



Products: I/Q Modulation Generator AMIQ, WinIQSIM, SMIQ

# Floppy Disk Control of the I/Q Modulation Generator AMIQ

## Application Note

The I/Q Modulation Generator AMIQ is best controlled by the software package WinIQSIM. However, for some applications it is necessary to control the AMIQ via a floppy disk. The application note introduces a convenient and easy to use solution for creating a control floppy disk. A detailed description of the process to generate a waveform to fit on a 1.44 MB floppy disk, and how to transfer the waveform to the AMIQ and trigger the waveform from the floppy disk is provided.



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### **1 Introduction**

The AMIQ I/Q Modulation Generator is an excellent tool for generating digitally modulated analog or digital I/Q baseband signals. To develop test signals, the AMIQ is normally operated using the GPIB (IEEE 488 or IEC 625) interface in a controlling PC. A serial RS-232 interface can also be used, but it is orders of magnitude slower than the GPIB interface link. Therefore, for most applications a GPIB connection, controlling the AMIQ is strongly recommended. The supporting PC software for the AMIQ is the simulation software WinIQSIM. The software simulates waveforms of up to 16 Msamples (only AMIQ variant 4) which are transmitted via the GPIB bus to the AMIQ.

It is possible to control the AMIQ via floppy disk instead of using an external controller such as a PC. There are two basic applications, that can be handled with floppy disk control.

- Waveforms can be directly downloaded from a “batch floppy” to the AMIQ hard disk drive. WinIQSIM can prepare such a batch floppy with a few simple operations. This procedure is described in detail in section 3.
- A floppy disk can be used to control the AMIQ to upload waveforms that are stored on the AMIQ hard disk. This procedure is outlined in section 4.

Furthermore, both procedures can be combined so that waveforms can be transmitted to the AMIQ hard disk or to AMIQs output memory (AMIQ RAM) and executed using floppy disk control. This procedure is outlined in section 5.

The advantages of a floppy disk control are:

- In production it is possible to change and execute waveforms only via floppy disk without the need of an external controller.
- The method is so quick and simple that it can be used to reduce production downtime.
- Executing IEC/IEEE-bus commands from a batch floppy disk to control the AMIQ without the need of an external controller.
- To extend the use of the AMIQ as a stand-alone instrument.

## 2 Alternative Ways to Transfer Waveforms to the AMIQ

Before describing floppy disk control in detail, here is a summary of the four methods available to transfer waveforms to the AMIQ.

Once a waveform has been generated with the aid of WinIQSIM the user can select one out of four methods to transfer the waveform to the AMIQ. Fig. 1 displays the options in the Destination section of the **AMIQ Transmission** panel of WinIQSIM:

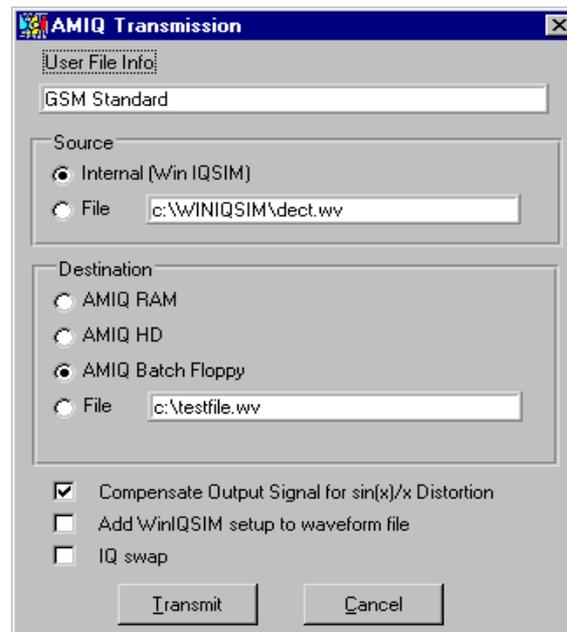


Fig. 1 The **AMIQ Transmission** panel in WinIQSIM. The destination section of the panel offers the user alternative options to transfer a waveform to the AMIQ.

