NLP-5x Demo/Emulation Board Manual

For FluentChip™ 5 Technologies

SENSORY®

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Introduction

Welcome to the NLP-5x and the world of low-cost, high-performance speech recognition! The resources in the **NLP-5x Demo/Emulation Toolkit** will allow you to produce innovative and powerful products that feature a high level of system integration using low-cost leading-edge speech technologies. This manual discusses the use of these resources for evaluation and development purposes. It assumes the reader is an experienced software developer who understands C language programming and embedded systems development methods, but who may not be specifically familiar with Sensory's ICs.

This Toolkit supports the NLP-5x only. It cannot be used to develop products for the RSC-164, 264, 364, 4128 or SVC families of chips.

Included in the NLP-5x Demo/Emulation Toolkit

- NLP-5x Demo/Emulation board (60-0258), featuring a NLP-5x running in emulation mode and all of the components necessary to evaluate Sensory's speech technologies.
- USB Cable
- (2) Speakers
- Wall-Mount Power Supply (120V) 9VDC
- *NLP-5x Toolkits Installer (Download from ftp://ftp4.sensoryinc.com/software/nlp5x/nlp5xtoolkit.zip)*
  - Complete Documentation including NLP-5x Demo/Emulation Manual (80-0314-x) (this manual) — For use as a Quick Start Guide
  - FluentChip™ 5 for NLP-5x Technology (FC5) Library, with speech recognition technologies including T2SI™ speaker-independent (SI), speaker-dependent (SD), speaker-verification (SV), plus speech and music synthesis, MP3 decoding, and a variety of other technologies
  - "QuickSynthesis™ 5" (QS5), which allows speech to be compressed for low data-rate synthesis
  - "SensoryLoader5" (SL5), which is used to download programs to the NLP-5x Programming/Verification Board

This toolkit works in conjunction with:

- ZView Tools for NLP-5x, which includes the ZViewIDE and the ZView C compiler.
- Quick T2SI™ Toolkit for NLP-5x (sold separately), which can be used to create speaker-independent recognition sets by simply typing the vocabulary into a PC based GUI and downloading it to the NLP-5x Demo/Emulation board.

The NLP-5x provides the following technology features important for low-cost consumer products:

- Wide operating voltage range (2.0 to 3.6V)
- Power-down sleep mode to conserve power
- Pulse Width Modulator (PWM) to directly drive an 8-ohm speaker
- Stereo D/A converters (DACs)
- Integrated microphone amplifiers requiring only a few additional passive components
- Ability to interface to optional external parallel and serial memories

Developing a product that effectively integrates Sensory's speech technologies requires hardware platform development, software development, product integration, and human-interaction testing. For the best speech recognition performance, each of these design areas should be error-free. Sensory helps to facilitate successful implementation by providing free design consultations and product reviews. Refer to the Speech Recognition Hardware Design Guide (80-0073-x) for more details.

Check for updates and the most recent versions of the technology libraries on the Sensory website at http://www.sensoryinc.com.

Additional Resources

- NLP-5x Datasheet (80-0317-x)
- FluentChip_NLP_Reference Manual (80-0316-x)
- Installing the ZViewIDE Installation Guide (80-0320-x)
- NLP-5x Debugging with the ZViewIDE Quick Start Guide (80-0328-x)
- Programming the NLP-5x Rapid Prototyping Module (80-0330-x)
- NLP-5x Programming/Verification Manual (80-0319-x)
- NLP-5x Product Brief (80-0329-x)
- Various other Design Notes, Design Guides and Schematics

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Getting Started

Step One: Installing USB Drivers

The NLP-5x Demo/Emulation board uses the FT232B(L) USB UART IC chip manufactured by Future Technology Devices Int'l (FTDI). In order to interface to a PC, you need to download and install their USB drivers. These drivers make the NLP-5x Demo/Emulation board appear as a Virtual COM Port. If you have used other Sensory boards in the past, you may already have drivers installed that will work with the NLP-5x Demo/Emulation board.

- To download the driver, refer to: http://www.ftdichip.com/Drivers/VCP.htm
- For installation instructions, refer to: http://www.ftdichip.com/Documents/InstallGuides.htm
- For more information, refer to the Future Technology Devices Int'l website at: http://www.ftdichip.com

In the above installation guides, you will be instructed to "connect the device to a spare USB port on your PC". In our case, this "device" is the Demo/Emulation board. The USB circuit for the PC loader is powered from the USB connector, so you do not need to turn on the Demo/Emulation board. Simply connect the USB cable to the USB connector located on the **bottom** of the board near the lower-left corner, which is **labeled "PC LOADER"**. There are three USB connectors near the lower-left corner, so be careful to connect to the correct one.

Note: The port number assigned to the Virtual COM Port may change if you plug the USB cable into a different USB connector on your computer!

Note: If a problem occurs with the USB connection to the NLP-5x Demo/Emulation board, try connecting the USB cable to a different connector on your computer, and try to bypass USB hubs if possible.

Uninstalling USB Drivers

If you need to remove the drivers, go to the Windows Control Panel, choose "Add or Remove Programs", and then remove "FTDI USB Serial Converter Drivers."

Step Two: Installing Sensory Tools

We recommend that you read all of the documents available in this archive before attempting to install any software or connect the Demo/Emulation board to your PC.

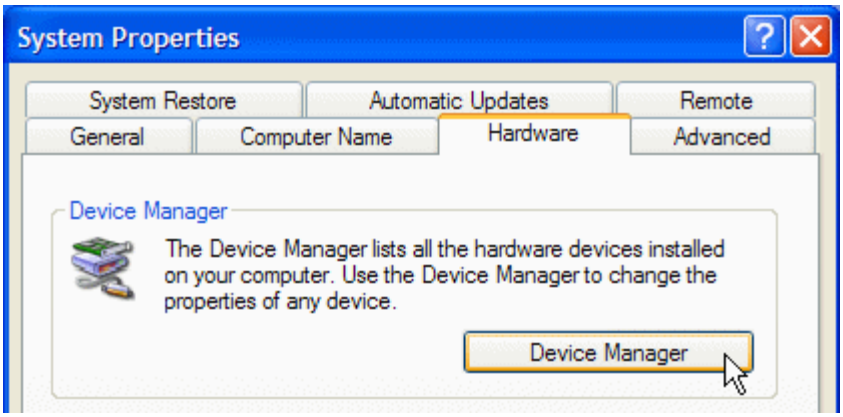
1) Navigate to the Main Window in the installer program.
2) Click "Install FluentChip™ 5" This will install Sensory's speech technology libraries.
3) Click "Install QuickSynthesis™5". This will install the tool that allows you to compress speech files for playback.
4) Click "Install SensoryLoader5." This will allow you to download demos and applications from your PC to the Demo/Emulation board.

