Digital Guitar Effects Pedal

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SPRP499

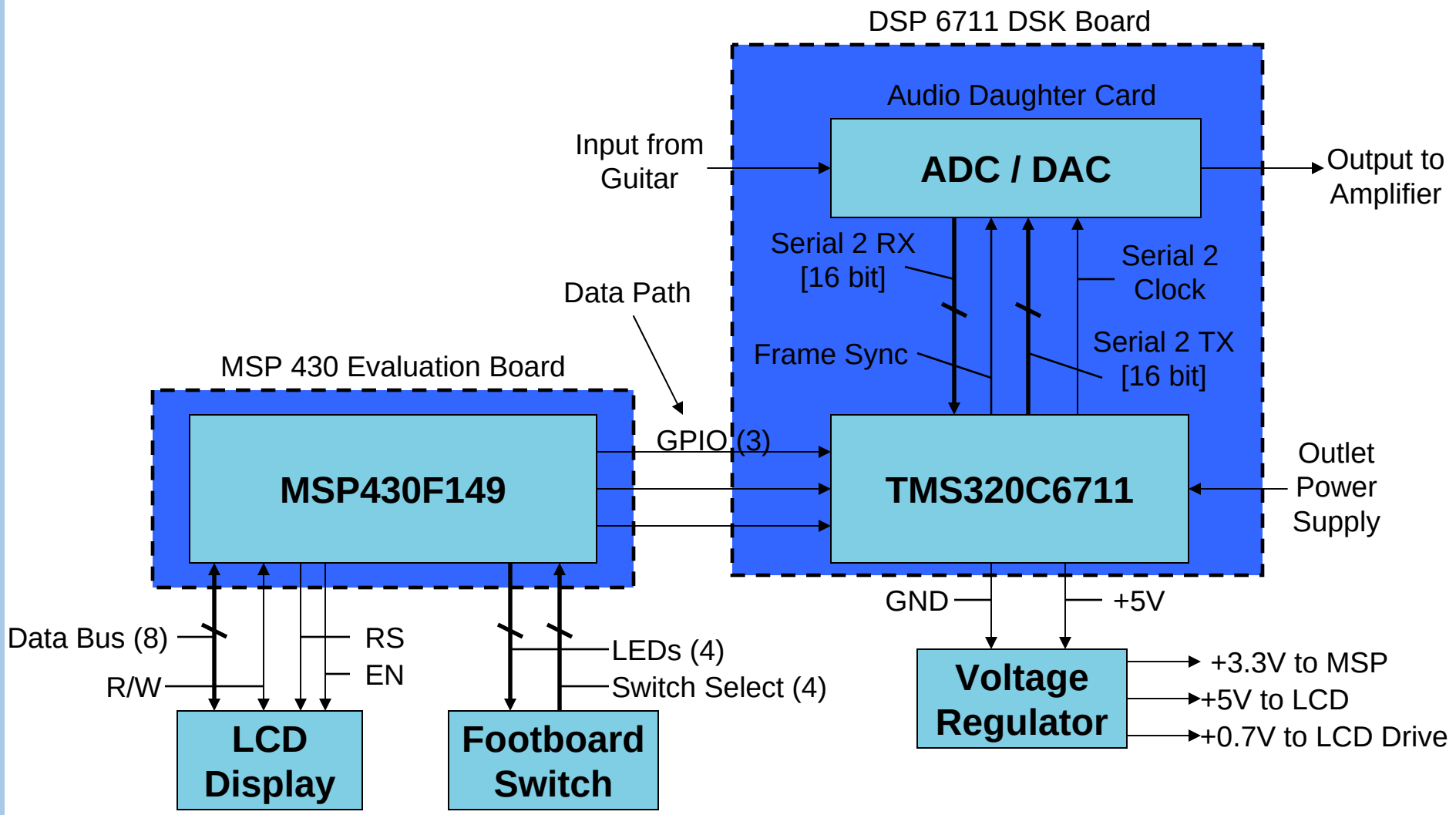
Presentation Outline

- **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

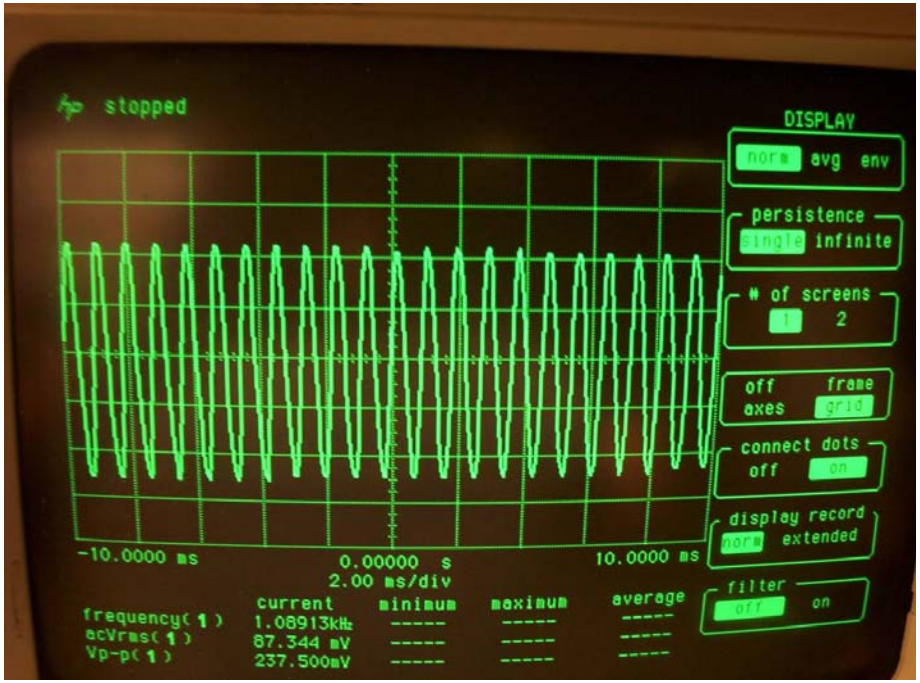
- **To create a digital guitar effects pedal**
- **All audio processing will be done with a DSP 6711 DSK board**
  - With an audio daughter card
- **All user peripherals will be controlled using a MSP430 evaluation board**
  - Using the F149 model chip
- **User Peripherals include…**
  - Floor board 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



