

-> extended version with
6 output channels

WOTAN - low cost ultra small formfactor console for Magnetic Particle Imaging

MPI control modul with 4 transmit channels (4x 250 kS/s, 8 bit, up to 4 MS/s possible) and one receive channel (2 MS/s, 12 bit).

Recording time: 15 ms. Data transfer over BLE (by adding the HC-05 bluetooth module or any bluetooth-UART module with 1.3 MBaud) with < 1.3 MBaud, or using the USBFS component included on the PSoC with 12.5 Mbps. Both interfaces allow writting new wave forms ("sequences") and receiving data.

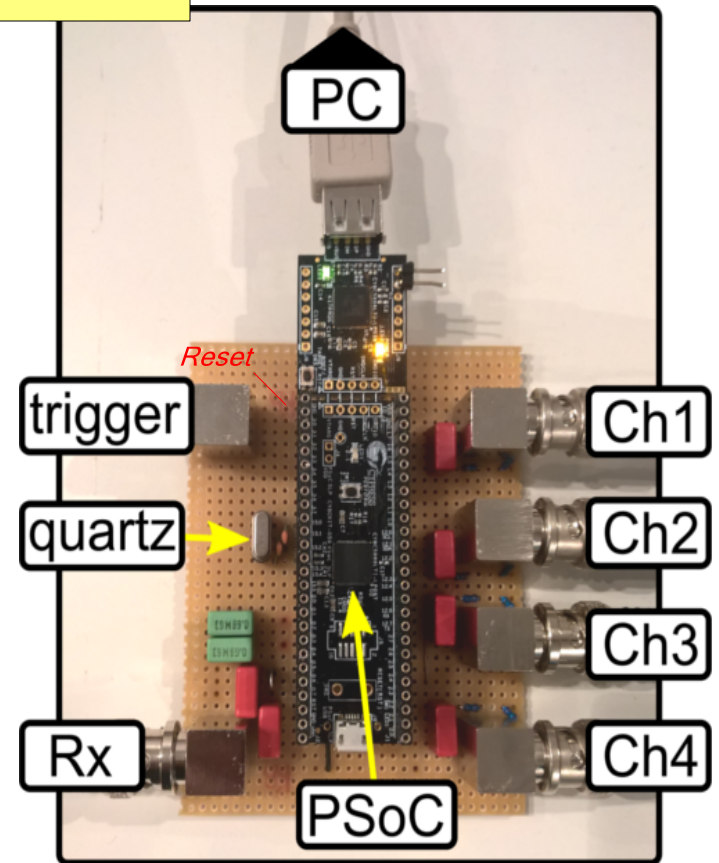
Both interfaces appear as COM ports and can be used interchangeable.

Example scripts for python 3:

These scripts work with both interfaces. Since they appear as COM port, only the port number needs to be changed. Bluetooth is slower and might require a higher value for timeout.

1) "UI_WOTAN/generate_sequence.py": writting arbitrary wave forms to the module (example code for showing the API)

2) "UI_WOTAN/run_sequence.py": running the board via bluetooth or USBFS (fullspeed USB-to-UART).



External components (see following tabs for details):

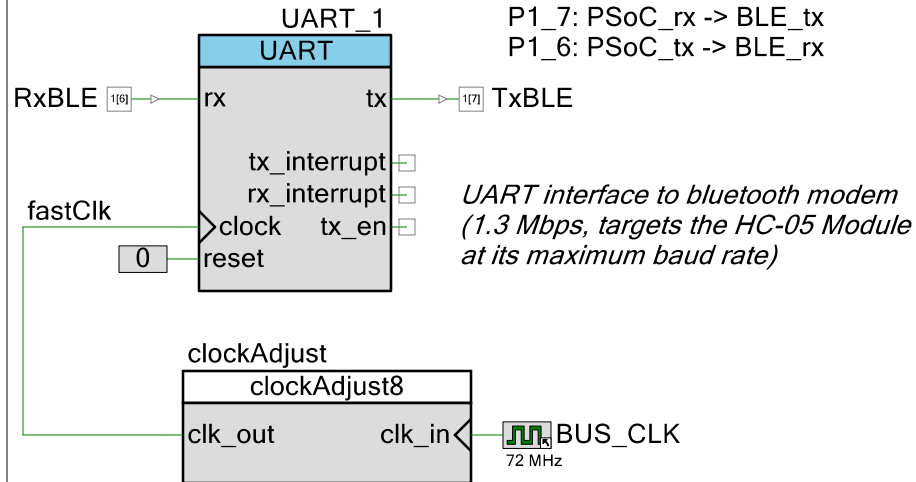
CH1..Ch4: 4x 1uF capacitors for dc-blocking (GPIO 2.0, 2.3, 2.5 and 2.7 respectively).