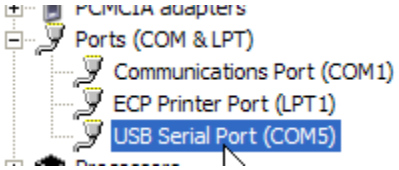
COM Port Configuration

When the NLP-5x Demo/Emulation board is connected to your computer, a COM port number is automatically assigned to the Virtual COM Port driver. The Sensory software tools must be configured to use this COM port number. The following screen shots show where to view and/or change the COM port in the Device Manager and the various Sensory tools.

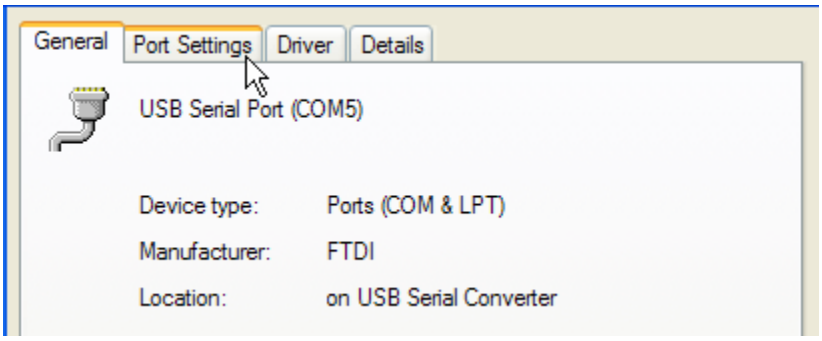
Note: The port number assigned to the Virtual COM Port may change if you plug the USB cable into a different USB connector on your computer!

To find out the port number selected for the Virtual COM Port driver, use the Device Manager in your PC's Administrative Tools Control Panel under Computer Management/System Tools—or—System Properties on My Computer. In the Device Manager, the Virtual COM Port will appear in the section for Ports (COM & LPT) as a USB Serial Port. In this example you will see that the USB Serial Port was assigned to COM5.





If for some reason you want to change the assigned port number, double-click on the USB Serial Port in the Device Manager list for access to the Properties window for that device, and then click on the Port Settings tab.



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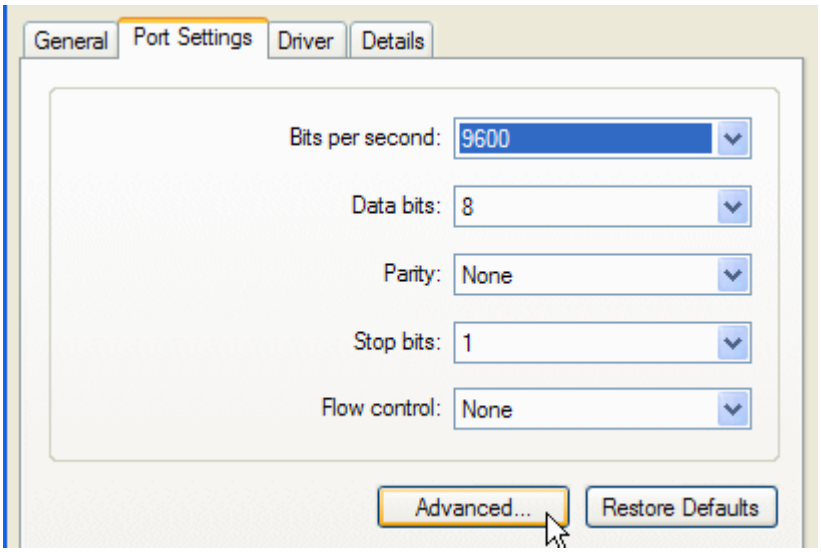
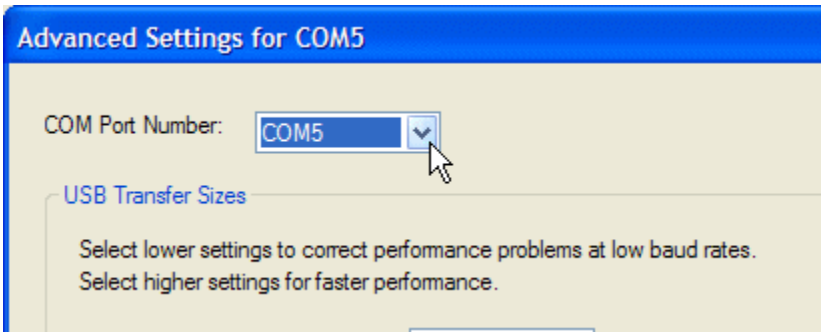
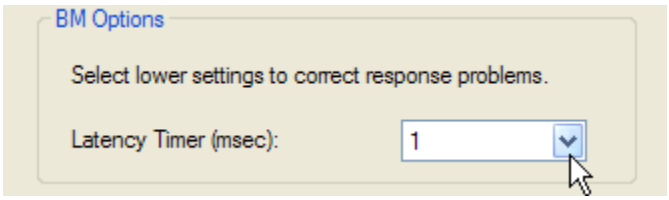
On the Port Settings tab, click on Advanced:



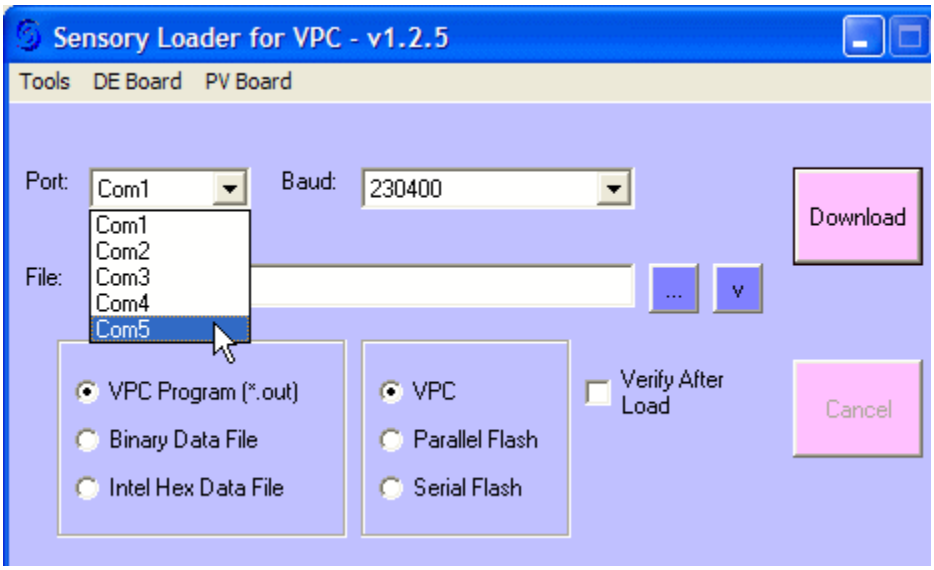
The Advanced Settings window allows you to change the COM Port number. While not necessary, you can also change the latency setting to the minimum value (1) to improve upload performance.





