This file contains the updates and notes for the

6-Band RX Bandpass Filter

by David Jordan, K1NQ

Table of Contents

Compiled by KV1J - 4 December 2008

Rev 3.0. **Changes from 2.2 are in bold type**.
10 October 2007

K1NQ, W1UE, KV1J and I have been looking over and building up some portions of the 6BPF boards and have come across some corrections that will need to be done before and as you build the boards. I've volunteered to put out the construction notes.

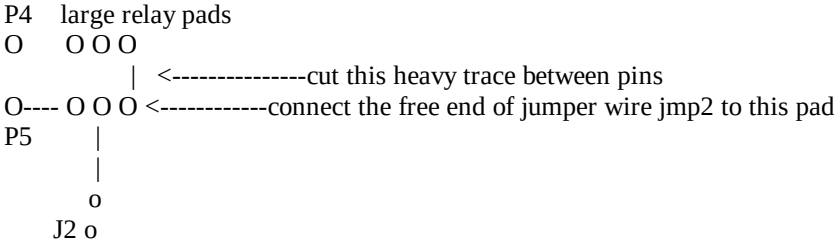
Essential updates:

1- The silkscreen pattern for D5 (the catch diode near K5) is backwards. The cathode band of this diode needs to go farthest away from the relay, not closest to it as marked. If you don't put this in right then Q4 will burn up when 40M is first energized. (The webpage schematic is not correct in this area either).

2- The transistors listed and sent for Q1-Q6 are the wrong part and should not be installed in the board. They need to be NPN's, not PNP's. PNP's will not work here. Any small signal or switching NPN transistor will do, like
2N3904 or 2N2222. If you do not have any, I suggest Radio Shack part number 276-1617, 15 transistors for $2.59, enough for 2 boards and a few for your junkbox.

3- Jumper "jump2" needs correction. One side of it should go to the hole marked "jump2" near C56, but do not connect the other end to the hole marked "jump2" under K3. Instead this end of the wire needs to go to one of the pins of relay K8 as shown below. **Use a piece of hookup wire under the board for this, and not RG174.**

Also cut the trace shown.



View of K8 solder pads from bottom side of board

4- The holes for L1, L2, and L3 aren't large enough to accept the #16 wire that the toroids are wound with. Drill all the holes out to 1/16", but this will destroy the plating connecting the top pad to the bottom one on the PCB, so make sure to solder the wire on both sides of the board.
Better yet, change to #20 wire to wind these inductors. See the “Inductor construction table (.xls file)” for more details.

5. Capacitors C18 and C19 in the 15M filter section need to be in parallel, not in series as laid out on the PCB. One way to fix this is to solder the two caps together and then bend the leads of one to go from the top hole of the C18 outline to the bottom hole (ground) of the C19 outline.

6. Some of the part designations in the initial documentation on the YCCC website changed on the final PCB. The listing that came with the parts kits is correct. For those that did not get parts kits, refer to the “updated 6bpf parts list” document for a complete listing. Especially note the changes for the 22, 56, 30, and 2.2 pf capacitors. (tnx N1MM)

Helpful information:

A. LED D3: the anode is the long lead and should go to the hole in the square pad. Do not solder this LED into the board. It will be on the front panel with extension leads connecting it to the PCB.

B. Coax jumper on top of board: use a 4" piece of the RG174 to go from "jmp1" located next to J1, over to "JUMP" located near Q1.

C. Bypass capacitors C67-C75 and C80-C86: the parts supplied have too narrow a lead spacing to fit the footprint in the board and need to be spread apart. Use a small needle nose plier to hold the lead when you bend it so as not to introduce small cracks in the seal of the ceramic body. Bend one lead as suggested below. Take care that the horizontal part of the bent lead does not short to any traces on the top of the board that go between the pads . This same technique should also be used for other caps having too close a lead spacing to fit the holes without straining the leads.

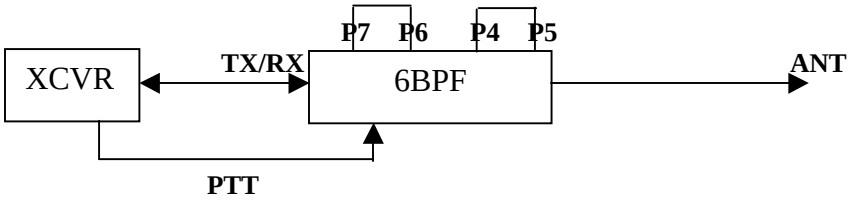
D. Capacitor C77 has the opposite problem to that above. Similarly bend one of its leads toward the other to shorten the spacing.

F. Cut lengths for the RG-174 coax.

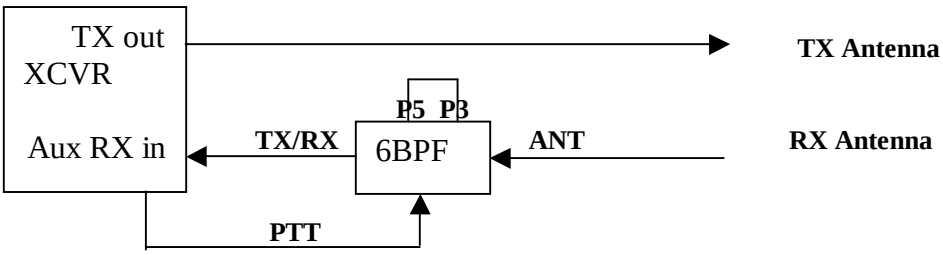
9 ¾" for the piece going to J1 on the PCB
10 ¼" for the piece going to J2 on the PCB

G. Wiring of Option Jumpers P3-P7:

For using the filter with a radio that transmits and receives on the same connector (the usual situation), put a jumper between P7 and P6, and another between P4 and P5, and be sure to hook up a PTT signal to the filter. Keep the jumpers at least 1/8" away from other traces on the PCB. (And see K1NQ's warnings about the absolute necessity of using a PTT signal, and its delay requirement.) When you transmit, the TX/RX port of the 6BPF will then be switched directly to its ANT port, bypassing any selected filter section, but you must have proper PTT setup for that to happen.



For use with a radio's Aux RX input or a separate receiver, put just one jumper between P5 and P3.



This will disconnect the RX antenna and grounds the 6BPF TX/RX port during transmit.
Again, see the K1NQ PTT setup warnings.

H. Delay putting in the largest caps until last, as they repeatedly got bent when the board was turned over. They could go in last, after the toroids. (tnx N1MM)

I. For spacers to mount the PCB in the box, use 1/4" high spacers for #6 screws. You can also use 2 dia 5/16" #6 nuts and a #6 flat washer as a spacer.

J. For the band decoder connector (J3) use the MALE on the chassis so that the cable end from the band decoder would not have live conductors exposed when it is not plugged in. The cable end would then be female. (The BOM looks like it has female on the chassis.)

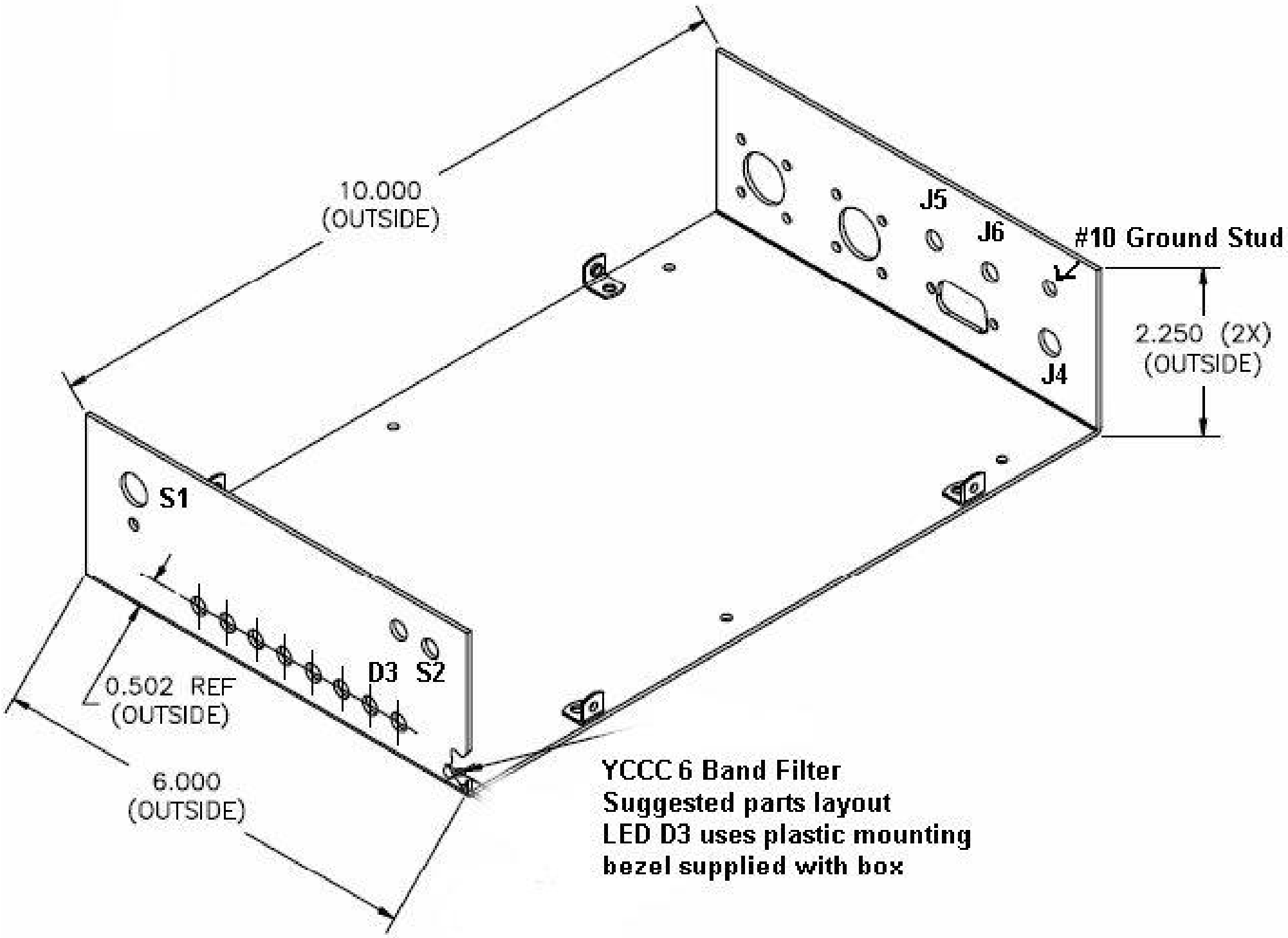
Please let us know of any further comments for this list.

