame/pattern trigger input to be ignored.)

Example 1

In this example, the timing diagram shows the trigger occurring on time (1.5 to 2.5 bit clocks before the present frame ends) to generate continuous frame timing. The rising edge of the trigger is shown to occur at any time after the last bit clock falling edge and before the next bit clock falling edge.
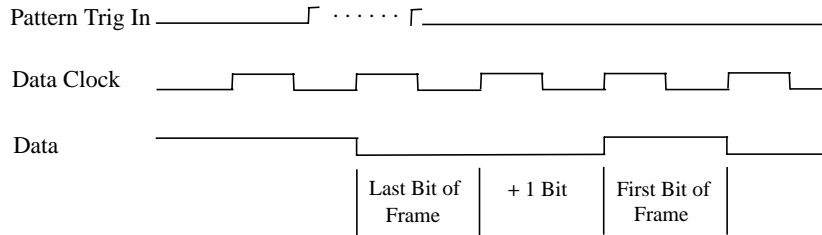
Example 2

In this example, two timing diagrams are shown. In the first, the trigger occurs late (1.5 to 0.5 bit clocks before the present frame ends). The outcome is an additional guard bit inserted between the last bit of the present frame and the first bit of the next frame.
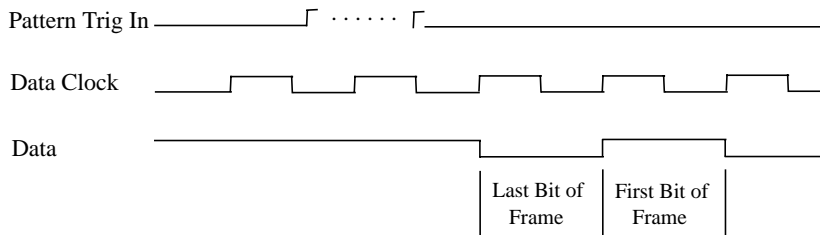
This timing diagram shows the trigger occurring between N − 1.5 to N − 2.5 bit clocks after the current frame ends. The first bit of the next frame begins N bit clocks after the current frame ends.
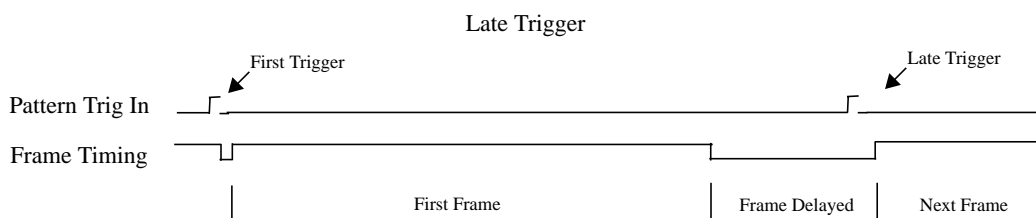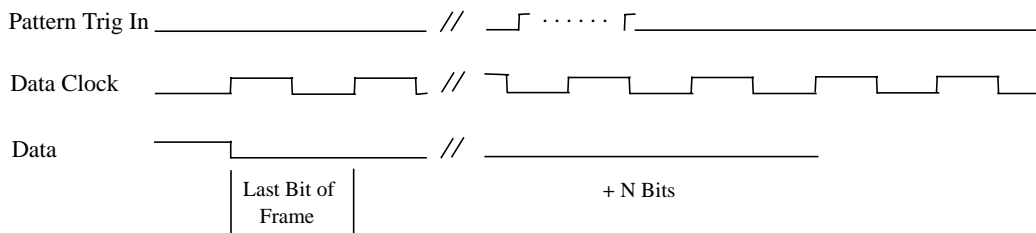
Example 3

This timing diagram shows the trigger occurring before the present frame ends. Trigger input is masked from the frame start until 2.5 bit clocks before the frame ends. Any triggers occurring during the mask are ignored. The next frame is delayed until the next valid trigger occurs.

Pattern Trig In

Data Clock

Data

Last Bit of
Frame

Early Trigger Ignored

First Trigger
Ignored Trigger
Valid Trigger

Pattern Trig In

Frame Timing

First Frame
Frame Delayed
Next Frame
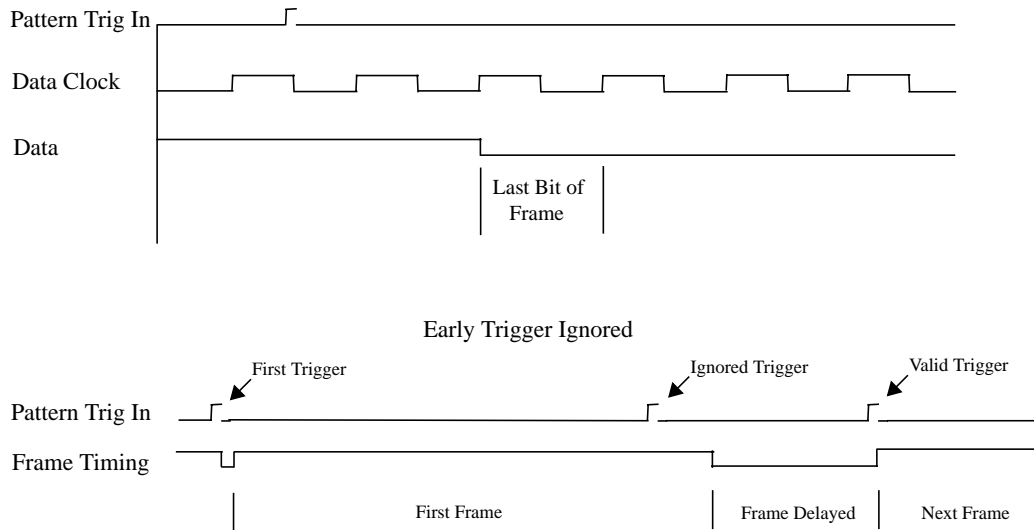
Alternate Amplitude and Alternate Timeslot Amplitude Control (Option UNA only)

The Alternate Amplitude Control feature comprises two separate subsystems, Alternate Amplitude and Alternate Timeslot Amplitude. The Alternate Amplitude Control subsystem provides the user with the capability of toggling the RF output power between a main amplitude and a definable alternate amplitude. The Alternate Timeslot Amplitude subsystem provides the capability of having different power levels on the transmitting digital data stream during framed data or non-framed external data.

Analog instruments with the Alternate Amplitude Control Option UNA are equipped with only the Alternate Amplitude subsystem. Digital instruments with baseband generators (Option UN8) have both Alternate Amplitude and Alternate Timeslot Amplitude subsystems.

NOTE	The two subsystems can operate independently or coupled depended on the configuration. Similar to data generation and I/Q Burst control, the firmware provides the most intuitive approach to signal coupling, but when necessary, the user can override all firmware couplings.

Table 4-3 Summary of Firmware Couplings

Mode State	Pattern/Framed Data	Alt State	Alt Trigger	RF Output	General Comments
OFF	N/A	ON	EXT	Main and Delta Toggling	Must supply trigger input to TRIGGER IN rear panel BNC
OFF	N/A	ON	MAN	Main and Delta Toggling	Use Softkey or remote command to toggle the RF
OFF	N/A	ON	INT	Main Only	INT trigger source has no effect when MODE OFF
ON	Int Pattern	OFF	N/A	Main or Delta (Manual Control)	Can manually turn on ALT and manually toggle RF
ON	Ext Pattern	ON	INT	Main and Delta toggling	Must supply trigger input to ALT PWR IN rear panel BNC
ON	Frame (all timeslots OFF)	OFF	N/A	NO RF	Alternate amplitude has no meaning when all timeslots are OFF

Mode State	Pattern/Framed Data	Alt State	Alt Trigger	RF Output	General Comments
ON	Frame (at least one timeslot ON with no delta selection)	OFF	N/A	MAIN power during ON timeslot	Alternate amplitude is OFF to avoid power drift when none of the timeslots are using Delta Amplitude.
ON	Frame (at least one timeslot ON with delta selection)	ON	INT	Assigned MAIN or DELTA power as selected	

For instruments with Option UN8, the alternate amplitude state is turned off to stabilize the circuitry and avoid subtle power drifting if a TDMA format is on and either all timeslots are off, or none of the timeslots turned on use alternate amplitude.

During non-framed/continuous EXT data transmission, alternate state is turned on (a signal must be provided at the ALT PWR IN rear panel BNC trigger input) to allow the capability of alternating the RF output power to the transmitting pattern. During these transmissions, the trigger rate determines the duration of the toggling amplitude. This can be useful in applications where external data, clock and symbol signals are provided for external framing. By providing a ALT PWR IN trigger in signal, different amplitudes can be positioned on the transmitting pattern, similar to the alternate timeslot amplitude effect with internal framing.

For analog instruments, the INT trigger source selection has no effect and this softkey is grayed out.

For instruments with Option UN8, unless a TDMA format or a Custom pattern modulation is turned on, the baseband generator does not function and the INT trigger source selection for alternate amplitude trigger has no effect.

User File Applications

Digital Modulation Data Programming with User Files Remote

Use the following SCPI command line to enter a user file for remote programming of the source's digital modulation:

`:MMEM:DATA "<file name>"`

Sample Command Line

A sample command line:

`:MMEM:DATA "<file name>",#ABC`

`"<file name>"` **the file name**

`A`   **the number of numeric digits to follow in B.**

`B`   **specifies the number of data bytes in C.**

`C`   **the digital modulation data.**

Example 1

In the following example, the data bytes are in ASCII.

```
:MMEM:DATA "NEWDATAFILE",#1912SA4D789
```
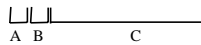
`"NEWDATAFILE"` **the file name**

`1`   defines the number of numeric digits to follow in B. After the #, this number points to the single digit 9 which defines the number of bytes of modulation data. (This variable is represented by A in the sample command line.)

`9`   reserves the 9 data digits (12SA4D789) that indicate the bytes (in ASCII) that are stored in the modulation data (C). This variable is represented by B in the sample command line.

`12SA4D789`   the digital modulation data in ASCII. This variable is represented by C in the sample command line.