Hardware: DSP and MSP

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

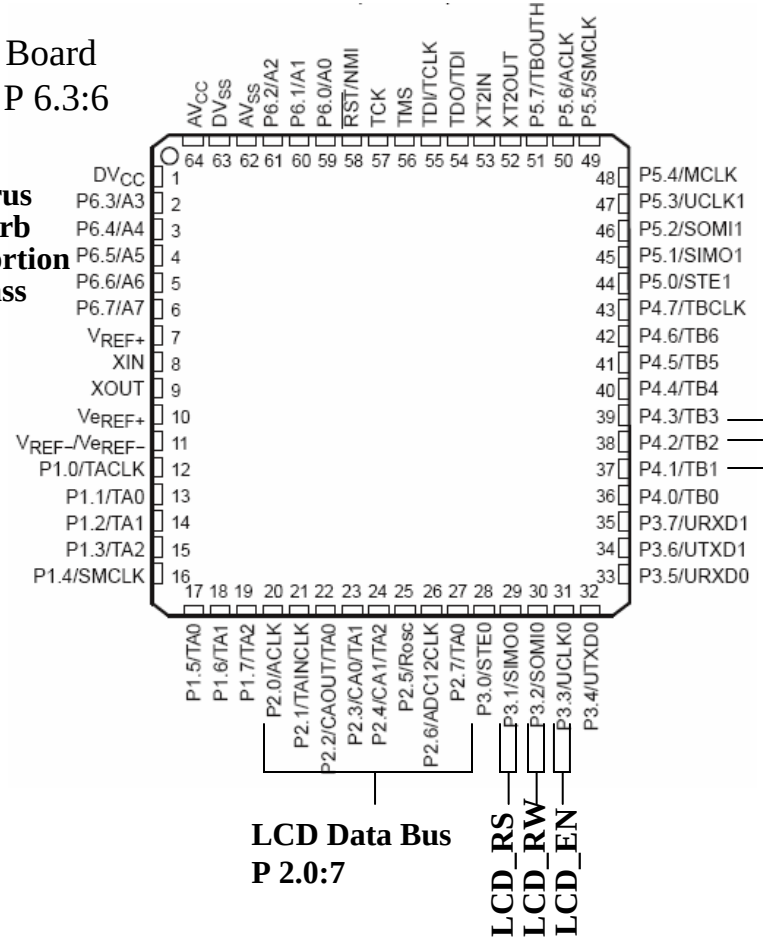
MSP and DSP Connection

MSP430F149

TMS320C6711

Floor Board
Input P 6.3:6

Chorus
Reverb
Distortion
Bypass



