**Goals**

- Design and implement a small format digital audio mixer using a SoC development board
- Four mono inputs with analog pre-amplification, line level stereo input
- Stereo output with variable digital gain
- Sample-by-sample processing
- Real time DSP functions per input:
  - 4-Band Parametric Equalization
  - High Pass Filtering
  - Compression
  - Expansion
  - Digital Gain

**Conceptual Design**

Single Channel Representation:

```
\[ x_1 \rightarrow \text{ADC} \rightarrow \text{DSP} \rightarrow \text{DAC} \rightarrow y \]
```

Input / Output Overview:

[Diagram showing input and output channels]

Digital Signal Processing:

```
\[ x_1 \rightarrow \text{MUTE} \rightarrow \text{HPF} \rightarrow \text{Expander} \rightarrow \text{Compression} \rightarrow \text{PEQ} \rightarrow \text{Digital Gain} \rightarrow y \]
```

**Design Challenges**

- SoC architecture and tools are rapidly evolving. Reference manuals, demos, and IP modules must match the toolset version to be considered useful.
- Effectively communicating between Programmable Logic and Processing System while meeting timing constraints
- Utilizing the limited amount of I/O to optimize the user interface while maintaining the desired channel count.
- DSP algorithm implementation in hardware

**Simulation Examples, Results**

- **Compression and Expansion**
  - [Graphs showing compression and expansion results]

- **Multi-Touch Display System**
  - Displays DSP function parameters and gain values
  - Parameter Selection
- **Digital Rotary Encoders**
  - Digital Gain Control
  - Parameter Modification
  - Channel Selection
- **Analog Pre-Amplification**
  - Potentiometer Controlled
- 12-bit, 96 kHz Sampling

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**References**