Example 2

In the following example, the data bytes are in ASCII.

```
:MMEM:DATA "NEWDATAFILE1",#21012&A%4D789
                               └┘└┘└──────────┘
                                A  B      C
```

`"NEWDATAFILE1"` the file name

`2`	defines the number of numeric digits to follow in B. After the #, this number points to the double digit 10 which defines the number of bytes of modulation data. This variable is represented by A in the sample command line.
`10`	reserves the 10 data digits (12&A%4D789) that indicate the bytes (in ASCII) that are stored in the modulation data (C). This variable is represented by B in the sample command line.
`12&A%4D789`	the digital modulation data in ASCII. This variable is represented by C in the sample command line.

NOTE	A user file must contain enough data to fill the entire field(s) for which it is selected. If a user file containing a data pattern with less than the required number of bits is selected, the resulting signal will not be usable. For example, if you want to fill the data field of an uplink normal TETRA burst, the user file must contain at least 432 bits of data. If the data is downloaded using ASCII characters (which represent one byte of data per character), you must enter 54 bytes of data. The six least-significant bits of the 54th byte will be truncated.

Querying the User File's Digital Modulation Data

Use the following SCPI command line to query a digital modulation user file:

```
:MMEM:DATA?"<file name>"
```

Sample Command Line

A sample command line:

```
:MMEM:DATA?"<file name>"
```

`"<file name>"` the file name

Example 1

In the following example, the data bytes are returned in ASCII.

```
:MMEM:DATA?"NEWDATAFILE"
```

`"NEWDATAFILE"` the file name

The data will be returned in the same #ABC format used in the earlier sample: #1912SA4D789 (in ASCII).

Example 2

In the following example, the data bytes are in ASCII.

`:MMEM:DATA?"DATAFILE1"`

`"DATAFILE1"`   the file name

The data be returned in the same #ABC format used in the earlier sample:
#21012&A%4D789 (in ASCII).

Reviewing the Memory Catalog

The memory catalog can be used to review the existing user files and any new files that have been transferred to the source's mass memory. To review the memory catalog:

1. Switch the source's line power on.

2. Press **Utility** (located in the MENUS section of the instrument's front panel). If the instrument is in remote mode, first press the **Local** key to return the instrument to local control.

3. Press **Memory Catalog, Catalog Type.**

4. Press **All** to review all the files in the system.

5. Press **Binary** to review all of the existing binary files.

6. Press **State** to review all of the existing state files.

7. Press **List** to review all of the existing list files.

8. Press **FIR** to review all of the existing FIR filter files.

9. To review the I/Q modulation files, press **More (1 of 2), Modulation Catalog Types, I/Q.** To review the FSK modulation files, press **More (1 of 2), Modulation Catalog Types, FSK.**

User File Example Programs

The following user file example programs are provided to help you understand how to apply basic SCPI concepts. Example Programs 1 through 4 were created in HP Basic (version 6.0). Example Program 5, which provides the same function as Example Program 4, is written in the C programming language.

Example Program 1, Send a File and Data to the Source's User File Directory

```
10 Sig_gen=719
20 LOCAL Sig_gen
30 CLEAR Sig_gen
40 CLEAR SCREEN
50 OUTPUT Sig_gen;"*RST"
60 OUTPUT Sig_gen;":MMEM:DATA ""DATAFILE",#1912SA4D789"
70 END
```

Example Program 2, Query a File and Data in the Source's User File Directory

```
10 DIM A$[10000]
20 Sig_gen=719
30 LOCAL Sig_gen
40 CLEAR Sig_gen


50 CLEAR SCREEN
60 OUTPUT Sig_gen;"*RST"
70 OUTPUT Sig_gen;":MMEM:DATA?""DATAFILE"""
80 ENTER Sig_gen;A$
90 PRINT A$
100 END
```

Example Program 3, Create a TETRA User File

```
10 Sig_gen=719
20 LOCAL Sig_gen
30 CLEAR Sig_gen
40 CLEAR SCREEN
50 OUTPUT Sig_gen;"*RST"
60 OUTPUT Sig_gen;"RADIO:TETRa ON"
70 OUTPUT Sig_gen;"RADIO:TETRa:BURST:STATE ON"
80 OUTPUT Sig_gen;"RADIO:TETRa:SLOT1:STATE ON"
90 OUTPUT Sig_gen;"RADIO:TETRa:SLOT1:UNORmal"
100 OUTPUT Sig_gen;"RADIO:TETRa:SLOT1:UNORmal "datafile""
110 END
```

Example Program 4, Upload User Data Using Integer Arrays to the Source's User File Directory

```
10 DATA 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
20 DATA 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 30 INTEGER
A(1:15), B(1:15)
40 READ A(*)
50 OUTPUT 719 USING "K, 15(B) ";":MMEM:DATA ""TESTDATA"",#215",A(*)
60 OUTPUT 719;":MMEM:DATA?""TESTDATA"""
70 DIM A$[4]
80 ENTER &!( USING "K, 30(B)";A$,B(*)
90 PRINT A$, B(*)
100 END
```

Example Program 5, Upload User Data Using Integer Arrays to the Source's User File Directory (C Language Version)

```
#include <stdio.h>

#include <string.h>

/*

* The following routine must be substituted for one in the user's
HPIB library.

*/

extern write_hpib(int address, int size, unsigned char* data);

/* HPIB Port Address

*/
```

```
#define HPIB_ADDRESS 719

/* SCPI string token for loading data into instrument */

#define FILE_LOAD_SCPI_TOKEN ":MMEM:DATA \"%s\",#%d%s"

/* File name to create int the instrument*/

#define FILE_NAME "Newdatafile"

/*
* The following is the binary data to load into the instrument. For this example
the data * is incremental, and in general would be more random. This data can also
be read from * a file by the programmer. This data is similar to the Basic example
(Example Program 4).
*/

unsigned char db[] = {

1,2,3,4,5,6,7,8,9,10,11,12,13,14

15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31

};

int

main(void)

{

int db_size= sizeof(db)/sizeof(unsigned char);

char token_string[128];

char db_size_string[64];

int db_size_string_length;

unsigned char data_buffer[512];


sprintf(db_size_string, "%d", db_size);

db_size_string_length=strlen(db_size_string);

sprintf(token_string,

  FILE_LOAD_SCPI_TOKEN,

  FILE_NAME,

  db_size_string_length,

  db_size_string);

memcpy(data_buffer, token_string, strlen(token_string));

memcpy(data_buffer+strlen(token_string), db, db_size);

write_hpib(HPIB_ADDRESS, strlen(token_string)+db_size,
data_buffer);

return 0;

}
```

Understanding Differential Encoding

Differential encoding is a digital-encoding technique whereby a binary value is denoted by a signal change rather than a particular signal state. Using differential encoding, binary data in any user-defined I/Q or FSK modulation can be encoded during the modulation process via symbol table offsets defined in the Differential State Map.

For example, consider the signal generator's default 4QAM I/Q modulation. (To see an I/Q State Map of this modulation, press **Mode**, **Real Time BaseBand** (if this key appears), **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **QAM**, **4QAM**.) With a user-defined modulation based on the default 4QAM template, the I/Q State Map contains data that represent 4 symbols (00, 01, 10, and 11) mapped into the I/Q plane using 2 distinct values, 1.000000 and -1.000000. These 4 symbols can be differentially encoded during the modulation process by assigning symbol table offset values associated with each data value. The following illustration shows the 4QAM modulation in the I/Q State Map table editor.

| NOTE | The number of bits per symbol can be expressed using the following formula. Because the equation is a ceiling function, if the value of x contains a fraction, x is rounded up to the next whole number. |

$$x = \lceil Log_r(y) \rceil$$

Where x = bits per symbol, and y = the number of differential states.

The following illustration shows a 4QAM modulation I/Q State Map. (To see the map on the signal generator, press **Mode**, **Real Time BaseBand** (if this key appears), **TDMA**, **TETRA**, **More (1 of 2)**, **Modify Standard**, **Modulation Type**, **Define User I/Q**, **More (1 of 2)**, **Load Default I/Q Map**, **QAM**, **4QAM**, **More (2 of 2)**, **Display I/Q Map**.)
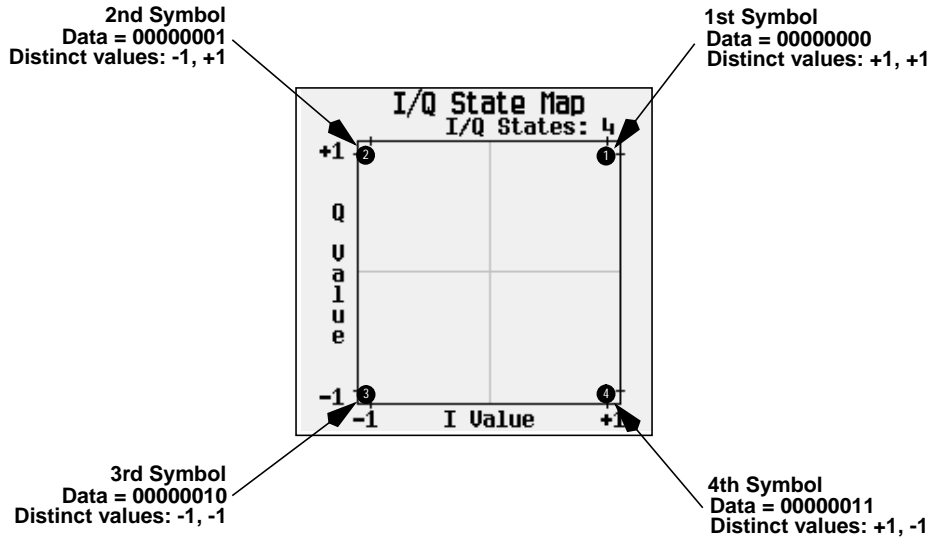
How Differential Encoding Works

Differential encoding employs offsets in the symbol table to encode user-defined modulation schemes. The Differential State Map editor is used to introduce symbol table offset values which in turn cause transitions through the I/Q State Map based on their associated data value. Whenever a data value is modulated, the offset value stored in the Differential State Map is used to encode the data by transitioning through the I/Q State Map in a direction and distance defined by the symbol table offset value.

Understanding The Differential State Map Editor

Pressing **Configure Differential Encoding** opens the Differential State Map editor. At this point, you see the data for the 1st symbol (00000000) and the cursor prepared to accept an offset value.

