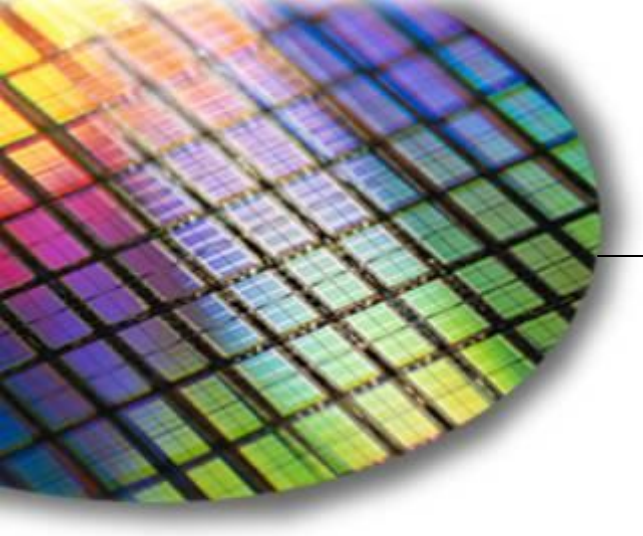

The World Leader in High Performance Signal Processing Solutions

Basic Microcontroller Integration Using Sigma Studio

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November 2010

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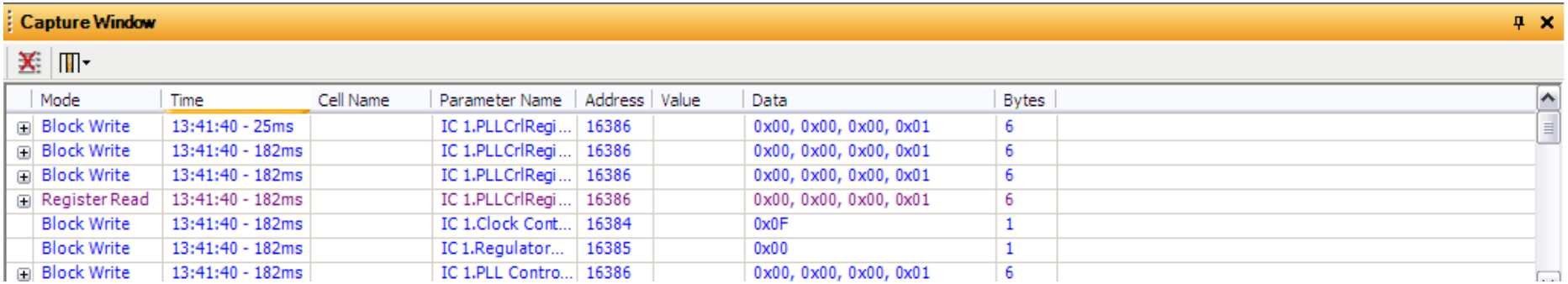
Overview

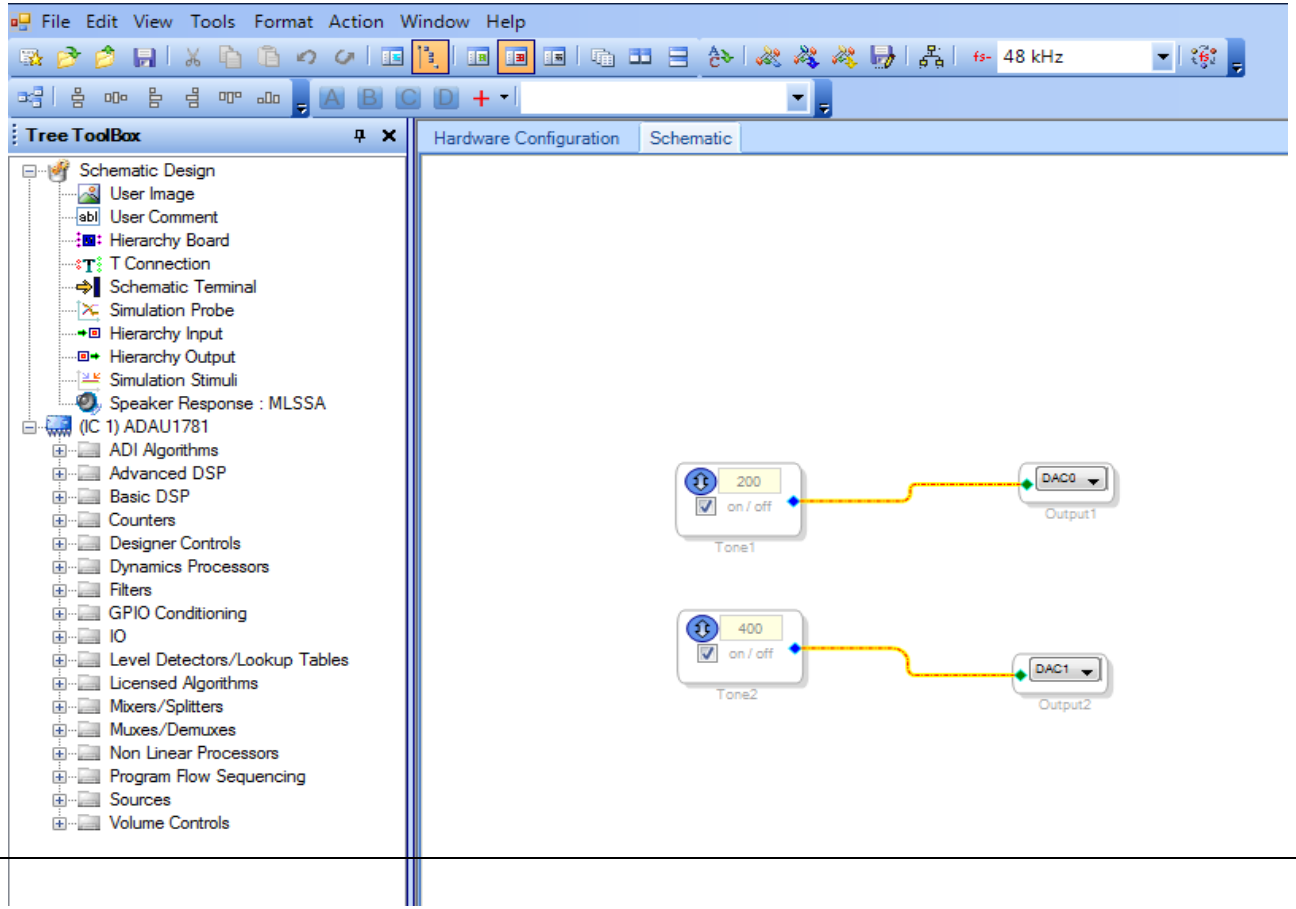
- **This document will describe how to program a microcontroller to emulate SigmaStudio to communicate with a SigmaDSP IC in a real production system.**
- **SigmaStudio already displays helpful information in the Capture Window, which is shown below.**
  - **Displays all data written over the USB communications link**
    - Parameter/register name, value, hex data, number of bytes
    - Data can easily be exported to a file
  - **Very useful for application development and debugging**
  - **Enable under SigmaStudio's "View" menu (Ctrl-5)**



