Options
Title: ALS162_Receiver
Author: henningM1r
Output Language: Python
Generate Options: QT GUI

Complexity: 35.355mbal

Import
Import: math

Import
Import: zmq

Windows needs the import of zmq

Variable
ID: samp_rate
Value: 192k

Variable
ID: decimation
Value: 12

Variable
ID: freq_ALS162
Value: 162k

Variable
ID: bits
Value: 1k

QT GUI Range
ID: gain
Label: Receiver Gain
Default Value: 750
Start: 1
Stop: 1k
Step: 1

Amplify receving signal power

QT GUI Range
ID: diff_gain
Label: diff_gain
Default Value: 545
Start: 1
Stop: 800
Step: 1

QT GUI Range
ID: zoom
Label: zoom
Default Value: 4.2k
Start: 0
Stop: 25k
Step: 10

QT GUI Range
ID: zero_one
Label: Zero One Threshold
Default Value: 1k
Start: 0
Stop: 10k
Step: 1

QT GUI Range
ID: one_two
Label: One Two Threshold
Default Value: 3.5k
Start: 0
Stop: 10k
Step: 1

QT GUI Range
ID: threshold_spike
Label: Spike Threshold
Default Value: 15k
Start: 0
Stop: 25k
Step: 100

osmocom Source
Device Arguments: airspyhf=0
Sync: Don't Sync
Number Channels: 1
Sample Rate (sps): 192k
Ch0: Frequency (Hz): 162k
Ch0: Frequency Correction (ppm): 0
Ch0: DC Offset Mode: 2
Ch0: IQ Balance Mode: 0
Ch0: Gain Mode: False
Ch0: RF Gain (dB): 30
Ch0: IF Gain (dB): 30
Ch0: BB Gain (dB): 0
Ch0: Bandwidth (Hz): 4k

QT GUI Frequency Sink
Name: original spectrum
FFT Size: 1024
Center Frequency (Hz): 162k
Bandwidth (Hz): 12k

Frequency Xlating FIR Filter
Decimation: 1
Taps: variable_low_pass_fi...
Center Frequency: 0
Sample Rate: 192k

Low-pass Filter Taps
ID: variable_...s_filter_taps
Gain: 750
Sample Rate (Hz): 192k
Cutoff Freq (Hz): 1k
Transition Width (Hz): 250
Window: Blackman
Beta: 6.76

Complex to Mag^2

QT GUI Time Sink
Name: received Signal Power
Number of Points: 192k
Sample Rate: 192k
Autoscale: No

QT GUI Time Sink
Name: received complex signal
Number of Points: 192k
Sample Rate: 192k
Autoscale: No

Null Source

Throttle
Sample Rate: 1

Null Sink

Add Const
Constant: 0

QT GUI Range
ID: pll_bw
Default Value: 25m
Start: 5m
Stop: 1
Step: 100u

Variable
ID: pll_limit
Value: 1

PLL Carrier Tracking
Loop Bandwidth: 2*m...mp_rate
Min Phase/sample: -2...p_rate
Max Phase/sample: 2*...p_rate

Rational Resampler
Interpolation: 1
Decimation: 12
Taps:
Fractional BW: 0

AGC2
Attack Rate: 100m
Decay Rate: 10m
Reference: 1
Gain: 1
Max Gain: 750

Phase Shift
Phase Shift: 0
Units: Radians

apply phase drift correction by shifting the phase to the opposite direction of the current long time average phase towards zero

Variable to Message
Variable: 0
Message Variable Name: ampl

get phase drift correction value from probe function (to deactivate if PLL Carrier tracking is activated)

Virtual Sink
Stream ID: 0

TCP Source
Address: 127.0.0.1
Port: 55.554k
Mode: Client

This block takes the ALS162 signal from a simulated channel at 162 kHz.

Frequency Xlating FIR Filter
Decimation: 1
Taps: variable_low_pass_fi...
Center Frequency: 162k
Sample Rate: 192k

Demodulation from 162 kHz down to the base band.

Multiply Const
Constant: 1.33333m

QT GUI Frequency Sink
Name: original spectrum
FFT Size: 1024
Center Frequency (Hz): 162k
Bandwidth (Hz): 12k

Virtual Source
Stream ID: 0

Complex to Arg

to obtain the phase of the complex signal

Moving Average
Length: 20
Scale: 50m
Max Iter: 150
Length of Vectors: 1

smoothening by removing glitches from a noisy phase (Averaging seems sufficent. A median filter will probably provide better noise resilience, but seems more performance-critical)

Virtual Sink
Stream ID: 7

to compute phase compensation

Interpolating FIR Filter
Interpolation: 1
Taps: 25*[1]+40*[0]+25*[-1]

Moving Average
Length: 20
Scale: 50m
Max Iter: 150
Length of Vectors: 1

to remove glitches from a noisy derivation of the phase

Virtual Sink
Stream ID: 1

to thresholders of the differentiated signal

Add Const
Constant: 0

no function intended!