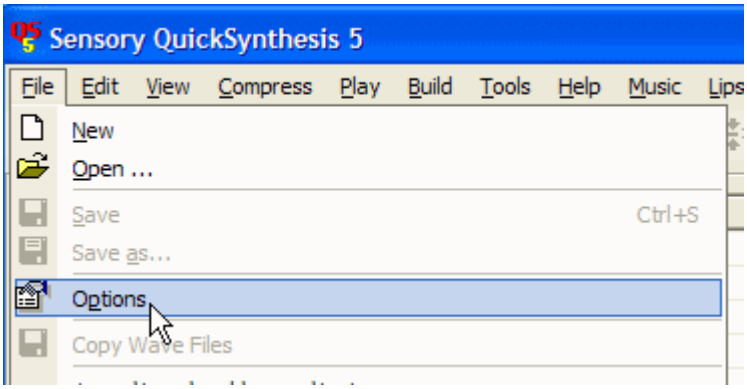
SensoryLoader5 (SL5)

SensoryLoader5 is a utility program for downloading executable and data files to the NLP-5x Demo/Emulation board. Use the pull-down menu to select the correct COM port number.



QuickSynthesis™ 5.

QuickSynthesis5 (QS5) is the tool used to compress speech and sound effects for NLP-5x projects. It has the ability to download projects to the NLP-5x Demo/Emulation board for listening tests. In order to use this feature, you will need to select the correct COM port. From QS5, click on the File menu, and then select Options.



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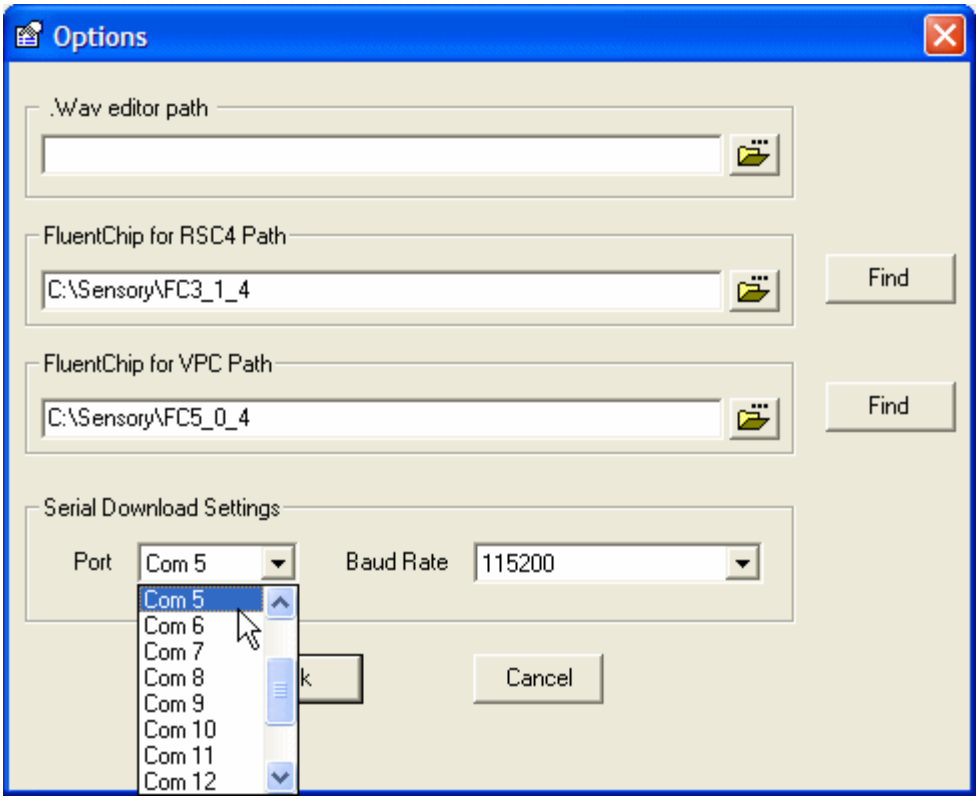
In the Options Window, select the COM port for the NLP-5x Demo/Emulation Board. To use the download feature, you will also need to select the FluentChip™ 5 for NLP-5x path. The easiest way to do this is to click on the Find button in the Options window *after* you have installed the FluentChip™ 5 Library.



Step Three: Running Programs on the Demo/Emulation Board

The Sensory Demo/Emulation Toolkit allows developers to quickly grasp how Sensory's speech technologies work. The Toolkit includes sample programs that use many of the Sensory technology functions.

Note: Although most sample programs will run with the default board DIP switch and jumper settings, some sample programs require different settings or additional hardware. Read the accompanying sample instructions before you download the sample program. The default DIP switch and jumper settings are found in the Demo/Emulation Hardware section.

Note: You can download and run previously compiled sample and application programs without installing the ZView tools.

1) Setting up the Hardware:
   - Place the On/Off switch (S4) of the Demo/Emulation board to the OFF position.
   - Connect the 9VDC power supply to J1 of the Demo/Emulation board, or install three AA batteries in the Demo/Emulation board if you want to power the board with batteries.
   - Connect a speaker to one of the speaker outputs of the Demo/Emulation board. Most demos use the SPKR PWM output. Other demos use two speakers connected to the stereo DAC outputs, SPKR L and SPKR R.
   - If required, connect other hardware to the Demo/Emulation board per the demo instructions.
   - Connect the USB connector from the computer to the USB connector (CN6) on the Demo/Emulation board, which is labeled as "PC LOADER". When the computer recognizes that a USB device is connected, you will hear the USB device connect sound. If you don't hear this sound, or see the error message on the computer, something went wrong. If this happens, it is probably because the FTDI USB drivers were not installed correctly. Uninstall the FTDI USB drivers, then install them again.
   - Place the On/Off switch (S4) in the ON position, and confirm that the green LED "POWER" turns on.