Mode	Time	Cell Name	Parameter Name	Address	Value	Data	Bytes
Block Write	13:41:40 - 25ms		IC 1.PLLCrlRegi...	16386		0x00, 0x00, 0x00, 0x01	6
Block Write	13:41:40 - 182ms		IC 1.PLLCrlRegi...	16386		0x00, 0x00, 0x00, 0x01	6
Block Write	13:41:40 - 182ms		IC 1.PLLCrlRegi...	16386		0x00, 0x00, 0x00, 0x01	6
Register Read	13:41:40 - 182ms		IC 1.PLLCrlRegi...	16386		0x00, 0x00, 0x00, 0x01	6
Block Write	13:41:40 - 182ms		IC 1.Clock Cont...	16384		0x0F	1
Block Write	13:41:40 - 182ms		IC 1.Regulator...	16385		0x00	1
Block Write	13:41:40 - 182ms		IC 1.PLL Contro...	16386		0x00, 0x00, 0x00, 0x01	6

Sigma Studio Overview

- **Suppose we have a simple SigmaStudio Project with two sine tone sources that looks like this:**



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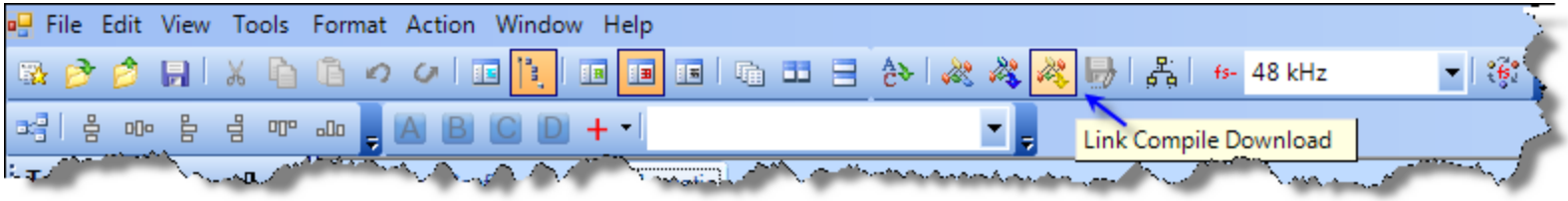
Sigma Studio Overview (cont…)

- **When the project has been verified and is ready to be ported to the microcontroller, there are few steps to start the process**
  - **First, locate and press the "Link Compile Download" button**



    - This compiles the project code and generates all necessary data files to run the project on the SigmaDSP)
    - If an evaluation board is attached to the computer, the capture window will display all data written from the computer to the SigmaDSP over the USB port.
  - **After compilation, the "Export System Files" button will be enabled**

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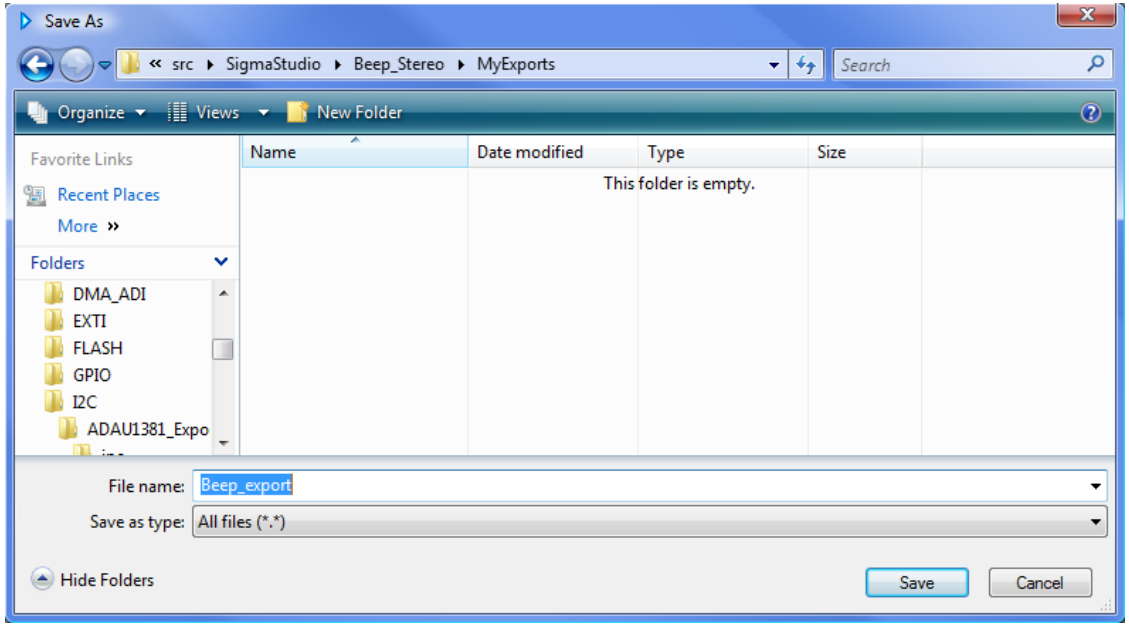
Sigma Studio Overview (cont...)

- Pressing the “Export System Files” button will display a dialog box which allows the user to choose a target folder for saving the exported files. In this example, the files are named “Beep_export”.



- A list of the files generated and their contents is explained in detail in the following slides.