Multiply Const
Constant: 1k

just to be visible in the (non-normalized) plot

Add Const
Constant: 0

no function intended!

Add Const
Constant: 0

no function intended!

Virtual Sink
Stream ID: 10

to the (hidden) plot for threshold levels

Threshold
Low: 15k
High: 15k
Initial State: 0

extreme spike upwards

Threshold
Low: 3.5k
High: 3.5k
Initial State: 0

above this value is a +2, below a +1

Threshold
Low: 1k
High: 1k
Initial State: 0

below this value is a 0, above a +1

Threshold
Low: 1k
High: 1k
Initial State: 0

below this value is a 0, above a -1

Threshold
Low: 3.5k
High: 3.5k
Initial State: 0

above this value is a -2, above a -1

Threshold
Low: 15k
High: 15k
Initial State: 0

extreme spike downwards

Float To Char
Scale: 1

Not

And

get +2 value

get +1 value

get 0 value

get -1 value

get -2 value

Char To Float
Scale: 1

Add Const
Constant: 2

Multiply Const
Constant: 1.3k

Virtual Sink
Stream ID: 5

to ALS162 bit detector

Multiply Const
Constant: 1.2k

Virtual Sink
Stream ID: 2

to ALS162 bit detector

Multiply Const
Constant: 1k

Virtual Sink
Stream ID: 4

to ALS162 bit detector

Multiply Const
Constant: -1.2k

Virtual Sink
Stream ID: 3

to ALS162 bit detector

Multiply Const
Constant: -1.3k

Virtual Sink
Stream ID: 6

to ALS162 bit detector

Multiply Const
Constant: 1k

Virtual Source
Stream ID: 8

average phase from the phase compensation block

QT GUI Time Sink
Name: Phase Signal Decoder
Number of Points: 16k
Sample Rate: 192k
Autoscale: No

Constant Source
Constant: two_hi

Constant Source
Constant: two_lo

Constant Source
Constant: one_upper_hi

Constant Source
Constant: one_upper_lo

Constant Source
Constant: one_lower_hi

Constant Source
Constant: one_lower_lo

Constant Source
Constant: zero_hi

Constant Source
Constant: zero_lo

Constant Source
Constant: 15k

Multiply Const
Constant: 1

Virtual Source
Stream ID: 10

Note
Note:

QT GUI Time Sink
Name: Phase Signal Decoder
Number of Points: 16k
Sample Rate: 192k
Autoscale: No

Virtual Source
Stream ID: 2

+1 values

Virtual Source
Stream ID: 3

-1 values

Virtual Source
Stream ID: 4

0 values

Virtual Source
Stream ID: 5

+2 values

Virtual Source
Stream ID: 6

-2 values

ALS162 Symbol detector
Sample_Rate: 16k
Tolerance: 3m

detects chip symbols with the values: +/-2, +/-1 and 0 and provides one message per detected chip

ALS162 Code Sequence Correlator

detects codewords from the chip symbols:
* the time symbol
* the position symbols

ZMQ PUSH Message Sink
Address: tcp://1....0.1:55555
Timeout (msec): 900

provide signal to a ZMQ server to futher decode the bits to human-readible date & time information

Message Debug
PDU Vectors: Off

Message Debug
PDU Vectors: Off

Note
Note:

Phase drift compensation block

QT GUI Range
ID: shift_step
Label: shift_step
Default Value: 1m
Start: 0
Stop: 3.5m
Step: 10u

QT GUI Range
ID: shift_poll_freq
Label: shift_poll_freq
Default Value: 24k
Start: 0
Stop: 192k
Step: 100

Function Probe
ID: fun_prob
Block ID: probe_signal
Function Name: level
Poll Rate (Hz): 24k

Python Module
ID: phase_shift_fct

phase rotates from pi to -pi for given poll frequency and given weight to countereffect the phase drift

Variable
ID: phase_shift
Value: 0

Virtual Source
Stream ID: 7

from phase

Moving Average
Length: 15k
Scale: 66.6667u
Max Iter: 25k
Length of Vectors: 1

compute average phase:
* if it is too short, it overcompensates and disturbs the desired the shorttime phases
* if it is too long, it converges too slowly due to the delay

QT GUI Time Sink
Name: Phase Dr...Compensation
Number of Points: 72k
Sample Rate: 192k
Autoscale: No

Fast Multiply Const
Constant: 1m

weighting parameter for corrective feedback

Probe Signal
ID: probe_signal

weighted poll signal for phase shift correction

Virtual Sink
Stream ID: 8

to plot