2) Downloading the sample:
   - Open SensoryLoader5.
   - Maker sure that the correct COM port number is selected.
   - In the file type box, click on the button labeled "NLP-5x Program (*.out)".
   - In the destination box, click on the button labeled "NLP-5x".
   - Click "…", then browse and select the desired executable file. Downloadable NLP-5x executable files have a ".out" extension.
   - Click on the "Download" button.
   - If downloading does not start immediately, press the "PROGRAM" button on Demo/Emulation board to switch to download mode.

   Note: Some sample programs require an additional data file to be downloaded to external memory; either serial or parallel flash. If this is the case, follow the procedure written in the sample instructions.

   Note: If the USB cable was not connected *before* you opened SensoryLoader5, the actual COM port might not be available to select. If this is the case, close SensoryLoader5, and re-open it after you have connected the USB cable.

   Note: When you click on the "Download" button in the SL5 window or press the "PROGRAM" button on the D/E board, the 4 LEDs on the D/E board should flash once with the left-to-right sequence. If they blink quickly and continuously, turn off the board with the ON/OFF switch (S4), wait a couple of seconds, power on again, and then press the "PROGRAM" button.

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3) Running the Sample:
   Press the “RUN” button on the Demo/Emulation board.

Step Four: Installing and getting a license for the ZView Tools for NLP-5x

Refer to the Installation Instruction for ZView (80-0320-x), for installation and licensing.

Step Five: Building a Sample Program with the ZViewIDE

Sample programs with source codes are included in the FluentChip™ 5 for NLP-5x library. You can find them in the library’s “samples” folder. For example, the T2SI sample program is found at:

C:\Sensory\FC5_0_3\samples\t2si

Note: “FC5_0_3” indicates that the library is FC5 and the version is 0.3. The library’s folder name will change accordingly to its version.

Building a sample program using the ZViewIDE is a great way to get going. The easiest way to start coding is to edit one of the sample programs that use the technology that your project will use.

The Workspace Folder

An empty folder named “workspace” is provided at the root of library, which is where you should keep all project folders. The folder is found at:

C:\Sensory\FC5_0_3\workspace

Copying the T2SI Sample Project to the Workspace Folder

Let’s start with the t2si sample. Copy the entire t2si folder to the workspace folder. After this has been done, the t2si folder will be a sub-folder of workspace:

C:\Sensory\FC5_0_3\workspace\t2si

Note: In addition to the code and application data, each sample folder includes the fairly complicated configuration data for the ZViewIDE, which is the essential information for compiling and building a project. Starting a new project by copying and then editing an existing sample program for your project will significantly simplify the process and save you time.

Note: When the library is updated, simply copy the project folder to the updated library, like this:

C:\Sensory\FC5_0_4\workspace\t2si

As long as you keep this format, no configuration files will need to be changed.

Opening the ZViewIDE

Double click on the ZViewIDE icon. When you do, the “Workspace Launcher” window will open. At “select a workspace”, browse to:

C:\Sensory\FC5_0_3\workspace

The ZViewIDE should then be open.

Importing the Project into the ZViewIDE Workspace

For a project to be accessible by the ZViewIDE, it must be imported into a workspace. From the "File" pull down menu, select "Import." The Import Window will then be opened. Select "Existing Project into Workspace", and browse to find the folder containing the project.

C:\Sensory\FC5_0_3\Workspace\t2si

Note: The "Project name:" box is highlighted in gray, and you will not be able to enter the new text. This is because the project name is a part of the IDE configuration, and it is already included in the project folder. In this case, the project folder is "t2si". When the project folder is selected, the project name will be displayed. In this case, it is "t2si".

When the project is loaded, the icon with the name of the project folder will appear the "DSP Projects" window. Click the "+" icon next to the "t2si" icon. This will expand the icon and will display the content at the root of the t2si folder. To view the application source code, double click on "t2siApp.c".

Renaming a Project

While it is not necessary to rename a sample project that you have copied to the workspace folder and imported, it may be a good idea to do so. You can't copy the same sample program to the workspace again without renaming or deleting the first version. To rename a project, just right-click on the project name in the "DSP Projects" window, and select "Rename."

Renaming the project also renames the project folder name on your disk, however, the executable name created by the compiler and linker tools will not change. If you want to change the executable file name, right-click on the project name in the "DSP Projects" window again and select "Properties". In the Project Properties window, click on Build Options. The Active Configuration should be shown to be DebugG1. Click on the "Manage…" button next to the configuration name. This window has a text box labeled "Artifact name:" which contains the name of the executable file produced by the compiler and linker tools.

Compiling and Linking a Project

To compile and link the t2si project, right click on "t2si" in the "DSP Projects" window, and select "Rebuild Project".

Note: Here we use "Rebuild Project" instead of "Build Project" because "Build Project" will not compile source files that have not changed since the last compilation. "Rebuild Project" compiles all source files (*.c, *.s) in the project folder and subfolders of the project folder whether they have changed or not.

The executable file is located in the "DebugG1" folder in the project folder, and the name of file (if you have not changed it as described in the above section) is "t2si.out".

Note: It is always a good idea to check the time that the file was created to make sure that the file was actually created. To do that, right, click on the ".out" file, and select "properties". In the properties window, you will find it in the "Last modified" column.

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Downloading the File to Demo/Emulation Board

- Confirm that the DIP switches and jumpers are set to the default settings
- Connect the speaker, and power up the Demo/Emulation board.
- Connect the USB cable from the computer to the "PC LOADER" connector of the Demo/Emulation board.
- Open SensoryLoader5. Select the COM port, click on the buttons labeled "NLP-5x Program (*.out)" and "NLP-5x" if these buttons are not already selected, then click on "…" to browse to the executable file "t2si.out" in the DebugG1 folder.
- Click the "Download" button.
- If downloading does not begin automatically, press the PROGRAM button on the NLP-5x Demo/Emulation board.

Note: There is a shortcut for opening SensoryLoader5 and selecting the executable file. Right click "t2si.out" in the "DSP Projects" window and select "Open with", then select "SensoryLoader5".

Note: When you click on the "Download" button in the SL5 window or press the "PROGRAM" button on the D/E board, the 4 LEDs on the D/E board should flash once with the left-to-right sequence. If they blink quickly and continuously, turn off the board with the ON/OFF switch (S4), wait a couple of seconds, power on again, and then press the "PROGRAM" button.

Running the t2si Sample Program

- Press the "RUN" button to start the t2si demo.
- You will hear a beep followed by a speech prompt.
- The trigger word is:
  - Sensory
- The command words are:
  - Appliance
  - Blue genie
  - MP3 player
  - Natural oven set
  - Natural time set
  - Recognition
  - Speech output
- Say "Sensory," and after the beep, say one of the command words. The demo will respond with the corresponding speech prompt.