Data   **Symbol Table Offset Values Entry Area**
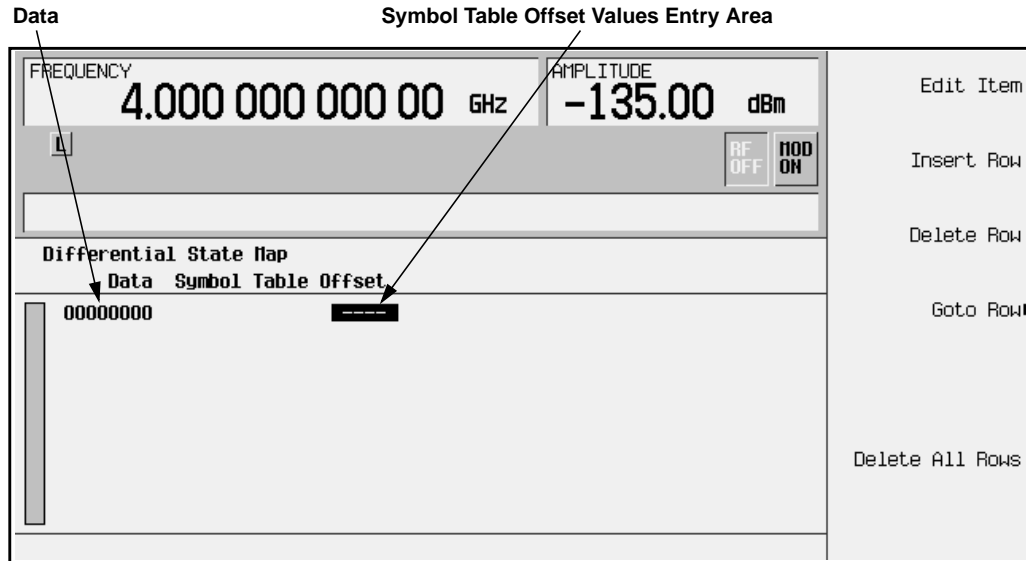
Entering a value of +1 will cause a 1-state forward transition through the I/Q State Map, as shown in the following illustration.

NOTE	The following I/Q State Map illustrations show all of the possible state transitions using a particular symbol table offset value. The actual state-to-state transition would depend upon which state the modulation had started in.

Entering the following values in the Differential State Map, and pressing **Return**, **Differential Encoding Off On** until **On** is highlighted, differentially encodes the user-defined I/Q or FSK modulation that is present in the I/Q State Map.

- For data 00000001, enter -1.

- For data 00000010, enter 2.

- For data 00000011, enter 0.

These symbol table offsets will result in one of the transitions shown in the following illustrations.

Data Value 00000000
with Symbol Table Offset +1
transition 1 state forward

Data Value 00000001
with Symbol Table Offset -1
transition 1 state backward

Data Value 00000010
with Symbol Table Offset +2
transition 2 states forward

Data Value 00000011
with Symbol Table Offset +0
no transition
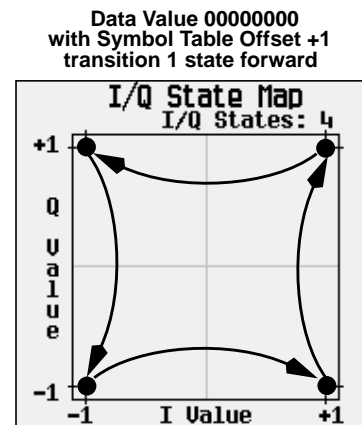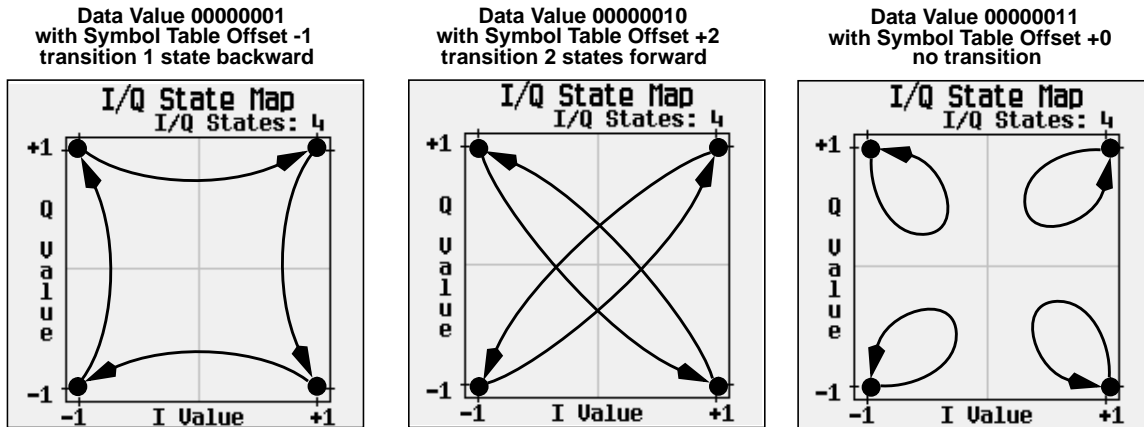
When applied to the user-defined default 4QAM I/Q map, starting from the 1st symbol (data 00), the differential encoding transitions for the data stream (in 2-bit symbols) 0011100001 appear in the following illustration.

Data Value	Symbol Table Offset
00	+1
01	-1
10	+2
11	+0
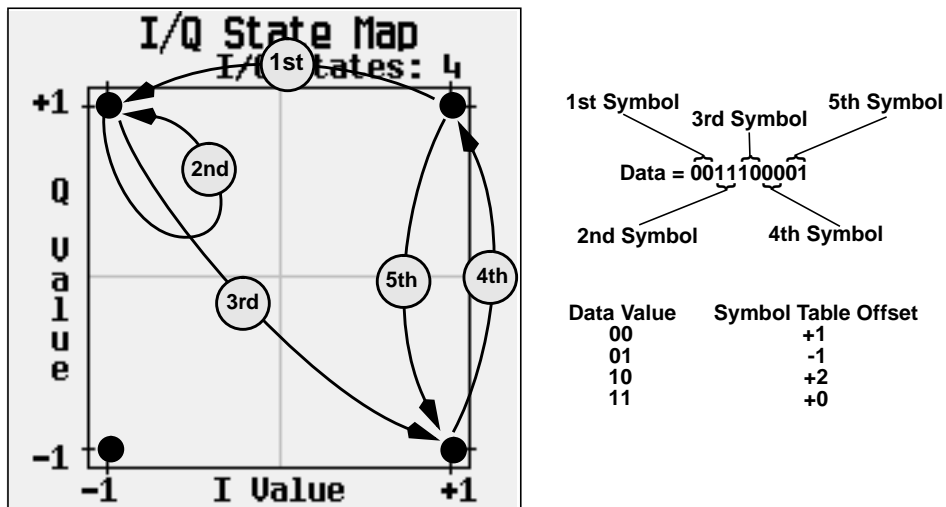
As you can see from the previous illustration, the 1st and 4th symbols, having the same data value (00), produce the same state transition (forward 1 state). In differential encoding, symbol values do not define location; they define the direction and distance of a *transition* through the I/Q State Map.

5 Remote Programming

This chapter contains a brief overview of the Standard Commands for Programmable Instruments (SCPI) programming language (including a command syntax description) and a listing of all of the TETRA subsystem SCPI commands in alphabetical order. The descriptions include syntax requirements, ranges, restrictions, query responses, and status at instrument preset.

Getting Started with SCPI

This section includes some basic reference material for the Standard Commands for Programmable Instruments language (SCPI). For more detailed information, see the Programming Guide.

Understanding Common Terms

The following terms are used throughout the remainder of this chapter.

Controller   A controller is any computer used to communicate with a SCPI instrument. A controller can be a personal computer, a minicomputer, or a plug-in card in a card cage. Some intelligent instruments can also function as controllers.

Instrument   An instrument is any device that implements SCPI. Most instruments are electronic measurement or stimulus devices, but this is not a requirement. Similarly, most instruments use an HP-IB or RS-232 interface for communication. The same concepts apply regardless of the instrument function or the type of interface used.

Program
Message   A program message is a combination of one or more properly formatted SCPI commands. Program messages always go from a controller to an instrument. Program messages tell the instrument how to make measurements and output signals.

Response
Message   A response message is a collection of data in specific SCPI formats. Response messages always go from an instrument to a controller or listening instrument. Response messages tell the controller about the internal state of the instrument and about measured values.

Command   A command is an instruction in SCPI. You combine commands to form messages that control instruments. In general, a command consists of mnemonics (keywords), parameters, and punctuation.

Query   A query is a special type of command. Queries instruct the instrument to make response data available to the controller. Query mnemonics always end with a question mark.

Standard Notation

This section uses several forms of notation that have specific meaning:

Command
Mnemonics   Many commands have both a long and a short form and you must use
             either one or the other (SCPI does not accept a combination of the two).
             Consider the `FREQuency` command, for example. The short form is `FREQ`
             and the long form is `FREQUENCY`. This notation type is a shorthand to
             document both the long and short form of commands. SCPI is not case
             sensitive, so `fREquEnCy` is just as valid as `FREQUENCY`, but `FREQ` and
             `FREQUENCY` are the only valid forms of the `FREQuency` command.

Angle
Brackets   Angle brackets indicate that the word or words enclosed represent
             something other than themselves. For example, `<new line>` represents the
             ASCII character with the decimal value 10. Similarly, `<END>` means that
             EOI is asserted on the HP-IB interface. Words in angle brackets have
             much more rigidly defined meaning than words shown in ordinary text.
             For example, this section uses the word "message" to talk about messages
             generally. But the bracketed words `<program message>` indicate a
             precisely defined element of SCPI. If you need them, you can find the exact
             definitions of words such as `<program message>` in a syntax diagram.

More About Commands

Query and Event Commands

You can query any value that you can set. For example, the presence of the signal
generator `FREQuency:OFFSet` command implies that a `FREQuency:OFFSet?` also exists. If
you see a command ending with a question mark, it is a query-only command. Some
commands are events and cannot be queried. An event has no corresponding setting if it
causes something to happen inside the instrument at a particular instant.

Implied Commands

Implied commands appear in square brackets. If you send a subcommand immediately
preceding an implied command, but do not send the implied command, the instrument
assumes you intend to use the implied command and behaves just as if you had sent it.
Notice that this means that the instrument expects you to include any parameters
required by the implied command. The following example illustrates equivalent ways to
program the signal generator using explicit and implied commands.

