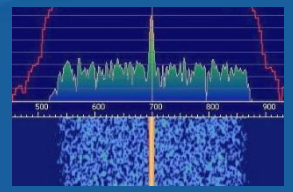
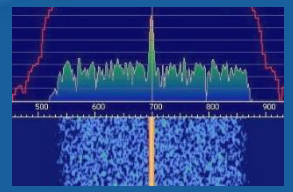


A Low Cost Panadapter Interface to a SDR dongle for radios with a 50 to 70 MHz 1st IF

+

+

Topics Covered



Design

- Find out what others have done & define design objectives
- Circuit design, component selection, PCB generation

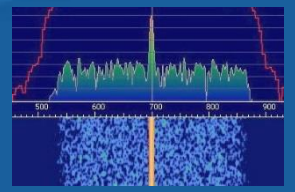
Prototype Construction & Testing

- Filters – simulation & verification
- Main board PCB
- Installing the PCB in a radio

Application Software

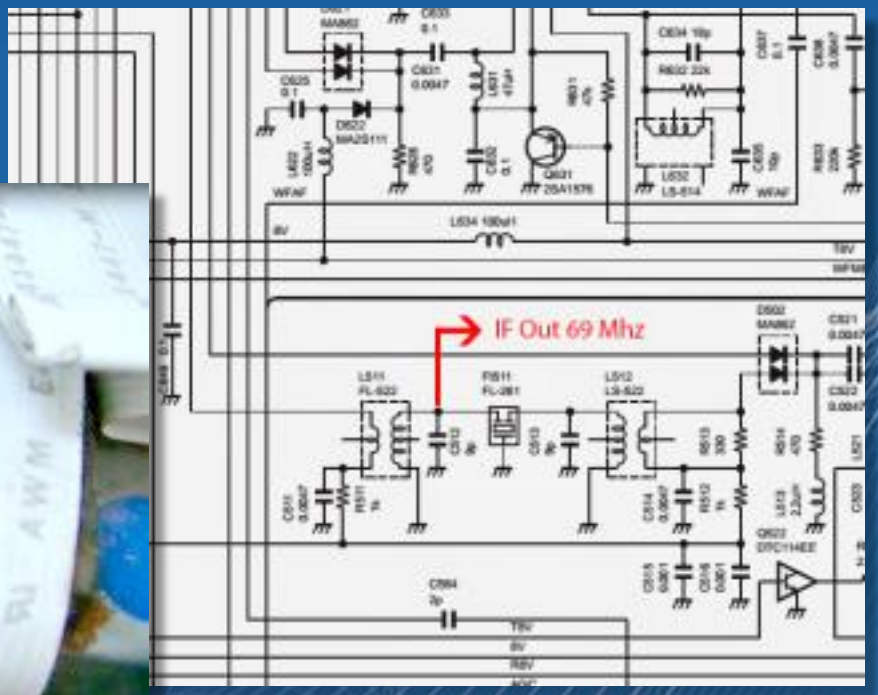
- How do you use this thing?

What others have done



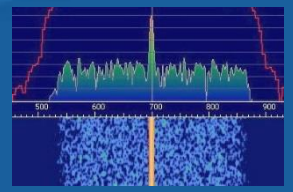
Coax connection directly to the radio's 1st IF

- It works but radio performance can be compromised



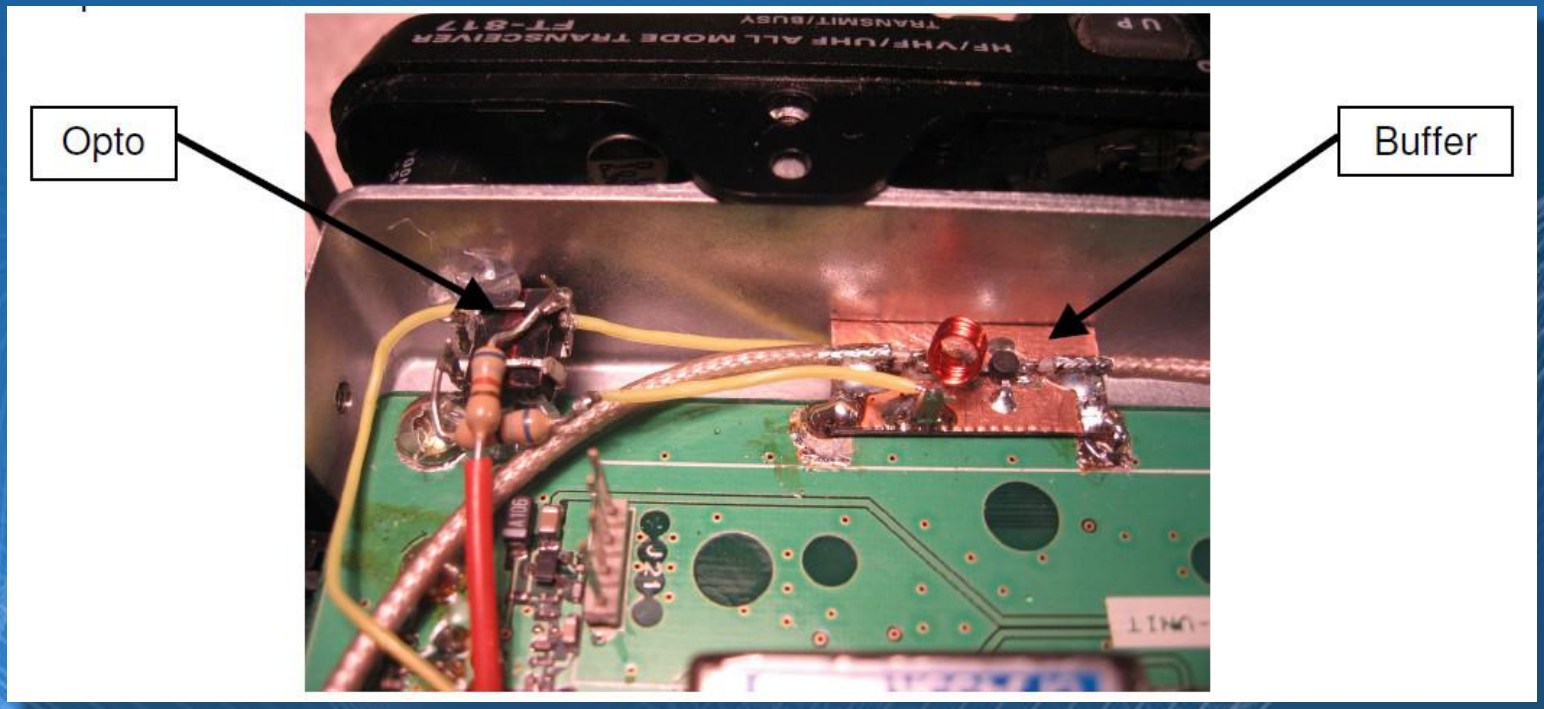
PU2VLW taps the IF on an ICOM 706

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



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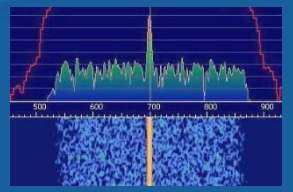
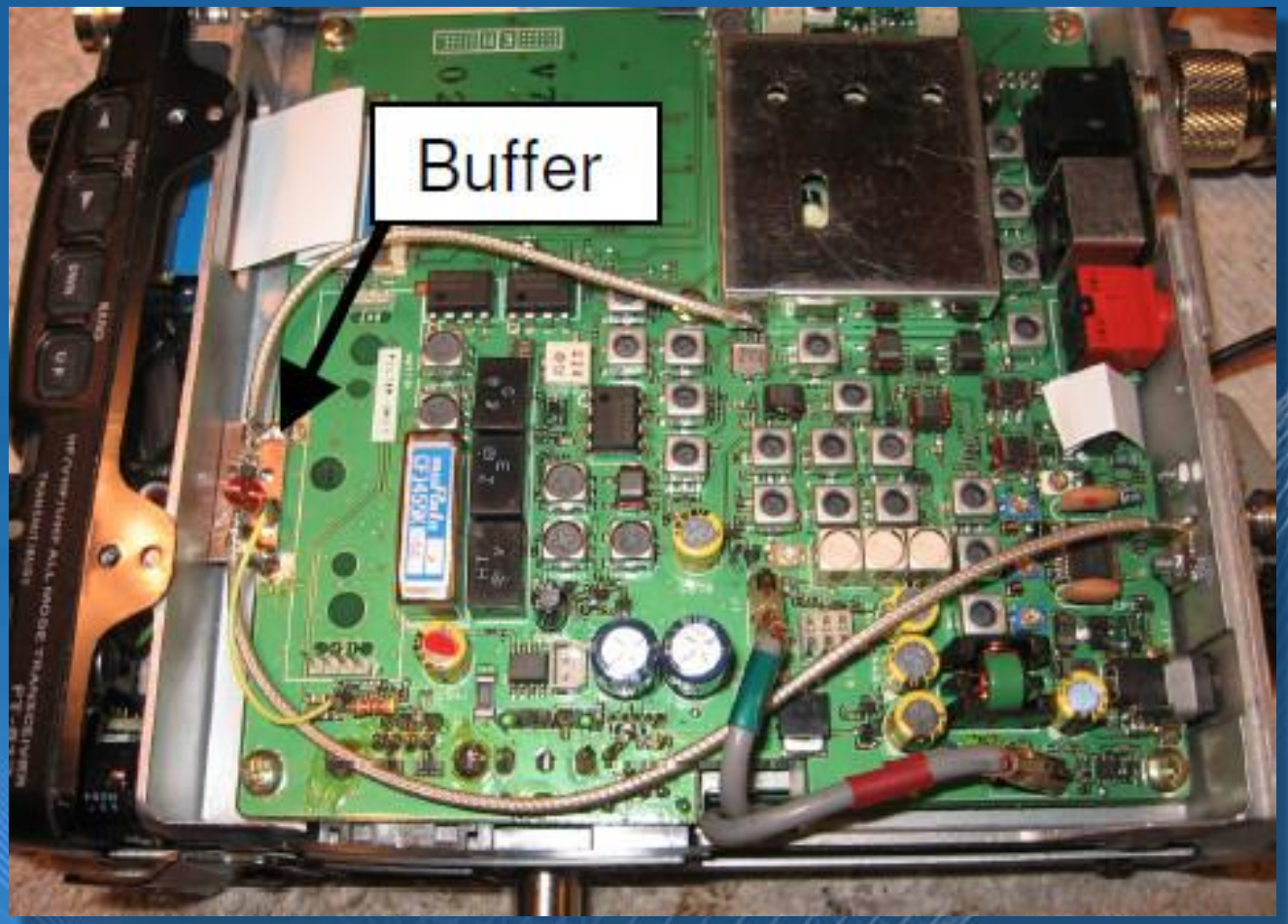
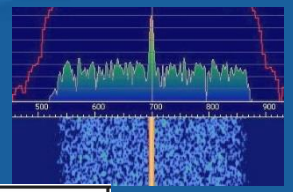


N1JEZ installation in FT817

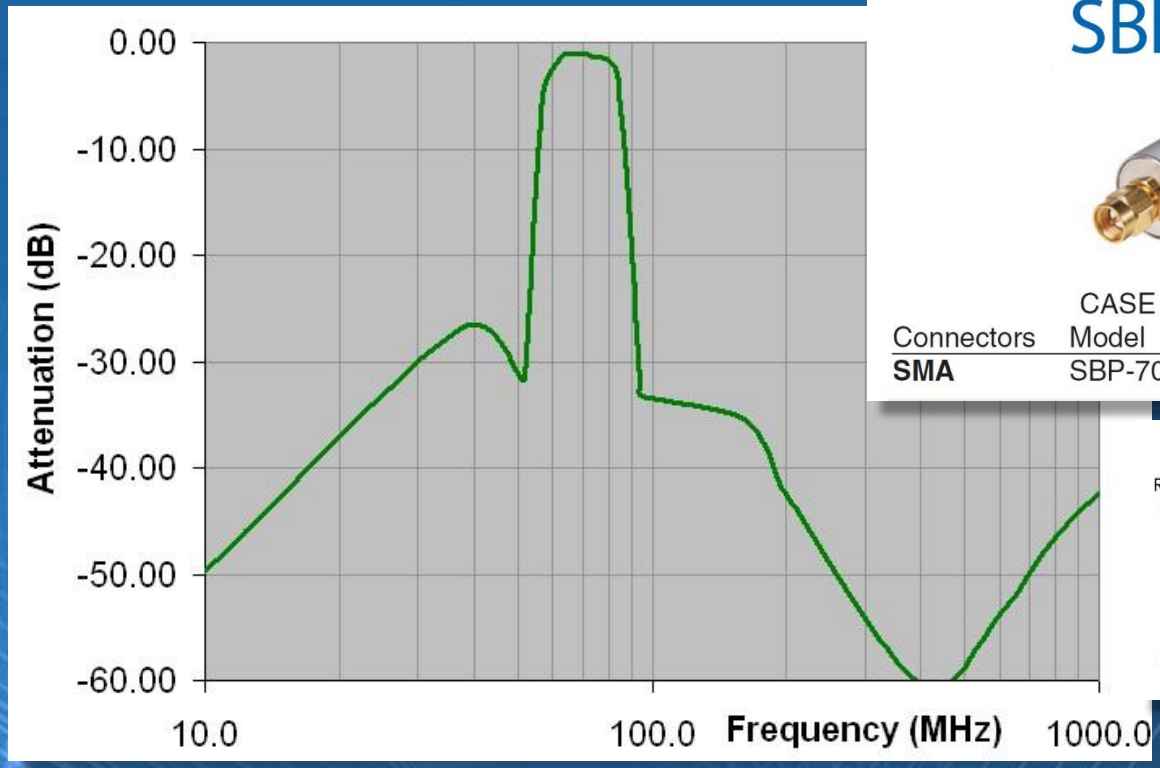


What others have done…



SPB70 Filter

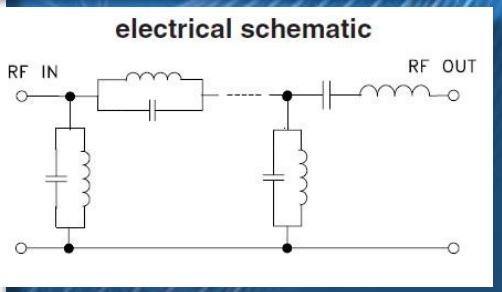
CENTER FREQ. (MHz)	PASSBAND (MHz) I.L. 1.5 dB Max.	3dB BANDWIDTH (MHz) Typ.	STOPBANDS (I. loss > 20 dB) at MHz	STOPBANDS (I. loss > 35 dB) at MHz
70	63-77	58-82	51 & 94	6.0 & 193-1000



SBP-70+

CASE STYLE: FF99

Connectors	Model	Price	Qty.
SMA	SBP-70+	$42.95 ea.	(1-9)



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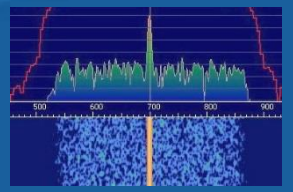
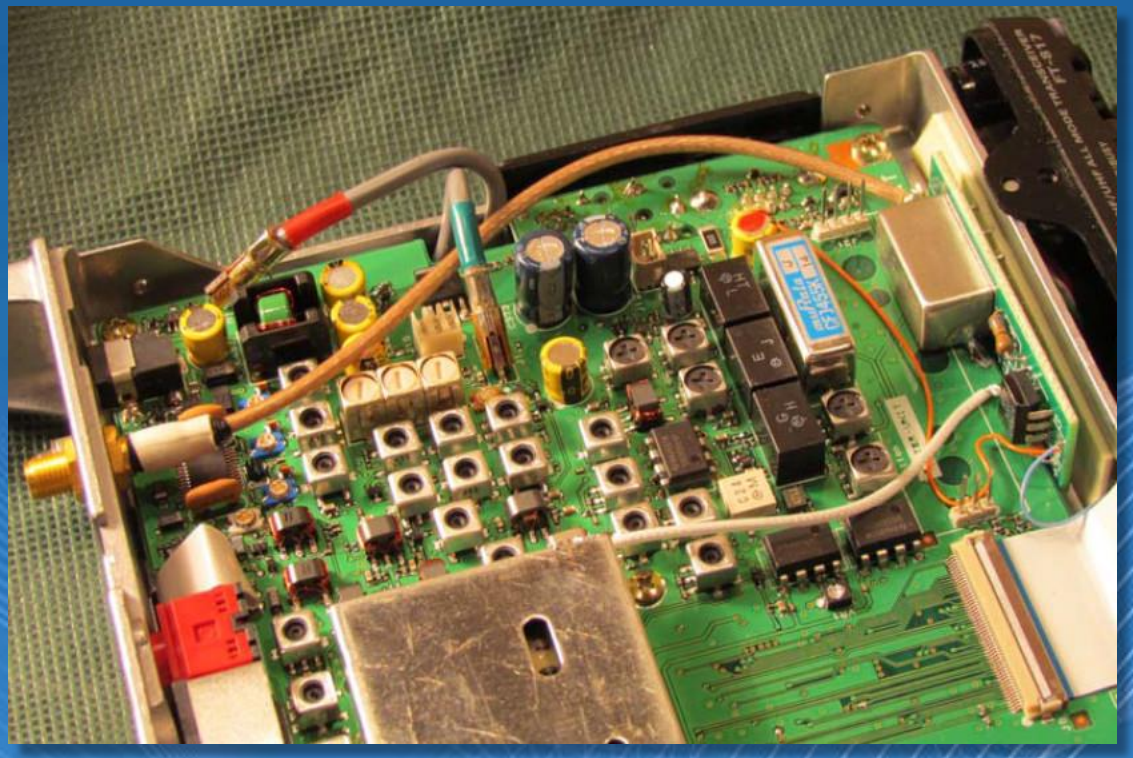


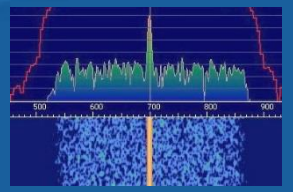
Paul Wade W1GHZ

PCB for the FT-817 Panadapter

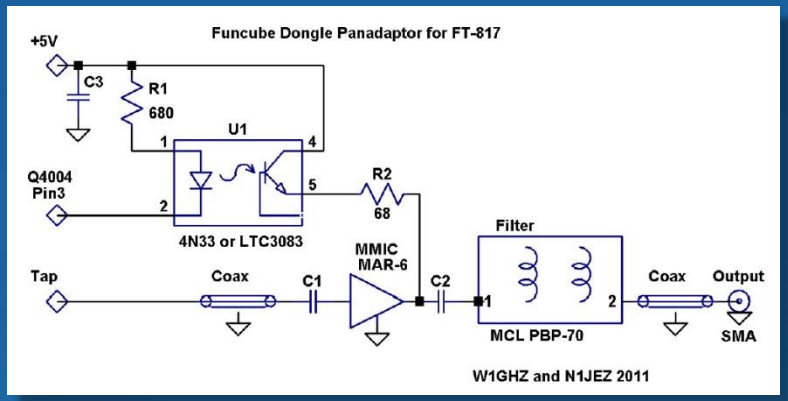
- Creates a PCB for Mike's design using less expensive PC mounted version of the Mini-Circuits MPL-PBP70 filter

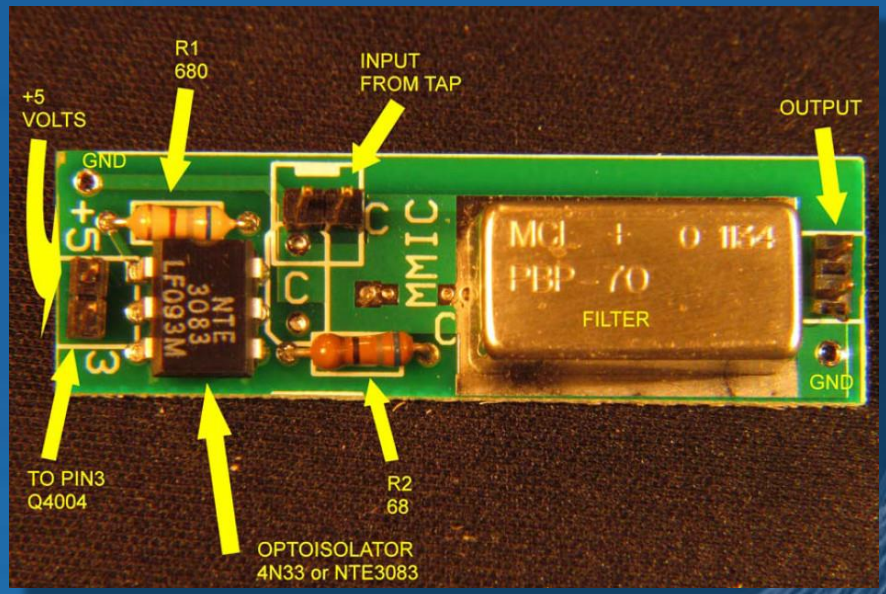


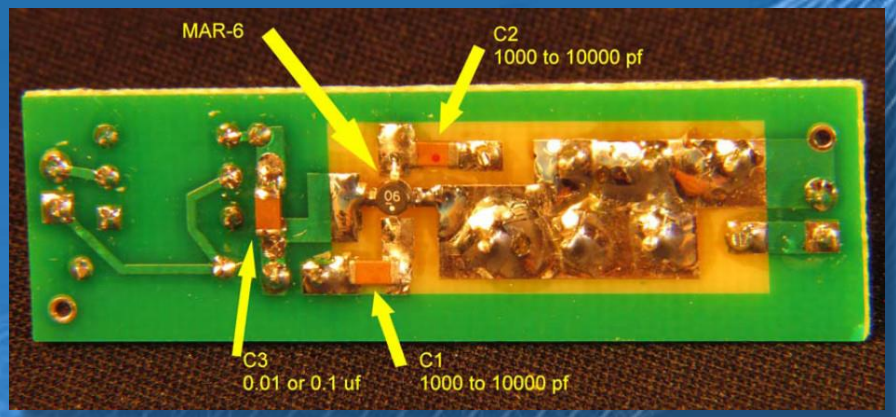
What others have done…



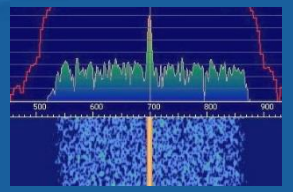
W1GHZ cont'd





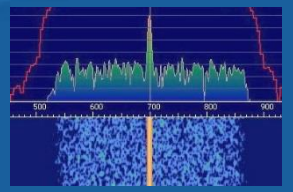


What others have done…

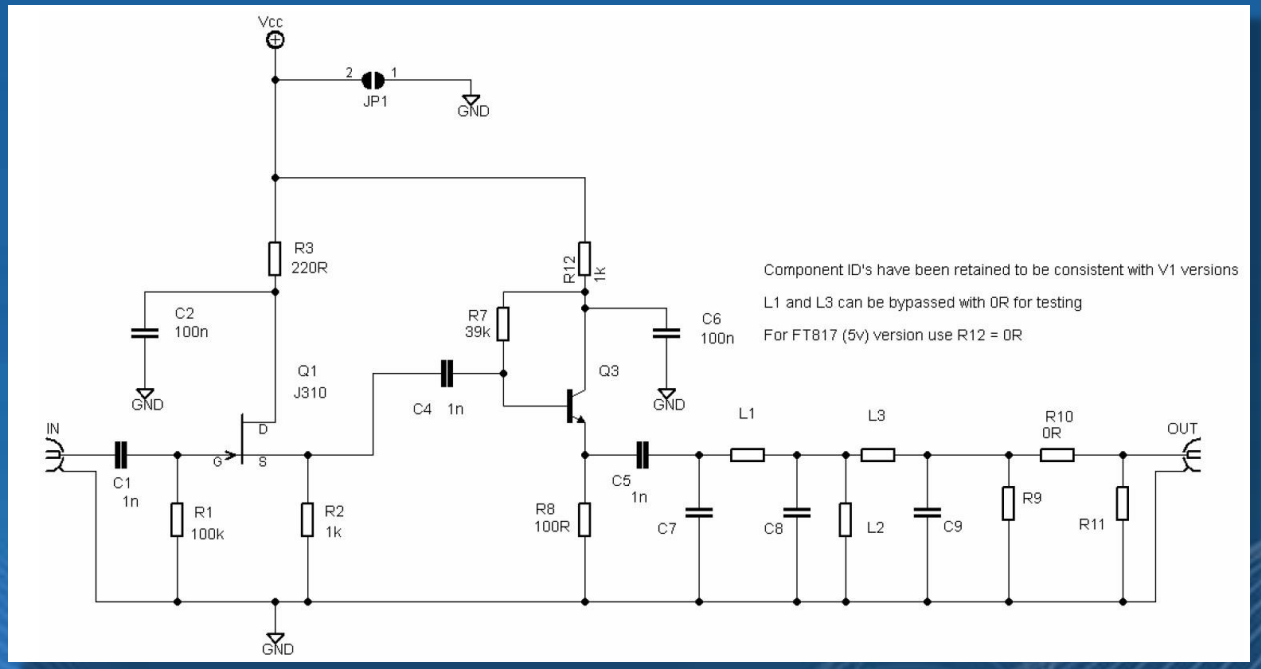


Mike shoe horns PCB into a unit with CW filter

What others have done…

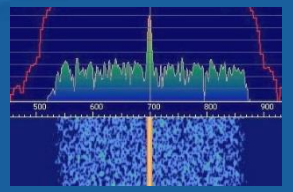


G4HUP PAT (Panoramic Adapter Tap)

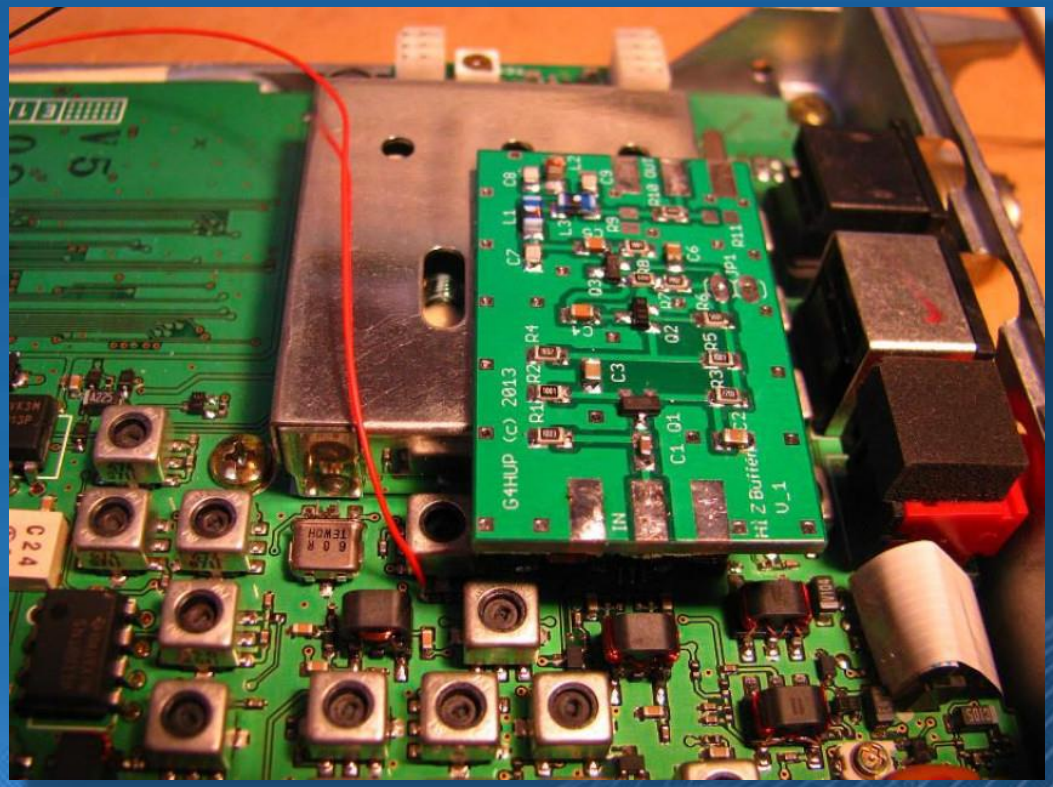


- Two voltage followers, low pass filter & attenuator
- Filter components can be chosen for IF's from 10-70MHz
- Power supply range is 5 to 13V.

