



**IQCreator<sup>®</sup>**

# **Arbitrary Waveform Creator and Packager**

## **Getting Started**

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Document no. 46892/599

Issue 9

15 November 2006

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# Getting started with ***IQCreator***<sup>®</sup>

## Introduction

***IQCreator***<sup>®</sup> is a software package that allows you to create and package an arbitrary waveform file that can be loaded onto a 3410 Series signal generator or a 3020 Series PXI Digital RF signal generator. It is also possible to package and download files that have been created using other tools. Arbitrary waveforms that can be created by ***IQCreator***<sup>®</sup> cover a wide range of digital modulation schemes.

This introductory document describes the process of creating, packaging and downloading a file using ***IQCreator***<sup>®</sup>.

## Licensing

You are asked to accept the terms of the Aeroflex software license agreement before you are permitted to use ***IQCreator***<sup>®</sup>.

## Associated document

Throughout this guide, reference is made to the ***IQCreator***<sup>®</sup> User Guide. This document provides further information on setting up your own file formats, and detailed information on the different modulation schemes that ***IQCreator***<sup>®</sup> can simulate.

The ***IQCreator***<sup>®</sup> User Guide part number is 46882/627. It is supplied with ***IQCreator***<sup>®</sup> and can also be downloaded from the Aeroflex website <http://www.aeroflex.com/>.

## System requirements

Intel-based PC with Pentium processor or equivalent.

Microsoft Windows 95, 98, 2000, XP or NT 4.0.

CD-ROM drive (for installation).

16 MB RAM minimum.

National Instruments GPIB interface card, or any GPIB card that provides VISA support.

### Installation

**IQCreator**<sup>®</sup> is available either from the Aeroflex website [www.aeroflex.com/IQCreator](http://www.aeroflex.com/IQCreator) or from the **IQCreator**<sup>®</sup> CD-ROM that accompanies your instrument.

- To download from the website, click on the link and follow the instructions.
- To download from the CD, stop any virus protection software and exit any programs that are running.

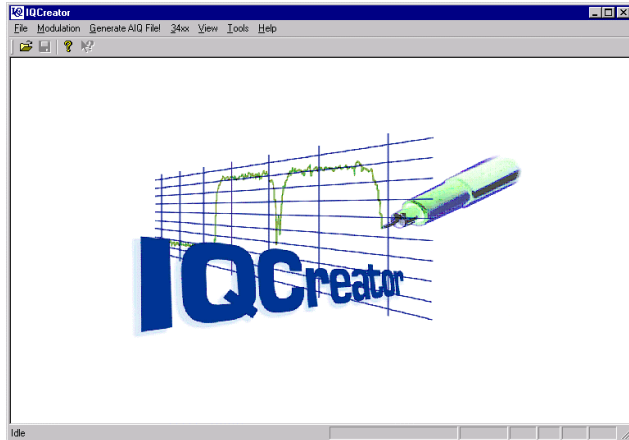
Insert the CD-ROM into the drive; it should open automatically at the contents page (if not, follow the instruction printed on the disk).

Click on • **Install IQCreator** .

Double-click on the *setup.exe* program in the Windows Explorer window that opens.

### Creating a file

Start the **IQCreator**<sup>®</sup> application either by selecting the application from the Start program, or by clicking on the **IQCreator**<sup>®</sup> icon on the desktop. This displays the screen shown in Fig. 1. Press the Alt key to toggle menu shortcuts on and off.



*Fig. 1 The **IQCreator**<sup>®</sup> application at start-up*

### Creating a waveform

To create a waveform select the Modulation menu, which presents you with all the modulation schemes currently supported by the application. Full details of supported schemes are listed in the **IQCreator**<sup>®</sup> User Guide.

## Example using Generic modulation

As an example, select **Generic\PSK**. You are presented with the dialog shown in Fig. 2, which gives two options to generate a waveform. These are: **New Default Settings** and **Example Settings**. The latter are pre-generated settings, which are stored in the **Example Files** directory within the **IQCreator®** directory. The pre-generated settings have the prefix **ats\_**. Note that the file structure (Fig. 3) employed in **IQCreator®** follows its menu structure.