YCCC 6 Band Receive Bandpass Filter
Inductor Winding Table
revision - 29 August 2007

BAND	REF	CORE	COLOR	WIRE SIZE	WIRE LENGTH	TURNS	NOTES
160	L16	T50-2	Red	#24	22"	28	N8RA needed 31 turns close wound
160	L17	T50-2	Red	#24	22"	28	N8RA needed 31 turns close wound
160	L18	T50-2	Red	#24	22"	28	N8RA needed 31 turns close wound
80	L13	T50-2	Red	#22	19"	23	N8RA used 22 turns spread over 80% of core
80	L14	T50-2	Red	#22	19"	23	N8RA used 22 turns spread over 80% of core
80	L15	T50-2	Red	#22	19"	23	N8RA used 22 turns spread over 80% of core
40	L10	T50-6	Yellow	#20	16"	18	N8RA used 17 turns spread over 80% of core
40	L11	T50-6	Yellow	#20	16"	18	N8RA used 17 turns spread over 80% of core
40	L12	T50-6	Yellow	#20	16"	18	N8RA used 17 turns spread over 80% of core
20	L7	T50-10	Grey	#20	13"	15	N8RA used 13 turns spread over 75% of core
20	L8	T50-10	Grey	#20	13"	15	N8RA used 13 turns spread over 75% of core
20	L9	T50-10	Grey	#20	13"	15	N8RA used 13 turns spread over 75% of core
15	L4	T50-10	Grey	#18	12"	10	N8RA compressed the 10 turns over 60% of core
15	L5	T50-10	Grey	#18	12"	10	N8RA compressed the 10 turns over 60% of core
15	L6	T50-10	Grey	#18	12"	10	N8RA compressed the 10 turns over 60% of core
10	L1	T50-10	Grey	#20	7"	8	N8RA spread the 8 turns over 40% of core
10	L2	T50-10	Grey	#20	7"	8	N8RA spread the 8 turns over 40% of core
10	L3	T50-10	Grey	#20	7"	8	N8RA spread the 8 turns over 40% of core

Note 1: Just putting the wire thru the core with a simple U-turn counts as the first turn.
Note 2 : L1-L3 changed from #16 wire
Note 3: David K1NQ suggests - You should be winding all the cores with the wire spread out to cover 3/4 of the core for best Q. The core's permeability can vary +/-20% from lot to lot. It is better to start off with the recommended turns and then remove 1 or 2 turns if needed. You can use a MFJ meter to sweep the filter for SWR to center the inductors
Note 4: The W3LPL app notes on K1TTT's website says to tune the filters by squeezing or spreading turns and/or adding or subtracting turns http://www.k1ttt.net/technote/w3lplfil.html

Note 5:N8RA used an Autek RF-1 to look at the swr thru each filter. The SWR increases very rapidly outside the passsband so he adjusts the turns and their initial spacing to achieve low swr in the band under test.
Final tweaking of spacing is done by listening to that band on the air while switching the filter in and out.
Note 6: W1UE has wound some coils with 1 more turn than nominal and will borrow an MFJ Antenna Analyzer to tune them after they are in the box.
Note 7: The toroids can be wound "CW" or "CCW" on the core.
One of these ways will match the outline on the PCB, but it makes no difference electrically.



YCCC 6 Band Filter
Suggested parts layout
LED D3 uses plastic mounting bezel supplied with box

		qty				Mouser part no
1	C1,C19	2	33p	Capacitor	NPO100	140-100N5-330J-RC
2	C2,C3,C4,C22	4	15p	Capacitor	NPO100	140-100N2-150J-RC
3	C5,C12,C23	3	10p	Capacitor	NPO100	140-100N2-100J-RC
4	C6,C34	2	27p	Capacitor	NPO100	140-100N5-270J-RC
5	C7,C45	2	47p	Capacitor	NPO100	140-100N5-470J-RC
6	C8,C10,C11,C15,C16,C17,C27	7	56p	Capacitor	NPO100	140-100N5-560J-RC
7	C9,C20,C21,C32,C40,C59	6	20p	Capacitor	NPO100	140-100N2-200J-RC
8	C13	1	8.2p	Capacitor	NPO100	140-500N2-8R2D-RC
9	C14,C62,C65	3	39p	Capacitor	NPO100	140-100N5-390J-RC
10	C18,C28,C44,C49	4	30p	Capacitor	NPO100	140-100N5-300J-RC
11	C24,C36	2	2.2p	Capacitor	NPO100	140-100N2-2R2D-RC
12	C25,C30,C35	3	22p	Capacitor	NPO100	140-100N5-220J-RC
13	C26,C33,C41,C42,C43,C47,C60	7	150p	Capacitor	SL	140-102S6-151J-RC
14	C29	1	68p	Capacitor	NPO100	140-100N5-680J-RC
15	C31,C37,C46,C48,C53,C54	6	100p	Capacitor	NPO100	140-100N5-101J-RC
16	C38,C63	2	180p	Capacitor	SL	140-102S6-181J-RC
17	C39,C55	2	220p	Capacitor	SL	140-102S6-221J-RC
18	C50	1	330p	Capacitor	SL	140-102S6-331J-RC
19	C51,C61	2	470p	Capacitor	SL	140-102S6-471J-RC
20	C52,C58	2	560p	Capacitor	SL	140-102S6-561J-RC
21	C56	1	1000p	Capacitor	SL	140-102S9-102J-RC
22	C57,C64	2	680p	Capacitor	SL	140-102S6-681J-RC
23	C66,C78	2	.01u	200v cap	C322	80-C322C103K2R
24	C67-C75, C80-C86	16	.01U	small cap	C315	80-C315C103K5R
25	C76	1	.001U	small cap	C317	140-50Z5-102M-RC
26	C77	1	.1U	small cap	CK05	140-50Q9-104Z-RC
27	D1,D2,D4-D13	12	4003	diode	1N4003	583-1N4003-B
28	D15,D23	2	4007	diode	1N4007	583-1N4007-B
29	D3	1	5mm	led orange		604-WP7113NC
30	D14	1	Green	small led RA 5mm	LUMEX	696-SSF-LXH100MGD
31	D16	1	YELLOW	small led RA 5mm	LUMEX	696-SSF-LXH100MYD
32	D17,D18,D19,D20,D21,D22	6	RED	small led RA 5mm	LUMEX	696-SSF-LXH100MLID
33	J1,J2	2	COAXJ	Coax jack	uhf	601-25-7350
34	J3	1	Conn8	9 pin male-chassis	9PIN Dsub	156-1209
35	mate for J3	1		9 pin female-cable	9PIN Dsub	156-1309

36	hood for J3 mate	1				156-3009-E
37	J4	1		2.5mm power jack		163-2325-E
38	J4 mate	1		2.5mm power plug		1710-2512
39	J5	1		3.5mm phonejack NC		16PJ135
40	J5 mate	1		3.5mm plug		17PP103
41	J6	1		phonojack		161-0253-EX
42	K1,K2,K3,K4,K5,K6,K7,K8	8		OEGDPDT		677-OMI-SH-212D
43	Q1,Q2,Q3,Q4,Q5,Q6	6	2N3904	Bipolar	TO92	
44	Q7	1	MPSA93	Bipolar	TO92	512-MPSA93
45	R1,R2,R3,R4,R5,R6	6	4.7K	Resistor (USA style)	R25	291-4.7K-RC
46	R10-R17, R7	9	470	Resistor (USA style)	R25	291-470-RC
47	R8	1	3k	Resistor (USA style)	R25	291-3K-RC
48	R9	1	30K	Resistor (USA style)	R25	291-30K-RC
49	S1	1	SW7	SP12T switch 1/4"sh		105-SR2511F-12RN
50	knob for S1	1		KNOB		45KN012-GRX
51	S2	1	SPST	Single pole switch		108-0001-EVX
52	L1,L2,L3	3	#16 8t	T50-10 Inductor	#16 8t	
53	L4,L5,L6	3	#18 10t	T50-10 Inductor	#18 10t	
54	L7,L8,L9	3	#20 15t	T50-10 Inductor	#20 15t	
55	L10,L11,L12	3	#20 18t	T50-6 Inductor	#20 18t	
56	L13,L14,L15	3	#22 23t	T50-2 Inductor	#22 23t	
57	L16,L17,L18	3	#24 28t	T50-2 Inductor	#24 28t	
58	coax	2	feet	RG316 or RG174		
59		8	feet	#24 MAGNET WIRE		
60		6	feet	#22 MAGNET WIRE		
61		12	feet	#20 MAGNET WIRE		
62		3	feet	#18 MAGNET WIRE		
63		2.5	feet	#16 MAGNET WIRE		

Rev - 29 January 2008

3 Mods for the 6BPF's

de N8RA

The first try to use these filters was the past WWDXCW. KD1EU and I set up two radios here, each equipped with a 6BPF. The filtering performance was great, but that first use did suggest a few things that could be enhanced.

