

# TI Developer Conference

February 28-March 2, 2008 • Dallas, TX

## Digital Guitar Effects Pedal

**SEE THE FUTURE**  
**CREATE YOUR OWN**

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SPRP499

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 TEXAS INSTRUMENTS

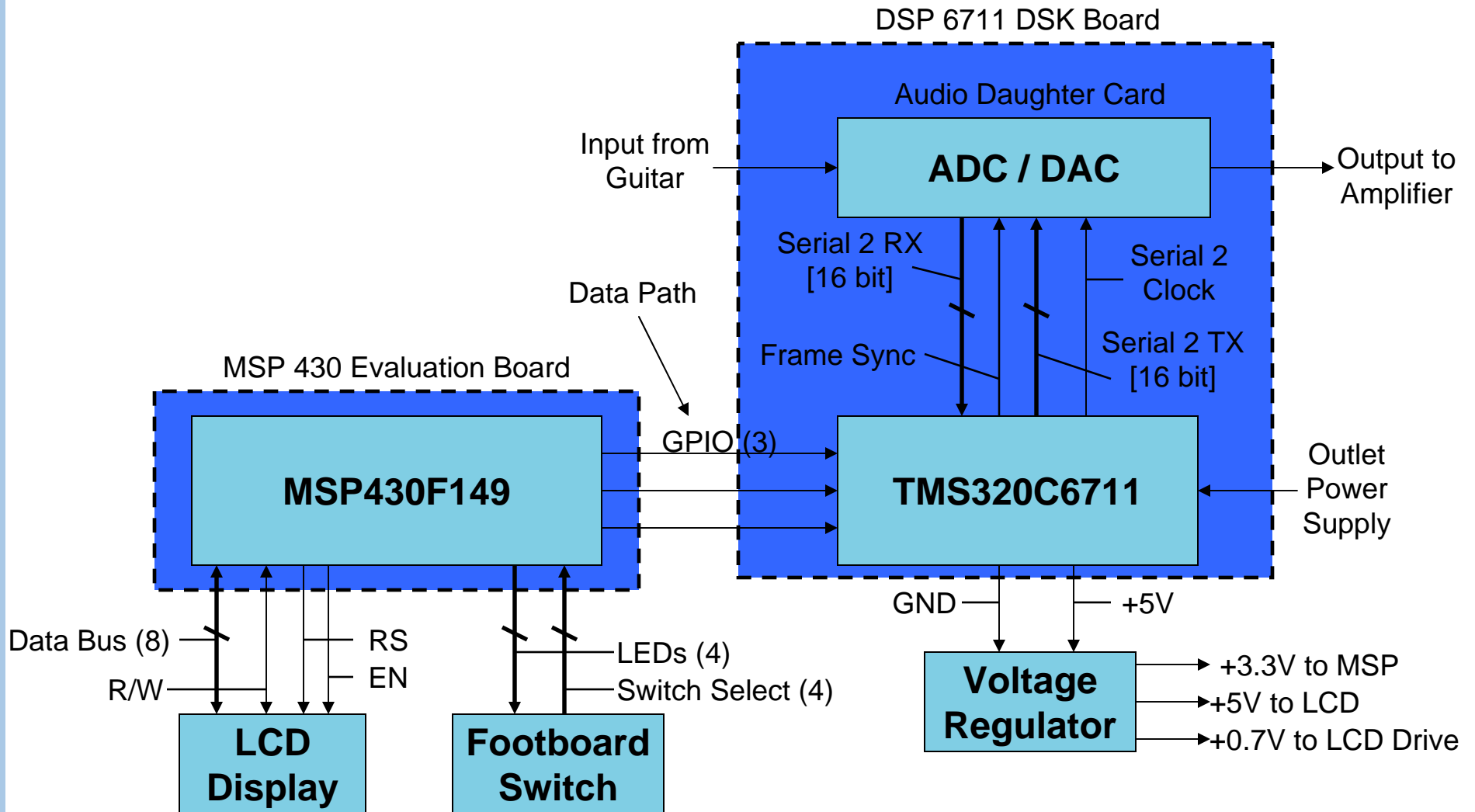
# Presentation Outline

- ◆ **Block Diagram**
- ◆ **Input Signal**
- ◆ **DSP Configuration (Audio Processing)**
  - Audio Daughter Card
    - Codec
- ◆ **MSP Configuration (User Peripheral Control)**
  - Pin Connections
  - User Interfaces
  - DSP Connection
- ◆ **MSP and DSP Connections**
- ◆ **Simulink Modeling**
- ◆ **MSP and DSP Software Flowcharts**