4x 12 kOhm resistors to adjust the output voltage of the IDAC8_n components to 2V-pp (pull GPIO 2.0, 2.3, 2.5, 2.7 to GND with 12 kohm each).

Rx: 2x 1uF capacitors for the Rx-channel (dc-block, input_p=) and 1 Mohm resistor. 2x 680nF bypass capacitors for the two SAR_ADC.

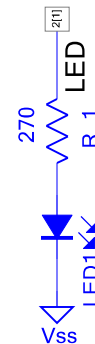
XTAL: 8MHz quartz and 2x 33pF (GPIO 15.0, 15.1, GPIO 15.2 and 15.3 are used as GND for the oscillator)

User - and debugging interface



Pins for BLE module:
P1_7: PSoC_rx -> BLE_tx
P1_6: PSoC_tx -> BLE_rx

*UART interface to bluetooth modem
(1.3 Mbps, targets the HC-05 Module
at its maximum baud rate)*

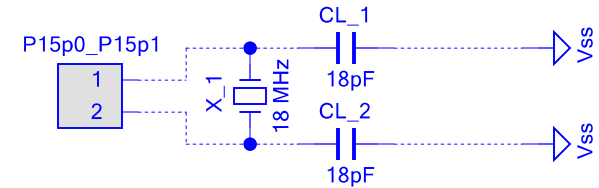


clockAdjust settings:

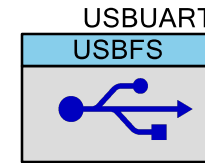
$$\begin{aligned} \text{ACCU_WORD} &= \\ &= \text{OVERSAMPLING} * \text{BAUDRATE} * 2^{**} \text{ACCU_WIDTH} / \text{BUS_CLK} \\ &= 2576980 \end{aligned}$$

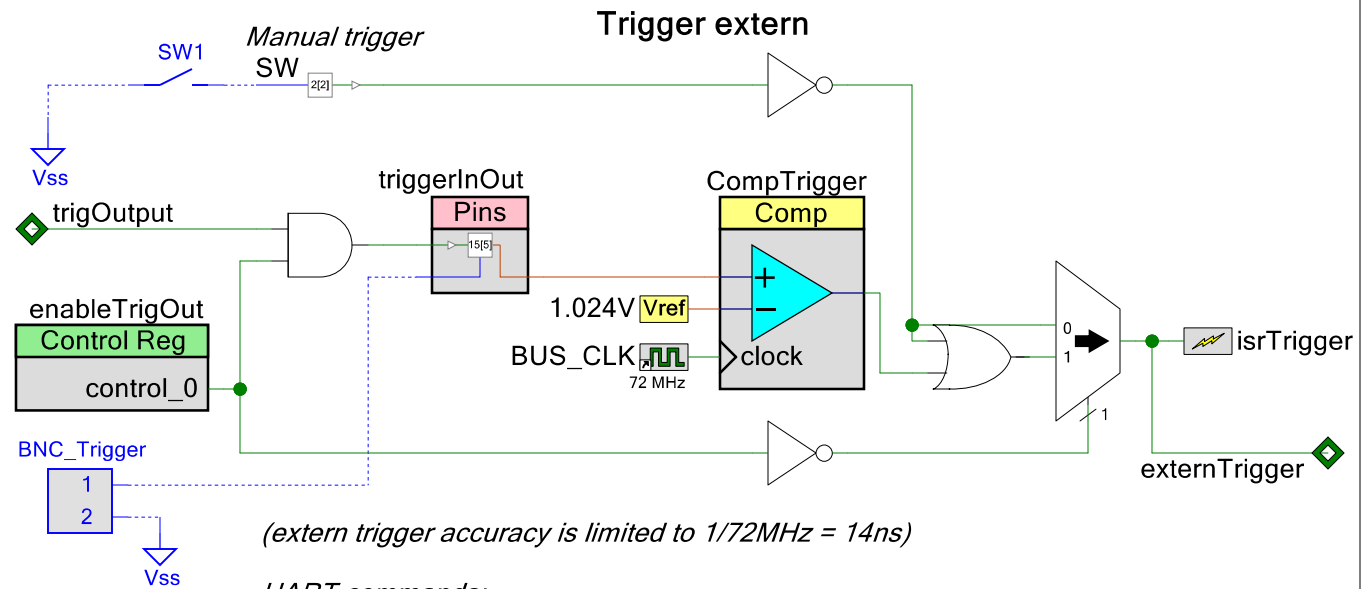
*OVERSAMPLING = 8
BAUDRATE = 1382400
ACCU_WIDTH = 24
BUS_CLK = 72e6*