What others have done…

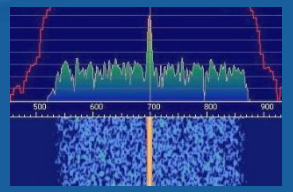


G4HUP PAT in a Yaesu FT817



- PAT on the PLL shield held in place with double sided tape
- PCB layout – generous space for beginner SMT assembly

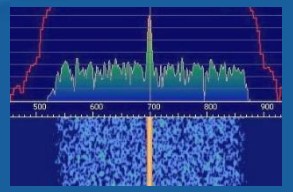
Design Objectives



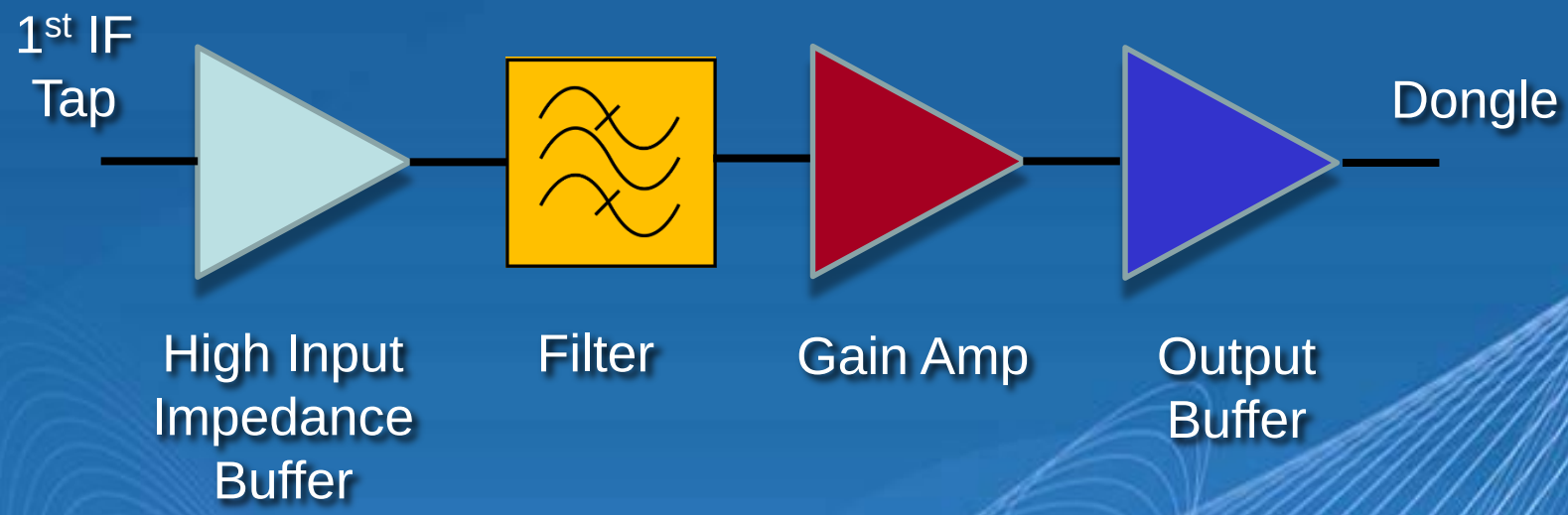
1st IF interface design goals

- Low current consumption. Target about 5mA
- No impact on receiver sensitivity
- Small size so that it could be installed into most radios
- Versatile
  - Can be used with a variety of supply voltages from 5 to 14V
  - Usable with any radio 1st IF's in the 50-70 MHz range
- IF output must remain stable with any dongle load or open circuit
- Low cost

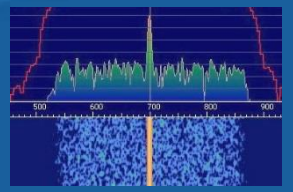
Interface Block diagram



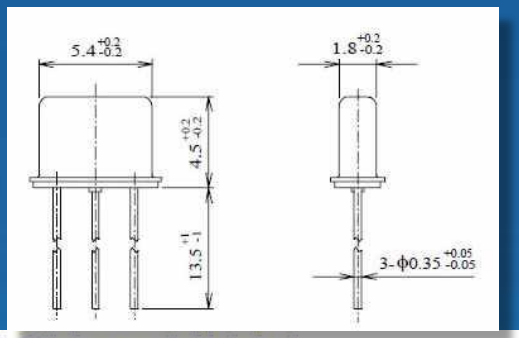
Three Stage Solution

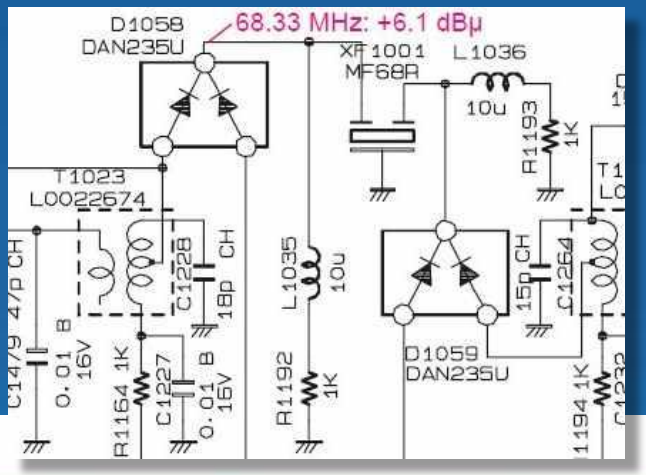


High Z Input Buffer



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

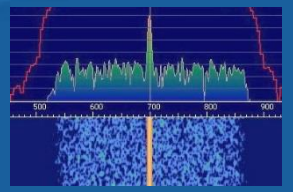




■標準仕様 ¦ Standard Shi yoshikidai

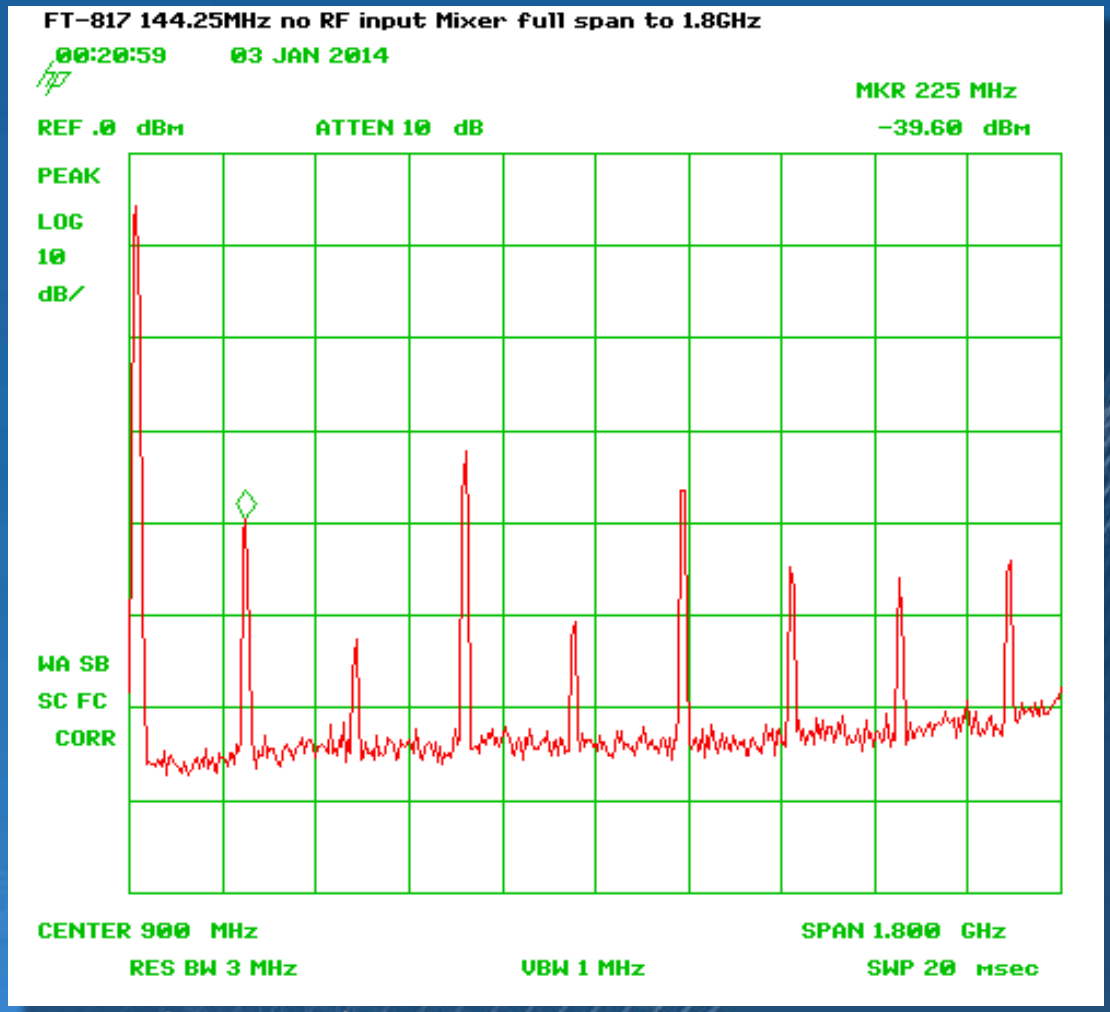
名称	Name	MF40M2(2pole)	MF45U9(2pole)	MF68Q(2pole)
公称周波数	Nominal Frequency		45.000 (MHz)	68.330 (MHz)
通過帯域幅	Bands domain via the web		3.0 (dB): ±15.0kHz min.	3.0 (dB): ±6.00kHz min.
減衰帯域幅	Bands domain via amplidude damping		15.0 (dB): ±60.0kHz max.	15.0 (dB): ±25.0kHz max.
ﾘﾌﾟﾙ	Ripple	1.0 max. (dB)	1.0 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)

Filter

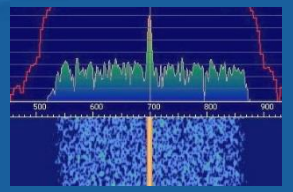


Why?...The 1st IF is not quiet !

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

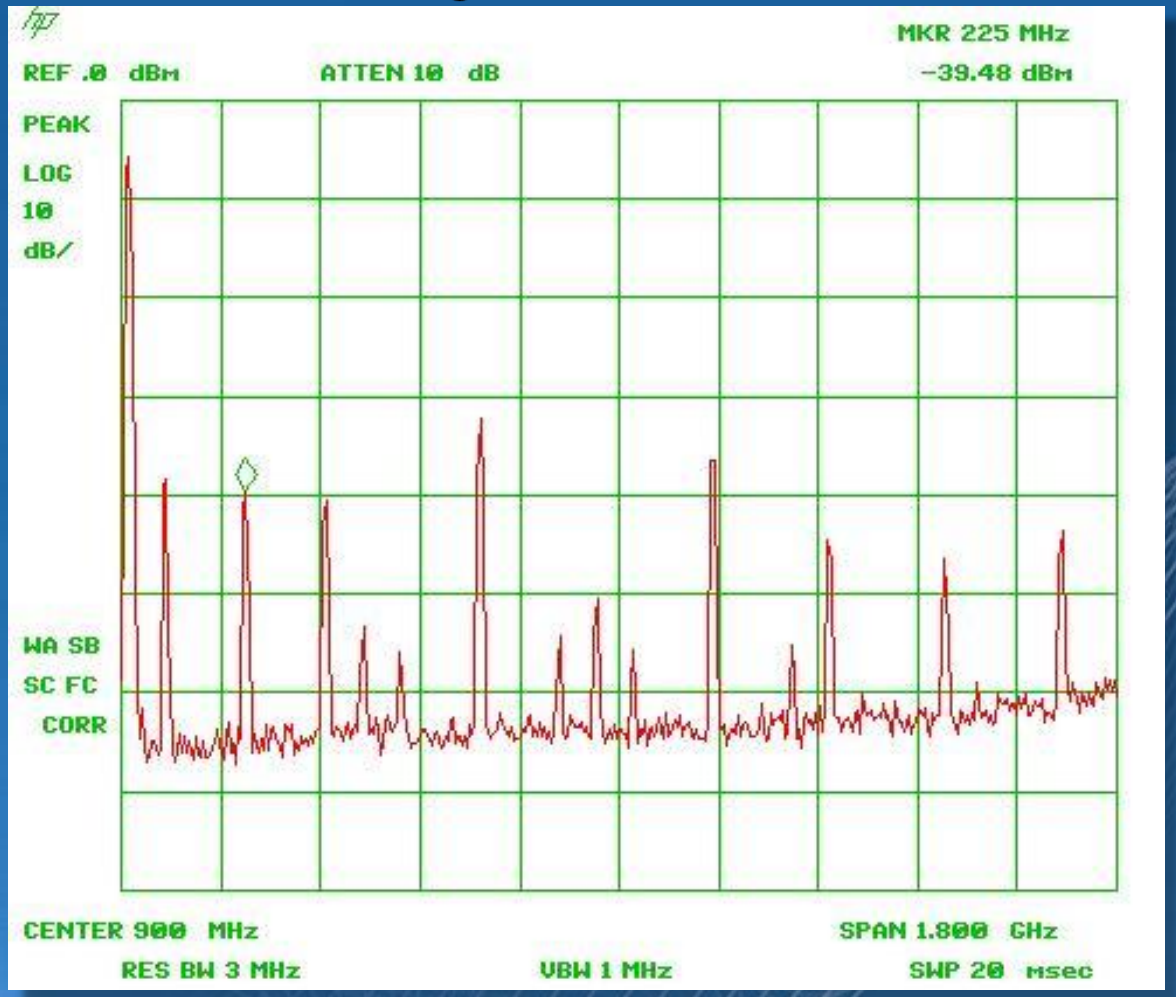


Filter (cont'd)

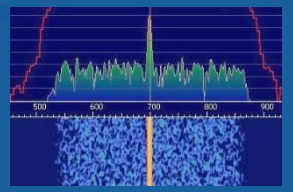


1st IF @ 2m with -50dBm CW signal at 144.25MHz

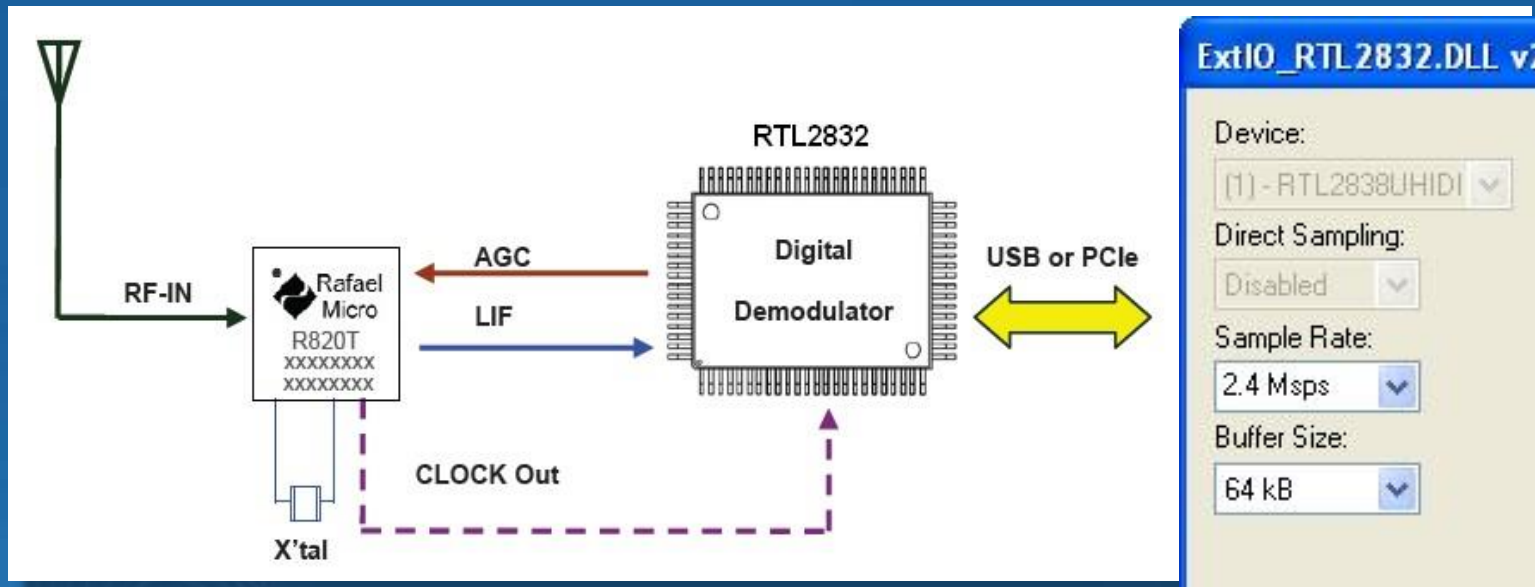
With a moderately large input signal there are several carriers that have levels close to or higher than the intended RF signal.

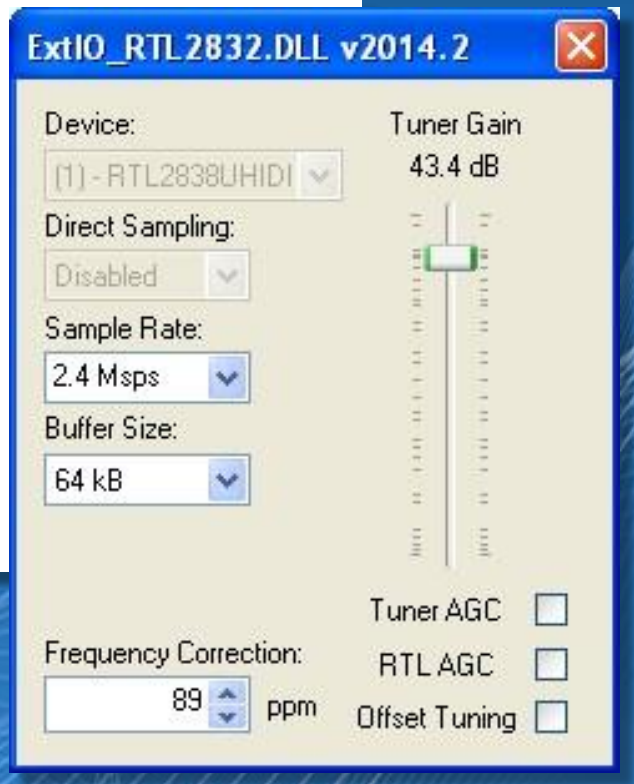


Filter (cont'd)



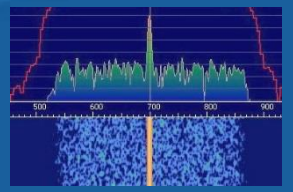
Impact of large out of band signals on receive sensitivity



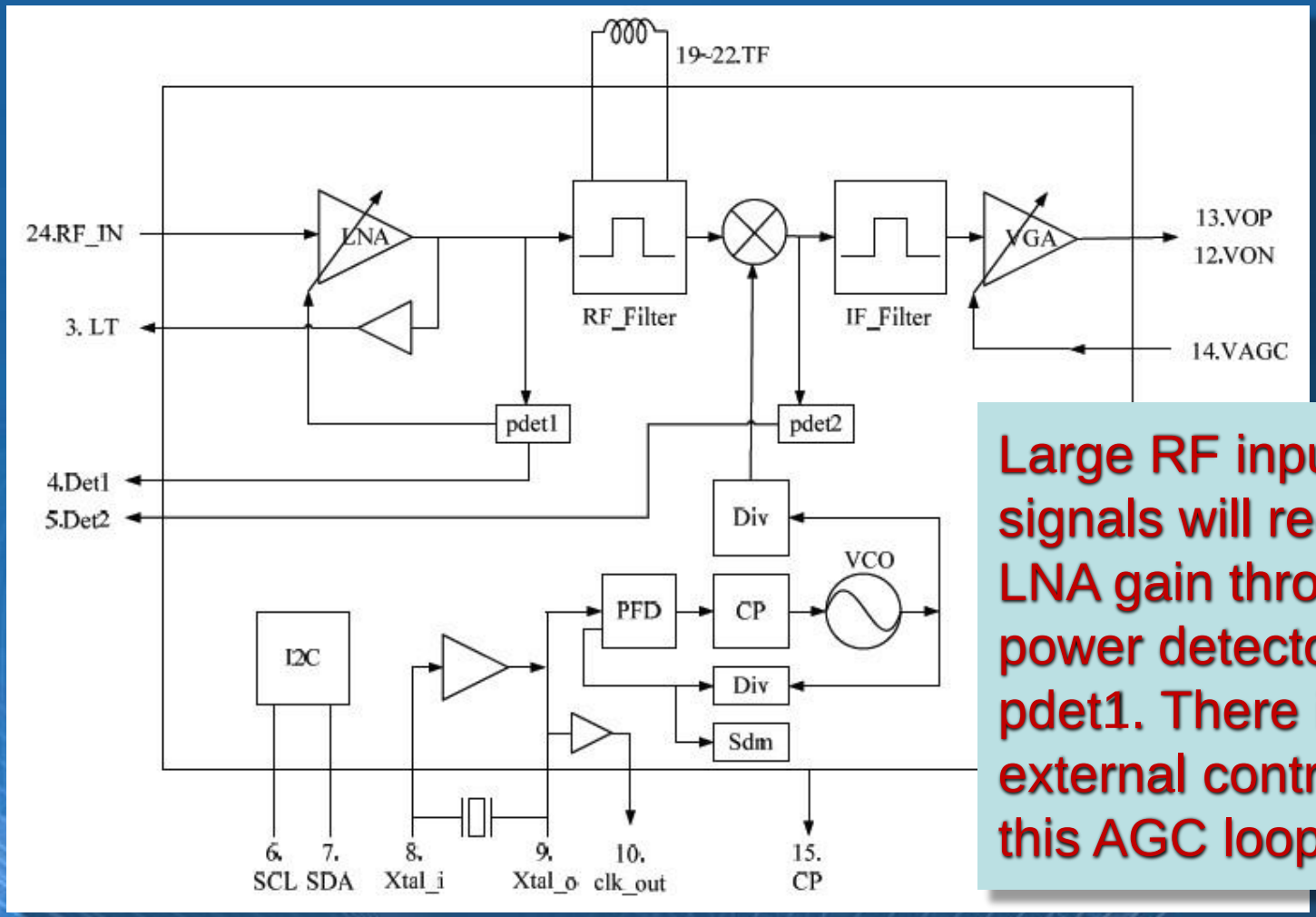


There are typically three AGC loops in most SDR dongles
Two can be selectively controlled by most applications

Filter (cont'd)

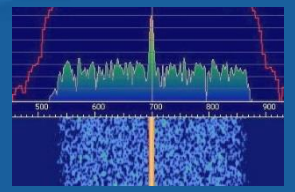


The third within the RT820 is autonomous AGC around the LNA



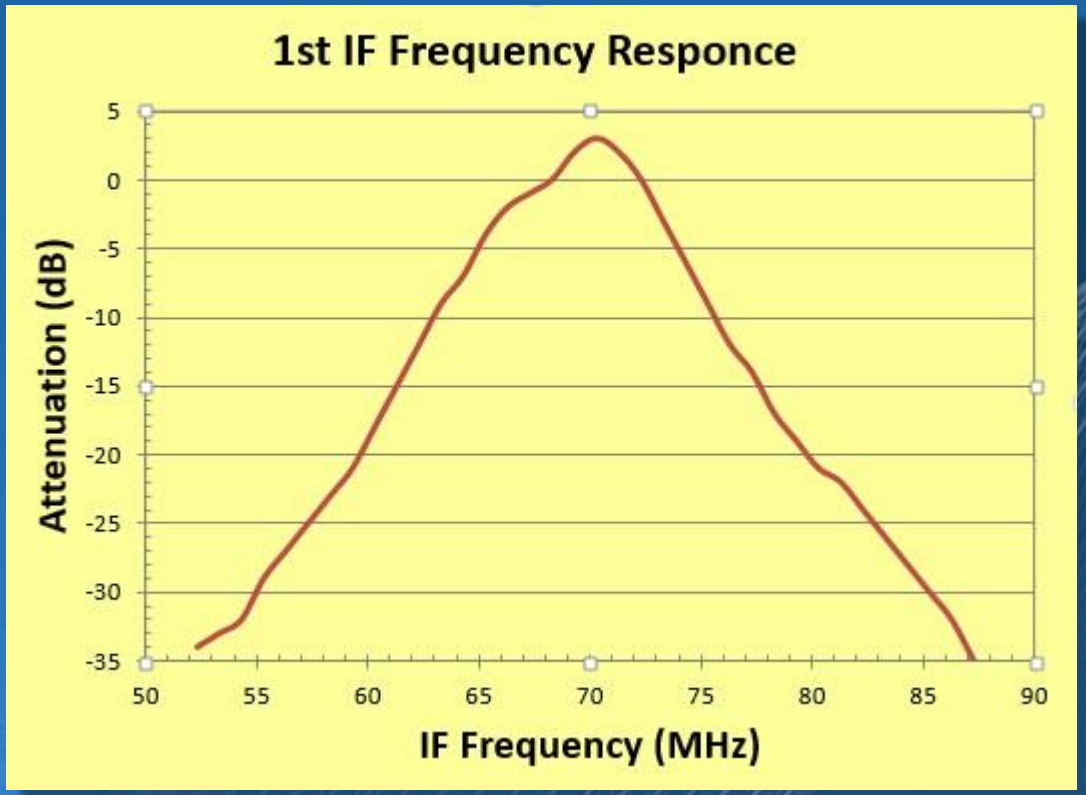
Large RF input signals will reduce LNA gain through power detector pdet1. There is no external control for this AGC loop

Filter (cont'd)

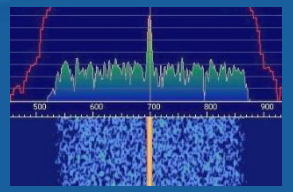


Large unwanted signals within the dongle's passband will reduce receiver sensitivity

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



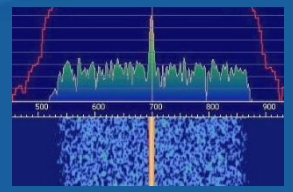
Filter (cont'd)



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

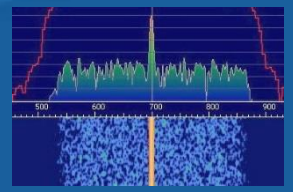
Filter (cont'd)



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?