# Objective \ Statements

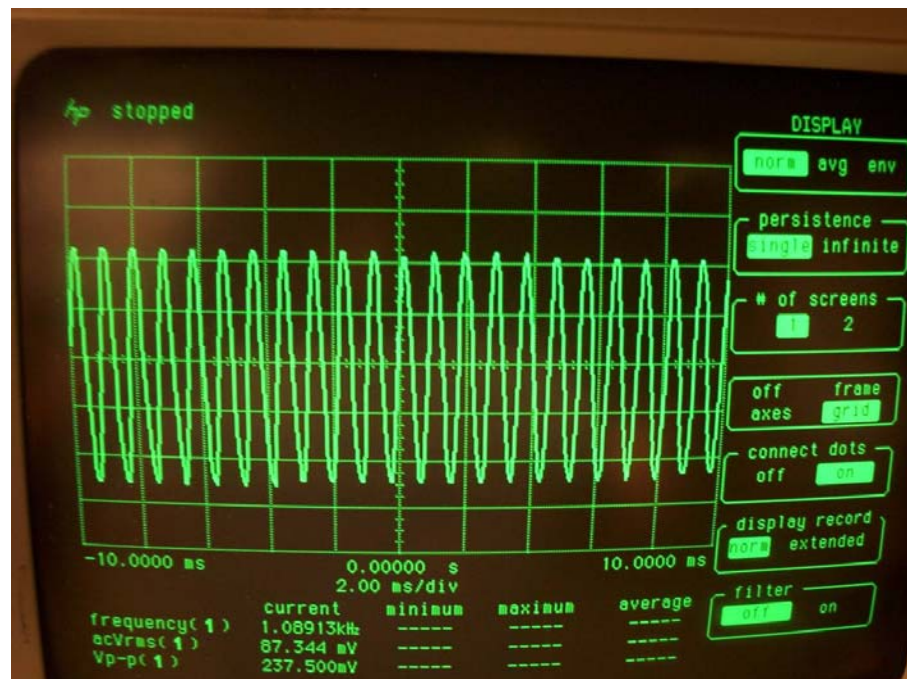
- ◆ **To create a digital guitar effects pedal**
- ◆ **All audio processing will be done with a DSP 6711 DSK board**
  - With an audio daughter card
- ◆ **All user peripherals will be controlled using a MSP430 evaluation board**
  - Using the F149 model chip
- ◆ **User Peripherals include...**
  - Floor board switches
  - LCD on main unit
- ◆ **Most guitar effect hardware that is available on the market is analog.**
- ◆ **Having a digital system would allow the user to update the system with new features without having to buy new hardware.**

# Block Diagram



# Guitar Input Signal

- ◆ **Voltage Range of Input Signal**
  - Nominal ~ 300 mV peak-to-peak
  - Maximum ~ 3 V
- ◆ **Frequency Range**
  - Standard Tuning
  - 500 Hz – 1500 Hz



The logo for the TI Developer Conference, featuring the letters 'TI' in a bold, black, sans-serif font, followed by a vertical line and the words 'Developer Conference' in a red, sans-serif font.

# TI Developer Conference

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The title 'Hardware: DSP and MSP' is displayed in a large, bold, black, sans-serif font. The background of the entire slide is a green circuit board pattern with various icons: a blue microscope, a red handheld device, a yellow car, and silhouettes of three people. A large, light blue, stylized 'S' shape is overlaid on the right side of the slide.

## Hardware: DSP and MSP

A white, rounded rectangular box containing the text 'SEE THE FUTURE' in bold black letters and 'CREATE YOUR OWN' in red letters below it.

**SEE THE FUTURE**  
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The Texas Instruments logo, consisting of a stylized 'ti' in a white circle on a black background, followed by the words 'TEXAS INSTRUMENTS' in a white, sans-serif font.

