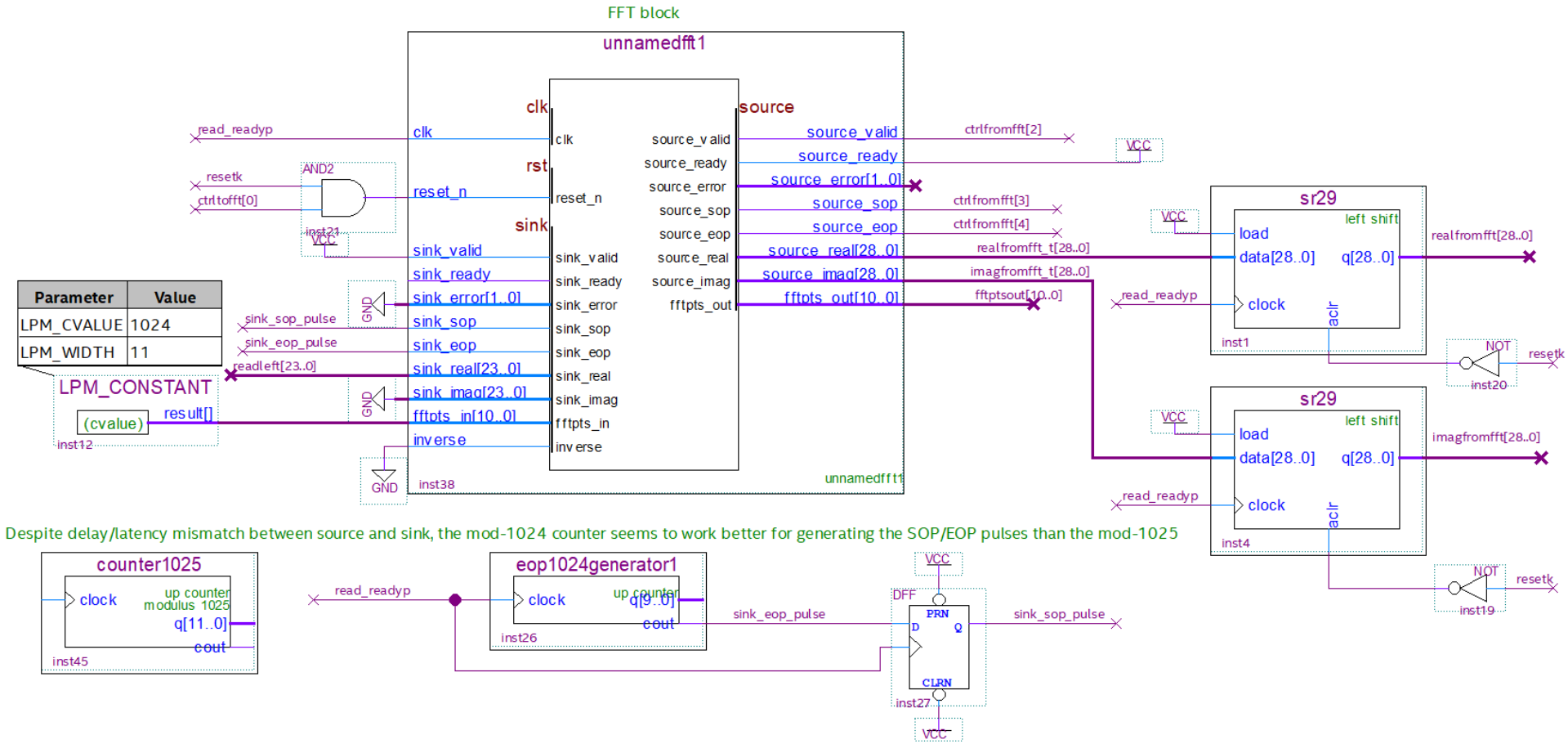
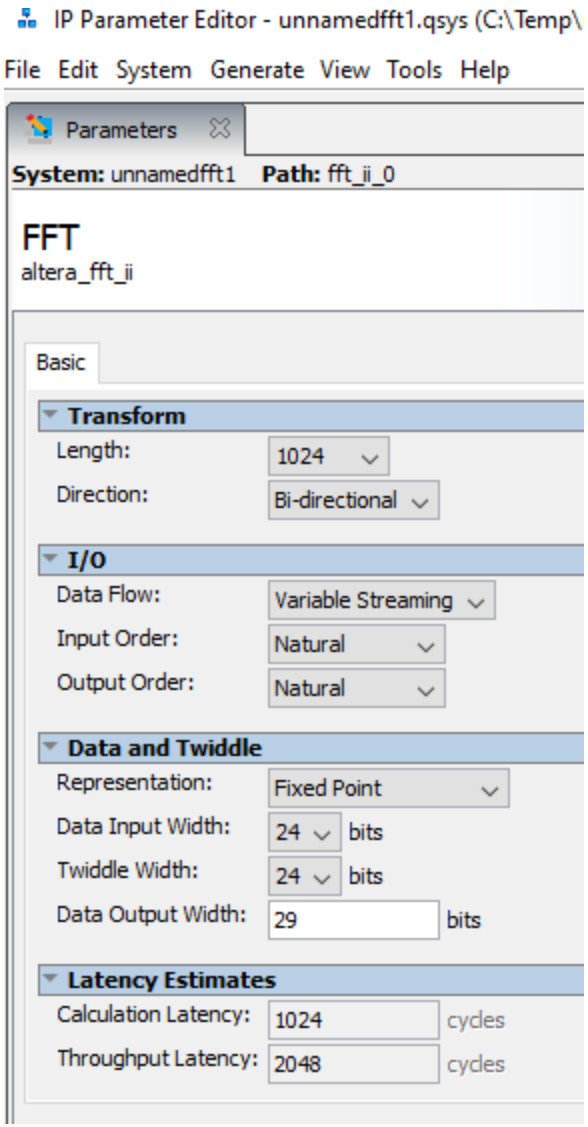
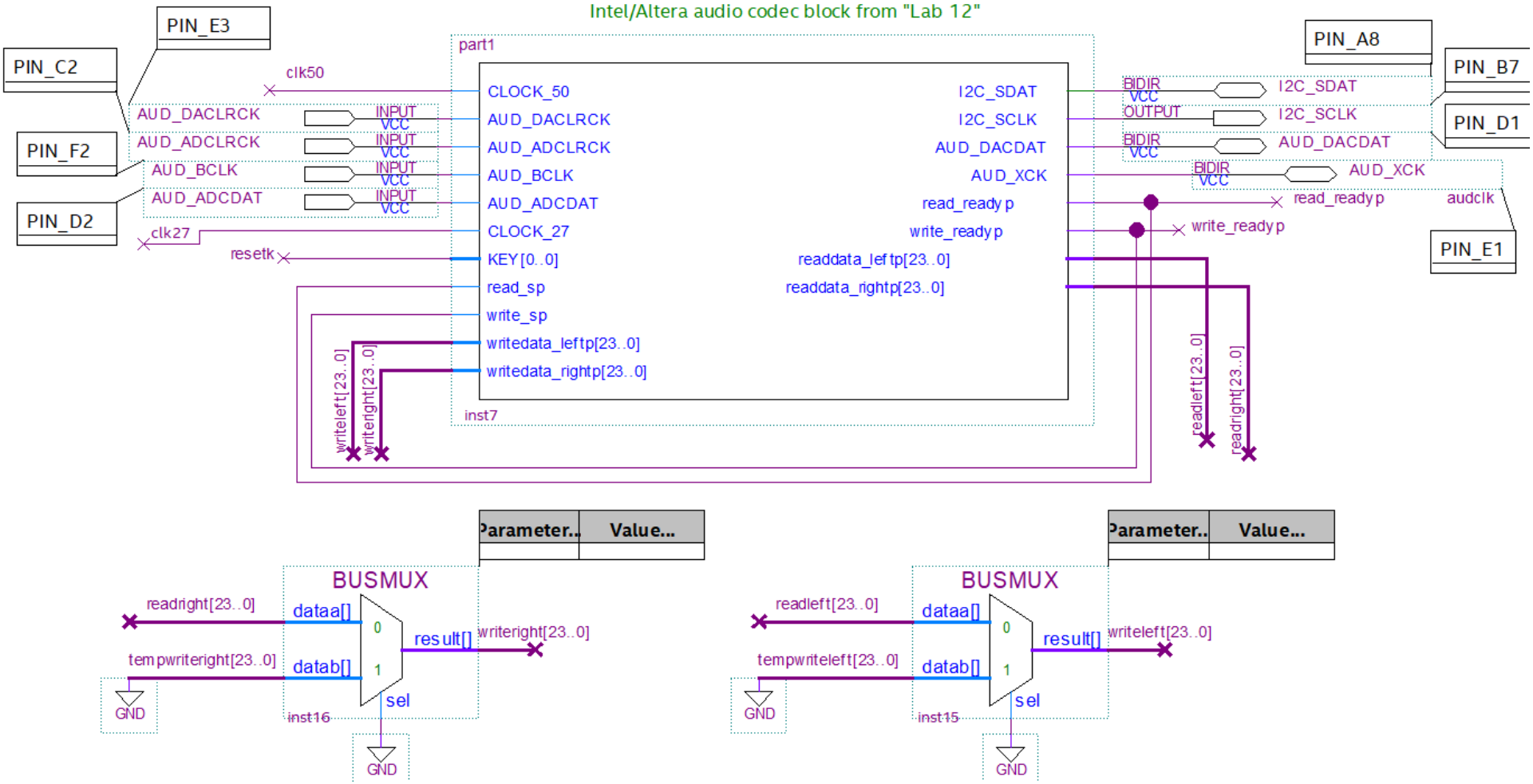
FFT spectrum-analyzer demo project with Nios, VGA, and audio input. Designed by Tim Gilmour 8/4/2022

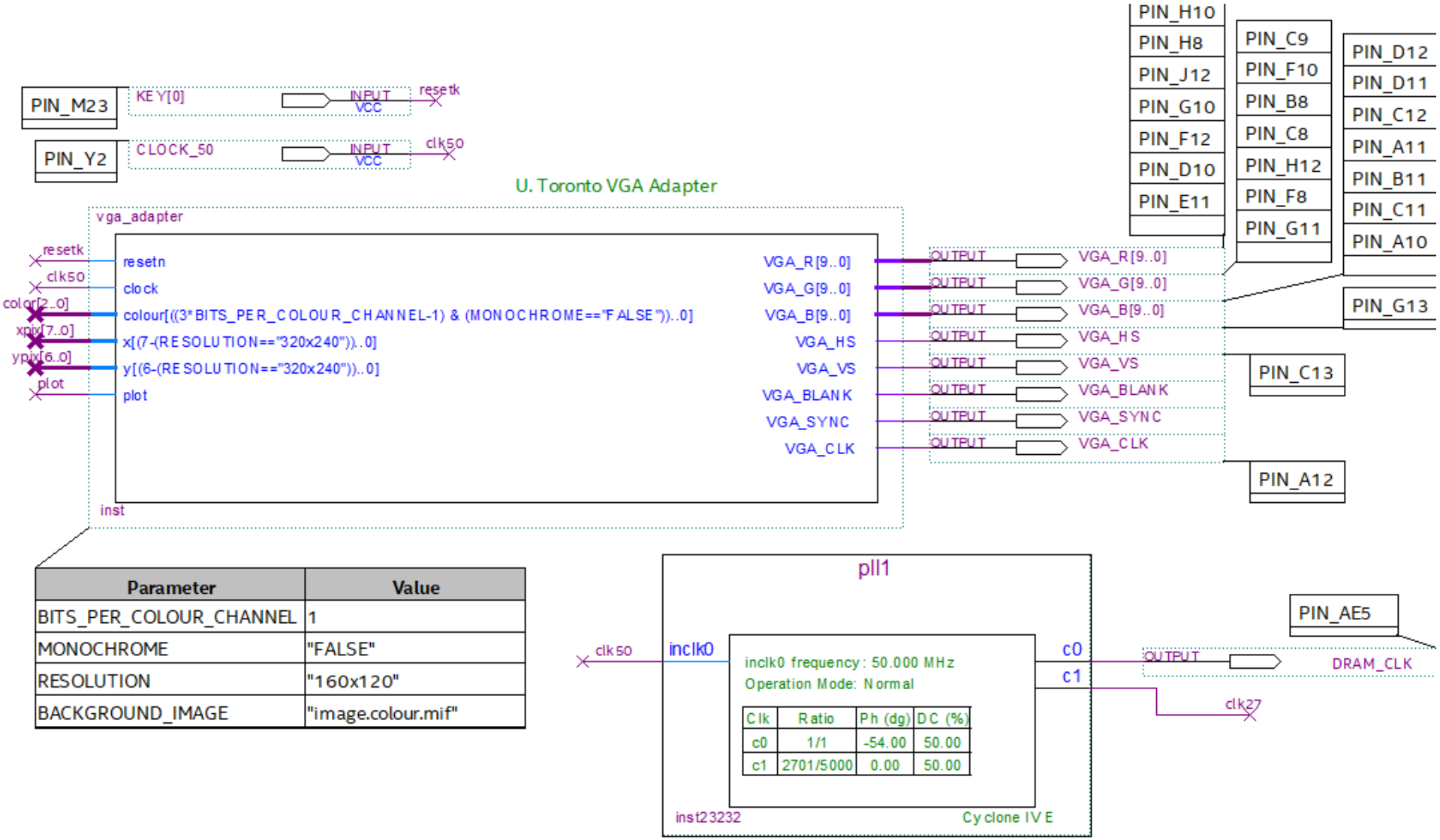



IP Parameter Editor - unnamedfft1.qsys (C:\Temp\
File Edit System Generate View Tools Help
Parameters
System: unnamedfft1 Path: fft_ii_0
FFT
altera_fft_ii
Basic
Transform
Length: 1024
Direction: Bi-directional
I/O
Data Flow: Variable Streaming
Input Order: Natural
Output Order: Natural
Data and Twiddle
Representation: Fixed Point
Data Input Width: 24 bits
Twiddle Width: 24 bits
Data Output Width: 29 bits
Latency Estimates
Calculation Latency: 1024 cycles