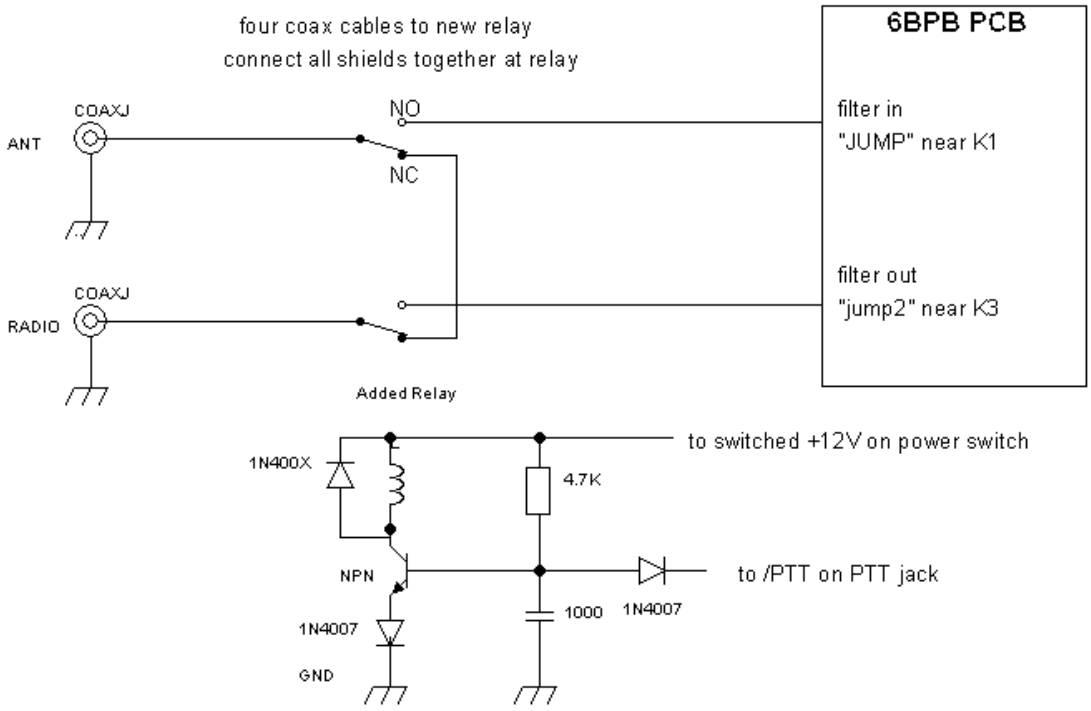
Mod 1: Front Panel LEDs Too Bright

The 6 LED's indicating the band setting of the 6BPF were too bright when the filter was sitting on top of the radio. The fix was to increase their series resistance by adding a 4.7K ohm resistor in series with each existing 490 ohm one. An easy way to do this is to heat the bottom of one of the solder pads of the existing resistor while gently pulling out the corresponding lead on the top of the board. Then trim one lead of the new 4.7K resistor to 1/8", and while heating the same bottom pad again, insert this short end into the hole. The free ends of the two resistors can then be joined together above the PCB.

Mod 2: Lower SWR through the filter when it is turned off

On the second day of the WWDX contest, I started to notice an intermittent in the switching of the T/R bypass operation of the 6BPF. When coming back to receive, sometimes the band would appear dead, but a quick cycling of the 6BPF bypass relays with the front panel power on/off switch or the ptt would bring it back. I think (without any proof) that the relay contacts were damaged by hot switching them when I used the "TUNE" button on the Orion. This TUNE is independent of the delay I had set in the N1MM logger, and RF comes out of the radio very soon after its PTT-OUT switches. So I now have a flaky 6BPF; what to do? Well I could replace the relays but that looks like major surgery. Another desire has been to change the bypass switching arrangement to lower the swr thru the filter when it is powered off. Taking care of both of these needs has turned out to be easy by adding another relay. I used an open frame one with 10A contacts and a 12V coil. If I ever damage the contacts again, I can now clean them. N1MM will say I made lemonade.

This schematic shows how to do it:



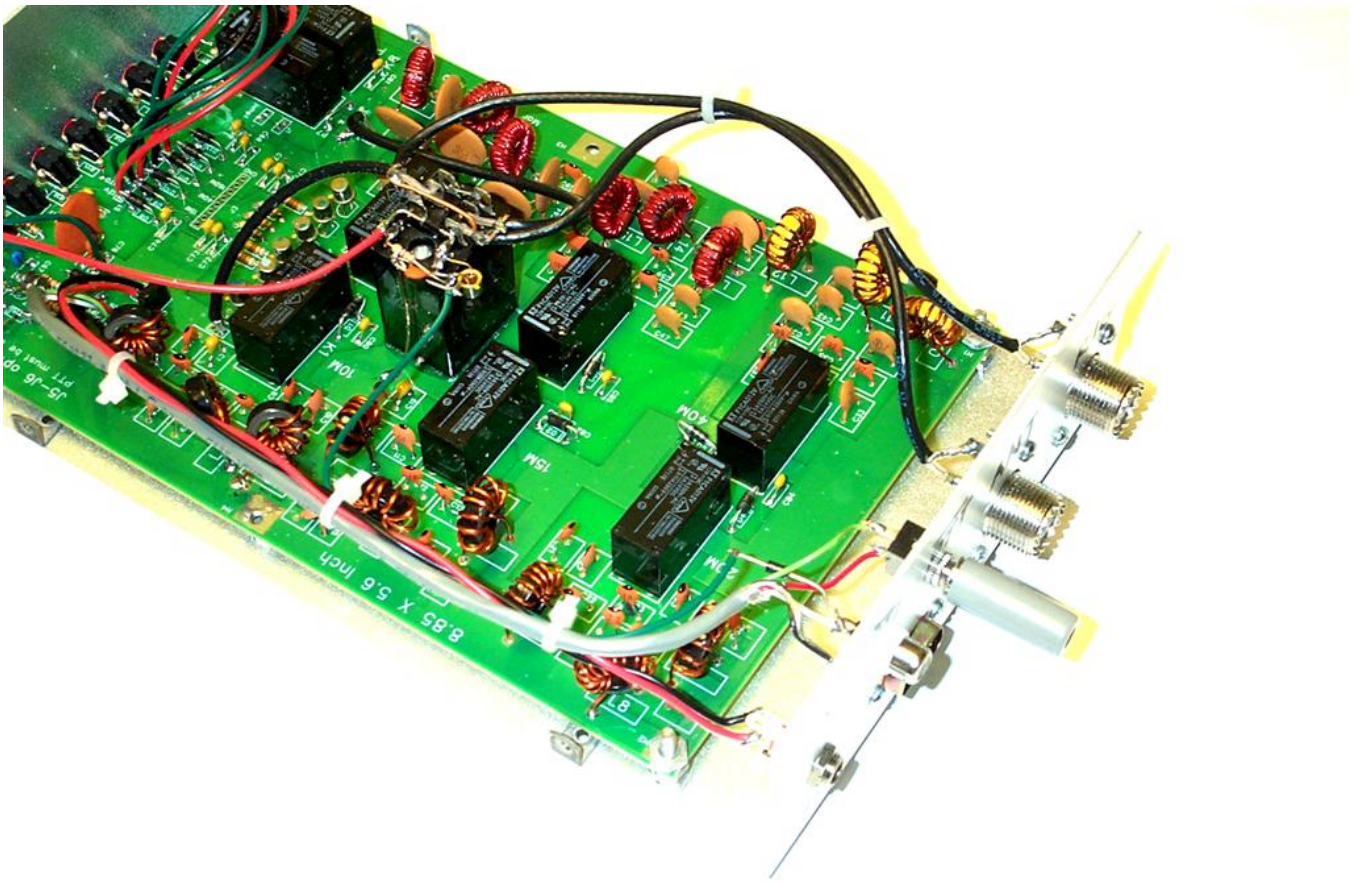
With this arrangement, when the power is off, or when PTT is asserted, the relay is de-energized and bypasses the filter. Because of the short connections, the swr thru the filter is now less than 1.3 to 1 from 160-10M when it is off. When the power is turned on, the relay is energized, and the filter will be “in-line”.

I epoxied a dpdt relay to the center of the PCB and routed the existing coax lines from the antenna and radio back panel SO239’s so they now go to the poles of the new relay. Add a wire across the normally closed relay contacts. When the relay is not energized the filter PCB is completely out of the line.

Then wire the input and the output of the filter to the appropriate normally open contacts on the relay. Specifically, route a coax from the filter input, labeled “JUMP” near K1, and one from the filter output labeled “jump2” between K7 and K3 to the relay’s NO antenna and radio contacts. Solder the coax shields of these 4 coaxes together at the relay.

To control the relay, add a transistor switch for the coil and tie it into the existing PTT wiring in the 6BPF. I built this circuitry right on the relay coil contacts. The connection to common was made with a bare wire going down to the PCB and soldered to the topside ground foil after scraping away a bit of the solder-mask.