For more details on how to use the ZViewIDE for NLP-5x development, refer to the "Operational Instructions for the ZViewIDE for NLP-5x" instructions.

Demo/Emulation Board Hardware

On the NLP-5x Demo/Emulation board, four chips are used to emulate an actual NLP-5x. These chips are:

- NLP-5x (U4) configured in emulation mode. This chip emulates all NLP-5x features except for the processor, on-chip memories, and the external address/data bus.
- A Verisilicon VSI403LP(U3) that emulates the NLP-5x processor and on-chip Instruction RAM, Instruction OTP, and Data RAM.
- A Xilinx FPGA XC3250AN (U1) that emulates the NLP-5x external parallel address/data bus, including signals A[22:0], D[15:0], –RD, -WR, -CS0 and –CS1.
- A 64Kx16 SRAM (U6) that emulates the NLP-5x Expansion OTP memory.

For application development purposes, you should consider the four chips listed above as a single NLP-5x.

WARNING

The NLP-5x Demo/Emulation board is not an exact duplicate of an actual NLP-5x. As much as possible, the FluentChip™ 5 for NLP-5x library tries to mask differences between the emulator and the real NLP-5x chip from application level programmers. Because differences do exist, it is necessary to verify all programs by programming an NLP-5x IC and running it on your application hardware, or by using the NLP-5x Program/Verification board (60-0263).

The Demo/Emulation board has another NLP-5x (U8), which with the USB interface IC FT232BL (U13), is used for downloading the programs and data from a PC. All components which are not application-related are placed on the bottom side of the board. The ICs which are necessary parts for emulating the NLP-5x: XC3250AN (U1), VSI403LP (U3), 64Kx16 SRAM (U6) are also placed on the bottom of the board.

All ICs and components such as memory ICs, buttons, LEDs, microphones, etc. that allow application developers to create hardware mockups of their final product are located on the top side of the board.

WARNING

Do NOT change the jumpers while the power is turned on. Before changing any jumpers, turn off the ON/OFF switch (S4).

The first time that you use the Demo/Emulation board, confirm that all jumper blocks are installed at the default settings before turning on the power.

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Default Setting of DIP Switches and Jumper Blocks

DIP Switch Setting

- All three DIP switches (S1, S9, and S10) at ON position

Jumper Blocks

- JP1 at CS0
- JP5 at AUTO
- JP6 at NC
- JP7 shorting block in place
- JP3 at Manual

Connectors are labeled as CN. They do not need jumper blocks.

ON/OFF Switch and the Power Supply Circuit

The Demo/Emulation board can be powered by an external 9VDC power supply or by on-board batteries. To use the external power supply, connect the adapter plug into J1 located near the upper-right corner of the board. To use batteries, install 3 AA batteries into the battery holder located on the bottom side of the board.

The On/Off switch (S4) is also located near the upper-right corner of the board. When this switch is in the ON position:

- If the external power supply is plugged in, the board is powered from the external power supply.
- If the external power supply is not plugged in, the board is powered from the on-board batteries.

When the power is applied to the board, the green LED (D8) will turn on.

The power supply circuit is located in the upper-right area of the board, and there are 5 power supply outputs with test points:

- VCCA: 3.3V, powers the application analog circuit
- VCCB: 3.3V, powers the application digital circuit
- VCCC: 3.3V, powers supporting circuits
- VCCINT: 1.2V, used for XC3250AN (U1) and VSI403LP (U3)
- VCCBAT: 5V if external power supply is used, and 4.5V if the battery is used. Powers the audio amplifier IC (U22)

IO Summary and Allocations

Port	NLP-5x IO Functions			NLP-5x Demo/Emulation Default IO Allocations		
P0.0					LED Green	
P0.1					LED Yellow	
P0.2					LED Orange	
P0.3					LED Red	
P0.4		T3 Gate	Edge Interrupt			LCD Segment
P0.5		T3 Clock	Edge Interrupt			LCD Segment
P0.6		HPI WR				LCD Segment
P0.7		HPI EN				LCD Segment
P0.8		HPI Data	Motor Sensor 0	Motor Sensor 0		
P0.9		”	Motor Sensor 0	Motor Sensor 0		
P0.10		”	Motor Sensor 1			LCD Segment
P0.11		”	Motor Sensor 1			LCD Segment
P0.12		”	Motor Sensor 2			LCD Segment
P0.13		”	Motor Sensor 2			LCD Segment
P0.14		”				LCD Segment
P0.15		”				LCD Segment
P1.0	IO Wake Interrupt	Comparator/ Line Input			Audio Shutdown	
P1.1	”	”	Motor Stop Input			LCD Segment
P1.2	”	”			Button A	
P1.3	”	”			Button B	
P1.4	”	”	Motor PWM 2 Fwd		Button C	
P1.5	”	”	Motor PWM 2 Rev		Button D	
P1.6	”	”	Motor PWM 1 Fwd	Motor PWM 1 Fwd	USB Detect	
P1.7	”	”	Motor PWM 1 Rev	Motor PWM 1 Rev	USB Pull-up	
P1.8	”	Comp. Out	Motor PWM 0 Fwd	Motor PWM 0 Fwd		
P1.9	”	Comp. Out	Motor PWM 0 Rev	Motor PWM 0 Rev		
P1.10	”					LCD Common 0
P1.11	”					LCD Common 1
P1.12	”					LCD Common 2
P1.13	”					LCD Common 3
P1.14	”					LCD Bias 0
P1.15	”					LCD Bias 1
P2.0	SPI / I2S –SS			Serial Flash -CS		
P2.1	SPI / I2S SCLK			Serial Flash SCLK	EEPROM SCL	
P2.2	SPI / I2S MISO			Serial Flash MISO		
P2.3	SPI / I2S MOSI			Serial Flash MOSI	EEPROM SDA	
P2.4	IR RXIR			IR RXIR		
P2.5	IR TXIR			IR TXIR		
P2.6	UART RXD			RS232 RXD		
P2.7	UART TXD			RS232 TXD		

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LEDs and Pushbuttons

There are four LEDs and four pushbuttons connected to the NLP-5x's IO ports. Refer to the chart for the IO summary and allocations.

LED SW Default DIP Switch (S9)

The LED SW default DIP Switch (S9) is provided to allow each LED and pushbutton to be disconnected from the NLP-5x IO pins so that the IO pins can be used for a different purpose. To disconnect them, place the switches on the OFF positions.

Connector (CN9)

This connector is provided to interface with the external devices which will be connected to in parallel with LEDs and switches.

Connector (CN8)

This connector is provided to connect different port pins to the LEDs and switches. To do this, place the LED SW default DIP switch to the OFF position, and make connections with hook-up wires to CN8 from the CN3 connector.