Throughput Latency: 2048 cycles


Intel/Altera audio codec block from "Lab 12"
PIN_E3
PIN_C2
PIN_F2
PIN_D2
PIN_A8
PIN_B7
PIN_D1
PIN_E1
part1
clk50
AUD_DACLRCK
AUD_ADCLRCK
AUD_BCLK
AUD_ADCDAT
clk27
resetk
INPUT
VCC
CLOCK_50
AUD_DACLRCK
AUD_ADCLRCK
AUD_BCLK
AUD_ADCDAT
CLOCK_27
KEY[0..0]
read_sp
write_sp
writedata_leftp[23..0]
writedata_rightp[23..0]
I2C_SDAT
I2C_SCLK
AUD_DACDAT
AUD_XCK
read_readyp
write_readyp
readdata_leftp[23..0]
readdata_rightp[23..0]
BIDIR
OUTPUT
audclk
writeleft[23..0]
writeright[23..0]
readleft[23..0]
readright[23..0]
inst7

Parameter...
Value...
BUSMUX
readright[23..0]
tempwriteright[23..0]
dataa[]
datab[]
result[]
writeright[23..0]
sel
GND
inst16

Parameter...
Value...
BUSMUX
readleft[23..0]
tempwriteleft[23..0]
dataa[]
datab[]
result[]
writeleft[23..0]
sel
GND
inst15



Parameter	Value
BITS_PER_COLOUR_CHANNEL	1
MONOCHROME	"FALSE"
RESOLUTION	"160x120"
BACKGROUND_IMAGE	"image.colour.mif"

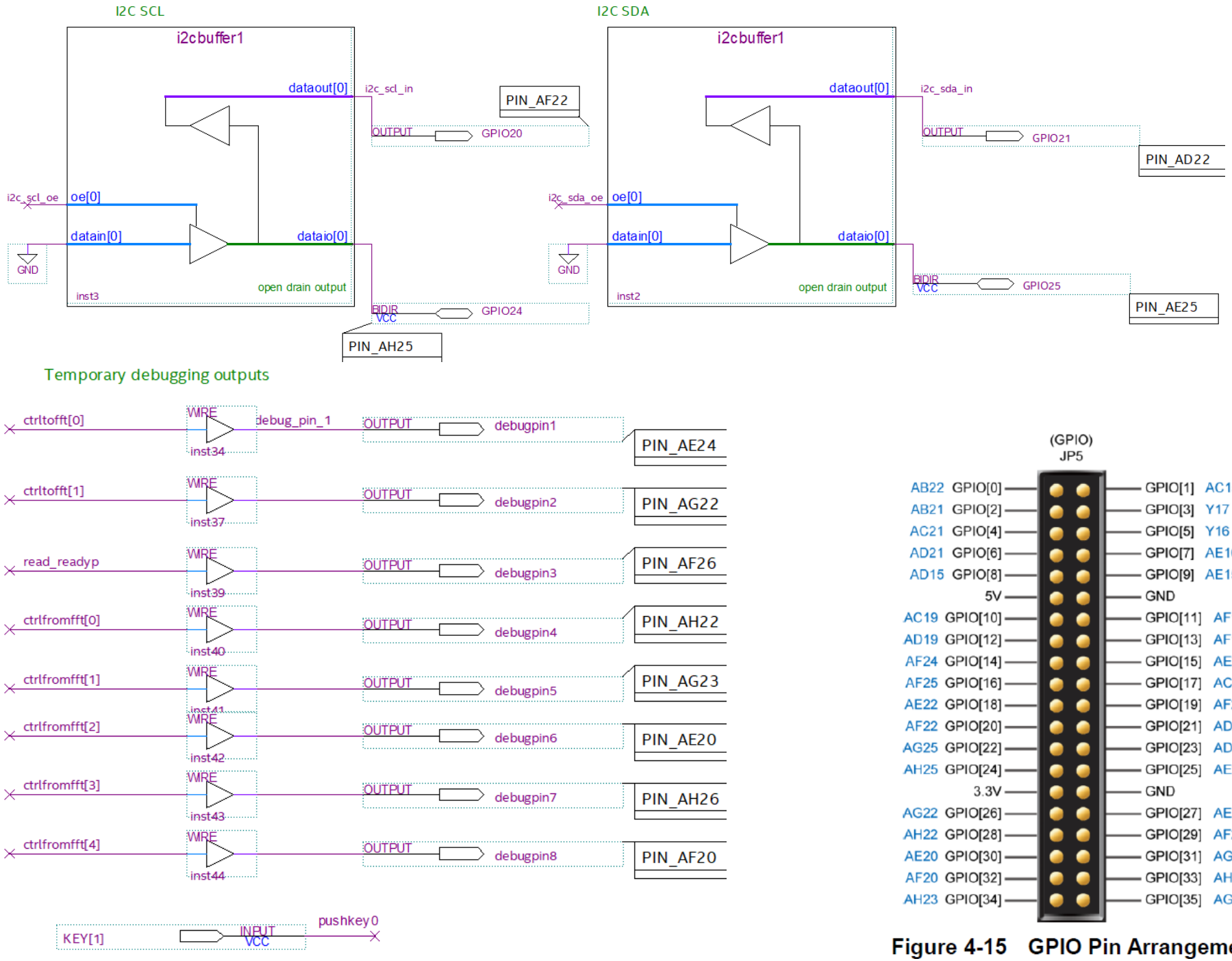
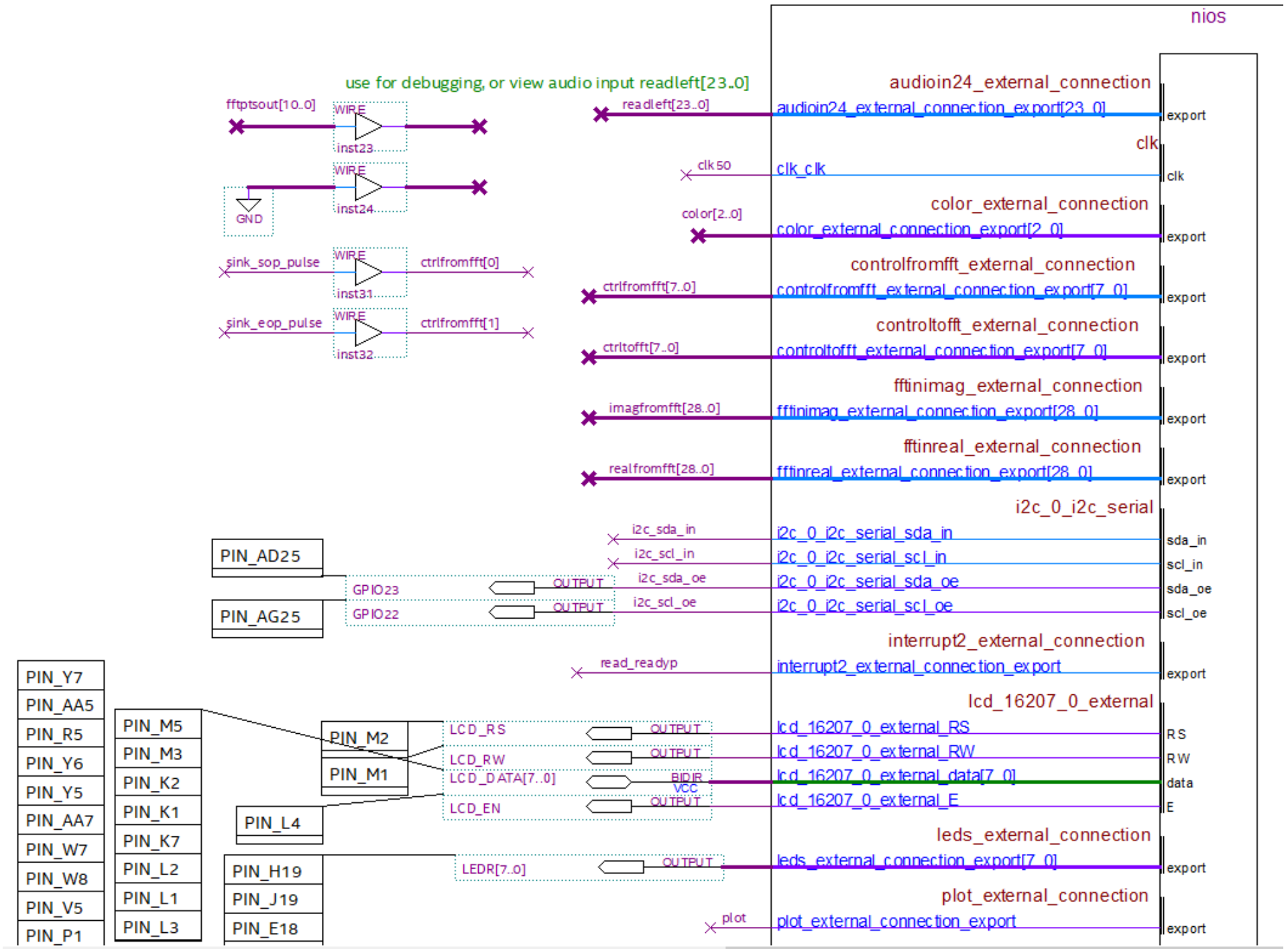
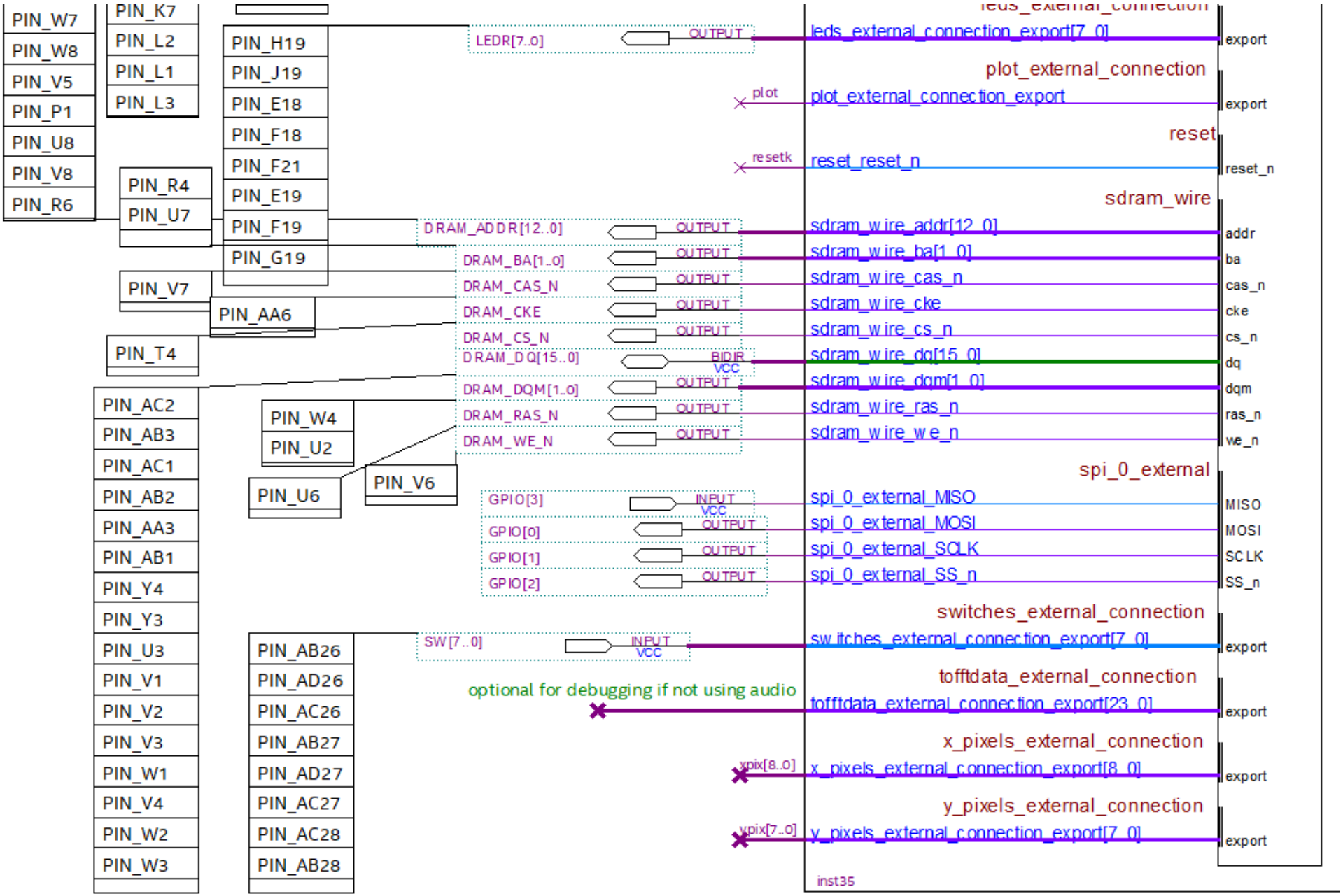


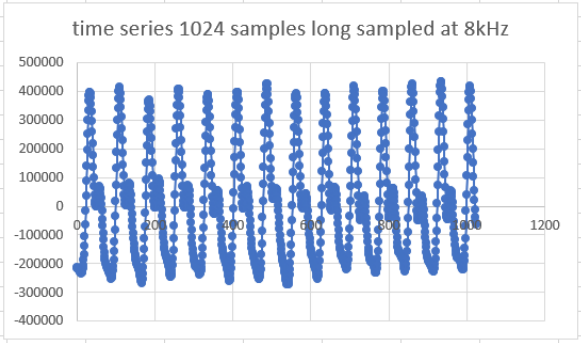
Figure 4-15 GPIO Pin Arrangement

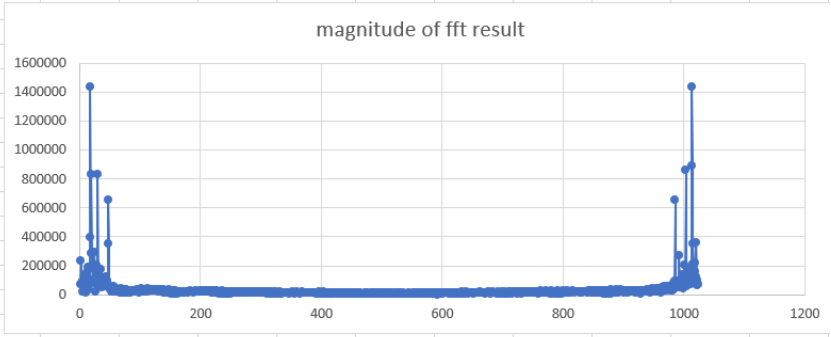

nios
use for debugging, or view audio input readleft[23..0]
fftptsout[10..0]
WIRE
inst23
WIRE
inst24
GND
sink_sop_pulse
WIRE
ctrlfromfft[0]
inst31
sink_eop_pulse
WIRE
ctrlfromfft[1]
inst32
readleft[23..0]
audioin24_external_connection
audioin24_external_connection_export[23..0]
export
clk
clk50
clk_clk
clk
color[2..0]