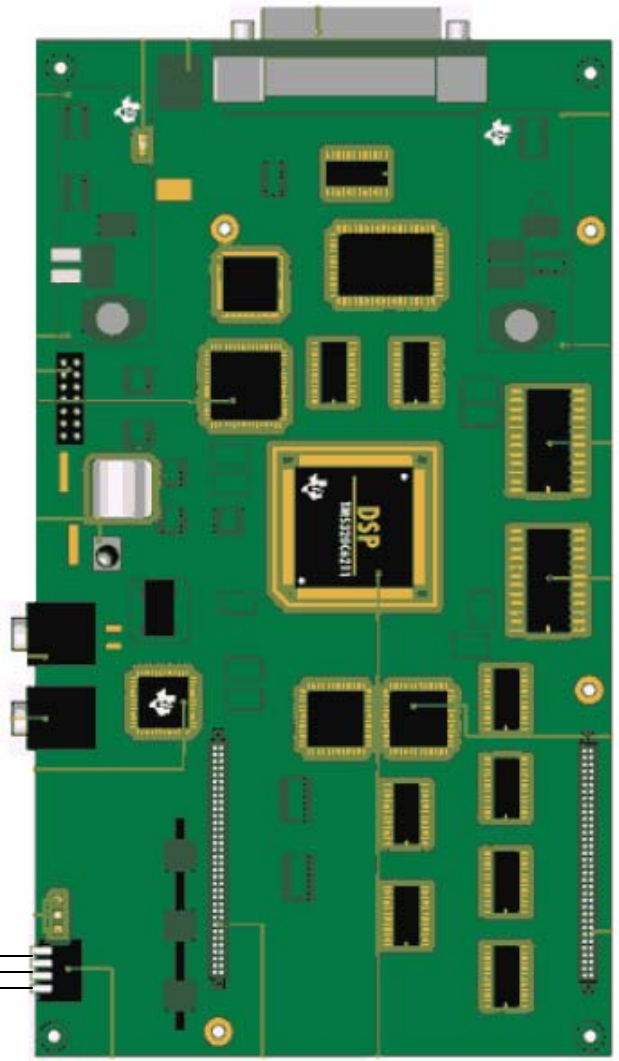
LCD Data Bus
P 2.0:7

LCD_RS
LCD_RW
LCD_EN

Chorus

Reverb

Distortion

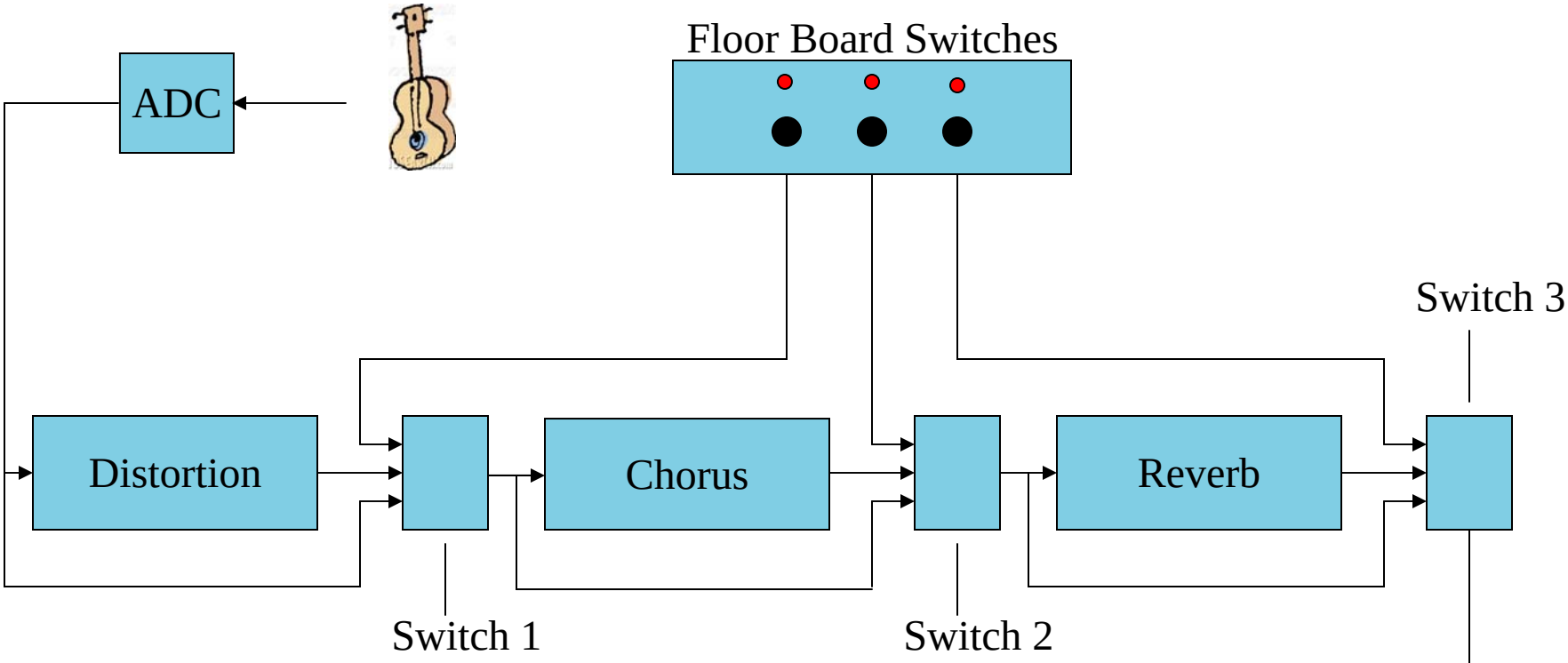


www.ti.com – slas272f.pdf

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