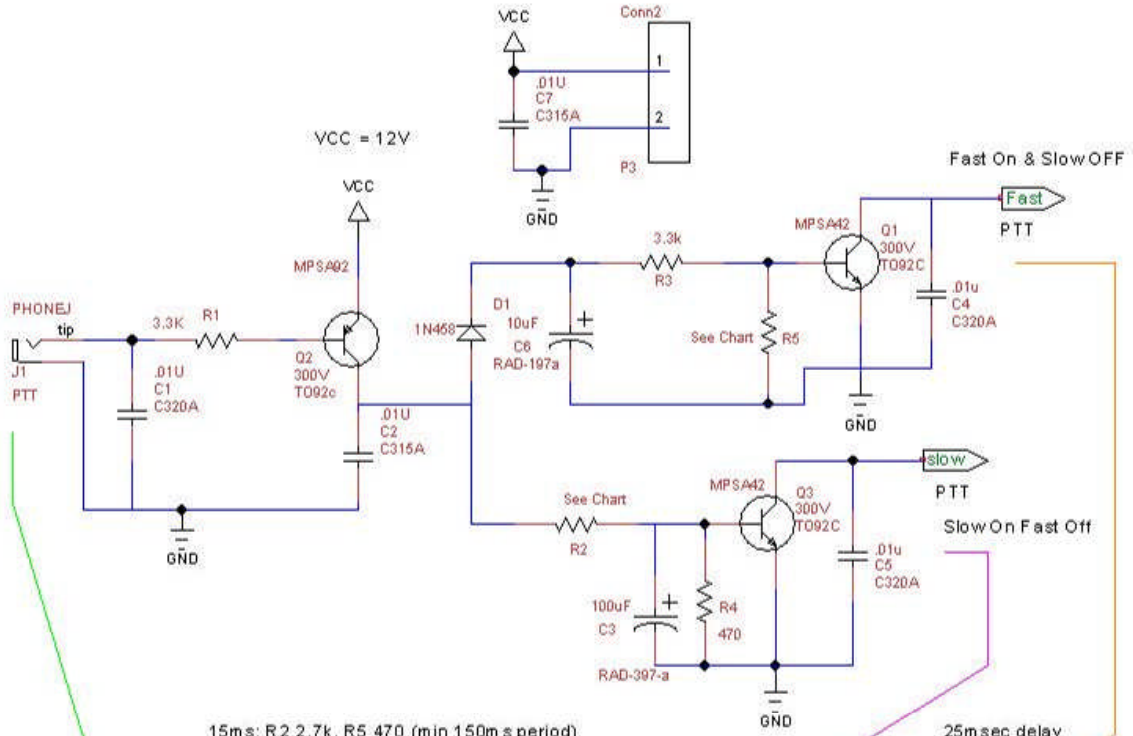
Finally, cut the control line PCB trace to the former T/R relays K3 and K8 since they are no longer used. I cut this trace on the top of board where it runs by R12 and R13.

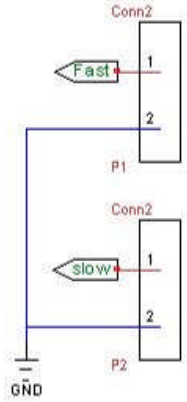


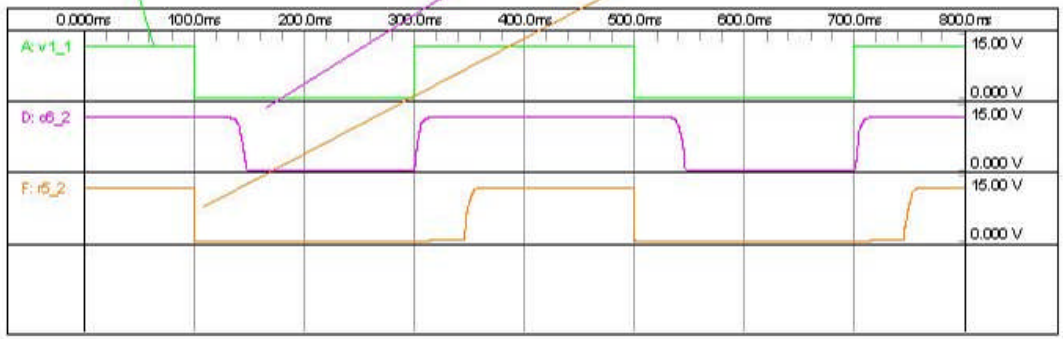
The photo above shows where I put the relay.

Mod 3) Adding an Aux Receive Antenna Input

The 6BPF works great when you receive and transmit on the same antenna. Sometimes you may want to use it with an aux receive antenna, like a beverage, to benefit from the filtering and receiver front end protection. This is easy. Add another small coaxial connector (like a phono) to the back panel with a coax going from it to a new SPDT switch added to the front panel. Cut the coax going to the filter input labeled “jump” and stretch it, or use two longer pieces that go to the new spdt switch. Wire the SPDT switch to allow selection of either the transmit or the aux antenna feeding the input of the filter. This is also a good way to add an aux antenna input to a radio that does not have one.







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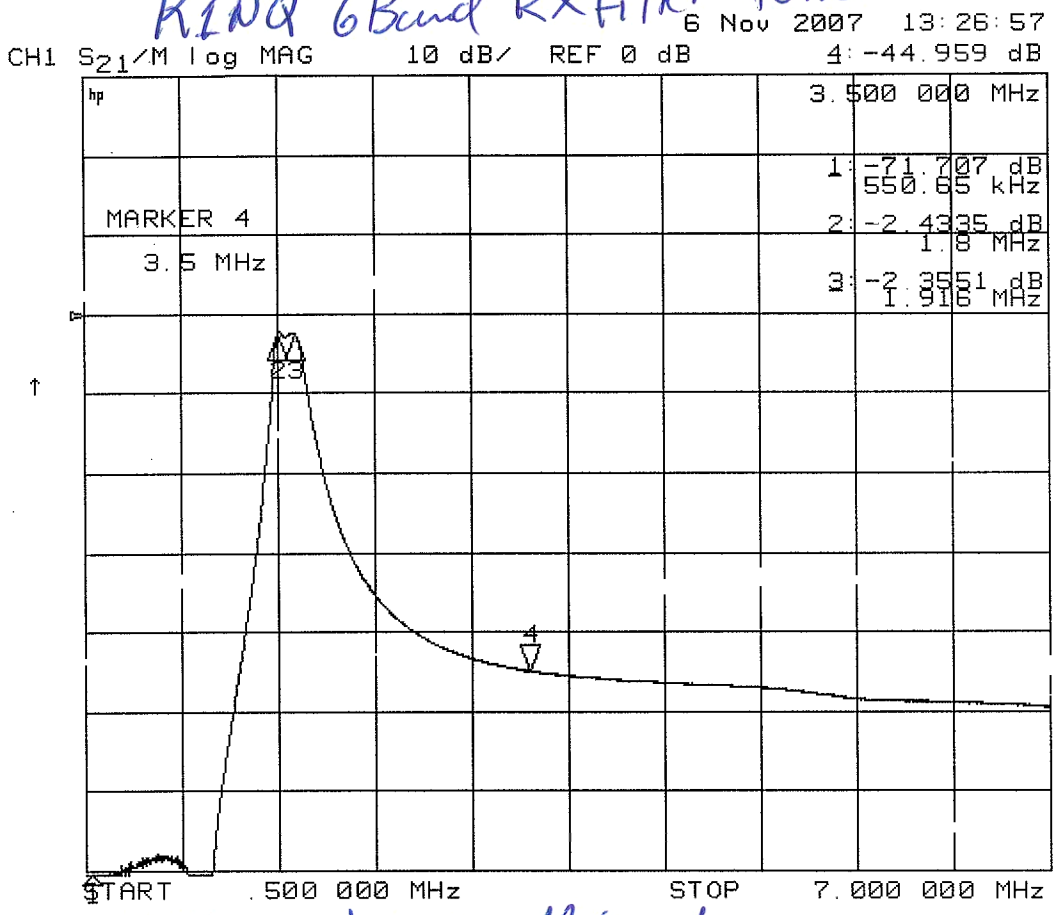
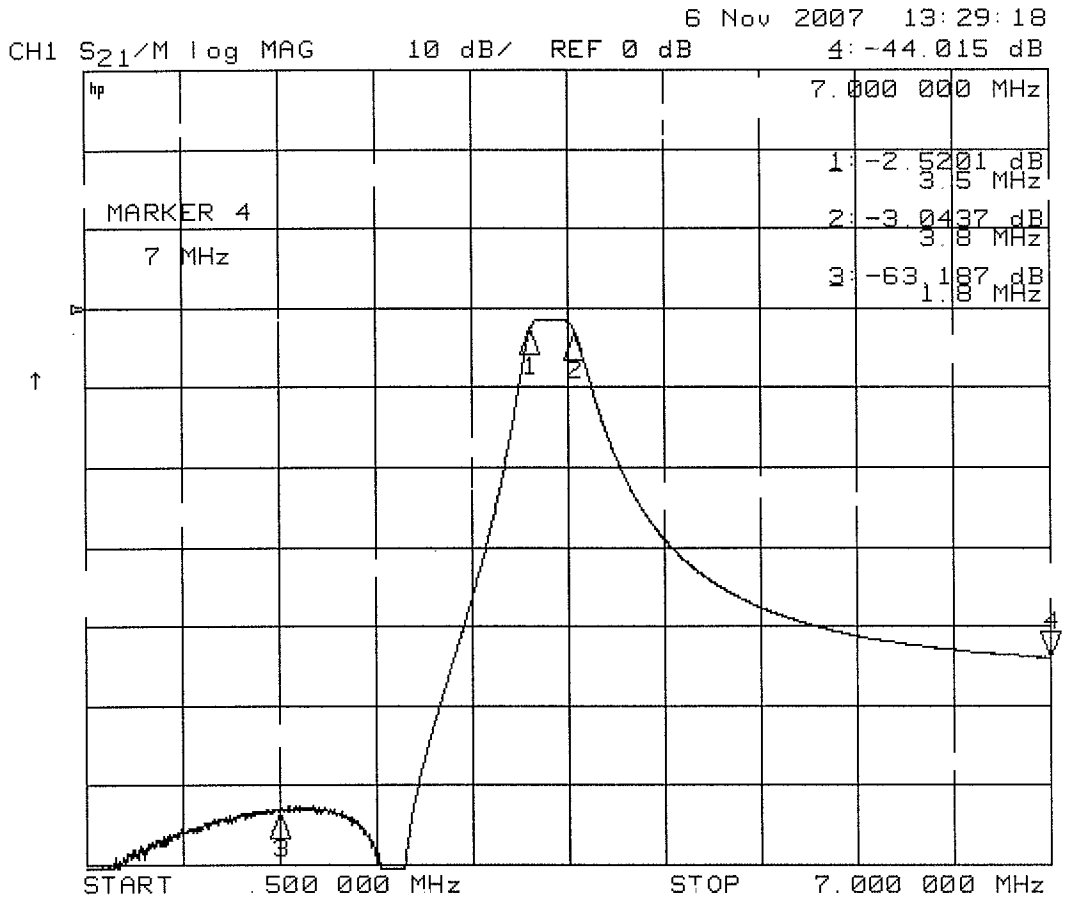
Author	K1NQ/KK1L	
File	C:\Program Files\TinyCAD\PTT.dsn	Document
Revision 1.1	Date Dec 4, 2008	Sheets 1 of 1