- **AMIQ RAM:** The waveform is directly transferred to the RAM memory of the AMIQ.
- **AMIQ HD:** If a path on the hard disk of the AMIQ has been assigned, WinIQSIM will directly transfer the waveform file to this destination. When a link to the AMIQ is established after **Transmit** is pressed, a file selection window will pop up and the path for the destination of the data file can be assigned.
- **AMIQ Batch Floppy:** A waveform configured by WinIQSIM is stored on a batch floppy disk. The information on the file of the AMIQ hard disk, on which the waveform should be stored, is saved on the batch floppy together with the waveform data. This special format is required for loading a waveform via the AMIQ floppy disk drive.
- **File:** Transfer of the waveform directly to an assigned path on the PC, for later transmission to the AMIQ. A path where a waveform file should be stored can be defined (e. g. c:\). The currently selected destination file is indicated in the File selection field. A file with the extension \*.wv (extension for waveform) can be selected where to store the waveform.

### 3 Batch Floppy Generated in WinIQSIM for the AMIQ

WinIQSIM offers all necessary tools to create a batch floppy disk, easily. Only a few simple steps are necessary.

**Note:** *If in the AMIQ Transmission panel (Fig. 1), in the Destination section the AMIQ Batch Floppy option is selected, WinIQSIM generates a "winiqsim.iec" batch command file directly on a floppy disk inserted in the PC floppy drive.*

- Create the desired waveform in WinIQSIM.
- Open the **Transmission** submenu in the **AMIQ** menu or use the **AMIQ** icon in the icon bar.
- Enter the desired comments in the User File Info field.

In the Source section of the panel (Fig. 1) choose whether the I/Q signal defined by WinIQSIM (Internal) or a signal previously stored on the hard disk of the PC should be transmitted (**File**).

- Select **Internal (WinIQSIM)** as source for transmitting the currently configured signal to the AMIQ.

If in a previous session a waveform file has been created, it is possible to recall the file from the PC hard disk.

- Select **File** in the Source section. The box next to **File** contains the path where the currently selected source file is located. To select another source file, click in the box next to **File**. A file selection window opens where a file with the extension "\*.wv" (\*.wv" stands for waveform) can be selected for transmission.
- For destination select **AMIQ Batch Floppy** in the Destination section of the panel.
- If you are generating analog AMIQ I/Q signals, select the box **Compensate Output Signal for sin(x)/x Distortion**.  
If digital signals are generated only, do not select this box.
- Do not select the box Add WinIQSIM setup to waveform file.

With this option activated, the current setup of WinIQSIM (\*.iqs" file) is transferred to the AMIQ together with the IQ data. This setup is then permanently coupled with the waveform in the AMIQ. It can be seen in this way how the IQ signal was generated, and the original IQ signal can be varied by editing parameters.

**Note:** *Transferring IQ data together with the setup will also expand waveform files by up to 200 Kbytes, thus limiting the number of waveforms that can be stored on a floppy disk or on the hard disk of the AMIQ.*

- Press the **Transmit** button at the bottom of the panel. The **Prepare AMIQ Floppy Disk** panel, Fig. 2, now pops up.
- Enter the file name and the destination directory in the, Select path on AMIQ HD where to store the waveform file section, for the batch floppy. Make sure you follow the DOS filename convention (maximum of 8 characters, with no spaces)

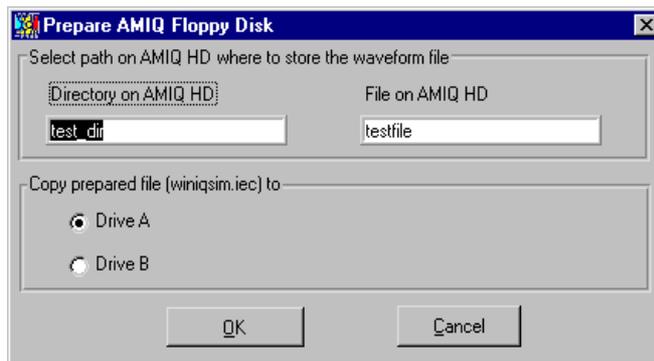


Fig. 2 The Prepare AMIQ Floppy Disk panel.



Fig. 3 If a directory already exists, an info message panel is displayed by WinIQSIM,.