Simulink Models for the DSP

Simulink System Diagram

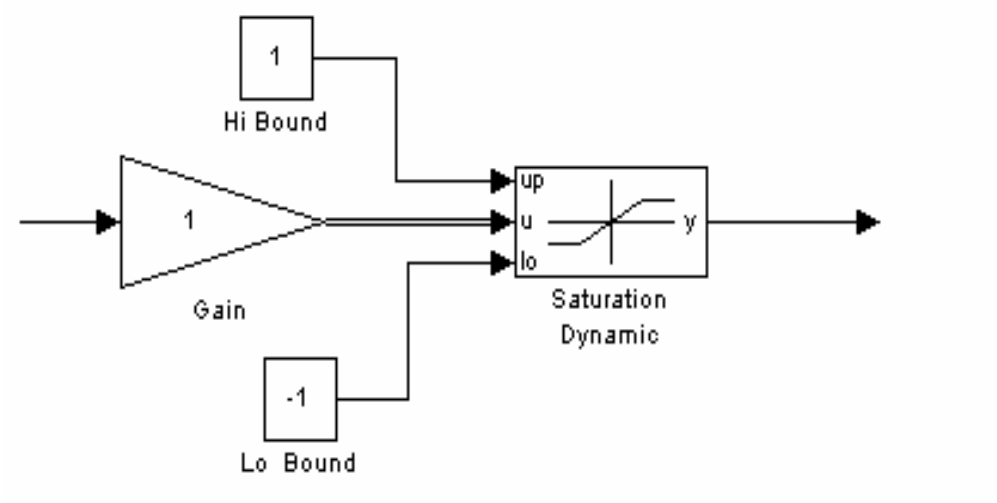


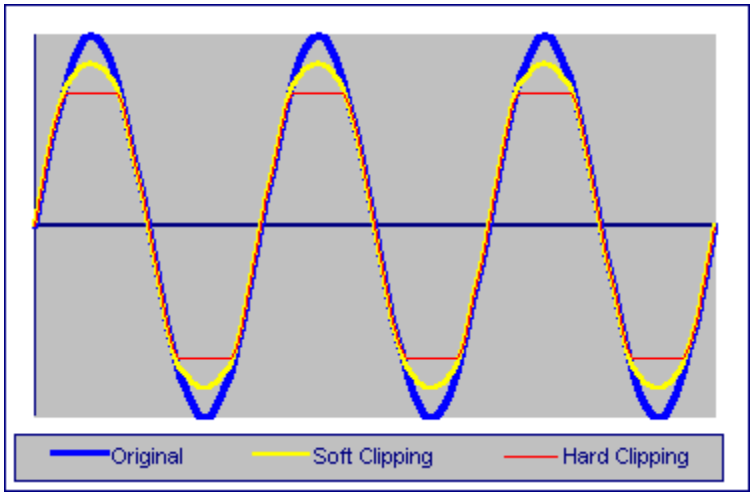
DAC

Sample-By-Sample Processing (No Buffering)

There is no audible delay from processing.