**TEXAS INSTRUMENTS**

# PCM3002 Analog Audio Codec

- ◆ **2 in 1 – ADC and DAC**
- ◆ **Sampling**
  - 16/20 bit
  - 8 kHz – 48 kHz
    - Meets 44.1 kHz for CD quality
- ◆ **Performance**
  - 20 Hz – 20 kHz range
    - Meets 500 – 1500 Hz guitar range
  - 85 dB ADC
  - 93 dB DAC
  - Built-in Filtering and Anti-Aliasing
- ◆ **Serial Output**
- ◆ **Applications**
  - Voice/Audio Processing

# MSP Controlled Peripherals

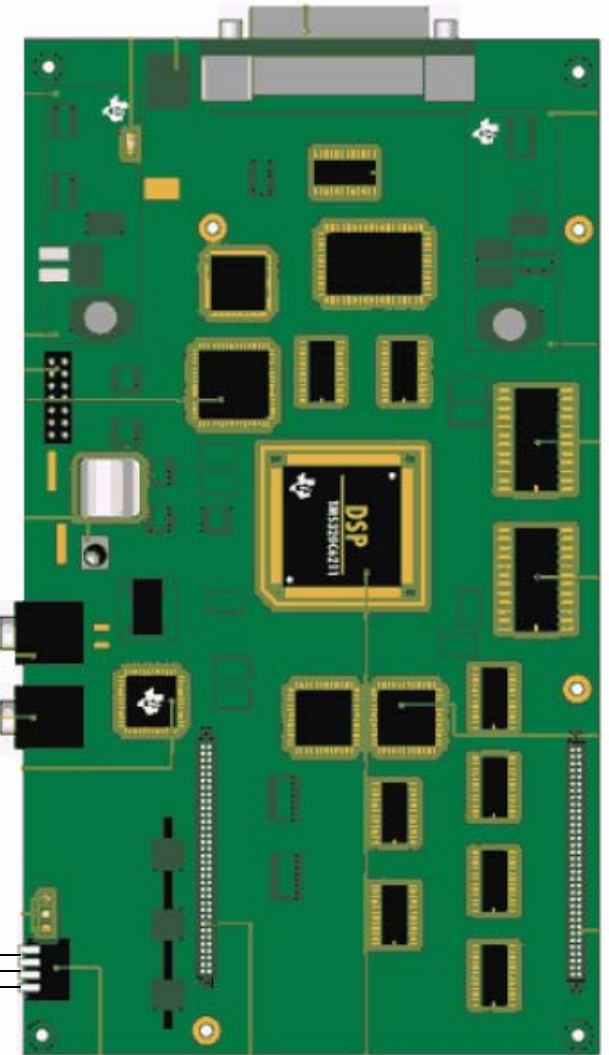
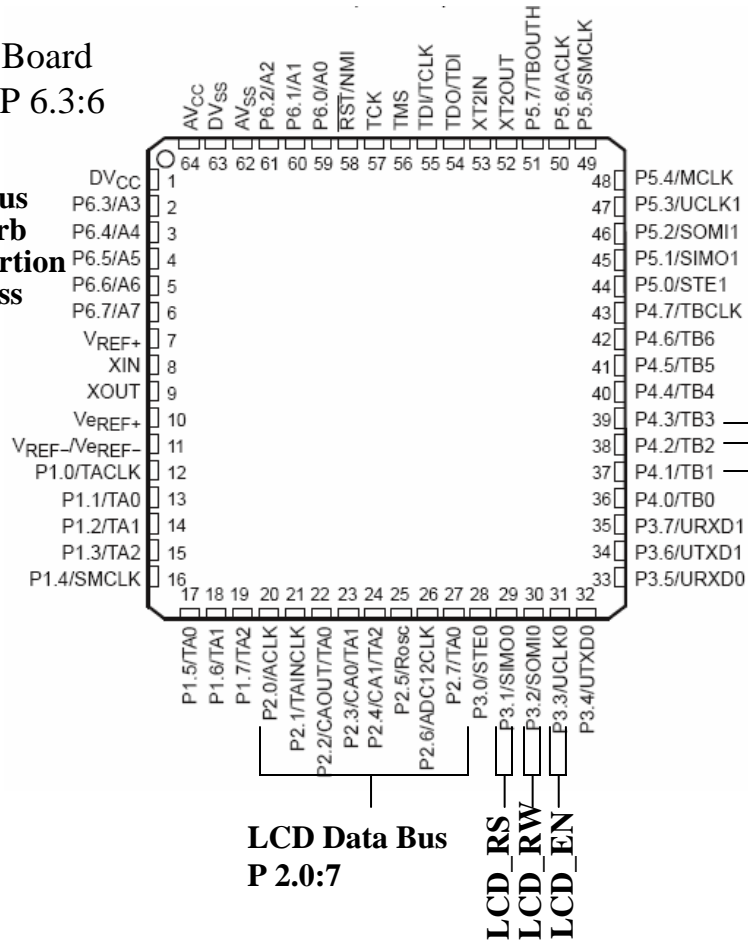
- ◆ **Liquid Crystal Display (LCD)**
  - Lumex - LCM – S02002
  - 2x20 Character Display
  - Built in Microcontroller (LCD Driver)
  - 16 (8x2) Pin Connection
    - 11 pins to MSP
  