If the destination directory does not already exist, it will be created on the AMIQ hard disk.

**Note:** *If the destination directory already exists, the AMIQ writes an information message to the error queue. The message is displayed, as soon as a user calls the **AMIQ Remote Control panel**.*

- Select whether your PC floppy drive is **Drive A:** or **B:**.
- Select the **OK** button at the bottom of the panel. You are prompted to insert an empty formatted floppy disk into the PC floppy disk drive. If the disk is not empty, normally no harm is done, but you may run out of disk space when generating a large waveform.

A file named “winiqsim.iec” will be generated on the floppy disk. Any existing file previously named “winiqsim.iec” will be overwritten without any warning.

## 4 Batch Floppy format

The batch file consists of three blocks as shown in figure 4. The batch file has at the top a sequence of IEC/IEEE-bus commands, as outlined in block ① (—————), which when executed upload the waveform from floppy disk to the AMIQ hard disk. The IEC/IEEE-bus commands are directly followed by a header block, block ② (-----), which contain all necessary waveform information and AMIQ settings for the AMIQ. The waveform itself is displayed in block ③ (—————). The block is introduced by “{IWAVEFORM-3207:...” and stored as binary data. The binary block is generally larger as the here presented example (Fig. 4).

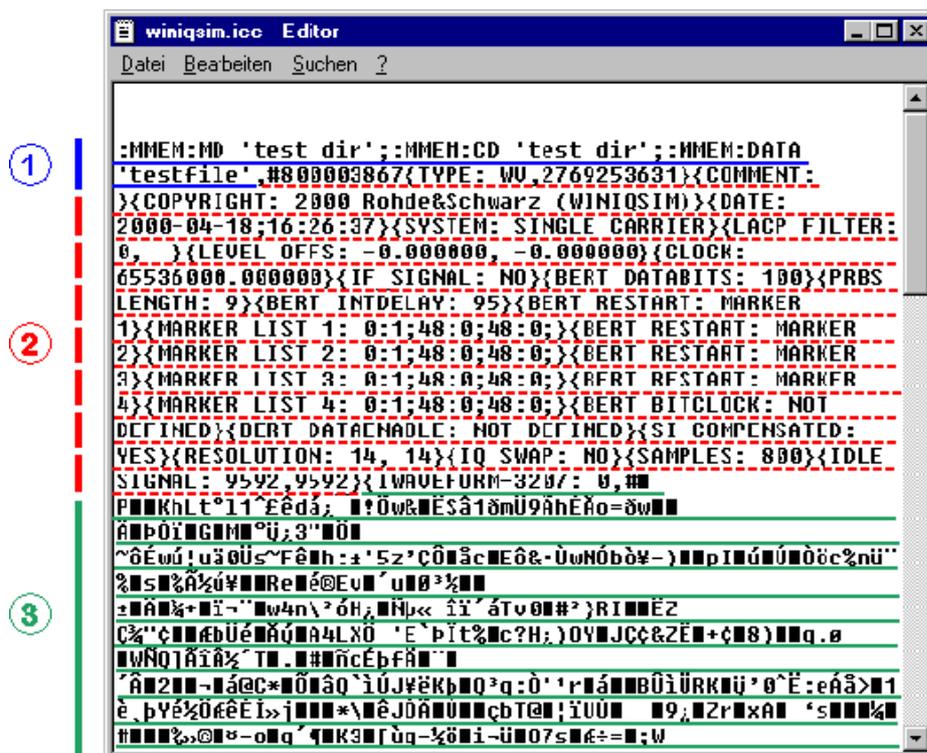


Fig. 4 presents an example of a waveform batch file, created by WinIQSIM

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The IEC/IEEE-bus commands in block ① can be explained as follows:

- The commands `:MMEM:MD 'test_dir'` create a new directory on the AMIQ hard disk drive. Here, `:MMEM` means mass memory and is for hard disk administration. `:MD` creates a directory with the name `'test_dir'` on the AMIQ hard disk. Up to 8 characters are supported for directory names. The AMIQ supports only *one* directory level, but can store up to 100 different directories.
- The command `:MMEM:CD 'test_dir'` sets the new directory as the current working directory. `:CD` refers to change directory.
- The command `:MMEM:DATA 'testfile'` creates a waveform data file with name `'testfile'` in the new directory.

