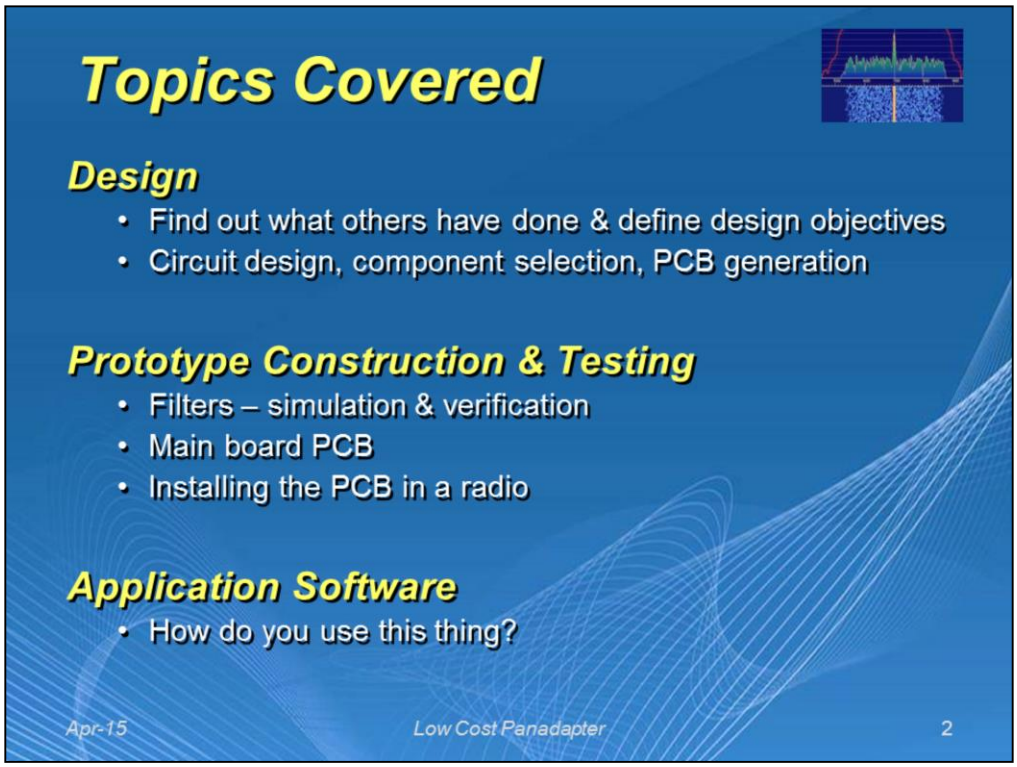
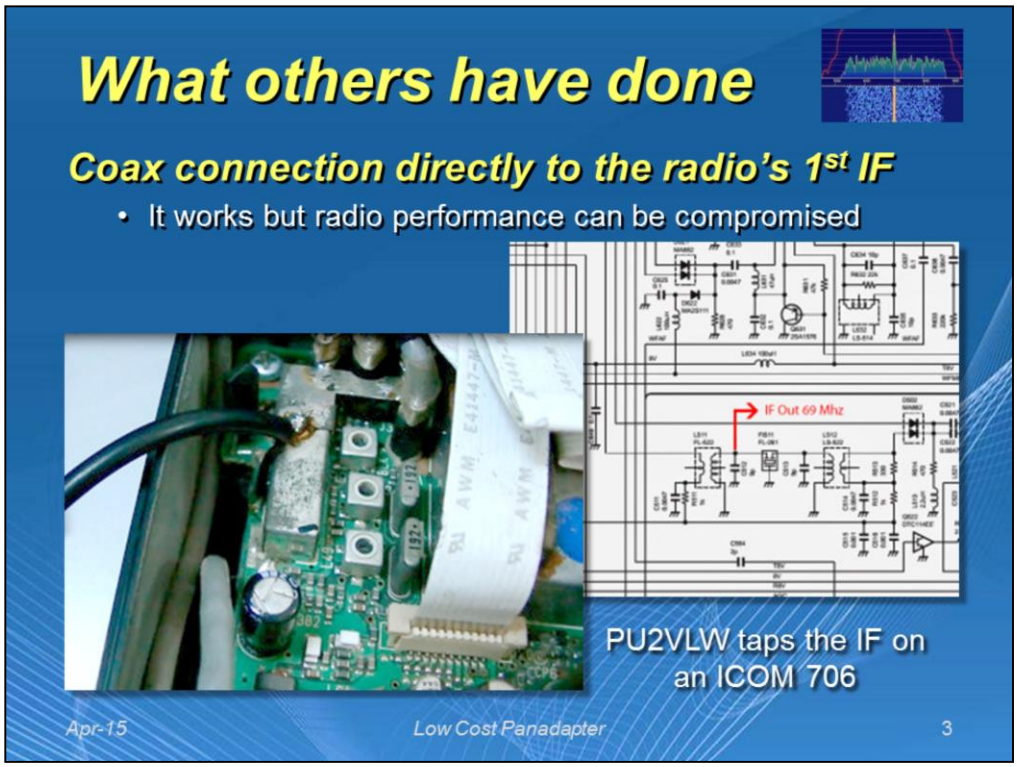

A Low Cost Panadapter
Interface to a SDR dongle
for radios with a
50 to 70 MHz 1st IF
NooElec
R820T SDR & DVB-T



•I always start out by looking around to see what others have done and how well it fits my needs. It helps me understand how to approach the problem and avoid pitfalls if I choose to do my own design

•During design and prototyping a number of unknowns especially around filtering needed to be addressed.

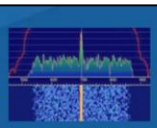
•Application software is critically important and there doesn't seem to be much around about how to use an IF panadapter. Additionally the SDR applications are typically undocumented save for an occasional bit about installation



Direct connections work in some cases but the load imposed on the IF by a direct connection often compromises radio performance.

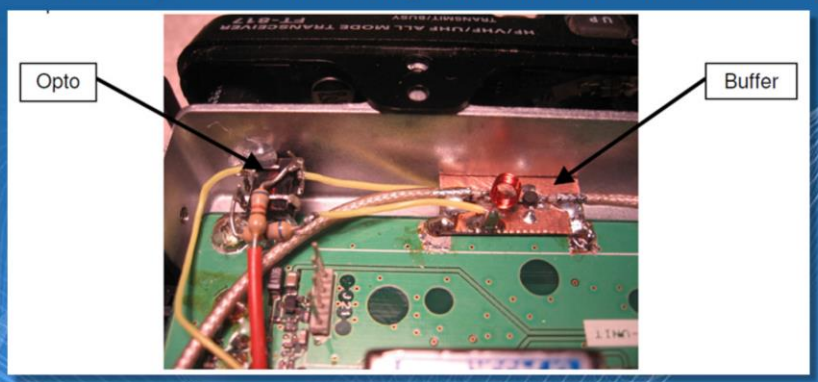
Intermediate frequency (IF) tap points tend to be at the input of a relatively high impedance filters input so the loading at this point from a dongle's input impedance can reduce sensitivity.

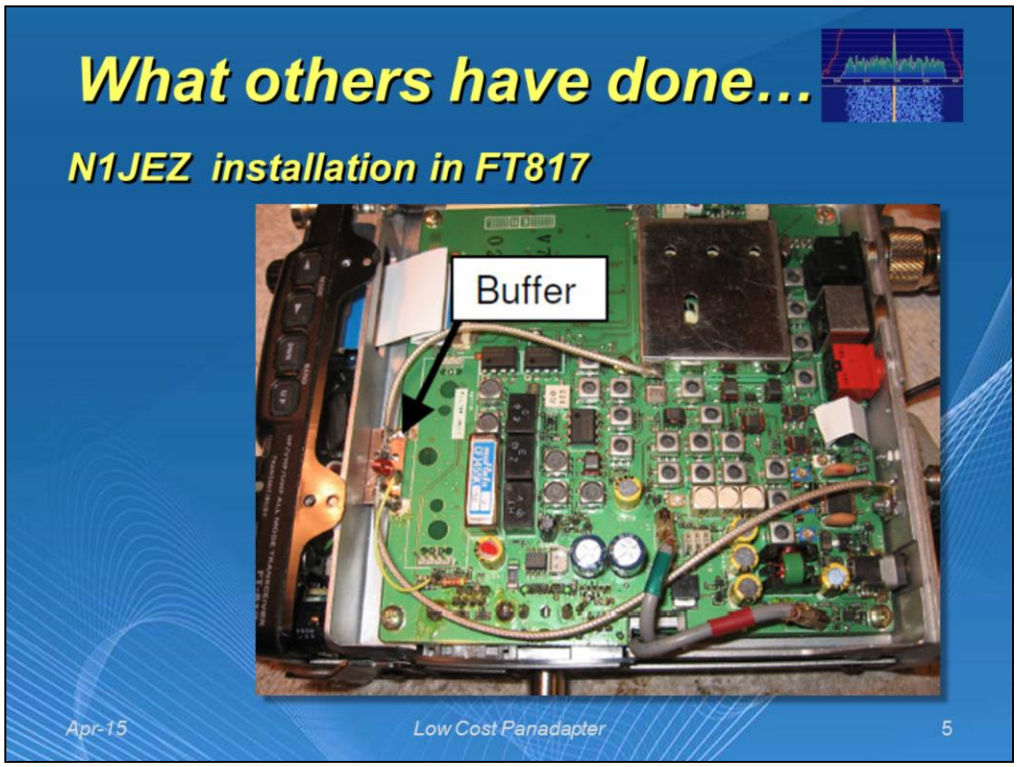
What others have done…



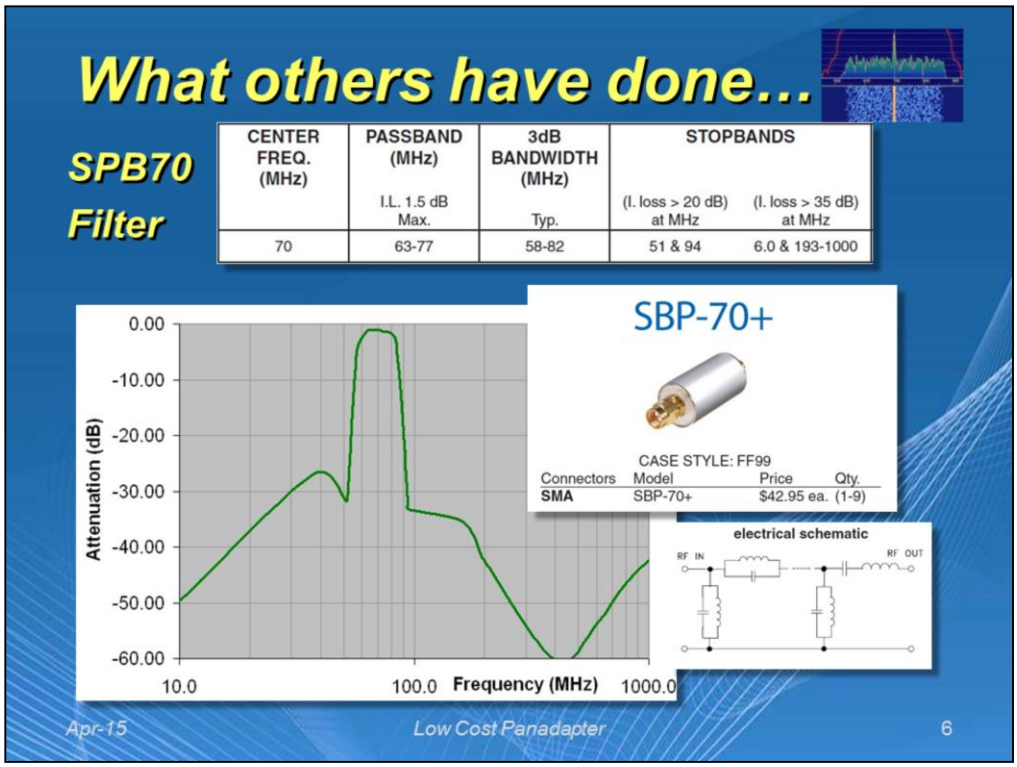
Mike Seguin N1JEZ & Don W1KEF

- Cap coupled MAR6 MMIC buffer amplifier at the 1st IF
- Opto isolator switch frm PTT line turns amplifier off during Tx
- Interface to FUNcube dongle via Mini-Circuits SBP70+ filter





It appears the picture was take before the optical isolator switch was added



Mini-Circuits SPB70+ filter was needed in front of the FunCube dongle to keep high level carriers present in the IF from reducing the dongle gain. More on this later

Note at 40+ dollars this filter is not cheap.

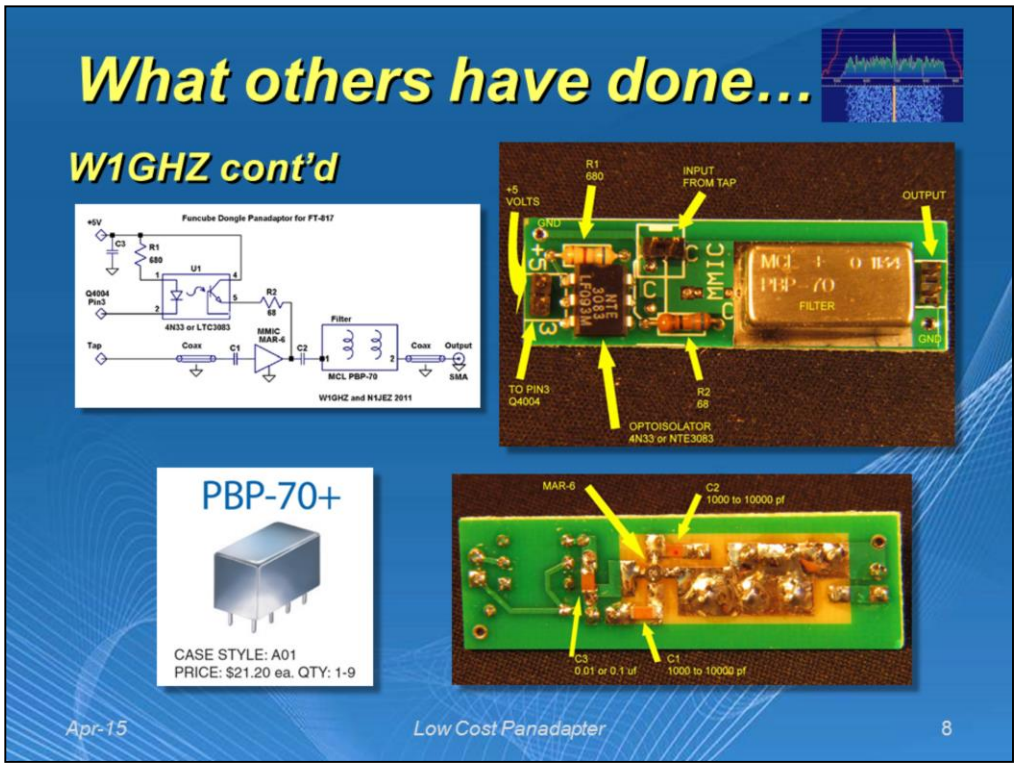
This is a very good elliptical filter design as it has just 1.1dB passband loss, steep skirts, and is quite compact.

Note how the attenuation decreases at frequencies above 500MHz.

Paul indicates this implementation is simply Mike's circuit put on a PCB.

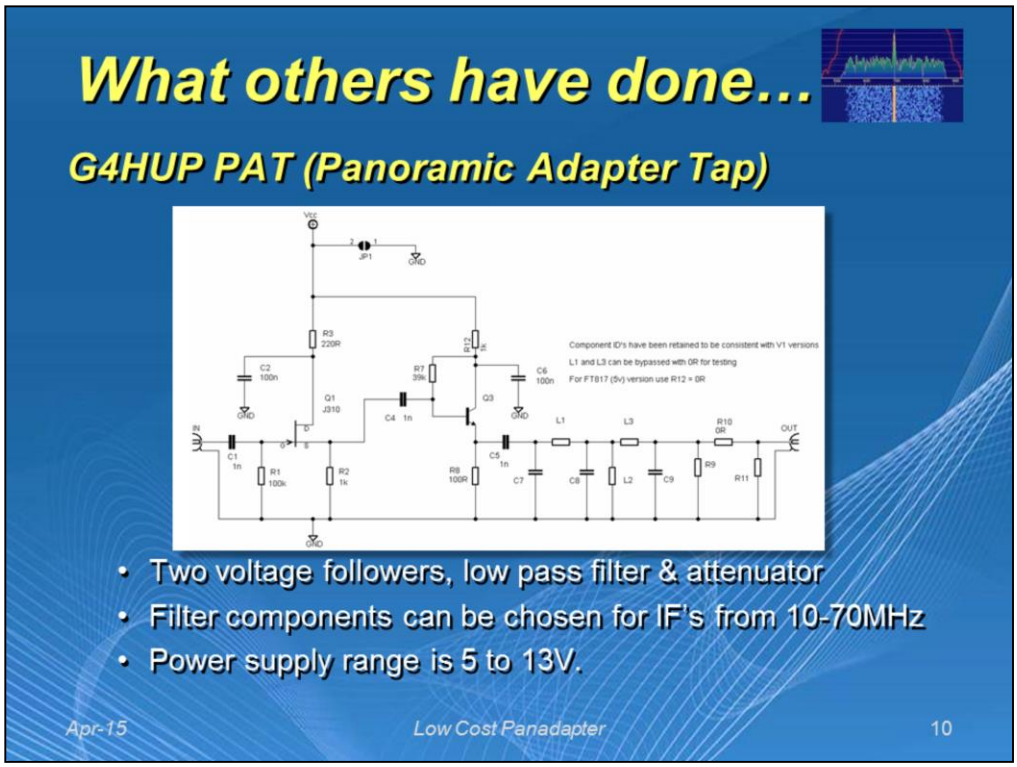
The PCB is mounted against front bulkhead with double sided tape.