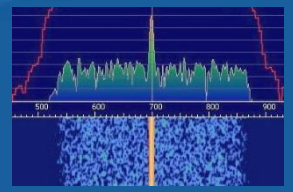
- Well not a lot really
- There is conversion gain from the RF input to the 1st IF

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

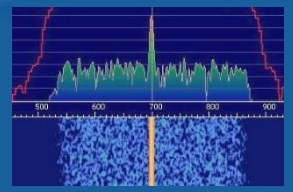
How much gain?



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.

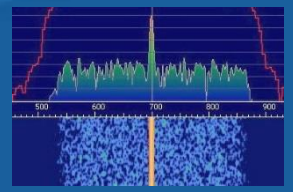
Output Driver



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.

NooElec RT820 Dongle



S11 @ 68.3MHz Rs=68ohms CP=13pF VSWR=1.6

Load Data | Refresh | Enabl | Main/Axis Titles | Legend | Copy | GIF | Print Preview | Dots On/Off | Line Weight | Generate Data

Rs — Max: 64.303 — Left scale (S11)

S11 Rs & S11 Cp vs Frequency

Right scale (S11) — Cp (pF) — Max: 18.85704

S11 Rs: 65, 64, 63, 62, 61, 60, 59, 58

S11 Cp (pF): 20, 18, 16, 14, 12, 10, 8, 6, 4, 2, 0

M1

50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100

Frequency (MHz)

Set/Lock Scales | Snapshots

50

Data currently loaded is from:
NoolElec RT820 SDR 50-100MHz.s2p (S11)
Modified: 01/01/2014 15:16:43

Change S2P Subset(s) | Save as S1P

Chart frequency markers are synchronized. Click on any chart to change marker.

Reference Lines: Left 1 | Right 1 | Left 2 | Right 2

Add/Subt T Line | Measure TL Parms

Click new point or use spinner. Click outside or press ESC to remove.

M1

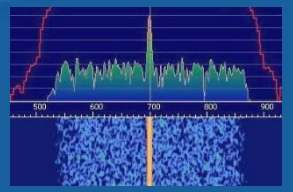
Use the Snapshots button to allow display of more than two trace lines.

Freq KHz/Hz

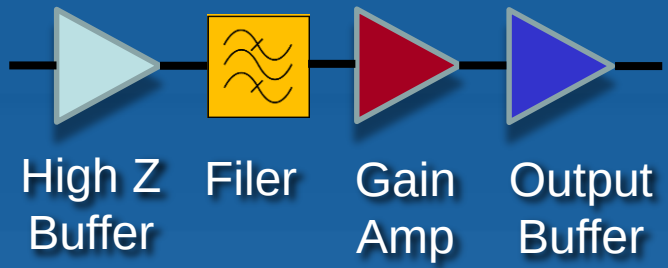
	Freq (MHz)	SWR	Rs	Xs	Zmag	Theta	Rho	RL	Phase
Marker1	68.250	1.617	61.917	-24.210	66.482	-21.36	0.2357	-12.554	-51.59

Text on screen

Solution Summary



Input Buffer



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

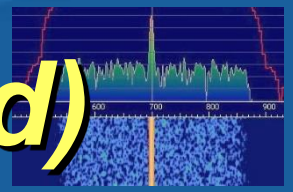
Filter

- 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

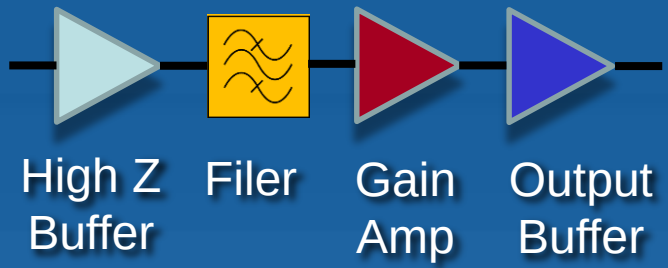
- 6-10 dB gain (4 to 8 dB overall after filter loss)
- Zin matched to filter - 50 Ohms

Solution Summary (cont'd)



Output Buffer

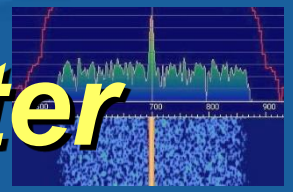
- Unconditionally stable working into an open circuit
- Able to drive most (all) dongles



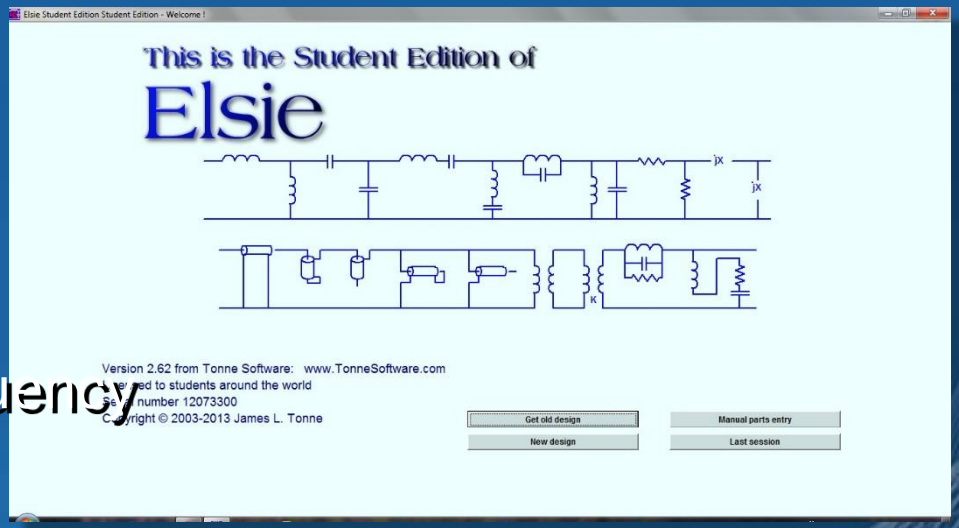
Other Criteria

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

Design…start with the filter



Elsie Filter Design

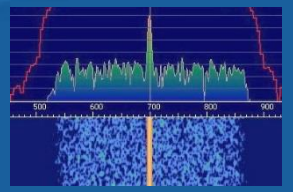


- Explore Filter topology & family
- Explore filter properties
  - bandwidth - center frequency
  - filter order - Z in & out
- Access impact of other parameters
  - capacitor and inductor Q

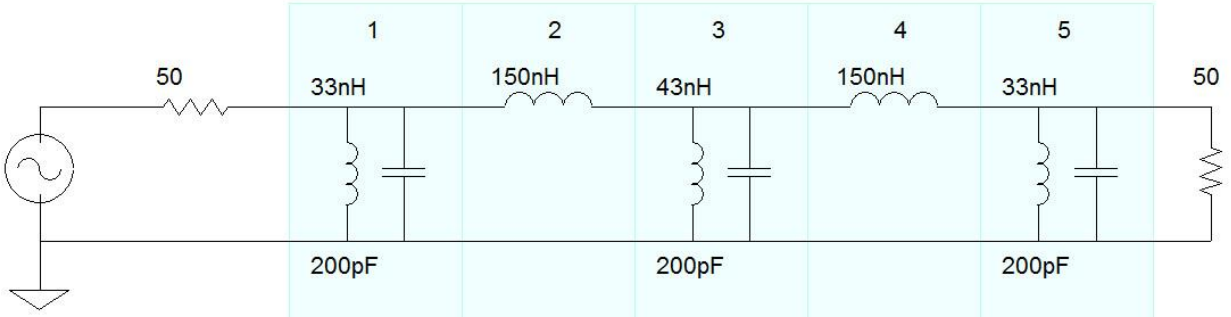
Filter Topology Chosen

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

Filter Quest



Choose the filter topology & key parameters

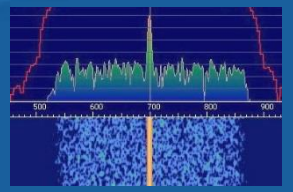


Design data:
Bandwidth: 10M
Center: 67M
Family: Manual entry

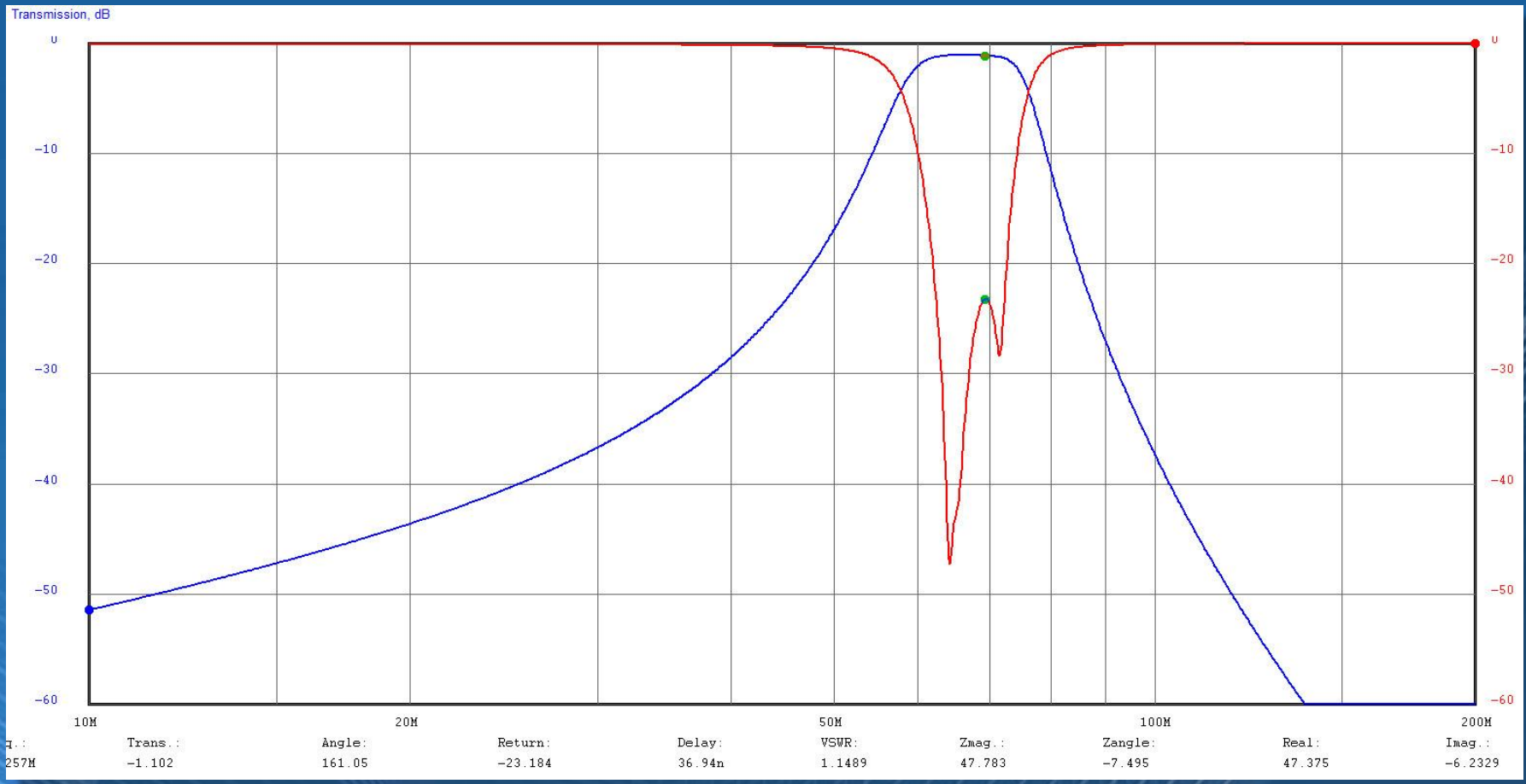
Q values:
Inductors: 80
Capacitors: 300

Maximum / minimum ratios:
Capacitors: 1
Inductors: 4.5455

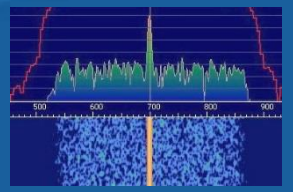
Filter Quest



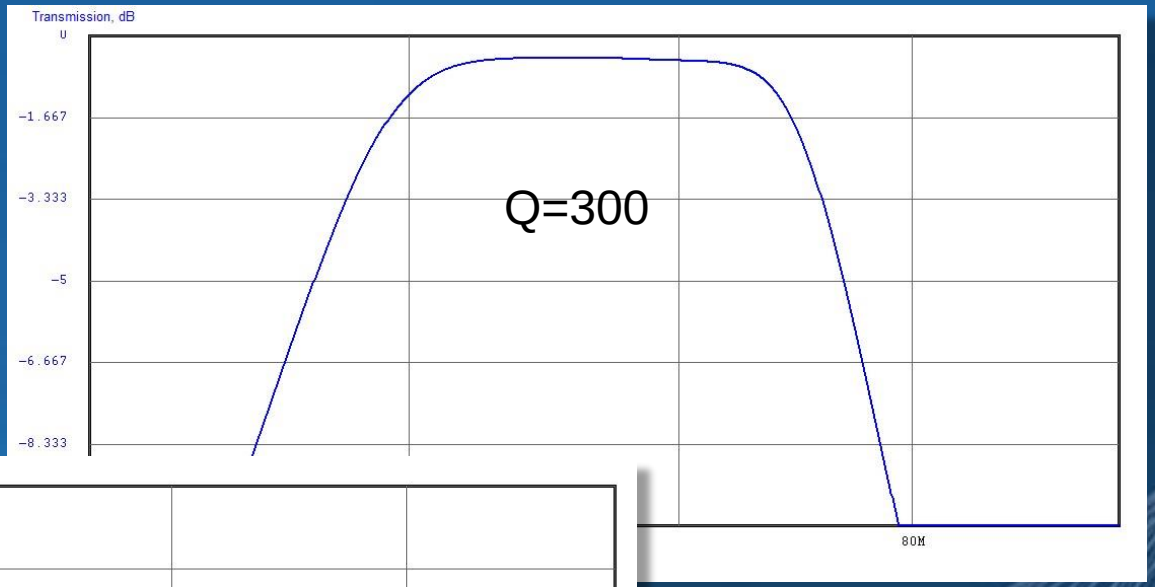
- Filter S21 & return loss - plot marker at 68.33MHz

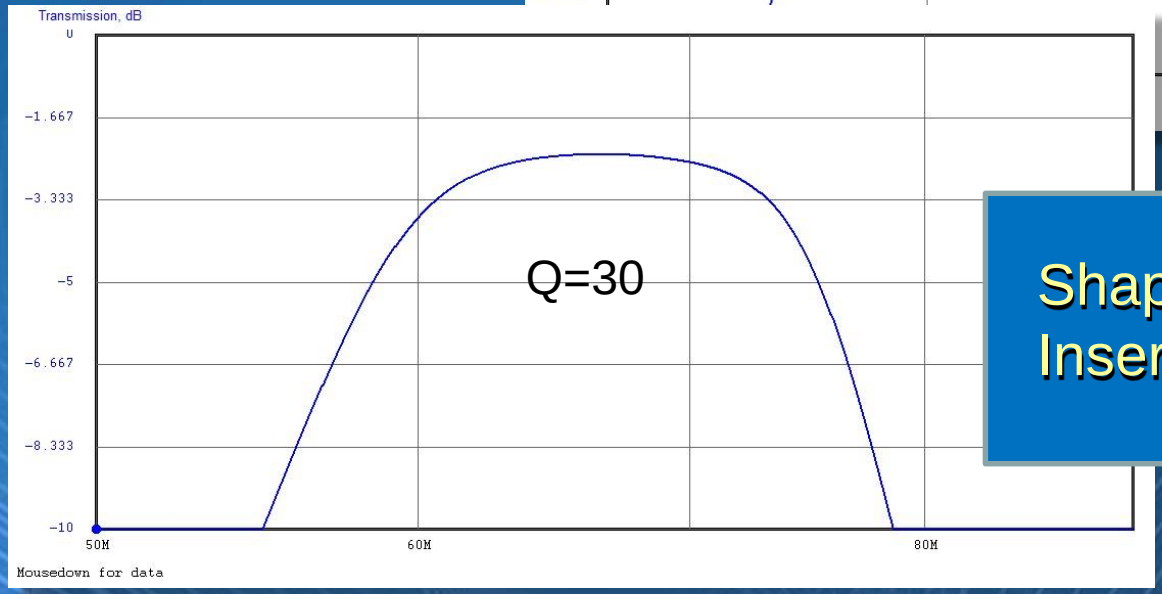


Filter Quest



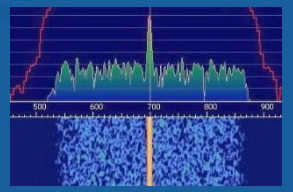
Inductor Q





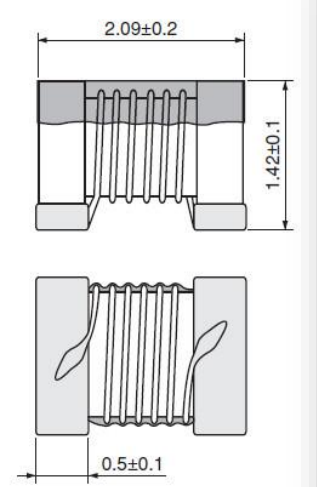
Shape factor degrades
Insertion loss increases

Filter Inductor Selection

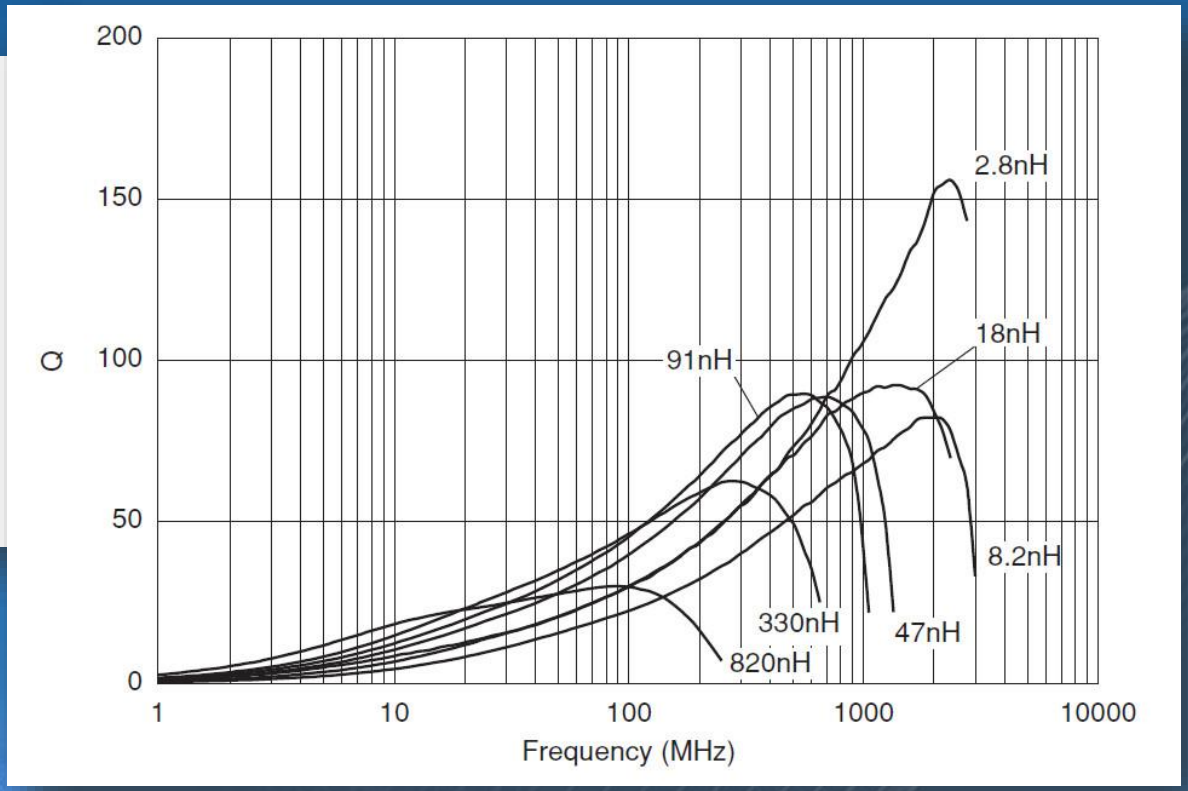


Inductors – hard to find small parts with high Q

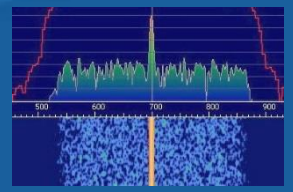
- Small Physical size < 3mm w & h x 6 -7 mm l
- Q > 50 preferably 70-100 at 70MHz.



Murata LQW2BA inductors

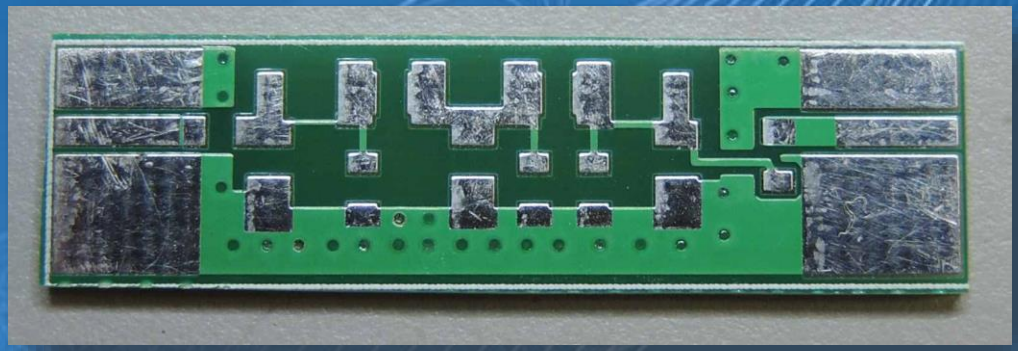


Filter Considerations

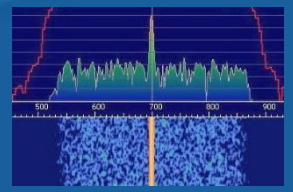


The criteria that simulation won't easily tell you

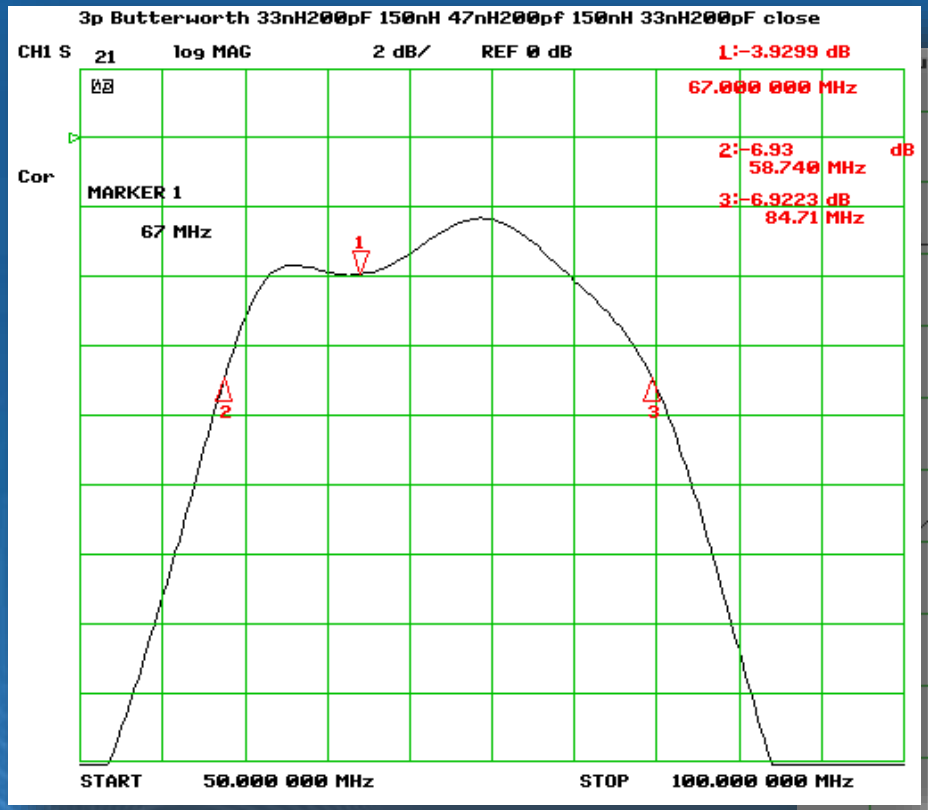
- Multiple inductor placement on PC & mutual coupling
  - Space in-line inductors a minimum of 2 diameters apart
  - Place inductors orthogonal where possible
- PCB groundplane impact on filter
  - Standard practice removes the ground plane under the filter on all cu planes – how far away from filter 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