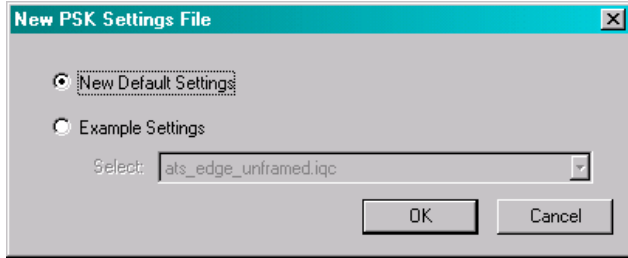


Fig. 2 New PSK Settings File dialog

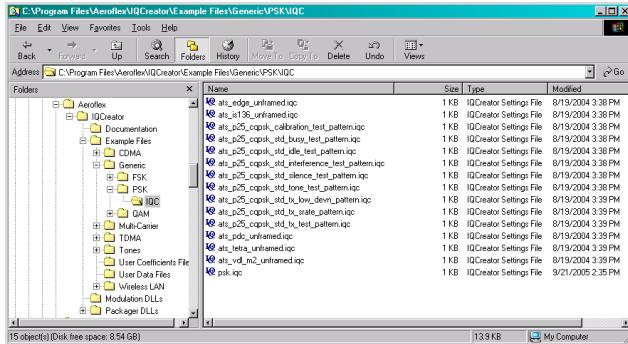
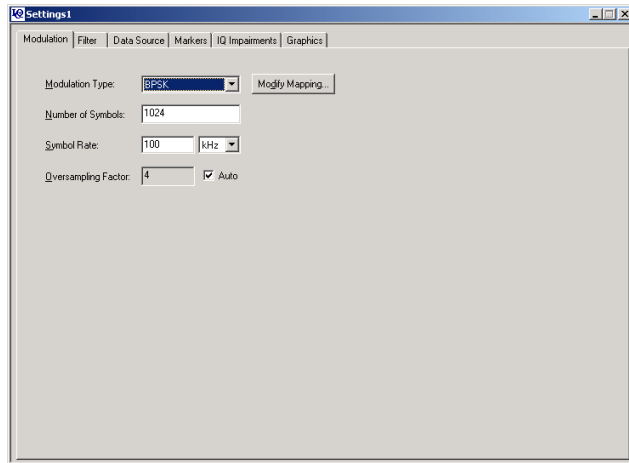


Fig. 3 IQCreator® file structure

For the purpose of this example, select New Default Settings and click OK. You are presented with a dialog as illustrated in Fig. 4. From the figure, you can see that the dialog contains several tabs, each of which is used to set up the required modulation scheme.



*Fig. 4 Modulation setup*

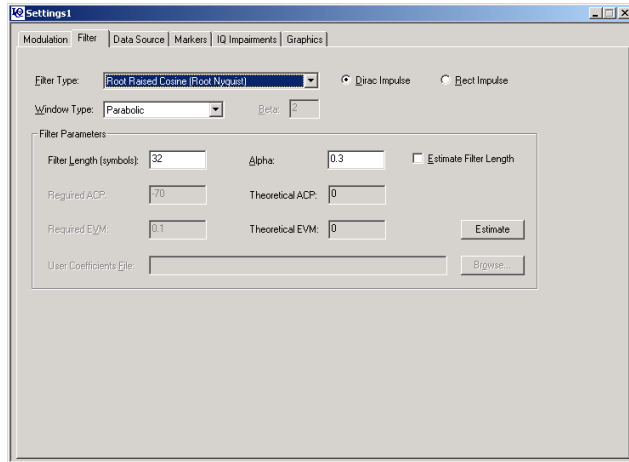
### Modulation

The Modulation tab shown in Fig. 4 allows you to set up the Modulation Type, Number of Symbols (how many symbols of data to generate), the Symbol Rate and the Oversampling Factor. For this example, select BPSK, keeping the number of symbols at 1024 and the symbol rate at 100 kHz.

For the oversampling factor, the default is 4, which means that the symbol rate is oversampled by a factor of 4 before filtering. In general, you would not want to change this value, but you can do so by unchecking the Auto check box.

### Selecting the channel filter

You can now choose the channel filter. Select the Filter tab, which displays the screen shown in Fig. 5.



*Fig. 5 Filter setup*

First, select the Filter Type required.

For this example, select a Root Raised Cosine filter. Then select the filter  $\Delta$ Alpha to set the bandwidth of the filter: in this case, use a value of 0.3.

Next, define the Filter Length.

If you know the length of filter required, enter the number; but if you are unsure, then check the Estimate Filter Length box and click the Estimate button. The software then calculates the filter length to give a filter that provides the ACP and EVM requested in the Required ACP and Required EVM boxes. The new estimates are presented.

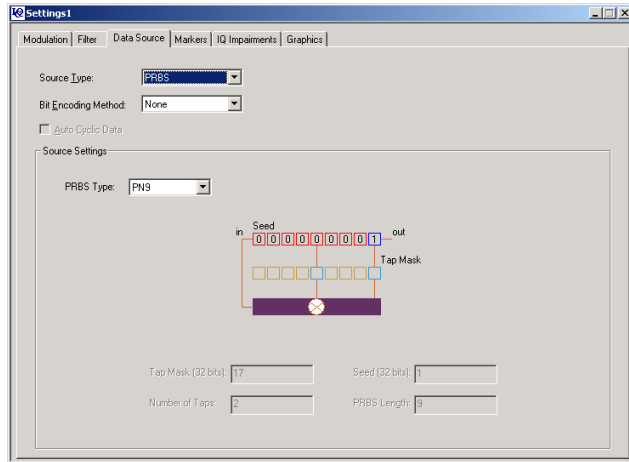
You can also select a Window Type function as part of the filter setup. Essentially, the window is used to enhance the stop band capability of the filter. There is a trade-off between stop band and EVM. Experiment, and choose the window that best suits your needs. In general, the Parabolic window is a good choice.

### User filter coefficients

**IQCreator**<sup>®</sup> provides most of the common filter types that you are likely to need. However, you can also use your own filter; details are given in the **IQCreator**<sup>®</sup> User Guide.

## Selecting the data source

Now set up the data source. Select the Data Source tab to display the screen shown in Fig. 6.



*Fig. 6 Data source setup*

Here, you can select the type of data source, which is the bit sequence that you want to modulate. There are three choices:

- PRBS
- a repeating pattern
- user data.

If you select PRBS, you have the option to either select one of seven preset PRBS sequences, or a user-defined one. The seed or tap mask can be toggled by clicking the left mouse button on the required bit.

The tap mask is fixed for the predefined PN sequences and cannot be altered. If you wish to change the mask, select PRBS Type User Defined.

For the purposes of this example, stay with the default settings. Note that at this stage you can decide on the Bit Encoding Method that you require.

## User data sequence

***IQCreator***<sup>®</sup> provides a variety of data sources. However, you can also use your own bit sequence: details are given in the ***IQCreator***<sup>®</sup> User Guide.