Note that this solution uses space occupied by CW filter option



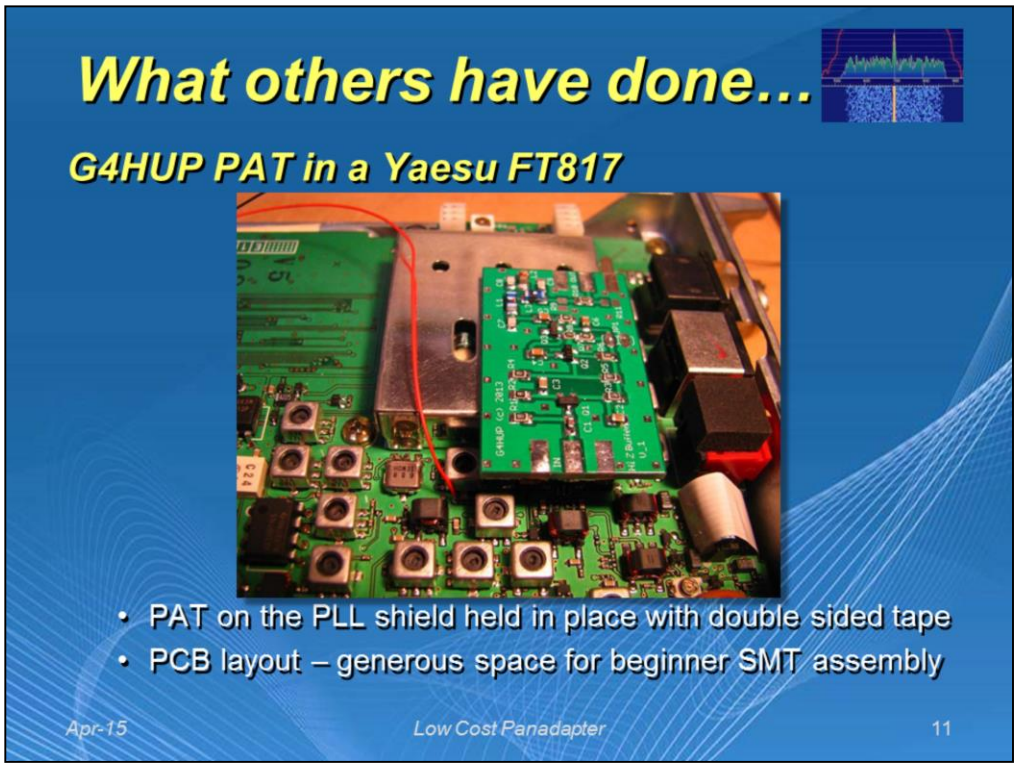
This double sided PCB solution has an optical switch and filter on one side and MMIC amplifier on the other

I'm not sure just how it was secured for mounting, but looks like it was glued in place to the front of the chassis.

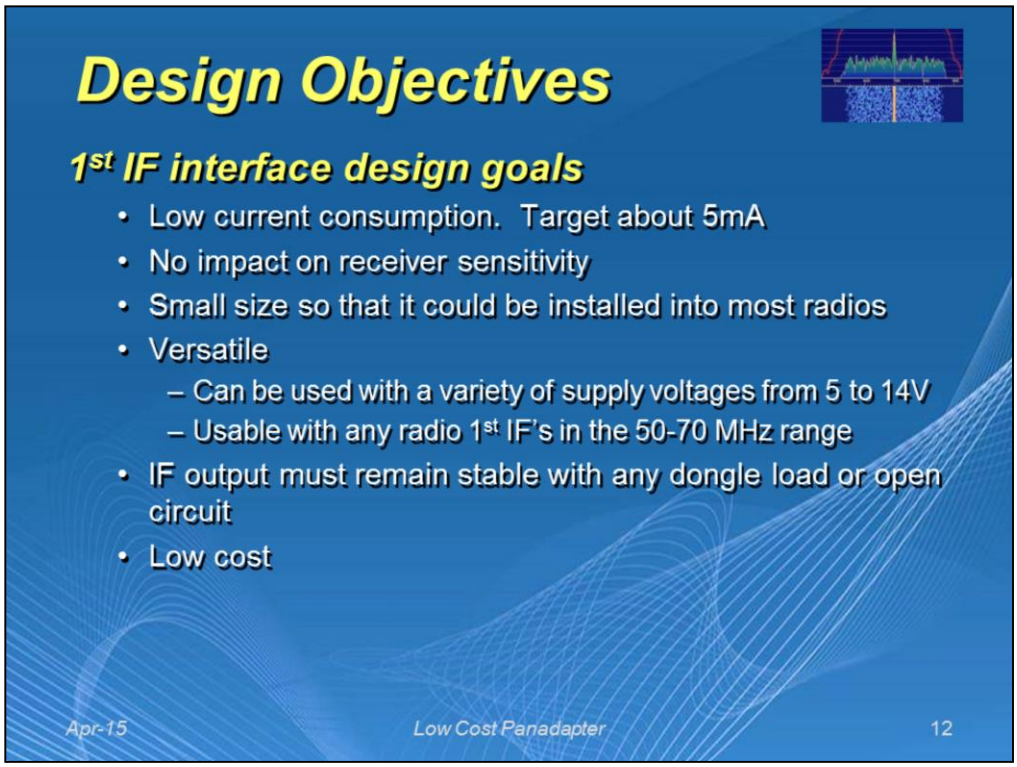


G4HUP's design features a buffer with two active stages, a JFET source follower for high input impedance and a bipolar transistor emitter follower capable of driving the filter. The buffers are followed by a 50 ohm low pass filter to attenuate signals above the IF.

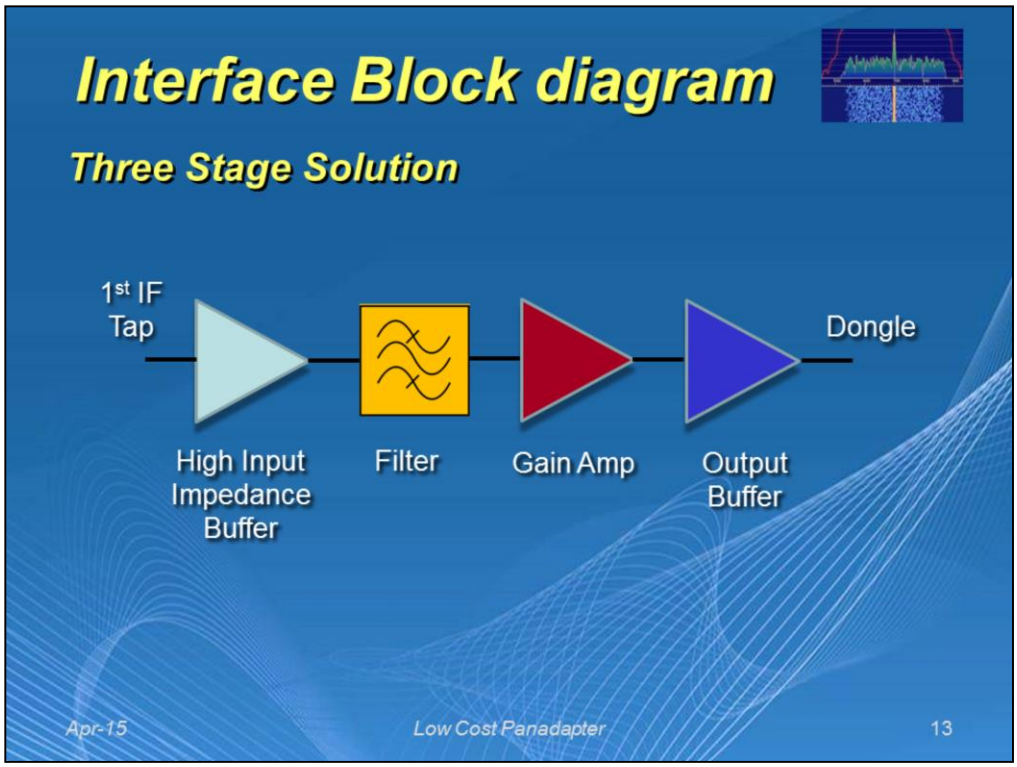
The filter circuit components can be configured for IF' s from 10 to 70 MHz. Power supply range is 5 to 13V.



The PCB is designed so that it can easily put together by individuals with little or no SMD soldering experience. At about 25x40mm the PCB is a bit of a challenge to tuck into smaller rigs.

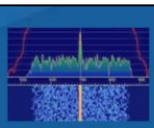


Low current consumption was a very important design parameter. I didn't want the solution to impact the battery operating time of portable rigs.

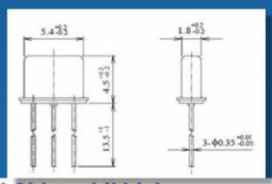


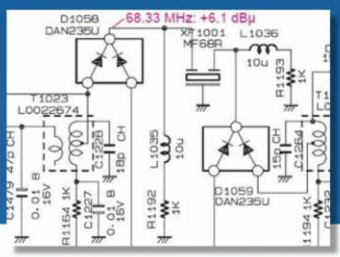
In the following slides let's take a look at the design considerations for each section of the interface.

High Z Input Buffer



Why?... The IF tap point is typically just ahead of a crystal filter that has a high Zin





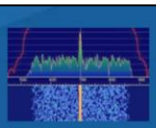
■標準仕様 ¦ Standard Shi yoshikidai

名称	Name	MF40M2(2pole)	MF45U9(2pole)	MF68Q(2pole)
公称周波数	Nominal Frequency		45.000 (MHz)	68.330 (MHz)
通過帯域幅	Bands domain via the web		3.0 (dB): ±15.0kHz min.	3.0 (dB): ±6.00kHz min.
減衰帯域幅	Bands domain via amplidude damping		15.0 (dB): ±60.0kHz max.	15.0 (dB): ±25.0kHz max.
リプル	Ripple	1.0 max. (dB)	1.0 max. (dB)	0.5 max. (dB)
挿入損失	Insertion Loss	2.5 max. (dB)	3.0 max. (dB)	2.5 max. (dB)
保証減衰量	Ensure that the amount of damping		65min. (dB) @ f_0 -910kHz	65min. (dB) @ f_0 -910kHz
入出力インピーダンス	Input & Output Impedance		1.2k(Ω)// 0.0(pF)	480(Ω)// 4.0(pF)

It's not easy to determine the driving point impedance to the crystal filter, so best to assume it's designed to be a match.

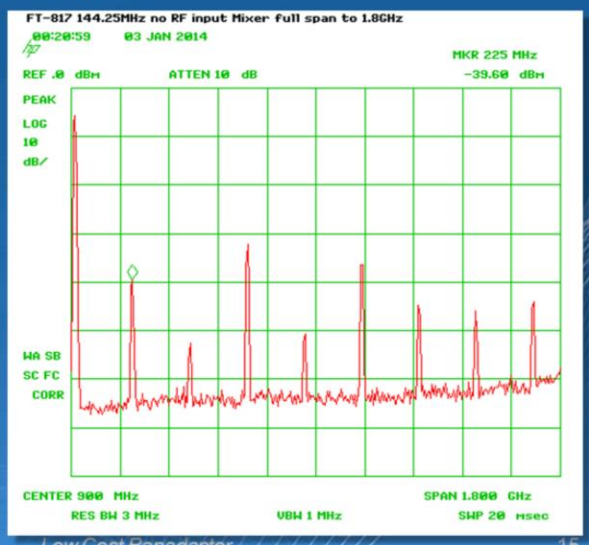
And yes those English spec translations are directly from Google translate. It give one an appreciation for the difficulty translators had with early equipment manuals from Japan.

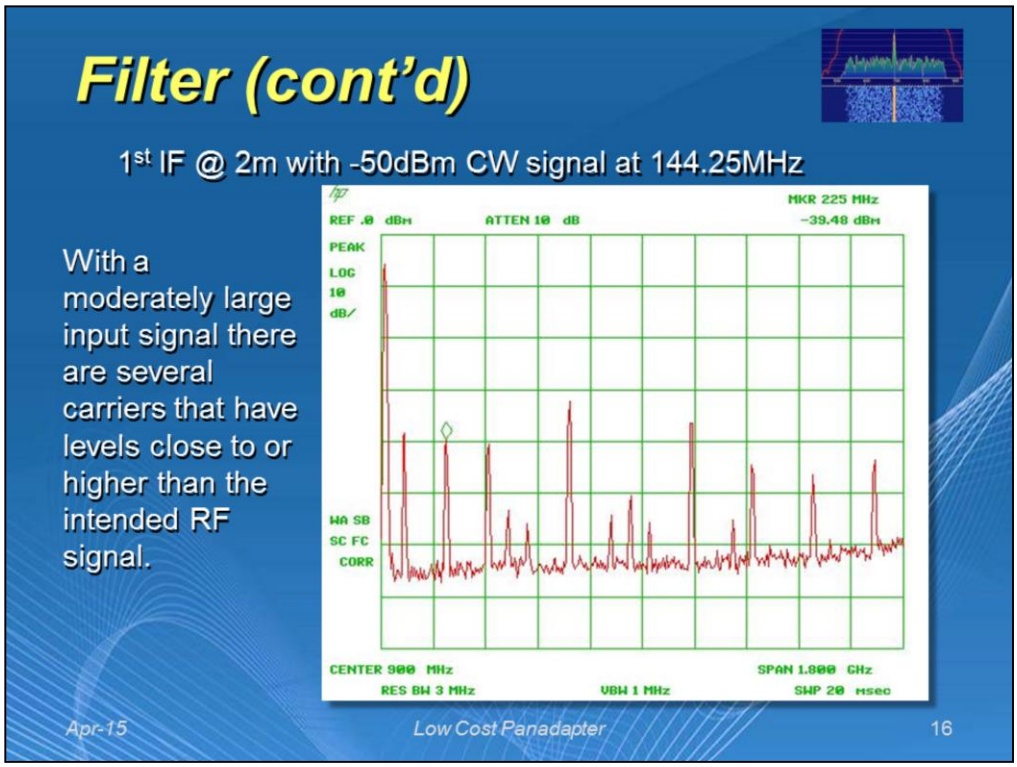
Filter



Why?...The 1st IF is not quiet !

This spectrum analyzer snapshot shows the FT817 IF when set to the 2 meter band with NO RF signal present.

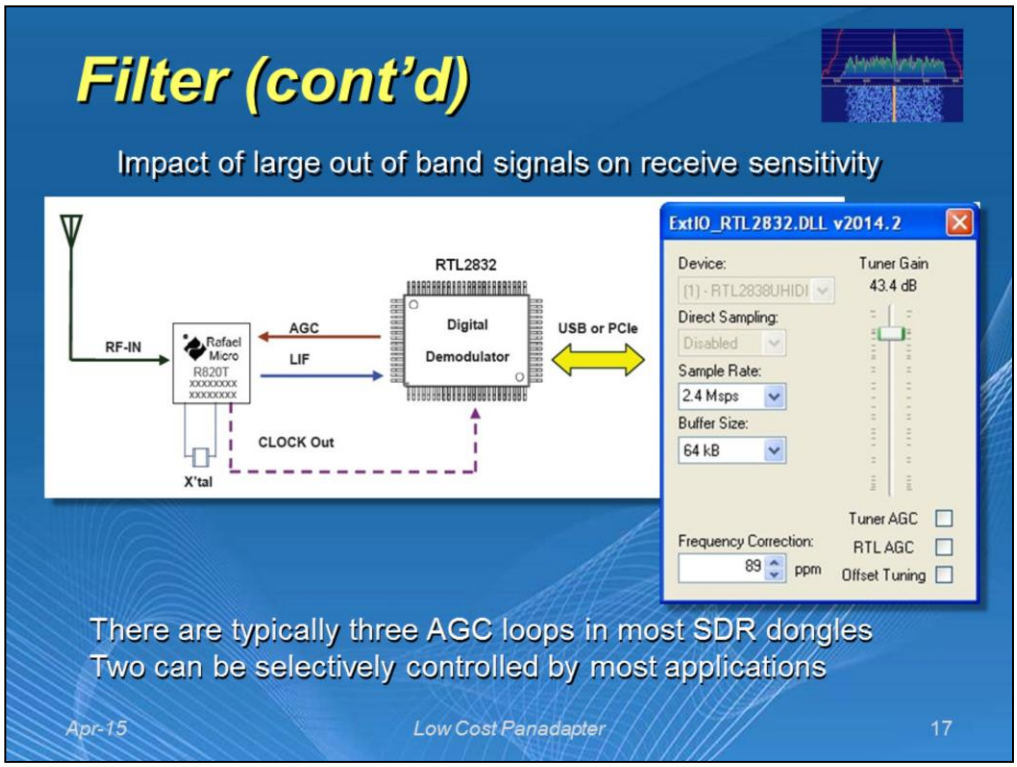




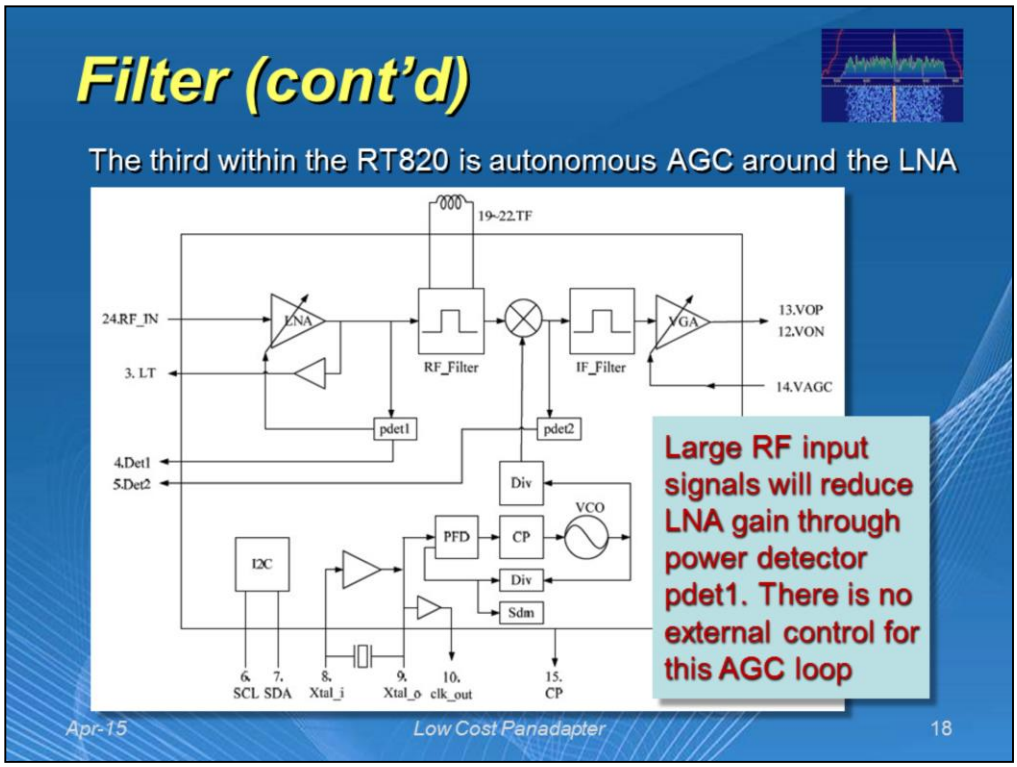
The frequency on the spectrum analyzer isn't very accurate with a wide span. The marker is actually at 144.25+IF or 212.58MHz

There are half a dozen signals with levels close to or higher than the 1st IF

The signal to the left of the marker is the IF of interest.