color_external_connection
color_external_connection_export[2..0]
export
ctrlfromfft[7..0]
controlfromfft_external_connection
controlfromfft_external_connection_export[7..0]
export
ctrltofft[7..0]
controltofft_external_connection
controltofft_external_connection_export[7..0]
export
imagfromfft[28..0]
fftinimag_external_connection
fftinimag_external_connection_export[28..0]
export
realfromfft[28..0]
fftinreal_external_connection
fftinreal_external_connection_export[28..0]
export
i2c_0_i2c_serial
i2c_sda_in
i2c_0_i2c_serial_sda_in
sda_in
i2c_scl_in
i2c_0_i2c_serial_scl_in
scl_in
i2c_sda_oe
i2c_0_i2c_serial_sda_oe
sda_oe
i2c_scl_oe
i2c_0_i2c_serial_scl_oe
scl_oe
PIN_AD25
PIN_AG25
GPIO23
GPIO22
OUTPUT
OUTPUT
interrupt2_external_connection
read_readyp
interrupt2_external_connection_export
export
lcd_16207_0_external
PIN_Y7
PIN_AA5
PIN_R5
PIN_Y6
PIN_Y5
PIN_AA7
PIN_W7
PIN_W8
PIN_V5
PIN_P1
PIN_M5
PIN_M3
PIN_K2
PIN_K1
PIN_K7
PIN_L2
PIN_L1
PIN_L3
PIN_M2
PIN_M1
PIN_L4
LCD_RS
LCD_RW
LCD_DATA[7..0]
LCD_EN
OUTPUT
OUTPUT
BIDIR
VCC
OUTPUT
lcd_16207_0_external_RS
lcd_16207_0_external_RW
lcd_16207_0_external_data[7..0]
lcd_16207_0_external_E
RS
RW
data
E
leds_external_connection
PIN_H19
PIN_J19
PIN_E18
LEDR[7..0]
OUTPUT
leds_external_connection_export[7..0]
export
plot_external_connection
plot
plot_external_connection_export
export


PIN_W7
PIN_W8
PIN_V5
PIN_P1
PIN_U8
PIN_V8
PIN_R6
PIN_K7
PIN_L2
PIN_L1
PIN_L3
PIN_H19
PIN_J19
PIN_E18
PIN_F18
PIN_F21
PIN_E19
PIN_F19