### Defining markers

**IQCreator**<sup>®</sup> allows you to mark important events within the file, such as the location of a burst or the start of a TDMA slot or frame, by defining up to four markers.

To do this, select the Markers tab. The display shown in Fig. 7 appears. As an example, set up a marker to define RF bursting.

#### Burst Control tab

Check the Use Markers box, which enables the marker setup parameters. Set the Marker Type to Burst Control from the drop down box. The burst-related parameters are made visible.

The burst control type is used to define the type of bursting you wish to apply. There are two types:

- RF Bursting: this burst marker is used to trigger a hardware burst modulator that adjusts the RF gain of the signal generator. This type of burst control is not supported by PXI.
- IQ Profiling: with this type of bursting the profile is implemented by **IQCreator**<sup>®</sup> by profiling the IQ data. This allows you to define multiple levels and adjacent slots.

The Rise/Fall Profile Shape field lets you define the burst's rise and fall responses:

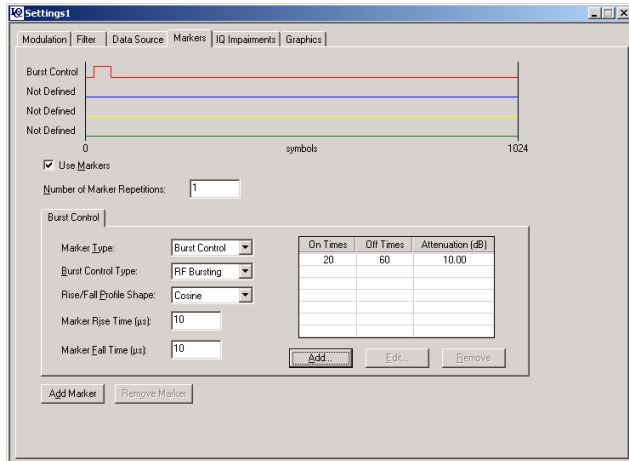
- Cosine gives a slower response with fewer sidebands;
- Gaussian gives a faster response, suitable for GSM testing;
- None gives an unshaped waveform with very fast rise and fall times.

For the Cosine and Gaussian responses, you can specify a Marker Rise Time and Marker Fall Time.

To define the on and off times of the marker click on Add... You can then enter the on and off times of the marker in symbols: for example, 20 and 60. You can also specify attenuation for the on period: for example, 10 dB.

The Number of Marker Repetitions parameter defines the number of times that the marker repeats within the file.

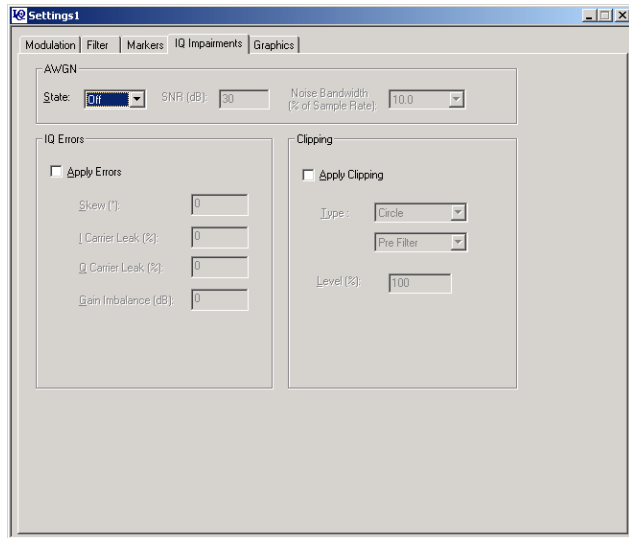
Further markers can be added, removed and defined by clicking on Add... and Remove...



*Fig. 7 Marker 1 setup*

### IQ impairments

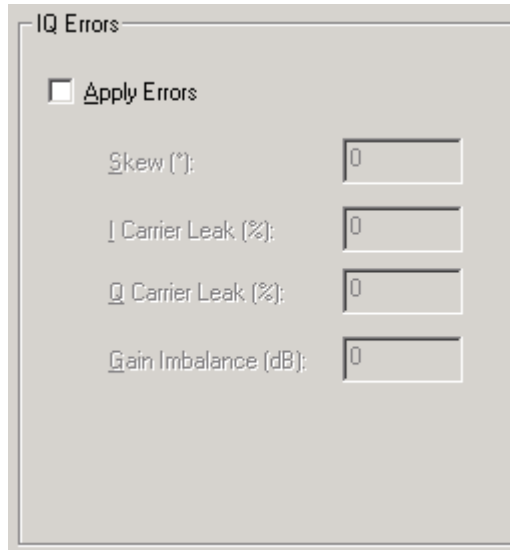
**IQCreator**<sup>®</sup> allows you to add IQ impairments to a waveform. For this, select the IQ Impairments tab. This displays the screen shown in Fig. 8.



*Fig. 8 IQ Impairments setup*

### **IQ Errors**

This section (Fig. 9) of the IQ Impairments screen allows you to add errors to a waveform.



The screenshot shows a dialog box titled "IQ Errors". At the top left, there is a checkbox labeled "Apply Errors" which is currently unchecked. Below this, there are four rows of parameters, each with a text label and a corresponding input field containing the value "0":

- Skew (°): 0
- I Carrier Leak (%): 0
- Q Carrier Leak (%): 0
- Gain Imbalance (dB): 0

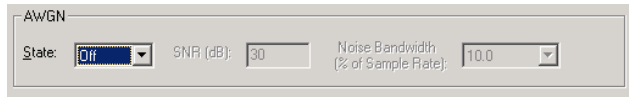
*Fig. 9 IQ Errors setup*

Check Apply Errors to enable the parameters.

