

Local Oscillator

The local oscillator consists of SI570 PLL chip, MCP9801 temperature sensor, three Shmitt trigger buffers and 74LCX74 dual D-flop Johnson counter as Quadrature clock divider.

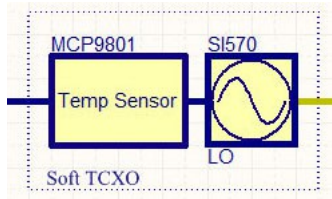


Fig1: LO block diagram

The SI570 chip is software controlled via I2C bus from the MCU. The frequency needed by the mixers is 4x the operating frequency. On the same I2C bus, thermally coupled to the oscillator chip is MC9801 temperature sensor. This chip has 12bit ADC connected to the thermal element and provides 0.0625 degrees Celsius resolution for the temperature of the SI570. The current consumption of the SI is around 80-90 mA due to high internal clock (5Ghz), so significant thermal output is produced. Tests show that after power up, the SI570 working temperature is in the 35-40 degrees C range.

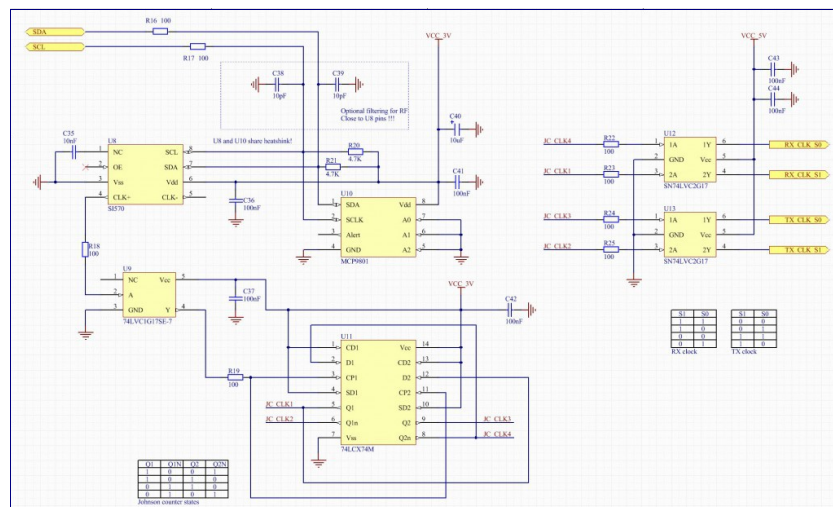


Fig2: LO schematics(click for larger view)

The software TCXO routine in the firmware implements a crude method of keeping the SI570 frequency spot on. The very precise resolution of the temperature sensor is not used, but rather 1 degree Celsius steps are more appropriate. I did some measurements of the SI570 frequency shift based on its temperature and created a look up table:

[ui_soft_tcxo.h](#)

Carefully looking into the values of the table will show that at 20 C the SI570 frequency will be 250Hz lower than what it should be at 25 C, and respectively at 60 C is 561Hz higher. There is no need to know absolute values only the shift from any current value. Main concerns here are that the relationship between frequency and temperature is non linear; second the 1 C steps used in the lookup table are too crude, as there is a gap of say 21Hz between 33 C and 34 C which is not covered by the compensation routine. This in practice results in poor compensation when temperature changes are too rapid. Here is some video which illustrates the process:

<https://youtu.be/3OhW0rsv1LU>

So the operation of the software TCXO is implemented via regular measurements of the SI570 temperature and issuing small frequency change commands to the chip to compensate the drift. Values are directly derived from the lookup table.