K1NQ 6Band RX filter tune



N8RA Inductors all Bands

K1NQ Rev 3/07 Rev B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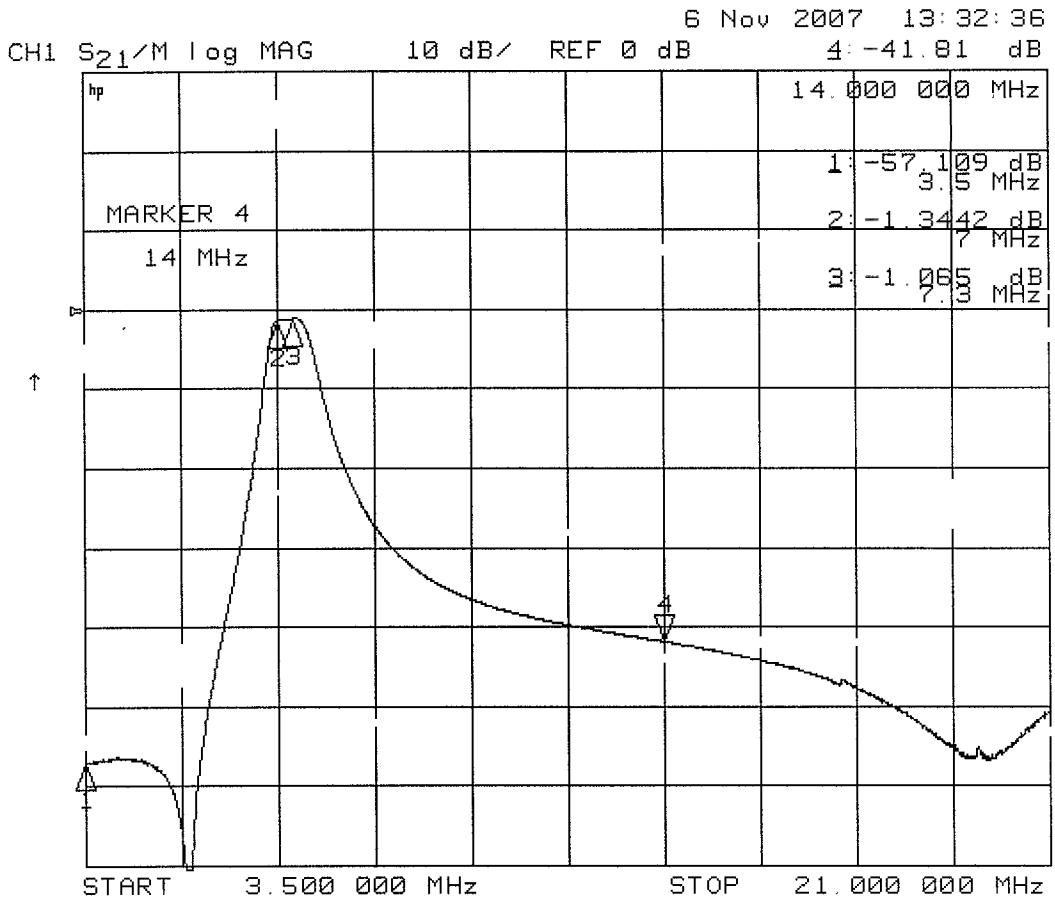
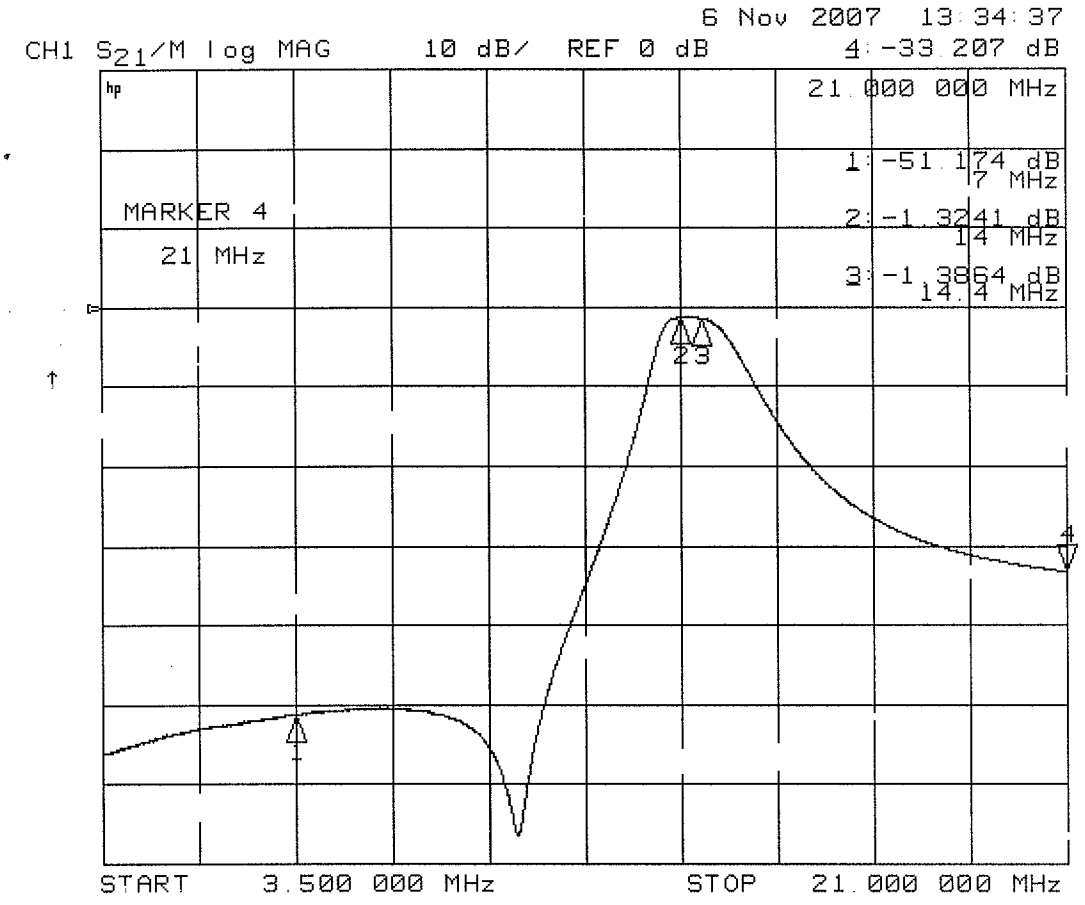
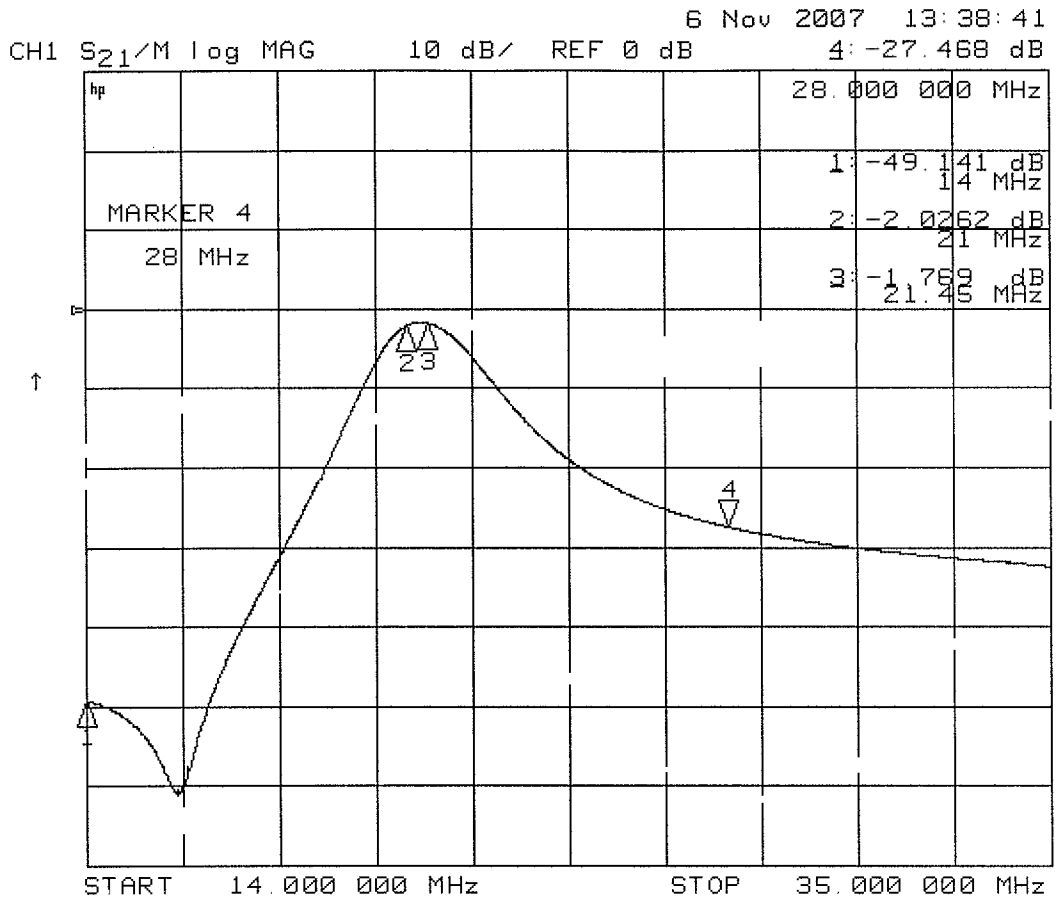
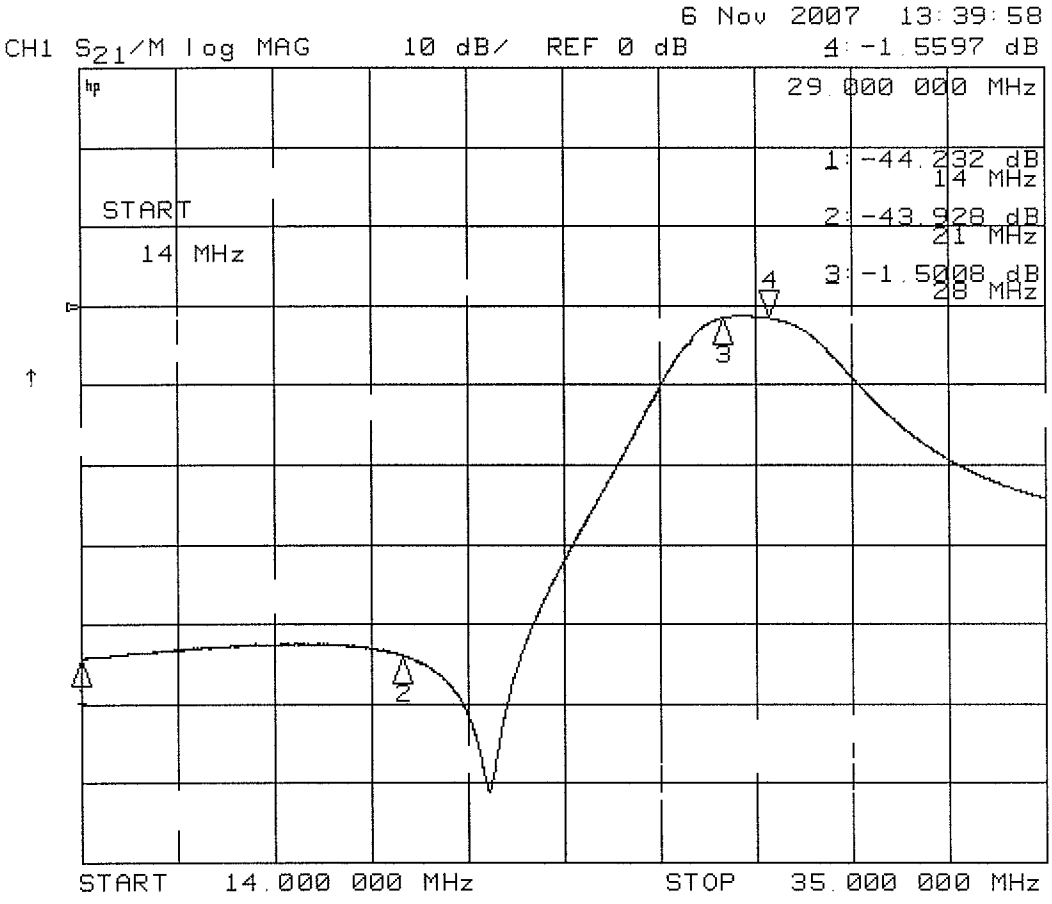
CH1 S21/M log MAG 10 dB/ REF 0 dB 4:-44.015 dB
hp
7.000 000 MHz
1:-2.5201 dB
3.5 MHz
MARKER 4
7 MHz
2:-3.0437 dB
3.8 MHz
3:-63.187 dB
1.8 MHz
START .500 000 MHz
STOP 7.000 000 MHz