There are four parameters that you can enter. The choices are self-explanatory.

### Interference

This section (Fig. 10) of the IQ Impairments screen provides the facility to inject additive white Gaussian noise (AWGN) into the waveform.



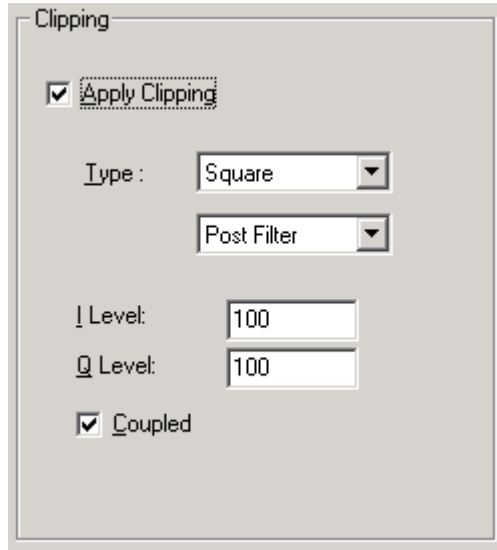
*Fig. 10 IQ Interference setup*

There are two parameters that need to be set: the SNR in dB and the Noise Bandwidth as a percentage of the sample rate. For this example, we shall not add AWGN to the waveform. Therefore, the AWGN State is set to Off.

Note that the bandwidth of the noise interference is set as a percentage of the sample rate. This means that with a sample rate of 400 kHz, as in our example, and a noise bandwidth of, say, 10%, the noise bandwidth will be 40 kHz. Now if the noise bandwidth setting is kept at 10% and the sample rate is increased to, say, 800 kHz, then the new noise bandwidth will be 80 kHz.

### Clipping

This section (Fig. 11) of the IQ Impairments screen provides the facility to clip the I or Q level of the waveform. Note that this section is visible only in some modulation schemes (for example, CDMA) and not in others (for example, Generic).



The screenshot shows a dialog box titled "Clipping" with the following settings:

- Apply Clipping
- Type: Square (dropdown menu)
- Post Filter (dropdown menu)
- I Level: 100 (text input)
- Q Level: 100 (text input)
- Coupled

*Fig. 11 IQ Clipping setup*

- Circle clips the IQ vector by the percentage specified.
- Square clips I and Q independently by the percentage specified.
- Pre filter clips the waveform before the selected filter is applied.
- Post filter clips the waveform after the filter is applied.

### Graphical display

You can view and save graphical representations of the waveform that you have set up. Select the Graphics tab to display the setup screen as shown in Fig. 12.

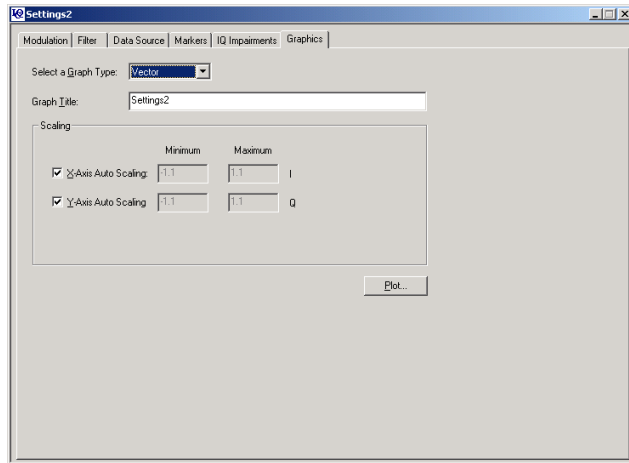


Fig. 12 Graphics setup

Set up the type of graph in the Select a Graph Type box and name the graph using the Graph Title box. Refer to the **IQCreator**<sup>®</sup> User Guide for further details.

**IQCreator**<sup>®</sup> normalizes the axes by default, but you can apply your own scaling to the axes of the graph. To do this, uncheck the X-Axis Auto Scaling box or Y-Axis Auto Scaling box and enter the limits for the axes in the Minimum and Maximum boxes.

Click on Plot... to view your waveform in the chosen graphical format and save it as a bitmap if required.

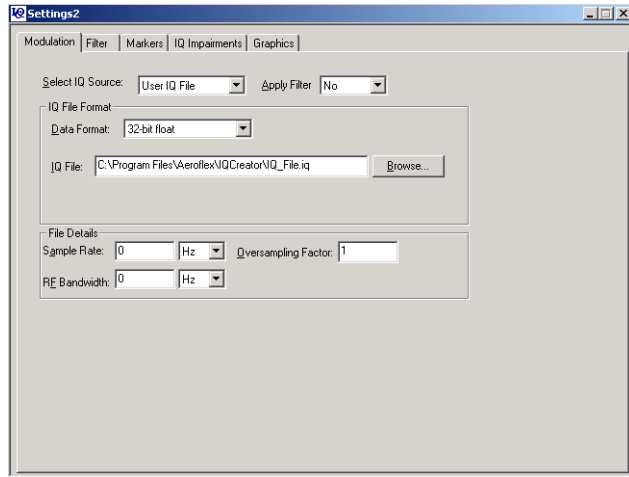
### Saving your settings

At this stage, you should have set all the parameters required to generate the waveform. If you want to save these settings for future use, select the menu option File\Save Settings or File\Save Settings As. If you want to generate a file using these settings, keep the settings window open.

Note that the saved settings file is of IQC type (\*.iqc) and that saving IQC files in the **IQCreator**<sup>®</sup> directory structure results in the saved settings file being available in the same way as example files.