Example signal generator commands with and without an implied command:

           `FREQuency[:CW] 500 MHz`   using explicit commands

           `FREQuency 500 MHz`   using implied commands

Optional Parameters

Optional parameter names are enclosed in square brackets. If you do not send a value for an optional parameter, the instrument chooses a default value. The instrument's command dictionary documents the values used for optional parameters.

Command Syntax

Following the heading for each programming command entry is a syntax statement showing the proper syntax for the command. An example syntax statement is shown here:

```
POWer[:LEVel] MAXimum|MIN
```

Syntax statements read from left to right. In this example, the :LEVel portion of the statement immediately follows the POWer portion of the statement with no separating space. A separating space is legal only between the command and its argument. In this example, the portion following the [:LEVel] portion of the statement is the argument. Additional conventions used in the syntax statements are defined as follows:

- Italics are used to symbolize a program code parameter or query response.

- ::= means "is defined as."

- | (vertical bar) indicates a choice of one element from a list. For example, <A>|<B> indicates <A> or <B> but not both.

- [] (square brackets) indicate that the enclosed items are optional.

- Upper-case lettering indicates that the upper-case portion of the command is the minimum required for the command. For example, in the command FREQuency, FREQ is the minimum requirement.

- Lower-case lettering indicates that the lower-case portion of the command is optional; it can either be included with the upper-case portion of the command or omitted. For example, in the command FREQuency, either FREQ, or FREQUENCY is correct.

- ? after a subsystem command indicates that the command is a query.

TETRA Subsystem SCPI Command Reference

The TETRA subsystem SCPI commands are used to set the controls and the parameters associated with TETRA communications standard via a remote controller.

Baseband Generator Data Clock Input

```
[:SOURce]:RADio:TETRa:BBCLock INT[1]|EXT[1]
[:SOURce]:RADio:TETRa:BBCLock?
```

This command allows you to select the data (bit) clock input to the baseband generator board to either Internal or External. This command is independent in each mode and works for both non-burst (continuous) and burst modes. This allows for a matrix of selections between burst/non-burst, internal/external data generation, internal/external data clock, and external bit/symbol data clock.

This command sets the instrument's data clock input for the baseband generator. Choosing INT[1] selects the instrument's internal data clock. Choosing EXT[1] selects an external data clock input.

At *RST, this value is set to Internal.

Begin Timeslot

```
[:SOURce]:RADio:TETRa:SOUT:SLOT <value>
[:SOURce]:RADio:TETRa:SOUT:SLOT?
```

This command selects the timeslot to output a 1-bit signal to the EVENT 1 connector. This is only used when `[:SOURce]:RADio:TETRa:SOUT:` has `SLOT` selected.

Burst Shape, Falling Edge Delay

```
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:DELay <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:DELay?
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FDELay <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FDELay?
```

This command adjusts the falling edge delay of the burst.

Range: minimum and maximum values depend upon modulation type and symbol rate.

At *RST, this value is set to 0.000 bits.

Burst Shape, Falling Edge Time

```
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:TIME <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:TIME?
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FTIMe <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:FTIMe?
```

This command adjusts the falling edge time of the burst.

Range: minimum and maximum values depend upon modulation type and symbol rate.

At *RST, this value is set to 7.814 bits.

Burst Shape, Rising Edge Delay

```
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:DELay <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:DELay?
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RDELay <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RDELay?
```

This command adjusts the rising edge delay of the burst.

Range: minimum and maximum values depend upon modulation type and symbol rate.

At *RST, this value is set to -1.000 bits.

Burst Shape, Rising Edge Time

```
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:TIME <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:TIME?
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RTIMe <value>
[:SOURce]:RADio:TETRa:BURSt:SHAPe:RTIMe?
```

This command adjusts the rising edge time of the burst.

Range: minimum and maximum values depend upon modulation type and symbol rate.

At *RST, this value is set to 9.376 bits.

Burst State

```
[:SOURce]:RADio:TETRa:BURSt[:STATe] ON|OFF|1|0
[:SOURce]:RADio:TETRa:BURSt[:STATe]?
```

This command enables and disables the TETRA burst function. The choices are On (1) or Off (0). When you activate the TETRA burst, you will be transmitting framed data. This means that you will be bursting the timeslots that you have switched on and there will be no RF carrier during the off timeslots. This is true for all uplink channels and for all downlink discontinuous channels. However, if you have configured any timeslot as a downlink continuous channel, the RF signal is not switched off between timeslots. Switching the burst state to Off allows modulation of pseudo-random sequences, user files, 4-bit patterns, or clocked data.

At *RST, this value is set to Off.

Channel Band

```
[:SOURce]:RADio:TETRa:FCHannel:BAND STANdard
[:SOURce]:RADio:TETRa:FCHannel:BAND?
```

This command selects the TETRA channel band. At this time, the only channel band variable for this command is Standard. The output frequency depends on both the channel band and channel number selections.

At *RST, this value is set to Standard.

Channel Number

```
[:SOURce]:RADio:TETRa:FCHannel:NUMBer <number>
[:SOURce]:RADio:TETRa:FCHannel:NUMBer?
```

This command selects the TETRA channel number. The output frequency depends on both the channel band and channel number selections.

At *RST, this value is set to 1.

Data

```
[:SOURce]:RADio:TETRa:DATA PN9|PN11|PN15|PN20|PN23|FIX4|
"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:DATA?
```

This command sets a data pattern for unframed transmission. The choices are PN9 (pseudorandom bit pattern), PN11 (pseudorandom bit pattern), PN15 (pseudorandom bit pattern), PN20 (pseudorandom bit pattern), PN23 (pseudorandom bit pattern), FIX4 (4-bit repeating sequence data pattern), "<file name>" (a file in the catalog of binary files), Ext (external input data pattern), P4 (four 1's and four 0's), P8 (eight 1's and eight 0's), P16 (sixteen 1's and sixteen 0's), P32 (thirty-two 1's and thirty-two 0's), or P64 (sixty-four 1's and sixty-four 0's).

NOTE	Pattern Repeat and Pattern Trigger functions are *not* available if you use either a PN data sequence, or an external data source.

At *RST, this value is set to PN23.

Differential Encoding

```
:MEMory:DATA:FSK "<file name>",num_states,f0,f1,...
[,diff_state,num_diff_states,diff0,diff1,...]
```

```
:MEMory:DATA:IQ "<file name>",offsetQ,num_states,i0,q0,i1,q1,...
[,diff_state,num_diff_states,diff0,diff1,...]
```

The user-defined FSK modulation and user-defined I/Q modulation SCPI commands contain the differential encoding information. Before designing a differential encoding scheme, you must first define the FSK or I/Q modulation to be encoded. The actual differential encoding-related input appears bolded in the command listing above.

This command line enables you to define the differential encoding criteria.

diff_state   Toggle for differential encoding. (ON|OFF|1|0)

num_diff_
states   The number of differential states (0 through 256)

diff0   Value of first differential state (an integer value from -128 through +127)

diff1   Value of second differential state (an integer value from -128 through +127)

Downlink Custom Continuous Data Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom PN9|PN15|FIX4|
"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom?
```

This command configures the downlink continuous data field. The choices are timeslots 1 through 4 and PN9 (pseudorandom bit pattern), PN15 (pseudorandom bit pattern), FIX4 (4-bit repeating sequence data pattern), "<file name>" (a file in the catalog of binary files), or Ext (external input data pattern), P4 (four 1's and four 0's), P8 (eight 1's and eight 0's), P16 (sixteen 1's and sixteen 0's), P32 (thirty-two 1's and thirty-two 0's), or P64 (sixty-four 1's and sixty-four 0's).

At *RST, this value is set to PN9.

Downlink Custom Continuous FIX4

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom:FIX4 <0-15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom:FIX4?
```

This command configures the downlink continuous custom data field FIX4 value for the selected timeslot.

At *RST, this value is set to 0000 (binary).

Downlink Custom Discontinuous Data Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom PN9|PN15|FIX4|
"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom?
```

This command allows you to configure the selected downlink custom discontinuous data field. The choices are timeslots 1 through 4 and PN9 (pseudorandom bit pattern), PN15 (pseudorandom bit pattern), FIX4 (4-bit repeating sequence data pattern), "<file name>" (a file in the catalog of binary files), or Ext (external input data pattern), P4 (four 1's and four 0's), P8 (eight 1's and eight 0's), P16 (sixteen 1's and sixteen 0's), P32 (thirty-two 1's and thirty-two 0's), or P64 (sixty-four 1's and sixty-four 0's).

At *RST, this value is set to PN9.

Downlink Custom Discontinuous FIX4

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom:FIX4 <0-15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom:FIX4?
```

This command configures the downlink custom discontinuous data field FIX4 value for the selected timeslot.

At *RST, this value is set to 0000 (binary).

Downlink Normal Continuous Data Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]
PN9|PN15|FIX4|"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]?
```

This command allows you to configure the selected downlink normal continuous data field. The choices are timeslots 1 through 4 and PN9 (pseudorandom bit pattern), PN15 (pseudorandom bit pattern), FIX4 (4- bit repeating sequence data pattern), "<file name>" (a file in the catalog of binary files), or Ext (external input data pattern), P4 (four 1's and four 0's), P8 (eight 1's and eight 0's), P16 (sixteen 1's and sixteen 0's), P32 (thirty-two 1's and thirty-two 0's), or P64 (sixty-four 1's and sixty-four 0's).

At *RST, this value is set to PN9.

Downlink Normal Continuous FIX4

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]:FIX4 <0-15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]:FIX4?
```

This command configures the downlink normal continuous data field FIX4 value for the selected timeslot.

At *RST, this value is set to 0000 (binary).

Downlink Normal Continuous Timeslot Broadcast Bits 1 Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B1 <14 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B1?
```

This command sets the first 14 broadcast bits for the selected downlink normal continuous timeslot.

At *RST, this value is set to 0000 (hexadecimal).

Downlink Normal Continuous Timeslot Broadcast Bits 2 Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B2 <16 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B2?
```

This command sets the last 16 broadcast bits for the selected downlink normal continuous timeslot.

At *RST, this value is set to 0000 (hexadecimal).

