**reg.v Document – Julie Swift**

**Interfaces**

|  |  |  |  |
| --- | --- | --- | --- |
| Signal Name | Direction | Bits | Comment |
| clk | in | 1 | Master Clock |
| rst | in | 1 | Reset |
| reg\_op | in | 1 | 1: write 0: read |
| reg\_addr | in | 32 | register address |
| reg\_wdata | in | 32 | data to be written for a write op |
| reg\_rts | in | 1 | ready to send |
| reg\_rtr | out | 1 | ready to receive |
| reg\_rdata | out | 32 | read return data |
| reg\_xfc | out | 1 | read data transfer complete |
| i2s\_inoverrun | in | 1 | will turn into sticky bit |

**Functional Requirements:**

* Data Plane Requirements:
  + Reading from I2C’s address, the reg.v will produce an output from whatever is stored in that address
  + When an overrun or underrun occurs from I2S’s FIFO, the status register field will input or output the audio FIFO overrun/underrun
* Control Plane Requirements:
  + There will be 256 register fields for the 512 filter coefficients
  + reg\_op configures the corresponding I/O port pin as either an input or an output to be respectively read or write data.
  + Registers will either be ready to send (reg\_rts) data or ready to be received (reg\_rtr) data in which data will be stored 8-bits at a time.
* Control and Status Interface Bit Descriptions:
  + Status Bit
    - i2s\_inoverrun = 1 then there was an overflow in FIFO, if it is = 0 then there is not overflow
  + Control Bits being stored
    - rf\_i2s0\_dec\_fact
      * sample and hold audio values
    - rf\_i2si\_dec\_factor
      * sample and hold audio values
    - rf\_filter\_chip\_en
      * 1- performs clipping
      * 0- no clipping
    - rf\_filter\_shift
      * number of bit positions to shift after filter accumulator
    - rf\_i2si\_bist\_en
      * 0- audio source is BIST
      * 1- audio source is i2si
    - rf\_soft\_reset
      * 0- normal operation
      * 1- assert soft reset
  + Status Bits being stored
    - ro\_fifo\_underrun- fifo overrun clear
    - trig\_fifo\_underrun- input audio fifo overrun
    - ro\_fifo\_overrun- fifo underrun clear
    - trig\_fifo\_overrun- output audio fifo underrun

**Micro-Architecture:**

* Sub-blocks
  + trig\_generater – when triggered, this sub-block generates a signal to clear any of the status bits (such as the overrun and underrun)
* Block Diagram  
  + Interfaces:

RESPONSE

CLK to I2C

Write Data

Address

Command

RTS

RTR

Read Data

XFC

RO

CLK

Reset

Rf

O

I

D

Q

CLK

Write Enable

Write Database

* + Internally­­­­­­­­­

**Design:**

* What the register block is storing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Register Name | Signal Name | RO/WO/RW | Bits | Comment |
| CHIP\_INFO |  |  |  |  |
|  | ro\_chip\_id | RO | 7:0 | Fixed Chip ID |
|  | ro\_revision\_id | RO | 15:8 | Fixed Revisions ID |
| CONTROL |  |  |  |  |
|  | rf\_soft\_reset | RW | 0:0 | 0- normal operation  1- assert soft reset |
|  | rf\_i2si\_bist\_en | RW | 1:1 | 0- audio source is i2si  1- audio source is BIST |
|  | rf\_filter\_shift | RW | 5:2 | number of bit positions to shift after filter accumulator |
|  | rf\_filter\_chip\_en | RW | 6:6 | 1- performs clipping  0- no clipping |
|  | rf\_i2si\_dec\_factor | RW | 11:8 | sample and hold audio values |
|  | rf\_i2s0\_dec\_fact | RW | 15:12 | sample and hold audio values |
| I2S\_CLOCK\_CONTROL |  |  |  |  |
|  | rf\_i2so\_clk2sck\_div | RW | 15:0 | half of the clock frequency divided by this # |
| STATUS |  |  |  |  |
|  | trig\_i2si\_fifo\_overrun\_clr | WO | 0:0 | fifo overrun clear |
|  | ro\_fifo\_overrun | RO | 1:1 | input audio fifo overrun |
|  | trig\_i2so\_fifo\_underrun\_clr | WO | 2:2 | fifo underrun clear |
|  | ro\_fifo\_underrun | RO | 3:3 | output audio fifo underrun |
| BIST |  |  |  |  |
|  | rf\_i2si\_bist\_start\_val | RW | 7:0 | start value of sawtooth wave |
|  | rf\_i2si\_bist\_incr | RW | 19:12 | increment of sawtooth wave |
|  | rf\_i2si\_bist\_upper\_limit | RW | 31:20 | upperlimit of the sawtooth wave |
| I2C\_REG\_INDIR\_ADDR |  |  |  |  |
|  | rf\_i2c\_reg\_indir\_addr | RW | 11:0 | address register used for indirect addressing via 12c |
| I2C\_REG\_INDIR\_DATA |  |  |  |  |
|  | ro\_i2c\_reg\_indir\_data | RO | 8:0 | data access register |
| FILT\_COEFFS\_0\_1 |  |  |  |  |
|  | rf\_filter\_coeff0 | RW | 15:0 | Filter Coefficient 0 |
|  | rf\_filter\_coeff1 | RW | 31:16 | Filter Coefficient 1 |
| FILT\_COEFFS\_2\_3 |  |  |  |  |
|  | rf\_filter\_coeff2 | RW | 15:0 | Filter Coefficient 2 |
|  | rf\_filter\_coeff3 | RW | 31:16 | Filter Coefficient 3 |
| FILT\_COEFS\_510\_511 |  |  |  |  |
|  | rf\_filter\_coeff510 | RW | 15:0 | Filter Coefficient 510 |
|  | rf\_fiter\_coeff511 | RW | 31:16 | Filter Coefficient 511 |

* Number of Gates and Flip-Flops
* Are all controls/statuses correct?

**Verification:**

* Testbench
* Test Plan
  + Physically check every address to make sure it is outputting the right data.
  + Physically check the default values of every address
  + Make sure the trig\_generater is functioning correctly
    - Making sure it is being triggered at the correct time
    - Making sure it is clearing the status bit every time it is executed