Extern 6 MHz crystal (3...24 MHz can be used)



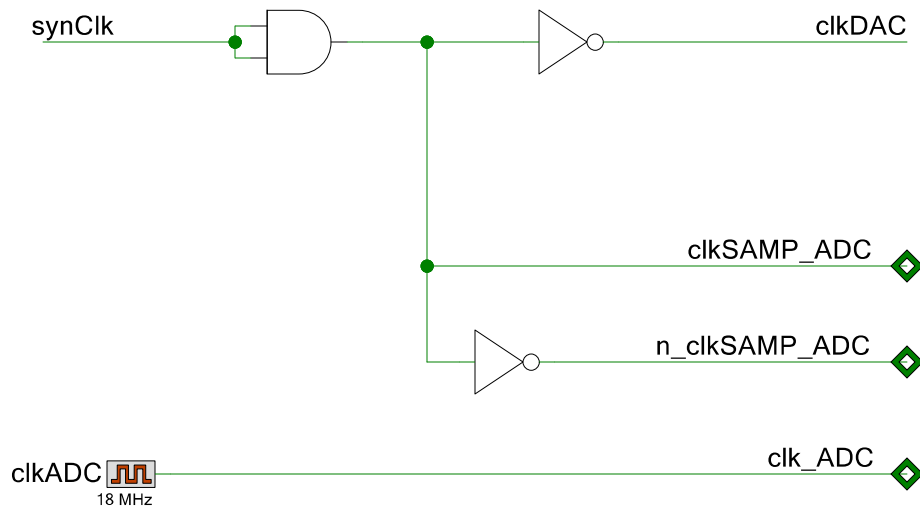
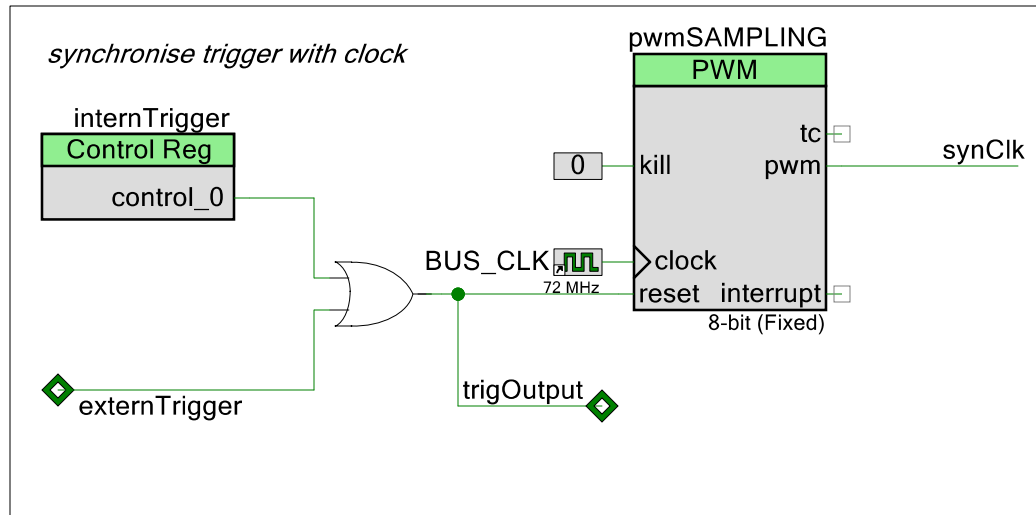
*USBUART for fast data transfer
(up to 12.5 Mbps, connected to micro USB Typ B)*