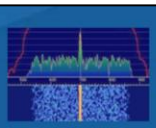


EXIO from HDSDR shows two AGC controls available, one to control gain in the RTL2832 and the second gain in the tuner in this case an Raphael R820 but the EL4000 used in many other SDR dongles is similar



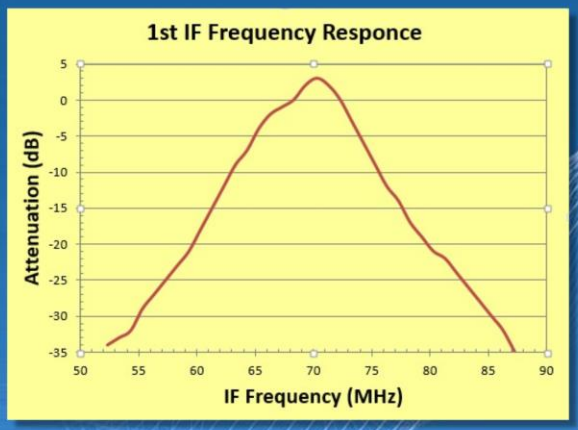
The RT820 front end tries to prevent overload from strong signals by reducing the LNA gain via power detector pdet1. This detector will respond to the sum of all signal levels in the dongle passband.

Filter (cont'd)

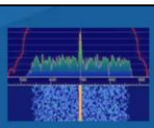


Large unwanted signals within the dongle's passband will reduce receiver sensitivity

NooElec RT820 passband is WIDE…about 25-1750MHz. Transceiver's first IF's usually have some a filtering to the RF input. The graph to the right shows FT817 normalized IF gain



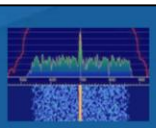
Filter (cont'd)



Large signals within the dongle's passband will reduce overall sensitivity

- While the transceiver offers some filtering of RF from the antenna to the 1st IF there are still a lot of strong carriers present on the radio's 1st IF.
- Large constant carriers present in the IF need to be attenuated to prevent the tuner chip LNA gain being reduced by the power detector
- Gain reductions caused by AGC power detector feedback can often be seen as a level shift in the displayed noise baseline

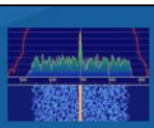
Filter (cont'd)



Filter Criteria

- Small footprint
- Moderate bandwidth – around 20 MHz keeps filter order manageable in small size
- Insertion loss less than conversion gain 3 - 4dB max.
- Center frequency IF 68.33 or a design that can be easily modified to suit IF's from 50 to 70 MHz.

How much gain?



How much gain is needed from the panadapter interface to optimize overall performance?

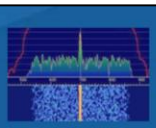
- Well not a lot really
- There is conversion gain from the RF input to the 1st IF

FT817 Conversion Gain vs Frequency

Frequency (MHz)	1.8	3.6	14.1	28.3	50.3	144	430
Conversion Gain (dB)	5.1	3.2	4.9	4.6	12.5	10.9	11.4

- And the SDR dongles are decent receivers. Measurement for 12dB SINAD…
  - FT817 at 50MHz CWNarrow using the 500Hz CW filter was -131dB
  - NooElec RT820 using SDR# at 68.33MHz CW with 300Hz bandwidth was -133dBm

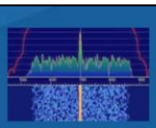
How much gain?



Additional gain won't improve sensitivity

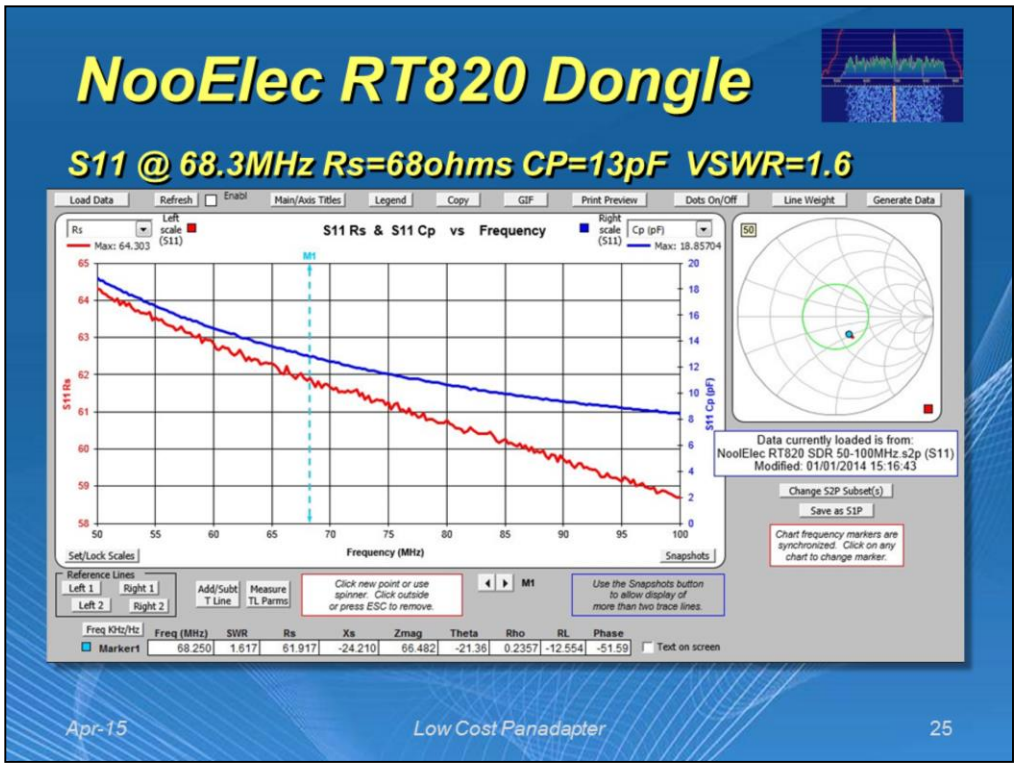
- There is enough gain in the transceiver & dongle without additional gain in the panadapter interface
- Sensitivity is determined by the receiver's front end noise figure & gain. It should be noted that losses though the interface filter if greater than the conversion gain will degrade the sensitivity if the RF input signal is at the receiver's noise threshold.
- Significant interface gain will simply boost signal levels and could result in additional distortion unless the interface is extremely linear at higher signal levels.
- Enough gain to overcome filter losses (1 to 2dB) plus a small bit 6dB or so would be good objective.

Output Driver



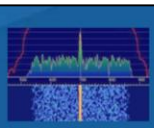
What's needed at the panadapter interface output to a dongle?

- Should be able to drive the dongle without impacting the interface's gain or filter frequency response.
- Must be stable driving an open circuit as the dongle may not always be attached
- Emitter follower buffer isolates the amplifier stage from the interface's output
- NooElec dongle impedance at the IF frequency looks quite reasonable as the next slide shows.

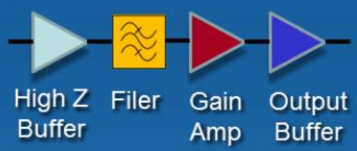


Ok so now that we have most of the criteria for the interface let's examine the design.

Solution Summary



Input Buffer



- Zin > 1k Ohm so it won't load the IF crystal filter
- Output drives 50 ohm Zin of filter

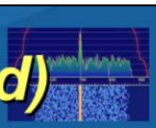
Filter

- Compact & fairly simple - 20 MHz or so bandwidth 3rd or 4th order
- Insertion loss less than conversion gain target < 3 dB
- Center frequency design alterable for between 50 & 70 MHz

Gain Block

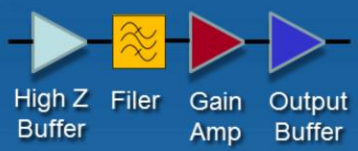
- 6-10 dB gain (4 to 8 dB overall after filter loss)
- Zin matched to filter - 50 Ohms

Solution Summary (cont'd)



Output Buffer

- Unconditionally stable working into an open circuit
- Able to drive most (all) dongles



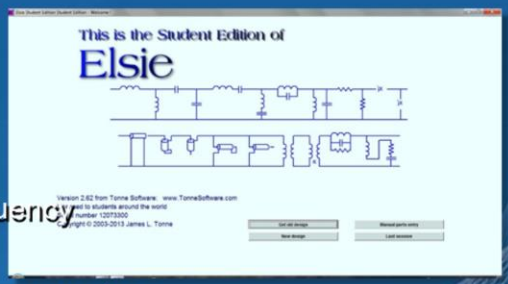
Other Criteria

- Small PCB size to fit into most rigs
- Low current consumption – 5 mA target

Design…start with the filter

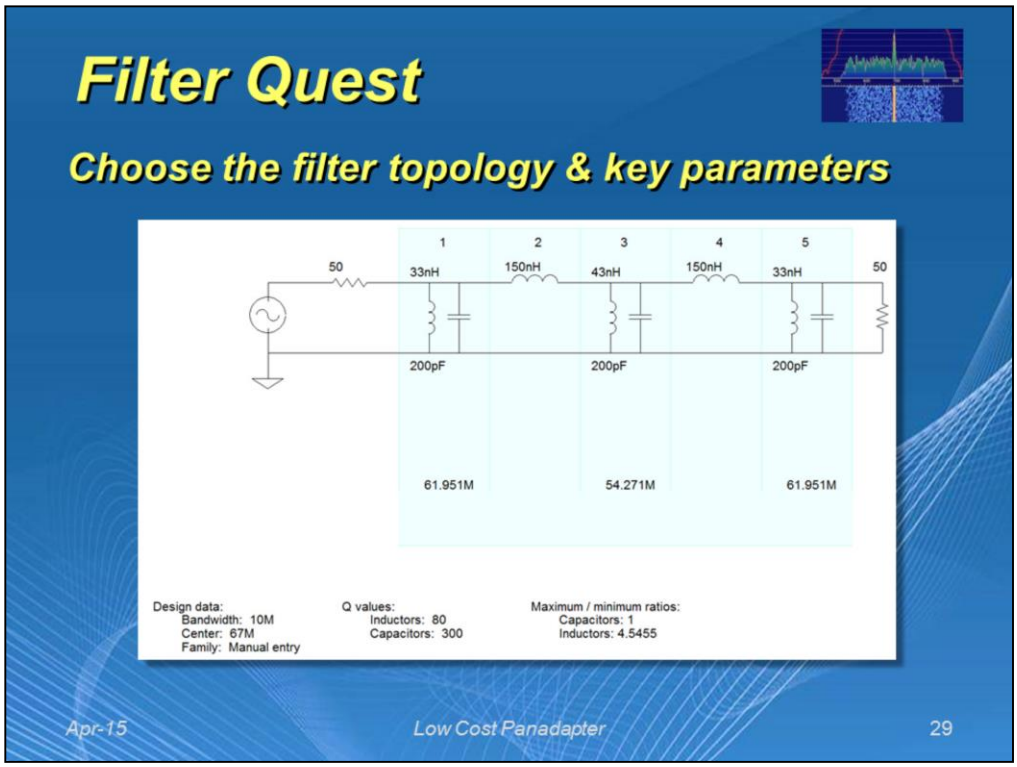
Elsie Filter Design

- Explore Filter topology & family
- Explore filter properties
  - bandwidth - center frequency
  - filter order - Z in & out
- Access impact of other parameters
  - capacitor and inductor Q



Filter Topology Chosen

- Nodal inductor coupled bandpass
  - A bit more complex but has steeper high frequency cut-off



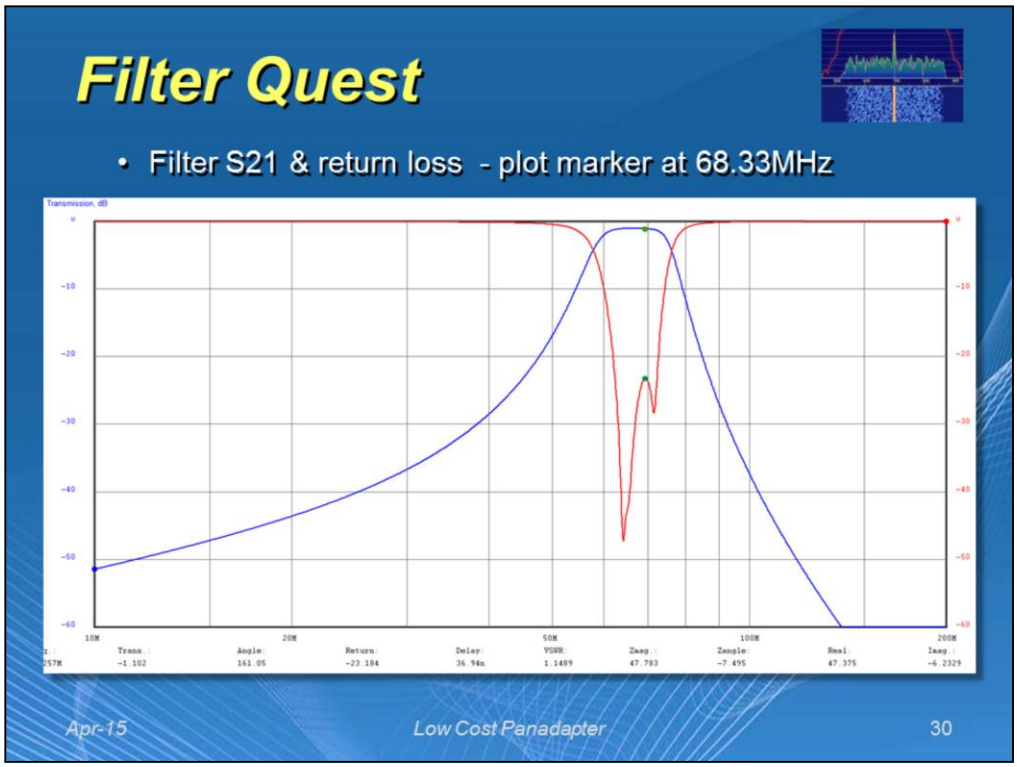
Begin by selecting a filter topology and order. Elsie quite nicely takes your hand and guides you through the process.