6 Nov 2007 13:32:36
CH1 S21/M log MAG 10 dB/ REF 0 dB
4: -41.81 dB
hp
14.000 000 MHz
1: -57.109 dB
3.5 MHz
MARKER 4
14 MHz
2: -1.3442 dB
7 MHz
3: -1.065 dB
7.3 MHz
START 3.500 000 MHz
STOP 21.000 000 MHz


6 Nov 2007 13:34:37
CH1 S21/M log MAG 10 dB/ REF 0 dB 4: -33.207 dB
hp
21.000 000 000 MHz
1: -51.174 dB
7 MHz
MARKER 4
21 MHz
2: -1.3241 dB
14 MHz
3: -1.3864 dB
14.4 MHz
START 3.500 000 MHz
STOP 21.000 000 MHz


6 Nov 2007 13:38:41
CH1 S21/M log MAG 10 dB/ REF 0 dB
4: -27.468 dB
28.000 000 00 MHz
1: -49.141 dB
14 MHz
MARKER 4
28 MHz
2: -2.0262 dB
21 MHz
3: -1.769 dB
21.45 MHz
START 14.000 000 MHz
STOP 35.000 000 MHz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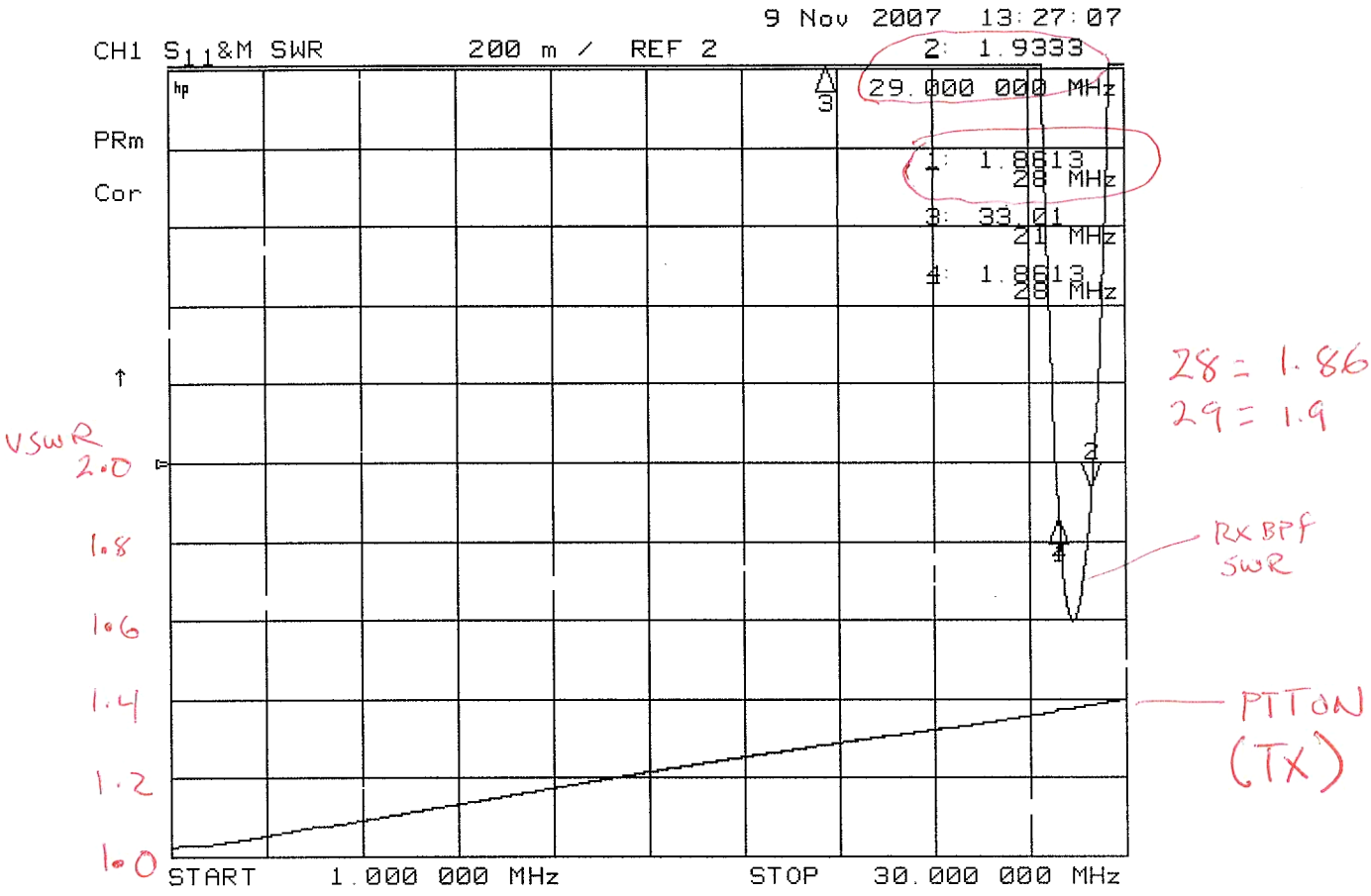
CH1 S21/M log MAG 10 dB/ REF 0 dB
4: -1.5597 dB
hp
29.000 000 0 MHz
1: -44.232 dB
14 MHz
START
14 MHz
2: -43.928 dB
21 MHz
3: -1.5008 dB
28 MHz
4
3
2
START 14.000 000 MHz
STOP 35.000 000 MHz