Serial Memory ICs

We have provided one 32Mbit Serial Flash IC, AT45DB321D, (U23) and one 128Kbit Serial EEPROM, 24LC128 (U24). Their connections can be disconnected by Serial Memory DIP switch (S10) in the OFF position.

If you are going to connect an external device with a SPI interface:

- Disconnect the on-board serial flash, or
- Use a dedicated port pin for –CS signal for the external device.

Parallel Memory IC

We have provided one 32Mbit parallel memory IC, AT49BV322D (U2).

Audio Outputs

The NLP-5x has one PWM audio output and two DAC audio outputs, which can be used for stereo applications. On the Demo/Emulation board, we have provided one audio jack for PWM (J6), and two audio jacks for DAC outputs (J4 and J5).

DAC Amplifier and Volume Control

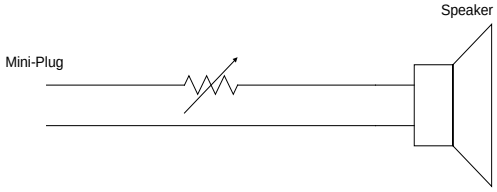
To amplify the NLP-5x's differential DAC outputs, we have provided a fully differential stereo audio amplifier, the TPA6021A4 (U22). Because each channel has differential outputs (bridge-tied loads) there is no common ground connection, so there are separate speaker jacks for each channel. Do not use a Y cable that shorts one of the outputs of each channel together.

The volume of the DAC outputs is controlled with the dial (R88). When a shorting block is placed at Manual at the "Audio Shutdown" header (JP3), the audio shutdown is controlled with this dial.

Adding Volume Control for PWM

To add volume control to the PWM output of the board:

- Disconnect the speaker cord from the mini-plug jack on the PCB.
- Cut into one side of the cord and insert a 200 Ohm potentiometer in series with the wire.



Microphone Circuit

There are two on-board microphones. To use the external microphone, plug the microphone cable into the microphone jack. If you do, the on-board microphone will be disconnected from the circuit.

Microphone Power

The microphones are powered with VCCA. If you can power the microphones with a IO port, remove the shorting block from MIC PWR (JP7), and connect the IO port to pin 2 of JP7.

Microphone Bias Resistors

MIC 1 has a 2.2K Ohms microphone bias resistor (R84), and MIC2 also has a 2.2K Ohms microphone bias resistor (R85). If you need to change the value of microphone bias resistor, replace these resistors. For selecting a microphone and bias resistor, refer to the design note – NLP-5x Microphone Selection Design Guide (80-0318).

USB

There are three USB connectors on Demo/Emulation board. They are labeled "PC LOADER", "DEBUG", and "APP USB". "PC LOADER" is used to download the code and data into the Demo/Emulation board. The one used for the application is "APP USB". "DEBUG" is reserved for future use.

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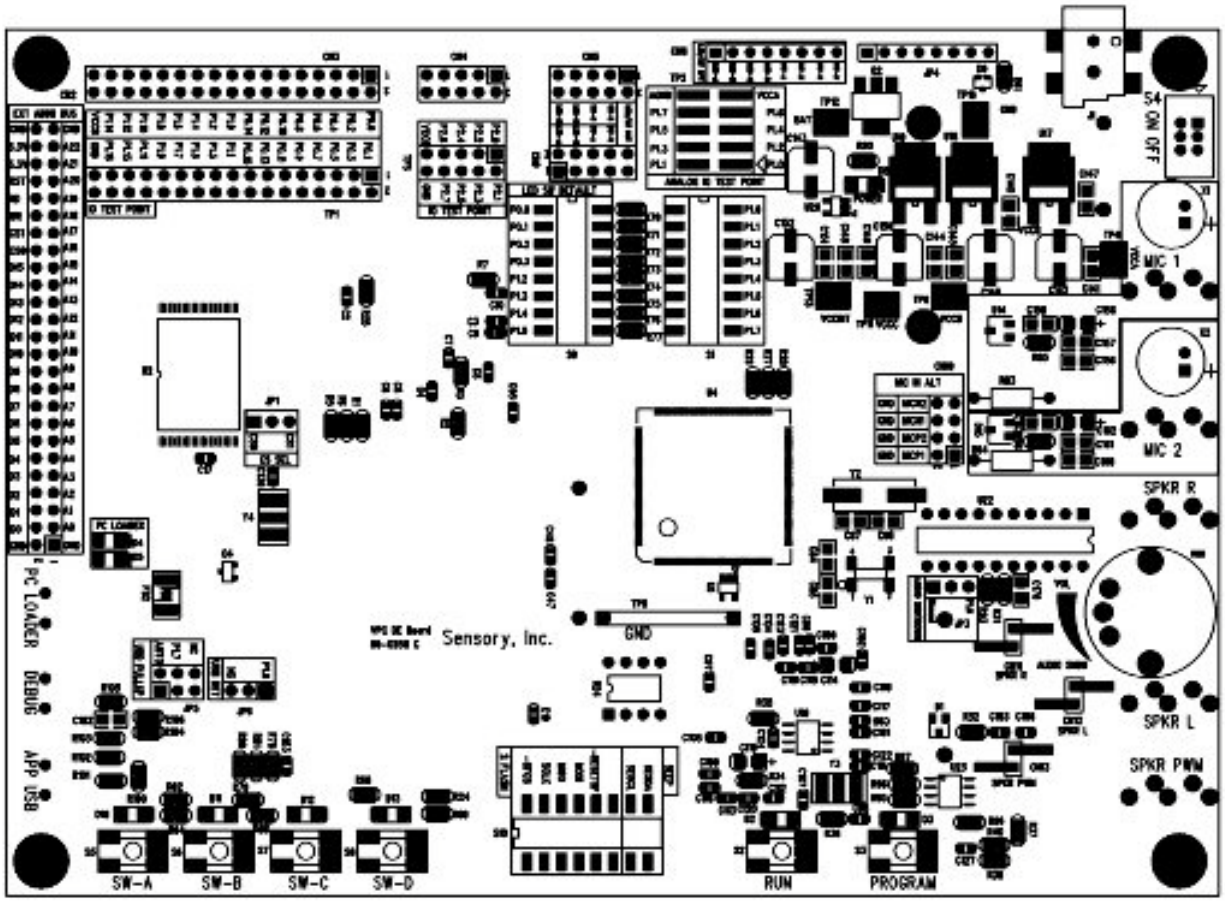
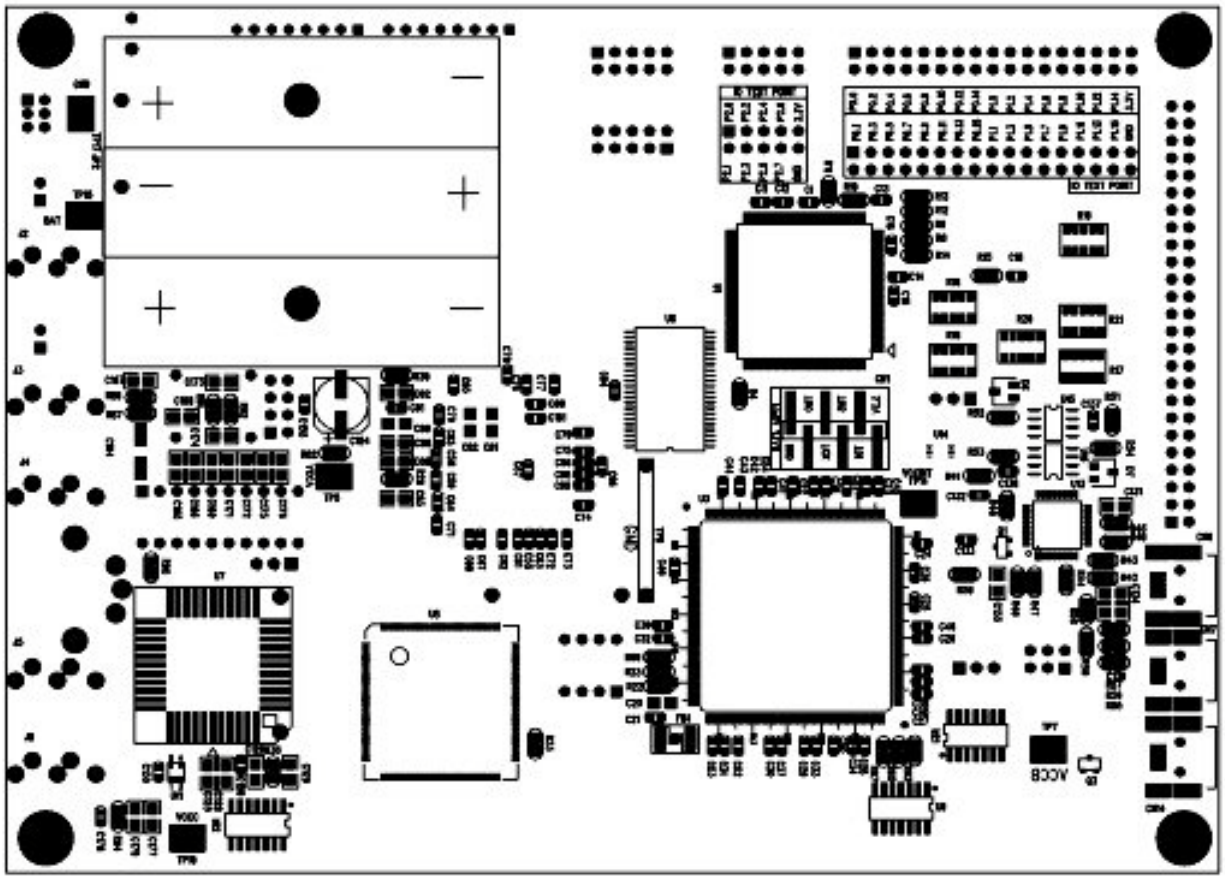
NLP-5x Demo/Emulation Board Parts Locator