Downlink Normal Continuous Timeslot Training Sequence Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:TSEQuence
<22 bit value>
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:TSEQuence?
```

This command specifies the normal training sequence bits (22-bit midamble) for the selected downlink normal continuous timeslot. When 1E90DE is selected, the data fields are scrambled as separate logical channels.

At *RST, this value is set to 343A74.

Downlink Normal Discontinuous Data Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal PN9|PN15|FIX4|
"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal?
```

This command allows you to configure the selected downlink normal discontinuous data field. The choices are timeslots 1 through 4 and PN9 (pseudorandom bit pattern), PN15 (pseudorandom bit pattern), FIX4 (4-bit repeating sequence data pattern), "<file name>" (a file in the catalog of binary files), or Ext (external input data pattern), P4 (four 1's and four 0's), P8 (eight 1's and eight 0's), P16 (sixteen 1's and sixteen 0's), P32 (thirty-two 1's and thirty-two 0's), or P64 (sixty-four 1's and sixty-four 0's).

At *RST, this value is set to PN9.

Downlink Normal Discontinuous FIX4

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:FIX4 <0-15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:FIX4?
```

This command configures the downlink normal discontinuous data field FIX4 value for the selected timeslot.

At *RST, this value is set to 0000 (binary).

Downlink Normal Discontinuous Timeslot Broadcast Bits 1 Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B1 <14 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B1?
```

This command sets the first 14 broadcast bits for the selected downlink normal discontinuous timeslot.

At *RST, this value is set to 0000 (hexadecimal).

Downlink Normal Discontinuous Timeslot Broadcast Bits 2 Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B2 <16 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B2?
```

This command sets the last 16 broadcast bits for the selected downlink normal continuous timeslot.

At *RST, this value is set to 0000 (hexadecimal).

Downlink Normal Discontinuous Timeslot Training Sequence Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:TSEQuence
<22 bit value>
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:TSEQuence?
```

This command specifies the normal training sequence bits (22-bit midamble) for the selected downlink normal discontinuous timeslot. When 1E90DE is selected, the data fields are scrambled as separate logical channels.

At *RST, this value is set to 343A74.

Downlink Synchronization Continuous Data Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA]PN9|PN15|FIX4|
"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA]?
```

This command allows you to configure the selected downlink synchronization continuous data field. The choices are timeslots 1 through 4 and PN9 (pseudorandom bit pattern), PN15 (pseudorandom bit pattern), FIX4 (4-bit repeating sequence data pattern), "<file name>" (a file in the catalog of binary files), or Ext (external input data pattern), P4 (four 1's and four 0's), P8 (eight 1's and eight 0's), P16 (sixteen 1's and sixteen 0's), P32 (thirty-two 1's and thirty-two 0's), or P64 (sixty-four 1's and sixty-four 0's).

At *RST, this value is set to PN9.

Downlink Synchronization Continuous FIX4

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA]:FIX4 <0–15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA]:FIX4?
```

This command configures the downlink continuous synchronization data field FIX4 value for the selected timeslot.

At *RST, this value is set to 0000 (binary).

Downlink Synchronization Continuous Frequency Correction Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:FCOR <80 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:FCOR?
```

This command sets the frequency correction bits for the selected downlink synchronization continuous data field.

At *RST, this value is set to FF0000000000000000FF.

Downlink Synchronization Continuous Synchronization Block Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:SSB <120 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:SSB?
```

This command sets the synchronization block bits for the selected downlink synchronization continuous timeslot.

At *RST, this value is set to 000000000000000000000000000000.

Downlink Synchronization Continuous Synchronization Training Sequence Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:STS <38 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:STS?
```

This command sets the synchronization training sequence for the selected downlink synchronization continuous timeslot.

At *RST, this value is set to 30673A7067.

Downlink Synchronization Continuous Timeslot Broadcast Bits Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:B <30 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:B?
```

This command sets the broadcast bits for the selected downlink synchronization continuous timeslot.

At *RST, this value is set to 00000000 (hexadecimal).

Downlink Synchronization Discontinuous Broadcast Bits Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:B <30 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:B?
```

This command sets the broadcast bits for the selected downlink synchronization discontinuous timeslot.

At *RST, this value is set to 00000000 (hexadecimal).

Downlink Synchronization Discontinuous FIX4

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA]:FIX4 <0-15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA]:FIX4?
```

This command configures the downlink discontinuous synchronization data field FIX4 value for the selected timeslot.

At *RST, this value is set to 0000 (binary).

Downlink Synchronization Discontinuous Frequency Correction Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:FCOR <80 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:FCOR?
```

This command sets the frequency correction bits for the selected downlink synchronization discontinuous timeslot.

At *RST, this value is set to FF0000000000000000FF.

Downlink Synchronization Discontinuous Synchronization Block Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:SSB <120 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:SSB?
```

This command sets the synchronization block bits for the selected downlink synchronization discontinuous timeslot.

At *RST, this value is set to 000000000000000000000000000000.

Downlink Synchronization Discontinuous Synchronization Training Sequence Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:STS <38 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:STS?
```

This command sets the synchronization training sequence for the selected downlink synchronization discontinuous timeslot.

At *RST, this value is set to 30673A7067.

External Data Clock

```
[:SOURce]:RADio:TETRa:EDCLock SYMBol|NORMal
[:SOURce]:RADio:TETRa:EDCLock?
```

This command allows you to set the external data clock use between Normal and Symbol. When you select Normal, you must supply a signal to the DATA CLOCK INPUT connector to clock the DATA and SYMBOL SYNC signals. When you select Symbol, no signal is required at the DATA CLOCK INPUT connector. Instead, the data is clocked on both the rising and falling edges of the SYMBOL SYNC signal.

This is a persistent state that is set to Normal at the factory.

External Trigger Delay

```
[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay <value>
[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay?
```

This command selects the number of delay bits for the external trigger delay. The choices for the variable are 0 to 65535.

At *RST, this value is set to 0.

External Trigger Delay State

```
[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay:STATe ON|OFF|1|0
[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay:STATe?
```

This command determines operating state of the external trigger delay. The choices are On (1) or Off (0).

At *RST, this value is set to Off.

Filter Alpha, Nyquist, or Root Nyquist

```
[:SOURce]:RADio:TETRa:ALPHa <value>
[:SOURce]:RADio:TETRa:ALPHa?
```

This command changes the Nyquist or root Nyquist filter's alpha value. The acceptable range for the variable `<value>` is 0.000 through 1.000.

This command is effective only *after* choosing a root Nyquist or Nyquist filter. It does not have an effect on other types of filters.

At *RST, this value is set to 0.350.

Filter BbT, Gaussian

```
[:SOURce]:RADio:TETRa:BBT <value>
[:SOURce]:RADio:TETRa:BBT?
```

This command changes the bandwidth-multiplied-by-bit-time (BbT) filter parameter. The acceptable range for the variable `<value>` is 0.100 through 1.000.

This command is effective only *after* choosing a Gaussian filter. It does not have an effect on other types of filters.

At *RST, this value is set to 0.350.

Filter Selection

```
[:SOURce]:RADio:TETRa:FILter RNYQuist|NYQuist|GAUSsian|RECTangle|
"<file name>"
```

```
[:SOURce]:RADio:TETRa:FILter?
```

This command selects the pre-modulation filter type. The choices are:

- `RNYQuist` - Root Nyquist filter

- `NYQuist` - Nyquist filter

- `GAUSsian` - Gaussian filter

- `RECTangle` - Rectangle filter

- `"<file name>"` - Any filter file that you have either created externally and downloaded into memory, or that you have created internally in the Define User FIR menu and then subsequently stored.

At *RST, this value is set to root Nyquist.

Filter Optimization

```
[:SOURce]:RADio:TETRa:CHANnel EVM|ACP
[:SOURce]:RADio:TETRa:CHANnel?
```

This command is used to optimize the filter for minimized error vector magnitude (select EVM) or for minimized adjacent channel power (select ACP). The EVM selection provides the most ideal passband. The ACP selection improves stopband rejection. This feature only applies to root Nyquist and Nyquist filters. The softkey is grayed out when any other filter is selected.

At *RST, this value is set to EVM.

FIX4 Data

```
[:SOURce]:RADio:TETRa:DATA:FIX4 <0-15>
[:SOURce]:RADio:TETRa:DATA:FIX4?
```

This command sets a 4-bit repeating sequence data pattern for unframed data.

At *RST, this value is set to 0000 (binary).

Frame/Pattern Repeat

```
[:SOURce]:RADio:TETRa:REPeat SINGle|CONTinuous
[:SOURce]:RADio:TETRa:REPeat?
```

This command sets the output of the data pattern you have selected. The choices are Single or Continuous. Choose Single to output one occurrence of the data pattern you have selected. Set to Continuous to output a continuous stream of your data pattern.

At *RST, this value is set to Continuous.

Frequency Channels State

```
[:SOURce]:RADio:TETRa:FCHannel[:STATe] ON|OFF|1|0
[:SOURce]:RADio:TETRa:FCHannel[:STATe]?
```

This command enables or disables the Frequency Channels mode. Once enabled, the instrument's RF output will be controlled by the channel number and channel band settings.

At *RST, this value is set to Off.

Modulation Configuration

Modulation Type

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE] BPSK|QPSK|IS95QPSK|GRAYQPSK|OQPSK|
IS95OQPSK|P4DQPSK|PSK8|PSK16|D8PSK|MSK|FSK2|FSK4|FSK8|FSK16|C4FM|QAM4|QAM16|
QAM32|QAM64|QAM256|UIQ|UFSK
```

```
[:SOURce]:RADio:TETRa:MODulation[:TYPE]?
```

This command sets the custom modulation to one of the available formats.

Status after *RST: `P4DQPSK`

Selecting a Custom FSK or I/Q Modulation File

`UFSK` "<file name>" defines the prestored FSK file that you want to use.
```
[:SOURce]:RADio:TETRa:MODulation:UFSK "<file name>"
[:SOURce]:RADio:TETRa:MODulation:UFSK?
```

This information is held in memory until you send the command that selects user FSK as the modulation type.
```
[:SOURce]:RADio:TETRa:MODulation:TYPE UFSK
```

`UIQ` "<file name>" defines the prestored I/Q file that you want to use.
```
[:SOURce]:RADio:TETRa:MODulation:UIQ "<file name>"
[:SOURce]:RADio:TETRa:MODulation:UIQ?
```

This information is held in memory until you send the command that selects user I/Q as the modulation type.
```
[:SOURce]:RADio:TETRa:MODulation:TYPE UIQ
```

Creating a Custom FSK Modulation

```
:MEMory:DATA:FSK "<file name>",num_states,f0,f1,...
[,diff_state,num_diff_states,diff0,diff1,...]
```

This command enables you to define and store a custom FSK file.