PIN_G19
PIN_R4
PIN_U7
PIN_V7
PIN_AA6
PIN_T4
PIN_AC2
PIN_AB3
PIN_AC1
PIN_AB2
PIN_AA3
PIN_AB1
PIN_Y4
PIN_Y3
PIN_U3
PIN_V1
PIN_V2
PIN_V3
PIN_W1
PIN_V4
PIN_W2
PIN_W3
PIN_W4
PIN_U2
PIN_U6
PIN_V6
PIN_AB26
PIN_AD26
PIN_AC26
PIN_AB27
PIN_AD27
PIN_AC27
PIN_AC28
PIN_AB28
LEDR[7..0]
OUTPUT
DRAM_ADDR[12..0]
DRAM_BA[1..0]
DRAM_CAS_N
DRAM_CKE
DRAM_CS_N
DRAM_DQ[15..0]
BIDIR
VCC
DRAM_DQM[1..0]
DRAM_RAS_N
DRAM_WE_N
GPIO[3]
INPUT
GPIO[0]
GPIO[1]
GPIO[2]
SW[7..0]
optional for debugging if not using audio
plot
resetk
xpix[8..0]
ypix[7..0]
leds_external_connection_export[7..0]
plot_external_connection
plot_external_connection_export
reset
reset_reset_n
sdram_wire
sdram_wire_addr[12..0]
sdram_wire_ba[1..0]
sdram_wire_cas_n
sdram_wire_cke
sdram_wire_cs_n