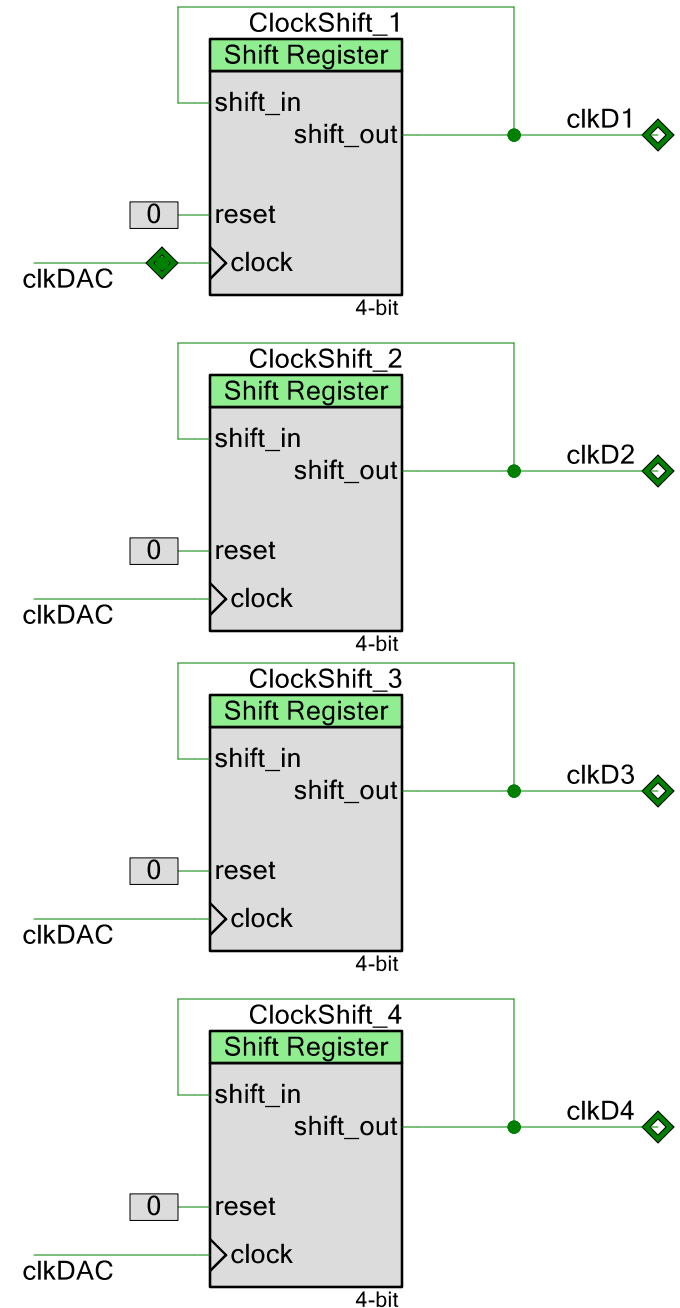


UART commands:
 use P3.0 as trigger input: "y"
 use P3.0 as trigger output: "x" (default setting,
 triggering via UART interface, or
 manually via SW1)