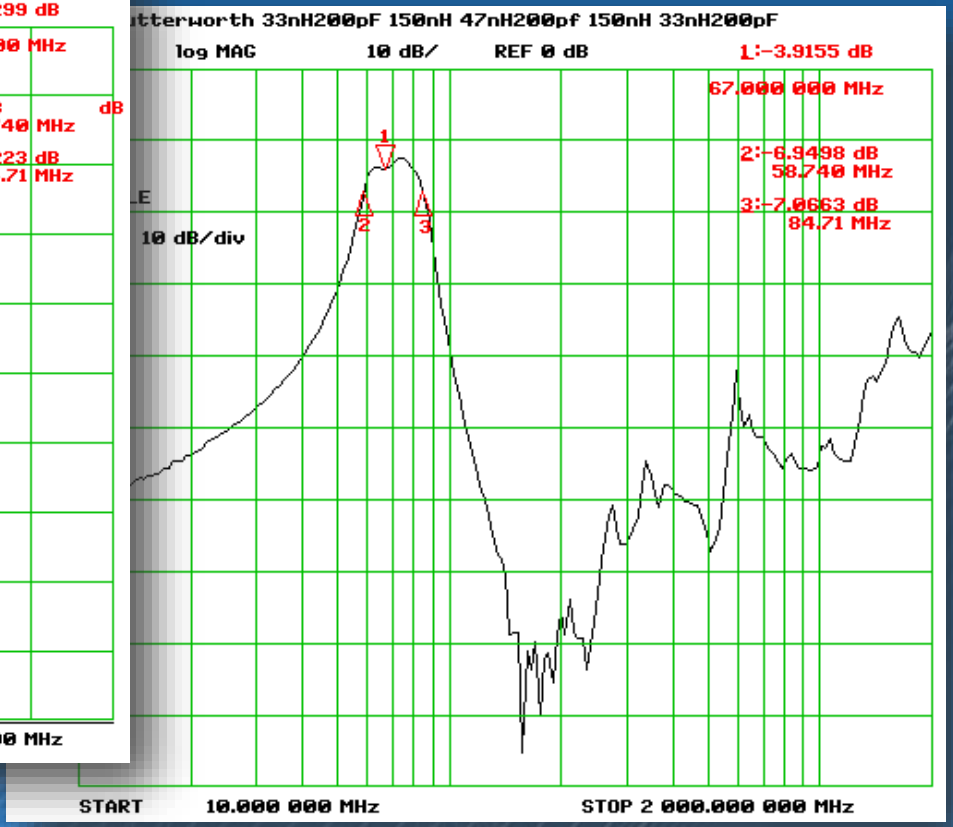


First Filter Tests

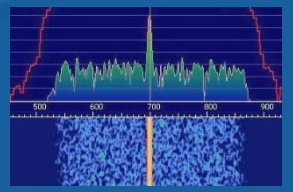


Didn't work out well

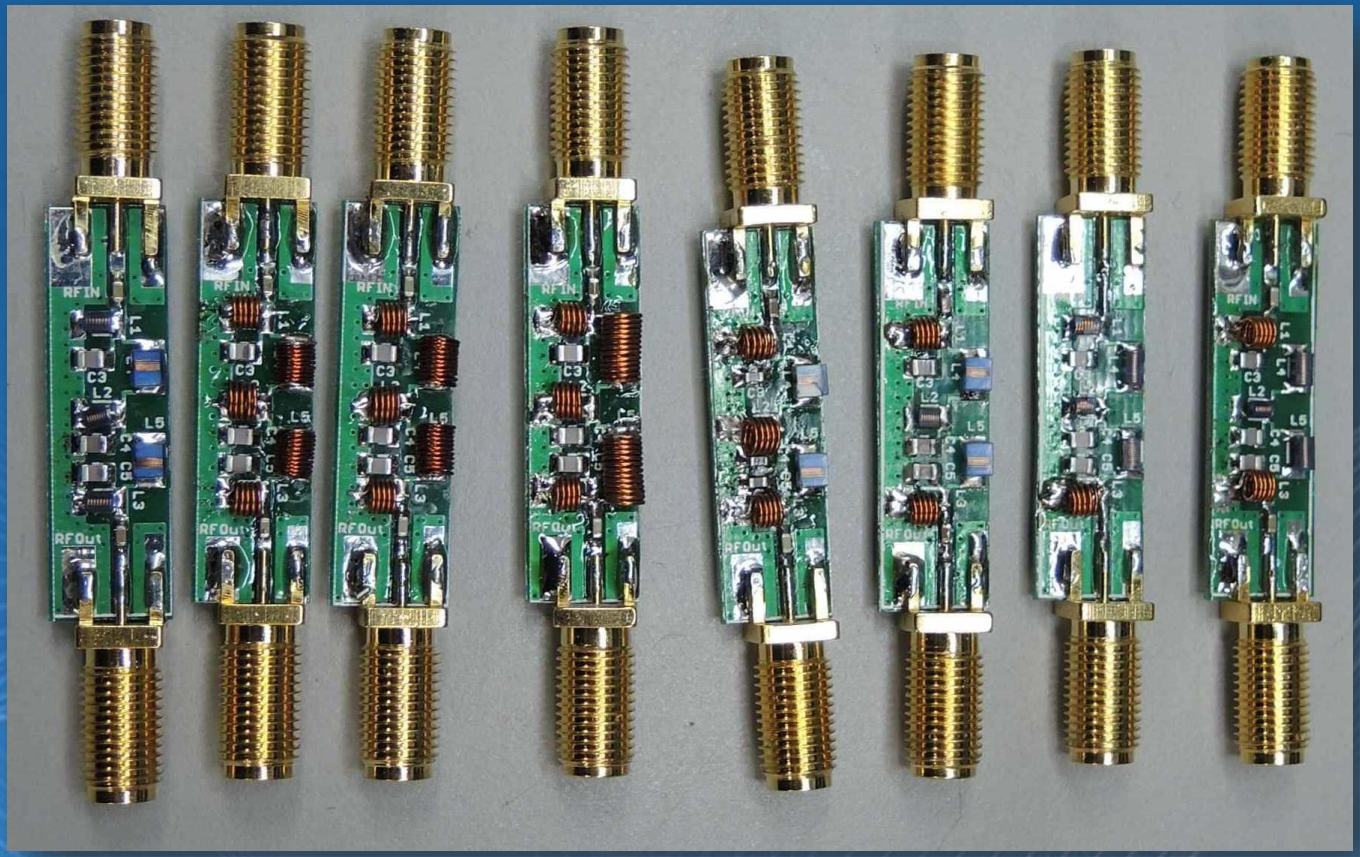




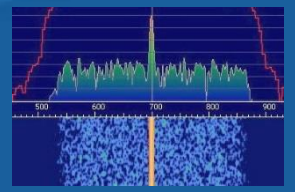
First Filter Tests (cont'd)



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



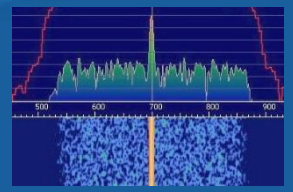
Test Equipment Added



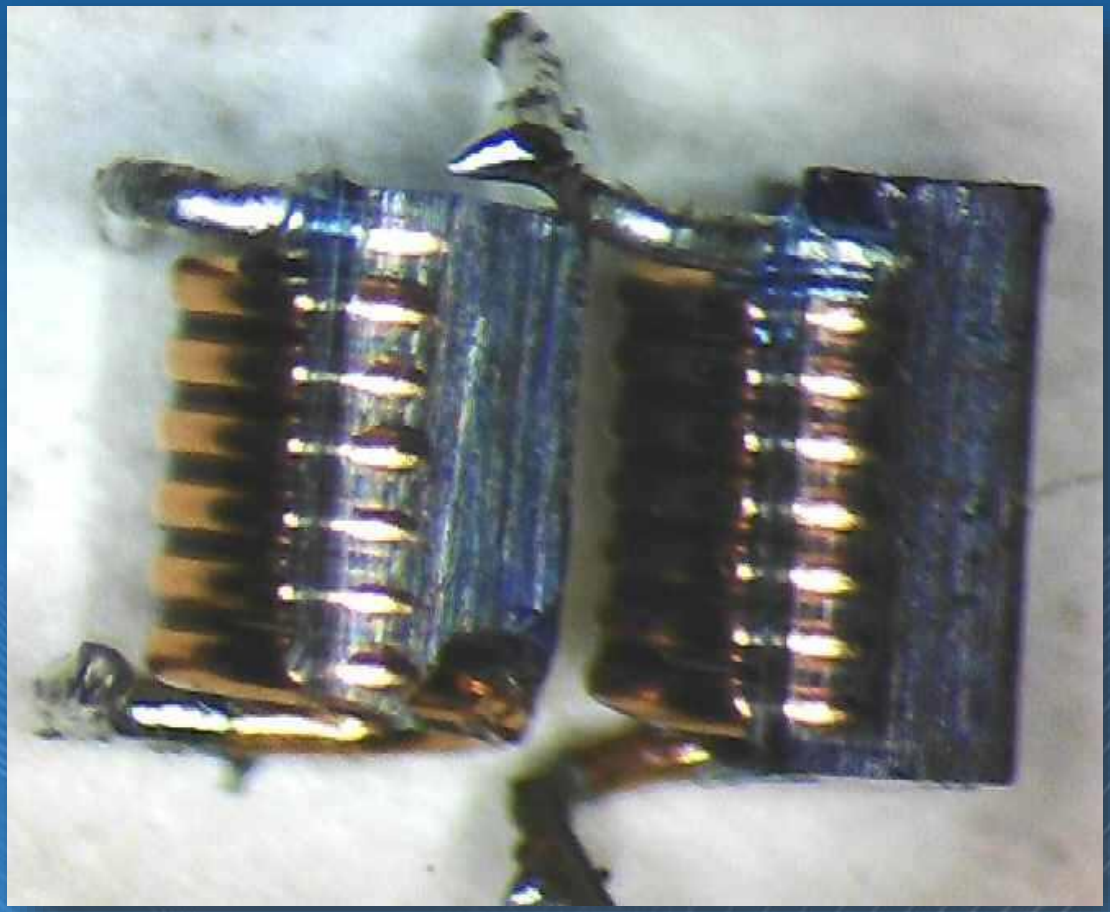
HP 4274 /5

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

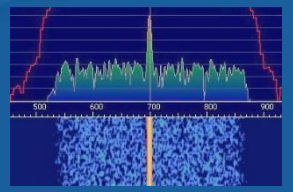
Found the Culprit



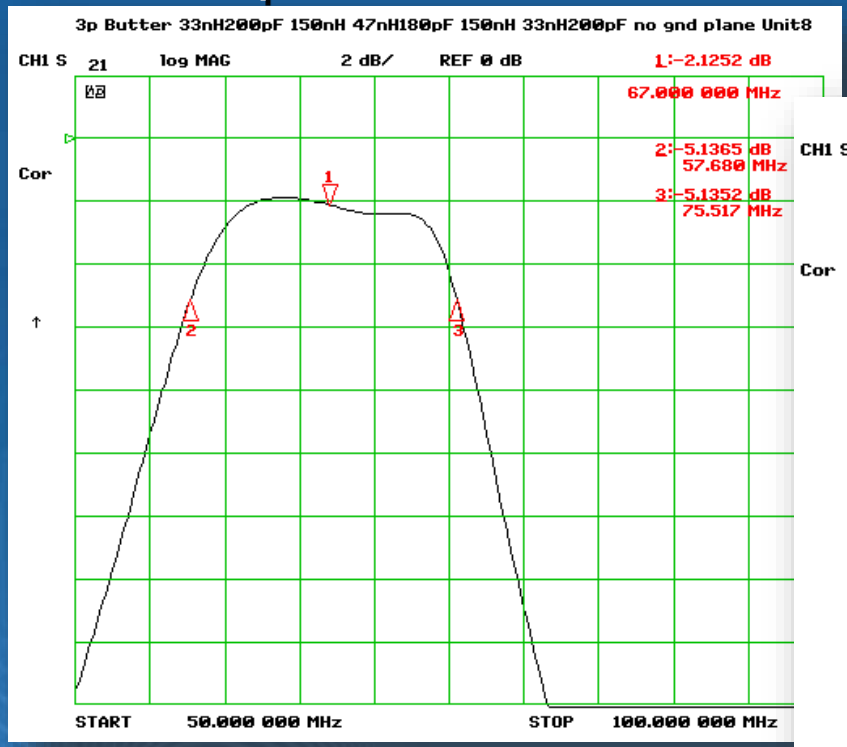
Abracon had mixed in some 22nH inductors along with 33nH parts. The inductors are the same diameter but one turn less

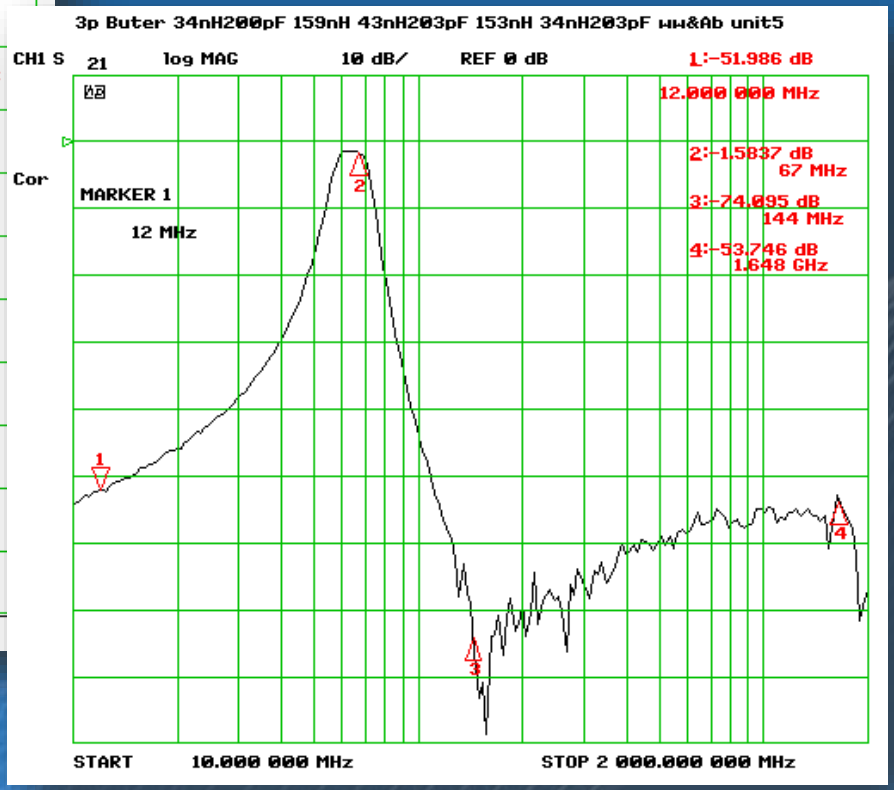


Working filter

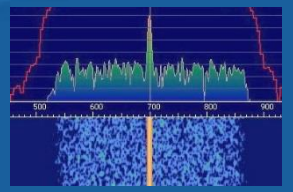


- Reasonable passband characteristics with standard parts
- Stop band attenuation best with full back ground plane

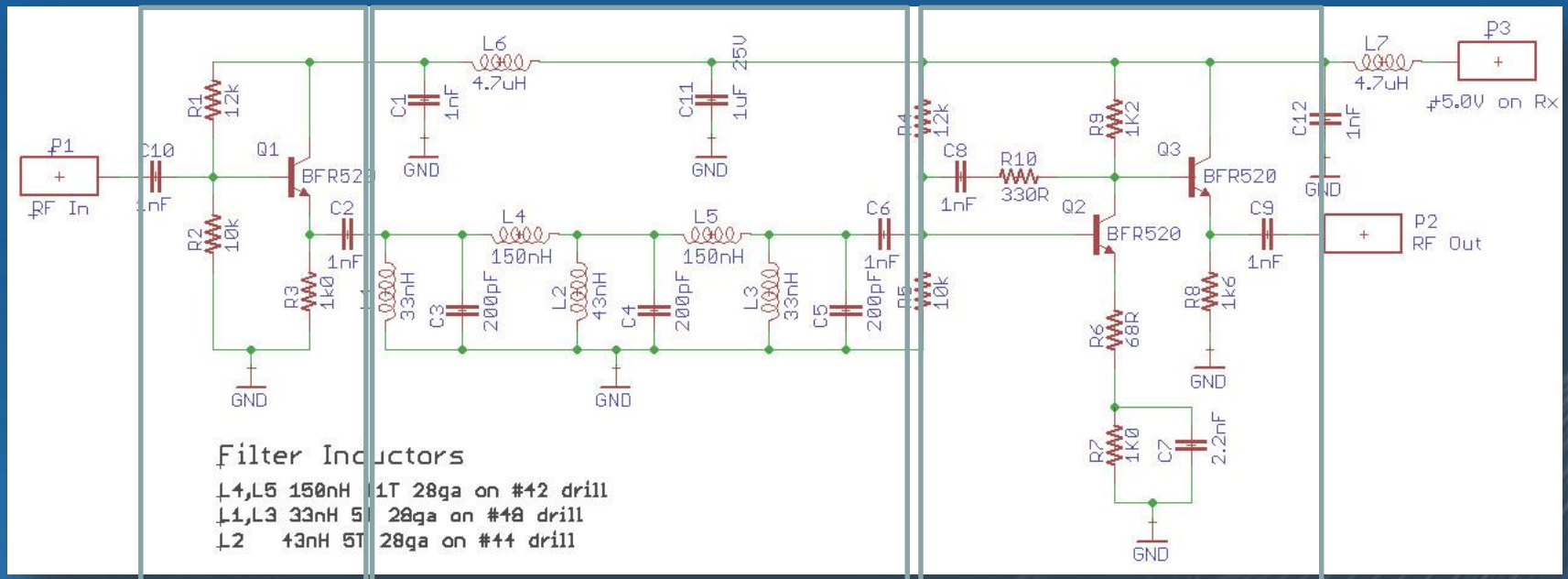




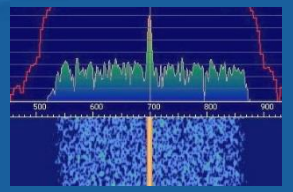
Interface Schematic



V0.1a

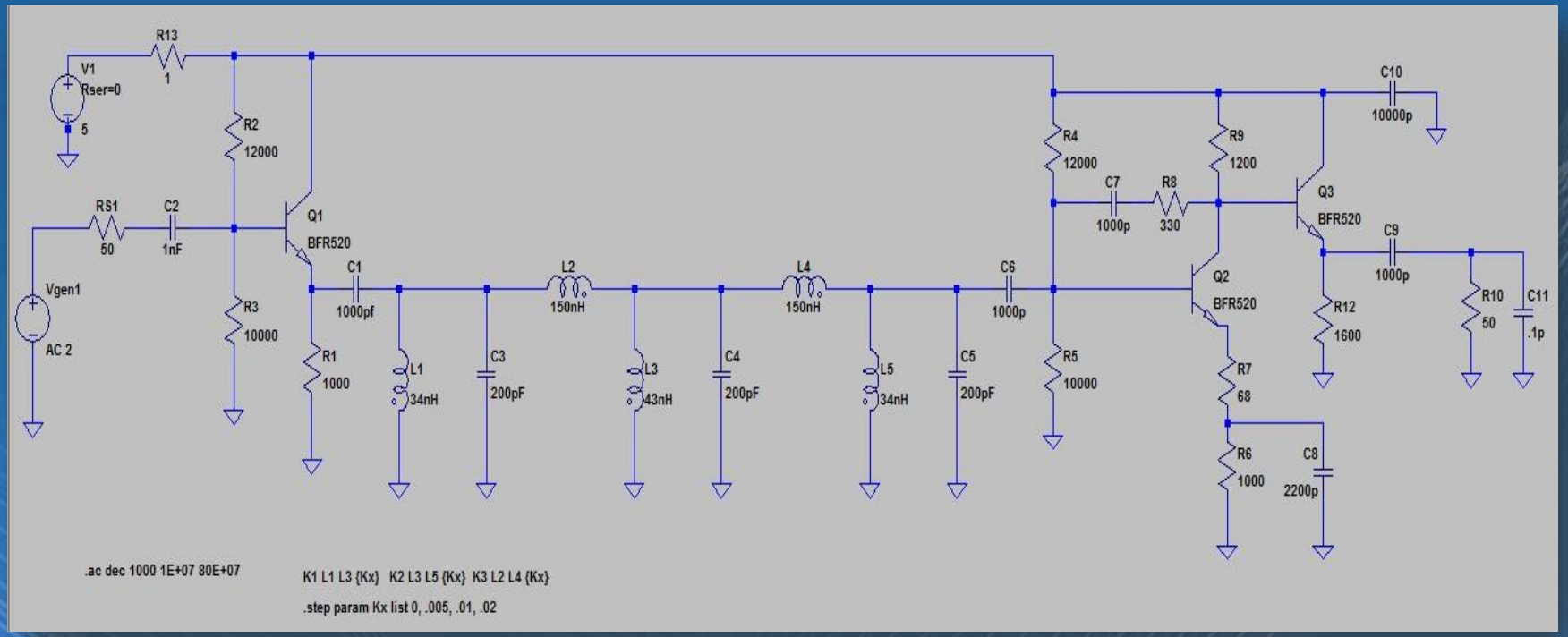


Circuit Simulation

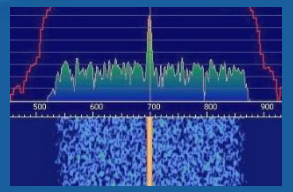


LTSpice simulation files

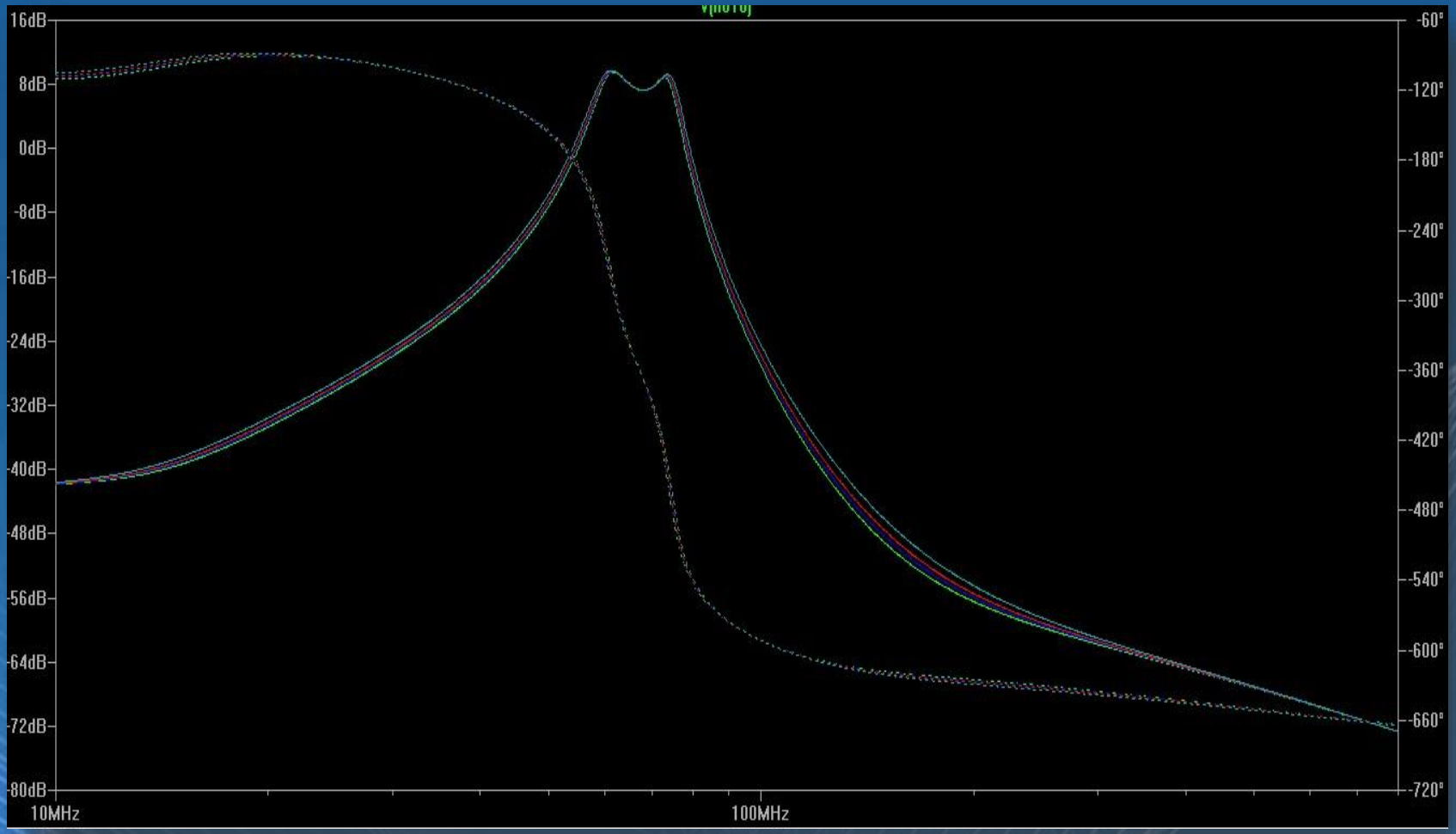
- Complete circuit &
- Output amplifier + buffer



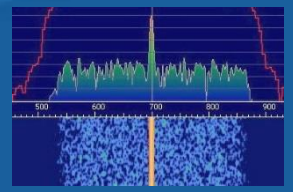
Circuit Simulation



LTSpice simulation results



PCB Layout



Small size to fit most transceivers

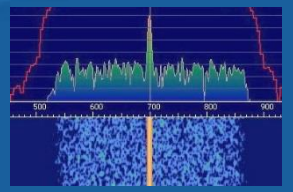
- 12mm x 40mm

All components on the top side no tracks on bottom

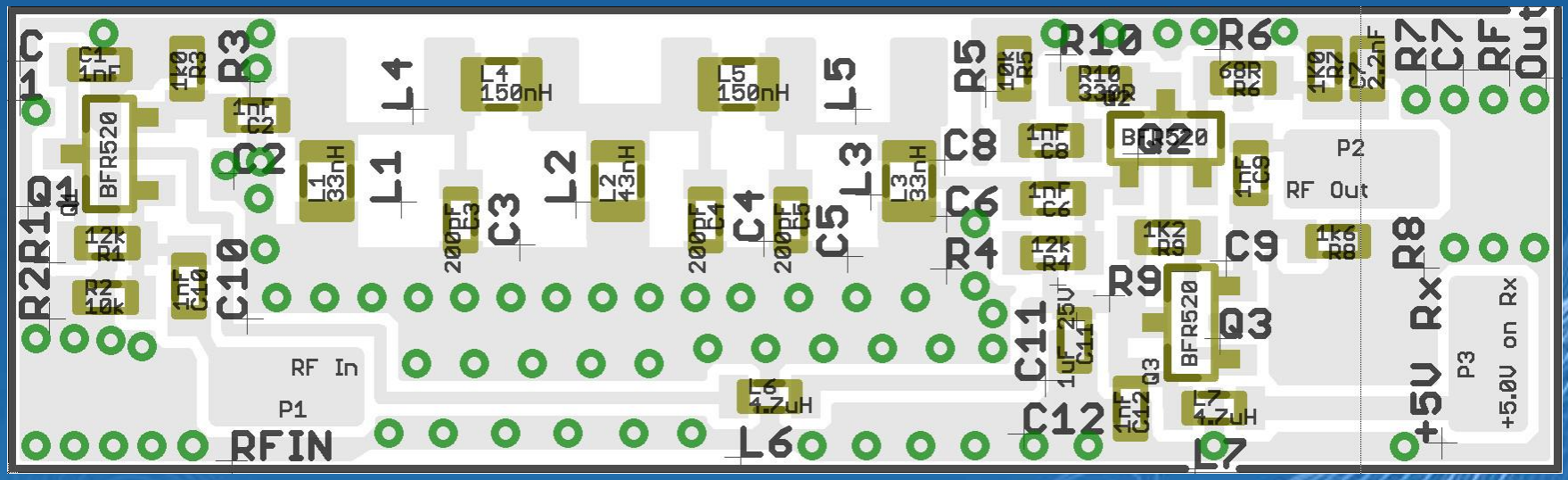
- Bottom is ground plane only, so PCB can be soldered to any grounded surface within the transceiver