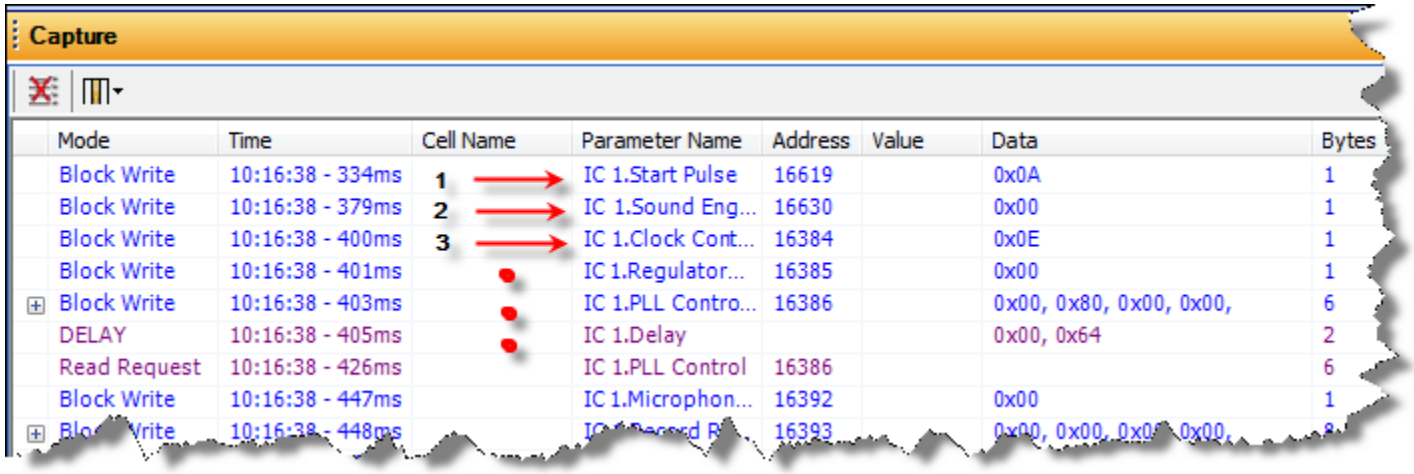
Sigma Studio Overview (cont…)

- **The following is a list of all files that are automatically generated, where the '*' represents the given name:**
  - ***.hex**
    - This contains the contents of the program RAM
  - ***.params**
    - Gives detailed information of Cell Name, Parameter Name, Address, Value, and Data. For example:

```
Cell Name                = Tone1
Parameter Name    = sin_lookupAlg19401mask
Parameter Address = 8
Parameter Value   = 255
Parameter Data :
0X00, 0X00, 0X00, 0XFF,
```

Sigma Studio Overview (cont…)

- **The following is a list of all files that are automatically generated, where the '*' represents the given name:**
  - ***_IC_1.h**
    - This file contains all the information needed to access the IC registers, program data, and param data using a method named "default_download()". This method calls all the registers and commands exactly as they appear on the capture window.



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Sigma Studio Overview (cont…)

- **The following is a list of all files that are automatically generated, where the '*' represents the given name:**
  - ***_IC_1_PARAM.h**
    - Contains the parameter definitions of each independent module. For example, here is an excerpt from the sine tone generator:

```
/* Module Tone1 - Sine Tone*/
#define MOD_TONE1_COUNT                          3
#define MOD_TONE1_DEVICE                         "IC1"
#define MOD_STATIC_TONE1_ALG0_MASK_ADDR          8
#define MOD_STATIC_TONE1_ALG0_MASK_FIXPT         0x000000FF
```

  - ***_IC_1_REG.h**
    - Contains the Register definitions and settings for the SigmaDSP IC. For example:

```
/* MCLK Pad Control  - Registers (IC 1) */
#define REG_MCLK_PAD_CONTROL_ADDR                0x4031
#define REG_MCLK_PAD_CONTROL_VALUE               0x2
```

Sigma Studio Overview (cont…)

- **The following is a list of all files that are automatically generated, where the '*' represents the given name:**
  - **defines.h**
    - This is rather a legacy header file that defines the total number of transactions (i.e. writes to the I^2C/SPI control port) already defined on our *_IC_1.h file. It also contains the total buffer size expressed in bytes. The "defines.h" is now seldom used, along with the "NumBytes_IC_1.dat" and "TxBuffer_IC_1.dat" files. Together, these three files duplicate the download sequence similar to default_download(). These files are still generated to maintain backwards-compatibility with older systems.
  - **NumBytes_IC_1.dat**
    - Contains an array, size of the total number of commands. Each element will let the microcontroller know how many bytes will be written in the transaction.
  - **TxBuffer_IC_1.dat**
    - Contains the actual data for the download transactions, which consists of address byte(s) followed by data.

Sigma Studio Overview (cont…)

- **SigmaStudioFW.h is the only file that is not automatically generated.**
  - It is located in the base SigmaStudio installation folder (by default, this is [Program Files]\Analog Devices\Sigma Studio 3.x).
  - It contains a template with pre defined macros. The user has to implement these macros manually to be used with the desired microcontroller family.
  - One macro that is very helpful is the command "SIGMA_WRITE_REGISTER_BLOCK (int devAddress, int address, int length, ADI_REG_TYPE *pData) ", which contains basic information such as device address, instruction address and length, and instruction data.

Microcontroller Implementation

- Now that the files have successfully been exported from SigmaStudio, microcontroller code can be developed.
- This example uses the ARM Cortex M3 series and Keil integrated development environment.
- The user should define the basic microcontroller configuration such System Clocks, NVIC, GPIO, and the communication protocol configurations (in our case I^2C) before continuing with this tutorial.