Filter parameters chosen Nodal inductor coupled bandpass Chebyshev Bandwidth 10MHz Center frequency 67MHz Filter order 3 Passband Ripple .01

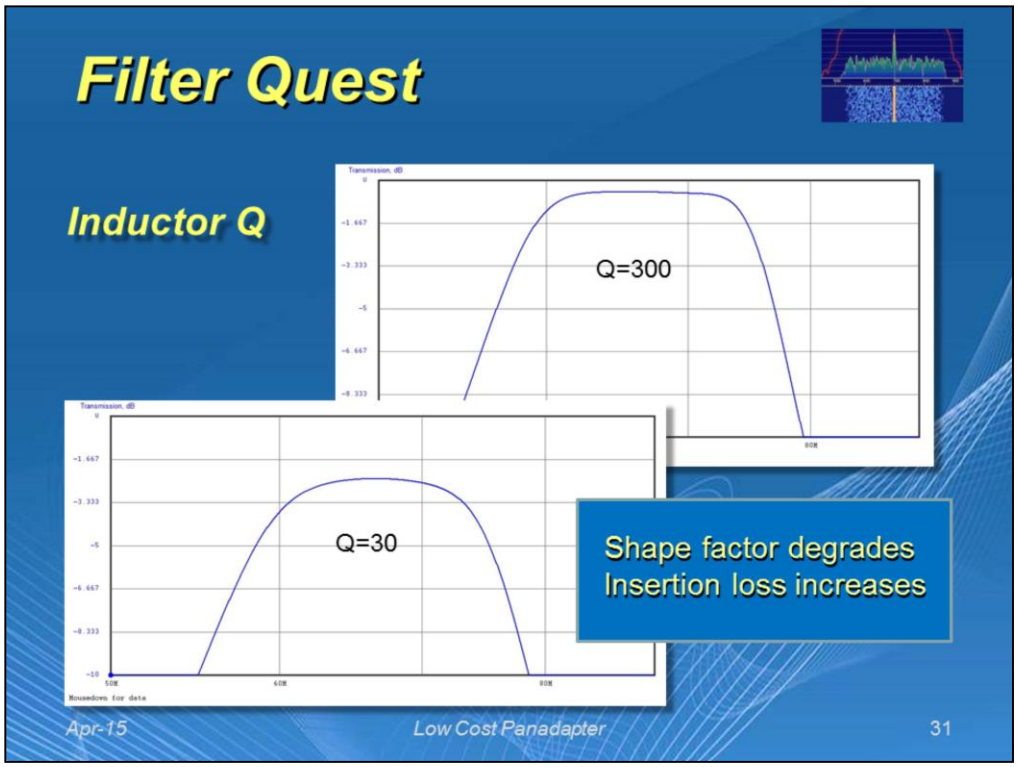
The Elsie design values are precisely calculated. They will need to be changed to values you can buy!

Note that Q values 80 for inductors 300 for caps. 80 is optimistic for commercial inductors but realizable for air core wire wound parts

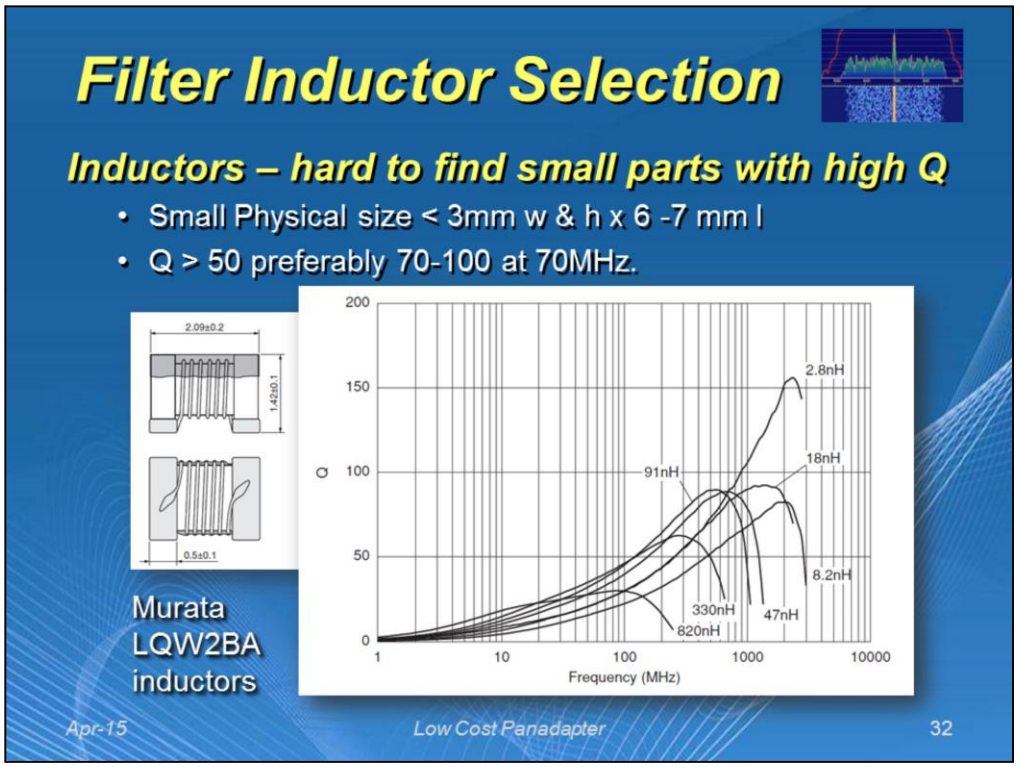
50ohm source and load impedance, makes the filter easy to test on an network analyzer



Passband loss about 1 to 1.5dB dB. 3dB bandwidth 18MHz



Insertion loss increases from 1 to 2.5dB



Wire wound inductors have higher Q than MLCC

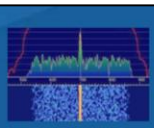
Wire wound air core below about 100nH have Q's top out around 100 most are 50-100

Above 100nH Q's tend to be around 30 or so

Note that Q increases with frequency to the inductors SRF then drops like a rock

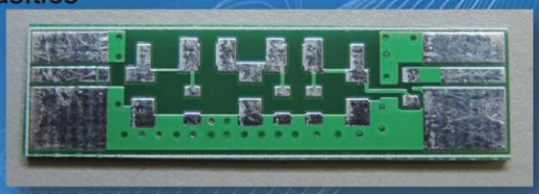
Also if the device is specified and measured at a higher frequency that you're using it the Q will be lower not higher.

Filter Considerations



The criteria that simulation won't easily tell you

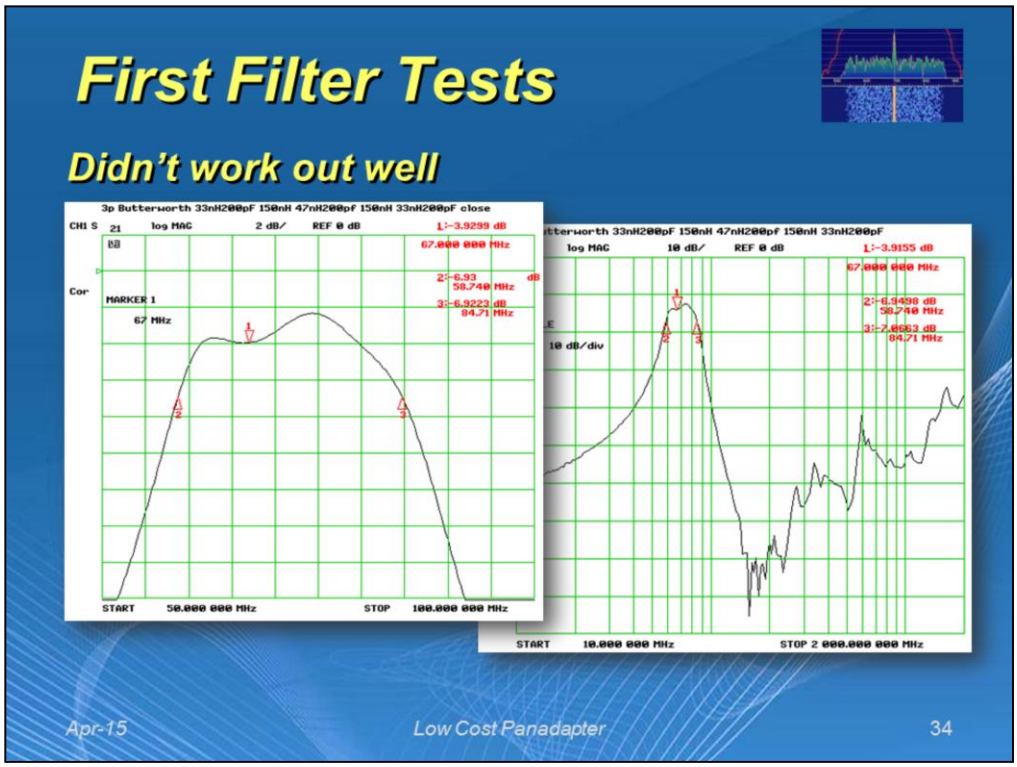
- Multiple inductor placement on PC & mutual coupling
  - Space in-line inductors a minimum of 2 diameters apart
  - Place inductors orthogonal where possible
- PCB groundplane impact on filter
  - Standard practice removes the ground plane under the filter on all cu planes – how far away from filter does it need to be?
- Capacitor Q and size (0805 vs.. 0603)
- Impact of layout parasitics
- Test PCB created to evaluate performance of the filter alone



Apr-15 Low Cost Panadapter 33

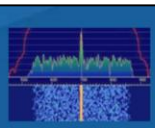
Since Zin=Zout=50 ohms the filter could be easily tested on a network analyzer.

There ware enough unknowns that a test board was created with and without groundplane under the filter.

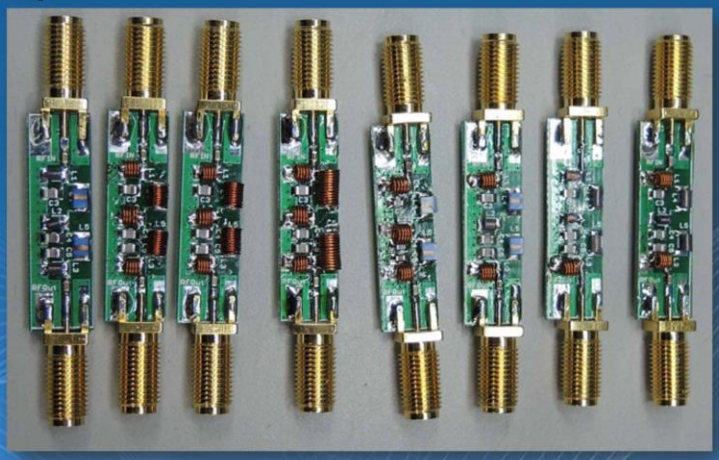


Not having worked with filters before I hand taken the plunge to simulate first with Elsie and LTSpice . Both gave fairly consistent results and looked good but something told me in reality parts on a PCB might be a bit different. But I didn't expect this!

First Filter Tests (cont'd)



So I built more filters from different components some looked better but not all

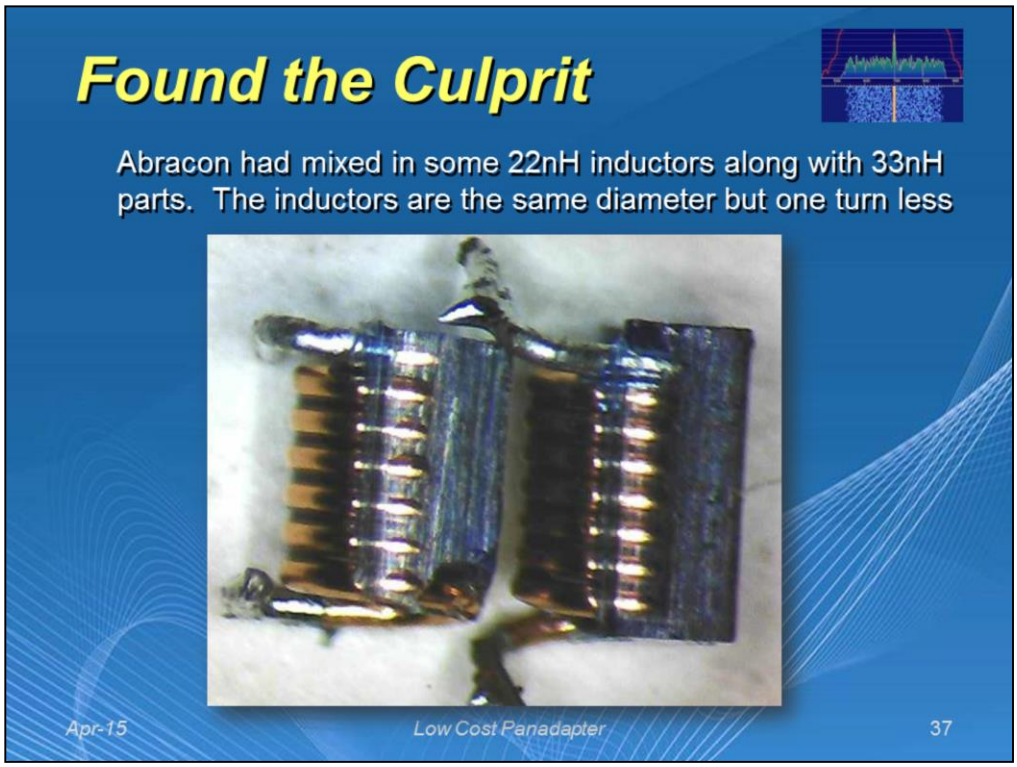


Test Equipment Added

HP 4274 /5

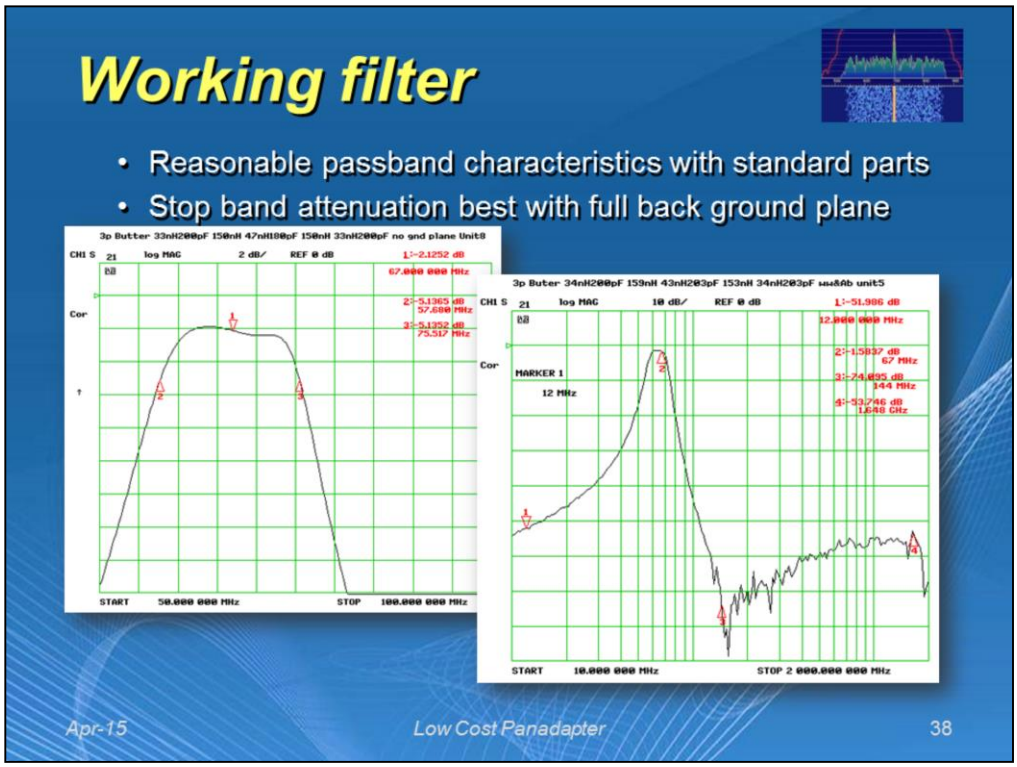
- Capable of measuring caps into the fF and inductors into the pH range.

Of course I had to build test jigs for inductors and buy jigs for caps. But I was now able to measure accurately.



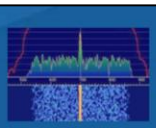
Because they're so tiny even under the microscope I couldn't see the difference. It wasn't until I removed each part from a filter and measured them individually that I found the difference.