- ◆ **Floor Board**
  - 4 output pins to MSP input pins
    - Effect Selection
  - 4 MSP output pins for LED control



# MSP and DSP Connection

Floor Board  
Input P 6.3:6

**Chorus**  
**Reverb**  
**Distortion**  
**Bypass**



[www.ti.com](http://www.ti.com) – slas272f.pdf

<http://focus.ti.com/graphics/tool/C6711brd1.gif>

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# TI Developer Conference

February 28-March 2, 2006 • Dallas, TX

The title 'Simulink Models for the DSP' in a large, bold, black, sans-serif font, set against a light blue, stylized background that resembles a Simulink block diagram.

## Simulink Models for the DSP

A white, rounded rectangular box containing the text 'SEE THE FUTURE' in bold black letters and 'CREATE YOUR OWN' in red letters below it.

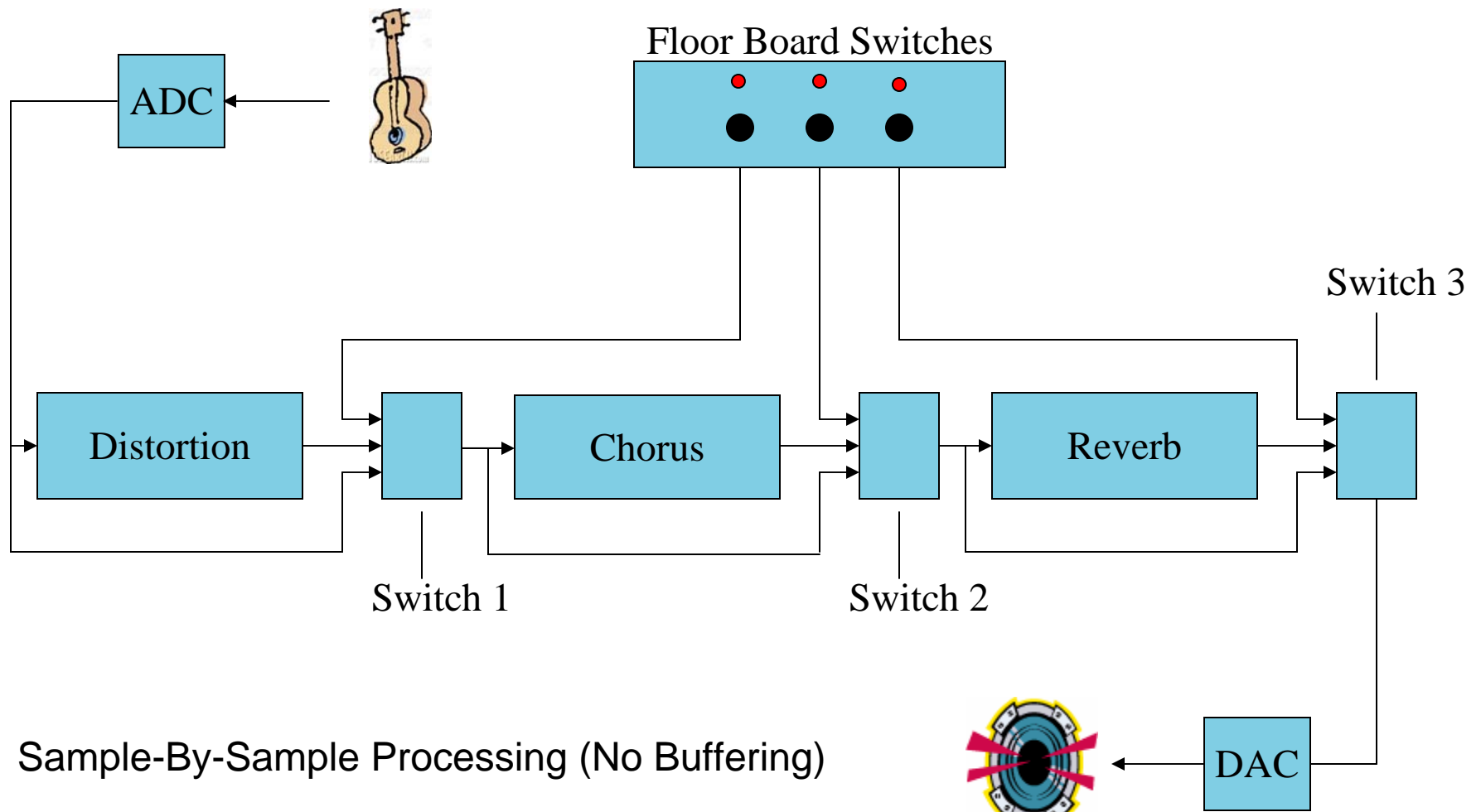
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**TEXAS INSTRUMENTS**