Distortion Model

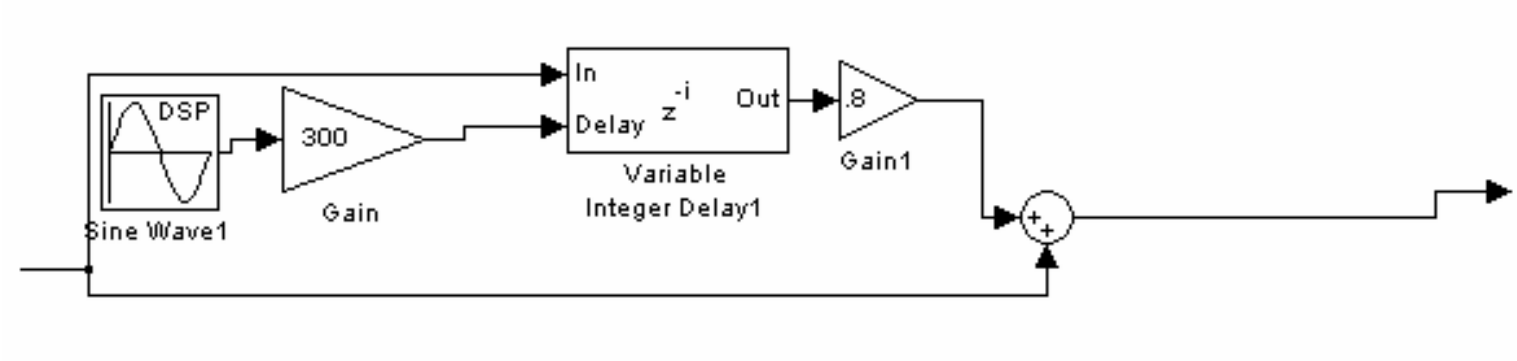




- Distortion is a music effect that gives a distinct, “heavy” sound.
- The signal is amplified to give it a certain gain.
- The amplitude of the signal is then limited symmetrically.

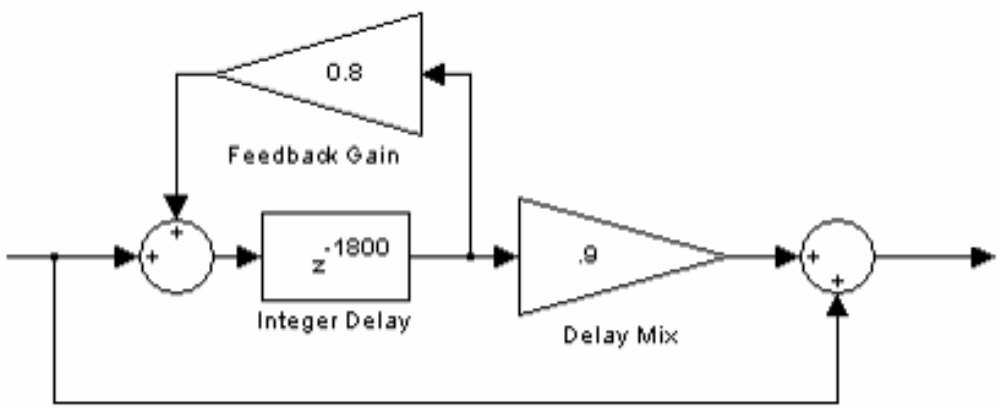
http://users.chariot.net.au/~gmarts/fx-desc.htm#Cho