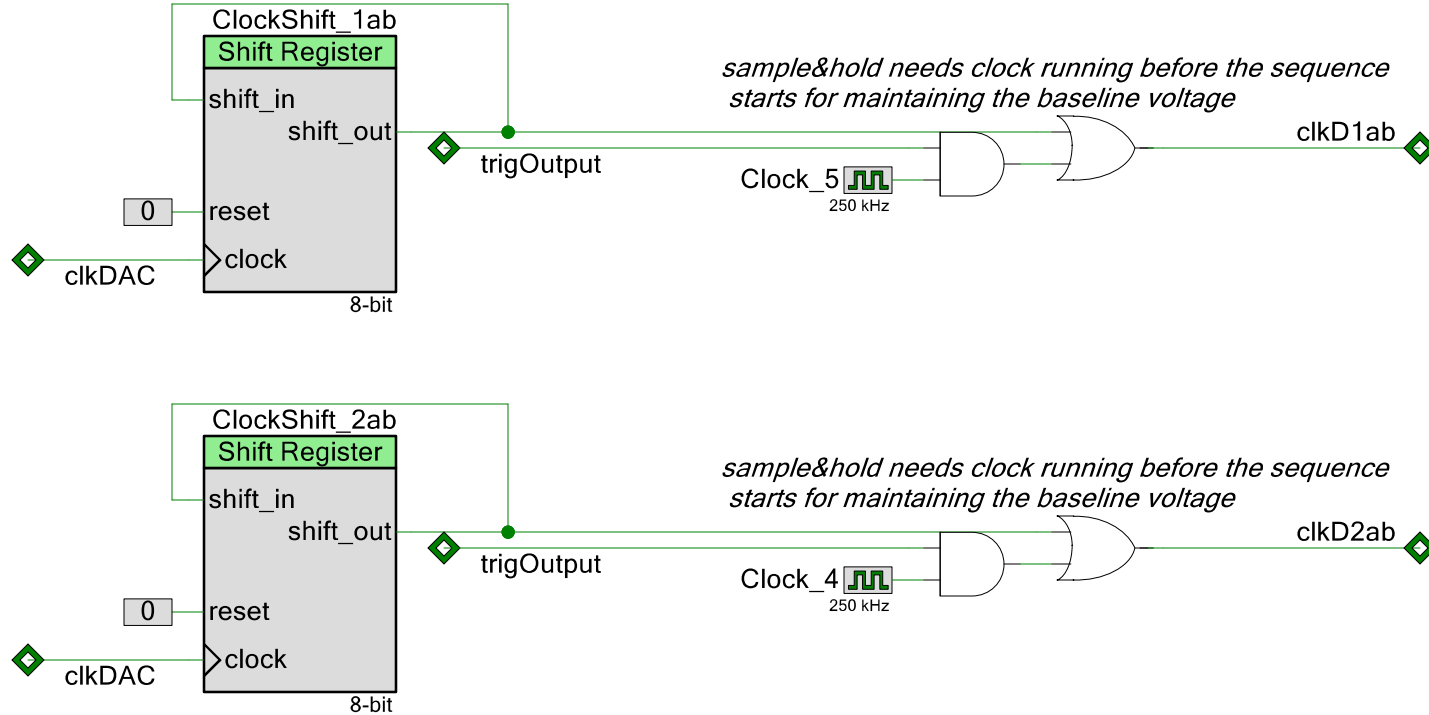
ADC- and DAC Clocks

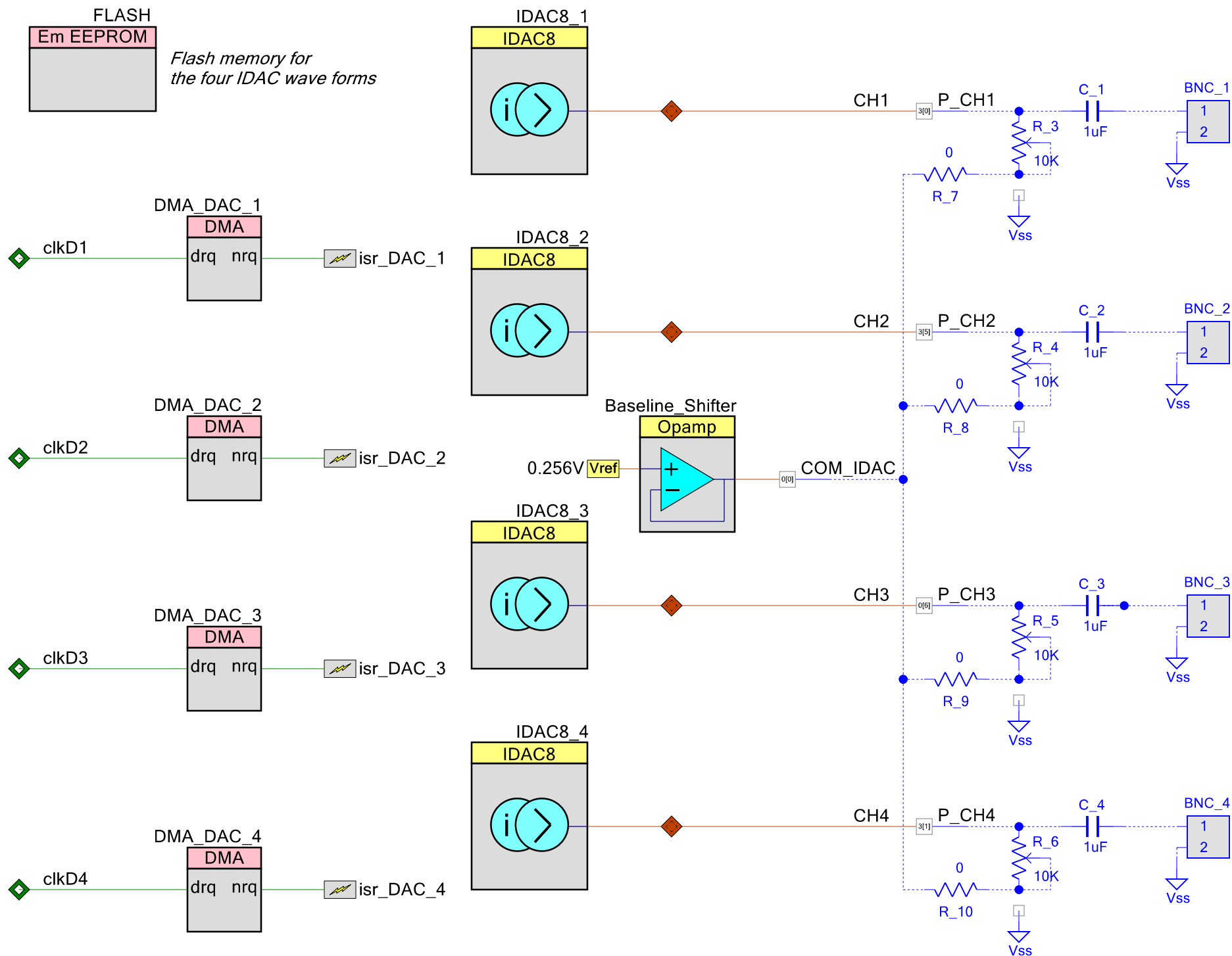


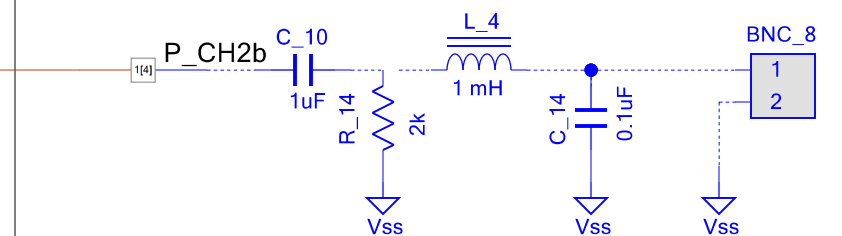