Top View



Bottom View



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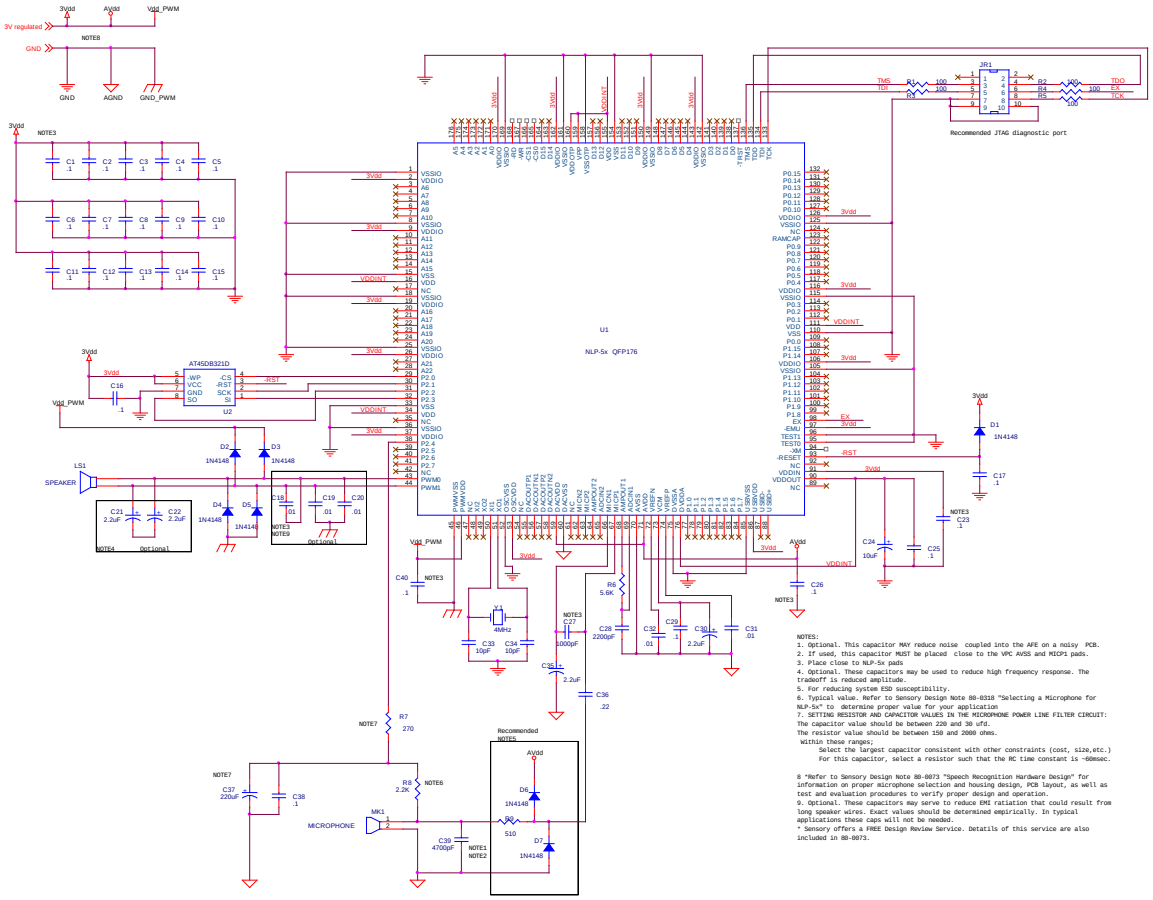
NLP-5x Schematic



Developing NLP-5x Applications on the NLP-5x Demo/Emulation Board

There are several differences between the way the NLP-5x Demo/Emulation board operates and the actual NLP-5x chip. The differences arise because the board uses a chip set to emulate the actual NLP-5x. The chipset consists of a Verisilicon VSI403 Processor, a 64KW SRAM, an FPGA, and a NLP-5x configured for emulation mode. The NLP-5x chip in the above-named chipset emulates all the functions of the NLP-5x except for the processor, on-chip memories, and external parallel memory interface.