About half the parts ordered were the incorrect value

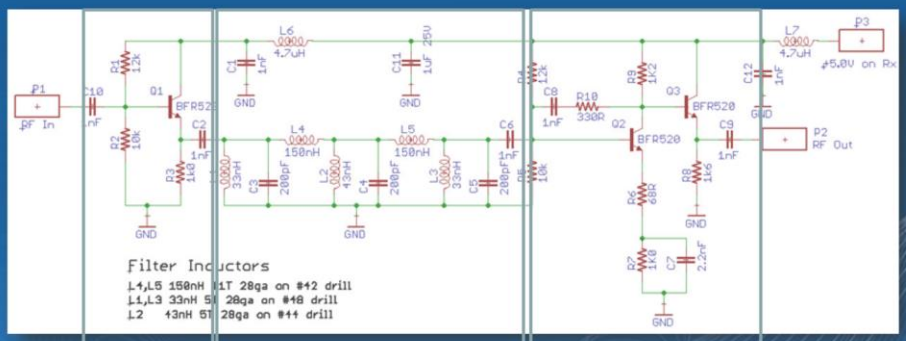


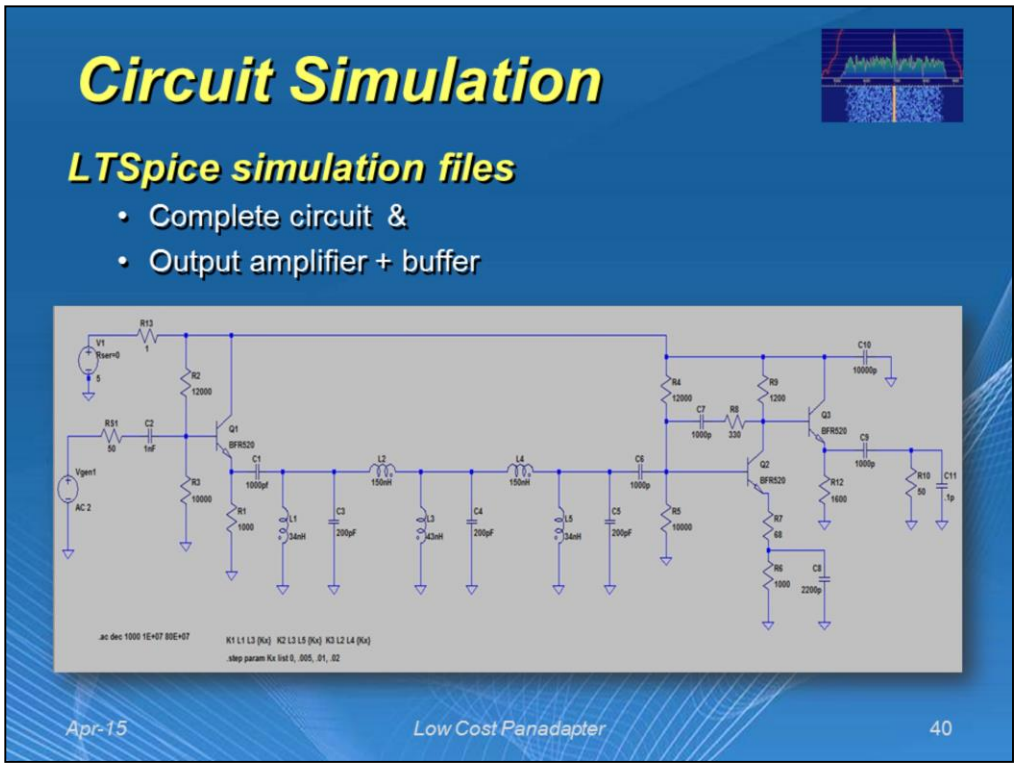
Center frequency choses was 67 MHz so that the 68.33MHz IF is shifted toward the upper portion of the pass band. This increases the attenuation of the IF+RF mixing products.

Interface Schematic



V0.1a





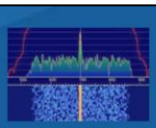
LT Spice simulation files are included in the documentation.

Filter analysis includes filter inductor mutual coupling and inductor parasitic resistance limiting Q.

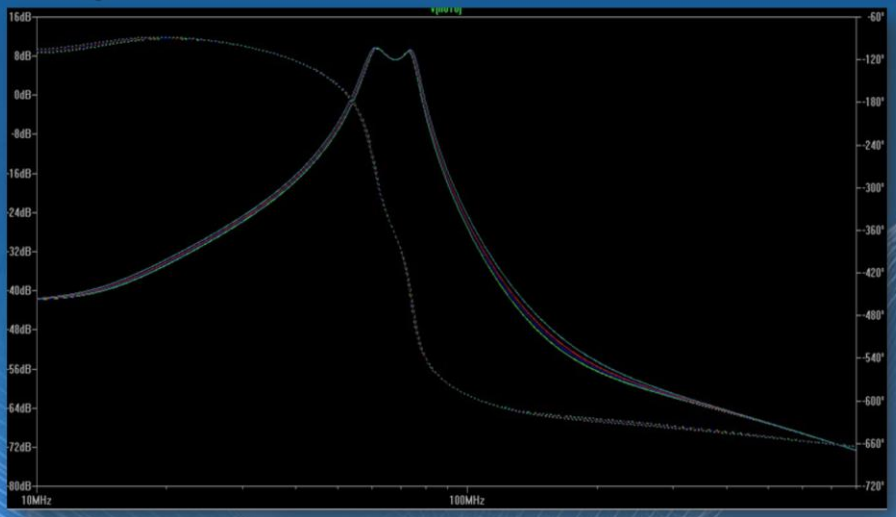
BRF520 spice parameters from NXP include in the component files.

Also included in the documents are simulation files for the second and third stages, gain and output buffer. Feedback on the amplifier stage is set to keep the input impedance a reasonable match to the filter output while providing moderate gain.

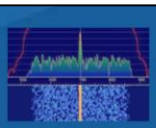
Circuit Simulation



LTSpice simulation results



PCB Layout



Small size to fit most transceivers

- 12mm x 40mm

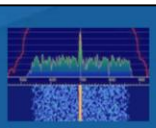
All components on the top side no tracks on bottom

- Bottom is ground plane only, so PCB can be soldered to any grounded surface within the transceiver

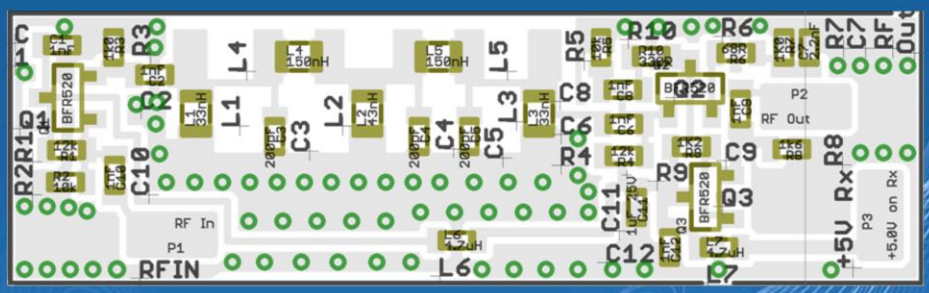
Keep-out areas allow PCB to be fitted against the PLL – Unit can in FT-817

•Eagle is used for schematic capture and PCB layout

PCB Layout

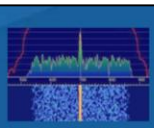


40 x 12mm

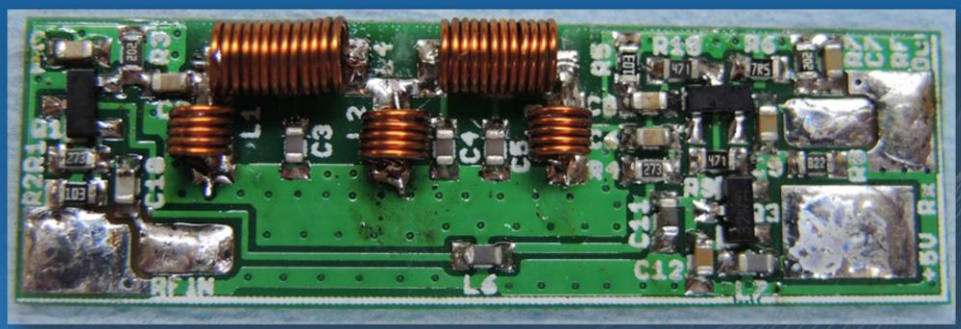


- Layout has keep-out areas that allow the board to easily fit against the side of the PLL - Unit shield in the FT-817
- All components are on the top side, bottom is ground plane

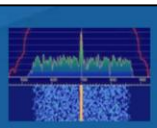
Assembled PCB



Using wire wound air core inductors

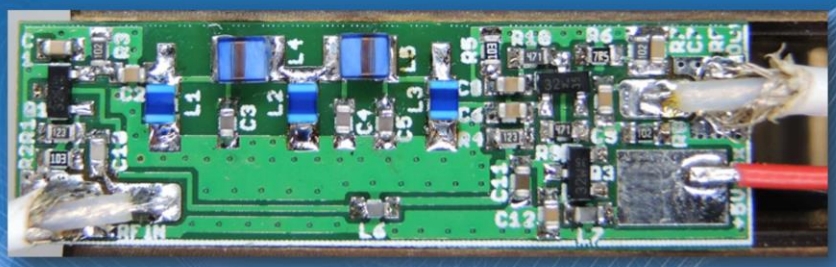


Assembled PCB (cont'd)

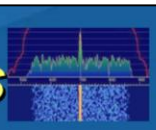


PCB also has pads for commercial inductors

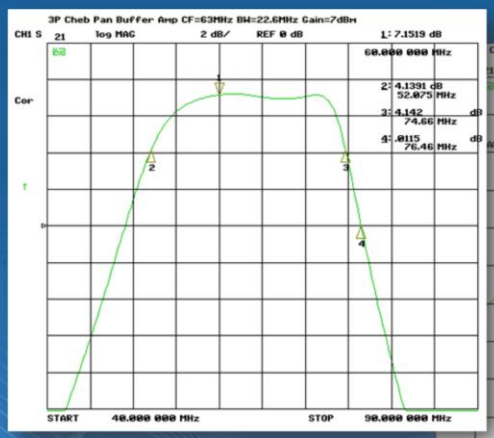
- L4 and L5 are 150nH - 1008
- L1 and L3 are 33nH - 0805
- L2 is 43nH - 0805
- These values shift the passband down slightly so that the 68.33 MHz center frequency is a bit closer to the upper edge

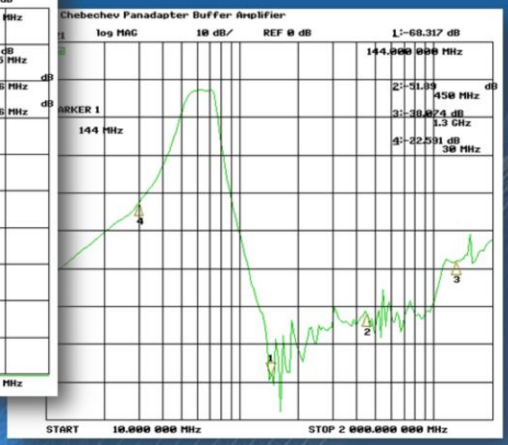


Bench Performance tests

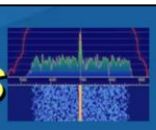


PCB made with home brew air core inductors

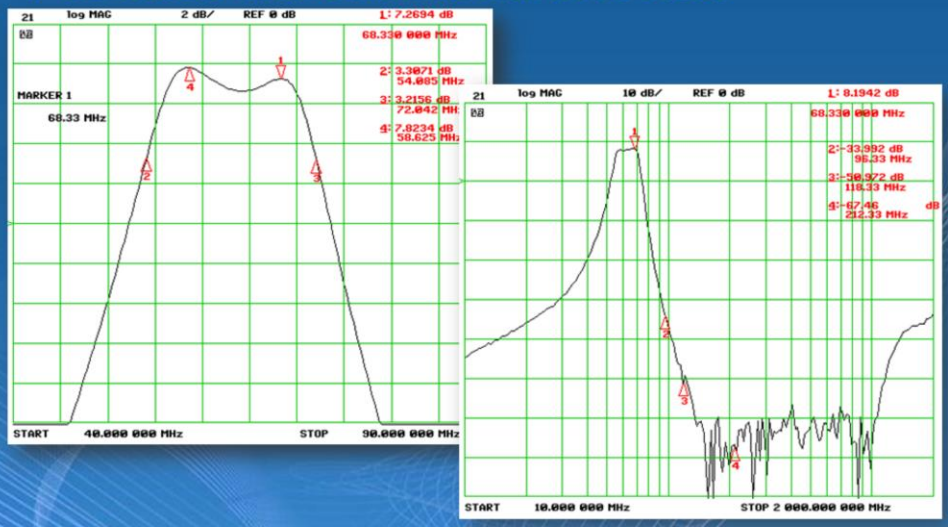




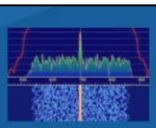
Bench Performance tests



PCB made with commercial inductors

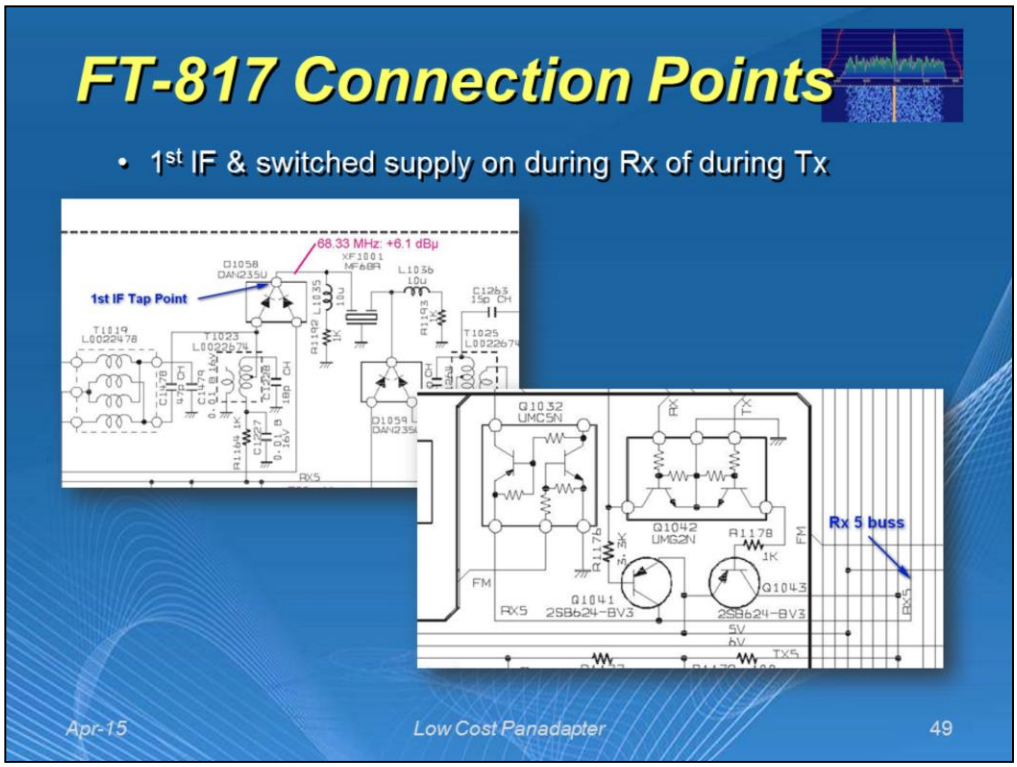


Interface to a FT-817



Four connections are needed from the interface PCB to the transceiver

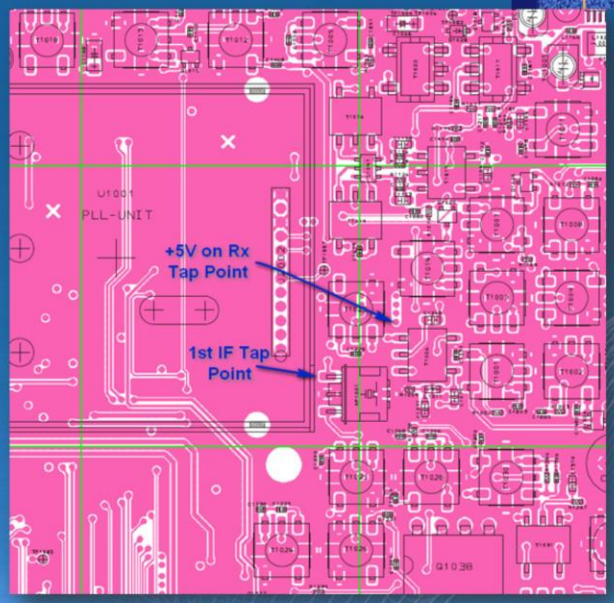
- Switched +5V – on during Rx – off during Tx. A switched supply is very desirable as the IF is used for both Tx & Rx so the dongle display is quiet during Tx
- RF input – tapped into the radio's 1st IF before a crystal filter
- RF output – port connects the interface output to the dongle typically through a connector on the radio's rear panel
- Ground



The RX5 buss travels to many places on the PCB but finding a connection point on the PCB top was not an easy task.