## User modulation

**IQCreator**<sup>®</sup> provides the facility to package and alter files that have been created using third-party tools. To create a user file, start **IQCreator**<sup>®</sup> and select the Modulation menu, then User. This displays the screen shown in Fig. 13.



*Fig. 13 User setup*

Set the Select IQ source. There are two formats available: User IQ File or User I and Q File. You need to select the appropriate data format from those available (refer to the **IQCreator**<sup>®</sup> User Guide for more details).

The Apply Filter parameter should be set to Yes if the file is defined in IQ symbols, with no Channel Filter applied in the file. If the file contains filtered IQ data, this parameter should be set to No. If a filter is to be applied, its settings can be modified by clicking on the Filter tab.

Now provide the filename(s) of the file(s) you want to use in the IQ File or I File and Q File fields.

Once you have selected the user file(s), enter an appropriate Sample Rate, Oversampling Factor and RF bandwidth. Note that the RF Bandwidth parameter is applicable only if no channel filter is to be applied.

For the oversampling factor, the default is 4, which means that the symbol rate specified is oversampled by a factor of 4 before any filtering. In general, you would not want to change this value, but you can do so by clearing the Auto check box.

For the Sample Rate and RF Bandwidth, the default is 0 Hz, requiring you to manually enter these values.

Once a valid user file has been selected, you may modify the filter, markers and impairment settings.

## Generating the waveform file

To generate the waveform file, select the menu option Generate AIQ File! This displays the dialog box shown in Fig. 14. For now, select Next>, as you are generating the file from Current Settings. This displays the dialog box shown in Fig. 15, which allows you to enter the File name, select the Destination Hardware (for our example the Aeroflex 3410 Series is selected) and add a Description of the file. The dialog also allows you to enter a Scaling parameter, as a percentage of the full-scale value of the DAC. Note that information is also given on the Input File Sampling Rate, Input File Oversampling Factor, and RF Signal Bandwidth.

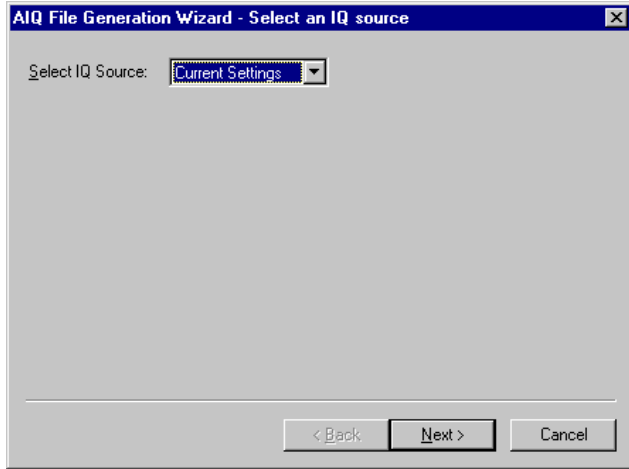


Fig. 14 AIQ Generation dialog

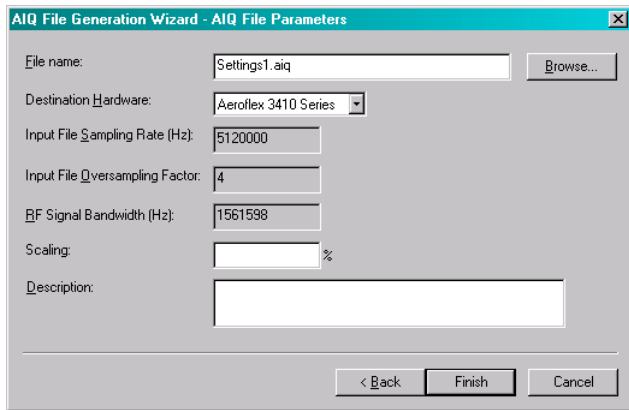
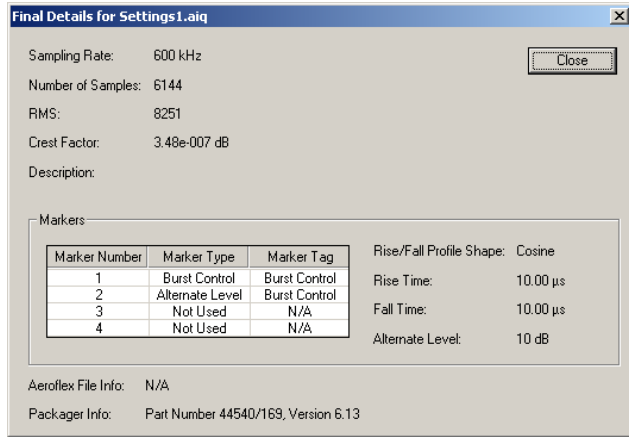


Fig. 15 AIQ File Generation Wizard: AIQ File Parameters dialog

Select Finish. This displays the dialog box shown in Fig. 16, which summarizes the parameters of the file, and shows how any markers that you have set up correspond to the physical signals that appear on the instrument's I/O connectors.



