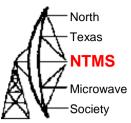


UHFSDR + USB2SDR = Flexible IF Rig

Eric Haskell KC4YOE



Why UHFSDR?



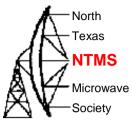
- Wanted IF rig
 - SDR

- Buildable
- Simple
- Frequency flexibility



- Enter UHFSDR
 - 1.75 700MHz (1/2 Si570 output)
 - 50 mW Transmit out
 - 2dB Noise Figure LNA





• Developer

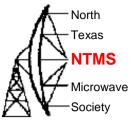
W5HN

- David Brainard WB6DHW
- http://wb6dhw.com/For_Sale.html
- <u>http://groups.yahoo.com/group/UHFSDR/</u>

Key Design Features

- Separate I and Q conversion with passive MCL ADE-2ASK passive mixers (not QSD)
- Pair of SY10EP52 D flip-flops create quadrature LO from Si570's differential pecl output
- ADUM1258 provides isolation for I²C connection for Si570 Frequency control

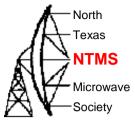
Limitations



- External RF filtering needed
 - No onboard RF filtering
 - Squarewave LO with fast rise-time insures lots of harmonics
- Si570 Performance
 - Gaps in frequency range :Grade A covers 10 to 945 MHz, 970 to 1134 MHz, and 1213 to 1417.5 MHz.
 - Crystal derived but not lockable to external reference
 - Temp stability spec'ed at +/- 50, 20, or 7 ppm -40C to +85C and priced high for better parts
 - Seems good up to 150 MHz but kind of bouncy at 450MHz
 - Touch the package and see immediate shift



Phase Noise

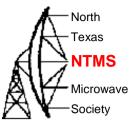


• Specs for phase noise look OK for UHF

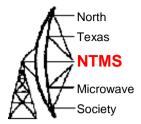
Offset Frequency (f)	120.00 MHz LVDS	156.25 MHz LVPECL	622.08 MHz LVPECL	Units
100 Hz	-112	-105	-97	0
1 kHz	-122	-122	-107	
10 kHz	-132	-128	-116	
100 kHz	-137	-135	-121	dBc/Hz
1 MHz	-144	-144	-134	
10 MHz	-150	-147	-146	
100 MHz	n/a	n/a	-148	

Table 8. Typical CLK± Output Phase Noise (Si570)

UHFSDR Build Considerations

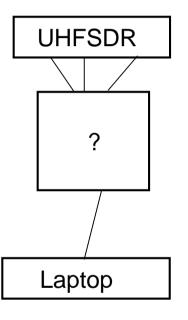


- Some parts orientation are not clear form the silk screen or overlay and may require close examination on example photo
- Some parts have alternative choices and the kit parts may not match the nominal BOM parts. Especially for RF switches. Check the marking to make sure the control line jumper is correct for your part
- PA inductor may need modification to reach some frequencies of interest, may need several values in series to present wideband high impedance to the PA

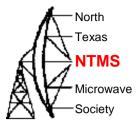


Interface Solution

- Need Laptop interface
 - IQ in and out
 - 24 bit (preferred)
 - 192ksps (preferred)
 - USB
 - Extra IO lines
 - I2C freq control
 - Filter selection
 - T/R switching
 - Simple cabling
 - Software Support
- Options Considered
 - SDR WIDGET
 - USB2SDR

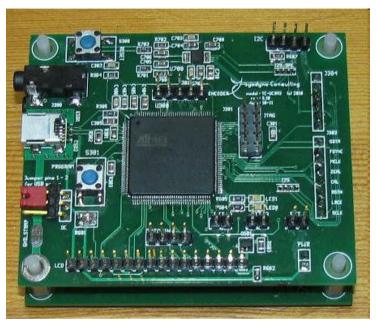




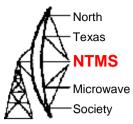


• Hardware Features

- 24-bit AK5384A ADC (135 dB)
- 24/32 bit ES9012 premium DAC
- I2C control bus
- 3 optocoupler buffered inputs
- 3 mosfet 'contact' outputs
- Connector for rotary encoder
- 16-bit LCD panel interface
- Software Features
 - Support 24-bit 48k/96k/192k sample rates on Linux and MacOS
 - Support Windows at 48k sample rate
- Developer George Boudreau
 - <u>http://www.yoyodyneconsulting.ca/pages/SDR-Widget.html</u>