The NLP-5x's processor is emulated by the VSI403. It has 32KW of on-chip code RAM that emulates the NLP-5x's 1KW Instruction RAM and 31KW (out of 32KW) of the NLP-5x's Instruction OTP. It also has 16KW of on-chip data RAM that emulates, and exceeds, the 11KW data RAM of the NLP-5x.

The NLP-5x's 32KW Expansion OTP memory is emulated by the first half of the 64KW SRAM in the chipset (the upper half is reserved).

The FPGA in the chipset emulates the NLP-5x's External Memory Bus.

The major differences between the NLP-5x Demo/Emulation Board and the actual NLP-5x:

Access Speed for Instruction OTP Memory

When the NLP-5x is configured to run at 40 MHz or less, it does not have to be in Turbo Mode, so the NLP-5x's Instruction OTP can be accessed at full speed. In this case the VSI403 and NLP-5x throughput are matched.

When the NLP-5x is configured to run faster than 40MHz, it must be in Turbo Mode. In this mode the NLP-5x processor can run at full speed from Instruction RAM, or when executing tight loops of 8 instructions or less from the processor's cache. When running from Instruction OTP, throughput is reduced by as much as one third because wait states will be inserted when reading the Instruction OTP memory.

The NLP-5x Demo/Emulation board will run *faster* than the real NLP-5x when executing from Instruction OTP. For most applications that do not approach the performance limits of the NLP-5x, this is not an issue. However, applications that approach and might exceed the limits of the NLP-5x must be verified on an actual NLP-5x chip.

Access Speed for Expansion OTP, External Memory, and Peripherals

Because these resources are all external to the processor chip in the NLP-5x Demo/Emulation chipset, they are accessed somewhat slower than with the real NLP-5x. Thus for applications that make heavy use of Expansion OTP or External Parallel Flash, the NLP-5x-DE emulator will run somewhat *slower* than the real NLP-5x, all other factors being equal.

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Timers in Turbo Mode

Timers #0, #1 and #3 will run twice as fast in Turbo Mode on the NLP-5x Demo/Emulation chipset than on the actual NLP-5x. When not in Turbo Mode, they run at the same rate on both platforms.

A global variable platform can be tested by software to determine when the program is running on the NLP-5x-DE. This is done automatically in library functions such as _SetupTimer0(). Here is an example of explicitly setting up timer 3 when in Turbo Mode, where the prescale value is selected based on the platform. This example is from the Timers sample in the FluentChip™ 5 for NLP-5x library.

```
if (_platform & 1)
  timerCtrl = (timerCtrl & 0xff00) + 3; // Emulator: use prescale = 16
else
  timerCtrl = (timerCtrl & 0xff00) + 2; // Real NLP-5x: prescale = 8
```

Other Differences

- XM Mode (i.e., internal OTP memories disabled) is not emulated by the NLP-5x Demo/Emulation board.
- The Low Voltage Detect NMI Interrupt is not emulated.
- The NLP-5x has more interrupt channels than are emulated by the NLP-5x Demo/Emulation board. Normally, applications will not need to use these additional interrupt channels. The FluentChip™ 5 for NLP-5x library will not use interrupt channels that cannot be emulated.
- The External Memory Interface is not electrically identical to the real NLP-5x, because it is emulated by an FPGA chip that has somewhat different characteristics, such as drive strength etc. The NLP-5x-Demo/Emulation board has permanent 200K-ohm pull-up resistors on the address, data, and control signals of the External Memory Interface, whereas the real NLP-5x can control whether each pull-up is present when the address and/or data lines are used as general purpose I/O pins.
- The NLP-5x Demo/Emulation board operating voltage is fixed at 3.3V.
- VSI403 Errata: the VSI403 chip uses an earlier version of the ZSP processor than that used in the NLP-5x. There are some problems in the VSI403 that have been fixed in the NLP-5x processor. Some of these are discussed in the Emulator Features chapter of the NLP-5x datasheet. The most important issue is that using a bitc, bits, or biti with the %ireq register may cause interrupts to be lost, and since the processor in the VSI403 uses edge-sensitive interrupts, the program may appear to “lock up” for lack of interrupts. The solution is to re-register interrupts after using one of the listed problematic instructions. Writing 0x1f to the miStatus register will re-register the 5 merged interrupt sources. Most application level programs will not need to modify the %ireq register.

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NLP-5x Natural Language Processor and Development Tools

The NLP-5x features a high-performance 80MHz 16-bit DSP with on-chip ADC, hi-fidelity stereo DAC, microphone preamplifiers, RAM, OTP code and constant memory, and many kinds of peripheral interfaces and control blocks. With Sensory's FluentChip™ 5 firmware, it provides a single chip solution capable of accurate speech recognition; text-to-speech (TTS) synthesis with morphing; compressed speech; high fidelity music; motor and LCD control; and man-machine interfaces (MMI) with interactive sensors. Sensory offers a complete suite of evaluation and development tools that include the ability to create complex grammars with a natural language interface in multiple languages.

RSC-4x Family of Microcontrollers and Developer Tools

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SC6 Slave Processor and Tools

The SC-691 is a standard slave synthesizer that accepts compressed speech data from other microprocessors or microcontrollers and converts it to speech. The chip operates up to 12.32 MIPS, and provides high-quality, low data-rate speech compression and MIDI music synthesis, with unlimited speech duration using external memory. Sensory offers hardware and software tools for analyzing speech files, editing speech data and generating coded speech.

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The BlueGenie Voice Interface software suite runs on CSR's BC-5 MM Kalimba DSP, and enables manufacturers of *Bluetooth* products to integrate full voice control and synthetic speech output without the need for visual displays or complex user interfacing. It frees designers to pack functionality onto small form factor *Bluetooth* devices and answers consumer demand for a "Truly Hands-Free" experience.

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