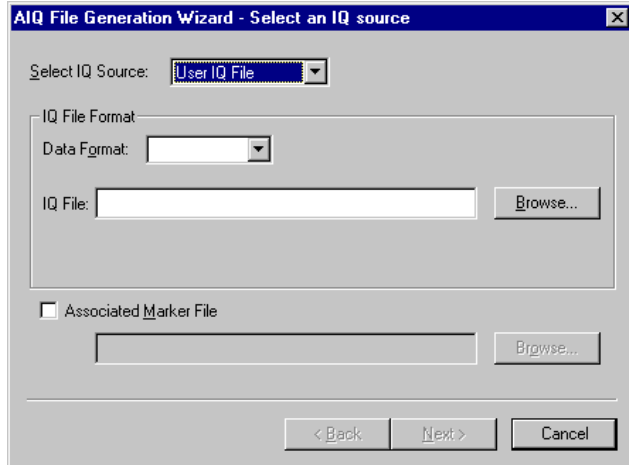
*Fig. 16 AIQ file details*

The waveform file has now been created and saved. It can be downloaded onto a 3410 Series signal generator as described in the section *Downloading an AIQ file* on page 21.

## Packaging a user file

**IQCreator**<sup>®</sup> provides the facility to package files that have been created by a user using third party tools, as well as those created by **IQCreator**<sup>®</sup>.

To package a user file, start **IQCreator**<sup>®</sup> and select the menu option Generate AIQ File! You are presented with the dialog shown in Fig. 17.



*Fig. 17 AIQ File Generation Wizard: Select an IQ source dialog*

Set the Select IQ Source. There are two formats available: User IQ File or User I and Q File. You will need to select the appropriate Data Format from those available (refer to the **IQCreator**<sup>®</sup> User Guide for more details). Now provide the filename(s) of the file(s) you want to package in the IQ File or I File and Q File fields.

You can also include user-defined marker files. To do this check the Associated Marker File check box and enter or browse the desired marker file (refer to the **IQCreator**<sup>®</sup> User Guide for details). Once you have done this, click Next> to display the dialog shown in Fig. 18.

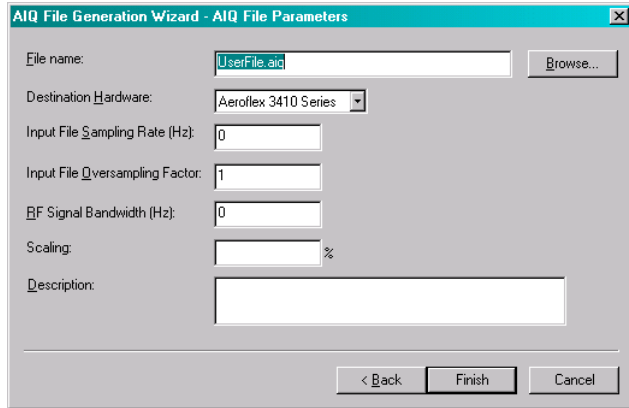


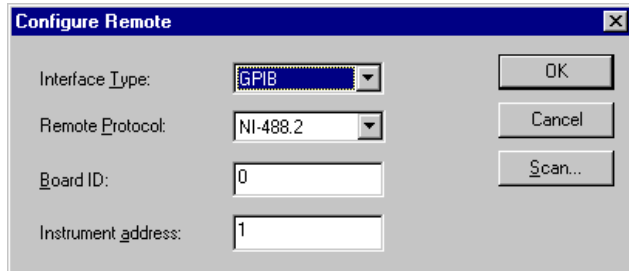
Fig. 18 AIQ File Generation Wizard: AIQ File Parameters dialog

With a user file, there are three other parameters that need to be set: the Input File Sampling Rate in Hz, the Input File Oversampling Factor, and the RF Signal Bandwidth in Hz. The dialog also allows you to enter a Scaling parameter, which sets the DAC value as a percentage of the total permissible value of the DAC. You may also enter a Description of the file. Refer to the **IQCreator**<sup>®</sup> User Guide for more details.

Now click on Finish. The file is ready to be downloaded. Refer to *Downloading an AIQ file* on page 21 for details on how to do this.

## Configuring the remote interface on 3410 Series

Before a file can be downloaded to a 3410 Series instrument, the remote interface must be configured. To do this, click on 34xx on the main menu and select the menu option Configure Remote... You are presented with the dialog shown in Fig. 19.



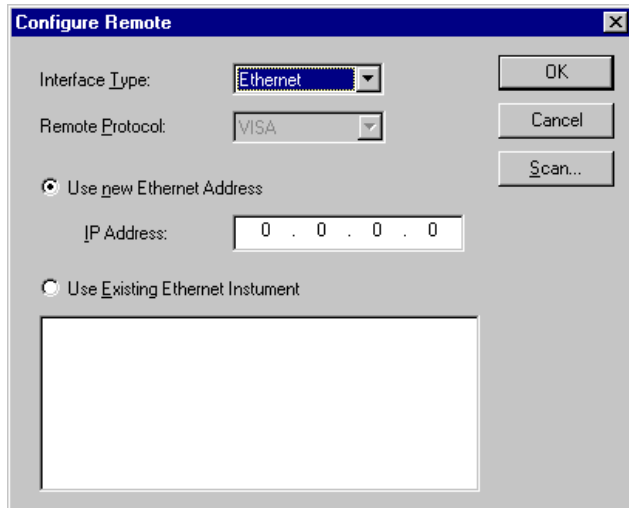
*Fig. 19 Configure Remote dialog*

Here you must select the Interface Type: either GPIB or Ethernet. The default is GPIB. If you select GPIB you must select the Remote Protocol to use: either NI-488.2 or VISA. The default is NI-488.2, which can only be used with National Instruments GPIB cards. The second option is VISA, which can be used with any VISA compatible GPIB card. However, you must have the version of VISA that came with your card installed on your PC.

Next, you must set the Board ID to that of your GPIB card. The default is 0, but if your PC has more than one GPIB card installed the ID may be different.