USB2SDR

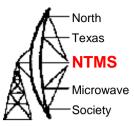


- Hardware Features
 - Up to 192 ksps including Windows
 - 92 dB ADC

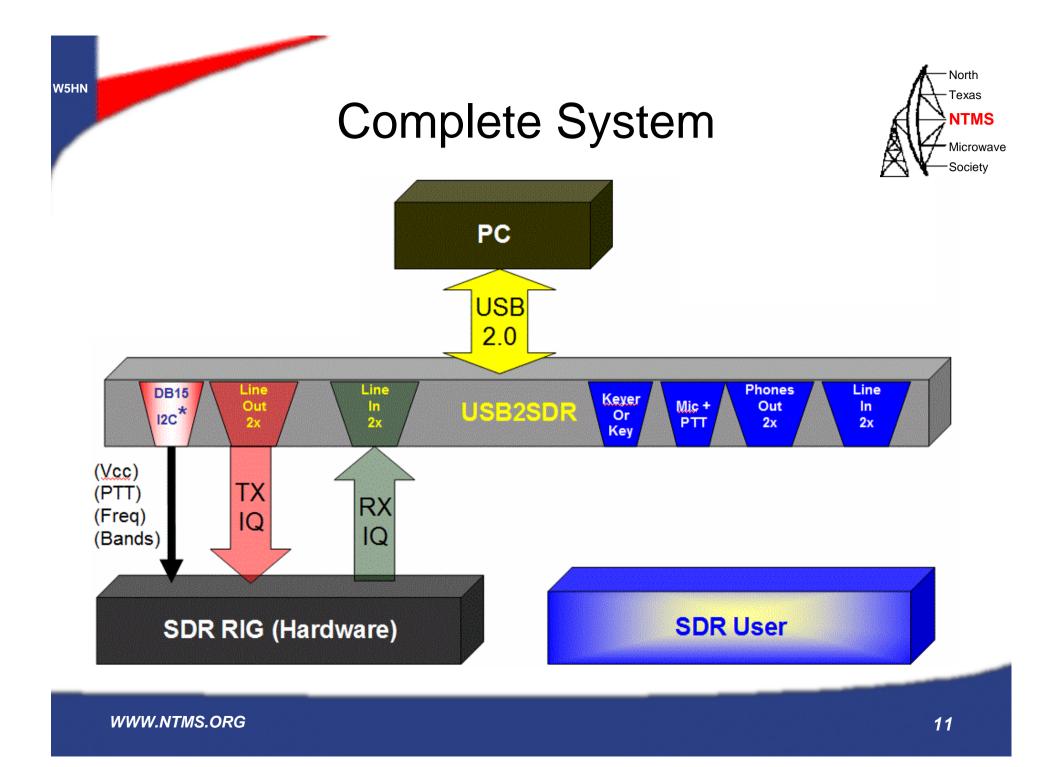
- I2C port with 8 I/O lines
- jack for a straight key or paddles
- USB PC Connection
- Connection for optional 24 bit ADC
- 4 audio input, 4 audio outputs
- NATIVE SUPPORT for PowerSDR-IQ
- Factory assembled
- Developer Christos Nickolaou SV1EIA
 - sv1eia at gmail.com
 - http://groups.yahoo.com/group/powersdr-iq/



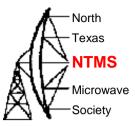
And the Winner is...