**Note:** *The waveform is limited in size, since it must fit on one 1.44 MB floppy disk.*

The IEC/IEEE commands in the “winiqsim.iec” batch file do not load the waveform directly into the AMIQ RAM, thus a waveform currently loaded in the AMIQ RAM is not affected by executing “winiqsim.iec”.

There are 2 ways to execute the waveform stored in “winiqsim.iec”.

- From WinIQSIM:
  - Select the **AMIQ** menu and open the submenu **Remote Control and Bert...**
  - Press the **Execute Batch** button in the Event Control section of the **Remote Control and Bert...** panel, to execute the batch file.
- From SMIQ:
  - Select the *AMIQ CTRL* menu of the SMIQ.
  - Go to the *SELECT WAVEFORM/EXECUTE BATCH...* submenu as presented in Fig. 6. Another submenu pops up. Scroll with the rotary knob down to *EXECUTE BATCH FROM FLOPPY 4*. Press the *SELECT* key on the SMIQ front panel.

You will see Floppy disk drive activity indicated by the green LED of the AMIQ floppy disk drive.

**Note:** *Only files named “winiqsim.iec” can be executed via **Execute Batch** in the **AMIQ Remote Control** panel (Fig. 5) or via the *AMIQ CTRL* menu in the SMIQ. If such a file is not found on the batch floppy the AMIQ will issue a warning with two short low frequency warning beeps. WinIQSIM or the SMIQ will display an error message, “-257 File name error; invalid or reserved name; C:batch\winiqsim.iec”. It is necessary to verify if such a file does actually exist on the floppy disk.*

The size of the waveform file is limited to the size of the floppy disk of 1.44 MB disk space. However, for most standard applications this is sufficient.

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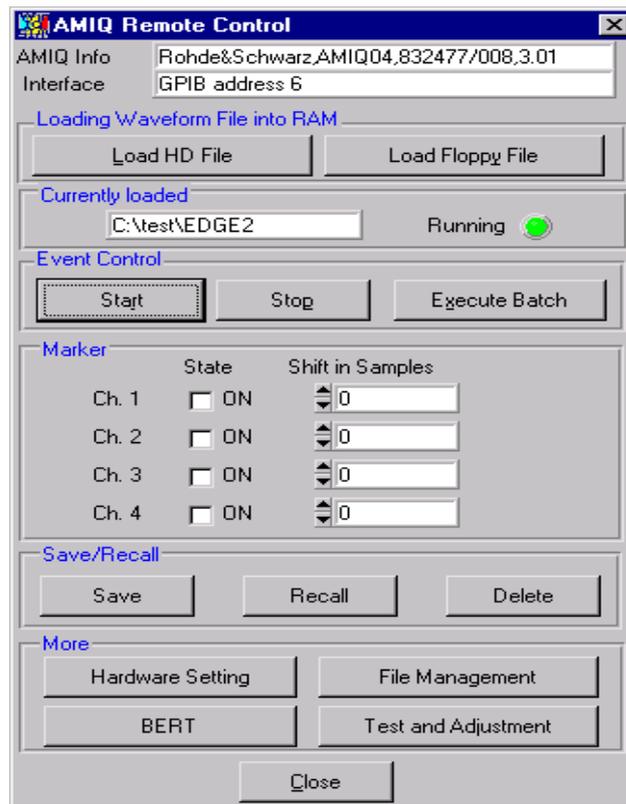


Fig. 5 In the **AMIQ Remote Control** panel of WinIQSIM a waveform file is executed by pressing the **Execute Batch** button.