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

PCB Layout

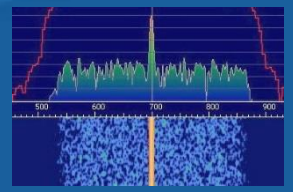


40 x 12mm



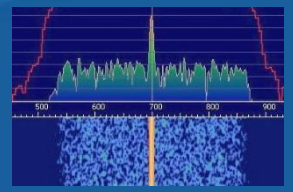
- Layout has keep-out areas that allow the board to easily fit against the side of the PLL - Unit shield in the FT-817
- All components are on the top side, bottom is ground plane

Assembled PCB



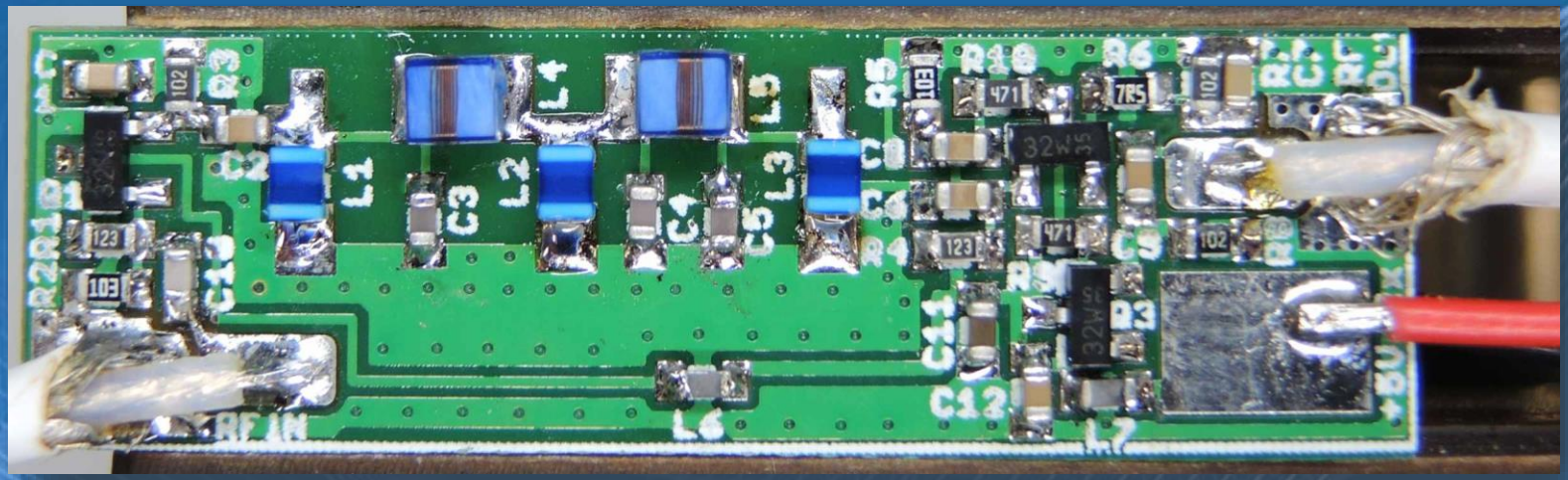
Using wire wound air core inductors

Assembled PCB (cont'd)

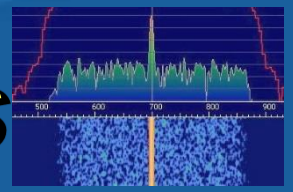


PCB also has pads for commercial inductors

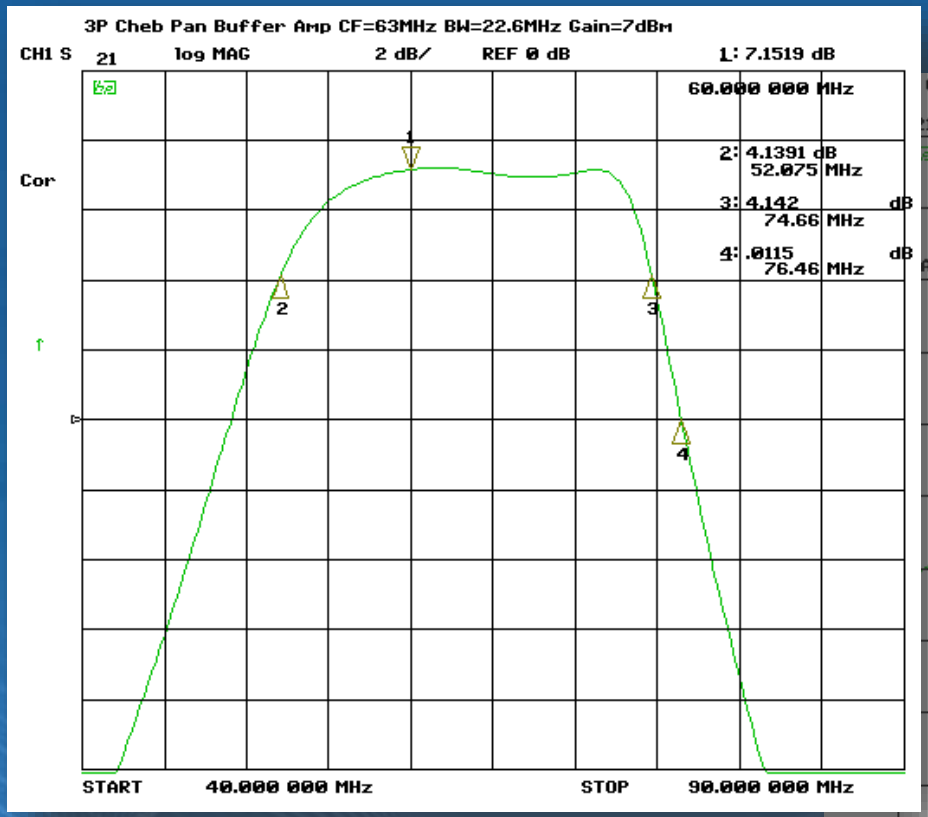
- L4 and L5 are 150nH - 1008
- L1 and L3 are 33nH - 0805
- L2 is 43nH - 0805
- These values shift the passband down slightly so that the 68.33 MHz center frequency is a bit closer to the upper edge

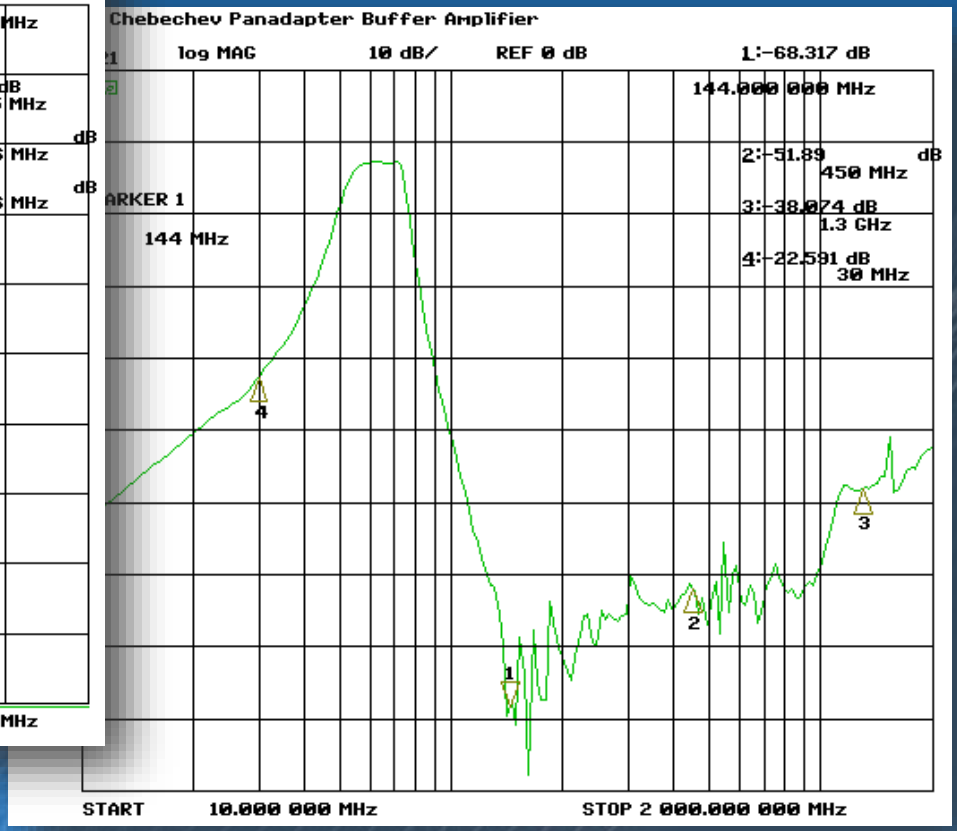


Bench Performance tests

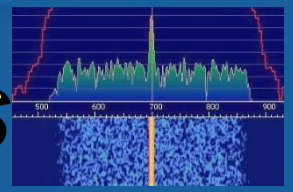


PCB made with home brew air core inductors

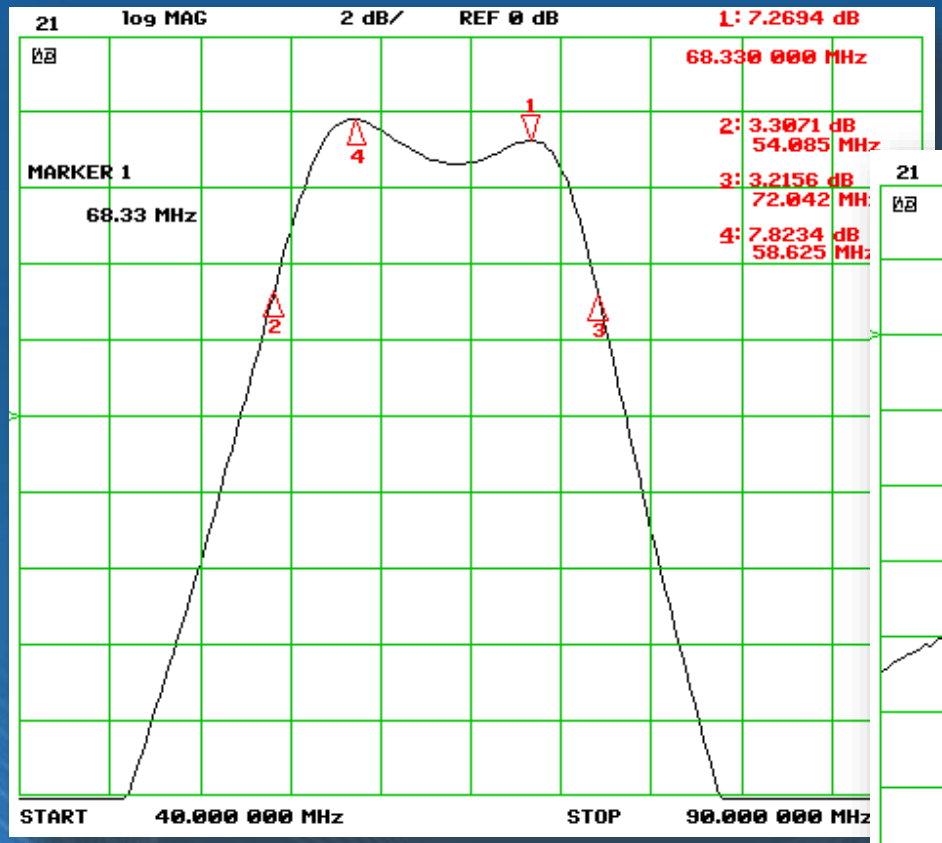


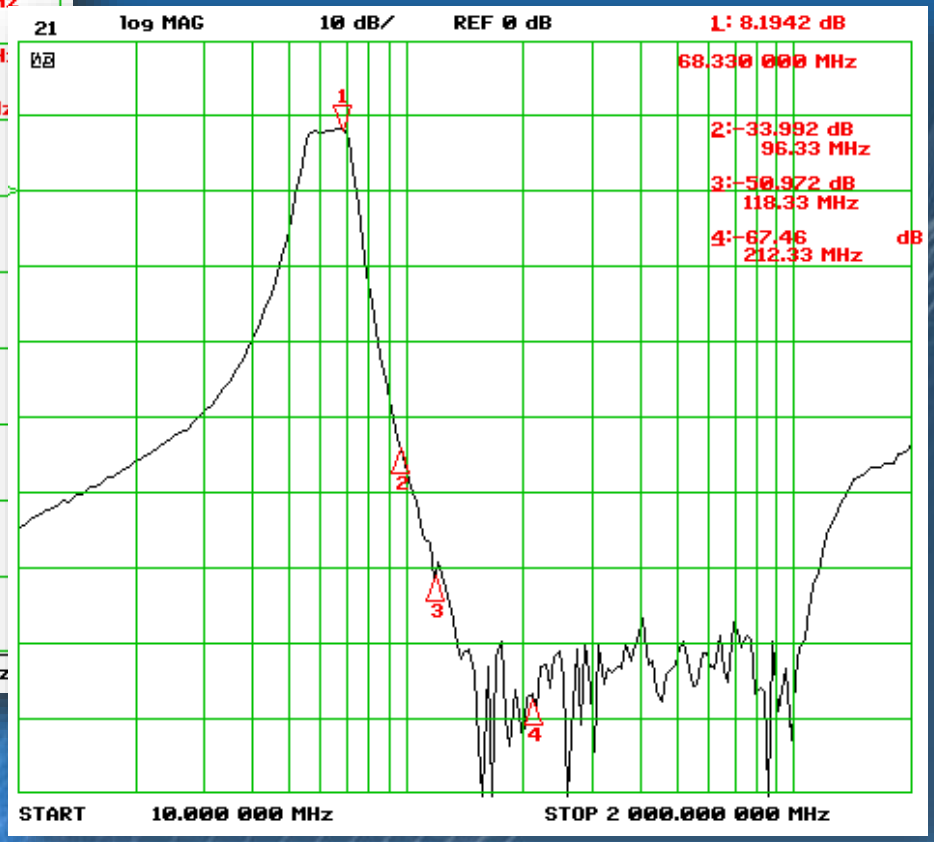


Bench Performance tests

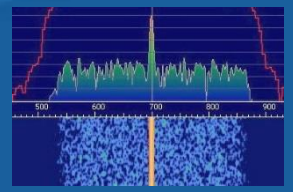


PCB made with commercial inductors





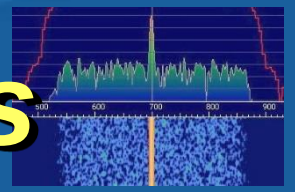
Interface to a FT-817



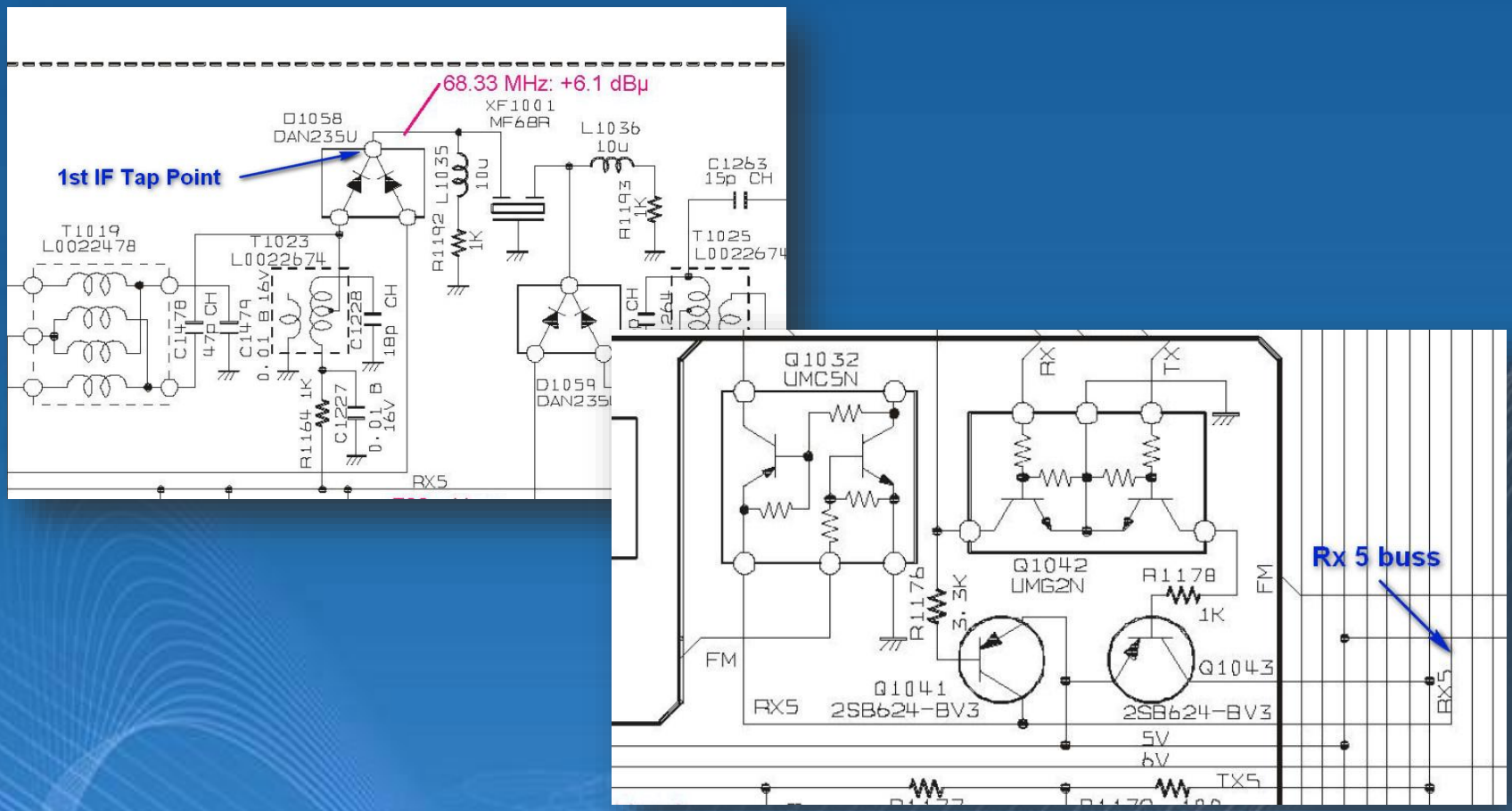
Four connections are needed from the interface PCB to the transceiver

- 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

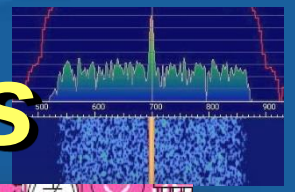
FT-817 Connection Points



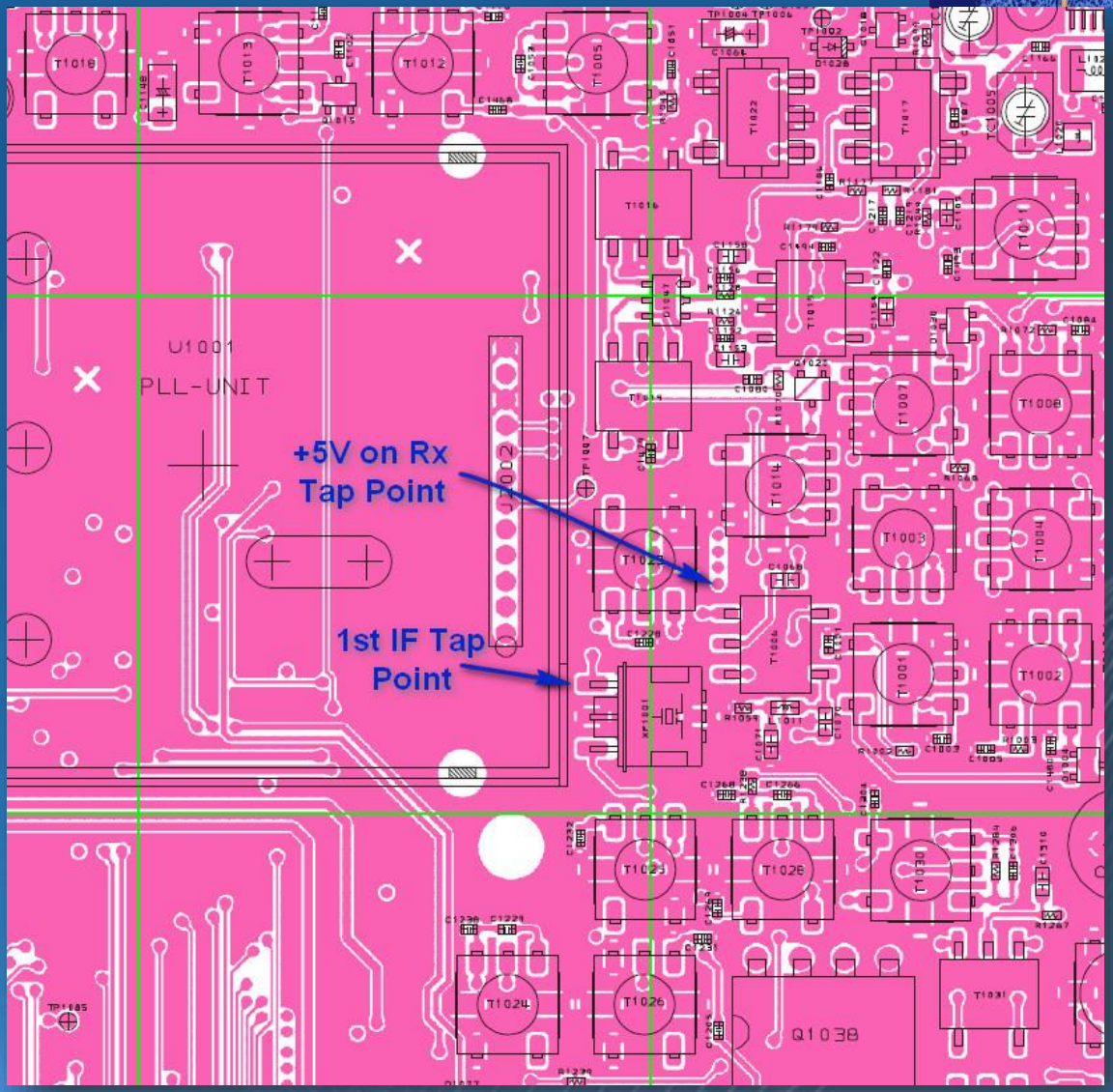
- 1st IF & switched supply on during Rx of during Tx



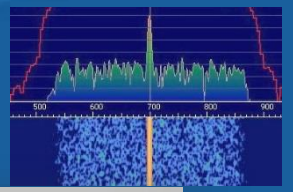
FT-817 Connection Points



- Top PCB Connection Points

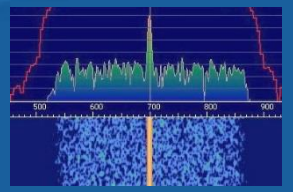


FT-817 – I/F Connections



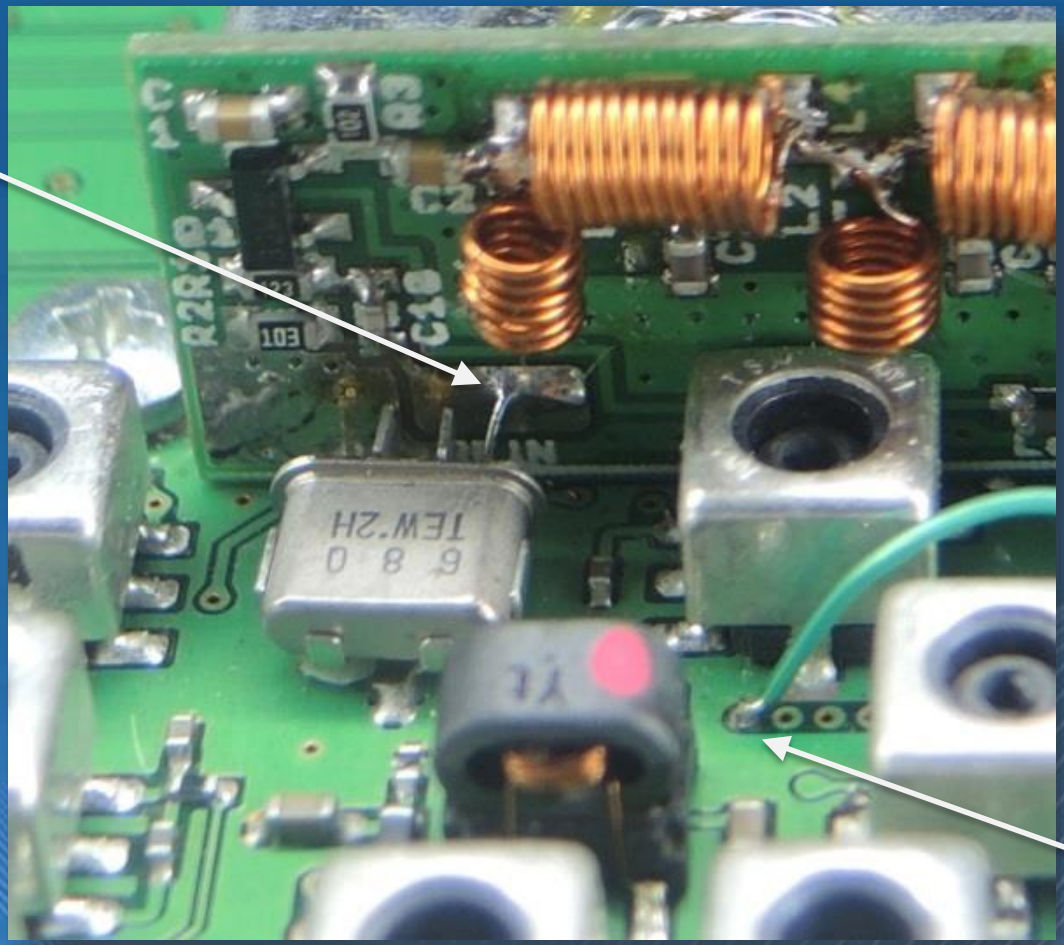
- Interface PCB bottom groundplane is soldered to the side of the PLL-Unit housing

