**Quad Mic Interface Units**

**Initial state of the control signals:**

|  |  |  |
| --- | --- | --- |
| **Signal** | **State** | **Description** |
| Dual\_V\_EN | 0 | Enable dual bias mode:  0 – disable  1 – enable |
| PlusEn | 0 | Enable routing the + data to the + input to the op-amp:  0 – routing blocked  1 – routing enabled |
| CLK\_EN | 0 | Enable the bit clock to clock the digital data from the mic:  0 – disable  1 – enable |
| NegEn | 0 | Enable routing the – data to the – input of the op-amp:  0 – routing blocked  1 – routing enabled |
| SingleGain | 0 | Enable gain for single ended operation:  0 – disable gain function  1 = enable gain function |
| Select | 1 | Select one of two mics:  0 – select first mic  1 – select second mic |
| XQ1 | 0 | Enable for the digital and analog modes (ckt 1)  0 – digital and analog are disabled  1 – digital and analog are enabled |
| Type | 0 | Selects between the digital and analog modes  0 – select analog  1 – select digital |
| PDM\_ENZ | 1 | Selects between digital and analog and PDM modes  0 – selects PDM mode   1. – selects digital and analog modes   \*The Z at the end of PDM\_ENZ means it’s active low. |
| XQ2 | 0 | Enable for the digital and analog modes (ckt 2)  0 – digital and analog are disabled  1 – digital and analog are enabled |

**There are eight mic types:**

|  |
| --- |
| Single-ended analog (ckt1) |
| Differential analog (ckt1) |
| Digital (ckt1) |
| PDM (ckt1) |
| Single-ended analog (ckt2) |
| Differential analog (ckt2) |
| Digital (ckt2) |
| PDM (ckt2) |

Using Dual\_Mic\_Interface\_1.sch for the discussion.

**Single-ended analog mode (ckt1):**

|  |  |
| --- | --- |
| Signal | State |
| Dual\_V\_EN | X |
| PlusEn | 1 |
| CLK\_EN | 0 |
| NegEn | 0 |
| SingleGain | 1 |
| Select | 1 |
| XQ1 | 1 |
| Type | 0 |
| PDM\_ENZ | 1 |
| XQ2 | 0 |

This mode will test the MEMS Single-ended analog microphone. This microphone is selected by applying the high level Select signal to J701 pin-6. There is a bias voltage, V\_Bias\_DUT\_1, applied to J701 pin-3 from DUT\_CLK\_Bias.sch through R701 sense resistor. The current sensing function will be discussed later. If this is a dual bias microphone, Dual\_V\_EN will be high. This will apply a bias voltage, V\_Bias\_DUT\_2, to J701 pin-7 from DUT\_CLK\_Bias.sch through analog switch 703A. The analog (+) signal from the DUT, J701 pin-4, is applied to the (+) input of U706A op-amp, through analog switch U702A which is switched on by PlusEn being high. All analog signals are capacitively coupled to the op-amp to remove the D-C component. The op-amp is configured for a gain of 10 by SingleGain being high switching U702D on.

The output is selected by thesignals XQ1 set high, Type set low, and PDM\_ENZ set high. This will turn on U711A on through U705A, U705B, U704C. The analog signal will leave this unit by AOut to Microcontroller.sch for processing.

**Differential analog mode (ckt1)**

|  |  |
| --- | --- |
| Signals | State |
| Dual\_V\_EN | X |
| PlusEn | 1 |
| CLK\_EN | 0 |
| NegEn | 1 |
| SingleGain | 0 |
| Select | 1 |
| XQ1 | 1 |
| Type | 0 |
| PDM\_ENZ | 1 |
| XQ2 | 0 |

This mode will test the MEMS differential analog microphone. This microphone is selected by applying the high level Select signal to J701 pin-6. There is a bias voltage, V\_Bias\_DUT\_1, applied to J701 pin-3 from DUT\_CLK\_Bias.sch through R701 sense resistor. The current sensing function will be discussed later. If this is a dual bias microphone, Dual\_V\_EN will be high. This will apply a bias voltage, V\_Bias\_DUT\_2, to J701 pin-7 from DUT\_CLK\_Bias.sch through analog switch 703A. The analog (+) signal from the DUT, J701 pin-4, is applied to the (+) input of U706A op-amp, through analog switch U702A which is switched on by PlusEn being high. The analog (-) signal is from the DUT, J701 pin5, is applied to the (-) input of the U706 op-amp, through the analog switch U702C which is switched on by NegEEn being high. All analog signals are capacitively coupled to the op-amp do remove the D-C component. The op-amp is configured for a gain of 10.