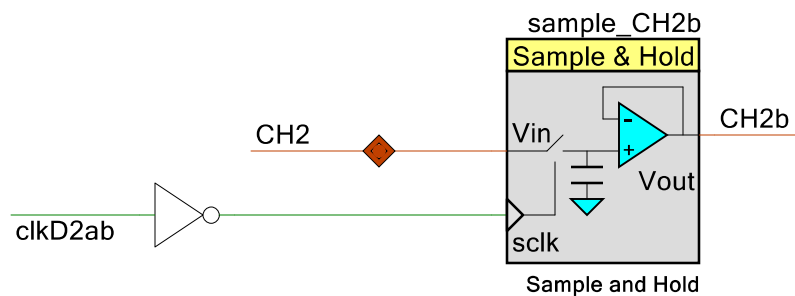
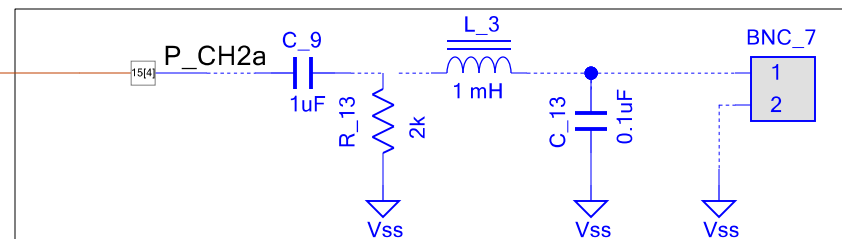
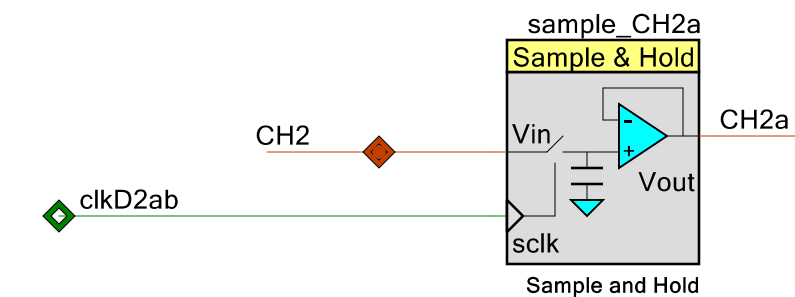
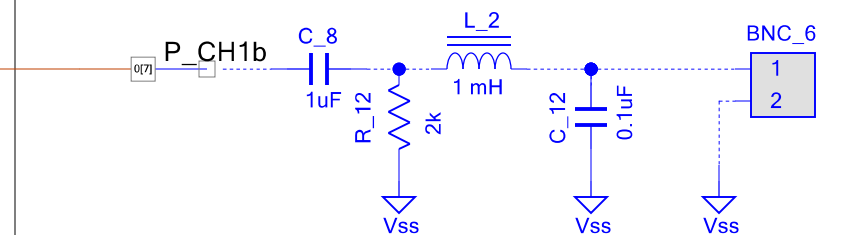