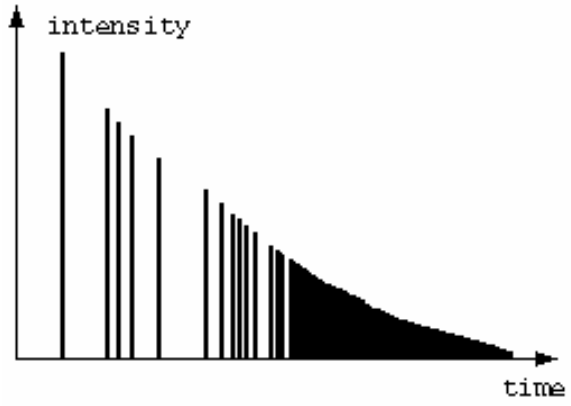
Chorus Model



- 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





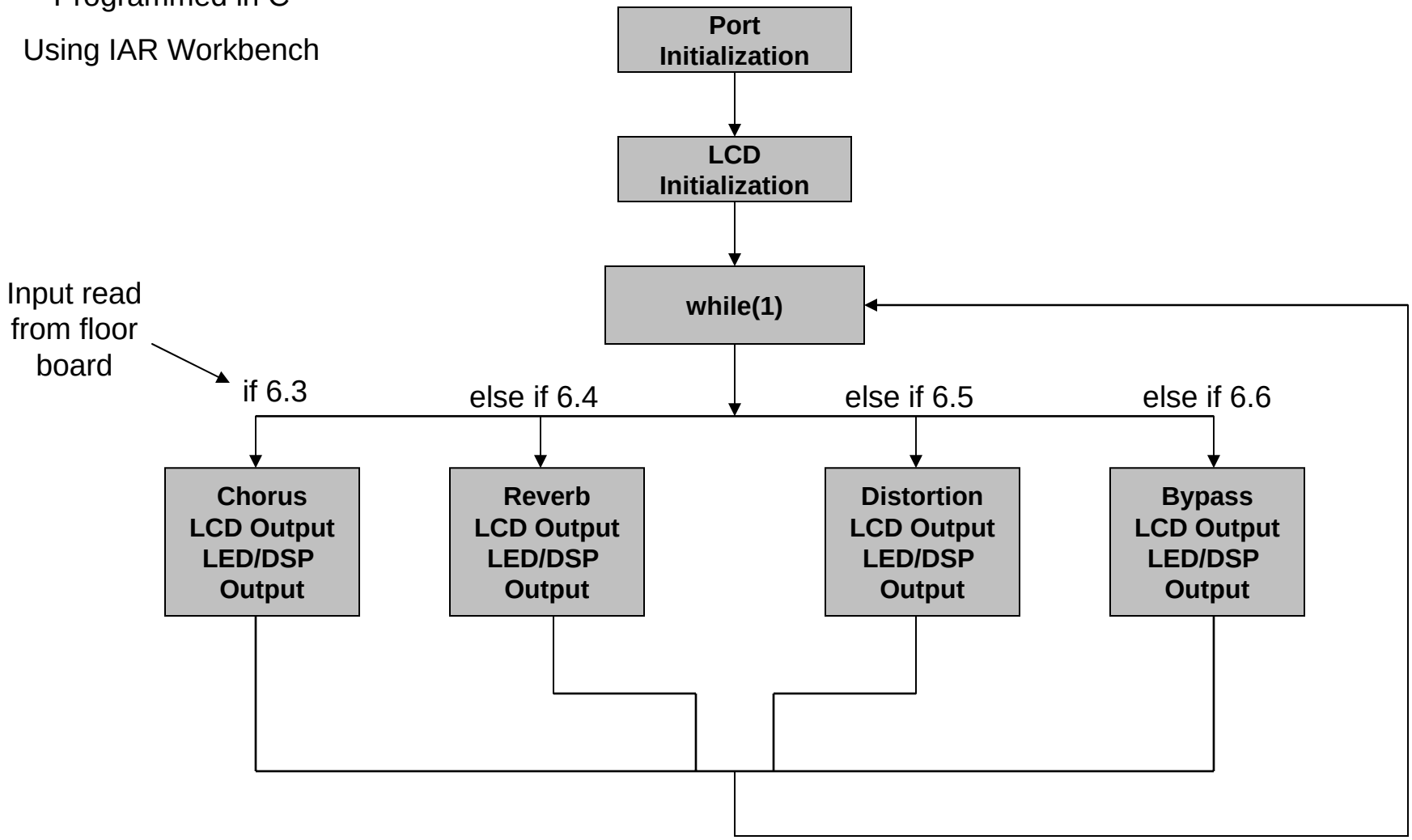
- Reverb simulates the acoustical effect of rooms and enclosed buildings.
- The sound heard = source + reflected sound.
- Reverberation time = the time taken for an impulse to decrease by 60dB of it's original magnitude.