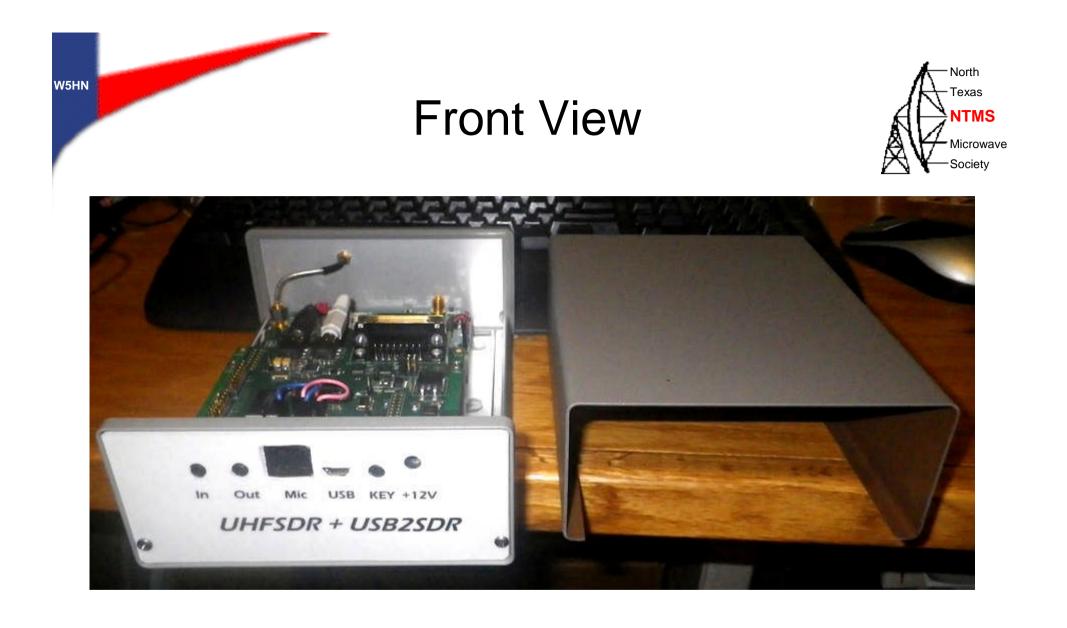
- No surprise here (if you read the title)
 - Comfort with the USB2SDR integration into PowerSDR-IQ
 - Positive reports using the UHFSDR and USB2SDR
 - (92 dB) ADC limitation but there is an upgrade path to a 24bit ADC (someday)
 - Still interested in the SDR Widget