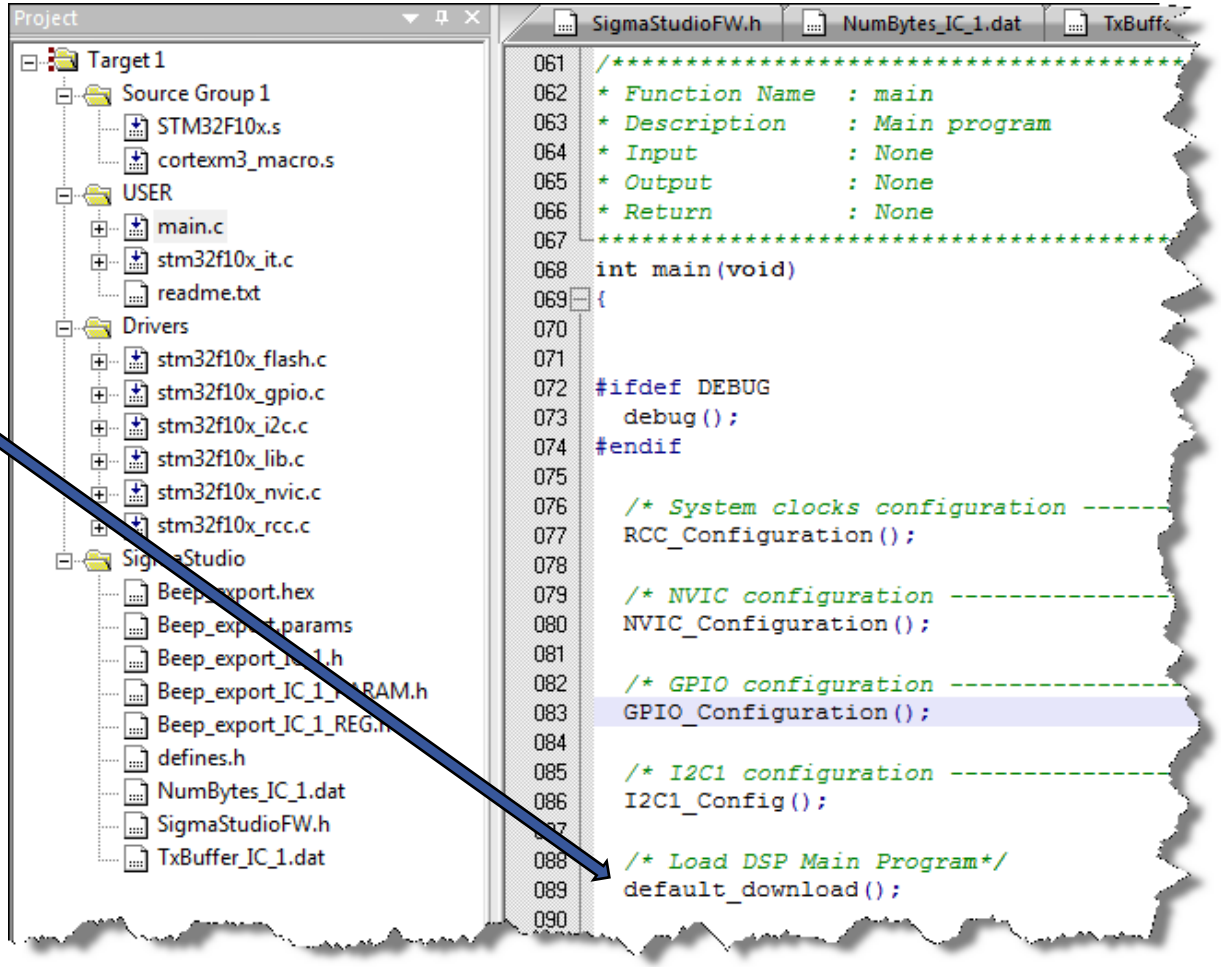
Microcontroller Implementation

- First, open the “main.c” file.
- In this file, the following header files must be included:
  - SigmaStudioFW.h (Assuming that the macros have been already defined by the user)
  - *_IC_1.h
  - *_IC_1_PARAM.h

Microcontroller implementation

- **The "main" function should look something like this:**

Notice that we are calling "default_dowload()". This function will actually grab all of the SigmaStudio code, parameters, data, and register settings, and load them to the SigmaDSP. In essence, this should allow the microcontroller to emulate what SigmaStudio does when the Link-Compile-Download button is pressed.



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Microcontroller implementation (cont…)

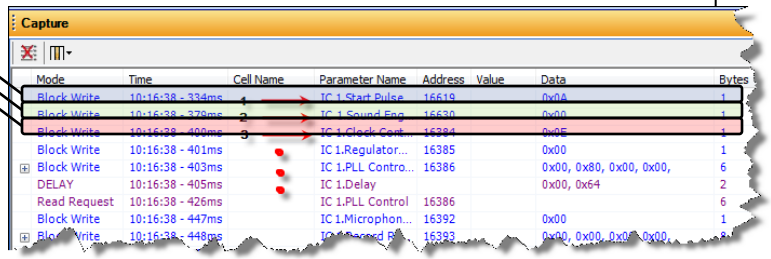
- The function “default_download()” looks like this:

```
void default_download() {
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_START_PULSE_ADDR, REG_START_PULSE_BYTE, R0_STA
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SOUND_ENGINE_RUN_ADDR, REG_SOUND_ENGINE_RUN_BYTE
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_PLL_CONTROL_ADDR, REG_PLL_CONTROL_BYTE, R2_PLL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_PLL_CONTROL_ADDR, REG_PLL_CONTROL_BYTE, R3_PLL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_PLL_CONTROL_ADDR, REG_PLL_CONTROL_BYTE, R4_PLL
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_CLOCK_CONTROL_ADDR, REG_CLOCK_CONTROL_BYTE, R5
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_REGULATOR_CONTROL_ADDR, REG_REGULATOR_CONTROL_B
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_PLL_CONTROL_ADDR, REG_PLL_CONTROL_BYTE, R7_PLL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_DIGITAL_MIC_AND_BEEP_CONTROL_ADDR, REG_DIGITAL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_RECORD_PWR_MANAGEMENT_ADDR , R9_RECORD_REGISTER
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SERIAL_PORT_CONTROL_0_ADDR , R10_SERIAL_PORT_C
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_CONVERTER_CTRL_0_ADDR , R11_CONVERTER_CONTROL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_ADC_CONTROL_0_ADDR , R12_ADC_CONTROL_REGISTERS_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_PLAYBACK_MIXER_LEFT_CONTROL_ADDR , R13_PLAYBACK
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_DAC_CONTROL_0_ADDR , R14_DAC_CONTROL_REGISTERS_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SERIAL_PORT_PAD_CONTROL_0_ADDR , R15_SERIAL_PA
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_COMM_PORT_PAD_CTRL_0_ADDR , R16_COMMUNICATION_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_MCLK_PAD_CONTROL_ADDR, REG_MCLK_PAD_CONTROL_BYT
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_LOW_LATENCY_REG_ADDR, REG_LOW_LATENCY_REG_BYTE
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_DIGITAL_POWER_DOWN_0_ADDR , R19_DIGITAL_POWER_D
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_GPIO_0_CONTROL_ADDR , R20_GPIO_REGISTERS_SIZE,
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_START_PULSE_ADDR, REG_START_PULSE_BYTE, R21_STA
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_ROUTING_MATRIX_INPUTS_ADDR, REG_ROUTING_MATRIX_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_ROUTING_MATRIX_OUTPUTS_ADDR, REG_ROUTING_MATRIX
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SERIAL_DATAGPIO_PIN_CONFIG_ADDR, REG_SERIAL_DA
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SERIAL_PORT_SAMPLE_RATE_SETTING_ADDR, REG_SERI
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_NON_MODULO_RAM_1_ADDR , R26_NON_MODULO_REGISTER
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, PROGRAM_ADDR, PROGRAM_SIZE, Program_Data);
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, PARAM_ADDR, PARAM_SIZE, Param_Data );
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SOUND_ENGINE_RUN_ADDR, REG_SOUND_ENGINE_RUN_BY
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_START_PULSE_ADDR, REG_START_PULSE_BYTE, R30_STA
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_DEJITTER_REGISTER_CONTROL_ADDR, REG_DEJITTER_R
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_DEJITTER_REGISTER_CONTROL_ADDR, REG_DEJITTER_
}
```