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

MSP Software Flowchart

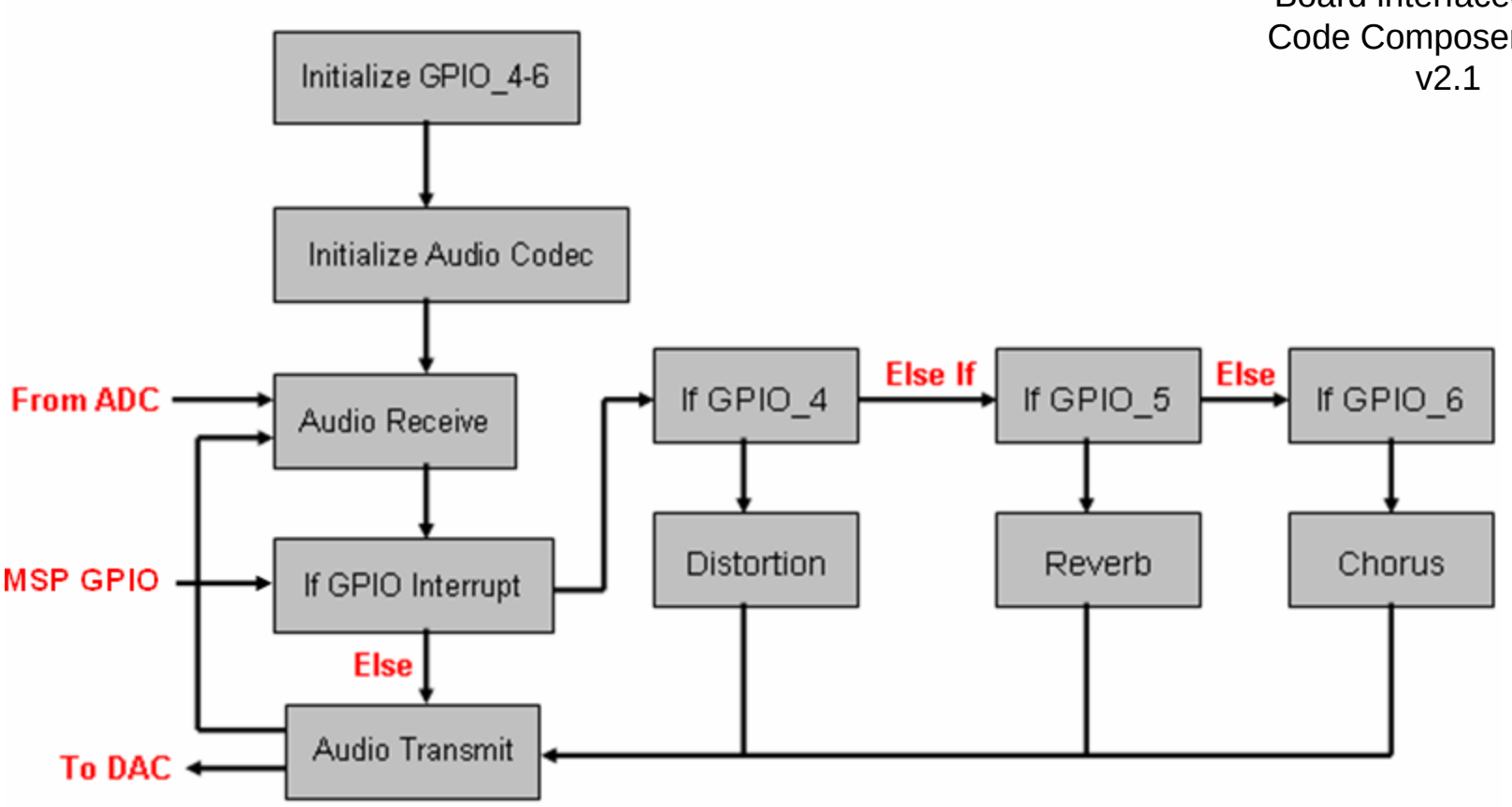
Programmed in C

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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CREATE YOUR OWN