`"<file name>"` The name under which to store the defined FSK information

`num_states` Number of frequency states (2 through 16)

`f0` Value of the first frequency

`f1` Value of the second frequency

`diff_state` Toggle for differential encoding. (ON|OFF|1|0)

`num_diff_states` The number of differential states (0 through 256)

`diff0` Value of first differential state (an integer value from -128 through +127)

`diff1` Value of second differential state (an integer value from -128 through +127)

Example

The following example creates and stores a four–level FSK file named 4FSK that has four states (frequencies) of -2 kHz, -1 kHz, 2 kHz, 1 kHz. Differential encoding is toggled ON, and there are two differential states: 1 and 0.

`:MEM:DATA:FSK "4FSK",4,-2 kHz,-1 kHz,2 kHz,1 kHz,ON,2,1,0`

Creating a Custom I/Q Modulation

```
:MEMory:DATA:IQ "<file name>",offsetQ,num_states,i0,q0,i1,q1,...
[,diff_state,num_diff_states,diff0,diff1,...]
```

This command enables you to define and store a custom I/Q file.

`"<file name>"` The name under which to store the defined I/Q information

`offsetQ` Whether the Q output is delayed by 1/2 symbol from the I output (OFF|ON|0|1)

`num_states` Number of symbols (2 through 256)

`i0` I value of first symbol (-1 through +1)

`q0` Q value of first symbol (-1 through +1)

`diff_state` Toggle for differential encoding. (ON|OFF|1|0)

`num_diff_states` The number of differential states (0 through 256)

`diff0` Value of first differential state (an integer value from -128 through +127)

`diff1` Value of second differential state (an integer value from -128 through +127)

Example

The following example creates and stores a two-symbol I/Q file named testBPSK that has offset Q turned on.

`:MEM:DATA:IQ "testBPSK",1,2,1,0,0,0`

FSK Frequency Deviation

```
[:SOURce]:RADio:TETRa:MODulation:FSK[:DEViation] <val><unit>
[:SOURce]:RADio:TETRa:MODulation:FSK[:DEViation]?
```

This command selects symmetric FSK frequency deviation; to define an asymmetric or different convention than the default, see "Creating a Custom FSK Modulation" on page 5-17.

Range: 0 Hz is the minimum value; the maximum value depends upon the symbol rate.

Status after *RST: 400.0 Hz

MSK Phase Deviation

```
[:SOURce]:RADio:TETRa:MODulation:MSK[:PHASe] <val><unit>
[:SOURce]:RADio:TETRa:MODulation:MSK[:PHASe]?
```

This command selects MSK phase deviation.

Range: 0 to 100 degrees.

Status after *RST: 90.00 degrees

Phase Polarity

```
[:SOURce]:RADio:TETRa:POLarity[:ALL] NORMal|INVerted
[:SOURce]:RADio:TETRa:POLarity[:ALL]?
```

This command sets the direction of rotation of the phase modulation vector. The choices are Normal or Inverted. Choose Inverted and, in the resulting modulation, the in-phase component will lag the quadrature-phase component by 90°. The inverted selection also applies to the I OUT and QOUT signals.

At *RST, this value is set to Normal.

RNYQ Optimization

```
[:SOURce]:RADio:TETRa:CHANnel EVM|ACP
[:SOURce]:RADio:TETRa:CHANnel?
```

This command allows you to optimize slight imperfections in the RNYQ filter to minimize either error vector magnitude (EVM) or adjacent channel power (ACP). Select EVM for a more ideal passband and select ACP for improved stopband rejection.

At *RST, this value is set to EVM.

Secondary Frame, Recalling

```
[:SOURce]:RADio:TETRa:SECondary:RECall
```

This command recalls the secondary frame instrument state, destroying the current instrument state.

Secondary Frame, Saving

```
[:SOURce]:RADio:TETRa:SECondary:SAVE
```

This command saves the current instrument state as the instrument state to use to generate the secondary frame pattern when the secondary frame state is activated. The file is saved under the name TETRA_SECONDARY_STATE.

Scramble Seed

```
[:SOURce]:RADio:TETRa:BURSt:SCRamble:SEED <32 bit value>
[:SOURce]:RADio:TETRa:BURSt:SCRamble:SEED?
```

This command allows you to select a seed for use in the scramble feature.

At *RST, this value is set to FFFFFFFF.

Scramble State

```
[:SOURce]:RADio:TETRa:BURSt:SCRamble[:STATe] ON|OFF|1|0
[:SOURce]:RADio:TETRa:BURSt:SCRamble[:STATe]?
```

This command selects the operating state of the scramble feature. The choices are On (1) and Off (0). When the scramble capability is activated, data on the related fields will be scrambled using the seed setting.

At *RST, this value is set to Off.

Secondary Frame State

```
[:SOURce]:RADio:TETRa:SECondary[:STATe] ON|OFF|1|0
[:SOURce]:RADio:TETRa:SECondary[:STATe]?
```

This command enables and disables the secondary frame function. The choices are On (1) or Off (0).

At *RST, this value is set to Off.

Select EVENT 1 Connector Output

```
[:SOURce]:RADio:TETRa:SOUT FRAME|SLOT|ALL
[:SOURce]:RADio:TETRa:SOUT?
```

This command sets the type of output at the EVENT 1 connector. The choices are Frame (to output a 1-bit signal to the EVENT 1 rear panel connector that is synchronized to the bit selected by the synchronization output offset of a framed data pattern), Slot (to output a 1-bit signal to the EVENT 1 rear panel connector that is synchronized to the bit selected by the synchronization output offset of a selected timeslot), or All (to output a 1-bit signal to the EVENT 1 rear panel connector that is synchronized to the bit selected by the synchronization output offset of each timeslot in a frame).

At *RST, this value is set to Frame.

Select Secondary Frame Trigger

```
[:SOURce]:RADio:TETRa:SECondary:TRIGger[:SOURce] KEY|EXT|BUS
[:SOURce]:RADio:TETRa:SECondary:TRIGger[:SOURce]?
```

This command selects the type of triggering for the secondary frame. The choices are Key (trigger using the front panel **Trigger** key), Ext (trigger using an external trigger supplied to the TRIGGER IN connector), or Bus (trigger with a command sent over HP-IB).

At *RST, this value is set to Key.

Symbol Rate

```
[:SOURce]:RADio:TETRa:BRATe <value>
[:SOURce]:RADio:TETRa:BRATe?

[:SOURce]:RADio:TETRa:SRATe <value>
[:SOURce]:RADio:TETRa:SRATe?
```

NOTE	The `BRATe` SCPI command sets the bit rate. The bit rate is adjusted to reflect symbol rate dependent on the number of bits per symbol for the modulation type.

This command sets the number of transmission symbols per second. Values range from 47.684 ksps to 12.500 Msps but will vary depending on the modulation type.

At *RST, this value is set to 18.000 ksps.

Synchronization Output Offset

```
[:SOURce]:RADio:TETRa:SOUT:OFFSet <value>
[:SOURce]:RADio:TETRa:SOUT:OFFSet?
```

This command moves the synchronization signal forward or back from the beginning of the data frame or timeslot. The choices for the variable <value> are −509 through +509 bits.

At *RST, this value is set to 0 bits.

TETRA State

```
[:SOURce]:RADio:TETRa[:STATe] ON|OFF|1|0
[:SOURce]:RADio:TETRa[:STATe]?
```

This command enables and disables the TETRA communications standard. The choices are On (1) or Off (0). Executing this command with ON sets up the internal hardware to generate a signal that follows the TETRA protocol. The internal I/Q modulator generates π/4DQPSK digital modulation and the `TETRA` and `I/Q` annunciators are switched on in the display. Although the digital modulation is enabled with this command, the RF carrier is modulated by the enabled modulation only when you have also activated the modulation.

At *RST, this value is set to Off.

Timeslot Amplitude Configuration (Option UNA only)

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:POWer MAIN|DELTa
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:POWer?
```

This command allows you to toggle the selected timeslot RF output power as main or alternate (delta). This feature is only available with the Alternate Power Control Option UNA.

At *RST, this value is set to Main.

Timeslot State

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:STATe ON|OFF|1|0
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:STATe?
```

This command enables and disables the selected timeslot. The choices are On (1) or Off (0). Continuous timeslots cannot be disabled.

At *RST, this value is set to Timeslot 1 On.

Timeslot Type

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE]
UCUSTom|UC1|UC2|UNORmal|DDNormal|DDSync|DCNormal|DCSync|DDCustom|DCCustom
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE]?
```

This command allows you to set the timeslot type for the selected timeslot. The choices are timeslots 1 through 4 and Uplink Custom, Uplink Control 1, Uplink Control 2, Uplink Normal, Downlink Discontinuous Normal, Downlink Discontinuous Synchronization, Downlink Continuous Normal, Downlink Continuous Synchronization, Downlink Discontinuous Custom, and Downlink Continuous Custom.

When Downlink is selected and the frame was Uplink, the following mapping is made to convert the Uplink protocols to Downlink. Also, an error will be generated.

From	To (Continuous Downlink Selected)	To (Discontinuous Downlink Selected)
UCUSTom	DCCustom	DDCustom
UC1	DCCustom	DDCustom
UC2	DCCustom	DDCustom
UNORmal	DCNormal	DDNormal

When Uplink is selected and the frame was Downlink, the following mapping is made to convert the Downlink protocols to Uplink. Also, an error will be generated.

From	To
DCCustom/ DDCustom	UCUSTom
DCNormal/ DDNormal	UNORmal
DCSync/ DDSync	UCUSTom

When continuous downlink protocols are selected, all timeslots must be on, and they cannot be turned off. Any attempts to do so will generate an error.

At *RST, this value is set to Uplink Normal for all Timeslots.

Trigger Mode

```
[:SOURce]:RADio:TETRa:TRIGger[:SOURce] KEY|EXT|BUS
[:SOURce]:RADio:TETRa:TRIGger[:SOURce]?
```

This command sets the mode for triggering your data. The choices are Key (trigger using the front panel **Trigger** key), Ext (trigger using an external trigger supplied to the TRIGGER IN connector), or Bus (trigger with a command sent over HP-IB).

At *RST, this value is set to Key.

Uplink Control 1 Data Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] PN9|PN15|FIX4|
"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA]?
```

This command allows you to configure the selected uplink control 1 data field. The choices are timeslots 1 through 4 and PN9 (pseudorandom bit pattern), PN15 (pseudorandom bit pattern), FIX4 (4-bit repeating sequence data pattern), "<file name>" (a file in the catalog of binary files), or Ext (external input data pattern), P4 (four 1's and four 0's), P8 (eight 1's and eight 0's), P16 (sixteen 1's and sixteen 0's), P32 (thirty-two 1's and thirty-two 0's), or P64 (sixty-four 1's and sixty-four 0's).