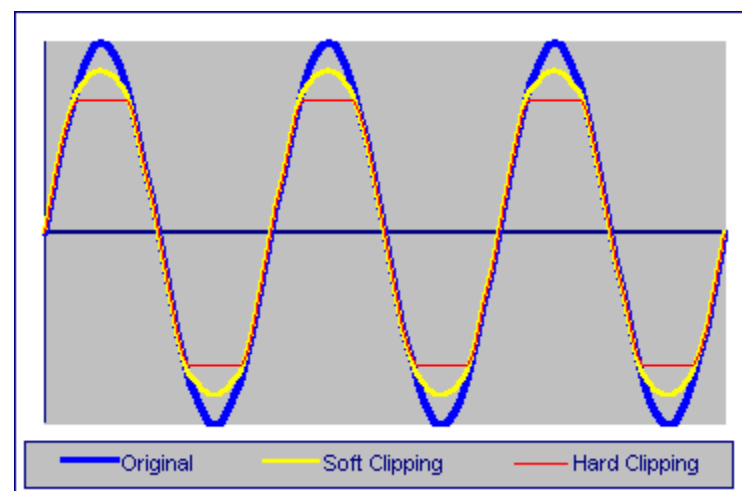
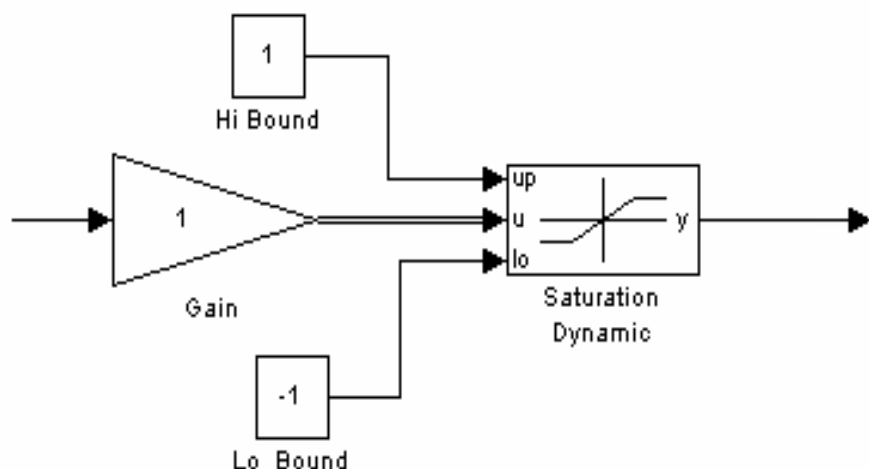
# Simulink System Diagram



Sample-By-Sample Processing (No Buffering)

There is no audible delay from processing.