sdram_wire_dq[15..0]
sdram_wire_dqm[1..0]
sdram_wire_ras_n
sdram_wire_we_n
spi_0_external
spi_0_external_MISO
spi_0_external_MOSI
spi_0_external_SCLK
spi_0_external_SS_n
switches_external_connection
switches_external_connection_export[7..0]
tofftdata_external_connection
tofftdata_external_connection_export[23..0]
x_pixels_external_connection
x_pixels_external_connection_export[8..0]
y_pixels_external_connection
y_pixels_external_connection_export[7..0]
export
addr
ba
cas_n
cke
cs_n
dq
dqm
ras_n
we_n
MISO
MOSI
SCLK
SS_n
inst35

Plotting one of the debug printouts in Excel… also the FFT closely matched the Matlab FFT (not shown). The captured 1024 time samples do not align with the captured FFT output samples, thus some difference is to be expected.

	A	B	C	D	E
1	v(t)	real	imag		magnitude
2	-214069	-64262	22960		68240.5
3	-216691	-232385	-31794		234550
4	-217311	-7662	-70767		71180.6
5	-216899	-7662	-70767		71180.6
6	-221118	-91526	24872		94845.3
7	-220475	-19231	-10702		22008.3
8	-225165	28130	-21087		35156.2
9	-228344	-6299	44074		44521.8
10	-229023	-59223	107916		123098
11	-231350	17192	42056		45434.3
12	-234451	6463	5354		8392.6
13	-233674	14912	-24087		28329.3
14	-232338	-24834	152221		154233
15	-230981	-6197	191079		191179
16	-223922	12563	103032		103795
17	-218351	-16437	27933		32410.3





Example spectrogram shown on the VGA screen (at 160x120 pixel resolution) (frequency on vertical axis, time on horizontal axis, power shown in color)