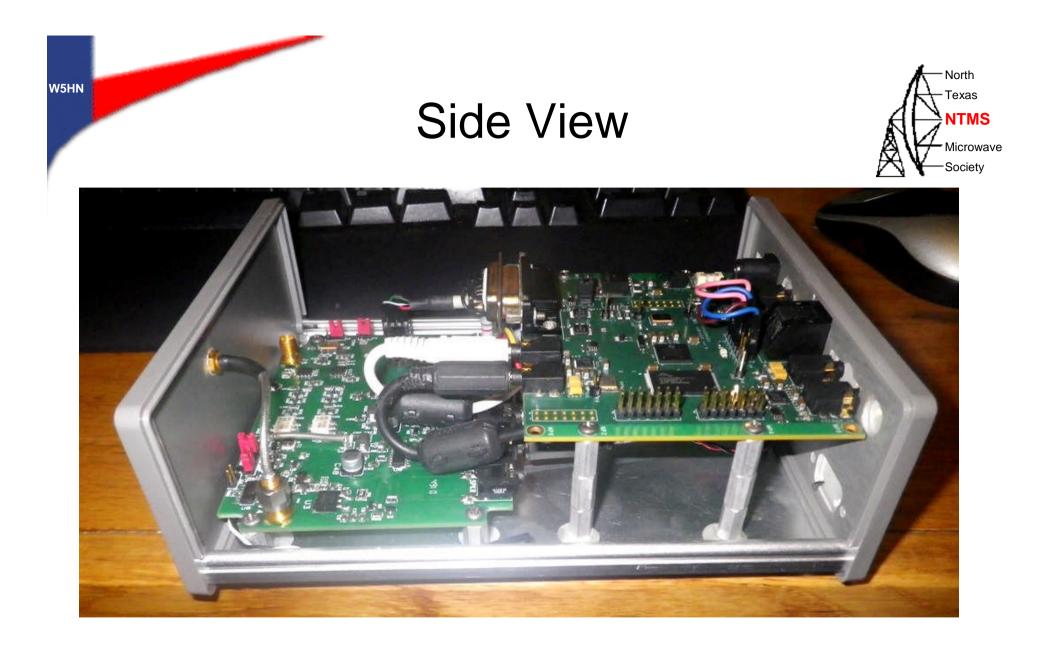


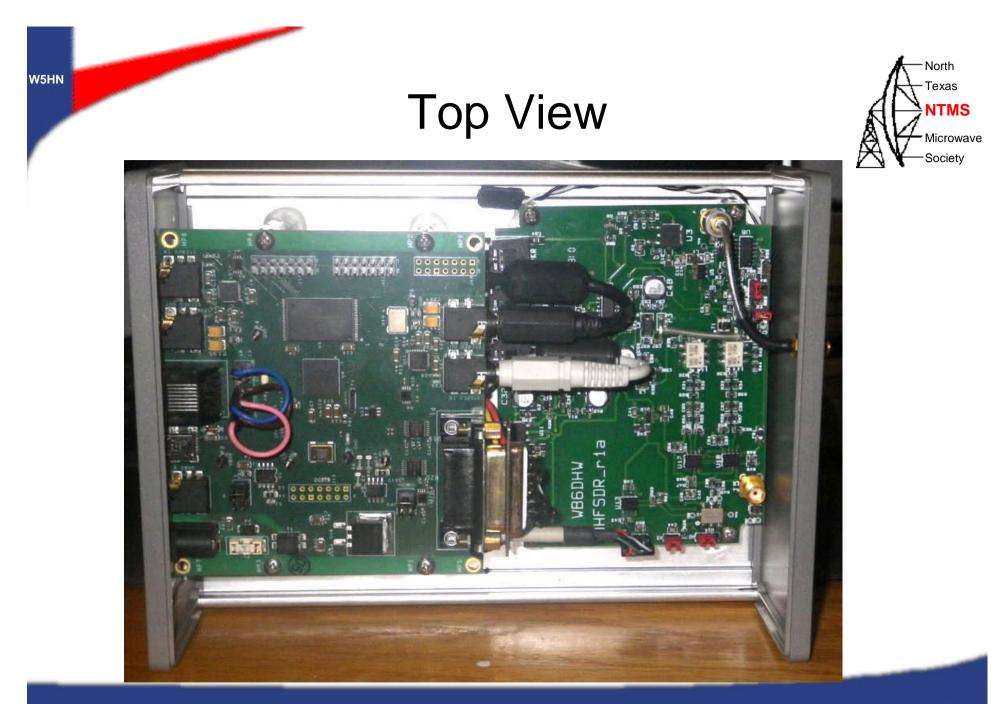
Mechanical Construction



- Reused Lansing MicroPak C style case from Ham-com (originally had Sony gadget inside)
- Scrapped original contents for parts
- Attached Aluminum spacer to PCB's
- Epoxied spacers to base plate (no drilling = no binding)
- Staggered board heights to avoid mechanical interference by cabling