At *RST, this value is set to PN9.

Uplink Control 1 FIX4

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA]:FIX4 <0-15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA]:FIX4?
```

This command configures the uplink control 1 data field FIX4 value for the selected timeslot.

At *RST, this value is set to 0000 (binary).

Uplink Control 1 Training Sequence Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1:TSEQuence <30 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1:TSEQuence?
```

This command specifies the extended training sequence bits (30-bit midamble) for the selected uplink control 1 timeslot.

At *RST, this value is set to 2743A743.

Uplink Control 2 Data Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] PN9|PN15|FIX4|
"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA]?
```

This command allows you to configure the selected uplink control 2 data field. The choices are timeslots 1 through 4 and PN9 (pseudorandom bit pattern), PN15 (pseudorandom bit pattern), FIX4 (4-bit repeating sequence data pattern), "<file name>" (a file in the catalog of binary files), or Ext (external input data pattern), P4 (four 1's and four 0's), P8 (eight 1's and eight 0's), P16 (sixteen 1's and sixteen 0's), P32 (thirty-two 1's and thirty-two 0's), or P64 (sixty-four 1's and sixty-four 0's).

At *RST, this value is set to PN9.

Uplink Control 2 FIX4

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA]:FIX4 <0-15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA]:FIX4?
```

This command configures the uplink control 2 data field FIX4 value for the selected timeslot.

At *RST, this value is set to 0000 (binary).

Uplink Control 2 Training Sequence Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2:TSEQuence <30 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2:TSEQuence?
```

This command specifies the extended training sequence bits (30-bit midamble) for the selected uplink control 2 timeslot.

At *RST, this value is set to 2743A743.

Uplink Custom Data Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUSTom PN9|PN15|FIX4|
"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUSTom?
```

This command allows you to configure the uplink custom data field. The choices are timeslots 1 through 4 and PN9 (pseudorandom bit pattern), PN15 (pseudorandom bit pattern), FIX4 (4-bit repeating sequence data pattern), "<file name>" (a file in the catalog of binary files), or Ext (external input data pattern), P4 (four 1's and four 0's), P8 (eight 1's and eight 0's), P16 (sixteen 1's and sixteen 0's), P32 (thirty-two 1's and thirty-two 0's), or P64 (sixty-four 1's and sixty-four 0's).

At *RST, this value is set to PN9.

Uplink Custom FIX4

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUSTom:FIX4 <0-15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUSTom:FIX4?
```

This command allows you to configure the selected uplink custom data field to FIX4 (4-bit repeating sequence data pattern).

At *RST, this value is set to 0000 (binary).

Uplink Normal Data Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] PN9|PN15|FIX4|
"<file name>"|EXT|P4|P8|P16|P32|P64
```

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA]?
```

This command allows you to configure the selected uplink normal data field. The choices are timeslots 1 through 4 and PN9 (pseudorandom bit pattern), PN15 (pseudorandom bit pattern), FIX4 (4-bit repeating sequence data pattern), "<file name>" (a file in the catalog of binary files), or Ext (external input data pattern), P4 (four 1's and four 0's), P8 (eight 1's and eight 0's), P16 (sixteen 1's and sixteen 0's), P32 (thirty-two 1's and thirty-two 0's), or P64 (sixty-four 1's and sixty-four 0's).

At *RST, this value is set to PN9.

Uplink Normal FIX4

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA]:FIX4 <0-15>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA]:FIX4?
```

This command configures the uplink normal data field FIX4 value for the selected timeslot.

At *RST, this value is set to 0000 (binary).

Uplink Normal Training Sequence Field

```
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal:TSEQuence <22 bit value>
[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal:TSEQuence?
```

This command specifies the extended training sequence bits (22-bit midamble) for the selected uplink normal timeslot. When 1E90DE is selected, the data fields are scrambled as separate logical channels.

At *RST, this value is set to 343A74.

User FIR Definition

```
MEMory:DATA:FIR "<file name>",osr,coefficient{,coefficient}
MEMory:DATA:FIR? "<file name>"
```

This command is used to define User FIR filters. The instrument hardware is limited to filters with a maximum length of 32 symbols, an oversample ratio between 4 and 16, and 256 coefficients. If your filter has more than 32 symbols or 256 coefficients, the instrument will be unable to use the filter. If the oversample ratio is different from the internal optimally selected one, the filter will be resampled to the optimal possible oversample ratio.

6 Programming Command Cross-Reference

This section lists TETRA hardkeys and softkeys and their corresponding SCPI commands. For a complete list of the signal generator's hardkeys and softkeys and their corresponding SCPI commands, refer to the main programming guide.

Table 6-1 Mode - TETRA Softkeys

Key	SCPI Command
π/4DPSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] P4DQPSK`
2–Lvl FSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] FSK2`

4 1's & 4 0's	`[:SOURce]:RADio:TETRa:DATA P4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom P4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom P4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] P4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] P4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] P4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] P4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] P4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] P4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] P4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] P4`

4–Lvl FSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] FSK4`
4QAM	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] QAM4`

8 1's & 8 0's	`[:SOURce]:RADio:TETRa:DATA P8`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom P8`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom P8`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] P8`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] P8`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] P8`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] P8`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] P8`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] P8`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] P8`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] P8`

8–Lvl FSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] FSK8`
8PSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] PSK8`

16 1's & 16 0's	`[:SOURce]:RADio:TETRa:DATA P16`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom P16`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom P16`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] P16`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] P16`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] P16`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] P16`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] P16`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] P16`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] P16`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] P16`

16–Lvl FSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] FSK16`
16PSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] PSK16`
16QAM	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] QAM16`

Key	SCPI Command

32 1's & 32 0's	`[:SOURce]:RADio:TETRa:DATA P32`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom P32`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom P32`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] P32`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] P32`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] P32`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] P32`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] P32`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] P32`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] P32`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] P32`

32QAM	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] QAM32`

64 1's & 64 0's	`[:SOURce]:RADio:TETRa:DATA P64`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom P64`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom P64`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] P64`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] P64`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] P64`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] P64`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] P64`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] P64`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] P64`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] P64`

64QAM	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] QAM64`
256QAM	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] QAM256`
All Timeslots	`[:SOURce]:RADio:TETRa:SOUT ALL`

B	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:B <30 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:B?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:B <30 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:B?`

B1	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B1 <14 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B1?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B1 <14 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B1?`

B2	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B2 <16 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:B2?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B2 <16 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:B2?`

BBG Data Clock Ext Int	`[:SOURce]:RADio:TETRa:BBCLock INT[1]|EXT[1]` `[:SOURce]:RADio:TETRa:BBCLock?`
Begin Frame	`[:SOURce]:RADio:TETRa:SOUT FRAME`
Begin Pattern	`[:SOURce]:RADio:TETRa:SOUT FRAME`

Key	SCPI Command

Begin Timeslot	`[:SOURce]:RADio:TETRa:SOUT SLOT`
	`[:SOURce]:RADio:TETRa:SOUT:SLOT <1 - 4>`
	`[:SOURce]:RADio:TETRa:SOUT:SLOT?`

BPSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] BPSK`
Bus	`[:SOURce]:RADio:TETRa:TRIGger[:SOURce] BUS` `[:SOURce]:RADio:TETRa:SECondary:TRIGger[:SOURce] BUS`
C4FM	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] C4FM`
Channel Band	`[:SOURce]:RADio:TETRa:FCHannel:BAND` `STANdard[:SOURce]:RADio:TETRa:FCHannel:BAND?`
Channel Number	`[:SOURce]:RADio:TETRa:FCHannel:NUMBer <number>` `[:SOURce]:RADio:TETRa:FCHannel:NUMBer?`

Configure Differential Encoding	`:MEMory:DATA:FSK "<file name>",num_states,f0,f0,...`
	`[,diff_state,num_diff_states,diff0,diff1,...]`
	
	`:MEMory:DATA:UIQ "<file name>",offsetQ,num_states,i0,q0,`
	`i1,q1,...[,diff_state,num_diff_states,diff0,diff1,...]`

Configure Dn Custom Cont	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom?`
Configure Dn Custom Disc	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom?`
Configure Up Custom	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom?`
D8PSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] D8PSK`

Data	`[:SOURce]:RADio:TETRa:DATA?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA]?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA]?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA]?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA]?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA]?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA]?`

Data Format Pattern Framed	`[:SOURce]:RADio:TETRa:BURSt[:STATe] ON|OFF|1|0` `[:SOURce]:RADio:TETRa:BURSt[:STATe]?`

Define User FIR	`:MEMory:DATA:FIR "<file name>",osr,coefficient`
	`{,coefficient}`
	`:MEMory:DATA:FIR?`

Differential Encoding Off On	`:MEMory:DATA:FSK "<file name>",num_states,f0,f0,...`
	`[,diff_state,num_diff_states,diff0,diff1,...]`
	
	`:MEMory:DATA:UIQ "<file name>",offsetQ,num_states,i0,q0,`
	`i1,q1,...[,diff_state,num_diff_states,diff0,diff1,...]`

Key	SCPI Command
Dn Custom Cont	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DCCustom`
Dn Custom Disc	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DDCustom`
Dn Normal Cont	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DCNormal`
Dn Normal Disc	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DDNormal`
Dn Sync Cont	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DCSync`
Dn Sync Disc	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] DDSync`

Ext	`[:SOURce]:RADio:TETRa:DATA EXT`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom EXT`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom EXT`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] EXT`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] EXT`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] EXT`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] EXT`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] EXT`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] EXT`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] EXT`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] EXT`
	`[:SOURce]:RADio:TETRa:TRIGger[:SOURce] EXT`
	`[:SOURce]:RADio:TETRa:SECondary:TRIGger[:SOURce] EXT`

Ext Data Clock Normal Symbol	`[:SOURce]:RADio:TETRa:EDCLock SYMBol|NORMal` `[:SOURce]:RADio:TETRa:EDCLock?`
Ext Delay Bits	`[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay <value>` `[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay?`