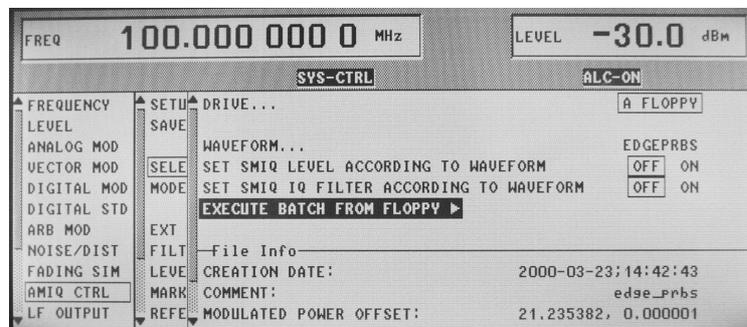


Fig. 6 In the **AMIQ CTRL** menu of the SMIQ execution of a waveform file is done in the submenu **EXECUTE BATCH FROM FLOPPY 4**

### **5 Accessing Waveform Files Stored on the AMIQ Hard Disk**

Waveforms stored on the AMIQ hard disk were either created with WinIQSIM or transferred to the AMIQ hard disk in a previous session. There are 3 different methods to execute such waveforms:

- From a PC over the GPIB (or serial) interface, using the **Load HD File** button in the **AMIQ Remote Control** menu under WinIQSIM, see also Fig. 5.
- From the SMIQ RF vector signal generator, in the *AMIQ CTRL* menu as shown in Fig. 2. Select a waveform file stored on the AMIQ hard disk drive or floppy disk drive using the menus on the SMIQ. This requires a GPIB cable between the SMIQ and the AMIQ. The SMIQ must be configured in the UTILITY menu for the *AMIQ CTRL* menu to appear.
- From a batch floppy disk inserted into the AMIQ floppy disk drive. At power-up, the AMIQ initially loads the waveform and setup which was active when it was last powered down. It then looks for the file "autoexec.iec" on the floppy disk. If this file is found, the content of the file is read and the IEC/IEEE-bus commands are executed as if they had been sent over GPIB. This feature can be used – by appropriate configuration of "autoexec.iec" – to load waveforms from the AMIQ hard disk drive or even from the floppy disk drive of the AMIQ into the output RAM. If no filename is found on the floppy, no additional action is accomplished, thus the AMIQ performs, as if no floppy is present (the previous power-down setup is active). If any errors<sup>1</sup> are encountered in the "autoexec.iec" batch command file, an error condition will be flagged, causing the AMIQ green ON-LED to continuously flash rapidly.

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<sup>1</sup> This status is not to confuse with warning messages, which are normally not acoustically or visually indicated by the AMIQ but generate an error message in the error queue. The message can be read out by using the IEC/IEEE-bus command, :SYST:ERR?.

### **6 Transferring a Waveform File from Floppy Disk to the AMIQ Hard Disk**

In production, the transfer of waveforms directly to the AMIQ from a floppy disk without using the SMIQ or the PC to execute the batch commands is in particular useful when quick changes in the testing procedures are necessary. If various waveforms are already stored on the AMIQ hard disk the batch floppy can change the waveforms within seconds.

- Create the waveform in WinIQSIM, as described in Section 3.
- On the PC rename the filename on the floppy disk from “winiqsim.iec” to “autoexec.iec”.
- Remove the floppy disk from the PC floppy disk drive and insert it into the AMIQ floppy disk drive.
- Power up the AMIQ with the batch floppy disk in the AMIQ drive. You should see the following activity at power up:

The green ON-LED will light as soon as the AMIQ is powered up.

A single high frequency beep will sound after approximately 10 seconds.

The floppy disk drive activates momentarily for an initial test of a few seconds and will then spin down again.

The CONTROL-LED (yellow LED) of the AMIQ will briefly light up.

A low frequency single beep will sound at the same time. If the previous AMIQ power-down setup included active outputs and the AMIQ was in the RUNNING mode, the RUNNING-LED will activate again and the CONTROL-LED will light up for a short period after the beep.

The floppy drive re-activates, and the IEC/IEEE-bus commands in the “autoexec.iec” file will be executed.

If the “autoexec.iec” file was not found on the floppy, nothing will happen after the first single low beep. If during the boot up process of the AMIQ any error occurs or if there are any errors in the file, the AMIQ will indicate the error with a warning beep and the ON indicator will flash rapidly.

**Note:** *This power-up sequence with the renamed “winiqsim.iec” file (renamed into “autoexec.iec”) only needs to be executed once per waveform, since it copies the waveform to the AMIQ hard disk drive.*

- Repeat the procedure to copy other waveforms to the AMIQ hard disk drive.