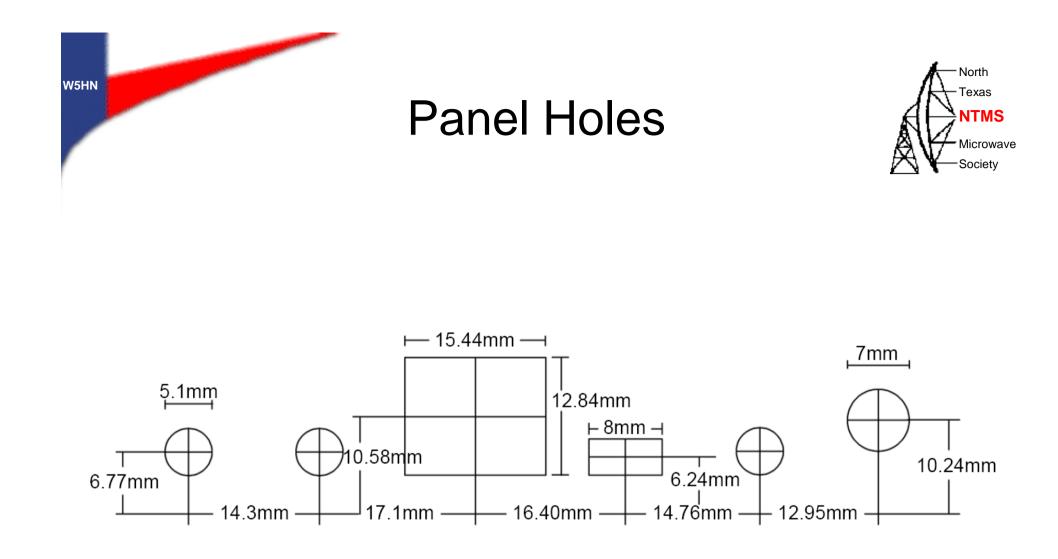


Front Panel

North Texas NTMS Microwave Society

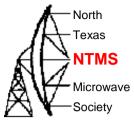
- Used nibbler tool to enlarge existing holes to fit USB2SDR
- Printed and laminated card stock to make panel face cover.
- Cut to size and cutout holes for connections
- Attached with no-foam doubles sided 3M tape



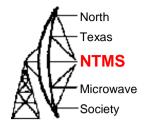




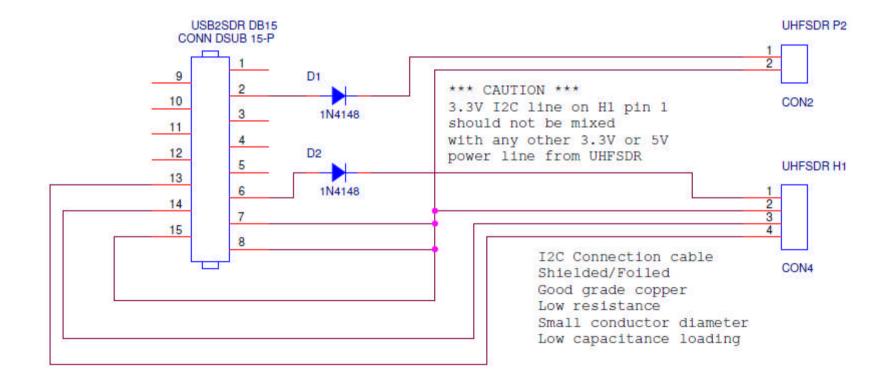
Tools Used



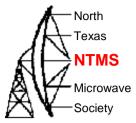




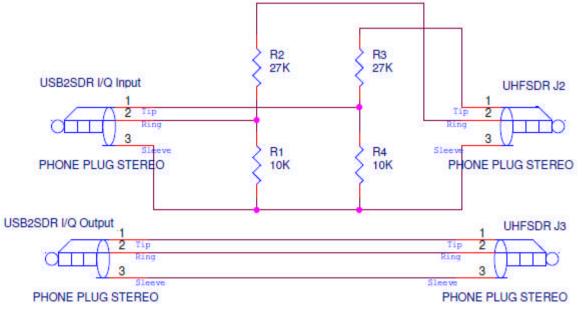
Interfacing the Boards



Interfacing the Audio

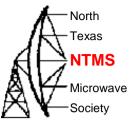


 UHFSDR Op-Amps Use 12Vdc, USB2SDR max input is 0.5Vrms, < 3.3V above ground, requiring pad down

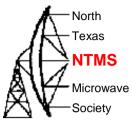


WWW.NTMS.ORG



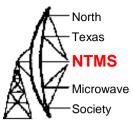


eneral Audio	Display	DSP Tra	nsmit	PA Settings	Appeara	nce Keyboar	d CAT Control	Tests
ardware Config	Options	Calibration	Filters	RX2	Navigation	USB2SDR	USB2SDR Filten	8
Radio Model C FLEX-5000 SDR-1000 Soft Rock 40 Demo/None USB2SDR		▼ S	Hardwa 570 SB2SDF			DDS		
		U	SB to I2		I	SI570 Options Crystal Free 1142898 2C Addr.Hex	55 🚖 Unit	gion ted States 🔻
			ultiplier F Multip	-		Max.VFO.MHz 2C Bus KHz	999 🚖 📃 R 400 🚖	eceive Only Wizard