Microcontroller implementation (cont…)

- **Each line in default_download() corresponds to a transaction shown in the capture window during SigmaStudio's Link-Compile-Download sequence.**

```
void default_download() {
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_START_PULSE_ADDR, REG_START_PULSE_BYTE, R0_STA
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SOUND_ENGINE_RUN_ADDR, REG_SOUND_ENGINE_RUN_BYTE
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_PLL_CONTROL_ADDR, REG_PLL_CONTROL_BYTE, R2_PLL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_PLL_CONTROL_ADDR, REG_PLL_CONTROL_BYTE, R3_PLL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_PLL_CONTROL_ADDR, REG_PLL_CONTROL_BYTE, R4_PLL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_CLOCK_CONTROL_ADDR, REG_CLOCK_CONTROL_BYTE, R5_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_REGULATOR_CONTROL_ADDR, REG_REGULATOR_CONTROL_B
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_PLL_CONTROL_ADDR, REG_PLL_CONTROL_BYTE, R7_PLL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_DIGITAL_MIC_AND_BEEP_CONTROL_ADDR, REG_DIGITAL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_RECORD_PWR_MANAGEMENT_ADDR , R9_RECORD_REGISTER
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SERIAL_PORT_CONTROL_0_ADDR , R10_SERIAL_PORT_C
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_CONVERTER_CTRL_0_ADDR , R11_CONVERTER_CONTROL_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_ADC_CONTROL_0_ADDR , R12_ADC_CONTROL_REGISTERS
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_PLAYBACK_MIXER_LEFT_CONTROL_ADDR , R13_PLAYBACK
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_DAC_CONTROL_0_ADDR , R14_DAC_CONTROL_REGISTERS
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SERIAL_PORT_PAD_CONTROL_0_ADDR , R15_SERIAL_PA
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_COMM_PORT_PAD_CTRL_0_ADDR , R16_COMMUNICATION_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_MCLK_PAD_CONTROL_ADDR, REG_MCLK_PAD_CONTROL_BYT
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_LOW_LATENCY_REG_ADDR, REG_LOW_LATENCY_REG_BYTE
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_DIGITAL_POWER_DOWN_0_ADDR , R19_DIGITAL_POWER_D
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_GPIO_0_CONTROL_ADDR , R20_GPIO_REGISTERS_SIZE,
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_START_PULSE_ADDR, REG_START_PULSE_BYTE, R21_STA
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_ROUTING_MATRIX_INPUTS_ADDR, REG_ROUTING_MATRIX_
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_ROUTING_MATRIX_OUTPUTS_ADDR, REG_ROUTING_MATRIX
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SERIAL_DATAGPIO_PIN_CONFIG_ADDR, REG_SERIAL_DA
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SERIAL_PORT_SAMPLE_RATE_SETTING_ADDR, REG_SERI
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_NON_MODULO_RAM_1_ADDR , R26_NON_MODULO_REGISTER
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, PROGRAM_ADDR, PROGRAM_SIZE, Program_Data);
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, PARAM_ADDR, PARAM_SIZE, Param_Data );
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_SOUND_ENGINE_RUN_ADDR, REG_SOUND_ENGINE_RUN_BY
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_START_PULSE_ADDR, REG_START_PULSE_BYTE, R30_STA
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_DEJITTER_REGISTER_CONTROL_ADDR, REG_DEJITTER_R
    SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, REG_DEJITTER_REGISTER_CONTROL_ADDR, REG_DEJITTER_
}
```



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Microcontroller implementation (cont…)

- In our example the SIGMA_WRITE_REGISTER_BLOCK(int devAddress, int address, int length, ADI_REG_TYPE *pData) macro is shown below

```
049  */
050 void SIGMA_WRITE_REGISTER_BLOCK(int devAddress, int address, int length, ADI_REG_TYPE *pData )
051 {
052
053 int ii=0;
054 int zz=0;
055 Tx_Idx = 0;
056
057 /*----- Transmission Phase -----*/
058     ThisBufferSize = Address_Length + length;
059
060 I2C1_Buffer_Tx[0] =    (address & 0xFF00)>>8;
061 I2C1_Buffer_Tx[1] =    address & 0x00FF;
062
063 for(zz=0;zz<length;zz++)
064 {
065 I2C1_Buffer_Tx [zz+Address_Length] =    pData[zz];
066 }
067  Tx_Idx = 0;
068   for(ii =0;ii < ThisBufferSize;ii++)
069  {
070
071     NextBufferEnd =  ThisBufferSize;//I2C1_numbytes[ii];
072     if(ii == 0) I2C_GenerateSTART(I2C1, ENABLE);
073     /* Send data */
074     while(Tx_Idx < NextBufferEnd)
075     {
076
077     }
078
079   }
080 }
```