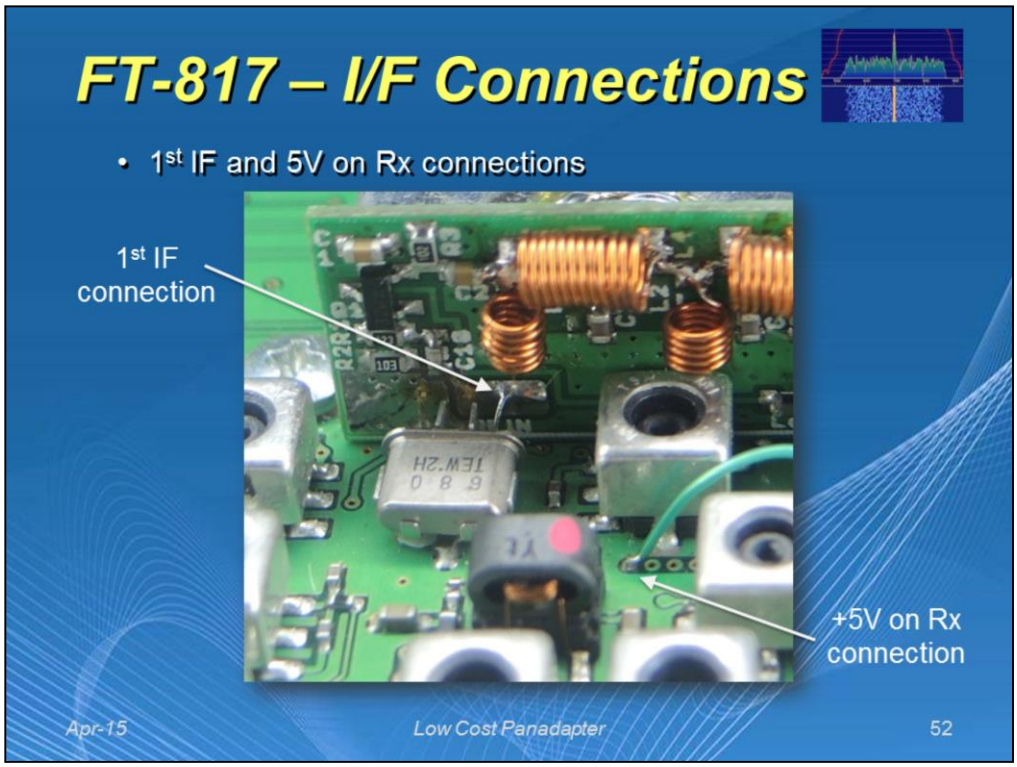
FT-817 Connection Points

- Top PCB Connection Points



FT-817 – I/F Connections

- Interface PCB bottom groundplane is soldered to the side of the PLL-Unit housing

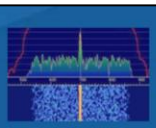


To attach 1st IF to the PCB first solder a small bear piece of wire-wrap or 30ga wire to the crystal filter input. Cut the wire to length and solder it to the interface PCB RF input pad

FT-817 – I/F Connections

- MCX push on connector jack is located above the SO239 antenna connector on the radio's rear panel

Sensitivity Tests



Before & After Panadapter installation

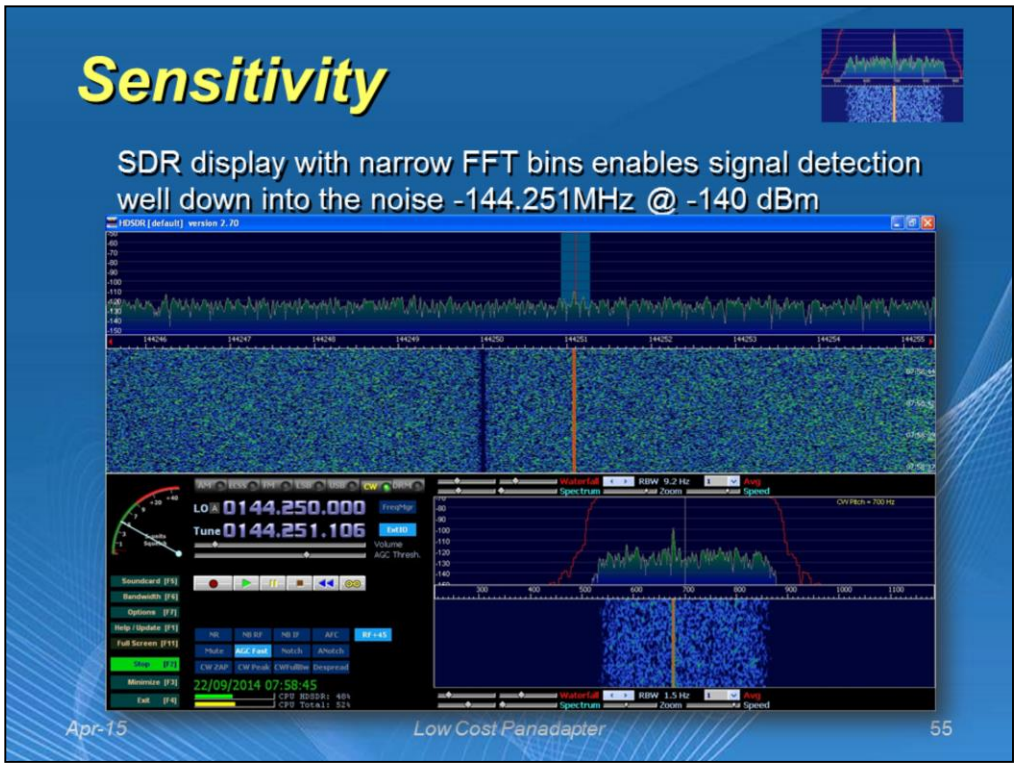
		Baseline Measurement				FT817 wit Panadapter Installed				Difference			
Frequency	Mode	SINAD	S Units			SINAD	S Units			SINAD	S Units		
MHz		12dB	1	5	9	12dB	1	5	9	12dB	1	5	9
3.6	CWN	-123.7	-100	-96	-72	-123.9	-99	-94	-72	0.2	-1	-2	0
	CWW	-110.8	-96	-92	-71	-112.1	-95	-91	-70	1.3	-1	-1	-1
	FM 3KHz	-115.7	-103	-99	-92	-115.8	-103	-97	-91	0.1	0	-2	-1
14.1	CWN	-126.7	-104	-100	-76	-126.9	-103	-99	-80	0.2	-1	-1	4
	CWW	-113.4	-100	-96	-74	-114.4	-99.5	-95	-73	1	-0.5	-1	-1
	FM 3KHz	-118.8	-108	-101	-98	-118.3	-107	-100	-95	-0.5	-1	-1	-3
28.25	CWN	-127.8	-104	-101	-78	-127.4	-104	-100	-77	-0.4	0	-1	-1
	CWW	-115.2	-101	-97	-75	-115.5	-99	-95	-73	0.3	-2	-2	-2
	FM 3KHz	-119.4	-109	-101	-96	-119.1	-108	-100	-95	-0.3	-1	-1	-1
50.25	CWN	-131.0	-111	-107	-80	-131.1	-110	-106	-83	0.1	-1	-1	3
	CWW	-118.2	-108	-103	-78	-118.6	-105	-101	-79	0.4	-3	-2	1
	FM 3KHz	-123.3	-115	-107	-102	-123.4	-114	-106	-101	0.1	-1	-1	-1
144.25	CWN	-130.2	-112	-109	-82	-129.8	-111	-107	-83	-0.4	-1	-2	1
	CWW	-116.2	-109	-105	-79	-116.1	-106	-102	-79	-0.1	-3	-3	0
	FM 3KHz	-122.2	-116	-110	-104	-122.1	-115	-108	-103	-0.1	-1	-2	-1
430.25	CWN	-130.4	-110	-106	-79	-129.1	-109	-105	-81	-1.3	-1	-1	2
	CWW	-117.4	-107	-103	-78	-116.6	-104	-100	-78	-0.8	-3	-3	0
	FM 3KHz	-121.9	-114	-107	-102	-121.4	-113	-105	-101	-0.5	-1	-2	-1

The measurements with the panadapter installed were conducted about six months after the baseline measurements were taken

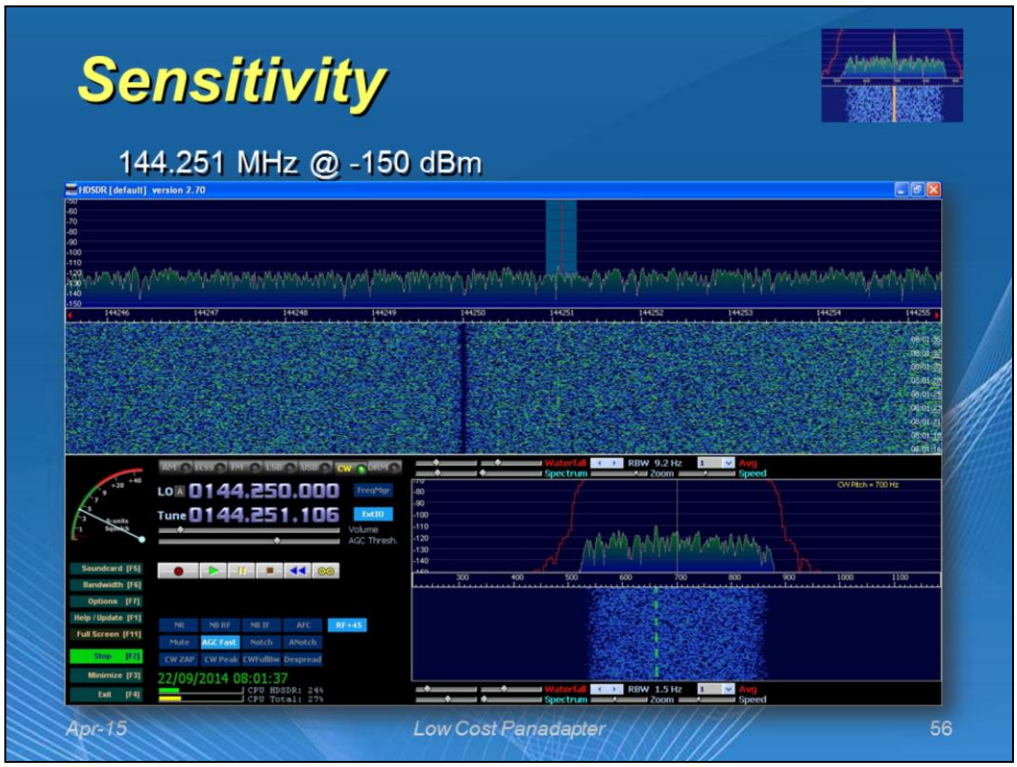
For these measurements the HF & 50MHz preamp was on (IPO set to off) and the attenuator was on (ATT not engaged)

The average change in SINAD was -0.04dB

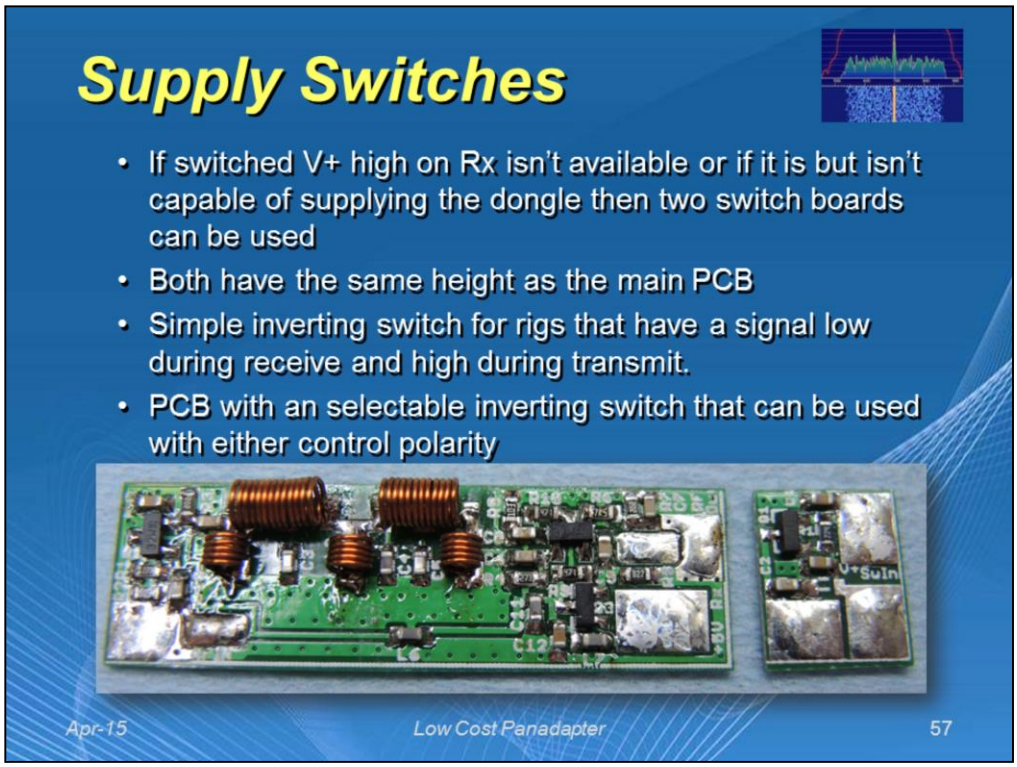
There was no difference in sensitivity noted when the SDR dongle was attached or removed from the panadapter output



144.251 MHz at -140 dBm



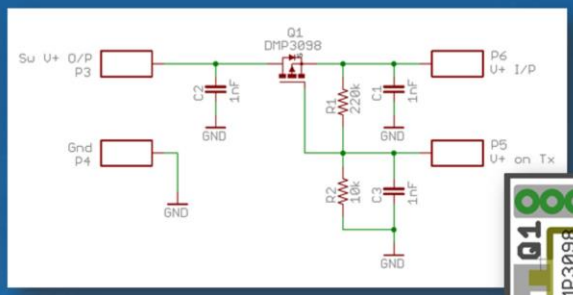
144.251 MHz at -150 dBm, signal is turned off and on to make the trace a little more evident.

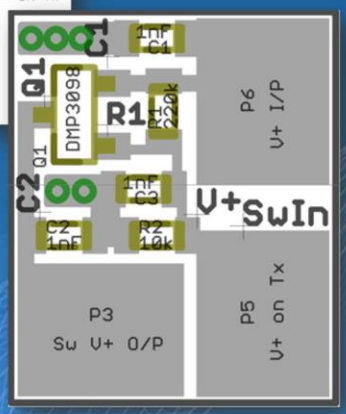


This switch provides a voltage at Sw V+ O/P that is essentially the same level as the voltage applied to V+ I/P. requires the signal to sink about 50uA from a 12V supply when off and requires a

has the same PCB height as the panadapter and is 10cm wide. All components are on the top side and the bottom metal is ground plane so that the PCB can be soldered against any convenient ground for support. The switch provides a supply voltage at Sw V+ O/P that is essentially the same as the V+ I/P. requires the signal to sink about 50uA from a 12V supply when off and requires a

Supply Switches (cont'd)

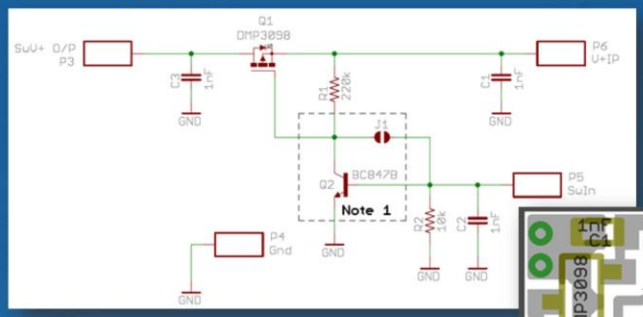


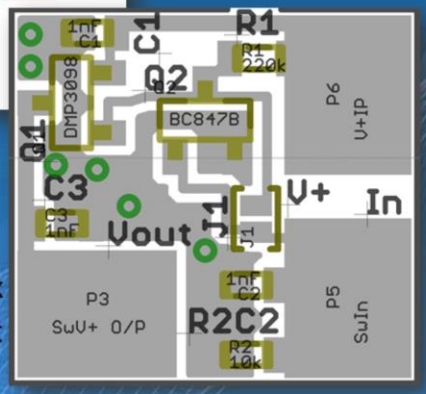


V+ Tx Switch

- 10 mm wide
- Switch input P5 Low on Rx & high on Tx

Supply Switches (cont'd)

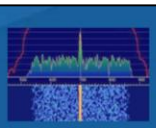




V+ Switch

- 13mm wide
- J1 Shorted Q2 not installed P5 input low on Rx high on Tx
- J1 Open Q2 installed P5 input high on Rx low on Tx

Application Software



HDSDR chosen as the best application

- Feature rich
- Interfaces smoothly to radio IF's and CAT software
- Not too difficult to install
  - Links to examples can be found on the HDSDR FAQ page

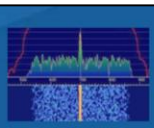
SDR#

- Nicest looking display
- Doesn't handle IQ swap correctly (version early Sept 2014) so wasn't usable with IF for this demo. Constantly updated so problem may have been solved

Gqrx

- Worked well but no time to fully evaluate

Steps to using HDSDR



Install on a computer

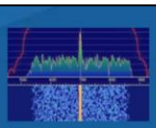
- Navigate to the HDSDR Hardware page
  http://www.hdsdr.de/hardware.html

- Scroll down to the RTLSDR (DVB-T/DAB with RTL2832) line.

RFSPACE SDR-IQ / SDR-14	Download	April 11, 2013
RTLSDR (DVB-T/DAB with RTL2832)	DLL How-To	February 04, 2014
SDR-1	Download	April 05, 2012

- Click on the How-To which will download a PDF with good install instructions

HDSDR -configuration



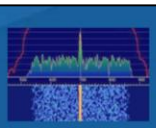
Start the program

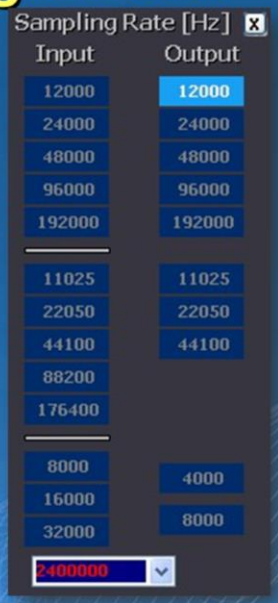
HDSDR has a slew of options that can be confusing.

- Start with the menu items lower left side.
- Leave the Soundcard [F5] alone.