Finally, you must set the Instrument address to that of your instrument or click Scan... for **IQCreator**<sup>®</sup> to scan the GPIB bus. **IQCreator**<sup>®</sup> will then present you with a list of instruments for you to select from.

If you select Ethernet in the Interface Type, the dialog will change to that shown in Fig. 20.



*Fig. 20 Configure Remote dialog for Ethernet*

Here you can either select Use new Ethernet Address and enter an IP address, or select Use Existing Ethernet Instrument for an existing list. You can also click Scan... for **IQCreator**<sup>®</sup> to scan the network. **IQCreator**<sup>®</sup> will then present a list of instruments for you to select from.

## Downloading an AIQ file

**IQCreator**<sup>®</sup> provides the facility to download \*.aiq files, for playback, to a 3410 Series signal generator.

After configuring the remote, you can download the \*.aiq file to a 3410 Series signal generator. To do this:

Select menu option 34xx. Select Download AIQ File... You are prompted for the waveform's filename. Download the file by clicking the download button.

## Viewing and deleting \*.aiq files in ARB memory

**IQCreator**<sup>®</sup> allows you to view and delete the \*.aiq files stored on the 3410 Series' ARB memory. To do this:

Select menu option 34xx. Select View Arb Memory... You are presented with the dialog shown in Fig. 21. You can delete or view details of a file by using the pop-up menu, which is illustrated in Fig. 22. Call up the menu by clicking the right mouse button on the required file. On the file details child window, illustrated in Fig. 23, file information (such as sampling rate, number of samples, RMS, crest factor, markers and user description) is given.

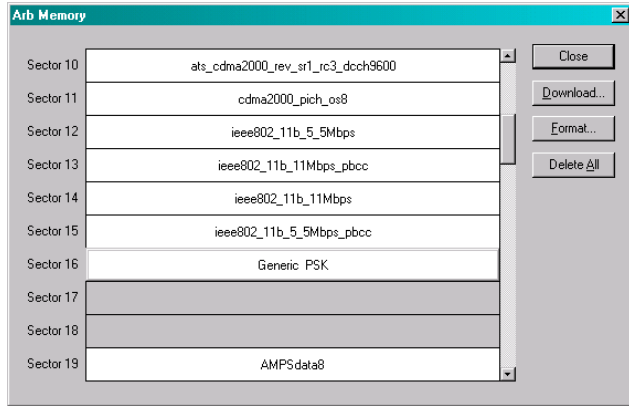


Fig. 21 Arb Memory dialog

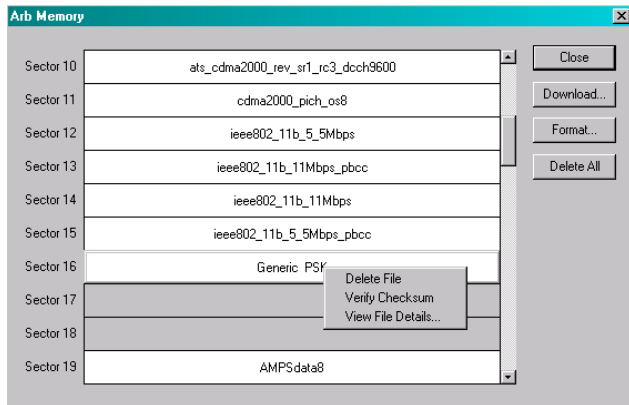


Fig. 22 Arb Memory dialog showing pop-up menu

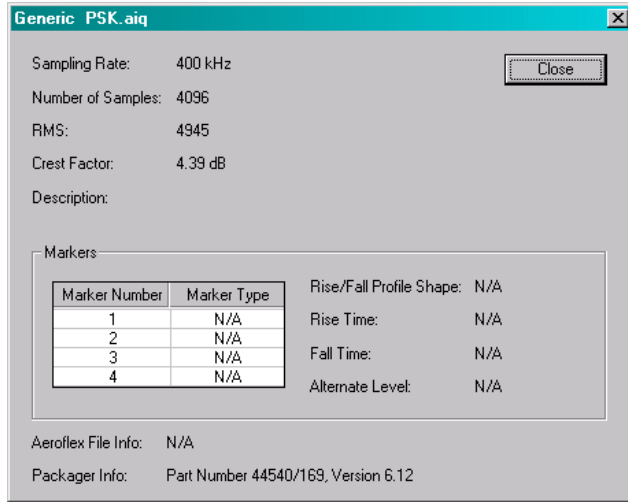


Fig. 23 ARB: file details dialog

## Creating real-time baseband files

**IQCreator**<sup>®</sup> allows you to generate real-time baseband (RTBB) configuration files (CFG files) for generic modulations. To create a \*.cfg file:

Select menu option **34xx**. Select **Create RTBB Config File**. You are presented with the dialog shown in Fig. 24. Enter a Filename and file Description. Generate the RTBB file by clicking on the **Create** button.

Note that you are only able to generate RTBB configuration files if the modulation is generic and the instrument is fitted with a real-time baseband board.

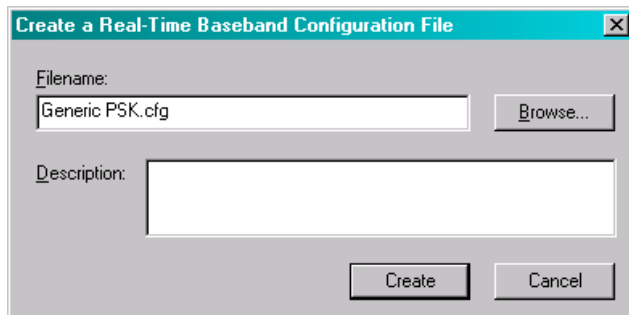


Fig. 24 Real-time Baseband Configuration file dialog

## Downloading a CFG file

**IQCreator**<sup>®</sup> provides the facility to download \*.cfg files to a 3410 Series signal generator fitted with a real-time baseband board.