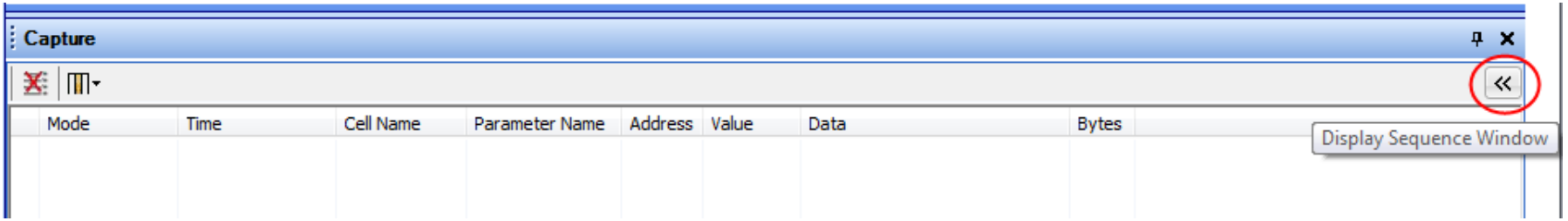
Microcontroller implementation (cont…)

- **How to access single registers or SigmaStudio cell parameters?**
  - **One example is to turn on/off the sine Tone 1 and sine Tone 2.**
    - First, we declare a value vector of type “ADI_REG_TYPE” with the desired value to be modified.
    - Then call the SIGMA_WRITE_REGISTER_BLOCK macro with the right parameters

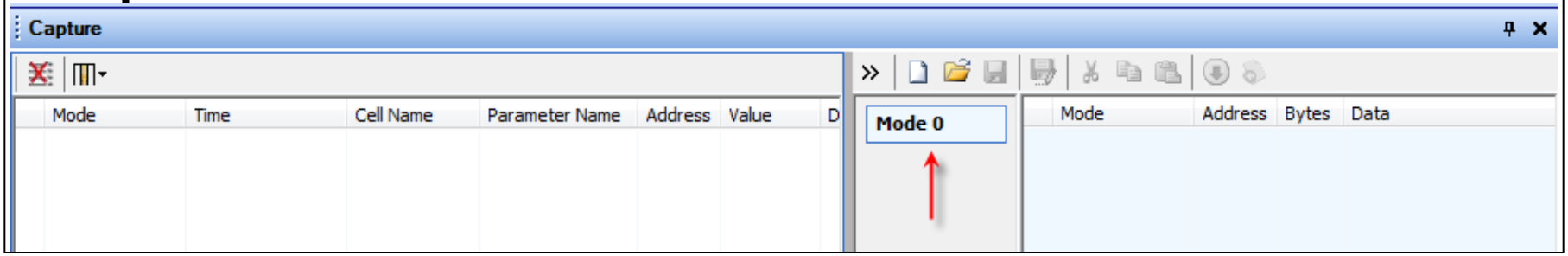
```
/*****************************************************************************
* Function Name  : Mute_Left_Tone
* Description    : Mutes Left Tone
* Input          : None
* Output         : None
* Return         : None
*****************************************************************************/
void Mute_Left_Tone(void)
{
   ADI_REG_TYPE Val[4] = {0x00, 0x00, 0x00, 0x00};
   ADI_REG_TYPE Val2[4] = {0x00, 0x80, 0x00, 0x00};

   /* Mutes the Left Tone */
   SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, MOD_TONE1_ALG0_ON_ADDR, 4, Val );

   /* Unmutes the Right Tone */
   SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, MOD_TONE2_ALG0_ON_ADDR, 4, Val2 );
}
```

Using the Sequencer Window

- The Sequencer window is a powerful tool that creates sets of instructions for a specific task. To access it, simply open the Data Capture window (Ctrl + 5) and click on the upper right double arrow button.



- Then, the Sequencer Window will appear as part of the Capture Window



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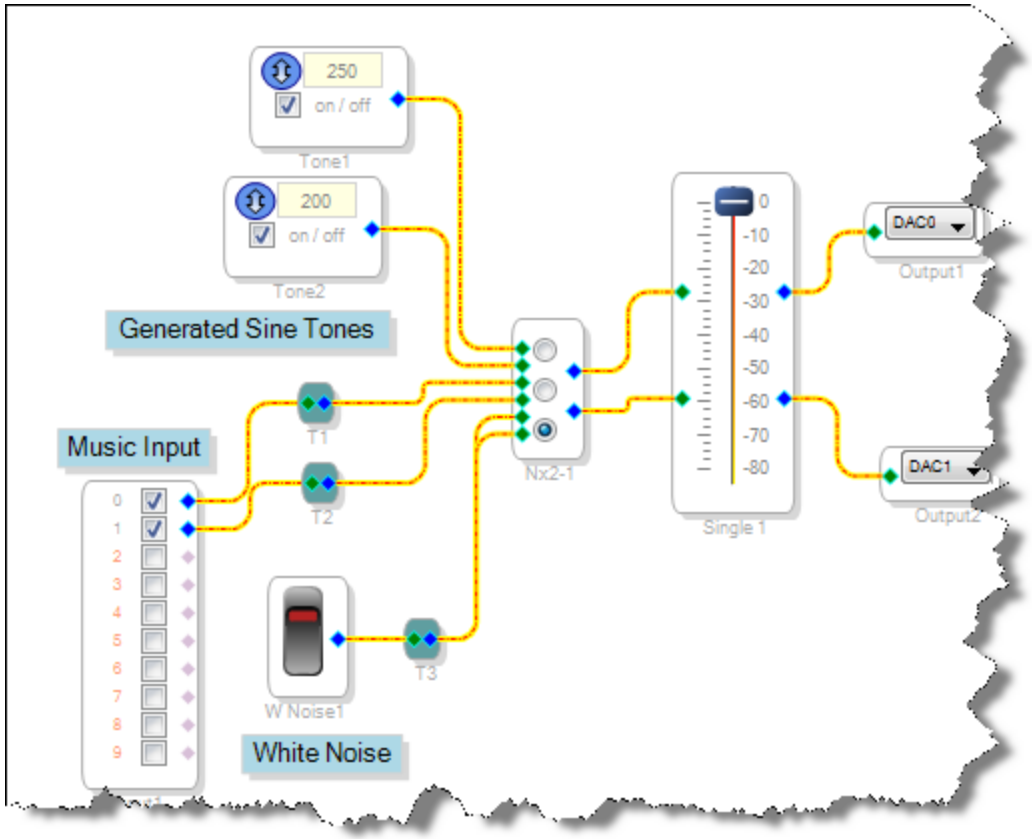
Using the Sequencer Window (cont…)