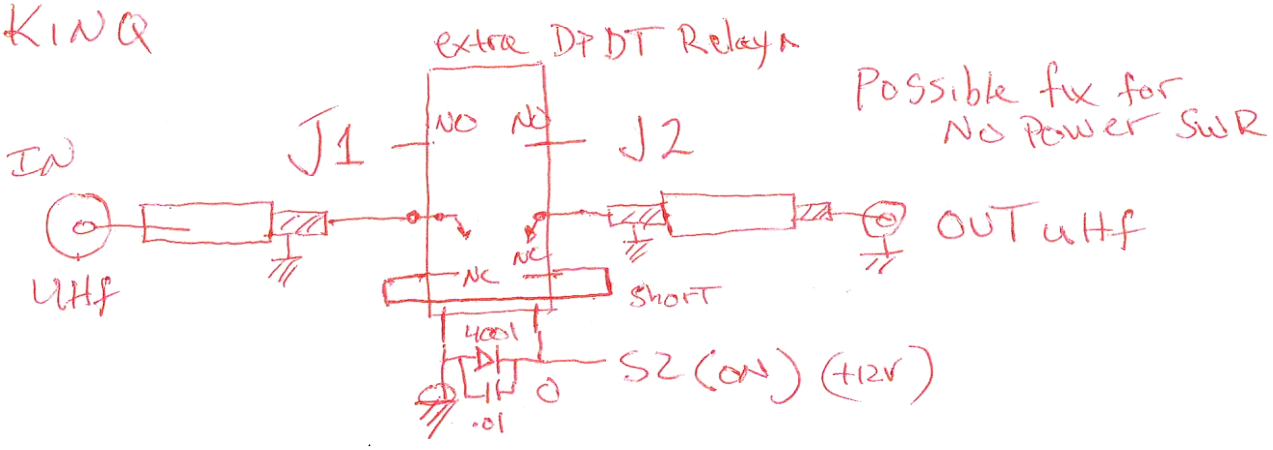


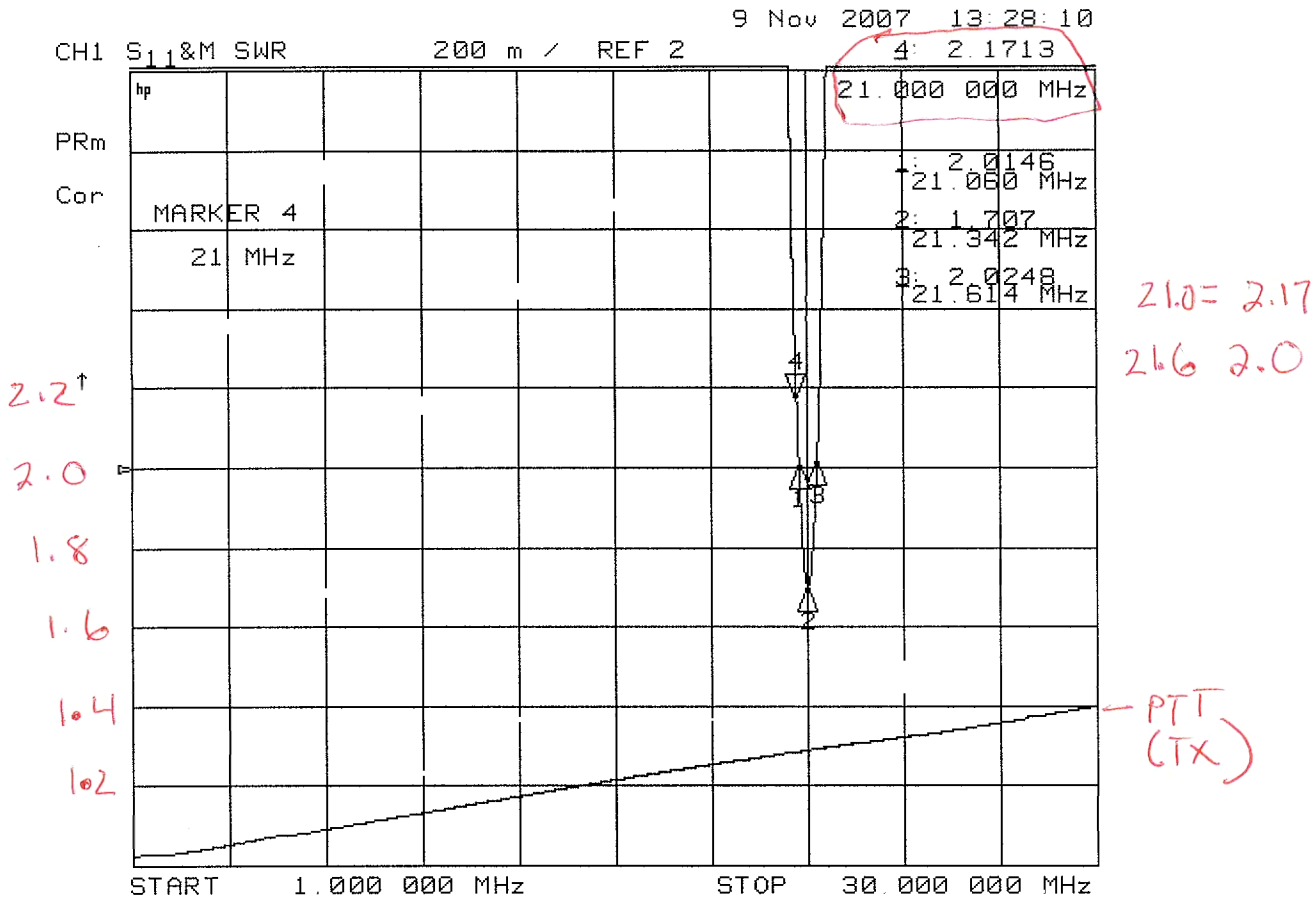
PTT = TX SWR max = 1.4 @ 30mhz

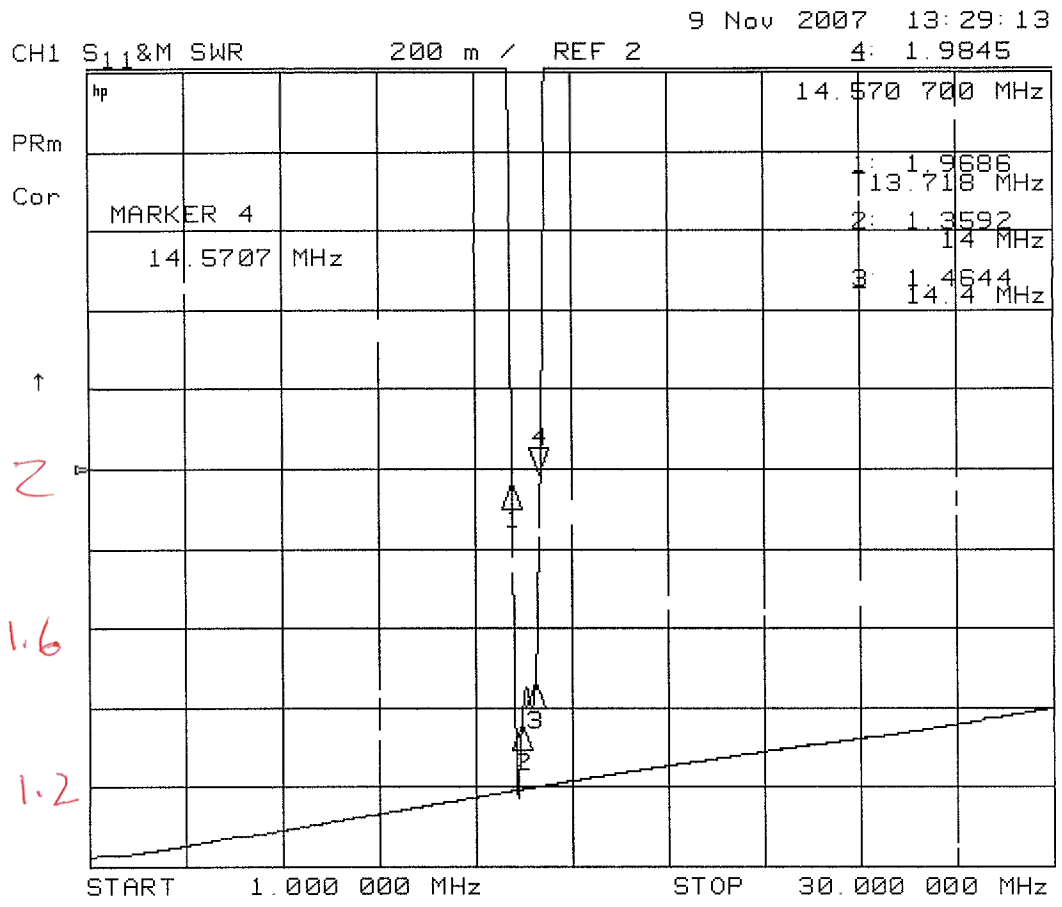
Note W/o Power SWR is gT 2:1 at 28mhz

Unit was Not designed for NO power mode

KINQ

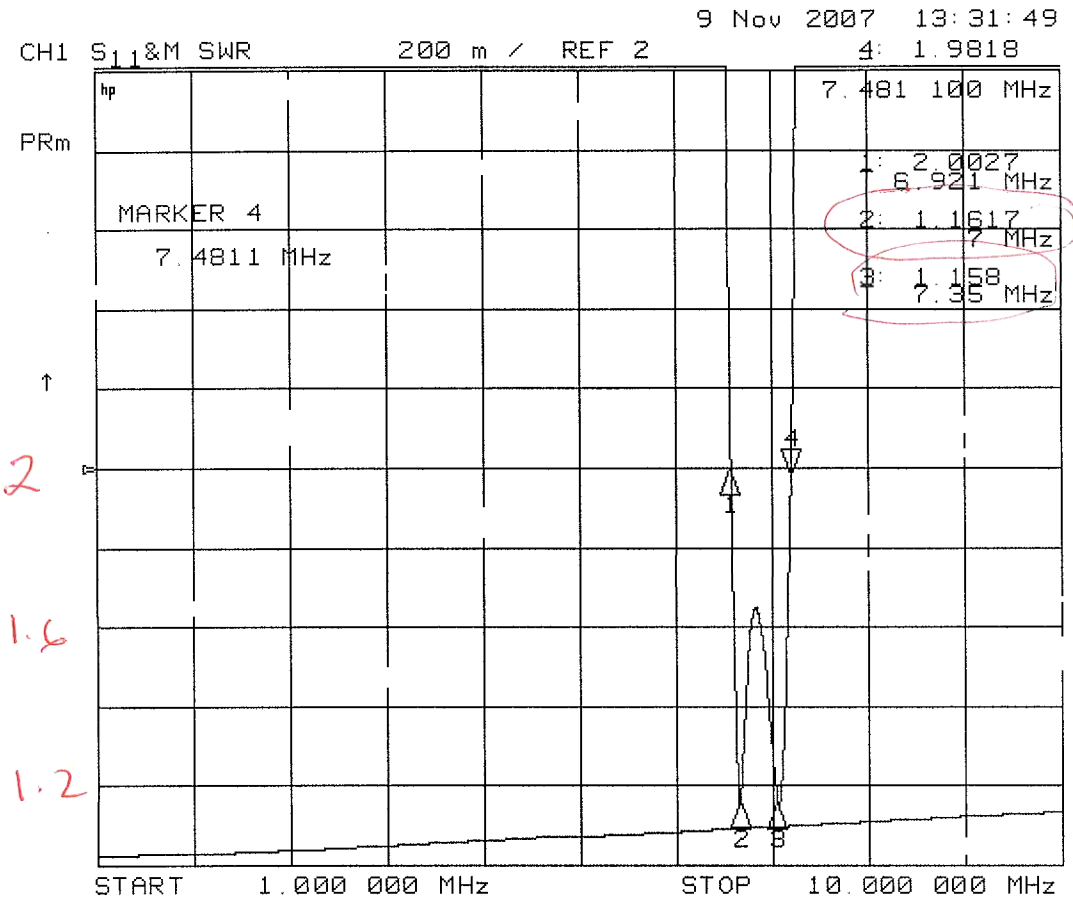



9 Nov 2007 13:28:10
CH1 S11&M SWR
200 m / REF 2
4: 2.1713
21.000 000 MHz
PRm
Cor
MARKER 4
21 MHz
1: 2.0146