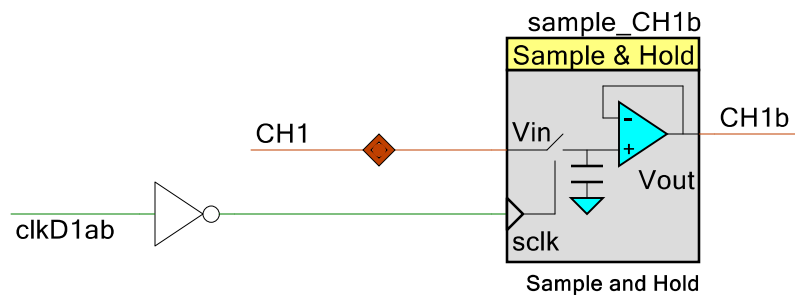
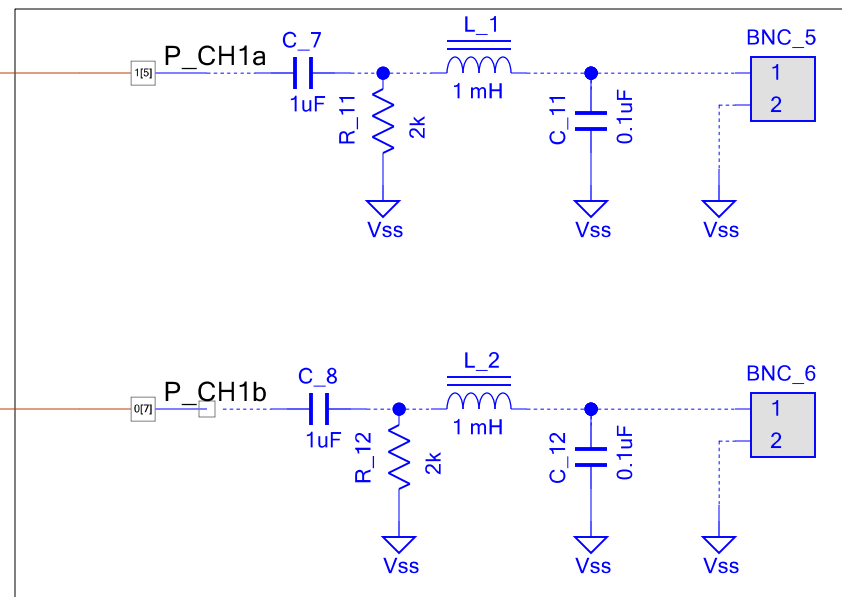
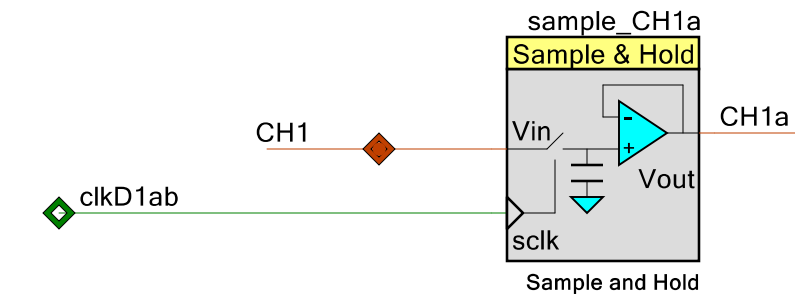
Shift DAC clock to avoid simultaneous DMA requests