The difference between a “winiqsim.iec” and a “autoexec.iec” file is in how these files are accessed and executed. The “winiqsim.iec” file name is automatically generated when a user creates a waveform file in WinIQSIM. WinIQSIM prepares the file so that it can be accessed and executed from a batch floppy using the **AMIQ Remote Control** panel in WinIQSIM by pressing the **Execute Batch** button in the Event Control section, as shown in Fig. 5. The SMIQ uses also a “winiqsim.iec” file to remotely access and execute the batch floppy. An “autoexec.iec” file, is interpreted by the AMIQ as an auto execution file. If a floppy disk with a file called “winiqsim.iec” is inserted into the AMIQ floppy drive, the AMIQ only executes the file after it has been externally called by the user. However if the AMIQ floppy drive

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finds a file called "autoexec.iec" the AMIQ directly accesses the file and executes the content of the file.

**Note:** *Five very fast high frequency beeps, during the AMIQ power-up sequence indicate that the AMIQ is looking for a firmware upgrade. Firmware versions, before version 3.01 instructed the AMIQ to look for a firmware update on the floppy disk during the power-up cycle. However, this does not affect the transfer of the waveform file from floppy disk to the AMIQ hard drive, or its execution, or the AMIQ operation itself. In order to prevent this warning it is recommended to update the firmware to the current version which corrects this problem.*

## **7 Loading and Starting Waveforms Directly Using Floppy Disk Control**

There are three ways to transfer the waveform from the AMIQ hard drive to the AMIQ RAM and activate the I and Q outputs. Either use WinIQSIM or an SMIQ connected via GPIB bus using the *AMIQ CTRL* menu as previously described. Alternatively if you want to use the AMIQ in a stand-alone fashion, an additional sequence of batch commands can be created. You have the choice to create an additional IEC/IEEE-bus command sequence file on a second floppy that copies the waveform from the AMIQ hard drive to the AMIQ RAM and then starts the arbitrary waveform generation. Or you use a more compact method that uses only a single disk operation to upload the waveform straight from floppy disk into the AMIQ RAM and executes the waveform so that it starts the arbitrary waveform generation immediately after finishing the loading process.

The advantage of the two floppy solution, is the flexibility of this method. If you want to use 5 different waveforms, you can copy them all to the AMIQ hard drive. Then create 5 different "execute" floppies, one for each waveform with the correct IEC/IEEE-bus commands. Just insert the proper "execute" floppy into the AMIQ and power up to get a particular waveform loaded from the AMIQ hard drive and enabled.

The advantage of the one floppy solution is that it is possible to download waveforms straight into the AMIQ RAM and execute the waveforms with only a single floppy disk.

### Two Floppy Solution

Create a file with a text editor named "autoexec.iec" on a floppy disk with the following content.

```
IEC/IEEE-bus commands:  *RST
                        :MMEM:CD `test_dir`
                        :MMEM:LOAD RAM, `test`
                        :OUTP:I FIX
                        :OUTP:Q FIX
                        :TRIG:MODE CONT
                        :ARM
                        :TRIG
```

This is the line by line form of the IEC/IEEE-bus commands. \*RST resets the AMIQ to its default settings, discarding any unwanted settings, which have been stored in a previous session. :OUTP:I FIX, :OUTP:Q FIX set the I and Q outputs of the AMIQ to a fixed output level of 1V<sub>p-p</sub>. With the IEC/IEEE-bus command :TRIG:MODE CONT is the internal trigger set to continuous triggering of the waveform. Any external trigger event will be ignored. :ARM is responsible for preparing the data memory for a trigger event and :TRIG is starting the waveform.

**Note:** The IEC/IEEE-bus commands can also be written in a more condensed form using semicolons to distinguish between different commands. The command sequence would look like as follows:

```
IEC/IEEE-bus commands:  *RST;:MMEM:CD `test_dir`;:MMEM
                        :LOAD RAM, `test`;:OUTP:I FIX;
                        :OUTP:Q FIX;:TRIG;:MODE CONT;
                        :ARM;:TRIG
```

- Insert the floppy disk into the AMIQ floppy drive. Power up the AMIQ.