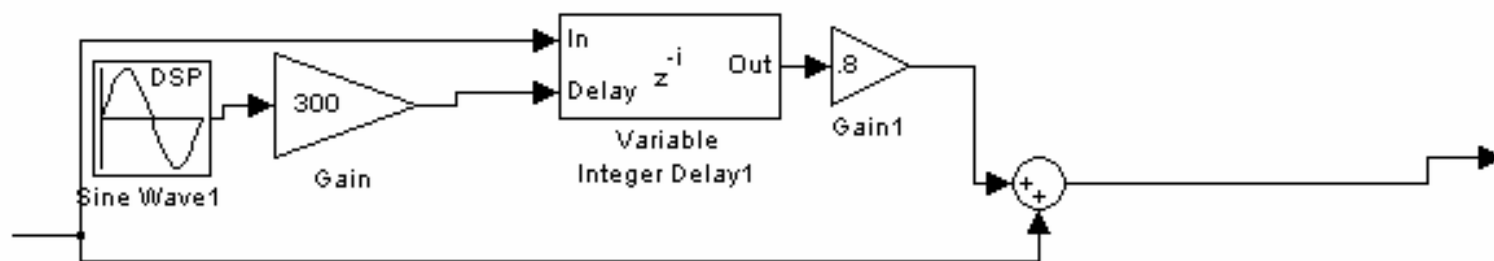
# Distortion Model



- Distortion is a music effect that gives a distinct, “heavy” sound.
- The signal is amplified to give it a certain gain.
- The amplitude of the signal is then limited symmetrically.

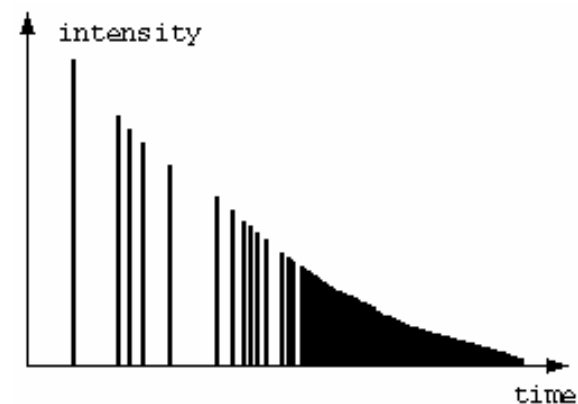
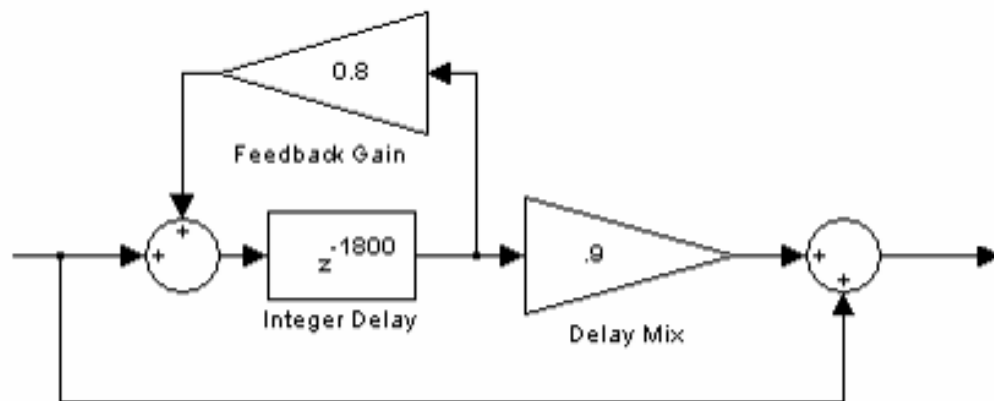
<http://users.chariot.net.au/~gmarts/fx-desc.htm#Cho>

# Chorus Model



- The chorus effect allows a single instrument to be modeled into a sound that replicates a group of instruments playing the same part.
- This is achieved by adding a single delayed signal (echo) to the original input.
- However, the delay of this echo is varied continuously between a minimum delay and maximum delay at a certain rate.