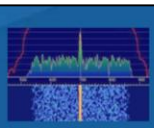
HDSDR - configuration

- Bandwidth [F4] select the following:

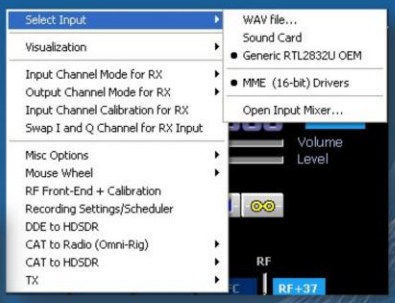




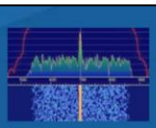
HDSDR - configuration



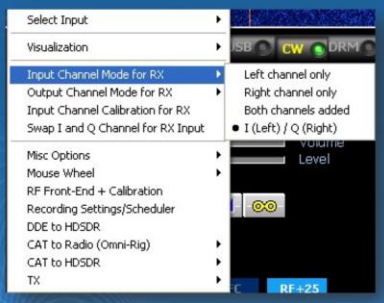
- Options [F7]
  - Select Input and visualization should look like the panels on this page
  - Don't change any submenus at this time

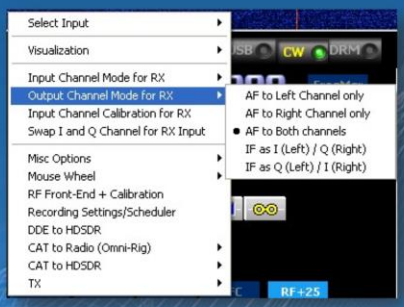


HDSDR - configuration

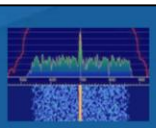


- Options [F7]
  - Input channel mode for Rx
  - Output Channel mode for Rx

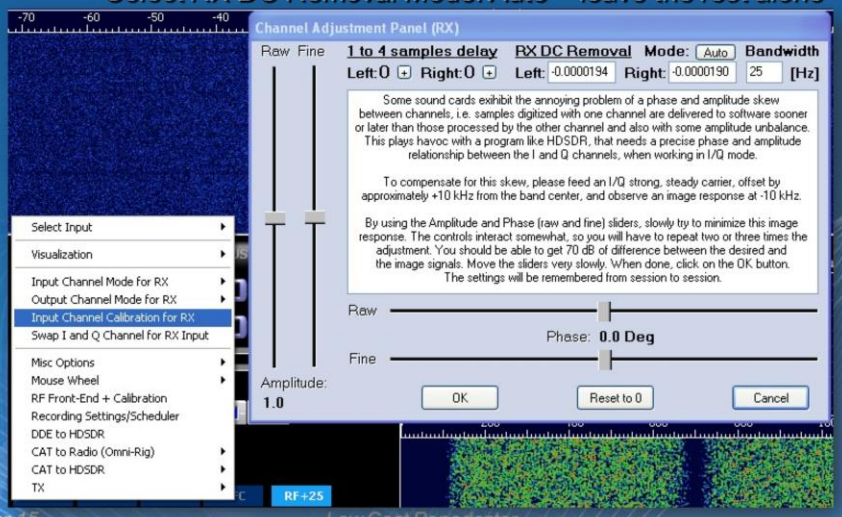




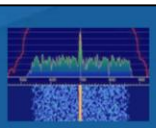
HDSDR - configuration



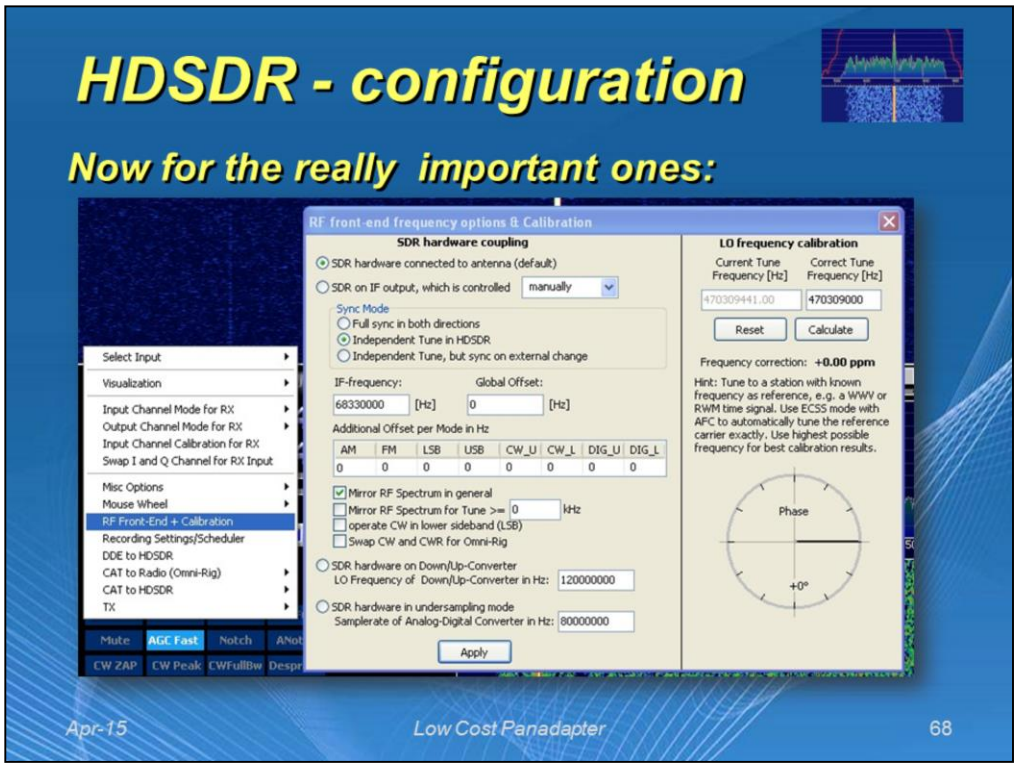
- Options [F7] - Input channel mode for Rx
  - Select RX DC Removal Mode: Auto - leave the rest alone



HDSDR - configuration



- Options [F7]
  - Misc.
  - Mouse Wheel

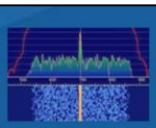


Set ‘SDR hardware connected to antenna

IF frequency isn’t important here but it’s a good time to enter the radio’s IF center frequency

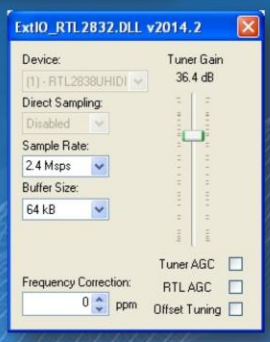
Mirror RF Spectrum in general should be checked.

HDSDR - configuration

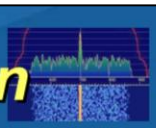


ExtIO

- Click on the ExtIO button
- Increase the tuner gain slider to between 30 and 40dB.
- Turn off all AGC
- Check that the sample rate and buffer size match the window on the right.



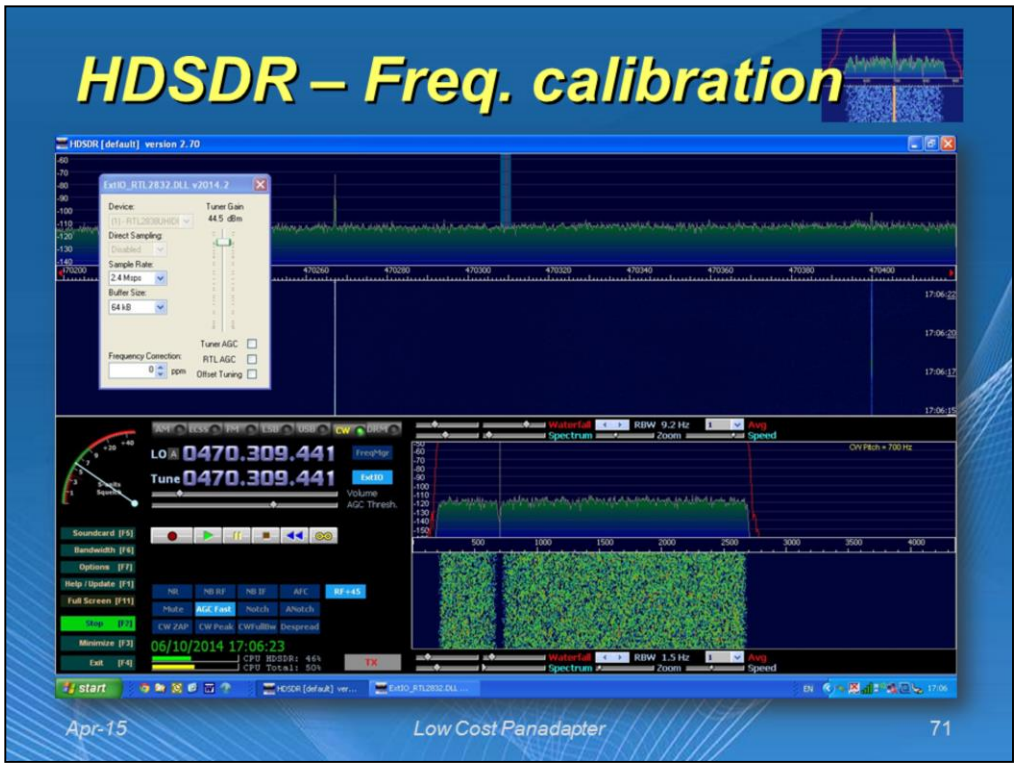
HDSDR – Freq. calibration



Frequency correction – Part 1

- Connect an antenna capable of receiving a signal of known frequency to the DVB-T dongle
  - A good choice for this is often a local off air HDTV signal as they are typically quite strong.
  - A pilot tone can be easily identified. It's 309,441 Hz above the lower band edge. The lower band edge frequency for all UHF channels can be found here:

    http://www.csgnetwork.com/tvfreqtable.html
  - Enter the known frequency values in the HDSDR LO and Tune values

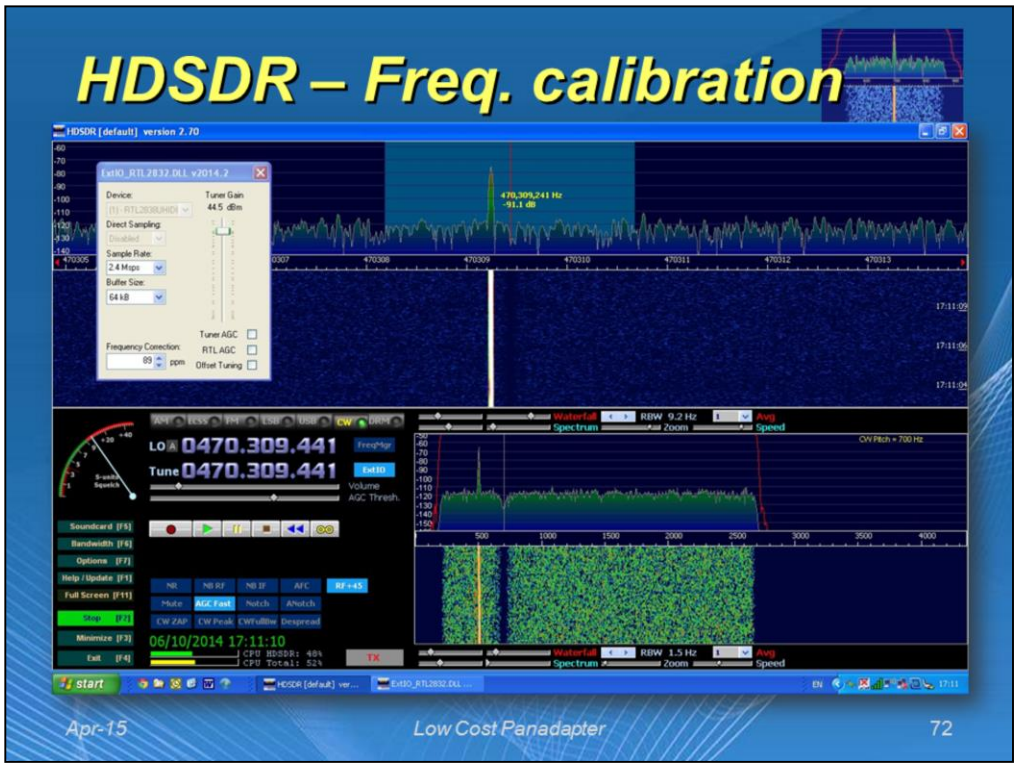


Set the LO and tune to the known frequency. In this case the channel 14 pilot, 470MIz channel lower band edge plus 309.441Hz.

The pilot can be seen to the left of the set frequency.

Change the ‘Frequency Correction’ value in the EXIO window to bring the carrier to the set frequency.

Increase the zoom control to more precisely view the correction value as the pilot approaches the set frequency.

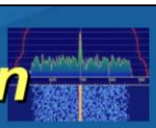


Note that the pilot is slightly below the desired frequency. The next frequency increment will place it above and further away from the desired frequency.

Get as close as possible. The value will be tweaked in the next step.

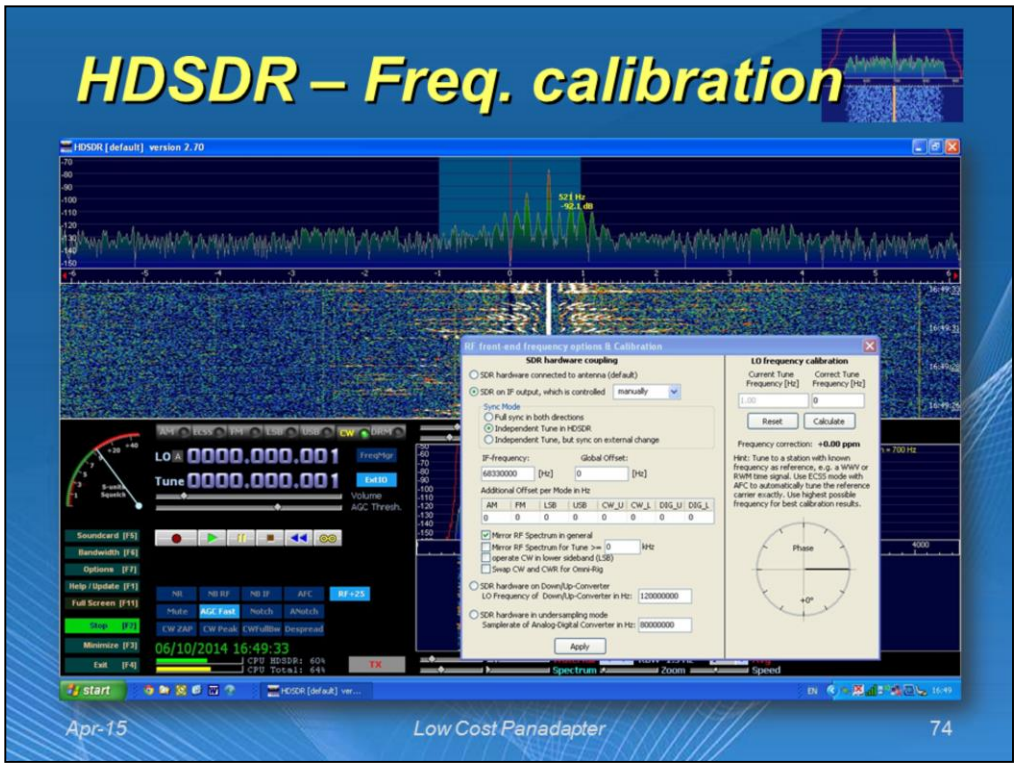
Record the value on the dongle for future reference as it's not likely to change much.

HDSDR – Freq. calibration



Next account for any transceiver 1st IF LO error

- Connect the DVB-T dongle to the radio's 1st IF interface.
- Tune the radio to a known frequency – WWV is good if it can be received. In Ottawa air band information channels can provide a good constant AM carrier. One such beacon is located at 132.950 MHz. Tune the radio to this frequency and set the mode to AM
- Set the HDSDR LO and Tune frequency to zero Hertz and the mode to AM.
- Change the RF gain as necessary to get a good display
- Zoom out if necessary to find the carrier. It should be within a couple kHz of the center frequency.
- Bring up the Options – RF Front-End & Calibration window

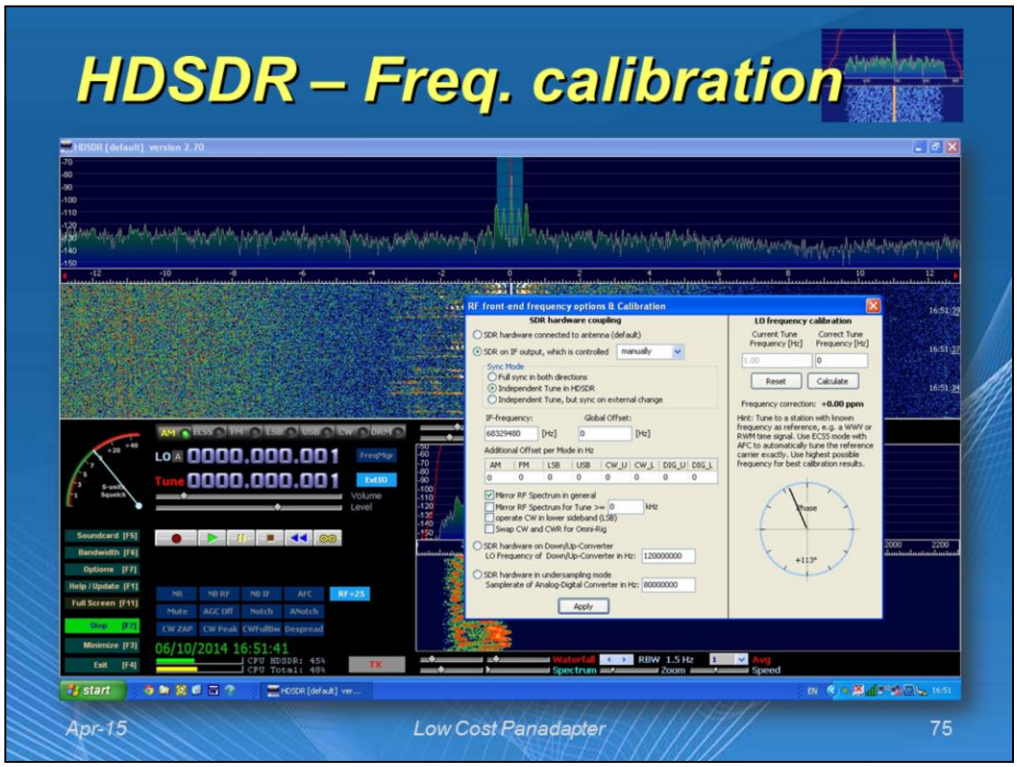


Again use the zoom slider to be able to see the two carriers with as much precision as possible.