After configuring the remote, you can download the \*.cfg file to a 3410 Series signal generator. To do this:

Select menu option 34xx. Select Download RTBB Config File. You are prompted for the waveform's filename. Download the file by clicking the download button.

## Viewing and deleting \*.cfg files in RTBB memory

**IQCreator**<sup>®</sup> allows you to view and delete \*.cfg files stored in the 3410 Series' RTBB memory. To do this:

Select menu option 34xx. Select View RTBB Memory... You are presented with the dialog shown in Fig. 25. You can delete or view details of a file by using the pop-up menu, which is illustrated in Fig. 26. Call up the menu by clicking the right mouse button on the required file. The file details child window, illustrated in Fig. 27, gives information about the file.

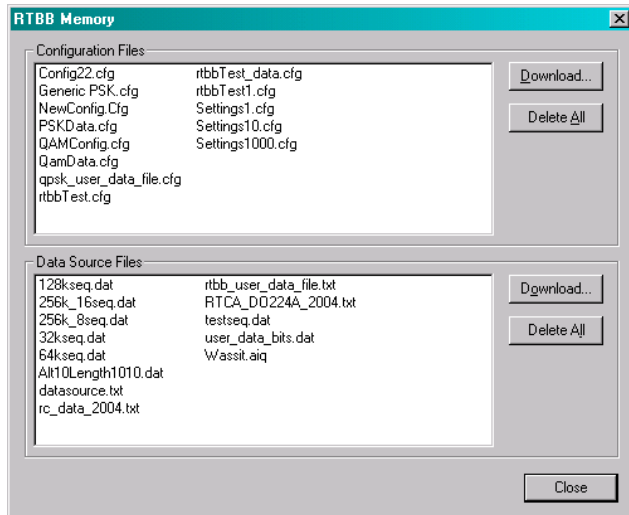


Fig. 25 RTBB Memory dialog

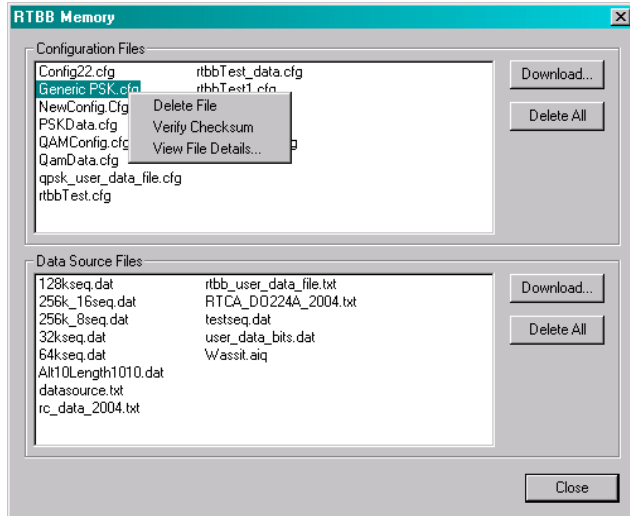


Fig. 26 RTBB Memory dialog showing pop-up menu

The RTBB memory dialog, shown in Fig. 26, also displays the data source files stored in the RTBB memory. Download data source files by selecting menu option 34xx and then choosing Download RTBB Data File...

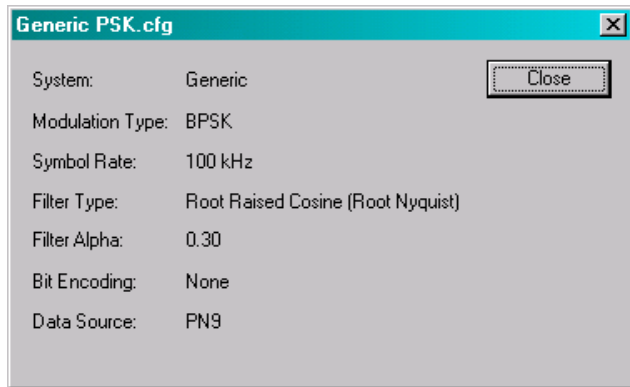


Fig. 27 RTBB: file details dialog

### Using AIQ files with PXI

Appropriately packaged \*.aiq files generated by **IQCreator**<sup>®</sup> may also be used with the Aeroflex 3020 Series PXI Digital RF signal generator.

Save the \*.aiq file to disk from where it may be loaded via, for example, the AF3020 Series soft front panel.

### Waveform types

The process to create, package and download a waveform is the same whatever the modulation scheme. The accompanying CD ROM contains waveforms and/or IQC (settings) files. Consult the Aeroflex website or your distributor for the latest additions.

### Modulation types

**IQCreator**<sup>®</sup> is undergoing continuous development and supports an increasing number of modulation standards. New modulations are available as DLLs.

#### Viewing/adding modulation types

Click on **T**ools on the main menu, followed by **R**egistered Modulation Types..., to see the modulation types currently available. Modulations that are built into **IQCreator**<sup>®</sup> do not have a part number.

Details of different modulation types are given in the **IQCreator**<sup>®</sup> User Guide.

Use the **A**dd... browse facility to add new modulation DLLs to the list of modulations.

### Finding out more about **IQCreator**<sup>®</sup>

For more information about user files and the different modulation schemes supported, ask for the **IQCreator**<sup>®</sup> User Guide (part no. 46882/627).