FT-817 – I/F Connections



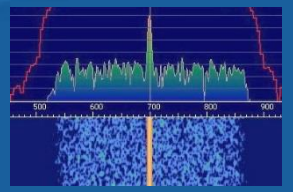
- 1st IF and 5V on Rx connections

1st IF connection



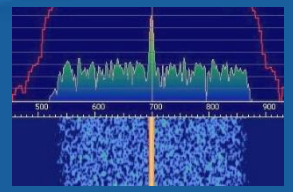
+5V on Rx connection

FT-817 – I/F Connections



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

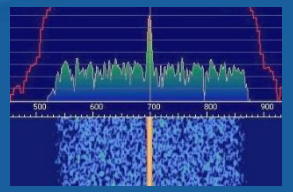
Sensitivity Tests



Before & After Panadapter installation

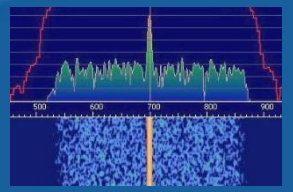
			Baseline Measurement				FT817 wit Panadapter Installed				Difference			
Frequency	Mode	SINAD	S Units				SINAD	S Units			SINAD	S Units		
MHz		12dB	1	5	9		12dB	1	5	9	12dB	1	5	9
3.6	CWN	-123.7	-100	-96	-72		-123.9	-99	-94	-72	0.2	-1	-2	0
	CWW	-110.8	-96	-92	-71		-112.1	-95	-91	-70	1.3	-1	-1	-1
	FM 3KHz	-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

Sensitivity



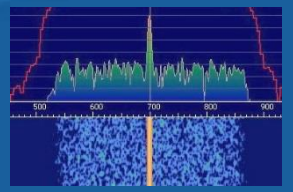
SDR display with narrow FFT bins enables signal detection well down into the noise -144.251MHz @ -140 dBm

Sensitivity

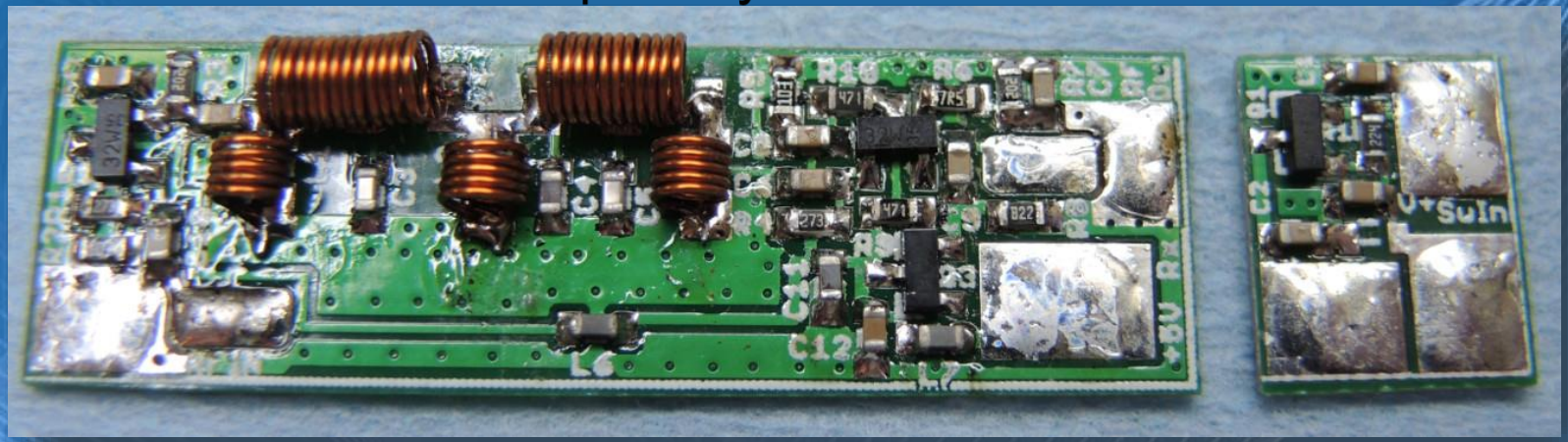


144.251 MHz @ -150 dBm

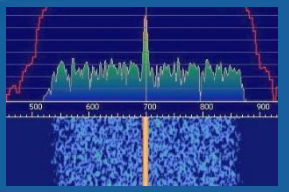
Supply Switches

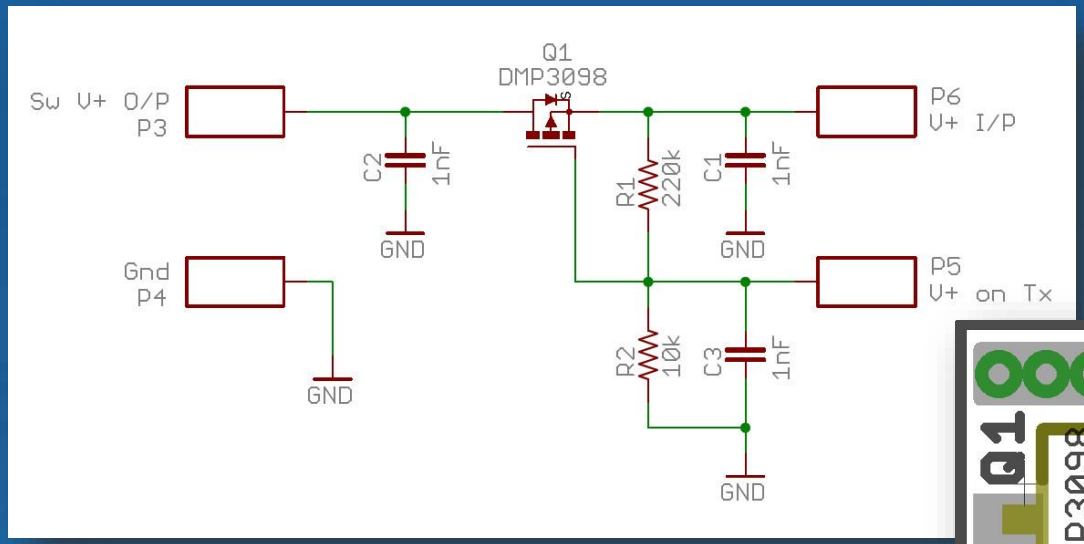


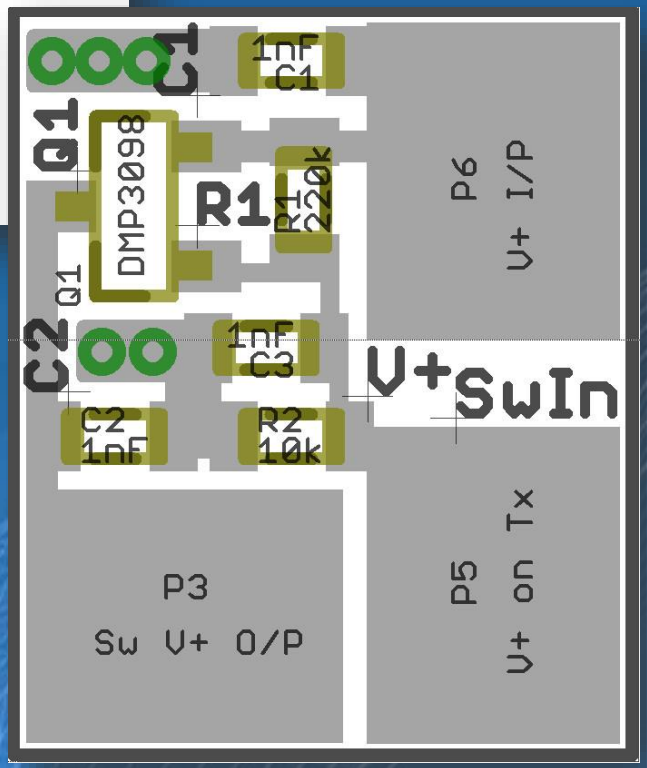
- If switched V+ high on Rx isn't available or if it is but isn't capable of supplying the dongle then two switch boards can be used
- Both have the same height as the main PCB
- Simple inverting switch for rigs that have a signal low during receive and high during transmit.
- PCB with an selectable inverting switch that can be used with either control polarity



Supply Switches (cont'd)



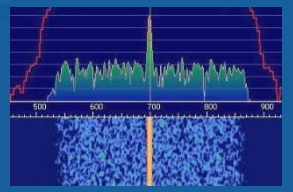


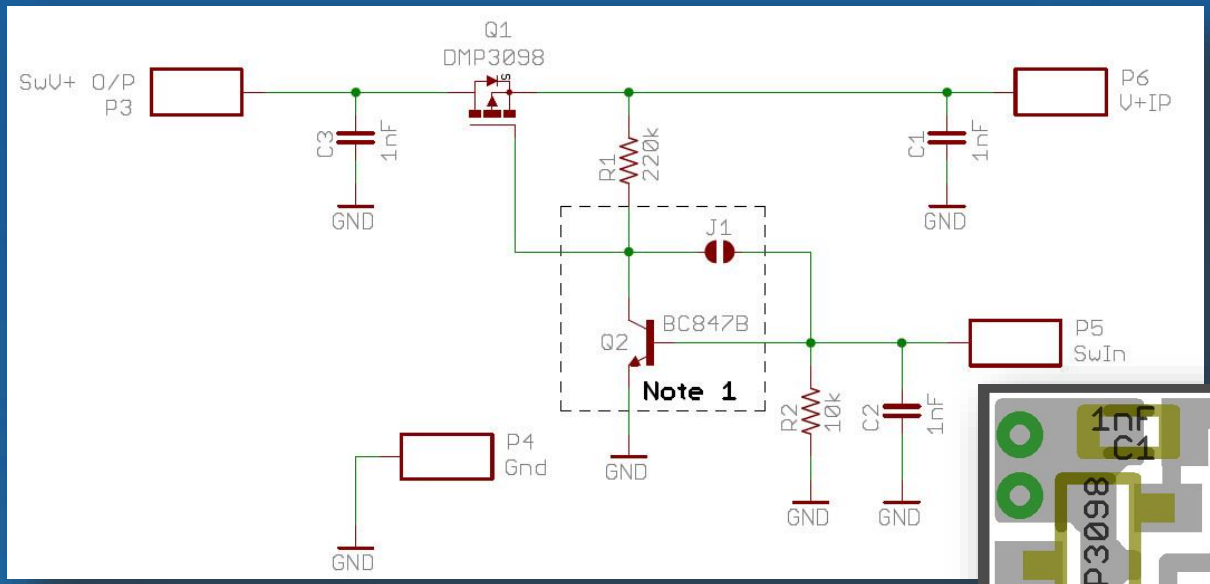


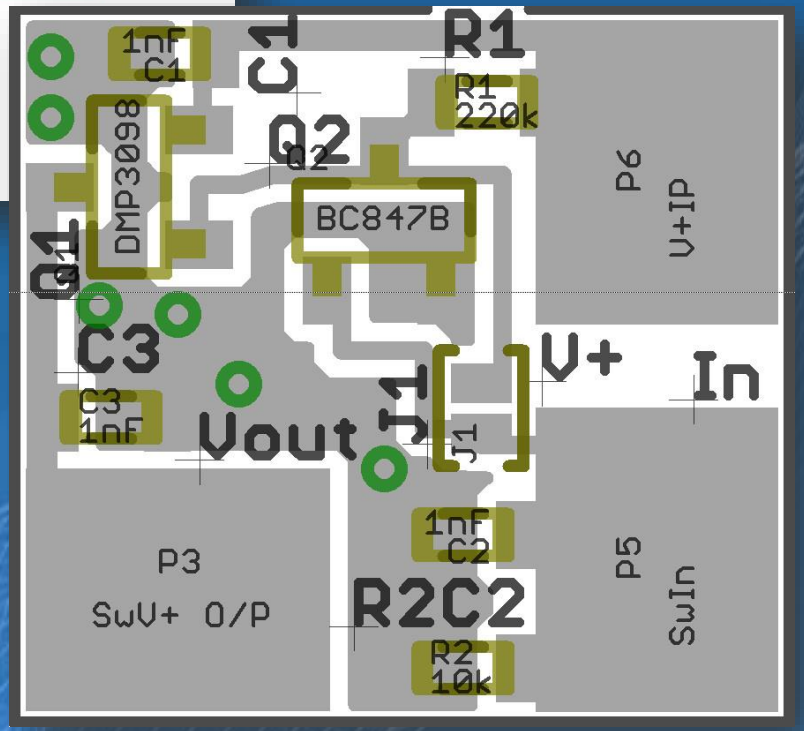
V+ Tx Switch

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

Supply Switches (cont'd)



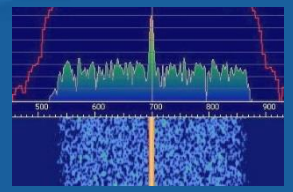




V+ Switch

- 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

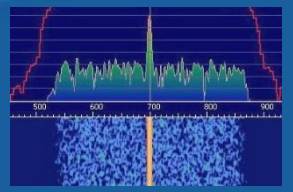
SDR#

- 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

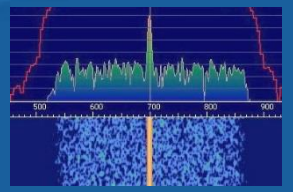
- Navigate to the HDSDR Hardware page http://www.hdsdr.de/hardware.html

- 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

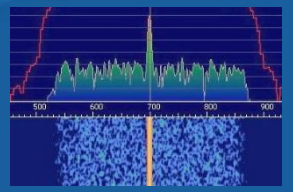


Start the program

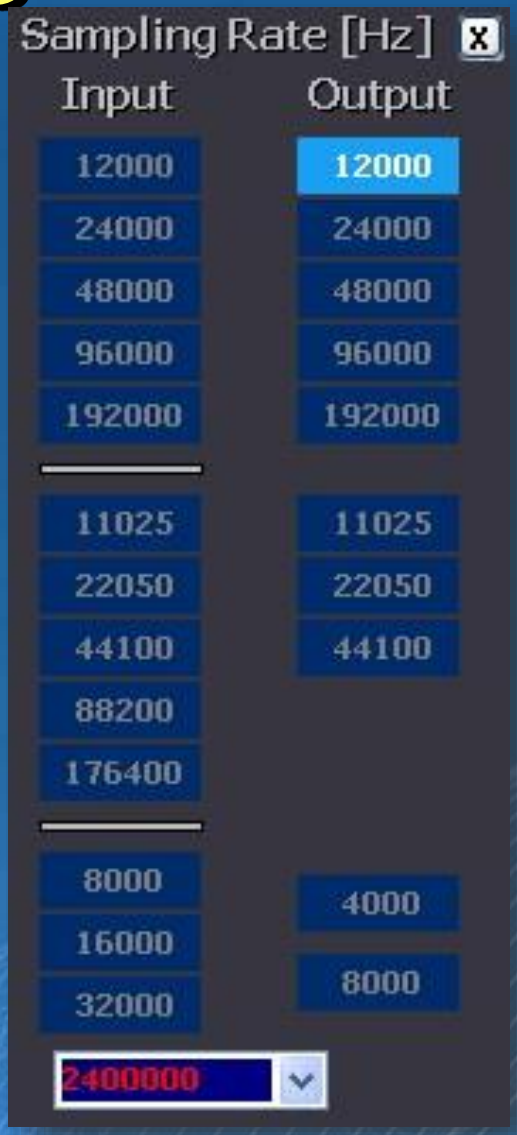
HDSDR has a slew of options that can be confusing.

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

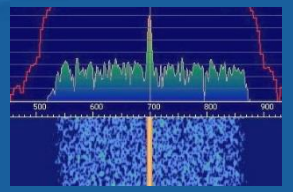
HDSDR - configuration



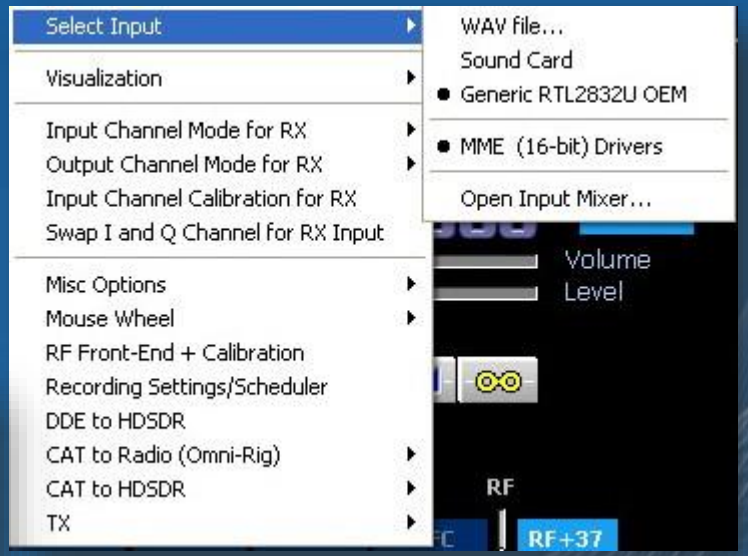
- Bandwidth [F4] select the following:

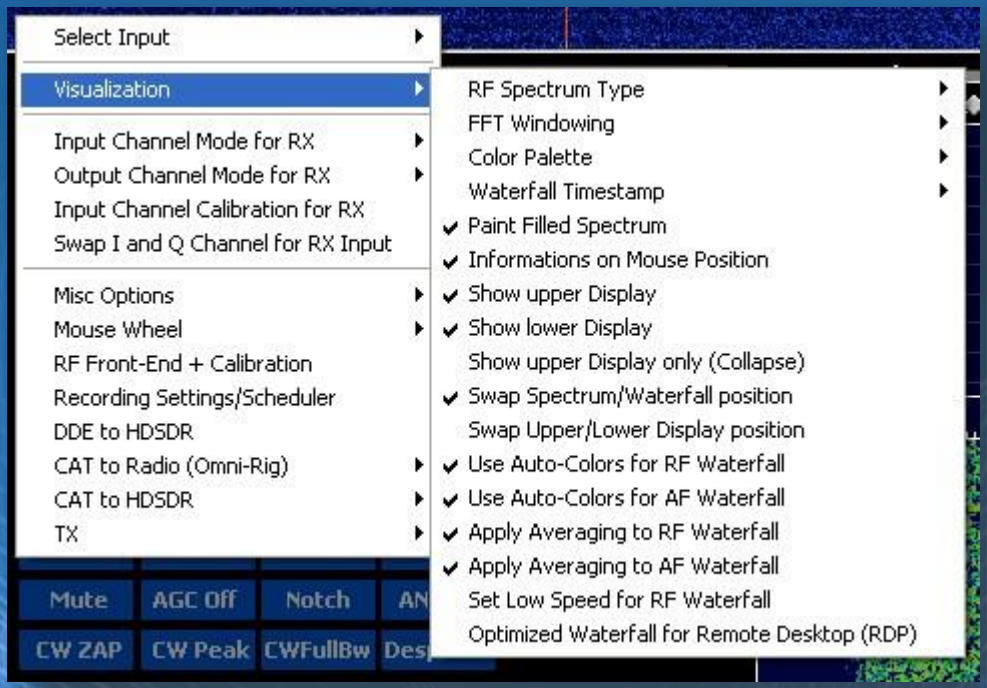


HDSDR - configuration

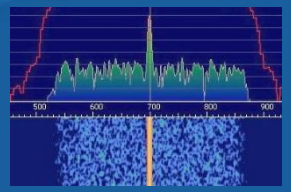


- Options [F7]
  - Select Input and visualization should look like the panels on this page
  - Don't change any submenus at this time

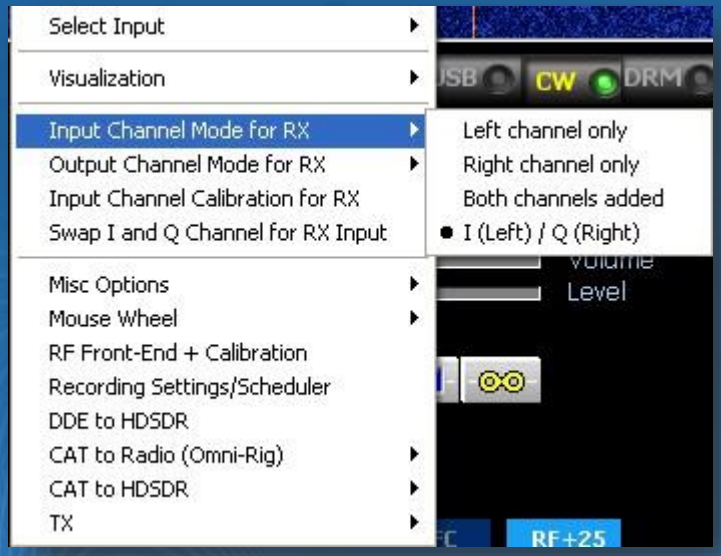


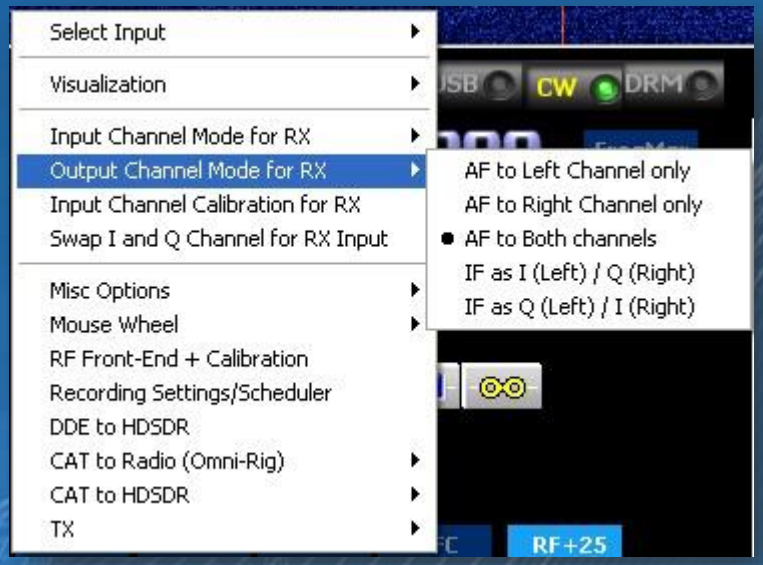


HDSDR - configuration

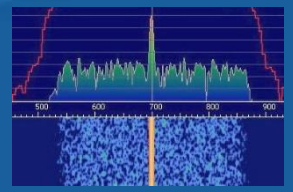


- Options [F7]
  - Input channel mode for Rx
  - Output Channel mode for Rx

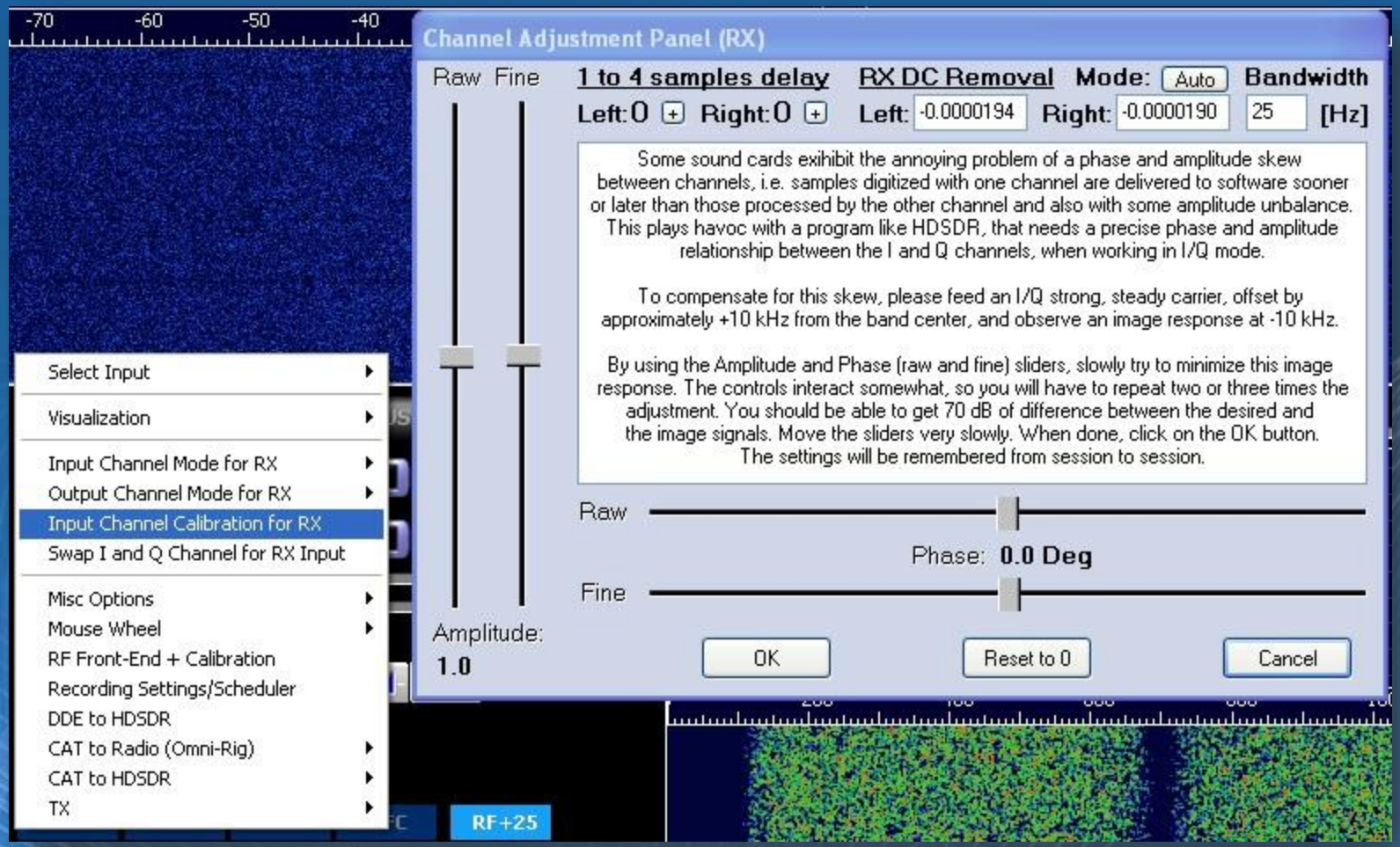




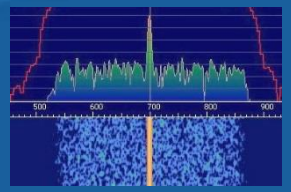
HDSDR - configuration



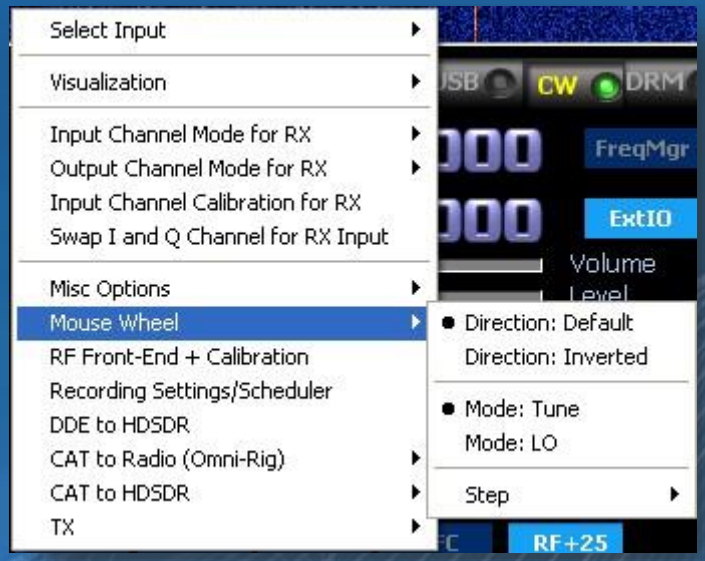
- Options [F7] - Input channel mode for Rx
  - Select RX DC Removal Mode: Auto - leave the rest alone