Move the cursor to the carrier and note the frequency difference between the carrier and desired frequency.

If the carrier is below the desired frequency add the difference to the IF-Frequency value.

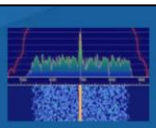
If the carrier is below the desired frequency subtract the difference from the IF-Frequency value.



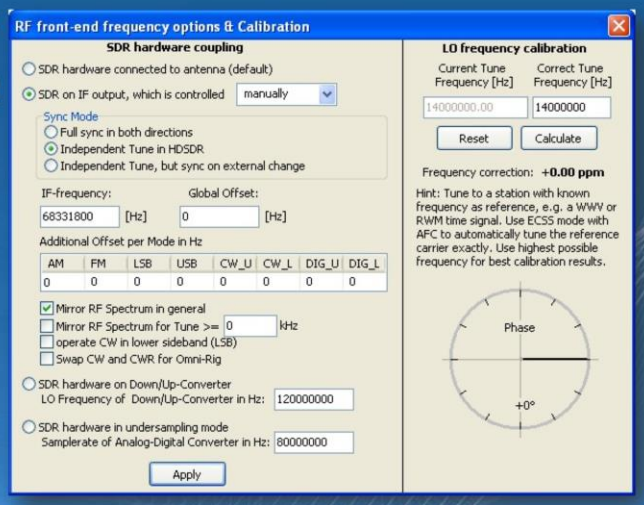
Corrected frequency.

Don't expect the frequency correction to remain stable. The oscillators involved aren't high precision. A one or two kilohertz drift over short periods of time is likely.

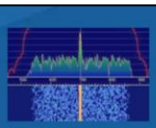
Use without CAT



- There is no communication between the transceiver and HDSDR
- Set the 'RF front –end frequency options & Calibration. Don't change the IF-Frequency



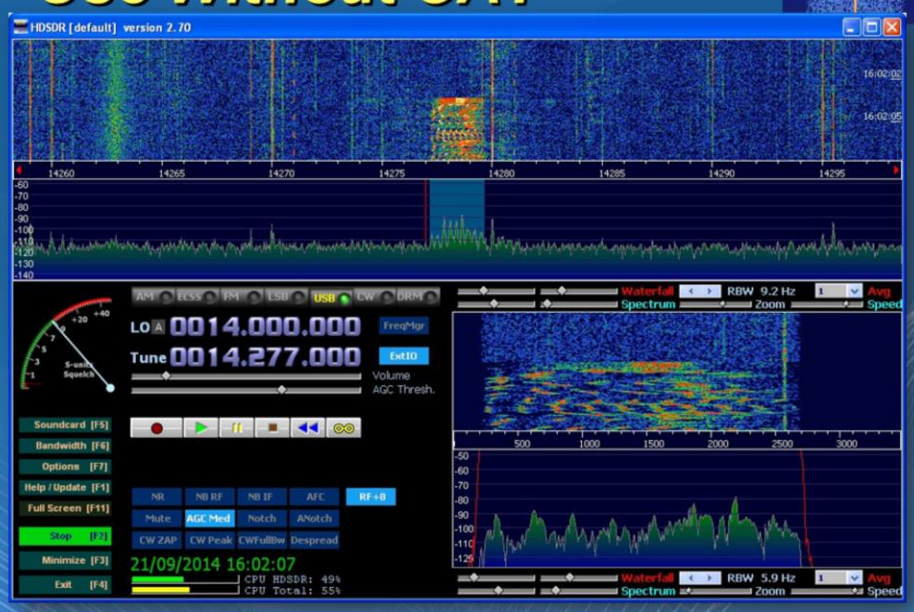
Use Without CAT



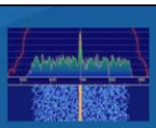
Mode 1

- Tune the transceiver to a band edge i.e. 14,000,000.
- Set the HDSDR LO and Tune to the same frequency.
- Use the HDSDR as the receiver.
- On the HDSDR screen move the band edge to the left of the screen and use the zoom slider to get the desired frequency window.
- Then use the Tune entry or mouse click on the panadapter display to change frequency
- Do not change the LO setting.
- Note if the transceiver frequency is changed the HDSDR LO and Tune must also be set to the same frequency.

Use Without CAT



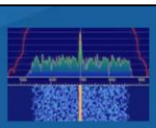
Use Without CAT



Mode 2 – tune to zero – useful for contesting

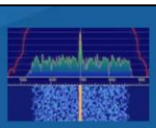
- Tune the transceiver to a frequency of interest say 144.250 MHz
- Set the HDSDR LO and Tune to zero. 144.250 MHz is now the display center
- Set the zoom to a range of frequencies that should be monitored for activity
- When a signal appears on the HDSDR display tune the radio so that the signal is positioned at zero.
- Make a contact, the frequency can be read off of the radio
- Don't forget to retune the radio back to 144.250 after the contact

Tune to zero example



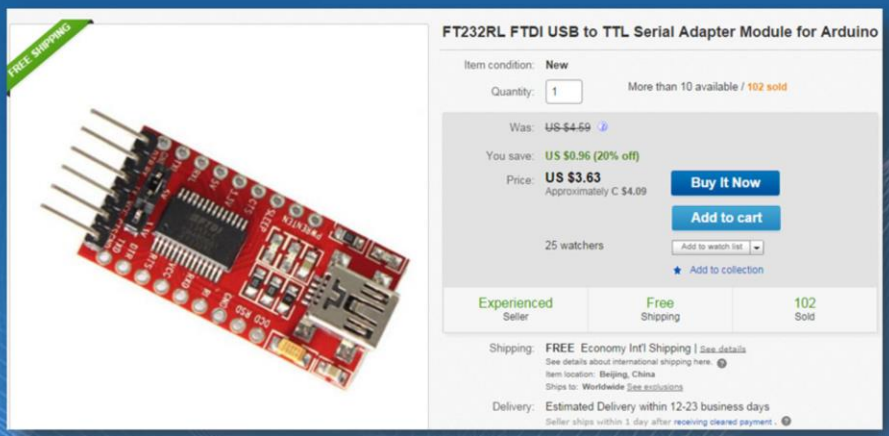
0 = 144.250MHz - watching 144.250-144.350 - signal @ 144.280

CAT-62 Cable



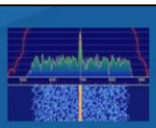
On the cheap

- Buy one of these along with a male 8 pin mini-DIN connector



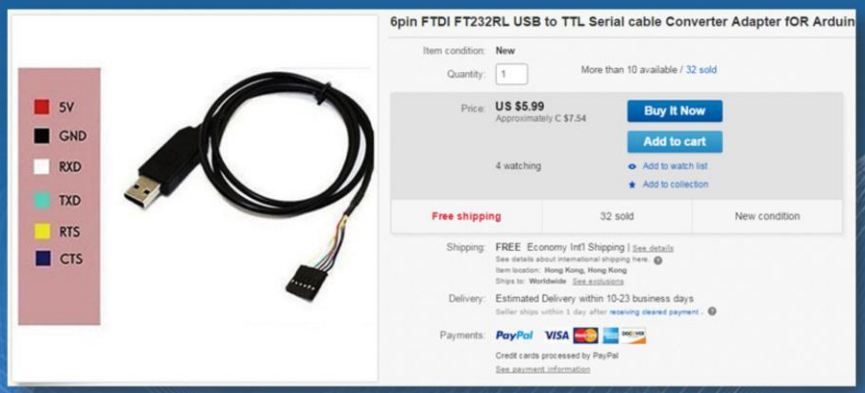
An FTDI USB - serial interface makes drivers easy to find and many operating system have them already installed

CAT-62 Cable

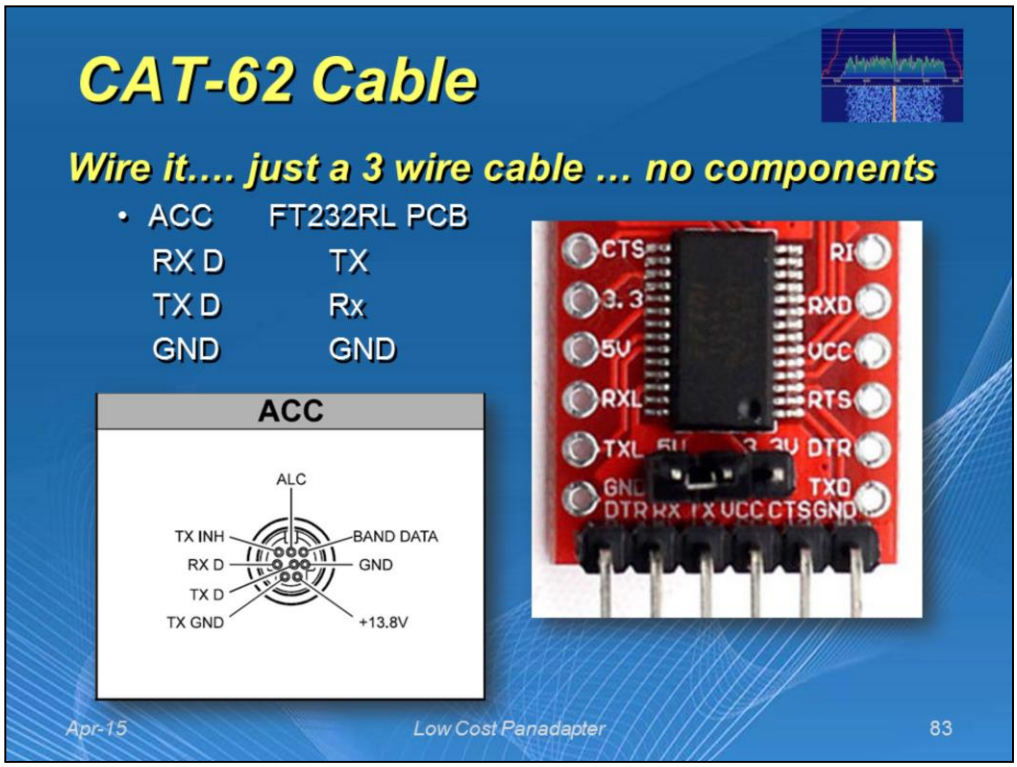


On the cheap

- Or one of these along with a male 8 pin mini-DIN connector

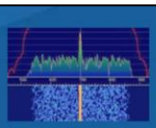


Again an FTDI USB – serial IC is the heart of this cable.



But do watch the ACC plug pin out. On the male connector pin 3 is Gnd, Pin 4 is TX D and pin 5 is RX D

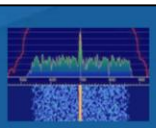
Use with CAT



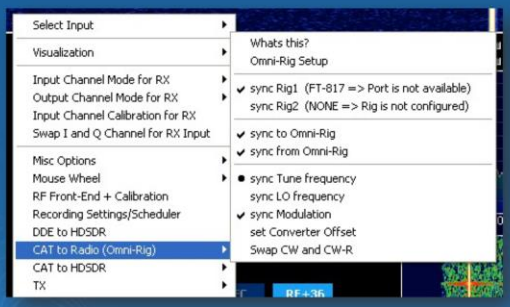
- Set the transceiver baud rate to match the application. The fastest rate reduces delays – 38,400 baud
  - The FT-817 does NOT autobaud, It must be configured manually
  - Download and install Omni-Rig with .ini files for the transceiver. Don't worry about the .ini files they're handled seamlessly during the installation.

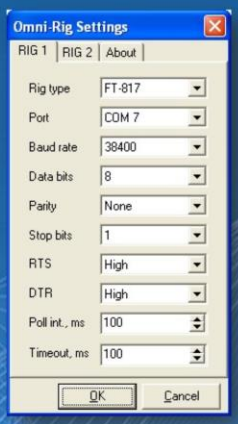
    http://www.dxatlas.com/OmniRig/
  - Configure Omni-Rig for use with HDSDR using the following

Omni-Rig Configuration



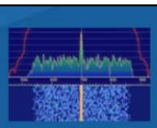
- Click on HDSDR Options [F7] button





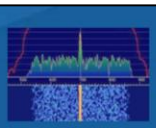
Also select 'Omni-Rig Setup' to bring up the 'Omni-Rig Settings' window and populate it with these values

Omni-Rig Configuration



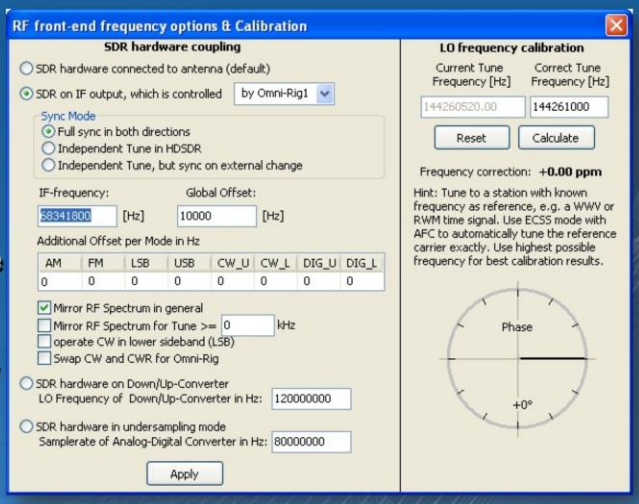
- This choice enables the Tx button within the HDSDR application

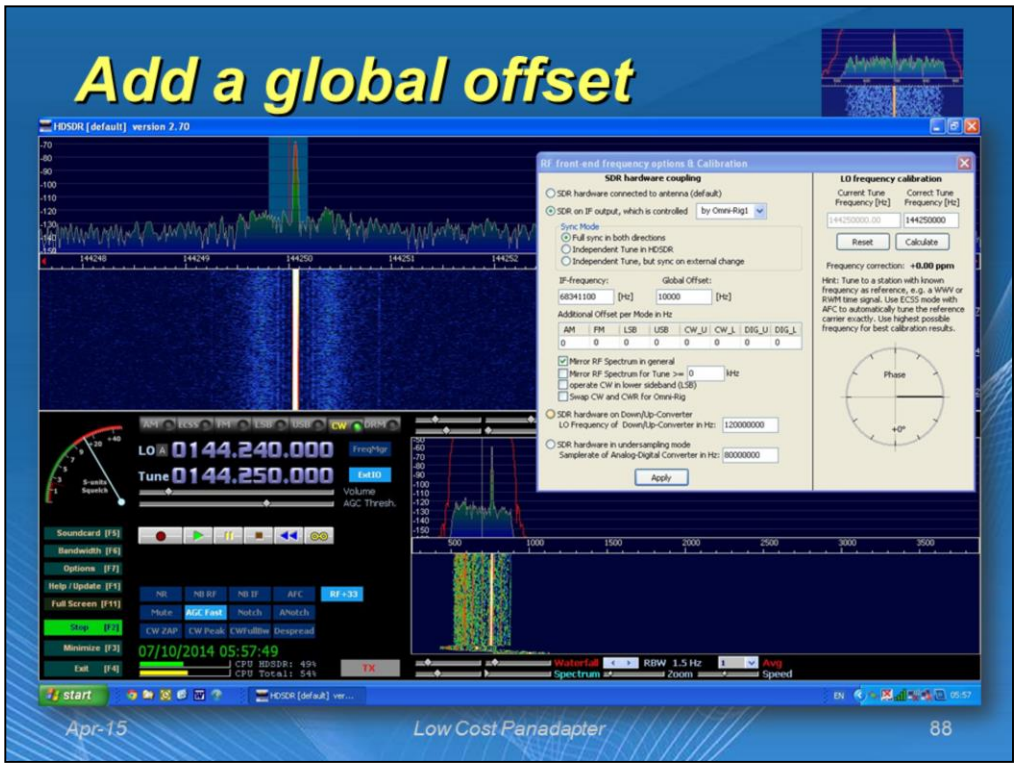
Omni-Rig Configuration



And finally

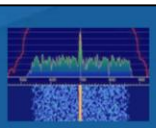
- Plug in the CAT-62 cable
- Band change, tune, or Tx from either HDSDR or the FT-817. Either way settings follow you around like a puppy





10kHz added here jut to shift CF signals away from DC as Rx DC removal was activated.

Bibliography



Web

- W1GHZ panadapter - http://www.w1ghz.org/small_proj/small_proj.htm
- G4HUP PAT http://g4hup.com/PAT.htm
- Elsie Filter design - http://tonnesoftware.com/elsie.html
- Linear Technology LT Spice http://www.linear.com/designtools/software
- NooElec DVB-T dongle http://www.nooelec.com/store/sdr/sdr-receivers/nesdr-mini-rtl2832-r820t.html
- HDSDR http://www.hdsdr.de/
- Omni-Rig http://www.dxatlas.com/OmniRig/