# Reverb Model

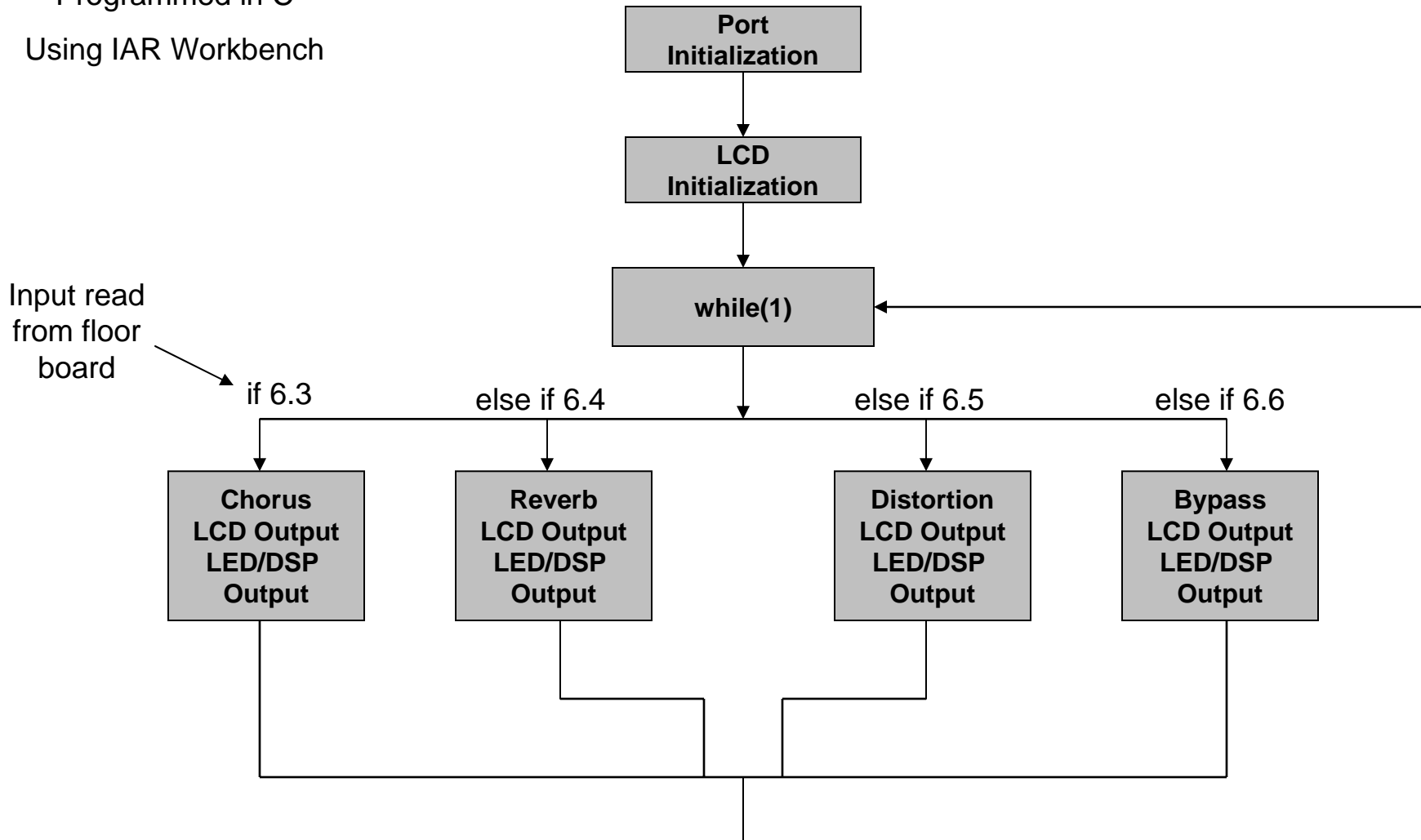


- Reverb simulates the acoustical effect of rooms and enclosed buildings.
- The sound heard = source + reflected sound.
- Reverberation time = the time taken for an impulse to decrease by 60dB of it's original magnitude.