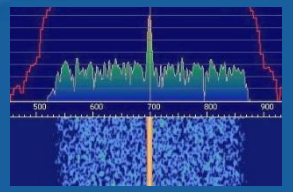
HDSDR - configuration



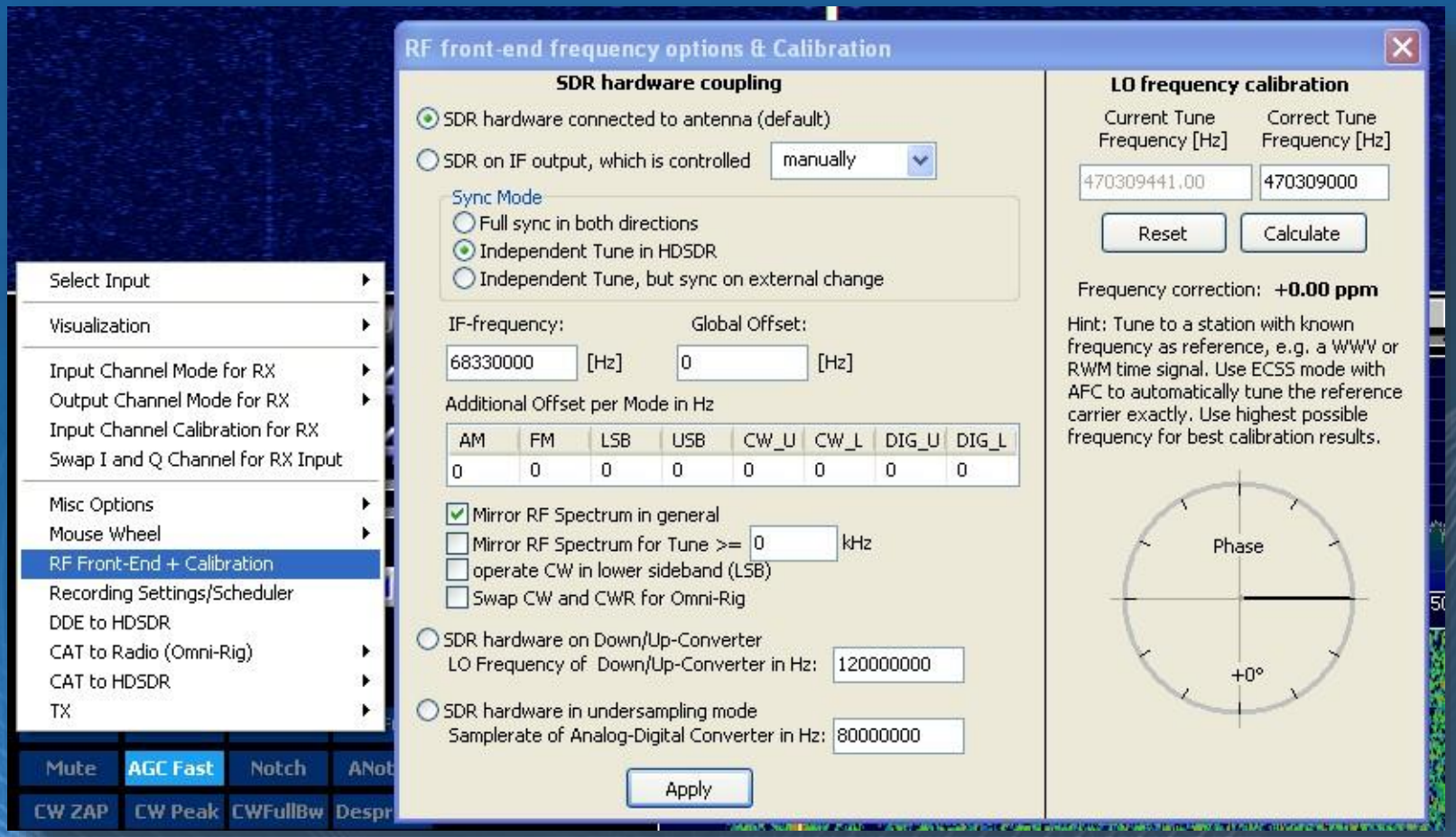
- Options [F7]
  - Misc.
  - Mouse Wheel



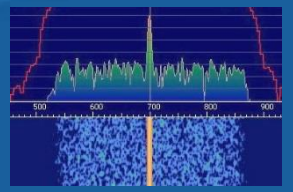
HDSDR - configuration



Now for the really important ones:

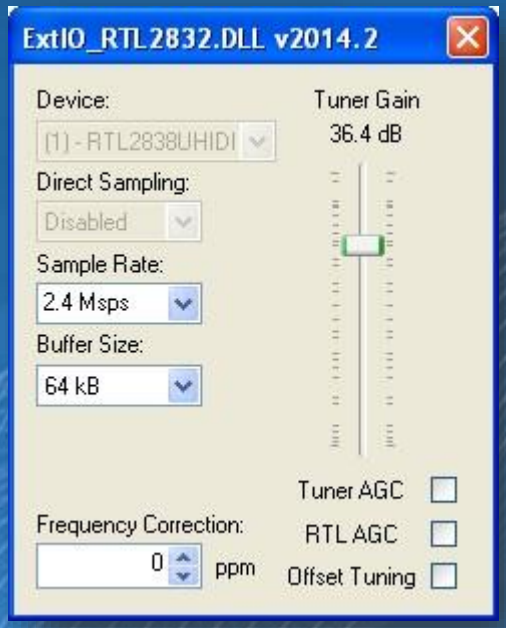


HDSDR - configuration

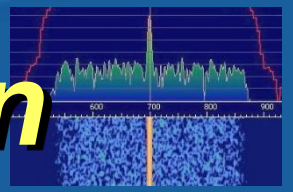


ExIO

- Click on the ExIO 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

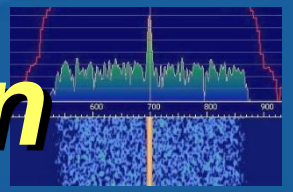


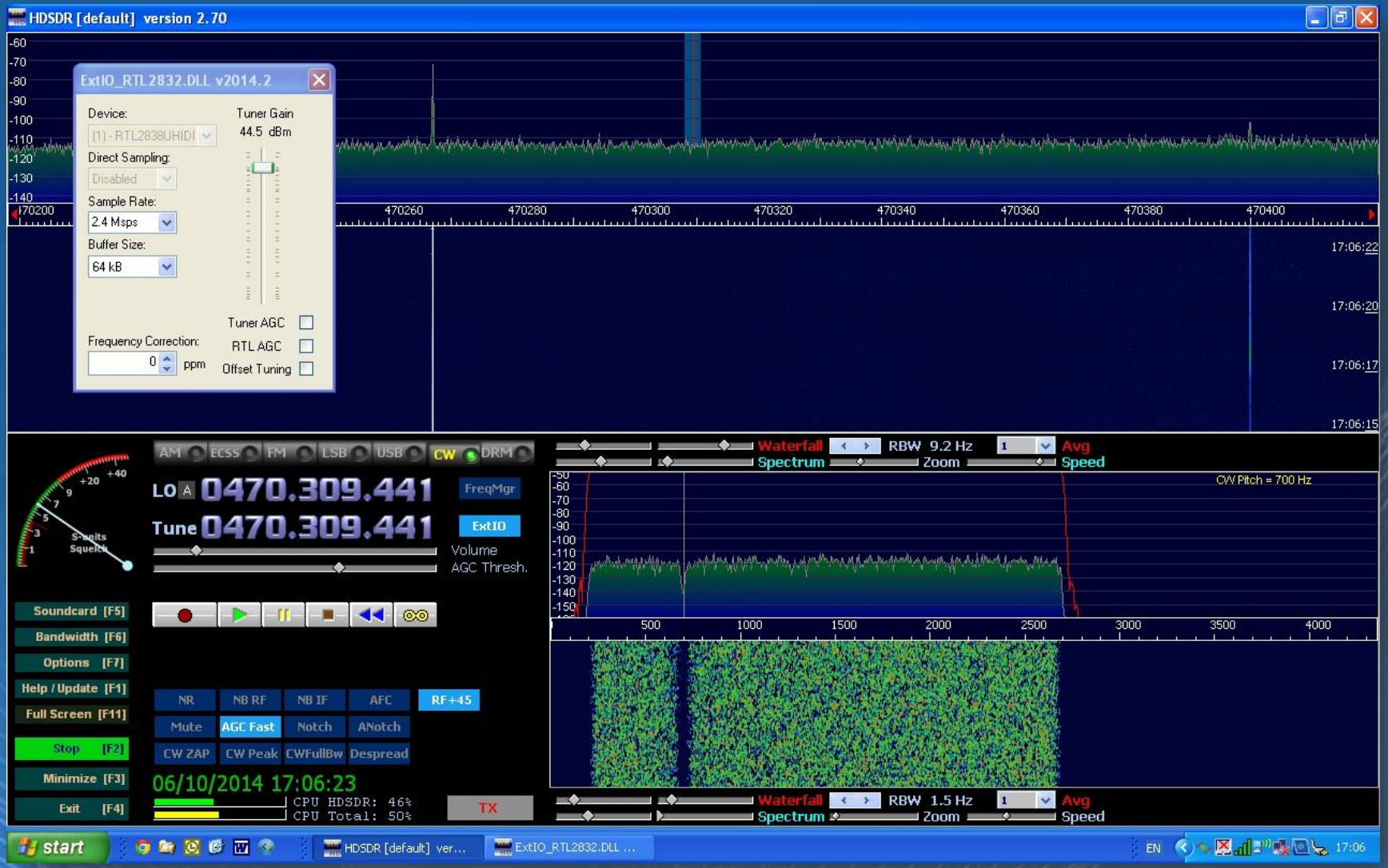
Frequency correction – Part 1

- 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:

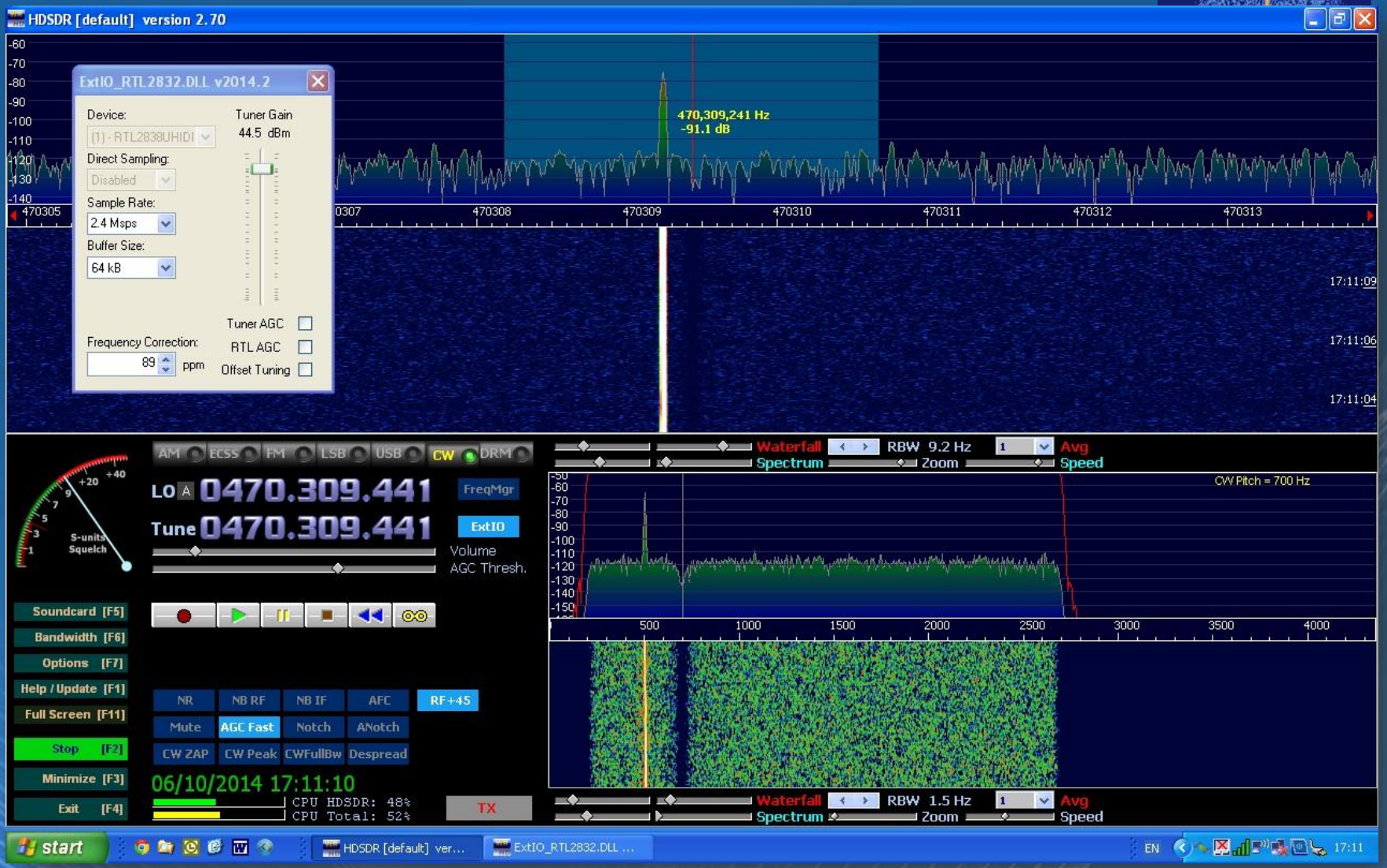
    http://www.csgnetwork.com/tvfreqtable.html
  - Enter the known frequency values in the HDSDR LO and Tune values

HDSDR – Freq. calibration

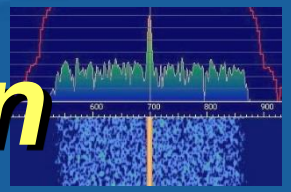




HDSDR – Freq. calibration



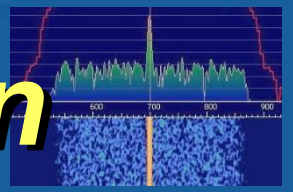
HDSDR – Freq. calibration

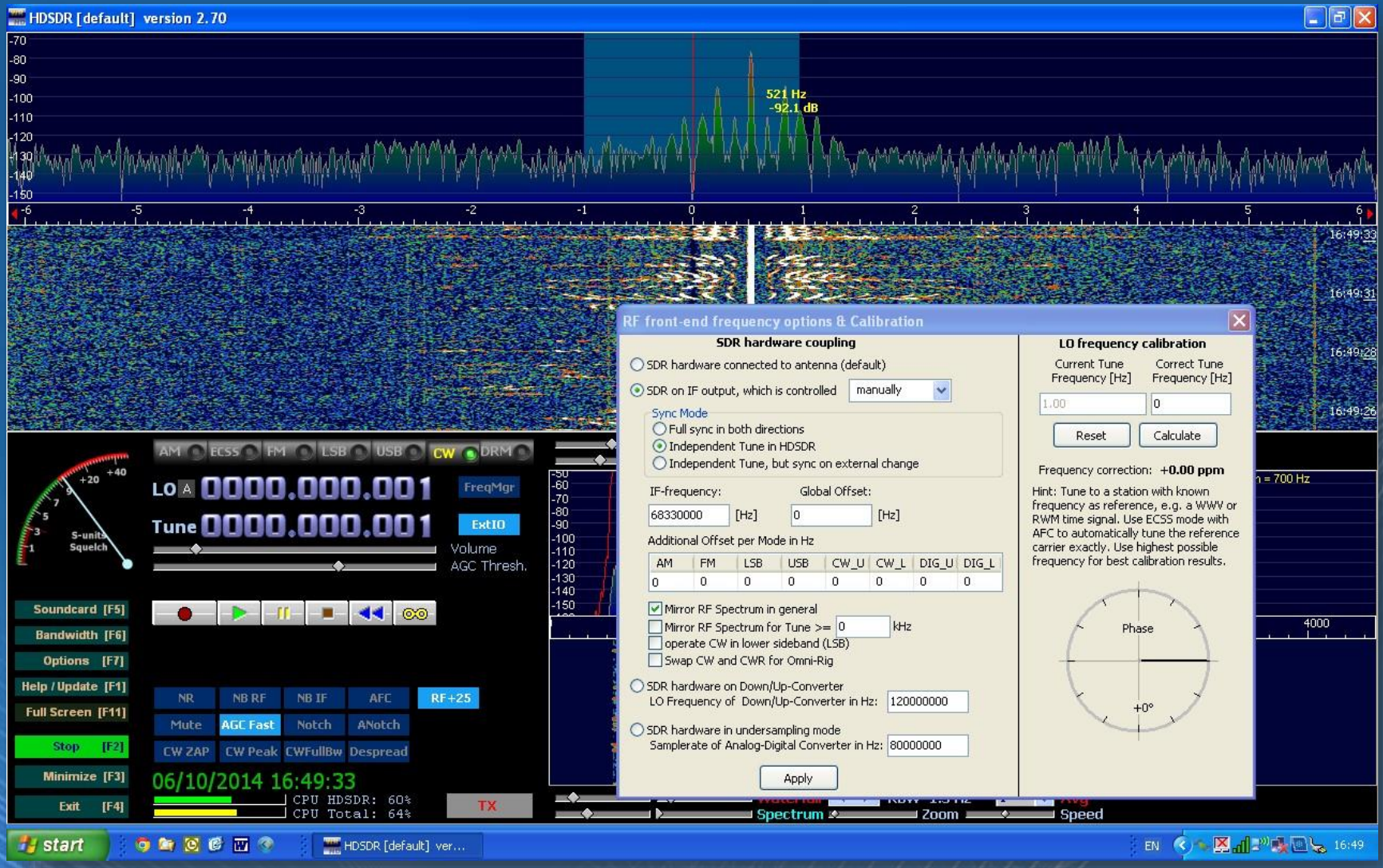


Next account for any transceiver 1st IF LO error

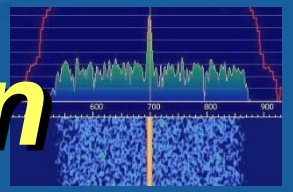
- Connect the DVB-T dongle to the radio's 1st IF interface.
- Tune the radio to a known frequency – WWV is good if it can be received. In Ottawa air band information channels can provide a good constant AM carrier. One such beacon is located at 132.950 MHz. Tune the radio to this frequency and set the 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

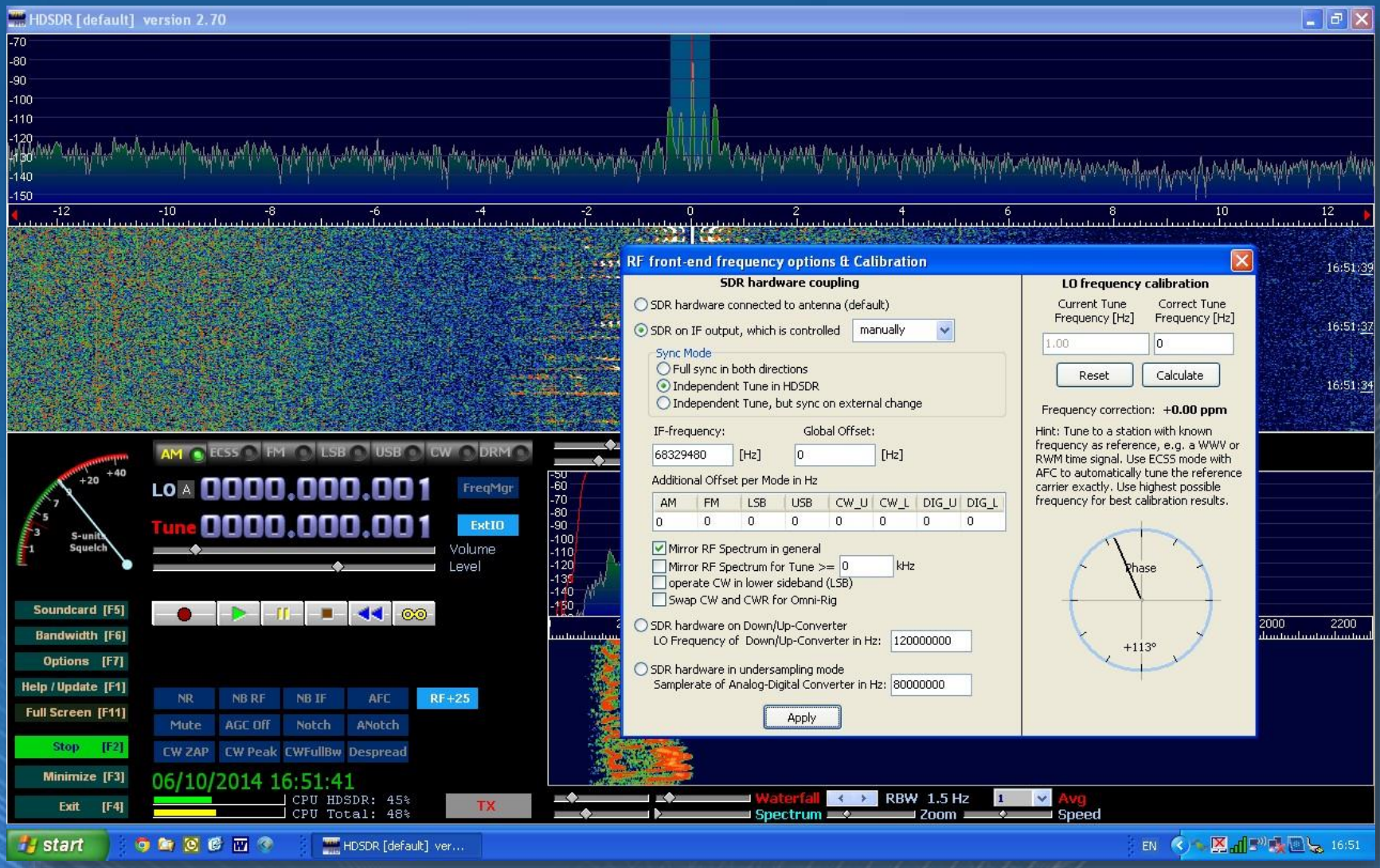
HDSDR – Freq. calibration



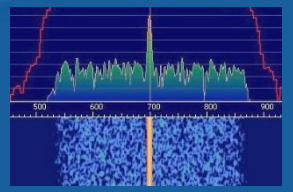


HDSDR – Freq. calibration





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

RF front-end frequency options & Calibration

SDR hardware coupling

- SDR hardware connected to antenna (default)
- SDR on IF output, which is controlled: manually

Sync Mode
- Full sync in both directions
- Independent Tune in HDSDR
- Independent Tune, but sync on external change

IF-frequency: 68331800 [Hz] Global Offset: 0 [Hz]

Additional Offset per Mode in Hz

AM	FM	LSB	USB	CW_U	CW_L	DIG_U	DIG_L
0	0	0	0	0	0	0	0

- [x] Mirror RF Spectrum in general
- [ ] Mirror RF Spectrum for Tune >= 0 kHz
- [ ] operate CW in lower sideband (LSB)
- [ ] Swap CW and CWR for Omni-Rig

- SDR hardware on Down/Up-Converter
  LO Frequency of Down/Up-Converter in Hz: 120000000
- SDR hardware in undersampling mode
  Samplerate of Analog-Digital Converter in Hz: 80000000

Apply

LO frequency calibration

Current Tune Frequency [Hz]: 14000000.00
Correct Tune Frequency [Hz]: 14000000

Reset Calculate

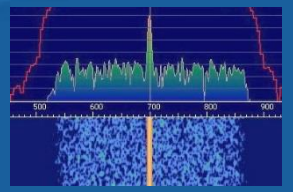
Frequency correction: +0.00 ppm

Hint: Tune to a station with known frequency as reference, e.g. a WWV or RWM time signal. Use ECSS mode with AFC to automatically tune the reference carrier exactly. Use highest possible frequency for best calibration results.