21.080 MHz
2: 1.707
21.342 MHz
3: 2.0248
21.614 MHz
2.2
2.0
1.8
1.6
1.4
1.2
21.0= 2.17
21.6 2.0
PTT (TX)
START 1.000 000 MHz
STOP 30.000 000 MHz



14.0 1.36
14.4 1.46

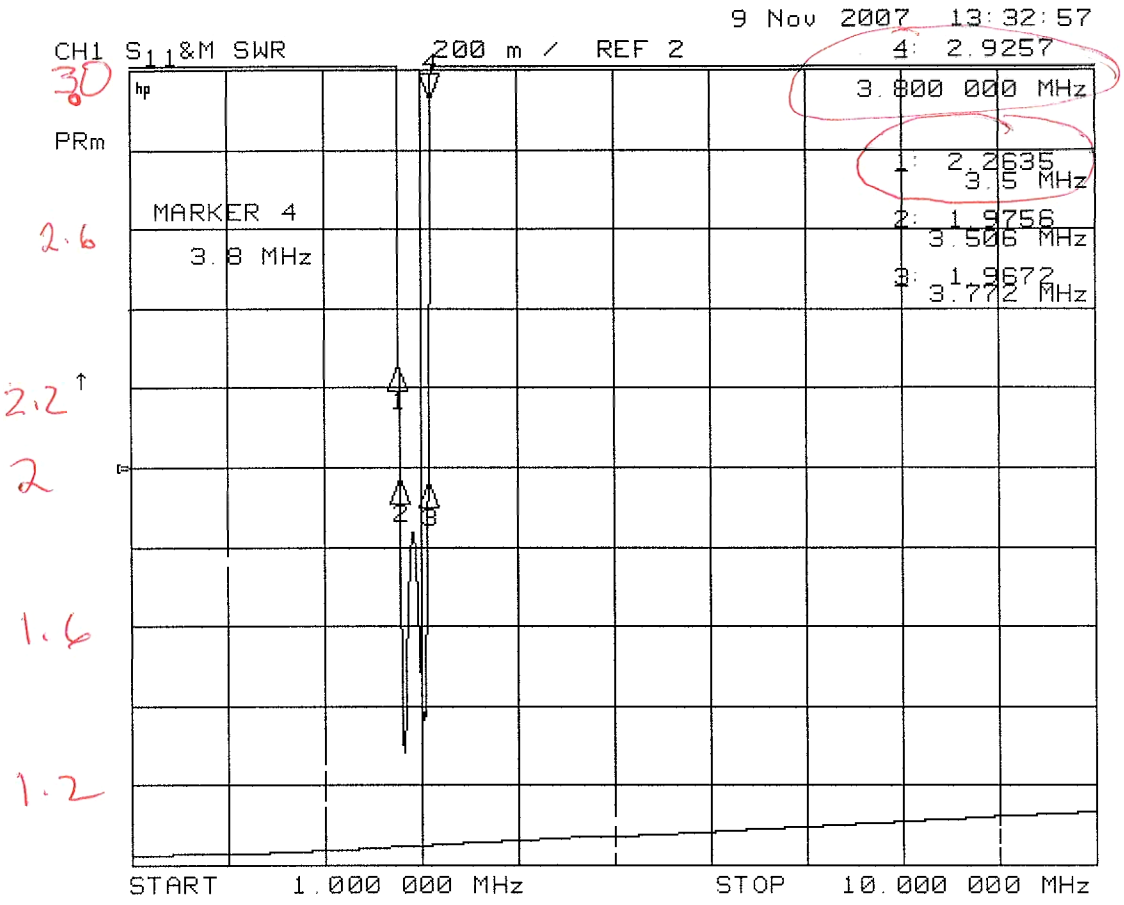
TX (PTT)



7 1.16

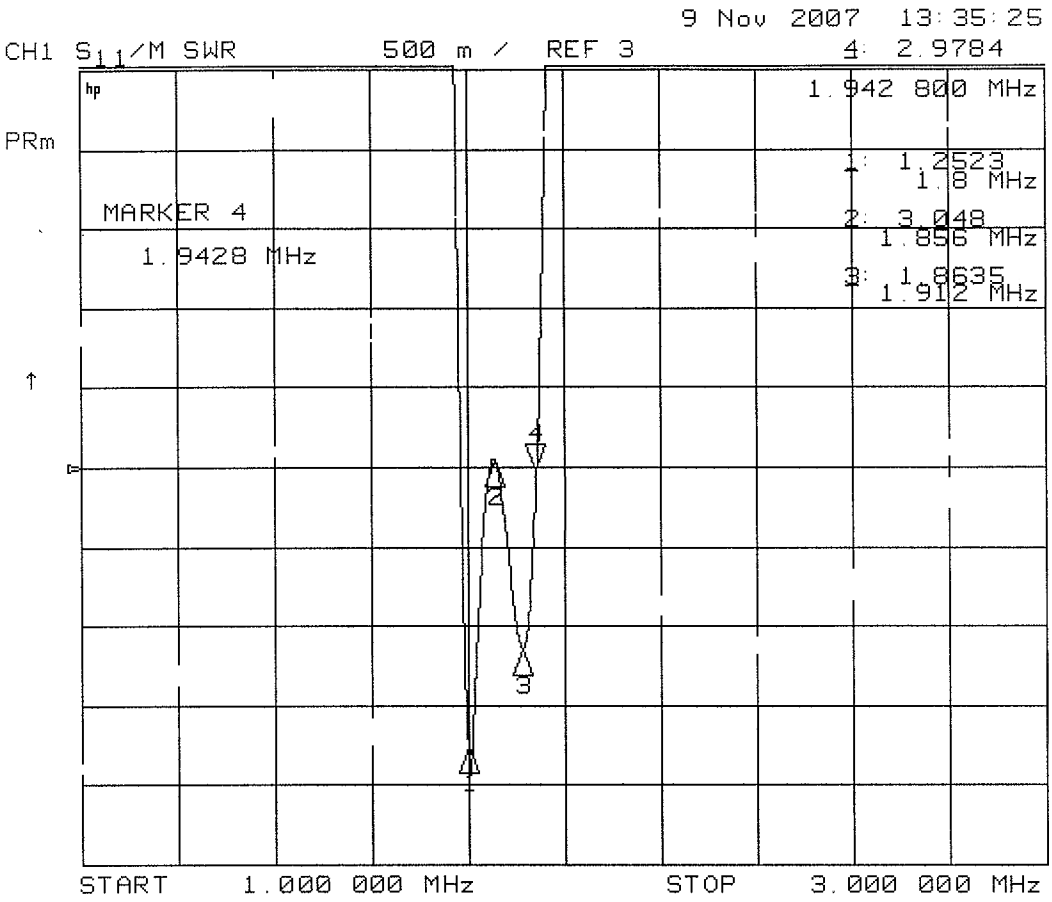
7.35 1.16

TXON PTT



30
2.6
2.2
2
1.6
1.2

3.5 2.26
3.77=2.0
3.8 = 2.9



1.8 1.25

1.856 3.0

1.912 1.86

1.942 3.0