<http://www.geocities.com/gitaarwerk/fxexp/reverb/Reverb.htm>

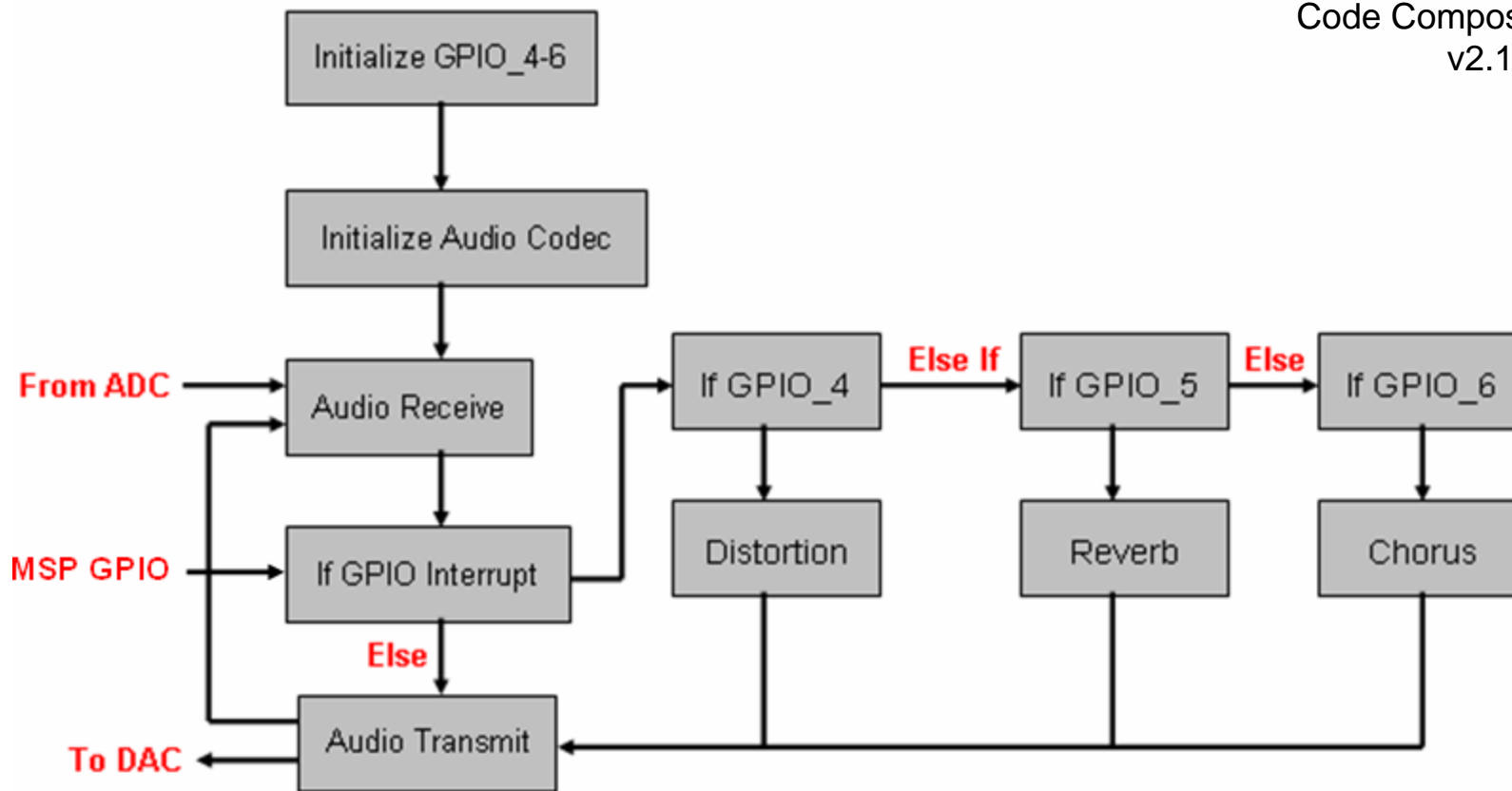
# MSP Software Flowchart

Programmed in C  
Using IAR Workbench



# DSP Software Flowchart

Converted C Code from  
Matlab's Simulink  
Board interfaced using  
Code Composer Studio  
v2.1







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