After a single low frequency beep, you see additional floppy activity, followed by activation of the new waveform. The RUNNING indicator of the AMIQ is active.

If you only wish to use one single waveform at power-up, you do not need a floppy in the AMIQ drive at the next power up, since the AMIQ always powers up with the same settings as it was previously powered down.

### **One Floppy Solution**

- Create a waveform batch floppy as described in section 3.
- Edit the batch floppy file using *WordPad* text tool from Windows.
  - Note:** *Using other text editors or text tools may result in changes of the binary block of the waveform file. NOTEPAD for example alters the content of the binary block by adding DOS specific format information into the block. This results in a erroneous waveform generation when loaded into the RAM of the AMIQ. So use WordPad or any binary format editor to alter the content of the batch floppy file.*
- Open the file in the editor. You should see the content of Fig. 4. Replace the IEC/IEEE-bus commands at the top of the file by the following sequence shown in Fig. 7:  
IEC/IEEE-bus commands:    \*RST  
                              :MEM:DATA RAM
- Search for the symbol '}' which marks the end of the binary block. Place the cursor at the end of '}' symbol and press ENTER. Continue with these IEC/IEEE-bus commands:  
IEC/IEEE-bus commands    :OUTP:I FIX  
                              :OUTP:Q FIX  
                              :TRIG:MODE CONT  
                              :ARM  
                              :TRIG
- Note:** *Also the condensed form of IEC/IEEE-bus commands is possible. Do not forget to include a semicolon between different commands.*
- Save the file.
- Rename the file from "winiqsim.iec" into "autoexec.iec".



Fig. 7 shows the altered content of the waveform file. The altered IEC/IEEE-bus commands are surrounded by boxes to highlight their location in the file. The content of the file has been condensed in order to show how the IEC/IEEE-bus command sequence is arranged in the file.

- Insert the new floppy disk into the AMIQ floppy drive and power the AMIQ up.

You will see the activities described in section 4. When the single low frequency beep occurs, you see additional floppy activity, followed by activation of the new waveform. The RUNNING indicator of the AMIQ light up.

The arbitrary waveform generator produces the desired waveform. If you are using an oscilloscope you can see the result of the I and Q outputs as a constellation diagram using the XY co-ordinate settings of the scope.

**Note:** After the AMIQ is powered down it will lose all waveform file information and AMIQ settings, since it loads the waveform directly into the volatile RAM of the AMIQ. By the next power-up cycle, it is necessary to repeat the one disk solution procedure.

## **8 Conclusion**

Floppy disk control of the I/Q Modulation Generator AMIQ for stand-alone applications is demonstrated. A method to create a batch floppy in WinIQSIM that controls the AMIQ without the use of an external control using a few simple steps is described. There exist different transfer options for waveforms from WinIQSIM or an SMIQ to the AMIQ. However, the focus is set to the transfer and/or execution of waveforms via floppy disk. Detailed explanations are provided how to carry out such a procedure. Also two methods are demonstrated to show a user the versatility of the floppy disk control for the AMIQ. This will seriously extend the use of the AMIQ towards a standalone instrument and is therefore an interesting solution for production.

## **9 References**

Vector Signal Generator SMIQB, Operating Manual, 1125.5610.12, Rohde & Schwarz (2000)

I/Q Modulation Generator AMIQ, Operating Manual, 1110.3339.12, Rohde & Schwarz (2000)

Software WinIQSIM for Calculating I/Q Signals for I/Q Modulation Generator AMIQ, Software Manual, 1013.1659.42, Rohde & Schwarz (2000)

## **10 Ordering Information**

### **I/Q Modulation Generator:**

AMIQ03 incl. WinIQSIM	4 Msamples Memory	1110.2003.03
AMIQ04 incl. WinIQSIM	16 Msamples Memory	1110.2003.04

### **Vector Signal Generator:**

SMIQ02B	300 kHz to 2.2 GHz	1125.5555.02
SMIQ03B	300 kHz to 3.3 GHz	1125.5555.03
SMIQ04B	300 kHz to 4.4 GHz	1125.5555.04
SMIQ06B	300 kHz to 6.6 GHz	1125.5555.06



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