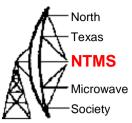
General A	udio	Display	DSP	Transmit	PA Settings	Appearance	Keyboard	CAT Control	Tests
Primary V	AC								
Primary	Sound	Card Set	up Detai	ls	Sound C	ard Selection			
Driver:	US	B2SDR		*	USB	2SDR		-	Expert
Input:	AIC	3204		¥	Buffer Siz	ze Li	ne In Gain	Channel	s
Output:	AIC	3204		÷	512	•	20 ≑	4	-
Mixer:	Nor	ne		-	Sample F	Rate M	ic In Gain		
Receive	e:				96000	•	50 🌲		
Transm	it			¥	Output V	oltage			
						Test		Mic Boo	

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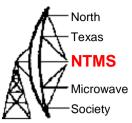
General	Audio	Display	DSP	Transm	nit P.	A Settings	Appearance	ce Keyboar	d CAT Control	Tests
Hardwa	e Config	Options	Calibr	ation Fi	lters	RX2	Navigation	USB2SDR	USB2SDR Filter	5
Freq	quency:	65.00000	00	Fr		ncy: 3.50 dBm):-73 Start	0000			

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General	Audio	Display	DSP	Transmit	PA Settings	Appearance	Keyboard	CAT Control	Tests	
Hardwar	e Config	Options	Calibra	tion Filten	s RX2 I	Navigation U	SB2SDR	USB2SDR Filte	ers	
S/W F	Rx I/Q Ga	ain Correc	ction		H/W Rx	I/Q Gain L	US	B Performance	Indication	
Left:	-	1	2	0	Left:	Right:	Re	ad BB:	1720	
0	-25		a ar	0	P		Wr	ite BB:	0	
Right				-0			Re	ad BB/min:	1720.0000	
0	-25		0 - 4)	0		5	Wr	ite BB/min:	0.000000	
HAVE	Rx I/Q Ph	nase Corr	ection		=		Ela	apsed sec.;	36	
Phase	1.5		0	W 14	95	\$ 95 \$	US	Bt.o.msec:	20 🚔	
0	-12		0	+127				Refresh		
							DB15 G	PIO Out Test -	Pins	
		UISa	ble WBIF	Enable	e PreAmp	0	2 🔲 3	4 🔲 10) 11 12	1

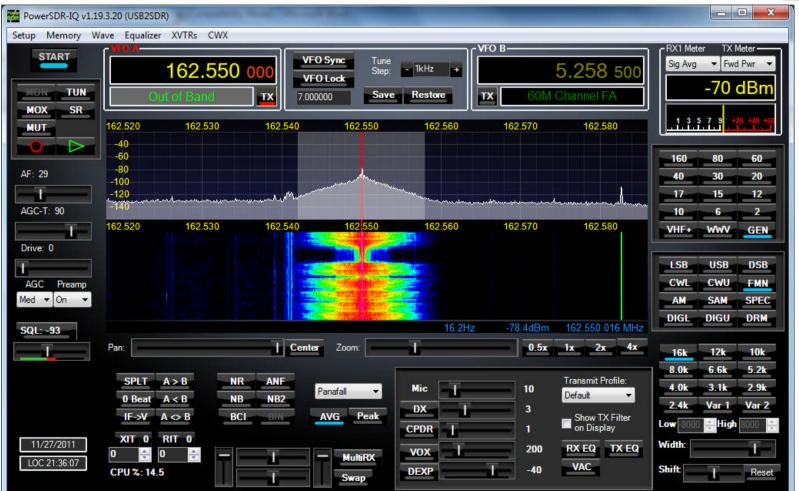
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General	Audio	Display	DSP	Transmit	PA Settings	Appearance		terror and the second se	
Hardwar	e Config	Options	Calibr	ation Filte	ers RX2	Navigation	USB2SDR	USB2SDR Filters	
BPF Se	ttings								
F	Iter	Frequen	icy MHz						
	0	0.0	-	Lowest F	req.				
	1	0.0	•						
	2	0.0	***						
	3	0.0	•						
	4	0.0							
	5	0.0	* -						
	6	0.0	\$						
	7	0.0	•	Highest F	Freq.				

PowerSDR-IQ

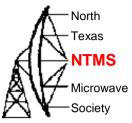
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Next Steps



- Filters for operating frequencies
- Characterize Si570 temperature vs frequency
- Experiment with temperature control
 - Insulation
 - Add thermal mass
 - Active controller
- 24 bit ADC option?
- Revisit SDR Widget?