Ext Delay Off On	`[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay`
	`:STATe ON|OFF|1|0`
	
	`[:SOURce]:RADio:TETRa:TRIGger[:SOURce]:EXTernal:DELay:STATe?`

Fall Delay	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:DELay <value>`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:DELay?`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:FDELay <value>`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:FDELay?`

Fall Time	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:TIME <value>`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:FALL:TIME?`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:FTIMe <value>`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:FTIMe?`

FCOR	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:FCOR <80 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:FCOR?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:FCOR <80 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:FCOR?`

Filter Alpha	`[:SOURce]:RADio:TETRa:ALPHa <value>` `[:SOURce]:RADio:TETRa:ALPHa?`

Key	SCPI Command
Filter BbT	`[:SOURce]:RADio:TETRa:BBT <value>` `[:SOURce]:RADio:TETRa:BBT?`

FIX4	`[:SOURce]:RADio:TETRa:DATA FIX4`
	`[:SOURce]:RADio:TETRa:DATA:FIX4 <0-15>`
	`[:SOURce]:RADio:TETRa:DATA:FIX4?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUSTom FIX4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom:FIX4 <0-15>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom:FIX4?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom FIX4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom:FIX4 <0-15>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom:FIX4?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] FIX4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]`
	`:FIX4 <0-15>`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA]:FIX4?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] FIX4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA]:FIX4 <0-15>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA]:FIX4?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] FIX4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA]`
	`:FIX4 <0-15>`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA]:FIX4?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] FIX4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA]`
	`:FIX4 <0-15>`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA]:FIX4?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] FIX4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA]:FIX4 <0-15>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA]:FIX4?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] FIX4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA]:FIX4 <0-15>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA]:FIX4?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] FIX4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA]:FIX4 <0-15>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA]:FIX4?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] FIX4`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA]:FIX4 <0-15>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA]:FIX4?`

Frame Repeat Single Cont	`[:SOURce]:RADio:TETRa:REPeat SINGle|CONTinuous` `[:SOURce]:RADio:TETRa:REPeat?`
Frame Trigger	`[:SOURce]:RADio:TETRa:TRIGger[:SOURce]?`
Freq Channels Off On	`[:SOURce]:RADio:TETRa:FCHannel[:STATe] ON|OFF|1|0` `[:SOURce]:RADio:TETRa:FCHannel[:STATe]?`
Freq Dev	`[:SOURce]:RADio:TETRa:MODulation:FSK[:DEViation] <val><unit>` `[:SOURce]:RADio:TETRa:MODulation:FSK[:DEViation]?`

Key	SCPI Command
Gaussian	`[:SOURce]:RADio:TETRa:FILTer GAUSsian` `[:SOURce]:RADio:TETRa:FILTer?`
Gray Coded QPSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] GRAYQPSK`
IS95 OQPSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] IS95OQPSK`
IS95 QPSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] IS95QPSK`

Modulation Type	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] BPSK|QPSK|`
	`IS95QPSK|GRAYQPSK|OQPSK|IS95OQPSK|P4DQPSK|PSK8|PSK16|`
	`D8PSK|MSK|FSK2|FSK4|FSK8|FSK16|C4FM|QAM4|QAM16|QAM32|`
	`QAM64|QAM256|UIQ|UFSK`
	
	`[:SOURce]:RADio:TETRa:MODulation[:TYPE]?`

MSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] MSK`
Nyquist	`[:SOURce]:RADio:TETRa:FILTer NYQuist` `[:SOURce]:RADio:TETRa:FILTer?`
Optimize FIR For EVM ACP	`[:SOURce]:RADio:TETRa:CHANnel EVM|ACP` `[:SOURce]:RADio:TETRa:CHANnel?`
OQPSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] OQPSK`
Pattern Repeat Single Cont	`[:SOURce]:RADio:TETRa:REPeat SINGle|CONTinuous` `[:SOURce]:RADio:TETRa:REPeat?`
Pattern Trigger	`[:SOURce]:RADio:TETRa:TRIGger[:SOURce]?`
Phase Dev	`[:SOURce]:RADio:TETRa:MODulation:MSK[:PHASe] <val><unit>` `[:SOURce]:RADio:TETRa:MODulation:MSK[:PHASe]?`
Phase Polarity Normal Invert	`[:SOURce]:RADio:TETRa:POLarity[:ALL] NORMal|INVerted` `[:SOURce]:RADio:TETRa:POLarity[:ALL]?`

PN9	`[:SOURce]:RADio:TETRa:DATA PN9`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom PN9`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom PN9`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] PN9`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] PN9`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] PN9`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] PN9`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] PN9`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] PN9`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] PN9`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] PN9`

PN11	`[:SOURce]:RADio:TETRa:DATA PN11`

Key	SCPI Command

PN15	`[:SOURce]:RADio:TETRa:DATA PN15`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStomPN15`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom PN15`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] PN15`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] PN15`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] PN15`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] PN15`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] PN15`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] PN15`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] PN15`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] PN15`

PN20	`[:SOURce]:RADio:TETRa:DATA PN20`
PN23	`[:SOURce]:RADio:TETRa:DATA PN23`
QPSK	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] QPSK`
Recall Secondary Frame State	`[:SOURce]:RADio:TETRa:SECondary:RECall`
Rectangle	`[:SOURce]:RADio:TETRa:FILTer RECTangle` `[:SOURce]:RADio:TETRa:FILTer?`

Rise Delay	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:DELay <value>`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:DELay?`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:RDELay <value>`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:RDELay?`

Rise Time	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:TIME <value>`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:RISE:TIME?`
	`[:SOURce]:RADio:TETRa:BURSt:SHAPe:RTIMe`
	`<value>[:SOURce]:RADio:TETRa:BURSt:SHAPe:RTIMe?`

Root Nyquist	`[:SOURce]:RADio:TETRa:FILTer NYQuist` `[:SOURce]:RADio:TETRa:FILTer?`
Save Secondary Frame State	`[:SOURce]:RADio:TETRa:SECondary:SAVE`
Scramble Off On	`[:SOURce]:RADio:TETRa:BURSt:SCRamble[:STATe] ON|OFF|1|0` `[:SOURce]:RADio:TETRa:BURSt:SCRamble[:STATe]?`
Scramble Seed	`[:SOURce]:RADio:TETRa:BURSt:SCRamble:SEED <32-bit val>` `[:SOURce]:RADio:TETRa:BURSt:SCRamble:SEED?`

Secondary Frame Off On	`[:SOURce]:RADio:TETRa:SECondary[:STATe] ON|OFF|1|0`
	
	`[:SOURce]:RADio:TETRa:SECondary[:STATe]?`

Select	`[:SOURce]:RADio:TETRa:FILTer RNYQuist|NYQuist|GAUSsian|`
	`RECTangle|"<user FIR>"`
	
	`[:SOURce]:RADio:TETRa:FILTer?`

Key	SCPI Command
Secondary Frame Trigger	`[:SOURce]:RADio:TETRa:SECondary:TRIGger` `[:SOURce]KEY|EXT|BUS[:SOURce]:RADio:TETRa:SECondary:TRIGger[:SOURce]?`

Select File	`[:SOURce]:RADio:TETRa:DATA "<file name>"`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UCUStom "<file name>"`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCCustom "<file name>"`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal[:DATA] "<file name>"`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync[:DATA] "<file name>"`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDCustom[:DATA] "<file name>"`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal[:DATA] "<file name>"`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync[:DATA] "<file name>"`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1[:DATA] "<file name>"`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2[:DATA] "<file name>"`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal[:DATA] "<file name>"`

SSB	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:SSB <120 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:SSB?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:SSB <120 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:SSB?`

STS	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:STS <38 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCSync:STS?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:STS <38 bit value>`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDSync:STS?`

Symbol Rate	`[:SOURce]:RADio:TETRa:BRATe <value>`
	`[:SOURce]:RADio:TETRa:BRATe?`
	`[:SOURce]:RADio:TETRa:SRATe <value>`
	`[:SOURce]:RADio:TETRa:SRATe?`

Sync Out	`[:SOURce]:RADio:TETRa:SOUT?`
Sync Out Offset	`[:SOURce]:RADio:TETRa:SOUT:OFFSet <value>` `[:SOURce]:RADio:TETRa:SOUT:OFFSet?`
TETRA Off On	`[:SOURce]:RADio:TETRa[:STATe] ON|OFF|1|0` `[:SOURce]:RADio:TETRa[:STATe]?`
Timeslot On Off	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:STATe ON|OFF|1|0` `[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:STATe?`
Timeslot Ampl Main Delta	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:POWer MAIN|DELTa` `[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:POWer?`

Key	SCPI Command
Timeslot Type	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE]?`
Trigger In Polarity Neg Pos	`:TRIGger[:SEQuence]:SLOPe` `POSitive|NEGative:TRIGger[:SEQuence]:SLOPe?`
Trigger Key	`[:SOURce]:RADio:TETRa:TRIGger[:SOURce] KEY` `[:SOURce]:RADio:TETRa:SECondary:TRIGger[:SOURce] KEY`

TS	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:TSEQuence`
	`<30 bit value>`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DCNormal:TSEQuence?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:TSEQuence`
	`<30 bit value>`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:DDNormal:TSEQuence?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1:TSEQuence`
	`<30 bit value>`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC1:TSEQuence?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2:TSEQuence`
	`<30 bit value>`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UC2:TSEQuence?`
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal:TSEQuence`
	`<22 bit value>`
	
	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4:UNORmal:TSEQuence?`

Up Control 1	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] UC1`
Up Control 2	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] UC2`
Up Custom	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] UCUStom`
Up Normal	`[:SOURce]:RADio:TETRa:SLOT[1]|2|3|4[:TYPE] UNORmal`
User FIR	`[:SOURce]:RADio:TETRa:FILTer "<file name>"` `[:SOURce]:RADio:TETRa:FILTer?`

User FSK	`[:SOURce]:RADio:TETRa:MODulation:UFSK "<file name>"`
	`[:SOURce]:RADio:TETRa:MODulation:UFSK?`
	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] UFSK`

User I/Q	`[:SOURce]:RADio:TETRa:MODulation:UIQ "<file name>"`
	`[:SOURce]:RADio:TETRa:MODulation:UIQ?`
	`[:SOURce]:RADio:TETRa:MODulation[:TYPE] UIQ`

Index

Index

Index

Index

Index

Index

Index

Index