*Shift DAC clock for channel splitting (alternate samples between channels:
CH1 -> CH1a = even samples / CH1b = odd samples)*

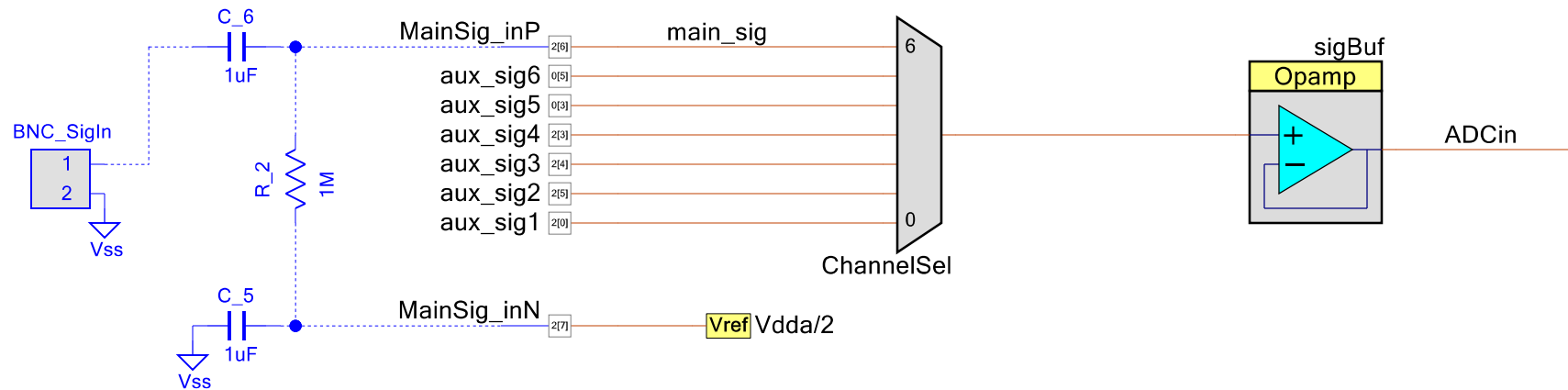






MPI signal receive channel
Input range: 0..5 V

*Channel switch (for debugging,
channel monitoring etc.)*



two ADCs for doubling the Sampling rate