- Suppose that we have a slightly more complicated Sigma Studio schematic



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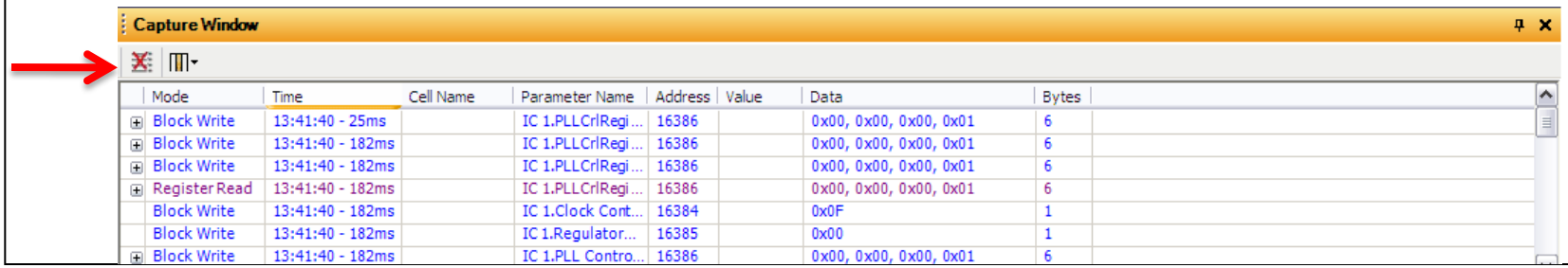
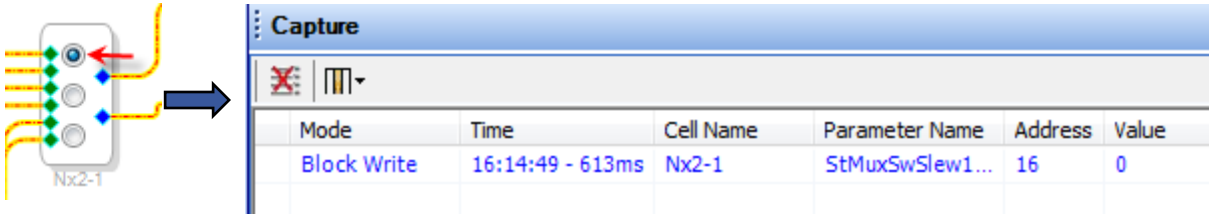
Using the Sequencer Window (cont…)

- We want to compile this Sigma Studio schematic or project and port the basic microcontroller information as previously described.
- Instead of duplicating the system initialization download, this time we will create sequences. Using the Data Capture window as a tool, we can start populating the sequencer window with data. For example, we want to switch between internal generated sine tones, external input, and white noise by clicking the multiplexer in the SigmaStudio project. Instead of using this graphical control, let's try using the sequencer window.
  - To get started, clear all possible information that currently may exist on the data capture window by clicking the red "x" button

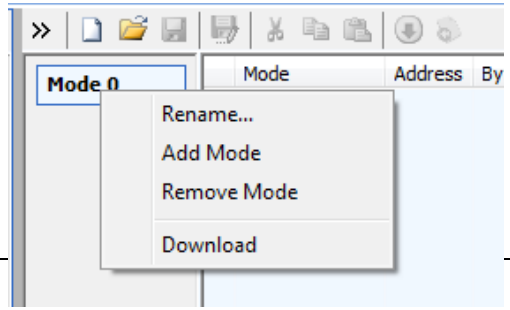


Using the Sequencer Window (cont…)

- **Now, its time to create modes using the data capture window.**
  - **A "mode" is a set of register and RAM writes that change something about the signal flow or device configuration**
  - **Clicking at the first radio button on our Nx2-1 control will display the corresponding write sequence in the Capture window**



  - **In the sequencer window, let's create a mode named "Tones" containing this write sequence (because it will route the sine tones to the output). Add a mode. Then right click on the mode, select "Rename" and type "Tones"**



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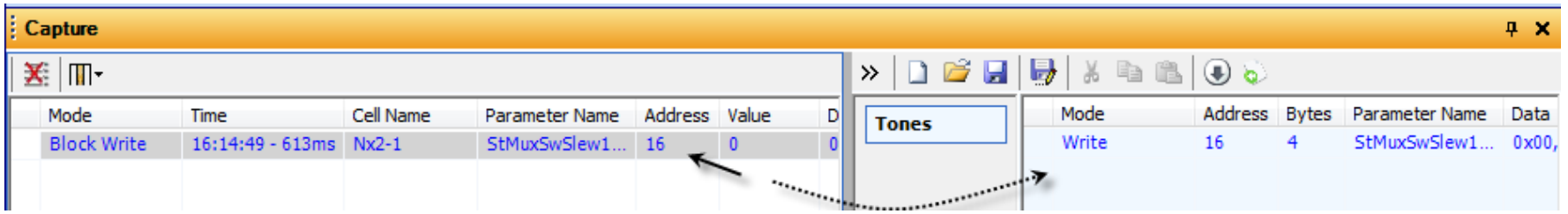
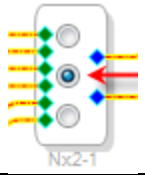
Using the Sequencer Window (cont…)

- **Now, its time to create modes using the data capture window.**
  - **Drag and drop the information displayed on the data capture window to the sequencer window. This creates a single write command in our "Tones" mode.**
  - **Multiple lines can be selected in the capcture window using shift-click or control-click**



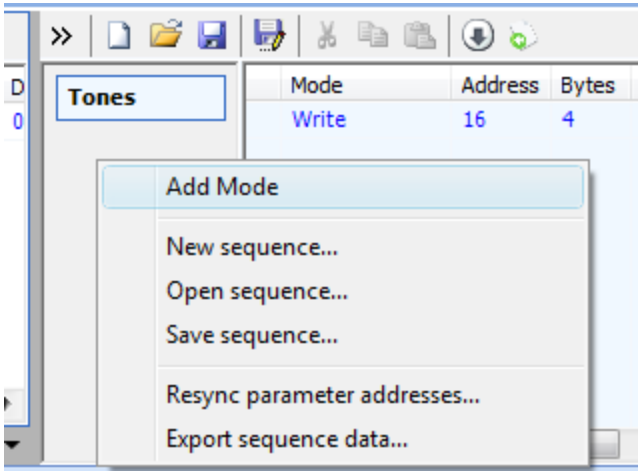
  - **Clear the data capture window again by clicking the red X in the its upper left corner. Now, select the next routing path from the Nx2-1 control.**



