

Mixed Signal SoC VGA Clock

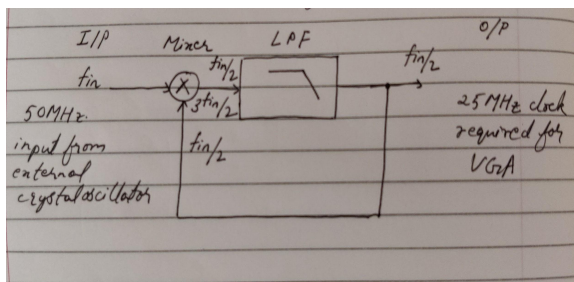
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Abstract—Goal is to design a mixed signal SoC which can display time through the VGA interface. It has an analog frequency divider which gives a 25MHz clock from an external 50MHz crystal oscillator. Digital parts implement a FSM for counting time in 24 Hr format and generate display signals required for VGA interface. Functionality to set hour and minute externally with the help of buttons is also implemented.

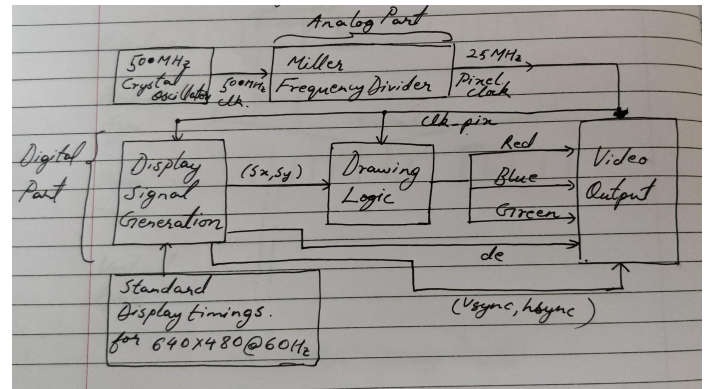
Circuit Details- The miller frequency divider is made up of a mixer, followed by a low pass filter. The cutoff frequency must be a little bit more than the frequency we want. In the digital part, we have the display signal generation block to generate various signals for VGA, with the help of display timing information and the drawing logic block which implements the clock as FSM. The latter is also responsible for rendering red, blue and green channels for video output, from the sprites (graphic image of each number is stored as a sprite in memory).

Reference Circuit Design-

Miller frequency divider



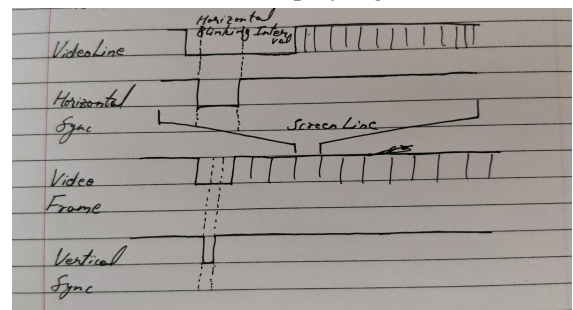
System level block diagram



Reference Waveforms and tables-
Display information table

Parameter	Horizontal	Vertical
Active Pixels	640	480
Front Porch	16	10
Sync Width	96	2
Back Porch	48	33
Total Blanking	160	45
Total Pixels	800	525
Sync Polarity	Negative	Negative

Waveforms for VGA display signal



References for design and ip cores-

- <https://projectf.io/posts/hardware-sprites/>
- <https://github.com/projf/projf-explore>
- <https://github.com/mattvonn/vga-clock.git>