The output is selected by thesignals XQ1 set high, Type set low, and PDM\_ENZ set high. This will turn on U711A on through U705A, U705B, U704C. The analog signal will leave this unit by AOut to Microcontroller.sch for processing.

**Digital mode (ckt1)**

|  |  |
| --- | --- |
| Signals | State |
| Dual\_V\_EN | X |
| PlusEn | 0 |
| CLK\_EN | 1 |
| NegEn | 0 |
| SingleGain | 0 |
| Select | 1 |
| XQ1 | 1 |
| Type | 1 |
| PDM\_ENZ | 1 |
| XQ2 | 0 |

This mode will test the MEMS differential analog microphone. This microphone is selected by applying the high level Select signal to J701 pin-6. There is a bias voltage, V\_Bias\_DUT\_1, applied to J701 pin-3 from DUT\_CLK\_Bias.sch through R701 sense resistor. The current sensing function will be discussed later. If this is a dual bias microphone, Dual\_V\_EN will be high. This will apply a bias voltage, V\_Bias\_DUT\_2, to J701 pin-7 from DUT\_CLK\_Bias.sch through analog switch 703A.

The digital signal from J701 pin-4 is applied to DOut through U703C. The logic circuit of U705C and U705D processes XQ1 being high and Type being high to turn on U703C. B\_Clk1 is applied to J701 pin-5 through analog switch 702B which is turned on by a high on CLK\_EN. B\_Clk clocks 1he data out which is sent to Microcontroller.sch for processing.

**PDM mode (ckt1)**

|  |  |
| --- | --- |
| Signals | State |
| Dual\_V\_EN | X |
| PlusEn | 0 |
| CLK\_EN | 1 |
| NegEn | 0 |
| SingleGain | 0 |
| Select | 1 |
| XQ1 | 0 |
| Type | 1 |
| PDM\_ENZ | 0 |
| XQ2 | 0 |

This mode will test the MEMS differential analog microphone. This microphone is selected by applying the high level Select signal to J701 pin-6. There is a bias voltage, V\_Bias\_DUT\_1, applied to J701 pin-3 from DUT\_CLK\_Bias.sch through R701 sense resistor. The current sensing function will be discussed later. If this is a dual bias microphone, Dual\_V\_EN will be high. This will apply a bias voltage, V\_Bias\_DUT\_2, to J701 pin-7 from DUT\_CLK\_Bias.sch through analog switch 703A.

The digital signal from J701 pin-4 is applied to PDM\_Out through U703D which is turned on by a low on PDM\_ENZ through U704B. B\_Clk1 is applied to J701 pin-5 through analog switch 702B which is turned on by a high on CLK\_EN. B\_Clk1 clocks 1he data out which is sent to PDM\_To\_I2S.sch for further processing.

The descriptions for the ckt2 microphones are the same as the ckt1 microphones. The names of the devices will change as shown in the schematic for circuit 2. The notable changes in the signals are that XQ1 will be replaced by XQ2 and Select will be a logic low. Select is converted to a high by U707 to be applied to J702 pin-6.

**Single-ended analog mode (ckt2)**

|  |  |
| --- | --- |
| Signal | State |
| Dual\_V\_EN | X |
| PlusEn | 1 |
| CLK\_EN | 0 |
| NegEn | 0 |
| 702SingleGain | 1 |
| Select | 1 |
| XQ1 | 0 |
| Type | 0 |
| PDM\_ENZ | 1 |
| XQ2 | 1 |

**Differential analog mode (ckt2)**

|  |  |
| --- | --- |
| Signals | State |
| Dual\_V\_EN | X |
| PlusEn | 1 |
| CLK\_EN | 0 |
| NegEn | 1 |
| SingleGain | 0 |
| Select | 1 |
| XQ1 | 0 |
| Type | 0 |
| PDM\_ENZ | 1 |
| XQ2 | 1 |