Phase

+0°

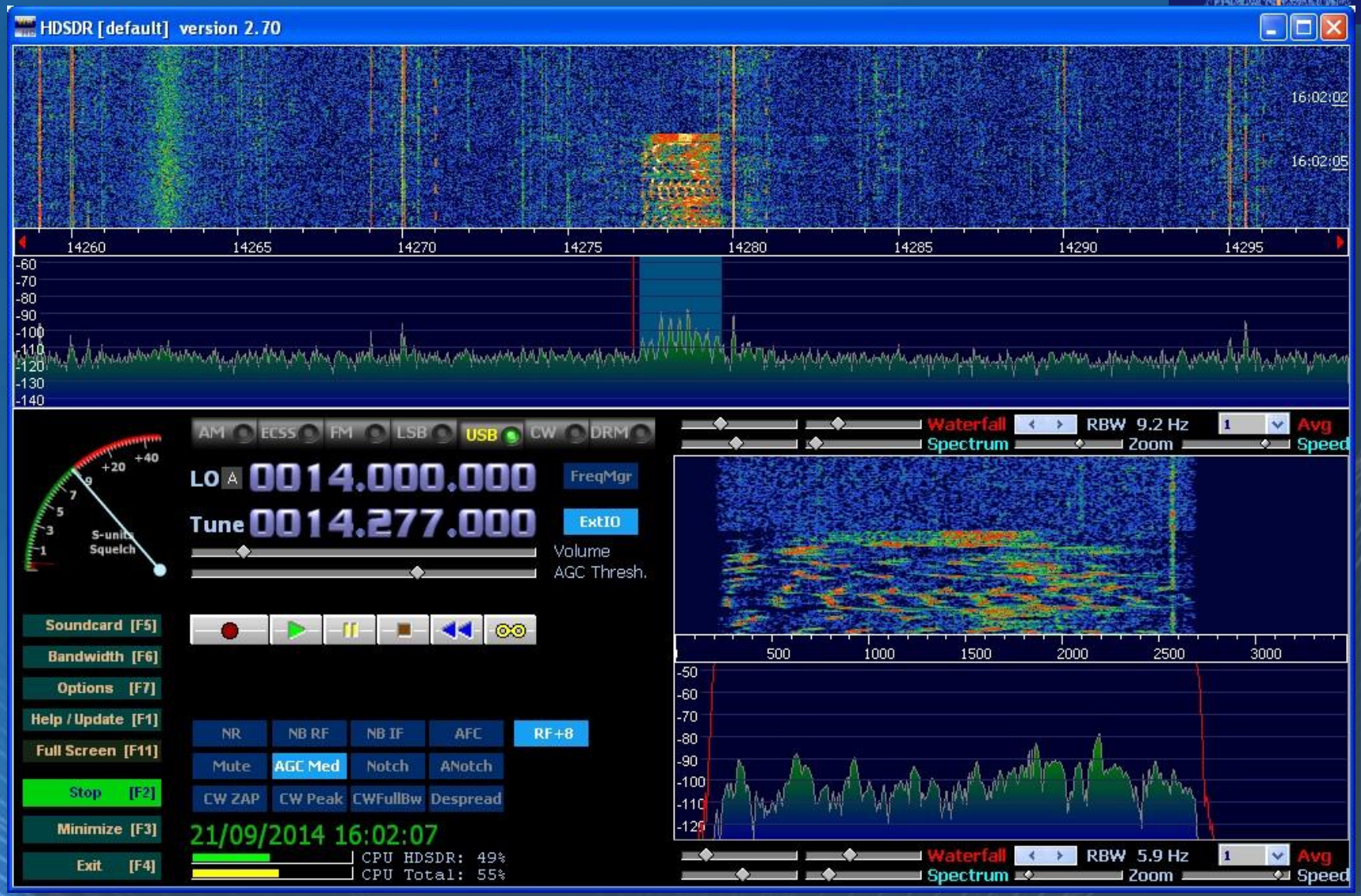
Use Without CAT



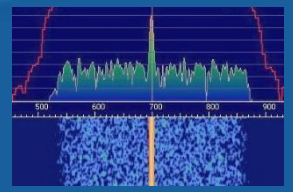
Mode 1

- 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



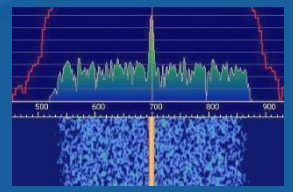
Use Without CAT



Mode 2 – tune to zero – useful for contesting

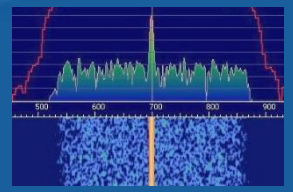
- Tune the transceiver to a frequency of interest say 144.250 MHz
- Set the HDSDR LO and Tune to zero. 144.250 MHz is now the display center
- Set the zoom to a range of frequencies that should be monitored for activity
- When a signal appears on the HDSDR display tune the radio so that the signal is 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



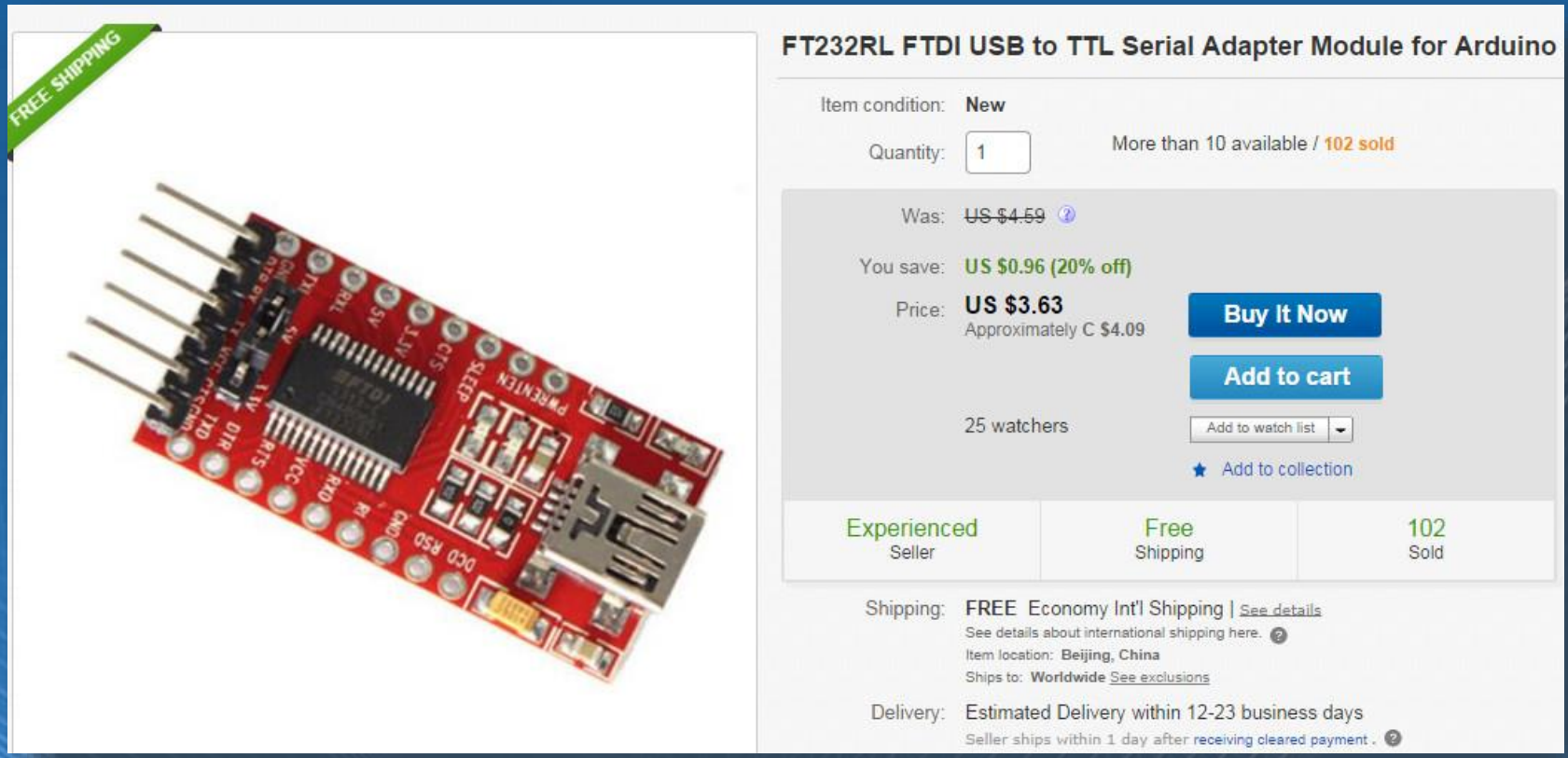
0 = 144.250MHz - watching 144.250-144.350 - signal @ 144.280

CAT-62 Cable

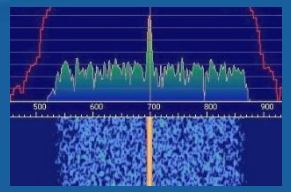


On the cheap

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

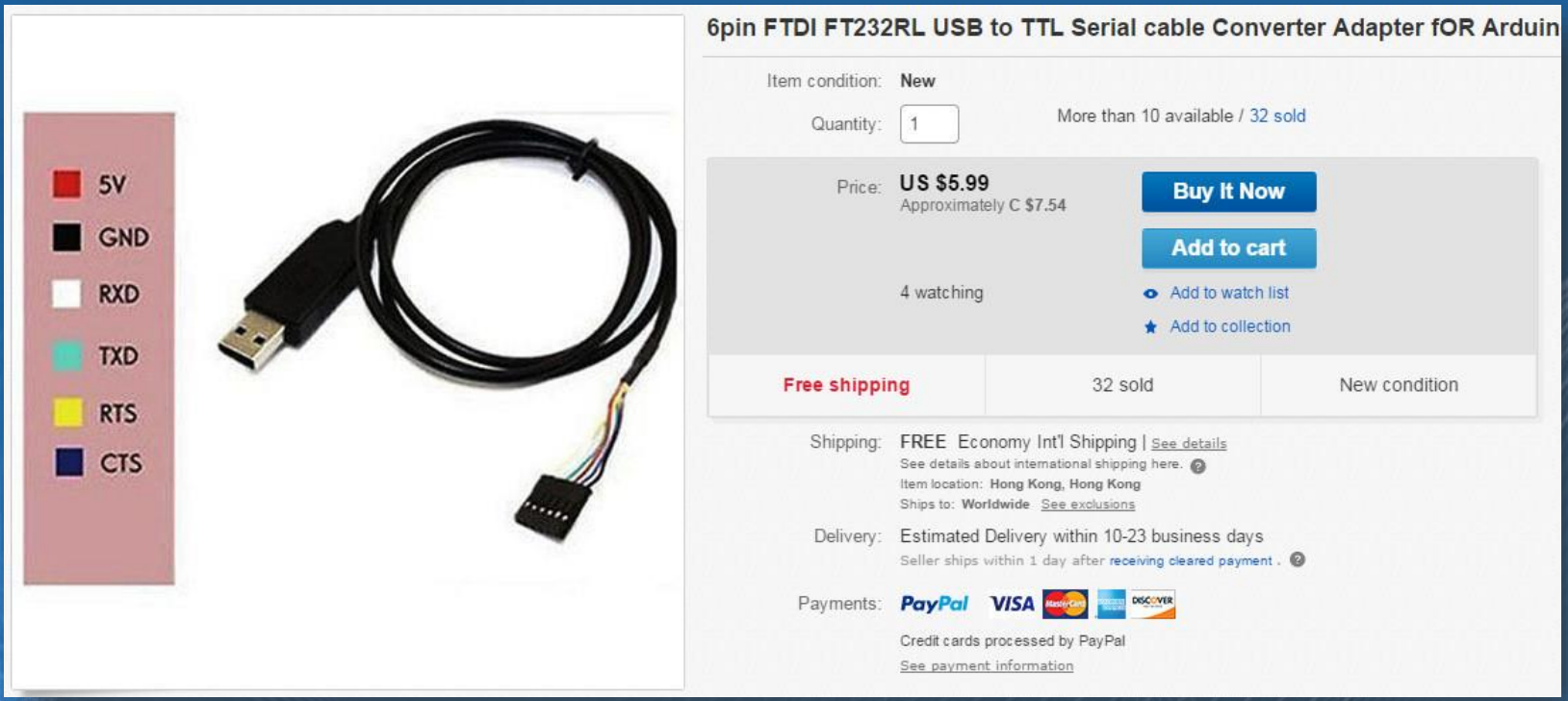


CAT-62 Cable

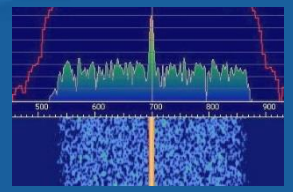


On the cheap

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

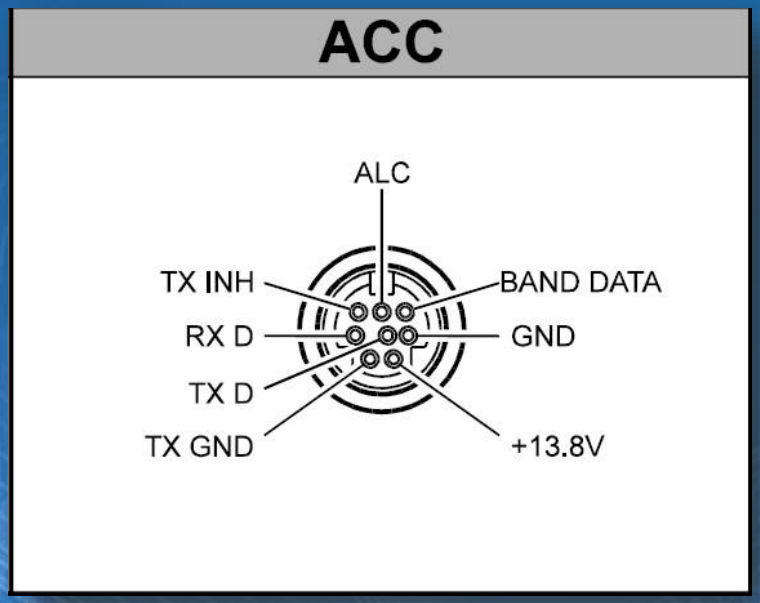


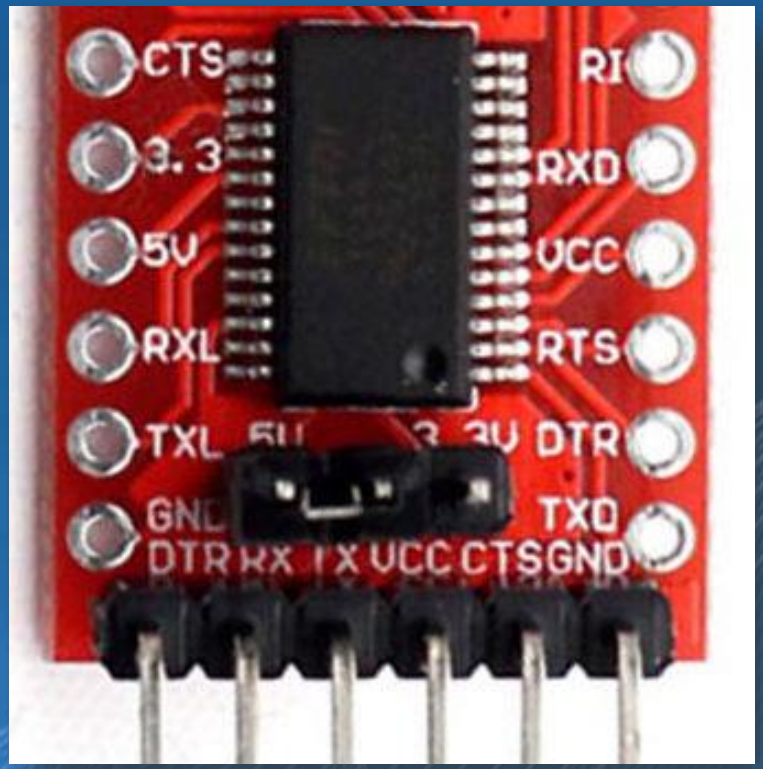
CAT-62 Cable



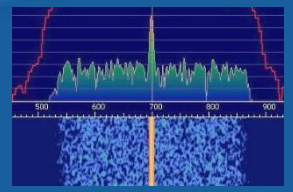
Wire it…. just a 3 wire cable … no components

- ACC FT232RL PCB
  - RX D TX
  - TX D Rx
  - GND GND





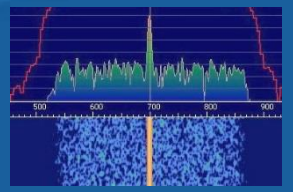
Use with CAT



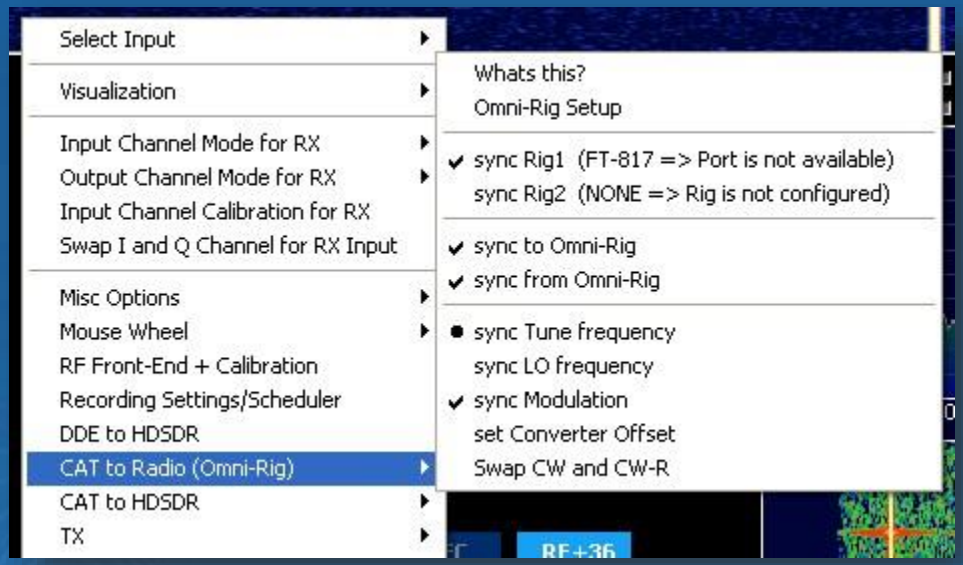
- Set the transceiver baud rate to match the application. The fastest rate reduces delays – 38,400 baud
  - The FT-817 does NOT autobaud, It must be configured manually
  - Download and install Omni-Rig with .ini files for the transceiver. Don't worry about the .ini files they're handled seamlessly during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

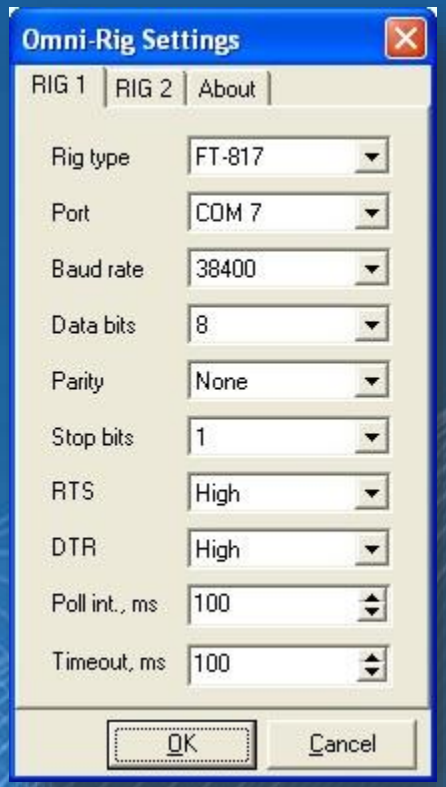
    http://www.dxatlas.com/OmniRig/
  - Configure Omni-Rig for use with HDSDR using the following

Omni-Rig Configuration



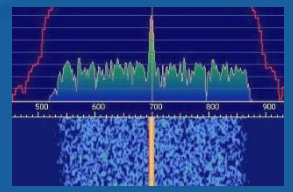
- Click on HDSDR Options [F7] button





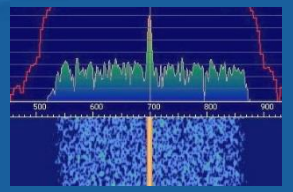
Also select ‘Omni-Rig Setup’ to bring up the ‘Omni-Rig Settings’ window and populate it with these values

Omni-Rig Configuration



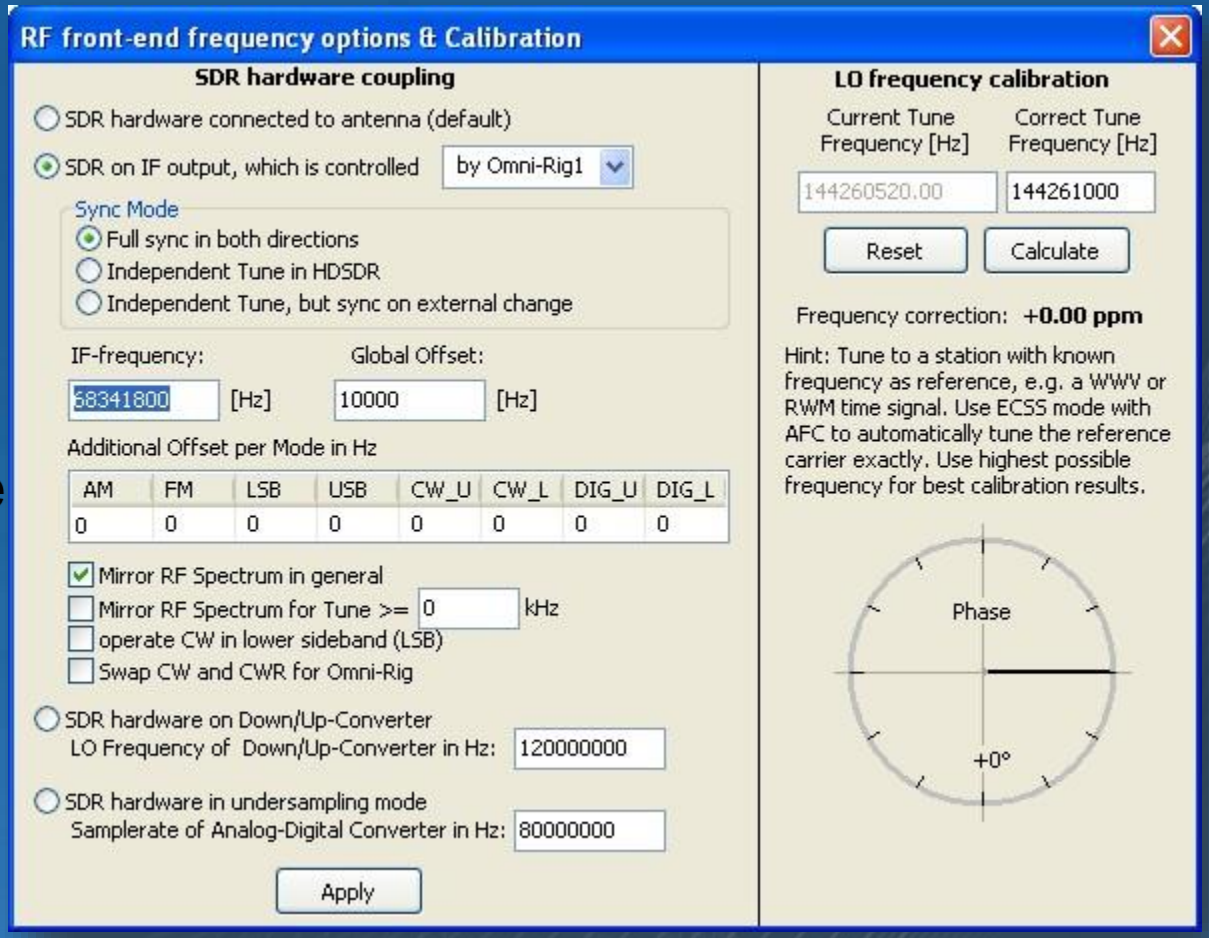
- This choice enables the Tx button within the HDSDR application

Omni-Rig Configuration

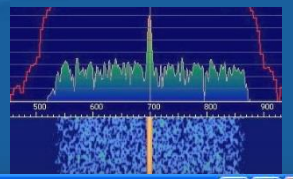


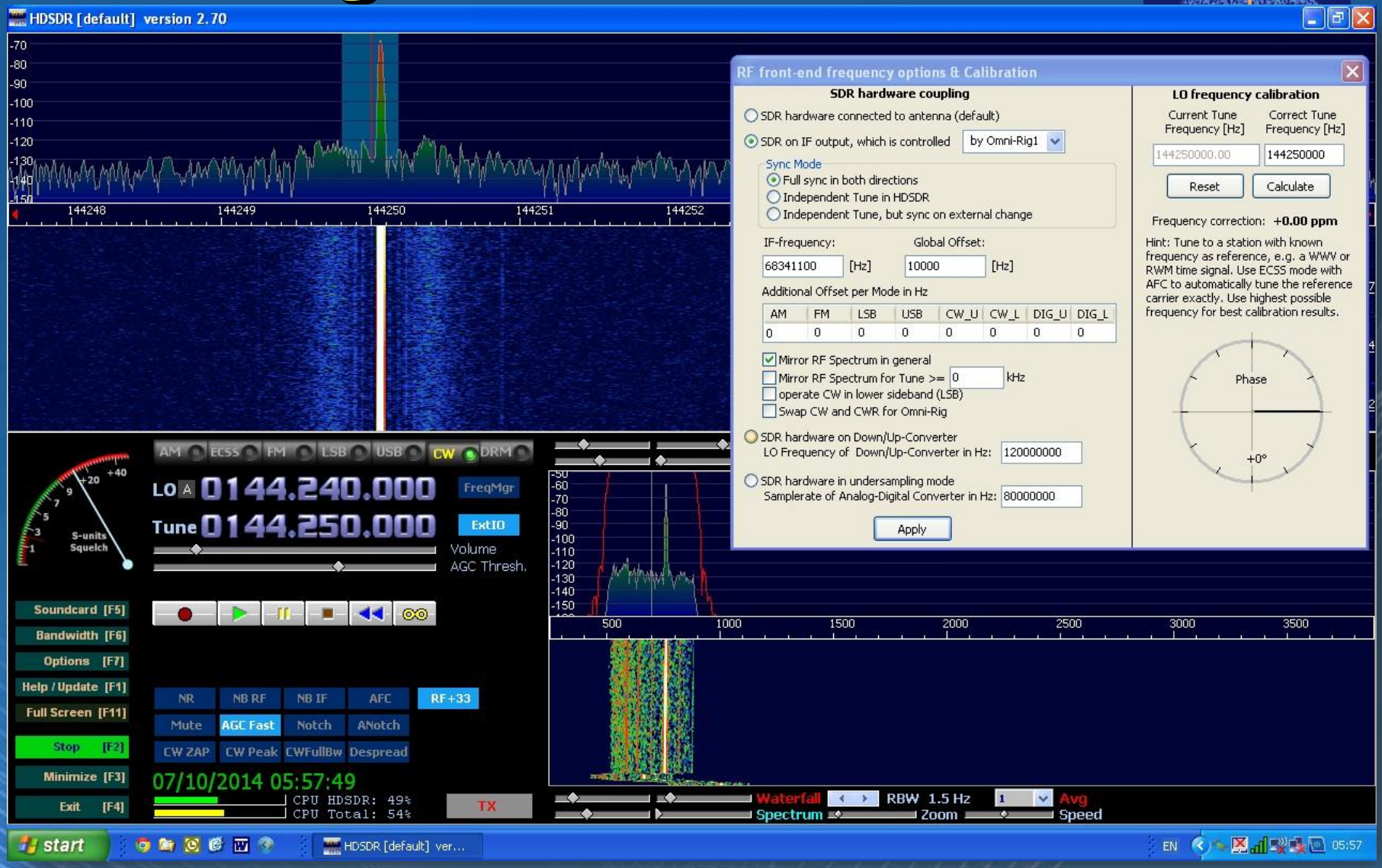
And finally

- 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

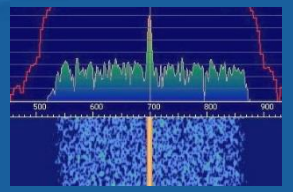


Add a global offset





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/