ANALOG DEVICES

Using the Sequencer Window (cont…)

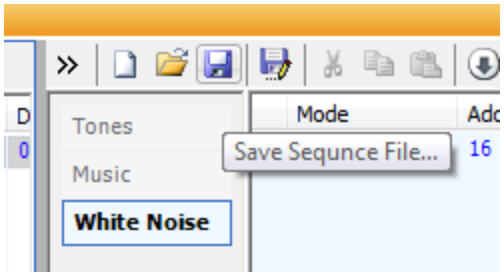
- **Now, its time to create modes using the data capture window.**
  - **Create another mode by right clicking under the “Tones” button. Select “Add Mode” and rename it to “Music”**



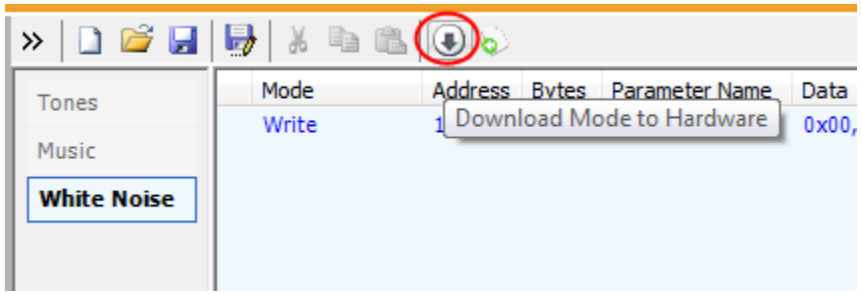
  - **Drag and drop the information from the data capture window into the sequencer window.**
  - **Repeat these steps for the last option on the multiplexer and create a mode named “White Noise”.**

Using the Sequencer Window (cont...)

- **Save the sequencer file on a folder by pressing the "Save Sequence File" button.**



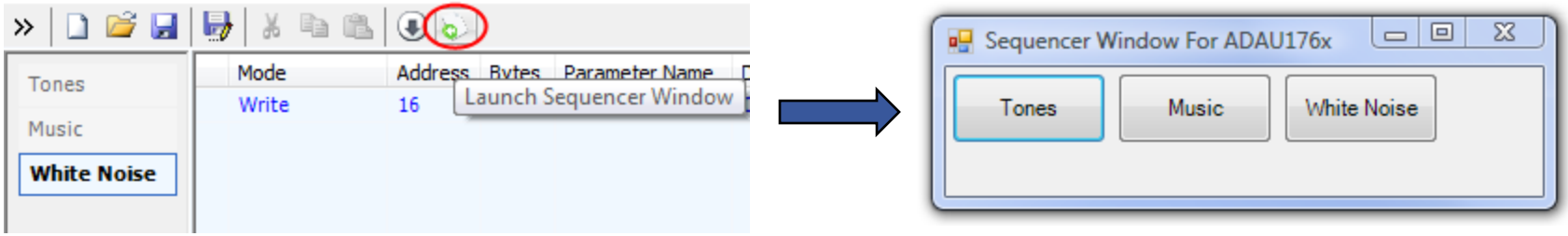
- **To test that the modes work, there are two buttons.**
  - The "Download Mode to Hardware" button downloads everything on the current selected mode. In the case shown here, it will only download the "White Noise" mode.



ANALOG DEVICES

Using the Sequencer Window (cont…)

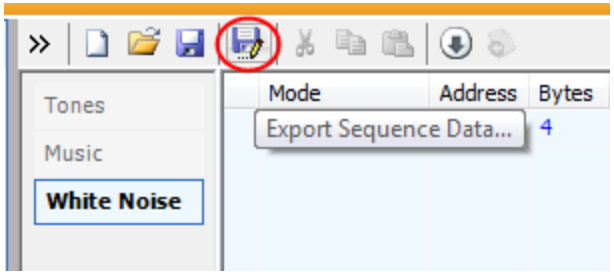
- The “Launch Sequencer Window” button creates a floating window with all modes created. This way, the user could download any mode in any order.



- You must save the sequence file (click the blue disk icon) before the Sequencer Window can be used

Exporting Sequences to a microcontroller

- Once all sequencer modes have been tested, and we already have our basic program in the microcontroller, the next step is to include some sequences and map each mode to a GPIO port on our ARM M3 series uC.
- First, we click on the “Export Sequence Data” button.



- Then, we give it a name. For this example we’ll name it “1761_Demo.h”. After pressing “OK” the following files will be created:
  - 1761_Demo.h
    - This file contains references for all modes

Exporting Sequences to a microcontroller (cont…)

- **Tones_Modes.h, Music_Modes.h, and White Noise_Modes.h**
  - Each independent file contains it mode data. For example:

```
ADI_REG_TYPE TONES_0[4] = {0x00, 0x00, 0x00, 0x00};
void TONES_download()
{
SIGMA_WRITE_REGISTER_BLOCK( DEVICE_ADDR_IC_1, 0x0010, 6,
  TONES_0);                                    /* StMuxSwSlew1coeffname
  */}
```

Accessing Sequencer Modes

- On the “main.c” file, we include the “1761_Demo.h” file.
- We create another c file named “1761Demo_seq.c”.
  - Within this file we just simply call the function by its name. Using the example above, we just type in “TONES_download();” and that’s all.

For reference

- See the example files that were created for an ADAU1761 and an ARM Cortex M3
  - ADAU1761_Demo.zip

Conclusion

- Porting and using SigmaStudio header files for microcontrollers is as easy as pressing the “Export System Files” button.
- The user needs to modify the SigmaStudioFW.h file to enable the pre configured macros within the microcontroller environment.
- All SigmaDSP register and program information is automatically generated and ready to be used.
- The Sequencer window is a powerful tool to access specific data within our SigmaDSP ICs.