**Digital mode (ckt2)**

|  |  |
| --- | --- |
| Signals | State |
| Dual\_V\_EN | X |
| PlusEn | 0 |
| CLK\_EN | 1 |
| NegEn | 0 |
| SingleGain | 0 |
| Select | 1 |
| XQ1 | 0 |
| Type | 1 |
| PDM\_ENZ | 1 |
| XQ2 | 1 |

**PDM mode (ckt2)**

|  |  |
| --- | --- |
| Signals | State |
| Dual\_V\_EN | X |
| PlusEn | 0 |
| CLK\_EN | 1 |
| NegEn | 0 |
| SingleGain | 0 |
| Select | 1 |
| XQ1 | 0 |
| Type | 1 |
| PDM\_ENZ | 0 |
| XQ2 | 0 |

**Monitor Selection Unit**

There are 10 PAC195X-1 IC that monitor 4 microphone current inputs for a total of 40 DUTs.

Each of the PAC195X-1 ICs has a dedicated I2C interface. This is used to query each of the 4 current sense functions. The results are fed back to the MCU.

**Microphone Selection Unit**

This section consists of 5 8-bit D Flip-Flops. They are configured as 8-bit shift registers daisy chained together. The initial condition sends the CLEARZ signal low. This clears the entire shift register. To start the process, the Init\_Bit is set high then clocked in with the RingCLK. This will select the first DUT on the XQ1 signal of the first Dual Mic Interface. The high state is clocked through all the DUTs one at a time.

**I2C Selector Unit**

Which I2C bus is active is determined by the input control logic. 2WAddr0, 2WAddr1, and 2WAddr2 address the 1 of 8 I2C ports on the selecting IC. 2WAddr3 and 2WAddr4 determine which IC determines the appropriate I2C bus. The I2C selector ICs are chained together.

**Clock Source Unit**

The bit clocks are generated in this unit. U3704 generates MIC\_CLK\_A, MIC\_CLK\_B, MIC\_CLK\_C, and MIC\_CLK\_D bit clock sources and the MST\_DATA\_CLK bit clock that is inverted The clock frequency is determined by information fed to U3704 from the MCU over an I2C bus.

The bit clocks are applied to the level shifting ICs for buffering and fanout, and having the bias voltage applied to the clock before distributing the clocks.

**DUT Clock Bias Unit**

The bias voltages for the DUT are developed here by a pair of DACs. U3803, controlled by an SPI bus interface from the MCU, develops the main bias voltage for the DUT and the clock bias voltage. U3805 develops the secondary voltage for the DUT. It is also controlled by an SPI bus interface from the MCU.

**PDM to I2S Unit**

In this unit there are 5 PDM to I2S converters. Each converter handles 8 MEMS microphones. The PDM data from the Dual Mic Interface is clocked in using the bit clocks and the I2S data is clocked out using the master data clock. The DUT selected is controlled by the PDM\_FSYNC which is the Select signal from the MCU. Each converter has its own dedicated I2C bus interface.

**Power Supplies Unit**

The power supplies generated are the +6V, +5V, +3.3V, and the +1.8V. The RESETZ signal is also generated here. It resets the MCU when the power supply drops out.

**IC Power Sections Unit**

This shows the power connections for the ICs from the Dual\_Mic\_Interface schematics.

**Microcontroller Unit**

The RingCLK, CLEARZ, Init\_Bit are output signals go to the MicrophoneSelection.sch to get specific information about that DUT.

For the specific DUT, SingleGain, PlusEn, Type, NegEn, AOut, PDM\_ENZ, DOut, MST\_DATA\_CLK, Select, Dual\_V\_EN, and CLK\_EN are sent to the Quad\_Mic\_Interface.sch to configure the interface to the DUT.

There is an I2S port to get the PDM data when required with MST\_DATA\_CLK, I2S\_Data, and Select signals. The MST\_DATA\_CLK is generated from the ClockSource.sch and the Select generated by the MCU itself. The I2S\_Data comes from the PDM͟\_To\_I2S.sch.